TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS INFORMATION AND SUPPLEMENTAL OPERATING, MAINTENANCE AND REPAIR PARTS INSTRUCTIONS)

FOR

AUGER, EARTH
SKID MOUNTED
TEXOMA MODEL 270-9
REEDRILL INC.
(NSN 3820-01-146-7204)

HEADQUARTERS, DEPARTMENT OF THE ARMY

21 MAY 1985

WARNING

SERIOUS BODILY INJURY OR DEATH COULD OCCUR IF THE FOLLOWING BASIC SAFETY PROCEDURES ARE NOT OBSERVED.

WEAR SAFETY HELMET, EAR PLUGS, AND SAFETY GLASSES WHEN OPERATING OR WORKING ON MACHINE. DO NOT PERFORM MAINTENANCE ON THIS EQUIPMENT WHILE IT IS IN OPERATION. ALL SYSTEMS MUST BE IN THE OFF MODE.

BEFORE STARTING ENGINE, STUDY OPERATOR'S CONTROLS, MAKE CERTAIN THAT ALL PERSONNEL ARE AWAY FROM OPERATING PARTS OF THE UNIT. MAKE SURE THE PATH IS CLEAR OF OBSTRUCTIONS AND PERSONNEL BEFORE MOVING MACHINE.

DURING OPERATION, MAKE SURE THAT NO TOOLS OR OTHER OBJECTS ARE LEFT ON THE ENGINE OR DRIVE MECHANISM. THEY COULD BE THROWN BY THIS EQUIPMENT WITH POWERFUL FORCE.

PROVIDE SUFFICIENT VENTILATION WHEN OPERATING THIS UNIT IN AN ENCLOSED AREA. EXHAUST GASES CONTAIN CARBON MONOXIDE, A DEADLY POISON WHICH IS COLORLESS AND ODORLESS.

LOWER MAST TO HORIZONTAL POSITION. RAISE SUPPORT JACK BEFORE MOVING MACHINE. DO NOT ATTEMPT TO TRAVEL ON TOO STEEP OF AN INCLINE, REFER TO TRUCK MANUAL FOR DEGREE OF INCLINE.

KEEP MACHINE CLEAR OF HIGH VOLTAGE WIRES.

WARNING

UNLAWFUL TO OPERATE THIS EQUIPMENT WITHIN 10 FEET OF HIGH VOLTAGE LINES.

KEEP THE OPERATOR'S WORK AREA FREE OF OIL, GREASE, AND MUD. KEEP OPERATOR'S PLATFORM CLEAR OF TOOLS AND DIRT.

DO NOT REMOVE ANY SAFETY SHIELDS OR GUARDS. KEEP CLOTHING AND HANDS CLEAR OF MOVING PARTS.

WHEN FILLING THE FUEL TANK, ALWAYS MAINTAIN A METAL-TO-METAL CONTACT.
THIS WILL PREVENT STATIC SPARKS AND AN EXPLOSION.

WHEN SERVICING THE BATTERY, DO NO SMOKE OR ALLOW AN OPEN FLAME NEAR BATTERIES. BATTERIES GENERATE HYDROGEN WHICH IS A HIGHLY EXPLOSIVE GAS.

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D.C., *4 December 1990*

**OPERATOR'S,
ORGANIZATIONAL, DIRECT SUPPORT,
AND GENERAL SUPPORT MAINTENANCE MANUAL
(INCLUDING REPAIR PARTS INFORMATION AND SUPPLEMENTAL OPERATING,
MAINTENANCE AND REPAIR PARTS INSTRUCTIONS)
FOR
AUGER, EARTH, SKID MOUNTED
TEXOMA MODEL 270-9
REEDRILL INC.
(NSN 3820-01-146-7204)**

Current as of 1 May 1990

TM 9-3820-245-14&P, 21 May 1985, is changed as follows:

1. Remove old pages and insert new pages.

2. New or changed material is indicated by a vertical bar in the margin of the page.

3. Added or revised illustrations are indicated by a vertical bar adjacent to illustration identification number.

Remove Pages	**Insert Pages**
Pages A and B	Pages A and B
Pages 1 and 2	Pages 1 and 2
Pages 63 and 64 (located in Part II)	Pages 63 and 64 (located in Part II)
Pages 41 and 42 and corresponding Operator/Crew PMCS Chart (2 pages) (located in Part III, Appendix M)	Pages 41 through 44, and corresponding Operator/Crew PMCS Chart (2 pages) (located in Part lll, Appendix M)
Pages 45 and 46 and corresponding Organizational PMCS Chart (2 pages) (located in Part III, Appendix N)	Pages 45 through 48, and corresponding Organizational PMCS Chart (2 pages) (located in Part III, Appendix N)
Pages 117 and 118	Pages 117 and 118
SOMARPI (2 pages) (located in Part lll) Pages 3 and 4	SOMARPI (2 pages) (located in Part lll) Pages 3 and 4

4. File this change sheet in front of the publication for reference purpose.

By Order of the Secretary of the Army:

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

Official:

PATRICIA P. HICKERSON
Colonel, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25-E, block 2116, Operator and Unit maintenance requirements for TM 5-3820-245-14&P.

CHANGE

NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC,

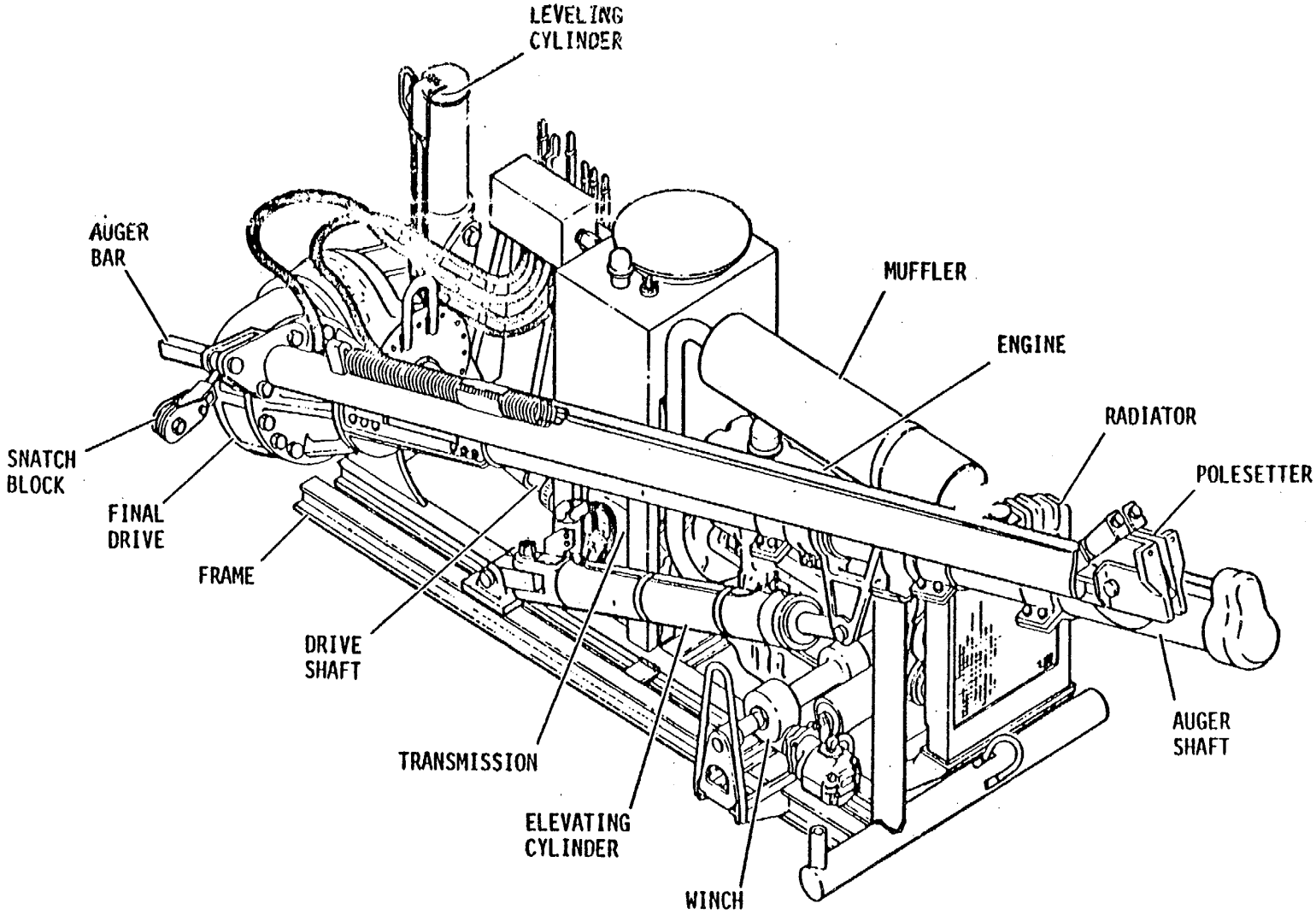
OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS LIST AND SPECIAL TOOLS LIST) FOR

AUGER, EARTH, SKID MOUNTED
TEXOMA MODEL 270-9
REEDRILL INC.
(NSN 3820-01-146-7204)
Current as of 1 November 1988

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

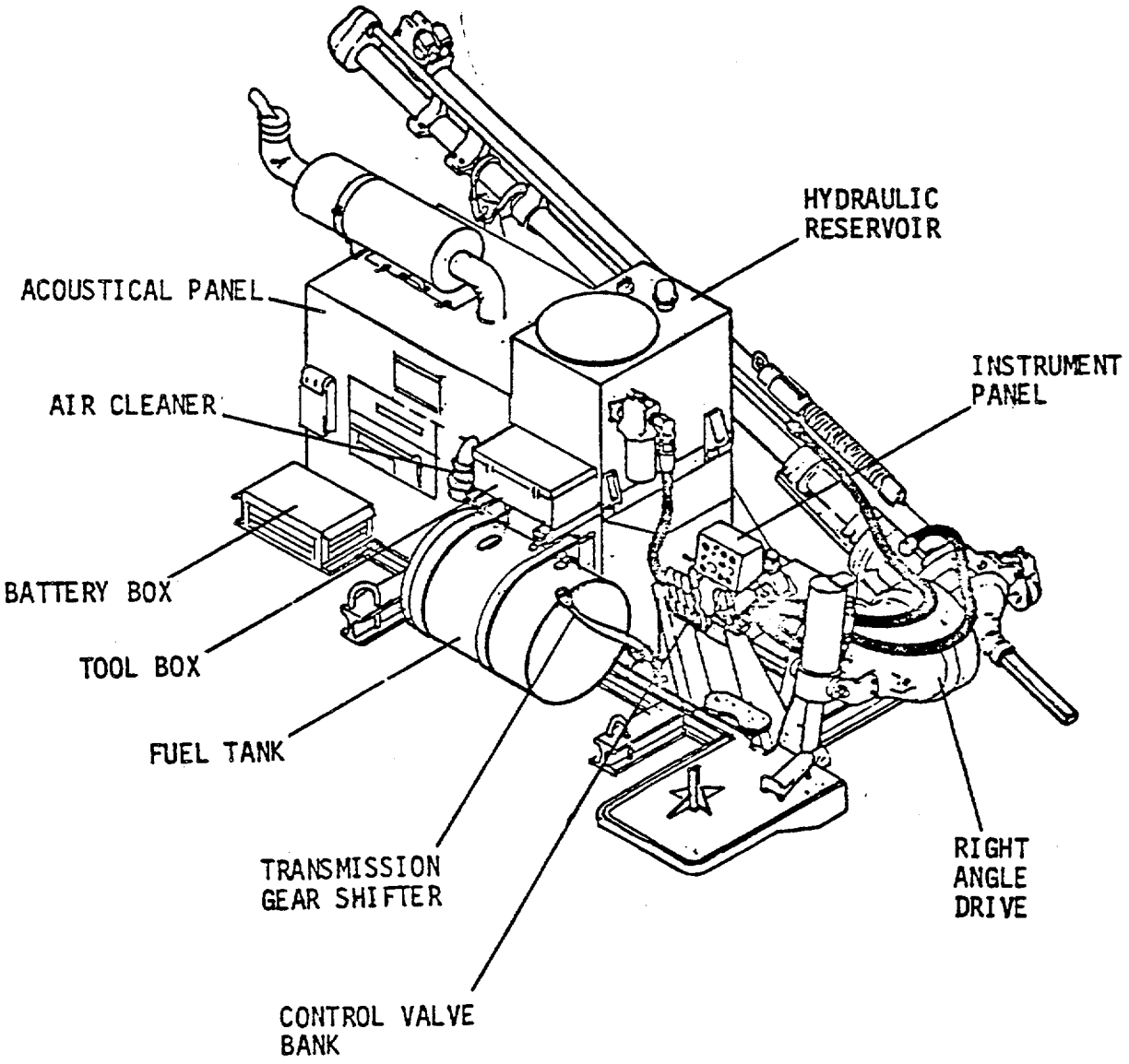
You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2, located in the back of this manual, direct to: Commander, U.S. Army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

This technical manual is an authentication of the manufacturer's commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.



EARTH AUGER RIGHT FRONT VIEW

C



EARTH AUGER LEFT REAR VIEW

TABLE OF CONTENTS

PART 1

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

CHAPTER 1

OPERATORS AND INSTRUCTION MANUAL

AUGER, EARTH, SKID MOUNTED

TEXOMA MODEL 270-9

1-1 GENERAL INFORMATION AND DESCRIPTION

A. SCOPE/DESCRIPTION

This manual contains instructions for use by personnel to whom the Earth Auger, model 270-9 is issued. It provides instructions on the operation and maintenance of the equipment. Also included are descriptions of major components and their functions in relationship to other components.

B. GENERAL

The Earth Auger, Model 270-9 is a self-contained, skid mounted, earth boring assembly driven by a diesel engine, Detroit Diesel 3-53 Engine. All operations of the boring assembly are controlled by a hydraulic system. The Auger is capable of boring holes 9 to 24 inches in diameter and to a depth of 9 feet. The boring assembly can be operated from vertical downward to 600 away from the truck, from vertical to 23° to the right and from vertical to 30° to left of truck, or 100 toward the truck.

C. ENGINE

The engine is a Detroit Diesel, 2 cycle in-line 3 cylinder engine.

D. TRANSMISSION

The transmission is a Funk Manufacturing Company, Model 12B704NO, with four speeds forward and reverse.

E. AUGER ASSEMBLY

The Auger Assembly consists of the auger, kelly bar, final drive, and right angle assembly. Operation of the auger assembly is controlled by the shuttle control and the hand or foot operated throttle control. The shuttle is used to engage and disengage the drive assembly.

F. WARNING/SAFETY DEVICES

The hydraulic system incorporates load lock valves on both the elevating and leveling cylinders. These prevent the cylinders from retracting in event of hydraulic system pressure loss.

1-2 INTRODUCTION

The operators and maintenance section contains detailed instructions, service information and technical data which the operator will need in order to properly operate the 270-9 Auger and to perform the various maintenance services that are required for keeping the equipment in good working condition at all times. Included herein are complete descriptions of each operating control and step-by-step instructions on how to start, operate and stop the equipment, and recommended operator's maintenance procedures.

The maintenance procedures and service instructions in this manual are included as recommendations only and are based on normal equipment working conditions. Changes should be initiated by the user in order to compensate for other than normal conditions and to meet the working requirements of any specific job application.

1-3 ENGINE AND POWER TRAIN

Power from the engine is transmitted to a torque converter and shuttle transmission, and a 4-speed transmission is used. The power is transferred through a heavy duty universal drive line into a right angle drive, final drive and kelly bar.

1-4 HYDRAULIC SYSTEM (FIGURE 1-1)

Oil is furnished by a 54 gallon tank through a suction strainer, to a gear-type pump. The oil flow is controlled by self-centering valves. Oil pressure is 1450 P.S.I. hot, adjustable at the valve bank. A regeneration system is used on the feed ram only. The oil is filtered through a micronic-type filter in the return line at the tank. This system is highly effective and will give long life with minimum maintenance, provided the system is kept clean.

1-5 FUNK MODEL 1213704N0 TRANSMISSION

A. Description

The Revers-O-Matic Drive, Model 1213704N0 is a shuttle-type transmission consisting basically of two (2) hydraulically actuated multiple disc clutches. When the front clutch is engaged, the output shaft rotates engine-wise and auger clockwise rotation is obtained. The rear clutch is driven by an idler/countershaft gear train and its rotation is opposite to that of the front clutch. Therefore, when the rear clutch is engaged, the output shaft rotates anti-engine-wise and auger counterclockwise rotation is obtained.

1-5 FUNK MODEL 1213704NO TRANSMISSION (Continued)

Power is transmitted from an engine to the Revers-O-Matic Drive through the use of a torque converter. Being no direct mechanical connection between power and load, a very smooth and shock-free drive is obtained with complete absence of engine stalling and lugging. Consequently, the maintenance of axles, bearings, differentials, and gears is reduced to a minimum. Another feature of torque converter drive is the automatic multiplication of engine torque during the periods of heavy pulldown loads. When loads are light, the converter transmits the engine power directly at almost engine speed without torque multiplication. With the output torque automatically adjusting to the load demand, the net result is an action like a transmission with infinitely variable and automatic speed ratios. The need for shifting gears, although present, is greatly reduced along with driver fatigue.

Like all mechanical equipment, the Model 1213704N0 Revers-O-Matic Drive will need attention and servicing. Routine checks will help prevent down-time. The operator can aid in preventive maintenance by occasionally reading the instrument panel gauges and keeping a watchful eye; reporting weak or borderline malfunctioning.

Because the unit operates "IN" oil and "BY" oil, most of the maintenance is concerned with oil replenishment and oil cleanliness.

B. Rules of Maintenance

Check oil level daily, stopping engine before check. Make sure area around oil fill is clean before removing dipstick. A drain cock or plug is provided on the oil fill side of the unit at oil level. If working conditions are severe, it is recommended that the oil level be checked using the drain cock; that is, if oil starts to drip out when opening the drain a proper oil level is being maintained. This method of checking the oil level is especially desirable on units operating in mines, sand and gravel pits, etc. where it is highly possible to have foreign material packed around the oil fill where it could fall into the unit when the dipstick is removed.

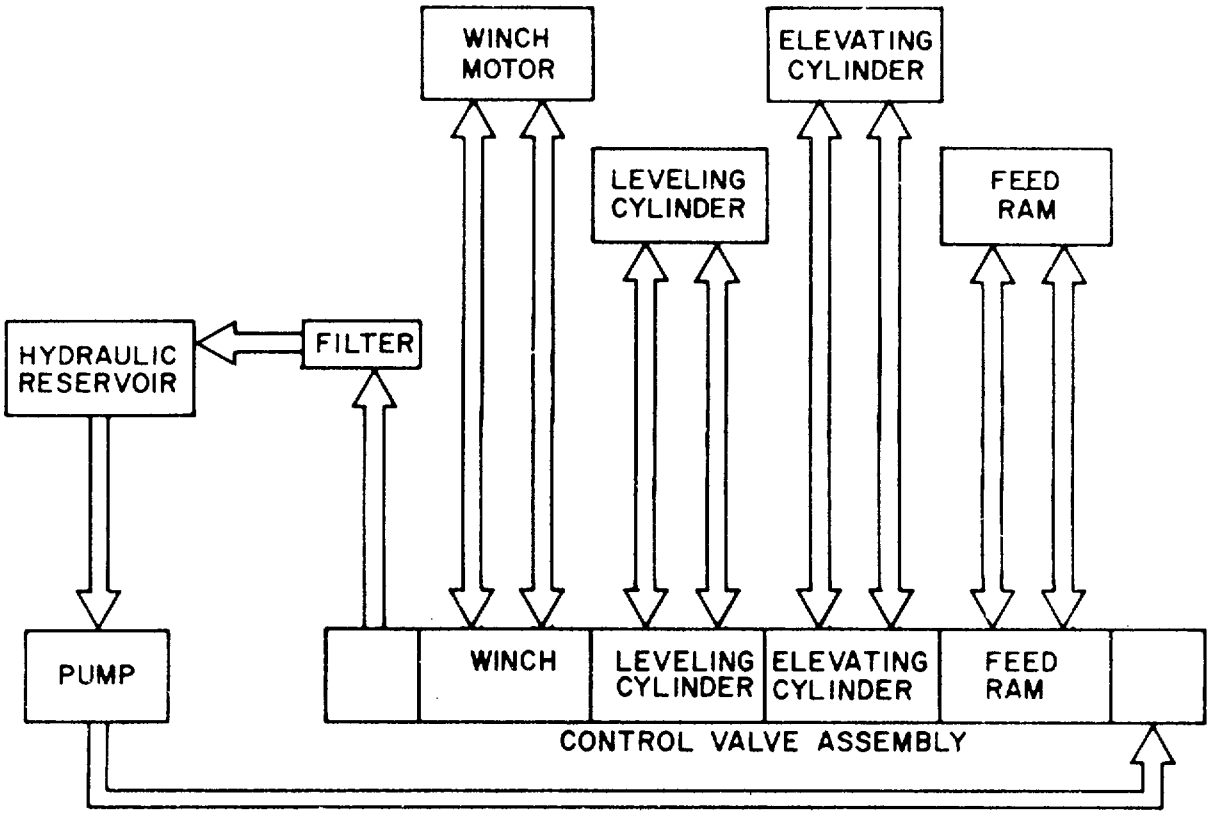


FIGURE 1-1. HYDRAULIC DIAGRAM

C. Service

The type of service and the operating conditions will determine the maintenance interval. However, as stated above, it is recommended that the oil level be checked daily; at the same time checking for oil leaks.

Because the hydraulic system is the heart of the transmission, it is especially important that the oil be kept clean.

When draining for an oil change, the Revers-O-Matic and ALL variable speed transmissions must be drained separately. In all the drain plugs are located on the side opposite the fill; that is, the left hand side.

NOTE: ANY REFERENCE AS TO THE LEFT OR RIGHT HAND SIDE OF THE MODEL 1213704NO IS MADE FROM THE REAR OF THE UNIT LOOKING FORWARD TOWARD THE ENGINE.

When servicing the unit for the first time after vehicle installation and/or after overhaul, or the regular oil change, fill as follows:

1. On units with 4-speed transmission, add 12 (9 if refill) quarts.

2. Lubricant Grade: Temperature Information.

   If fluid is below 10°F (-23°C), an external heat source must be used to raise the fluid temperature to -10°F.

   USE AUTOMATIC TRANSMISSION FLUID TYPE MIL-L-2104

3. Start engine and run at idle speed for two (2) minutes with unit in neutral. This is to let the hydraulic system charge.

4. Stop engine and add automatic transmission fluid to the shuttle transmission to bring the oil level to the full mark on dipstick, or until oil starts to drip out opened drain cock. This will generally take approximately three (3) quarts providing the unit was completely drained.

5. Start engine and run at idle speed for two minutes with unit in neutral. Stop engine and check oil level again.

D. Service Procedure and Recommendations

1. Stop engine before checking or adding oil.

2. Clean around oil fill before checking or adding oil.

3. It is recommended that all lubricating oil and oil filter be changed after the first 50 hours of operation and/or after overhaul.

4. Thereafter and under normal operating conditions, it is recommended that all lubricating oil and oil filter be changed after every 500 hours of operation.

   The oil in the system must be changed whenever the oil shows traces of dirt or the affects of high operating temperature evidence by discoloration or strong odor.

   If the oil in the system has become contaminated with metal particles, ALL the components of the hydraulic system (oil tubes, manifold, oil pump, oil filter, control valve, converter, clutches, heat exchanger, sump) must be thoroughly cleaned. Generally, this means a tear-down of the unit. Metal particles in the oil is evidence of failure of some part.

5. Drain dirty oil while unit is still warm, examining for contamination as described above.

6. Clean all magnetic drain plugs before replacing.

7. Replace oil filter element.

8. Always use clean oil and clean containers.

9. Do not overfill.

10. Keep all joints in the shuttle box and transmission controls properly lubricated with heavy grease.

11. If radiator is drained during winter storage, the heat exchanger on the Model 1213704N0 should also be drained, using the drain plug provided on the left hand side.

1-6 SERVICE UPON RECEIPT OF MATERIAL

A. Inspecting and Servicing the Earth Auger

NOTE: Make certain the Earth Auger is completely depreserved before operating. Make sure preservatives have been removed from the crankcase and fuel tank when required.

1. Inspection. Visually inspect the Earth Auger for loss of parts or damage which may have occurred during loading, shipping, or unloading. Check Earth Auger identification for positive identification of Earth Auger.

2. Service. Fill the radiator with coolant. Fill the fuel tank with diesel fuel. Lubricate according to Lubrication Chart, Chapter 4-13. Open the battery box, fill battery per Chapter 4-15.

B. Installation of Auger onto Carrier

WARNING **THIS EQUIPMENT MUST BE INSTALLED INTO PROPER TRUCK CHASIS FOR SAFE OPERATION BOTH ON AND OFF ROAD. USE: TRUCK, CARGO, 5 TON, 6X6 M54AZ W/W**

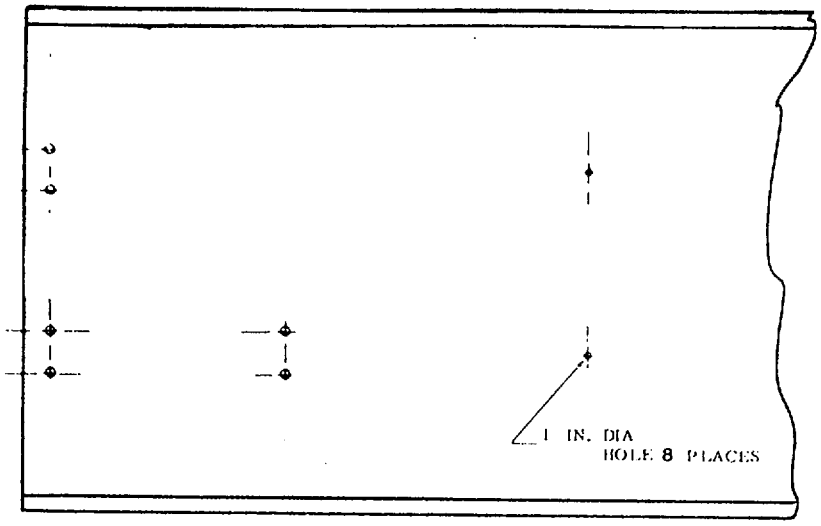
WARNING **DO NOT USE A LIFTING DEVIC WITH LESS TAHN 15,000 POUND CAPACITY.**

NOTE: Tailgate must be removed from body of truck before installation of auger.

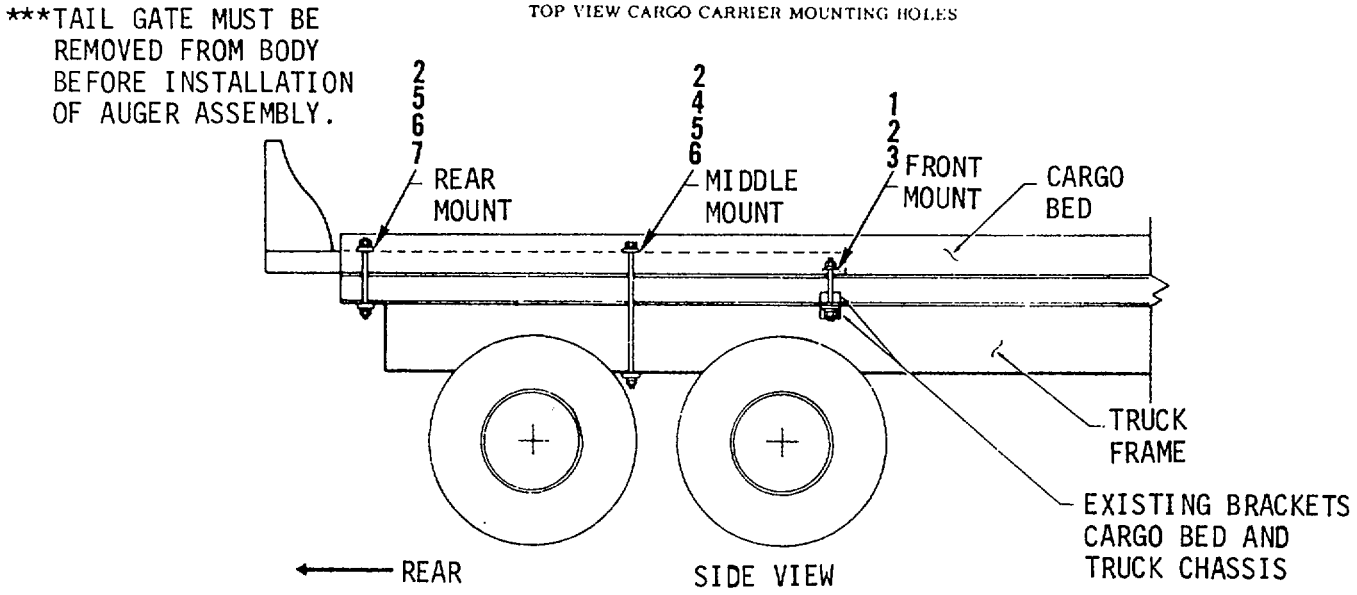
1. Attach suitable lifting device to three lifting eyes on auger.

2. Position auger over carrier.

3. Slowly lower the auger to the carrier and mount as shown in Figure 1-2.

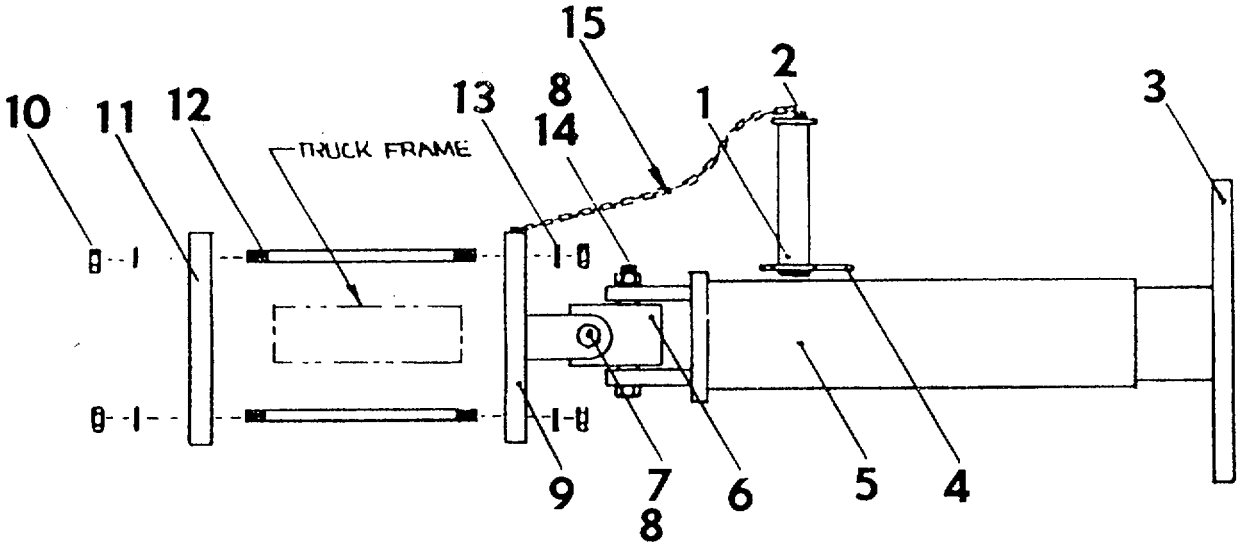


TOP VIEW CARGO CARRIER MOUNTING HOLES



ITEM	PART NO	QTY	DESCRIPTION
1	42745	2	BOLT TIE DOWN 3/4 X 3 1/2 NC
2	5965	12	WASHER LOCK CUT 3/4
3	46980	2	PALTE
4	7813	2	BOLT TIE DOWN 3/4 X 6 1/2 NC
5	6371	12	NUT HEX 3/4 NC
6	47471	6	STRAP TIE DOWN
7	18283	4	BOLT TIE DOWN 3/4 X 18

FIGURE 1-2. AUGER ASSEMBLY MOUNTING BASE PLAN



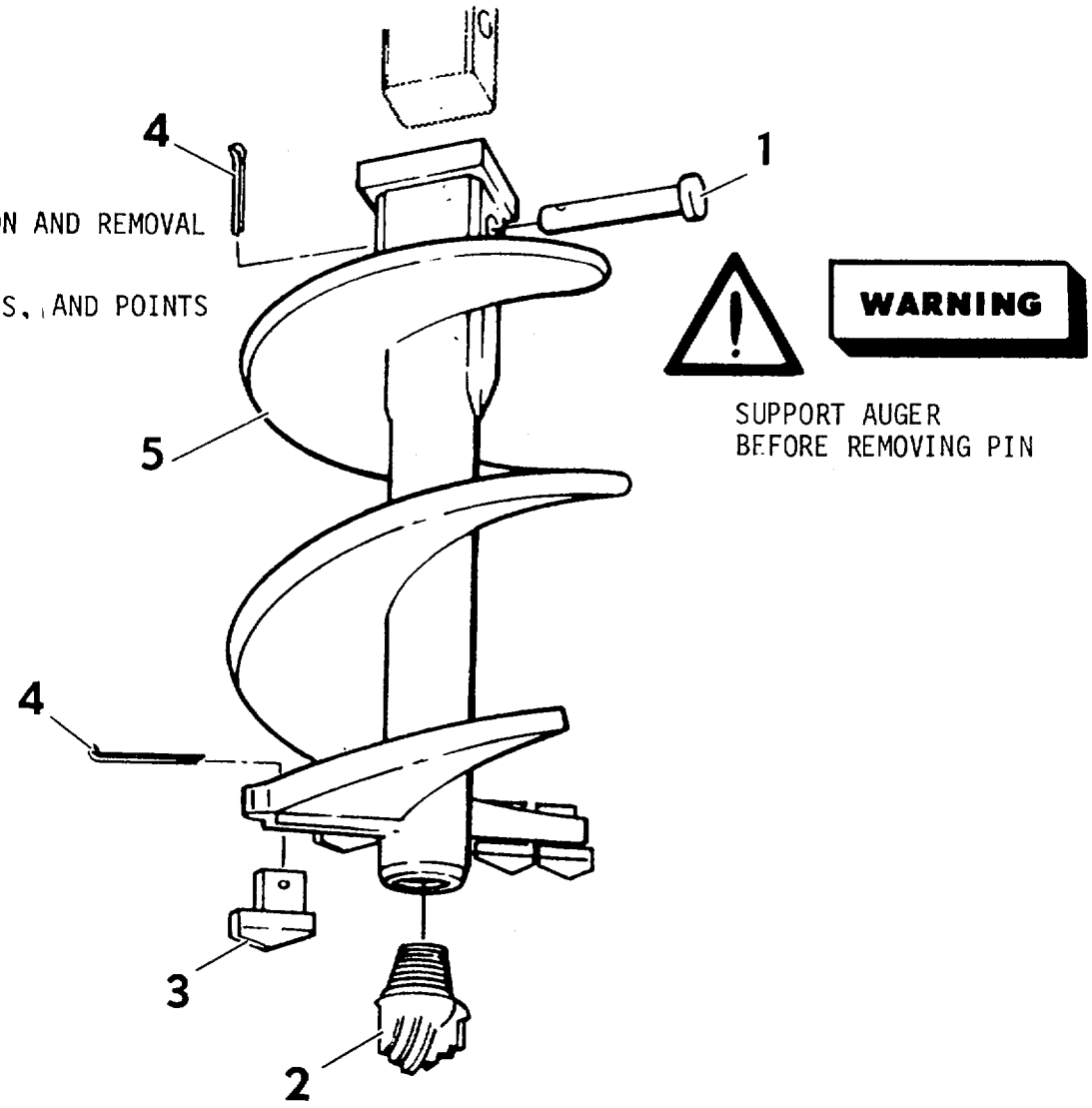
NOTE: ONE JACK ONLY SHOWN

ITEM	PART NO	QTY	DESCRIPTION
1	45218	2	PIN - CLEVIS - 1X 6 LG
2	37394	4	SCREW - SELF TAPPING
3	45217	2	PAD AND LOWER TUBE - LOCK
4	19156	2	CLIP - HAIR PIN - 5/32
5	11626	2	TUBE - JACK UPPER
6	8498	2	BLOCK - UNIVERSAL
7	7810	2	CAPSCREW - HEX RD - 3/4 NC X 5 LG
8	42606	4	NUT - ELASTIC STOP - 3/4 NC
9	17035	2	BRACKET - JACK
10	6371	8	NUT - HEX - 3/4 NC
11	17034	2	BAR - HOLD DOWN
12	34046	4	BOLT - TIE - 3/4 X 28
13	5965	8	WASHER - LOCK CUT - 3/4
14	8279	2	CAPSCREW - HEX HD - 3/4 NC X 4 1/2 LG - GRD 5
15	32898	3	CHAIN - #30 SASH - 18 LG

FIGURE 1-2A. JACK ASSEMBLY MOUNTING PLAN

D. INSTALLATION AND REMOVAL

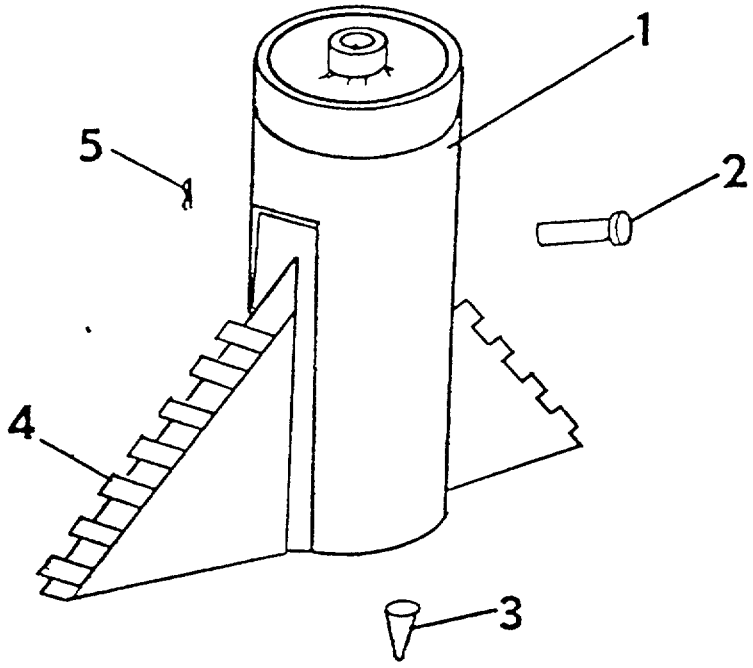
OF AUGER BITS, AND POINTS



ITEM	PART NO	QTY	DESCRIPTION
1	11581	1	PIN, AUGER
2	16845	4	POINT, PILOT
3	16845	14	BIT, ROCK
	17318	28	BIT, DIRT
4	6242	40	PIN, COTTER
	29137	1	AUGER, 9 INCH
5	29138	1	AUGER, 12 INCH
	29130	1	AUGER, 16 INCH
	29157	1	AUGER, 24 INCH
6	29685	1	GOPHER, UNDEREAMER 24 INCH NOT SHOWN

FIGURE 1-4.

E. GOPHER, UNDER REAMER



ITEM	PART NO.	QTY	DESCRIPTION
1	36185	1	UNDER REAMER - 24" DIA X 2 1/2" BOX
2	11581	1	PIN, AUGER
3	11984	1	STINGER
4	11376	14	BLADE, DIRT
5	6242	1	PIN, COTTER

FIGURE 1-5.

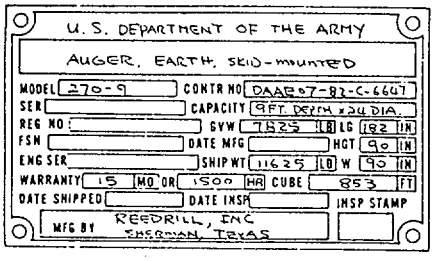
C. Identification

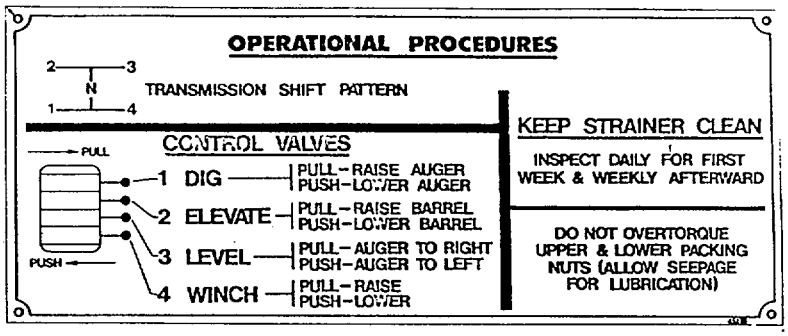
The Earth Auger has three identification plates. -

1. Manufacturer's nameplate. Mounted on the rear of the skid, specifies model number, capacity, NSN, auger serial number, engine serial number, and contractor number.

2. Shipping data plate. Mounted on the front left side of the accoustical panel. It gives model number, information concerning lifting points, and lift eye capacity.

3. Operational procedures data plate. Located on the rear of the accoustical panel directly below the hydraulic filter. Provides data for operating auger controls. Also gives instructions concerning strainer, filters, and packing nuts.





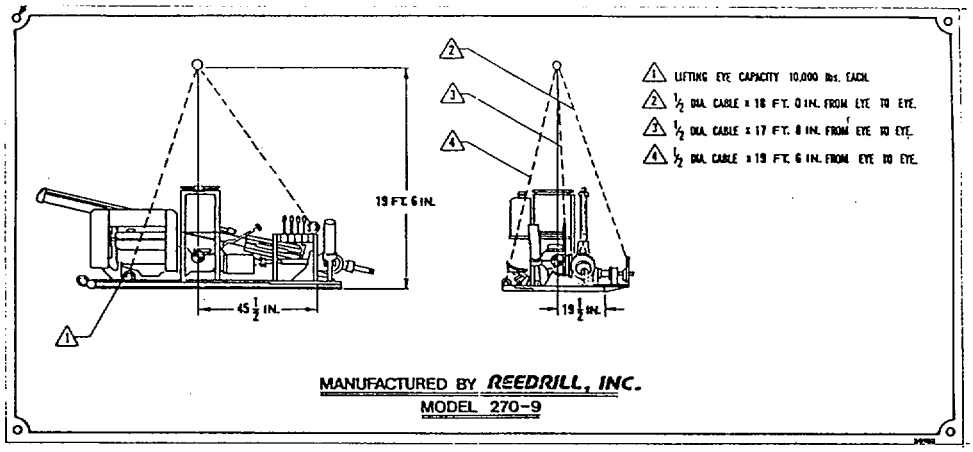


FIGURE 1-3. IDENTIFICATION DATA

1-7 TECHNICAL DATA

Engine	Diesel 3-53
Horsepower	95 at 2400 RPM
Torque	190 Ft/Lbs
Oil Capacity	6 Quarts
Coolant Capacity	19 Quarts
Number of Cylinders	3
Electrical System	12 Volts
Batteries Required	1 (12 Volts)
Ground	Negative
Transmission	Funk Model 1213704N0
Torque Converter	13 Inch
Clutches	Hydraulic - 8 Plates
	4 Forward - 4 Reverse
Rotary	Ring Gear and Pinion
Kelly Bar	2-1/2 Inch
Hydraulic System	
Pump	Gear-Type
Tank Capacity	65 Gallon
Filter	10 Micron
Strainer	100 Mesh
Pressure	1450 PSI
Hole Diameter	24 Inches
Hole Depth	9 Feet
Winch	5240 Pound Line Pull
Cable	7/16 In. X 125 Ft.
Jacks	Support Jack (1)
Drilling Angle	60° Away From Truck
(From Vertical)	15° Toward Truck
	40° To Right or Left

CHAPTER II
INSTRUMENTS AND CONTROLS
FUNCTIONS AND LIMITATIONS

2-1 EARTH AUGER LEFT REAR VIEW

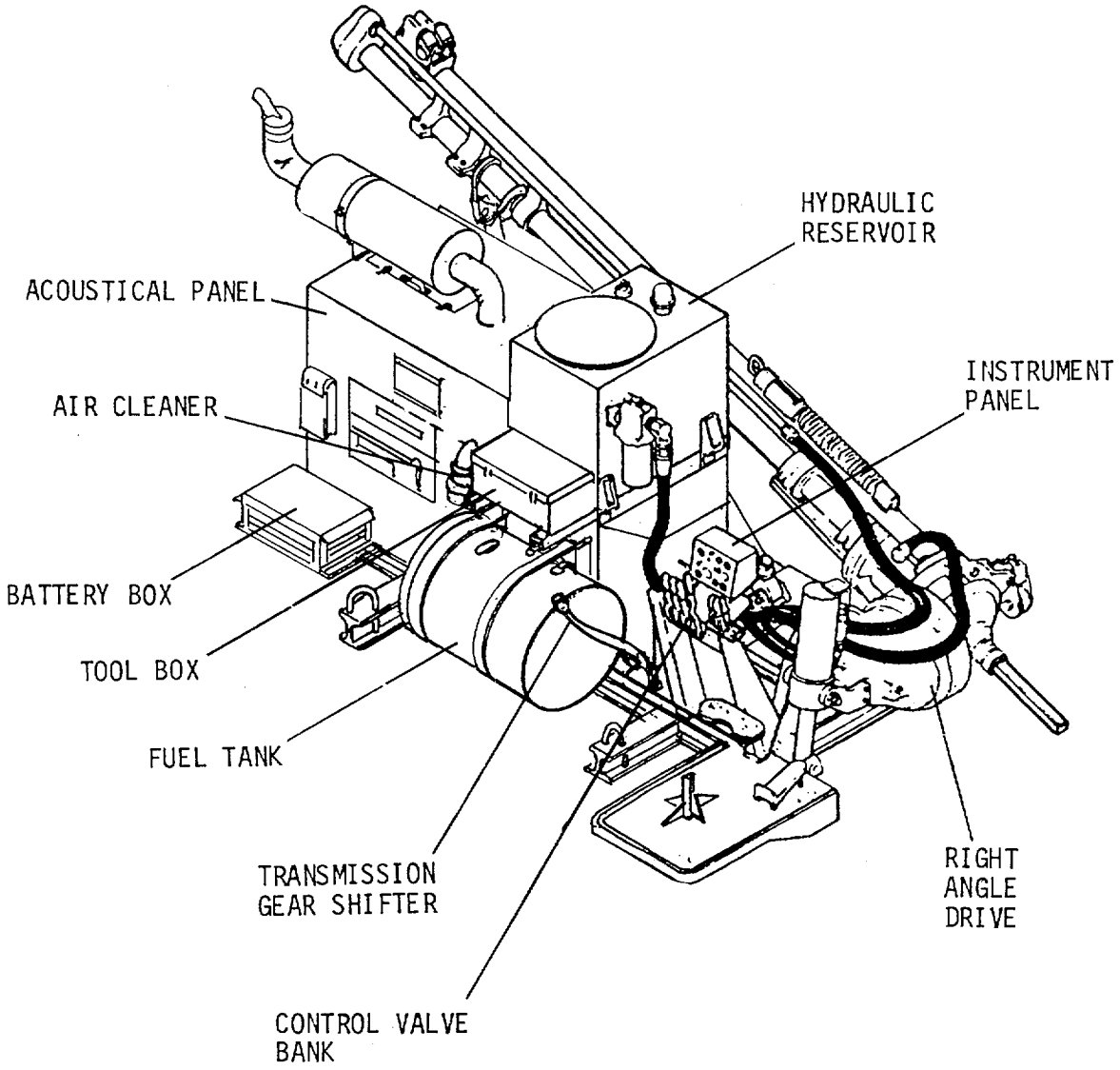


FIGURE 2-1.

2-2 EARTH AUGER RIGHT FRONT VIEW

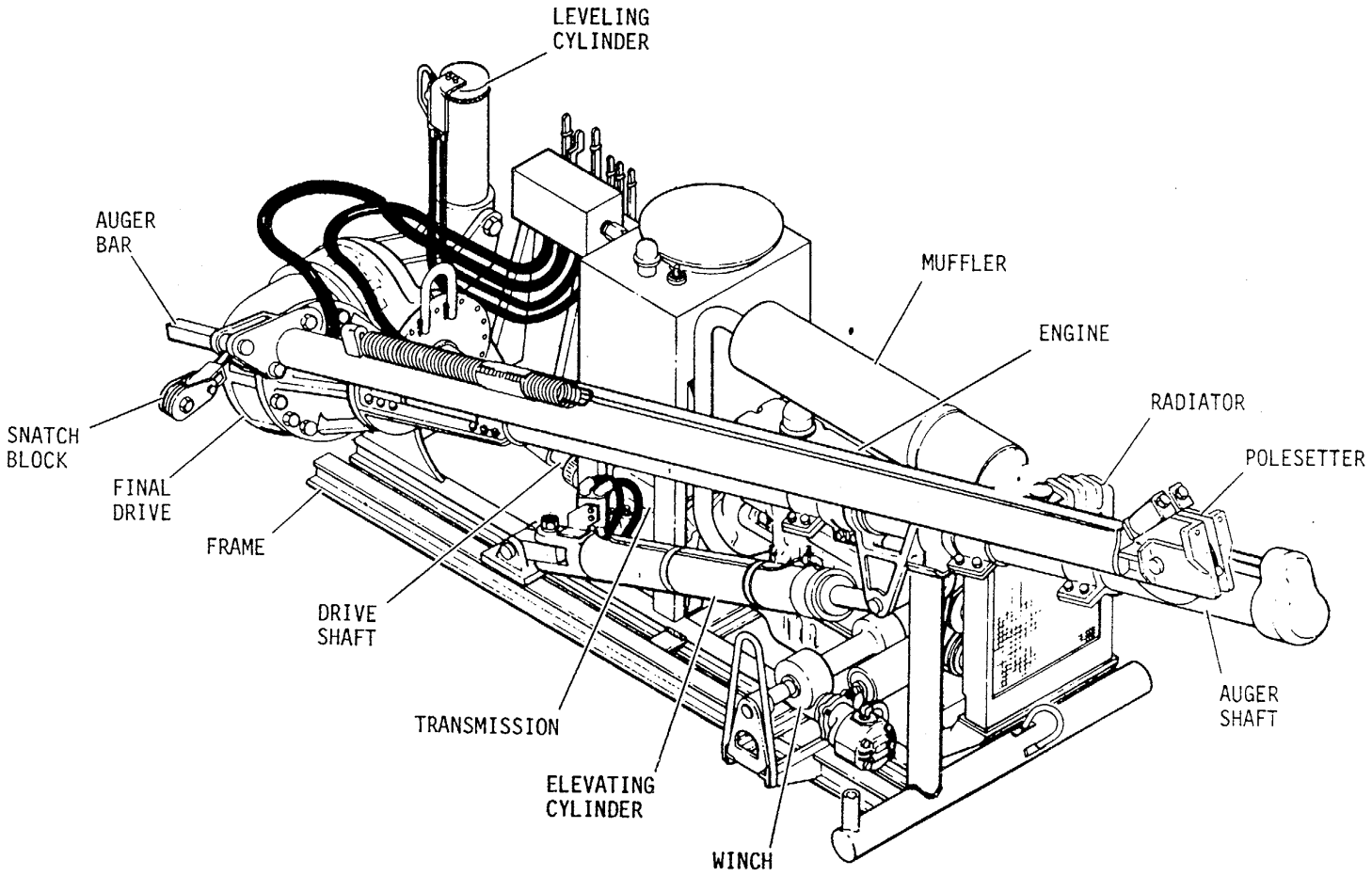


FIGURE 2-2.

2-3 GENERAL DESCRIPTION

Accoustical Panels - The exclusive purpose of the accoustical panels is to control the sound level of the operation of the earth auger, and do not contribute to the operation. Maintenance of most components requires the removal of one or more panels for accessibility.

Air Cleaner - A Donaldson 5BG Series is designed for fast, easy disassembly so that it may be serviced efficiently and quickly. The air cleaner should be inspected periodically to maintain maximum engine protection and maximum service life.

Auger Bar - Is made of a high grade of AISI-4142H steel. The auger bar is a 2-1/2 inch square with round corners. The auger bar is also referred to as the Kelly Bar. It is hydraulically fed for crowd and mechanically rotated for drilling.

Auger Shaft - It is also known as the Feed Ram. It is the cylinder providing the hydraulic feed for the crowd of the auger bar.

Control Valve Bank/Auger Controls (Figure 2-3)

A. Accelerator Pedal - The accelerator Pedal is located directly by the operator's right foot, so that he has positive control of the engine at all times. Press pedal downward to increase engine RPM.

B. Auger Bar - The auger bar is used for raising and lowering the auger bar. Pull to raise, push to lower.

C. Elevating Cylinder - The elevating cylinder raises the bar into the vertical digging position. This is accomplished by pulling the handle of the elevating cylinder control valve, push to lower.

D. Leveling Cylinder - The leveling cylinder positions the bar assembly vertically from left to right. Push the control valve handle to move right, pull for left.

E. Transmission Gear Selector - The 4-speed gear selector is located within easy reach of the operator. By moving the gear selector, the operator can choose any gear ratio to give auger rotational speed best suited for a specific digging operator.

F. Winch Brake - The winch brake is located directly left of the operator, so that he has positive control of the winch free spooling. Depress to allow cable to be manually unreeled.

G. Winch Control - The winch is controlled hydraulically by the control valve - push reels out the cable, pull reels cable in.

Drive Shaft - The drive shaft transmits transmission output to the right angle drive. The drive shaft has two universal joints that requires lubrication every 250 hours.

Engine - The engine is a Detroit Diesel 3-53 Series. It is the sole power source for the earth auger.

Final Drive - The final drive is a direct drive assembly for the kelly bar rotation. It is directly driven thru the right angle drive.

Frame - The main frame is a steel structure that the entire digger is mounted on.

Fuel Tank - The fuel tank is to be serviced only with diesel fuel. The capacity is 35 U.S. gallons.

Instrument Panel/Auger Gages (Figure 2-3)

A. Ammeter - The ammeter shows the electrical charge of the engine electrical system.

B. Engine emergency stop switch - The emergency stop switch is used only for emergency shutdown. It shuts the engine off by cutting off air to the intake. Needs to be reset at the engine after use.

C. Engine kill switch - The engine kill switch is used normal engine shutdown.

D. Engine oil temp w/sender - The engine oil temperature gauge monitors the engine oil temperature.

E. Fuel Gauge - The fuel gauge monitors the quantity of fuel of the fuel tank.

F. Hourmeter - The hourmeter accumulates total hours of the engine operation.

G. Ignition Switch - The ignition switch is used to start the engine.

H. Oil Pressure - The oil pressure gauge is used to monitor the oil pressure of the engine.

I. Tachometer - The tachometer monitors the engine RPM.

J. Transmission Pressure - The transmission pressure gauge monitors the oil pressure of the transmission.

K. Transmission Temperature - The transmission temperature gauge monitors the transmission oil temperature.

Leveling Cylinder - The leveling cylinder is a hydraulic cylinder used to obtain the desired side-to-side leveling.

Muffler - The purpose of the muffler is to control the sound level of the engine exhaust system.

Polesetter - The polesetter is a device used for setting poles, used in combination with the winch.

Radiator - The radiator is used to keep the engine cool during operation.

Right Angle Drive - The right angle drive transmits power to the final drive from the transmission.

Snatch Block - The snatch block is used to redirect the winch cable to drag an object to the digger. Do not pull objects to the digger with the cable from the top of the feed ram.

Tool Box - The tool box is a component that allows storage for small tools.

Winch - The winch is hydraulically driven, has a safe load rating of 8,000 pounds, but the lifting capacity is limited to 5,000 pounds. The winch is controlled hydraulically by a control valve.

2-4 CONTROL AND INDICATION CHART

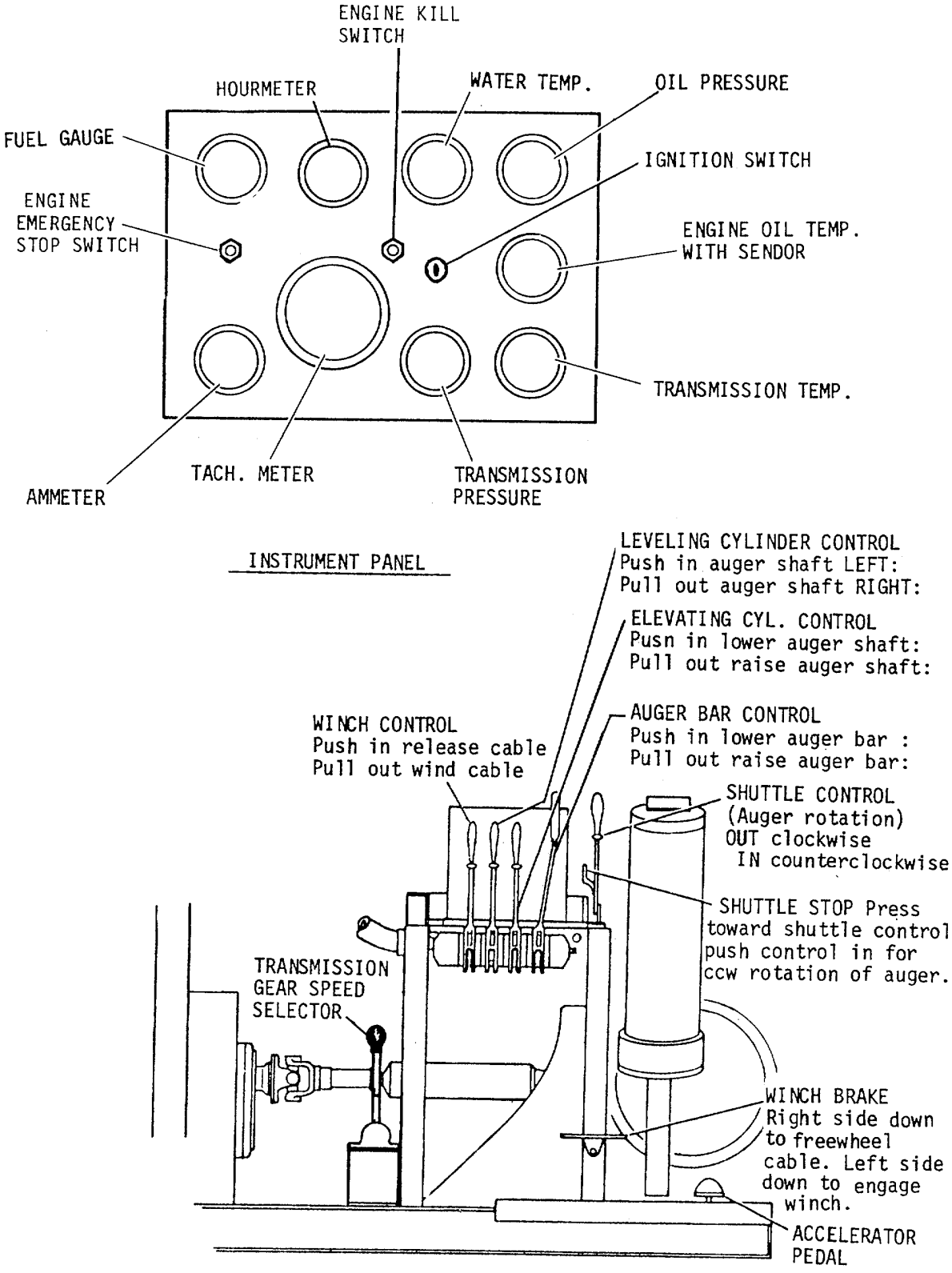


FIGURE 2-3.

2-5 AUGER OPERATION CHART

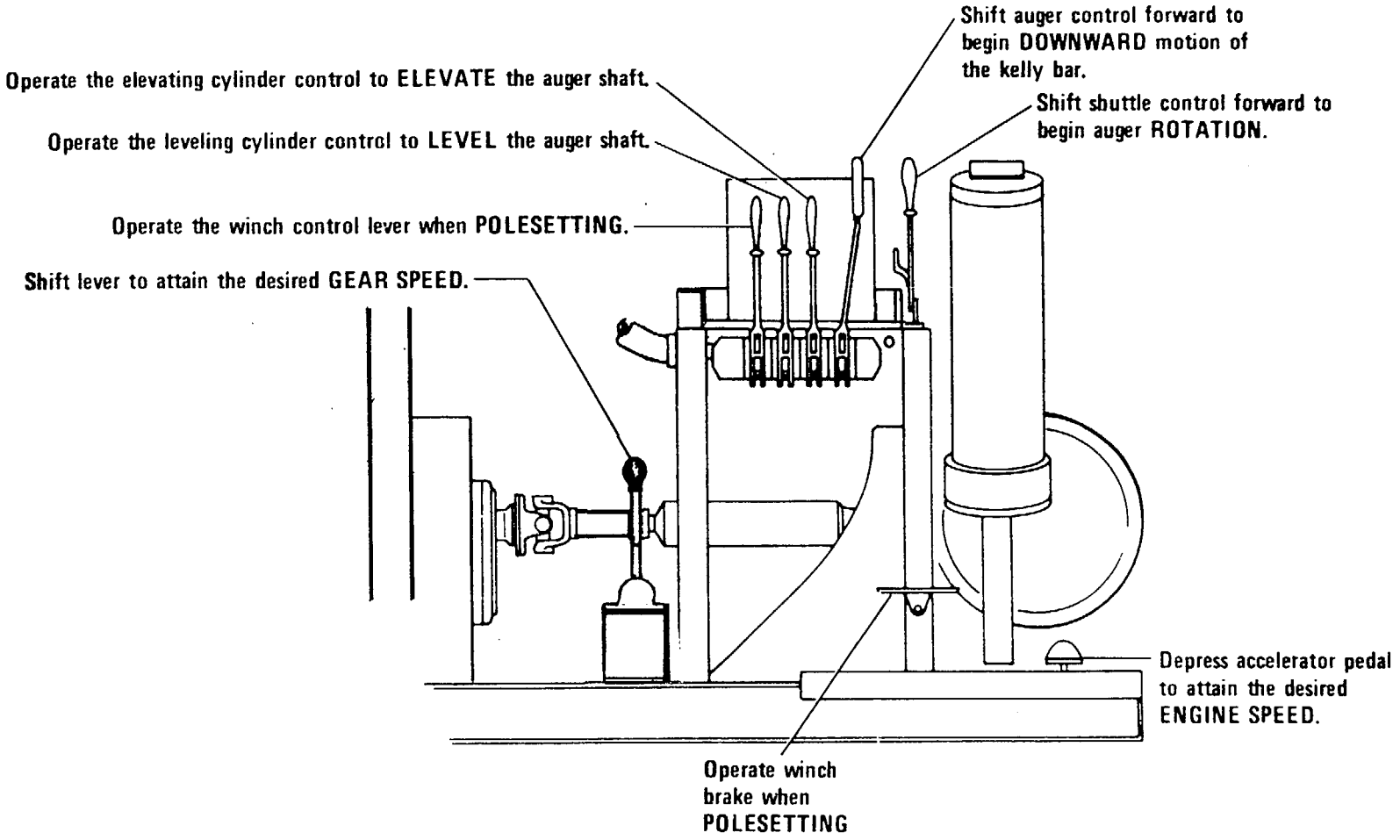


FIGURE 2-4.

CHAPTER III

OPERATING INSTRUCTIONS

3-1 AUGER READINESS

To insure that the auger is ready for operation, it should be systematically inspected before starting on a job and again after a job is completed. In addition, the operator should always be on the alert during operation in order to detect any trouble which might occur. Any trouble discovered during operations should be noted by the operator for correction at the earliest possible time. The operator should STOP the digging operation immediately if a defect is discovered which could result in damage to the auger if operation was continued.

3-2 AUGER INSPECTION DAILY USE

Before placing the auger into service, make the following inspection:

A. Make a thorough, visual inspection of the auger and see that it is in good general working condition. Look for loose, missing or damaged parts.

B. Check fuel systems, examine each tank and make sure there are no loose hose or line connections and all caps are on tight. Check tanks for physical damage that could cause leakage.

C. Check exhaust system for cracks, breaks, loose or missing clamps or caps.

D. Check the intake system. Inspect air cleaner and air cleaner hose for air leaks.

E. Check all electrical wiring for cracks, breaks or other signs of damage. Check for loose connections and signs of scorching which could indicate overheating or short circuits.

F. Check electric alternator. Make sure it is securely fastened and look for cracks, breaks, or other physical damage. Check for proper belt tension.

G. Check hydraulic oil reservoir for breaks, bends or other physical damage. Make sure there are no leaks and be sure reservoir is full.

H. Inspect hydraulic pump for damage and signs of leaks.

I. Check radiator and hoses for leaks and fill to proper level.

J. Check converter and shuttle for proper oil level and signs of leakage.

K. Check transmission for signs of leakage and proper level.

L. Check right angle drive for signs of leakage and oil level.

M. Check final drive for signs of leakage and oil level.

N. Check feed ram for proper oil seepage - upper packing and lower packing.

O. Make a visual inspection of all gauges to see that there is no broken glass or loose wires.

P. Make sure complete auger is properly lubricated (refer to lubrication section).

WARNING **THIS MACHINE IS NOT INSULATED. DO NOT OPDERATE OPERATE MACHINE WITHIN 10 FEET OF HIGH VOLTAGE LINES.**

3-3 AUGER OPERATIONS

A. Always shift the Revers-O-Matic to neutral before starting the engine.

B. Select the speed range desired by shifting the transmission behind the shuttle box and then engage the directional clutch (forward or reverse) in the Revers-O-Matic.

C. Engage forward and reverse clutches at idle speed only.

D. Slow motion before applying the opposite clutch.

E. Pay particular attention to the instrument panel.

F. The oil pressure gauge should read approximately 160 P.S.I. with the engine running above 1200 R.P.M. If pressure varies more than 15 P.S.I. from the above, check per "IRREGULAR OIL PRESSURE." At engine idle speeds, and/or when the hydraulic clutches are engaged, the pressure will momentarily drop but should return to normal as soon as the engine is reved up.

If the oil temperature gauge which is the converter oil "Out" temperature rises above 250°F, stop the vehicle immediately. Shift Revers-O-Matic to neutral and run the engine at 1200 R.P.M. The temperature should drop rapidly to the engine water temperature within 3 or 4 minutes. If the temperature does not drop, trouble is indicated. The cause of trouble should be determined before further operation of the vehicle;

refer to "TROUBLESHOOTING" instructions to be found elsewhere in this manual.

Generally, when overheating does occur, it is due to rapid reversals in the high gear ratios. Shifting to a lower gear will help eliminate overheating due to this cause.

WARNING **NEVER SUSPEND A POLE OR HEAVY OBJECT WITH THE WINCH AND THEN MOVE THE TRUCK. ALWAYS KEEP THE BOOM VERTICAL AND THE AUGER ON THE GROUND.**

3-4 WINCH OPERATIONS

A. When setting and pulling poles or using the winch for any type of heavy work, position the Kelly bar vertical, place the auger with bit on the ground and apply some down pressure. Jacks should be used, if so equipped.

B. When using the winch to drag an object to the digger from a distance, use the snatch block provided at the top of the final drive. The polesetter boom should never be used as a crane.

3-5 DIGGING TECHNIQUE

A. Engine RPM. During all operations, except actual digging, the engine should be run as low RPM as possible. Raising the feed ram, leveling, and the smaller accessories should all be operated as close to engine idle as possible. Only the winch should have the full power of the engine available.

B. Gear Selection. The selection of the proper gear is very important to the digging operation and life of the digger. The gears should be selected with regard to the size of the auger and digging conditions. Larger diameter augers and hard digging conditions require slower operating speeds. Therefore, you should start in the highest gear usable without stalling the torque converter or lugging the engine.

CAUTION **LOW GEAR OR REVERSE SHOULD NEVER BE USED WITH ENGINE AT FULL POWER. IF MORE AUGER SPEED IS REQUIRED, USE 2ND GEAR AND CONTROL THE SPEED WITH THE ENGINE RPM.**

3-6 DIGGING

After the controls have been learned and you are thoroughly familiar with the digger, proceed as follows:

A. Set the parking brake on the truck and set the support jack. Be sure the digging clutch is disengaged.

B. Start engine and let it run until normal operation temperature.

CAUTION **IF ENGINE FAILS TO START AFTER 30 SECONDS CRANKING, RELEASE IGNITION SWITCH AND ALLOW STARTER TO COOL FOR AT LEAST TWO MINUTES. THEN ATTEMPT STARTING PROCEDURES AGAIN. IF ENGINE STILL WILL NOT START, STOP THE STARTING PROCEDURES AND DETERMINE THE CAUSE AND CORRECT BEFORE MAKING ANOTHER ATTEMPT.**

C. Raise feed ram bar and level with leveling cylinder.

D. Push the auger bar control until the auger touches the ground.

E. Place the gear selector in high gear.

F. Engage the clutch and increase engine RPM. At the same time, "BUMP" the auger bar control pushing the turning auger into the ground. Use only the engine RPM required to dig the hole. Excess speeds will damage the unit.

G. After several "BUMPS" of the auger bar valve, the auger should be sufficiently loaded. -

H. Release engine RPM and disengage clutch. Pull the auger bar control and raise the auger out of the hole. Increase RPM as required. When auger clears the ground, at engine idle, engage the clutch and raise engine RPM throwing off the dirt removed from the hole.

I. Keep repeating until the hole is to the required depth. Try to anticipate when the feed ram piston will hit the top of the barrel when raising the auger. <u>This will eliminate unnecessary shock.</u>

J. When returning into the hole, do not allow the auger to turn. This and insufficient down pressure will cause chatter and excessive vibration and may cause damage to the drive train.

CAUTION **DO NOT ROTATE AUGER WHEN RETURNING TO HOLE, WILL CAUSE DAMAGE TO DRIVE TRAIN.**

3-6 DIGGING (Continued)

K. When returning into the hole, do not hold the auger bar control valve open after the auger hits bottom. This will raise the truck and may shift the digger off the hole.

L. Do not attempt to dig too fast or overload the auger for a period of time. The unit is new and requires a certain amount of break-in. This period is important since it allows the operator to become familiar with the new digger at the same time.

M. When digging with extra-depth diggers, dig the first three to five feet slowly; then continue at normal speed. This helps stabilize the auger and bar, thus eliminating bar slap inside the barrel.

N. In the event the auger gets overloaded and it cannot be lifted with the auger bar control, disengage clutch, shift the transmission into reverse, re-engage clutch; this will back the auger out of the hole. Use the auger bar control to pull up at the same time. When the auger is clear, disengage the clutch and shift the transmission back forward and continue digging.

O. If for some reason the hydraulic system should fail while the auger is in the hole, place the transmission in reverse, shovel dirt into the hole, pull control marked auger bar, engage clutch and the auger will back itself out. When the auger reaches the top of the hole, push the elevating cylinder control, move the truck forward slowly, and the barrel will lower. By using the control valve, lower the barrel to travel position.

P. For efficient digging, the bit point and cutting teeth should be kept sharp at all times. If hard digging is encountered, such as sandstone, limestone, frozen ground, etc., the auger speed should be reduced and a slight down pressure put on the auger to allow the auger to cut its way. Excessive speeds and down pressure cause undue wear on auger teeth and may damage the drive train if the auger should hang.

Q. Tight rock formations and friable materials can easily be handled by the auger equipped with rock boring head and Tungsten Carbide cutting points. This combination will handle any digging that can be considered "DIGGER" material. Rock drilling can also be assisted by adding water to the cut for lubrication and cooling.

3-6 DIGGING (Continued)

CAUTION **THE KELLY BAR SHOULD NEVER BE USED TO PUSH THE TRUCK IN THE EVENT IT BECOMES STUCK OR DISABLED. A BENT KELLY BAR IS USUALLY THE RESULT OF SUCH AN OPERATION.**

R. Operating the collapsible wire reel.

1. The wire reel is designed to be mounted onto the end of the winch assembly shaft. It must be secured to the winch shaft using the clevis pin and hair pin provided for this purpose.

2. With the wire reel mounted horizontally onto the winch shaft, position the handle in the horizontal position to wind cable. To remove cable, position handle perpendicular to the winch shaft.

3-7 MOVING THE UNIT TO NEW DIGGING SPOT, SAME WORK-SITE

Before moving the digger, raise the auger and lower the feed ram to the traveling position. Raise support jack and stop engine.

CAUTION **BEFORE AND DURING LOWERING OF THE FEED RAM, LINE UP THE DOTTED LINE ON FRAME RING TO MARKER ON THE RIGHT ANGLE DRIVE TO PREVENT FEED RAM FROM DAMAGING ENGINE AND ACOUSTICAL PANEL.**

3-8 MOVEMENT TO A NEW WORK-SITE

A. Short distance movement

1. If the earth auger is to be moved only a short distance, it will be moved on its carrier.

2. Refer to Page 10 and remove the auger from auger shaft.

CAUTION **BEFORE MOVING TO NEW SITE, SEE PAGE 10.**

3. Stow auger and bit, all equipment and tools on the carrier.

4. Move carrier to new work-site.

B. Long distance movement

1. Refer to Page 10 and remove the auger from auger shaft.

CAUTION REMOVING AUGER FROM CARRIER, SEE PAGE 10.

2. Drain the auger engine fuel tank.

3. Refer to Page 8 and remove the front, center, and rear mounting hardware securing the auger assembly to the truck frame.

4. Use a suitable lifting device with at least 15,000 pounds capacity and lift auger assembly from the truck frame.

5. Refer to TM 38-230-2 and prepare the auger assembly for shipment to the new work-site.

C. Reinstallation after movement

1. Remove all packaging and preservation tape from the auger assembly.

2. Reinstall the auger assembly on the carrier frame per Page 8.

3-8 OPERATION UNDER UNUSUAL CONDITIONS

A. Operation in Extreme Cold (Below O"F).

1. Inspect radiator to be sure that antifreeze is correct for the lowest possible temperature expected.

2. Inspect the cooling system and report any leaks to direct support maintenance.

3. Keep battery fully charged. After adding water, run the engine for at least one hour.

4. Keep fuel tank as full as possible to prevent condensation.

5. Drain and service fuel strainers frequently.

6. Before applying load, allow engine to reach normal operating temperature.

7. Lubricate as specified in Lubrication Diagram this manual. SEE PAGES 37-40

B. Operation in Extreme Heat

1. Cooling System.

   a. Check the coolant level frequently. Clean and flush the cooling system frequently.
   b. Make sure the fan belts are in good condition and that the tension is adjusted properly. Make sure that the thermostat is in proper working condition.
   c. Clean between the fins of the radiator core frequently to get the best possible cooling. Use compressed air if available to blow all dust and dirt out of the core. Avoid using water that contains substances likely to cause excessive scale and rust.

2. Lubrication System. Lubricate the unit for hot weather operation in accordance with Lubrication Diagram this manual.

3. Fuel System.
   a. Clean the fuel strainer frequently and check the fuel filters.
   b. Check the air cleaner. Keep it clean and free from foreign matter.
   c. Be sure the tank vents in the fuel system are open.

B. Operation in Extreme Heat (Continued)

4. Electrical System. Check the electrolyte level in the battery daily, and fill to three-eight inch above the plates with distilled water, if available. Clean, mineral free water may be used.

C. Operation in Salt Water Areas

1. Lubrication System.
   a. Keep oil filler caps and plugs tight.
   b. Be sure to clean and dry all fittings before lubricating.

2. Cooling System. Be sure the water in the cooling system is free from salt or alkali. Use an approved rust inhibitor to prevent the formation of rust or scale in the cooling system.

3. Electrical System.
   a. Clean electrical connections and keep them dry.
   b. Coat the battery terminals with grease and secure battery box cover.

4. Protection.
   a. Wash the unit frequently with clean, fresh water.
   b. Remove corrosion from any unpainted surface. Report areas in need of painting to organizational maintenance.

D. Operation at High Altitudes

1. The engine in this unit is designed to operate under normal conditions up to 5,000 feet above sea level without special service or adjustment.

2. Above 5,000 feet, the engine efficiency will be reduced. This is a normal condition which cannot be prevented, but maximum performance can be maintained by following all service instructions carefully. Be sure air cleaners are clean and free of objects that might restrict flow of air to the unit.

3. Be alert for pressure leaks that allow the coolant to boil with resultant loss of coolant. Inspect the radiator cap and gasket frequently for tight sealing.

E. Operation Under Rainy or Humid Conditions

1. Lubrication System.
   a. Lubricate the unit in accordance with Lubrication Diagram this manual.
   b. Keep the filler caps and plugs tight to prevent water from entering the lubrication system.

2. Fuel System.
   a. Keep fuel tank full when not in operation to prevent condensation and keep fill caps tight.
   b. Inspect fuel strainer for accumulated water more often than is required for normal operation.

3. Electrical System.
   a. Check wiring for cracked or frayed insulation. See that wiring is kept dry and water-proofed.
   b. Coat the battery terminals with grease and keep the battery box secured.

F. Operation in Dusty or Sandy Areas

1. Cooling System.
   a. Keep the radiator core free of dust, sand, or foreign matter to avoid overheating of the engine.
   b. Keep dust and sand from entering the radiator by wiping dust or sand from the cap before adding coolant.

2. Lubrication System.
   a. Lubricate the unit in accordance with this manual.
   b. Keep all lubrication points clean and avoid spilling oil on the unit as it will collect dust and sand.
   c. Clean and replace filters more often than in normal operation.

3. Fuel System.
   a. Take all precautions necessary to keep dirt or other foreign material out of the fuel tanks and fuel system. Clean the fuel strainer and water trap frequently.
   b. Check and service the air cleaner as necessary.

4. Electrical System.
   a. Service the batteries frequently and keep battery box cover securely fastened.
   b. If any of the instrument gauges have loose-fitting glass, use a sealer or tape to keep dust or sand from entering.

CHAPTER IV

PREVENTIVE MAINTENANCE

4-1 GENERAL INFORMATION

This section contains all of the recommended procedures, instructions, and technical data which the operator will need in order to perform necessary preventive maintenance.

4-2 EQUIPMENT LUBRICATION

Determination of when oil changes are made, filter elements are to be cleaned and/or replaced and lubrication of equipment is required, should be based on the severity of operation. The recommended lubricating instructions provided herein are based upon normal operation, and should be varied in accordance with the hours of operation, climate and digging conditions. An equipment lubrication diagram has been included to show the general location of all points which require periodic lubrication. This chart also lists the various points and provides data such as quantities, types of lubricants recommended, and the recommended frequency of lubrication.

4-3 CARE OF LUBRICANTS

Keep all lubricants and oils in closed containers. Store them in a clean, dry place protected from excessive heat. Make sure no dirt, water or other foreign matter becomes mixed with lubricants. Lubricating equipment and containers should be kept clean and ready for use.

4-4 LUBRICATION POINT CARE

Before lubricating, or filling hydraulic fluids, the fittings, caps, and filler plugs should be thoroughly cleaned to prevent contamination. After lubrication and filling, remove any excess spilling. After lubrication and filling, make a thorough check of all lines, connections and fittings for signs of leaks. Start and operate, so a thorough inspection can be made of equipment under normal operating pressures in order to check for other damage.

4-5 PREVENTIVE MAINTENANCE

In order that the operator may be sure his digger is ready for operation at any time a regular program of preventive maintenance should be adopted. A maintenance program should be established on the basis of the operator and/or maintenance personnel performing specific maintenance work during various periods of equipment operations, at intervals during which the equipment will be idle, and during extended periods of time when the equipment

4-5 PREVENTIVE MAINTENANCE (Continued)

will be in storage. When the digger is in continual, daily use, a program of daily service requirements should be established with preventive maintenance being performed on a "before operation;" "during operation;" and "after operation" schedule.

4-6 COOLING SYSTEM MAINTENANCE

The engine's cooling system is designed to provide adequate cooling during all normal operating conditions. Engine over-heating can become the primary cause for extensive repair work, lost operating time, and possibly result in the eventual and complete engine and/or transmission failure. Cooling system maintenance should, therefore, hold an important place in the digger maintenance program.

4-7 COOLING SYSTEM FREEZE PROTECTION

In the late fall, before temperatures drop below 32°F, the complete cooling system should be drained and flushed. The thermostat should be removed during flushing. Check for proper operation or replace before reinstalling. When refilling, add a sufficient amount of antifreeze for your climate. A 50-50 mixture is recommended for maximum protection.

4-8 DRY-TYPE AIR CLEANER

Under normal conditions, dry-type filters should be serviced each 500 hours of operation. Extreme conditions will require daily service. Element can be cleaned best by blowing compressed air from inside out. Do not apply air closer than 2 inches and do not use more than 30 pounds pressure. Do not damage gasket surface or bend element. Cleaning can only be done a few times as the element will finally clog and restrict air flow. The element must then be replaced.

4-9 ELECTRICAL SYSTEM

So far as electrical system maintenance is concerned, the operator's primary responsibility is restricted to making sure the wiring remains in good condition and the battery is filled and kept charged. Repair and replacement of worn or damaged parts must be done according to the maintenance allocation.

4-10 TRANSMISSION

This unit requires very little preventive maintenance. The clutches are self-adjusting and pressure is internally regulated. Before operation, the operator should start the engine and run for two minutes and stop engine and check oil level. Add if necessary, using automotive automatic transmission fluid - MIL-L-2104 only. Do not over

4-10 TRANSMISSION (Continued)

fill and stop operation if any leak is detected. Repair leak and fill with oil before using. Do not operate at temperatures above 2500. Shift into neutral and allow to cool.

4-11 EQUIPMENT CLEANLINESS

One of the most important procedures in any maintenance program should be to make sure it is kept clean, for not only will it look better, it will run better too. Washing metal surfaces frequently, and keeping it painted will prevent rusting and corrosion and it is much easier to detect cracks, bends of other damage that may be hidden under layers of dirt and grime. The digger should, therefore, be washed and cleaned thoroughly at least once each week during normal operation. The Earth Auger is designed for service under the most rugged conditions and will require a minimum amount of maintenance to assure its dependable operation for many years. Most owners have found that if a good tool is properly serviced, it will more than properly serve its owner.

4-12 HYDRAULIC SYSTEM

There is a 10 Micron Filter on the return line mounted to the side of the oil reservoir. The filter element should be changed after the first 8 hours of operation and every 200 hours. A 100 mesh suction strainer located inside the oil reservoir should be removed and cleaned at 100 hour intervals. The strainer can be removed by lifting out attached spring loaded handle inside oil reservoir. The strainer can be cleaned with a solvent and dried with compressed air. After cleaning, inspect the strainer carefully for damage. If damaged, replace. Check Fluid level frequently with dipstick. Add SAE 10 grade anti-wear type hydraulic oil with Foam depressant, rust and oxidation inhibitors, meeting performance classifications, OE/HDO MIL-L-2104. Added oil should be strained through 100 mesh strainer, CLEANLINESS IS OF UTMOST IMPORTANCE.

CAUTION **If filter warning light comes on, SHUT DOWN MACHINE AS SOON AS IT IS POSSIBLE TO DO SO SAFELY, REPLACE AUTIO ELEMENTS. REFER TO TROUBLE SHOOTING CHART.**

NOTE: **If hydraulic pump needs to be removed or replaced, an auxiliary plug is provided to prevent loss of oil from reservoir. Lift out spring loaded handle attached to strainer and insert plug with attached handle in its place. Plug with handle is attached inside oil reservoir to top with chain.**

4-12 HYDRAULIC SYSTEM (Continued)

CAUTION **Plug must be removed and strainer reinstalled before starting engine to prevent damaging pump.**

A. Hydraulic Hoses

Inspect all hoses for cracks, breaks, damage or loose fittings. Tighten loose fittings. Replace damaged or defective hose.

B. Hydraulic Pump

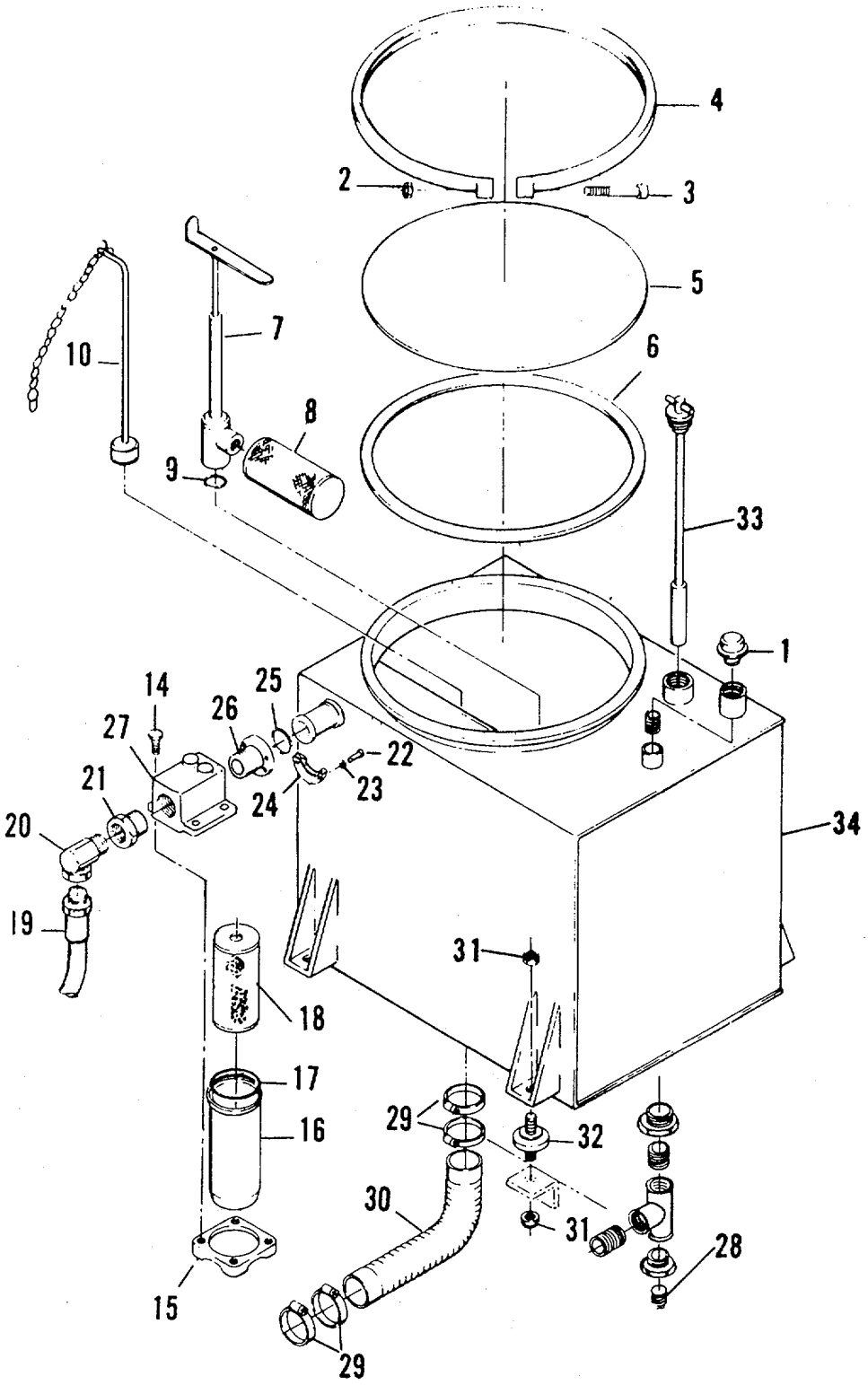
Visually insert the pump for any cracks in housing or other damage. Replace a damaged pump. Refer to Section 6-2.

C. Hydraulic Reservoir (Tank)

1. Breather Cap.
   a. Removal and installation. Remove the breather cap, refer to Figure 4-1 (Hydraulic Reservoir), From the top of the hydraulic reservoir by rotating the cap counterclockwise and removing. Installation is opposite of removal.
   b. Servicing. Clean the breather cap in an approved cleaning solvent and dry with compressed air. Inspect cap for damage, replace a damaged cap.

2. Oil Strainer.
   a. Removal. Loosen the nut (Item 2) and bolt (Item 3) and remove the clamp (Item 4) retaining the hydraulic tank cover and remove the tank cover (Item 5) and gasket (Item 6). Remove suction adapter (Item 7) and install auxiliary plug (Item 10) in place of adapter. Remove strainer. Remove O-Ring (Item 9) from adapter.
   b. Servicing and Inspection. Clean the strainer with an approved cleaning solution and allow to dry. Inspect the strainer for holes in filter screen or any other damage. Replace a damaged strainer.
   c. Installation. Install strainer and cover by reversing removal procedures.

3. Filter
   a. Removal. Remove the four bolts (Item 14), retaining flange (Item 15), and filter housing and remove the housing (Item 16) and gasket (Item 17). Remove the filter element (Item 18).



1. Breather cap
2. Nut
3. Bolt
4. Clamp
5. Cover
6. Gasket
7. Adapter
8. Strainer
9. O-ring
10. Auxiliary plug
11. ---
12. ---
13. ---
14. Bolt
15. Flange
16. Housing
17. Gasket
18. Filter element
19. Hose
20. Elbow
21. Adapter
22. Nut
23. Lockwsher
24. Clamp half
25. O-ring
26. Flange
27. Filter head
28. Drain plug
29. Clamp
30. Hose
31. Nut
32. Mount
33. Oil level gauge
34. Hydraulic reservoir

FIGURE 4-1. HYDRAULIC RESERVOIR

C. Hydraulic Reservoir (Tank) (Continued)

b. Servicing. Clean the filter housing with an approved cleaning solvent and dry thoroughly. Old filter and gaskets shall be discarded and replaced with new filters and gasket.
c. Installation. Install the filter by reversing the procedures used for removal.

4. Reservoir
a. Removal. Drain hydraulic oil from reservoir. Remove breather cap, oil strainer and filter (Refer to Paragraph 1-2-3 of this section). Disconnect hose (Item 19), remove elbow (Item 20) and adapter (Item 21). Remove four nuts (Item 22) and lock washers (Item 23) and two clamp halves (Item 24). Remove O-Ring (Item 25), then unscrew flange (Item 26) from filter head (Item 27). Loosen clamps (Item 29) and remove the hose (Item 30). Remove eight nuts (Item 31) and four mounts (Item 32). Remove oil level gauge (Item 33) from hydraulic reservoir (Item 34).
b. Cleaning and Inspecting. Clean the reservoir with an approved solvent and dry thoroughly. Inspect for cracks, dents or other damage.
c. Repair and Replacement. Minor dents in the reservoir may be repaired using simple shop repair methods. Major damage will necessitate the replacement of the reservoir. Use replacement parts in lieu of worn or damaged parts.
d. Installation. Install the reservoir and associated parts by reversing the removal procedures. After installation, service the hydraulic reservoir as instructed in Lubrication Diagram in Section 4-13.

4-13 LUBRICATION

A. Intervals on chart are based on normal operations. Adjust to compensate for abnormal operations and severe conditions. During inactive periods, sufficient lubrication must be performed for adequate preservation.

1. Clean fittings before lubrication.

2. Re-lubricate after washing or fording.

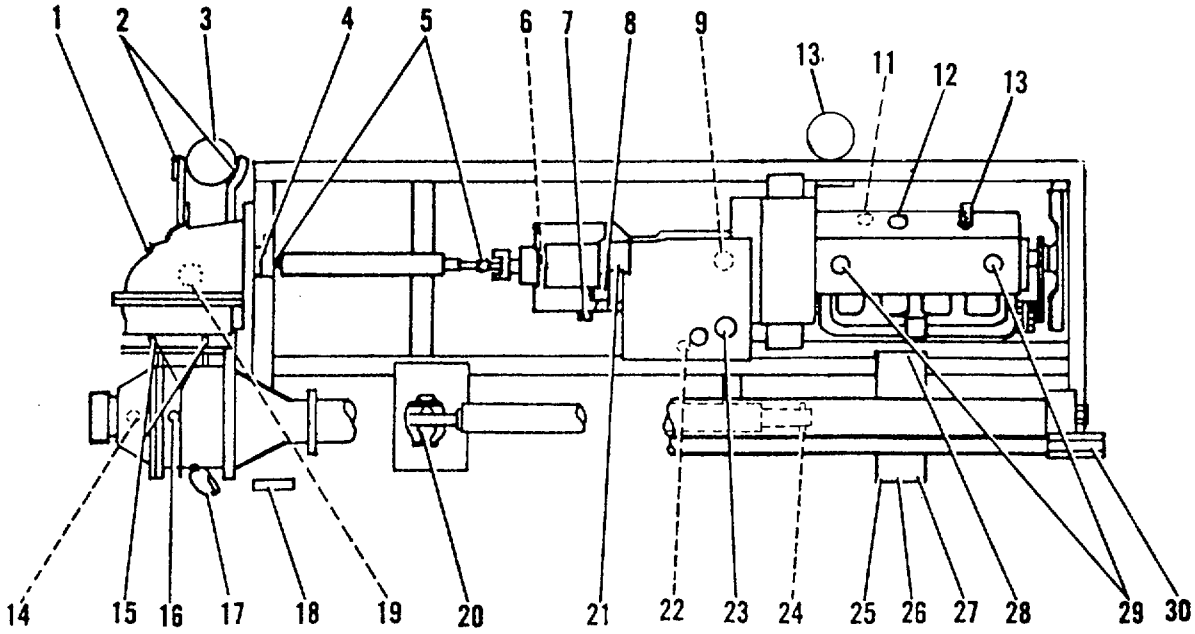
3. Clean parts with SOLVENT, dry-cleaning Type II (SD-2). Dry before lubricating.

4-13 LUBRICATION (Continued)

WARNING

DRY CLEANING SOLVENT, SD-2, USED TO CLEAN PARTS A IS POTENTIALLY DANGEROUS TO PERSONNEL AND PROPERTY. DO NOT USE NEAR OPEN FLAME OR EXCESSIVE HEAT. USE WITH ADEQUATE VENTILATION.

4. Drain gear grease when hot. Fill and check level.



A dotted circle indicates a drain below.

FIGURE 4-2. LUBRICATION DIAGRAM

LUBRICATION DIAGRAM			AUGER, EARTH: SKID MOUNTED, DETROIT DIESEL ENGINE DRIVEN REEDRILL, INC. MODEL 270-9		
INTERVAL HOURS	*MAN HOURS	REF. NO.	IDENTIFICATION	SERVICE	LUBRICANT	NO. OF SERVICE POINTS
10	2.3	28	WINCH SHAFT BEARINGS	LUBE	GAA	2
		12	CRANKCASE OIL LEVEL GAGE	CHECK LEVEL	OE/HDO	1
		30	UPPER MAST SHEAVE	LUBE	GAA	1
		18	LOWER MAST SHEAVE	LUBE	GAA	1
		4	RIGHT ANGLE DRIVE PINION CARRIER	LUBE (SPARINGLY)	GAA	4
		2	LEVELING CYLINDER SUPPORT	LUBE (SPARINGLY)	GAA	2
		3	LEVELING CYLINDER	LUBE	GAA	1
		17	SNATCH BLOCK	LUBE	GAA	1
		15	FINAL DRIVE PINION CARRIER	LUBE	GAA	4
		24	ELEVATING CYLINDER UPPER	LUBE (SPARINGLY)	GAA	1
		20	ELEVATING CYLINDER LOWER	LUBE (SPARINGLY)	GAA	2
50	2.0	7	TRANSMISSION FILL AND LEVEL	CHECK LEVEL	OE/HDO	1
		1	RIGHT ANGLE DRIVE FILL AND LEVEL GAGE	CHECK LEVEL (SEE KEY)	GO	1
		26	WINCH LEVEL PLUG	CHECK LEVEL	GO	1
		25	WINCH FILL PLUG	FILL (SEE KEY)	GO	1
		23	HYDRAULIC TANK FILL AND LEVEL	CHECK LEVEL	OE/HDO	1
		9	HYDRAULIC OIL STRAINER - T	CLEAN OR REPLACE	---	1
		16	FINAL DRIVE FILL AND LEVEL GAGE	CHECK LEVEL (RAISE ELEVATOR TO VERTICAL POISITION TO CHECK LEVEL)	GO	1
100	0.9	11	CRANKCASE OIL DRAIN	DRAIN AND REFILL	OE/HDO	1
		13	OIL FILTER (ENGINE)	REMOVE, INSTALL NEW FILTER (SEE NOTE 2)	OE/HDO	1
		29	CRANKCASE FILL AND BREATHERS	FILL AND CLEAN BREATHERS	OE/HDO	2

* THE TIME SPECIFIED IS THE TIME REQUIRED TO PERFORM ALL SERVICES AT THE PARTICULAR INTERVAL.

FIGURE 4-3. LUBRICATION DIAGRAM CHART

LUBRICATION DIAGRAM			AUGER, EARTH: SKID MOUNTED, DETROIT DIESEL ENGINE DRIVEN REEDRILL, INC. MODEL 270-9			
INTERVAL HOURS	*MAN HOURS	REF. NO.	IDENTIFICATION	SERVICE	LUBRICANT	NO. OF SERVICE POINTS
250	0.5	5	UNIVERSAL JOINT	LUBE (SPARINGLY)	GAA	3
		21	HYDRAULIC FILTER	REMOVE, CLEAN HOUSING, ADD NEW FILTER ELEMENT, REINSTALL	OE/HDO	1
500	0.6	6	TRANSMISSION DRAIN	DRAIN AND REFILL	OE/HDO	1
		8	TRANSMISSION OIL FILTER	REMOVE, INSTALL NEW FILTER	OE/HDO	1
1000	1.3	27	WINCH DRAIN PLUG	DRAIN AND REFILL	GO	1
		19	RIGHT ANGLE DRIVE DRAIN PLUG	DRAIN AND REFILL (SEE KEY)	GO	1
		22	HYDRAULIC TANK DRAIN	DRAIN AND REFILL	OE/HDO	1
		14	FINAL DRIVE DRAIN PLUG	DRAIN AND REFILL	GO	1

* THE TIME SPECIFIED IS THE TIME REQUIRED TO PERFORM ALL SERVICES AT THE PARTICULAR INTERVAL.

FIGURE 4-3. LUBRICATION DIAGRAM CHART (Continued) IV

LUBRICANTS	CAPACITY	EXPECTED TEMPERATURES		
		ABOVE +32°F	+40°F TO -10°F	0°F TO -65°F
OE/HDO OIL, LUBRICATING OIL, ENGINE				
ENGINE CRANKCASE	4.5 QT	OE/HDO 30	OE/HDO 10	OEA
HYDRAULIC TANK	260 QT	OE/HDO 10		
GO - LUBRICATING OIL, GEAR				
RIGHT ANGLE DRIVE	3 QT	G090	G090	GOS
FINAL DRIVE	3-½ QT			
Winch	1 QT			
Transmission	13 QT	OE/HDO 10		OEA
GAA - GREASE, AUTOMOTIVE & ARTILLERY	ALL TEMPERATURES			

FIGURE 4-4. LUBRICATION KEY

NOTES:

1. For operation of equipment in protracted cold temperatures below -10°F, remove lubricants prescribed in the key for temperatures above -10°F. Re-lubricate with lubricants specified in the key for temperatures below -10°F.

2. Oil Filter. After installing new filter, fill crankcase, operate engine 5 minutes, check for leaks, check crankcase oil level and bring to full mark.

3. Lubricants. The following is a list of lubricants with the Military symbols and applicable specification numbers:

   OE/HDO - MIL-L-2104
   GAA - MIL-G-10924
   GO - MIL-L-2105
   OEA - MIL-L-46167

Copy of this Lubrication Diagram will remain with the equipment at all times; instructions herein are mandatory.

4-14 COLLAPSIBLE WIRE REEL

A. Removal and Disassembly. Remove and disassemble the collapsible wire reel by following the sequence of index number (1 through 30) assigned to Figure 4-5.

B. Inspection and Repair.

1. Inspect all parts for visible signs of wear or damage.

2. Repair by using replacement parts in lieu of worn or damaged parts.

C. Installation. Install the wire reel by reversing the procedures used to remove and disassemble the reel.

1. Hair pin retainer
2. Clevis pin
3. Nut
4. Bolt
5. Nut
6. Bolt
7. Nut
8. Bolt
9. Shaft
10. Fitting
11. Bracket
12. Cotter pin
13. Clevis pin
14. Link
15. Saddle
16. Nut
17. Bolt
18. Spider
19. Spider
20. Nut
21. Setscrew
22. Nut
23. Bolt
24. Lever cap
25. O-ring
26. Shaft
27. Setscrew
28. Pin
29. Link
30. Handle

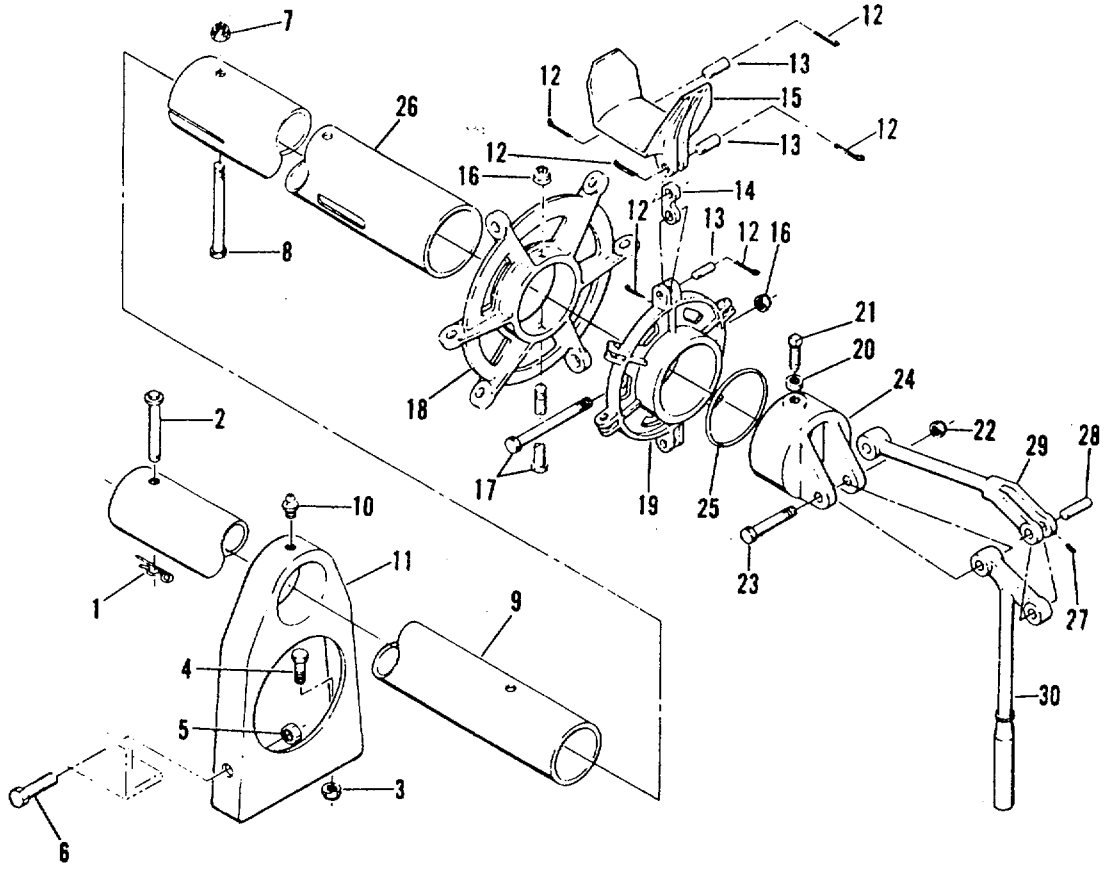


FIGURE 4-5. COLLAPSIBLE WIRE REEL

4-15 BATTERY AND BATTERY BOX

A. Removal and Installation.

1. Unlock battery box.

2. Open the battery box cover. -

3. Loosen and remove the two battery cables.

4. Install the battery box and battery by reversing removal procedures.

5. Lock the battery box when service is not required.

B. Testing. The state of charge of the battery is indicated by the specific gravity of the battery solution. Check the specific gravity with a hydrometer to determine the condition of the battery. If specific gravity is less than 1.280, the battery should be recharged. If the battery does not hold a charge, it should be replaced. If the difference is specific gravity between cells is more than 20-25%, the battery should be replaced.

C. Service. Fill the battery to the ring with distilled water or clean rain water. The battery terminals should be kept tight and free of corrosion. A solution of two tablespoons of baking soda to a pint of water makes an excellent cleaning agent for corroded battery terminals and a dirty battery base. Apply the solution with a paint brush or whisk broom and thoroughly flush the outside of the battery with clean water when finished. Coat the battery terminals with a light grease or petroleum jelly to inhibit corrosion.

CAUTION **DO NOT ALLOW THE SODA SOLUTION TO ENTER THE BATTERY CELLS. IT MAY CAUSE THE BATTERY TO BE NEUTRALIZED.**

D. Inspection and Repair. Inspect the box and fastening hardware for damage. Use replacement fasteners as needed. Straighten any dents using simple shop repair methods.

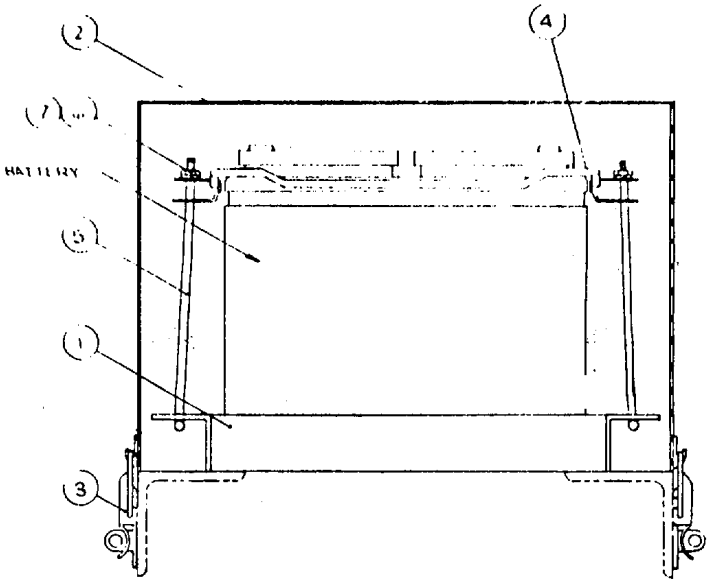


FIGURE 4-6. BATTERY / BATTERY BOX

4-16 KELLY BAR (LOWER) PACKING NUT

A. After initial operation, the Kelly bar packing nut will tend to leak somewhat. Therefore, the nut must be tightened in such a manner that the "leakage" leave only a "film" of hydraulic oil on the Kelly bar. The nut must be tightened to the extent that the Kelly bar is dry.

B. To tighten the packing nut, refer to Figure 4-7.

1. **Loosen CLAMP BOLT.**
2. **Rotate PACKING NUT counterclockwise until snug**
3. **Tighten CLAMP BOLT.**

NOTE: When properly tightened, packing will allow only a light film on the KELLY BAR.

* TIGHTEN WITH CHAIN WRENCH SUPPLIED WITH THIS EQUIPMENT. (SEE PARTS MANUAL, SPECIAL TOOL SECTION FOR DESCRIPTION).

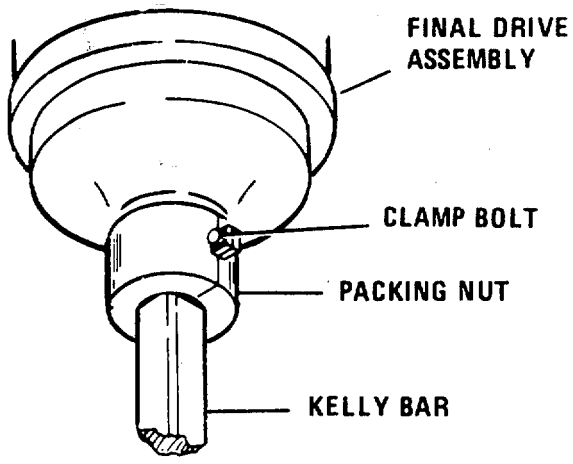


FIGURE 4-7. KELLY BAR (LOWER) PACKING NUT

4-17 SOUND LEVEL CONTROL ACOUSTICAL PANELS

A. The exclusive purpose of the acoustical panels is to control the sound level of the operation of the earth auger, and do not contribute to the operation. Maintenance of most components requires the removal of one or more panels for accessibility.

B. Acoustical doors must be closed while machine is in operation.

C. Shaft cover must be closed while engine is running.

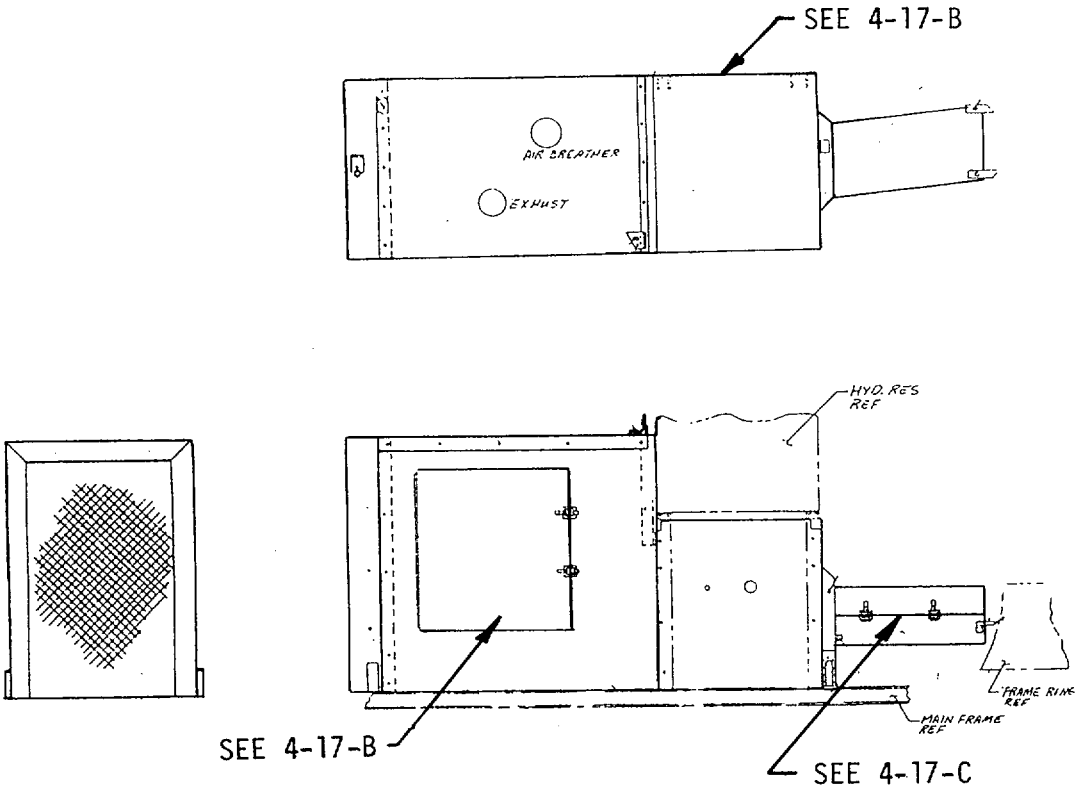


FIGURE 4-8. ACOUSTICAL PANELS

CHAPTER V

TROUBLE SHOOTING

5-1 HYDRAULIC SYSTEM TROUBLE SHOOTING

CONDITION	PROBABLE CAUSE	REMEDY
Sluggish or no response to hydraulic controls	A. Suction line plugged.	Check plug in tank, clean strainer.
	B. Check oil level.	If low, refill with proper lubricant to oil level mark in tank. See Lubrication Chart.
	C. Check strainers mounted in tank.	If flow of oil is obstructed by foreign matter in screen, remove and clean with solvent or kerosene, but NEVER SOAK IN GAS AND BURN TO REMOVE FOREIGN MATTER.
	D. Hydraulic leak in line.	Replace with recommended hydraulic line and length.
	E. Faulty relief valve.	Check relief valve for foreign matter that might possibly be holding relief valve in return to tank position. Clean and reassemble, checking pressure to proper setting.
	F. Malfunction of one operation only.	If sluggish or no hydraulic response is encountered on one cylinder only, disassemble cylinder and check the rings and piston assembly and repair parts as shown in the exploded views for the particular cylinder.
	G. Hydraulic pump.	If all the above check points prove negative, the probable cause is malfunction of hydraulic pump. Replace with new pump. Determine the cause of pump failure.

5-1 HYDRAULIC SYSTEM TROUBLE SHOOTING (Continued)

CONDITION	PROBABLE CAUSE	REMEDY
Pressure drop from original pressure setting on the machine.	Relief valve spring relaxed or normal loss of flow due to pump wear.	The system is equipped with single bank of valves. Loosen jam nut on inlet section and turn adjustment screw clockwise until the original pressure setting is reached. If unable to raise pressure by adjusting relief valve, the pump is badly worn and should be replaced. Check exploded views for proper machine model and pump number. PROPER RESSURE IS 1450 PSI.
Noisy pump caused by cavitation.	A. Oil supply low.	Fill reservoir check with dipstick.
	B. Oil too heavy.	Change to proper oil. See Lubrication Chart.
	C. Oil filter plugged.	Install new filter.
	D. Suction line strainer plugged.	Clean strainer.
Oil heating.	A. Oil supply low.	Fill reservoir. See Lubrication Chart.
	B. Contaminated oil.	Drain reservoir and refill with clean oil.
	C. Setting of relief valves too high or too low.	Set to correct pressure.
	D. Oil in system too light.	Drain reservoir and refill with proper viscosity oil.
Shaft seal leakage.	A. Worn shaft seal.	Replace shaft seal.
	B. Broken molded V seal or gasket. Bearing out of position. Excessive internal wear.	If replacing the shaft does not stop leakage, the pump should be disassembled and checked for worn parts.

5-2 FUNK TRANSMISSION TROUBLE SHOOTING

A. Diagnosing Problem

The diagnosis of trouble in the transmission always should start by making certain preliminary checks before it is assumed that the transmission is at fault, or before carrying out any other trouble shooting procedures.

1. Check the coolant level in engine radiator.

2. Check the oil level in transmission. A low oil level can affect the operation of the transmission, and may indicate fluid leaks that could cause transmission damage. A high level can cause foaming of the oil which, in turn, may result in clutch slippage or leakage at the breather or filler tube.

3. Check the oil pressure gauge on instrument panel. This should be as described under "OPERATION" on the previous page.

4. Check the oil temperature gauge on instrument panel. This should never exceed 250°F.

5. Check the adjustment of the control and governor linkages. Make sure that the engine starts to rev up immediately after the pedal or lever leaves the neutral zone, and that the governor is being held wide open with pedal or lever in the full throttle position. All interference's that limit top R.P.M. should be remedied.

   The linkage rod from the shuttle control box to the valve lever must be adjusted so that equal tension or pressure is applied to the spring on top of the valve lever. This is to insure that the valve is always open to its fullest extent in either direction.

   If the unit starts with a jerk, check the engine idle speed which is recommended at 1200 R.P.M. If idle speed is lower than this, unit will die too easily in rapid reversals; and if higher than this, the converter will transmit too much torque for smooth starts. Any external interference's in the control linkages that enables the engine to accelerate prior to clutch engagement must be eliminated if smooth starts are to be expected.

6. Upon complaint of engine-transmission performance, first check the engine to see if it is performing satisfactory.

5-2 FUNK TRANSMISSION TROUBLE SHOOTING (Continued)

B. Performance and Stall Test - Funk Transmission

If all preliminary checks are satisfactory, make a performance and stall test as described below:

1. Run the engine at 1200 R.P.M. with the unit in neutral until normal engine operating temperature is reached.

2. Attach a tachometer to the engine and position the instrument so that it can be read from the driver's seat.

3. Apply the service brakes firmly.

4. With a steady pressure, depress the forward pedal or lever to the wide open throttle position. Observe the tachometer reading. The engine should turn up to the TOP governed R.P.M. If engine speed is below the minimum requirements, it is an indication that the engine is not operating at peak efficiency. Take all necessary steps to correct the engine deficiency, and again perform the test. Check the R.P.M. with the reverse pedal or lever fully depressed. The engine speed should be the same as above.

5. Next, place the transmission behind the Revers-O-Matic (shuttle box) in high gear leaving all brakes applied. With a steady pressure, depress the forward pedal or lever to the wide open throttle position. Make note of the tachometer reading. The engine should turn up to the "MINIMUM" static R.P.M. If engine speed is below the minimum requirements, it is an indication that the engine is at fault and should be checked out as described in (4) above. If a drop in stall speed persists, it indicates trouble in the transmission. If the stall speed is considerably below the minimum specified, it is an indication that the trouble is more likely in the converter. The remedy is to disassemble the converter and examine the converter parts for wear and any irregularities. If the engine speed is over the "MAXIMUM" static R.P.M., or if engine runaway is apparent, release the accelerator pedal or return the lever to neutral immediately to prevent possible damage to the transmission. This is an indication of transmission malfunction, and should be checked out per the Trouble Shooting Chart. Stall test tachometer readings require careful interpretation. During a stall test, the engine, torque converter, and hydraulic clutches are all under test at the same time.

5-2. FUNK TRANSMISSION TROUBLE SHOOTING (Continued)

Because of the rapid rise in oil temperature, the stall condition should be maintained only long enough for the tachometer reading to stabilize. Five seconds is usually adequate time for an accurate reading. Under no circumstances should the stall period exceed 30 seconds at a time. Between test, run the engine for at least two (2) minutes at 1200 R.P.M. with the Revers-O-Matic in neutral. This will permit the converter oil to flow into the oil cooler and back to the transmission sump.

Never disassemble any hydraulic fitting or connection until the pressure gauge on the instrument panel has returned to a zero (O) pressure reading.

CONDITION	PROBABLE CAUSE	REMEDY
Low engine speed at converter stall.	A. Engine low output torque.	Tune engine and check output.
	B. Converter element interference.	Listen for noise at stall, overhaul converter.
	C. Improper starter installation.	Disassemble converter and examine parts affected, making sure starter is not in backwards.
High engine speed at converter stall.	A. Low oil level.	Fill with transmission oil.
	B. Low converter out pressure.	Check for leaks. Disassemble the third regulator valve (front right side) by first removing the oil temperature. Line inspect all parts and reassemble.
	C. Clogged lines.	Clean as required.
	D. Bad oil pump.	Replace pump.
	E. Clutch slippage.	Rebuild clutch.

5-2. TRANSMISSION TROUBLE SHOOTING (Continued)

CONDITION	PROBABLE CAUSE	REMEDY
Irregular oil pressure.	A. Low or high oil level.	Adjust oil level as required.
	B. Air in oil. pump suction tube.	Rotate or replace O-Rings on
	C. Converter hub seal ring.	Replace seal ring.
Loss of power (foaming oil)	A. Low or high oil level.	Adjust oil level as required.
	B. Seal ring broken.	Disassemble, replace parts as required.
	C. Plugged oil filter.	Replace.
	D. Worn pump.	Replace.
	E. Starter improper installation.	Disassemble converter and examine parts affected, making sure starter is not in backwards.
	F. Clutch plate slippage.	Disassemble clutch stack and check piston seals for nicks, cuts, or wear. Replace worn parts as required.
	G. Water in oil.	Replace oil.
No power transmitted in either clutch.	A. Low clutch pressure.	Refer to irregular oil pressure.
	B. Clutch selector valve not operating properly.	Inspect linkages from shuttle control box to valve for proper adjustment. Remove valve cover and inspect arm that actuates the clutch selector valve for proper operation. Disassemble the clutch selector valve (one in center on left hand side looking from the rear) by removing end cap.

5-2. TRANSMISSION TROUBLE SHOOTING (Continued)

CONDITION	PROBABLE CAUSE	REMEDY
No power transmitted in either clutch (Continued)		NOTE: Valve cover must be off in order to accomplish this. Inspect parts and bore for wear, replace worn parts as required. Parts must be free from burrs and sharp edges.
Power transmitted in only one clutch. required.	A. Clutch stack malfunction. B. Broken seal rings on input and output shaft. C. Broken oil sleeve distributor tube.	Disassemble clutch stack. Replace worn parts as Replace broken seal rings. Replace.
Buzzing condition exists.	A. Irregular oil pressure. B. High oil pressure.	Refer to irregular oil pressure. Refer to high oil pressure.
Low clutch engage-ment.	A. Foaming oil. B. Low clutch pres-sure. C. Worn piston seals.	Refer to irregular oil pressure and loss of power. Refer to irregular oil pressure. Replace seals as required.
Creeps forward in neutral but stalls when shifted to reverse.	A. Failed forward clutch.	Overhaul forward clutch replacing all worn and defective parts.
Creeps backward in neutral but stalls when shifted to forward.	A. Failed reverse clutch.	Overhaul reverse clutch replacing all worn and defective parts.

5-2. TRANSMISSION TROUBLE SHOOTING (Continued)

CONDITION	PROBABLE CAUSE	REMEDY
Noisy transmission.	A. Improper oil level.	Add oil if required. Refer to irregular oil pressure.
	B. Clogged oil filter.	Replace oil filter if necessary.
	C. Air leaks.	Inspect around oil tubes, seals, and gaskets. Repair as necessary.
	D. Loose mounting bolts.	Tighten bolts to proper torque.
	E. Damaged gear teeth.	Replace as necessary.
	F. Flaws in gear shaft.	Replace as necessary.
	G. Flywheel housing misalignment.	Realign using indicator if required.
Excessive vibration.	A. Loose mounting bolts.	Tighten bolts to proper torque.
	B. Damaged gear teeth.	Replace as necessary.
	C. Gear box bearings.	Inspect and replace bearings as necessary.
Difficult to change gear ratios.	A. Transmission linkage.	Check for bent, worn, or broken parts. Replace faulty parts and readjust linkage.
	B. Engaged clutch in shuttle box.	Return lever to neutral.
	C. Drag in shuttle box.	First check for proper control linkage adjustment between control box and control valve. If clutch drag is still prevalent, disassemble clutch stack and inspect parts in clutch affected for malfunction.

5-2. TRANSMISSION TROUBLE SHOOTING (Continued)

CONDITION	PROBABLE CAUSE	REMEDY
Transmission will not stay in proper ratio (jumps out of gear).	A. Transmission linkage.	Check for bent or worn parts. Replace faulty parts and readjust linkage.
	B. Excessive endplay due to wear in the shift forks, sliding gear, fork grooves, thrust washers, output shaft, or countershaft bearings.	Replace faulty parts and readjust for faulty endplay.
Foaming oil breather (oil is foaming out the breather).	A. Improper oil level, oil and air leaks, pump suction tube, worn pump parts, water in oil.	Refer to irregular oil pressure, and loss of power sections.
	B. Broken converter hub gear seal ring.	Replace seal ring.
Wet converter housing.	A. Converter hub gear seal ring.	Inspect for breakage. Replace if required.
	B. Oil seal inside of converter.	Replace if required.

5-3. FEED RAM ASSEMBLY TROUBLE SHOOTING

CONDITION	PROBABLE CAUSE	REMEDY
Excessive leaking of hydraulic fluid around kelly bar.	Lower packing nut loose.	Tighten packing nut until slight seepage remains.
Kelly bar squeaks when extended.	Lower packing nut too tight.	Loosen nut until slight amount of seepage is encountered on kelly bar.

5-3. FEED RAM ASSEMBLY TROUBLE SHOOTING (Continued)

CONDITION	PROBABLE CAUSE	REMEDY
Packing nut completely taken up.	Lower packing worn out. NEW PACKING SOAK IN HYD OIL 4 to 8 HRS. BEFORE INSTALLING.	Remove lower packing nut and gland. Using hydraulic pressure blow out old packing, Replace with new set of packing allowing a slight amount of seepage.
Excessive leaking around main drive on upper portion of final drive assembly.	Upper packing nut loose.	Tighten upper packing nut until slight seepage remains.
Upper packing nut running extremely hot.	Upper packing nut too tight.	Loosen upper packing nut until slight seepage is encountered on the main drive.
Unable to seal flow of hydraulic oil on upper packing drive or packing nut completely taken up.	Upper packing worn out. NOT NECESSARY TO SOAK UPPER PACKING.	Remove upper packing nut, gland and using hydraulic pressure, blow out old packing. Replace with a new set of packing, allowing a slight amount of seepage.
Loss of hydraulic pressure when retracting kelly bar with a loaded auger or unable to keep down pressure when digging.	Piston assembly failure.	Piston rings badly worn or damaged. A quick method of checking is with the feed ram assembly in vertical position. Apply down pressure on kelly bar until truck is slightly raised off the ground. If digger falls back at a rapid pace, disassemble feed ram assembly and replace piston rings. If the piston assembly has deep scars on the piston, the feed ram cylinder itself should be checked for damage. If marks are not excessive, cylinder can be honed and reused. If honing does not dress marks out of cylinder, replace complete cylinder. When reassembling, do not over torque bolts on feed ram assembly.

5-3. FEED RAM ASSEMBLY TROUBLE SHOOTING (Continued)

CONDITION	PROBABLE CAUSE	REMEDY
Excessive whipping of kelly bar while digging.	Bent kelly bar.	Upon encountering this condition, immediately shut down operation. With kelly bar fully extended, locate bend in kelly bar. If bow is more than 4 feet from the drive, the bar can be straightened in the machine. If the bend has occurred above 4 feet, the bar must be removed from the machine. Refer to feed ram disassembly procedure.
Bar will extend but not retract.	Piston assembly.	Rings have failed on pistons. Refer to feed ram disassembly procedure. Before assembling check feed ram cylinder for damage.
Too much time lapse when bar reaches bottom of hole.	Flow control valve not properly adjusted.	Adjust valve mounted in line to the bottom of the feed ram. Screw in to increase bar speed and out to decrease bar speed.

5-4. OPERATIONAL CYLINDERS TROUBLE SHOOTING

CONDITION	PROBABLE CAUSE	REMEDY
Leakage around shafts.	Normal packing wear.	Tighten adjusting nut on packing glands equal amount.
Hydraulic cylinder will not hold.	Worn piston packing.	Disassemble cylinders and repack. All cylinders except feed ram cylinder use 1/4" Belmont packing.
Leakage around thread.	Loose cylinder cap.	Remove from digger and disassemble checking threads for damage. Reassemble using nylon ribbon tape sealer.

5-4. OPERATIONAL CYLINDERS TROUBLE SHOOTING (Continued)

CONDITION	PROBABLE CAUSE	REMEDY
Hydraulic oil escaping from polesetter extension.	Normal packing wear.	Remove cable from sheave on top of polesetter extension. Disconnect both 12 inch hydraulic hoses from bottom of 6 foot extension; pull forward until gland is exposed. Tighten packing gland nuts equal amount, or until hydraulic flow is sealed off. If adjustment has been completely taken up, repack using Chevron type packing.
Leveling cylinder too slow or too fast.	Flow control valve not properly adjusted	Adjust flow control valve mounted in lower port of leveling cylinder.

5-5. DRIVE ASSEMBLY TROUBLE SHOOTING

CONDITION	PROBABLE CAUSE	REMEDY
Kelly bar will not rotate. and pinion assembly.	Damage to ring gear	Disassemble final drive at retainer rings on intermediate housing. Slide final drive assembly out until pinion drive is free. Rotate pinion assembly if kelly bar does not turn. Damage is in final drive assembly. Disassemble according to disassembly procedure for final drive. Always use ring gear and pinion furnished by Reedrill, Inc.
Trouble not located in final drive.	A. Ring gear and pinion. Right angle drive.	If key is not damaged, check pinion teeth. Check ring gear teeth by rotating ring gear carrier assembly and inspect teeth through the pinion carrier opening on right angle housing.

5-5. DRIVE ASSEMBLY TROUBLE SHOOTING (Continued)

CONDITION	PROBABLE CAUSE	REMEDY
	B. Ring gear output drive.	Check ring gear carrier for weld failure on the internal spline assembly for excessive wear in the internal spline. If worn or cracked, replace with complete new carrier assembly.
Kelly bar will not rotate.	A. Clutch slipping. B. Drive line.	Refer to clutch section. Check weld on drive line assembly. If weld has failed, remove drive line from digger; realign in lathe and reweld using AWS-ASTM-E6010 rod.
Kelly bar will not rotate under load.	Torque converter.	Refer to torque converter section 5-2
Housing running extremely hot.	Bearing failure.	Disassemble housing and replace with original equip-ment replacement bearing.
Gear grease leak at pinion carrier assembly right angle.	Grease seal.	Remove drive line and companion flange. Replace seal.
Gear grease leak-ing between right angle housing and intermediate housing.	Gasket	Refer to right angle assembly procedure for replacement.
Gear grease leak-ing between inter-mediate ring and final drive housing.	Packing.	Replace packing on inner face of final drive flange.

5-5. DRIVE ASSEMBLY TROUBLE SHOOTING (Continued)

CONDITION	PROBABLE CAUSE	REMEDY
Gear grease leaking around main drive.	Grease seal.	Drain housing and remove lower packing nut and gland. Remove old seal using a punch to pry out. **CAUTION**: Caution must be exercised not to damage main drive in removing and replacing the grease seal.
Upper grease seal leaking on main drive.	Housing overfilled.	Drain oil to proper oil level. Check for water in oil.
Water in final drive housing.	Upper seal.	Upper seal has failed or improperly installed. Refer to final drive assembly.
New seal will not stop leak.	Main drive.	Main drive excessively worn. Disassemble and replace with a new main drive.

CHAPTER VI,

REPAIR INSTRUCTIONS

INTRODUCTION

The instructions contained in this section are intended for use by personnel responsible for servicing and repairing the Model 270-9 Auger.

6-1 HYDRAULIC SYSTEM NOTE

Before starting any hydraulic type repair, the hydraulic reservoir must be plugged. To do this, the following steps must be observed:

A. The hydraulic reservoir top plate must be removed. See Reservoir Illustration, Figure 6-1.

B. Push down on suction release adapter (Item 1), then pull up to release.

C. Place auxiliary plug (Item 2) in suction release adapter (Item 1) position before removal.

This will stop the flow of hydraulic oil thru the hydraulic system while working on hydraulic repairs.

CAUTION REMEMBER TO REPLACE SUCTION RELEASE ADAPTER PLUG AFTER ALL REPAIRS HAVE BEEN COMPLETED.

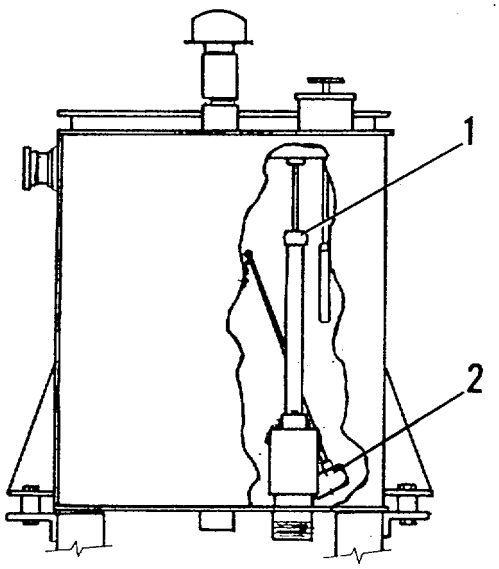


FIGURE 6-1. HYDRAULIC RESERVOIR

1. ADAPTER
2. PLUG-AUXILIARY

6-2 HYDRAULIC PUMP REPAIR INSTRUCTIONS

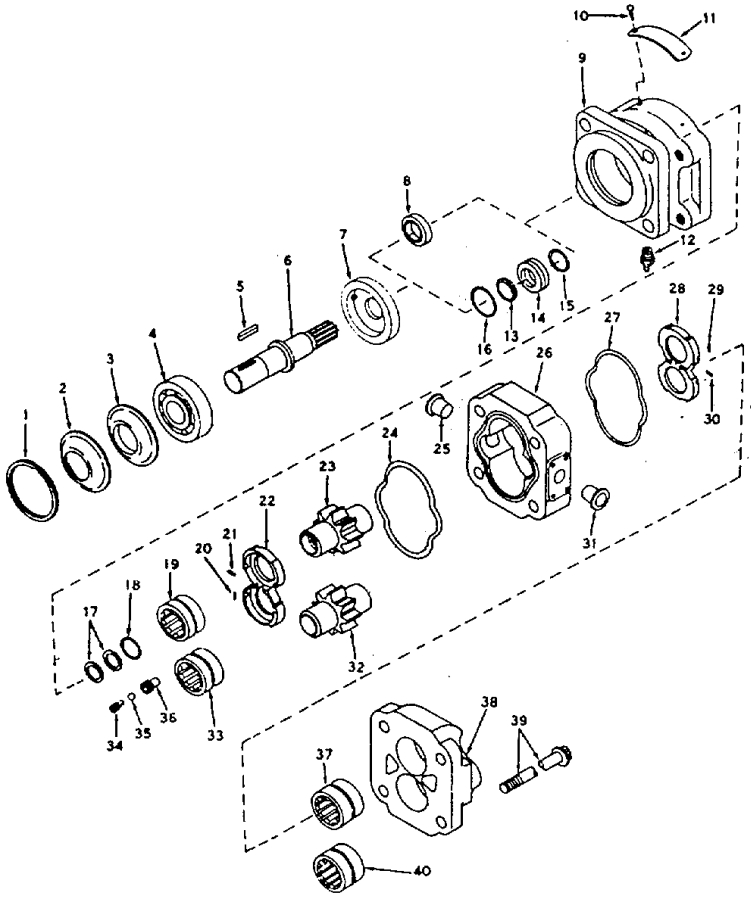
NOTE: READ PARAGRAPH 6-1 BEFORE STARTING REPAIRS.

A. Removal of Pump

1. Disconnect all hydraulic lines and, if possible, remove all the fittings from the pump.
2. Remove the four attaching nuts and lock washers to remove the pump from the drive unit assembly.

B. DISASSEMBLY OF PUMP

REFER TO FIGURE 6-2 AND PAGES 61 THRU 63



No.	Description	No.	Description	No.	Description
1	Spirolox Snap Ring	15	"O" Ring Shaft Seal	29	Pocket Seals
2	Bearing Shield	16	"O" Ring Gasket	30	Pocket Seals
3	Bearing Seal	17	Back-Up Rings	31	Plastic Pipe Closure
4	Shaft Ball Bearing	18	Shaft "O" Ring	32	Driven Gear
5	Key	19	Roller Bearing	33	Roller Bearing
6	Drive Shaft	20	Pocket Seals	34	Check Ball Retainer
7	Bearing Spacer	21	Pocket Seals	35	Check Ball
8	Oil Seal	22	Thrust Plate	36	Check Valve Seat
9	Shaft End Cover	23	Drive Gear	37	Roller Bearing
10	Drive Screws	24	"O" Ring Gasket	38	Port End Cover
11	Name Plate	25	Plastic Pipe Closure	39	Cap Screws
12	Grease Fitting	26	Housing	40	Roller Bearing
13	Back-Up Ring	27	"O" Ring Gasket		
14	Bronze Insert	28	Thrust Plate		

FIGURE 6-2. EXPLODED VIEW OF PUMP

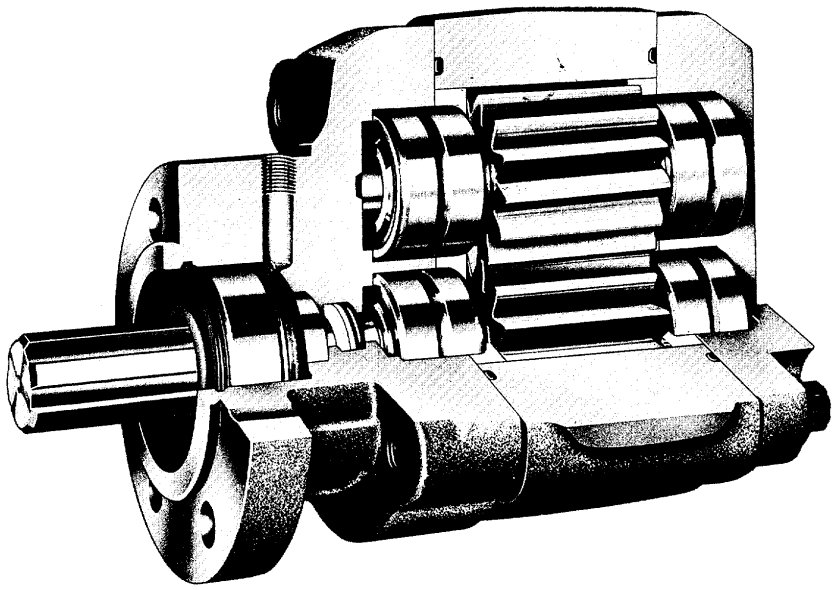


FIGURE 6-3

single pump disassembly

GENERAL NOTES

Remember dirt is the enemy of any hydraulic system. The best way to fight this enemy is to prevent its entry into the system. Make sure you disassemble and reassemble this pump in spotlessly clean surroundings. Apply a coating of grease (cup grease consistency) to surfaces of all "O" rings and oil seals to facilitate positive location as they are installed in a reassembly.

DISASSEMBLY BY SUBASSEMBLY

1. Index mark the port end cover (38), gear housing (26) and shaft end cover (9) to facilitate reassembly.
2. Remove the four cap screws (39) from the port end cover (38).
3. Lift off port end cover (38); the thrust plate (28) with pocket seals and the roller bearings (37, 40) will also be removed in this operation.
4. Remove the driven gear (32).
5. Remove the gear housing (26) and drive gear (23) from the shaft end cover (9). Be sure to keep gears together as they are a matched set.

SHAFT END COVER

1. Turn the shaft end cover (9) over so that the drive end of the shaft is facing up. With a screwdriver remove the snap ring (1) then remove the bearing shield (2) and bearing seal (3).
2. Pull the drive shaft (6) from the shaft end cover. The shaft ball bearing (4) will also be removed. Then lift out the bearing spacer (7).
3. Remove and discard the oil seal (8) from the shaft end cover.
4. Turn the cover over so that the thrust plate is up. Pry off thrust plate (22) carefully with a knife blade or thin screwdriver. Remove and discard the pocket seals (20), (21).
5. Pull the bearings (19, 33) with a bearing puller from the shaft end cover (9)-ONLY-if they are being replaced.
6. Remove the check valve assemblies (34, 35, 36).
7. Remove the shaft "O" ring (18) and the back-up rings (17) from shaft end cover (9).
8. Remove key (5) and press bearing (4) from shaft (6).

HOUSING

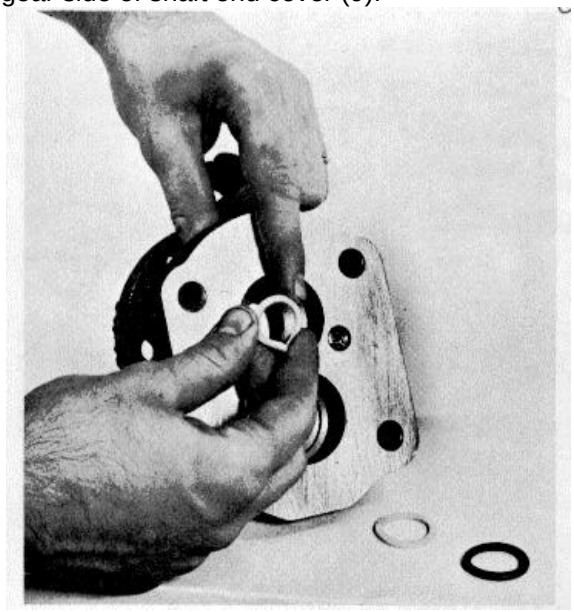
1. Remove and discard "O" rings (24, 27) from grooves in housing (26).

PORT END COVER

1. Pry off the thrust plate (28) with a knife blade or thin screwdriver. Remove and discard the pocket seals (29), (30).
2. Pull the bearings (37, 40) with a bearing puller from the port end cover (38)-ONLY-if they are being replaced.

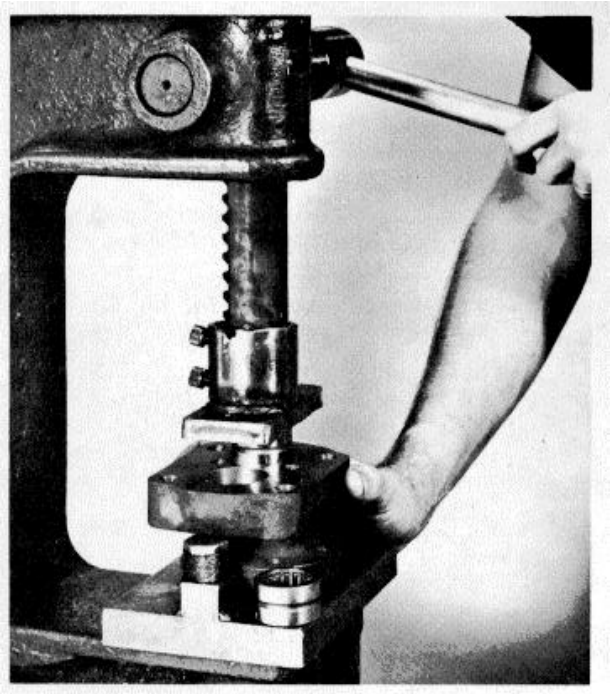
SHAFT END COVER SUBASSEMBLY

1. Install back-up rings (17) and shaft "O" ring (18) in gear side of shaft end cover (9).



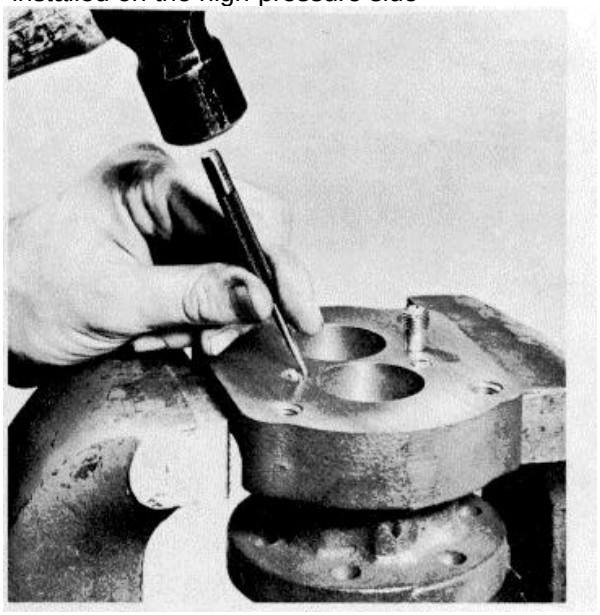
Installing back-up ring
FIGURE 6-4

2. Install two new roller bearings (19, 33) in the bores of the cover-IF-the used ones were removed.



Installing roller bearings
FIGURE 6-5

3. Place the shaft end cover (9) gear side up in a vise having soft jaws and reassemble the two check valves for double rotation by inserting the ball (35) into the check valve seat (36) and screwing the check ball retainer (34) flush into the check valve seat being sure the check ball is free to move. Screw the two check valve assemblies into their respective holes, approximately two threads below face of shaft end cover (9). Single rotation units do not require check assemblies. Instead, a plug is installed on the high-pressure side

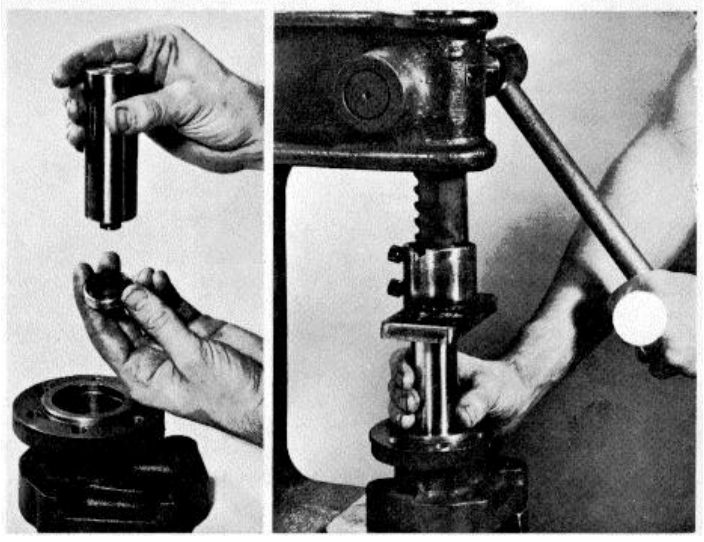


Peening over check valve seat
FIGURE 6-6

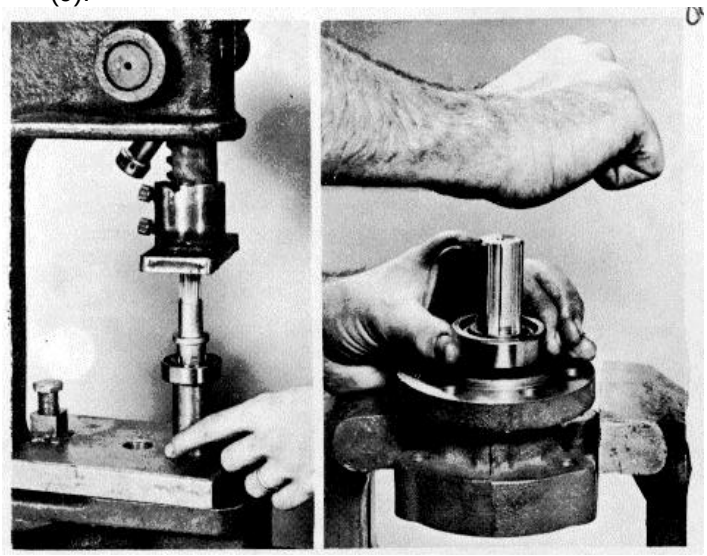
of pump with the low-pressure side left open. Peen over the check valve seat and ball retainer to prevent the valves from backing out.

4. Remove shaft end cover (9) from vise, turn over, place in arbor press and press in oil seal (8) with the open side down facing toward the bearing bore.

Pressing in oil seal FIGURE 6-7



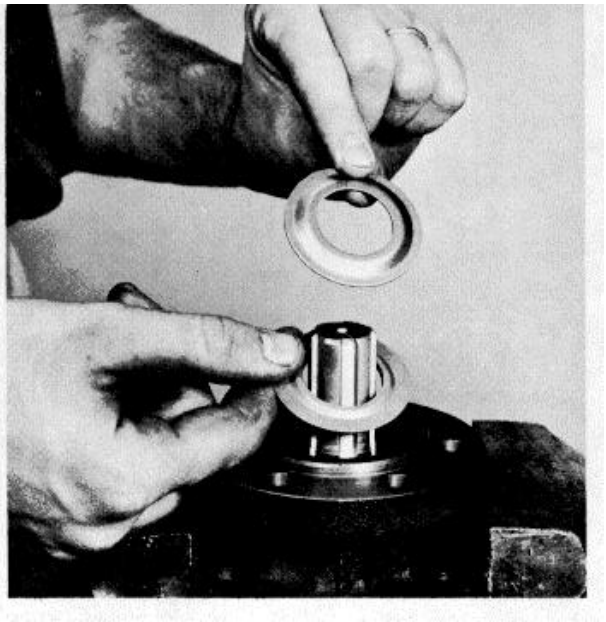
5. Then install the bearing spacer (7) open side up. NOTE: For motors-use special bronze insert (14) with back-up ring (13) and shaft seal (15) in I.D. groove of insert and "O" ring gasket (16) in O.D. groove of insert.
6. Repack the shaft ball bearing (4) with a #2 consistency lithium base, high temperature, ball bearing grease. Press the bearing onto the drive shaft (6) being sure it is seated against the shaft shoulder.
7. Insert the assembled shaft into the shaft end cover (9).



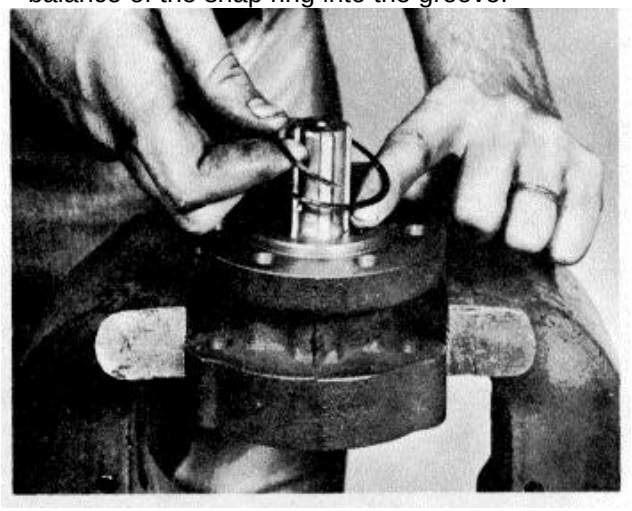
Inserting assembled shaft
FIGURE 6-8

8. Place bearing seal (3) and bearing shield (2) on shaft.

Installing bearing seal and shield
FIGURE 6-9

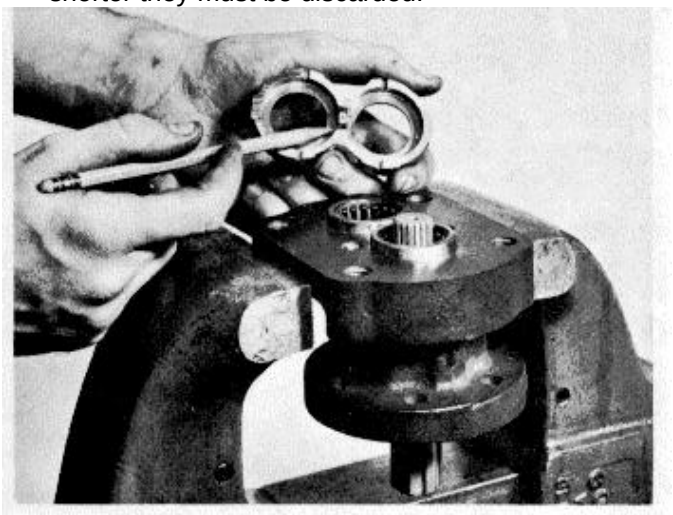


9. With ends of "Spirolox" snap ring (1) spread apart, insert one end of snap ring into groove. Then wind balance of the snap ring into the groove.



Installing Spirolox snap ring
FIGURE 6-10

10. Turn shaft end cover over, place in vise with gear side up.
11. Lay the thrust plate (22) on the bench and cut four pocket seals (21) slightly (1/22" to 1/16") longer than the four outer slots in the thrust plate. Set them aside for a minute.
12. Place some heavy grease in the two middle slots of the thrust palte (22). Cut two pocket seals (20) 3/16" long. They may run 1/64" longer but if cut any shorter they must be discarded.

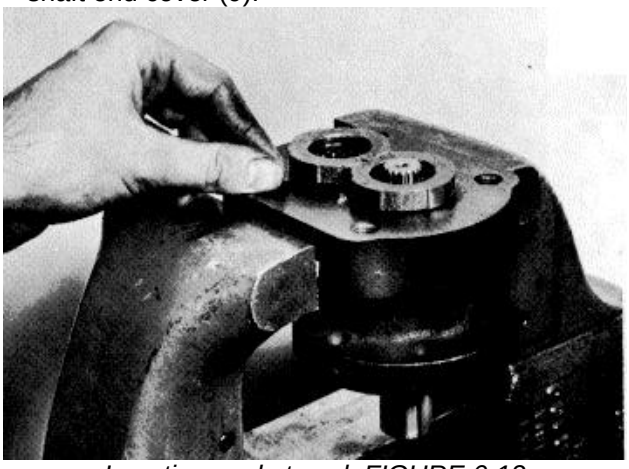


Inserting socket seals
FIGURE 6-11

NOTE: All pocket seals are cut from a strip obtainable as a service item. They must be cut with a razor blade as a pocket knife is not sharp enough.

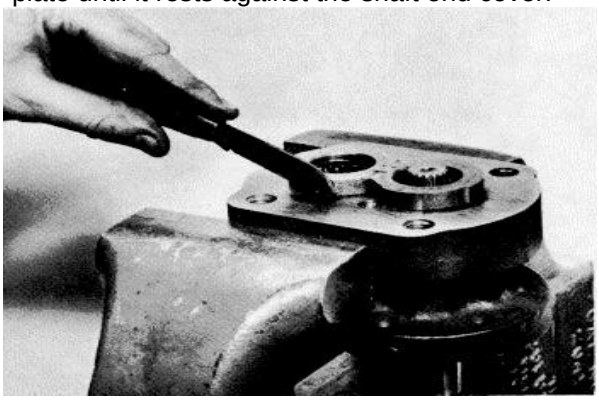
Insert the seals in the slots.

13. Place the thrust plate (22) with the slots toward the face of the shaft end cover (9) over the bearings (19, 33). Check to see that the pocket seals in the center slots are still in place. Now tap the thrust plate into position until a clearance of approximately 1/32" is left between the thrust plate (22) and the shaft end cover (9).



Inserting pocket seal FIGURE 6-12

14. Into each of the four slots in the thrust plate (22) insert one of the pocket seals (21) cut in Step 11. Be sure to push each seal all the way into the slot so that the hidden end is in contact with the roller bearing race. Then tap the assembled thrust plate until it rests against the shaft end cover.



Trimming pocket seal FIGURE 6-13

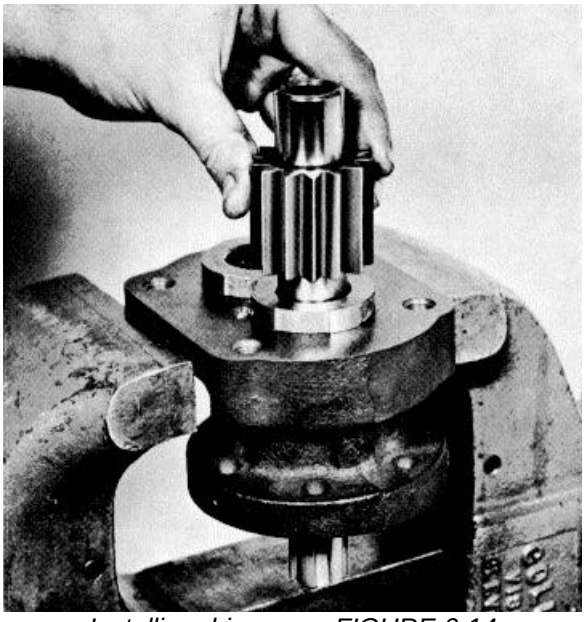
15. Using a razor blade, trim away the excess from the exposed ends of the pocket seals (21) square and flush with the sides of the thrust plate.

PORT END COVER SUBASSEMBLY

1. Install the new roller bearings (37, 40) into the bores of the port end cover (38)-IF-the used ones were removed.
2. Lay the thrust plate (28) on the bench and cut four pocket seals (30) slightly (1/32" to 1/16") longer than the four outer slots in the thrust plate. Set them aside for a minute.
3. Place some heavy grease in the two middle slots of the thrust plate (28). Cut two pocket seals (29) 1/16" long. They may run 1/64" longer but if cut any shorter they must be discarded.
   NOTE: All pocket seals are cut from a strip obtainable as a service item. They must be cut with a razor blade as a pocket knife is not sharp enough.
   Insert the seals in the slots.
4. Place the thrust plate (28) with the slots toward the face of the port end cover (38) over the bearings (37, 40). Check to see that the pocket seals in the center slots are still in place before tapping the thrust plates into position. Leave a clearance of approximately 1/32" between the thrust plate (28) and the port end cover (38).
5. Into each of the four slots in the thrust plate (28) insert a pocket seal (30) cut in Step 2. Push each seal all the way into the slot so that the hidden end is in contact with the bearing race. Tap the assembled thrust plate into position against the face of the port end cover.
6. Using a razor blade, trim away the excess from the exposed ends of the pocket seals (30) square and flush with the sides of the thrust plate.

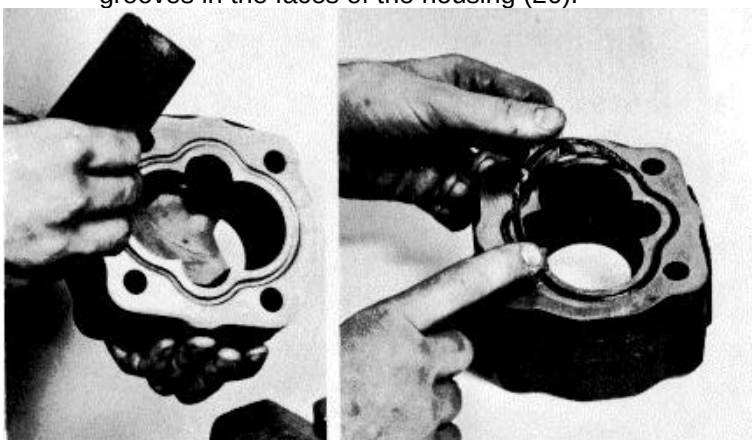
FINAL ASSEMBLY

1. Place the assembled shaft end cover in a vise, gear side up.
2. Pour a small amount of oil on face of thrust plate to provide lubrication of gears. Install the drive gear (23) on the shaft (6). Stone the gear ends before installation to remove any minute burrs.



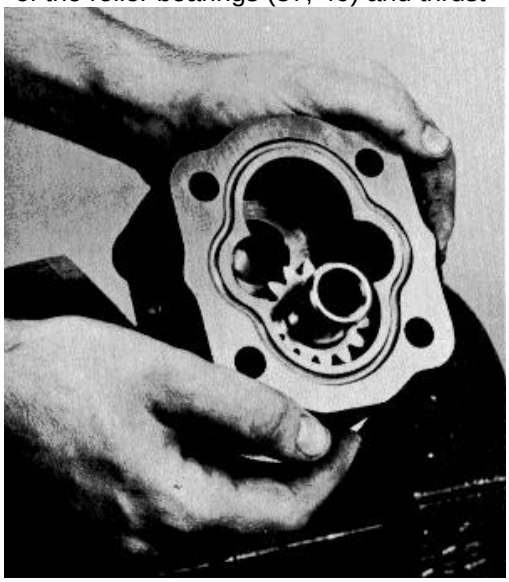
Installing drive gear FIGURE 6-14

3. Stone the faces of the gear housing (26) to remove any burrs that might have occurred in handling. Clean all surfaces (air blast or wipe). Install pre-greased "O" rings (24, 27) in the grooves in the faces of the housing (26).



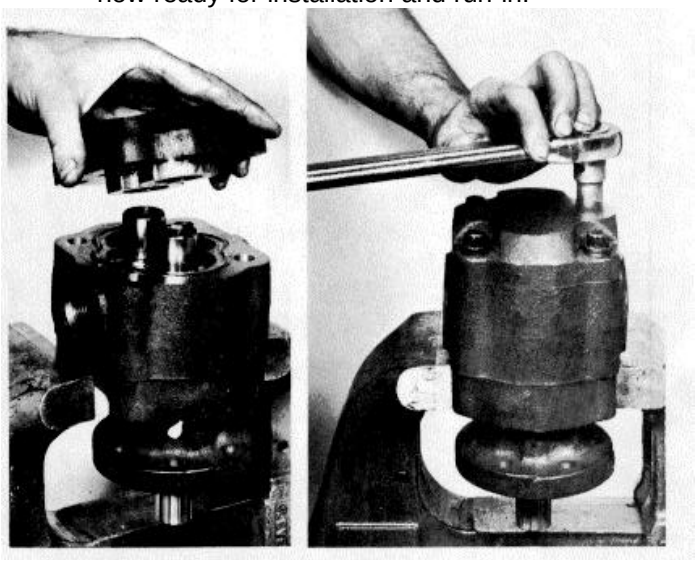
Installing pre-greased "O" ring
FIGURE 6-15

4. Place the gear housing (26) over the drive gear (23) and tap into position with a soft hammer (plastic or leatherhead). Be careful not to pinch the "O" ring (24) when positioning the housing. Install the driven gear (32) into its respective bore. Pour a small amount of oil over the gears to provide initial lubrication when putting the pump back into service.
5. Install the port end cover subassembly on the gear housing (26). Hubs of gears fit into the I.D. of the roller bearings (37, 40) and thrust plate (28) fits into the gear housing. Use a soft hammer to seat or position the port end cover assembly against the housing, making sure the "O" ring (27) on the face of the housing is not pinched.



Installing gear housing
FIGURE 6-16

6. Thread the four cap screws (39) into the shaft end cover. Tighten the four cap screws alternately to 100 ft. lbs. of torque.
7. Rotate the shaft with a six inch wrench. Protect the shaft splines when using a wrench. The shaft should rotate easily.
8. Thread the grease fitting (12) into the shaft end cover (9)-IF-it was removed. Fill the cavity with a #2 consistency, lithium base, high temperature, ball bearing grease until a grease film appears around the shaft (6). The pump is now ready for installation and run-in.



Installing port end cover
FIGURE 6-17

IMPORTANT PRECAUTION TO OBSERVE BEFORE OPERATING NEW OR REBUILT HYDRAULIC PUMPS AND MOTORS

To avoid possible damage to a new or rebuilt hydraulic pump or motor, back off the main relief valve adjusting screw (or remove adjusting shims or spacers) before operating unit. Then, AFTER UNIT HAS RUN-IN FOR ABOUT 5 MINUTES AT ZERO PRESSURE (with all control levers in neutral position) adjust relief valve pressure to proper and prescribed setting. Failure to observe this precaution can result in almost immediate failure of the hydraulic unit-if the relief valve pressure setting should be excessive.

D. Remounting of Pump

1. Align the pump with the bolts on the drive unit assembly and replace nuts and lockwashers to secure the pump in place.

2. Connect the hydraulic fittings and hoses to the pump.

CAUTION **Remember to replace suction release adapter plug. Refer to Paragraph 6-1.**

6-3. CONTROL VALVE BANK REPAIR INSTRUCTIONS

The control valve bank is a six sections, (includes inlet and outlet valve). Each valve section is identified per use in illustration of valve bank assembly, Figure 6-18. Starting at right side, this valve section, P/N 40019, is an outlet section containing no working parts. The next valve section is a regenerative valve section, P/N 39050. The next two valve sections are double acting valve sections, P/N 40022. The next valve section is a double acting free flow control valve, P/N 39627. The last valve section is an inlet valve section, P/N 40017. Inlet valve section pressure setting should be 1450 P.S.I.

NOTE : Before starting any repair functions, read Paragraph 6-1. Read all instructions pertaining to control valve bank thoroughly before starting any repairs. Refer to Parts Manual for part numbers.

A. Removal of Control Valve Bank

1. Before removing, mark each valve and all the hoses that connect to the valves in order to simplify remounting procedures. The marking must be one which will provide a more permanent mark, so much so that the mark will not only positively identify the valve, but will ensure that the mark will not be washed off or rubbed off during disassembly and repair functions.

2. Having marked the hoses, disconnect them. Remove all fittings from the valves. Remove the attaching hardware and remove the valve bank as an assembly.

CAUTION **DO NOT DISASSEMBLE VALVE IN THE FIELD.**

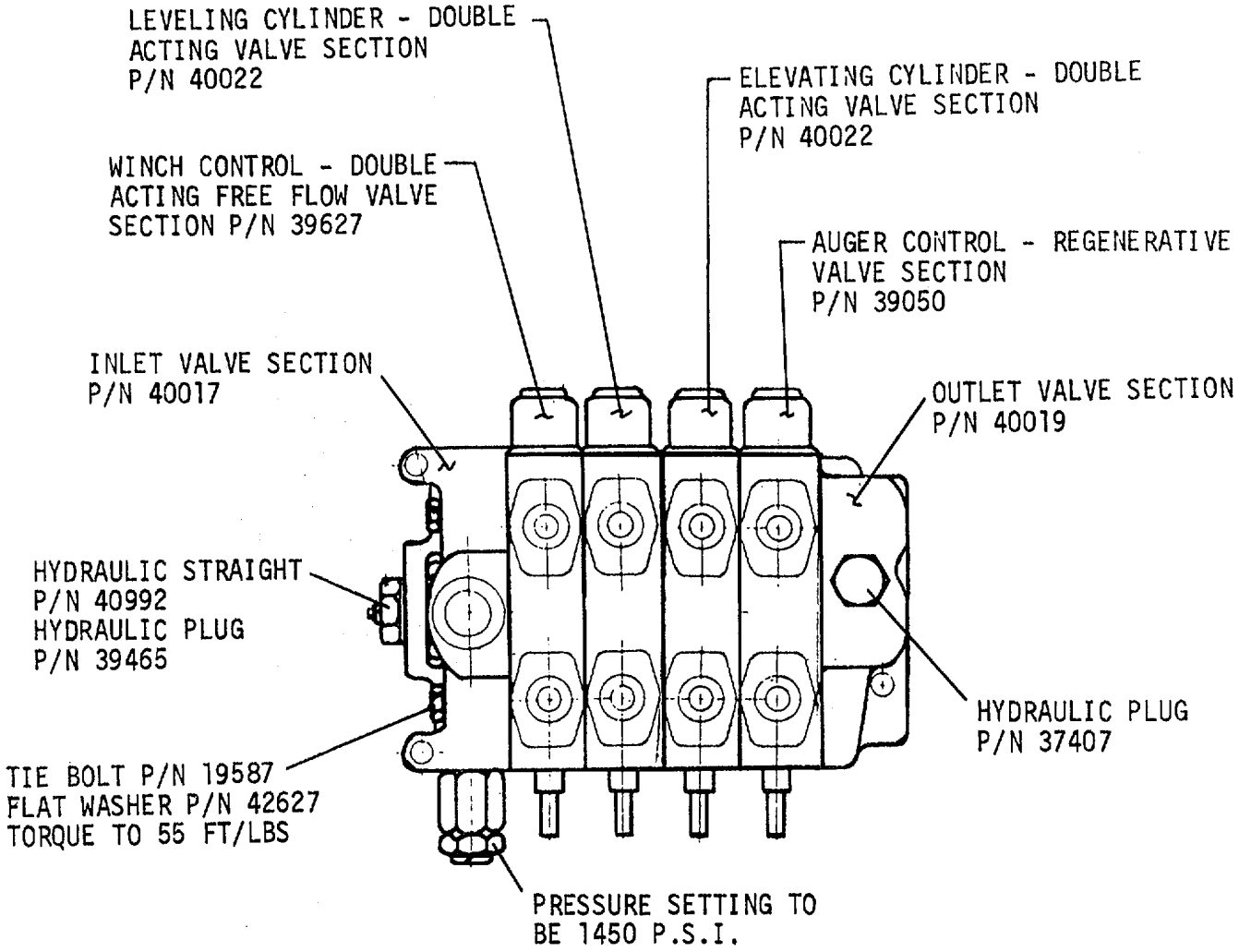


Figure 6-2. CONTROL VALVE BANK ASSEMBLY

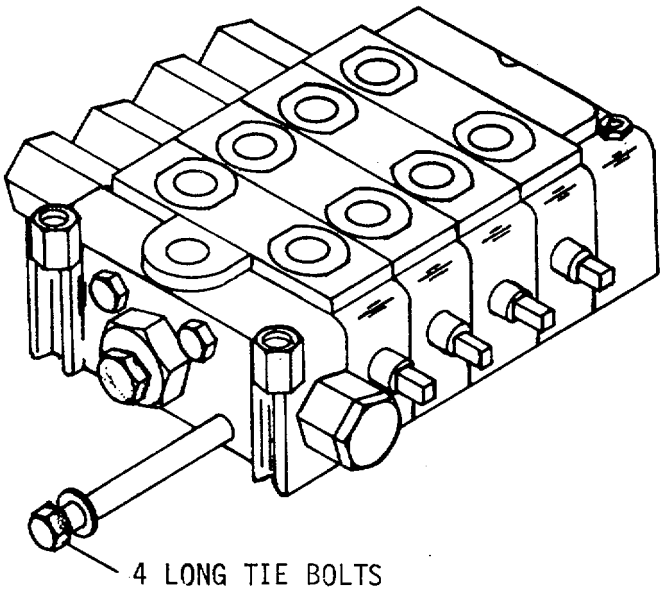
B. Disassembly of Control Valve Bank

1. Plug all open ports in valve bank assembly to prevent dirt and foreign matter from entering the valve bank assembly. Clean the outside of the valve bank assembly before starting disassembly.

2. Place valve bank assembly on a flat work bench. To separate the individual valves and inlet and outlet sections, unscrew the four long tie bolts. Inspect the complete valve bank for cracks. Separate the various sections and remove and discard the O-Rings that fit between the sections.

CAUTION **The inlet and outlet sections are different from the control flow valve sections. They are identified by numbers stamped on the port closest to the lever end of the valve.**

3. Disassembly shall be limited to the removal of parts required to replace O-Rings, springs and poppet sleeves. Replacement of parts other than these is not usually required, nor is it recommended.



Pull valve sections apart noting the location and position of each valve section.

NOTE: SEE PARTS MANUAL FOR PART NUMBERS.

Figure 6-3. CONTROL VALVE BANK ASSEMBLY - TIE BOLTS

C. Valve Section Disassembly and Reassembly

1. To disassemble valve section, (double acting and double acting free flow), remove two cover screws. See Figure 6-20, Item #1.

   Remove dust cap, pull spool out of housing. Inspect spool for nicks, cuts, or galling. Inspect housing for cracks and excessive wear in spool passage. If spool or spool housing shows signs of excessive wear, it is necessary to replace valve assembly. With a sharp pointed tool, remove O-Rings from housing on lever end. Clean all parts before reassembly. See Figure 6-4.

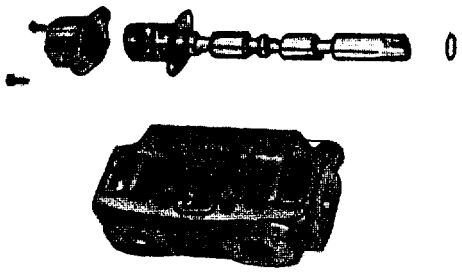


Figure 6-20. CONTROL VALVE BANK SECTION DISASSEMBLY

CAUTION **Excessive wear or galling in either spool or spool bore will require replacement of valve assembly. Spool and housing not serviced separately.**

   To reassemble, install new O-Rings in valve housing (see Parts Manual for part numbers) with lever down. Coat all O-Rings with vasoline or lubricant before installing. Install O-Ring and backup O-Ring on spool. Coat spool and inside of housing with a light coat of lubricating oil. Install spool in housing, taking care not to cut O-Ring in housing. Install O-Ring over spool and seat O-Ring boss in housing. Install backup washers, retainer plate and end cap. Torque end capscrews to approximate 35 inch pounds.

2. Overhaul procedure for inlet valve section, (see Figure 6-19). To disassemble, remove plugs from working ports. Remove relief cartridge from body assembly by unscrewing the complete cartridge from body, (see Figure 6-21). Remove all O-Rings. Clean both mounting faces using fine emery cloth. Clean body with solvent and blow dry with compressed air.

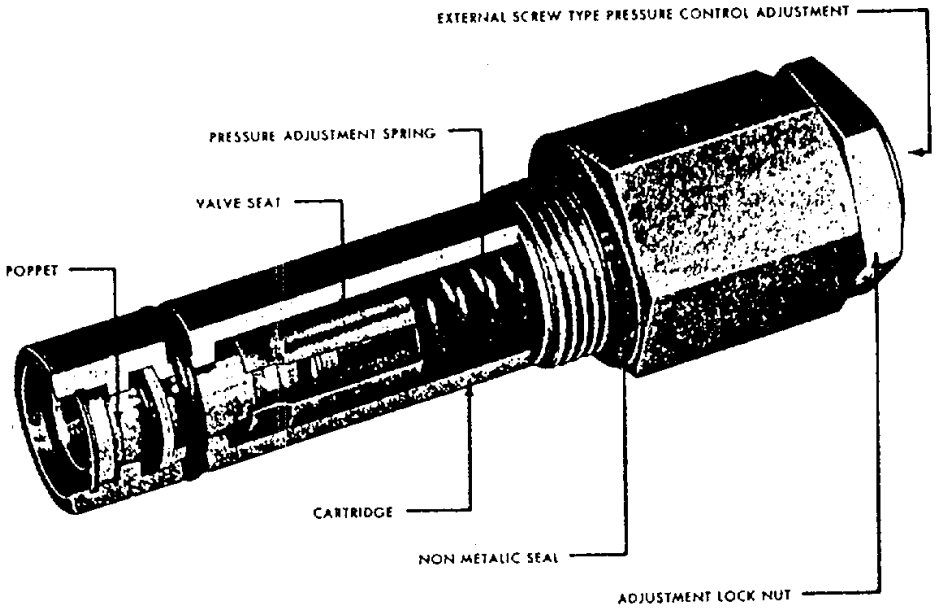


Figure 6-21. VALVE SECTION DISASSEMBLY INLET

3. Inspect conditions of threads in working ports. Inspect body casting for cracks. Inspect cartridge, O-Rings, seal port in body for pits or scores.

CAUTION **Excessive wear or galling in either spool or spool bore will require replacement of valve assembly. Spool and housing not serviced separately.**

Clamp edge, (hex portion of relief valve) cartridge in a vise. Using a 1-1/2 inch open end wrench, .loosen adjustment locknut. Unscrew external screw pressure control from cartridge and remove pressure adjusting spring.

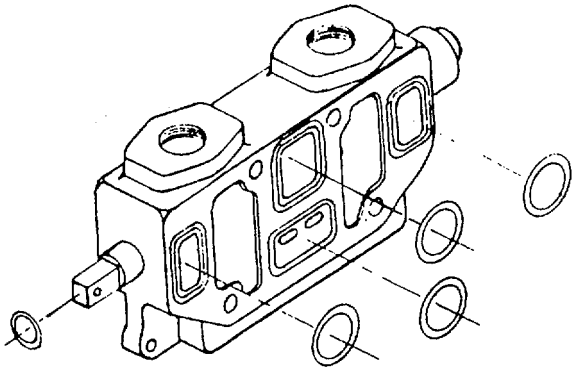
NOTE: There should be no spring tension on pressure control when pressure control is backed out.

Remove valve seat assembly, inspect valve for galling and scores. Replace all necessary parts. Replace O-Rings and backup O-Rings. Coat valve section with light oil before assembly. Reinstall relief cartridge into body.

D. Reassembly Control Valve Bank

1. After overhaul procedure for valve section is complete, you are now ready to reassemble valve bank assembly. On a flat work bench, install O-Rings to port grooves. Four (4) O-Rings are required between each valve section. (See Figure 6-22). Use vasoline or lubricant to hold O-Rings in position.

NOTE: Seal kit for 10 valve sections, P/N 47227.



3 - O-RINGS P/N 16237
1 - O-RING P/N 16238

Figure 6-22. VALVE SECTION O-RINGS

2. Position each section on a flat work bench in correct order. Feed the four (4) tie bolts thru all valve sections and screw bolts thru treads in outlet section, draw bolts snug. With a rubber or plastic mallet, tap center of each valve section to make sure sections are aligned and flat on bench.

3. Torque the four (4) tie bolts to 25 ft-lbs. of torque. Retap top of each section for alignment; complete torquing of the tie bolts to maximum of 55 ft-lbs. Add sufficient amount of oil to all open ports to ensure sufficient oil in each spool to prevent spool from sticking. Replace plastic caps in all ports to prevent leakage of oil. Check valve bank assembly with Figure 6-18.

   NOTE: Pressure setting for inlet valve to be 1450 P.S.I.

6-4. FUNK TRANSMISSION SERVICE AND REPAIR

A. Service Instruction for Torque Converter The torque converter consists of three major components: a turbine assembly, an impeller (or pump) assembly, and a stator and sprag (or one way clutch) assembly. In this installation, the assembled converter is bolted to a front cover assembly.

The principle cause of faulty operation is leakage due to failure of oil seal rings. As this type is of bolted construction, it can be disassembled and repaired.

1. Disassembly Torque Converter.

    a. Disassembly requires some means of supporting the converter assembly on the bench. The simplest form is a hole in the bench top, slightly longer than the impeller hub, or a hollow square approximately 8 inches made with two, two-by-fours. The front cover assembly will then be uppermost so the lock nuts can be removed from the cover bolts and the front cover assembly and O-Ring gasket can be removed.

    b. Next, remove the turbine forward thrust washer from the turbine assembly. The turbine assembly can then be removed.

    c. In removing the stator and sprag assembly, care should be taken in order that the thrust washers and races are not allowed to drop onto the bench, as the highly machined surfaces may be damaged. The stator thrust washer, the sprag, and the inner and outer races are held in the stator assembly by snap rings; thus this can be removed as a unit. Further disassembly is accomplished by compressing the snap ring so that it can be removed from the groove on the stator.

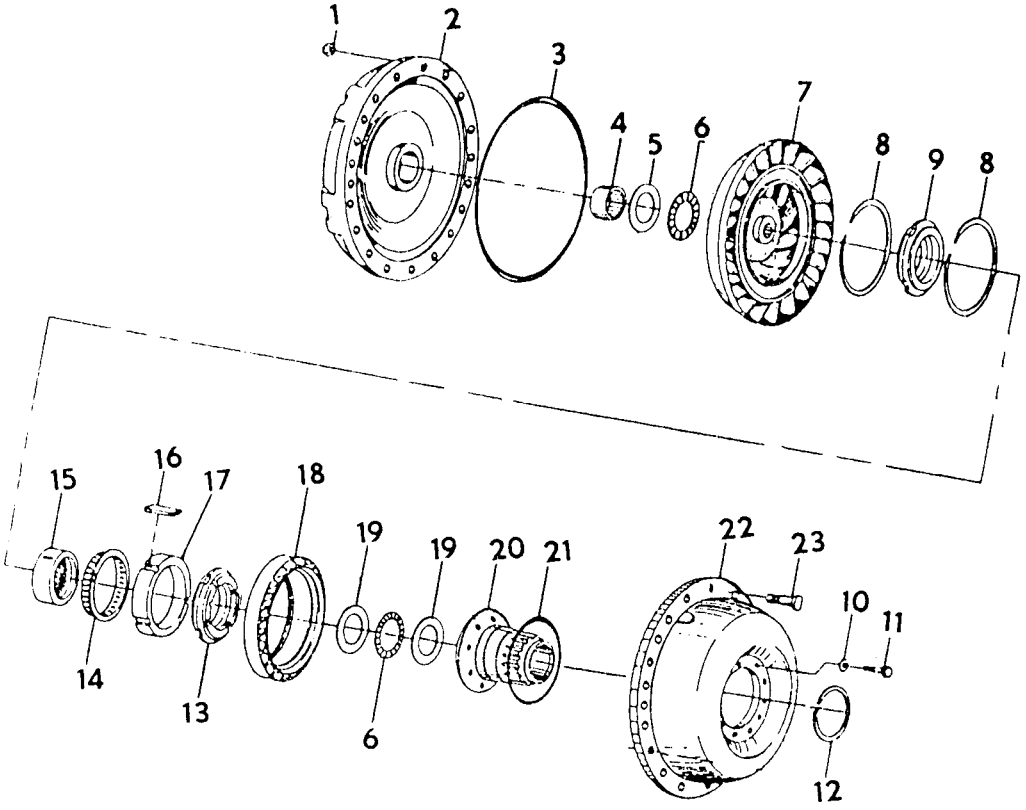
    d. If the impeller hub has been damaged, or the O-Ring gasket is faulty, it will be necessary to remove the impeller hub. Turn the impeller assembly over and remove the eight screws and lockwashers which fasten the hub to the assembly, thus making the seal available for inspection.

2. Reassemble Torque Converter

    a. Thoroughly clean and inspect all parts.

        1) A new hub seal should be placed on the flange of the impeller hub. The hub should then be placed in the machine recess of the impeller assembly with the tapped holes lined up so the lockwashers and the capscrews can be installed. The complete assembly should then be placed on the bench with the hub down. Do not install front hub seal ring at this time.

        2) If the sprag is replaced, it is also advisable to replace the inner and outer race as there is no means of compensation for unequal wear on these parts.



1. NUT - HEX
2. CONVERTER FRONT
3. O-RING GASKET
4. BEARING
5. WASHER - TURBINE THRUST
6. NEEDLE - THRUST BEARING
7. TURBINE ASSEMBLY
8. SNAP RING
9. RETAINER FRONT CLUTCH
10. WASHER
11. CAPSCREW
12. RING SEAL
13. RETAINER CLUTCH REAR
14. RACE
15. RACE INNER CLUTCH
16. KEY SQUARE
17. CLUTCH SPRAG ASSEMBLY
18. STATOR
19. THRUST RACE
20. HUB CONVERTER
21. O-RING
22. PUMP IMPELLER 13 IN CONVERTER
23. CAPSCREW

Figure 6-22A

CAUTION EXTREME CARE SHOULD BE USED TO KEEP THESE PARTS FREE FROM DIRT, DUST, AND FINGER PRINTS.

3. Lay the stator on the bench with the side marked "FRONT" up and insert one snap ring in the lower groove. Next, lay stator thrust washer on top with counter-bore side up. Install the outer race and sprag which must have either the flange edge or that marked "FRONT" facing up. The inner race is set in this with the splined end up. The second stator thrust washer with counter-bore down, and the snap ring complete the assembly.

4. Then replace the turbine assembly, resting the turbine hub on the stator thrust washer. Place the front cover O-Ring gasket around cover just inside the bolt holes and lay the front cover assembly on the flange of the impeller assembly and install cover bolts and nuts. Tighten in sequence to avoid distortion. Torque to 22 ft-lbs. Install front hub seal ring and protect from damage.

B. Disassembly Shuttle Assembly

1. The shuttle assembly consists of three major components: a hydraulic charge pump, a control valve which contains all pressure regulators and clutch control valve, and the forward and reverse clutches. A failure of any one component can cause extensive damage to all. If any one component has failed, it is necessary to completely disassemble, clean and inspect the entire unit.

2. In addition to the ordinary line of hand tools, the following items will be required when overhauling the Model 12000 Revers-O-Matic Drive:

   a. Suitable hoist.

   b. Small arbor press.

   c. Double solvent cleaning tank, one for preliminary cleaning and the other for final cleaning of parts.

   d. Snap ring pliers.

   e. Air pressure hose with squirt nozzle.

   f. Oil can be filled with automatic transmission fluid MIL-L-2104.

   g. A closely graduated scale rule or a depth mic to check end clearance in final assembly.

CAUTION **CLEANLINESS IS OF EXTREME IMPORTANCE AND AN ABSOLUTE MUST IN THE REPAIR AND OVERHAUL OF THIS UNIT. BEFORE ATTEMPTING ANY REPAIRS, THE EXTERIOR MUST BE THOROUGHLYCLEANED TO PREVENT THE POSSIBILITY OF DIRT AND FOREIGN MATTER ENTERING THE MECHANISM. AFTER DISASSEMBLING, ALL PARTS AND CASE SHOULD BE THOROUGHLY CLEANED IN A SOLVENT TANK, THEN CLEANED AGAIN WITH CLEAN SOLVENT BEFORE REASSEMBLING.**

3. After removal of transmission to work area, remove the capscrews attaching the four speed transmission. (Note number of-clutch shaft adjusting shims removed).

   a. Remove heat exchanger. Discard all used O-Rings.

   b. Remove control valve assembly.

   c. Remove oil pump and filter assembly; discard suction tube O-Rings.

   d. Remove converter housing assembly.

   e. Remove oil pan, gaskets and screen.

   f. Remove front plate and stator support tube.

   g. Remove countershaft, counter gear, bearings, washers.

   h. Remove clutch shaft assembly.

   i. Remove idler shaft, idler gear, bearings, and washers. The case is now completely disassembled; if it is necessary to go into the clutch shaft, continue. If an exchange clutch shaft assembly is used, clean all parts and replace as required. Proceed to Paragraph D-9 for assembly of unit.

C. Disassembly Clutch Stack

1. Remove and discard input shaft seal rings.

2. Remove snap ring. Remove input shaft, washer, and hub. Remove all plates.

3. Using a pair of bars and a small arbor press, press down the piston spring retainer and remove snap ring. Release press slowly and remove spring and spring retainer.

4. Turn the cylinder over, blow air pressure into hole in bushing in center of cylinder, 100 P.S.I. This will blow the piston out of the cylinder. Lift up cylinder, remove O-Rings and discard.

5. Remove oil tube by pulling out of the clutch shaft. Discard all seal rings. Remove snap ring from rear clutch, lift cylinder assembly from shaft.

6. Remove the snap ring, hub, plates washer, and output gear. Remove and discard all seal rings.

7. Clean and inspect all bearings, bushings, shaft and other parts. Replace as required.

D. Clutch Shaft Assembly Hints

1. Handle all transmission parts with care. Nicks, scratches, or dents caused by careless handling of parts can cause subsequent transmission failure.

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

3. When assembling ball bearings, pressure should be applied to the member being assembled (inner ring on shaft or outer ring on housing). Bearing must be started squarely on shaft or in housing and seated squarely against shoulder. Check housing and shaft for nicks, scratches prior to bearing installation. Always oil bearings and bushings during assembly as this will assure lubrication during the first few moments of operation.

4. Parts incorporating bushings should be replaced if total radial clearance exceeds .0035. Parts incorporating roller bearings should be replaced if total radial clearance exceeds .0025.

5. Before installing oil seals, check shafts and bores for nicks and scratches. Make sure that the seals are started squarely. Always press seals on the outside diameters, using a thick piece of shim stock around the shaft to protect the sealing edge of the seal against possible damage when it is required to slide over splines or keyways. Pre-lubricate oil seals and O-Rings immediately before installation.

6. Grease all seals, rings and center in grooves prior to installation. Be particularly careful against breakage when installing seal rings.

7. Check all snap rings after installation, making sure that they are securely seated in their grooves.

8. Check all rotating parts for free motion.

9. When assembling the shaft and clutch assembly, it is very important that a smooth external tooth steel reaction plate be installed against the aluminum piston. DO NOT, under any circumstances, place a grooved internal tooth friction plate first against the aluminum piston. Alternate steel and bronze plates until each clutch has eight (8) of each.

CAUTION **THE STEEL PLATES ARE SLIGHTLY CONICAL, NOT FLAT, AND THE SLOPE ON THESE PLATES WHEN INSTALLED IN THE UNIT SHOULD BE PARALLEL WITH THE "DISHED" SIDE TOWARD THE OPEN END OF THE CYLINDER.**

10. The clutch stack end-play is adjusted with clutch stack adjustment shims. Check end-play (.020 to .035 recommended) by bumping and pulling the input shaft.

E. Reassembly Clutch Shaft Assembly

1. Press the output bearing on the output shaft. Install snap ring to retain bearing. Place thrust washer on shaft. Now place output gear assembly on shaft. Place thrust washer on shaft.

2. Lower the rear clutch hub on the output shaft, thrust face down.

3. Install snap ring on the output shaft to retain the rear clutch hub. Make sure the ring is securely seated in its groove. Check the output gear for free motion.

4. Pre-lubricate and install two seal rings in the lower two grooves on the output shaft.

5. Install the outer seal on the clutch piston and inner seal in the clutch cylinder, pre-lubrication seals immediately before installation. Lower the piston into the clutch cylinder to the bottom of its travel, using an arbor press if necessary.

6. Insert the coil clutch spring into the piston. Place the spring retainer in position and depress the spring with a pair of bars under an arbor press so that the snap ring may be installed to retain the spring. Make sure the snap ring is securely seated in its groove.

7. Lower a full complement of eight clutch plates and eight separate plates into the clutch cylinder, alternating first a separator place (steel plate with external tooth) then a clutch plate (bronze plate with internal teeth). Alternate the plates until the full complement is installed. It is very important that a smooth steel separator plate be

installed against the aluminum piston. DO NOT, under any circumstances, place a bronze plate in first against the aluminum piston. The steel plates are slightly conical (not flat) and the slope on these plates when installed in the unit should be parallel with the "dished" side toward the workman.

8. Remove the clutch plate stack from one of the clutch assemblies and lower over the rear clutch hub.

9. Lower the clutch cylinder assembly over the clutch plate stack.

CAUTION **CENTER THE FRONT SEAL RINGS IN THE SHAFT GROOVES SO THAT THEY ARE NOT DAMAGED WHEN THE CLUTCH CYLINDER ASSEMBLY IS LOWERED IN PLACE.**

10. Install the outer snap ring into the rear clutch cylinder. Make sure it is securely seated in its groove.

11. Pre-lubricate and install the two seal rings in the upper grooves on the output shaft.

12. Lower the front clutch cylinder assembly on the output shaft.

13. Install the hub retainer snap ring on the output shaft. Make sure that it is securely seated in its groove.

14. Lower the front clutch hub in the splined output shaft and into the clutch plate teeth, thrust face up. Install the thrust washer on top of the front clutch hub.

15. Pre-lubricate and install seal rings on oil sleeve. Install sleeve into output shaft.

16. Install the input bearing on the input shaft and lower into the front clutch cylinder.

CAUTION **CENTER ALL THE SEAL RINGS IN THEIR GROOVES BEFORE LOWERING THE INPUT SHAFT INTO PLACE TO AVOID DAMAGING THE SEAL RINGS.**

17. Install the outer snap ring into the front clutch cylinder. Make sure the ring is securely seated in its groove.

18. Pre-lubricate and install the seal rings in the grooves in the input shaft.

19. Oil the seal rings, bearings, and clutch plates. Slide the shaft and clutch assembly into the case, being very careful not to damage the three seal rings at the head end of the assembly.

F. Reassembly Shuttle Assembly

1. Install stator support tube and plate using new O-Ring and seal.

2. Install idler gear with new bearings and thrust washers if required.

3. Install countershaft, countergear with new bearings, and thrust washers if required.

4. Install oil pan with new gaskets and clean strainer.

5. Flush clean the variable speed transmission and install on shuttle assembly, using the same number of clutch stack adjusting shims as removed and new gasket.

6. To check clutch shaft end-play, push the front of the shaft in and pull it out. There should be .020 to .035 end-play in the clutch shaft. (Add or remove shims to adjust).

7. After converter housing has been inspected and repaired as required, using a new gasket, install the converter housing assembly to the shuttle.

8. Install new or rebuilt pump with new filter element.

CAUTION **MAKE SURE O-RINGS ON THE SUCTION TUBE ARE SEATED TO PREVENT AIR LEAKS.**

9. After complete disassembly and cleaning, install control valve and heat exchanger. Make sure all O-Rings are seated properly.

10. Support unit with hoist so that it can be positioned directly in line with the converter hub. Center converter hub gear seal ring in its groove. Apply grease to hold in position. Carefully insert input shaft well centered in bore. Advance unit toward engine slowly in order to feel when splines begin to mate. If unit stops advancing at this point, rock gently to permit splines to line up. DO NOT USE BRUTE FORCE AT ANY TIME. When all splines and gear teeth line up, unit will close up easily.

11. Torque Specifications:

13 In. Converter Cover Bolts	18 ft. lbs.
1/4 In. Bolts or Capscrews	8 ft. lbs.
5/16 In. Bolts or Capscrews	16 ft. lbs.
3/8 In. Bolts or Capscrews	16 ft. lbs.
7/16 In. Bolts or Capscrews	40 ft. lbs.
1/2 In. Bolts or Capscrews	60 ft. lbs.
9/16 In. Bolts or Capscrews	90 ft. lbs.
Regulator Capscrews	25 ft. lbs.

12. Fill entire unit with automatic transmission fluid Dextron Type II only. Test unit as outlined in Performance Check.

6-5 FEED RAM ASSEMBLY REPAIR INSTRUCTIONS

A. Removal Feed Ram Assembly

1. If machine is equipped with a polesetter attachment, it will be necessary to remove same before proceeding to remove the feed ram assembly.

2. Loosen the clamping bolt and nut in the lower packing nut. This nut has left hand threads and can be removed with a chain wrench. Slide nut and lower gland off end of kelly bar. Loosen the set screw that locks upper packing nut in place. This nut has left hand threads and may be removed with a chain wrench even though the amount of working room is limited. Allow nut and upper gland to slide down main drive until they rest against main drive housing. Start digger engine and very slowly actuate the kelly bar valve handle as to apply up-pressure to the assembly. This will force both the upper packing set and the lower packing set out into the open except for possibly the last packing in each set, which can easily be removed by hand.

3. Disconnect all hydraulic hose connections at feed ram assembly. Remove all bolts, washers, and nuts around base of lower support.

4. Remove capscrews and nut from shaft that secures the elevating cylinder assembly to the saddle assembly. Remove shaft using a hammer and soft punch.

5. Remove feed ram assembly by lifting it out of headache rack and towards front of truck or backing truck away from it, depending on type of hoist setup available. Once the kelly bar is slid partially out of main drive brass, it may be necessary to clamp kelly bar to the barrel assembly to keep the bar from sliding out.

B. Disassembly Feed Ram Assembly (figure 6-23)

1. Set feed ram assembly on some type of rack to provide a good working height.

2. Remove transfer tube clamps, split flange clamp halves and transfer tube assembly. Remove O-Ring located in tip end of transfer tube assembly.

3. Remove the 12 capscrews from the feed ram cap. Slide cap off end of barrel. Remove O-Ring and backup ring located inside cap. Remove lock ring by lifting the ring end up with a screwdriver and coiling it out of the ring groove and off end of barrel. Slide retainer off end of barrel.

4. Loosen nuts on saddle and slide saddle off end of barrel.

5. Remove all bolts and nuts from working barrel braces and remove braces.

6. Remove barrel support from barrel by turning support counterclockwise. Remove O-Ring and backup ring as located inside support.

7. Push on auger end of kelly bar until piston at tip end is exposed. Continue pushing bar until approximately 8 inches of kelly bar is exposed.

8. Remove piston rings with a ring expander tool.

9. Locate the piston pin in top end of piston. Head of pin will be flush with O.D. of piston, but can usually be located by discoloration. The general location will be marked by a center punch mark on the top end of the position. Drill down through wall of piston plug. This will cause an internal pressure leak if plug is reused. Drill only deep enough to remove pin. Screw piston plug out of piston.

10. Using a plastic or rawhide hammer, knock piston back towards auger end of bar until it slides off the bearing assembly.

11. Remove cotter pin and piston nut. Remove piston bearing and bearing cup with a bearing puller. Slide piston offer end of kelly bar. Pull bar out either end of barrel.

NOTE: **Wrap the bar end that will be rubbing the I. D. of the barrel while being removed to protect barrel wall from possible damage. Pick up the exposed end of bar slightly during removal to relieve the heavy metal-to-metal contact between kelly bar corners and barrel wall.**

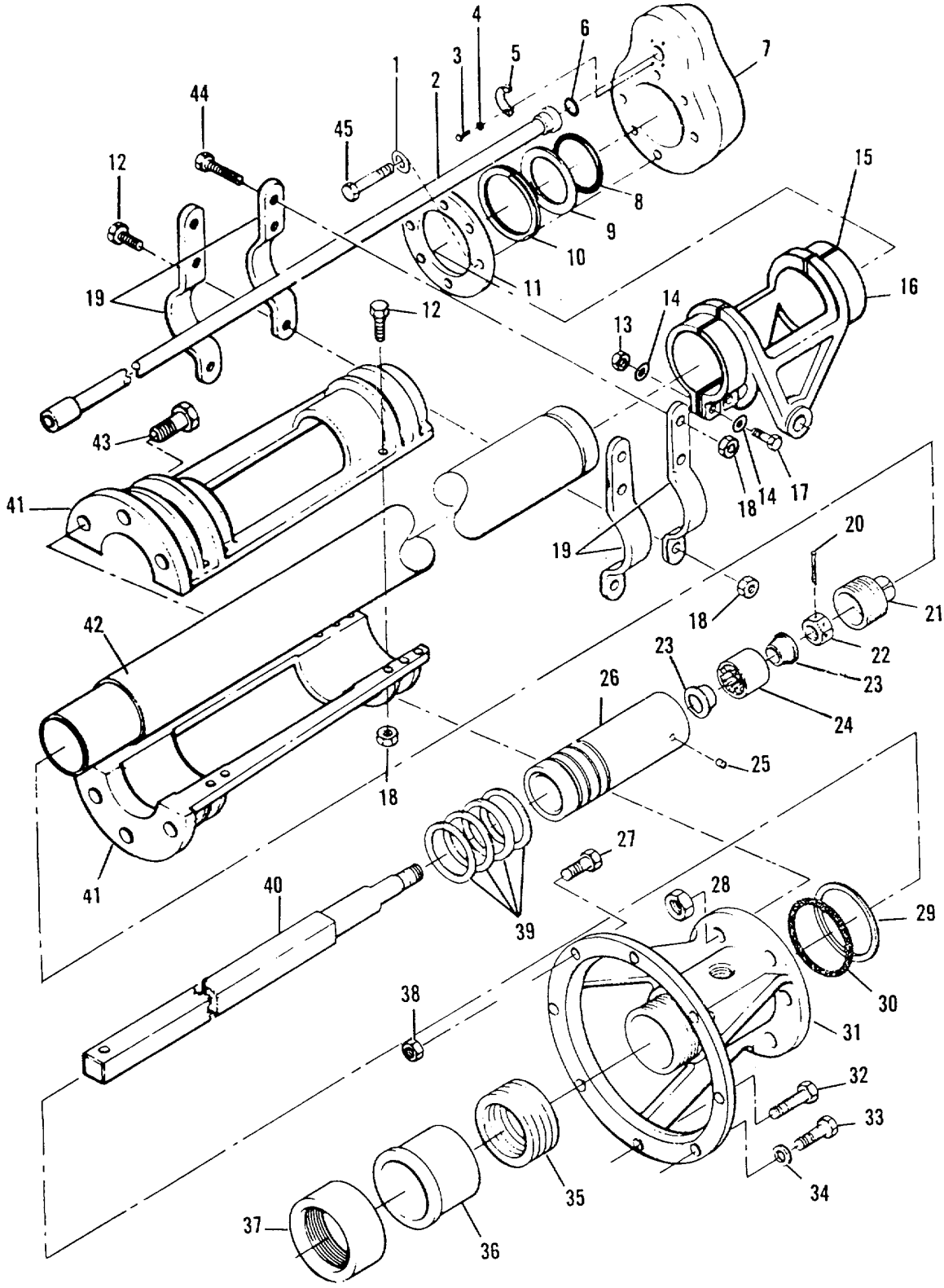


FIGURE 6-23. FEED RAM BREAKDOWN OF PARTS

ITEM	QTY.	DESCRIPTION
1	12	WASHER - LOCK - INTERNAL 3/8 IN
2	1	TUBE - TRANSFER
3	4	CAPSCREW - HEX HD - 7/16 - 14 NC X 1 1/2 LG - GRD 5
4	4	WASHER - LOCK 7/16 IN
5	2	FLANGE - SPLIT - HALF - 1 1/4 IN
6	1	O-RING - 1 1/2 ID X 1 3/4 OD X 1/8
7	1	CAP - END - BARREL - FEED RAM
8	1	O-RING - 4 1/4 ID X 4 5/8 OD X 3/16
9	1	RING - BACKUP 4 1/4 ID X 4 5/8 OD X 3/16 WIDE
10	1	RING - LOCK - 4 1/4 OD - BARREL - FEED RAM
11	1	RETAINER - CAP - FEED RAM - 4 1/4 OD
12	12	CAPSCREW HEX HD 1/2 - 13 NC X 2 1/4 LG - GRD 5
13	10	NUT - HEX - 1/2 - 13 NC
14	20	WASHER - HARDEN - 1/2 IN
15	6	SHIM - FEED RAM - CLAMP
16	1	SADDLE - BARREL - FEED RAM
17	10	CAPSCREW - HEX HD - 1/2 - 13 NC X 1 3/4 LG GRD 5
18	18	NUT - ELASTIC STOP - 1/2 - 13 NC
19	4	CLAMP - TRANSFER TUBE - HALF
20	1	PIN - COTTER 1/4 DIA X 2 1/2 LG
21	1	PLUG - PISTON
22	1	NUT - CASTELLATED - THIN - 1 3/8 - 12 NF
23	2	BEARING - CONE - 1.500 ID
24	1	BEARING - CUP - 3.151 OD
25	1	PIN - PISTON PLUG
26	1	PISTON - FEED RAM - 3 3/4 OD
27	2	CAPSCREW - HEX HD 5/8 - 11 NC X 2 3/4 LG GRD 5
28	6	NUT - ELASTIC STOP - 3/4 - 10 NC
29	1	RING - BACKUP - 4 1/8 ID X 4 1/2 OD X 3/16 WIDE
30	1	O-RING - 4 1/8 ID X 4 1/2 OD X 3/16
31	1	SUPPORT - FEED RAM
32	4	CAPSCREW - HEX HD - 5/8 - 11 NC X 2 1/4 LG GRD 5
33	2	CAPSCREW - HEX HD - 5/8 - 11 NC X 2 3/4 LG GRD 5
34	2	WASHER - LOCK - CUT - 5/8 IN
35	1	PACKING SET - UPPER FEED RAM
36	1	GLAND - PACKING - UPPER
37	1	NUT - UPPER PACKING
38	6	NUT - ELASTIC STOP - 5/8 - 11 NC
39	4	RING - PISTON 3 3/4 OD
40	1	KELLY - 2 1/2 SQ
41	2	BRACE - BARREL - FEED RAM
42	1	BARREL - FEED RAM - 3 3/4 ID
43	6	CAPSCREW - HEX HD - 3/4 - 10 NC X 2 1/2 LG GRD 5
44	4	CAPSCREW - HEX HD - 1/2 - 13 NC X 2 3/4 LG GRD 5
45	12	CAPSCREW - HEX HD - 3/8 - 16 NC X 1 1/2 LG GRD 5
46	1	SCREW - SET SQ HD - 3/8 - 16 NC X 3 (NOT SHOWN)
47	8	PACKING - LOW FEED RAM (NOT SHOWN)
48	1	GLAND - PACKING - LOWER (NOT SHOWN)

FIGURE 6-23. FEED RAM BREAKDOWN OF PARTS

C. Reassembly Feed Assembly

1. Clean all parts thoroughly. Insert O-Ring and backup ring into O-Ring groove inside working barrel support with backup ring on top of O-Ring. Lubricate O-Ring backup ring, inside threads in support and threads on barrel. Screw support on barrel until it is tight. (Figure 6-23, Item #29 & 30).

2. Place barrel braces on barrel. Place bolts and nuts in the barrel braces and leave loose. Align holes in braces with holes in support and place all bolts through holes and screw on nuts. Torque all barrel brace nuts to 10 ft. lb. maximum.

3. Slide saddle over end of barrel to approximate location.

4. With machined end of kelly bar (Item #4) wrapped, slide bar into barrel starting through barrel support end of assembly. The wrapping around the machined end of the bar will prevent damage to the wall of the barrel while bar is being pushed through. Allow machined end of bar to extend approximately two feet out top end of barrel.

5. Remove wrappings on end of bar and slide piston past machined area with I.D. threads toward end of bar.

6. Drive one of the bearing cones on bearing journal until it contacts shoulder. Place bearing cup on cone, and drive other bearing cone into cup. Screw kelly bar nut on bar until bearing assembly shows no play, but still turns freely. If cotter pin hole does not line up with slots in nut, it will be necessary to re-drill bar to 1/4 inch diameter. Install cotter pin.

7. Heat top end of piston (Item #26) (low temperature) with a torch, and with a plastic or rawhide hammer, drive piston over bearing assembly until shoulder in piston contacts rear of bearing cup.

8. Screw piston plug into piston until it contacts front edge of bearing cup tight. If hole in plug is out of line with hole in piston, it will be necessary to re-drill through piston and into plug approximately 3/16 inch. Drive pin through piston and into plug until it swells and locks in place. File down portion of pin protruding-out of piston.

9. Place piston rings into piston ring grooves with a ring expander tool. Check rings to be sure that they function freely in grooves.

10. Lubricate piston and rings and secure ring compressor tightly over assembly. Insert a round rod through auger pin hole in bar and pull -piston into barrel.

11. Slide retainer over top end of barrel and past groove in barrel with relieved slide of retainer facing end of barrel. Place lock ring into groove starting with one end and coiling it into place. Install new O-Ring and backup ring in cap, slide cap into place, over end of barrel and align holes with the holes in the retainer. Screw capscrews into cap and torque to 67 ft. lbs.

12. Place O-Ring into top end of transfer tube. Install all clamps on barrel loosely, leaving top bolt out of each clamp. Set transfer tube in clamps and slide against cap. Place split flanges around top end of transfer tube and align holes with the holes in the cap. Screw bolts into cap tight. Replace remaining bolts in clamps and tighten all nuts. Do not tighten to the point of distorting tube.

D. Remounting Feed Ram Assembly

1. Reverse removal procedure.

2. After feed ram assembly has been mounted on digger, torque nuts on elevating cylinder saddle clamp to 60 ft. lbs maximum, all other clamps torque to 10 ft. lbs. maximum.

3. After replacing the upper and lower packing, adjust upper packing to allow a very slight seepage of oil to ensure proper lubrication of main brass drive. The lower packing should be adjusted to allow an oil film to be present on the kelly bar at all times to ensure maximum packing life.

6-6 FINAL DRIVE ASSEMBLY REPAIR INSTRUCTIONS

A. Disassembly Final Drive Assembly (Figure 6-24)

1. Remove elevating cylinder pin, and support feed ram at lower barrel support.

2. Remove all capscrews, tab locks. Remove retainer ring. Remove capscrews on front of lower barrel.

3. Use a hoist to lift the final drive assembly away from right angle drive housing and slide off kelly bar.

CAUTION: CLAMP KELLY BAR TO BARREL ASSEMBLY TO PREVENT BAR FROM SLIDING.

4. Remove the tab locks and capscrews, Items 4, 5, 6. Note: The location of drain plug in housing cover. Lift lower-housing cover off the main drive brass.

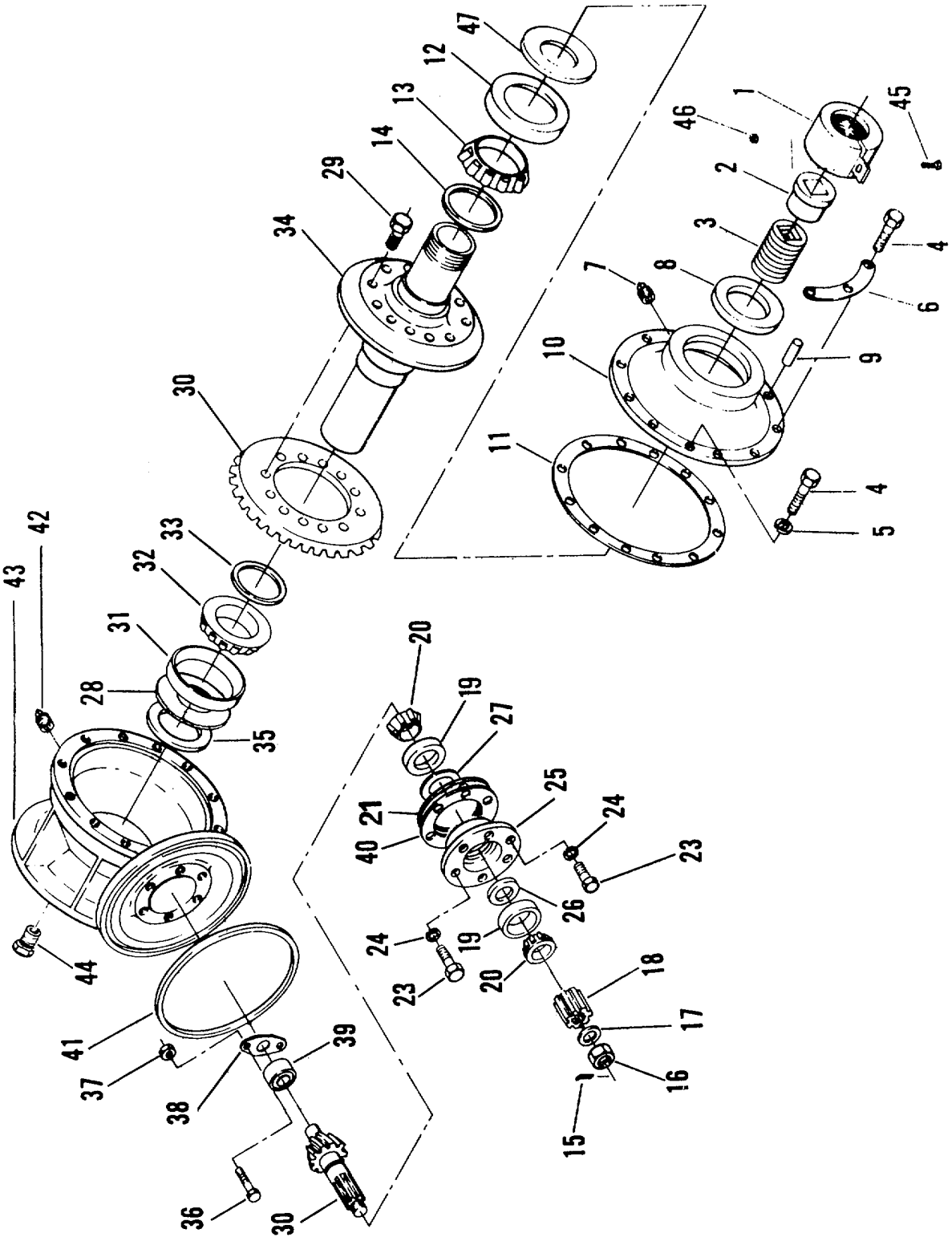


Figure 6-24. FINAL DRIVE ASSEMBLY

ITEM	QTY.	DESCRIPTION
1	1	NUT - PACKING - FINAL DRIVE
2	1	GLAND - PACKING
3	8	PACKING - LOWER FEED RAM
4	11	CAPSCREW - HEX HD - 1/2 - 13 UNC X 1 1/4 - GR 5
5	2	WASHER - LOCK CUT - 1/2
6	3	TAB LOCK
7	1	FITTING-PLUG-PIPE - 1/2 - 14 NPT-SQ HD - MAG
8	1	SEAL - GREASE - (455371)
9	4	PIN - SPRING - TUBULAR SPLIT - 3/8 X 1 1/4
10	1	HOUSING - LOWER - FINAL DRIVE
11	1	GASKET SET - HOUSING (1/64, 1/32, 3/64)
12	1	CUP - BEARING - (68712)
13	1	CONE - BEARING - (68462)
14	1	SHIM SET - (.005, .010, .015) - 5-5/8 O.D.
15	1	PIN - COTTER - 1/8 DIA X 1 3/4
16	1	NUT - PINION DRIVE - HEX - 1 1/4 - 12 UNF THIN
17	1	WASHER - SPACER - .156 THK
18	1	ADAPTER - PINION DRIVE
19	2	CUT - BEARING
20	2	CONE - BEARING - (53176)
21	1	SPACER - 6 1/2 O.D. X 4 1/2 I.D. X .130
22	-	
23	6	CAPSCREW- HEX HD - 9/16 - 12 UNC X 1-1/2 - GR 5
24	6	WASHER LOCK - CUT - 9/16
25	1	HOUSING - BEARING
26	1	SPACER - BEARING - .533 THK
27	1	SHIM SET - (.005, .010, .015) 2 1/8 O.D.
28	1	SHIM SET - (.005, .010, .015) 6 O.D. X 5 1/2 I.D.
29	12	CAPSCREW - HEX HD - 7/16 - 20 UNF X 2 1/4 - GR 8 LOCK
30	1	GEAR ASSEMBLY - RING & PINION
31	1	CUP - BEARING - (52618)
32	1	CONE - BEARING - (52400)
33	1	SHIM SET - LAMINATED (.002, .032) 5 1/8 O.D.
34	1	DRIVE - MAIN - 2 1/4
35	1	SEAL - GREASE - (55035)
36	2	CAPSCREW - HEX HD - 1/4 -20 UNC X 1 1/2 - GR 5
37	2	NUT - ELASTIC STOP - 1/4 - 20 UNC
38	1	COVER - BEARING RETAINER
39	1	BEARING - ROLLER (RS5305W)
40	1	SHIM SET - (.005, .010, .015)
41	1	PACKING
42	1	GAUGE - SIGHT - 1/2 NPT
43	1	HOUSING - FINAL DRIVE
44	1	FITTING - PRESSURE RELIEF - 1/8 NPT - 5 LB
45	1	CAPSCREW - HEX HD - 1/2 - 13 UNC X 1 3/4 GR 5
46	1	NUT - ELASTIC STOP - 1/2 - 13 UNC
47	1	SHIM SET (.005,.010, .015) - 7 O.D. X 6 I.D.

Figure 6-24. FINAL DRIVE PARTS LIST (REF. ONLY)

5. Using lift fixture and hoist, lift the main drive and ring gear out of the housing, Items 13, 14, 30, 34, 33, 32. Inspect ring gear and pinion teeth. If they are to be replaced, remove all ring gear bolts; DISCARD BOLTS, DO NOT REUSE.

6. Use a puller or press to remove upper and lower bearings, Items 13, 32; SAVE AND RECORD NUMBER OF SHIMS, under each bearing. Part numbers 11150 and 11149. Remove bearing cups Items 12, 31, from housing. This can be done by laying a bead of electric weld around the inside of the cup and using a suitable puller.

7. Remove upper and lower grease seals and pinion bearing retainer covers. Remove six (6) bolts from pinion housing. Using soft drift, drive pinion, Item 13, and case assembly out of final drive housing.

8. Remove unit from vise. Place bearing housing in vise and using soft drift, drive pinion shaft out of bearing, spacer, and shims. NOTE NUMBER OF SHIMS.

9. Remove pinion housing bearing cups with a soft drift. Drive 1/4 inch wide blade into the packing in final drive housing at right angle and pry one end up and pull out.

WARNING **USE OF STEEL PUNCH REMOVING BEARING CUPS COULD CAUSE PERSONAL INJURY.**

B. Final Drive Assembly

1. Thoroughly clean all parts and housing. Inspect and replace as required. NOTE: Have your parts book handy to refer to for part numbers. Place pinion shaft, Item 30, in vise with splined end up. Install pinion bearing against shoulder, Item 39. NOTE: USE SOFT JAWS OR ADEQUATE CLAMPING MEANS TO HOLD PINION SHAFT TO PREVENT DAMAGE TO PINION.

2. Install both housing cups, Item 19, in pinion housing. Lubricate both bearings. Set pinion housing on bearing on pinion shaft. Install reuseable spacer and shims or new shims. Install second pinion bearing, adapter, washer, and nut on pinion, torque pinion nut to 150 ft. lbs. NOTE: THE HOUSING SHOULD BE ROTATED WHILE TIGHTENING THE PINION END NUT IN ORDER TO SEAT AND ALIGN THE BEARING

3. To measure the preload, wrap a strong cord or soft wire about the pinion housing and attach the end to the spring scale, making sure pinion is locked in vise. Read scale only while pinion housing is turning. Scale should read 5 to 14 lbs. If adjustment is required, add or remove shims until proper adjustment is made.

4. Start with basic shim pack approximately 0.018. **NOTE: BASIC SHIM THICKNESS IS USED AS A STARTING POINT, MAY BE NECESSARY TO ADD OR SUBTRACT SHIMS FOR DESIRED PRELOAD AND/OR BACKLASH.**

5. Install pinion tail bearing retainer (Figure 6-4, Item #38) and pinion tail bearing in final drive housing. One retainer on each side of tail bearing plates hold tail bearing in housing. Install pinion, pinion shaft housing and shims in final drive housing with the short bolt in its PROPER LOCATION, tighten all bolts to 170 lbs. of torque. Rotate pinion to check for binding. Remove pinion housing and shims.

6. Install ring gear on final drive using new bolts, flat washers, and shake-proof lockwasher. With final drive brass (Item #34) setting on its small end, install large bearing cone using shims as available from previous installation. Heating of this bearing with steam or in an oven will ease installation of this bearing. Turn main drive over, install shims as available from previous installation, and install small bearing cone. Heating of this bearing in an oven or with steam will also ease installation of this bearing.

7. Lubricate bearings and cones with light coating of oil. Set main drive brass assembly in final drive housing. Install cover and cover capscrews. Torque capscrews to 90 ft. lbs. before installing pinion and housing sub-assembly, check main drive for proper preload across bearing. There should be no available free motion and the preload across bearing should be sufficient to require from 10 to 20 in pounds torque to turn the shaft. If drag is too much, add to the shims between housing or reduce shims total if too small. With the correct preload on the final drive brass, install pinion and housing sub-assembly, and shim pack. Make sure the short bolt is in its proper location. Torque mounting bolts to 90 ft. lbs. Install dial indicator in the pinion splines, check the backlash at four equal intervals of the output shaft rotation. Backlash should be from 0.005 to 0.008. If the backlash must be corrected, this is accomplished by removing the final drive housing cover, and the final drive brass assembly, backlash changes almost equally to ratio as the output gear is moved. Therefore, if backlash must be increased by 0.005, the shim adjacent to the small bearing should be increased by a like amount, namely 0.005. In order to do this, the small bearing shim must be removed and reassembled over the final drive brass. When the final drive brass bearing shim is changed, a compensating change to the housing cover gasket is generally required to keep the bearing preload proper. Once the backlash has been set in the proper range, rotate the pinion ten (10) full turns in both directions. Remove the pinion and housing sub-assembly and inspect the pinion pattern comparing to the example, (see Figure 6-9). The concave side of the pinion is the major load side and its pattern is NOT CORRECT. The pattern should be adjusted by

changing the amount of shims in the housing. For example, increasing the shim pack 0.010 moves the pattern down on the flank approximately 0., and reducing the shim moves it up, within the range of adjustment required, usually less than 0.20. When both patterns and backlash areas required the gear set is properly positioned. Remove cover bolts, and install new tab locks, retorque capscrews to 90 ft. lbs. Bend up tab lock capscrews in position. Install new seals in housing permatex. On the outside edges. The upper seal is installed with the lip up.

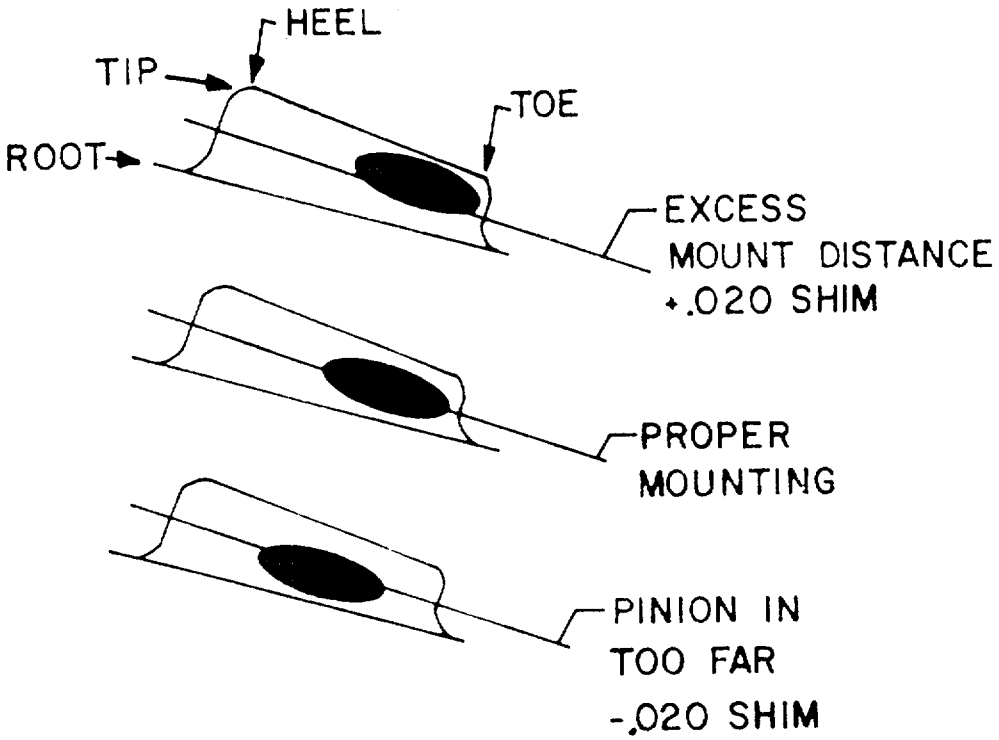


Figure 6-25. EXAMPLE OF PINION PATTERN

6-7 RIGHT ANGLE DRIVE REPAIR INSTRUCTIONS

A. Disassembly of Right Angle Drive

1. Before right angle drive can be removed from digger, it is necessary to remove the feed ram and the final drive assembly. After the feed ram and final drive have been removed, disconnect the drive line at the rear U-joint. Disconnect the leveling cylinder.

CAUTION **CLAMP KELLY BAR TO BARREL ASSEMBLY TO PREVENT BAR FROM SLIDING.**

2. Remove all capscrews, washers and tab locks from retainer ring. Using a lifting device, lift the right angle drive assembly out of the main frame ring, (have parts manual with you to refer to for part numbers).

3. Remove the brass liner from the intermediate ring by driving a flat, thin punch between the rear face of the liner and the intermediate ring.

4. Using a pin punch, drive out the four dowel pins. Remove all capscrews that hold the intermediate ring to the right angle housing. Lift the intermediate ring off the right angle housing and remove gasket.

5. Lift the ring gear and carrier out of the housing. If the ring gear is to be replaced, remove ring gear from carrier.

6. Remove bearings with a bearing puller. NOTE THE NUMBER OF OF SHIMS REMOVED. Remove cup from intermediate housing with a punch.

7. Remove pinion housing assembly. NOTE THE NUMBER OF SHIMS REMOVED. Place pinion in padded vise and remove pin, nut washer, and yoke.

8. Remove unit from vise, and place housing in vise and drive pinion shaft out of bearings, spacer and shims. NOTE THE NUMBER OF SHIMS REMOVED.

9. Remove roller bearing from shaft. Use bearing puller, DO NOT PUNCH.

10. Remove bearing cup from housing by welding a bead completely around the inside of the cup. This will cause the cup to contract and a hard blow with a hammer on the outside of the housing directly over the cup area will knock it out.

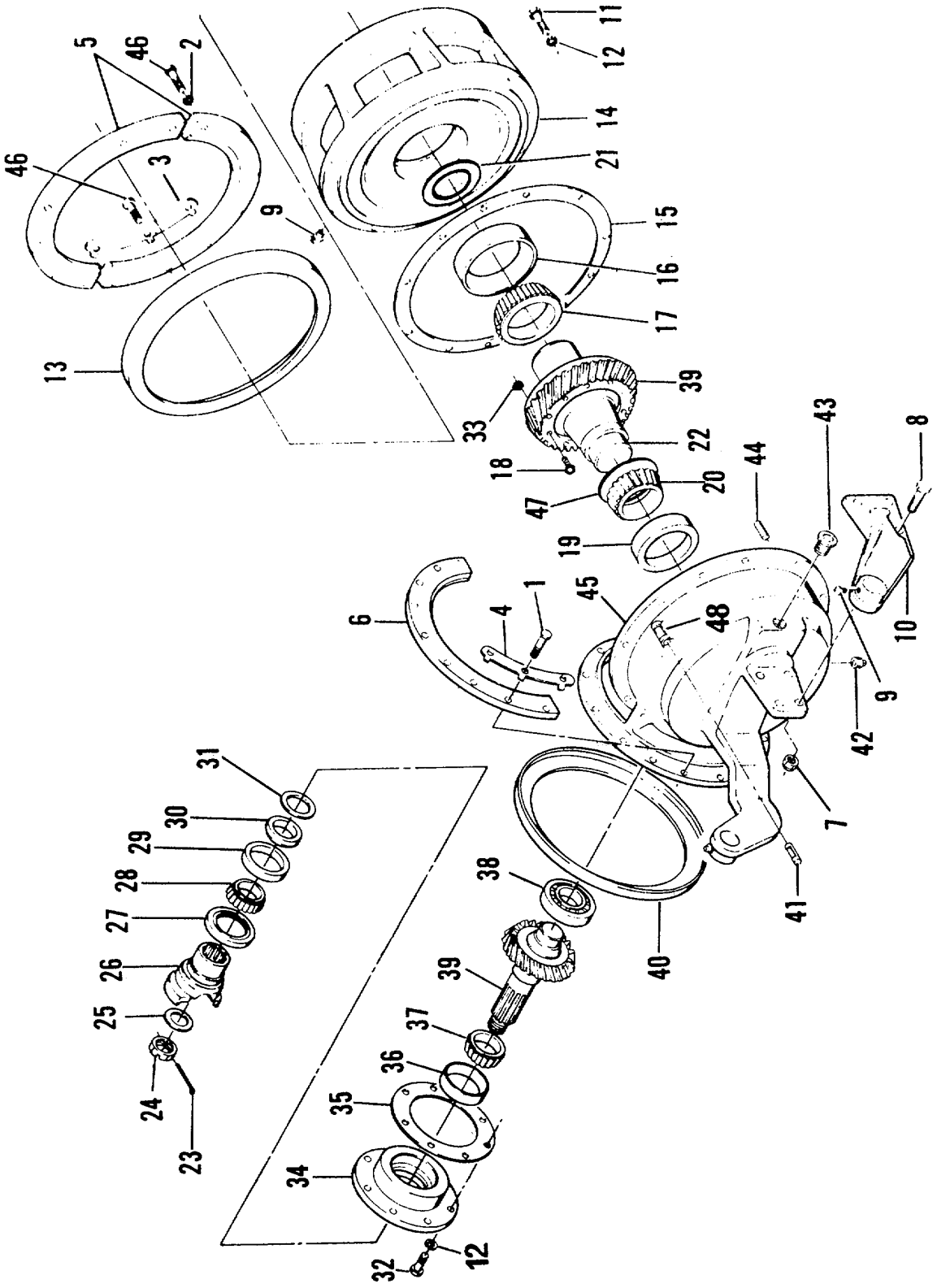


Figure 6-26. RIGHT ANGLE DRIVE ASSEMBLY

ITEM	QTY.	DESCRIPTION
1	18	CAPSCREW - HEX HD - 7/16 - 14 UNC 1 3/4 - GR 5
2	2	WASHER - LOCK - INTERNAL - 7/16
3	4	LOCK TAB
4	6	LOCK TAB
5	1	RING - RETAINER - FINAL DRIVE
6	1	RING - RETAINER
7	4	NUT- LOCK - 5/8 - 11 UNC
8	4	CAPSCREW - 5/8 - 11 UNC X 2 1/2
9	9	FITTING - GREASE - STR - 1/8 NPT
10	1	ARM - BOLT ON TYPE
11	11	CAPSCREW - HEX HD - 1/2 - 13 UNC X 1 1/4 - GR 5
12	19	WASHER - LOCK - CUT - 1/2
13	1	LINER - BRASS - INTERMEDIATE RING
14	1	RING - INTERMEDIATE
15	1	GASKET
16	1	CUP - BEARING
17	1	CONE - BEARING
18	12	CAPSCREW - HEX HD - 1/2 - 20 UNF X 2 LG - GR 8
19	1	CUP - BEARING
20	1	CONE - BEARING
21	1	SHIM - LAMINATED - (.005, .015)
22	1	CARRIER - RING GEAR
23	1	PIN - COTTER - 1/8 DIA X 1 3/4 LG
24	1	NUT - PINION
25	1	WASHER - SPACER
26	1	YOKE
27	1	SEAL - PINION DRIVE
28	1	CONE - BEARING
29	1	CUP - BEARING
30	1	SPACER - BEARING
31	1	SHIM - SET
32	8	CAPSCREW - HEX HD - 1/2 - 13 UNC X 1 1/2 LG - GR 8
33	12	NUT - SPECIAL - 1/2 - 20 UNF - GR 8
34	1	CARRIER - PINION
35	1	SHIM
36	1	CUP - BEARING
37	1	CONE - BEARING
38	1	BEARING - ROLLER
39	1 SET	RING GEAR AND PINION SET
40	1	LINER - BRASS - FRAME RING
41	2	LEVEL - LINE
42	1	PLUG- PIPE - 1/2 - SQ. HD. MAGNETIC
43	1	GAUGE - SIGHT - 1/2 NPT
44	4	PIN - DOWEL
45	1	HOUSING - RIGHT ANGLE
46	14	CAPSCREW - HEX HD - 7/16 - 14 UNC X 1 3/4 - GR 8
47	1	SHIM SET (.010, .005)
48	2	HOLDER - LEVEL
49	1	POINTER (NOT SHOWN)

Figure 6-26. RIGHT ANGLE DRIVE ASSEMBLY PARTS LIST

B. Reassembly of Right Angle Drive

1. Thoroughly clean all parts and housing. Inspect and replace as required.

2. Place the pinion shaft in padded vise with splined end up. Install pinion bearing against shoulder.

3. Install both bearing cups in housing and place on shaft and bearing. Place same number of shims as removed and spacer on shaft inside housing. Install bearing yoke, washer, and nut.

4. Turn housing to obtain bearing load. It should turn freely with no end-play. If adjustment is required, add or remove shims until proper adjustment is obtained. Remove nut, washer, and yoke and install seal into housing with sealing lip in. Grease the seal and yoke, reassemble on pinion shaft. Tighten nut and install pin.

5. Place ring gear on carrier with teeth facing small end of carrier. Use new grade eight bolts.

6. Install carrier bearings using the same number of shims removed. Install cups in housing.

7. Install pinion assembly into housing using the same number of shims as removed. Tighten all bolts.

8. The adjusting procedures are the same as Paragraph B-7, #7 for the final drive.

9. Install new brass liners. Installation is the reverse of removal.

6-8 WINCH MAINTENANCE AND REMOVAL

Inspect all parts for visible signs of wear or damage. Repair by using replacement parts.

Remove the winch by removing eight (8) capscrews and locknuts.

Winch brake adjustment, loosen adjusting screw locknut. Turn adjusting screw clockwise to increase brake tension or counterclockwise to decrease tension. Turn the adjusting screw only ½ turn at a time until proper adjustment is achieved. Retighten adjustment screw locknut after correct tension is acquired.

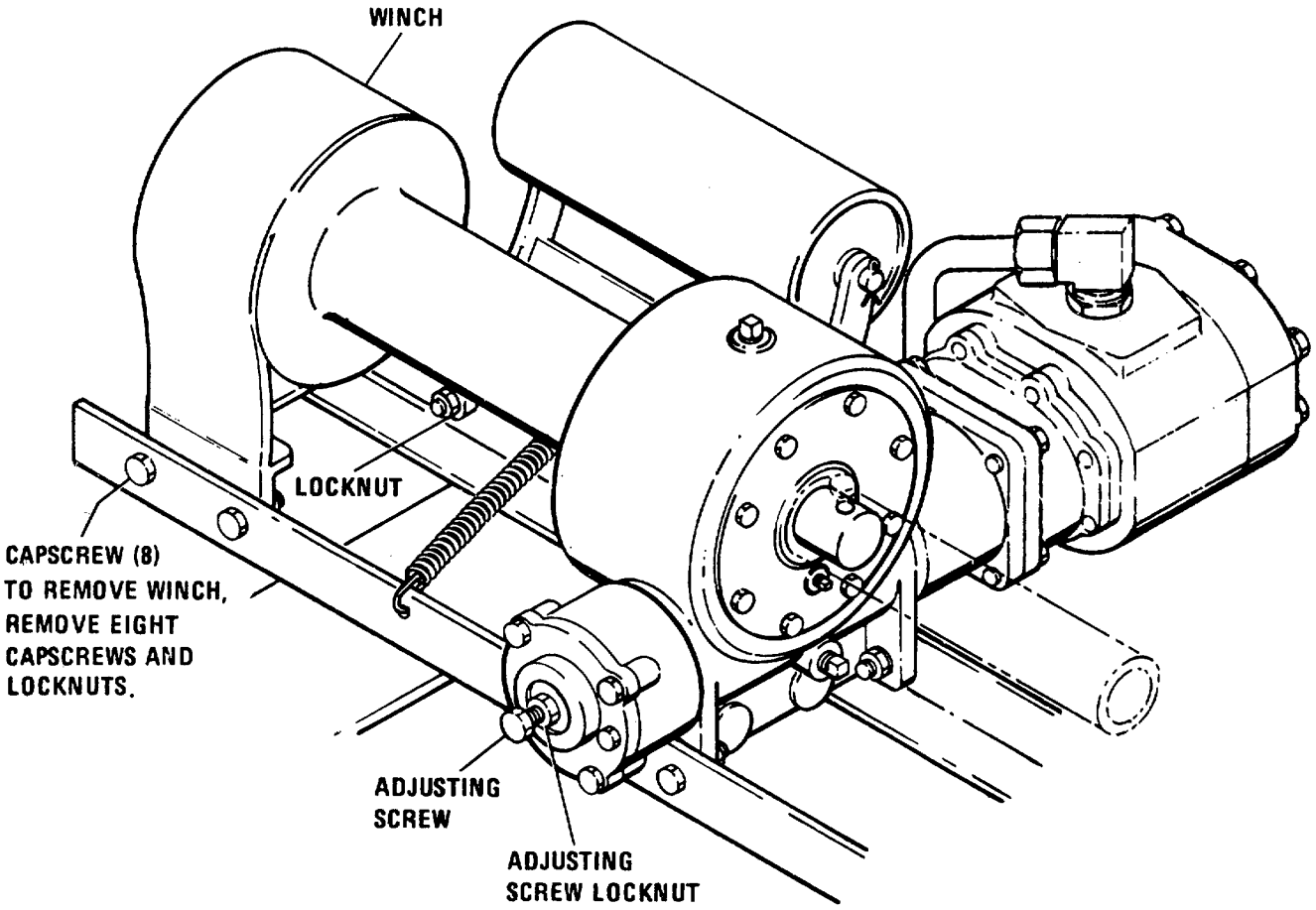


Figure 6-27. WINCH

6-9 WINCH HYDRAULIC MOTOR

Visually inspect the motor for any cracks in housing or other damage. Replace damaged motor.

Remove the hydraulic motor as instructed in figure below. Operate winch lever to align set screw with pipe plug lever.

Install the hydraulic motor by reversing the procedures given for removal.

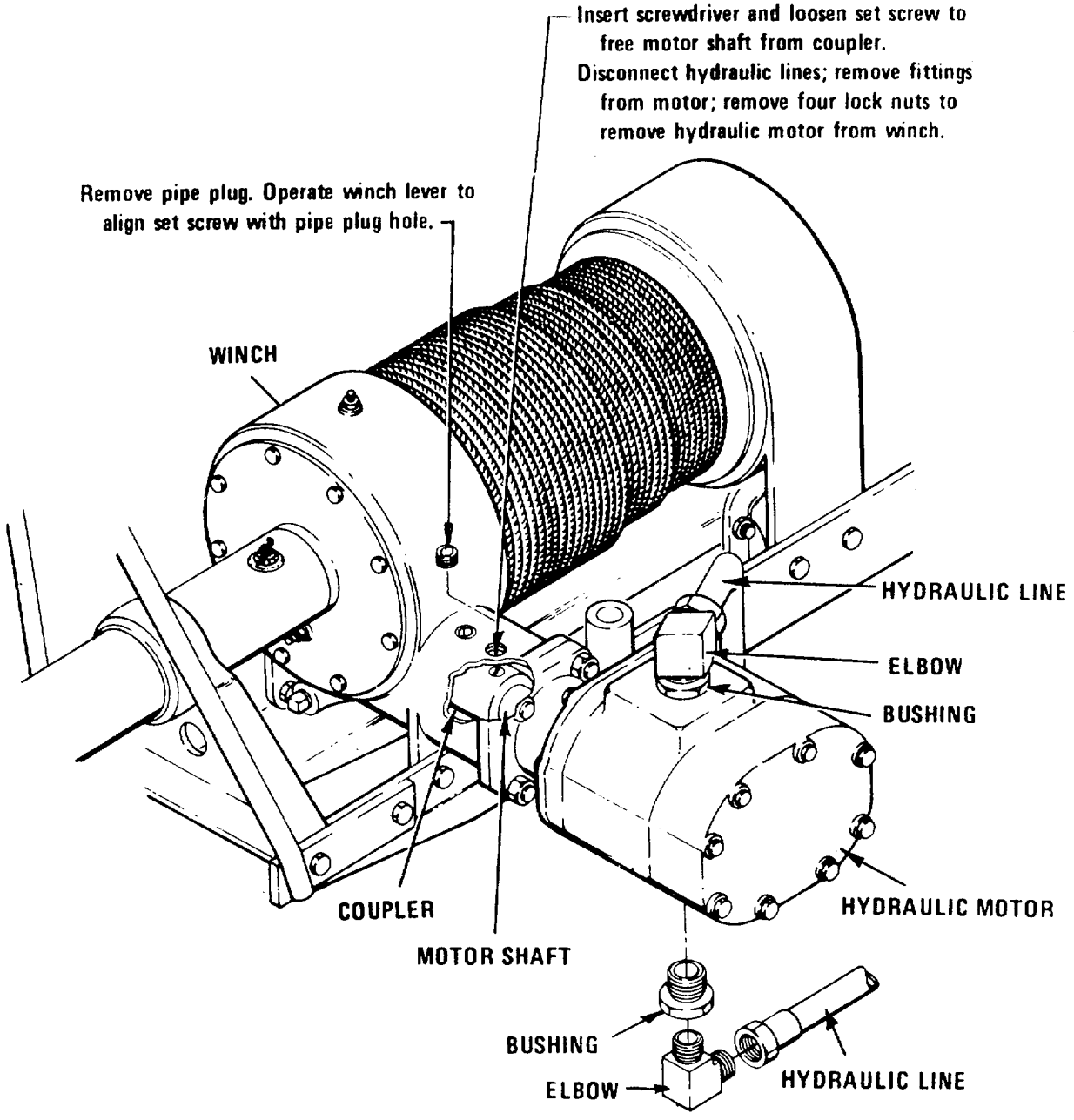


Figure 6-28. WINCH MOTOR

6-10 LEVELING CYLINDER REPAIR INSTRUCTIONS

A. Check for Hydraulic Leakage

Cycle two or three times, level the feed ram, polesetter and adjust pressure to maximum and let set for a minute or two. Examine the seal around the cylinder rod for evidence of leakage.

WARNING **FEED RAM AND POLESETTER WILL FALL WHEN LEVELING CYLINDER IS REMOVED. SUPPORT FEED RAM AND POLESETTER.**

B. Repacking Leveling Cylinder

When a leak is found in a cylinder, the most reliable way to stop the leak is to tear down the repack cylinder. To repack the cylinder, proceed as follows:

NOTE: Read Paragraph 6-1 before starting repairs.

1. Remove cylinder from machine. Refer to Figure 6-30, Leveling Cylinder Installation, reverse procedure. Refer to Figure 6-29 while performing remainder of cylinder packing procedure, and Paragraph C-2 thru C-5.

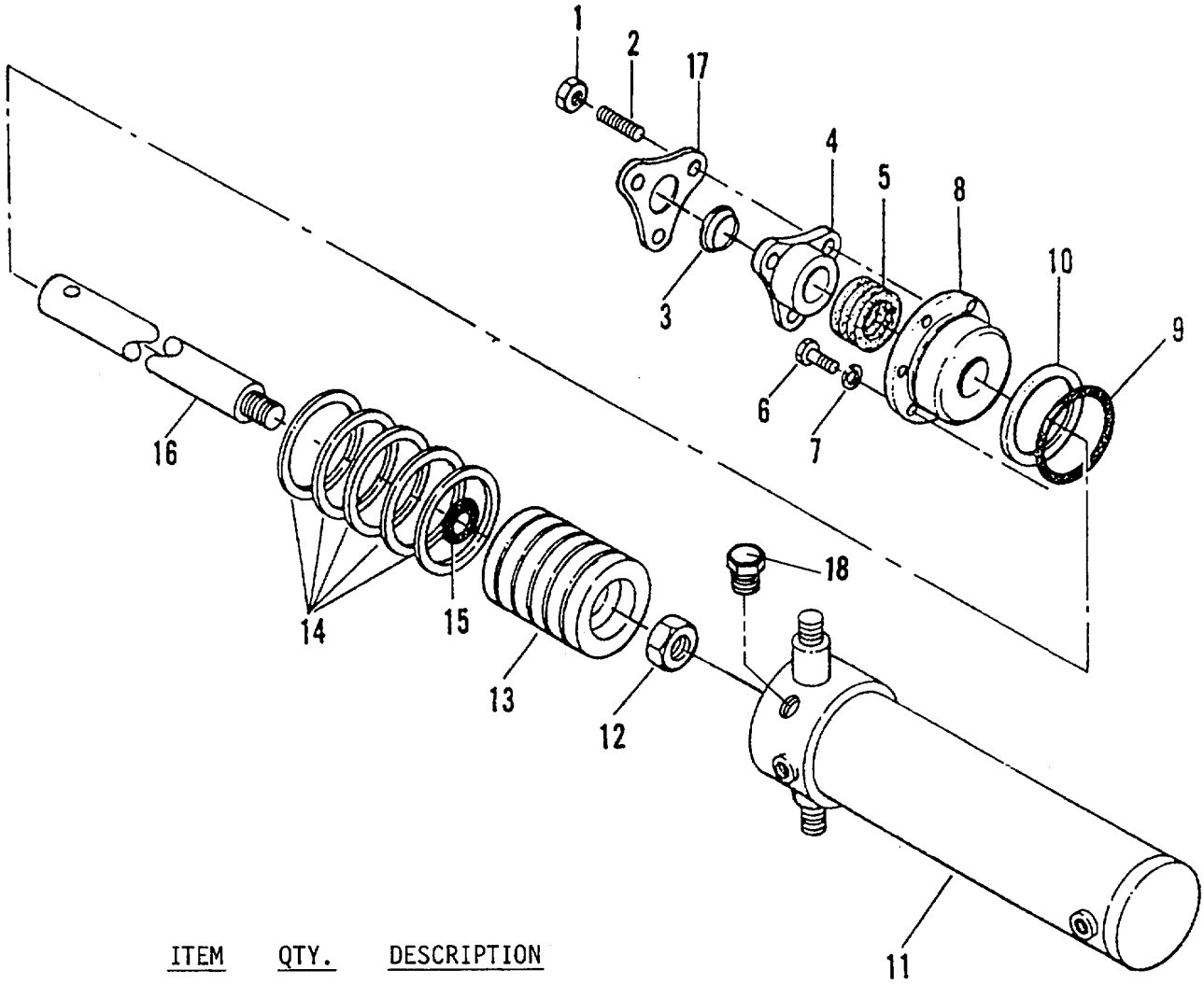
2. Remove bolt stud and elastic stop nut (Items 1 and 2) quantity of three each. Separate gland packing (Item 4) from cylinder.

3. Remove capscrews and lockwashers (Items 6 and 7), quantity of six each. Separate cylinder cap (Item 8) with backup ring (Item 10), and O-Ring (Item 9), shaft packing (Item 5), as a unit.

4. Remove and discard backup ring and O-ring. Replace with new parts.

5. Remove cylinder shaft (Item 16), piston (Item 13), piston packing (Item 14), O-ring (Item 15), and nut (Item 12) from cylinder assembly.

6. If piston is not worn, it is possible to replace the piston seal, and O-ring without removing the piston from shaft.



ITEM	QTY.	DESCRIPTION
1	3	NUT - HEX - 1/2 20 UNF-3B
2	3	BOLT-STUD-1/2 NC X 1/2 NF X 2 1/2 LG
3	1	WIPER - ROD - 2 I.D.
4	1	GLAND - PACKING
5	1 SET	PACKING - ROD - 2 I.D.
6	6	CAPSCREW-STL-1/2 - 13 NC X 1 3/4
7	6	WASHER - LOCK - 1/2 DIA
8	1	CAP - CYL - 7 1/2 O.D. X 2 I.D.
9	1	O-RING - 5 3/4 I.D. X 6 O.D. X 1/8 (NAT #623034)
10	1	BACKUP RING - 6 DIA (NAT #624434)
11	1	BARREL ASSEMBLY - MACHINES
12	1	LOCKNUT - 1 1/4 NF
13	1	PISTON - CYL - 6 DIA
14	4	PACKING - PISTON - 1/4 X 1/4 X 19
15	1	O-RING - 1/8W X 1 1/4 I.D. X 1 1/2 O.D.
16	1	SHAFT - 2 O.D. X 28 3/4
17	1	RETAINER
18	1	VALVE - RELIEF - THERMAL

Figure 6-29. LEVELING CYLINDER

7. If piston is worn, it must be removed and replaced with a new part.

CAUTION **AFTER REMOVAL OF SET SCREW AND NUT, CHECK FOR THREAD DAMAGE. IF THERE IS DAMAGE TO SHAFT OR NUT, REPLACE WITH NEW PARTS.**

8. Remove piston from shaft, remove O-ring (Item 15). Replace O-ring at this time.

9. Replace all O-rings and packing with new parts as identified in Parts Manual parts list, and reassemble cylinder in reverse order of disassembly procedure, torquing the capscrews to 10 ft. lbs.

   NOTE: Torque nut (Item 12) to 400-600 ft. lbs. using Loctite 242.

10. Reinstall cylinder on machine. Refer to Parts Manual for routing of hydraulic lines. Observe cylinder during operation to verify that cylinder does not leak.

C. Installation Leveling Cylinder

1. Inspect the leveling cylinder for any cracks or leaks. Replace a damaged cylinder.

2. Connect two nuts at the cylinder mounting studs.

3. Attach cylinder to the frame.

4. Attach the four capscrews and lockwasher at the leveling cylinder bracket as shown in Figure 6-30.

5. Connect all hydraulic lines, refer to Parts Manual. For routing of lines.

6. The removal is reverse of installation.

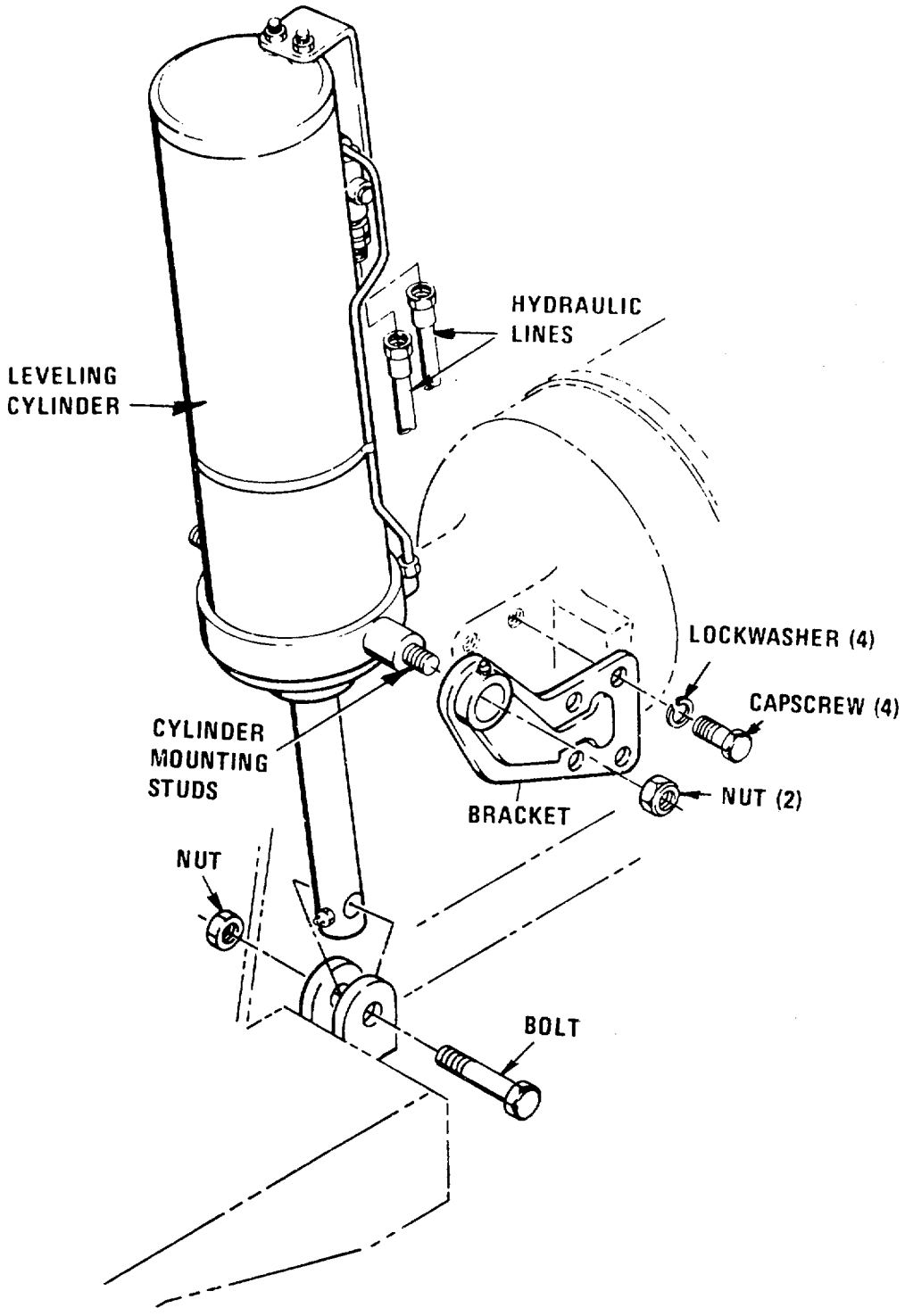


Figure 6-30. LEVELING CYLINDER INSTALLATION

6-11 ELEVATING CYLINDER REPAIR INSTRUCTIONS

Service of the elevating cylinder includes checks for leaks and repair as necessary.

NOTE: Read Paragraph 6-1 before starting and hydraulic repair.

WARNING **FEED RAM, POLESETTER ASSEMBLY MUST BE SUPPORTED BEFORE REMOVAL OF CYLINDER. SUPPORT FEED RAM POLESETTER.**

A. Check for Hydraulic Leakage

Cycle two or three times, then raise the mast and adjust pressure to maximum and let set for a minute or two. Examine seal around the cylinder rod for evidence of leakage. If leakage is present, perform procedures as outlined in B.

B. Repacking Elevating Cylinder

When a leak is found in a cylinder, the best way to stop the leak is to tear down and repack the cylinder. To repack cylinder, proceed as follows:

1. Remove cylinder from machine. Refer to Figure 6- 32 Installation of Elevating Cylinder, reverse procedure.
2. Refer to illustrated parts list in Parts Manual while performing remainder of cylinder packing procedure. Refer to Figure 6-31 in this manual.
3. Remove capscrews and lockwashers, quantity of four each. Separate gland packing and rod wiper.
4. Remove capscrews and lockwashers. Separate packing cap, with backup ring and O-ring as a unit.
5. Remove and discard backup ring, O-ring and rod wiper. Replace with new parts.
6. Remove cylinder shaft with spacer, piston, piston seal, wear ring, and nut from cylinder assembly.
7. If piston is not worn, it is possible to replace the piston seal, and wear ring without removing the piston from shaft.

NOTE: O-ring (Item 20) is seldom replaced. If required to do so, refer to Paragraph B-9.

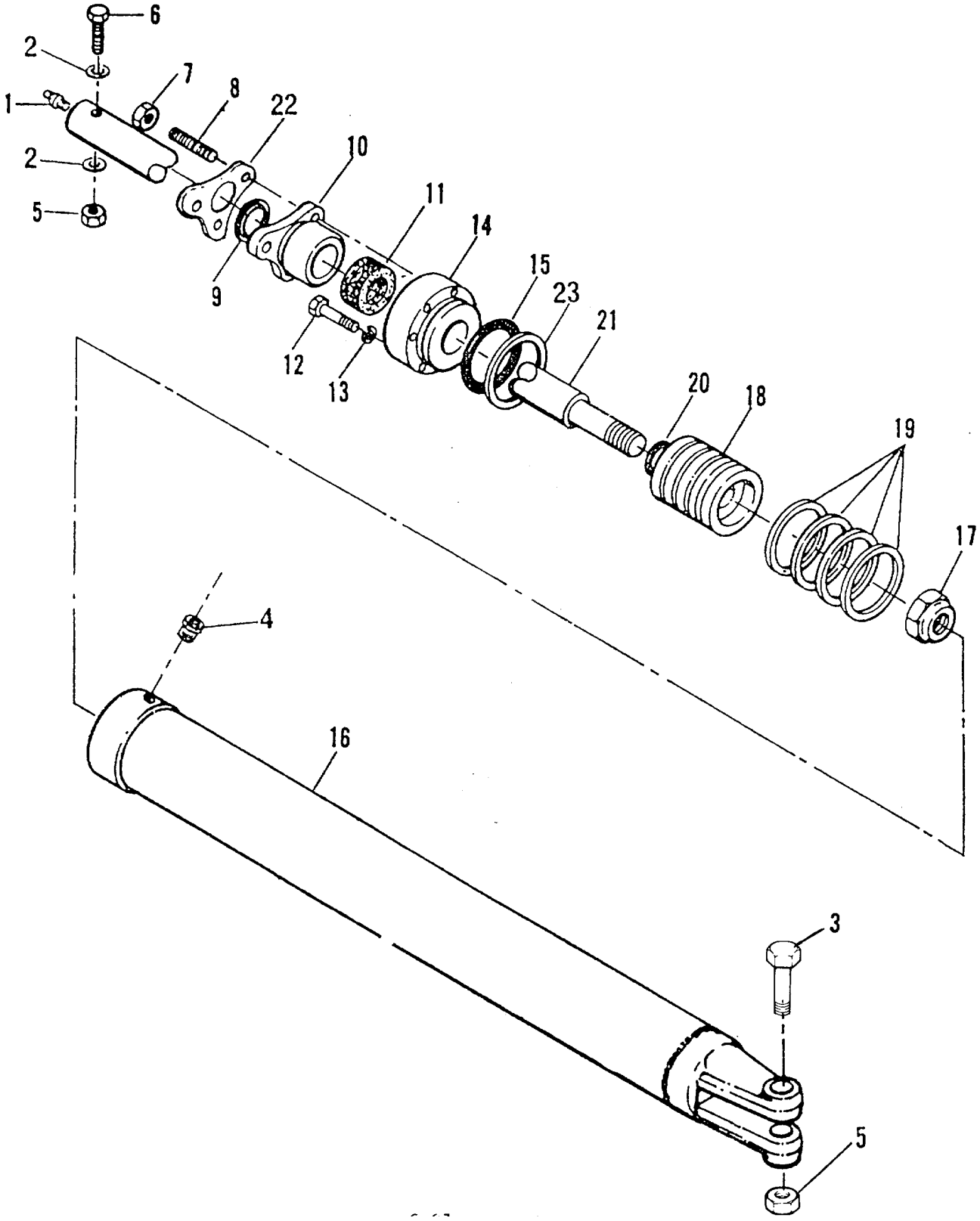


Figure 6-31. ELEVATING CYLINDER

ELEVATING CYLINDER PARTS LIST

ITEM	QTY.	DESCRIPTION
1	3	GREASE - 1/8 NPT
2	2	SPACER - MOUNTING - UPPER
3	1	CAPSCREW - HEX HD - 1 - 8 UNC X 7 1/2-GR 8
4	1	VALVE - RELIEF - THERMAL - 1/8 NPT - 3000#
5	2	NUT - ELASTIC STOP - 1 - 8 UNC
6	1	CAPSCREW - HEX HD - 1 - 8 UNC X 6 1/2 GR 8
7	3	NUT - STOP - ELASTIC - 1/2 - 20 UNF
8	3	BOLT - STUD - 1/2 X 2
9	1	WIPER - ROD - 2 IN I.D.
10	1	GLAND - PACKING
11	1	PACKING
12	6	CAPSCREW - 3/8 - 16 NC X 1 3/4 LG - GR 5
13	6	WASHER - LOCK - CUT - 3/8
14	1	CAP - CYLINDER
15	1	O-RING - 4 3/4 D -
16	1	BARREL ASSEMBLY - 4 3/4 I.D. X 69 3/4
17	1	NUT - STOP - ELASTIC - 1 1/4 - 12 NF
18	1	PISTON
19	1	PACKING - BELMONT - 1/4 SQ X 70 IN LG
20	1	O-RING - 1/8 X 1 1/4 I.D. X 1 1/2 O.D.
21	1	SHAFT -2 DIA X 75
22	1	RETAINER
23	1	RING - BACKUP - 4 3/4 D.

Figure 6-31.

8. If piston is worn, it must be removed and replaced with a new part. Remove set screw and nut.

CAUTION **AFTER REMOVEL OF NUT (ITEM 17), CHECK FOR THREAD DAMAGE. IF THERE IS DAMAGE TO SHAFT OR NUT, REPLACE WITH NEW PARTS.**

9. Remove piston from shaft, remove O-ring. Replace O-ring at this time.

10. Replace all O-rings and packing with new parts as identified in Parts Manual parts list, and reassemble cylinder in reverse order of disassembly procedure, torquing the capscrews to 10 ft. lbs.

    NOTE: Torque nut (Item 17) to 400-600 ft. lbs. using Loctite 249.

11. Reinstall cylinder on machine. Refer to Parts Manual for routing of hydraulic lines. Observe during operation to verify that cylinder does not leak.

C. Installation Elevating Cylinder

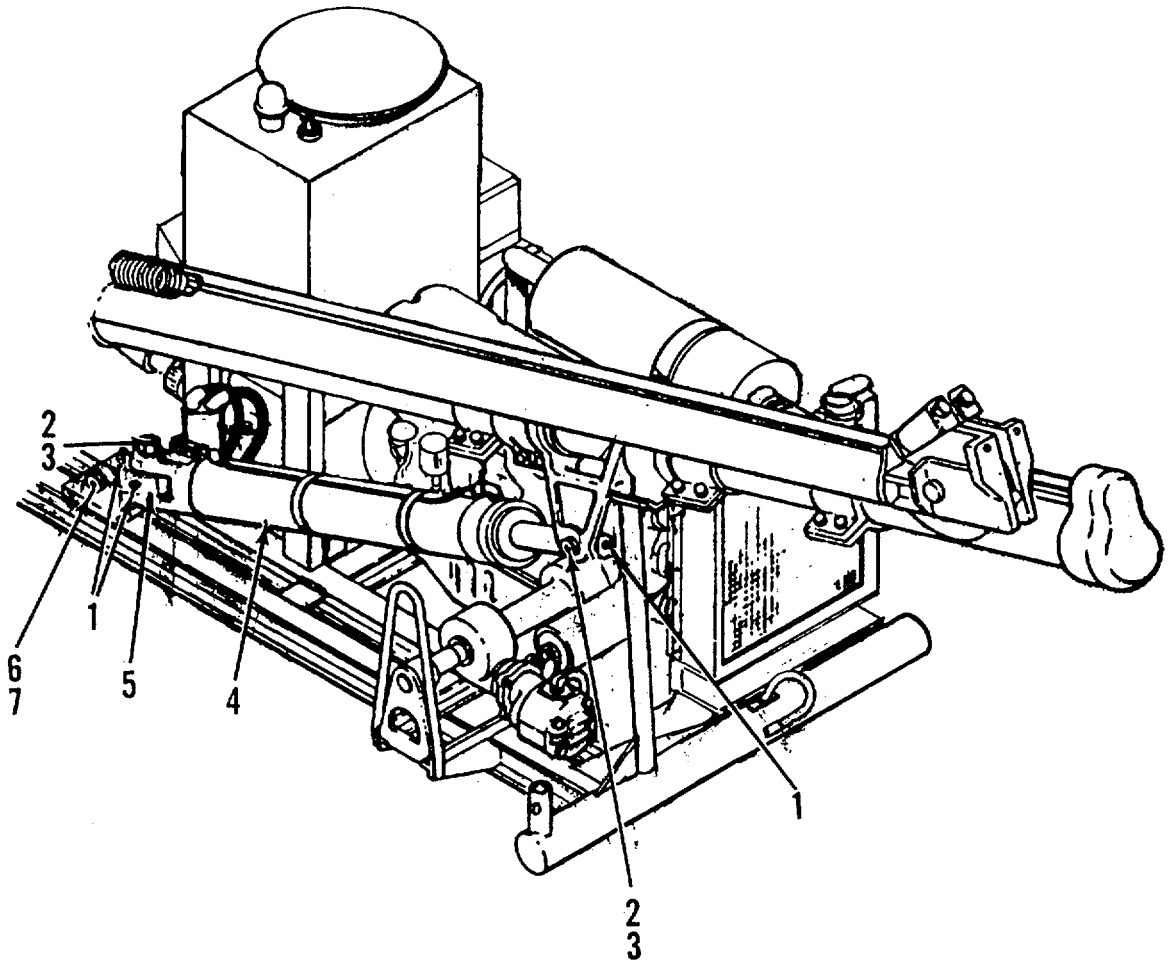
WARNING **FEED RAM, POLESETTER ASSEMBLY MUST BE BRACED BEFORE REMOVAL OF CYLINDER. SUPPORT FEED RAM AND POLESETTER.**

1. Inspect the elevating cylinder for any cracks or leaks. Replace damaged cylinder.

2. Connect (Figure 6-24, Items 6 & 7) capscrew, elastic stop nut to mounting on frame of machine. Connect (Items 3 and 5) capscrew and elastic stop nut to side of frame. Connect (Items 4 and 5) capscrew and elastic stop nut to feed ram polesetter assembly.

3. Connect hydraulic lines.

4. The removal is reverse of installation.



ITEM	QTY	DESCRIPTION
1	3	FITTING - GREASE - 1/8 NPT
2	2	CAPSCREW - HES HD - 1-8 UNC X 6 GRD 8
3	2	NUT - ELASTIC STOP - 1-8 UNC
4	1	ELEVATING CYLINDER ASSEMBLY
5	1	BLOCK- PIVOT
6	1	CAPSCREW - HEX HD - 1 1/4 - 7 UNC X 8 GRD 8
7	1	NUT - ELASTIC STOP - 1 1/4 - 7 UNC

Figure 6-32. ELEVATING CYLINDER INSTALLATION

6-12 DRY TYPE AIR CLEANER INSTRUCTIONS

A. Inspection

1. Check to see that all connections are tight and leak-free; and that break away joints, both intake and exhaust, are aligned and sealing.

2. Make sure the vacuator valve is not damaged or plugged. Is the cup joint sealing? This should take care of most air cleaner related performance problems.

B. Removal and Installation

CAUTION **ALWAYS COVER THE ENGINE INTAKE PIPE WHILE THE AIR CLEANER IS BEING SERVICED.**

1. When restriction readings finally indicate a change, remove the primary element carefully. Use a damp cloth to wipe out all excess dust in the air cleaner.

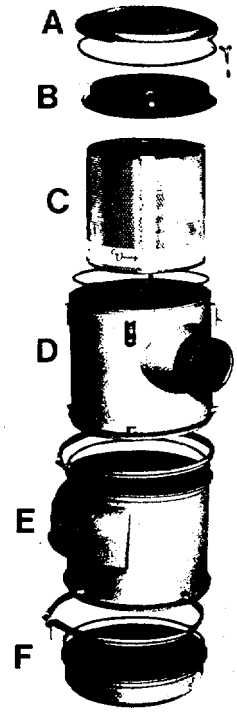
2. If you reuse primary elements, clean them with care.

CAUTION **RAPPING, TAPPING, OR POUNDING DUST OUT OF ELEMENT WILL CAUSE SEVERE DAMAGE TO ELEMENT.**

3. Thorough cleaning with air or water is recommended in many cases. But be careful, too much pressure can break the filter paper and destroy the element. Do not apply air or water closer than 2 inches and do not use more than 30 pounds of air pressure. Do not damage gasket surface or bend primary element. Cleaning can only be done a few times, as the element will finally clog and restrict air flow; the element must then be replaced.

CAUTION **NEVER ATTEMPT TO CLEAN A SECONDARY ELEMENT. CHANGE SECONDARY ELEMENTS AFTER THREE (3) PRIMARY ELEMENTS CHANGES.**

4. Carefully check new or properly cleaned elements for damage before installing. Then make it a habit not to disturb the element until restriction again reaches the service limit.



The Donaldson SBG Series air cleaner is either a four- or six-piece unit, depending upon size. A larger model is shown on left. The air cleaner is designed for fast, easy disassembly so that it may be serviced efficiently and quickly.

A. Outer Cover

Easily removable for service to element. Contains cover gasket.

B. Inner Cover

Is lightweight, durable secondary cover for safety.

C. Duralife Filter Element

D. Upper Body Assembly

Contains Duralife filter and gasket and inner cover gasket.

E. Lower Body Assembly

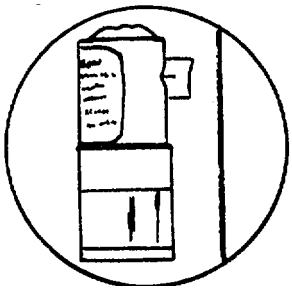
Contains Donaclone tubes which perform the initial separation of nearly all of the dust entering system. Tubular or shrouded inlets are optional.

F. Dust Cup

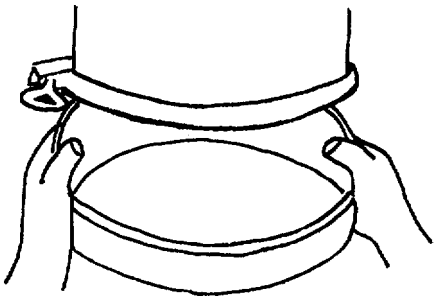
Reservoir for dust separated from the air stream by Donaclone tubes. In place of the standard cup, a Quick- Release dust cup can be supplied for faster servicing (see "E" SRG illustration).

SERVICE PROCEDURE

Maximium engine protection against the ravages of dust is possible ONLY if the air cleaner is serviced at regular intervals. Over-servicing does not utilize the air cleaner features to the fullest. The procedure is simple - just follow these easy steps as shown.



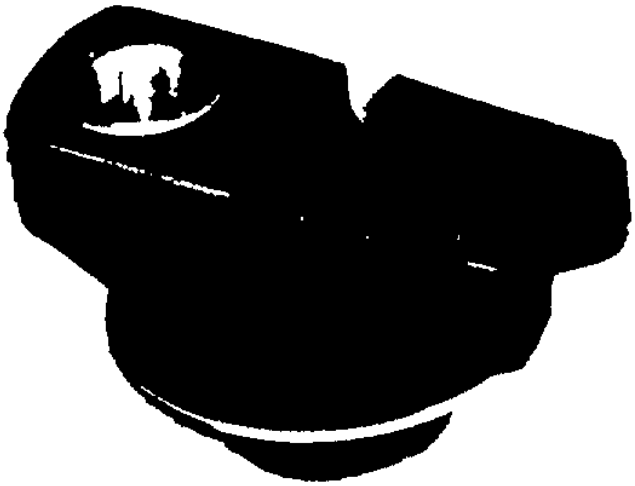
1. Measure the restriction of the air cleaner with a Donaldson restriction indicator, service gauge, or a water manometer at the restriction tap provided in the air cleaner, the transfer pipe, or the blower intake. Replace or clean the element only when the restriction has reached the maximum allowed by the engine or equipment manufacturer.



2. Dust cups should be dumped when 2/3 full. Frequency of dust cup service will vary with dust conditions. Reinstall the dust cup, making sure it seals 360° around the air cleaner body. On Vacuator Valve equipped models, dust cup service is cut to a minimum; a quick check to see that the Vacuator Valve is not inverted, damaged, or plugged is all that is necessary.

3. Inspect and tighten all air cleaner induction system connections.

4. Inspect all gaskets. Replace if worn or damaged. Annual replacement of all gaskets is recommended.



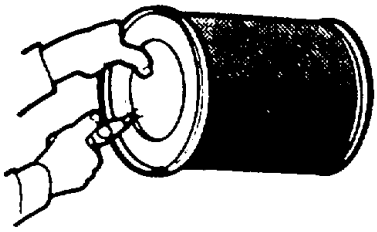
SAFETY ELEMENT SERVICE

The safety element is not intended to be cleaned. For maximum engine protection and air cleaner service life, replace the safety element with a new safety element every third primary element change or cleaning or as indicated by the Donaldson Safety Signal Service Indicator.

ELEMENT CLEANING METHODS

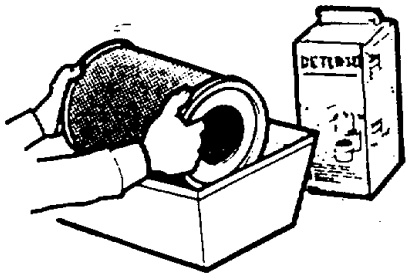
Clean Duralife element by one of the following methods:

- Compressed air or washing.
- Compressed air is recommended when element will be re-used immediately because a washed element must be dried before re-use. However, washing does a better job and-must be used when exhaust soot has lodged in fine pores of the filter media. Use Donaldson D-1400 detergent which contains a special additive for removing soot and carbon.
- Replace element after six (6) cleanings or annually, whichever occurs first.
- Do not remove plastic fin assembly back-flowing with compressed air or washing will remove dust from beneath the fin assembly.
- Request Form P45-7188 "How to Service Duralife and Duralife II Elements" for additional information.



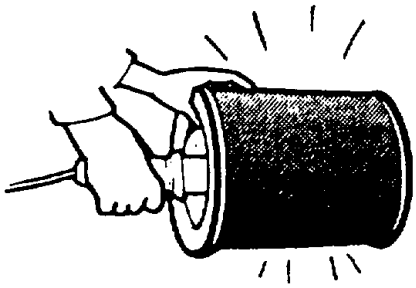
Compressed Air

Direct air through element in the direction opposite to normal air flow through the element. Move nozzle up and down while rotating element. Keep nozzle at least one inch from pleated paper. Maximum air pressure to prevent damage of element is 100 P.S.I.



Washing

1. Soak element 15 minutes or more in Donaldson D-1400 and water solution. See carton for full instructions.
2. Rinse until water is clear (Maximum water pressure 40 P.S.I.)
3. Air-dry or use warm flowing air, maximum 160°F. Do not use compressed air or light bulbs.



Inspection

Place bright light inside element and rotate element slowly. If any rupture, holes or damaged gaskets are discovered - replace.

GENERAL SERVICE TIPS

The air cleaner should be inspected periodically to maintain maximum engine protection and maximum service life. These inspections should include the following points:

1. Inspect the air transfer duct between the air cleaner and the engine to be sure all clamps are tight, all flange joints are tight, and there are no cracks in the ducting.
2. Air cleaner mounting bolts and clamps must be tight to hold the air cleaner securely.
3. Check the dust cup to make sure it is sealing 360° around the air cleaner body.
4. Vacuator valve must be in place, not inverted or damaged, and free from obstruction.
5. Check for dents and damage to the air cleaner which could mean a leak.
6. Make sure all inlet accessories are free from obstructions and securely mounted.
7. Check pre-cleaner fins for plugging.

6-13. AUGER, BITS, AND POINT INSTALLATION AND REMOVAL

A. Inspection

Check auger bits and points for excessive wear or defects. Replace as necessary.

B. Removal and Installation

Installation instructions are given in Pages 10 & 11. Removal is accomplished by reversing the installation instructions.

CHAPTER VII

DESCRIPTION

PRINCIPLES OF OPERATION

The diesel engine Is an internal combustion power unit, in which the heat of fuel is converted into work in the cylinder of the engine.

In the diesel engine, air alone is compressed in the cylinder; then, after the air has been compressed, a charge of fuel is sprayed into the cylinder and Ignition is accomplished by the heat of compression.

The Two-Cycle Principle

In the two-cycle engine, intake and exhaust take place during part of the compression and power strokes respectively, as shown in Fig. 1. In contrast, a four-cycle engine requires four piston strokes to complete an operating cycle; thus, during one half of its operation, the four-cycle engine functions merely as an air pump.

A blower is provided to force air into the cylinders for expelling the exhaust gases and to supply the cylinders with fresh air for combustion. The cylinder wall contains a row of ports which are above the piston when it is at the bottom of its stroke. These ports admit the air from the blower into the cylinder as soon as the rim of the piston uncovers the ports as shown in Fig. I (scavenging).

The unidirectional flow of air toward the exhaust valves produces a scavenging effect, leaving the cylinders full of clean air when the piston again covers the inlet ports.

As the piston continues on the upward stroke. the exhaust valves close and the charge of fresh air is subjected to compression as shown in Fig. 1 (compression).

Shortly before the piston reaches its highest position, the required amount of fuel is sprayed Into the combustion chamber by the unit fuel Injector as shown in Fig. I (power). The intense heat generated during the high compression of the air ignites the fine fuel spray immediately. The combustion continues until the injected fuel has been burned.

The resulting pressure forces the piston downward on its power stroke. The exhaust valves are again opened when the piston is about halfway down, allowing the burned gases to escape into the exhaust manifold as shown in Fig. I (exhaust). Shortly thereafter, the downward moving piston uncovers the inlet ports and the cylinder is again swept with clean scavenging air. This entire combustion cycle is completed in each cylinder for each revolution of the crankshaft, or, In other words, in two strokes; hence, it is a "two-stroke cycle ".

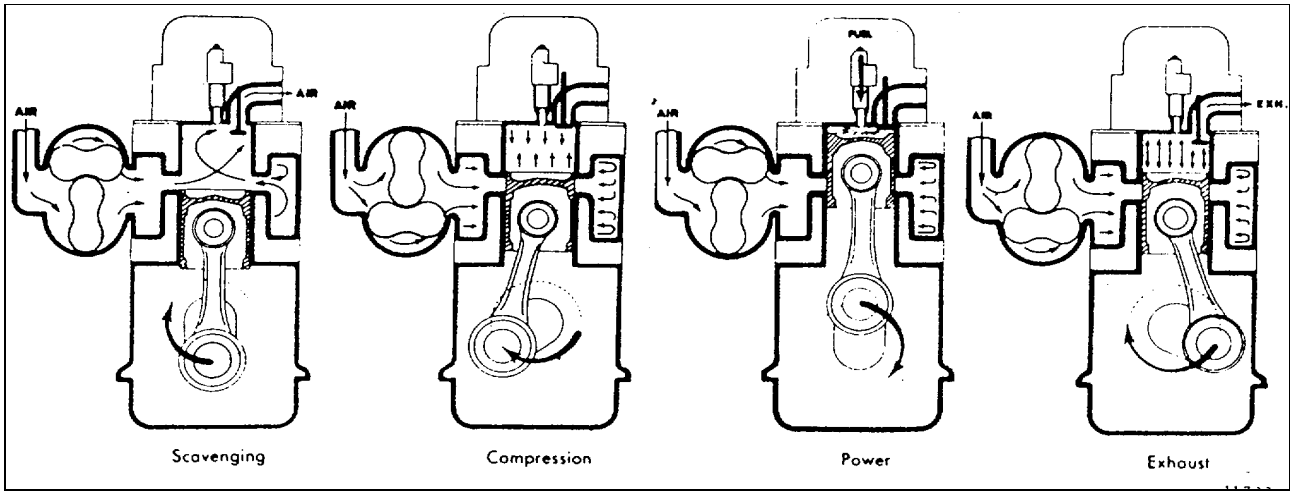


Figure 7-1 The Two-Stroke Cycle

GENERAL DESCRIPTION

The two-cycle diesel engines covered in this manual have the same bore and stroke and many of the major working parts such as injectors, pistons, connecting rods, cylinder liners and other parts are interchangeable.

The In-line engines, including the inclined marine models, include standard accessories such as the blower, water pump, governor and fuel pump, which, on some models, may be located on either side of the engine regardless of the direction the crankshaft rotates. Further flexibility in meeting installation requirements is achieved with the cylinder head which can be installed to accommodate the exhaust manifold on either side of the engine.

The meaning of each digit in the model numbering system is shown in Figs. 2 and 3.

The letter L or R indicates left or right-hand engine rotation as viewed from the front of the engine. The letter A, B, C or D designates the blower and exhaust manifold location on the In-line engines as viewed from the rear of the engine.

Each engine is equipped with an oil cooler, replaceable element type lubricating oil filter, fuel oil strainer, fuel oil filter, an air cleaner or air silencer, a governor, a heat exchanger and raw water pump or a fan and radiator, and a starting motor.

Full pressure lubrication is supplied to all main bearings, connecting rod bearings, and camshaft bearings, and to other moving parts.

Oil is drawn by suction from the oil pan through the intake screen and pipe to the oil pump where it is pressurized and delivered to the oil filter and the oil cooler. From the oil cooler, the oil enters oil galleries in the cylinder block and cylinder head for distribution to the main bearings, connecting rod bearings, camshaft bearings, rocker arm mechanism and other functional parts.

The cooling system has a centrifugal water pump which circulates the engine coolant through the oil cooler and water jackets. The engine temperature is regulated by a thermostat(s).

Fuel is drawn from the supply tank through the fuel strainer and enters a gear type fuel pump at the inlet side. Upon leaving the pump under pressure, the fuel is forced through the fuel filter into the inlet manifold where it passes through fuel pipes into the inlet side of the fuel injectors. The fuel is filtered through elements in the injectors and then atomized through small spray tip orifices into the combustion chamber. Excess fuel is returned to the fuel tank through the fuel outlet galleries and connecting lines.

Air for scavenging and combustion is supplied by a blower which pumps air into the engine cylinders via the air box and cylinder liner ports. All air entering the blower first passes through an air cleaner or air silencer.

The engine may be started by an electric starting system.

The engine speed is regulated by a mechanical type engine governor, depending upon the engine application.

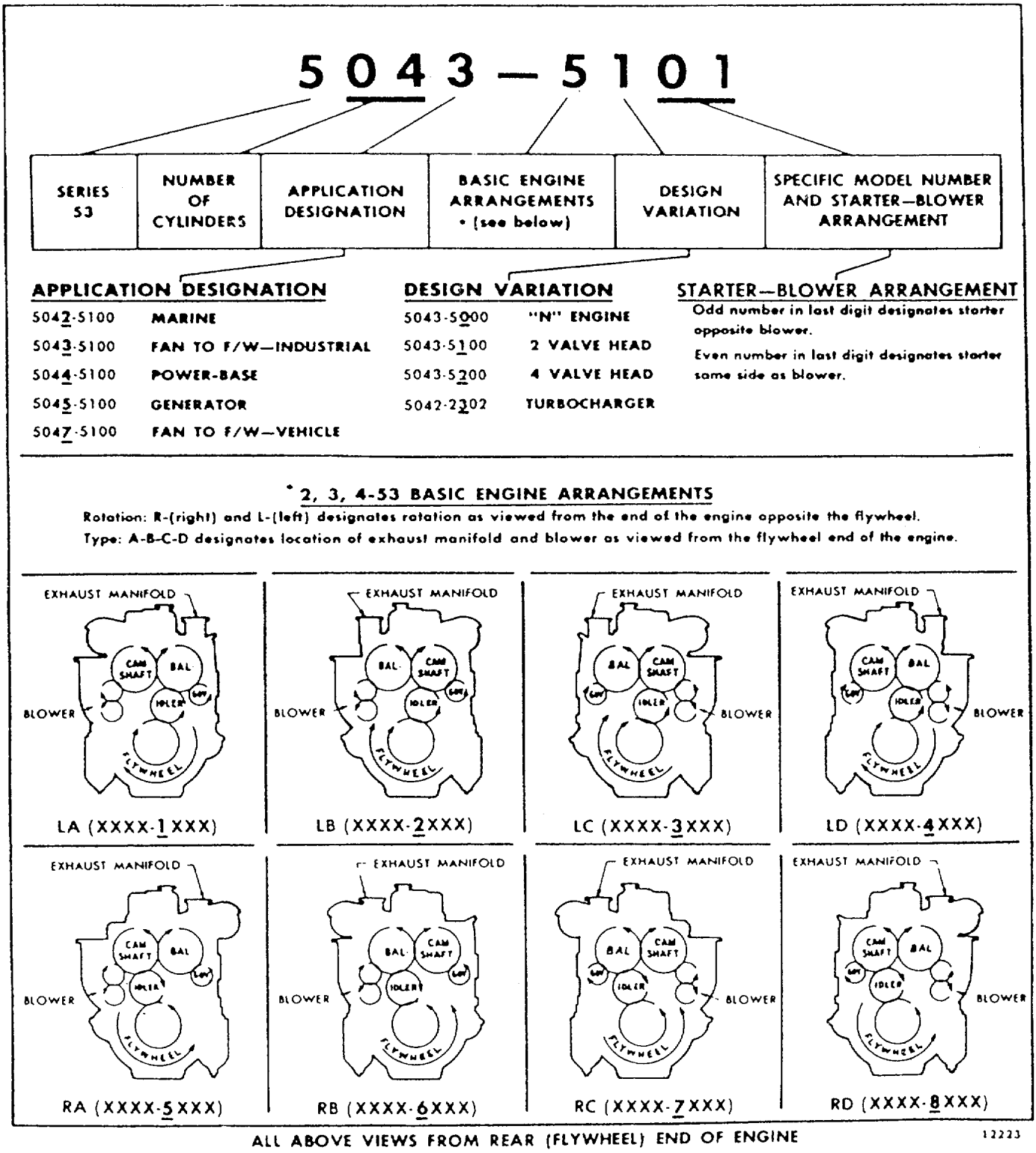


Figure 7-2. In-Line Engine Model Description, Rotation and Accessory Arrangement

GENERAL SPECIFICATIONS

Type	2 Cycle
Number of Cycle	3
Bore (inches)	3.875
Bore (mm)	98
Stroke (inches)	4.5
Stroke (mm)	114
Compression Ratio (nominal)(standard engines)	17 to 1
Compression Ratio (nominal)("N" engines)	21 to 1
Total Displacement - cubic inches	159
Total Displacement - liters	2.61
Number 6f main bearings	4

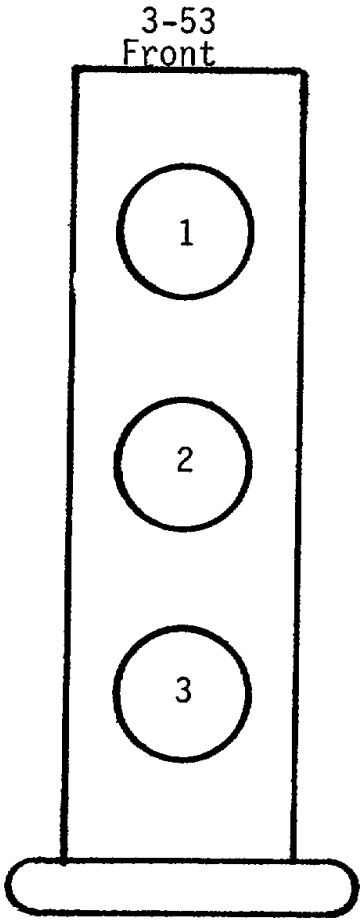


Figure 7-3. Series 53 Cylinder Arrangement

ENGINE MODEL AND SERIAL NUMBER DESIGNATION

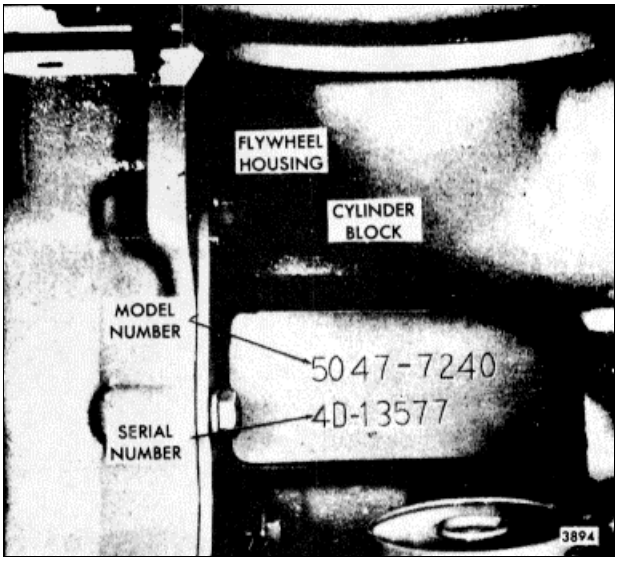


Figure 7-4. Typical Model and Serial Numbers as Stamped on Cylinder Block (In-Line Engine)

On the In-line engines, the model number and serial number are stamped on the right-hand side of the cylinder block in the upper rear corner (Fig. 5).

An option plate, attached to the valve rocker cover, is also stamped with the engine serial number and model number and, in addition, lists any optional equipment used on the engine (Fig. 7).

With any order for parts, the engine model number and serial number must be given. in addition, if a type number is shown on the option plate covering the equipment required, this number should also be included on the parts order.

Power take-off assemblies, torque converters, hydraulic marine gears, etc. May also carry nameplates pertaining to the particular assembly to which they are attached. The information on these nameplates is useful when ordering parts for these assemblies.

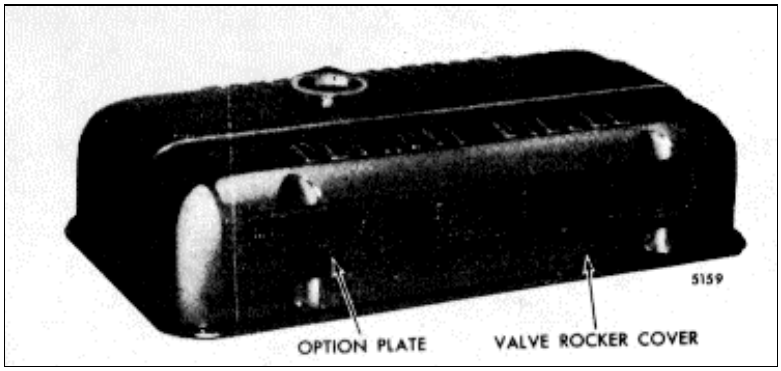


Figure 7-5 - Option Plate

SECTION I ENGINE

1.1000 CYLINDER BLOCK

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY
		1.1001 BLOCK ASSEMBLY CYLINDER	
1A	5196490	BLOCK ASSEMBLY 3-53	1
1A	5145009	PLUG 1/8" (12.9550)	6
1A	443762	EXTENSION TUBE (12.9540)	1
		1.1002 GASKET KIT ENGINE OVERHAUL	
	5199791	GASKET KIT 3-53 NOT SHOWN	AR
		1.1020 PLATE CYLINDER BLOCK END-REAR	
1A	5121365	PLATE ASSEMBLY	1
1A	5121459	PLUG 3/8 - 24 NUT	8
1A,B	9409079	BOLT 3/8"-16 X 7/8" (12.9001)	13
1A,B	103321	LOCKWASHER 3/8" (12.9200)	AR
		1.1030 GASKET, CYLINDER BLOCK END PLATE	
1A	5116354	GASKET	1
		1.1040 COVER, CYLINDER BLOCK HAND HOLE COVER	
1C	5116373	COVER 3-53 (ITEM 5)	1
	180120	BOLT 3/8"-16 X 3/4 (12.9001)	6
	103321	LOCKWASHER 3/8 (12.9200)	6
		1.1050 GASKET, CYLINDER BLOCK HAND HOLE COVER	
1C	5116380	GASKET 3-53 (ITEM 5)	1
		1.1060 COVER, CYLINDER BLOCK WATER HOLE	
1A,B	5164190	COVER (1/4 TAPPED HOLE)	1
1A,B	5115097	COVER (3/8 TAPPED HOLE)	1
1A,B	5189143	COVER (1/2 TAPPED HOLE)	1
1A,B	5150023	COVER (PLAIN)	1
1A	114981	DRAIN COCK 1/8 (12.9510)	1
1A,B	186618	BOLT 5/16"-18 X 5/8" (12.9001)	2
1A,B	186625	BOLT 5/16"-18 X 7/8" (12.9001)	2
1A,B	103320	LOCKWASHER 5/16" (12.9200)	2
1A,B	5116357	GASKET	1

1.1000A AIR BOX DRAINS

		1.1100 TUBE, AIR BOX DRAIN	
10B	5132286	TUBE, DEV. L. 12.00"	1
	225810	ELBOW 1/4" INV. FL. TUBE 90° (12.9480)(NOT SHOWN).	1
	137397	NUT 1/4" INV. FL. TUBE (12.9500) (NOT SHOWN))	1

SECTION I ENGINE

1.2000 CYLINDER HEAD

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY
		1.2001 HEAD ASSEMBLY CYLINDER	
2A	5198203	HEAD ASSEMBLY (4 VALVE) 3,6V53	1
	5144425	ADAPTER, FUSE PLUG (NOT SHOWN)	1
	5198655	PLUG, FUSE PLUG (NOT SHOWN)	1
2A	5145009	PLUG 1/8" PIPE (12.9550)	2
2A	5121182	PLUG 1/4" HEX SKT. PIPE (2.4015) (NOT SHOWN)	6
2A	5154453	PLUG 3/8"-16 SL. HDLS. (NOT SHOWN)	
2A	5151449	PLUG 13/16" CUP (1.1001)	3
	5139997	PLUG 7/8" DIA. CUP (STAINLESS) (NOT SHOWN)	3
		1.2002 GASKET KIT, CYLINDER HEAD OVERHAUL	
	5199811	GASKET KIT (NOT SHOWN)	AR
		1.2005 NOZZLE, CYLINDER HEAD WATER	
	5119293	NOZZLE	4
		1.2010 GASKET, CYLINDER HEAD COMPRESSION	
1B,C	5121254	GASKET	3
		1.2022 GASKET, CYLINDER HEAD WATER & OIL	
1A	5116290	RING, SEAL (END WATER HOLE)	4
1A,C	5121207	RING, SEAL (CENTER WATER HOLE)	4
1B.C	5116122	RING, SEAL (OIL HOLE) (NOT SHOWN))	2
1A,C	5116292	RING, SEAL	1
		1.2030 BOLT, CYLINDER HEAD	
2A	5121263	BOLT 5/8"-11 X 6 1/4" (12 PT.HD.)	8
		1.2043 COVER, CYLINDER HEAD WATER HOLE	
2A	5136610	COVER (PLAIN).(USE 3/8"-16 X 1" BOLT)	1
10C	5123168	COVER 1/8" PIPE TAP, CENTERED	1
10C	5127837	COVER 1/8" PIPE TAP, OFF CENTER (NOT SHOWN))	1
10C	5139226	COVER 1/8" X 3/8" PIPE TAP (1.1060) (NOT SHOWN)	1
	5129019	COVER 1/4" PIPE TAP (NOT SHOWN)	1
10C	5123352	COVER 3/8" PIPE TAP (NOT SHOWN)	1
10C	5109707	COVER 1/4" AND 1/2" PIPE TAPS (NOT SHOWN)	1
10C	5145009	PLUG 1/8" PIPE SQ.HD. (12.9550)	1
10C	5121182	PLUG 1/4" PIPE (2.4015) (NOT SHOWN))	2
10C	5145014	PLUG 3/8" PIPE SQ.HD. (12.9550) (NOT SHOWN)	1
10C	5115214	PLUG 1/2" PIPE SQ.HD. (12.9550) (NOT SHOWN))	1
	179839	BOLT 3/8"-16 X 1" (12.9001)	
2A	103321	LOCKWASHER, 3/8" (12.9200)	2
		1.2044 GASKET, CYLINDER HEAD WATER HOLE COVER	
2A	5116242	GASKET	1
		1.2045 TUBE, INJECTOR HOLE	
2A	8925981	TUBE KIT (INCLUDES SEAL RING IN 1.2046) (2.1290)	A/R

Fuel Injector

The fuel injector combines in a single unit all of the parts necessary to provide complete and independent fuel injection at each cylinder. The injector creates the high pressure necessary for fuel injection, meters the proper amount of fuel, atomizes the fuel and times the injection into the combustion chamber.

Since the injector is one of the most important and carefully constructed parts of the engine, it is recommended that the engine operator replace the injector as an assembly if it is not operating properly. Authorized Detroit Diesel Allison Service Outlets are properly equipped to service injectors.

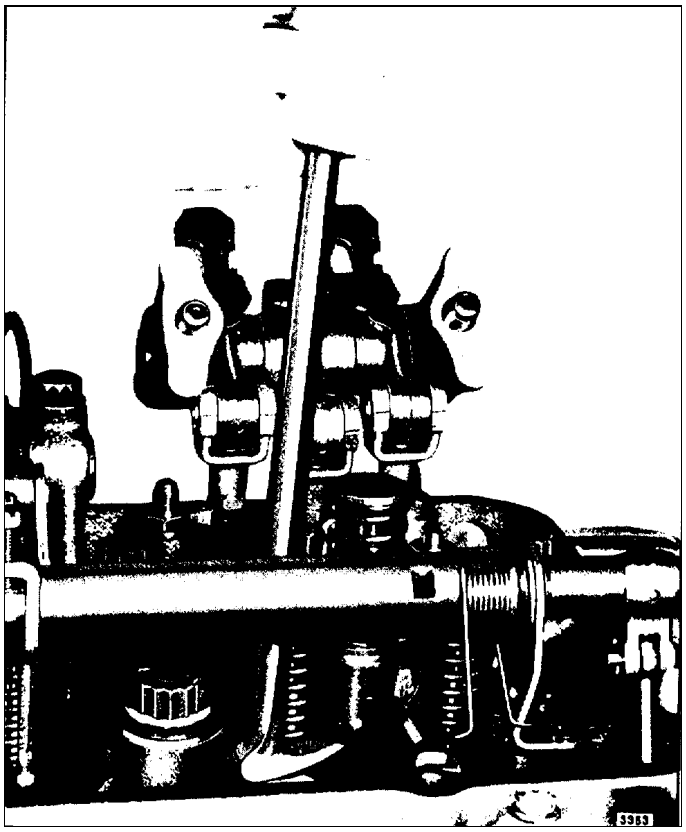


Figure 7-8. Removing Injector from Cylinder Head

Remove Injector

An injector may be removed in the following manner:

1. Clean and remove the valve rocker cover.
2. Disconnect the fuel pipes from both the injector and the fuel connectors.
3. Immediately after removing the fuel pipes, cover the injector inlet and outlet fittings with shipping caps to prevent dirt from entering.

4. Turn the Crankshaft manually in the direction of engine rotation or crank the engine with the starting motor, if necessary, until the rocker arms for the particular cylinder are aligned in a horizontal plane.

NOTE

If a wrench is used on the crankshaft bolt at the front of the engine, do not turn the crankshaft in a left-hand direction of rotation as the bolt will be loosened. Remove the starting motor and use a pry bar against the teeth of the flywheel ring gear to turn the crankshaft.

5. Remove the two rocker shaft bracket bolts and swing the rocker arm assembly away from the injector and valves.

6. Remove the injector clamp bolt, washer and clamp'.

7. Loosen the inner and outer adjusting screws on the injector rack control lever and slide the lever away from the injector.

8. Free the injector from its seat as shown in Fig. 3 and lift it from the cylinder head.

9. Cover the injector hole in the cylinder head to keep foreign particles out of the cylinder.

Install Injector

Before installing an injector, be sure the beveled seat of the injector tube is free from dirt particles and carbon deposits.

A new or reconditioned injector may be installed by reversing the sequence of operations given above for removal.

Be sure the injector is filled with fuel oil. If necessary, add clean fuel oil at the inlet filter until it runs out the outlet filter.

NOTE

On four valve cylinder heads, there is a possibility of damaging the exhaust valves if the exhaust valve bridge is not resting on the ends of the exhaust valves when tightening the rocker shaft bracket bolts. Therefore, note the position of the exhaust valve bridge before, during and after tightening the rocker shaft bracket bolts.

Do not tighten the injector clamp bolt to more than 20-25 lb-ft (27-34 Nm) torque, as this may cause the moving parts of the injector to bind. Tighten the rocker shaft bolts to 50-55 lb-ft (68-75 Nm) torque.

Align the fuel pipes and connect them to the injector and the fuel connectors. Use socket J 8932-01 and a torque wrench to tighten the fuel pipe nuts to 12-15 lb-ft (16-20 Nm) torque.

NOTE

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

Time the injector, position the injector rack control lever and adjust the exhaust valve clearance (cold setting) as outlined in the engine tune-up procedure. If all of the injectors have been replaced, perform a complete tune-up on the engine.

Fuel Pump

A positive displacement gear-type fuel pump is attached to the governor or blower on the In-line engines.

A spring-loaded relief valve, incorporated in the pump body, normally remains in the closed position, operating only when the pressure on the outlet side (to the fuel filter) becomes excessive due to a plugged filter or fuel line.

The fuel pump incorporates two oil seals. Two tapped holes are provided in the underside of the pump body, between the oil seals, to permit a drain tube to be attached. If fuel leakage exceeds one drop per minute, the seals must be replaced.

An authorized Detroit Diesel Allison Service Outlet is properly equipped to replace the seals.

Fuel pumps are furnished in either left or right-hand rotation, according to the engine model, and are stamped RH or LH. These pumps are not interchangeable and cannot be rebuilt to operate in an opposite rotation.

Fuel Strainer and Fuel Filter

A replaceable-element type fuel strainer and fuel filter (Fig. 4) are used in the fuel system to remove impurities from the fuel. The strainer removes the larger particles and the filter removes the small foreign particles.

The fuel strainer and fuel filter are basically identical in construction, both consisting of a cover, shell and replaceable element. Since the fuel strainer is placed between the fuel supply tank and the fuel pump, it functions under suction; the fuel filter, which is installed between the fuel pump and the fuel inlet manifold in the cylinder head, operates under pressure.

Replace the elements as follows:

1. With the engine shutdown, place a suitable container under the fuel strainer or filter and open the drain cock. The fuel will drain more freely if the cover nut is loosened slightly.

2. Support the shell, unscrew the cover nut and remove the shell and element.

3. Remove and discard the element and gasket. Clean the shell with fuel oil and dry it with a cloth or compressed air.

4. Place a new element, which has been thoroughly soaked in clean fuel oil, over the stud and push it down on the seat. Close the drain cock and fill the shell approximately two-thirds full with clean fuel oil.

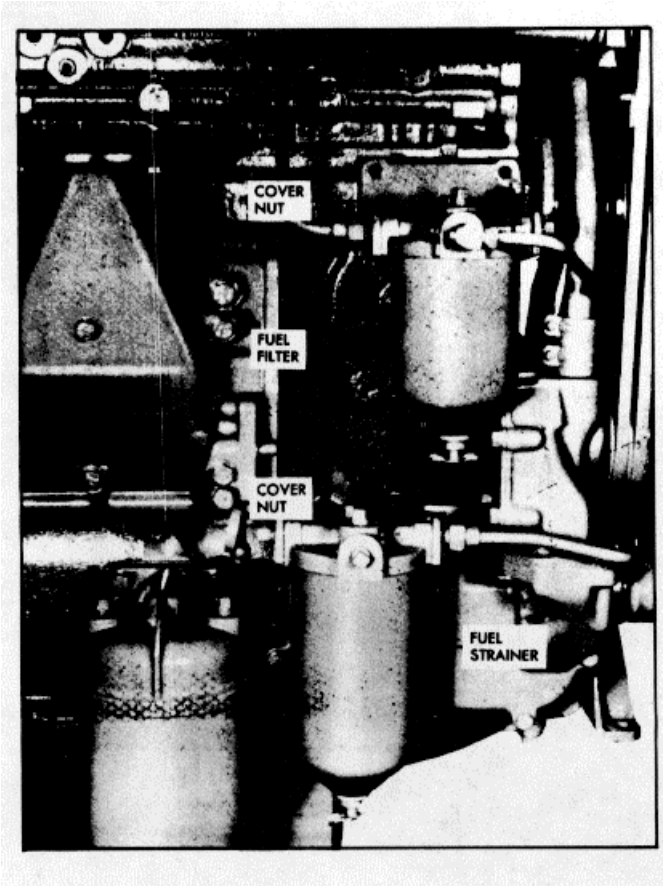


Figure 7-9 - Typical Fuel Strainer and Filter Mounting

5. Affix a new shell gasket, place the shell and element into position under the cover and start the cover nut on the shell stud.

6. Tighten the cover nut only enough to prevent fuel leakage,

7. Remove the plug in the strainer or filter cover and fill the shell with fuel. Fuel system primer J 5956 may be used to prime the fuel system.

8. Start and operate the engine and check the fuel system for leaks.

Fuel Tank

Refill the fuel tank at the end of each day's operation to prevent condensation from contaminating the fuel.

NOTE

A galvanized steel tank should never be used for fuel storage because the fuel oil reacts chemically with the zinc coating to form powdery flakes which quickly clog the fuel strainer and filter and damage the fuel pump and the fuel injectors.

Engine Out of Fuel

The problem in restarting the engine after it has run out of fuel stems from the fact that after the fuel is exhausted from the fuel tank, fuel is them pumped from the primary fuel strainer and sometimes partially removed from the secondary fuel filter before the fuel supply becomes insufficient to sustain engine firing. Consequently, these components must be refilled with fuel and the fuel pipes rid of air in order for the system to provide adequate fuel for the injectors.

When an engine has run out of fuel, there is a definite procedure to follow for restarting the engine.

1. Fill the fuel tank with the recommended grade of fuel oil. If only partial filling of the tank is possible, add a minimum of ten gallons (38 litres) of fuel.

2. Remove the fuel strainer shell and element from the strainer cover and fill the shell with fuel oil. Install the shell and element.

3. Remove and fill the fuel filter shell and element with fuel oil as in Step 2.

4. Start the engine. Check the filter and strainer for leaks.

NOTE

In some instances, it may be necessary to remove a valve rocker cover and loosen a fuel pipe nut in order to bleed trapped air from the fuel system. Be sure the fuel pipe is retightened securely before replacing the rocker cover.

Primer J 5956 may be used to prime the entire fuel system. Remove the filler plug in the fuel filter cover and install the primer. Prime the system. Remove the primer and install the filler plug.

AIR SYSTEM

In the scavenging system used in two-cycle engines, a charge of air is forced into the cylinders by the blower and thoroughly sweeps out all of the burned gases through the exhaust valve ports. This air also helps to cool the internal engine parts, particularly the exhaust valves. At the beginning of the compression stroke, each cylinder is filled with fresh, clean air which provides for efficient combustion.

The air, entering the blower from the air silencer or air cleaner, is picked up by the blower rotor lobes and carried to the discharge side of the blower. The continuous discharge of fresh air from the blower enters the air chamber of the cylinder block and sweeps through the intake ports of the cylinder liners.

The angle of the ports in the cylinder liner creates a uniform swirling motion to the intake air as it enters the cylinder. This motion persists throughout the compression stroke and facilitates scavenging and combustion.

Air Cleaners

Several types of air cleaners are available for use with industrial engines.

The air cleaners are designed for fast, easy disassembly to facilitate efficient servicing. Maximum protection of the engine against dust and other forms of air contamination is possible if the air cleaner is serviced at regular intervals.

The United Specialties dry-type air cleaner shown in Fig. 12 consists of a body, dust unloader and element clamped to a base.

Air is drawn through the cleaner intake pipe and is automatically set into a circular motion. This positive spinning of the dirty air "throws out" the heavier particles of dust and dirt where they are collected in the dust port and then expelled through the dust unloader. The circular action continues even during low air intake at engine idle speeds.

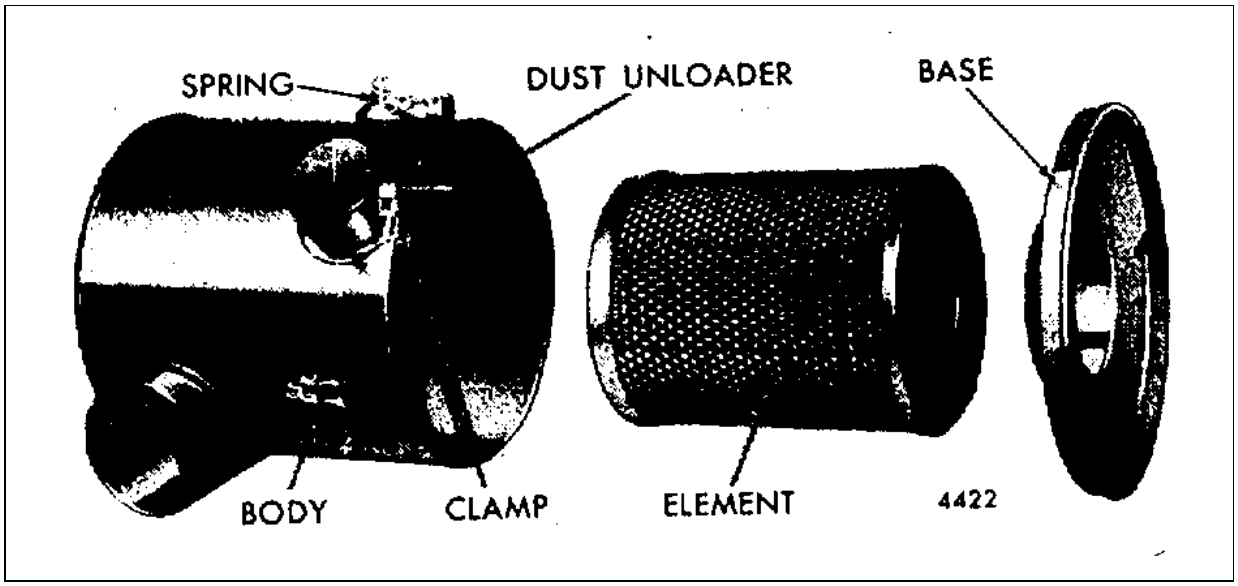


Figure 7-10 - United Specialties Dry-Type Cleaner

The United Specialties dry-type air cleaner should be serviced, as operating conditions warrant, as follows:

1. Loosen the clamp screw and check the dust unloader for obstruction or damage.

2. Unlock the spring clamps that hold the cleaner body to the cleaner base which is bolted to the air inlet housing. Remove the body and then remove the element from the cleaner base.

3. The paper pleated air cleaner element can be cleaned as follows:

    a. For a temporary expedient in the field, tap the side or end of the element carefully against the palm of your hand.

NOTE
Do not tap the element against a hard surface. This could damage the element.

b. Compressed air can be used when the major contaminant is dust. The compressed air (not to exceed 30 psi or 207 kPa) should be blown through the element in a direction opposite to the normal air flow. Insert the air nozzle inside of the element and gently tap and blow out the dust with air. When cleaning the dust from the outside of the element, hold the nozzle at least 6" from the element.

c. Wash the element if compressed air is not available, or when the contaminant is carbon, soot, oily vapor or dirt which cannot be removed with compressed air.

d. Agitate the element in warm water containing a non-sudsing detergent.

NOTE
Do not use solvents, oil, fuel oil, gasoline or water hotter than your hand can stand.

Preceding the washing, it helps to direct air (not exceeding 30 psi or 207 kPa) through the element in a direction opposite the normal air flow to dislodge as much dust as possible. Reverse flush with a stream of water (not exceeding 40 psi or 276 kPa) until the water runs clean to rinse all loosened foreign material from the element. Shake out excess water from the element and allow it to dry thoroughly.

NOTE
Do not attempt to remove excess water by using compressed air.

4. Inspect the cleaned element with a light bulb after each cleaning for damage or rupture. The slightest break in the element will admit sufficient airborne dirt to cause rapid failure of piston rings. If necessary, replace the element.

5. Inspect the gasket on the end of the element. If the gasket is damaged or missing, replace the element.

6. Install the element on the base with the gasket side of the element down against the base. Place the body over the element and base and tighten the spring clamps by hand.

7. Replace the element after 10 washings or 1 year of service, whichever comes first, or any time damage is noted.

8. Install the dust unloader and tighten the clamp.

Crankcase Ventilation

Harmful vapors which may form within the engine are removed from the crankcase, gear train and valve compartment by a continuous, pressurized ventilation system.

A slight pressure is maintained within the engine crankcase by the seepage of a small amount of air from the airbox past the piston rings. This air sweeps up through the engine and is drawn off through a crankcase breather.

In-line engines are equipped with a breather assembly which is mounted on the rocker cover or the flywheel housing.

The wire mesh pad (element) in the breather assemblies should be cleaned if excessive crankcase pressure is observed. If it is necessary to clean the element, remove the breather housing from the flywheel housing (In-line engines). Wash the element in fuel oil and dry it with compressed air. Reinstall the element and the breather assembly.

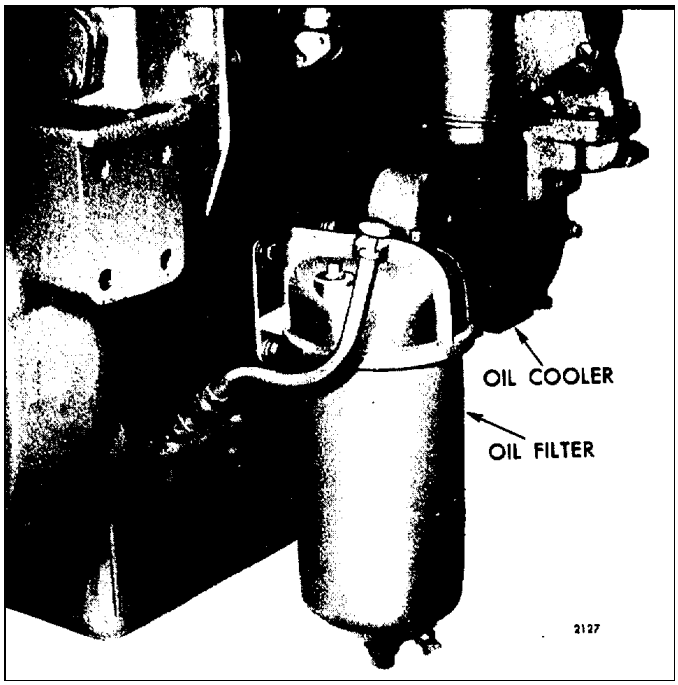


Figure 7-11. Typical In-Line Engine Oil Filter Mounting

The Series 53 engine lubricating system, illustrated in Fig. 16, includes an oil intake screen and tube assembly, an oil pump, a pressure regulator, a full-flow oil filter or bypass filter with bypass valve, and an oil cooler with a bypass valve.

Lubricating-oil from the pump passes from the lower front cover through short oil galleries in the cylinder block. From the block, the oil flows to the full-flow oil filter, then through the oil cooler (if used) and back into the front engine cover and cylinder block oil galleries for distribution to the various engine bearings. The drains from the cylinder head(s) and other engine parts lead back to the oil pan.

Oil pressure is regulated by a pressure relief valve mounted in the engine front ,cover. Oil cooler and oil filter bypass valves prevent the stoppage of oil flow if these items become plugged.

Oil Filters

Each engine is equipped with a full-flow type lubricating oil filter (Fig. 14). If additional filtering is required, a bypass-type oil filter may also be installed.

All of the oil supplied to the engine passes through the full-flow filter that removes the larger foreign particles without restricting the normal flow of oil.

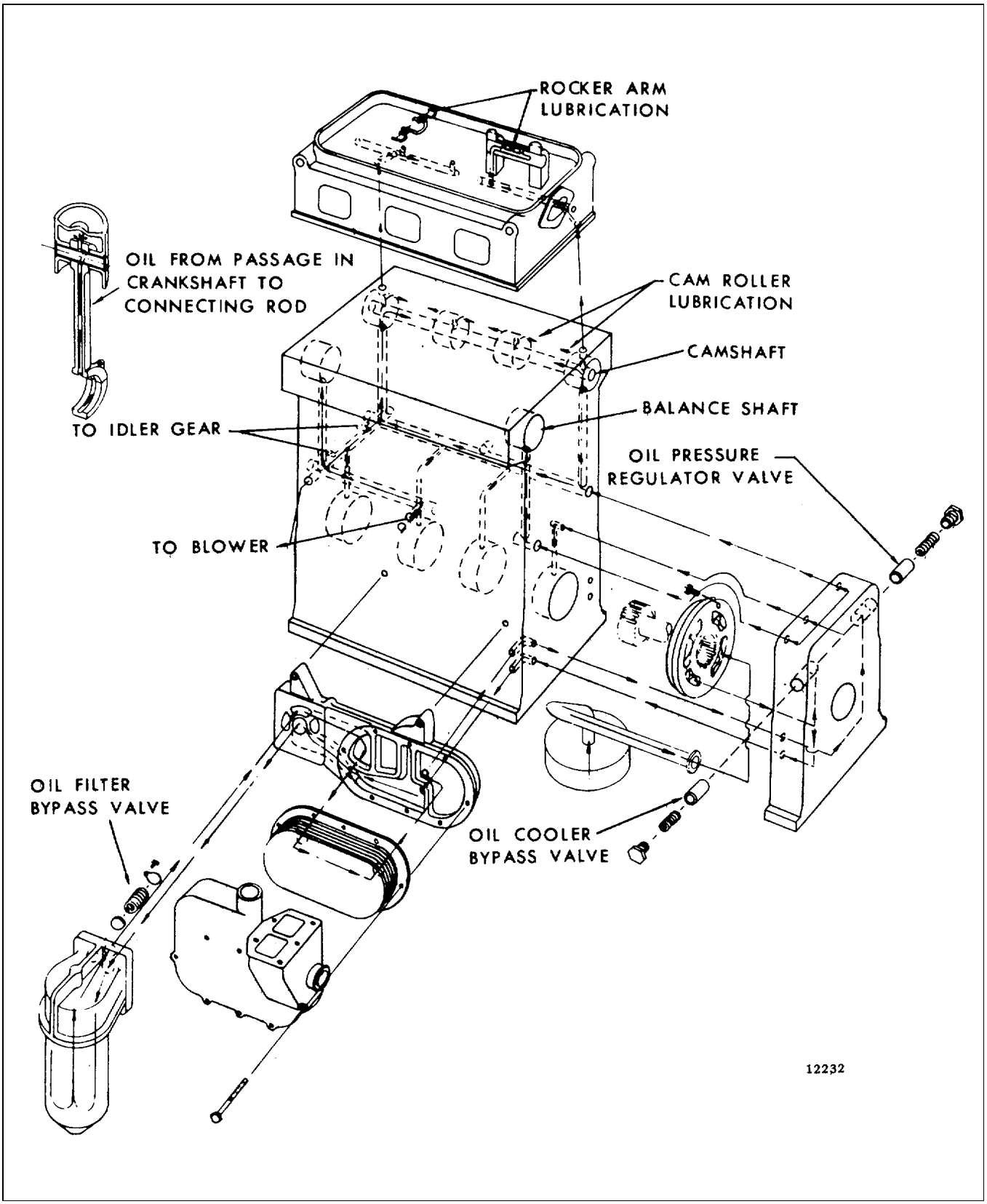


Figure 7-12. Schematic Diagram of Typical In-Line Engine Lubricating System

The bypass filter assembly, when used, continually filters a portion of the lubricating oil that is being bled off the oil gallery when the engine is running. Eventually all of the oil passes through the filter, filtering out minute foreign particles that may be present.

The lubricating oil filter elements should be replaced, each time the engine oil is changed, as follows:

1. Remove the drain plug and drain the oil.

2. The filter shell, element and stud may be detached as an assembly, after removing the center stud from the base. Discard the gasket.

3. Clean the filter base.

4. Discard the used element, wipe out the filter shell and install a new element on the center stud.

5. Place a new gasket in the filter base, position the shell and element assembly on the gasket and tighten the center stud carefully to prevent damaging the gasket or center stud.

6. Install the drain plug and, after the engine is started, check for oil leaks.

COOLING SYSTEM

The cooling system used on a Series 53 engine is a radiator and fan. A centrifugal-type water pump is used to circulate the engine coolant in each system. Each system incorporates thermostats to maintain a normal operating temperature of 160-185°F (71-85°C). Typical engine cooling systems are shown in Fig. 18.

Radiator Cooling System

The engine coolant is drawn from the bottom of the radiator core by the water pump and is forced through the oil cooler and into the cylinder block. The coolant circulates up through the cylinder block into the cylinder head, then to the water manifold and thermostat housing. From the thermostat housing, the coolant returns to the radiator where it passes down a series of tubes and is cooled by the air stream created by the fan.

When starting a cold engine or when the coolant is below operating temperature, the coolant is restricted at the thermostat housing(s) and a bypass provides water circulation within the engine during the warm-up period.

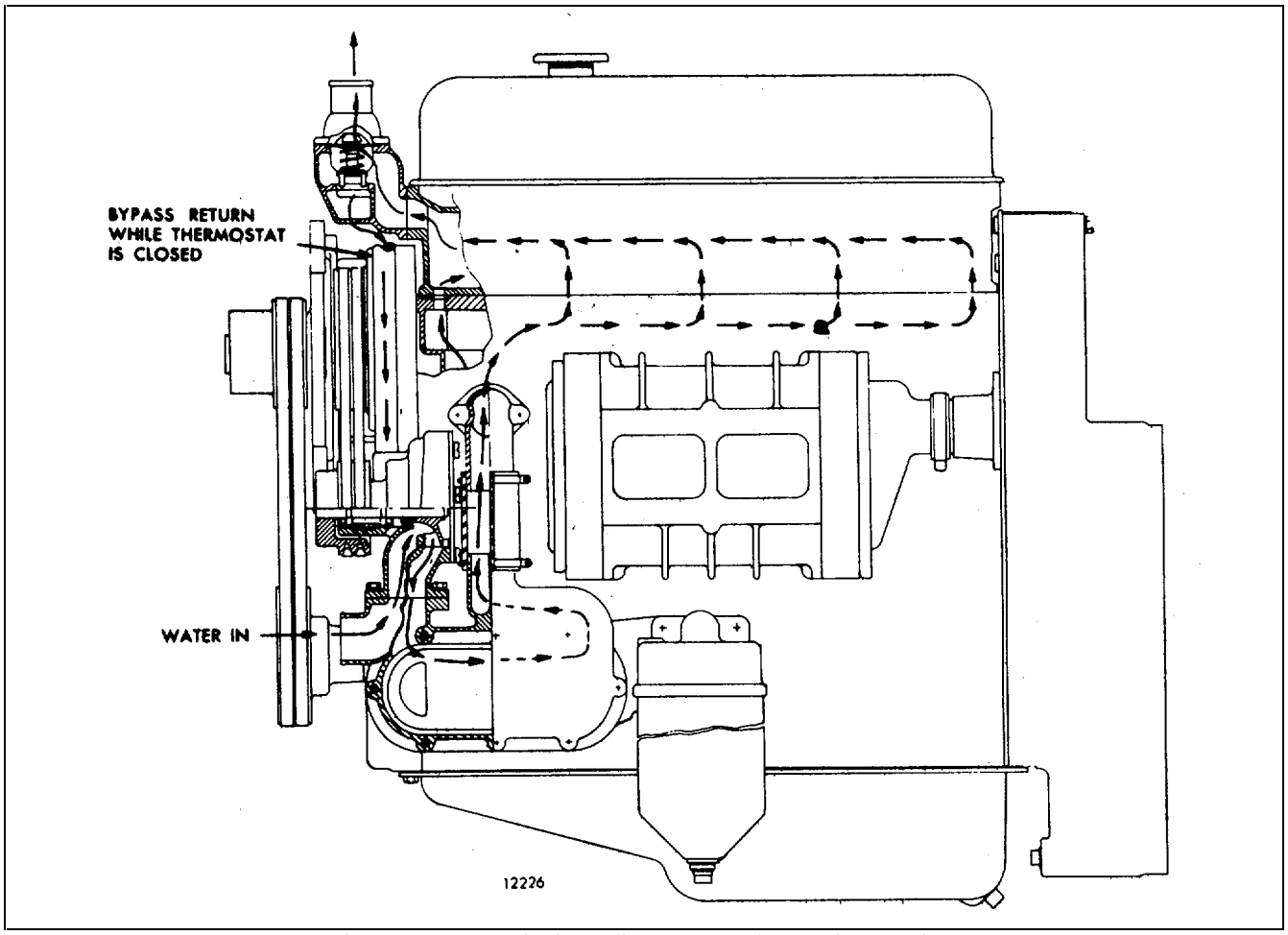


Figure 7-13. Typical Cooling System for In-Line Engines

ENGINE COOLING SYSTEM MAINTENANCE

Engine Coolant

The function of the engine coolant is to absorb the heat, developed as a result of the combustion process in the cylinders, from the component parts such as exhaust valves, cylinder liners and pistons which are surrounded by water jackets. In addition, the heat absorbed by the oil is also removed by the engine coolant in the oil-to-water oil cooler.

For the recommended coolant, refer to Engine Coolant.

Cooling System Capacity

The capacity of the basic engine cooling system (cylinder block, head, thermostat housing and oil cooler housing) is shown in Table 1.

To obtain the complete amount of coolant in the cooling system of an engine, the additional capacity of the radiator, hoses, etc. must be added to the capacity of the basic engine. The capacity of radiators and related equipment should be obtained from the equipment supplier.

Fill Cooling System

Before starting an engine, close all of the drain cocks and fill the cooling system completely. If the unit has a raw water pump, it should be primed, since operation without water may cause impeller failure.

COOLING SYSTEM CAPACITY CHART (BASIC ENGINE)		
ENGINE	CAPACITY	
	Quarts	Liters
3-53	87	7.6

TABLE 1

Start the engine and, after normal operating temperature has been reached, allowing the coolant to expand to its maximum, check the coolant level. The coolant level should be within 2" of the top of the filler neck.

Should a daily loss of coolant be observed, and there are no apparent leaks, there is a possibility of gases leaking past the cylinder head water seal rings into the cooling system. The presence of air or gases in the cooling system may be detected by connecting a rubber tube from the overflow pipe to a water container. Bubbles

in the water in the container during engine operation will indicate this leakage. Another method for observing air in the cooling system is by inserting a transparent tube in the water outlet line.

Drain Cooling System

The engine coolant is drained by opening the cylinder block and radiator (heat exchanger) drain cocks and removing the cooling system filler cap. Removing of the filler cap permits air to enter the cooling passages and the coolant to drain completely from the system.

The 3-53 cylinder block has a drain cock or plug located on the side of the block opposite the oil cooler.

NOTE
Drain cocks or plugs on both sides of the engine must be opened to drain the engine completely.

In addition to the drains on the cylinder blocks, the In-line engines have a drain cock located on the bottom of the oil cooler housing. Radiators, etc., that do not have a drain cock, are drained through the oil cooler housing drain.

To insure that all of the coolant is drained completely from an engine, all cooling system drains should be opened. Should any entrapped water in the cylinder block or radiator freeze, it will expand and may cause damage. When freezing weather is expected, drain all engines not adequately protected by antifreeze. Leave all of the drain cocks open until refilling the cooling system.

Raw water pumps are drained by loosening the cover attaching screws. It may be necessary to tap the raw water pump cover gently to loosen it. After the water has been removed, tighten the screws.

Flushing

The cooling system should be flushed each spring and fall. The flushing operation cleans the system of antifreeze solution in the spring and removes the summer rust inhibitor in the fall, preparing the cooling system for a new solution. The flushing operation should be performed as follows:

1. Drain the previous season's solution from the engine.

2. Refill the cooling system with soft clean water. If the engine is hot, fill slowly to prevent rapid cooling and distortion of the engine castings.

3. Start the engine and operate it for 15 minutes to circulate the water thoroughly.

4. Drain the cooling system completely.

5. Refill the system with the solution required for the coming season.

Cooling System Cleaners

If the engine overheats and the fan belt tension and water level are satisfactory, clean and flush the entire cooling system. Remove scale formation by using a quality descaling solvent. Immediately after using the solvent, neutralize the system with the neutralizer. It is important that the directions printed on the container of the descaling solvent be thoroughly read and followed.

After the solvent and neutralizer have been used, completely drain the engine and radiator and reverse flush before filling the cooling system.

Reverse Flushing

After the engine and radiator have been thoroughly cleaned, they should be reverse flushed. The water pump should be removed and the radiator and engine reverse flushed separately to prevent dirt and scale deposits clogging the radiator tubes or being forced through the pump. Reverse flushing is accomplished by hot water, under air pressure, being forced through the cooling system in a direction opposite to the normal flow of coolant, loosening and forcing scale deposits out.

The radiator is reverse flushed as follows:

1. Remove the radiator inlet and outlet hoses and replace the radiator cap.
2. Attach a hose at the top of the radiator to lead water away from the engine.
3. Attach a hose to the bottom of the radiator and insert a flushing gun in the hose.
4. Connect the water hose of the gun to the water outlet and the air hose to the compressed air outlet.
5. Turn on the water and, when the radiator is full, turn on the air in short blasts, allowing the radiator to fill between air blasts.

NOTE

Apply air gradually. Do not exert more than 30 psi (207 kPa) air pressure. Too great a pressure may rupture a radiator tube.

6. Continue flushing until only clean water is expelled from the radiator.

The cylinder block and cylinder head water passages are reverse flushed as follows:

1. Remove the thermostat and the water pump.
2. Attach a hose to the water inlet of the cylinder block to drain the water away from the engine.

3. Attach a hose to the water outlet at tile top of the cylinder block and insert the flushing gun in the hose.

4. Turn on the water and, when the water jackets are filled, turn on the air in short blasts, allowing the engine to fill with water between air blasts.

5. Continue flushing until the water from the engine runs clean.

If scale deposits in the radiator cannot be removed by chemical cleaners or reverse flushing as outlined above, it may, be necessary to remove the upper tank and rod out the individual radiator tubes with flat steel rods. Circulate water through the radiator core from the bottom to the top during this operation.

Miscellaneous Cooling System Checks

In addition to the above cleaning procedures, the other components of the cooling system should be checked periodically to keep the engine operating at peak efficiency. The thermostat and the radiator pressure cap should be checked and replaced, if found defective. The cooling system hoses should be inspected and any hose that feels abnormally hard or soft should be replaced immediately.

Also, check the hose clamps to make sure they are tight. All external leaks should be corrected as soon as detected. The fan belt must be adjusted to provide the proper tension, and the fan shroud must be tight against the radiator core to prevent re-circulation of air which may lower cooling efficiency.

Water Pump

A centrifugal-type water pump is mounted on top of the engine oil cooler housing, either on the right-hand or left-hand side of the engine, depending upon the engine model and rotation. It circulates the coolant through the cooling system.

The pump is belt driven, by either the camshaft or balance shaft (In-line engines) or by one of the camshafts (V-type engines).

An impeller is pressed onto one end of the water pump shaft, and a water pump drive pulley is pressed onto the opposite end. The pump shaft is supported on a sealed double-row combination radial and thrust ball bearing. Coolant is prevented from creeping along the shaft toward the bearing by a seal. The shaft and bearing constitute an assembly and are serviced as such, since the shaft serves as the inner race of the ball bearing.

The sealed water pump shaft ball bearing is filled with lubricant when assembled. No further lubrication is required.

Contact an authorized Detroit Diesel Allison Service Outlet if more information is needed.

AUTOMATIC ELECTRICAL SHUTDOWN SYSTEM

The automatic electrical shutdown system shown in Fig.3 protects the engine against a loss of coolant, overheating of the coolant, loss of oil pressure, or over speeding. In the event one of the foregoing conditions arises, a switch will close the electrical circuit and energize the solenoid switch, causing the shutdown solenoid to release the air shutdown latch and stop the engine.

Operation

The electrical circuit is de-energized under normal operation conditions. When the engine is started, the oil pressure switch opens when the oil pressure reaches approximately 10 psi (69 kPa) and the fuel oil pressure switch closes at approximately 20 psi (138 kPa) fuel pressure. The water temperature switch remains open.

If the oil pressure drops below 10 psi (69 kPa), the oil pressure switch will close the circuit and energize the shutdown solenoid. This will activate the shutdown mechanism and stop the engine.

A loss of coolant or an increase in coolant temperature to approximately 203°F (95°C) will close the contacts in the water temperature switch, thus closing the electrical circuit and activating the shutdown mechanism.

The water temperature switch consists of a temperature-sensing valve and a microswitch. The valve contacts a copper plug (heat probe) which extends into the exhaust manifold outlet. Engine water is directed over the power element of the valve and should the water temperature exceed approximately 203°F (95°C), the valve will close the contacts in the micro-switch and energize the shutdown circuit. If a loss of water occurs, the heat of the exhaust gases will be transmitted through the copper plug to the temperature-sensing valve and cause the shutdown circuit to be activated.

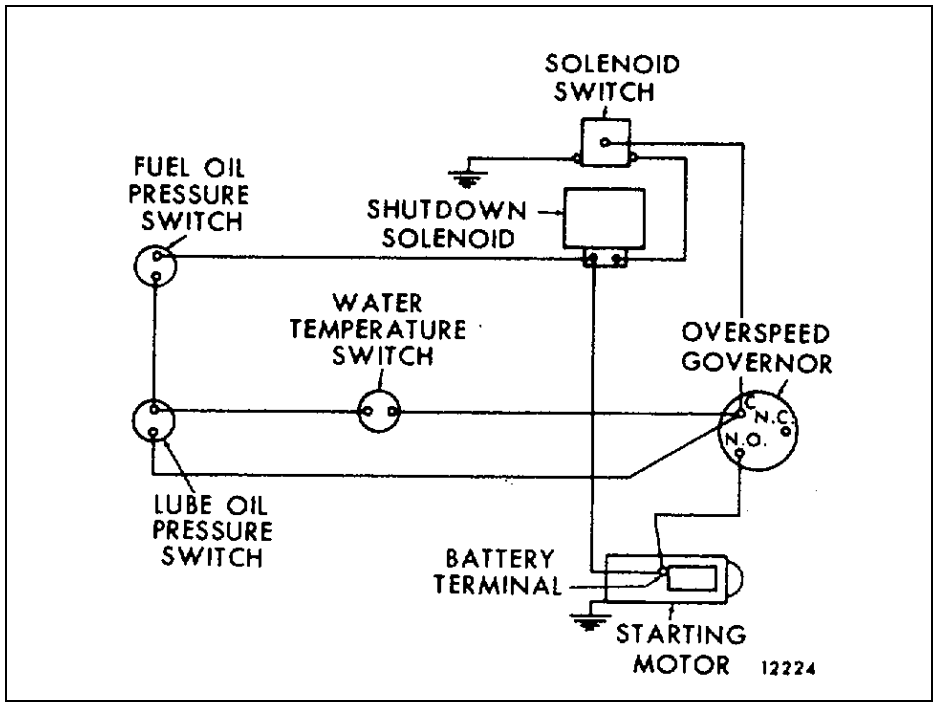


Figure 7-14 - Automatic Electrical Shutdown System Diagram

If the engine speed exceeds the high speed setting of the overspeed governor, the governor switch will close and activate the shutdown mechanism.

When the engine is shut down, the decrease in speed will open the governor switch and the decrease in oil and fuel pressures will close the oil pressure switch, and open the fuel pressure switch, thus de-energizing the circuit.

The cause of the abnormal conditions must then be determined and corrected before the engine is started again. Also, the air shutoff valve must be manually reset in the open position before the engine can be started.

Since the fuel pressure builds up rapidly,-the fuel oil pressure switch could close before the lubricating oil pressure switch opens and stop the engine. The hot wire relay, however, delays the closing of the fuel oil pressure switch for several seconds to enable the lubricating oil pressure to build up and open the oil pressure switch contacts.

When the lubricating oil pressure falls below 10+2 psi (69+14 kPa), the contacts in the oil pressure switch used in this system will close and current will flow through the hot wire relay to the solenoid. The few seconds required to heat the hot wire relay provides sufficient delay to avoid stopping the engine when low oil pressure is caused by a temporary condition such as an air bubble or a temporary overlap in the operation of the oil pressure switch and the fuel oil pressure switch when starting or stopping the engine.

The water temperature switch, which remains open during normal engine operation, is installed in the side of the thermostat housing. The switch contacts close when the water temperature reaches approximately 205°F (96°C) and activate the shutdown solenoid.

STARTING SYSTEMS

ELECTRICAL STARTING SYSTEMS

The electrical system on the engine generally consists of a battery-charging alternator, a starting motor, voltage regulator, storage battery, starter switch and the necessary wiring. Additional electrical equipment may be installed on the engine unit at the option of the owner.

Starting Motor

The starting motor has a Sprag overrunning clutch. Pressing the starting switch engages the starting motor pinion with the teeth of the flywheel ring gear and energizes the starting motor. The starting motor drives the pinion and rotates the crankshaft. When the engine begins to operate, the Sprag clutch permits the pinion to overrun on its shaft, until the starting switch is released, and prevents over-speeding the starting motor.

Starter Switch

To start the engine, a switch is used to energize the starting motor. Release the switch immediately after the engine starts.

Alternator

The battery-charging alternator provides the electrical current required to maintain the storage battery in a charged condition and to supply sufficient current to carry any other electrical load requirements up to the rated capacity of the alternator.

Regulator

A voltage regulator is introduced into the electrical system to regulate the voltage and current output of the battery-charging alternator and to maintain a fully charged storage battery.

Storage Battery

The lead-acid storage battery is an electrochemical device for converting chemical energy into electrical energy.

The battery has three major functions:

1. It provides a source of electrical power for starting the engine.

2. It acts as a stabilizer to the voltage in the electrical system.

3. It can, for a limited time, furnish current when the electrical demands of the unit exceed the output of the alternator.

The battery is a perishable item which requires periodic servicing. A properly cared for battery will give long and trouble-free service.

1. Check the level of the electrolyte regularly. Add water if necessary, but do not overfill. Overfilling can cause poor performance or early failure.

2. Keep the top of the battery clean. When necessary, wash with a baking soda solution and rinse with fresh water. Do not allow the soda solution to enter the cells.

3. Inspect the cables, clamps and hold-down bracket regularly. Clean and reapply a light coating of grease when needed. Replace corroded, damaged parts.

4. Use the standard, quick in-the-unit battery test as the regular service test to check battery condition.

5. Check the electrical system if the battery becomes discharged repeatedly.

CAUTION

Explosive gas may remain in or around the battery for several hours after it has been charged. Sparks or flame can ignite this gas causing an explosion which could shatter the battery.

If the engine is to be stored for more than 30 days, remove the battery. The battery should be stored in a cool, dry place. Keep the battery fully charged and check the level of the electrolyte regularly.

The Lubrication and Preventive Maintenance section of this manual covers the servicing of the starting motor and alternator.

Consult an authorized Detroit Diesel Allison Service Outlet for information regarding the electrical system.

GOVERNORS

Horsepower requirements of an engine may vary continually due to the fluctuating loads; therefore, some means must be provided to control the amount of fuel required to hold the engine speed reasonably constant during such load fluctuations. To accomplish this control, one of three types of governors is used on the engines. Installations requiring maximum and minimum speed control, together with manually controlled intermediate speeds, ordinarily use a limiting speed mechanical governor. Applications requiring a near constant engine speed under varying load conditions, that may be changed by the operator, are equipped with a variable speed mechanical governor. The hydraulic governor is used where uniform engine speed is required under varying load conditions with a minimum speed droop.

Lubrication

The mechanical governors are lubricated by oil splash from the engine gear train. Oil entering the governor is directed by the revolving governor weights to the various moving parts requiring lubrication.

The hydraulic governor is lubricated by oil under pressure from the engine.

Service

Governor difficulties are usually indicated by speed variations of the engine. However, speed fluctuations are not necessarily caused by the governor and, therefore, when improper speed variations become evident, the unit should be checked for excessive load, misfiring or bind in the governor operating linkage. If none of these conditions are contributing to faulty governor operation, contact an authorized Detroit Diesel Allison Service Outlet.

SECTION IV

OPERATING INSTRUCTIONS

ENGINE OPERATING INSTRUCTIONS

PREPARATION FOR STARTING ENGINE FIRST TIME

Before starting an engine for the first time, carefully read and follow these instructions. Attempting to run the engine before studying these instructions may result in serious damage to the engine.

NOTE: When preparing to start a new or overhauled engine or an engine which has been in storage, perform all of the operations listed below. Before a routine start (at each shift), see Daily Operations in the Lubrication and Preventive Maintenance Chart.

Cooling System

Install all of the drain cocks or plugs in the cooling system (drain cocks are removed for shipping).

Open the cooling system vents, if the engine is so equipped.

Remove the filler cap and fill the cooling system with clean, soft water or a protective solution consisting of high boiling point type antifreeze, if the engine will be exposed to freezing temperatures. Refer to Engine Coolant. Keep a liquid level about two inches below the filler neck to allow for fluid expansion.

Close the vents, if used, after filling the cooling system.

On marine installations, prime the raw water cooling system and open any sea cocks in the raw water pump intake line. Prime the raw water pump by removing the pipe plug or electrode provided in the pump outlet elbow and pour water in the pump.

NOTE:
Failure to prime the raw water pump may result in damage to the pump impeller.

Lubrication System

The lubricating oil film on the rotating parts and bearings of a new or overhauled engine, or one which has been in storage, may be insufficient for proper lubrication when the engine is started for the first time.

It is recommended that the engine lubricating system be charged with a pressure prelubricator, set to supply a minimum of 25 psi (172 kPa) oil pressure, to ensure an immediate flow of oil to all bearings at the initial engine start-up. The oil supply line should be attached to the engine so that oil under pressure is supplied to the main oil gallery.

With the oil pan dry, use the prelubricator to prime the engine with sufficient oil to reach all bearing surfaces. Use heavy-duty lubricating oil as specified under lubricating Oil Specifications. Then remove the dipstick, wipe it with a clean cloth, insert and remove it again to check the oil level in the oil pan. Add sufficient oil, if necessary, to bring it to the full mark on the dipstick. Do not overfill.

If a pressure prelubricator is not available, fill the crankcase to the proper level with heavy-duty lubricating oil as specified. Then prelubricate the upper engine parts by removing the valve rocker covers and pouring lubricating oil, of the same grade and viscosity as used in the crankcase, over the rocker arms.

Fuel System

Fill the fuel tank with the fuel specified under Fuel Specifications. If the unit is equipped with a fuel valve, it must be opened. To ensure prompt starting, fill the fuel system between the pump and the fuel return manifold with fuel. If the engine has been out of service for a consider- able length of time, prime the filter between the fuel pump and the injectors. The filter may be primed by removing the plug in the top of the filter cover and slowly filling the filter with fuel.

In addition to the above, on an engine equipped with a hydrostarter, use a priming pump to make sure the fuel lines and the injectors are full of fuel before attempting to start the engine.

NOTE: The fuel system is filled with fuel before leaving the factory. If the fuel is still in the system when preparing to start the engine, priming should be unnecessary.

Lubrication Fittings

Fill all grease cups and lubricate at all fittings with an all purpose grease. Apply lubricating oil to the throttle linkage and other moving parts and fill the hinged cap oilers with a hand oiler.

Drive Belts

Adjust all drive belts as recommended under Lubrication and Preventive Maintenance.

Storage Battery

Check the battery. The top should be clean and dry, the terminals light and protected with a coat of petroleum jelly and their electrolyte must be ;it the proper level.

NOTE: When necessary, check the battery with a hydrometer; the reading should be 1.265 or higher.- However, hydrometer readings should always be corrected for the temperature of the electrolyte.

Generator Set

Where applicable, fill the generator end bearing housing with the same lubricating oil as used in the engine.

A generator set should be connected and grounded in accordance with the applicable local electrical codes.

NOTE: The base of a generator set must be grounded.

Clutch

Disengage the clutch, if the unit is so equipped.

STARTING

Before starting the engine-for the first time, perform the operations listed under Preparation For Starting Engine First Time.

Before a routine start, see Daily Operations in the Lubrication and Preventive Maintenance Chart.

If a manual or an automatic shutdown system is incorporated in the unit, the control must be set in the open position before starting the engine.

The blower will be seriously damaged if operated with the air shutoff valve in the closed position.

Starting at air temperatures below 40°F (4°C) requires the use of a cold weather starting aid. The instructions for the use of a cold weather fluid starting aid will vary dependent on the type being used. Reference should be made to these instructions before attempting a cold weather start.

CAUTION: Starting fluid used in capsules is highly inflammable, toxic and possesses anesthetic properties.

Initial Engine Start (Electric)

Start an engine equipped with an electric starting motor as follows: Set the speed control lever at part throttle, then bring it back to the desired no-load speed. In addition, on mechanical governors, make sure the stop lever on the governor cover is in the run position. Then press the starting motor switch firmly. If the engine fails to start within 30 seconds, release the starting switch and allow the starting motor to cool a few minutes before trying again. if the engine fails to start after four attempts, an inspection should be made to determine the cause.

NOTE: To prevent serious damage to the starter, if the engine does not start, do not press the starting switch again while the starting motor is running.

RUNNING

Oil Pressure

Observe the oil pressure gage immediately after starting the engine. If there is no pressure indicated within 10 to 15 seconds, stop the engine and check the lubricating oil system. The minimum oil pressure should be at least 18 psi (124 kPa) at 1200 rpm. The oil pressure at normal operating speed should be 40-60 psi (276-414 kPa).

Warm-Up

Run the engine at part throttle and no-load for approximately five minutes, allowing it to warm-up before applying a load.

If the unit is operating in a closed room, start the room ventilating fan or open the windows, as weather conditions permit, so ample air is available for the engine.

Clutch

Do not engage the clutch at engine speeds over 1000 rpm.

Inspection

While the engine is running at operating temperature, check for coolant, fuel or lubricating oil leaks. Tighten the line connections where necessary to stop leaks.

Engine Temperature

Normal engine coolant temperature is 160-185°F (71-850C).

Crankcase

If the engine crankcase was refilled, stop the engine after normal operating temperature has been reached, allow the oil to drain back into the crankcase for approximately twenty minutes and check the oil level. Add oil, if necessary, to bring it to the proper level on the dipstick.

Use only the heavy duty lubricating oil specified under Lubricating Oil Specifications.

Cooling System

Remove the radiator or head exchanger tank cap slowly after the engine has reached normal operating temperature and check the engine coolant level. The coolant level should be near the top of the opening. If necessary, add clean soft water or a high boiling point type antifreeze (refer to Engine Coolant).

Avoid Unnecessary Engine Idling

During long engine idling periods, the engine coolant temperature will fall below the normal operating range. The incomplete combustion of fuel in a cold engine will cause crankcase dilution, formation of lacquer or gummy deposits on the valves, pistons, and rings and rapid accumulation of sludge in the engine.

NOTE: When prolonged engine idling is necessary, maintain at least 800 rpm.

STOPPING

Normal Stopping

1. Release the load and decrease the engine speed. Put all shift levers in the neutral position.

2. Allow the engine to run at half speed or slower with no load for four or five minutes, then move the stop lever to stop to shut down the engine.

Emergency Stopping

To stop an engine (normal or emergency) equipped with the spring-loaded (one screw) design injector control tube, pull the governor stop lever to the stop position. If an engine equipped with the non-spring loaded (two screw) design injector control tube does not stop after using the normal stopping procedure, pull the emergency stop knob all the way out. This control cuts off the air to the engine. Do not try to restart again until the cause for the malfunction has been found and corrected.

NOTE: The emergency shutdown system should never be used except in an emergency. Use of the emergency shutdown can cause oil to be sucked past the oil seals and into the blower housing.

The air shutoff valve, located on the blower air inlet housing, must be reset by hand and the "Emergency Stop" knob pushed in before the engine is ready to start again.

Fuel System

If the unit is equipped with a fuel valve, close it. Fill the fuel tank; a full tank minimizes condensation.

Exhaust System

Drain the condensation from the exhaust line or silencer.

Cooling System

Drain the cooling system if it is not protected with antifreeze and freezing temperatures are expected. Leave the drains open. Open the raw water drains of a heat exchanger cooling system.

Crankcase

If the engine crankcase was refilled, stop the engine after normal operating temperature has been reached, allow the oil to drain (approximately 20 minutes) back into the crankcase and check the oil level. Add oil, if necessary, to bring it to the proper level on the dipstick.

Use only the heavy-duty lubricating oil specified under Lubricating Oil Specifications.

Clean Engine

Clean and check the engine thoroughly to make certain it will be ready for the next run.

Refer to Lubrication and Preventive Maintenance and perform all of the daily maintenance operations. Also perform the operations required for the number of hours or miles the engine has been in operation.

Make the necessary adjustments and minor repairs to correct difficulties which became apparent to the operator during the last run.

SECTION V

LUBRICATION AND PREVENTIVE MAINTENANCE

The Lubrication and Preventive Maintenance Schedule is intended as a guide for establishing a preventive maintenance schedule. The suggestions and recommendations for preventive maintenance should be followed as closely as possible to obtain long life and best performance from a Detroit Diesel engine. he intervals indicated on the chart are time or miles (in thousands) of actual operation.

MAINTENANCE SCHEDULE EXPLANATION

The time or mileage increments shown apply only to the maintenance function described. These functions should be coordinated with other regularly scheduled maintenance.

The daily instructions pertain to routine or daily starting of an engine and not to a new engine or one that has not been operated for a considerable period of time. For new or stored engines, carry out the instructions given under Preparation for Starting Engine First Time under Operating Instructions in Section 4.

INDUSTRIAL OFF HIGHWAY	TIME INTERVALS										
	DLY.	8 240	50 1,500	100 3,000	150 4,500	200 6,000	300 9,000	500 15,000	700 20,000	1,000 30,000	2,000 60,000
1. Lubricating Oil	X				X						
2. Fuel Tank	X							X	X		
3. Fuel Lines	X										
4. Battery				X							
5. Tachometer Drive				X							
6. Air Cleaners		X						X			
7. Drive Belts		X				X					
8. Throttle and Clutch Controls						X					
9. Lubricating Oil Filter								X		X	
10. Fuel Strainer and Filter							X				
11. Coolant Filter								X			
12. Starting Motor*								X			
13. Air Systems									X		
14. Exhaust System									X		
15. Emergency Shut down									X		
16. Radiator									X		
17. Shutter Operation									X		
18. Oil Pressure									X		
19. Overspeed Governor								X			
20. Throttle Delay*											
21. Battery-Charging Alternator						X					
22. Engine and Trans-mission Mounts											X
23. Crankcase Pressure											X
24. Fan Hub*									X		
25. Thermostats & Seals									X		
26. Blower Screen										X	
27. Crankcase Breather										X	
28. Engine Tune-Up*											

*See Item

Item 1 - Lubricating Oil

Check the lubricating oil level with the engine stopped. If the engine has just been stopped, wait approximately twenty minutes to allow the oil to drain back to the oil pan. Add the proper grade oil as required to maintain the correct level on the dipstick (see Lubricating Oil Specifications in this section).

NOTE: Oil may be blown out through the crankcase breather if the crankcase is overfilled.

Make a visual check for oil leaks around the filters and external oil lines.

Change the lubrication oil at the intervals shown in Table 1.

Max. Engine Oil Change Interval		
Diesel Fuel Sulfur Content % by Wt. Max.		
0 to .50	0.51 to 0.75	0.76 to 1.00
150 Hours	30 Hours	15 Hours*

*These oil change intervals are based upon worst case with chrome-faced rings. Oil change periods with plasma rings can be established by oil analysis.

TABLE 1

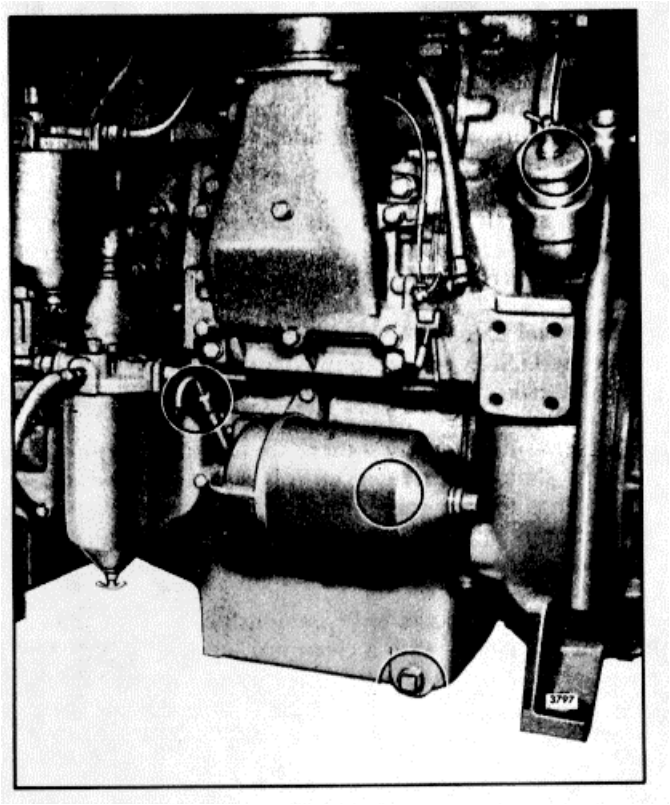
The drain interval may be established on the recommendations of an independent oil analysis laboratory or the oil supplier (based upon the used oil sample analysis) until the most practical oil change period has been determined. Select the proper grade of oil in accordance with the instructions given in the Lubrication Oil Specifications in this section.

NOTE: If the lubricating oil is drained immediately after an engine has been run for some time, most of the sediment will be in suspension and will drain readily.

Item 2 - Fuel Tank

Keep the fuel tank filled to reduce condensation to a minimum. Select the proper grade of fuel in accordance with the Diesel Fuel Oil Specifications in this section.

Open the drain at the bottom of the fuel tank every 500 hours (15,000 miles) to drain off any water and/or sediment.



Items 1 and 9

Every 12 months or 20,000 miles (700 hours) tighten all fuel tank mountings and brackets. At the same time, check the seal in the fuel tank cap, the breather hole in the cap and the condition of the crossover fuel line. Repair or replace the parts as necessary.

Diesel Fuel Contamination

The most common form of diesel fuel contamination is water. Water is harmful to the fuel system in itself, but it also promotes the growth of microbiological organisms (microbes). These microbes clog fuel filters with a "slime" and restrict fuel flow.

Water can be introduced into the fuel supply through poor maintenance (loose or open fuel tank caps), contaminated fuel supply or condensation.

Condensation is particularly prevalent on units which stand idle for extended periods of time, such as marine units. Ambient temperature changes cause condensation in partially filled fuel tanks.

Water accumulation can be controlled by mixing isopropyl alcohol (dry gas) into the fuel oil at a ratio of one pint per 125 gallons fuel (or 0.10% by volume).

Item 3 - Fuel Lines

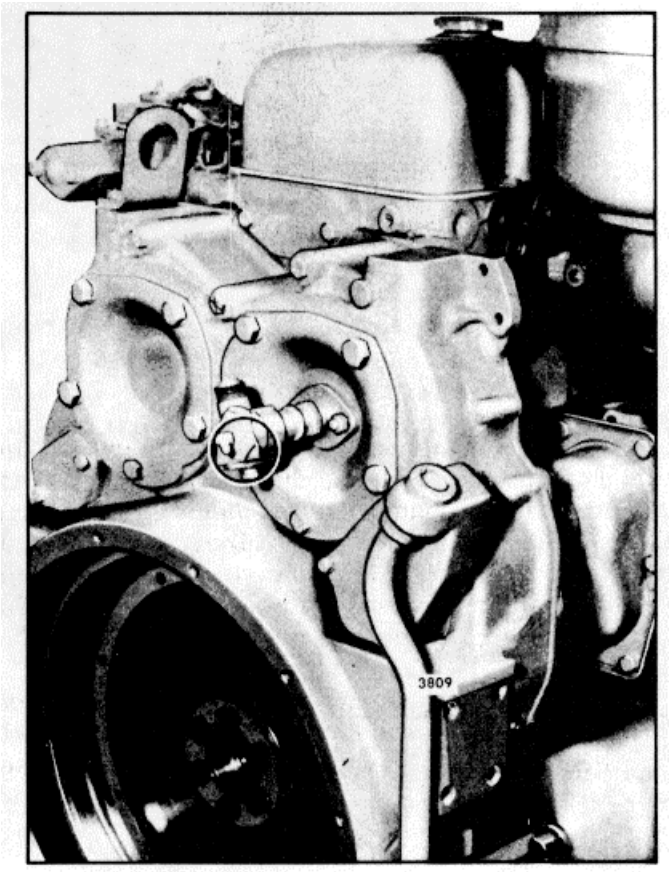
Make a visual check for fuel leaks at the crossover lines and at the fuel tank suction and return lines. Since fuel tanks are susceptibly to road hazards, leaks in this area may best be detected by checking for accumulation of fuel under the tanks.

Item 4 - Battery

Check the specific gravity of the electrolyte in each cell of the battery every 100 hours (3,000 miles). In warm weather, however, it should be checked more frequently due to a more rapid loss of water from the electrolyte. The electrolyte level should be maintained in accordance with the battery manufacturer's recommendations.

Item 5 - Tachometer Drive

Lubricate the tachometer drive every 100 hours (3,000 miles) with an all purpose grease at the grease fitting. At temperatures above +300F (-10C), use a No. 2 grade grease. Use a No. I grade grease below this temperature.



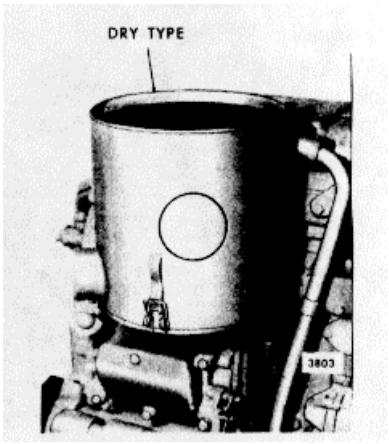
Item 5

Item 6 - Air Cleaner

Under no engine operation conditions should the air inlet restriction exceed 25 inches of water (6.2 kPa) for non-turbocharged engines or 20 inches of water (5.0 kPa) for turbocharged engines. A clogged air cleaner element will cause excessive intake restriction and a reduced air supply to the engine.

Dry Type

Dry type elements should be discarded and replaced with new elements after one year of service or when the maximum allowable air intake restriction has been reached, whichever comes first. In cases where the air cleaner manufacturer recommends cleaning or washing the elements, the maximum service life is still one year or maximum restriction. Cleaning, washing and inspection must be done per the manufacturer's recommendations. Inspection and replacement of the cover gaskets must also be done per the manufacturer's recommendations.



Item 6

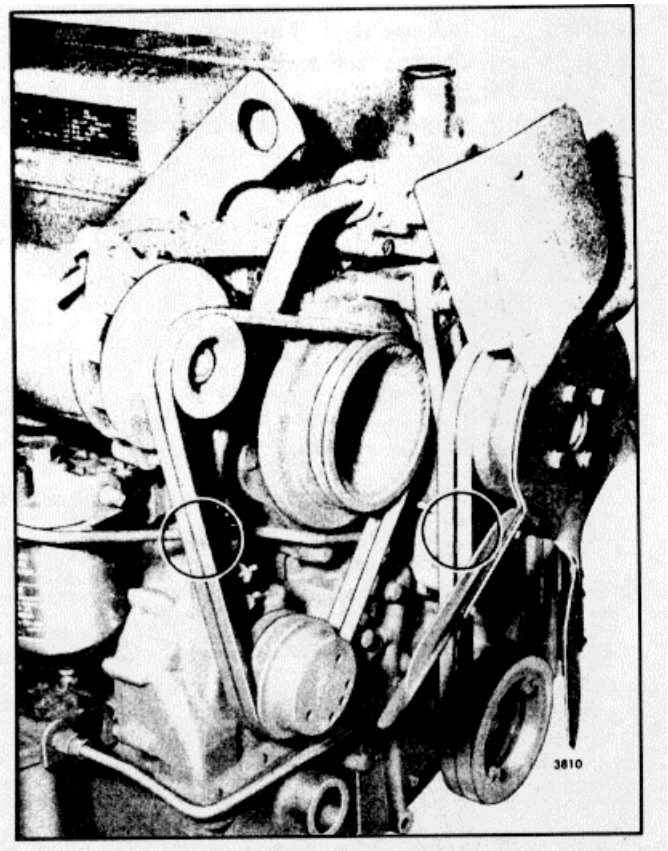
Item 7 - Drive Belts

New standard V-belts will stretch after the first few hours of operation. Run the engine for 15 seconds to seat the belts, then readjust the tension. Check the belts and tighten the fan drive, pump drive, battery-charging alternator and other accessory drive belts after 1/2 hour (15 miles) and again after 8 hours (240 miles) of operation. Thereafter, check the tension of the drive belts every 200 hours (6,000 miles) and adjust, if necessary. Too tight a belt is destructive to the bearings of the driven part; a loose part will slip.

Replace all belts in a set when one is worn. Single belts of similar size should not be used as a substitute for a matched belt set; premature belt wear can result because of belt length variation. All belts in a matched belt set are within .032" of their specified center distances.

Adjust the belt tension so that a firm push with the thumb, at a point midway between the two pulleys, will depress the belt ½" to ¾". If belt tension gage J-23600-b or equivalent is available, adjust the belt tension as outlined in the chart.

NOTE: When installing or adjusting an accessory drive belt, be sure the bolt at the accessory adjusting pivot point is properly tightened, as well as the bolt in the adjusting slot.



Item 7

	Fan Drive		Generator Drive		
Model	2 or 3 belts	Single belt	Two or 3/8" or 1/2" belts	One 1/2" belt	One 9/16" belt
3-53	40-50	-	40 - 50	50-70	40-50
ALL	For 3-point or triangular drive, use a tension of 90-120				

BELT TENSION CHART (lbs/belt)

Item 8 - Throttle and Clutch Controls

Every 200 hours (6,000 miles) lubricate the limiting speed governor speed control shaft (in-line 53) through a grease fitting located in the end of the shaft. Use an all purpose grease (No. 2 grade) at temperatures +30°F (-1°C) and above. At temperatures below this, use a No. 1 grade grease.

Lubricate the clutch control levers and all other control mechanisms, as required, with engine oil.

Item 9 - Lubricating Oil Filter

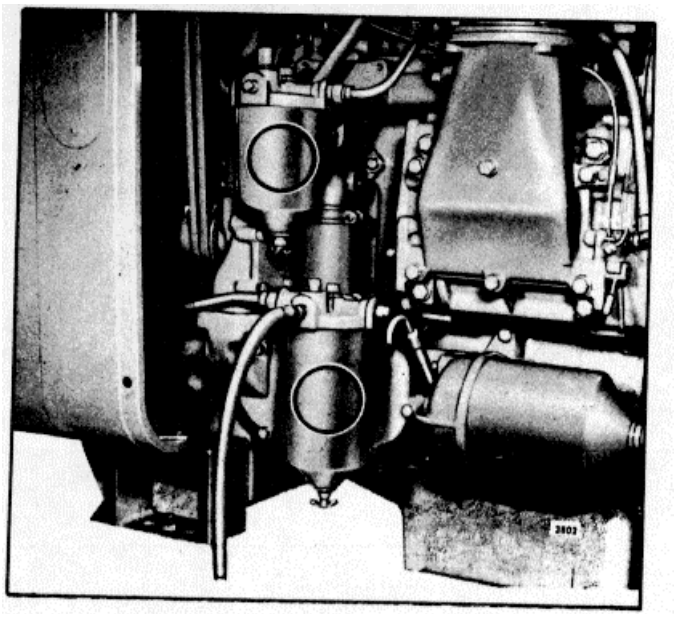
Install new oil filter elements and gaskets at a maximum of 500 hours (15,000 miles) or each time the engine oil is changed, whichever occurs first. Any deviation, such as changing filters every other oil change, should be based on a laboratory analysis of the drained oil and the used filter elements to determine if such practice is practical for proper protection of the engine.

Make a visual check of all lubricating oil lines for wear and chafing. If any indication of wear is evident, replace the oil lines and correct the cause. Check for oil leaks after starting the engine.

Item 10 - Fuel Strainer and Filter

Install new elements every 300 hours (9,000 miles) or when plugging is indicated.

A method of determining when elements are plugged to the extent that they should be changed is based on the fuel pressure at the cylinder head fuel inlet manifold and the inlet restriction at the fuel pump. In a clean system, the maximum pump inlet restriction must not exceed 6 inches of mercury (20.3 kPa). At normal operating speeds (1800-2800 rpm), the fuel pressure is 45 to 70 PSI (310 to 483 kPa). Change the fuel filter elements whenever the inlet restriction (suction) at the fuel pump reaches 12 inches of mercury (41 kPa) at normal operating speeds and whenever the fuel pressure at the inlet manifold falls to 45 PSI (310 kPa).



Item 10

Item 11 - Coolant Filter

If the cooling system is protected By a cool 0il filter and conditioner, the filter element should be changed every 500 hours (15,000 miles). Select the proper coolant filter element in accordance with the instructions given under Engine coolant in this section. Use a new filter cover gasket when installing the filter element. After replacing the filter and cover gasket, start the engine and check for leaks.

Item 12 - Starting Motor

The electrical starting motor is lubricated at the time of original assembly. Oil can be added to the oil wicks which project through each bushing and contact the armature shaft, by removing the pipe plugs on the outside of the motor. The wicks should be lubricated whenever the starting motor is taken off the engine or disassembled. The Sprag overrunning clutch drive mechanism should be lubricated with a few drops of light engine oil whenever the starting motor is overhauled.

Item 13 - Air System

Check all of the connections in the air system to be sure they are tight. Check all hoses for punctures or other damage and replace, if necessary.

Item 14 - Exhaust System

Check the exhaust manifold retaining nuts, exhaust flange clamp and other connections for tightness. Check for proper operation of the exhaust pipe rain cap, if one is used.

Item 15 - Emergency Shutdown

With the engine running at idle speed, check the operation of the emergency shutdown every 700 hours (20,000 miles). Reset the air shutdown valve in the open position after the check has been made.

Item 16 - Radiator

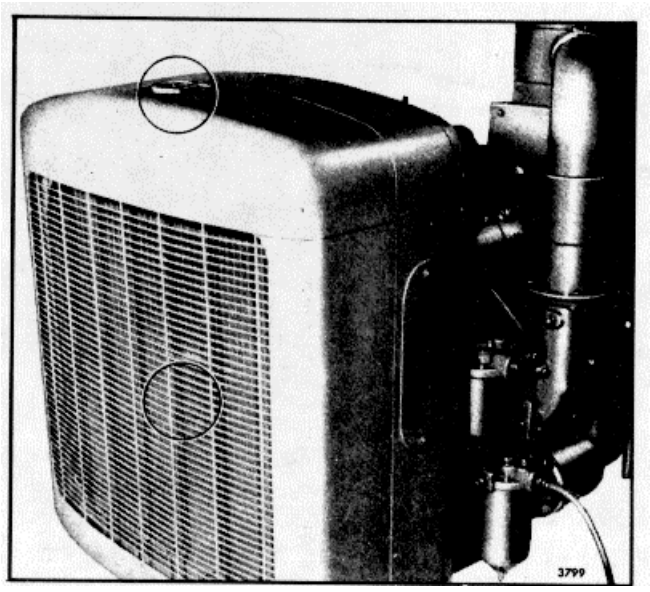
Inspect the exterior of the radiator core every 700 hours (20,000 miles) and, if necessary, clean it with a quality grease solvent such as mineral spirits and dry it with compressed air. Do not use fuel oil, kerosene or gasoline. It may be necessary to clean the radiator more frequently if the engine is being operated in extremely dusty or dirty areas.

Item 17 - Shutter Operation

Check the operation of the shutters and clean the linkage and controls.

Item 18 - Oil Pressure

Under normal operation, oil pressure is noted each time the engine is started. In the event the engine is equipped with warning lights rather than pressure indicators, the pressure should be checked and recorded every 700 hours (20,000 miles).



Item 16

Item 19 - Overspeed Governor

Lubricate the overspeed governor, if it is equipped with a hinge-type cap oiler or oil cup, with 5 or 6 drops of engine oil every 500 hours (15,000 miles). Avoid excessive lubrication and do not lubricate the governor while the engine is running.

Item 20 - Throttle Delay

Inspect and adjust, if necessary, every 30 months or 50,000 miles.

The throttle delay system limits the amount of fuel injected during acceleration by limiting the rate of injector rack movement with a hydraulic cylinder. The initial location of this cylinder must be set with the proper gage to achieve the appropriate time delay (Section 6).

Inspect the check valve by filling the throttle delay cylinder with diesel fuel and watching for valve leakage while moving the throttle from the idle to the full-fuel position. If more than a drop of fuel oil leaks, replace the check valve.

Item 21 - Battery-Charging Alternator

Inspect the terminals for corrosion and loose connections and the wiring for frayed insulation.

Lubricate the battery-charging alternator bearings or bushings with 5 or 6 drops of engine oil at the hinge cap oiler every 200 hours (6,000 miles).

Some alternators have a built-in supply of grease, while others use sealed bearings. If these latter two cases, additional lubrication is not necessary.

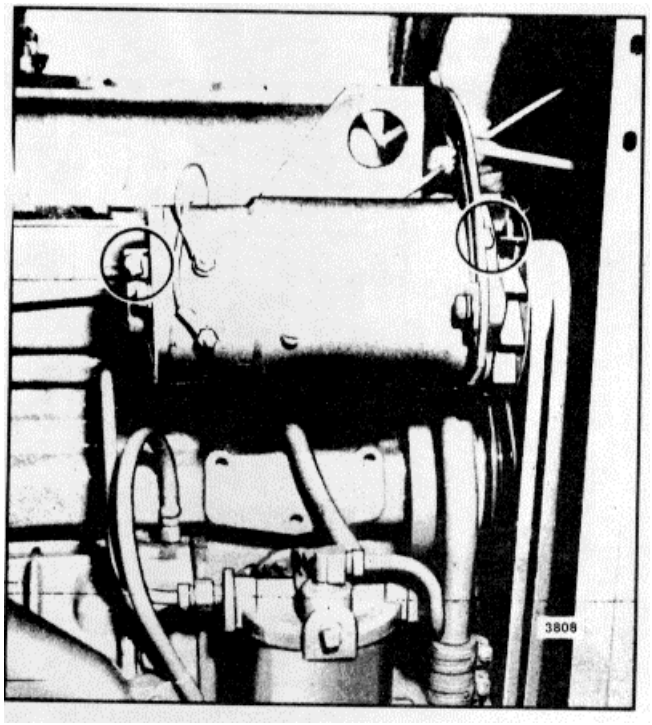
On alternators, the slip rings and brushes can be inspected through the end frame assembly. If the slip rings are dirty, they should be cleaned with 400 grain or finer polishing cloth. Never use emery cloth to clean the slip rings. Hold the polishing cloth against the slip rings with the alternator in operation and blow away all dust after the cleaning operation. If the slip rings are rough or out of round, replace them.

Item 22 - Engine and Transmission Mounts

Check the engine and transmission mounting bolts and the condition of the mounting pads every 2000 hours (60,000 miles). Tighten and repair as necessary.

Item 23 - Crankcase Pressure

Check and record the crankcase pressure every 2000 hours (60,000 miles).



Item 21

Item 24 - Fan Hub

If the fan bearing hub assembly is provided with a grease fitting, use a hand grease gun and lubricate the bearings with one shot of Texaco Premium RB grease, or an equivalent Lithium base multi-purpose grease, every 20,000 miles (approximately 700 hours).

Every 4000 hours, clean, inspect and repack the fan bearing hub assembly with the above recommended grease.

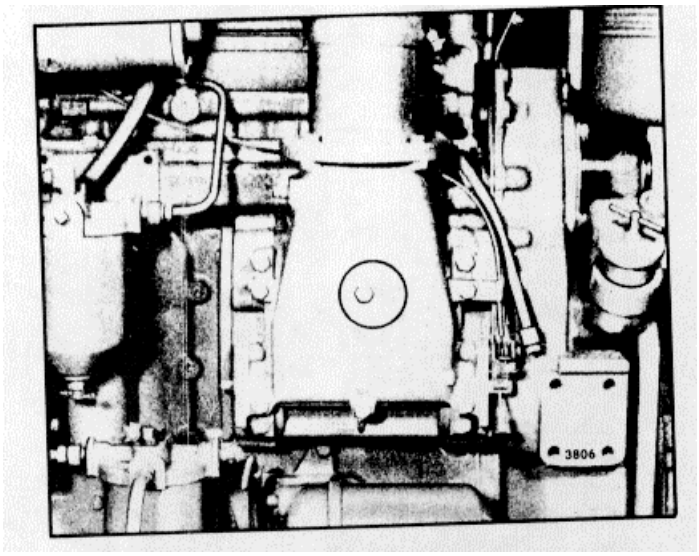
At a major engine overhaul, remove and discard the bearings in the fan hub assembly. Pack the hub assembly, using new bearings, with Texaco Premium RB grease or an equivalent Lithium base multi-purpose grease.

Item 25 - Thermostats and Seals

Check the thermostats and seals (preferably at the time the cooling system is prepared for winter operation). Replace the seals if necessary.

Item 26 - Blower Screen

Inspect the blower screen and gasket assembly every 1,000 hours (30,000 miles) and, if necessary, clean the screen in fuel oil and dry it with compressed air. Install the screen and gasket assembly with the screen side of the assembly toward the blower. Inspect for evidence of blower seal leakage.

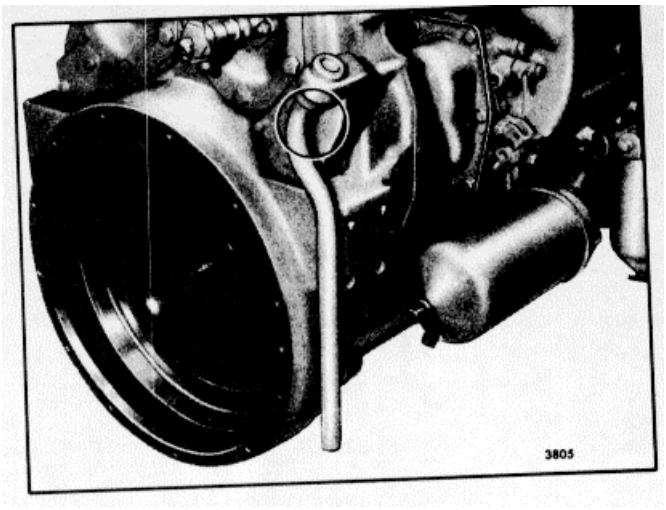


Item 26

Item 27 - Crankcase Breather

Remove the externally mounted crankcase breather assembly every 1,000 hours (30,000 miles) and wash the steel mesh pad in clean fuel oil. This cleaning period may be reduced or lengthened according to severity of service.

Clean the breather cap, mounted on the valve rocker cover, in clean fuel oil every time the engine oil is changed.



Item 27

Item 28 - Engine Tune-Up

There is no scheduled interval for performing an engine tune-up. As long as the engine performance is satisfactory, no tune-up should be needed. Minor adjustments in the valve and injector operating mechanisms, governor, etc. should only be required periodically to compensate for normal wear on parts.

LUBRICATING OILS FOR DETROIT DIESEL ENGINES

DIESEL LUBRICATING.OILS GENERAL CONSIDERATIONS

All diesel engines require heavy-duty lubricating oils Basic requirements of such oils are lubricating quality, high heat resistance, and control of contaminants

LUBRICATING QUALITY. The reduction of friction and wear by maintaining an oil film between moving parts is the primary requisite of a lubricant. Film thickness and its ability to prevent metal-to-metal contact of moving parts Is related to oil viscosity The optimums for Detroit Diesel engines are SAE 40 or 30 weight

HIGH HEAT RESISTANCE. Temperature is the most important factor in determining the rate at which deterioration or oxidation of the lubricating oil will occur The oil should have adequate thermal stability at elevated temperatures, thereby precluding formation of harmful carbonaceous and/or ash deposits

CONTROL OF CONTAMINANTS. The piston and compression rings must ride on a film of oil to minimize wear and prevent cylinder seizure At normal rates of consumption, oil reaches a temperature zone at the upper part of the piston where rapid oxidation and carbonlzation can occur In addition, as oil circulates through the engine, It is continuously contaminated by soot, acids, and water originating from combustion. Until they are exhausted, detergent and dispersant additives aid In keeping sludge and varnish from depositing on engine parts. But such additives in excessive quantities can result in detrimental ash deposits If abnormal amounts of insoluble deposits form, particularly on the piston In the compression ring area, early engine failure may result

Oil that is carried up the cylinder liner wall is normally consumed during engine operation The oil and additives leave carbonaceous and/or ash deposits when subjected to the elevated temperatures of the combustion chamber. The amount of deposits is Influenced by the oil compositon, additive content, engine temperature, and oil consumption rate.

OIL QUALITY is the responsibility of the oil supplier. (The term "old supplier" is applicable to refiners, blenders, and rebranders of petroleum products, and does not include distributors of such products) There are hundreds of commercial crankcase oils marketed today Obviously, engine manufacturers or users cannot completely evaluate the numerous commercial oils The selection of a suitable lubricant In consultation with a reliable oil supplier, observance of his oil drain recommendations (based on used oil sample analysis and experience), and proper filter maintenance will provide the best assurance of satisfactory oil performance.

It should be noted that lube oil manufacturers may reformulate an old while maintaining the same API classification, or may reformulate to a new API classification and continue the brand name designation. For example, SE oils being reformulated to SF letter code classification may perform differently after this reformulation. A close working relationship with the lube oil manufacturer should be maintained so that any reformulation can be reviewed and decision made as to its affect on continued satisfactory performance.

COLD WEATHER OPERATION

Two important considerations relate to satisfactory operation under cold ambient temperature conditions These are (1)'the ability to crank the engine fast enough to secure starting, and (2) providing adequate lubrication to internal wearing surfaces during starting and warm-up Once started and warmed up, external ambient temperatures have little effect on Internal engine temperatures Both cold weather considerations can be adequately met through proper lube oil selection and the use of auxiliary heat prior to starting Auxiliary heat can be used in the form of jacket water and oil pan heaters, hot air space heaters applied to engine compartments, or some combination of these.

Proper oil selection and oil heat can assure lubricant flow immediately upon starting. Improper oil selection and oil heat may result In starting with cold oil congealed in the oil pan, and little or no oil flow for lubricating internal parts once the engine has started.

Proper oil selection and jacket water heating can assure cranking capability by maintaining an oil film on cylinder walls and bearing surfaces in a condition which provides low friction, and hence, less cranking effort to achieve cranking speeds necessary for reliable starting Improper oil selection and jacket water heating may result in congealed oil films on cylinder walls and bearing surfaces, which result in high friction loads and more cranking effort than is available, thus preventing sufficient cranking speeds to assure reliable starting.

LUBE OIL SPECIFICATIONS

Detroit Diesel Alllson lubricant recommendations are based on general experience with current lubricants of various types and give consideration to the commercial lubricants presently available.

RECOMMENDATION

Detroit Diesel 2-cycle engines have provided optimum performance and experienced the longest service life operating with lubricating oils meeting the following ash limits, zinc requirements, oil performance levels, viscosity grades, and evidence of satisfactory performance.

Sulfated Ash Limit (ASTM D-874)

The sulfated ash content of the lubricant shall not exceed 1.000% by weight, except lubricants that contain only barium detergent-dispersant salts where 1.5% by weight is allowed Lubricants having a sulfated ash content between 0 55% and 0 85% by weight, have a history of excellent performance In Detroit Diesel engines. Lubricants having a sulfated ash content exceeding 0.85% by weight, are prone to produce greater deposit levels in the piston ring grooves, exhaust valve faces and seats.

Zinc Content

The zinc content (zinc diorganodithiophosphate) of all the lubricants recommended for use in Detroit Diesel 2-cycle engines shall be a minimum of 0.07% by weight This requirement is waived where single grade SAE 40, intermediate viscosity index lubricants qualified for use in Electro-Motive Division (EMD) diesel engines are used.

VISCOSITY GRADE AND OIL PERFORMANCE LEVEL

Single Grade SAE 40 & SAE 30 Lubricants

Single grade SAE 40 and SAE 30 grade lubricants are preferred and recommended for use in all Detroit Diesel 2-cycle engines provided they meet the sulfated ash and zinc content requirements indicated above and any of the oil performance levels shown in Table L-1. EVIDENCE OF SATISIFACTORY PERFORMANCE (see section under this title) is desired where new formulation SAE 40 or SAE 30 oils will be used. Selection of the appropriate viscosity grade is shown In Table L-2.

Multigrade Lubricants

Multigrade oils have not provided performance comparable to SAE-40 or SAE-30 lubricants In some engine service applications. Because of this experience, the use of 1 5W-40 and all other multigrade oils is not recommended for Series 149 engines, and restrained usage in Series 53, 71 and 92 engines is advised If the use of a 15W-40 multigrade oil in Series 53, 71 or 92 engines is being considered, It must meet the CD/SE oil performance level shown in Table L-1. Table L-2 indicates that 15W-40 multigrades may be selected when ambient temperatures are at, or less than, freezing. However, because our experience has disclosed that the performance of straight grade oils has been superior to multigrade oils in some service applications, Detroit Diesel recommends that the user obtain proven service experience and evidence of satisfactory performance supplied by the lube oil manufacturer or follow the guidelines in the section entitled, "EVIDENCE OF SATISFACTORY PERFORMANCE." Upon request, the Detroit Diesel Allison Regional Office will counsel with customers in selecting a lubricating oil that will be suitable for their specific needs.

Other Multigrade Oils

Detroit Diesel Allison does not recommend the use of 1 OW-30, 1 OW-40, 20W-40 or any other multigrade oils in 2-cycle engines. As previously indicated, 15W-40 oils are the only lubricants that should be considered if prolonged severe cold, ambient temperatures, are expected.

EVIDENCE OF SATISFACTORY PERFORMANCE

It is recommended that evidence of satisfactory lubricant performance in Detroit Diesel 2-cycle engines be obtained from the oil supplier prior to procurement. Controlled oil performance evaluations in field test engines are recommended. The type of field test used by the oil supplier depends on the Series engine in which the candidate oil will be used and the service application. This information is summarized in Table L-3. The candidate test oil-operated engines should all operate for the mileage/hours indicated. Fuel and lube oil consumption should be monitored during the test period. Any serious mechanical problems experienced should be recorded. All of the oil test engines should be disassembled at the conclusion of the oil test period and inspected. The following oil performance parameters should be compared.

- Ring sticking tendencies and/or ring conditions
- Piston skirt scuffing and cylinder liner wear and scuffing Exhaust valve face and seat deposits
- Piston pin and connecting rod bushings (Note Trunk pistons used In Series 53 engines)
- Overall valve train and bearing wear levels.

USED LUBE OIL ANALYSIS PROGRAM

A used lube oil analysis program should be conducted In conjunction with the oil performance field test. In order to determine the condition of the lube oil that will prevail when subjected to various engine operational modes in specific service applications, it is recommended that frequent oil samples be investigated This subject is more comprehensively addressed In the OIL CHANGES section below.

OIL CHANGES

Table L-4 shows the Initial oil drain Intervals for all Series 2-cycle engines used in the various service applications Oil drain intervals in all service applications may be Increased or decreased with experience using a specific lubricant. Detroit Diesel Alllson recommends the use of a controlled, used lube oil analysis monitoring program This is especially prudent when extended oil drain intervals (e.g., 100,000 miles) are being considered. The frequency at which used lube oil samples are obtained may be scheduled for the same period as when other preventive maintenance is conducted. For example, a used lube oil sample for analysis may be obtained every 10,000 miles when engines are brought in for fuel and coolant filter replacement. Table L-5 shows the routine specific laboratory tests that are recommended. Sometimes further confirmatory tests are required, especially when fuel and/or coolant dilution is suspected. Table L-5 indicates the routine and confirmatory tests recommended The lube oil should be drained if any of the maximum tolerable warning limits are exceeded.

THE INFLUENCE OF DIESEL FUEL SULFUR CONTENT ON LUBE OIL CHANGE INTERVALS

Table L-4 shows the reduced oil drain intervals that are recommended if the use of high sulfur fuel is unavoidable. The use of diesel fuels having a sulfur content exceeding 0.50% by weight can have a negative effect on piston ring life and lube oil deposit levels. For this reason, it is recommended that oil drain intervals be drastically shortened to minimize the adverse effect of acid build-up in the lubricant. These relatively short oil drain intervals may be altered if a lubricant with high alkaline reserve (i.e., high TBN ASTM D-664) and low sulfated ash (i.e., less than 1.000% by weight ASTM D-874) can be obtained. Table L-5 indicates that the TBN of the used oil should never be less than 1.0 (ASTM D-664). If laboratory analysis reveals that the TBN is less than 1.0, this is an indication that the acceptable drain interval has been exceeded.

MIL-L-46167 ARCTIC LUBE OILS FOR NORTH SLOPE AND OTHER EXTREME SUB-ZERO OPERATIONS

Lubricants meeting this specification are used in Alaska and other extreme sub-zero locations. Generally, they may be described as 5W-20 multigrade lubricants made up of synthetic base stock and manifesting low volatility characteristics. Although they have been used successfully in some severe cold regions, Detroit Diesel Allison does not consider their use as desirable as the use of SAE-40 or SAE-30 oils with auxiliary heating aids. For this reason, they should be considered only where engine cranking is a severe problem and auxiliary heating aids are not available on the engine.

EMD (RR) OILS

Lubricants qualified for use in Electro-Motive Division (EMD) diesel engines may be used in Detroit Diesel 2-cycle engines provided the sulfated ash (ASTM D-874) content does not exceed 1.000% by weight. These lubricants are frequently desired for use in applications where both Detroit Diesel and Electro-Motive powered units are operated. These fluids may be described as SAE-40 lubricants that possess medium Viscosity Index properties and do not contain any zinc additives.

SYNTHETIC OILS

Synthetic lubricants may be used in Detroit Diesel 2-cycle engines provided the ash limit, zinc requirements, and specified oil performance levels (for example, CD/SE or MIL-L-2104B, etc.) shown elsewhere in this specification are met Viscosity grades SAE-40 or SAE-30 are recommended.

LUBE OIL FILTER CHANGE INTERVAL

Full-Flow Filters

A full-flow filtration system is used in all Detroit Diesel 2-cycle engines To ensure against physical deterioration of the filter element, it should be replaced at a maximum of 25,000 miles for on-highway vehicles. For all other applications, the filter should be replaced at a maximum of 500 hours.

OIL CHANGE INTERVAL BASED ON SURVEY OF SATISFIED END USERS

A number of successful Detroit Diesel (2-cycle engine) customers in numerous service applications do not utilize oil analysis procedures. They prefer conservative lube oil drain and filter change intervals.

Lubricant and filters were changed based on experience, and the customer felt he saved money in eliminating costly lube oil analysis programs. Naturally, Detroit Diesel supports the lube oil and filter change practices used in these successful service operations.

Large 149 Series Engines Powering Off-Road Equipment (Construction & Mine Site Service Applications)

Oil Change Interval	150 Hours
Filter Change Interval	300 Hours

City Transit Coaches

Oil Change Interval	12,500 Miles
Filter Change Interval	25,000 Miles

Pickup & Delivery Metro Area Truck Service

Oil Change Interval	12,000 Miles
Filter Change Interval	24,000 Miles

Stationary (Usually Stand By) Engines

Oil Change Interval	150 Hours or One Year
Filler Change Interval	300 Hours or One Year

LUBE OIL PERFORMANCE LEVELS

API Letter Code Service Classification	Military Specification	SAE Grade
CB	MIL-L-2104A (Supplement 1)	40 or 30
CC	MIL-L-2104B	40 or 30
CD	MIL-L-45199B (Series 3)	40 or 30
CC/SE	MIL-L-46152	40 or 30
CD/SC	MIL-L-2104C	40 or 30
Numerous Combinations of Above	Single Grade Universal No MIL- Spec.	40 or 30
CD/SE	Multigrade Universal No MIL- Spec.	15W-40

Table I -1

VISCOSITY GRADE SELECTION

AMBIENT TEMPERATURE degrees Celsius	AMBIENT TEMPERATURE degrees Fahrenheit	RECOMMENDATIONS PRIMARY	SECONDARY	THIRD
		SAE 40	SAE 30	None
10	50	SAE 40 Plus Starting Aids	SAE 30 Usually Unaided	None
0	32	SAE 40 Plus Starting Aids	SAE 30 Plus Starting Aids	15W-40 Usually Unaided
18	0	SAE 40 Plus Starting Aids	SAE 30 Plus Starting Aids	15W-40 Plus Starting Aids

Table I -2

INDIVIDUAL USER SERVICE APPLICATION LUBE FIELD TESTING

Engine Series	Service Application	Test Duration	No. Engines on Candidate Test Oil	No. Sister Engines on Reference Baseline SAE 40 or SAE 30
53	Pickup & Delivery Metro Area	50,000 Miles	5	5
71 & 92	Hwy. Truck 72,000 Lbs. GCW	200,000 Miles	5	5
149	Off Road Rear Dump 120 Ton	10,000 Hours	3*	3

*Single Grade Only - No Multigrades Recommended For Series 149 Engines

Table I -3

LUBE OIL DRAIN INTERVAL

Service Application	Engine Series	Max. Lube Oil Drain Interval* Diesel Fuel Sulfur Content Wt. % 0 to 0.50	0.51 to 0.75	0.76 to 1.00
Hwy. Truck (Long Distance Hauls) and Inter-City Buses	71 & 92	100,000 Miles**	20,000 Miles	10,000 Miles
City Transit Coaches and Pickup and Delivery Truck Service (Stop-And-Go Short Distance	53, 71, 92	12,500 Miles	2,500 Miles	1,250 Miles
Industrial and Marine	53, 71, 92	150 Hours	30 Hours	15 Hours +
Large Industrial and Marine	149	(NA) 500 Hours (T) 300 Hours	100 Hours 60 Hours	50 Hours + 30 Hours +

*Maximum lube oil drain intervals must be based on the laboratory test results obtained from used lube oil samples.

**If supported by oil analysis at 10,000 mile intervals or when recommended fuel filter maintenance is performed.

+ These oil change intervals are based upon worst case with chrome-faced rings. Oil change periods with plasma-faced rings can be established by oil analysis.

Table I-4

USED LUBE OIL ANALYSIS WARNING VALUES

	ASTM Designation	Limits	Routine Or Confirmatory
Pentane Insolubles, Wt. %, Max.	D-893	1.00	Routine
TGA Carbon (Soot) Content, Wt. %, Max.	None	0.80	Routine
Viscosity at 100°F, SUS	D-445		Routine
% Max. Increase	&	40.00	
% Max. Decrease	D-2161	15.00	
Iron Content, PPM., Max.	None	150.00	Routine
Total Base Number (TBN), Min.	D-664	1.00	Routine
Water Content, Vol. %, Max.	D-95	0.30	Confirmatory
Flash Point, °F, Max. Reduction	D-92	40.00	Confirmatory
Fuel Dilution, Vol. %, Max.	—	2.50	Confirmatory
Glycol Dilution, PPM., Max.	D-2982	1000.00	Confirmatory
Sodium Content, PPM., Max. Allowed Over Lube Oil Baseline	—	50.00	Routine
Boron Content, PPM., Max. Allowed Over Lube Oil Baseline	—	20.00	Routine

Table I-5

MISCELLANEOUS FUEL AND LUBRICANT INFORMATION

ENGINE OIL CLASSIFICATION SYSTEM

The American Petroleum Institute (API), the Society of Automotive Engineers (SAE), and the American Society for Testing and Materials (ASTM) jointly have developed the present commercial system for designating and identifying motor oil classifications. The table in this section shows a cross-reference of current commercial and military lube oil identification and specification systems.

PUBLICATION AVAILABLE SHOWING COMMERCIAL "BRAND" NAME LUBRICANTS

A list of "brand" name lubricants distributed by the majority of worldwide oil suppliers can be purchased front the Engine Manufacturers Association (EMA). The publication is titled *EMA Lubricating Oils Data Book for Heavy-Duty Automotive and Industrial Engines*. The publication shows the brand names, oil performance levels, viscosity grades, and sulfated ash contents of most "brands" marketed.

ENGINE MANUFACTURERS ASSOCIATION
111 EAST WACKER DRIVE
CHICAGO, ILLINOIS 60601

Upon request, the Detroit Diesel Allison Regional Office will counsel with customers in selecting a lubricating oil that will be suitable for their specific needs.

STATEMENT OF POLICY ON FUEL AND LUBRICANT ADDITIVES

In answer to requests concerning the use of fuel and lubricating oil additives, the following excerpt has been taken from a policy statement of General Motors Corporation:

"It has been and continues to be General Motors policy to build motor vehicles that will operate satisfactorily on the commercial fuels and lubricants of good quality regularly provided by the petroleum industry through retail outlets."

Therefore, Detroit Diesel Allison does not recommend the use of any supplementary fuel or lubricant additives.

These include all products marketed as fuel conditioners, smoke suppressants, masking agents, reodorants, tuneup compounds, top oils, break-in oils, graphitizers, and friction-reducing compounds.

NOTICE: The manufacturer's warranty applicable to Detroit Diesel engines provides in part that the provisions of such warranty shall not apply to any engine unit which has been subject to misuse. negligence or accident. Accordingly, malfunctions attributable to neglect or failure to follow the manufacturer's fuel or lubricating recommendations may not be within the coverage of the warranty.

CROSS REFERENCE OF LUBE OIL CLASSIFICATION SYSTEM

API CODE LETTERS	COMPARABLE MILTARY OR COMMERCIAL INDUSTRY SPECIFICATION
CA	MIL-L-2104A
CB	Supplement 1
CC	MIL-L-2104B (See Note Below)
CD	MIL-L-45199B (Series 3)
‡	MIL-L-46152 (Supersedes MIL-L-2104B Military Only)
□	MIL-L-2104C (Supersedes MIL-L-45199B for Military Only)
SA	None
SB	None
SC	Auto Passenger Car 1964 MS Oils - Obsolete System
SD	Auto Passenger Car 1968 MS Oils - Obsolete System
SE	Auto Passenger Car 1972 MS Oils - Obsolete System
SF	Auto Passenger Car 1980 Production
‡	Oil performance meets or exceeds that of CC and SE oils.
□	Oil performance meets or exceeds that of CD and SC oils.

NOTE: MIL-L-2104B lubricants are obsolete for military service applications only.
MIL-L-2104B lubricants are currently marketed and readily available for commercial use.

Consult the following publications for complete descriptions:

1. Society of Automotive Engineers (SAE) Technical Report J-1 83a.
2. Federal Test Method Standard 791a.

ENGINE COOLANT

The coolant provides a medium for heat transfer and controls the internal temperature of the engine during operation. In an engine having proper coolant flow, the heat of combustion is conveyed through the cylinder walls and the cylinder head into the coolant. Without adequate coolant, normal heat transfer cannot take place within the engine, and engine temperature rapidly rises. In general, water containing various materials in solution is used for this purpose.

The function of the coolant is basic to the design and to the successful operation of the engine. Therefore, coolant must be carefully selected and properly maintained.

COOLANT REQUIREMENTS

Coolant solutions must meet the following basic requirements:

1. Provide for adequate heat transfer.

2. Provide a corrosion-resistant environment within the cooling system.

3. Prevent formation of scale or sludge deposits in the cooling system.

4. Be compatible with the cooling system hose and seal materials.

5. Provide adequate freeze protection during cold weather operation.

The first four requirements are satisfied by combining a suitable water with reliable inhibitors. When freeze protection is required, a solution of suitable water and an antifreeze containing adequate inhibitors will provide a satisfactory coolant. Ethylene glycol-based antifreeze is recommended for use in Detroit Diesel engines.

WATER

Any water, whether of drinking quality or not, will produce a corrosive environment in the cooling system, and the mineral content may permit scale deposits to form on internal cooling system surfaces. Therefore, water selected as a coolant must be properly treated with inhibitors to control corrosion and scale deposition.

To determine if a particular water is suitable for use as a coolant when properly inhibited, the following characteristics must be considered: the concentration OOLANT of chlorides and sulfates, total hardness and dissolved solids.

Chlorides and/or sulfates tend to accelerate corrosion, while hardness (percentage of magnesium and calcium salts broadly classified as carbonates) causes deposits of scale. Total dissolved solids may cause scale deposits, sludge deposits, corrosion or a combination

	PARTS PER MILLION	GRAINS PER GALLON
Chlorides (Maximum)	40	2.5
Sulfates (Maximum)	100	5.8
Total Dissolved Solids (Maximum)	340	20
Total Hardness (Maximum)	170	10

TABLE 1

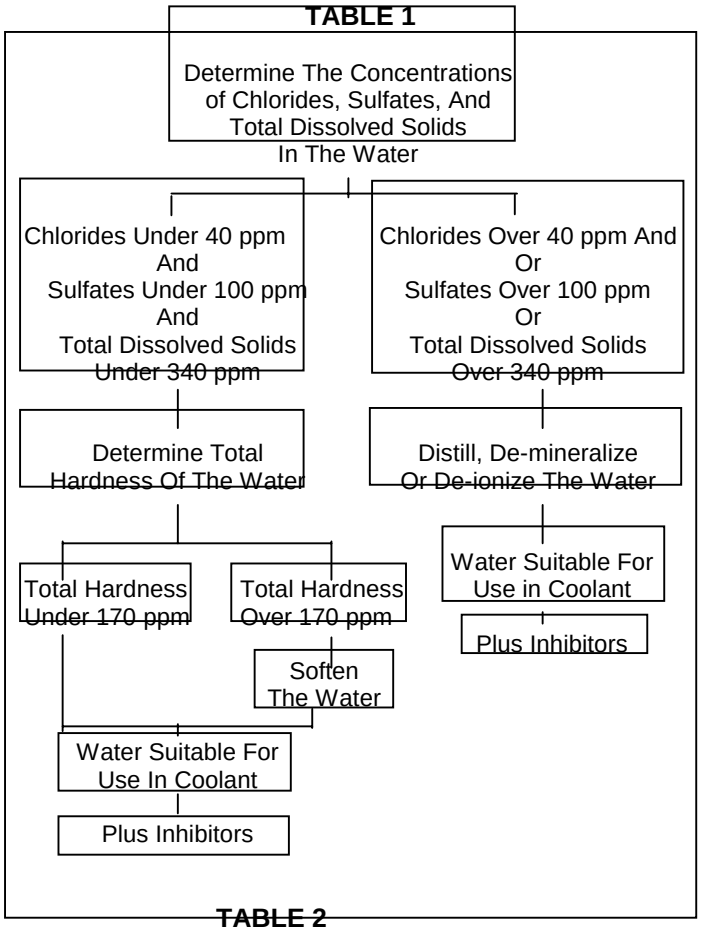


TABLE 2

of these. Chlorides, sulfates, magnesium and calcium are among the materials which make up dissolved solids. Water, within the limits specified in Table 1 is satisfactory as an engine coolant when proper inhibitors are added. The procedure for evaluating water intended for use in a coolant solution is shown in Table 2.

CORROSION INHIBITORS VITAL

A corrosion inhibitor is a water-soluble chemical compound which protects the metallic surfaces of the cooling system against corrosive attack. Some of the more commonly used corrosion inhibitors are chromates, borates, nitrates, nitrites and soluble oil. (Soluble oil is not recommended as a corrosion inhibitor). Depletion of all types of inhibitors occurs through normal operation. Therefore, strength levels must be maintained by the addition of inhibitors at prescribed intervals.

The importance of a properly inhibited coolant cannot be overstressed. A coolant which has insufficient inhibitors, the wrong inhibitors, or-worse-no inhibitors at all invites the formation of rust and scale deposits within the cooling system. Rust, scale, and mineral deposits can wear out water pump seals and coat the walls of the cylinder block water jackets and the outside walls of the cylinder liners. As these deposits build up, they insulate the metal and reduce the rate of heat transfer. For example, a 1/16" deposit of rust or scale on 1" of cast iron is equivalent to 4-1/4" of cast iron in heat transferability (Fig. 1).

An engine affected in this manner overheats gradually over a period of weeks or months. Liner scuffing, scoring, piston seizure and cylinder head cracking are the inevitable results. An improperly inhibited coolant can also become corrosive enough to "eat away" coolant passages and seal ring grooves and cause coolant leaks to develop. If sufficient coolant accumulates on top of a piston, a hydrostatic lock can occur while the engine is being started. This, in turn, can result in a bent connecting rod. An improperly inhibited coolant can also

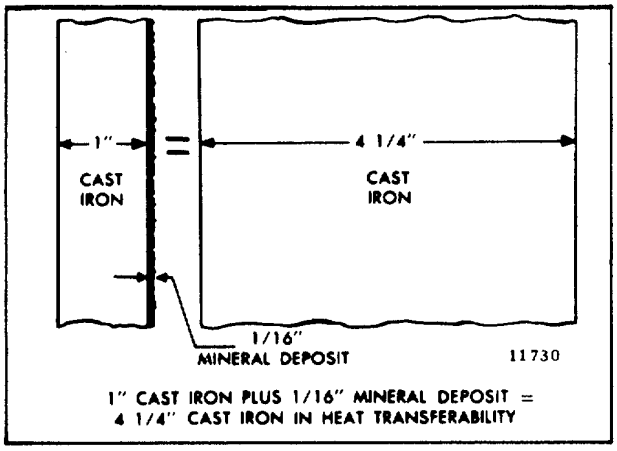


Fig. 1 - Heat Transfer Capacity

contribute to *cavitation erosion*. Cavitation erosion is caused by the collapse of bubbles (vapor pockets) formed at the coolant side of an engine component. The collapse results from a pressure differential in the liquid caused by the vibration of the engine part. As bubbles collapse, they form pin points of very high pressure. Over a period of time, the rapid succession of millions of tiny bursting bubbles can wear away (erode) internal engine surfaces.

Components such as fresh water pump impellers and cylinder liners are especially susceptible to cavitation erosion. In extreme cases their surfaces can become so deeply pitted that they appear to be spongy, and holes can develop completely through them.

Chromates

Sodium chromate and potassium dichromate are two of the best and most commonly used *water* system corrosion inhibitors. Care should be exercised in handling these materials due to their toxic nature.

Chromate inhibitors should *not* be used in antifreeze solutions. Chromium hydroxide, commonly called "green slime", can result from the use of chromate inhibitors with antifreeze. This material deposits on the cooling system passages and reduces the heat transfer rate (Fig. 1) which results in engine overheating. Engines which have operated with a chromate-inhibited water must be chemically cleaned before the addition of antifreeze. A commercial heavy duty descaler should be used in accordance with the manufacturer's recommendation for this purpose.

Soluble Oil

Soluble oil has been used as a corrosion inhibitor for many years. It has, however, required very close attention relative to the concentration level due to adverse effects on heat transfer if the concentration exceeds 1% by volume. For example: 1.25% of soluble oil in the cooling system increases fire deck temperatures 6% and a 2.50% concentration raises fire deck temperature up to 15%. *Soluble oil is not recommended as a corrosion inhibitor.*

Non-Chromates

Non-chromate inhibitors (borates, nitrates, nitrites, etc.) provide corrosion protection in the cooling system with the basic advantage that they can be used with either water or a water-and-antifreeze solution.

INHIBITOR SYSTEMS

An inhibitor system is a combination of chemical compounds which provide corrosion protection, pH control and water-softening ability. Corrosion protection is discussed under the heading *Corrosion Inhibitors Vital*. The pH control is used to maintain an acid-free solution. The water-softening ability deters formation of mineral deposits. Inhibitor systems are available in various forms such as coolant filter

elements, liquid and dry bulk inhibitor additives and as an integral part of antifreeze.

Commercially packaged inhibitor systems are available which can be added directly to the engine coolant or to bulk storage tanks containing coolant solution. Both chromate and non-chromate systems are available and care should be taken regarding inhibitor compatibility with other coolant constituents.

Non-chromate inhibitor systems are recommended for use in Detroit Diesel engines. These systems can be used with either water or water-and-antifreeze solutions and provide corrosion protection, pH control and water softening. Some non-chromate inhibitor systems offer the additional advantage of a simple on-site test to determine protection level. Since they are added directly to the coolant, require no additional hardware or plumbing.

All inhibitors become depleted through normal operation and additional inhibitor must be added to the coolant at prescribed intervals to maintain original strength levels. Always follow the supplier's recommendations on inhibitor usage and handling.

TEST STRIPS

Some chemical manufacturers have developed *test strips* for use with their antifreeze or coolant additives.

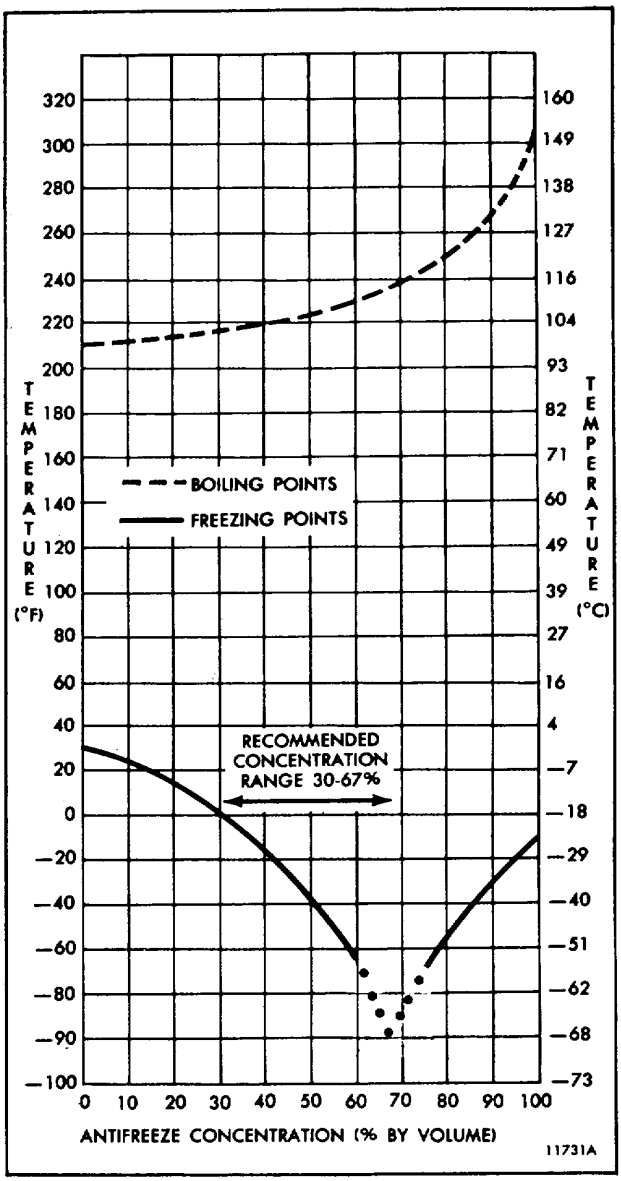


Fig. 2 - Coolant Freezing and Boiling Temperatures vs. Antifreeze Concentration (Sea Level)

These test strips are used to measure the freeze protection and/or inhibitor strength of ethylene glycol-based antifreeze. To avoid a false reading caused by variations in reserve alkalinity. Detroit Diesel Allison suggests using test strips that measure depletable inhibitor concentration directly. *Do not use one manufacturer's test strips to measure the chemical content of another's antifreeze and/or inhibitors*. Always follow the manufacturer's recommended test procedures.

ANTIFREEZE

When freeze protection is required, an antifreeze meeting GM specification 1899M must be used. An inhibitor system is included in this type of antifreeze and no additional inhibitors are required on initial fill if a minimum antifreeze concentration of 30% by volume is used. Solutions of less than 30% concentration do not provide sufficient corrosion protection. Concentrations over 67% adversely affect freeze protection and heat transfer rates (Fig. 2).

Ethylene glycol base antifreeze is recommended for use in all Detroit Diesel engines. Methyl alcohol base anitfreeze is not recommended because of its effect on the non-metallic components of the cooling system and because of its low boiling point. Methoxy propanol base antifreeze is not recommended for use in Detroit Diesel engines due to the presence of fluoroelastomer seals in the cooling system.

Before installing ethylene glycol base antifreeze in a unit that has previously operated with methoxy propanol, the entire cooling system should be drained, flushed with clean water, and examined for rust, scale contaminants, etc. If deposits are present, the cooling system must be chemically cleaned with a commercial grade heavy-duty descaler.

The inhibitors in antifreeze should be replenished at approximately 500 hour intervals or by test with a non-chromate inhibitor system. Commercially available inhibitor systems may be used to reinhibit antifreeze solutions.

Sealer Additives

Antifreeze with sealer additives is not recommended for use in Detroit Diesel engines due to plugging possibilities throughout various areas of the cooling system, including cooling system bleed holes and water pump drain holes.

GENERAL RECOMMENDATIONS

All Detroit Diesel engines incorporate pressurized cooling systems which permit operation at temperatures higher than non-pressurized systems. It is essential that these systems be kept clean and leakfree, that filler caps and pressure relief mechanisms be correctly installed at all times and that coolant levels be properly maintained.

Always maintain engine coolant at the proper level. A low coolant level allows the water pump to mix air with the coolant. Air bubbles in the coolant can "insulate" the cylinder walls, preventing normal heat transfer. An abnormally low coolant level can cause the water pump to become (: air-bound," a condition in which it works feverishly but pumps nothing. Without proper heat transfer, silicone elastomer head-to-block water hole seals can deteriorate and cylinder components can expand so that pistons rapidly cut through the lubricant on the liner walls. Scuffing and piston seizure may follow.

CAUTION: Use extreme care when removing a radiator pressure control cap from an engine. The sudden release of pressure from a heated cooling system can result in a loss of coolant and possible personal injury (scalding) from the hot liquid.

An engine may contain the correct amount of properly inhibited coolant, but still fail to adequately cool the engine. In cases where this occurs, other causes of low coolant flow, either engine or cooling system related, should be investigated.

1. Always use a properly inhibited coolant.

2. Do not use soluble oil.

3. Maintain the prescribed inhibitor strength.

4. Always follow the manufacturer’s recommendations on inhibitor usage and handling.

5. If freeze protection is required, use a solution of water and antifreeze meeting GM specification 1899M.

6. Reinhibit antifreeze with a recommended nonchromate inhibitor system.

7. Do not use a chromate inhibitor with antifreeze.

8. Do not use methoxy propanol base antifreeze in Detroit Diesel engines.

9. Do not mix ethylene glycol base antifreeze with methoxy propanol base antifreeze in the cooling system.

10. Do not use antifreeze containing sealer additives.

11. Do not use methyl alcohol base antifreeze.

12. Use extreme care when removing the radiator pressure control cap.

ENGINE TUNE-UP PROCEDURES

There is no scheduled interval for performing an engine tune-up. As long as the engine performance is satisfactory, no tune-up should be needed. Minor adjustments in the valve and injector operating mechanisms, governor, etc. should only be required periodically to compensate for normal wear on parts.

The mechanical engine governors are identified by a nameplate attached to the governor housing.

Normally, when performing a tune-up on an engine in service, it is only necessary to check the various adjustments for a possible change in the settings. However, if the cylinder head, governor or injectors have been replaced or overhauled, then certain preliminary adjustments are required before the engine is started.

The preliminary adjustments consist of the first four items in the tune-up sequence. The procedures are the same except that the valve clearance is greater for a cold engine.

To tune-up an engine completely, perform all of the adjustments in the applicable tune-up sequence given below after the engine has reached normal operating temperature. Since the adjustments are normally made while the engine is stopped, it may be necessary to run the engine between adjustments to maintain normal operating temperature.

Use a new valve rocker cover gasket(s) after the tune-up is completed.

Tune-Up Sequence for Mechanical Governor

NOTE: Before starting an engine after an engine speed control adjustment or after removal of the engine governor cover, the serviceman must determine that the injector racks move to the no-fuel position when the governor stop lever is placed in the stop position. Engine overspeed will result if the injector racks cannot be positioned at no fuel with the governor stop lever.

1. Adjust the exhaust valve clearance.
2. Time the fuel injectors.
3. Adjust the governor gap.
4. Position the injector rack control levers.
5. Adjust the maximum no-load speed.
6. Adjust the idle speed.
7. Adjust the buffer screw.
8. Adjust the throttle booster spring (variable speed governor only).
9. Adjust the supplementary governing device (if used).

EXHAUST VALVE CLEARANCE ADJUSTMENT

The correct exhaust valve clearance at normal engine operating temperature is important for smooth, efficient operation of the engine.

Insufficient valve clearance can result in loss of compression, misfiring cylinders and, eventually, burned valve seats and valve seat inserts. Excessive valve clearance will result in noisy operation, increased valve face wear and valve lock damage.

Whenever the cylinder head is overhauled, the exhaust valves reconditioned or replaced, or the valve operating mechanism is replaced or disturbed in any way, the valve clearance must first be adjusted to the cold setting to allow for normal expansion of the engine parts during the engine warm-up period. This will ensure a valve setting which is close enough to the specified clearance to prevent damage to the valves when the engine is started.

All of the exhaust valves may be adjusted, in firing order sequence, during one full revolution of the crankshaft. Refer to Section 1 of the manual for the engine firing order.

FOUR VALVE CYLINDER HEADS

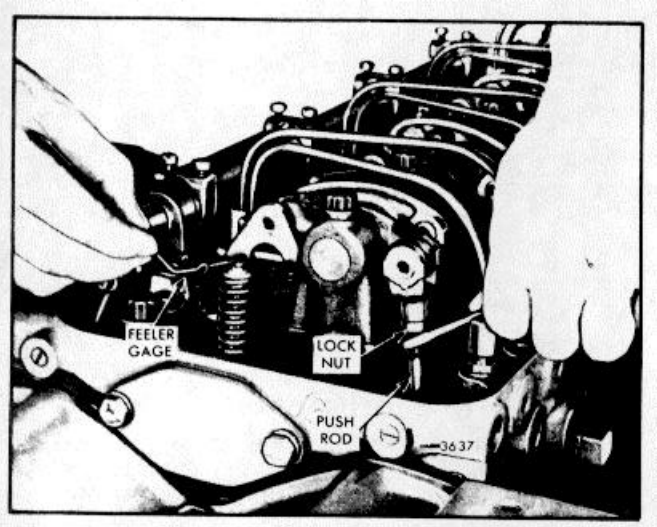


Fig. 2 - Adjusting Valve Clearance (Four-Valve Cylinder Head)

Valve Clearance Adjustment (Cold Engine)

1. Remove the loose dirt from the valve rocker cover(s) and remove the cover(s).

2. Place the governor speed control lever in the *idle* speed position. If a stop lever is provided, secure it in the *stop* position.

3. Rotate the crankshaft. manually or with the starting motor. until the injector follower is fully depressed on the cylinder to be adjusted.

NOTE: If a wrench is used on the crankshaft bolt at the front of the engine, do not turn the crankshaft in a left-hand direction of rotation as the bolt may be loosened.

4. Loosen the exhaust valve rocker arm push rod lock nut.

5. Place a .026" feeler gage (J 9708-01) between the end of one exhaust valve stem and the rocker arm bridge (Fig. 2). Adjust the push rod to obtain a smooth pull on the feeler gage.

6. Remove the feeler gage. Hold the push rod with a 5/16” wrench and tighten the lock nut with a ½” wrench.

7. Recheck the clearance. At this time if the adjustment is correct, the .025" gage will pass, freely between the end of one valve stem and the rocker arm bridge hut the .027" gage will not pass through. Readjust the push rod, if necessary.

8. Check and adjust the remaining exhaust valves, in the same manner as above.

Valve Clearance Adjustment (Hot Engine)

Maintaining normal engine operating temperature is particularly important when making the final valve clearance adjustment. If the engine is allowed to cool off before setting any of the valves. the clearance, when running at full load, may become insufficient.

1. With the engine at normal operating temperature (160-185°F or 71-85'C), recheck the exhaust valve clearance with feeler gage J 9708-01. At this time, if the valve clearance is correct. the .023" gage will pass freely between the end of one valve stem and the rocker arm bridge, but the .025" feeler gage will not pass through. Readjust the push rod, if necessary.

2. After the exhaust valve clearance has been adjusted, check the fuel injector timing.

Check Exhaust Valve Clearance Adjustment

1. With the engine operating at 100' F (38- C) or less, check the valve clearance.

2. If a .026" feeler gage (J 9708-01) ±.006" will pass between the valve stem and the rocker arm bridge. the valve clearance is satisfactory. If necessary adjust the push rod.

FUEL INJECTOR TIMING

To time a fuel injector properly, the injector follower must be adjusted to a definite height in relation to the injector body.

All of the injectors can be timed, in firing order sequence, during one full revolution of the crankshaft. Refer to Section 1 of the manual for engine firing order.

Time Fuel Injector

After the exhaust valve clearance has been adjusted, time the fuel injector as follows:

1. Place the governor speed control lever in the idle speed position. If a stop lever is provided, secure it in the stop position.

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

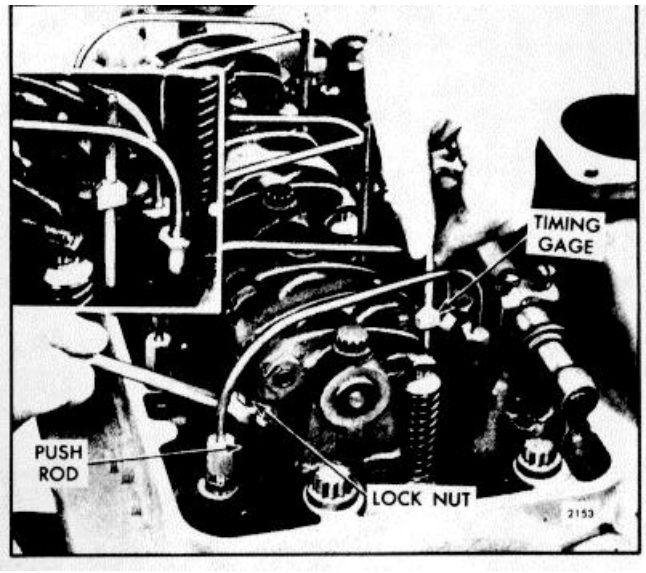


Fig. 3 - Timing Fuel Injector

NOTE: If a wrench is used on the crankshaft bolt at the front of the engine, do not turn the crankshaft in a left-hand direction of rotation as the bolt may be loosened.

3. Place the small end of the injector timing gage in the hole provided in the top of the injector body with the flat of the gage toward the injector follower (Fig. 3). Refer to Table I for the correct timing gage.

4. Loosen the injector rocker arm push rod lock nut.

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

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

7. Time the remaining injectors as outlined above.

8. If no further engine tune-up is required, install the valve rocker cover(s), using a new gasket.

VARIABLE SPEED MECHANICAL GOVERNOR (ENCLOSED LINKAGE) AND INJECTOR RACK CONTROL ADJUSTMENT

IN-LINE

The single-weight variable speed governor is mounted on the rear end plate of the engine and is driven by a gear that extends through the end plate and meshes with either the camshaft gear or the balance shaft gear, depending upon the engine model.

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor and position the injector rack control levers.

NOTE: Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. After the adjustments are completed, reconnect and adjust the supplementary governing device.

Adjust Governor Gap

With the engine stopped and at operating temperature, adjust the governor gap as follows:

1. Disconnect any linkage attached to the governor levers.

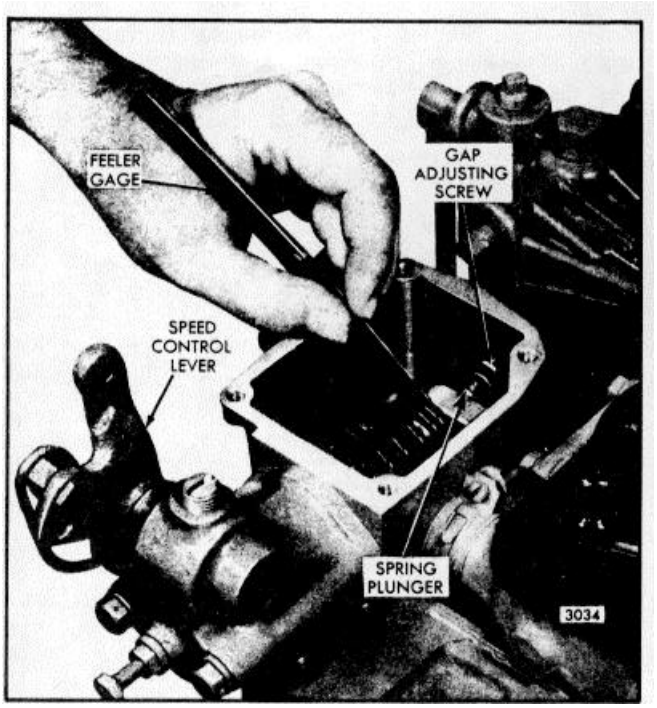


Fig. 1. Checking Governor Gap

2. Back out the buffer screw until it extends approximately 5/8 " from the lock nut.

3. Clean and remove the governor cover and valve rocker cover. Discard the gaskets.

4. Place the speed control lever (Fig. 1) in the maximum speed position.

5. Insert a .006 " feeler gage between the spring plunger and the plunger guide as shown in Fig. 1. If required, loosen the lock nut and turn the gap adjusting screw in or out until a slight drag is noted on the feeler gage.

6. Hold the adjusting screw and tighten the lock nut. Check the gap and readjust if necessary.

7. Use a new gasket and install the governor cover as follows:

   a. Place the cover on the governor housing, with the pin in the throttle shaft assembly entering the slot in the differential lever.

   b. Install the four cover screws and lock washers finger tight.

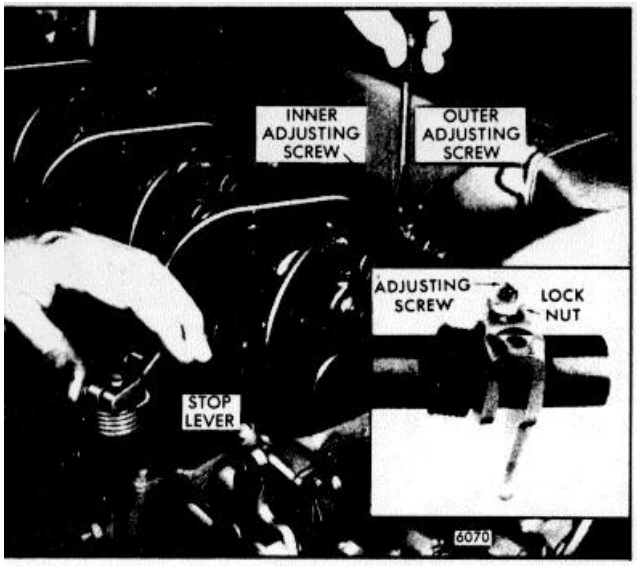


Fig. 2 - Positioning the Rear Injector Rack

c. Pull the cover assembly in a direction away from the engine, to take up the slack, and tighten the cover screws.

NOTE: This step is required since no dowels are used to locate the cover on the housing.

Position Injector Rack Control Levers

The position of the injector control rack levers must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load.

Certain engines use spring-loaded injector control tube assemblies which have a yield spring at each injector rack control lever and only one screw and lock nut to keep each injector rack properly positioned. Adjust the single screw and lock nut on each injector rack control lever the same as for the two screw rack control lever.

Properly positioned injector control rack levers with the engine at full-load will result in the following:

1. Speed control lever at the maximum speed position.

2. Stop lever in the run position.

3. Injector fuel control racks in the full-fuel position.

Adjust the rear injector rack control lever first to establish a guide for adjusting the remaining levers.

1. Loosen all of the inner and outer injector rack control lever adjusting screws (Fig. 2). Be sure all of the levers are free on the injector control tube.

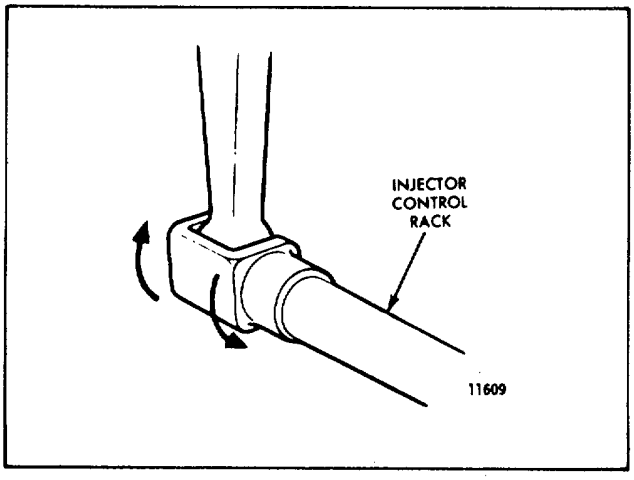


Fig. 3 - Checking Rotating Movement of Injector Control Rack

2. Move the speed control lever to the maximum speed position.

3. Move the stop lever to the run position and hold it in that position with light linger pressure. Turn the inner adjusting screw of the rear injector rack control lever down until a slight movement of the control tube is observed or a step-up in effort to turn the screwdriver is noted. This will place the rear injector rack in the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws. This should result in placing the governor linkage and control tube in the respective positions that they will attain while the engine is running at full load.

NOTE: Over tightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 lb-in(3-4 Nm).

4. To be sure of proper rack adjustment, hold the stop lever in the run position and press down on the injector rack with a screwdriver or finger tip and note "rotating" movement of the injector control rack (Fig. 3). Hold the stop lever in the run position and, using a screwdriver, press downward on the injector control rack. The rack should tilt downward (Fig. 4) and, when the pressure of the screwdriver is released, the control rack should "spring" back upward.

If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw. The setting is too tight if, when moving the stop lever from the stop to the run position, the injector

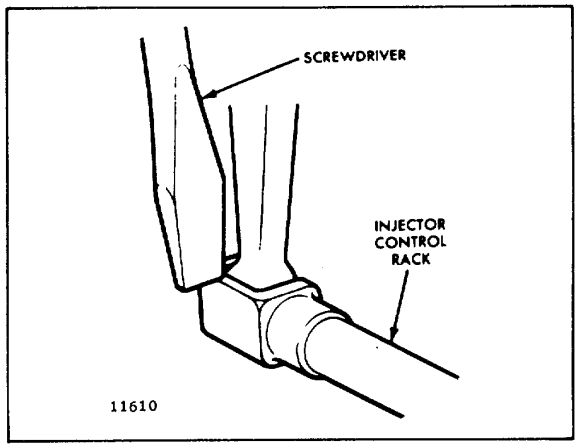


Fig. 4 - Checking Injector Control Rack "Spring"

rack becomes tight before the stop lever reaches the end of its travel. This will result in a step-up in effort required to move the stop lever to the RUN position and a deflection in the fuel rod (fuel rod deflection can be seen at the bend). If the rack is found to be too tight, back off the inner adjusting screw slightly and tighten the outer adjusting screw.

5. To adjust the remaining injector rack control levers, remove the clevis pin from the fuel rod and the injector control tube lever, hold the injector control racks in the full-fuel position by means of the lever on the end of the control tube. Turn down the inner adjusting screw on the injector rack control lever of the adjacent injector until the injector rack has moved into the full-fuel position and the inner adjusting screw is bottomed on the injector control tube. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

6. Recheck the rear injector rack to be sure that it has remained snug on the ball end of the rack control lever while adjusting the adjacent injector rack. If the rack of the rear injector has become loose, back off the inner adjusting screw slightly on the adjacent injector rack control lever and tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective control levers.

7. Position the remaining injector rack control levers as outlined in Steps 4, 5 and 6.

8. When all of the injector rack control levers are adjusted, recheck their settings. With the control tube lever in the full-fuel position, check each control rack as in Step 4. All of the control racks must have the same "spring" condition with the control tube lever in the full-fuel position.

9. Insert the clevis pin in the fuel rod and the injector control tube levers.

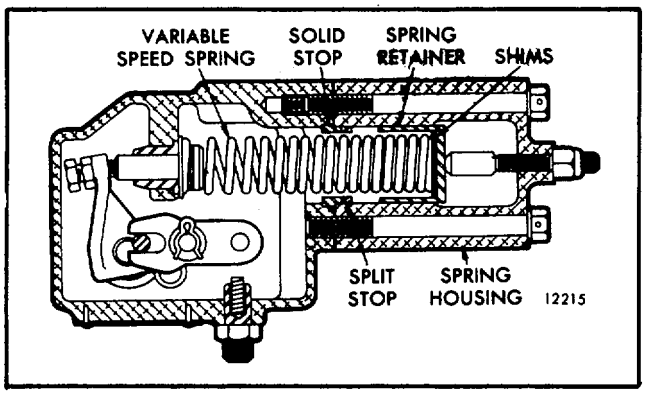


Fig. 5 - Locating of Shims and Stops

10. Use a new gasket and replace the valve rocker cover.

Adjust Maximum No-Load Speed

All governors are properly adjusted before leaving the factory. However, if the governor has been reconditioned or replaced, and to ensure the engine speed will not exceed the recommended no-load speed as given on the option plate, the maximum no-load speed may be set as follows:

Start the engine and after it reaches normal operating temperature, determine the maximum no-load speed of the engine with an accurate tachometer. Then stop the engine and make the following adjustments, if required.

1. Refer to Fig. 8 and disconnect the booster spring and the stop lever retracting spring.

2. Remove the variable speed spring housing and the variable speed spring retainer located inside of the housing.

3. Refer to Table 1 and determine the stops or shims required for the desired full-load speed. Do not use more than four thick and one thin shim. A split stop can only be used with a solid stop (Fig. 5).

Full Load Speed RPM	STOPS		SHIMS
	Solid Ring	Split Ring	
2575-2800	0	0	As Required
2101-2575	1	0	As Required
1701-2100	1	1	As Required
1200-1700	1	2	As Required

TABLE 1

4. Install the variable speed spring retainer and housing and tighten the two bolts.

5. Connect the booster spring and stop lever spring. Start the engine and recheck the maximum no-load speed.

6. If required, add shims to obtain the necessary operating speed. For each .001" in shims added, the operating speed will increase approximately 2 rpm. If the maximum no-load speed is raised or lowered more than 50 rpm by the installation or removal of shims, recheck the governor gap. If readjustment of the

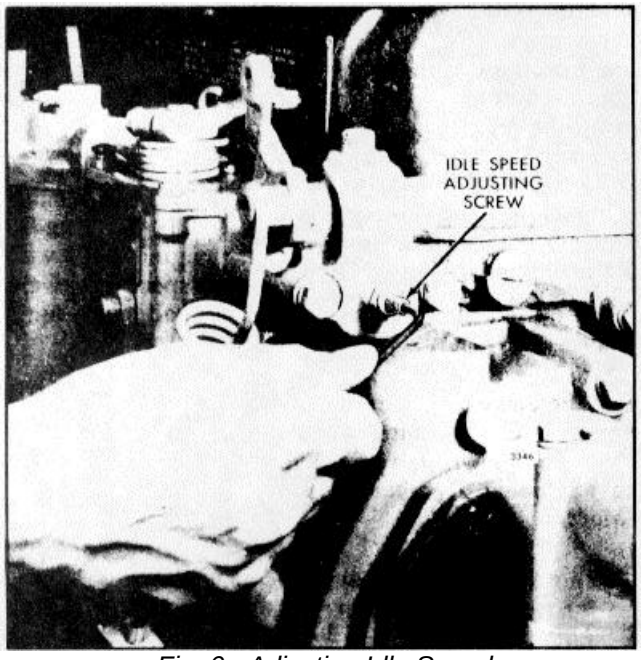


Fig. 6 - Adjusting Idle Speed

governor gap is required, the position of the injector racks must be rechecked.

NOTE: Governor stops are used to limit the compression of the governor spring which determines the maximum speed of the engine.

Adjust Idle Speed

With the maximum no-load speed properly adjusted, adjust the idle speed as follows:

1. Place the stop lever in the run position and the speed control lever in the idle position.

2. With the engine running at normal operating temperature, back out the buffer screw to avoid contact with the differential lever.

3. Loosen the lock nut and turn the idle speed adjusting screw until the engine is operating at approximately 15 rpm below the recommended idle speed (Fig. 6). The recommended idle speed is 550 rpm, but may vary with special engine applications.

4. Hold the idle speed adjusting screw and tighten the lock nut.

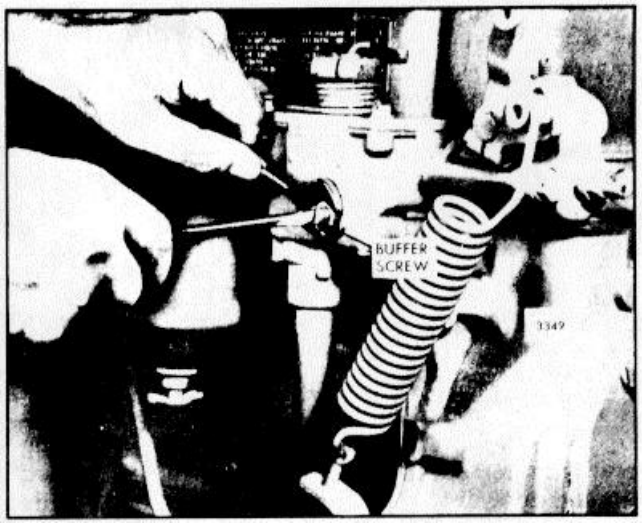


Fig. 7 - Adjusting Buffer Screw

Adjust Buffer Screw

1. With the engine running at normal operating temperature, turn the buffer screw in (Fig. 7) so that it contacts the differential lever as lightly as possible and still eliminates engine roll.

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

2. Hold the buffer screw and tighten the lock nut.

Adjust Booster Spring

With the engine idle speed set, adjust the booster spring as follows:

1. Move the speed control lever to the idle speed position.

2. Refer to Fig. 8 and loosen the booster spring retaining nut on the speed control lever. Loosen the lock nuts on the eye bolt at the opposite end of the booster spring.

3. Move the spring retaining bolt in the slot of the speed control lever until the center of the bolt is on or slightly over center (toward the idle speed position) of an imaginary line through the bolt, lever shaft and eye bolt. Hold the bolt and tighten the lock nut.

4. Start the engine and move the speed control lever to the maximum speed position and release it. The speed control lever should return to the idle speed position. If it does not, reduce the tension on the booster spring. If the lever does return to the idle position, continue to increase the spring tension until the point is reached

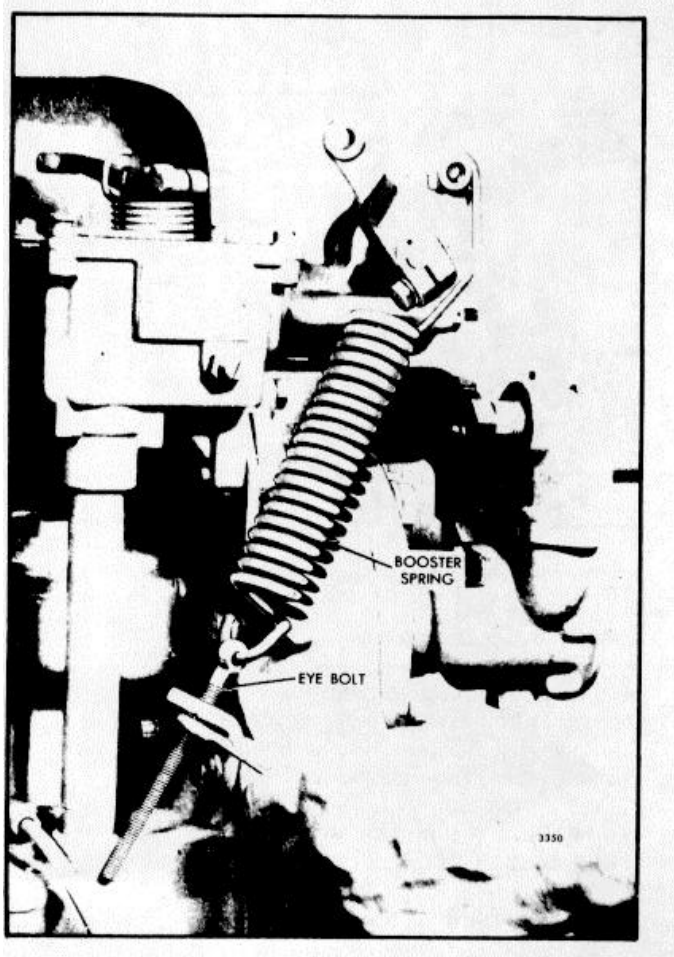


Fig. 8 - Adjusting Booster Spring

where it will not return to idle. Then reduce the spring tension until the lever does return to idle and tighten the lock nuts on the eye bolt. This setting will result in the minimum force required to operate the speed control lever.

5. Connect the linkage to the governor levers.

If the engine is equipped with a supplementary governing device, adjust it at this time.

ADJUSTMENT OF MECHANICAL GOVERNOR SHUTDOWN SOLENOID

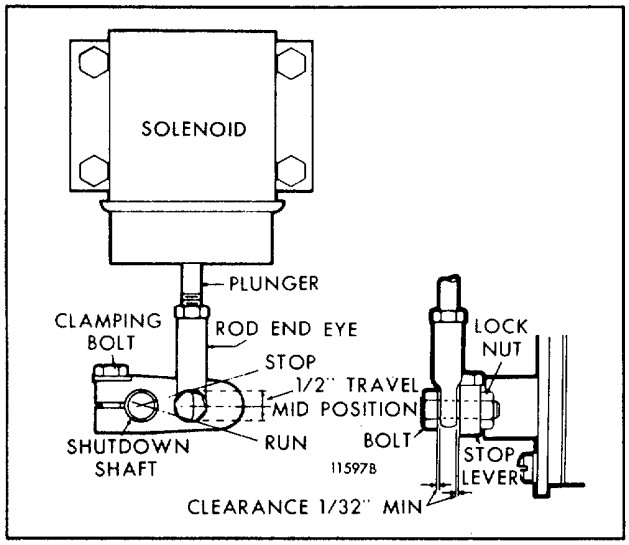


Fig. 7 - Typical Variable Speed Governor Lever Position

When a governor shutdown solenoid is used on an engine equipped with a mechanical governor, the governor stop lever must be properly adjusted to match the shutdown solenoid plunger travel.

The solenoid plunger can be properly aligned to the governor stop lever as follows:

1. Remove the bolt connecting the rod end eye (variable speed governor), or the right angle clip (limiting speed governor) to the stop lever (Figs. 7 and 8). Align and clamp the lever to the shutdown shaft in such a way that, at its mid-travel position, it is perpendicular to the solenoid plunger. This assures that the linkage will travel as straight as possible. The solenoid plunger has available 1/2 " travel which is more than adequate to move the injector control racks from the full-fuel to the complete no-fuel position and shutdown will occur prior to attaining complete travel.

2. With the stop lever in the run position, adjust the rod end eye or right angle clip for minimum engagement on the solenoid plunger when the connecting bolt is installed. The oversize hole in the eye or clip will thereby permit the solenoid to start closing the air gap, with a resultant build-up of pull-in force prior to initiating stop lever movement.

3. The bolt through the rod end eye or the right angle clip should be locked to the stop lever and adjusted to a height that will permit the eye or clip to float vertically. The clearance above and below the eye or clip and the bolt head should be approximately 1/32" minimum.

NOTE: The lock nut can be either on top of or below the stop lever.

4. Move the lever to the stop position and observe the plunger for any possible bind. If necessary, loosen the mounting bolts and realign the solenoid to provide free plunger motion.

STORAGE

PREPARING ENGINE FOR STORAGE

When an engine is to be stored or removed From operation for a period of Lime, special precautions should be taken to protect the interior and exterior of the engine, transmission and other parts from rust accumulation and corrosion. The parts requiring attention and the recommended preparations are given below.

It will be necessary to remove all rust or corrosion completely from any exposed part before applying a rust preventive compound. Therefore, it is recommended that the engine be processed for storage as soon as possible after removal from operation.

The engine should be stored in a building which is dry and can be heated during the winter months. Moisture absorbing chemicals are available commercially for use when excessive dampness prevails in the storage area.

TEMPORARY STORAGE (30 days or less)

To protect an engine for a temporary period of time, proceed as follows:

1. Drain the engine crankcase.

2. Fill the crankcase to the proper level with the recommended viscosity and grade of oil.

3. Fill the fuel tank with the recommended grade of fuel oil. Operate the engine for two minutes at 1200 rpm and no load.

   NOTE: Do not drain the fuel system or the crankcase after this run.

4. Check the air cleaner and service it, if necessary, as outlined under Air System.

5. If freezing weather is expected during the storage period, add a high boiling point-type antifreeze solution in accordance with the manufacturer's recommendations. Drain the raw water system and leave the drain cocks open.

6. Clean the entire exterior of the engine (except the electrical system) with fuel oil and dry it with air.

7. Seal all of the engine openings. The material used for this purpose must be waterproof, vapor proof and possess sufficient physical strength to resist puncture and damage from the expansion of entrapped air.

An engine prepared in this manner can be returned to service in a short time by removing the seals at the engine openings, checking the engine coolant, fuel oil, lubricating oil, transmission, and priming the raw water pump, if used.

EXTENDED STORAGE (more than 30 days)

When an engine is to be removed from operation for an extended period of time, prepare it as follows:

1. Drain and thoroughly flush the cooling system with clean, soft water.

2. Refill the cooling system with clean, soft water.

3. Add a rust inhibitor to the cooling system (refer to Corrosion Inhibitor under Cooling System).

4. Remove, check and recondition the injectors, if necessary, to make sure they will be ready to operate when the engine is restored to service.

5. Reinstall the injectors in the engine, time them, and adjust the valve clearance.

6. Circulate the coolant through the entire system by operating the engine until normal operating temperature is reached (160-185°F or 71-85°C).

7. Stop the engine.

8. Remove the drain plug and completely drain the engine crankcase. Reinstall and tighten the drain plug. Install new lubricating oil filter elements and gaskets.

9. Fill the crankcase to the proper level with a 30-weight preservative lubricating oil MIL-L-21260, Grade 2 (P10), or equivalent.

10. Drain the engine fuel tank.

11. Refill the fuel tank with enough rust preventive fuel oil such as American Oil Diesel Run-In Fuel (LF 4089), Mobil 4Y17, or equivalent, to enable the engine to operate 10 minutes.

12. Drain the fuel filter and strainer. Remove the retaining bolts, shells and elements. Discard the used elements and gaskets. Wash the shells in clean fuel oil and insert new elements. Fill the cavity between the element and shell about two-thirds full of the same rust preventive compound as used in the fuel tank and reinstall the shell.

13. Operate the engine for 10 minutes to circulate the rust preventive throughout the engine.

14. Refer to Air System and service the air cleaner.

PROCEDURE FOR RESTORING AN ENGINE TO SERVICE WHICH HAS BEEN IN EXTENDED STORAGE

1. Remove the covers and tape from all of the openings of the engine, fuel tank, and electrical equipment. DO NOT OVERLOOK THE EXHAUST OUTLET.

2. Wash the exterior of the engine with fuel oil to remove the rust preventive.

3. Remove the rust preventive from the flywheel.

4. Remove the paper strips from between the pulleys and the belts.

5. Remove the drain plug and drain the preservative oil from the crankcase. Reinstall the drain plug. Then refer to Lubrication System in the Operating Instructions and fill the crankcase to the proper level with the recommended grade of lubricating oil.

6. Fill the fuel tank with the fuel specified under Diesel Fuel Oil Specifications.

7. Close all of the drain cocks and fill the engine cooling system with clean soft water and a rust inhibitor. If the engine is to be exposed to freezing temperatures, add a high boiling point-type antifreeze solution to the cooling system (the antifreeze contains a rust inhibitor).

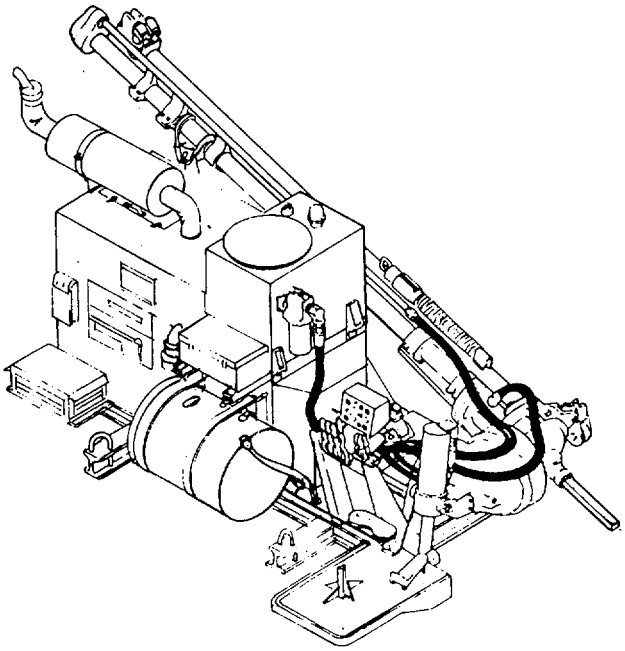
8. Install and connect the battery.

9. Service the air cleaner as outlined under Air System.

PART II

PARTS MANUAL

FOR
AUGER, EARTH, SKID MOUNTED
TEXOMA MODEL 270-9
REEDRILL INC.
(NSN 3820-01-146-7204)



A

HOW TO USE YOUR PARTS MANUAL

USE THIS SECTION GUIDE TO LOCATE THE ASSEMBLY OR MAJOR COMPONENTS YOU NEED.

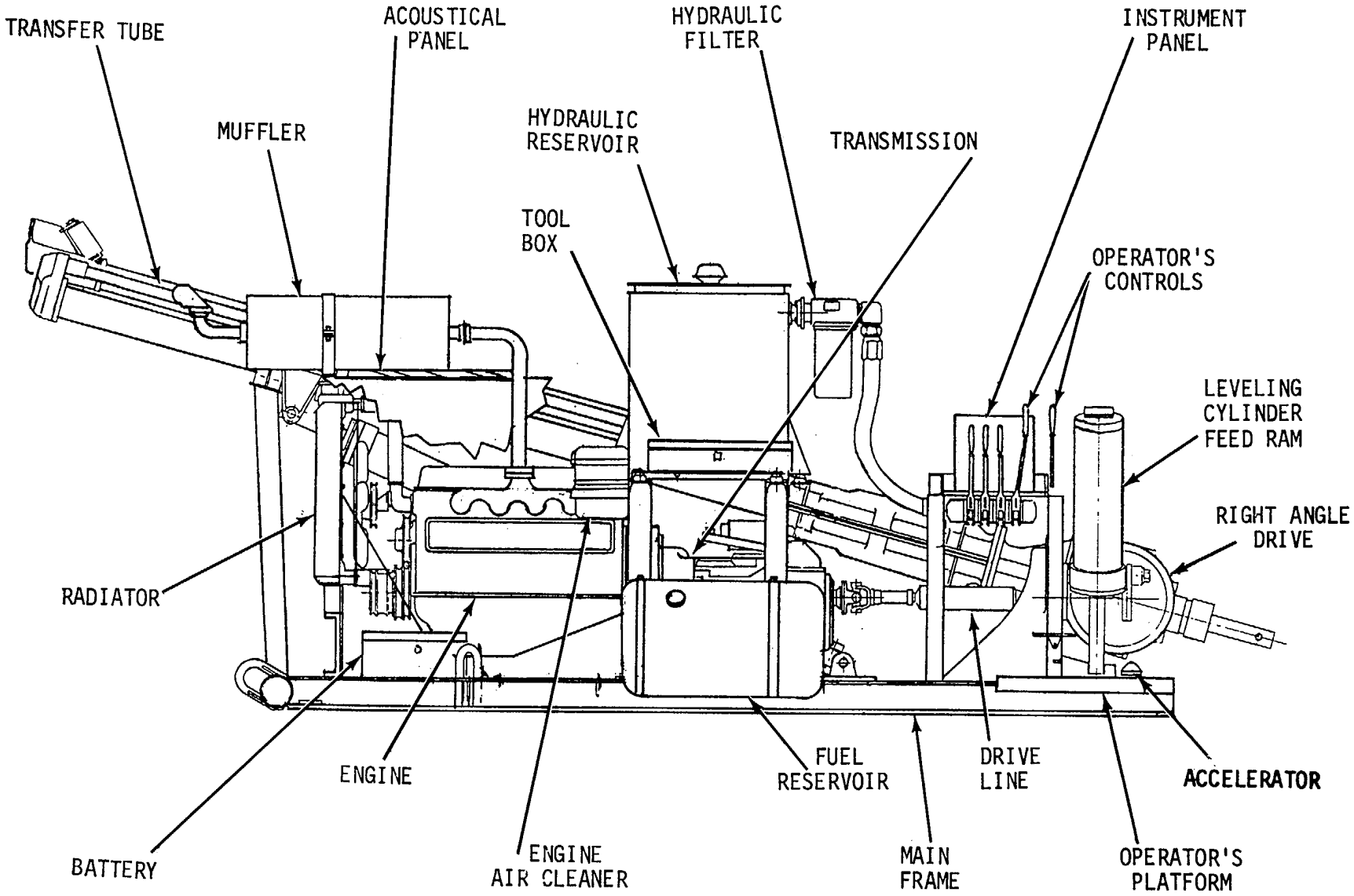
USE THE INDEX ON THE FOLLOWING PAGE TO LOCATE THE ASSEMBLY OR SUB-ASSEMBLY YOU NEED.

PAGE

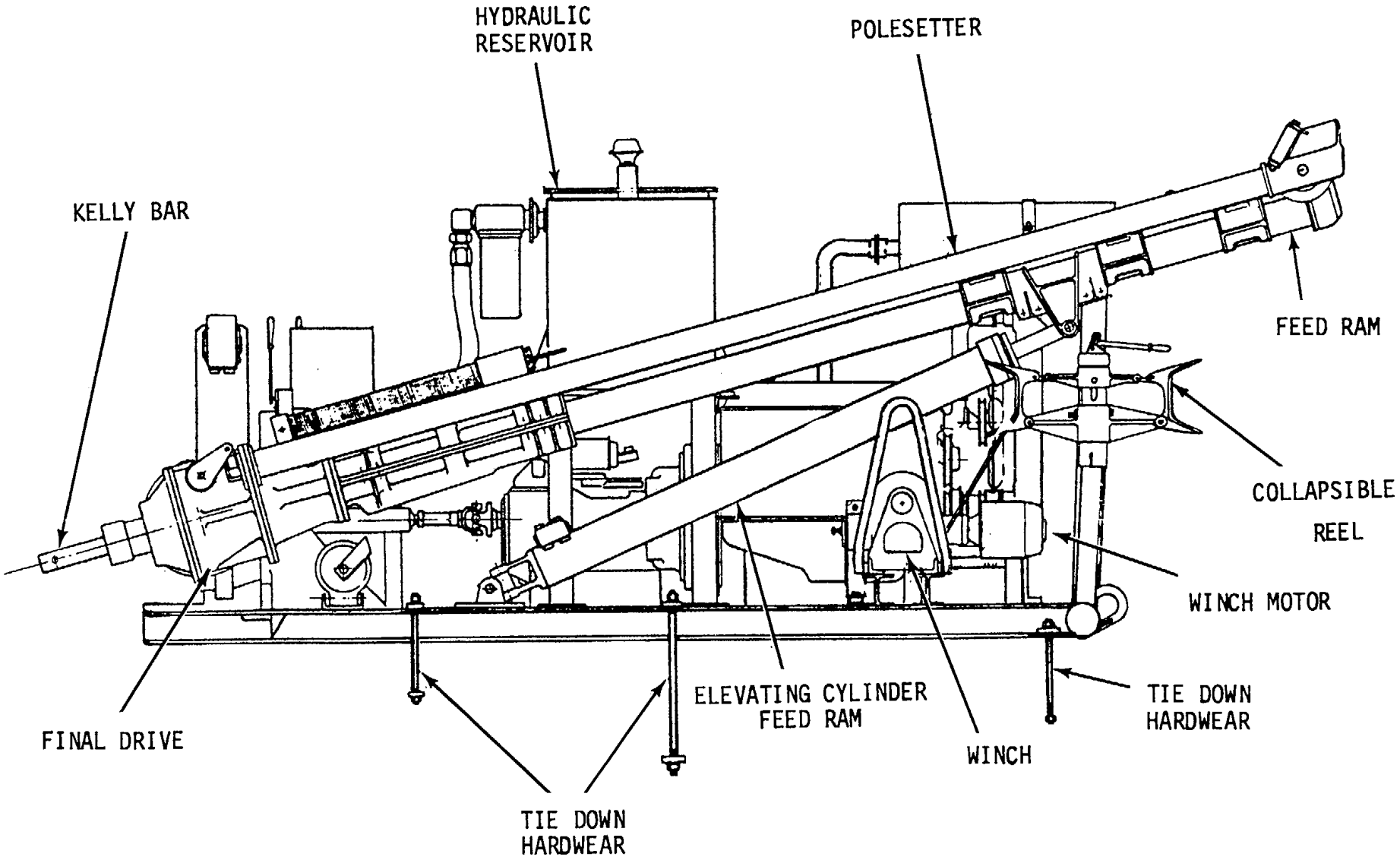
PAGE

PAGE

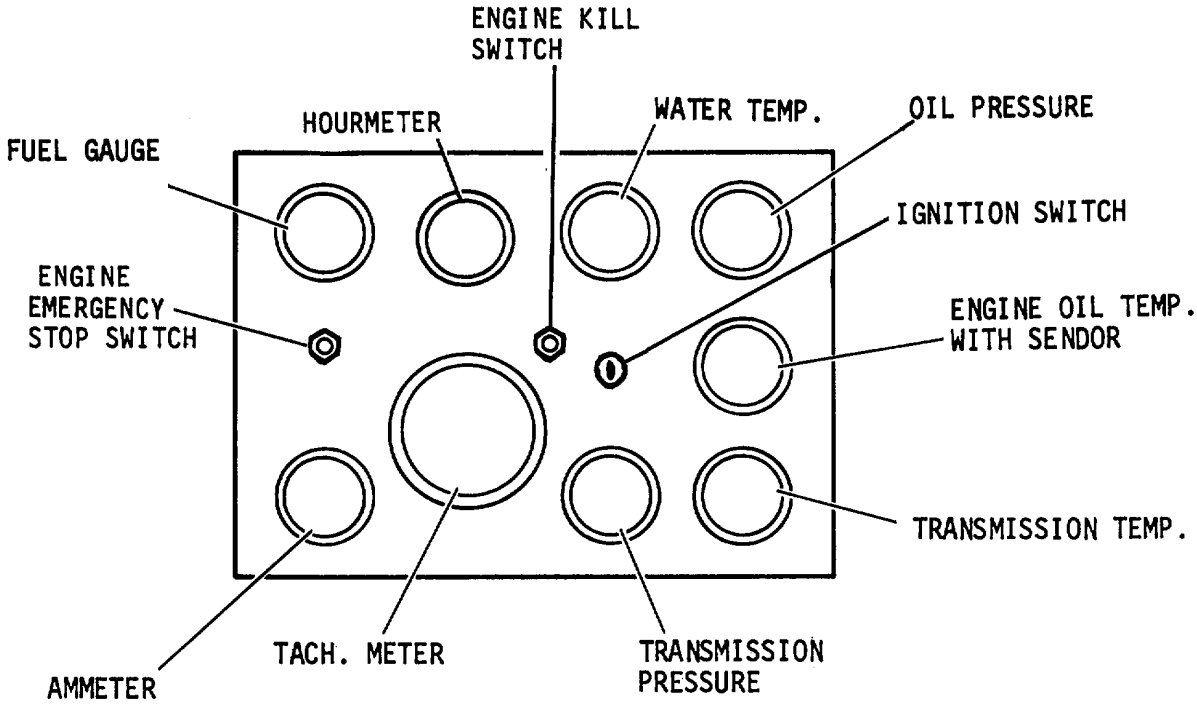
PAGE

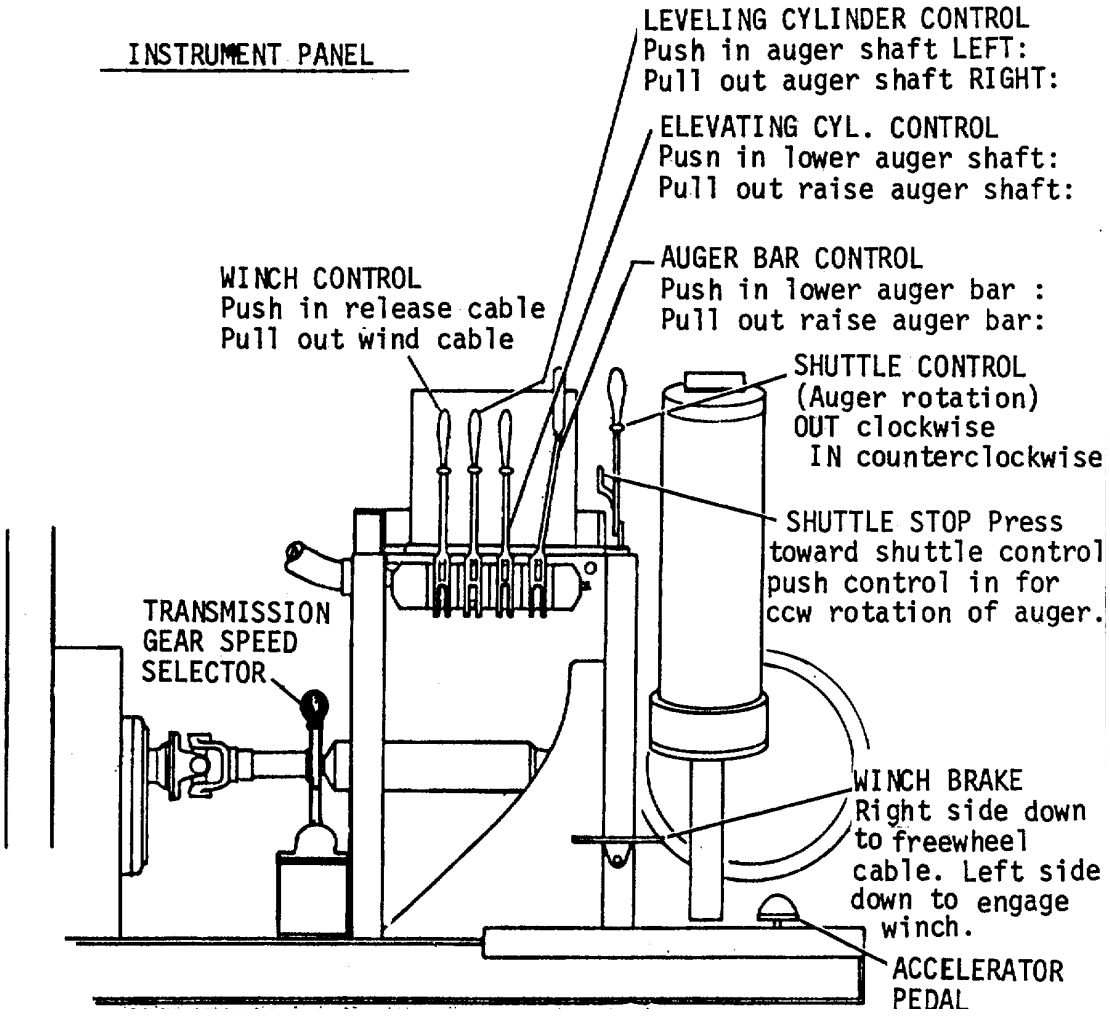


GENERAL ARRANGEMENT/LOCATOR DRAWING



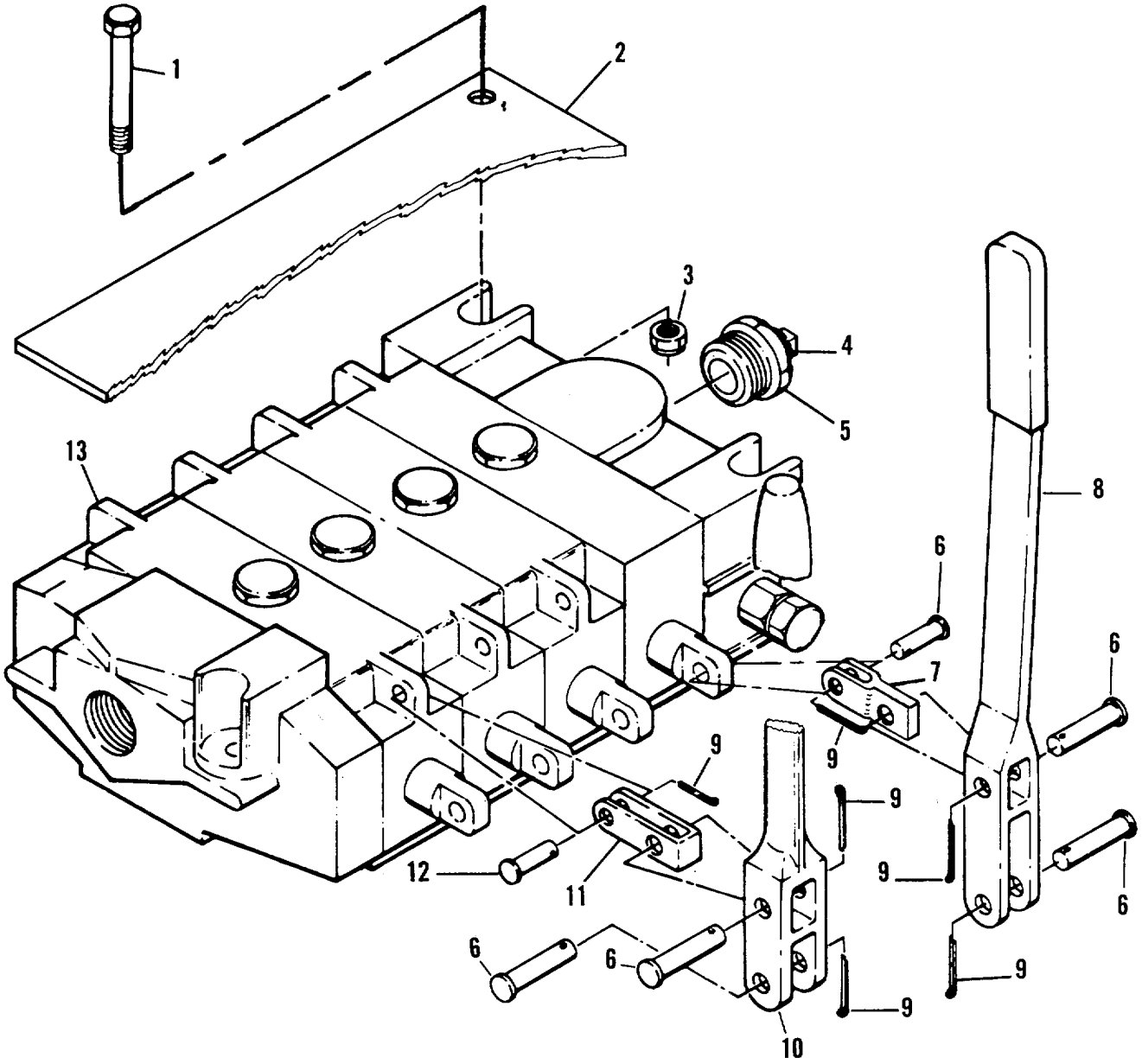
OPERATOR'S CONTROLS/INDICATORS LOCATOR





OPERATOR'S CONTROLS/INDICATORS LOCATOR

CONTROL VALVE INSTALLATION REF 59559



ITEM	PART NO.	QTY.	DESCRIPTION
1	7793	3	CAPSCREW - HEX HD - ½ - 13 NC X 5 GRDS
2	45064	1	SUPPORT - INSTRUMENT
3	6291	3	NUT - ELASTIC STOP ½ - 13 NC
4	39465	1	FITTING - HYD - PLUG ¼ M. O-RING
5	40992	1	FITTING - HYD - STR 1 M.O-RING X ¼ F. O-RING
6	11618	9	PIN - CLEVIS ½ X. 1 1/2
7	44992	1	LINK - Y SHAPE - CONTROL [A35]
8	16907	1	HANDLE - VALVE OPERATING [CROWD]
9	5939	12	PIN - COTTER - 1/8 X 1
10	16095	3	HANDLE - VALVE HANDLE
11	16099	3	LINK - VALVE HANDLE
12	11495	3	PIN - CLEVIS 3/8 X 1 IN
13	39079	1	VALVE ASSY - 4 SPOOL [SPOOL THIS SECTION]

CONTROL VALVE BANK ASSEMBLY REF 39079

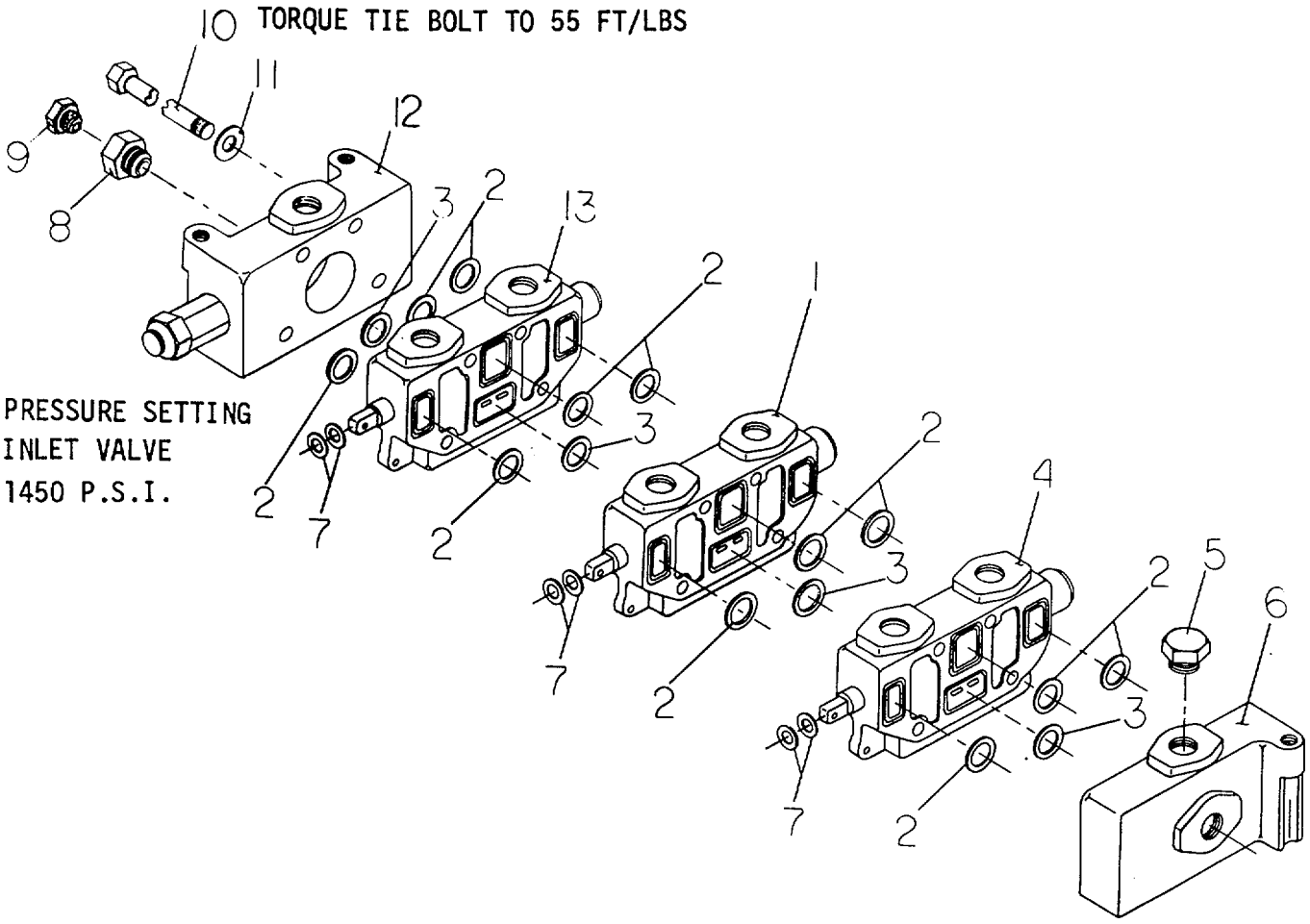
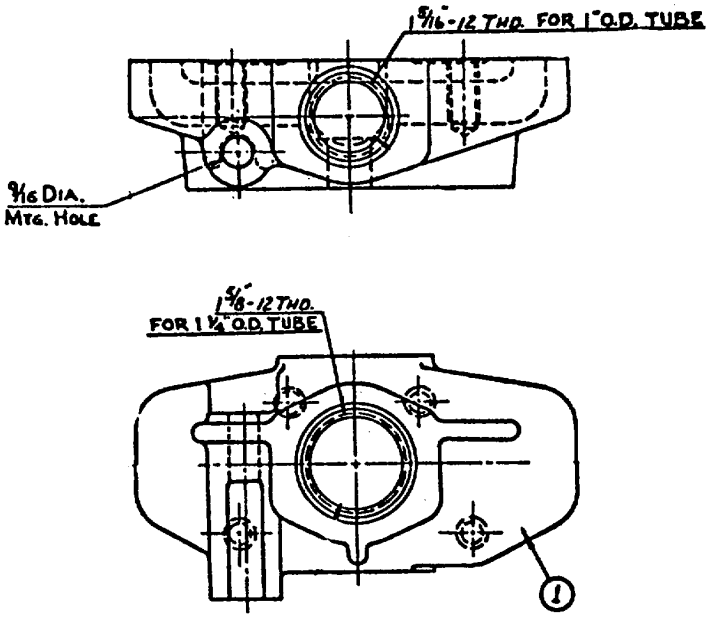


ILLUSTRATION SHOWS VALVES PORT SIDE UP

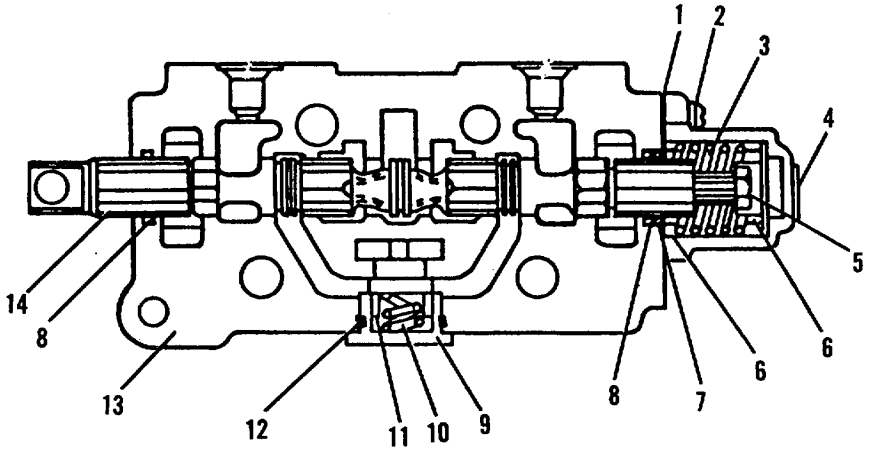
ITEM	PART NO.	QTY.	DESCRIPTION
1	40022	2	VALE - SECTION [SEE THIS SECTION]
2	16237	15	O-RING
3	16238	5	O-RING
4	39627	1	VALVE - DOUBLE ACTING [SEE THIS SECTION]
5	37407	1	FITTING - HYD - PLUG
6	40019	1	VALVE - OUTLET SECTION [SEE THIS SECTION]
7	16200	8	O-RING - VALVE SHAFT
8	40992	1	FITTING - HYD - STRAIGHT
9	39465	1	FITTING - HYD - PLUG
10	19587	4	BOLT - TIE - VALVE BANK
11	42627	4	WASHER - FLAT - STD - ½ IN
12	40017	1	VALVE - INLET - SECTION [SEE THIS SECTION]
13	39050	1	VALVE - REGENERATIVE [SEE THIS SECTION]

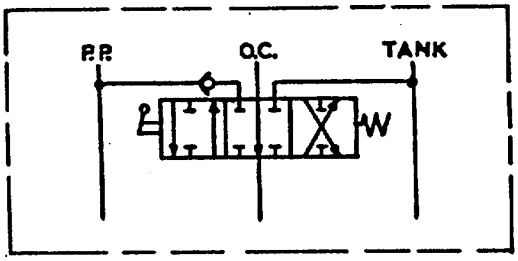
OUTLET SECTION REF 40019



ITEM	PART NO.	QTY.	DESCRIPTION
1	58896	1	HOUSING - OUTLET SECTION

VALVE SECTION CLOSED REF 40022

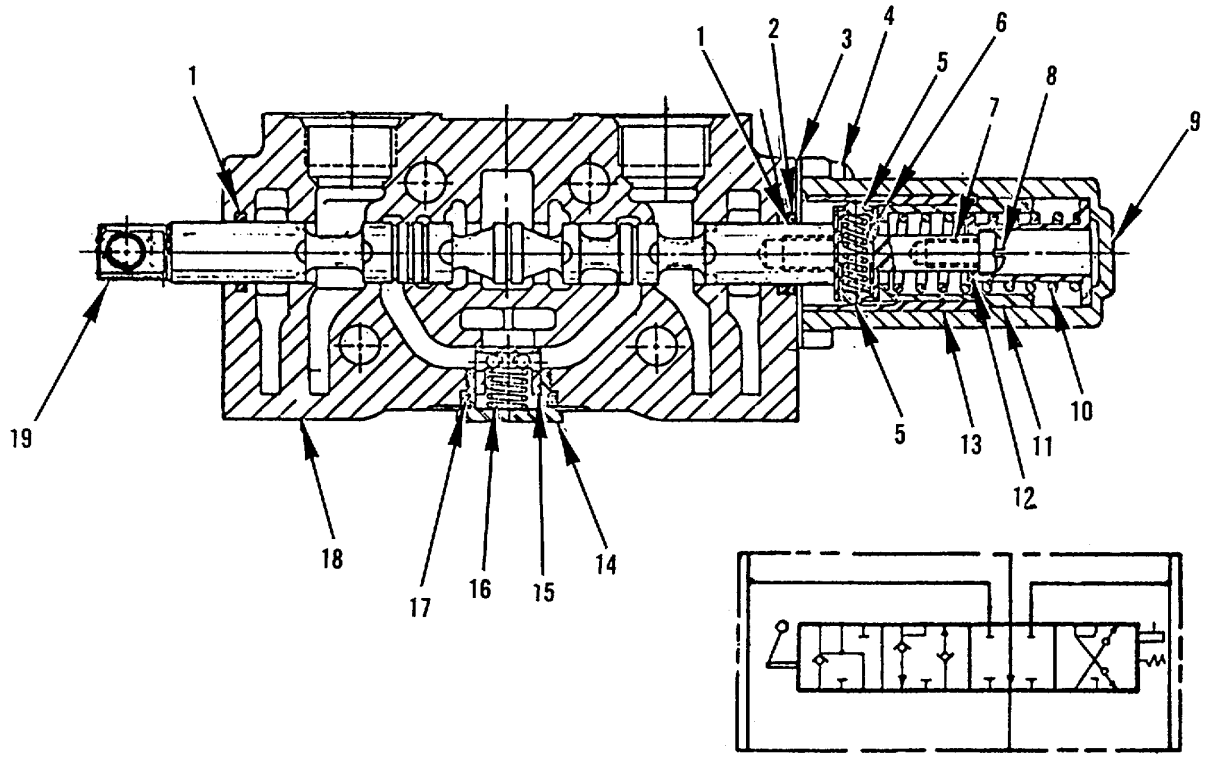




ITEM	PART NO.	QTY.	DESCRIPTION
1	16219	1	RETAINER PLATE (NOT SERVICED SEPARATELY)
2	42809	2	SCREW - FILLISTER
3	58903	1	SPRING - CAP
4	16229	1	CAP - VALVE
5	16242	1	BOLT - STRIPPER
6	16240	2	SPRING GUIDE
7	16218	1	BACKUP RING
8	16200	2	O-RING (SPOOL)
9	16234	1	CAP - CHECK
10	16232	1	SPRING
11	16231	1	POPPET
12	16233	1	O-RING (CHECK)
13	*58900	1	HOUSING - VALVE
14	*58901	1	SPOOL (NOT SERVICED SEPARATELY)
15	16237	3	O-RING (NOT SHOWN)
16	58902	1	O-RING (NOT SHOWN)

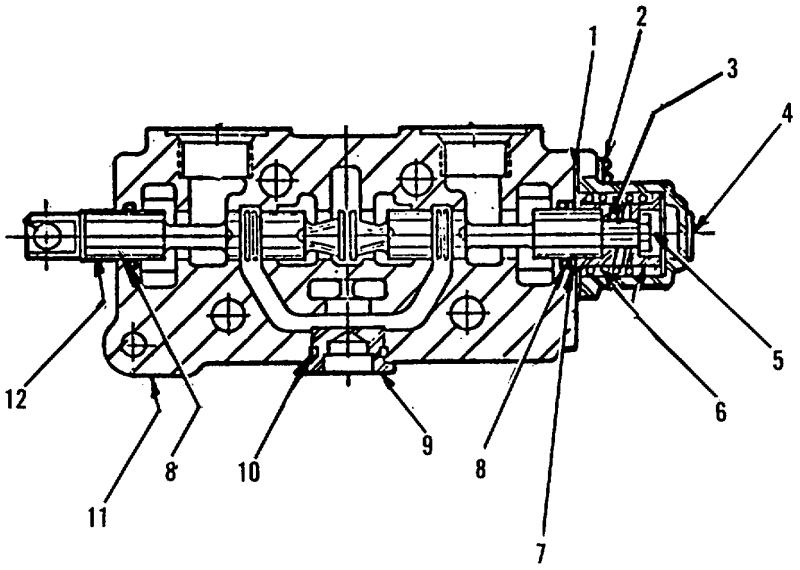
*NOT SERVICED SEPARATELY

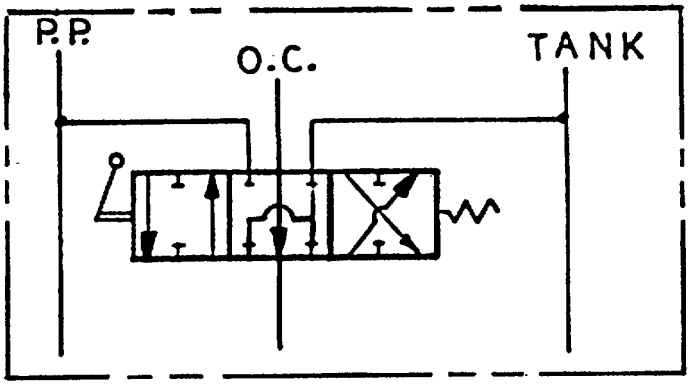
REGENERATIVE SECTION REF 39050



ITEM	PART NO.	QTY.	DESCRIPTION
1	16200	2	O-RING
2	16218	1	BACKUP RING
3	16219	1	RETAINING PLATE (NOT SERVICED SEPARTELY)
4	42810	2	SCREW - FILLISTER
5	16221	2	POPPET
6	16222	1	SPRING - POPPET
7	16223	1	POPPET - RETAINING
8	42811	1	SCREW - FILLISTER
9	16229	1	CAP - VALVE
10	58898	1	SPRING - CENTERING
11	16227	1	SPRING - RETAINING
12	16226	1	SPRING - RETAINING
13	16225	1	SLEEVE - POPPET
14	16234	1	CAP - CHECK VALVE
15	16231	1	CHECK - POPPET
16	16232	1	SPRING
17	16233	1	O-RING
18	58897	1	HOUSING - VALVE
19	16220	1	SPOOL (NOT SERVICED SEPARTELY)
20	16237	3	O-RING (NOT SHOWN)
21	58899	1	O-RING (NOT SHOWN)

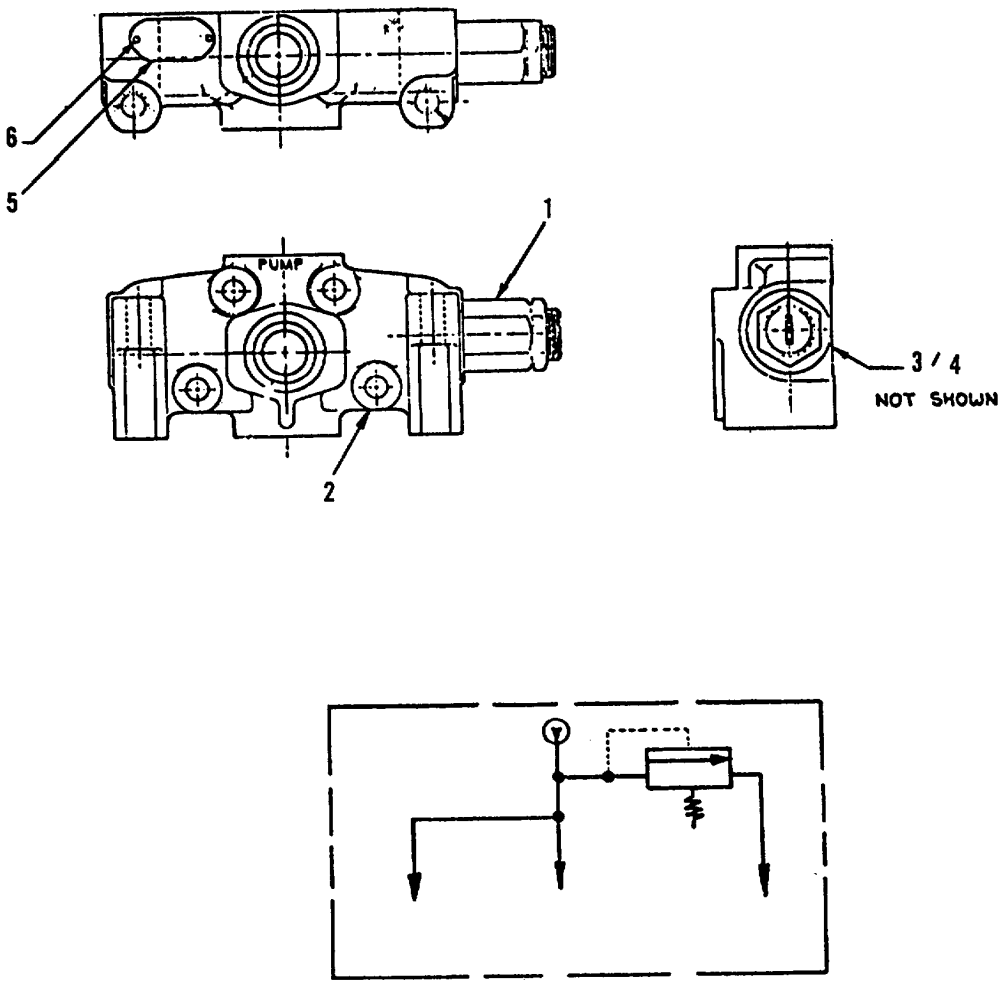
DOUBLE ACTING SECTION REF 39627





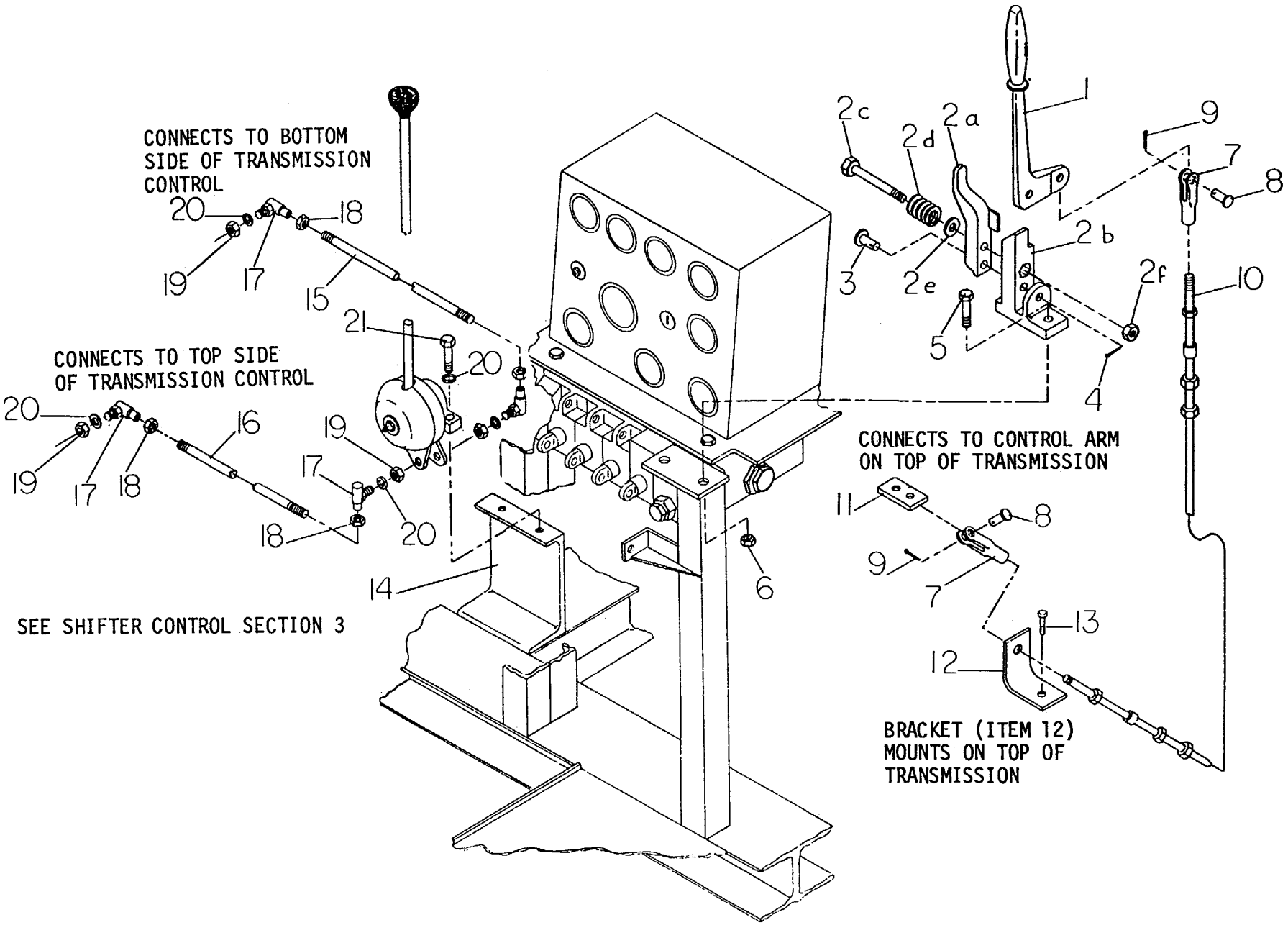
ITEM	PART NO.	QTY.	DESCRIPTION
1	16219	1	
2	42809	2	RETAINER PLATE (NOT SERVICED SEPARATELY)
3	58903	1	SCREW - FILLISTER
4	16229	1	SPRING - CAP
5	16242	1	CAP - VALVE
6	16240	2	BOLT - STRIPPER
7	16218	1	SPRING GUIDE
8	16200	2	O-RING (SPOOL)
9	58907	1	CAP - CHECK
10	16233	1	O-RING (CHECK)
11	*58905	1	HOUSING - VALVE
12	*58906	1	SPOOL (NOT SERVICED SEPARTELY)
13	16237	3	O-RING (NOT SHOWN)
14	58899	1	O-RING (NOT SHOWN)

INLET SECTION REF 40017



ITEM	PART NO.	QTY.	DESCRIPTION
1	33972	1	CARTRIDGE - R/V - ASSEMBLY
2	58904	1	HOUSING - INLET
3	58809	1	O-RING
4	16237	3	O-RING
5	----	1	NAME PLATE
6	----	2	SCREW-DRIVE

SHIFTING CONTROL KIT REF 59186

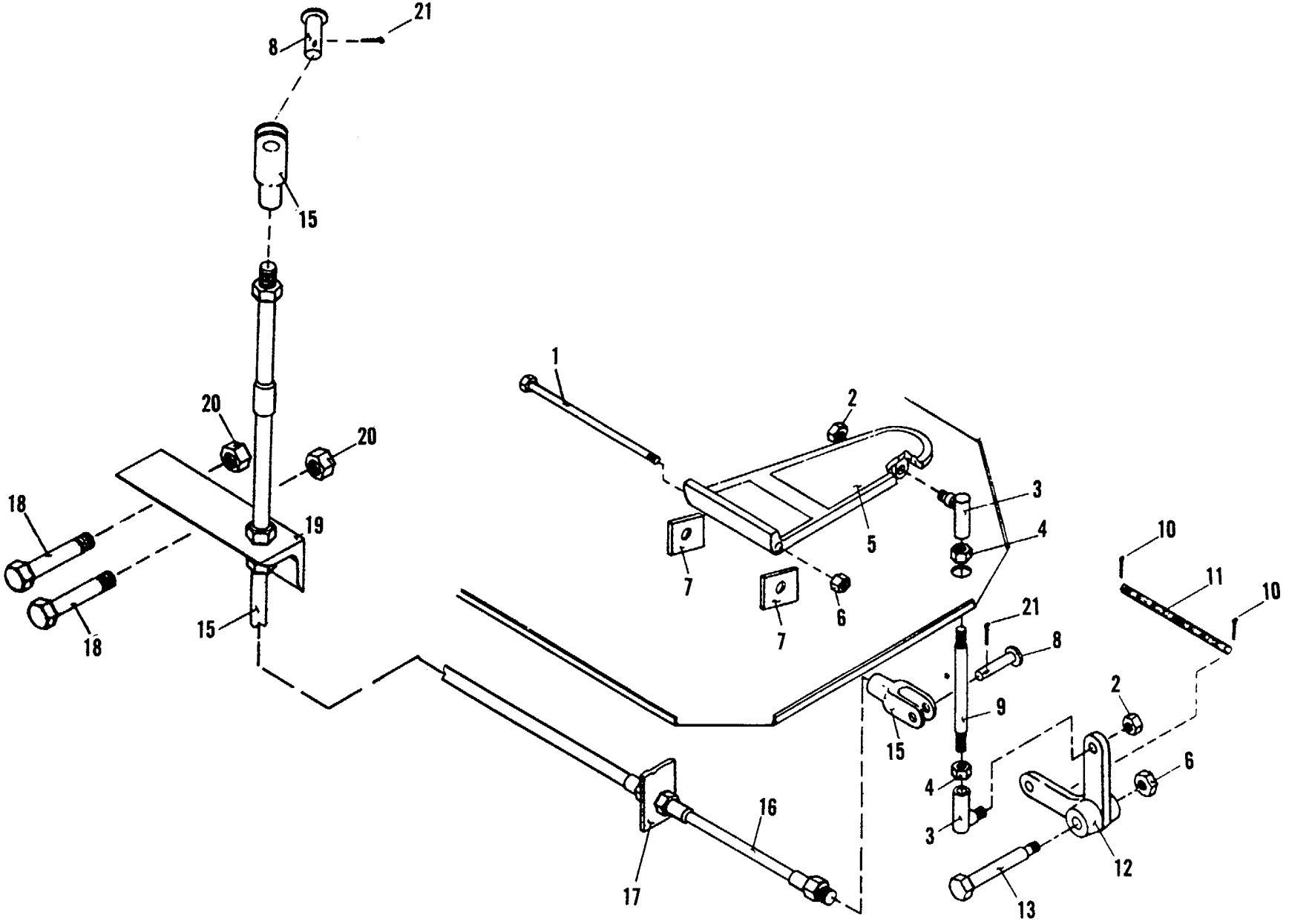


SHIFTING CONTROL KIT REF 59186

ITEM	PART NO.	QTY.	DESCRIPTION
1	35311	1	LEVER CONTROL
2	32631	1	BRACKET ASSEMBLY
2a	17135	1	LEVER - LOCKOUT
2b	17136	1	BASE
2c	42719	1	CAPSCREW ¼ IN NC X 2 ½ IN
2d	9486	1	SPRING
2e	42835	1	WASHER - FLAT ¼ IN
2f	6293	1	NUT - ELASTIC STOP ¼ IN NC
3	11242	1	PIN - CLEVIS
4	6718	1	PIN - COTTER
5	42573	2	CAPSCREW 3/8 IN NC X 1 ½ IN
6	7972	2	NUT ELASTIC STOP ¼ IN NC
7	19022	2	YOKE END ADJUSTABLE
8	6163	2	PIN - CLEVIS
9	6289	2	PIN - COTTER
10	18999	1	CONTROL CABLE
11	52843	1	MOUNT - SHIFTER - FORWARD AND REVERSE
12	39348	1	BRACKET CABLE SHIFTING
13	6096	1	CAPSCREW HEX HD 5/16 NC X 1 LG
14	52915	1	MOUNT - SHIFTER - TRANS
15	59187	1	ROD - SHIFTING
16	59188	1	ROD - SHIFTING
*17	21246	4	BALL - JOINT
*18	21247	4	NUT - JAM
*19	21248	4	NUT
*20	21192	6	WASHER - LOCK
*21	21243	2	CAPSCREW

*PART OF SHIFTER CONTROL ASSEMBLY REED PART NO 21238, SEE SECTION 3

ACCELERATOR CONTROL INSTALLATION REF 59181

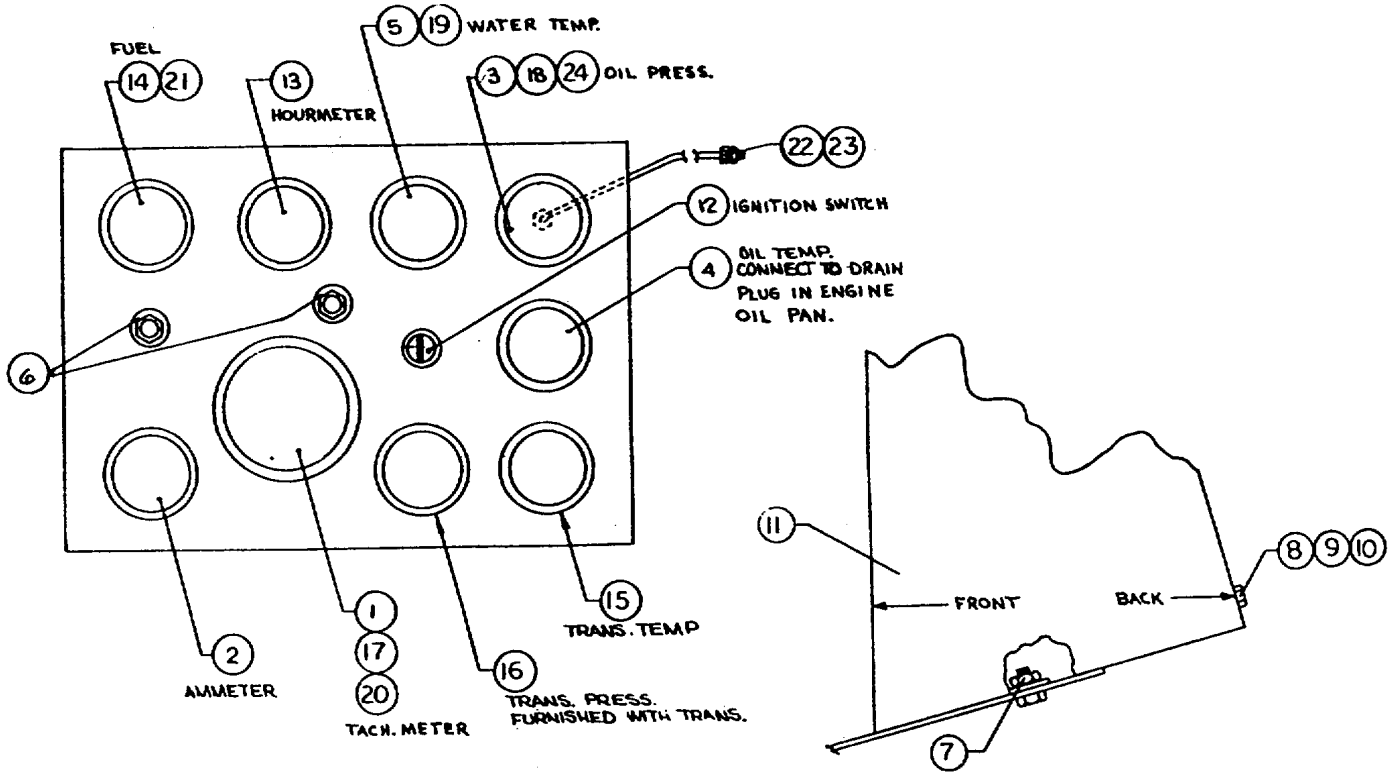


ACCELERATOR CONTROL INSTALLATION REF 59181

ITEM	PART NO.	QTY.	DESCRIPTION
1	42562	1	CAPSCREW - HEX HD - 1/4 IN NC X 5 IN
2	9123	2	ELASTIC STOP NUT 1/4 IN NF
3	16727	2	JOINT - BALL
4	6004	2	NUT - HEX 1/4 IN NC
5	16716	1	PEDAL - ACCELERATOR
6	6293	2	NUT - ELASTIC STOP 1/4 IN NC
7	47296	2	MOUNT - BRACKET - FOOT PEDAL
8	7339	2	PIN - CLEVIS
9	16725	1	ROD - ACCELERATOR - FOOT PEDAL
10	5939	2	PIN - COTTER
11	17951	1	SPRING
12	16717	1	CRANK - BELL
13	42550	1	CAPSCREW - HEX HD 1/4 IN NC X 2 1/2 IN
*14	49658	2	MOUNT - BRACKET - BELL CRANK
15	16989	2	CLEVIS
16	18723	1	CABLE
*17	49659	1	MOUNT - BRACKET - CABLE
18	42570	3	CAPSCREW - HEX HD 3/8 IN NC X 1 IN
19	52821	1	MOUNT - CABLE THROTTLE
20	7972	2	NUT - ELASTIC STOP 3/8 IN NC
21	6289	2	PIN - COTTER

***BELL CRANK MOUNT AND CABLE MOUNT CALLED OUT ON MAIN FRAME**

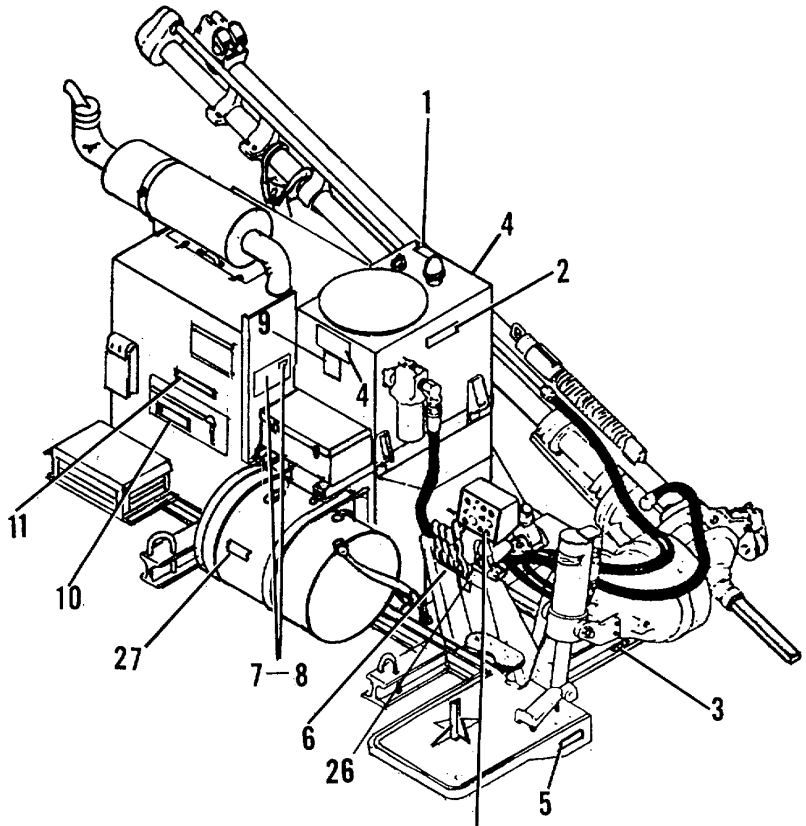
INSTRUMENT PANEL INSTALLATION REF 58537



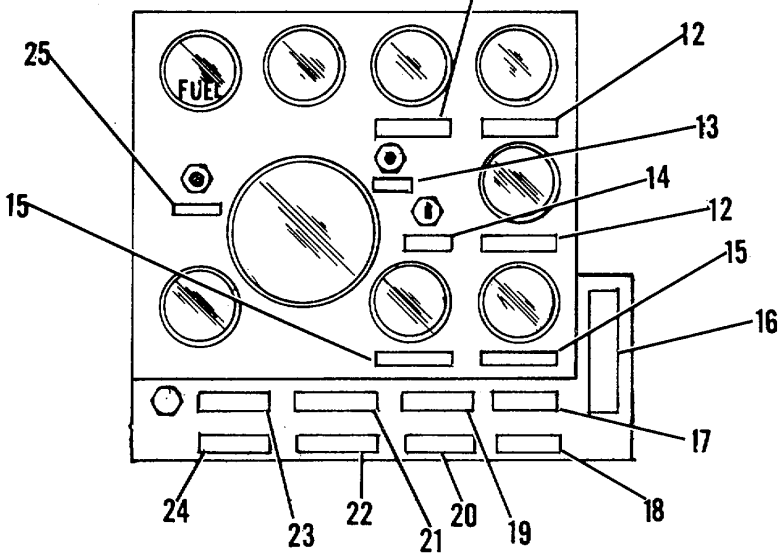
ITEM	PART NO.	QTY.	DESCRIPTION
1	54737	1	TACHOMETER - 1:1 RATIO
2	34530	1	GAUGE - AMMETER - 60-0-60
3	59271	1	GAUGE - OIL PRESSURE - 0 - 100 PSI
*4	35331	1	GAUGE - OIL TEMP
5	59270	1	GAUGE - WATER TEMP
6	42259	2	ENGINE - EMERGENCY - STOP SWITCH
7	7972	2	NUT - ELASTIC STOP - 3/8 - 16 UNC
8	6093	1	CAPSCREW - HEX HD - 5/16 - 18 UNC X 3/4 LG GR. 5
9	6292	1	NUT - ELASTIC - STOP - 5/16 - 18-UNC
10	37167	1	CLAMP - SUPPORT - HOSE
11	59013	1	PANEL - INSTRUMENT
12	18333	1	IGNITION SWITCH
13	16900	1	HOURMETER
14	32403	1	GAUGE - FUEL LEVEL - 12 V
15	35331	1	GAUGE - OIL TEMP. - TORQUE CONV.
16	35330	1	GAUGE - OIL PRESSURE - TORQUE - CONV
17	54696	1	SENDER - TACHOMETER
18	57654	1	SENDER - OIL PRESSURE
19	57655	1	SENDER - WATER TEMPERATURE
20	54739	1	TIP - DRIVE - SENDER - TACHOMETER
21	32404	1	SENDER - FUEL LEVEL- ELECTRIC
22	36230	18 FT	TUBING - RD - COPPER - 1/8
23	36228	1	FITTING - BRASS - STR - 1/8 M PIPE X 1/8 TUBE
24	38560	1	FITTING - BRASS - STR - 1/8 F PIPE X 1/8 TUBE

*REPLACEMENT PART NUMBER

DECAL INSTALLATION REF 58540



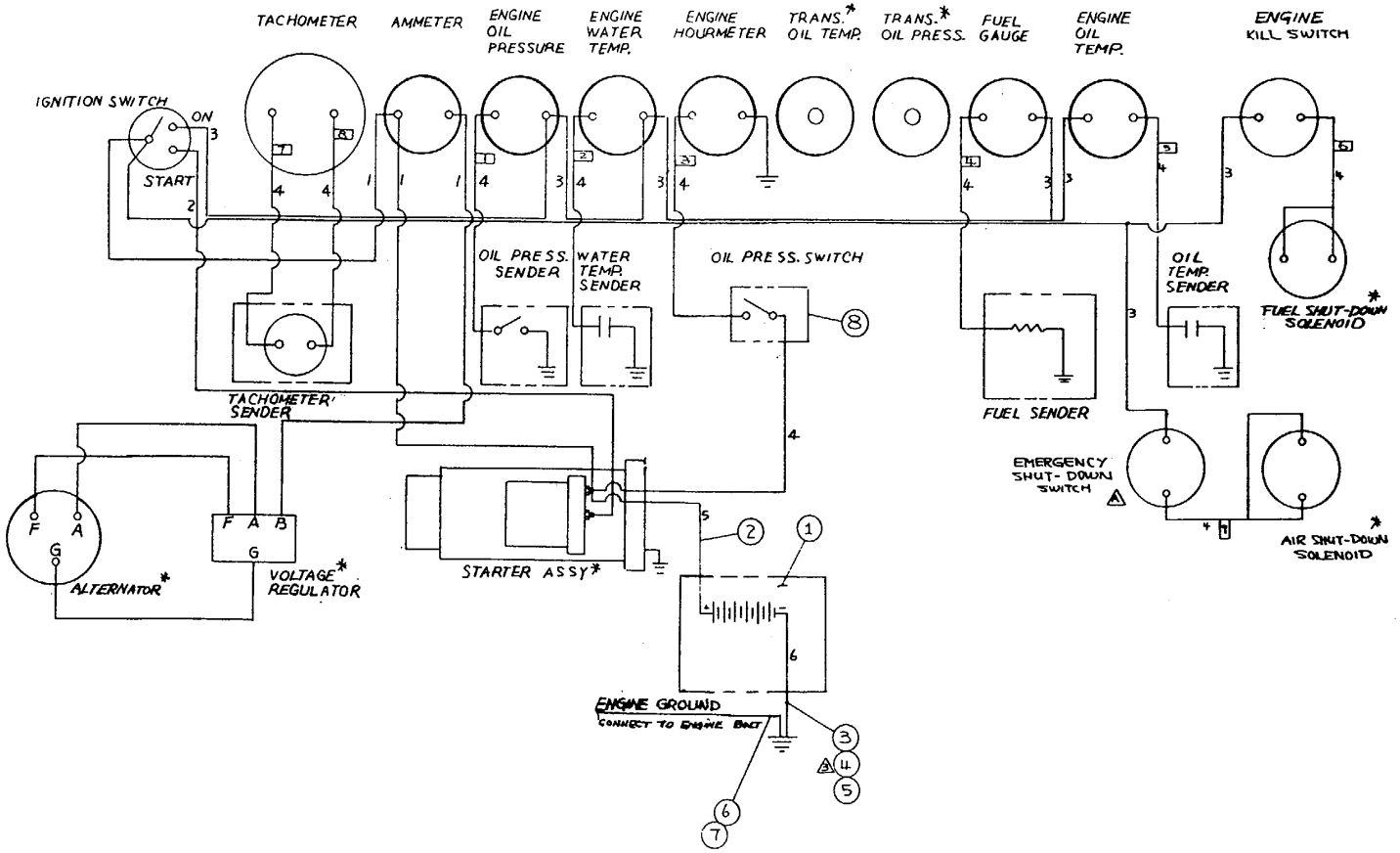
DETAIL OF INSTRUMENT PANEL



DECAL INSTALLATION REF 58540

ITEM	PART NO.	QTY.	DESCRIPTION
1	31842	1	DECAL - HYDRAULIC OIL
2	38393	1	DECAL - OPERATIONAL WARNING
3	34015	1	DECAL - LOWER PACKING
4	61132	2	DECAL - HEARING PROCTION
5	59252	1	PLATE - IDENTIFICATION
6	32495	1	DECAL - REMOVE PANEL FOR LUBE POINT
7	32606	1	DECAL - CAUTION (INSTLN 59573)
8	45170	1	DATA PLATE - OPERATIONAL PROCEDURES (INSTLN 59573)
9	38392	1	DECAL - OPERATIONAL WARNING
10	59103	1	DATA PLATE - LIFTING
11	34016	1	DECAL - MOUNTING AUGER
12	34257	4	DECAL - ENGINE
13	59591	1	DECAL - ENGINE STOP
14	59102	1	DECAL - IGNITION OFF/ON/START
15	34256	2	DECAL - TRANSMISSION
16	34262	1	DECAL - F-N-R
17	46926	1	DECAL - AUGER BAR
18	59632	1	DECAL - BAR DOWN & UP
19	46923	1	DECAL - ELEVATING CYLINDER
20	59635	1	DECAL - MAST UP & DOWN
21	46925	1	DECAL - LEVELING CYLINDER
22	59634	1	DECAL - TILT RIGHT & LEFT
23	46924	1	DECAL - WINCH MOTOR
24	59633	1	DECAL - CABLE IN & OUT
25	54471	1	DECAL - ENGINE EMERGENCY STOP
26	34252	1	DECAL - SPECIFICATION - LUBRICATION
27	31674	1	DECAL - DIESEL

ELECTRICAL WIRING INSTALLATION REF 58538



NOTES:

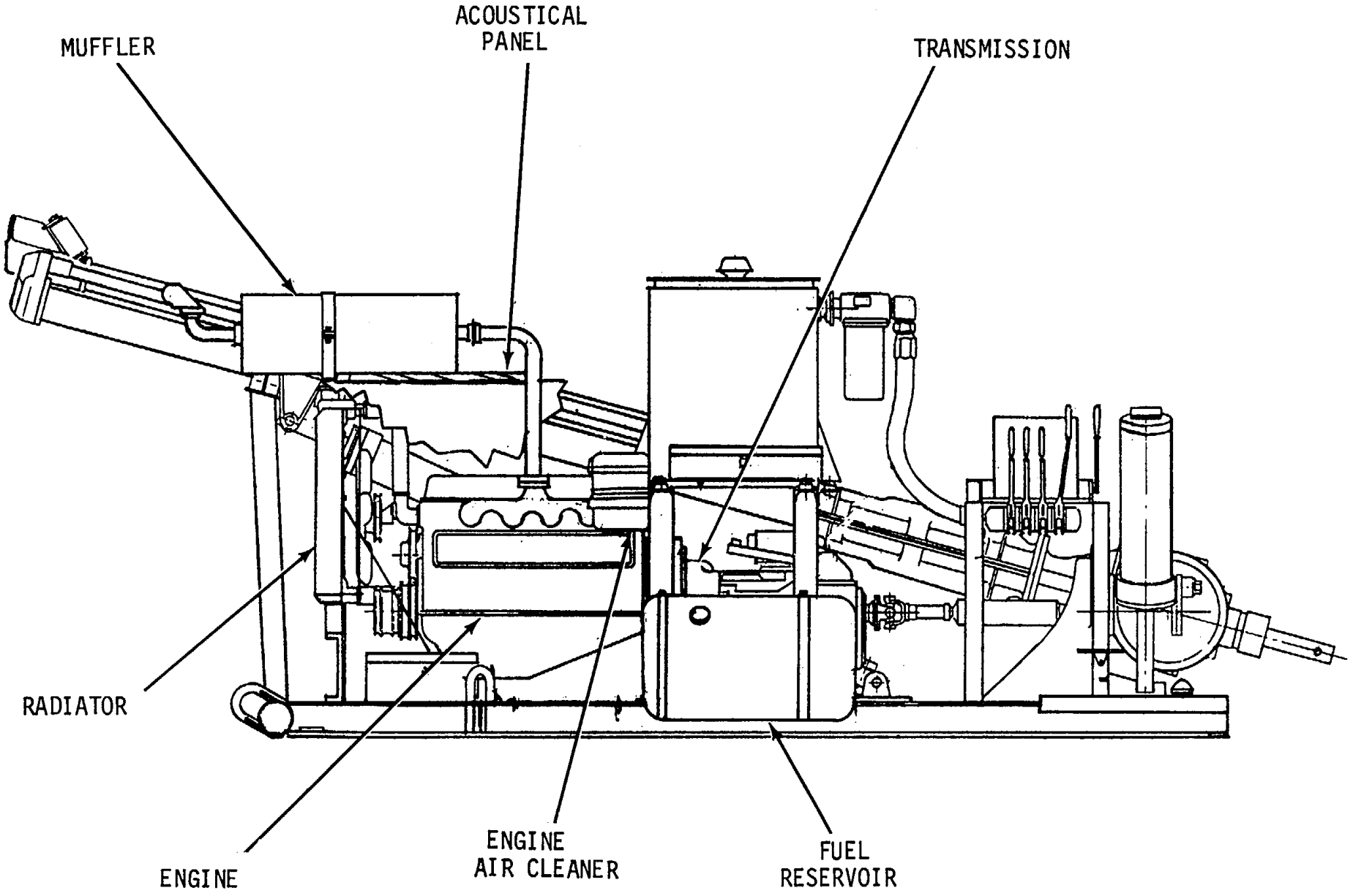
1 ACID RESISTANT PAINT IS REQ'D FOR BATTERY COMPARTMENT
2. AUTOMATIC SHUT DOWN SYSTEM IS FURNISHED WITH ENGINE
3.WELD ITEM 4 TO MAIN FRAME FOR BETTER GROUND.
4.ALL WIRING NOT CALLED OUT IN WIRING COLOR CODE IS FURNISHED WITH ENGINE.
5. * FURNISHED WITH ENGINE, OR TRANSMISSION
6. ▭ WIRE IDENTIFICATION

WIRE COLOR CODE	
NO	WIRE DESCRIPTION
1	RED -10 GA. WIRE
2	WHITE -10 GA. WIRE
3	PURPLE -16 GA. WIRE
4	YELLOW -16 GA. WIRE
5	RED - BATTERY CABLE
6	BLACK-BATTERY CABLE

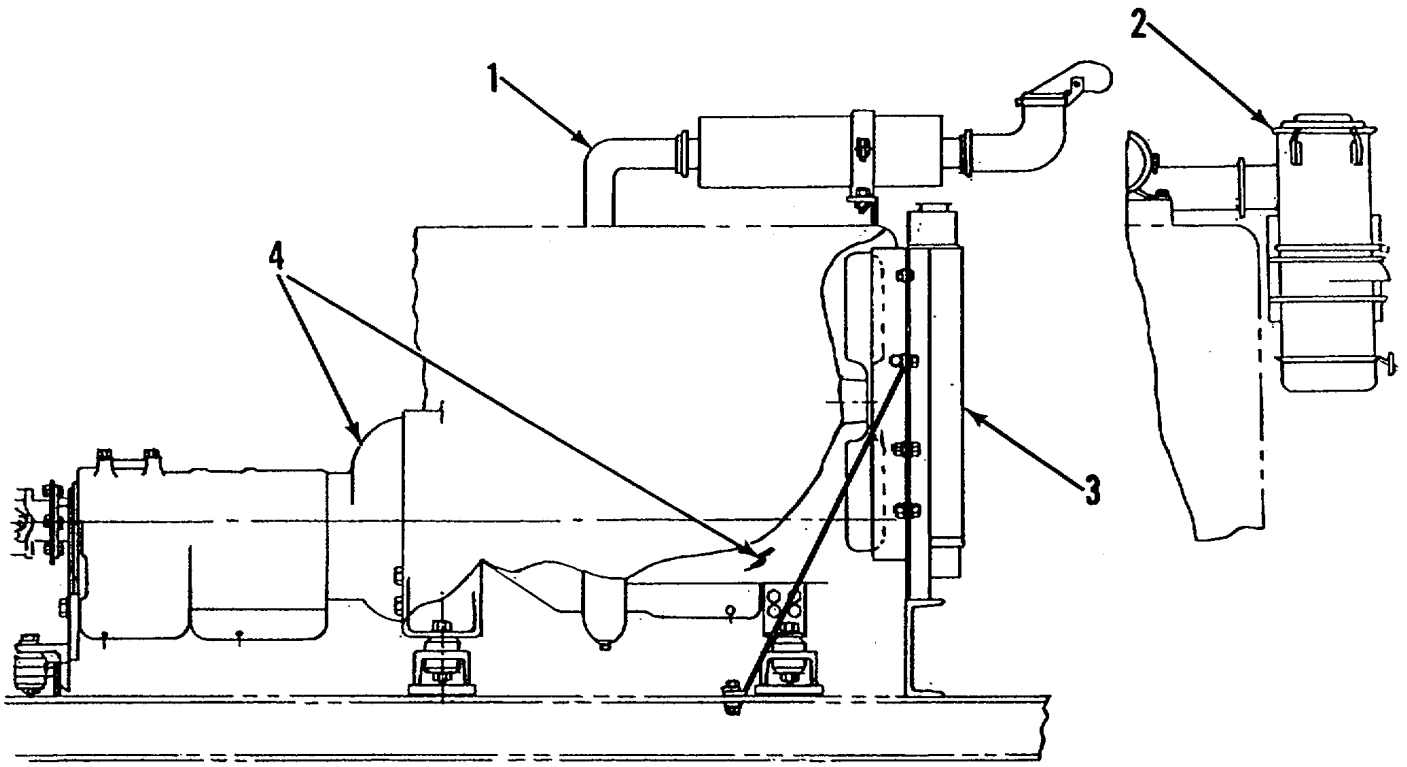
ELECTRICAL WIRING INSTALLATION REF 58538

ITEM	PART NO.	QTY.	DESCRIPTION
1	59297	1	BATTERY - 12V - 205 AMP - D8D-OP6
2	44549	1	BATTERY POSITIVE CABLE 45"
3	43813	1	BATTERY NEGATIVE CABLE 18"
4	42570	1	CAPSCREW HEX HD 3/8 - 16 UNC X 1 IN
5	7972	1	NUT - ELASTIC STOP 3/8 - 16 UNC
6	17833	3 FT	BATTERY GROUND CABLE
7	17830	2	BATTERY EYE
8	32189	1	OIL PRESSURE SWITCH
9	41892	1	BATTERY - BOARD

ENGINE AND TRANSMISSION LOCATOR



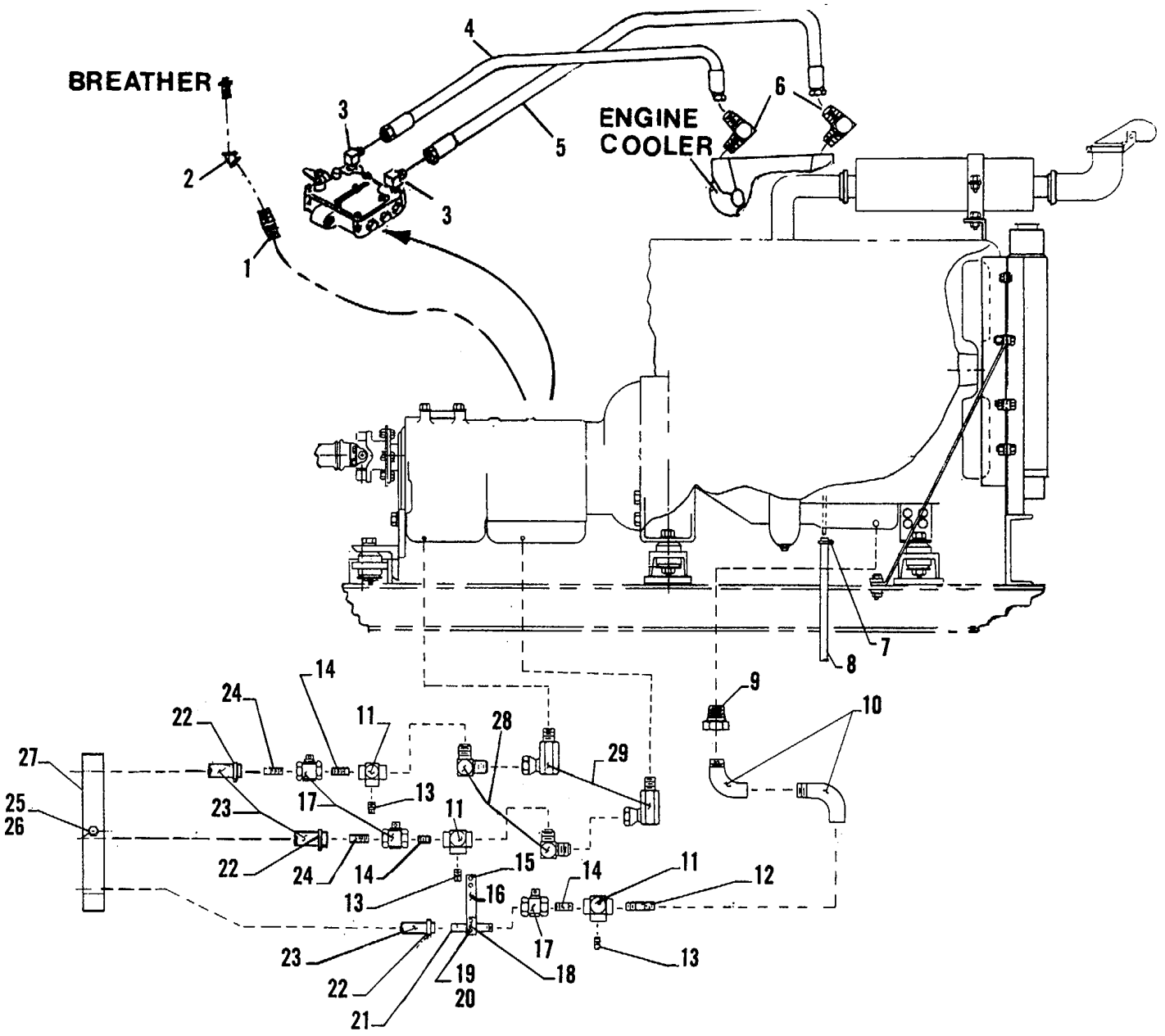
ENGINE/EXHAUST/RADIATOR LOCATOR



ITEM	PART NO	QTY	DESCRIPTION
1	58923	1	EXHAUST ASSEMBLY
2	58917	1	AIR INTAKE ASSEMBLY
3	58974	1	RADIATOR AND PLUMBING ASSEMBLY
4	58956	1	ENGINE AND TRANSMISSION ASSEMBLY

SEE THIS SECTION FOR BREAKDOWN OF PARTS.

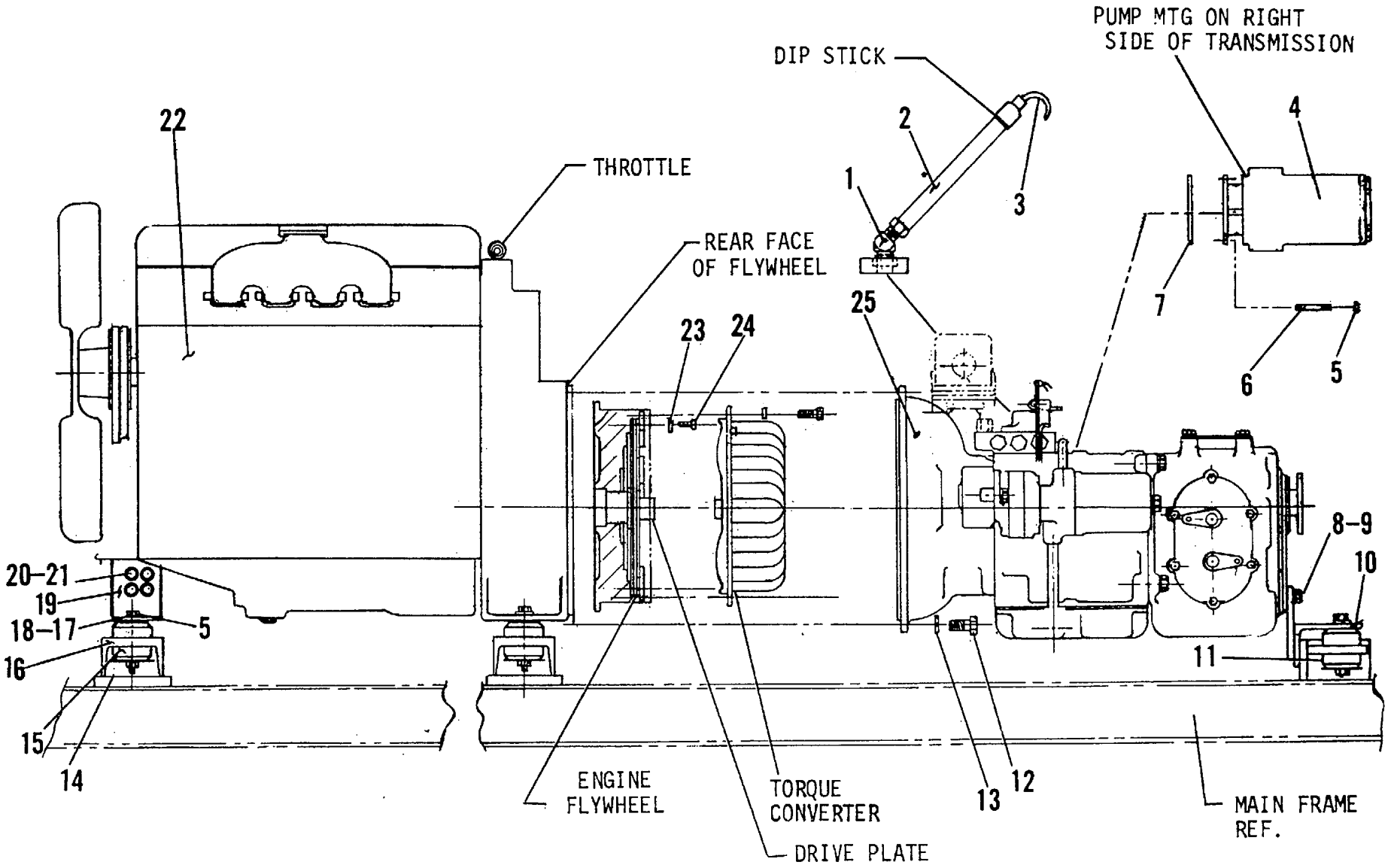
ENGINE AND TRANSMISSION INSTALLATION REF 58956 & 58532



ENGINE AND TRANSMISSION INSTALLATION REF 58956 & 58532

ITEM	PART NO.	QTY.	DESCRIPTION
1	6662	1	NIPPLE - 1 IN
2	6665	1	FITTING - 450 ELL - 1 IN
3	34865	2	FITTING - 900 - 3/4 M O-RING X 3/4 M JIC
4	41977	1	HOSE ASSY 3/4 F JIC X 3/4 F JIC X 39 IN
5	42476	1	HOSE ASSY 3/4 F JIC X 3/4 F JIC X 55 IN
6	31805	2	FITTING - 900 - 3/4 M PIPE X 3/4 M JIC
7	16886	1	CLAMP - 5/8 IN TO 3/4 IN
8	15132	8 FT	HOSE - FUEL - 1/4 ID X 8 FT
9	8334	1	BUSHING - 3/4 M PIPE X 1/2 F NPT
10	8314	2	ELBOW - STREET - 1/2 MPT X 1/2 FPT
11	8370	3	FITTING - TEE- PIPE - 1/2 IN
12	9450	1	NIPPLE - STL - SCH 80 - 1/2 X 6 IN
13	59453	3	FITTING - PLUG - SQHD - 1/2 MAGNETIC
14	8357	3	FITTING - ADAPTER - 1/2 NPT X 3 IN
15	42570	2	CAPSCREW HEX HD 3/8 - 16 IN NC X 1 IN
16	59584	1	MOUNT - ENGINE - OIL DRAIN - CLAMP
17	34726	3	VALVE - GAS SERVICE STOP - 1/2 NPT
18	41674	1	CLAMP - 3/4 TUBE
19	6284	2	CAPSCREW HEX HD 1/4 IN NC X 2 IN
20	6293	2	NUT - ELASTIC STOP 1/4 IN NC
21	59585	1	NIPPLE - STL - SCH 80 - 1/2 X 4 1/2 IN
22	16888	3	CLAMP - HOSE - 3/4 TO 1
23	30212	25 FT	HOSE - HEATER - 3/4 ID
24	59559	2	NIPPLE - STL - SCH 80 - 1/2 X 3 IN
25	42573	1	CAPSCREW - HEX HD - 3/8 IN NC X 1 1/2 IN
26	7972	1	NUT - STOP - ELASTIC 3/8 IN NC
27	59638	1	BRACKET - MOUNT - OIL DRAIN LINES
28	32565	2	ADAPTER - 90° - 1/2 M PIPE X 1/2 M PIPE
29	8747	2	FITTING - 90° - 1/2 M PIPE X 1/2 F NPSM

ENGINE AND TRANSMISSION ASSEMBLY REF 58596



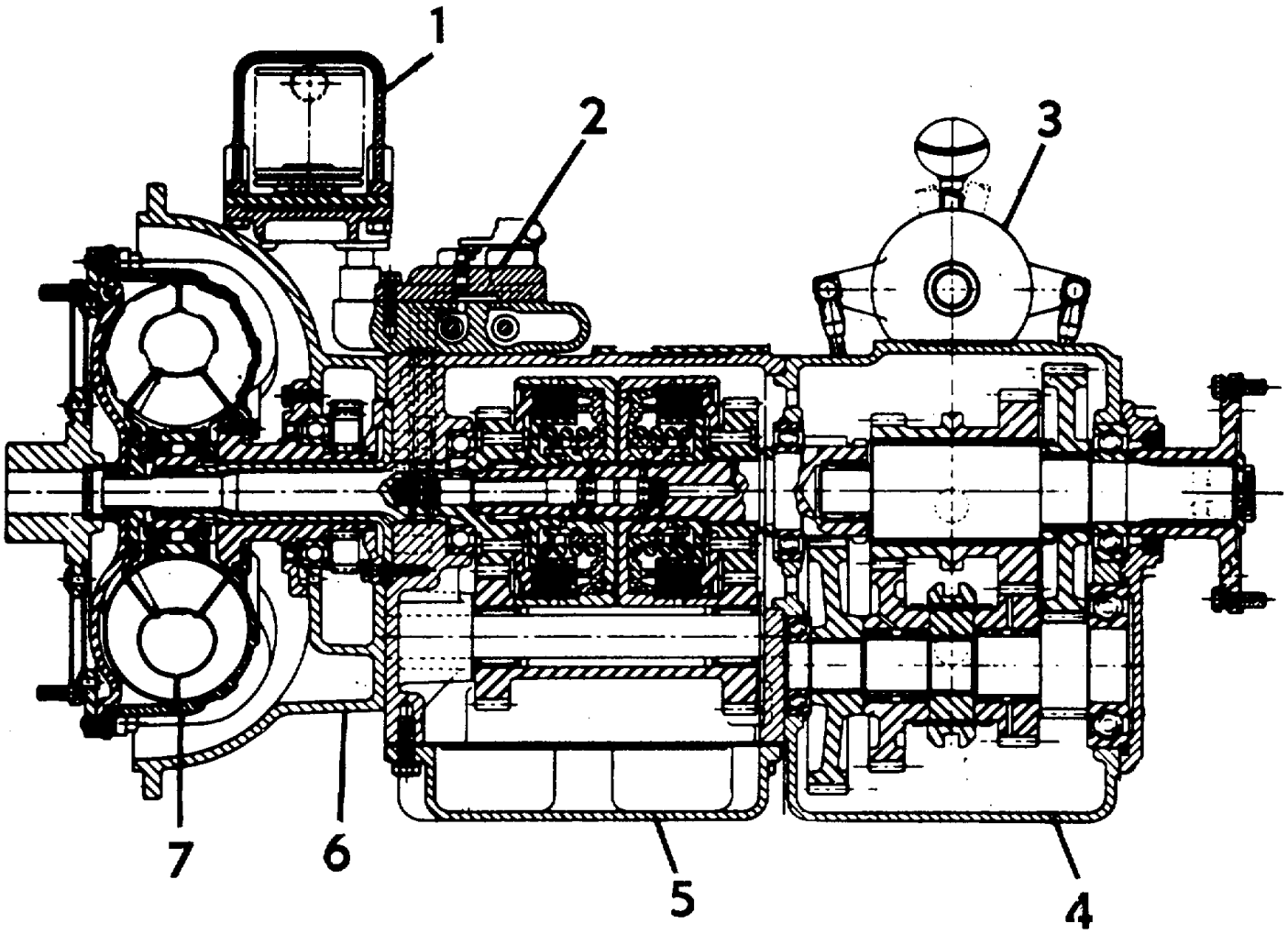
SHEET 1 OF 2

PUBLICATION DWG. NO. PM-156-18

ENGINE AND TRANSMISSION ASSEMBLY REF 58596

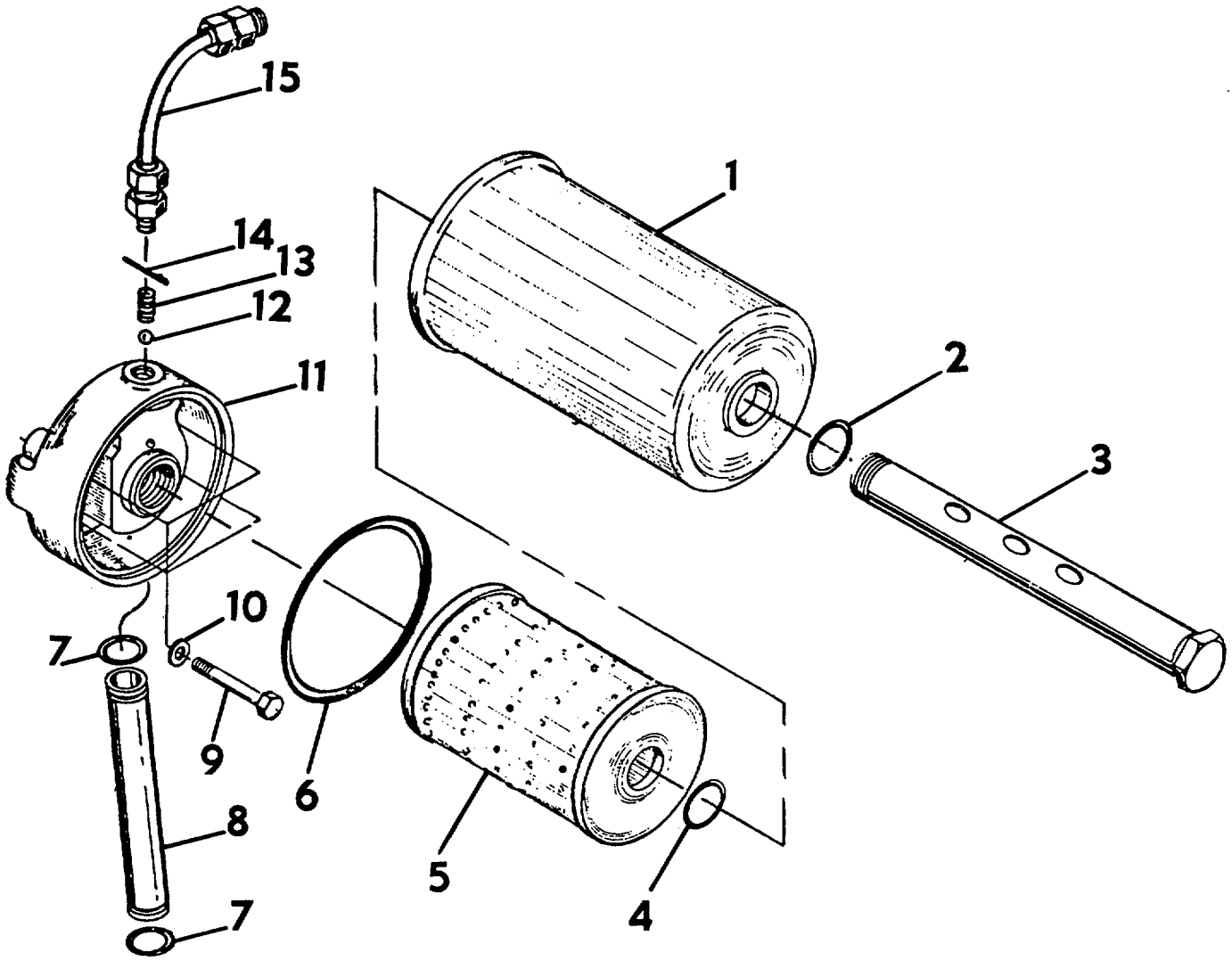
ITEM	PART NO.	QTY.	DESCRIPTION
1	30834	1	FITTING - HYD - 45 - 1/2 M PT X 1/2 M JIC
2	59530	1	TUBING - DIPSTICK - T/M - 270
3	59529	1	DIPSTICK - TRANSMISSION - 270
4	18603	1	PUMP
5	18794	4	NUT - ELASTIC STOP - 1/2 - 20 UNF
6	16256	4	BOLT - STUD - 1/2 - 20 UNF & 13 UNC X 2 1/2 LG
7	40598	2	GASKET - PUMP
8	8278	2	CAPSCREW - HEX HD - 9/16 - 12 UNC X 1 1/4 LG GR. 5
9	6351	2	WASHER - LOCK - 9/16
10	58949	1	WELDMENT - T/M - MOUNT
11	58946	2	WELDMENT - T/M - MOUNT - LOWER
12	5988	12	CAPSCREW - HEX HD - 3/8 - 16 UNC X 1 1/4 LG
13	5989	12	WASHER - LOCK - CUT - 3/8
14	58938	6	SPACER - MOUNT - ISOLATOR
15	58947	6	ISOLATOR - MOUNT - ENGINE - 3-53
16	58955	2	MOUNT - ENGINE - 3-53
17	55185	6	WASHER - FLAT HARDENED - 1/2
18	5993	6	CAPSCREW - HEX HD - 1/2 - 13 UNC X 3 1/4 LG GR.5
19	58937	2	BRACKET - MOUNT - ENGINE - 3-53
20	5988	8	CAPSCREW - HEX HD - 3/8 - 16 UNC X 1 1/4 LG GR.5
21	5989	16	WASHER - CUT - 3/8
22	58909	1	ENGINE ASSY - DIESEL - DETROIT - 3-53
23	5962	8	WASHER - STARLOCK - INTERNAL - 3/8
24	9134	8	CAPSCREW - SOC. HD - 3/8 - 16 UNC X 3/4 LG
25	21101	1	TRANSMISSION ASSY - FUNK 12700 - 13 IN CONV.

TRANSMISSION ASSEMBLY REF 21101



ITEM	PART NO.	TY	DESCRIPTION
1	20104	1	HEAT EXCHANGER ASSEMBLY
2	21214	1	CONTROL VALVE ASSEMBLY
3	21238	1	SHIFT CONTROL ASSEMBLY
4	20103	1	FOUR SPEED TRANSMISSION ASSEMBLY
5	21155	1	SHUTTLE ASSEMBLY
6	21102	1	CONVERTER HOUSING ASSEMBLY
7	58280	1	CONVERTER ASSEMBLY

OIL MANIFOLD - OIL FILTER GROUP MILITARY 270

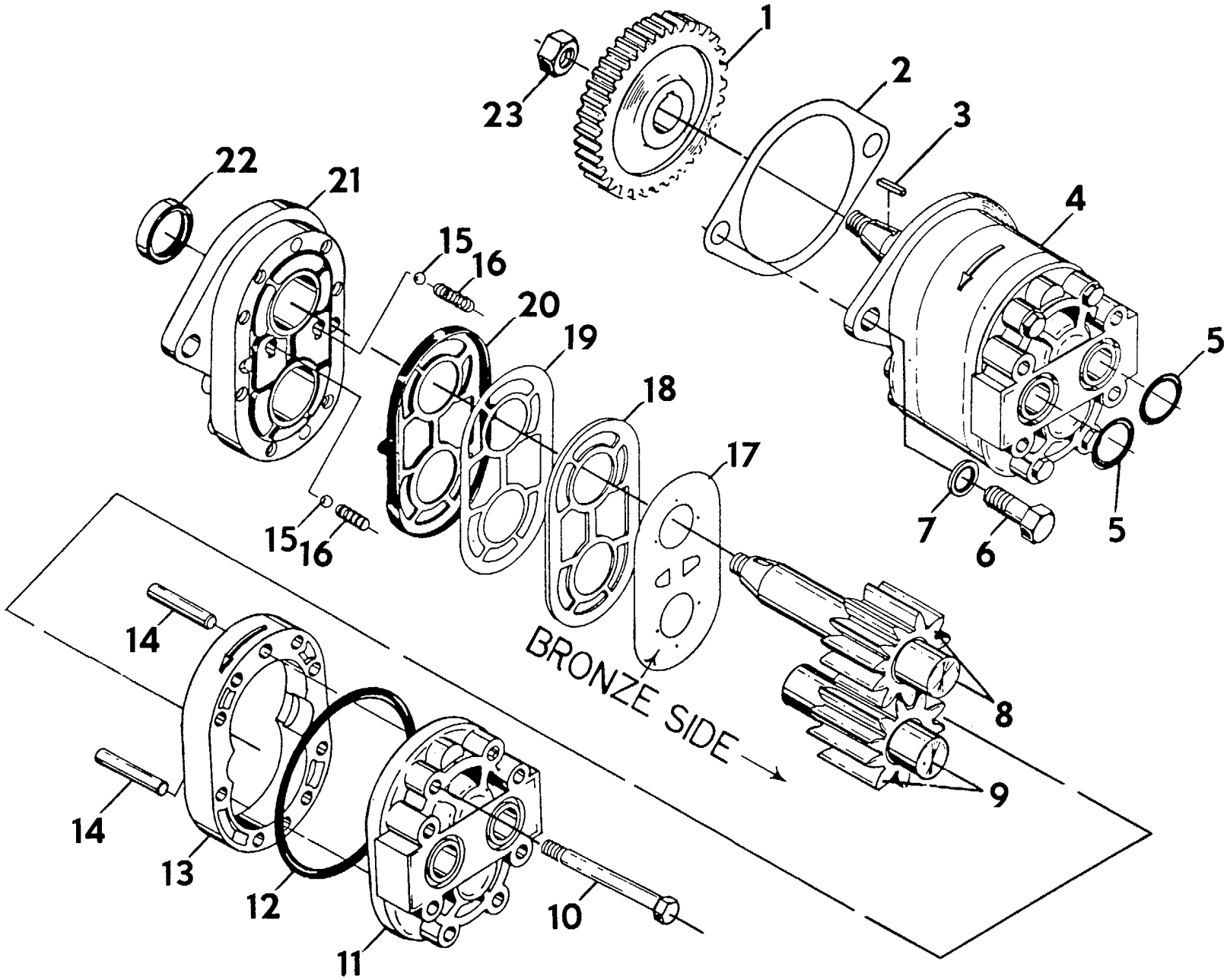


ITEM	PART NO.	QTY.	DESCRIPTION
1	20143	1	OIL FILTER COVER SEAL O-RING
2	**	1	STUD SEAL O-RING
3	20145	1	OIL FILTER COVER STUD
4	**	1	OIL FILTER ELEMENT BUMPER O-RING
5	**	1	OIL FILTER ELEMENT
6	**	1	OIL FILTER COVER SEAL O-RING
7	*	2	OIL TUBE SEAL O-RING
8	20139	1	SUMP TO MANIFOLD OIL TUBE
9	46858	4	CAPSCREW HEX HD 5/16 IN NC X 4 1/2 IN
10	*	4	WASHER 5/16 IN
11	20135	1	OIL MANIFOLD BODY
12	20136	1	BYPASS VALVE BALL
13	20137	1	BYPASS VALVE SPRING RETAINER
14	20138	1	PIN SPRING BYPASS VALVE
15	20140	1	OIL TUBE ASSEMBLY MANIFOLD TO VALVE

*OIL MANIFOLD KIT PART NO. 20978

**OIL FILTER KIT PART NO. 20979

PRIMARY PUMP ASSEMBLY REF 20159

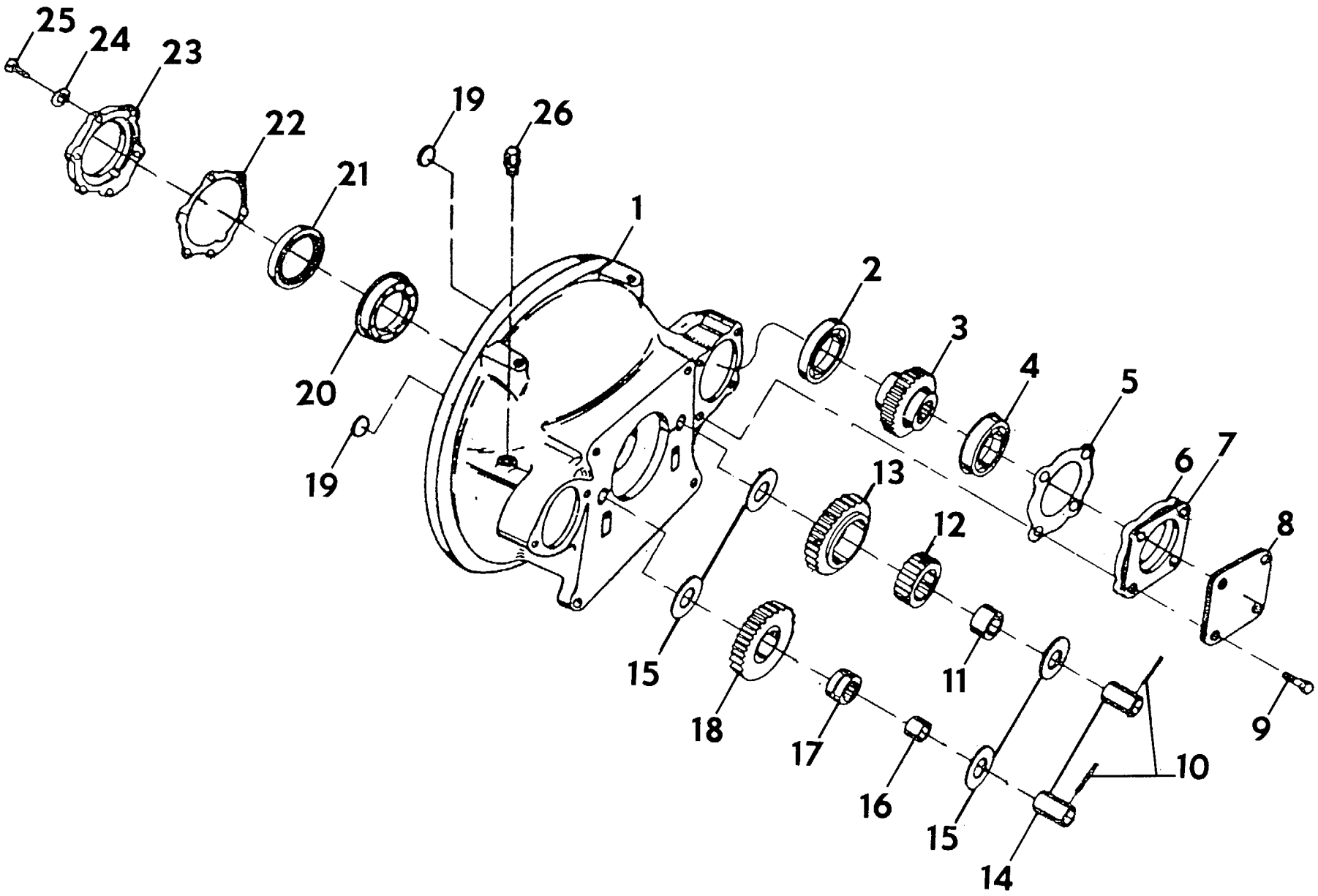


PRIMARY PUMP ASSEMBLY REF 20159

ITEM	PART NO.	QTY.	DESCRIPTION
1	20131	1	PRIMARY PUMP DRIVE GEAR
2	*	1	PUMP MOUNT GASKET
3	20130	1	PRIMARY PUMP SHAFT KEY
4	20129	1	PRIMARY PUMP
5	*	2	BACK PLATE SEAL O-RING
6	--------	2	CAPSCREW HEX HD 7/16 IN NC X 1 IN
7	*	2	WASHER 7/16 IN CYNA-SEAL
8	46866	1	DRIVE GEAR ASSEMBLY
9	46867	1	IDLER GEAR ASSEMBLY
10	7723	4	CAPSCREW HEX HD 5/16 IN NC X 2 3/4 IN
11	46861	1	BACK PLATE ASSEMBLY
12	46872	1	O-RING
13	46862	1	PRIMARY PUMP BODY
14	46859	2	DOWEL PIN 5/16 X 1 3/4 IN
15	46870	2	BALL 7/32 IN DIA. STEEL
16	46869	2	SPRING
17	46864	1	DIAPHRAGM
18	46871	1	GASKET PROTECTOR
19	46865	1	BACKUP GASKET
20	46863	1	DIAPHRAGM SEAL
21	46860	1	FRONT PLATE ASSEMBLY
22	46868	1	SEAL SHAFT OIL
23	---------	1	LOCK NUT 7/16 IN NC

*PRIMARY PUMP KIT P/N 20977

CONVERTER HOUSING ASSEMBLY REF 21102

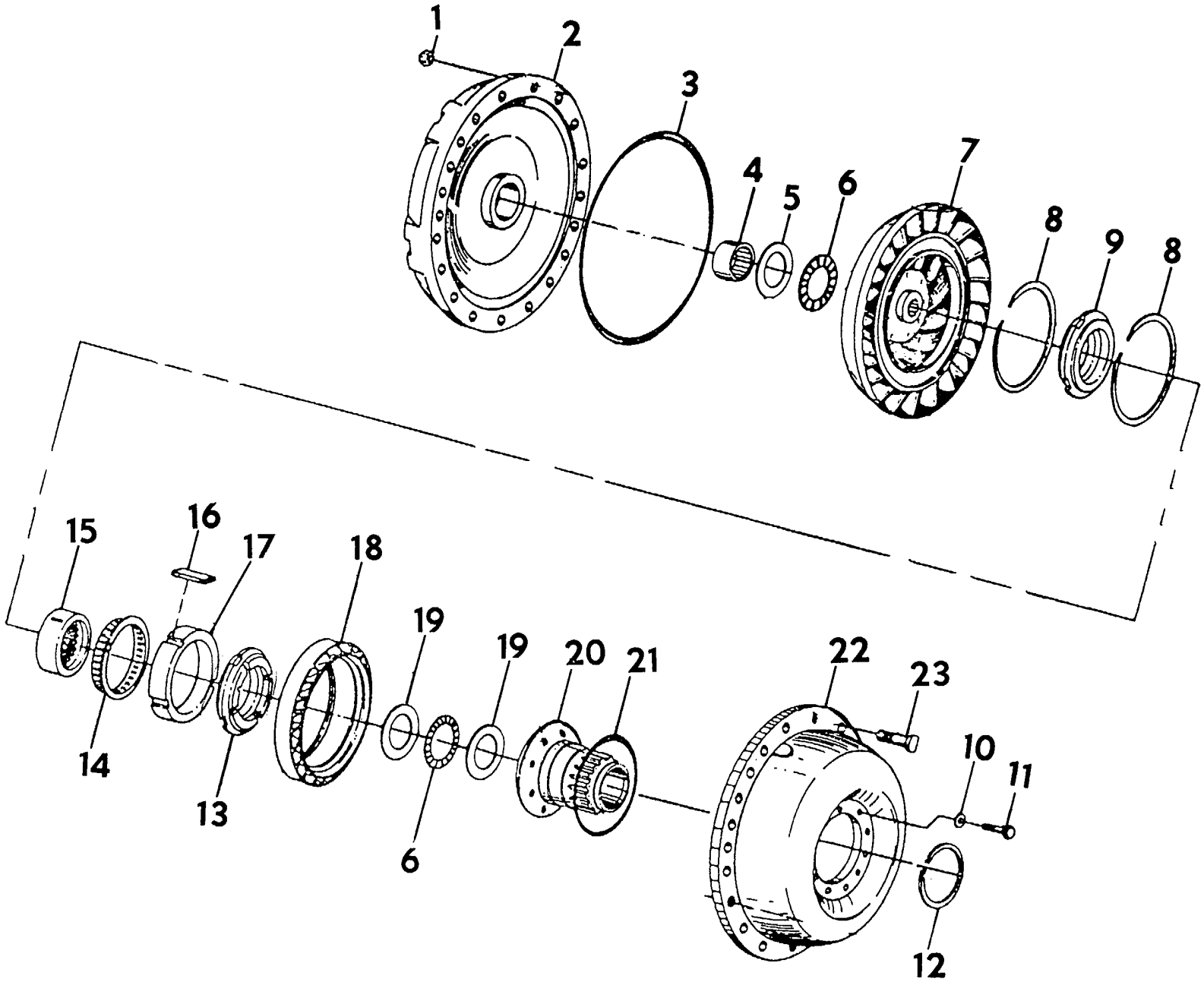


CONVERTER HOUSING ASSEMBLY REF 21102

ITEM	PART NO.	QTY.	DESCRIPTION
1	21067	1	CONVERTER HOUSING
2	21111	1	BALL BEARING
3	21112	1	GEAR DRIVEN
4	21113	1	BALL BEARING
5	21109	1	GASKET
6	21110	1	ADAPTER PLATE
7	21114	1	GASKET
8	21117	1	COVER PLATE
9	7574	2	CAPSCREW
10	21107	2	ROLL PIN
11	21116	1	INNER RACE
12	21115	1	BEARING
13	20405	1	IDLER GEAR
14	20114	2	IDLER GEAR SHAFT
15	20117	4	THRUST WASHER
16	21106	1	INNER RACE
17	21105	1	IDLER GEAR BEARING
18	20111	1	IDLER GEAR
19	21108	2	FREEZE PLUG
20	21104	1	BALL BEARING
21	*	1	OIL SEAL
22	*	1	GASKET
23	20107	1	RETAINER BEARING
24	*	6	WASHER
25	9020	6	CAPSCREW-SOCKET HEAD
26	21103	1	BREATHER

*CONVERTER HOUSING KIT P/N 20976

CONVERTER ASSEMBLY REF 58280

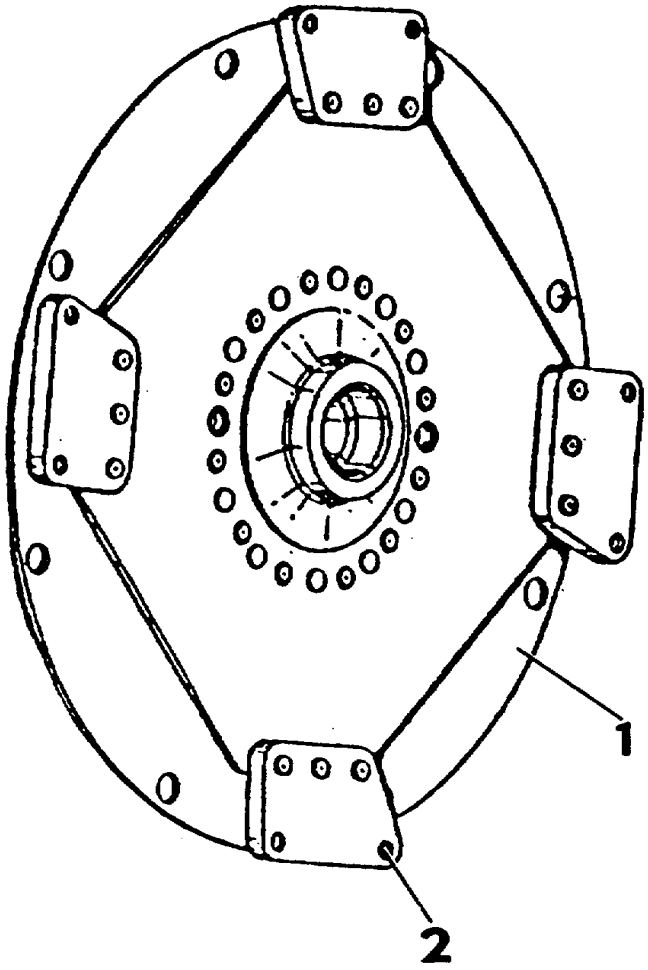


CONVERTER ASSEMBLY REF 58280

ITEM	PART NO.	QTY.	DESCRIPTION
1	21135	16	HEX NUT
2	21209	1	CONVERTER FRONT
3	21123	1	O-RING GASKET
4	21122	1	BEARING
5	21126	1	WASHER - TURBINE THRUST
6	21129	2	NEEDLE THRUST BEARING
7	21125	1	TURBINE ASSEMBLY
8	21207	2	SNAP RING
9	21205	1	RETAINER FRONT CLUTCH
10	20054	12	WASHER
11	21470	12	CAPSCREW
12	21119	1	RING SEAL
13	21204	1	RETAINER CLUTCH REAR
14	21202	1	RACE
15	21201	1	RACE INNER CLUTCH
16	21206	4	KEY SQUARE
17	21203	1	CLUTCH SPRAG ASSEMBLY
18	21208	1	STATOR
19	21469	2	THRUST RACE
20	21131	1	HUB CONVERTER
21	21133	1	O-RING
22	21200	1	PUMP IMPELLER 13 IN CONVERTER
23	21210	16	CAPSCREW

TORQUE SPECIFICATIONS CONVERTER COVER BOLTS 18 FT.LBS.
CONVERTER REPAIR KIT 20975
CONSISTS OF 2 O-RINGS, 1 SEAL, 12 WASHERS

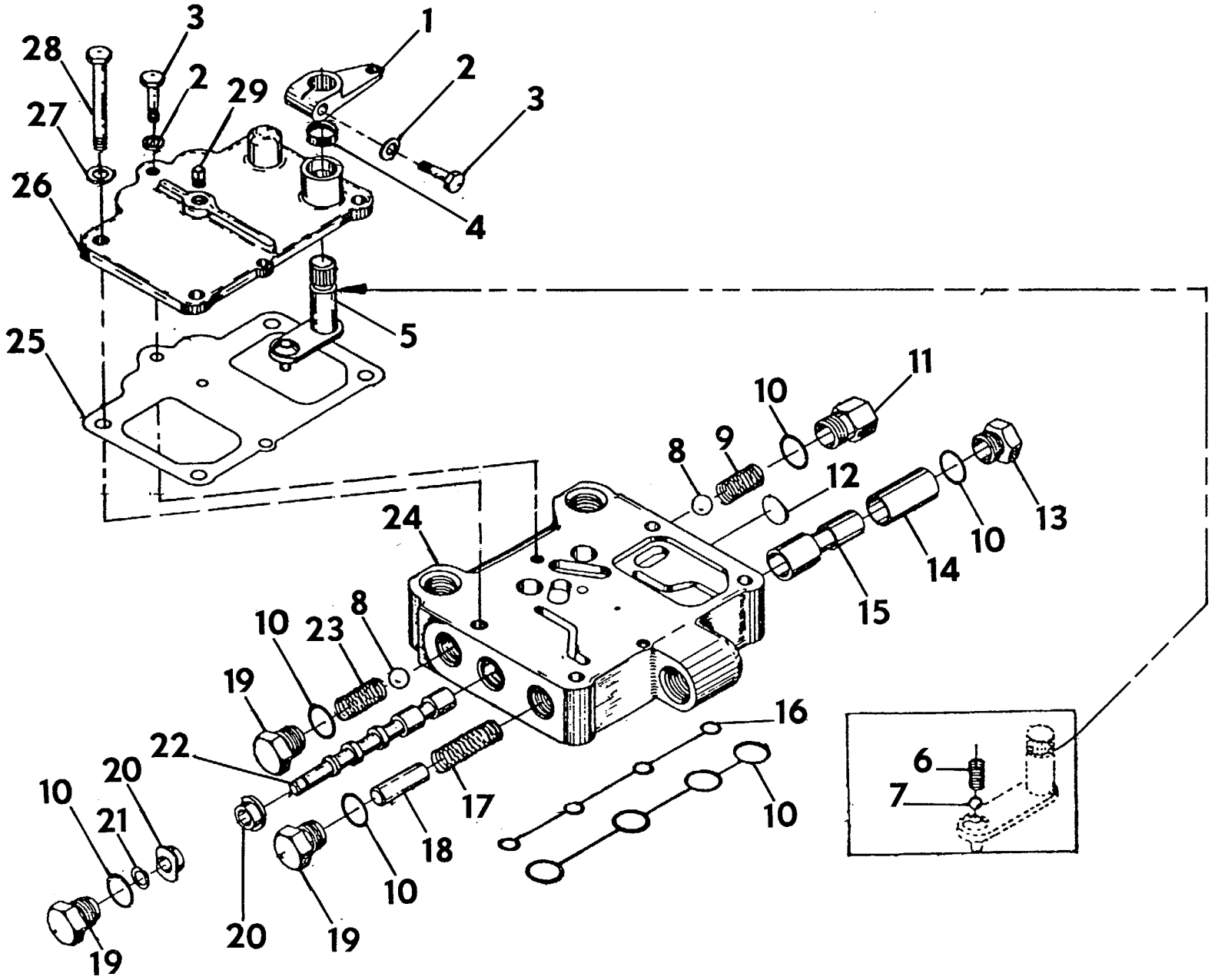
DRIVE PLATE ASSEMBLY MILITARY 270



ITEM	PART NO	QTY	DESCRIPTION
1	21249	1	DRIVE PLATE ASSEMBLY
2	21085	8	CAPSCREW SOC. HD 5/16 IN NF X 2 3/4 IN (SUPPLIED WITH DRIVE PLATE ASSEMBLY)
*3	5962	8	LOCK WASHER INTERNAL 3/8 IN
*4	20998	8	CAPSCREW SOC. HD. 3/8 IN NC X 3/4 IN

*LOCK WASHER AND CAPSCREW (ITEM 3 AND 4) USED TO BOLT ON CONVERTER SHOWN ON ENGINE AND TRANSMISSION ASSEMBLY

CONTROL VALVE ASSEMBLY REF 21214

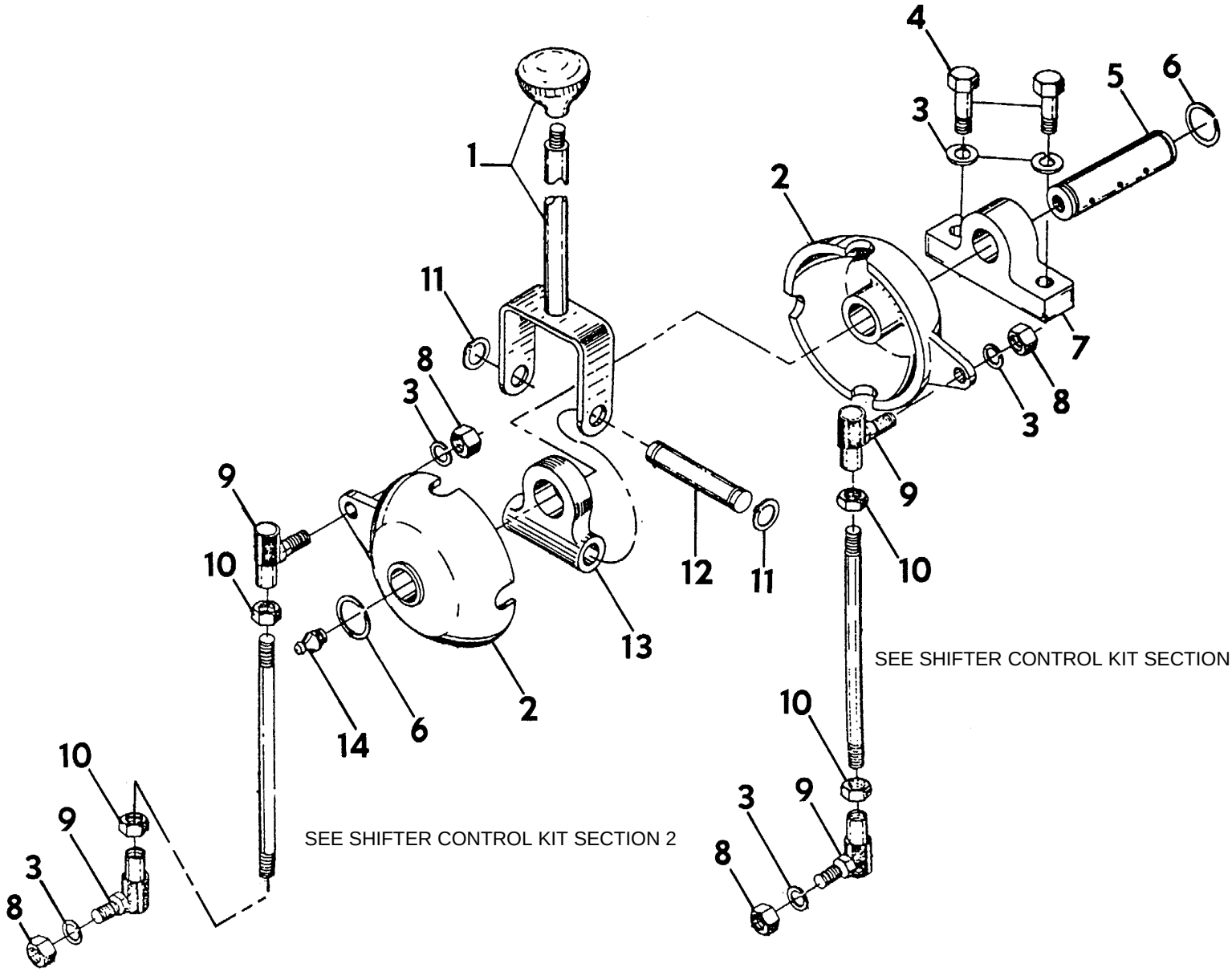


CONTROL VALVE ASSEMBLY REF 21214

ITEM	PART NO.	QTY.	DESCRIPTION
1	21226	1	ARM CONTROL VALVE
2	21192	3	LOCKWASHER
3	21227	3	CAPSCREW
4	*	1	OIL SEAL
5	20267	1	ARM ASSEMBLY
6	21231	1	SPRING
7	21230	1	CONTROL VALVE ARM BALL
8	21221	2	BALL VALVE
9	20262	1	SPRING (3RD REGULATOR VALVE)
10	*	9	O-RING
11	21228	1	PLUG CONTROL VALVE
12	21217	1	EXPANSION PLUG
13	21222	1	CAP (4RD REGULATOR VALVE)
14	21218	1	FEMALE VALVE
15	20255	1	MALE VALVE
16	*	4	O-RING
17	20257	1	SPRING
18	21219	1	PIN
19	21220	3	REGULATOR VALVE CAP
20	21215	2	SPACER VALVE
21	21216	2	SNAP RING
22	20249	1	CLUTCH SEPARATOR VALVE
23	20261	1	SPRING (2ND REGULATOR VALVE)
24	20248	1	CONTROL VALVE BODY
25	*	4	VALVE COVER GASKET
26	20266	1	CONTROL VALVE COVER
27	21170	4	LOCKWASHER
28	21225	4	CAPSCREW
29	21229	1	PLUG

*CONTROL VALVE KIT P/N 20984

SHIFTER CONTOL ASSEMBLY REF 21238



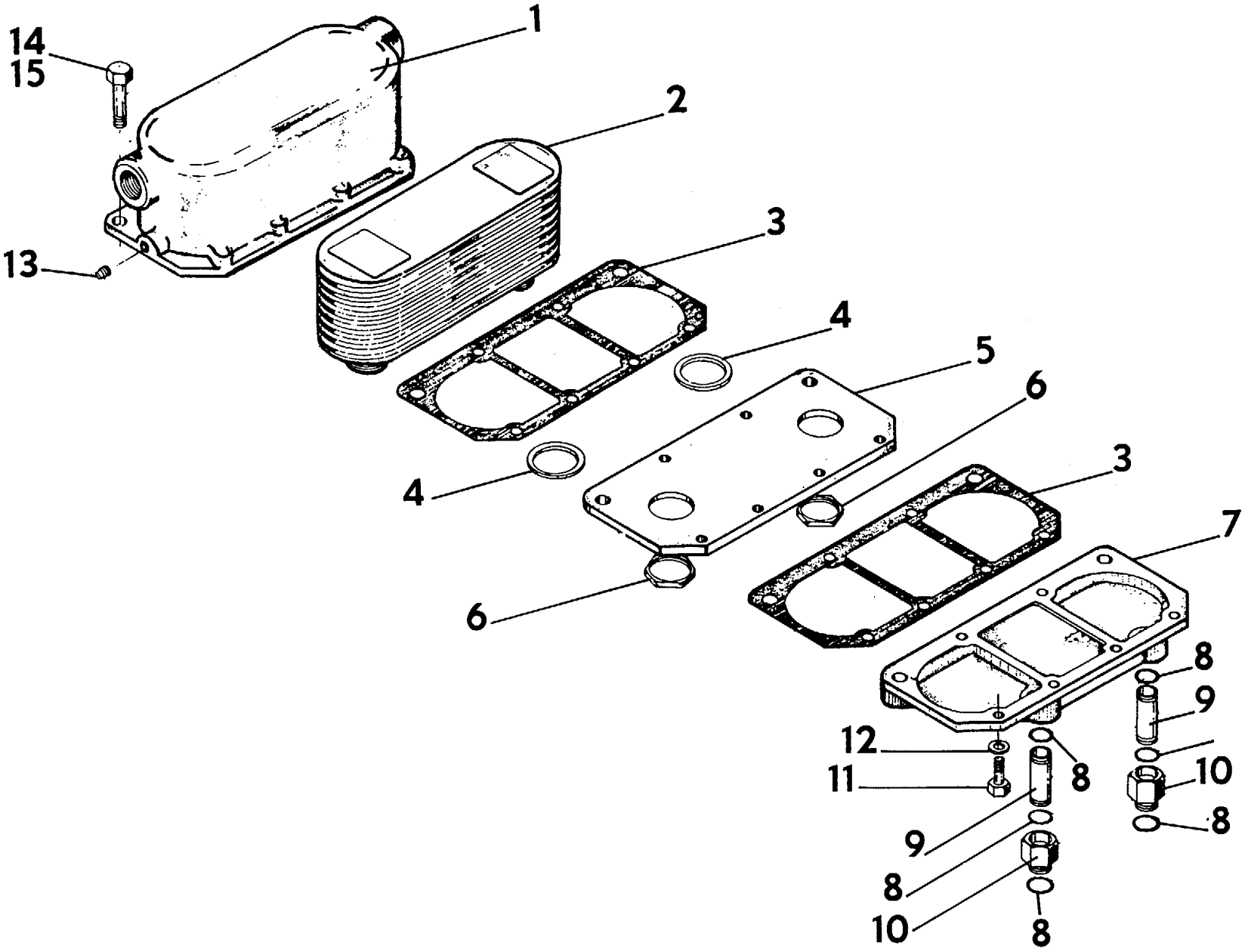
SHIFTER CONTROL ASSEMBLY REF 21238

ITEM	PART NO.	QTY.	DESCRIPTION
*1	20246	1	HAND LEVER ASSEMBLY
2	21239	2	SHELL SHIFT CONTROL
3	21192	6	LOCKWASHER
4	21243	2	CAPSCREW
5	20300	1	FULCRUM PIN
6	21242	2	RETAINER PIN
7	20302	1	BRACKET ASSEMBLY
8	21248	4	NUT
9	21246	4	BALL JOINT
10	21247	4	JAM NUT
11	21241	2	SNIP RING
12	20298	1	PIN
13	21240	1	KNUCKLE
14	5929	1	GREASE FITTING

SEE SHIFTER CONTROL KIT SECTION 2

*THIS PART MODIFIED BY REEDRILL.

HEAT EXCHANGER ASSEMBLY REF 20104

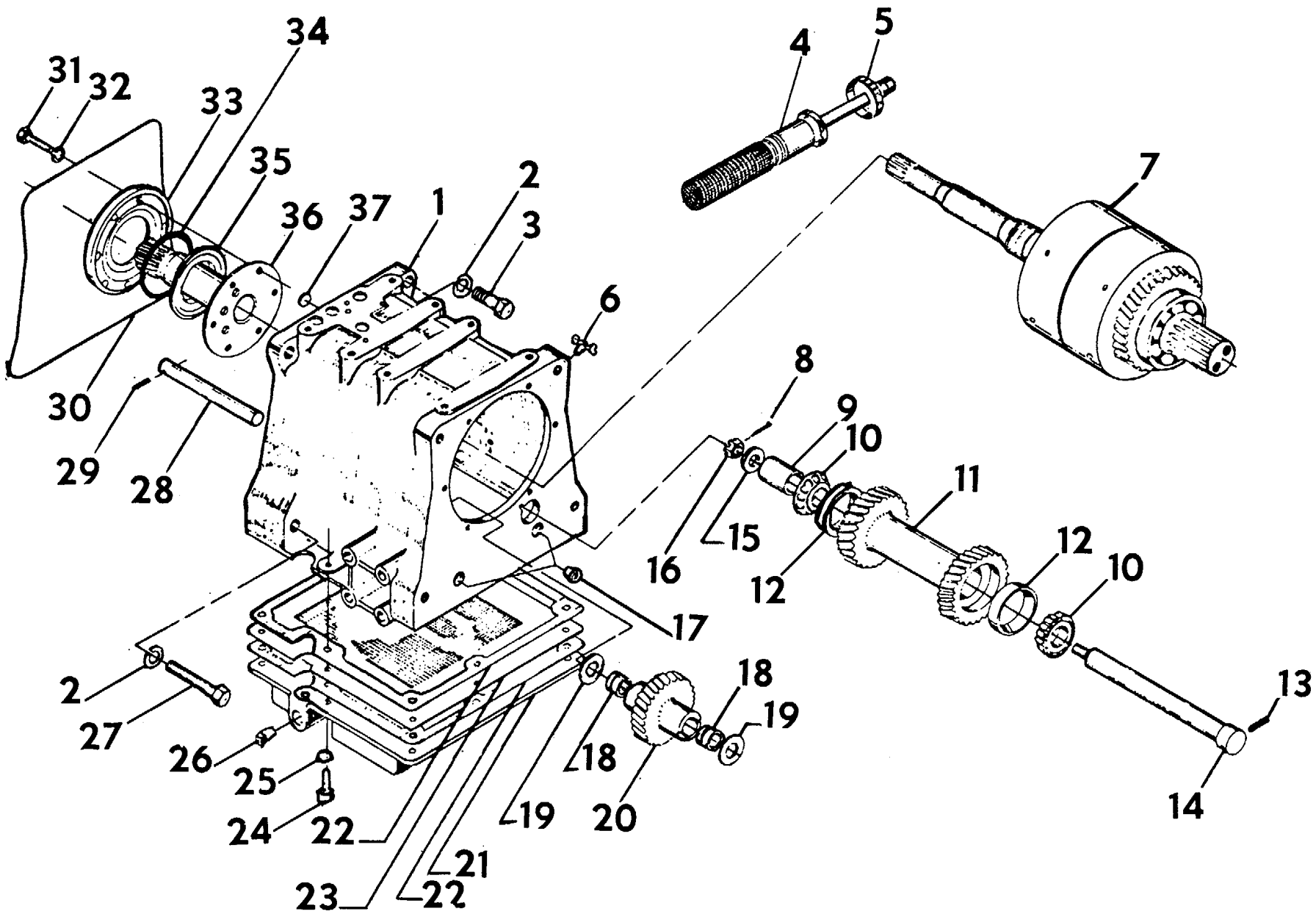


HEAT EXCHANGER ASSEMBLY REF 20104

ITEM	PART NO.	QTY.	DESCRIPTION
1	20277	1	COVER
2	20271	1	HEAT EXCHANGER CORE
3	*	2	CORE PLATE GASKET
4	*	2	INLET/OUTLET GASKET
5	20273	1	CORE PLATE
6	20274	2	CORE NUT
7	20276	1	BASE
8	*	6	O-RING OIL TUBE SEAL
9	20279	2	TUBE - OIL VALVE TO HEAT EXCHANGER
10	20278	2	OIL TUBE FITTING
11	42573	6	CAPSCREW HEX HD 3/8 IN NC X 1 1/2 IN
12	5989	6	WASHER SPRING LOCK
13	6104	1	PIPE PLUG 1/8 NPT SQ HD
14	42676	2	CAPSCREW HEX HD 7/16 IN NC - 2 3/4 IN
15	5962	2	WASHER 7/16 (NOT SHOWN)

*HEAT EXCHANGER KIT P/N 20987

SHUTTLE TRANSMISSION ASSEMBLY REF 21155

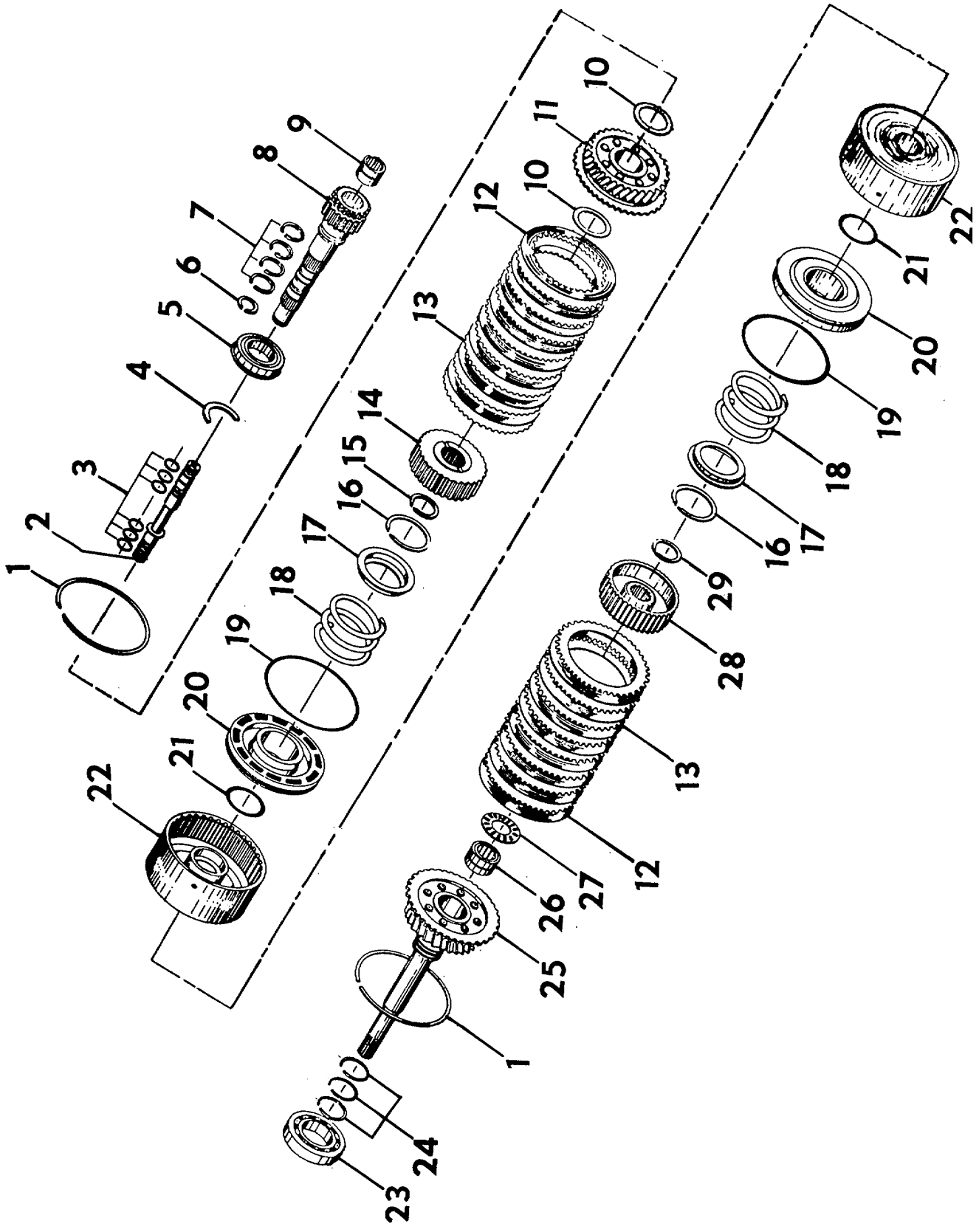


SHUTTLE TRANSMISSION ASSEMBLY REF 21155

ITEM	PART NO.	QTY.	DESCRIPTION
1	21156	1	CASE
2	21173	4	LOCKWASHER
3	21174	2	CAPSCREW
4	21176	1	OIL FILTER TUBE/STRAINER ASSEMBLY
5	21175	1	DIPSTICK CAP ASSEMBLY
6	21177	1	DRAIN COCK OIL LEVEL CHECK
7	21150	1	SHAFT AND CLUTCH ASSEMBLY (SEE THIS SECTION FOR BREAKDOWN)
8	21164	1	PIN COTTER
9	21162	1	COUNTERSHAFT SPACER
10	21159	2	BEARING CONE
11	21157	1	COUNTER GEAR
12	21158	2	BEARING CUP
13	-----	1	SCREW DRIVE (FUNK F310063)
14	21160	1	COUNTER GEAR SHAFT
15	21163	1	COUNTERSHAFT WASHER
16	21165	1	CASTLE NUT
17	21195	2	PLUG (NOT REQ. WITH 4 SPEED)
18	21188	2	IDLER GEAR BEARING
19	21187	2	IDLER GEAR THRUST WASHER
20	21189	1	IDLER GEAR
21	21184	1	SUMP
22	*	2	SUMP GASKET
23	21186	1	SUMP SCREEN ASSEMBLY
24	21183	8	CAPSCREW
25	21182	8	LOCKWASHER
26	21181	1	DRAIN PLUG
27	21180	2	CAPSCREW
28	21179	1	IDLER GEAR SHAFT
29	21178	1	ROLL PIN
30	*	1	GASKET
31	21169	6	CAPSCREW
32	21170	6	LOCKWASHER
33	21166	1	COVER
34	21167	1	O-RING
35	21168	1	FLOATING SEAL
36	21171	1	TUBE STATOR SUPPORT
37	---------	1	PLUG (FUNK F22007)

*SHUTTLE TRANSMISSION KIT P/N 20981

SHAFT AND CLUTCH ASSEMBLY REF 21150

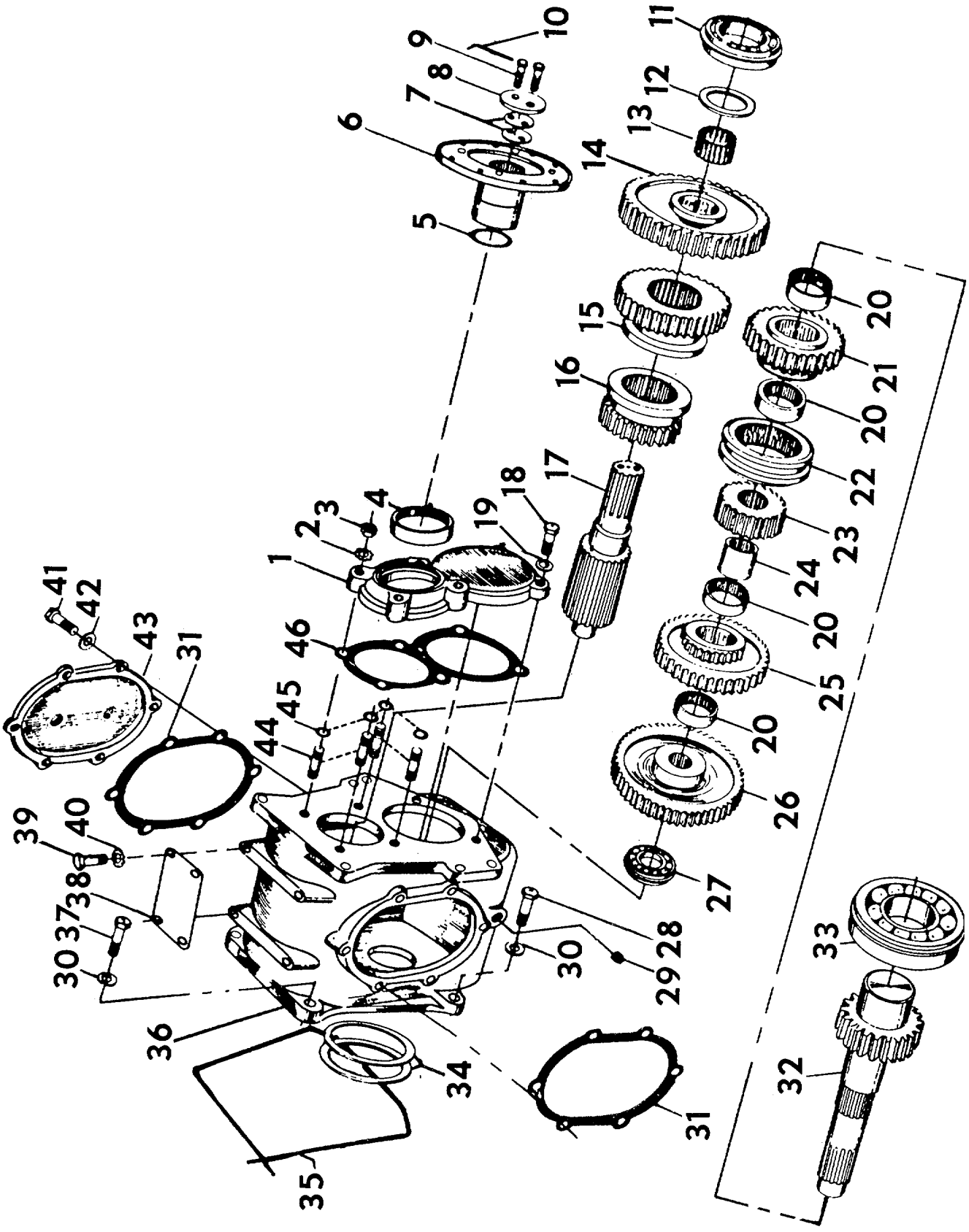


SHAFT AND CLUTCH ASSEMBLY REF 21150

ITEM	PART NO.	QTY.	DESCRIPTION
1	20205	2	RING RETAINING
2	20182	1	TUBE OIL ASSEMBLY
3	*	6	RING SEAL OIL TUBE
4	21149	1	SNAP RING
5	21148	1	BEARING
6	*	1	RING SEAL OUTPUT SHAFT
7	20190	4	RING SEAL OUTPUT SHAFT
8	21152	1	SHAFT OUTPUT
9	21151	1	BEARING
10	20181	2	WASHER THRUST OUTPUT GEAR
11	20180	1	GEAR OUTPUT ASSEMBLY
12	21137	16	PLATE CLUTCH FRICTION INT. SPINE
13	20204	16	PLATE CLUTCH REACTION EXT. SPLING
14	21138	1	HUB REAR CLUTCH
15	21139	1	RING RETAINER HUB REAR
16	21140	2	RETAINER RING CLUTCH SPRING
17	20201	2	RETAINER CLUTCH RETURN SPRING
18	20200	2	SPRING CLUTCH RETURN
19	*	2	SEAL PISTON OUTER
20	20197	2	PISTON
21	*	2	O-RING PISTON INNER
22	20196	2	CLUTCH CYLINDER ASSEMBLY
23	21145	1	BEARING BALL
24	*	3	SEAL RING
25	21154	1	SHAFT ASSEMBLY INPUT
26	21144	1	BEARINT PILOT INPUT SHAFT
27	21153	1	THRUST BEARING ASSEMBLY
28	21143	1	HUB FRONT CLUTCH
29	21142	1	RING RETAINER HUB FRONT

*SHAFT AND CLUTCH KIT P/N 20983

FOUR SPEED TRANSMISSION ASSEMBLY REF 20103

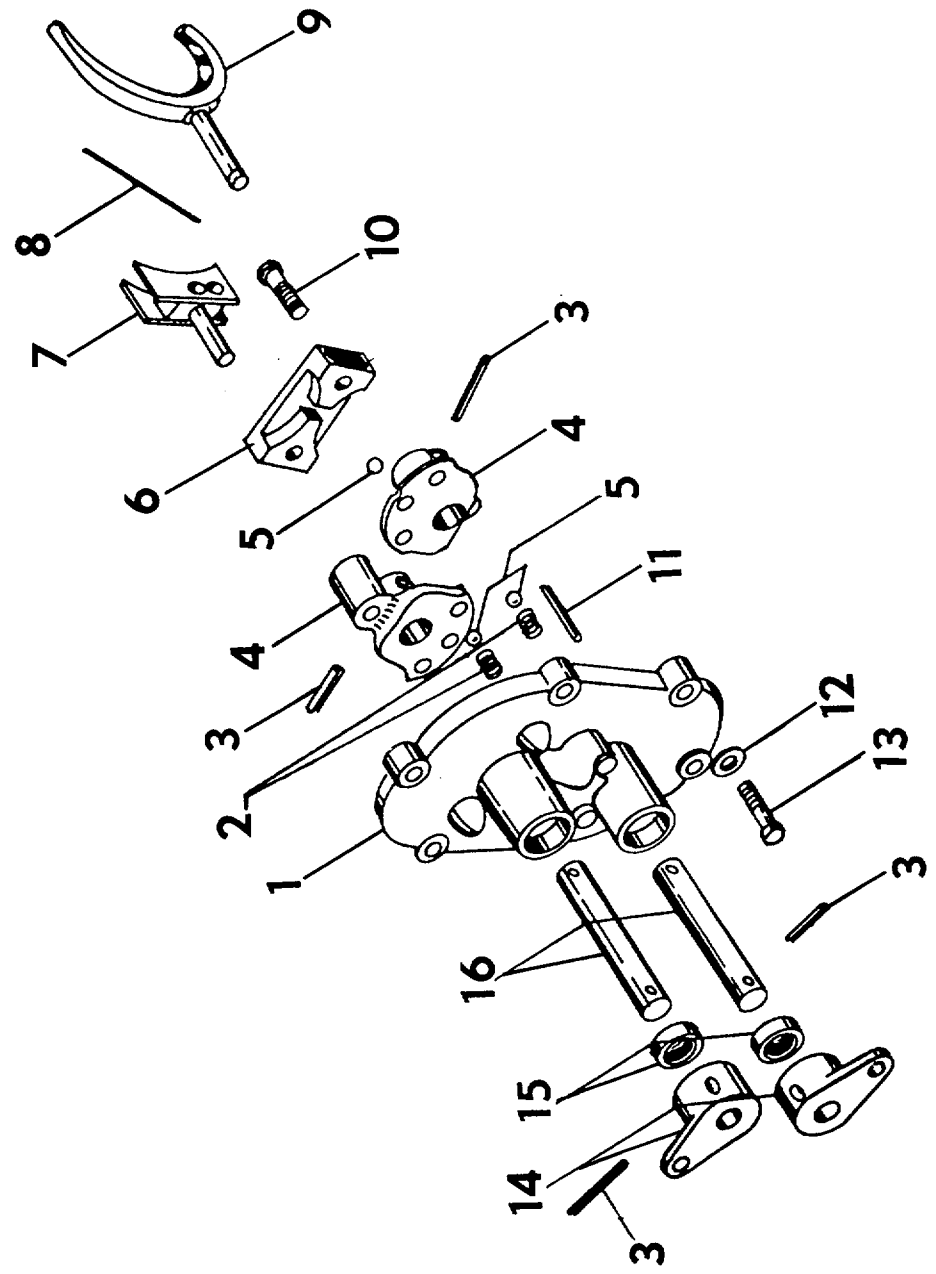


FOUR SPEED TRANSMISSION ASSEMBLY REF 20103

ITEM	PART NO.	QTY.	DESCRIPTION
1	20233	1	REAR BEARING RETAINER
2	6157	4	WASHER 1/2 IN LOCK
3	5973	4	HEX HD NUT 1/2 IN NC
4	*	1	SEAL - OIL - COMPANION FLANGE SEAL
5	20307	1	OUTPUT SHAFT SEAL O-RING
6	20306	1	COMPANION FLANGE
7	20264	0 TO 5	COMPANION FLANGE ADJUSTMENT SHIM
8	20308	1	COMPANION FLANGE RETAINER WASHER
9	42925	2	CAPSCREW DRILLED HEX HD 7/16 IN NF X 1 IN
10	20287	1	WIRE - SAFETY .040 X 4 IN
11	20224	1	BEARING - TRANSMISSION OUTPUT
12	20220	1	WASHER THRUST MAIN SHAFT LOW GEAR
13	20219	34	ROLLER LOOSE MAIN SHAFT LOW GEAR BEARING
14	20218	1	GEAR LOW MAIN SHAFT
15	20221	1	GEAR SECOND MAIN SHAFT
16	20222	1	GEAR THIRD MAIN SHAFT
17	20223	1	SHAFT MAIN (OUTPUT)
18	5972	2	CAPSCREW HEX HD 1/2 IN NC X 1 1/2 IN
19	*	2	WASHER 1/2 IN
20	20215	4	BEARING - SECOND AND THIRD GEAR COUNTERSHAFT
21	20213	1	GEAR - SECOND COUNTERSHAFT
22	20210	1	SHIFTING COLLAR COUNTERSHAFT SECOND AND THIRD
23	20211	1	SHIFTING COLLAR HUB
24	20209	1	BEARING SLEEVE COUNTERSHAFT THIRD GEAR
25	20214	1	GEAR - THIRD COUNTERSHAFT
26	20208	1	COUNTERSHAFT DRIVE GEAR -/
27	20216	1	BEARING - COUNTERSHAFT FRONT
28	6637	2	CAPSCREW HEX HD 9/16 IN NC X 2 IN
29	20110	1	TRANSMISSION DRAIN PLUG 1/2 NPT MAGNETIC
30	6351	4	WASHER 9/16 LOCK
31	*	2	SIDE COVER AND CAP GASKET
32	20212	1	COUNTERSHAFT
33	20217	1	BEARING - COUNTERSHAFT REAR
34	20226	1 TO 3	CLUTCH STACK ADJUSTMENT SHIM
35	*	1	TRANSMISSION TO SHUTTLE CASE GASKET
36	20225	1	TRANSMISSION CASE
37	42704	2	CAPSCREW HEX HD 9/16 IN NC X 2 1/4 IN
38	20239	1	SHIFT PATTERN - 4 SPEED TRANSMISSTON
39	20998	2	CAPSCREW HEX HD 3/4 IN NC X 3/4 IN
40	5962	2	WASHER 3/8 IN LOCK
41	42570	6	CAPSCREW HEX HD 3/8 IN NC X 1 IN
42	*	6	WASHER 3/8 IN
43	20228	1	SIDE COVER
44	20237	4	TRANSMISSION BRAKE MOUNT STUD
45	*	4	STUD SEAL O-RING
46	*	1	REAR BEARING RETAINER GASKET

*FOUR SPEED TRANSMISSION KITP/N 20985

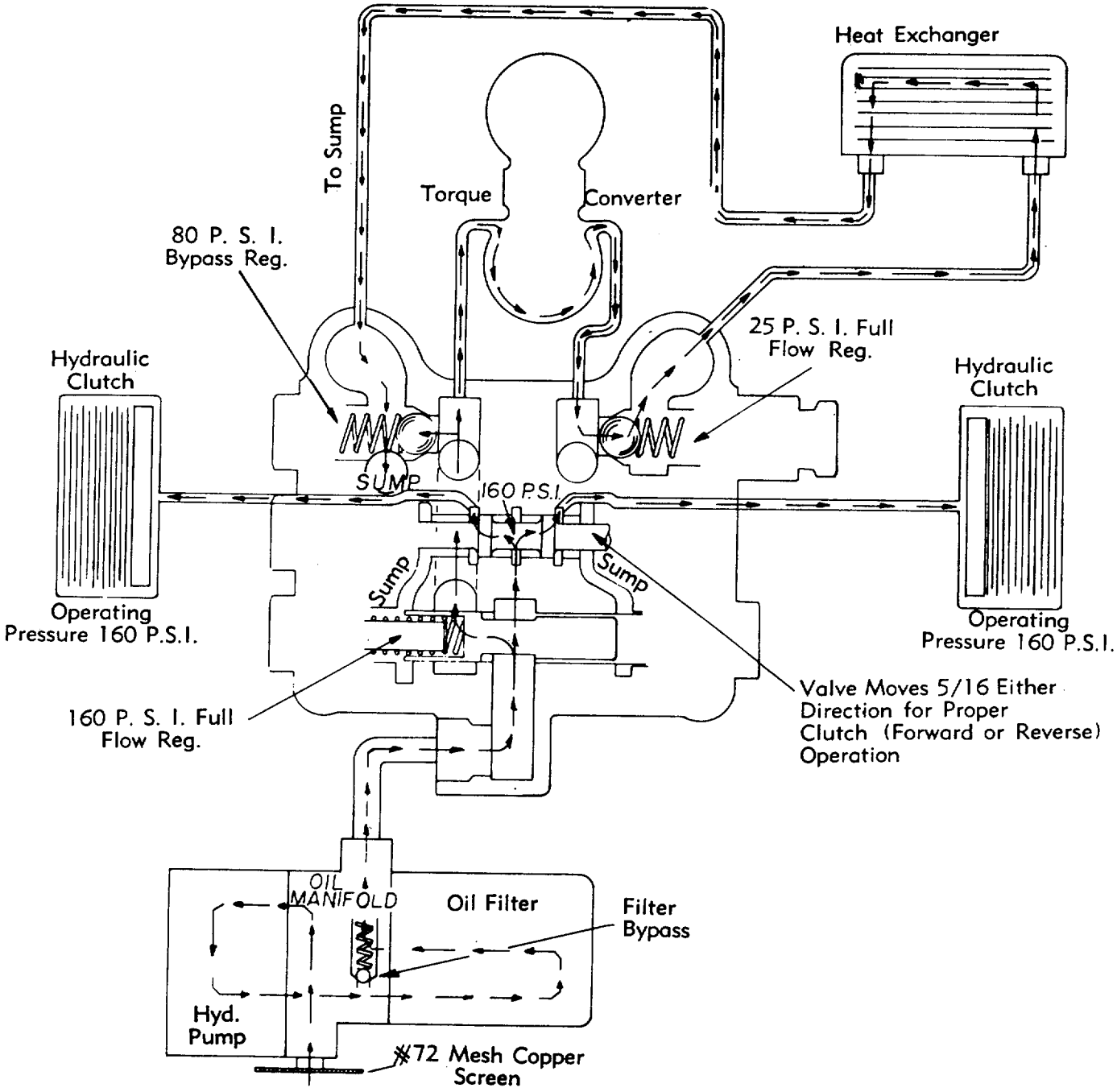
SIDE CAP ASSEMBLY REF 20281



SIDE CAP ASSEMBLY REF 20281

ITEM	PART NO.	QTY.	DESCRIPTION
1	20282	1	TRANSMISSION SHIFT SIDE CAP
2	20252	2	TRANSMISSION SHIFT DETENT SPRING
3	20291	4	SHIFTER & ARM RETAINER PIN
4	20285	2	SHIFT SELECTOR
5	20251	3	STEEL BALL 3/8 DIA
6	20286	1	INHIBITOR BLOCK
7	20284	1	LOW & HIGH SHIFTER FORK
8	20287	4 IN	SAFETY WIRE
9	20283	1	SECOND AND THIRD SHIFTER FORK
10	42760	2	DRILLED HD CAPSCREW 3/8 IN NC X 1 1/4 IN
11	20288	4	OVERSHIFT STOP RETAINER PIN
12	16083	6	FLAT WASHER SEALING 3/8 IN
13	42570	6	CAPSCREW HEX HD 3/8 IN NC X 1 IN
14	20290	2	TRANSMISSION SHIFT ARM
15	20292	2	SHIFT SECTOR SHAFT OIL SEAL
16	20289	2	SHIFT SECTOR SHAFT

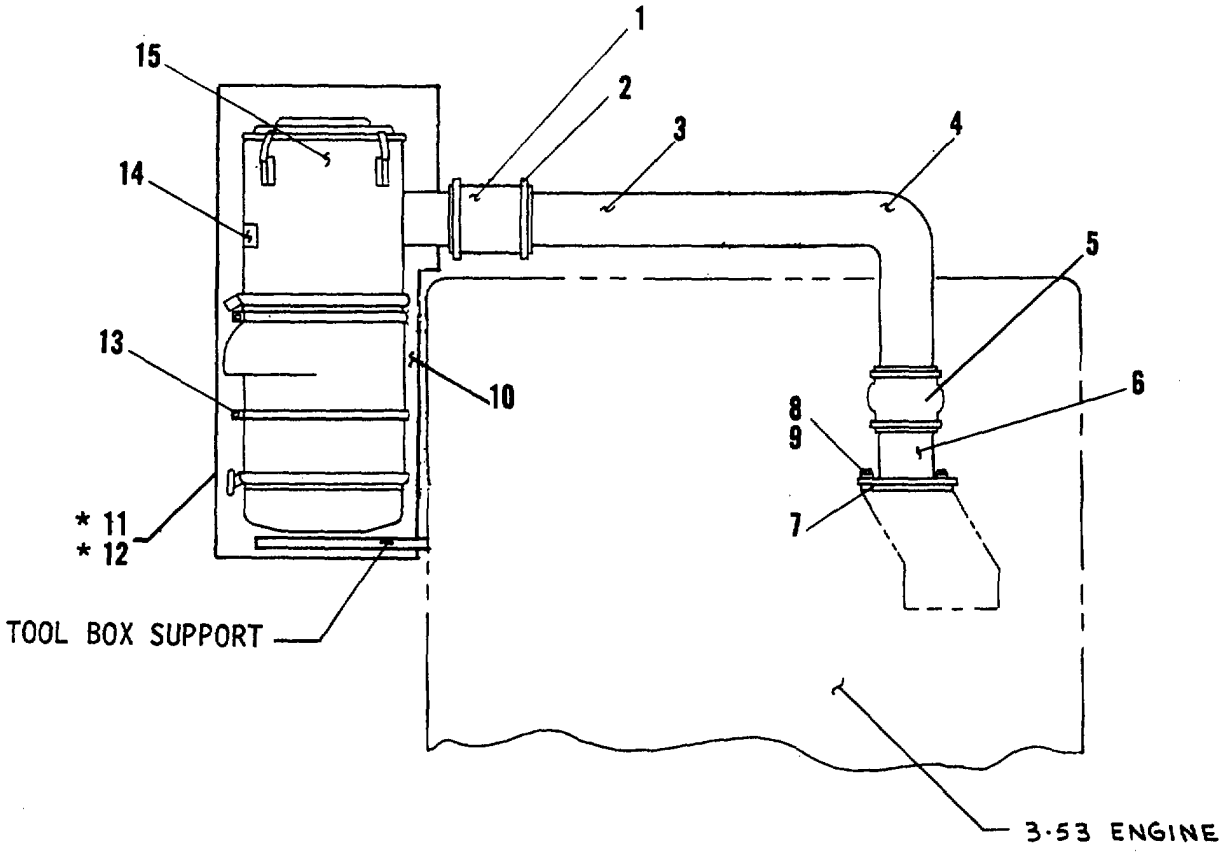
CONVERTER AND VALVE FLOW DIAGRAM FOR TRANSMISSION



SHEET 1 OF 1

PUBLICATION DWG. NO. PM-156-33

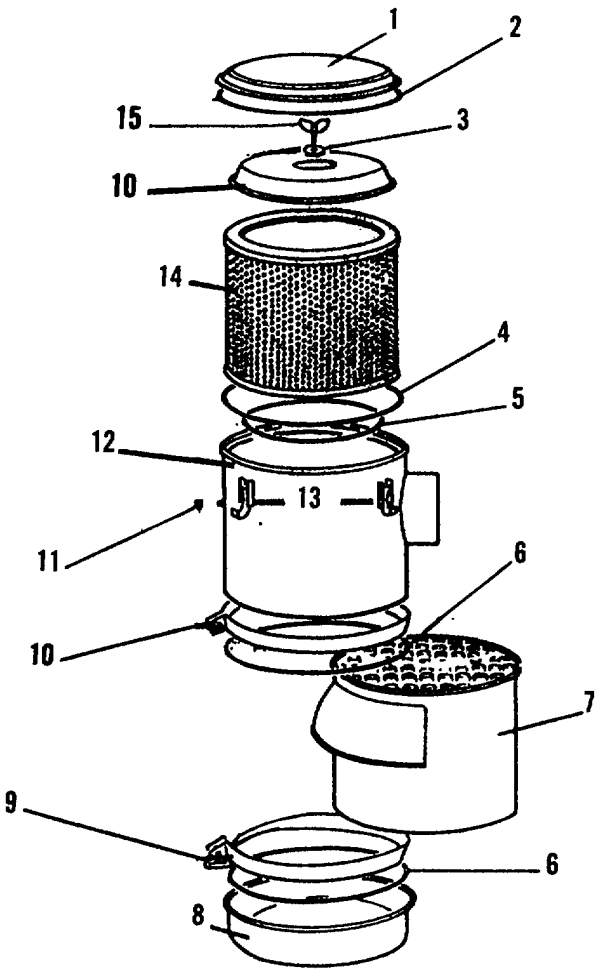
AIR INTAKE SYSTEM 3-53 ENGINE REF 58917



*TIGHTEN AIR FILTER TO ITEM 10 WITH ITEMS 11 & 12

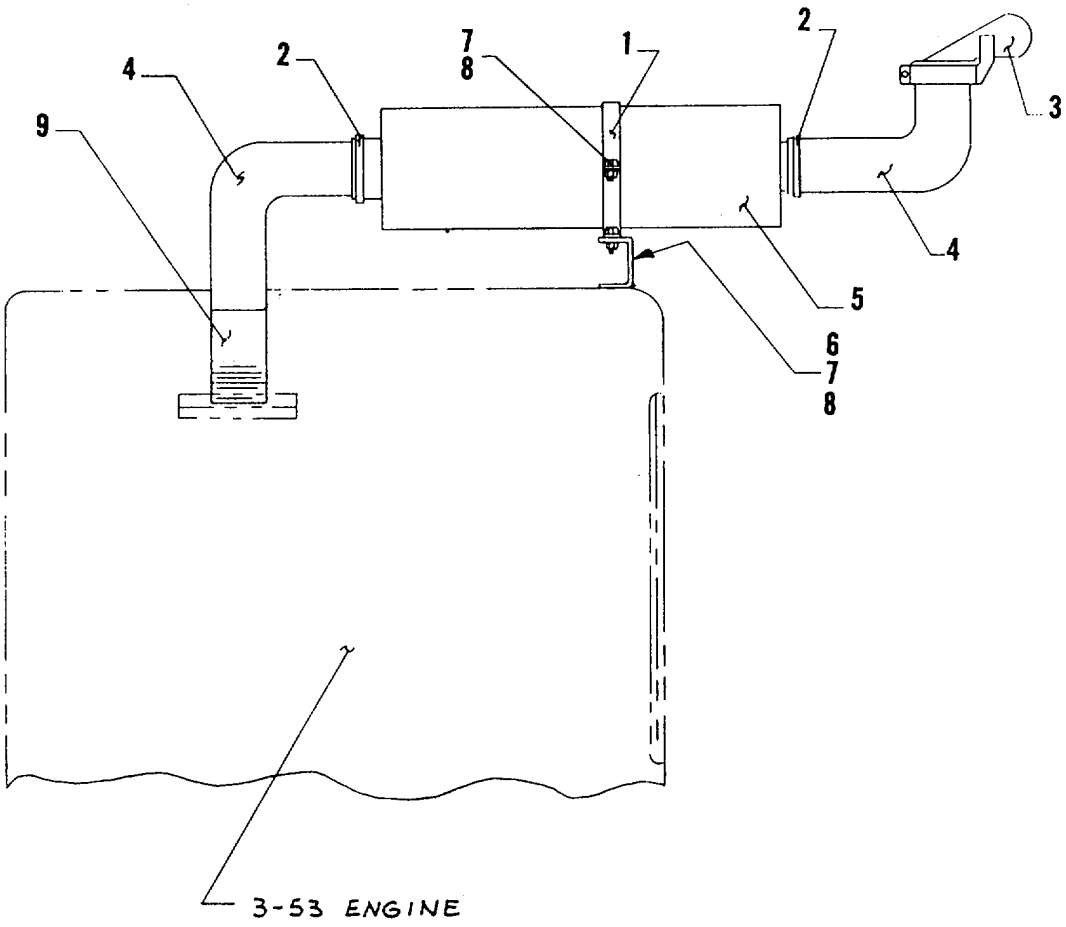
ITEM	PART NO.	QTY.	DESCRIPTION
1	30024	1	HOSE - AIR - VENT - 4 ID X 5 ½ LG
2	16895	4	CLAMP - HOSE - 3 ½ X 4
3	58915	1	TUBING - AIR FILTER
4	49971	1	ELBOW - 90°
5	33990	1	HOSE - HUMP - STR
6	49972	1	ADAPTER - FLANGE - INTAKE
7	52277	1	GASKET - AIR INLET
8	6096	4	CAPSCREW - HEX HD 5/16 IN NC X 1 LG GRD 5
9	42625	4	WASHER - FLAT - SD 5/16 IN
10	59532	1	BRACKET - AIR CLEANER
11	42570	6	CAPSCREW - HEX HD 5/8 IN NC X 1 LG GRD 5
12	7972	6	NUT - ELASTIC STOP - 3/8 IN NC
13	49125	2	BAND - STRAP - AIR FILTER
14	43481	1	INDICATOR FILTER - SERVICE
15	49124	1	FILTER - AIR (SEE THIS SECTION)

AIR FILTER ASSEMBLY REF 49124



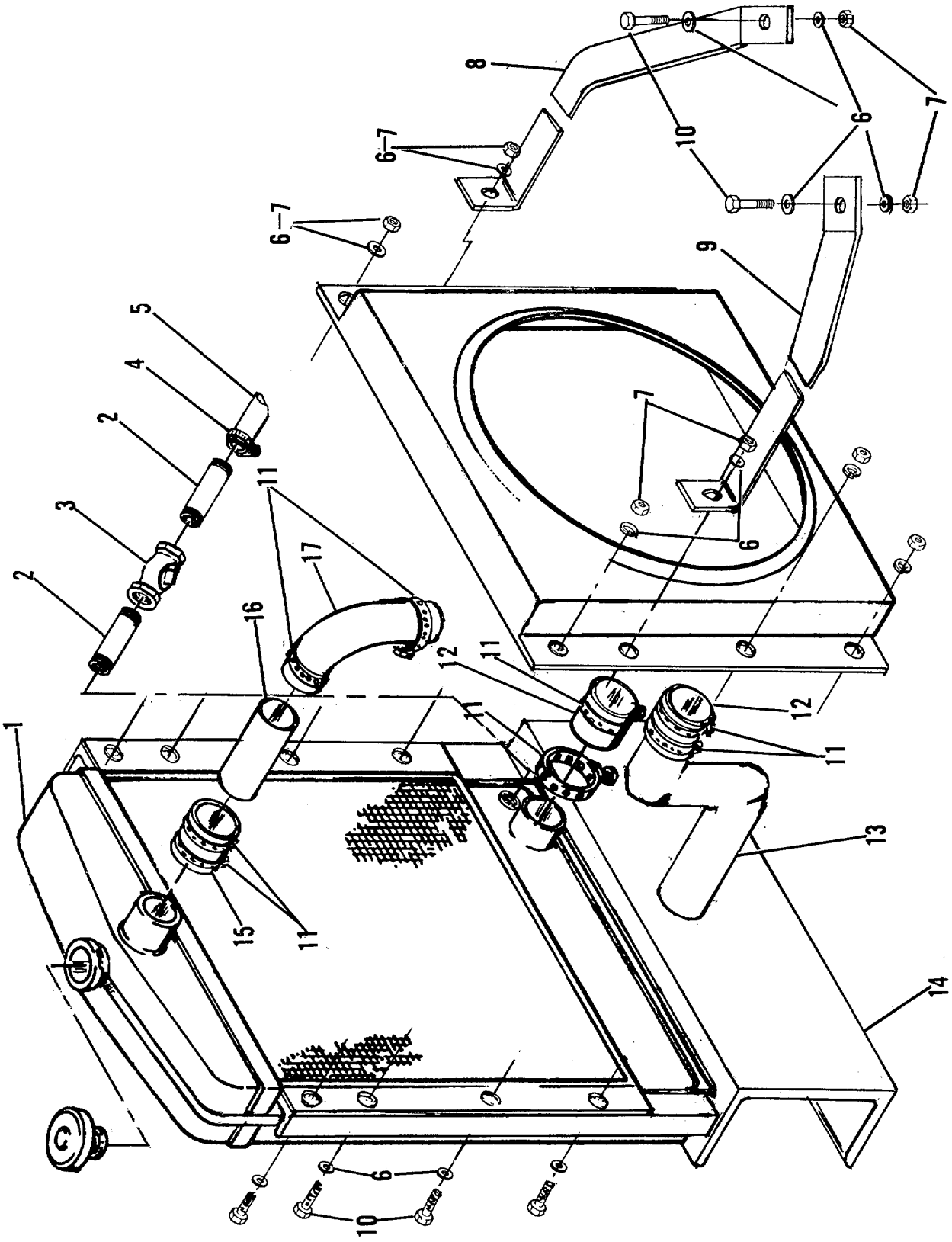
ITEM	PART NO.	QTY.	DESCRIPTION
1	58975	1	COVER ASSEMBLY
2	58976	1	COVER GASKET
3	58978	1	GASKET WASHER
4	58981	1	INNER COVER ASSEMBLY
5	58983	1	ELEMENT GASKET
6	58987	2	BODY AND CUP GASKET
7	58988	1	LOWER BODY ASSEMBLY
8	58990	1	CUP ASSEMBLY
9	58989	1	CUP CLAMP ASSEMBLY
10	58986	2	CLAMP ASSEMBLY
11	58985	1	RESTRICTION CLIP
12	58982	1	UPPER BODY ASSEMBLY
13	58984	2	COVER CLIP SPRING
14	58979	1	ELEMENT ASSEMBLY
15	58977	1	THUMB SCREW

EXHAUST ASSEMBLY 3-53 ENGINE REF 58923



ITEM	PART NO.	QTY.	DESCRIPTION
1	43708	1	BRACKET - MOUNTING - MUFFLER
2	36360	2	CLAMP-MUFFLER
3	36686	1	CAP - PIPE - EXHAUST
4	30587	2	ADAPTER - ELBOW 90° - 3 ½ DIA
5	43030	1	MUFFLER
6	58922	1	SUPPORT - MUFFLER
7	7972	4	NUT - ELASTIC STOP - 3/8 IN NC
8	20998	4	CAPSCREW HEX HD 3/8 IN NC X ¾ LG GRD 5
9	52906	1	NIPPLE - 3 STD - PIPE - 9 LG - THD ONE END

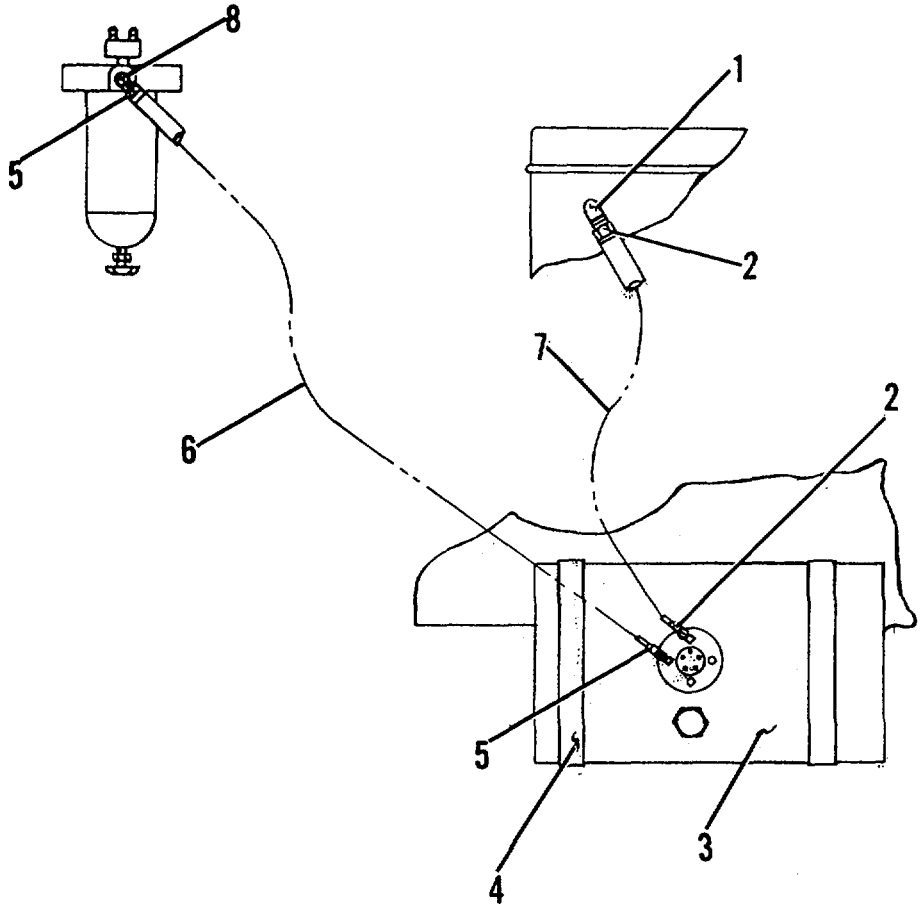
RADIATOR ASSEMBLY REF 58974



RADIATOR ASSEMBLY REF 58974

ITEM	PART NO.	QTY.	DESCRIPTION
1	58910	1	RADIATOR - 3-53 ENG ASSY
2	6655	2	NIPPLE - STL - SCH - 80 - 1/4 X 1 ½ LG
3	34053	1	GAS SERVICE VALVE - STOP 1/4 NPT
4	16888	1	HOSE CLAMP 3/8 TO 1 IN
5	34054	11 FT	RADIATOR DRAIN HOSE - HEATER - 3/8 - ID
6	16083	20	WASHER - FLAT - STD 3/8
7	7972	10	NUT - ELASTIC STOP - 3/8 - 16 UNC
8	58935	1	RADIATOR MOUNTING BRACKET - RIGHT SIDE
9	58934	1	RADIATOR MOUNTING BRACKET - LEFT SIDE
10	5988	10	CAPSCREW - HEX HD - 3/8 - 16 UNC X 1 1/4 LG GR.5
11	16891	8	HOSE CLAMP - 1 5/16 - 2 1/4
12	52336	2	HOSE - 2 IN DIA X 3 1/2 IN LG
13	58966	1	LOWER RADIATOR TUBE - 3-53 ENGINE
14	58958	1	RADIATOR MOUNT - 3-53 ENGINE
15			CUT TO 3 1/4" LONG OFF ITEM #17
16	58962	1	UPPER RADIATOR TUBE - 3-53 ENGINE
17	52339	1	HOSE - 1 5/8 I.D.

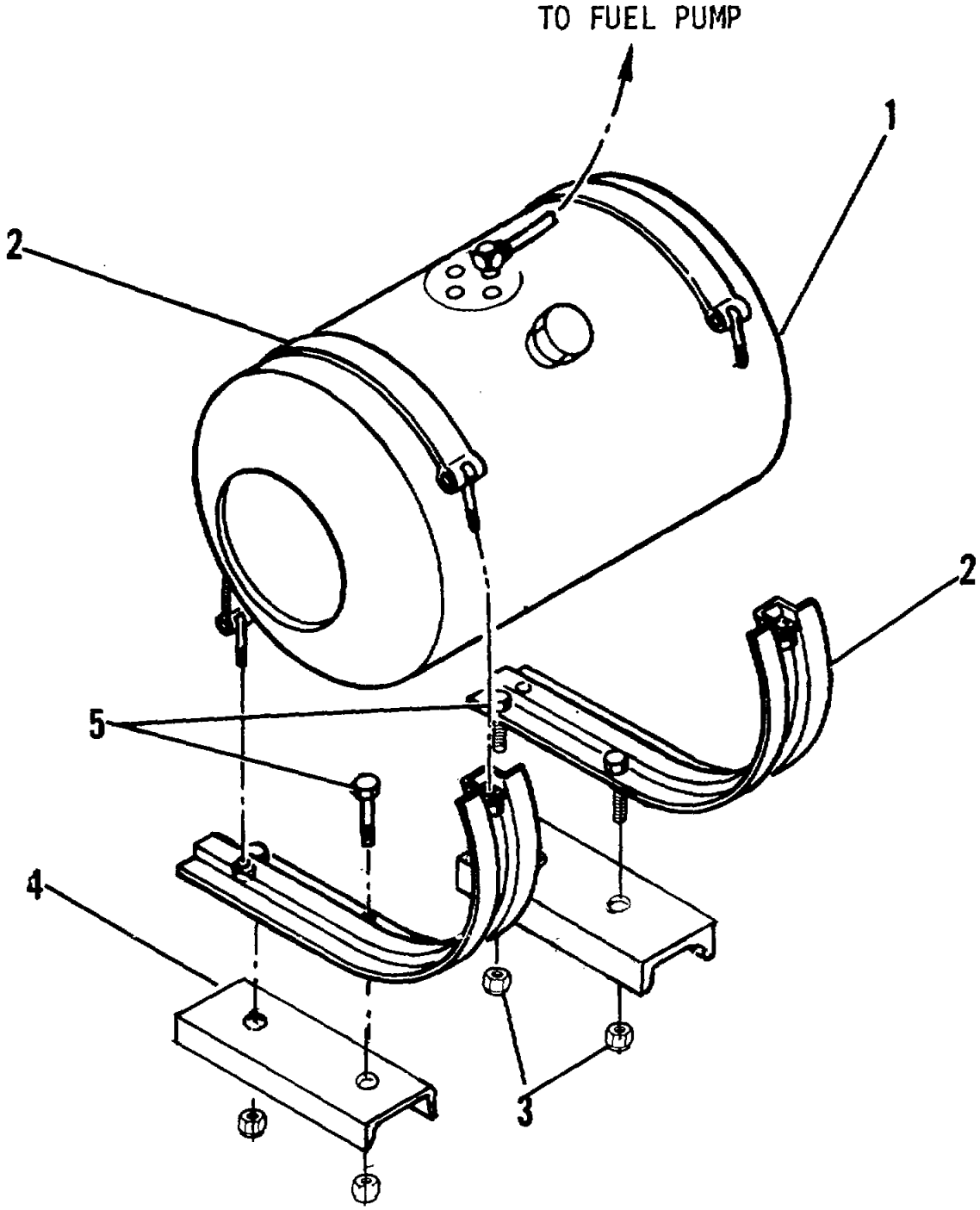
FUEL RESERVOIR PLUMBING REF 58536



ITEM	PART NO.	QTY.	DESCRIPTION
1	31809	1	HYDRAULIC FITTING - 90° ¼ JIC
2	32961	2	HOSE FITTING - REUSABLE - SOCKETLESS - ¼ FJIC X ¼
3	18380	1	FUEL TANK
4	18381	2	FUEL TANK BRACKET
5	32104	2	HOSE FITTING - REUSABLE - SOCKETLES - 3/8 FJIC X3/8
6	15145	4.5 ft	FUEL HOSE - 3/8 250 PSI
7	15132	8 ft	FUEL HOSE - ¼ - 250 PSI
8	31829	1	ADAPTER - 90° ¼ MPT X 3/8 MJIC

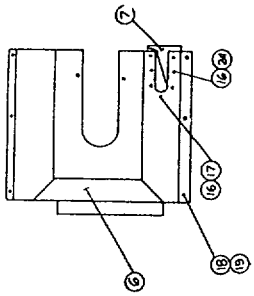
SEE SECTION 6

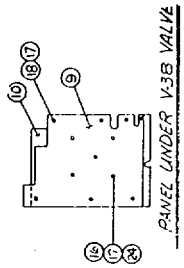
FUEL TANK INSTALLATION

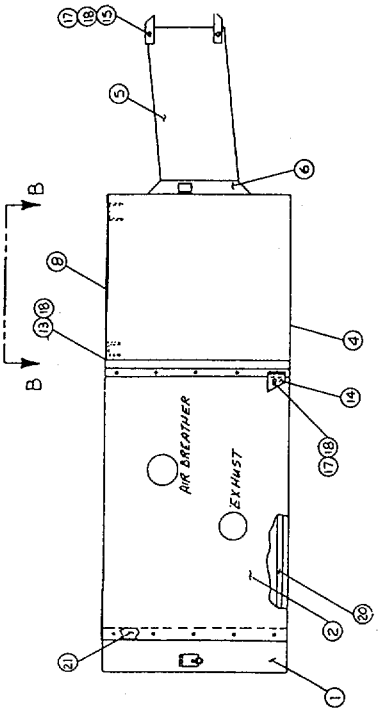


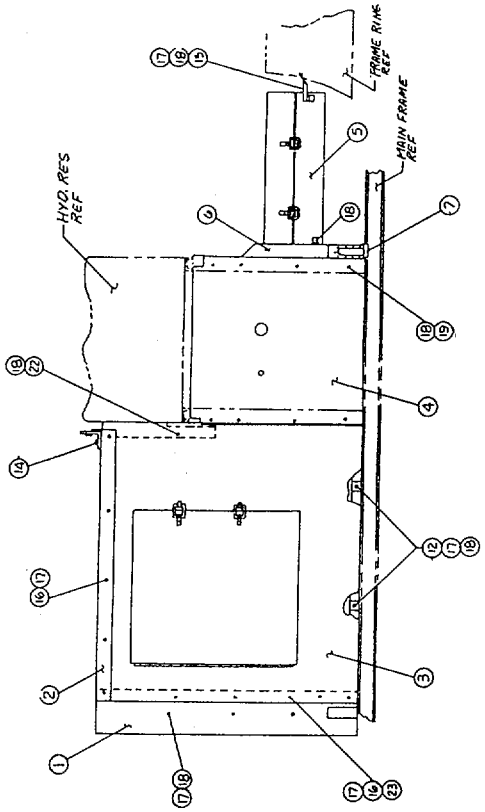
ITEM	PART NO.	QTY.	DESCRIPTION
1	18380	1	FUEL TANK
2	18381	2	FUEL TANK BRACKET
3	6716	4	NUT - ELASTIC STOP 5/8 - 11 UNC
4	52011	2	MOUNT - FUEL ANK
5	7801	4	CAPSCREW - HEX. HD. - 5/8 - 11 UNC X 4" LG. GR. 5

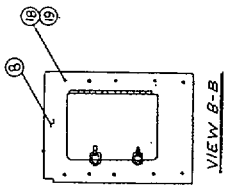
ACOUSTICAL PANEL INSTALLATION REF 58539

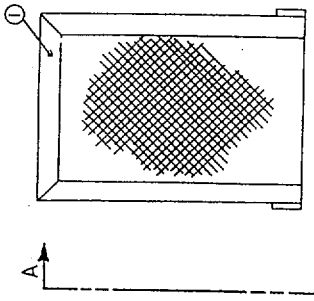


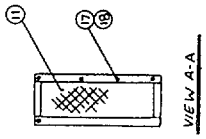








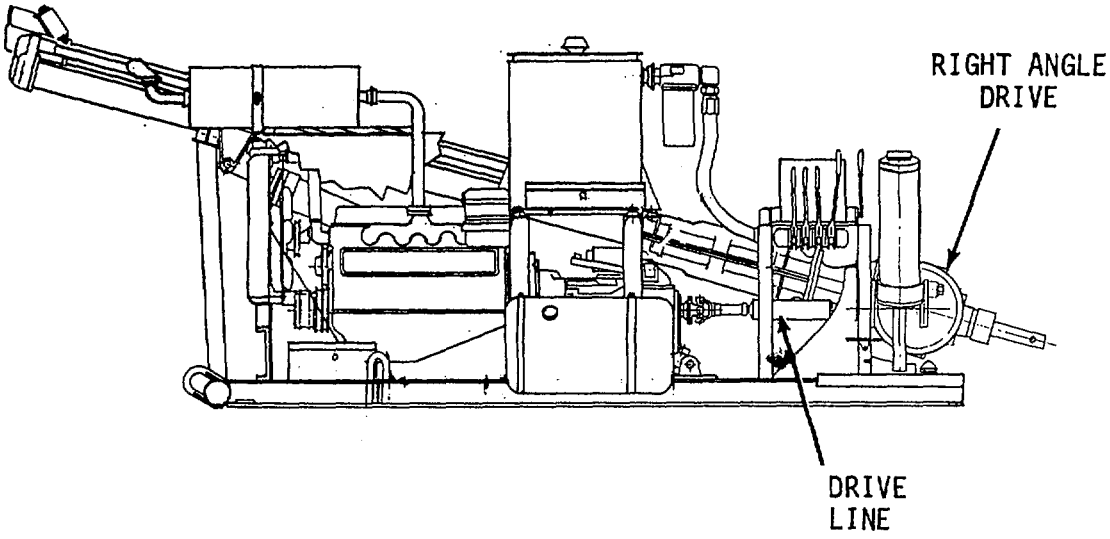


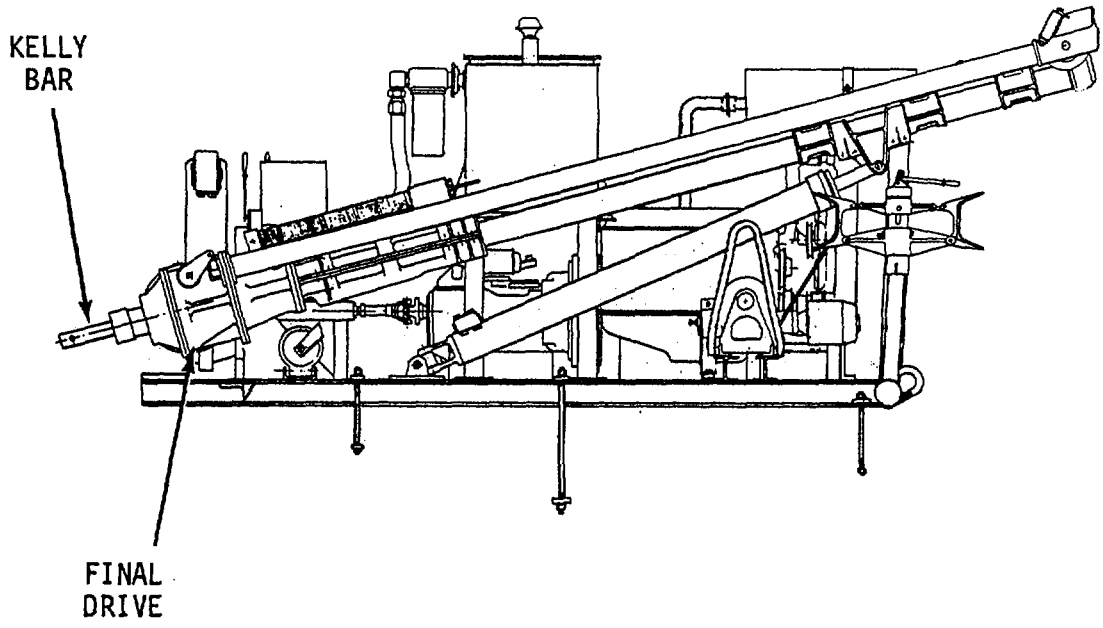


ACOUSTICAL PANEL INSTALLATION REF 58539

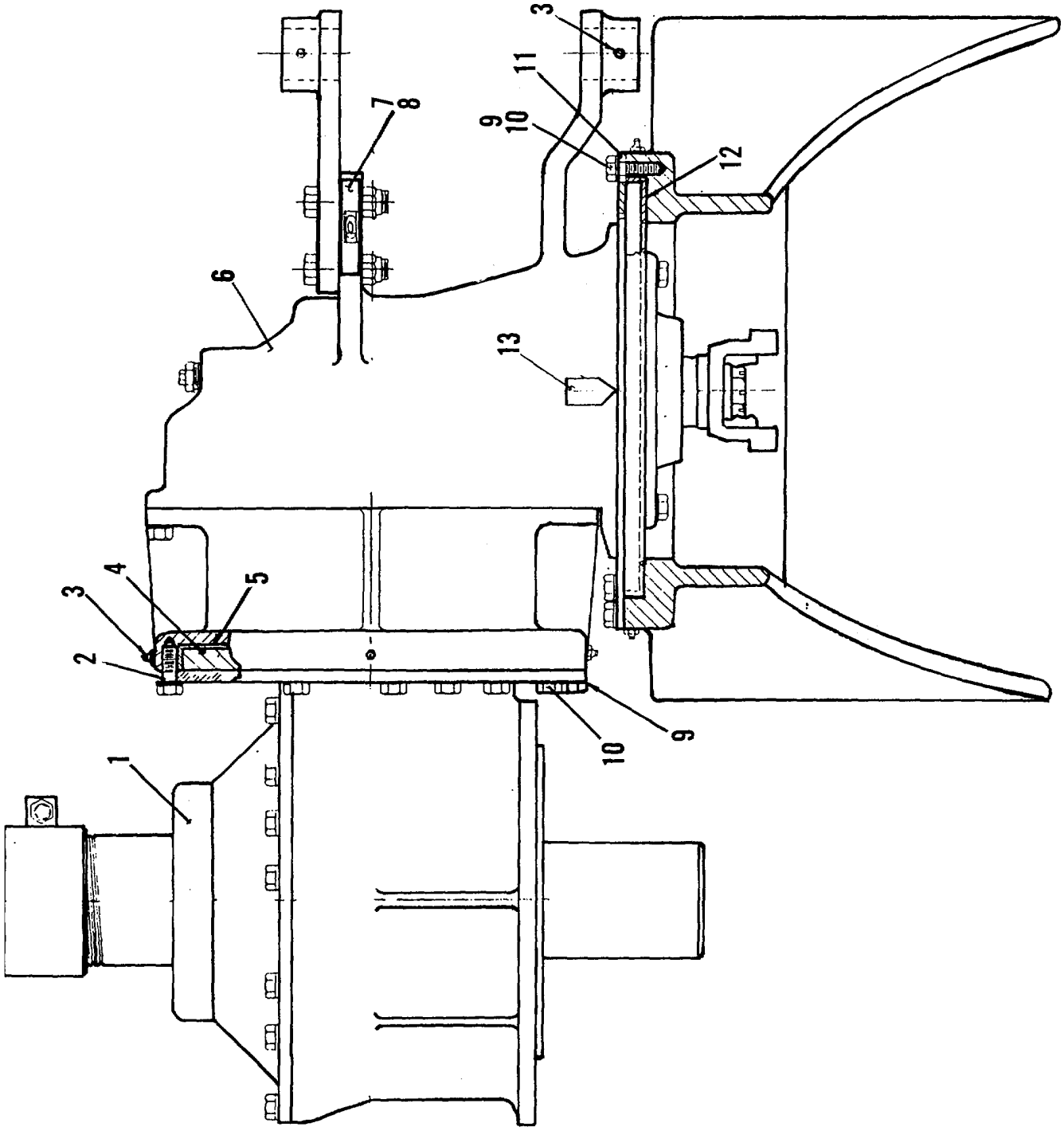
ITEM	PART NO.	QTY.	DESCRIPTION
1	60342	1	SHROUD - ASSEMBLY - 3-53
2	60643	1	PANEL - TOP - ENGINE - 3-53
3	60649	1	PANEL - ASSEMBLY - ENGINE DOOR
4	60656	1	PANEL - MOUNT - FUEL TANK
5	60641	1	DRIVE - LINE - COVER ASSEMBLY
6	60642	1	PANEL - FORMED - TRANSMISSION
7	60655	1	RUBBER - TRANSMISSION - COVER
8	60348	1	DOOR - ACCOUSTICAL PANEL
9	60660	1	PANEL - VALVE - STAND
10	60659	1	RUBBER - COVER - VALVE - STAND
11	60654	1	PANEL - ENGINE - RIGHT SIDE
12	60657	2	MOUNT - SIDE - PANEL - ENGINE
13	60650	1	MOUNT - PANEL - TOP - RIGHT SIDE
14	60658	1	MOUNT - TOP - ENGINE - PANEL
15	60349	2	MOUNT - DRIVE LINE - COVER
16	42540	75	CAPSCREW HEX HD 1/4 -20 NC X 1 LG - GR 5
17	5968	50	NUT - HEX HD - 1/4 - 20 NC
18	42543	10	CAPSCREW HEX HD 1/4 - 20 NC X 1 1/2 LG GD 5
19	45207	20	RIVNUT - 1/4 - 20 N
20	34096	18 SQ FT	INSULATION - RARR SH SFB-1.O LBS LEAD
21	34095	50 FT	INSULATION - RUBBER - 1/4 X 2
22	60651	1	MOUNT - PANEL TOP LEFT SIDE
23	42624	85	WASHER - FLAT - STD 1/4
24	5970	51	WASHER - LOCK CUT 1/4

DRIVE ASSEMBLIES LOCATOR





FINAL AND RIGHT ANGLE DRIVE INSTALLATION REF 58534

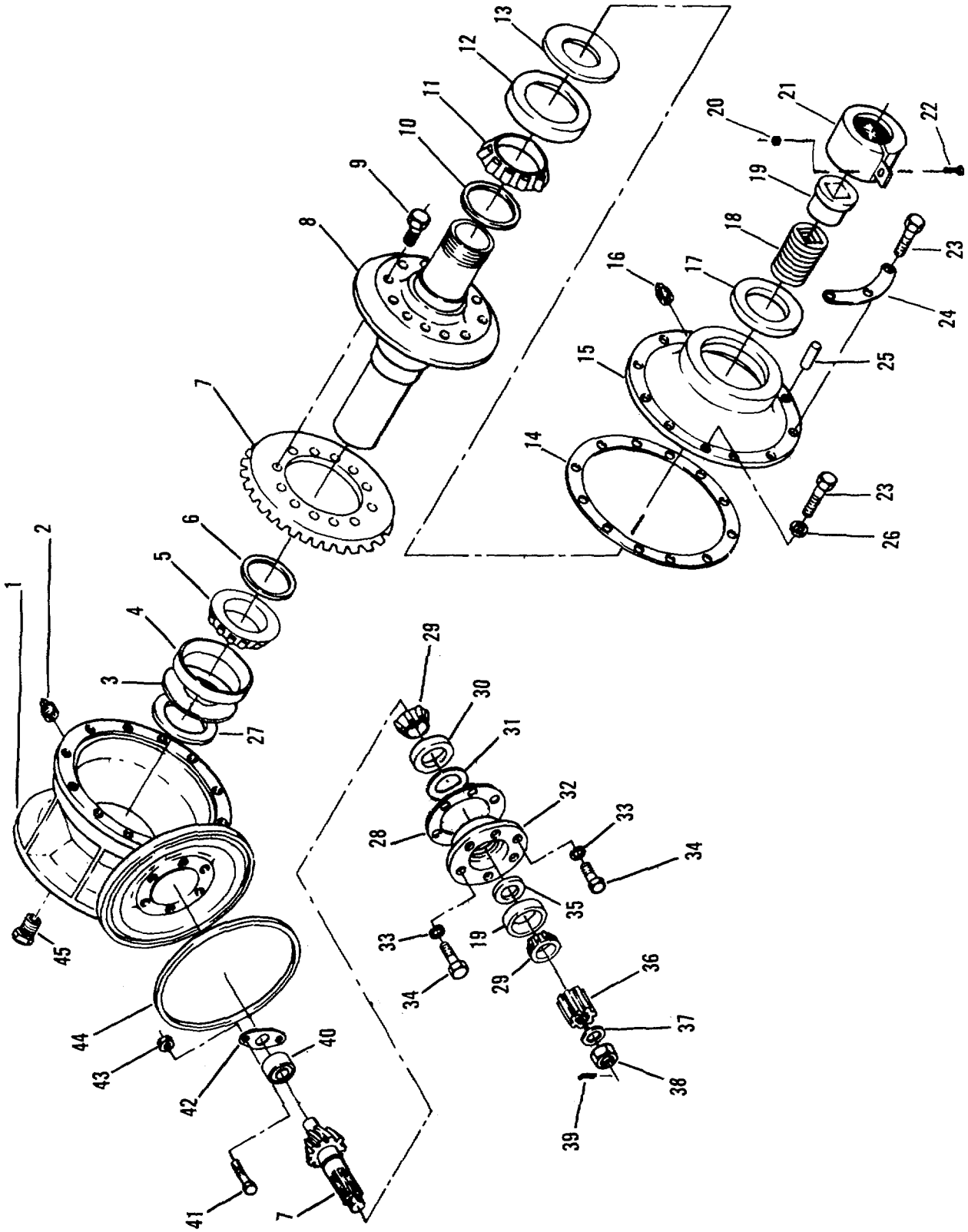


FINAL AND RIGHT ANGLE DRIVE INSTALLATION REF 58534

ITEM	PART NO.	QTY.	DESCRIPTION
1	58566	1	DRIVE ASSY - FINAL
2	8397	1	RING - RETAINER - FINAL DRIVE
3	5929	11	FITTING - GREASE - STR - 1/8 NPT
4	18849	1	PACKING - BELMONT
5	16835	1	LINER - BRASS - INTERMEDIATE RING
6	58565	1	DRIVE ASSY - RT. ANGLE
7	16161	2	HOLDER - LEVEL
8	8695	2	LEVEL
9	55880	32	WASHER - FLAT - HARDENED - 7/16
10	42727	32	CAPSCREW - HEX HD - 7/16 - 14 UNC X 1 3/4 GR 8
11	8388	1	RETAINER - RING - RT. ANGLE
12	16003	1	LINER - BRASS - FRAME RING
13	19584	1	GAUGE - MARKET LEVELING

NOTE: TORQUE ITEM 10 CAPSCREW TO 85 FT.LBS.

FINAL DRIVE ASSEMBLY REF 58566

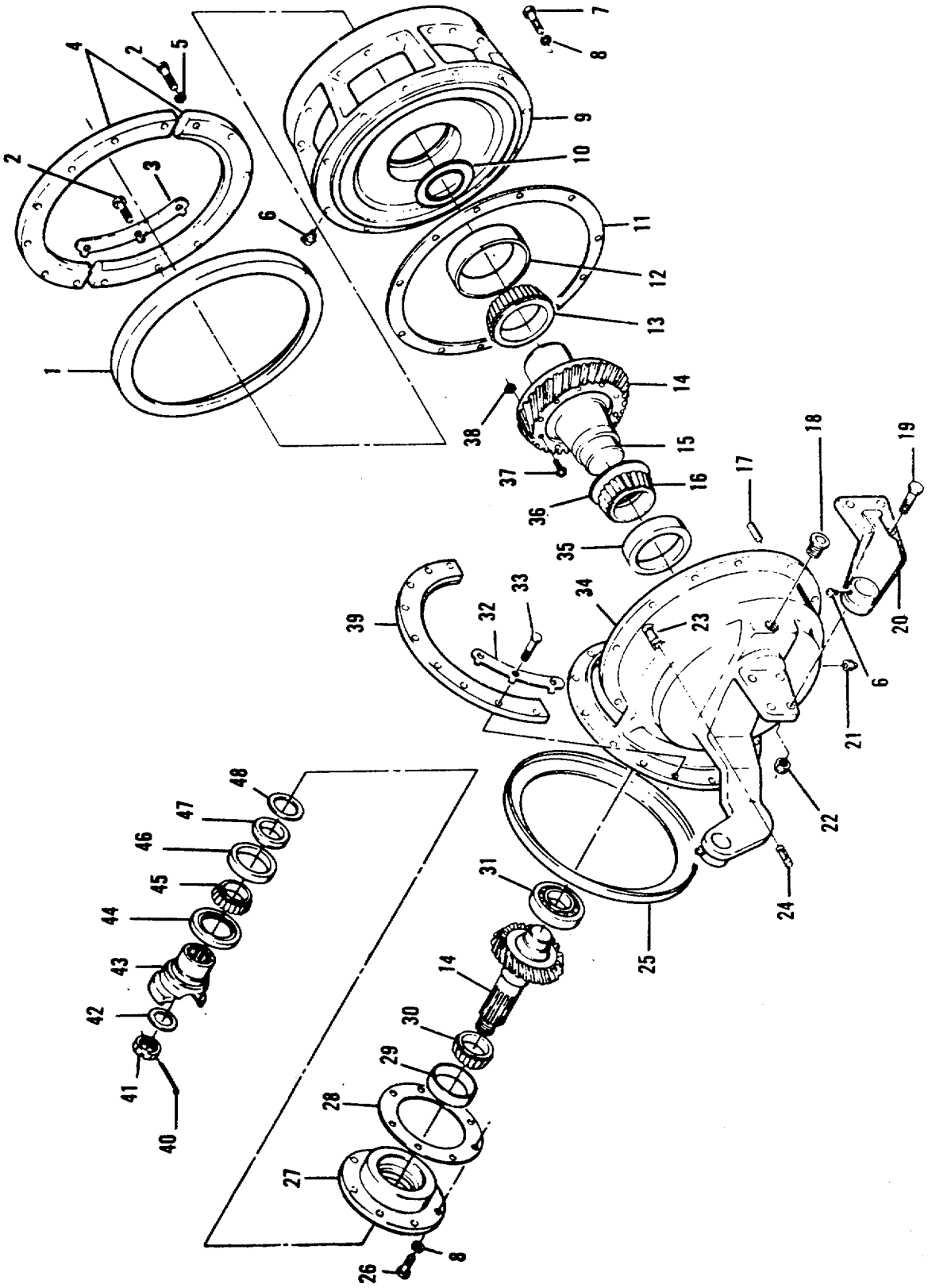


FINAL DRIVE ASSEMBLY REF 58566

ITEM	PART NO.	QTY.	DESCRIPTION
1	11161	1	HOUSING - FINAL DRIVE
2	32601	1	GAUGE - SIGHT - 1/2 NPT
3	37165	1	SHIM SET (.005, .010, .015) 60DX 5 1/2 ID
4	6122	1	CUP - BEARING (52618)
5	6121	1	CONE - BEARING (52400)
6	11150	1	SHIM SET - LAMINATED (.002, .032) 5 1/8 OD
7	32366	1	GEAR ASSEMBLY - RING AND PINION
8	12022	1	DRIVE - MAIN - 2 1/2
9	30929	12	CAPSCREW-HEX HD-7/16 IN NF X 2 1/4 GRD 8 - LOCK
10	11149	1	SHIM SET - (.005, .010, .015) 5 5/8 OD
11	9895	1	CONE - BEARING (68462)
12	9894	1	CUP - BEARING (68712)
13	16996	1	SHIM SET (.005, .010, .015) 7 OD X 6 ID
14	5348	1	GASKET SET - HOUSING (1/64, 1/32, 3/64)
15	8396	1	HOUSING - LOWER - FINAL DRIVE
16	59453	1	FITTING - PIPE PLUG - 1/2 - NPT - SQHD - MAG
17	9893	1	SEAL - GREASE (45531)
*18	11572	8	PACKING - LOWER FEED RAM
*19	11024	1	GLAND - PACKING
20	6291	1	NUT - ELASTIC STOP 1/2 - 13 NC
**21	9892	1	NUT - PACKING - FINAL DRIVE
22	5986	1	CAPSCREW - HEX HD 1/2 - 13 NC X 1 3/4 IN GRD 5
23	5977	1	CAPSCREW - HEX HD 1/2 - 13 NC X 1 1/4 IN GRD 5
24	16985	3	TAB LOCK
25	16162	4	PIN - SPRING - TUBULAR - SPLIT 3/8 X 1 1/4
26	5975	2	WASHER - LOCK CUT - 1/2 IN
27	6135	1	SEAL - GREASE (55035)
28	5347	1	SHIM SET (.005, .010, .015)
29	6130	2	CONE - BEARING (53176)
***30	6131	2	CUP - BEARING
31	11114	1	SHIM SET (.005, .010, .015) 2 1/8 OD
***32	19905	1	HOUSING - BEARING
33	6351	6	WASHER - LOCK - CUT - 9/16 IN
34	8278	6	CAPSCREW - HEX HD - 9/16 - 12 NC X 1 1/4 GRD 5
35	11079	1	SPACER - BEARING - .533 THK
36	11407	1	ADAPTER - PINION DRIVE
37	11760	1	WASHER - SPACER - .156 THK
38	11759	1	NUT - PINION DRIVE - HEX 1 1/4 NF - THIN
39	7604	1	PIN - COTTER 1/8 DIA X 1 3/4 IN
40	6119	1	BEARING - ROLLER (RS5305W)
41	42543	2	CAPSCREW - HEX HD - 1/4 NC X 1 1/2 - GRD 5
42	6068	1	COVER - BEARING RETAINER
43	6293	2	NUT - ELASTIC STOP 1/4 - NC
****44	18849	1	PACKING
45	30642	1	FITTING - PRESSURE RELIEF - 1/2 NPT - 5 LB

*PART OF FEED RAM ASSEMBLY
**PART OF DRIVE - MAIN ITEM 8
***ITEM 30 AND 32 COME AS (PRESS FITTED) AN ASSEMBLY P/N 6423
****PART OF FINAL DRIVE AND RIGHT ANGLE DRIVE INSTALLATION

RIGHT ANGLE DRIVE ASSEMBLY REF 58565

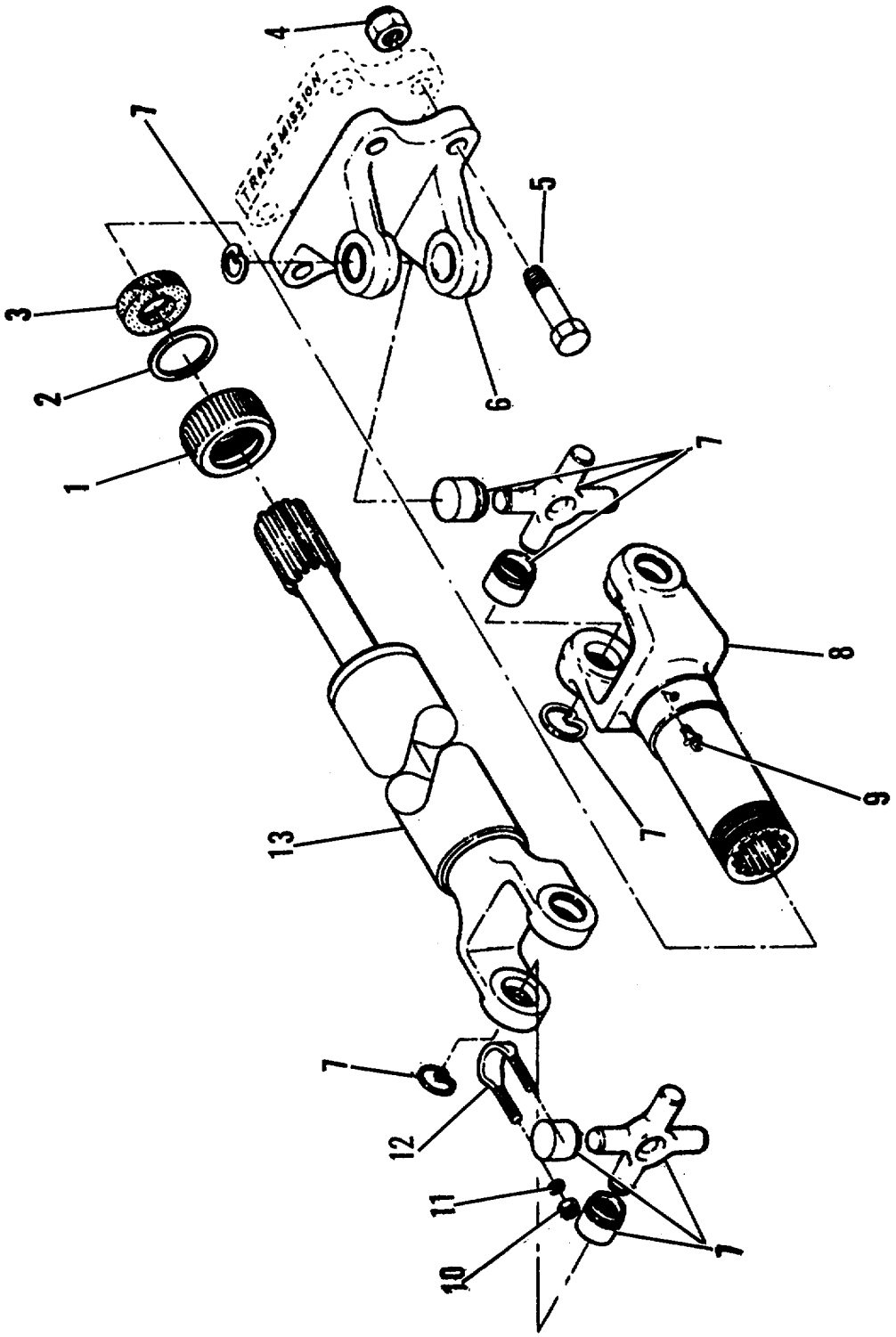


RIGHT ANGLE DRIVE ASSEMBLY REF 58565

ITEM	PART NO.	QTY.	DESCRIPTION
*1	16835	1	LINER - BRASS - INTERMEDIATE RING
*2	42727	14	CAPSCREW - HEX HD-7/16 - 14 NC X 1 3/4 IN GRD 8
*3	16984	4	LOCK TAB
*4	8397	1	RING - RETAINER - FINAL DRIVE
*5	55880	2	WASHER - FLAT - HARDEN 7/16 IN
*6	5929	9	FITTING - GREASE - STR - 1/8 NPT
7	5977	11	CAPSCREW - HEX HD 1/2 - 13 NC X 1 1/4 - GRD 5
8	5975	19	WASHER - LOCK - CUT - 1/2 IN
9	11018	9	RING - INTERMEDIATE
10	11151	1	SHIM - LAMINATED (.005, .015)
11	5348	1	GASKET
12	7775	1	CUP - BEARING
13	7774	1	CONE - BEARING
14	18757	1 SET	RING GEAR AND PINION SET
15	30876	1	CARRIER - RING GEAR
16	6127	1	CONE - BEARING
17	16162	4	PIN - DOWEL
18	32601	1	GAUGE - SIGHT - 1/2 NPT
**19	6643	4	CAPSCREW - 5/8 - 11 NC X 2 1/2 IN
**20	34454	1	ARM - BOLT ON TYPE
21	59453	1	PLUG - PIPE 1/2 SQHD - MAGNETIC
**22	6716	4	NUT - LOCK - 5/8 - 11 NC
*23	16161	2	HOLDER - LEVEL
*24	8695	2	LEVEL - LINE
*25	16003	1	LINER - BRASS - FRAME RING
26	42728	8	CAPSCREW - HEX HD - 1/2 - 13 NC X 1 1/2 GRD 8
27	16149	1	CARRIER - PINION
28	11170	1	SHIM
29	11167	1	CUP - BEARING
30	11168	1	CONE - BEARING
31	11166	1	BEARING - ROLLER
*32	16983	6	LOCK TAB
33	5997	18	CAPSCREW - HEX HD 7/16 - 14 NC X 1 3/4 GRD 5
34	11031	1	HOUSING - RIGHT ANGLE
35	6128	1	CUP - BEARING
36	16840	1	SHIM SET (.010-.005)
37	42902	12	CAPSCREW - HEX HD - 1/2 - 20 NF X 2 - GRD 8
38	30490	12	NUT - SPECIAL 1/2 - 20 NF - GRD 8
*39	8388	1	RING - RETAINER
40	7604	1	PIN - COTTER - 1/8 DIA X 1 3/4 LG
41	11127	1	NUT - PINION
42	16999	1	WASHER - SPACER
43	16151	1	YOKE
44	16148	1	SEAL - PINION DRIVE
45	6130	1	CONE - BEARING
46	6131	1	CUP - BEARING
47	11643	1	SPACER - BEARING
48	11114	1	SHIM - SET
*49	19584	1	POINTER (NOT SHOWN)

*PART OF FINAL DRIVE AND RIGHT ANGLE DRIVE INSTALLATION
**PART OF HOUSING ASSEMBLY

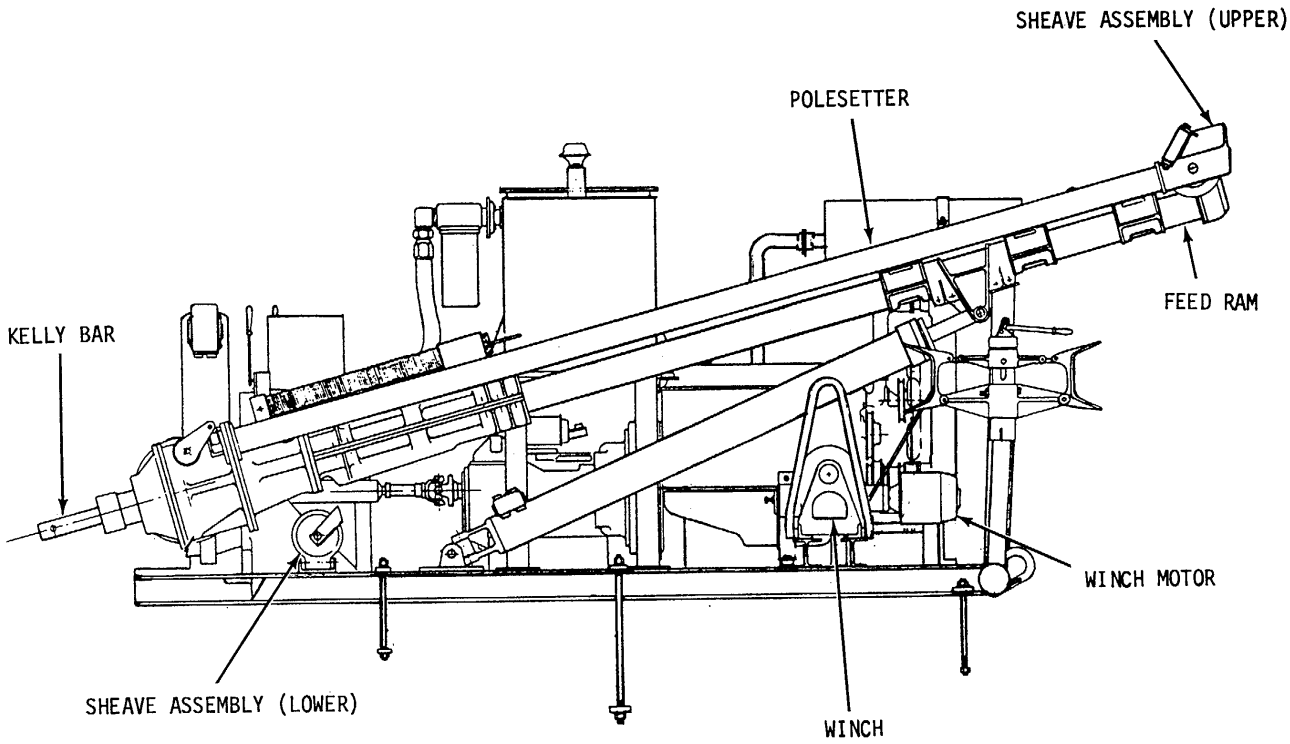
DRIVE LINE ASSEMBLY



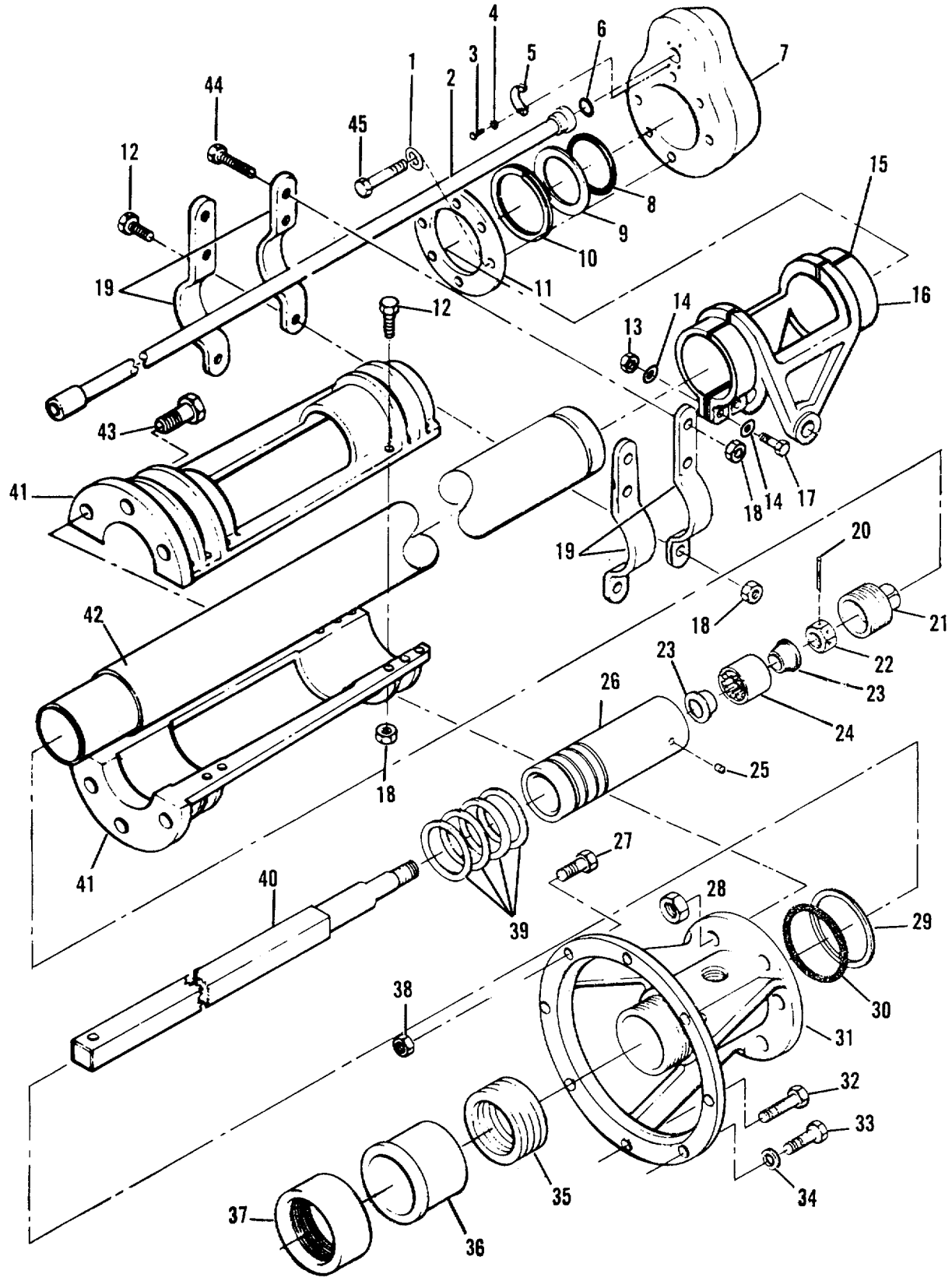
DRIVE LINE ASSEMBLY REF 58765

ITEM	PART NO.	QTY.	DESCRIPTION
1	18122	1	DUST - CAP - DRIVE LINE
2	18123	1	WASHER - DRIVE LINE
3	18124	1	WASHER - DRIVE LINE
4	5988	8	CAPSCREW - HEX. HD. - 3/8 - 24 UNF X 1 1/4 LG.
5	7972	8	NUT - ELASTIC STOP - 3/8 - 24 UNF
6	16913	1	YOKE FLANGE
7	16562	2	BEARING KIT - UNIVERSAL
8	18125	1	YOKE SLEEVE - UNIVERSAL
9	5929	1	GREASE FITTING - STRAIGHT
10	42644	4	NUT - ELASTIC STOP - 7/16 - 20 UNF
11	5959	4	WASHER - LOCK - 7/16
12	16561	2	U - BOLT
13	58782	1	DRIVE SHAFT (SPICER 1480 SERIES)

FEED RAM / POLSETTER LOCATOR



FEED RAM ASSEMBLY REF 58564

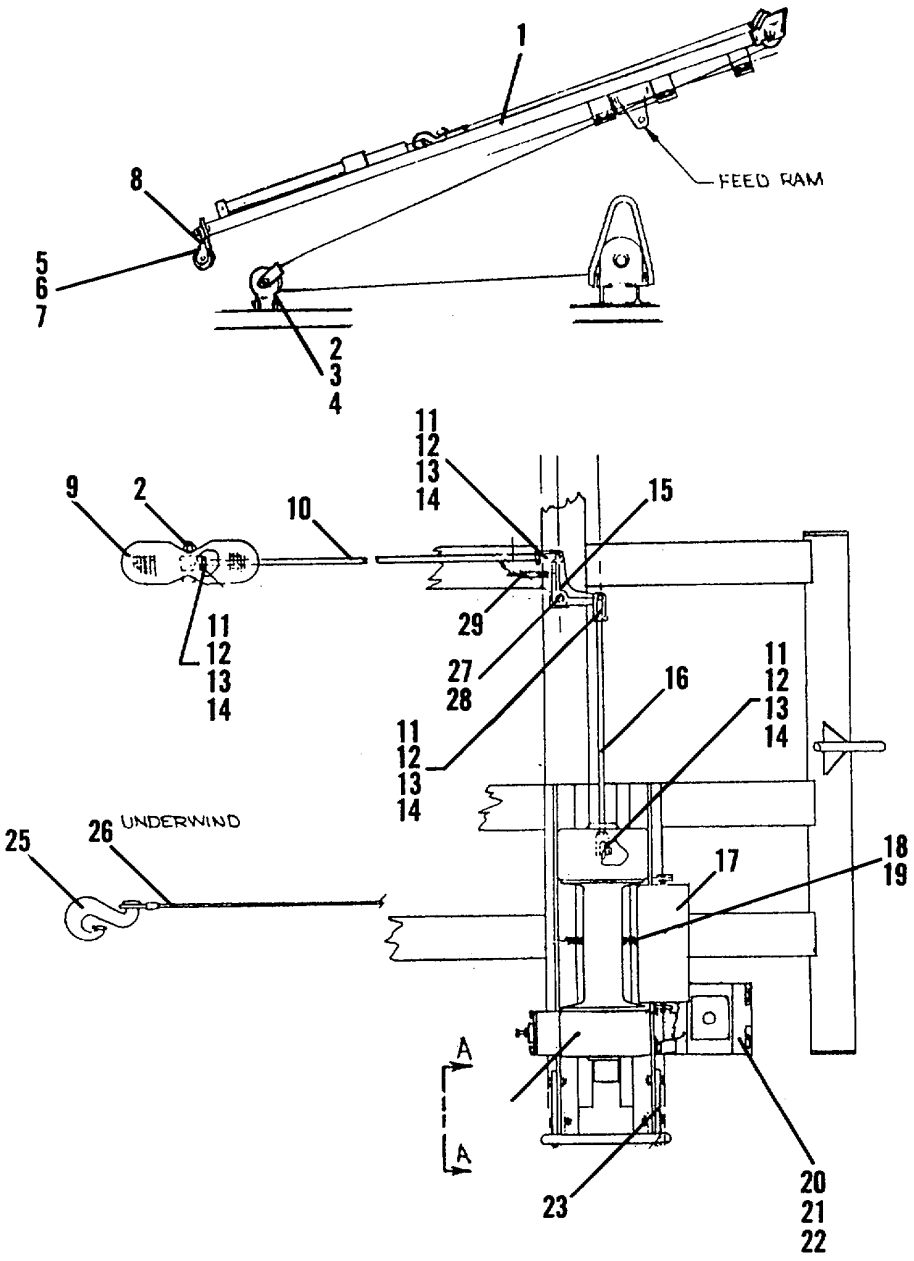


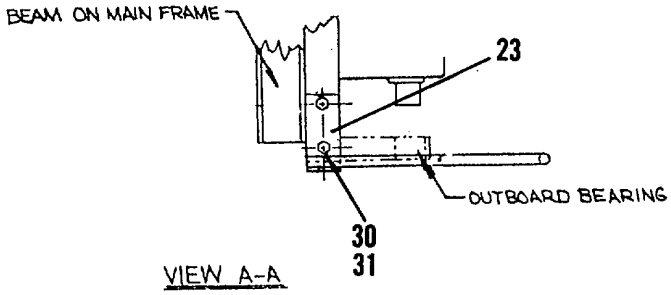
FEED RAM ASSEMBLY REF 58564

ITEM	PART NO.	QTY.	DESCRIPTION
1	5962	12	WASHER - LOCK - INTERNAL 3/8 IN
2	58562	1	TUBE - TRANSFER
3	7784	4	CAPSCREW - HEX HD - 7/16 - 14 NC X 1 1/2 LG - GRD 5
4	5959	4	WASHER - LOCK 7/16 IN
5	16628	2	FLANGE - SPLIT - HALF - 1 1/4 IN
6	16600	1	O-RING - 1 1/2 ID X 1 3/4 OD X 1/8
7	16444	1	CAP - END - BARREL - FEED RAM
8	16701	1	O-RING - 4 1/4 ID X 4 5/8 OD X 3/16
9	16700	1	RING - BACKUP 4 1/4 ID X 4 5/8 OD X 3/16 WIDE
10	16699	1	RING - LOCK - 4 1/4 OD - BARREL - FEED RAM
11	16698	1	RETAINER - CAP - FEED RAM - 4 1/4 OD
12	5985	12	CAPSCREW HEX HD 1/2 - 13 NC X 2 1/4 LG - GRD 5
13	58363	10	NUT - HEX - 1/2 - 13 NC
14	55185	20	WASHER - HARDEN - 1/2 IN
15	57954	6	SHIM - FEED RAM - CLAMP
16	57939	1	SADDLE - BARREL - FEED RAM
17	42729	10	CAPSCREW - HEX HD - 1/2 - 13 NC X 1 3/4 LG GRD 5
18	6291	18	NUT - ELASTIC STOP - 1/2 - 13 NC
19	16251	4	CLAMP - TRANSFER TUBE - HALF
20	5941	1	PIN - COTTER 1/4 DIA X 2 1/2 LG
21	4238	1	PLUG - PISTON
22	4283	1	NUT - CASTELLATED - THIN - 1 3/8 - 12 NF
23	6125	2	BEARING - CONE - 1.500 ID
24	6124	1	BEARING - CUP - 3.151 OD
25	11744	1	PIN - PISTON PLUG
26	11146	1	PISTON - FEED RAM - 3 3/4 OD
*27	6414	2	CAPSCREW - HEX HD 5/8 - 11 NC X 2 3/4 LG GRD 5
28	42606	6	NUT - ELASTIC STOP - 3/4 - 10 NC
29	16696	1	RING - BACKUP - 4 1/8 ID X 4 1/2 OD X 3/16 WIDE
30	16695	1	O-RING - 4 1/8 ID X 4 1/2 OD X 3/16
31	16694	1	SUPPORT - FEED RAM
*32	42705	4	CAPSCREW - HEX HD - 5/8 - 11 NC X 2 1/4 LG GRD 5
*33	42821	2	CAPSCREW - HEX HD - 5/8 - 11 NC X 2 3/4 LG GRD 5
*34	5984	2	WASHER - LOCK - CUT - 5/8 IN
*35	16758	1	PACKING SET - UPPER FEED RAM
*36	3589	1	GLAND - PACKING - UPPER
37	3588	1	NUT - UPPER PACKING
*38	6716	6	NUT - ELASTIC STOP - 5/8 - 11 NC
39	11136	4	RING - PISTON 3 3/4 OD
40	58561	1	KELLY - 2 1/2 SQ
41	11450	2	BRACE - BARREL - FEED RAM
42	58563	1	BARREL - FEED RAM - 3 3/4 ID
43	7807	6	CAPSCREW - HEX HD - 3/4 - 10 NC X 2 1/2 LG GRD 5
44	6368	4	CAPSCREW - HEX HD - 1/2 - 13 NC X 2 3/4 LG GRD 5
45	42724	12	CAPSCREW - HEX HD - 3/8 - 16 NC X 1 1/2 LG GRD 5
*46	42827	1	SCREW - SET SQ HD - 3/8 - 16 NC X 3 (NOT SHOWN)
47	11572	8	PACKING - LOW FEED RAM (NOT SHOWN)
48	11024	1	GLAND - PACKING - LOWER (NOT SHOWN)

*FEED RAM INSTALLATION 58535

POLESETTER AND WINCH INSTALLATION REF 59477

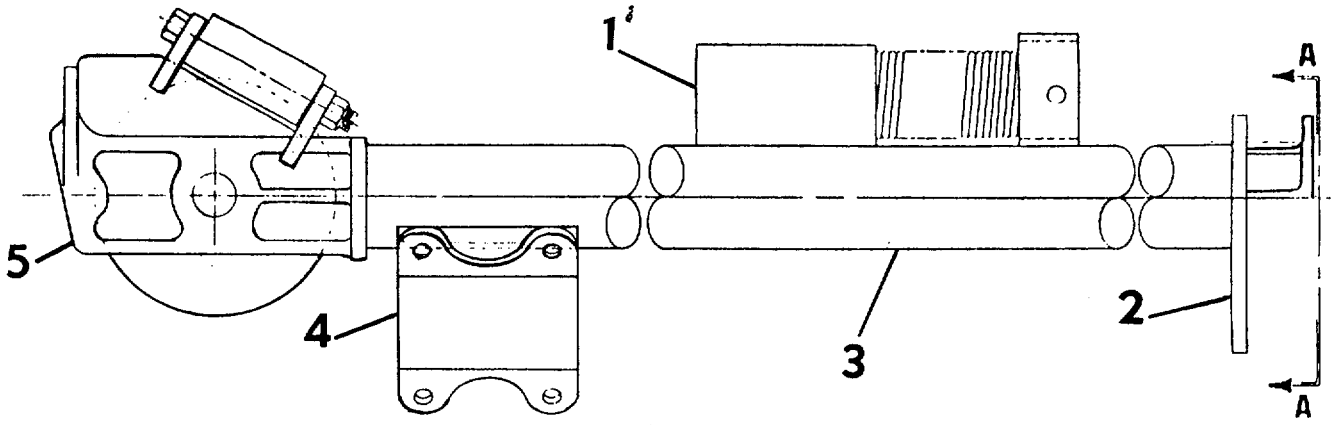


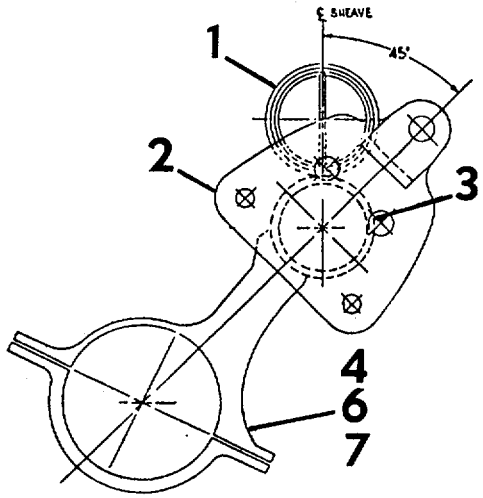


POLESETTER AND WINCH INSTALLATION REF 59477

ITEM	PART NO.	QTY.	DESCRIPTION
1	44848	1	BOOM ASSY
2	42606	2	NUT - ELASTIC STOP - 3/4 - 10 UNC -
3	7811	1	CAPSCREW - HEX HD - 3/4 - 10 UNC X 5 1/2 - GR 5
4	16851	1	SHEAVE ASSY - 6 IN LOWER
5	16450	1	BLOCK - SNATCH
6	7801	1	CAPSCREW - HEX HD - 5/8 - 11 UNC X 4 - GR 5
7	6716	1	NUT - ELASTIC STOP - 5/8 UNC
8	47028	1	SPACER - SNATCH BLOCK
9	16096	1	PEDAL - WINCH
10	32622	1	ROD - SHIFTING - LONG
11	5978	4	NUT - HEX - 5/8 - 11 UNC
12	6718	4	PIN - COTTER - 3/32 X 1 1/4
13	11242	4	PIN - CLEVIS - 7/16 X 1 1/2
14	11329	4	CLEVIS - JAW - 5/8 TAP - 7/16 PIN
15	44920	1	LINK - SHIFTING - 900
16	59476	1	ROD - SHIFTING - WINCH
17	17020	1	ROLLER ASSY - WINCH - J8
18	34027	1	SPRING - ROLLER - .132 WIRE
19	9207	2	PIN - COTTER - 1/4 X 1 1/2
20	29931	1	MOTOR - WINCH
21	5972	4	CAPSCREW - HEX HD - 1/2 NC X 1 1/2 - GR 5
22	5975	4	WASHER - LOCK - CUT - 1/2 IN
23	44910	2	BRACKET - LIFTING EYE
24	31649	1	WINCH - RAMSEY J8 W/EXTENDED SH.
25	18567	1	HOOK - CABLE
26	59249	1	CABLE - 7/16 X 150 W/EYE
27	42627	2	WASHER - FLAT - STD- 1/2
28	5986	1	CAPSCREW - HEX HD - 1/2 - 13 UNC X 1 3/4 - GR 5
29	16515	1	SPRING - BELL CRANK - .120 WIRE
30	5985	2	CAPSCREW - HEX HD - 1/2 - 13 UNC X 2 1/4 - GR 5
31	6291	2	NUT - ELASTIC STOP - 1/2- 13 UNC

POLESETTER BOOM ASSEMBLY REF 44848

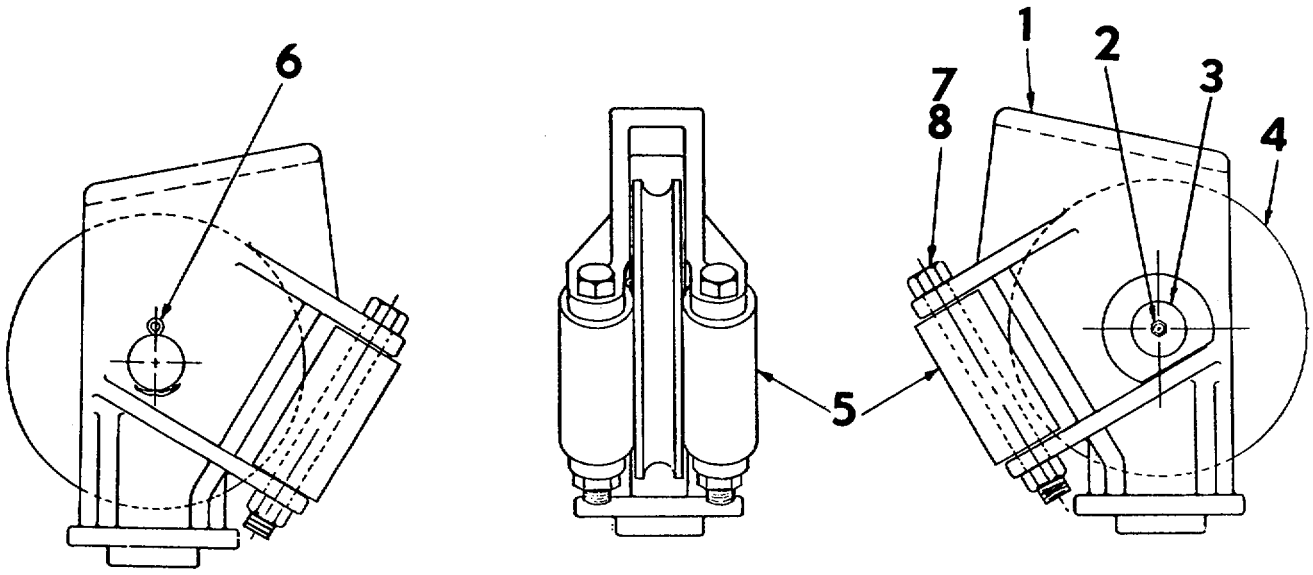




SECT. “A-A”

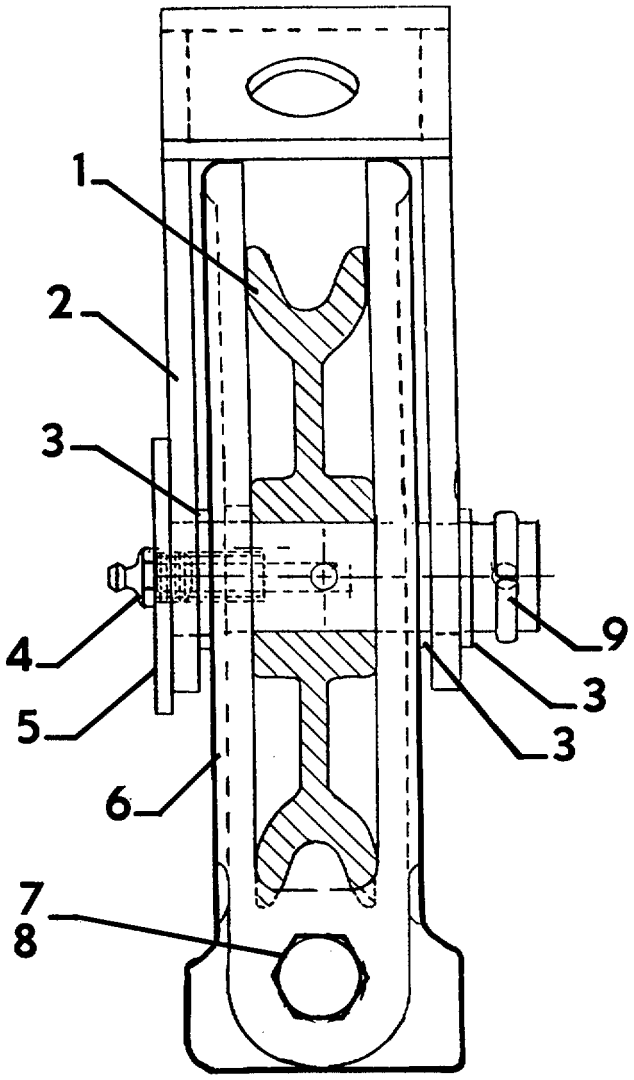
ITEM	PART NO	QTY	DESCRIPTION
1	16469	1	CABLE ANCHOR - SPRING
2	17043	1	PLATE - BASE - POLESETTER
3	12141	12 FT	PIPE - STL - SCH 40 - 3 DIA
4	11630	3	CLAMP ASSEMBLY
5	43373	1	SHEAVE ASSEMBLY (SEE THIS SECTION)
6	5994	12	CAPSCREW - HEX HD - 1/2 NC X 2 LG - GRD 5
7	6291	12	NUT - ELASTIC STOP - 1/2 NC

UPPER SHEAVE ASSEMBLY REF 43373



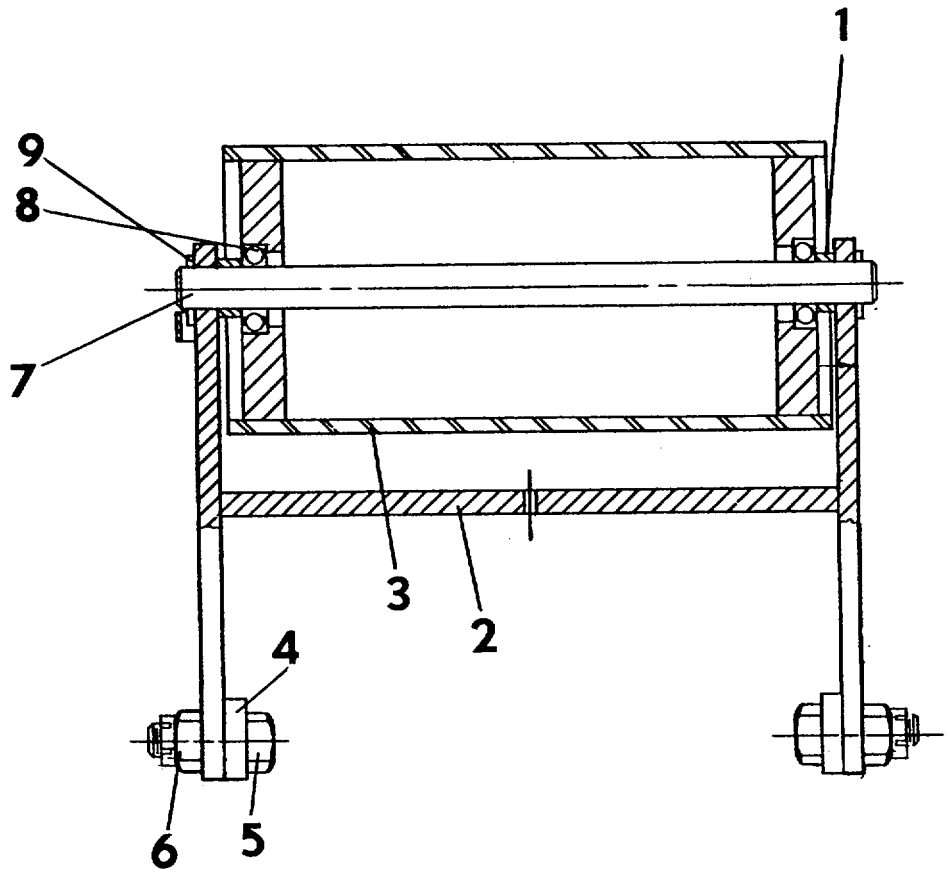
ITEM	PART NO	QTY	DESCRIPTION
1	45562	1	HOUSING - SHEAVE - POLESETTER
2	5929	1	FITTING - GREASE - STR - 1/8 NPT
3	16764	1	PIN - SHEAVE
4	19556	1	SHEAVE - UPPER - 8 DIA
5	35028	2	POLESETTER SHEAVE ROLLER ASSEMBLY
6	40180	1	PIN - COTTER
7	7813	2	CAPSCREW- HEX HD 3/4 NC X 6 1/2 LG
8	42606	2	NUT-ELASTIC STOP - 3/4 NC

LOWER SHEAVE ASSEMBLY REF 16851



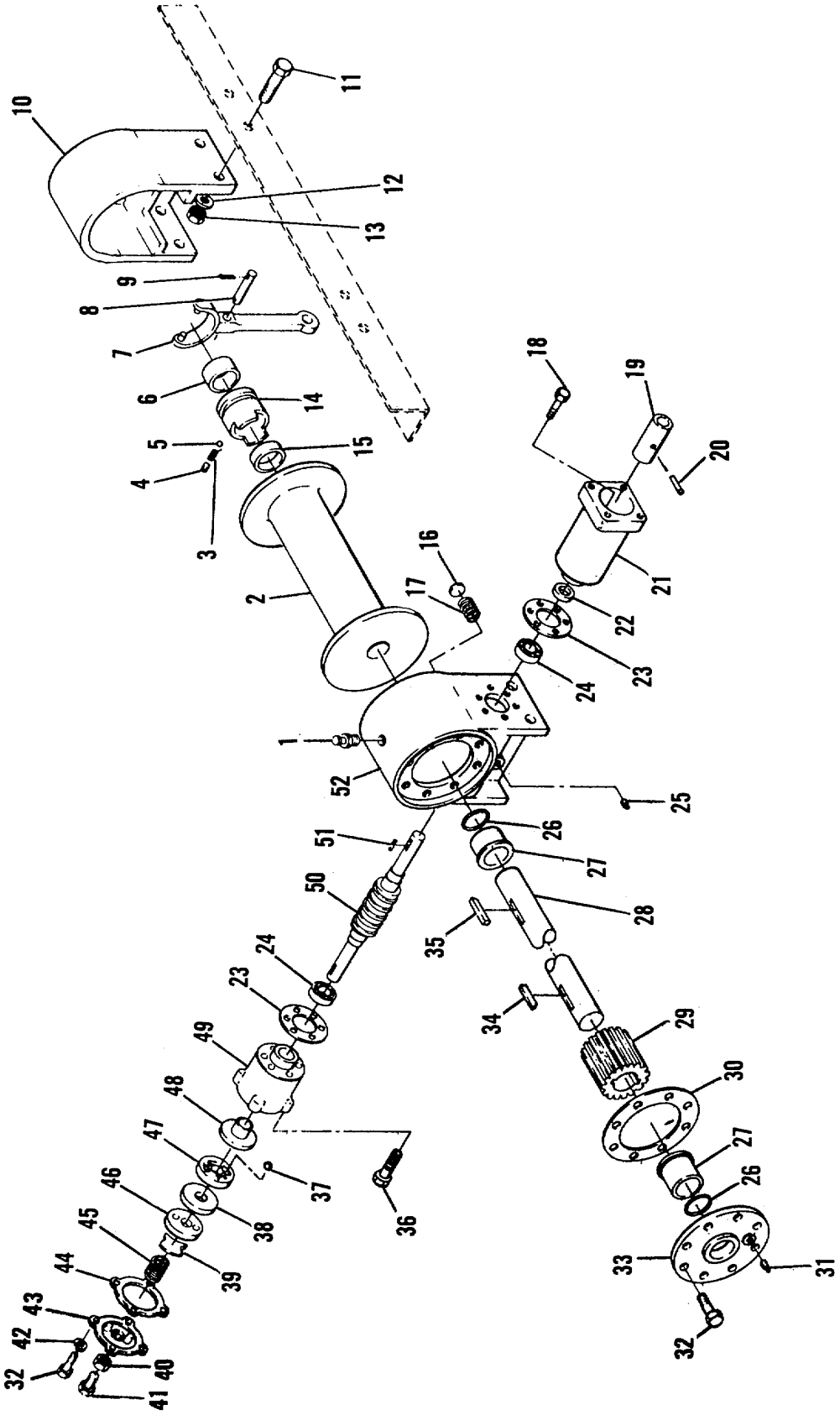
ITEM	PART NO	QTY	DESCRIPTION
1	11510	1	SHEAVE - 6 IN - LOWER
2	16452	1	CABLE GUIDE - LOWER
3	11762	3	WASHER - FLAT - 1 IN
4	5929	1	FITTING - GREASE - STR - 1/8 NPT
5	11513	1	SHEAVE - PIN - LOWER
6	11727	1	HOUSING - SHEAVE
7	7811	1	CAPSCREW HEX HD - 3/4 NC X 5 1/2 LG
8	42606	1	NUT - ELASTIC STOP 3/4 NC
9	42949	1	PIN COTTER - 1/4 DIA X 1 3/4 LG

WINCH ROLLER ASSEMBLY REF 17020



ITEM	PART NO	QTY	DESCRIPTION
1	19759	2	SPACER - SHAFT - ROLLER BEARING
2	17021	1	BRACKET - ROLLER - WINCH
3	17022	1	ROLLER - WINCH - 5 1/4 OD
4	19760	2	LUG - BRACKET - WINCH ROLLER
5	5972	2	CAPSCREW - HEX HD - 1/2-13 UNC X 1 1/2 LG
6	6291	2	NUT - ELASTIC STOP - 1/2-13 UNC
7	19773	1	SHAFT - ROLLER - WINCH
8	18602	2	SEAL - BEARING - WINCH ROLLER
9	43221	2	PIN - SPRING 1/8 DIA X 1 1/4 LG

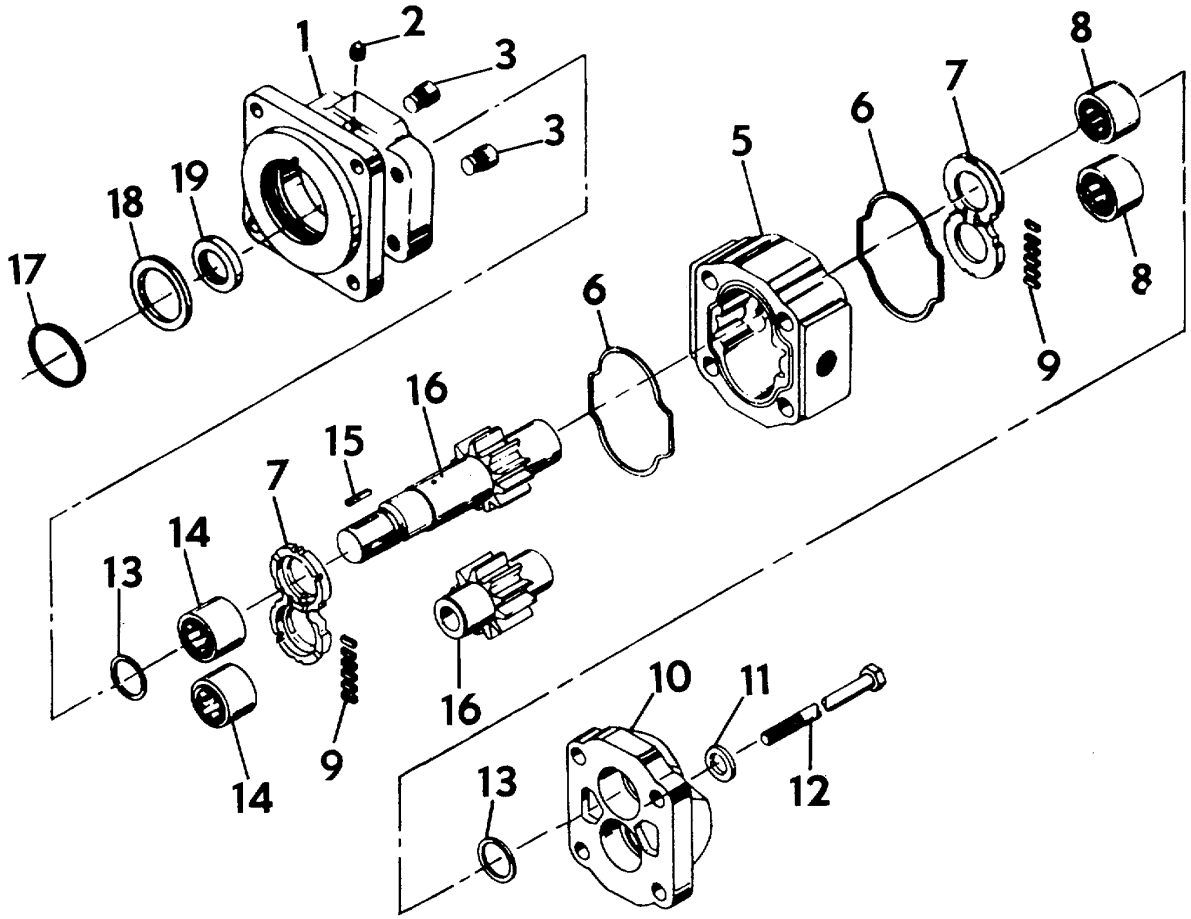
WINCH ASSEMBLY WITH SHAFT EXTENSION REF 31649



WINCH ASSEMBLY WITH SHAFT EXTENSION REF 31649

ITEM	PART NO.	QTY.	DESCRIPTION
1	16280	1	PRESSURE RELIEF PLUT
2	16433	1	DRUM
3	16437	1	SPRING
4	16438	1	SCREW - ADJUSTING
5	16436	1	BALL
6	16439	1	BUSHING
7	16440	1	YOKE
8	17029	1	SHAFT
9	6718	2	COTTER PIN
10	16441	1	HOUSING
11	5994	8	CAPSCREW - HEX HD - 1/2 - NC X 2 IN
12	5975	8	LOCKWASHER - 1/2
13	6291	8	LOCKNUT - 1/2 - NC
14	16435	1	CLUTCH
15	16434	1	SPACER
16	17223	1	DRAG BRAKE
17	16432	1	SPRING
18	-----	6	CAPSCREW - SOCKET HEAD - 9/16 - NC X 1 IN
19	16430	1	ADAPTER
20	-----	1	PIN
21	16428	1	HOUSING
22	16427	2	SEAL
23	16420	2	GASKET
24	16332	2	BEARING
25	5950	1	PIPE PLUG
26	17030	2	O-RING
27	16424	2	BUSHING
28	32234	1	SHAFT
29	16340	1	GEAR
30	16341	1	GASKET
31	6008	1	PIPE PLUG
32	6093	12	CAPSCREW - HEX HD - 5/16 - NC X 3/4 IN
33	16410	1	COVER
34	16339	2	KEY
35	16426	2	KEY
36	-----	6	CAPSCREW - SOCKET HEAD
37	16417	2	BALL
38	16415	1	DISC
39	16413	1	SPRING
40	6169	1	NUT - JAM - 1/2 - NF
41	5972	1	CAPSCREW - HEX HD - 1/2 - NF X 1 1/2 IN
42	6001	4	LOCKWASHER - 5/16
43	16423	1	COVER
44	16411	1	GASKET
45	16412	1	COIL SPRING
46	16414	1	RETAINER
47	16416	1	CAM
48	16418	1	HUB

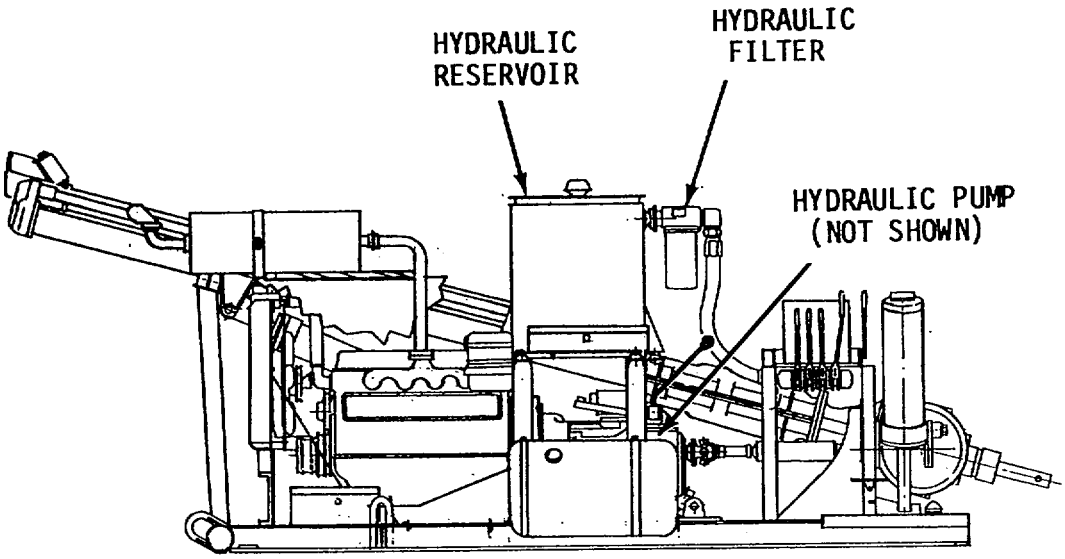
WINCH MOTOR ASSEMBLY REF 39941

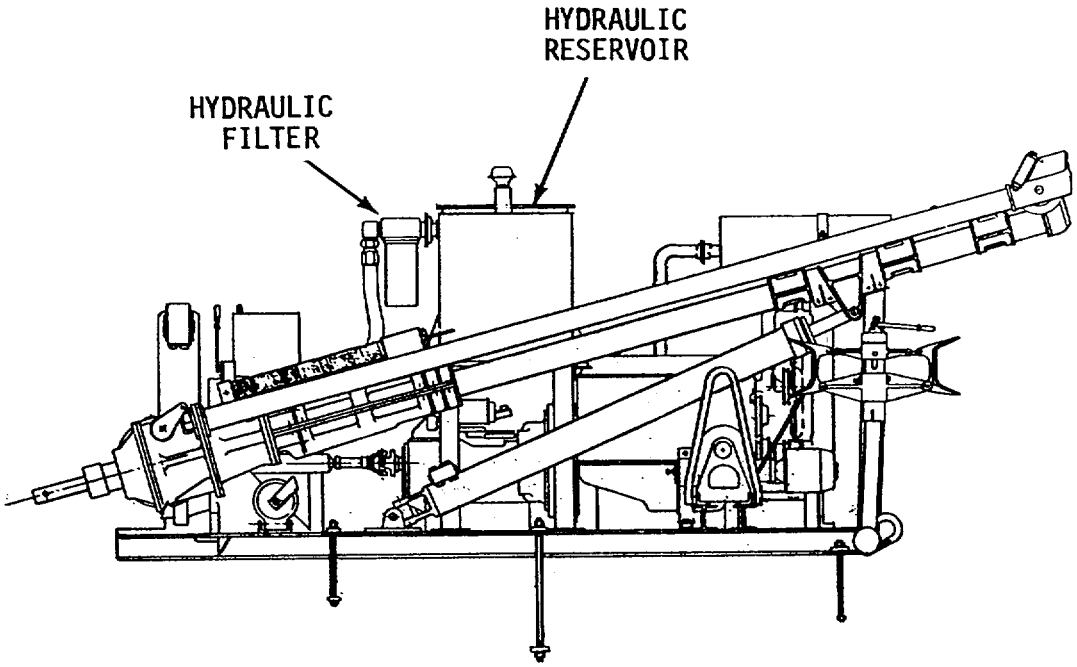


ITEM	PART NO.	QTY.	DESCRIPTION
1	35821	1	SHAFT END COVER
2	35822	1	PLUG
3	35823	2	CHECK ASSEMBLIES
4	-----		
5	51351	1	GEAR HOUSING
6		2	O-RINGS
7	*	2	THRUST PLATES
8			
9	*	1 STRIP	POCKET SEALS
10	31319	1	PORT END COVER
11	18677	4	WASHERS
12	39623	4	CAPSCREWS
13	*	1	RING SEAL
14	*	4	ROLLER BEARINGS
15	*	1	KEY
16	51352	1 SET	INTEGRAL SHAFT & GEAR
17	35818	1	SNAP RING
18	51353	1	WEAL RETAINER
19	35817	1	SEAL

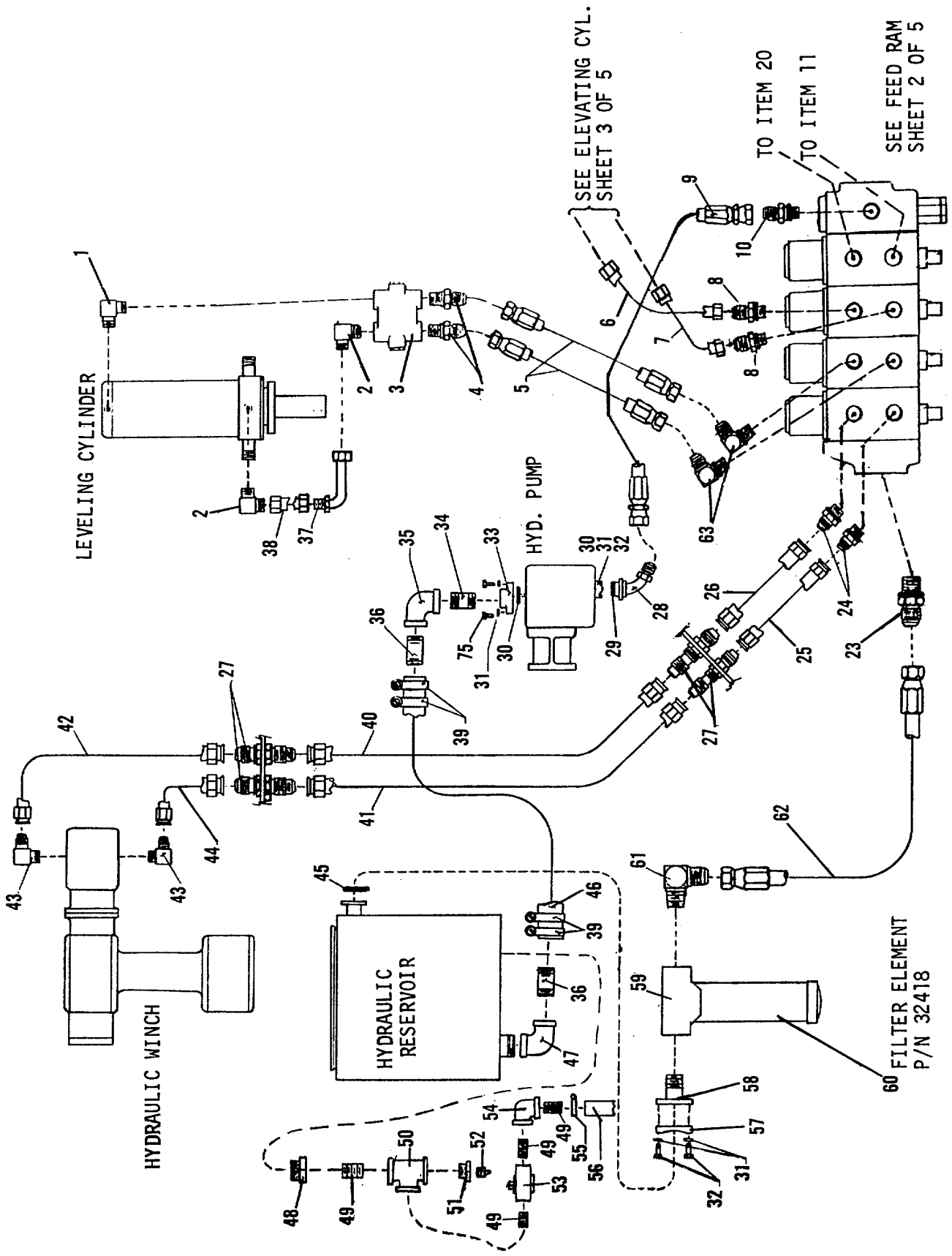
*MAJOR REPAIR KIT P/N 47223 SEAL KIT P/N 47222 ITEMS 13-9-6

HYDRAULICS / PLUMBING LOCATOR

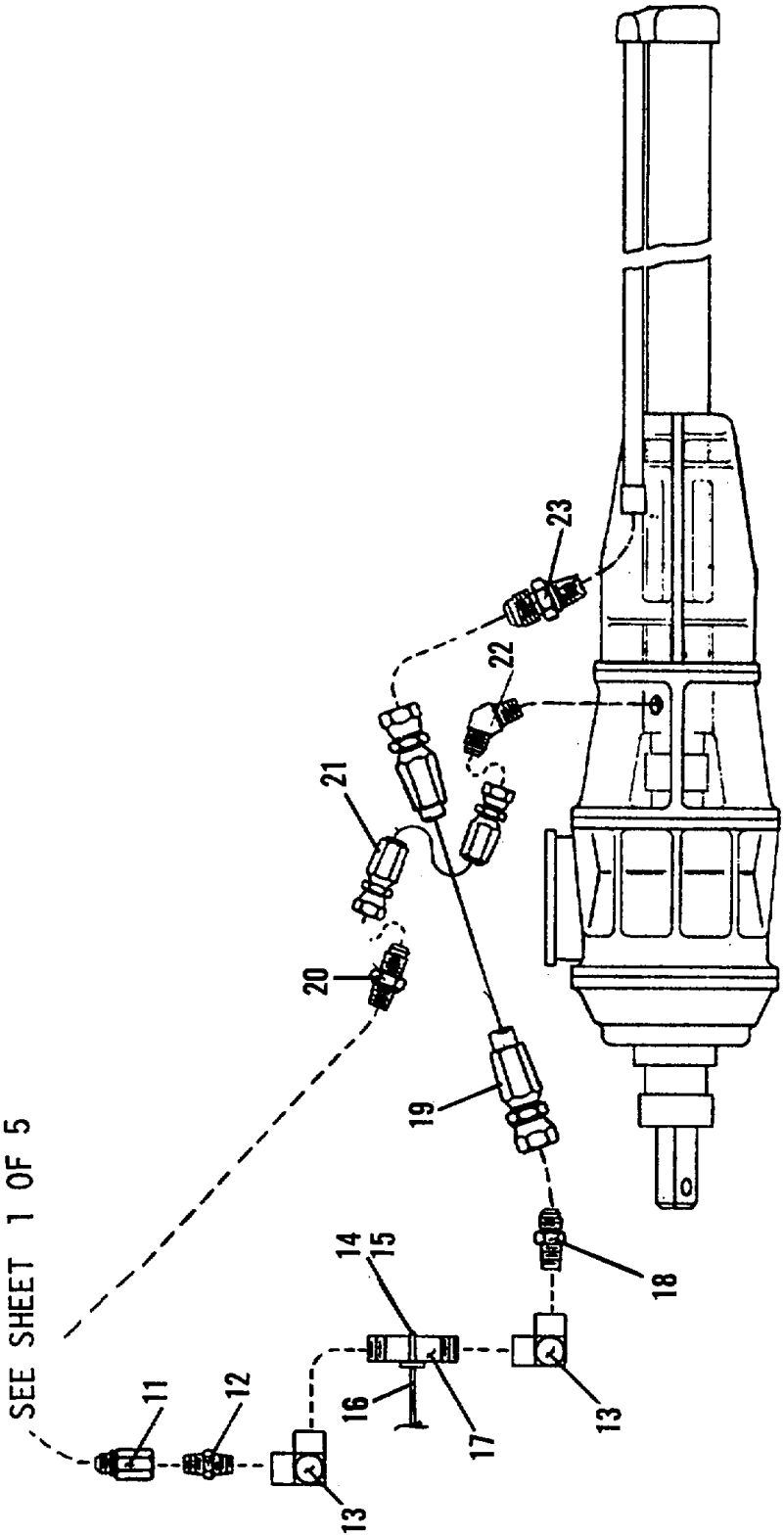




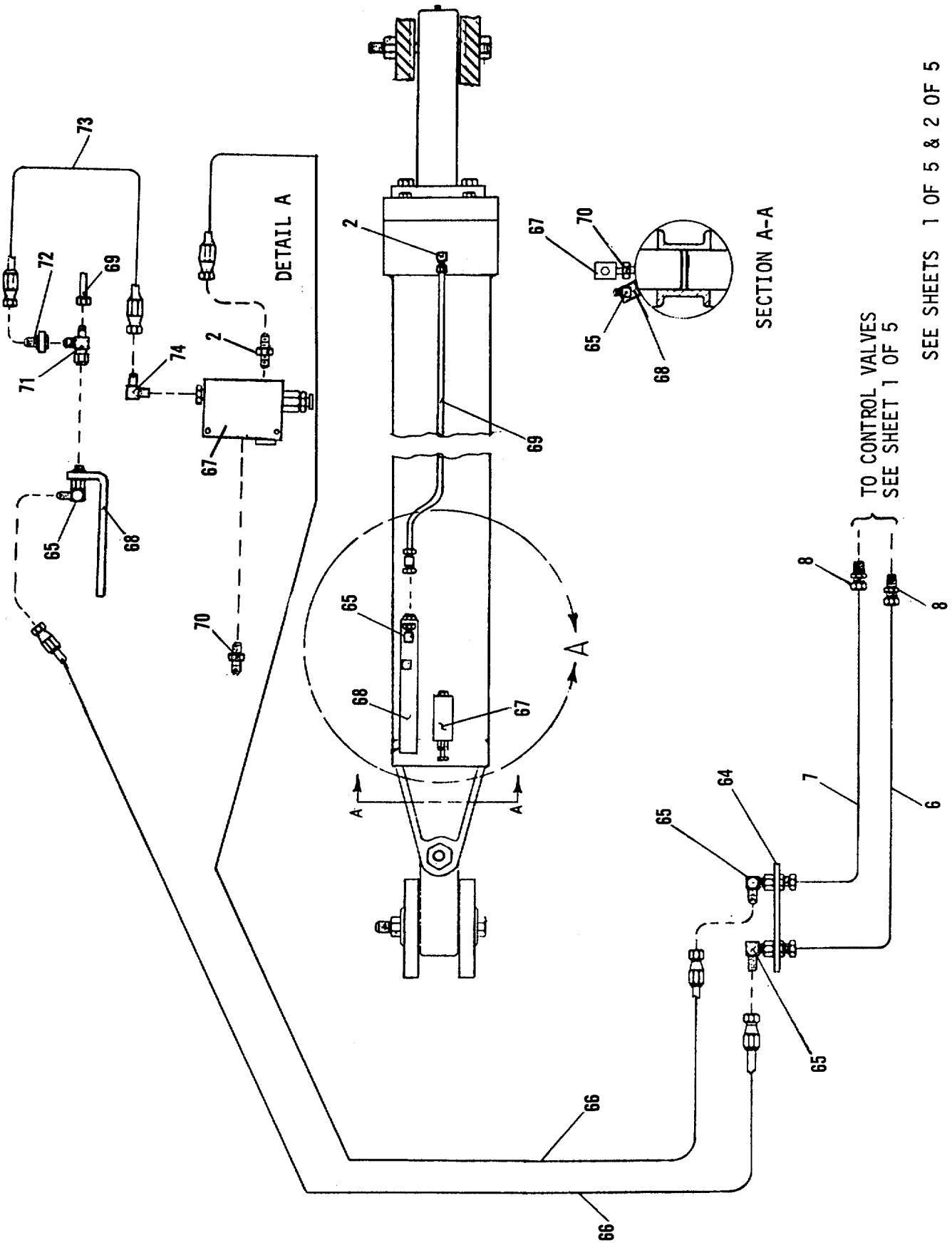
HYDRAULIC PLUMBING INSTALLATION REF 58560



HYDRAULIC PLUMBING INSTALLATION REF 58560



HYDRAULIC PLUMBING INSTALLATION REF 58560



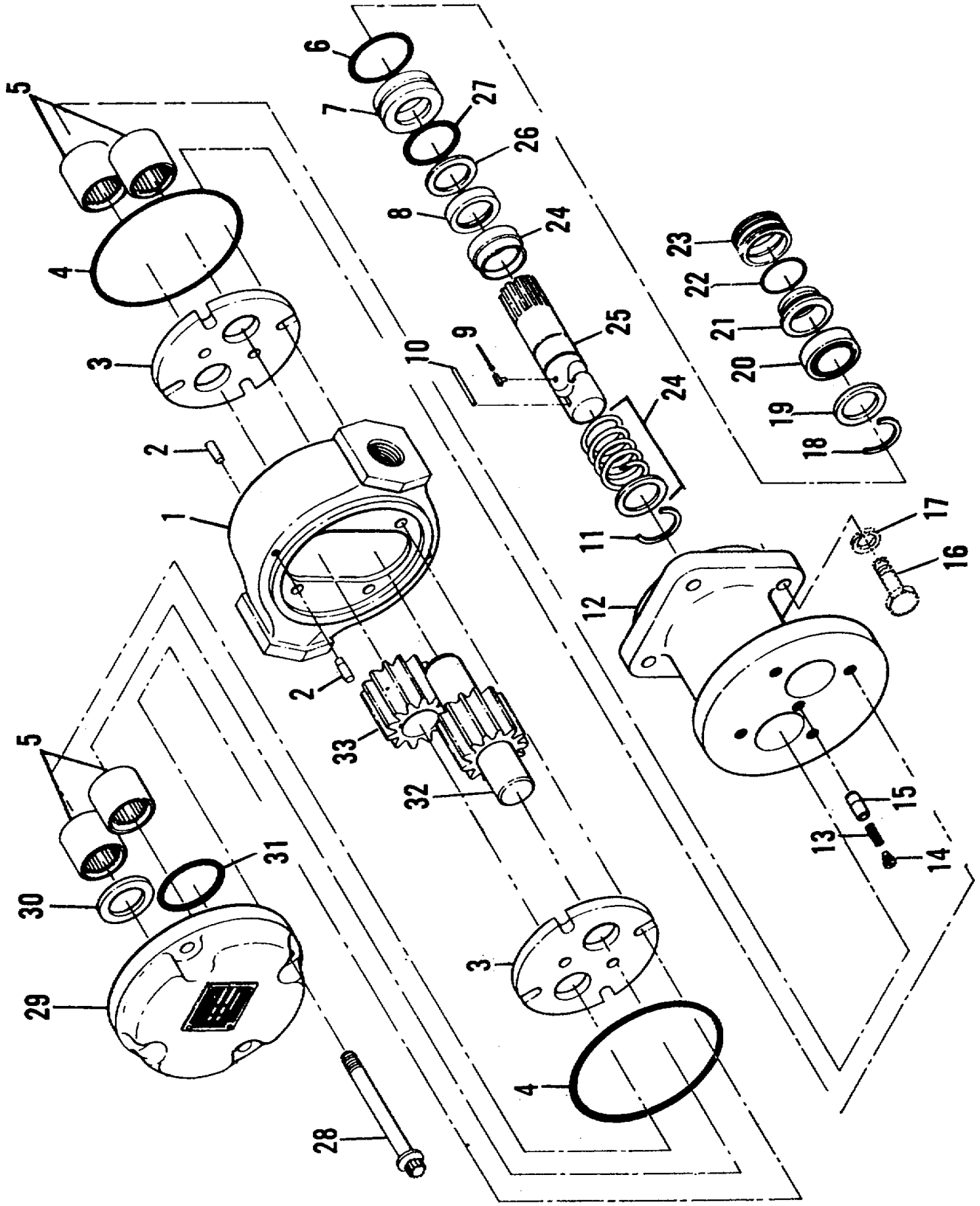
HYDRAULIC PLUMBING INSTALLATION REF 58560

ITEM	PART NO.	QTY.	DESCRIPTION
1	32565	1	ADAPTER
2	30835	4	ADAPTER
3	18259	1	VALVE - LOCK - DOUBLE OUTLET
4	31396	2	ADAPTER - STR - 1/2 MNPT X 1/2 MNPT
5	41992	2	HOSE ASSEMBLY
6	24768	1	TUBING - ELEV.-CYL - VALVE - SHORT
7	24769	1	TUBING - ELEV.-CYL - VALVE - LONG
8	18571	2	ADAPTER - STR
9	43058	1	HOSE ASSEMBLY
10	37689	1	ADAPTER - STR
11	38707	1	ADAPTER - STR
12	33342	1	ADAPTER - HEX NIPPLE 1 MP
13	33330	2	ADAPTER --900
14	31742	1	U-BOLT
15	6292	2	NUT STOP ELASTIC 5/16 NC
16	59432	1	BRACKET - SUPPORT - PLUMBING
17	59644	1	NIPPLE - STL - SCH 80 X 1 X 9 LG
18	38623	1	ADAPTER - STR
19	60804	1	HOSE ASSEMBLY
20	18556	1	ADAPTER - 900
21	42073	1	HOSE ASSEMBLY
22	32149	1	ADAPTER - 450 - 1 M PIPE X 1 M JIC
23	27688	2	ADAPTER - STR
24	36084	2	ADAPTER - STR
25	24767	1	TUBING - WINCH - SHORT - VALVE
26	24766	1	TUBING - WINCH - LONG - VALVE
27	34860	4	ADAPTER - BULKHEAD
28	38675	1	ADAPTER - 450
29	16622	2	O-RING - 1 7/8 I.D. X 2 1/8 O.D.
30	16682	2	FLANGE - SPLIT HALF 1 1/2
31	5975	12	WASHER - LOCK - 1/2 IN
32	7662	4	CAPSCREW - HEX HD - 1/2 NF X 1 1/4 IN
33	19734	1	FLANGE
34	17771	1	NIPPLE - EXTRA HEAVY - 1 1/2 IN
35	17714	1	ADAPTER - ELL - REDUCING
36	16881	2	NIPPLE - STL - SCH 80 - 2 X 3
37	38690	1	ADAPTER - 90° - 1/2 F JIC
38	24630	1	TUBING ASSEMBLY
39	16894	4	CLAMP - HOSE - 1 7/8 - 3 3/4
40	24763	1	TUBING - WINCH - SHORT - FRAME
41	24764	1	TUBING - WINCH - LONG - FRAME
42	24765	1	TUBING - WINCH - MOTOR - LONG
43	36085	2	ADAPTER
44	24762	1	TUBING - WINCH - MOTOR - SHORT
45	16357	1	O-RING - 2 1/4 I.D. X 2 1/2 O.D.
46	16863	1.5 FT	HOSE - BULK - SUCTION
47	17694	1	ADAPTER - ELBOW - SCH 90
48	34048	1	ADAPTER
49	7173	4	NIPPLE - STL - SCH 80 - 3/4 X 2

HYDRAULIC PLUMBING INSTALLATION REF 58560

ITEM	PART NO.	QTY.	DESCRIPTION
50	8371	1	ADAPTER - TEE - PIPE
51	8334	1	ADAPTER - BUSHING - PIPE - HEX
52	59453	1	PLUG - MAGNETIC X 1/2 NPT
53	17783	1	VALVE
54	8317	1	ADAPTER - O-PIPE - 3/4 - EXTRA HEAVY
55	16888	1	CLAMP - HOSE - 1/2
56	30213	6 FT	HOSE - HEATER - RUBBER
57	16822	2	FLANGE - SPLIT - HALF - 2 IN
58	31900	1	ADAPTER - FILTER
59	44923	1	FILTER ASSEMBLY - HYD 1 1/2 NPT
60	32418	1	ELEMENT - FILTER
61	36382	1	ADAPTER
62	43054	1	HOSE ASSEMBLY
63	18565	2	ADAPTER - 90°
64	19702	1	BRACKET - TUBING
65	37820	3	ADAPTER - BULKHEAD
66	38245	2	HOSE ASSEMBLY
67	18294	1	VALVE - HOLDING
68	43803	1	BRACKET - BULKHEAD
69	24640	1	TUBING - ASSEMBLY
70	33340	1	ADAPTER - HEX - NIPPLE
71	35626	1	ADAPTER - TEE
72	47035	1	ADAPTER - REDUCER
73	40685	1	HOSE ASSEMBLY
74	31804	1	ADAPTER - 90°
75	7169	4	CAPSCREW - SOC HD

HYDRAULIC PUMP ASSEMBLY REF 16780



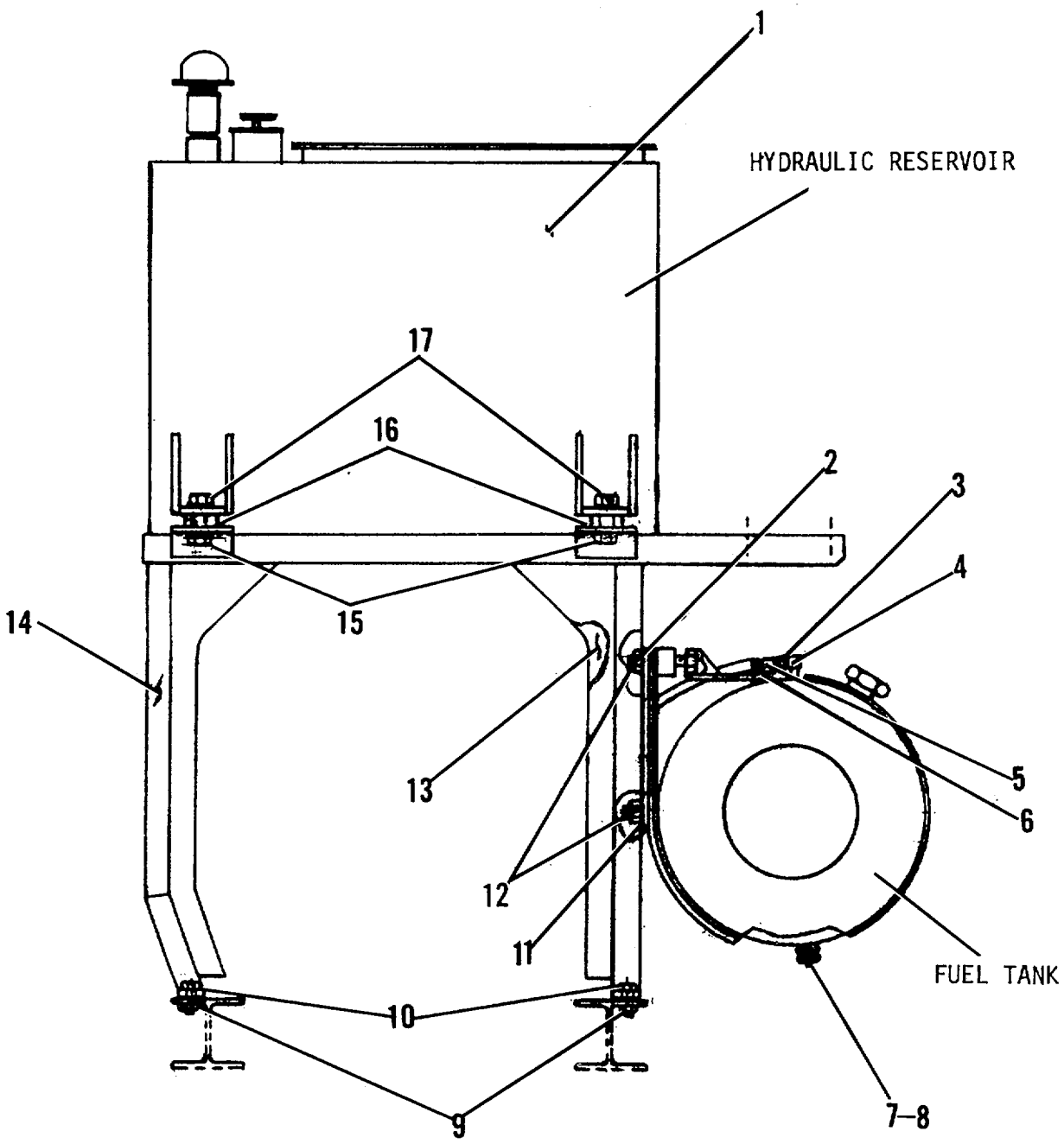
HYDRAULIC PUMP ASSEMBLY REF 16780

ITEM	PART NO.	QTY.	DESCRIPTION
1	16812	1	HOUSING
2	16795	4	DOWEL PIN
3	16803	2	PLATE - WEAR
4	16796	2	O-RING
5	16798	4	BEARING
6	16808	1	O-RING
7	16790	1	SEAT - ASSY - SEAL
8	16785	1	SEAL SLEEVE
9	16811	1	KEY - DRIVE
10	16802	1	DOWEL PIN
11	16792	1	RING - SNAP
12	16786	1	ADAPTER
13	16805	2	GUIDE
14	16807	2	CHECK
15	16806	2	SPRING
**16	5986	4	CAPSCREW
**17	5975	4	WASHER
18	16788	1	RING - SNAP
19	16789	1	RETAINER - RING - SNAP
20	16787	1	BEARING
21	16782	1	SEAL
22	16784	1	O-RING
23	16783	1	RETAINER
24	16791	1	SEAL ASSEMBLY
25	16781	1	SHAFT
26	16809	2	BACKUP RING
27	16810	1	O-RING
28	16799	4	CAPSCREW
29	16804	1	COVER
30	16801	1	WASHER - THRUST
31	16793	4	O-RING
32	16797	1	DRIVEN GEAR
33	16800	1	DRIVE GEAR
*34	16794	AS REQD	SHIM

*ITEM 35 (16794-SHIM) NOT SHOWN, WHEN REQUIRED, IS USED BETWEEN MATING FACES OF ITEM 30 AND ITEM 3, BOTH SIDES.

**SHOWN FOR REFERENCE ONLY.

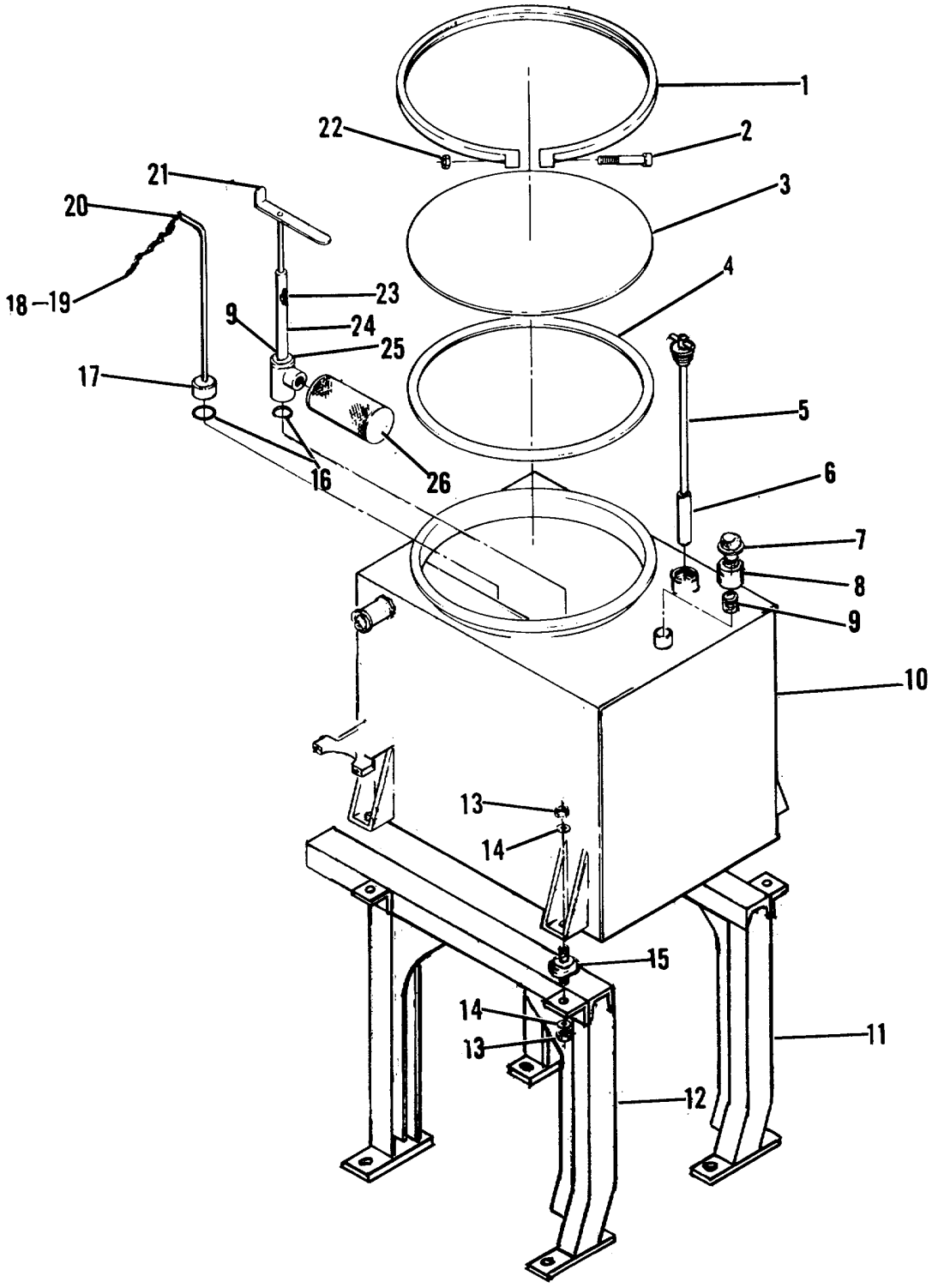
HYDRAULIC AND FUEL RESERVOIR INSTALLATION REF 58536



HYDRAULIC AND FUEL RESERVOIR INSTALLATION REF 58536

ITEM	PART NO.	QTY.	DESCRIPTION
1	44954	1	HYDRAULIC RESERVOIR ASSEMBLY
2	52011	2	FUEL TANK MOUNT
3	32961	2	HOSE FITTING - REUSEABLE SOCKETLESS 3/8 F JIC X 3/8
4	35435	1	HOSE FITTING - ELBOW 90° - 1/2 NPT X 1/4 JIC
5	37294	1	SIPHON ASSEMBLY FITTING 3/8 MJIC X 1/2 M PIPE X 18 IN
6	32104	2	HOSE FITTING REUSEABLE SOCKETLESS - 3/8 FJIC X 3/8
7	32810	1	DRAIN COCK - 3/8 NPT
8	8332	1	FITTING - RED - 1/2 M PIPE X 3/8 F PIPE
9	6291	8	NUT - ELASTIC STOP 1/2 - 13 UNC
10	5977	8	CAPSCREW - HEX HD - 1/2 - 13 UNC X 1 1/4 LG GR. 5
11	6716	4	NUT - ELASTIC STOP 5/8 - 11 UNC
12	7801	4	CAPSCREW-HEX HD - 5/8 - 11 UNC X 4 IN LG GR. 5
13	58894	1	SUPPORT - RESERVOIR - OIL & FUEL - REAR
14	58893	1	SUPPORT - RESERVOIR - OIL AND FUEL - FRONT
15	5991	8	NUT - HEX HD - 3/8 - 16 UNC
16	5962	8	WASHER - STARLOCK- 3/8
17	32576	4	RUBBER - RESERVOIR MOUNT

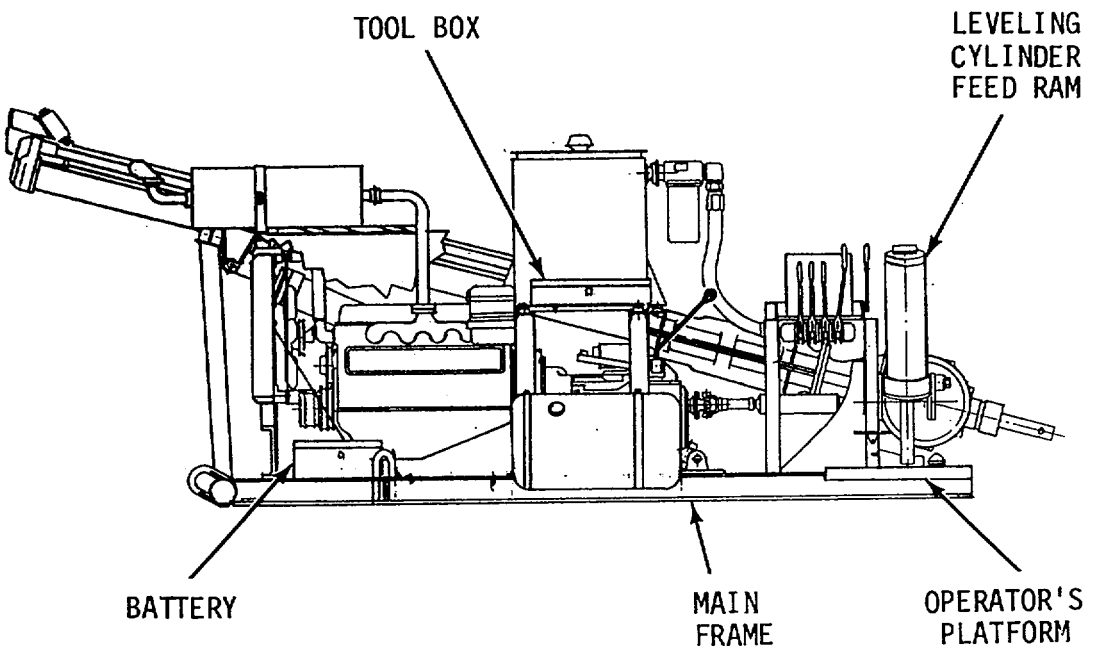
HYDRAULIC RESERVOIR INSTALLATION/ASSEMBLY REF 44954 & 58536

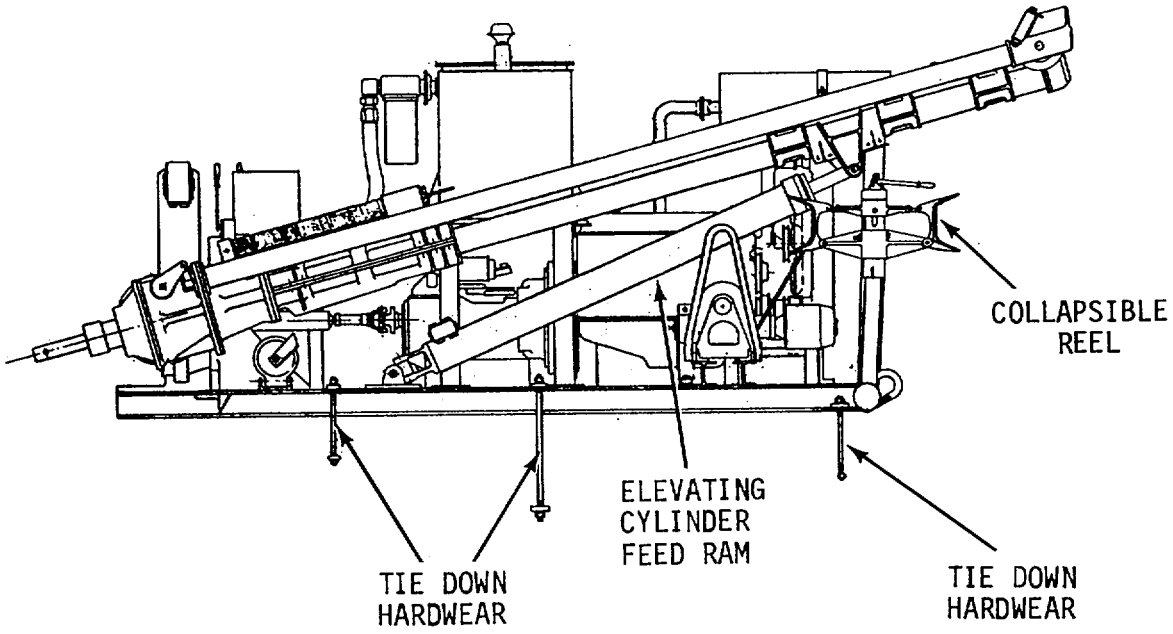


HYDRAULIC RESERVOIR INSTALLATION/ASSEMBLY REF 44954 & 58536

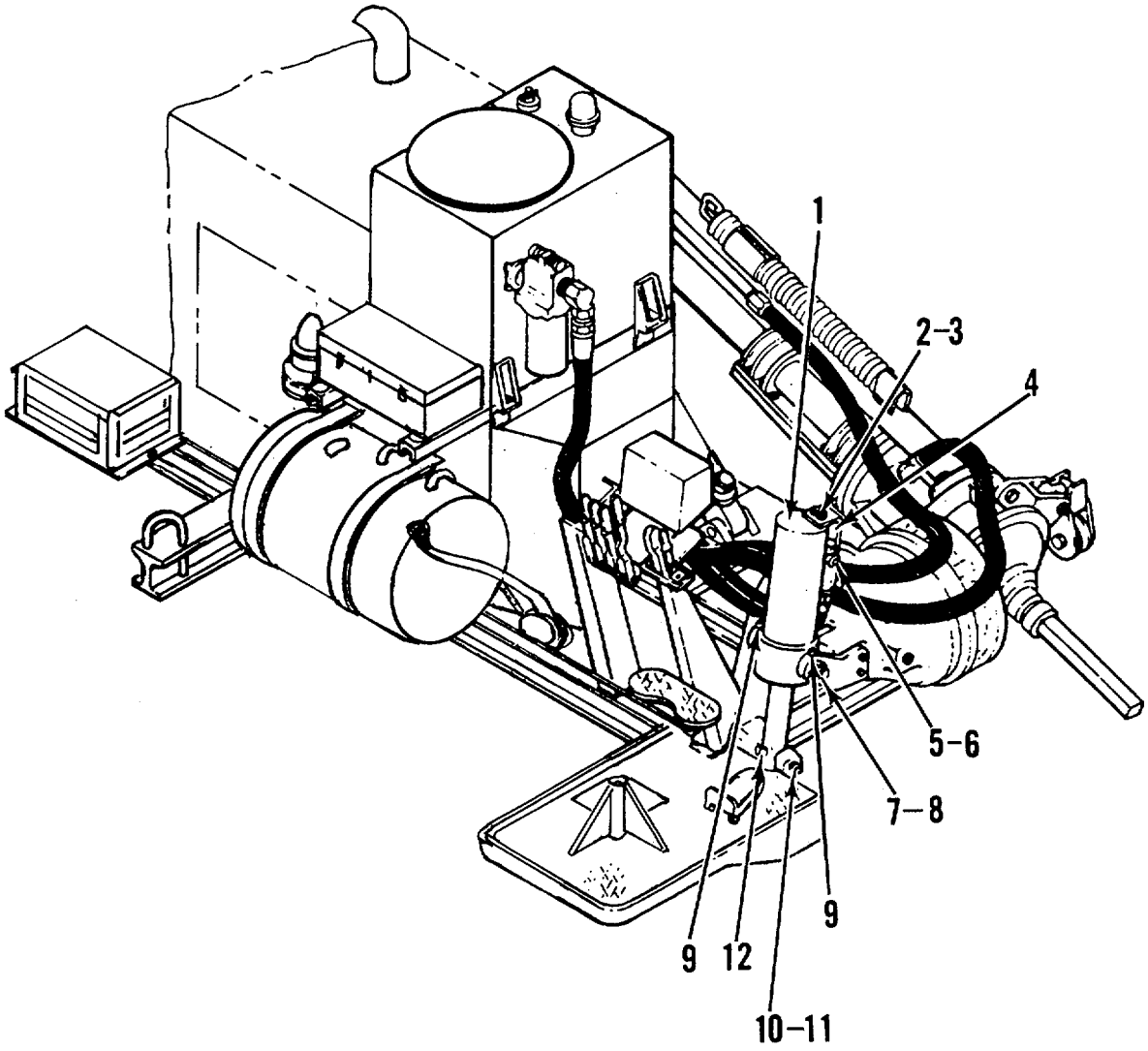
ITEM	PART NO.	QTY.	DESCRIPTION
1	31739	1	BAND
2	31740	1	BOLT - 3/8 NC X 4 1/2 LG
3	31738	1	LID
4	31736	2	GASKET
5	18449	1	OIL LEVEL GAUGE
6	18450	1	MAGNETIC TRAPPER - TANK
7	16076	1	BREATHER - DONALDSON BA 500-0099
8	34067	1	BREATHER EXTENSION
9	16897	2	NIPPLE - STL - SCH 40 2 X 2 CLOSE
10	32491	1	HYDRAULIC RESERVOIR
11	58893	1	FRONT SUPPORT RESERVOIR - OIL FUEL
12	58894	1	REAR SUPPORT RESERVOIR - OIL FUEL
13	5991	8	NUT - HEX HD 3/8 - 16 UNC
14	5962	8	WASHER - STAR LOCK 3/8
15	32576	4	RUBBER RESERVOIR MOUNT
16	16823	2	0 RING 2 1/4 ID X 2 5/8 OD X 3/16 DIA
17	16832	1	PLUG AUXILIARY
18	32898	1.5 FT	CHAIN - SSSH #30 BLUE CHROME
19	5939	2	COTTER PIN - 1/8 X 1
20	30345	1	AUXILIARY PLUG HANDLE
21	30632	1	SUCTION ADAPTER HANDLE
22	31741	1	NUT - HEX SPECIAL 3/8 - 16 UNC
23	45131	1	SPRING - 1 IN DIA X 12 GA
24	30636	1	NIPPLE - STL - SCH 40 1 X 12 - PLUGGED
25	16819	1	SUCTION ADAPTER -
26	16821	1	HYDRAULIC OIL STRAINER

MAIN FRAME COMPONENTS LOCATOR



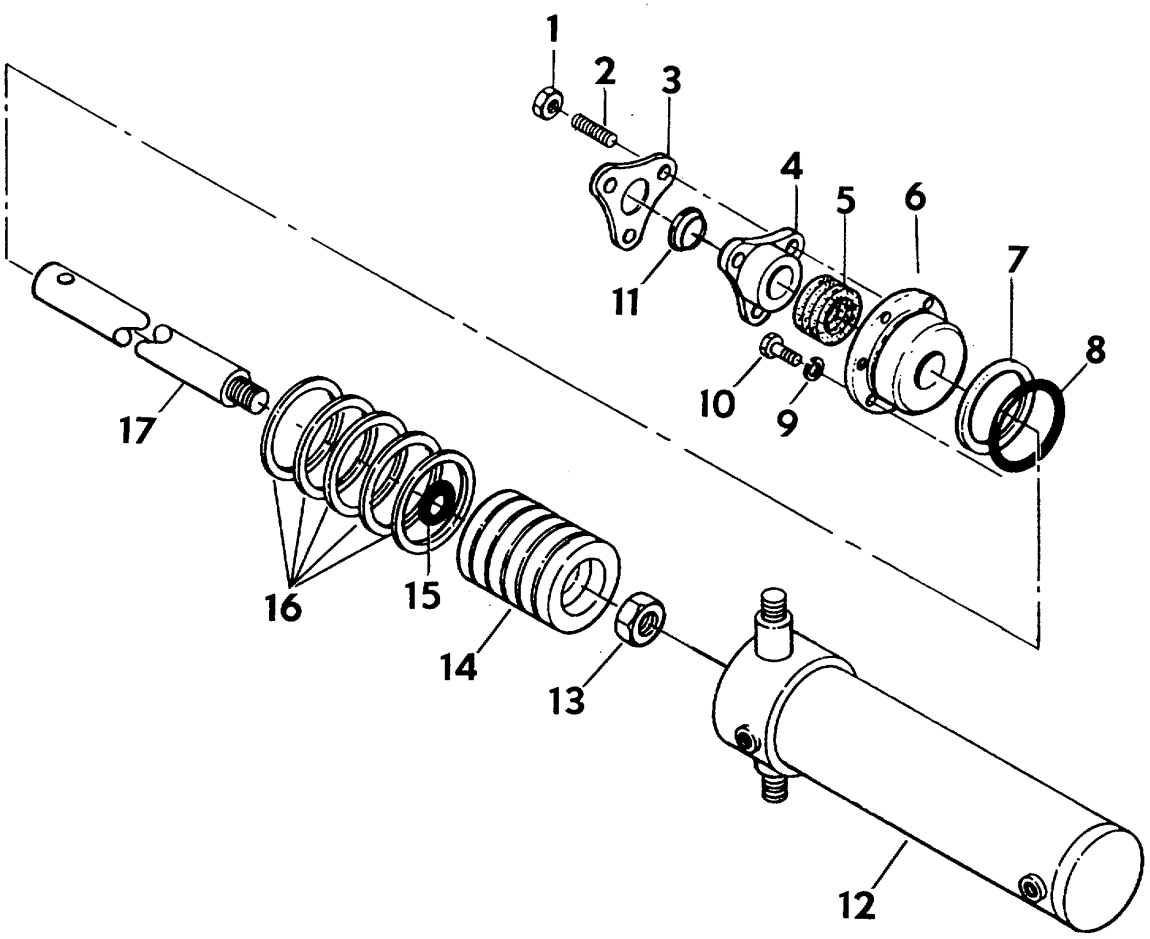


LEVELING CYLINDER INSTALLATION REF 45086



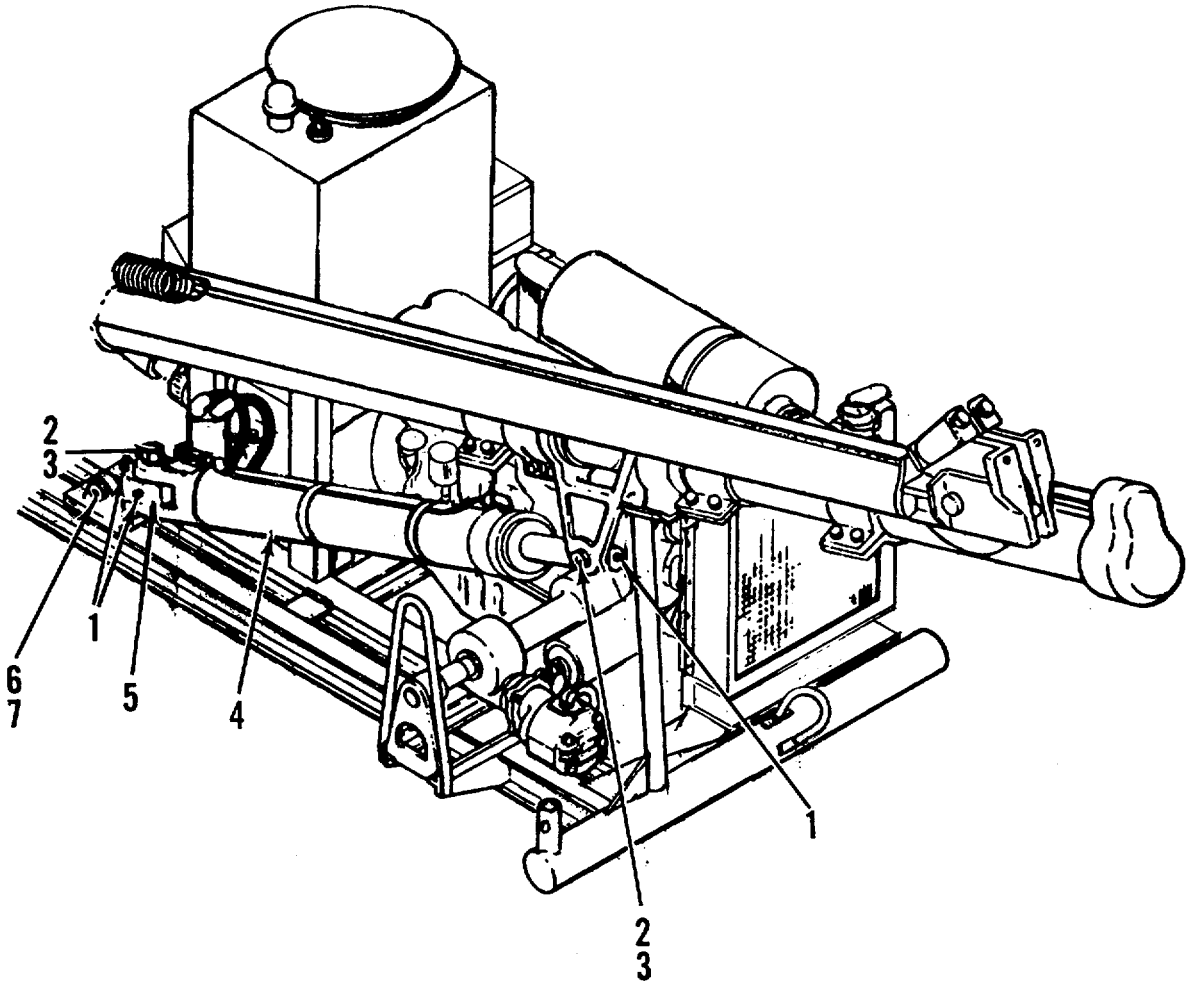
ITEM	PART NO.	QTY.	DESCRIPTION
1	32272	1	CYLINDER - LEVELING
2	6092	2	CAPSCREW - HEX. HD. - 1/2 - 13 UNC X 1 - GR 5
3	6291	2	NUT - ELASTIC STOP - 1/2 - 13 UNC
4	33380	1	BRACKET - VALVE - LOADLOCK
5	7722	2	CAPSCREW - HEX. HD. - 5/16 - 18 UNC X 2 1/2 - GR 5
6	6292	2	NUT - ELASTIC STOP - 5/16 - 18 UNC
7	42968	2	NUT - ELASTIC STOP - THIN - 1 - 14 UNS
8	11762	2	WASHER - FLAT - STD - 1"
9	5929	2	FITTING - GREASE - 1/8 NPT - STR.
1Q	7829	1	CAPSCREW - HEX. HD. - 1 - 8 UNC X 6 - GR 5
11	42701	1	NUT - ELASTIC STOP - 1 - 8 UNC
12	18377	1	FITTING - GREASE - 1/8 NPT - 900

LEVELING CYLINDER ASSEMBLY REF 32272



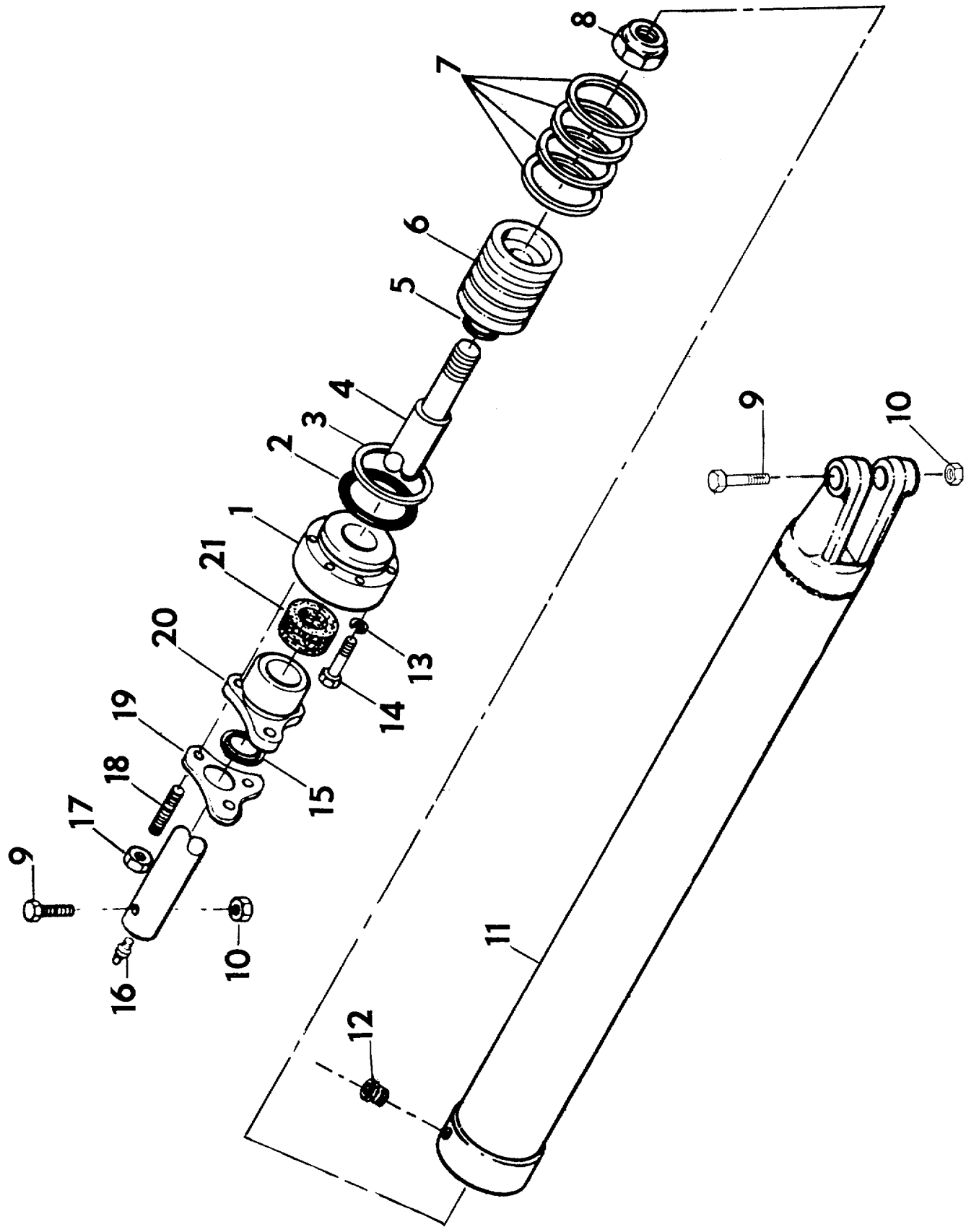
ITEM	PART NO	QTY	DESCRIPTION
1	9440	3	NUT HEX 1/2 UNF -3B
2	16256	3	BOLT STUD 1/2 NC X 1/2 NF X 2 1/2 LG
3	32581	1	RETAINER
4	32270	1	GLAND PACKING
5	14061	1 SET	PACKING ROD 2 ID
6	30837	1	CAP CYLINDER 7 1/2 OD X 2 ID
7	30288	1	BACK UP RING 6 DIA
8	19729	1	O-RING 5 3/4 ID X 6 OD X 1/8
9	5975	6	WASHER LOCK 1/2 DIA
10	5986	6	CAPSCREW HEX HD 1/2 NC X 1 3/4 LG
11	19321	1	WIPER ROD 2 ID
12	33401	1	BARREL ASSEMBLY MACHINED
13	42646	1	LOCKOUT 1 1/4 NF
14	30299	1	PISTON CYLINDER 6 DIA
15	16610	1	O-RING 1/8 W X 1 1/4 ID X 1 1/2 OD
16	18849	4	PACKING PISTON 1/4 X 1/4 X 19
17	33399	1	SHAFT 2 OD X 28 3/4 LG
18	35117	1	VALVE RELIEF THERMAL (NOT SHOWN)

ELEVATING CYLINDER INSTALLATION REF 45127



ITEM	PART NO	QTY	DESCRIPTION
1	5929	3	FITTING - GREASE - 1/8 NPT
2	42783	2	CAPSCREW - HES HD - 1-8 UNC X 6 GRD 8
3	42701	2	NUT - ELASTIC STOP - 1-8 UNC
4	32271	1	ELEVATING CYLINDER ASSEMBLY
5	12001	1	BLOCK- PIVOT
6	35806	1	CAPSCREW - HEX HD- 1 1/4 - 7 UNC X 8 GRD 8
7	34091	1	NUT - ELASTIC STOP - 1 1/4 7 UNC

ELEVATING CYLINDER ASSEMBLY REF 32271

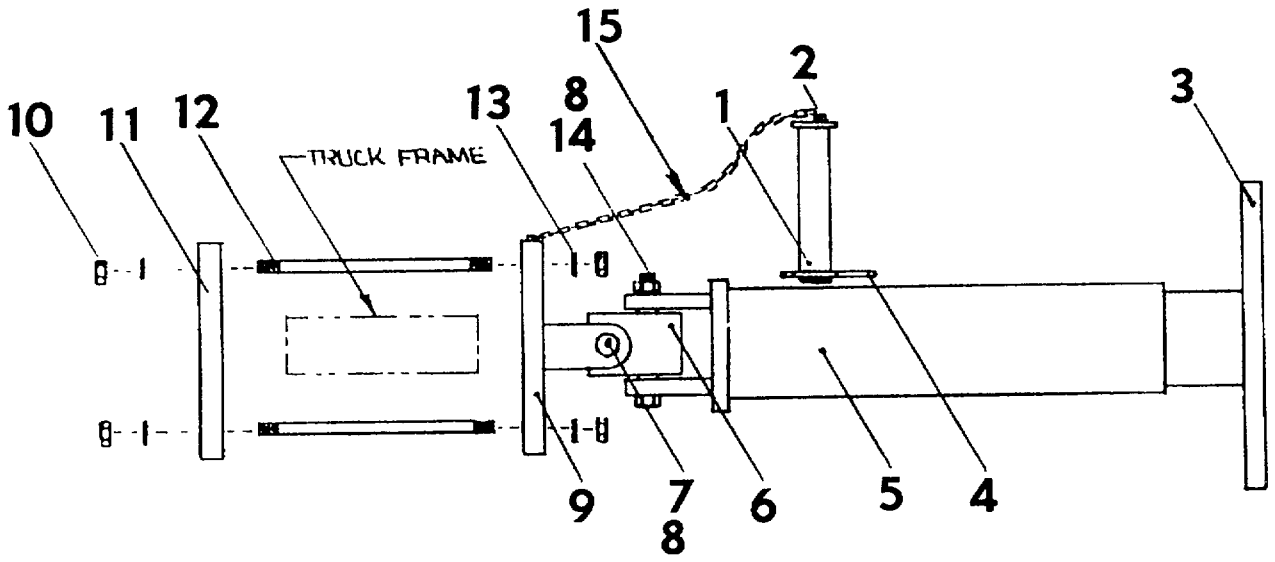


ELEVATING CYLINDER ASSEMBLY REF 32271

ITEM	PART NO.	QTY.	DESCRIPTION
1	30504	1	CAP - CYLINDER
2	19725	1	O-RING - 4 3/4 D
3	30287	1	RING - BACKUP - 4 3/4 D.
4	16508	1	SHAFT - 2 DIA X 75
5	16610	1	O-RING - 1/8 X 1 1/4 I.D. X 1 1/2 O.D.
6	30502	1	PISTON
7	18849	1	PACKING - BELMONT - 1/4 SQ X 70 IN LG
8	42646	1	NUT - STOP - ELASTIC - 1 1/4 - 12 NF
9*	42783	2	CAPSCREW - HEX HD - 1 - 8 UNC X 6 GR 8
10*	42701	2	NUT - ELASTIC STOP - 1 - 8UNC
11	44908	1	BARREL ASSEMBLY - 4 3/4 I.D. X 69 3/4
12	35117	1	VALVE - RELIEF - THERMAL - 1/8 NPT
13	5989	6	WASHER - LOCK - CUT - 3/8
14	42575	6	CAPSCREW - 3/8 - 16 NC X 1 3/4 LG - GR 5
15	19321	1	WIPER - ROD - 2 IN I.D.
16*	5929	3	GREASE - 1/8 NPT
17	9440	3	NUT - STOP - ELASTIC - 1/2 - 20 UNF
18	16256	3	BOLT - STUD - 1/2 X 2
19	32581	1	RETAINER
20	32270	1	GLAND - PACKING
21	14061	1	PACKING

*ELEVATING CYLINDER INSTALLATION REF. 45127

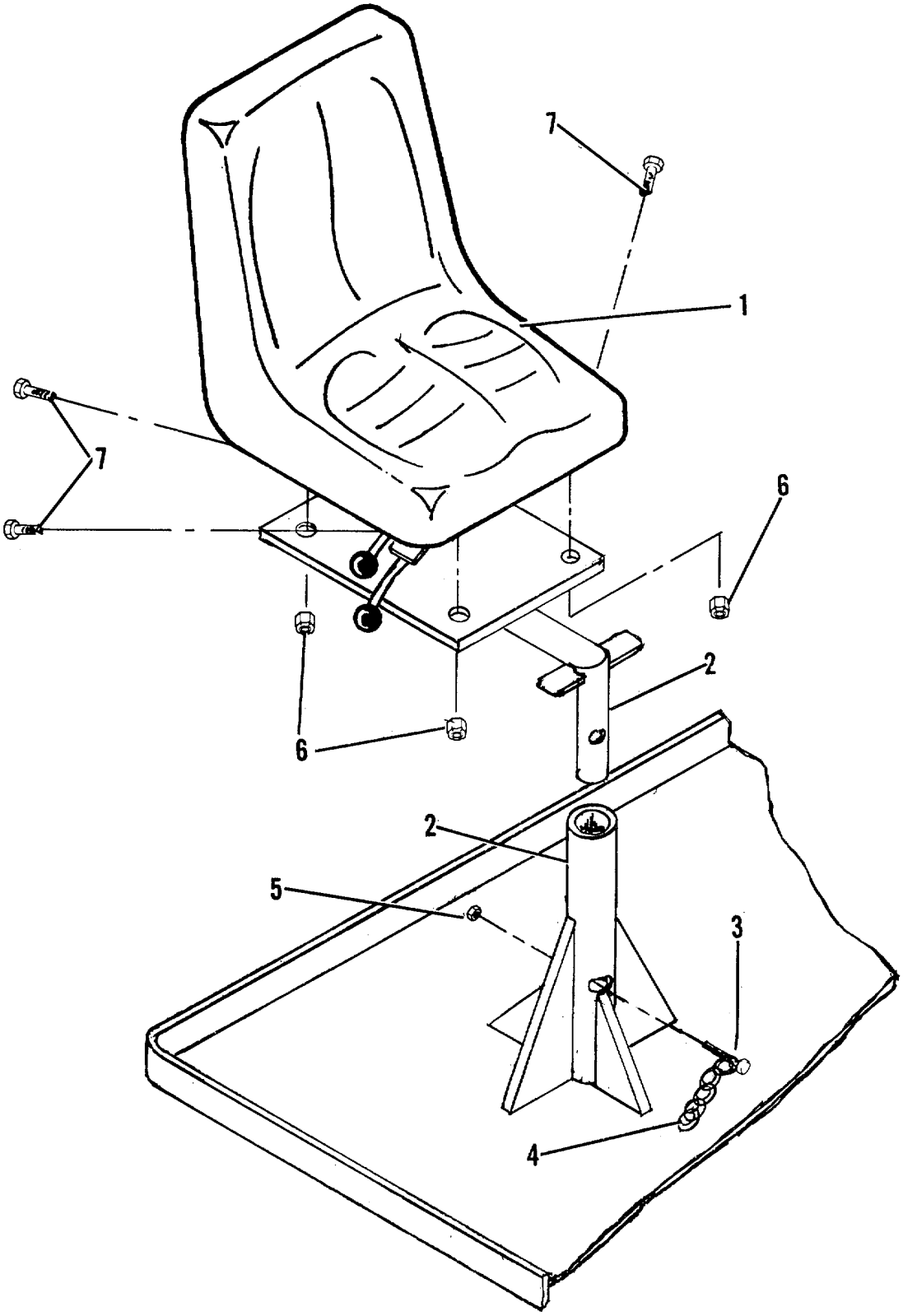
SUPPORT JACKS ASSEMBLY REF 45199



NOTE: ONE JACK ONLY SHOWN

ITEM	PART NO	QTY	DESCRIPTION
1	45218	2	PIN - CLEVIS - 1 X 6 LG
2	37394	4	SCREW - SELF TAPPING
3	45217	2	PAD AND LOWER TUBE - LOCK
4	19156	2	CLIP - HAIR PIN - 5/32
5	11626	2	TUBE - JACK UPPER
6	8498	2	BLOCK - UNIVERSAL
7	7810	2	CAPSCREW - HEX HD - 3/4 NC X 5 LG - GRD 5
8	42606	4	NUT - ELASTIC STOP - 3/4 NC
9	17035	2	BRACKET - JACK
10	6371	8	NUT - HEX - 3/4 NC
11	17034	2	BAR - HOLD DOWN
12	34046	4	BOLT - TIE - 3/4 X 28
13	5965	8	WASHER - LOCK CUT - 3/4
14	8279	2	CAPSCREW - HEX HD - 3/4 NC X 4 1/2 LG - GRD 5
15	32898	3	CHAIN - #30 SASH - 18 LG

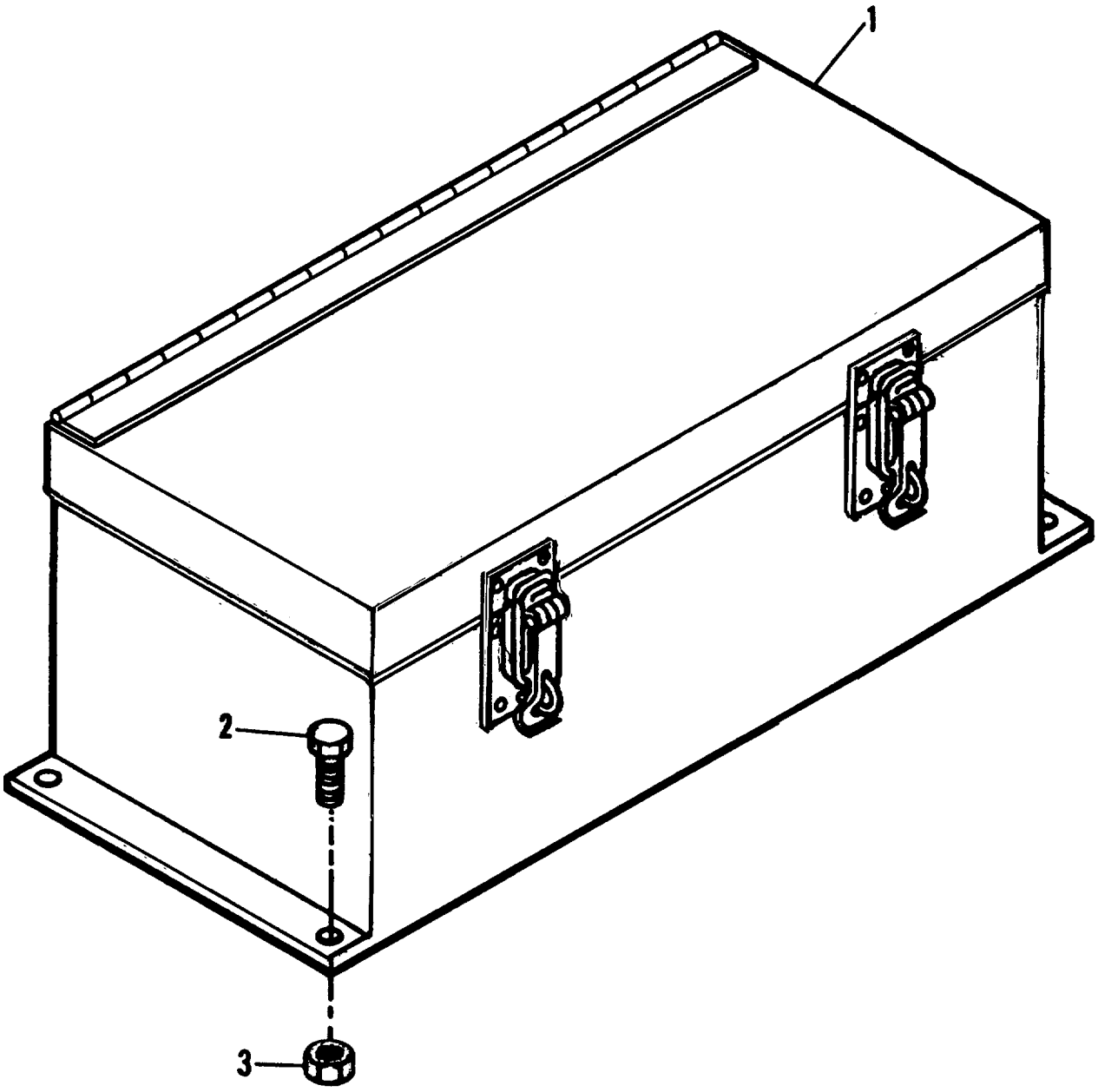
OPERATOR'S SEAT INSTALLATION REF 59182



OPERATOR'S SEAT INSTALLATION REF 59182

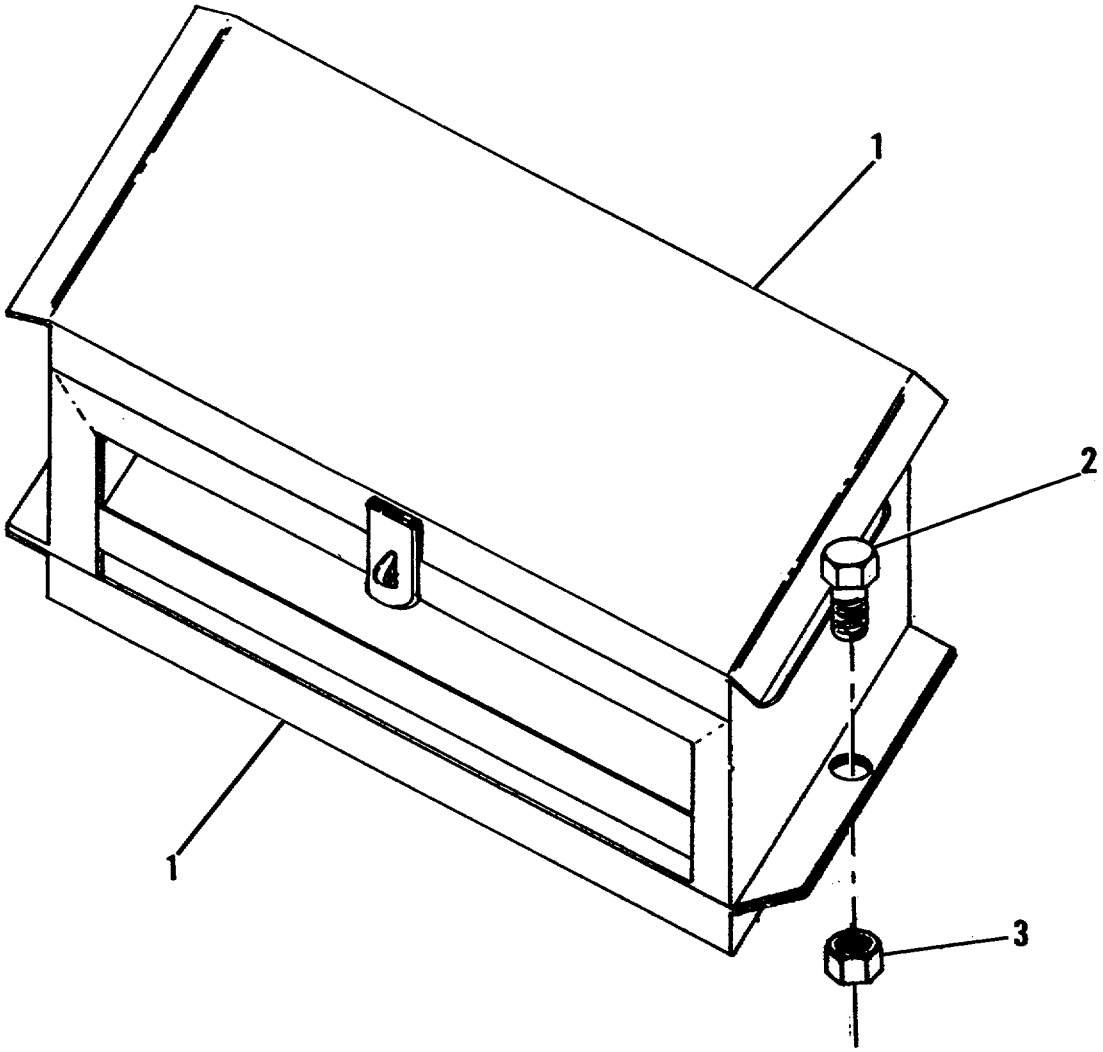
ITEM	PART NO.	QTY.	DESCRIPTION
1	18286	1	SHOCKFREE SEAT
2	47430	1	SEAT SWIVEL BRACKET - 700
3	43196	1	STOVEBOLT #10 - 32 X 3/4 LG.
4	32898	1 FT.	CHAIN - SASH - CAMPBELL NO. 30
5	43195	1	NUT - HEX. HD. #10 - 32
6	6292	4	NUT - ELASTIC STOP 5/16 - 18 UNC
7	6096	4	CAPSCREW - HEX. HD. 5/16 - 18 UNC X 1 LG - GR 5

TOOL BOX INSTALLATION REF 45237



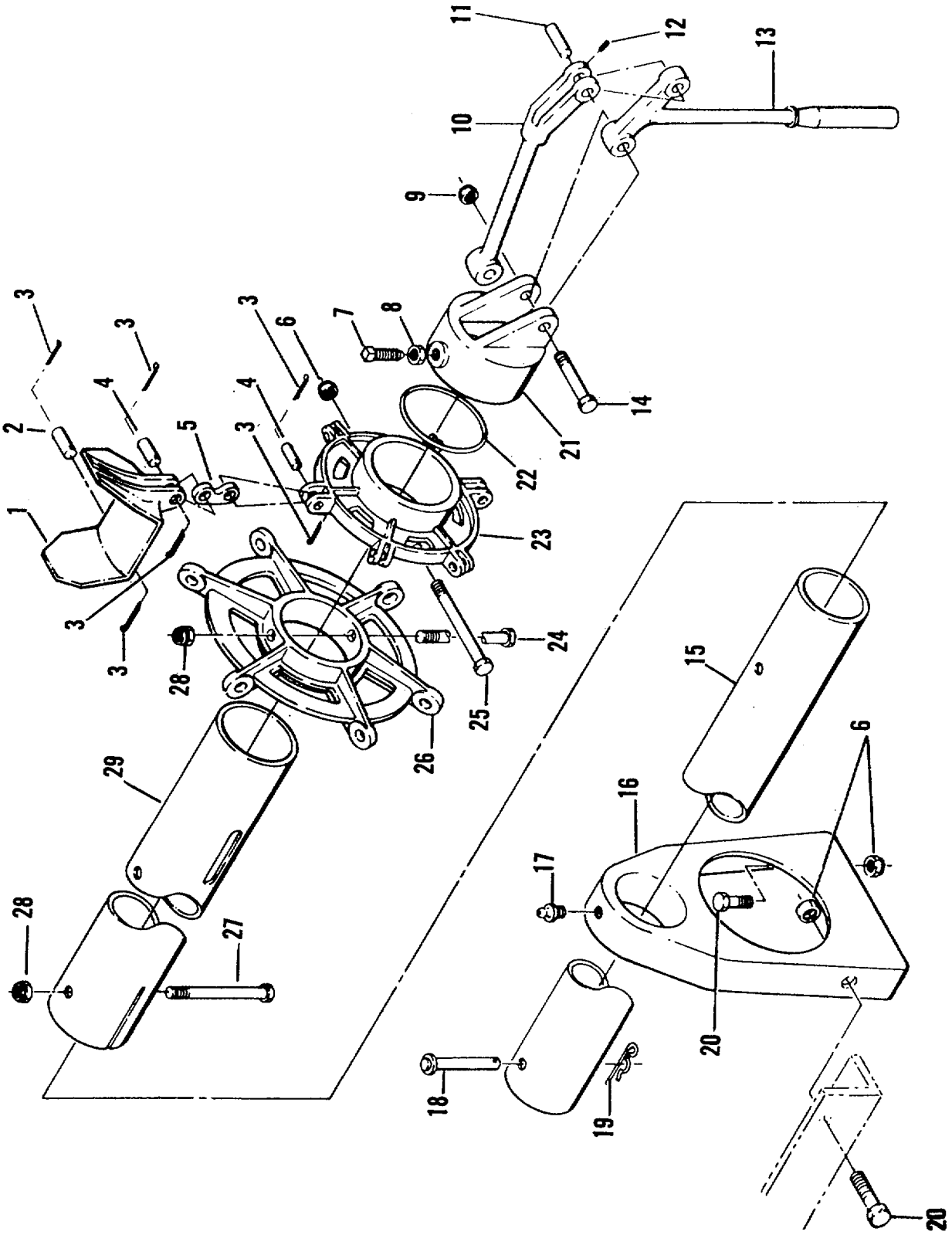
ITEM	PART NO.	QTY.	DESCRIPTION
1	17129	1	BOX - TOOL-ASSEMBLY
2	6092	4	CAPSCREW - HEX HD - 1/2 - 13 UNC X 1
3	6291	4	NUT - ELASTIC STOP - 1/2 - 13 UNC

BATTERY BOX REF 59053



ITEM	PART NO.	QTY	DESCRIPTION
1	43561	1	BATTERY BOX - 8D
2	5972	2	CAPSCREW - HEX. HD. 1/2 - 13 UNC X 1 1/2 LG.
3	6291	2	NUT - ELASTIC STOP 1/2 - 13 UNC

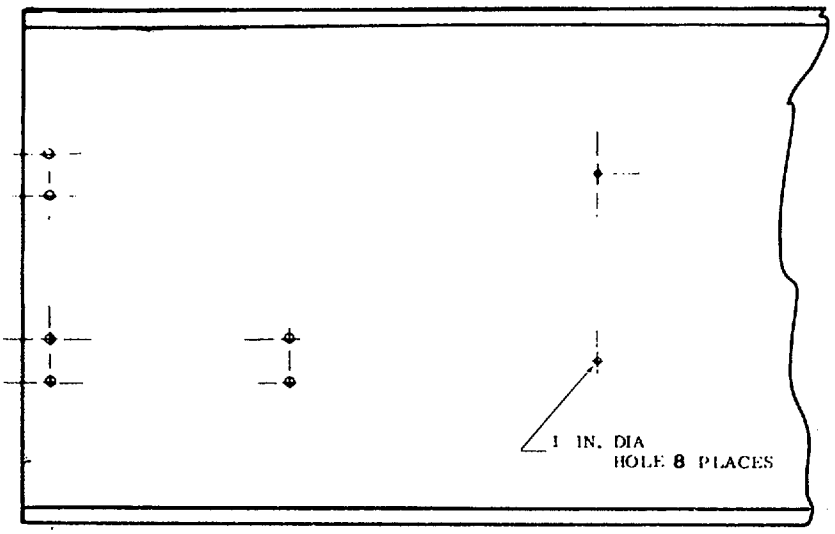
COLLAPSIBLE REEL ASSEMBLY REF 44950



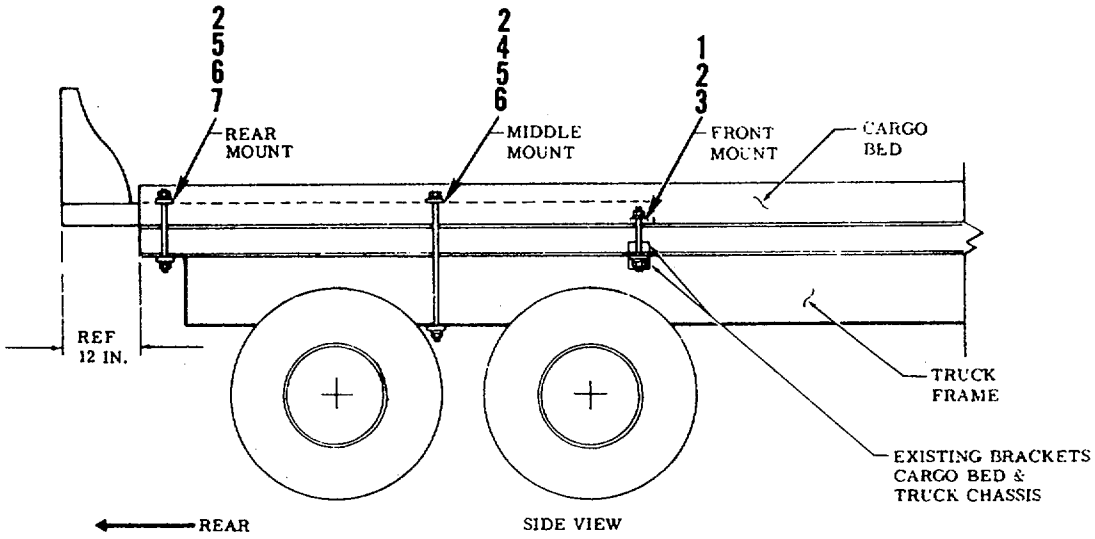
COLLAPSIBLE REEL ASSEMBLY REF 44950

ITEM	PART NO.	QTY.	DESCRIPTION
1	11955	6	SADDLE
2	32236	6	PIN - 5/8 DIA X 2 7/8
3	5939	36	PIN - COTTER - 1/8 DIA X 1
4	32237	12	PIN - 5/8 DIA X 2
5	11993	6	LINK - SADDLE
6	6291	5	NUT - STOP - ELASTIC - ½ UNC GR 5
7	42795	2	SETSCREW - SQHD - 3/8 UNC X 1
8	5991	2	NUT - HEX - 3/8 UNC GR 5
9	7972	1	NUT - STOP - ELASTIC - 3/8 UNC
10	11992	1	LINK - LEVER
11	32238	1	PIN - 3/8 DIA X 1 ½ LG
12	6413	1	SETSCREW - SOC. HD - ¼ - UNC X ¼ LG
13	11990	1	HANDLE
14	6881	1	CAPSCREW - HEX HD - 3/8 UNC X 3 LG GR 5
15	34000	1	SHAFT - EXTENDED - J8 WINCH
16	17130	1	BEARING - OUTBOARD - J8
17	5929	1	FITTING - GREASE - STR - 1/8 NPT
18	32415	1	PIN - 5/8 DIA X 3
19	32414	1	PIN - HAIR
20	5986	4	CAPSCREW - HEX HD - ½ UNC X 1 ¾ GR 5
21	11991	1	CAP - LEVER BRACKET
22	32239	1	O-RING - 3 I.D. X 3 3/8 O.D. X 3/16 DIA
23	11994	1	SPIDER - FLOATING
24	7802	1	CAPSCREW - HEX HD - 5/8 UNC X 5 GR 5
25	7793	1	CAPSCREW - HEX HD - ½ UNC X 5 GR 5
26	11996	1	SPIDER - STATIONARY
27	5963	1	CAPSCREW - HEX HD -5/8 UNC X 4 ½ GR 5
28	6716	2	NUT - STOP - ELASTIC - 5/8 UNC
29	32235	1	SHAFT
30	10056	10	SHIM (NOT SHOWN)

MOUNTING HARDWARE / LOCATION **REF 45239**



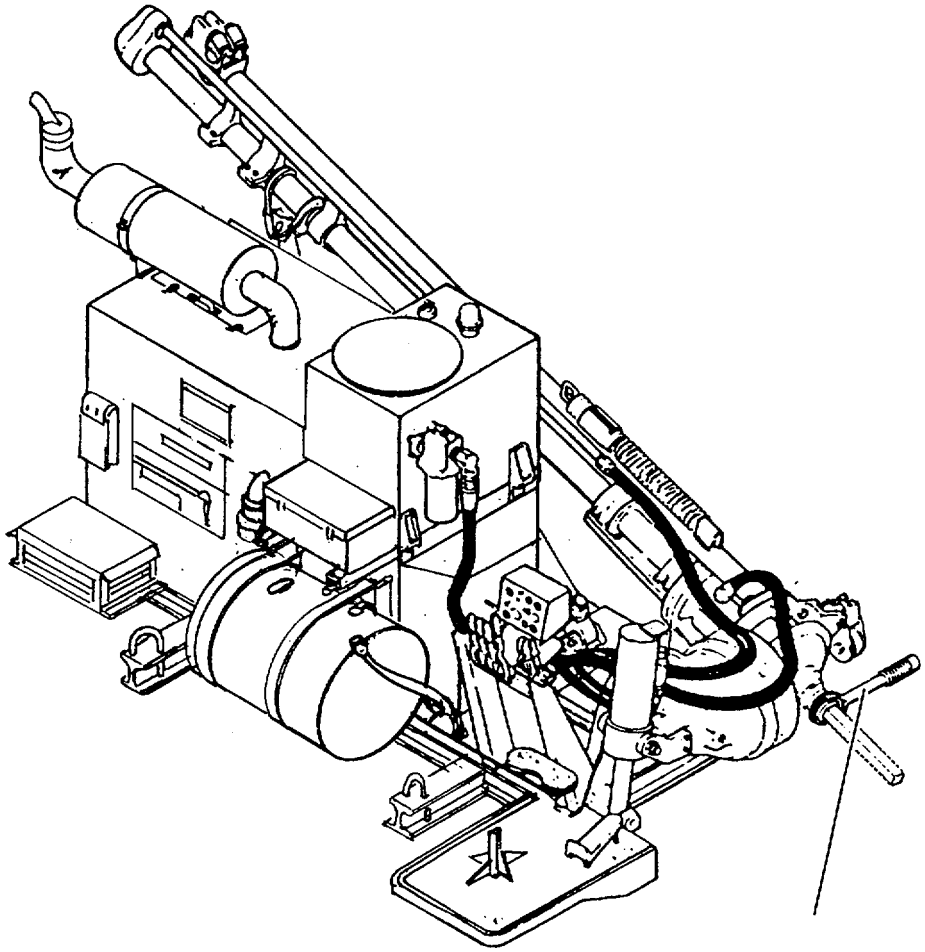
TOP VIEW CARGO CARRIER MOUNTING HOLES



SIDE VIEW

ITEM	PART NO	QTY	DESCRIPTION
1	42745	2	BOLT TIE DOWN 3/4 X 3 1/2 NC
2	5965	12	WASHER LOCK CUT 3/4
3	46980	2	PALTE
4	7813	2	BOLT TIE DOWN 3/4 X 6 1/2 NC
5	6371	12	NUT HEX 3/4 NC
6	47471	6	STRAP TIE DOWN
7	18283	4	BOLT TIE DOWN 3/4 X 18

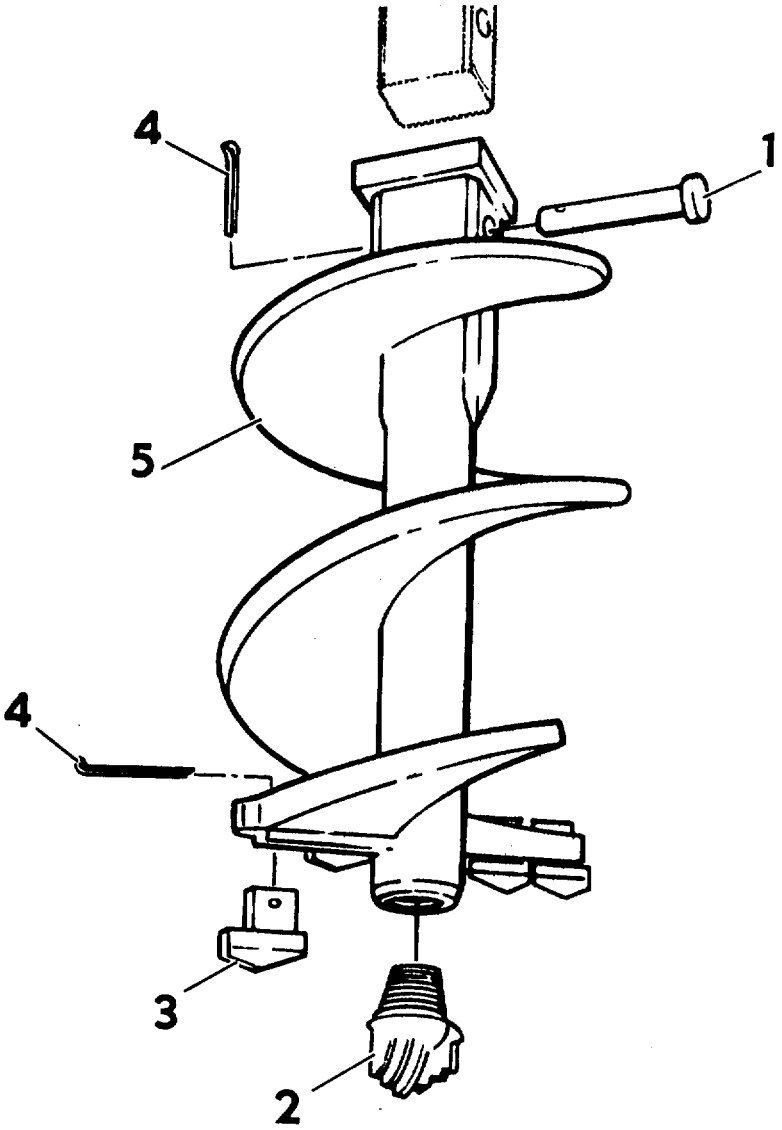
SPECIAL TOOL DESCRIPTION **REF 19186**



RATCHETING CHAIN WRENCH
MADE BY
OWATONNA TOOL COMPANY
(FED. MFG. CODE 45225)
*OTC PART NO. 887-D

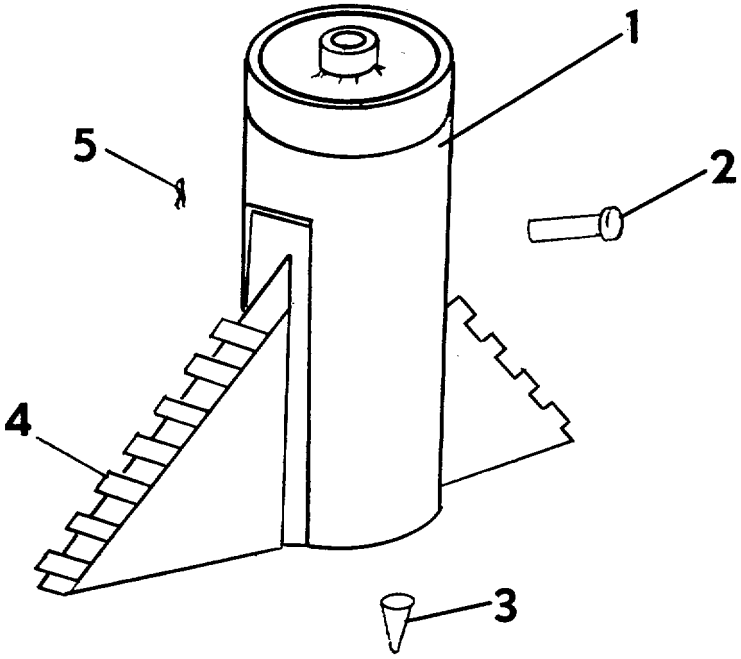
* THIS OTC PART MUST BE MODIFIED BY ADDING 8 INCHES OF REPLACEMENT CHAIN (TOTAL CHAIN LENGTH TO BE 24 INCHES)

AUGER EQUIPMENT



ITEM	PART NO	QTY	DESCRIPTION
1	11581	1	PIN, AUGER
2	16845	4	POINT, PILOT
3	16845 17318	14 28	BIT , ROCK BIT, DIRT
4	6242	40	PIN, COTTER
5	29137 29138 29130 29157	1 1 1 1	AUGER, 9 INCH AUGER, 12 INCH AUGER, 16 INCH AUGER, 24 INCH

AUGER EQUIPMENT



ITEM	PART NO.	QTY	DESCRIPTION
1	36185	1	UNDER REAMER - 24" DIA X 2 i/2" BOX
2	11581	1	PIN, AUGER
3	11984	1	STINGER
4	11376	14	BLADE, DIRT
5	6242	1	PIN, COTTER

Parts Catalog

Detroit Diesel Engines

SERIES 53 MODELS

GROUP NOMENCLATURE

1.0000 ENGINE (less major assemblies)
- 1.1000 Cylinder Block
- 1.1000A Air Box Drains
- 1.2000 Cylinder Head
- 1.2000A Engine Lifter Bracket
- 1.3000 Crankshaft, Oil Seals and stabilizers
- 1.3000A Crankshaft Front Cover
- 1.3000B Vibration Damper
- 1.3000C Crankshaft Pulley
- 1.3000D Crankshaft Pulley Belt
- 1.4000A Flywheel
- 1.5000A Flywheel Housing
- 1.5000B Flywheel Housing Adaptor
- 1.6000 Connecting Rod and Piston
- 1.7000 Camshaft and Gear Trail
- 1.7000A Balance Weight Cover
- 1.7000B Accessory Drive
- 1.8000 Valve and Injector Operating Mechanism
- 1.8000A Rocker Cover

2.0000 FUEL SYSTEM
- 2.1000A Fuel Injector
- 2.2000 Fuel Pump
- 2.2000A Fuel Pump Drain
- 2.3000A Fuel Filter
- 2.4000 Fuel Manifold and/or Connections
- 2.4000A Dual Fuel System
- 2.5000A Fuel Lines and Fuel Cooler
- 2.60004 Fuel Tank
- 2.7000A Mechanical Governor
- 2.8000A Hydraulic Governor
- 2.9000 Injector Controls
- 2.9000A Throttle Controls

3.0000 AIR SYSTEM
- 3.1000A Air Cleaner and/or Adaptor
- 3.2000A Air Silencer
- 3.3000A Air Inlet Housing
- 3.4000 Blower
- 3.4000A Blower Drive Shaft
- 3.4000B Blower End Plate Cover
- 3.5000A Turbocharger and Intercooler

4.0000 LUBRICATING SYSTEM
- 4.1000A Oil Pump
- 4.1000B Oil Distribution System
- 4.1000C Oil Pressure Regulator
- 4.2000A Oil Filter
- 4.3000A Oil Filter Lines
- 4.4000A Oil Cooler and Marine Gear Lines
- 4.5000A Oil Filler
- 4.6000A Dipstick
- 4.7000A Oil Pan
- 4.8000A Ventilating System

5.0000 COOLING SYSTEM
- 5.1000 Fresh Water Pump
- 5.1000A Fresh Water Pump Cover
- 5.2000A Water Outlet Manifold and/or Elbow
- 5.2000B Thermostat
- 5.2000C Water By-pass Tube
- 5.3000A Radiator
- 5.3000B Water Connections
- 5.4000A Fan
- 5.4000B Fan Shroud
- 5.5000A Heat Exchanger or Keel Cooling
- 5.6000A Raw Water Pump
- 5.7000A Water Filter

6.0000 EXHAUST SYSTEM
- 6.1000A Exhaust Manifold
- 6.2000A Exhaust Muffler and/or Connections

7.0000 ELECTRICAL-INSTRUMENTS
- 7.1000A Battery Charging Generator
- 7.2000A Battery Cables
- 7.2000B Automatic Starting
- 7.3000A Starting Motor
- 7.4000A Instruments
- 7.4000B Tachometer Drive
- 7.4000C Shut-off, Alarm and O.S. Governor
- 7.5000A Power Generator
- 7.6000A Control Cabinet
- 7.7000A Wiring Harness
- 7.8000A Air Heater
- 7.10000A Hydraulic Governor Solenoid

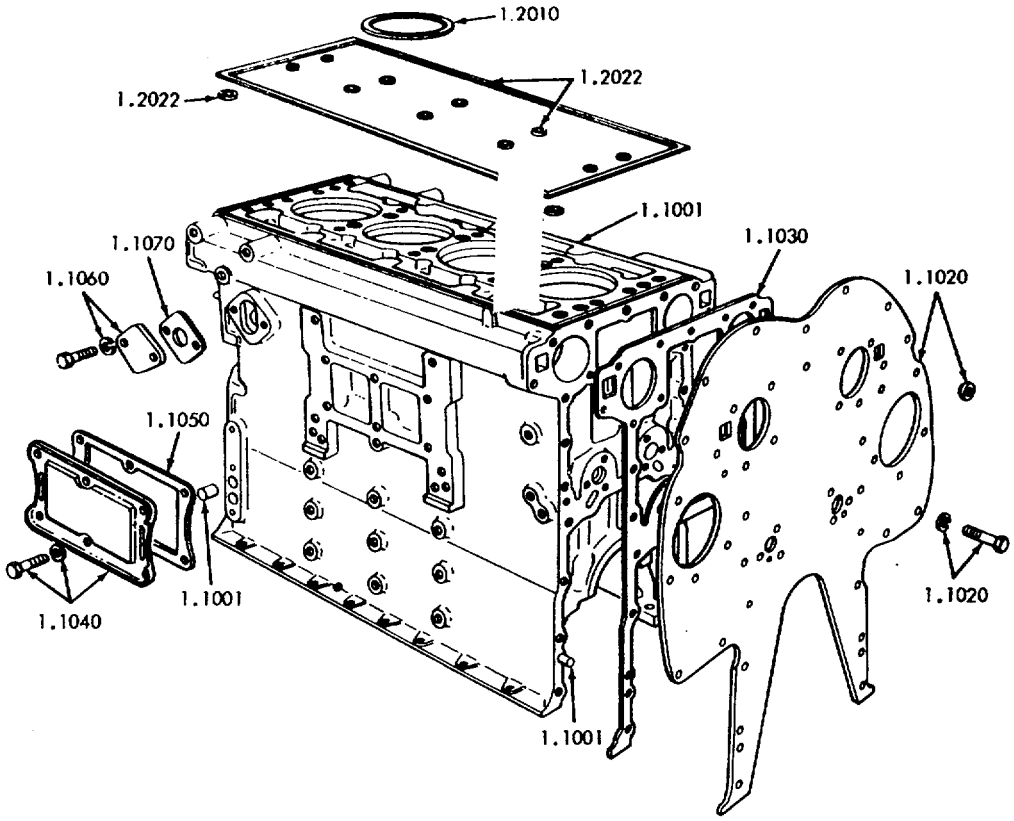
8.0000 POWER TAKE-OFF
- 8.1000A Power Take-off and/or Clutch
- 8.3000A Torque Converter
- 8.3000B Transmission Lines

9.0000 TRANSMISSION AND PROPULSION
- 9.1000A Hydraulic Marine Gear
- 9.2000A Reverse and Reduction Gear (mechanical)
- 9.3000A Power Transfer Gear
- 9.4000 Transmission-Highway
- 9.7000 Transmission-Off-highway
- 9.9000 Transmission-Rail Car

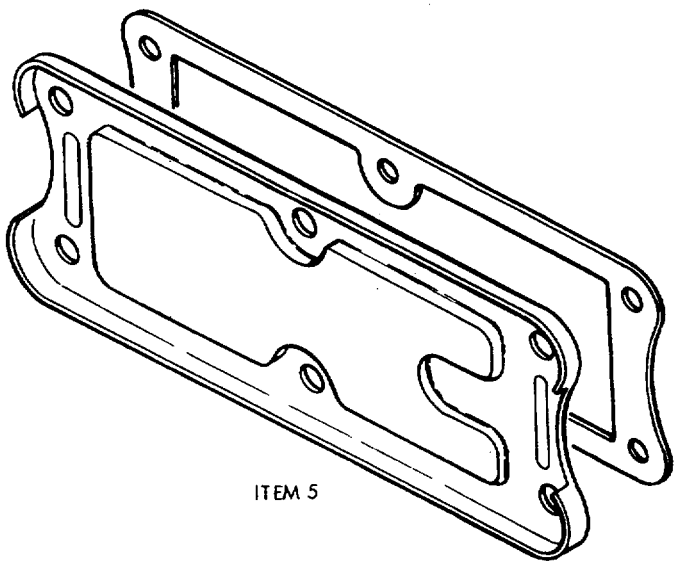
10.0000 SHEET METAL
- 10.1000A Engine Hood

11.0000 ENGINE MOUNTING
- 11.1000A Engine Mounting and Base

12.0000 MISCELLANEOUS
- 12.2000A Bilge Pump
- 12.3000A Vacuum Pump
- 12.4000A Air Compressor
- 12.5000A Hydraulic Pump
- 12.6000A Gasoline Starter
- 12.6000B Air Starter
- 12.6000C Cold Weather Starting Aid
- 12.6000D Hydraulic Starter
- 12.6000E Hydraulic Starter Accessories
- 12.8000A Supplies
- 12.8000B Fabrication Material
- 12.8000C Service Kits

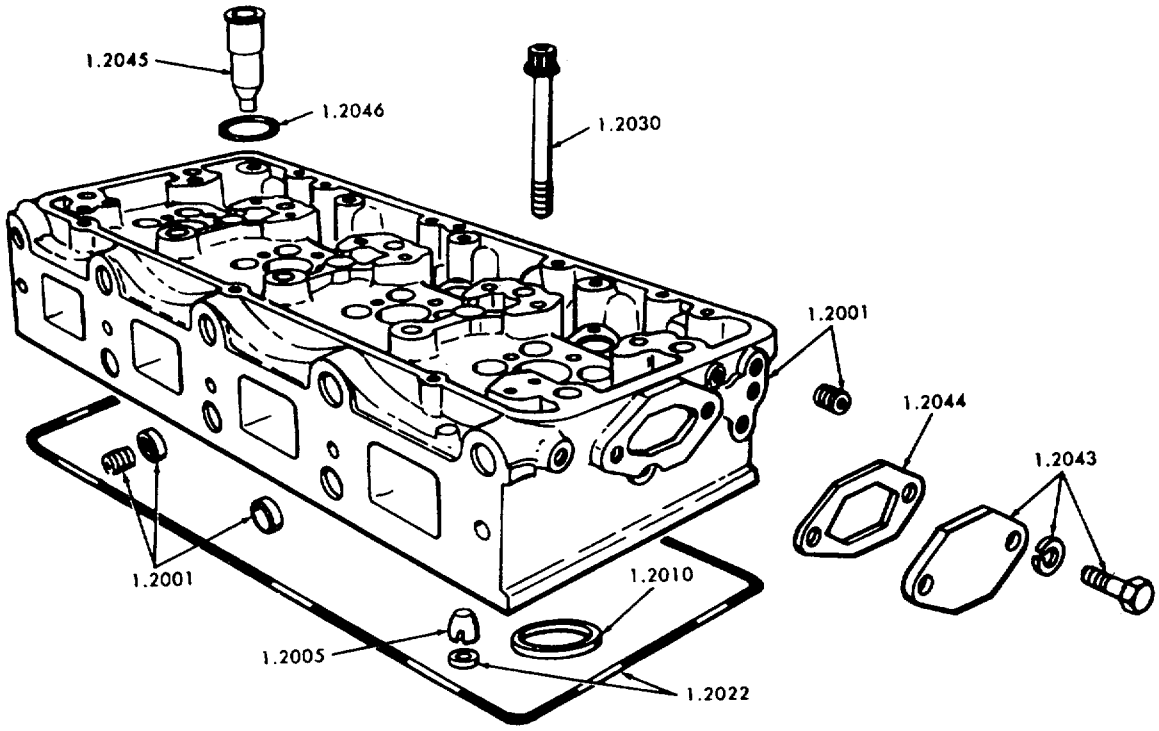


SECTION 1 FIG. 1A. CYLINDER BLOCK (IN-LINE MODELS)

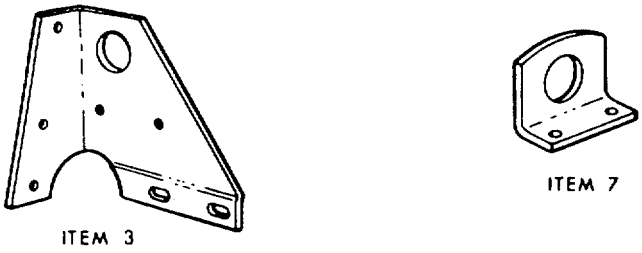


SECTION 1 FIG. 1C. CYLINDER BLOCK HANDLE HOLE

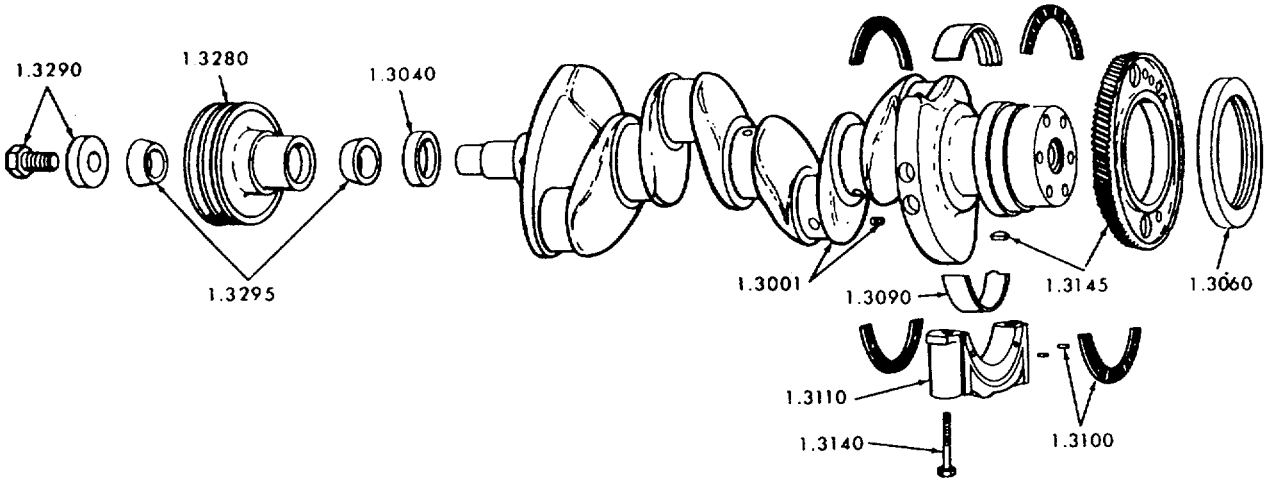
SECTION I ENGINE



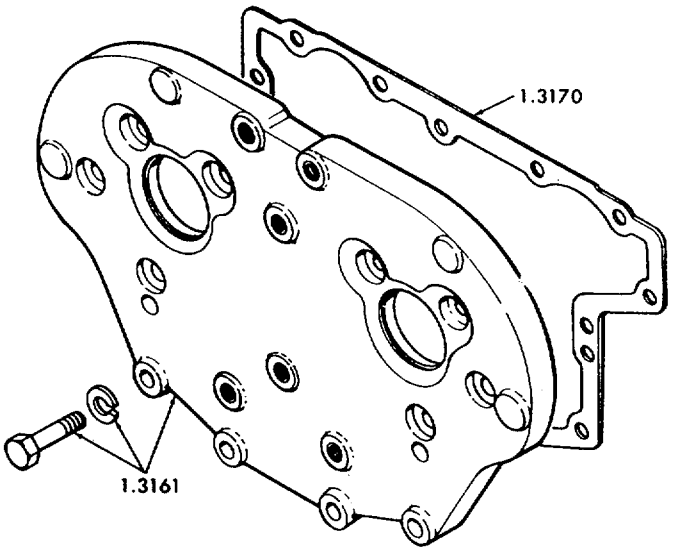
SECTION 1 FIG. 2A. CYLINDER HEAD



SECTION 1 FIG. 2B. LIFTER BRACKETS

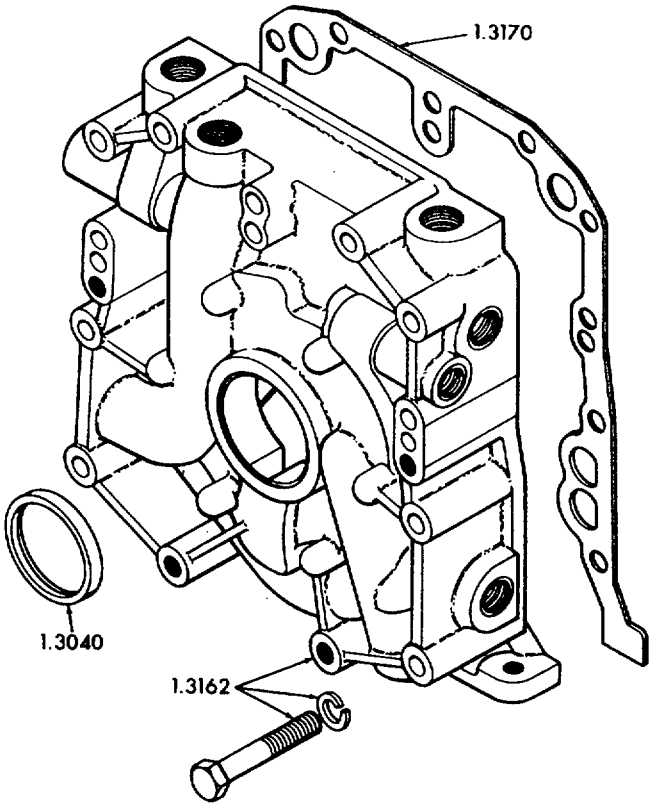


SECTION 1 FIG. 3A. CRANKSHAFT

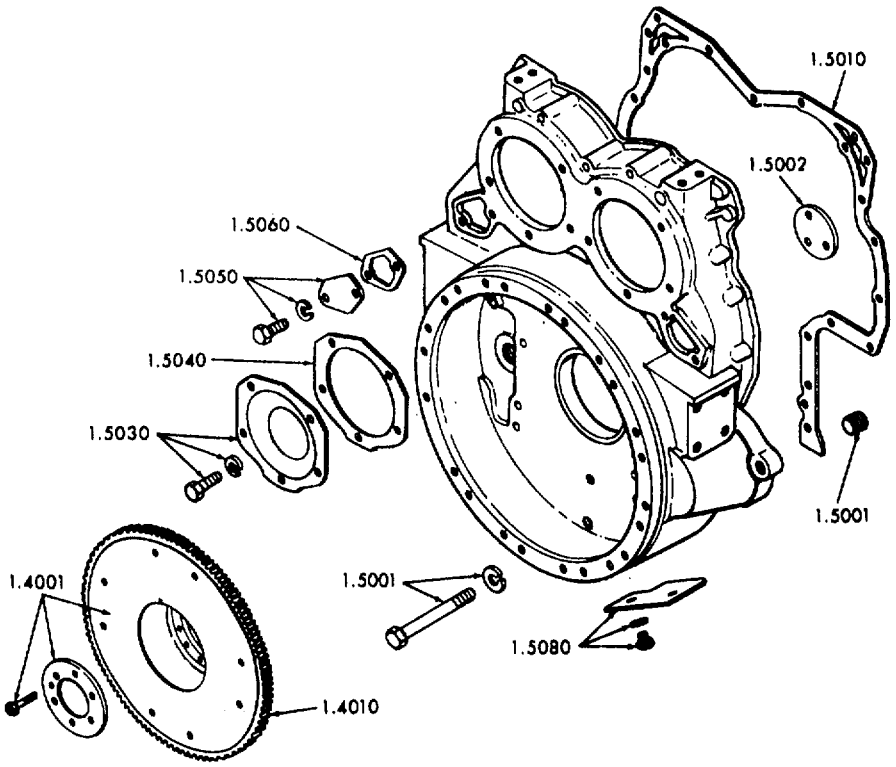


SECTION 1 FIG. 4A. UPPER FRONT COVER

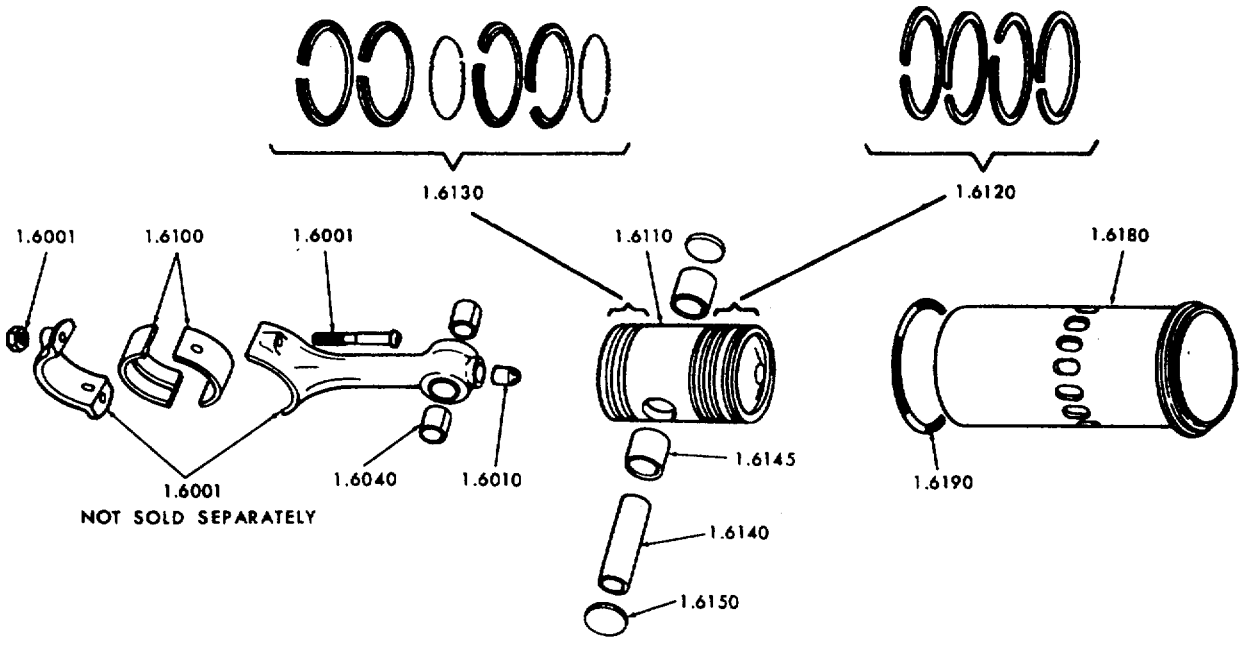
(IN-LINE MODELS)



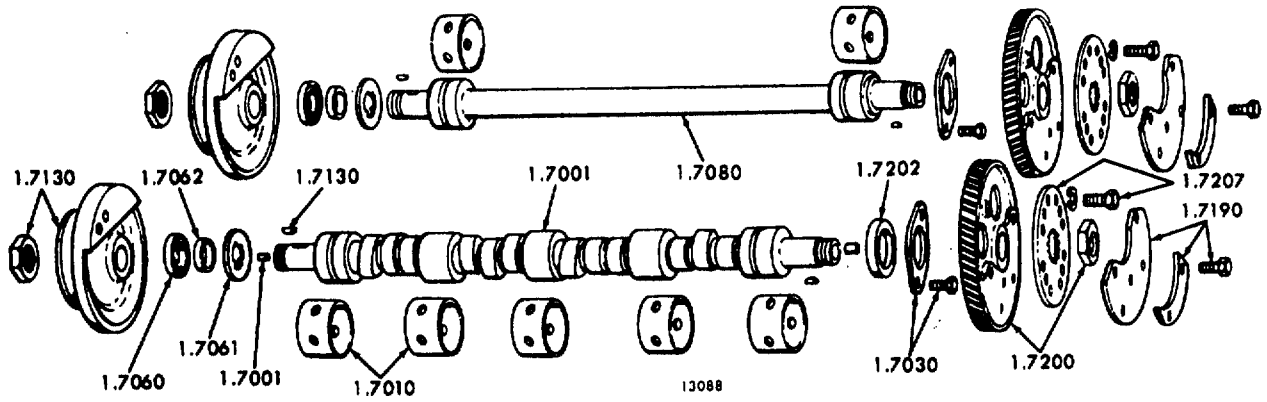
SECTION 1 FIG. 4D. LOWER FRONT COVER
(IN-LINE MODELS)



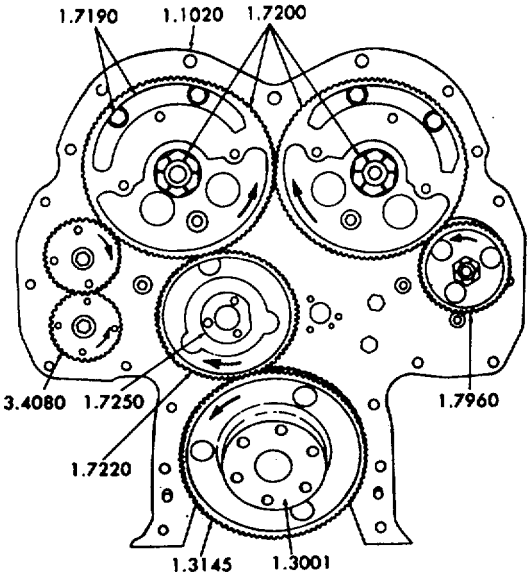
SECTION 1 FIG. 5A. FLYWHEEL AND FLYWHEEL HOUSING



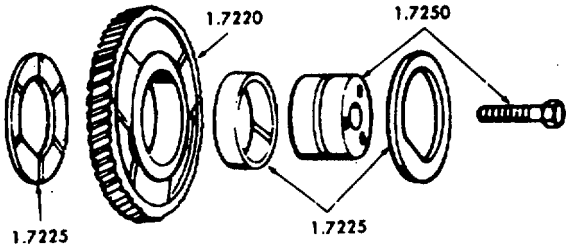
SECTION 1 FIG. 6A. CONNECTING ROD, PISTON AND LINER



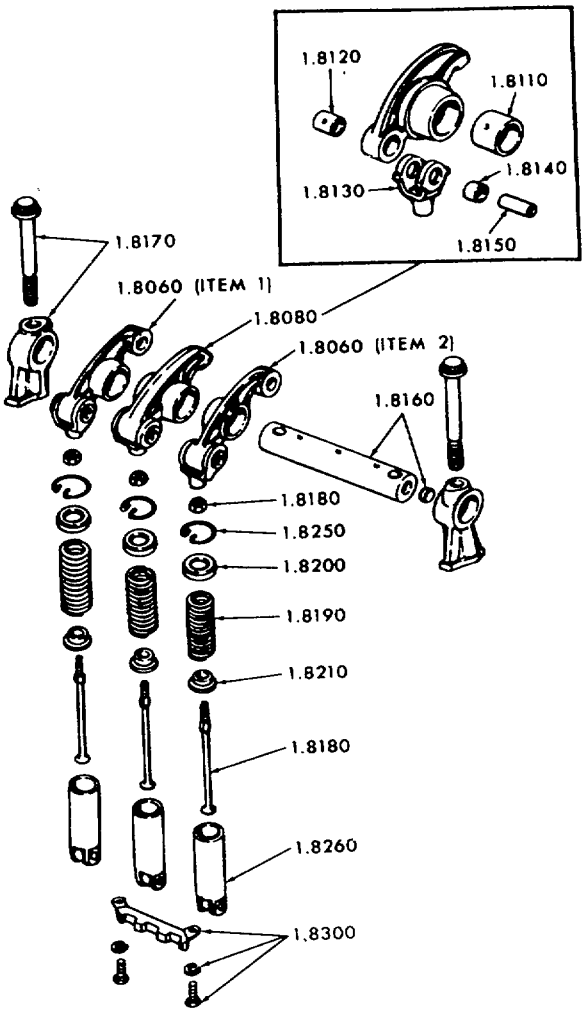
SECTION 1 FIG. 7A. CRANKSHAFT



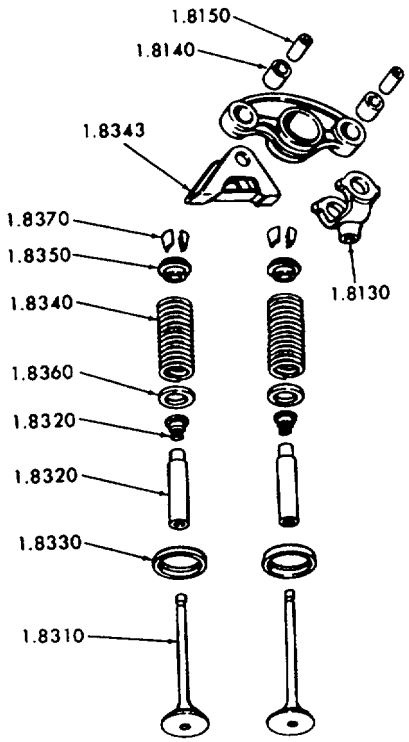
SECTION 1 FIG. 7F. IDLER GEAR



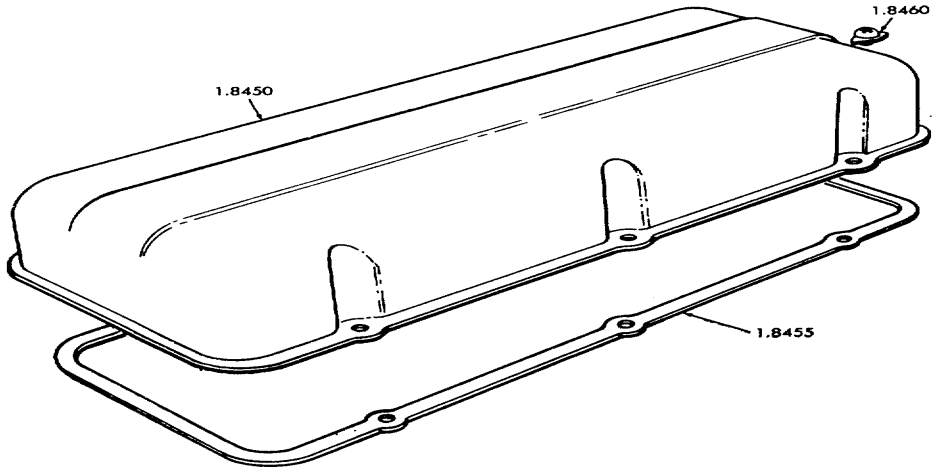
SECTION 1 FIG. 7C. GEAR TRAIN



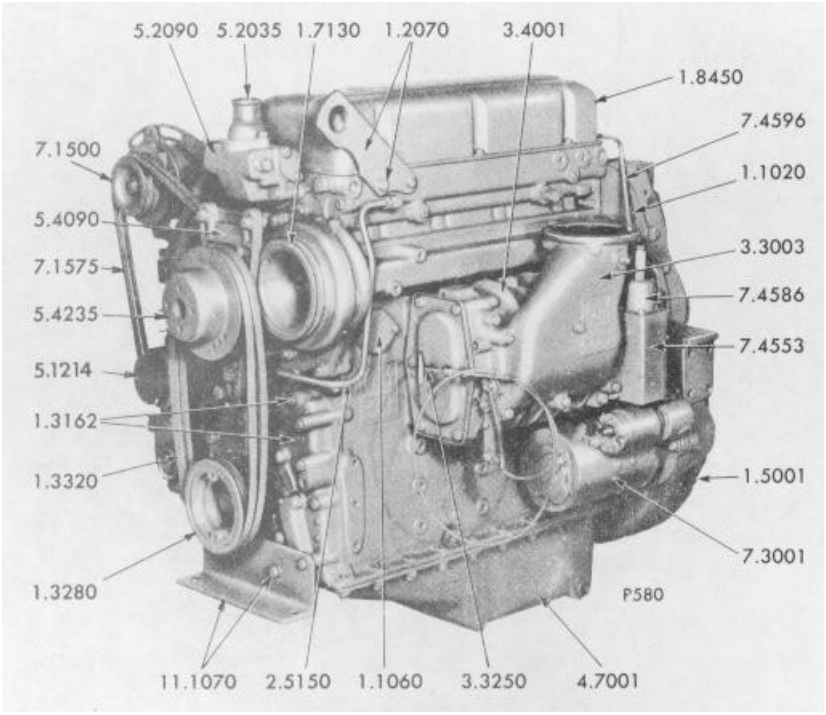
SECTION 1 FIG. 9A. VALVE AND INJECTOR OPERATING MECHANISM



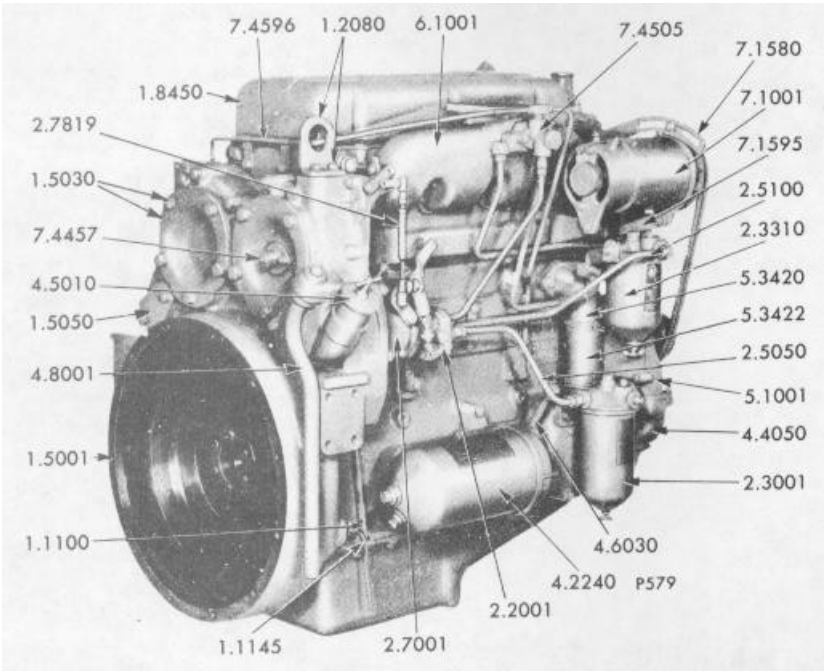
SECTION 1 FIG. 9C. 4 VALVE (WITH BRIDGE)



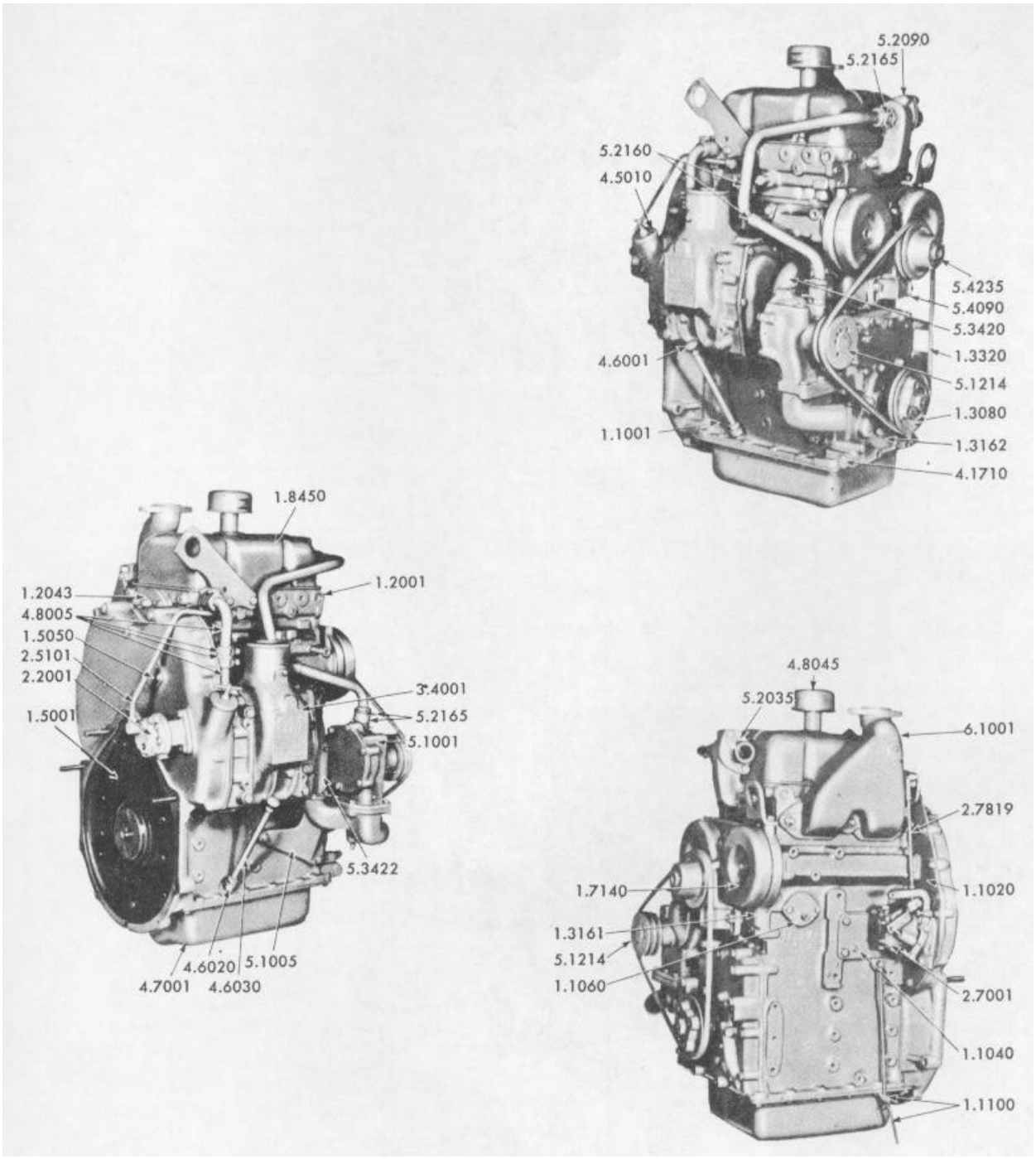
SECTION 1 FIG. 9D. ROCKER COVER



SECTION 1 FIG. 10B. FAN TO FLY WHEEL



SECTION 1 FIG. 10A. TYPICAL FAN TO FLYWHEEL



SECTION 1 FIG. 10C.

SECTION I ENGINE

1.1000 CYLINDER BLOCK

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY
		1.1001 BLOCK ASSEMBLY CYLINDER	
1A	5196490	BLOCK ASSEMBLY 3-53	1
1A	5145009	PLUG 1/8" (12.9550)	6
1A	443762	EXTENSION TUBE (12.9540)	1
		1.1002 GASKET KIT ENGINE OVERHAUL	
	5199791	GASKET KIT 3-53 NOT SHOWN	AR
		1.1020 PLATE CYLINDER BLOCK END-REAR	
1A	5121365	PLATE ASSEMBLY	1
1A	5121459	PLUG 3/8 - 24 NUT	8
1A,B	9409079	BOLT 3/8"-16 X 7/8" (12.9001)	13
1A,B	103321	LOCKWASHER 3/8" (12.9200)	AR
		1.1030 GASKET, CYLINDER BLOCK END PLATE	
1A	5116354	GASKET	1
		1.1040 COVER, CYLINDER BLOCK HAND HOLE COVER	
1C	5116373	COVER 3-53 (ITEM 5)	1
	180120	BOLT 3/8"-16 X 3/4 (12.9001)	6
	103321	LOCKWASHER 3/8 (12.9200)	6
		1.1050 GASKET, CYLINDER BLOCK HAND HOLE COVER	
1C	5116380	GASKET 3-53 (ITEM 5)	1
		1.1060 COVER, CYLINDER BLOCK WATER HOLE	
1A,B	5164190	COVER (1/4 TAPPED HOLE)	1
1A,B	5115097	COVER (3/8 TAPPED HOLE)	1
1A,B	5189143	COVER (1/2 TAPPED HOLE)	1
1A,B	5150023	COVER (PLAIN	1
1A	114981	DRAINCOCK 1/8 (12.9510)	1
1A,B	186618	BOLT 5/16"-18 X 5/8" (12.9001)	2
1A,B	186625	BOLT 5/16"-18 X 7/8" (12.9001)	2
1A,B	103320	LOCKWASHER 5/16" (12.9200)	2
1A,B	5116357	GASKET	1

1.1000A AIR BOX DRAINS

		1.1100 TUBE, AIR BOX DRAIN	
10B	5132286	TUBE, DEV. L. 12.00"	1
	225810	ELBOW 1/4" INV. FL. TUBE 90° (12.9480)(NOT SHOWN)	1
	137397	NUT 1/4" INV.FL. TUBE (12.9500) (NOT SHOWN)	1

SECTION I ENGINE

1.2000 CYLINDER HEAD

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY
		1.2001 HEAD ASSEMBLY CYLINDER	
2A	5198203	HEAD ASSEMBLY (4 VALVE) 3,6V53	1
	5144425	ADAPTER, FUSE PLUG (NOT SHOWN)	1
	5198655	PLUG, FUSE PLUG (NOT SHOWN)	1
2A	5145009	PLUG 1/8" PIPE (12.9550)	2
2A	5121182	PLUG 1/4" HEX SKT. PIPE (2.4015) (NOT SHOWN))	6
2A	5154453	PLUG 3/8"-16 SL.HDLS. (NOT SHOWN)	
2A	5151449	PLUG 13/16" CUP (1.1001)	3
	5139997	PLUG 7/8" DIA. CUP (STAINLESS) (NOT SHOWN))	3
		1.2002 GASKET KIT, CYLINDER HEAD OVERHAUL	
	5199811	GASKET KIT (NOT SHOWN)	AR
		1.2005 NOZZLE, CYLINDER HEAD WATER	
	5119293	NOZZLE	4
		1.2010 GASKET, CYLINDER HEAD COMPRESSION	
1B,C	5121254	GASKET	3
		1.2022 GASKET, CYLINDER HEAD WATER & OIL	
1A	5116290	RING, SEEL (END WATER HOLE)	4
1A,C	5121207	RING, SEAL (CENTER WATER HOLE)	4
1B.C	5116122	RING, SEAL (OIL HOLE) (NOT SHOWN)	2
1A,C	5116292	RING, SEAL	1
		1.2030 BOLT, CYLINDER HEAD	
2A	5121263	BOLT 5/8"-11 X 6 1/4" (12 PT.HD.)	8
		1.2043 COVER, CYLINDER HEAD WATER HOLE	
2A	5136610	COVER (PLAIN).(USE 3/8"-16 X 1" BOLT)	1
10C	5123168	COVER 1/8" PIPE TAP, CENTERED	1
10C	5127837	COVER 1/8" PIPE TAP, OFF CENTER (NOT SHOWN)	1
10C	5139226	COVER 1/8" X 3/8" PIPE TAP (1.1060) (NOT SHOWN)	1
	5129019	COVER 1/4" PIPE TAP (NOT SHOWN)	1
10C	5123352	COVER 3/8" PIPE TAP (NOT SHOWN)	1
10C	5109707	COVER 1/4" AND 1/2" PIPE TAPS (NOT SHOWN)	1
10C	5145009	PLUG 1/8" PIPE SQ.HD. (12.9550)	1
10C	5121182	PLUG 1/4" PIPE (2.4015) (NOT SHOWN)	2
10C	5145014	PLUG 3/8" PIPE SQ.HD. (12.9550) (NOT SHOWN)	1
10C	5115214	PLUG 1/2" PIPE SQ.HD. (12.9550) (NOT SHOWN)	1
	179839	BOLT 3/8"-16 X 1" (12.9001)	
2A	103321	LOCKWASHER, 3/8" (12.9200)	2
		1.2044 GASKET, CYLINDER HEAD WATER HOLE COVER	
2A	5116242	GASKET	1
		1.2045 TUBE, INJECTOR HOLE	
2A	5199527	TUBE KIT (INCLUDES SEAL RING IN 1.2046) (2.1290)	A/R

SECTION I ENGINE

1.2000 CYLINDER HEAD (CONTINUED)

FIG	PART NUMBER	NAME AND DESCRIPTION	QTY.
		1.2046 RING, INJECTOR HOLE TUBE SEAL	
2A	5104701	RING (PART OF KIT IN 1.2045) (2.1300)	
		1.2000A ENGINE LIFTER BRACKET	
		1.2070 BRACKET, ENGINE LIFTER FRONT	
2B	5100428	BRACKET (R.H.) (ITEM 3)	1
2A	5164294	SPACER 1/8" THICK (7.1581) (NOT SHOWN)	2
	179839	BOLT 3/8"-16 X 1" (12.9001)	2
	5101377	BOLT 3/8"-16 X 1" (W/SEAL AND LOCKING PATCH) (5.2020) (NOT SHOWN)	1
	103341	WASHER 3/8" (12.9190) (NOT SHOWN)	2
	103321	LOCKWASHER 3/8" (12.9200)	3
		1.2080 BRACKET, ENGINE LIFTER REAR	
2B	5119379	BRACKET (1.2070) (ITEM 7)	1
	9409028	BOLT 3/8"-16 X 1" (12.9001) (NOT SHOWN)	2
		1.3000 CRANKSHAFT	
		1.3001 CRANKSHAFT ASSEMBLY	
3A	5116447	CRANKSHAFT ASSEMBLY 3-53	1
3A	444687	PLUG 1/8" PIPE (12.9550) (NOT SHOWN)	3
		1.3040 SEAL, CRANKSHAFT OIL - FRONT	
3A,4B	5116224	SEAL	1
	5198503	SEAL, SINGLE LIP O.S - USE WITH 5198502 SLEEVE IN 1.3001	1
		1.3056 SLEEVE, CRANKSHAFT FRONT OIL SEAL SPACER	
3B	5198502	SLEEVE, 2,3,4,6V53 (USE WITH 5198503 SEAL IN GRP 1.3040) (NOT SHOWN))	1
		1.3060 SEAL, CRANKSHAFT OIL -REAR	
3A,5A	5116229	SEAL (SINGLE LIP, STANDARD)	1
3A,5A	5128917	SEAL (DOUBLE LIP, STANDARD) (NOT SHOWN)	1
		1.3066 SLEEVE,CRANKSHAFT REAR OIL SEAL	
	5196851	SLEEVE (WITH O.S OIL SEAL) (NOT SHOWN)	AR
		1.3100 WASHER, CRANKSHAFT MAIL BEARING THRUST	
3A	5116197	WASHER, STD INLINE 53	4
3A	141346	PIN 3/16" X 1/2" DOWEL (12.9290)	4
		1.3110 CAP, CRANKSHAFT MAIN BEARING	
3A	5195935	CAP, 2,3,4-53 (FINISHED)	4
		1.3140 BOLT, CRANKSHAFT MAIN BEARING CAP	
3A	5116199	BOLT, 2,3,4-53	8

SECTION I ENGINE

1.3000 CRANKSHAFT (CONTINUED)

FIG	PART NUMBER	NAME AND DESCRIPTION	QTY.
		1.3145 GEAR, CRANKSHAFT TIMING	
3A,7C	5116195	GEAR, 2,3,4,6V53	1
	127559	KEY 1/4" X 3/4" WOODRUFF (12.9350)	1
		1.3000A CRANKSHAFT FRONT COVER	
		1.3161 COVER, ENGINE FRONT - UPPER	
	5101347	COVER ASSEMBLY, 3,4-53	1
	5146900	PIN 3/8" X 1 1/8" DOWEL (12.9290)(NOT SHOWN)	
4A	186622	BOLT 3/8"-16 X 1 1/4" (12.9001)	9
	179844	BOLT 3/8"-16 X 1 5/8" (12.9001) (NOT SHOWN)	4
	103341	WASHER 3/8" (12.9190) (NOT SHOWN)	13
4A	103321	LOCKWASHER 3/8" (12.9200)	13
		1.3162 COVER, ENGINE FRONT - LOWER	
4D	5197415	COVER ASSEMBLY, 3,4-53	1
	5145009	PLUG 1/8" PIPE (12.9550) (NOT SHOWN)	1
	5146648	PLUG 1/2" PIPE (1.3162) (NOT SHOWN))	7
	186282	BOLT 3/8"-16 X 3 1/4" (12.9001)	11
4D	103321	LOCKWASHER 3/8" (12.9200)	11
		1.3170 GASKET,ENGINE FRONT COVER	
4B	5121082	GASKET 3,4-53 (UPPER))	1
4D	5116386	GASKET 3,4-53 (LOWER))	1
		13.000C CRANKSHAFT PULLEY	
		1.3280 PULLEY, CRANKSHAFT	
3A	5116484	PULLEY (5.38" DIA., 2 GROOVES)	1
		1.3290 RETAINER, CRANKSHAFT PULLEY	
3A	5180291	RETAINER (WASHER)	1
3A	5180629	BOLT 3/8"-16 X 1 3/4" L	1
3A	271632	BOLT 3/4"-16 X 1 3/4" (12.9001) (NOT SHOWN)	1
		1.3000D CRANKSHAFT PULLEY BELT	
		1.3320 BELT, CRANKSHAFT PULLEY	
10A	5137300	BELT SET (2 BELTS) (39.00"L., 500"W.)	1
	5132591	BELT SET (2 BELTS) (46.00"L., 380"W.)(NOT SHOWN)	1
		1.4000A FLYWHEEL	
		1.4001 FLYWHEEL ASSEMBLY	
5A,B	5124929	FLYWHEEL ASSEMBLY (SAE #3) (NC)	1
5A,B	5126671	PLATE, SCUFF (BOLT RETAINER)	1
5A,B	9412018	BOLT, LOCK (2 1/4"L.)	6
		1.4010 GEAR, FLYWHEEL RING	
5A,B	5116301	GEAR (SAE #3-126 TEETH)	1

SECTION I ENGINE

1.5000A FLYWHEEL HOUSING

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		1.5001 HOUSING, FLYWHEEL	
5A	5132260	HOUSING, (SAE #3) 2,3,4-53	1
5A	5145014	PLUG, 3/8" PIPE (12.9550)	1
	5115214	PLUG 1/2" PIPE (12.9550) (NOT SHOWN)	1
5A	9409126	BOLT 5/16"-18 X 2 1/2" (12.9001)	2
	5101779	BOLT 3/8"-16 X 7/8" LOCK (12.9001)	1
5A	9414215	BOLT 3/8"-16 X 2 1/2" (12.9001)	4
	427588	BOLT 3/8"-16 X 2 1/2" (12.9001) (NOT SHOWN)	6
	191249	BOLT 3/8"-16 X 3 3/4" (12.9001) (NOT SHOWN)	
	5170489	BOLT 3/8"-24 X 3 9/16" LOCK (12.9001)	3
5A	103321	LOCKWASHER 3/8" (12.9200)	AR
		1.5002 SHIM, FLYWHEEL HOUSING TO END PLATE	
	5123802	SHIM	1
		1.5010 GASKET, FLYWHEEL HOUSING	
5A	5121334	GASKET, 2,3,4-53	1
		1.5030 COVER, FLYWHEEL HOUSING LARGE HOLE	
5A	5122281	COVER	2
5A	179857	BOLT 7/16"-14 X 7/8" (12.9001)	2
5A	122408	BOLT 1/2"-13 Xl" (12.9001) (NOT SHOWN)	8
5A	5150568	WASHER 7/16" COPPER (2.4050) (NOT SHOWN)	2
5A	103323	LOCKWASHER 1/2" (12.9200)	8
		1.5040 GASKET, FLYWHEEL HOUSING LARGE HOLE COVER	
5A	5104506	GASKET	2
		1.5050 COVER, FLYWHEEL HOUSING SMALL HOLE	
5A	5116411	COVER	AR
5A	186625	BOLT 5/16"-18 X 7/8" (12.9001)	AR
5A	103320	LOCKWASHER 5/16" (12.9200)	4
		1.5060 GASKET, FLYWHEEL HOUSING SMALL HOLE COVER	
5A	5116391	GASKET	2
		1.5080 COVER, FLYWHEEL HOUSING INSPECTION HOLE	
	5108939	COVER	1
	181309	BOLT 1/4"-28 X 1/2" (12.9001)	AR
	120380	LOCKWASHER 1/4" (12.9200)	AR

1.6000 CONNECTING ROD AND PISTON

		1.6001 CONNECTING ROD ASSEMBLY	
6A	5121262	ROD ASSEMBLY 2,3,4-53	1
6A	5197852	BOLT 3/8"-24 X 2.76"L	2
6A	839103	NUT 3/8"-24	2

SECTION I ENGINE

1.6000 CONNECTING ROD AND PISTON (CONTINUED)

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		1.6010 NOZZLE, CONNECTING ROD SPRAY	
6A	5150140	NOZZLE	1
		1.6020 ORIFICE, CONNECTING ROD	
	5198179	ORIFICE 5/16" X 7/16"	1
		1.6040 BUSHING, CONNECTING ROD PISTON PIN	
6A	5116181	BUSHING	2
		1.6100 SHELL, CONNECTING ROD BEARING	
	5195929	SHELL SET (STANDARD)	AR
		1.6110 PISTON ASSEMBLY	
6A	5198877	PISTON ASSEMBLY ("N" ENGINE) 3,4,6,8V53	1
		1.6120 RING, PISTON COMPRESSION	
6A	5116184	RING (CHROMED) (2ND,3RD AND 4TH)	3
		1.6130 RING, PISTON OIL CONTROL	
6A	5195933	RING (UPPER AND LOWER GROOVE)	2
		1.6140 PIN, PISTON	
6A	5116189	PIN	1
		1.6145 BUSHING, PISTON PIN	
6A	5116181	BUSHING (1.6040)	2
		1.6150 RETAINER, PISTON PIN	
6A	5108131	RETAINER	2
		1.6180 LINER, CYLINDER	
6A	5132803	LINER (STANDARD)	1
		1.6182 CYLINDER KIT	
	5198899	CYLINDER KIT ("N" ENGINES) (21:1 RATIO)(NOT SHOWN)	AR
		1.6190 SEAL, CYLINDER LINER	
6A	5121256	SEAL	2
		1.7000 CAMSHAFT AND GEAR TRAIN	
		1.7001 CAMSHAFT ASSEMBLY	
7A	5149091	CAMSHAFT ASSEMBLY 3.53 LA-LD-RB-RC ENGINE	1
	5151277	PLUG (1/2" DRIVE)	2
		1.7010 BEARING, CAM AND BALANCER SHAFT	
7A	5198209	BEARING SET (STD 3-53)	1

SECTION I ENGINE

1.7000 CAMSHAFT AND GEAR TRAIN (CONTINUED)

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		1.7030 WASHER, CAM AND BALANCE SHAFT END BEARING THRUST	
7A	5116198	WASHER	2
7A	9409028	BOLT 3/8"-16 X 1" LOCK (12.9001)	4
		1.7062 SPACER, CAM AND BALANCER SHAFT PULLEY	
	5106360	SPACER	2
		1.7080 SHAFT, BALANCER	
7A	5121073	SHAFT, 3-53	1
		1.7130 PULLEY, FRONT BALANCE	
7A	5121108	PULLEY	2
7A	218217	KEY, 3/16" X 5/8" WOODRUFF (12.9350)	2
7A	5150087	NUT, 1 1/8"-18 (1.7140)	2
		1.7190 WEIGHT, REAR BALANCER	
7A,C	5119277	WEIGHT (ON CAMSHAFT))	2
7A,C	9409028	BOLT, 3/8"-16 X 1" LOCK (12.9001)	4
		1.7200 GEAR, CAMSHAFT AND BALANCER SHAFT	
7A,C	5107072	GEAR (R.H HELIX)(R BANK CAMSHAFT R.H ENG., L. BANK CAMSHAFT L.H ENG.)	1
7A,C	5107073	GEAR (L.H HELIX)(L.BANK CAMSHAFT R.H ENG., R. BANK CAMSHAFT L.H ENG.) (NOT SHOWN)	1
7A	218217	KEY, 3/16" X 5/8" WOODRUFF (12.9350)(NOT SHOWN)	2
7A	5150087	NUT, 1 1/8"-18 (1.7140) (NOT SHOWN)	2
		1.7202 SPACER, CAMSHAFT GEAR	
7A	5121077	SPACER	1
		1.7207 RETAINER, CAM AND BALANCE SHAFT GEAR NUT	
7A	5172734	RETAINER	2
7A	181360	BOLT, 3/8"-24 X 3/4" (12.9001)	4
7A	103321	LOCKWASHER, 3/8" (12.9200)	4
		1.7220 GEAR ASSEMBLY, IDLER	
7C	5107075	GEAR ASSEMBLY (L.H HELIX)	1
		1.7225 BEARING, IDLER GEAR	
7F	5196793	BEARING	1
7F	5132504	WASHER (THRUST)	2
		1.7250 HUB, IDLER GEAR	
7F	5124458	HUB	1
7F	5157244	BOLT, 3/8"-16 X 1 3/4" (4.4190)	1

SECTION I ENGINE

1.8000 VALVE OPERATING MECHANISM

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		1.8060 ARM ASSEMBLY, EXHAUST VALVE ROCKER	
9A	5135268	ARM ASSEMBLY (RIGHT) (4 VALVE) (ITEM 2)	3
9A	5135267	ARM ASSEMBLY (LEFT) (4 VALVE) (ITEM 1)	3
		1.8080 ARM ASSEMBLY, INJECTOR ROCKER	
9A	5179954	ARM ASSEMBLY	3
		1.8110 BUSHING, INJECTOR ROCKER ARM - LARGE	
9A	5150318	BUSHING	3
		1.8120 BUSHING, INJECTOR ROCKER ARM - SMALL	
9A	5150311	BUSHING	3
		1.8130 CLEVIS, INJECTOR & EXHAUST VALVE ROCKER ARM	
9A	5150312	CLEVIS	9
		1.8140 BUSHING, INJECTOR & EXHAUST VALVE ROCKER ARM CLEVIS	
9A,C	5123700	BUSHING	15
		1.8150 PIN, INJECTOR & EXHAUST VALVE ROCKER ARM CLEVIS	
9A	5150314	PIN (CLEVIS END)	9
9A,C	5123711	PIN (BRIDGE END) (NOT SHOWN)	6
		1.8160 SHAFT, ROCKER	
9A	5116072	SHAFT ASSEMBLY	3
9A	5151272	PLUG, 11/32" DIA. X 1/4" SPECIAL	3
		1.8170 BRACKET, ROCKER SHAFT	
9A	5116128	BRACKET	6
9A	5119198	BOLT, 7/16"-14 X 3.38"	6
		1.8210 SEAT, PUSH ROD SPRING - LOWER	
9A	5123250	SEAT	9
		1.8250 RETAINER, PUSH ROD	
9A	5150303	RETAINER (SNAP RING)	9
		1.8260 FOLLOWER ASSEMBLY, CAM	
9A	5106642	FOLLOWER ASSEMBLY (INCLUDES ROLLER SET)	9
		1.8265 ROLLER SET, CAM FOLLOWER	
	5149733	ROLLER SET (STANDARD) (NOT SHOWN)	9
		1.8300 GUIDE, CAM FOLLOWER	
9A	5116125	GUIDE	3
9A	443603	BOLT, 1/4"-20 X 3/4" (12.9001)	6
9A	103319	LOCKWASHER 1/4" (12.9200)	6

SECTION I ENGINE

1.8000 VALVE OPERATING MECHANISM (CONTINUED)

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		1.8310 VALVE, EXHAUST	
9C	5199323	VALVE (INCLUDES LOCK) (4 VALVE)	12
		1.8320 GUIDE, EXHAUST VALVE	
9C	5131961	GUIDE (4 VALVE)	12
	5198529	KIT, VALVE GUIDE AND SEAL (NOT SHOWN)	12
9C	8921741	SEAL, VALVE GUIDE (4 VALVE)	12
	5199912	INSTALLAER, EXHAUST VALVE SEAL (4 VALVE)	AR
		1.8330 INSERT, EXHAUST VALVE	
9C	5116361	INSERT (STANDARD) (4 VALVE)	12
9C	5196752	INSERT (.010" O.S O.D.)(4 VALVE) (NOT SHOWN)	AR
		1.8180 ROD, PUSH	
9A	5128640	ROD	9
9A	5151601	LOCKNUT	9
		1.8190 SPRING, PUSH ROD	
9A	5108918	SPRING (TWO ORANGE STRIPES) (INJECTOR & VALVE)	9
		1.8200 SEAT, PUSH ROD SPRING - UPPER	
9A	5108919	SEAT (INJECTOR & VALVE)	9
		1.8340 SPRING, EXHAUST VALVE	
9C	5147424	SPRING (BLUE AND WHITE STRIPE)(4 VALVE)	12
		1.8343 BRIDGE, EXHAUST VALVE	
9C	5135262	BRIDGE	A/R
		1.8350 CAP, EXHAUST VALVE SPRING	
9C	5123330	CAP (4 VALVE)	A/R
		1.8360 SEAT, EXHAUST VALVE SPRING	
9C	5111467	SEAT (.063"THICK) (4 VALVE)	A/R
		1.8370 LOCK, EXHAUST VALVE SPRING	
9C	5116341	LOCK (HALVES) (4 VALVE)	A/R

1.8000A ROCKER COVER

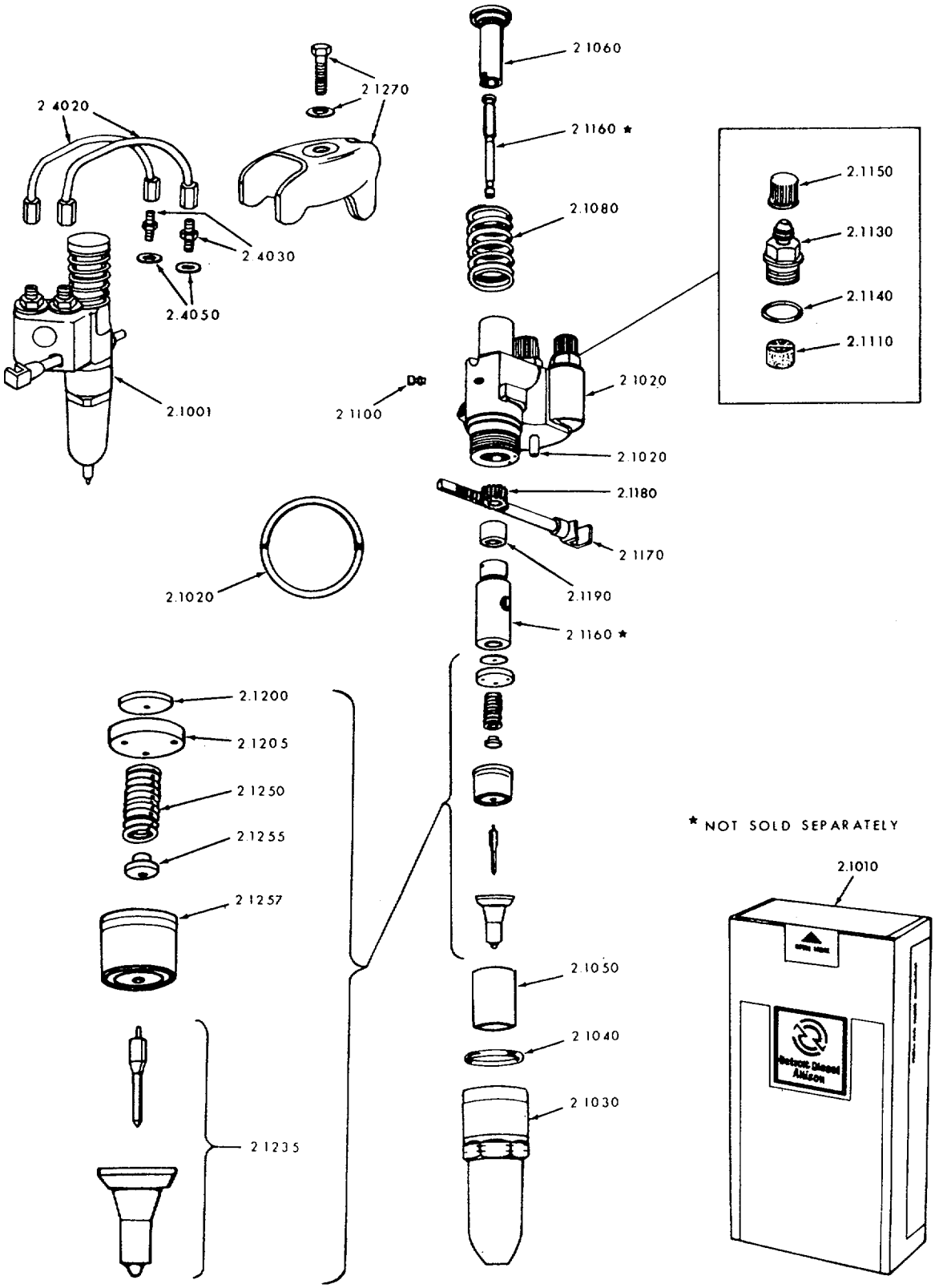
		1.8450 COVER, ROCKER	
9D	5125356	COVER, 3,6V53 (PLAIN)	1
		1.8455 GASKET, ROCKER COVER	
9D	5147994	GASKET, 3,6V53	1
		1.8460 BOLT, ROCKER COVER	
	5100104	SCREW ASSEMBLY	4

SECTIONI ENGINE

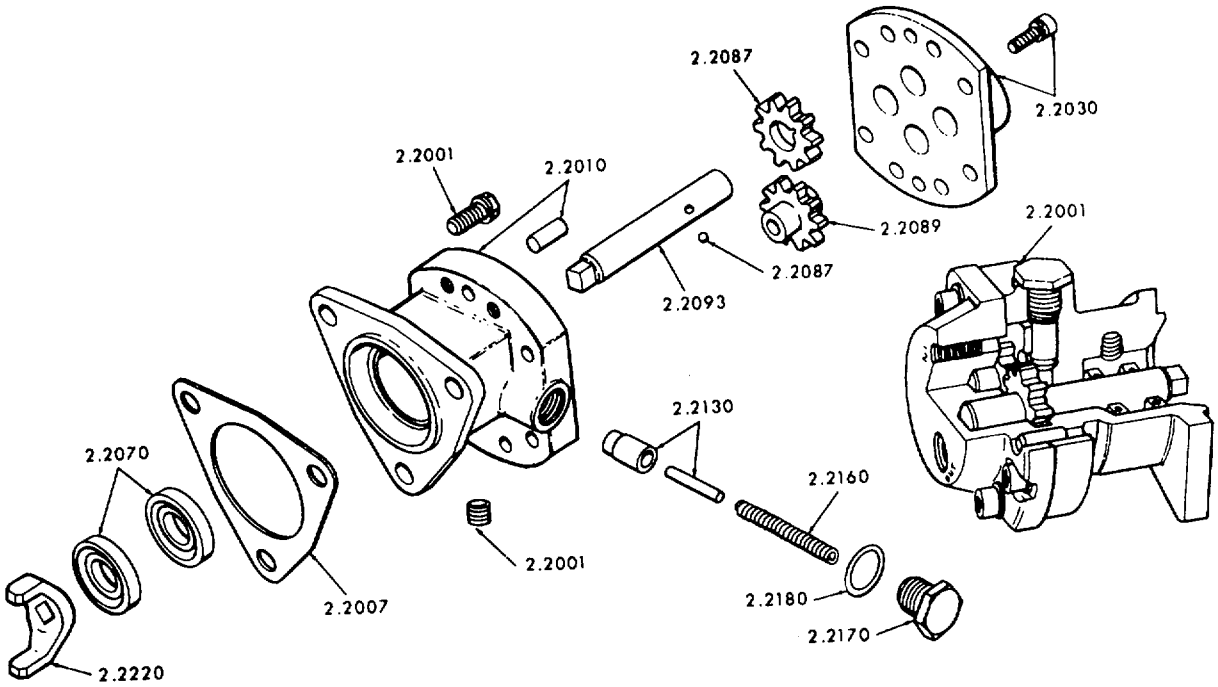
1.8000A ROCKER COVER (CONTINUED)

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		1.8502 RETAINER, NAME PLATE	
	5178347	RETAINER, NAME PLATE (NOT SHOWN))	1

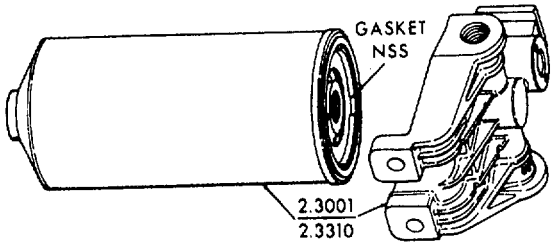
SECTION 2 FUEL SYSTEM



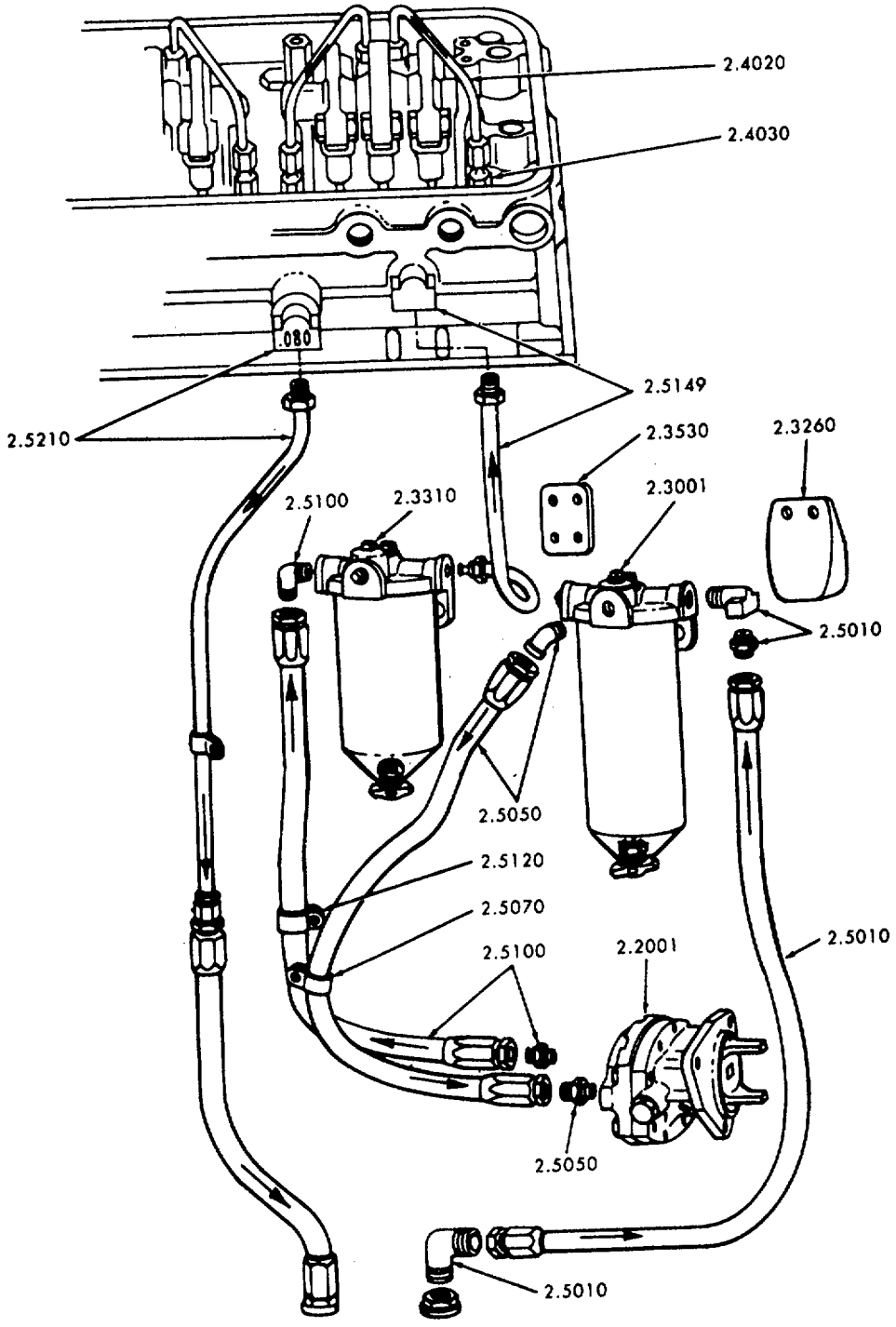
SECTION 2 FIG. 1B. FUEL INJECTOR



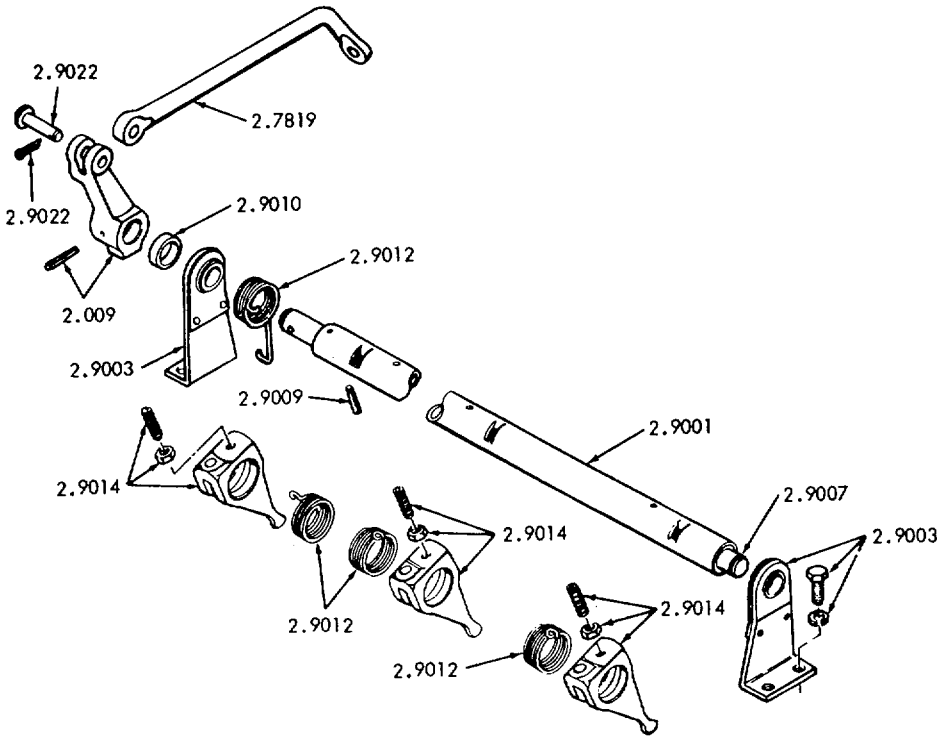
SECTION 2 FIG. 2A. FUEL PUMP



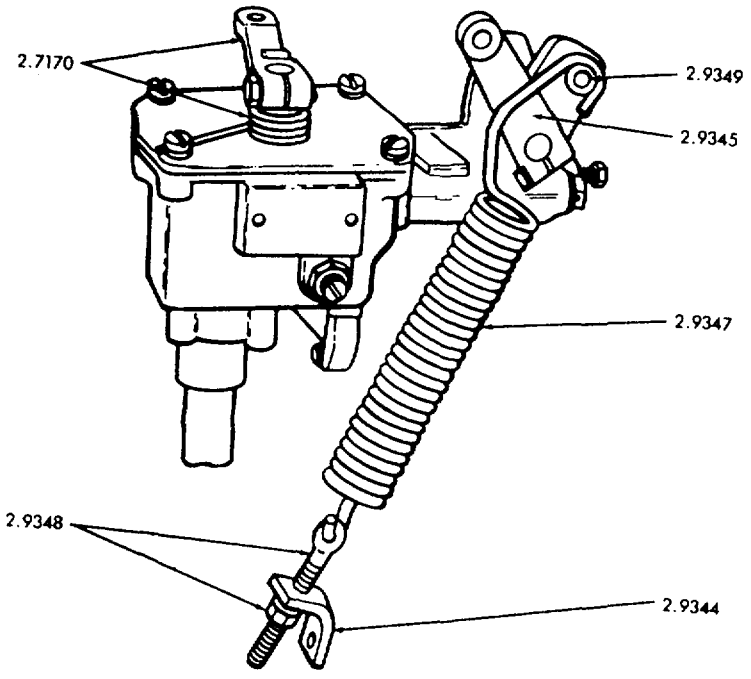
SECTION 2 FIG. 3D. FUEL STRAINER, FUEL FILTER



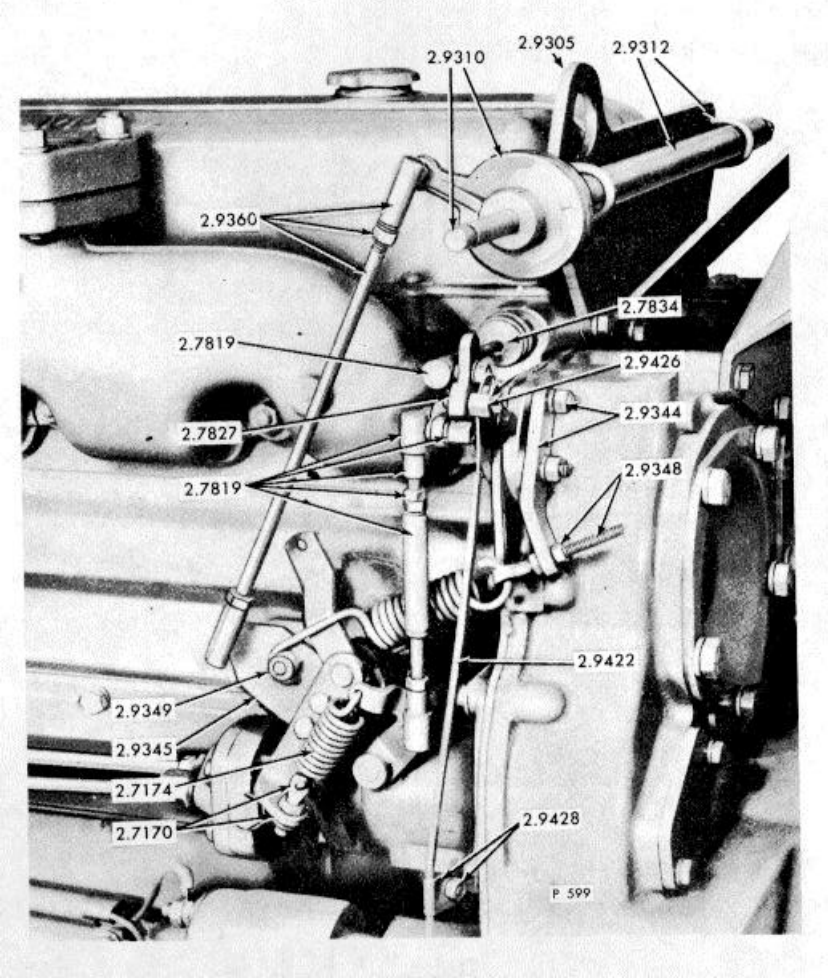
SECTION 2 FIG. 4A. TYPICAL FUEL SYSTEM



SECTION 2 FIG. 7A. INJECTOR CONTROL TUBES SPRING LOADED



SECTION 2 FIG. 7E. THROTTLE CONTROLS



SECTION 2 FIG. 8A. THROTTLE CONTROL

2.1000A FUEL INJECTOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		2.1001 INJECTOR ASSEMBLY	
1B	5228783	*INJECTOR ASSEMBLY (N50)	1
		*THESE INJECTORS HAVE FILTER ELEMENT AT FUEL INLET SIDE ONLY.	
		2.1002 OVERHAUL KIT, INJECTOR	
	5229649	OVERHAUL KIT (NOT SHOWN)	AR
		2.1010 CONTAINER, INJECTOR SHIPPING	
1B	5149669	CONTAINER (12.8050	AR
		2.1020 BODY ASSEMBLY, INJECTOR	
1B	5228583	BODY ASSEMBLY	1
	5226416	DOWEL (NOT SHOWN)	1
	5226912	PLUG, BODY	2
1B	5228772	TAG, NUMBER (N50) (NOT SHOWN)	1
		2.1030 NUT, INJECTOR VALVE	
1B	5228601	NUT	1
		2.1040 RING, INJECTOR SEAL	
1B	5229167	RING	1
		2.1050 DEFLECTOR, INJECTOR SPILL	
1B	5228109	DEFLECTOR	1
		2.1060 FOLLOWER, INJECTOR	
1B	5228104	FOLLOWER	1
		2.1080 SPRING, INJECTOR PLUNGER	
1B	5228739	SPRING	1
		2.1100 PIN, INJECTOR STOP	
1B	5228608	PIN	1
		2.1110 ELEMENT, INJECTOR FILTER	
1B	5228587	ELEMENT	1
		2.1130 CAP, INJECTOR FILTER	
1B	5228588	CAP	2
		2.1140 GASKET, INJECTOR FILTER CAP	
1B	5226186	GASKET	2
		2.1150 CAP, INJECTOR SHIPPING	
1B	5226414	CAP	AR

2.1000A FUEL INJECTOR (CONTINUED)

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		2.1160 PLUNGER AND BUSHING ASSEMBLY, INJECTOR	
		PLUNGERS AND BUSHINGS ARE NOT SOLD SEPARATELY. AN ASSEMBLY INCLUDES PIN IN 2.1165.	
1B	*5228749	PLUNGER AND BUSHING ASSEMBLY (N50)(M60)	1
		2.1165 PIN, BUSHING GUIDE	
	5226393	PIN (NOT SHOWN)	1
		2.1170 RACK, INJECTOR	
1B	5226719	RACK	1
		2.1180 GEAR, INJECTOR	
1B	5226400	GEAR	1
		2.1190 RETAINER, INJECTOR GEAR	
1B	5228586	RETAINER	1
		2.1200 VALVE, INJECTOR CHECK	
1B	5228694	VALVE	1
		2.1205 CAGE, INJECTOR CHECK VALVE	
1B	5228696	CAGE	1
		2.1255 SEAT, INJECTOR VALVE SPRING	
1B	5228766	SEAT	1
		2.1257 CAGE, INJECTOR VALVE SPRING	
1B	5228594	CAGE	1
		2.1270 CLAMP, INJECTOR	
1A	5121259	CLAMP	1
1A	5150250	WASHER	1
1A	180130	BOLT, 3/8"-16 X 2" (12.9001)	1
		2.1235 TIP ASSEMBLY, INJECTOR SPRAY	
1B	5229034	TIP ASSEMBLY (M65,N40,N45,N50)	1
		2.1238 VALVE KIT, INJECTOR	
	5228769	VALVE KIT (SHORT QUILL NEEDLE) (NOT SHOWN)	AR
		2.1250 SPRING, INJECTOR VALVE	
1B	5228596	SPRING	1

2.2000 FUEL PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		2.2001 PUMP ASSEMBLY, FUEL	
2A	5108064	PUMP ASSEMBLY, 3,4,6V53 (L.H.) (3/8" INLET)	1
	5199560	PUMP KIT, FUEL (NOT SHOWN)	1
2A	5145009	PLUG, 1/8" PIPE (12.9550)	2
2A	5131685	BOLT, 5/16"-18 X 3/4" (WITH NYLOC INSERT)(5.1031)	3
		NOT SERVICED, COMPONENTS ARE AVAILABLE. FOR COMPLETE REPLACEMENT, USE PUMP KIT SHOWN IN SAME TYPE.	
		2.2004 OVERHAUL KIT, FUEL PUMP	
	5195078	OVERHAUL KIT (NOT SHOWN	AR
		2.2007 GASKET, FUEL PUMP TO ENGINE	
2A	5150193	GASKET, 3.4.6,8V53 (5.1010)	1
		2.2220 FORK, FUEL PUMP COUPLING	
2	5121398	FORK, 3-533	1
		2.2230 COUPLING, FUEL PUMP DRIVE	
	5154216	COUPLING, 4-53 (NOT SHOWN)	1

2.3000A FUEL FILTER

		2.3001 STRAINER ASSEMBLY, FUEL	
3C	25011011	STRAINER CARTRIDGE (T-936)(SPIN-ON)	1
3C	8921410	COVER (SPIN-ON).	1
	5121182	PLUG, 1/4" PIPE (2.4015) (NOT SHOWN)	2
	114674	SCREW, 3/8"-16 X 1 1/4" (12.9030)(NOT SHOWN)	2
	103321	LOCKWASHER, 3/8" (12.9200) (NOT SHOWN)	2
	102635	NUT, 3/8"-16 (12.9120) (NOT SHOWN)	2
		2.3260 BRACKET, FUEL STRAINER MOUNTING	
	5138051	BRACKET (NOT SHOWN).	1
	5145014	PLUG, 3/8"-18 PIPE (]2.9550) (NOT SHOWN)	1
		2.3310 FILTER ASSEMBLY, FUEL	
3B	25010959	FILTER CARTRIDGE (TP-928)	1
3B	5148171	FILTER COVER (SPIN-ON)	1
	5121182	PLUG, 1/4" PIPE (2.4015) (NOT SHOWN)	2
	181377	BOLT,3/8"-24 X 1 3/4" (12.9001) (NOT SHOWN)	2
	186622	BOLT, 3/8"-16 X 1 1/4" (12.9001) (NOT SHOWN)	2
	103321	LOCKWASHER, 3/8" (12.9200) (NOT SHOWN)	2

2.4000 FUEL MANIFOLD CONNECTIONS

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		2.4020 PIPE, FUEL	
1B,4A	5116204	*PIPE ASSEMBLY (INLET AND OUTLET)	AR
		*QUANTITY IS TWO TIMES CYLINDER COUNT.	
		2.4030 CONNECTOR, FUEL PIPE	
1B,4A	5152138	*CONNECTOR	AR
		*QUANTITY IS TWO TIMES CYLINDER COUNT.	
		2.4050 WASHER, FUEL PIPE CONNECTOR	
1B	5152148	*WASHER , 3/8" X 9/16" COPPER	AR
		*QUANTITY IS TWO TIMES CYLINDER COUNT.	

2.5000A FUEL LINES

		2.5050 TUBE, STRAINER TO FUEL PUMP	
4A	5121100	TUBE ASSEMBLY (DEV.L.9.40")	1
	193004	ELBOW, 3/8" INV.FL. TUBE 90° (12.9480)	2
	442323	CONNECTOR, 3/8" INV.FL. TUBE (12.9460)	AR
		2.5100 TUBE, FUEL PUMP TO FILTER	
4A	5134897	TUBE ASSEMBLY (DEV. L. 36.22")	1
	442323	CONNECTOR, 3/8" INV. FL. TUBE (12.9460)	1
	193004	ELBOW, 3/8" INV.FL. TUBE 90° (12,9480)	1
		2.5120 CLIP, FUEL PUMP TO FILTER TUBE	
4A	5177623	CLIP (3/8" TUBE)	2
		2.5151 TUBE, FILTER OUTLET	
	5129623	TUBE ASSEMBLY (DEV.L. 12.68")	1
	193004	ELBOW, 3/8" INV.FL. TUBE 9Q0 (12.9480)	1
	442323	CONNECTOR, 3/8" INV.FL. TUBE (12.9460)	1
		2.5210 TUBE, FUEL DRAIN	
4A	5116440	ELBOW, 5/16" RESTRICTED	1

2.9000 INJECTOR CONTROLS

		2.9001 TUBE AND LEVER ASSEMBLY, INJECTOR CONTROL	
		A TUBE ASSEMBLY INCLUDES ONE (1) BRACKET IN 2.9003 AND ITEMS IN 2.9007 THRU 2.9009. A TUBE AND LEVER ASSEMBLY INCLUDES BRACKETS IN 2.9003 PLUS ITEMS IN 2.9009 THRU 2.9014.	
7A	5103276	TUBE AND LEVER ASSEMBLY, 3-53	1

2.9000 INJECTOR CONTROLS (CONTINUED)

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		2.9003 BRACKET, INJECTOR CONTROL TUBE	
7B	5116264	BRACKET	2
7B	9422203	BOLT, 1/4"-20 X 5/8" (12.9001)	4
7B	120380	LOCKWASHER, 1/4" (12.9200)	8
		2.9007 SHAFT, INJECTOR CONTROL TUBE END	
7B	5150259	SHAFT, 8V53 (1 1/16"L.)	1
		2.9009 LEVER, INJECTOR CONTROL TUBE	
7A	5116267	LEVER, 3-53	1
7B	142486	PIN, 1/8" X 3/4" GROOVE (12.9270	1
7B	142487	PIN, 1/8" X 7/8" GROOVE (12.9270)	1
		2.9010 SPACER, INJECTOR CONTROL TUBE LEVER	
7A	5116266	SPACER, 3-53	1
		2.9012 SPRING, INJECTOR CONTROL TUBE	
7A	5101295	SPRING (R.H. HELIX	1
7A	5101258	SPRING (L.H. HELIX)	2
7A	5116265	SPRING, 3.4-53 (L.H. HELIX)	1
7A	5101295	SPRING, 3,4,6V53 (R.H. HELIX) (NOT SHOWN)	1
7A	5101258	SPRING, 3,4,6V53 (L.H. HELIX) (NOT SHOWN)	2
		2.9014 LEVER, INJECTOR CONTROL TUBE RACK	
7A	5101397	LEVER	3
7A	5101392	SCREW, 1/4" - 28 X 90"	3
7A	120613	NUT, 1/4" - 28 JAM (12.9120)	3

2.9000A THROTTLE CONTROLS

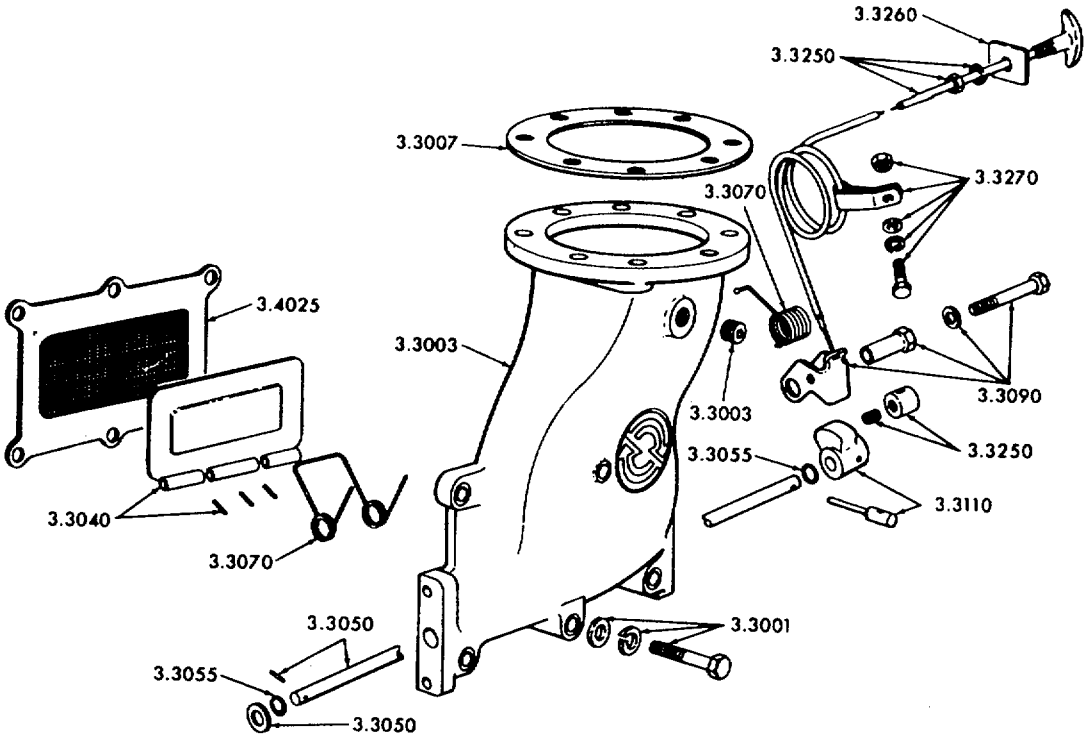
		2.9105 WASHER, THROTTLE CONTROL TUBE BRAKE	
	5113377	WASHER, 2,3,4-53 (NOT SHOWN)	1
	5113378	PAD, 2,3,4-53 (NOT SHOWN)	1
		2.9305 BRACKET, THROTTLE CONTROL CROSS SHFT. SUP. (ENG. LIFTER)	
8A	5124616	BRACKET, 3,4-53 (2.9720)	1
	179838	BOLT, 3/8"-16 X 7/8" (12.9001) (NOT SHOWN)	2
	103321	LOCKWASHER, 3/8" (12.9200) (NOT SHOWN)	2
		2.9306 GASKET, THROTTLE CONTROL CROSS SHAFT BRACKET	
	5175882	GASKET, 2,3,4-53 (4.4115)	4
		2.9310 SHAFT, THROTTLE CONTROL CROSS	
8A	5121163	LEVER & SHAFT ASSEMBLY, 3,4-53	1
	5113358	SPRING, 2,3,4-53 (NOT SHOWN)	1
	5113359	SPACER, 2,3,4-53 (NOT SHOWN)	1
	122295	NUT, 1/2"-20 (12.9120) (NOT SHOWN)	2

2.9000A THROTTLE CONTROLS (CONTINUED)

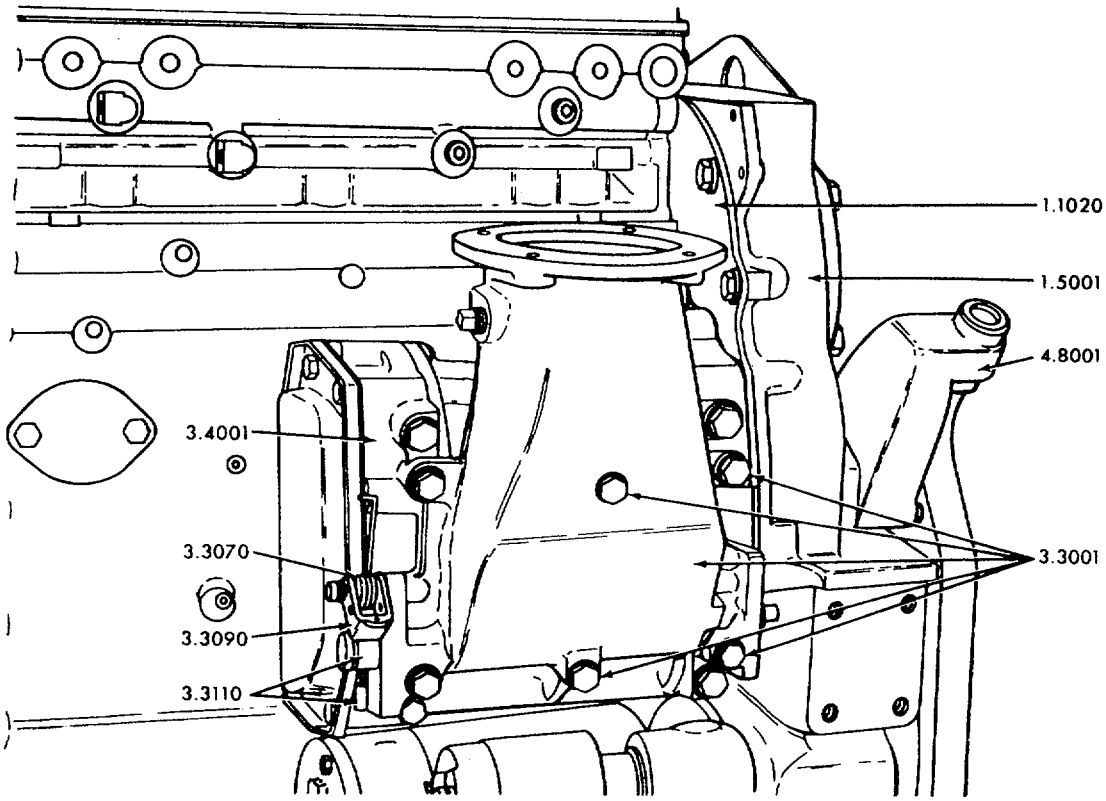
FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		2.9312 TUBE, THROTTLE CONTROL CROSS SHAFT	
8A	5121166	TUBE, 3.4-53 (2.9310)	1
	5113397	BUSHING, 2,3,4-53 (2.9142) (NOT SHOWN)	2
8A	5180116	BOLT, "U" 1/4"-20 2,3,4-53 (2.9867) (NOT SHOWN)	2
	103319	LOCKWASHER, 1/4" (12.9200) (NOT SHOWN)	4
	120375	NUT, 1/4"-20 (12.9120) (NOT SHOWN)	4
		2.9344 BRACKET, THROTTLE BOOSTER SPRING	
7E	5123878	BRACKET, 2,3,4-53	1
7E	454906	BOLT, 3/8"-16 X 1 1/2" (12.9001) (NOT SHOWN)	1
		2.9347 SPRING, THROTTLE BOOSTER	
7E	5143344	SPRING, 2,3,4-53	1
		2.9348 EYE, THROTTLE BOOSTER ADJUSTING	
7E	5123762	EYE, 2,3,4-53	1
7E	120375	NUT, 1/4"-20 (12.9120	2
		2.9349 HANGER, THROTTLE BOOSTER SUPPORT	
7E	5186749	NUT, 5/8"L. 2,3,4-53 (SPRING HANGER) (NOT SHOWN)	1
7E	5171045	BOLT, 5/16 -24 X 5/8" (1/8" HEAD) (NOT SHOWN)	1
		2.9360 SHAFT, THROTTLE CONTROL	
	5124614	ROD ASSEMBLY, 3.4-53 (2.9720) (NOT SHOWN)	1
	103320	LOCKWASHER, 5/16" (12.9200) (NOT SHOWN)	2
	114493	LOCKNUT, 5/16"-24 (2.7170) (NOT SHOWN)	2
		2.9390 LEVER, GOVERNOR CONTROL SHAFT	
	5147640	LEVER, 2,3,4-53 (3.3110) (NOT SHOWN)	1
	454813	BOLT, 1/4"-20 X 7/8" (12.9001) (NOT SHOWN)	1
	120380	LOCKWASHER, 1/4" (12.9200) (NOT SHOWN)	1
		2.9410 LEVER, GOVERNOR CONTROL	
8	5124615	LEVER	1
	454813	BOLT, 1/4"-20 X 7/8" (12.9001) (NOT SHOWN)	1
	120380	LOCKWASHER, 1/4" (12.9200) (NOT SHOWN)	1
		2.9422 WIRE, GOVERNOR CONTROL	
8A	5146239	WIRE ASSEMBLY, 2,3,4-53 (90"L.)	1
	5184255	PLATE, NAME 2,3,4-53 (NOT SHOWN)	1
	110730	LOCKWASHER, 3/8" (12.9200) (NOT SHOWN)	1
	122236	NUT, 3/8"-24 (12.9120) (NOT SHOWN)	1

2.9000A THROTTLE CONTROLS (CONTINUED)

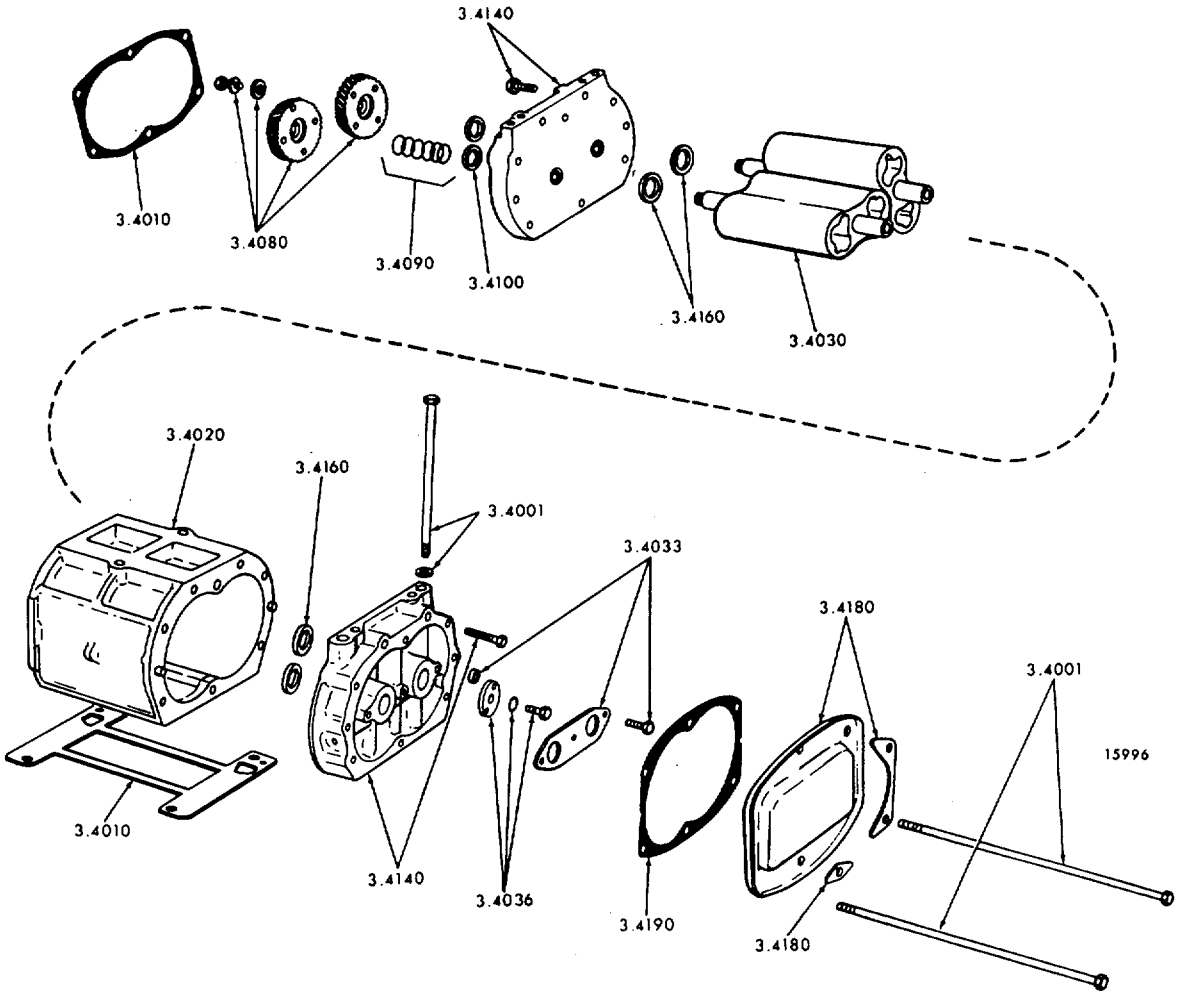
FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		2.9426 PIN, GOV. CONTROL WIRE SWIVEL	
8A	5161464	PIN, 2,3,4-53	1
	120393	WASHER, 11/32" (12.9190) (NOT SHOWN)	1
	142583	RETAINER, 13/64" (SPRING)(12.9640) (NOT SHOWN)	1
8A	132105	SCREW, #10-32 X 3/8" FIL. HD. (12.9010)	1
		2.9428 CLIP, GOV. CONTROL WIRE TUBE	
8A	3290569	CLIP (AT FLYWHEEL HOUSING) (7.8320)	1
	5159738	CLIP (INTERMEDIATE) (7.8320) (NOT SHOWN)	1
	5155782	CLIP (7.8320) (NOT SHOWN)	1
	123298	BOLT, 1/4"-28 X 3/8" (12.9001) (NOT SHOWN)	1
	179833	BOLT, 3/8"-16 X 1/2" (12.9001) (NOT SHOWN)	1
	120392	WASHER, 1/4" (12.9190)	1
	103319	LOCKWASHER, 1/4" (12.9200) (NOT SHOWN)	1
	103321	LOCKWASHER, 3/8" (12.9200) (NOT SHOWN)	1
	121902	NUT, 1/4"-28 (12.9120).	1



SECTION 3 FIG. 3A. AIR INLET HOUSING



SECTION 3 FIG. 3B. BLOWER AND AIR INLET HOUSING



SECTION 3 FIG. 4A. BLOWER ASSEMBLY (3-CYL)

3.3000A AIR INLET HOUSING

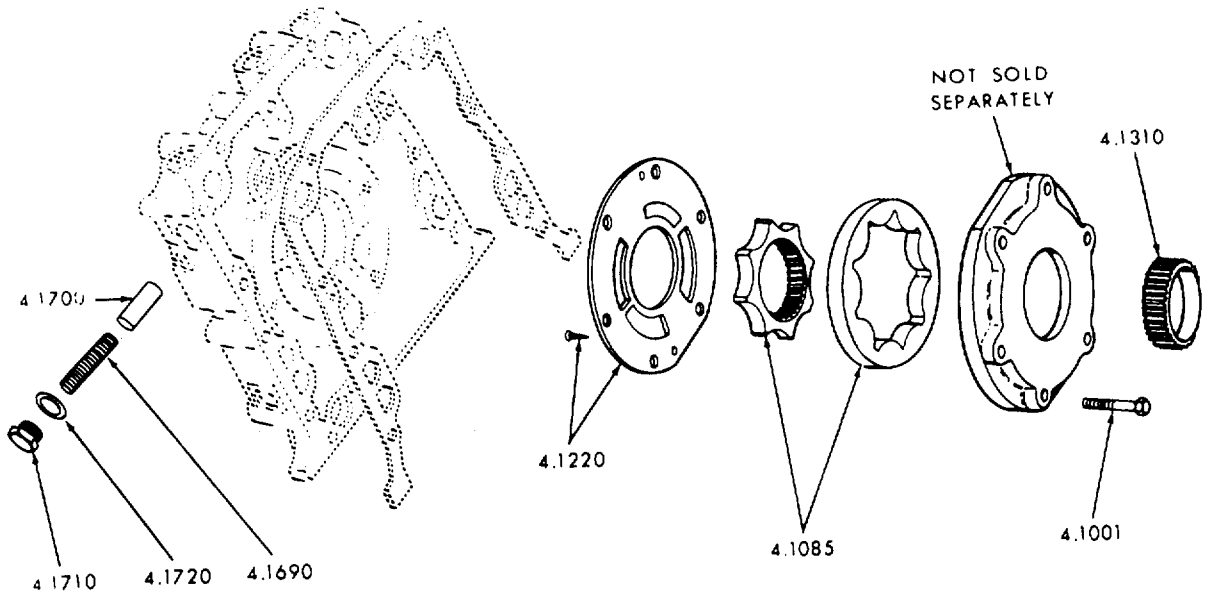
FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		3.3001 HOUSING ASSEMBLY, AIR INLET	
3B	5121181	HOUSING ASSEMBLY, 3-53	1
3A	5157244	BOLT, 3/8"-16 X 1 3/4" (TO BLOWER) (4.4190) (NOT SHOWN	4
	179846	BOLT 3/8"-16 X 1 7/8" (12.9001) (NOT SHOWN)	1
3A	179851	BOLT 3/8"-16 X 3" (12.9001)	1
3A	103341	WASHER 3/8" (12.9190)	6
3A	103321	LOCKWASHER 3/8" (12.9200)	6
		3.3003 HOUSING, AIR INLET	
3A	5116383	HOUSING, 3-53 (REM. MTD. CLNR)	1
3A	5121182	PLUG, 1/4" PIPE(2.4015)	1
		3.3007 GASKET, AIR INLET HOUSING FLANGE	
	5124405	GASKET	1
	5196053	GASKET (3.4025) (NOT SHOWN	1
		3.3040 VALVE, AIR INLET HOUSING SHUTDOWN	
3A	5116456	VALVE, 3-53	1
3A	273436	PIN, 1/8" X 11/16" ROLL (12.9300)	2
		3.3050 SHAFT, AIR INLET HOUSING SHUTDOWN VALVE	
3A	5116444	SHAFT, 3-53	1
3A	103341	WASHER 3/8" (12.9190)	1
3A	273436	PIN 1/8" X 11/16" ROLL (12.9300)	1
		3.3055 SEAL, AIR INLET HOUSING SHUTDOWN VALVE SHAFT	
3A	5182977	SEAL RING (1.2020)	2
		3.3070 SPRING, AIR INLET HOUSING SHUTDOWN VALVE TENSION	
3A	5111904	SPRING (VALVE) (INTERNAL)	1
3A	5112787	SPRING (LATCH) (R.H. HELIX)	1
		3.3090 LEVER, AIR INLET HOUSING SHUTDOWN VALVE	
3A,B	5114727	LATCH	1
3A	5143836	BUSHING-ECCENTRIC	1
3A	179803	BOLT, 1/4"-20 X 1 3/4" (12.9001)	1
3A	120380	LOCKWASHER, 1/4" (12.9200)	1
		3.3110 LEVER, AIR INLET HOUSING SHUTDOWN RESET	
	103341	WASHER, 3/8" (12.9190)	6
3A	5114974	HANDLE	1
3A	5122623	CAM	1
		3.3250 WIRE, AIR INLET HOUSING SHUTDOWN CONTROL	
	5146239	WIRE ASSEMBLY, 90"L. (2.9422)	1

3.3000A AIR INLET HOUSING (CONTINUED)

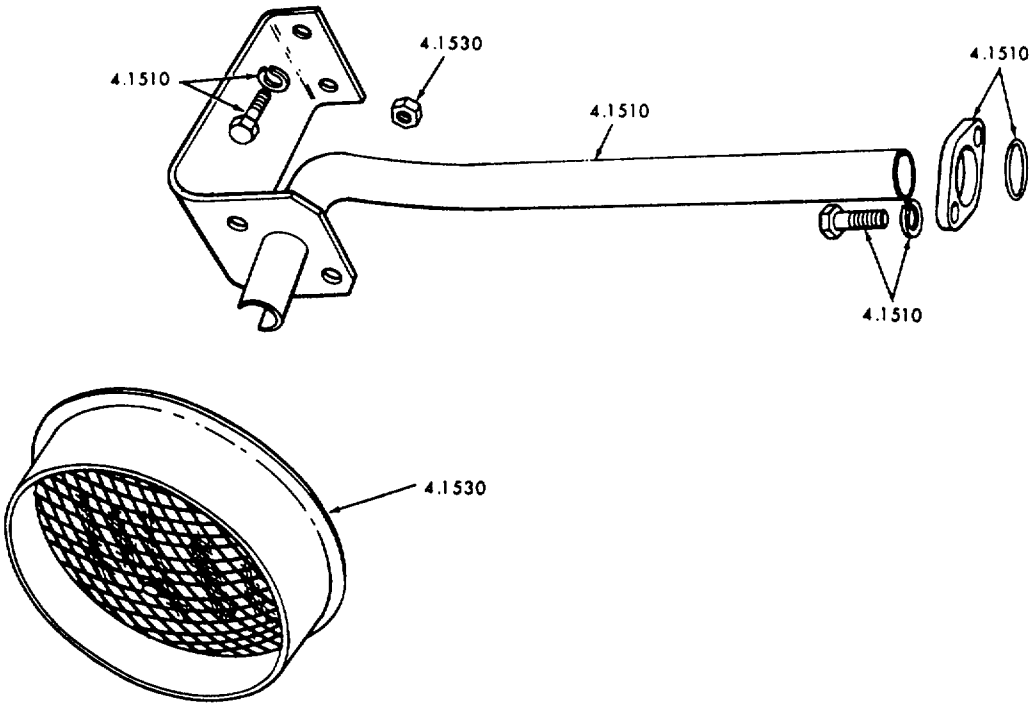
FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		3.3250 WIRE, AIR INLET HOUSING SHUTDOWN CONTROL (CONTINUED)	
3A	3796374	GUIDE (2.9426)	1
3A	140855	SCREW, #8.32 X 5/16" HEX SOCKET (12.9027)	1
3A	110730	LOCKWASHER, 3/8" (12.9200)	1
3A	124925	NUT, 3/8"-24 (12.9120)	1
		3.3260 PLATE, AIR INLET HOUSING SHUTDOWN CONTROL	
	5186687	PLATE, INSTRUCTION (NOT SHOWN)	1
		3.3270 CLIP, AIR INLET HOUSING SHUTDOWN CONTROL WIRE	
3A	3290569	CLIP, 1 3/16"L.-3/8" BOLT (7.8320)	1
	123298	BOLT, 1/4"-28 X 3/8" (12.9001)	1
	120380	LOCKWASHER, 1/4" (12.9200)	1
3A	121902	NUT, 1/4"-28 (12.9120)	1
		3.4000 BLOWER	
		3.4001 BLOWER ASSEMBLY	
4A	5107535	BLOWER ASSEMBLY, 3-53 (RH) (NOT SHOWN)	1
	5131913	WASHER, 7/16"	4
	9433110	BOLT, 7/16-14 X 6 11/16" (12.9001)	4
	5121464	BOLT, 3/8"-24 X 10 3/16" (WITH NYLON INSERT)	2
		3.4005 BLOWER KIT, REPAIR	
	5198683	BLOWER REPAIR KIT, 3,4,6V-53 (TURBO AND NON-TURBO) (NOT SHOWN)	AR
		3.4010 GASKET, BLOWER	
4A	5116295	GASKET, 3-53 (TO BLOCK)	1
		3.4020 HOUSING, BLOWER	
4A	5119391	HOUSING ASSEMBLY, 3-53 (INCLUDES PINS)	1
	141242	PIN, 3/8" X 7/8" DOWEL (12.9290) (NOT SHOWN)	4
		3.4030 ROTOR, BLOWER	
4A	5139297	ROTOR ASSEMBLY, 3-53	2
		3.4033 PLATE, BLOWER ROTOR THRUST	
4B	5134179	PLATE, 4, 6V-53	1
4B	5116170	SPACER	3
4B	9409062	BOLT, 1/4"-20 X 1" (12.9001)	3
		3.4036 WASHER, BLOWER ROTOR SHAFT THRUST	
4B	5127077	WASHER, 25/64" I.D	2
4B	9409034	BOLT, 3/8"-24 X 7/8" (12.9001)	2
		3.4080 GEAR, BLOWER DRIVE	
4B	5107081	GEAR, 4-53 (R.H. HELIX)	1

3.4000 BLOWER (CONTINUED)

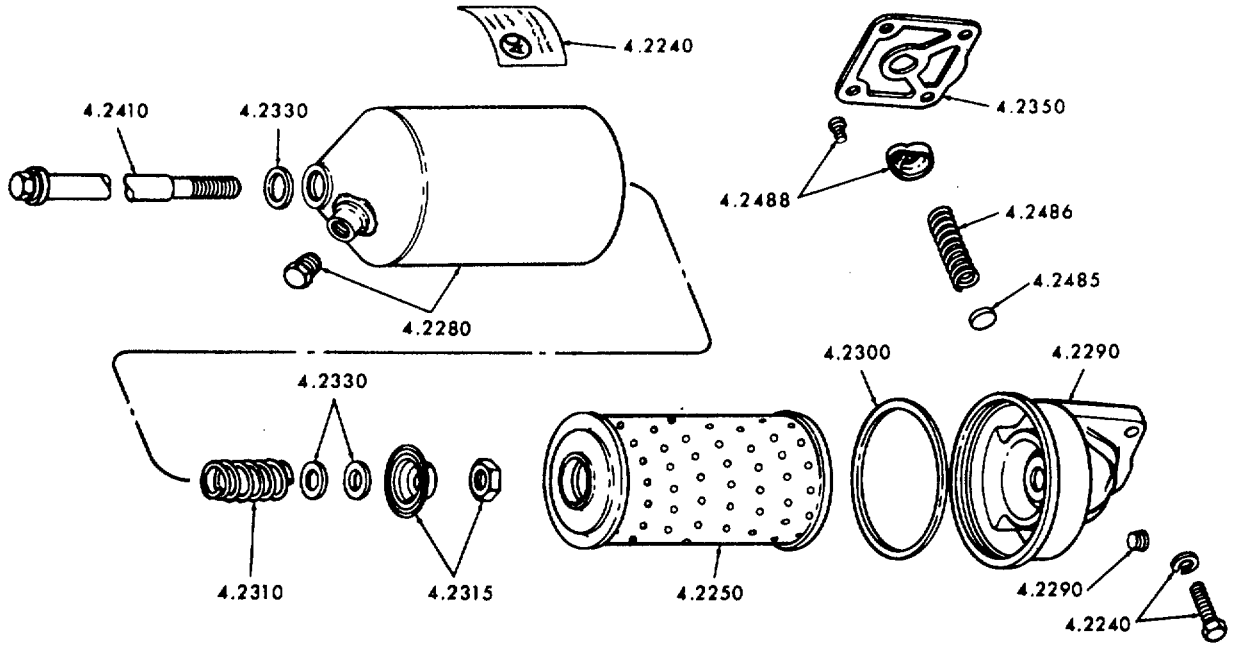
FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		3.4080 GEAR, BLOWER DRIVE (CONTINUED)	
4B	5107082	GEAR, 4-53 (L.H. HELIX)	1
4B	9409018	BOLT, 5/16"-24 X 7/8" (12.9001)	2
4B	5121403	WASHER, 21/64" X 1" X 3/16	2
		3.4090 SHIM, BLOWER ROTOR GEAR	
4B	5116164	SHIM (.002")	AR
4B	5116165	SHIM (.003")	AR
4B	5116166	SHIM (.004")	AR
4B	5116167	SHIM (.005")	AR
		3.4100 SPACER, BLOWER ROTOR GEAR	
4B	5116168	SPACER	2
		3.4140 PLATE, BLOWER HOUSING END	
4A	5134914	PLATE, 3-53 FRONT AND REAR	1
4A	5139299	PLATE, 3-53 REAR (NOT SHOWN)	1
		5145009 PLUG, 1/8" PIPE (12.9550) (NOT SHOWN)	2
	117297	SCREW, 5/16"-18-1 3/4" (12.9010)	4
		3.4160 SEAL, BLOWER HOUSING END PLATE	
4A	5142266	SEAL	4
		3.4180 COVER, BLOWER HOUSING END PLATE	
4A	5119429	COVER, 3,4, 6V-53 (FRONT)	1
4A	5119394	PLATE, REINFORCEMENT (LARGE)	2
4A	5119395	PLATE, REINFORCEMENT (SMALL)	2
		3.4190 GASKET, BLOWER HOUSING END PLATE COVER	
4A	5119433	GASKET	2



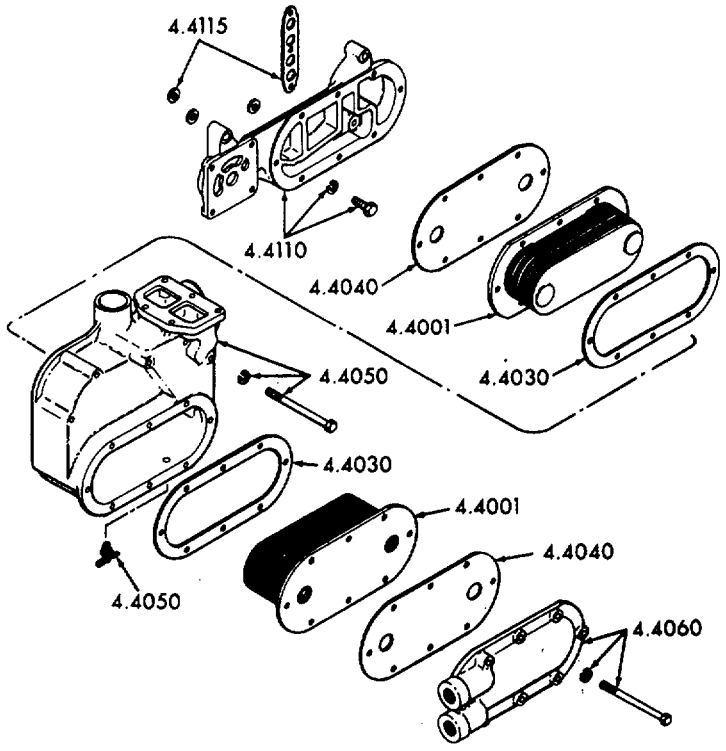
SECTION 4 FIG. 1A. OIL PUMP AND PRESSURE REGULATOR



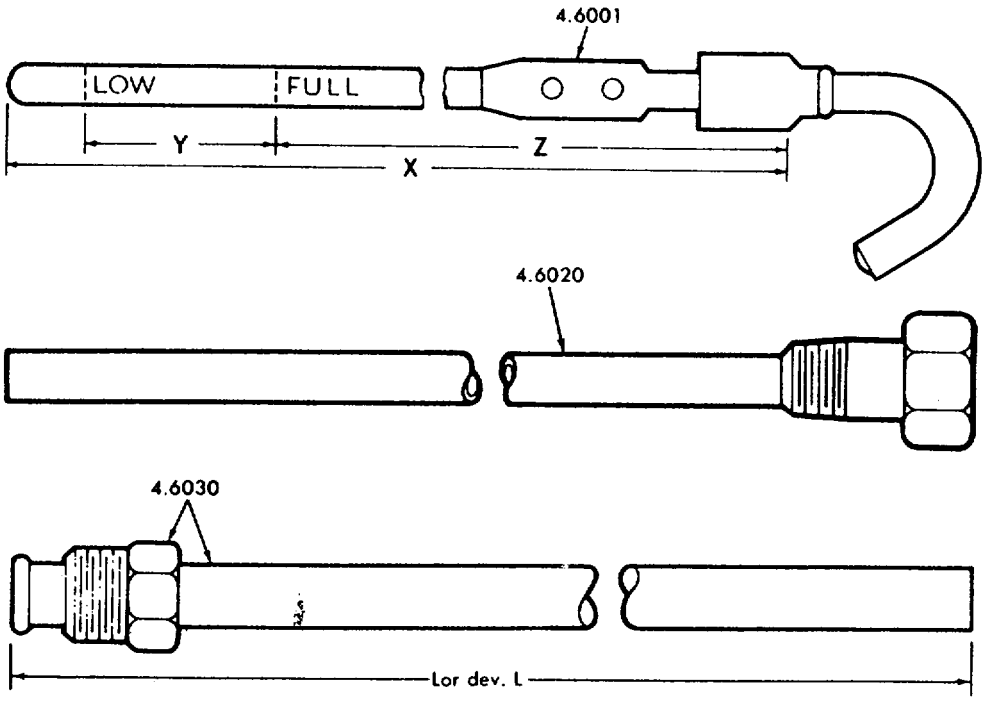
SECTION 4 FIG. 2A. OIL DISTRIBUTION SYSTEM



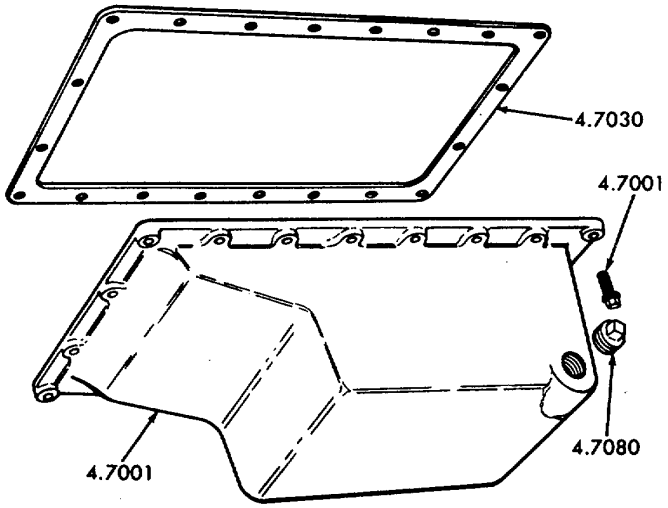
SECTION 4 FIG. 3A. OIL FILTER



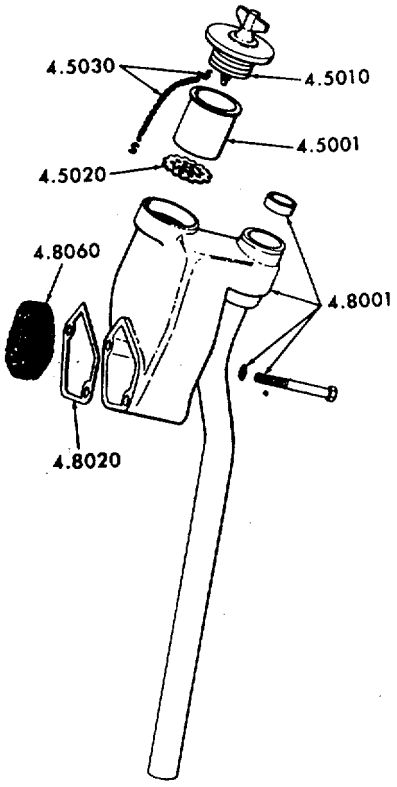
SECTION 4 FIG. 4B. TORQUE CONVERTER OIL COOLER



SECTION 4 FIG. 6A. DIPSTICK



SECTION 4 FIG. 7A. OIL PAN



SECTION 4 FIG. 8B. BREATHER AND OIL FILTER

4.1000A OIL PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		4.1001 PUMP ASSEMBLY, OIL	
	5116110	PUMP ASSY, 3-53 (NOT SHOWN).	1
1A	193942	BOLT, 5/16"-18 X 1 5/8"(AA LOCK) (12.9001)	6
		4.1085 ROTOR ASSEMBLY, OIL PUMP	
1A	5195714	ROTOR SET, 3-53	1
		4.1220 COVER, OIL PUMP	
1A	5195685	COVER	1
1A	145067	SCREW, #6 X 3/8" DRIVE (12.9067)	2
		4.1310 GEAR, OIL PUMP DRIVE (ON CRANKSHAFT)	
1A	5144375	GEAR	1
		4.1510 PIPE, OIL PUMP INLET	
2A	5126212	TUBE ASSY 3-53 (A-7.52",B-5.70")	1
2A	5119425	FLANGE	1
2A	5127175	SEAL RING	1
2A	179816	BOLT, 5/16"-18 X 3/4" (12.9001)	4
2A	103340	WASHER, 5/16" FLAT (12.9190) (NOT SHOWN)	2
2A	103320	LOCKWASHER, 5/16" (12.9200)	4

4.1000B OIL DISTRIBUTION SYSTEM

		4.1530 SCREEN, OIL PUMP INLET	
2A	5126456	SCREW ASSEMBLY	1
2A	274558	NUT, 5/16"-24 LOCK (12.9140) (NOT SHOWN)	2

4.1O00C OIL PRESSURE REGULATOR

		4.1690 SPRING, OIL PRESSURE REGULATOR	
1A	5126436	SPRING, 2,3,4-53,6V53 (ORANGE STRIPE)(4.1260)	2
		4.1700 VALVE, OIL PRESSURE REGULATOR	
1A	5177777	VALVE (4.4140)	2
		4.1710 PLUG, OIL PRESSURE REGULATOR	
1A	5113657	PLUG	2
1A	5177773	GASKET (4.4170)	2

4.2000A OIL FILTER

		4.2240 FILTER ASSEMBLY, OIL	
3A	5104419	ADAPTER ASSEMBLY (SPIN-ON) (NOT SHOWN)	1
3A	179846	BOLT, 3/8"-16 X 1 7/8" (12.9001)	4
	103341	WASHER, 3/8" (12.9190) (NOT SHOWN)	4
3A	103321	LOCKWASHER, 3/8" (12.9200)	4

4.2000A OIL FILTER (CONTINUED)

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		4.2250 ELEMENT, OIL FILTER	
3A	25011106	ELEMENT	1
		4.2485 VALVE, OIL FILTER BYPASS	
3A	5133431	VALVE	1
		4.2486 SPRING, OIL FILTER BYPASS VALVE	
3A	5134477	SPRING	1
		4.2488 PLUG, OIL FILTER BYPASS VALVE	
3A	5134456	RETAINER	1
3A	160221	SCREW, #12-24 X 1/2" (12.9026)	1
	5121182	PLUG, 1/4" PIPE (12.9550) (NOT SHOWN)	2
		4.4000A OIL COOLER	
		4.4001 CORE ASSEMBLY, OIL COOLER	
4B	8539953	CORE ASSEMBLY, 3,4-53 (8 PLATE)	2
		4.4030 GASKET, OIL COOLER CORE INNER	
4B	5150155	GASKET	2
		4.4040 GASKET, OIL COOLER CORE OUTER	
4B	5102506	GASKET	2
		4.4050 HOUSING, OIL COOLER	
4B	5116492	HOUSING, 3. 4-53	1
4B	103647	DRAINCOCK, 1/4" (12.9510)	1
4B	215386	BOLT, 5/16"-18 X 6" (12.9001)	
4B	103320	LOCKWASHER, 5/16" (12.9200).	
		4.4060 COVER, OIL COOLER HOUSING	
4B	5107975	COVER	1
	5142549	PLUG,3/4" PIPE (12.9550) (NOT SHOWN)	2
4B	446597	BOLT, 5/16"-18 X 6 1/2" (12.9001)	7
	9437758	BOLT, 5/16"-18 X 7 1/4" (12.9001) (NOT SHOWN)	1
	120393	WASHER, 5/16" (12.9190) (NOT SHOWN)	8
4B	103320	LOCKWASHER, 5/16" (12.9200)	8
		4.4110 ADAPTER, OIL COOLER	
4B	5123413	ADAPTER, 3-53	1
4B	186622	BOLT, 3/8"-16 X 1 1/4" (12.9001)	4
	179847	BOLT, 3/8"-16 X 2" (12.9001) (NOT SHOWN)	2
4B	103321	LOCKWASHER, 3/8" (12.9200)	6
		4.4115 GASKET, OIL COOLER ADAPTER TO BLOCK	
4A,B	5119286	GASKET, 3,4, 6V53	1
4A,B	5175882	GASKET, 3,4, 6V53	3

4.5000A OIL FILLER

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		4.5001 TUBE, OIL FILLER	
8B	5121051	TUBE, 2,3,4-53	1
		4.5010 CAP, OIL FILLER TUBE	
8B	5120098	CAP ASSEMBLY, 2,3,4-53 (EXPANSION, 1.75" DIA.)	1
		4.5020 STRAINER, OIL FILLER TUBE	
8B	5121058	STRAINER, 2,3,4-53	1
		4.5030 CHAIN, OIL FILLER TUBE	
	5113825	CHAIN (5.3125)	1
	5146248	HOOK, FILLER CAP	2

4.6000A DIPSTICK

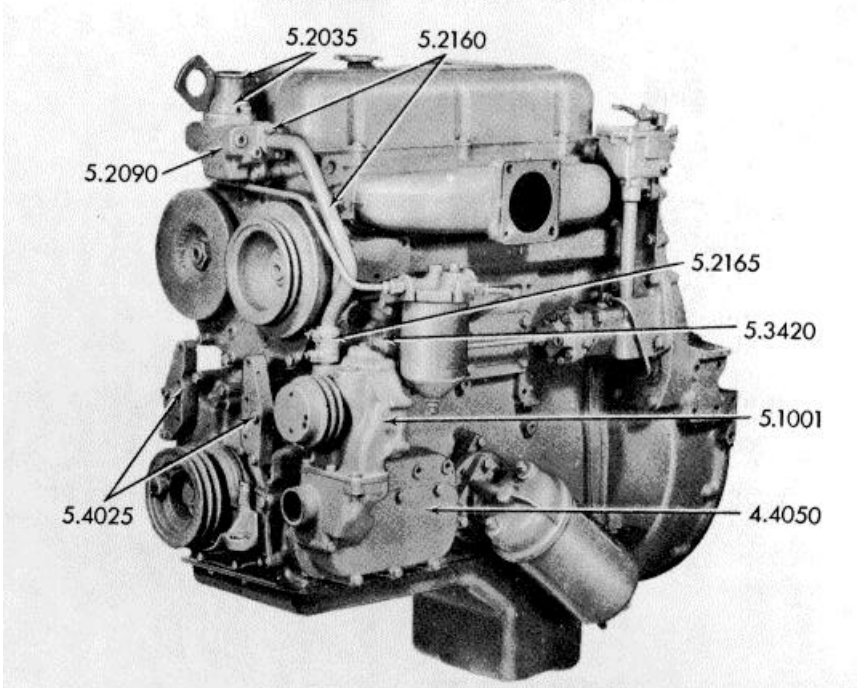
		4.6001 DIPSTICK	
6A	5162934	DIPSTICK, 3-53 (X-23",Y-1.18",Z-20.88")	1
		4.6010 GASKET, DIPSTICK	
	5106906	SEAL, .75"L. (RUBBER)	1
		4.6020 GUIDE, DIPSTICK	
6A	5121062	GUIDE (1 1/8"L)	1
		4.6030 ADAPTER, DIPSTICK	
6A	5138290	ADAPTER ASSEMBLY, 3-53 (19.24" DEV. L.)	
		4.6040 CLIP, DIPSTICK	
	140582	CLIP, 2,3-53, 1/2" TUBE (12.9630) (NOT SHOWN)	1

4.7000A OIL PAN

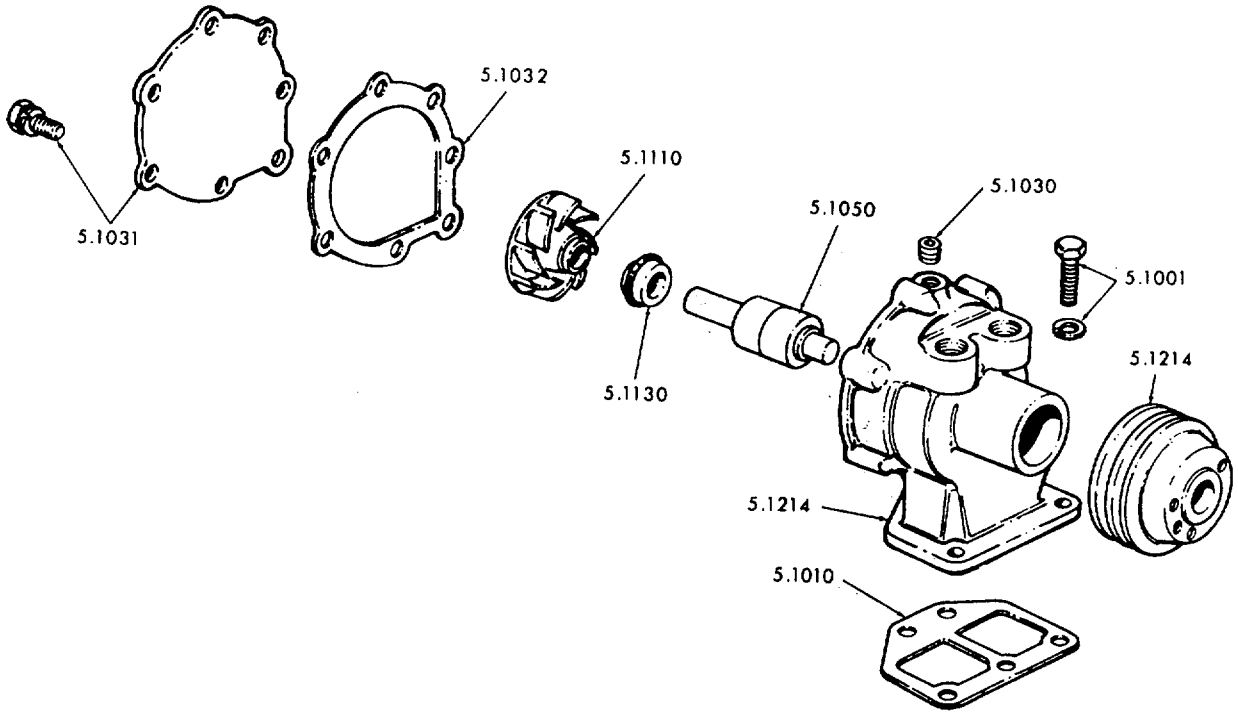
		4.7001 PAN, OIL	
7A	5144592	PAN, 3-53 STAMPED	1
7A	5148437	BOLT, 5/16"-18 X 1" (W/LW)(2.3260)	20
		4.7030 GASKET, OIL PAN TO BLOCK	
7A	5116256	GASKET, 3-53	1
		4.7080 PLUG, OIL PAN DRAIN	
7A	5121182	PLUG, 1/4" PIPE (2.4015)	2
	5115214	PLUG, 1/2"-14 HEX SKT (12.9550) (NOT SHOWN)	2
	5142549	PLUG, 3/4" PIPE SQ. SKT. (12.9550) (NOT SHOWN)	1

4.8000A VENTILATING SYSTEM

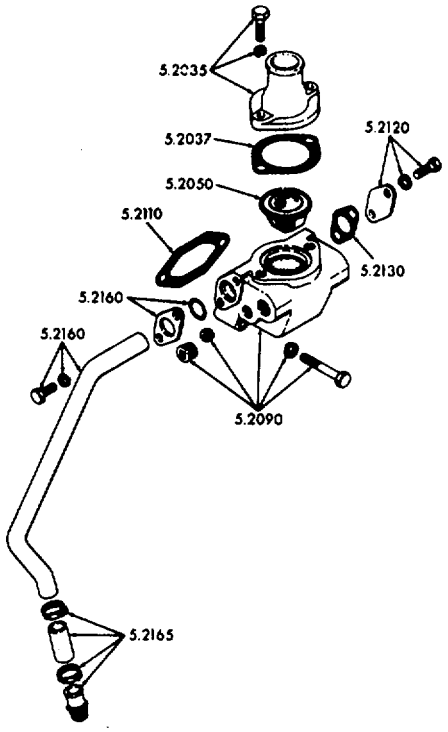
FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		4.8001 PIPE, BREATHER	
8B	5121056	PIPE, 2,3,4-53	1
8A,B	5150829	PLUG, 7/8" CUP	1
8A,B	179828	BOLT, 5/16"-18 X 2 1/2" 12.9001)	2
8A,B	103320	LOCKWASHER, 5/16" (12.9200)	2
		4.8020 GASKET, BREATHER TUBE	
8B	5116391	GASKET, 2,3,4-53 (1.5060)	1
		4.8060 FILTER UNIT, BREATHER OIL SEPARATOR	
8B	5104007	ELEMENT, 3-53	1



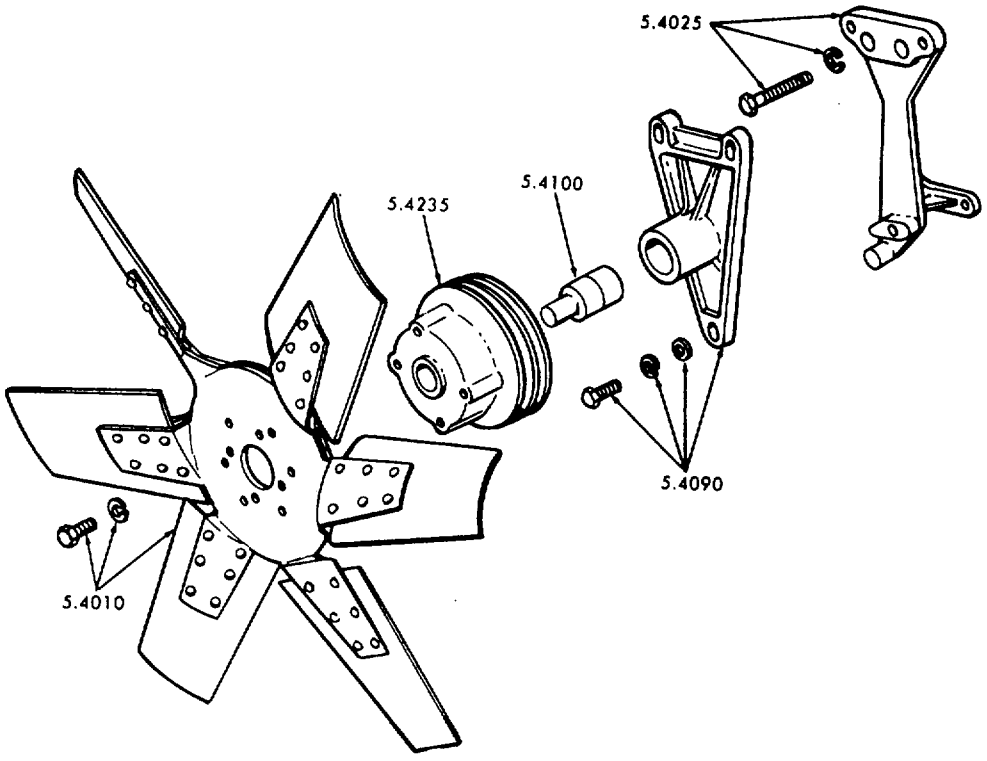
SECTION 5 FIG. 1A. TYPICAL COOLING SYSTEM'



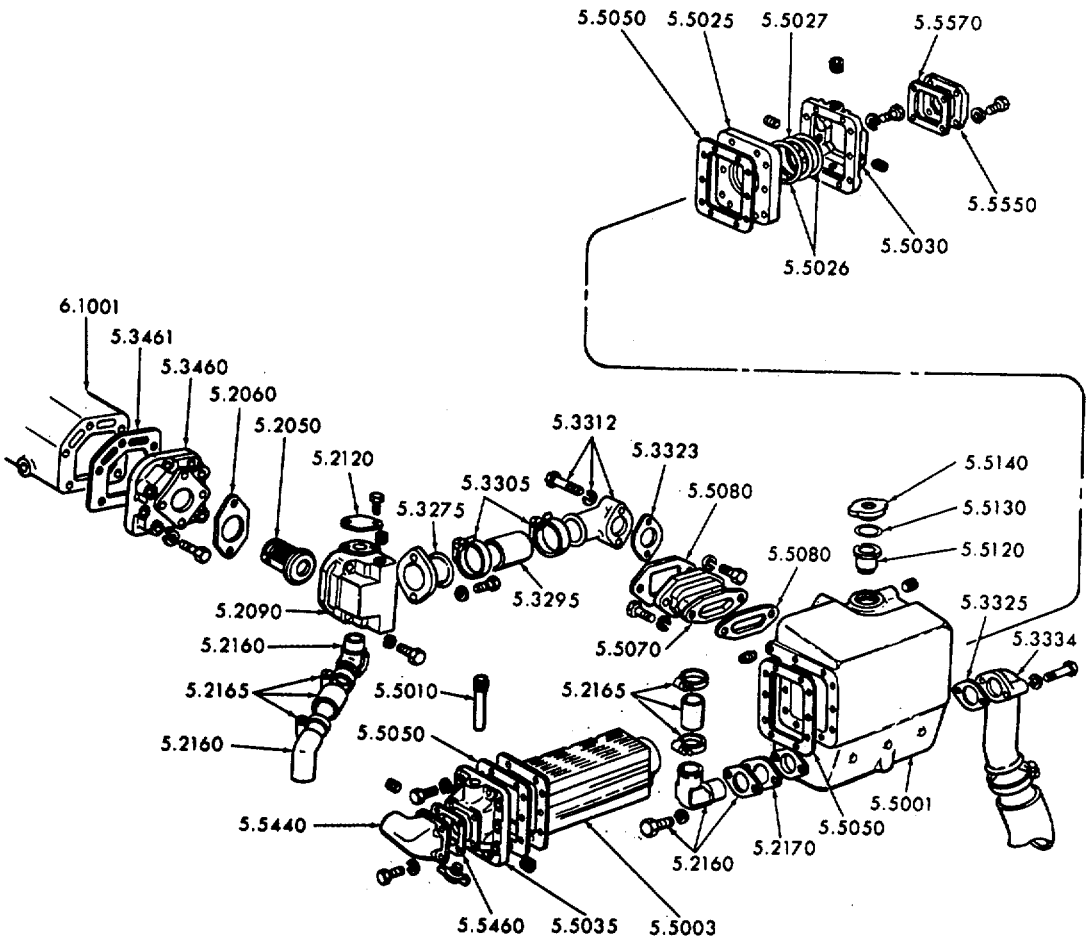
SECTION 5 FIG. 2A. FRESH WATER PUMP



SECTION 5 FIG. 3B. THERMOSTAT



SECTION 5 FIG. 4A. FAN AND SHAFT AND PULLEY



SECTION 5 FIG. 6A. HEAT EXCHANGER

5.1000 FRESH WATER PUMP

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		5.1001 PUMP ASSEMBLY, FRESH WATER	
1A	5144685	PUMP ASSY, 3,4-53 (L.H. ROTATION)	1
	186625	BOLT, 5/16"-18 X 7/8" (12.9001) (NOT SHOWN)	5
		5.1002 RECONDITIONING KIT, FRESH WATER PUMP	
	5199533	RECONDITIONING KIT, 2,3,4,8V53 (L.H. ROTATION PUMP) (NOT SHOWN)	1
		5.1010 GASKET, FRESH WATER PUMP	
2A	5133107	GASKET, 3,4,6V,8V53	1
		5.1115 REPLACEMENT KIT, FRESH WATER PUMP SEAL SEAT	
	5197279	REPLACEMENT KIT, IMPELLER INSERT 2,3,4,6,8V53 (NOT SHOWN).	AR

5.2000A WATER OUTLET MANIFOLD AND/OR ELBOW

		5.2035 ELBOW, WATER OUTLET	
1A,3B	5116409	FLANGE, 2,3,4,6,8V53 (2 1/2"L.) (NOT SHOWN)	1
	186619	BOLT, 3/8"-16 X 1 1/8" (12.9001) (NOT SHOWN)	2
	103321	LOCKWASHER, 3/8" (12.9200) (NOT SHOWN)	2
		5.2037 GASKET, WATER OUTLET ELBOW	
	5116092	GASKET, 2,3,4,6,8V53 (NOT SHOWN)	1

5.2000B THERMOSTAT

		5.2050 THERMOSTAT ASSEMBLY	
6A,B	3041379	THERMOSTAT ASSY., 2,3,4,6V53 (170° OPENING TEMP)	1
		5.2090 HOUSING, THERMOSTAT	
1A,B	5108088	HOUSING ASSY., 2,3,4,6V53 (INCLUDES PLUGS IN 5.2090)	1
	5145014	PLUG, 3/8" PIPE (12.9550) (NOT SHOWN)	2
	5115214	PLUG, 1/2" PIPE (12.9550) (NOT SHOWN)	2
	108608	BOLT, 3/8"-16 X 2 1/8" (12.9001) (NOT SHOWN)	2
		5.2110 GASKET, THERMOSTAT HOUSING	
3B	5116242	GASKET, 2,3,4,6,8V53 (TO CYLINDER HEAD)(1.2044)	1
		5.2120 COVER, THERMOSTAT HOUSING	
	5119426	FLANGE, 2,3,4,6V53	1
	186618	BOLT, 5/16"-18 X 5/8" (12.9001)	2
	103320	LOCKWASHER, 5/16" (12.9200)	AR
		5.2130 GASKET, THERMOSTAT HOUSING COVER	
38B	5128139	GASKET, 2,3,4,6V53	1

5.2000C WATER BYPASS TUBE

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		5.2160 TUBE, WATER BYPASS	
1A	5108944	TUBE, 3-53	1
1A	5119425	FLANGE, 2,3,4-53 (4.1510)	1
	5144702	CONNECTOR (4.2165)	1
1A	5184301	SEAL RING (4.4060)	1
	5142549	PLUG, 3/4" PIPE (12.9550)	1
	186625	BOLT, 5/16" - 18 X 7/8" (12.9001)	2
		5.2165 HOSE, WATER BYPASS TUBE	
1A	5169721	HOSE, 7/8" I.D. X 1.74"L. 2,3,4-53 (4.8010)	1
1A	5186840	CLAMP, 1" DIA. HOSE (12.9660)	2

5.3000A RADIATOR

	8922091	RADIATOR ASSY (NOT SHOWN)	1
	103647	DRAINCOCK, 1/4" (12.9510) (NOT SHOWN)	1
	181360	BOLT, 3/8"-24 X 3/4" (12.9001) (NOT SHOWN)	8
	103321	LOCKWASHER, 3/8" (12.9200) (NOT SHOWN)	8
		5.3120 CAP, RADIATOR FILLER	
	5197822	CAP (NOT SHOWN)	1
		5.3130 GASKET, RADIATOR FILLER CAP	
	850627	GASKET (NOT SHOWN)	1

5.3000B WATER CONNECTIONS

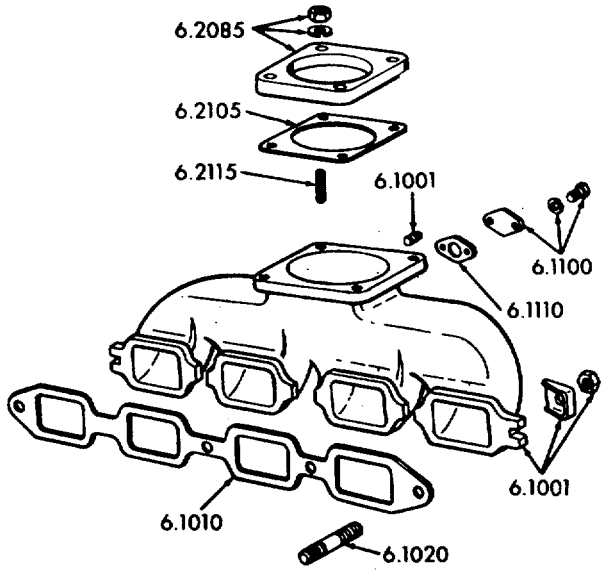
		5.3290 HOSE, RADIATOR INLET	
	5129251	HOSE, 2,3,4-53 (FORMED) (NOT SHOWN)	1
		5.3300 CLAMP, RADIATOR INLET HOSE	
	2337379	CLAMP, 1 1/2" DIA. HOSE (12.9660) (NOT SHOWN)	2
	5199778	HOSE (2"I.D. X 2") 2,3,4-53 (3.1270) (NOT SHOWN)	1
	5110373	HOSE (2"I.D. X 3") 3,4-53 (NOT SHOWN)	1
		5.3340 CLAMP, RADIATOR OUTLET HOSE	
	8920537	CLAMP, 1 9/16" - 2 1/2" DIA. HOSE (12.9660) (NOT SHOWN)	4
		5.3420 ELBOW, OIL COOLER WATER OUTLET	
1A	5121184	ELBOW	1
	179819	BOLT, 5/16"-18 X 1 1/8" (12.9001) (NOT SHOWN)	2
	103320	LOCKWASHER, 5/16" (12.9200) (NOT SHOWN)	2

5.3000B WATER CONNECTIONS

		5.3422 HOSE, OIL COOLER WATER OUTLET ELBOW	
	5199777	HOSE (1 7/8"I.D. X 4 3/4") (NOT SHOWN)	1
	8920537	CLAMP,1 9/16"-2 1/2" DIA HOSE (12.9660)(NOT SHOWN)	2
	272865	CLAMP,2 9/32" DIA. HOSE (12.9660) (NOT SHOWN)	2

5.4000A FAN

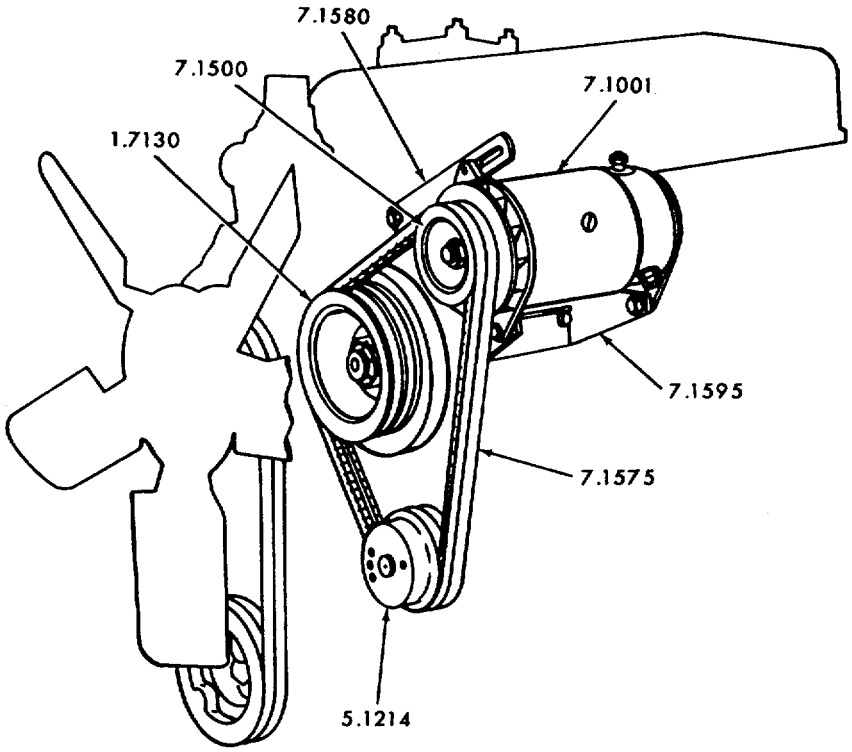
FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		5.4010 BLADE, FAN	
4A	5172003	BLADE, 26"-6 BLADE, BLOWER	1
4A	103320	LOCKWASHER, 5/16" (12.9200)	AR
4A	179822	BOLT, 5/16"-18 X 1 1/2"	6
		5.4025 SUPPORT, FAN MOUNTING	
1A	5108945	SUPPORT	2
	186612	BOLT, 3/8"-16 X 1 3/8" (12.9001) (NOT SHOWN)	4
	186282	BOLT, 3/8"-16 X 3 1/4" (12.9001) (NOT SHOWN)	4
	9409914	BOLT, 3/8"-16 X 4 1/4" (12.9001) (NOT SHOWN)	
	8291168	PULLEY (NOT SHOWN)	1
		5.4090 BRACKET, FAN SHAFT	
	5164294	SPACER, 7/8" X 13/32" X 1/8" (7.1581)(NOT SHOWN)	4
		5.4180 CAP AND SPACER, FAN HUB	
	5103718	SPACER, .80" THICK (NOT SHOWN)	1
	5103676	SPACER, .56" THICK (NOT SHOWN)	1



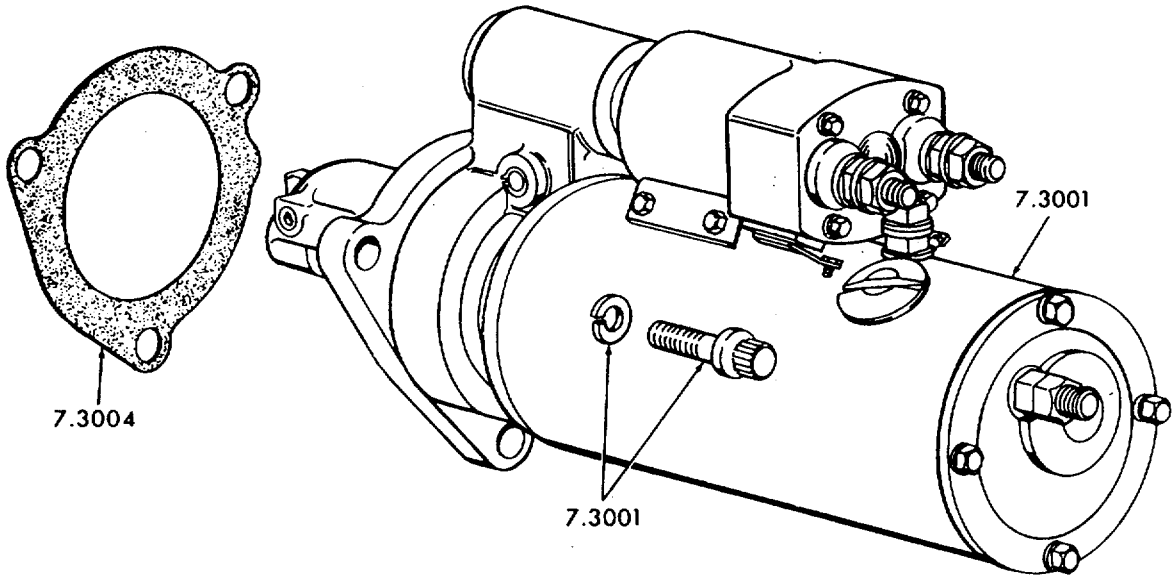
SECTION 6 FIG. 1A. EXHAUST MANIFOLD (CENTER OUTLET)

6.1000A EXHAUST MANIFOLD

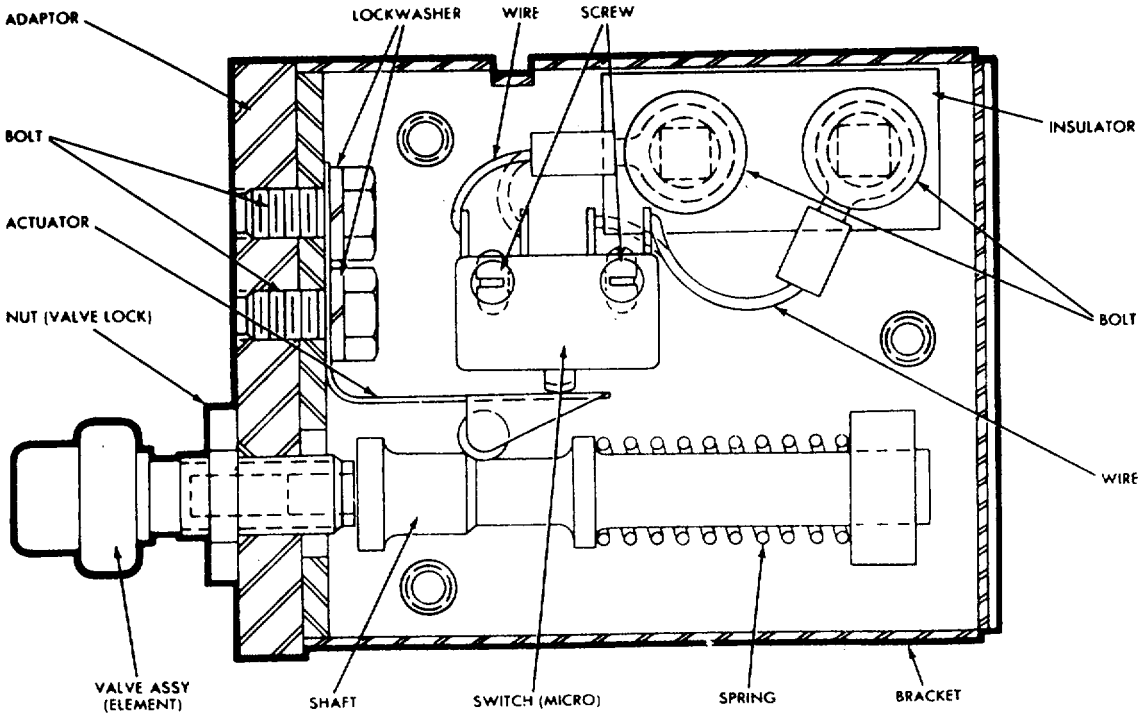
FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		6.1001 MANIFOLD, EXHAUST	
1A	5130330	MANIFOLD	AR
1A	113175	PLUG, 1/8" PIPE (12.9550)	AR
1A	5104439	WASHER, 7/16"	8
1A	127855	NUT, 7/16"-20 (12.9120)	8
		6.1010 GASKET, EXHAUST MANIFOLD	
1A	5116205	GASKET	AR
		6.1020 STUD, EXHAUST MANIFOLD TO HEAD	
1A,B	5112899	STUD, 7/16" X 2 3/32"L	AR
		6.2000A EXHAUST MUFFLER AND/OR CONNECTIONS	
		6.2085 FLANGE, EXHAUST	
1A	5108632	FLANGE (3"P.T.) (ITEM 10)	2
1A	103321	LOCKWASHER, 3/8" (12.9200)	AR
1A	114547	NUT, 3/8"-24 (12.9120)	8
		6.2105 GASKET, EXHAUST OUTLET	
1A	5108377	GASKET	2
		6.2115 STUD, EXHAUST OUTLET	
1A	5109158	STUD 3/8"-16-24 X 1 1/2"	8



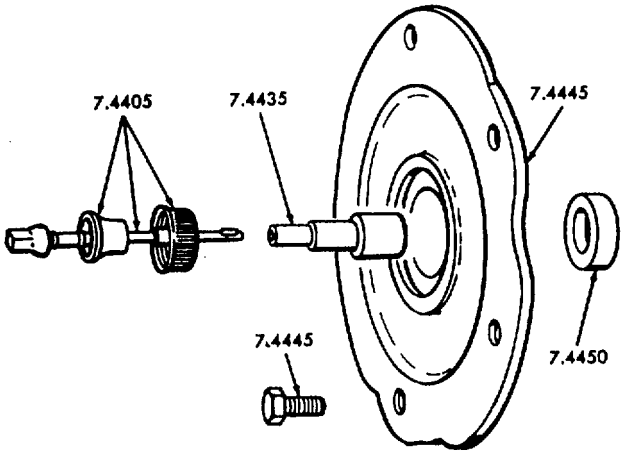
SECTION 7 FIG. 1A. BATTERY CHARGING GENERATOR



SECTION 7 FIG. 3A. STARTING MOTOR



SECTION 7 FIG. 4B. SWITCH ASSY., WATER TEMPERATURE SHUTDOWN



SECTION 7 FIG. 5B REAR MOUNTED WITH FLEXIBLE SHAFT

SECTION 7 ELECTRICAL-INSTRUMENTS

7.1000A BATTERY CHARGING GENERATOR

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		7.1001 GENERATOR ASSEMBLY	
1A	1117242	GENERATOR, 12V, 42 AMP, CW/CCW (METRIC)	1
1A	11500730	BOLT, M1O X 1.5 X 110 MM (12.9001)	1
1A	11500192	LOCKWASHER, M10 (12.9200)	1
1A	5131433	WASHER, .41 X .81 X .14 (1.5001)	2
1A	11501052	NUT, M10O 1.5 (12.9120)	1
		7.1440 FAN, GENERATOR	
1A	1970765	FAN (INCLUDES BAFFLE)	1
1A	5148796	PULLEY, 2.76" DIA., 2 GROOVES	1
		7.1575 BELT, GENERATOR DRIVE	
1A	5133173	BELT SET (2 BELTS, 42.00"L. X .380"W	1
		7.1580 STRAP, GENERATOR ADJUSTING	
1A	5148287	STRAP	1
1A	186624	BOLT, 5/16"-18 X 1 1/4" (12.9001)	1
1A	5121403	WASHER, 21/64" X 1" X 3/16" (3.4080)	1
1A	103320	LOCKWASHER, 5/16" (12.9200)	1
1A	120376	NUT, 5/16-18 (12.9120)	1
		7.1582 BRACKET, GENERATOR ADJUSTING STRAP	
	11500868	BOLT, M8 X 1.25 X 30 MM (12.9001)	1
	186619	BOLT, 3/8"-16 X 1 1/8" (12.9001) (NOT SHOWN)	1
	11500191	LOCKWASHER, M8 (12.9200) (NOT SHOWN)	1
	103321	LOCKWASHER, 3/8" (12.9200) (NOT SHOWN)	1
		7.1595 BRACKET, GENERATOR MOUNTING	
1A	5102203	BRACKET (R.H.) (METRIC)	1
	5137947	BUSHING (NOT SHOWN)	1
	186628	BOLT, 3/8"-16 X 1 1/2" (12.9001) (NOT SHOWN)	3
		7.1630 WIRE ASSEMBLY, GENERATOR TO REGULATOR	
	5100420	WIRE ASSEMBLY (INCLUDES RECTIFIER) (NOT SHOWN)	1
	11504530	LOCKNUT, M6 (12.9120) (NOT SHOWN)	1

7.3000A STARTING MOTOR

		7.3001 MOTOR ASSEMBLY, STARTING	
3A	1113216	MOTOR ASSY., 12V., C.W., GRD. SPRAG	1
3A	9418228	BOLT, 5/8"-11 X 1 3/4", 12 PT. (12.9005)	1
	223435	BOLT, 5/8"-11 X 1 3/4" (12.9001) (NOT SHOWN)	2
3A	103325	LOCKWASHER, 5/8" (12.9200)	3
		7.3004 GASKET, STARTING MOTOR	
3A	5130995	GASKET (W/WET FLYWHEEL HOUSING	1

SECTION 7 ELECTRICAL-INSTRUMENTS

7.4000A INSTRUMENTS

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		7.4005 PANEL, INSTRUMENT	
4A	1582507	PANEL (CLUSTER) (INCLUDES MOUNTING IN 7.4010)	1
4A	1586206	CLUSTER ASSY (NO TEMPERATURE GAUGE)	1
4A	5193755	MOUNTING ASSY (ANTI-VIBRATION)	AR

7.4000B TACHOMETER DRIVE

		7.4435 SHAFT, TACHOMETER DRIVE	
5B	5125159	SHAFT	1
		7.4445 COVER, TACHOMETER DRIVE	
5B	5125153	COVER ASSY (INCLUDES SEAL IN 7.4450)	1
	179858	BOLT, 7/16"-14 X 1" (12.9001)	1
	179882	BOLT, 1/2"-13 X 1 1/8" (12.9001) (NOT SHOWN)	4
	5150568	WASHER, 7/16" COPPER (12.9190) (NOT SHOWN)	1
	103323	LOCKWASHER, 1/2" (12.9200) (NOT SHOWN)	4
		7.4450 SEAL, TACHOMETER DRIVE COVER	
5B	3202615	SEAL	1
		7.4455 GASKET, TACHOMETER DRIVE ADAPTER	
5104506		GASKET (COVER) (1.5040) (NOT SHOWN)	1

7.4000C SHUTOFF OR ALARM SYSTEM

	7.4505	SWITCH, WATER TEMPERATURE	
4B	5146080	SWITCH	1
		7.4519 SOLENOID, AIR SHUTOFF	
4B	1118128	SOLENOID (12V)	1
	179795	BOLT, 1/4"-20 X 5/8" (12.9001) (NOT SHOWN)	4
	120392	WASHER, 1/4" (12.9190) (NOT SHOWN)	4
	103319	LOCKWASHER, 1/4" (12.9200) (NOT SHOWN)	4
	120375	NUT, 1/4"-20 (12.9120)	4
		7.4530 BRACKET, AIR SHUTOFF SOLENOID	
4B	5140279	BRACKET	1
	179846	BOLT, 3/8"-16 X 1 7/8" (12.9001) (NOT SHOWN)	2
		7.4538 ROD, AIR SHUTOFF SOLENOID CONTROL	
4B	5124918	LINK	1
	5124916	SPACER, 9/32" X 7/16" X .30" (NOT SHOWN)	1
	112526	PIN, 1/16" X 3/8" COTTER (12.9250) (NOT SHOWN)	1
	5115204	BOLT, 1/4"-28 X 1 1/4" (7.4519) (NOT SHOWN)	1
	120380	LOCKWASHER, 1/4" (12.9200) (NOT SHOWN)	1
	114492	NUT, 1/4"-28 JAM (12.9120) (NOT SHOWN)	2
		7.4586 SWITCH, OIL PRESSURE	
5100722		SWITCH (10# BREAK) (NOT SHOWN	1

SECTION 7 ELECTRICAL-INSTRUMENTS

7.4000C SHUTOFF OR ALARM SYSTEM (CONTINUED)

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		7.4598 SWITCH, ALARM SHUTOFF (FUEL)	
	5100679	SWITCH (20# MAKE) (NOT SHOWN)	
	112877	BUSHING, 1/4" X 1/8" RED (12.9570) (NOT SHOWN)	1
	120401	ELBOW, 1/8" STREET 90° (12.9550) (NOT SHOWN)	
		7.4707 RELAY, TIME DELAY	
	5146219	RELAY ASSY (NOT SHOWNO	1
	132788	SCREW, #8-32 X 1 3/4" FIL. HD. (12.9010) (NOT SHOWN)	2
	446143	WASHER, #8 (12.9190) (NOT SHOWN)	2
	121841	LOCKWASHER, #8 (12.9200) (NOT SHOWN)	2
		7.4711 PLATE, TIME DELAY RELAY MOUNTING	
	5147454	BRACKET (NOT SHOWN)	1
	186629	BOLT, 5/16"-18 X 1" (12.9001) (NOT SHOWN)	2
	5159714	WASHER, 11/16" (2.7290) (NOT SHOWN)	2
	103320	LOCKWASHER, 5/16" (12.9200) (NOT SHOWN)	2

SECTION 8, SECTION 9, AND SECTION 10 ARE PURPOSELY DELETED.

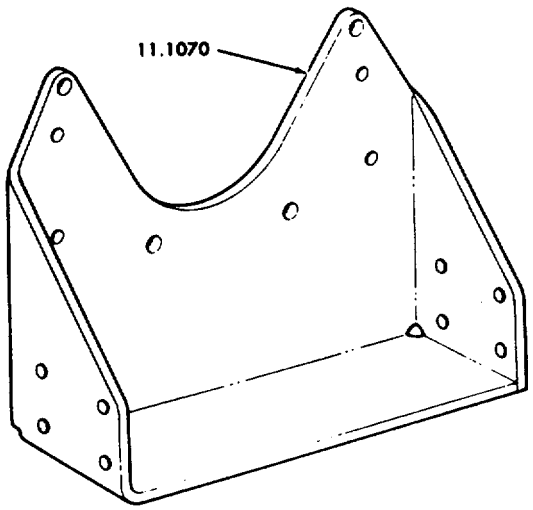
SECTION 10 SHEET METAL

10.1000A ENGINE HOOD

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		10.1001 HOOD ASSEMBLY, ENGINE	
	5135967	HOOD	1
	181309	BOLT, 1/4"-28 X 1/2" (12.9001)	14
	103319	LOCKWASHER, 1/4" (12.9200)	14
	114492	NUT, 1/4"-28 (12.9120)	14
		10.1025 SUPPORT, ENGINE REAR HOOD	
	5146353	SUPPORT	1
	454990	BOLT, 1/2"-13 X 1 1/8" (12.9001)	4
	10334-3	WASHER, 1/2" (12.9190)	4
	103323	LOCKWASHER, 1/2" (12.9200)	4
		10.1057 CATCH, ENGINE HOOD SIDE PANEL	
	5171531	CATCH ASSEMBLY, HOOD	4
	5135805	BRACKET	4
	181309	BOLT, 1/4"-28 X 1/2" (12.9001)	8
	103319	LOCKWASHER, 1/4" (12.9200)	8
	114492	NUT,1/4"-20 (12.9120)	8
		10.1100 PANEL, ENGINE HOOD SIDE	
	5135964	PANEL	2

NOTE: ALL ABOVE ITEMS NOT SHOWN

SECTION 11 ENGINE MOUNTING



SECTION 11 FIG. 1C FRONT ENGINE SUPPORT (STATIONARY)

SECTION II ENGINE MOUNTING

11.1000A ENGINE MOUNTING AND BASE

FIG.	PART NUMBER	NAME AND DESCRIPTION	QTY.
		11.1070 SUPPORT, ENGINE FRONT	
1C	5123945	SUPPORT	1
	186283	BOLT, 3/8"-16 X 3 1/2" (12.9001) (NOT SHOWN)	4
	454933	BOLT, 7/16" - 14 X 1 1/8" (12.9001)(NOT SHOWN)	4
	103322	LOCKWASHER, 7/16" (12.9200) (NOT SHOWN)	AR
		11.1075 BRACKET, ENGINE SUPPORT	
	5123841	BRACKET (R.H.) (11.1070) (NOT SHOWN)	1
	5123842	BRACKET (L..H.) (11.1070) (NOT SHOWN))	1
	181361	BOLT,3/8"-24 X 7/8" (12.9001) (NOT SHOWN)	8
	103321	LOCKWASHER, 3/8" (12.9200) (NOT SHOWN)	8
	117049	NUT, 3/8"-24 (12.9120) (NOT SHOWN))	8

PART III

SUPPLEMENTAL OPERATING,

MAINTENANCE AND REPAIR PARTS

INSTRUCTIONS

(SOMARPI)

SOMARPI 5-3820-245

AUGER, EARTH, SKID MOUNTED, TYPE I

TEXOMA MODEL 270-9

REEDRILL, INC.

NSN 3820-01-146-7204

A

PART III

SUPPLEMENTAL OPERATING MAINTENANCE AND

REPAIR PARTS INSTRUCTIONS
FOR
AUGER, EARTH, SKID MOUNTED, TYPE I

TEXOMA, MODEL 270-9

NSN 3820-01-146-7204

TABLE OF CONTENTS

TABLE OF CONTENTS (Con't)

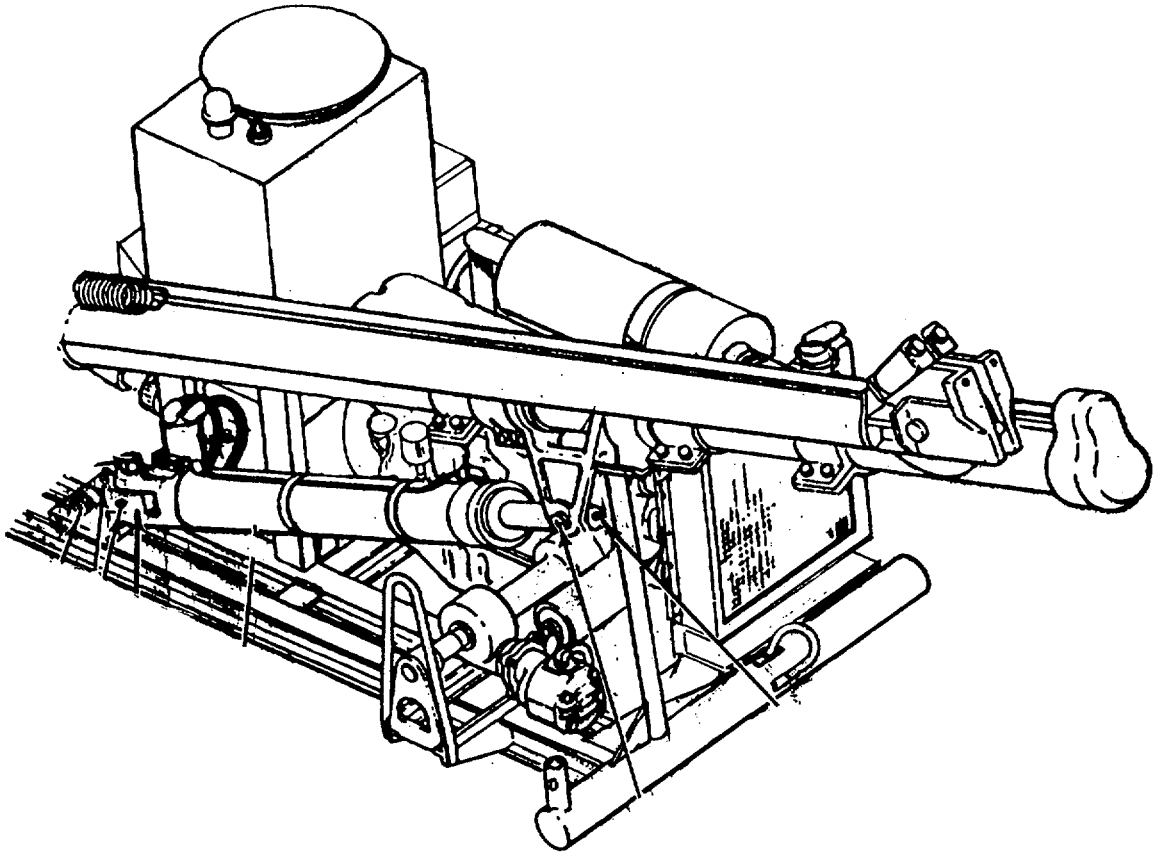


Figure 1. Auger, Earth, Right Side

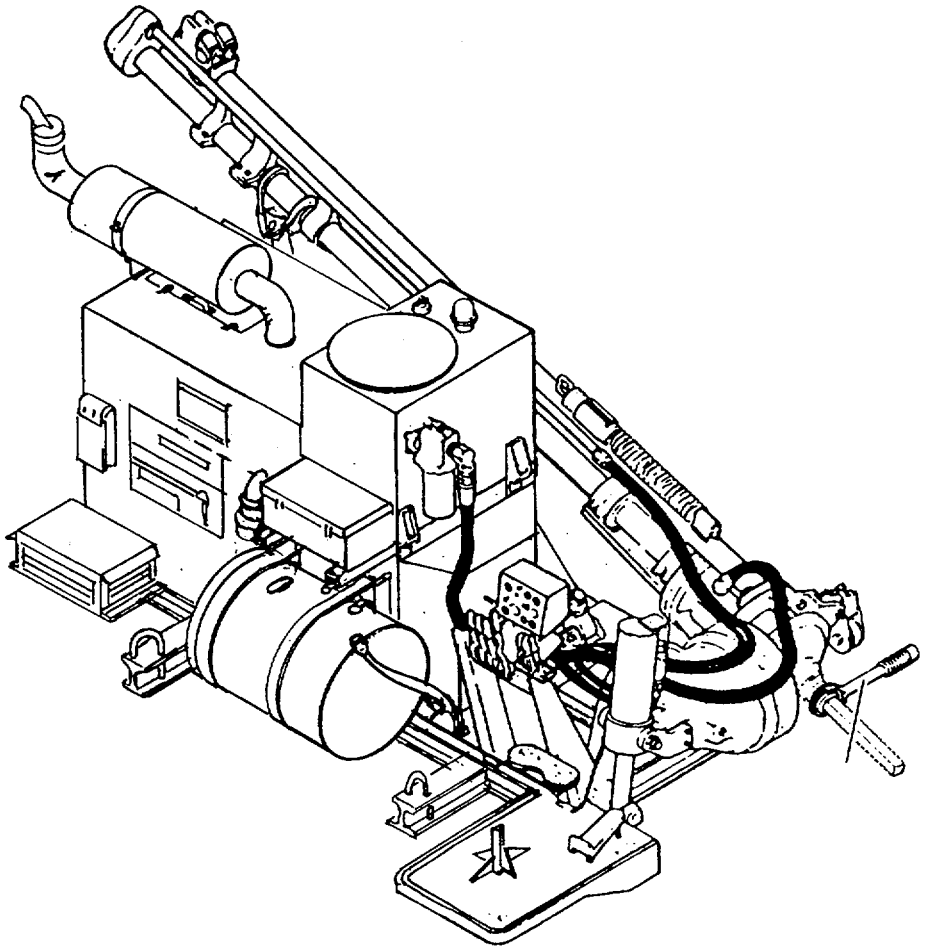


Figure 2. Auger, Earth, Left Side

PART I

INTRODUCTION

1-1. SCOPE

The instructions in this Supplemental Operating, Maintenance and Repair Parts Instruction (SOMARPI) are for:

a. The user of the Construction Equipment (CE), Auger, Earth, Skid Mounted, Type I, Reedrill Inc., Texoma Incorporated, Model 270-9.

b. Maintenance personnel responsible for maintaining and/or repairing the Auger, Earth.

c. Supply personnel responsible for requisitioning and stockage of repair parts.

1-2. REPORTING

Reports of errors, omissions, and recommendations for improving the publication by the individual user is encouraged. Reports should be submitted on DA Form 2028, Recommended Changes to Publications, and forwarded direct to; Commander, US Army Tank-Automotive Command, ATTN: DRSTA-MVB, Warren, Michigan 48090.

PART II

MAINTENANCE SUPPORT DATA

2-1. PURPOSE

The Auger is designed for use in boring holes in the earth for construction purposes such as fence, power lines, anchor post holes, or for explosives.

2-2. DESCRIPTION

a. General. The Texoma Incorporated Earth Auger Model 270-9, in Figures 1-1 and 2-2, is a self-contained, skid mounted, earth boring assembly, driven by a diesel engine, Detroit Model 3-53. All operations of the boring assembly are controlled by a hydraulic system. The Auger is capable of boring holes 9 to 24 inches in diameter and to a depth of 9 feet. The boring assembly can be operated from vertical downward to 60° away from the truck, from vertical to 23° to the right and from vertical to 30° to left of truck, or 10° toward the truck.

b. Engine. The engine is a Detroit Diesel Model 3-53 line, 3 cylinder, pressure lubricated, diesel engine.

c. Transmission. The transmission is a Funk Manufacturing Company, Model 12B704N with four speeds forwarded and four reverse speeds.

d. Auger Assembly. The Auger assembly consists of the Auger, Kelly Bar, Final Drive assembly, and Right Angle Drive assembly. Operation of the Auger assembly is controlled by the shuttle control and the hand or foot operated throttle control. The shuttle is engage and disengage the drive assembly.

e. Warning/Safety Devices. The hydraulic system incorporates load lock valves on both the elevating and leveling cylinders. These valves prevent the cylinders from retracting in event of hydraulic system pressure loss.

f. Electrical System. The Auger has a 12 volt electrical starting system.

g. Instruments. The Auger is equipped with waterproof gauges and switches. The following instruments are on the panel.

(1) Engine Water Temperature Gage

(2) Tachometer/Hourmeter

(3) Ammeter 0 to 15 AMPS

(4) Transmission Oil Pressure Gage 140 PSI

(5) Transmission Oil Temperature Gage 220o F

(6) Engine Oil Temperature Gage 0-235°F

* U S GOVERNMENT PRINTING OFFICE 1991 - 543-025 40035

PIN: 057778-001

(7) Engine Oil Pressure Gage 30-60 PSI

(8) Fuel Gage

(9) Safety Switch

(10) Starter Button

(11) Emergency Shut-Down Switch

h. Battery. One (1) 12 volt battery 205 AMP, 8D, is installed to provide 12 volts for the starting system. The battery is located on the left side of the Auger assembly, next to the fuel tank.

i. Lubricants.

(1) Engine - MIL-L-2104 lubricating oil is recommended for use in this engine when the ambient temperature is above minus 10 degrees Fahrenheit. MIL-L-2104 oils are available under the following NSN:

NSN	QUANTITY	WEIGHT
9150-00-189-6727	1 Qt	10
9150-00-186-6668	5 Gal	10
9150-00-191-2772	55 Gal	10
9150-00-186-6681	1 Qt	30
9150-00-188-9858	5 Gal	30
9150-00-189-6729	55 Gal	30

(2) Hydraulic System - (260 Qt) MIL-L-2104 OE/HDA 10. See above listing for NSN and quantity.

(3) Transmission - (13 Qt) OE SAE 10 MIL-L-2104. See above listing for NSN and quantity.

(4) Lubricating Oil Gear	NSN
Right Angle (3 Qt) G090	9150-00-001-9395
Final Drive (3-1/2 Qt) G90	Quantity - 5 Gal
Winch (1 Qt) G90	Grade - 90

Operational and maintenance procedures are covered in the Manufacturer's Manual overpacked with the equipment (see Appendix A). The category of maintenance for the Auger will be in accordance with the Maintenance Allocation Chart (MAC) (see Appendix B) of this SOMARPI. Refer to paragraph 2-7 of this SOMARPI for requisitioning of repair parts and support.

2-3. PROCUREMENT STATUS

a. This is a one year procurement.

b. The procurement was awarded under Contract DAAE07-82-C-6647, dated 29 Sep 82, to Reedrill, Inc., P.O. Box 998, Sherman, Texas 75090.

2-4. CONDITIONS OF DEPLOYMENT

a. The Earth Auger is capable of being operated or stored in intermediate, hot, dry, warm, cold, or wet climate conditions.

b. The Earth Auger has a mission duration of eight hours per shift with two shift operations on an occasional basis, and one-half hour operational and preventive maintenance each shift.

2-5. MAINTENANCE CONCEPT

a. The introduction of this Auger will not introduce any new requirements for special consideration. The existing organizations will be utilized for support.

(1) Operator/Crew Maintenance. Operator and crew maintenance is limited to daily preventive maintenance services.

(2) Organization Maintenance. Organizational maintenance consists of scheduled preventive maintenance services, minor repairs, and adjustments.

(3) Direct Support Maintenance. Direct support maintenance consists of all the repairs required to restore an unserviceable end item or assembly to a serviceable condition.

(4) General Support Maintenance. General support maintenance will repair those assembled modules which overflow from or exceed the capabilities of direct support maintenance.

(5) Depot Maintenance. Depot maintenance is not authorized for the Earth Auger Model 270-9.

b. The government may enter into an overhaul and/or rebuild contract with the auger manufacturer when determined to be more economical or feasible.

2-6. SUPPORT EQUIPMENT

This equipment must be installed on a proper truck chassis for SAFE operation both on and off roads. Use Truck, Cargo, 5 Ton, 6x6 M54A2, (National Stock Number 2320-00-055-9265).

2-7. REPAIR PARTS AND SUPPORT

a. Repair parts support. The basic policies and procedures in AR710-2 and AR725-50 are generally applicable to repair parts management for CE items.

b. Manufacturer's parts manuals are furnished with this CE item instead of Department of the Army Repair Parts and Special Tools List (RPSTL).

c. National Stock Numbers (NSN) are initially assigned only to PLL/ASL parts and major assemblies, i.e., engines, transmissions, etc. Additional NSN are assigned by the supply support activities as demands warrant.

d. Automated processing (AUTODIN) for Federal Supply Code Manufacturer (FSCM) part number requisitions, without edit for matching NSN and exception data, is authorized.

e. Proper use of Direct Support System (DSS) project codes and weapon systems designator codes on parts requisitions is essential.

f. Repair parts are available from commercial sources for CONUS units and may be purchased locally in accordance with AR710-2 and AR735-110.

g. Initial recommended Prescribed Load List (PLL) and Authorized Package List (ASL) will be distributed by Tank-Automotive Command (TACOM) DRSTA-MVB (see appendix I).

(1) Prescribed Load List (PLL). The PLL prepared and distributed by TACOM is an estimated 15 days supply recommended for initial stockage at organizational maintenance. Management of PLL items will be governed by the provisions of AR710-2 and local command procedures. An initial stock of PLL parts will be shipped to OCONUS units before shipment of the end item. Selection of PLL parts for shipment to OCONUS units is based upon the receiving command's recommendations after their review of the TACOM prepared list. Organizations and activities in CONUS will establish PLL stock through normal requisitioning process.

(2) Authorized Stockage List (ASL). The ASL prepared and distributed by TACOM is an estimated 45 days supply of repair parts for support units and activities. An initial stock of ASL parts will be shipped to designated end items. The parts shipped will be selected according to the recommendations of the receiving commands, after they have reviewed the initial list distributed by TACOM support units and activities in CONUS will establish ASL stocks through normal requisitioning process.

h. Requisitioning Repair Parts.

(1) Using Units/Organizations: Requisitions (DA Form 2765 Series) will be prepared according to,AR710-2 and local command directives. All requisitions will have the Weapons System Designator Code "37" (see appendix D of AR710-2) entered in the 2d and 34th positions of Block 18. Units in CONUS will use the appropriate DSS Code (See appendix C) in Block 19. Units OCONUS will enter in Block 19 project code "JZC" (see appendix D).

(2) Support Units and Activities

(a) General. All MILSTRIP requisitions (DD Form 1348) Series) · prepared for repair parts support of CCE items will include distribution and project codes, (see appendixes C, D, and E).

(b) Distribution Code. Supply customers in CONUS will use Code "F" in card column 54. Customers OCONUS will use the appropriate code from appendix P, paragraph P-3a(1) of AR725-50. Weapons System Designator Code "37" (appendix H of AR710-2) will be entered in card columns 55 and 56 of all requisitions for parts support for the Model 270-9 Earth Auger.

(c) Project Codes. The applicable DSS project code (appendix C) will be entered in card columns 57 through 59 of requisitions for NSN parts, whether CONUS or OCONUS customers. The DSS Code will also be used by the CONUS customer when requisitioning part numbered parts. Supply customers OCONUS will use project code "JZC" for part numbered parts.

i. Submitting Requisitions.

(1) Using units and organizations will submit DA Form 2765 Series requisitions to designated support units or activities in accordance with local procedures.

(2) Support units and activities will forward MILSTRIP requisitions for NSN parts through the Defense Automated Addressing System (DAAS) to the Managing Supply Support Activity (see appendix E). Requisitions for part numbered parts will be forwarded through DAAS to the Defense Construction Supply Center (DCSC) (see appendix D).

NOTE: When the manufacturer's part number and Federal Supply Code Manufacturer (FSCM) exceed the space in card columns 8 through 22 of A02/AOB requisitions, prepare an A05/A03 requisition (DD Form 1348-6) and mail it to: Commander, Defense Construction Supply Center, ATTN: DCSC-OSR, Columbus, OH 43215.

2-8. PERSONNEL AND TRAINING

a. MOS Requirements.

(1) Operator: Earth Auger Operator, MOS 62J20.

(2) Organizational: Engineer Equipment Repairman, MOS 62B20.

(3) Direct/General Support: Engineer Equipment Repairmen, MOS 62B30.

b. New Equipment Training. New Equipment Training Teams (NETTS) are available to major field commands. Requests for NETTS should be forwarded to Commander, US Army Tank-Automotive Command (TACOM), ATTN: DRSTA-MLT, Warren, Michigan 48090. Training teams should be requested only when trained personnel are not available in the command to operate and/or maintain the Earth Auger.

2-9. EQUIPMENT PUBLICATIONS

a. Equipment publications initially will be manufacturer's commercial manual (see appendix A). Two manuals are overpacked and shipped with each end item.

b. After initial distribution, manuals normally will be Department of the Army (DA) authenticated and become available from the Adjutant General (TAG).

c. If DA authenticated publications are not available, additional commercial manuals may be obtained by requisitioning from Defense Construction Supply Center (DCSC). Requisitions to DCSC should be prepared in the same manner as for part numbered repair parts, using the Federal Supply Code Manufacturer's (FSCM) and manual number listed in appendix A. If DD Form 1348-6 is used, mail it direct to Commander, Defense Construction Supply Center, ATTN: DCSC-OSR, Columbus, Ohio 43215.

d. The Army Equipment Maintenance System (TAMMS) TM 38-750 applies.

2-10. FACILITIES

No special maintenance facilities are required for the auger.

2-11. LOGISTICS ASSISTANCE (AR700-4)

US Army Tank-Automotive Command's Field Maintenance Technicians stationed at CONUS and OCONUS installations are available to furnish on-site training and/or technical assistance. When training-or technical assistance is required contact the appropriate Logistics Assistance Office (LAO) listed in appendix B, AR700-4.

2-12. WARRANTY

The contractor warrants for 15 months after acceptance, all supplies furnished under this contract will be free from defects in design (except to the extent that design is specified by the contract specifications), material and workmanship, and will conform with the specifications and all other requirements of the contract. The contractor will include a copy of all such warranties in the operator's manual, furnished for each Earth Auger. Failure of defective components, parts, or assemblies covered by the manufacturer's warranty will be processed by the using unit under the warranty claims actions published in TM 38-750, paragraph 3-7.4.2.

COMMERCIAL VEHICLE WARRANTY

a. Definitions

(1) The word "acceptance" as used herein means the execution of the Acceptance Block and signing of a DD Form 250 by the authorized government representative.

(2) The word "supplies" as used herein means the end item and all parts and accessories thereof, furnished by the contractor, and any related services required under this contract. The word does not include technical data.

(3) Notwithstanding inspection and acceptance by the government of the supplies furnished under the contract or any provision of this contract concerning the conclusiveness thereof, the contractor hereby warrants that the supplies are free from defects in material, and workmanship and will conform with the specifications and all other requirements of this contract for a period of 15 months from date of acceptance, as shown on the Material Inspection and Receiving Report (DD Form 250) or 1500 hours of operation, whichever occurs first. Further, if the government, prior to placing vehicles in service, elects to place quantities of such newly delivered vehicles in government depot storage, the contractor agrees that the time period of the warranty will not begin to run for such stored vehicles until each vehicle is withdrawn from government storage or until six months from date of acceptance, which ever occurs first. The government prior to placing each new vehicle in storage and again at time of its withdrawal, shall notify the contractor thereof and identify each vehicle at its time in and out of storage. Vehicles designated as Production Samples shall be treated as vehicles placed in storage for warranty purposes. If-a Safety Recall defect occurs during vehicle warranty period, the contractor agrees to extend the term of the warranty by a period of time equal to the time period required to make necessary safety defect corrections. Additionally, to the extent the contractor or his supplier(s) provide to commercial customers a greater warranty for the supplies furnished herein, the contractor hereby likewise provides such greater warranty to the government. To the extent the terms of such greater warranty are inconsistent with or conflict with this warranty, the provisions of such greater warranty shall govern.

(4) With respect to defective supplies, wherever located, the warranty shall include the furnishing, without cost to the government, F.O.B. contractor's plant, branch or dealer facility or F.O.B. original CONUS destination or F.O.B. US Port of Embarkation, at the government's option, new supplies to replace any that prove to be defective within the warranty period. On all government owned vehicles and Foreign Military Sales (FMS) vehicles destined for shipment outside CONUS, the contractor's liability regarding warranty is limited to furnishing replacement parts F.O.B. CONUS port of debarkation for those parts which prove to be defective in material or workmanship.

(5) In addition, the government shall have the option (a) to return the vehicles or parts thereof to the contractor's plant, branch or dealer facility for correction or (b) to correct the supplies itself. When the government elects to return the vehicles or parts to the contractor's plant, branch or dealer facility, the cost of labor involved in the correction of the defective supplies shall be borne by the contractor. When the vehicle or parts thereof are returned to the contractor for correction, the contractor shall bear all transportation costs to the contractor's plant and return. With respect to defective supplies located within the 50 states, when the government elects to correct them itself, the cost of labor involved in the correction of defects shall be borne by the contractor and shall be computed at the contractor's then prevailing hourly rate for such services in that geographical area, based upon the number of labor hours appearing in the contractor's flat rate time schedule manual, or the government's actual cost, whichever is less. With respect to defective supplies located outside the 50 states, when the government elects to correct them itself, the cost of labor involved shall be borne by the contractor at the then prevailing hourly rate in the geographical-area for such services based upon the number of labor hours appearing in the contractor's flat rate time schedule manual or the government's actual cost, whichever is less. Additionally, the contractor shall be responsible for reasonable costs of disassembly/reassembly of items necessarily removed in connection with repair or replacement on vehicles wherever located.

(6) If the government elects to have warranty repair or replacement performed by the contractor, the government shall deliver the vehicle to contractor's local facility or dealership for warranty corrective repair or replacement. Receipt for such vehicle by the contractor's local facility or dealership will be deemed proper notification by the government of any breach of the warranty provided by this provision. If the government elects to effect warranty repairs or replacement itself, the contractor shall be notified in writing of any breach in the warranty within 30 days after discovery of the defect. Within 10 days after receipt of such notice, the contractor shall submit to the Contracting Officer a written recommendation as to the corrective action required to remedy the breach. In any event, the Contracting Officer may, upon the expiration of the 10 day period set forth above, proceed with correction or replacement as set forth in paragraph d, above, and the contractor shall, notwithstanding any disagreement regarding the existence of a breach of warranty, comply with any Contracting Officer directions related to such correction or replacement. After the notice of

breach, but not later than 30 days after receipt of the contractor's recommendation for corrective action, the Contracting Officer will, in writing, notify the contractor of the parts used by the government in repair or replacement and all other costs or expenses required for government correction of warranty defect as set forth in the paragraph d, above. The contractor shall respond within 30 days after receipt of this notice, of his intention to furnish identified replacement parts and/or cost reimbursements to the government. In the event it is later determined that the contractor did not breach the warranty in paragraph c, above, the contract price will be equitably adjusted pursuant to the terms of the "Changes" clause of the contract. Failure to agree to such an equitable adjustment or upon any determination to be made under this clause shall be a dispute concerning a question of fact within the meaning of the "Disputes" clause of this contract.

(7) Any supplies or parts thereof corrected or furnished in replacement pursuant to this clause shall also be subject to all provisions of this clause to the same extent as supplies initially delivered.

The contractor shall prepare and furnish to the government, data and reports applicable to any correction required under this clause (including revision and updating of all affected data called for under this contract) at no increase in the contract price.

The contractor shall furnish with his proposal a listing of distributors, dealers, franchise outlets where warranty claims may be exercised.

(8) The contractor will take all actions necessary to assure that all current flat rate time schedule manuals concerning vehicles under contract are on file with the TACOM Maintenance Directorate (DRSTA-M), or if not on file, within 60 days after contract award and furnish same to said Maintenance Directorate.

(9) A synopsis or simplified summary of the warranty coverage and its implementation will be imprinted on a decalcomania approximately 3" x 4" and shall be mounted in view of the operator as near as possible to the center of the instrument panel of each vehicle. On those vehicles requiring concealed markings and registration numbers, said decalcomania shall be placed in a readable position on the engine side of the firewall.

(10) The rights and remedies of the government provided in this clause are in addition to and do not limit any rights afforded to the government by any other clause in the contract.

2-13. EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIRs)

Submit EIRs in accordance with instructions contained in TM 38-750.

2-14. DESTRUCTION TO PREVENT ENEMY USE

Refer to TM 750-244-3, procedures for destruction of equipment to prevent enemy use.

2-15. FIRE PROTECTION

a. A hand operated fire extinguisher can be installed at the discretion of the Commander.

b. For usage refer to TM 5-4200-200-10, Hand Portable Fire Extinguisher Approved for Army Users.

2-16. SHIPMENT AND STORAGE

a. Shipment and Storage. Refer to TB 740-97-2 for procedures covering preservation of equipment for Shipment and Storage.

b. Administrative Storage. Refer to TM 740-90-1 for instructions covering Administrative Storage of equipment.

2-17. MANUFACTURER'S FIELD CAMPAIGNS AND MODIFICATIONS

Modifications will be corrected by the Auger manufacturer after the approval of the field campaigns or modification plan by TACOM (see appendix H).

2-18. BASIC ISSUE ITEM LIST (BIIL)

A list of items which accompany the Auger or are required for installation, operation, or operator's maintenance (see appendix G).

2-19. MAINTENANCE AND OPERATION SUPPLY LIST

A listing of maintenance and operating supplies required for initial operation (see appendix L).

APPENDIX A

PUBLICATIONS

DA EQUIPMENT PUBLICATIONS		
NOMENCLATURE	**EQUIPMENT PUBLICATION NUMBER**	**DATE AVAILABLE**
	NONE	

OTHER THAN OFFICIAL DA EQUIPMENT PUBLICATIONS			
NOMENCLATURE	**EQUIPMENT PUBLICATION NUMBER OR TYPE**	**DATE AVAILABLE**	**SOURCE OF SUPPLY**
Auger, Earth Model 270-9	58541 Operator and Service Manual 03476		DCSC
Auger, Earth Model 270-9	58542 Parts Manual 03476		DCSC

APPENDIX A (Con't)

PUBLICATIONS

DA EQUIPMENT PUBLICATIONS		
NOMENCLATURE	**EQUIPMENT PUBLICATION NUMBER**	**DATE AVAILABLE**

OTHER THAN OFFICIAL DA EQUIPMENT PUBLICATIONS			
NOMENCLATURE	**EQUIPMENT PUBLICATION NUMBER OR TYPE**	**DATE AVAILABLE**	**SOURCE OF SUPPLY**
Supplementary Operating Maintenance and Repair Parts Instruction	SOMARPI-5-3820- 245-		TACOM

APPENDIX B

MAINTENANCE ALLOCATION CHART

FOR

AUGER, EARTH, SKID MOUNTED
TYPE I (DED)

TEXOMA MODEL 270-9

Section I. INTRODUCTION

1. General: This Maintenance Allocation Chart designates responsibility for performance of Maintenance functions to specific Maintenance Categories.

2. Maintenance Functions:

a. Inspect: To determine the serviceability of an item by comparing its physical, mechanical and/or electrical characteristics with established standards through examination.

b. Test: To verify serviceability and detect incipient failures by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service: Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust: To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specific parameters.

e. Align: To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate: To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of a comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install: The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace: The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

APPENDIX B (Con't)

i. Repair: The application of maintenance services or other maintenance actions to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item or system.

j. Overhaul: The maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild: Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipments/components.

3. Column Entries: Columns used in the Maintenance Allocation Chart are explained below:

a. Column 1, Group Number: Column] lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Components/Assembly: Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions: Column 3 lists the functions to be performed on the item listed in Column 2.

d. Column 4, Maintenance Category: Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number of complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "work time" figures will be shown for each category. The number of man-hours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/ quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the Maintenance Allocation Chart.

APPENDIX B (Con't)

e. Column 5, Tools and Equipment: Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks: Column 6 contains an alphabetic code which leads to the remark in Section IV, Remarks, which is pertinent to the item opposite the particular code.

g. Maintenance Expenditure Limits: The average life expectancy for the auger is 12 years.

PERCENT OF REPAIR	YEAR
59%	1986
55%	1988
50%	1990
45%	1992
35%	1994
25%	1996
20%	1998

MAINTENANCE ALLOCATION CHART FOR
Auger, Earth, Skid Mounted, Type I

(MD SOP 700.5)

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIPMENT
			C	O	F	H	D	
01	Engine							1
0100	Engine Assy, Diesel	Service	0.5					1
		Test		2.0				
		Replace			8.0			
		Repair			16.0			
		Overhaul				80.0		
	Engine Mounts Replace				3.0			
0101	Crank Case, Block, Cylin- der Head							1
	Crankcase	Inspect				0.5		
		Repair				5.0		
	Cylinder Head Assy	Inspect			0.5			
		Replace			4.0			
		Repair				6.0		
	Cylinder Sleeve Assy	Replace				3.0		
0102	Crankshaft	Replace				10.0		1
	Crankshaft	Repair				8.0		
	Bearing Sleeve	Replace				2.0		
	Vibration Damper	Replace			1.0			
	Crankshaft Pulley	Replace			1.0			
	Seals	Replace				2.0		
0103	Flywheel, Assy							1
	Flywheel	Replace			1.5			
		Repair				2.0		
0104	Pistons, connecting Rods							1
	Pistons	Replace				2.0		
	Connecting Rods	Replace				2.0		
	Rings and Bearings	Replace				1.5		
0105	Valves, Camshaft & Timing System							
	Rocker Arm	Replace			1.0			
	Valve Spring	Test			1.0			
		Replace			2.5			
		Adjust			1.5			

MAINTENANCE ALLOCATION CHART FOR
Auger, Earth, Skid Mounted, Type I

(MD SOP 700.5)

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIPMENT
			C	O	F	H	D	
0106	Engine Lubrication System							1
	Oil Pan	Replace			1.5			
		Repair			1.0			
	Oil Pump	Replace			2.0			
		Repair				3.0		
	Oil Cooler	Replace			1.5			
		Repair			2.0			
	Oil Pressure Regulator	Adjust			0.2			
		Replace			0.5			
	Oil Filter Assy	Service		0.2				
		Replace			0.5			
		Repair			0.5			
	Oil Filter Element	Replace		0.3				
03	Fuel System							1
0301	Fuel Injector	Test			0.5			
		Adjust			0.5			
		Replace			1.0			
		Repair				1.0		
0302	Fuel Pump and Lines							1
	Fuel Pump	Test			0.5			
		Replace			2.0			
		Repair			3.0			
	Fuel Lines	Inspect	0.3					
		Replace		1.0				
0304	Air Cleaner							
	Air Cleaner	Service	0.5					
		Replace		0.5				
		Repair		1.0				
	Air Cleaner, Element	Replace		0.5				
		Service	0.2					
0306	Tank, Lines, Fittings, Headers							1
	Fuel Tank	Service	0.5					
		Replace		1.5				
		Repair			2.0			
	Lines and Fittings	Replace		2.0				
		Repair		1.0				

MAINTENANCE ALLOCATION CHART FOR
Auger, Earth, Skid Mounted, Type I

(MD SOP 700.5)

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIPMENT
			C	O	F	H	D	
0309	Fuel Filters							1
	Fuel Filters	Service	0.3					
		Replace		0.5				
	Fuel Strainers	Service	0.1					
		Replace		0.5				
0311	Engine Starting Aids							1
	Cold Start Kit	Service	0.1					
		Replace		0.5				
0312	Accelerator, Throttle Control							1
	Throttle Control	Adjust		0.5				
		Replace		1.0				
		Repair		0.5				
04	Exhaust System							1
0401	Muffler and Pipes							1
	Muffler and Pipes	Replace		1.0				
		Repair		1.0				
05	Cooling Systems							1
0501	Radiator							
	Radiator Assy	Service	0.2					
		Replace		2.0				
		Repair			2.0			
	Hoses, Radiator	Replace	0.8					
0502	Cowling, Defectors, Air Ducts, Shrouds							
	Shrouds	Replace		1.0				
		Repair		0.5				
0503	Water Manifold, Headers Thermostats & Housing Gasket							
	Thermostat	Test		0.2				
		Replace		0.5				
	Gasket	Replace		1.0				
	Hoses and Clamps	Replace		0.5				
	Hydraulic Oil	Inspect	0.1					

MAINTENANCE ALLOCATION CHART FOR
Auger, Earth, Skid Mounted, Type I

(MD SOP 700.5)

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIPMENT
			C	O	F	H	D	
0503	Cooler	Replace		1.0				
		Repair			2.0			
0504	Water Pump							1
	Pump Assy	Replace	1.0					
		Repair		1.0				
	Belt Drive	Adjust	0.2					
		Replace	0.5					
0505	Fan Assembly							1
	Fan	Inspect	0.1					
		Replace		0.5				
		Repair			1.0			
	Belt, Drive	Adjust		0.2				
		Replace		0.5				
06	Electrical System							1
0601	Alternator	Test		0.5				1
		Replace		0.5				
		Repair			1.5			
	Drive Belt	Adjust	0.2					
		Replace		0.5				
0602	Voltage Regulator							1
	Voltage Regulator	Test		0.5				
		Adjust			0.5			
		Replace			0.5			
0603	Starting Motor							1
	Starter	Test	0.5					
		Replace		1.0				
		Repair			2.0			
0606	Engine Safety Switches							1
	Switches	Replace		0.2				
0607	Instrument Panel	Inspect		0.2				1
	Gauges	Replace		0.5				
	Wires	Replace		0.5				
0608	Miscellaneous Items							1
	Fuses	Replace	0.1					

MAINTENANCE ALLOCATION CHART FOR
Auger, Earth, Skid Mounted, Type I

(MD SOP 700.5)

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIPMENT
			C	O	F	H	D	
0612	Batteries, Storage	Inspect	0.1					1
		Service		0.5				
		Replace		1.5				
0613	Wiring Harness	Replace		2.0				1
		Repair		3.0				
07	Transmissions							1
0700	Transmission	Service		0.5				1
		Replace			3.0			
		Repair				8.0		
		Overhaul				12.0		
15	Frame, Towing, Attachments and Drawbar							1
1501	Frame Assy	Replace				16.0		
		Repair			6.0			
18	Body, Cab, Hood, Hull							1
1801	Accustical Panels	Replace		1.0				1
1802	Seat	Replace	0.5					1
		Repair		1.0				
1803	Tool Box	Replace	0.5					1
		Repair		0.5				
20	Hoist, Winch, Cap Stan, Windlass, Power Control Unit, & Power Take-off							1
2001	Winch Assembly							1
	Reel, Wire	Replace		1.0				
		Repair		0.5				
	Winch Assembly	Adjust		0.3				
		Replace		2.5				
		Repair			1.0			
22	Body, Chassis & Hull Accessory Items							1

MAINTENANCE ALLOCATION CHART FOR
Auger, Earth, Skid Mounted, Type I

(MD SOP 700.5)

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIPMENT
			C	O	F	H	D	
2201	Transportation Plate							1
	Plate, Instruction	Replace		0.2				
	Plate, Identification	Replace		0.2				
24	Hydraulic & Fluid Systems							1
2401	Hydraulic Motor	Replace		1.5				1
		Repair			4.5			
	Hydraulic Pump	Replace		1.5				
		Repair			4.5			
2402	Control Valve	Adjust		0.1				1
		Replace		1.5				
		Repair			1.0			
2403	Hydraulic Controls and/or Manual Controls							1
	Handle, Control	Replace		0.2				
	Gage, Pressure	Adjust			0.2			
		Replace		1.0				
2406	Strainers, Filters, Hose Pipe Fittings, Tubing,etc.							1
	Strainer Assy	Service	0.1					
		Replace		0.2				
	Hose Assy	Replace		1.0				
2407	Cylinders, Hydraulic	Replace			1.5			1
		Repair				2.0		
2408	Liquid Tank & Reservoirs,							
	Cap, Breather	Service		0.1				1
		Replace		0.1				
	Tank, Oil	Replace		1.0				
		Repair			0.5			
74	Cranes, Shovels, & Earth Moving Equip Components							1
7474	Lift & Swing Mech Pole							
	Setter	Replace			3.0			1
		Repair			2.5			
7474	Drive Mechanism Drive right angle	Service		1.1				1

MAINTENANCE ALLOCATION CHART FOR
Auger, Earth, Skid Mounted, Type I

(MD SOP 700.5)

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIPMENT
			C	O	F	H	D	
7474	Drive Mechanism Drive, right angle	Adjust			0.5			
		Replace			4.0			
		Repair			3.0			
	Shaft, Drive	Service		0.1				
		Replace			1.0			
		Repair			0.5			
	Drive, Main Drill Head	Service		0.2				
		Adjust			0.5			
		Replace			4.0			
		Repair			3.0			
7475	Spindle & Cutter, Auger, Bits C Points	Replace		0.6				
		Repair			1.0			
7476	Feed & Leveling Arm Cylinder Brace	Replace		0.5				1
	Barrel, Ram Feed	Replace			3.0			
	Shaft, Feed Ram Kelly	Replace			3.0			
7477	Hand Controls C Linkage	Replace		1.0				
		Repair		0.5				

MAINTENANCE ALLOCATION CHART FOR
Auger, Earth, Skid Mounted, Type I

(MD SOP 700.5)

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1.		Unless otherwise noted, all maintenance functions can be accomplishes with the tools contained in the following common tool sets		
	F,H	Shop Equip Contact Maint Truck Mounted (SC 4940-97-CL-E05)	4940-00-294-9518	LIN T10138
	F,H	Shop Equip Gen Purp Repair Semitrir MTD (SC 4940-97-CL-E03)	4940-00-287-4894	LIN T10549
	F,H	Shop Equip Org Repair Light Truck MTD (SC 4940-97-CL-E04)	4940-00-294-9516	LIN T13152
	F,H	Tool Kit Automotive Fuel and Elec Sys Repair (SC 4910-95-CL-A50)	4910-00-754-0655	LIN W32456
	O,F,H	Tool Kit Auto Maint: ORG Maint Common #1 (SC 4910-95-CL-A74)	4910-00-754-0654	LIN W32593,
	O,F,H	Tool Kit Auto Maint: ORG Maint Common #2 (SC 4910-95-CL-A72)	4910-00-754-0650	LIN 132730
	O,F,H	Tool Kit Auto Mech: Light Weight (SC 5180-90-CL-W26)	5180-00-177-7033	LIN W33004
	F,H	Tool Kit Master Mech: Equip Maint & Repair (SC 5180-90-CL-E05)	5180-00-699-5273	LIN W45060
	F,H	Wrench Set Socket:.3/4" Drive Hex Type	5130-00-357-5135	LIN Y75239
	F,H	Wrench Torque: 3/4" Drive 100-500 lb Capacity	5120-00-542-5577	LIN Y84966
	F,H	Shop Eqp Fuel & Elec Sys Engine (SC 4910-95-CL-A01)	4910-00-754-0714	T30414
	F,H	Shop Set Fuel & Elec Sys Supp No 2 (SC 4910-95-CL-A65)	4910-00-390-7775	T30688
	F,H .	Test Set DSL-Inj.	4910-00-317-8265	V73742

MAINTENANCE ALLOCATION CHART FOR
Auger, Earth, Skid Mounted, Type I

(MD SOP 700.5)

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
	F,H	Shop Eqp Auto Maint & Repair Org Supply No. 1 Less Power (SC 4910-95-CL-A73)	4910-00-754-0653	W32867
	F,H	Shop Eqp Machine Shop	3740-00-754-0708	T15644
	F,H W44512	Tool Kit Machinist (SC 5280-95-CL-A02)		5280-00-511-1950
	F,H	Shop Eqp Welding (SC 3970-95-CL-A08)	3740-00-357-7268	T16714
	F,H	Tool Kit Body & Fender Repair	5180-00-754-0643	W33680
	F,H	Multimeter	6625-00-999-7465	M80242

MAINTENANCE ALLOCATION CHART FOR
Auger, Earth, Skid Mounted, Type I

(MD SOP 700.5)

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS

(1) Reference CODE	(2) Maintenance LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NO.
	F,H	Tool Packing-Lower		16949
	F,H	Ratcheting Chain; Wrench 24 inch lg, 887-D (45225)		887-D
	F,H	Torque Wrench; 2500 Ft Lb, Model PD250	5120-00-482-2543	YB17A7

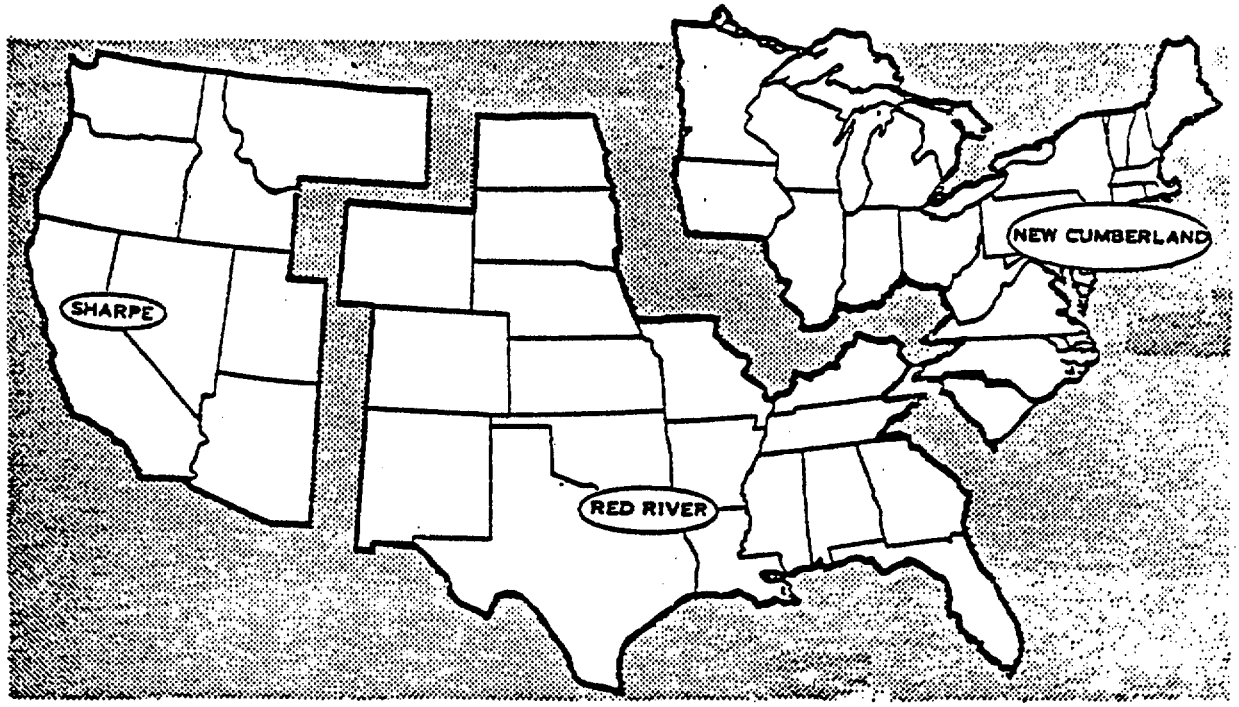
SECTION IV. REMARKS

REFERENCE CODE	REMARKS

APPENDIX C

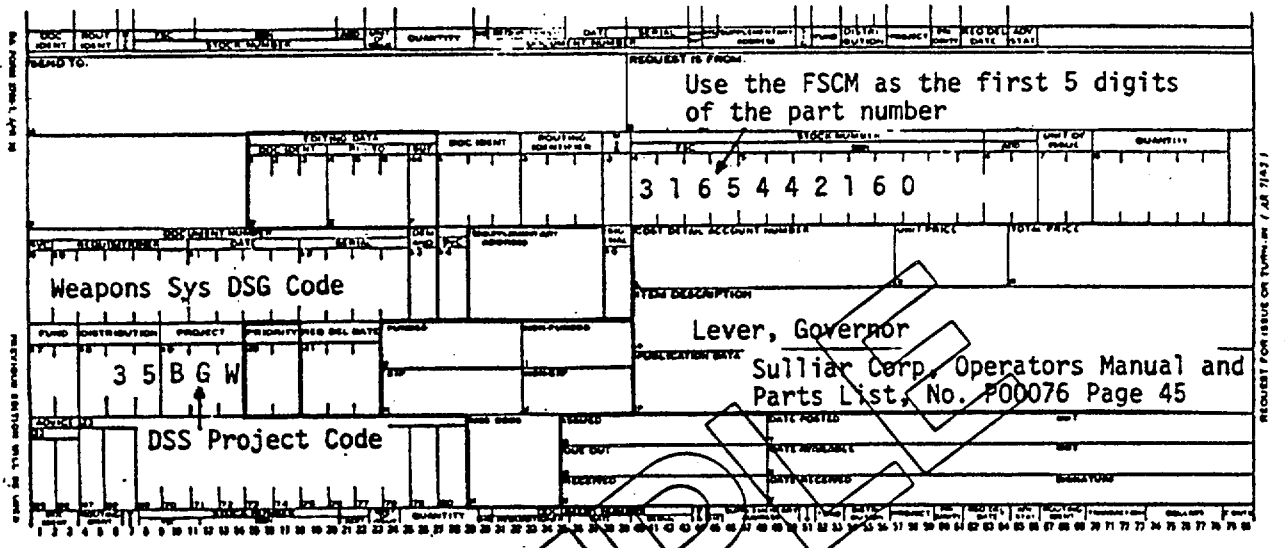
DSS PROJECT CODES

Geographic Location	*ASL*	*NSL*
CONUS (Eastern US)	XDC	NSC
CONUS(Central US)	XDA	NSA
CONUS (Western US)	XDB	NSB

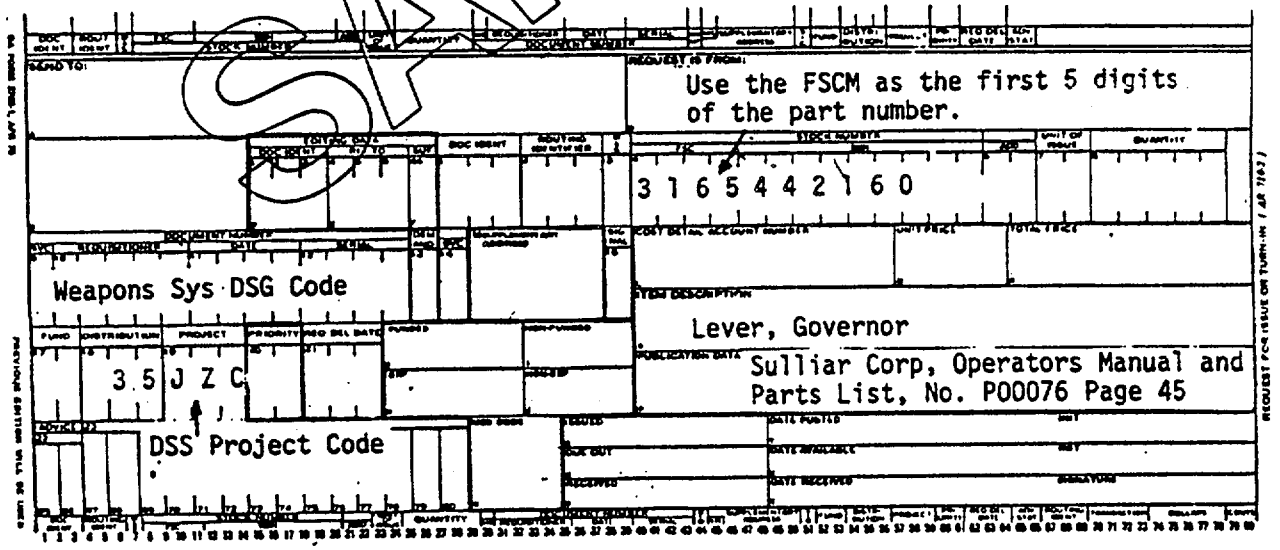


Designated distribution depot support areas.

APPENDIX D



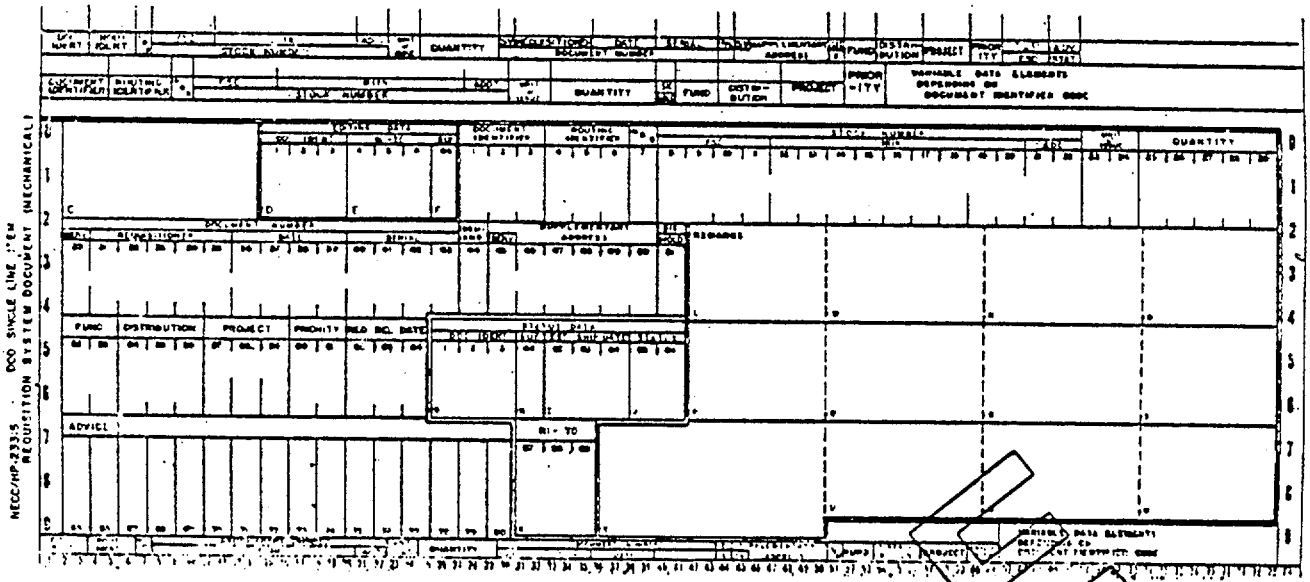
Sample format - DA Form 2765 Part number request (CONUS REQUESTER)



Sample format - DA Form 2765 Part number request (OCONUS REQUESTER)

TA072409

APPENDIX E

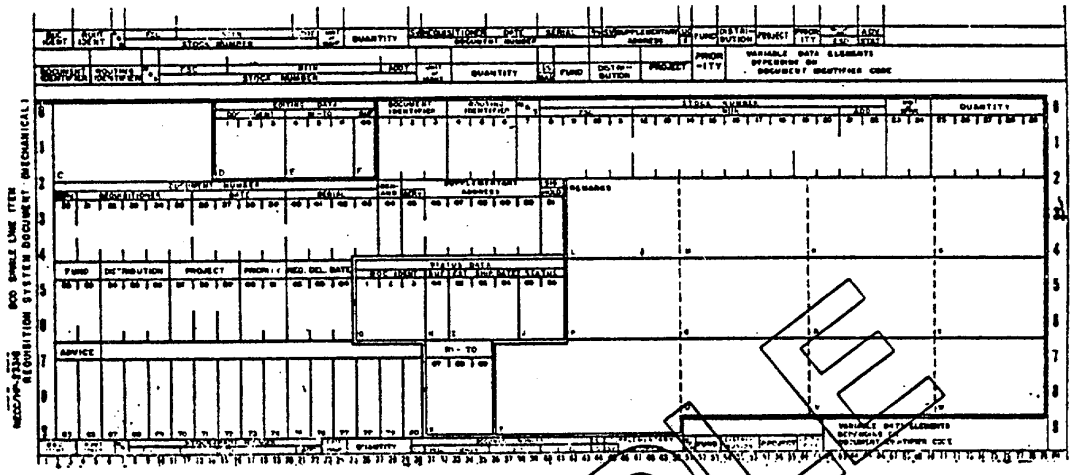


Card Column	Description of Data	Mandatory Entry for CCE
1-3	Document Identifier Code	AØA - CONUS AØ1 - Overseas
4-6	Routing Identifier Code	
7	Media/Status Code	
8-22	NSN	
23-24	Unit of Issue	
25-29	Quantity	
30-43	Document Number	
44	Demand Code	
45-50	Supplementary Address	
51	Signal Code	
52-53	Fund Code	
54-56	Distribution Code CC-54	"F" for CONUS; see AR 725-50 for OCONUS
	CC-55-56	Weapons System Code (DSS) Code
57-59	Project Code	
60-61	Priority Code	
62-64	Required Delivery Date	
65-66	Advice Code	

Sample format - Milstrip requisition for CCE (NSN)

TA072410

APPENDIX E



CARD COLUMN	DESCRIPTION OF DATA	MANDATORY ENTRY FOR CCE
1-3	Document Identifier Code	AØB - CONUS AØ2 - Overseas
4-6	Routing Identifier Code	Always S9C
7	Media/Status Code	
8-22	FSCM and Part Number	
23-24	Unit of Issue	
25-29	Quantity	
30-43	Document Number	
44	Demand Code	
45-50	Supplementary Address	
51	Signal Code	
52-53	Fund Code	
54-56	Distribution Code CC-54	"F" for CONUS; see AR 725-50 for OCONUS
	CC-55-56	Weapons System Code CCE (DSS) Code
57-59	Project Code	
60-61	Priority Code	
62-64	Required Delivery Date	
65-66	Advice Code	
67-69	Blank	
70	Identification code applicable to entry in cc 71-80. A - Technical order or Technical Manual. B - End Item Identification C - Noun Description D - Drawing or Specification No.	
71-80	Reference Identification	Identification of reference specified in cc 70.

Sample format - MILSTRIP requisition for CCE (Non-NSN).

TAO72411

APPENDIX E

INSTRUCTIONS

This form will only be used in those cases where the manufacturer' s code and part number exceed the spaces allocated in card columns 8 - 22 of the requisition.

CARD COLUMN	DESCRIPTION DATA	MANDATORY ENTRY FOR CCE
1 - 3	Document Identifier Code	A∅E - CONMS A∅5 - OCONUS
4 - 6	Routing Identifier Code	Always S9C
7	Media Status Code	
8 - 22	PSCM and Part Number	Leave Blank Enter In Block 1 under Identification Data
23 - 24	Unit of Issue	
25 - 29	Quantity	
30 - 43	Document Number	
44	Demand Code	
45 - 50	Supplementary Address	
51	Signal Code	
52 - 53	Fund Code	
54 - 56	Distribution Code CC 54	"F" for CONUS. (See AR 725-50 for OCOUNS)
	CC 55-56	Weapon System Code
57 - 59	Project Code	
60 - 61	Priority Code	
62 - 64	Required Delivery Date	
65 - 66	Advice Code	
67 - 80		Blank

IDENTIFICATION DATA - Lower half of DD For 13148-6, complete Blocks 1 thru 9.

APPENDIX F

DOCU-MENT IDENTI-FIER	ROUT-ING IDENTI-FIER	M & S	MANUFACTURER'S CODE * AND PART NUMBER		UNIT OF ISSUE	QUANTITY	DOCUMENT NUMBER			
			FSCM	PART NUMBER			SERV	REQUISI-TIONER	DATE	SERIAL
1 2 3	4 5 6	7	8 9 10 11 12	13 14 15 16 17 18 19 20 21 22	23 24	25 26 27 28 29	30 31	32 33 34 35 36	37 38 39	40 41 42 43

DEMAND	SUPPLEMENTARY ADDRESS		SIGNAL	FUND CODE	DISTRI-BUTION CODE	PROJ-ECT CODE	PRIOR-ITY	REQUIRED DELI-VERY DATE	ADVICE CODE	BLANK		REJECT CODE (FOR USE BY SUPPLY SOURCE ONLY)	
	SERV												
44	45 46	47 48 49 50	51	52 53	54 55 56	57 58 59	60 61	62 63 64	65	66 67	68 69 70 71 72	73 74 75 76 77 78 79 80	65 66

IDENTIFICATION DATA

* 1. MANUFACTURER'S CODE & PART NO. *(When they exceed Card Columns 8 thru 22)*	2. MANUFACTURER'S NAME
3. MANUFACTURER'S CATALOG IDENTIFICATION AND DATE	4. TECHNICAL ORDER NUMBER
5. TECHNICAL MANUAL NUMBER	6. NAME OF ITEM REQUESTED
7. DESCRIPTION OF ITEM REQUESTED	7a. COLOR 7b. SIZE
8. END ITEM APPLICATION AND SOURCE OF SUPPLY	
8a. MAKE	8b. MODEL NUMBER / 8c. SERIES / 8d. SERIAL NUMBER
9. REQUISITIONER *(Clear Text Name and Address)*	10. REMARKS

FOLD LINE FOLD LINE

SAMPLE

DD FORM 1 APR 77 1348-6 EDITION OF 1 MAR 74 MAY BE USED UNTIL EXHAUSTED

NON-NSN REQUISITION *(MANUAL)*

Sample Format - MILSTRIP requisition for CCE (Non-NSN) (Manual)

APPENDIX G

BASIC ISSUE ITEMS LIST (CCE)

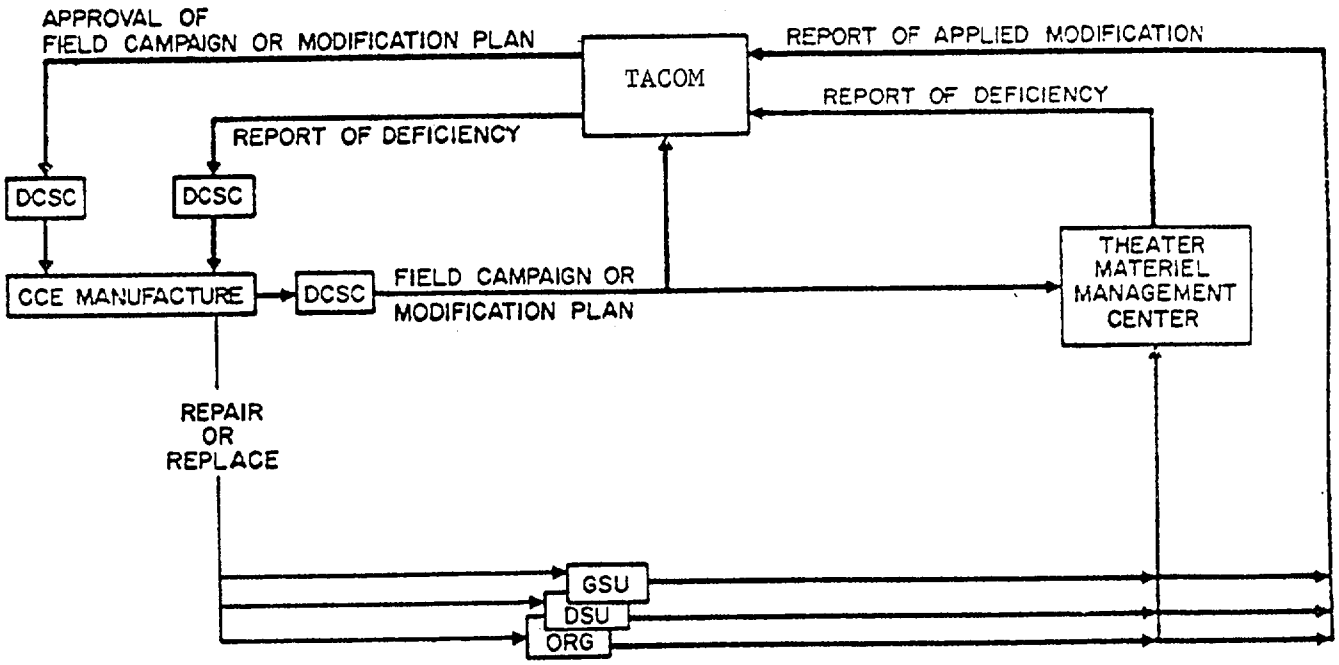
(1) MFR PART NO.	(2) MFR FED NO.	(3) DESCRIPTION	(4) UNIT OF ISSUE	(5) QUANTITY FURNISHED W/EQUIP
29137	03476	Auger Bits, 9 inch	Each	1
29138	03476	Auger Bits, 12 inch	Each	1
29130	03476	Auger Bits, 16 inch	Each	1
29157	03476	Auger Bits, 24 inch	Each	1
36185	03476	Undereamer, 24 inch	Each	1
16949	03476	Tool, Packing, Lower	Each	1
19186	03476	Wrench - Chain	Each	1

ITEMS TROOP INSTALLED OR AUTHORIZED LIST

(1) SMR CODE	(2) NATIONAL STOCK NUMBER Code	(3) DESCRIPTION Ref No. & MFR On Code Usable MEASURE	(4) UNIT OF	(5) QTY AUTH

APPENDIX H

CCE MANUFACTURER FIELD CAMPAIGNS AND MODIFICATION PROCEDURES



-----FLOW OF REPORTING

-----FIELD CAMPAIGN OR MODIFICATION PLAN

TA072413

PRESCRIBED LOAD LIST (PLL)
AUTHORIZED STOCKAGE LIST (ASL)

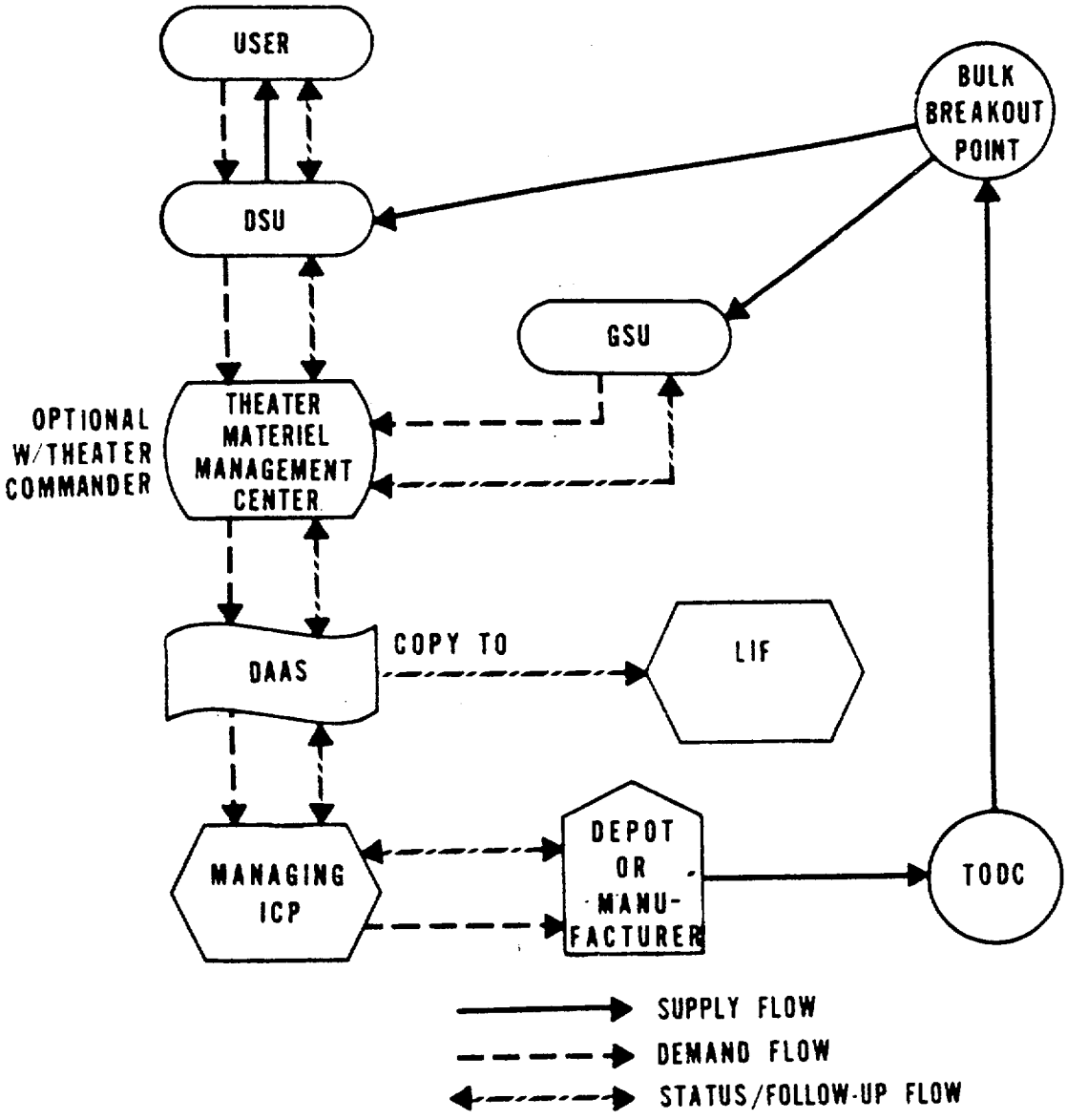
END ITEM: AUGER, EARTH, SKID MOUNTED TYPE I	MAKE: TEXOMA	MODEL:
MFR PART NO:	NSN:	SERIAL NUMBER RANGE _____TO_____ DATE:

SMR CODE	NATIONAL STOCK NUMBER	PART NUMBER	FSCM	PART DESCRIPTION	Est. Price	U/M	Qty of Parts Req'd for No. Of End Items			
							PLL	ASL		
							1-5	1-5	6-20	21-50
PAOZZ	2910-00-287-5473	5573263	70040	Element, Fuel Filter			1	3	6	6
PAOZZ	2910-00-792-8985	AT553	81136	Element, Fuel Strainer			1	3	6	6
PAOZZ	2940-00-019-8087	PF147	70040	Element, Oil Filter			1	2	3	4
PAOZZ	3030-00-865-2470	5131395	72582	Belt, Set Crankshaft Pulley			1	1	2	2
PAOZZ	4330-00-297-2359	J-25	08832	Element, Filter Hydraulic			1	2	4	6
PAOZZ	2940-00-825-4400	CH200PL	73370	Element, Filter Transmission			1	1	2	2

APPENDIX J

FLOW OF REQUISITIONS AND MATERIEL

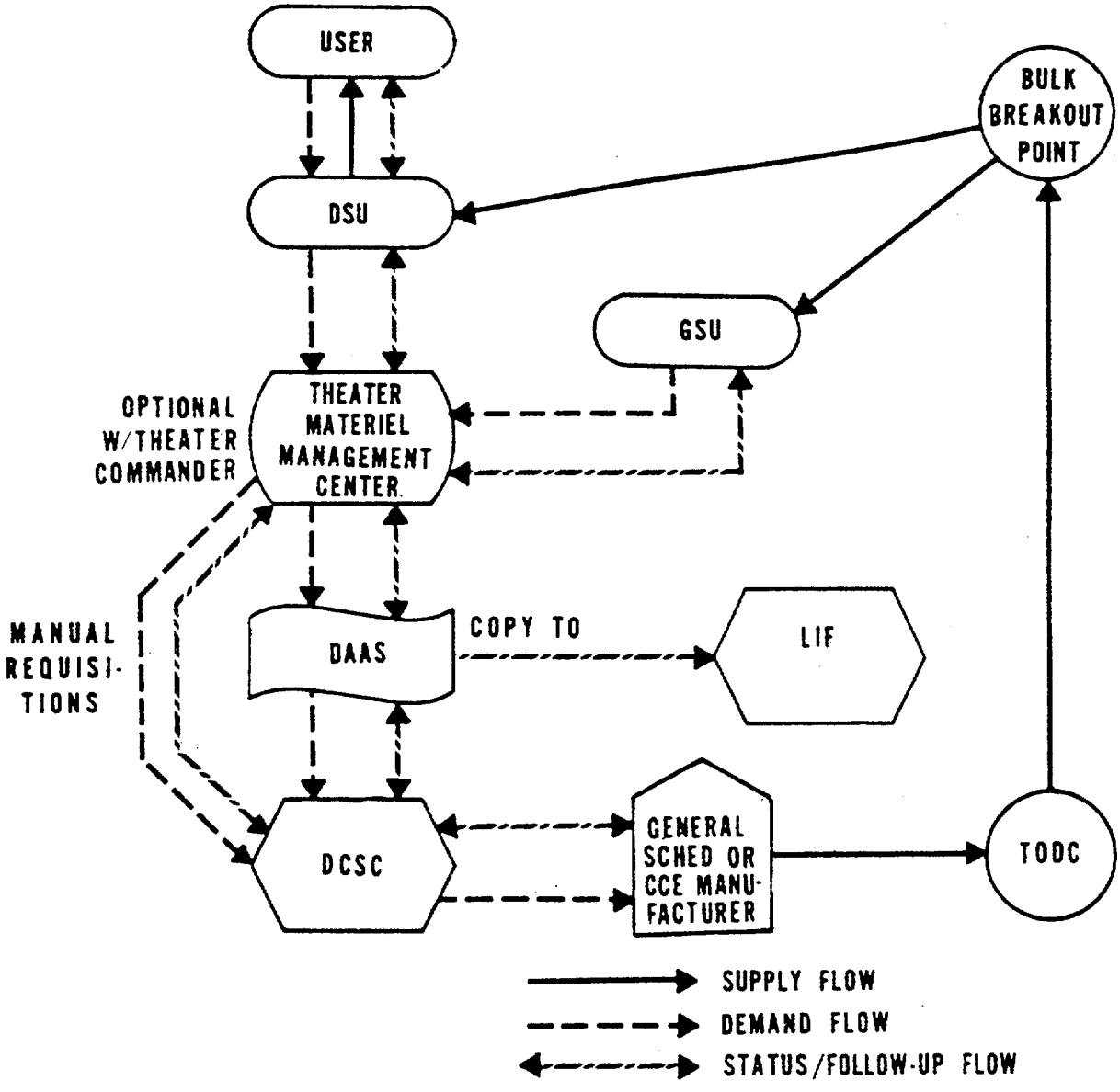
CCE PARTS (NSN)



APPENDIX K

FLOW OF REQUISITIONS AND MATERIEL

CCE PARTS (NON-NSN)



USER MAINTENANCE SUPPORT PLAN

APPENDIX L

MAINTENANCE AND OPERATING SUPPLY LIST (CCE)

NOMENCLATURE: AUGER, EARTH, SKID MOUNTED, TYPE I	MAKE TEXOMA	MODEL: 270-9
MFR PART NO: 270-9	NSN: 3820-01-146-7204	SERIAL NUMBER RANGE _____TO_____ DATE:

(1) COMPONENT APPLICATION	(2) MFR PART NO. NAT'L STOCK NO.	(3) DESCRIPTION	(4) QTY REQ F/INITIAL OPN	(5) QTY REQ F/8 HOURS OPN	(6) NOTES
Engine Transmission Torque Converter Hydraulic System Grease Lubrication Points		See Part II, Page 5 of this SOMARPI, For Lubrication NSNs.			

APPENDIX M

OPERATOR/CREW

PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

1. Maintenance Forms and Records

Every mission begins and ends with the paperwork. There isn't much of it, but you have to keep it up. The forms and records you fill out have several uses. They are a permanent record of the services, repairs, and modifications made on your equipment. They are reports to organizational maintenance and to your commander. And they are a checklist for you when you want to know what is wrong with the equipment after its last use, and whether those faults have been fixed. For the information you need on forms and records, refer to DA PAM 738-750.

2. Preventive Maintenance Checks and Services

a. Do your before (B) PREVENTIVE MAINTENANCE just before you operate the equipment. Pay attention to the CAUTIONS and WARNINGS.

b. Do your during (D) PREVENTIVE MAINTENANCE while you operate the equipment, and at halts or rest stops.

c. Do your after (A) PREVENTIVE MAINTENANCE right after operating the equipment. Pay attention to the CAUTIONS AND WARNINGS.

d. Do your weekly (W) PREVENTIVE MAINTENANCE weekly.

e. Do your monthly (M) PREVENTIVE MAINTENANCE once a month.

f. If something doesn't work, troubleshoot it with the instructions in this manual or notify your supervisor.

g. Always do your PREVENTIVE MAINTENANCE in the same order so it gets to be a habit. Once you've had some practice, you'll spot anything wrong in a hurry.

h. If anything looks wrong and you can't fix it, write it on your DA Form 2404. If you find something seriously wrong, report it to organizational maintenance RIGHT NOW.

i. When you do your PREVENTIVE MAINTENANCE, take along the tools you need to make all the checks. You always need a rag or two.

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Always wear protective goggles, and gloves and use only in 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 solvent's flash point is 100°F-138°F (38°C-59°C). If you become dizzy while using cleaning solvent, immediately get fresh air and get medical help. If solvent contacts eyes, immediately wash your eyes with water and get medical aid.

(1) Keep it clean: Dirt, grease, oil and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use dry cleaning solvent (P-D-680) on all metal surfaces. Use soap and water when you clean rubber or plastic material.

(2) Bolts, nuts and screws: check them all for obvious looseness, missing, bent or broken condition. You can't try them all with a tool, of course, but look for chipped paint, bare metal or rust around bolt heads. If you find one you think is loose, tighten it, or report it to organizational maintenance if you can't tighten it.

(3) Welds: Look for loose or chipped paint, rust or gaps where parts are welded together. If you find a bad weld, report it to organizational maintenance.

(4) Electric wires and connectors: Look for cracked or broken insulation, bare wires and loose or broken connectors. Tighten loose connectors and make sure the wires are in good shape.

(5) Hoses and fluid lines: Look for wear, damage and leaks and make sure clamps and fittings are tight. Wet spots show leaks, of course. But a stain around a fitting or connector can mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, report to organizational maintenance.

j. It is necessary for you to know how fluid leakage affects the status of your equipment. The following are definitions of the types/classes of leakage an operator or crew member needs to know to be able to determine the status of his/her equipment. Learn, then be familiar with them and REMEMBER - WHEN IN DOUBT, NOTIFY YOUR SUPERVISOR.

LEAKAGE DEFINITIONS FOR OPERATOR/CREW PMCS

Class I	See page of fluid (as indicated by wetness or discoloration) not enough to form drops.
Class II	Leakage of fluid great enough to form drops, but not enough to cause drops to drip from item being checked/inspected.
Class III	Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

- **EQUIPMENT OPERATION IS ALLOWABLE WITH MINOR LEAKAGES (CLASS I OR II). OF COURSE, CONSIDERATION MUST BE GIVEN TO THE FLUID CAPACITY IN THE ITEM/SYSTEM BEING CHECKED/INSPECTED. WHEN IN DOUBT, NOTIFY YOUR SUPERVISOR.**
- **WHEN OPERATING WITH CLASS I OR II LEAKS, CONTINUE TO CHECK FLUID LEVELS AS REQUIRED IN YOUR PMCS.**
- **CLASS III LEAKS SHOULD BE REPORTED TO YOUR SUPERVISOR OR TO ORGANIZATIONAL MAINTENANCE FOR CORRECTIVE ACTION.**

OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B - BEFORE D - DURING A - AFTER W - WEEKLY M - MONTHLY
AUGER, EARTH, SKID MOUNTED MODEL 270-9

ITEM NO	INTERVAL					ITEM TO BE INSPECTED PROCEDURE:CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/AVAILABLE IF:
	B	D	A	W	M		
						PERFORM WEEKLY AS WELL AS BEFORE PMCS IF:	
						a. You are the assigned operator but have not operated the unit since the last weekly.	
						b. You are operating the equipment for the first time.	
1						GENERAL	
	•	•				Look for evidence of fluid leakage (oil, fuel, coolant).	Class III leaks are found or any fuel leakage.
2						ENGINE CRANKCASE	
	•					Check dipstick for proper level.Add oil as necessary to full mark.	
3						RADIATOR	
						WARNING	
						Radiator cooling system is pressurized. Remove cap slowly and only when engine is cool or painful burns could result.	
				•		Check coolant level. Add coolant as required. (Level should be approxi- one inch from bottom of filler neck).	
4						CONTROLS AND INSTRUMENTS (CHECK FOR PROPER INDICATION AND OPERATION)	
		•				a. Engine coolant temperature gauge 160°-1850F (71°-850C).	
		•				b. Engine oil pressure gauge 18 psig at 1200 rpm (idle speed).	
		•				c. Ammeter slight (+) charge.	
		•				d. Tachometer/hours meter 550 rpm - idle, 2500 rpm - max	

OPERATOR/CREW PREVENTIVE MAINTENANCE CHECKS AND SERVICES

B - BEFORE D - DURING A - AFTER W - WEEKLY M - MONTHLY
AUGER, EARTH, SKID MOUNTED MODEL 270-9

ITEM NO	INTERVAL					ITEM TO BE INSPECTED PROCEDURE:CHECK FOR AND HAVE REPAIRED, FILLED, OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/AVAILABLE IF:
	B	D	A	W	M		
5						AIR FILTER (ENGINE)	
					•	Check air cleaner.	Check air cleaner more frequently based on conditions on areas of operation (e.g., if dirty, organizational maintenance replaces).
						V BELTS	
				•		Check for frayed, cracked, or broken belts.	V Belts missing or broken.
						FOUR SPEED TRANSMISSION	
				•		Check oil level weekly. Fill to level plug.	

APPENDIX N

ORGANIZATIONAL
PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

1. General

a. To make sure that your equipment is ready for operation at all times, inspect it systematically so you can discover any defects and have them corrected before they result in serious damage or failure. The charts on the next few pages contain your organizational PMCS. The item numbers indicate the sequence of minimum inspection requirements. If you're operating the equipment and notice something wrong which could damage the equipment if you continue operation, stop operation immediately.

b. Record all deficiencies and shortcomings, along with the corrective action taken, on DA Form 2404. The Item Number column is the source for the numbers used on the TM Number column on DA Form 2404.

2. Preventive Maintenance Checks and Services

a. Do your quarterly (Q) PREVENTIVE MAINTENANCE every three months.
b. Do your semiannually (S) PREVENTIVE MAINTENANCE every six months.
c. Do your annually (A) PREVENTIVE MAINTENANCE once every year.
d. Do your biennially (B) PREVENTIVE MAINTENANCE once every two years.
e. Do your hourly (H) PREVENTIVE MAINTENANCE at the interval listed.
f. Do your mile (M) PREVENTIVE MAINTENANCE at the mile interval listed.
g. If something doesn't work, troubleshoot it according to the instructions in this manual or notify your supervisor.
h. Always do your preventive maintenance in the same order so it gets to be a habit. Once you've had some practice, you'll spot anything wrong in a hurry.
i. If anything looks wrong and you can't fix it, write it down on your DA Form 2404. If you find something seriously wrong, report it to direct support maintenance RIGHT NOW.
j. When you do your PREVENTIVE MAINTENANCE, take along the tools you need to make all the checks. You always need a rag or two.

WARNING

- **Dry cleaning solvent P-D-680 is toxic and flammable. wear protective goggles, and gloves and use only in 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, immediately get fresh air and medical aid. If solvent contacts eyes, immediately wash your eyes with water and get medical aid.**

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

(1) Keep it clean: Dirt, grease, oil and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use dry cleaning solvent (P-D-680) on all metal surfaces. Use soap and water when you clean rubber or plastic material.

(2) Bolts, nuts and screws: Check them all for obvious looseness, missing, bent or broken condition. You can't try them all with a tool, of course, but look for chipped paint, bare metal, or rust around bolt heads. Tighten any bolt, nut, or screw that you find loose.

(3) Welds: Look for loose or chipped paint, rust, or gaps where parts are welded together. If you find a bad weld, report it to direct support.

(4) Electric wires and connectors: Look for cracked or broken insulation, bare wires, and loose or broken connectors. Tighten loose connections and make sure the wires are in good shape.

(5) Hoses and fluid lines: Look for wear, damage, and leaks, and make sure clamps and fittings are tight. Wet spots show leaks, of course. But a stain around a fitting or connector can also mean a leak. If a leak comes from a loose fitting or connector, tighten the fitting or connector. If something is broken or worn out, either correct it or report it to direct support (refer to the Maintenance Allocation Chart).

k. It is necessary for you to know how fluid leakage affects the status of your equipment. The following are definitions of the types/classes of leakage you need to know to be able to determine the status of your equipment. Learn and be familiar with them and REMEMBER - WHEN IN DOUBT, NOTIFY YOUR SUPERVISOR!.

LEAKAGE DEFINITIONS FOR ORGANIZATIONAL PMCS

Class I	Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
Class II	Leakage of fluid great enough to form drops, but not enough to cause drops to drip from the item being checked/inspected.
Class III	Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

- **EQUIPMENT OPERATION IS ALLOWABLE WITH MINOR LEAKAGES (CLASS I OR II). OF COURSE, CONSIDERATION MUST BE GIVEN TO THE FLUID CAPACITY IN THE ITEM/SYSTEM BEING CHECKED/INSPECTED. WHEN IN DOUBT, NOTIFY YOUR SUPERVISOR.**
- **WHEN OPERATING WITH CLASS I OR II LEAKS, CONTINUE TO CHECK FLUID LEVELS AS REQUIRED IN YOUR PMCS.**
- **CLASS III LEAKS SHOULD BE REPORTED TO YOUR SUPERVISOR.**

ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

Q - QUARTERLY **S - SEMIANNUALLY** **A - ANNUALLY** **B - BIENNIALLY** **H - HOURS** **M - MILES**

AUGER, EARTH, SKIT MOUNTED MODEL 270-9

ITEM NO.	INTERVAL Q	S	A	B	H	M	ITEM TO BE INSPECTED PROCEDURE: CHECK FOR AND HAVE REPAIRED, FILLED OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/ AVAILABLE IF;
1					8		ENGINE Check for leaks, loose mounts and proper operation.	
2					150		OIL FILTER Change oil filter.	Army Oil Analysis Program will be used in lieu of hourly interval.
3					300		FUEL FILTER AND STRAINER Change filter and strainer.	
4					200		V BELTS Check tension.	
5					1000		RADIATOR (15 Qt. Coolant Capacity) a. Check for leaks and clean exterior as required. b. Check antifreeze protection. c. Drain, flush, and fill radiator and engine.	
6					500		AIR FILTER Replace element. (Change more frequently in dusty conditions.)	
7					500		FUEL TANK Drain of any water or sediment.	

ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

Q - QUARTERLY **S - SEMIANNUALLY** **A - ANNUALLY** **B - BIENNIALLY** **H - HOURS** **M - MILES**

AUGER, EARTH, SKIT MOUNTED MODEL 270-9

ITEM NO.	INTERVAL Q	S	A	B	H	M	ITEM TO BE INSPECTED PROCEDURE: CHECK FOR AND HAVE REPAIRED, FILLED OR ADJUSTED AS NEEDED	EQUIPMENT IS NOT READY/ AVAILABLE IF;
8					100		BATTERY Check specific gravity of electrolyte in each cell (more frequently in warm weather).	
9					1000		HYDRAULIC OIL SYSTEM Change fluid and filter.	
10					500		FOUR SPEED TRANSMISSION Drain, flush, and fill to level plug (13 qt.).	
11					1000		RIGHT ANGLE DRIVE Drain, flush, and fill to level plug (3 qt.).	
12					1000		FINAL DRIVE Drain, flush, and fill to level gage (31 qt.).	
13					1000		WINCH Drain, flush, and fill to level plug (1 qt.).	
14					100		ENGINE CRANKCASE OIL PAN Drain and refill to full mark (12 qt.).	Army Oil Analysis Program will be used in lieu of hourly interval.

APPENDIX O

CROSS REFERENCE LIST

EARTH. AUGER, MODEL 270-9

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
5929	03476	MS15003-1	96906
5939	03476	MS24665-353	96906
5941	03476	MS24665-627	96906
5962	03476	MS35338-46	96906
5963	03476	MS90728-174	96906
5965	03476	MS35338-51	96906
5972	03476	MS35307-413	96906
5975	03476	MS35338-48	96906
5988	03476	MS90725-62	96906
5989	03476	MS35338-46	96906
5993	03476	MS35309-420	96906
6093	03476	MS90725-32	96906
6096	03476	MS35307-334	96906
6119	03476	RS5305-W	08162
6121	03476	52400	60038
6122	03476	52618	60038
6127	03476	3984	60038
6130	03476	53176	60038
6131	03476	53375	60038
6284	03476	MS90725-14	96906
6289	03476	MS51873-101	96906
6291	03476	MS17828-8C	96906
6351	03476	MS35338-49	96906
6655	03476	MS51953-29	96906
6662	03576	NIPPLE - 1" NPT X 1-1/2 - XH	80996
6665	03476	ELBOW - 450 - 1" NPT - XH	80996
6718	03476	MS24665-287	96906
6881	03476	MS90728-70	96906
7169	03476	MS16995-96	96906
7173	03476	MS51873-101	96906

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
7774	03476	497	60038
7775	03476	493	60038
7801	03476	MS35307-472	96906
7802	03476	MS90728-176	96906
7810	03476	MS90725-199	96906
8278	03476	MS90725-136	96906
8279	03476	MS90725-197	96906
8314	03476	ELBOW 90 DIG 1/2 NPT-XH	80996
8332	03476	11091-4	05573
8334	03476	BUSHING - HEX - 3/4 X 1/2 X H	80996
8357	03476	MS51953-80	96906
8370	03476	8444230-2	19204
8747	03476	8NOX - 8FPX - 90	24161
9134	03476	MS90725-62	96906
9440	03476	MS51968-14	96906
9450	03476	MS51953-86	96906
9894	03476	68712	60038
9895	03476	68462	60038
11166	03476	UC-1306-TAM	24617
11167	03476	55443	60038
11168	03476	55187C	60038
15010	03476	C/L-09-13042** 6 IN. DIA X 1 IN BORE JAPANNED FINISH - 1-1/16 HUB*	76257
15145	03476	1525-6	01276
16076	03476	BAS00-009	18265
16083	03476	MS35338-46	96906
16200	03476	AS11-212	11314
16218	03476	S1352-1	13829
16219	03476	P1532	13829
16221	03476	H1329	13829
16222	03476	A1327-174	13829
16223	03476	SHW1182	13829
16225	03476	SHJ1317-2	13829

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
16226	03476	SHEA1023-2	13829
16227	03476	SHFA1023	13829
16229	03476	AM1311	13829
16231	03476	C1530--3	13829
16232	03476	A1327-119	13829
16233	03476	AS11-216	11314
16234	03476	M1021	13829
16237	03476	AS-11-129	11314
16238	03476	L3006-108	13829
16240	03476	DA 1023	13829
16242	03476	G1048	13829
16280	03476	3084	23911
16332	03476	402044	23911
16339	03476	342120	23911
16341	03476	334016	23911
16341	03476	442010	23911
16357	03476	623006	81596
16410	03476	328057	23911
16411	03476	442020	23911
16412	03476	494010	23911
16413	03476	494020	23911
16414	03476	352020	23911
16415	03476	474004	23911
16416	03476	314003	23911
16417	03476	400007	23911
16418	03476	340024	23911
16420	03476	442019	23911
16423	03476	406	23911
16424	93476	308048	23911
16426	03476	342123	23911
16427	03476	486012	23911
16528	03476	300007	23911

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
16430	03476	324205	23911
16432	03476	494006	23911
16433	03476	332004	23911
16434	03476	362007	23911
16435	03476	324102	23911
16436	03476	400003	23911
16437	03476	494011	23911
16438	03476	414971	23911
16439	03476	412005	23911
16440	03476	370005	23911
16441	03476	338026	23911
16562	03476	SP-5-188X	95019
16600	03476	62272S32	76680
16622	03476	623003	81596
16781	03476	4X20X25X52	02892
16782	03476	A907X5	02892
16783	03476	713X36	02892
16784	03476	AS-11-134	11314
16786	03476	2X20X78	02892
16787	03476	Z754X4	02892
16788	03476	812X137	02892
16789	03476	A506X12	02892
16790	03476	10X20X3	02892
16791	03476	10X20X5	02892
16792	03476	812X90	02892
16793	03476	A395X25	02892
16796	03476	AS11-249	11314
16797	03476	6X2025X2	02892
16798	03476	A340X34	02892
16799	03476	A136X14	02892
16800	03476	6X20-25X6	02892
16801	03476	834X6	02892
16802	03476	A956X4	02892

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
16803	03476	12X20X5	02892
16804	03476	3X20X43	02892
16805	03476	416X121	02892
16806	03476	A501X438	02892
16807	03476	513X13A	02892
16808	03476	A848X33	02892
16809	03476	A985X1	02892
16810	03476	A395X19	02892
16812	03476	1X2025X30	02892
16821	03476	M500-B	27473
16886	03476	705-1171	70842
16888	03476	705-1013	70842
16891	03476	4-1203-0-R-H30	70842
16895	03476	705-1027	70842
16897	03476	5611-60-06A	37562
16900	03476	M15001-2	57733
17029	03476	346006	23911
17223	03476	438001	23911
18286	03476	SA1838N	53800
18379	03476	MS15003-6	96906
18380	03476	996259R92	89346
18381	03476	99183R91	89346
18449	03476	41230	01943
18450	03476	503	60894
18602	03476	S8PP	21335
18603	03476	P50A-378-BEOR-25-7	13829
19156	03476	9	65029
20054	03476	4F18002	96105
20054	03476	4F18002	96105
20103	03476	4012700	96105
20104	03476	4012970	96105
20107	03476	12211	96105

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
20108	03476	F65015	96105
20109	03476	4012213	96105
20110	03476	F200004	96105
20114	03476	4012219	96105
20117	03476	4012222	96105
20129	03476	40121245	96105
20130	03476	4000456	96105
20131	03476	4000595	96105
20135	03476	4012241	96105
20136	03476	F74000-160	96105
20137	03476	4012246	96105
20138	03476	F25125-16	96105
20139	03476	4012248B	96105
20140	03476	4000668	96105
20143	03476	F37030-243	96105
20145	03476	4012274	96105
20180	03476	4012330	96105
20181	03476	4012336	96105
20182	03476	4012340	96105
20190	03476	4012365	96105
20197	03476	4012374-E	96105
20205	03476	4012383	96105
20209	03476	4012702	96105
20300	03476	4012777	96105
20302	03476	4012782	96105
20306	03476	4012815	96105
20307	03476	4F37030224	96105
20308	03476	4012817	96105
20404	03476	31208	96105
20405	03476	4012217-C	96105
20998	03476	MS90728-58	96906
21067	03476	40122053-C	96105

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
21100	03476	4045098	96105
201101	03476	1200 SPEC 8030 MODEL 12870	96105
21102	03476	40122013-C	96105
21103	03476	F68203	96105
21104	03476	F40114R	96105
21105	03476	4F5207234	96105
21106	03476	5410716	96105
21107	03476	JF2518714	96105
21108	03476	F22015	96105
21109	03476	4012295C2	96105
21110	03476	12294C	96105
21111	03476	F41208	96105
21112	03476	4012293C	96105
21113	03476	F40208R	96105
21114	03476	4061009	96105
21115	03476	F61482040	96105
21116	03476	40122188	96105
21117	03476	4012299C	96105
21119	03476	4012129	96105
21122	03476	4F46028-12	96105
21123	03476	4000537	96105
21125	03476	4045404	96105
21126	03476	4045129	96105
21129	03476	4F55136-50	96105
21131	03476	4012991	96105
21133	03476	4F37030-236	96105
21135	03476	4F131110D0	96105
21137	03476	4002787	96105
21138	03476	40121205	96105
21139	03476	4F39010-50	96105
21140	03476	4F80500-250	96105
21142	03476	F39010-143	96105

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
21143	03476	40121204	96105
21144	03476	F52072-44	96105
21145	03476	4F41210	96105
21148	03476	4F41211-RHH	96105
21149	1 03476	4F812000-261	96105
21150	03476	40121280	96105
21151	03476	4F41209	96105
21152	03476	4012351	96105
21153	03476	40121212	96105
21154	03476	40121249	96105
21155	03476	4012179	96105
21156	03476	40121221	96105
21158	03476	4F58520	96105
21159	03476	4F58024	96105
21160	03476	40121223	96105
21162	03476	40121224	96105
21163	03476	40121225	96105
21165	03476	4F2006-12	96105
21166	03476	4012436A	96105
21167	03476	4F37030-233	96105
21168	03476	40121259	96105
21170	03476	4F16201	96105
21171	03476	4012433	96105
21175	03476	40121314	96105
21176	03476	40121322	96105
21177	03476	4012403	96105
21179	03476	4012389	96105
21181	03476	4F00004	96105
21184	03476	4012421	96105
21186	03476	4012422	96105
21187	03476	4012388	96105
21188	1 03476	4F5207154	96105
21189	03476	4012385	96105

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
21192	03476	4F16202	96105
21200	03476	4012164A	96105
21201	03476	4045076	96105
21202	03476	4045077	96105
21203	03476	4045081	96105
21204	03476	4045126	96105
21205	03476	4045079	96105
21206	03476	F36604	96105
21207	03476	F80200381	96105
21208	03476	4045055	96105
21209	03476	4045161	96105
21210	03476	F1002524	96105
21214	03476	4012500A	96105
21215	03476	4RCF7204	96105
21216	03476	F3901037	96105
21217	03476	F22007	96105
21218	03476	4012009	96105
21219	03476	F2710540	96105
21220	03476	4TRC-6225	96105
21221	03476	F7400020	96105
21222	03476	40121232	96105
21225	03476	F1003044	96105
21226	03476	4012535	96105
21227	03476	F1002016	96105
21228	03476	4001290	96105
21229	03476	F190012	96105
21230	03476	F7400012D	96105
21231	03476	4TRC-7204	96105
21238	03476	40127708	96105
21239	03476	4012771	96105
21240	03476	4012772	96105
21241	03476	F3901050	96105

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
21242	03476	40121347	96105
21243	03476	F1003024	96105
21246	03476	F351004R	96105
21247	03476	F79105	96105
21248	03476	F13006000	96105
21249	03476	40121342	96105
30834	03476	2023-8-8S	01276
31319	03476	ZA1603	13829
31649	03476	J-8R COLLAPSIBLE	23911
31805	03476	2024-4-4	01276
31829	03476	2024-4-6	01276
32104	03476	4797-4B	01276
32189	03476	132244-R91	31007
32234	03476	J-8R W/EXTENSION	23911
32239	03476	622740	76680
32403	03476	82712-DIA-2-1/32	57733
32404	03476	391-D	57733
32414	03476	98335A084	96652
32418	03476	MS51500AP-P	96906
32565	03476	2085-8-85	01276
32961	03476	4797-4B	01276
33340	03476	2083-8-8S	01276
33972	03476	BL-6625K-2	13829
34053	03476	86C	93195
34091	03476	MS17829-20C	96906
34530	03476	82700	57733
34726	03476	900T	27164
34865	03476	2062-10-125-37D-FLAR	01276
35330	03476	6838450	73342
35331	03476	6838457	73342
35435	03476	4-8-07202	81343
34048	03476	2081-24-12C	01276

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
35817	03476	X73-50-8	13829
35818	03476	X134-283	13829
35821	03476	HD1685-4	13829
35822	03476	M50	13829
35823	03476	M1391K	13829
36686	03476	17404	18265
37407	03476	900598-16S	01276
37820	03476	2043-8-8-S	01276
38675	03476	24-20S	01276
39050	03476	A35XDR59	13829
39465	03476	900598-4	01276
39623	03476	XZ-103	13829
39627	03476	A35MA59	13829
40017	03476	A35AA91	13829
40019	03476	A35Z15	13829
40022	03476	A35DA63	13829
40180	03476	MS24665-625	96906
40992	03476	719F50-16X4	09509
41220	03476	2781-20	01276
41674	03476	SP-390-DP-AS	53790
42548	03476	MS90728-15	96906
42259	03476	996097	73342
42570	03476	MS35307-360	96906
42573	03476	MS90725-64	96906
42627	03476	MS27183-17	96906
42646	03476	MS51922-83	96906
42727	03476	MS90725-90	96906
42745	03476	MS90725-193	96906
42949	03476	MS24665-624	96906
43030	03476	MOM9-0159	18265
43058	03476	FC250-20	01276
43196	03476	90566	05573

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
43481	03476	RAZ00-2325	18265
43813	03476	3406DIT	11083
46860	03476	40122311	96105
46861	03476	4000496	96105
46862	03476	4000043	96105
46863	03476	40122314	96105
46864	03476	40122315	96105
46865	03476	4012236	96105
46866	03476	4000044	96105
46867	03476	4000045	96105
46868	03476	40122319	96105
46869	03476	4000453	96105
46870	03476	F74007D	96105
46871	03476	4000457	96105
46872	03476	4000046	96105
49124	03476	SBG10-0160	18265
49125	03476	P00-4076	18265
51351	03476	MA1688-25-64	13829
51352	03476	SD11357-1-25	13829
51353	03476	SD1135M-1-20	13829
52277	03476	5124405	73342
54696	03476	340001	59197
54737	03476	350501	59197
54739	03476	340060	59197
55185	03476	MS27183-17	46906
57655	03476	280-ED	57733
58280	03476	4045470	96105
58896	03476	JA1125-22	13829
58897	03476	SB111-28	13829
58898	03476	A-1327-131	13829
58899	03476	AC-3006-133	13829
44481	03476	8-8FBTXS	30780

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
58903	03476	A-1327-129	13829
58904	03476	U1126-80	13829
58907	03476	39-0581-031	13829
58909	03476	5033-7001	72582
58910	03476	8922091	73342
58917	03476	33990	3476
58947	03476	22002-14	31393
58975	03476	P-18180	18265
58976	03476	P-18181	18265
58977	03476	P-16984	18265
58978	03476	P-18462	18265
58979	03476	P-11-8340	18265
58981	03476	P-10-1077	18265
58982	03476	P1070	18265
58983	03476	P-18182	18265
58984	03476	P-17673	18265
58985	03476	P10-0091	18265
58986	03476	P10-1846-S	18265
58987	03476	P10-1401	18265
58988	03476	P10-1078	18265
58989	03476	P10-1846	18265
58990	03476	P-18577	18265
59271	03476	82705	57733
59297	03476	D8D-OP6	08163
59453	03476	MS35844-49	96906
59644	03476	MS51953-135	96906
634860	03476	2041-12-12S	01276
4012759	03476	900010-32C	00624
4012988	03476	4012988-1	96105
32244R91	03476	M1421	74400
11089-4	05573	MS51887-132	96906
D8D-OP6	08163	8D	65705

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
MV-1306	09332	UC-1306-4AM	24617
4255490	09367	MS49005-27	96906
P10-5609	18265	33990	03476
5116357	24617	MS35338-46	96906
705-1017	70842	MS35842-12	96906
114674	72582	MS90725-65	96906
5116357	72582	MS35338-46	96906
5197415	72582	MS35842-15	96906
103320	73342	MS35338-45	96906
103321	73342	MS35338-46	96906
122236	73342	MS35691-21	96906
5145009	73342	4255490	09367
15001	74400	99023N	13555
BUSH HEX 3/4 X 1/2	80996	MS51887-132	96906
ELBOW 90D 4-1/2	80996	MS39230-2	96906
TEE 1/2 IN NPT	80996	8444230-2	19204
22002-14	81860	58947	03476
996183R91	89346	5M-420F	99024
996259R92	89346	SC13520	99024
1006056	96105	F1006056	96005
'4012727	96105	MS90725-140	96906
4012972	96105	20987	03476
F15003	96105	MS35338-46	96906
F79108	96105	MS51967-14	96906
F15005	96105	MS35338-48	96906
F1002044	96105	MS90725-43	96906
F10030R	96105	MS90725-179	96906
F40208	96105	C181-9	35301
F1004516R	96105	MS90726-85	96906
F1005024	96105	MS390725-113	96906
F1006036	96105	MS90725-141	96906

CONTRACTOR'S PART NUMBER	FSCM CODE	MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE
F1006056	96105		
F2600512	96105	MS24665-132	96906
F90032C	96105	MS20995-C32	96906
1767A11	96652	1767A11	96906
MS27183-18	96906	55185	03476

APPENDIX P

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
10X20X3	02892	16790	03476
10X20X5	02892	16791	03476
11091-4	05573	8332	03476
1200 Spec 8030 Model 12870	96105	201101	03476
12211	96105	20107	03476
12X20X5	02892	16803	03476
12294C	96105	21110	03476
13244-R91	31007	32189	03476
1525-6	01276	15145	03476
17404	18265	36686	03476
1767A11	96906	1767A11	96652
1X2025X30	02892	16812	03476
2041-12-12S	01276	634860	03476
22002-14	31393	58947	03476
280-ED	57733	57655	03476
20987	03476	4012972	96105
2085-8-85	01276	32565	03476
2083-8-8S	01276	33340	03476
2X20X78	02892	16786	03476
2062-10-125-370-FLAR	01276	34865	03476
2023-8-8S	01276	30834	03476
2024-4-4	01276	31805	03476
2024-4-6	01276	31829	03476
2043-8-8S	01276	37820	03476
2081-24-12C	01276	34048	03476
24-20S	01276	38675	03476
2781-20	01276	41220	03476
300007	23911	16528	03476
3084	22911	16280	03476
308048	23911	16424	03476
31208	96105	20404	03476
314003	23911	16416	03476
324102	23911	16435	03476

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
324205	23911	16430	03476
328057	23911	16410	03476
332004	23911	16433	03476
334016	23911	16341	03476
338026	23911	16441	03476
33990	03476	P10-5609	18265
33990	03476	58917	03476
340001	59197	54696	03476
340060	59197	54739	03476
342120	23911	16339	03476
3406DIT	11083	43813	03476
340024	23911	16418	03476
342123	23911	16426	03476
346006	23911	17029	03476
350501	59197	54737	03476
352020	23911	16414	03476
362007	23911	16434	03476
37005	23911	16440	03476
391-D	57733	32404	03476
3984	60038	6127	03476
3X20X43	02892	16804	03476
400003	23911	16436	03476
400007	23911	16417	03476
4000043	96105	46862	03476
4000045	96105	46867	03476
4000046	96105	46872	03476
4000453	96105	46869	03476
4000456	96105	20130	03476
4000457	96105	46871	03476
4000496	96105	46861	03476
400537	96105	21123	03476
4000595	96105	20131	03476
4000668	96105	20140	03476
4001290	96105	21228	03476

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
4002787	96105	21137	03476
4012009	96105	21218	03476
40121204	96105	21143	03476
40121205	96105	21138	03476
40121212	96105	21153	03476
401212164A	96105	21200	03476
40121245	96105	20129	03476
40121232	96105	21222	03476
40121249	96105	21154	03476
40121221	96105	21156	03476
40121223	96105	21160	03476
40121224	96105	21162	03476
40121225	96105	21163	03476
40121259	96105	21168	03476
40121280	96105	21150	03476
4012129	96105	21119	03476
40121314	96105	21175	03476
40121322	96105	21176	03476
40121342	96105	21249	03476
4012179	96105	21155	03476
40122013-C	96105	21102	03476
40122053-C	96105	21067	03476
4012213	96105	20109	03476
4012217-C	96105	20405	03476
4012219	96105	20114	03476
40122188	96105	21116	03476
4012222	96105	20117	03476
40122311	96105	46860	03476
40122314	96105	46863	03476
40122315	96105	46864	03476
40122316	96105	46865	03476
40122319	96105	46868	03476
4012241	96105	20135	03476
4012246	96105	20137	03476
4012248B	96105	20139	03476

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
4012274	96105	20145	03476
4012293C	96105	21112	03476
4012295C2	96105	21109	03476
4012299C	96105	21117	03476
4012330	96105	20180	03476
4012336	96105	20181	03476
4012340	96105	21152	03476
4012351	96105	21152	03476
4012365	96105	20190	03476
4012374-E	96105	20197	03476
4012383	96105	20205	03476
4012385	96105	21189	03476
4012388	96105	21187	03476
4012389	96105	21179	03476
4012403	96105	21177	03476
4012421	96105	21186	03476
4012422	96105	21187	03476
4012433	96105	21171	03476
4012436A	96105	21166	03476
4012500A	96105	21214	03476
4012535	96105	21226	03476
4012700	96105	20103	03476
40127708	96105	21238	03476
4012702	96105	20209	03476
4012771	96105	21239	03476
4012772	96105	21240	03476
4012777	96105	20300	03476
4012782	96105	20302	03476
4012815	96105	20306	03476
4012817	96105	20308	03476
4012970	96105	20104	03476
4012991	96105	21131	03476
402044	96105	16332	03476

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
4045055	96105	21208	03476
4045076	96105	21201	03476
4045077	96105	21202	03476
4045079	96105	21205	03476
4045081	96105	21203	03476
4045098	96105	21100	03476
4045126	96105	21204	03476
4045129	96105	21126	03476
4045161	96105	21209	03476
4045404	96105	21125	03476
4045470	96105	58280	03476
406	23911	16423	03476
4061009	96105	21114	03476
412005	23911	16439	03476
41230	01943	18449	03476
414971	23911	16438	03476
416X121	02892	16805	03476
4255490	09367	5145009	73342
438001	23911	17223	03476
442010	23911	16341	03476
442019	23911	16420	03476
442020	23911	16411	03476
474004	23911	16415	03476
4797-4B	01276	32104	03476
4797-4B	01276	32961	03476
486012	23911	16427	03476
493	60038	7775	03476
494006	23911	16432	03476
494010	23911	16412	03476
494020	23911	16413	03476
497	60038	7774	03476
4-1203-O-R-H30	70842	16891	03476
4-8-07202	81343	35435	03476

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
4F00004	96105	21181	03476
4F131110DO	96105	21135	03476
4F16201	96105	21170	03476
4F16202	96105	21192	03476
4F18002	96105	20054	03476
4F2006-12	96105	21165	03476
4F37030-224	96105	20307	03476
4F37030-233	96105	21167	03476
4F37030-236	96105	21133	03476
4F39010-50	96105	21139	03476
4F41209	96105	21151	03476
4F41210	96105	21145	03476
4F41211-RHH	96105	21148	03476
4F46028-12	96105	21122	03476
4F5207154	96105	21188	03476
4F5207234	96105	21105	03476
4F55136-50	96105	21129	03476
4F58024	96105	2159	03476
4F58520	96105	21158	03476
4F80500-250	96105	21140	03476
4F812000-261	96105	21149	03476
4RCF7204	96105	21215	03476
4TRC-6225	96105	21220	03476
4TRC-7204	96105	21231	03476
4X20X25X52	02892	16781	03476
503	60894	18450	03476
5124405	73342	52277	03476
513X13A	02892	16807	03476
52400	60038	6121	03476
52618	60038	6122	03476
53176	60038	6130	03476
53375	60038	6131	03476
5410716	96105	21106	03476
55185	03476	MS27183-18	96906

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
55187C	60038	11168	03476
55443	60038	11167	03476
5611-60-06A	37562	16897	03476
58947	03476	22002-14	81860
5M-420F	99024	996183R91	89346
62272S32	76680	16600	03476
622740	76680	32239	03476
623003	81596	16620	03476
623006	81596	16357	03476
6838450	73342	35330	03476
6838457	73342	35331	03476
68462	60038	9895	03476
68712	60038	9894	03476
6X2025X2	02892	16797	03476
6X20-25X6	02892	16800	03476
705-1013	70842	16888	03476
705-1027	70842	16895	03476
705-1171	70842	16886	03476
713X36	02892	16783	03476
719F50-16X4	09509	40992	03476
812X90	02892	16792	03476
812X137	02892	16788	03476
82700	57733	34530	03476
82710-DIA-2-1/32	57733	32403	03476
834X6	02892	16801	03476
8444230-2	19204	8370	03476
844230-2	19204	TEE 1/2 IN NPT	80996
86C	93195	34053	03476
8NOX-8FPX-90	24161	8747	03476
9	65029	19156	03476
900598-4	01276	39465	03476
900598-16S	01276	37407	03476
900T	27164	34726	03476
90566	05573	43196	03476

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
90566	05573	43196	03476
98335A084	96652	32414	03476
99023N	13555	15001	74400
99183R91	89346	18381	03476
996097	73342	42259	03476
996259R92	89346	18380	03476
A1327-119	13829	16232	03476
A1327-131	13829	58898	03476
A1327-174	13829	16222	03476
A136X14	02892	16799	03476
A340X34	02892	16798	03476
A35AA91	13829	40017	03476
A35DA63	13829	40022	03476
A35XDR59	13829	39050	03476
A35Z15	13829	40019	03476
A35MA59	13829	39627	03476
A395X19	02892	16810	03476
A395X25	02892	16793	03476
A501X438	02892	16806	03476
A506X12	02892	16789	03476
A848X33	02892	16808	03476
A907X5	02892	16782	03476
A956X4	02892	16802	03476
AC-3006-133	13829	58899	03476
AM1311	13829	16229	03476
A985X1	02892	16809	03476
AS-11-129	11314	16237	03476
AS-11-134	11314	16784	03476
AS-11-212	11314	16200	03476
AS-11-216	11314	16233	03476
AS-11-249	11314	16796	03476
BAS00-009	18265	16076	03476
BL-6625K-2	13829	33972	03476

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
Bushing-Hex-3/4X1/2XH	80996	8334	03476
C1530-3	13829	162B1	03476
C181-9	35301	F40208	96105
C/L-09-13042 6 in Dia X 1 in bore	76257	15010	03476
DA1023	13829	16204	03476
Elbow-450 1" NPT-XH	80996	6665	03476
Elbow-900 1/2 NPT-XH	80996	8314	03476
F1002016	96105	21227	03476
F1002524	96105	21210	03476
F1003024	96105	21243	03476
F1003044	96105	21225	03476
F1006056	96105	1006056	96105
F1300600	96105	21248	03476
F190012	96105	21229	03476
F200004	96105	20110	03476
F22007	96105	21217	03476
F22015	96105	21108	03476
F2518714	96105	21107	03476
F25125-16	96105	20138	03476
F2710540	96105	21219	03476
F351004R	96105	21246	03476
F36604	96105	21206	03476
F37030-243	96105	20143	03476
F3901037	96105	21216	03476
F3901050	96105	21241	03476
F39010-143	96105	21142	03476
F40114R	96105	21104	03476
F40208R	96105	21113	03476
F41208	96105	21111	03476
F52072-44	96105	21144	03476
F61482040	96105	21115	03476
F65015	96105	20108	03476
F68203	96105	21103	03476
F7400012D	96105	21230	03476

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
F74000-160	96105	20136	03476
F7400020	96105	21221	03476
F74007D	96105	46870	03476
F79105	96105	21247	03476
F80200381	96105	21207	03476
FC250-20	01276	43058	03476
G1048	13829	16242	03476
H1329	13829	16221	03476
HD1685-4	13829	35821	03476
J-8R Collapsible	23911	31649	03476
J-8R w/extension	23911	32234	03476
JA1125-22	13829	58896	03476
L3006-108	13829	16238	03476
M1021	13829	16234	03476
M1391K	13829	35823	03476
M15001-2	57733	16900	03476
M50	13829	35822	03476
M500-B	27473	16821	03476
MA1688-25-64	13829	51351	03476
MOM9-0159	18265	43030	03476
MS15003-1	96906	5929	03476
MS15003-6	96906	18379	03476
MS16995-96	96906	7169	03476
MS17828-8C	96906	6291	03476
MS17829-20C	96906	34091	03476
MS20995-C32	96906	F90032C	96105
MS24665-132	96906	F2600512	96105
MS24665-287	96906	6718	03476
MS24665-353	96906	5939	03476
MS24665-624	96906	42949	03476
MS24665-625	96906	40180	03476
MS24665-627	96906	5941	03476
MS27183-17	96906	42627	03476

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
MS27183-17	96906	55185	03476
MS35307-334	96906	6096	03476
MS35307-360	96906	42570	03476
MS35307-413	96906	5972	03476
MS35307-472	96906	7801	03476
MS35309-420	96906	5993	03476
MS35338-45	96906	1033207	73342
MS35338-46	96906	103321	73342
MS35338-46	96906	F15003	96105
MS35338-46	96906	16083	03476
MS35338-46	96906	5962	03476
MS35338-46	96906	5989	03476
MS35338-46	96906	5116357	73342
MS35338-48	96906	F15005	96906
MS35338-48	96906	5975	96906
MS35338-49	96906	6351	03476
MS35338-51	96906	5965	03476
MS35691-21	96906	122236	03476
MS35842-12	96906	705-1017	70842
MS35842-15	96906	5197415	03476
MS39230-2	96906	Elbow 90D 4 1/2"	80996
MS49005-27	96906	4255490	03476
MS390725-113	96906	F1005024	03476
MS51500AP-P	96906	32418	03476
MS51873-101	96906	6289	03476
MS51873-101	96906	7173	03476
MS51887-132	96906	Bush Hex 3/4 X 1/21	80996
MS51922-83	96906	42646	03476
MS51953-29	96906	8357	03476
MS51953-29	96906	6655	03476
MS51953-86	96906	9450	03476
MS51967-14	96906	F79108	03476
MS51968-14	96906	9440	03476

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
MS90725-14	96906	6284	03476
MS90725-32	96906	6093	03476
MS90725-43	96906	F1002044	03476
MS90725-62	96906	9134	03476
MS90725-62	96906	5988	03476
MS90725-64	96906	42573	03476
MS90725-65	96906	114674	72582
MS90725-90	96906	42727	03476
MS90725-136	96906	8278	03476
MS90725-140	96906	4012727	03476
MS90725-141	96906	F1006036	03476
MS90725-179	96906	F10030R	03476
MS90725-193	96906	42745	03476
MS90725-197	96906	8279	03476
MS90725-199	96906	7810	03476
MS90726-85	96906	F1004516R	03476
MS90728-15	96906	42548	03476
MS90728-58	96906	20998	03476
MS90728-70	96906	6881	03476
MS90728-174	96906	5963	03476
MS90728-176	96906	7802	03476
Nipple 1" NPTX 1 1/2 - XH	80996	6'662	03476
PO0-4076	18265	49125	03476
P1532	13829	16219	03476
P50A-378-BEOR-25-7	13829	18603	03476
RAZOO-2325	18265	43481	03476
RS5305-W	08162	6119	03476
S1352-1	13829	16218	03476
S8PP	21335	18602	03476
SA1838N	53800	18286	03476
SB111-28	13829	58897	03476
SBG10-0160	18265	49124	03476
SC13520	99024	996259R92	89346

MANUFACTURER'S (VENDOR'S) PART NUMBER	FSCM CODE	CONTRACTOR'S PART NUMBER	FSCM CODE
SD11357-1-25	13829	51352	03476
SD1135M-1-20	13829	51353	03476
SHEA1023-2	13829	16226	03476
SHFA1023	13829	16227	03476
SHJ1317-2	13829	16225	03476
SHW1182	13829	16223	03476
SP-390-DP-A5	53790	41674	03476
SP-5-188X	95019	16562	03476
UC-1306-TAM	24617	11166	03476
UC-1306-4AM	24617	MV-1306	09332
X73-50-8	13829	35817	03476
X134-283	13829	35818	03476
XZ-103	13829	39623	03476
Z754X4	02892	16787	03476
ZA1603	13829	31319	03476

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Official: Chief of Staff

DONALD J. DELANDRO
Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25BR, Operator's, Organizational, Direct Support, and General Support Maintenance Manual (Including Repair Parts and Special Tools List) for Earth Drilling Machine.

☆U.S. GOVERNMENT PRINTING OFFICE: 1985-554-019/20108

TEAR ALONG PERFORATED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH THIS PUBLICATION?

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA, FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ▸ ARE OBSOLETE.

P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

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

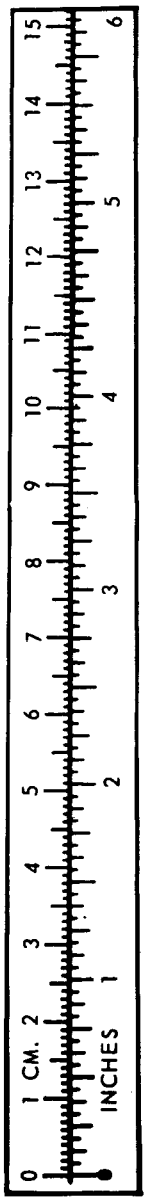
TEMPERATURE

$5/9\,(^0F - 32) = {}^0C$
212^0 Fahrenheit is equivalent to 100^0 Celsius
90^0 Fahrenheit is equivalent to 32.2^0 Celsius
32^0 Fahrenheit is equivalent to 0^0 Celsius
$9/5\,C^0 + 32 = F^0$

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
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

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
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621



TA089991

PIN: 057778-000