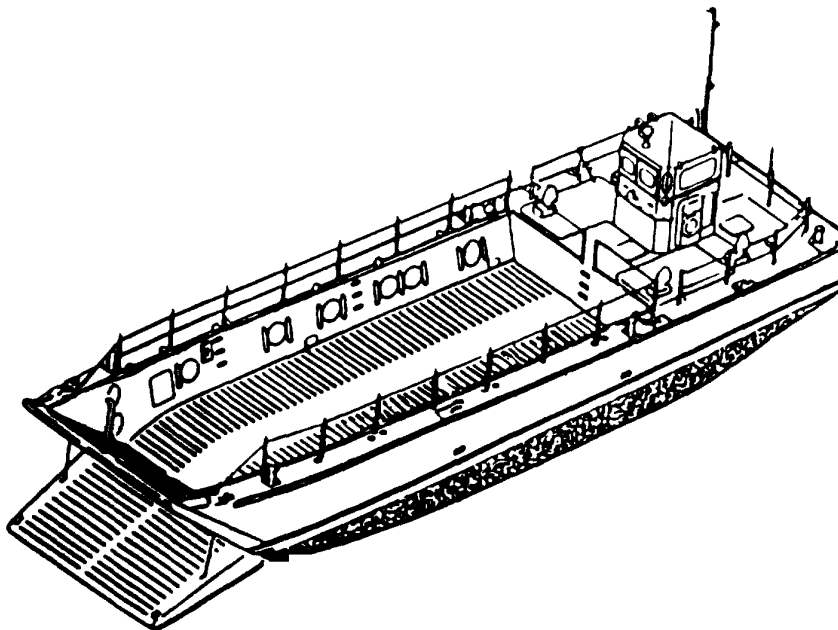


**TECHNICAL MANUAL  
OPERATOR, UNIT AND INTERMEDIATE  
(DIRECT AND GENERAL SUPPORT)  
MAINTENANCE MANUAL**

**LANDING CRAFT, MECHANIZED  
STEEL, DED, OVERALL LENGTH 74 FEET,**

**MOD 1, MARK VIII, NAVY DESIGN LCM-8**

**HULL NUMBERS 8500 THROUGH 8519 (MARINETTE MARINE CORP.)  
NSN 190-0169-0938.**



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PAGE 1-1**

**OPERATING  
INSTRUCTIONS  
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DIRECT SUPPORT  
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**APPENDIXES**

**This copy is a reprint which includes current pages from Change 1.**

**Approved for public release; distribution is unlimited.**

**HEADQUARTERS, DEPARTMENT OF THE ARMY**

**30 June 1989**

CHANGE

NO. 1

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 4 APRIL 1994

OPERATOR, UNIT AND INTERMEDIATE  
(DIRECT AND GENERAL SUPPORT)  
MAINTENANCE MANUAL

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NSN 1905-01-169-0938

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1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages

i and ii  
C-9 through C-16  
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Insert pages

i and ii  
C-9 through C-16  
C-17 and C-18

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

Official:

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*Administrative Assistant to the*  
*Secretary of the Army*  
06575

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*General, United States Army*  
*Chief of Staff*

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## INTRODUCTION

This manual is printed in four volumes as follows:

TM 55-1905-221-14-1, consisting of Chapter 1 thru 4.

TM 55-1905-221-14-2, consisting of Chapter 5.

TM 55-1905-221-14-3, consisting of Chapter 6.

TM 55-1905-221-14-4, consisting of Chapter 6 (continued) and Appendices.

**WARNING**

**DANGEROUS CHEMICALS**

are used in this equipment

**SERIOUS INJURY OR DEATH**

may result if personnel fail to observe  
these safety precautions:

- Be sure all cargo is secure, especially during rough seas.
- Corrosive battery electrolyte, and potassium hydroxide, are potentially dangerous to personnel and property. Wear rubber gloves, apron, and face shield when handling leaking batteries. If potassium hydroxide is spilled on clothing or other material, wash immediately with clean water. If spilled on personnel, start flushing the affected area immediately with clean water. Continue washing until medical assistance arrives.
- Wipe or flush any spillage. Volatile materials will not be brought aboard; electrical circuits will not be energized; fuel tanks will not be topped off; and engines will not be started before CO<sub>2</sub> firefighting equipment is available and operative.
- Observe NO SMOKING rules when refueling. Do not work on live circuits. Tag circuit and warn other personnel not to energize the circuit. Never use a blow torch or other similar means for heating fuel or oil lines.

**ASPHYXIATION DANGER**

- Be sure engine room ventilators are open when operating the engine(s). The engine exhaust gases contain carbon monoxide, which is a colorless, odorless, and poisonous gas.
- All piping and exhaust lines shall be treated as being insulated with Asbestos material. Protective clothing and respirators shall be worn at all times when handling suspect asbestos-covered piping and exhaust lines.

**WARNING (Continued)**

**SERIOUS INJURY OR DEATH**

**may result if personnel fail to observe  
these safety precautions:**

- **Hatches must be opened before energizing any electrical circuit or starting engines. Do not smoke or use open flame in the vicinity when servicing batteries as hydrogen gas, an explosive is generated. Use only distilled water to maintain battery electrolyte level. Do not fill fuel tank while engine is running. Provide metallic contact between the fuel container and fuel tank to prevent a static spark from igniting fuel.**
- **When cutting with a torch, or when welding, always station fire watches, ready with fire extinguishers, in the vicinity on both sides of the plate that is being cut or welded.**
- **Prior to cutting or welding on the ramp, remove drain plugs on both sides of the ramp and check if ramp interior is primer coated. If primer coated, flush thoroughly with steam, carbon dioxide, or water. Do not reinstall drain plugs until the cutting and/or welding operations is completed. Failure to take this precaution may result in explosion of accumulated primer vapors.**
- **When refueling, shut down the electrical system. Observe the no smoking rule. Do not permit anyone to operate tools or equipment which may produce sparks near the refueling operation. Sparks or fire may ignite the diesel fuel and produce an explosion.**
- **Fuel oil and other petroleum products are highly volatile in extreme heat. To minimize the possibility of explosion, wipe up all spills at once, see that fuel lines and valves are not leaking and pump bilges regularly.**
- **Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or possible death to maintenance personnel.**
- **Before disconnecting a line in the hydraulic system, bleed the pressure from the portion of the line. Failure to do so may result in injury or possible death to maintenance personnel.**

TECHNICAL MANUAL

No. 55-1905-221-14-4

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 30 June 1989**OPERATOR, UNIT AND INTERMEDIATE  
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MAINTENANCE MANUAL****LANDING CRAFT, MECHANIZED:  
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**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 these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Aviation and Troop Command, ATTN: AMSAT-I-MP, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished directly to you.

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**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS.**

---

a. The cylinder block serves as the main structural part of the engine. Transverse webs provide rigidity and strength and ensure alignment of the block bores and bearings under load.

b. The block is bored to receive replaceable cylinder liners. The cylinder block is designed to provide water cooling below the air inlet port belt. An air box between the cylinder banks and extending around the cylinders at the air inlet port belt conducts the air from the blower to the cylinders. Air box openings on each side of the block permit inspection of the pistons and compression rings. Through the air inlet ports in the cylinder liners. The air box openings in the cylinder block assembly are about 1-7/8 inch x 3-1/8 inch (4.76 cm x 7.94 cm) and are covered with cast covers. The camshaft bores are located on the inner side of each cylinder bank near the top of the block.

c. The upper halves of the main bearing supports are cast integral with the block. The main bearing bores are line-bored with the bearing caps in place to ensure longitudinal alignment. Drilled passages in the block carry the lubricating oil to all moving parts of the engine.

d. The top surface of each cylinder bank is grooved to accommodate a block-to-head oil seal ring. Each water or oil hole is counterbored to provide for individual seal rings.

e. Each cylinder liner is retained in the block by a flange at its upper end. The liner flange rests on an insert located in the counterbore in the block bore. An individual compression gasket is used at each cylinder. When the cylinder heads are installed, the gaskets and seal rings compress to form a tight metal-to-metal contact between the heads and the block.

f. Cylinder block assemblies include the main bearing caps and bolts, dowels and the necessary plugs. Since the cylinder block is the main structural part of the engine, the various subassemblies must be removed from the cylinder block when an engine is overhauled.

---

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

---

**This task covers:**

- a. Inspection
- b. Repair

- c. Cleaning
- d. Pressure Test

- e. Inspect
- 

**INITIAL SETUP****Test Equipment**

Feeler gage  
 Straight edge  
 Depth gage  
 Master ring gage J5580-1  
 Cylinder bore gage J5347

**References**

NONE

**Equipment****Condition****Condition Description**

Paragraph

6-22

Power Unit Removal

**Special Tools**

Drift 3/4 inch  
 Hammer 1 pound  
 Hone  
 120 grit hones  
 Torque wrench

**Tools**

General Mechanic's Tool Kit  
 NSN 5180-00-629-9783

**Material/Parts**

Gasket kit P/N 5193115  
 Pickling Acid  
 Alkaline Solution  
 (heavy duty)  
 Permatex #1  
 International Compound #2  
 or equivalent  
 Rust preventive

**Special Environmental Conditions**

NONE

**Personnel Required**

2

**General Safety Instructions**

Observe all WARNINGS in this procedure.

---

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSPECTION</b>		
1. Engine	a. Inspect cylinder block for cracks, and signs of damage.	Replace.
	b. Inspect air box covers for leaking gaskets.	Replace.
	c. Inspect air box drains for bent or broken tubes.	Replace.
	d. Inspect water holes for leaking gaskets.	Replace.
	e. Inspect pipe plugs for leaking.	Replace.
	f. Inspect end plate gaskets for leaking gaskets.	Replace.
<b>REPAIR</b>		
2. Cylinder Block	a. Remove air box drain tube (1), and elbow (2).	If damaged.
	b. Remove air box cover bolt (3), flatwasher (4), copper gasket (5), cover (6), and gasket (7).	If gasket is leaking.
	c. Remove water hole cover bolt assemblies (8), cover (9), and gasket (10).	If gasket is leaking.
	d. Replace pipe plugs (11 through 16).	If damaged.
	e. Replace special plug (17).	If damaged.
	f. Replace plug caps (18 through 20).	If damaged.
	g. Replace expansion plugs (21 and 22).	If gasket is leaking.

## 6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REPAIR (Cont)

- h. Remove dowel pins (23 and 24) if damaged.

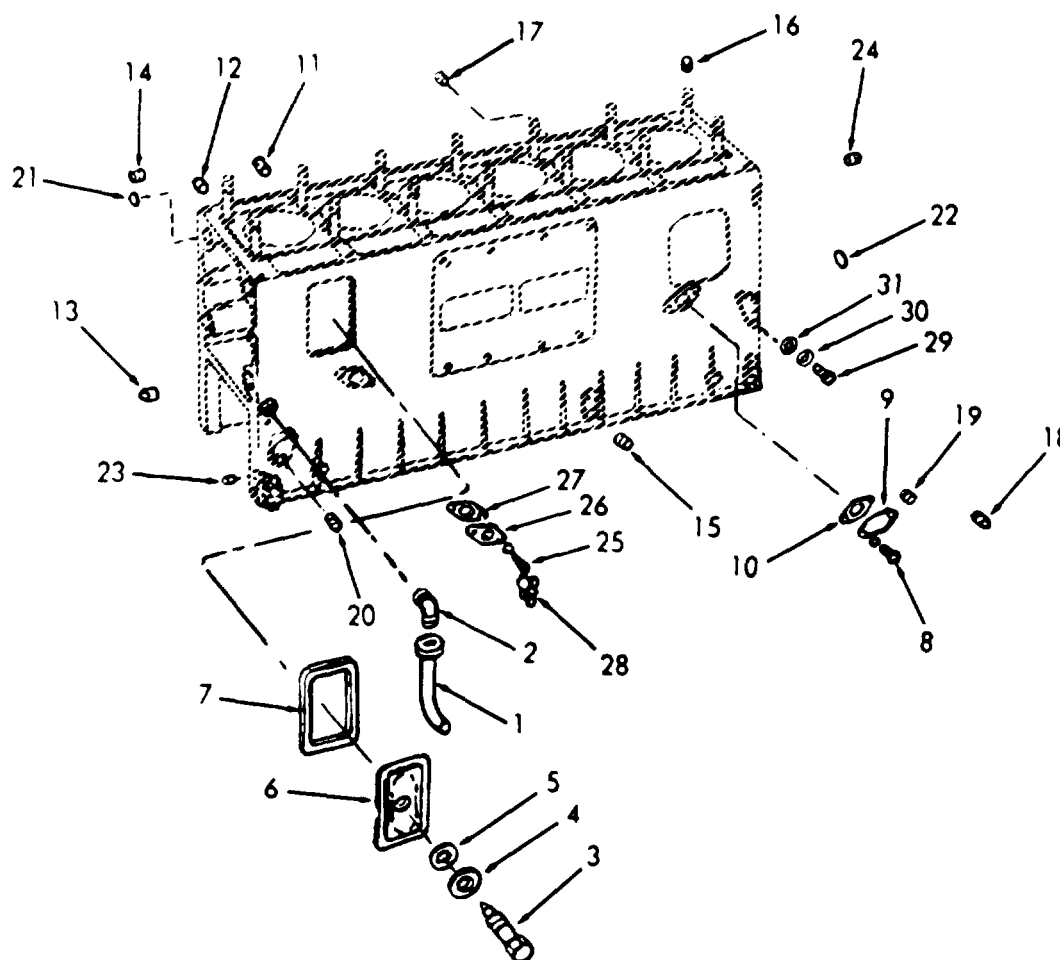
The dowels must extend 5/8 inch from block.

- i. Remove water hole cover bolt assemblies (25), cover (26), gasket (27), and drain cock (28).

If gasket or drain cock is leaking or defective.

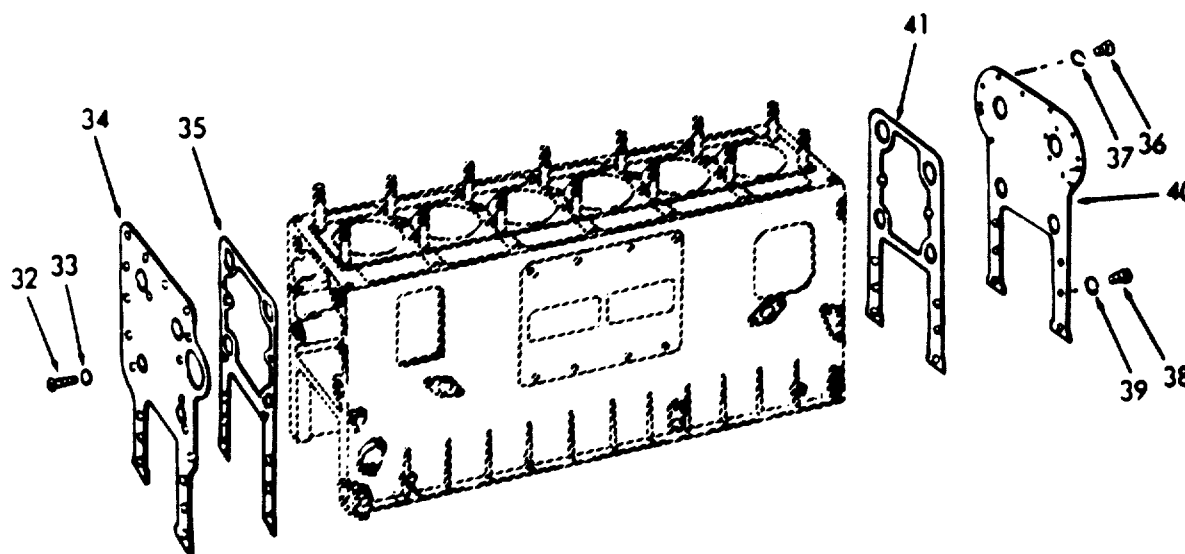
- j. Remove hole filler screw (29), lockwasher (30), and flatwasher (31).

If leaking.



**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REPAIR (Cont)</b>		
3. Cylinder Block End Rear Plate	a. Remove six screws (32) and lockwashers (33).	If necessary
	b. Remove rear plate (34) and gasket (35).	If necessary
4. Cylinder Block Front End Plate	a. Remove six screws (36) and lockwashers (37).	If necessary
	b. Remove two screws (38) and lockwashers (39).	If necessary.
	c. Remove front end plate (40) and gasket (41).	If necessary



**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>CLEANING</b>		
5. Cylinder Block	<p>a. Scrape all gasket material from the cylinder block. Then remove all oil gallery plugs and core hole plugs (except cup plugs) to allow the cleaning solution to contact the inside of the oil and water passages. This permits more efficient cleaning and eliminates the possibility of the cleaning solution attacking the aluminum core hole plug gaskets (if used).</p> <p>b. If a core hole plug is difficult to remove, hold a 3/4 inch drift against the plug and give it a few sharp blows with a one pound hammer. With a 1/2 inch flexible handle and a short extension placed in the countersunk hole in the plug, turn the plug slightly in the direction of tightening. Then turn it in the opposite direction and back the plug out.</p> <p>c. Clean the cylinder block as follows:</p> <p>(1) Remove the grease by agitating the cylinder block in a hot bath of commercial heavy-duty alkaline solution.</p> <p>(2) Wash the block in hot water or steam clean it to remove the alkaline solution.</p>	

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>CLEANING (Cont)</b>		
	(3) If the water jackets are heavily scaled, proceed as follows:	
	(a) Agitate the block in a bath of inhibited commercial pickling acid.	
	(b) Allow the block to remain in the acid bath until the bubbling stops (approximately 30 minutes).	
	(c) Lift the block, drain it and re-immerses it in the same acid solution for 10 minutes.	
	(d) Repeat Step (c) until all scale is removed.	
	(e) Rinse the block in clear hot water to remove the acid solution.	
	(f) Neutralize the acid that may cling to the casting by immersing the block in an alkaline bath.	
	(g) Wash the block in clean water or steam clean it.	



---

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**


---

LOCATION/ITEM	ACTION	REMARKS
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---

**CLEANING (Cont)****WARNING**

**Wear protective eye goggles when using compressed air.**

- (4) Dry the cylinder block with compressed air.
- (5) Make certain that all water passages, oil galleries and air box drain openings have been thoroughly cleaned.

**NOTE**

**The above cleaning procedure may be used on all ordinary cast iron and steel parts of the engine. Mention will be made of special cleaning procedures whenever necessary.**

- (6) After the block has been cleaned and dried, coat the threads of the plugs with sealant and, using new gaskets, reinstall the core hole plugs. Tighten the 1-3/4 inch-16 plugs to 150 - 180 lb-ft (203.4 - 244.0 Nm) torque and the 2-1/2 inch-16 plugs to 230 - 270 lb-ft (311.8 - 366.1 Nm) torque.

---

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**


---

LOCATION/ITEM	ACTION	REMARKS
---------------	--------	---------

---

**CLEANING (Cont)****CAUTION**

Excessive torque applied to the core hole plugs may result in cracks in the water jacket.

- d. If for any reason the cup plugs in the water jackets were removed, install new plugs as follows:
  - (1) Clean the cup plug holes and apply Permatex No. 1 sealant, or equivalent, to the outer diameter of the plugs.
  - (2) Drive the plugs in place with the handle and adapter.

**PRESSURE TEST**

6.

**WARNING**

**Wear protective eye goggles when using compressed air.**

After the cylinder block has been cleaned, it must be pressure tested for cracks or leaks by either one of two methods.

- a. This method may be used when a large enough water tank is available and the cylinder block is completely stripped of all parts.

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
---------------	--------	---------

**PRESSURE TEST (Cont)**

- (1) Seal off the water inlet and outlet holes air tight. This can be done by using steel plates and suitable rubber gaskets held in place by bolts. Drill and tap one cover plate to provide a connection for an air line.
- (2) Immerse the block for twenty minutes in a tank of water heated to 180°-200°F (82.2°-93.3°C).
- (3) Apply 40 psi (275.8 kPa) air pressure to the water jacket and observe the water in the tank for bubbles which indicate the presence of cracks or leaks in the block. A cracked cylinder block must be replaced by a new block.
- (4) After the pressure test is completed, remove the block from the water tank. Then remove the plates and gaskets and dry the block with compressed air.

---

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**


---

LOCATION/ITEM	ACTION	REMARKS
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---

**PRESSURE TEST (Cont)****WARNING**

**Wear protective eye goggles when using compressed air.**

b. This method may be used when a large tank is unavailable, or when it is desired to check the block for cracks without removing the engine from the equipment which it powers. However, it is necessary to remove the cylinder heads, blower, oil cooler, air box covers and oil pan.

(1) Attach sealing plates and gaskets as in method "a". Before attaching the last sealing plate, fill the water jacket with a mixture of water and one gallon of antifreeze. The antifreeze will penetrate small cracks and its color will aid in detecting their presence.

(2) Install the remaining sealing plate and tighten it securely.

(3) Apply 40 psi (275.8 kPa) air pressure to the water jacket and maintain this pressure for at least two hours to give the water and anti freeze mixture ample time to work its way through any cracks which may exist.

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**PRESSURE TEST (Cont)**

- (4) At the end of the test period, examine the cylinder bores, air box, oil passages, crankcase and exterior of the block for presence of the water and antifreeze mixture which will indicate the presence of cracks. A cracked cylinder block must be replaced by a new block.
- (5) After the test is completed, remove the plates, drain the water jacket and blow out all of the passages in the block with compressed air.

**INSPECT**

- 7.
  - a. After cleaning and pressure testing, inspect the cylinder block.
  - b. Since most of the engine cooling is accomplished by heat transfer through the cylinder liners to the water jacket, a good liner-to-block contact must exist when the engine is operating. Whenever the cylinder liners are removed from an engine, the block bores must be inspected.

**NOTE**

Before attempting to check the block bores, hone them throughout their entire length until about 75% of the area above the ports has been "cleaned-up".

---

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**


---

LOCATION/ITEM	ACTION	REMARKS
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---

**INSPECT (Cont)**

- c. Hone the block bores as follows:
- (1) Use a hone in which the cutting radius of the stones can be set in a fixed position to remove irregularities in the bore rather than following the irregularities as with a spring-loaded hone. Clean the stones frequently with a wire brush to prevent stone loading. Follow the hone manufacturer's instructions regarding the use of oil or kerosene on the stones. Do not use such cutting agents with a dry hone. Use 120 grit stones.
  - (2) Insert the hone in the bore and adjust the stones snugly to the narrowest section. When correctly adjusted, the hone will not shake in the bore, but will drag freely up and down the bore when the hone is not running.

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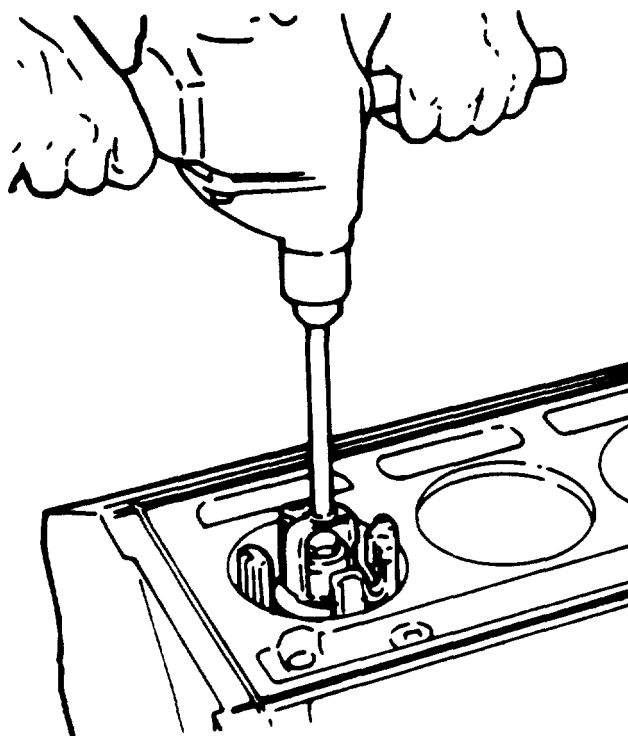
**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

---

LOCATION/ITEM	ACTION	REMARKS
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INSPECT (Cont)



- (3) Start the hone and "feel out" the bore for high spots which will cause an increased drag on the stones. Move the hone up and down the bore with short, overlapping strokes about 1 inch (2.54 cm) long. Concentrate on the high spots in the first cut. As these are removed, the drag on the hone will become lighter

---

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**


---

LOCATION/ITEM	ACTION	REMARKS
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---

**INSPECT (Cont)**

and smoother. Do not hone as long as the air inlet port area as in the rest of the bore because this area, as a rule, cuts away more rapidly. Feed lightly to avoid an excessive increase in the bore diameter. Some stones cut rapidly even under low tension.

- (4) When the bore is fairly clean, remove the hone, inspect the stones, and measure the bore. Determine which spots must be honed most. Moving the hone from the top to the bottom of the bore will not correct an out-of-round condition. To remain in one spot too long will cause the bore to become irregular. Where and how much to hone can be judged by feel. A heavy cut in a distorted bore produces a steady drag on the hone and makes it difficult to feel the high spots. Therefore, use a light cut but with frequent stone adjustments.
- (5) Wash the cylinder block thoroughly after the honing operation is completed.



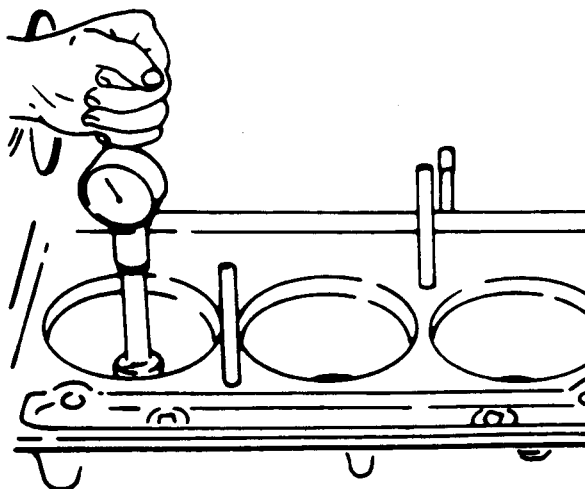
## 6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## INSPECT (Cont)

d. Check the cylinder block bore:

- (1) Visually check the contact area as revealed by the honed surface. There must not be any low spots which are larger in area than a half dollar.
- (2) Measure the entire bore of each cylinder with cylinder bore gage J5347 which has a dial indicator calibrated in .0001 inch increments. The standard block bore is 4.6260 inch to 4.6270 inch.



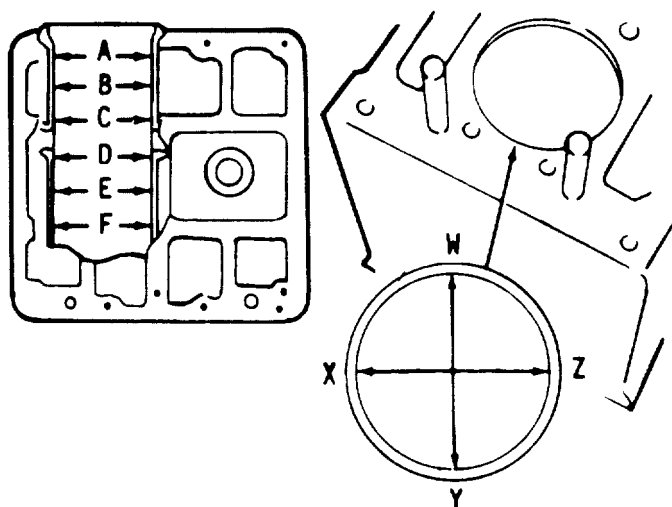
- (3) First, place the bore gage in the master ring gage J5580-1 which has an I.D. of 4.6270 inch and set the dial to zero. Next, rotate the dial clockwise .0005 inch to give a zero dial indicator setting of 4.6265 inch.

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECT (Cont)**

Take measurements on the cleaned-up surface only at positions A, B, C, D, E, and F in the bore on axes 45° apart. Read the measurements from the zero mark on the gage.



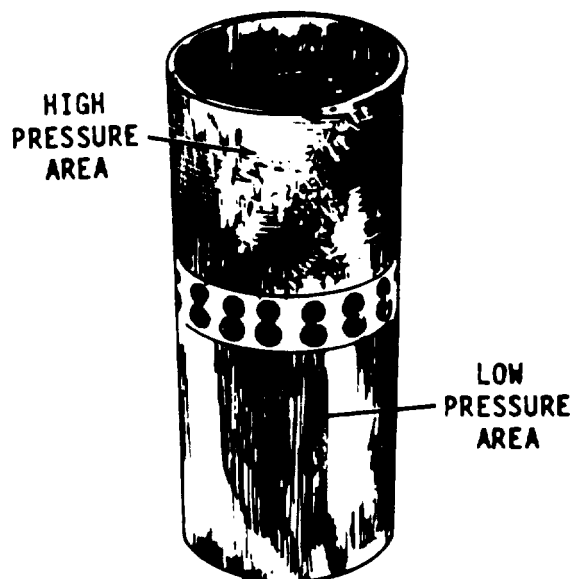
- (4) The cylinder liner is alternately expanding and contracting during engine operation, due to temperature variations. This may result in irregularities in the block bores (out-of-round and taper), the effects of which will be seen as high pressure areas on the outside of the cylinder liner.

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECT (Cont)**

- (5) If a new liner and piston is installed in the block without properly fitting the liner, galling and seizing of the piston may result. This is caused by the new piston having to travel over the irregularities without time to conform to the particular shape of the block bore.



**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSPECT (Cont)</b>		
	e. Fit the liner to the cylinder block: The liner-to-block clearance with new parts is zero to .002 inch. With used parts, the maximum liner-to-block clearance is .0025 inch. Examine the block bore measurements to determine if standard or .001 inch oversize O.D. liners can be used, or if the cylinder block should be bored oversize. A light push fit between the liner and the block is desirable. However, a good fit between the cylinder liner and block may be obtained by comparing the average bore sizes in Table below.	
For Average Block Bore I.D. Size of	Use Liner O.D. Size	To Give A Liner-to-Block Clearance of
<u>4.6260 inches</u> 4.6275 inches	Standard	.000 inch to .0025 inch
<u>4.6270 inches</u> 4.6285 inches	.001 inch Oversize	.000 inch to .0025 inch

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECT (Cont)**

f. If necessary, bore the cylinder block as follows:

- (1) Each bore in a used block must not be out-of-round or tapered more than .002 inch. If the average block bore is over 4.6285 inches, the block should be bored oversize as shown below.

Block Boring Dimensions	Liner O.D. Size	Maximum Block Bore I.D. on a Used Block
<u>4.631 inches</u> 4.632 inches	.005 inch Oversize	4.6325 inches
<u>4.636 inches</u> 4.637 inches	.010 inch Oversize	4.6375 inches
<u>4.646 inches</u> 4.647 inches	.020 inch Oversize	4.6475 inches
<u>4.656 inches</u> 4.657 inches	.030 inch Oversize	4.6575 inches

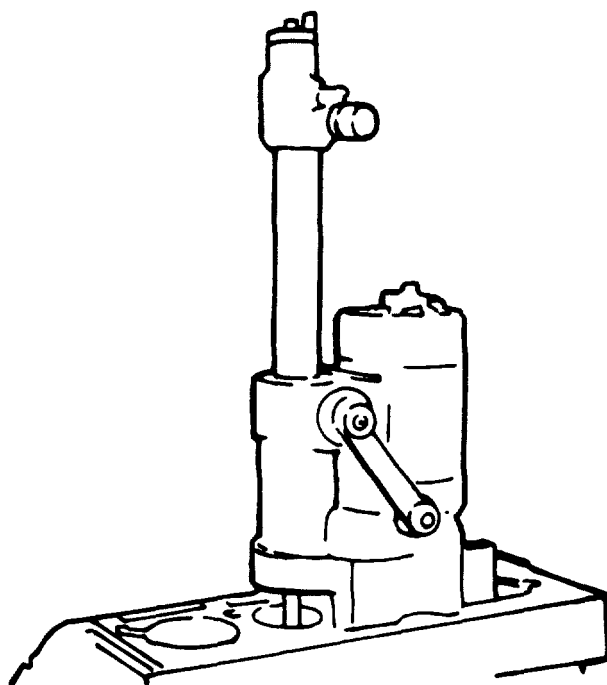
- (2) A typical commercially available portable boring bar is illustrated below. Instructions on correct use of the boring bar are provided by the manufacturer.

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECT (Cont)**

- (3) After boring the block for an oversize cylinder liner, check the bore finish to be sure it is smooth (120 RMS). Heat transfer from the cylinder liner to the block will be adversely affected if the block isn't smooth.



- (4) Wash the block thoroughly after the boring operation.

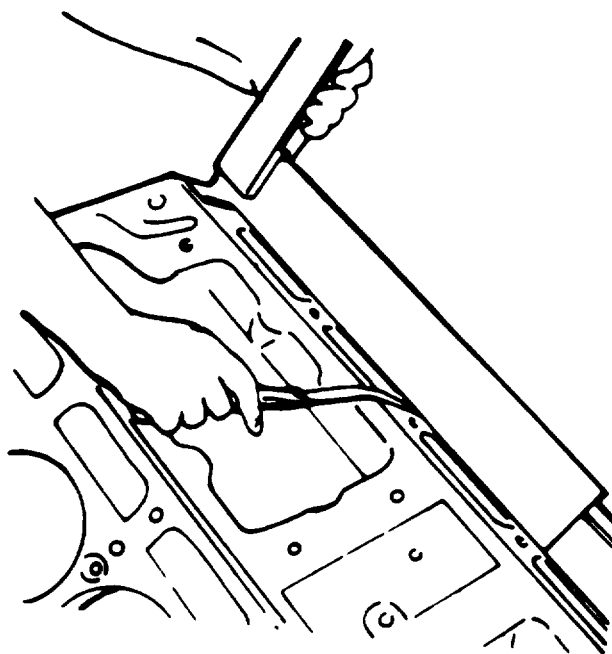
## 6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## INSPECT (Cont)

(5) When an oversize liner is used, stamp the size of the liner on the top deck of the block adjacent to the liner counter-bore. An oversize liner insert must be installed whenever an oversize liner is used.

g. Check the top of the block (cylinder head contact surfaces) for flatness with an accurate straight edge and a feeler gage.

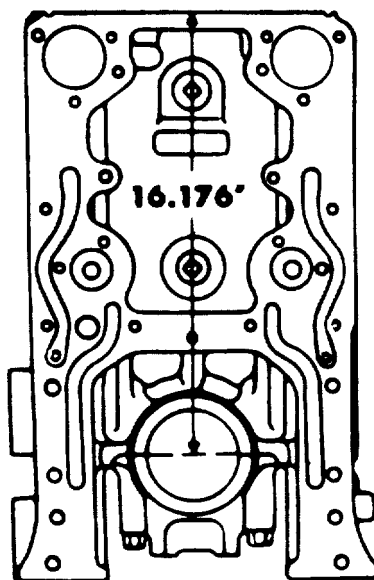


**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECT (Cont)**

- (1) The top surface of the block must not vary more than .003 inch transversely and not over .006 inch, .007 inch or .009 inch longitudinally on the 3, 4, and 6 cylinder blocks respectively. It will be difficult to prevent water, oil, and compression leaks if the top surface of the block exceeds these tolerances.
- (2) If it is necessary to machine these surfaces to correct for the above conditions, do not remove more than .008 inch of metal. Stamp the amount of stock removed on the face of the block. The distance from the centerline of the crankshaft to the top of the cylinder head surface of the block must not be less than 16.176 inches.





## 6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

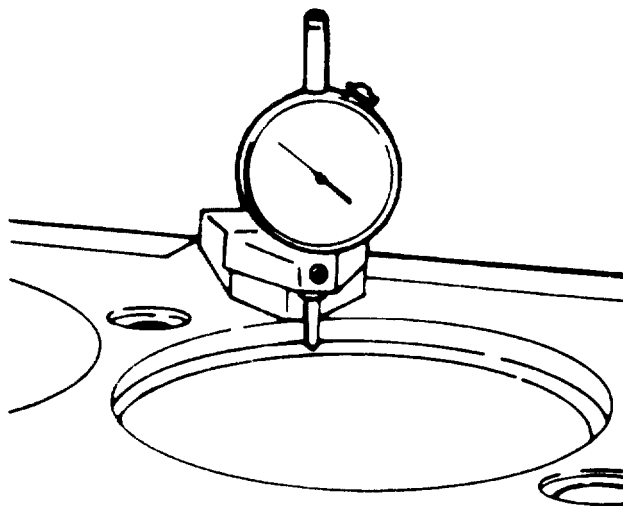
LOCATION/ITEM	ACTION	REMARKS
INSPECT (Cont)		
<p>(3) If stock is removed from the cylinder head contact surfaces of the block, check the depth of the seal ring grooves and counterbores. The cylinder head seal strip grooves must be .092 - .107 inch deep. The large water hole counterbores (between the cylinders) must be .109 - .120 inches deep, and the combination water and oil hole counterbores and small water hole counterbores must be .087 - .098 inches deep. If necessary, deepen the grooves or counterbores to the specified limits to retain the proper "crush" of the seal rings. It is not necessary to deepen the counterbores for the cylinder liners since .004 since .004 inch and .008 inch undersize thickness inserts are available for adjusting the liner portion as outlined in paragraph 3-31.4, under <u>Fitting Cylinder Liner in Block Bore</u>.</p>	<p>h. Make sure the cylinder liner counterbores in the block are clean and free of dirt. Then check the depth. The depth must be .4770 inch to .4795 inch and must not vary more than .0015 inch throughout the entire circumference. The counterbored surfaces must be smooth and square with the cylinder bore within .001 inch total indicator reading. There must not be over .001 inch difference between any</p>	

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECT (Cont)**

two adjacent cylinder counter-bores when measured along the cylinder longitudinal centerline of the cylinder block.



- i. Check the main bearing bores as follows:
  - (1) Check the bore diameters with the main bearing caps in their original positions. Lubricate the bolt threads and bolt head contact areas with a small quantity of International Compound No. 2, or equivalent. Then install and tighten the bolts to 165-175 lb-ft (223.7 - 237.3 Nm) torque. When making this check, do not install the main bearing cap stabilizers. The specified bore diameter is 4.812 to 4.813 inch. If the bores do not fall within these limits, the cylinder block must be rejected.

## 6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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INSPECT (Cont)

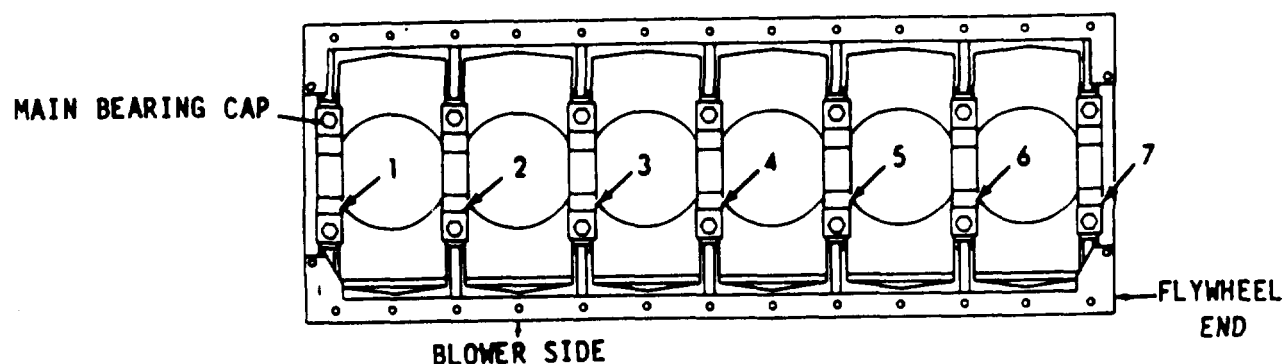
**CAUTION**

Main bearing cap bolts are especially designed for this purpose and must not be replaced by ordinary bolts.

**NOTE**

Bearing caps are numbered to correspond with their respective positions in the cylinder block. It is imperative that the bearing caps are reinstalled in their original positions to maintain the main bearing bore alignment. The number of the front main bearing cap is also stamped on the face of the oil pan mounting flange of the cylinder block, adjacent to its permanent location in the engine as established at the time of manufacture. The No. 1 main bearing cap is always located at the end opposite the flywheel end of the cylinder block.

- (2) Finished and unfinished main bearing caps are available for replacing broken or damaged caps. When fitting a finished replacement bearing cap, it may be necessary to try several caps before one will be found to provide the correct bore diameter and bore alignment. If a replacement bearing cap is installed, be sure to stamp the correct bearing position number on the cap.



**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECT (Cont)****NOTE**

**Use the unfinished bearing caps for the front and intermediate bearing positions. The finished bearing caps, machined for the crankshaft thrust washers, are to be used in the rear bearing position.**

- (3) Main bearing bores are line-bored with the bearing caps in place and thus are in longitudinal alignment. Bearing bores may be considered properly aligned with one another if the crankshaft can be rotated freely by hand after new bearing shells have been installed and lubricated and the bearing caps have been secured in place and the bolts tightened to 180-190 lb-ft (244.0-257.6 Nm) torque. If main bearing bore is more than .001 inch out of alignment, the block must be line-bored or scrapped. Misalignment may be caused by a broken crankshaft, excessive heat or other damage.
- (4) If the main bearing bores are not in alignment or a replacement bearing cap is used, the block must be line-bored. Install the bearing caps in their original positions (without the bearing cap stabilizers) and tighten the bolts to 165-175 lb-ft (223.7-237.3 Nm) torque. Line bore the block, but do not remove more than .001 inch stock. After boring, all bores must be within the specified limits 3.812 inch to 3.813 inch.

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**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**


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LOCATION/ITEM	ACTION	REMARKS
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**INSPECT (Cont)**

- j. Replace loose or damaged dowel pins. The dowels at the ends of the cylinder block must extend .630 inch from cylinder blocks. The dowels used to retain the crankshaft thrust washers on the rear main bearing cap must extend .110 inch to .120 inch from the surface of the bearing cap.
- k. If used, replace damaged or broken cylinder head studs. Drive new studs to a height of 4-3/8 inch  $\pm$  1/32 inch above the block at a minimum of 75 lb-ft (101.7 Nm) torque. Also, examine the cylinder head retaining bolt holes. If the threads are damaged, use a tap to "clean-up" the threads or install an helical thread insert.
- l. The tapped holes in the cylinder blocks may be tapped with a 5/8 inch-11 UNC3B thread tap. The stud holes and unplugged bolt holes must have the thread extending 1.84 inches below the block surface.

**6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECT (Cont)**

- m. Check the remaining cylinder block surfaces and threaded holes. Check all of the mating surfaces, or mounting pads, for flatness, nicks, and burrs. Clean-up damaged threads in tapped holes with a tap or install helical thread inserts if necessary.
- n. After inspection, if the cylinder block is not to be used immediately, spray the machined surfaces with engine oil. If the block is to be stored for an extended period of time, spray or dip it in a polar-type rust preventive such as Valvoline Oil company's "Tectyl 502-C", or equivalent. Castings free of grease or oil will rust when exposed to the atmosphere.

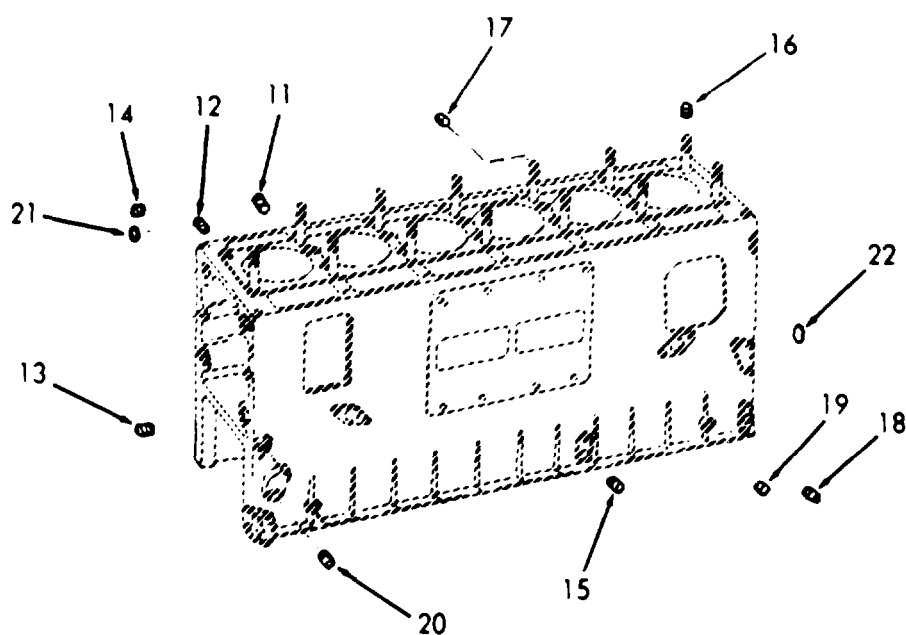
**NOTE**

**Before a reconditioned or new service replacement cylinder block is used, steam clean it to remove the rust preventive and blow out the oil galleries with compressed air.**

## 6-29. CYLINDER BLOCK - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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INSPECT (Cont)



11. Pipe plug 1/8 inch
12. Pipe plug 1/8 inch
13. Pipe plug 1 inch
14. Pipe plug 3/8 inch
15. Pipe plug 3/4 inch
16. Pipe plug 1/4 inch
17. Special pipe plug 3/4-16
18. Pipe plug 1/4 inch, allen head
19. Pipe plug 3/8 inch, hexagon
20. Pipe plug, hexagon socket head
21. Expansion core plug
22. Expansion plug

**6-30. FUEL PUMP.****This task covers:**

- |                |                        |
|----------------|------------------------|
| a. Disassembly | c. Inspection/Overhaul |
| b. Cleaning    | d. Assembly            |

**INITIAL SETUP****Test Equipment**

NONE

**References**

NONE

**Special Tools**

NONE

**Equipment****Condition Condition Description**

Paragraph

5-17 Fuel pump removed

**Tools**

General Mechanic's Tool Kit

NSN 5180-00-629-9783

Material/Parts

Clean fuel oil

Emery cloth or crocus cloth

**Special Environmental Conditions**

NONE

**Personnel Required**

MOS 61C10

**General Safety Instructions**

Observe WARNINGS in procedure.

**LOCATION/ITEM****ACTION****REMARKS****DISASSEMBLY**

- Fuel Pump Assembly

Refer to paragraph 2-17 and disassemble fuel pump.

**CLEANING**

- Fuel Pump

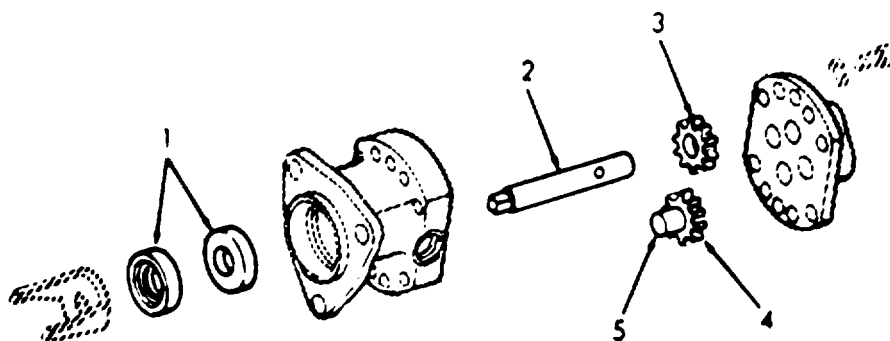
**WARNING**

**Wear safety goggles to prevent eye injury when using compressed air.**



**6-30. FUEL PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSPECTION/OVERHAUL</b>		
3. Fuel Pump	<p>a. Oil seals (1), once removed from the pump body, must be discarded and replaced with new seals. The lips of the oil seals must fit snug around the pump shaft (2) and must be free of nicks or cracks.</p> <p>b. Check the pump gear teeth (3 and 4) for scoring, chipping or wear. Check the ball slot in the drive gear (2) for wear. If necessary, replace with a new gear.</p> <p>c. Inspect the drive (2) and driven (5) shafts for scoring or wear. Replace with new shafts if necessary. The driven shaft (5) is serviced as a gear and shaft assembly only.</p>	



**6-30. FUEL PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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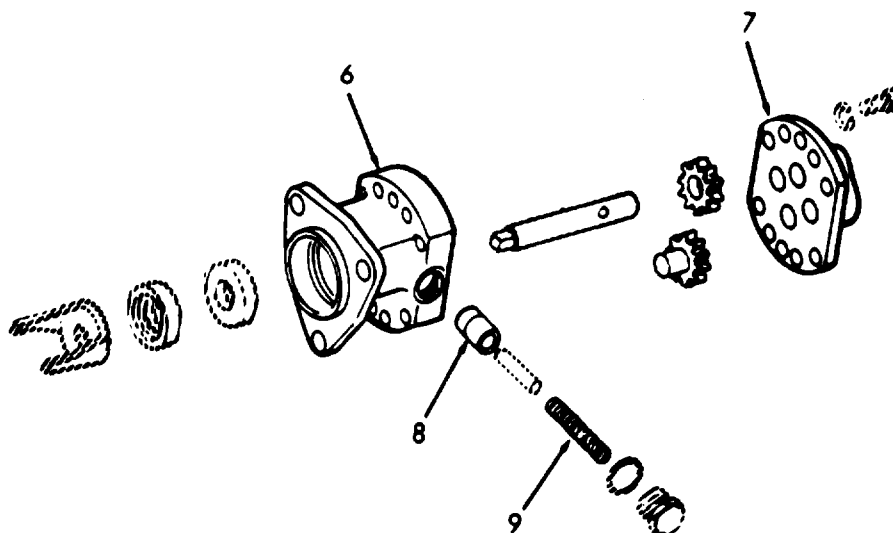
**INSPECTION/OVERHAUL (Cont)**

- d. The mating faces of the pump body (6) and cover (7) must be flat and smooth and fit tightly together. Any scratches or slight damage may result in pressure leaks. Also check for wear at areas contacted by gears and shafts. Replace the cover or body if necessary.
- e. The relief valve (8) must be free from score marks and burrs and fit its seat in the pump body. If the relief valve is scored and cannot be cleaned up with fine emery cloth or crocus cloth, the valve must be replaced.
- f. The valve spring (9) has a free length of 1.97 inches and requires a load of  $7.3 \pm .2$  lbs. to compress it to a length of 1.18 inches when new. If the spring falls below the specifications, replace the spring.

## 6-30. FUEL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## INSPECTION/OVERHAUL (Cont)



- g. Replace all gaskets and other defective parts as required.

## ASSEMBLY

## 4. Fuel Pump

Refer to paragraph 5-17 and reassemble the fuel pump.

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**6-31. FUEL INJECTORS**


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**This task covers:**

- a. Testing
- b. Disassembly/Overhaul
- c. Cleaning

- d. Inspection
- e. Lapping
- f. Assembly

- g. Testing After Assembly
- 

**INITIAL SETUP****Test Equipment**

Comparator  
 Testing and popping fixture  
 Injector bushing  
 inspectalite  
 Gage injector timing  
 1.460 (HV7)

**References**

NONE

**Special Tools**

Tool Set J5286-01 (33287)  
 Remover J1227-01 (33287)  
 Tool J6868-01 (33287)  
 Pin vice J 4298-1  
 Spray tip cleaner J9464-01  
 Wire, spray #110 cleaner  
 .006 (HV7) J21461 (33287)  
 Lapping blocks J22090  
 Reamer J21089

**Equipment****Condition      Condition Description**

Paragraph

5-18      Injectors removed

**Tools**

General Mechanic's Tool Kit  
 NSN 5180-00-629-9783

**Material/Parts**

Repair Kit J1241-06 (33287)  
 Clean fuel oil  
 Methyl Ethyl Ketone (MEK)

**Special Environmental Conditions**

NONE

**Personnel Required**

MOS 61C10

**General Safety Instructions**

Observe WARNINGS in procedure.

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**6-31. FUEL INJECTORS (Continued).**

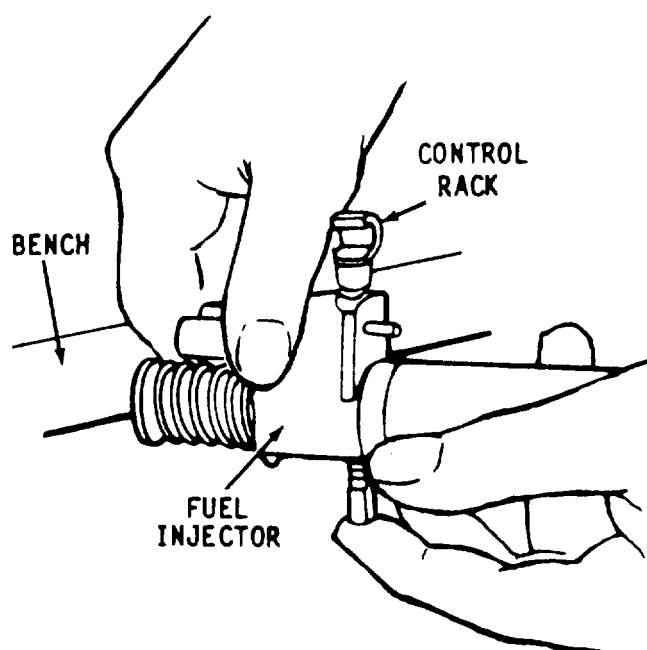
LOCATION/ITEM	ACTION	REMARKS
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**TESTING**

1. Fuel Injector	<p>a. Injector rack and plunger movement.</p> <p>Check to see if plunger works freely in its bushing by placing the injector against a bench as shown and depressing the follower to the bottom of its stroke while moving the rack back and forth. Lack of free rack movement indicates the internal parts of the injector are dirty or damaged.</p>	
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**WARNING**

The injector must always be held in such a way as to prevent any fuel spray from penetrating a person's skin. Fuel oil which enters the blood stream may cause a serious infection.



## 6-31. FUEL INJECTORS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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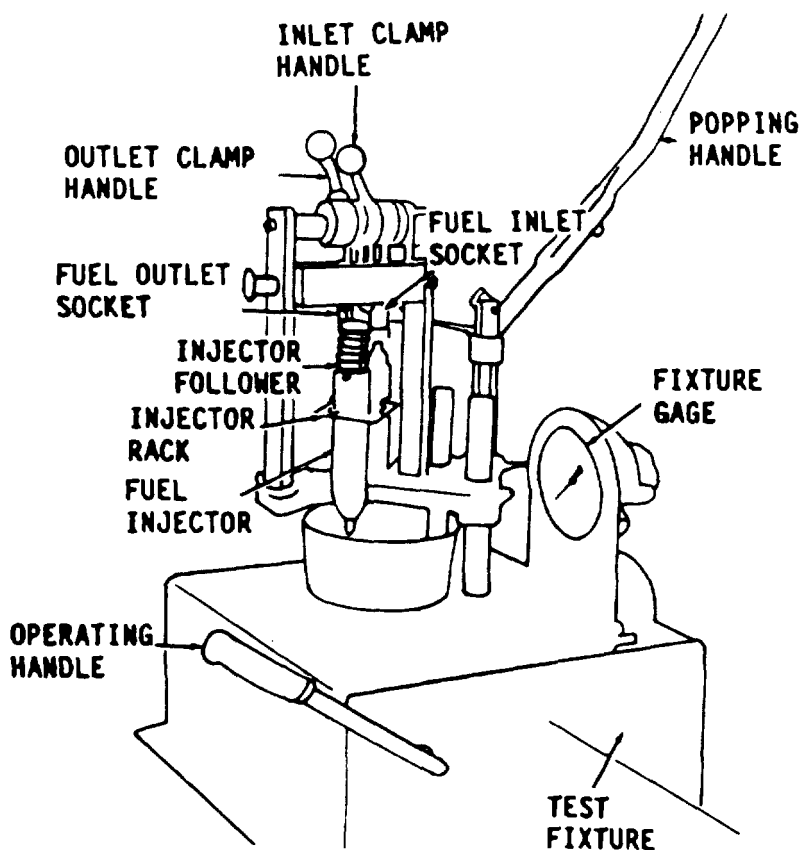
## TESTING (Cont)

## NOTE

Before using the injector tester, or when refilling it with fuel oil, disconnect the tube of the gage and operate the handle until all the air is expelled from the system. Then connect the tube to the gage.

b. Valve opening (pop-pressure) test.

- (1) Place the fuel injector in the testing and popping fixture as shown, with dowel on the under-side of the injector located in the proper slot of the adaptor plate. Position injector support plate and popping handle support to the proper height.



**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**TESTING (Cont)****WARNING**

The injector must always be in proper position in relation to the spray deflector before it is tested, in order to prevent the fuel spray from penetrating the skin. Fuel entering a person's blood stream may cause serious infection.

- (2) Connect the fuel injector to fuel line by rotating inlet clamp handle to move fuel inlet socket against the fuel injector inlet filler cap. Purge injector of air by stroking the operating handle until clear fuel flows from the outlet cap.
- (3) Connect the outlet line to fuel injector by rotating outlet clamp handle to seal socket against fuel injector outlet filter cap. Operate the tester to build up slight pressure in system and stroke the popping handle two or three times.
- (4) With the injector rack in FULL FUEL position, operate handle of test fixture with smooth even strokes. Check fixture gage and record the injector valve opening (pop) pressure, indicated when the injector sprays fuel. The pop pressure should be 450 to 850 pounds per square inch (psi).

**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**TESTING (Cont)**

If the pop pressured does not fall within the above range, repair or replace the injector.

- c. Valve holding pressure test.
  - (1) Operate the pump handle to bring the fuel injector pressure up to a point just below the injector pop pressure (450 psi).
  - (2) Close the fuel shutoff valve and note the pressure drop. The time for a pressure drop from 450 pounds per square inch to 250 pounds per square inch should not be less than 40 seconds.
  - (3) If the injector pressure drops from 450 pounds per square inch to 250 pounds per square inch in less than 40 seconds, perform the following:

**WARNING**

**Wear safety goggles when using compressed air to avoid eye injury.**

- (a) Thoroughly dry the injector with compressed air. Open the test fixture fuel valve and operate the pump handle to maintain the testing pressure of 450 pounds per square inch.



**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**TESTING (Cont)**

- (b) Observe for leaks at the injector rack opening. If this occurs a poor bushing to body fit is indicated .
- (c) A leak around the spray tip or seal ring usually is caused by a loose injector nut, damaged seal ring or a hardened surface on the injector nut or spray tip.
- (d) A leak at filter cap indicates loose filter cap or damaged filter cap gasket.

**NOTE**

**A drop or two of fuel at the spray tip is only an indication of the fuel trapped in the spray tip at the beginning of the test and is not detrimental as long as the pressure drop specified in 1c(3) above is not less than 40 seconds.**

- (e) A "dribble" at the spray tip orifices indicates a leaky valve assembly due to damaged surface or dirt. Leakage at this tip will cause preignition in the engine.

**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**TESTING (Cont)**

- d. High pressure test.
- (1) The high pressure test is necessary to detect any fuel leaks at the injector filter caps, body plugs, nut seal ring and internal lapped surfaces which did not appear during the valve holding pressure test (lb above). It also indicates whether or not the plunger and bushing clearances are satisfactory.

**WARNING**

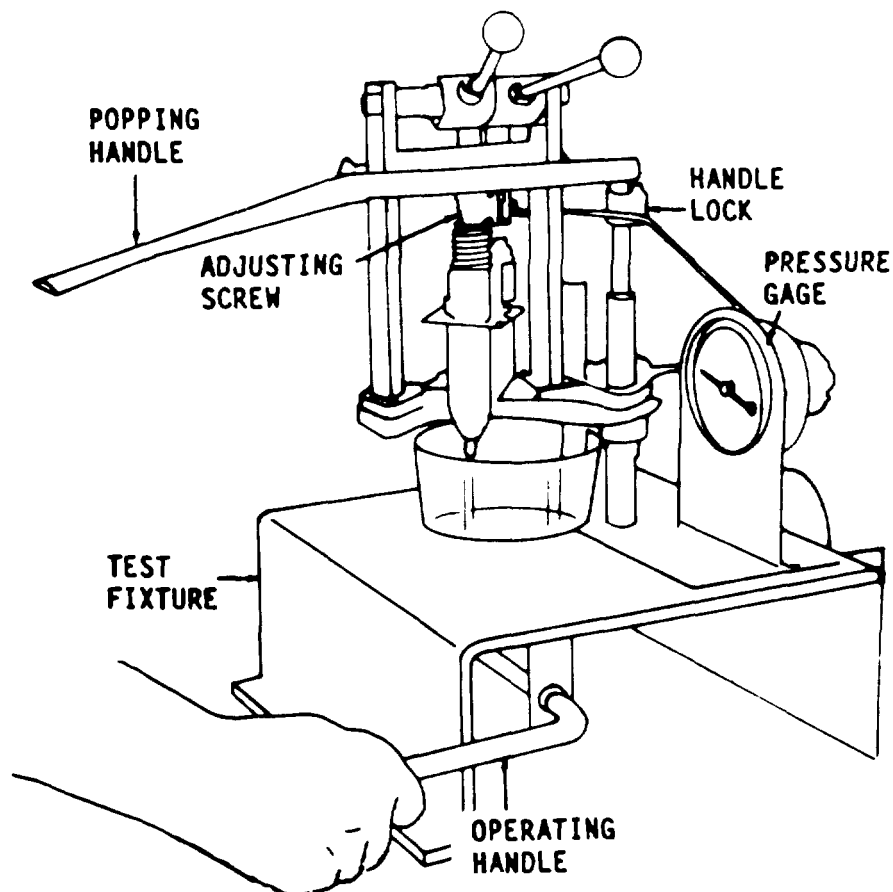
**Wear protective eye goggles when using compressed air to avoid eye injury.**

- (2) Thoroughly dry the injector with compressed air. Check all fuel connections for leaks and tighten if necessary. If leaks have occurred, dry the injector again.
- (3) With the injector rack in FULL FUEL position and the popping handle locked in position by means of a handle lock as shown stroke pump operating handle to build up and maintain pressure.

## 6-31. FUEL INJECTORS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## TESTING (Cont)

**CAUTION**

Do not permit the pressure in the test fixture to equal or exceed the capacity of the pressure gage.

- (4) Use the adjusting screw in the injector tester handle and depress the injector plunger just far enough to close both ports in the injector bushing. The point at which both ports are closed is easily noticed because the injector spray will decrease appreciably and the pressure will rise.

**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>TESTING (Cont)</b>		
	(5) If there is excessive clearance between the plunger and the bushing, the operator will be unable to pump up pressure beyond normal valve opening (pop) pressure. Replacement of the plunger and bushing is then necessary.	
	(6) Pump the test fixture and maintain a pressure of 1600 to 2000 pounds per square inch and inspect for leaks at the injector filter cap gaskets, body plugs, injector nut seal ring area, and injector rack hole.	
	e. Spray pattern test.	
	(1) With the injector in the FULL FUEL position, stroke the pump operating handle to maintain a fuel pressure just below the valve opening (pop) pressure [1.b.(1) above].	
	(2) Pop the injector several times with the popping handle and observe the spray pattern at the spray tip orifice. Fuel should be discharged from each orifice and the spray should produce a uniform pattern.	
	(3) If the spray tip does not produce a uniform pattern, clean the orifice of the spray tip during overhaul of the injector.	

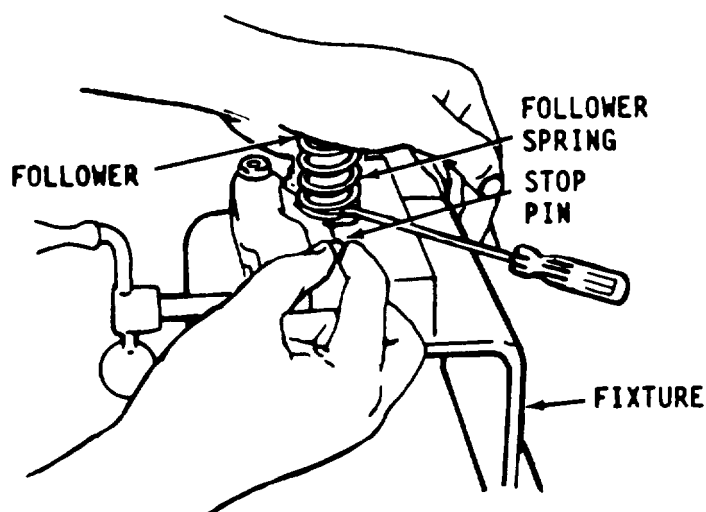
## 6-31. FUEL INJECTORS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## TESTING (Cont)

f. Visual inspection of injector plunger.

- (1) If the injector passes all the above tests (paragraphs 1.a. through e. above) visually check the plunger under a magnifying glass, for excessive wear or a possible chip on the bottom helix. There is a small area on the bottom helix and lower portion of the upper helix, if chipped, that will not be indicated in any of the tests.
- (2) Remove the plunger from the injector as follows:
  - (a) Position the injector in the holding fixture as shown, right side up.

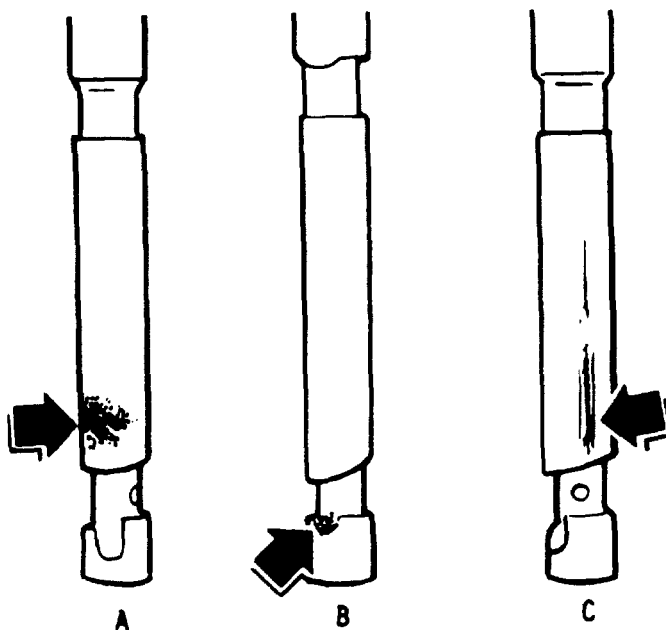


**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**TESTING (Cont)**

- (b) Compress the follower spring, then using a screw driver, raise spring above stop pin and remove the pin. Allow the plunger spring to raise gradually.
- (c) Remove the injector from the holding fixture and turn injector up side down, to prevent entry of dirt in injector and catch the spring and plunger in hand.
- (d) Inspect the plunger. If chipped, replace the plunger and bushing after the fuel output test is performed. Plunger (B as shown), illustrates a chipped plunger at the helix.



- A. Dirt in fuel. Shows advanced stages of abrasive matter in fuel.
- B. Chipped at low helix.
- C. This condition caused by lack of fuel at high speed, or water in fuel.

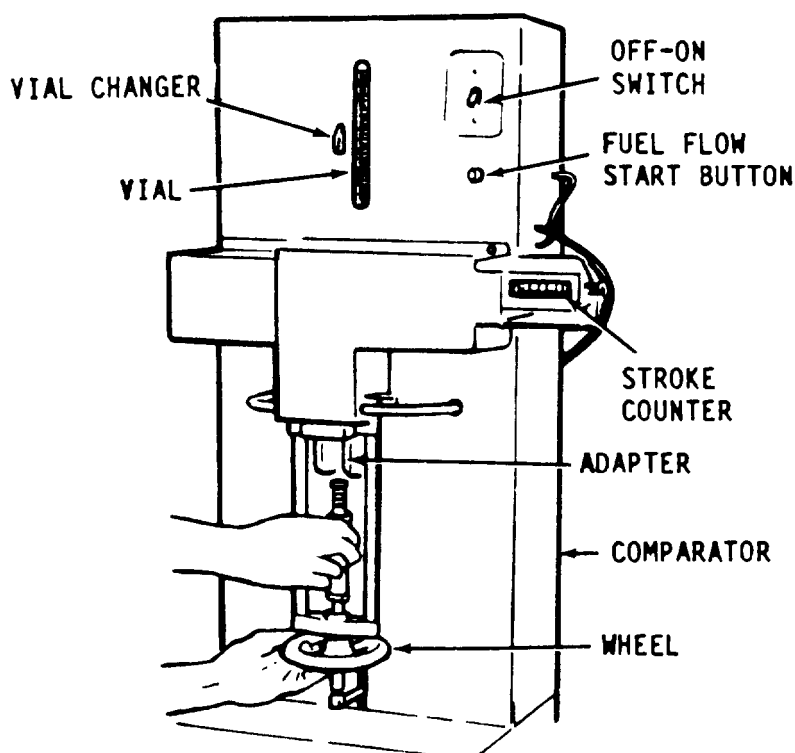
## 6-31. FUEL INJECTORS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## TESTING (Cont)

g. Fuel output test.

- (1) Set the comparator at 1000 strokes.
- (2) Place the injector in the comparator as shown, seal firmly and check injector fuel output as follows:



- (a) Pull control rack (1) out to the NO FUEL position and start the comparator. After the comparator has started, push injector rack to FULL FUEL position.

**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>TESTING (Cont)</b>		
	(b) Run the injector for 30 seconds to purge all air that may be in system. Press fuel flow start button to start flow of fuel into vial. The comparator will automatically stop fuel flow after 1000 strokes.	
	(c) After fuel stops flowing into vial, pull the rack out to the NO FUEL position, turn off the comparator, reset the counter and observe the vial reading.	
	(d) If the injector fuel output in the vial does not fall within a minimum of 30 cc (cubic centimeters) or maximum of 36cc, the injector is defective and must be repaired.	
<b>DISASSEMBLY/OVERHAUL</b>		
2. Filter Cap and Element	a. Support injector assembly upright in fixture tool as shown.	



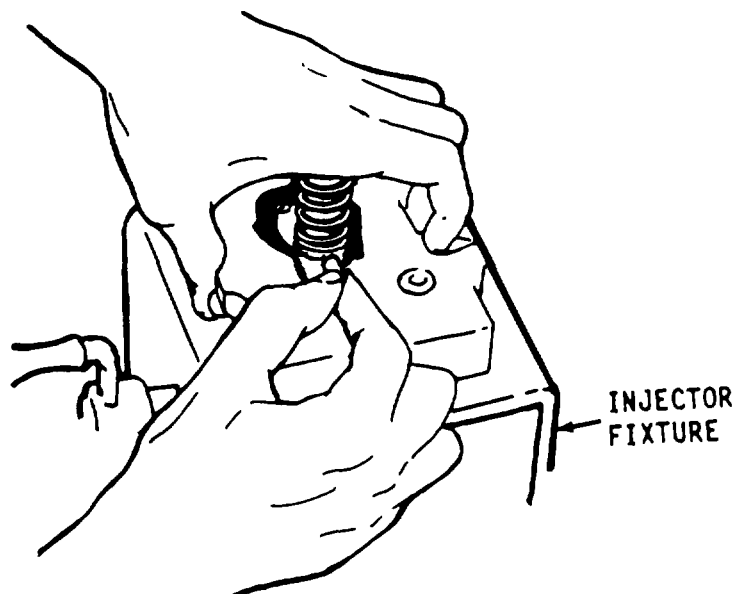
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**6-31. FUEL INJECTORS (Continued).**

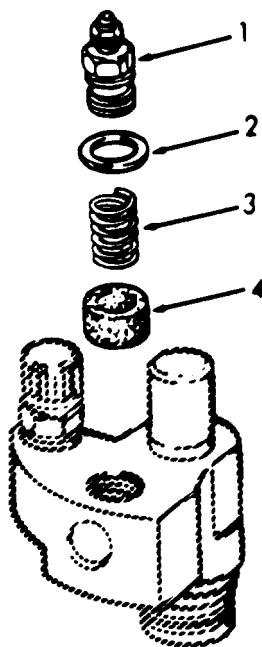
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LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY/OVERHAUL (Cont)**

- b. Remove filter cap (1), gasket (2), compression spring (3), and filter element (4).



## 6-31. FUEL INJECTORS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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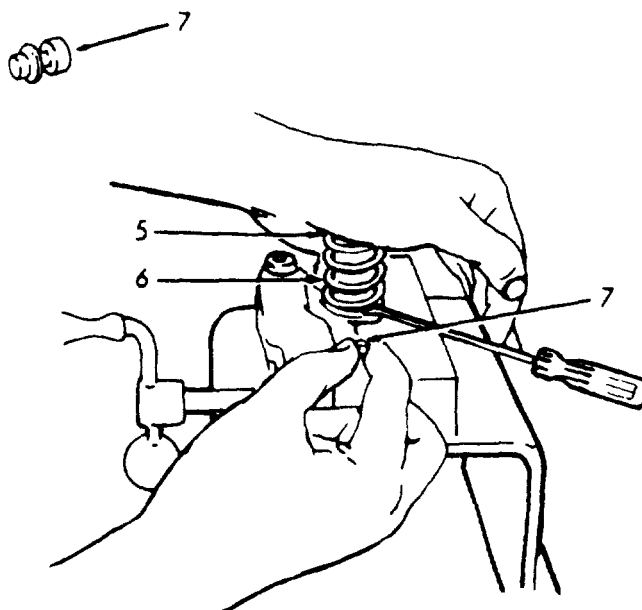
## DISASSEMBLY/OVERHAUL (Cont)

## NOTE

When fuel injector is disassembled, replace element, spring, gasket, and cap.

## 3. Stop Pin

Depress follower (5) and follower spring (6) with palm of hand as shown and remove stop pin (7).



## 4. Injector Nut

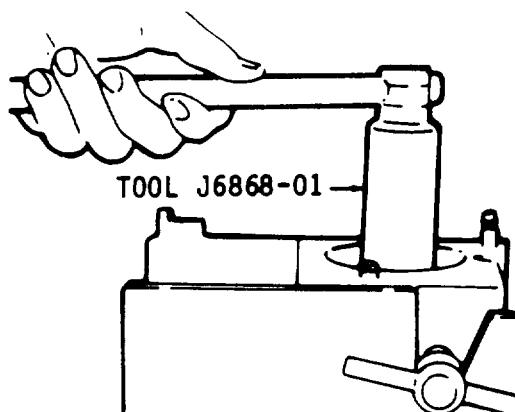
- Reverse injector in fixture.
- Loosen injector nut (8).
- Unscrew injector nut and lift straight up, being careful not to dislodge the spray tip and valve parts.

Use tool J6868-01.

## 6-31. FUEL INJECTORS (Continued).

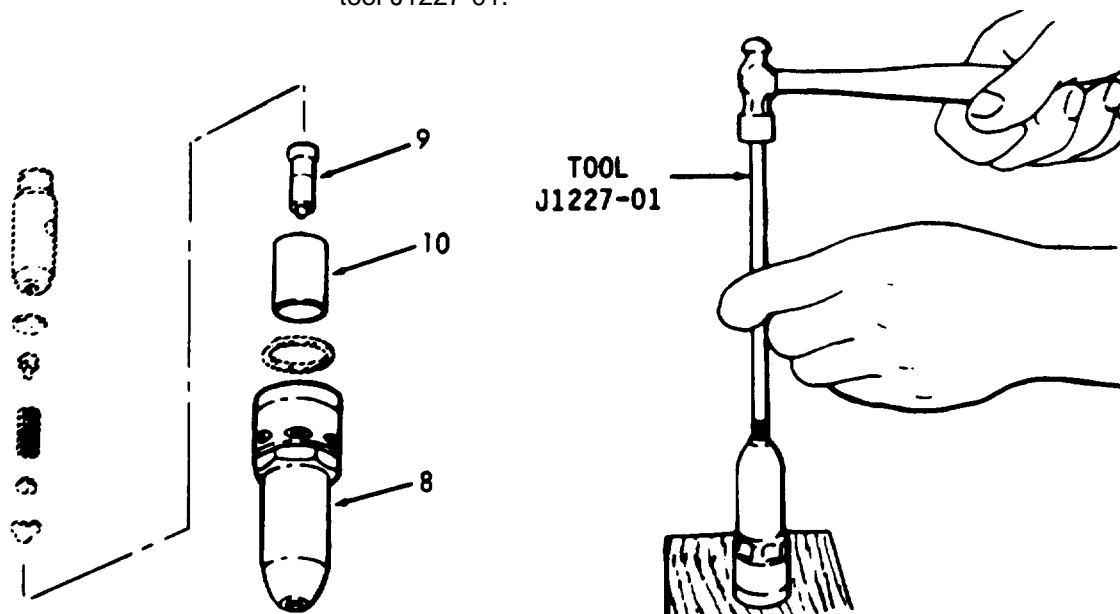
LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY/OVERHAUL (Cont)



## 5. Spray Tip and Valve Parts

- a. Remove spray tip (9) and valve parts from spill deflector (10) and place them in a clean receptacle until ready for assembly.
- b. When an injector has been in use for some time, the spray tip (9), even though clean on the outside, may not be pushed readily from the nut with the fingers. In this event, support the nut on a wood block and drive the tip down through the nut, using tool J1227-01.

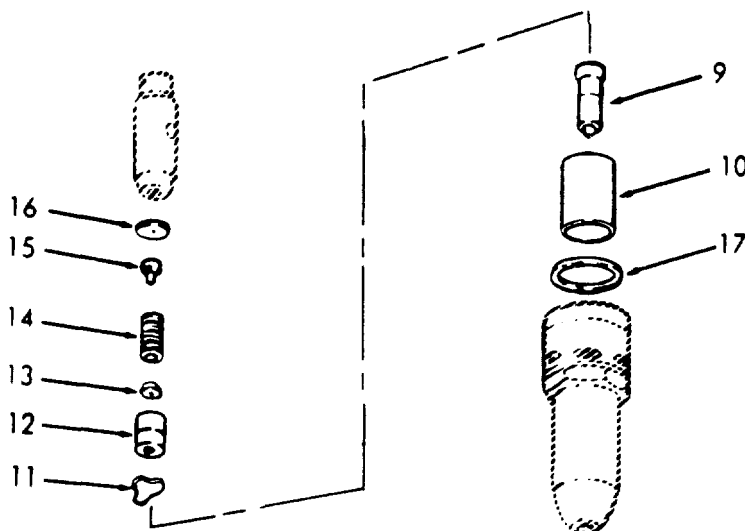


## 6-31. FUEL INJECTORS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY/OVERHAUL (Cont)

- c. Remove check valve (11), cage (12), valve stem (13), spring (14), injector valve (15), valve seat (16), spill deflector (10), and packing (17).



## 6. Plunger Assembly

- a. Remove headless pin (18) from plunger assembly.
- b. Remove plunger assembly (19), spacer sleeve (20), from injector body.
- c. Remove injector body (21) from holding fixture.
- d. Turn over and catch spur gear (22) in your hand as it falls out of injector body.

Lift plunger assembly straight out of injector body.

**6-31. FUEL INJECTORS (Continued).**

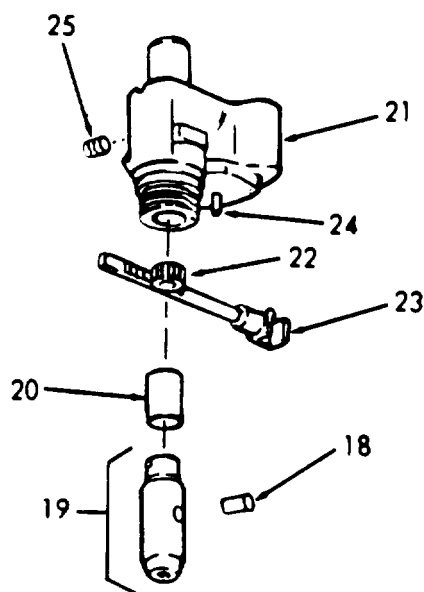
LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY/OVERHAUL (Cont)**

e. Remove injector control rack (23).

f. Remove pins (24 and 25) from injector body.

If damaged.

**CLEANING**

7. Injector

a. Since most injector difficulties are the result of dirt particles, it is essential that a clean area be provided on which to place the injector parts after cleaning and inspection.

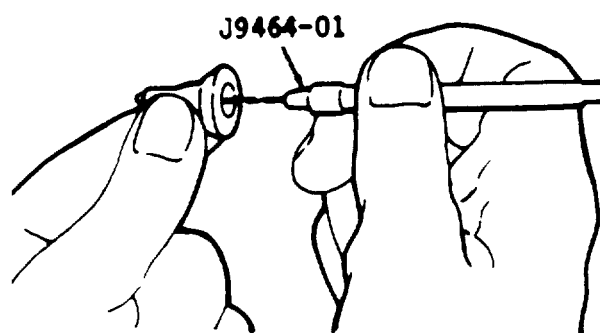
**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING (Cont)****WARNING**

**Wear protective eye goggles when using compressed air to prevent eye injury.**

- b. Wash all of the parts with clean fuel oil and dry them with clean, filtered compressed air. Do not use waste or rags for cleaning purposes. Clean out all of the passages, drilled holes and slots in all of the injector parts.
- c. Carbon on the inside of the spray tip may be loosened for easy removal by soaking for approximately 15 minutes in a suitable solution prior to the external cleaning and buffing operation. Methyl Ethyl Ketone solution is recommended for this purpose.
- d. Clean the spray tip with tool J9464-01.



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**6-31. FUEL INJECTORS (Continued).**

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LOCATION/ITEM	ACTION	REMARKS
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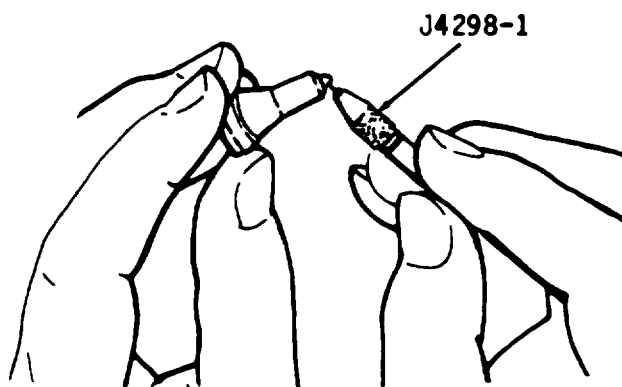
**CLEANING (Cont)****WARNING**

Wear protective eye goggles when using compressed air to prevent eye injury.

**CAUTION**

Care must be exercised when inserting the carbon remover J9464-01 in the spray tip to avoid contacting the needle valve seat in the tip.

- e. Wash the tip in fuel oil and dry it with compressed air. Clean the spray tip orifices with pin vise J4298-1 and the proper size spray tip cleaning wire. Use wire J21461 to clean .006 inch diameter holes.
- f. Before using the wire, hone the end until it is smooth and free of burrs. Allow the wire to extend 1/8 inch from tool J4298-1.



**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING (Cont)**

- g. The exterior surface of an injector spray tip may be cleaned by using a brass wire buffing wheel. To obtain a good polishing effect and longer brush life, the buffing wheel should be installed on a motor that turns the wheel at approximately 3000 rpm. A convenient method of holding the spray tip while cleaning and polishing is to place the tip over the drill end of the spray tip cleaner tool and hold the body of the tip against the buffing wheel. In this way, the spray tip is rotated while being buffed.

**CAUTION**

**Do not buff excessively. Do not use a steel wire buffing wheel or the spray tip holes may be distorted.**

- h. When the body of the spray tip is clean, lightly buff the tip end in the same manner. This cleans the spray tip orifice area and will not plug the orifices.

**WARNING**

**Wear protective eye goggles when using compressed air to prevent eye injury.**

- i. Wash the spray tip in clean fuel oil and dry it with compressed air.



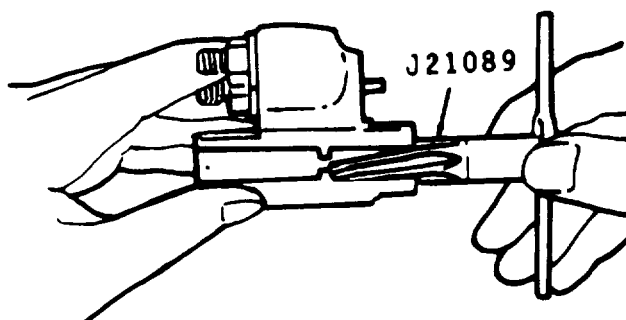
**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING (Cont)**

j. Clean and brush all of the passages in the injector body. Blow out the passages and dry them with compressed air.

k. Carefully insert reamer J21089 in the injector body. Turn it in a clockwise direction a few turns, then remove the reamer and check the face of the ring for reamer contact over the entire face of the ring. If necessary, repeat the procedure until the reamer does make contact with the entire face of the ring. Clean up the opposite side of the ring in the same manner.



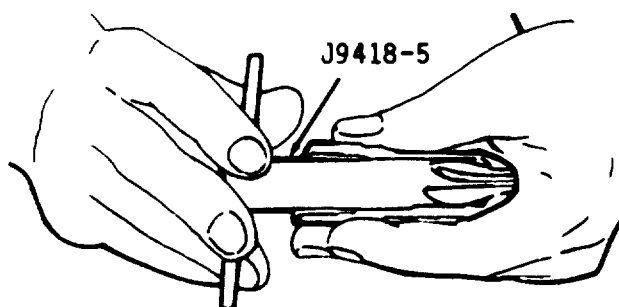
l. Carefully insert straight fluted reamer inside the ring bore in the injector body. Turn the reamer in a clockwise direction and remove any burrs inside the ring bore. Then wash the injector body in clean fuel oil and dry it with compressed air.

**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING (Cont)**

- m. Carefully insert carbon remover tool J8418-1 in the injector nut. Turn it in a clockwise direction to remove the carbon deposits on the flat spray tip seat as shown below. Remove the carbon deposits from the lower end of the injector nut with carbon remover J9418-5, in the same manner. Use care to prevent removing any metal or setting up burrs on the spray tip seat.

**WARNING**

**Wear protective eye goggles when using compressed air to prevent eye injury.**

- n. Wash the injector nut in clean fuel oil and dry it with compressed air. Carbon deposits on the spray tip seating surfaces of the injector nut will result in poor sealing and consequent fuel leakage around the spray tip.

**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>CLEANING (Cont)</b>		
	<ul style="list-style-type: none"> <li>o. When handling the injector plunger, do not touch the finished plunger surfaces with your fingers. Wash the plunger and bushing with clean fuel oil and dry them with compressed air. Be sure the high pressure bleed hole is not plugged. If this hole is plugged, fuel leakage will occur at the upper end of the bushing where it will drain out of the injector body vent and rack holes, during engine operation, causing a serious oil dilution problem. Keep the plunger and bushing together as they are mated parts.</li> <li>p. After washing, submerge the parts in a clean receptacle containing clean fuel oil. Keep the parts of each injector assembly together.</li> </ul>	
<b>INSPECTION</b>		
8. Injector	<ul style="list-style-type: none"> <li>a. Inspect the teeth on the control rack gear for excessive wear or damage. Also check for excessive wear in the bore of the gear and inspect the gear retainer. Replace damaged or worn parts.</li> <li>b. Inspect the injector follower and pin for wear.</li> </ul>	

**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)**

- c. Inspect both ends of the spill deflector for sharp edges or burrs which could create burrs on the injector body or injector nut and cause particles of metal to be introduced into the spray tip and valve parts. Remove burrs with a 500 grit stone.
- d. Inspect the follower spring for visual defects. Then check the spring with spring tester and an accurate torque wrench.
- e. The injector follower spring (.142" diameter wire) has a free length of approximately 1.668" and should be replaced when a load of less than 48 lbs. will compress it to 1.028".
- f. Check the seal ring area on the injector body for burrs or scratches. Also check the surface which contacts the injector bushing for scratches, scuff marks or other damage. If necessary, lap this surface. A faulty sealing surface at this point will result in high fuel consumption and contamination of the lubricating oil. Replace any loose injector body pump or a loose dowel pin. Install the proper number tag on a service replacement injector body.

**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)**

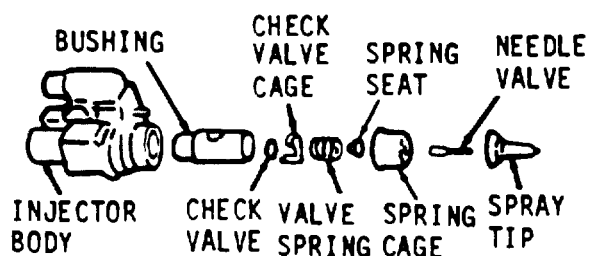
- g. Inspect the injector plunger and bushing for scoring, erosion, chipping or wear. Check for sharp edges on that portion of the plunger which rides in the gear. Remove any sharp edges with a 500 grit stone. Wash the plunger after stoning it. Injector Bushing Inspectalite can be used to check the port holes in the inner diameter of the bushing for cracks or chipping. Slip the plunger into the bushing and check for free movement. Replace the plunger and bushing as an assembly if any of the above damage is noted, since they are mated parts. Use new mated factory parts to assure the best performance from the injector.
- h. Injector plungers cannot be reworked to change the output. Grinding will destroy the hardened case at the helix and result in chipping and seizure or scoring of the plunger.
- i. Examine the spray tip seating surface of the injector nut and spray tip for nicks, burrs, erosion and brinelling. Reseat the surface or replace the nut or tip if it is severely damaged.

## 6-31. FUEL INJECTORS (Continued).

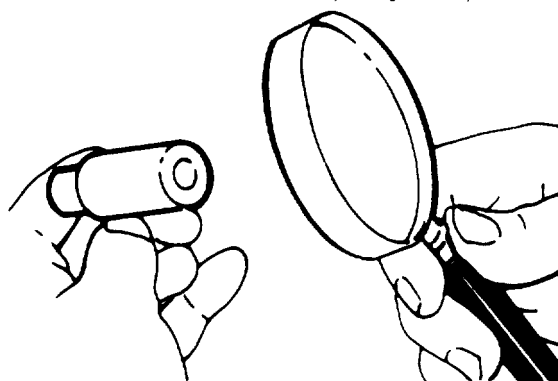
LOCATION/ITEM	ACTION	REMARKS
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## INSPECTION (Cont)

- j. The injector valve spring plays an important part in establishing the valve opening pressure of the injector assembly. Replace the worn or broken spring.
- k. Inspect the sealing surfaces of the injector parts indicated by arrows below.



- l. Examine the sealing surfaces with a magnifying glass as shown below for even the slightest imperfections that will prevent the injector from operating properly. Check for burrs, nicks, erosion, cracks, chipping and excessive wear. Also check for enlarged orifices in the spray tip.



**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)**

Replace damaged or excessively worn parts. Check the minimum thickness of the lapped parts as noted in the chart.

**CAUTION**

**Be sure that no compound is accidentally placed on the lapped surfaces located higher up in the spray tip. The slightest lapping action on these surfaces can alter the near-perfect fit between the needle valve and tip.**

- m. Before reinstalling used injector parts, lap all of the sealing surfaces indicated by the arrows in the figure in step j. It is also good practice to lightly lap the sealing surfaces of new injector parts which may become burred or nicked during handling.

**LAPPING**

## 9. Injector

Lap the sealing surfaces indicated in the figure in step 8.j. as follows:

**WARNING**

**Wear protective eye goggles when using compressed air to prevent eye injury.**

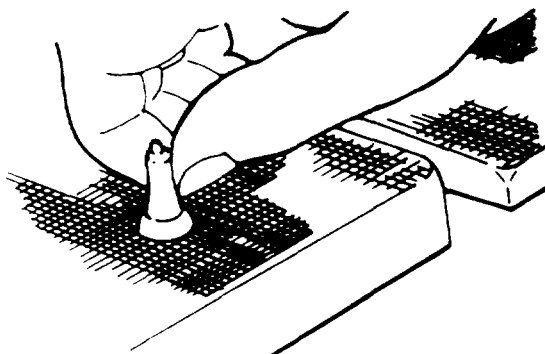
- a. Clean the lapping blocks J22090 with compressed air. Do not use a cloth or any other material for this purpose.

**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**LAPPING (Cont)**

- b. Spread a good quality 600 grit dry lapping powder on one of the lapping blocks.
- c. Place the part to be lapped flat on the block as shown below and, using a figure eight motion, move it back and forth across the block. Do not press on the part, but use just enough pressure to keep the part flat on the block. It is important that the part be kept flat on the block at all times.



- d. After each four or five passes, clean the lapping powder from the part by drawing it across a clean piece of tissue placed on a flat surface and inspect the part.
- e. When the part is flat, wash it in cleaning solvent and dry it with compressed air.



**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**LAPPING (Cont)**

- f. Place the dry part on the second block. After applying lapping powder, move the part lightly across the block in a figure eight motion several times to give it a smooth finish. Do not lap excessively. Again wash the part in cleaning solvent and dry it with compressed air.
- g. Place the dry part on the third block. Do not use lapping powder on this block. Keep the part flat and move it across the block several times, using the figure eight motion. Lapping the dry part in this manner gives it the "mirror" finish required for perfect sealing.

**WARNING**

**Wear protective eye goggles when using compressed air to prevent eye injury.**

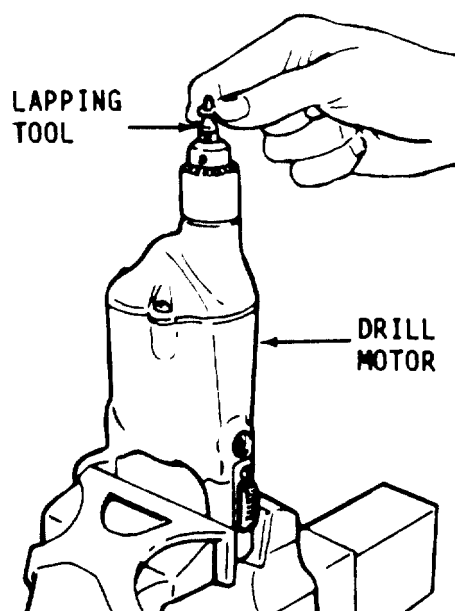
- h. Wash all of the lapped parts in clean fuel oil and dry them with compressed air.
- i. Only the edge of the hole in crown valve seat contacts the valve, this edge must be nearly perfect, must be a true circle and present an unbroken surface. Examine the edge of the hole under a magnifying glass for chipping or cracks. If the edge of hole shows irregularities, the hole must be lapped.

## 6-31. FUEL INJECTORS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## LAPPING (Cont)

- j. Position a drill motor in a vice and mount the lapping tool in the motor as shown and place a small amount of oil mixture on the tool.



- k. Place the valve seat over the pilot of the tool and start the drill. Holding the valve with the fingers, touch it lightly against the rotating lapping tool to produce a uniform seat at the hole. After lapping the edge of the hole in this manner, flat lap the face of the seat lightly, then clean and examine the width of the edge. Width of the chamfer produced at the edge of the hole should be within .002 to .005 inch. A width in excess of these limits will lower the pop pressure of the injector.

**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY**

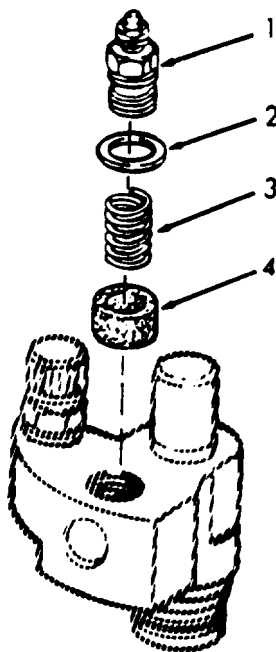
10. Filter  
Assembly

**NOTE**

The fuel filters have a dimple at one end. Install the filter with the dimple down.

- Install new filter elements (4) with dimple down.
- Install springs (3).
- Place a new gasket (2) on each filter cap (1).
- Lubricate filter cap threads and install.
- Tighten caps (1) to 65-70 lb-ft (88.1-94.9 Nm) torque.

Use 9/16 inch  
deep socket.



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**6-31. FUEL INJECTORS (Continued).**


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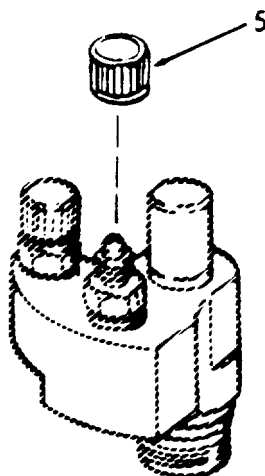
LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)****WARNING**

**Wear protective eye goggles when using compressed air to prevent eye injury.**

- f. Purge filters after installation by directing compressed air or fuel through the filter caps.
- g. Install shipping caps (5) on all openings to prevent any dirt particles from entering injector.



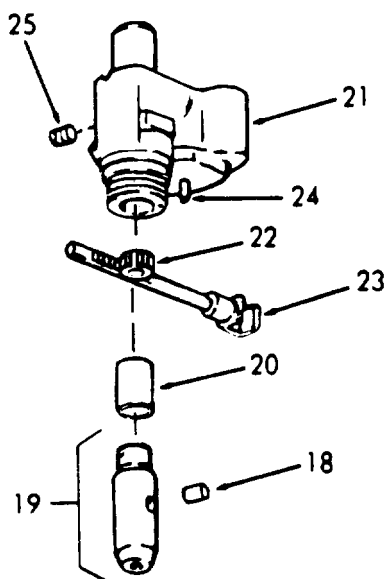
11. Control Rack  
and Gear

**NOTE**

**Observe the two marked teeth when looking into the bore of the gear from the bottom side of the injector body.**

**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>ASSEMBLY (Cont)</b>		
a. Hold injector body (21) bottom end up and slide rack (23) through injector body.		
b. Slide gear (22) into proper position with the rack.		
c. Install spacer sleeve (20) on top of gear (22).		
d. Align headless pin (18) in plunger assembly (19) with slot in injector body, then slide end of plunger into place.		
e. Install pins (24 and 25).		If removed.



**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

- |                               |   |  |
|-------------------------------|---|--|
| 12. Spray Tip and Valve Parts | <ul style="list-style-type: none"> <li>a. Support injector body bottom end up in holding fixture.</li> <li>b. Place packing (17) on shoulder of injector body.</li> <li>c. Place spill deflector (10) over barrel of body.</li> <li>d. Install valve seat (16), injector valve (15), valve spring (14), valve stem (13), cage (12), check valve (11), and spray tip (9) into injector nut (8).</li> </ul>   |  |
| 13. Injector Nut              | <ul style="list-style-type: none"> <li>a. Lubricate the threads in the injector nut (8) and carefully thread the nut on the injector body by hand. Rotate the spray tip between your thumb and first finger while threading the nut on the injector body. Tighten the nut as tight as possible by hand. At this point there should be sufficient force on the spray tip to make it impossible to turn with your fingers.</li> <li>b. Use socket J6868-01 and a torque wrench to tighten the injector nut to 75-85 lb-ft (101.7-115.2 Nm) torque.</li> </ul> |  |

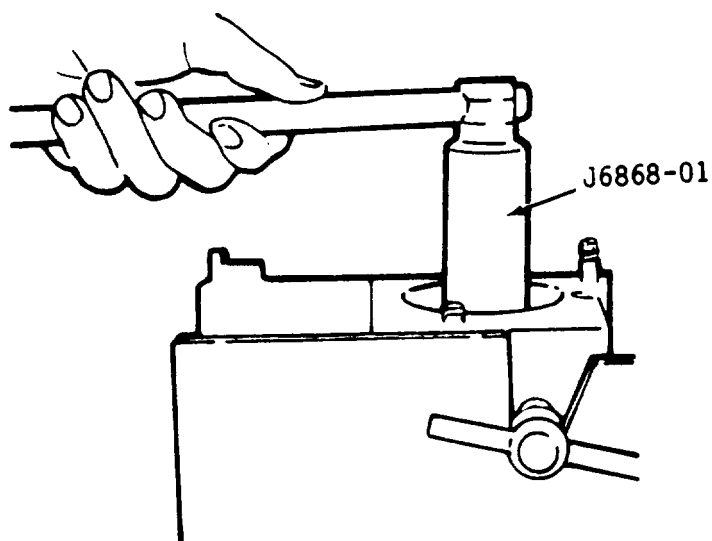
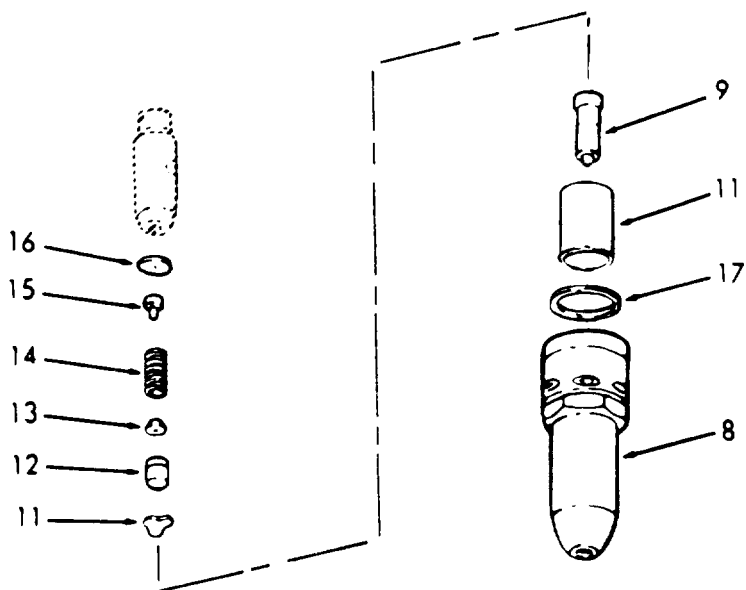
**NOTE**

**Do not exceed the specified torque. Otherwise, the nut may be stretched and result in improper sealing of the lapped surfaces in a subsequent injector overhaul.**

6-31. FUEL INJECTORS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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ASSEMBLY (Cont)

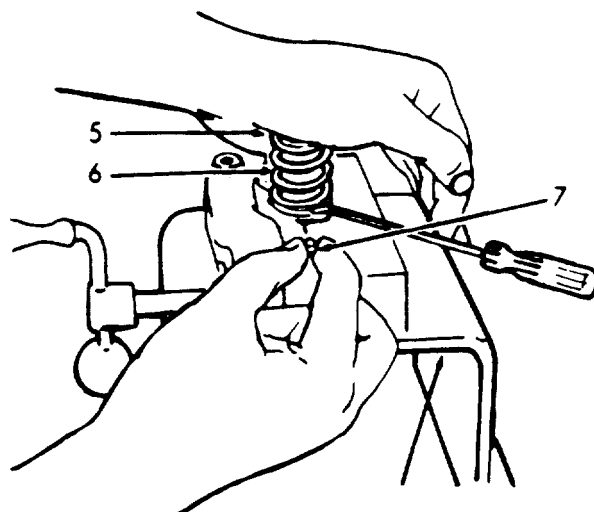


**6-31. FUEL INJECTORS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)****14. Stop Pin and Follower**

- a. Place the stop pin (7) on the injector body so that the follower spring (6) rests on the narrow flange of the stop pin.
- b. Align the slot in the follower (5) with the stop pin hole in the injector body.
- c. Press down on the follower (5) and at the same time press the stop pin (7) into position. When in place, the spring (6) will hold the stop pin in position.

**TESTING AFTER ASSEMBLY****15. Injectors**

Refer to step 1.a. through g. and test injector(s).



**6-32. FRESH WATER PUMP.**

This task covers:

- a. Disassembly
- b. Cleaning

- c. Inspection
- d. Overhaul

- e. Assembly

**INITIAL SETUP****Test Equipment**

NONE

**References**

NONE

**Special Tools**

Drive coupling remover tool  
J1930 J4292  
Arbor press

**Equipment**

Paragraph

**Condition    Condition Description**

5-25 Fresh Water Pump removed

**Tools**

General Mechanic's Tool Kit  
NSN 5180-00-629-9783

**Material/Parts**

Sealant  
Dry cleaning solvent  
Fed. Spec. P-D-680

**Special Environmental Conditions**

NONE

**Personnel Required**

MOS 61C10

**General Safety Instructions**

Observe WARNINGS in procedure.

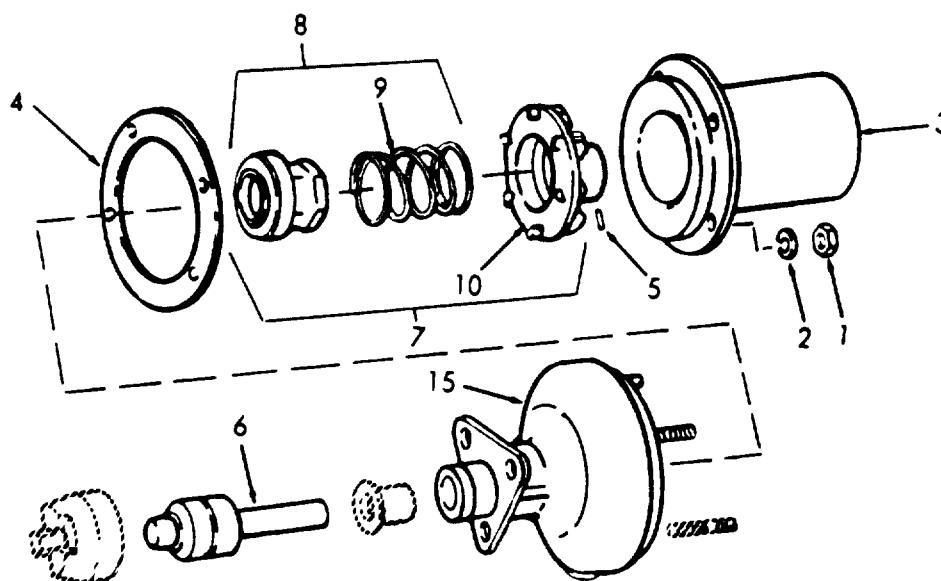
LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY**

- |               |  |                 |
|---------------|--|-----------------|
| 1. Water Pump | <ul style="list-style-type: none"> <li>a. Remove hex nuts (1) and lock-washers (2) from pump cover (3).</li> <li>b. Remove pump cover (3) and cover gasket (4) from body assembly (15).</li> </ul> | Discard gasket. |
|---------------|--|-----------------|

**6-32. FRESH WATER PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
	c. Remove pin (5) from impeller (10).	If used. Use a punch and hammer to remove.
	d. Place pump assembly on its mounting flange in an arbor press.	
	e. Place a short steel rod on pump shaft.	
	f. Press shaft and bearing assembly (6) from impeller and seal assembly (7).	
	g. Remove impeller and seal assembly (7) from pump body (15).	
	h. Remove seal assembly (8) and spring (9) from impeller (10).	



6-32. FRESH WATER PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

i. Tap or press bushing sleeve (11) off shaft and bearing assembly (6).

j. Remove deflector (12) from shaft and bearing assembly (6) using a steel rod clamped in a vise and tool J1930.

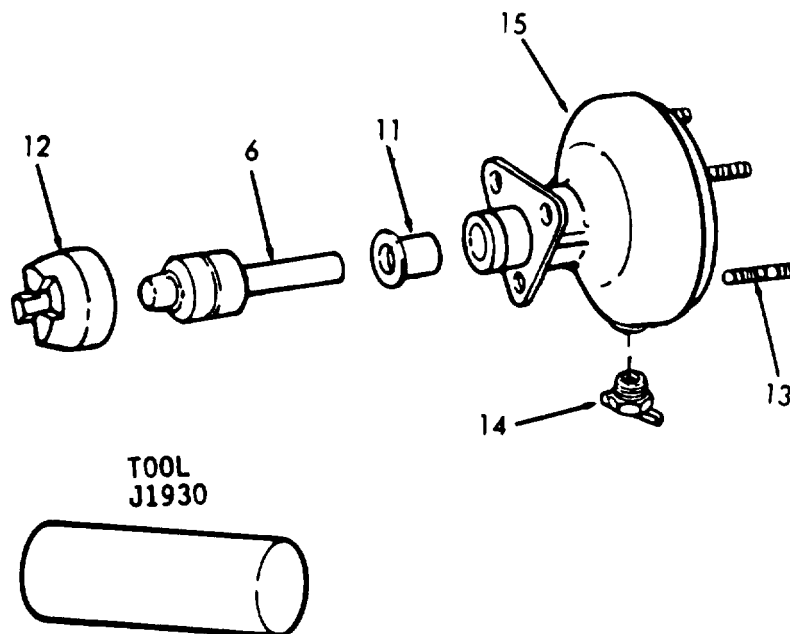
If necessary, use tool J1930.

k. Remove studs (13) from pump body (15).

If damaged.

l. Remove drain cock (14).

If damaged.



**6-32. FRESH WATER PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING**

2.

**WARNING**

Dry cleaning solvent, P-D-680, used to clean parts, is potentially dangerous to personnel and property. Avoid repeated or prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° - 138°F (38° - 59°C).

**CAUTION**

The sealed type pump shaft and bearing must not be immersed in cleaning solvent since dirt may be washed in and the fluid cannot be entirely removed.

Clean parts in cleaning solvent  
Fed. Spec P-D-680 and dry  
thoroughly.

**INSPECTION**

3.

- a. Inspect impeller for nicks, chips, cracks, or breaks.
- b. Inspect threaded parts for crossed or stripped threads.
- c. Inspect body for cracks or breaks.
- d. Inspect cover for cracks or breaks.
- e. Inspect spring for cracks or loss of tension.

**6-32. FRESH WATER PUMP (Continued).**

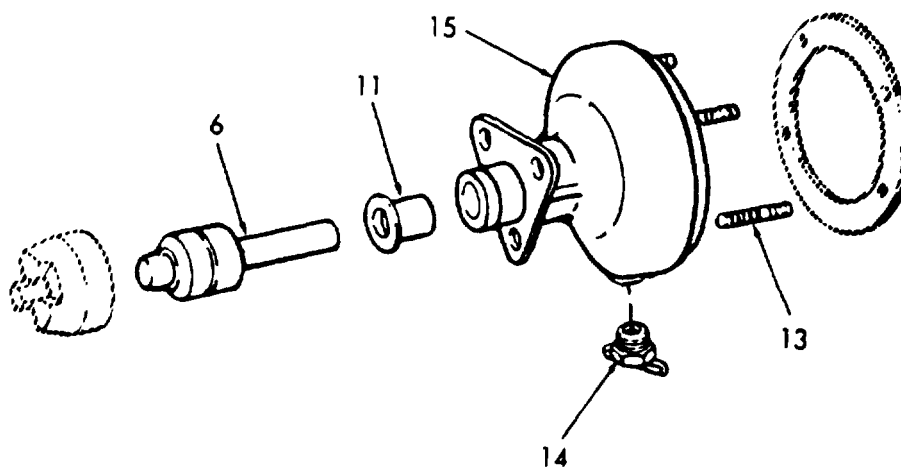
LOCATION/ITEM	ACTION	REMARKS
<b>INSPECTION (Cont)</b>		
	f. Inspect pump shaft bearing for rough spots by rotating by hand.	
	g. Inspect coupling for burrs nicks or cracks.	
<b>OVERHAUL</b>		
4.	a. Replace gaskets, seals, bearings and springs.	
	b. Replace other damaged or defective parts as required.	
	c. Replace water pump damaged beyond repair.	
<b>ASSEMBLY</b>		
5. Water Pump	a. Install drain cock (14).	If removed.
	b. Install studs (13)	If removed. Apply a coat of good sealant to lower portion of threads and torque to 10-12 lb-ft (13.6 - 16.3 N•m).
	c. Install bushing sleeve (11) onto shaft and bearing assembly (6).	Install with flange of sleeve approximately 3/16 inch from end of outer race of bearing assembly.

**6-32. FRESH WATER PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

- d. Support the impeller end of the pump body on an arbor press, and insert the coupling end of the shaft and bearing assembly (6) into the pump body (15). Then, press against the outer race of the bearing until the bearing contacts the shoulder in the pump body. Stake the end of the pump body in three places to prevent the bearing from moving endwise.



6-590

**6-32. FRESH WATER PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>ASSEMBLY (Cont)</b>		
	<p>e. With the surface of the water pump seal (8) clean and free from dirt and metallic particles, apply a thin coat of liquid soap on the inside diameter of the rubber seal . Do not scratch or mar the surface of the carbon seal washer. Slide the seal assembly on the pump shaft until the carbon seal washer is seated firmly against the pump body insert. Then, install the spring (9) with the small end toward the seal.</p>	
	<p>f. Support the bearing end of the shaft (not the drive coupling) on the bed of an arbor press. Then, press the impeller (10) onto the shaft. The end of the shaft must be flush with the face of the impeller hub with the bearing being held against the shoulder in the water pump body.</p>	
	<p>g. Install key (5).</p>	
	<p>h. Support the impeller end of the pump shaft on a suitable arbor and press the coupling (12) onto the shaft. The drive coupling must be flush with the end of the shaft. Make sure the drive coupling is tight on the shaft.</p>	

**NOTE**

Rotate shaft and bearing assembly by hand to be sure rear face of impeller blades do not rub pump body.





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**6-33. RAW WATER PUMP.**

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This task covers:

- a. Removal
- b. Disassembly

- c. Cleaning
- d. Inspection

- e. Repair
  - f. Assembly
- 

**INITIAL SETUP****Test Equipment**

NONE

**References**

NONE

**Special Tools**

Brass rod  
Torque wrench  
Gear puller

**Equipment****Condition    Condition Description**

NONE

**Tools**

Tool Set NSN 5180-00-629-9783

**Material/Parts**

Dry cleaning solvent  
Fed. Spec. P-D-680  
Reconditioning Kit (5197224)  
Sealant

**Special Environmental Conditions**

NONE

**Personnel Required**

MOS 61C10

**General Safety Instructions**

Observe WARNINGS in procedure.

**6-33. RAW WATER PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL**

1. Hose, Lines,  
and Water Pump

**NOTE**

**Drain raw water system.**

- a. Loosen hose clamps (1) on outlet line hose (2).
- b. Remove hose (2).
- c. Remove pipe (3) from water pump flange (5).
- d. Remove nuts (4) and flange (5) from water pump (10).
- e. Remove nuts (6) from inlet line (7).
- f. Remove inlet line (7).
- g. Remove adapter to flywheel mounting bolts (8) and lock-washers (9).

**NOTE**

**Using a wood block or soft hammer, loosen pump from flywheel housing by tapping on edge of adapter.**

- h. Withdraw pump (10) with attached adapter straight out from flywheel housing, disengaging drive gear from coupling.

- i. Remove gasket.

Discard.

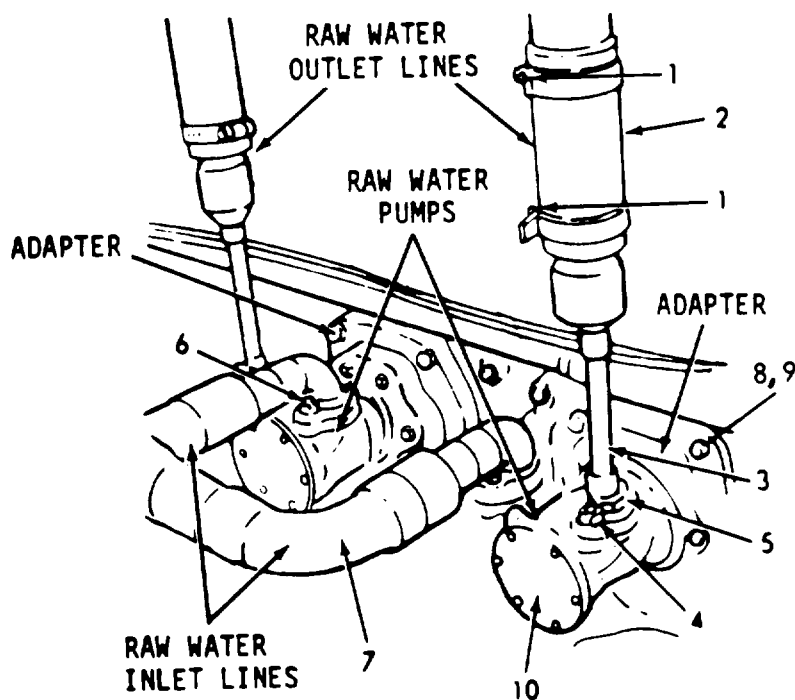
**CAUTION**

**Cover pump opening in flywheel housing with a clean cloth to prevent entrance of foreign matter.**

## 6-33. RAW WATER PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REMOVAL (Cont)



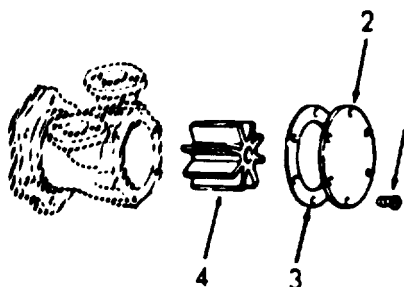
## DISASSEMBLY

## 2. Water Pump

- Remove cover screws (1), cover (2), and cover gasket (3).
- Using two pliers, grasp a blade at each side of impeller and pull impeller (4) from shaft.
- Insert two wires, each with hook at one end, between housing and seal with hook over edge of seal.

Discard screws, cover and gasket.

Discard impeller.

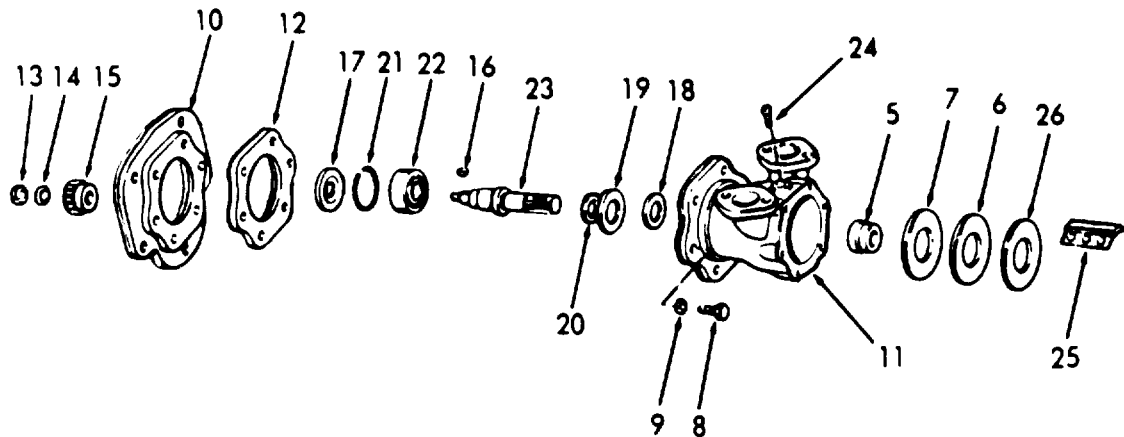


**6-33. RAW WATER PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
	d. Pull seal (5) from shaft.	Discard seal.
	e. Remove flatwasher (6) and packing (7) in a similar manner.	
	f. Scribe a mark on body (11) and adaptor (10) for reference when reassembling.	
	g. Remove cap screws (8) and lock-washers (9) from pump body (11).	
	h. Separate adapter (10) from pump body ( 11 ).	
	i. Remove gasket (12).	Discard.
	j. Clamp drive gear (15) in a soft-jawed vise.	
	k. Remove locknut (13) and lock-washer (14) from pump shaft.	
	l. Remove gear from vise and, using a suitable gear puller, pull gear (15) from shaft.	
	m. Remove woodruff key (16) from shaft.	Discard key.
	n. Remove plain seal (17) from pump body (11).	Discard seal.
	o. Place pump body in arbor press with mounting flange resting on bed of press and splined end of shaft under ram of press.	
	p. Press shaft and ball bearing from pump body (11).	Use a brass rod between shaft and ram.

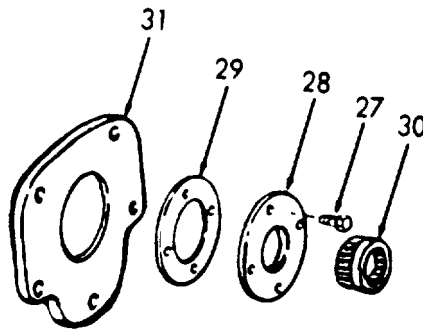
6-33. RAW WATER PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
	q. Remove deflector (18).	Discard.
	r. Remove bearing seal (19) and sleeve spacer (20).	Discard seal.
	s. Discard retaining ring (21), bearing (22), and shaft (23).	
	t. Remove machine screws (24) from offset cam and remove cam (25).	Discard screws.
	u. Lift wear plate (26) off dowel.	



**6-33. RAW WATER PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
	v. Remove bolts (27) from drive plate.	
	w. Remove drive plate (28) and retaining plate (29) from flywheel housing.	
	x. Remove drive coupling (30) from drive plate (28).	Discard coupling.
	y. Remove gasket (31).	Discard.

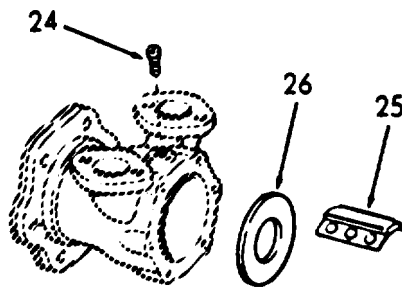
**CLEANING****3. Water Pump****WARNING**

Dry cleaning solvent, P-D-680, used to clean parts, is potentially dangerous to personnel and property. Avoid repeated or prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° - 138°F (38° - 59°C).

Clean all parts with cleaning solvent Fed. Spec. P-D-680.

**6-33. RAW WATER PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSPECTION</b>		
4. Water Pump	a. Inspect wear plate for burrs or nicks.  b. Inspect threaded parts for thread damage.	
<b>REPAIR</b>		
5. Water Pump	a. Remove any burrs from wear plate using a file.  b. Replace other damaged or defective parts as necessary.	
<b>ASSEMBLY</b>		
6. Water Pump	a. Install wear plate (26) in housing.  b. Place offset cam (25) in pump body and secure with new screws (24).	Make sure locating hole in plate is over dowel.   Make sure end of cam is flush with end of body.



**6-33. RAW WATER PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>ASSEMBLY (Cont)</b>		
	c. Install bearing (22) on shaft (23).	Support splined end of new shaft (23) on wood block on bed of arbor press. Start new bearing (22) straight on shaft and, using a sleeve between ram of press and inner race of bearing, press bearing on shaft tight against shoulder on shaft.
	d. Install retaining ring (21) in groove on pump shaft.	Use new ring.
	e. Slide sleeve spacer (20) over splined end of shaft.	
	f. Lubricate lip of seal (19), and slide over splined end of shaft.	Use new seal.
	g. Push spacer (20) and seal (19) up against bearing (22).	
	h. Install deflector (18) in pump body.	Use new deflector.
	i. Install plain seal (17) in pump body.	Use new seal. Insert splined end of shaft into flanged end of housing and start seal (17) straight into counterbore in housing. Support housing in



## 6-33. RAW WATER PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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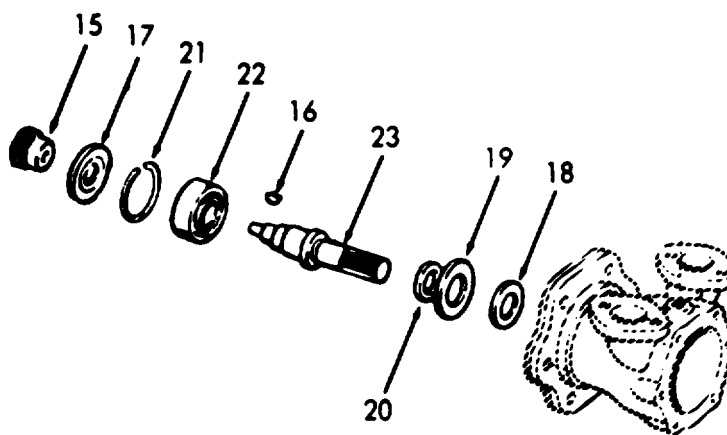
## ASSEMBLY (Cont)

- j. Install woodruff key (16) in pump shaft (23).
- k. Start drive spur gear (15) straight on shaft and over key.

arbor press with threaded end of shaft under ram of press using a suitable sleeve between ram and outer race of seal, press seal (17) into counter-bore in housing.

Use new key.

Place housing in arbor press with splined end of shaft supported on a wood block, and press gear on shaft tight against shoulder on shaft.



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## 6-33. RAW WATER PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
<b>ASSEMBLY (Cont)</b>		
	l. Clamp gear and shaft in a soft-jawed vise and install lockwasher (14) and locknut (13).	Tighten nut to 25-30 lb-ft (34 - 41 Nm) torque. Do not exceed specified torque, otherwise shaft fracture and consequent early pump failure may result. Remove gear from vise.
	m. Position pump to adaptor gasket (12) in place.	Use new gasket.
	n. Position adaptor (10) in place on pump body (11) and secure with lockwashers (9) and cap screws (8).	Make sure scribe marks are aligned on pump body and adaptor.
	o. Install packing (7) and flat washer (6) in body.	
	p. Install seal (5) on pump drive shaft (23).	Use new seal.
	q. Compress impeller blades enough to clear offset cam (25) and press impeller (4) onto splined end of drive shaft (23).	Use new impeller.
	r. Position cover plate gasket (3) in place on pump body (11) .	Use new gasket.
	s. Install cover (2) onto body (11) with screws (1).	Use new cover and screws.
	t. Secure retaining plate (29) and drive plate (28) to flywheel housing with bolts (27).	

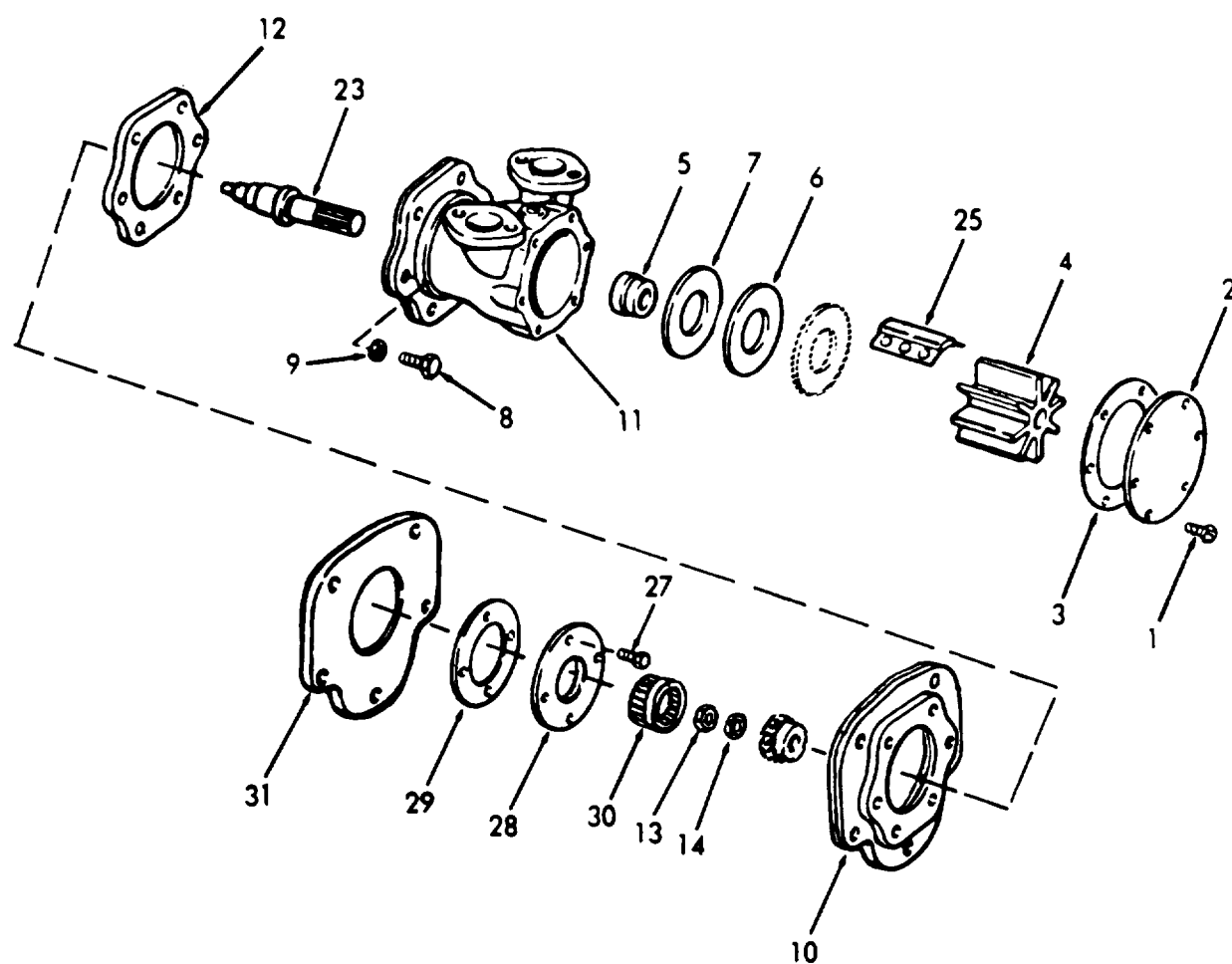
6-33. RAW WATER PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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ASSEMBLY (Cont)

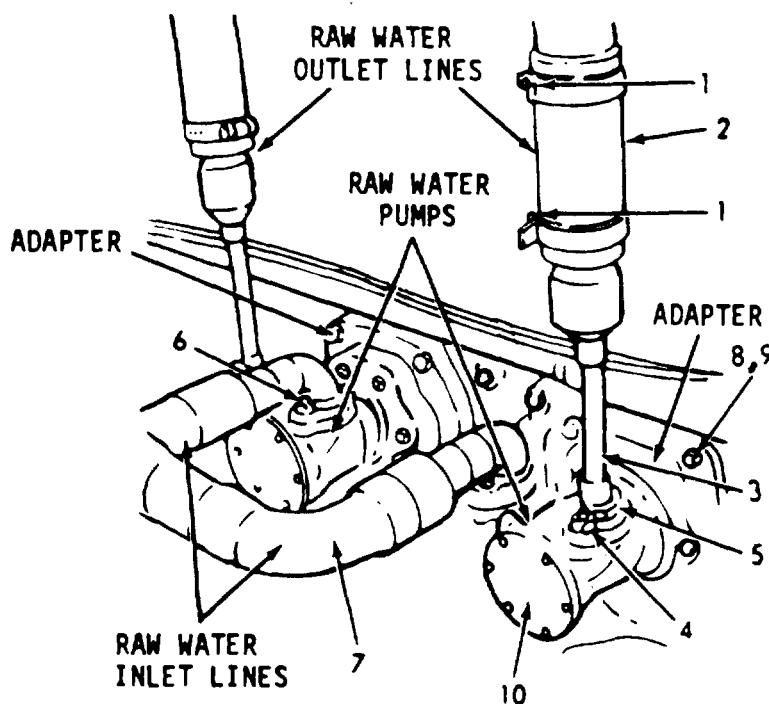
u. Insert drive coupling (30)  
into drive plate (28).

Use new coupling.



**6-33. RAW WATER PUMP (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSTALLATION</b>		
7. Water Pump, Hoses, Lines, and Fittings	a. Remove cloth cover from pump opening in flywheel housing.	Use new gasket.
	b. Position gasket and pump assembly (10) in place on flywheel housing.	
	c. Secure with lockwashers (9) and mounting bolts (8).	
	d. Install inlet line (7) using nuts (6).	
	e. Install flange (5) using nuts (4).	
	f. Install pipe (3) into flange (5).	
	g. Place hose (2) over outlet line openings and tighten hose clamps (1).	



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**6-34 . ENGINE SPEED GOVERNOR.**

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This task covers:

- a. Disassembly
- b. Cleaning

- c. Inspection
- d. Overhaul

- e. Assembly
- 

**INITIAL SETUP****Test Equipment**

NONE

**References**

NONE

**Special Tools**

Bearing installer J21068  
 Gage, governor spring gap  
 0.170 inch J5407  
 Arbor press  
 Torque wrench

**Equipment**

Paragraph

**Condition      Condition Description**

5-29      Governor removed

**Tools**

General Mechanic's Tool Kit  
 NSN 5180-00-629-9783

**Material/Parts**

Clean engine oil  
 Loctite, sealant grade HV  
 Cleaning solvent Fed. Spec.  
 P-D-680  
 Clean lint free cloths  
 Grease

**Special Environmental Conditions**

NONE

**Personnel Required**

MOS 61C10

**General Safety Instructions**

Observe WARNINGS in procedure.

**6-34. ENGINE SPEED GOVERNOR (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY</b>		
1. Governor Clutch	a. Remove plug (1) from shutdown shaft (9).	
	b. Remove cap screw (2) and lockwasher (3) from shutdown shaft.	If necessary for replacement.
	c. Remove shutdown shaft (4) from throttle shaft.	
	d. Remove straight pin (5) from lever assembly (6).	
	e. Lift lever assembly (6) and flatwasher (7) from shutdown shaft (9).	Remove pin (8) from lever assembly if damaged.
	f. Withdraw shutdown shaft (9) from cover assembly (19).	Remove straight pin (10) from shutdown shaft if damaged.
	g. Remove spring (11) from cam (14).	
	h. Remove retaining ring (12) and flatwasher (13) from cam pin (15).	
	i. Remove cam (14) from cam pin (15) and packing (16) from cover assembly (19).	Remove cam pin (15) from cover if worn or damaged.
	j. Remove screw with washer (17), lockwasher (18), cover assembly (19), and gasket (20) from housing (22).	

## 6-34. ENGINE SPEED GOVERNOR (Continued).

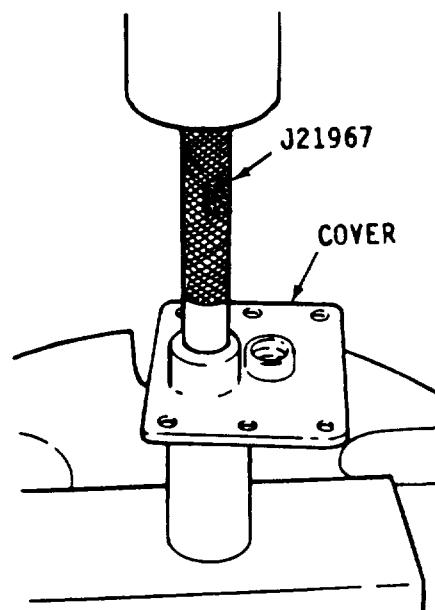
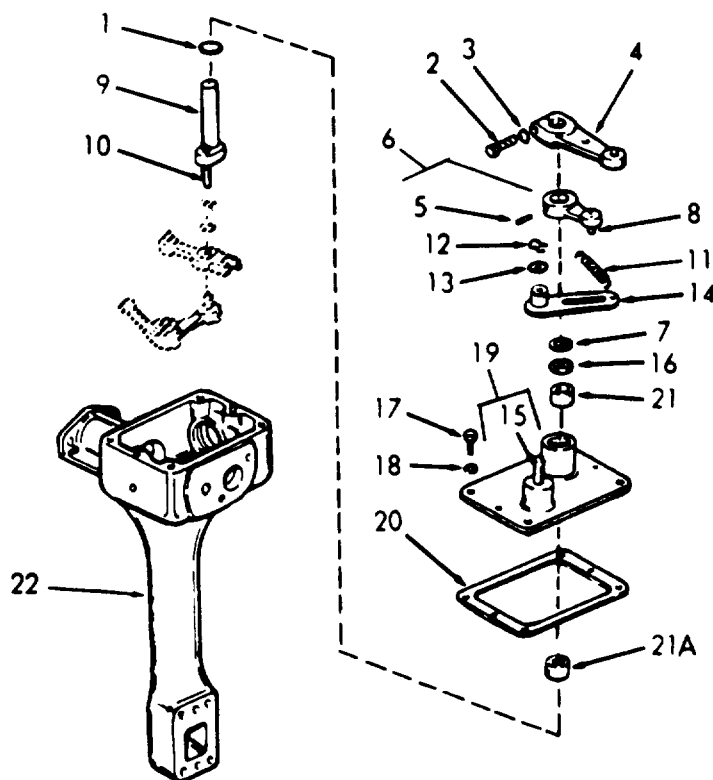
LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)

k. Wash the cover assembly (19) (containing needle bearings (21 and 21A) thoroughly in clean fuel oil and inspect the needle bearings for wear or damage.

l. If needle bearing removal is necessary, place the inner face of the cover over the opening in the bed of the press. Place remover J21967 on top of the bearing and under the ram of the press; then press both bearings out of the cover.

If bearings are satisfactory for further use do not remove.



**6-34. ENGINE SPEED GOVERNOR (Continued).**

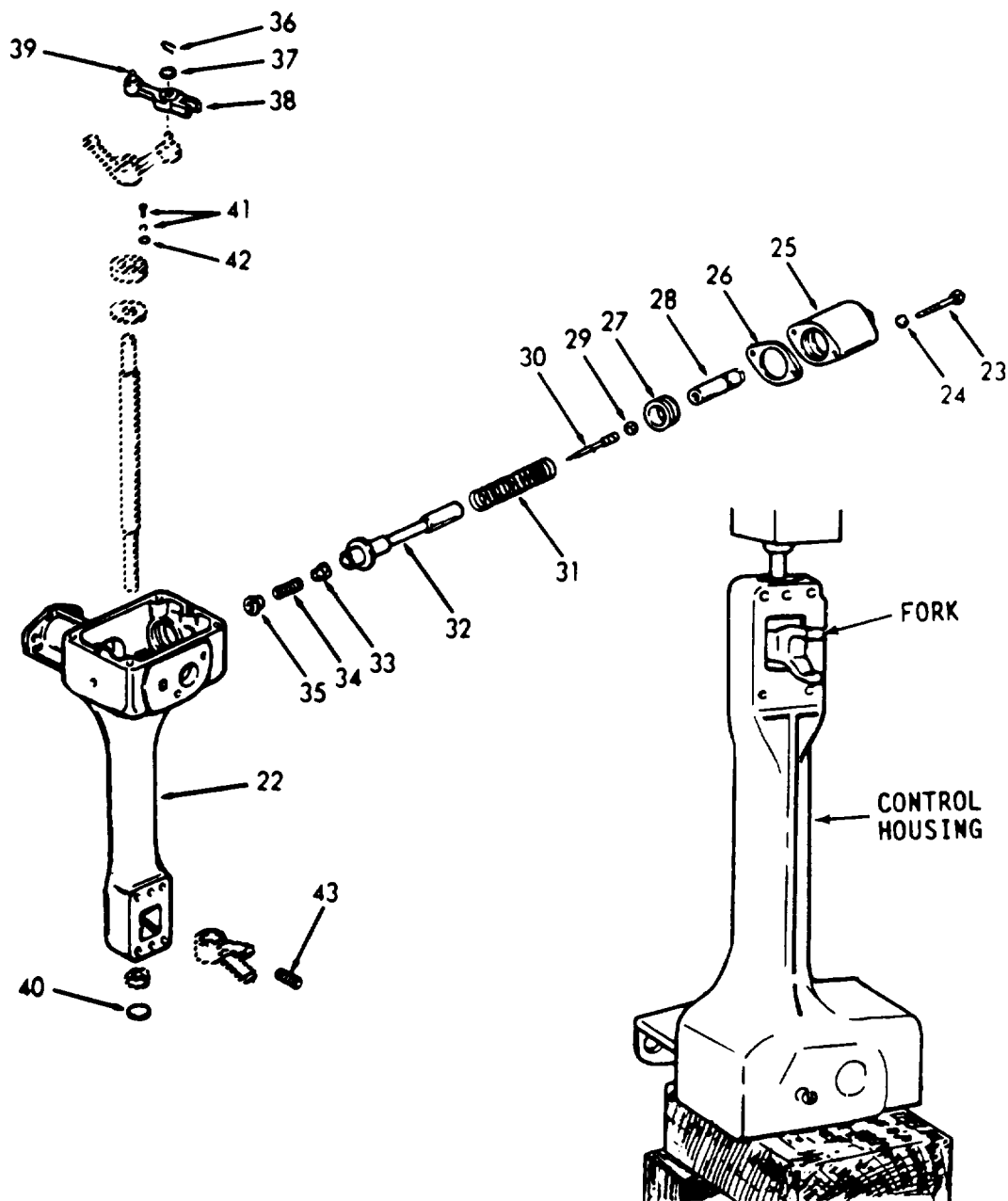
LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
2. Governor Control Housing	a. Place governor control housing (22) in a soft-jawed vise.	Remove pin (39) from differential lever (38), if damaged.
	b. Remove cap screws (23), lock-washers (24), high speed spring housing (25), and gasket (26) from control housing (22).	
	c. Loosen locknut (27)', then remove high speed spring retainer (28), hex nut (29), adjusting screw (30), high speed adjusting spring (31), plunger (32), low speed spring seat (33), low speed spring (34), and retainer (35) .	
	d. Remove retainer (36) and flat washer (37) from differential lever (38).	
	e. Remove differential lever (38).	
	f. Remove expansion plug (40) from housing (22).	
	g. Remove bearing retainer screw and lockwasher assembly (41) and flatwasher (42).	
	h. Remove operating fork setscrew (43).	
	i. Support control housing in bed of arbor press as shown.	



6-34. ENGINE SPEED GOVERNOR (Continued).

LOCATION/ITEM	ACTION	REMARKS
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DISASSEMBLY (Cont)

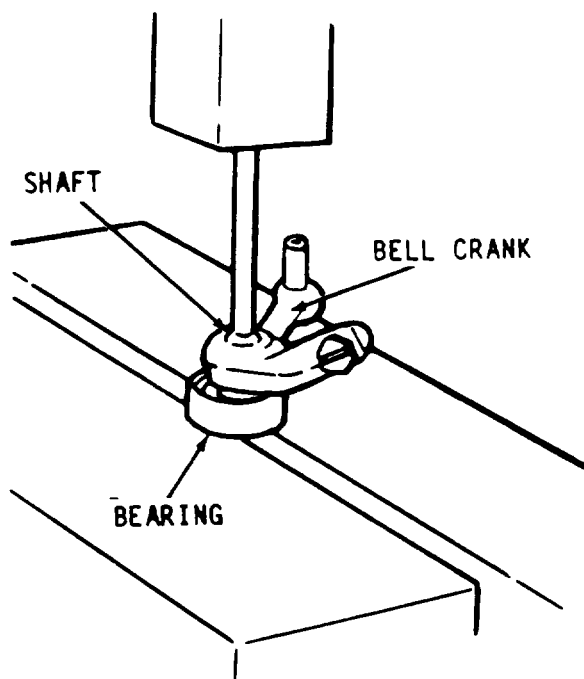
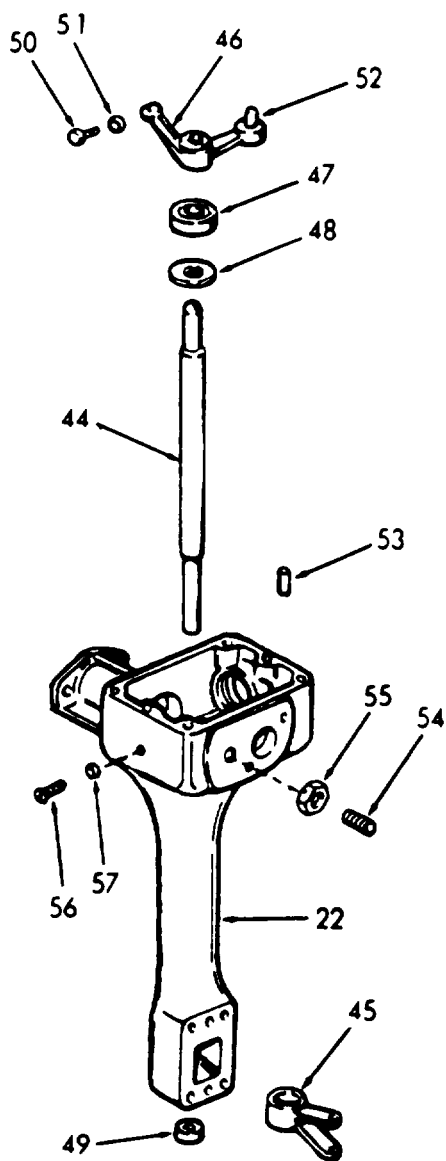


**6-34. ENGINE SPEED GOVERNOR (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
j. Press operating shaft (44) from governor shaft fork (45) with bell crank (46), bearing (47), and flatwasher (48) attached.		Use a brass rod in press to remove shaft and associated parts.
k. Support operating shaft and bell crank in arbor press as shown.		Use a brass rod to press shaft from bell crank and bearing.
l. Remove governor shaft fork (45) from housing (22) and press bushing (49) from fork.		Remove bushing only if defective.
m. Press shaft (44) from bell crank (46), bearing (47), and flat washer (48).		
n. Remove gap adjusting setscrew (50), hex nut (51), and pin (52) from bell crank (46).		If necessary.
o. Remove pins (53), buffer screw with spring (54), hex nut (55), screw (56), and copper gasket (57) from housing (22).		If necessary.

6-34. ENGINE SPEED GOVERNOR (Continued).

LOCATION/ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)		



**6-34. ENGINE SPEED GOVERNOR (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
3. Governor Weight Housing	a. Place weight housing (58) in a soft-jawed vise.	
	b. Remove cap (59) and flatwasher (60) from housing.	
	e. Thread a 5/16 inch-24x3 inch bolt into tapped end of weight shaft (67).	
	f. Support weight housing (58) on bed of arbor press as shown.	
	g. Press shaft and carrier assembly (68) from ball bearing.	

**NOTE**

**Thrust bearing is especially designed to absorb thrust loads; therefore, looseness between mating parts does not indicated excessive wear.**

- h. Slide thrust bearing (69) and riser (70) from shaft (67).
- i. Remove ball bearing (71) from weight housing.

## 6-34. ENGINE SPEED GOVERNOR (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)

## NOTE

Mark weights and carrier with a center punch for identification, also note position of thin washers between the weights so that parts can be replaced in their original position.

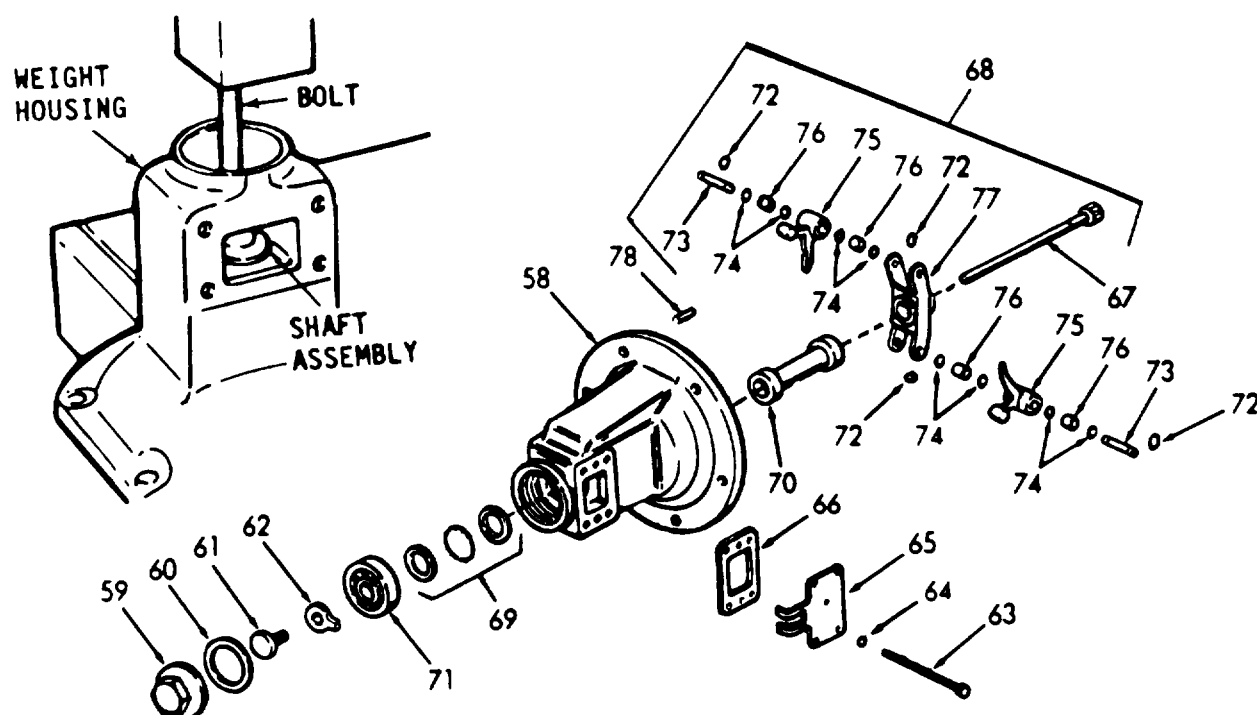
j. Remove retaining rings (72) from grooved pins (73).

k. Remove pins (73), flatwashers (74), and weights (75) from carrier (77).

Remove roller bearing (76) from weights, if necessary.

l. Remove dowel pins (78) from housing (58).

If necessary.



**6-34. ENGINE SPEED GOVERNOR (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING**

4. Engine  
Speed  
Governor

**WARNING**

- Wear safety goggles when using compressed air to avoid possible eye injury. Air pressure should not exceed 30 psi (206.8 kPa).
- Dry cleaning solvent, P-D-680, used to clean parts, is potentially dangerous to personnel and property. Avoid repeated or prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° - 138°F (38° - 59°C).
  - a. Clean parts with cleaning solvent Fed. Spec. P-D-680 and dry thoroughly.
  - b. Clean all passages with compressed air.

**INSPECTION**

5. Engine Speed  
Governor

- a. Rotate ball bearings slowly by hand to detect rough or flat spots, corrosion or pitting.
- b. Inspect riser thrust bearings for corrosion, flat spots or wear.
- c. Inspect bushings in weights for wear.
- d. Inspect operating shaft and bushing for wear.

**6-34. ENGINE SPEED GOVERNOR (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)|**

- e. Inspect weight carriers, weights and retaining pins for wear.
- f. Inspect threaded parts for crossed or stripped threads.

**OVERHAUL****6. Engine Speed Governor**

- a. Replace governor assembly, if damaged beyond overhaul.
- b. Replace ball bearings and needle bearings.
- c. Replace riser thrust bearings.
- d. Replace all gaskets and springs.
- e. Replace lockwashers with tangs on them.
- f. Replace worn operating shaft and bushing assembly.
- g. Replace other damaged or defective parts as required.

**6-34. ENGINE SPEED GOVERNOR (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>ASSEMBLY</b>		
7. Governor Weight Housing	a. Install dowel pins (78) in housing (58).	If removed.
	b. Install roller bearings (76) in weights (75).	If removed.
	c. Install retaining ring (72) in groove of grooved pin (73).	
	d. Place a flatwasher (74) over grooved pin.	
	e. Start pin (73) through opening of carrier (77).	
	f. Place another flatwasher (72) over pin (73).	
	g. Insert weight (75) between arms of carrier (77) and push pin (73) through weight (75).	
	h. Place another flatwasher (74) over pin and against weight (75).	
	i. Push pin (73) completely through carrier (77) and place fourth flatwasher (74) against carrier (77).	
	j. Install locking ring (72) to secure pin (73) .	
	k. Install other weight in the same manner.	
	l. Insert shaft (67) through assembled carrier assembly (68).	

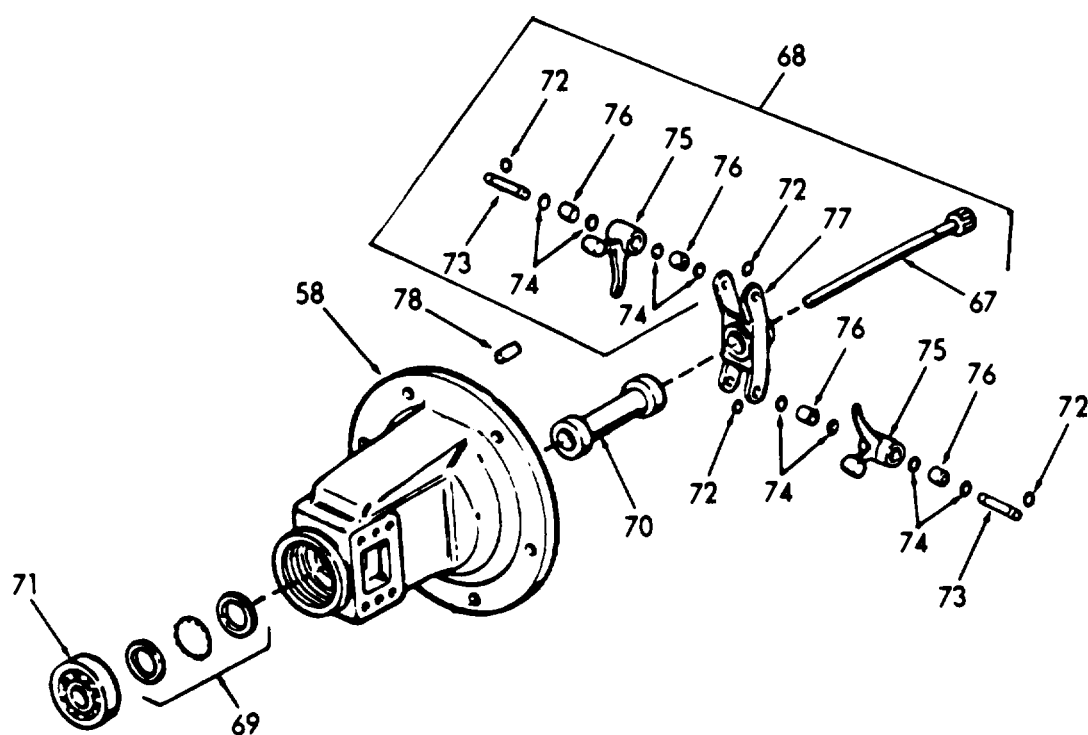


## 6-34. ENGINE SPEED GOVERNOR (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

- m. Slide riser (70) and thrust bearing (69) onto shaft assembly with bearing race with the smallest inside diameter against riser (70).
- n. Insert carrier and shaft assembly (68) into housing (58).



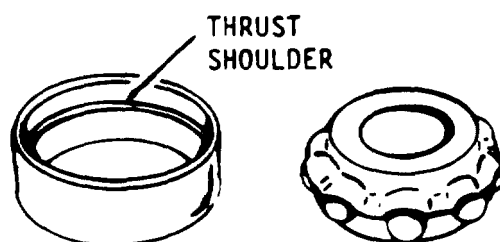
## 6-34. ENGINE SPEED GOVERNOR (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

## CAUTION

Ball bearing (71) has thrust capacity in one direction only. Be sure to install the bearing so that the thrust shoulder is toward the governor weights as shown. Otherwise, the force exerted by the weights will pull the inner race and ball assembly away from the outer race and result in damage to the bearing and erratic governor operation.



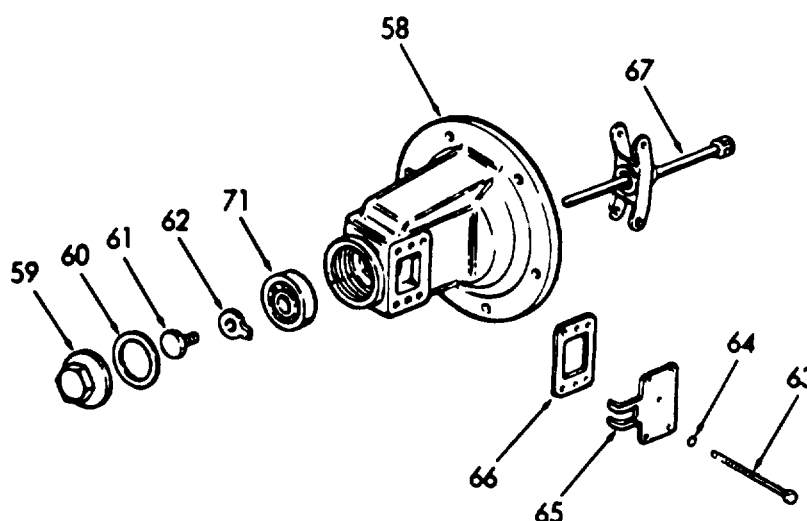
- o. Support the splined end of the shaft on the bed of an arbor press. Start the shaft end bearing (71) in the housing and over the end of the shaft with the numbered side of the bearing facing away from the shaft. Press the bearing in place with a sleeve that bears against the inner race.
- p. Place key washer (62) over shaft (67).
- q. Thread bearing retainer bolt (61) into tapped end of shaft and tighten.

**6-34. ENGINE SPEED GOVERNOR (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

- r. Bend tang on the key washer (62) against head of bolt (61).
- s. Place flatwasher (60) in housing (58) against ball bearing (71).
- t. Coat threads of weight cap (59) with Loctite sealant grade HV or equivalent and install in housing. Torque cap to 30-60 ft-lb (40.7-81.3 Nm).
- u. Position cover gasket (66) and cover (65) in place on housing (58). If removed.
- v. Secure with lockwashers (64) and capscrews (63). If removed.



**6-34. ENGINE SPEED GOVERNOR (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>ASSEMBLY (Cont)</b>		
5. Governor Control Housing	a. Install copper gasket (57) and screw (56) into housing (22).	If removed.
	b. Thread hex nut (55) onto buffer screw with spring (54) and thread screw into housing (22).	If removed.
	c. Install pins (53).	If removed.
	d. Install pin (52), gap adjusting hex nut (51), and setscrew (50) in bell crank (46).	If removed.
	e. Press bushing (49) into governor shaft fork (45).	
	f. Place flatwasher (48) over short finished end of governor shaft (44).	
	g. Place bearing (47) over end of shaft (44).	
	h. Support opposite end of shaft on bed of a press and press bearing (47) on the shaft against washer (48).	Use a sleeve which has the same diameter as bearing inner race.
	i. Place bell crank (46) over end of shaft with pin (52) up with flat on shaft registering with flat surface in bell crank.	
	j. Press bell crank onto shaft (44) tight against bearing (47).	

**6-34. ENGINE SPEED GOVERNOR (Continued).**

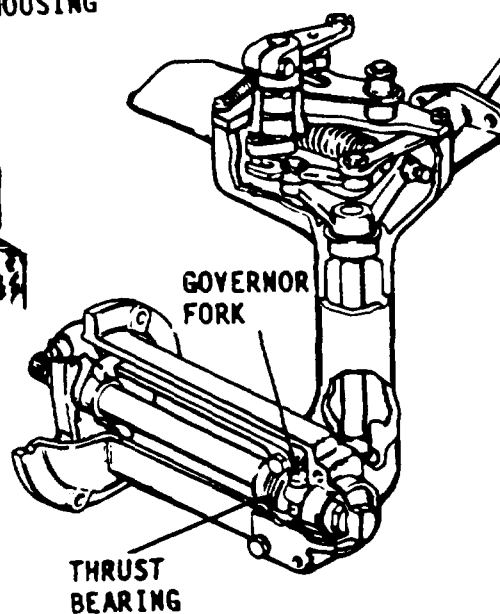
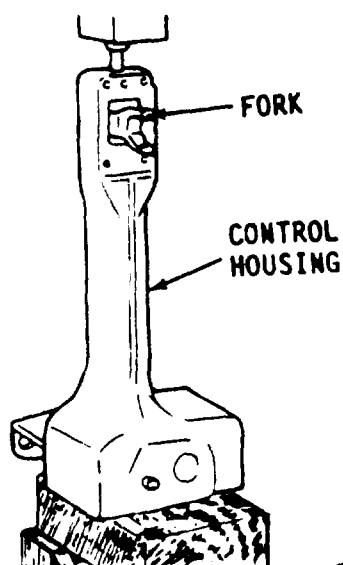
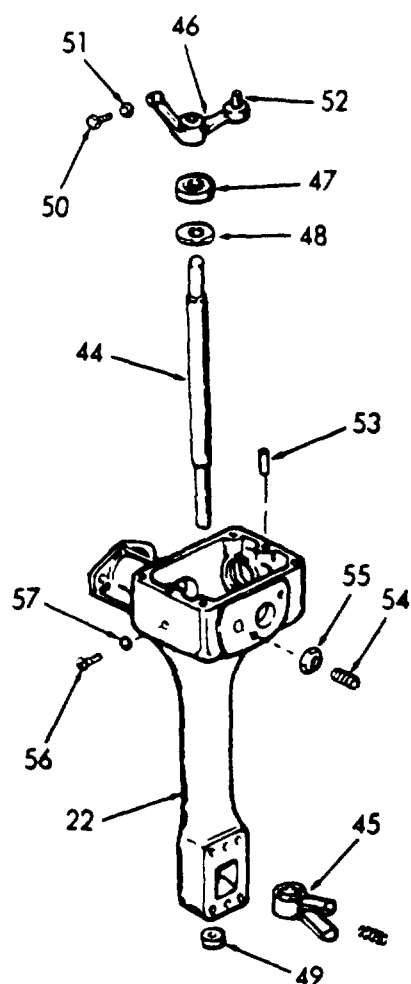
LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

k. Lubricate bearing (47) on shaft and bushing (49) in governor shaft fork (45) with clean engine oil.

l. Insert bell crank and shaft into housing (22).

m. Position governor shaft fork (45) over lower end of shaft as shown so finished side of fork will rest against thrust bearing when governor is assembled.



**6-34. ENGINE SPEED GOVERNOR (Continued).**

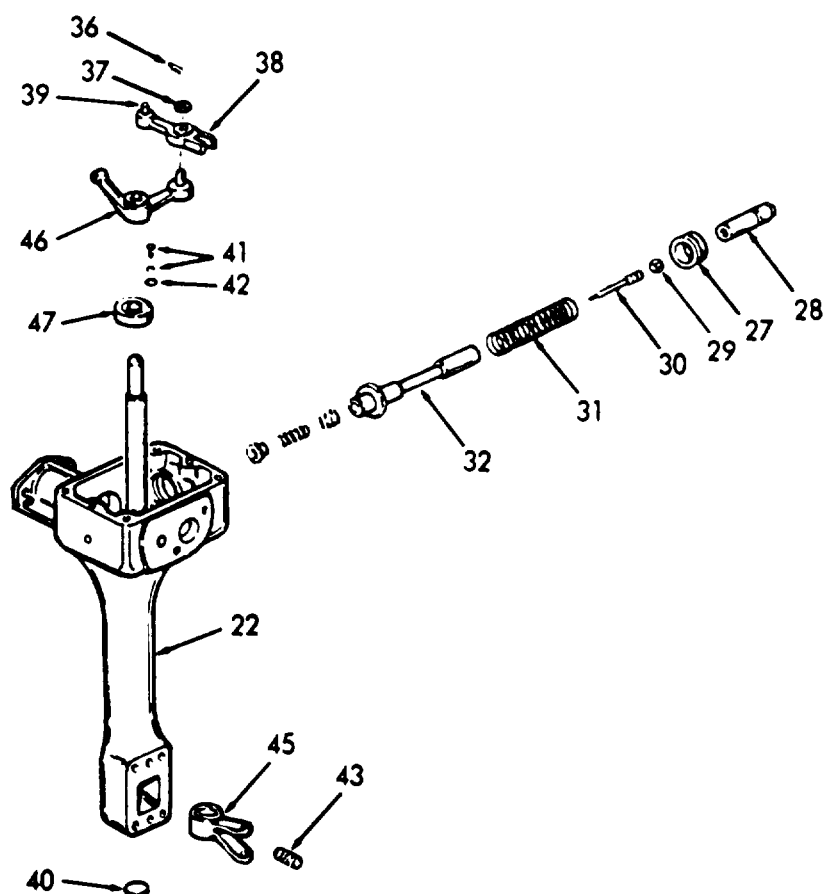
LOCATION/ITEM	ACTION	REMARKS
<b>ASSEMBLY (Cont)</b>		
	<p>n. Support the operating shaft and control housing in an arbor press with the upper end of the operating shaft resting on a steel block. Align the flat in the fork with the flat on the operating shaft. Then, place a sleeve over the end of the shaft and rest it on the fork. Bring the ram of the press down on the sleeve and press the fork straight down and tight against the shoulder on the shaft.</p>	
	<p>o. Install setscrew (43) in governor shaft fork (45).</p>	
	<p>p. Coat outer edges of expansion plug with sealant and press plug (40) into housing (22).</p>	
	<p>q. Install flatwasher (42) and bearing retaining lockwasher assembly (41) to secure bearing (47).</p>	
	<p>r. Install pin (39) in differential lever (38).</p>	
	<p>s. Place differential lever (38) over pin of bell crank (46).</p>	
	<p>t. Secure with flatwasher (37) and retainer (36).</p>	
	<p>u. Thread the locknut (27) on the high speed spring retainer (28) approximately 1-1/2 inch. Place the high speed spring (31) over the high speed spring plunger (32) with the tightly wound end of the spring against the shoulder of the plunger.</p>	

## 6-34. ENGINE SPEED GOVERNOR (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

- v. Insert the plunger and spring assembly in the high speed spring retainer. Thread the idle screw (30) approximately 1 inch into the tapped end of the plunger. Thread the lock-nut (29) over the idle screw.

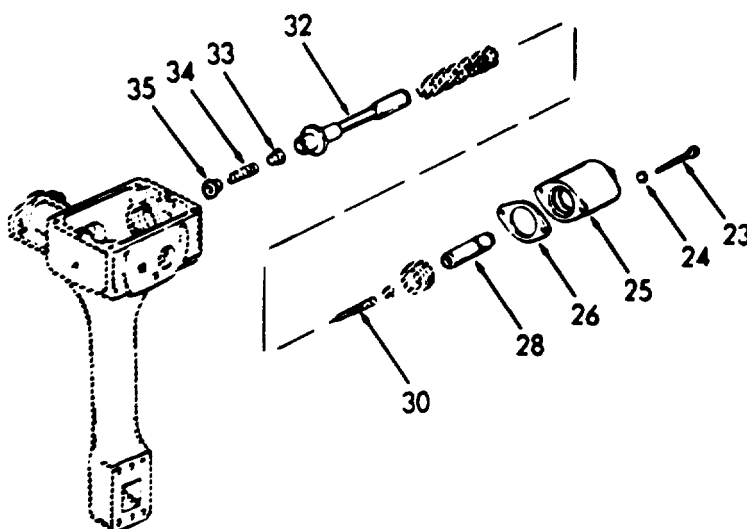


**6-34. ENGINE SPEED GOVERNOR (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

- w. Insert the low speed spring (34) in the low speed spring cap (35) and the small end of the spring seat (33) in the opposite end of the low speed spring (34).
- x. Insert the low speed spring seat and low speed spring and cap assembly in the high speed spring plunger (32) with the spring seat (33) against the shoulder of the idle screw (30).
- y. Start the governor high speed spring assembly into the opening of the control housing (22) and thread the high speed spring retainer (28) in the housing approximately 1 inch.
- z. Install high speed spring cover gasket (26), housing (25), mounting lockwashers (24) and cap screws (23).





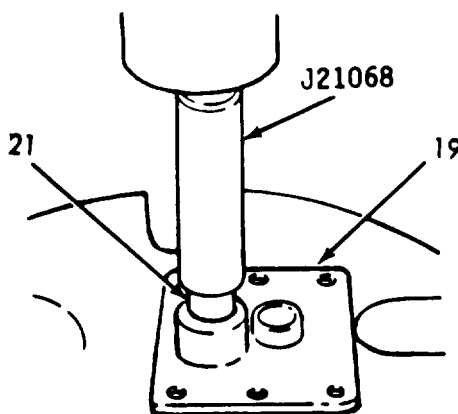
## 6-34. ENGINE SPEED GOVERNOR (Continued).

LOCATION/ITEM	ACTION	REMARKS
<b>ASSEMBLY (Cont)</b>		
6. Governor Cover	a. Place governor cover (19) on bed of an arbor press with inner face of the cover <u>down</u> .	
	b. Start upper bearing (21) straight into bearing bore of cover <u>with</u> <u>number on bearing up</u> .	If removed.

**NOTE**

**Do not use impact tools to install needle bearings.**

- c. Insert bearing installer  
J21068 in bearing and  
press bearing in until  
shoulder on tool contacts  
cover (19) as shown.



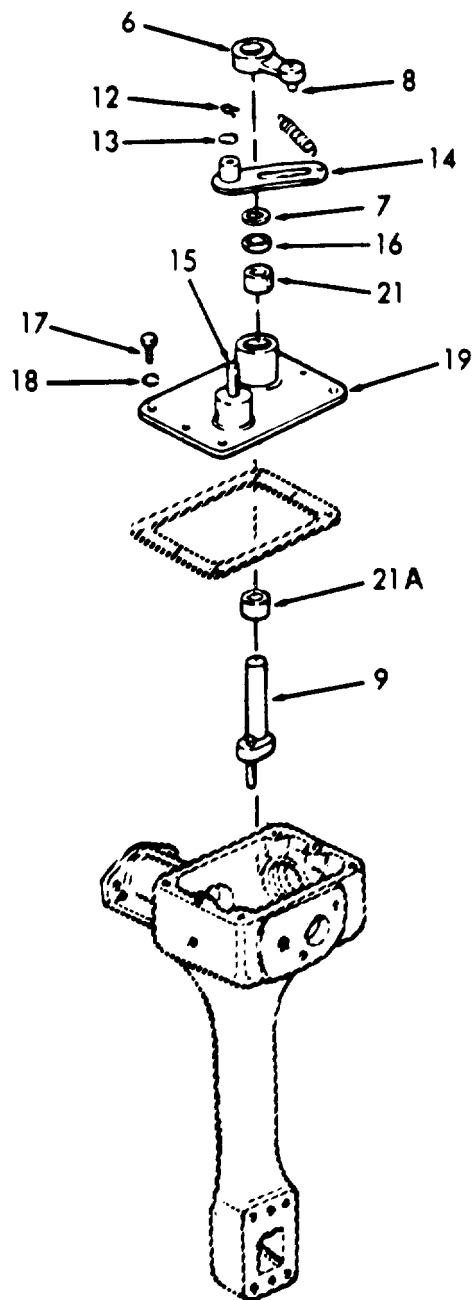
**6-34. ENGINE SPEED GOVERNOR (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>ASSEMBLY (Cont)</b>		
	d. Turn cover over and start lower bearing (21A) <u>number side up</u> , in bearing bore. Press bearing in flush with cover using tool J21068.	
	e. Install dowel pin (15) in cover.	If removed.
	f. Install packing (16) in cover assembly (19).	
	g. Apply lubricant to dowel pin (15) and place cam (14) over dowel pin with boss of cam <u>up</u> .	
	h. Place washer (13) over pin and secure with retaining ring (12).	
	i. Pack needle bearings (21 and 21A) with grease. Then slide throttle shaft (9) through bearings.	Install pin (10) in throttle shaft, if removed.
	j. Place flatwasher (7) over shaft.	
	k. Start lever assembly (6) over throttle shaft (9) with holes in lever and shaft in alignment for installation of straight pin.	Install pin (8) in lever assembly (6), if removed.

6-34. ENGINE SPEED GOVERNOR (Continued).

LOCATION/ITEM	ACTION	REMARKS
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ASSEMBLY (Cont)



**6-34. ENGINE SPEED GOVERNOR (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

l. Support the lower end of throttle shaft on the bed of arbor press, then place a sleeve on throttle lever and under ram of press. Align the slot in cam with pin in throttle lever, then press the lever down on the shaft until hole in the lever is in line with the hole in the shaft.

m. Insert the straight pin (5) in the hole of the lever, then support the lever and cover assembly on a steel block and drive the pin into place.

n. Position shutdown shaft (4) on throttle shaft and tighten capscrew (2).

Install lock-washer (3) and capscrew (2), if removed.

o. Install plug (1) in throttle shaft.

p. Attach one end of spring (11) in small end of lever assembly (6).

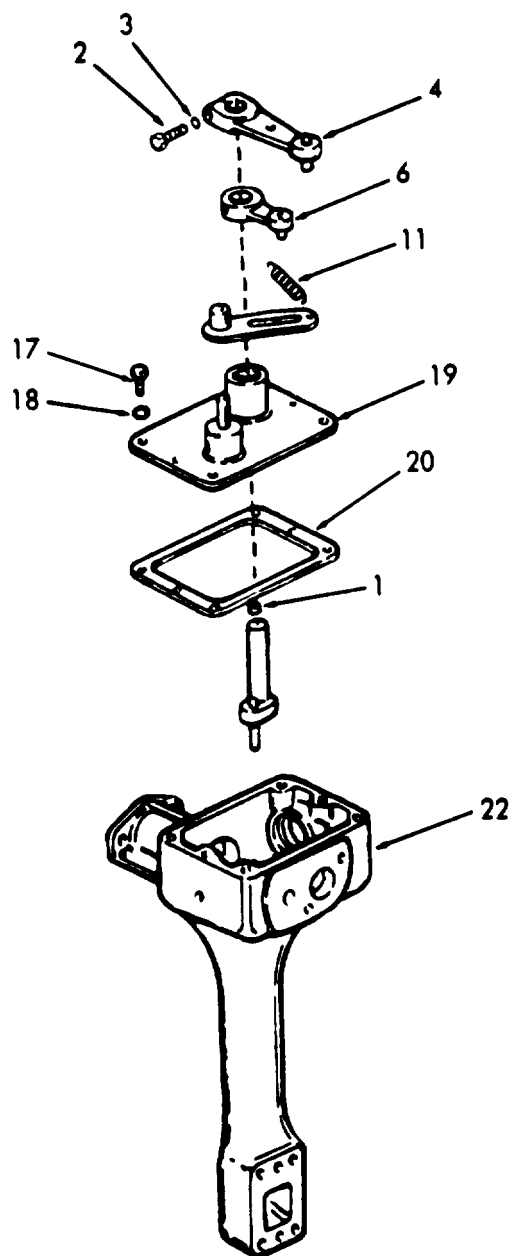
q. Position cover gasket (20) in place on housing (22).

## 6-34. ENGINE SPEED GOVERNOR (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

- r. Secure cover assembly (19) to housing (22) with lockwashers (18) and capscrews (17).



**6-35. BLOWER ASSEMBLY.****This task covers:****A. Air Silencer****1. Inspection****2. Removal/Service****3. Installation****B. Blower Assembly****1. Removal****4. Inspection****7. Assembly****2. Disassembly****5. Replacement****8. Installation****3. Cleaning****6. Repair****INITIAL SETUP****Test Equipment**

Feeler gage, blower clearance  
J1698-02 (33287)

**References**

NONE

**Special Tools**

Adaptor J6471-4 (1/2"-20  
threads) (33287)  
Adaptor, J6471-10 (9/16"-18  
threads) (33287)  
Blower drive cam installer  
J1471  
Slide hammer and shaft  
J6471-01 (33287)  
Tool set blower service  
J6270-02 (33287)  
Safety goggles

**Equipment****Condition Condition Description**

NONE

**Tools**

General Mechanic's Tool Kit  
NSN 5180-00-629-9783

**Material/Parts**

Clean cloths  
Cleaning solvent Fed. Spec.  
P-D-680  
Fuel oil

**Special Environmental Conditions**

NONE

**Personnel Required**

MOS 61C10

**General Safety Instructions**

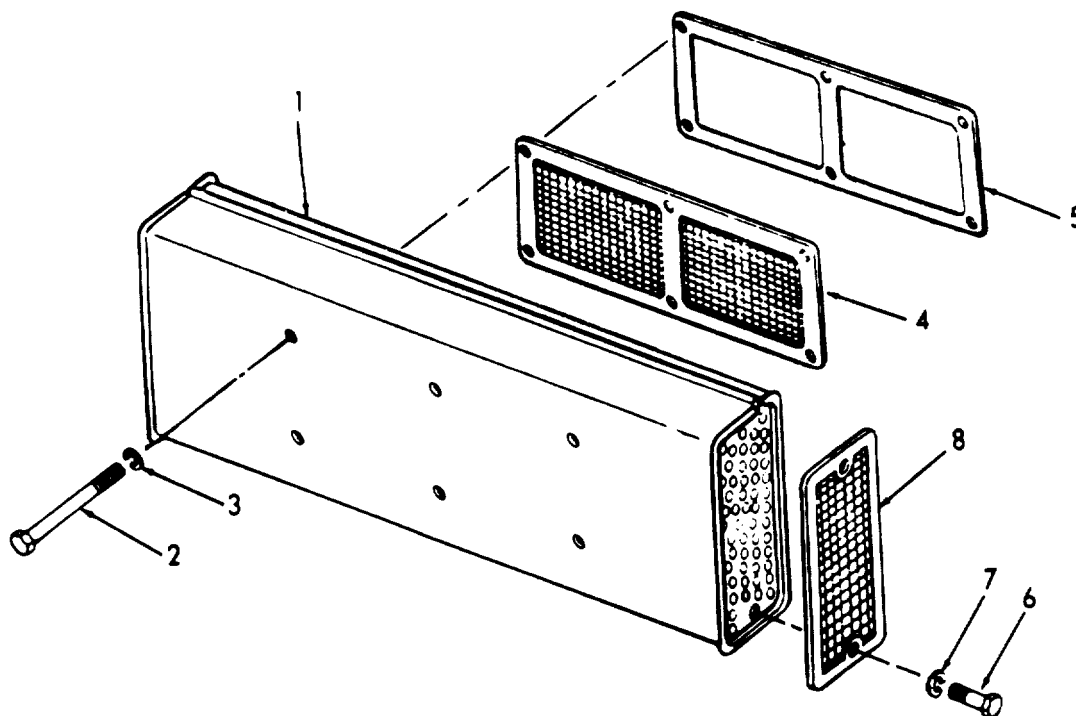
Observe WARNINGS in procedure.

**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSPECTION</b>		
1. Blower Assembly	<ul style="list-style-type: none"> <li>a. Inspect blower for cracked housing and end plates.</li> <li>b. Inspect blower for evidence of leaking.</li> <li>c. Inspect blower for loose or missing mounting hardware.</li> <li>d. Inspect air inlet silencer for cracks, breaks, dents, or other defects.</li> </ul>	
<b>REMOVAL/SERVICE</b>		
2. Air Inlet Silencer	<ul style="list-style-type: none"> <li>a. Remove bolt that retains breather pipe to the air silencer.</li> </ul>	

## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
REMOVAL/SERVICE		
	b. While supporting silencer (1), remove attaching bolts (2) and lockwashers (3).	
	c. Remove strainer element (4) and gasket (5) from blower.	Discard gasket.
	d. Remove bolts (6) and lockwashers (7) from screen.	
	e. Remove screen (8).	





**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL/SERVICE (Cont)****WARNING**

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated or prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° - 138°F (38° - 59°C).

- f. Clean interior and exterior of air silencer using clean cloths dampened in cleaning solvent Fed. Spec. P-D-680 and dry thoroughly.
- g. Clean element and air inlet screen in cleaning solvent Fed. Spec. P-D-680 and dry thoroughly.

**WARNING**

**Wear safety goggles when using compressed air to avoid eye injury.**

- h. Use compressed air (30 psi [ 206.8 kPa ] or less) to remove any trapped foreign matter in element and screen not removed with cleaning solvent.

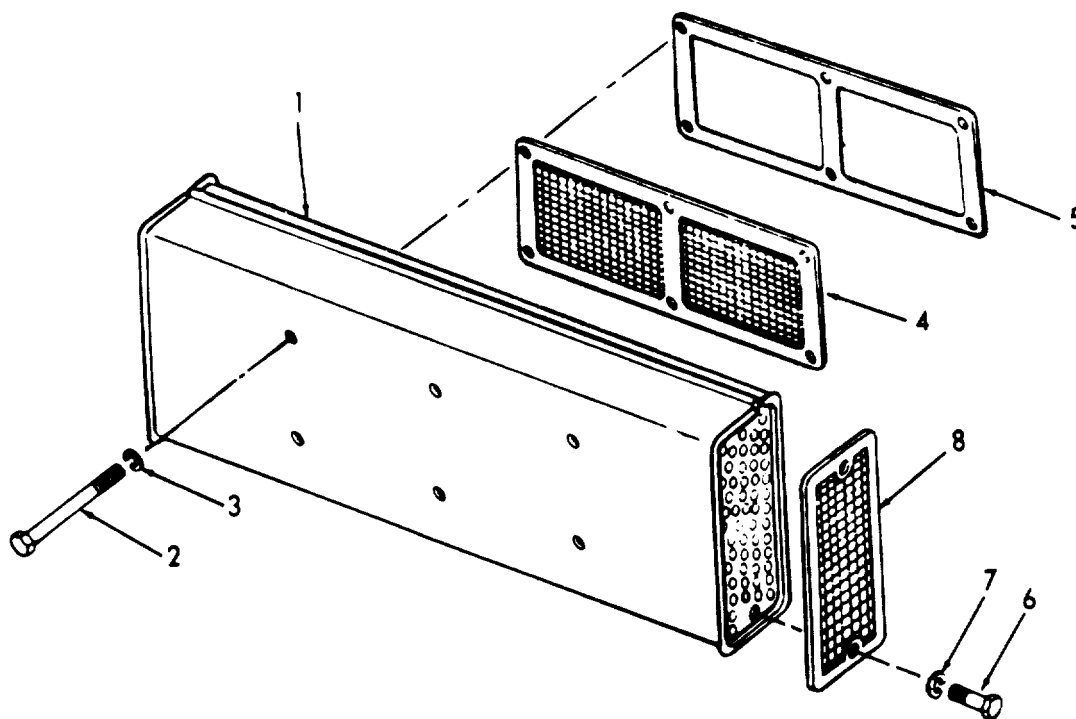
**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION**

3. Air Inlet  
Silencer

- a. Install air inlet screen (8) on air silencer (1) and secure with lock-washers (7) and screws (6).
- b. Attach new gasket (5) and element (4) to blower and install silencer (1). Secure with washers (3) and bolts (2).



**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- c. Install bolt that retains the breather pipe to the air silencer.

**REMOVAL**

- 4. Governor Cover

**NOTE**

For a more simplified removal of the blower assembly; the governor drive, fresh water pump, fuel oil pump, and blower drive shaft cover should be removed with the blower as an assembly.

- a. Drain the cooling system.

**NOTE**

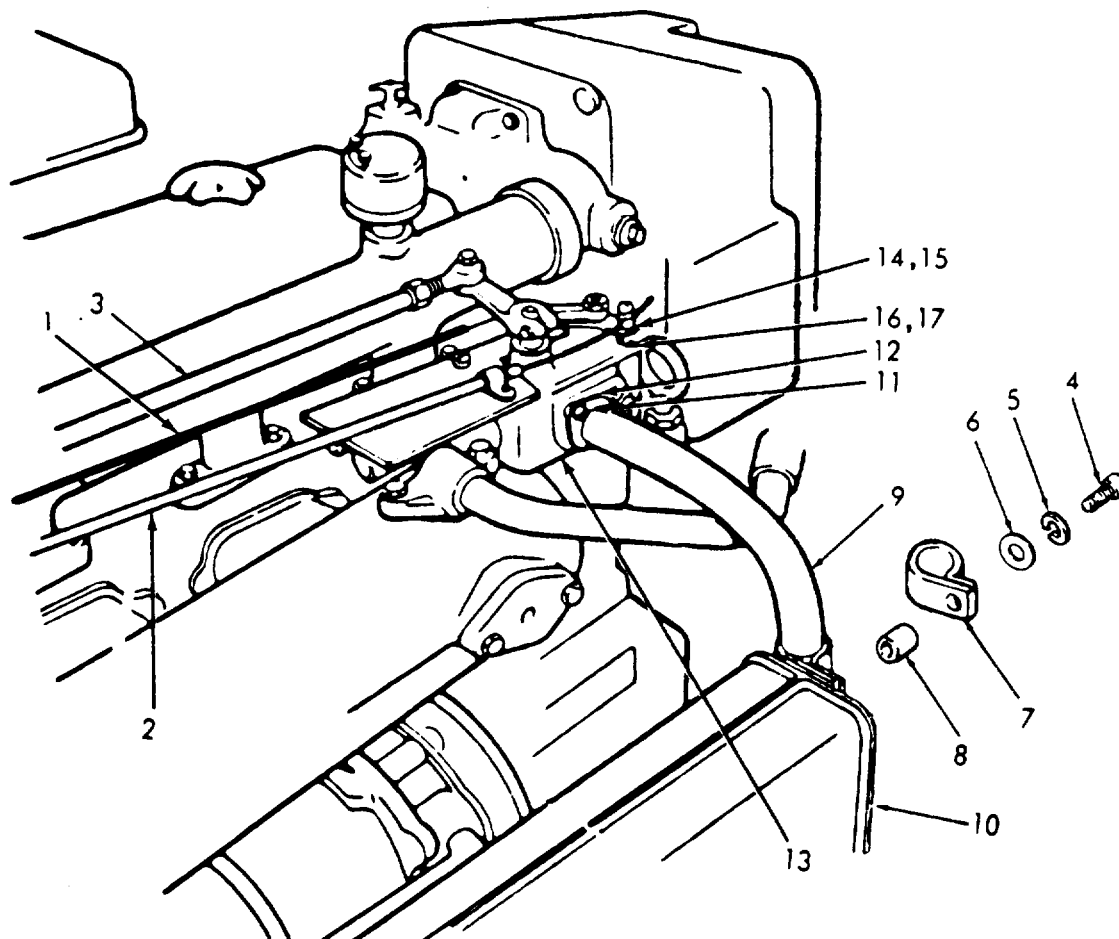
Each governor has an identification plate located on the control housing, containing the governor assembly number, type, idle-range rpm, and drive ratio. The maximum engine speed, not shown on the identification plate, is stamped on the option plate attached to the valve rocker cover.

**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REMOVAL (Cont)</b>		
	b. Disconnect throttle and stop control cables (1 and 2).	
	c. Disconnect governor control rod (3).	
	d. Remove cap screw (4), lockwasher (5), flat washer (6), tube clip (7), and spacer (8) that secures breather tube (9) to the air silencer (10).	
	e. Remove two fillister head screws (11) from other end of breather tube.	
	f. Remove breather tube (9) and gasket (12) from governor control housing (13).	Discard gasket.
	g. Remove four screws (14) and lockwashers (15) from governor housing (13).	
	h. Remove governor cover (16) and gasket (17) from housing.	Discard gasket.

6-35. BLOWER ASSEMBLY (Continued).

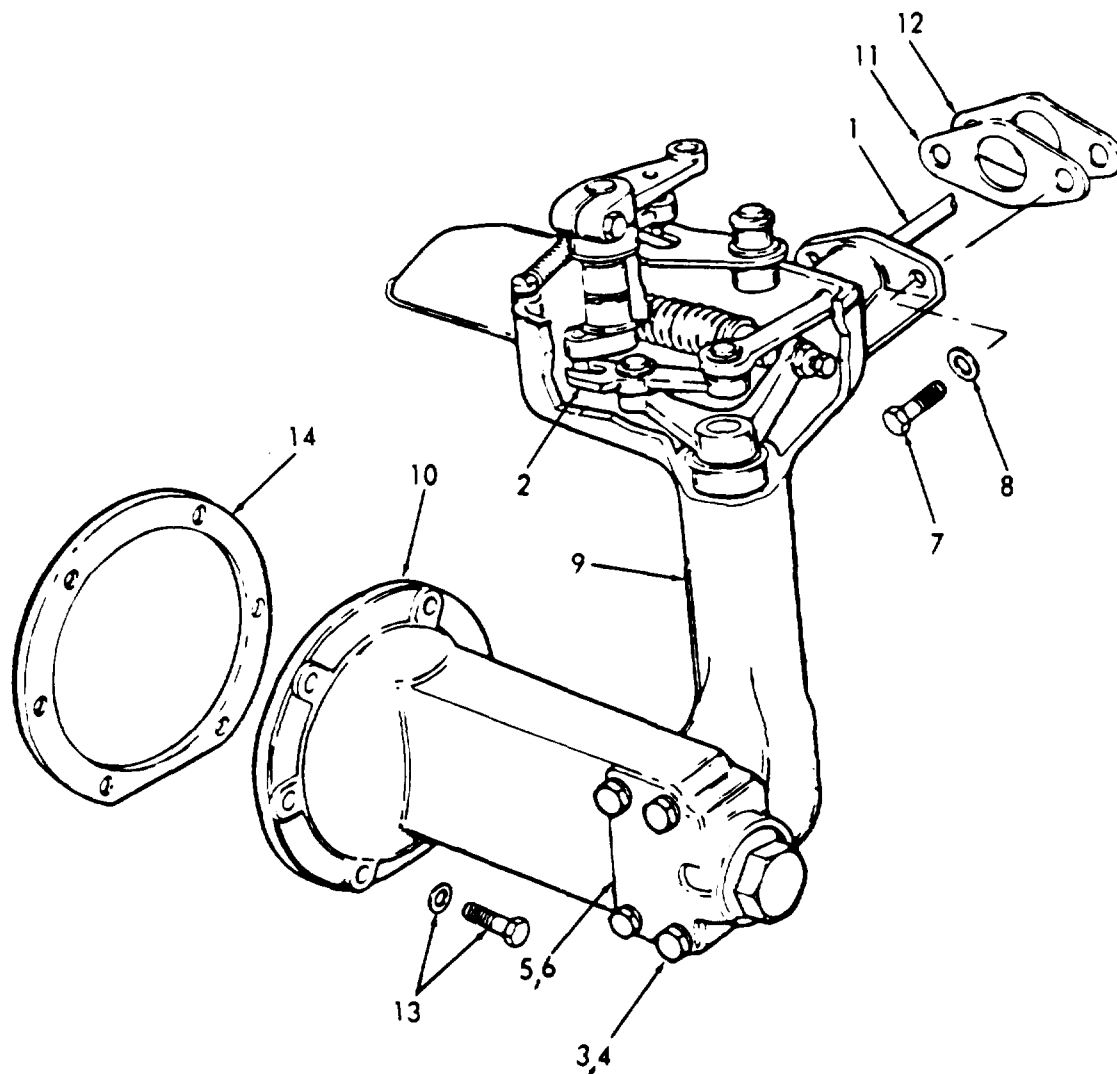
LOCATION/ITEM	ACTION	REMARKS
REMOVAL (Cont)		





6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
REMOVAL (Cont)		



**6-35. BLOWER ASSEMBLY (Continued).**

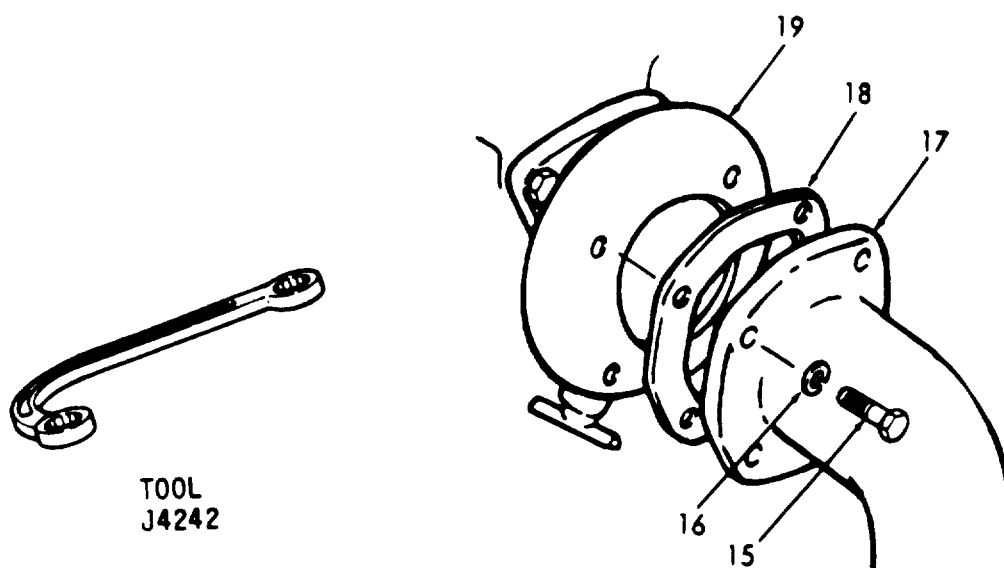
LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

6. Water Pump  
Inlet Elbow

- a. The fresh water pump circulates coolant through the cylinder block, cylinder head, heat exchanger (keel cooler), and oil coolers. The pump is mounted on the front end of the blower and is driven by the lower blower rotor shaft. The sealed type ball bearing is filled with lubricant at the time it is assembled to the pump shaft and no further lubrication is required.
- b. Remove bolts (15) and lock-washers (16) from inlet elbow (17).
- c. Remove inlet elbow (17) and gasket (18) from water pump (19).

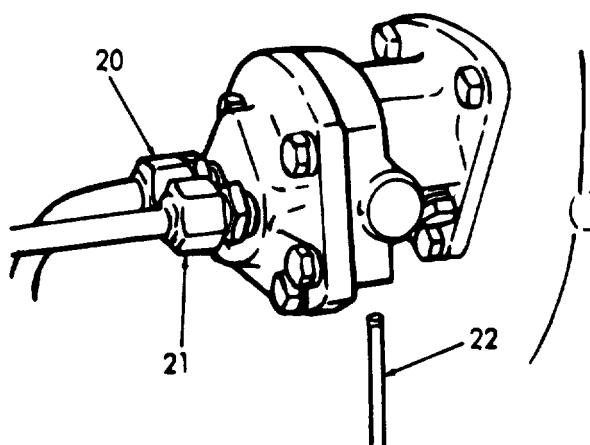
Use tool J4242.





**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REMOVAL (Cont)</b>		
7. Fuel Pump Lines	a. Disconnect inlet line (20).	Cap open end.
	b. Disconnect outlet line (21).	Cap open end.
	c. Disconnect drain tube (22) from pump body.	



**6-35. BLOWER ASSEMBLY (Continued).**

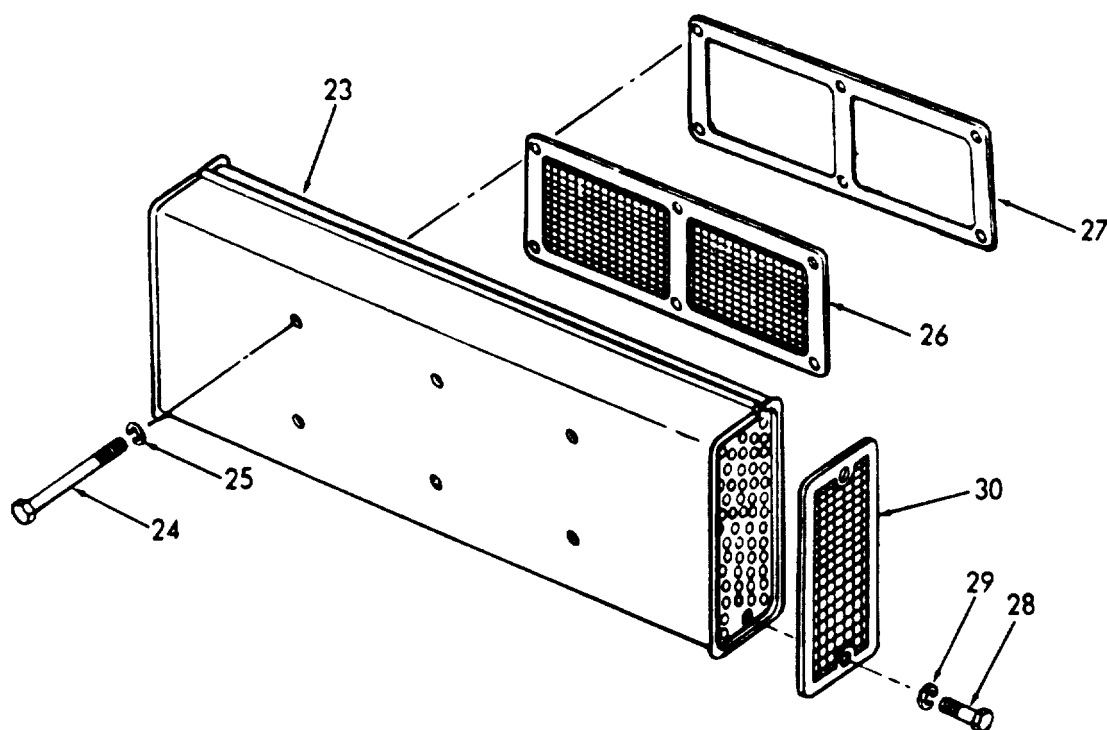
LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

8. Air Inlet  
Silencer

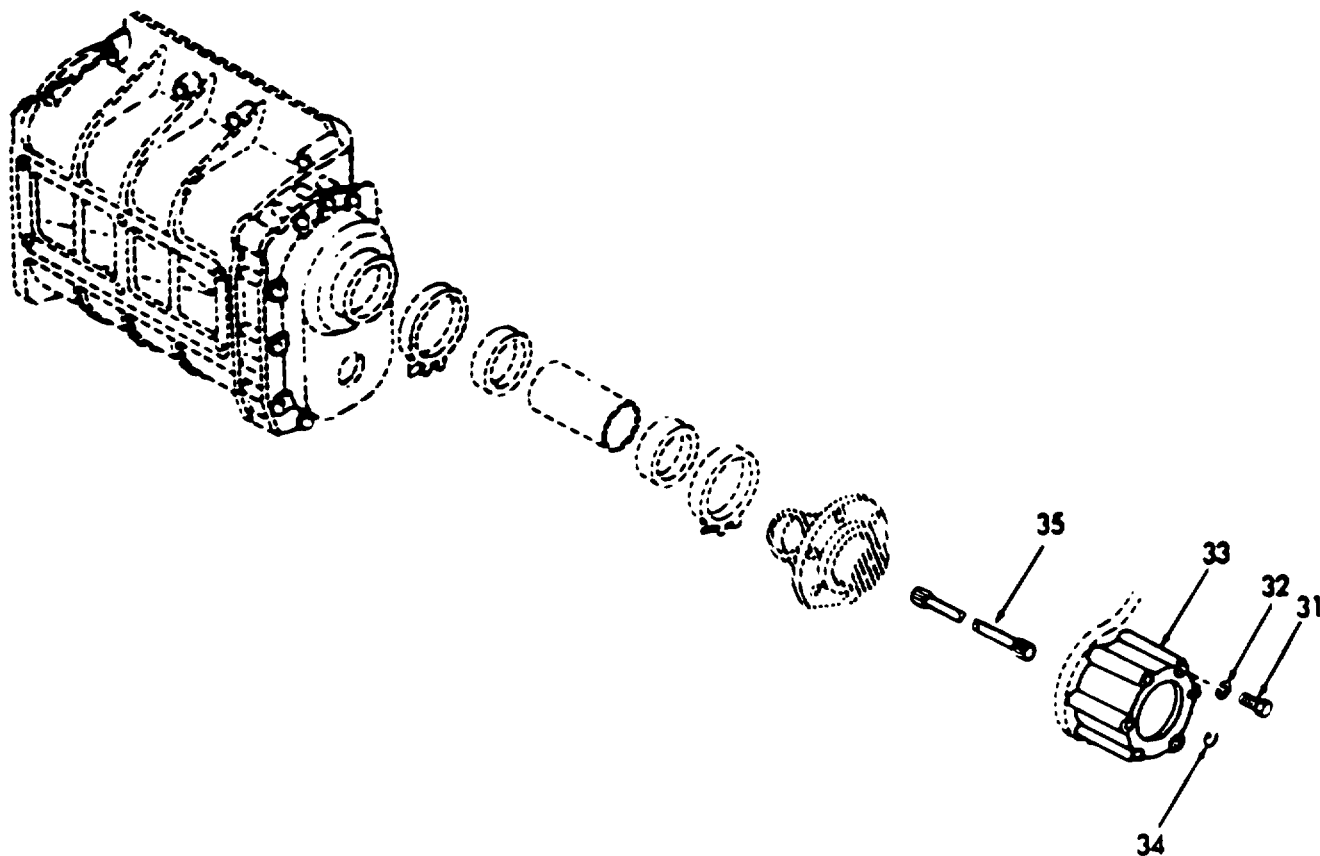
- a. Remove bolt that retains breather pipe to the air silencer.
- b. While supporting silencer (23), remove attaching bolts (24) and lockwashers (25).
- c. Remove strainer element (26) and gasket (27) from blower.
- d. Remove bolts (28) and lockwashers (29) from screen.
- e. Remove screen (30).

Discard gasket.



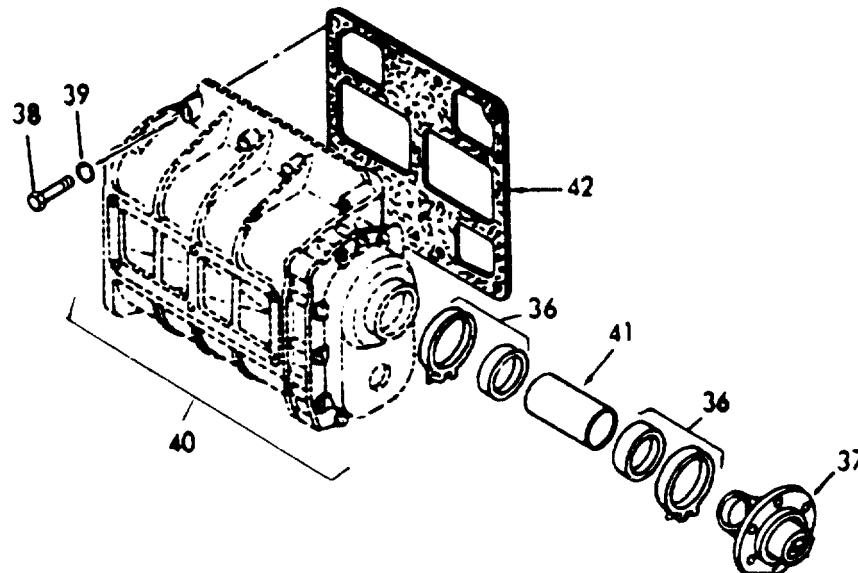
**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REMOVAL (Cont)</b>		
9. Blower Drive Shaft	<p>a. Remove six bolts (31) and lock-washers (32) securing flywheel housing small hole cover.</p> <p>b. Remove cover (33).</p> <p>c. Remove snapping (34) from blower drive shaft.</p> <p>d. Remove blower drive shaft (35) from drive assembly.</p>	



### 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
<b>REMOVAL (Cont)</b>		
<b>NOTE</b>		
<ul style="list-style-type: none"> <li>• A broken drive shaft indicates an unusual loading which may have been caused by a bearing failure or other malfunction. Inspect the blower drive, blower rotors and the housing before replacing the drive shaft.</li> <li>• Some shafts have a tapped hole in the end which can be used as an aid in removing the shaft.</li> </ul>		
10. Blower	a. Loosen blower drive shaft cover seal clamp (36) at rear of blower drive gear hub support (37).  b. Remove capscrews (38) and flat-washers (39) securing blower assembly (40) to cylinder block.  c. Slide blower assembly (40) slightly forward, withdraw drive shaft cover (41) from seal (50), then lift blower assembly (40) away from cylinder block.  d. Remove mounting gasket (42).	Discard clamp seal.           Discard gasket.

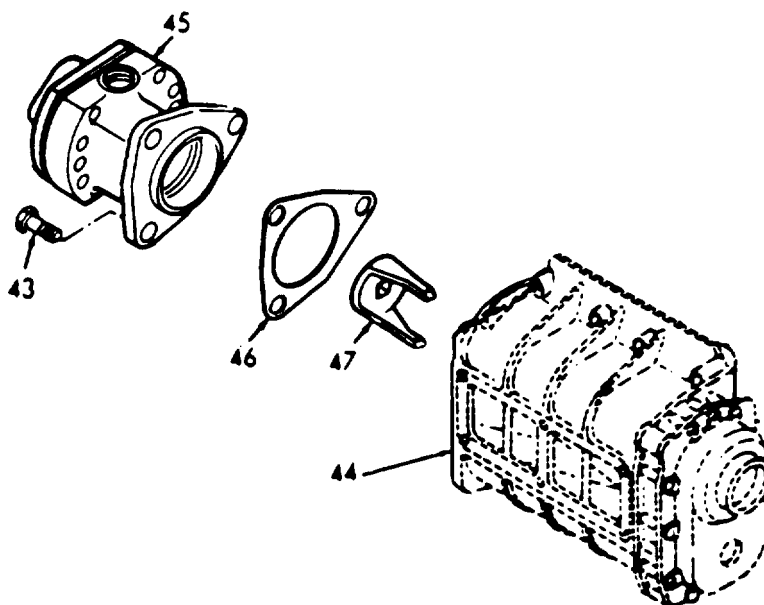


**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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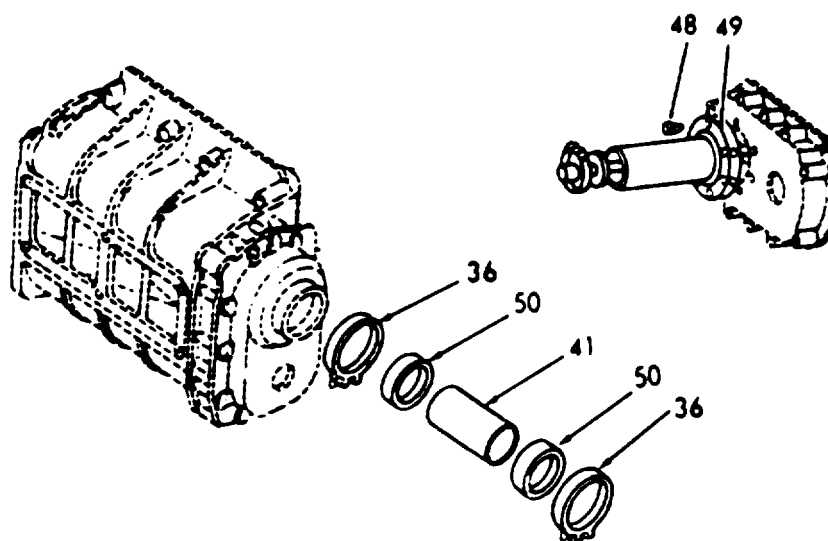
**REMOVAL (Cont)**

- |                                       |   |                 |
|---------------------------------------|---|-----------------|
| 11. Fuel Pump and Drive Coupling Fork | <p>a. Remove three bolt and seal assemblies (43) securing fuel pump (45) to blower rear end plate cover (44).</p> <p>b. Remove fuel pump (45), and mounting gasket (46) from blowers.</p> <p>c. Remove drive coupling fork (47) from fuel pump spur gear shaft.</p> | Discard gasket. |
|---------------------------------------|---|-----------------|



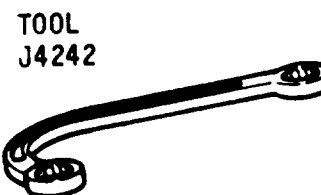
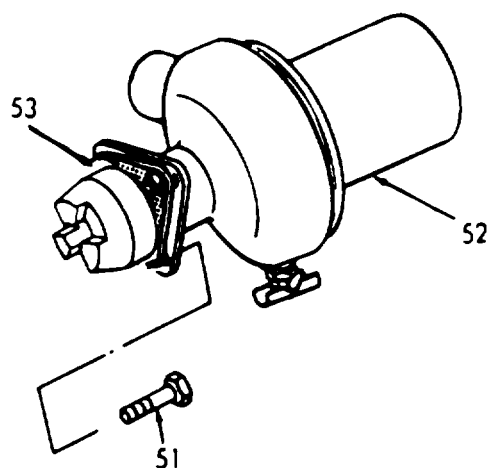
**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REMOVAL (Cont)</b>		
12. Blower Drive Shaft Cover, Seal and Clamps	a. Loosen seal clamp (36) securing blower drive shaft cover (41) to blower end plate.	Clamps and seals will be attached.
	b. Remove six bolt assembled seals (48) from cover (41).	
	c. Remove cover (41) and gasket (49).	
	d. Remove clamps (36) and seals (50) from cover (41).	



**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REMOVAL (Cont)</b>		
13. Fresh Water Pump	a. Remove three bolt and seal assemblies (51) attaching pump to blower front end plate cover.	Use tool J4242.
	b. Remove water pump (52) and mounting gasket (53).	If necessary, tap pump with a plastic hammer to loosen it. Discard mounting gasket.

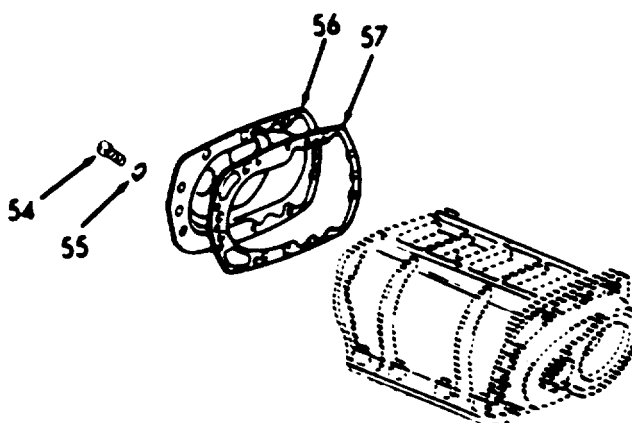


**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY**

- |                              |  |   |
|------------------------------|--|---|
| 14. Front End<br>Plate Cover | <ul style="list-style-type: none"> <li>a. Remove ten capscrews (54) and lockwashers (55) from front end cover (56).</li> <li>b. Tap end of cover (56) with hammer to loosen cover from gasket and dowel pins.</li> <li>c. Remove end plate cover (56) and mounting gasket (57).</li> </ul> | <p>Use plastic hammer.</p> <p>Discard gasket.</p> |
|------------------------------|--|---|



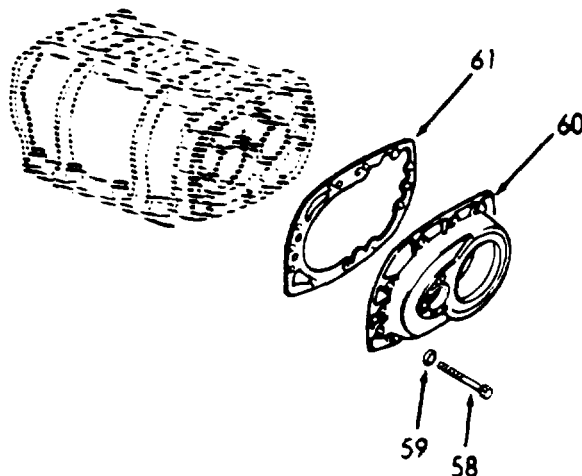
- |                             |   |                            |
|-----------------------------|---|----------------------------|
| 15. Rear End<br>Plate Cover | <ul style="list-style-type: none"> <li>a. Remove ten capscrews (58) and lockwashers (59) from rear end plate cover (60).</li> <li>b. Tap end of cover with hammer to loosen cover from gasket and dowel pins.</li> <li>c. Remove rear end plate cover (60) and mounting gasket (61).</li> </ul> | <p>Use plastic hammer.</p> |
|-----------------------------|---|----------------------------|



## 6-35. BLOWER ASSEMBLY (Continued).

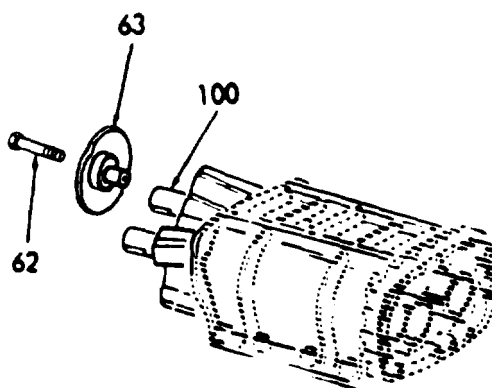
LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)



16. Water Pump  
Drive  
Coupling

- a. Place a clean folded shop towel between the rotors and a towel between the rotors and housing to prevent rotors from turning.
- b. Remove capscrew (62) securing coupling (63) to blower rotor shaft (100).
- c. Thread adapter J6471-4 (1/2"-20 threads) or adapter J6471-10 (9/16"-18) into the water pump drive coupling, then attach slide hammer and shaft J6471-1 to the adapter and pull the drive coupling (63) from the blower rotor shaft.

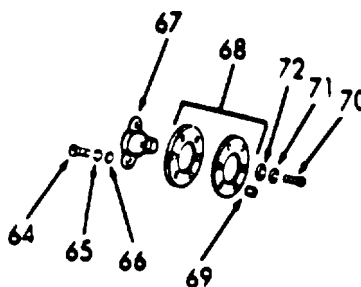


**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- |  |   |  |
|--|---|--|
| 17. Blower Rotor<br>Drive Hub,<br>Plates and<br>Spacers. | <p>a. Remove bolts (64), lockwashers (65), and flatwashers (66), securing drive hub (67) and plates (68) to timing gear.</p> <p>b. Remove drive hub (67), plates (68), and spacers (69), from timing gear.</p> <p>c. Remove bolts (70), lockwashers (71), and flatwashers (72) securing drive plates (68) together.</p> | <p>Plates will be attached to hub.</p> <p>If plates are damaged.</p> |
|--|---|--|



- |                                 |  |                             |
|---------------------------------|--|-----------------------------|
| 18. Blower Rotor<br>Timing Gear | <p>a. Remove capscrew (73), key washer (74), and hex washer (75) from right-hand helix rotor shaft.</p> <p>b. Remove capscrew (73), key washer (74), and fuel pump rotor disc (76) from left hand rotor shaft.</p> <p>c. Back out center screw on gear pullers and secure to gears with 5/16"x24x1-1/2" bolts.</p> | <p>Use pullers J6270-1.</p> |
|---------------------------------|--|-----------------------------|

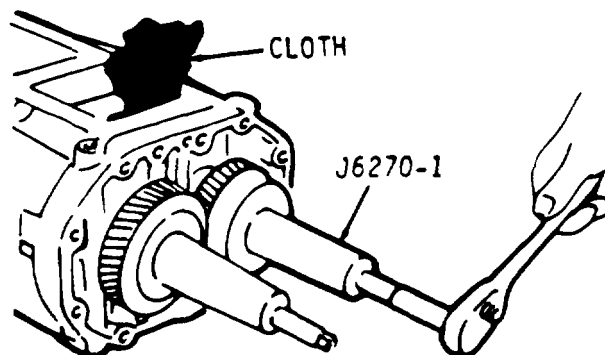
**NOTE**

**Both gears must be pulled from the rotor shafts at the same time.**

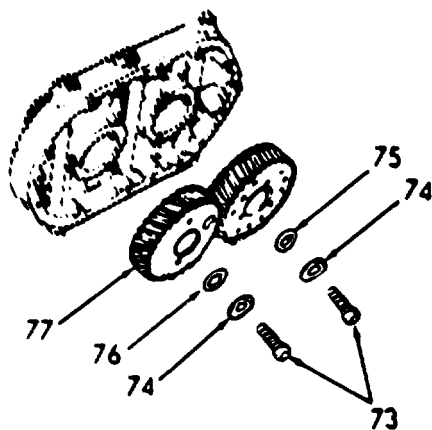
## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)



- d. With the shop towels between the blower rotors and housing to prevent them from turning, turn the puller screws uniformly clockwise and pull the gears (77) from the rotor shafts.

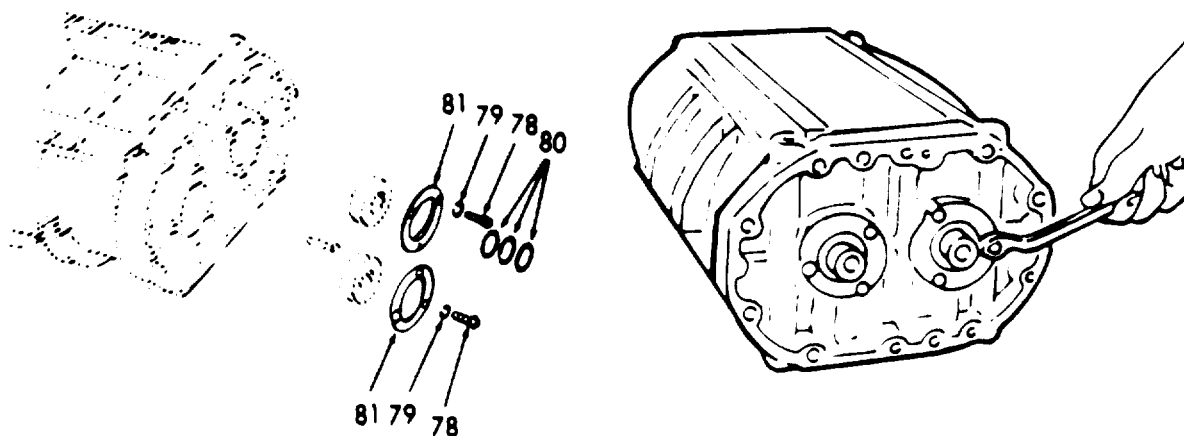


**6-35. BLOWER ASSEMBLY (Continued).**

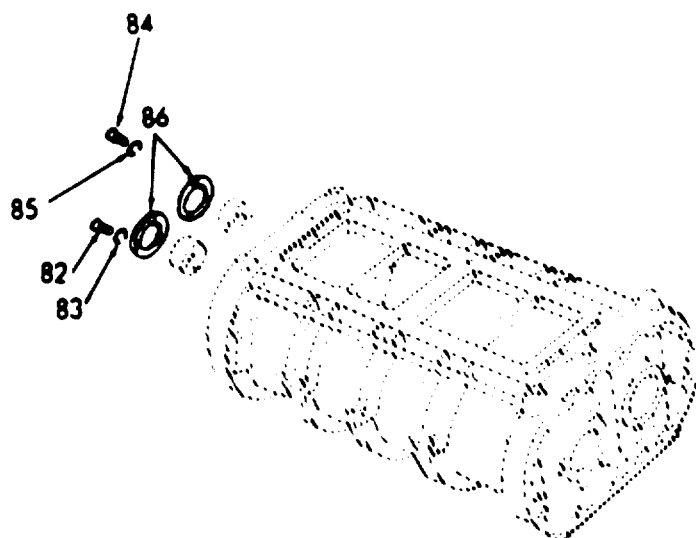
LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

19. Rear End  
Plate Bearing  
Retainers
- Remove capscrews (78), lock-washers (79), and shims (80) from rear end plate bearing retainers.
  - Remove retainers (81).



20. Front End  
Plate Bearing  
Retainers
- Remove capscrews (82), lock-washers (83), capscrews (84), and lockwashers (85) from front end plate.
  - Remove retainers (86).



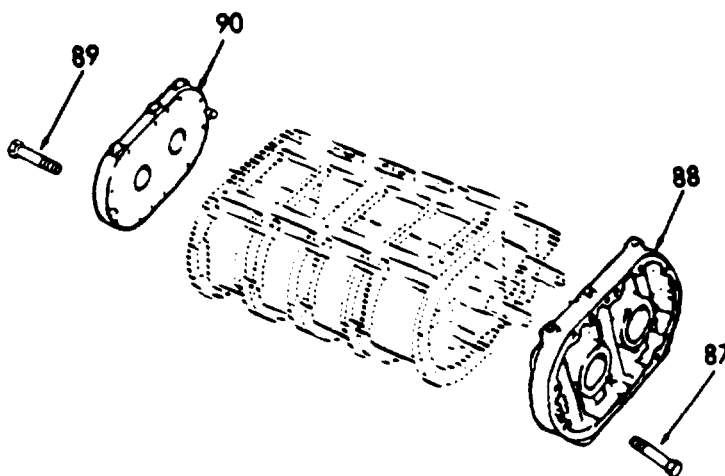
**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
21. Rear and Front End Plates and Rotor	a. Remove fillister head screws (87) from rear end plate (88).	
	b. Loosen fillister head screws securing front end plate (90) to blower housing <u>approximately three turns</u> .	
	c. Back out the center screw of the pullers far enough to permit the flange of each puller to lay flat on the face of the end plate.	Use pullers J6270-1.
	d. Secure pullers to the end plate with six 1/4"-20x1-1/4" bolts.	

**NOTE**

**Be sure that the 1/4"-20 bolts are threaded all the way into the tapped holes in the end plate to eliminate possible damage to the end plate.**

- e. Turn the two puller screws uniformly clockwise and withdraw the rear end plate (88) and bearings from the blower housing and rotors.
- f. Remove the fillister head screws (89) securing the front end plate (90) to the housing.



**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
	g. Back out the center screws of the pullers far enough to permit the flange of each puller to lay flat on the face of the end plate.	
	h. Secure the pullers to the end plate with six 1/4"-20x1-1/4" bolts.	
<b>NOTE</b>		
<b>Be sure that the 1/4"-20 bolts are threaded all the way into the tapped holes in the end plate to eliminate possible damage to the end plate.</b>		
	i. Turn the two puller screws uniformly clockwise and withdraw the front end plate (90) and bearings from the blower housing and rotors.	
	j. Withdraw rotors (91) from housing (92).	
	k. Remove pins (93 and 94) from end plates (88 and 90).	If damaged.
22. End Plate Bearings and Seals	a. Remove the bearing (95) and the lip type oil seals (96) from the blower front end plate (90).	

**NOTE**

**Inspect oil seals. If the seals are scored, or hard, new seals must be installed. If necessary, the seals may be removed from the end plates at the same time the individual bearings are removed.**

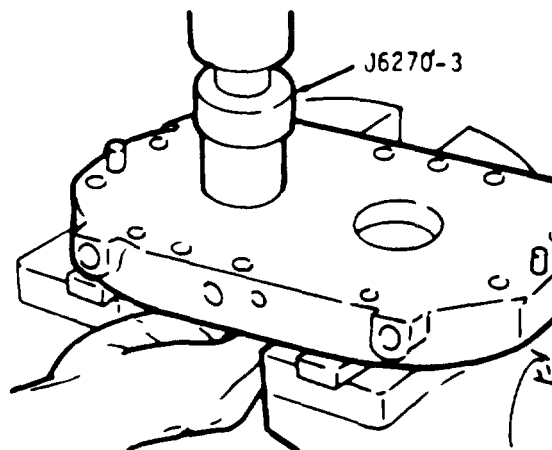
- (1) Support the outer face of the end plate on wood blocks on the bed of an arbor press.
- (2) Place the long end of the oil seal remover and installer J6270-3 down through the oil seal and into the bearing,

## 6-35. BLOWER ASSEMBLY (Continued).

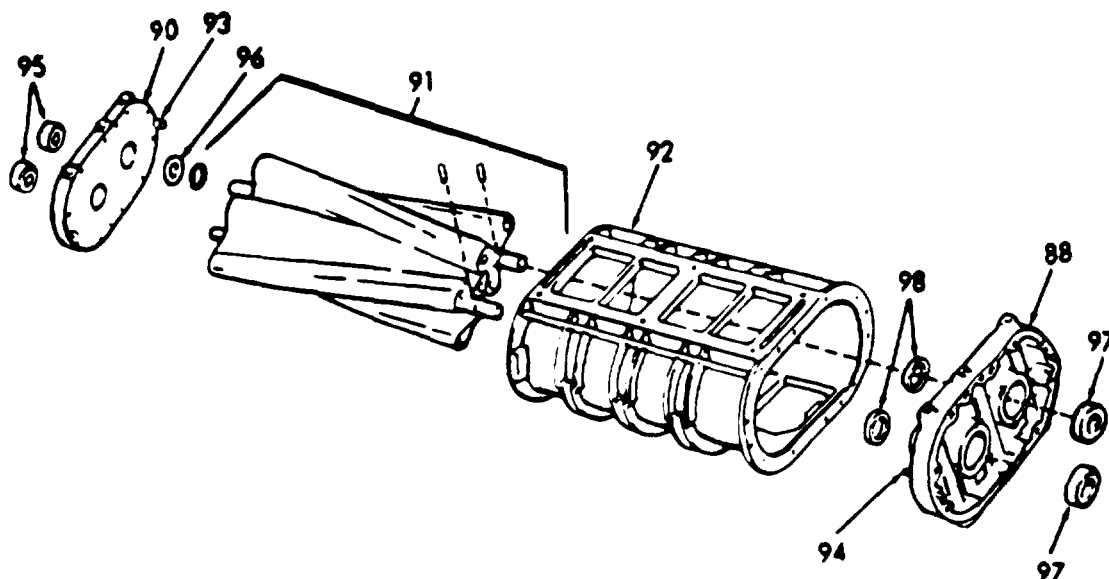
LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)

with the opposite end of the remover under the ram of the press. Then, press the bearing and oil seal out of the end plate.



- (3) Remove the remaining bearings (97) and oil seals (98) from the rear end plate (88) in the same manner.



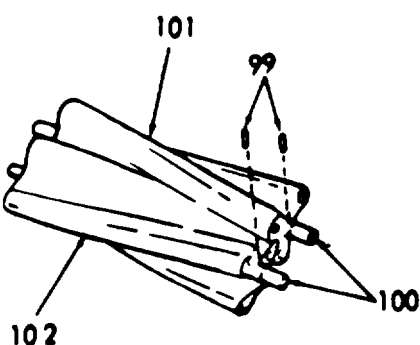
**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

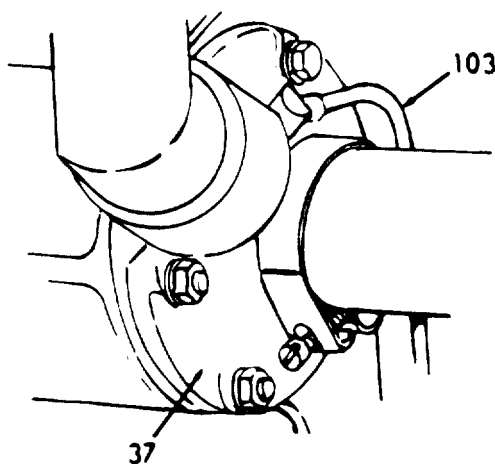
23. Rotor Shaft  
Assembly

- a. Remove pins (99) that secure rotor shaft to rotors.
- b. Remove rotor shaft (100).
- c. Repeat steps a and b for each upper right hand rotor assembly (101) and lower right hand rotor assembly (102).



24. Blower  
Drive

- a. Remove blower drive oil line (103) from hub support (37) and cylinder block (104).





**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- b. Straighten tangs on lockwasher (117) and loosen drive gear hub nut (116).

Do not remove hub nut and lockwasher.

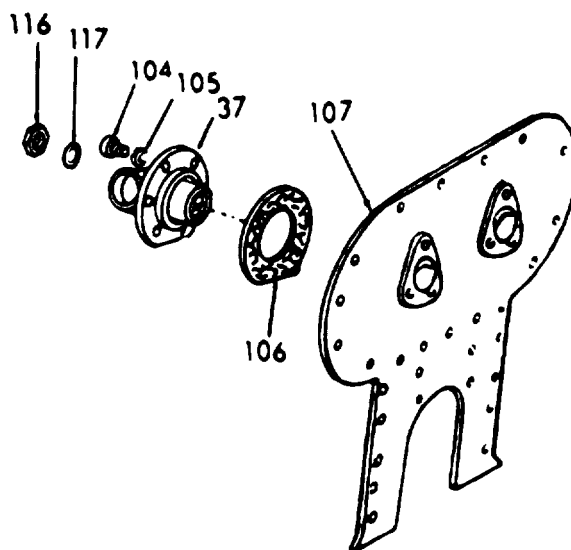
- c. Remove blower drive support mounting capscrews (104) and lockwashers (105).

**CAUTION**

Take care when removing blower drive support to prevent damage to blower drive gear teeth.

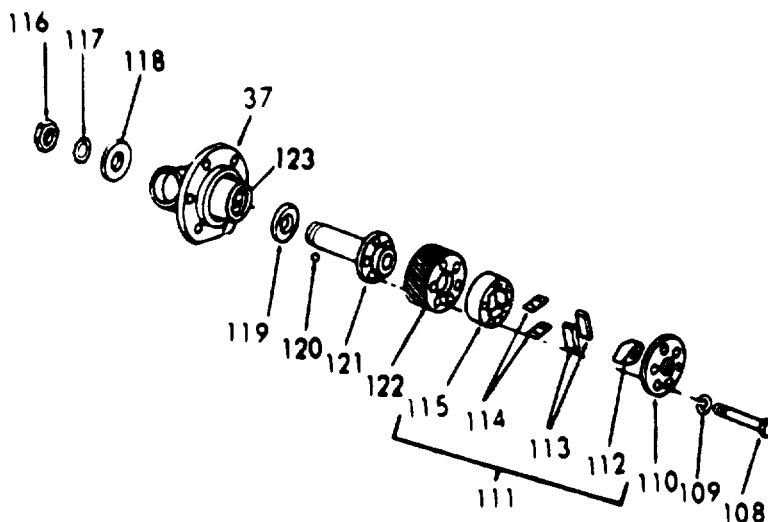
- d. Remove support (37) and mounting gasket (106) from cylinder block rear end plate (107).

Tap blower drive lightly with a soft hammer to loosen. Discard mounting gasket.



**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
	e. Secure drive gear and support assembly in a soft-jawed vise.	
	f. Remove drive coupling bolts (108) and lockwashers (109).	
	g. Remove retainer (110) and coupling support assembly (111).	Remove cam (112) leaf spring (113), and seats (114) from drive coupling support (115) if damaged or worn.
	h. Remove drive gear hub nut (116), key washer (117), thrust washers (118 and 119) and steel ball (120) from blower drive gear hub (121).	
	i. Remove blower drive gear hub (121) and gear (122) as a unit.	
	j. Press gear hub (121) from drive gear (122).	
	k. Press sleeve bearing (123) from hub (37).	If worn or scored.



**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING**

25. Blower

**WARNING**

Dry cleaning solvent, P-D-680, used to clean parts, is potentially dangerous to personnel and property. Avoid repeated or prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°-138°F (38°-59°C).

Clean all metal parts in cleaning solvent Fed. Spec. P-D-680 and dry thoroughly.

26. Blower  
Drive**WARNING**

Wear safety goggles when using compressed air to avoid eye injury.

Clean all metal blower drive parts with clean fuel oil and dry thoroughly with compressed air.

**INSPECTION**27. Blower  
Assembly

- a. Examine the bearings for any indications of corrosion or pitting. each bearing with light engine oil; then, while holding the bearing inner race from turning, revolve the outer race slowly by hand and check for rough spots.

**NOTE**

The double-row ball bearings are pre-loaded and have no end play. A new double-row bearing will seem to have considerable resistance to motion when revolved by hand.

**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)**

- b. Check the oil seal rings, carriers and collars for wear and scoring.

**NOTE**

**When a blower with lip type oil seals is being reconditioned, the installation of new seals is recommended. Oversize oil seals and oil seal spacers are available in the blower kit to replace the standard oil seals when the blower rotor shafts are grooved.**

- c. Inspect the blower rotor lobes, especially the sealing ribs, for burrs and scoring. Rotors must be smooth for efficient operation of the blower. If the rotors are slightly scored or burred, they may be cleaned up with emery cloth.
- d. Examine the rotor shaft serrations for wear, burrs, or peening. Also, inspect the bearing and oil seal contact surfaces of the shafts for wear and scoring.
- e. Inspect the inside surface of the blower housing for burrs and scoring. The inside surface must be smooth for efficient operation of the blower. If the inside surface of the housing is slightly scored or burred, it may be cleaned up with emery cloth.

**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)**

- f. Check the finished ends of the blower housing, for flatness and burrs. The end plates must set flat against the blower housing.

**NOTE**

**The finished inside face of each end plate must be smooth and flat. If the finished face is slightly scored or burred it may be cleaned up with emery cloth.**

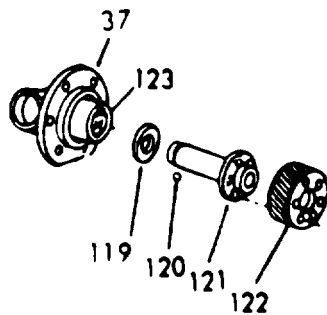
- g. Examine the serrations in the blower timing gears for wear and peening; also check the teeth for wear, chipping or damage. If the gears are worn to the point where the backlash between the gear teeth exceeds .004 inch, or damaged sufficiently to require replacement, both gears must be replaced as a set.
- h. Check the blower drive shaft serrations for wear or peening. Replace the shaft if it is bent.
- i. Inspect the serrations inside the rotor drive hub for wear and peening.
- j. Inspect threaded parts for thread damage.

**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSPECTION (Cont)</b>		
28. Blower Drive	<ul style="list-style-type: none"> <li>a. Inspect thrust washers for scoring and wear.</li> <li>b. Inspect sleeve bearings for wear or scoring.</li> <li>c. Inspect blower drive shaft for worn or damaged serrations.</li> <li>d. Inspect blower drive gear teeth for wear, scoring or pitting.</li> <li>e. Inspect blower drive coupling support, cam, spring seats and spring packs for wear or damage.</li> <li>f. Inspect threaded parts for thread damage.</li> </ul>	
<b>REPLACEMENT</b>		
29. Blower Assembly	Replace a blower assembly damaged beyond repair.	
30. Blower Drive	Replace a blower drive assembly damaged beyond repair.	
<b>REPAIR</b>		
31. Blower Assembly	<ul style="list-style-type: none"> <li>a. Replace all gaskets.</li> <li>b. Replace any damaged or defective parts as required.</li> </ul>	
32. Blower Drive	a. Replace worn or scored thrust washers.	

**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REPAIR (Cont)</b>		
	<ul style="list-style-type: none"> <li>b. Replace damaged or defective bearings.</li> <li>c. Replace blower drive shaft if serrations are worn or damaged.</li> <li>d. Replace drive gear if worn, scored, or pitted.</li> <li>e. Replace worn or damaged spring seats, spring packs, cam, or coupling support.</li> <li>f. Replace damaged threaded parts.</li> </ul>	
<b>REASSEMBLY</b>		
33. Blower Drive Gear and Hub	<ul style="list-style-type: none"> <li>a. Place drive gear support (37) in a vise with soft jaws.</li> <li>b. Press drive gear hub (121) into drive gear (122).</li> <li>c. Press sleeve bearing (123) into drive gear support.</li> </ul>	Lubricate sleeve bearing with clean engine oil.



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**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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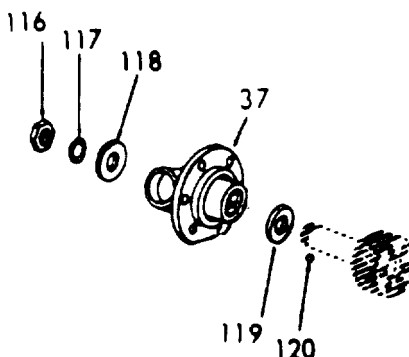
**REASSEMBLY (Cont)**

- |  |  |
|--|--|
| d. Place thrust washer (119) on protruding bearing in gear side of support then insert blower drive gear hub and gear assembly into drive gear support (37). | Lubricate thrust washer with clean engine oil. |
| e. Position steel ball (120) in its place on drive gear hub (121) and slide thrust washers (119) into position over steel ball.                              |  |

**NOTE**

**Thrust washer must be installed with tapered face toward threads on hub.**

- |   |  |
|---|--|
| f. Place thrust washer (118) and a new key washer (117) on hub (121). | Lubricate thrust washer with clean engine oil. |
| g. Install drive gear hub nut (116).                                  | Finger tight only.                             |

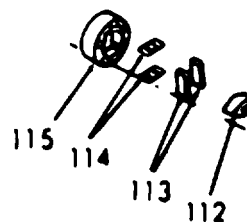
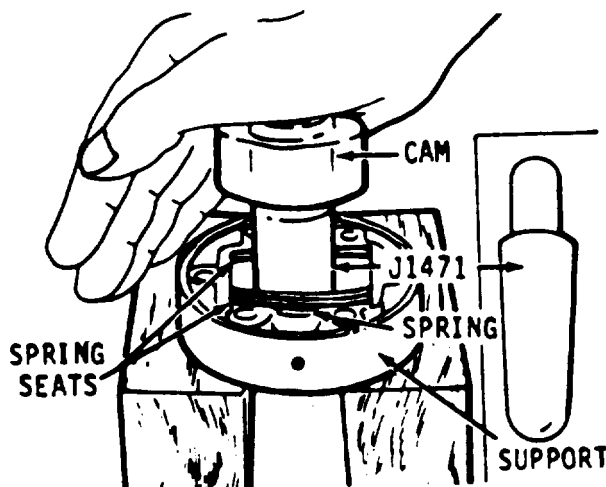


- h. Install two bolts into threaded holes in drive gear hub. Place a suitable holding bar across bolts to keep hub from rotating and torque hub nut (116) to 50-60 lb-ft (67.8 - 81.3 Nm).



**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REASSEMBLY (Cont)</b>		
34. Blower Drive Coupling	i. Bend ears of key washer against nut to locknut in place. Remove the two bolts.	
	a. Place drive gear hub on wood blocks as shown.	
	b. Install springs (114).	
	c. Place spring seats (113) in each corner of drive coupling support (115).	
	d. Apply clean engine oil to drive coupling springs (there are 21 leaves in each spring pack) and insert them in drive coupling support (115).	
	e. Place blower drive cam (112) on installer, insert round end of tool between springs seats (113) and press cam (112) into position.	Use tool J1471.

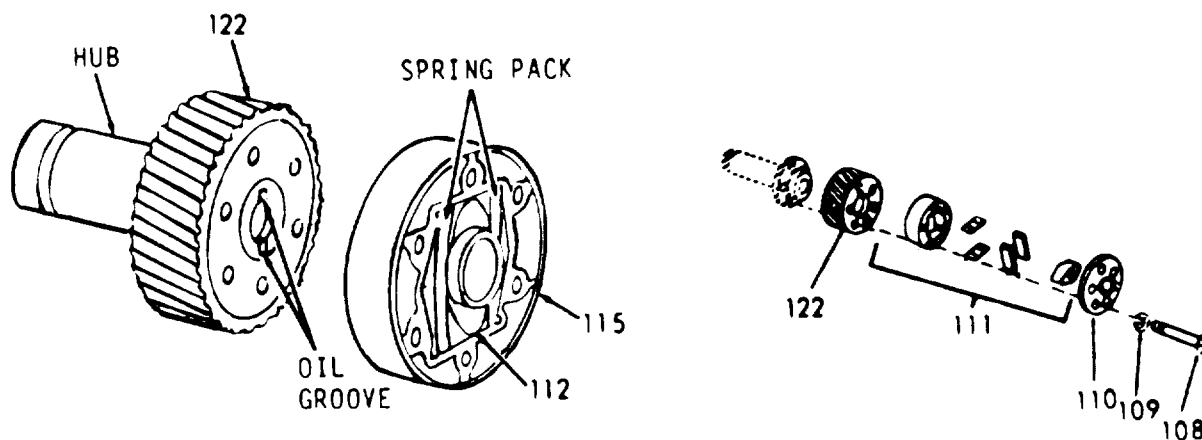


## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- f. Place the coupling support assembly (111) against the drive gear (122) with the blower drive shaft ring groove in the cam facing away from the drive gear. Then, place the drive coupling retainer (110) against the coupling support with the flared edge away from the support. Revolve the coupling assembly on the hub flange until the cam lobes are in line with the oil grooves in the gear hub as shown to ensure proper lubrication.
- g. Install the drive coupling lockwashers (109) and bolts (108).

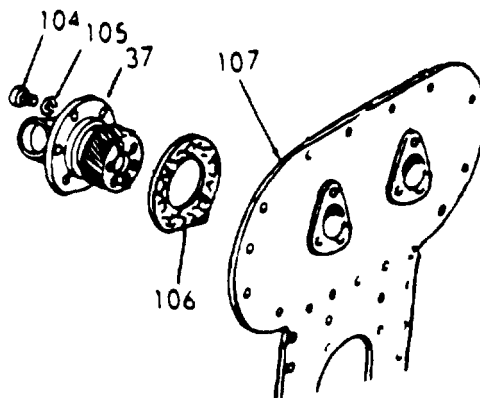


**6-35. BLOWER ASSEMBLY (Continued).**

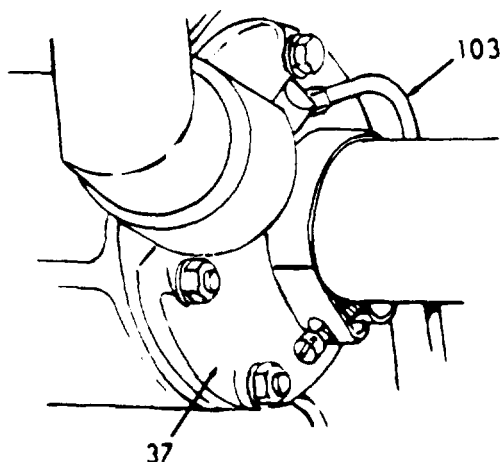
LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)****35. Support  
Assembly**

- a. Check clearance between the drive support and gear hub thrust washer before installing blower drive support assembly. The clearance must be .006 to .014 inch.
- b. Position a new gasket (106) on mounting face of hub support (37).
- c. Secure support assembly to cylinder block rear end plate (107) with lockwashers (105) and capscrews (104).



- d. Reconnect oil line (103) to hub support (37) and cylinder block (104).



**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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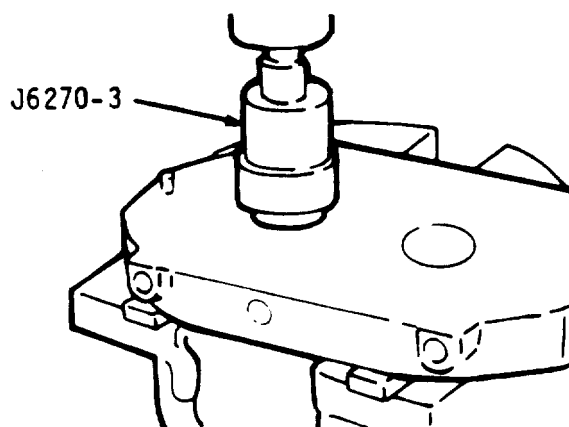
**REASSEMBLY (Cont)**

- |  |   |
|--|---|
| 36. Front End Plate, Oil Seals, and Pins | a. Support front end plate (90), finished surface facing up, on wood blocks on bed of an arbor press. |
|--|---|

**NOTE**

If oversize oil seals are being used in end plates, use installer J1682-13 to install oversize spacers on the rotor shafts.

- |   |
|---|
| b. Start oil seals (96) straight into bore in end plate with sealing edge facing down (toward bearing bore).  |
| c. Place the short end of the oil seal remover and installer J6270-3 in the oil seal and under the ram of the press. Then, press the oil seal (96) into the end plate until the shoulder on the installer contacts the end plate. |

**NOTE**

A step under the shoulder of the installer will position the oil seal approximately .005 inch below the finished face of the end plate. This is within the .002 inch to .008 inch specified.

**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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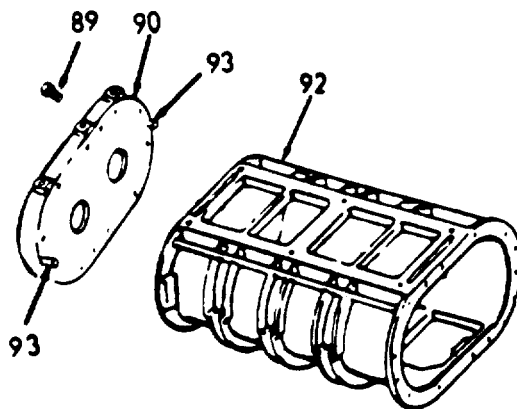
**REASSEMBLY (Cont)**

- d. Install the remaining oil seals (96) in the end plates in the same manner.
- e. Install the blower front end plate (90), making sure the mark TOP on the outer ribbed side is at the top of the blower housing, identified by the flange with supports the housing on the top edge of the cylinder block.

**NOTE**

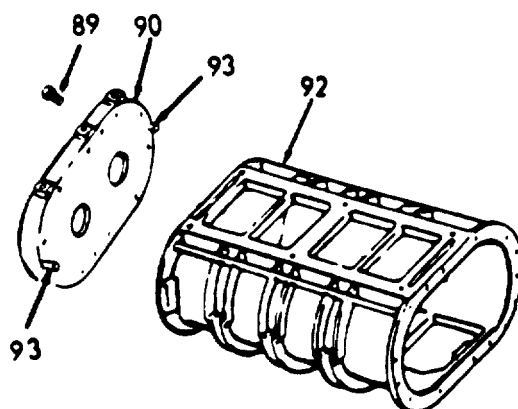
The front end and rear end plates of the blower are interchangeable. One end plate should be assembled to the front end of the blower housing first and the other plate should be assembled to the rear of the blower housing after the rotors are in place.

- f. Attach an end plate to the front of the blower housing as follows:
  - (1) Check the dowel pins (93). The dowel pin must project .380 inch from the flat inner face and .270 inch from the outer face of the front end plate to assure proper alignment of the end plate to the housing and the cover to the end plate.



## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
<b>REASSEMBLY (Cont)</b>		
	(2) Place the blower housing (92) on a bench with the top of the housing up, and the front end of the housing facing the outside of the bench.	
	(3) Position the end plate in front of the blower housing with the flat finished face of the end plate facing the housing and the end marked TOP facing the flanged side of the housing. Then, start the dowel pins (93) straight into the dowel pin holes in the housing. Push or tap the end plate (90) against the housing.	Note that gas-kets are not used between the housing; therefore, the mating surfaces must be flat and smooth.
	(4) Insert the two fillister head screws (89) through the end plate and thread them into the housing. Tighten the screws securely. Do not use lockwashers on these screws.	



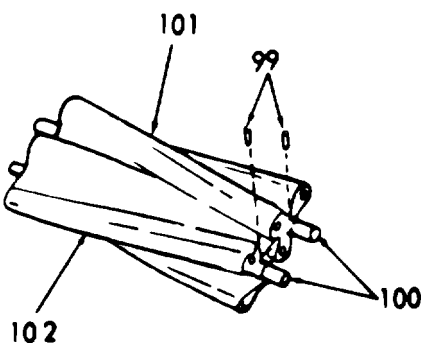
**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

37. Blower  
Assembly  
Rotors

- a. The lobes on the upper blower rotor and the teeth on its gear form a right-hand helix while the lobes and teeth of the lower rotor and gear form a left-hand helix. Therefore, a rotor with right-hand helix lobes must be used with a gear having right-hand helix teeth and vice versa. With this precaution in mind proceed with blower assembly.
- b. Place rotor shafts (100) through rotors to secure.
- c. Install pins (99) in rotor shafts (100).
- d. Place lower right hand rotor assembly (102) in mesh with upper right hand rotor assembly (101).



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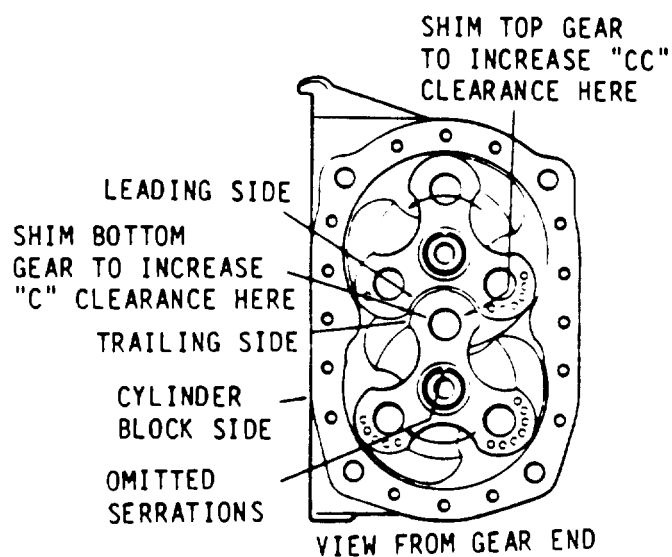
## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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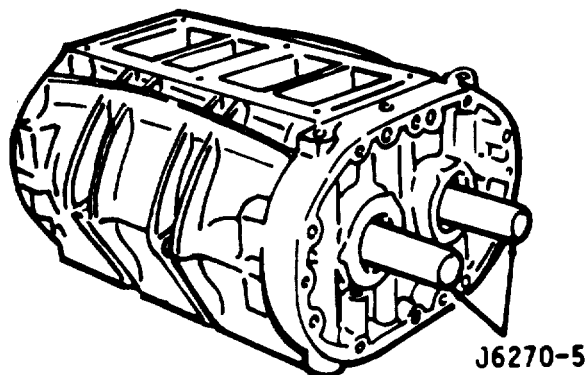
## REASSEMBLY (Cont)

38. Blower  
Rotors

- a. Assemble the blower rotors in the blower housing and front end plate as follows. The rotor must be assembled in the blower housing with the omitted serrations in the rotor shafts aligned as shown.



- b. Place an oil seal pilot J6270-5 on the short (nonsplined) end of each rotor shaft (100). Then place the rotors in mesh with the omitted serration in the shafts in alignment as shown.





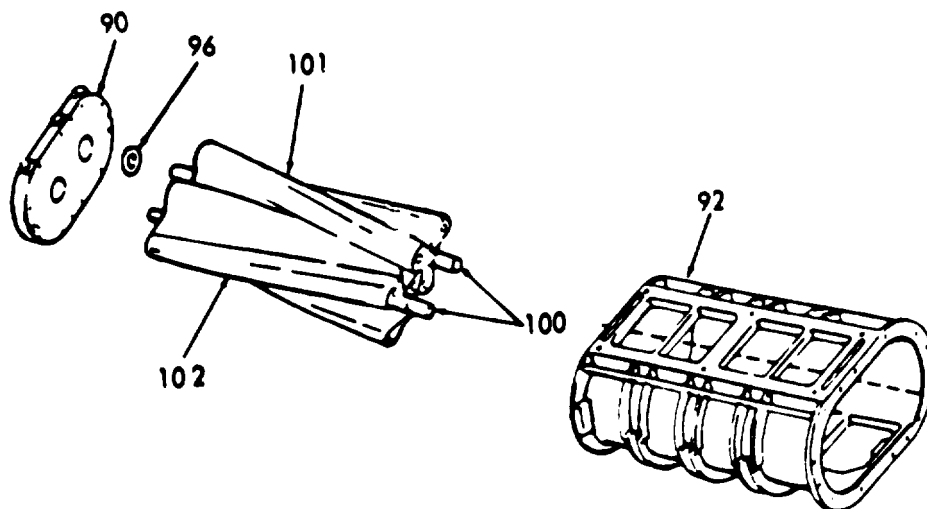
**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)****NOTE**

When oversize oil seals are used in the blower end plate, use oil seal spacer installers J1682-13 for the oil seal pilots in place of J6270-5.

- c. Insert the blower rotors (101 and 102) with oil seal pilots straight into the blower housing (92) with the right hand helix rotor at the top, flange, side of the housing. Then, push the rotor shafts and oil seal pilots on through the oil seal (96) in the front end plate (90).
- d. Remove the oil seal pilots from the rotor shafts.



**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

39. Rear End  
Plate  
and Pins

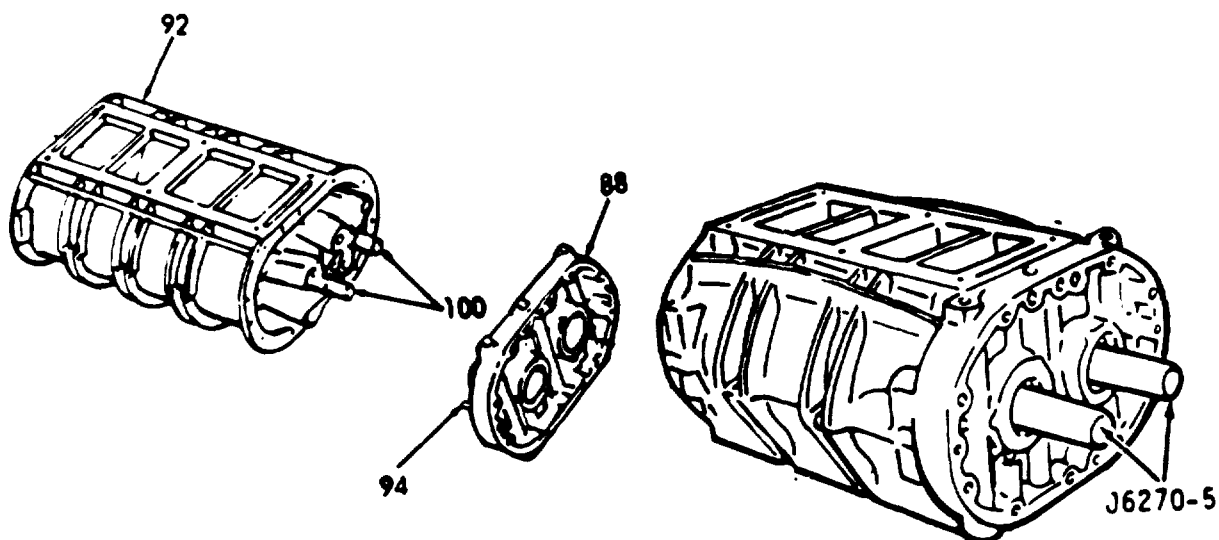
Attach the blower rear end plate (88)  
to the blower housing (92) as follows:

- (1) Reverse the blower housing (92) on the bench (rear end of housing facing the outside of the bench).
- (2) Place an oil seal pilot J6270-5 on the serrated end of each rotor shaft (100).

**NOTE**

**When oversize oil seals are used in the blower end plate, use oil seal spacer installer J1682-13 for the oil seal pilots in place of J6270-5.**

- (3) Check the dowel pins (94). The dowel pins must project .380" from the flat inner face, and .270" from the outer face of the rear end plate to assure proper alignment of the end plate to the housing and cover to the end plate.

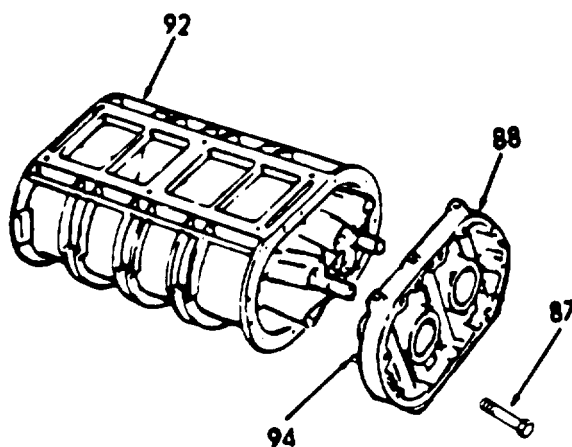


**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- (4) Place the rear end plate (88) in position in front of the oil seal pilots with the flat finished face of the end plate facing the blower housing and the mark TOP on the end plate at the top flange side of the housing.
- (5) Place the rear end plate (88) over the oil seal pilots and start the dowel pins (94) straight into the dowel pin holes in the housing. Push or tap the end plate against the housing.
- (6) Insert the two fillister head screws (87) through the end plate (88) and thread them into the housing (92). Tighten the screws securely. Do not use lockwashers on these screws.
- (7) Remove the oil seal pilots from the rotor shafts.



**6-35. BLOWER ASSEMBLY (Continued).**

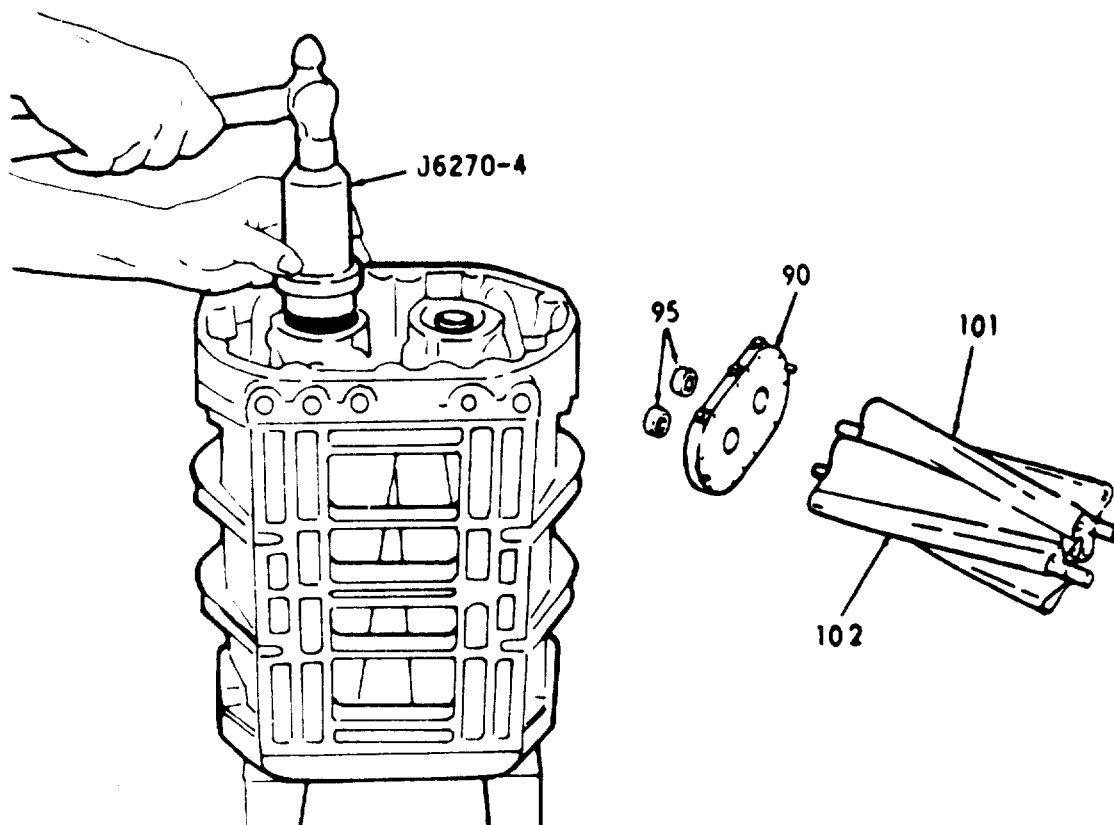
LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

40. Front End  
Plate and  
Rotor  
Shaft  
Ball  
Bearings

With the blower housing, rotors and end plates still supported in a vertical position on the two wood blocks, install the roller bearings on the rotor shafts and in the front end plate as follows:

- (1) Lubricate one of the roller bearings (95) with clean engine oil. Start the bearing, numbered end up, straight on one of the rotor shafts (101 or 102).
- (2) Place installer J6270-4 on top of the bearing (95) and tap the bearing on the shaft (101 or 102) and into the front end plate (90).

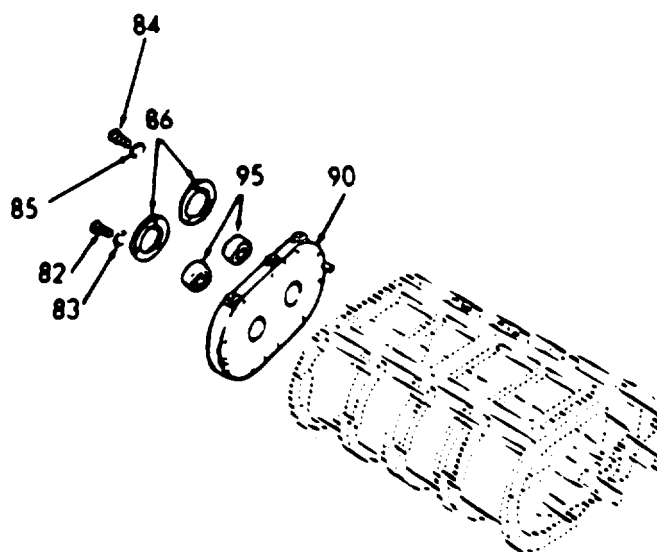


## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- (3) Repeat steps (1 and 2) and install all other bearings (95) in the same manner.
- (4) Place the bearing retainers (86) on top of the bearings (95) and the end plate (90). Then install the retainer lockwashers (83 and 85) and bolts (82 and 84). Tighten the bolts to 7 - 9 lb-ft (9 - 12 Nm) torque.



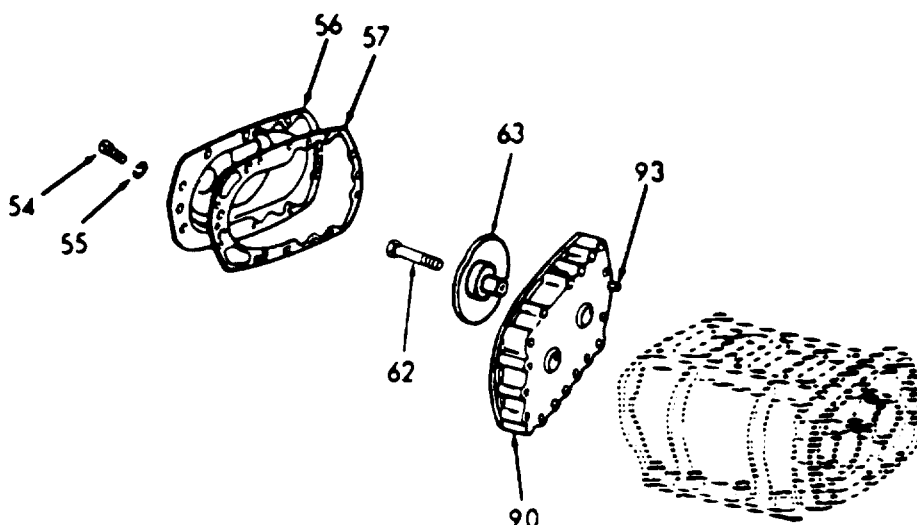
**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

41. Water Pump  
Drive  
Coupling  
and Front  
End Plate  
Cover

- a. Start the end of the water pump drive coupling (63) straight into the left-hand helix rotor shaft. Then, place a clean shop towel between the blower rotors to prevent them from turning. Install the drive coupling retaining capscrew (62) and draw the coupling and slinger tight against the end of the shaft, then tighten the cap screw to 18 lb-ft. (24 Nm) torque.
- b. Affix a new gasket (57) to the blower front end plate cover (56).
- c. Position end plate cover (56) over the end plate dowel pins (93), with the large hole in the cover toward the top of the end plate (90), then push the cover (56) against the end plate (90). Install the ten lockwashers and capscrews. Tighten the capscrews to 13-17 lb-ft (17-23 Nm) torque.



**6-35. BLOWER ASSEMBLY (Continued).**

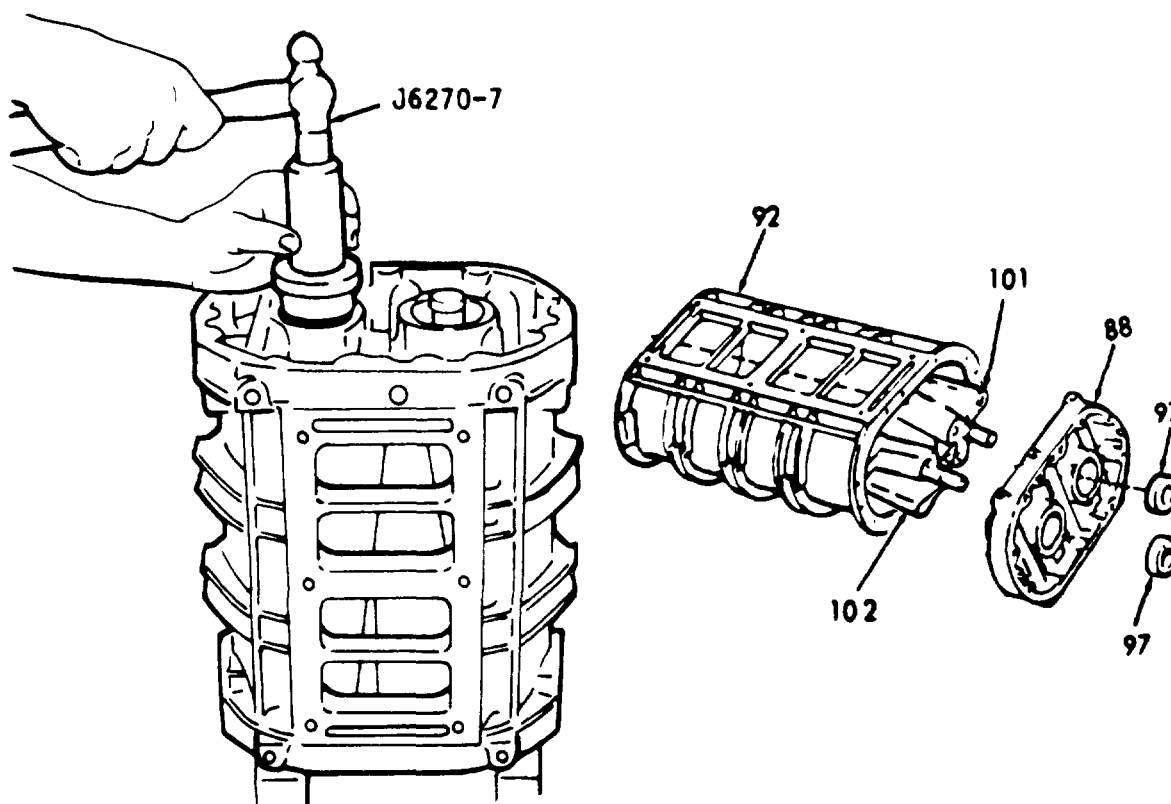
LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

42. Rear End  
Plate and  
Rotor  
Shaft Ball  
Bearings

Install the ball bearings on the rotor and shafts in the rear end plate as follows:

- (1) Reverse the position of the blower housing on the two wood blocks, end for end.
- (2) Lubricate the ball bearings (97) with engine oil. Start the bearing, numbered end up, straight on one of the rotor shafts (101 or 102).
- (3) Place installer J6270-7 on top of the bearing and tap the bearing straight on the shaft and into the rear end plate (88).

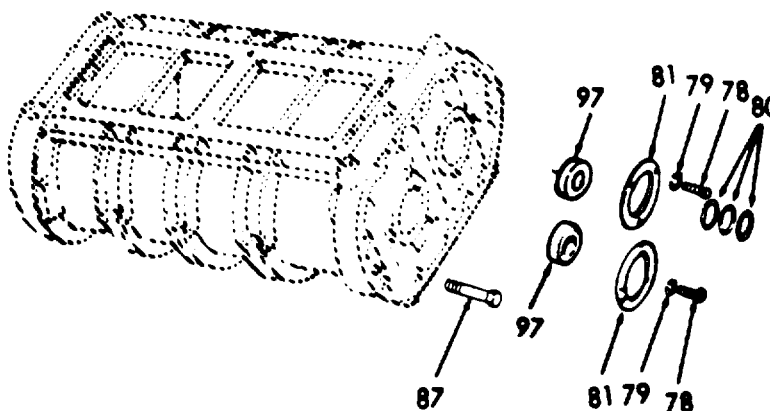


**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- (4) Place the bearing retainers (81) on top of the bearings (97) and the end plate (88), then, install the shims (80), retainer lockwashers (79) and capscrews (78). Tighten the capscrews (78) to 7 - 9 lb-ft (9 - 12 Nm) torque.



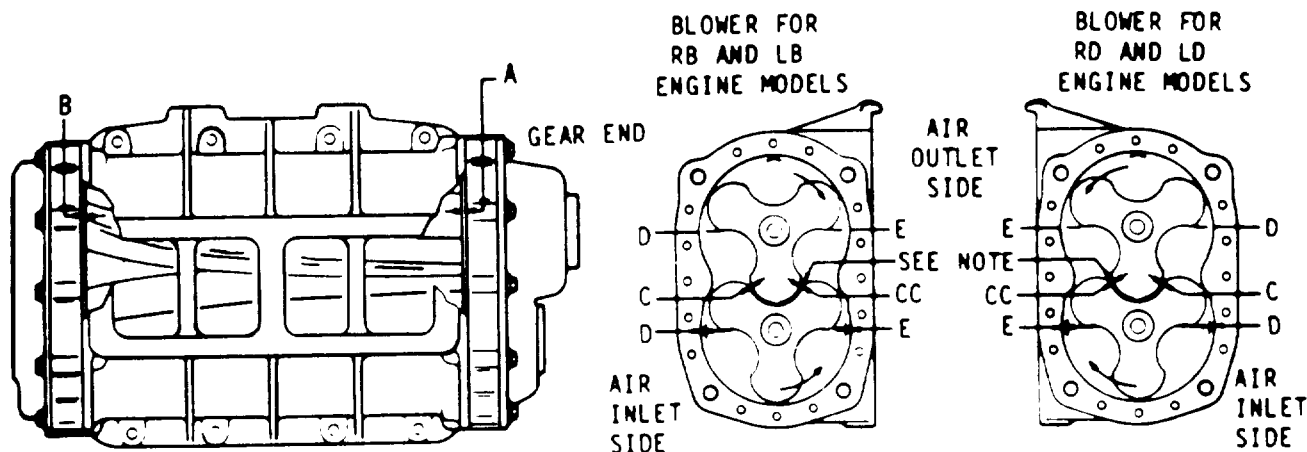
- (5) Make a preliminary check of the rotor-to-end plate and rotor-to-housing clearances at this time with a feeler gage. Refer to figure below for minimum blower clearances.



## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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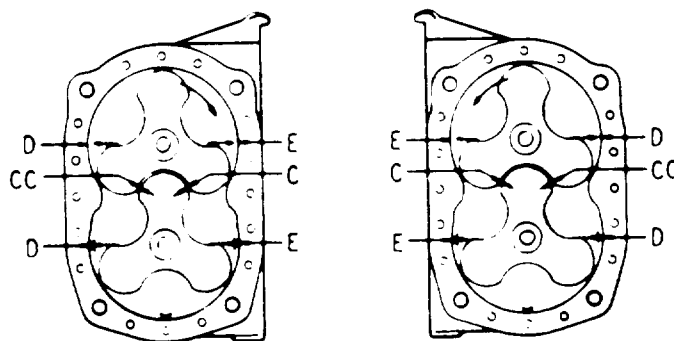
## REASSEMBLY (Cont)



NOTE: TIME ROTORS TO DIMENSION ON CHART FOR CLEARANCE BETWEEN TRAILING SIDE OF UPPER ROTOR AND LEADING SIDE OF LOWER ROTOR (CC) FROM BOTH OUTLET AND INLET SIDE OF BLOWER.

	A	B	C	CC	D	E
MIN.	.007	.014	.014	.002	.015	.004
MAX.				.006		

TIME ROTORS TO DIMENSIONS ABOVE



ALL VIEWS FROM REAR OF ENGINE

43. Timing  
Gears

Install the blower rotor timing gears to blower as follows:

## NOTE

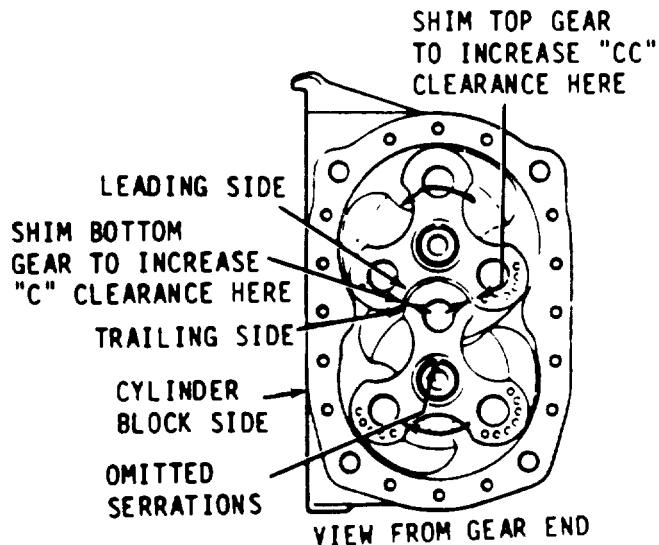
One serration is omitted on the drive end of each blower rotor shaft and a corresponding serration is omitted in each gear. Assemble the gears on the rotor shafts with the serrations in alignment.

## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- (1) Place the blower housing (92) with installed rotor assembly on the bench with the air inlet side of the housing facing up and the rear end (serrated end of the rotor shafts) of the blower facing the outside of the bench.
- (2) Rotate the rotors to bring the omitted serrations on the shafts in alignment and facing the top of the blower housing as shown.



## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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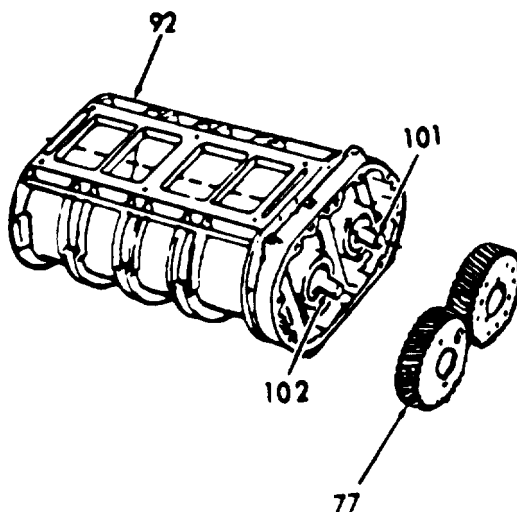
## REASSEMBLY (Cont)

- (3) Install the same number and thickness of shims on the rotor shafts (101 and 102) that were removed at the time of disassembly.

**NOTE**

When rebuilding a blower with new rotors or new gears, first install the gears on the rotor shafts without the shims, then check the clearances between the rotors to determine the location and thickness of shims to be used; refer to figure above.

- (4) Lubricate the serrations of the rotor shafts (101 and 102) with clean engine oil.
- (5) Place the teeth of the rotor gears (77) in mesh so that the omitted serrations inside the gears are in alignment and facing the same direction as the serrations on the shaft.



**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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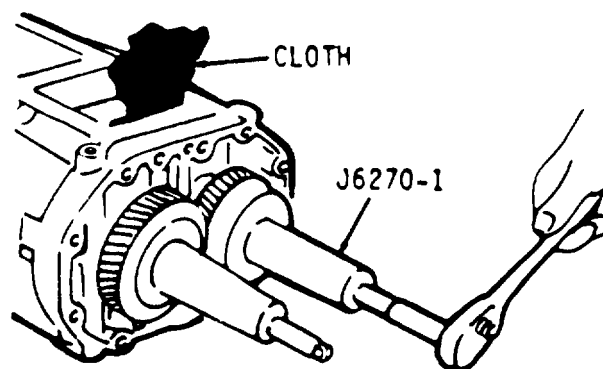
**REASSEMBLY (Cont)****NOTE**

**A center punch mark placed in the end of each rotor shaft at the omitted serrations will assist in aligning the gears on the shafts.**

- (6) Start both rotor gears (77) straight on the rotor shafts with the right-hand helix gear on the right-hand helix rotor and the left-hand helix gear on the left-hand helix rotor, and the omitted serrations in the gears in line with the omitted serrations on the rotor shafts.
- (7) Thread an installer screw J6270-8 in the end of each rotor shaft until it bottoms. Place gear installer J6270-6 over the installer screw and against the right-hand helix gear, and gear installer J6270-1 over the installer screw and against the left-hand helix gear; then, thread a nut on each installer screw as shown.
- (8) Place a clean shop towel between the rotors, and another one between the rotor and the housing to prevent the rotors from turning. Then turn the nuts on the installer screws clockwise and force the gears into position tight against the shims and bearing inner races.

## 6-35. BLOWER ASSEMBLY (Continued).

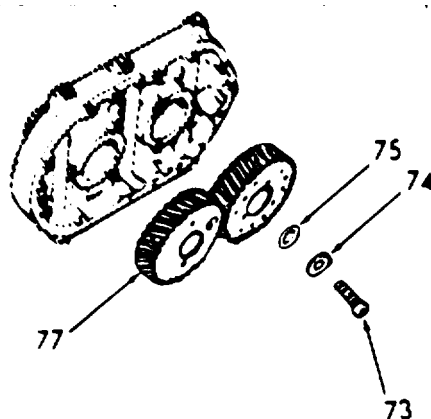
LOCATION/ITEM	ACTION	REMARKS
REASSEMBLY (Cont)		



## NOTE

Both gears must be pressed on the rotor shafts at the same time.

- (9) Remove the rotor timing gear installers from the rotor shafts.
- (10) Place a key washer (74) and gear retaining key washer (75) on one of the gear retaining cap screws (73). Thread the bolt into the right-hand helix rotor shaft and guide the lugs on the retaining key washer (75) in the slots in the gear hub, then bend one of the tangs on the key gear over into the slot of the retaining key washer. Tighten the gear retaining capscrew to 55 - 65 ft-lb (74 - 88 Nm) torque.

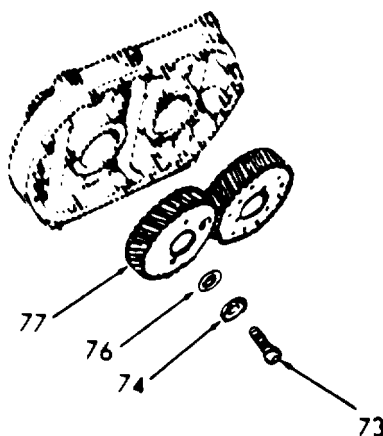


## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- (11) Place a key washer (74) and the fuel pump drive coupling disc (76) on the remaining gear retaining capscrew (73). Thread the capscrew (73) into the left-hand helix rotor shaft and guide the lugs on the disc (76) in the slots in the gear hub (77), then bend one of the tangs on the key washer (74) over the slot in the disc (76). Tighten the gear retaining capscrew to 55 - 65 ft-lb (74 - 88 Nm) torque.



- (12) Bend one of the tangs of each key washer over against the head of the gear retaining capscrew.

## 44. Timing Rotors

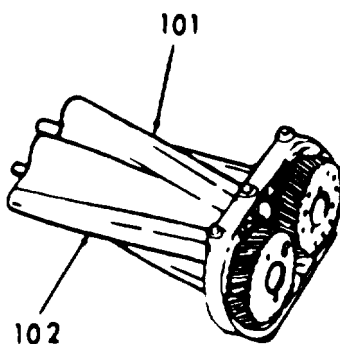
- a. After the blower rotors and timing gears are installed, the blower rotors must be timed.
- b. The blower rotors, when properly positioned in the housing, run with a slight clearance between the lobes. This clearance may be varied by moving one of the helical gears in or out on the shaft relative to the other gear.

## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- c. If the right-hand helix gear is moved out, the right-hand helix rotor (101) will turn counter-clockwise when viewed from the gear end. If the left-hand helix gear is moved out, the left-hand helix rotor (102) will turn clockwise when viewed from the gear end. This positioning of the gear, to obtain the proper clearance between the rotor lobes, is known as blower timing.

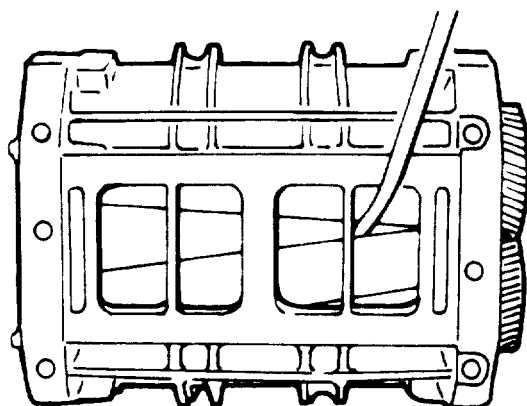


- d. Moving the gears OUT or IN on the rotor shafts is accomplished by adding or removing shims between the gears and the bearings.
- e. The clearance between the rotor lobes should be checked with 1/2 inch wide feeler gages. When measuring clearances of more than .005 inch, laminated feeler gages that are made up of .002 inch, .003 inch, or .005 inch feeler stock are more practical and suitable than a single feeler gage. Clearances should be measured from both the inlet and outlet sides of the blower as shown below.

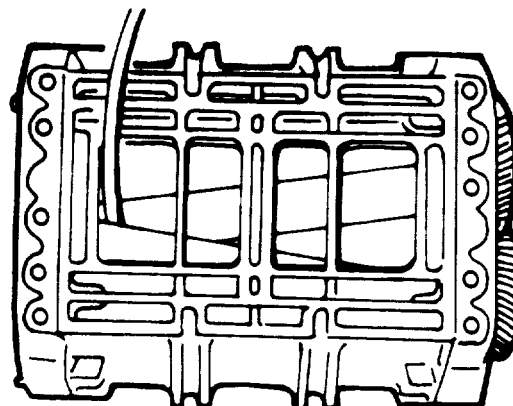
## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)



AIR INLET SIDE SHOWN



AIR OUTLET SIDE SHOWN

- f. A specially designed feeler gage set J1698-02 for the blower clearance operation is available. Time the rotors as follows:
- (1) Time the rotors to have .002 inch to .006 inch clearance between the TRAILING edge of the UPPER rotor and LEADING edge of the LOWER rotor ("cc" clearance) measured from both the inlet and outlet sides as shown in figure below. If possible, keep this clearance to the minimum (.002 inch). Then check the clearance between the LEADING edge of the UPPER and the TRAILING edge of the LOWER rotors ("cc" clearance) for the minimum clearance shown. Rotor-to-rotor measurements should be taken 1 inch from the governor end, at the center, and 1 inch from the drive end.

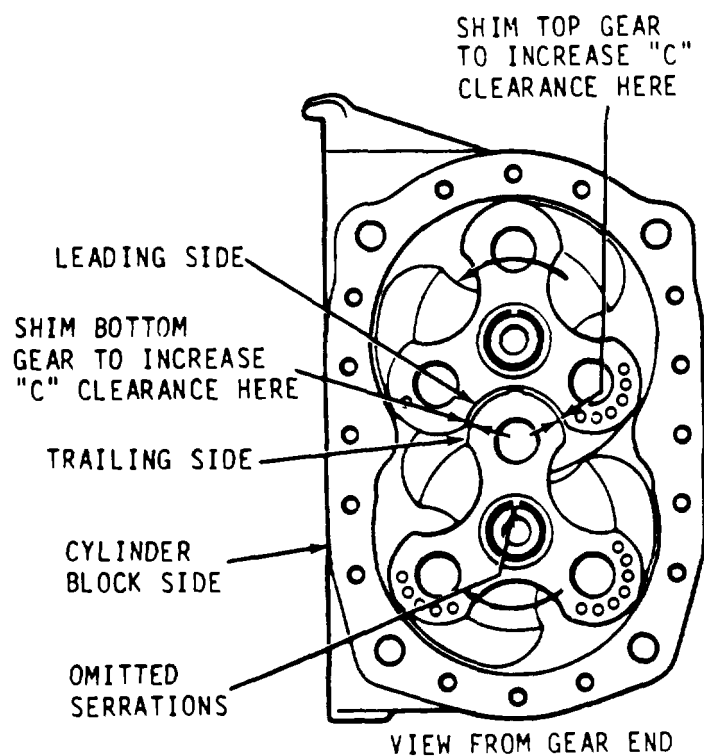


## 6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)|

- (2) After determining the amount one rotor must be revolved to obtain the proper clearance, add shims back of the proper gear as shown to produce the desired result. When more or less shims are required, both gears must be removed from the rotors. Placing a .003 inch shim in back of a rotor gear will revolve the rotor .001 inch.
- (3) Install the required thickness of shims back of the proper gear and next to the bearing inner race and reinstall both gears. Recheck the clearances between the rotor lobes.

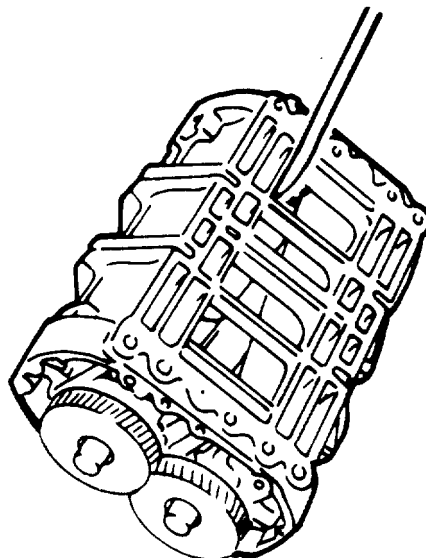


**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

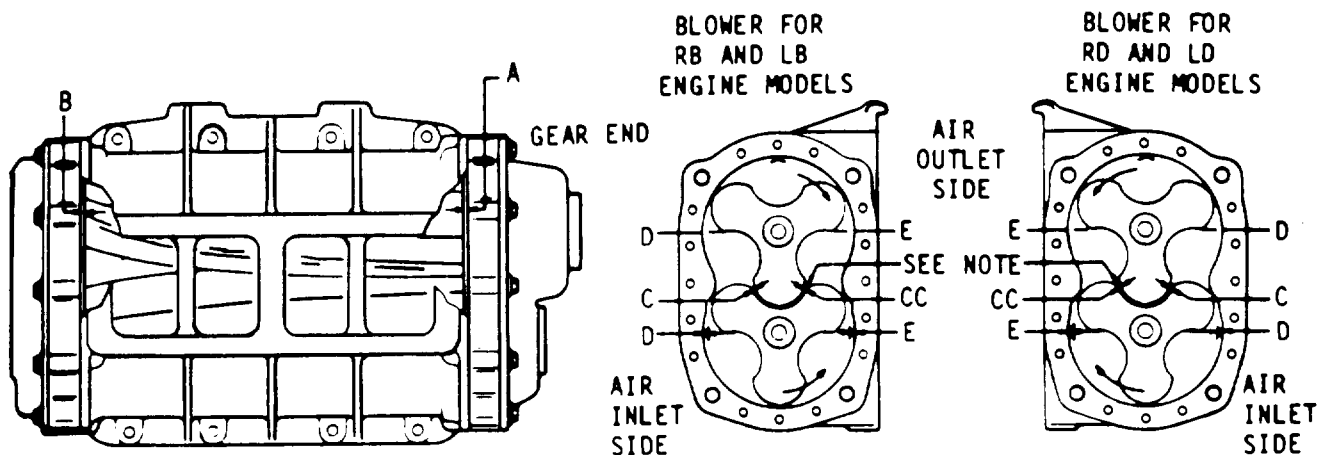
- (4) Determine the minimum clearances at points "A" and "B" as shown. Insert the feeler gages between the end plates and the ends of the rotors. This operation must be performed at the ends of each lobe, making twelve measurements in all.



- (5) Check the clearance between each rotor lobe and the blower housing at both the inlet and outlet side - twelve measurements in all. See figure below for minimum clearances.

6-35. BLOWER ASSEMBLY (Continued).

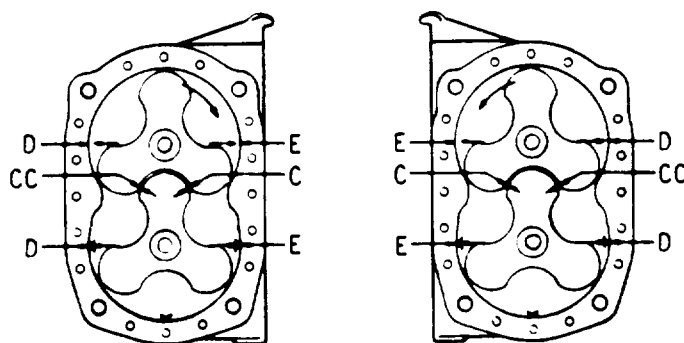
LOCATION/ITEM	ACTION	REMARKS
REASSEMBLY (Cont)		



NOTE: TIME ROTORS TO DIMENSION ON CHART FOR CLEARANCE BETWEEN TRAILING SIDE OF UPPER ROTOR AND LEADING SIDE OF LOWER ROTOR (CC) FROM BOTH OUTLET AND INLET SIDE OF BLOWER.

	A	B	C	CC	D	E
MIN.	.007	.014	.014	.002	.015	.004
MAX.				.006		

TIME ROTORS TO DIMENSIONS ABOVE



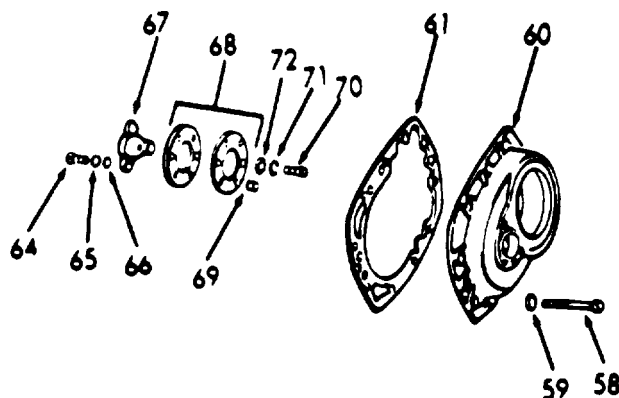
ALL VIEWS FROM REAR OF ENGINE

**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REASSEMBLY (Cont)</b>		
45. Blower Rotor Drive Hub and Plates	a. Secure drive hub plates (68) together with flatwashers (72), lockwashers (71) and bolts (70).	If removed. Torque bolts to 25 - 30 lb-ft (34 - 40 Nm).
	b. Position spacers (69), drive hub plates (68), and drive hub (67) in place on blower drive gear.	
	c. Secure with three flatwashers (66), lockwashers (65), and bolts (64).	Torque bolts to 25 - 30 lb-ft (34 - 40 Nm).
	d. Check the runout of the splines in the rotor drive hub with an indicator. The spline runout must not exceed .020 inch total indicator reading.	
	e. Affix a new gasket (61) to the blower rear end plate cover (60).	
	f. Position the end plate cover (60) over the end plate dowel pins, then push the cover against the end plate. Install the ten capscrews (58) and lockwashers (59). Tighten capscrews to 13 - 17 lb-ft (17 - 23 Nm) torque.	

## 6-35. BLOWER ASSEMBLY (Continued).

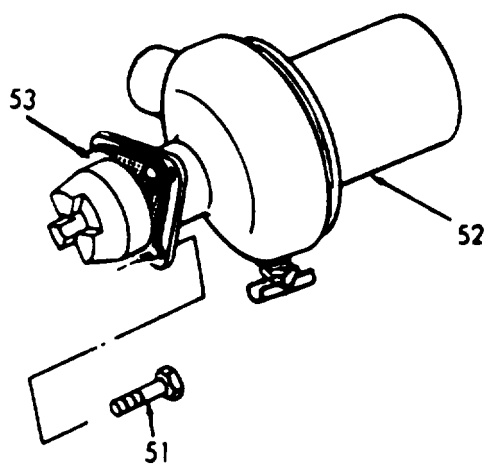
LOCATION/ITEM	ACTION	REMARKS
REASSEMBLY (Cont)		



## INSTALLATION

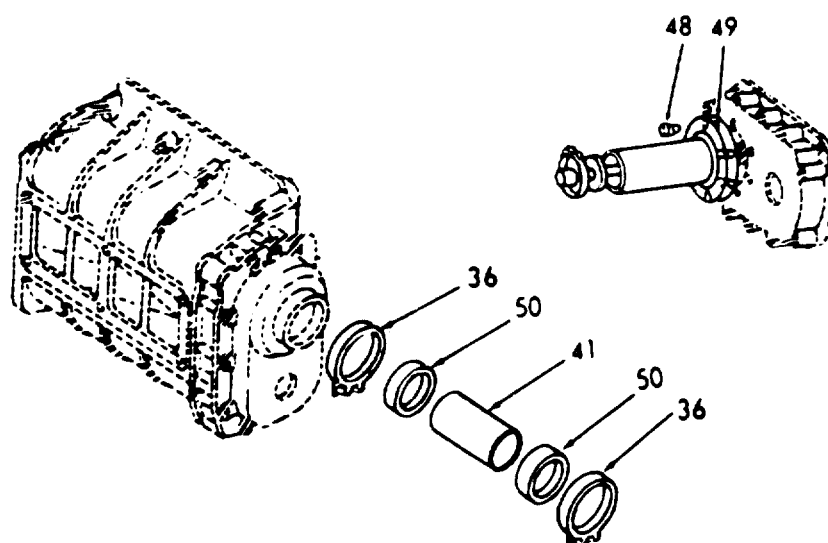
## 46. Fresh Water Pump

- Position a new mounting gasket (53) in place.
- Place water pump (52) in position on blower front end plate cover.
- Secure assembly with three bolt and seal assemblies (51).



**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSTALLATION (Cont)</b>		
47. Blower Drive Shaft Cover, Seals and Clamps	<p>a. Place seals (50), and clamp (36) over end of cover (41).</p> <p>b. Position new mounting gasket (49) in place on blower end plate and secure cover (41) with six bolt assembled seals (48).</p> <p>c. Tighten seal clamps (36).</p>	



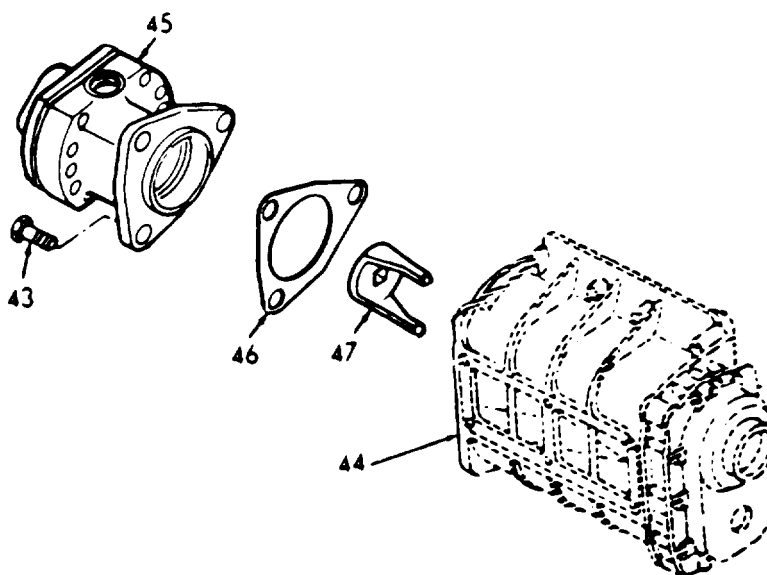
6-694

**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)****48. Fuel Pump and Drive Coupling Fork**

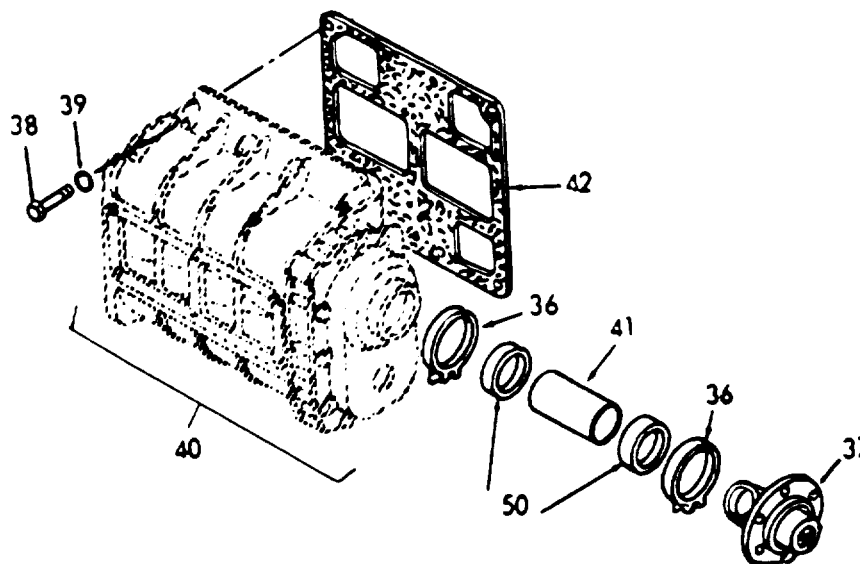
- a. Install drive coupling fork (47) on fuel pump spur gear shaft.
- b. Position a new mounting gasket (46) in place on fuel pump (45).
- c. Secure fuel pump (45) to rear end plate cover (44) with three bolt and seal assemblies (43).

**49. Blower****NOTE**

Check inside of blower for any foreign material and revolve rotors by hand to be sure they turn freely.

**6-35. BLOWER ASSEMBLY (Continued).**

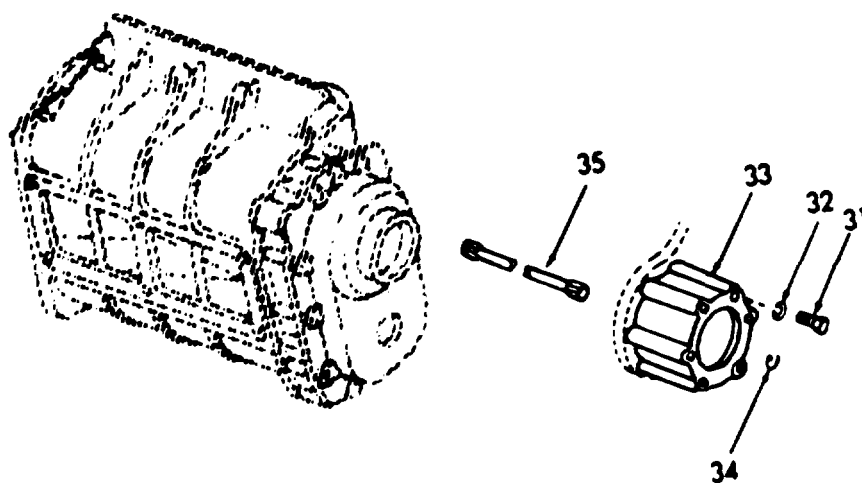
LOCATION/ITEM	ACTION	REMARKS
INSTALLATION (Cont)		
	a. Place a new blower to cylinder block gasket (42) on the cylinder block. block side only.	Use a non-hardening sealant on the
	b. Secure blower assembly (40) to cylinder block with flat washers (39), and capscrews (38).	Torque capscrews to 55 - 60 ft-lbs (74 - 81 Nm).
	c. Place a new seal (50) and clamp (36) over ends of shaft cover (41) and place cover over opening in end plate.	
	d. Place gear hub support (37) over end of cover.	
	e. Tighten clamps (36) securely.	





**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSTALLATION (Cont)</b>		
50. Blower Drive Shaft	a. Place blower drive shaft (35) in drive assembly.	Install the blower drive shaft by pushing the plain end, without squared hole, of the shaft through the blower drive coupling from the rear of the engine, then into the blower drive gear hub. If necessary, rotate the blower rotors slightly to align the splines of the drive shaft with those in the gear hub. Then, install the lock ring in the blower drive cam.
	b. Secure with snapring (34).	
	c. Position flywheel housing small hole cover (33) in place.	
	d. Secure with six lockwashers (32) and bolts (31).	



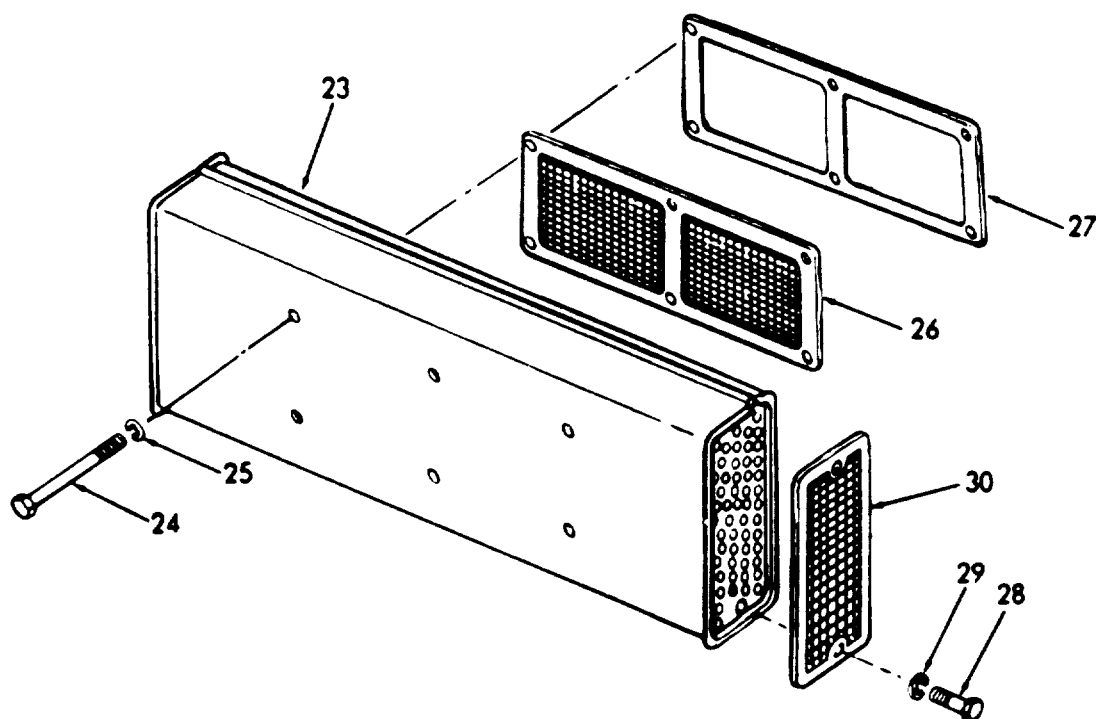
**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

51. Air Inlet  
Silencer

- a. Install screen (30) onto end of silencer (23) using two lockwashers (29) and bolts (28).
- b. Position strainer element (26) and gasket (27) in place on silencer.
- c. Secure silencer (23) to blower housing with six lockwashers (25) and bolts (24).
- d. Secure breather pipe to silencer with bolt.



52. Fuel  
Pump  
Lines

- a. Reconnect drain tube (22) to pump body.
- b. Remove cap and reconnect outlet line (21) to fuel pump.

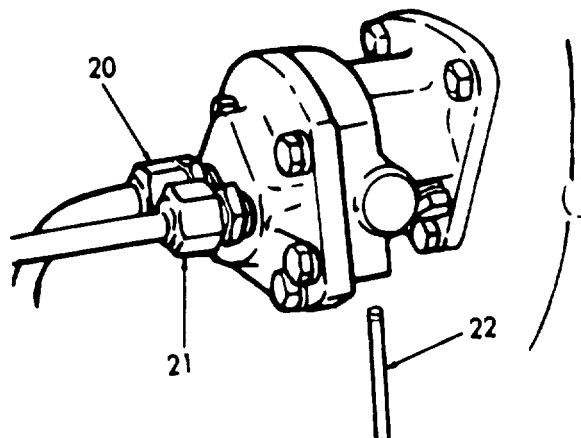
If removed.

## 6-35. BLOWER ASSEMBLY (Continued).

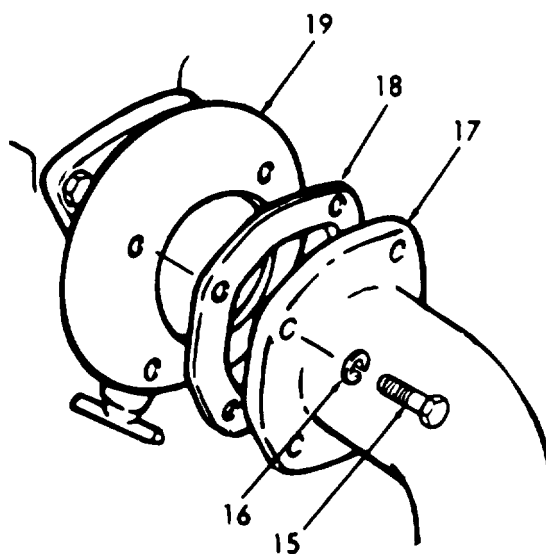
LOCATION/ITEM	ACTION	REMARKS
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## INSTALLATION (Cont)

- c. Remove cap and reconnect inlet line (20) to fuel pump.

53. Water  
Pump  
Inlet  
Elbow

- a. Position a new mounting gasket (18) in place on inlet elbow (17).
- b. Secure elbow (17) to water pump (19) with lockwashers (16) and bolts (15).



**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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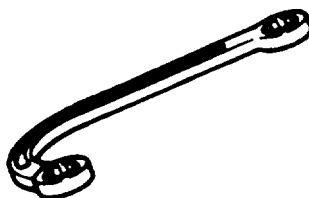
**INSTALLATION (Cont)**

54. Governor

- a. Position a new mounting gasket (14) in place on weight housing (10).
- b. Insert weight housing (10) into blower.
- c. Secure with six bolt assembled washers (13).

Use tool J4242.

**T00L  
J4242**



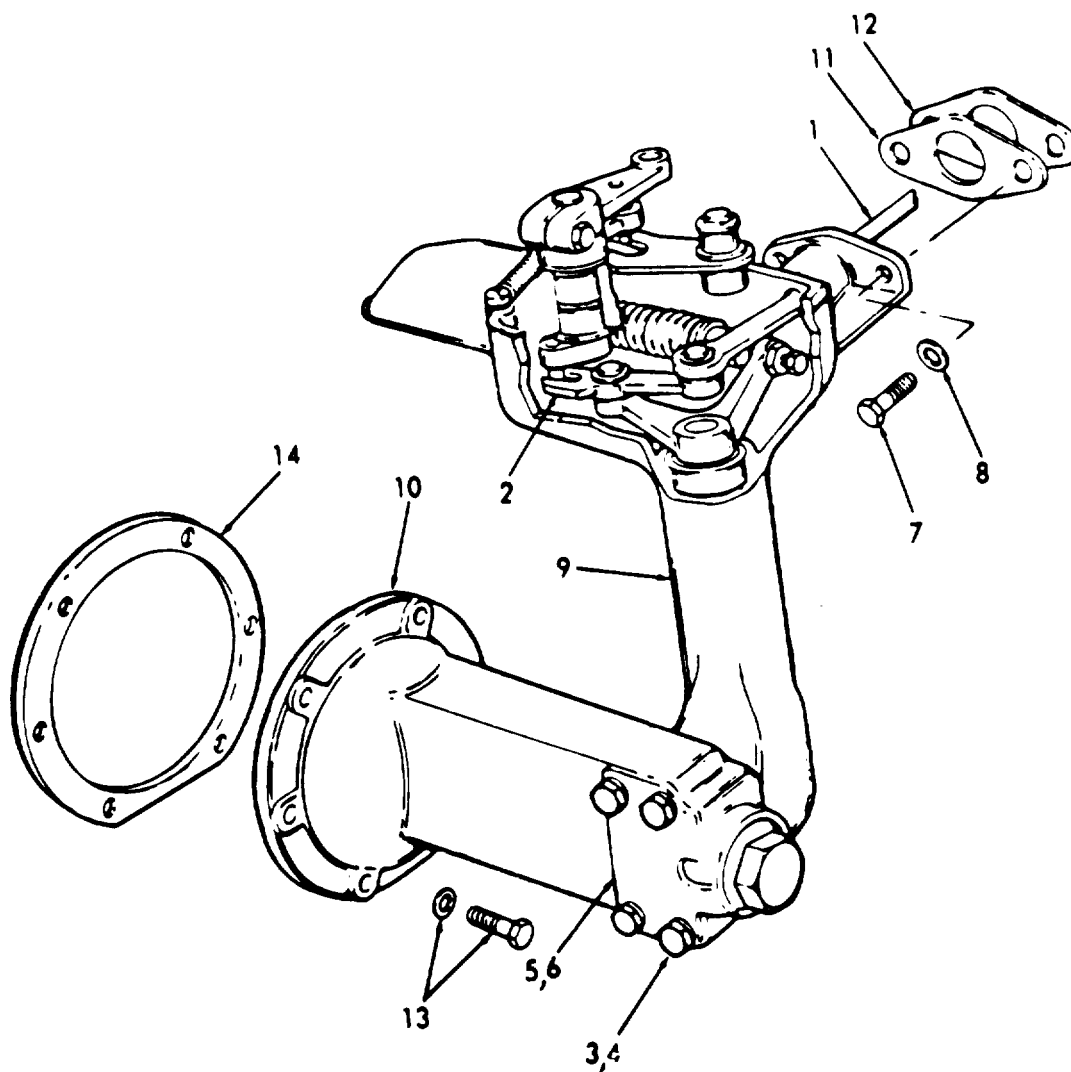
- d. Place mounting gasket (11) and spacer (12) over end of control housing fuel rod.
- e. Insert control housing (9) into position in weight housing (10).
- f. Secure with two lockwashers (8) and screws (7).
- g. Install weight housing cover gasket (6) and cover (5) with lockwashers (4) and bolts (3).
- h. Reconnect fuel rod (1) to differential lever (2).

Use new gasket.

Use new gasket.

6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
INSTALLATION (Cont)		



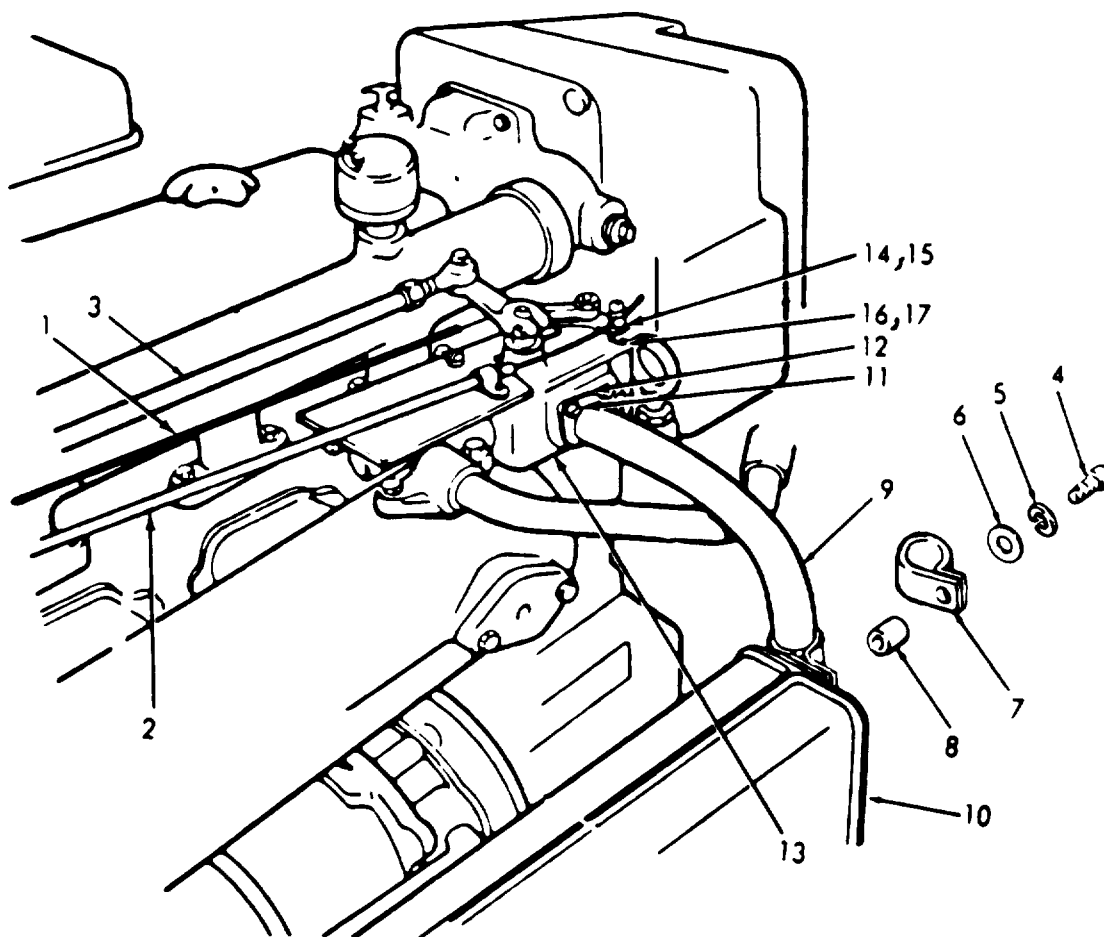
6-701

**6-35. BLOWER ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSTALLATION (Cont)</b>		
55. Governor Cover	a. Place cover gasket (17) and cover (16) in position on control housing (13).	Use new gasket.
	b. Secure with four lockwashers (15) and screws (14).	
	c. Position breather tube gasket (12) and breather tube (9) in place on control housing (13).	Use new gasket.
	d. Secure with two fillister head screws (11).	
	e. Secure other end of breather tube (9) to air silencer (10) with spacer (8), tube clip (7), flatwasher (6), lockwasher (5), and capscrew (4).	
	f. Reconnect governor control rod (3).	
	g. Reconnect throttle and stop control cables (1 and 2).	
	h. Refill cooling system.	

6-35. BLOWER ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
INSTALLATION (Cont)		



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**6-36. TRANSMISSION OIL PUMP.**

---

**a. General.**

1. Oil pressure to operate the forward and reverse clutches of the torqmatic marine gear is provided by a positive displacement rotor type oil pump mounted on the rear face of the flywheel housing and driven by the blower drive shaft through two coupling hubs and a coupling.

2. The pump has a constant flow control valve incorporated with the pressure relief valve, forming a constant flow and relief valve assembly. At all engine speeds, the oil flow is approximately 6 gpm.

3. The pump has a constant flow control valve incorporated with the pressure relief valve, forming a constant flow and relief valve assembly. This valve assembly of the pump, controls the amount of oil pumped through the hydraulic system regardless of engine speed. At all engine speeds, the oil flow is approximately 6 g.p.m. By controlling the oil flow, the operating pressure will be more constant resulting in a smooth and positive reversing action. The flow control valve is sensitive only to engine speed and operates independently of the pressure relief valve section of the assembly which controls the pressure within the complete hydraulic system.

4. As illustrated below an inner rotor (1), locked to a shaft (2) by a drive pin revolves inside an outer rotor (3), the bore of which is eccentric to the shaft and the inner rotor.

5. The outer periphery of the inner rotor and the inner periphery of the outer rotor are such that, when one lobe of the inner rotor is in full engagement with a cavity of the outer rotor, the former can revolve inside the latter without interference. Since the inner rotor has six lobes compared to seven cavities in the outer rotor, the outer rotor revolves inside the housing at six-sevenths of the speed of the inner rotor.

6. The outer rotor (3) rides in a replaceable bushing (4) pressed into the pump body. The shaft (2) rides in two replaceable bushings - one (5) in the pump body, the other (6) in the pump cover. Bearing alignment for the rotor shaft and true travel of the rotor in the housing are assured by the use of two dowel pins in addition to four bolts which rigidly secure the cover to pump body.

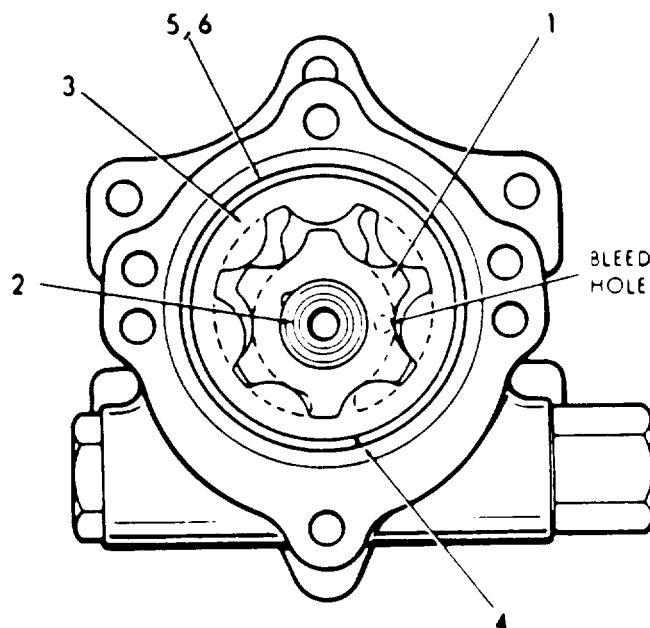
7. Two single lip oil seals in the pump body and a single lip oil seal in the pump cover are located outside the two oil pump shaft bushings to prevent oil leaks along the shaft.



**6-36. TRANSMISSION OIL PUMP (Continued).**

8. Pumps are built for right-hand and left-hand rotation depending on the engine model on which they are used. The direction of rotation is marked on the pump body.

9. A bleed hole in the oil pump body and the cover leads from the oil seal cavity to the intake side of the pump to avoid a pressure build-up back of the oil seals.



b. Operation.

1. The intake and discharge ports in the pump cover and passages in the pump body are separated by the respective castings so that, when the pump is operating, the two ports are sealed, one from the other. As the inner rotor revolves, a vacuum is formed on the intake side of the pump as the cavity between the lobes of the inner and outer rotor increases; consequently, oil is drawn into the rotor compartment until this cavity reaches the lower end of the port.

2. Oil drawn into the cavities between the inner and outer rotors on the inlet side of the pump is forced out under pressure at the outlet side of the pump.

3. A loss of hydraulic oil pressure is an indication of worn parts within the pump or malfunction of either the flow control valve or the pressure relief valve. The recommended oil pressure for the hydraulic oil system is between 90 psi and 150 psi (620.5 kPa and 1034.2 kPa). If the pressure drops below 90 psi (620.5281 kPa) inspect the pump.

**6-36. TRANSMISSION OIL PUMP (Continued).****This task covers:**

- |                |               |                 |
|----------------|---------------|-----------------|
| a. Removal     | c. Cleaning   | e. Assembly     |
| b. Disassembly | d. Inspection | f. Installation |

**INITIAL SETUP****Test Equipment**

NONE

**References**

NONE

**Special Tools**

Slide hammer J5901-1 and  
 adapter J5901-3  
 Oil Pump Service Tool  
 Set J6904  
 Oil Seal Remover and  
 Installer Tool Set J3154-04

**Equipment****Condition Condition Description**

NONE

**Tools**

General Mechanic's Tool Kit  
 NSN 5180-00-629-9783

**Material/Parts**

Emery or crocus cloth  
 Sealing compound  
 Cup grease

**Special Environmental Conditions**

NONE

**Personnel Required**

1

**General Safety Instructions**

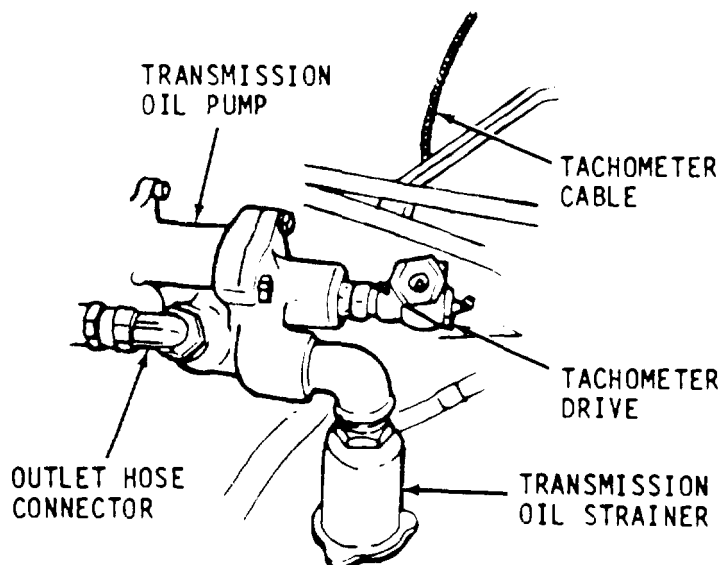
Observe WARNINGS in procedure.

**LOCATION/ITEM****ACTION****REMARKS****REMOVAL**

- |             |   |
|-------------|---|
| 1. Oil Pump | a. Disconnect the tachometer drive<br>cable from the drive assembly.<br><br>b. Disconnect the transmission oil<br>strainer.<br><br>c. Disconnect the oil pump outlet<br>hose. |
|-------------|---|

## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
REMOVAL (Cont)		

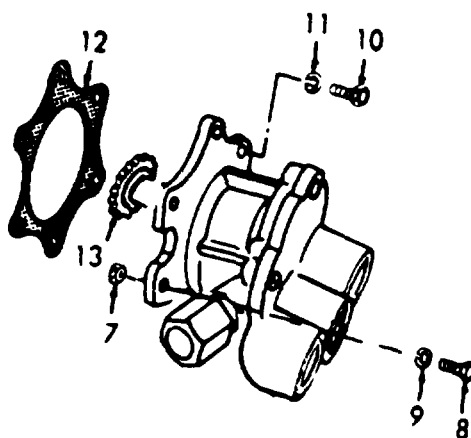


- d. Remove four nuts (7), screws (8), and lockwashers (9).
- e. Remove two screws (10) and lockwashers (11).
- f. Remove the oil pump and gasket (12) from the flywheel housing.
- g. Remove the drive coupling hub (13) from flexible coupling.

Screws are 3/8-24x5-1/2 inch.

Screws are 3/8-16x1 inch.

Discard gasket.

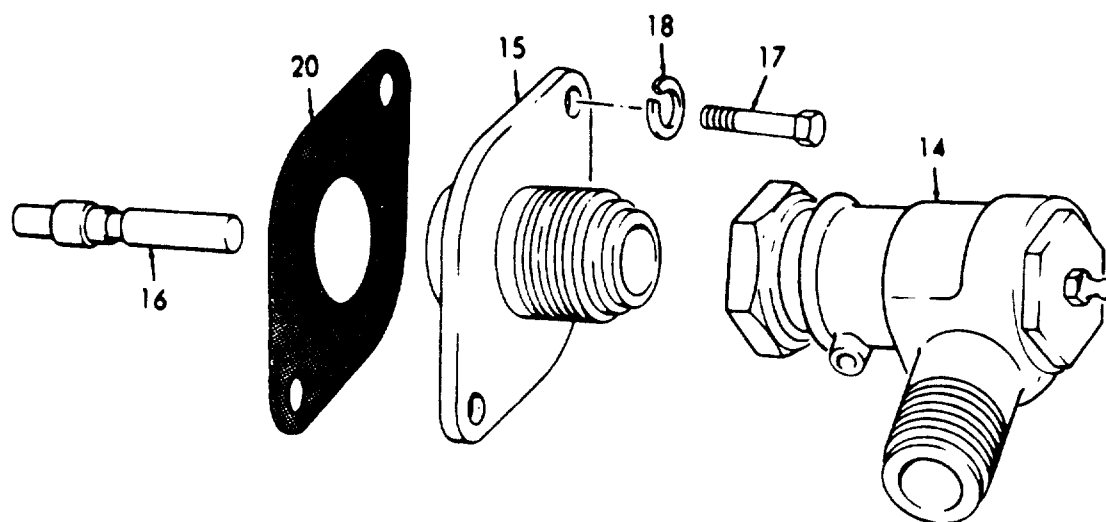


## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY

2.
  - a. Clamp the flange of oil pump body in the soft jaws of a bench vise.
  - b. Remove the tachometer drive assembly (14) from the drive adaptor (15) on the oil pump cover.
  - c. Remove the tachometer drive key from the tachometer drive shaft (16).
  - d. Remove the two bolts (17) and lockwashers (18) securing the tachometer drive adaptor (15) to the oil pump cover (19); then, remove the adaptor (15) and gasket (20) from the cover.
  - e. Remove the tachometer drive shaft (16) from the oil pump drive shaft with slide hammer J5901-1 and adaptor J5901-3.

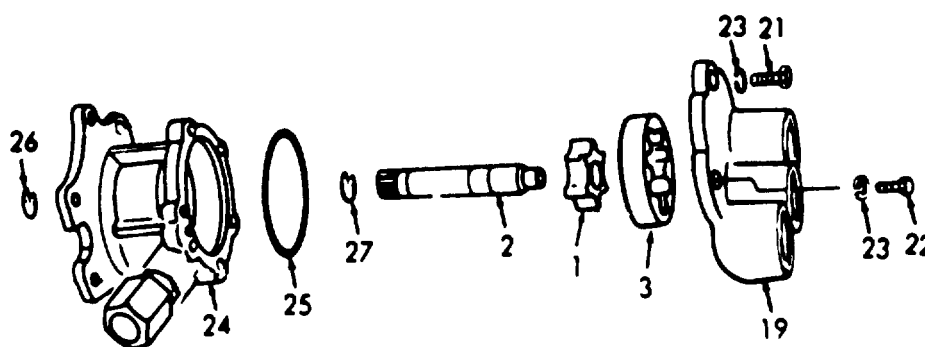


## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)

- |  |   |
|--|---|
| <p>f. Remove the four screws (21 and 22) and lockwashers (23) securing the oil pump cover (19) to the oil pump body (24). Remove the cover and cover gasket (25) from the pump body.</p> <p>g. Remove the oil pump shaft snapping (26) from the groove in the drive (serrated) end of the oil pump shaft (2).</p> <p>h. Remove the oil pump shaft (2) and inner rotor (1) as an assembly from the oil pump body (24).</p> <p>i. Slide the outer rotor (3) straight out of the oil pump body.</p> <p>j. Remove the oil pump inner rotor (1) from the oil pump shaft (2) as follows:</p> <p>(1) Remove snapping (27) from the non-splined end of the oil pump shaft (2) next to the inner rotor (1).</p> | <p>Screws (21) are 3/8-16x1-1/4 inch and screws (22) are 3/8-16 X 2-3/4 inch.</p> |
|--|---|



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**6-36. TRANSMISSION OIL PUMP (Continued).**


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LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- (2) Slide the inner rotor (1) off the oil pump shaft (2) and, at the same time guard against losing the rotor drive pin (28) imbedded in the shaft beneath the inner rotor.
- (3) Remove the second snapring (29) from the oil pump shaft (2).
- k. Remove and disassemble the oil pressure relief valve assembly as follows:
  - (1) Remove the oil tube adaptor cap (30), relief valve cap (31), and gaskets (32) from the sides of the oil pump body.
  - (2) Remove the flow control valve spring (33) and the relief valve assembly (34) from the oil pump body.

## 6-36. TRANSMISSION OIL PUMP (Continued).

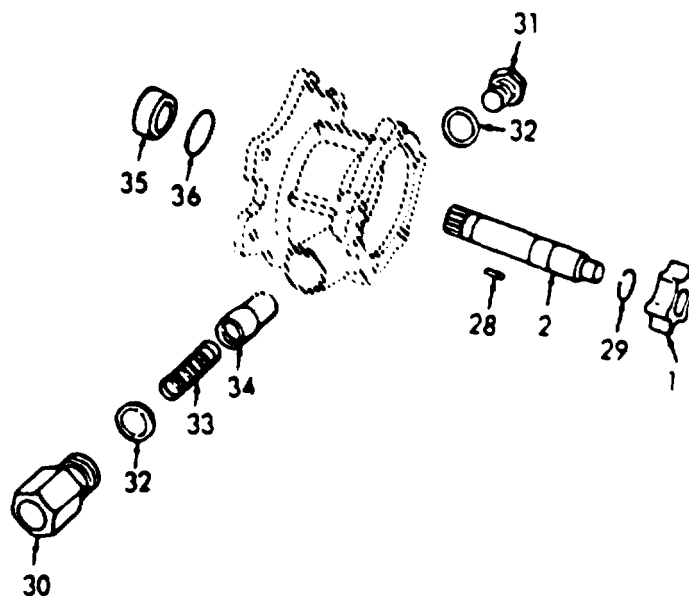
LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)

- I. If inspection of the oil seals and bushings in the oil pump body and cover, as outlined in Inspection, reveals only the seals need replacing, place the body and cover on a work bench with the rotor end up, and drive the oil seals out with a suitable brass drift inserted through the shaft opening.

## NOTE

Any time the oil pump is disassembled either for inspection or repair, the large oil pump shaft oil seals (35) and seal gasket (36) must be replaced. It is impossible to remove the oil pump shaft without damaging the lip of the oil seals when the splines on the end of the shaft pass through the oil seals.



## 6-36. TRANSMISSION OIL PUMP (Continued).

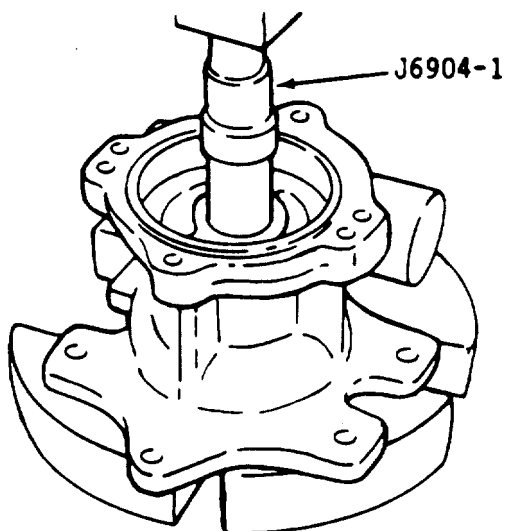
LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)

m. However, if both the oil seals and bushings need replacing, they may be removed as follows:

(1) Place the oil pump body on the bed of an arbor press with the rotor cavity end of the pump body facing up.

(2) Place the bushing removing end of tool J6904-1 inside the oil pump body bushing (5) and under the ram of the press, as shown.



(3) Bring the ram of the press down on the end of the remover tool and press the bushing (5) and oil seals (35) out of the oil pump body (24). Remove and discard gasket (36).

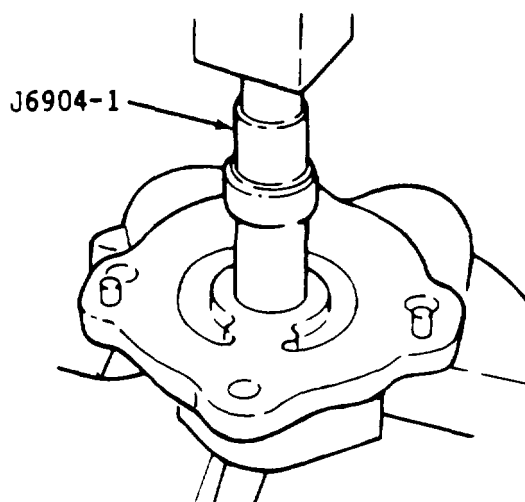


## 6-36. TRANSMISSION OIL PUMP (Continued).

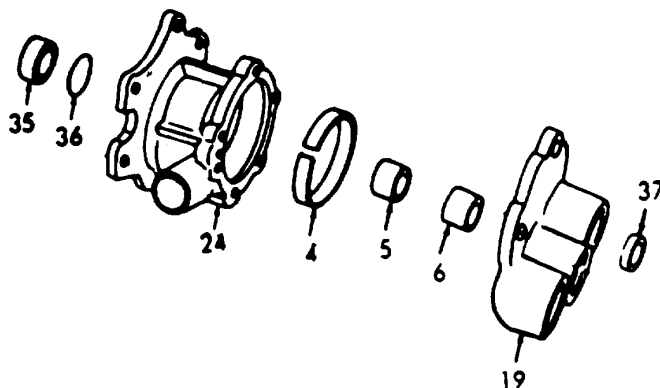
LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)

- (4) Place the oil pump cover (19) on the bed of an arbor press with the rotor end of the cover facing up, and press the bushing (6) and the oil seal (37) out of the cover with remover J6904-1 as shown.



- n. If inspection of the rotor bushing (4) in the oil pump body reveals the bushing needs replacing, clamp the oil pump body in the soft jaws of the bench vise with the rotor cavity facing up.



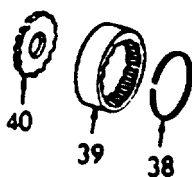
## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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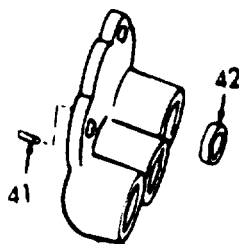
## DISASSEMBLY (Cont)

With a small punch and hammer, drive against the outer edge of the rotor bushing next to the split in the bushing, to loosen the bushing in the body. Then, remove the bushing.

- o. Remove snapping (38), pump drive coupling (39), and blower shaft drive coupling (40) from end of blower drive shaft, if necessary.



- p. Remove pump cover dowel pin (41), if necessary.
- q. Remove plug (42), if necessary.



## CLEANING

3.

**WARNING**

**Wear protective eye goggles when using compressed air to prevent eye injury.**

Wash all of the oil pump parts in clean fuel oil, blow dry with compressed air.

## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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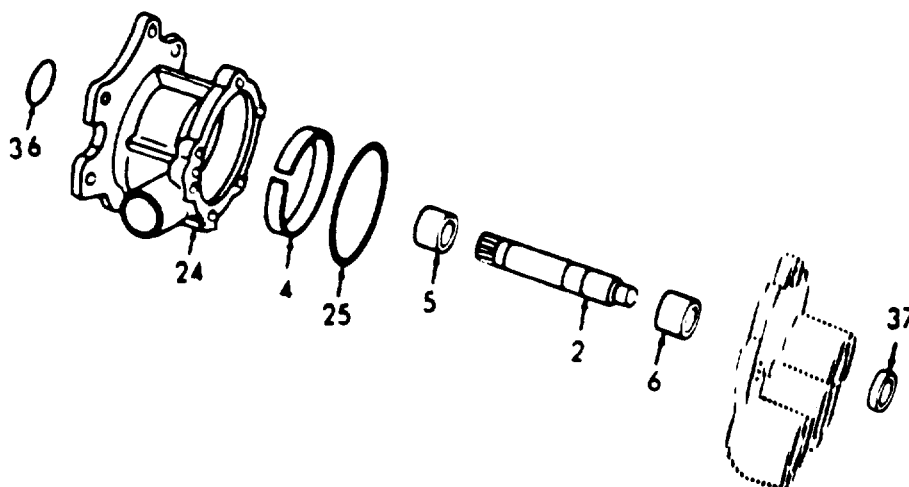
## INSPECTION

- |    |  |  |
|----|--|--|
| 4. | a. If the lip of the oil pump cover oil seal (37) is rough or charred, replace the oil seal. |  |
|----|--|--|

## NOTE

Any time the oil pump drive shaft (2) has been removed from the oil pump body (24), the oil seals (25) and the seal gasket (36) in the oil pump body must be replaced with new oil seals and seal gasket.

- |  |   |  |
|--|---|--|
|  | b. If the oil pump body bushing (5) and cover bushing (6) are worn excessively or scored, they must be replaced.              |  |
|  | c. Clearance between the shaft (2) and shaft bushing (5 and 6) should be between .0016 and .0035 inch (0.0041 and 0.0089 cm). |  |
|  | d. If the rotor bushing (4) is scored or worn excessively, it must be replaced.   |  |



## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## INSPECTION (Cont)

- e. Examine the oil pump shaft (2) for wear and scoring where the shaft contacts the bushings and oil seals. Also examine the serrations on the end of the drive shaft for peening and wear. If the serrations are peened or worn excessively, or the shaft is scored and cannot be suitably cleaned up with fine emery paper or crocus cloth, it must be replaced.
- f. The rotor cavity in the pump body must be perfectly smooth for efficient operation. Examine the cavity for score marks.
- g. The mating faces of the pump body and cover must be perfectly flat so when they are bolted together they form a tight joint. If the body and cover do not join tightly, leakage is not only apt to occur, but the proper clearance between the rotors and the body and cover will not be maintained.
- h. If any of the above surfaces are damaged, it is recommended that new parts be used.
- i. Examine the inner rotor (1) and outer rotor (3). If the rotors are worn or scored excessively, they must be replaced.
- j. The end clearance of the rotors is the clearance between the cover face of the body and the rotor set when placed in the rotor pocket and should be between .0015 and .0035 inch (0.0038 and 0.0089 cm). A good

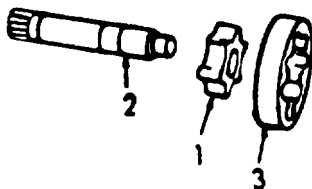
## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## INSPECTION (Cont)

straight edge and a .0015 inch (0.0038 cm) feeler blade should be used as a "go" gage and a .004 inch (0.010 cm) feeler be used as "no go" gage. The end clearance is by far the most important clearance in the pump. Too little end clearance will possibly result in a severe failure due to the lack of an oil film between the rotor set and the adjacent surfaces. Too great an end clearance will result in a low flow or weak pump. Housing and rotor faces must be flat and smooth when checking this clearance. Too great an end clearance will result in a low flow or weak pump. Housing and rotor faces must be flat and smooth when checking this clearance.

- k. The tooth clearance between the inner rotor (1) and outer rotor (3) must be less than .008 inch (0.020 cm). This clearance can be measured with standard feeler gages.
- l. The clearance between the O.D. of the outer rotor (3) and the I.D. of the rotor cavity bushing should be between .004 and .008 inch (0.010 and 0.020 cm); this clearance is also measured with standard feeler gages.



## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## INSPECTION (Cont)

- m. If any of the above clearances exceed the stated limits, the rotor set should be replaced.
- n. Although the possibility of the rotors being scored or unduly worn is remote, they should be examined for scoring or wear. If scored or worn excessively, replace the rotors.
- o. The inner and outer rotors are available in pairs only; therefore, if either rotor is damaged, both rotors must be replaced.
- p. The relief valve and flow control valve should be examined for score marks. If scored excessively and it cannot be cleaned up, replace.
- q. The flow control valve and pressure relief valve (34) are serviced as an assembly only; therefore, if either valve is damaged, both must be replaced.
- r. The flow control valve spring (33) should be replaced when a load of less than 16 lbs (7.3 kg) will compress the spring to a 1.20 inch (3.05 cm) dimension.



## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## INSPECTION (Cont)

- s. If the serrations in the drive hubs are peened and worn, or the teeth of the drive coupling are worn or chipped, replace the drive hubs and coupling.

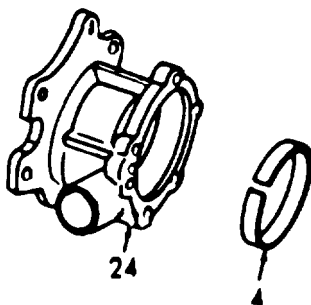
## ASSEMBLY

5.

## NOTE

The pump body for the left-hand pump, from outward appearances, is the same as the right-hand pump body. Similarly, the left-hand and right-hand pump covers appear alike. The difference between the pump bodies as well as the pump covers is in the location of the oil seal bleed hole which must always be in the intake port. When rebuilding pumps particular attention should be directed to the location of the bleed hole because its position and the assembled position of the flow control and relief valve assembly determines the direction of flow through the pump.

- a. If removed, install the rotor bushing in the oil pump body as follows:
  - (1) Place the oil pump body (24) on the bed of an arbor press with the rotor cavity end of the body facing up.
  - (2) Lubricate the outside diameter of the rotor bushing (4) with engine oil.

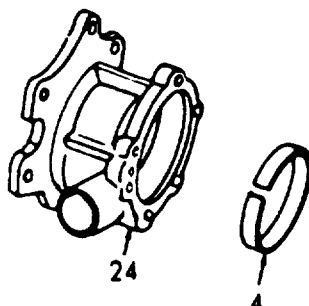
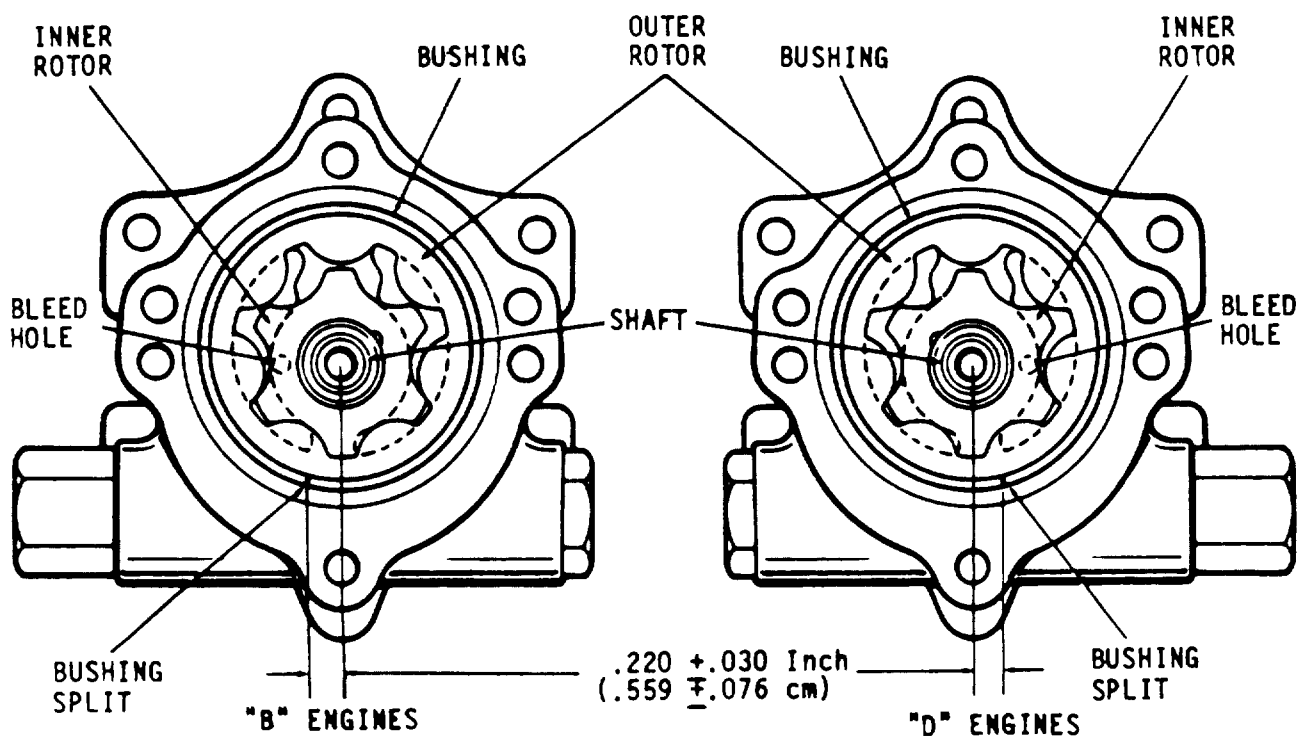


## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

- (3) Start the rotor bushing  
(4) straight into the  
cavity of the pump body  
(24) with the split in the  
bushing located as shown  
below.





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6-36. TRANSMISSION OIL PUMP (Continued).

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LOCATION/ITEM	ACTION	REMARKS
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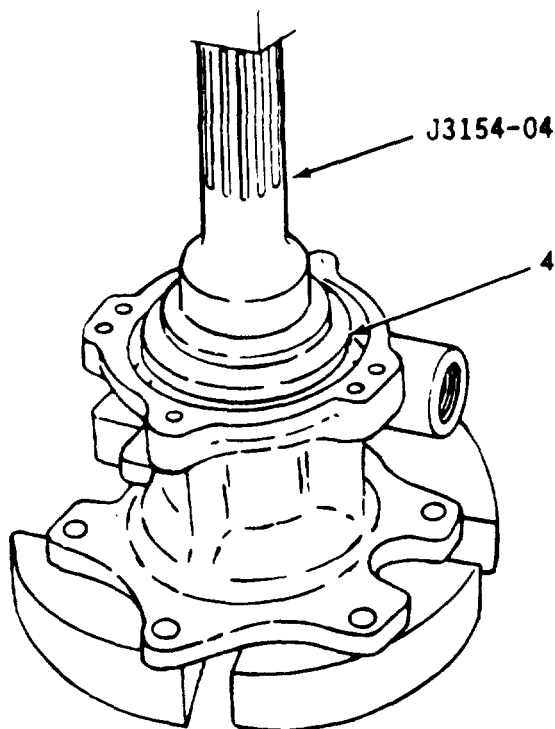
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## ASSEMBLY (Cont)

## NOTE

When installing the rotor bushing in the oil pump body, refer to the above figure for the proper location of the split in the bushing for "B" or "D" engine oil pumps.

- (4) Place tool J3154-04 with suitable plates on top of the bushing (4) and under the ram of the press as shown below.



- (5) Bring the ram of the press down on the tool and press the bushing straight into the body from flush to .010 inch (0.025 cm) below the finished face of the body.

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**6-36. TRANSMISSION OIL PUMP (Continued).**

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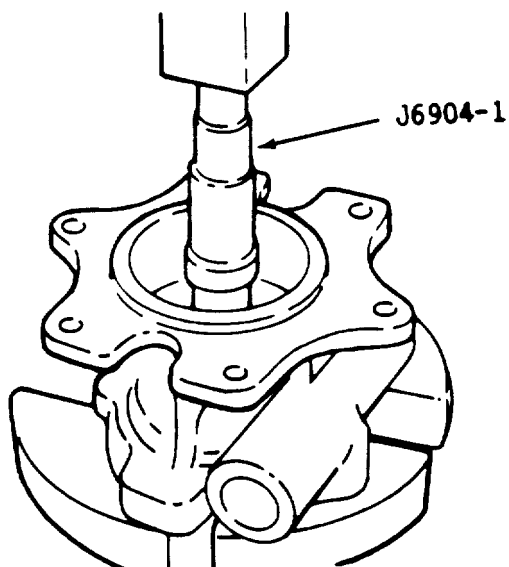
LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

b. If removed, install the oil pump shaft bushings (5 and 6) in the oil pump body (24) and cover (19) as follows:

- (1) Place the oil pump body on the bed of an arbor press with the rotor cavity end of the body facing down.
- (2) Lubricate the periphery of the bushing (5) with engine oil. Then, place the bushing over the installing end of tool J6904-1.

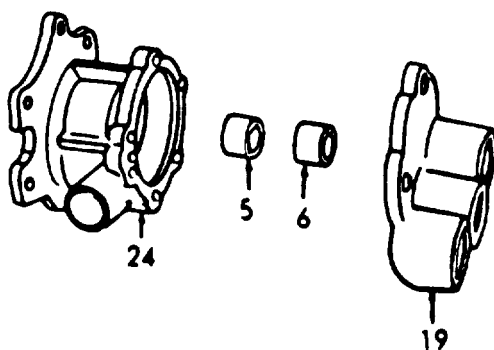


## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

- (3) Start the bushing (5) with the installer straight into the bushing bore in the pump body.
- (4) Bring the ram of the press down on the end of the installer, as shown below, and press the bushing straight into the pump body until the shoulder of the installer contacts the pump body.
- (5) Place the oil pump cover (19) on the bed of an arbor press with the rotor end of the cover facing up. Then, install the bushing (6) in the pump cover in the same manner as described in steps (2), (3), and (4) above.



## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

## NOTE

The step under the shoulder of the installer properly locates the bushing in the oil pump body and cover.

- (6) With the bushing installed in the oil pump cover, open the oil bleed hole in the cover with a 1/8" drill, entering from the rotor side of the cover.
- c. Blow the drill chips out of the oil pump cover (19). Then, attach the oil pump cover to the pump body with two screws placed diametrically opposite each other.
- d. Lubricate the periphery of the oil pump drive shaft (2) with engine oil. Then, slide the shaft through the bushings (5 and 6) in the pump body (24) and cover (19) and check for freeness.
- e. Remove two screws and oil pump cover (19) from the pump body (24).
- f. Install a new oil seal (37) in the oil pump cover (19) as follows:
  - (1) Place the oil pump cover (19) on the bed of an arbor press with the outer end of the cover facing up.
  - (2) Apply a thin coat of sealing compound to the outside diameter of the oil seal (37) casing.

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**6-36. TRANSMISSION OIL PUMP (Continued).**

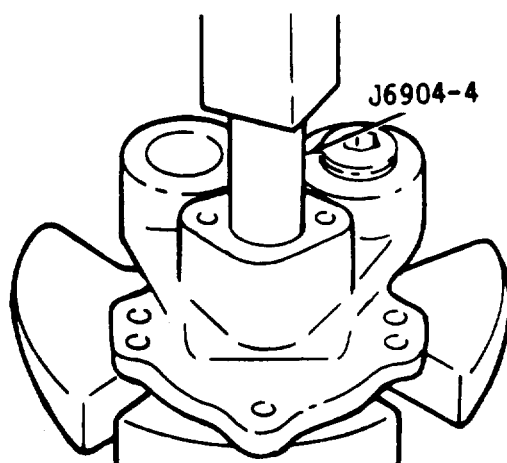
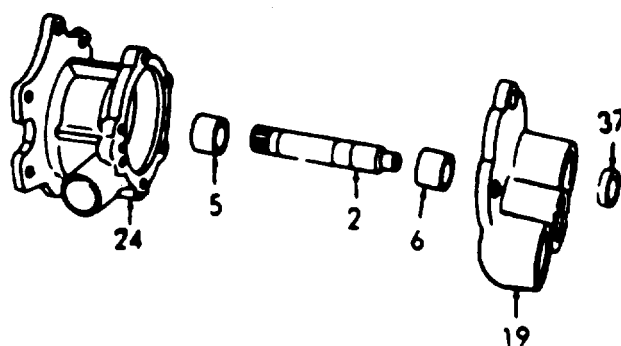
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LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

- (3) Start the oil seal (37) straight into the opening in the oil pump cover (19) with the lip of the oil seal facing the outer end of the cover.
- (4) Place the oil seal installer J6904-4 on top of the oil seal and under the ram of the press. Bring the ram of the press down on the installer and press the oil seal down against the shoulder in the cover.



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**6-36. TRANSMISSION OIL PUMP (Continued).**


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LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

- g. Install the oil pump inner rotor (1) on the oil pump drive shaft (2) as follows:
  - (1) Install one of the inner rotor snaprings (29) in the second snapping groove from the non-splined end of the oil pump drive shaft.
  - (2) Apply a small amount of cup grease on the inner rotor drive pin (28); then, place the drive pin in the small pocket in the side of the shaft between the two snapping grooves.
  - (3) Place the inner rotor (1) over the end of the shaft with the slot in the inner diameter of the rotor in alignment with the drive pin (28). Slide the rotor on the shaft and over the drive pin and against the snapping.
  - (4) Install the second snapring (27) in the snapping groove next to the rotor.
- h. Lubricate the periphery of the outer rotor (3) with engine oil. Then, place the outer rotor in the rotor cavity in the oil pump body (24).

## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

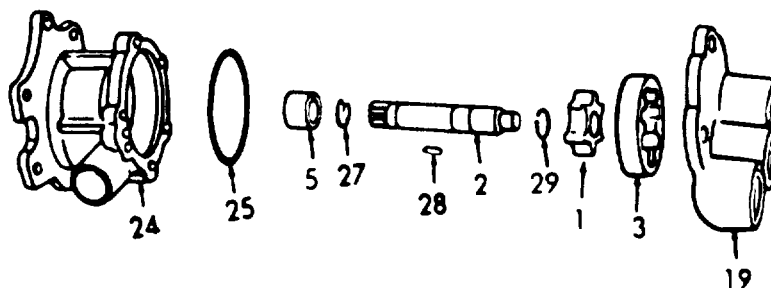
i. Lubricate the periphery of the oil pump drive shaft (2) with engine oil. Then insert the shaft and inner rotor assembly, the serrated end of the shaft first, straight into the pump body bushing (5). Push the shaft through the bushing and at the same time mesh the inner rotor with the outer rotor.

j. Install the oil pump cover (19) on the oil pump body (24) as follows:

(1) Place the oil pump body (24) with the shaft and rotors on the work bench with the rotor end of the body facing up.

(2) Place a new oil pump cover gasket (25) in the counter-bore in the oil pump body (24).

(3) Lubricate the oil pump rotors and the O.D. of the oil pump shaft with engine oil.



## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

- |     |  |  |
|-----|--|--|
| (4) | Position the oil pump cover (19) over the top of the oil pump body (24). Then, lower the cover and enter the end of the oil pump drive shaft (2) straight into the bushing (6) in the cover. Rotate the cover and align the dowel pins (41) in the pump cover with the dowel pin holes in the body; then, lower the cover against the gasket (25). |  |
| k.  | Install the four screws (21 and 22) and lockwashers (23) securing the cover to the body. Clamp the oil pump body between soft jaws in a bench vise. Tighten the bolts to 30-35 ft-lb (40.7 - 46.5 Nm) torque.  | Screws (21) are 3/8-16 x 1-1/4" and screw (22) is 3/8-16 x 2-3/4".<br>A- |

**NOTE**

**When tightening the oil pump cover bolts, rotate the drive shaft and check for any bind.**

- |     |   |
|-----|---|
| l.  | Install the oil pressure relief valve assembly (34) in the oil pump body (24) as follows: |
| (1) | Lubricate the periphery of the oil pressure relief valve assembly (34) with engine oil.   |

**NOTE**

**As viewed from the cover end of the oil pump assembly the oil pressure relief valve is always installed in the right-hand side of the pump body on "B" engines, and in the left-hand side of the pump body on "D" engines.**

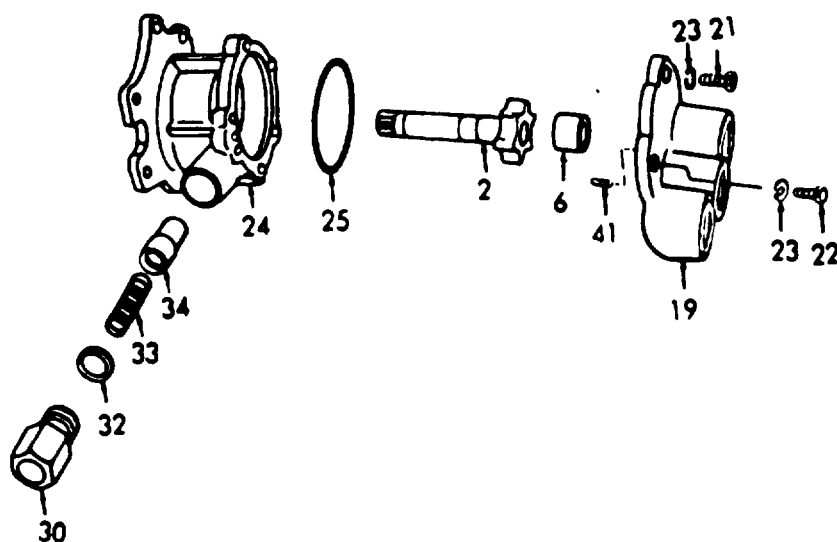


## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

- (2) Observe the inlet opening in the oil pump cover. Then, insert the solid end of the oil pressure relief valve straight into the relief valve bore at the inlet side of the pump body.
- (3) Insert the flow control valve spring (33) in the opening in side of the oil pump body, and into the bore in the end of oil pressure relief valve.
- (4) Place a gasket (32) on the oil tube adaptor cap (30). Then, thread the adaptor cap into the relief valve bore and against the flow control valve spring.



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**6-36. TRANSMISSION OIL PUMP (Continued).**


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LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

- (5) Place the second gasket (32) on the relief valve cap (31). Then, install the relief valve cap in the relief valve bore in the opposite side of the pump body. Tighten both caps securely.
- m. Install the oil pump drive shaft oil seals (35) in the oil pump body (24) as follows:
  - (1) Place the oil pump assembly on the bed of an arbor press with the serrated end of the oil pump drive shaft facing up.
  - (2) Place the oil seal gasket (36) over the end of the shaft and into the oil seal bore in the body.
  - (3) Place an oil seal (35) over the tapered end of the oil seal protector J6904-2 with the lip of the oil seal facing down.

**NOTE**

**The lip of the inner oil seal faces the rotors when installed in the body.**

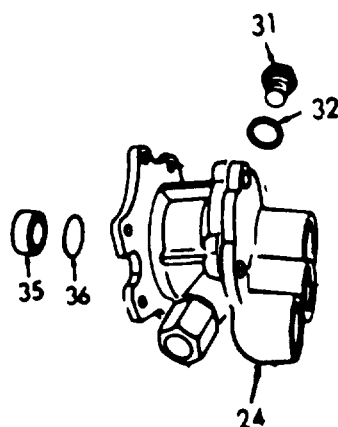
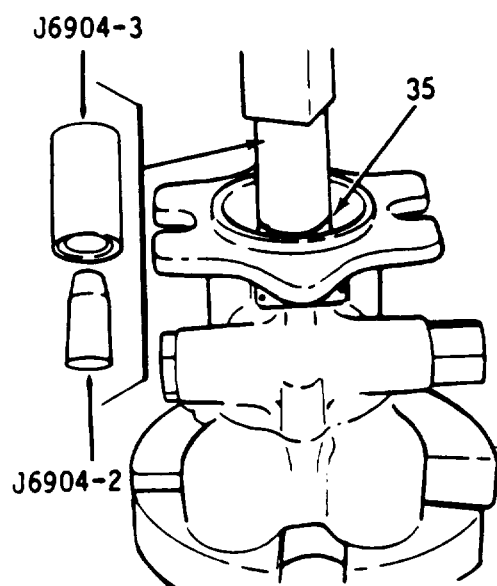
- (4) Apply a thin coat of sealing compound to the outside diameter of the oil seal casing.

## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

- (5) Place the oil seal lip protector with the oil seal over the end of the oil pump drive shaft. Then, slide the oil seal down over the protector and against the pump body.
- (6) Place the oil seal installer J6904-3 over the oil seal lip protector J6904-2 and rest on the oil seal.
- (7) Bring the ram of the press down on the installer and press the oil seal straight into the pump body until the installer contacts the top of the oil seal lip protector.

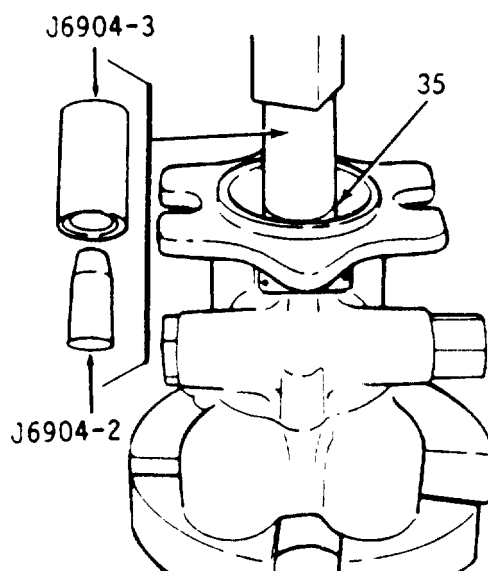


## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

- (8) Remove the oil seal installer and the oil seal lip protector from the oil pump shaft.
- (9) Place the second oil seal (35) over the tapered end of the oil seal lip protector J6904-2 with the lip of the oil seal facing up.

**NOTE**

The lip of the outer oil seal points away from the rotors when installed in the body.

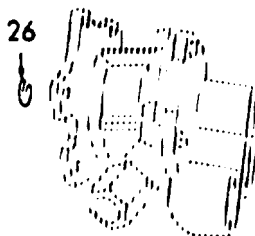
- (10) Apply a thin coat of sealing compound to the outside diameter of the oil seal casing.

## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

- (11) Place the oil seal lip protector with the oil seal over the end of the oil pump drive shaft. Then, slide the oil seal down over the protector and against the pump body.
  - (12) Place the oil seal installer over the top of the oil seal lip protector and rest on the oil seal.
  - (13) Bring the ram of the press down on the installer and press the oil seal into the pump body until the inner oil seal rest on the gasket.
  - (14) Remove the oil seal installer and the oil seal lip protector from the shaft.
- n. Place the oil pump assembly on the work bench and install snapring (26) in the groove in the serrated end of the oil pump drive shaft.



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**6-36. TRANSMISSION OIL PUMP (Continued).**


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LOCATION/ITEM	ACTION	REMARKS
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**ASSEMBLY (Cont)**

o. Install the tachometer drive shaft and oil slinger assembly in the oil pump drive shaft as follows:

- (1) Lubricate the flat sides of the tachometer drive shaft (16) with engine oil. Then, start the tachometer drive shaft straight into the square opening in the end of the oil pump drive shaft.
- (2) Support the oil pump assembly on the bed of an arbor press with a small 3/8 inch thick steel plate placed directly under the serrated end of the drive shaft.

**NOTE**

The tachometer drive shaft is a press fit in the oil pump drive shaft. Therefore, it is necessary that the steel plate be placed under the opposite end of the drive shaft when installing the tachometer drive shaft to prevent damage to the oil pump inner rotor.

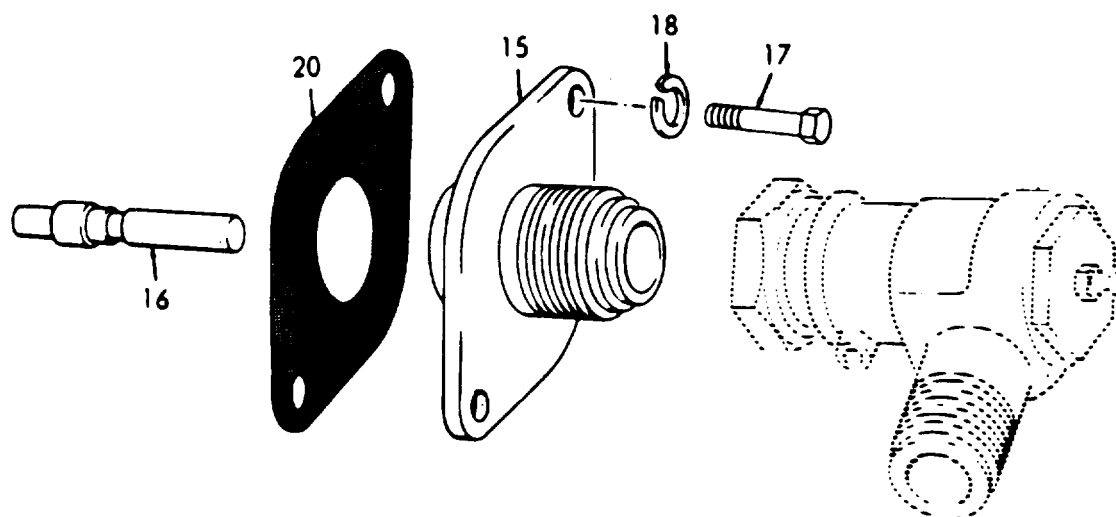
- (3) Bring the ram of the press down on the end of the tachometer drive shaft and press the shaft straight into the oil pump drive shaft until the shoulder on the tachometer shaft contacts the end of the pump shaft.

## 6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ASSEMBLY (Cont)

- p. Affix a new gasket (20) to the bolting flange of the tachometer flange of the tachometer drive shaft adaptor (15)
- q. Place the tachometer drive shaft adaptor (15) over the drive shaft and against the oil pump cover. Install the two screws (17) and lockwashers (18) and tighten to 13-17 ft-lb (17.6-23.0 Nm) torque.



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**6-36. TRANSMISSION OIL PUMP (Continued).**


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LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION**

- |    |   |  |
|----|---|--|
| 6. | a. Affix a new gasket (12) to the flange of the oil pump body (24). |  |
|----|---|--|

**NOTE**

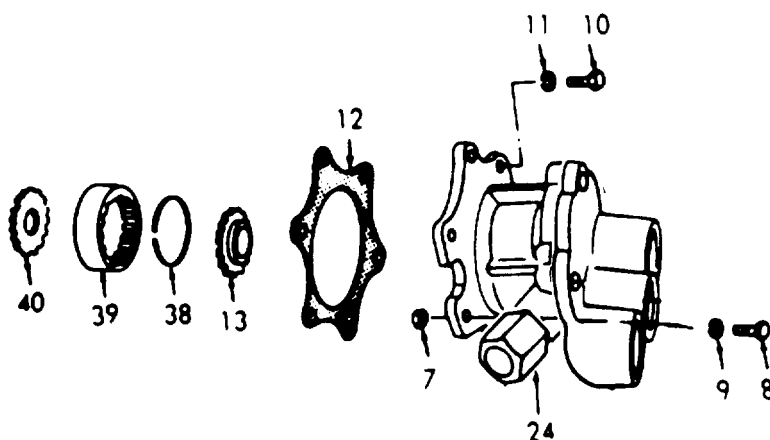
The oil pump to flywheel housing gasket and the flywheel housing small hole gasket are very similar in design. When installing a new oil pump to flywheel housing gasket, be sure to use the proper gasket to prevent oil leaks. The oil pump gasket has an inside diameter of approximately 3-17/32".

- |    |  |  |
|----|--|--|
| b. | Install the oil pump drive coupling hub (13) on the end of the oil pump drive shaft (2).   |  |
| c. | If removed, place the oil pump drive coupling (39) over the drive coupling hub (40) on the end of the blower drive shaft. Install snapping (38).   |  |
| d. | Position the oil pump assembly in back of the flywheel housing. Then with the teeth on the drive coupling hub in position to mesh with the teeth in the drive coupling, place the pump against the flywheel housing and secure in place with screws (8 and 10), lockwashers (9 and 11) and nuts (7). | Screws (8) are 3/8-24 x 5-1/2 inch, screws (10) are 3/8-16 x 1 inch. |



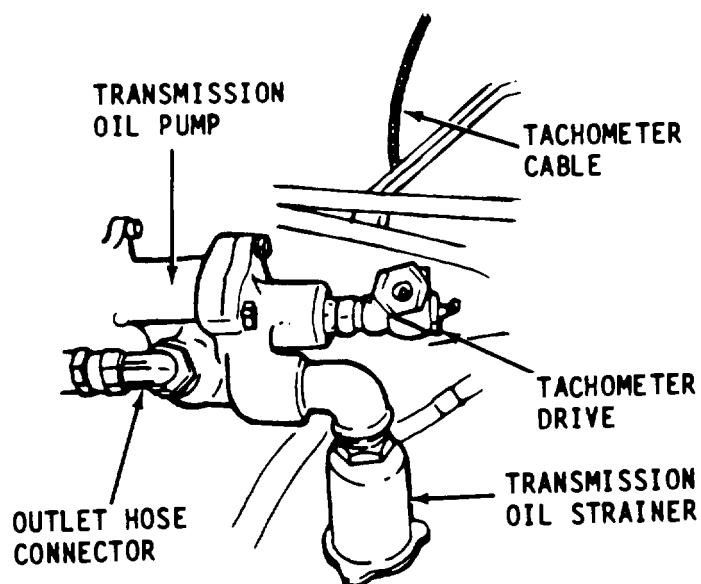
6-36. TRANSMISSION OIL PUMP (Continued).

LOCATION/ITEM	ACTION	REMARKS
INSTALLATION (Cont)		



e. Reconnect the transmission oil strainer.

f. Reconnect the oil pump outlet hose.



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**6-36. TRANSMISSION OIL PUMP (Continued).**

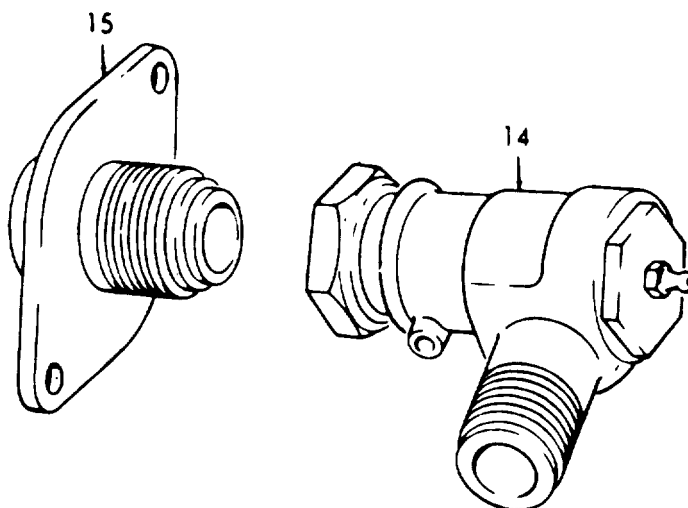
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LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- g. Attach the tachometer drive assembly (14) to the oil pump as follows:
- (1) Insert the tachometer drive key in the end of the tachometer drive shaft.
  - (2) Place the tachometer drive assembly over the drive key and attach it to the adaptor (15).
  - (3) Attach the tachometer drive cable to the tachometer drive assembly.



- h. Start engine and check for oil leaks.

---

**6-37. POWER TAKE-OFF ASSEMBLY.**

---

**a. General.**

1. The front end direct drive, 35 HP rating, power take-off illustrated below is attached to the front end of the engine and driven by the crankshaft, includes an 8 inch diameter one piece single plate dry disc-clutch facing (1). A coupling and flange assembly (2) is keyed and retained on the crankshaft by a special washer and bolt. A clutch drive adaptor (3) and an accessory drive pulley (4) is bolted to the coupling and flange assembly. The clutch driving ring (5) is bolted to this assembly. The clutch drive shaft (6) is supported by a pilot ball bearing (7) at the forward end and tapered roller bearings (8 and 9) at the outer end. The clutch housing (10) is attached to the power take-off adaptor (11).

2. The tapered roller bearings (8 and 9) absorb the greatest portion of the thrust and radial load on the clutch drive shaft. An adjustable bearing retainer (12) is secured with a lock plate (13) and a bolt (14), provides a means of adjusting the tapered roller bearings.

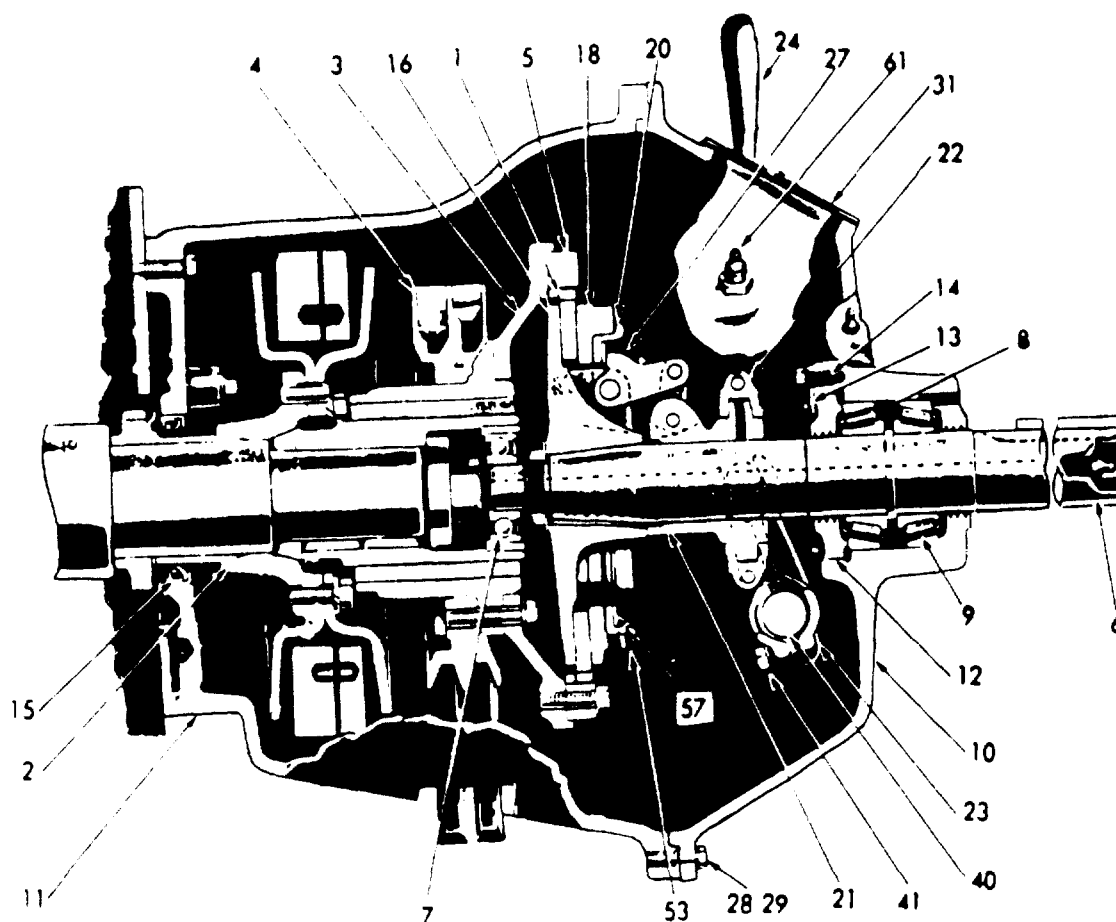
3. The front end power take-off adaptor (11) supports the power take-off assembly and surrounds the clutch and drive mechanism. The adaptor retains the crankshaft front oil seal (15) and is bolted to the engine front end plate and cylinder block.

4. The clutch mechanism consists of a one piece dry disc clutch facing. The clutch facings are supported in and driven by the driving ring (5). An outer pressure plate (16) is keyed to and retained on the clutch drive shaft by a nut (17), and inner pressure plate (18) are carried on the hub of and driven by the outer pressure plate. Clutch pressure plate separator springs (19) separate the inner and outer pressure plates when the clutch is disengaged, and a clutch adjusting ring (20) to adjust for wear on the clutch facings; a clutch release sleeve (21), together with linkage assembly, operated by a clutch release collar (22), a yoke (23), and a hand operated lever (24) for engaging and disengaging the clutch. The clutch release lever springs (25) assists in holding the clutch in the disengaged position.

**b. Operation.**

1. When the hand lever (24) is moved toward the engine, yoke (23) moves the release sleeve (21) toward the clutch. This movement forces the outer end of links (26) away from the axes of rotation causing the levers (27) to contact the face of the adjusting ring (20), which locks the clutch facing (1) between the outer and inner pressure plates (16) and (17). Thus, the power of the engine is transmitted to the drive shaft (6).

## 6-37. POWER TAKE-OFF ASSEMBLY (Continued).

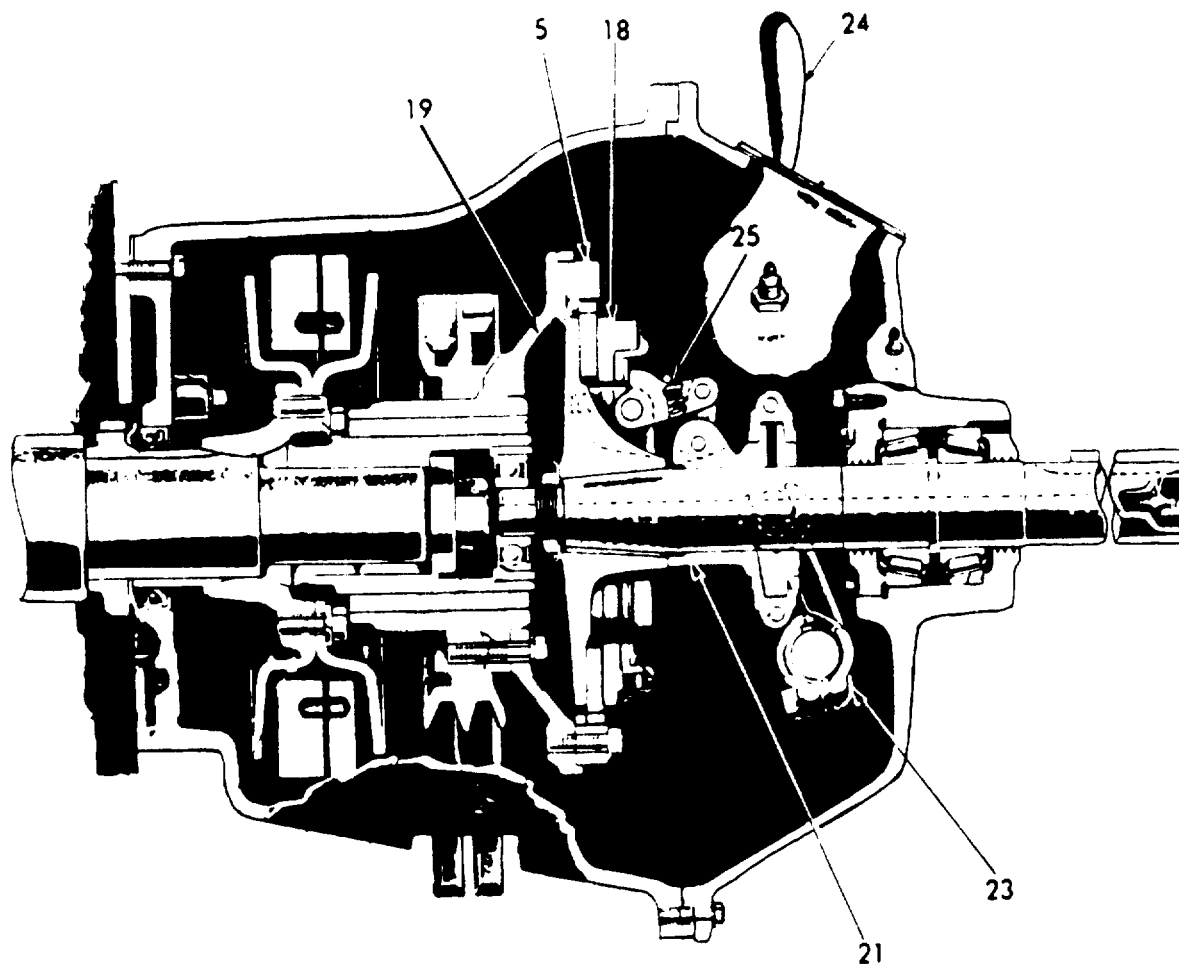


1. Clutch Facing (One Piece)
2. Coupling and Flange Assembly
3. Adaptor - Clutch Drive
4. Pulley - Accessory Drive
5. Ring - Clutch Driving
6. Shaft - Clutch Drive
7. Bearing - Clutch Drive Shaft Pilot (Ball)
8. Bearing Assembly - Roller (Inner)
9. Bearing Assembly - Roller (Outer)
10. Housing - Clutch
11. Adaptor - Power Take-Off
12. Retainer - Drive Shaft Bearing
13. Lockplate - Bearing Retainer
14. Bolt - Retainer Lockplate
15. Oil Seal - Crankshaft (Front)
16. Plate - Clutch Pressure (Outer)
17. Drive Shaft Nut
18. Plate - Clutch Pressure (Inner)
19. Pressure Plate Separator Spring

20. Ring - Clutch Adjusting
21. Sleeve - Clutch Release
22. Collar - Clutch Release Sleeve
23. Yoke - Clutch Release
24. Lever - Clutch Hand
25. Release Lever Spring
26. Links
27. Lever - Clutch Release
28. Bolt - Clutch Housing
29. Lockwasher
31. Cover - Inspecting Hole
40. Shaft - Clutch Release
41. Bolt - Yoke to Shaft
53. Lock - Clutch Adjusting Ring Spring
57. Plate - Adjusting Ring Wear
61. Fitting - Grease

**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

2. When the hand lever (24) is moved away from the engine, the yoke (23) moves the release sleeve (21) away from the clutch, and the springs (19) and (25) return the pressure plate (18) to its released position. Thus, pressure between the pressure plates and the clutch facing is relieved, permitting the pressure plates and the drive shaft to cease rotating. Since the clutch facing has external teeth and mesh with the teeth in the inner diameter of the driving ring (5), which is bolted to the flywheel, the clutch facing continues to rotate while the engine is running.



- 5. Ring - Clutch Driving
- 18. Plate - Clutch Pressure (Inner)
- 19. Pressure Plate Separator Ring
- 21. Sleeve - Clutch Release

- 23. Yoke - Clutch Release
- 24. Lever - Clutch Release
- 25. Release Lever Spring

**6-37. POWER TAKE-OFF ASSEMBLY (Continued).****This task covers:**

- |                |               |                 |               |
|----------------|---------------|-----------------|---------------|
| a. Removal     | c. Cleaning   | e. Reassembly   | g. Adjustment |
| b. Disassembly | d. Inspection | f. Installation |               |

**INITIAL SETUP****Test Equipment**

NONE

**References**

Paragraph	
6-28.3	Crankshaft Seal Replacement

**Special Tools**

Rope sling  
Chain hoist

**Equipment****Condition Condition Description**

Paragraph

5-6.1	Coupling Guard and Ramp Hoist Pump
6-26	Engine Oil Filter

**Tools**

General Mechanic's Tool Kit  
NSN 5180-00-629-9783

**Material/Parts**

Clean fuel oil  
Cleaning solvent  
Fed. Spec. P-D-680  
Grease shell Alvania #2  
or equivalent  
Grease ball and roller bearing  
Clutch plate kit 5198658  
Clean engine oil

**Special Environmental Conditions**

NONE

**Personnel Required**

1

**General Safety Instructions**

Observe WARNINGS in procedure.

**LOCATION/ITEM****ACTION****REMARKS****REMOVAL**

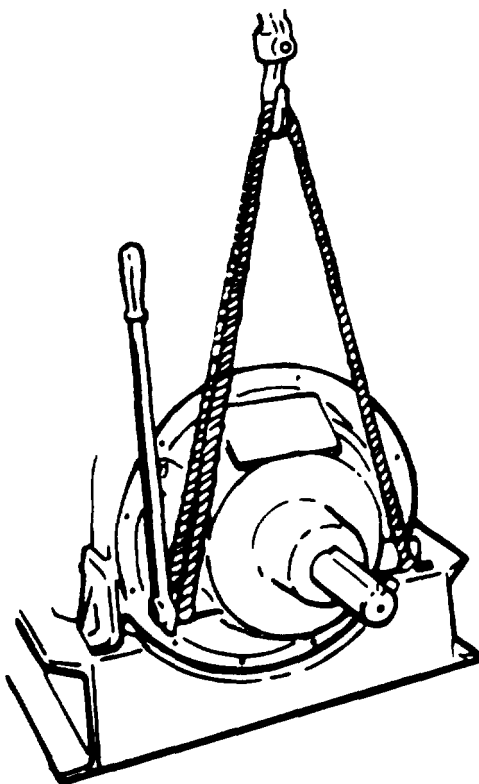
1. Coupling Guard and Ramp Hoist Pump	Remove coupling guard and ramp hoist pump.	Refer to paragraph 5-6.1.
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**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

- |                      |  |                          |
|----------------------|--|--------------------------|
| 2. Engine Oil Filter | a. Remove hoses.<br>b. Remove filter.  | Refer to paragraph 6-26. |
| 3. Power Take-Off    | a. Support the weight of power take-off assembly with a rope sling and chain hoist. Engage the clutch with the hand lever to hold the clutch facings in place. |                          |



- b. Remove bolts (28) and lockwashers (29) securing power take-off assembly to the front end power take-off adaptor (11).

**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

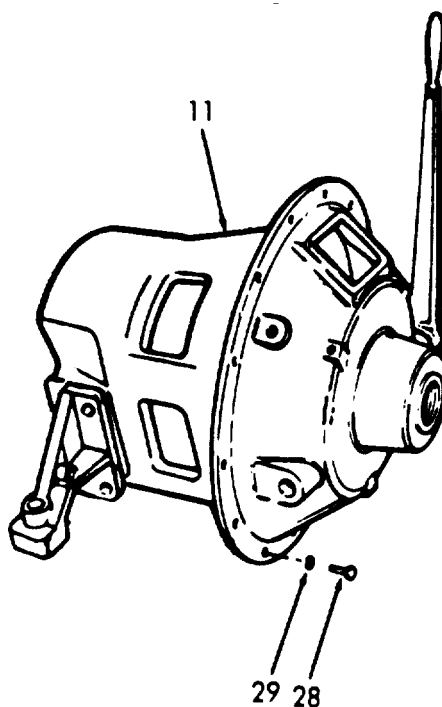
LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

- c. Screw two of the clutch housing attaching bolts (28) into the tapped holes provided in the flange of the clutch housing and push the power take-off assembly away from the front end power take-off adaptor. Pull the power take-off assembly straight back away from the engine.

**CAUTION**

Do not permit the outer end of the unit to tip down when being removed from the engine or the clutch pilot bearing may be damaged.



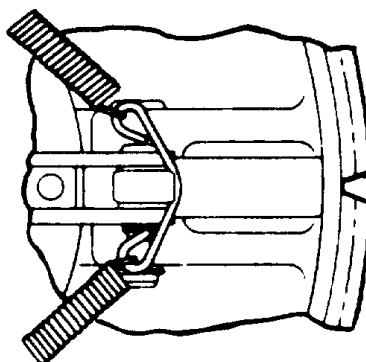


**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY**

- |                      |   |   |
|----------------------|---|---|
| 4. Power<br>Take-Off | <ul style="list-style-type: none"> <li>a. Remove screws (30), inspection hole cover (31), and gasket (32).</li> <li>b. Hold the outer end of the flexible grease tube (33) from turning (inside of clutch housing) and remove the flexible tube retaining nut.</li> <li>c. Pull the outer end of flexible grease tube (33) inside of the clutch housing and remove the opposite end from the release sleeve collar.</li> <li>d. Support the power take-off assembly on wood blocks with the clutch drive shaft in a horizontal position. Then, bend the edge of the lockwasher (34) up off the flat side of the clutch drive shaft nut (17).</li> <li>e. Disengage the clutch with the hand lever.</li> <li>f. Slide the "garter" type clutch release lever spring (25) off the clutch release levers (27) and on the release sleeve (21).</li> </ul> | Expose the adjusting ring (20), and linkage (26). |
|----------------------|---|---|

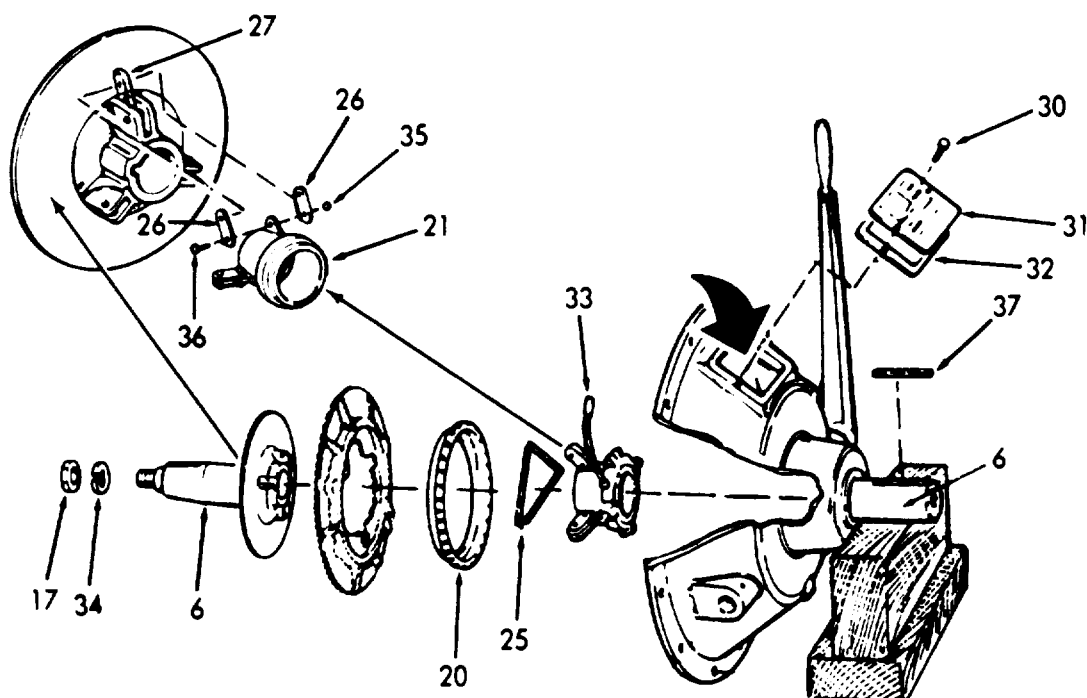


### 6-37. POWER TAKE-OFF ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)

- g. Remove retaining rings (35) from pins (36), then remove the pins from the links (26).
- h. Install the key (37) in the keyway of the clutch drive shaft (6). Attach a chain wrench to the drive shaft to prevent the drive shaft from turning. Then, remove the nut (17) and lockwasher (34) from the shaft.



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**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

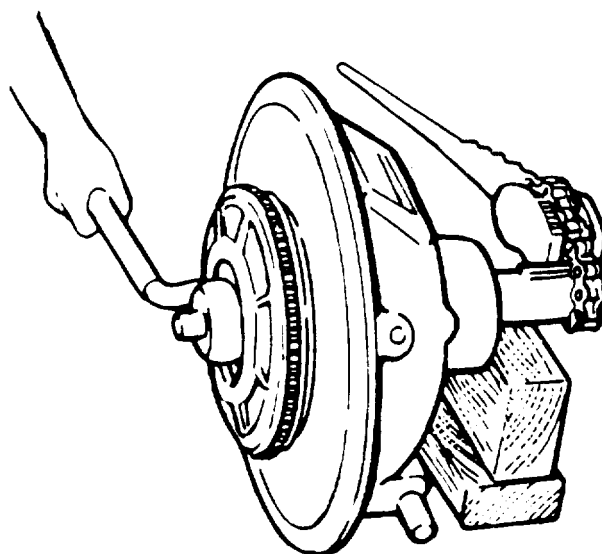
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LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)****CAUTION**

Be sure and place the teeth of the chain wrench on top of the key to prevent damage to the drive shaft while holding the drive shaft from turning. If the key or drive shaft is damaged and cannot be cleaned up, they must be replaced.

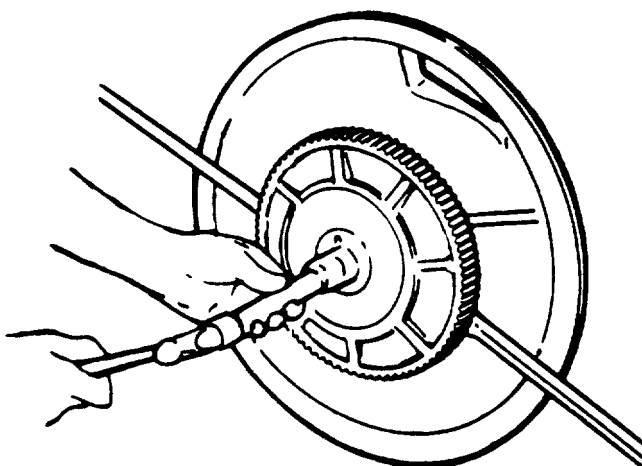


- i. Place pry bars behind the inner clutch pressure plate. While exerting pressure on the outer ends of the pry bars, loosen the clutch assembly from the tapered shaft and key with a brass drift and hammer.

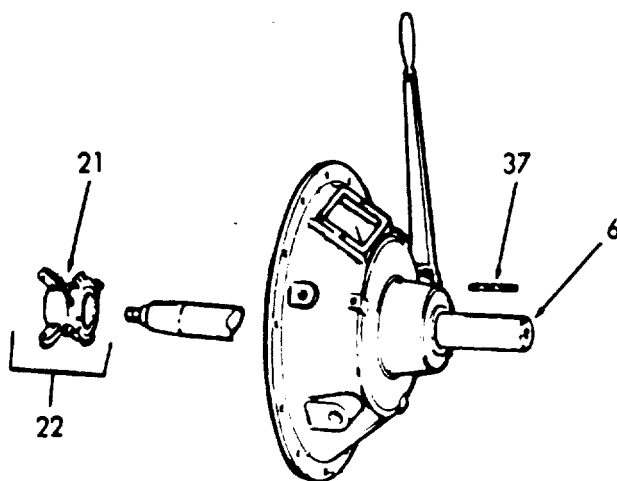
## 6-37. POWER TAKE-OFF ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)



- j. Remove the clutch assembly from the clutch drive shaft (6) and place it on a bench with the forward face down.
- k. Remove the chain wrench from the clutch drive shaft (6).
- l. Remove the clutch retaining key (37) from the clutch drive shaft (6).
- m. Slide the clutch release sleeve (21) and release sleeve collar (22) assembly off the clutch drive shaft (6).

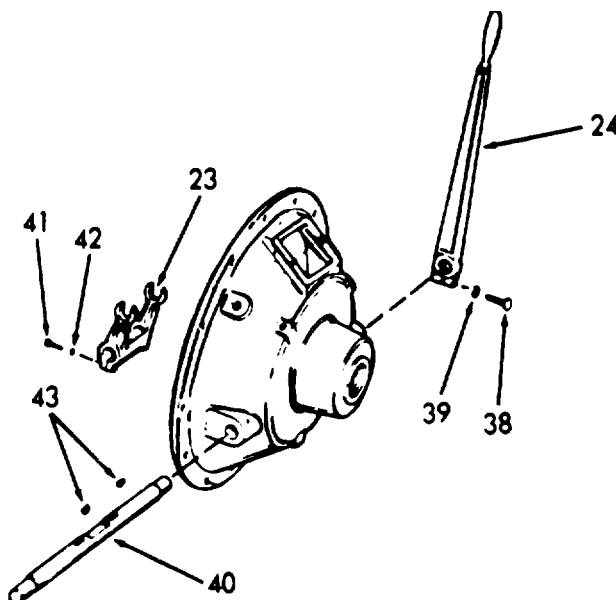


**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- |   |   |
|---|---|
| 5. Clutch<br>Release<br>Shaft<br>and Yoke | <p>a. Remove the hand lever attaching bolt (38) and lockwasher (39), then slide the hand lever (24) off the clutch release shaft (40).</p> <p>b. Remove the two clutch release yoke clamping bolts (41) and lockwashers (42) from the clutch release yoke (23).</p> <p>c. Slide the clutch release yoke (23) to the right or left and the clutch release shaft (40) in the opposite direction until the two woodruff keys (43) are free from the clutch release yoke.</p> <p>d. Remove the two woodruff keys (43) from the clutch release shaft (40); then withdraw the clutch release shaft from the clutch housing and release yoke (23).</p> |
|---|---|

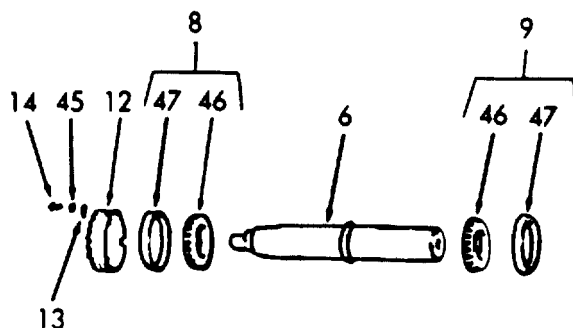


**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- |                       |  |  |
|-----------------------|--|--|
| 6. Clutch Drive Shaft | <p>a. Remove the bearing retainer lock plate bolts (14), lockwasher (45), and bearing retainer lock plates (13) from inside the clutch housing.</p> <p>b. Remove the bearing retainer (12) from the clutch housing by turning the retainer counterclockwise.</p> <p>c. Pull the clutch drive shaft (6) and roller bearings and cones (46), and bearing cup (47) from the clutch housing as an assembly. If the bearing cones or cup tend to stick in the clutch housing, tap on the outer end of the clutch drive shaft lightly with a plastic hammer to loosen the bearing cup.</p> |  |
|-----------------------|--|--|

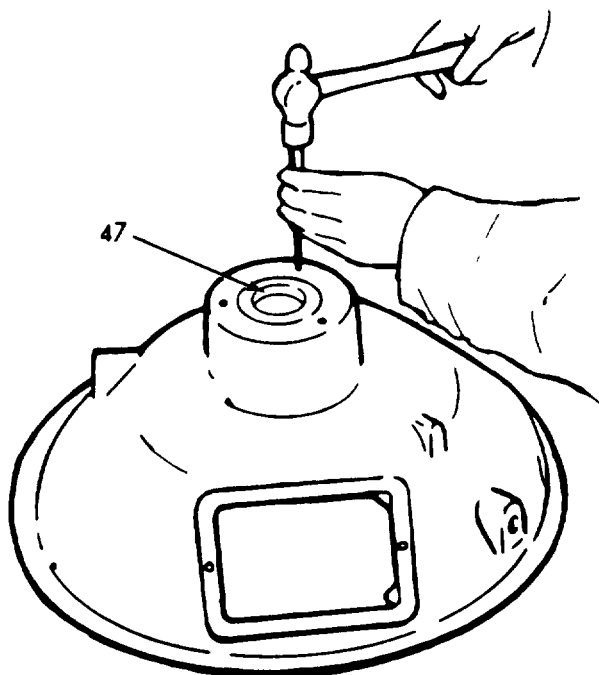


**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- d. The bearing cup (47) of the inner roller bearing will remain in the clutch housing when the clutch drive shaft is removed from the clutch housing. It may be removed by inserting a punch in the holes provided at the rear of the clutch housing and tapping the punch alternately at three points. Do not cock the bearing cup when removing it.



6-751

## 6-37. POWER TAKE-OFF ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)

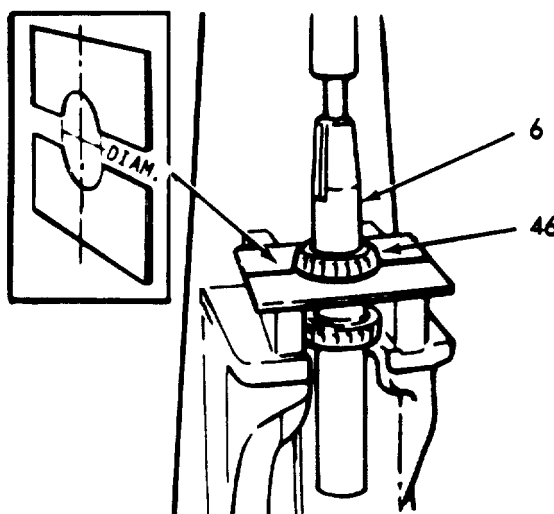
**WARNING**

**Wear protective eye goggles when using compressed air to avoid eye injury.**

- e. Wash the roller bearing cups and cones thoroughly in clean fuel oil, dry with compressed air, and examine for wear, corrosion or rough spots. If the bearings are unsatisfactory for further use, they must be removed from the clutch drive shaft.

7. Roller  
Bearing  
Cones

- a. Place two split plates between the bearing cones (46). Then, support the clutch drive shaft (6) and split plates on two steel supports on the bed of the arbor press.



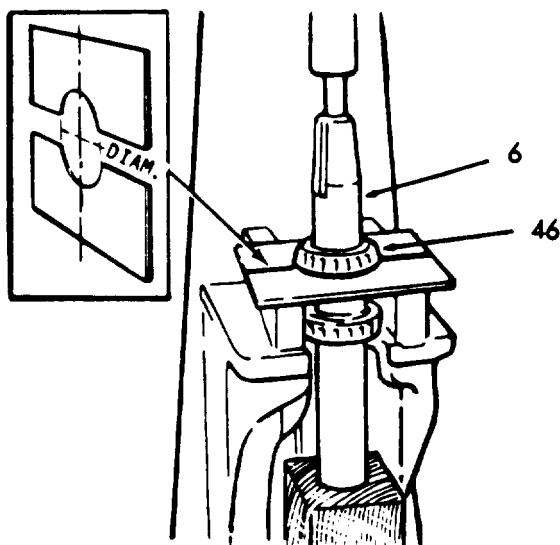


**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- b. Place wood blocks under the lower end of the clutch drive shaft (6) to prevent the drive shaft from falling and being damaged when it is pressed from the bearing.
- c. With the ram of the press resting on the end of the drive shaft (6), press the shaft out of the roller bearing cone (46).
- d. Reverse the clutch drive shaft (6) on the bed of the press and remove the second bearing cone in the same manner.



6-753

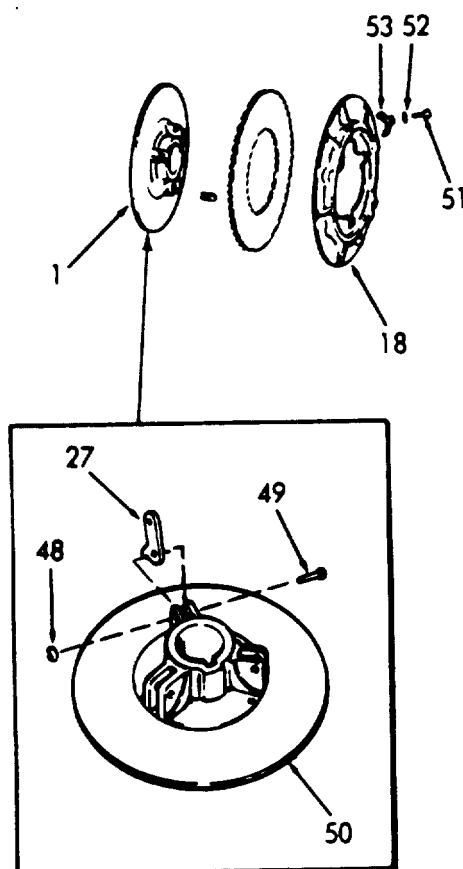
**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)****8. Clutches**

- a. Remove the retaining rings (48) from pins (49) that connect release levers (27) to the bosses on the outer clutch pressure plate assembly (16). Remove the other pins and levers from the outer pressure plate (50).
- b. Remove the clutch adjusting ring spring lock retaining screw (51), lockwasher (52), and spring lock (53) from the inner clutch pressure plate (18).

Discard outer pressure plate.



**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
	c. Remove the clutch adjusting ring (20) by turning it counterclockwise out of the inner clutch pressure plate (18).	
	d. Lift the inner clutch pressure plate (18) straight up off the bosses on the outer clutch pressure plate (16).	Discard inner clutch plate.
	e. Remove the one piece clutch facing (1) from the outer clutch pressure plate (16).	
	f. Remove the three clutch pressure plate separator springs (19) from the holes in the outer clutch pressure plate (16).	Discard springs.
	g. Remove the clutch release lever spring (25) as an assembly from the clutch release sleeve assembly (22).	
	h. Matchmark both halves of the release sleeve collar (54) to assure that they will be assembled in the same position.	
	i. Remove the two nuts (55) from bolts (56) securing the two halves of the collar (54) together, then remove the collar from the release sleeve (21).	
	j. Remove the retaining rings (35) from pins (36) that connect links (26) to the release sleeve (21). Remove the pins and links from the release sleeve.	

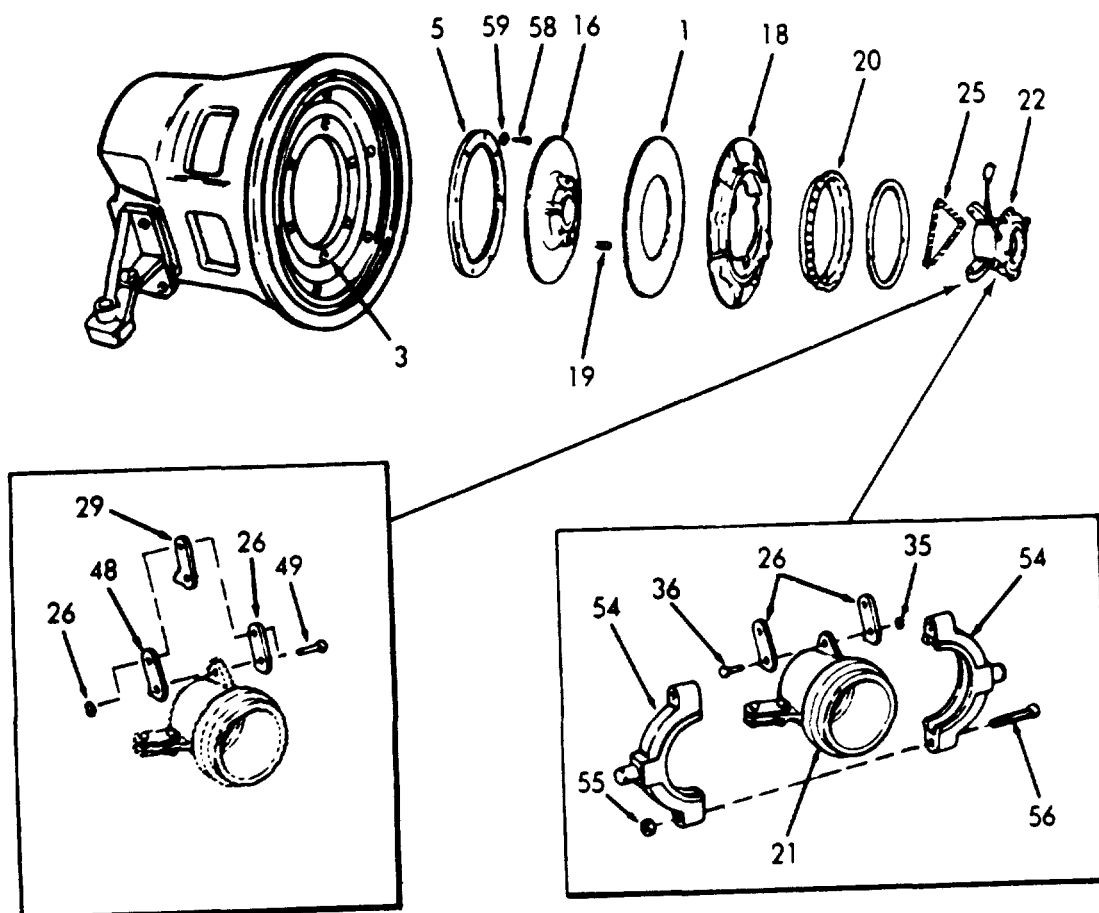
**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

k Remove the retaining rings (48) from the pins (49) that connect the clutch release levers (27) to the connecting links (26).

l. Remove screws (58), and lockwashers (59) that attach clutch driving ring (5) to adapter (3). Then remove ring (5).



**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING**

9. All Parts

**WARNING**

- Wear protective eye goggles when using compressed air to avoid eye injury.
- Dry cleaning solvent, P-D-680, used to clean parts, is potentially dangerous to personnel and property. Avoid repeated or prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° - 138°F (38° - 59°C).

Wash all of the power take-off parts except the clutch facings in solvent, (Fed. Spec. P-D-680) then, dry with compressed air.

**INSPECTION**

10.

- Examine the bearings for corrosion and pitting. Lubricate each bearing with light engine oil, then, while holding the inner race or cone from turning, revolve the outer race or cup slowly by hand and check for rough spots.
- Examine the clutch facing for wear, burning or scoring. Also, check the teeth for wear or damage and measure the thickness of the facing. Replace the clutch facing if the teeth are worn or damaged, or if the facing is badly burned, scored or worn to the approximate worn thickness of 1/4 inch minimum.

**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)**

- c. Inspect the friction surfaces of the clutch pressure plates for being flat, smooth and free from cracks or heat checks. Also, examine the drive bosses, the keyway in the outer pressure plate, the adjusting ring threads and the notches in the inner pressure plate.
- d. Examine all of the release levers, link pins and pin holes in the links, release levers, release sleeve and pressure plate for wear.
- e. Inspect the clutch adjusting ring wear plate and ring threads for wear. If the wear plate is worn excessively, reverse the plate. If both sides of the plate are worn, replace it.
- f. Examine the wear surface of the clutch release sleeve collar and the mating surface on the release sleeve for wear and scoring.
- g. Inspect the mating surface of the clutch release yoke fingers and mating trunnions on the release sleeve collar for wear.

**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)**

- |   |   |
|---|---|
| h. Check for wear or broken pressure plate separator springs. Check the spring load on the springs with a spring tester. The approximate free length is 7/8 inch and the approximate outside diameter is 3/8 inch. Springs should be replaced when force exerted is less than 12 - 15 ft-lbs (16.2 - 20.3 Nm) at 5/8 inch length. | Replacement springs are part of repair kit. |
|---|---|

**REASSEMBLY**

- |            |   |                               |
|------------|---|-------------------------------|
| 11. Clutch | a. Place the outer pressure plate (50) on the bench with the hub end of the pressure plate up.  | Use new outer pressure plate. |
|            | b. Place the three pressure plate separator springs (19) in the holes in the outer pressure plate (50). Then, place the one piece clutch facing (1) on top of the pressure plate. | Use new springs.              |

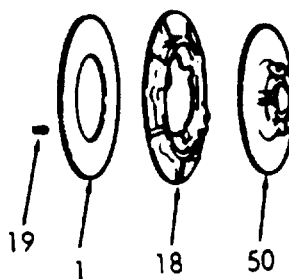
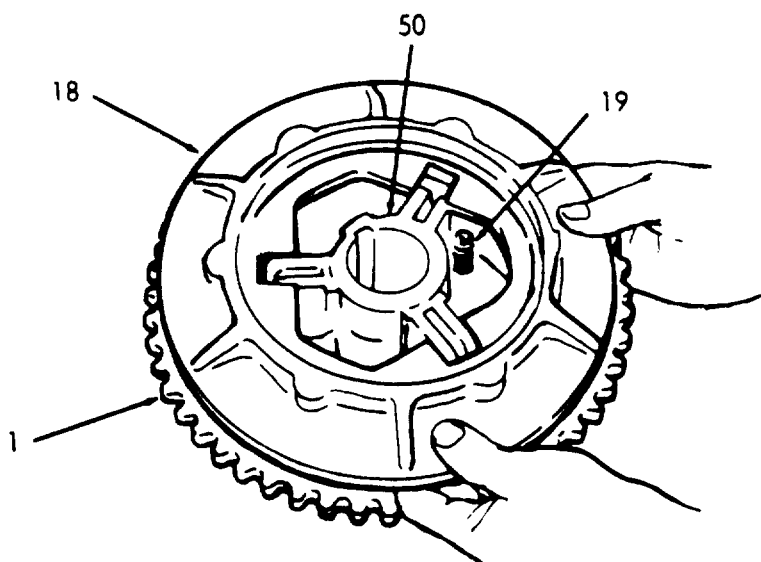
## 6-37. POWER TAKE-OFF ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- c. With the notches in the inner pressure plate (18) aligned with the bosses on the outer pressure plate (50), place the inner pressure plate over the bosses and rest it on the three pressure plate separator springs (19).

Use new inner pressure plate.





**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

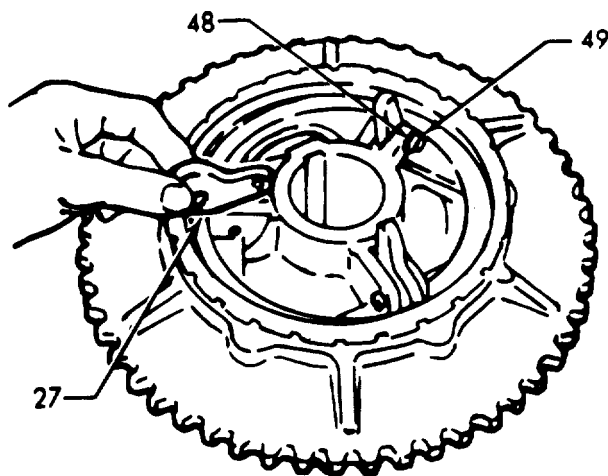
LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- d. Lubricate the threads of the clutch adjusting ring (20) lightly with engine oil; then, thread the adjusting ring into the inner pressure plate (16) until it bottoms.
- e. Place the clutch adjusting ring wear plate (57) in the cavity in the adjusting ring (20).
- f. Align the holes in the clutch release levers (27) and the pressure plate (50); insert the clutch release lever pins (49) through the holes and secure them in place with the retaining rings (48).

**NOTE**

Be sure the retaining rings (48) are securely locked in the groove in the release lever pins (49).

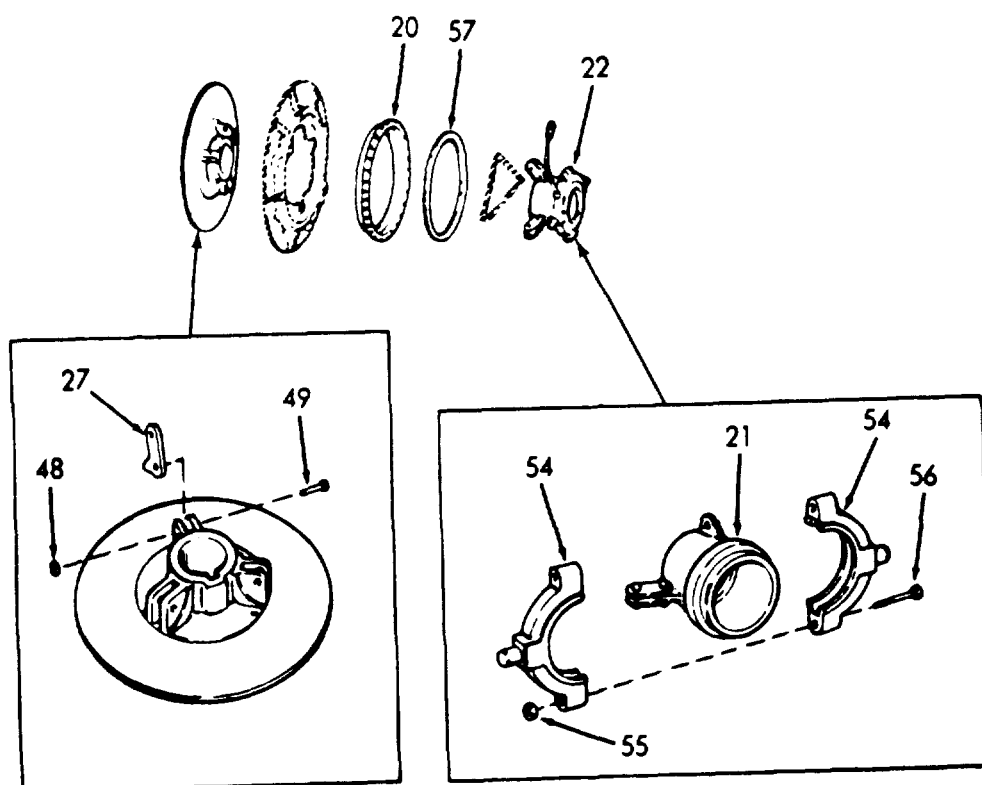


## 6-37. POWER TAKE-OFF ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- g. Lubricate the inside diameter of the clutch release sleeve collar (54) sparingly with an all purpose grease such as Shell Alvania No. 2 or its equivalent. Note the match-marks previously placed on the collar, then place the two halves of the collar over the shoulder on the clutch release sleeve (21) and secure in place with two bolts (56) and nuts (55). Rotate the collar on the sleeve to be sure it rotates freely. If necessary, loosen the retaining bolts, nuts, and tap the edge of the collar lightly with a plastic hammer to free it up then retighten the nuts.



**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- h. Place the clutch release lever spring (25) over the end of the clutch release sleeve (22) and against the clutch release sleeve collar (54).
- i. Note the position of the stop on the clutch release lever links (26). Then attach a pair of release lever links to each ear on the clutch release sleeve (21) with link pins (36) and retaining rings (35).

**NOTE**

**Be sure the retaining rings (35) are securely locked in the groove in the link pins (36).**

- j. Place the clutch release sleeve (22) on the top of the clutch pressure plates with each pair of release lever links (26) astride the release levers (27). Then, connect the release lever links to the release levers with pins (49) and retaining rings (48).

**NOTE**

**Be sure the retaining rings (48) are securely locked in the groove in the link pins (49).**

- k. Slide the clutch release lever spring (25) over the end of the release lever links (26) and into place on the clutch release levers (27).

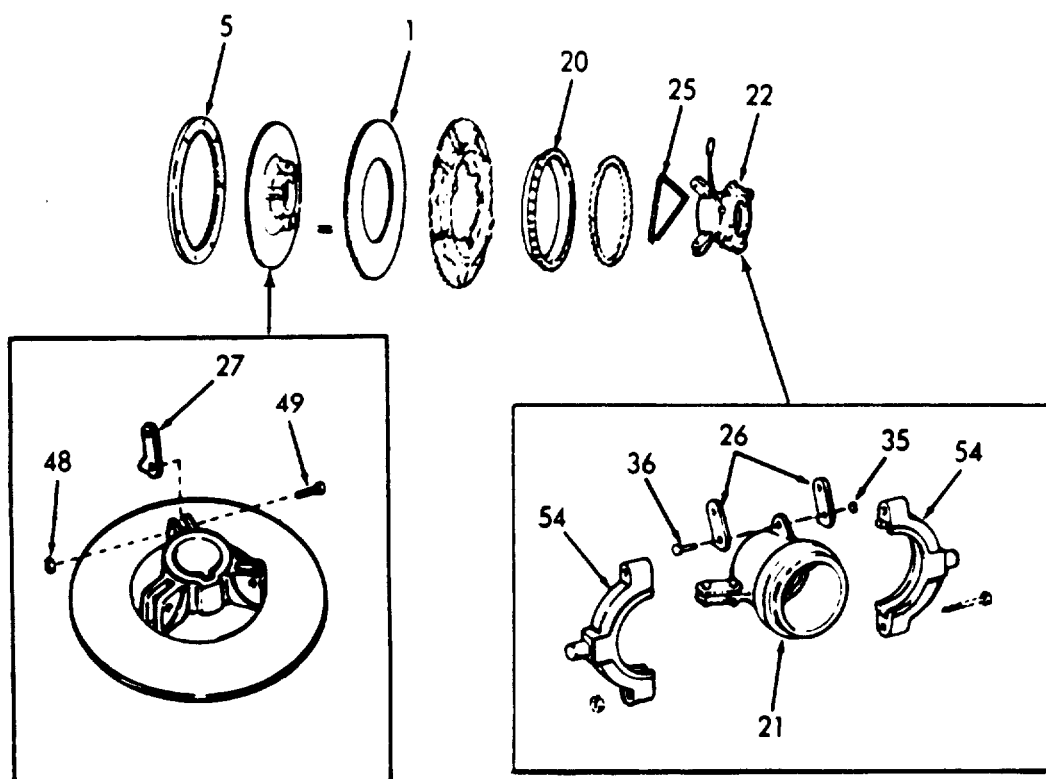
## 6-37. POWER TAKE-OFF ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

I. Lock the clutch facing (1) between the inner and outer pressure plates as follows:

- (1) With the clutch assembly resting on a bench, forward face down, turn the clutch adjusting ring (20) counter-clockwise until the inner pressure plate almost contacts the clutch facing.
- (2) Place the clutch driving ring (5) over the clutch facing (1) with the teeth in the driving ring in mesh with the teeth on the clutch facing. Then, position the driving ring centrally relative to the pressure plates.



**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)****NOTE**

If the driving ring (5) is not positioned centrally relative to the pressure plates, the clutch cannot be assembled to the clutch drive adaptor, because the teeth of the clutch facing will not enter the teeth of the driving ring even though the clutch drive shaft enters the pilot bearing.

- (3) Lock the clutch facing (1) between the pressure plates by applying pressure on the outer end of the clutch release sleeve and collar assembly (22). If the clutch facing is still free to move, disengage the clutch and turn the adjusting ring (20) counterclockwise just enough to lock the clutch facing in place when the clutch is engaged.

**NOTE**

The clutch must now be kept engaged until the power take-off is assembled and attached to the engine.

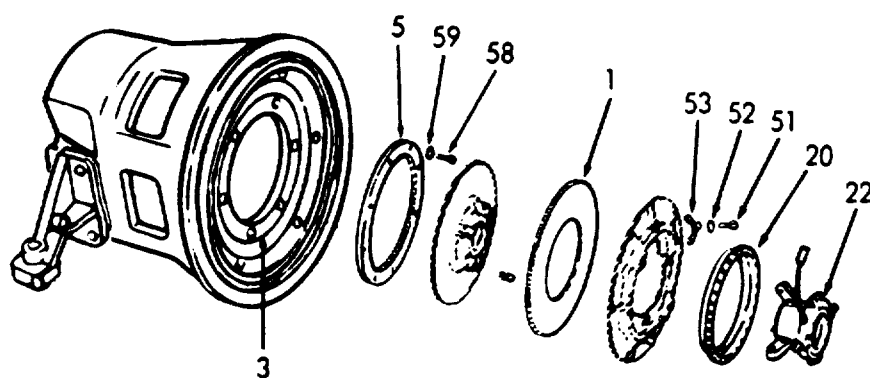
- m. Remove the clutch driving ring (5) from the clutch facing (1) and attach it to the clutch drive adaptor (3) at the front end of the engine, with bolts (58) and lockwashers (59). Tighten the 3/8"-16 bolts to 70 to 75 ft-lb (95 to 102 Nm) torque.

**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- n. Attach the adjusting ring spring lock (53) to the inner pressure plate with screw (51) and lockwasher (52). Be sure the ends of the spring lock are in the notches in the adjusting ring.



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**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REASSEMBLY (Cont)</b>		
12. Roller Bearing Cones	<p>a. If the roller bearing cones (46) were removed from the clutch drive shaft (6) install them as follows:</p> <p>(1) Lubricate the inside diameter of the roller bearing cone with engine oil. Then start the bearing cone straight on the drive shaft with the wide face of the race facing the shoulder on the drive shaft.</p> <p>(2) Place a steel ring approximately 1/4" thick over the end of the shaft and rest it on the inner race of the bearing cone.</p>	

**CAUTION**

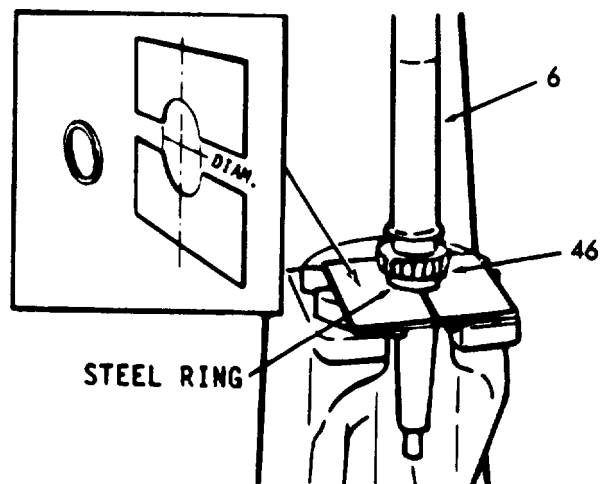
**The steel ring must bear against the inner race of the bearing cone. Do not allow any pressure to be applied against the roller bearing cage or the bearing cone will be damaged.**

- (3) Support the clutch drive shaft, bearing cone and steel ring on the bed of an arbor press with the split plates under the steel ring. Then, press the drive shaft straight into the bearing cone until the inner race is tight against the shoulder on the shaft.

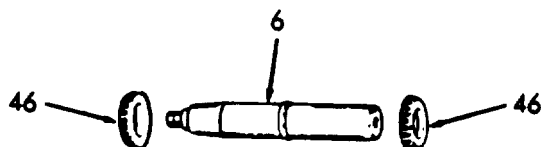
6-37. POWER TAKE-OFF ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)

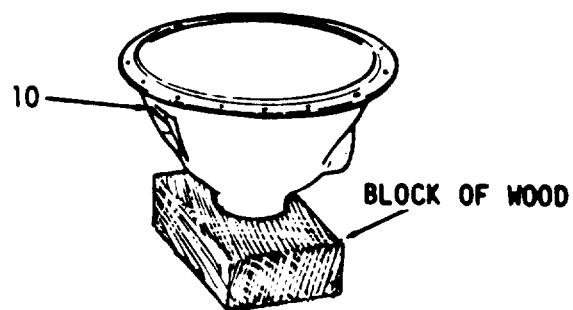


- (4) Install the second roller bearing cone (46) on the clutch drive shaft in the same manner.



13. Clutch Drive Shaft

- a. Support the clutch housing (10) on a wood block with the forward (bell) side of the housing up.





**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- b. If removed, lubricate the outside diameter of the outer roller bearing (9) cup, with engine oil. Then start it straight into the bearing bore in the clutch housing with the tapered inner diameter of the cup facing up.
- c. Place a (1" O.D. x 15" long) hard wood block on the top edge of the bearing cup, then use a hammer, to tap the bearing cup down in the clutch housing by tapping it alternately at several places.

**CAUTION**

**Be careful not to get any wood chips off of the wood block under the bearing cup.**

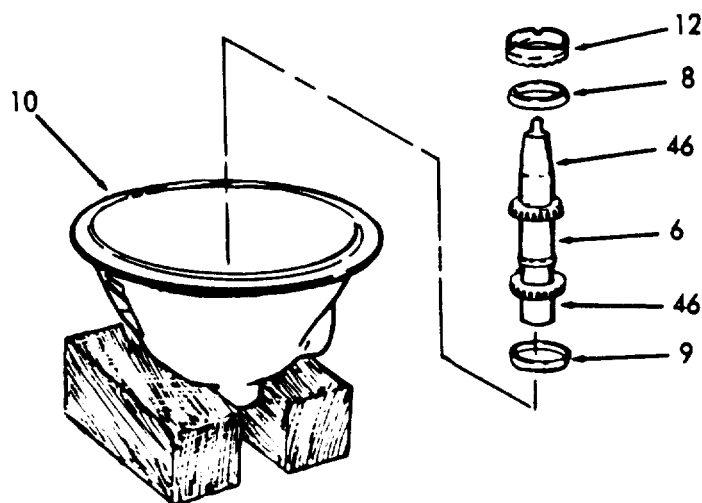
- d. Support the clutch housing (10) on wood blocks in a horizontal position.
- e. Lubricate the roller bearing cones (46) with light engine oil. Then insert the outer end of the clutch drive shaft (6) through the bearing bore from the forward side of the clutch housing until the bearing cone contacts the bearing cup.

**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- f. Lubricate the outside diameter of the inner roller bearing (8) cup with engine oil. Place the cup over the forward end of the clutch drive shaft with the tapered inner diameter of the cup facing the bearing cone.
- g. Start the roller bearing cup straight in the bearing bore of the clutch housing (10). Then, tap the cup in against the rollers of the bearing cone by tapping alternately around the cup with a hard wood block and hammer.
- h. Lubricate the threads of the roller bearing retainer (12) with engine oil. Place the retainer over the forward end of the drive shaft (6) with the notches in the end of the retainer facing the forward end of the shaft.

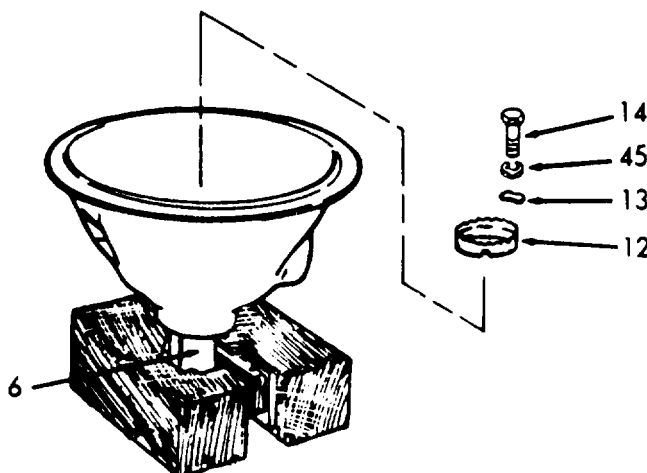


**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

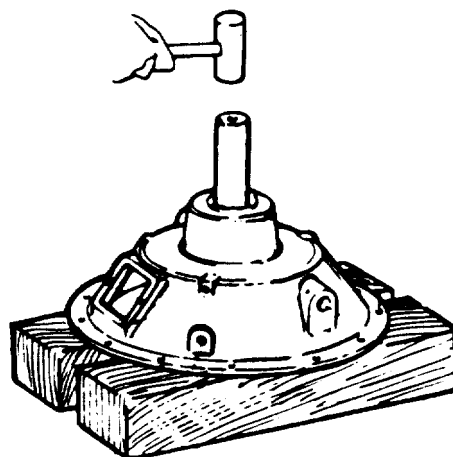
- i. Thread the bearing retainer (12) into the bearing bore until it is against the bearing cup. Tighten the bearing retainer while rotating the drive shaft (6) until the bearing retainer is tight and the bearing cups are seated. When the bearing cups are seated it will be noted by the increase effort required to rotate the drive shaft.



- j. Back the bearing retainer (12) out 2 or 3 notches.
- k. Install retainer lock plates (13), lockwashers (45) and bolts (14).
- l. Support the clutch housing and shaft assembly on wood blocks with the outer end of the clutch drive shaft up. Then, tap on the outer end of the drive shaft with a plastic hammer to force the roller bearing cup down until the bearing cup seats on the bearing retainer.

**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)****ADJUSTMENT**

14. Clutch  
Drive  
Shaft  
Bearing  
End Play

- a. To check the end play in the clutch drive shaft bearing, the power take-off must be removed from the engine and the clutch assembly removed from the drive shaft to be checked correctly. If the clutch drive shaft and bearing assembly has just been installed in the clutch housing, the end play in the drive shaft bearing must be checked before the clutch is attached to the drive shaft.
- b. Servicing personnel should read the instructions on the clutch housing name plate. Instructions on the name plate are correct for the particular power take-off to which they are attached. If an occasion occurs that a unit does not have the clutch drive shaft end play listed on the clutch housing name plate, the bearing should be adjusted in accordance with the recommendations listed in the table below.

Clutch Sizes	End Play
8"	.004 to .006"

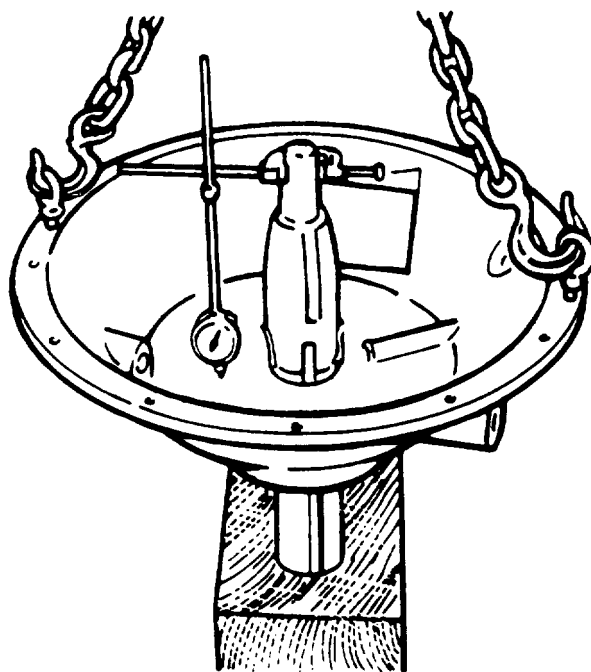
**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**ADJUSTMENT (Cont)**

c. With the clutch drive shaft and bearing assembly installed in the clutch housing, the clutch drive shaft bearing end play may be checked as follows:

- (1) Support the clutch housing with a sling and chain hoist with the drive (pulley) end of the shaft down.



- (2) Lower the clutch housing until the end of the drive shaft rests on the wood block.
- (3) Insert four pieces of shim stock, which are the same thickness, between the bearing retainer and the drive shaft.

**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>ADJUSTMENT (Cont)</b>		
(4)	Attach a dial indicator to the pilot bearing end of the drive shaft, then position the indicator point on the face of the clutch housing next to the bearing retainer. Set the dial indicator at zero.	
(5)	Lift the clutch housing and drive shaft assembly from the wood block.	
(6)	Tap lightly on the pilot bearing end of the drive shaft to move the drive shaft and bearing outer cone assembly against the outer roller bearing cup.	
(7)	Note the reading on the dial indicator. The dial indicator will show the amount of end play in the clutch drive shaft bearing.	
(8)	Lower the clutch housing until the end of the drive shaft rests on the wood block and the weight of the housing is off of the chain hoist.	
(9)	Tap lightly on the inner side of the clutch housing alternately around the bearing retainer to be sure the inner roller bearing cone rests against the bearing cap. The dial indicator should read zero.	

**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>ADJUSTMENT (Cont)</b>		
(10)	If necessary, turn the bearing retainer clockwise to decrease or counterclockwise to increase the drive shaft bearing end play.	
(11)	Repeat the above steps to make sure the readings are correct. Then install the bearing retainer lock plate, lock washer and bolt.	
(12)	Remove the shim stock and the dial indicator.	
(13)	Support the clutch housing and drive shaft assembly on wood blocks in a horizontal position.	
(14)	Fill the roller bearing cavity through the grease fitting, above the bearing, with a grease gun until the grease just starts to seep out around the clutch drive shaft at the bearing retainer, or at the rear of the clutch housing.	

**NOTE**

Rotate the clutch drive shaft when filling the bearing cavity to be sure the bearing cavity is full of grease.

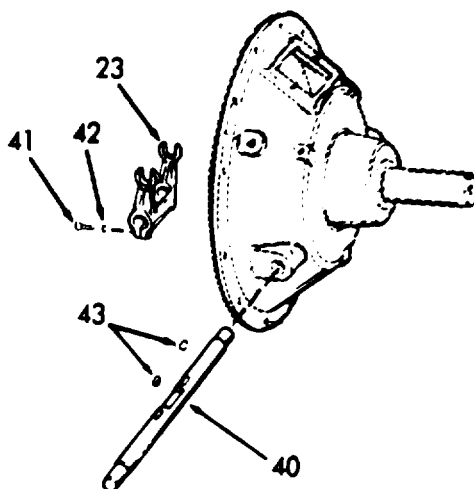
**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY - CONTINUED**

15. Clutch  
Release  
Shaft  
and Yoke

- a. Squirt engine oil in the clutch release shaft holes in the clutch housing.
- b. Slide the clutch release shaft (40) through one of the holes in the side of the clutch housing. Position the clutch release yoke (23) in front of the release shaft inside of the clutch housing, so that the heads of the clamping bolts (41) will face the forward end of the clutch housing. Slide the release shaft through the release yoke and through the hole in the opposite side of the clutch housing.
- c. Move the release yoke to one side of the clutch housing to expose the two keyways in the shaft. Then, install the two woodruff keys (43) in the release shaft.





**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY - CONTINUED (Cont)**

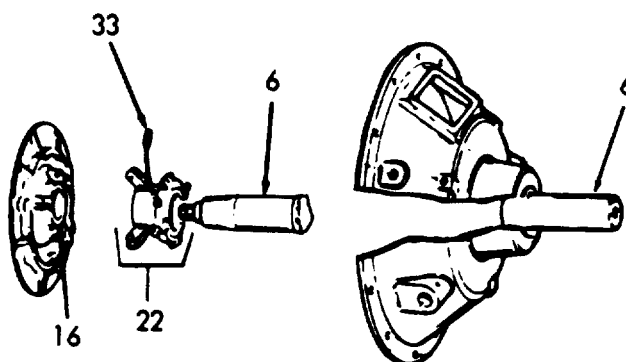
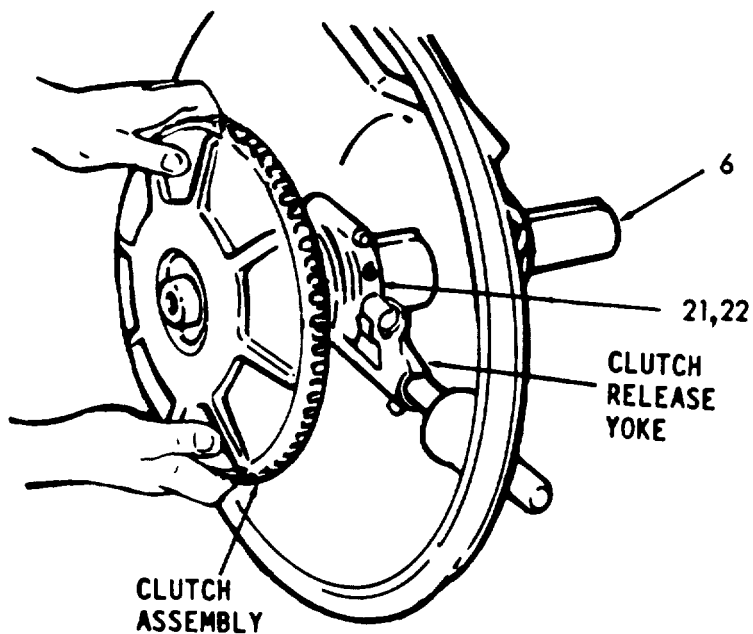
- |                            |   |  |
|----------------------------|---|--|
|                            | <p>d. Align the keyways in the release yoke with the woodruff keys in the release shaft; then move the release yoke over the keys until it is centrally located in the clutch housing and each end of the release shaft extends an equal distance outside of the clutch housing.</p> <p>e. Install the two clamp bolts (41) and lockwashers, and tighten the bolts to 30-35 ft-lb (40.7-47.5 Nm) torque.</p>  |  |
| <p>16. Clutch Assembly</p> | <p>a. Support the clutch housing and drive shaft assembly on wood blocks with the drive shaft in a horizontal position and the inspection hole in the clutch housing facing up.</p> <p>b. Lubricate the inside diameter of clutch release sleeve (21) with engine oil; then start the clutch assembly over the tapered end of the clutch drive shaft (6) with the keyway in the hub of the outer pressure plate (16) in line with the keyway in the clutch drive shaft. Position the clutch release sleeve collar (22) so the tapped hole in the side of collar is in the proper relation to the flexible tube hole in the side of clutch housing, so that the flexible grease tube (33) can be connected at each</p> |  |

# 6-37. POWER TAKE-OFF ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY - CONTINUED (Cont)

point. Then guide the fingers of the release yoke over the trunnions on the release sleeve collar.



**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY - CONTINUED (Cont)****CAUTION**

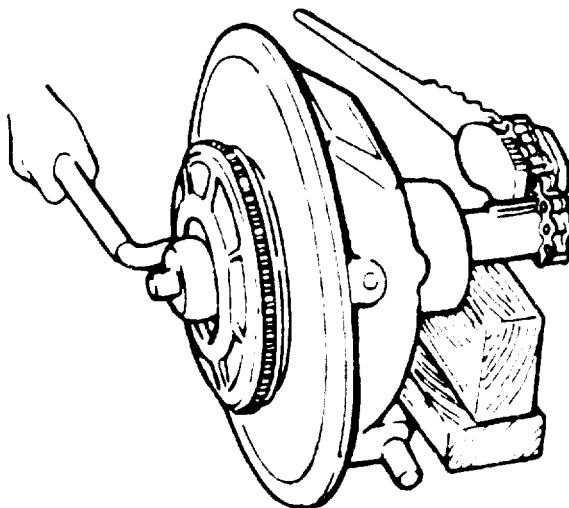
**The clutch release sleeve is a close fit on the drive shaft and must be started straight over the clutch drive shaft to prevent any bind between the release sleeve and the drive shaft.**

- c. Slide the clutch assembly back on the clutch drive shaft (6) until it is tight against the taper on the drive shaft. Then insert the key (60) in the keyway and tap it into place with a punch and a hammer.
- d. Place the lockwasher (34) on the drive shaft and against the outer pressure plate with the tang on the inner diameter of the lockwasher in the keyway in the pressure plate.
- e. Install clutch drive shaft nut (17).
- f. Install the key in the keyway of the clutch drive shaft. Attach a chain wrench to the drive shaft to prevent the drive shaft from turning.

## 6-37. POWER TAKE-OFF ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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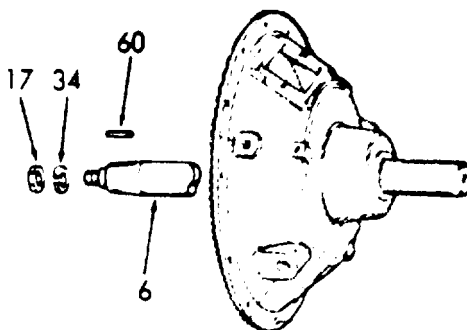
## REASSEMBLY - CONTINUED (Cont)

**CAUTION**

Be sure and place the teeth of the chain wrench on top of the key to prevent damage to the drive shaft while holding the drive shaft from turning. If the key or the shaft is damaged and cannot be cleaned up, they must be replaced.

- g. Tighten the clutch drive shaft nut (17) to the torque specified in the table below. Then, bend the edge of the lockwasher (34) over against the flat side of the nut.

Clutch Size	Nut Size	Ft-Lb Torque	Nm Torque
8"	1-1/8"-12	165-170	223.7-230.5



**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

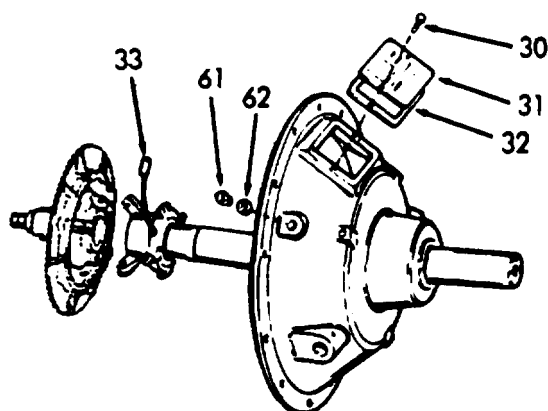
LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY - CONTINUED (Cont)**

- h. Thread the small end of the flexible grease tube (33) in the hole in the side of the clutch release sleeve collar. Then, insert the opposite end of the tube through the hole in the side of the clutch housing and install the tube retaining nut.

Tighten the retaining nut while holding the tube nut inside the clutch housing from turning. If removed, install the grease fitting, (61) and adaptor (62) in the tube.

- i. Attach the inspection hole cover (31) and gasket (32) to the clutch housing using screws (30).



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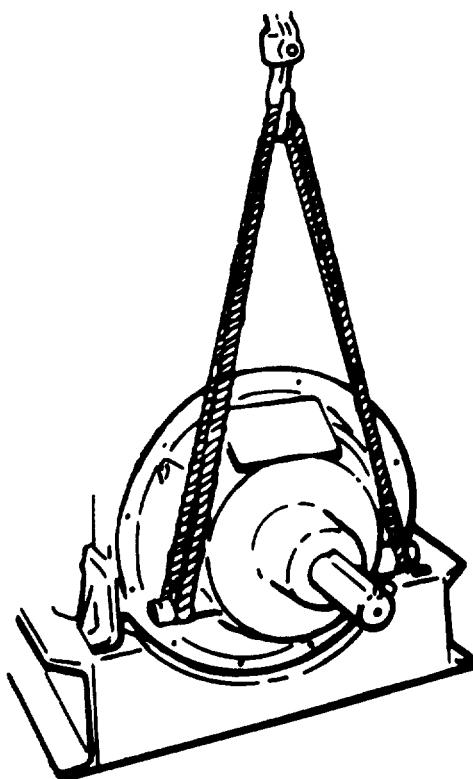
**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION**

## 17. Power Take-Off

- a. Support the power take-off assembly with a rope sling and chain hoist, then position the power take-off assembly at the adaptor at the front end of the engine with the clutch drive shaft in line with the pilot bearing in the coupling and flange assembly.



**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

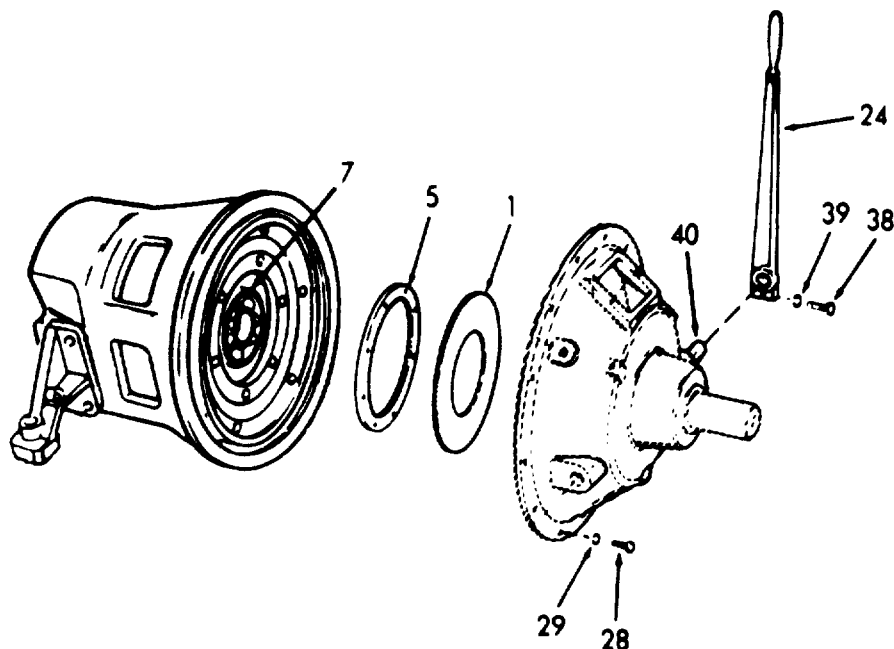
LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- b. Push the power take-off forward and guide the forward end of the drive shaft straight into the clutch pilot bearing (7), and engage the teeth on the outer diameter of the clutch facings (1) with the teeth in the inner diameter of the driving ring (5).
- c. Guide the pilot on the clutch housing straight into the front end adaptor opening, then install the clutch housing to adaptor using bolts (28), and lockwashers (29). Tighten bolts to 30-35 ft-lb (40.7-47.5 Nm) torque.
- d. Remove chain hoist and rope sling.
- e. Install the clutch control hand lever (24) on the clutch release shaft (40) and secure it in place with a bolt (38) and lockwasher (39).

**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

f. Install engine oil hoses and filter

Refer to paragraph 6-26.

g. Install ramp hoist pump and coupling guard.

Refer to paragraph 5-6.1.

**ADJUSTMENT**

18. Clutch

a. These instructions refer to field adjustment for facing wear. Frequency of adjustment depends upon the amount and nature of the load. To insure longest facing life and best clutch performance, the clutch should be adjusted before slippage occurs.



**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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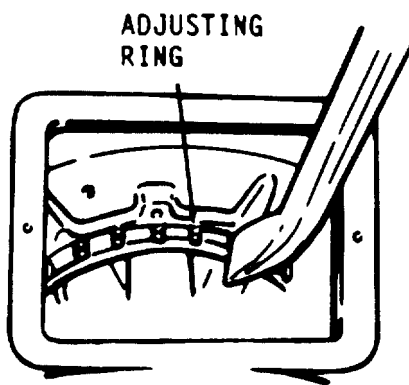
**ADJUSTMENT (Cont)**

- b. When the clutch is properly adjusted, heavy pressure is required at the outer end of the hand lever to move the throwout linkage to the "over center" or locked position.
- c. Adjust clutches as follows:
  - (1) Disengage the clutch, with the hand lever.
  - (2) Remove the inspection hole cover to expose the clutch adjusting ring.
  - (3) Rotate the clutch, if necessary, to bring the clutch adjusting ring lock within reach.
  - (4) Remove the clutch adjusting ring spring lock screw and lock from the inner clutch pressure plate and adjusting ring. Then, while holding the clutch drive shaft to prevent the clutch from turning, turn the clutch adjusting ring counterclockwise and tighten the clutch until 40 to 55 lbs (18.1-24.9 kg) pressure on the outer end of the hand lever, at the clutch release shaft is obtained. Then, reinstall the clutch adjusting ring spring lock, making sure the ends of the lock are in the notches in the adjusting ring.

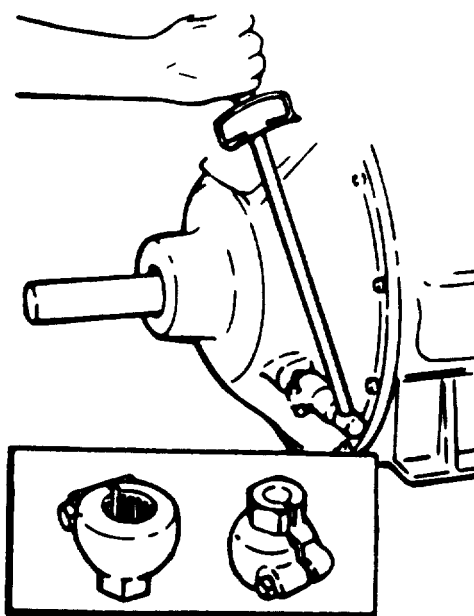
## 6-37. POWER TAKE-OFF ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## ADJUSTMENT (Cont)



- (5) A suitable spring scale may be used to check the pounds pressure required to engage the clutch.
- (6) A more accurate method of checking the clutch adjustment is shown below.



**6-37. POWER TAKE-OFF ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>ADJUSTMENT (Cont)</b>	(7) To fabricate an adaptor, saw the serrated end off a clutch hand lever and weld a 1-1/8" nut (across the hex) on it. Then, saw a slot through the nut.	
	(8) When checking the clutch adjustment with a torque wrench, engage the clutch slowly noting the torque just before the clutch engages (goes over center). The specified torque is 56-63 ft-lb (75.9-85.4 Nm).	

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**6-38. TRANSFER GEAR ASSEMBLY.**

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**a. General.**

The hydraulic marine transfer gear is shown below. Power developed by the two engines is delivered through the hydraulic marine gear system to the power drive gear (1) thence to the power driven gear (2) which is secured to and drives the power driven shaft (3).

Each drive gear (1) is internally splined to receive the reverse gear drive shaft (4) and is mounted on two ball bearings. The forward ball bearing (5) is carried in the reverse gear housing (6) and, the rear ball bearing (7) is carried in the transfer gear housing (8).

Endwise movement of the drive gears is restricted by the shoulder in the bearing bore of the reverse gear housing at the forward bearing and by the drive shaft bearing cover (9) at the rear bearing, which in turn holds the inner race of bearings against the shoulder on hub of drive gears (1).

A retaining ring groove is present in the bore of each drive gear. However, retaining rings are not used for restraining the lateral movement of the marine gear drive shafts. Each marine gear drive shaft is held in position by a shoulder on the shaft (at the drive gear end) and the reverse planetary retaining ring in the reverse gear assembly.

An adaptor plate (10), to which the reverse gear housings (6) are attached, is doweled and bolted to the forward face of the transfer gear housing.

The power driven gear (2), which meshes with the power drive gears (1), is splined to the power driven shaft (3) and positioned between a spacer (11), bearing against a shoulder on the power driven shaft at the rear, and a locknut (12) on the forward side.

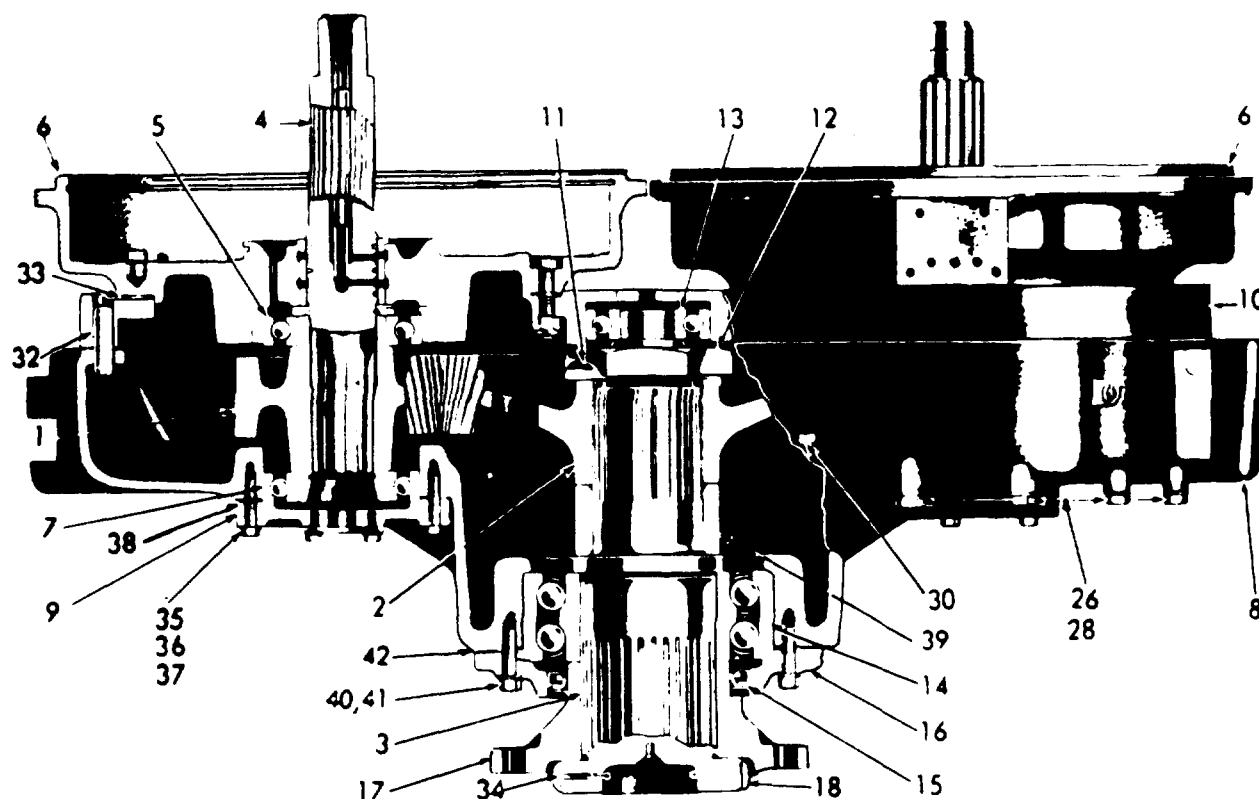
The power driven shaft (3) is mounted on a single row ball bearing (13) at the forward end, and a double row ball bearing (14) at the rear end. The forward ball bearing (13) is carried in the adaptor plate, and the rear ball bearing is carried in the adaptor plate, and the rear ball bearing is carried in the transfer gear housing (8).

The driven gear and driven shaft are restricted from endwise movement by locking the rear bearing against the shoulder in the bearing bore of the transfer gear housing with the bearing retainer which, in turn, is bolted to the transfer gear housing.

An oil seal (15) which is pressed into the driven shaft bearing retainer (16), guards against oil leaks along the drive flange.

The drive flange (17) is splined to and retained on the power driven shaft with a nut (18) and cotter pins.

## 6-38. TRANSFER GEAR ASSEMBLY (Continued).



- |                                     |                             |
|-------------------------------------|-----------------------------|
| 1. Gear-Power Drive                 | 26. Bolt-Gear Housing to    |
| 2. Gear-Power Driven                | Adaptor Plate               |
| 3. Shaft-Power Driven               | 28. Bolt-Gear Housing to    |
| 4. Shaft-Power Drive                | Adaptor Plate               |
| 5. Bearing-Power Drive Gear (Front) | 30. Bolt-Gear Housing to    |
| 6. Housing-Reverse Gear             | Adaptor Plate               |
| 7. Bearing-Power Drive Gear (Rear)  | 32. Dowel Pin               |
| 8. Housing-Transfer Gear            | 33. Gasket-Gear Housing to  |
| 9. Cover-Drive Shaft                | Adaptor Plate               |
| 10. Adaptor Plate-Reverse Gear      | 34. Cotter Pin              |
| 11. Lockwasher-Driven Gear          | 35. Lockwire                |
| 12. Nut-Driven Gear Lock            | 36. Bolt-Cover              |
| 13. Bearing-Driven Shaft Pilot Ball | 37. Lockwasher              |
| 14. Bearing-Driven Shaft Ball       | 38. Gasket                  |
| 15. Oil Seal-Driven Shaft Bearing   | 39. Spacer-Driven Gear      |
| Retainer                            | 40. Bolt-Bearing Retainer   |
| 16. Retainer-Driven Shaft Bearing   | 41. Lockwashers             |
| 17. Flange-Driven Shaft Drive       | 42. Gasket-Bearing Retainer |
| 18. Nut-Drive Flange Lock           |                             |

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**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

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**b. Lubrication**

The drive gear bearings, and power driven shaft bearings are lubricated by splash from the drive and driven gears. On some industrial power transfer gears, a force feed oil pump and tubes were added to supply additional lubricating oil to the teeth of the drive and driven gears.

An oil filler pipe, with a breather cap is pressed into the top of transfer gear housing for adding oil to the gear compartment. A plug is located at the lower rear side of the gear housing for draining oil, and the dipstick is located at the rear left-hand side of the gear housing for checking the oil level.

The oil level in the transfer gear should be checked daily with the engines stopped or clutches disengaged. Keep the oil level to the FULL mark on the dipstick.

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

This task covers:

a. Removal

b. Disassembly

c. Cleaning

d. Inspection

e. Reassembly

f. Installation

**INITIAL SETUP****Test Equipment**

NONE

**References**

NONE

**Special Tools**

Wrench J4385-01  
 Gear puller  
 Arbor press  
 Torque wrench  
 Torque multiplier  
 wrench J9291  
 Installer J3154-04

**Condition****Equipment****Tools**

General Mechanic's Tool Kit  
 NSN 5180-00-629-9783  
 Chain hoists  
 Wooden blocks  
 Slings

**Paragraph      Condition Description**

6-40	Transmission Oil-Drain
5-30	Transmission Control Valve-Remove
6-22	Propulsion Unit Removal

**Material/Parts**

Dry cleaning solution  
 P-D-680  
 Engine oil  
 Sealing compound

**Special Environmental Conditions**

Do not drain oil into bilges. Use oil separation and recovery system to collect drained oil.

**Personnel Required**

2

**General Safety Instructions**

Observe WARNING in procedure.

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

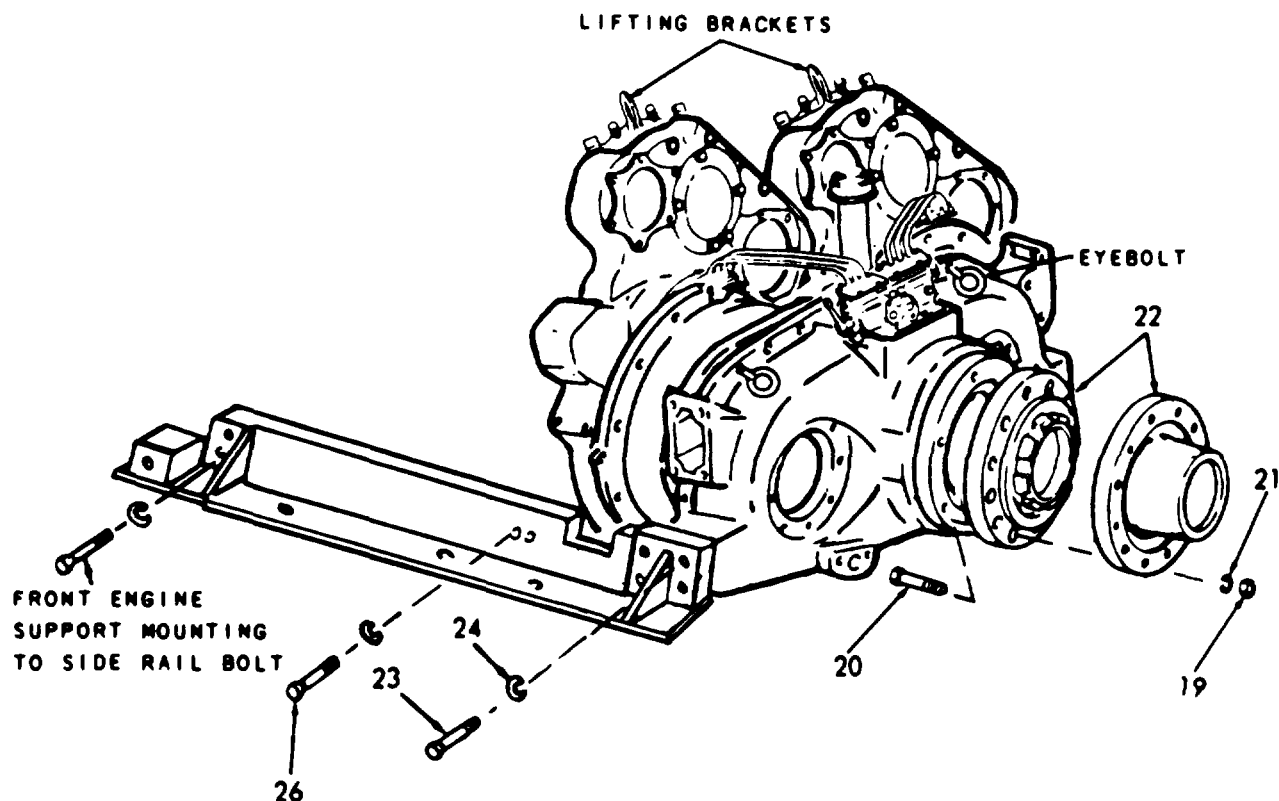
LOCATION/ITEM	ACTION	REMARKS
<b>REMOVAL</b>		
1. Transfer Gear	Drain oil. and Flywheel Housing	1. Drain into a suitable container.  2. Refer to paragraph 6-40.
2. Transfer Gear Housing to Reverse Gear Housing Oil Tubes	Remove.	
3. Transmission Control Valve	Remove.	Refer to para- graph 5-30.
4. Fuel Lines and Strainer	Remove.	
5. Propeller Shaft Flange	a. Remove 12 nuts (19) and bolts (20) and lockwashers (21).  b. Slide the flange halves (22) apart.	The flanges should be approximately 1 inch apart.
6. Transfer Gear Housing Mounting to Side Rail	Remove 4 bolts (23) and lockwashers (24).	Remove on both sides.
7. Front Engine Support Mounting to Side Rail	Loosen bolts.	



## 6-38. TRANSFER GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REMOVAL (Cont)



## 8. Engine Flywheel Housing

- Attach a sling and chain hoist to lifter bracket at the top of each engine flywheel housing.
- Remove two bolts (26).
- Raise the rear end of engines.

On each side

Raise engines just enough to ease the load on transfer case from the engine side rails.

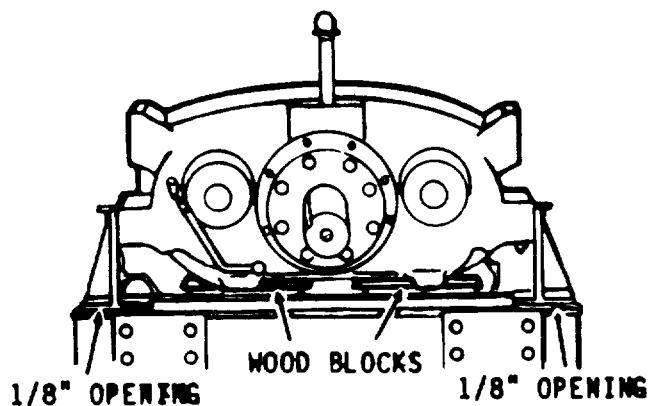
**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

- d. Place wood blocks beneath each flywheel housing.

Support engines. When blocking is in place and load of engines is resting thereon, the space between the mounting boss at each side of transfer gear housing and end of side rails should be approximately 1/8".

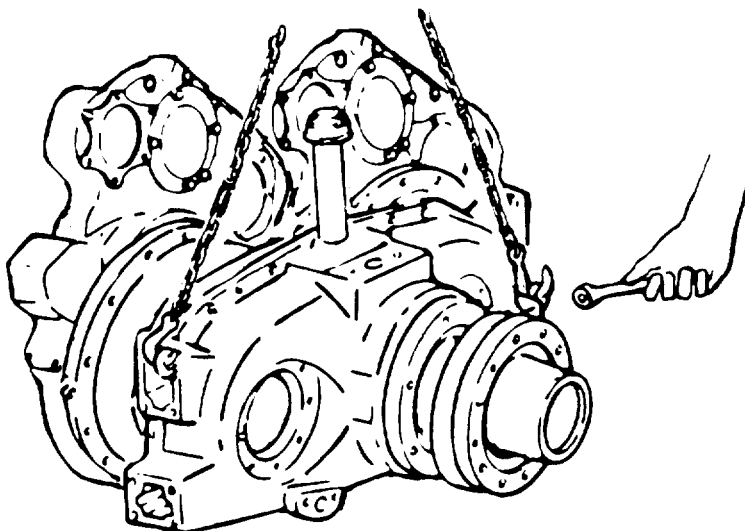
**9. Transfer**

- Remove name plates (25) on Gear Housing both sides.
- Thread an eyebolt into one of the tapped holes provided at each side of gear housing, and attach a chain from hoist to each eyebolt to support transfer gear.

## 6-38. TRANSFER GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REMOVAL (Cont)



- c. Remove four bolts (26) and lockwashers (27).

Bolts are 3/8-16 X 4-1/2 inch long.

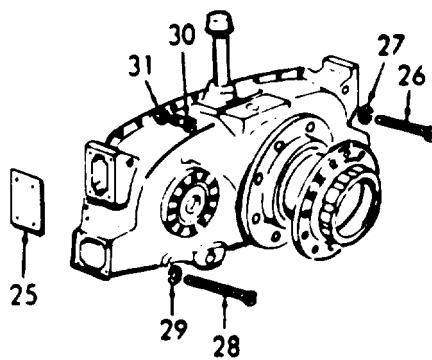
- d. Remove four bolts (28) and lockwashers (29).

Bolts are 3/8-16 X 5 inch long.

- e. Remove sixteen bolts (30) and lockwashers (31).

Bolts are 3/8-16 X 1-1/4 inch long.

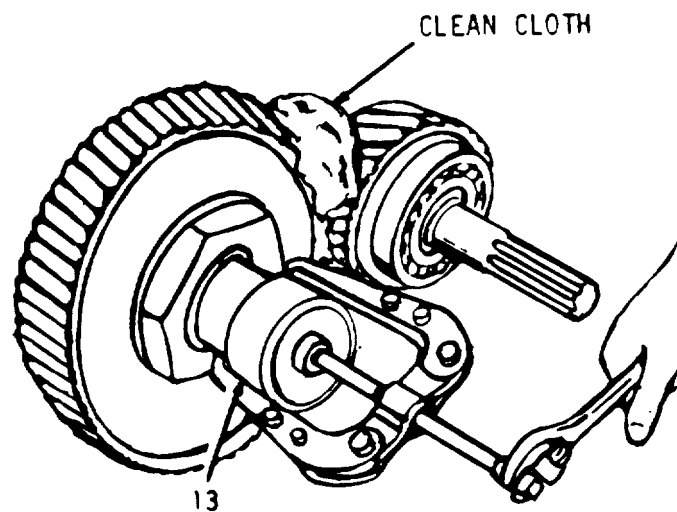
- f. Install four bolts in tapped holes on bolting flange of gear housing.



6-795

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REMOVAL (Cont)</b>		
	g. Tighten bolts evenly to crowd transfer gear housing from adapter plate.	Move off of dowel pins (32).
	h. Remove from unit.	
	i. Remove gasket (33).	Discard gasket.
<b>DISASSEMBLY</b>		
10. Transfer Gear Housing	a. Place on suitable wooden blocks.	Power driven shaft should be in a horizontal position.
	b. Place a clean cloth between the gear teeth.	Prevents gears from turning.
	c. Remove driven shaft pilot ball bearing (13).	Use gear puller.



6-796

## 6-38. TRANSFER GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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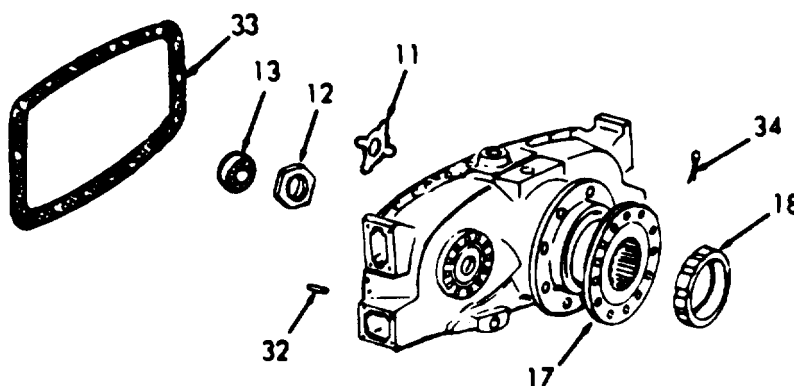
## DISASSEMBLY (Cont)

## CAUTION

Do not attempt to loosen or tighten the driven gear or drive flange retaining nuts by using a hammer with drift or chisel. Damage to the nuts will occur. Also, the proper torque cannot be obtained when tightening the nuts in this manner .

- d. Loosen power driven gear locknut (12) and drive flange locknut (18) as follows:

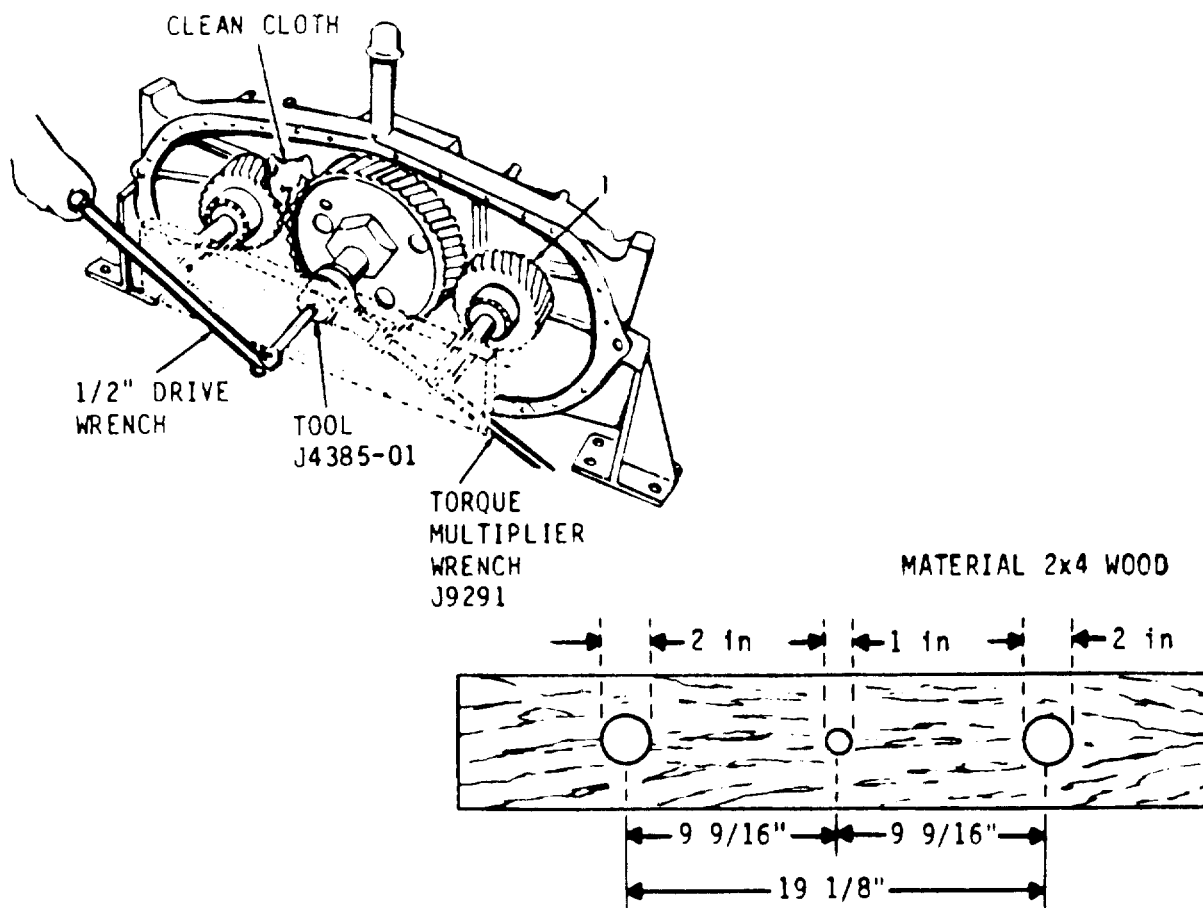
1. Straighten ears on lock-washer (11).
2. Remove cotter pins (34) from drive flange (17) and locknut (18).



6-797

## 6-38. TRANSFER GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
DISASSEMBLY (Cont)		
	3. Clean cloth should be wedged between gear teeth.	Prevents power driven shaft from turning.
	4. Place wrench J4385-01 over driven gear locknut (12).	
	5. Attach torque multiplier wrench, with the end of handle resting on the floor.	
	6. Insert spare reverse gear shaft in each power drive gear (1).	
	7. Place a supporting member over the splined end of the two drive shafts and push it against the torque multiplier wrench.	a. Fabricate as shown below. b. Prevents the drive gears from spreading.

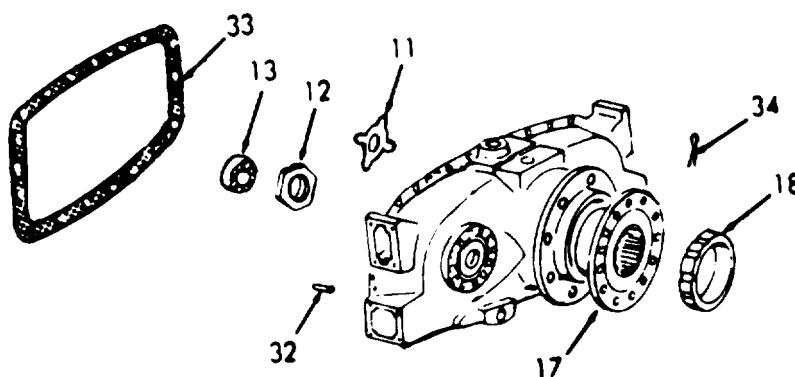


**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- |    |  |   |
|----|--|---|
| 8. | Insert a 1/2 inch square drive short extension. Then attach a flex handle.                       | Through the one inch hole in the supporting member.                           |
| 9. | While holding the transfer gear housing in a fixed position loosen the driven gear locknut (12). | Turn the next counterclockwise.   |
| e. | Loosen the drive flange locknut (18).  | 1. Use the same procedure as in step d. above.<br><br>2. Use wrench J4384-01. |



6-799

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
	f. Remove lockwire (35), screws (36) and lock-washers (37).	
	g. Remove drive gear covers (9) and gaskets (38).	Discard gaskets.
	h. Slide both power drive gears (4) with front bearings (5), and rear bearings (7) out forward face of transfer gear housing (8).	If bearing sticks in gear housing, tap the outer end of drive shaft lightly with a plastic hammer to loosen.
	i. Remove power driven gear locknut (12) and lock-washer (11).	
	j. Slide the driven gear (2) straight forward from driven shaft (3).	
	k. Remove output spacer (39).	
	l. Remove drive flange retaining nut (18).	
	m. Pull flange (17) from shaft (3).	Use puller if necessary.
	n. Remove eight bolts (40) and lockwashers (41).	
	o. Remove bearing retainer (16) and gasket (42).	Discard gasket.
	p. Remove bearing retainer oil seal (15).	Discard.



## 6-38. TRANSFER GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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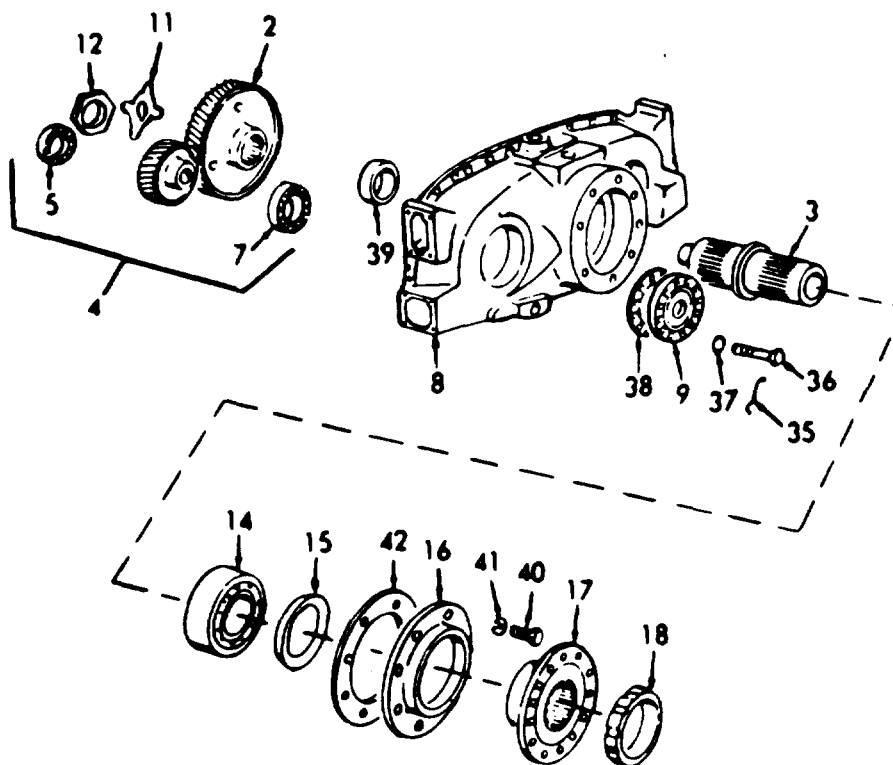
## DISASSEMBLY (Cont)

q. Support the transfer gear housing (8) and driven shaft (3) on wood blocks to maintain the shaft in a horizontal position.

r. Tap the forward end of the shaft (3) with a plastic hammer.

This will free the shaft and bearing assembly.

s. Remove the driven shaft (3) and bearing (14) as an assembly from the transfer gear housing (8).



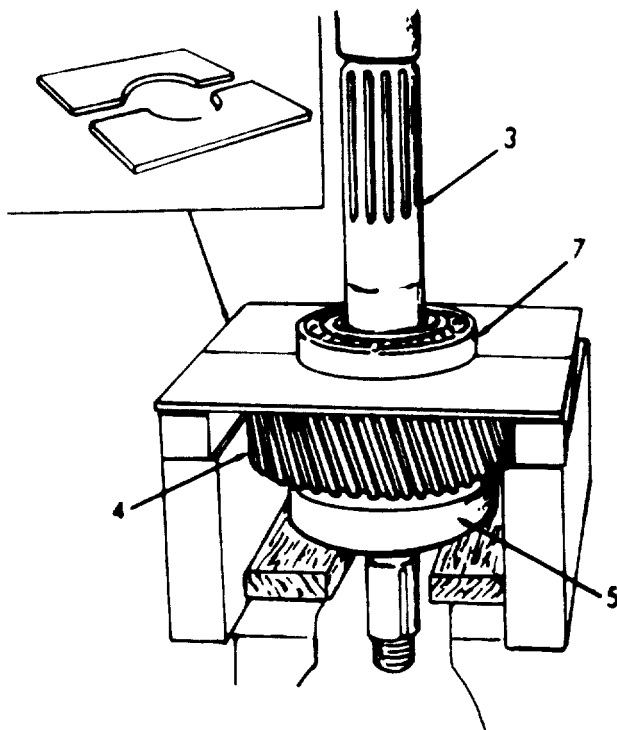
**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

t. Remove ball bearings (5 and 7) from drive gear (4) as follows:

1. Insert two split plates between the bearing and drive gear. Then, support the drive shaft (3), drive gear (4), bearings (5 and 7), and split plates on two steel supports on bed of arbor press as shown below.



6-802

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>DISASSEMBLY (Cont)</b>		
2.	Place two strips of wood on bed of press directly under each edge of drive gear to protect the teeth of gear when shaft is pressed out of the bearing.	
3.	Bring ram of press down on end of power drive shaft, and force drive shaft from the bearing.	
4.	Reverse the drive shaft and drive gear on bed of press and remove the second bearing in the same manner.	

**WARNING**

Be very careful when pressing the drive gear from the bearings, not to allow the gear and shaft assembly to fall from the steel supports. Injury to personnel or damage to parts may occur if gear and shaft assembly are allowed to fall.

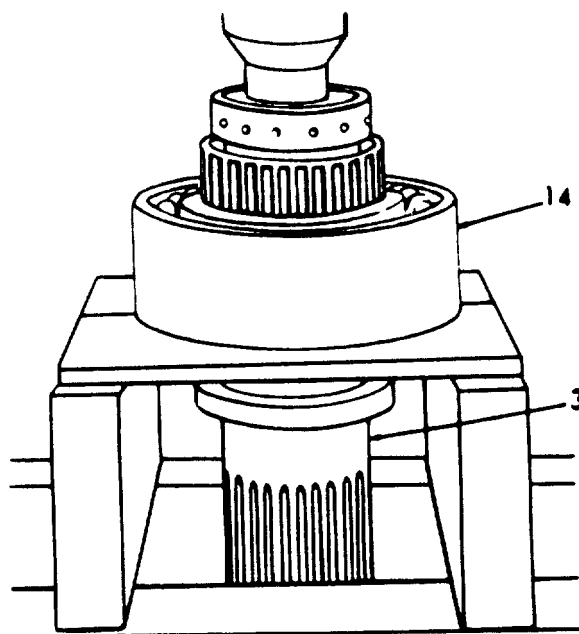
**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

u. Remove ball bearing (14) from power driven shaft (3) as follows:

1. Insert two split plates around the driven shaft between the bearing. Then, support the driven shaft, bearing and split plates on two steel supports on the bed of a hydraulic press as shown below.



2. Place wood blocks under the lower end of the driven shaft to ensure the shaft will not fall and be damaged when pressed from the bearing.
3. Bring the ram of the press down on the end of the driven shaft and force the shaft out of the bearing.

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

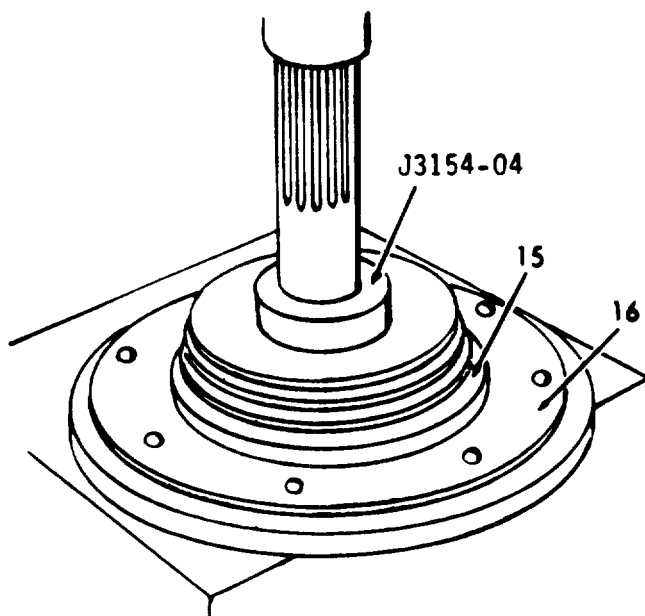
LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- v. Remove the oil seal (15) from the power driven shaft bearing retainer (16) as follows:

If inspection reveals the lip of oil seal is rough or charred, it may be removed as outlined below:

1. Support the driven shaft bearing retainer on two steel supports on the bed of an arbor press, spaced far enough apart to permit the removal of the oil seal, with the rear face of the retainer up, as shown below.
2. Place tool J3154-04 with suitable plates on top of the oil seal and under ram of press, then press the oil seal out of the bearing retainer.



6-805

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING**

11. All Parts

**WARNING**

- Dry cleaning solvent, P-D-680, used to clean parts, is potentially dangerous to personnel and property. Avoid repeated or prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°-138°F (38°-59°C).
- Wear protective eye goggles when using compressed air to prevent eye injury.
  - a. Wash all parts in dry cleaning solution P-D-680.
  - b. Blow dry with compressed air.

**INSPECTION**

12. Bearings

Inspect bearing races, cups, and balls for indications of corrosion or pitting. Apply light engine oil to bearings; then, while holding inner race from turning, revolve the outer race or cup slowly by hand to check for free rolling of the balls or rollers on the races or cups. Rough spots in the bearings are sufficient cause for rejection.

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSPECTION (Cont)</b>		
13. Gears and	<p>a. Examine teeth of drive shafts and driven gears for wear, scoring or for a chipped or nicked condition. Gears may show considerable wear and still be usable. If gears are worn excessively or chipped and nicked and cannot be cleaned up, they must be replaced.</p> <p>b. Examine splines in gear hubs, drive flange and on shafts for wear and peening. If wear and peening is excessive replace shafts, gears and drive flange.</p> <p>c. Examine threads on the drive and driven shaft for damage. If threads are severely damaged and cannot be cleaned up, replace the shaft.</p>	
14. Oil Seals and Gaskets	<p>a. Examine oil seals, and if lip of oil seal is nicked, rough or charred so that a perfect seal will be impossible, replace the oil seals.</p> <p>b. Remove all traces of old gaskets before installing the new gaskets.</p>	

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REASSEMBLY</b>		
15. Transfer Gear Housing	<p>a. Install ball bearing (14) on the power driven shaft (3) as follows:</p> <ol style="list-style-type: none"> <li>1. Lubricate the inside diameter of bearing race with engine oil. Then, place the bearing over forward end of driven shaft and start it straight on the bearing surface of the shaft.</li> <li>2. Place two split plates on two steel supports on the bed of a hydraulic press with the recess in the plates facing down.</li> <li>3. Lower the forward end of the shaft with bearing straight down through the split plates. Rest the inner race of the bearing with the upper end of the shaft under the ram of the press.</li> </ol>	



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**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

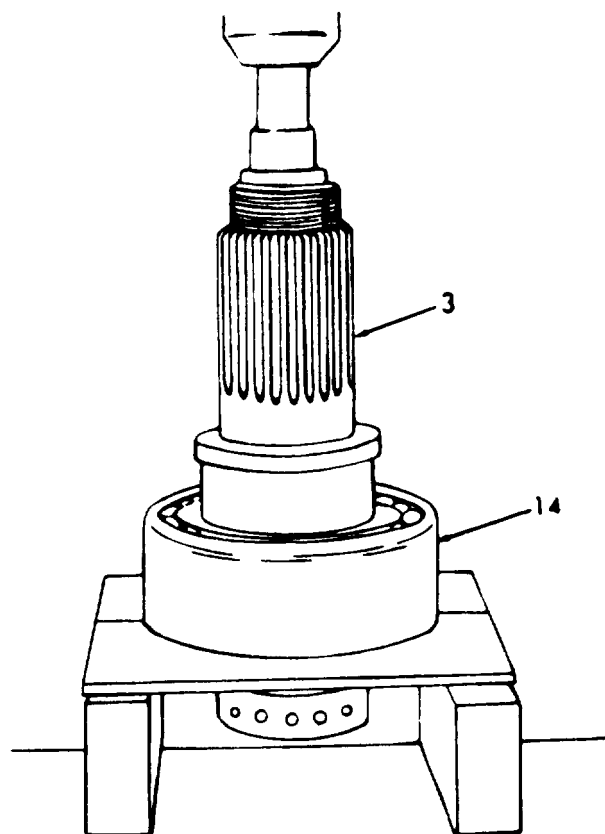
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LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

4. Press the shaft straight down through the bearing until the shoulder on the shaft seats tight against the inner race of the bearing.

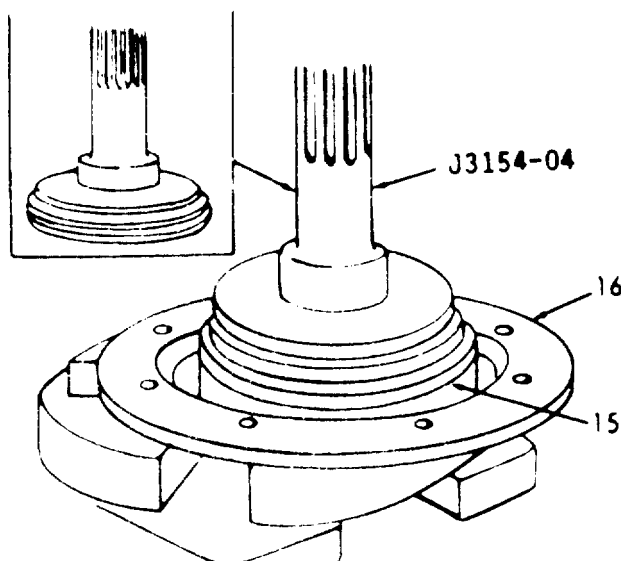
**6-809**

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- b. Install the oil seal (15) in the driven shaft bearing retainer (16) as follows:
  1. Support the driven shaft bearing retainer on the bed of an arbor press with the inner (machined) face up.
  2. Apply a thin coat of sealing compound to the outside diameter of the oil seal casing.
  3. Start the oil seal straight into the bore of the retainer with the lip of the oil seal facing up.
  4. Place tool J3154-04 with suitable plates on top of the oil seal and under the ram of the press. Then, press the oil seal straight into the retainer until the plates of the tool contact the retainer.

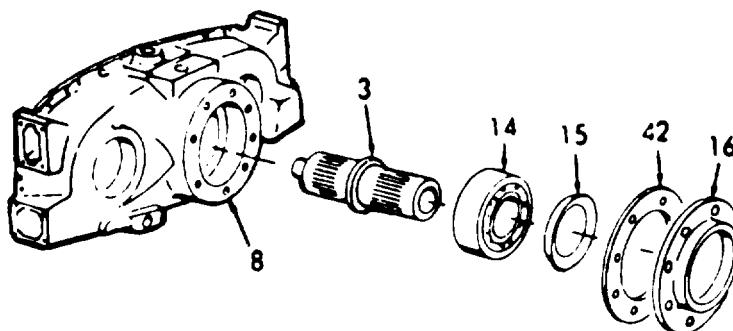


**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- c. Support the transfer gear housing (8) on wood blocks with the forward face of gear housing down, and high enough so the driven shaft will clear the floor when installed in the gear housing.
- d. Lubricate the balls and the outside diameter of the bearing (14) with engine oil. Then, insert the forward end of the driven shaft (3) straight through the bearing bore of the gear housing and start the bearing straight into the bearing bore.
- e. Tap against end of driven shaft (3) with a plastic hammer and drive the bearing and shaft assembly down until the bearing seats in gear housing.
- f. Install driven shaft bearing retainer (16) on transfer gear housing as follows:
  1. Affix a new gasket (42) to the forward face of the bearing retainer.



**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)****NOTE**

Since the bolt holes in the gasket and bearing retainer are not equally spaced, they can only be attached to the gear housing in one position .

2. Screw 7/16"-14 X 3" pilot studs in two diametrically opposite bolt holes.
3. Lubricate the lip of oil seal (15) in the bearing retainer with engine oil. Then, rotate the bearing retainer so the bolt holes in the retainer will be in alignment with the bolt holes in the gear housing.
4. Place the bearing retainer (16) straight and true over the end of the driven shaft and over the pilot studs, being very careful not to damage lip of the oil seal. Push the retainer down against the gear housing.
5. Install six 7/16"-14 X 1-5/8" bolts (40) with lockwashers (41) then remove the pilot studs and install the two remaining bolts (40) and lockwashers (41). Tighten bolts to 46-50 ft-lb (62.4-67.8 Nm) torque.
6. Rotate the driven shaft (3) and check for freeness.

**NOTE**

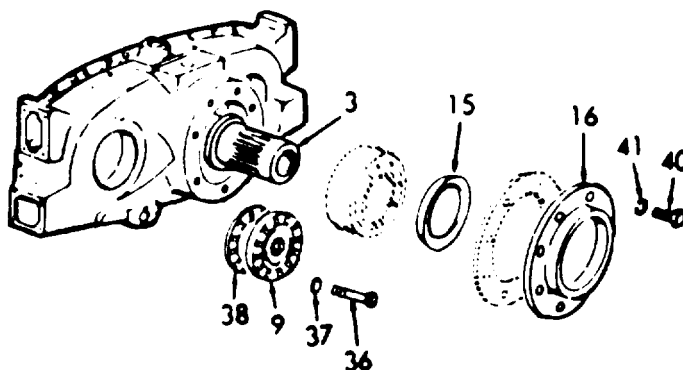
Use one or more bearing retainer gaskets to obtain the minimum end play but maintain oil seal.

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- g. Attach the drive shaft bearing covers (9) to the transfer gear housing as follows:
1. Affix a new gasket (38) to the forward face of the drive shaft bearing cover.
  2. Place the drive shaft bearing cover down on the transfer gear housing with the bolt holes in cover in alignment with the bolt holes in the gear housing.
  3. Install the six 3/8"-16 X 1-1/2" self-locking bolts (36) and flatwashers (37) finger tight only. Do not tighten bolts at this time.
  4. Install the second drive shaft bearing cover in the same manner as described above.



6-813

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

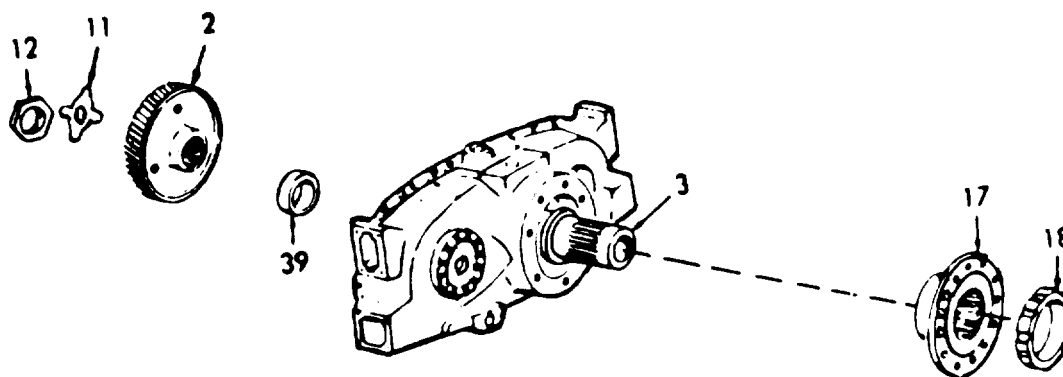
- h. Install the drive flange (17) on the power driven shaft (3) as follows:
  1. Lubricate the splines of the driven shaft, and the oil seal contact surface on the outside diameter of the drive flange with engine oil.
  2. Start the drive flange straight on the end of the driven shaft and, with the splines in alignment, push the flange tight against the inner race of bearing.
  3. If necessary, use a heavy plastic hammer and tap the drive flange onto shaft.
  4. Lubricate the threads on driven shaft with engine oil, then thread the retaining nut (18) tight against drive flange. Do not tighten at this time.
- i. Support the transfer gear housing on wood blocks with the forward face of gear housing up, and high enough for the driven shaft to clear the floor.
- j. Place the power driven gear spacer (39) straight over forward end of driven shaft (3) and slide it against the shoulder on shaft.
- k. Lubricate the splines inside the power driven gear (2) with engine oil.

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- l. Start the driven gear (2) straight on the end of the driven shaft (3) with the protruding end of gear hub facing down and with the splines in alignment, push the gear tight against the spacer (39).
- m. Place the driven gear lockwasher (11) over the end of the driven shaft (3) and against the driven gear (2). If the old lockwasher is being reused, place the bent over edges of washers over flats on hub of gear.
- n. Lubricate the threads on driven shaft (3) with engine oil, then thread the retaining nut (12) tight against the lockwasher (11). Do not tighten at this time.

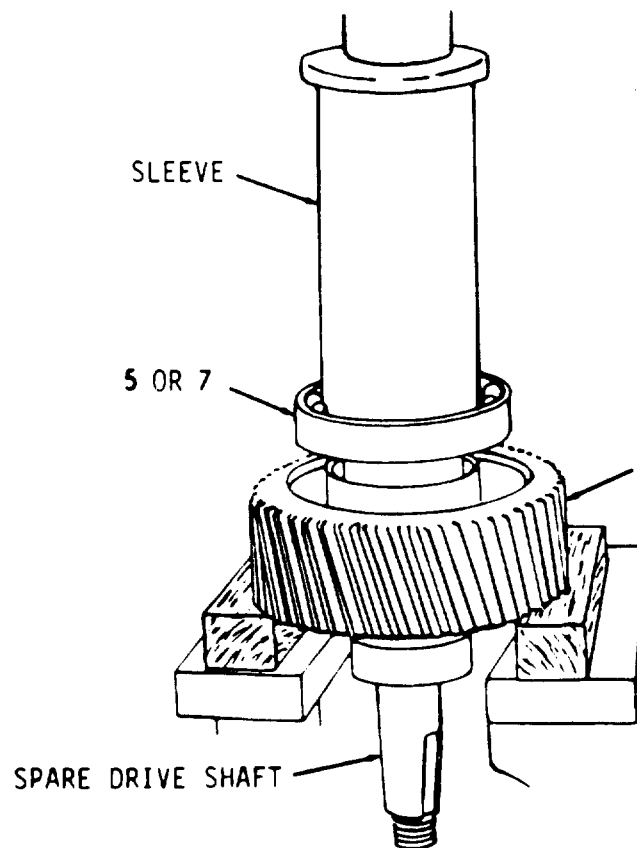


**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- o. Install the ball bearings (5 and 7) on the power drive gears (1) as follows:
  - 1. Support the power drive gear and spare drive shaft on two wood blocks, on bed of arbor press.



- 2. Lubricate the inside diameter of inner race of both drive gear ball bearings with engine oil.



**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REASSEMBLY (Cont)</b>		
3.	Place a drive gear bearing with the number on race of bearing facing up and, start it straight on hub of drive gear.	
4.	Place a 3 inch ID steel sleeve approximately 8 inch long over end of drive shaft and rest on inner race of bearing.	
5.	Place a steel plate on top of steel sleeve and under ram of press, bring ram of press down on plate and press the bearing straight down against shoulder on hub of drive gear.	
6.	Reverse the position of the drive gear on bed of press, and install the second ball bearing on opposite end of drive gear hub in the same manner as described above.	
7.	Remove spare drive shaft.	
p.	Install the power drive gear assembly in the transfer gear housing as follows:	
1.	Lubricate the rear drive gear bearing (the bearing on the long protruding end of the gear hub) with engine oil.	

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

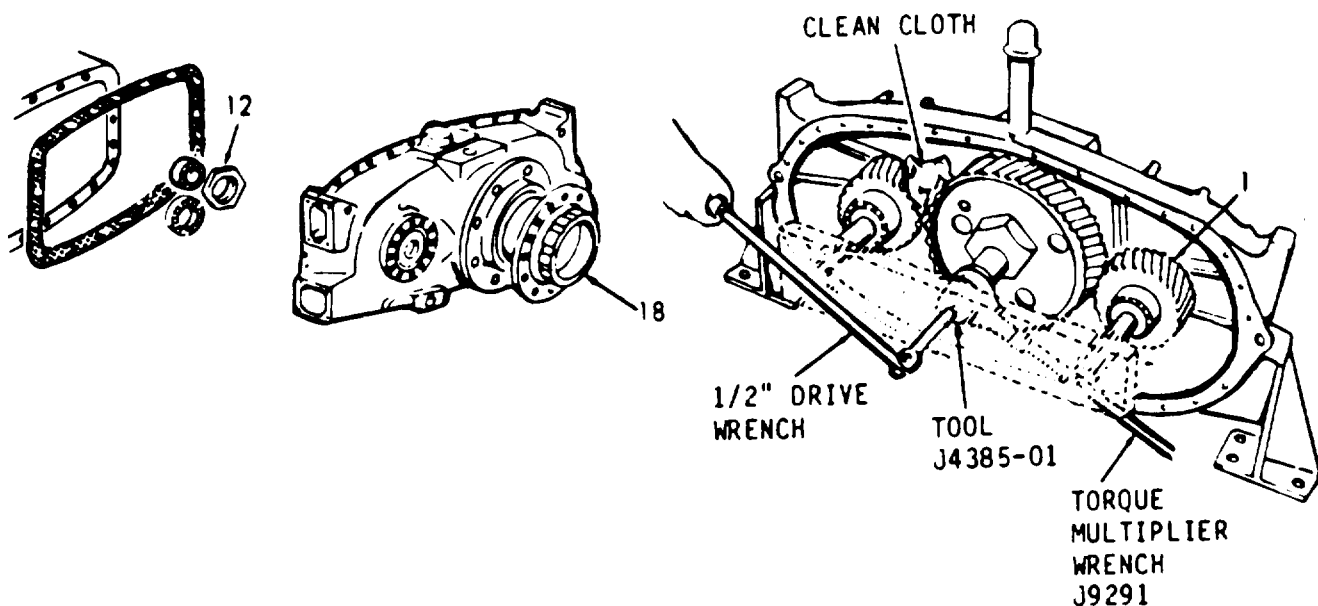
LOCATION/ITEM	ACTION	REMARKS
<b>REASSEMBLY (Cont)</b>		
	2. Position the drive gear with bearings over one of the openings in the gear housing with the long protruding end of the gear hub down.	
	3. Lower the drive gear straight down and mesh the teeth of drive gear with the driven gear. Then, start the bearing straight into the bearing bore of gear housing. Push or tap the gear and bearing into the gear housing until the bearing seats squarely in the counterbore of the bearing cover.	
	4. Install the second drive gear and bearing assembly in the opposite opening of the gear housing in the same manner as described above.	
	q. Support the transfer gear housing on suitable wood blocks with the power driven shaft in a horizontal position.	
	r. Tighten the power driven gear locknut (12) and drive flange retaining nut (18) as follows:	
	1. Wedge a clean cloth between the gear teeth to prevent the power driven shaft from turning.	

## 6-38. TRANSFER GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

2. Place wrench J4385-01 over the driven gear locknut. Then, attach a torque multiplier wrench J9291 to wrench J4385-01 with the end of handle resting on the floor.
3. Place a supporting member with two 2" holes having centers 19-1/8" apart, and a 1" hole centered between the two 2" holes, over the splined end of the two drive shafts and push it against the torque multiplier wrench, to prevent the drive gears from spreading.



**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REASSEMBLY (Cont)</b>		
4.	Insert a spare reverse gear shaft in each power drive gear, then place the supporting member over the end of the drive shafts to prevent the gears from spreading.	
5.	Insert a 1/2 inch square drive short extension through the 1 inch hole in the supporting member and into the torque multiplier wrench; then, attach a torque wrench (0-200 ft-lb range) to the short extension. With the transfer gear held in a fixed position and a clean cloth between the gear teeth, tighten the driven gear locknut to 250-300 ft-lb (339-407 Nm) torque by turning the nut clockwise.	
6.	Bend the edge of the lock-washer (11) over a flat edge of the nut at two places, and over on the two flat surfaces on hub of driven gear.	
7.	Tighten the drive flange retaining nut (18) in the same manner as outlined in steps 1 through 5 above, using spanner wrench J4384-01. Tighten the retaining nut to 450-750 ft-lb (610-1017 Nm) torque then, install cotter pins (34) in diametrically opposite pin holes through shaft and nut, and bend ends of cotter pins over.	

## 6-38. TRANSFER GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

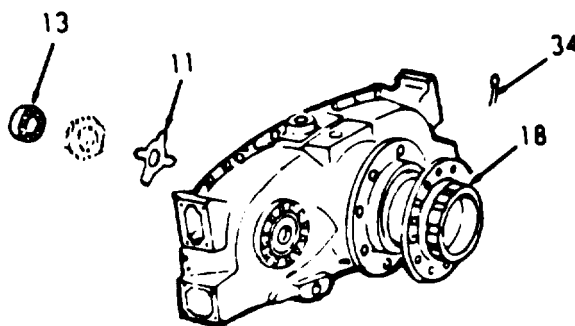
**CAUTION**

Do not attempt to tighten the driven gear or drive flange retaining nuts by using a hammer with drift or chisel. Damage to the nuts will occur. Also, the proper torque cannot be obtained when tightening the nuts in this manner.

t. Install the power driven shaft pilot bearing (13) on driven shaft as follows:

1. Heat the ball bearing in hot oil to approximately 180°F (82°C).
2. Start the bearing straight over the end of the shaft with the number on the race of the bearing facing out away from the driven gear, and slide it down against the shoulder on the shaft.

If necessary, tap the bearing into place on the shaft with a plastic hammer.



6-821

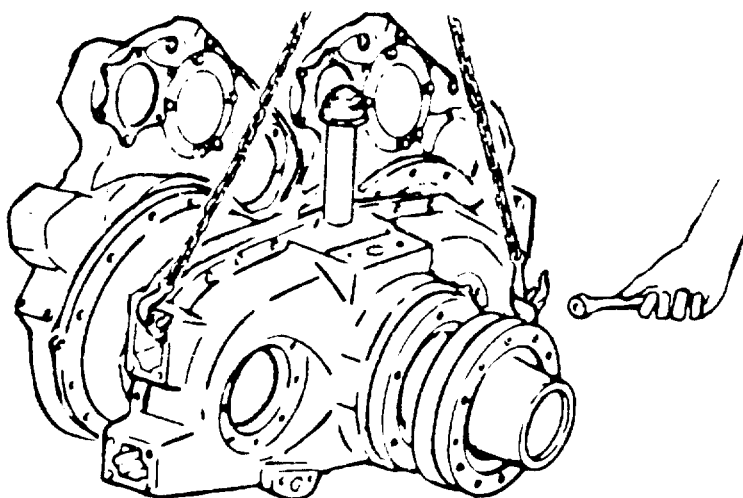
**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION**

16. Transfer  
Gear Housing

- a. Thread an eyebolt into tapped hole at each side of the transfer gear housing, then attach a chain hoist and sling to the eyebolts.



- b. Affix a new gasket (33) to the rear face of adaptor plate (10).
- c. Lubricate the splines of both drive shafts (4), the driven shaft pilot bearing (13) and the two drive gear bearings (5) with engine oil.
- d. With the blocking still in place beneath the two engine flywheel housings, same as when the transfer gear assembly was removed, position the gear assembly directly in back of the adaptor plate with the drive shafts in line with the center of drive gears.

**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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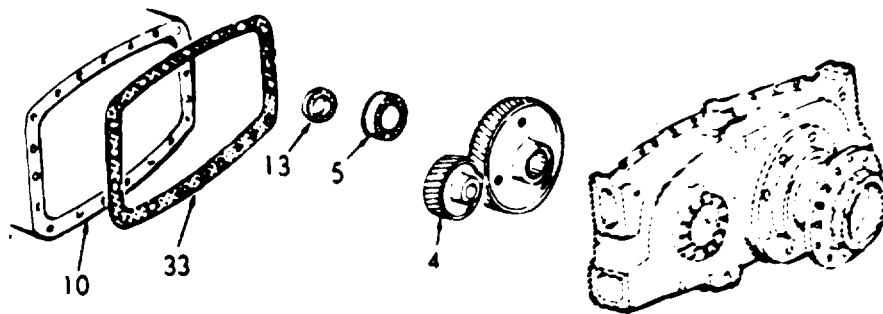
**INSTALLATION (Cont)**

- e. Move the transfer gear assembly forward and pilot the drive shafts straight into the hubs of drive gears. Continue to move the assembly forward and engage the splines of drive shafts with splines in hub of drive gears.

**NOTE**

If the splines on the drive shafts do not readily engage those in the gear hubs, press forward on the gear assembly and, at the same time, turn the driven shaft drive flange slightly to align the splines. If one drive shaft enters and the other does not, bar the engine of the non-engaging gear over by hand until the shaft enters the splines in gear hub.

- f. With the drive shafts entered into the hubs of drive gears, continue to push the assembly forward to enter the driven shaft pilot bearing and the drive gear bearings straight into bearing bores in the adaptor plate. Push the assembly forward over the dowel pins and against the adaptor plate gasket.

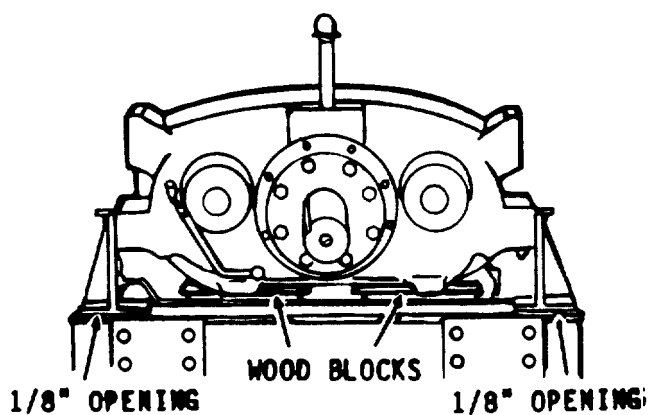


**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- |    |   |  |
|----|---|--|
| g. | Install the gear housing to the adaptor plate bolts (26, 28, and 30) with lockwashers (27, 29, 31). Tighten the bolts (28) to 30-35 ft-lb (40.7-47.5 Nm).<br>Four bolts (26) 3/8-16 X 4-1/2 inch. Four<br>Sixteen bolts (30) 3/8-16 X 1-1/4 inch. |  |
| h. | Remove the sling, chain hoist and eyebolts from transfer gear housing.  |  |
| i. | Attach a sling and chain hoist to the lifting bracket at the top of each engine flywheel housing. Lift the rear of the engines just enough to permit the removal of the blocking from beneath the flywheel housings.                              |  |



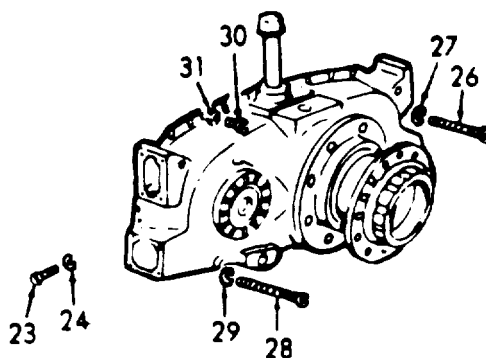


**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

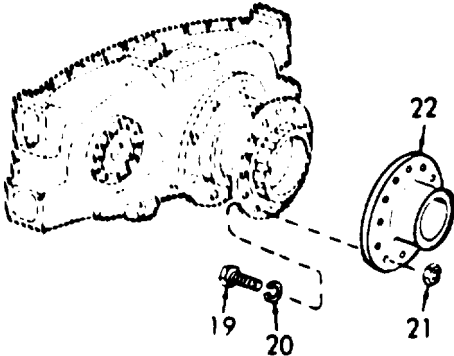
LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- j. Lower the unit so it rests on the side rails. Align the bolt holes in the side rail with the bolt holes in the flywheel and transfer gear housings. Then, install the two side rails to the flywheel housing bolts (26) with lockwashers on each engine, and the four side rails to gear housing bolts (23) with lockwashers (24) at each side of the gear housing.
- k. Tighten the side rail to the flywheel housing and gear housing bolts (23) to 71-75 ft-lb (96.2-101.7 Nm) torque.
- l. Tighten the front support bracket to side rail bolt nuts (25) to 83-93 ft-lb (112.5-126.1 Nm) torque.
- m. If not previously tightened, the drive shaft bearing cover bolts should be tightened to 40-45 ft-lb (54.2-61.0 Nm) torque.
- n. Remove the chain hoist and sling from the engine lifting brackets.



**6-38. TRANSFER GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSTALLATION (Cont)</b>		
17. Propeller Shaft Flange (22)	a. Align flanges. Refer to para- graph 6-22.  b. Install twelve bolts (19), lockwashers (20), and nuts (21).	
		
18. Fuel Lines and Strainer	Install.	
19. Transmission Control Valve	Install. Refer to paragraph 5-30.	
20. Transfer Gear Housing To Reverse Gear Housing Oil Tubes	Install.	
21. Transfer Case and Flywheel Housing	Install oil. Refer to paragraph 6-40.	

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**6-39. REVERSE GEAR ASSEMBLY.**

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**a. General.**

The torqmatic marine reverse gear used on multiple engine units shown below, along with the flywheel assembly provide an emergency forward clutch lock, positive clutch engagement or release by simply moving the selector valve lever to the desired position for forward, neutral or reverse.

Each marine gear consists of a flywheel and forward drive clutch assembly, and a reverse drive clutch assembly with a through drive shaft. Also, each has an oil pump (refer to paragraph 3-40) for supplying oil under pressure for operating the forward and reverse clutches, a control valve (refer to paragraph 2-32) to admit oil to the clutches, an oil strainer, a full-flow oil filter and an oil cooler.

Power from the diesel engine is imparted to the through drive shaft by locking the forward or reverse clutch plate between the hydraulically operated piston and a drive plate.

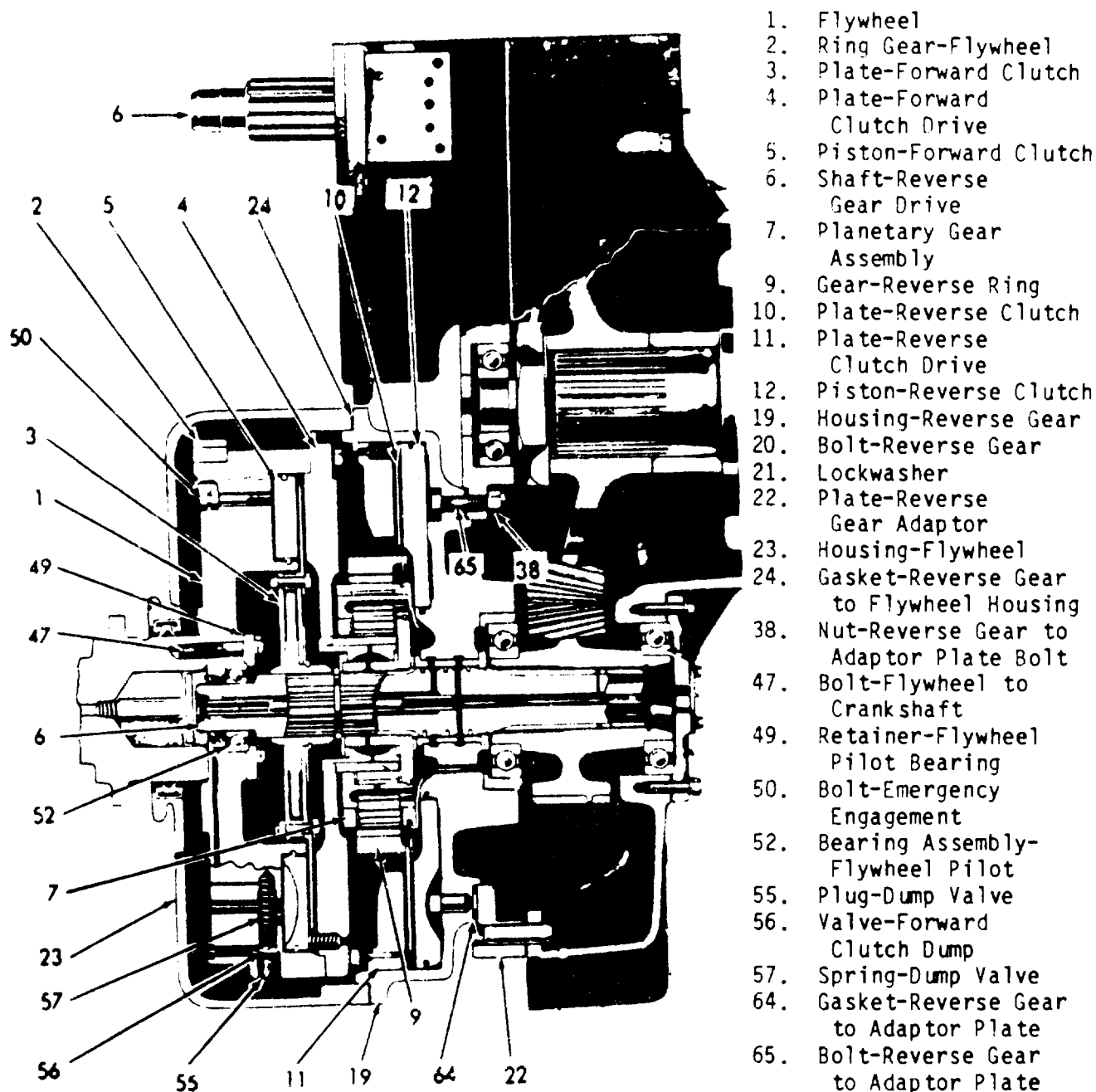
Each flywheel consists of a flywheel (1), ring gear (2), forward clutch plate (3), forward clutch drive plate (4), forward clutch piston (5) and a forward clutch piston type dump valve.

The flywheel, with the ring gear installed, is bolted directly to the crankshaft. The forward clutch drive plate is bolted to the aft face of the flywheel. This plate also serves as a drive for the reverse planetary gear set since the gear teeth at the inner diameter mesh with the teeth of the sun gear.

The forward clutch piston rides in the flywheel and is driven by three clutch drive pins anchored in the flywheel. Movement of the piston is obtained by admitting oil under pressure into the cavity between the flywheel and the forward face of the piston. Oil leakage from this cavity is prevented by seal rings and expanders at the inner and outer diameters of the piston. When the oil pressure is released, a series of springs within the forward clutch drive plate move the piston forward.

Facings on the forward clutch plate (3) are sandwiched between the drive plate (4) and the forward piston (5) while splines at the clutch plate hub engage mating splines on the through drive shaft. When the facings on the clutch plate are locked between the piston and the drive plate by movement of the piston, the clutch plate and the shaft are driven in a forward direction.

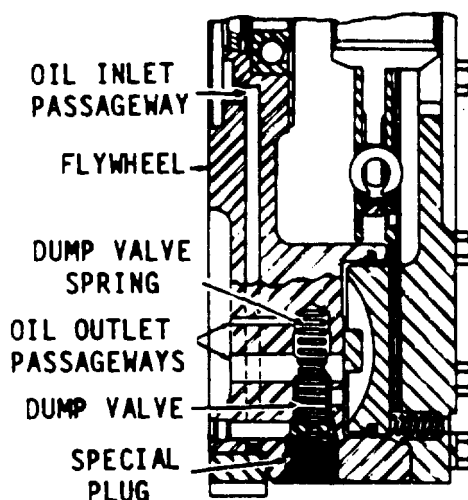
## 6-39. REVERSE GEAR ASSEMBLY (Continued,).



Transfer Gear Housing

**6-39. REVERSE GEAR ASSEMBLY (Continued).**

On the forward clutch piston type dump valves, the oil pressure behind the forward clutch piston is controlled by the pressure sensitive centrifugally balanced dump valve moving in the cavity at the outer diameter of the flywheel. These valves are of such weight and area that their mass exactly balances the centrifugal force of the oil pressure. A spring behind the valve provides a constant force for returning the valve to the dump position when the oil pressure is shut off.



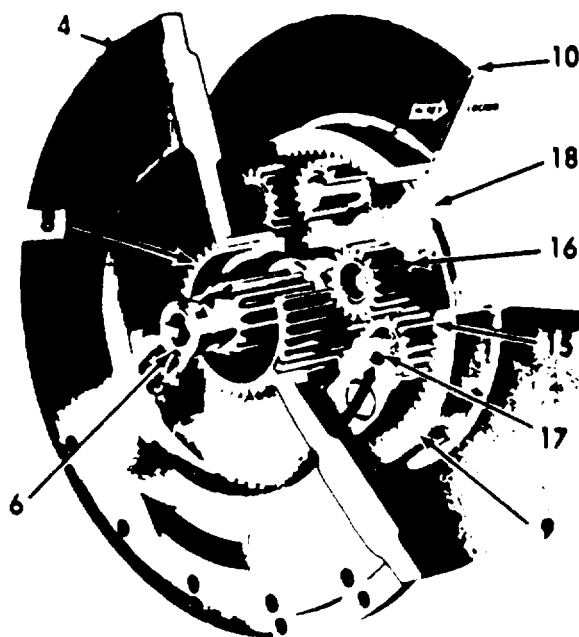
Reverse rotation of the drive shaft (6) is accomplished through a planetary gear set (7). Teeth at the inner diameter of the forward clutch drive plate (4) mesh with the teeth on the sun gear (8) which drives the planetary gear set. A ring gear (9) surrounding the planet gears is splined to a reverse clutch plate (10) which is held stationary in reverse between the reverse clutch drive plate (11), and the piston (12).

The reverse clutch drive plate (11) is retained by a snapping (13) assembled in the reverse gear housing and is restrained from rotating by three dowel pins at its periphery. A reverse clutch piston (12) is mounted inside the reverse gear housing aft of the reverse clutch plate. Like the forward drive piston, the reverse piston is mounted on drive pins (14) to prevent radial motion.

The following figure shows the construction and illustrates the working principle of the planet assembly which imparts a reverse motion to the drive shaft when the engine is running.

**6-39. REVERSE GEAR ASSEMBLY (Continued).**

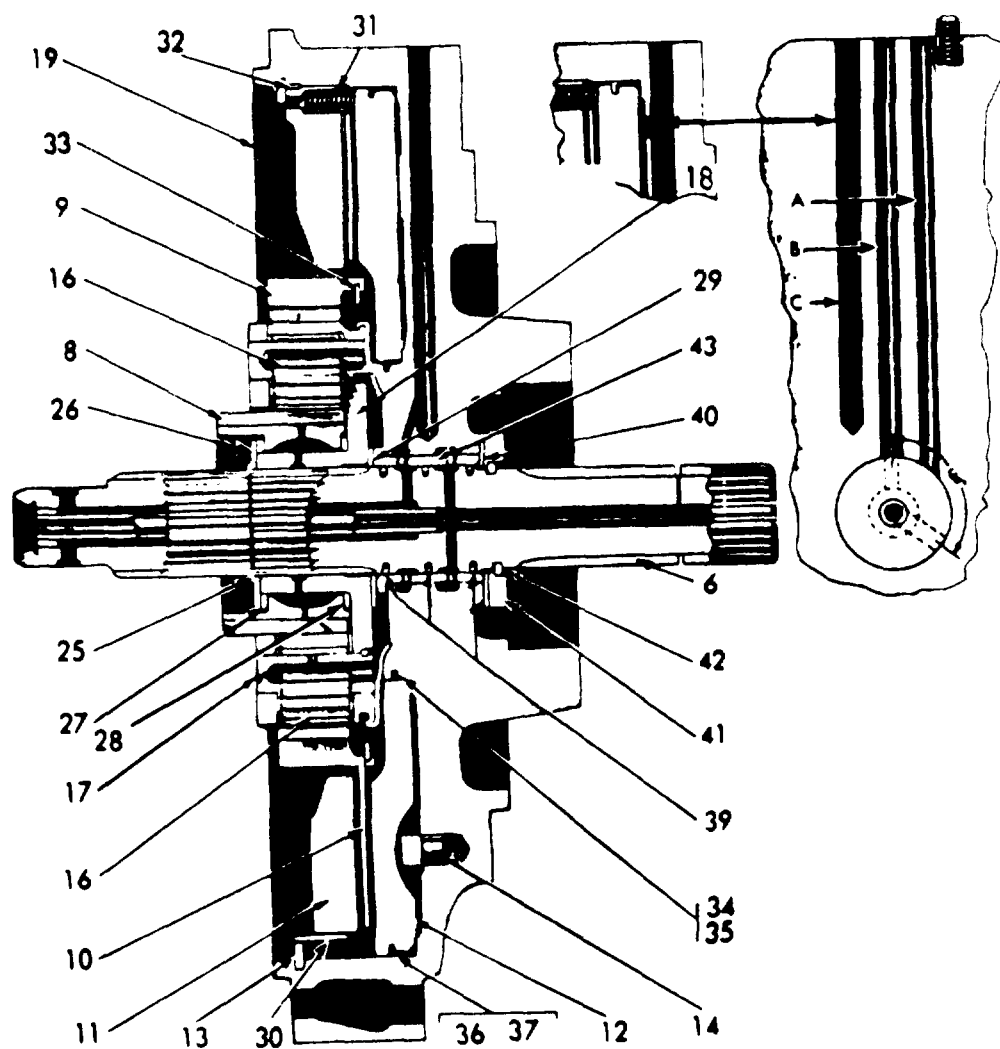
Four pairs of needle bearing-mounted planet gears (15) and (16), meshing together, are carried on shafts (17) fixed in a carrier (18). The mounting shafts for the four gears (16) are nearer the center of the carrier than the four shafts for gears (15) thus gears (16) mesh with the sun gear (8) at the center of the carrier and gears (15) mesh with the ring gear (9) surrounding the planet carrier. The planet carrier is splined to and rotates with the drive shaft (6). The sun gear (8) is free to rotate on the hub of carrier (18) while the ring gear (9) may be locked from rotating by the reverse clutch plate (10). Since the sun gear (8) meshes with and is driven by the forward clutch drive plate (4) which is a part of the flywheel, motion is imparted to the sun gear in a forward direction and, if the ring gear (9) is held stationary, the planet assembly will revolve in a reverse direction to the engine flywheel carrying the drive shaft along with it. The reversal of motion is more fully explained under Operation.



- |   |                               |
|---|-------------------------------|
| 4. Plate-Forward Clutch Drive<br>(Reaction) | 10. Plate-Reverse Clutch      |
| 6. Shaft-Reverse Gear Drive                 | 15. Gear-Reverse Planet       |
| 8. Gear-Reverse Sun                         | 16. Gear-Reverse Planet       |
| 9. Gear-Reverse Ring                        | 17. Shaft-Reverse Planet Gear |
|   | 18. Carrier-Reverse Planet    |

**Gear Train Diagram of Planet and Reverse Drive - L.H. Rotation Engine**

6-39. REVERSE GEAR ASSEMBLY (Continued).



Reverse Gear Assembly

6-831

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**6-39. REVERSE GEAR ASSEMBLY (Continued).**


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## Reverse Gear Assembly Legend

- A. Passage-Forward Oil
- B. Passage-Neutral Oil
- C. Passage-Reverse Oil
- 6. Shaft-Reverse Gear Drive
- 8. Gear-Reverse Sun
- 9. Gear-Reverse Ring
- 10. Plate-Reverse Clutch
- 11. Plate-Reverse Clutch Drive
- 12. Piston-Reverse Clutch
- 13. Snapring-Reverse Clutch Drive Plate
- 14. Pin-Clutch Drive
- 16. Gear-Reverse Planet
- 17. Shaft-Reverse Planet Gear
- 18. Carrier Assy.-Reverse Planet
- 19. Housing-Reverse Gear
- 25. Snapring-Planetary Gear Retaining
- 26. Washer-Planetary Gear Retaining
- 27. Thrust Washer-Reverse Sun Gear
- 28. Thrust Washer-Reverse Sun Gear
- 29. Thrust Washer-Planetary Gear
- 30. Pin-Snapring Retaining Spring
- 31. Spring-Reverse Clutch Piston Retracting
- 32. Dowel Pin
- 33. Snapring
- 34. Seal Ring-Reverse Clutch Piston (Inner)
- 35. Expander-Reverse Clutch Piston Seal Ring (Inner)
- 36. Seal Ring-Reverse Clutch Piston (Outer)
- 37. Expander-Reverse Clutch Piston Seal Ring (Outer)
- 39. Ring-Drive Shaft Oil Seal
- 40. Thrust Washer-Reverse Gear Drive Shaft
- 41. Thrust Washer-Reverse Gear Drive Shaft
- 42. Snapring-Drive Shaft Thrust Washer
- 43. Sleeve-Oil Transfer

## b. Operation.

Motion from the marine engine is imparted to the drive shaft by locking either the forward or reverse clutch plate between a hydraulically-operated piston and a drive plate. The following paragraphs explain how the mechanism operates. A previous figure illustrates the direction of motion of the various gears and allied parts of the planet to impart reverse motion to the drive shaft.



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

The sun gear (8) is free to rotate around the hub of the planet carrier (18) which is, in turn, splined to the drive shaft (6). Gear teeth at the inner diameter of the forward clutch drive plate (4) mesh with the teeth on the sun gear. Consequently, when the engine is running, the sun gear is carried around with the flywheel.

Four pairs of planet gears (15) and (16) are needle-bearing-mounted on shafts (17) fixed in the carrier (18). Four of the planet gears (16) mesh with the sun gear; the other four planet gears (15) mesh with gears (16) and with ring gear (9) surrounding the planet gears but separate from the planet carrier (18). The reverse clutch plate (10) is splined to the ring gear (9).

When the reverse clutch is applied, the ring gear (9) is held stationary. Then, with the sun gear (8) traveling in the same direction as the engine and at engine speed, planet gears (16) will revolve counterclockwise and planet gears (15) will revolve clockwise inside the stationary ring gear (9), thus turning the planet carrier (18) and drive shaft (6) in a counterclockwise direction at engine speed.

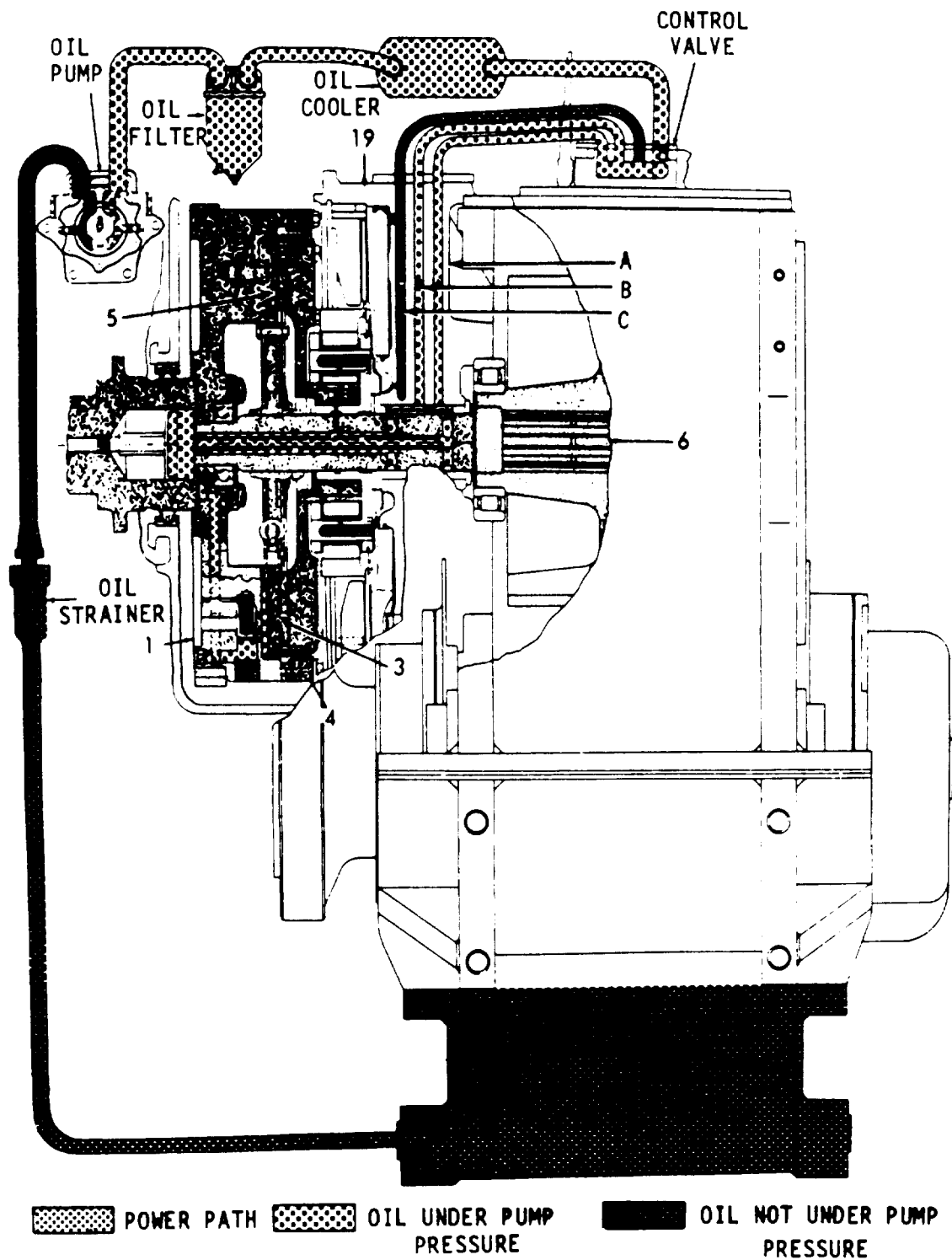
**(1) Forward Drive**

As shown below when the engine is running, forward drive to the shaft (6) is accomplished by moving the selector control valve lever to the forward position. This admits oil under pressure from the pump to the oil passage (A) in the reverse gear housing (19) and into a quill in the drive shaft (6), thence through a radial passage in the flywheel to an intersecting horizontal passage-leading to the cavity between the flywheel and the forward clutch piston.

**Oil Flow Diagram for Application of Forward Drive Clutch Including Power Flow Legend**

- A. Passage-Forward Oil
- B. Passage-Neutral Oil
- C. Passage-Reverse Oil
- 1. Flywheel
- 3. Plate-Forward Clutch
- 4. Plate-Forward Clutch Drive
- 5. Piston-Forward Clutch
- 6. Shaft-Reverse Gear Drive
- 19. Housing-Reverse Gear

6-39. REVERSE GEAR ASSEMBLY (Continued).



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

The piston type dump valve which is located at the outer diameter of the flywheel are backed up by a spring. When the flywheel is rotated, the spring pressure tends to push the valve out toward the periphery of the flywheel. When the control valve is opened to admit oil to operate the forward piston (5), the pressurized oil overrides the tension of the valve spring and pushes the valve in toward the center of the flywheel. When the valve is pushed in, the valve uncovers the port in the flywheel, leading to the piston, and admits pressurized oil into the cavity forward of the piston. The pressurized oil moves the piston toward the drive plate, thereby locking the clutch plate between the piston and the drive plate.

Since the drive plate (4), which is bolted to the flywheel, is in constant mesh with the sun gear (8) and the planet carrier (18) is splined to the drive shaft, there is no relative motion between the sun gear and the planet gears (16) when in forward drive with the result that the planet assembly including the ring gear (9) and the reverse clutch plate (10), revolves in a forward direction with the flywheel.

**(2) Neutral**

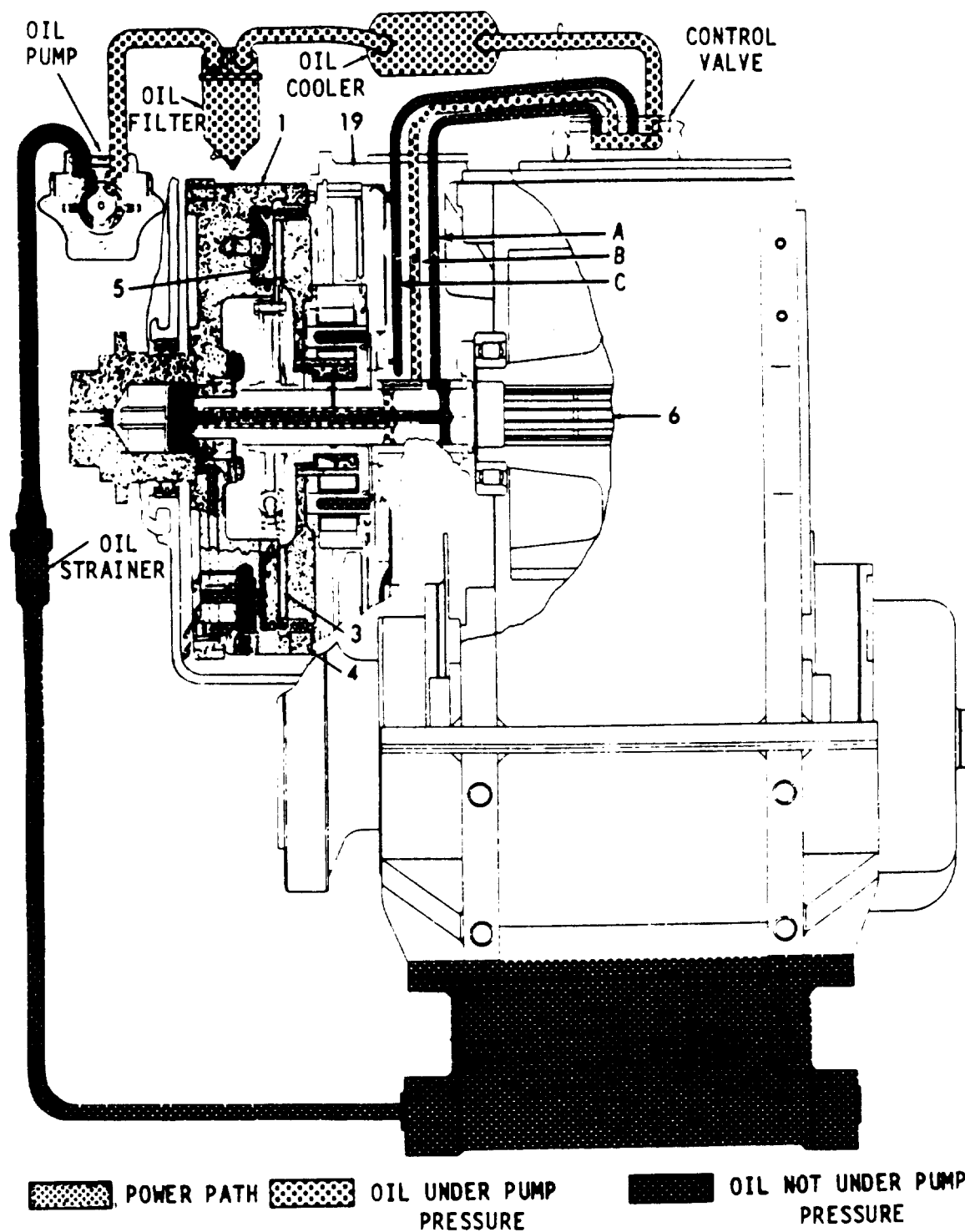
When the selector control valve lever is moved to the neutral position, oil pump pressure is relieved from the dump valve and the pressure of the spring pushes the valve out, cutting off the oil supply to the forward piston, thereby permitting the oil to drain from the cavity forward of the piston. Thus, the piston moves forward, releasing the clutch plate.

With the selector control valve lever set in neutral position, pump pressure is cut off from both the forward and reverse clutch passages (A) and (C), but not from passage (B), as shown below.

**Oil Flow Diagram for Lubrication of Marine Gear in Neutral Legend**

- A. Passage-Forward Oil
- B. Passage-Neutral Oil
- C. Passage-Reverse Oil
- 1. Flywheel
- 3. Plate-Forward Clutch
- 4. Plate-Forward Clutch Drive
- 5. Piston-Forward Clutch
- 6. Shaft-Reverse Gear Drive
- 19. Housing-Reverse Gear

6-39. REVERSE GEAR ASSEMBLY (Continued).



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**6-39. REVERSE GEAR ASSEMBLY (Continued).**

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**(3) Reverse Drive**

As shown below, when the engine is running, reverse drive to the shaft (6) is accomplished by moving the selector control valve lever to the reverse position which admits oil under pressure from the pump to the oil passage (C) in the reverse gear housing (19) and to the cavity aft of the piston (12). When oil pressure is applied to this piston, it moves forward to lock the clutch plate (10) between the piston and the stationary drive plate (11) and, since the clutch plate is splined to the ring gear (9), the ring gear is held stationary.

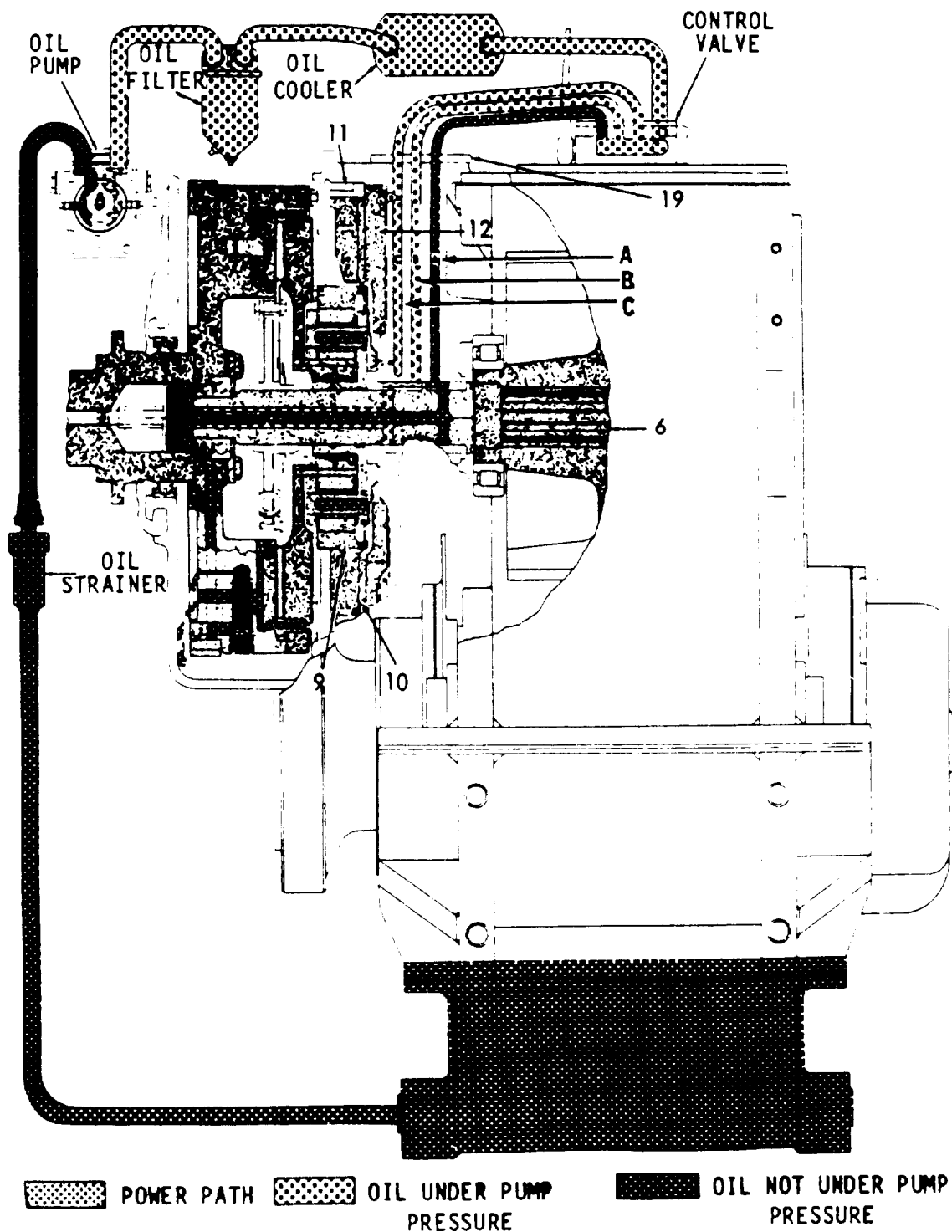
Shifting from forward to reverse drive through neutral may be made at any speed; however, it is advisable to shift at low engine speeds. For longest clutch life, reduce the engine speed to idle, make the shift and then increase the engine speed.

The landing craft has a locking (brake) device to prevent the propeller shaft from rotating when not under direct propulsion. The forward motion of the vessel causes the propeller shaft to rotate. Thus, with the marine oil pump not operating, lubricating oil is not circulated through the marine gear. Therefore, overheating and damage to the marine gear is possible unless the rotation of the propeller shaft is prevented.

**Oil Flow Diagram for Application of Reverse Clutch Including Power Flow Legend**

- A. Passage-Forward Oil
- B. Passage-Neutral Oil
- C. Passage-Reverse Oil
- 6. Shaft-Reverse Gear Drive
- 9. Gear-Reverse Ring
- 10. Plate-Reverse Clutch
- 11. Plate-Reverse Clutch Drive
- 12. Piston-Reverse Clutch
- 19. Housing-Reverse Gear

6-39. REVERSE GEAR ASSEMBLY (Continued).



**6-39. REVERSE GEAR ASSEMBLY (Continued).****This task covers:**

- |                |               |                 |
|----------------|---------------|-----------------|
| a. Removal     | c. Cleaning   | e. Reassembly   |
| b. Disassembly | d. Inspection | f. Installation |

**INITIAL SETUP****Test Equipment**

NONE

**References**

NONE

**Special Tools**

Pilot bearing remover  
 adapter J5901-2  
 Piston remover tool J4746  
 Oil seal remover tool J4700  
 Flywheel lifting tool J6361-01  
 Arbor press  
 Slide hammer  
 Adapter 5/16-18

**Equipment  
Condition****Paragraph****Condition Description**

6-38	Transfer Gear Case-Removal
6-22	Propulsion Unit Removal

**Tools**

General Mechanic's Tool Kit  
 NSN 5180-00-629-9783  
 Rope slings  
 Chain hoist  
 Clamps

**Material/Parts**

Engine oil  
 Sealing compound  
 Grease, cup

**Special Environmental Conditions**

NONE

**Personnel Required**

2

**General Safety Instructions**

Observe WARNINGS in procedure.

**LOCATION/ITEM****ACTION****REMARKS****REMOVAL**

- |                |   |                          |
|----------------|---|--------------------------|
| 1. Marine Gear | a. Remove power transfer gear assembly. | Refer to paragraph 6-38. |
|----------------|---|--------------------------|

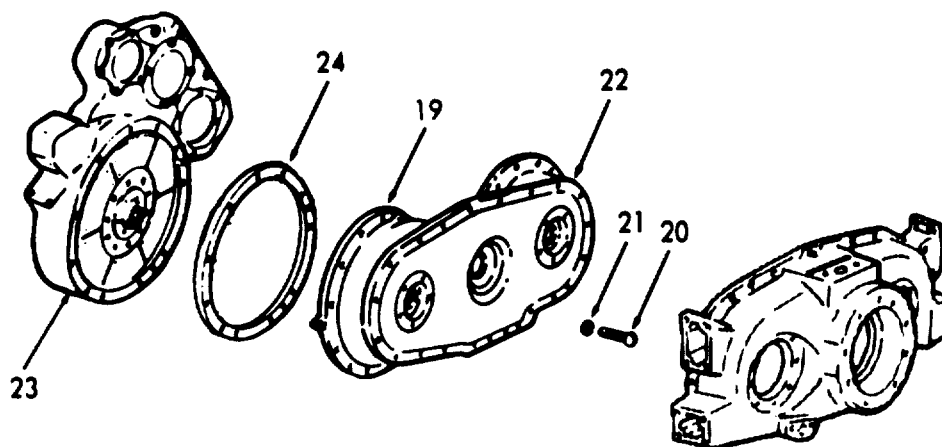
**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)****NOTE**

**Do not remove engine support blocks.**

- b. Remove screws (20) and lock-washers (21).      Screws are 1/2-13 X 3-1/4 long.
- c. Install two rope slings and a Support for re-chain hoist.      verse gears and adapter plate.
- d. Start four bolts into tapped holes provided in the bolting flange at each side of reverse gear housing.      Bolts are 3/8-16.
- e. Tighten bolts evenly and crowd the reverse gear housing away from the flywheel housings.
- f. Pull the adapter plate (22) and reverse gear housings (19) assembled straight back until the drive shafts clear the flywheel housings (23).
- g. Lift assembly away from the engines and support on wood blocks.
- h. Remove gasket (24).      Discard.



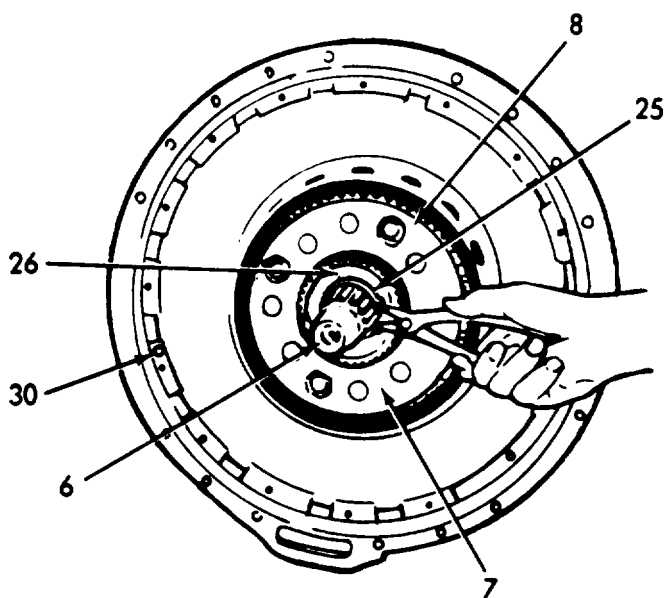


**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY**

- |                 |  |  |
|-----------------|--|--|
| 2. Reverse Gear | a. Remove planetary gear retaining ring (25). Use snapping pliers. |  |
|-----------------|--|--|



- |   |   |
|---|---|
| b. Slide planetary gear retaining washer (26) off the end of drive shaft (6). with the sun gear.  | If the washer tends to stick, it may be removed later |
| c. Remove the reverse sun gear (8), reverse planetary gear assembly separately. (7), and the sun gear thrust washers (27 and 28) as an assembly from the drive shaft (6). | These parts may be removed separately.                |

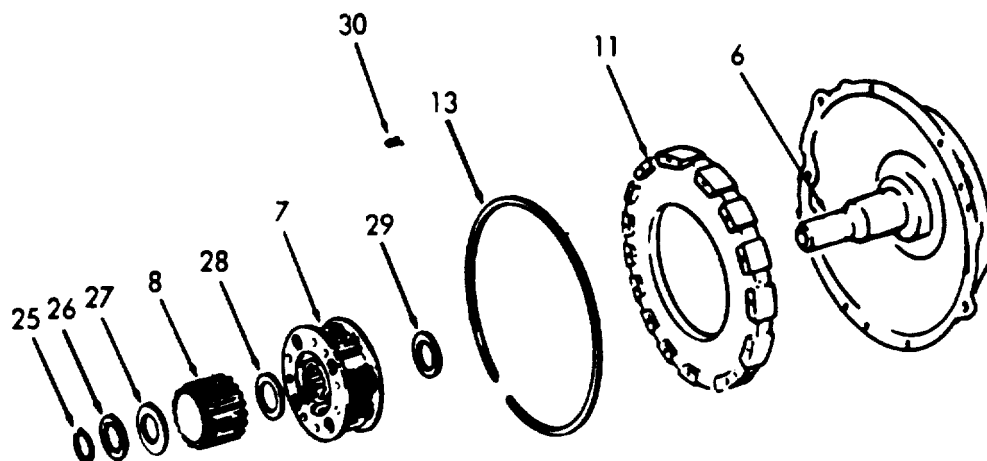
## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## DISASSEMBLY (Cont)

d. Remove reverse gear thrust washer (29) from drive shaft (6).

e. Tap the three snapping retaining spring pins (30) into the reverse clutch drive plate (11), until they clear the edge of the retaining ring (13). Use a small punch and hammer.

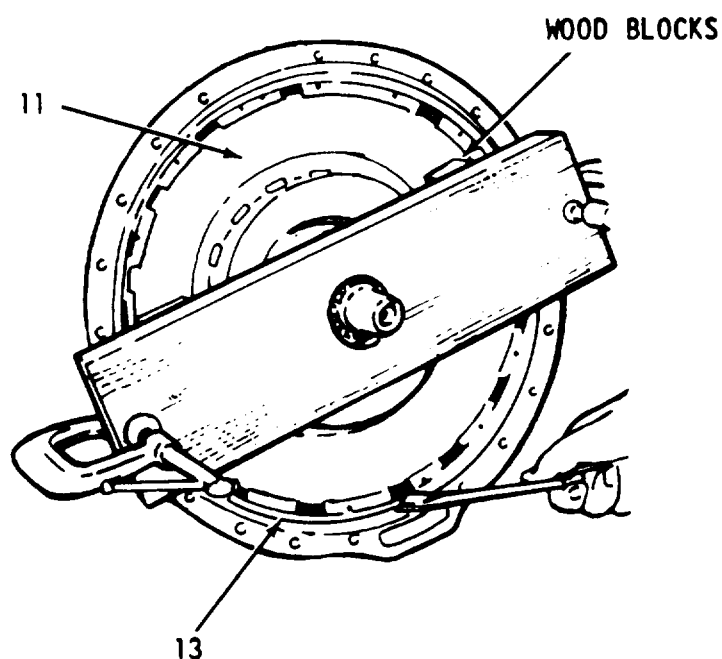


**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- f. Clamp a board across the face of the reverse gear housing with a one inch wood block at each end between the board and the clutch drive plate (11).
- g. Remove retaining ring (13) Use a screw from the groove in the driver housing.



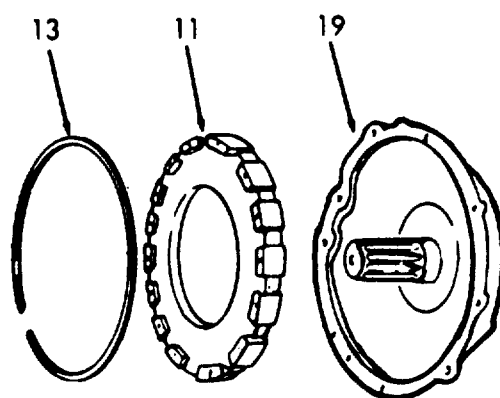
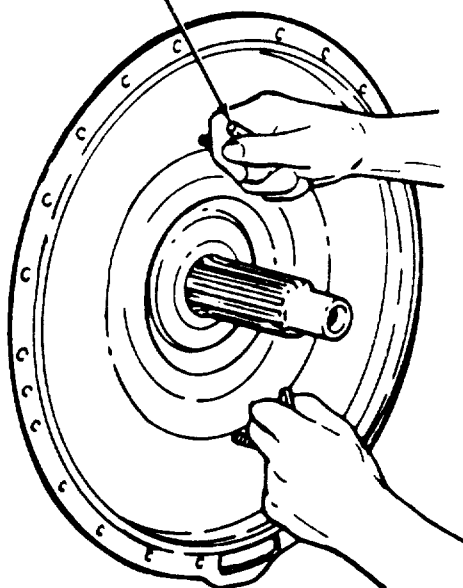
- h. Remove the clamps, board, and wood blocks from the reverse gear.
- i. Thread a piston remover Use tool J4746 tool into each of two tapped (T-head bolt) holes in the forward face of the reverse clutch drive plate (11).

**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- j. Pull the reverse clutch drive plate (11) straight forward until it is free in the reverse gear housing (19).

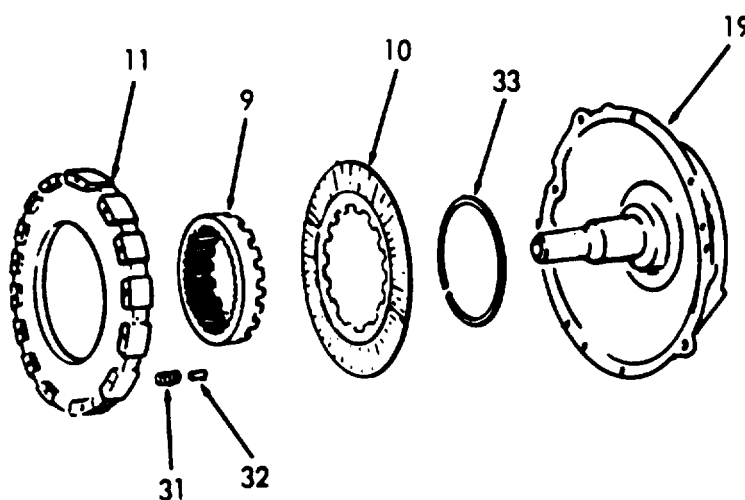
**TOOL J4746**

**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- k. Lift drive plate (11), ring gear (9), and reverse clutch plate (10) as an assembly from the gear housing (19).
- l. Remove the sixteen clutch release springs (31) and three dowel pins (32) from the gear housing (19), and the reverse clutch drive plate (11).
- m. Remove the reverse clutch Use a screw-plate retaining ring (33) driver. from the groove in the reverse ring gear (9).
- n. Lift the clutch plate (10) from the ring gear (9).

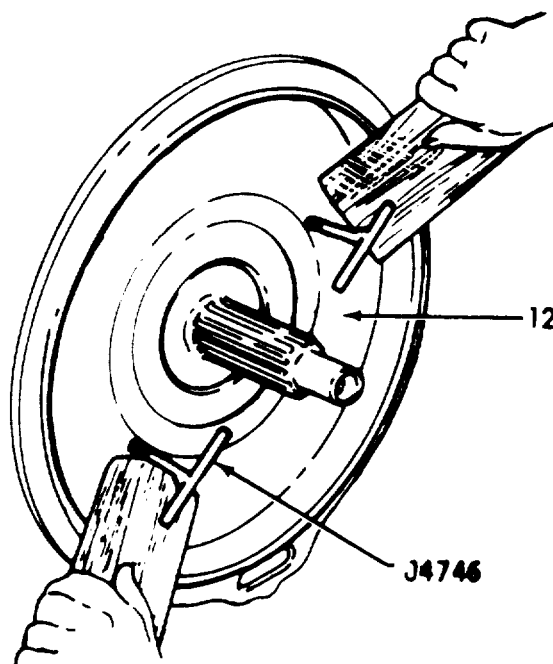


**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- o. Thread a piston remover Use tool J4746 into each of two tapped (T-head bolt) holes in the forward face of the reverse clutch piston (12).
- p. Place a 2 inch X 4 inch X 2 foot length of wood block over the edge of the reverse gear housing and beneath the cross bar of each remover tool. Push down evenly on the end of the two wood blocks, and break the oil seal (vacuum lock) in back of the piston, thus freeing the piston (12) in the housing.



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**6-39. REVERSE GEAR ASSEMBLY (Continued).**

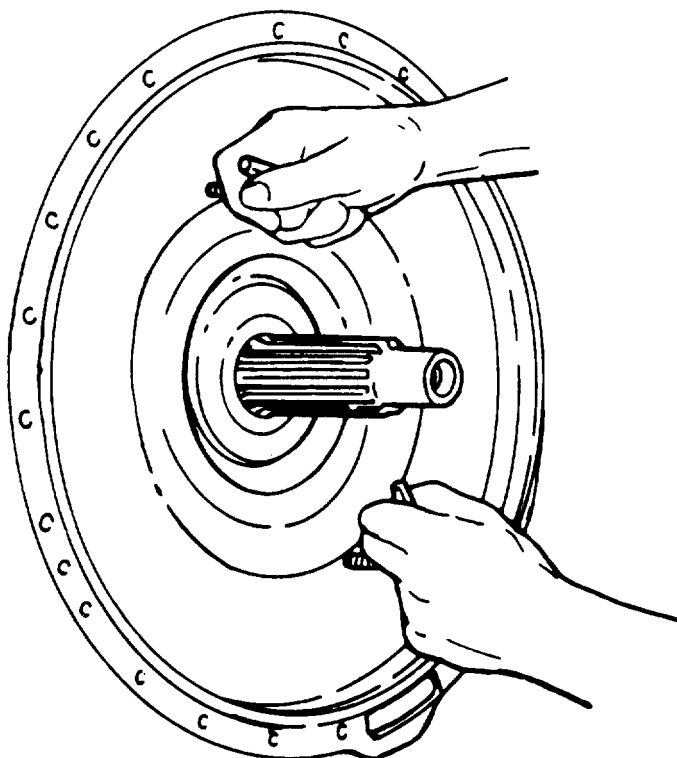
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LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- q. Remove both wood blocks.
- r. Pull the reverse clutch piston (12) straight forward out of the reverse gear housing (19).



- s. Insert a small screwdriver beneath the reverse clutch piston inner seal ring (34) in the reverse gear housing (19) and work the seal ring out of its groove in the gear housing.
- t. Remove the inner seal ring (34) and seal ring expander (35).

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**6-39. REVERSE GEAR ASSEMBLY (Continued).**

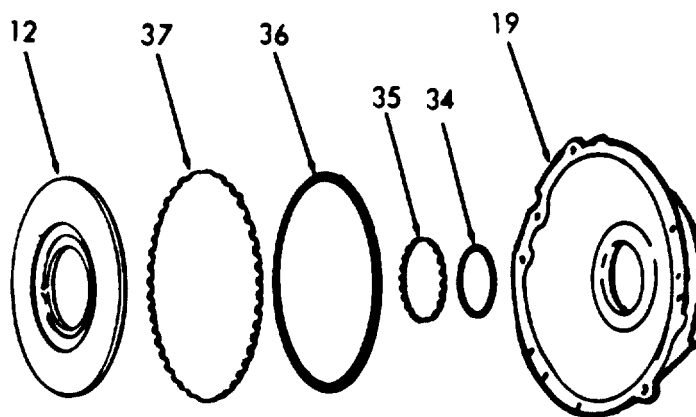
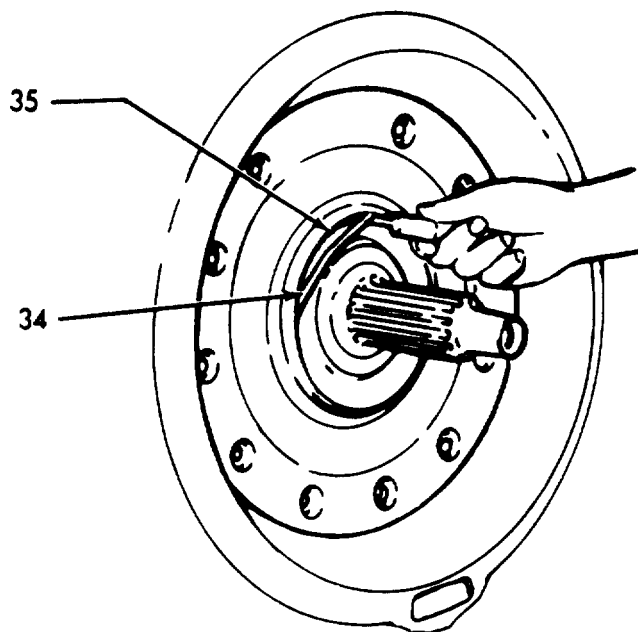
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LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- u. Remove the outer seal ring (36) and seal ring expander (37).



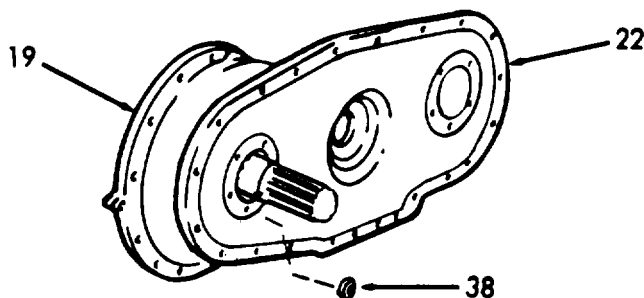


**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)**

- |                               |  |   |
|-------------------------------|--|---|
| 3. Reverse Gear Adapter Plate | a. Disassemble reverse gear components.  | Refer to step c above.                                  |
|                               | b. Support the reverse gear housings and adapter plate on three wood blocks, with the rear face of the adapter plate facing up.  |   |
|                               | c. Remove eleven elastic stop nuts (38).   | Secure reverse gear housing (19) to adapter plate (22). |
|                               | d. Turn the reverse gear housings and adapter plate over and rest the rear face of the adapter plate on the wood blocks.   |   |
|                               | e. Tap evenly around the back side of the reverse gear housing with a plastic hammer to loosen the reverse gear housing (19) from the adapter plate (22). Then, lift the reverse gear housing straight up away from the adapter plate. |   |



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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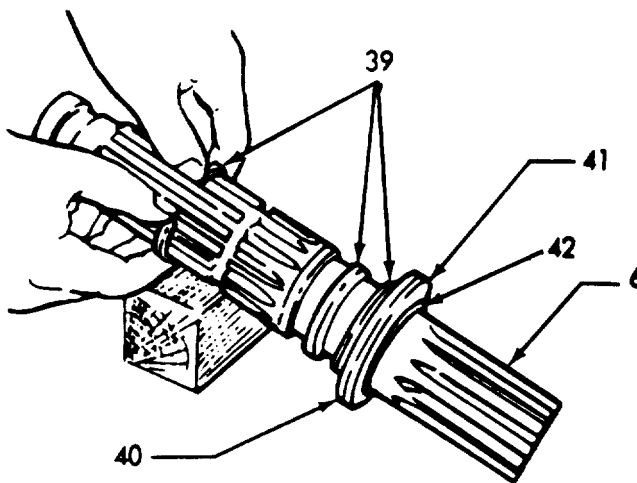
**DISASSEMBLY (Cont)**

- |                             |  |  |
|-----------------------------|--|--|
| 4. Reverse Gear Drive Shaft | a. Remove reverse gear drive shaft (6) from the reverse gear housing (19). |  |
|-----------------------------|--|--|

**CAUTION**

**Do not spread the seal rings more than necessary to slip them over the shaft to avoid breakage.**

- |  |                      |
|--|----------------------|
| b. Unhook the ends of the three oil seal rings (39). Slide each ring off the forward end of the drive shaft (6). |                      |
| c. Move the bronze thrust washer (40) and the steel thrust washer (41) forward on the drive shaft (6).           | Expose rear          |
| d. Remove snapring (42) from the drive shaft (6).  | Use snapring pliers. |
| e. Slide thrust washers (40 and 41) off the rear end of the drive shaft (6).                                     |                      |



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**6-39. REVERSE GEAR ASSEMBLY (Continued).**

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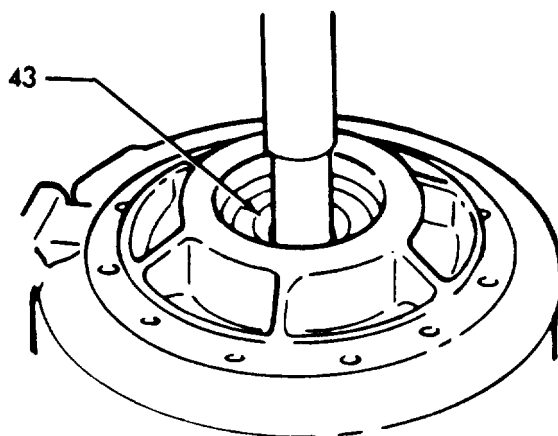
LOCATION/ITEM	ACTION	REMARKS
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**DISASSEMBLY (Cont)****NOTE**

If the oil transfer sleeve (43) in the reverse gear housing is worn excessively or damaged, it should be removed as outlined in steps f thru h below.

- f. Support the reverse gear housing on the bed of a hydraulic press. The forward face of the reverse gear housing must be facing down.



- g. Place a 2-1/2 inches O.D. brass bar approximately 4 inches long on top of the oil transfer sleeve and under the ram of the press.

**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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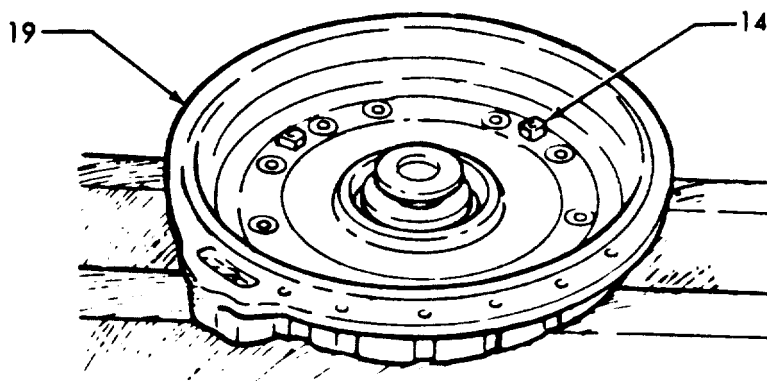
**DISASSEMBLY (Cont)**

- h. Bring the ram of the press down on the brass bar and force the oil transfer sleeve out of the gear housing. Catch the oil transfer sleeve and brass bar by hand to prevent them from falling on the floor.

**NOTE**

**If the reverse clutch drive pins (14) in the inner face of the reverse gear housing (19) are damaged or worn excessively, they should be removed as outlined in steps i through k below.**

- i. Place a scribe mark along one side of each clutch drive pin on the gear housing to use as a guide when replacing the drive pins.
- j. Attach a suitable slide hammer and a 5/16 inch-18 adapter to the drive pin. Remove the drive pin with a few sharp blows against the shaft handle with the weight.
- k. Remove the two remaining drive pins in the same manner.

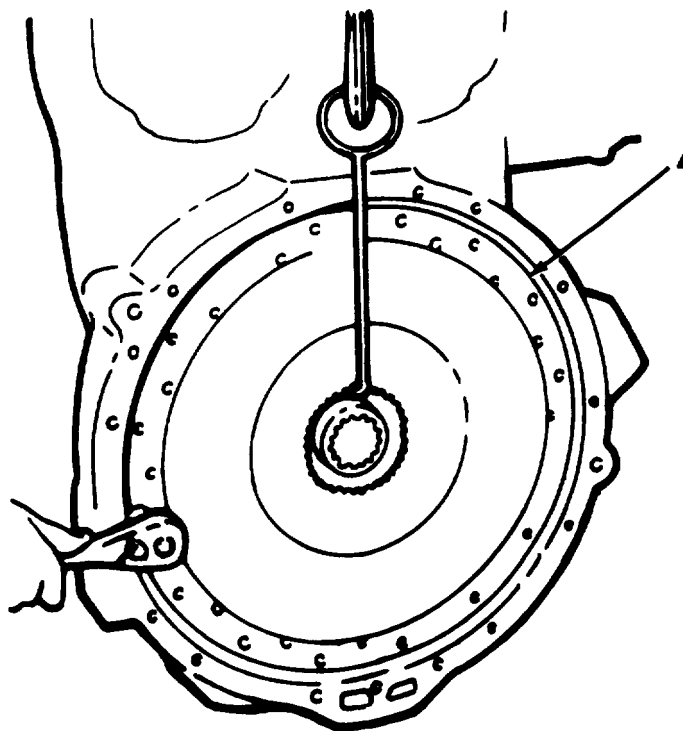


## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REMOVAL

- |                   |  |  |
|-------------------|--|--|
| 5. Forward Clutch | a. Remove fourteen of the sixteen bolts (44) and lockwashers (45).   | 1. Secures forward clutch drive plate (4) to the flywheel (1). |
|                   | 2.   | Leave bolts at the 90° and 270° locations.                     |
|                   | b. Support the forward clutch drive plate (4) with lifting hook and a chain hoist to prevent the plate from falling. |  |

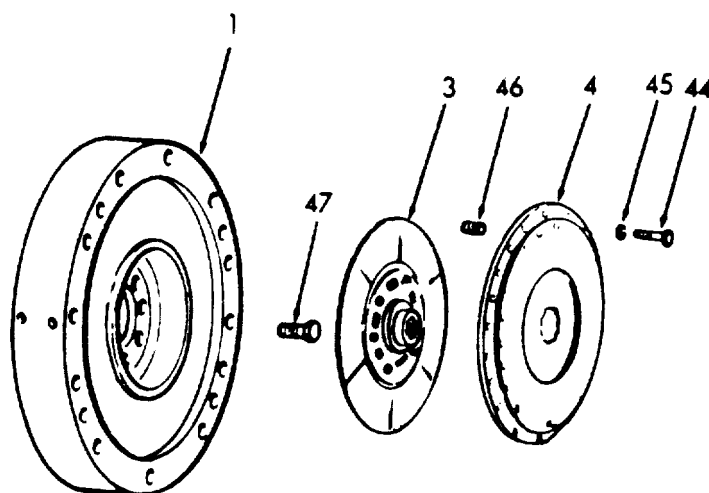


**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

- c. Remove the two remaining bolts (44), and lockwashers (45).
- d. Lift the forward clutch drive plate (4) away from removing the flywheel (1). Use care when plate not to lose the sixteen clutch release springs (46) in the forward face of the drive plate.
- e. Remove the sixteen clutch release springs (46) from the clutch drive plate (4).
- f. Remove the forward clutch plate assembly (3) from the flywheel (1).
- g. Loosen the six self-locking bolts (47) securing the flywheel (1) to the engine crankshaft.



6-854

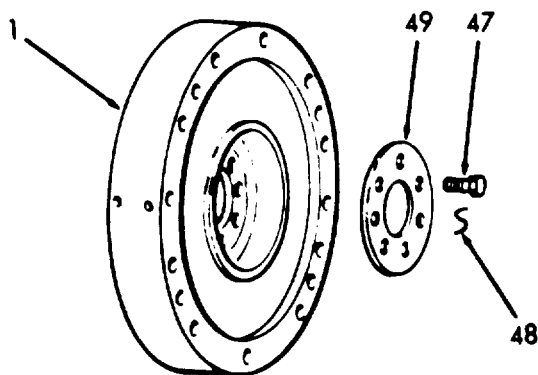
**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)****NOTE**

If the unit is not equipped with self-locking bolts, remove the lock-wire (48) from the head of the bolts.

- h. Remove bolts (47) and pilot bearing retainer (49).



- i. Attach flywheel lifting tool to the flywheel with two 7/16 inch 14 bolts of suitable length. Tool is J6361-01.
- j. Attach a chain hoist to the lifting tool to support the flywheel.

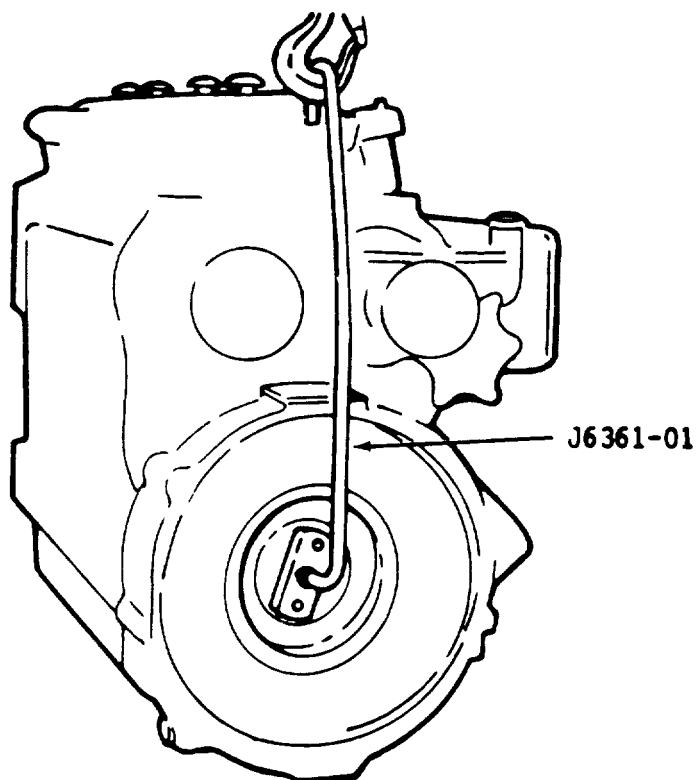
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**6-39. REVERSE GEAR ASSEMBLY (Continued).**

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LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

- k. Move the upper end of the tool in and out to loosen the flywheel, then withdraw the flywheel (1) from the crankshaft and the flywheel housing.
- l. Support the flywheel on two wood blocks, with the ring gear side of the flywheel facing up.

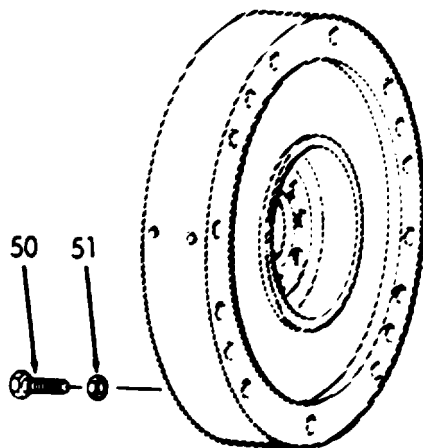


**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

- m. Remove the three emergency engagement bolts (50), and jam nuts (51) from the flywheel.

**NOTE**

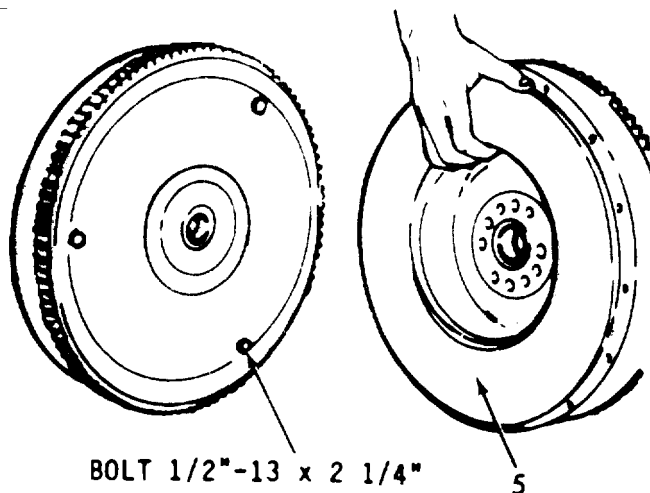
**On the flywheel assembly that incorporates six emergency engagement bolts, it is only necessary to remove three of the bolts (every other one).**

- n. Stand the flywheel up on edge with a thin strip of wood under the rear edge to prevent it from tipping over.
- o. Thread a 1/2 inch-13 X 2-1/4 inch bolt with long thread into each of the emergency engagement bolt holes until they contact the forward clutch piston (5).

## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REMOVAL (Cont)



- p. While supporting the flywheel and piston, continue to turn the bolts in **EVENLY** until the periphery of the piston with seal ring is free of the flywheel. Then, lift the piston away from the flywheel.

**CAUTION**

**The piston must be forced **EVENLY** out of the flywheel to prevent damage occurring to the seal rings in the piston and the flywheel.**

- q. Remove the three 1/2 inch-13 X 2-1/4 inch bolts from the flywheel that were used to remove the piston from the flywheel. Then support the flywheel on two wood blocks, with the ring gear side of the flywheel facing down.

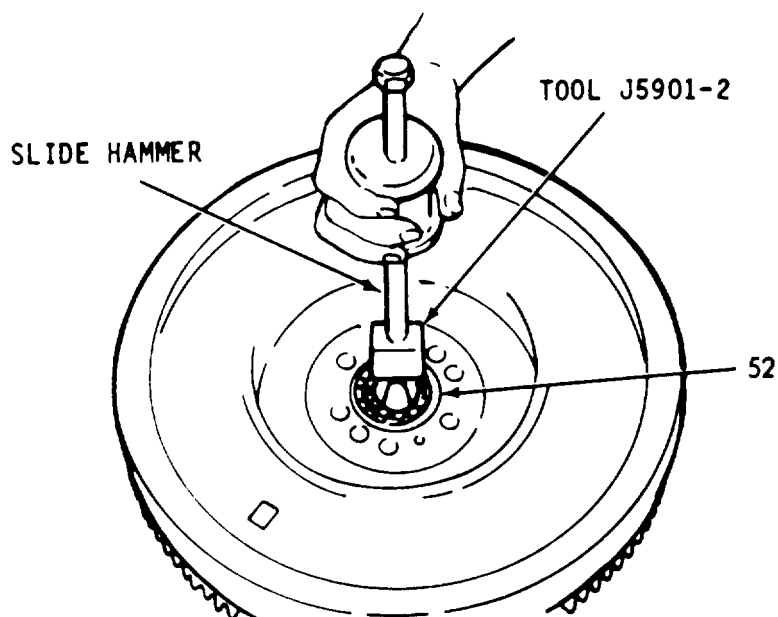
## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REMOVAL (Cont)

- r. Remove the pilot bearing (52) from the flywheel with adapter J5901-2. remover adapter and slide hammer.

Use remover



- s. Inspect the lip of the drive shaft pilot bearing oil seal (53) for nicks, roughness and charring. If inspection reveals the oil seal is unfit for further use, proceed to step t. If the oil seal is not damaged, proceed to step v.

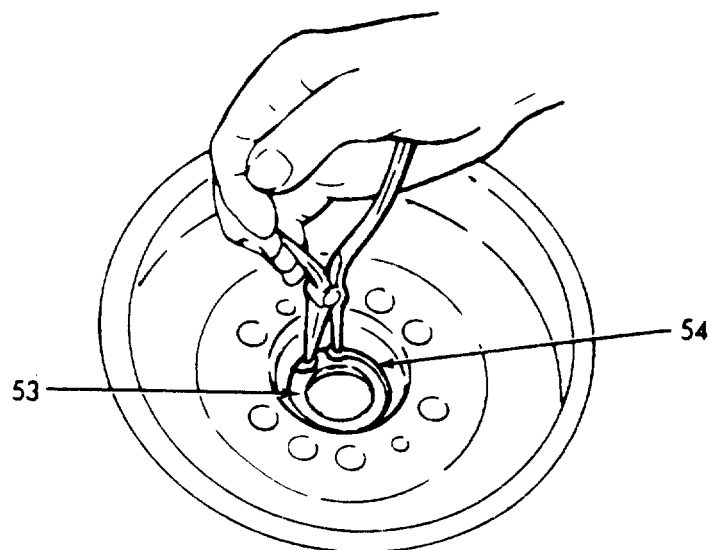
seal is unfit

- t. Remove the oil seal retaining ring (54) from the back side small-nose of the oil seal (53) in the pliers.

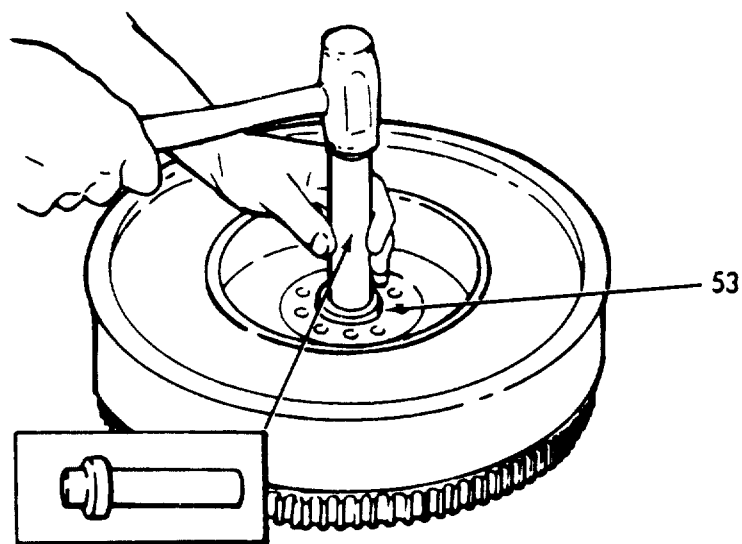
Use a pair of

**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

- u. Place the oil seal remover on top of the oil seal (53). Then drive the oil seal out of the flywheel with a hammer.



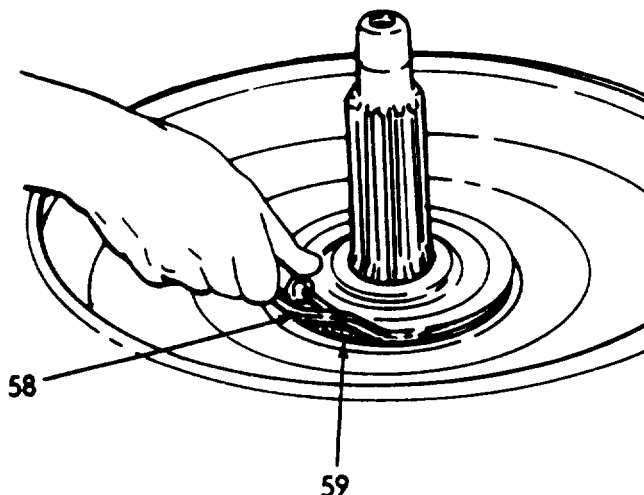
**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

v. Remove the special plug (55), forward clutch dump valve (56), and spring (57) from the periphery of the flywheel.

w. Insert a small screw driver beneath the forward clutch piston inner seal ring (58) in the flywheel and work the seal ring out of its groove. Then, remove the seal ring and seal ring expander (59) from the groove in the flywheel.



x. Remove the outer seal ring (60) and expander (61) from the forward clutch piston (5).

step w, above.

y. If the forward clutch piston drive pins (62) in the inner face of the flywheel are damaged or worn excessively, they should be removed as outlined in steps z and aa following.

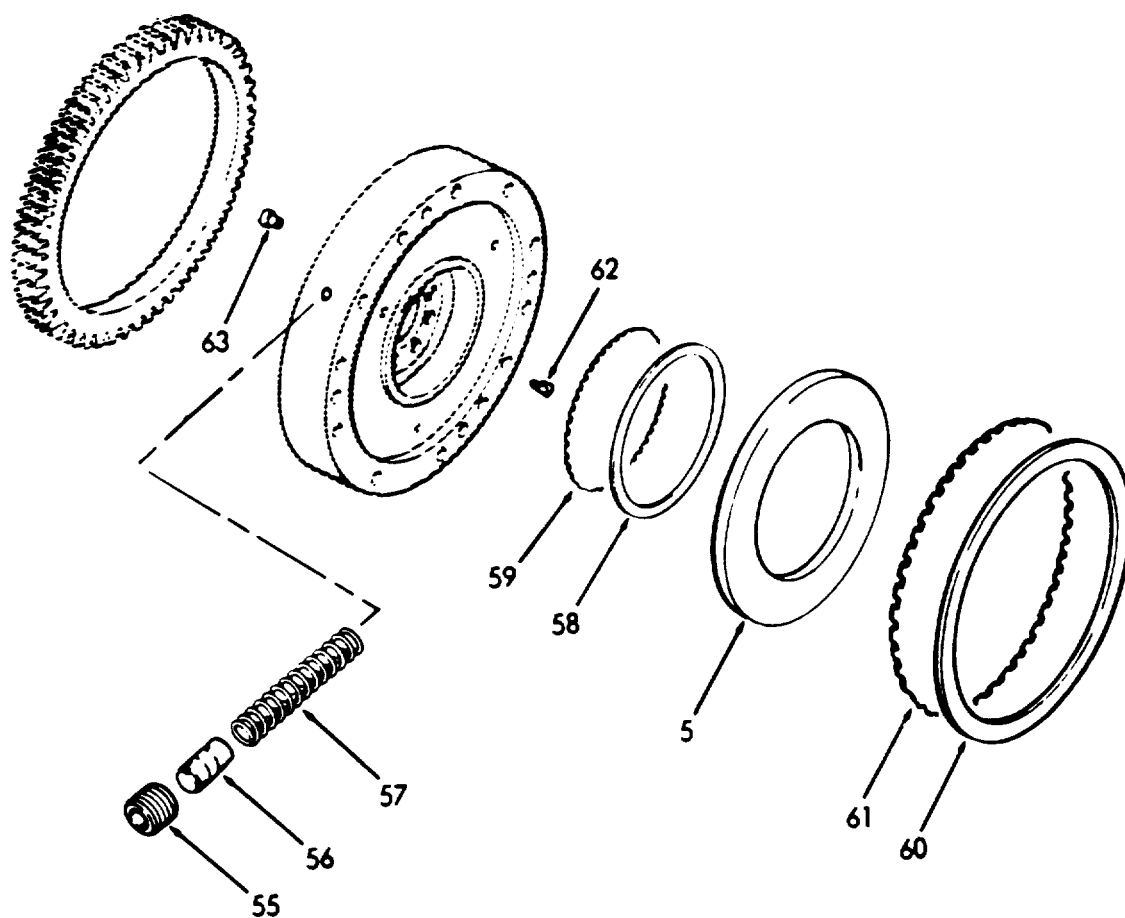
**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

z. Place a scribe mark along one side of each clutch drive pin on the flywheel to use as a guide when replacing the drive pins.

aa. Remove the drive pins with a drift and hammer through the holes provided in the forward face.



ab. Remove oil passage plugs (63) if damaged.

**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING**

6. All Parts

**WARNING**

- Dry cleaning solvent, P-D-680, used to clean parts, is potentially dangerous to personnel and property. Avoid repeated or prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°-138°F (38°-59°C).
- Wear protective eye goggles when using compressed air. Wash in cleaning solvent P-D-680 and blow dry with compressed air.

7. Oil Passages

Wash in cleaning solvent P-D-680 and blow dry with compressed air. Clean all oil passages in flywheel, reverse gear housing and drive shaft with compressed air.

8. Oil Tubes,  
Pump,  
Strainer,  
Control  
Valve and  
Oil Cooler

Clean and blow out with compressed air.

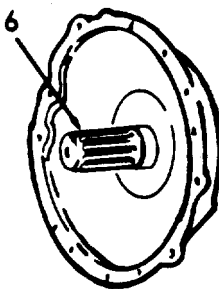
Perform when a major overhaul is required.

**INSPECTION**

9. Drive Shaft  
(6)

Inspect for wear or excessive peening on splines.

Replace if damaged.



6-863

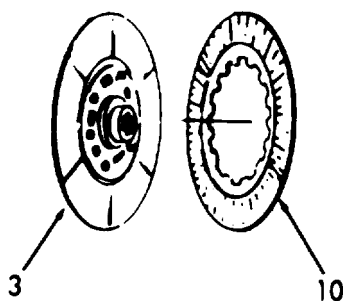
**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)**

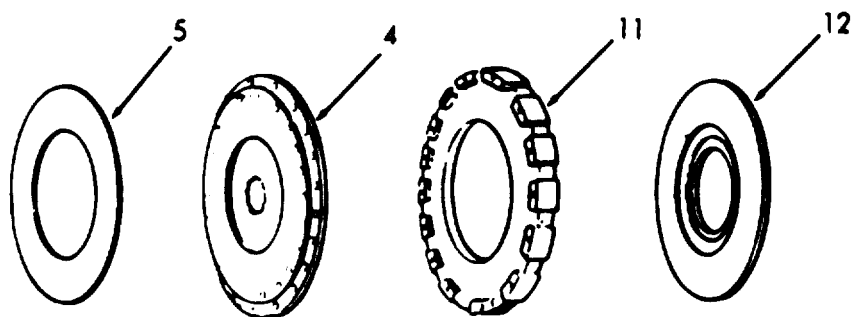
10. Forward and Reverse Clutch Plates (3 and 10)	Inspect facings for signs of over-heating or excessive wear.	Replace if damaged.
--	--	---------------------

11. Forward Clutch Plate (3)	Inspect splines in hub for excessive wear or peening.	Replace if damaged.
------------------------------	---	---------------------



12. Reverse and Forward Pistons (5 and 12) and Drive Plates (4 and 11)	Inspect clutch facing (friction) surfaces for scratches, wear, or signs of overheating.	Replace if damaged.
--	---	---------------------

13. Reverse and Forward Pistons (5 and 12)	Inspect the slots for the drive pins in the backside of the pistons for excessive wear.	Replace pistons and drive pins.
--	---	---------------------------------



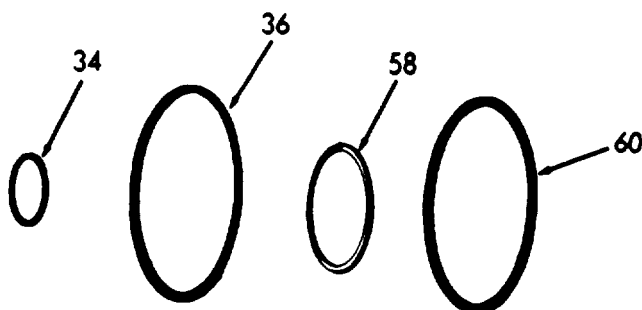


6-39. REVERSE GEAR ASSEMBLY (Continued).

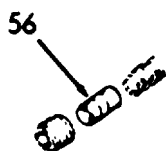
LOCATION/ITEM	ACTION	REMARKS
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INSPECTION (Cont)

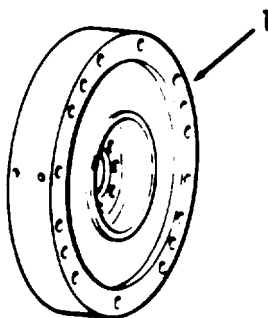
- |  |                                 |   |
|--|---------------------------------|---|
| 14. Forward Seal Rings (34 and 36) and Reverse Seal Rings (58 and 60) for the clutch pistons | Inspect for cuts and scratches. | Replace if cut, scratched, or deformed. |
|--|---------------------------------|---|



- |  |                                 |   |
|--|---------------------------------|---|
| 15. Forward Clutch Piston Type Dump Valve (56) | Inspect for scoring or pitting. | Replace if cleanup with crocus cloth is impossible. |
|--|---------------------------------|---|

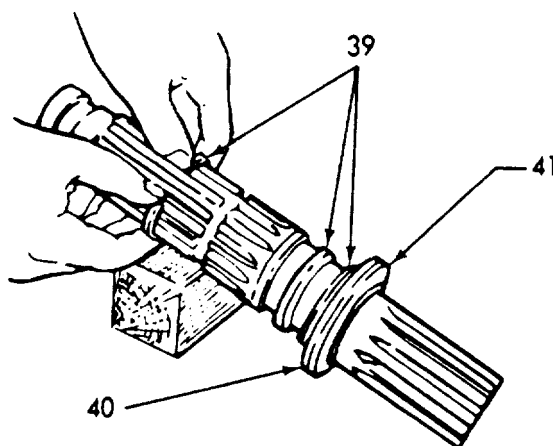


- |                  |                                     |                                   |
|------------------|-------------------------------------|-----------------------------------|
| 16. Flywheel (1) | Inspect dump valve bore brinelling. | Replace if cleanup is impossible. |
|------------------|-------------------------------------|-----------------------------------|

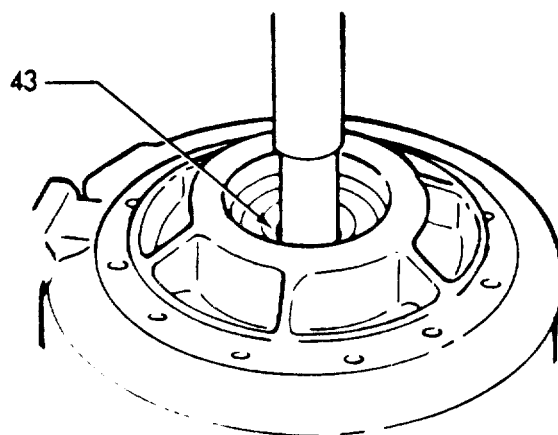


**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSPECTION (Cont)</b>		
17. Reverse Gear Drive Shaft Thrust Washers (40 and 41)	Inspect for wear or excessive scoring.	Replace if defective.
18. Reverse Gear Drive Shaft Oil Seal Rings (39)	Inspect for wear or excessive scoring.	Replace if defective.



19. Oil Transfer Sleeve (43)	Inspect inside diameter for wear or excessive scoring.	Replace if defective.
---------------------------------	--	-----------------------



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)**

20. Drive Shaft  
Pilot Bearing  
(52)

Inspect for corrosion or pitting.



Lubricate the bearing with light engine oil; then, while holding the bearing inner race from turning, revolve the outer race slowly by hand to check for rough spots in the bearing. Rough spots in the bearing is sufficient cause for rejection.

21. Planetary  
Gear  
Assembly  
(7)

Inspect for a maximum backlash of .015 inch between any two gears within assembly.



Replace assembly if backlash is excessive.

**REPAIR**

22. Flywheel  
Ring Gear  
(2)

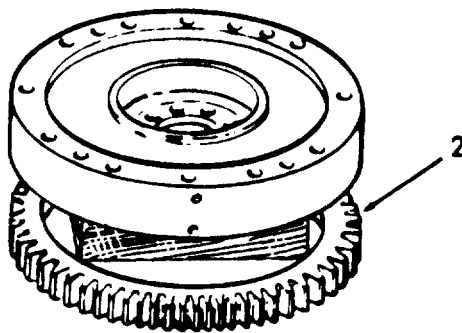
**NOTE**

Observe whether the ring gear teeth are chamfered. The replacement gear must be installed so that the chamfer on the teeth faces the same direction with relationship to the flywheel as on the gear that is to be removed.

## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REPAIR (Cont)



- a. Support the flywheel, crankshaft side down, on a solid flat surface or hardwood block, which is slightly smaller than the inside diameter of the ring gear.
- b. Drive the ring gear off the flywheel, with a suitable drift and hammer. Work around the circumference of the ring gear to avoid binding the gear on the flywheel.
- c. Turn the flywheel, ring gear side up, on a solid flat surface.
- d. Rest the new ring gear on a flat metal surface and heat the ring gear uniformly with an acetylene torch, keeping the torch moving around the gear to avoid hot spots.

**CAUTION**

**Do not, under any circumstances, heat the gear over 400°F, excessive heating may destroy the original heat treatment.**

**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REPAIR (Cont)****NOTE**

Heat indicating "crayons", which are placed on the ring gear and melt at a pre-determined temperature, may be obtained from most tool vendors. Use of one of these "crayons" will insure against overheating the gear.

- e. Use a pair of tongs to place the gear on the flywheel with the chamfer, if any facing the same direction as on the gear just removed.
- f. Tap the gear into place against the shoulder on the flywheel. If the gear cannot be tapped into place readily, remove it and apply additional heat, heeding the above caution about overheating.

**REASSEMBLY**

- |                                 |   |   |
|---------------------------------|---|---|
| 23. Flywheel and Forward Clutch | a. Install oil passage plugs (63).  | 1. If removed.  |
|                                 |   | 2. Plugs should be flush or slightly below the outer surface of the flywheel. |
|                                 | b. Support the flywheel (1) on wood blocks with the forward (ring gear) side up.                  |   |
|                                 | c. Install the pilot bearing oil seal retaining ring (54) in the ring groove in the flywheel (1). | Use a pair of small-nose pliers.  |

## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

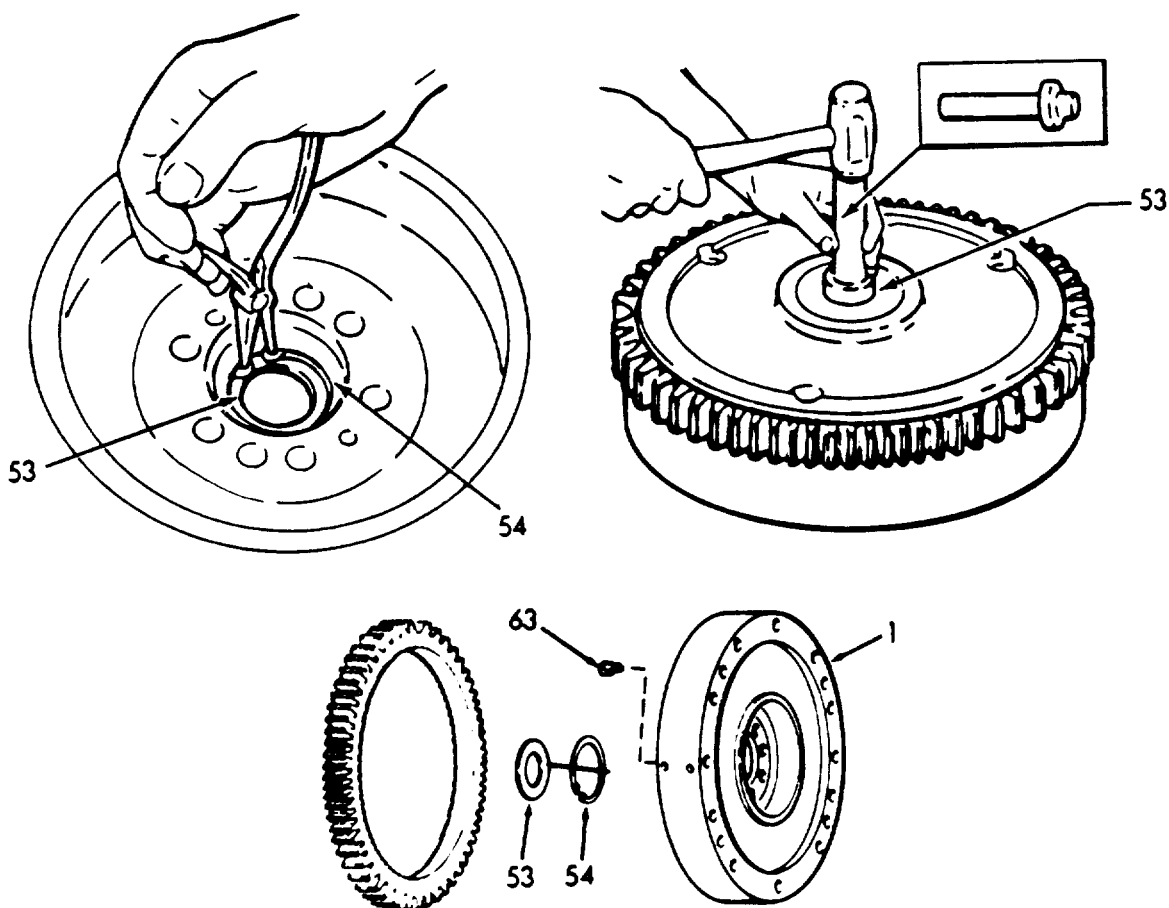
d. Apply a thin coat of sealing compound to the outside diameter of the pilot bearing oil seal (53) casing.

e. Place the oil seal (53) on the pilot oil seal replacer with the lip of the seal facing the flange of the tool.

Use tool J4700.

## NOTE

The lip of the oil seal must face the crankshaft side of the flywheel.



## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- f. Start the oil seal (53) straight into the bore of the flywheel, and tap it down against the oil seal retaining ring (54).

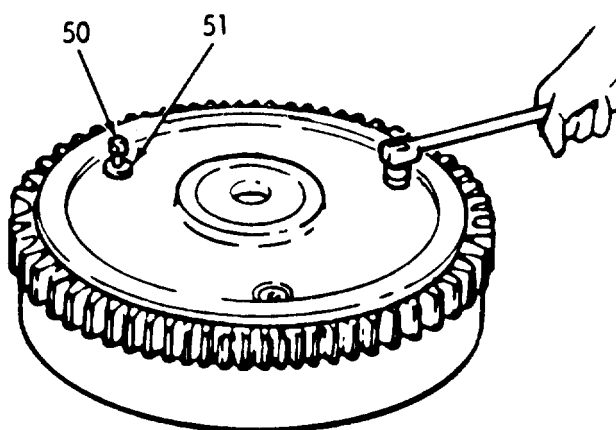
**CAUTION**

When installing the oil seal, use care not to drive too hard against oil seal retaining ring or damage to the thin flange of the retaining ring groove may occur.

- g. Install the emergency engagement bolts (50) with a jam nut (51) on each bolt, in the tapped holes in the forward face of the flywheel. Tighten the bolts securely against the jam nuts.

**NOTE**

The jam nuts serve as spacers to prevent the emergency engagement bolts from contacting the forward piston during normal operation.



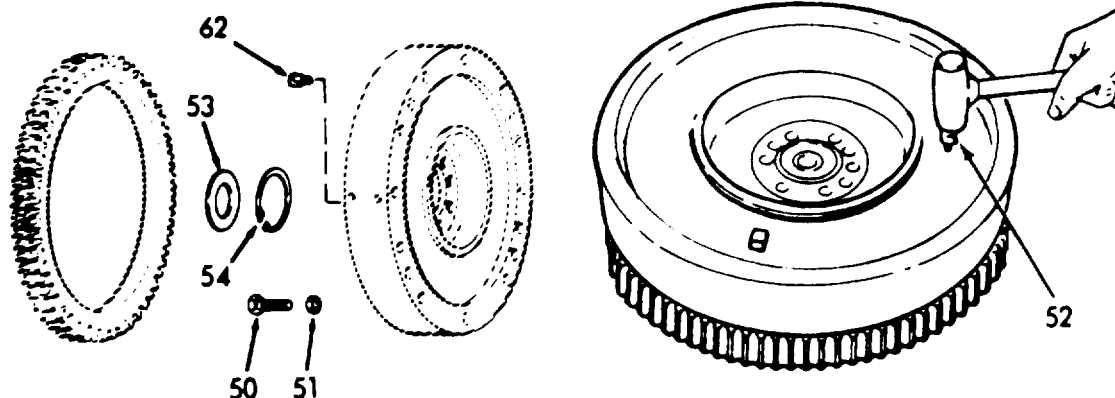
## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- h. Install the forward clutch piston drive pins (62) in the flywheel.

If removed, perform steps i through l.  
If not removed, proceed to step m.



- i. Support the flywheel on wood blocks with the forward (ring gear) side down.
- j. Note the scribe marks placed on the flywheel at the time the old pins were removed. Start a drive pin in each of the drive pin holes in the rear face of the flywheel, with the square head of the drive pin in line with the scribe mark.
- k. With a soft (lead) hammer, drive the pins straight into the flywheel until the head of the pins contact the surface of the flywheel.



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)****NOTE**

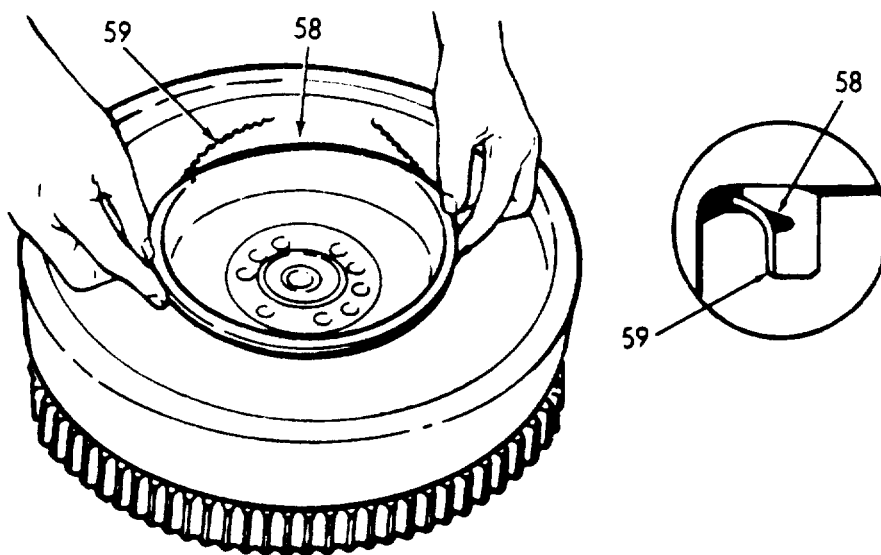
The sides of the pins must align with the scribe marks. If a pin has twisted slightly out of line when installing, line it up with a wrench.

- l. Place the forward clutch piston (5) without seal ring-down over the drive pins to assure the heads of the pins will engage the slots in the piston without binding. Then, remove the piston from the flywheel.
- m. Lubricate the pilot bearing (52) with clean engine oil. Start the bearing straight into the bore of the flywheel with the shielded side of the bearing facing the oil seal. Tap the bearing down in the flywheel with a clean wood block and hammer.
- n. Place the seal ring expander (59) in the seal ring groove of the flywheel. Then, starting at the approximate center of the expander, feed the thick lip of the seal ring (58) into the groove next to the expander with the narrow lip of the seal ring pointed down into the flywheel.

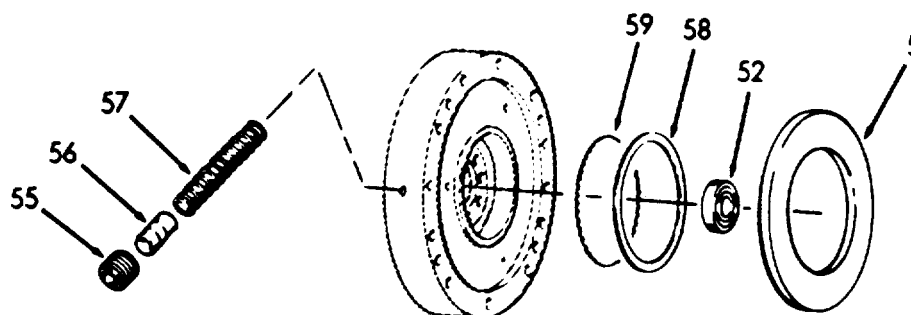
## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)



- o. Lubricate the outside of the forward clutch dump valve (56) with engine oil. Place the dump valve spring (57) inside the dump valve. Insert the spring and valve into the valve opening in the flywheel and install the retaining plug (55). Tighten the plug until it is flush with the periphery of the flywheel. Then, stake the plug at two places with a center punch.

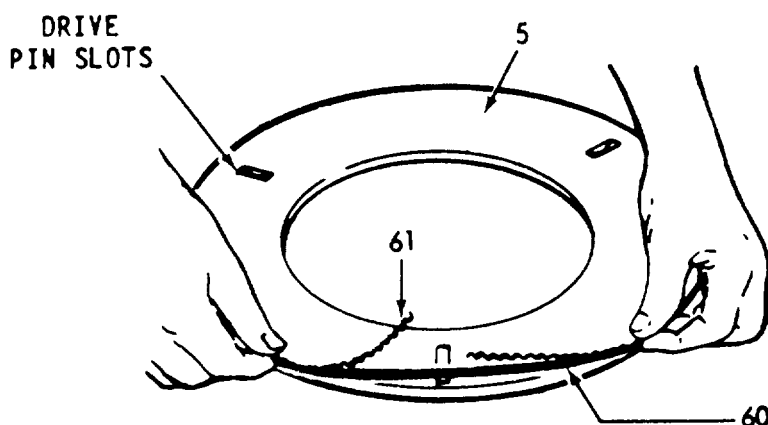


## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- p. Place the forward clutch piston (5) on a bench with the drive pin slots inside of the piston facing up.
- q. Place the outer seal ring expander (61) in the seal ring groove at the periphery of the piston; then starting at the approximate center of the expander, feed the thick lip of the seal ring (60) into the groove next to the expander with the narrow lip of the seal ring facing the side of the piston having the drive pin slots.

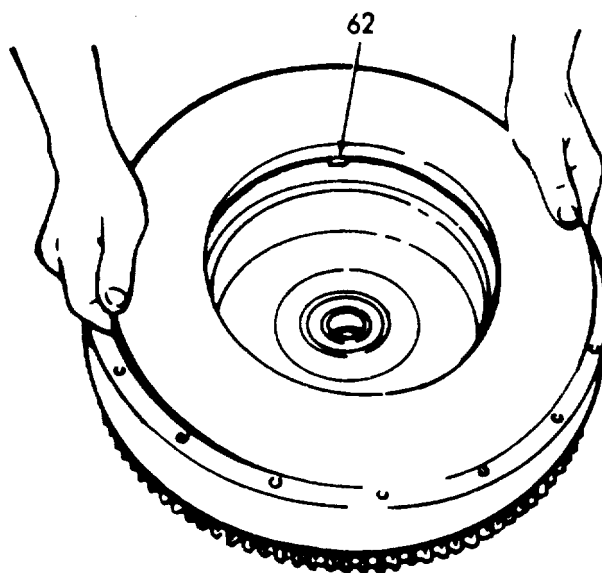


- r. Apply a light grade of engine oil to the seal ring in the forward clutch piston (5) and in the flywheel (1).
- s. With the flywheel resting on the bench (ring gear side down), place the piston (7) into the flywheel with the slots in the under side of the piston in alignment with the drive pins (62) in the flywheel.

## 6-39. REVERSE GEAR ASSEMBLY (Continued).

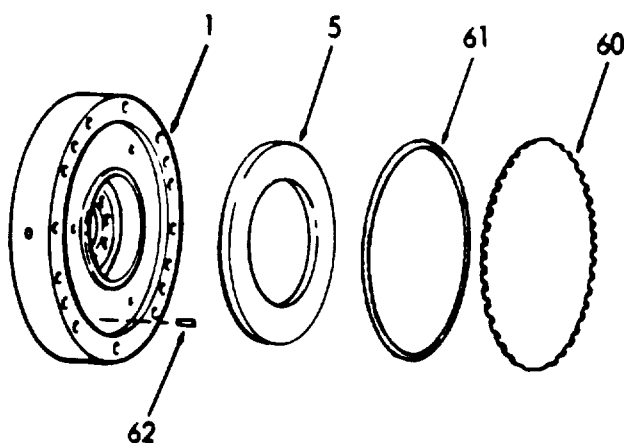
LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)



t. Lower the piston (5) into the flywheel, and press the piston uniformly down over the drive pins, using extreme care not to dislodge the seal rings from their grooves.

u. Insert the end of a .006 inch feeler gage between the lip of the outer seal ring (60) and the flywheel (1).



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)****CAUTION**

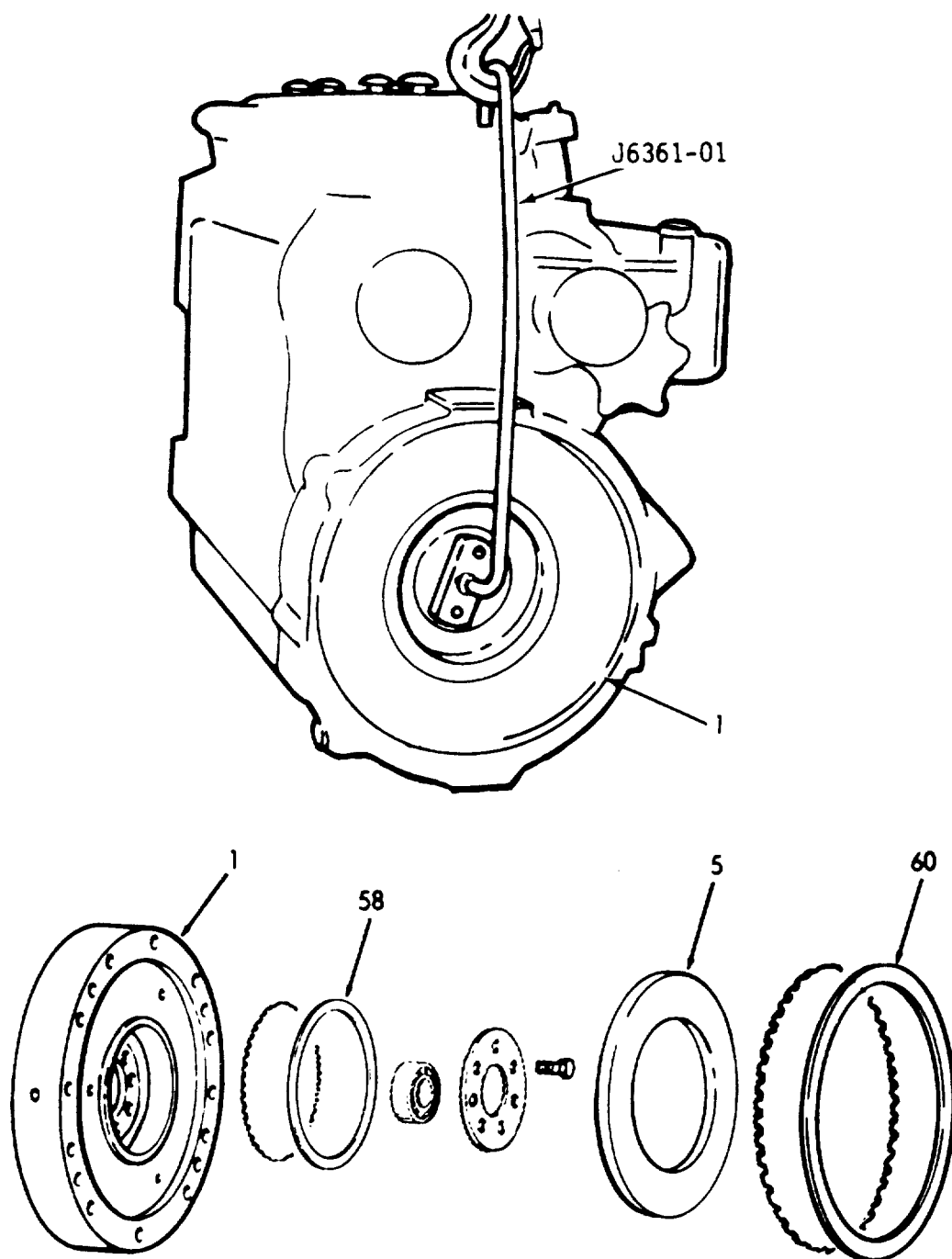
**The end and edges of the feeler gage must be smooth and free of nicks or burrs.**

- v. Carefully slide the feeler gage around between the outer seal ring (60) and the flywheel (1) and check for any bind on the feeler gage. Then, check the clearance between the inner seal ring (58) and flywheel (1). If a bind occurs, the lip of the seal ring may have turned up or the piston (5) may not be centrally located.
  - w. If the lip of either of the seal rings has turned up, remove the piston (5) and install a new seal ring. Recheck the clearance.
  - x. If the piston (5) is not centered, tap the face of the piston (opposite the bind) lightly with a plastic hammer. If the bind still exists, remove the piston (5) and turn 120° or 240°, reinstall the piston and again check clearance.
  - y. Attach flywheel lifting tool to the flywheel (1) with two 7/16-14 inch bolts of suitable length. Then, with the use of a chain hoist, position the flywheel in the flywheel housing and in line with the crankshaft.
- Use tool  
J6361-01.

6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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REASSEMBLY (Cont)



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)****NOTE**

Since one flywheel-to-crankshaft bolt hole is offset, the flywheel can be installed in one position only.

- z. Rotate the flywheel until the dowel pin holes in the flywheel align with the dowels in the crankshaft. Then, pilot the flywheel over the dowels. Install two of the flywheel-to-crankshaft bolts (47) and tighten them sufficiently to draw the flywheel against the end of the crankshaft.
- aa. Remove the flywheel lifting tool and the two bolts that were used to draw the flywheel up against the crankshaft.
- ab. Place the pilot bearing retainer (49) up against the flywheel with the bolt holes in alignment. Then, install the six flywheel-to-crankshaft bolts (47). Tighten the bolts to 150-160 ft-lb (203.48-216.93 Nm) torque.
- ac. If the flywheel attaching bolts (47) have drilled heads, lock each pair of bolts together with lockwire (48).
- ad. Place the forward clutch plate (3) in the flywheel (1) next to the piston (5) with the spring loaded side of the plate inside the flywheel.

## 6-39. REVERSE GEAR ASSEMBLY (Continued).

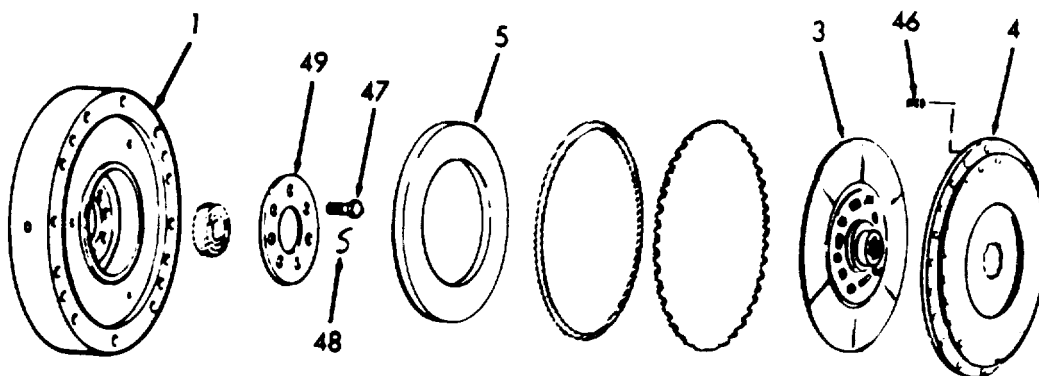
LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

## NOTE

Immerse the clutch plate in a very light grade of engine oil for approximately one-half hour before assembly.

- ae. Thread a 3/8 inch-16 X 3 inch pilot studs into each of two diametrically opposite bolt holes in the rear of the flywheel.
- af. Apply a small amount of cup grease on one end of each forward clutch release spring (46). Then, insert the greased end of the springs into the sixteen holes in the forward face of the drive plate (4).
- ag. Attach the forward clutch drive plate (4) to the flywheel by supporting the drive plate with lifting hook and a chain hoist and position the drive plate (4) over the pilot studs in the flywheel housing. Remove the chain hoist and lifting hook.





**6-39. REVERSE GEAR ASSEMBLY (Continued).**

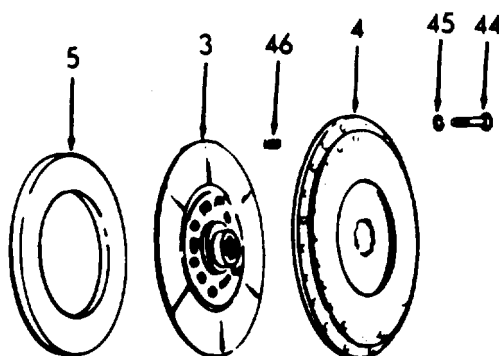
LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- ah. Carefully slide the drive plate (4) forward until the release springs (46) in the lower portion of drive plate contact the clutch plate (3).
- ai. Raise the clutch plate (3) just enough to permit the release springs (46) to pass under it, then push the drive plate forward until the springs contact the piston (5).
- aj. Install fourteen of the drive plate to flywheel attaching bolts (44) and lockwasher (45). Remove the two pilot studs and install the two remaining bolts and lockwashers. Tighten the bolts uniformly to 30-35 ft-lb (40.67-47.45 Nm) torque.

**NOTE**

**Make sure the clutch plate remains free between the piston and drive plate when tightening the bolts.**



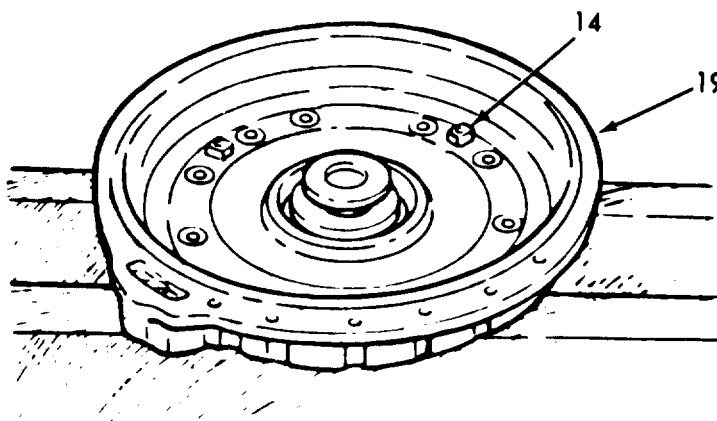
**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)****24. Reverse Gear****NOTE**

**If the reverse clutch drive pins (14) were removed from the reverse gear housing (19) proceed as follows. If the pins were not removed proceed to step e.**

- a. Support the reverse gear housing (19) on wood blocks, with the rear face of the housing down.
- b. Note the scribe marks placed on the gear housing (19) at the time the old pins were removed. Start a new drive pin (14) in each of the drive pin holes in the forward face of the gear housing, with the square head of the drive pin in line with the scribe mark.
- c. With a soft (lead) hammer, drive the pins (14) straight into the gear housing (19) until the head of the pins contact the surface of the gear housing.



## 6-39. REVERSE GEAR ASSEMBLY (Continued).

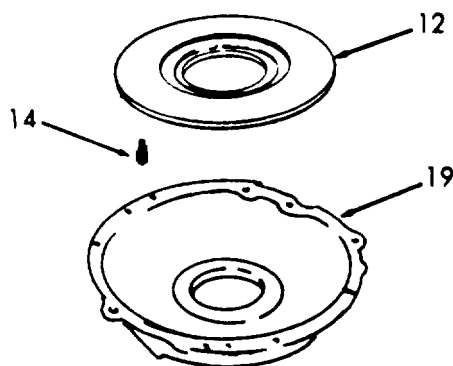
LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

## NOTE

The sides of the pins must align with the scribe marks in the gear housing (19). If a pin has twisted slightly out of line when installing, line it up with a wrench.

- d. Place the reverse clutch piston (12) - without the seal ring - down over the drive pins (14) to assure the heads of the pins will engage the slots in the piston without binding. Then, remove the piston from the reverse gear housing.



## NOTE

If the oil transfer sleeve (43) in the reverse gear housing (19) requires replacement proceed. If the sleeve was not removed, proceed to step i.

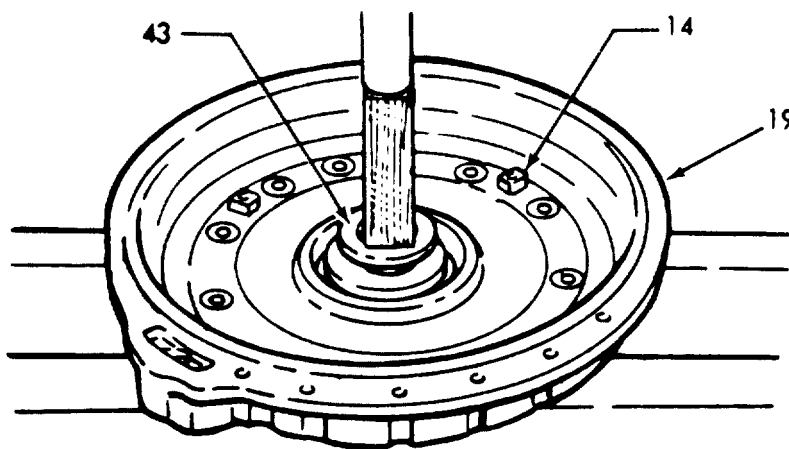
- e. Support the reverse gear housing (19) on the bed of a hydraulic press with the forward face of the housing up.

**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- f. Lubricate the periphery of the oil transfer sleeve (43) with engine oil.
- g. Start the oil transfer sleeve (43) straight into the bore of the gear housing (19). Then, place a wood block on top of the sleeve and under the ram of the press.
- h. Bring the ram of the press down on the wood block and press the sleeve (43) straight into the gear housing (19) until the flange on the sleeve contacts the housing.
- i. Remove the reverse gear housing (19) from the hydraulic press and support the housing (forward face down) on wood blocks approximately 6" high.



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

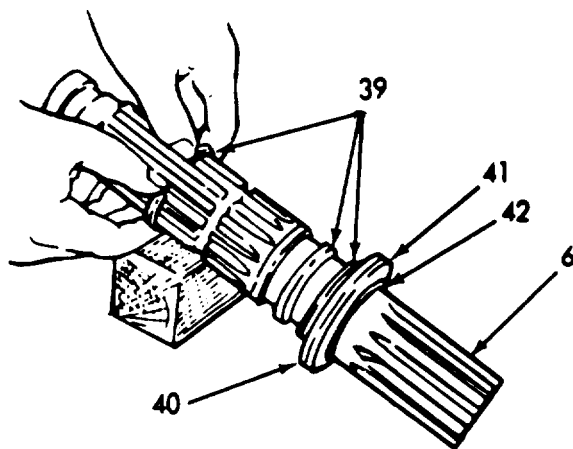
LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- j. Place the bronze thrust washer (40) over the aft end of the reverse gear drive shaft (6). Place the steel thrust washer (41) over the aft end of the shaft with the wide flat face of the washer next to the bronze thrust washer. Install the snapring (42) in the groove in the shaft, then slide the steel thrust washer back over the snapring.
- k. Apply a small amount of cup grease in each of the oil seal ring grooves in the reverse gear drive shaft (6). Then, slip the oil seal rings (39) in turn, over the end of the shaft and into the grooves in the shaft. Hook the ends of the oil seal rings together.

**CAUTION**

Do not spread the seal rings more than necessary to slip them over the shaft, to avoid breakage.



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

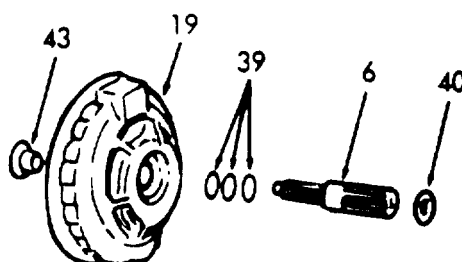
LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- I. With the reverse gear housing (19) resting on the wood blocks, insert the forward end of the reverse gear drive shaft (6) through the opening in the aft side of the gear housing and start it straight into the oil transfer sleeve (43). Lower the drive shaft (6) through the oil transfer sleeve (43) until the first oil seal ring (39) contacts the oil transfer sleeve (43). Carefully work the shaft through the sleeve until all three seal rings are piloted into the sleeve and the thrust washer (40) bears against the sleeve and gear housing.

**CAUTION**

Use care when installing the reverse gear drive shaft (6) to avoid breaking the oil seal rings (39).



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- |  |   |
|--|---|
| 25. Reverse Gear Housing to Reverse Gear Adapter Plate | a. Support the reverse gear housings (19) (forward face down) on three wood blocks approximately 6 inch high, with the top of each housing facing the same direction. |
|--|---|

**NOTE**

**The three wood blocks should all be the same thickness, so the housing will be level.**

- |  |  |
|--|--|
|  | b. Remove all traces of the old gasket (64).   |
|  | c. Place a new gasket (64) over the attaching bolts (65) in the rear face of each reverse gear housing (19).   |
|  | d. Position the reverse gear adaptor plate (22) over the top of the reverse gear housings (19) with the flat smooth side of the adaptor plate facing the reverse gear housings, and the top of the plate facing the top of the housings. |
|  | e. Lower the adaptor plate (22) straight over the attaching bolts (65) in both reverse gear housing (19) and against the gaskets (64).   |
|  | f. Install the elastic stop nuts (38) and draw the adaptor plate down tight against the housings. Tighten the nuts to 83-93 ft-lb (112.5-126.1 Nm) torque.   |

**6-39. REVERSE GEAR ASSEMBLY (Continued).**

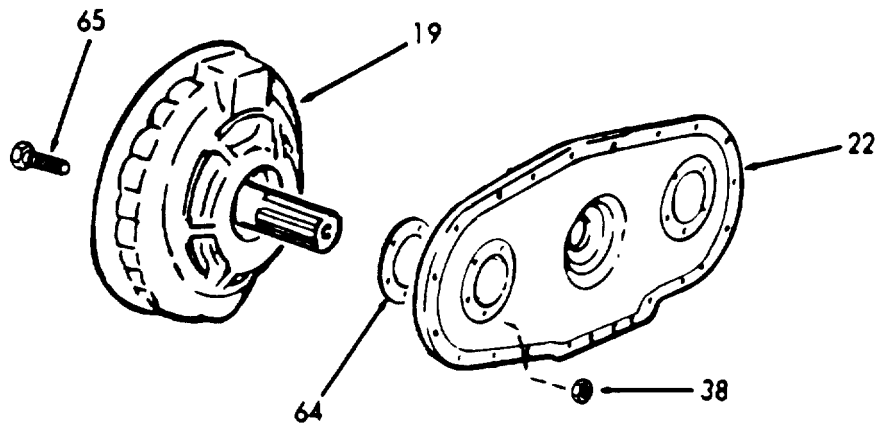
LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- g. Raise the reverse gear housings (19) and adaptor plate (22) up into a near vertical position. Place wood blocks under the aft end of each reverse gear drive shaft to support the assembly in this position.

**NOTE**

With the wood blocks in place, the top of the assembly should tilt back at approximately a 5° angle. This will prevent the assembly from tipping over forward.



6-888

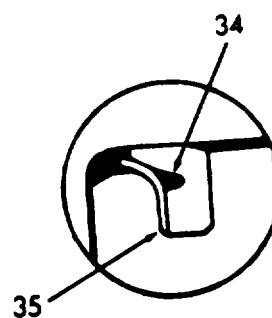
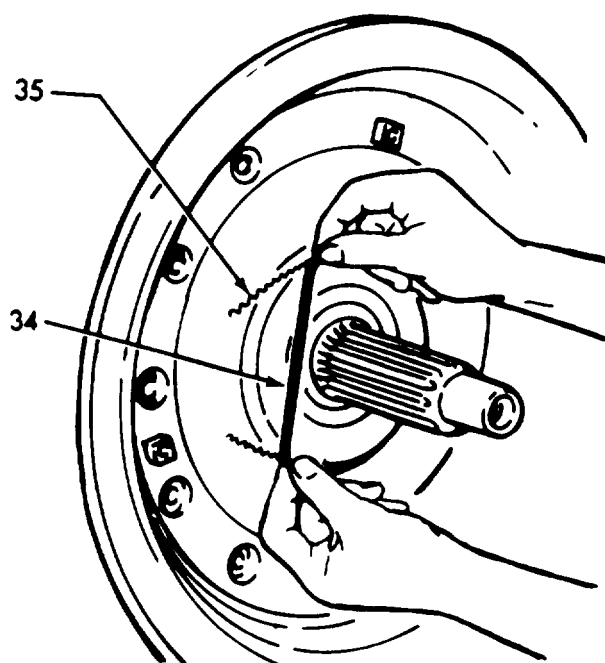


**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- h. Place the inner seal ring expander (35) in the seal ring groove of the reverse gear housing (19); then, starting at approximate center of the expander, feed the thick lip of the inner seal ring (34) into the groove next to the expander with the narrow lip of the seal ring pointed down into the gear housing.

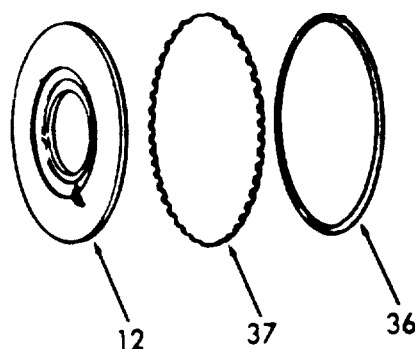
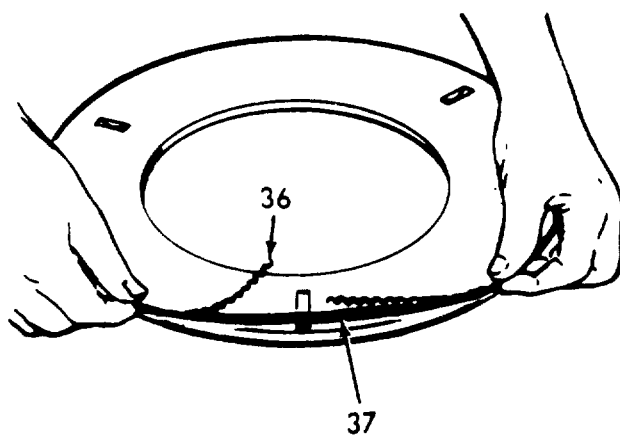


## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- i. Place the reverse clutch piston (12) on a work bench with the drive pin slots in the rear face of the piston facing up. Place the outer seal ring expander (36) in the seal ring groove at the periphery of the piston. Then, starting at the approximate center of the expander, feed the thick lip of the outer seal ring (37) into the groove next to the expander with the narrow lip of the seal ring facing the side of the piston incorporating the drive pin slots.



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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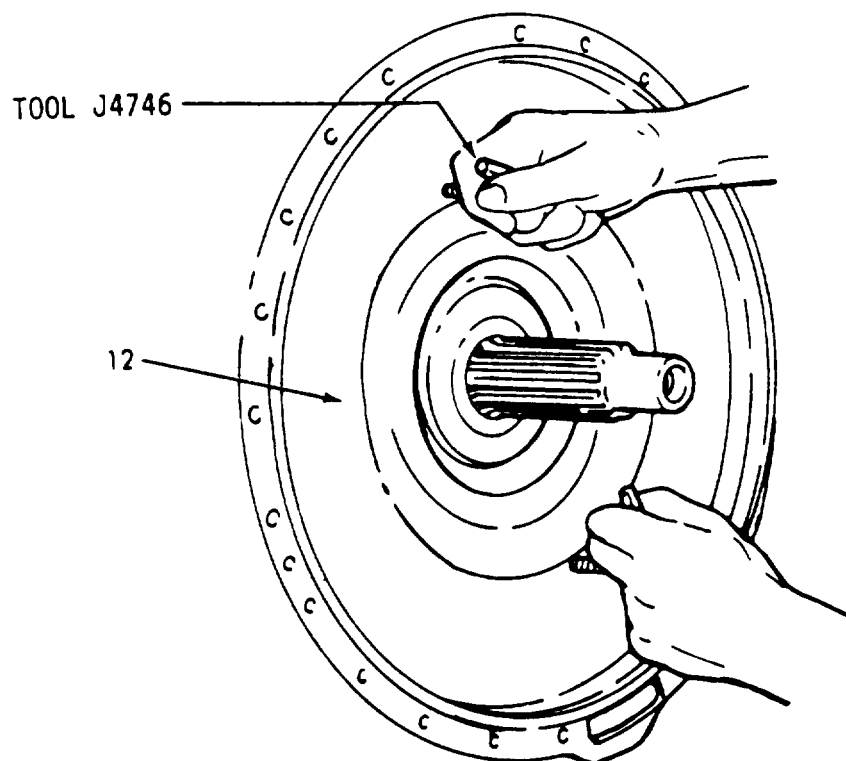
**REASSEMBLY (Cont)**

j. Thread a piston remover tool (T-head bolt) into each of the two tapped holes in the forward face of the reverse clutch piston (12).

Use tool J4746.

k. Apply a light grade of engine oil to the seal ring (37) in the piston (12) and in the gear housing (19).

l. Place the piston (12) over the reverse gear drive shaft (6) with the slots in the rear face of the piston in alignment with the drive pins (14) in the gear housing (19).



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

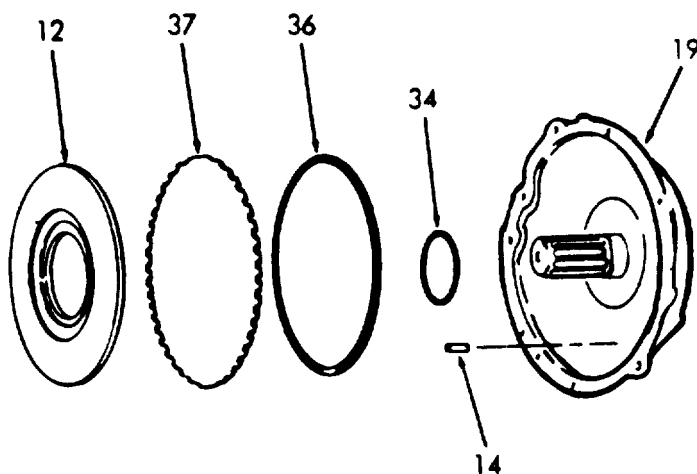
LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- m. Start the piston (12) straight into the gear housing (19) and push the piston uniformly in over the drive pins (14) using extreme care not to dislodge the seal rings (34 and 36) from their grooves.
- n. Check the clearances between the piston seal rings (34 and 36) and the reverse gear housing (19) by inserting the end of a .006 inch feeler gage between the lip of the outer seal ring (36) and the gear housing.

**NOTE**

The end and edges of the feeler gage must be smooth and free of nicks or burrs.



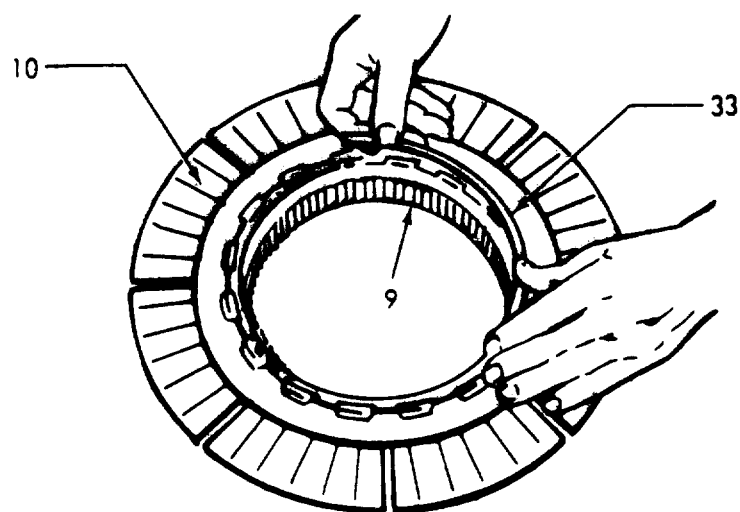
**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REASSEMBLY (Cont)</b>		
	<p>o. Carefully slide the feeler gage around between the outer seal ring (36) and the gear housing (19) and check for any bind on the feeler gage. Then, check the clearance between the inner seal ring (34) and the gear housing. If a bind occurs, the lip of the seal ring may have turned up or the piston may not be centrally located.</p>	
	<p>p. If the lip of either of the seal rings has turned up, remove the piston (12) and install a new seal ring. Recheck the clearance.</p>	
	<p>q. If the piston (12) is not centered, tap the face of the piston (opposite the bind) lightly with a plastic hammer. If the bind still exists, remove the piston and turn 120° or 240°, reinstall the piston (12) and again check the clearance.</p>	
	<p>r. Place the reverse ring gear (9) on the work bench, with the forward face of the ring gear down.</p>	
	<p>s. Place the reverse clutch plate (10) on top of the reverse ring gear (9).</p>	
	<p>t. Install the retaining ring (33) in the groove in the top inner diameter of the ring gear (9).</p>	

# 6-39. REVERSE GEAR ASSEMBLY (Continued).

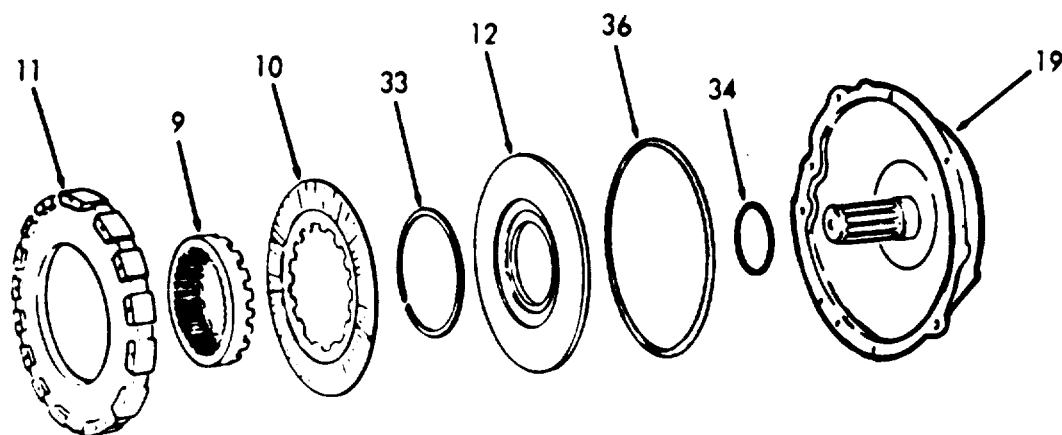
LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)



- u. Thread a piston remover (T-head bolt) into each of the two tapped holes in the forward face of the reverse clutch drive plate (11).

Use tool J4746.



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REASSEMBLY (Cont)</b>		
	v. Support the reverse clutch drive plate (11) on an angle (rear face of the plate facing up) with the weight of the plate resting on the tools (T-head bolts).	
	w. Apply a small amount of cup grease on one end of each reverse clutch release spring (31). Then, insert the greased end of the springs into the sixteen holes in the rear face of the drive plate (11).	
	x. Place the reverse clutch plate (10) and ring gear (33) assembly against the reverse clutch drive plate (11) with the ring gear projecting through the center of the drive plate.	

**NOTE**

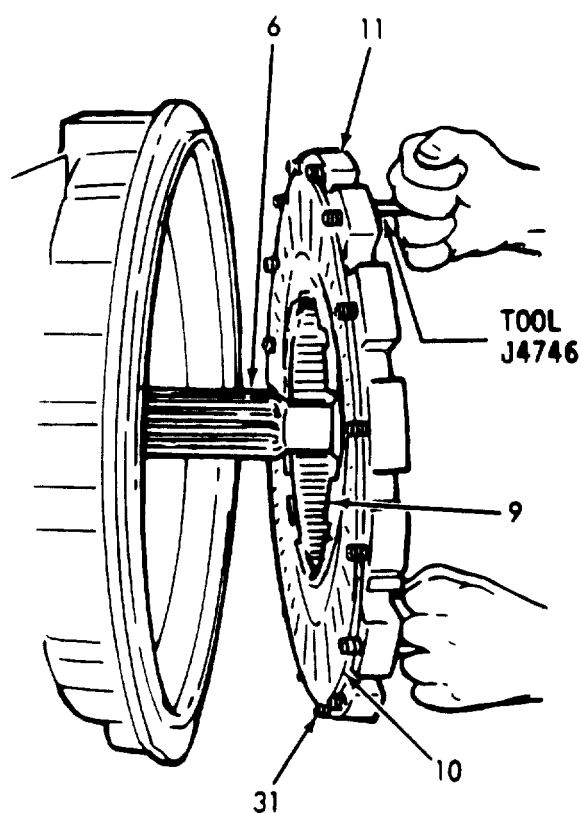
Immerse the reverse clutch plate in a light grade of engine oil for approximately one-half hour before assembling in the gear housing.

## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- y. Raise the reverse clutch drive plate (11), clutch plate (10) and release springs (31) up to a near vertical position. Then, lift the drive plate assembly and pilot it over the drive shaft (6) and start it straight into the gear housing. Use care to prevent the clutch plate from tipping forward or the release springs from dropping out of the drive plate.



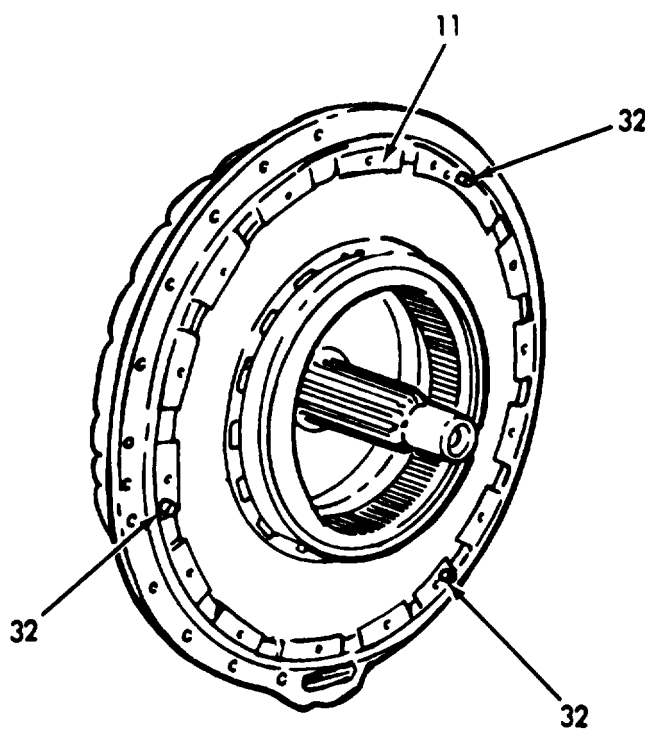


## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- z. Push the drive plate assembly straight into the gear housing (19) until the release springs (31) contact the reverse clutch piston (12).
- aa. Rotate the reverse clutch drive plate (11) and align the dowel pin (32) slots in the periphery of the drive plate with the slots in the gear housing. Install the three dowel pins (32) and push the pins in flush with the forward face of the plate.

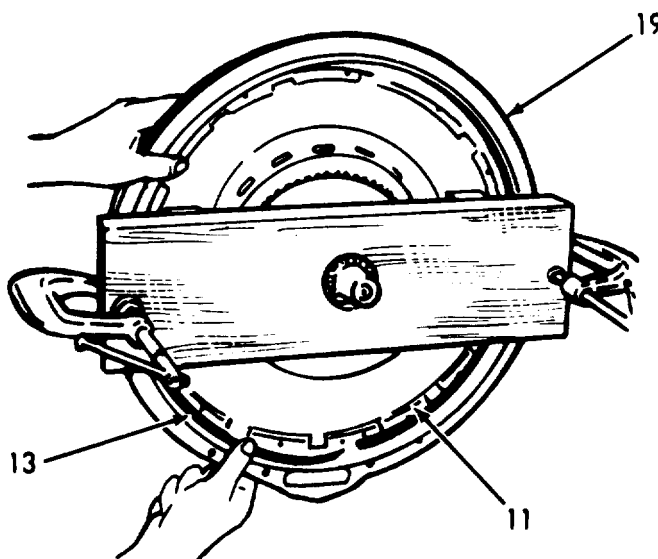


**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- ab. Place the reverse clutch drive plate retaining ring (13) in the reverse gear housing (19) and against the drive plate (11) with the open ends of the retaining ring at the bottom of the gear housing.
- ac. Clamp a board across the face of the gear housing with a 1 inch wood block at each end between the board and the drive plate.



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- ad. Tighten the clamps and draw the drive plate (11) straight into the gear housing until the retaining ring groove in the housing is exposed.
- ae. If the three dowel pins (32) extend above the face of the drive plate (11) push or tap the pins down flush with the face of the drive plate.
- af. Starting at the lower edge of the gear housing (19), feed the retaining ring (13) in the groove in the gear housing. Then, remove clamps, board and blocks.

**NOTE**

**The ends of the retaining ring, when installed in the gear housing, must always be directly above the oil drain hole in the gear housing.**

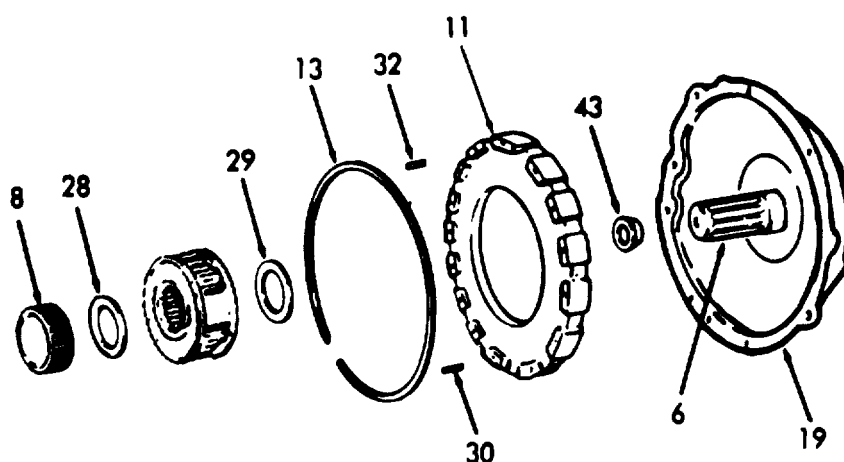
- ag. Install a retaining ring retaining spring pin (30) in each of the three holes in the forward face of the drive plate (11). Then, tap the spring pins in the drive plate to within 1/16 inch of the outer surface of the retaining ring with a punch and hammer.

## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- ah. Lubricate the planetary gear thrust washer (29) with engine oil. Then, place the thrust washer over the reverse gear drive shaft (6) and against the oil transfer sleeve (43).
- ai. Lubricate one of the reverse sun gear thrust washers (28) with engine oil. Then, place the thrust washer over the planetary hub and against the inside face of the hub.
- aj. Place the sun gear (8) over the planetary hub and through the planetary gears (large inside diameter of sun gear facing up) and against the thrust washer.



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REASSEMBLY (Cont)**

- ak. Place the planetary gear assembly (7) with sun gear (8) over the end of the drive shaft (6) (oil collector ring side facing the ring gear). Align the splines in the sun gear (8) with the splines on the drive shaft (6). Slide the assembly straight back on the drive shaft (6) and through the ring gear (9) until it contacts the planetary gear thrust washer (28).

**NOTE**

**When installing the planetary gear assembly (7), the reverse ring (9) must be raised up to permit the planetary gears to mesh with the internal teeth of the ring gear.**

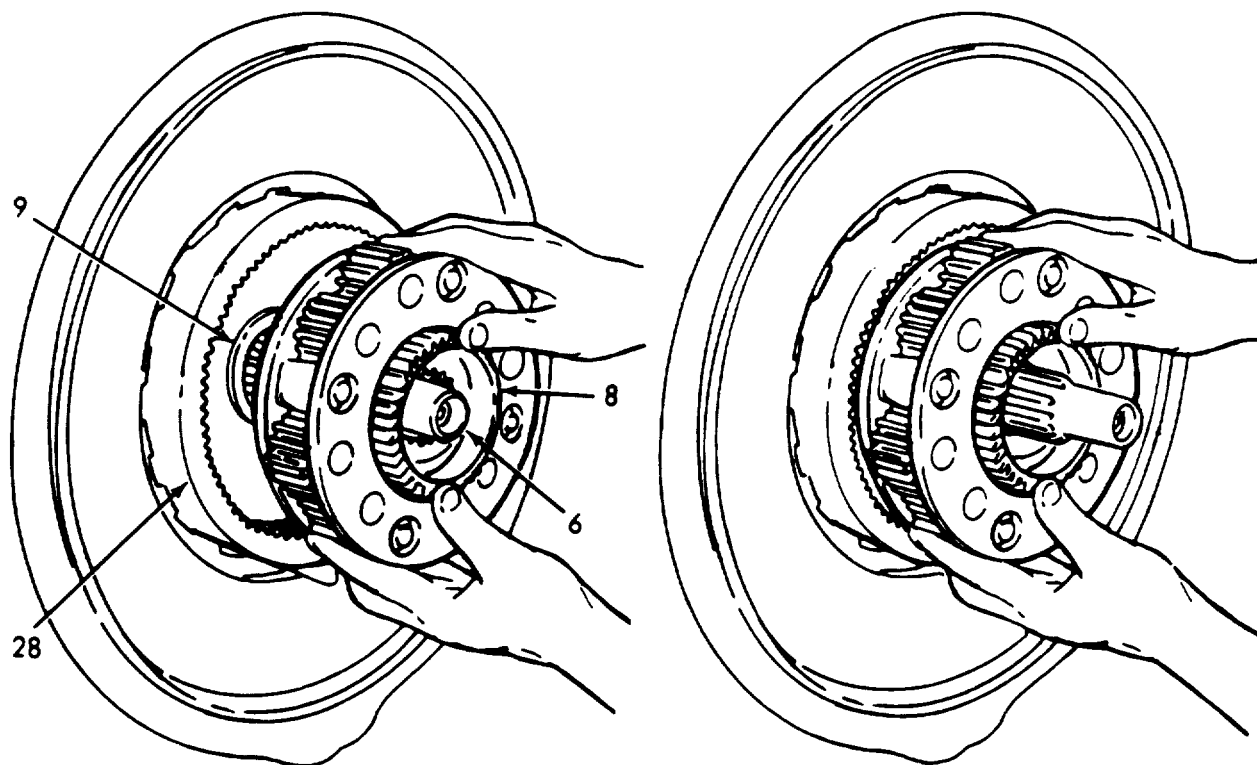
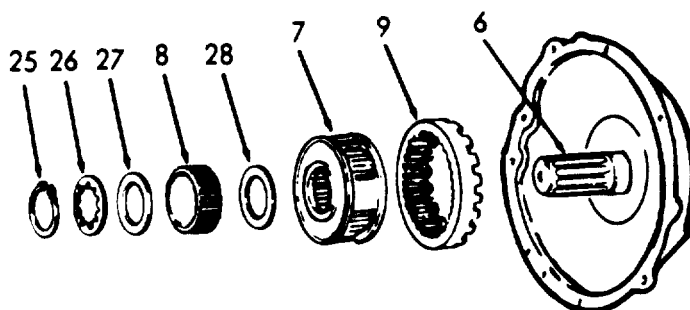
- al. Lubricate the second reverse sun gear thrust washer (27) with engine oil. Then, place the thrust washer over the end of the drive shaft (6) and over the end of the planetary gear assembly (7) hub.
- am. Install the planetary gear retaining washer (26) over the end of the drive shaft (6) and against the end of the planetary hub.

## 6-39. REVERSE GEAR ASSEMBLY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REASSEMBLY (Cont)

- an. Install the planetary gear retaining ring (25) in the groove in the drive shaft next to the retaining washer (26) using a pair of snap-ring pliers.



**6-39. REVERSE GEAR ASSEMBLY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSTALLATION</b>		
26. Marine Gear	<ul style="list-style-type: none"> <li>a. Affix a new gasket (24) to the forward face of each reverse gear housing (19).</li> <li>b. Support the reverse gear housing (19) and adapter plate (22) with two rope slings and a chain hoist.</li> <li>c. Lubricate the pilot bearing surface and the splines on the forward end of each reverse gear drive shaft (6) with engine oil.</li> <li>d. With the blocking still in place beneath the two flywheel housings (23), same as when the reverse gears and adapter plate assembly was removed, position the assembly directly in back of the engines with the forward end of the drive shafts in line with the center of the flywheels.</li> <li>e. Move the reverse gears and adapter plate forward and pilot the drive shafts (6) straight into and through the hub of each forward clutch plate (3).</li> </ul>	

**NOTE**

**If the splines on the drive shafts do not readily engage those in the hub of each clutch plate, press forward slightly on the assembly and at the same time, turn one or both of the drive shafts slightly to align the splines.**

**6-39. REVERSE GEAR ASSEMBLY (Continued).**

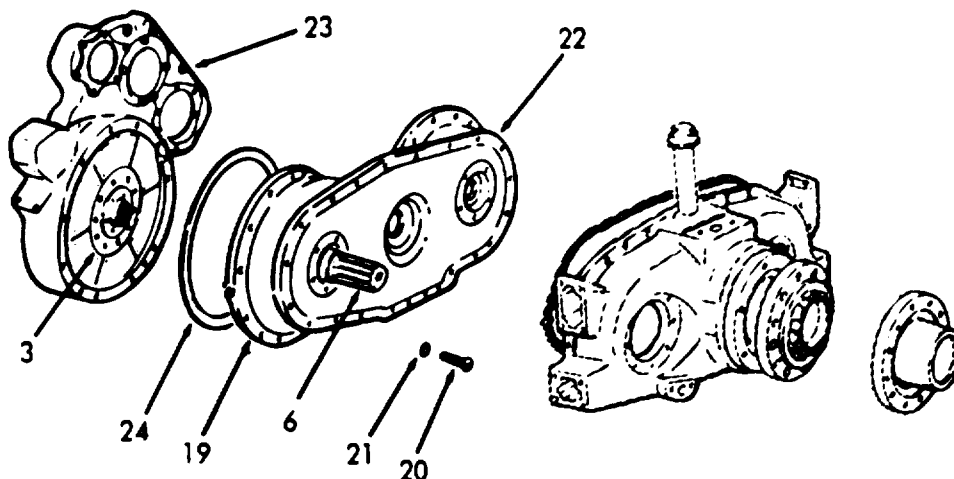
LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- f. With the drive shafts (6) entered into the hubs of the clutch plates (3), continue to push the assembly forward and pilot the drive shafts straight into the pilot bearings, then enter the pilot on the reverse gear housings straight into the flywheel housing.

**NOTE**

If the sun gear does not readily enter the forward clutch drive plates, rotate the drive shafts very slowly until the sun gears enter the drive plates.



- g. Install the screws (20) and lockwashers (21) securing the reverse gear housings to the flywheel housings. Tighten the bolts to 30-35 ft-lb (40.7-47.5 Nm) torque.
- h. Install the power transfer gear assembly (paragraph 3-42).



**6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS.**

a. The flywheel housing is a one-piece casting, mounted against the rear cylinder block end plate, which provides a cover for the gear train and the flywheel. It also serves as a support for the starting motor and the Marine Gear.

b. The crankshaft rear oil seal, which is pressed into the housing may be removed or installed without removing the housing (paragraph 3-43).

**This task covers:****a. Removal****b. Inspection****c. Installation****INITIAL SETUP :****Test Equipment**

Concentricity test  
gages J9737

**References**

Para 6-25	Oil Pan Removed
Para 4-30	Electric Starter Motor Removed
Para 4-35	Hydrostarter Motor Removed

**Special Tools**

Chain hoist  
Hammer (soft)  
Studs (four)  
1/2-13 X 3-1/4 lg.

**Equipment**

<u>Condition</u>	<u>Condition Description</u>
Paragraph	

6-39	Torquematic Marine Gear Removed
6-25	Oil Pan Removed
4-35	Hydrostarter Motor Removed
6-22	Propulsion Unit Removed
4-30	Electric Starter Motor Removed

**Tools**

General Mechanic's Tool Kit  
NSN 5180-00-629-9783

**Material/Parts**

Gasket kit P/N 5193113  
Engine oil

**Special Environmental Conditions**

NONE

**Personnel Required**

2

**General Safety Instructions**

NONE

**6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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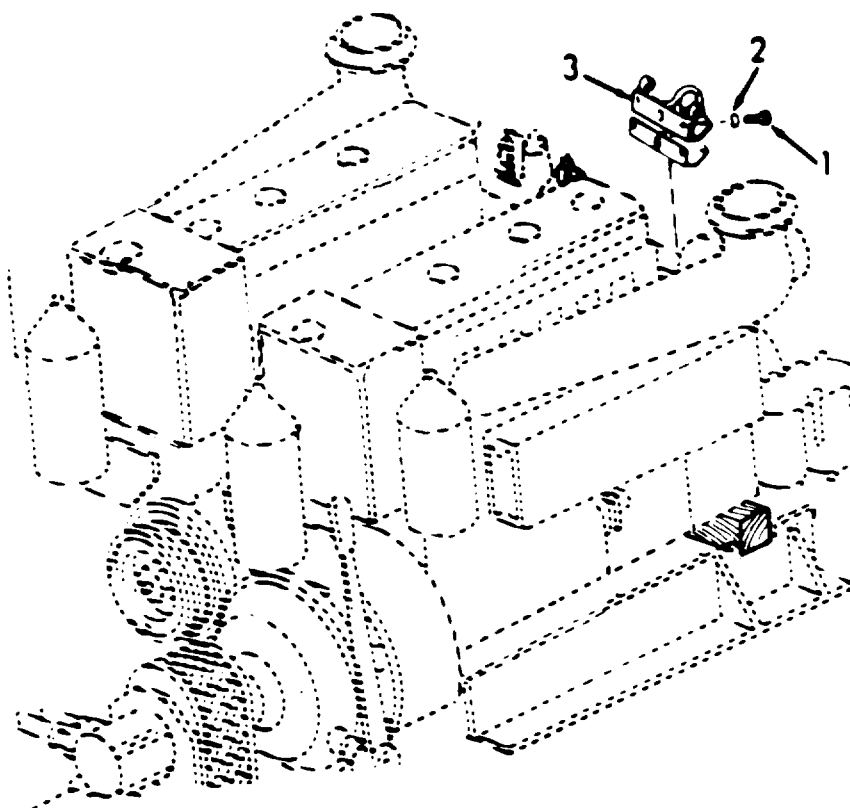
**REMOVAL**

1. Engine

a. Block rear of engine.

b. Remove two bolts (1) and lockwashers (2) that attach rear engine lifter bracket (3) to cylinder head.

The lifter bracket is left attached to the flywheel housing for ease in removal.



**6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)****NOTE**

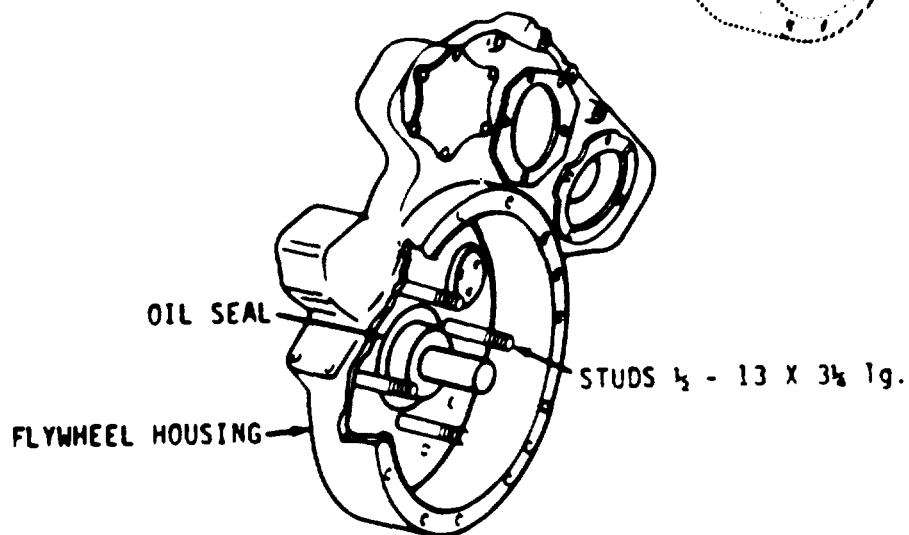
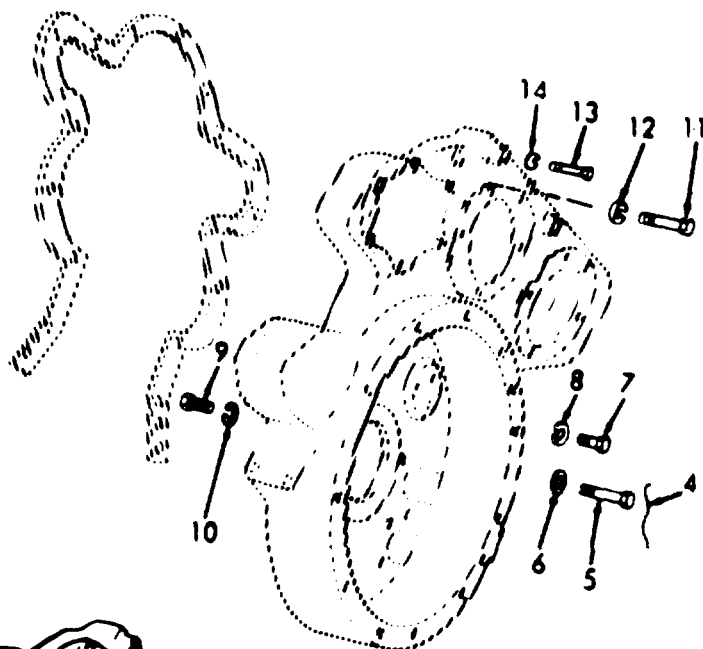
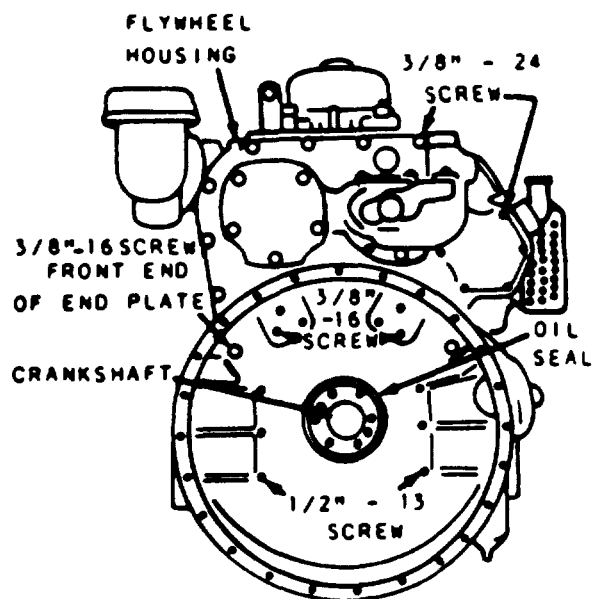
**When removing the flywheel housing bolts, note the location of the various bolts and washers so they may be reinstalled in their proper location.**

2. Flywheel Housing	a. Cut and remove two lockwires (4).	
	b. Remove six bolts (5) and flatwashers (6) inside flywheel housing bell which attach the housing to the idler gear hub and spacer.	Bolts are 3/8-2 X 16.
	c. Remove six bolts (7) and lockwashers (8) inside flywheel housing bell which attach the housing to the cylinder block.	Bolts are 1/2-13 X 3-1/4 lg.
	d. Obtain four pilot studs. Insert in holes where screws were removed.	Studs are 1/2-13 X 3-1/4 lg.
	e. Remove two bolts (9) and lockwashers (10) which go through the rear end plate from the front and thread into the housing.	Bolts are 3/8-16 X 1 lg.
	f. Remove four bolts (11) and lockwashers (12).	Bolts are 3/8-24 X 4 lg.
	g. Remove eight bolts (13) and lockwashers (14).	Bolts are 3/8-24 X 5 lg.

6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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REMOVAL (Cont)



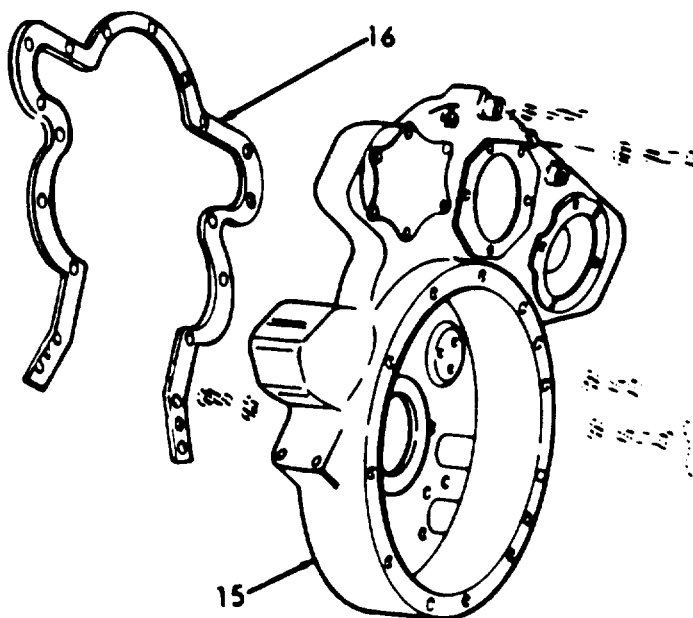
**6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

- h. With the flywheel housing (15) supported by a chain hoist attached to the lifter bracket, strike the front face of the housing alternately on each side with a soft hammer to work it off the dowels and away from the cylinder block rear end plate.
- i. Remove gasket (16).

It is very important that all old gasket material be thoroughly removed from the flywheel housing and the end plate.

**INSPECTION**

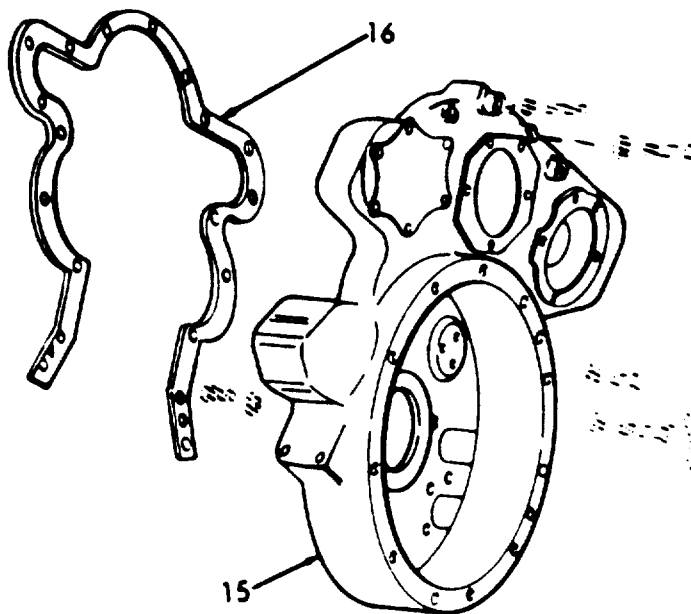
3. Clean and inspect flywheel housing (15) for cracks and other damage.

**6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
---------------	--------	---------

**INSTALLATION**

- |                      |  |
|----------------------|--|
| 4. Engine Rear Plate | <ul style="list-style-type: none"> <li>a. Lubricate the gear train teeth with clean engine</li> <li>b. Attach gasket (16) to end plate.</li> <li>c. Coat the lip of the oil seal with engine oil.</li> <li>d. Install pilot studs if necessary.</li> </ul> |
| 5. Flywheel Housing  | <ul style="list-style-type: none"> <li>a. Lift flywheel housing (15) with chain hoist. Position housing over the crankshaft and up against the cylinder block rear end plate and gasket.</li> </ul>  |



**6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
---------------	--------	---------

**INSTALLATION (Cont)**

- |  |   |
|--|---|
| b. Install six bolts (5) and flatwashers (6) in positions 1 through 6 (idler gear hub and idler gear hole spacer). | Bolts are 3/8-16. Tighten finger tight. |
|--|---|

**NOTE**

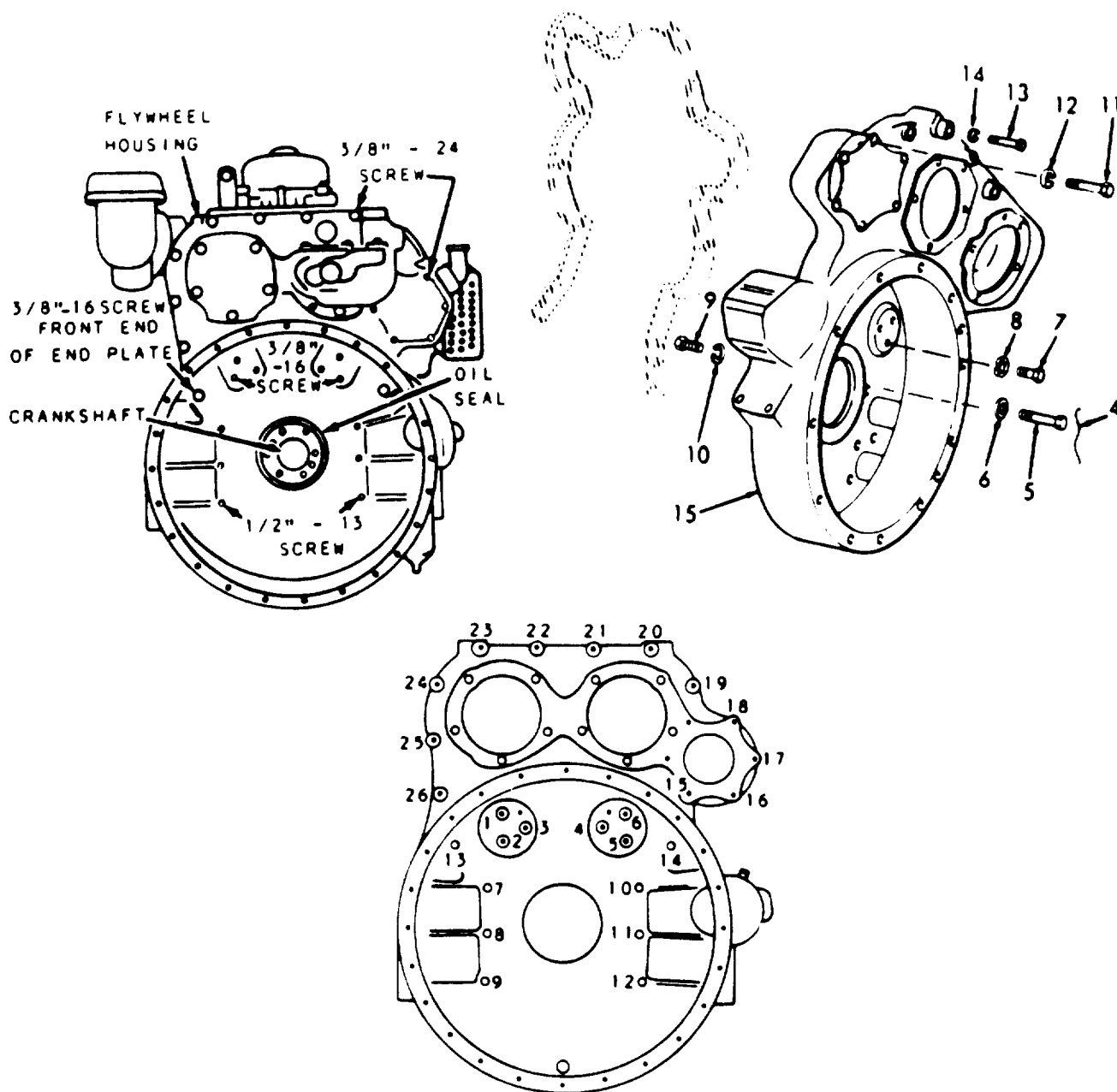
**When tightening the idler gear hub bolts, turn the crankshaft to prevent any bind or brinelling of the idler gear bearing. The crankshaft must be rotated for the flywheel housing bell tightening also.**

- |   |   |
|---|---|
| c. Remove pilot studs.  |   |
| d. Install six bolts (7) and lockwashers (8) in position 7 through 12. tight. | Bolts are 1/2-13 X 3-1/4 long. Tighten finger   |
| e. Install two bolts (9) and lockwashers (10) in positions 13 and 14.         | Bolts are 3/8-16 X 1 lg. Tighten finger tight.  |
| f. Install four bolts (11) and lockwashers (12) in positions 15 through 18.   | Bolts are 3/8-24 X, 4 lg. Tighten finger tight. |
| g. Install eight bolts (13) and lockwashers (14) in positions 19 through 26.  | Bolts are 3/8-24 X 5 lg. Tighten finger tight.  |

6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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INSTALLATION (Cont)





**6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- h. First Tightening Sequence.  
Bolts - Start at one and tighten in sequence, materials together evenly.

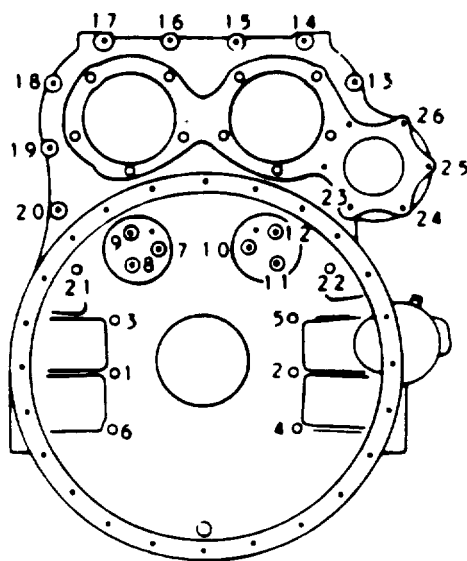
Tighten to torque shown in table.

**NOTE**

Start at number 1 on right hand rotation engines and at number 4 on left hand rotation engines.

**TORQUE**

Bolts	lb-ft	Nm
1/2-13	75-85	102.4 - 116.0
3/8-16	15-25	20.5 -34.1
3/8-16	15-20	20.5 -27.3
3/8-24	15-20	20.5 -27.3



**6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- i. Second Tightening Sequence.  
Bolts - Start at one and  
tighten in sequence.

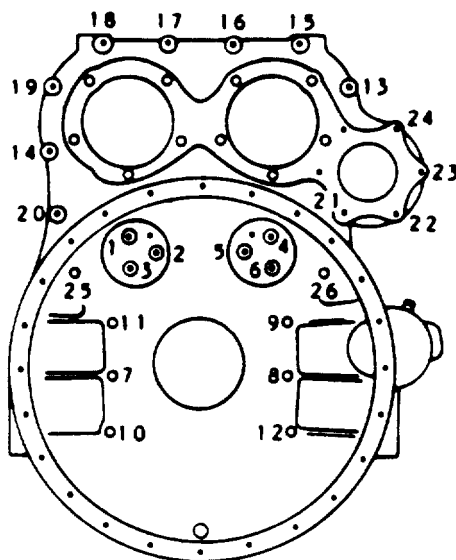
Tighten to  
torque shown  
in table.

**TORQUE**

Bolts	lb-ft	Nm
1/2-13	90-100	122.9-136.5
3/8-16	25-40	34.1-54.6
3/8-16	25-30	34.1-41.0
3/8-24	25-30	34.1-41.0

**NOTE**

Be sure to rotate the crankshaft when tightening the idler gear hub bolts and flywheel housing bell.



A technical line drawing of a mechanical assembly, likely a turbine or compressor section. The assembly features a central circular component with a flange, surrounded by a larger housing. A tool, labeled "TOOL J9737", is shown inserted into a slot on the right side of the assembly. The tool has a long, thin shaft and a specialized head. The drawing is a black and white line art, showing various bolts, flanges, and internal components.

**6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
---------------	--------	---------

**INSTALLATION (Cont)**

- b. Position the dial indicators straight and square with the flywheel housing bell face and inside bore of the bell. Make sure each indicator has adequate travel in each direction.

**NOTE**

**If the flywheel extends beyond the housing bell, the bore and face must be checked separately. Use the special adaptor in the tool set to check the housing bore.**

- c Pry the crankshaft toward one end, play is in one direction only.
- d. Adjust each dial indicator to read zero at the twelve o'clock position. Then rotate the crankshaft one full revolution, taking readings at 450 intervals (8 readings each for the bore and the bolting flange face). Stop and remove the wrench or cranking bar before recording each reading to ensure accuracy. The maximum total indicator reading must not exceed .013" for either the bore or the face.

**6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSTALLATION (Cont)</b>		
	<p>e. If the run-out exceeds the maximum limits, remove the flywheel housing and check for dirt or foreign material, such as old gasket material, between the end plate, flywheel housing and the new gasket end plate, flywheel housing and the new gasket (and between the end plate and the cylinder block).</p> <p>f. Reinstall the flywheel housing and the flywheel and tighten the attaching bolts in the proper sequence and to the specified torque. Then recheck the run-out. If necessary, replace the flywheel housing.</p>	
8. Lifter Bracket (3)	<p>a. Remove screws (17), lockwashers (18), and bracket (3) from flywheel housing.</p> <p>b. Remove gasket (19).</p> <p>c. Affix new gasket (19) to bracket.</p>	Discard gasket.

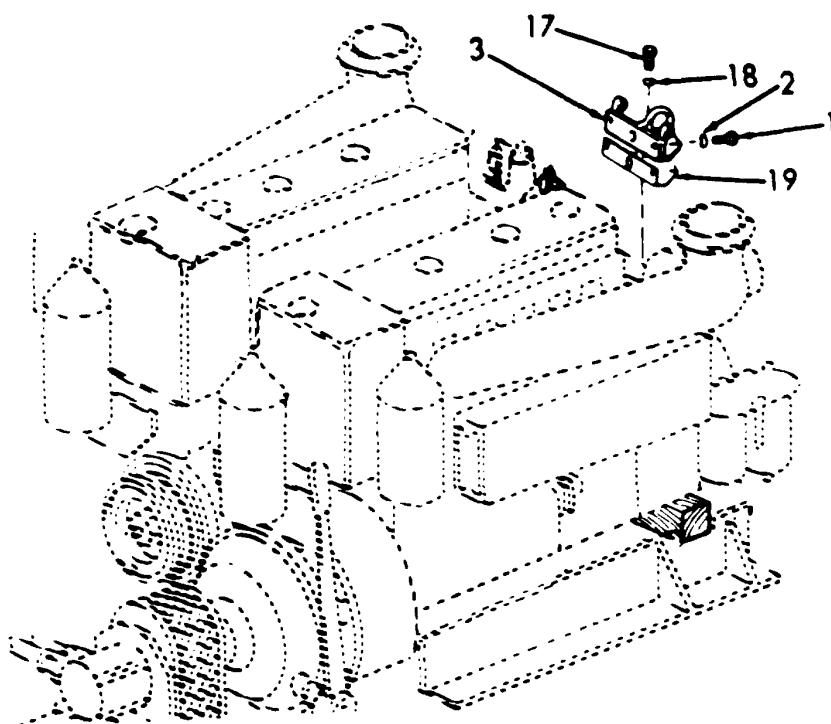
## 6-40. FLYWHEEL HOUSING - MAINTENANCE INSTRUCTIONS (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## INSTALLATION (Cont)

- d. Install bolt (1), screw (17), and lockwashers (2 and 18).

Alternately tighten the bracket-to-flywheel housing screws (17) and the bracket-to-cylinder head bolt (1). Drawing the bracket into the corner formed by the cylinder head and housing.



9. Oil Pan

Reinstall - Refer to paragraph 3-29.

10. Components

Removed - Reinstall.

**6-41. POWER TAKE-OFF COUPLING AND VIBRATION DAMPER.**

The front end power take-off adapter and drive mechanism consists of an adapter which retains the crankshaft front oil seal and is bolted to the engine front end plate and cylinder block.

A coupling and flange assembly is keyed and retained on the crankshaft by a special washer and bolt, a clutch drive adapter and an accessory drive pulley is bolted to the coupling and flange assembly. The clutch driving ring is bolted to this assembly. The forward end of the clutch drive shaft is supported by a pilot ball bearing and a bearing retainer in the coupling and flange assembly.

**This task covers:**

- |                    |                        |
|--------------------|------------------------|
| <b>a. Removal</b>  | <b>c. Inspection</b>   |
| <b>b. Cleaning</b> | <b>d. Installation</b> |

**INITIAL SETUP****Test Equipment**

NONE

**References**

NONE

**Special Tools**

Slide hammer J5901-1  
and adapter J5901-2  
Adapter J6758  
Bar type puller J4558  
Oil seal remover and  
installer J3154-04

**Equipment****Condition**

Paragraph

**Condition Description**

6-37

Power Take-Off Removal

**Tools**

General Mechanic's Tool Kit  
NSN 5180-00-629-9783  
Chain hoist

**Material/Parts**

Engine oil  
Sealing Compound  
All purpose grease  
(Shell Alvania No. 2  
or equivalent)

**Special Environmental Conditions**

Do not drain oil into bilges. Use  
oil separation and recovery system.

**Personnel Required**

2 MOS 61C10

**General Safety Instructions**

Observe WARNING in procedure.

**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REMOVAL</b>		
1. Power Take-Off Coupling	a. Remove power take-off.	Refer to paragraph 6-37.

**NOTE**

**For removal of the clutch drive adapter (1) only from the coupling assembly proceed.**

- b. Remove the six bolts (2) and lockwashers (3) securing the drive adapter (1) to the flange of the coupling (4). Then, remove the drive adapter from the flange of the coupling.

**NOTE**

**For removal of the coupling assembly, accessory pulley, clutch driving ring and clutch drive adaptor as an assembly from the crankshaft perform the following steps c through g.**

- c. Use slide hammer J5901-1 and clutch pilot bearing remover adaptor J5901-2 to remove the pilot bearing (5). If a pilot bearing retainer (6) is used with the pilot bearing, use slide hammer J5901-1 and adaptor J6758 to remove the pilot bearing retainer (6).
- d. Remove the coupling to crankshaft bolt (7) and special washer (8) securing the clutch drive coupling and flange assembly (4) to the engine crankshaft. Remove the special washer from the bolt, then reinstall the bolt approximately half way in the crankshaft.

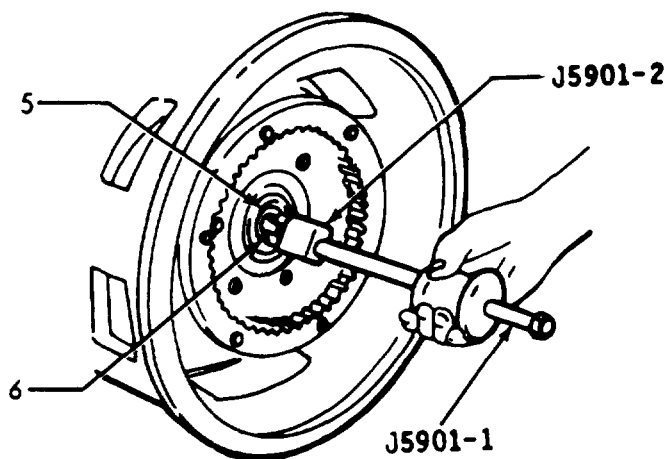
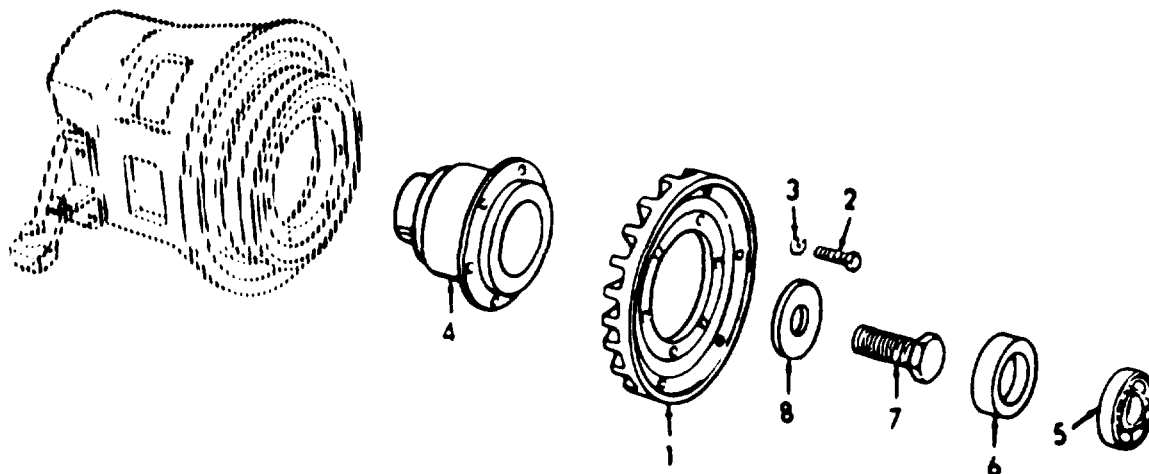


6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).

LOCATION/ITEM	ACTION	REMARKS
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REMOVAL (Cont)

- e. Install two of the clutch drive adaptor to coupling flange attaching bolts (2) and lockwashers (3) diametrically opposite each other.

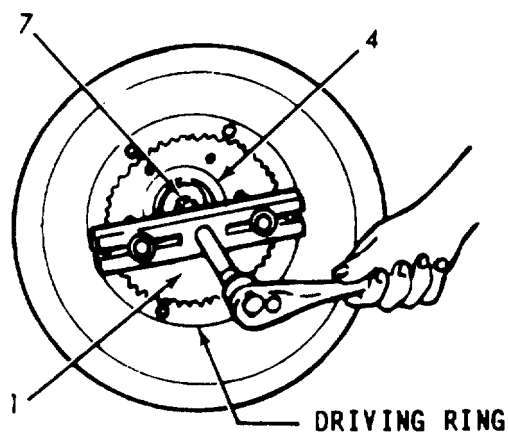


**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

- f. Attach a bar type puller J4558 to the coupling flange with two long 3/8"-16 bolts, with the center screw of the puller in the center of the bolt (7) head in the crankshaft as shown below.



- g. Turn the center screw and pull the coupling assembly (4), accessory pulley (9), drive adapter (1) and driving ring as an assembly from the crankshaft as shown above.
- h. Remove the remaining bolts (2) and lockwashers (3) securing the clutch drive adapter (1) and the accessory drive pulley (9) to the flange of the drive coupling assembly (4), then remove the drive adapter and accessory pulley from the coupling.
- i. Remove the Woodruff keys (10) from the keyways in the crankshaft.

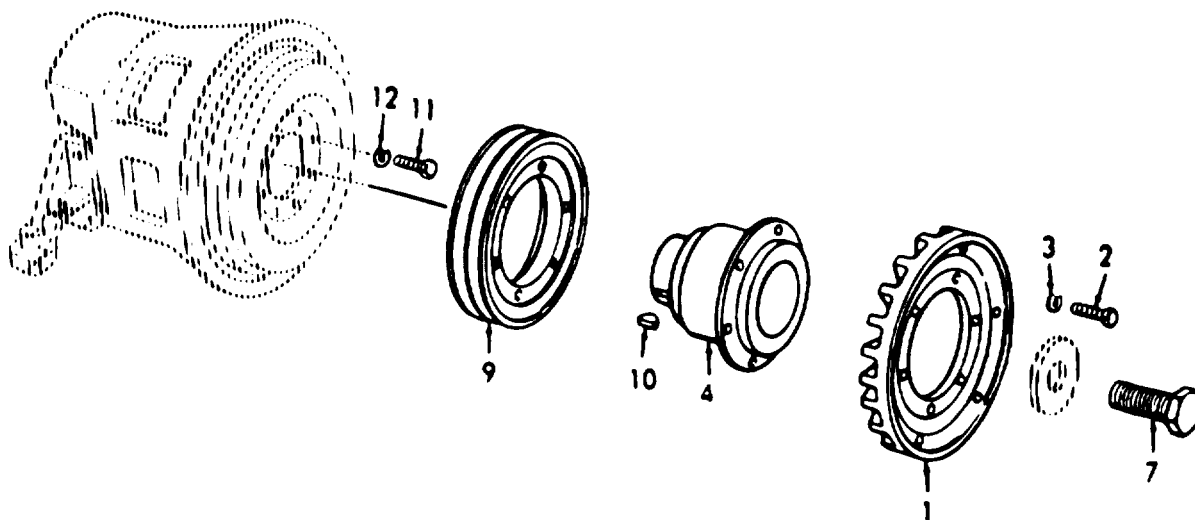
The driving ring is part of the power take-off assembly. Refer to paragraph 6-37.

## 6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## REMOVAL (Cont)

- j. Remove two of the vibration damper to hub attaching bolts (11) and lockwashers (12) diametrically opposite each other.

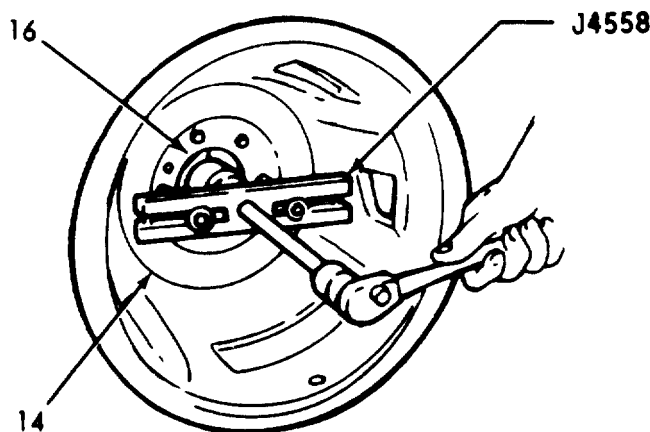


**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

- k. Attach a bar type puller J4558 to the vibration damper hub (13) with two long 7/16"-20 bolts, with the center screw of the puller in the center of the bolt (7) head in the crankshaft as shown below.
- l. Turn the center screw and pull the vibration damper hub (13), vibration dampers (14 and 15), and front vibration damper hub cone (16) forward on the crankshaft approximately one quarter of an inch as shown. Remove the puller from the vibration damper hub (13).

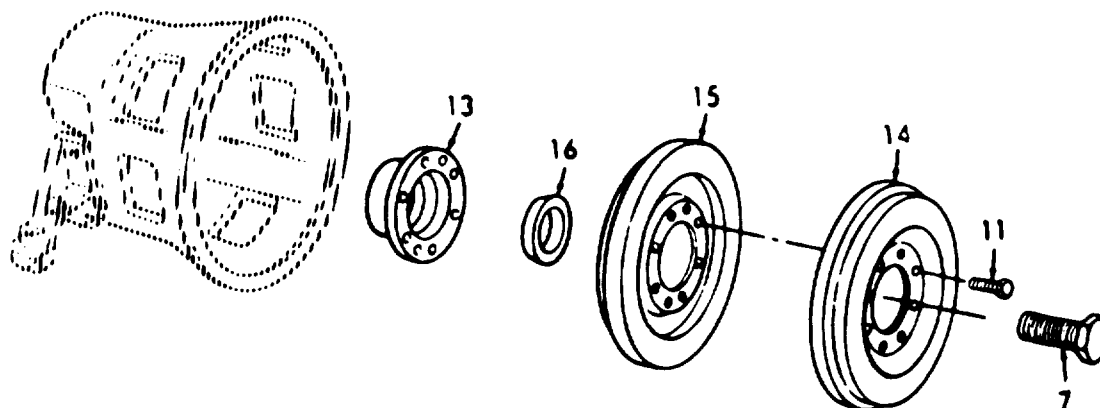


**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

- m. Loosen the vibration damper hub (13) from the front cone (16) by tapping alternately against the hub, adjacent to the attaching bolts (11) with a brass rod and a hammer. Insert a screwdriver in the slot in the front cone to spread and loosen it, then pull the cone straight off the crankshaft. Remove the vibration damper and hub assembly from the crankshaft.



**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)****CAUTION**

**Pounding with a hammer, or prying with other tools must not be resorted to when removing the viscous type damper from the crankshaft. Dents in the damper outer case may render the damper ineffective. The damper cannot be repaired.**

- |   |  |
|---|--|
| <p>n. If necessary, remove the remaining bolts (11) and lockwashers (12) securing the vibration dampers to the damper hub (13) then remove the dampers from the dowel pins (17) in the hub.</p> <p>o. Remove the oil pan drain plug and drain the engine oil.</p> <p>p. Remove the four oil pan to adaptor attaching bolts (18) and lockwashers (19). Loosen all the remaining oil pan attaching bolts along each side of the engine, so the oil pan (20) and gasket (21) can be lowered approximately 1/4" at the front end of the engine.</p> | <p>Use the oil recovery and separation system.</p> |
|---|--|

**NOTE**

**Be sure and loosen the oil pan gasket from the bottom of the power take-off adapter. If the gasket is damaged in any way it must be replaced.**

- q. Remove the bolts (22) and lockwashers (23) securing the front engine, supports (24) to the engine base.

## 6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).

LOCATION/ITEM	ACTION	REMARKS
---------------	--------	---------

## REMOVAL (Cont)

r. Attach a suitable lifting sling and chain hoist to the front engine lifter bracket. Then, lift the front end of the engine just enough to free the supports from the base.

s. Remove four bolts (25) and lockwashers (26).

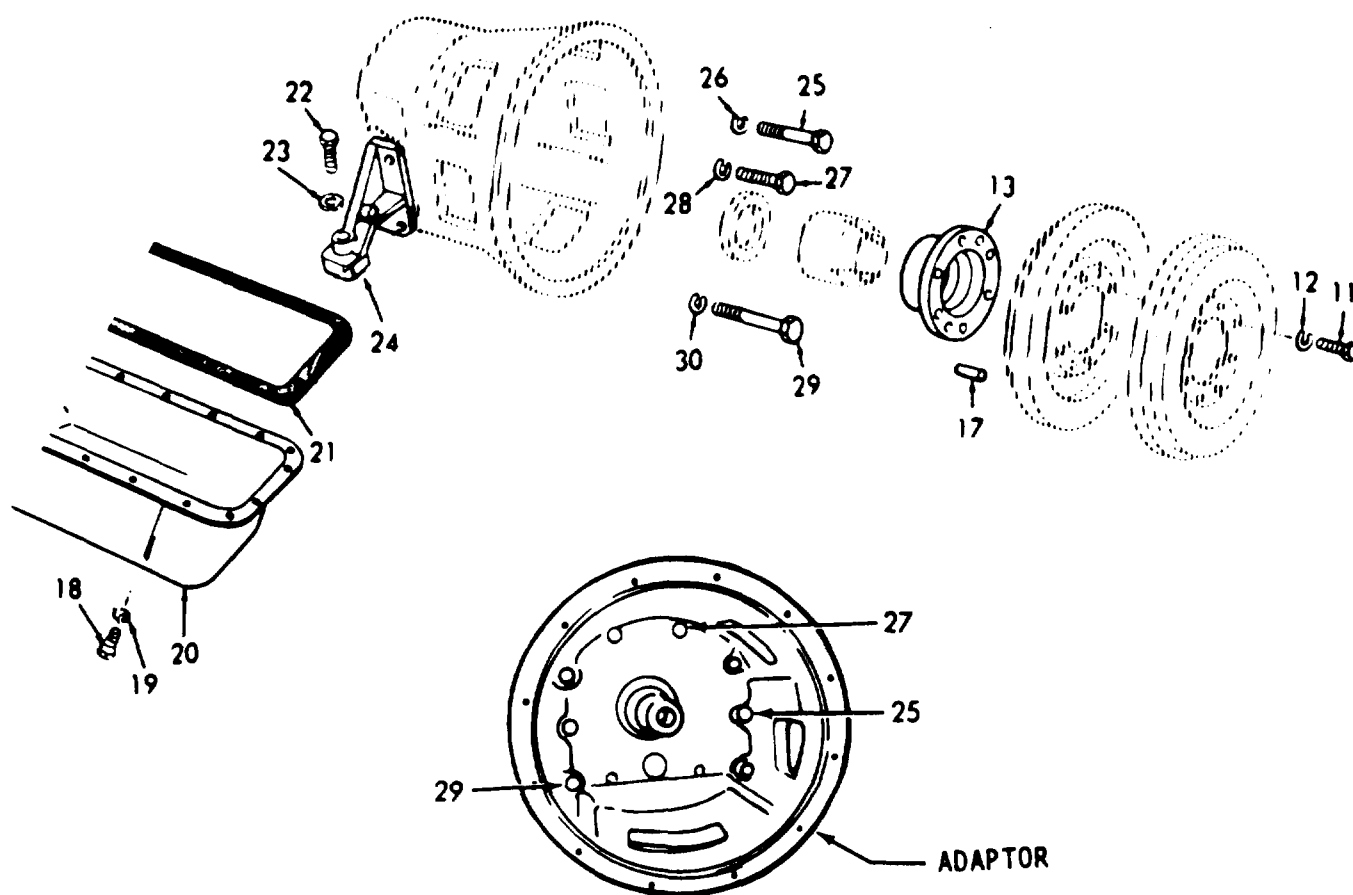
Bolts are 1/2-13  
X 2-3/4 inch.

t. Remove two bolts (27) and lockwashers (28).

Bolts are 3/8-16  
X 2 inch.

u. Remove two bolts (29) and lockwashers (30).

Bolts are 1/2-13  
X 3-1/4 inch.



**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>REMOVAL (Cont)</b>		
	v. Install a 1/2"-13 X 6" pilot stud in two of the attaching bolt holes, diametrically opposite each other to support the adaptor.	
	w. While supporting the front end of the power take-off adaptor (31) tap alternately against the back side of the engine supports with a plastic hammer to free the adapter from the end plate and dowel pins in the cylinder block. Then, slide the adapter off of the pilot studs and crankshaft being careful not to damage the oil seal (32).	
	x. If necessary, remove the vibration damper hub rear cone (33) from the crankshaft.	
	y. Remove the crankshaft front oil seal (32) from the power take-off adapter (31). If the lip of the oil seal is rough or hard, remove the oil seal as follows: <ol style="list-style-type: none"> <li>1. Support the power take-off adapter on wood blocks with the forward face of the adapter down.</li> </ol>	



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**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

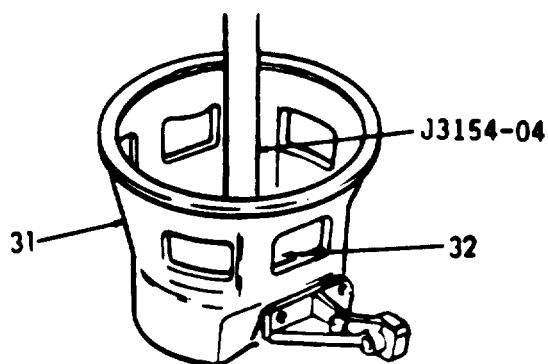
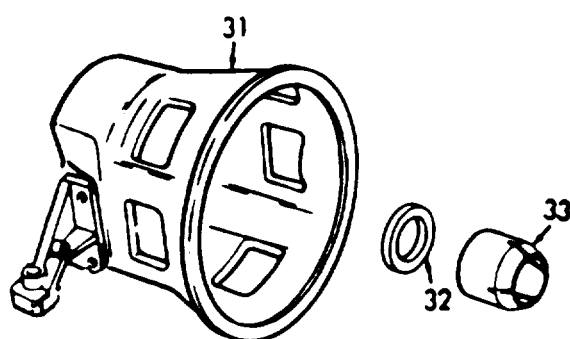
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LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

2. Place tool J3154-04 with suitable plates on top of the oil seal, then drive the oil seal out of the adapter.



**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING**

2. Power Take-Off  
Coupling and  
Vibration Damper

**WARNING**

- Dry cleaning solvent, P-D-680, used to clean parts, is potentially dangerous to personnel and property. Avoid repeated or prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°-138°F (38°-59°C).
- Wear protective eye goggles when using compressed air.

**CAUTION**

Do not allow the rubber bonded vibration dampers and coupling and flange assembly to remain in the dry cleaning solution or the rubber may be loosened. They should be cleaned in dry cleaning solution and dried with compressed air immediately after being cleaned.

Wash all parts with dry cleaning solution P-D-680. Then dry with compressed air.

**INSPECTION**

3. Power  
Take-Off
  - a. Examine the clutch pilot ball bearing (5) for corrosion or pitting. Lubricate the bearing with light engine oil. Then while holding the bearing inner race from turning, revolve the outer race slowly by hand. Any rough spot in the bearing is cause for rejection.



6-930

**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

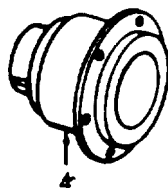
LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)**

- b. Examine the oil seal (32) and if the lip of the oil seal is rough or hard, replace the oil seal.



- c. Inspect the coupling and flange assembly (4) to see that the rubber is firmly bonded to the metal at each end of the coupling and flange assembly. If the coupling and flange assembly has been exposed to fuel oil, lubricating oil or excessive heat, the rubber may have become loosened. In this event, the coupling and flange assembly should be replaced.

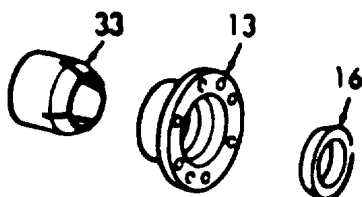


**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSPECTION (Cont)**

- |                     |   |  |
|---------------------|---|--|
| 4. Vibration Damper | <p>a. Inspect the damper to see that the rubber is firmly bonded to the metal parts at each side. If the damper has been exposed to fuel oil, lubricating oil or excessive heat, the rubber may have become loosened from the metal. In this event, the damper should be discarded and replaced with a new one. Also, check to see that the metal discs are not bent.</p> <p>b. If damage to the vibration damper is extensive, inspect the crankshaft as outlined in paragraph 6-28.2. A loose or defective vibration damper, after extended operation, may result in a cracked crankshaft.</p> <p>c. Inspect the damper inner (33) and outer (16) cones, damper hub (13) and the end of the crankshaft for galling or burrs. Slight scratches or burrs may be removed with emery cloth. If seriously damaged, the parts should be replaced and the end of the crankshaft refinished. Check the outside diameter of the inner cone for wear at the crankshaft front oil seal contact surface. If worn, the oil seal and cone should be replaced.</p> |  |
|---------------------|---|--|

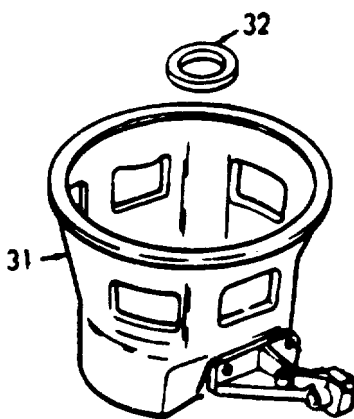


**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION**

- |  |   |  |
|--|---|--|
| 5. Power Take-Off and Vibration Damper | <p>a. Install the crankshaft front oil seal (32) in the power take-off adapter (31) as follows:</p> <ol style="list-style-type: none"><li>1. Apply a thin coat of sealing compound to the outside diameter of the oil seal casing.</li><li>2. Start the oil seal (32) straight into the oil seal bore of the adapter from the forward (front) face of the adapter with the lip of the oil seal facing down.</li></ol> |  |
|--|---|--|



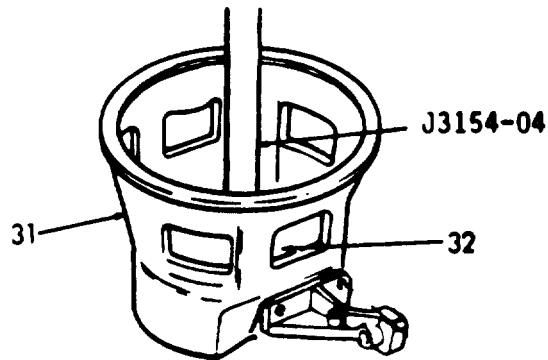
6-933

**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

3. Place a 1/4 inch steel plate approximately 4 inch square on the bed of an arbor press, then support the adapter (31) with oil seal, rear face of adapter down, on top of the steel plate. Be sure the center of the adapter is resting flat on the steel plate.
4. Place tool J3154-04 with suitable plates on top of the oil seal (32) and under the ram of the press as shown below. Then, press the oil seal (32) straight into the adapter until the oil seal contacts the steel plate on the bed of the press.

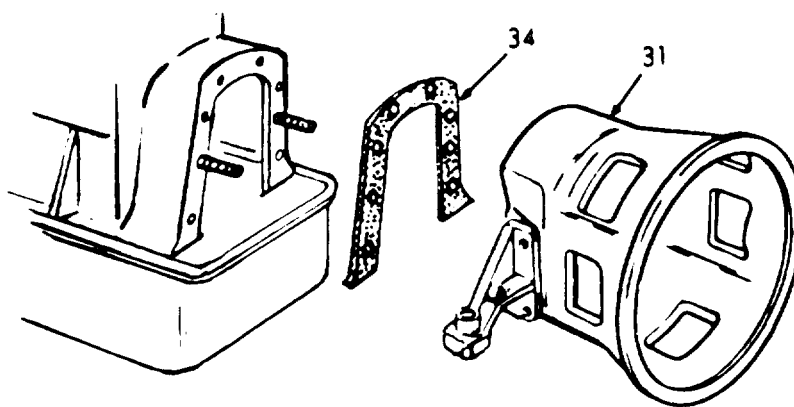


**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- b. Install a 1/2"-13 X 6" pilot stud in two of the attaching bolt holes, diametrically opposite each other to support the adapter.
- c. Place a new adapter gasket (34) over the pilot studs and against the end plate. Then trim the ends of the gasket off flush with the bottom edge of the cylinder block.
- d. Place the power take-off adapter (31) and oil seal assembly over the crankshaft, and guide the pilot studs into the bolt holes of the adapter, being careful not to damage the oil seal. Slide the adaptor straight back over the pilot studs and dowel pins and against the gasket (34) as shown below.

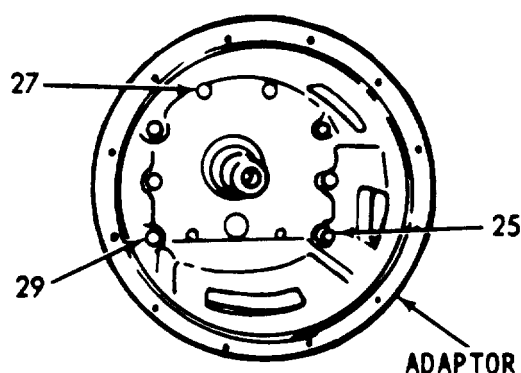


**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- |  |                                |
|--|--------------------------------|
| e. Install four bolts (25) and lockwashers (26).   | Bolts are 1/2-13 X 2-3/4 inch. |
| f. Install two bolts (27) and lockwashers (28).  | Bolts are 3/8-16 X 2 inch.     |
| g. Install two bolts (29) and lockwashers (30).  | Bolts are 1/2-13 X 3-1/4 inch. |
| h. Tighten bolts (25 and 29) to 70-75 lb-ft (94.9-101.7 Nm) torque. Tighten bolts (27) to 30-35 lb-ft (40.7-47.5 Nm) torque. |                                |



- |  |
|--|
| i. If removed, place the vibration damper rear cone (33) over the end of the crankshaft with the tapered end of the cone facing the front end of the crankshaft, then slide the cone through the oil seal and against the oil slinger. |
| j. Lower the front end of the engine so the front engine supports (24) rest on the engine base, then install the bolts (22) and lockwashers (23) securing the front engine supports to the engine base. Tighten the bolts securely.    |



**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

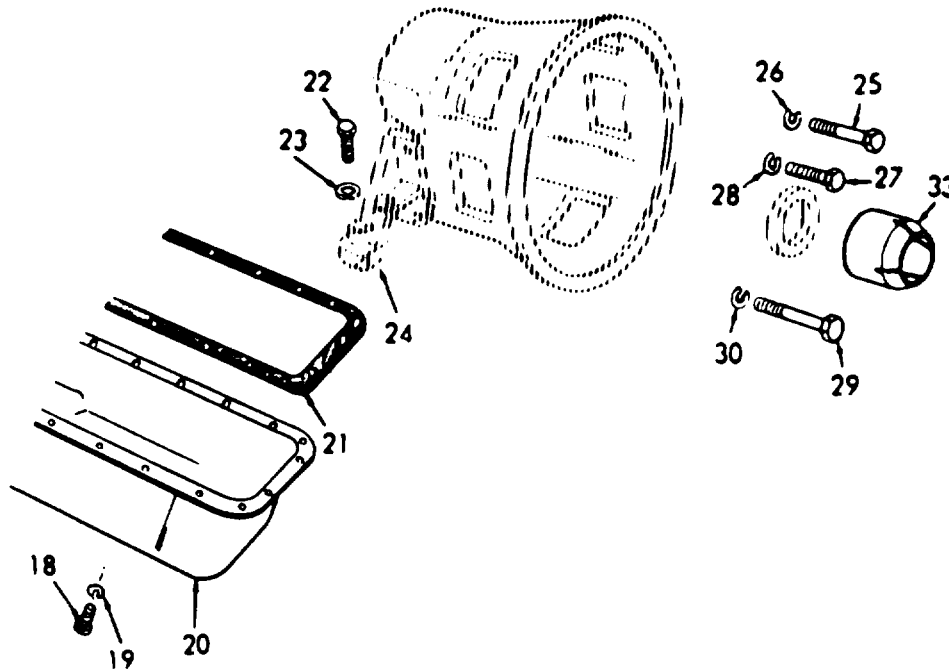
LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- k. Remove the chain hoist and sling from the engine.
- l. Install the four oil pan adapter bolts (18) and lockwashers (19). Then tighten all of the remaining oil pan bolts along each side of the oil pan (20) that were loosened.

**NOTE**

If the oil pan gasket (21) was damaged in anyway during disassembly, it should be replaced at this time before the bolts are installed and tightened.



**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

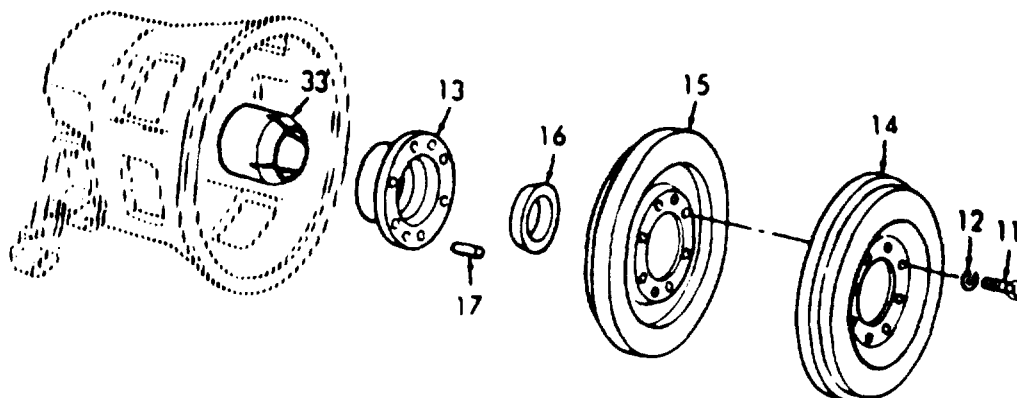
LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

m. If the light and heavy vibration dampers (14) and (15) were removed from the hub (13), assemble the two dampers over the dowels (17) and against the hub with the flat faces of the dampers facing each other, then install the bolts (11) and lockwashers (12). Tighten the bolts to 57-61 lb-ft (77.3-82.7 Nm) torque.

n. Place the vibration dampers and hub assembly over the end of the crankshaft, long end of hub facing rear cone, and against the taper on the rear cone (33).

o. Place the front cone (16) over the end of the crankshaft with the tapered end of the cone facing the hub. Insert the blade of a screw driver in the slot in the cone to expand it. Then slide the cone straight forward until the taper on the cone contacts the taper on the damper hub. Remove the screw driver.



**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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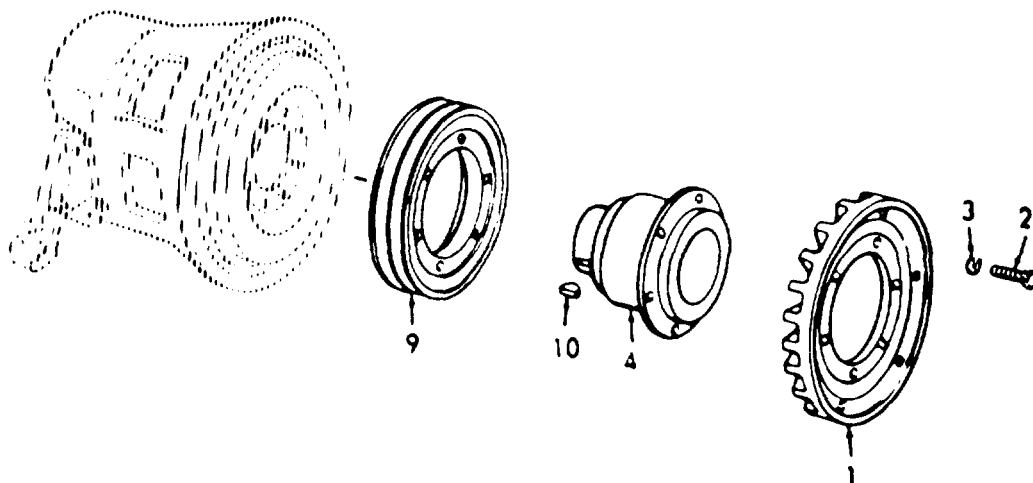
**INSTALLATION (Cont)**

p. If the clutch drive adapter (15) and accessory drive pulley (9) were removed from the flange of the coupling (4), place the accessory drive pulley against the rear face of the coupling flange and the clutch drive adapter against the front face of the coupling flange, then install the bolts (2) and lockwashers (3). Tighten the bolts after the coupling and flange assembly has been installed on the crankshaft.

q. If removed, place the clutch driving ring against the clutch drive adapter. Then install the bolts and lockwashers. Tighten the bolts after the coupling assembly has been installed on the crankshaft.

Refer to paragraph 6-37.

r. Install the two Woodruff keys (10) in the keyways in the crankshaft.

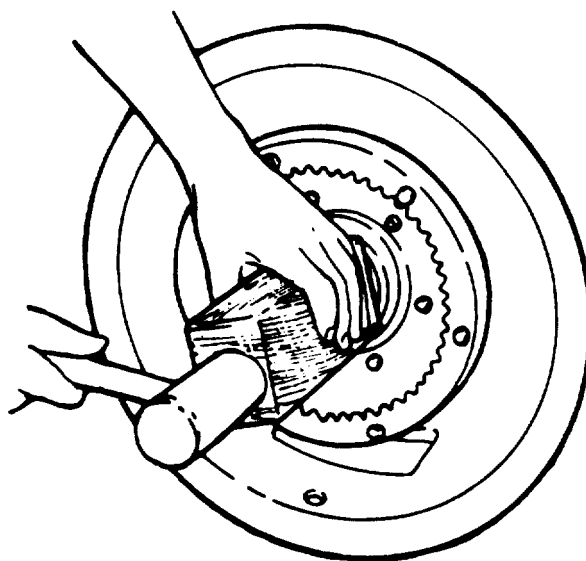


**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

- s. Lubricate the forward end of the crankshaft with engine oil. Start the coupling and flange assembly, with accessory pulley and clutch drive adapter attached, straight on the crankshaft with the keyway in the coupling in line with the keys in the crankshaft, then drive the coupling and flange assembly on the crankshaft with a hard wood block and hammer as shown below until it contacts the front vibration damper hub cone.



- t. Place the special washer (8) on the coupling to crankshaft bolt (7) then thread the bolt in the crankshaft. Tighten the bolt to 290-310 lb-ft (393.2-420.3 Nm) torque.

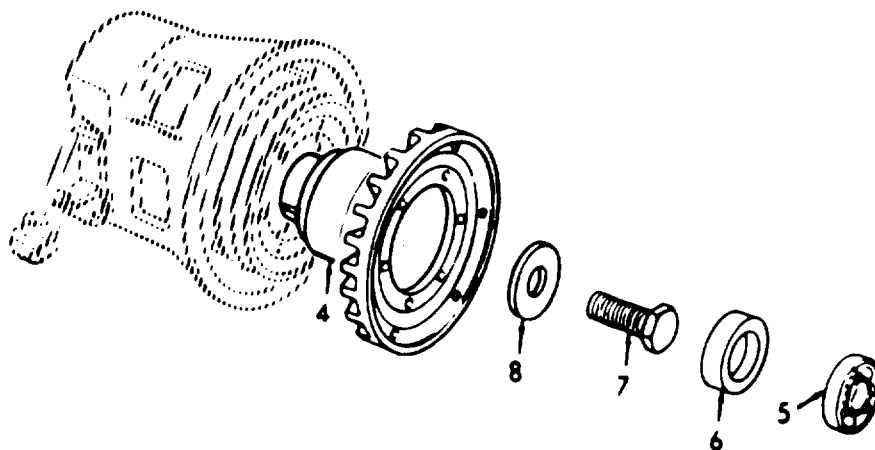
**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

Tighten the clutch drive adaptor, and the clutch driving ring attaching bolts at this time to 30-35 lb-ft (40.7-47.5 Nm) torque.

- u. Install the clutch pilot bearing (5) and bearing retainer (6) in the clutch drive coupling and flange assembly (4) as follows:
  1. Lubricate the outside diameter of the clutch pilot bearing with engine oil. Then, start the bearing, shielded side of bearing up, straight into the bearing retainer.
  2. Place the bearing retainer and pilot bearing on the bed of an arbor press, pilot bearing side up. Then place a round steel plate slightly smaller than the inside diameter of the bearing retainer on top of the bearing and under the ram of the press. Then, press the bearing straight into and against the shoulder in the retainer.



**6-41. POWER TAKE OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)****NOTE**

The clutch pilot bearing retainer is used only on the front end direct drive power take-off unit.

3. Pack the cavity in the coupling and flange assembly one-third full with an all purpose grease such as Shell Alvania No. 2 or its equivalent.

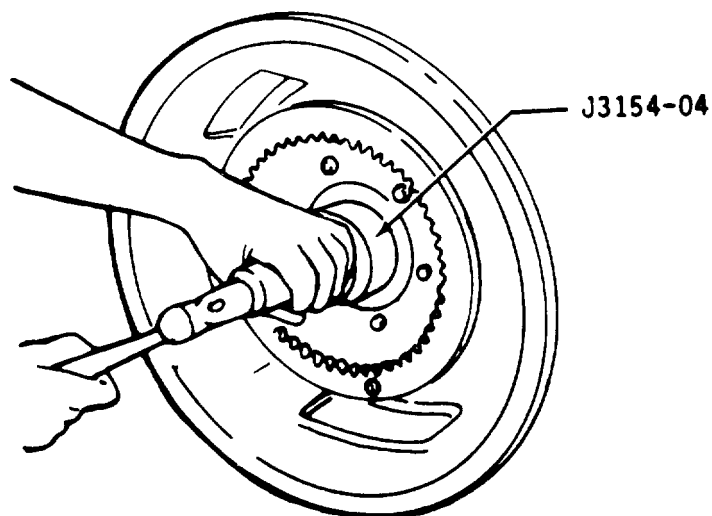
**CAUTION**

Do not fill the cavity in the coupling and flange assembly more than one-third full of grease.

4. Start the bearing retainer and bearing assembly, shielded side of bearing facing out, straight into the bore in the coupling and flange assembly. Then, drive the pilot bearing and retainer straight into and against the shoulder in the coupling and flange assembly with a bearing driver, tool J3154-04, as shown below.

**6-41. POWER TAKE-OFF COUPLING AND VIBRATION DAMPER (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

v. Install the power take-off.

Refer to paragraph 6-37.

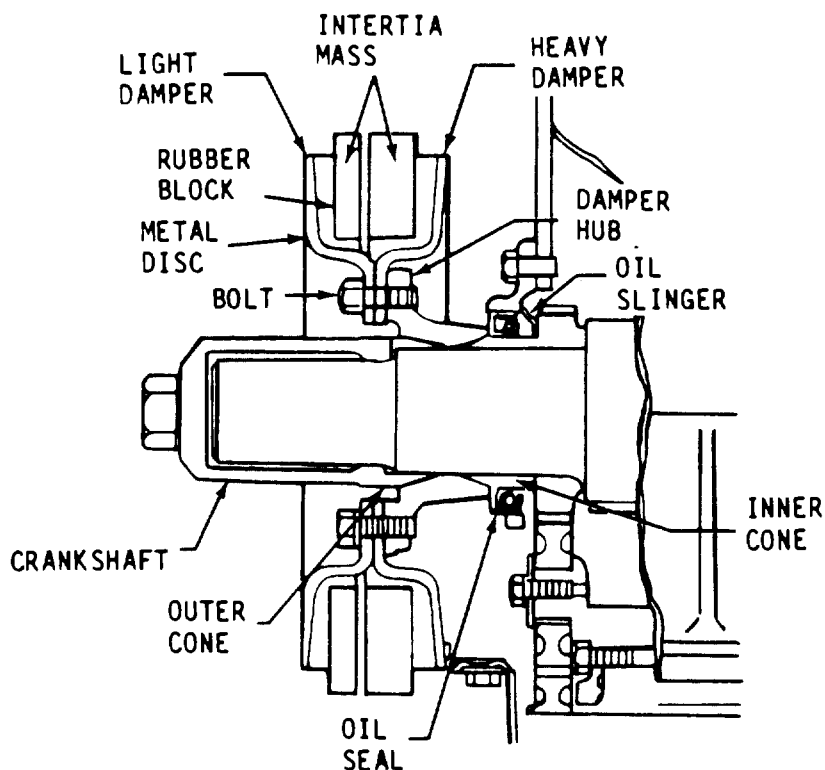
w. Reinstall engine oil drain plug and refill engine with oil.

**6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY.**

LOCATION/ITEM	ACTION	REMARKS
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## a. Vibration Damper.

The double (rubber) damper shown below is made up of a light damper, a heavy damper, a hub, an inner cone, and an outer cone. The light and heavy dampers in the assembly are in turn made up of rubber blocks bonded to an inertia mass in the form of metal ring on one side, and a stamped metal disc on the opposite side.



The two metal parts are, therefore, entirely separated and free to move freely within certain prescribed limits by virtue of the rubber blocks. The light and heavy dampers are bolted and doweled together and to the driving hub. The hub in turn is secured in place at the front end of the crankshaft between an inner and outer cone as shown. The two cones provide an adequate rigid mounting when the crankshaft pulley is drawn up tight against the outer cone by the bolt in the end of the crankshaft.

Even though these vibration dampers are rigidly constructed, and should give no trouble if given proper care; nevertheless, since rubber is used in the assembly, certain precautions are necessary. Fuel oil and lubricating oil, as well as excessive heat, are destructive to rubber. The assembly, therefore, should be protected against these destructive agents. Furthermore, for the damper to function properly and safeguard the crankshaft, it should be securely fastened to the shaft by the cones and the crankshaft pulley.



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**6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).**

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LOCATION/ITEM	ACTION	REMARKS
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The vibration damper must be removed whenever the crankshaft, crankshaft front cover, or crankshaft front oil seal is removed or replaced.

b. Crankcase Front Cover.

The crankshaft front cover is mounted against the end plate at the lower front end of the engine. It serves as a housing for the vibration damper. The engine is supported at the front end by means of engine supports attached to the front cover.

The crankshaft front cover needs no servicing except replacement of the front crankshaft oil seal, when such becomes necessary.

It will be necessary to remove the crankshaft front cover to remove and install a crankshaft, or when engine is overhauled.

c. Crankcase Pulley.

The crankshaft pulley is mounted over two Woodruff keys at the front of the crankshaft. A special washer and bolt are used to secure the pulley to the crankshaft.

**6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).**

This task covers:

- a. Removal
- b. Cleaning

- c. Inspection
- d. Installation

**INITIAL SETUP****Test Equipment**

NONE

**References**

NONE

**Special Tools**

Torque wrench  
Puller J4558

**Equipment****Condition Condition Description**

NONE

**Tools**

General Mechanic's Tool Kit

**Special Environmental Conditions****Materials/Parts**

Dry cleaning solvent  
Fed. Spec. P-D-680  
Cup grease  
Engine oil  
Shellac

Do not drain oil into bilges. Use  
oil separation and recovery system  
to collect drained oil.

**Personnel Required**

2

**General Safety Instructions**

Observe WARNING in procedure.

**LOCATION/ITEM****ACTION****REMARKS****REMOVAL**

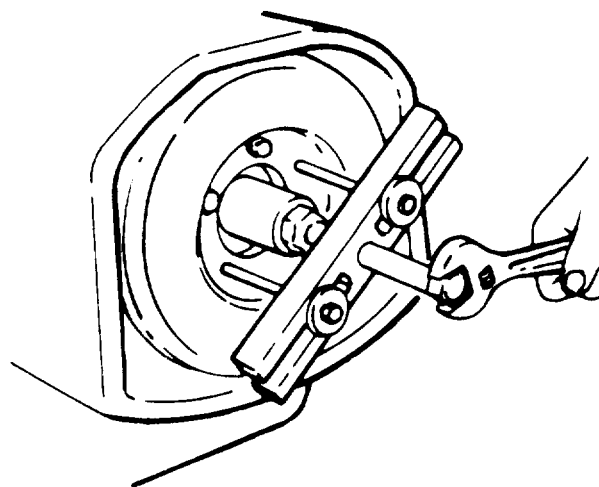
1. Crankcase  
Pulley

- a. Remove bolt (1) and washer (2).
- b. In tapped holes in the pulley hub, install the pulley bolt (1) in end of the crankshaft and use puller J4558 as shown below.

## 6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).

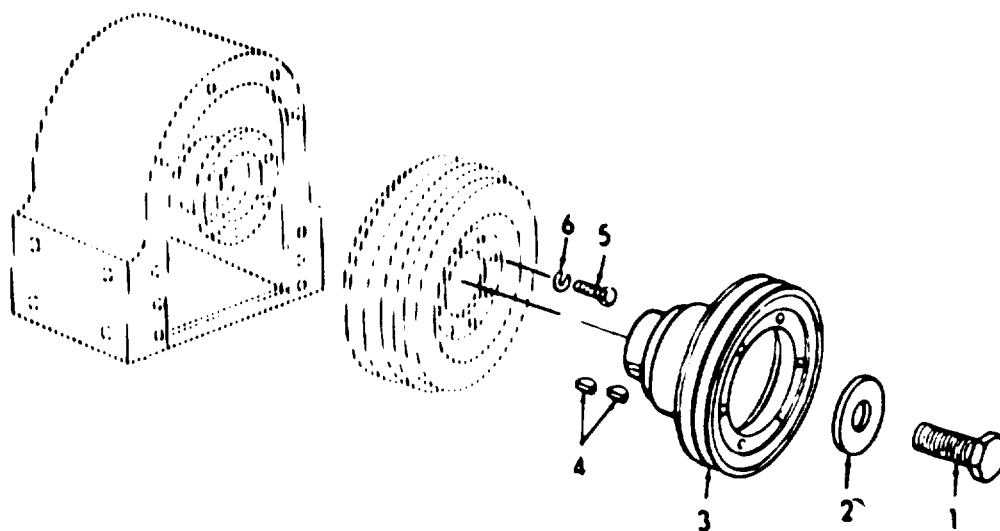
LOCATION/ITEM	ACTION	REMARKS
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## REMOVAL (Cont)



- c. Remove bolt (1).
- d. Remove pulley (3) and two Woodruff keys (4).
- a. Remove two damper-to-hub bolts (5) and lockwashers (6) diametrically opposite to each other.

## 2. Vibration Damper



**6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)****CAUTION:**

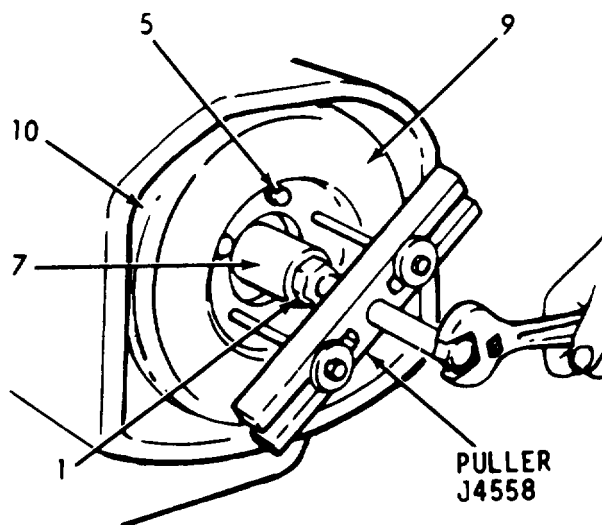
Pounding with a hammer, or prying with other tools must not be resorted to in removing the viscous type damper from the crankshaft, since the outer shell may be dented and cause the flywheel to turn at the same speed as the outer shell, thus rendering the damper ineffective! The damper cannot be repaired.

- b. Reinstall the pulley crankshaft bolt (1) and install puller as shown below to loosen the outer cone (7) wedged between the crankshaft and the damper hub (8). After loosening the cone it may be "fished" from the inner diameter of the damper hub with two thin shank screw drivers.
- c. Slide the light vibration damper (9) and heavy damper (10) with damper hub (8) as an assembly off the end of the crankshaft by hand.

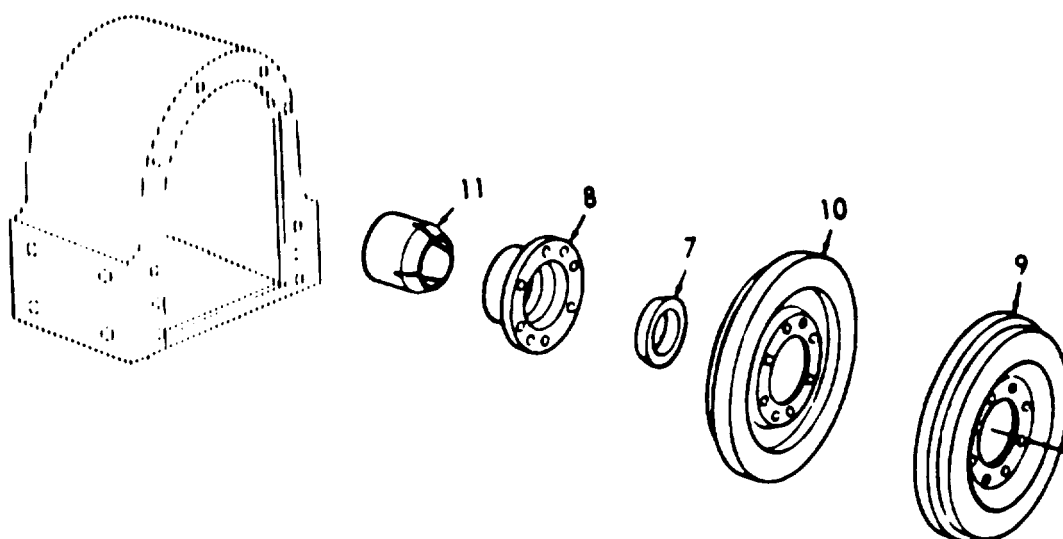
6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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REMOVAL (Cont)



- d. Slide the inner cone (11) from the crankshaft.



**6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**REMOVAL (Cont)**

3. Crankcase Front Cover	a. Remove the oil pan drain plug and drain the engine oil.	Use the oil recovery and separation system.
	b. Remove the four oil pan to adapter attaching bolts (12) and lockwashers (13). Loosen all the remaining oil pan attaching bolts along each side of the engine, so the oil pan (14) and gasket (15) can be lowered approximately 1/4" at the front end of the engine.	

**NOTE**

**Be sure and loosen the oil pan gasket from the bottom of the crankcase front cover. If the gasket is damaged in any way it must be replaced.**

c. Remove the bolts (16) and lockwashers (17) securing the front engine supports (18) to the engine base.	
d. Remove six bolts (19) and lockwashers (20).	Bolts are 1/2-13 X 2-1/4 long.
e. Remove four bolts (21) and lockwashers (22).	Bolts are 3/8-16 X 2-1/8 long.

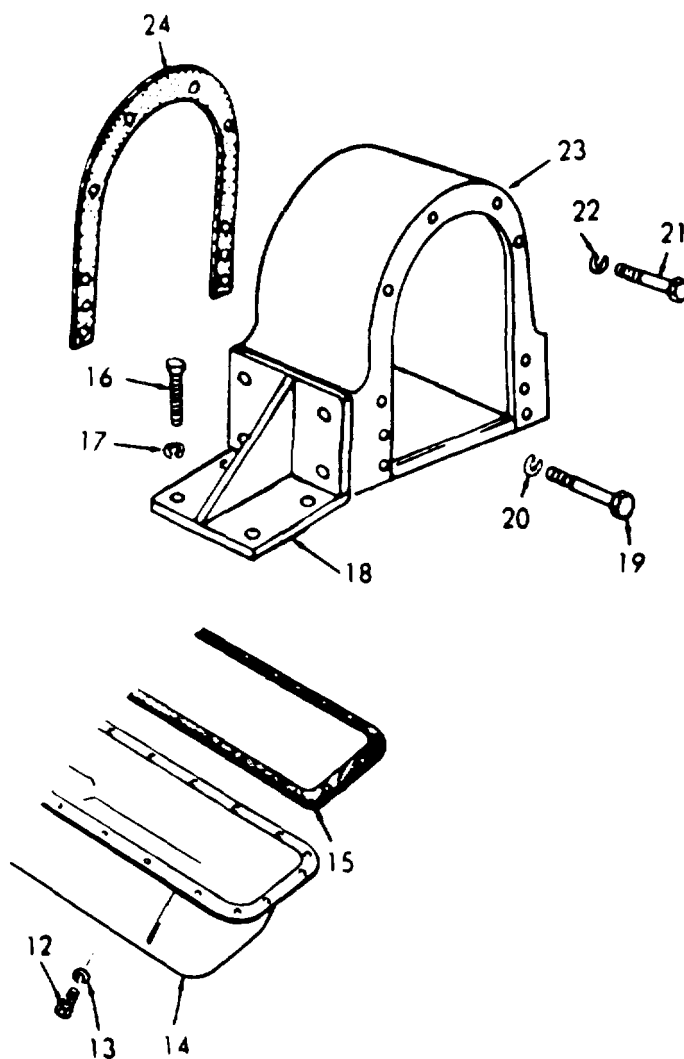
6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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REMOVAL (Cont)

f. Remove cover (23) and gasket (24).

Discard gasket.



**6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**CLEANING****WARNING**

- Dry cleaning solvent P-D-680, used to clean parts, is potentially dangerous to personnel and property. Avoid repeated or prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°-138°F (38°-59°C).
- Wear protective eye goggles when using compressed

4. Vibration Damper	Clean with dry cleaning solution P-D-680 and blow dry with compressed air.	
5. Crankcase Front Cover	Clean with dry cleaning solution P-D-680 and blow dry with compressed air.	
6. Crankcase Pulley	Clean with dry cleaning solution P-D-680 and blow dry with compressed air.	



**6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSPECTION</b>		
7. Vibration Damper	<p>a. Inspect the damper to see that the rubber is firmly bonded to the metal parts at each side. If the damper has been exposed to fuel oil, lubricating oil, or excessive heat, the rubber may have become loosened from the metal. In this event, the damper should be discarded and replaced with a new one. Also, check to see that the metal discs are not bent.</p> <p>b. Inspect the damper inner and outer cones, damper hub and the end of the crankshaft for galling or burrs. Slight scratches or burrs may be removed with emery cloth. If seriously damaged, the parts should be replaced and the end of the crankshaft refinished. Check the outside diameter of the inner cone for wear at the crankshaft front oil seal contact surface. If worn, the oil seal and cone should be replaced.</p>	
8. Crankcase Front Cover	Inspect for damage.	
9. Crankcase Pulley	Inspect for damage.	

**6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
<b>INSTALLATION</b>		
10. Crankcase Front Cover	a. Shellac new gasket (24) to bolting flange of crankcase front cover.	
	b. Coat lip of oil seal lightly with cup grease.	
	c. Attach crankshaft front cover (23) to cylinder block front end plate with bolts (21) and lockwashers (22). Use plain washers in addition to lockwashers on aluminum covers.	
	d. Install six bolts (19), and lockwashers (20).	Bolts are 1/2-13 X 2-1/14 long.
	e. Install four bolts (21), and lockwashers (22).	Bolts are 3/8-16 X 2-1/8 long.
	f. Tighten bolts holding front cover against end plate following the tightening sequence indicated below. This sequence should be followed as the bolts are drawn up and then tightened to their proper torque in order to effect a good seal between the mating parts. The 3/8"-16 bolts should be tightened to 25-30 ft-lb (33.9-40.7 Nm) and the 1/2"-13 bolts to 80-90 ft-lb (108.5-122.0 Nm) torque.	
	g. Install bolts (16) and lockwashers (17), securing the front engine supports (18) to the engine base.	

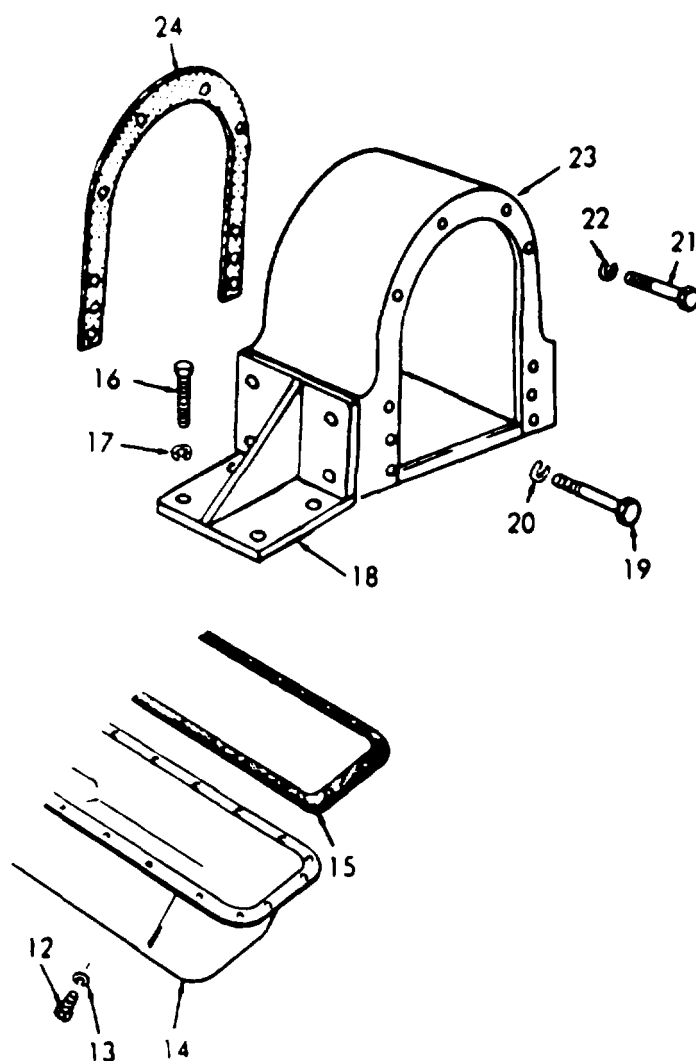
## 6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).

LOCATION/ITEM	ACTION	REMARKS
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## INSTALLATION (Cont)

h. Install the four oil pan to adapter attaching bolts (12), and lockwashers (13). Tighten all the remaining oil pan bolts.

i. Install oil pan drain plug and fill engine with oil.



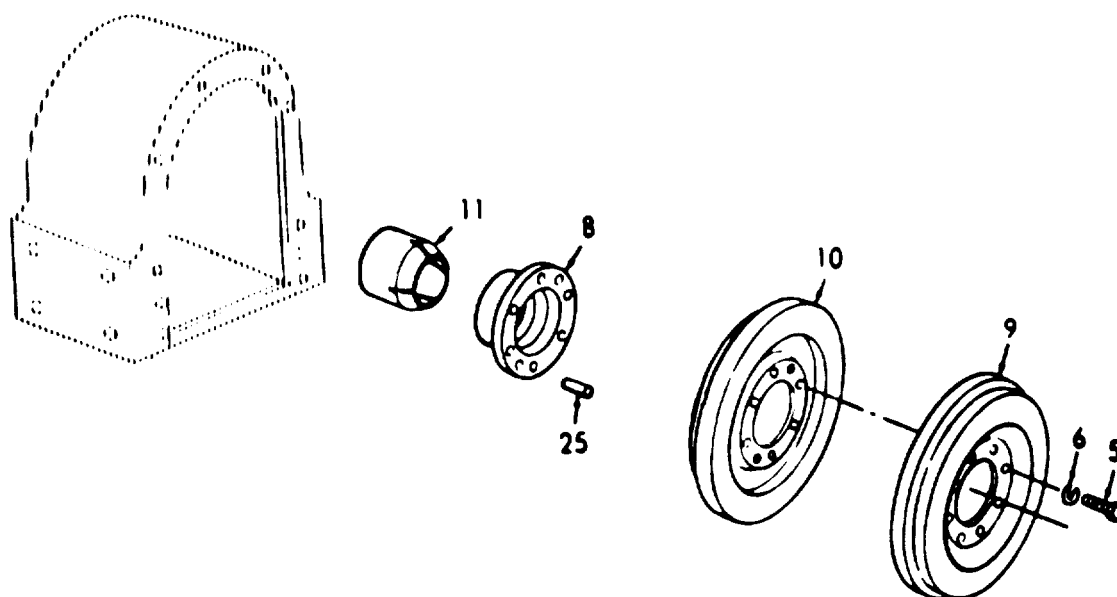
**6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
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**INSTALLATION (Cont)**

11. Vibration  
Damper

- a. Apply a light coat of cup grease to the front oil seal and slide the inner cone (11) onto the crankshaft next to the oil slinger, with the tapered end of the cone pointing toward the front end of the crankshaft.
- b. If, for any reason, the light (9) and heavy dampers (10) were removed from the hub, assemble the two dampers over the dowels (25) and against the hub (8) with the flat faces of the dampers facing each other. Secure the dampers to the hub with bolts (5) and lockwashers (6).
- c. Slide the damper and hub as an assembly - long end of hub facing crankshaft cover - into position.

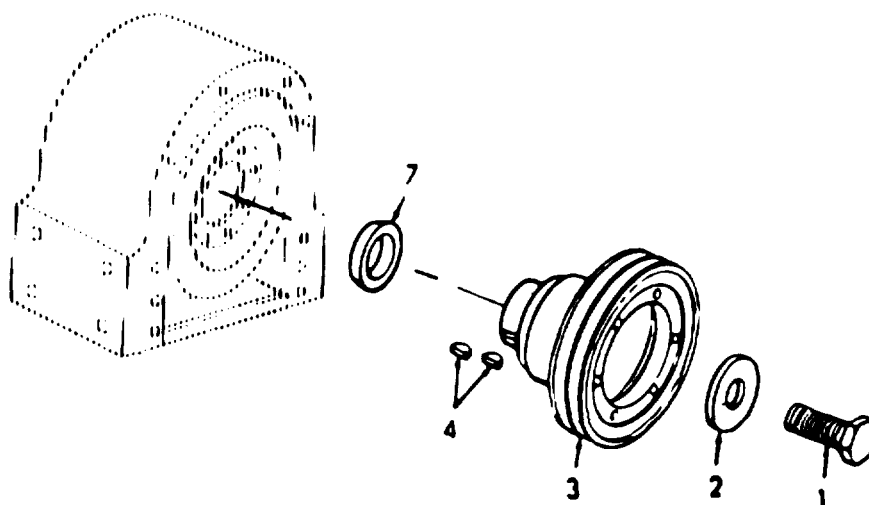


**6-42. VIBRATION DAMPER, CRANKCASE FRONT COVER AND CRANKSHAFT PULLEY (Continued).**

LOCATION/ITEM	ACTION	REMARKS
---------------	--------	---------

**INSTALLATION (Cont)**

12. Crankshaft Pulley
- d. Slide the outer cone (7) over the shaft and into the hub of the damper.
  - a. Place the Woodruff keys (4) in the key slot in the front end of the crankshaft.
  - b. Slide the pulley (3) over the end of the crankshaft.
  - c. Install washer (2) and bolt (1).

**CAUTION**

The damper assembly must be securely fastened to the crankshaft. When the bolt is drawn up to the specified torque, the cones will hold the damper rigidly in place.

- d. Tighten the crankshaft pulley retaining bolt (1) to 290-310 lb-ft (393.2-420.3 Nm) torque.

**6-43. ENGINE ALARMS WARNING LIGHTS AND SENDING UNITS.**

LOCATION/ITEM	ACTION	REMARKS
---------------	--------	---------

## a. General.

(1) Sending units (lube oil pressure switch and water temperature switch) are installed on each engine to provide warnings which are indicated on the engine alarm panel located in the pilothouse.

(2) If the engine lubricating oil pressure falls below 10 psi (69 kpa) or if the water temperature exceeds  $200 \pm 5^\circ \text{F}$  ( $93 \pm 2.8^\circ \text{C}$ ) the respective warning lights will be activated and alert the operator to shut down the engine. The fuel oil pressure switch activates the low oil pressure and high water temperature switches when the fuel pressure attains 20 psi (138 kpa) after starting the engine.

(3) To protect the circuit and switches, the circuit is not energized until the fuel oil pressure switch is closed. The fuel oil pressure switches are installed in the fuel oil manifolds which are an integral part of the engine cylinder head casting.

## b. Testing.

(1) With engine stopped, place a jumper wire across the fuel oil pressure switch terminals.

(2) Move the engine alarm indicator switch on the distribution panel to the ON position. The lamp should light for the circuit being tested.

**6-43. ENGINE ALARMS WARNING LIGHTS AND SENDING UNITS.**

This task covers:

**REPAIR****INITIAL SETUP****Test Equipment**

NONE

**References**

NONE

**Special Tools**

NONE

**Equipment****Condition Condition Description**

NONE

**Tools**

General Mechanic's Tool Kit  
NSN 5180-00-629-9783

**Material/Parts**

NONE

**Special Environmental Conditions**

NONE

**Personnel Required**

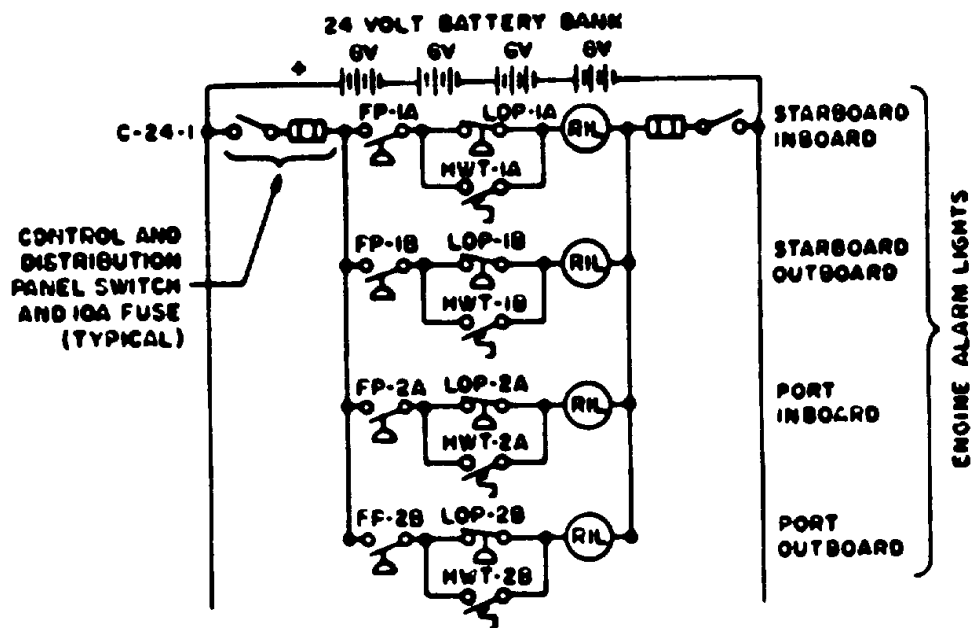
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**General Safety Instructions**

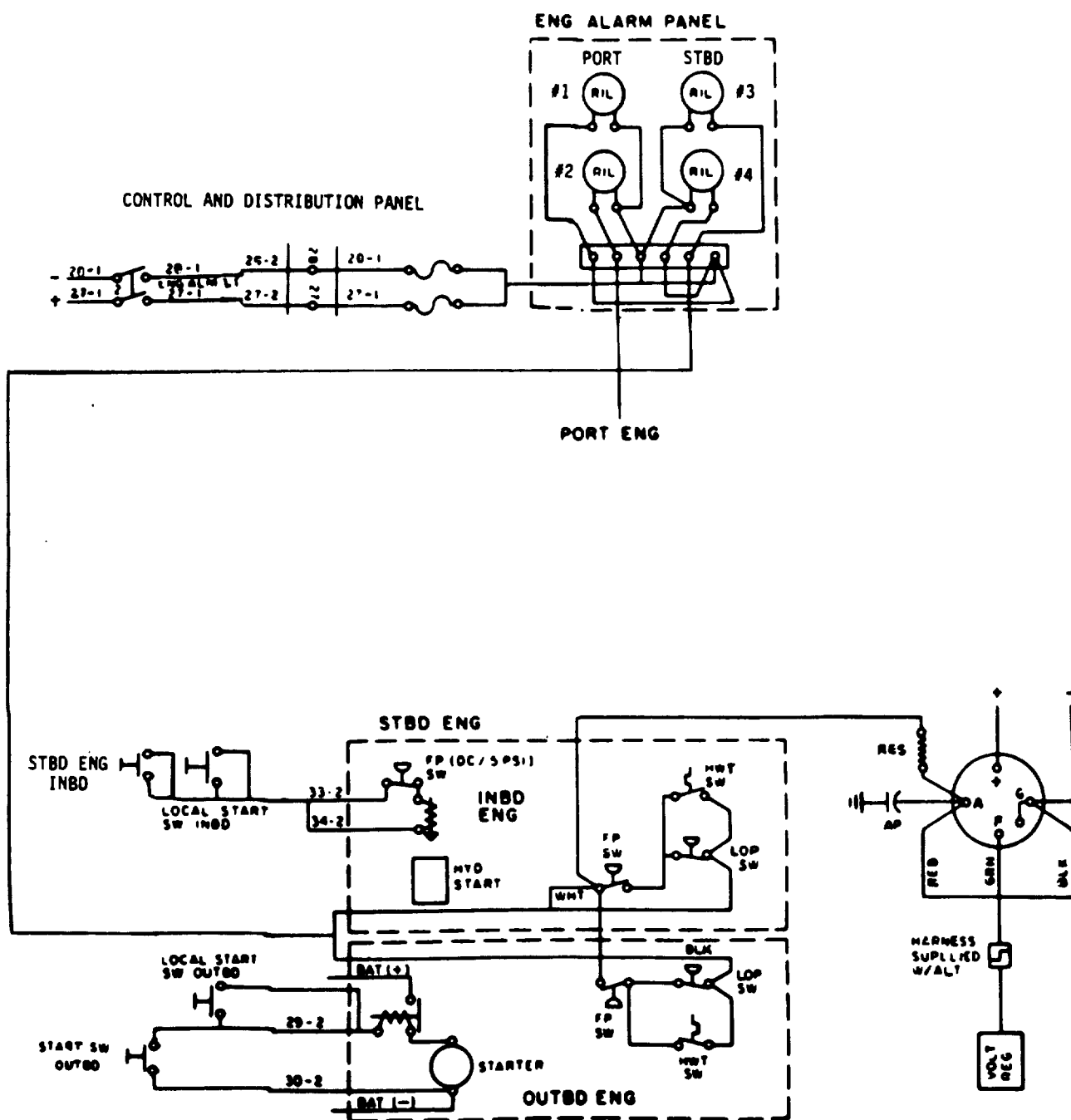
NONE

**LOCATION/ITEM****ACTION****REMARKS****REPAIR**

Refer to the following schematics for repair.



# 6-43. ENGINE ALARMS WARNING LIGHTS AND SENDING UNITS (Continued).



HWT = HIGH WATER TEMPERATURE  
 LOP = LOW OIL PRESSURE  
 FP = FUEL PRESSURE



**6-44. RUDDER ANGLE INDICATOR.**

This task covers:

**REPAIR****INITIAL SETUP****Test Equipment**

NONE

**References**

TM 55-1905-217-12 Adjustment

**Special Tools**

NONE

**Equipment****Condition Condition Description**

NONE

**Tools**General Mechanic's Tool Kit  
NSN 5180-00-629-9783**Special Environmental Conditions****Material/Parts**

NONE

NONE

**Personnel Required**

2

**General Safety Instructions**

NONE

**LOCATION/ITEM****ACTION****REMARKS****REPAIR**

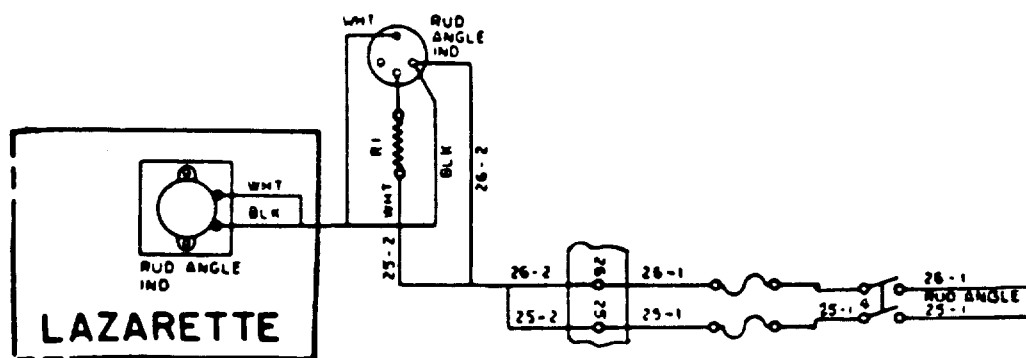
1. Rudder Angle Indicator

Replace the following as required.

6-44. RUDDER ANGLE INDICATOR (Continued).

LOCATION/ITEM	ACTION	REMARKS
---------------	--------	---------

REPAIR (Cont)



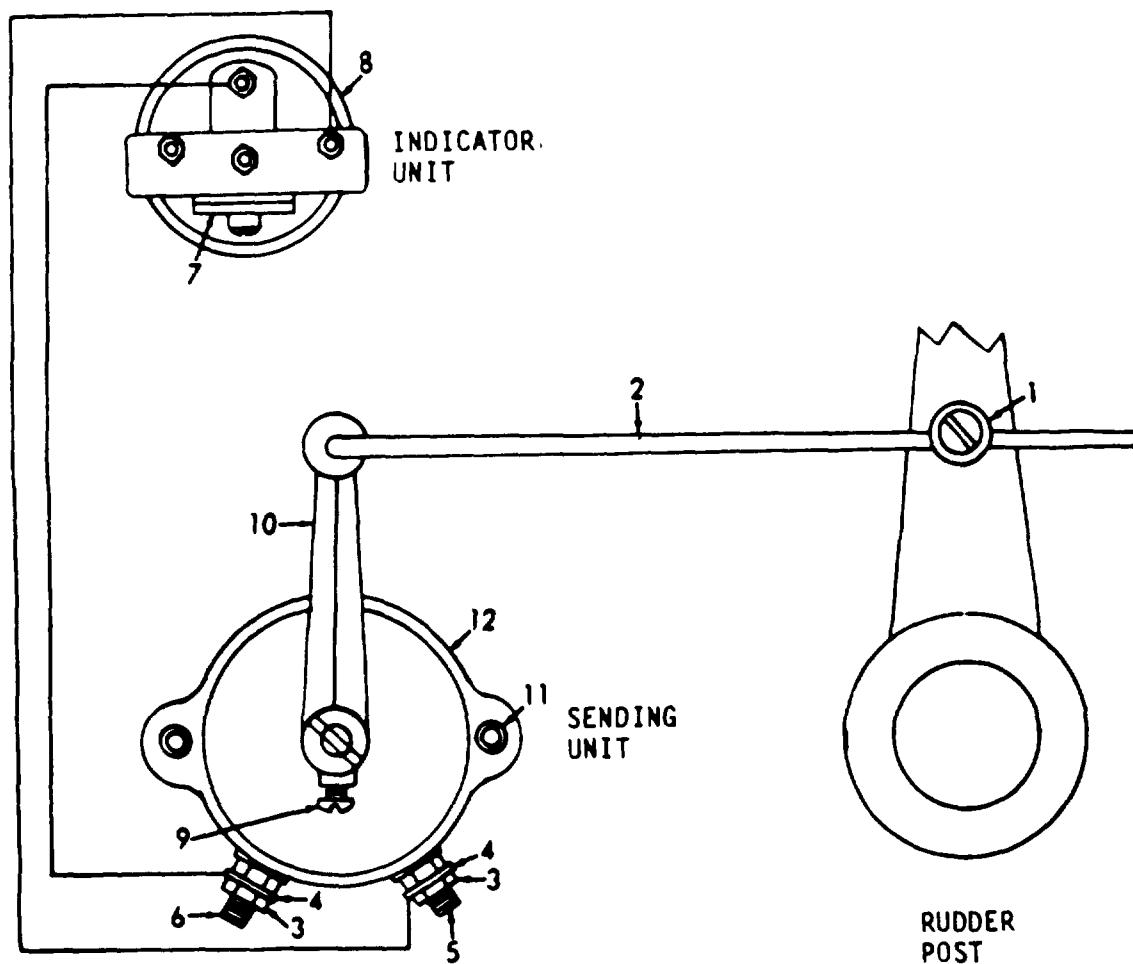
6-962

## 6-44. RUDDER ANGLE INDICATOR (Continued).

LOCATION/ITEM	ACTION	REMARKS
---------------	--------	---------

## REPAIR (Cont)

ITEM	DESCRIPTION
1	Lever Arm Stud
2	Lever Arm
3	Terminal Nut
4	Flatwasher
5	Screw
6	Screw
7	Indicator Resistor (R1)
8	Receiver
9	Mounting Arm Screw
10	Rudder Arm
11	Screw
12	Sending Unit



## APPENDIX A

### REFERENCES

A-1. FIRE PROTECTION

TB5-4200-200-10

Hand Portable Fire Extinguishers  
Approved for Army Users

A-2. LUBRICATION

LO55-1905-221-12

Landing Craft, Mechanized; Steel;  
Diesel-Power Driven, 74 ft. lg.  
Hull Numbers LCM 8500 through  
LCM 8519

A-3. PAINTING

TB43-0114

Painting of Vessels

A-4. MAINTENANCE

TB750-651

Use of Antifreeze Solutions and  
Cleaning Compounds in Engine  
Cooling System

TM5-2090-201-14&P

Operator, Organizational, Direct  
and General Support Maintenance  
Manual (Including Repair Parts and  
Special Tools List), 5 GPM Oil/  
Water Separator

## APPENDIX A

## REFERENCES (Continued)

TM9-6140-200-14	Operator, Organizational, Direct and General Support Maintenance Manual for Lead-Acid Storage Batteries.
TM11-5820-401-12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tools List): Radio Set AN/VRC-46 and AN/VRC-47
TM11-5820-401-34-2	Direct Support and General Support Maintenance Manual: Radio Sets AN/VRC-46 and AN/VRC-47
TM11-5820-401-34-3	Direct Support and General Support Maintenance Manual: Radio Sets AN/VRC-46 and AN/VRC-47
TM11-5820-820-12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tools List): Radio Sets AN/URC-80(V)1 and AN/URC-80(V)3
TM11-5820-820-30	Direct Support Maintenance Manual: Radio Set AN/URC-80(V)1/3
TM11-5820-873-12	Operator and Crew Maintenance Manual AN/URC-92
TM11-5820-873-34	Direct and General Support Maintenance Manual AN/URC-92
TM11-5915-224-14	Operator, Organizational, Direct and General Support Maintenance Manual: Suppressor, Electrical Transient MX-7778A/GRC
TM38-750	The Army Maintenance Management System (TAMMS)

**APPENDIX A**

**REFERENCES (Continued)**

A-5. SHIPMENT AND STORAGE

TB740-90-1  
TB740-97-4

Administrative Storage of Equipment  
Preservation of Vessels for Storage

A-6. DESTRUCTION OF EQUIPMENT

TM750-244-3

Procedures for Destruction of  
Equipment to Prevent Enemy Use

**A-3/(A-4 Blank)**

**APPENDIX B****MAINTENANCE ALLOCATION CHART****SECTION I. INTRODUCTION****B-1. GENERAL.**

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component and the work measurement time required to perform the functions by the designated maintenance level. The implementation of the maintenance functions upon the end item or components will be consistent with the assigned maintenance functions.

c. Section III lists the tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV lists the remarks referenced from Section II.

**B-2. EXPLANATION OF COLUMNS IN SECTION II.**

a. Column (1), Group Number. Column 1 lists group numbers to identify related components, assemblies, subassemblies, and modules with their next higher assembly. The applicable groups are listed in the MAC in disassembly sequence beginning with the first group removed.

b. Column (2), Component/Assembly. This column contains the known names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column (3), Maintenance Functions. This column lists the functions to be performed on the item listed in Column 2. The maintenance functions are defined as follows:

(1) Inspect. To determine serviceability of an item by comparing its physical, mechanical, or electrical characteristics with established standards through examination.

(2) Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item, and comparing those characteristics with prescribed standards.

(3) 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.

(4) Adjust. To maintain within prescribed limits, by grinding into proper or exact position, or by setting the operating characteristics to specified parameters.

(5) Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

(6) Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparison 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.

(7) 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.

(8) Replace. The act of substituting a serviceable like type part, subassembly or module (component or assembly) for an unserviceable counterpart.

(9) Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining or resurfacing) 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.

(10) Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards in appropriate technical manuals. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to a like-new condition.

(11) Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with organizational manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered to classifying Army equipments/components.

d. Column (4) - Maintenance Level. This column is made up of subcolumns for each category of maintenance. Work time figures are listed in these subcolumns for the lowest level of maintenance authorized to perform the function listed in Column 3. These figures indicate the average active time required to perform the maintenance function at the indicated category of maintenance under typical field operating conditions.



e. Column (5) Tools and Equipment. This column is provided for referencing by code, the common tool sets (not individual tools) special tools, test and support equipment required to perform the designated functions.

f. Column (6), Remarks. This column is provided for referencing by code of the remarks pertaining to the designated functions.

### B-3. EXPLANATION OF COLUMNS IN SECTION III.

a. Column (1), Reference Code. The tool and test equipment referenced code correlates with a maintenance function on the identified end item or component.

b. Column (2), Maintenance Level. The lowest level of maintenance authorized to use the tool or test equipment.

c. Column (3), Nomenclature. Name or identification of the tool or test equipment.

d. Column (4), National/NATO Stock Number. The National or NATO stock number of the tool or test equipment.

e. Column (5), Tool Number. The manufacturer's part number.

### SECTION II. MAINTENANCE ALLOCATION CHART

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
01	Nav Lights: Bulbs, Globes and Gaskets	Inspect Service Replace	0.5 0.5	0.5				V
02	Search Light: Bulb, Reflector and Glass	Inspect Service Replace	0.2 0.5	0.3				
03	Horn, Electric: Switch and Packing	Inspect Replace		0.2 0.5				

## SECTION II. MAINTENANCE ALLOCATION CHART (CONTINUED)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
04	Pilot House Canopy: Mast, Wipers and Windows	Inspect Service Replace Repair	0.5 0.5	1.0	2.0			
05	Instruments and Panel: Gages, Switches, Levers, and Lights	Inspect Service Replace	0.5 0.5	1.0				R,S
06	Throttle Controls (Pilot House): Bearings, Links, Rods and Gaskets	Inspect Service Adjust Replace Repair		0.5 1.0 1.0	1.5 2.0			
07	Ramp Controls (Pilot House):	Inspect Service Replace Repair		0.5 0.5	1.5 3.0			
08	Steering System	Inspect Replace Repair Overhaul		0.5	3.0	5.0 7.5	47,66,67, 68,69	W AA
09	Radio System Transmitters and Receivers	Inspect Service Replace Repair Overhaul		0.5	1.5 1.0	1.5 12.0		

## SECTION II. MAINTENANCE ALLOCATION CHART (CONTINUED)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
10	Hull (Above Waterline): Bitts, Chocks, Tie-Downs, Stanchions, Life Lines, Hatches and Ports	Inspect Service Replace	0.5 0.5	0.5 1.5 2.0				
11	Ramp: Chains, Wire rope Latch and Seal	Inspect Service Replace Repair	0.5 0.5	1.0		2.4 2.4		
12	Hoisting Assembly (Ramp): Motor Winch, Blocks and Controls	Inspect Service Replace Repair Overhaul		1.5 0.5		16.0 24.0 30.0	48,49,50	
13	Hull (Under- water Line): Anodes and Plating	Inspect Service Repair				1.0 24.0 24.0		
14	Rudders: Bearing, Packing and Gaskets	Inspect Replace Repair				1.5 16.0 24.0		
15	Propellers and Shafts	Inspect Service Align Replace Repair				0.5 0.5 1.5 2.0 12.0	51,52,53	X

## SECTION II. MAINTENANCE ALLOCATION CHART (CONTINUED)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
16	Keel Cooler	Inspect Test Replace Repair				0.5 1.0 6.0 3.0		
17	Alternator	Inspect Test Service Replace Repair Overhaul		0.5 0.5 0.5	1.5 4.0	8.0		L
18	Electric Cranking Motor	Inspect Service Replace Repair Overhaul		0.5 0.5 4.0	6.0	8.0		M
19	Hydraulic Starting Pipe System	Inspect Service Replace Repair		1.5 1.5	3.0	3.0		
20	Hydraulic Starter	Inspect Replace Repair Overhaul		0.5 3.5	6.0	8.0		
21	Solenoid Valve Starting Motor	Inspect Replace Repair		0.5 1.5	2.5			
22	Pump, Hydraulic Starter	Inspect Replace			0.5 3.0	0.5	54,55	

## SECTION II. MAINTENANCE ALLOCATION CHART (CONTINUED)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
23	Accumulator: Hydraulic Starting	Inspect Service Replace Repair		0.5 1.5	1.5 2.5		17,18	Y
24	Hydraulic Hand Pump	Inspect Service Replace Repair	0.5 0.5		1.5 2.5			
25	Filter: Hydraulic Oil	Inspect Service Replace		0.2 0.4 0.5				
26	Power Unit: Multiple Engine	Inspect Service Adjust Replace Repair Overhaul				1.5 1.5 2.0 19.0 28.0 56.0	46	Q
27	Rocker Arm	Inspect Adjust Replace		0.5	1.5 5.0		28,29	N
28	Cylinder Head	Inspect Replace Repair		1.0	18.0 22.0		30,31,57, 58,59,60 61,62,63	0

## SECTION II, MAINTENANCE ALLOCATION CHART (CONTINUED)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
29	Cam and Balance Shaft Bearings	Inspect Replace				1.7 7.0		
30	Idle Gear and Bearings	Inspect Replace				1.5 8.0	32,33	
31	Engine Lifting Bracket	Inspect Replace		0.1 0.2				
32	Oil Pan	Inspect Replace			0.2 7.5			
33	Engine Oil Pump Assembly	Inspect Replace Repair				1.0 3.5 5.0		
34	Piston and Connecting Rods	Inspect Replace				2.0 3.5	34,35,36, 37,38,39, 40,41,42	
35	Crankshaft	Inspect Replace Overhaul				1.2 4.0 24.0	43,44,45, 64,65	P
36	Cylinder Block	Inspect Replace			0.5	12.0		
37	Air Inlet Silencer	Inspect Service Replace		0.5 1.0 1.0				A

## SECTION II. MAINTENANCE ALLOCATION CHART (CONTINUED)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
38	Exhaust Manifold	Inspect Replace		0.5 3.0				
39	Oil Filter Assembly	Inspect Service Replace		0.2 0.3 0.5				B
40	Oil Filler, Dipstick and Breather	Inspect Service Replace		0.2 0.5 0.5				C
41	Engine Oil Cooler	Inspect Replace		0.2 0.5				
42	Fuel Filter Assembly	Inspect Service Replace		0.1 0.2 0.2				
43	Fuel Strainer (Engine Mtg)	Inspect Service Replace		0.1 0.2 0.2				
44	Fuel Strainer (Line)	Inspect Service Replace		0.1 0.2 0.2				
45	Fuel Pump	Inspect Replace Repair Overhaul		0.5 1.5	3.5	4.0		D

## SECTION II. MAINTENANCE ALLOCATION CHART (CONTINUED)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
46	Rocker Arm Cover	Inspect Replace		0.2 0.5				
47	Fuel Injectors	Inspect Test Service Adjust Replace Repair Overhaul		0.1 0.4 0.2 0.2	0.3    2.5	    6.0	2,3,4 5,6,7,	G
48	Injector Control Tube	Inspect Replace		0.1	0.5			
49	Engine Room Throttle Controls	Inspect Service Adjust Replace Repair		0.1 0.1 0.2	1.5 2.0			
50	Heat Exchange (Engine)	Inspect Replace		0.3	2.0			
51	Engine Cooling Piping	Inspect Replace Repair		0.5 3.0	4.0			F
52	Fuel Tank and Piping	Inspect Service	0.5 0.5					



## SECTION II. MAINTENANCE ALLOCATION CHART (CONTINUED)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
53	Sea Water Piping	Inspect Replace Repair	0.5	3.0	4.0			
54	Engine Control	Inspect Service	0.5 0.5					
55	Pilothouse Distribution Panel	Inspect Service	0.5 0.5					
56	Muffler and Exhaust Piping	Inspect Replace Repair		0.5	4.0 1.5			H
57	Fresh Water Pump	Inspect Replace Repair Overhaul		0.2 1.2	3.0	5.0	8	
58	Raw Water Pump	Inspect Replace Repair Overhaul		0.2 1.2	3.0	5.0	9	
59	Water Manifold (Engine)	Inspect Replace		0.5 1.5				
60	Sea Water Strainer Duplex	Inspect Service Replace Repair		0.2 0.5 1.0	2.0			

## SECTION II. MAINTENANCE ALLOCATION CHART (CONTINUED)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
61	Engine Speed Governor	Inspect		0.5			10,11	J
		Test		0.5				
		Adjust		0.5				
		Replace		3.0				
		Repair			8.0			
		Overhaul				12.0		
62	Blower Assembly	Inspect				0.5	12,13,14, 15	
		Service				0.5		
		Adjust				0.5		
		Replace				6.0		
		Repair				12.0		
63	Transmission Oil Filter	Inspect		0.1				K
		Service		0.3				
		Replace		0.5				
64	Transmission Oil Strainer	Inspect		0.3				
		Service		0.3				
		Replace		0.7				
65	Transmission Oil Cooler	Inspect		0.3				
		Replace		2.0				
66	Transmission Control	Inspect		0.5				
		Adjust		0.5				
		Replace		1.0				
		Repair		4.0				
67	Tachometer Drive Cable	Inspect		0.1				
		Service		0.3				
		Replace		0.5				

## SECTION II. MAINTENANCE ALLOCATION CHART (CONTINUED)

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
68	Transmission Oil Pump	Inspect Replace Repair				0.5 1.5 3.5	16	
69	Power Take-Off Assembly	Inspect Replace Repair				0.5 3.5 8.0	56	
70	Transfer Gear Assembly	Inspect Service Replace Repair Overhaul				1.0 1.0 7.5 6.0 10.0	19,20	
71	Reverse Gear Assembly	Inspect Service Replace Repair Overhaul				0.5 1.0 10.0 12.0 16.0	21,22 23	
72	Flywheel Housing	Inspect Service Replace			0.5	0.5 1.5	24,25 26	
73	Power Take-Off Coupling	Inspect Replace				0.5 5.0	27	
74	Batteries and Cables	Inspect Service Replace		0.5 0.5 4.0				U

**SECTION II. MAINTENANCE ALLOCATION CHART (CONTINUED)**

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category				(5) Tools And Equipment	(6) Remarks
			C	O	F	H		
75	Bilge Piping	Service Replace		0.5 1.5				
76	Bilge Pump	Inspect Service Replace Repair		0.3 0.5 2.5 4.5				
77	Hand Bilge Pump	Replace Repair		0.2 1.5				
78	Cabin Fan	Service Replace Repair		0.5 0.5 4.0				
79	Oil/Water Separator	Inspect Replace Repair Overhaul		0.5 1.5 2.5		3.0		

## SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

(1) Reference Number	(2) Maintenance Level	(3) National/NATO Nomenclature	(4) Tool Stock Number	(5) Number
1	H	Wrench: Fuel Line Fittings	5120-00-019-5232	J8932-01 (33287)
2	H	Repair Kit, Injector Service	2815-00-705-9281	J1241-06 (33287)
3	F	Tool Set: Injector Tube Service	5180-00-596-8541	J5286-01 (33287)
4	O	Remover: Injector and Spring Compressor	5120-00-219-8400	J1227-01 (33287)
5	F	Fixture: Injector Assembly		J6868-01 (33287)
6	O	Gage: Injector Timing 1.460 (HV7)	5220-00-387-9581	J1853 (33287)
7	O	Wire: Spray Tip Cleaner .006 (HV7)		J21461 (33287)
8	O	Remover: Coupling, Fresh Water Pump Oil Seal	5120-00-363-7572	J1930 (33287)
9	O	Wrench: Fuel & Water Pump	5120-00-591-2685	J4242 (33287)
10	H	Installer: Governor Bearing	4910-00-779-6078	J21068 (33287)
11	F	Gage: Gap Governor Spring, 0.170 inch	5210-00-972-0468	J5407 (33287)

**SECTION III. TOOL AND TEST EQUIPMENT  
REQUIREMENTS CONTINUED)**

(1) Reference Number	(2) Maintenance Level	(3) National/NATO Nomenclature	(4) Tool Stock Number	(5) Number
12	H	Tool Set: Blower Service	5120-00-936-4376	J6270-02 (33287)
13	H	Adapter Set: Slide Hammer	5120-00-937-7266	J6471-02 (33287)
14	H	Installer: Blower Drive Cam	5120-00-219-8405	J1471 (33287)
15	H	Gage: Feeler, Blower Clearance	5120-00-363-7573	J1698-02 (33287)
16	H	Tool Kit: Service Marine Hydraulic Oil Pump		J6904 (33287)
17	O	Hose Assembly, Accumulator Charging	4730-00-412-3805	TSE8600 (01843)
18	O	Gage Assembly: Accumulator		TSE8601 (33287)
19	F	Wrench: Coupling Flange Lock Nut		J4385-01 (33287)
20	F	Wrench: Remover-Replacer, Shaft/ Lock Nut		J4384-01 (33287)
21	F	Puller Set: Slide Hammer Reverse Gear	5120-00-856-3558	J5901 (33287)

### SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS CONTINUED)

(1) Reference Number	(2) Maintenance Level	(3) National/NATO Nomenclature	(4) Tool Stock Number	(5) Number
22	F	Remover-Replacer: Seal, Reverse Gear	5110-00-786-2994	J4700 (33287)
23	F	Remover: Installer Reverse Gear Piston Model M		J4746 (33287)
24	F	Installer: Oil Seal, Flywheel Housing	5120-00-999-8619	J9727 (33287)
25	F	Expander: Oil Seal, Crankshaft, Rear		J1357 (33287)
26	F	Installer Handle: Oil Seal, Flywheel Housing	5120-00-808-5082	J3154-1 (33287)
27	F	Puller: Crankshaft Pulley		J4558 (33287)
28	O	Gage Set: Feeler, Valve Lash	5220-00-176-0638	J9708 (33287)
29	F	Fixture: Cam Follow Pin Remover	2815-00-705-9278	J5840 (33287)
30	F	Wrench, Torque, 1/2" Drive 0-200 Ft Lb		J1264 (33287)
31	F	Tester: Spring Valve Compression	5120-00-937-7265	J9666 (33287)

### SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS CONTINUED)

(1) Reference Number	(2) Maintenance Level	(3) National/NATO Nomenclature	(4) Tool Stock Number	(5) Number
32	H	Puller, Camshaft Gear	5120-00-219-8397	J1902-01 (33287)
33	H	Adapter Plate Set: Camshaft Gear Removal	5120-00-113-1005	J6202 (33287)
34	F	Installer-Remover Set: Piston & Connecting Rod Bushing	5180-00-776-7240	J1513-02 (33287)
35	F	Installer: Piston Pin Retainer	5120-00-733-8874	J4895-01 (33287)
36	F	Reamer Set: Piston Bushing	4910-00-789-2104	J3071-01 (33287)
37	F	Gage Set Feeler Piston to Liner	5210-00-670-1769	J5438 (33287)
38	F	Remover-Installer Piston Rings	5120-00-494-1846	J8128 (33287)
39	F	Insertor: Piston		J3272-02 (33287)
40	F	Remover: Spray Nozzle, Connecting Rod	5120-00-937-7632	J8995 (33287)
41	F	Holder: Connecting Rod Bearing Removal & Installation	5120-00-972-0416	J7632 (33287)



### SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS CONTINUED)

(1) Reference Number	(2) Maintenance Level	(3) National/NATO Nomenclature	(4) Tool Stock Number	(5) Number
42	F	Fixture: Reamer, Connecting Rod Bushing	4910-00-733-8896	J1686-02 (33287)
43	H	Puller: Gear, Oil Pump Drive Crankshaft	2815-00-670-5005	J3051 (33287)
44	H	Attachment: Ball Micrometer	5120-00-494-1738	J4757 (33287)
45	F	Installer: Oil Seal, Crankshaft, Front	5120-00-936-4377	J9783 (33287)
46	O	Gage: Cylinder Compression Test Set		J1319-03 (33287)
47	H	Installer: Helm Unit Valve Spring		600057 (96151)
48	H	Puller: Bearing, Ramp Winch (Gunderson)		C13115 (36581)
49	H	Installer: Bushing, Ramp Winch, (Gunderson)		B1397 (36581)
50	H	Remover: Snap Ring, Ramp Motor (Gunderson)		B13009 (36581)

**SECTION III. TOOL AND TEST EQUIPMENT  
REQUIREMENTS CONTINUED)**

(1) Reference Number	(2) Maintenance Level	(3) National/NATO Nomenclature	(4) Tool Stock Number	(5) Number
51	H	Metalizing Set		
52	H	Grinding Tool		
53	H	Pitch Block		
54	F	Installer: Oil Pump Piston Hydro Starter		J7181 (33287)
55	F	Installer, Oil Pump Seal Hydro Starter	5120-00-711-6305	J7192 (33287)
56	F	Wrench: Torque, 3/4" Drive 0.300 Ft Lb		J9187 (33287)
57	F	Compressor: Spring Valve	5120-00-733-8888	J7455 (33287)
58	H	Remover: Valve Guide	5120-00-473-7392	J267 (33287)
59	H	Installer: Valve Guide	5120-00-156-9405	J9530 (33287)
60	H	Brush: Valve Guide Cleaner	5120-00-766-2141	J5437 (33287)
61	H	Remover: Insert, Valve Seat		J4821-01(33287)

**SECTION III. TOOL AND TEST EQUIPMENT  
REQUIREMENTS CONTINUED)**

(1) Reference Number	(2) Maintenance Level	(3) National/NATO Nomenclature	(4) Tool Stock Number	(5) Number
62	H	Installer: Insert, Valve Seat	5120-00-423-6723	J17361 (33287)
63	H	Grinder Set: Valve Seat		J8165 (33287)
64	H	Adapter: Puller, Crankshaft Oil Plug	5120-00-316-9170	J8183 (33287)
65	H	Hammer: Slide Crankshaft Oil Plug Removal	5120-00-909-5727	J6471-1 (33287)
66	F	Gage: Cylinder Bore		J5347 (33287)
67	F	Gage: Ring Cylinder Bore 4.2500	5210-00-937-7282	J5580-1 (33287)
68	H	Remover: Cylinder Liner	5120-00-387-9615	J1918-02(33287)
69	H	Clamps: Cylinder Hold Down	5120-00-999-8618	J21793 (33287)

### SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS CONTINUED)

(1) Reference Number	(2) Maintenance Level	(3) National/NATO Nomenclature	(4) Tool Stock Number	(5) Number
70		Seal Installer Handle: Fuel Pump Seal		J1508-8
71		Adapter: Fuel Pump Installer Seal		J1508-9
72		Reamer Tool Set: Connecting Rod Bushing		J1686-03
73		Insert Installer: Cylinder Head		J1736
74		Installer: Balance Shaft Gear Installer		J1903
75		Bearing Installer: Governor Cover Bearing Installer		J21068
76		Reamer: Fuel Injector Cleaner		J21089
77		Bearing Remover: Governor Bearing		J21967
78		Lapping Blocks: Fuel Injector Cleaning		J22090
79		Oil Seal Installer: Crankshaft Rear Oil Seal Removal and Installer		J3154-04

### SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS CONTINUED)

(1) Reference Number	(2) Maintenance Level	(3) National/NATO Nomenclature	(4) Tool Stock Number	(5) Number
80		Ring Compressor: Piston Ring Installer.		J3272-01
81		Pin Vice: Fuel Injector Cleaning		J4298-1
82		Insert Remover: Cylinder Head		J4824
83		Pilot Bearing Adapter: Reverse Gear Pilot Bearing Removal		J5901-2
84		Transmission Oil Pump Adapter: Transmission Oil Pump Seal Removal		J5901-3
85		Spacer: Camshaft Gear Removal		J6202-2
86		Flywheel Lifting Tool: Flywheel Remover and Installer		J6361-01
87		Adapter: Blower Disassembly		J6471-4
88		Adapter: Blower Disassembly		J6471-10
89		Adapter: Power Take-off Remover		J6758
90		Comparator: Injector Comparator		J7041

**SECTION III. TOOL AND TEST EQUIPMENT  
REQUIREMENTS CONTINUED)**

(1) Reference Number	(2) Maintenance Level	(3) National/NATO Nomenclature	(4) Tool Stock Number	(5) Number
91		Gear Puller: Oil Pump Drive Gear Removal		J8174
92		Torque Multiplier Wrench: Transfer Gear Installation		J9291
93		Cleaner: Fuel Injector Cleaning		J9464-01
94		Engine Test Set: Engine Diagnostic Test Set		J9531
95		Concentricity Test Gage: Flywheel Housing Gage		J9737
96		Injector Tester: Fuel Injector Tester		J9787

**SECTION IV. REMARKS  
FOR  
LCM-8 MOD-1**

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**MAINTENANCE ALLOCATION CHART**

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REFERENCE CODE	REMARKS
A	Service is limited to silencer and air passage keep free of foreign material.
B	Cleaning of filter assembly included with changing filters.
C	Clean breather pipe and silencer air intake area.
D	Caution: Do not overtorque fuel line fittings.
E	Service is limited to external surface of tank.
F	Replacement of hoses and clamps is from keel cooler shut-off valve to water pump and adjacent areas.
G	Service of injectors and seat is limited to cleaning and carbon removal.
H	Replace includes exhaust insulation.
I	Service includes cleaning of debris.
J	Replacing governor springs includes readjustment.
K	Service of strainer includes strainer housing.
L	Caution: Do not parallel regulator - this will damage diodes in alternator.
M	Service of brushes is cleaning and seating new brushes.
N	Engine tune-up is required if any changes are made to valve operating mechanism.
O	Use torque wrench to draw down cylinder head.
P	Replacement of front seal only.
Q	Compression tests indicate condition of engine.

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**SECTION IV. REMARKS  
FOR  
LCM-8 MOD-1 (CONTINUED)**

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**MAINTENANCE ALLOCATION CHART (CONTINUED)**

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**REFERENCE  
CODE**

**REMARKS**

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R	Replacement of panel gages includes general maintenance of control panel.
S	Service of miscellaneous electrical items includes cleaning any corrosion.
T	Service includes cleaning and lubricating wire and chain in hulls 8500-8519.
U	Service of batteries includes cleaning racks and adjacent areas.
V	Replacement of hull wiring includes sections and harness.
W	Inspection of steering cylinders includes tightening rod packing gland.
X	Repair includes straightening, metalizing and balancing.
Y	Service includes charging accumulator with gas (Nitrogen).
Z	Service of packing in stuffing box includes adjustment of glands.
AA	Service includes replacement of "D" batteries in the rudder angle indicator.

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**APPENDIX C****COMPONENTS OF END ITEM AND  
BASIC ISSUE ITEMS LISTS****SECTION I. INTRODUCTION****C-1. SCOPE.**

This appendix lists components of end item and basic issue items for the LCM-8 to help you inventory items required for safe and efficient operation.

**C-2. GENERAL.**

The Components of End Item and Basic Issue Items List is divided into the following sections:

a. Section II. Components of End Item. This listing is for informational purposes only, and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

b. Section III. Basic Issue Items. These are the minimum essential items required to place the LCM-8 in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged, BII must be with the LCM-8 during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement BII, based on TOE/MTOE authorization of the end item.

**C-3. EXPLANATION OF COLUMNS.**

The following provides an explanation of columns found in the tabular listings:

a. Column (1) - Illustration Number (Illus Number). This column indicates the number of the illustration in which the item is shown.

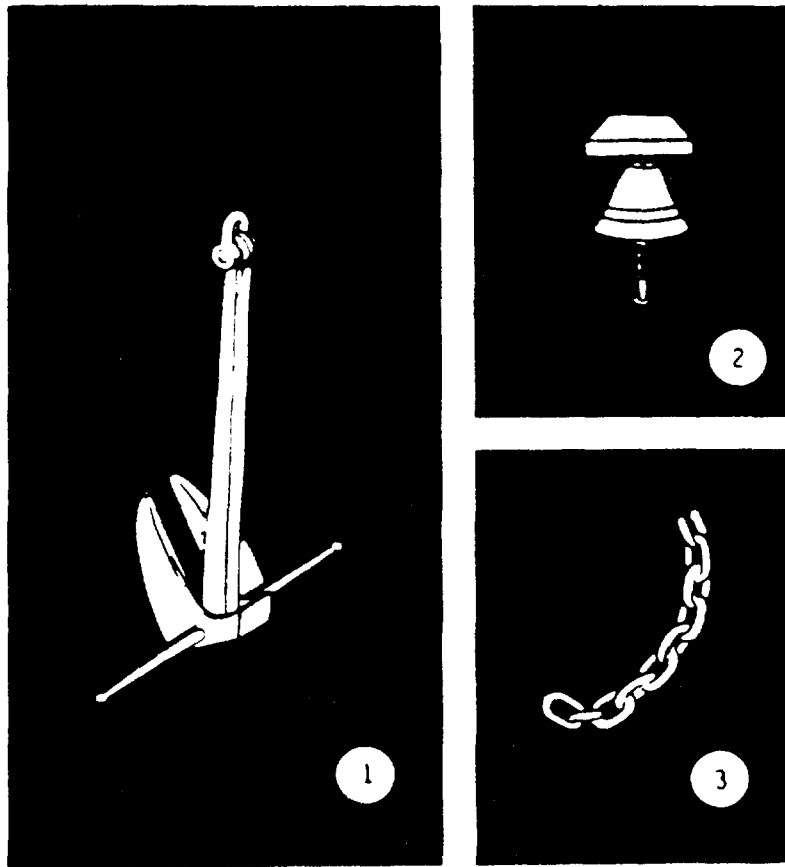
b. Column (2) - National Stock Number. Indicates the National Stock Number assigned to the item and will be used for requisitioning purposes.

c. Column (3) - Description. Indicates the Federal item and, if required, a minimum description to identify and locate the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

d. Column (4) - Unit of Measure (U/M). Indicates the measure used in performing the actual operational/maintenance function. This measure is expressed by a two-character, alphabetical abbreviation (e.g., ea, in, pr).

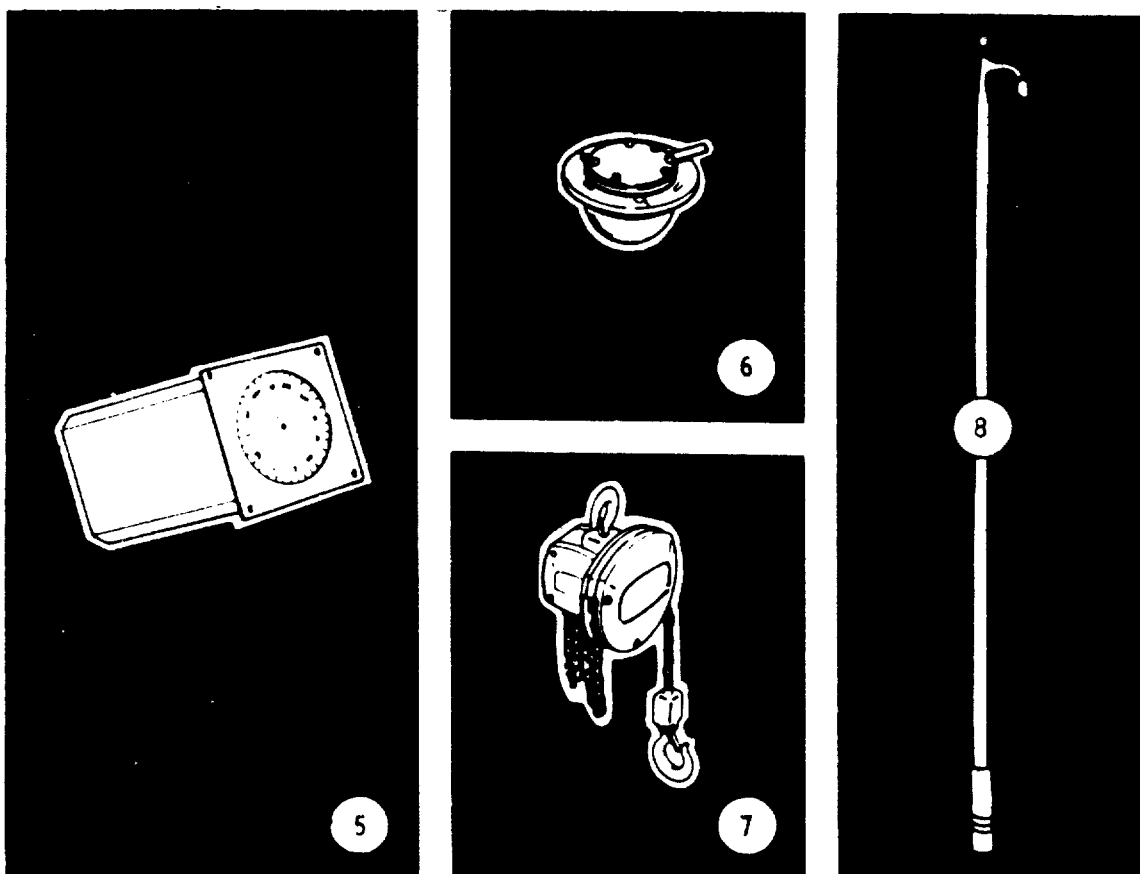
e. Column (5) - Quantity required (Qty rqr). Indicates the quantity of the item authorized to be used with/on the equipment.

## SECTION II. COMPONENTS OF END ITEMS



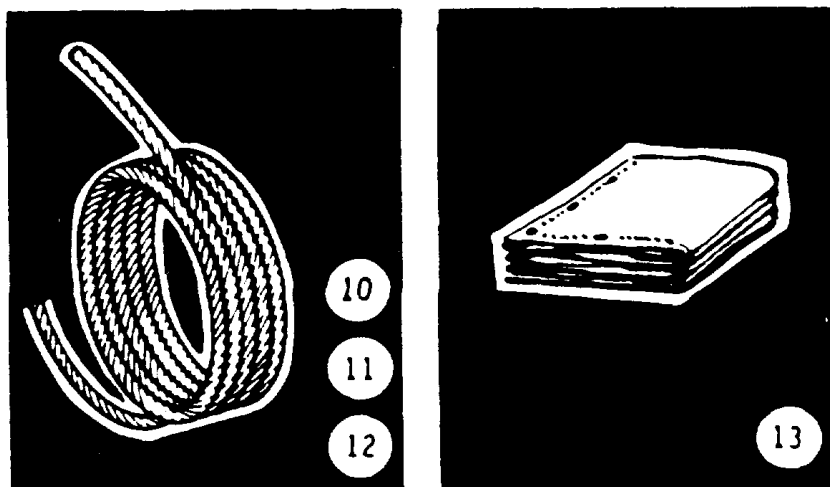
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
1	2040-00-377-8599	Anchor, Marine, 75 Lb (81349) MIL.-A-15707	EA	1
2	6350-00-256-9061	Bell, Ship, 20 Lb (81349) B-674	EA	1
3	4010-00-555-9510	Chain Assembly, Anchor, 3/8 in (81349) C-2683	EA	1
	6605-01-069-7004	Remote Magnetic Heading System (RMHS) (07187) 4008338-902	EA	1

## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)



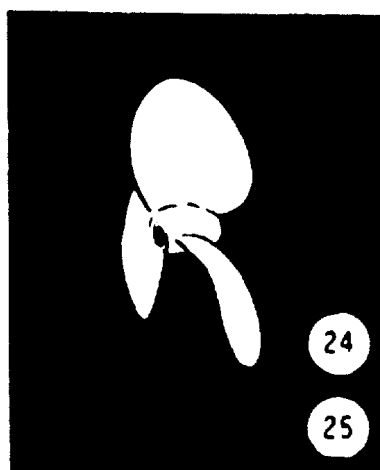
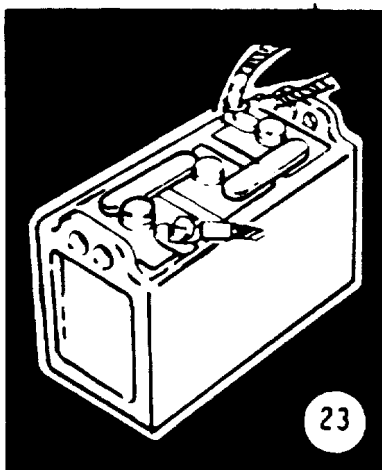
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
5	6605-00-106-9560	Indicator, RMHS (07187) 2593843-901	EA	1
6	6605-00-106-9561	Transmitter, RMHS (07187) 2590057-901	EA	1
7	3950-00-235-4239	Hoist, Chain (81349) H-904	EA	1
8	2040-00-268-9250	Hook, Boat, Wood, 10 Ft (81349) H-3496	EA	1

## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)



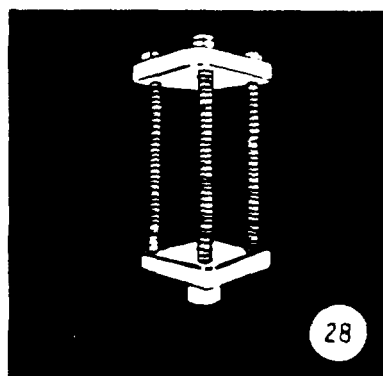
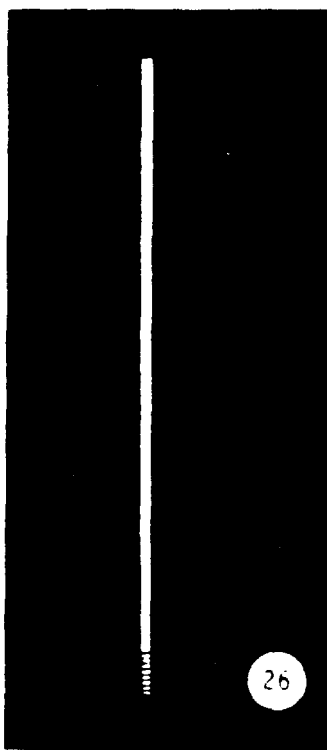
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
	5120-00-416-9553	Key, Adjustable, Deck Plates (46576) Fig. 826	EA	3
10	4020-00-919-3443	Rope, Nylon, 3" Cir, 600 Ft (81349) MIL-R-17343	EA	1
11	4020-00-919-3443	Rope, Nylon, 3" Cir, 450 Ft (81349) MIL-R-17343	EA	1
12	4020-00-919-3443	Rope, Nylon, 3" Cir, 48 Ft (81349) MIL-R-17343	EA	2
13	8340-00-753-6438	Tarpaulin, #6, Cargo Cover (81349) KP-146	EA	1

## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)



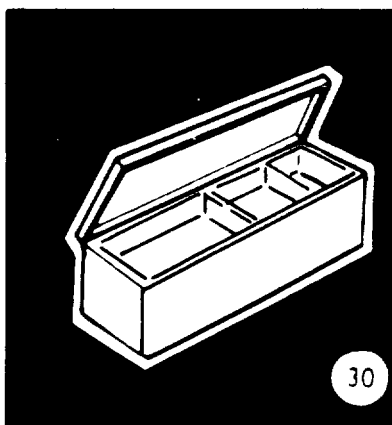
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
23	5820-00-097-0082	Radio (SSB) AN/URC-80(V) 1	EA	1
		Radio Set (SSB) AN/URC-92	EA	1
	5820-00-223-7433	Radio Set (FM) AN/VRC-46	EA	1
	5820-00-223-7434	Radio Set (FM) AN/VRC-47	EA	1
		Antenna (80058) AS-2594/U	EA	1
	5985-00-115-2071	Antenna (80058) AS-2594/U	EA	1
		Suppressor MX-7778/GRC	EA	1
		COM SEC TSEC/KY-57	EA	1
		COM SEC TSEC/KY-65	EA	1
	6140-00-195-5339	Battery, Storage, Engine Starting 6 Volt (81348) W-B-131, Type 7D	EA	4
24	2010-00-540-7689	Propeller, Ship, LH (72201) Seagull Type 1 LH	EA	1
25	2010-00-540-7690	Propeller, Ship, RH (72201) Seagull Type 1 RH	EA	1

## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)



(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
26	2010-00-127-4796	Shaft, Propeller w/Monel Sleeve (98042) MMC 42, M3	EA	2
28	5120-00-372-0652	Puller, Propeller (72201) Fig. 802, Size 3	EA	1
	4320-00-574-7645	Pump, Reciprocating, Hand (46463) 3799	EA	1

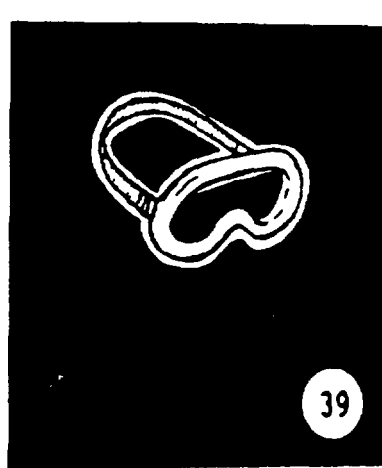
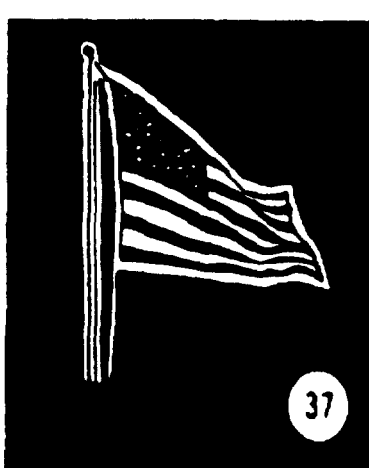
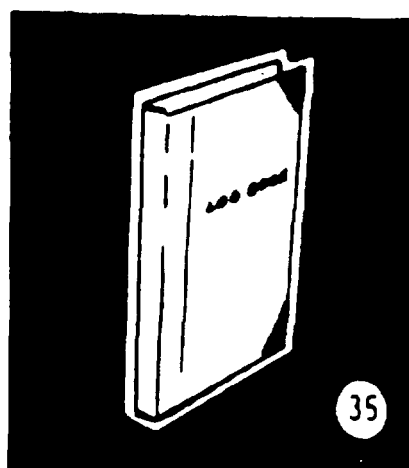
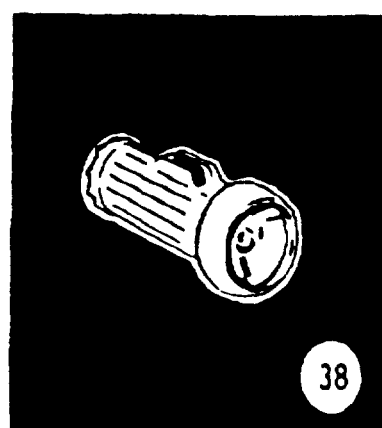
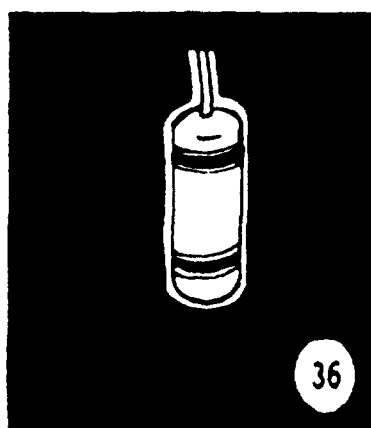
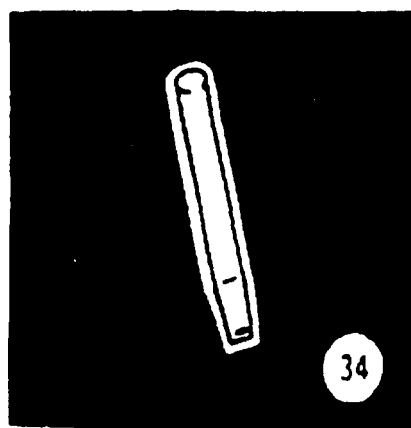
## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)



(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
30	5180-00-629-9783	Tool Kit, General Mechanic (50980) SC-5180-90-CL-N28	EA	1
	5120-00-277-1575	Wrench, Box, Propeller Nut (81348) GGG-W-636	EA	1
	5120-00-277-1576	Wrench Box, Shaft Nut (81348)	EA	1
	5120-00-712-0517	Wrench, Fuel Sounding Tube (80064) 210-451094	EA	1

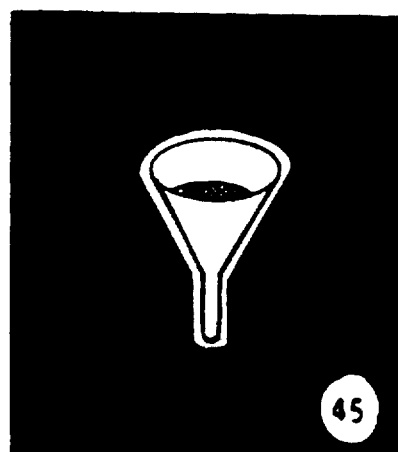
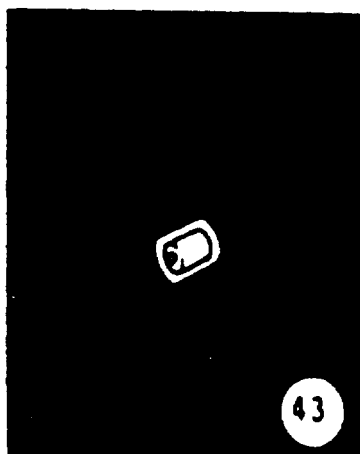
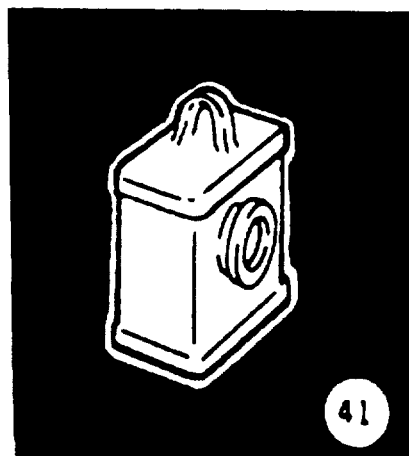
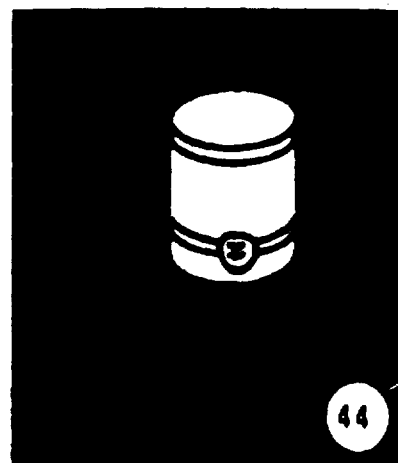
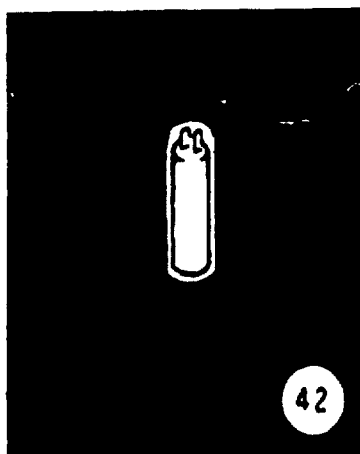
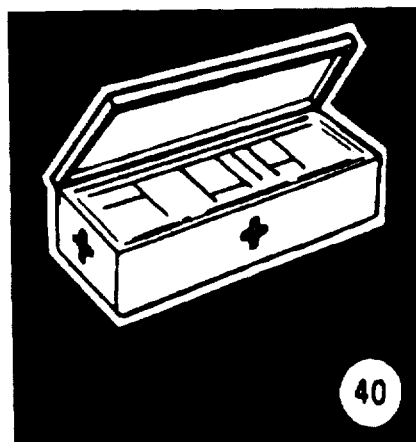


## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)



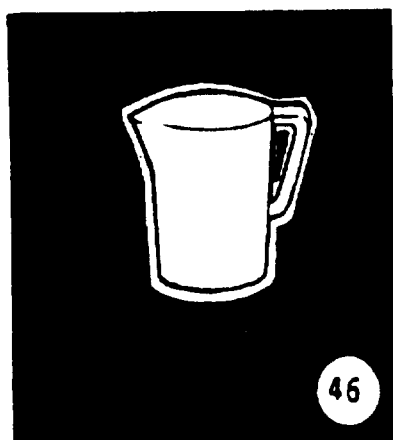
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
34	5110-00-222-2117	Chisel, Round, 1/4 in. (81348)GGG-C-313	EA	1
35	7510-00-889-3494	Binder, Equipment Log Book (81239) B-43064	EA	8
36	2040-00-565-9142	Fender, Marine, 18" dia. x 36" long (14348) Fendaire	EA	6
37	8345-00-245-2040	Rag, National (81348) DDD-F-416	EA	1
38	6230-00-264-8261	Flashlight, Water-tight (81348) F-3747	EA	1
39	4240-00-052-3776	Goggles, Plastic, Safety (81348) GG-G-531	EA	3

## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)

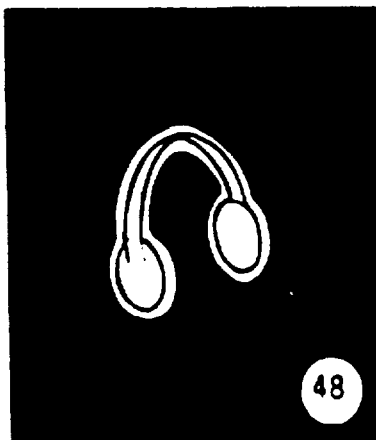


(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
40	6545-00-922-1200	Kit, First Aid, 12 Units (33333) Noree	EA	1
41	6230-00-781-3189	Lantern, Electric, 6 Volt (96906) 100-1	EA	2
42	6135-00-050-0915	Battery, Battle Lantern (80063) BA-23	EA	4
43	6135-00-120-1020	Battery, Flashlight (80063) BA-30	EA	6
44	7240-00-256-7700	Can, Waste, Flammable, 10 Gal. (81348) RR-C-114	EA	1
45	7240-00-527-9868	Funnel W/Strainer, 1 Qt., Cap. (81348) RR-F-800	EA	1

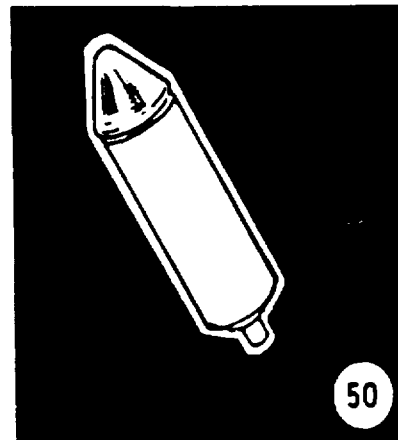
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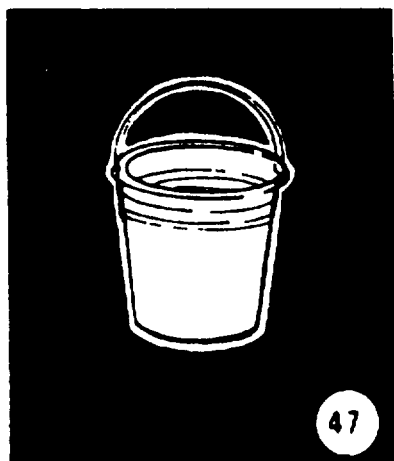
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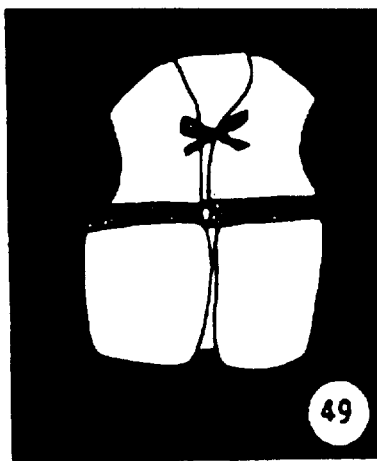
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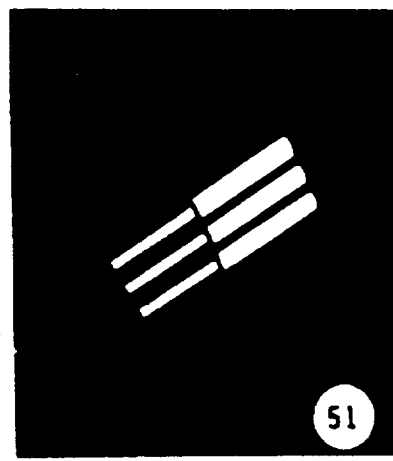
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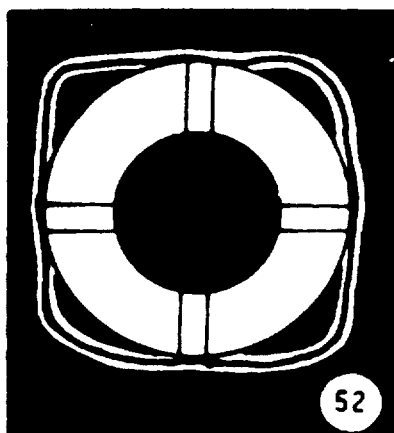
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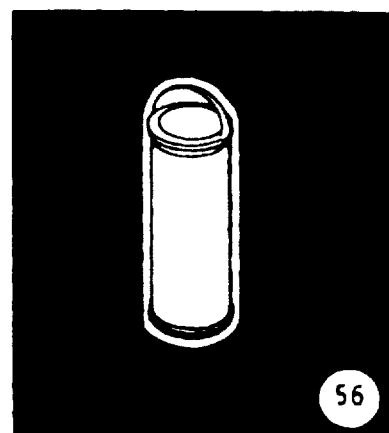
51

(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
46	7240-00-233-6025	Measure, Liquid, 1 Gal. (81348) RR-M-190	EA	1
47	7240-00-160-0455	Pail, Metal, 3-1/2 Gal. (81348) RR-P-35	EA	1
48	4240-00-022-2946	Ear Protector (81348) MIL-P-38268	EA	2
49	4220-00-200-0538	Life Preserver, Adult (81349) MIL-L-10845	EA	6
50	6260-01-086-8077	Light, Chemiluminescent (83289) 95270-58	EA	16
51	6230-00-782-0643	Light, Marker, Distress, Rail (80064) 815-119249	EA	2

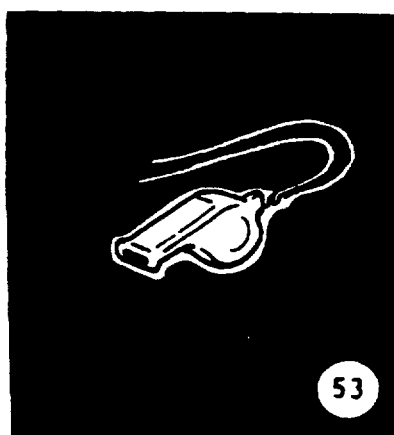
## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)



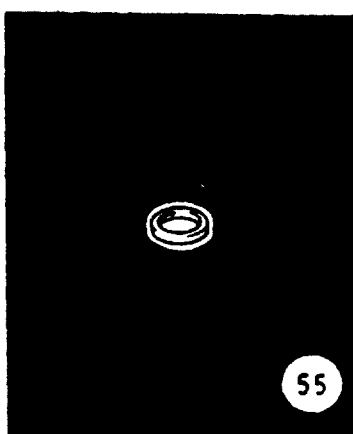
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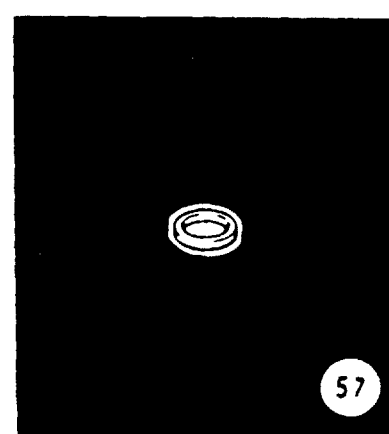
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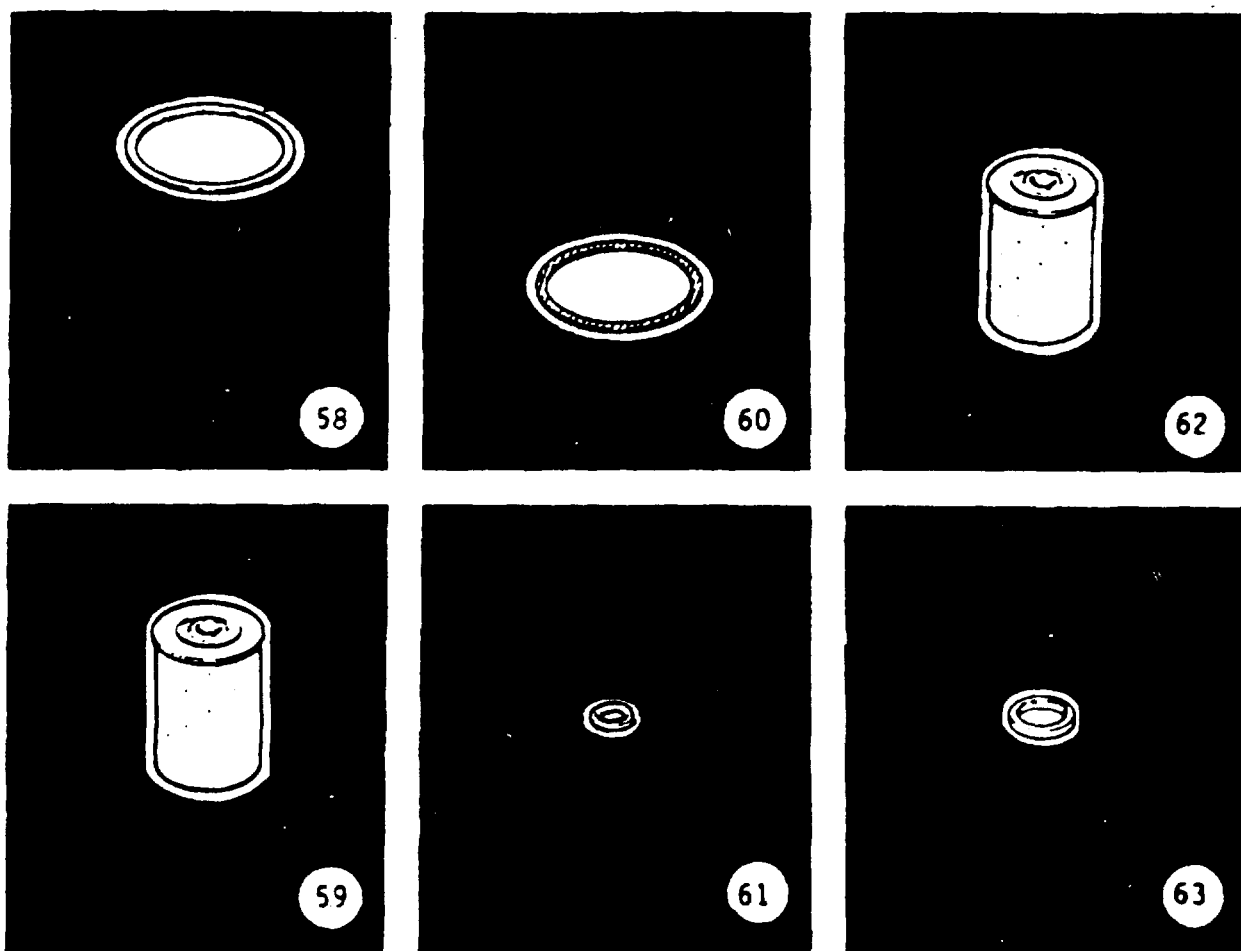
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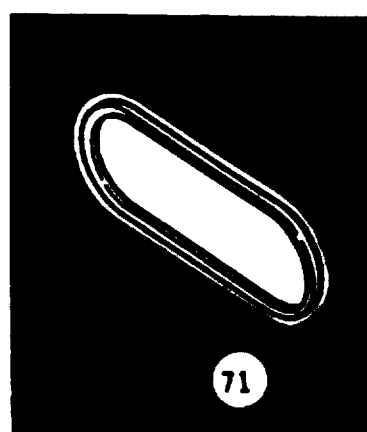
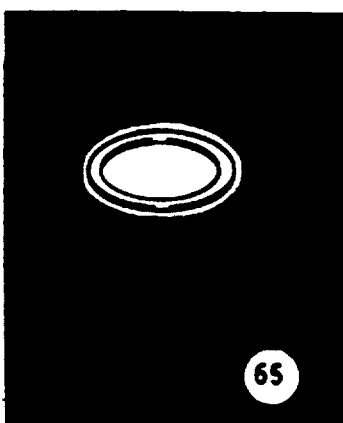
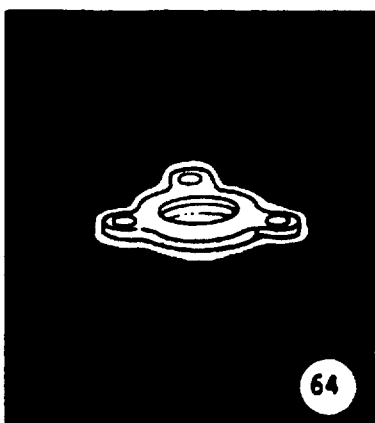
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
52	4220-00-275-3157	Ring Buoy, Floating, 30" (81349) R-16847	EA	3
53	8465-00-254-8803	Whistle, Life Jacket, with Lanyard (81349) MIL-W-1053	EA	16
	5300-00-599-4823	Washer, Non-Metallic, Fuel Strainer, Primary Engine Cover (72582) 5193704	EA	4
55	5330-00-364-2674	Gasket, Fuel Strainer, Primary Engine, Plug (72582) 694203	EA	4
56	2910-00-287-1912	Element, Secondary Fuel Filter (81349) MIL-E-20627	EA	8
57	5330-00-285-3825	Gasket, Cover, Nut, Secondary Fuel Filter (72582) 2243465	EA	4

## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)



(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
58	5330-00-627-4085	Gasket, Shell, Secondary Fuel Filter (72582) 5192801	EA	8
59	2940-00-580-6283	Element, Lube Oil Filter, Engine	EA	4
60	5330-00-290-7860	Washer, Non-Metallic, Engine Lube Oil Filter Shell (72582)5573024	EA	4
61	5330-00-604-8094	Packing, Preformed, Cover, Engine Lube Oil Filter, Nut (72582) 5187310	EA	4
62	2940-00-019-8087	Element, Marine Gear Oil Filter (72582) 5574978	EA	4
63	5330-00-290-7860	Washer, Non-Metallic, Marine Gear Oil Filter, Shell (72582) 5573024	EA	4

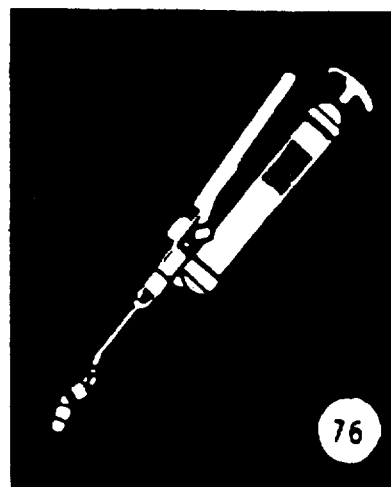
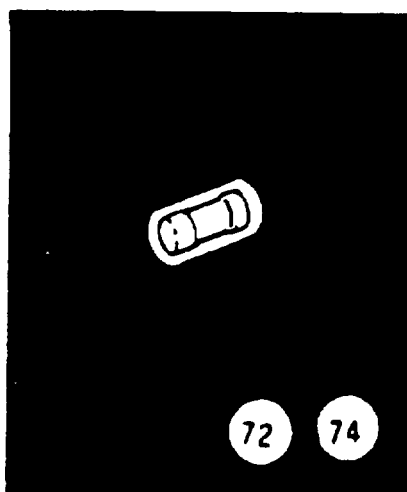
## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)



(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
64	5330-00-786-5320	Gasket, Transmission Oil Strainer Cover (72582) 5112511	EA	4
65	5330-00-929-8730 (deleted)	Gasket, Cylinder, sea Water Strainer (72922) 10	EA	8
	3030-00-528-4614	Belt, V, Pump Drive, Bilge Pump (24161) 3580	EA	2
	3030-00-528-4627	Belt, V, Pump Drive, Bilge Pump (24161) 3720	EA	1
	3030-00-529-0479	Belt, V, Alternator Drive (96906) MS-39256B51	EA	2
	3030-00-529-0482	Belt, V, Pump Drive, Bilge Pump (96906) MS-39256B42	EA	1
71	3030-00-460-2502	Belt, V, Pump Drive, Bilge Pump (96906) MS-39256B58	EA	1

Change 1 C-14

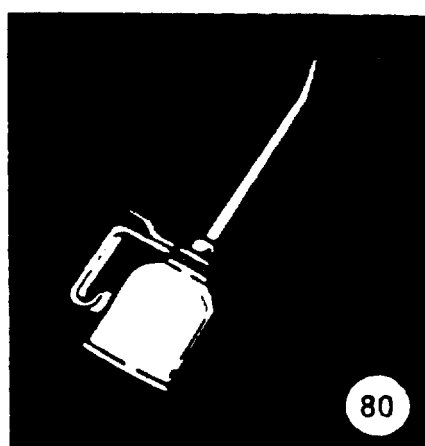
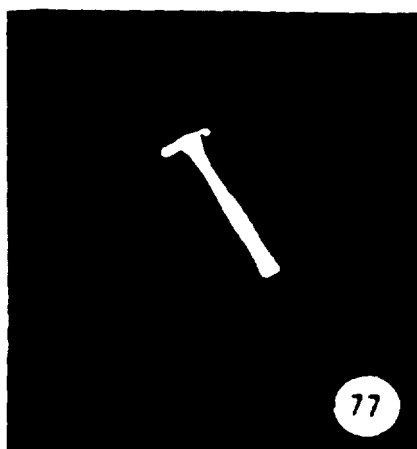
## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)



(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
72	5920-00-686-9548	Fuse, Cartridge, 10 Amp, Pilot House Control Panel (81349) F09A250V10A	EA	8
73	5920-00-280-3168	Fuse, Cartridge, 15 Amp, Pilot House Control Panel (81349) F07A32V15A	EA	4
74	5920-00-296-0445	Fuse, Cartridge, 5 Amp, Remote Magnetic Heading System (81349) F60C500V5A	EA	2
	5120-00-529-4124	Carrier, Battery, Hand (81349) C-19482	EA	1
76	4930-00-253-2487	Grease Gun, Hand, 16 Oz. (81349) G-3859	EA	2

Change 1 C-15

## SECTION II. COMPONENTS OF END ITEMS (CONTINUED)



(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
77	5120-00-224-4111	Hammer, Scaling, Hand, 1 lb. (81348) GGG-H-886	EA	2
78	6630-00-171-5126	Tester, Battery (81348) GG-T-258	EA	1
	5120-00-293-1039	Lifter, Scraper, Battery (74267) 177	EA	1
80	4930-00-266-9182	Oiler, Hand, 8 Oz. (81348) GGG-O-591	EA	1



**Section III. BASIC ISSUE ITEMS LIST**  
**Firefighting, Safety, and Damage Control Items**

(1) Item Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/I	(5) Qty rqr
	4220-00-276-8926	Buoyant Vest, Work Type		EA	6
	N/A	Bum Dressing Kit: * Contains:		EA	1
		8" x 18" Dressing		EA	2
		4" x 16" Dressing		EA	1
		4" x 4" Dressing		EA	4
		12" x 16" (Face Mask Dressing)		EA	1
		Bum-Jel Topical Dressing		PK	1
		* Ordering Information: (Local Purchase Item)			
		Water-Jel AWK Kit			
		H & H Associates, Inc.			
		P.O. Box 4469			
		Alexandria, VA 22303			
		Phone: 1-800-326-5708			
	N/A	Coverall, Anti-exposure, Stems Model 1 FS-580, Orange **		EA	4
		** Ordering Information: (Local Purchase Item)			
		Lifesaving Systems Corp.			
		720 4th St. SW			
		Ruskin, FL 33570-1829			
		Phone: (813) 645-2768			
	4240-01-116-9888	Emergency Escape Breathing Device (EEBD)		EA	1
	N/A	Emergency Position Indicating Radio Beacon (EPIRB), Category 1, 406 MHz Satellite, F.C.C. Approved (No NSN, Local Purchase Item)		EA	1
	4210-00-889-2491	Extinguisher, Fire, Dry Chemical, 10 lb., A-B-C, USCG Approved		EA	4
	4240-00-542-2048	Face Shield, Industrial, Tilting		EA	1
	4210-00-142-4949	Fire Ax		EA	1
	N/A	Fire Blanket, 72" x 60" ***		EA	1
		** Ordering Information: (Local Purchase Item)			
		Water-Jel AWK Fire Blanket			
		H & H Associates, Inc.			
		PO. Box 4469			
		Alexandria, VA 22303			
		Phone: 1-800-326-5708			
	8345-00-935-0445	Flag, Signal, "A" Intn'l Code, Size 6 (81349) MIL-F-2692		EA	1
	8345-00-926-6803	Flag, Signal, "B" Intn'l Code, Size 6 (81349) MIL-F-2692		EA	1

**Section III. BASIC ISSUE ITEMS LIST**  
**Firefighting, Safety, and Damage Control Items**

(1) Item Number	(2) National Stock Number	(3) Description CAGEC and Part Number	Usable On Code	(4) U/I	(5) Qty rqr
	8345-00-935-0451	Flag, Signal, "O" Intn'l Code, Size 6 (81349) MIL-F-2692		EA	1
	8345-00-926-6814	Flag, Signal, "U" Intn'l Code, Size 6 (81349) MIL-F-2692		EA	1
	8345-00-935-0455	Flag, Signal, "V" Intn'l Code, Size 6 (81349) MIL-F-2692		EA	1
	8345-00-935-0456	Flag, Signal, "W" Intn'l Code, Size 6 (81349) MIL-F-2692		EA	1
	4240-01-258-1245	Fountain, Eye and Face Wash, Portable, 16 Gallons		EA	1
	6840-01-315-9841	Bacteriostatic Additive (Eye & Face Wash Fountain)		BX	1
	8415-01-267-9661	Gloves, Anti-Flash		PR	6
	4240-00-190-6432	Goggle, Industrial, No Vents, (Chemical Splash)		EA	1
	8465-01-004-2893	Goggles, Safety, Wind, Dust, Sand, Spray		EA	4
	8415-00-935-3136	Hard Hat, Orange		EA	3
	8415-00-935-3139	Hard Hat, White		EA	1
	4240-00-022-2522	Harness, Safety, Torso		EA	2
	8415-01-268-3473	Hood, Anti-Flash		EA	6
	4240-00-022-2518	Lanyard, Harness, Safety, Torso		EA	2
	4020-01-344-0552	Line, Heaving, Safety, 100'		EA	2
	5120-00-255-1476	Maul, Ship's, 5 lb. (Damage Control Plugs)		EA	1
	5510-00-260-8953	Plug, Soft Wood, 1" x 0" x 3" Long		EA	5
	5510-00-260-8962	Plug, Soft Wood, 3" x 0" x 8" Long		EA	10
	5510-00-260-8969	Plug, Soft Wood, 7" x 3" x 10" Long		EA	5
	2090-00-058-3737	Shoring, Steel, Adjustable, Short, 3' to 5'		EA	1
	2090-00-052-1581	Shoring, Steel, Adjustable, Long, 6' to 11'		EA	1
	1370-01-030-8330	Signal, Distress, Orange Smoke, Red Illumination		EA	12
	9390-01-078-8660	Tape, Retroreflective, 3" x 50 yds Long		RL	1
	5510-00-268-3479	Wedge, Plug, Tapered, Hardwood, 2" x 2" x 8" Long		EA	6
	5510-00-268-3475	Wedge, Shoring, Tapered, Hardwood, 1-1/2" x 2" x 12" Long		EA	6

**APPENDIX D  
EXPENDABLE SUPPLIES AND MATERIALS LIST**

**SECTION I. INTRODUCTION**

**D-1. SCOPE.**

This appendix lists expendable supplies and materials you will need to operate and maintain the equipment. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

**D-2. EXPLANATION OF COLUMNS.**

a. Column (1) - Item number. This number is assigned to the entry in the listing, and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, item 5, App. D").

b. Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew

O - Organizational Maintenance

F - Direct Support Maintenance

H - General Support Maintenance

c. Column (3) - National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column (4)-- Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Support Code for Manufacturer (FSCM) in parentheses followed by the part number.

e. Column (5) - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

## SECTION II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	O/C	8030-00-251-3980	Anti-Seize Compound, MIL-A-907	CN
2	O/C	9150-00-190-0900	Grease, Auto And Artillery MIL-G-10926 PL	
3	O/C	9150-00-530-6814	Grease, Wire Rope Exposed MIL-G-18458	PL
4	O/C	9150-00-183-9858	Lubricating Oil, Engine OE/HDO-30- MIL-L-2104	CN
5	O/C	7920-00-291-8305	Broom, Upright, Corn (81348) H-B-51	EA
6	O/C	7920-00-240-6358	Brush, Dusting Bench (81348) H-B-180	EA
7	O/C	7920-00-224-8308	Pan, Dust (81348) RR-D-800	EA
8	O/C	7920-00-267-1218	Handle, Mop, Wood (81348) NN-H-101	EA
9	O/C	7920-00-171-1148	Mop Head, Cotton (81348) T-M-561	EA
10	O	5640-01-021-0212	Insulation, Pipe, 5 inch (81349) MIL-I-2781	RO
11	O	5640-01-021-0213	Insulation, Pipe, 6 inch (81349), MIL-I-2781	RO

**SECTION II. EXPENDABLE SUPPLIES AND  
MATERIALS LIST  
(CONTINUED)**

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
12	D, F	6350-00-281-1985	Cleaning Solvents P-D-680	GAL
13	D	9150-00-190-0900	Grease, Auto and Artillery, 5 lb can, MIL-C-10924, Symbol GAA	CN
14	D, F	9150-00-663-9795	Grease, Ball and Roller Bearing, BR 5 lb can, MIL-G-18709 (81349)	CN
15	D	9140-00-491-7197	Oil, Lubrication OE/HDO-10, Emery 3908D (33358)	CN
16	D		Petroleum Jelly	CN
17	D		Gasket Cement, Non-hardening	LB
18	D		Sealant, Pipe Threads	TU
19	D	9150-00-252-0293	Hydraulic Fluid, Automatic Transmission	CN
20	D		Solvent Mineral Oil	GL
21	D		Crocus Cloth	SH
22	D		Paper, Glossy	SH
23	D, F		Hydraulic Fluid, MIL-17672B, 2135TH, 2075TH	CN
24	D	3439-00-188-6988	Solder, Fed. Spec. QQ-S-571	1 SL
25	D, F	5970-00-644-2636	Tape, Electrical, MIL-I-3158	RO

**SECTION II. EXPENDABLE SUPPLIES AND  
MATERIALS LIST  
(CONTINUED)**

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
26	D		Glyptal, Red	EA
27	D, F		Methylchloroform, Inhibited	BT
28	D		Grease, BM 1146	CN
29	D		Loctite Sealant	TU
30	D		Prussian Blue	BT
31	D	9140-00-286-5294	Fuel Oil	GAL
32	F		Abrasive Paper, 600 Grit	SH
33	F	9140-00-405-2987	Transmission Oil, SAE-90	GAL
34	F		Varnish, MIL-V-1137, Grade CB	GL
35	F		Paper, Flint, Fed. Spec. P-P-111	SH
36	F		Lubricating Oil, Cindol 1705	GL
37	F	8030-00-829-4554	Thread Compound, International #2	2 BT
38	F		Grease, Shell Alvania #2	CN

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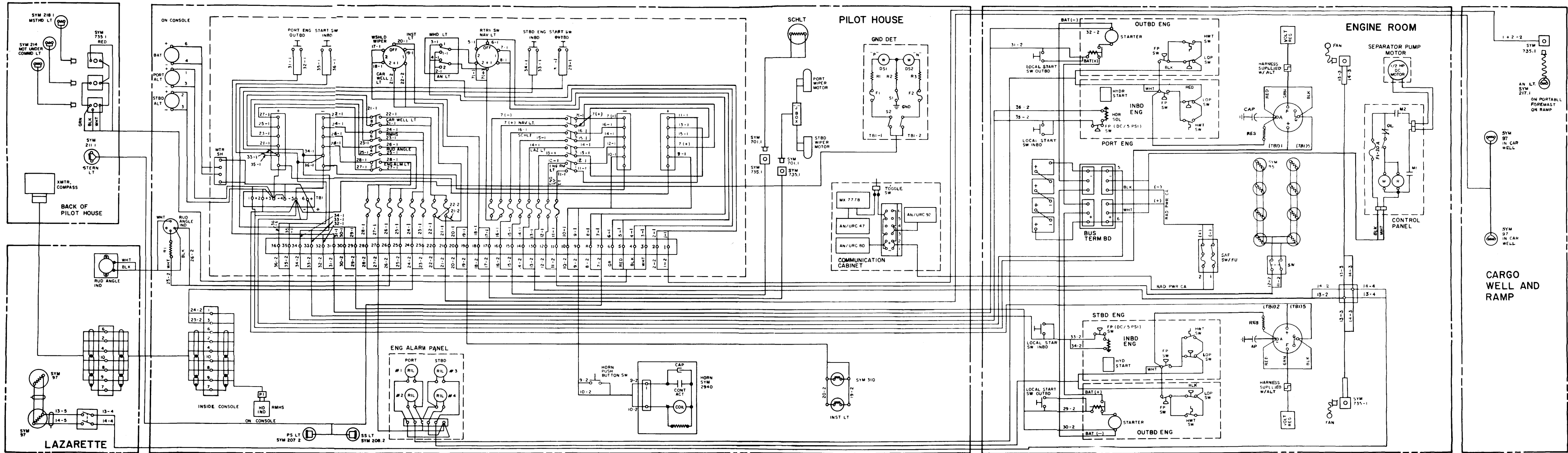
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FP-1/(FP-2 Blank)

FO-1. Electrical Wiring Diagram

FP-1/(FP-2 Blank)

By Order of the Secretary of the Army:

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


Official:

WILLIAM J. MEEHAN, II  
*Brigadier General, United States Army*  
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PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.				

IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

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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 = .39 inch  
 1 decimeter = 10 centimeters = 3.94 inches  
 1 meter = 10 decimeters = 39.37 inches  
 1 dekameter = 10 meters = 32.8 feet  
 1 hectometer = 10 dekameters = 328.08 feet  
 1 kilometer = 10 hectometers = 3,280.8 feet

### *Weights*

1 centigram = 10 milligrams = .15 grain  
 1 decigram = 10 centigrams = 1.54 grains  
 1 gram = 10 decigrams = .035 ounce  
 1 decagram = 10 grams = .35 ounce  
 1 hectogram = 10 decagrams = 3.52 ounces  
 1 kilogram = 10 hectograms = 2.2 pounds  
 1 quintal = 100 kilograms = 220.46 pounds  
 1 metric ton = 10 quintals = 1.1 short tons

### *Liquid Measure*

1 centiliter = 10 milliliters = .34 fl. ounce  
 1 deciliter = 10 centiliters = 3.38 fl. ounces  
 1 liter = 10 deciliters = 33.81 fl. ounces  
 1 dekaliter = 10 liters = 2.64 gallons  
 1 hectoliter = 10 dekaliters = 26.42 gallons  
 1 kiloliter = 10 hectoliters = 264.18 gallons

### *Square Measure*

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch  
 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches  
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet  
 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet  
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres  
 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

### *Cubic Measure*

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch  
 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches  
 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

## Approximate Conversion Factors

<i>To change</i>	<i>To</i>	<i>Multiply by</i>	<i>To change</i>	<i>To</i>	<i>Multiply by</i>
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

## Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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