TM 9-1785A

WAR DEPARTMENT TECHNICAL MANUAL

ORDNANCE MAINTENANCE

Engine, Engine Accessories, and Torque Converter for 18-Ton M4 and 38-Ton M6 High Speed Tractors

WAR DEPARTMENT • 27 MARCH 1944

FOR ORDNANCE PERSONNEL ONLY

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Washington 25, D. C., 27 March 1944

TM 9-1785A, Ordnance Maintenance: Engine, Engine Accessories, and Torque Converter for 18-ton M4 and 38-ton M6 High Speed Tractors, is published for the information and guidance of all concerned.

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(For explanation of symbols, see FM 21-6.)

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ORDNANCE MAINTENANCE—ENGINE, ENGINE ACCESSORIES, AND TORQUE CONVERTER FOR 18-TON M4 AND 38-TON M6 HIGH SPEED TRACTORS

CHAPTER 1

INTRODUCTION

1. SCOPE.

a. This manual is published for the information and guidance of ordnance maintenance personnel. It contains detailed instructions for inspection, disassembly, assembly, maintenance, and repair of the Waukesha Model 145 GZ gasoline engine and the Twin-disk Model T-10010 torque converter used in both the 18-ton M4 and 38-ton M6 High Speed Tractors (Allis-Chalmers). This manual does not contain information which is intended primarily for the using arms, since such information is available to ordnance maintenance personnel in 100-series TM's and FM's.

b. Chapter 2 contains information for disassembling, inspecting, and rebuilding the engine and accessories in the 18-ton High Speed Tractor M4. Chapter 3 contains maintenance instructions for the clutch housing assembly and propeller shaft, and chapter 4 contains information for the maintenance of the torque converter. Special tools required for disassembly and assembly operations are listed in chapter 5.

c. TM 9-785 contains operating and second echelon maintenance information for the 18-ton High Speed Tractor M4.

d. TM 9-788 contains operating and second echelon maintenance information for the 38-ton High Speed Tractor M6.

e. TM 9-1785B contains descriptive and maintenance procedure information as outlined in subparagraph **b** above for the cab and seats, and power train which consists of the transmission, differential, speedometer drive, final drives, suspensions, winch and controls, power take-off and main frame, fuel tank and pintles.

f. Maintenance information for standard engine equipment or accessories is not included in this manual but is available in the following manuals:

Cranking motor, generator, regulator, and ignition system (Delco-Remy) ..... TM 9-1825A
Carburetors (Zenith) ..... TM 9-1826C
Air compressor (Bendix-Westinghouse) ..... TM 9-1827A
Fuel pump (A-C) ..... TM 9-1828A

2. DIFFERENCES BETWEEN M4 AND M6 TRACTORS.

a. Engine. The 18-ton High Speed Tractor M4 is powered by one engine while the 38-ton High Speed Tractor M6 is powered by two. The two engines in the M6 are both right-hand rotation engines and are mounted side by side in the same relative position in the hull

as in the M4. They are tilted away from each other at the top at a 10-degree angle. Each M6 engine has exactly the same accessories and internal components mounted in the same manner as in the M4 with only three exceptions, namely:

(1) Right and left flywheel housing are used to provide for mounting of each cranking motor on outer side of each engine.

(2) A long jack shaft and bevel gear fan drive shaft housing extending across the top of both engines is used instead of two separate L-shaped fan-drive assemblies.

(3) Only one generator is used, and it is mounted in the conventional place on the right-hand engine instead of on the fuel tank as in the M4. The engine controls are operated in unison by the same controls in cab of tractor. The release and engagement of the clutches of the two engines is accomplished by a common shaft. Provision, however, is made for operation of either clutch individually in the event either engine becomes inoperative. Separate cooling radiators and fans, one on each side of tractor, provides for cooling. Maintenance, disassembly, repair, and assembly of the engine in the M6 tractor will be the same as for the engine in the M4 tractor.

b. Torque Converter. Two torque converters are used in the M6 tractor; only one is used in the M4 tractor. These are the same and the information contained in Chapter 4 of this manual will apply in all ways to the torque converters in either tractor.

3. MWO AND MAJOR UNIT ASSEMBLY REPLACEMENT RECORD.

a. Description. Every vehicle is supplied with a copy of AGO Form No. 478 which provides a means of keeping a record of each MWO completed or major unit assembly replaced. This form includes spaces for the vehicle name and U. S. A. Registration Number, instructions for use, and information pertinent to the work accomplished. It is very important that the form be used as directed and that it remain with the vehicle until the vehicle is removed from service.

b. Instructions for Use. Personnel performing modifications or major unit assembly replacements must record clearly on the form a description of the work completed and must initial the form in the columns provided. When each modification is completed, record the date, hours and/or mileage, and MWO number. When major unit assemblies, such as engines, transmissions, or transfer cases, are replaced, record the date, hours and/or mileage and nomenclature of the unit assembly. Minor repairs and minor parts and accessory replacements need not be recorded.

c. Early Modifications. Upon receipt by a third or fourth echelon repair facility of a vehicle for modification or repair, maintenance personnel will record the MWO numbers of modifications applied prior to the date of AGO Form No. 478.

CHAPTER 2

ENGINE AND ACCESSORIES (18-TON HIGH SPEED TRACTOR M4)

Section I

DESCRIPTION AND TABULATED DATA

4. GENERAL DESCRIPTION.

a. General. The Model 145 GZ 6-cylinder gasoline engine is of high compression, 4-cycle, water-cooled type, with two down-draft carburetors and electric ignition system. The crankcase and cylinder block is cast in one unit with ribs and baffles for controlling circulation of coolant. The drop forged steel crankshaft, supported by seven main bearings is carried in the crankcase section. Cylinder heads of twin valve-in-head type are interchangeable, front or rear. Main and connecting rod bearings are of the replaceable precision type and do not require reaming or hand scraping when installed.

b. Lubrication. All moving parts of the engine are lubricated by a positive pressure system. There are few outside oil lines, the oil being delivered by a gear-type combination scavenger and pressure pump to the various operating parts through drilled passages in the cylinder block and head, crankshaft, connecting rods, camshaft, and rocker arm assemblies. Oil pressure is regulated by pressure relief valves located in the oil pump and cylinder block oil gallery.

c. Cooling. The engine is cooled by circulation of water through the cylinder head and block by a large capacity water pump. A cooling radiator and fan cools the water delivered to the engine by the water pump. Engine temperature is controlled by a thermostat assembly at outlet of water manifold.

d. Location of Accessories. The electric cranking motor, oil cooler, water pump, and air compressor are mounted on exhaust manifold side of engine; the ignition coil, distributor, carburetors, fuel pump, and governor on the opposite side. The L-shaped fan drive, bolted to side of cylinder block, provides a means of driving the cooling fan.

5. TABULATED DATA.

a. General.

Make	Waukesha
Model and series	145 GZ
Type	Gasoline, water-cooled
Number of cycles	4

ENGINE AND ACCESSORIES (18-TON HIGH SPEED TRACTOR M4)

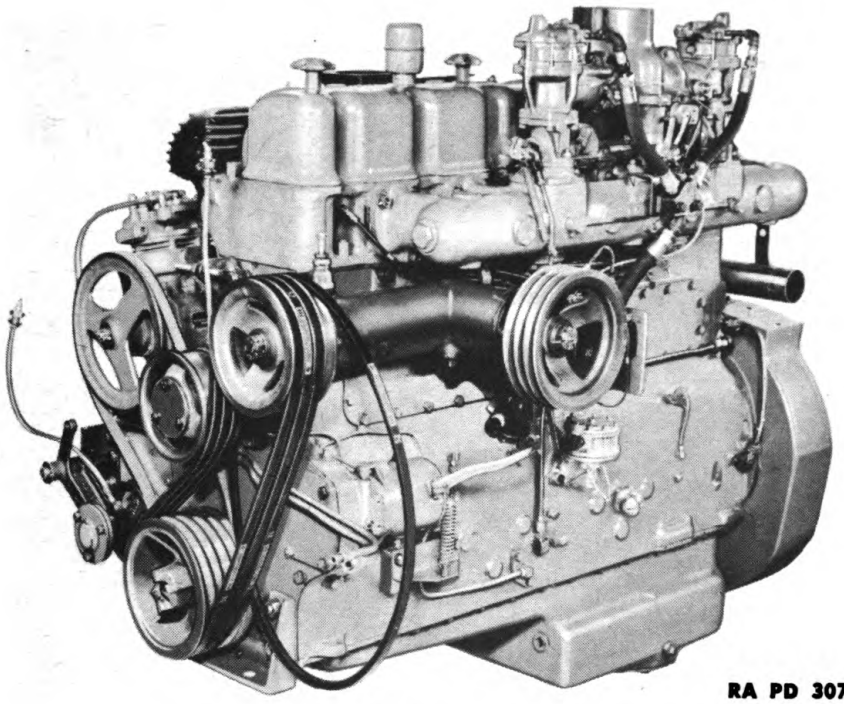

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Figure 1 — Engine — Left Front

Number of cylinders	6
Firing order	1-5-3-6-2-4
No. 1 cylinder location	At end opposite flywheel
Bore and stroke	5⅜ in. x 6 in.
Piston displacement	817 cu in.
Compression ratio	5.95 to 1
Rated speed	2,100 rpm
Rated brake horsepower	210 at 2,100 rpm
Governed speed (full load)	2,100 rpm
Maximum torque	550 ft-lb at 1,700 rpm
Rotation of crankshaft (viewing end opposite flywheel)	Clockwise
Dimensions:	
Over-all length	55¼ in.
Over-all height	48 in.
Over-all width	35 in.
Weight:	
With accessories	Approx. 2,150 lb
Less accessories	Approx. 1,800 lb

b. Direction of Rotation of Accessories or Components (Viewed from Flywheel End).

Cranking motor	Clockwise
Generator	Counterclockwise

ORDNANCE MAINTENANCE—ENGINE, ENGINE ACCESSORIES, AND TORQUE CONVERTER FOR 18-TON M4 AND 38-TON M6 HIGH SPEED TRACTORS

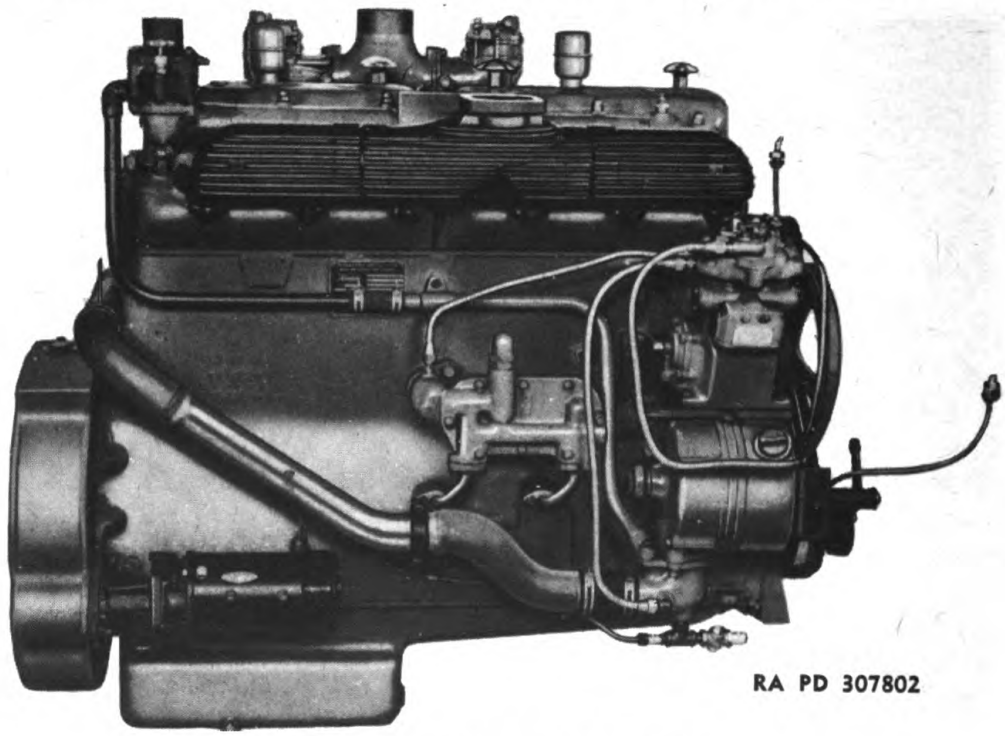


Figure 2 — Engine — Right Side

Water pump	Counterclockwise
Oil pump (looking down on shaft)	Counterclockwise
Distributor (looking down on shaft)	Clockwise
Governor	Clockwise
Air compressor	Counterclockwise

c. Ratio of Drive to Crankshaft Speed.

Cranking motor	20.65 to 1
Generator	1.2 to 1
Water pump	0.5 to 1
Oil pump	0.77 to 1
Distributor	0.5 to 1
Governor	1.5 to 1
Air compressor	0.85 to 1

d. Ignition System.

(1) CRANKING MOTOR.

Make	Delco-Remy
Model	644

(2) COIL.

Make	Delco-Remy
Model	1115252

ENGINE AND ACCESSORIES (18-TON HIGH SPEED TRACTOR M4)

(3) DISTRIBUTOR.

Make	Delco-Remy
Model	1110162
Breaker point gap	0.018 in.

(4) SPARK PLUGS.

Make	Champion
Model	6 Com.
Size	18 mm
Gap	0.025 in.

(5) GENERATOR.

Make	Delco-Remy
Model	1105906

(6) GENERATOR REGULATOR.

Make	Delco-Remy
Model	5641

e. Fuel System.

(1) FUEL PUMP.

Make	A-C
Model	D-8274
Pressure at outlet end of pump	3½ to 4 lb

(2) CARBURETORS (TWO).

Make	Zenith
Model	29 BW and 29 BBW
Type	Down-draft, fixed jet

(3) FUEL FILTER.

Make	A-C
Model	T-2
Type	Laminated disk

(4) GOVERNOR.

Make	Waukesha
Type	Mechanical-centrifugal
Setting	Spring tension

f. Cooling System.

(1) WATER PUMP.

Make	Waukesha
Model	145
Type	Centrifugal

(2) THERMOSTAT.

Type	Thermal expansion
Location	At outlet of water manifold

g. Lubricating System.

(1) OIL PUMP.

Make	Waukesha
Model	145
Relief valve opening pressure setting	55 to 60 lb

(2) OIL FILTER..

Make ..... A-C
Model ..... Standard military
Type ..... Replaceable cartridge

h. Clutch.

Make ..... Long
Model 17

6. IGNITION SYSTEM.

a. The ignition system consists of a source of power (generator or battery), the ignition distributor, ignition coil, wiring, and spark plugs. The ignition system, operating through a set of points in the distributor, supplies pulsations of direct current to the ignition coil. The coil converts these to high-voltage surges which are produced at the correct intervals and with the correct timing to the engine. Each high-voltage surge produces a spark, at the spark plug gap, which ignites the mixture of air and fuel that has been drawn into the cylinder. When the contact points are closed, current flows through them to the ignition coil, causing a magnetic field to build up in the coil. When the contact points open, the current stops flowing, the magnetic field collapses, causing a high-voltage surge to be induced. This high-voltage surge is led through the wiring, distributor cap, and rotor to the correct spark plug.

7. FUEL SYSTEM.

a. Fuel is drawn from the supply tank through a disk-type fuel filter and delivered to the carburetors by the mechanical fuel pump located on carburetor side of engine. The pump is operated by a lever which contacts a cam on the engine camshaft. Air is drawn from the atmosphere through a precleaner and oil-bath air cleaner and mixed with fuel in the carburetors. The combustible mixture of gasoline and air is then drawn through the intake manifold into the cylinders where it is ignited and furnishes power.

8. COOLING SYSTEM.

a. The cooling system of the engine consists of the water passages in cylinder block and head, water outlet manifold, thermostat assembly, water pump, oil cooler assembly, radiator (center one of the three in radiator assembly), and cooling fan, as well as the necessary water lines for circulation of cooling liquid. The water is circulated by the water pump driven by the timing gears. It draws the cooled water from the radiator and forces it, through the oil cooler, to cool the oil delivered to the engine, and thence into the cylinder block and cylinder head, and then out into the water outlet manifold. The thermostat (if engine is equipped with thermostat) remains closed,

and water circulates through a by-pass tube and through engine only until engine reaches operating temperature. As operating temperature is reached, the thermostat automatically opens to let the water pass into the water outlet manifold, and to the radiator to be cooled. Part of the heated water also circulates through the fuel and air intake manifold to heat the fuel and air as it is drawn into the cylinders. A by-pass line in the system provides for circulation of water through the air compressor to cool it. The heated water is delivered to the radiator, and the cooling fan draws air through the radiator, thus dissipating the heat and lowering the temperature of the water, while it passes through the radiator from top to bottom.

9. LUBRICATING SYSTEM.

a. The engine is lubricated by a positive pressure oiling system. Oil is drawn from the crankcase oil pan sump through a screen and inlet at the bottom of the pump and through a scavenger pipe from the pump gear housing extending to the front shallow area of the oil pan. The pump maintains a pressure of, from 55 to 60 pounds. Oil is forced by the pump through an outlet pipe to a connection in the crankcase wall which leads to the oil cooler. Cooling water from the radiator is forced through the cooler housing, and surrounds the unit through which the lubricating oil flows. The cooled oil is then conducted through a drilled passage, across the cylinder block, to the main drilled oil header in the block, and distributed to the main bearings, camshaft bushings, and connecting rod bearings by the drilled passages in crankshaft and cylinder block.

b. Oil delivered to the connecting rod bearings is forced up through rifled drilled passages in the connecting rods to the piston pin bushings to lubricate these bushings, then runs back down the inside of the pistons and cylinders, carrying heat away from the pistons and cylinder walls, and lubricating the pistons and cylinder walls.

c. The oil is delivered to the camshaft bushings, lubricates these bushings and is forced through passages in the cylinder block from the first and fourth camshaft bushing through a line to each of the two rocker arm bushings. Excess oil from the rocker arms lubricates the upper push rod seats and flows over the valve stems to lubricate the stem guides. The intake valve stem guides are tapered 45 degrees to an edge around the valve stem to cause excess oil to flow down around the guide and drain back to the oil pan.

d. The timing gear train is lubricated by oil flowing from the front camshaft bushing through a hole drilled in the camshaft journal and a hole drilled in the hub of the camshaft gear. From the hub in the gear, centrifugal force drives the oil across the inner surface of the gear, and through three holes drilled between the gear teeth. The meshing gear teeth distribute the oil to the entire gear train.

e. A hole drilled from the front camshaft bushing through the crankcase casting and across the diameter of the governor support bearing to an outside fitting and copper line, delivers oil to the support bearing and through the line to the drilled governor shaft bushing. From the shaft bushing excess oil drains to the crankcase.

f. To provide ample lubrication to the engine bearings in the event of clogged filters or lines and to prevent failure of pump gears or fittings, the oiling system is provided with three pressure relief valves. A valve in the pump body housing is set at around 55 to 60 pounds. The main oil-header relief valve is set to open at about 40-pounds pressure with oil hot and engine running at 2,100 revolutions per minute. A by-pass valve in the oil cooler is set to open at 6 to 7 pounds pressure.

g. The tappet assemblies are lubricated by spray from the crankshaft and also by the oil running down the push rods from the rocker arm seats.

h. As the oil returns to the sump, part of it is bypassed through two cartridge type filters where dirt and sludge are removed from it.

10. ELECTRICAL SYSTEM.

a. Electrical equipment for the engine consists of the cranking motor, generator, generator regulator, ignition coil, distributor, spark plugs, and radio filter. The cranking motor provides a means of cranking the engine for starting. The generator replaces energy drained from the battery by cranking motor, lights, and other electrical equipment, and is regulated by the generator regulator. The ignition system is explained in paragraph 6. The above units are described in detail in TM 9-1825A. The radio filter eliminates interference created by the electrical system.

11. INTAKE AND EXHAUST SYSTEM.

a. **Air Intake System.** The air intake system consists of the air precleaner, oil-bath air cleaner, and connecting tube. The air drawn from the atmosphere is first drawn through the air precleaner where most of the dirt is trapped, then through the oil-bath air cleaner, where it passes through oil-filled mats, and the remaining dirt is removed before air passes through the connecting tube to the carburetors. Fuel from the carburetors mixes with the air as it is drawn through the carburetors, making a combustible mixture which is drawn into the cylinders of the engine through the intake manifold and intake valves.

b. **Exhaust System.** After the combustible mixture of air and gasoline is ignited and burned on the power stroke of the pistons, the burned gases are discharged from the cylinders through the exhaust valves into the exhaust manifold. They then pass through the exhaust pipe elbows and muffler to the atmosphere.

Section II

ENGINE REMOVAL

12. ENGINE REMOVAL.

a. Procedure for removal of engine from tractor, high-speed, 18-ton, M4 is outlined in the operator's manual TM 9-785. Removal from tractor, high-speed, 38-ton, M6 is covered in the operator's manual TM 9-788.

Section III

CLEANING AND INSPECTION OF ASSEMBLED ENGINE

13. CLEANING.

a. After engine has been removed from vehicle, the dirt, oil, etc. must be removed from engine before it is disassembled. Before cleaning, cover openings such as openings in water manifold, carburetor air inlet, and exhaust manifold, to prevent dirt from entering them, and plug fuel, or oil fittings that are open. The use of soapy water or steam will usually prove to be successful in cleaning the exterior parts of the engine. Information regarding other cleaning agents will be found in TM 9-850.

14. INSPECTION.

a. After engine has been cleaned, and before disassembling, make as complete an inspection of engine as possible to determine the extent of disassembly necessary to replace, or repair, worn or damaged parts. Review any reports available regarding cause of failure of the engine that made removal of the unit necessary. Observe if components or accessories on engine that may have been replaced previously, were correctly installed, or alined, or if proper adjustments have been maintained. Report irregularities found.

Section IV

REMOVAL OF ACCESSORIES AND EXTERNAL COMPONENTS

15. REMOVAL OF ACCESSORIES AND EXTERNAL COMPONENTS.

a. General. The following procedure outlines the most logical sequence of operations for the removal of the various units preparatory to disassembling engine. Use separate boxes or pans for the

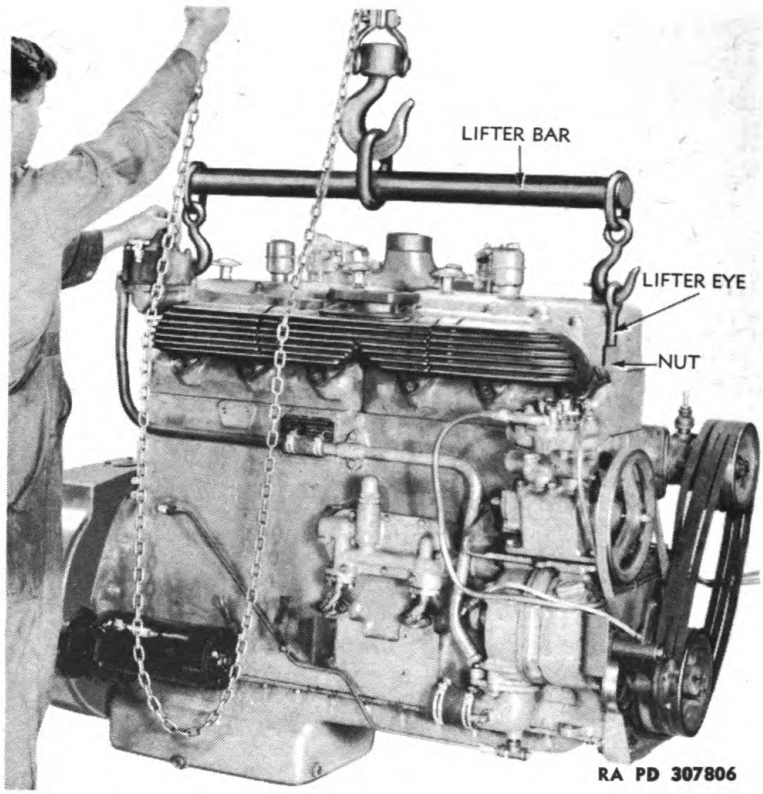


Figure 3 — Lifting Engine, With Lifting Sling 41-S-3831-810

parts and bolts so the cap screws and bolts for each component will be readily found when accessories are again installed. Make a list of new gaskets and parts that will be needed for reassembly as parts are removed. Use an engine stand or, if a stand is not available, use suitable blocks or a bench to support engine in positions stated below.

b. Install Lifter Eyes. Remove nut from center cylinder head stud at flywheel end of engine, and nut from cylinder head stud at opposite end of engine, and install the lifter eyes of special engine lifter (41-S-3831-810) on these two studs. Hook lifter into eyes, with shorter end of bar towards flywheel end of engine as shown in figure 3, and lift engine onto stand, blocks, or bench. Remove engine lifter and lifter eyes.

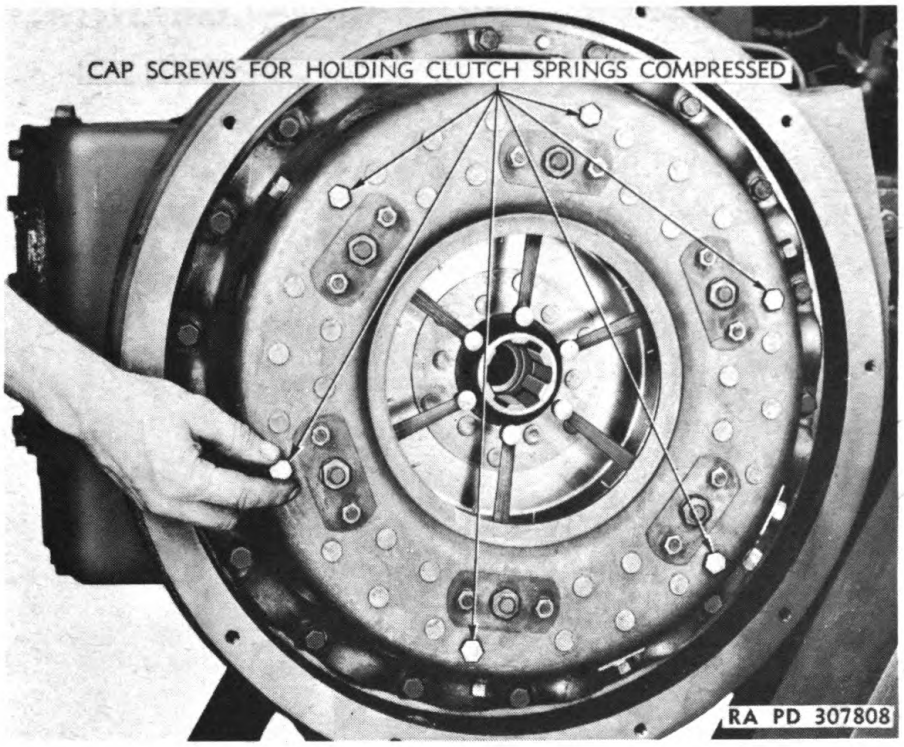


Figure 4 — Installing Cap Screws To Hold Clutch Springs Compressed

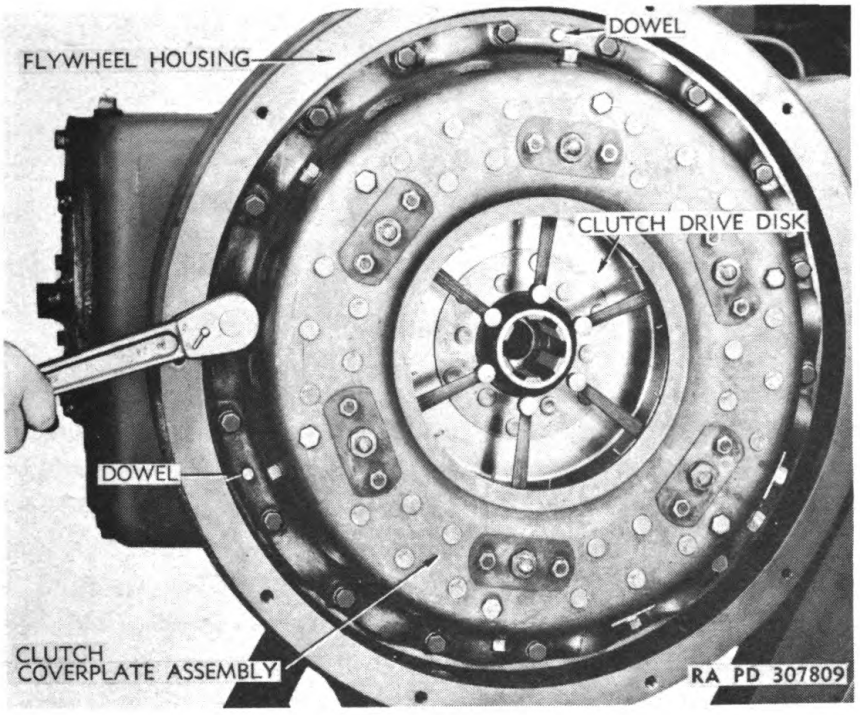


Figure 5 — Removing Clutch Assembly

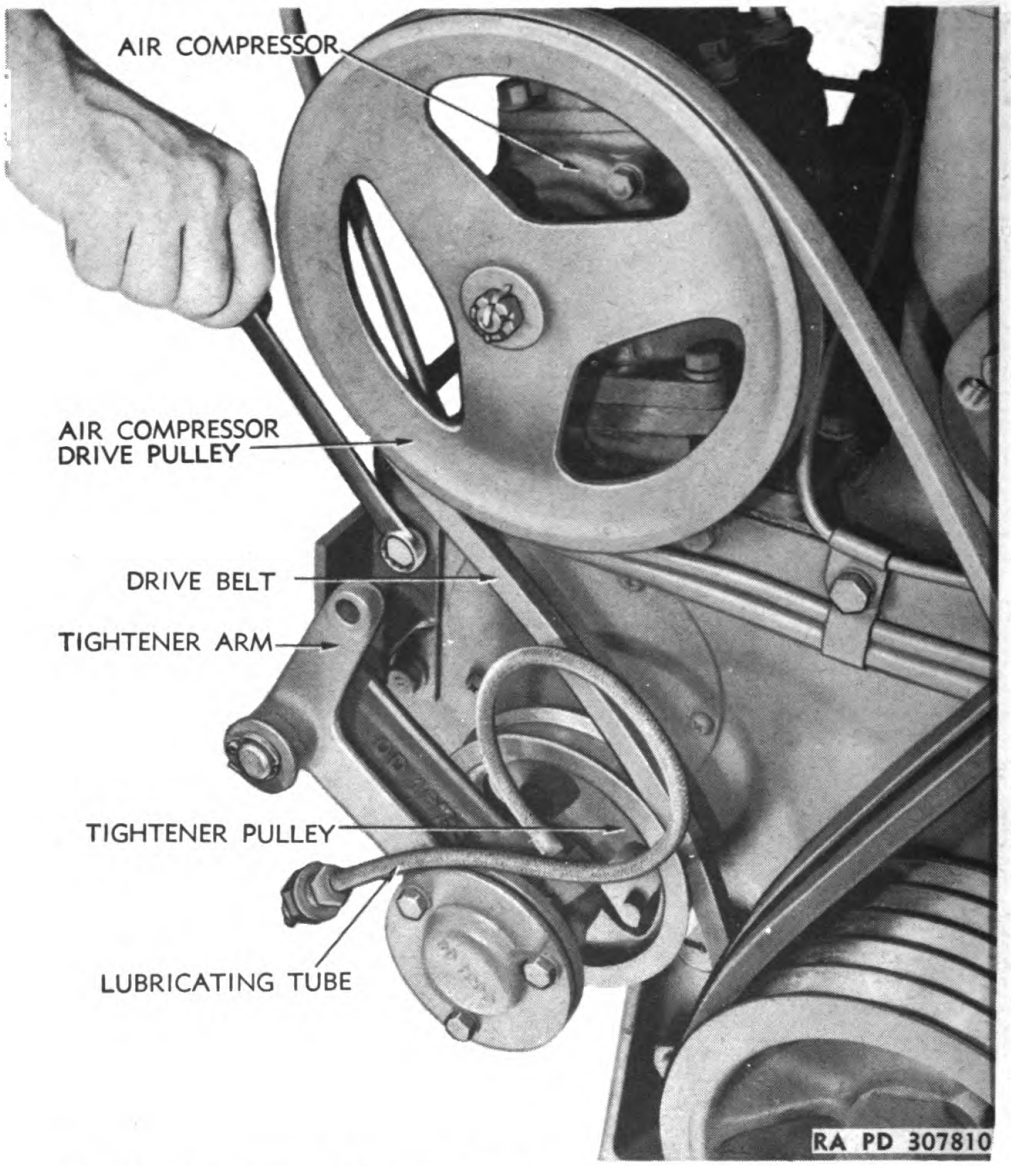


Figure 6 — Removing Air Compressor Drive Belt Tightener

c. Remove Master Clutch Assembly. Insert six ⅜- x 1½-inch NC cap screws through holes in clutch coverplate and screw them into tapped holes in bosses of pressure plate (fig. 4) until the heads of the cap screws are against coverplate. These are to hold clutch springs compressed while clutch is removed. Remove the 18 cap screws attaching clutch assembly to flywheel and remove clutch cover plate and pressure plate assembly (fig. 5). Clutch drive disk will be removed at same time. Do not lose small coverplate dowels which may pull out of flywheel with coverplate.

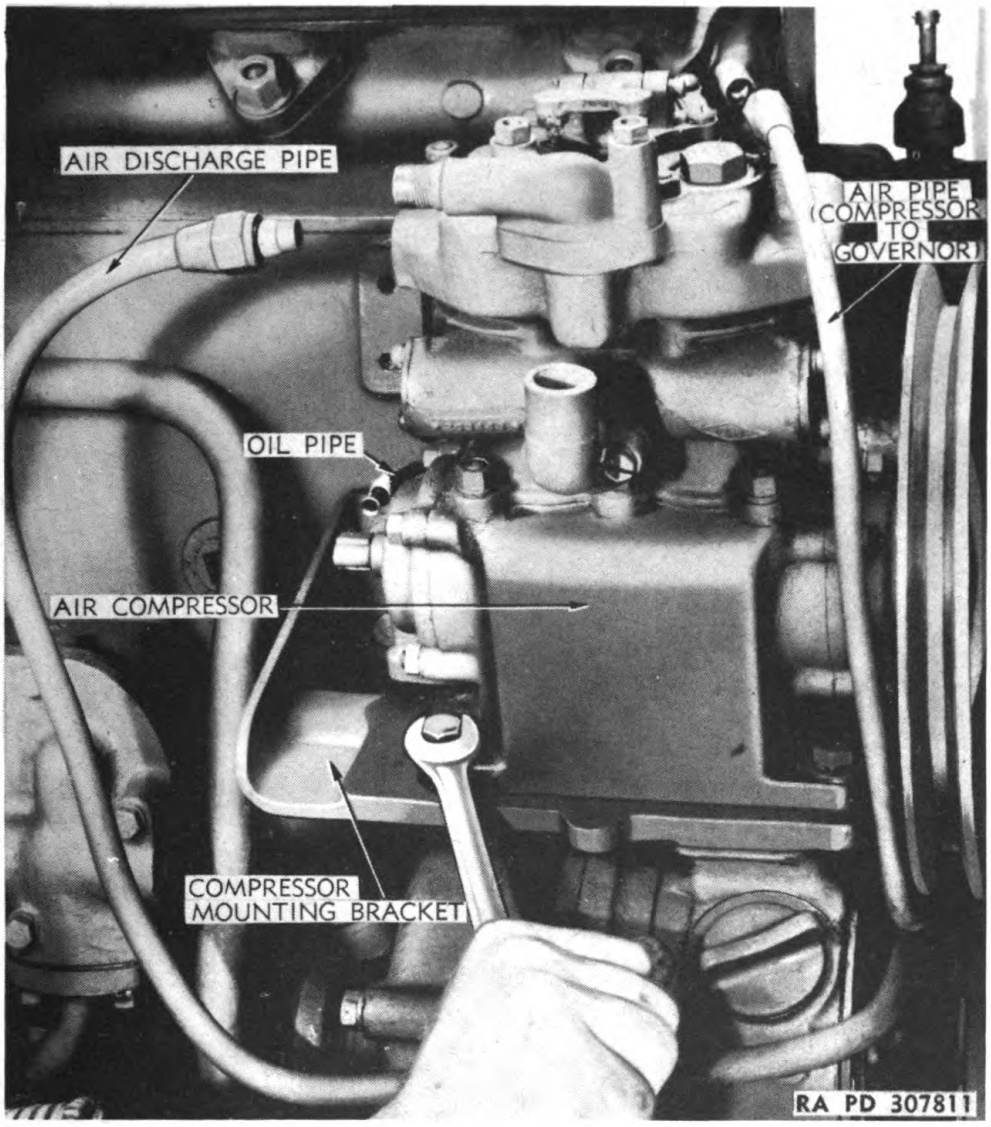


Figure 7 — Removing Air Compressor

d. Remove Compressor Drive Belt Tightener Assembly. Remove two cap screws and lock washers attaching tightener assembly to timing gear housing (fig. 6), and remove tightener assembly from engine.

e. Remove Air Compressor. Disconnect all air, oil, and water lines from compressor, remove the four cap screws attaching compressor to mounting bracket (fig. 7) and lift off compressor.

f. Remove Exhaust Manifold. Remove the eighteen nuts and washers from manifold studs (fig. 8) and lift manifold assembly and gaskets from studs.

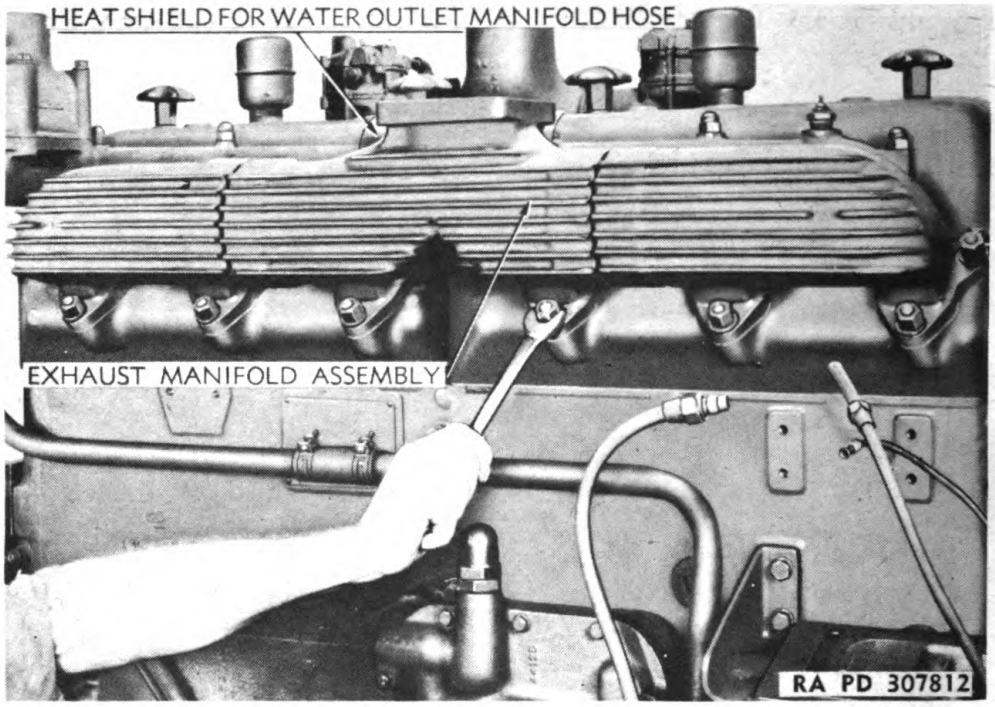


Figure 8 — Removing Exhaust Manifold Assembly

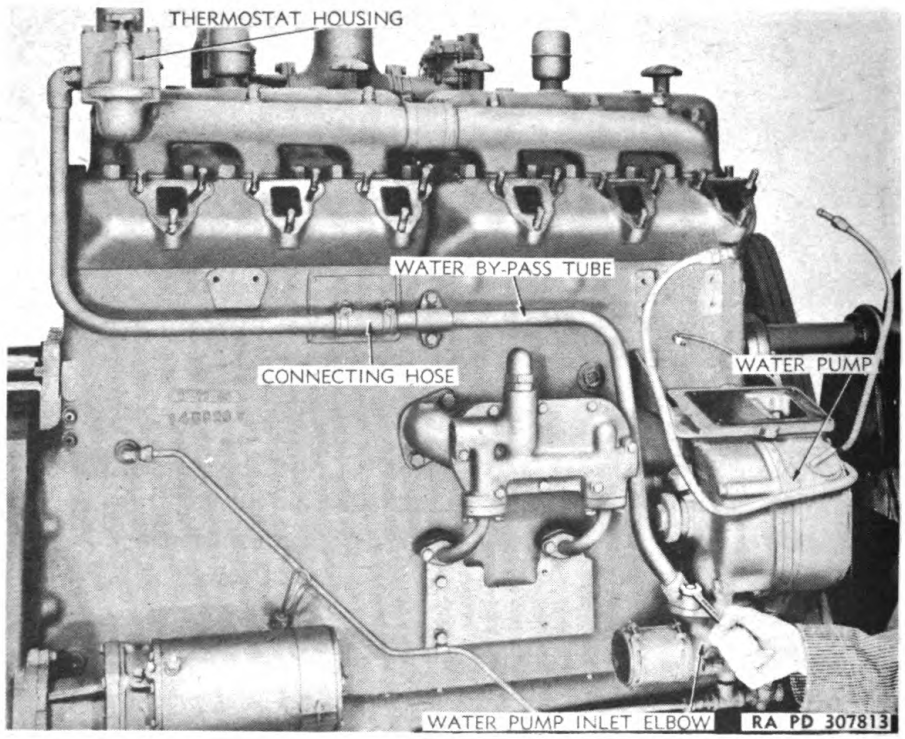


Figure 9 — Disconnecting Water By-pass Tube at Water Pump

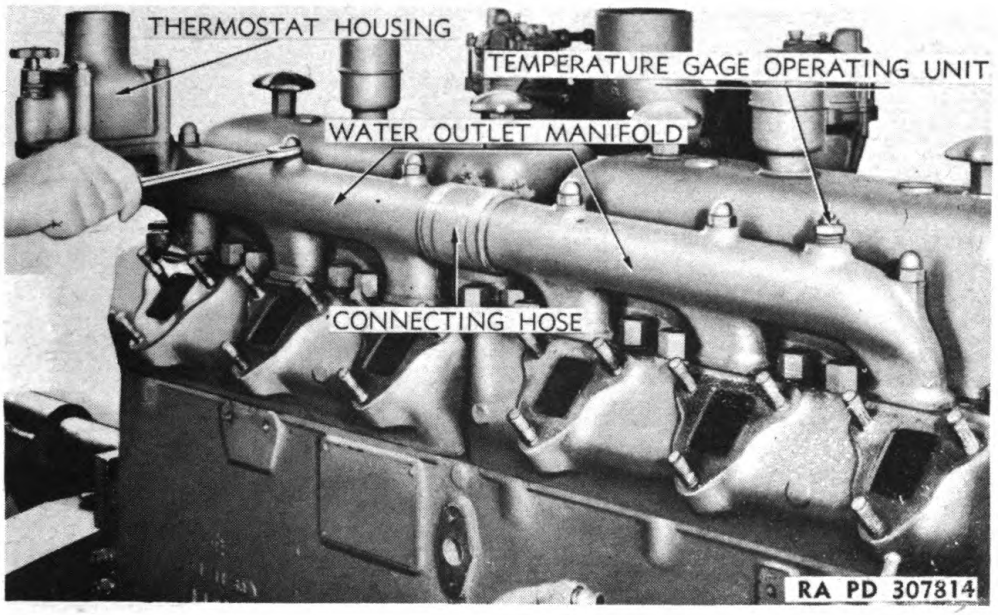


Figure 10 — Removing Water Outlet Manifold Assembly

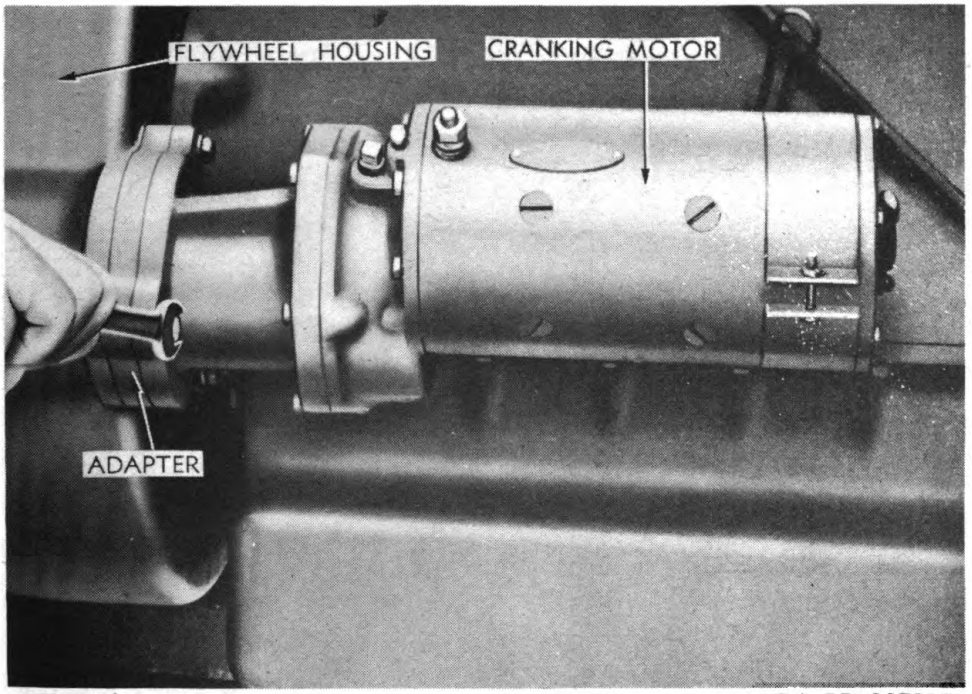


Figure 11 — Removing Cranking Motor

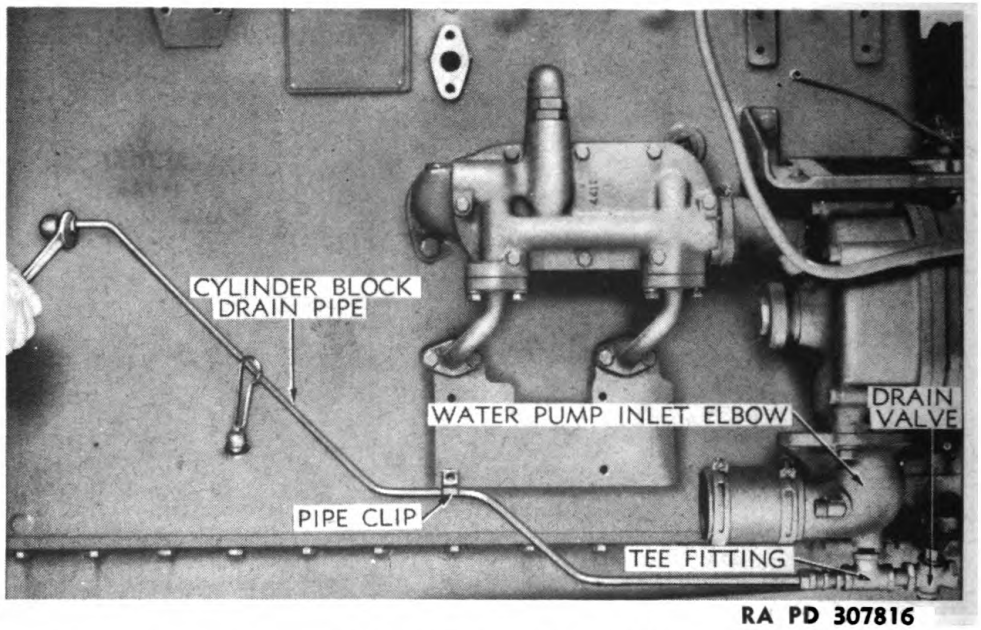


Figure 12 — Removing Cylinder Block Water Drain Pipe

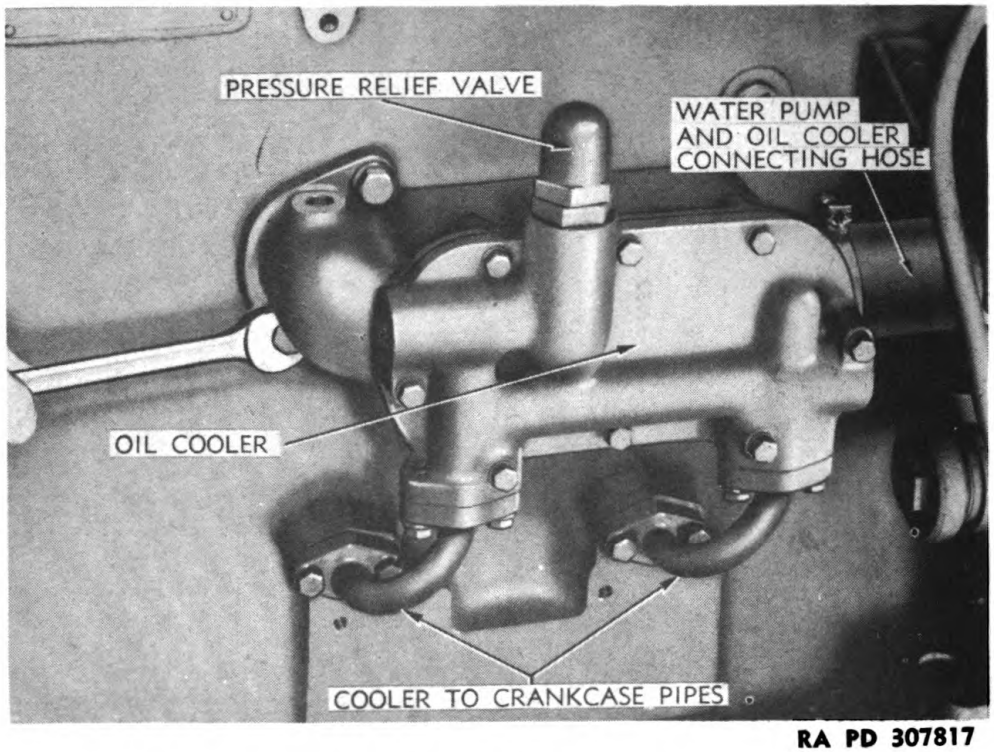


Figure 13 — Oil Cooler Removal

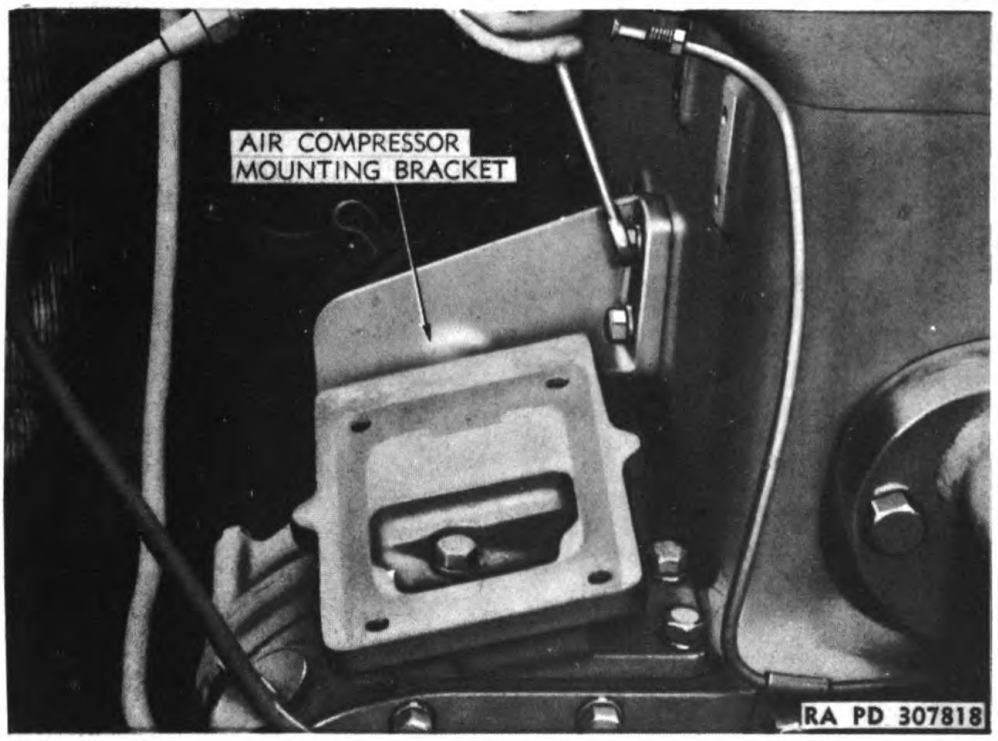


Figure 14 — Removing Air Compressor Mounting Bracket

g. Remove Water Outlet Manifold. Remove two cap screws and lock washers to disconnect lower end of water by-pass tube from water pump inlet elbow (fig. 9). Remove two cap screws and lock washers to disconnect upper end of tube from thermostat housing. Remove the two cap screws and lock washers attaching tube to side of cylinder block, and remove water by-pass tube assembly. Remove the six acorn nuts from water outlet manifold mounting studs (fig. 10) and lift off water outlet manifold assembly with thermostat assembly, as a unit. Remove manifold gaskets.

h. Remove Cranking Motor. Remove the three cap screws and lock washers holding cranking motor to flywheel housing (fig. 11) and remove cranking motor and spacer from housing.

i. Remove Cylinder Block Drain Pipe. Disconnect pipe from fitting in side of cylinder block (fig. 12) and from fitting on water pump inlet elbow and remove pipe.

j. Remove Lubricating Oil Cooler (fig. 13). Loosen clamp on hose connecting water pump and cooler. Disconnect lower ends of oil cooler to crankcase pipes from cylinder block by removing two cap screws and lock washers from each pipe attaching flange. Remove the two cap screws and lock washers attaching cooler assembly

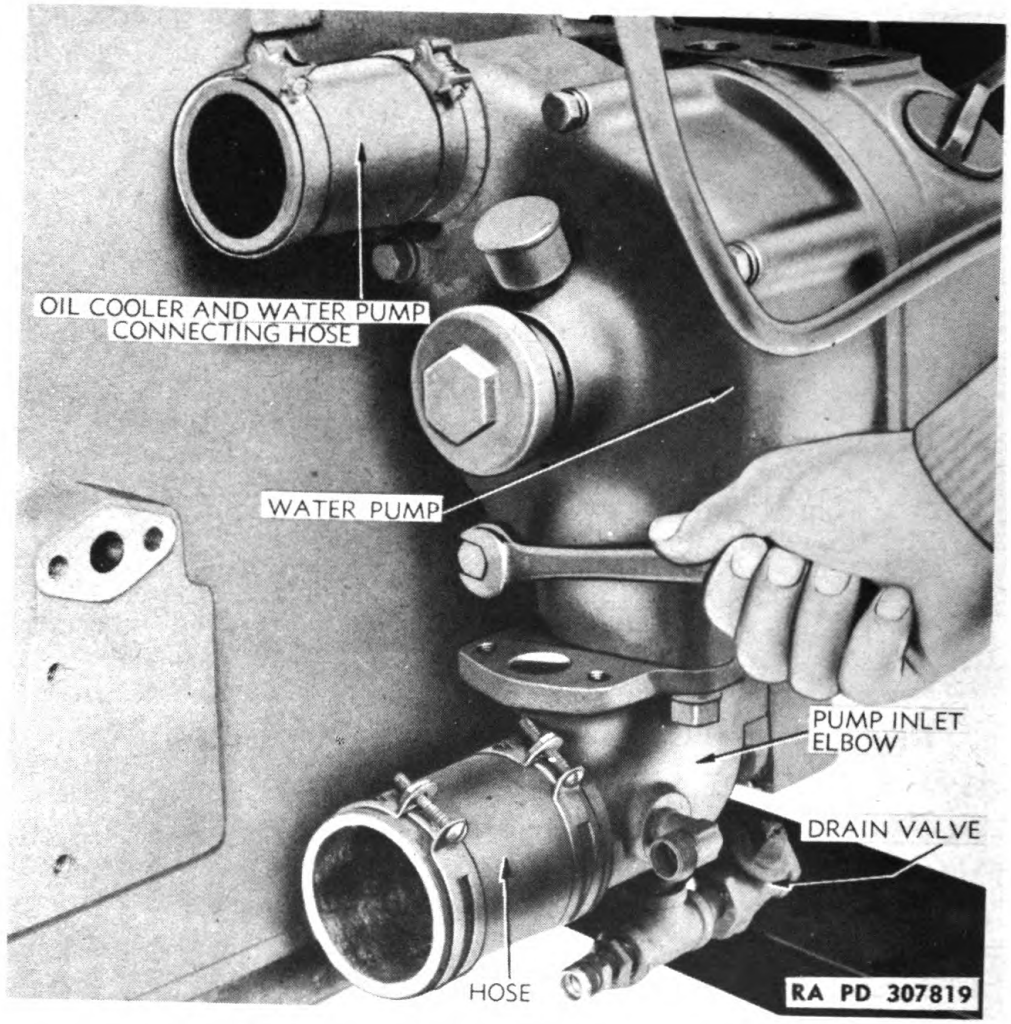


Figure 15 — Removing Water Pump

to cylinder block, pull cooler away from engine, and out of hose, and remove cooler assembly.

k. Remove Water Pump. Remove two cap screws and lock washers attaching compressor mounting bracket to cylinder block (fig. 14), and the three cap screws and lock washers attaching bracket to timing gear housing and remove bracket from engine. Remove the four remaining cap screws and lock washers (two are at rear of pump near cylinder block, the other two are removed from rear of pump, and extend through timing gear housing), and pull water pump out of timing gear housing.

l. Remove Fan Drive Assembly. Remove four cap screws and lock washers attaching fan drive to mounting bracket on side of engine

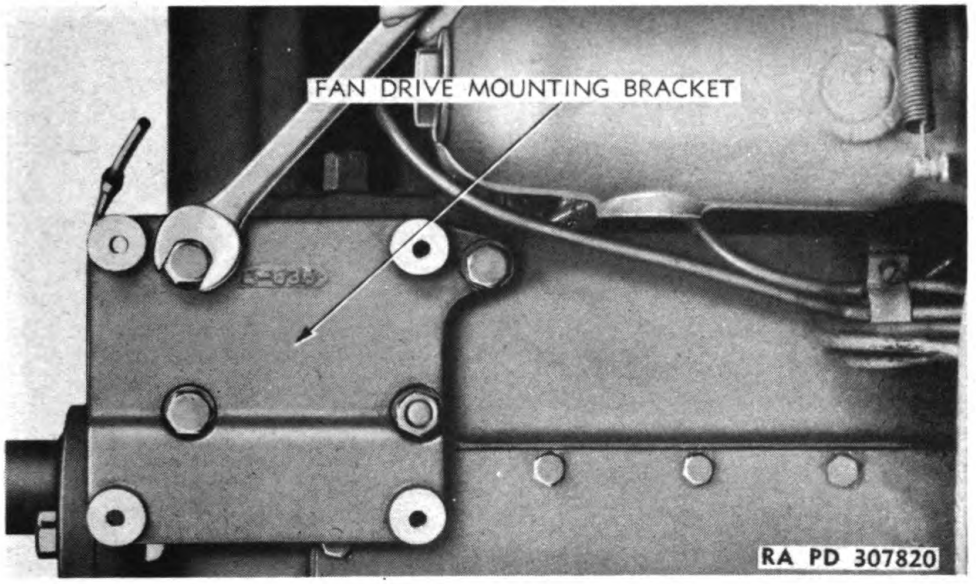


Figure 16 — Removing Fan Drive Mounting Bracket

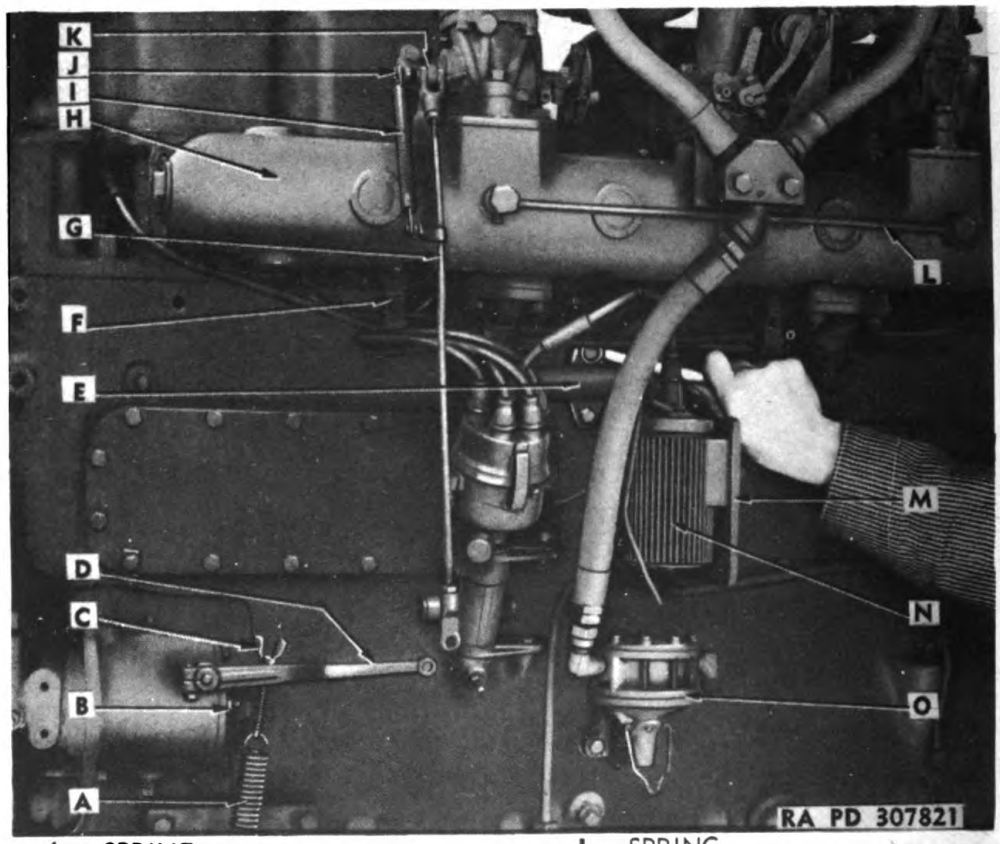
and remove drive assembly. Remove three cap screws and one nut and lock washers and remove fan drive mounting bracket (fig. 16).

m. Remove Carburetor and Intake Manifold Assembly (fig. 17). Pull cotter pin and remove yoke pin to disconnect throttle control rod from governor lever. Remove two cap screws and lock washers connecting center section of water intake manifold pipe to cylinder block. Remove nut and washer to disconnect wire from engine ignition switch. Disconnect end of hose from fuel pump. Remove eighteen nuts from intake manifold mounting studs, and lift off manifold and carburetor assembly as a unit.

n. Remove Ignition Coil and Radio Filter Assemblies (fig. 17). Unscrew retainer and lift wire from top of coil. Remove nut to disconnect distributor wire from terminal on coil. Remove four cap screws and copper washers attaching mounting bracket to cylinder block and remove assembly.

o. Remove Fuel Pump (fig. 17). Remove two cap screws attaching pump to cylinder block and remove fuel pump and gasket.

p. Remove Distributor and Tachometer Drive Assemblies (fig. 18). Remove cap screws from tachometer drive clamping arm, loosen lock nut and loosen set screw holding tachometer drive in cylinder block. Pull ends of wires from spark plugs, then lift distributor and tachometer drive from cylinder block.



A —SPRING
B —STOP SCREW
C —ADJUSTING SCREW
D —GOVERNOR LEVER
E —WATER INTAKE MANIFOLD
F —SPARK PLUG CABLE BRACKET
G —CARBURETOR TO GOVERNOR ROD
H —INTAKE MANIFOLD
I —SPRING
J —THROTTLE LEVER
K —FLOATING LEVER
L —PRIMER MANIFOLD
M —COIL AND FILTER BRACKET
N —IGNITION COIL
O —FUEL PUMP

Figure 17 — Disconnecting Water Intake Pipe

q. Remove Governor Assembly (fig. 23). Remove two cap screws and lock washers to disconnect spring bracket from cylinder block. Disconnect ends of the two oil lines from fittings on governor. Remove nuts and lock washers and the mounting clamp from the two governor mounting bolts and remove governor assembly.

r. Remove Lubricating Oil Pressure Gage Unit (fig. 23). Remove pressure gage unit by unscrewing it from side of cylinder block.

s. Remove Lubricating Oil Pressure Relief Valve Assembly (fig. 23). Remove acorn nut and copper gasket, loosen lock nut, and unscrew pressure adjustment screw from side of cylinder block, then

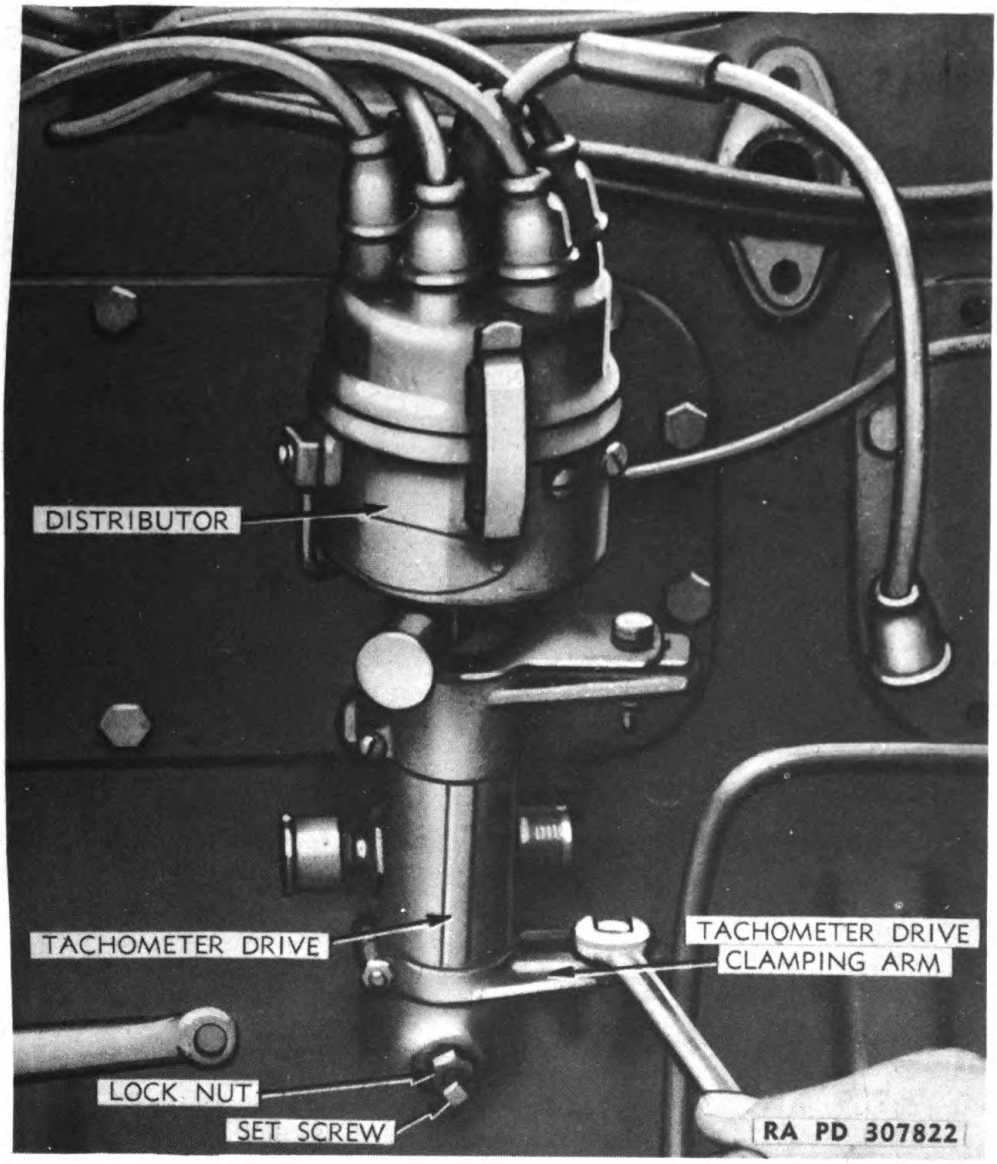


Figure 18 — Removing Distributor and Tachometer Drive

lift out valve spring and plunger. Disconnect and remove all remaining external oil lines.

t. Remove Crankshaft Drive Pulley. Rotate engine ¼ turn in stand. Remove large nut from end of crankshaft (fig. 24), and pull drive pulley from crankshaft with any standard sheave puller. Remove key from slot in shaft.

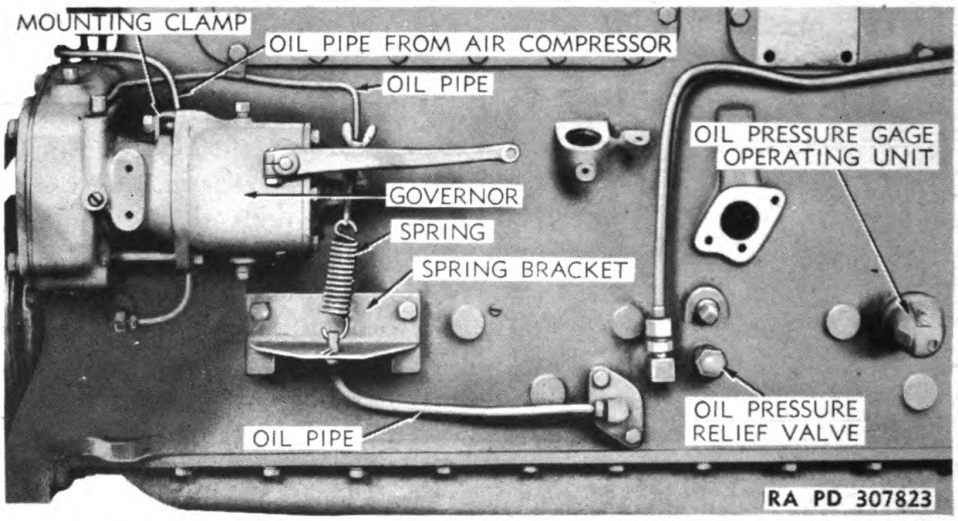


Figure 19 — Governor

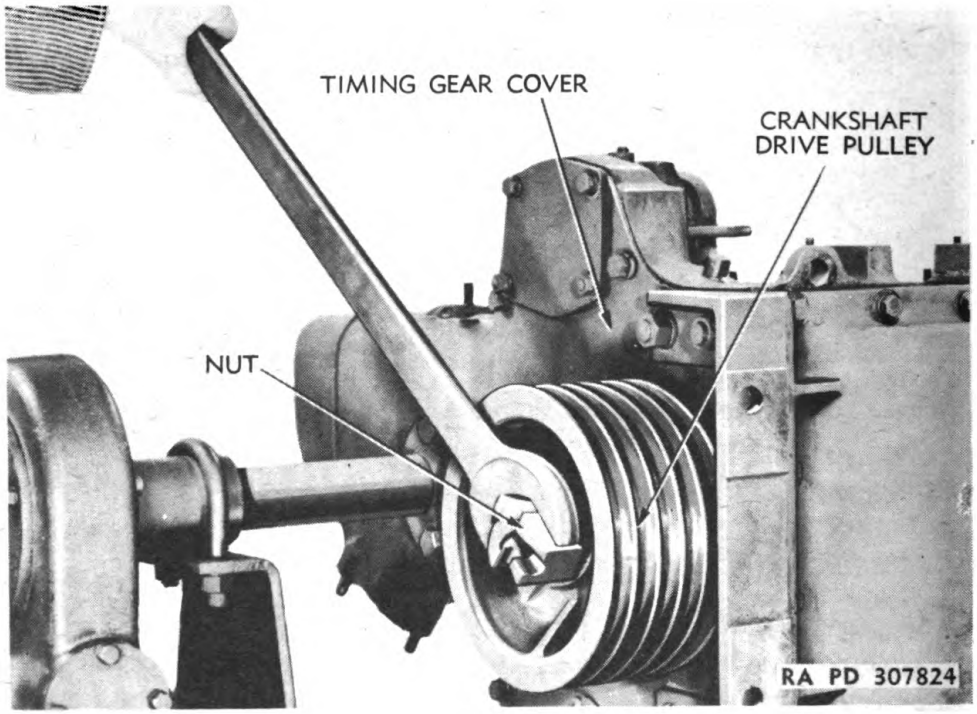


Figure 20 — Removing Drive Pulley

Section V

DISASSEMBLY OF STRIPPED ENGINE

16. INSPECTION BEFORE DISASSEMBLY.

a. Before a subassembly is removed from the engine, check the fits and tolerances, if any, with component parts to determine the degree of wear and whether or not the degree of wear will necessitate replacement of parts. Refer to section VII where all fits and tolerances are stated. Do not disassemble parts, if inspection and measurements prove they are within usable limits, unless these parts must be removed in order to remove others. While disassembling engine, make a list of damaged or worn parts, or gaskets, for which replacement parts, or gaskets, will be needed to reassemble it.

17. DISASSEMBLY INTO SUBASSEMBLIES.

a. Remove Timing Gear Cover (fig. 20). Remove the three nuts and lock washers and large screw from engine support and the four cap screws and lock washers at rear of cover and remove engine support. Remove the five remaining cap screws from cover, and remove cover and oil seal assembly as a unit.

b. Remove Flywheel and Flywheel Housing (fig. 21). Cut lock wire and remove the six cap screws attaching flywheel to crankshaft.

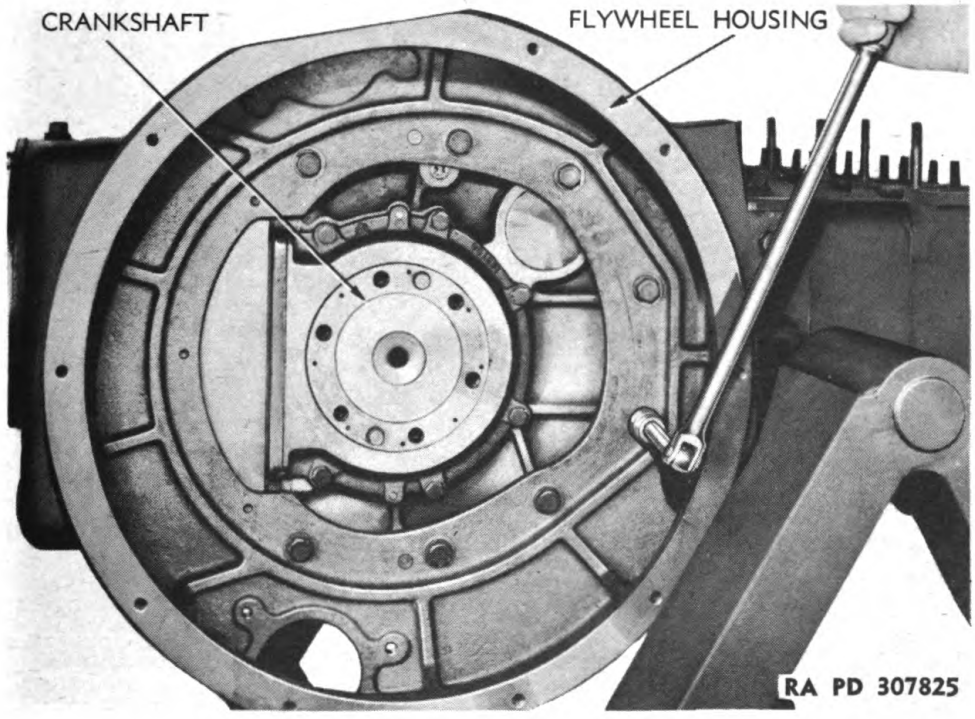


Figure 21 — Removing Flywheel Housing

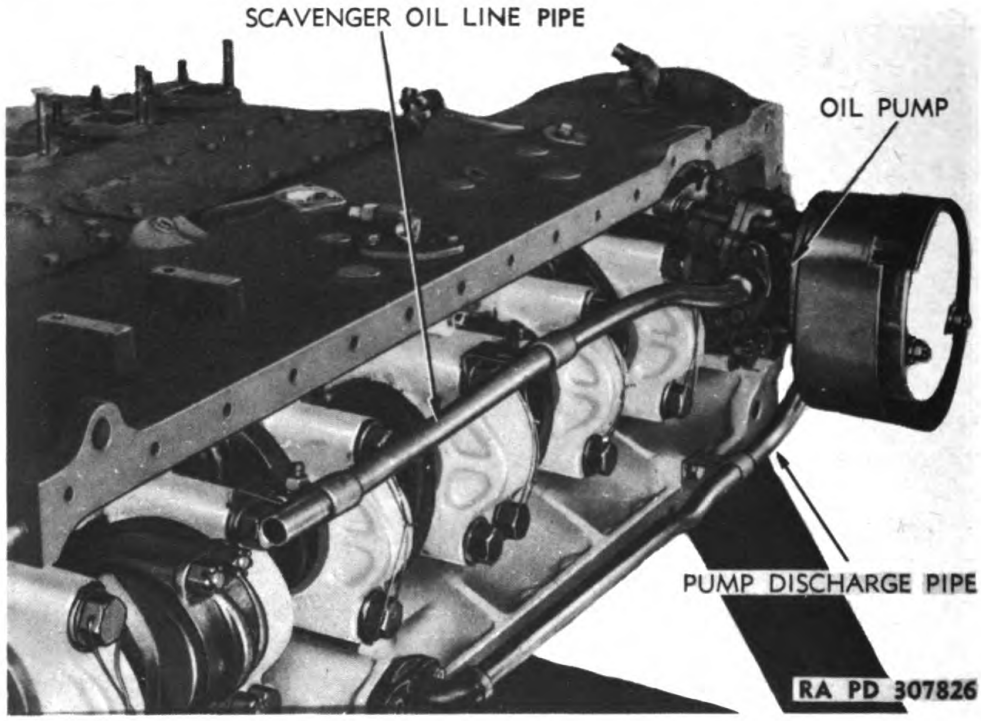


Figure 22 — Oil Pump and Pipes

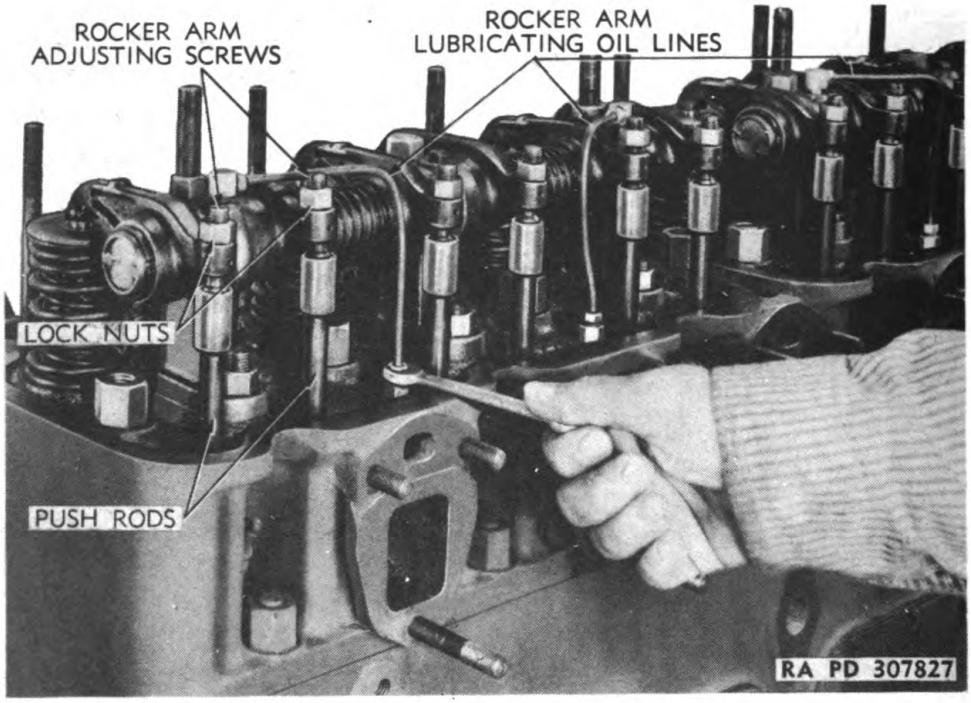


Figure 23 — Disconnecting Rocker Arm Lubricating Oil Line

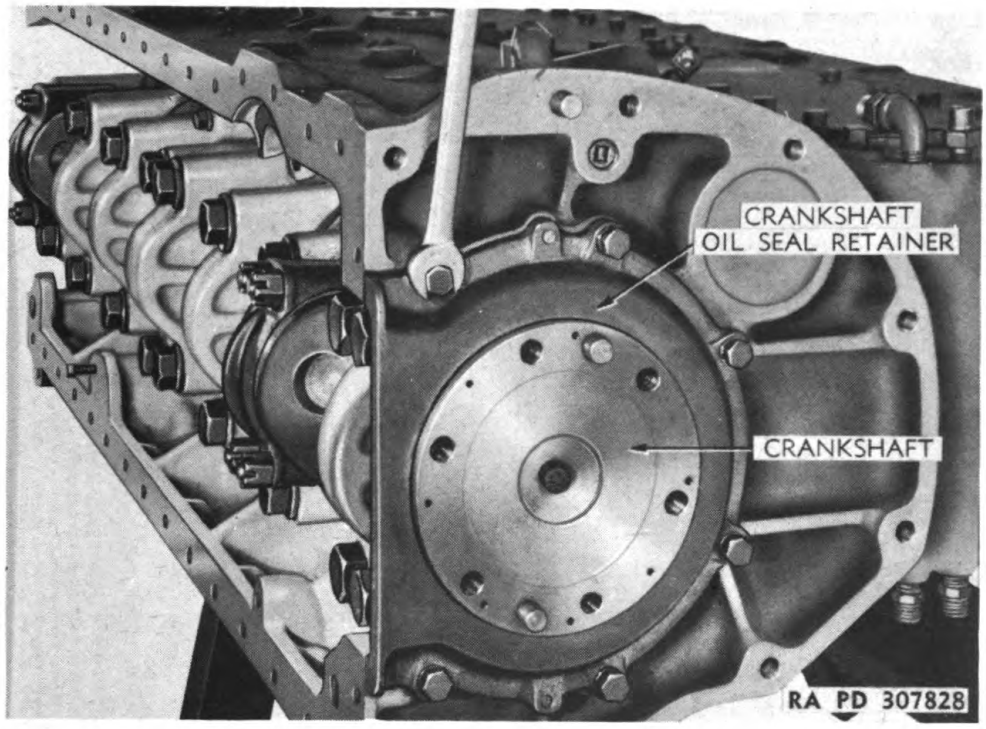


Figure 24 — Removing Crankshaft Oil Seal

Remove the two cap screws and lock washers and lift small cover from top of flywheel housing. Using a bar through hole in top of housing and a wood block and hammer through cranking motor hole in front of housing, tap and pry flywheel from crankshaft. Remove the eight cap screws and lock washers attaching flywheel housing to cylinder block and remove housing.

c. Remove Oil Pan and Lubricating Oil Pump (fig. 22). Remove the 32 cap screws and lock washers attaching oil pan to crankcase and remove oil pan and gasket. Remove the two cap screws and lock washers attaching pump to crankcase. Cut lock wires on cap screws holding scavenger oil line pipe clips to main bearing caps and remove these cap screws from the clips and main bearing caps. Remove the cap screw from the pump discharge pipe clip and the two nuts attaching discharge pipe flange to crankcase and remove pump with pipes attached. Remove two cap screws and lock washers from attaching flange and remove scavenger line and gasket from oil pump. Remove two cap screws and lock washers from attaching flange and remove discharge pipe and gasket from oil pump.

d. Remove Cylinder Head Assemblies (fig. 23). Rotate engine in stand until it is right side up. Unscrew hand wheel nuts in rocker arm covers from studs and lift covers and cover gaskets from cylinder heads. Disconnect lower ends of rocker arm lubricating oil lines.

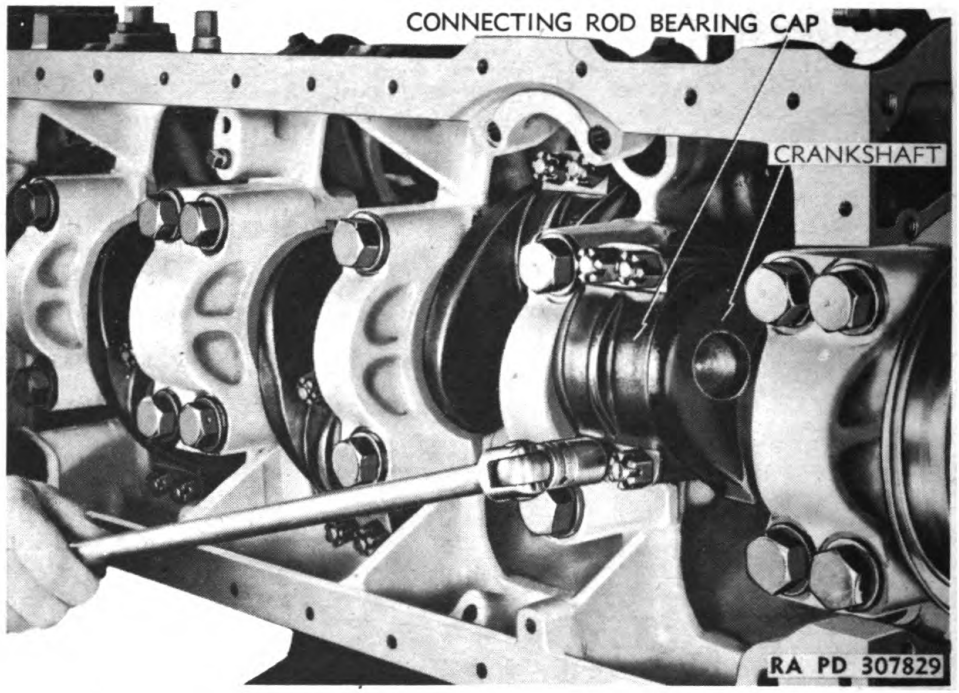


Figure 25 — Removing Connecting Rod Bearing Cap

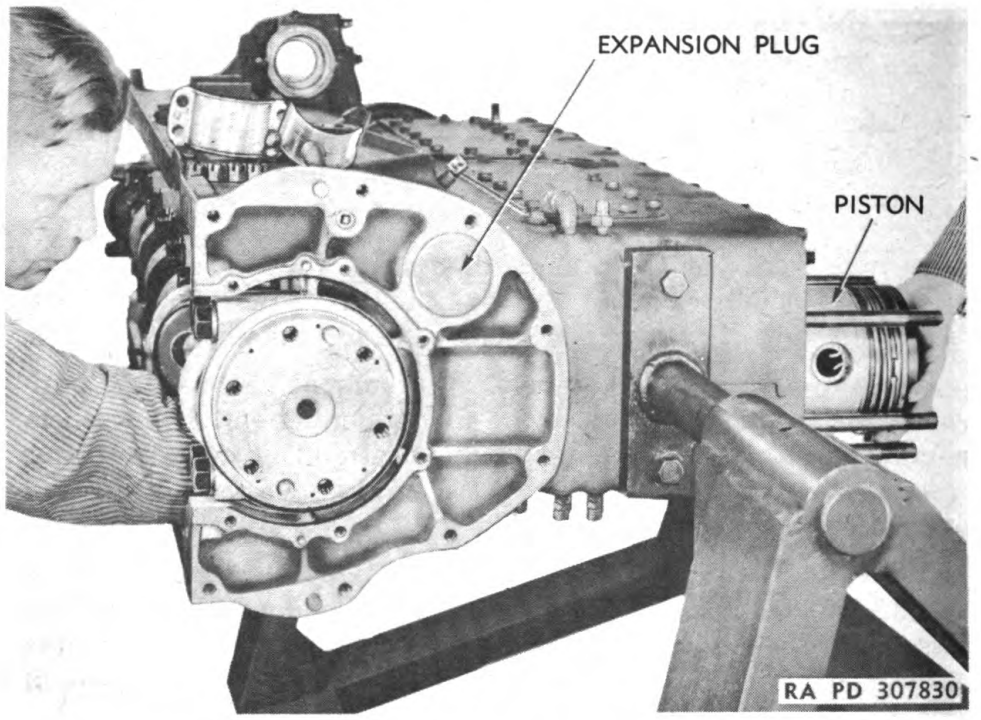


Figure 26 — Removing Piston and Connecting Rod Assembly

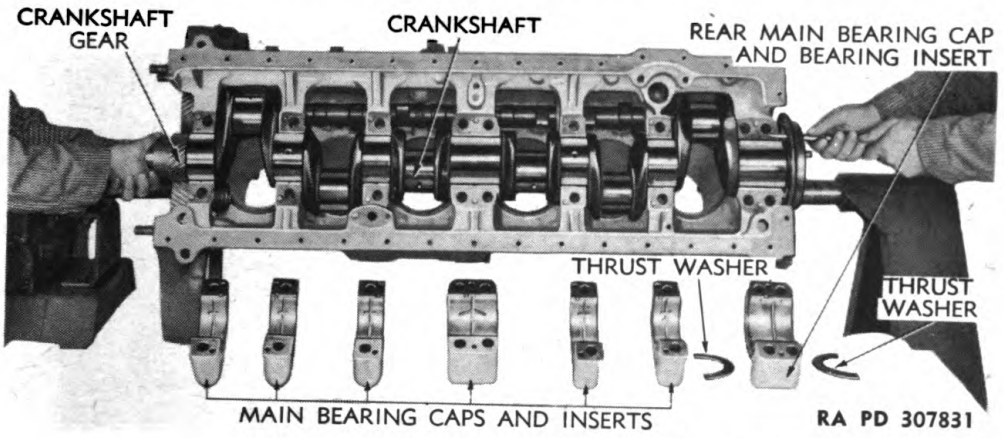


Figure 27 — Removing Crankshaft

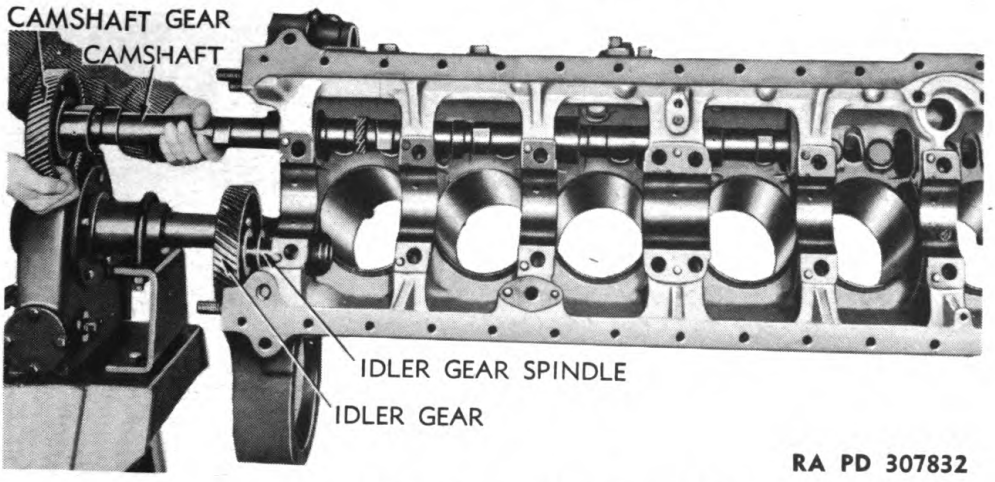


Figure 28 — Removing Camshaft

Remove nuts from the 12 rocker arm bracket studs, and lift rocker arm assemblies off the studs. Remove nuts from the cylinder head studs and lift cylinder heads and cylinder head gaskets off the studs.

e. Remove Crankshaft Oil Seal. Turn engine in stand into position shown in figure 24. Remove the six cap screws and lock washers from crankshaft oil seal retainer at flywheel end of cylinder block, pry retainer off the two dowels in block and remove the oil seal and retainer assembly.

f. Remove Piston and Connecting Rod Assemblies. Remove cotter pins from connecting rod nuts. Remove piston and connecting rod assemblies one at a time. Pull cotter pins and remove the nuts from the connecting rod bolts (fig. 25). Remove bearing cap and bearing insert from connecting rod. Scrape carbon from cylinder wall above piston, then using a hammer handle or wood block against lower end of connecting rod, push piston out of cylinder as shown in

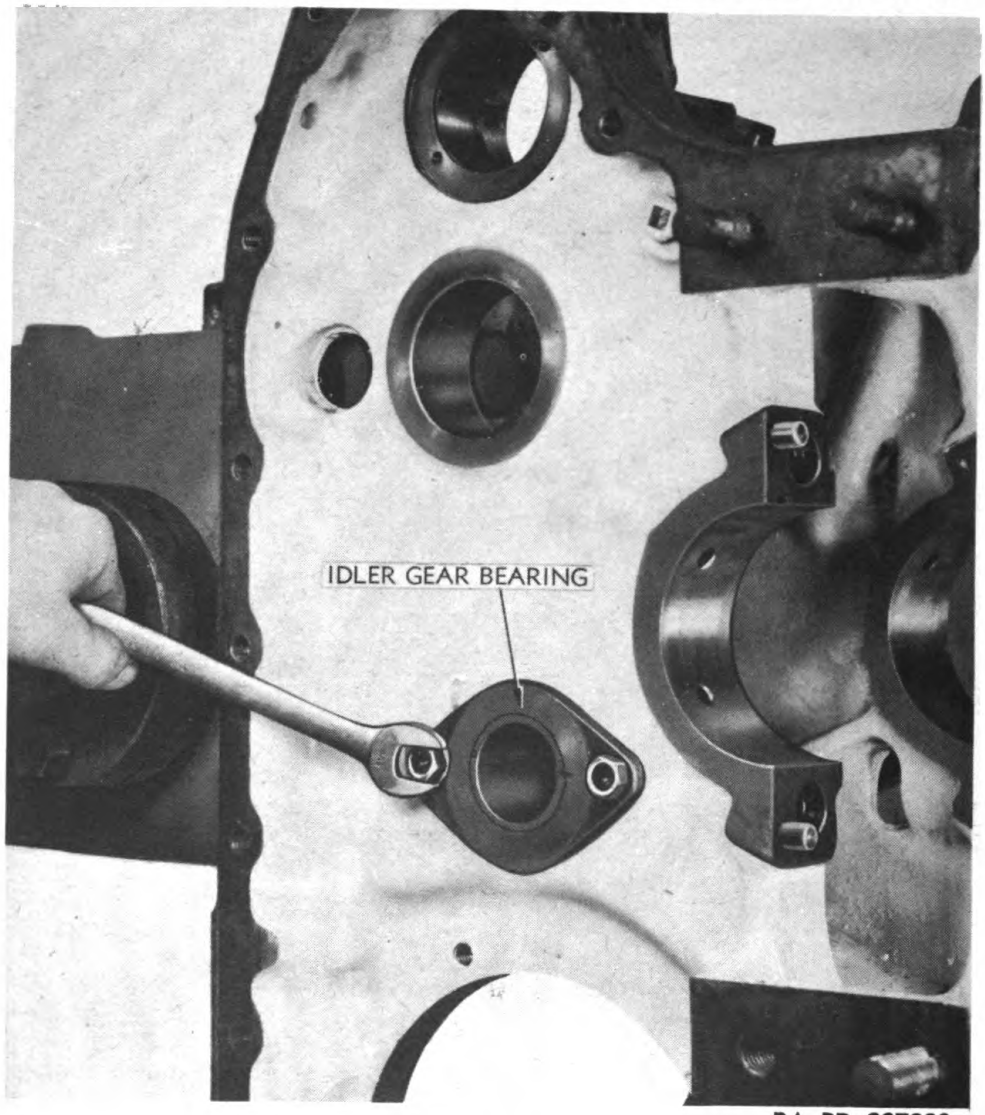


Figure 29 — Removing Idler Gear Bearing

figure 26. Remove remaining connecting rod assemblies in same manner. Reinstall bearing caps, and bearing inserts and shims, (if any) on connecting rods to keep the individual assemblies together.

g. Remove Crankshaft. Cut lock wires and remove the cap screws from all the main bearing caps. Remove each bearing cap and insert separately, keeping each bearing insert with the proper bearing cap. Tie, or wire, any shims that are removed, to the side of cap with which they were removed. Lift out crankshaft (fig. 27). Remove upper halves of bearing inserts from crankcase, and lay them with their respective mating caps and inserts.

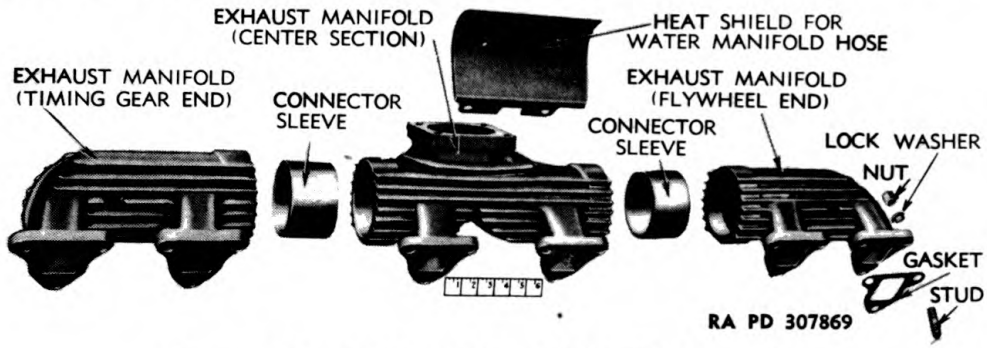


Figure 30 — Exhaust Manifold Disassembled

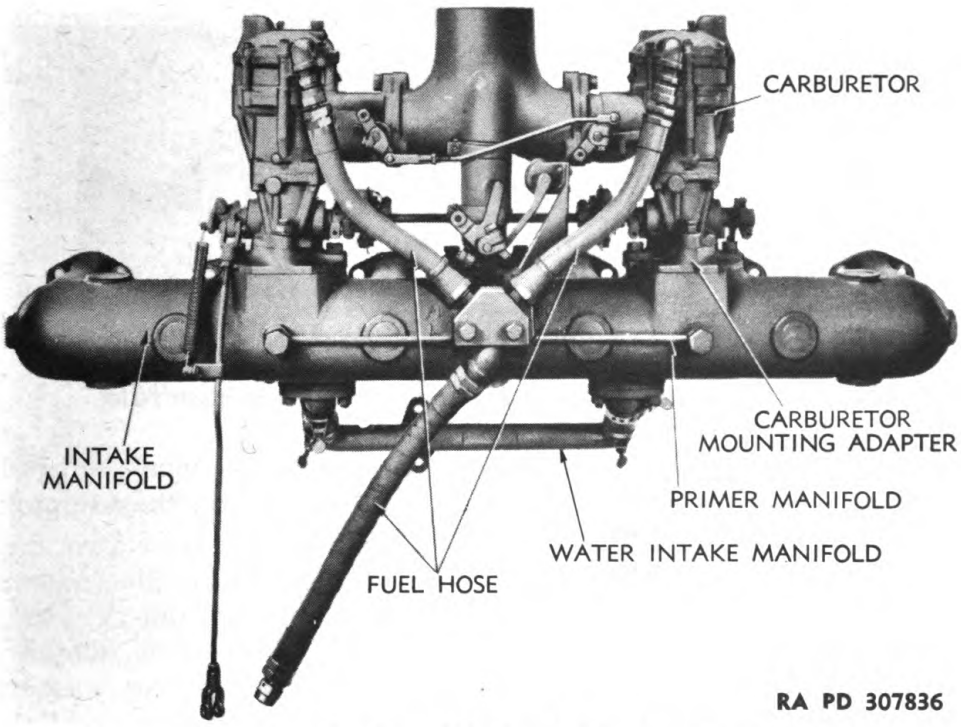


Figure 31 — Intake Manifold and Carburetors Assembled

h. Remove Camshaft and Gear Assembly. Pull camshaft and gear assembly from cylinder block as shown in figure 28. Slide the 12 cam lifters from bottom of cylinder block.

i. Remove Idler Gear Assembly. Pull idler gear and spindle from cylinder block (fig. 28). Remove the two special idler gear bearing retaining cap screws (fig. 29) and pull bearing from cylinder block.

j. Remove Cylinder Sleeves. In most cases the sleeves can be removed from cylinder block by tapping against bottom of sleeve with a wood block and hammer.

18. DISASSEMBLY OF ENGINE SUBASSEMBLIES.

a. Disassemble Exhaust Manifold Assembly. Tap the two end

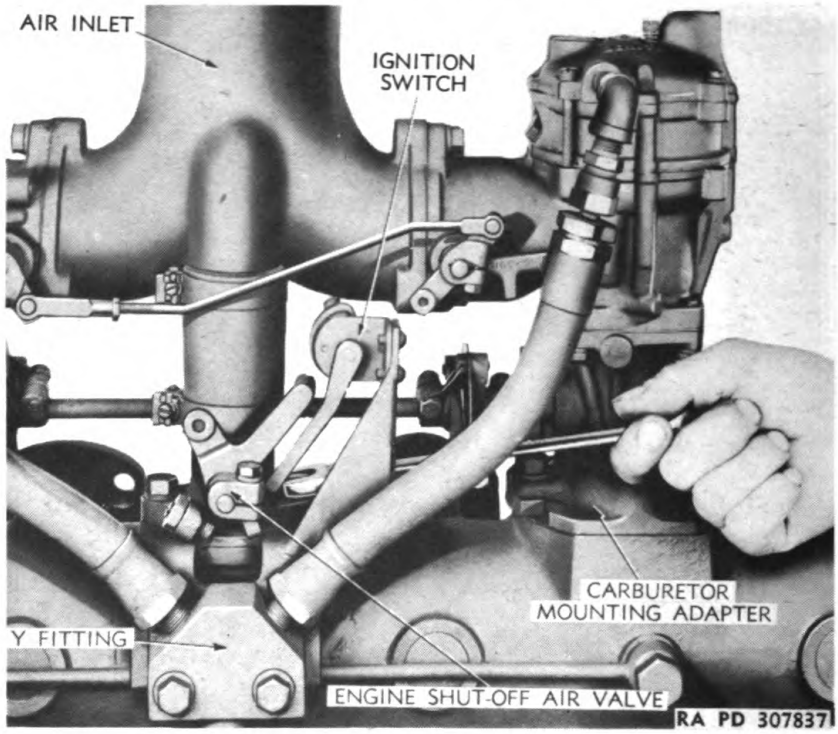


Figure 32 — Disconnecting Air Valve From Manifold

sections of manifold off the sleeves connecting the sections, then pull connector sleeves (fig. 30) from the sections in which they remain.

b. Disassemble Intake Manifold Assembly. Remove two cap screws and lock washers connecting engine shut-off air valve assembly to intake manifold (fig. 32). Remove four nuts from the studs connecting the two carburetors to the carburetor mounting adapters on manifold (fig. 31). Remove the two cap screws and washers attaching Y-fitting for fuel hose to bracket on intake manifold (fig. 32). Lift off carburetor and carburetor air inlet assembly with air valve assembly, and governor throttle control rod attached (fig. 35) from manifold. Remove nuts from the four studs attaching water intake manifold to manifold (fig. 33) and remove the manifold. Remove two bolts (fig. 34) and remove primer manifold and washers. Loosen screw in choke valve lever, remove three cap screws and lock washers connecting carburetor to air inlet (fig. 35), and loosen clamp screw on carburetor connecting shaft. Remove carburetor by pulling it away from air inlet and carburetor connecting shaft. Use same procedure to remove second carburetor from air inlet. Remove air valve assembly (fig. 35), by loosening lower clamp on hose connecting it to carburetor air inlet and pulling assembly from hose.

c. Disassemble Water Outlet Manifold (fig. 73). Remove four cap screws and lock washers and lift thermostat housing from mani-

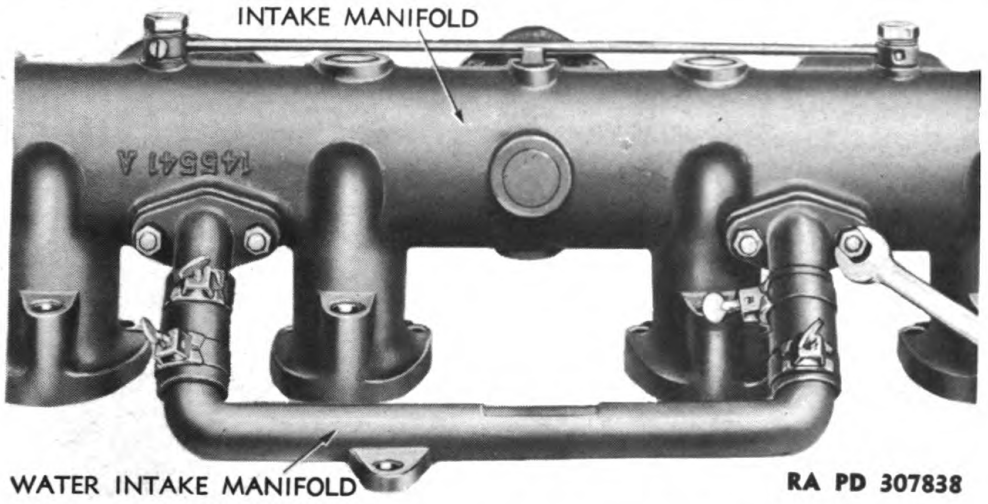


Figure 33 — Removing Water Intake Manifold

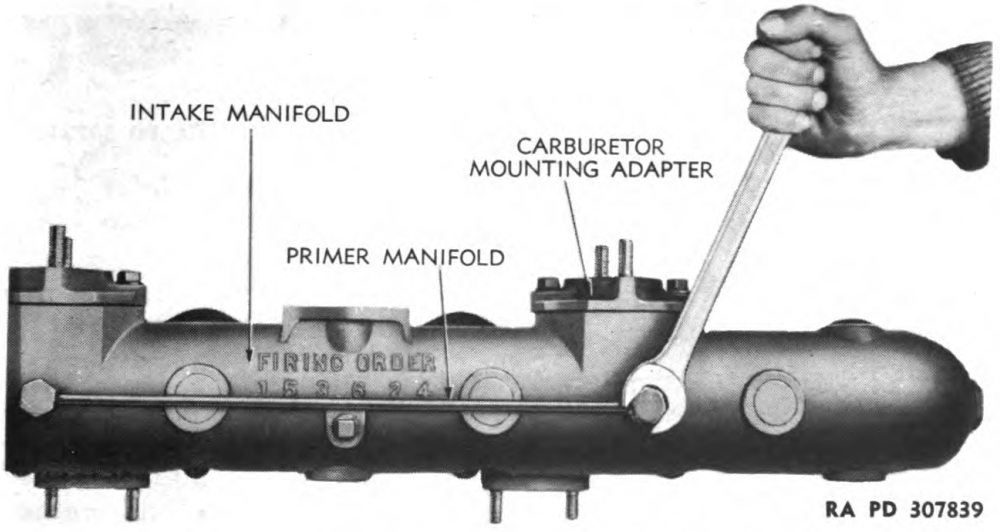


Figure 34 — Removing Primer Manifold

fold. Lift out thermostats (if any are installed) from manifold. Loosen connecting hose clamps and separate the two sections of manifold.

d. Disassemble Valve Rocker Arm Assembly (fig. 36). Remove snap rings from ends of shafts and slide rocker arms, rocker shaft brackets, and springs off shaft.

e. Disassemble Cylinder Head Assembly. Remove spark plugs from cylinder head using wrench (41-W-3328) (fig. 42). Turn cylinder head on side and compress valve spring with a valve lifter tool (41-L-1408) as shown in figure 38 until the taper locks can be removed from end of valve stem. After removing the taper locks (two halves), remove valve lifter tool, then remove valve spring seat

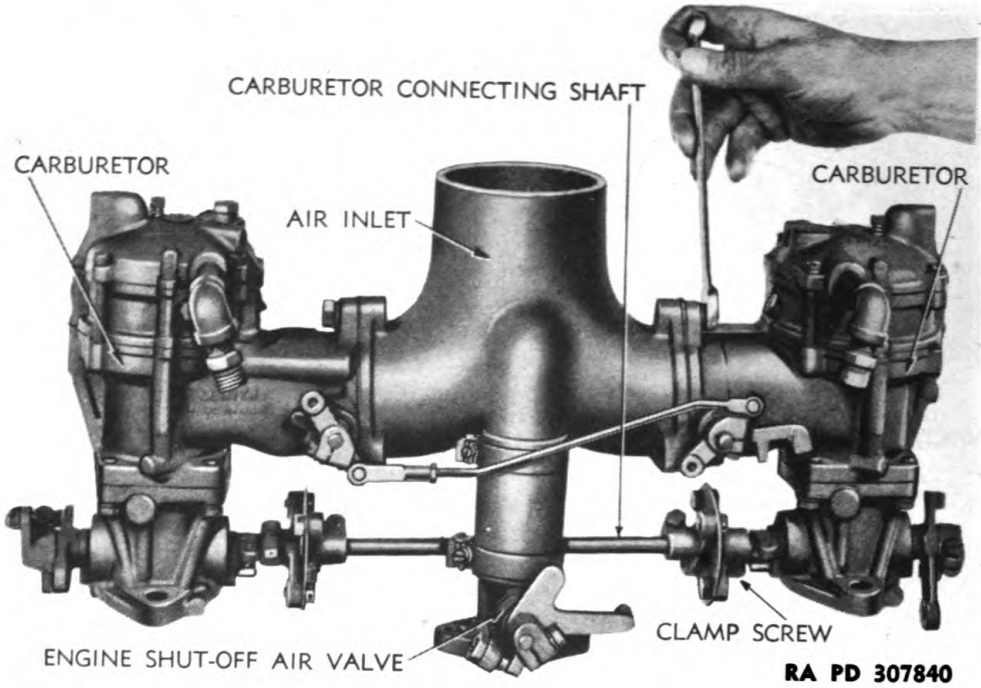


Figure 35 — Disconnecting Carburetor From Air Inlet

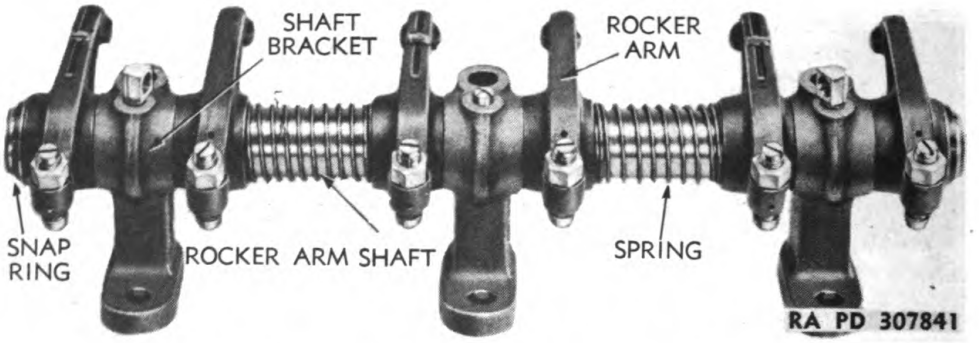


Figure 36 — Rocker Arm Assembly

and valve spring. Remove valve from cylinder head. Repeat the above operations on remaining valves. Turn cylinder head bottom side up and using ½-inch valve guide driver tool (41-R-2377-600), drive valve guides out of cylinder head (fig. 39). Remove all studs from cylinder head, if necessary, with a stud wrench. It is not practical to remove the hardened valve seats and install new ones, so removal of these will not be discussed.

f. Disassemble Connecting Rod and Piston Assembly (fig. 40). Spread piston rings with a piston ring expander and remove them from piston. Remove snap rings from piston at each end of piston

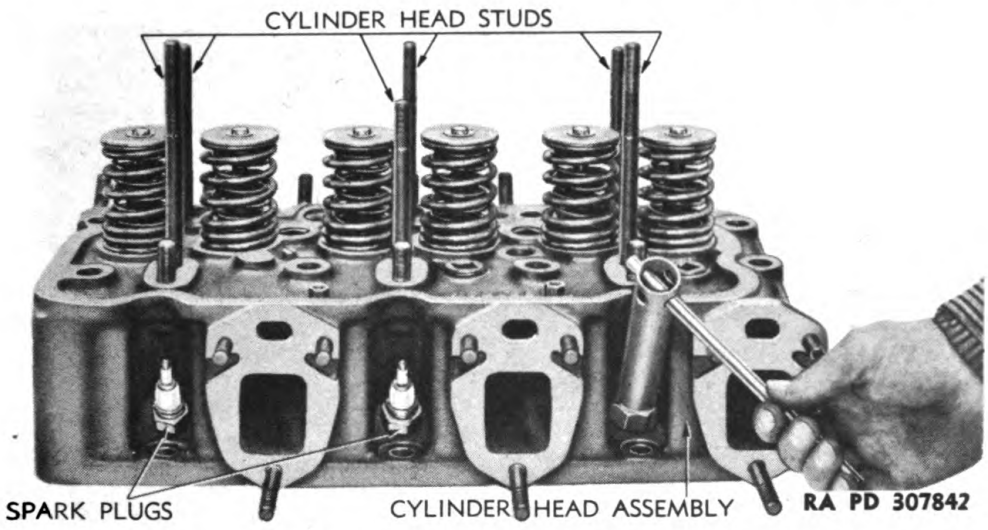


Figure 37 — Removing Spark Plug From Cylinder Head, Using Wrench 41-W-3328

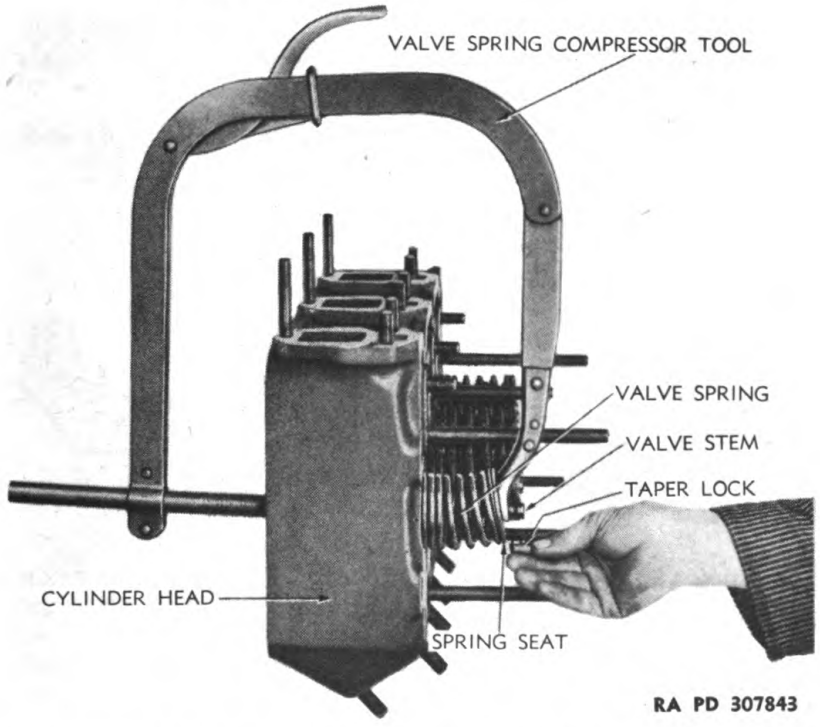


Figure 38 — Removing Valve Taper Locks, With Tool 41-L-1408

pin (fig. 41). It is necessary to heat piston to remove piston pin. Immerse piston in hot water until it expands enough for piston pin to be tapped out. The removal of the piston pin separates the connecting rod from piston. Press bushing out of upper end of connecting rod if bushing is worn beyond usable limits.

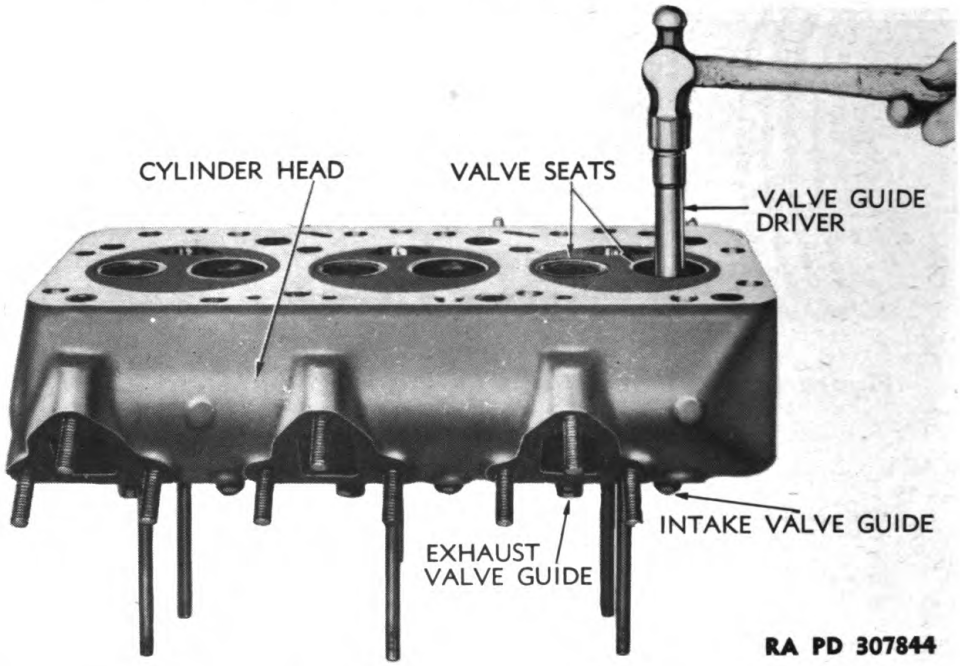


Figure 39 — Valve Guide Removal, With Tool 41-R-2377-600

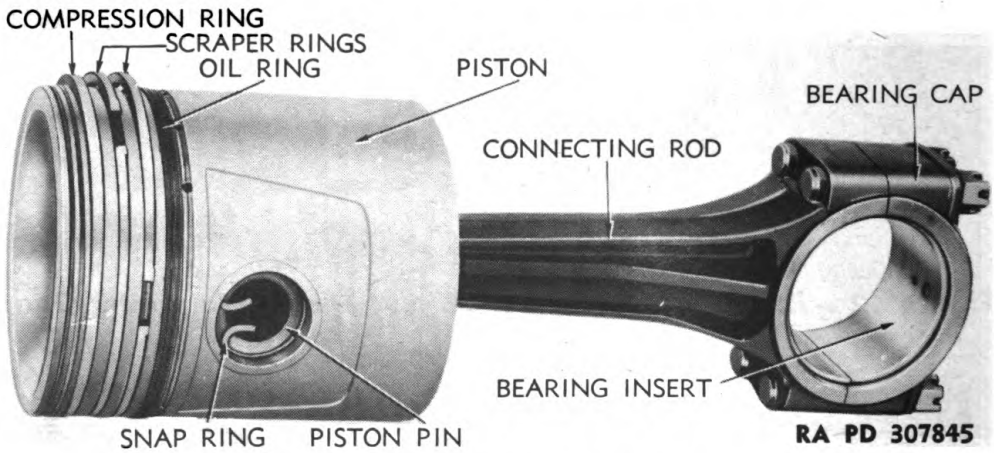


Figure 40 — Piston and Connecting Rod Assembly

g. Disassemble Idler Gear Assembly (fig. 42). Remove thrust button and spring from recess in spindle. Press spindle out of gear, then remove key from slot in spindle.

h. Disassemble Camshaft Assembly (fig. 43). Remove the thrust button and spring from recess in end of shaft in same manner as from idler gear shaft (fig. 42). Install shaft and gear in arbor press and press shaft out of gear. Remove key from slot in shaft.

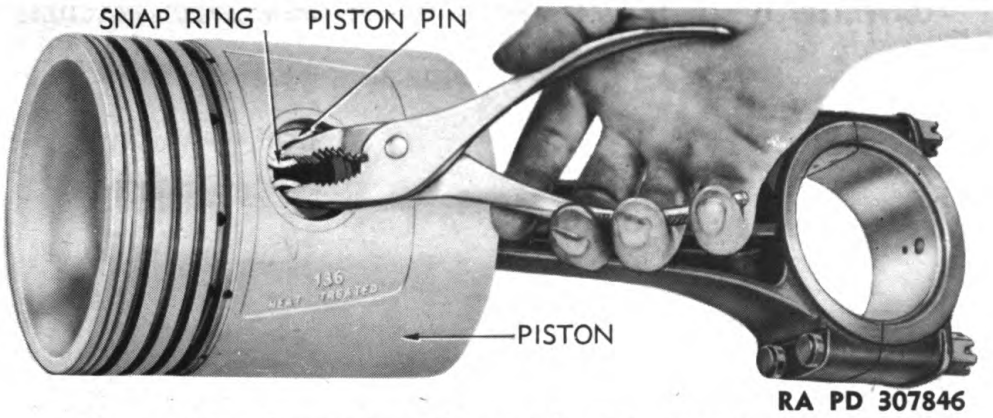


Figure 41 — Removing Piston Pin Retainer Snap Ring

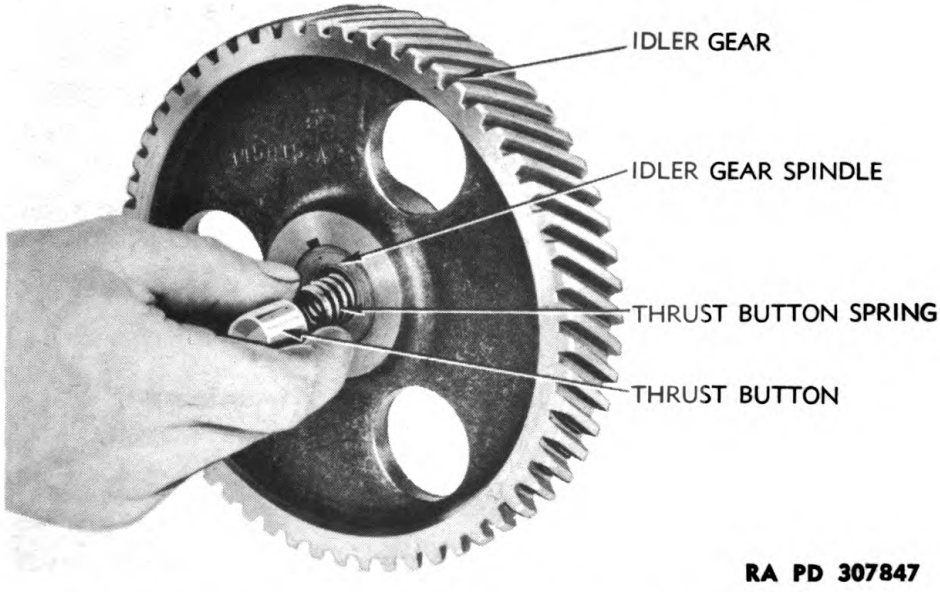


Figure 42 — Removing Thrust Button and Spring From Idler Gear

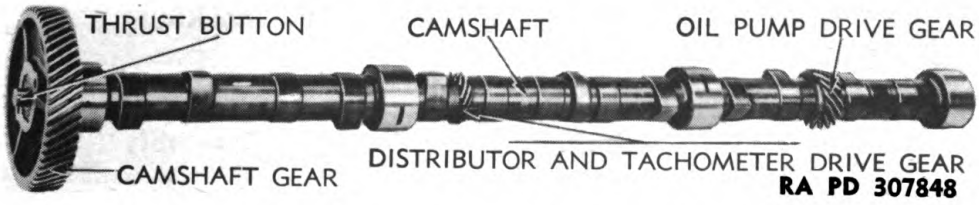


Figure 43 — Camshaft Assembly

i. Remove Packing Rings From Cylinder Sleeves (fig. 44). Remove the packing rings from lower end of cylinder sleeves by prying them out of grooves in sleeve with screwdriver.

j. Remove Camshaft Bushings From Cylinder Block. Figures 45 and 46 show a tool specially designed for the replacement of these

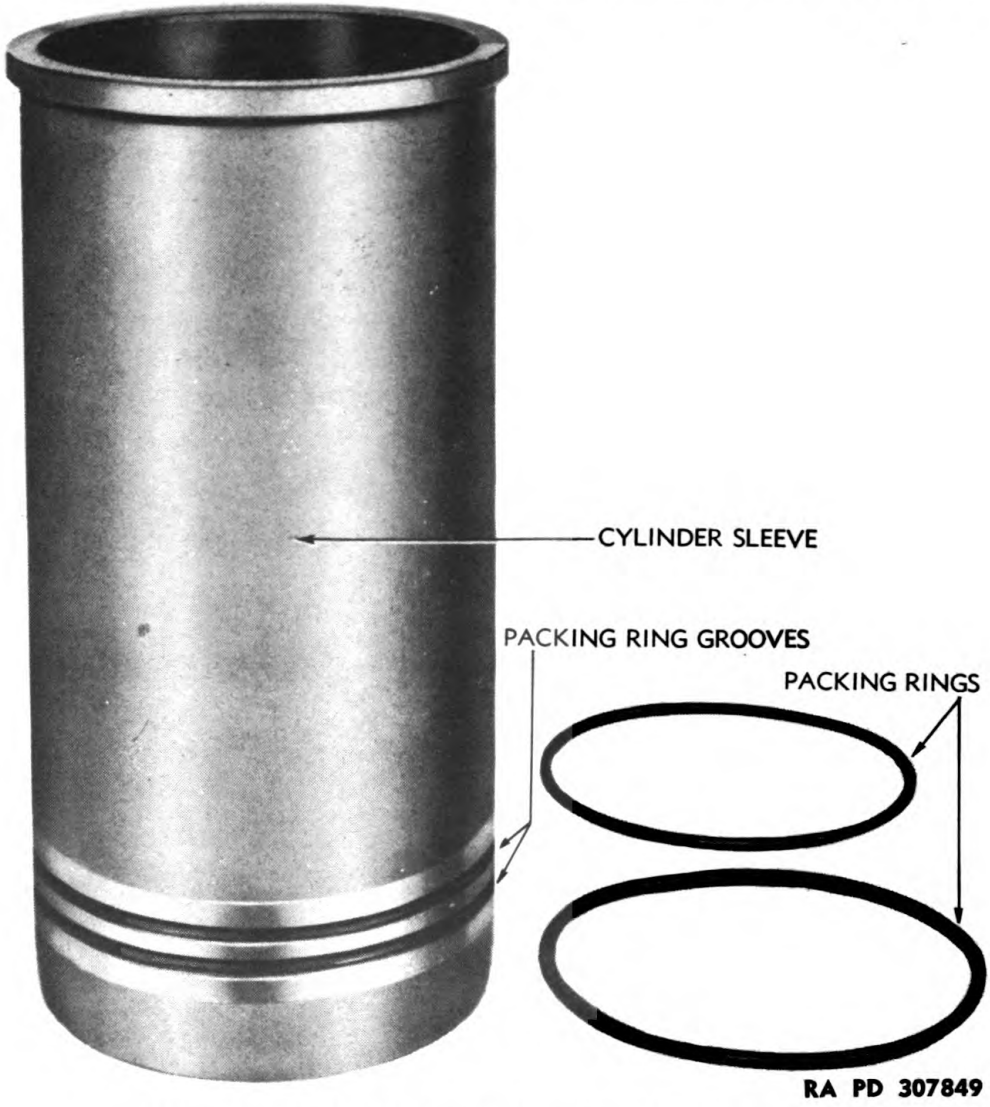


Figure 44 — Cylinder Sleeve and Packing Rings

bushings. This tool has two different length handles which screw into the driver head. The short handle (41-H-1396-650) is used for removing or installing the bushings closest to ends of block; the longer handle (41-H-1396-655) is used to remove or install the intermediate bushings. The driver head has a removable pilot bushing. Remove bushings by slipping the guide bushing off the driver head, then inserting the driver head into the bushing and driving the bushing out. If the above mentioned bushing driver is not available, use a similar bushing driver of the proper size.

k. Disassemble Timing Gear Cover Assembly. Remove the six

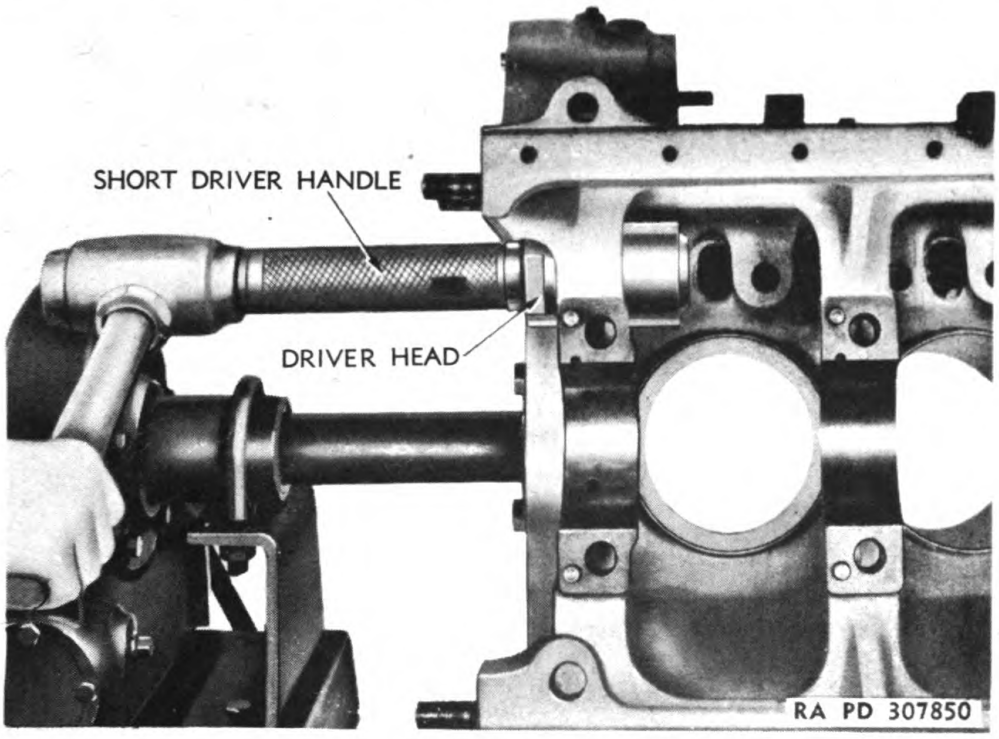


Figure 45 — Removing Outer Camshaft Bushing, Using Handle 41-H-1396-650

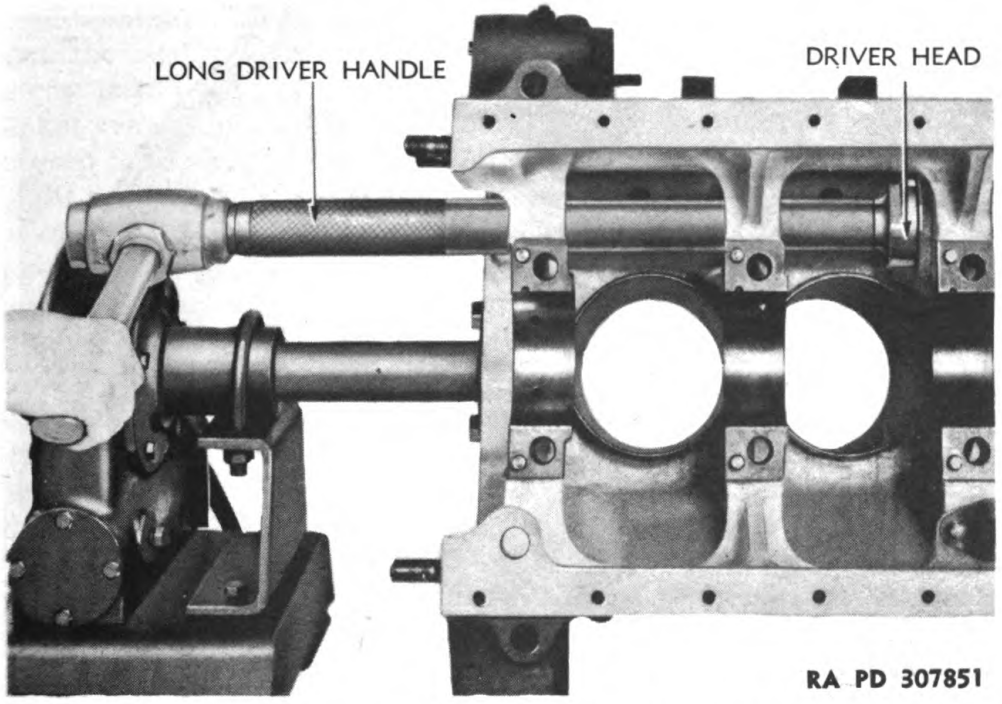


Figure 46 — Removing Intermediate Camshaft Bushing, Using Handle 41-H-1396-655

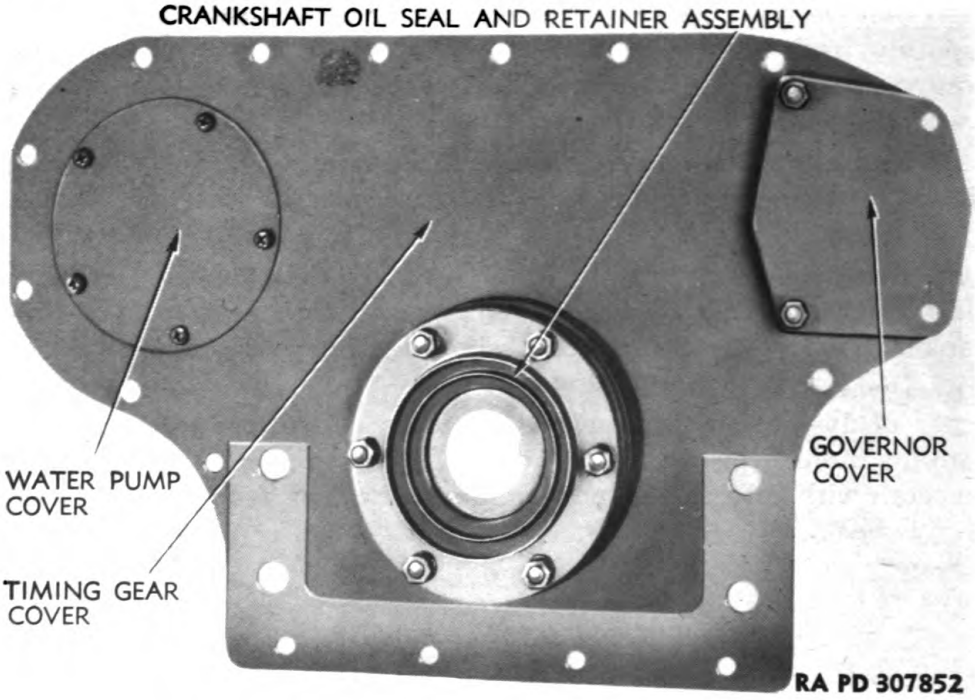


Figure 47 — Timing Gear Cover Assembly

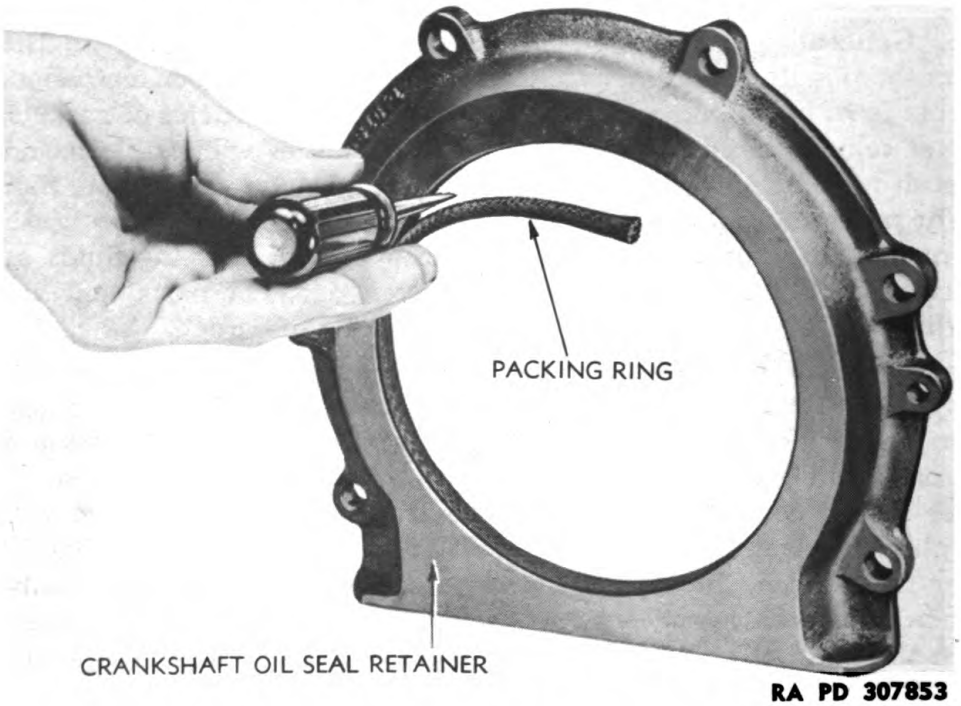


Figure 48 — Removing Packing Ring From Crankshaft Oil Seal Retainer

nuts and remove crankshaft front dust shield from studs (fig. 47). Then remove the dust seal retainer, seal plate, and seal and retainer assembly from studs and dowels in cover. It is not necessary to remove the governor hole cover or water pump hole cover unless new gaskets are to be installed.

l. Remove Packing Ring From Crankshaft Oil Seal Retainer (fig. 48). Remove packing ring from groove in retainer with screwdriver or similar tool.

m. Remove Gear From Pulley End of Crankshaft (fig. 69). Slide spacer off end of shaft, then remove cork seal from slot in crankshaft. Pull gear from crankshaft with a gear puller.

n. Disassemble Flywheel. Pull clutch shaft pilot bearing from center of flywheel with pilot bearing puller. If necessary to remove cranking motor ring gear from flywheel, cut into gear between two of the teeth with cold chisel and hammer to expand gear, then tap gear off flywheel.

Section VI

CLEANING AND INSPECTION OF PARTS

19. CLEANING.

a. General. After engine has been disassembled, clean all the parts thoroughly for inspection. Scrape or brush all carbon, corrosion, or rust from parts thus affected and scrape off all particles of gaskets, gasket cement, or like material, so gasket surfaces will be clean and smooth for assembly. Remove all burs or nicks, at same time, that might prevent a tight seal between surfaces. Do not use wire brush on machined or polished surfaces. Use approved cleaning fluids as specified in TM 9-850, SNL K-1. Broken parts, or parts that are readily seen to be unfit for further use, may be discarded.

b. Cylinder Block. Clean entire block thoroughly with live steam or cleaning fluid and blow dry with compressed air. Remove plugs from ends of oil galleries and clean the oil passages with pressure driven cleaning fluid and blow out dry. A rifle brush will in some cases loosen deposits in the oil galleries and, if properly used, will simplify the cleaning process. Reinstall oil gallery plugs immediately after the cleaning process, using white or red lead or a similar substance to insure against leakage. Seven pipe plugs may be removed from the main oil gallery to permit cross probing from main gallery to each main bearing. Clean oil passages from camshaft bearings at end of cylinder block to cylinder head face of crankcase. This is important as the rocker arm mechanism receives lubricant through these passages. With cylinder sleeves removed and after thorough

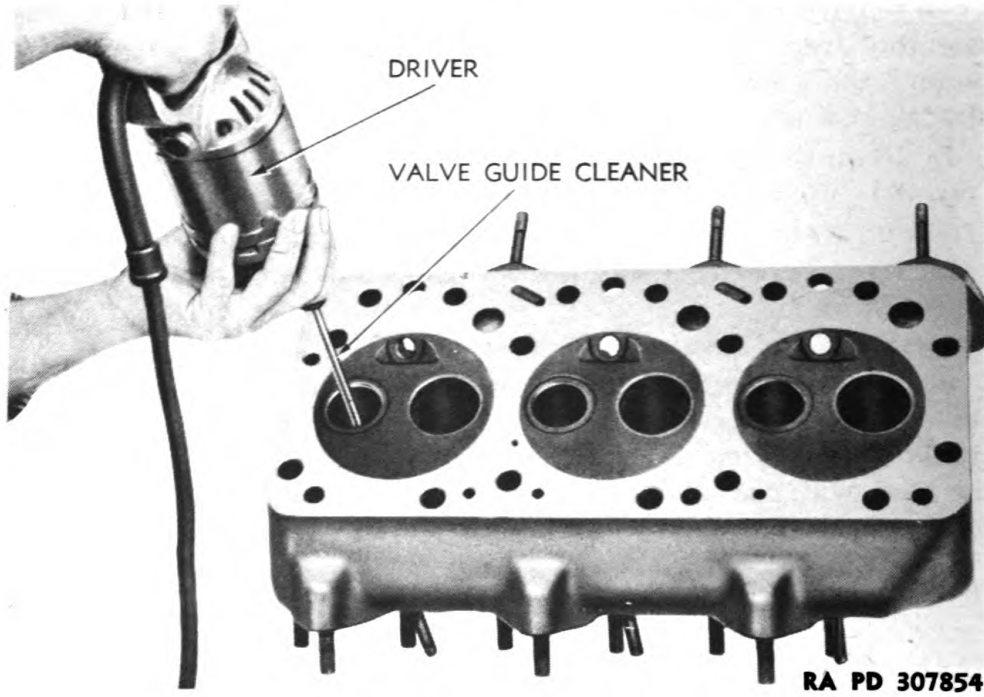


Figure 49 — Cleaning Valve Guides

washing, inspect water jacket surfaces for excessive lime deposit, all of which must be scraped or chipped away, following which the surfaces must be washed once more. In the event engine is to remain in dismantled condition following washing in dry-cleaning solvent, thoroughly lubricate parts to prevent corrosion or rust.

c. Cylinder Sleeves and Pistons. Remove all traces of rubber from sealing grooves and clean water contact surface with coarse file to remove scale or lime, then wash and dry sleeves.

d. Pistons. Clean ring grooves of carbon and foreign material. Wash pistons with dry-cleaning solvent and blow dry with compressed air.

e. Crankshaft. Blow out all oil passages in crankshaft with compressed air. Probe these passages to remove all accumulated carbon or foreign matter of any kind. Thoroughly wash these passages with dry-cleaning solvent and dry with compressed air.

f. Camshaft. Clean all oil holes and oil passages in camshaft and wash camshaft. Dry with compressed air.

g. Rocker Arms and Shafts. Clean all oil holes and oil passages and wash parts thoroughly with cleaning fluid.

h. Valves and Valve Guides. Clean carbon and lead deposits from valves and guides. Use a wire buffer to clean valves. Ream

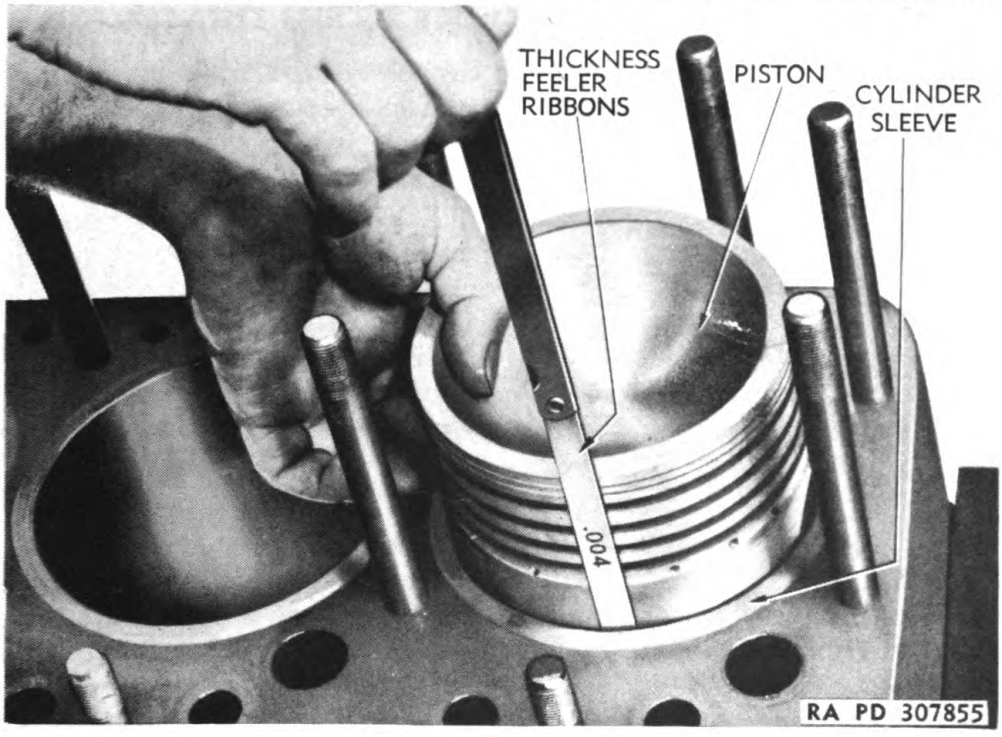


Figure 50 — Measuring Clearance Between Piston and Cylinder Sleeve, Using Gage 41-G-400

carbon from guides with a valve guide cleaning tool as shown in figure 49. This must be done with guides installed in head. Rotate tool in guides until gum, carbon, or other foreign material has been removed.

i. Bearings and Gears. Wash all bearings, gears, shafts, etc. with dry-cleaning solvent and dry with compressed air. CAUTION: *Never spin bearings with compressed air. This is a sure way to mutilate them.* Oil bearings with light engine oil, and wrap in clean paper to protect them until they are installed.

20. INSPECTION.

a. General. Refer to section VII for maximum wear allowed on parts. Discard all broken or damaged parts and parts that are worn beyond usable limits. If a part is worn almost to the maximum allowable limit, replace that part to prevent engine failure or faulty operation soon after engine is placed in service. Remove all burs or nicks from parts.

b. Cylinder Block. Measure diameter of cylinder sleeve bore over its entire length with a dial indicator gage. Check for maximum wear and to determine whether or not cylinders are out of round (egg shaped) or tapered (larger at one end than at the other). If worn, replace the sleeve, or sleeves, with new parts. Since piston skirts are tapered from the bottom to a point just below oil ring groove, and the skirts are cam-ground as well, it is difficult to correctly check pistons

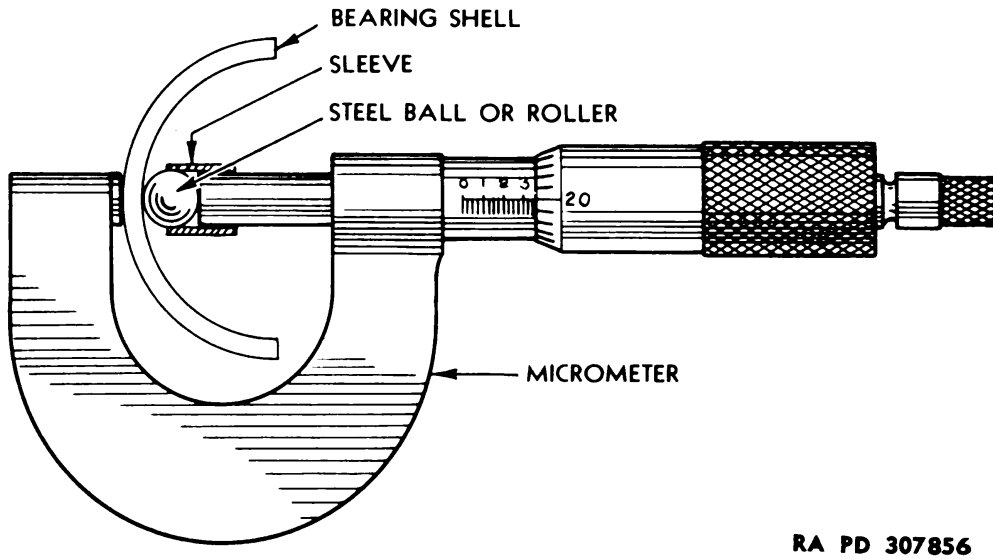


Figure 51 — Measuring Bearing Shell Thickness Using Micrometer Calipers

for out-of-roundness. Insert thin feeler ribbons gage (41-G-400), totalling 0.011 inch in thickness, in cylinder sleeve. While holding ends of feeler ribbons, insert piston cylinder sleeve (fig. 50). In this way, check clearance between piston and sleeve crossways of the piston pin. Feeler ribbons must pull out with a drag of, from four to eight pounds. If clearance is more than 0.018 inch at top of skirt, below oil ring groove or 0.016 inch at bottom of skirt, replace piston, or sleeve, or both. Check rings, and ring grooves, for wear. Inspect piston pins and piston pin bosses for wear and replace them if beyond maximum allowable wear. Check fit of piston pins in bushings in small end of connecting rods. Replace piston pins or rod bushings if clearance is beyond maximum allowable limit. It is usually advisable to install new piston rings. Always install new rings when new pistons or cylinder sleeves are installed.

c. Crankshaft and Bearings. Clean and inspect crankshaft for signs of scoring, overheating, or abnormal wear. If there is any indication of any of these, replace crankshaft. Measure all main and connecting rod journals in several places on the circumference to determine the smallest diameter in case journals or crank pins are worn out of round. Measure the thickness of the main bearing and connecting rod bearing shells with micrometer calipers (41-C-307) and steel ball as shown in figure 51. Any variation from standard thicknesses will indicate the amount of wear on the shell being measured. Main bearing shells have a thickness of 0.125 inch (standard size bearings) and connecting rod bearing shells have a thickness of 0.110 inch (standard size bearings) at a point 90 degrees from the

parting line. The two shells for each journal and crank pin do not form a true circle when not installed, and when measured for inside diameter, must be installed in their caps and block, with caps bolted firmly in place. Normal clearance between shells and main journals is 0.002 to 0.004 inch and should not exceed 0.008 inch. Normal clearance between shells and crank pins is 0.001 to 0.003 inch and should not exceed 0.005 inch. Discard any shell showing signs of chipping, pitting, scoring, corrosion, or overheating. All load is carried on the lower half of the main bearings and upper half of the connecting rod bearings. It is not always necessary, therefore, to replace the other half if it is not worn or damaged. Replace the crankshaft seals in oil retainer at flywheel end of engine and in timing gear cover. These seals must be in perfect condition or oil leaks will develop.

d. Camshaft, Cam Follower, and Rocker Arms. Examine all bearings and journals for good bearing surfaces and wear. Examine surfaces of cams, and cam followers, and thrust plate, and if roughness or excessive wear is apparent, replace the affected parts. If any of the bearings show damage, or scoring, or are worn so clearances exceed limits given in section VII, install new bearings. Bearings are not precision type and must be aline-reamed to size specified in section VII. Examine camshaft drive gear and crankshaft gear for burs and broken teeth. Worn gears cause excessive backlash and noisy operation. Broken teeth may eventually lead to a serious failure of the entire gear train. When assembling engine, test clearances between gears and replace those not within prescribed limits. Inspect gears on camshaft, that are used for oil pump and distributor drive, for wear. Replace camshaft if these gears are worn or grooved. Inspect mechanical fuel pump operating cam on camshaft. Replace if badly grooved, in order to insure delivery of maximum amount of fuel to carburetors.

e. Idler Gear Assembly. Inspect idler gear for wear or burs or broken teeth. Inspect idler gear spindle bushing for wear, pitting, and signs of overheating. If there is evidence of any of these, replace adapter assembly with bushing. The idler gear spindle bushing cannot be replaced as a separate item. Spindle size when new is 1.4980 to 1.4985 inches. The clearance between idler gear spindle and bushing should be 0.001 to 0.002 inch and should not exceed 0.004 inch. Replace worn parts if clearance is found to be excessive. Inspect fibre-thrust washer between idler gear hub and face of idler gear spindle adapter for wear. Thickness of washer should be $\frac{3}{32}$ inch. Inspect thrust button and hardened thrust surface on timing gear cover for wear and replace if thrust surfaces appear to be worn. Inspect thrust button spring. Replace spring if broken or rusted.

f. Valves. Check clearance between valve stems and guides. If clearance exceeds 0.006 inch (intake) and 0.007 inch (exhaust),

replace either worn valves, or guides, or both. Replace valves if the heads are warped or the stems are bent.

g. Cylinder Heads. Inspect heads thoroughly for cracks due to overheating.

h. Accessories. Inspection of other components or accessories of engine will be found in pertinent paragraphs in section XII.

Section VII

FITS AND TOLERANCES

21. TABLE OF FITS AND TOLERANCES.

a. Cylinder Sleeves and Pistons.

Diameter of cylinder sleeve (inside) ..... 5.375 in.
Diameter of piston at top of skirt
(crossways of piston pin) ..... 5.362–5.3635 in.
Diameter of piston at bottom of skirt
(crossways of piston pin) ..... 5.364–5.3655 in.
Clearance between sleeve and piston at top of skirt ..... 0.013 in.
Maximum allowable clearance ..... 0.018 in.
Clearance between sleeve and piston at bottom of skirt ..... 0.011 in.
Maximum allowable clearance ..... 0.016 in.
Piston and cylinder sleeve fitting: Piston should be fitted to sleeve using thin feeler ribbons ½ inch wide and totalling 0.011 inch in thickness which must pull out with a 4- to 8-pound drag.

b. Piston Rings.

Type and width:
Top—Plain compression ..... 0.1860–0.1865 in.
2nd—Notched scraper ..... 0.1860–0.1865 in.
3rd—Notched scraper ..... 0.1860–0.1865 in.
4th—Simplex oil ring ..... 0.242–0.245 in.

Ring gap:
Top—0.030–0.040 in. Maximum allowable gap ..... 0.070 in.
2nd—0.020–0.030 in. Maximum allowable gap ..... 0.050 in.
3rd—0.020–0.030 in. Maximum allowable gap ..... 0.050 in.
4th—0.036–0.044 in. Maximum allowable gap ..... 0.070 in.

Groove clearances:
Top—0.003–0.0045 in. Maximum allowable clearance ... 0.008 in.
2nd—0.003–0.0045 in. Maximum allowable clearance ... 0.008 in.
3rd—0.003–0.0045 in. Maximum allowable clearance ... 0.008 in.
4th—0.007–0.011 in. Maximum allowable clearance ... 0.014 in.

c. Piston Pins.

Diameter	1.6244–1.6247 in.
Fit of pin in piston	0.0001 in. loose to 0.0004 in. tight (With piston heated by immersion in water at 100° F, pin should enter bosses with slight pressure)
Maximum allowable clearance	0.002 in.
Clearance between pin and connecting rod bushing	0.0005–0.0013 in.
Maximum allowable clearance	0.003 in.

d. Connecting Rods and Bearings.

Running clearance of bearings	0.001–0.003 in.
Maximum allowable clearance	0.005 in.
Side clearance (sum of both sides)	0.010–0.016 in.
Tension for tightening connecting rod bolt nuts	75 ft–lb

e. Crankshaft and Main Bearings.

Diameter of main bearing journals	3.499–3.500 in.
Diameter of connecting rod journals	2.999–3.000 in.
Clearance between main bearings and crankshaft	0.002–0.004 in.
Maximum allowable clearance	0.008 in.
Maximum undersize crankshaft allowable	0.060 in.
Crankshaft end thrust (normal)	0.003–0.007 in.
Maximum before replacing rear main bearing	0.015 in.
Tension for tightening main bearing cap screws	250 ft–lb

f. Cylinder Head.

Tension for tightening cylinder head stud nuts	175 ft–lb

g. Camshaft.

Diameter of bearing journals (all)	2.499–2.500 in.
Clearance between journals and bushings	0.002–0.0025 in.
Maximum allowable clearance	0.005 in.
Timing (set intake valves for 0.010 in. and exhaust valves for 0.0135 in. clearance with engine cold for checking following timing):	
Intake valve opens	5 deg ATDC
Intake valve closes	55 deg ABDC
Exhaust valve opens	50 deg BBDC
Exhaust valve closes	10 deg ATDC

h. Valves.

Diameter of intake valve head	2 3/8 in.
Diameter of exhaust valve head	1 27/32 in.
Seat angle (intake)	30 deg
Seat angle (exhaust)	45 deg

Valve stem diameter (intake)	0.4965–0.4975	in.
Valve stem diameter (exhaust)	0.4955–0.4965	in.
Valve stem clearance in guides (intake)	0.0015–0.0035	in.
Valve stem clearance in guides (exhaust)	0.0025–0.0045	in.
Maximum allowable clearance (intake)	0.006	in.
Maximum allowable clearance (exhaust)	0.007	in.
Ream guides (intake and exhaust)	0.500	in.
Valve lift (intake)	0.594	in.
Valve lift (exhaust)	0.531	in.
Cam lift (intake)	0.351	in.
Cam lift (exhaust)	0.317	in.
Free length of inner valve springs (intake or exhaust)	$3\frac{5}{32}$	in.
Spring pressure when compressed to $2\frac{1}{16}$ in. (with valve open)	92–108	
Minimum allowable pressure	85	lb
Free length of outer valve spring (intake or exhaust)	$3\frac{15}{32}$	in.
Spring pressure when compressed to $2\frac{3}{8}$ in. (with valve open)	145-171	lb
Minimum allowable pressure	135	lb

i. Timing Gears.

Backlash	0.002–0.003	in.
Maximum allowable backlash	0.006	in.

Section VIII

REPAIR OF ENGINE

22. REPAIR OF ENGINE PARTS.

a. General. Repair work on the engine consists mainly of replacement of worn, or damaged parts, when engine is assembled. Reconditioning or repair is possible on only a few parts of the engine.

b. Dowels and Rods. Repair or retrace damaged threads, if any, in housing or castings. Replace broken dowels in castings and smooth parts that are burred or nicked. Straighten any bent, or twisted control rods, and free sticking controls.

c. Valves. Recondition valves that are not warped or bent and are not worn close to, or beyond, usable limits by refacing them with a valve refacing grinder. Grind seating surface of intake valves to

a 30-degree angle and the exhaust valves to a 45-degree angle. Valve seats will be reconditioned as explained in paragraph 23 **e**.

d. Flywheel. Chuck flywheel in a lathe if surface contacted by clutch is warped or scored, and refinish surface to make it smooth and flat for greatest efficiency of clutch operation. Do not remove more than $\frac{1}{12}$ inch material from flywheel. If necessary to cut more than $\frac{1}{12}$ inch, replace flywheel. Installation of new ring gear on flywheel is explained in paragraph 23 **a**.

e. Exterior. Repair of the various engine exterior components and accessories will be found in pertinent paragraphs in section XII.

Section IX

ASSEMBLY OF ENGINE

23. ASSEMBLY OF SUBASSEMBLIES.

a. Install Ring Gear on Flywheel. Heat gear until it expands enough to slip into place over flywheel with light tapping (side of gear with chamfered ends of teeth away from shoulder of flywheel). Tap gear back against shoulder of flywheel and allow it to cool. Tap or press clutch shaft pilot bearing (shielded side of bearing facing away from ring gear) into recess in center of flywheel, leaving outer side of bearing flush with face of flywheel.

b. Install Crankshaft Gear on Crankshaft. Tap key into slot in threaded end of crankshaft and press gear on the shaft over key and against shoulder on shaft with timing marks on gear towards end of shaft.

c. Install Gears on Camshaft and Idler Gear Spindle (fig. 52). Tap key into slot in end of camshaft and press camshaft gear (54 teeth) onto end of camshaft with timing mark towards outer side. Tap key into slot in end of idler gear spindle and press idler timing gear (57 teeth) onto end of spindle with timing marks towards outer side.

d. Assemble Connecting Rods and Pistons (figs. 53 to 55). Press new bushings into upper end of connecting rod if the old ones were removed, then ream bushings to allow from 0.0005- to 0.0013-inch clearance between piston pin and bushing. Heat piston by immersion in water heated to 100° F and press pin through piston and connecting rod. If fit of piston with pin is correct, a slight pressure will be necessary to press pin through piston. Install retainer snap rings in grooves of piston at each end of piston pin. Clamp connecting rod in vise for installation of piston rings. Measure rings for correct gap by placing each ring in the cylinder in which the piston

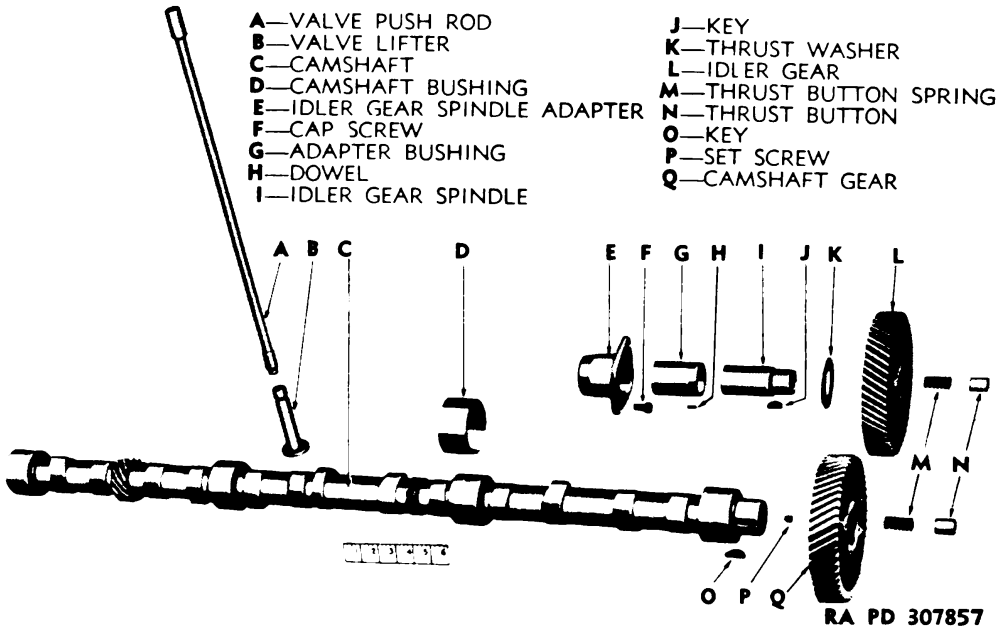


Figure 52 — Camshaft and Idler Gear Assemblies Disassembled

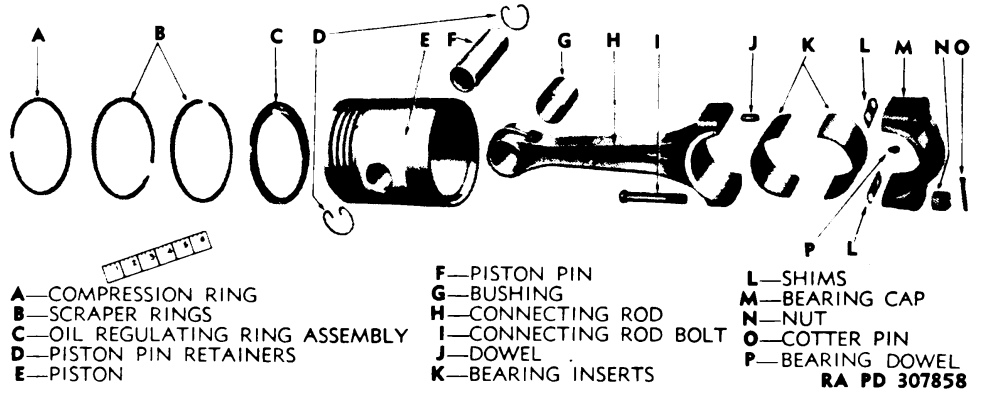


Figure 53 — Connecting Rod and Piston Assembly Disassembled

on which rings are being assembled is to be installed, then measuring gap with feeler ribbons using gage (41-G-400) (fig. 54). Refer to paragraph 21 b for correct gap width. Dress ends of ring with file if necessary to increase gap width. Make sure piston ring grooves in piston are clean, then install the oil regulating ring assembly which consists of an expander and laminated ring sections in lower groove of piston. Wrinkled part of expander is installed next to piston, then smooth flat section, then sections of ring. Install two scraper rings in the next two grooves and compression ring in top groove. The straight sides of scraper rings must be towards top of piston (fig. 55).

e. Assemble Cylinder Heads.

(1) Install valve guides in cylinder heads. The intake valve guides will be identified by rounded tops (fig. 56). The installation

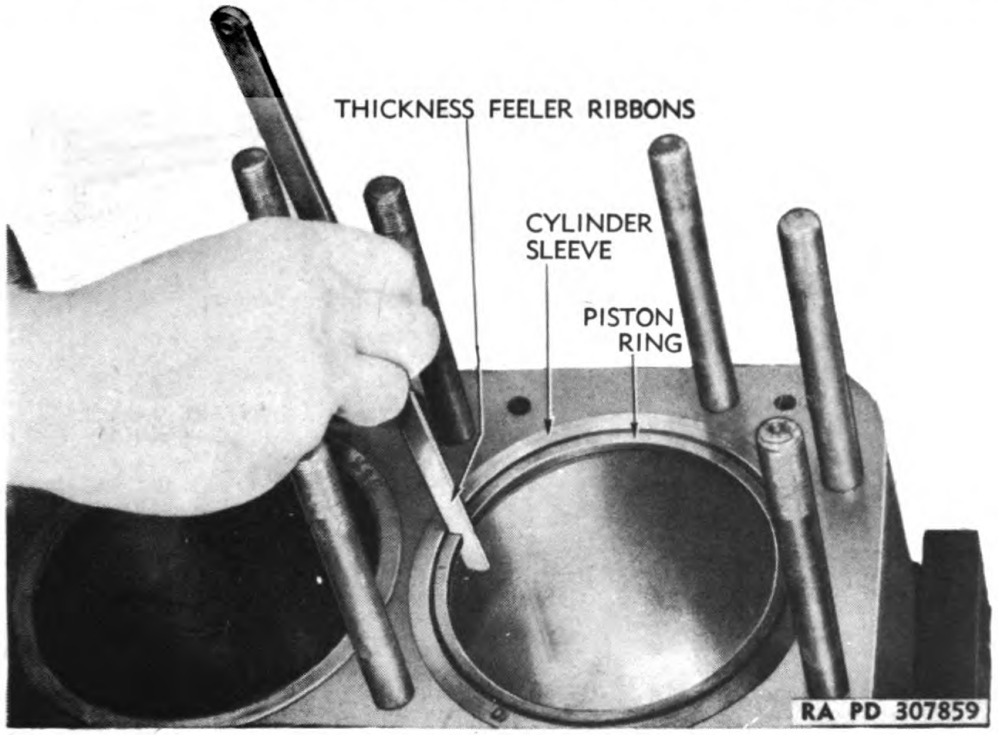


Figure 54 — Measuring Ring Gap Width, Using Gage 41-G-400

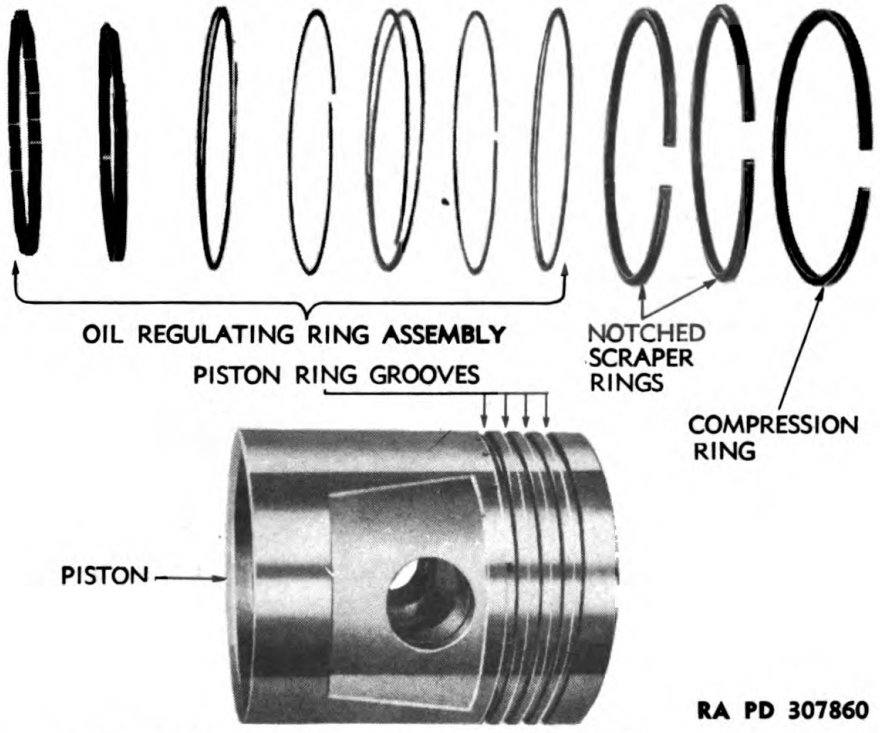


Figure 55 — Relative Positions of Piston Rings With Piston

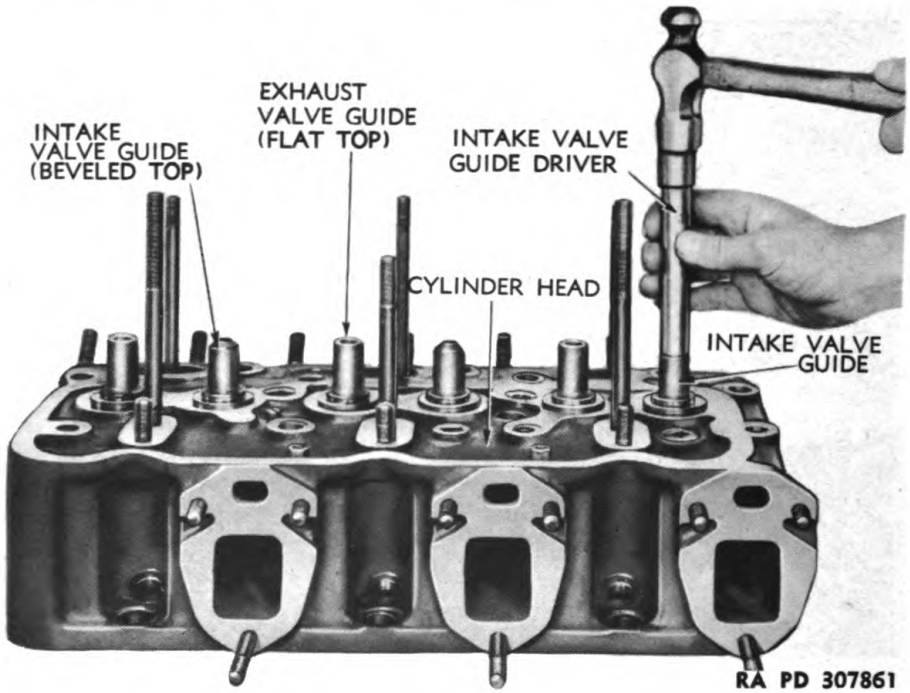


Figure 56 — Intake Valve Guide Installation, Using Replacer 41-R-2390-480

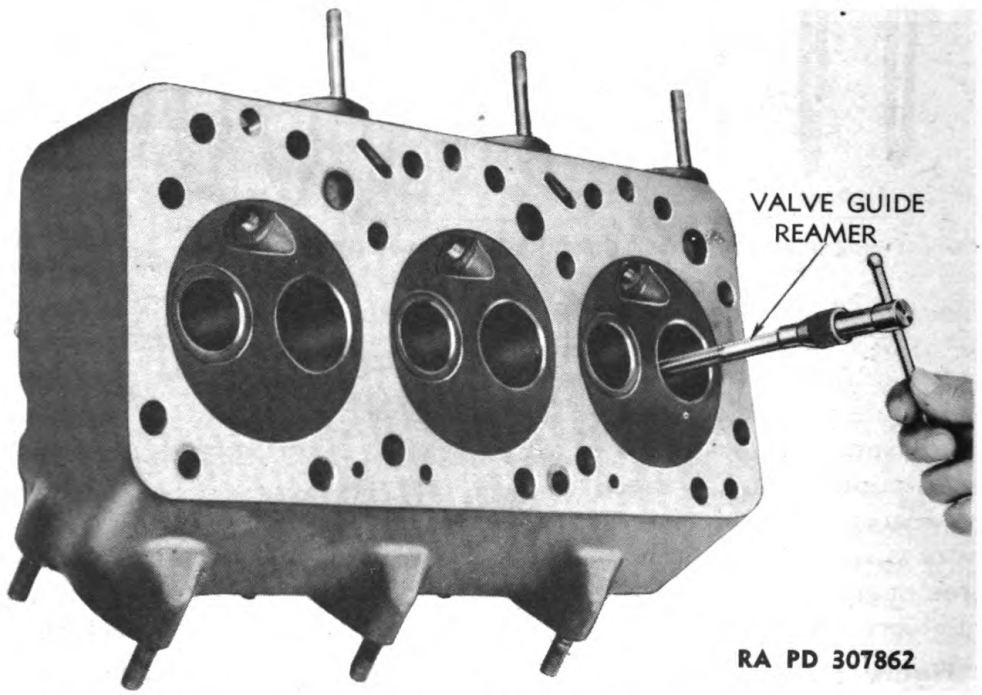


Figure 57 — Reaming Valve Guide, Using Reamer 40-R-2310

Figure 58 — Dressing Valve Seat Grinding Stone, Using Valve Tool Set 41-V-535

of the intake valve guides require the use of a special ½-inch valve guide driver replacer (41-R-2390-480), the shoulder of which is beveled to fit the rounded tops of the guides. Use a ½-inch driver with a square shoulder for installing the exhaust valve guides. Guides must fit snugly in head. After all guides are installed, they must be reamed with a ½-inch valve guide reamer (40-R-2310) (fig. 57). If valve seats require refacing, this should be done at this time. Lubricate pilot of valve seat grinding stone and grind intake valve seats to a 30-degree angle and exhaust valve seats to a 45-degree angle, using first a rough grinding stone, then a finish stone. Figure 58 illustrates dressing of grinding stone for true angle using valve tool set (41-V-535); figure 59 shows pilot for grinding stone being installed; figure 60 shows grinding of valve seat. After grinding seat, use a dial gage (41-I-100)

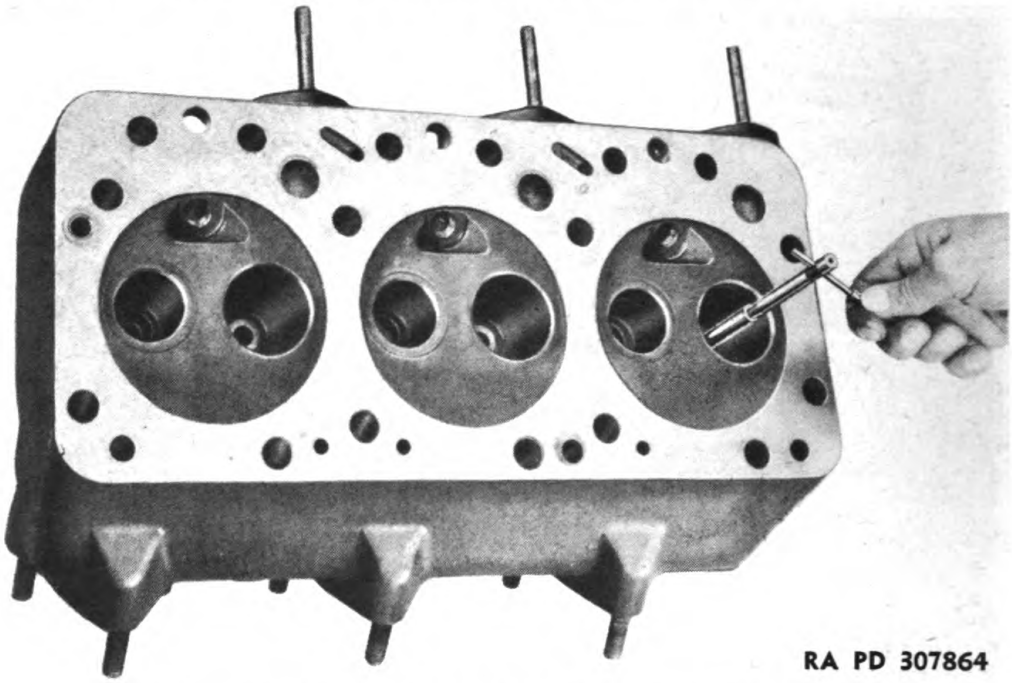


Figure 59 — Grinding Stone Pilot Installation, Using Valve Tool Set 41-V-535

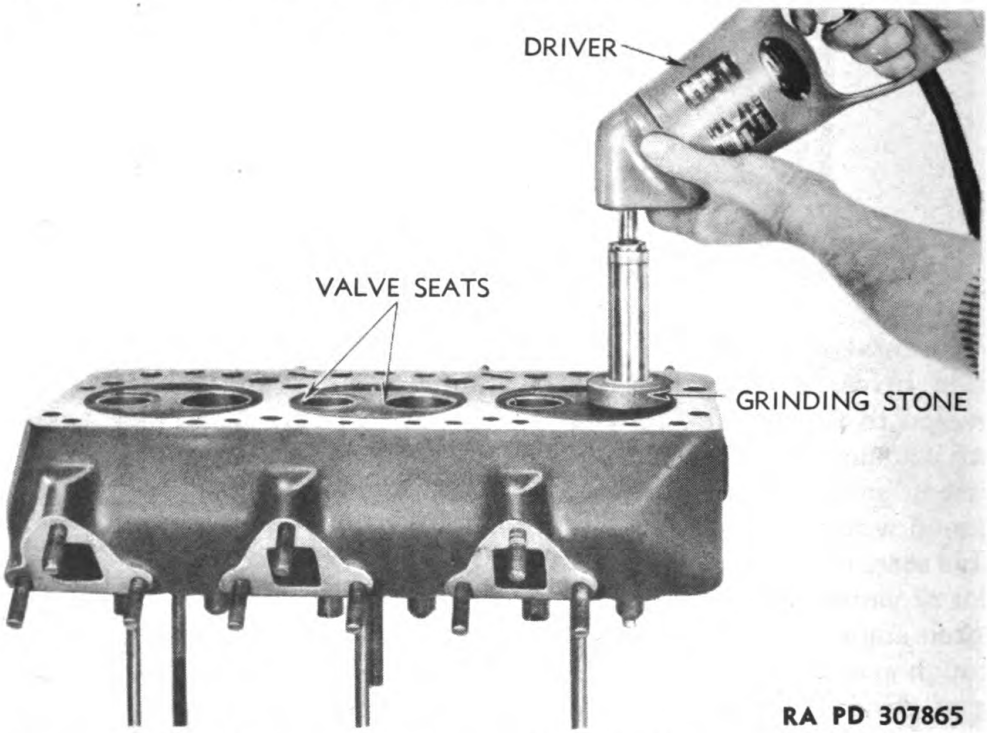


Figure 60 — Grinding Valve Seat, Using Valve Tool Set 41-V-535

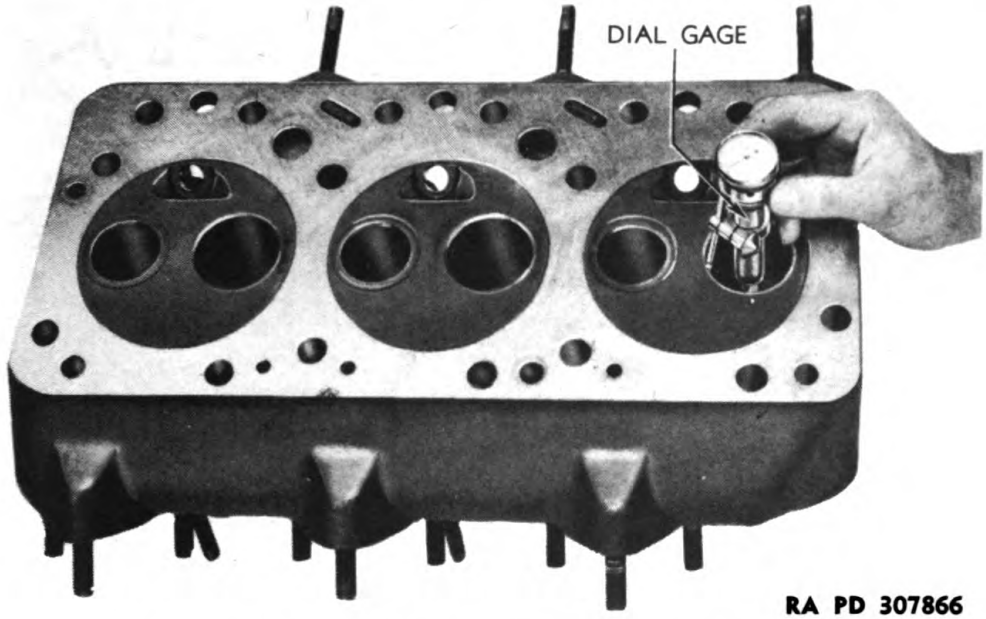


Figure 61 — Checking Concentricity of Valve Seat With Gage 41-I-100

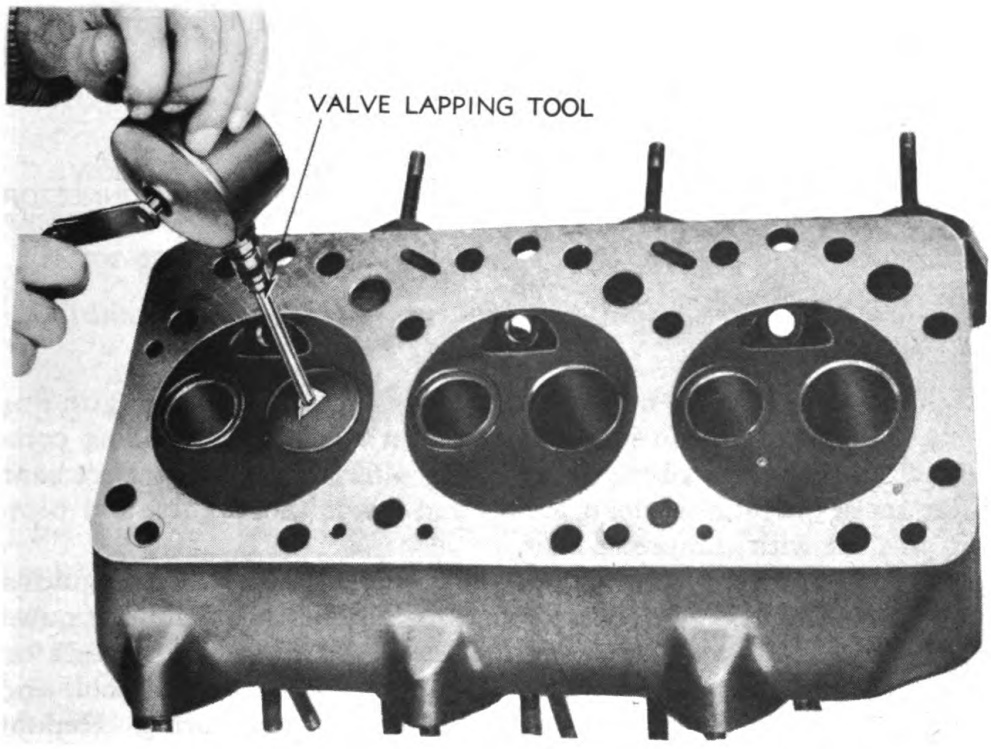


Figure 62 — Lapping Valve Seat, Using Valve Tool Set 41-V-535

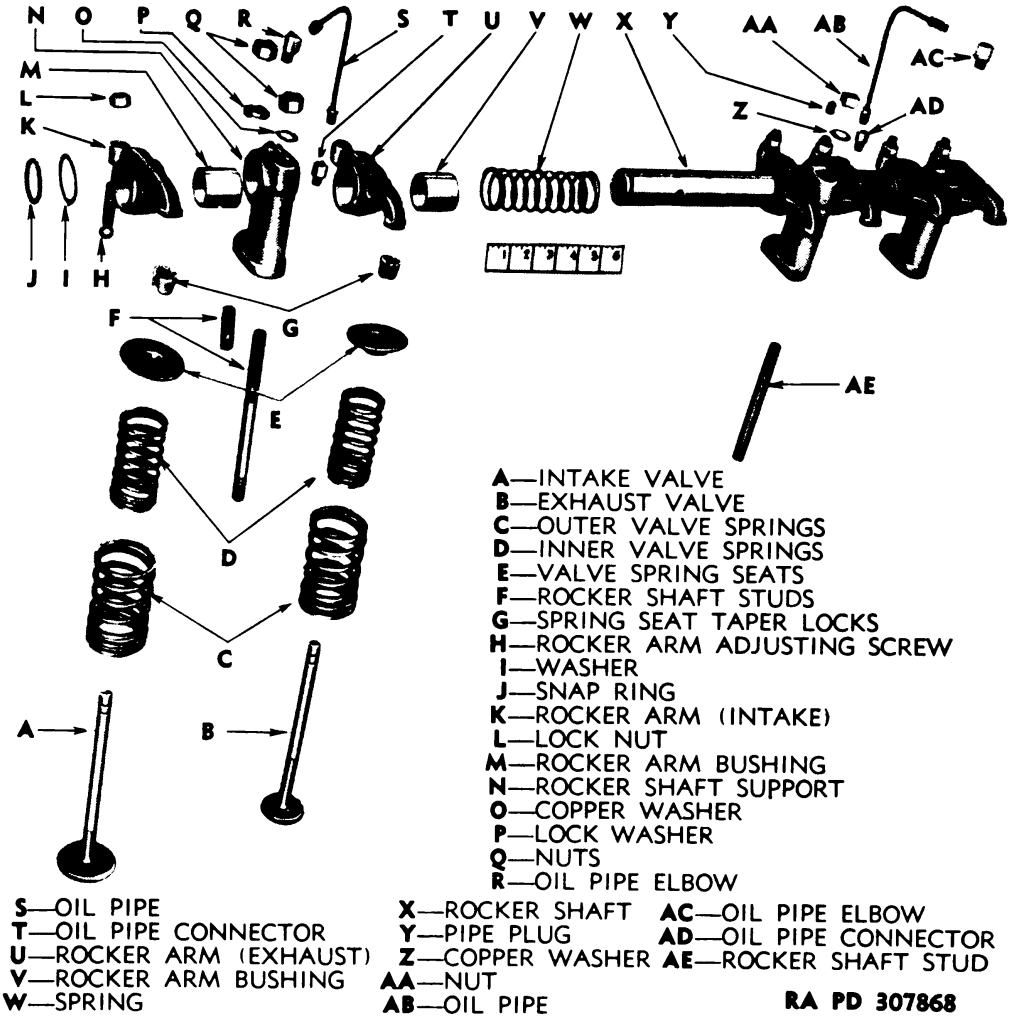


Figure 63 — Valves and Rocker Arm Assembly Disassembled

to check concentricity of seat with guide (fig. 61). After grinding seats, lap each valve to its respective seat with valve grinding compound and lapping tool as shown in figure 62 to insure a perfect seat. After these operations, clean valves and heads thoroughly, and blow out all dust with compressed air.

(2) With all valve guides installed in heads, insert valves in guides, lay heads on bench right side up, and install one inner and one outer spring over each valve stem and guide. Place valve spring seats on springs and valve stems, compress springs with compressor tool, and install the taper locks in ends of valve stem. Release spring. Repeat these operations until all valves are installed.

f. Assemble Valve Rocker Arm Assemblies. Slide rocker arms, rocker arm brackets, and springs on rocker arm shafts as shown in

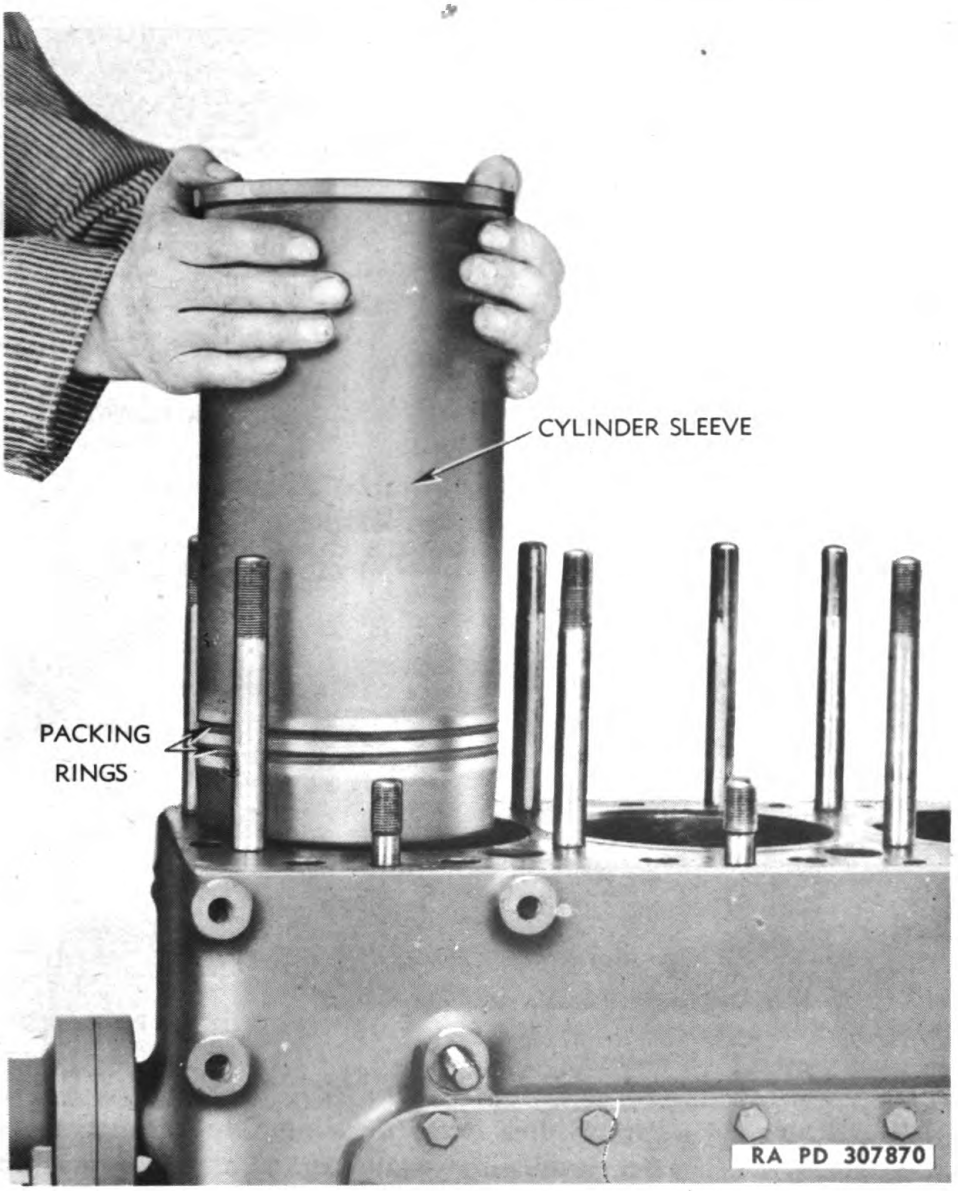


Figure 64 — Installing Cylinder Sleeve

figure 36, (parts are shown in figure 63) and install snap rings in grooves at ends of shafts.

g. Assemble Exhaust Manifold (fig. 30). Tap connector sleeves into ends of center section of manifold. Then tap the two end sections of manifold onto connector sleeves with fins and attaching flanges of the three sections in line.

24. ASSEMBLY OF ENGINE.

a. Install Cylinder Sleeves (fig. 64). Make sure grooves in lower ends of sleeves for packing rings are clean, then install the two pack-

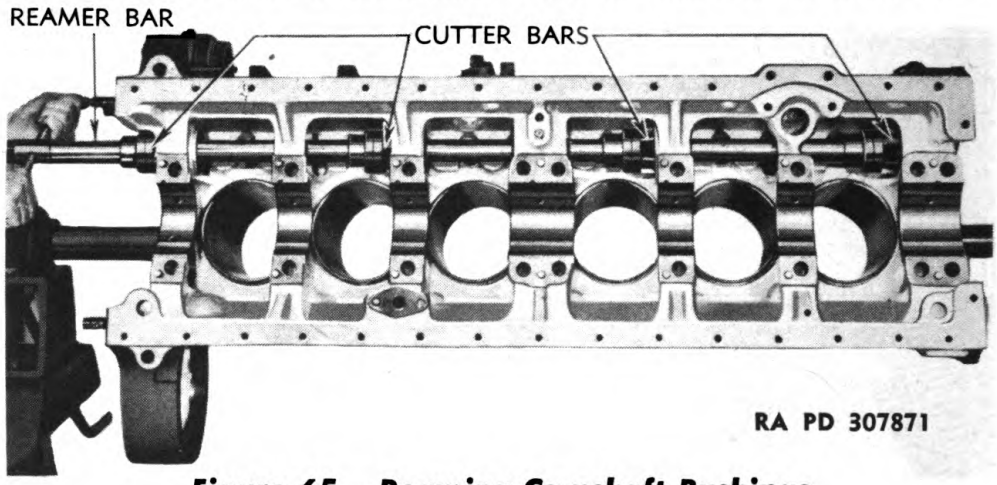


Figure 65 — Reaming Camshaft Bushings, Using Boring Bar 41-B-20

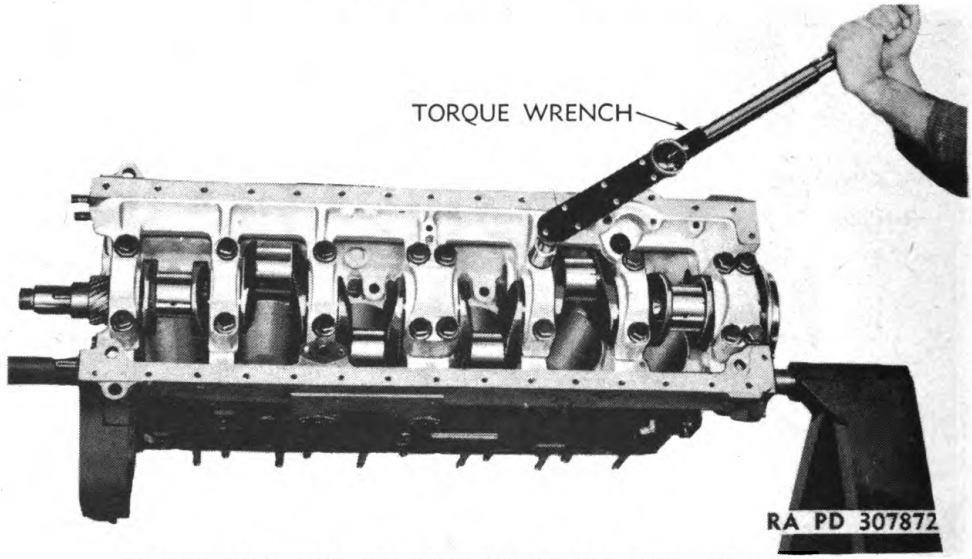


Figure 66 — Tightening Main Bearing Cap Screws, Using Wrench 41-W-3630

ing rings in grooves of each sleeve. Be sure the rings are not twisted before sleeves are installed. Clean recesses in cylinder block for upper shoulders of sleeves, then coat packing rings with white lead or other approved lubricant and install sleeves in cylinder block. Tap them solidly into place with hammer and wood block.

b. Install Camshaft Bushings.

(1) Use tools similar to those shown in figures 45 and 46 to install bushings. Install the two intermediate bushings first, then the two outer bushings. This tool (41-H-1396–650 or 655) has a removable pilot bushing on driver head which is removed from head, then the longer of the two handles is screwed into driver head and head in-

serted through bore for end bushing. The camshaft bushing is then placed on driver head against shoulder and the pilot bushing is slipped on next to bushing. Start pilot bushing into bore in crankcase for intermediate bushing, and drive camshaft bushing into place by driving on end of tool handle. Then remove pilot bushing from driver head and withdraw tool from bushing. Install second intermediate bushing next in same manner, then the two end bushings, using the shorter driver handle in driver head for installing end bushings.

(2) After all four bushings have been installed, they must be reamed to correct size. This is accomplished by use of a boring bar (41-B-20) which reams all four bushings at one time to proper size (fig. 65). Blow all cuttings from crankcase with compressed air after reaming.

c. Install Crankshaft Assembly (fig. 66). Make sure all dowels are in place in crankshaft bearing bosses. Install upper halves of main bearing shells in crankcase bosses with tangs on inserts registering with notches in bosses (refer to fig. 27). Install upper halves of end thrust washers on dowels in sides of bearing boss at flywheel end of engine. Wipe bearing surfaces with clean cloth, lubricate with light engine oil, and lay crankshaft in crankcase. Install lower halves of bearing shells in main bearing caps and install lower halves of end thrust washers on dowels in sides of main bearing cap for end journal at flywheel end of engine. Install caps over crankshaft as shown in figure 66, tapping them onto dowels, and secure with main bearing cap screws. Use a stud washer on each cap screw and tighten cap screws evenly with a torque wrench (41-W-3630) using 250 foot-pounds pull on wrench. Install lock wires in heads of cap screws.

d. Install Pistons and Connecting Rod Assemblies. Lubricate piston rings and ring grooves in piston with light engine oil and stagger ring gaps around piston. Remove connecting rod bearing cap and shims (if any) from lower end of connecting rod (keep shims so they will be installed on side from which they were removed). Use piston ring compressor to compress rings in piston and lower connecting rod and piston through cylinder from top with numbered side of rod towards camshaft side of engine. Tap or push piston down through cylinder with wood block or hammer handle. Install upper half of bearing shell in connecting rod with tang of insert registering with notch in connecting rod (refer to fig. 53) and lubricate bearing with light engine oil. Bring rod and bearing down onto crankshaft, then place lower half of bearing shell in cap and install shims (place three shims of 0.002-inch thickness on each side) and cap on bolts in connecting rod with numbered side of cap towards numbered side of rod. Adjust running fit of each connecting rod bearing by addition or removal of an equal thickness of shims from each side. This clearance can be measured by placing a very small piece of solder on bearing,

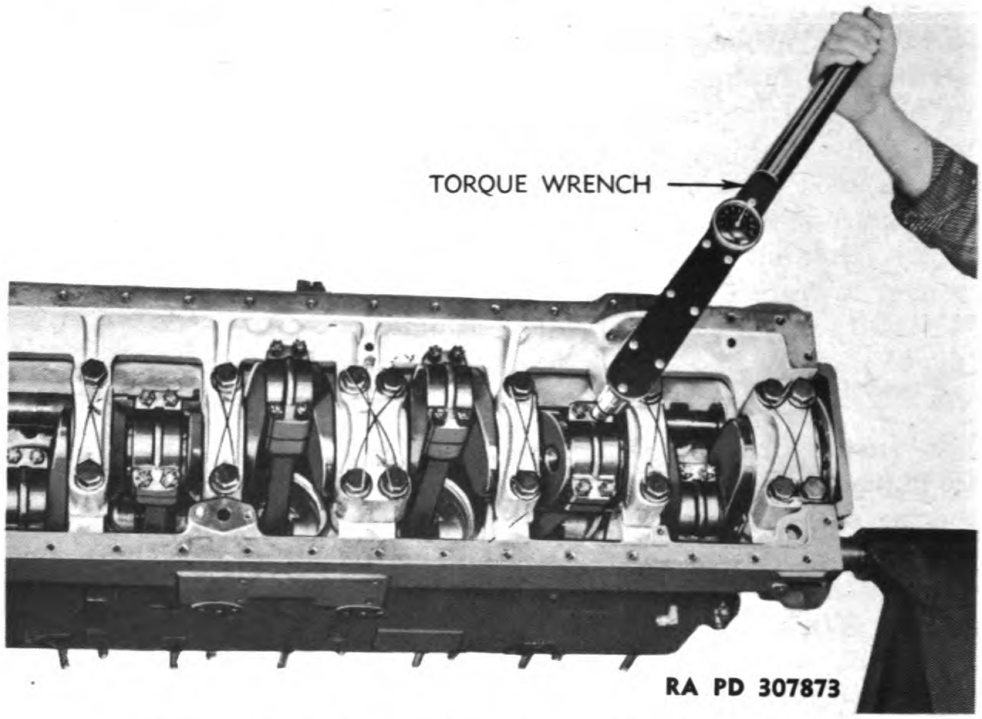


Figure 67 — Tightening Connecting Rod Bolts, Using Wrench 41-W-3630

then installing bearing cap and tightening connecting rod bolts. Remove cap again after tightening and measure thickness of solder crushed between bearing and crankshaft. Use 75 foot-pounds pull on torque wrench (41-W-3630) for tightening connecting rod bolts (fig. 67). Install remaining piston and connecting rod assemblies and adjust bearings in same manner as above. Install cotter pins in connecting rod bolts to prevent loosening.

e. Install Camshaft and Idler Gear Assemblies. Install valve lifters in holes in crankcase. Install idler gear spindle bushing adapter assembly in end of cylinder block with two self-locking cap screws (fig. 29). CAUTION: *These cap screws will be damaged if too much force is used on wrench when tightening them.* Slip thrust washer on spindle and insert spindle into adapter, engaging idler gear with crankshaft gear so that the tooth marked "X" on idler gear registers with tooth marked "X" on crankshaft gear (fig. 68). Insert camshaft through camshaft bushings in cylinder block (fig. 28) and mesh camshaft gear with idler gear so that tooth marked "C" on camshaft gear registers with tooth marked "C" on idler gear (fig. 68). Install large expansion plug in end of cylinder block at end of camshaft (fig. 26).

f. Install Lubricating Oil Pump Assembly (fig. 22). Cement gaskets to connecting flanges of oil pump scavenger and discharge

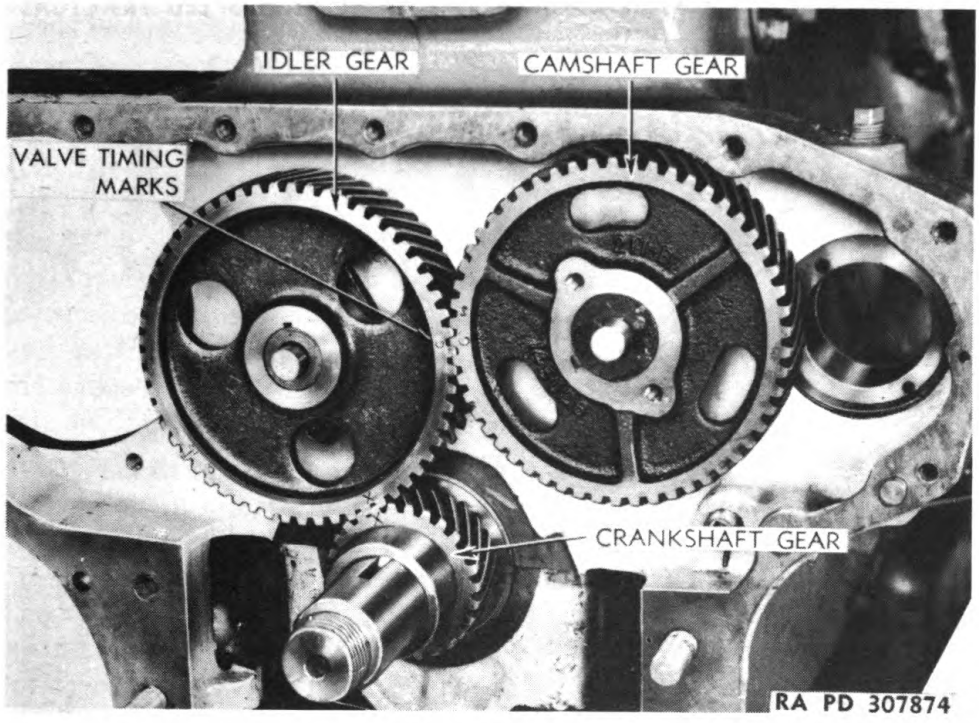


Figure 68 — Valve Timing

pipes. Connect pipes to oil pump with two cap screws with lock washers in each. Install oil pump in crankcase and secure pump with two cap screws with lock washers. Connect end of discharge pipe to crankcase with two self-locking nuts. Install cap screw to secure pipe clip on pipe to crankcase. Secure the two pipe clips on scavenger pipe to second and center main bearing caps with two of the main bearing cap screws. Secure main bearing cap screws that were removed with lock wire. Tighten bolts in clips.

g. Install Crankshaft Oil Seal. Install new packing ring in groove in oil seal retainer (fig. 48) so that point where the two ends meet will be at top of retainer when installed on engine. Cement gasket to retainer and tap retainer onto dowels in flywheel end of cylinder block (fig. 24). Secure retainer with six cap screws with lock washers.

h. Install Oil Pan. Cement gasket to oil pan. Coat upper side of gasket with cup grease and install oil pan on crankcase (sump towards flywheel end) with 32 cap screws with lock washers. Do not tighten cap screws until timing gear cover has been installed.

i. Install Flywheel Housing and Flywheel. Attach flywheel housing to end of cylinder block in position shown in figure 21 with eight cap screws with lock washers. No gasket is required between housing and cylinder block. Tap flywheel onto dowels in hub on end of crankshaft with holes in hub and flywheel alined. Attach flywheel to

A—CRANKSHAFT
B—KEY
C—CRANKSHAFT GEAR
D—CORK
E—PULLEY SPACER
F—GASKET
G—DOWEL
H—OIL SEAL RETAINER
I—OIL SEAL ASSEMBLY
J—GASKET
K—SEAL PLATE
L—DUST SEAL RETAINER
M—DUST SEAL (FELT)
N—DUST SEAL SHIELD
O—LOCK WASHER
P—NUT
Q—NARROW SPACER
R—DRIVE PULLEY
S—KEY
T—NUT

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Figure 69 — Crankshaft Oil Seal Assembly and Drive Pulley Disassembled

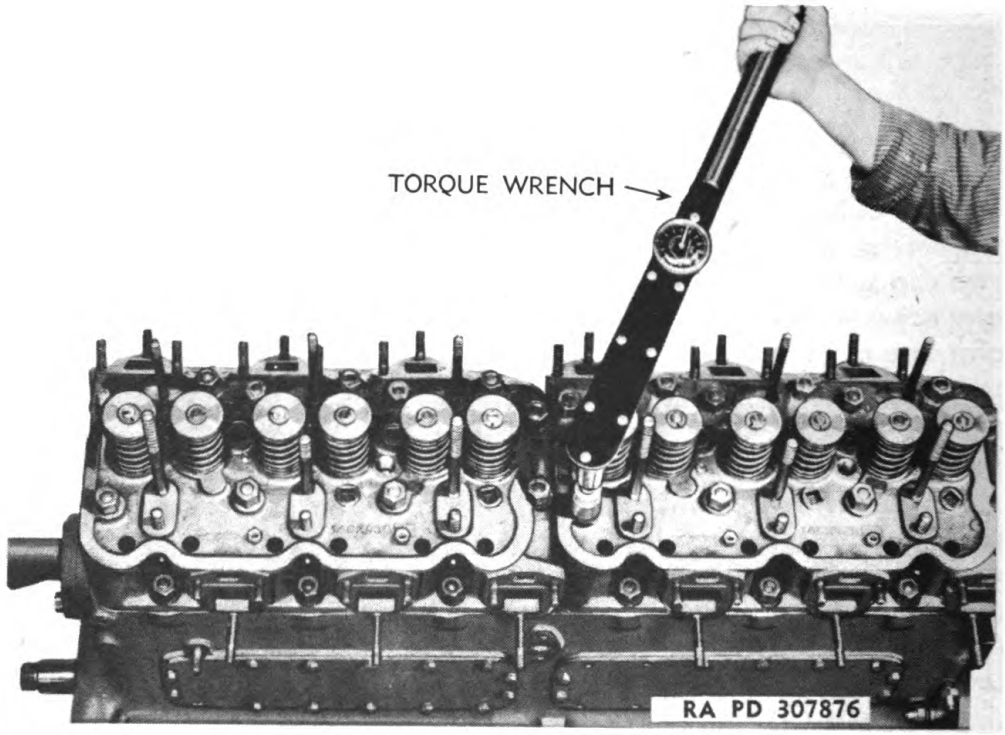


Figure 70 — Tightening Cylinder Head Stud Nuts, Using Wrench 41-W-3630

hub with six cap screws. Tighten cap screws firmly, then thread lock wire through heads of cap screws and twist ends. Insert felt wick for lubrication of clutch shaft pilot bearing into end of crankshaft leaving end sticking out even with shoulder of recess in flywheel for bearing.

j. Install Timing Gear Cover and Engine Support. Insert thrust button springs and thrust buttons into holes in ends of camshaft and idler gear spindle (fig. 42). Cement gasket to timing gear cover and install cover on dowels in end of cylinder block. Secure cover with five cap screws with lock washers (do not install cap screws in holes where cap screws also attach covers or pipe clips as well as timing gear cover). Attach engine support to timing gear cover and engine with three nuts and lock washers on studs and one large screw (screw to be installed in countersunk hole in support). Install the four cap screws that attach oil pan to timing gear cover, then draw these cap screws and oil pan cap screws up tight evenly so oil pan will be drawn against timing gear cover as well as crankcase.

k. Install Crankshaft Front Oil Seal Assembly (fig. 69). Cement gasket for oil seal retainer to timing gear cover, then coat outer side of gasket with gasket cement. Tap oil seal retainer onto dowels in timing gear cover. Slip wide spacer onto crankshaft against gear, then force small cork plug into key slot in crankshaft under spacer. Install spring-loaded oil seal assembly on crankshaft and into retainer with cork side towards end of crankshaft. Cement gasket to outer surface of oil seal retainer, then coat outer surface of gasket with gasket cement and install seal plate, dust seal retainer and dust seal and shield on studs of oil seal retainer. Install six nuts and lock washers on retainer studs and tighten nuts.

l. Install Cylinder Head Assemblies (fig. 70). Turn engine right side up in stand. Blow or wipe all dust or dirt from cylinders and tops of pistons, and wipe off top of cylinder block and lower surface of heads. Lay cylinder head gaskets on heads over studs with crimped edges around holes down (top side of new gaskets are marked "THIS SIDE UP"). Do not use any gasket cement on cylinder head gaskets. Set cylinder head assemblies on cylinder block as shown in figure 70. Start cylinder head stud nuts onto studs, then working from center of each head towards ends, tighten nuts evenly with torque wrench (41-W-3630) for 175 foot-pounds tension.

m. Install Rocker Arm Assemblies. Insert rocker arm push rods through holes in cylinder heads and drop them into valve lifters above camshaft. Set rocker arm assemblies over studs in heads in positions shown in figure 23 and install and tighten the twelve rocker arm bracket stud nuts. Install rocker arm lubricating oil lines, also all oil lines and fittings connecting oil passages in lower part of cylinder block on carburetor side of engine (fig. 1). Install tappet chamber covers with new gaskets if they were removed.

Section X

INSTALLATION OF ACCESSORIES AND EXTERNAL COMPONENTS

25. INSTALLATION OF ACCESSORIES AND EXTERNAL COMPONENTS.

a. Install Crankshaft Drive Pulley (fig. 20). Turn engine sideways in stand. Install square key in slot in end of crankshaft and tap pulley onto shaft with long end of hub of pulley towards engine. NOTE: *On some of the first engines, a narrow spacer was used behind pulley (fig. 69). If one was removed with pulley and same pulley is reinstalled, be sure this spacer is used.* If new pulley is installed, the spacer is unneccessary as pulleys from spare parts stock, and on later engines have a longer hub. Install large nut on end of crankshaft and tighten securely to force pulley tight against pulley spacer.

b. Install Lubricating Oil Pressure Relief Valve (fig. 19). Insert plunger in crankcase (valve end first) and slide spring onto shaft of plunger. Screw slotted adjusting screw into crankcase, place copper gasket on screw, install adjusting nut on screw and tighten. Install second copper gasket on screw, then install acorn nut and tighten. Adjust valve for correct opening pressure as explained in paragraph 39 **d** (5) after engine has been installed in tractor.

c. Install Lubricating Oil Pressure Gage Unit (fig. 19). Coat threads of unit with white lead or other suitable sealing compound and screw unit into side of cylinder block.

d. Install Governor Assembly (fig. 19). Install mounting studs in governor housing and crankcase if they were removed. Lay oil line, leading from air compressor across front of engine to fitting below governor compartment of timing gear housing (fig. 19) at this time, as it cannot be installed with governor in place. Insert drive gear end of governor into timing gear compartment of crankcase, set mounting clamp on upper stud, and attach governor to crankcase with two nuts with lock washers on mounting studs. Install oil line fittings (if removed) and connect oil lines as shown in figure 19 to governor and crankcase. Install spring bracket on crankcase in position shown with two cap screws with lock washers. Connect spring to governor spring adjustment screw and spring bracket.

e. Install Distributor and Tachometer Drive Assemblies (fig. 18). Insert drive end into hole in side of cylinder block and mesh drive gear with gear on camshaft. Use new adapter seal ring at lower end of adapter when setting assembly in place. Install cap screw with lock washer in clamping arm on tachometer drive adapter

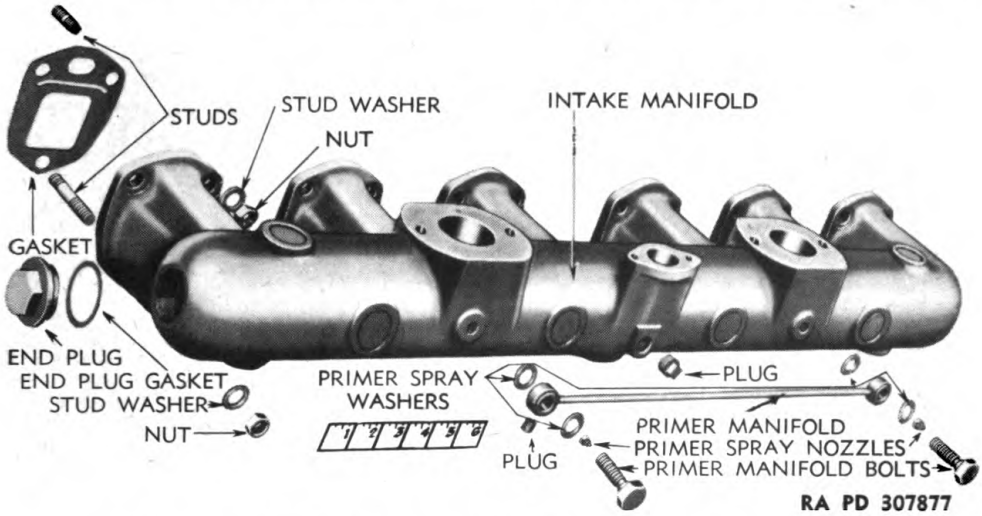


Figure 71 — Intake Manifold Assembly Exploded

and cylinder block. Screw set screw in against tachometer drive adapter and tighten lock nut. Set distributor assembly in place in tachometer drive adapter and install cap screw with lock washer in distributor. Timing of distributor is explained in paragraph 26.

f. Install Fuel Pump. Use new attaching gasket and install fuel pump on cylinder block as shown in figure 17 with two cap screws with lock washers.

g. Install Ignition Coil and Radio Filter Assemblies (fig. 17). Install mounting bracket on engine with ignition coil and radio filter attached with four cap screws with lock washers. If coil and filter have been removed from bracket, attach coil to bracket with two cap screws with lock washers and attach filter with four screws.

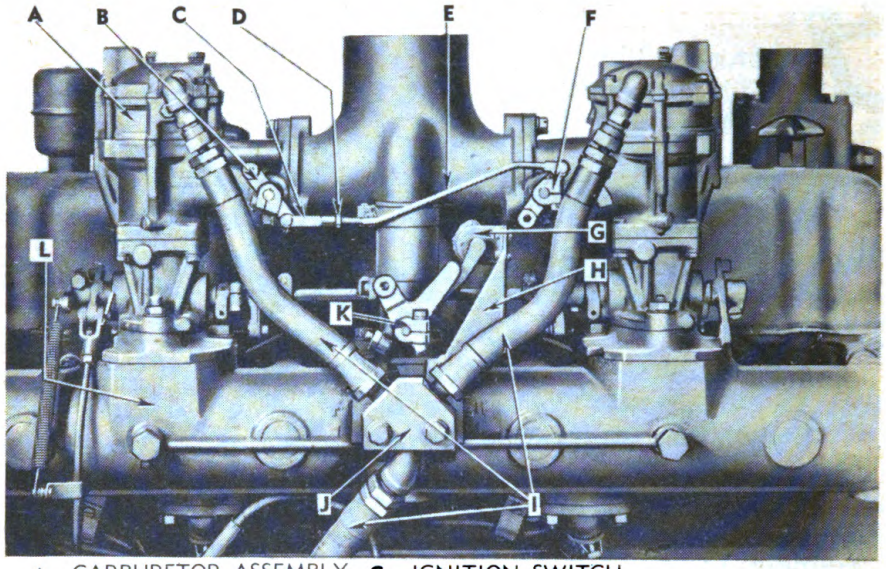
h. Install Intake Manifold Assembly (figs. 17 and 71).

(1) Cement gaskets to end pieces of water intake manifold pipe and attach each of them to intake manifold with two cap screws with lock washers in each.

(2) Cement gaskets to attaching faces of intake manifold and attach manifold to cylinder heads with 18 nuts and stud washers. Draw all nuts up evenly to avoid cracking manifold.

(3) Attach primer manifold to intake manifold with two special cap screws. Use copper gaskets between intake manifold and side of primer manifold and between side of primer manifold and cap screw heads.

(4) Cement gasket to attaching flange of center piece of water intake manifold pipe, slip a connecting hose with clamps onto each end of pipe, then slip other ends of hose onto end pieces already installed on manifold as pipe is placed in position. Attach pipe to cylinder block with two cap screws with lock washers, adjust hose, and tighten hose clamps.



A—CARBURETOR ASSEMBLY
B—CHOKE VALVE LEVER
C—ROD YOKE
D—LOCK NUT
E—CHOKE VALVE LEVER CONNECTOR ROD
F—CHOKE VALVE LEVER
G—IGNITION SWITCH
H—SWITCH MOUNTING BRACKET
I—FUEL HOSE
J—Y FITTING
K—ENGINE SHUT-OFF AIR VALVE ASSEMBLY
L—INTAKE MANIFOLD

RA PD 307878

Figure 72 — Carburetor and Engine Shut-off

i. Install Engine Shut-off Air Valve and Ignition Switch (fig. 72). Install switch mounting bracket and air valve assembly on intake manifold in position shown in figure 72 with two cap screws with lock washers. Use gasket between bracket and intake manifold and between bracket and air valve housing. Set short hose over air valve housing. Install ignition switch on bracket as shown with two screws.

j. Install Carburetor Assembly. Install carburetor mounting adapters on intake manifold with two cap screws with lock washers in each (fig. 34). Use new gaskets between adapters and manifold. Connect each of the two carburetors to air inlet with three slotted head cap screws with lock washers (fig. 35), using new gaskets between inlet and carburetors. Slip carburetor connecting shaft couplings onto ends of carburetor throttle shafts as carburetors are connected to air inlet. Cement new gaskets to lower attaching flanges of carburetors and set carburetor assembly onto studs in carburetor mounting adapters on intake manifold, engaging air inlet in upper end of air valve and air inlet connecting hose at same time. Secure each carburetor with two nuts on mounting studs. Adjust hose on air valve and air inlet and tighten clamps. Connect end of choke valve lever connecting rod to upper end of choke valve lever as shown in figure 72 with yoke pin and secure with cotter pin. Hold choke

valves against stop in open position and adjust length of connecting rod by means of the adjustable rod yoke so that when yoke is connected to lower end of choke valve lever on second carburetor, both valves will be in open position. Connect rod yoke to lever with yoke pin and cotter pin. Unscrew throttle stop screws on each carburetor so both throttle shaft arms can contact stop pins, hold arms in closed position and tighten clamp screws in carburetor connecting shaft couplings. Install and connect ends of governor throttle control rod to carburetor throttle lever and to governor lever as shown in figures 17 and 71. Install return spring.

k. Install Fuel Lines (fig. 72). Attach Y-fitting to ignition switch mounting bracket with two cap screws with lock washers. Connect upper fuel hose to Y-fitting and carburetors. Connect lower hose to lower side of Y-fitting and fuel pump.

l. Connect Ignition and Spark Plug Wires (fig. 17). Install spark plugs in cylinder heads if they are not already installed. Rotate engine crankshaft until No. 1 piston (opposite flywheel end of engine) is near top of its compression stroke (both valves closed). Remove distributor cap to determine position of distributor rotor. Install end of spark plug wire leading to No. 1 spark plug in socket in cap corresponding to the segment with which distributor rotor would be in contact with cap installed. Install remaining wires in distributor cap and on spark plug terminals to conform with firing order of engine (1-5-3-6-2-4 in clockwise direction looking down on distributor). Spark plug wires must be supported by the cable brackets with separators which are suspended from two of the intake manifold mounting studs. Install wire to connect terminal on side of distributor and inside terminal on top of coil. Install short jumper wire to connect upper terminal of radio filter and inside terminal on top of coil. Install wire to connect upper terminal of radio filter with ignition switch. Install wire to connect outer terminal on top of coil and lower terminal of radio filter. Insert end of cable with attached suppressor into center socket in top of distributor and insert other end into socket in top of coil and screw nut on end of wire into socket.

m. Install Fan Drive Assembly. Attach fan drive mounting bracket on side of engine as shown in figure 16 with three cap screws and one nut with lock washers. Attach fan drive assembly (fig. 1) to bracket with four cap screws with lock washers.

n. Install Water Pump. Cement gasket to attaching face of pump cover and insert pump drive gear into timing gear housing. Secure pump in housing by installing two cap screws with lock washers closest to cylinder block (fig. 15) and two cap screws with lock washers through timing gear cover and into upper part of pump (fig. 14). Cement gasket to water pump inlet elbow and install elbow on pump as shown in figure 15 with two cap screws with lock washers.

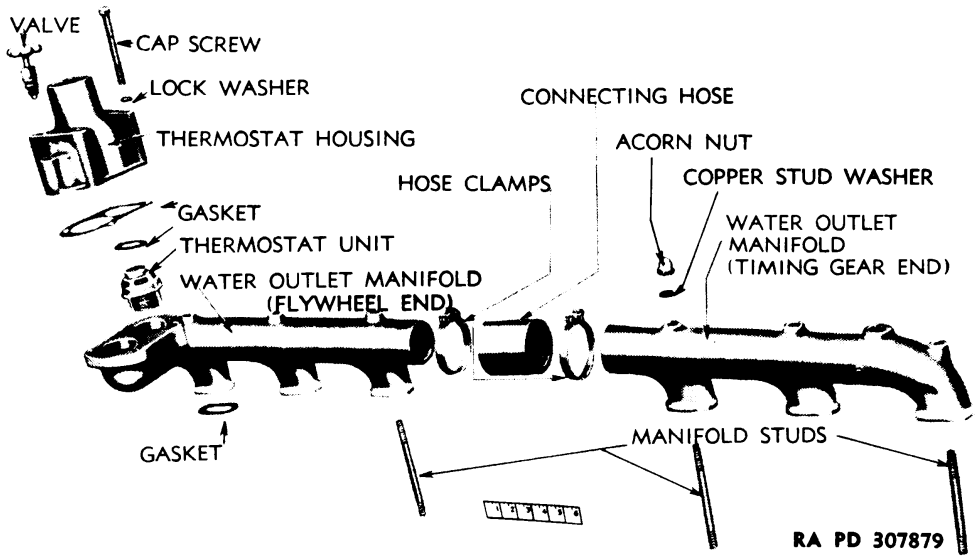


Figure 73 — Water Outlet Manifold Disassembled

Install pipe fittings and drain valve on inlet elbow. Slip oil cooler connecting hose onto upper part of pump and radiator pipe connecting hose onto lower part of pump.

o. Install Lubricating Oil Cooler (fig. 13). Cement gasket to discharge flange of oil cooler. Slip intake end of cooler into upper hose on water pump and attach cooler to cylinder block with two cap screws with lock washers. Cement gaskets to attaching flanges on ends of oil cooler to crankcase pipes and attach each pipe to oil cooler and crankcase with four cap screws with lock washers. Adjust hose connecting cooler and water pump and tighten hose clamps.

p. Install Cylinder Block Drain Pipe (fig. 12). Connect water drain pipe to fitting in side of cylinder block and to tee-fitting in water pump inlet elbow. Do not install cap screw in pipe clip until after bracket for large water radiator pipe is installed.

q. Install Cranking Motor. Install cranking motor on flywheel housing as shown in figure 11 with three cap screws with lock washers. Install adapter between housing and cranking motor.

r. Install Water Outlet Manifold and Thermostat (figs. 10 and 73). Slip connecting hose with clamps onto one section of the manifold. Cement gaskets to attaching faces of the two sections of manifold and set them on studs in cylinder heads with end for thermostat at flywheel end of engine. Install copper stud gasket washer and acorn nut on each stud. Tighten nuts evenly. Adjust connecting hose evenly on both sections of manifold and tighten hose clamps. If thermostat units are to be installed, set thermostat units (two) in

holes in manifold with bellows part down and place gaskets on thermostat units. Cement attaching gasket to thermostat housing and install housing on manifold with four cap screws with lock washers. Screw engine temperature gage unit into tapped hole in opposite end of manifold.

s. Install Water By-pass Tube (fig. 9). Cement gaskets to the two attaching flanges on lower sections of pipe and on the attaching flange on upper section. Slip connecting hose onto end of lower section and attach pipe to cylinder block and water pump inlet elbow with two cap screws with lock washers at each end. Slip end of upper section of pipe into connecting hose and connect upper end of pipe to thermostat housing with two cap screws with lock washers. Adjust connecting hose and tighten hose clamps.

t. Install Exhaust Manifold (fig. 8). Place an exhaust manifold gasket on studs at each of the exhaust ports in cylinder heads. Set manifold assembly on studs. Set water manifold hose heat shield on two of the studs directly opposite connecting hose of water outlet manifold. Install a stud washer and unit on each stud, and tighten them evenly to prevent cracking manifold.

u. Install Air Compressor. Cement gasket to timing gear housing above water pump and install compressor mounting bracket (fig. 14) with three cap screws with lock washers attaching it to timing gear housing and two cap screws with lock washers attaching it to cylinder block. Cement gasket to mounting bracket and install compressor on bracket as shown in figure 7 with four cap screws with lock washers. Install the two air pipes leading from compressor across timing gear housing. The upper ends of these pipes connect to fittings on head of compressor, then lead across timing gear housing where they are held by two pipe clips. Install oil line leading from fitting on end of compressor opposite drive pulley to fitting in crankcase below governor at this time as pipe clips on this line are held by same cap screws as air pipe clips. Install the two cap screws in clips and timing gear cover. Install water pipe shown in figure 2 leading from cylinder head of compressor to discharge elbow on lubricating oil cooler.

v. Install Air Compressor Drive Belt Tightener. Install tightener as shown in figure 6 with two cap screws with lock washers through tightener bracket and timing gear cover into water pump cover.

w. Install Master Clutch. Turn engine sideways in stand. Tap the three small dowels with snap rings into holes in flywheel (fig. 5). Place driving disk of clutch against flywheel with shorter end of hub towards flywheel, hold clutch coverplate assembly against flywheel on the three dowels and install the 18 cap screws with lock washers attaching assembly to flywheel. Center driving disk with clutch shaft pilot bearing before tightening cap screw. After tightening cap

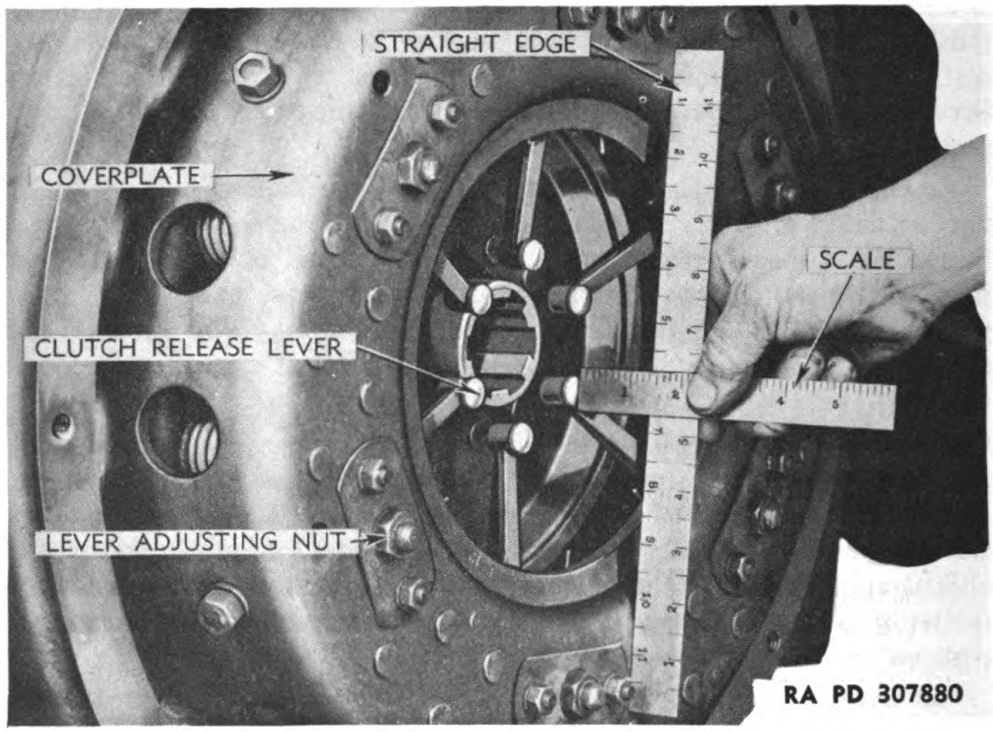


Figure 74 — Checking Clutch Release Lever Adjustment

screws, remove the six cap screws in coverplate (fig. 4) that have been installed to hold clutch springs compressed for installation purposes. Clutch release lever adjustment must now be checked and corrected if necessary. Hold straight edge across cover plate and measure distance from straight edge to face of thrust button in each lever as shown in figure 74. This distance must be 1⅜ inches. Adjust for this measurement, if necessary, by turning the lever, adjusting nuts clockwise to decrease measurement or counterclockwise to increase measurement. These nuts are self-locked by friction.

x. Adjust Valves and Install Rocker Arm Covers. Lift distributor cap. Use wrench or bar or large nut on drive pulley end of crankshaft and rotate crankshaft in clockwise direction until the rotor arm of distributor points to segment in distributor cap connected by spark plug wire to No. 1 cylinder and points are open, then turn crankshaft one-quarter turn more. Valves of No. 1 cylinder are now fully closed and adjustment of valves for that cylinder may be made. Check clearance between rocker arms and ends of valve stems with thickness feeler ribbons. Adjust rocker arm of intake valve for 0.016-inch clearance and exhaust valve for 0.022-inch clearance by loosening lock nuts on adjusting screws in rocker arms and turning screws until proper clearance is obtained. Tighten lock nuts and check again. There must be a slight drag on 0.016 and 0.022 inch

feeler ribbons inserted after lock nuts are tightened. Adjust valves of remaining cylinders in same manner. After all valves are adjusted and distributor cap replaced, cement gaskets to rocker arm covers and install covers on heads and tighten with hand-wheel nuts in covers.

y. Install Fan Drive Belt Tightener and Large Water Pipe. Install engine lifter as explained in paragraph 15 **b.** and remove engine from stand. Remove engine stand adapter from end of cylinder block and install the three fan drive belt tightener mounting studs in holes from which adapter cap screws were removed. Install tightener assembly on these studs with three nuts and lock washers. Install bracket for large water pipe on side of engine (fig. 2) with two cap screws with lock washers. Lower cap screw also holds water drain pipe clip. Insert lower end of large water pipe into hose on water pump inlet elbow and clamp pipe in bracket. Tighten hose clamp.

z. Install Drive Belts. Place air compressor drive belt, generator drive belt, and fan drive belts on pulleys in arrangement shown in figure 1. Adjust fan drive belts for ¾- to 1-inch deflection by means of the adjusting bolt on tightener.

aa. Lubricate Engine. Make sure all drain and level plugs are tight, then fill crankcase with required amount and grade of engine lubricating oil. Fill fan drive housing to level of level plug with engine oil and lubricate water pump, distributor, tachometer drive assemblies, and engine controls. If engine is to be placed in storage, follow regular instructions for preparing engine for storage.

Section XI

ENGINE IGNITION TIMING

26. ENGINE IGNITION TIMING.

a. General. Ignition timing consists of adjusting the distributor so that with engine running at 2,100 revolutions, ignition will take place 26 to 27 degrees before crankshaft reaches top dead center on the compression stroke of the pistons. This is required for most power and most efficient engine operation. If ignition takes place earlier when using 70-octane gasoline, detonation, heating, and burning of pistons will result. Late timing will result in lack of power and speed and overheating of engine.

b. Timing Mechanism. A pointer in top of flywheel housing and marks on outer rim of flywheel are provided for ignition timing purposes. One mark "DIS" is at a point on flywheel 3 degrees before top

dead center, which is the point at which the distributor points should just start to open. The automatic advance mechanism in distributor will cause a nominal advance of 22 degrees, however the distributors have a manufacturing tolerance of plus or minus 2 degrees and in most cases lean toward the maximum so a normal automatic advance will be 22 to 24 degrees.

c. Timing Procedure (Engine Stationary). Remove small cover from top of flywheel housing. Rotate engine crankshaft until No. 1 piston is near top of its compression stroke and "DIS" mark on flywheel is directly under pointer in top of flywheel housing. Both valves of No. 1 cylinder will be nearly closed at this time. Remove distributor cap. If timing is correct, distributor points will be just starting to open to the point where it is possible to insert a 0.0015-inch feeler ribbon between the points. If points are not open or are open too far, loosen cap screw in distributor clamping arm, turn distributor body until points are open 0.0015 inch, then tighten cap screw and recheck. When the points are adjusted for this clearance, timing should be correct. Replace distributor cap and cover on flywheel housing.

d. Timing Procedure (Engine Running). Remove small cover from top of flywheel housing. On all but some of the first production engines, a second mark will be found on flywheel approximately 4½ inches ahead of top dead center mark. If engine does not have this mark, make one ⅛ inch wide with white chalk or like material. Start engine and allow it to warm up, then attach timing light according to instructions with light. Adjust throttle to maintain an engine speed of 2,100 revolutions per minute. Hold light over pointer in top of flywheel housing. White line on mark 4½ inches from top dead center mark should now be seen under pointer as light flashes on if automatic advance in distributor is functioning normally. Advance timing, if necessary, by loosening cap screw in distributor clamping arm and turning distributor body counterclockwise. Retard timing by turning it clockwise. After most satisfactory performance of engine is effected, tighten clamp cap screw.

Section XII

ENGINE ACCESSORIES AND COMPONENTS

27. GENERAL.

a. Each paragraph in this section gives a general description of an accessory or component of the engine and the procedure for disassembly, inspection, repair, assembly, and adjustments and tests

(if any) of that unit. For replacement of these units with engine installed in tractor, refer to TM 9-785 (M4) and TM 9-788 (M6). Removal and installation with engine removed from tractor is given in paragraphs 15 and 25.

28. FUEL PUMP (A-C, MODEL D-8274).

a. Refer to TM 9-1828A for maintenance information on pump.

29. CARBURETORS.

a. Two Zenith carburetors, Models 29 BW and 29 BBW are used on the engine. Refer to TM 1826C for carburetor maintenance information.

30. ENGINE SHUT-OFF AIR VALVE ASSEMBLY.

a. Description. This air valve is simliar in construction to a carburetor choke valve and is mounted midway between the two carburetors. The valve and ignition switch are operated by the "ENGINE STOP" control. When the "ENGINE STOP" knob is pulled out (running position) the ignition switch is closed and air valve is closed. When knob is pushed in, the air valve is opened and the ignition switch lever is pushed forward and opens ignition switch. With this air valve open, the engine cannot operate in counterclockwise direction by auto ignition which is the tendency of a high compression engine when it is shut down immediately after heavy loading. The action of the valve is to admit air from the air inlet directly into the intake manifold and cylinders and in this way prevent a combustible mixture of air and gasoline from carburetors from reaching the combustion chambers.

b. Disassembly of Air Valve (fig. 75). Loosen clamp screw in lever, spread clamping part of lever, and pull lever from valve shaft. Remove washer and felt seal behind lever from shaft. Working from bottom of valve, remove the two screws in shaft and slip the valve plate out of slot in shaft. Tap on end of shaft projecting from side of valve body with soft hammer and drive shaft out of body. The expansion plug on opposite end of body will be driven out at same time.

c. Assembly of Air Valve. Insert valve shaft through housing, leaving unslotted end projecting from stop screw side of housing. Slide valve plate into slot in shaft so that beveled edges of plate will fit tightly against sides of housing when shaft is rotated in counterclockwise direction. Secure valve plate in shaft with two screws with lock washers. Tap expansion plug into housing at short end of shaft. Insert new felt dust seal over projecting end of shaft and into recess in housing. Slip flat washer onto shaft and against felt seal, then tap lever onto valve shaft. Adjust lever so slot in clamping part of lever is parallel with attaching face of housing with valve closed (fig. 72),

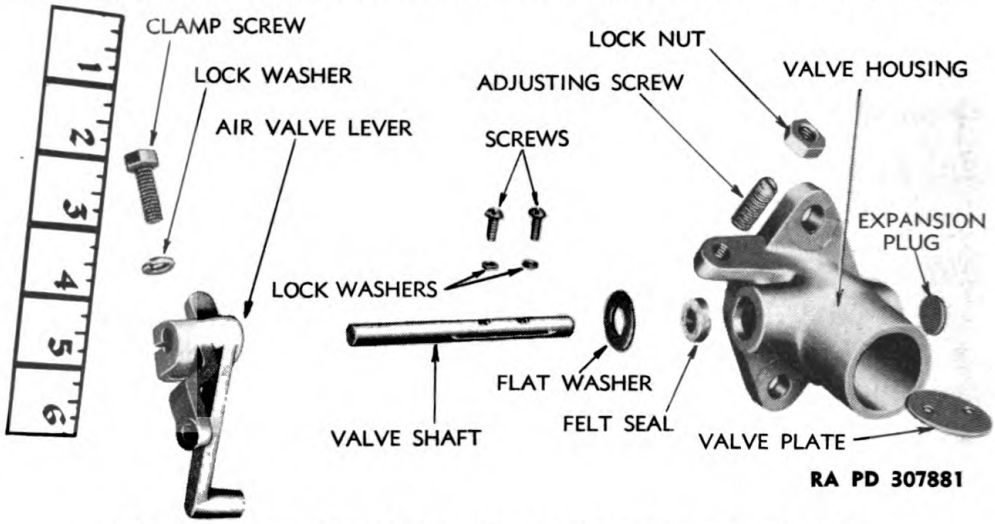


Figure 75 — Air Valve Assembly Disassembled

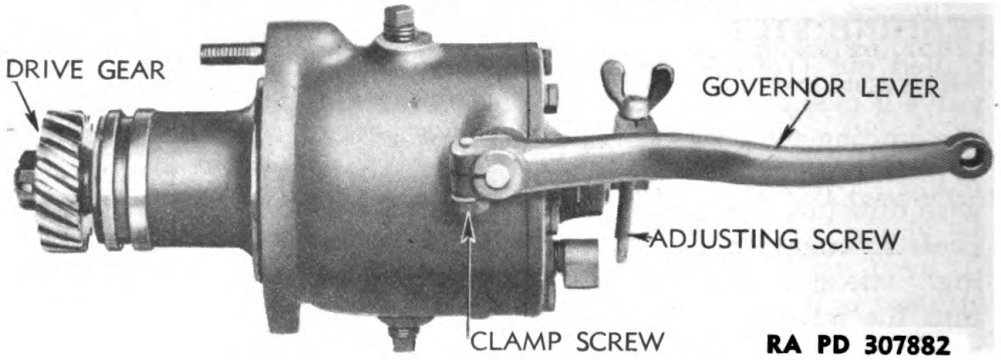


Figure 76 — Governor Assembly

then install clamp screw and lock washer and tighten lever on shaft. Rotate shaft with lever until valve is fully opened, then adjust stop screw so that end of screw is against stop on lower part of lever and tighten lock nut on screw.

31. GOVERNOR.

a. Construction. The governor is a self-contained assembly of the mechanical type mounted in timing gear compartment of crankcase, and driven by the camshaft gear. The governor shaft is supported by two double row ball bearings in the governor housing and also receives additional support from a plain bronze bushing in the governor cover. The governor lever shaft is supported by two needle bearings. Two forged steel weights are carried on pins through the governor weight carrier, which is keyed to the governor shaft, and the weights act against a hardened shifter which moves freely on the governor shaft. A thrust bearing, pressed onto the shifter and protected by a hardened cage, contacts the prongs of the shifter lever on the governor lever shaft.

b. Operation. The revolving governor weights are pivoted on their carrier, and move outward from the governor shaft, as engine speed increases, due to centrifugal force. This outward movement of the weights is opposed by a spring, the tension of which is adjustable. As the weights move outward, small projections on the weights contact the governor shifter, forcing it to move the governor shifter lever which transmits the movement through the governor lever and governor throttle control rod to the carburetor butterfly valves. These valves commence closing and in this way engine speed is governed in relation to the tension of the governor spring. The carburetor connecting shaft, connecting both carburetor throttle shafts, insures equal movement of both carburetor butterfly valves.

c. Lubrication. The governor is lubricated by oil under pressure, which enters the housing at the center of the cover, and flows past the cover bushing into the governor weight compartment, where a sufficient oil level is maintained to permit agitation, due to the revolving weights and weight carrier. The agitated oil throughly lubricates the governor weights and the thrust bearing, and finds its way through the rear ball bearing into the compartment between the two ball bearings. Additional oil finds its way through the front bearing into the compartment between the ball bearings.

d. Disassembly. Loosen clamp screw (fig. 76) and tap governor lever off shifter lever shaft. Remove six cap screws and lock washers (fig. 77) and remove cover from governor housing. Pull cotter pin and remove slotted nut from governor shaft (fig. 78). Pull gear from shaft with a standard gear puller. Remove key from slot in shaft, turn shaft so widest part of weight carrier is parallel with control shaft, and tap shaft out of housing with soft hammer (fig. 79). Bearing spacer, one double row ball bearing, weight carrier, shifter sleeve, thrust bearing, and thrust bearing retainer (fig. 80) will remain on shaft. Remove bearing spacer from shaft, and slip thrust bearing and retainer, and shifter sleeve from small end of shaft. Press the ball bearing from shaft and remove weight carrier spacer. Drive taper pin out of weight carrier and shaft (fig. 81) and press weight carrier assembly off shaft. NOTE: *Refer to subparagraph e. before moving weight carrier.* Remove snap ring from groove in small end of housing (fig. 82) and pull bearing from housing with a pilot bearing puller. Drive the two pins from shifter lever and shaft (fig. 83). Drive on shaft with soft hammer, as shown in figure 91, to remove expansion plug, then shaft can be driven out. Remove needle bearings and oil seals from governor housing at ends of shifter lever shaft with small punch and hammer. NOTE: *These bearings and seals will be damaged and new ones installed in their places, therefore remove only to replace.*

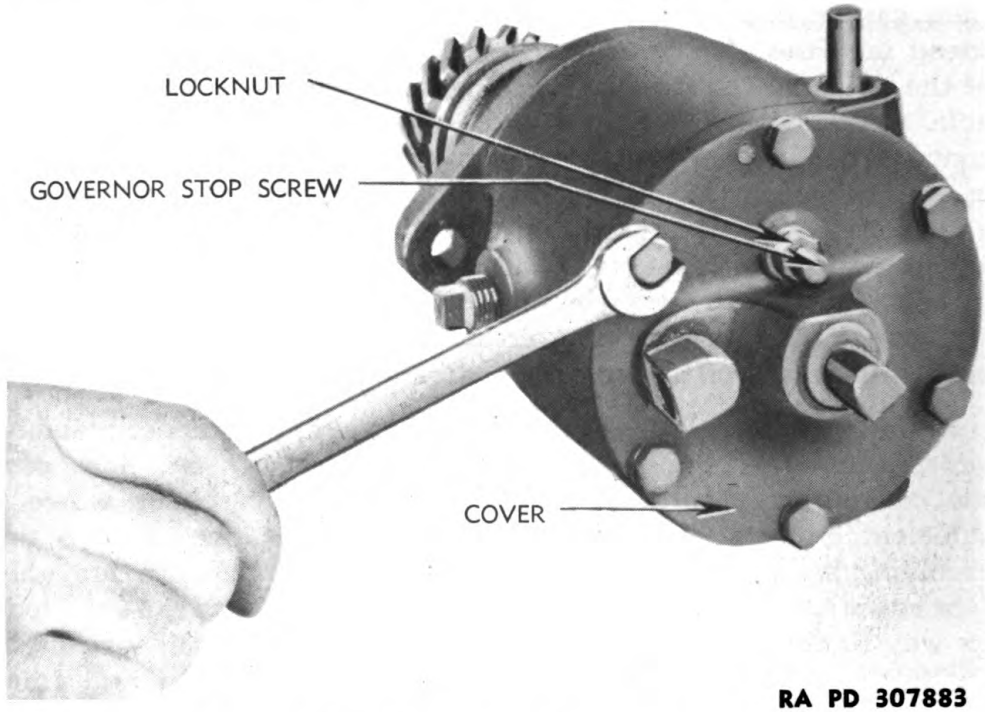


Figure 77 — Governor Cover Removal

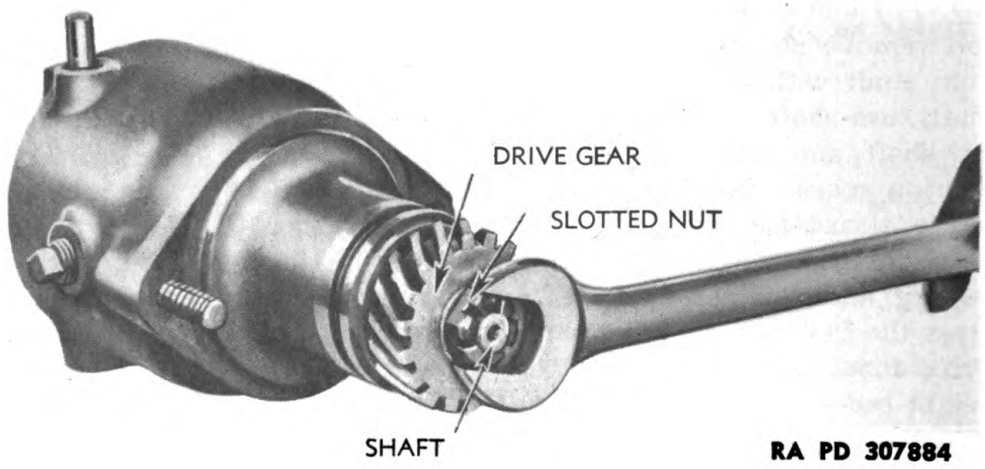


Figure 78 — Removing Nut From Governor Shaft

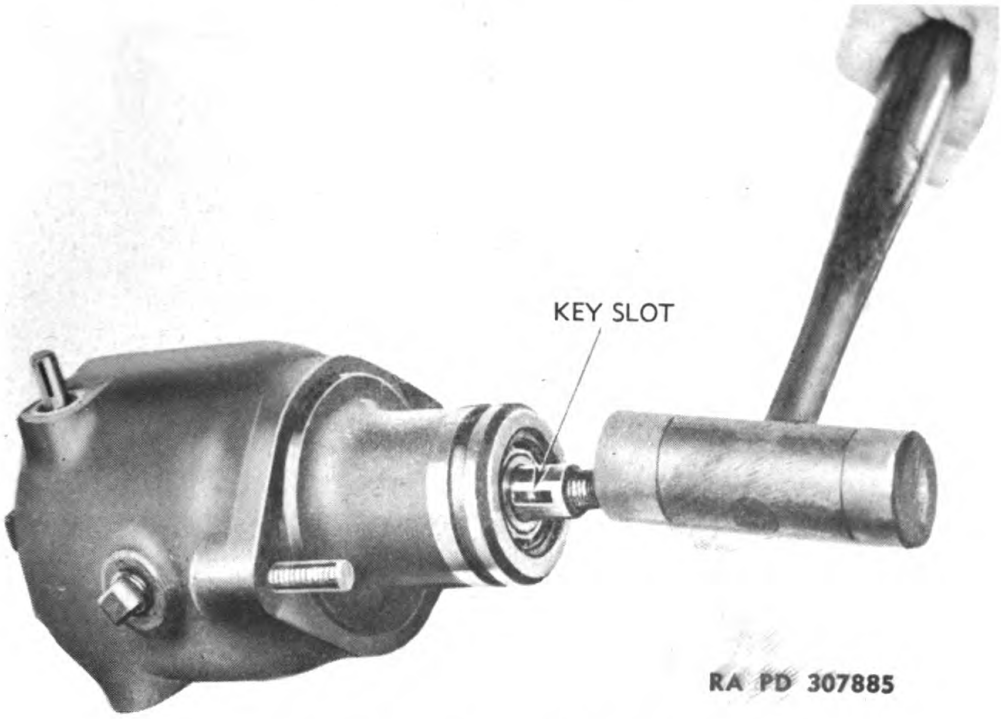


Figure 79 — Driving Shaft Assembly From Housing

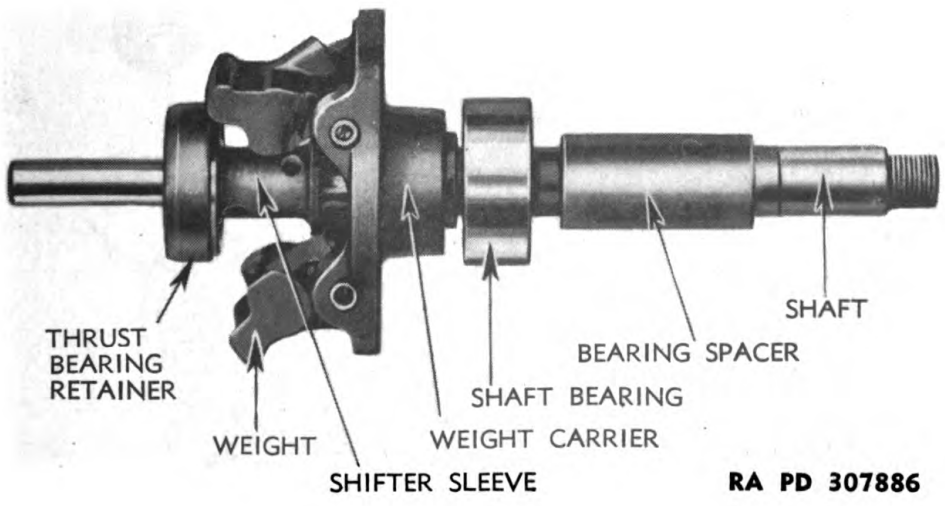


Figure 80 — Governor Shaft and Weight Carrier Assembly

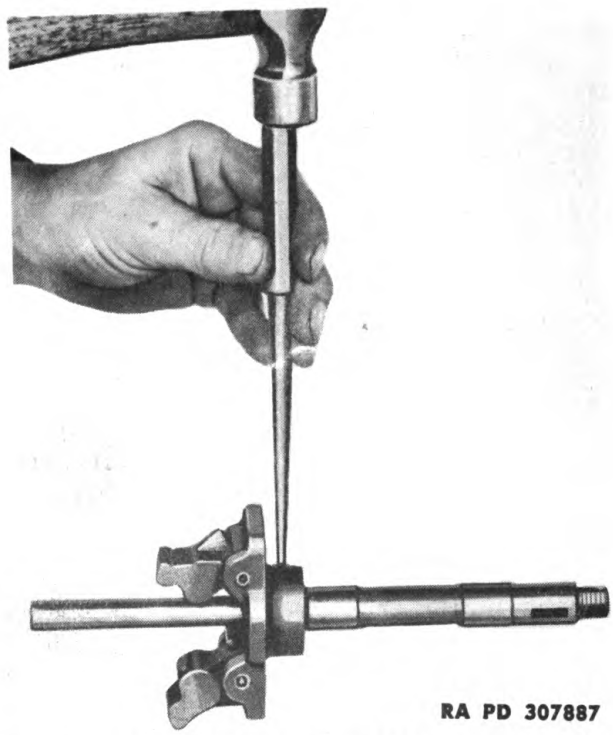


Figure 81 — Driving Taper Pin From Weight Carrier and Shaft

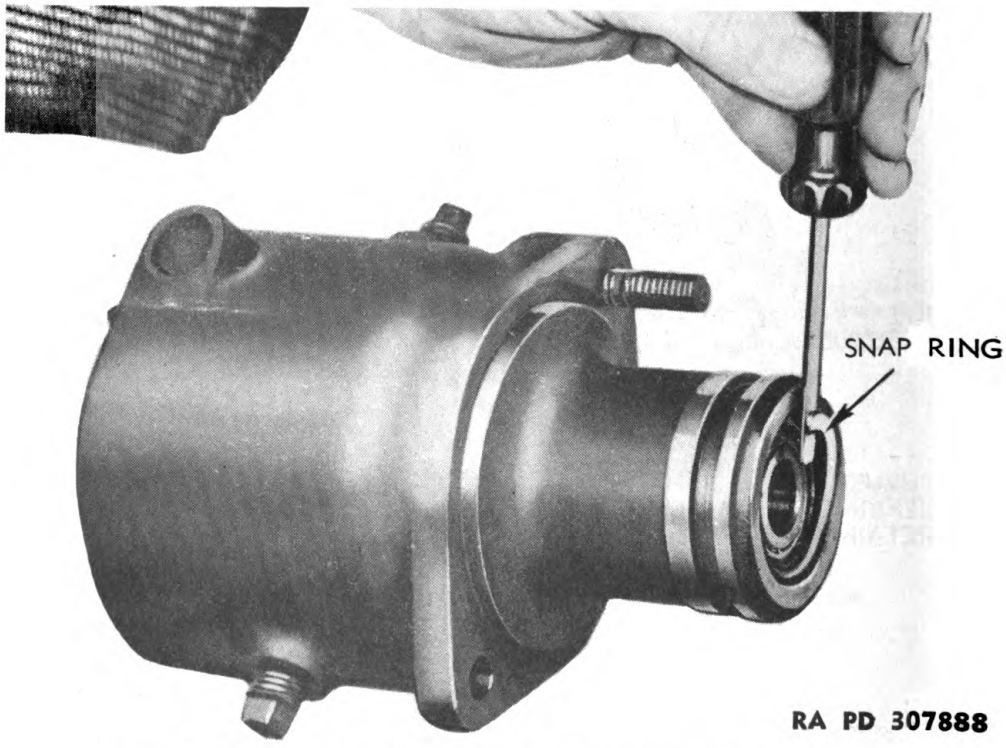


Figure 82 — Removing Snap Ring From Housing

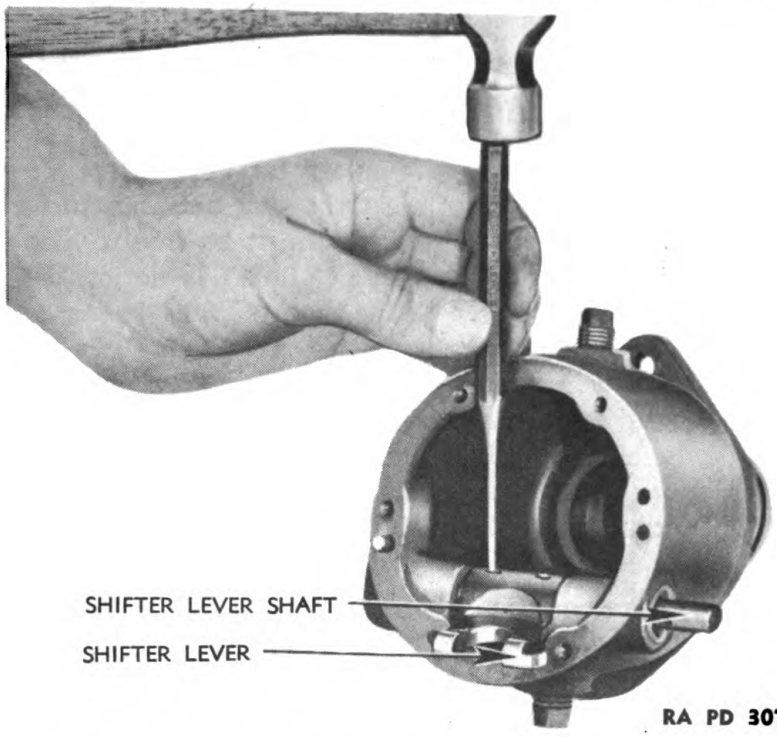


Figure 83 — Driving Pins From Shifter Lever and Shaft

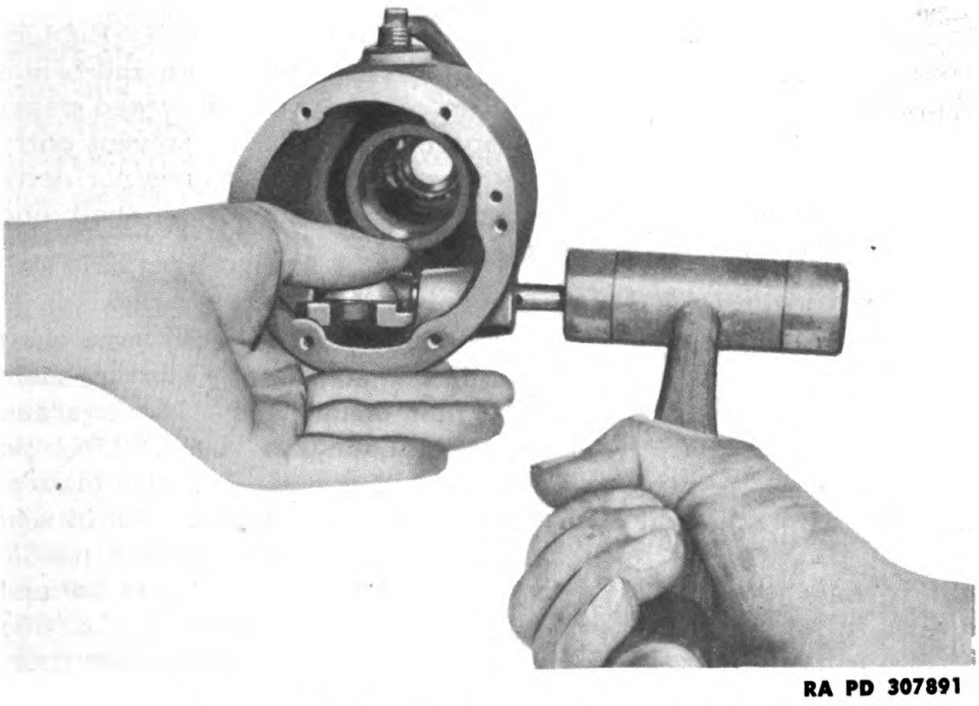


Figure 84 — Removing Shifter Lever Shaft

e. Cleaning and Inspection of Parts. Clean and wash all parts with dry-cleaning solvent and blow dry with compressed air. Discard all cracked or broken parts. Scrape all old gaskets from parts so gasket surfaces will be clean and smooth for assembly. Remove all burs or nicks that would prevent a tight seal between surfaces. Inspect governor weights. These weights must be free to move on the pins, however, if any undue motion (wobble) is noticeable, replace the weights and weight pins. Since there should be no movement of the pins in the governor weight carrier, it will usually not be necessary to remove the weight carrier from the governor shaft for inspection. If the governor weight carrier is removed from the shaft, replacement of the shaft will be necessary because it is difficult to line up the governor weight carrier so as to use the original taper pin hole in the shaft, and if multiple holes are drilled in a small diameter shaft of this kind, it is apt to break during operation. Inspect governor lever shaft for wear at the point where it contacts the needle bearings. Replace shaft if any wear is apparent. Inspect governor lever shaft needle bearings and replace, if there is any evidence of rust or wear. Replace governor lever shaft seal and install a new expansion plug in the opposite housing opening. The governor shifter will not require replacement unless it is worn at point of governor weight finger contact. Inspect shaft bushing in governor housing cover. Replace in event clearance exceeds 0.005 inch. The original clearance is 0.001 to 0.0025 inch. Inspect ball bearings. Replace bearings, if ball races are rough, or if balls are not smooth and bright after washing. Dip bearings in clean oil and wrap in waxed paper immediately after cleaning and inspection in order to prevent entry of dirt prior to reassembly of the governor. Inspect governor drive gear and replace if teeth are worn. Inspect threads on shaft and make sure they are not stripped or battered.

f. Assembly.

(1) INSTALL SHIFTER LEVER AND SHAFT. If shifter lever shaft needle bearings were removed, install new bearings by starting them into end of housing, then inserting bolt through both bearings and pulling them into place by tightening nut on bolt. CAUTION: *Do not drive them into place with hammer or punch.* Tap new oil seal into end of housing against needle bearing (fig. 86) with lip of seal facing it. Tap shifter lever shaft through oil seal and first needle bearing, then hold shifter lever in position shown in figure 84 and drive shaft through lever. Insert three spacing washers (fig. 86) between lever and second bearing boss, then drive shaft through these washers and second needle bearing. Aline the two holes in the shaft with the two holes in lever and install taper pins in these holes (fig. 83). Tap expansion plug into housing opposite oil seal (fig. 86).

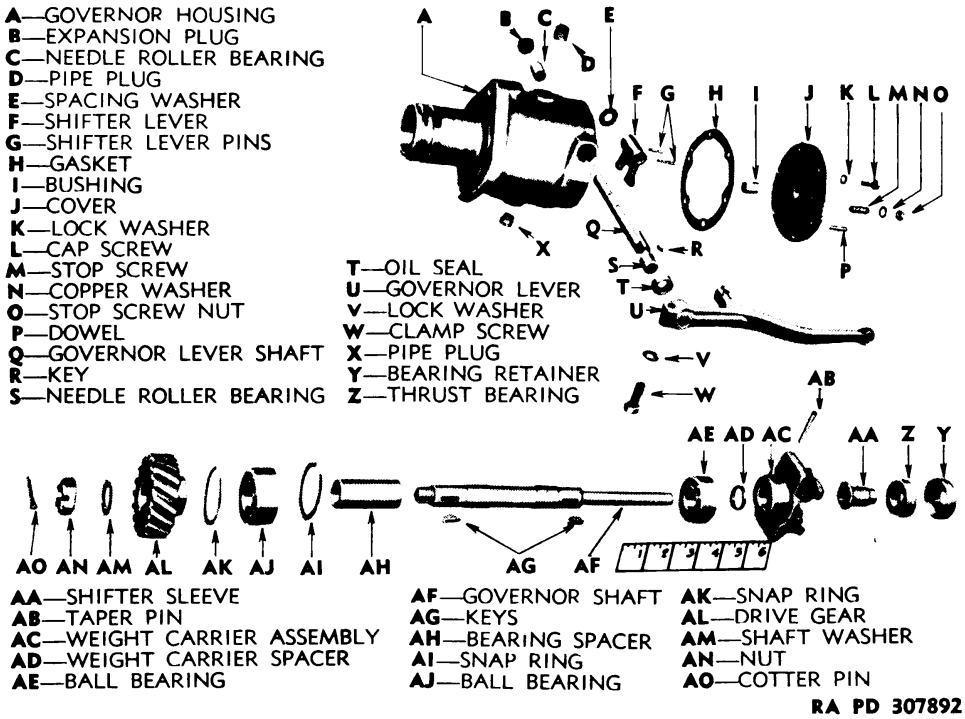


Figure 85 — Governor Assembly Disassembled

(2) INSTALL GOVERNOR SHAFT AND WEIGHT ASSEMBLY. Install snap ring in small end of housing in second groove from end (fig. 87). Press one of the double-row ball bearings into housing against snap ring and install second snap ring in outer groove. If weight carrier was removed from shaft, tap key into slot near center of shaft, then press weight carrier shaft through weight carrier with holes in shaft and carrier in line and install taper pin (fig. 81). Slip weight carrier spacer onto large end of shaft, then press second double-row ball bearing onto shaft against spacer. Press thrust bearing onto end of governor shifter sleeve (fig. 87) and tap bearing retainer onto thrust bearing. Slip shifter sleeve onto small end of shaft against weight carrier. Slip bearing spacer onto shaft, then insert large end of shaft into rear end of housing and down through end bearing. NOTE: *Hold end of shifter lever toward end of housing, and place widest part of weight carrier parallel with shifter lever shaft, when installing the assembly in housing.* Install key in slot in end of shaft; drive gear on shaft and key; washer on shaft next to gear and install and tighten slotted nut. Secure nut with cotter pin. Use new gasket and install cover on large end of housing with six cap screws with lock washers. Tap small key into end of shifter lever shaft and tap governor lever onto shaft and key (fig. 76). Tighten clamp screw.

(3) INSTALL COVER AND LEVER. Press new bushing into cover, if old one was removed, and ream for 0.001- to 0.0025-inch clearance

ORDNANCE MAINTENANCE—ENGINE, ENGINE ACCESSORIES, AND TORQUE CONVERTER FOR 18-TON M4 AND 38-TON M6 HIGH SPEED TRACTORS

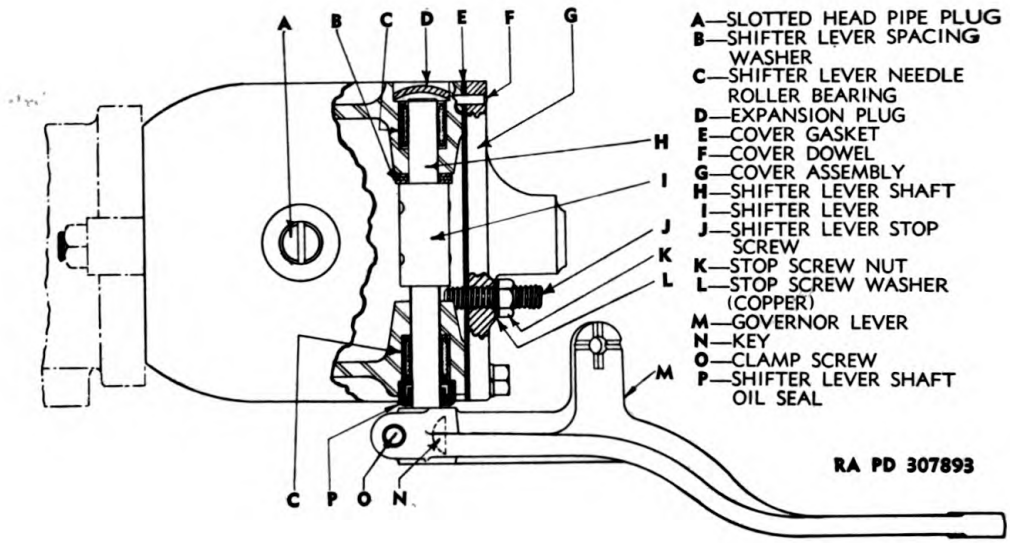


Figure 86 — Governor — Top View Drawing

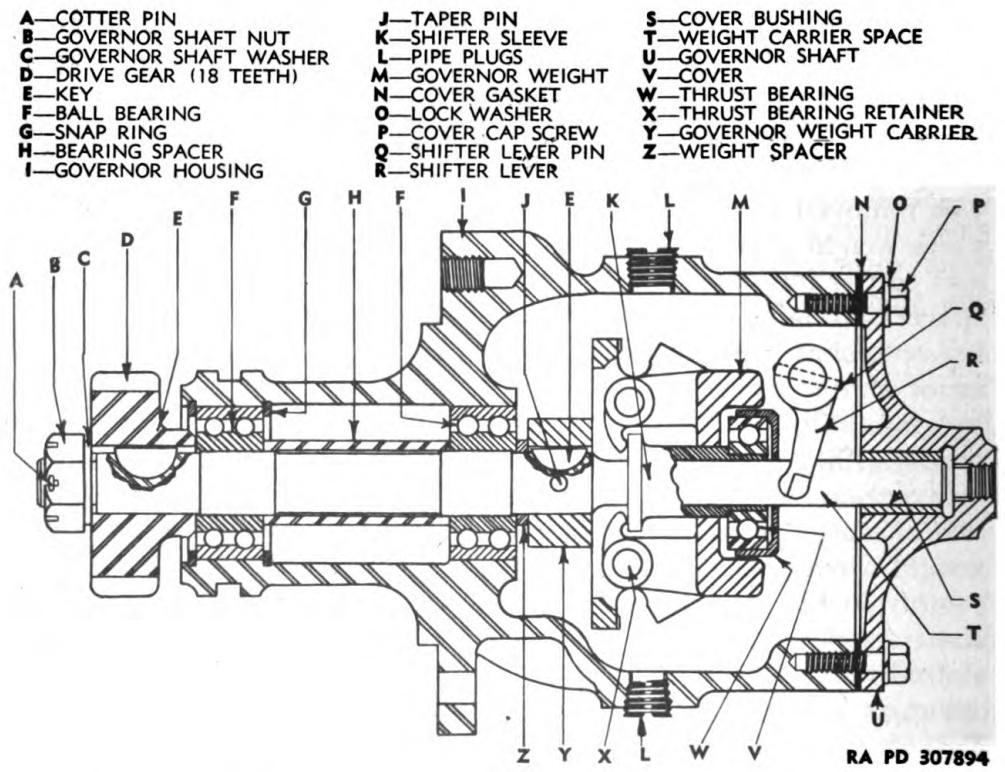


Figure 87 — Governor — Cross Section Drawing

with shaft. Use new cover gasket and install cover on housing with six cap screws with lock washers (fig. 77). Tap small key into slot in end of shifter lever shaft, and tap governor lever onto shaft and key (fig. 76). Tighten clamp screw.

g. Adjustment of Governor. The governor acts to limit the high idle speed, and to prevent overspeed of the engine. The governor lever does not move until the engine speed is above 2,100 revolutions per minute. With throttle fully opened, the engine should run at 2,100 revolutions per minute, with clutch engaged, and 2,300 revolutions per minutes with clutch disengaged. The foot accelerator linkage, the governor to throttle rod, and the governor spring must be adjusted correctly to maintain these speeds. NOTE: *The governor must be installed and engine ready for operation before the following adjustments can be made. Refer to figure 17 when making these adjustments.*

(1) GOVERNOR SPRING ADJUSTMENT. Run the engine with the clutch disengaged. Turn the wing nut on governor spring adjustment screw to adjust the tension on spring so that movement of the governor lever starts when the engine speed is increased above 2,100 revolutions per minute. The governor lever should have sufficient travel to limit the high idle speed to aproximately 2,300 revolutions per minute. Increasing the spring tension increases the high idle speed, decreasing the spring tension decreases high idle speed. The wing nut locks at every half turn.

(2) LINKAGE ADJUSTMENT. If the engine speed does not reach 2,100 revolutions per minute with clutch engaged, or exceeds 2,300 revolutions per minute with clutch disengaged, make the following adjustments:

(a) Adjust the foot-accelerator linkage to obtain full travel of throttle shaft from fully closed to fully open positions.

(b) Remove the carburetor to governor rod spring and disconnect both ends of rod. Turn yoke ends on rod to adjust distance between centers of yoke pin holes to 18¼ inches measured on a straight line. (On older tractors it may be necessary to straighten the lower bends out of the rod to obtain the above measurement, and have a sufficient amount of rod in the yoke ends). After rod has been adjusted, connect rod to governor and throttle levers and install spring, then check to make sure there is no interference between upper yoke end and the intake manifold or carburetor mounting adapter. Make this check with governor lever at its rest position. If necessary, cut a small portion away from adapter or manifold to make clearance and prevent preloading the throttle shaft.

(c) Loosen clamp screw in throttle lever contacted by governor-operated floating lever. Hold throttle in full open position against stop. Rotate throttle lever on shaft to obtain 0.010-to 0.020-inch

clearance between the flat faces of the floating lever and throttle lever, then tighten clamp screw in throttle lever.

(d) Using screwdriver or small pry bar, raise governor lever until shifter lever in governor contacts the stop screw in governor cover, which limits the upward travel of the lever. Hold lever against stop. With throttle in closed position, adjust governor stop screw to allow 0.010- to 0.020-inches clearance between flat surfaces of throttle lever and floating lever, when governor lever is at its upper limit of travel. CAUTION: *Use only enough pressure on lever to hold it against stop. Additional pressure would spring the lever and a false setting will result.*

(e) Check high idle speed and reset, if necessary, as outlined in step (1), above. With throttle in closed position, check again for interference of throttle levers or carburetor to governor rod with intake manifold or carburetor mounting adapter. Remove material from levers, if necessary, to eliminate interference.

32. IGNITION COIL (DELCO-REMY, MODEL 1115252).

a. Refer to TM 9-1825A for maintenance information.

33. DISTRIBUTOR (DELCO-REMY, MODEL 1110162).

a. Refer to TM 9-1825A for maintenance information.

34. GENERATOR (DELCO-REMY, MODEL 1105906).

a. Refer to TM 9-1825A for maintenance information.

35. GENERATOR REGULATOR (DELCO-REMY, MODEL 5641).

a. Refer to TM 9-1825A for maintenance information.

36. CRANKING MOTOR (DELCO-REMY, MODEL 644).

a. Refer to TM 9-1825A for maintenance information.

37. LUBRICATING OIL PUMP.

a. Description of Pump. The oil pump is located in the crankcase and is driven by a spiral gear on the camshaft which engages the drive gear keyed and pinned to the upper end of the pump drive shaft. Two gears in the body housing are keyed to the lower end of the shaft, the lower pumping drive gear and the upper scavenger gear. Each driving gear engages an idler which revolves freely in the body housing on the idler shaft which is pinned in the lower coverplate. A fine mesh cup-shaped oil screen is suspended on the lower cover plate assembly on two studs extending from the cover. A baffle or "oil level equalizer" extends over and down around the screen and extends below the bottom surface of the screen. This insures against the pump sucking air when the oil level at the inlet hole is very low. A long scavenger pipe connected to the pump body extends to the shallow front area of the oil pan. This pipe is held

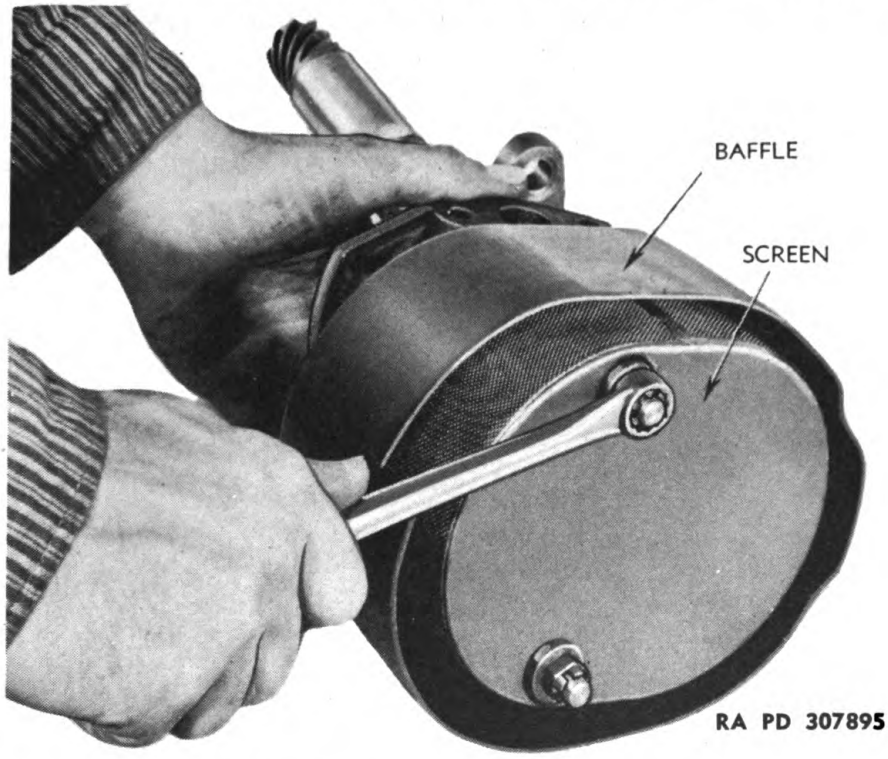


Figure 88 — Removing Oil Pump Screen

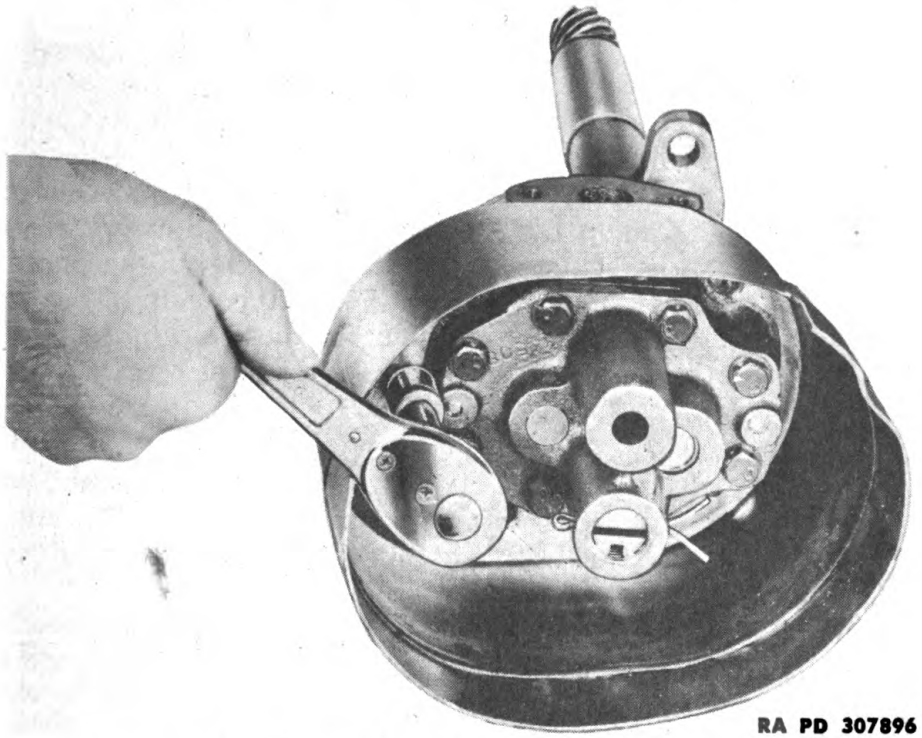


Figure 89 — Removing Oil Pump Screen Baffle

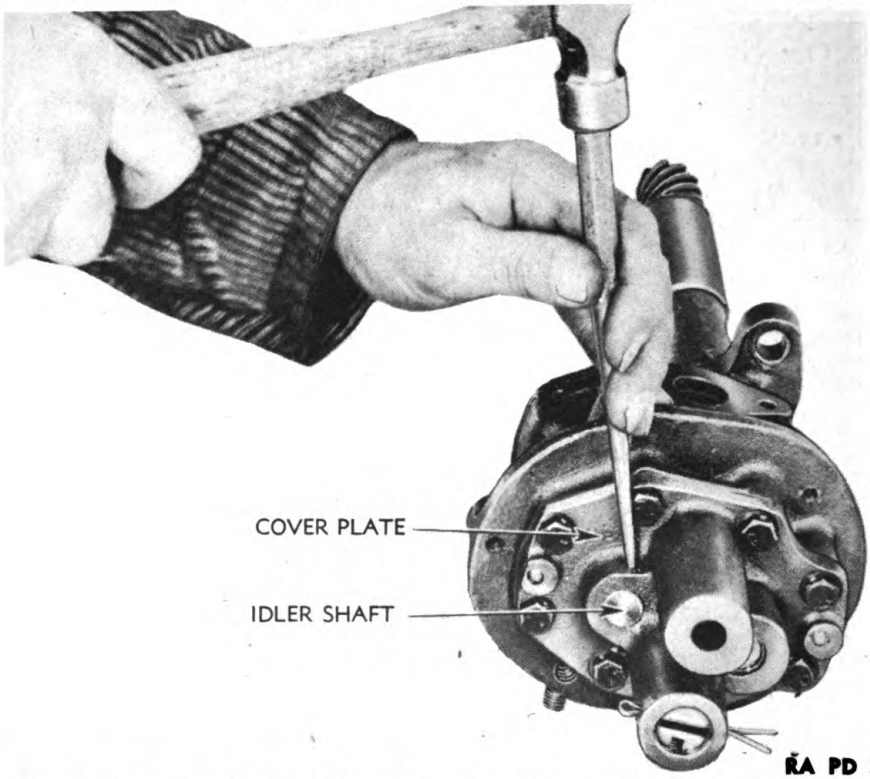


Figure 90 — Driving Pin Out of Cover and Idler Shaft

rigidly throughout its length by heavy strap brackets fastened to one side of the main bearing caps. If the engine is tilted so that the oil is collected in the shallow or front end of the pan, the scavenger pipe and gears will return oil to main oil sump, where it can be drawn into the pump by the pressure gears. A flanged outlet pipe connected to the pump body delivers oil under pressure, to the oil cooler. Pressure is regulated by a relief valve set in the pump body housing and adjusted to a pressure of 55 to 60 pounds. This is about 15 pounds more than the adjustment for the main oil header relief valve as there is some pressure loss as the oil passes through the oil lines, oil cooler, and fittings.

b. Disassembly of Pump.

(1) REMOVE SCREEN AND BAFFLE. Pull cotter pins and remove the two slotted nuts from screen retaining studs (fig. 88), and draw screen from studs. Cut lock wire, remove three cap screws (fig. 89) and remove the screen baffle.

(2) REMOVE BOTTOM COVER PLATE. Cut and remove lock wire from cover plate cap screws. Drive the straight pin out of plate boss and idler shaft (fig. 90). It will be necessary to file or chip off around the hole at one end of this pin before it can be driven out. Remove the cover plate retaining cap screws and pry the plate from the pump body with a large screwdriver. The gasket, of course, will

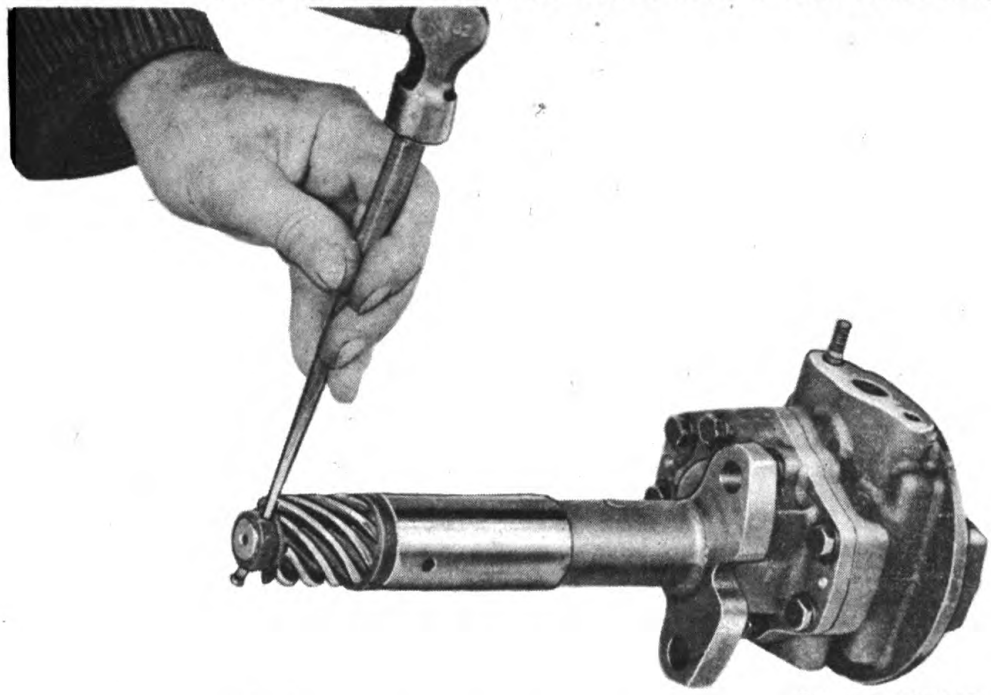


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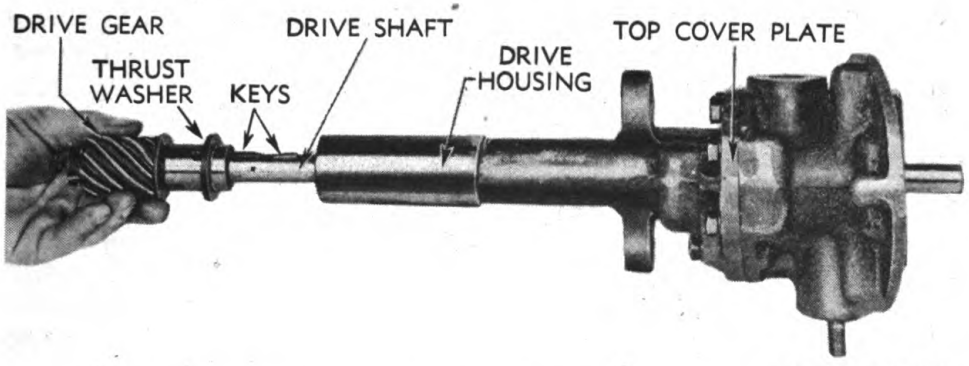
Figure 91 — Removing Pin From Pump Drive Gear



RA PD 307899

Figure 92 — Removing Drive Gear and Thrust Washer

be damaged in this operation. Pry the plate off carefully, inserting the blade of the screwdriver at numerous points in the gasket seal. The two ¾-inch taper pins driven through the cover into the body will come off with the cover, and may then be driven out through the peened edges of the hole and cover. Lift bottom idler gear and bushing off the idler shaft, and drive or press the idler shaft out through the scavenger gear and top cover plate.

(3) REMOVE UPPER SHAFT DRIVE GEAR. Drive pin out of the upper end of the shaft (fig. 91) and pull gear off the shaft. The drive gear thrust washer (fig. 92) will be removed at same time. Remove the two keys from slots in drive shaft.

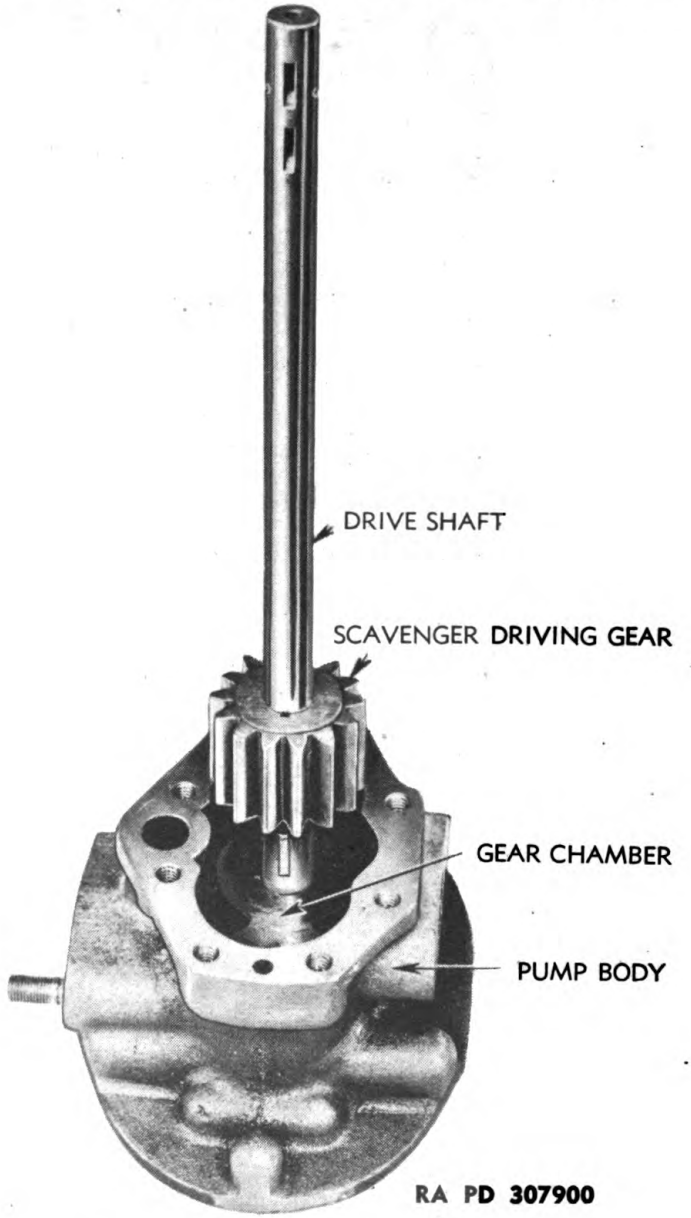


Figure 93 — Scavenger Drive Gear

(4) REMOVE SHAFT HOUSING AND COVER. Remove the eight top cover plate retaining cap screws and lock washers and pry cover from body of pump in same manner as the bottom plate was removed. Use care not to damage the bushing in the cover when the shaft housing is removed from the pump drive shaft. Drive the two taper pins out of cover. Lift scavenger idler gear out of pump body.

(5) REMOVE SCAVENGER DRIVE GEAR. The scavenger drive gear is the upper of the two drive gears in the pump body. Several small

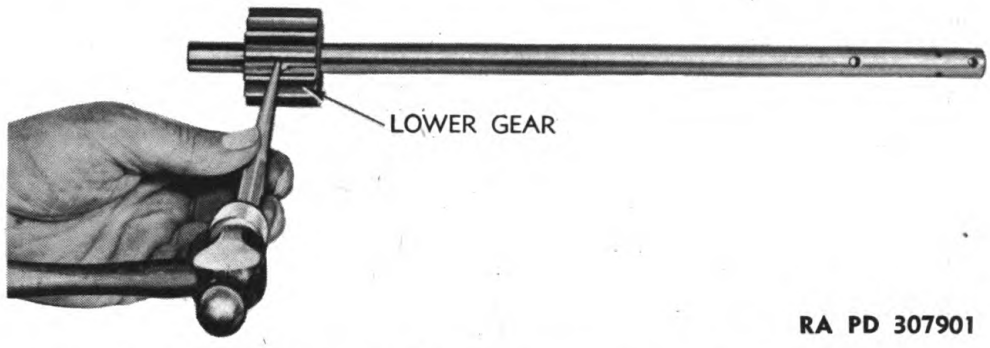


Figure 94 — Driving Pin From Pump Drive Gear and Shaft

pieces of hardwood about two inches long and approximately ⅜ inch square will be needed to remove this gear. Support the pump body in arbor press so that the shaft and lower drive gear will clear the support. Press the shaft down through the scavenger drive gear ⅜ inch. If pressed farther, the key in the shaft will strike the center of the body. Now reverse the pump assembly in the press and press the shaft back ⅜ inch. When the assembly is again turned to its upright position, it will be seen that the upper gear has been moved ⅜ inch up on the shaft, and there is now approximately ⅜-inch clearance between the bottom surface of the gear and the floor of the gear chamber. Insert two of the hardwood pieces in this space, one on each side of the shaft. Repeat the pressing process and build up underneath gear until the gear clears the key in the shaft. Remove key from slot in shaft, then press or drive the shaft with lower gear attached out of scavenger drive gear and pump body. Drive pin out of lower gear and shaft (fig. 94) and press shaft out of lower gear.

(6) REMOVE AND DISASSEMBLE OIL RELIEF VALVE. Remove the cotter pin that runs through the slotted head of the relief valve adjusting screw (fig. 95). Remove adjusting screw from valve housing. Lift out valve spring. Shake plunger out of housing. NOTE: *It may be necessary to drive the short straight pin, that holds the valve bushing in position, into the open valve body, and shake it out before the plunger may be removed.* This pin has a slight taper and if too much force is required to drive it through the drilled hole in the casting, drill it out.

c. Cleaning and Inspection of Parts.

(1) Wash all parts in dry-cleaning solvent and blow dry with compressed air. Scrape all old gaskets from gasket contacting surfaces of the pump parts. Do not scrape oil screen with edged or pointed tool as this may break the mesh or enlarge the holes in mesh.

(2) Inspect all parts, discarding broken or worn parts. The principal wearing parts are the gears and housing. The drive gears

A—LOCKWIRE (11½ IN.)
B—NUT
C—SCREEN
D—SCREEN STUDS
E—LOCKWIRE (16 IN.)
F—CAP SCREW
G—LOCK WASHER
H—SCREEN BAFFLE
I—GASKET
J—PRESSURE RELIEF ADJUSTMENT SCREW
K—PRESSURE RELIEF SPRING
L—PRESSURE RELIEF PLUNGER
M—PRESSURE RELIEF BUSHING
N—TAPER PIN
O—DRIVEN GEAR SHAFT PIN
P—PUMP BODY COVER
Q—BUSHING
R—LOWER COVER GASKET
S—PUMP BODY
T—TAPER DOWEL PIN
U—TOP COVER GASKET
V—BUSHING
W—DRIVE HOUSING
X—LOCK WASHER
Y—CAP SCREW
Z—BUSHING
AA—PIN
AB—OIL PUMP DRIVE GEAR
AC—DRIVE GEAR THRUST WASHER
AD—PUMP DRIVING SHAFT
AE—CAP SCREW
AF—SHAFT KEYS
AG—DRIVEN GEAR SHAFT
AH—DRIVEN SCAVENGER GEAR
AI—DRIVEN GEAR BUSHING
AJ—OIL PUMP DRIVEN GEAR
AK—DRIVEN GEAR BUSHING
AL—COTTER PIN
AM—CAP SCREW
AN—LOCK WIRE (14 IN.)
AO—PIN
AP—OIL PUMP DRIVING GEAR
AQ—SCAVENGER DRIVING GEAR

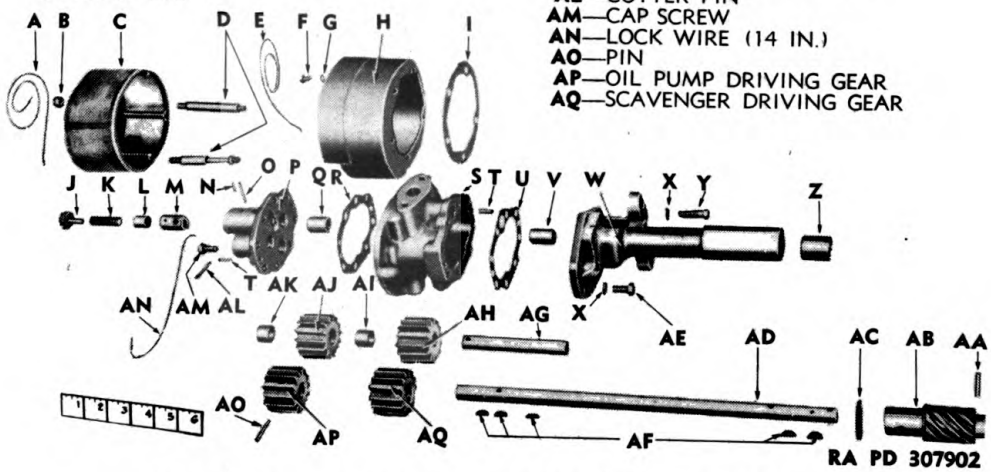


Figure 95 — Oil Pump Assembly Disassembled

are a press fit on the drive shaft. The idler gears are a slip fit on the idler shaft. The clearance between gear surfaces and the gear well surfaces in the pump body should be approximately 0.005 to 0.010 inch. If gear teeth are worn appreciably, or scored, replace them. Gears should be free running inside the housing with no perceptible looseness. Inspect all bushings or bearing surfaces for wear, replacing parts containing badly worn bushings. Drive shaft should have only a slip fit in cover bushings.

(3) Inspect relief valve parts. Replace scored or worn parts.

d. Assembly of Oil Pump Assembly.

(1) INSTALL DRIVE GEARS AND SHAFT IN PUMP BODY. Tap keys into the two lower slots at lower end of pump drive shaft. Lubricate shaft and press lower gear onto shaft and keys until holes in shafts and gear are in line, then install pin through gear and shaft (fig. 94). Insert shaft through pump body from bottom, then place key for the scavenger drive gear in slot in shaft (fig. 93). Press scavenger gear down on the shaft and key, leaving 0.005-inch clearance between

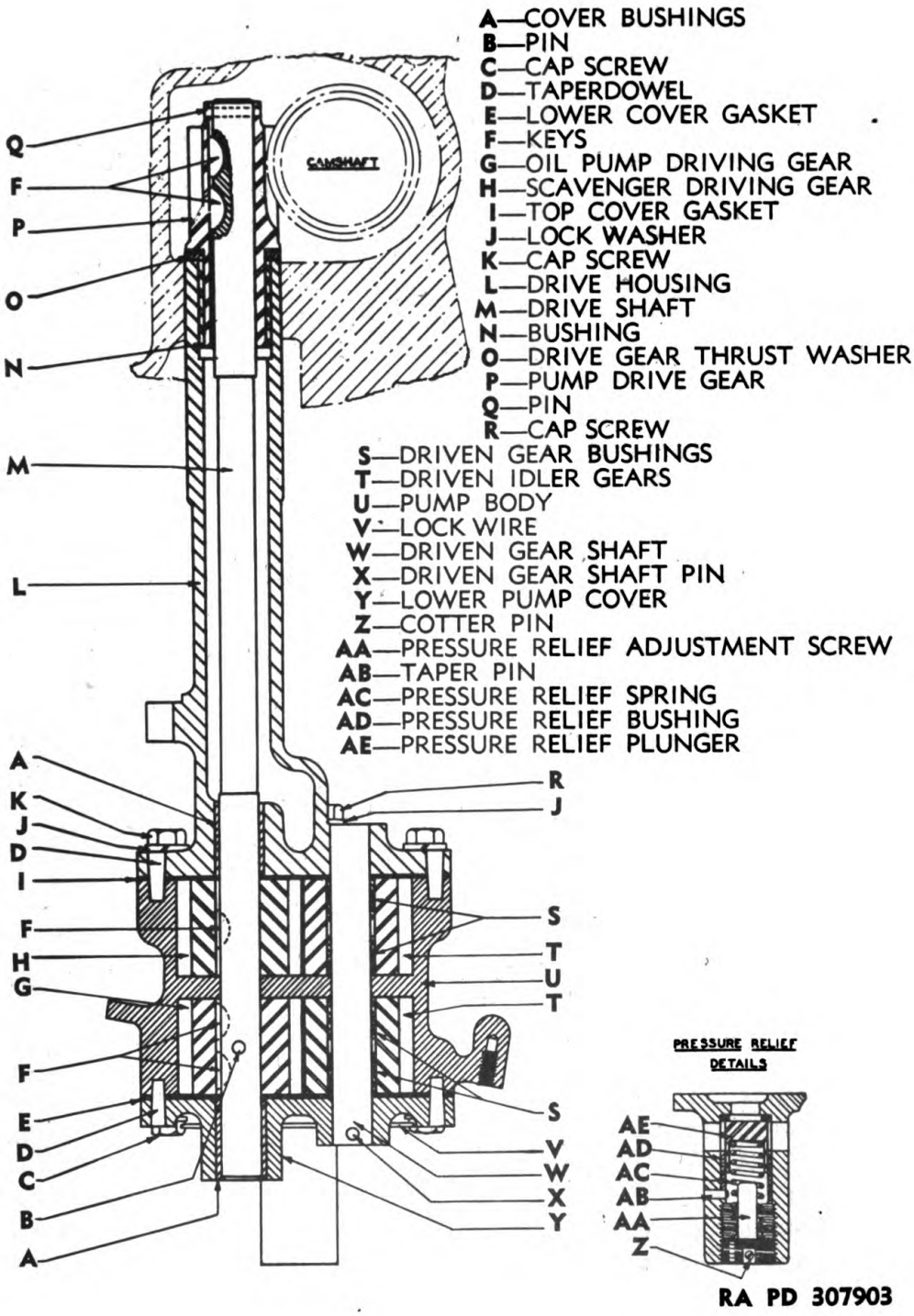


Figure 96 — Oil Pump — Sectional View

the mating surfaces of the drive gear and body housing. Drop the scavenger driven gear into upper part of housing.

(2) INSTALL TOP COVER PLATE AND SHAFT HOUSING. Tap the two tapered dowels (fig. 96) into top cover plate if they were removed. Place new gasket on pump body and slide the cover and shaft housing down over the upper end of the shaft, being careful of the bushing pressed into housing. Before tapping top cover plate tightly against pump body, insert the scavenger idler gear shaft (end with hole down) up through housing and scavenger idler gear and into cover. After idler gear shaft is installed, tap top cover plate into position with dowels in cover plate entering holes in pump body. Install eight cap screws with lock washers in cover and body. Tighten cap screws evenly to prevent distortion of casting. Peen edges of dowel holes over dowels.

(3) INSTALL BOTTOM COVER PLATE. Turn pump bottom side up and slip pump idler gear into body on the idler shaft. Tap the two taper dowels into bottom cover if they were removed. Place new gasket on pump body and place bottom cover over the stub ends of the drive shaft and idler shaft. Install eight cap screws in cover and pump body, tighten them evenly. Thread lock wire through heads of cap screws and twist ends. Line up drilled hole in idler shaft with hole in cover and insert pin (fig. 90). Peen ends of pin. Peen edges of dowel holes in cover over dowels.

(4) INSTALL TOP SHAFT DRIVE GEAR. Turn pump right end up and slide thrust washer (fig. 92) tight against the collar on the gear. Tap keys into the two slots in end of shaft and press drive gear onto the shaft and into the bushing set in the housing. Oil the bushing contact surface of the gear before seating it. Line up the holes in the drive shaft and gear and install pin, peening over the metal at both ends. Grasp drive gear and rotate pump drive shaft and gears by hand. Shaft should turn easily but with no looseness. End play of drive shaft should be no more than 0.005 to 0.010 inch.

(5) INSTALL RELIEF VALVE ASSEMBLY (fig. 96). Make sure the valve seat and bushing surfaces as well as the valve plunger are clean. Coat parts with a light film of oil. Insert valve and spring and adjusting screw and turn down screw. Approximately 55 pounds pressure should be necessary to force plunger off its seat and uncover the relief vent. This setting will be obtained by turning adjusting screw into housing until 3½ of the internal threads are exposed, however, if test equipment is available it should be used for a more accurate setting. After setting the adjusting screw, insert cotter pin through slot of screw. If the taper pin holding the bushing has been removed, be careful when replacing it not to distort, or damage, the bushing, as this will cause the plunger to bind, and it will not yield to the proper pressure.

(6) INSTALL BAFFLE AND SCREEN. Use new attaching gasket and install baffle on pump as shown in figure 89 with three cap screws with copper washers. Thread lock wire through heads of cap screws and twist ends. Install the two screen retaining studs into bottom cover. Slip the screen into place over the two studs and install washers and slotted nuts on studs to secure screen (fig. 88). Install cotter pins through nuts and studs.

38. LUBRICATING OIL COOLER.

a. Description. The oil cooler assembly (fig. 100) consists of a housing inside of which is a multiple-plate type metal element somewhat similar to the core of a steam radiator. This assembly is mounted on the cylinder block next to the water pump. The oil passes through the cooler element just before it is delivered to the engine. Water from the engine cooling system circulates around the element as it passes through the cooler housing. The fins of the element dissipate the heat from the oil inside the element into the cooling water which surrounds the element inside the cooler housing. A by-pass valve is provided in the housing cover, which opens to allow the oil to by-pass the cooler in the event the cooler becomes clogged, or the oil is too thick to flow through the cooler element, when engine is first started in cold weather.

b. Disassembly of Cooler. Remove oil cooler to crankcase pipes by removing two cap screws and lock washers that attach each pipe to cover of cooler. Remove the eight cap screws and lock washers that attach cover to housing (fig. 97) and remove cover from housing. Lift element from housing (fig. 98). Remove large acorn nut and gasket from pressure relief adjustment screw, loosen lock nut, and unscrew pressure relief adjustment screw from cover. Then pull spring and plunger from cover (fig. 99). NOTE: *Do not disassemble the relief valve assembly unless in need of cleaning or repair.*

c. Cleaning and Inspection of Parts.

(1) CLEANING. Wash all parts with dry-cleaning solvent and blow dry with compressed air. Scrape all particles of old gaskets from housing, element, and cover. Clean all oil passages in cover and element. To effectively clean the cooler element, it is necessary to circulate a special solvent through the element for some time by the use of a force pump. If live steam is available, a jet of steam, used after applying a soapy substance, is a very effective cleaner. After cleaning, remove all traces of water with compressed air. If steam is not available, place the cooler unit in a vessel and fill with carbon tetrachloride, or other suitable cleaner, to a level of at least, one inch above openings in the cooler plate. Force the dry-cleaning solvent back and forth through the plates with a force pump until unit is clean. CAUTION: *Cleaning with carbon tetra-*

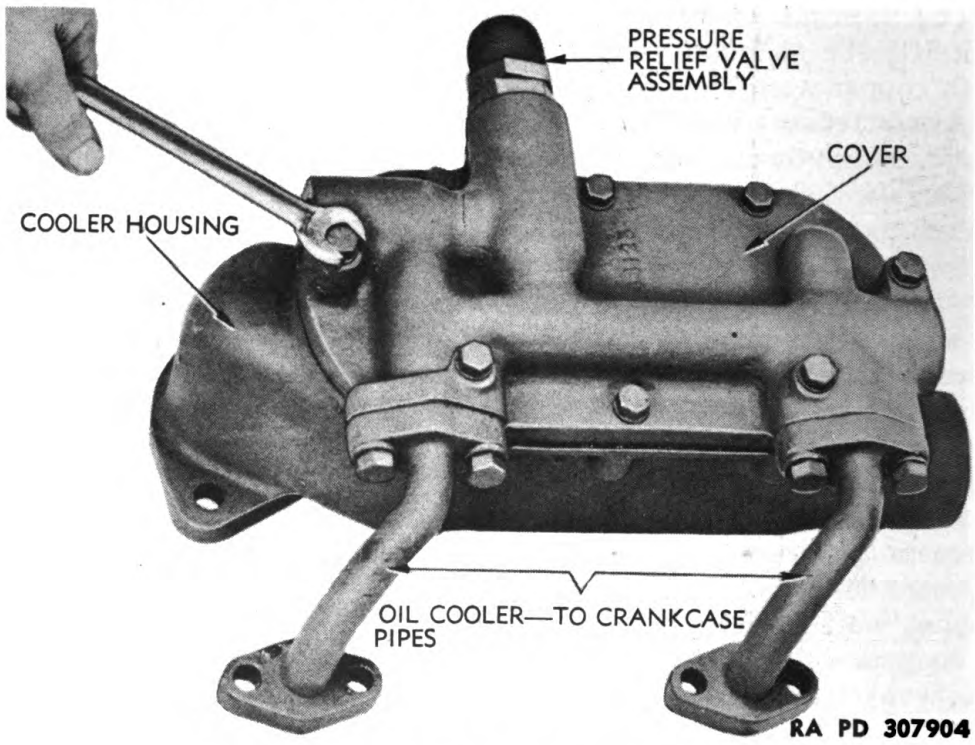


Figure 97 — Oil Cooler Cover Removal

chloride must be done in the open air, or with adequate ventilation, because of the toxic qualities of the chemical.

(2) INSPECTION. Inspect cooler element for leaks or corrosion. Some kinds of water contain agents that will attack and corrode this element. Replace element if leak or corrosion is evident. Inspect plunger of pressure relief valve, discard if scored.

d. Assembly of Oil Cooler.

(1) INSTALL AND ADJUST PRESSURE RELIEF VALVE. Insert relief valve plunger into cover (fig. 99), then install plunger spring and adjustment screw. Valve must now be adjusted to open with six-pound pressure. This can be done as follows: Plug the two holes (at bottom and inside of cover) in end of cover farthest from relief valve and remove the pipe plug from end of cover. Using proper fittings, connect an oil line with an oil pressure gage in the line to this hole and connect a suitable pump to other end of line. Turn adjustment screw of valve in, or out, until valve will open and allow oil to pass through and out of other end of cover with six-pound pressure registering on gage, as oil is pumped through. Then install copper gasket and lock nut on screw, tighten lock nut, and install second copper gasket and acorn nut. Remove plugs and oil line from cover and install pipe plug, using white on red lead on threads.

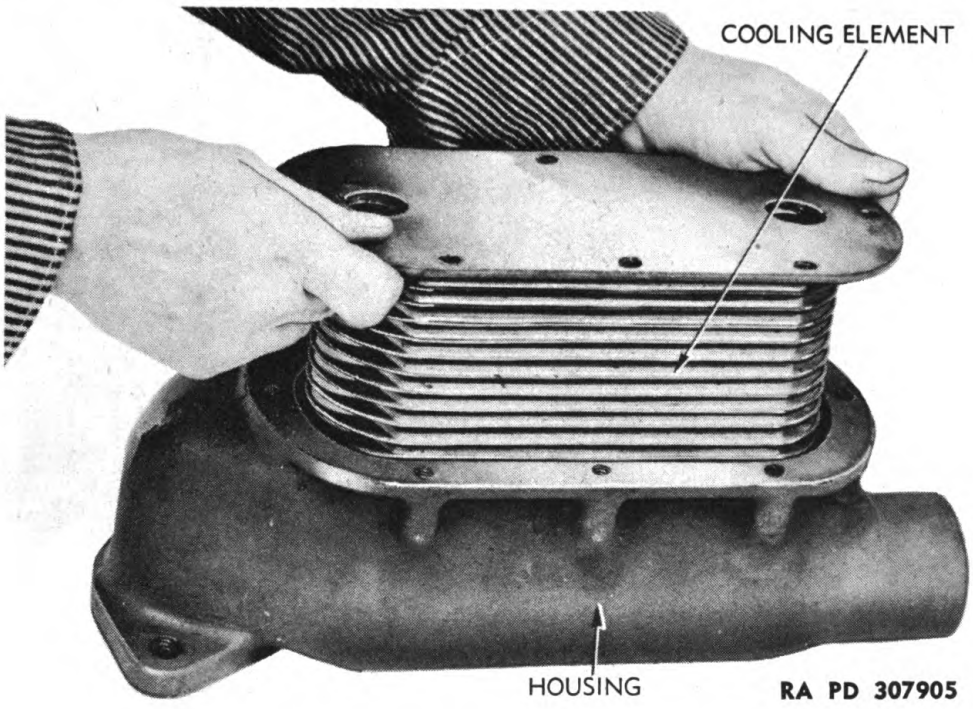


Figure 98 — Lifting Element From Oil Cooler Housing

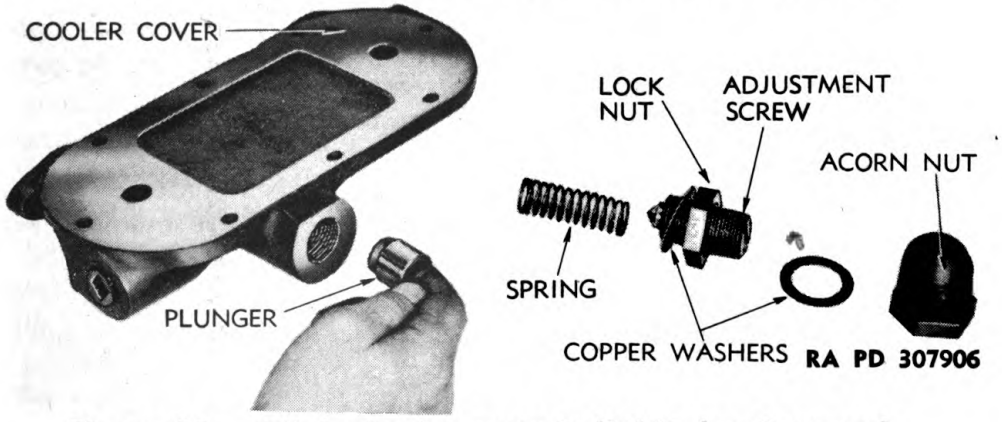


Figure 99 — Oil Cooler Pressure Relief Valve Removal

(2) ASSEMBLE ELEMENT AND HOUSING. Cement new gasket to cooler housing. Coat outer side of gasket with cement and set element in housing (fig. 98). Cement new gasket to outer plate of element, coat outer side of gasket with cement, set cover on element and housing, and attach with eight cap screws with lock washers (fig. 97). Use new gaskets and attach oil cooler to crankcase pipes to cooler cover as shown in figure 97 with two cap screws with lock washers in each.

39. LUBRICATING OIL PRESSURE RELIEF VALVE.

a. Description. Stabilized lubricating oil pressure is maintained

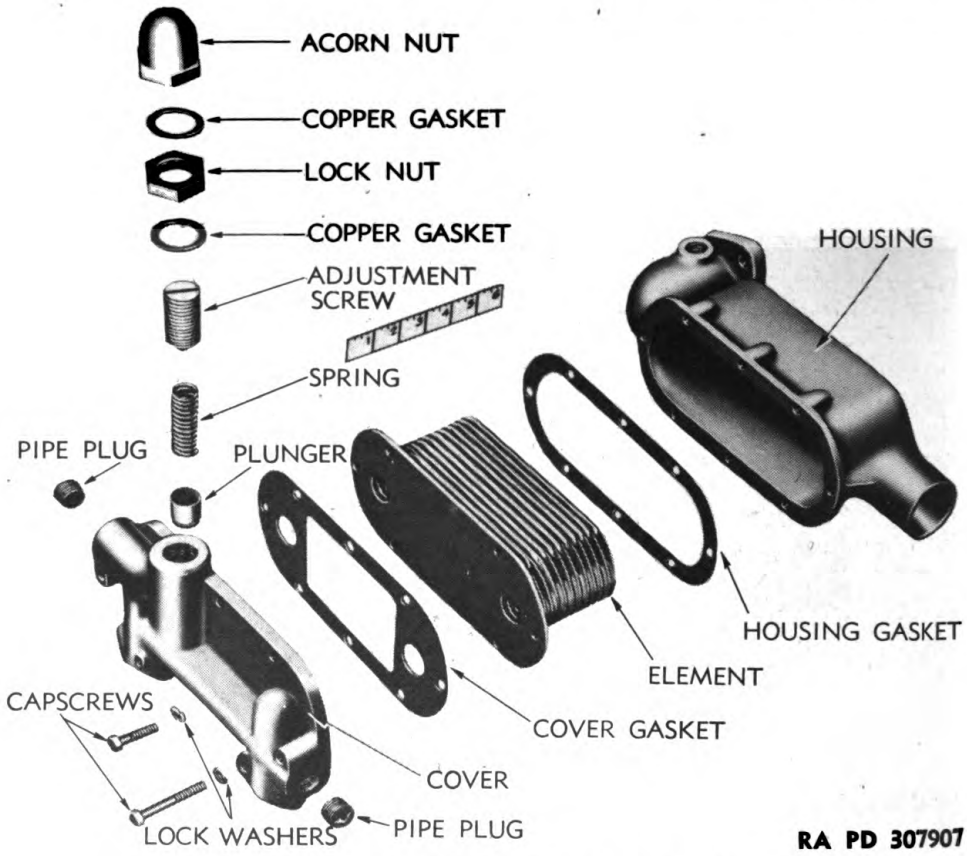


Figure 100 — Oil Cooler Assembly Disassembled

within the engine at all speeds, regardless of oil temperature by means of this regulator valve located on carburetor side of cylinder block under fuel pump where it engages with main oil gallery in block. It consists of a piston type valve, a spring, and an adjusting screw with an acorn nut cover. The valve is held on its seat by the spring, which is held in compression by the adjusting screw. When conditions are such that the oil pressure at the valve exceeds 40 pounds per square inch, the valve is lifted off its seat to open the vent of a drilled passage to the interior of the crankcase. The oil then flows through this passage to relieve the pressure. The amount of pressure needed to raise the plunger can be varied by turning the adjusting screw to increase, or lessen, the tension of the valve spring.

b. Disassembly and Assembly. The relief valve is disassembled in removal (par. 15 **s**). It is assembled when installed in cylinder block (par. 25 **b**).

c. Cleaning and Inspection of Parts. Wash parts with dry-cleaning solvent and dry with compressed air. Test valve for free movement in crankcase. Valve must be free from score marks and

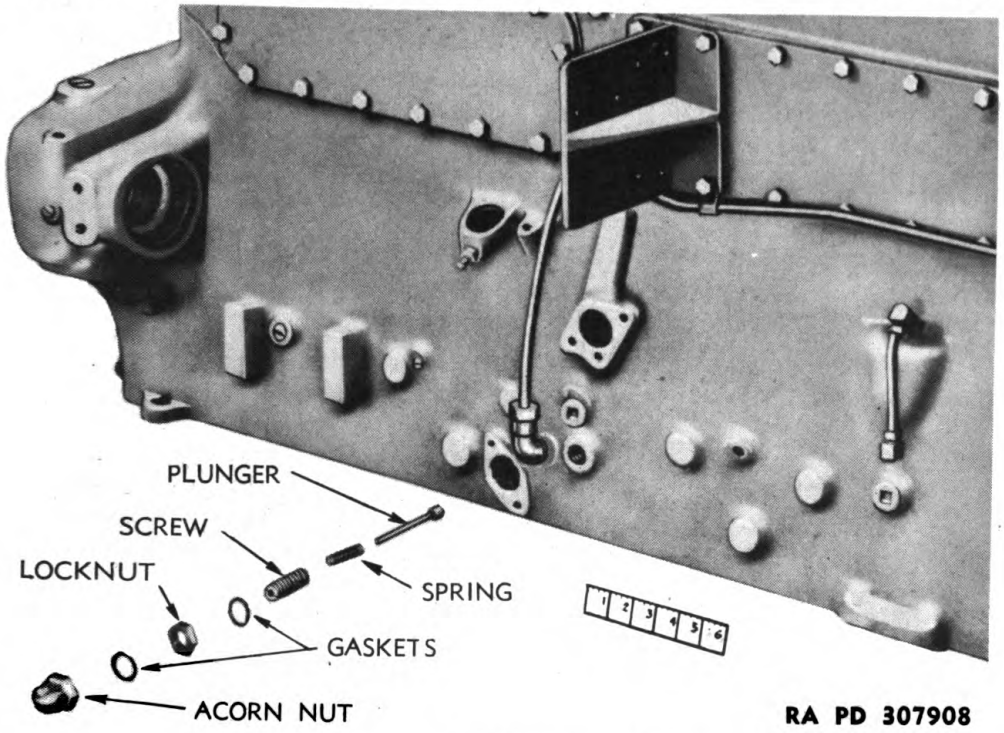


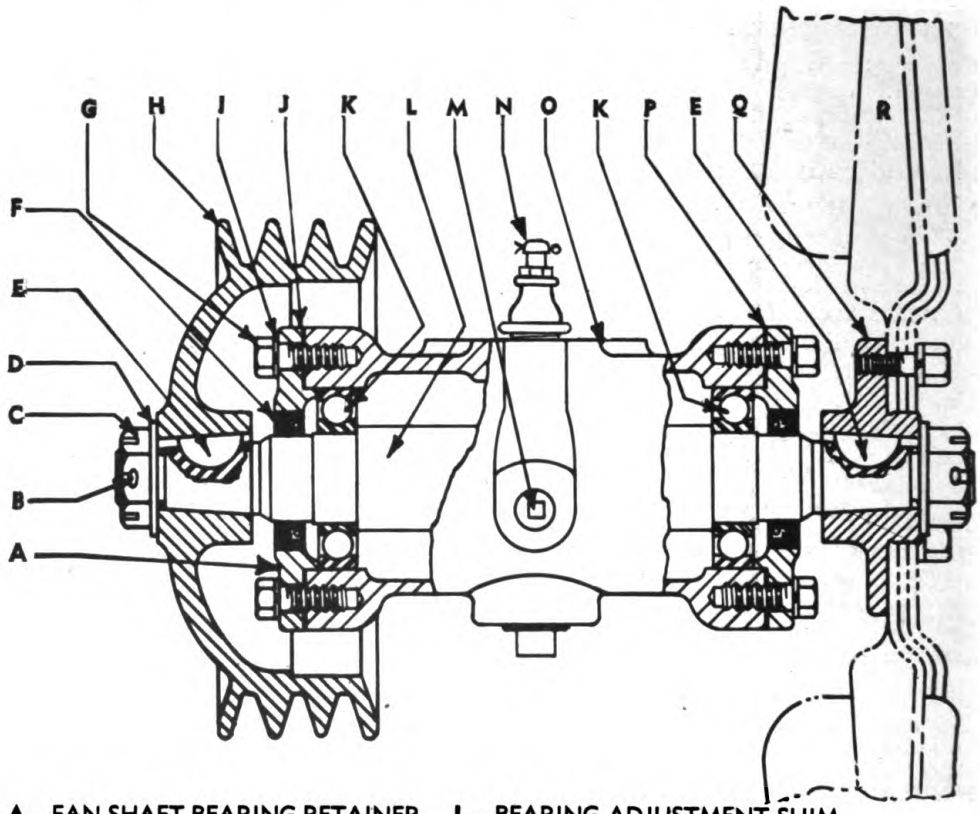
Figure 101 — Relief Valve Disassembled

seating surface must be flat. Discard valve spring if cocked or crystallized at any point.

d. Adjustment of Valve Opening Pressure. The valve must be adjusted for correct opening pressure after engine is installed and can be operated. Run engine until the oil has reached normal operating temperature, then stop engine. Remove the pipe plug on side of cylinder block directly above relief valve or the pipe plug towards flywheel housing and install an oil pressure gage in its place. Remove acorn nut cover from relief valve and loosen adjusting screw lock nut. Start engine, then turn adjusting screw in or out until 40 pounds pressure registers on gage with engine running at 1,500 revolutions per minute. After this adjustment has ben made, tighten lock nut and install acorn nut. Remove oil pressure gage and install pipe plug.

40. COOLING FAN.

a. Description. The fan assembly is mounted on a cross member of the radiator supporting frame of the tractor instead of on the engine. The 6-blade suction-type fan is driven by V-belts from the pulley on engine crankshaft through an L-shaped fan-drive gear arrangement (par. 41) and a pulley on end of fan shaft opposite fan. The purpose of the fan is to draw air through the radiator cores to speed cooling of the engine cooling liquid, transmission oil, and torque converter fluid as they are circulated through the radiators. The fan shaft is



A—FAN SHAFT BEARING RETAINER
B—COTTER PIN
C—SLOTTED NUT
D—WASHER
E—SHAFT KEYS
F—OIL SEAL
G—CAP SCREW
H—DRIVE PULLEY
I—LOCK WASHER
J—BEARING ADJUSTMENT SHIM
K—FAN SHAFT BEARINGS
L—FAN SHAFT
M—LEVEL PLUG
N—BREATHER FILLER PLUG
O—FAN SHAFT HOUSING
P—FAN SHAFT BEARING RETAINER GASKET
Q—FAN BLADE HUB
R—FAN BLADE ASSEMBLY RA PD 307909

Figure 102 — Fan Assembly — Cross Section

supported in the housing by two ball bearings. Oil is carried at a specified level in the housing for lubrication of the bearings. A breather in filler plug provides a vent for housing.

b. Disassembly of Fan Assembly (fig. 102).

(1) REMOVE FAN BLADE ASSEMBLY AND DRIVE PULLEY. Remove the six cap screws and lock washers attaching fan blade assembly to hub and remove fan blade assembly. Pull cotter pins from slotted nuts on ends of fan shaft and remove nuts and washers. Using puller (41-P-2905-60) as shown in figure 106 and pull drive pulley from shaft. Pull fan blade hub from other end of shaft with a gear puller. Pulley and fan hub may also be removed with arbor press if pullers are not available. Remove keys from slots in ends of shaft.

(2) REMOVE FAN SHAFT AND BEARINGS. Remove drain plug and drain oil from housing. Install plug after housing is drained. Remove four cap screws and lock washers and tap bearing retainer and shims from pulley end of housing. Screw fan shaft adapter (41-A-18-165) onto end of shaft, then, using puller (41-P-2905-60) with puller legs and end caps in similar manner as shown in figure 107, pull shaft and bearings from housing. Remove four cap screws and lock washers and tap bearing retainer from fan end of housing.

(3) REMOVE BEARINGS FROM SHAFT AND OIL SEALS FROM RETAINERS. Press shaft from bearings with arbor press or bearing puller. Press oil seals from bearing retainers with arbor press as shown in figure 115.

c. Cleaning and Inspection of Parts.

(1) CLEANING. Wash all parts with dry-cleaning solvent and dry with compressed air. CAUTION: *Do not spin bearings with compressed air after washing them.* Make sure opening in filler plug vent is cleaned thoroughly. Clean all gasket surfaces and file off any burs that would prevent a tight seal.

(2) INSPECTION. Inspect all parts for breaks or wear, discarding all worn or broken parts. Inspect fan blades, making sure they are not bent or cracked at center and that all rivets are tight. Roll bearings in their races, noting any tendency to bind and observe if balls or races are rough or corroded. Discard bearings that are corroded or do not roll smoothly. Replace oil seals if they are worn or brittle. In most cases these should be replaced with new seals when rebuilding fan assembly. Test magnetism of magnet in drain plug, replace if it will not attract and hold small metal particles. Replace worn shaft keys.

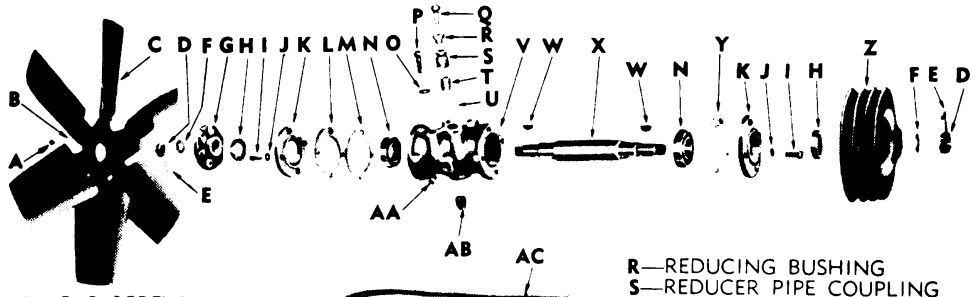


Figure 103 — Fan Assembly Disassembled

RA PD 307911

Figure 104 — Installing Fan Shaft and Bearings

d. Assembly of Fan Assembly. Refer to figures 102 and 103 for identification of parts.

(1) INSTALL FAN SHAFT AND BEARINGS IN HOUSING. Press a bearing onto each end of shaft against shoulders with numbered side of bearings towards ends of shafts. Drive or press bearings and shaft into housing (fig. 104). Housing and shaft are the same at both ends.

(2) INSTALL BEARING RETAINERS AND SHIMS. Press new oil seals into bearing retainers if old ones were removed with arbor press (fig. 115). Lips of seals should face inner side of retainers. Cement gasket to one of the retainers and install a retainer on one end of housing with four cap screws with lock washers. Use care to prevent folding of oil seal when retainer is installed. Install second retainer on opposite end of housing, using shims totaling approximately 0.050 inch in thickness between retainer and housing. After tightening retainer cap screws, test for end movement of shaft and bearings. Adjust for free rolling of shaft and bearings with no end play by adding or removing shims.

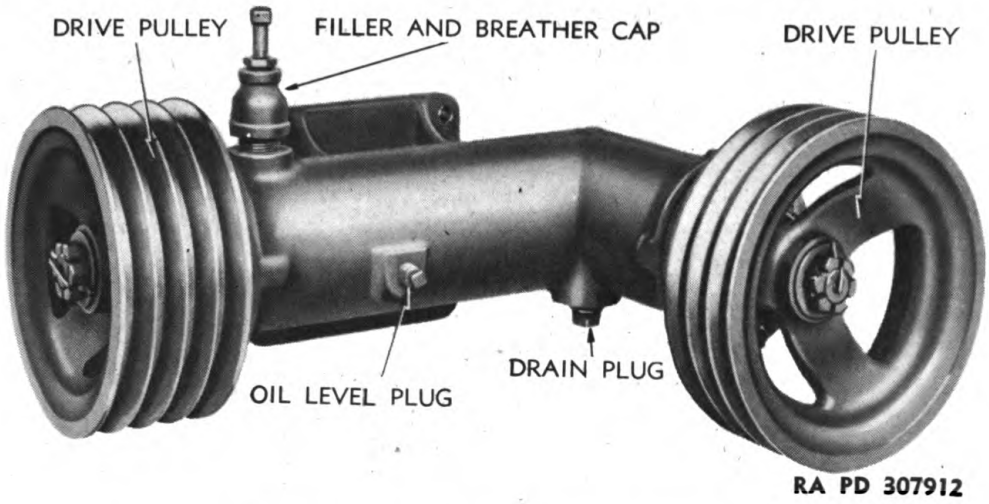


Figure 105 — Fan Drive Assembly

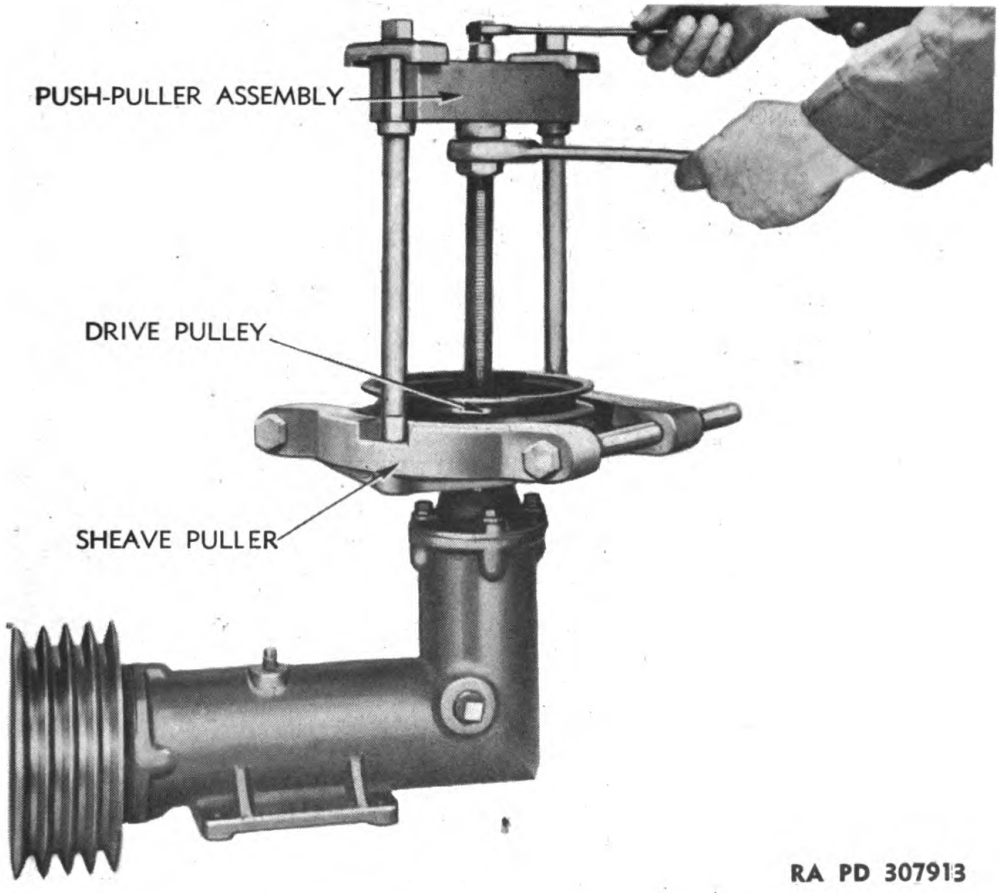


Figure 106 — Removing Fan Drive Pulley, Using Puller 41-P-2905-60

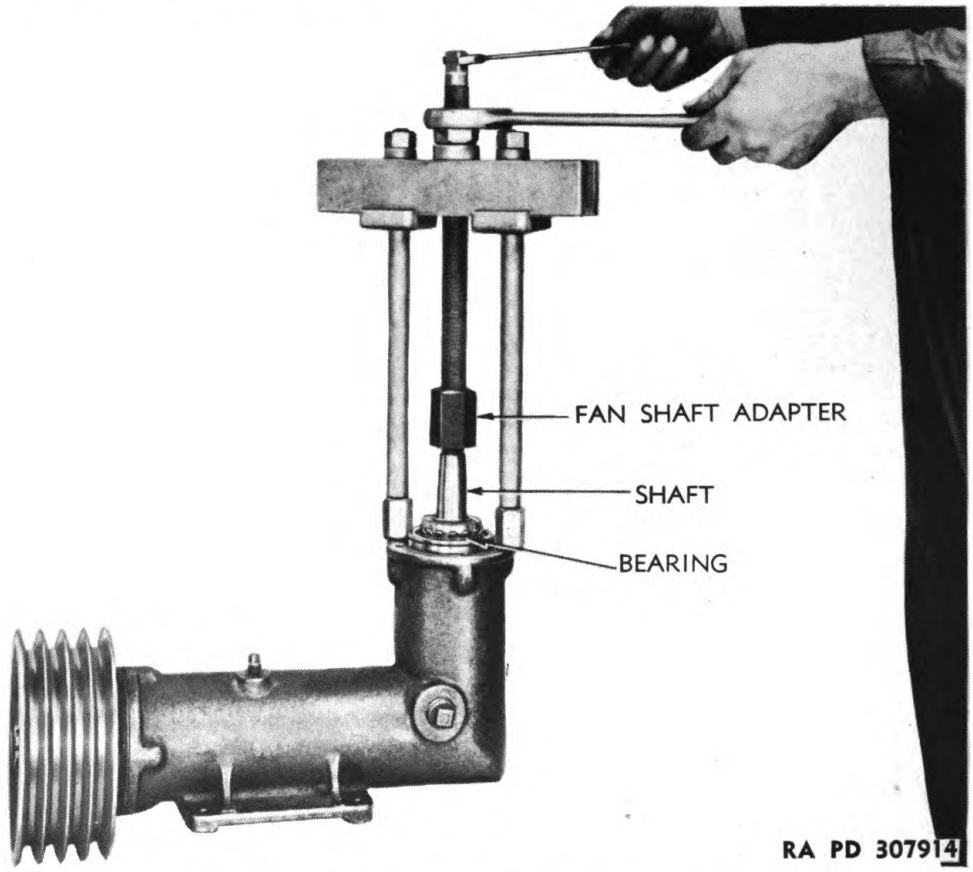


Figure 107 — Pulling Fan Drive Shaft and Bearings, Using Puller 41-P-2905-60 and Adapter 41-A-18-165

(3) INSTALL FAN BLADE ASSEMBLY AND DRIVE PULLEY. Tap keys into slots at ends of shaft. Tap drive pulley onto shaft and key, place flat washer on end of shaft and start slotted nut onto shaft. Install fan hub on opposite end of shaft in same manner, then draw pulley and fan hub tightly onto tapers of shaft by using a wrench on each nut. After tightening nuts, insert cotter pins through nuts and shaft.

(4) LUBRICATE ASSEMBLY. Tighten magnetic drain plug. With assembly in its normal upright position, fill housing with oil to level of the level plug in side of housing. Install and tighten level and filler plugs.

41. FAN DRIVE ASSEMBLY.

a. Description. Due to the fan and radiator being mounted at side of engine, instead of the usual place in front of engine, the L-shaped fan-drive assembly is necessary to provide a means of driving the fan by the engine crankshaft drive pulley. This assembly con-

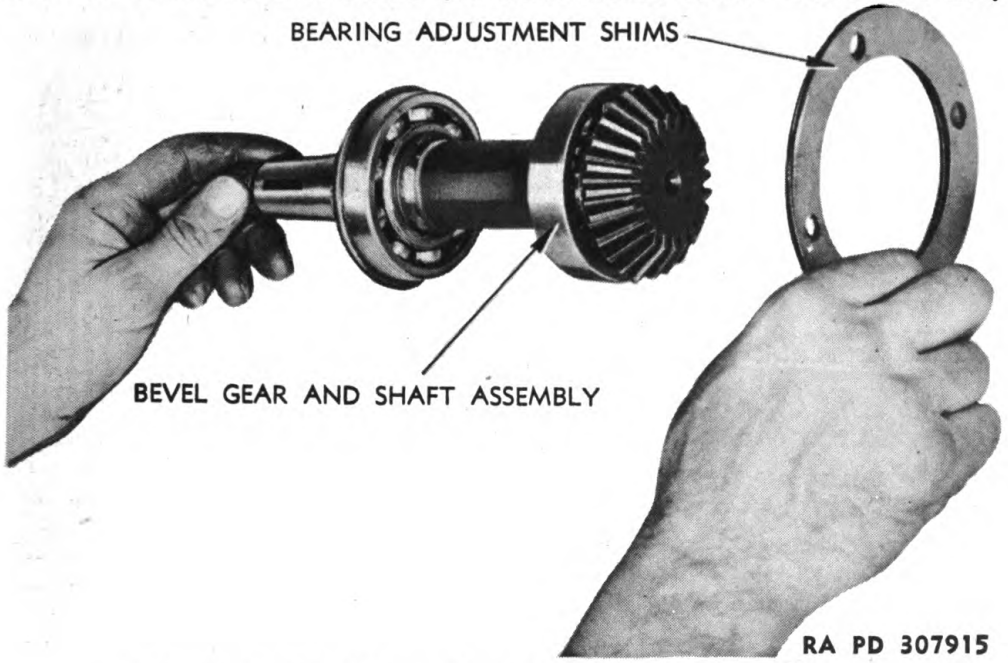


Figure 108 — Removing Gear Adjusting Shims

sists of an L-shaped housing containing two shafts with mating leveled gears at their inner ends and with belt pulleys mounted on their outer ends. Each shaft is supported in the housing by two ball bearings. The housing provides an oil reservoir for lubrication of the gears and bearings and is equipped with a breather in filler plug for venting purposes.

b. Disassembly of Fan Drive.

(1) REMOVE PULLEY FROM SHORT END OF DRIVE. Pull cotter pin and remove slotted nut and washer from end of shaft, using puller assembly (41-P-2905-60) as shown in figure 106 and pull drive pulley from shaft. Remove key from slot in shaft.

(2) REMOVE GEAR SHAFT AND BEARINGS. Remove four cap screws and lock washers and remove bearing retainer. Using adapter (41-A-18-165) and puller (41-P-2905-60) as shown in figure 107. Pull gear shaft and bearings from housing. Remove shims from outer bearing (fig. 108).

(3) REMOVE BEARINGS FROM GEAR SHAFT. Clamp gear shaft in vise. Bend prongs of lock washer out of bearing nut and remove nut from shaft (fig. 109) with spanner wrench (41-W-3250-10). Remove lock washer. Remove outer bearing from shaft with arbor press (fig. 110). Remove the two snap rings from grooves in shaft with snap ring pliers. Then press or pull inner bearing from shaft.

(4) REMOVE PULLEY AND GEAR SHAFT ASSEMBLY FROM LONG END OF DRIVE. Follow exactly the same procedure as in above steps to remove and disassamble parts in long end of drive housing.

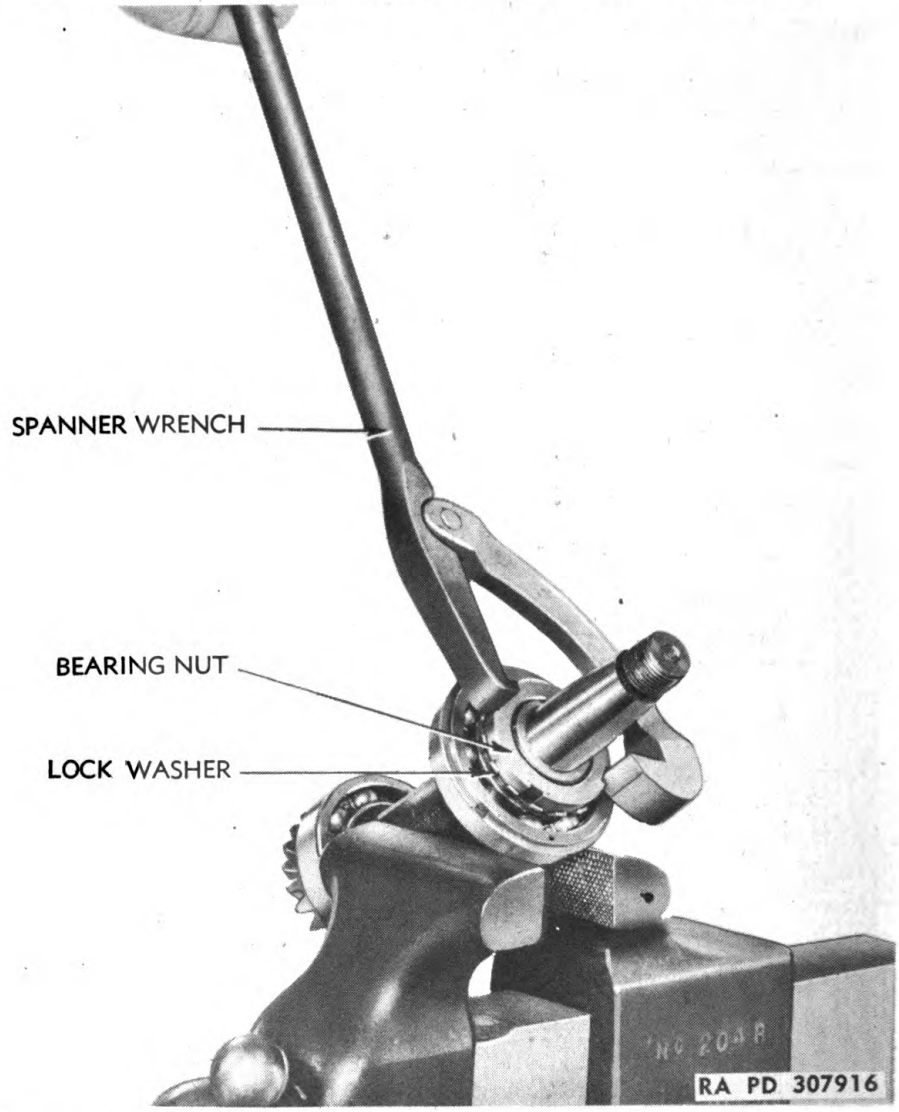


Figure 109 — Removing Gear Shaft Bearing Nut, Using Wrench 41-W-3250-10

c. Cleaning and Inspection of Parts. Wash all parts with dry-cleaning solvent and blow dry with compressed air. CAUTION: *Do not spin bearings with compressed air after washing them.* Inspect bearings closely; discard any that have rough, discolored, or corroded balls, or bearing races, or that show tendency to bind in any place when rolled by hand. Inspect for broken, worn, or cracked parts; replace these with new ones. File off any burs or nicks in mating surfaces of parts. Inspect gears on shafts. If gear teeth are worn or broken, replace with new shaft and gear. Test magnet of drain plug for magnetism, replace plug if magnet will not attract small metal particles. Make sure vent of filler plug is in good condition.

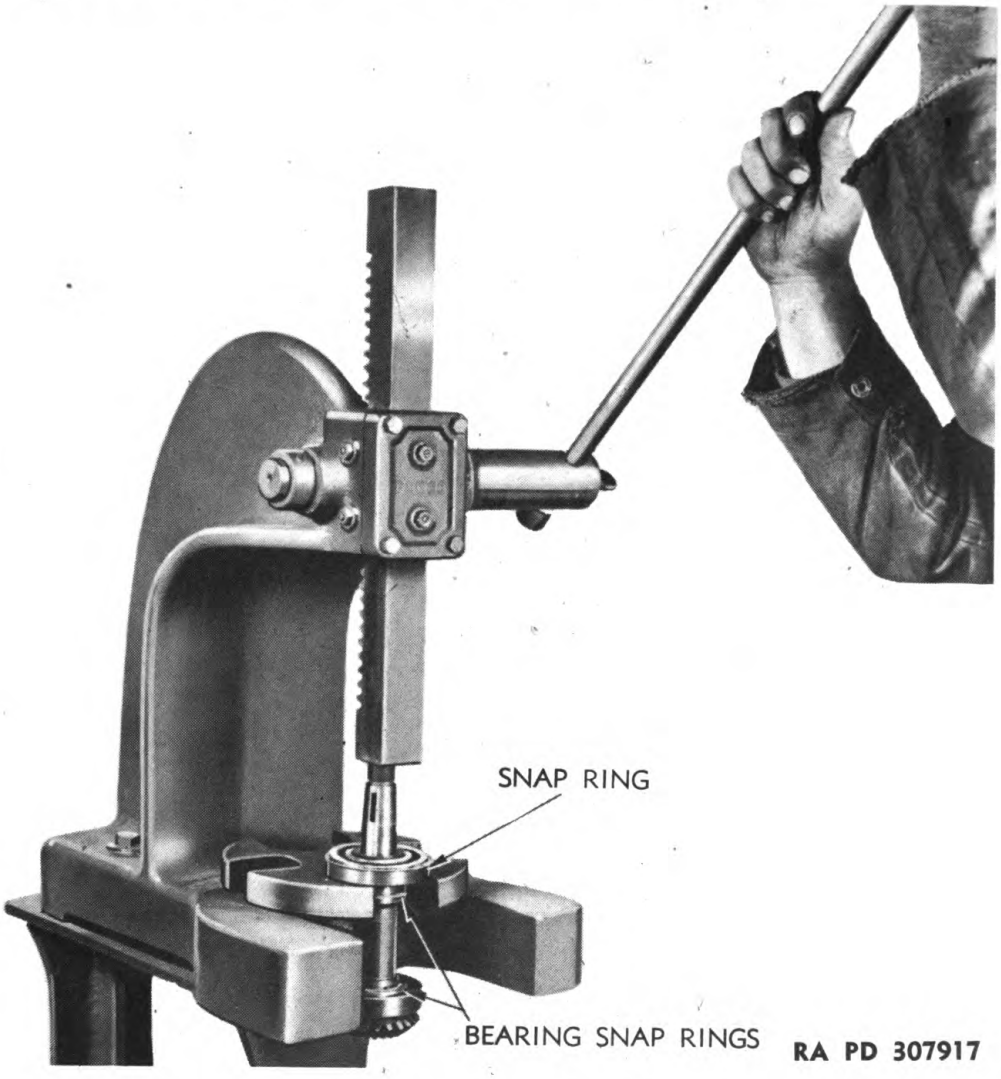


Figure 110 — Removing Bearings From Gear Shaft

d. Assembly of Fan Drive.

(1) ASSEMBLY GEAR SHAFT AND BEARINGS. Press inner bearing (without snap ring groove in outer race) onto shaft against gear. Install snap ring in groove of shaft next to bearing and install second snap ring in second groove in shaft (fig. 110). Install snap ring in groove of outer bearing race and press bearing onto shaft against snap ring in shaft (fig. 110). Place lock washer on end of shaft against outer bearing and install and tighten bearing nut with spanner wrench (fig. 113). After tightening nut, bend one or two prongs of lock washer into slots of nut.

(2) INSTALL GEAR SHAFT ASSEMBLY IN HOUSING. Place a total of approximately 0.050 inch of shims on outer bearing against snap ring and drive or press gear shaft and bearing assembly into housing

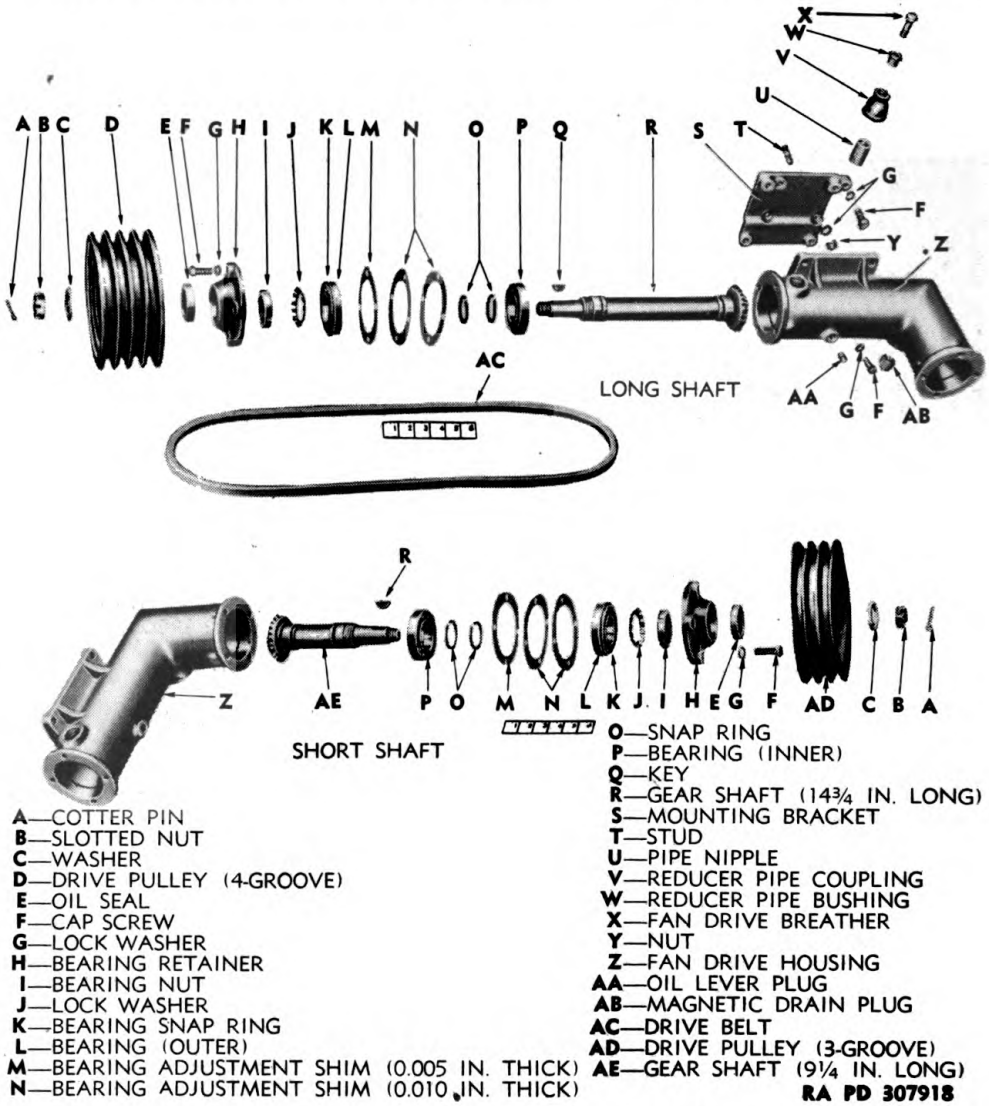


Figure 111 — Fan Drive Assembly Disassembled

(fig. 114). If oil seal was removed from bearing retainer, press new seal into cover (lip of seal towards inner side of retainer) as shown in figure 115. Install retainer on end of housing with four cap screws with lock washers (no gasket required). Be careful not to wrinkle or double back lip of oil seal when retainer is slipped onto shaft.

(3) ASSEMBLY AND INSTALL SECOND GEAR SHAFT AND BEARING ASSEMBLY. Install bearings on second gear shaft and install shaft and bearing assembly in other end of housing in exactly the same manner as explained in steps (1) and (2).

(4) ADJUST LEVEL GEARS. After both gear shafts and bearings are installed, the gears must be adjusted so that the heels of the teeth on gears are flush and gears have 0.008- to 0.010-inch back lash. With

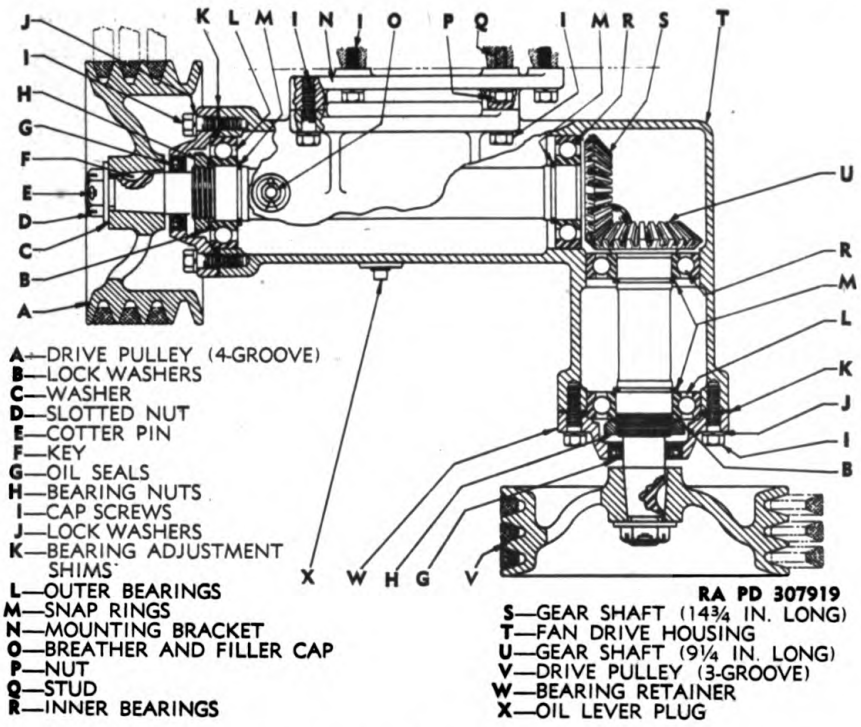


Figure 112 — Fan Drive Assembly — Cross Section

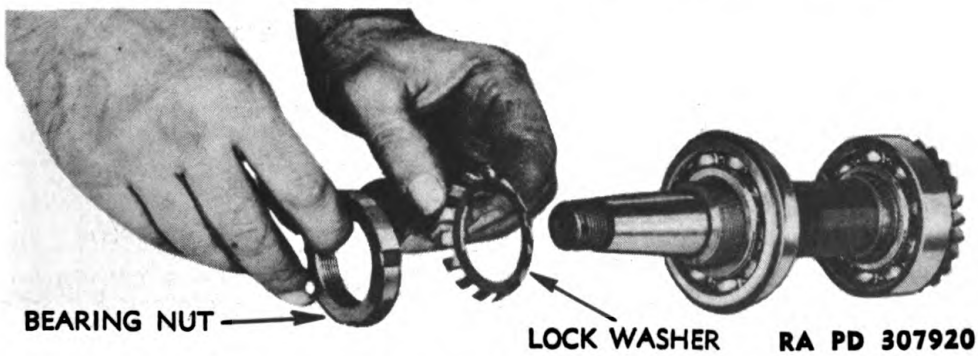


Figure 113 — Installing Lock Washer and Bearing Nut

drain plug under corner of housing removed, observe position of gears. Adjust for proper meshed position and back lash by adding or removing shims between retainers and ends of housing.

(5) INSTALL BELT PULLEYS. Tap keys into slots in ends of shafts and tap pulleys onto shafts and keys. Install 4-groove pulley on longer shaft, 3-groove pulley on shorter shaft. Then install flat washers against pulleys, install slotted nuts and draw pulleys tightly onto tapered ends of shafts. Secure nuts with cotter pins.

(6) LUBRICATE ASSEMBLY. Make sure drain plug is tight, then fill housing with oil to level of level plug. Install level and filler plugs.

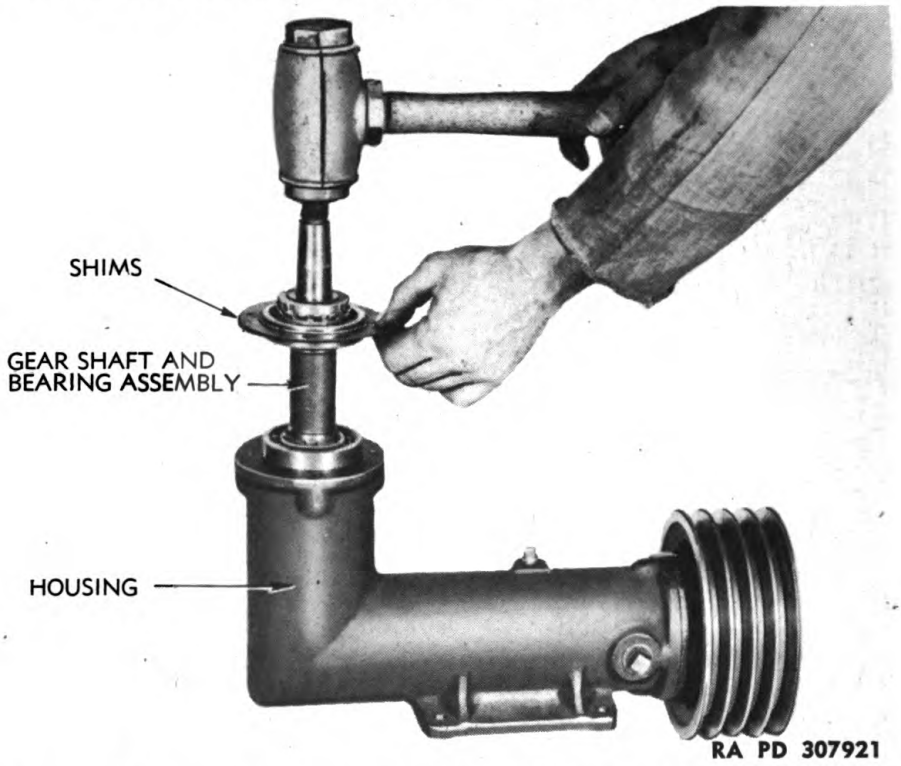


Figure 114 — Installing Gear Shaft Assembly in Housing

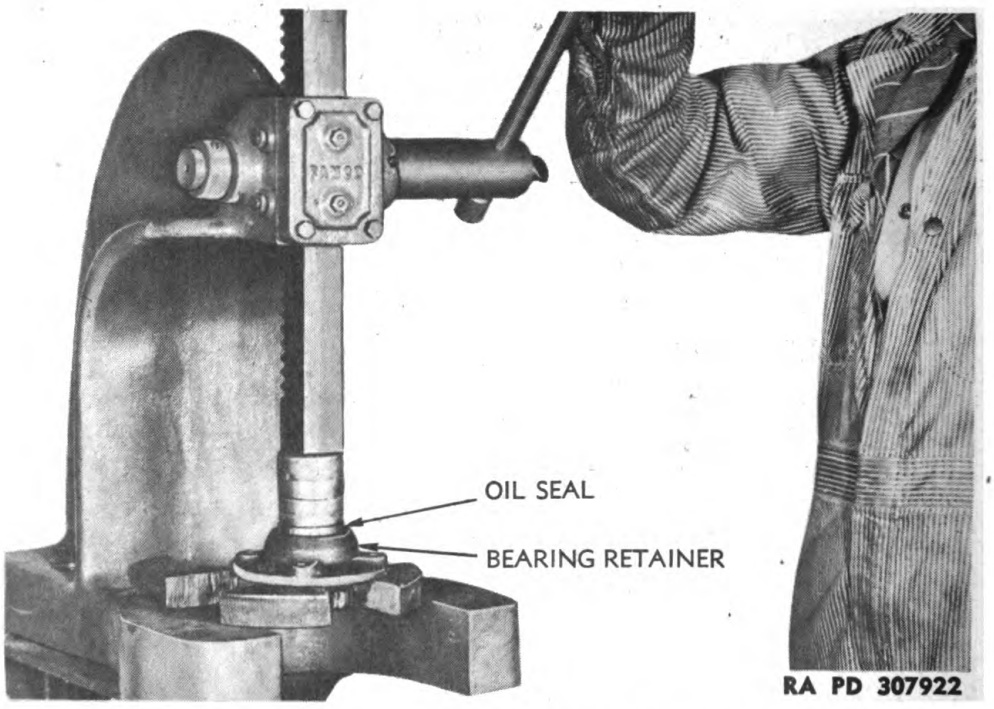


Figure 115 — Pressing Oil Seal Into Bearing Retainer

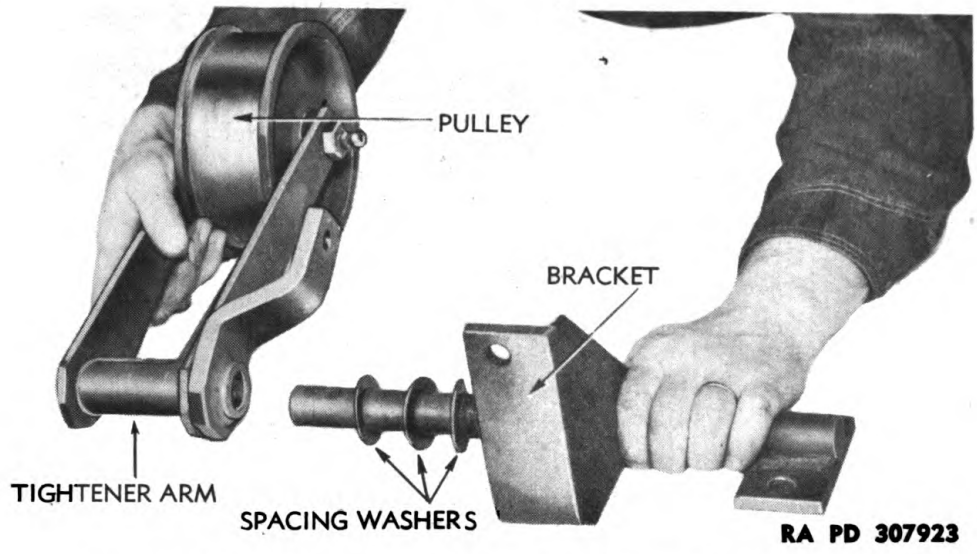


Figure 116 — Removing Tightener Arm From Bracket

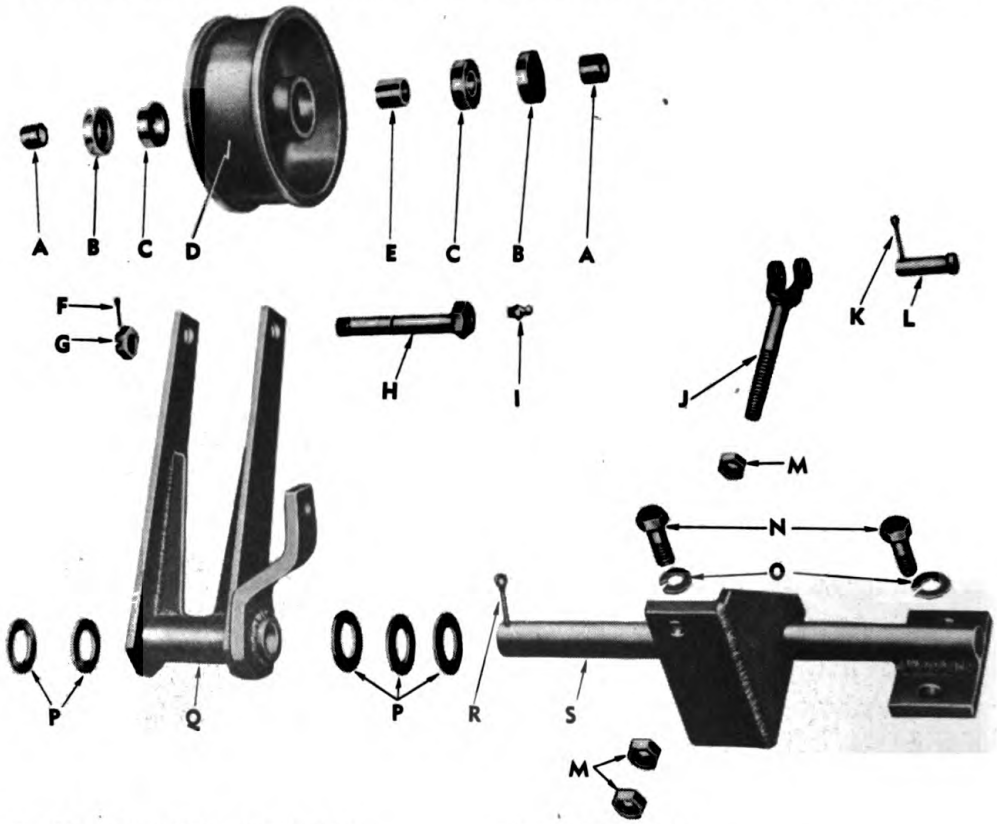
42. FAN BELT TIGHTENER.

a. Description. The fan belt tightener is mounted on the fuel tank of the Medium Tractor, M4, and provides a means of maintaining correct tension on the fan belts. It consists of a ball bearing-equipped flanged pulley mounted on a tightener arm which pivots on a shaft in mounting bracket. An adjusting rod connected to tightener arm provides for belt tension adjustment.

b. Disassembly of Tightener. Pull cotter pin and slide the two outer flat washers, tightener arm, and three inner spacing washers off pivot shaft (fig. 116). Remove lubrication fitting from end of pulley shaft. Pull cotter pin and remove slotted nut from shaft, then drive, or press, shaft, out of tightener arm and pulley. Slip spacers out of ends of pulley hub, then, using pilot bearing puller as in figure 123, pull bearings and oil seals from pulley. Remove inner bearing spacer.

c. Cleaning and Inspection of Parts. Wash all parts in dry-cleaning solvent and blow dry with compressed air. Inspect bearings; replace bearings if balls, or races, are discolored, rough, pitted, or corroded, or if they do not spin freely when turned by hand. **CAUTION:** *Do not spin bearings with compressed air after washing.* Replace oil seals if worn, or brittle, unless soaking them in warm oil will make them serviceable. Replace bracket or tightener arm if worn. Repair broken parts by welding if practical. Make sure lubricant passage in pulley shaft is open and clean and that threads of adjusting rod bolt are in good condition.

d. Assembly of Tightener. Lubricate bearings with light engine oil and press one bearing into counterbore of pulley against shoulder. Press oil seal into hub (fig. 118) until seal is flush with end of hub



A—SPACER (11/16 IN. LONG)
B—OIL SEAL
C—BEARING
D—PULLEY
E—BEARING SPACER (0.908 IN. LONG)
F—COTTER PIN
G—SLOTTED NUT
H—TIGHTENER SHAFT
I—LUBRICATING FITTING
J—ADJUSTING ROD
K—COTTER PIN
L—YOKE PIN
M—ADJUSTING ROD NUTS
N—CAP SCREWS
O—LOCK WASHERS
P—SPACING WASHERS
Q—TIGHTENER ARM
R—COTTER PIN
S—TIGHTENER BRACKET

RA PD 307924

Figure 117 — Fan Belt Tightener Disassembled

(lip of seal towards end of hub). Turn pulley over and drop inner bearing spacer (0.908 inch long) into hub against installed bearing and press second bearing into hub against spacer (fig. 119). Aline spacer with bearings at this time. Press second oil seal into hub in same manner as seal in opposite end. Set outer spacers in place by pushing one through each oil seal, using care not to damage or double lips of seals. Hold pulley assembly and tightener arm as shown in figure 120 and tap shaft through arm and pulley. Install and tighten slotted nut on end of shaft. Secure nut with cotter pin. Screw lubrication fitting into end of shaft. Slip three flat spacing washers onto pivot shaft of bracket, then slide tightener arm onto shaft as shown in figure 116. Place two more spacing washers on shaft and install cotter pin in end of shaft. With one nut on adjusting rod, insert end of

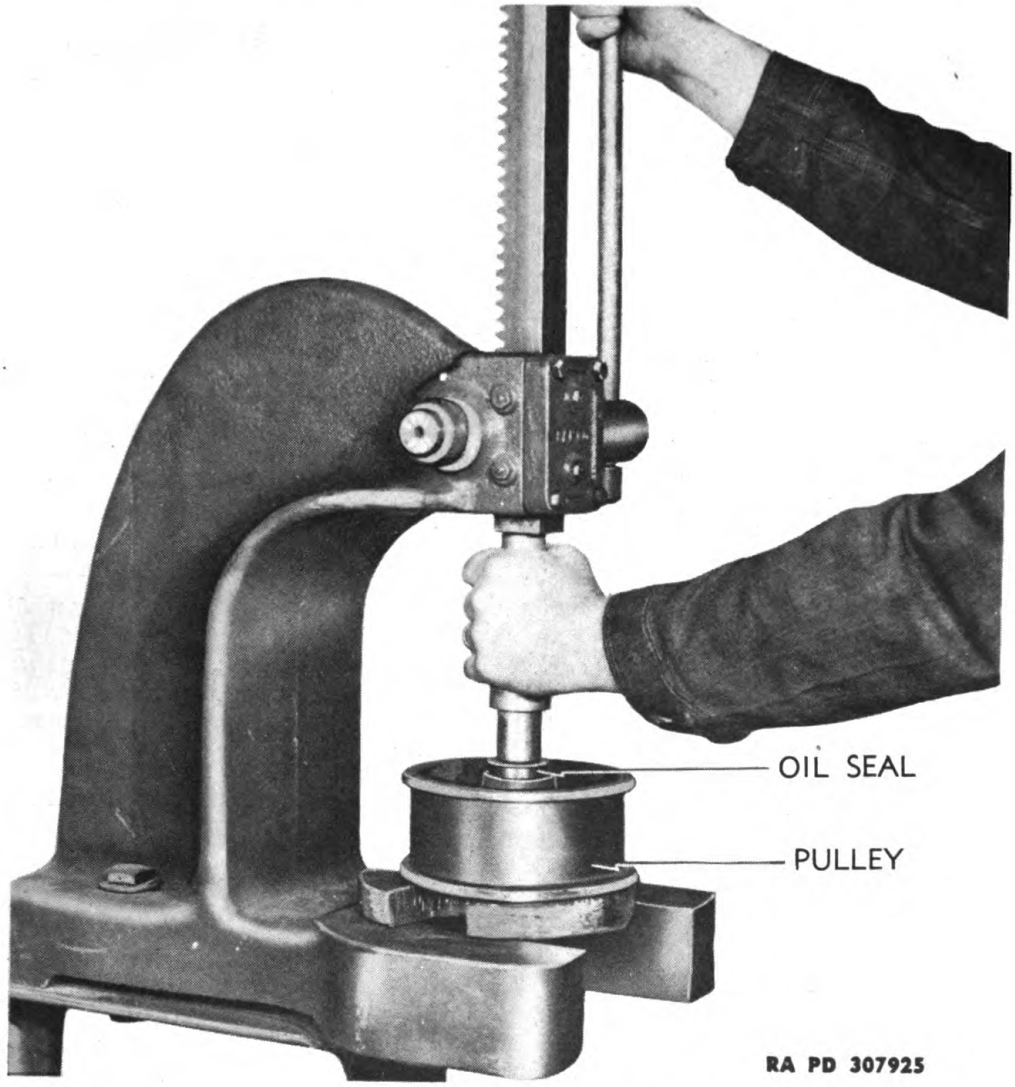


Figure 118 — Pressing Oil Seal Into Pulley Hub

rod through hole in pivot shaft bracket and connect yoke of rod to tightener arm lever with yoke pin and cotter pin. Install two more nuts on outer end of adjusting rod. Lubricate assembly.

43. FAN DRIVE BELT TIGHTENER.

a. Description. The fan drive belt tightener is mounted on drive pulley end of cylinder block and provides a means of maintaining correct tension on the crankshaft to fan drive belts. It consists of a ball bearing-equipped flanged pulley mounted on a tightener arm which pivots on a pin projecting from the mounting bracket. An adjusting rod connected to tightener arm provides for belt tension adjustment.

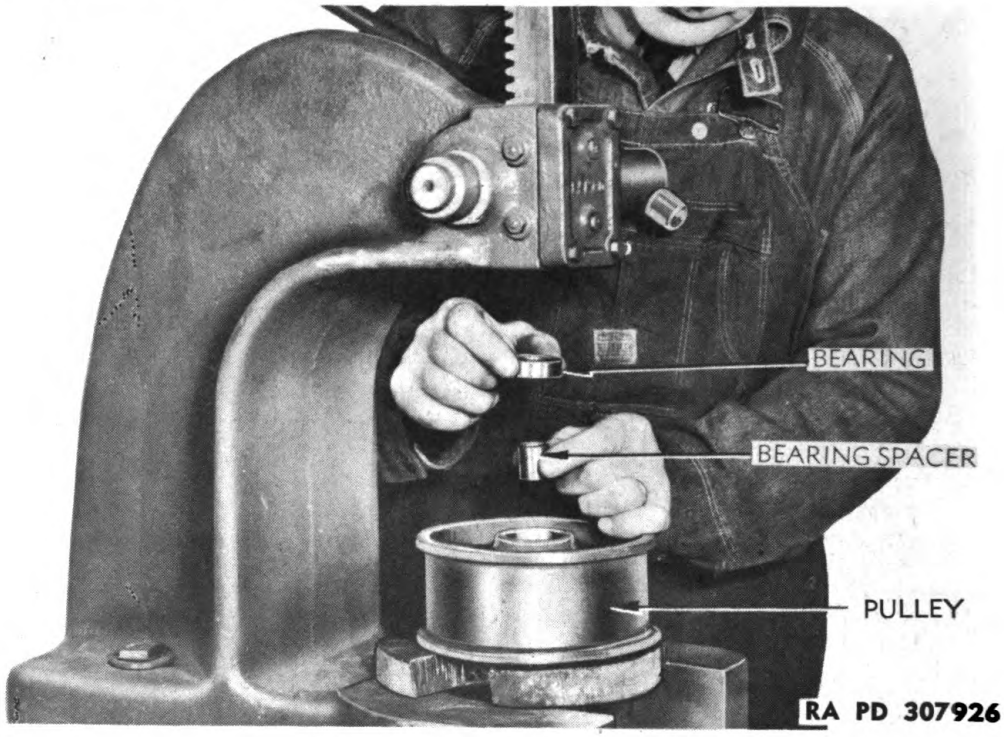


Figure 119 — Installing Inner Spacers and Second Bearing

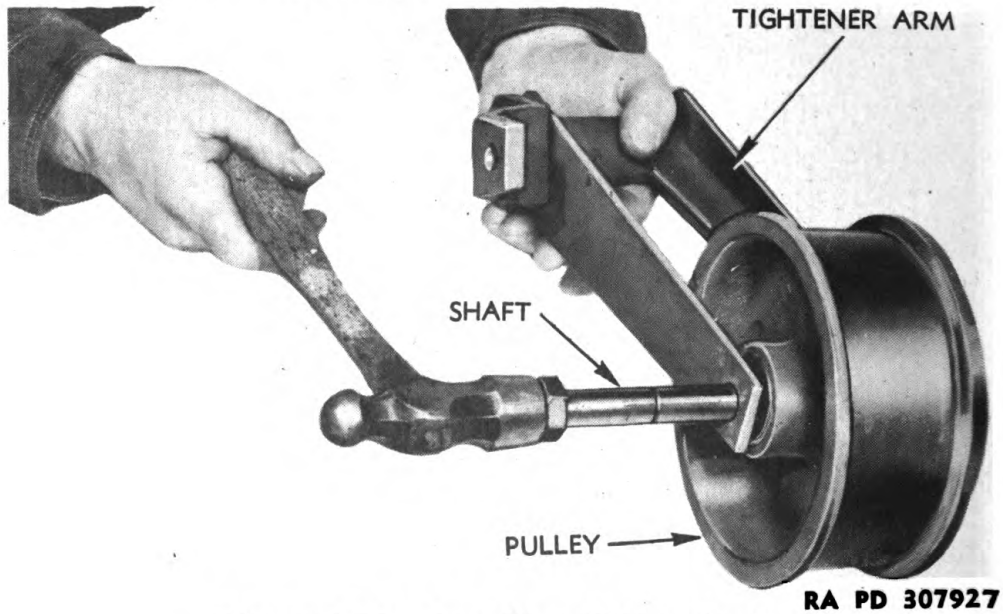


Figure 120 — Installing Pulley Shaft

b. Disassembly of Tightener. Pull cotter pin and remove yoke pin from belt tightener arm and yoke of adjusting bolt (fig. 121). Remove cotter pin and washer from tightener pivot pin and slide tightener arm off pin. Remove three cap screws and lock washers

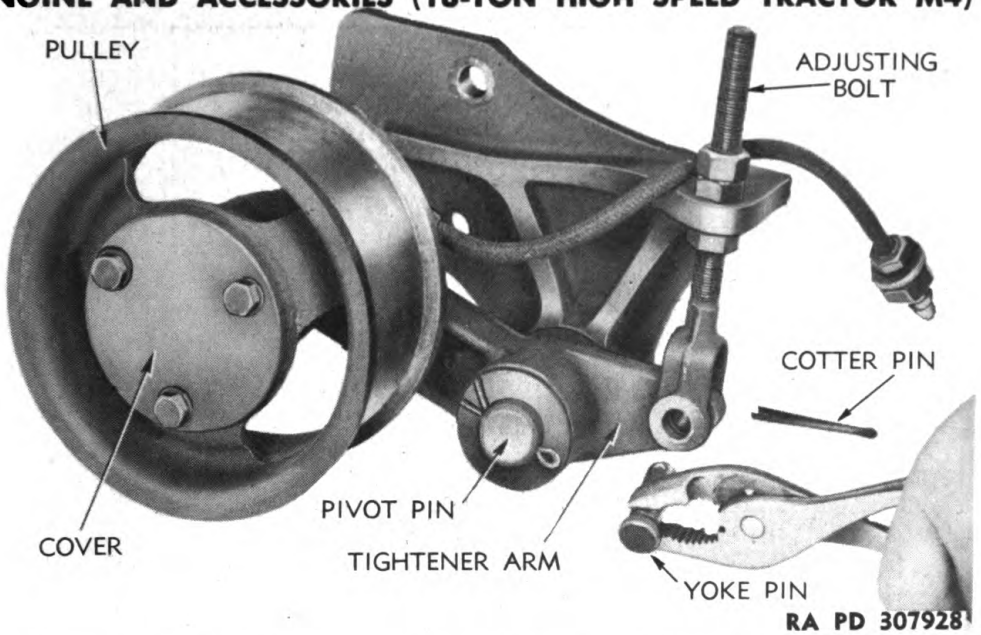


Figure 121 — Disconnecting Adjusting Rod From Tightener Arm

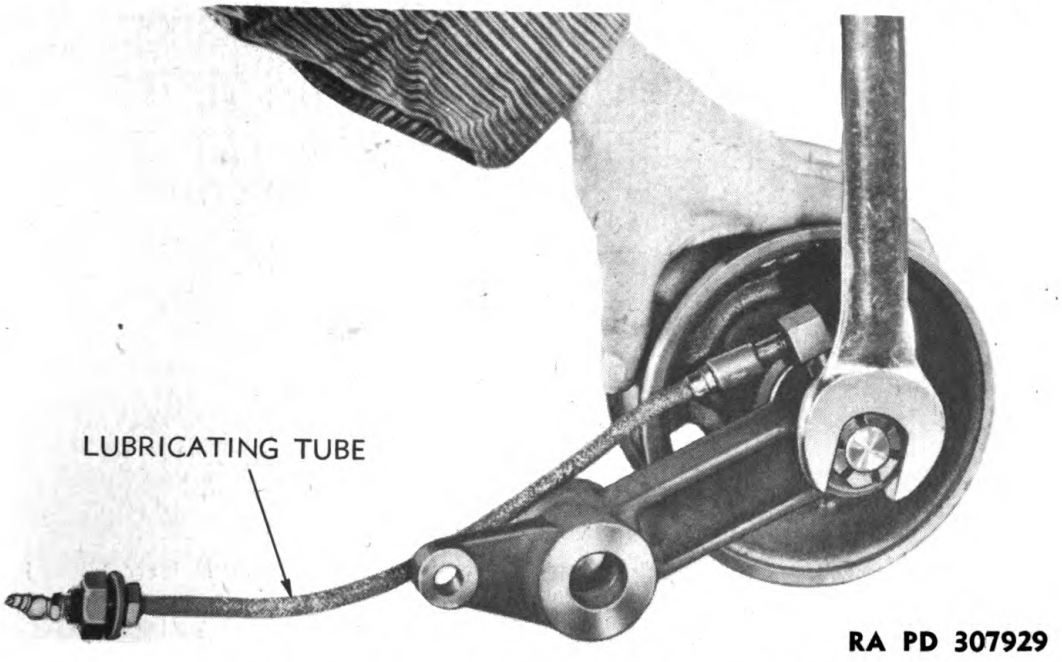


Figure 122 — Removing Slotted Nut From Tightener Shaft

and remove cover from pulley. Pull cotter pin and remove slotted nut from rear end of pulley shaft (fig. 122). Tap shaft out of arm and pulley bearings. Unscrew lubricating oil tube from fitting on arm. Use a pilot bearing puller (41-P-2905-60), as shown in figure 123 and pull outer bearing from pulley. Remove inner bearing spacer (fig. 124), then, using same puller, pull the outer bearing, oil seal,

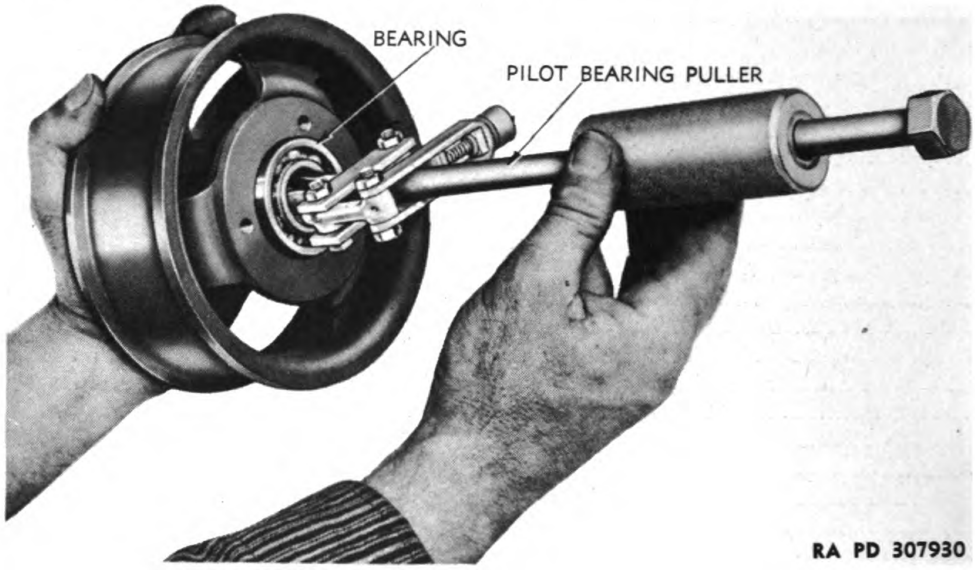


Figure 123 — Removing Tightener Bearing, Using Puller 41-P-2905-60

and spacer from pulley. Remove adjusting bolt (fig. 121) by removing the two nuts from outer end of bolt.

c. Cleaning and Inspection of Parts. Wash all parts in dry-cleaning solvent and blow dry with compressed air. CAUTION: *Do not spin bearings with compressed air after washing them.* Inspect ball bearings; discard any that have discolored, rough, pitted, or corroded balls or races, or that do not roll freely when turned by hand. Replace oil seal if worn, also pivot pin in bracket. Repair breaks in tightener arm or bracket by welding. Inspect threads of tightener adjusting rod, if not in good condition, replace rod. Clean lubricating tube by forcing clean grease through tube, inspect at same time for leak in tube; replace if necessary with new tube. Make sure passage in shaft for delivery of lubricant to pulley bearings is open and clean.

d. Assembly of Tightener. Lubricate bearings with light engine oil. Press inner ball bearing into counterbore in long end of pulley. Press pulley shaft through outer bearing, slip inner bearing spacer onto shaft, then insert threaded end of shaft through hub and inner bearing and press on shaft until outer bearing is against shoulder in cover end of pulley hub. Press oil seal into inner end of hub (lip of seal facing away from bearing) until it is flush with hub. Then slip outer spacer onto shaft and press it through oil seal and against bearing. Insert end of shaft through tightener arm, install flat washer on shaft, then install slotted nut and tighten firmly (fig. 122). Secure nut with cotter pin. Cement gasket to pulley cover and install cover on pulley with three cap screws with lock washers (fig. 121). Slide

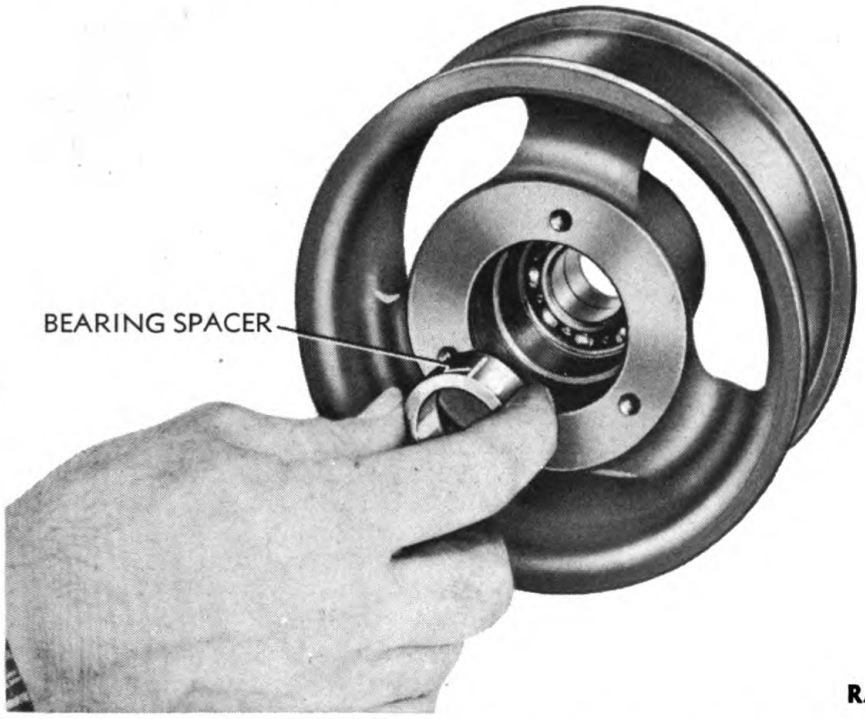


Figure 124 — Removing Inner Bearing Spacer

tightener arm onto pivot pin in bracket as shown in figure 116 and secure with washer and cotter pin. Install adjusting rod in bracket as shown in figure 121 and connect yoke to tightener arm with yoke pin and cotter pin. Screw lubricating tube fitting into tightener arm and connect tube to fitting. Fill pulley with lubricant.

44. WATER PUMP.

a. Description.

(1) CONSTRUCTION. The water pump assembly is of the centrifugal type and is driven by the idler gear. A cast iron impeller with straight blades is pressed on to the water pump shaft and is pinned with two taper pins through hub and shaft. The shaft is surface hardened to resist wear and corrosion. A pressed bronze bushing supports the shaft at the rear. A single row, double-shielded ball bearing supports the shaft at the drive end. This ball bearing is filled with lubricant when assembled. No further lubricant is necessary. An oil slinger clamped between the driving gear and the ball bearing spacer, shrouds the ball bearing and prevents lubricating oil from finding its way past the bearing. The water pump is sealed against leakage of water by means of a spring-loaded carbon seal. A synthetic rubber grommet incorporated in the seal assembly provides further protection against leakage. The complete seal assembly rotates with the impeller and is located so that the correct amount of spring pres-

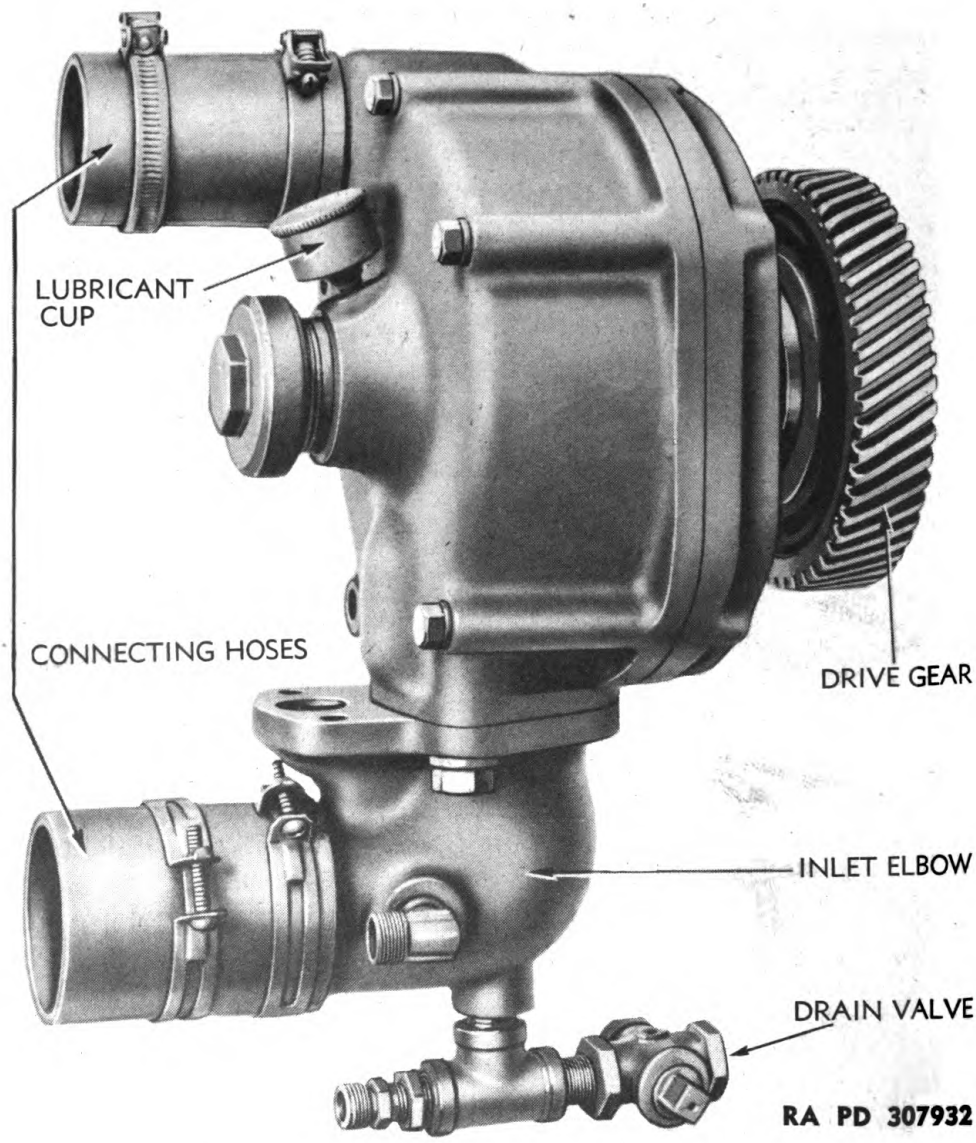


Figure 125 — Water Pump Assembly

sure forces the carbon disk against the smooth surface of a bronze insert in the water pump cover. Providing an occasional drop of water passes the seal, it is deflected by a slinger into a grooved channel and drains to the outside, through a drilled hole in the water pump cover. In this way water is prevented from reaching the ball bearing. A threaded cap covers the shaft opening in the water pump body, and prevents entry of dirt and loss of water which passes the rear bushing. Water passing the rear bushing is drawn from the rear compartment through a drilled opening which leads to the suction side of the pump housing.

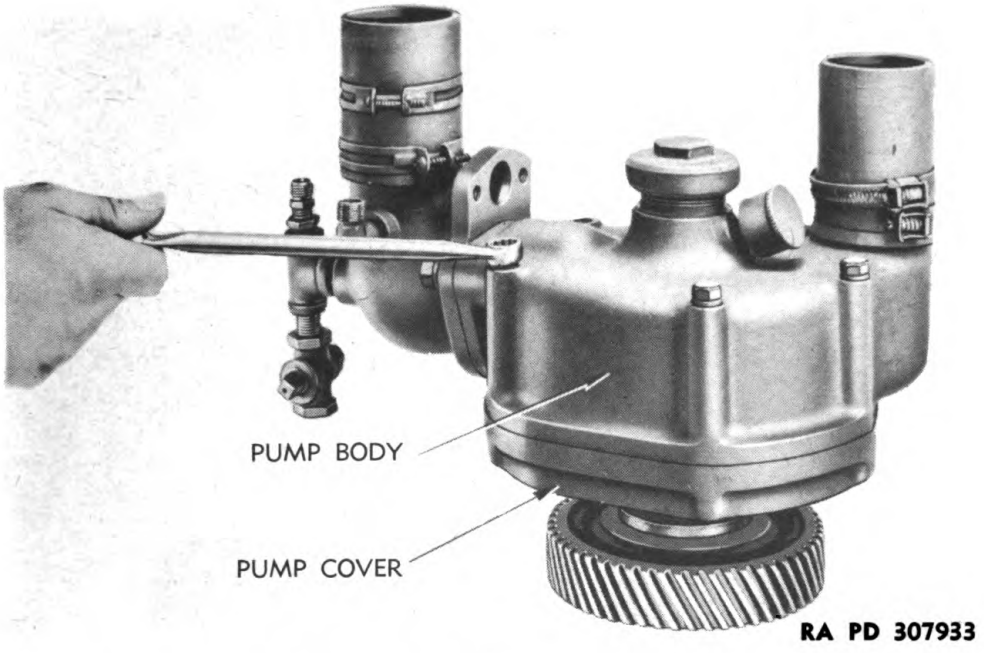


Figure 126 — Removing Water Pump Body From Cover

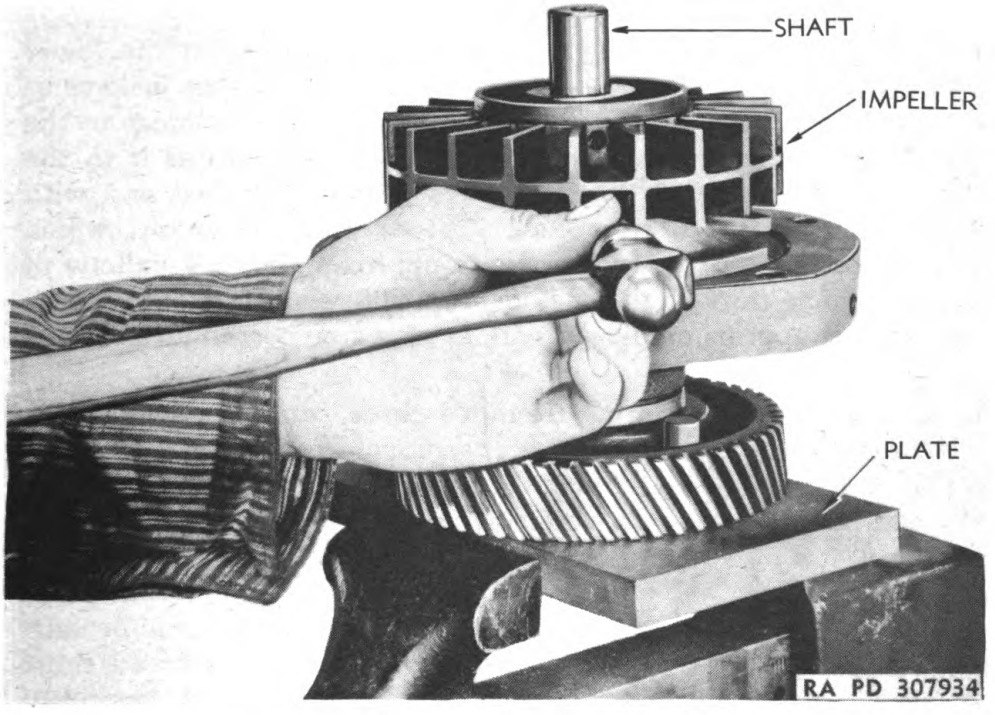


Figure 127 — Driving Pins From Impeller and Shaft

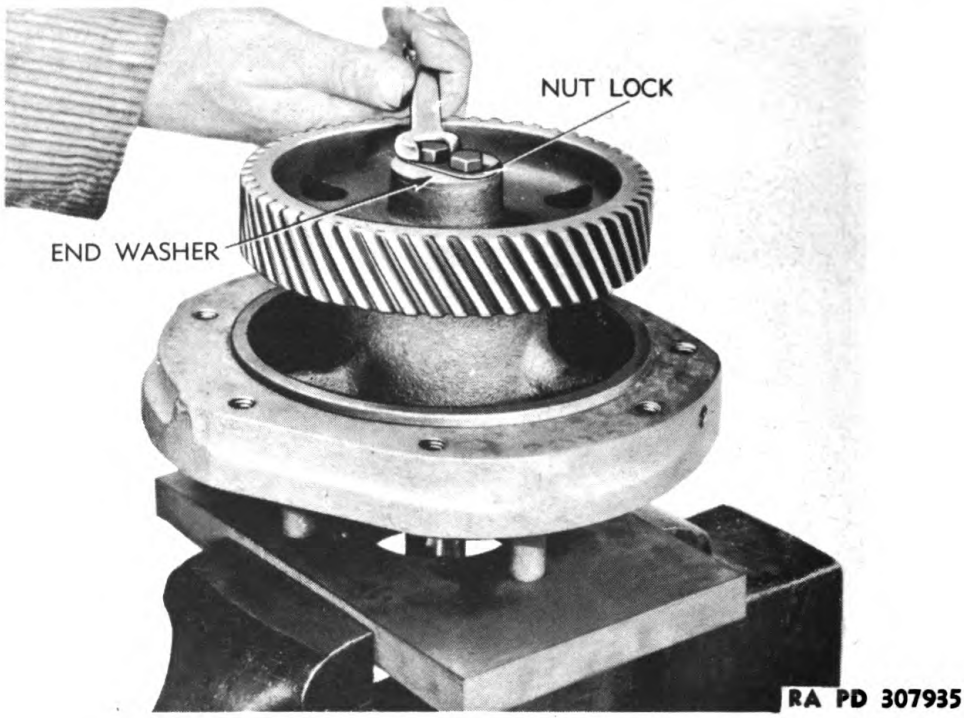


Figure 128 — Removing Pump Shaft End Cover

(2) OPERATION. The water pump draws water from the lower radiator connection and circulates it through the water jackets of the engine. Then it forces the heated water through openings in the cylinder heads into the top water pipe and finally returns it to the top tank of the radiator. With thermostat units installed and with engine operating at 2,100 revolutions per minute, the pump, which runs at ½ engine speed, will circulate approximately 74 gallons of water per minute through the engine. At 1,500 revolutions per minute of the engine, approximately 46 gallons of water per minute will be circulated through engine.

b. Disassembly of Pump. Remove three cap screws and lock washers remaining in pump body after removal from engine (fig. 126), pry body loose from cover, and lift body from cover. Pump inlet elbow and hose may be removed from cover if gaskets or hose are to be replaced. In illustrations of disassembly, a special puller assembly consisting of a puller and stud plate is shown, however, an arbor press and standard gear pullers may be used. Clamp drive gear in soft-jawed vise and drive the two tapered pins from impeller and shaft (fig. 127). Pull or press impeller from shaft. Seal assembly (fig. 134) will remain in impeller hub. Since shafts are apt to be encrusted due to deposits from the water and because the impeller is a press fit on shaft, it should not be removed unless a new shaft is

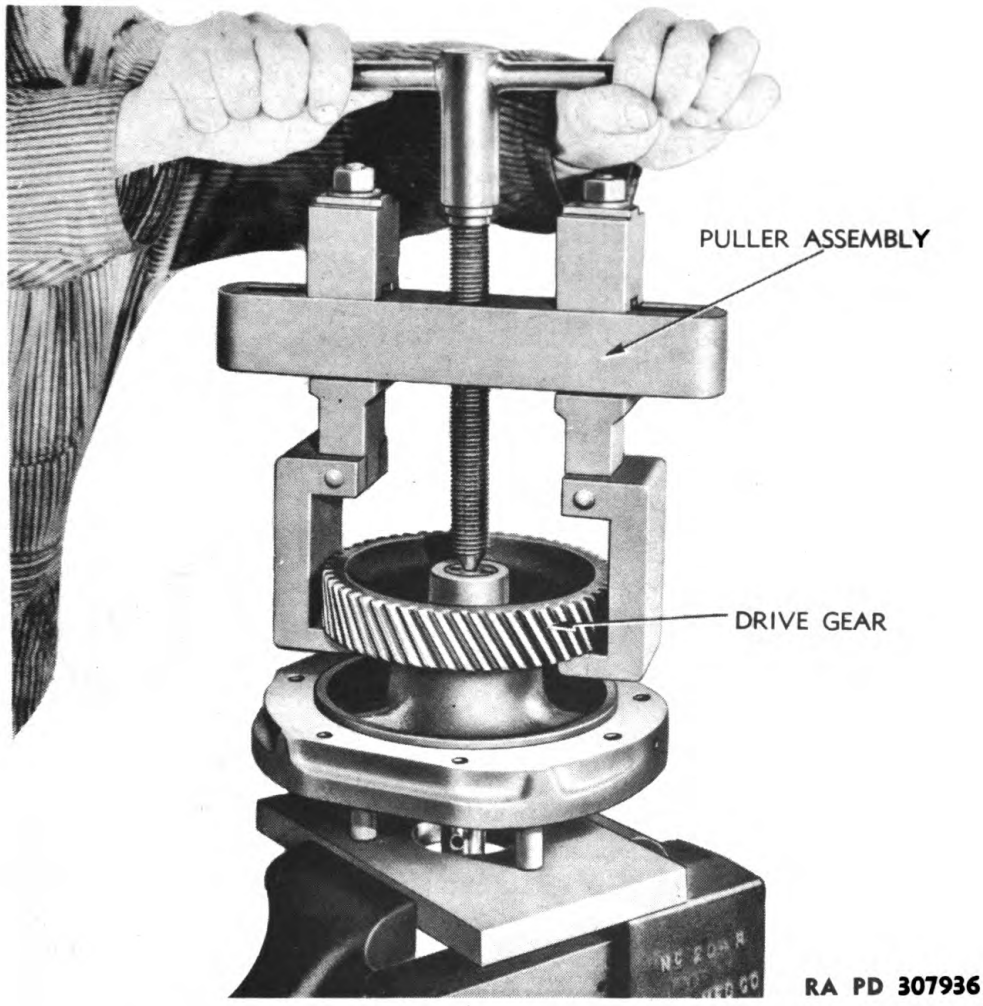


Figure 129 — Removing Water Pump Drive Gear, Using Puller 41-P-2911

required. Straighten nut lock, remove the two cap screws, and remove shaft end washer (fig. 128). Pull drive gear from shaft using puller (41-P-2911) (fig. 129), then remove key from slot. Remove outside oil thrower and spacer (fig. 130), then remove snap ring from cover as shown in figure 131. Press bearing spacer, shaft, bearing, and inside oil thrower out of pump cover (fig. 132). Press shaft out of bearing (fig. 133) and remove inside water thrower from shaft. Pull seal cup off impeller hub and lift carbon seal ring, spring seat and guide assembly, and spring from impeller hub (fig. 134). Drive bushing from pump body if worn (fig. 135), and remove seal insert from cover if worn.

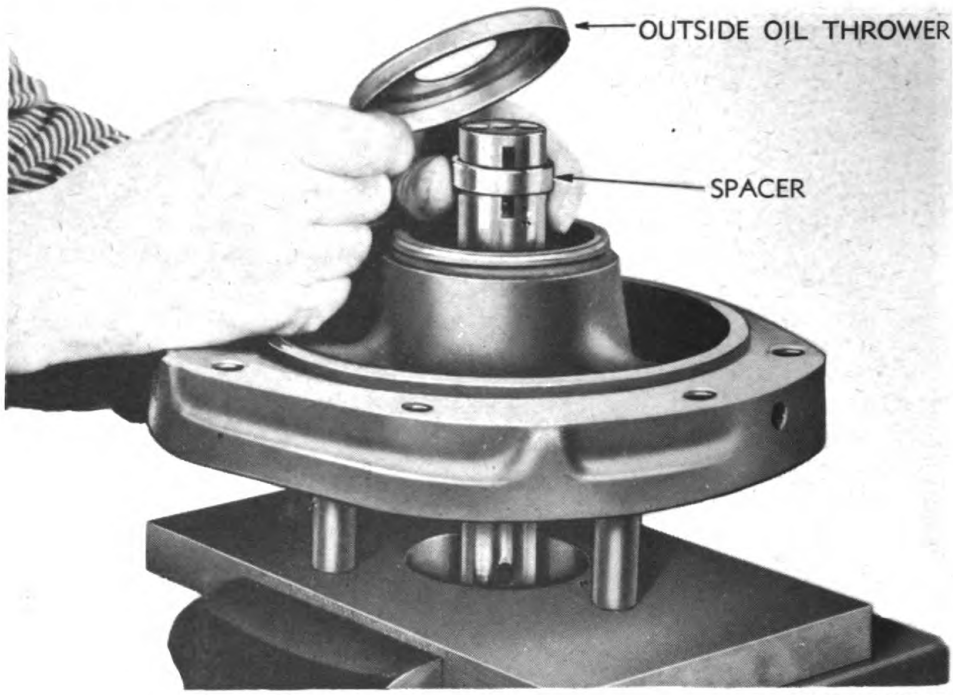


Figure 130 — Removing Oil Thrower and Spacer

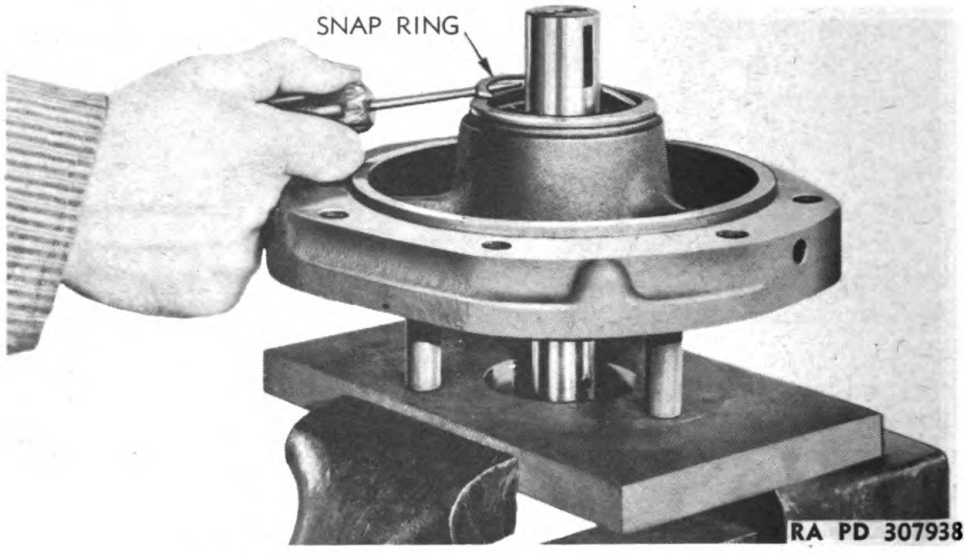


Figure 131 — Removing Snap Ring

c. Cleaning and Inspection of Parts. Clean all rust and corrosion from parts and thoroughly inspect all parts. Replace all worn or defective parts with new ones. If impeller is damaged, replace both shaft and impeller with new parts, as it is difficult to position

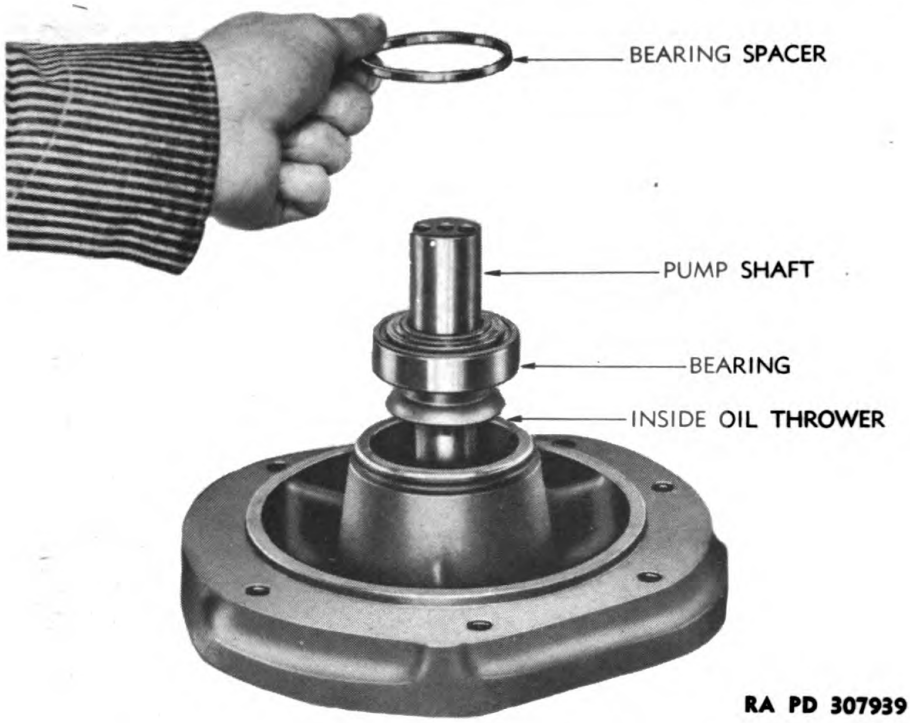


Figure 132 — Removing Pump Shaft and Bearing

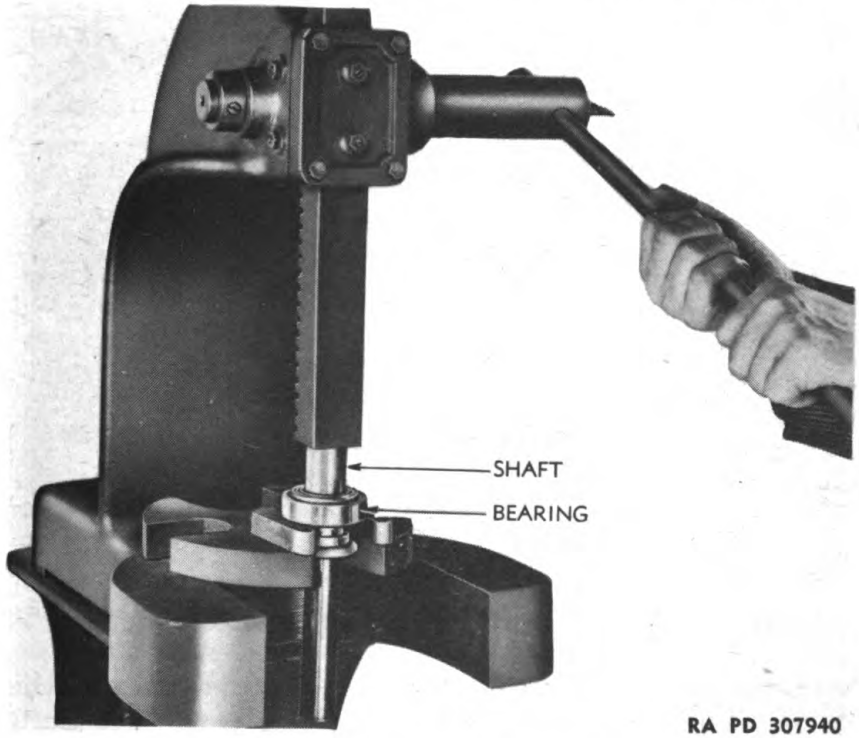


Figure 133 — Pressing Pump Shaft Out of Bearing

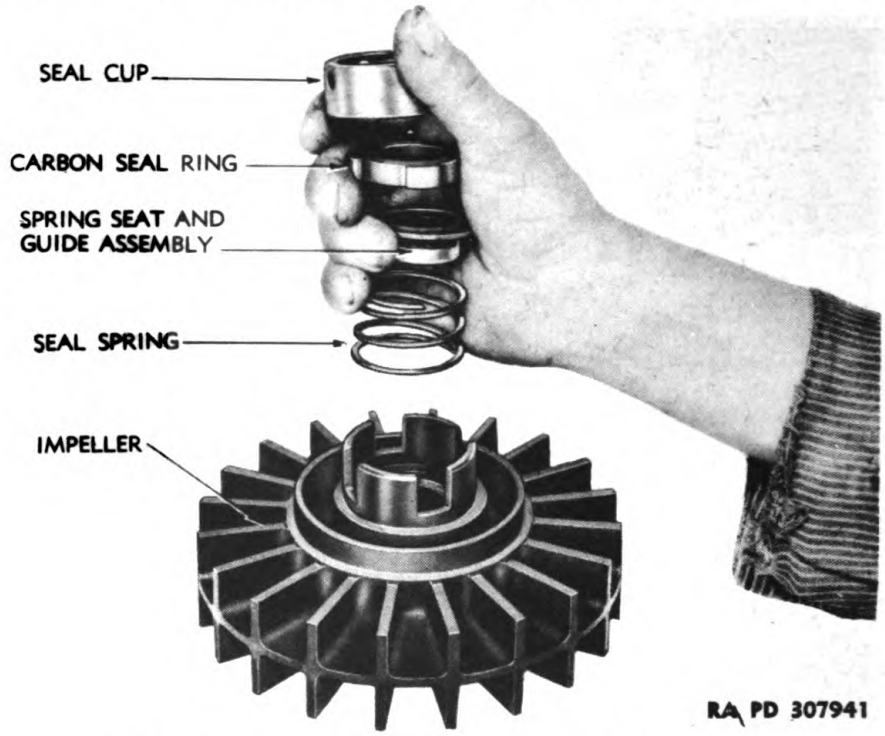


Figure 134 — Impeller and Seal Assembly

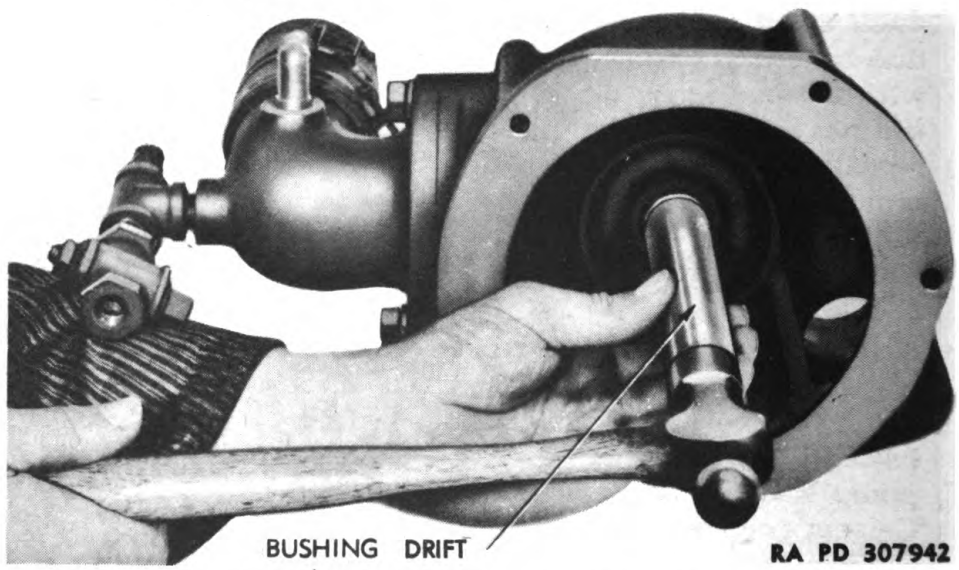
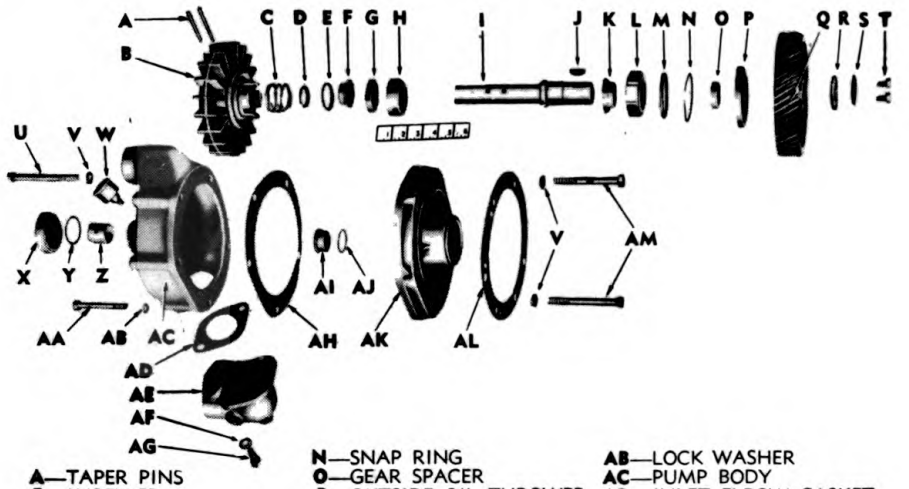


Figure 135 — Removing Bushing From Pump Body

a new vane on an old shaft so that the two pin holes will line up. Drilling multiple holes in a shaft of this size is apt to weaken the section considerably and cause the shaft to break. Make sure the bronze seal insert in pump cover is perfectly smooth. Replace the insert if



A—TAPER PINS
B—IMPELLER
C—SEAL SPRING
D—SEAL WASHER
E—SEAL GUIDE
F—SEAL
G—CARBON SEAL RING
H—SEAL CUP
I—PUMP SHAFT
J—KEY
K—INSIDE OIL THROWER
L—BEARING
M—BEARING SPACER
N—SNAP RING
O—GEAR SPACER
P—OUTSIDE OIL THROWER
Q—DRIVE GEAR
R—END WASHER
S—BOLT LOCK
T—CAPSCREWS
U—CAPSCREW
V—LOCKWASHERS
W—LUBRICANT CUP
X—SHAFT END COVER
Y—END COVER GASKET
Z—BUSHING
AA—CAP SCREW
AB—LOCK WASHER
AC—PUMP BODY
AD—INLET ELBOW GASKET
AE—INLET ELBOW
AF—LOCK WASHER
AG—CAP SCREW
AH—COVER GASKET
AI—PUMP BODY INSERT
AJ—INSERT GASKET
AK—PUMP COVER
AL—COVER TO CRANKCASE GASKET
AM—CAP SCREWS

Figure 136 — Water Pump Assembly Disassembled

it is grooved or rough. Probe exposed inside of pump housing for evidence of thin sections that may have been partially eaten away due to electrolysis. It is usually possible to tap the housing lightly with a metal screw driver and determine by sound whether or not the metal is of uniform thickness. Always install new seal kit when rebuilding pump as carbon seal ring will usually be broken in removal. Replace drive gear if teeth are badly worn or chipped. Test ball bearing by spinning it by hand. As the bearing cannot be cleaned or repacked easily, replace it unless certain of its being in usable condition.

d. Assembly of Pump. Install inner water thrower on section of water pump shaft, with cupped end towards smallest end of shaft. Press ball bearing onto large end of shaft against shoulder (fig. 133). Install bushing in pump cover (if removed) and ream for slip fit on pump shaft. Insert shaft, small end first, into water pump cover. Cement gasket to back side of flange of insert, then slide pump body insert over small end of shaft with flanged end toward end of shaft and press it into place in pump cover. Install bearing spacer in pump cover against bearing (fig. 132) and install cover snap ring (fig. 131) next to bearing spacer in groove in pump cover. Slip gear spacer over shaft, then outside oil thrower with cupped side towards cover (fig. 130). Tap key into slot in end of shaft and press drive gear onto shaft and key. Install shaft end washer on end of shaft with two

cap screws and nut lock (fig. 128). Tighten cap screws, then bend nut lock against cap screw heads. Install seal assembly in slotted end of impeller hub in the following order: spring seat, guide assembly, and carbon seal ring (fig. 134). Tap seal cup over hub above the aforementioned parts. Press water pump impeller and seal assembly onto water pump shaft, first lining up the tapered pin holes in shaft and impeller (fig. 127). Support assembly on drive gear when pressing impeller onto shaft. Drive the two tapered pins through impeller and shaft. NOTE: *If a new impeller or water pump shaft is required, drilling and reaming for the tapered pins will be necessary.* In this event, press impeller onto shaft until impeller has 0.020-to 0.040-inch clearance between fins of impeller and pump cover. With impeller in this position, drill holes through the shaft for the tapered pins, using a $^{15}/_{64}$-inch drill and No. 5 taper reamer. After drilling and reaming, remove impeller from shaft (subpar. **b**). Blow drill cuttings and reamer cuttings out with compressed air. Then press impeller back onto shaft and insert taper pins. Use new gasket between water pump body and cover and install water pump body on cover with three cap screws with lock washers. Place new copper gasket in shaft end cover and screw cover tightly onto end of pump body. NOTE: *This cover has left-handed threads.* Fill grease cup and force grease in, to lubricate shaft and bushing.

45. THERMOSTAT.

a. Description. The thermostat housing and water outlet manifold provides for installation of two bellows-type thermostat units for control of engine temperature. Valves of these units remain closed when engine is cold and cause the water or other coolant to circulate through the engine only until the temperature rises. As engine temperature rises to near normal, expansion of the thermostat units which takes place causes the valves to open and allows the water to flow to the radiator to be cooled. A manually operated handwheel valve in the housing, when opened, permits escape of air when filling cooling system and allows water trapped in pipes above thermostat to drain down when draining system. NOTE: *All tractors do not have thermostat units installed in housings when they leave the factory.* If tractor is to be used in a cold climate, installation of thermostat units will be necessary to maintain operating temperature.

46. AIR COMPRESSOR (BENDIX-WESTINGHOUSE, MODEL 2-UE-7¼-VW).

a. Maintenance information on air compressor will be found in TM 9-1827A.

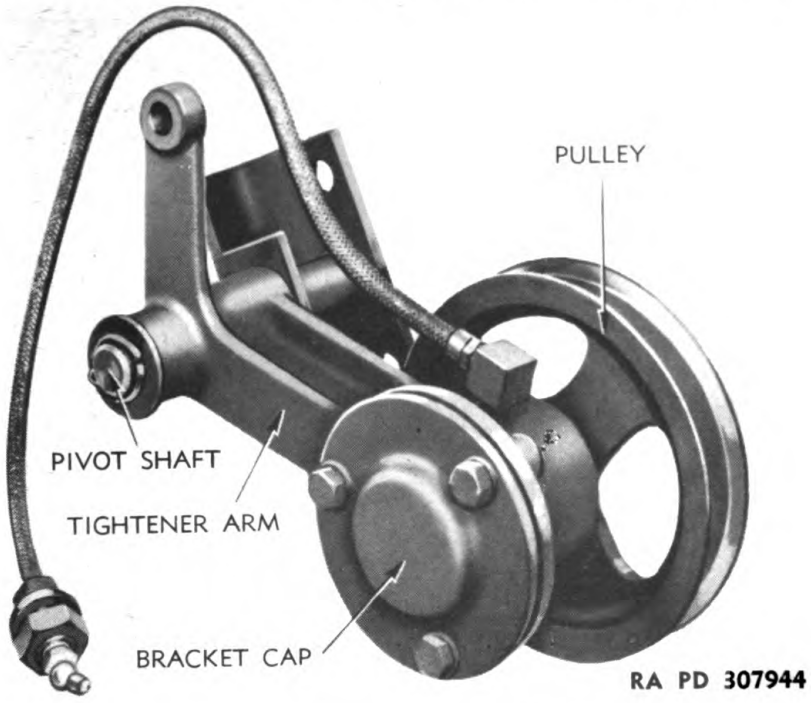


Figure 137 — Air Compressor Belt Tightener

47. AIR COMPRESSOR DRIVE BELT TIGHTENER.

a. Description. This tightener assembly is mounted on timing gear housing for the purpose of maintaining correct tension on air compressor drive belt. It consists of a ball-bearing-equipped flanged pulley, and shaft, on a tightener arm which pivots on a pin in mounting bracket. An adjusting rod is provided for adjusting belt tension.

b. Disassembly of Tightener. Remove cotter pin and flat washer from tightener arm pivot shaft and remove tightener arm from bracket. Remove three cap screws and lock washers and remove tightener bracket cap and gasket. Pull cotter pin and remove slotted nut from end of pulley shaft (fig. 138). Tap shaft out of tightener bracket, then pull cotter pin and remove slotted nut from pulley end of shaft. Press or pull pulley from shaft. Unscrew lubricating tube from fitting on tightener bracket. Use a pilot bearing puller similar to the one shown in figure 123 and remove bearings and spacer from tightener arm housing. Remove oil seal and snap rings.

c. Cleaning and Inspection of Parts. Wash all parts with dry-cleaning solvent and dry with compressed air. Wash ball bearings, then inspect ball and races for discoloration, pitting, roughness, or corrosion. Replace them if any of these conditions are evident or if bearings do not roll freely when turned by hand. CAUTION: *Do not spin bearings with compressed air after washing.* Inspect pivot shaft in mounting bracket and tightener arm for wear. Pivot shaft may be

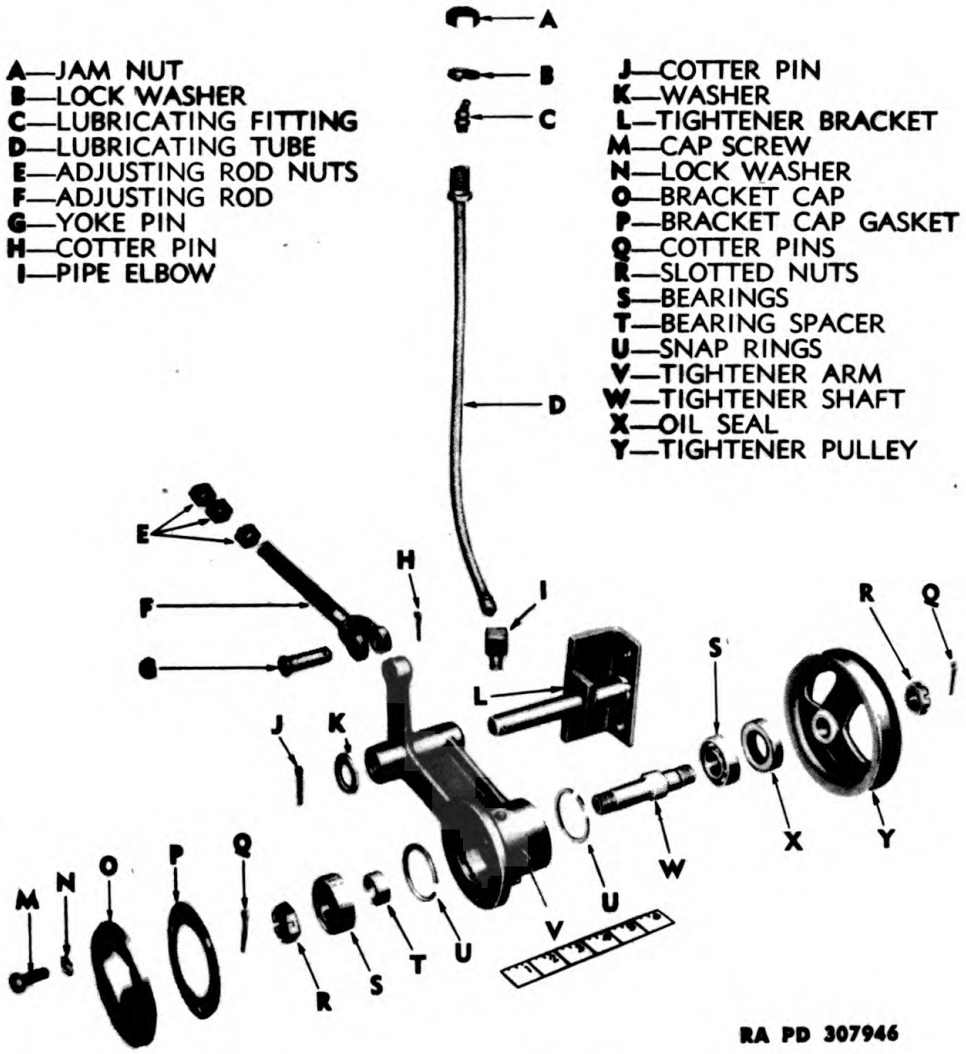


Figure 139 — Air Compressor Belt Tightener Disassembled

48. MASTER CLUTCH.

a. Description.

(1) CONSTRUCTION AND OPERATION. The clutch (Long, Model 17) is of the spring-loaded type. Thirty compression springs between the cover plate and pressure plate hold the driven member tightly against flywheel of engine. The driven member consists of a metal disk which is riveted to a splined hub and lined on both sides with friction facings. These facings are held on disk by a special cement and rivets. An oil slinger on each side of clutch disk prevents excess lubricant from release bearing or oil which might leak from engine from getting onto clutch facings to cause slippage. Six release levers on clutch pressure plate, which are contacted by release bearing when clutch pedal is depressed, provide for dis-

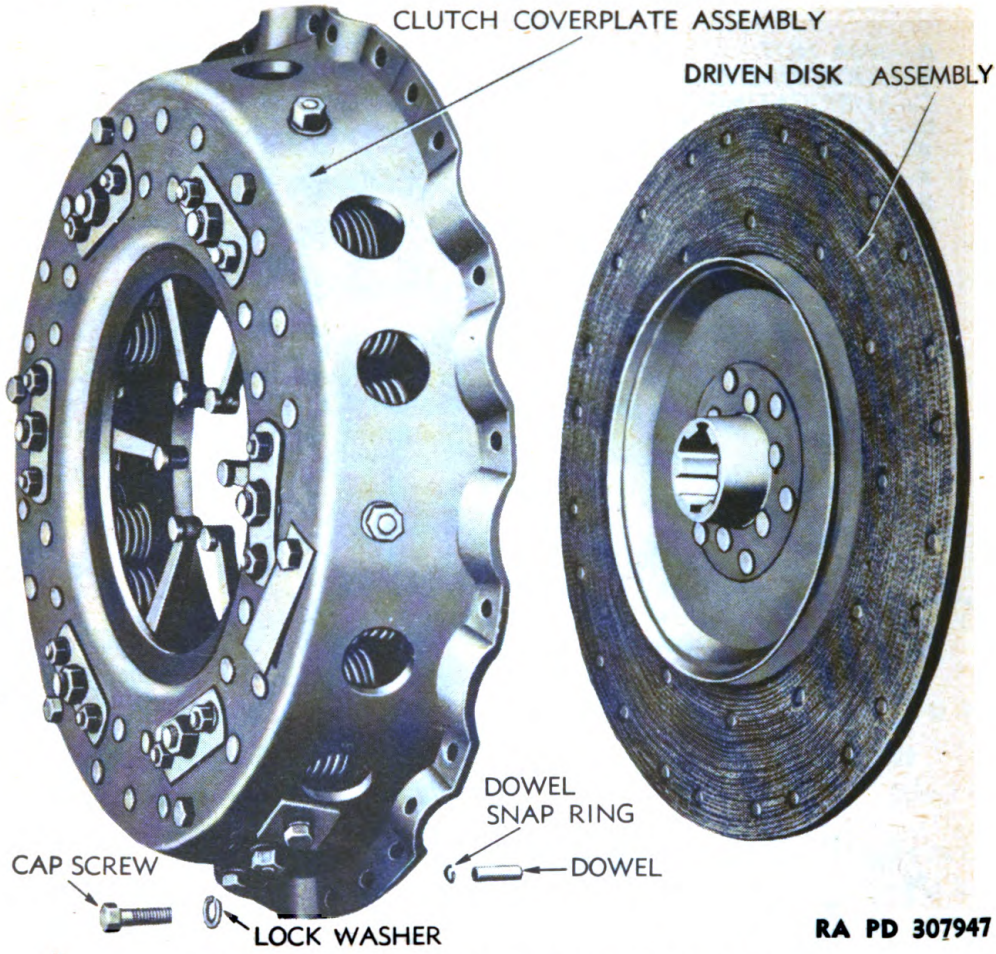


Figure 140 — Master Clutch Assembly

engagement of clutch for gear shifting. These levers are equipped with needle roller bearings.

(2) SPECIFICATIONS.

Driven member:

Friction surface area (total of both sides)	283.64 sq in.
Thickness of facings	0.184-0.190 in.
Minimum thickness before replacement	0.120 in.

Coverplate assembly:

Free length of compression springs (approx.)	2.843 in.
Pressure when compressed to 2 in.	120-125 lb

b. Disassembly of Clutch.

(1) DISASSEMBLE COVER PLATE ASSEMBLY. Place cover plate and pressure plate assembly in arbor press with ½ inch spacers under pressure plate, lay wood block across cover plate as shown in figure 141 and press block down tightly enough to hold springs com-

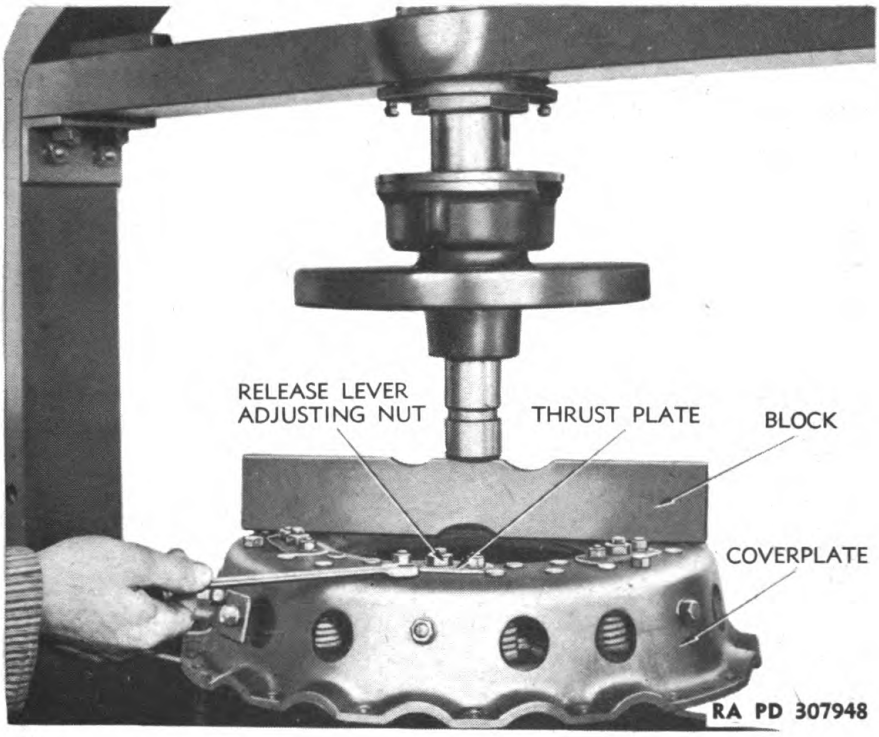


Figure 141 — Removing Clutch Coverplate

pressed. Remove the six cap screws that were installed to remove assembly from flywheel. Remove the twelve nuts and lock washers and remove thrust plates from cover plate. Remove the six release lever adjusting nuts, mark position of coverplate in relation to pressure plate with file or center punch, and slowly release pressure of press. Lift off coverplate (fig. 142). Lift springs and insulating washers from pressure plate (fig. 145). Pull cotter pins and remove pins connecting release levers to pressure plate (fig. 143). Remove lever assemblies from pressure plate. Pull cotter pins, remove washers, and pull pins to separate lever tension springs and yokes from clutch release levers.

(2) REMOVE FACINGS FROM DRIVEN DISK. Remove clutch disk facings, if worn beyond usable limits, by punching rivets out of facings, and drive disk with a brake lining riveting machine.

c. Cleaning and Inspection of Parts. Wash all parts with dry-cleaning solvent and dry with compressed air. Gasoline is the most efficient cleaning agent for washing oil or grease from clutch facings. Inspect all parts for wear or breaks; replace broken parts. Inspect pressure plate. If scored, heat checked, or warped, grind or turn face smooth to leave a clean, unmarked surface. If necessary to remove more than 0.062 inch, replace pressure plate. Replace thrust buttons in ends of clutch release levers if worn to their full diameter. Replace worn or damaged needle bearings or worn yoke pins in

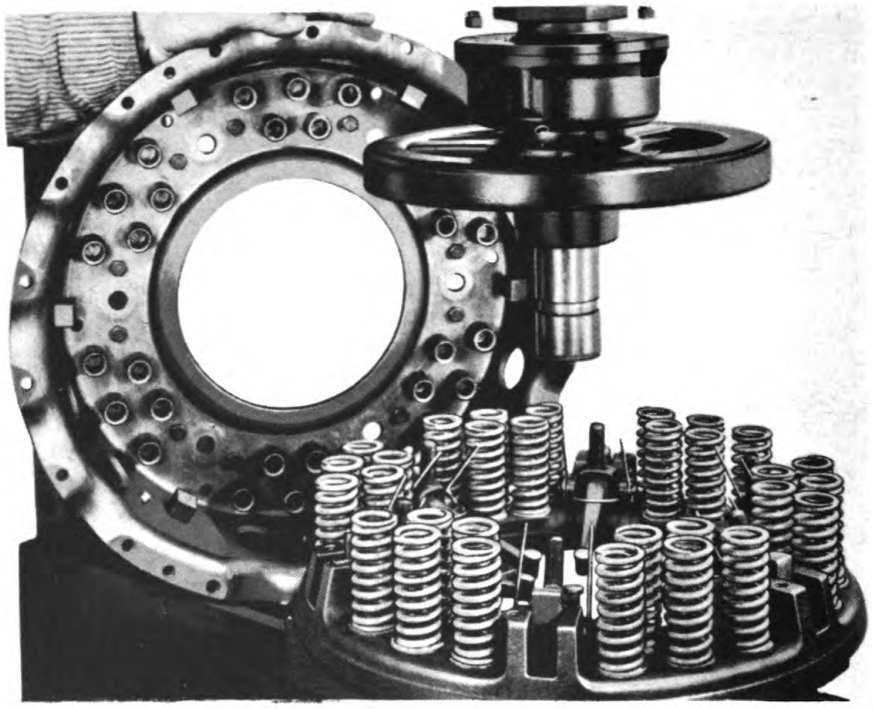


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Figure 142 — Pressure Plate Assembly — Coverplate Removed

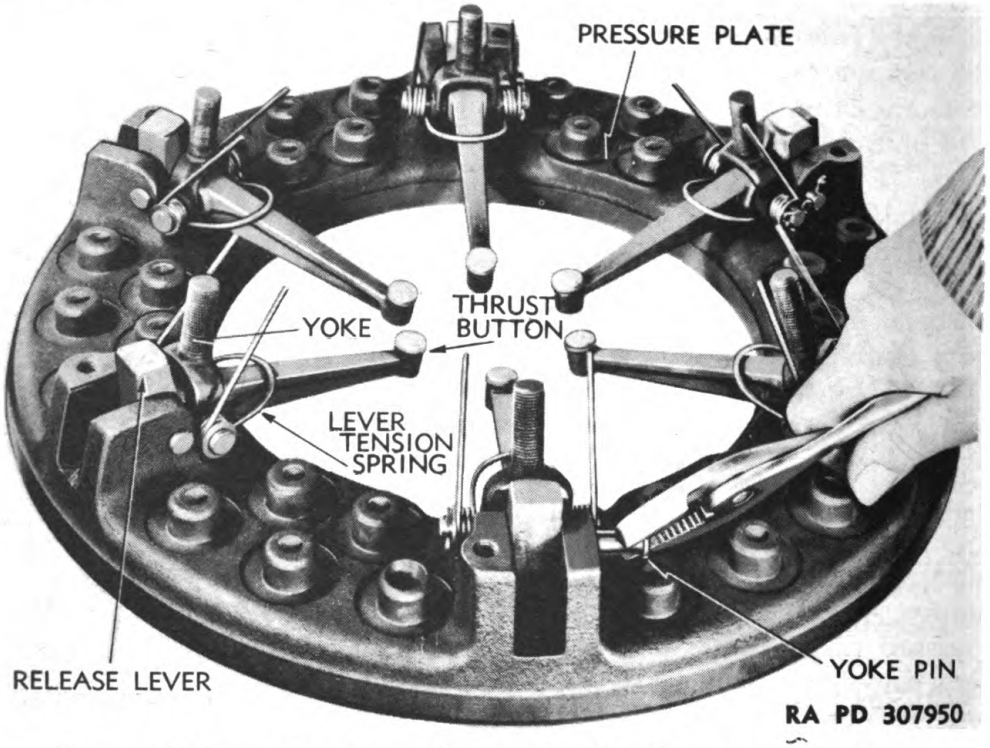


Figure 143 — Pressure Plate and Clutch Release Levers

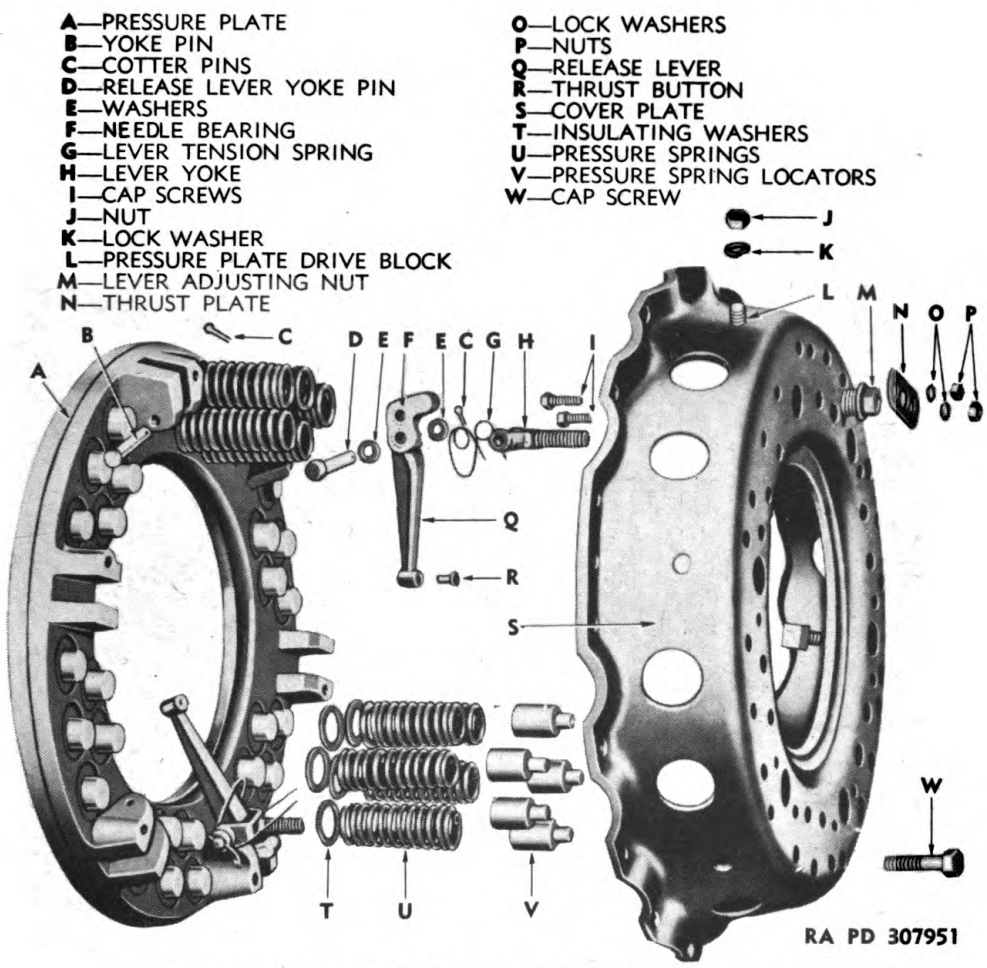


Figure 144 — Master Clutch Assembly Disassembled

levers. Check pressure springs for specified load (120-125 lb) at specified working height (2 inches). If more than 5 percent under low limit on load, replace them. Replace entire drive disk assembly if disk or hub are twisted or worn.

d. Assembly of Clutch.

(1) INSTALL CLUTCH FACINGS ON DRIVE DISK. Facings can be either cemented or riveted to disk. For best results in cementing facings to disk, the disk should be sand blasted after all particles of old facings have been scraped off. Apply a good resin cement to both facings and disk, then bake facings to disk for 10 minutes at 300° F under pressure of 200 pounds per square inch. If equipment for cementing is not available, rivet facings to disk with steel tubular rivets of proper dimensions, star setting the rivets.

(2) ASSEMBLE PRESSURE PLATE ASSEMBLY. Tap thrust buttons into ends of release levers. If lever yokes have been removed from release levers, some dummy pins $\frac{5}{16}$ inch in diameter by $\frac{3}{4}$ inch long are required for reassembly. Place the pins in the lever holes

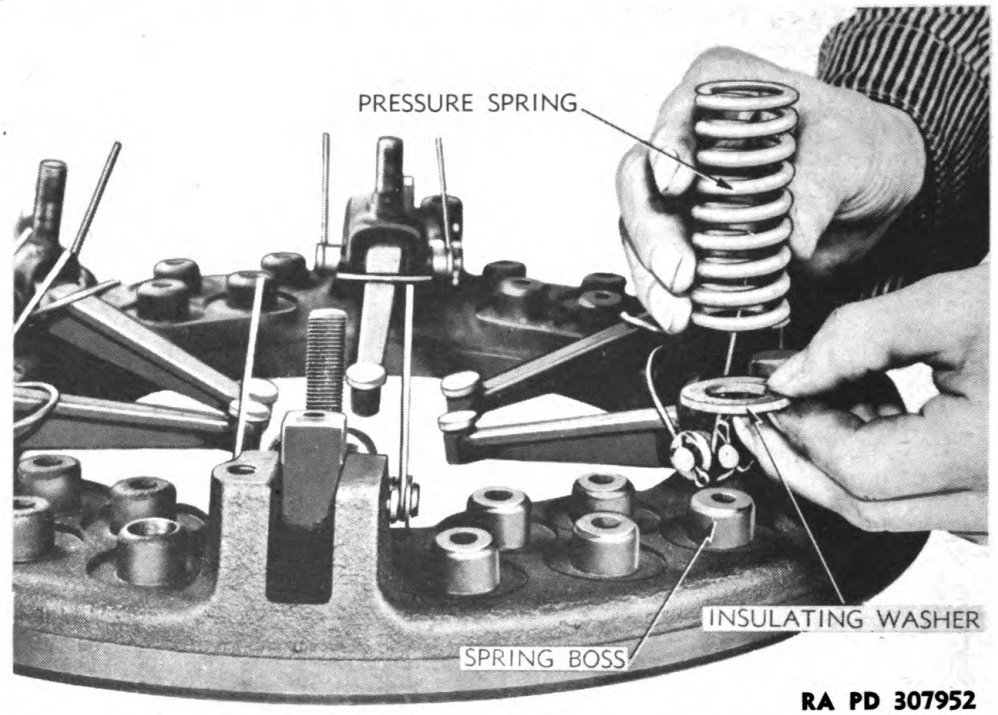


Figure 145 — Installing Pressure Springs and Insulating Washers on Pressure Plate

and install the needle rollers around them. Place the release lever yokes and lever tension springs in position over the levers as shown in figure 143 and insert the pins through yokes, springs, and levers, pushing the dummy pins out of levers as the yoke pins are pushed into place. Use a flat washer at each end of yoke pins and secure pins with cotter pins. Assemble needle rollers in end holes of levers in same manner as above, place release levers in pressure plate in position shown in figure 143 and insert pins through bosses and levers, pushing out dummy pins. Secure pins with cotter pins.

(3) ASSEMBLE PRESSURE PLATE AND COVER PLATE. Set pressure plate face down on some spacers ½ inch thick and try on cover plate to make sure it fits freely. Set pressure plate in arbor press on blocks (fig. 142). Place an insulating washer and spring on each of the spring bosses on pressure plate (fig. 145). **NOTE:** *If plate was machined off, install shims under insulating washers of the same total thickness as the amount machined off plate.* Place cover over springs and compress slowly. Using fingers or screwdriver, guide ends of lever yokes through holes in cover plate as cover plate is pressed down. When flange of cover plate is pressed down ½ inch below face of pressure plate, screw six ⅜- x 1½-inch cap screws through coverplate and into tapped holes in bosses of pressure plate until

cap screw heads touch coverplate, then release press. Install nuts on the release lever yoke bolts, then install a thrust plate over each nut and secure with two nuts and lock washers. Adjustment of release levers cannot be made until clutch is installed on flywheel (refer to paragraph 25 w for this adjustment).

CHAPTER 3

CLUTCH HOUSING AND PROPELLER SHAFT (M4)

Section I

CLUTCH HOUSING

49. DESCRIPTION.

a. The clutch housing is located in main frame of tractor and held on two rigid supports. When engine is installed, the clutch housing is bolted to the flywheel housing of engine and supports that end of engine. Enclosed in the housing are the clutch and clutch shaft, clutch shifter shaft assembly, and release bearing assembly. The release sleeve and bearing assembly is carried on the clutch shaft sleeve. The clutch shaft is supported at one end by the pilot bearing in flywheel and at the other end by a ball bearing in the clutch housing. A coupling flange on the clutch shaft connects to the propeller shaft.

50. REMOVAL.

a. It is necessary to remove the engine before the clutch housing can be removed. After engine has been removed, disconnect clutch shaft from propeller shaft by removing the eight bolts from the coupling flanges connecting the two shafts. With source of electricity cut off, remove the bolts attaching magnetic cranking motor switch to clutch housing, and remove cap screws from clips supporting wires or cables on housing. Disconnect clutch control rod from lever at end of clutch shifter shaft by pulling cotter pin and removing yoke pin from lever and rod yoke. Remove four cap screws and lock washers from top of each housing support at sides of housing and lift housing assembly out of tractor.

51. DISASSEMBLY.

a. **Disassemble Into Subassemblies.**

(1) REMOVE RELEASE SLEEVE AND BEARING ASSEMBLY. Remove jam nut from clutch release bearing lubricating tube (fig. 155). This nut also holds lubricating tube support bracket to housing. Remove bolt from clip holding tube to inside of housing, then pull end of release bearing lubricating tube down out of top of housing. Unhook ends of retractor springs from ends of clutch shifter yoke and slide springs from release sleeve (fig. 146). Slide release sleeve and bearing assembly off clutch shaft.

(2) REMOVE CLUTCH SHAFT ASSEMBLY (fig. 147). Remove four cap screws from clutch shaft bearing retainer. Pull or tap clutch shaft

CLUTCH HOUSING AND PROPELLER SHAFT (M4)

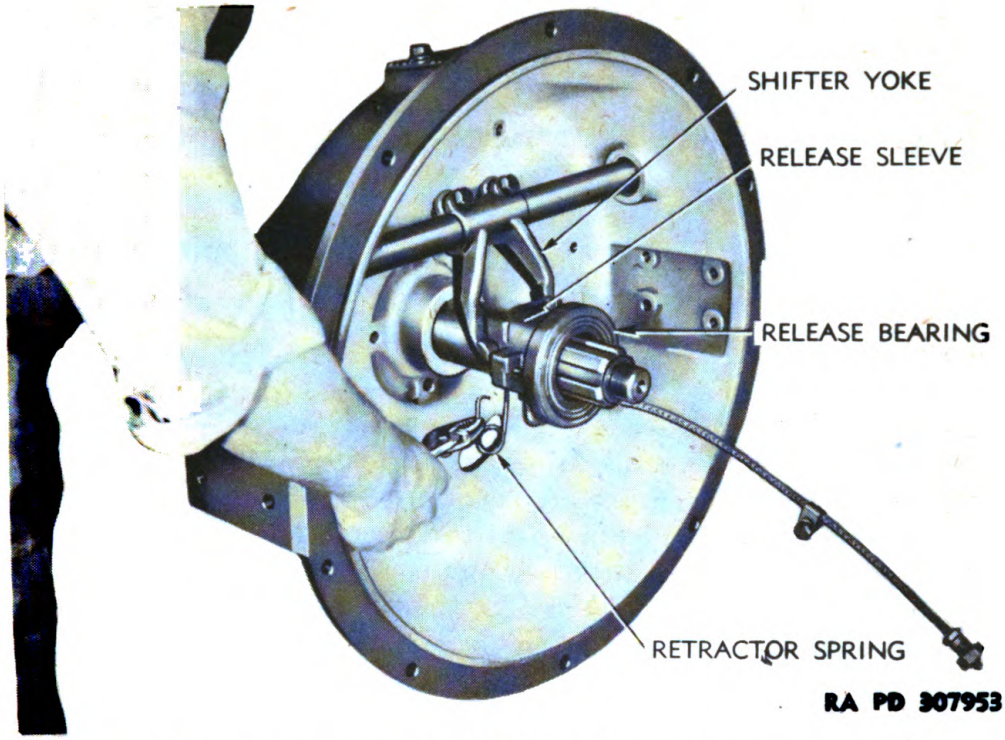


Figure 146 — Removing Clutch Shifter Retractor Springs

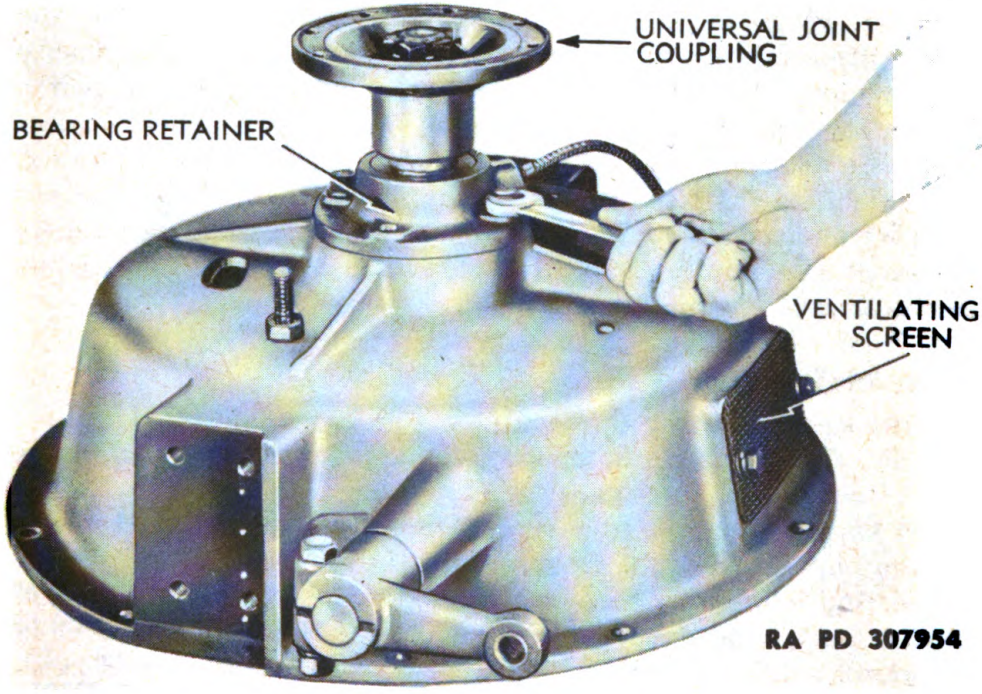


Figure 147 — Removing Bearing Retainer Cap Screws

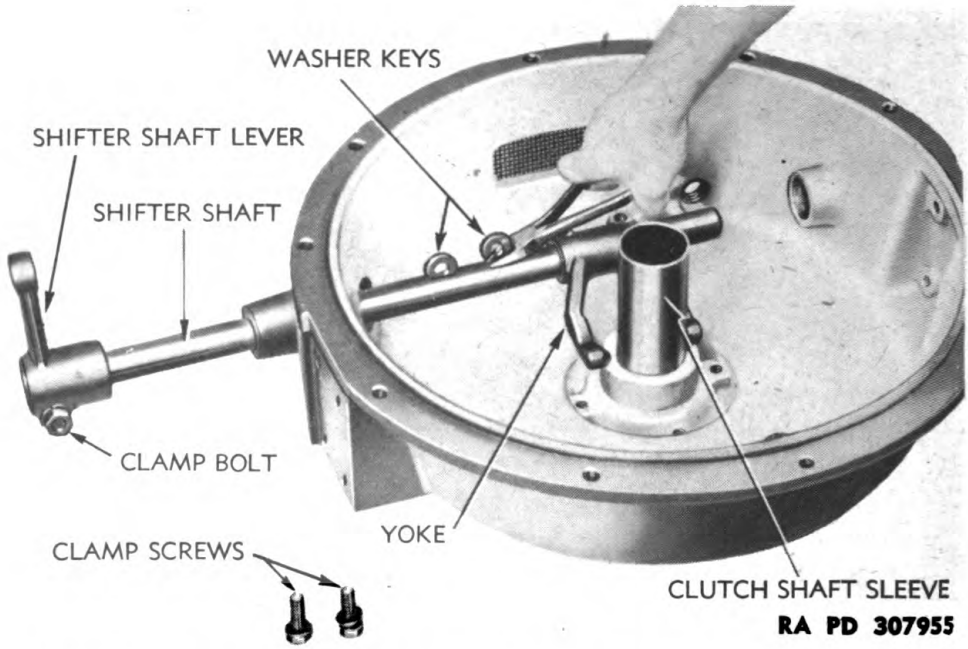


Figure 148 — Removing Keys From Clutch Shifter Shaft

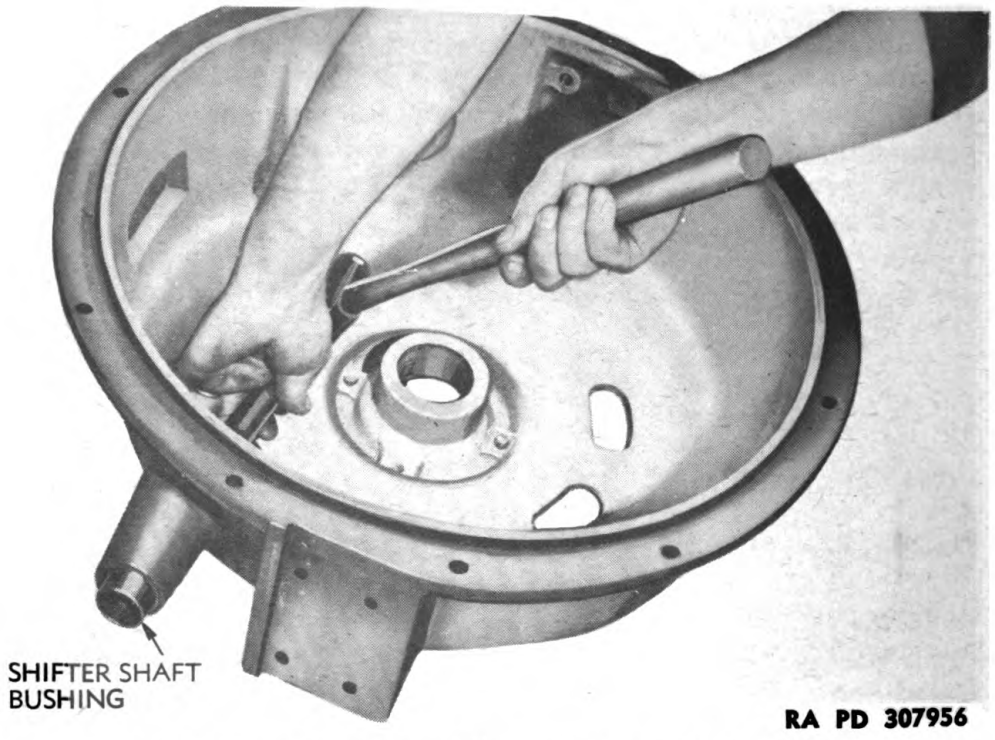


Figure 149 — Removing Clutch Shifter Shaft Bushings

CLUTCH HOUSING AND PROPELLER SHAFT (M4)

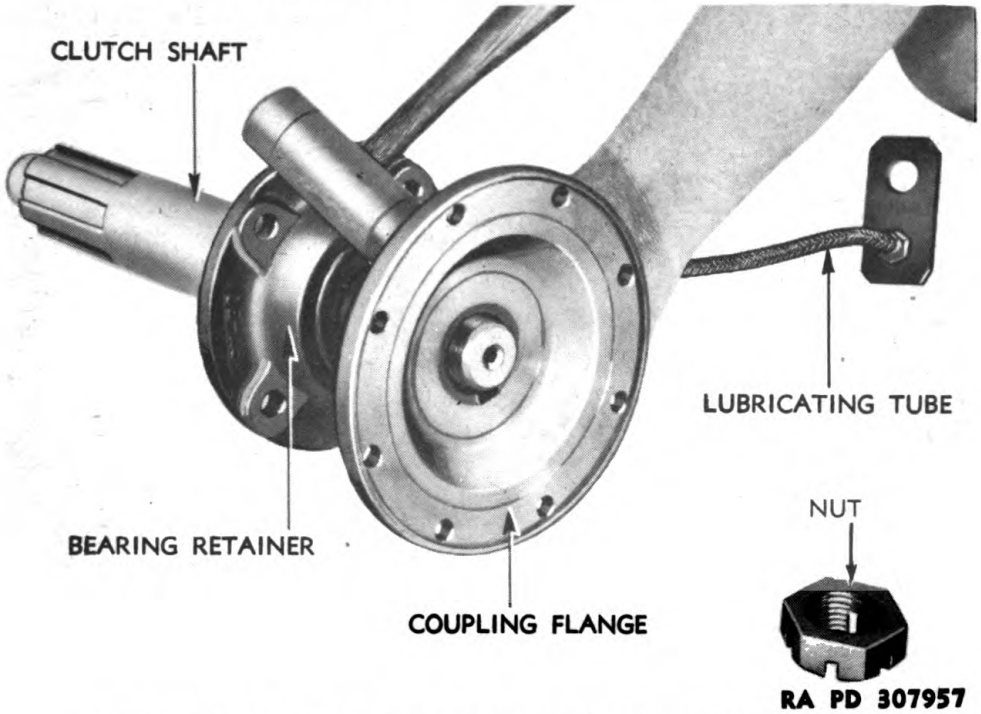


Figure 150 — Removing Universal Coupling Flange From Clutch Shaft

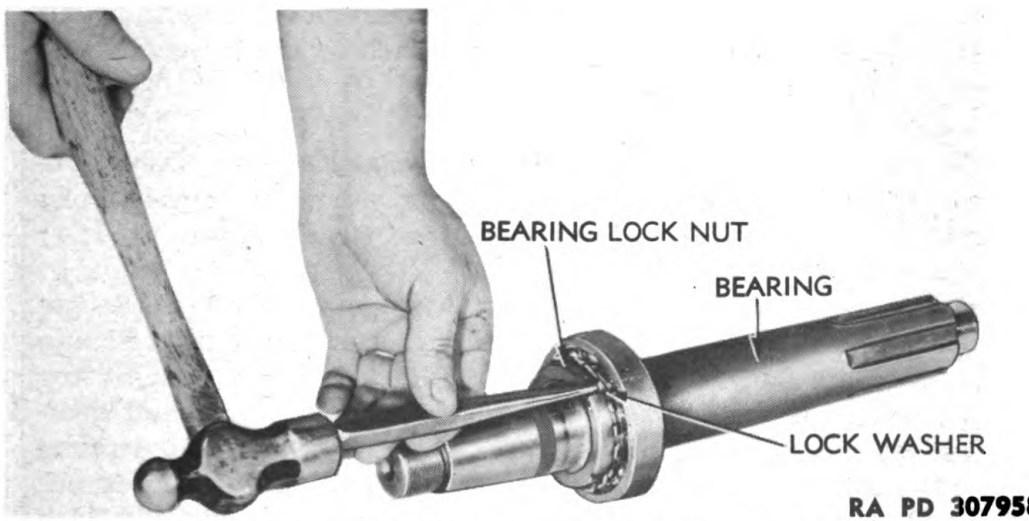


Figure 151 — Straightening Prong of Bearing Nut Lock Washer

assembly back and out of sleeve and housing. Bearing retainer and universal joint coupling flange will remain on shaft.

(3) REMOVE CLUTCH SHIFTER SHAFT ASSEMBLY (fig. 148). Remove the two clamp screws from clutch shifter yoke and drive shaft and shifter yoke sideways until the two washer keys can be removed from shaft. Then pull shaft on out of housing and shifter yoke. Drive or press shaft bushings from bosses in sides of housing if worn

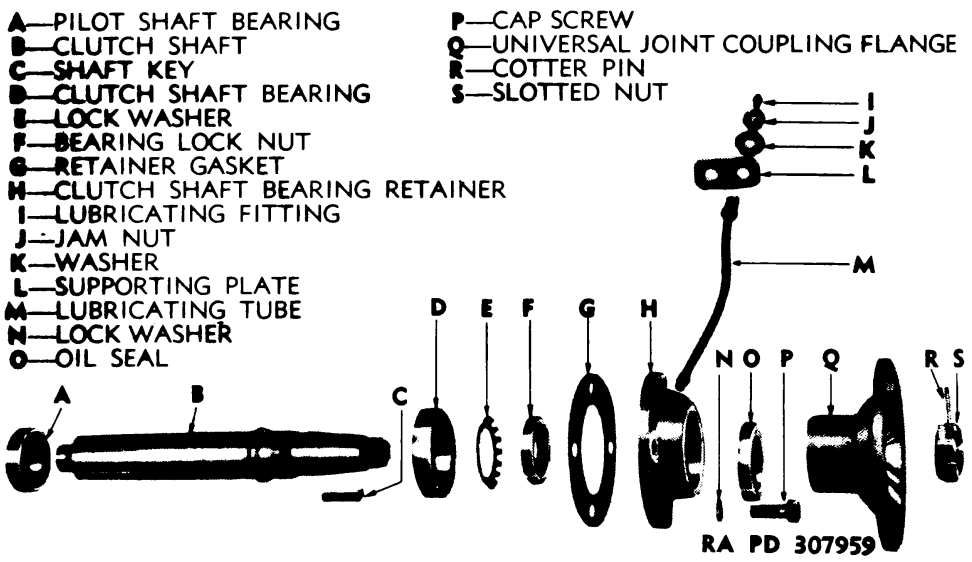


Figure 152 — Clutch Shaft Assembly Disassembled

(fig. 149). Expansion plug in one boss will be driven out at same time.

(4) REMOVE SLEEVE FROM CLUTCH HOUSING. Use arbor of proper diameter and drive or press clutch shaft sleeve (fig. 148) out of housing. Remove two cap screws and washers and lift ventilating screen (fig. 147) from top of housing.

b. Disassemble Subassemblies.

(1) DISASSEMBLE RELEASE SLEEVE AND BEARING ASSEMBLY. Unscrew release bearing lubricating tube from elbow in sleeve. Press bearing out of release sleeve. Drive or press wear buttons (fig. 154) from sleeve if they are to be replaced.

(2) DISASSEMBLE CLUTCH SHAFT ASSEMBLY. Pull cotter pin from slotted nut on end of shaft and remove nut. Drive or press universal coupling flange from shaft (fig. 150). Remove straight key from slot in shaft. Remove lubricating tube from clutch shaft bearing retainer and tap bearing retainer off bearing. Straighten prong of lock washer in notch in bearing lock nut (fig. 151). Loosen nut with spanner wrench (41-W-3250-10) and remove nut and lock washer. Press shaft out of bearing and press oil seal from bearing retainer.

(3) REMOVE LEVER FROM CLUTCH SHIFTER SHAFT. Loosen clamp bolt in lever (fig. 148) and tap lever off shaft. Remove key from slot in shaft.

52. CLEANING AND INSPECTION OF PARTS.

a. Wash all parts with dry-cleaning solvent and dry with compressed air. Inspect for defective, worn, or broken parts. If found,

CLUTCH HOUSING AND PROPELLER SHAFT (M4)

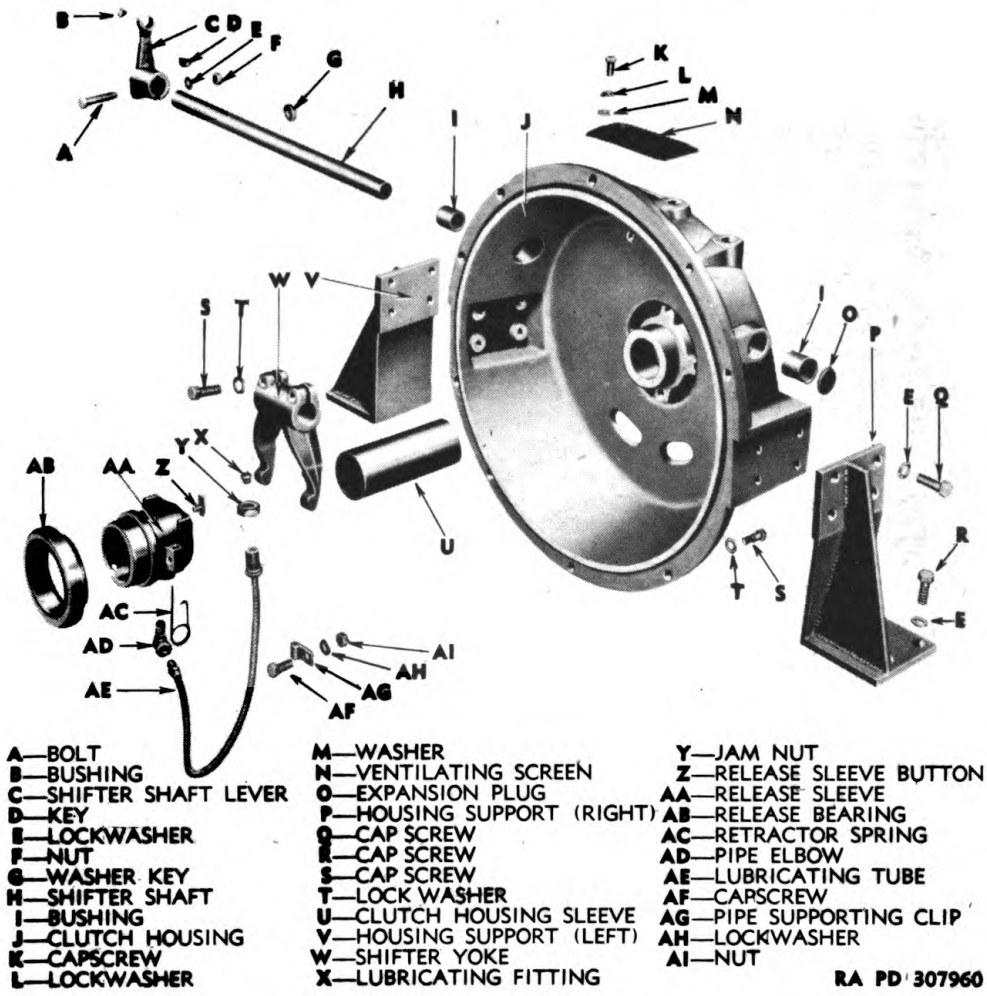


Figure 153 — Clutch Housing and Release Bearing and Sleeve Disassembled

replace with new ones. Replace release bearing or clutch shaft bearing if balls or races are discolored, chipped, or show tendency to bind in any place when rolled by hand. If oil seal in clutch shaft bearing retainer is worn or damaged, replace seal. Slip release sleeve onto clutch shaft sleeve to see if it slides freely on sleeve. Smooth sleeve with emery cloth if it is scored or rough. Check lubricating tubes for breaks to make sure lubricant will not ooze from side of tube instead of being forced into bearings. Replace clutch shifter yoke or wear buttons in shifter sleeve that are contacted by clutch shifter yoke if they are worn. Replace housing ventilator screen if mesh is broken. Make sure threads on clutch shaft and in tapped holes in sides of housing for support bolts are in good condition.

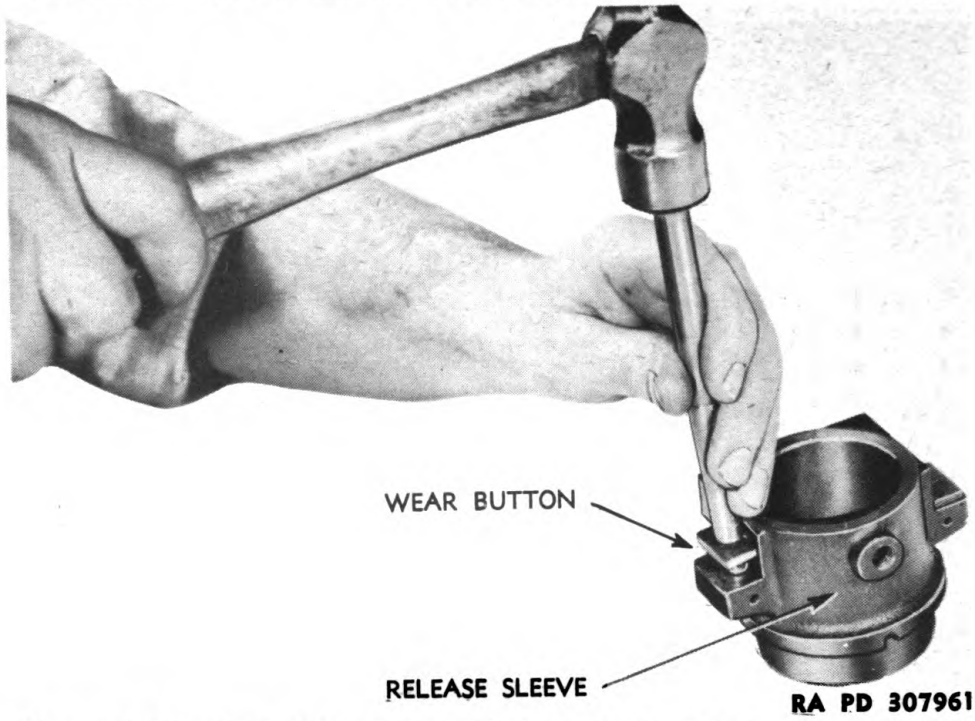


Figure 154 — Installing Wear Buttons in Clutch Release Sleeve

53. ASSEMBLY.

a. Assemble Subassemblies.

(1) INSTALL LEVER ON CLUTCH SHIFTER SHAFT. Tap key into slot in end of lever. Aline slot in lever with key and tap lever onto shaft until end of shaft and lever are flush (fig. 146) and tighten clamp screw.

(2) ASSEMBLE CLUTCH SHAFT ASSEMBLY. Lubricate bearing with light engine oil, then press bearing onto tapered end of clutch shaft and against shoulder on shaft. Place star lock washer on shaft next to bearing with prongs pointing away from bearing. Install and tighten bearing lock nut against bearing with spanner wrench (41-W-3250-10) and bend one or more prongs of lock washer into a slot in nut (fig. 151). Press oil seal into small end of clutch shaft bearing retainer with lip of seal facing in. Slide retainer onto shaft (use care not to damage or double lip of seal) and tap or press retainer over bearing. Screw pipe elbow (if removed) into tapped hole in retainer, then screw end of flexible lubricating tube into elbow. Tap straight key into slot in end of shaft, aline slot in coupling with key, and tap or press universal coupling flange onto end of shaft. Install and tighten slotted nut on end of shaft to draw flange tightly onto taper of shaft. Secure nut with cotter pin.

(3) ASSEMBLE RELEASE SLEEVE AND BEARING ASSEMBLY. Tap wear buttons into sides of release sleeve (fig. 154). Press release

CLUTCH HOUSING AND PROPELLER SHAFT (M4)

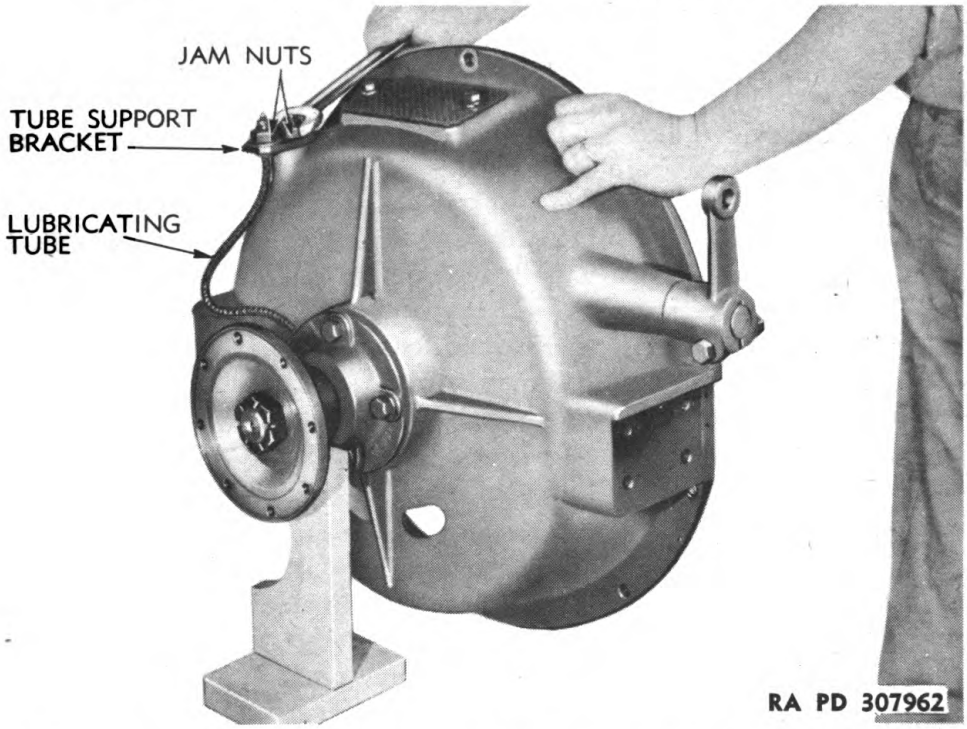


Figure 155 — Installing Lubricating Tube and Support Bracket

bearing onto release sleeve against shoulder of sleeve. Screw pipe elbow into tapped hole in sleeve (if removed), then screw flexible lubricating tube into pipe elbow.

b. Install Subassemblies in Clutch Housing.

(1) INSTALL CLUTCH SHAFT SLEEVE AND VENTILATING SCREEN. Install ventilating screen on top of clutch housing (fig. 147) with two cap screws with lock washers. Drive or press clutch shaft sleeve (fig. 148) into housing.

(2) INSTALL SHIFTER SHAFT AND YOKE. Drive or press shifter shaft bushings (fig. 149) into bosses in housing. Ream, if necessary, for slip fit of shifter shaft in bushings. Insert end of shifter shaft through side of housing from which boss extends out (fig. 148). Start shifter yoke onto shaft with slot in top of yoke in line with key slots in shaft. Tap washer keys into the two slots in shaft, then tap shaft through yoke and through bushing in other side of housing. Install and tighten clamp screws in shifter yoke. Test to make sure shaft turns easily.

(3) INSTALL CLUTCH SHAFT ASSEMBLY. Cement gasket to clutch shaft bearing retainer. Slide shaft through housing and clutch shaft sleeve from rear of housing. Turn retainer so lubricating tube will point towards top of housing, then attach retainer to housing with four cap screws with lock washers (fig. 147).

(4) INSTALL RELEASE SLEEVE AND BEARING ASSEMBLY. Slip assembly onto clutch shaft with bearing towards end of shaft (fig. 146). Make sure sleeve slides freely on shaft. Insert straight ends of retractor springs up through holes in sides of release sleeve until other end can be hooked into holes in back of ends of shifter yoke. Insert end of release bearing lubricating tube up through hole in upper part of housing (fig. 155). Place tube support bracket over end of tube, then install and tighten jam nut on tube. Attach pipe clip on tube to inside of housing with cap screw and lock washer. Insert end of clutch shaft bearing lubricating tube up through bracket and install jam nut. Fill bearing with lubricant through these tubes.

54. INSTALLATION.

a. Set housing in place between supports in tractor frame. Attach housing to supports with four cap screws with lock washers in each support and side of housing. Attach universal coupling flange on clutch shaft to propeller shaft coupling flange with eight bolts with lock washers. Attach cranking motor switch to top of housing. Connect yoke on end of clutch control rod to lever on clutch shifter shaft with yoke pin and cotter pin. After installing engine, attach wire support clips to clutch housing.

Section II

PROPELLER SHAFT

55. DESCRIPTION.

a. The propeller shaft consists of two universal joints equipped with needle roller bearings. The inner yoke of one universal joint has a short splined shaft which slips into the splined sleeve of the inner yoke of the other universal joint. The outer yoke flanges provide for coupling the propeller shaft to the coupling flanges on the clutch shaft and to the pump shaft of the torque converter.

56. DISASSEMBLY.

a. Bend prongs of lock plates away from heads of cap screws, remove cap screws from bearing caps, and remove lock plates and bearing caps. Jar needle bearing assemblies out of yokes and yoke flanges. Slip the small oil seals off inner ends of needle bearing assemblies. Remove journal assemblies from yokes and yoke flanges. Unscrew dust cap off sleeve yoke, then slide sleeve yoke off shaft yoke. Remove cork and steel washer from shaft yoke.

CLUTCH HOUSING AND PROPELLER SHAFT (M4)

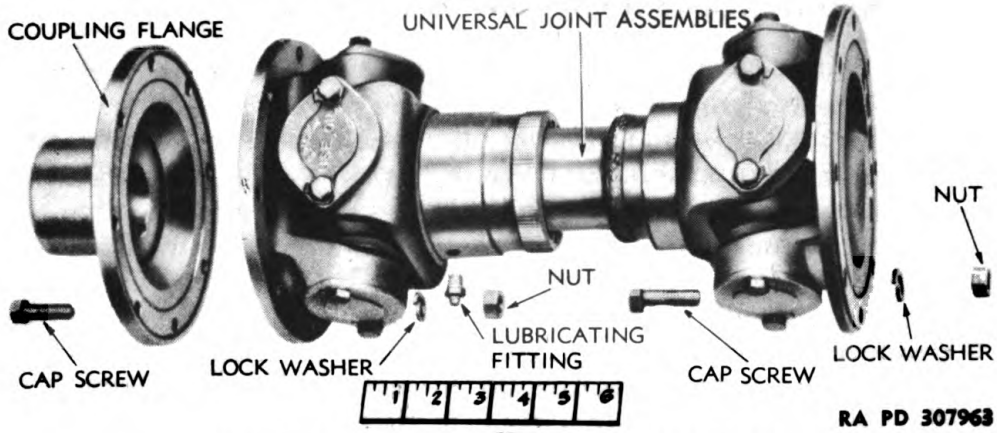


Figure 156 — Propeller Shaft Assembly

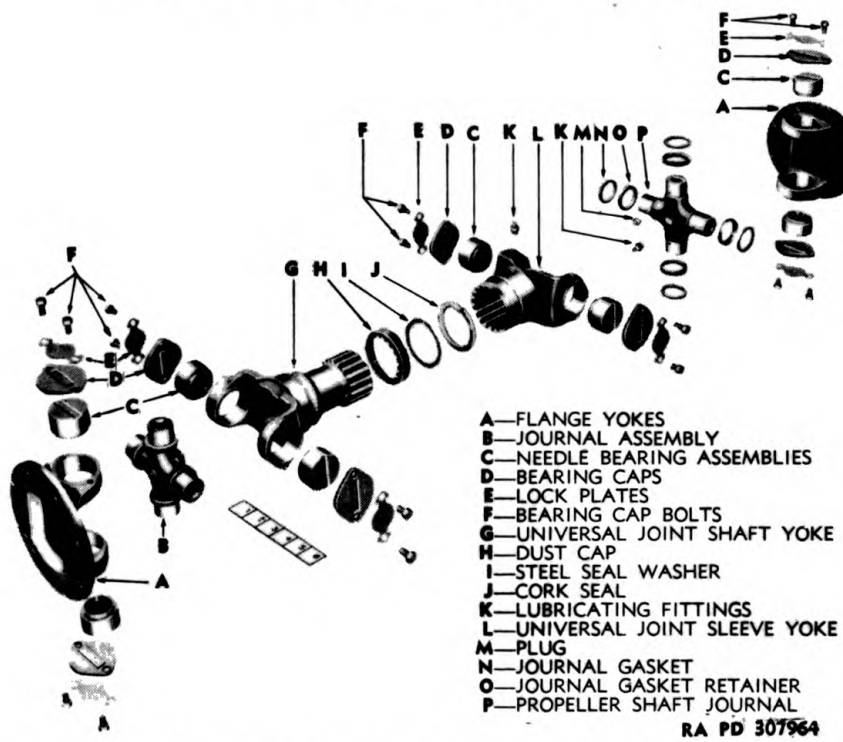


Figure 157 — Propeller Shaft Assembly Disassembled

57. CLEANING AND INSPECTION OF PARTS.

a. Wash all parts with dry-cleaning solvent and dry with compressed air. Inspect splines on shaft and in sleeve for wear. If wear or perceptible looseness is evident, replace these parts. Replace needle bearings or shaft yoke and shaft sleeve if bearings fit loosely. Discard needle bearings if wear or damage is evident. A sloppy fit of any of the parts in the propeller shaft assembly requires the replacement of worn parts as vibration in operation and loss of lubricant would result. Replace all cork oil seals with new ones.

ORDNANCE MAINTENANCE—ENGINE, ENGINE ACCESSORIES, AND TORQUE CONVERTER FOR 18-TON M4 AND 38-TON M6 HIGH SPEED TRACTORS

58. ASSEMBLY.

a. Refer to figure 157 for identification of parts. Install one flange yoke and shaft yoke on one of the journal assemblies, the second flange yoke and sleeve yoke on the other journal assembly. Slip a cork seal onto inner end of each needle bearing assembly, then install a seal cup over each cork. Slip bearings onto ends of journals and into yokes. Place bearing caps over bearings with bars of caps engaging in slots in ends of bearings and secure each bearing cap on yokes with two cap screws and lock plate. After tightening cap screws, bend prongs of lock plate against heads of cap screws. Fill universal joints with lubricant. Make sure plugs or lubrication fittings are tightly installed. Slip dust cap onto shaft yoke (pronged side first), then slip steel seal washer and cork seal washer onto shaft yoke. These washers can be spread for installation. Lubricate splines and slip splined sleeve yoke onto shaft yoke. Screw dust cap firmly onto sleeve to hold seal washers against end of sleeve. Force lubricant into splines through fitting.

CHAPTER 4

TORQUE CONVERTER

Section I

DESCRIPTION AND DATA

59. CONSTRUCTION OF CONVERTER.

a. The outer case of the torque converter is of cast iron, in two sections held together by 24 studs. This case is not merely a cover, but an essential part of the device, because its inside contours form the hydraulic chamber in which the fluid circulates, and to this case are riveted the guide or reaction blades which direct the fluid flow. In a separate compartment in the input section of the case, called the end plate, is a pair of gears which drive the auxiliary fluid pump. The input shaft, terminating in a flange for connection to the engine through a propeller shaft, carries the impeller at its inner end. The impeller is essentially like that of a centrifugal pump, the fluid entering near the hub and being thrown from the blades at the periphery. The turbine, the hollow hub of which is splined for the output connection, is piloted to the projecting end of the input shaft through a combination bearing and free-wheel device whose function is to lock the output shaft to the input shaft when the former attempts to over-run the latter, thus permitting the engine compression to be used to brake the vehicle or the engine to be started by towing. The turbine is composed of three sets of blades, so positioned as to receive the impact of the circulating fluid directly from the impeller and also from the two sets of guide blades fastened to the housing. The hydraulic chamber must be continuously filled with fluid, which is an essential "working part" inasmuch as the power is transmitted entirely by it.

60. THEORY OF OPERATION.

a. In the hydraulic torque converter, the incoming power drives the centrifugal pump or impeller, which gives rotary motion to the fluid in the converter. As the fluid leaves the impeller it encounters the first set of blades of the turbine, which is thus caused to rotate. Not all of the energy from the moving fluid can be released against this first set of blades (that is, the fluid is still moving rapidly as it leaves the blades) and in order to utilize this remaining energy a ring of reaction or guide blades, attached to the housing, redirects the fluid flow so that it enters the second set of turbine blades at the correct angle. This process is repeated once more before the fluid, having released virtually all of its energy, is returned to the inlet at the hub of the impeller so that the cycle may again take place.
NOTE: *The power is transmitted by moving fluid and is not a matter*

of fluid pressure. A basic pressure is supplied by the auxiliary fluid pump at the inlet to the impeller, but only to prevent vacuum pockets from forming at the entrance to the impeller.

61. SPECIFICATIONS.

a. Dimensions and Weight.

Length, coupling flange to face of turbine hub	15½ in.
Over-all diameter (excluding bosses)	18⅞ in.
Weight (without fluid)	350 lb

b. Capacities.

Operating fluid (converter only)	14 qt
Lubricating oil (auxiliary pump gear compartment)	2⅓ pt

c. Fluid Pressure and Temperatures.

Operating base pressure (at 1,000-1,200 rpm)	35-45 lb per sq in.
Operating temperature	
Normal	160°-220° F
Maximum safe continuous duty	260° F

Section II

DISASSEMBLY, CLEANING, AND INSPECTION

62. DISASSEMBLY OF CONVERTER.

a. Remove Turbine Housing Cover Assembly. With the converter resting on the transmission studs on a suitable stand, which permits projection of the turbine hub downwards, remove the cotter pins and castle nuts from the 24 studs holding the two sections of the housing together. Attach a suitable hook to the input flange, and lift with a hoist as in figure 158, being careful that the pull is directly upward so as to avoid damage to turbine blades.

b. Remove Outer Race of Free-wheel Unit. Using an Allen wrench, remove the three screws which hold the cup-shaped outer race of the combination pilot bearing and free-wheel assembly in place in turbine housing. Then lift out the race and the six pins (fig. 187) which project from the surface on which it rested.

c. Remove Turbine Housing From Turbine. Turn the output half of the converter over so it rests on the 24 projecting studs. Bend the locking lug out of slot in nut and, with the special wrench (41-W-3739-400) shown in figure 181, remove the retainer nut on the outer end of the turbine hub. Now hook the hoist to opposite transmission studs and lift the housing off the turbine as shown in figure 159, tapping the hub if necessary to loosen it. This operation must be performed carefully to avoid damage to the turbine or its

TORQUE CONVERTER

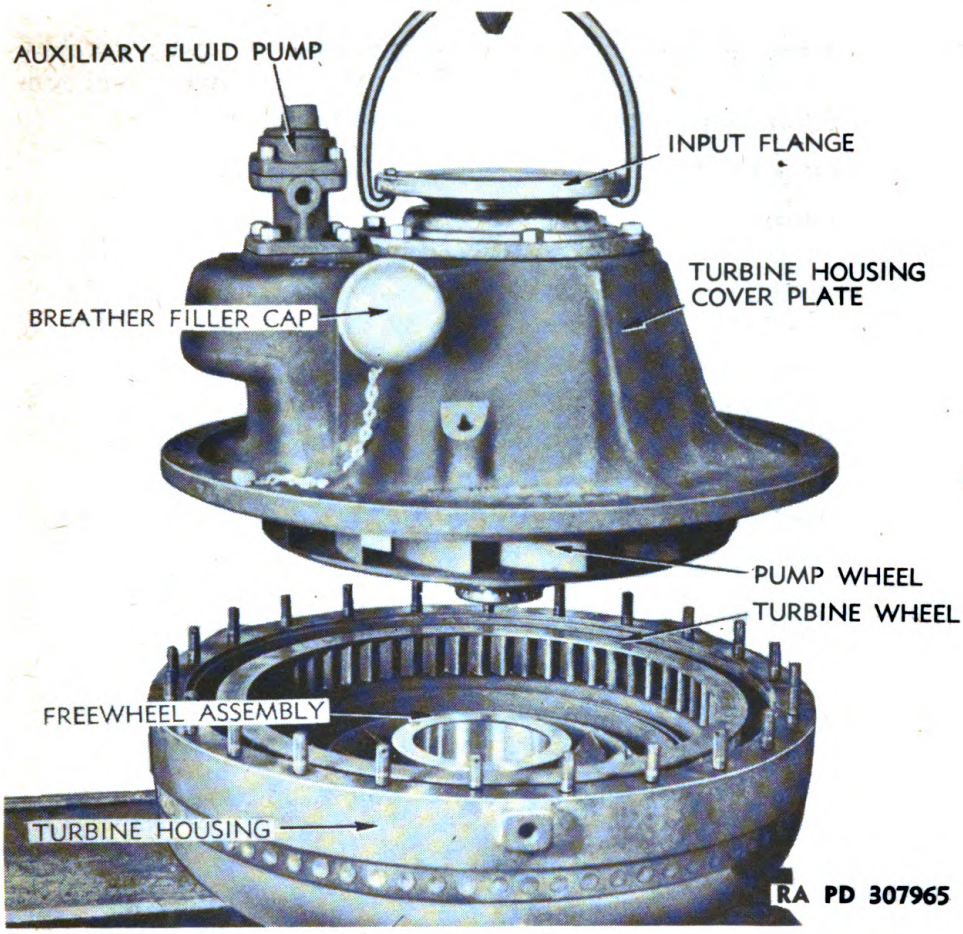


Figure 158 — Removing Turbine Housing Cover Assembly

blades. Lift the mating ring and mating ring washer from the turbine hub. Tap the plug which seals the turbine hub out of hub (see fig. 187), if desired, by inserting a bar through the hub.

d. Remove Bearing and Seals From Turbine Housing. Again place the output half of the converter housing so that it rests on the 24 studs. Pry out the snap ring which holds the bearing in place (fig. 160), then turn the housing over and drive out, or press out, the bearing. The ground joint seal and lip seal may be driven out in similar fashion. Normally these seals will not be removed except to replace them when they fail to function properly, but if it is intended that these same seals are to be used again, the driving out must be very carefully done so they will not be damaged. A flat tool, with the end bent to form an "L" projecting approximately ¼ inch, is handy for this purpose.

e. Remove Auxiliary Fluid Pump From Housing Cover Plate. Remove the four nuts which hold the pump in place in housing cover

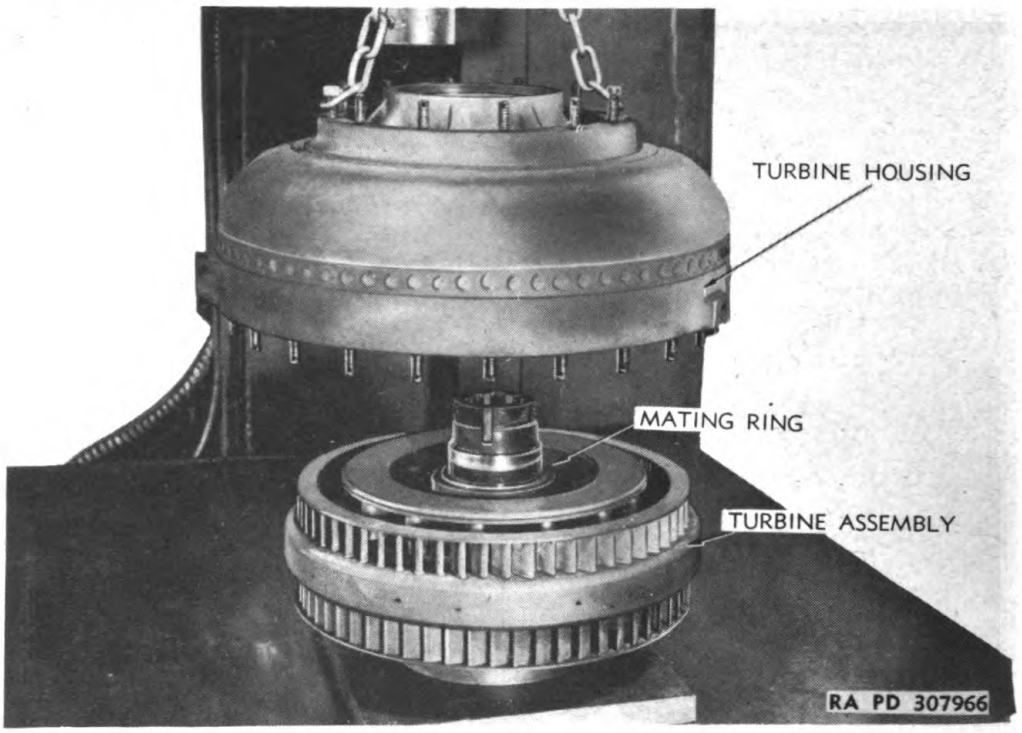


Figure 159 — Lifting Turbine Housing off Turbine

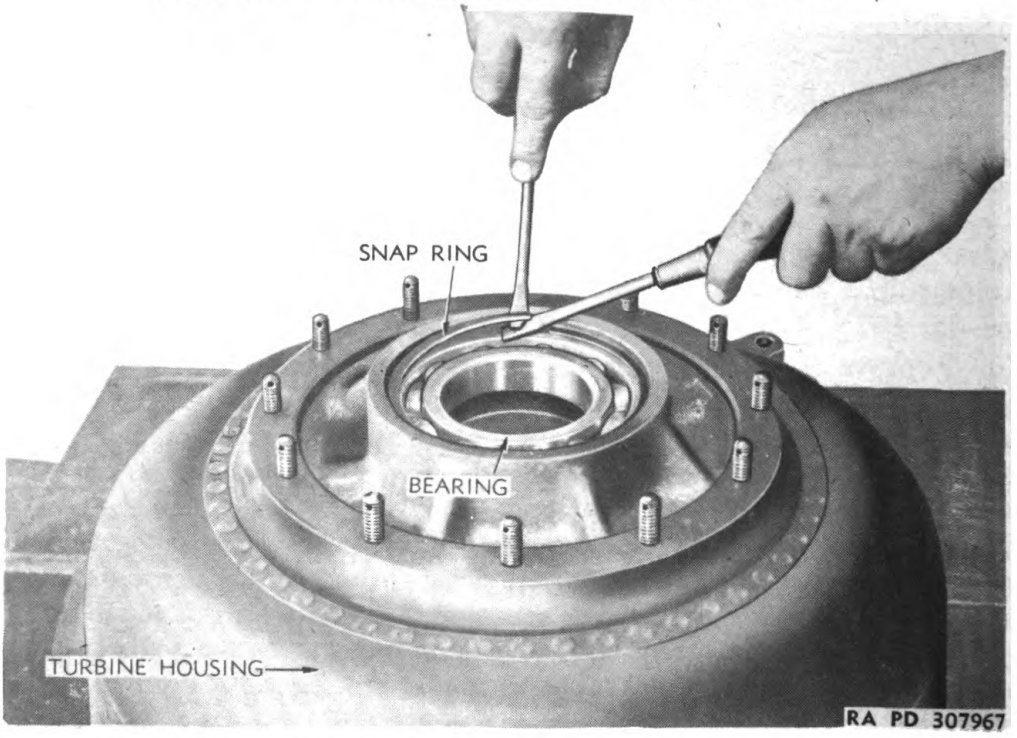


Figure 160 — Removing Bearing Snap Ring

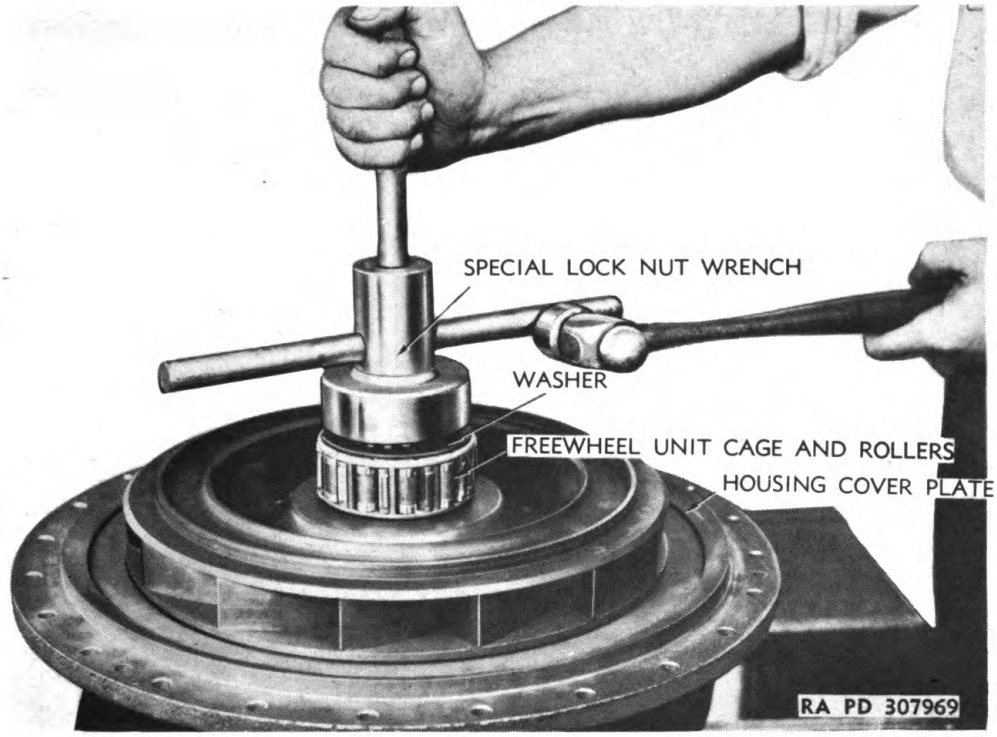


Figure 161 — Removing Input Shaft End Nut, Using Wrench 41-W-3160

(fig. 158). Do not loosen the socket-head screws on the pump itself in this operation. Lift pump from cover.

f. Remove Input Shaft Assembly From Housing Cover Plate. Remove the six cap screws attaching the input bearing retainer (fig. 162) to cover plate. Turn the turbine housing cover plate over to rest on the input shaft flange. Bend the locking lug out of nut and remove lock nut with wrench (41-W-3160) as shown in figure 161. Take off washer and lift cage with rollers from the inner race. Place the housing in a support which bears on the outer flange of cover and leaves about 6-inches space below the input shaft flange as shown in figure 162. Press the input shaft out of the impeller as shown in figure 163. This will free the inner race of the pilot bearing, which together with the washer below it may be lifted off.

g. Disassemble Input Shaft Assembly. Secure the input shaft flange by pins in a stand as shown in figure 164, bend locking lug out of nut and remove bearing lock nut holding auxiliary pump drive gear on shaft. Use special wrench (41-W-3739-400), shown in figure 181, to remove nut. Remove the gear, the bearing retainer, and input bearing from the input shaft with the gear puller (41-P-2910) as shown in figure 165. Then press bearing and seal from the bearing retainer.

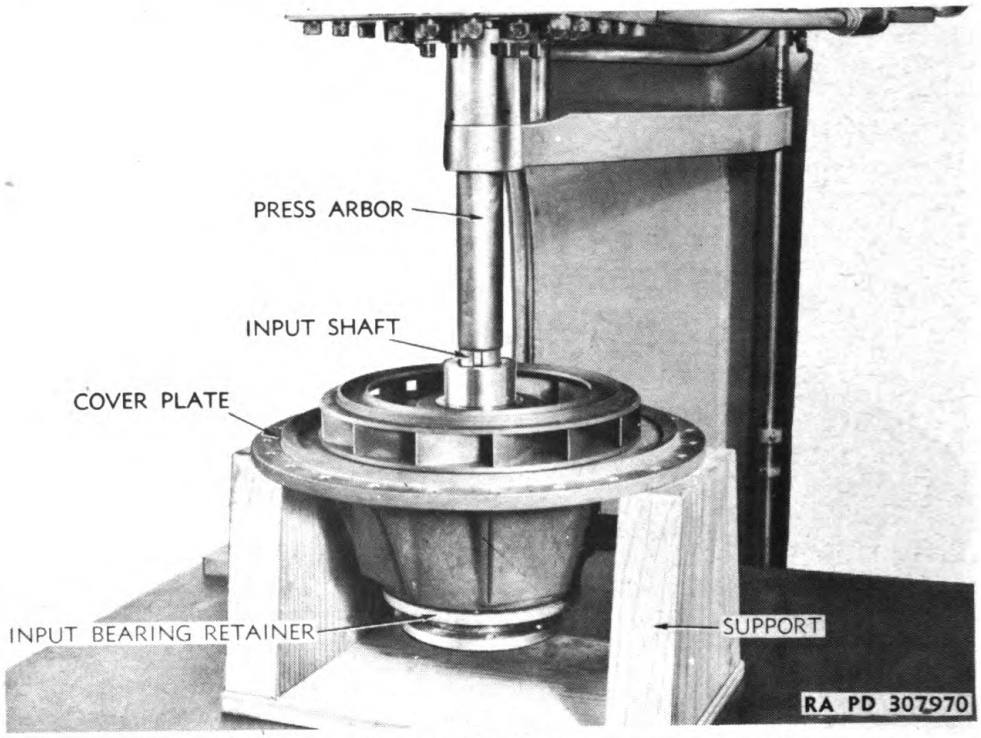


Figure 162 — Pressing Input Shaft From Housing Cover Plate

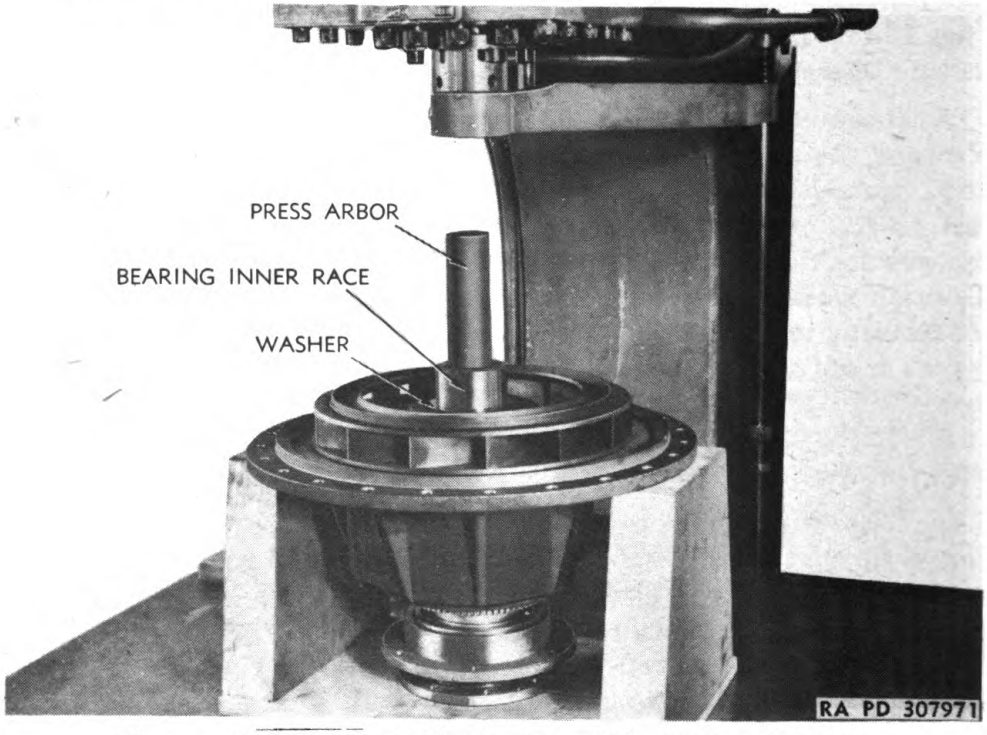


Figure 163 — Input Shaft Assembly Pressed From Housing Cover Plate

TORQUE CONVERTER

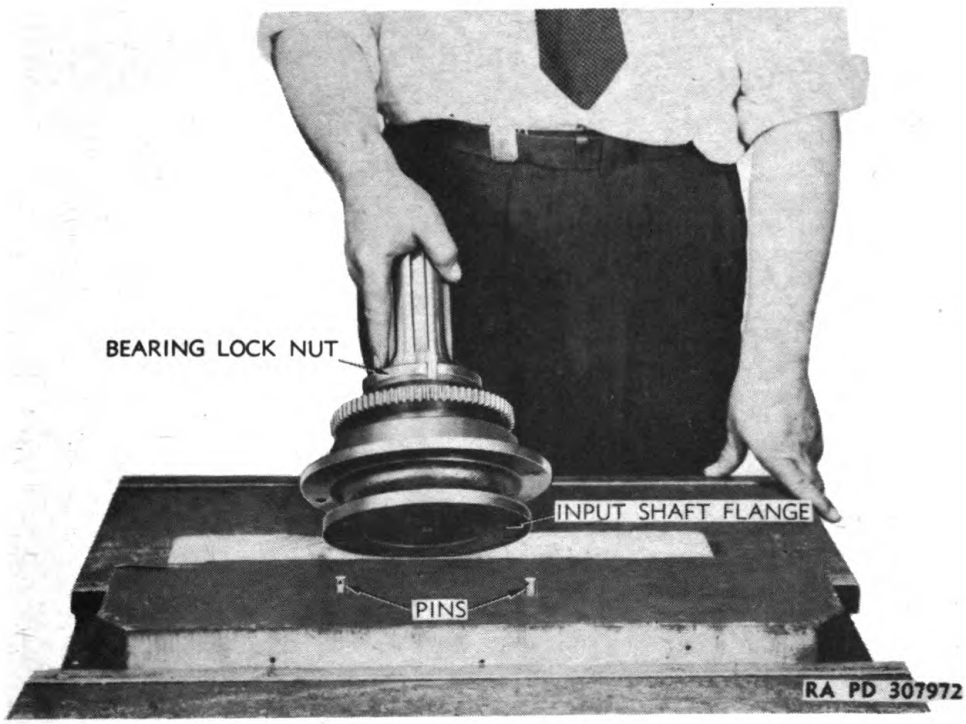


Figure 164 — Stand for Disassembling Input Shaft Assembly

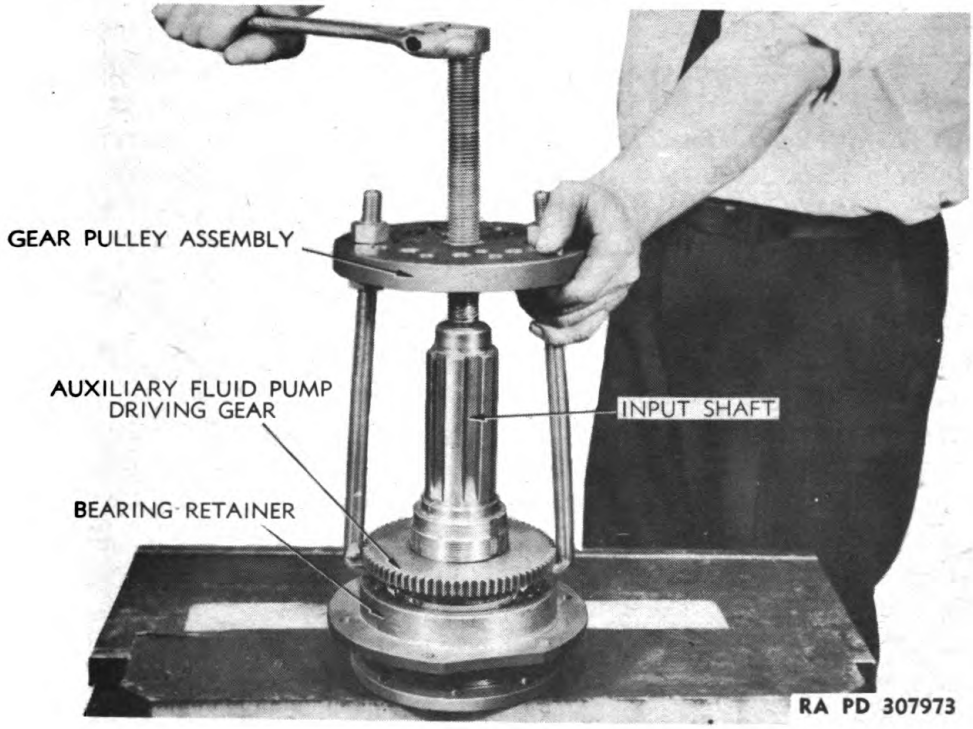


Figure 165 — Pulling Auxiliary Pump Driving Gear, Using Puller 41-P-2910

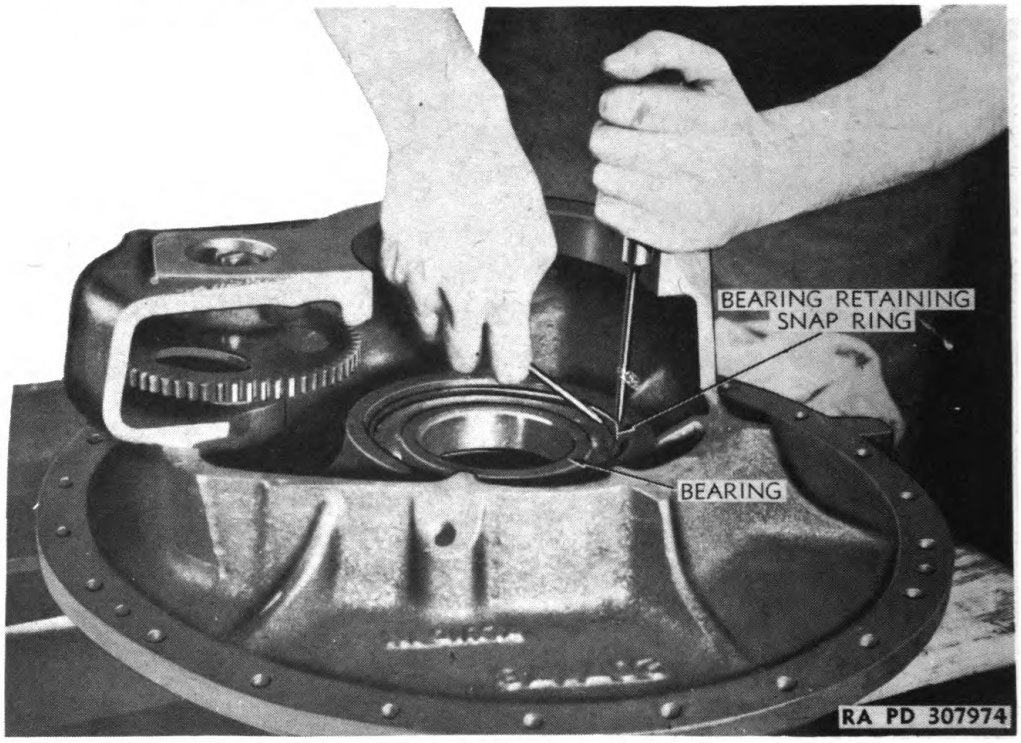


Figure 166 — Removing Bearing Retaining Ring From Cover Plate

h. Remove Impeller, Bearing, and Seals From Housing Cover Plate. Turn cover plate, still containing the impeller, over to rest on the impeller. Bend locking lug out of lock nut and remove lock nut from impeller hub with special wrench (41-W-3739-400) shown in figure 181. Lift cover plate from impeller, tapping hub of impeller gently, if necessary, to free it. Lift mating ring and mating ring washer from impeller hub. Pry out retaining rings as shown in figure 166, then press the bearing and two seals out of cover plate.

i. Remove Auxiliary Fluid Pump Drive Shaft, Gear, and Bearings. Screw puller screw of special puller (41-P-2951-49) onto auxiliary pump drive shaft, set puller block on mounting studs, then screw nut onto puller screw and pull shaft out of cover plate as shown in figure 167. Outer bearing will come with shaft and can be slipped off, when shaft is free. Drive gear will also be removed. Be careful not to lose the Woodruff key, which locks the gear on this shaft. Then insert longer puller bolt of tool through inner bearing, screw flat nut onto end of bolt under bearing and pull bearing in same manner as shown in figure 168.

63. DISASSEMBLY OF AUXILIARY FLUID PUMP.

a. Remove the four cap screws and lock washers that attach the pump cap to pump housing and remove cap from rotors (fig. 169).

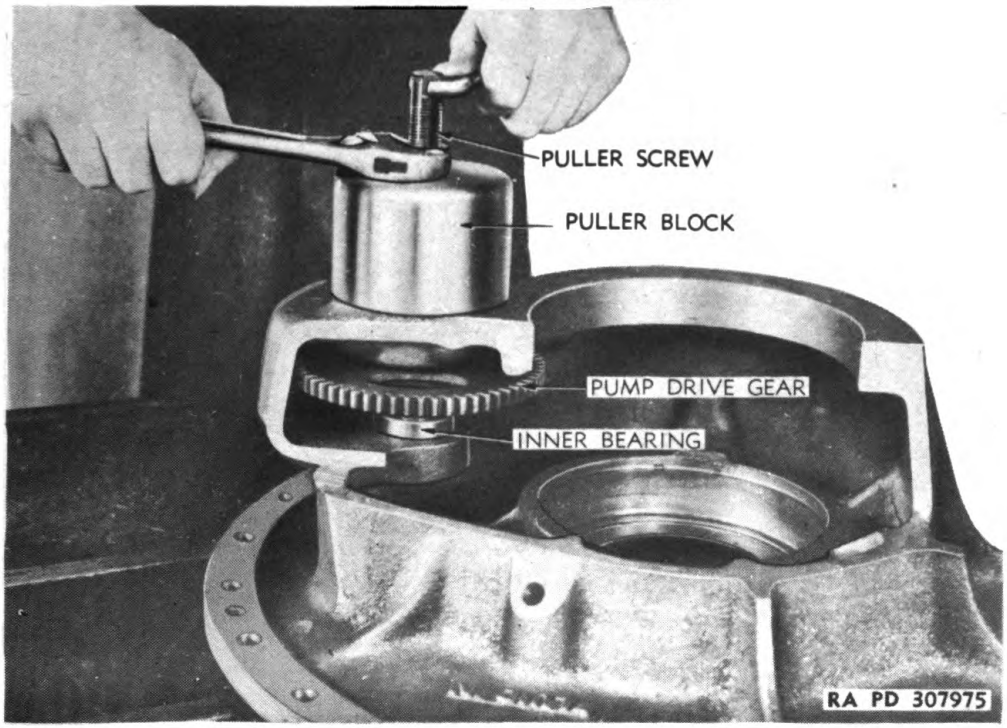


Figure 167 — Removing Pump Drive Shaft and Outer Bearing Using Puller 41-P-2951-49

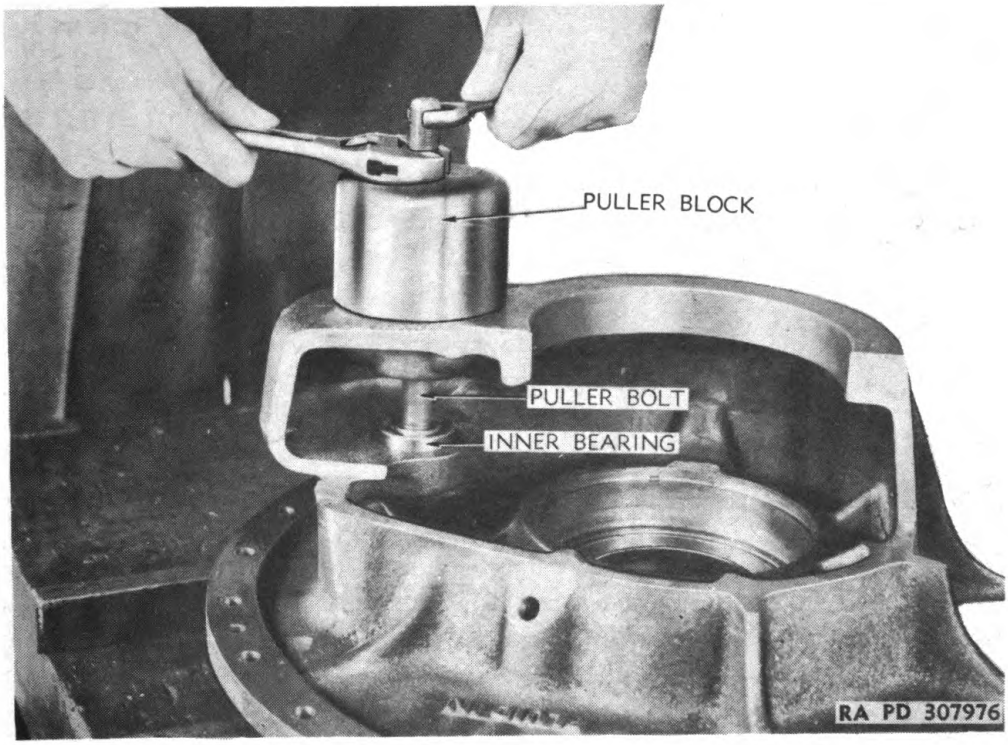


Figure 168 — Removing Inner Pump Drive Shaft Bearing, Using Puller 41-P-2951-49

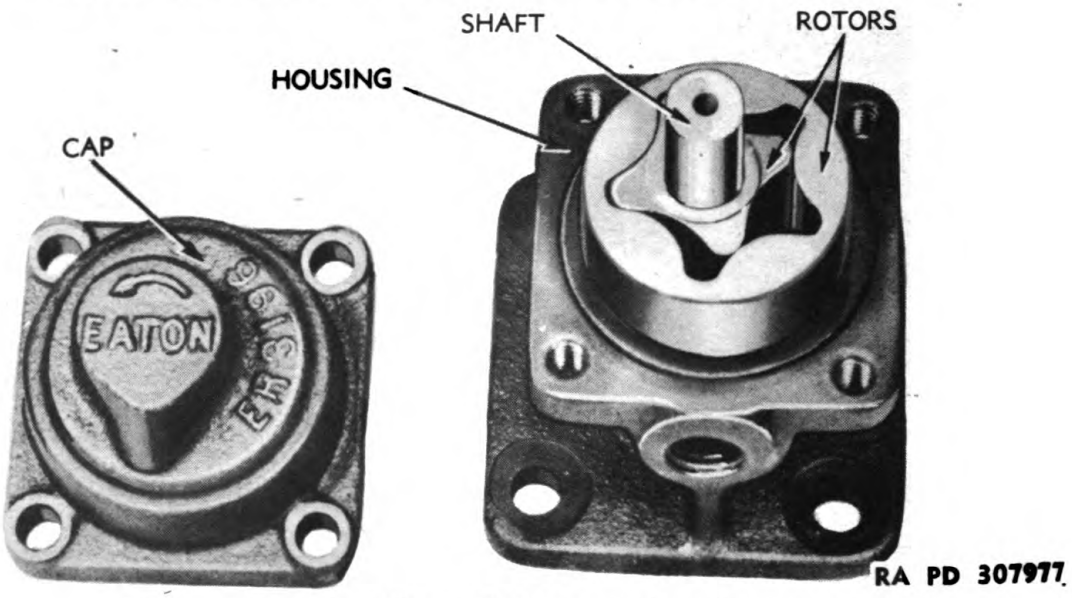


Figure 169 — Auxiliary Fluid Pump Cap Removed

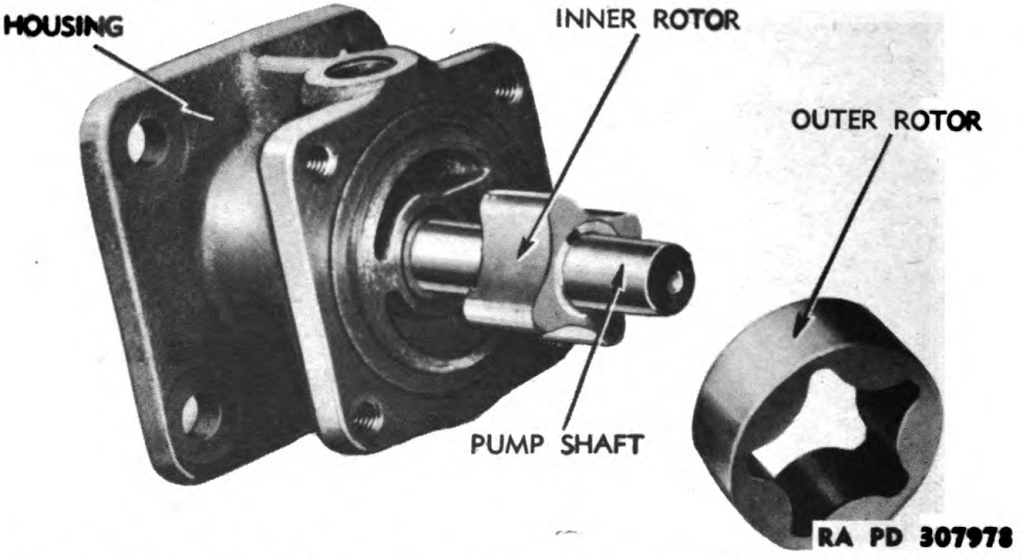


Figure 170 — Fluid Pump Outer Rotor Removed From Pump Shaft

Lift outer and inner pump rotors from shaft (fig. 170) and remove key from slot in shaft. Slide shaft towards rear and out of pump housing. Press on drive bearings and bushings from housing.

64. CLEANING AND INSPECTION OF PARTS.

a. **Cleaning.** Wash all parts thoroughly with dry-cleaning solvent and dry with compressed air. Discard all worn parts. Scrape all particles of old gaskets or gasket cement from mating surfaces. When

cleaning use care not to bend, or damage, blades in housing or turbine wheel. Make sure all holes in impeller are free of obstructions. After cleaning and inspecting bearings, coat them with light engine oil and wrap in paper to prevent entrance of dust. CAUTION: *Do not spin bearings with compressed air after cleaning.*

b. Inspection.

(1) INPUT SHAFT. Inspect shaft and splines for wear. If shaft is grooved, rough, or worn below 3.485 inches in diameter or if sides of splines are stepped, the shaft must be replaced as this will cause a loose fit with inner race of free-wheel unit.

(2) BEARINGS. Discard any bearings that show signs of wear or if balls or races are rough, chipped, pitted, or discolored. Balls of bearings and bearing races must have bright polished surfaces if they are to be used again. Roll bearings slowly by hand. Replace any that have a tendency to bind or do not roll smoothly and freely. NOTE: *Bearings must fit snugly on shafts and in housing bores.* Replace shaft, housing or bearing cage, or the bearing (whichever is worn) if bearings do not fit snugly as looseness might result in shaft turning in inside race of bearing or outer race of bearing might turn in housing. The three converter bearings (MRC-216S) are the same and, when new, have an inside diameter of from 3.1490 to 3.1496 inches and an outside diameter of 5.5108 to 5.5118 inches. The two oil pump drive bearings (MRC-2035) are also the same and have an inner diameter of from 0.6690 to 0.6693 inch and an outside diameter of from 1.5743 to 1.5748 inches when new. A wear tolerance of from 0.015 to 0.019-inch end play or from 0.025 to 0.032-inch tilt with 22-pounds thrust applied is permissible for the MRC-216S bearings; a wear tolerance of from 0.008 to 0.012-inch end play or from 0.012 to 0.019-inch tilt with 5½-pounds thrust applied is permissible for the MRC-206S bearings.

(3) OIL SEALS. Always install new seals throughout when assembling converter. In emergency cases only should the old seals be used, however the old seals must not be used if worn, grooved, or rough, as leakage would result.

(4) FREE-WHEEL ASSEMBLY. Replace inner race or shaft or both if worn or damaged or if race is loose on shaft. Inspect cage and roller assembly. Replace if rollers show flat spots, chipping, or discoloration due to heat or if sprags have wear lines more than $\frac{3}{32}$ inch wide on either outside or inside surfaces. Replace outer race if wavy, worn or discolored due to heat. All contacting surfaces of races or rollers must have a bright polish and roll freely.

(5) TURBINE HOUSING AND TURBINE WHEEL. If either housing, or wheel, are damaged, or blades in either are damaged, the affected unit must be replaced, as neither can be repaired.

(6) AUXILIARY PUMP GEARS. Inspect gears for general wear and broken teeth. Replace gears if backlash exceeds 0.020 inch or if

teeth show deep pits or steps, due to wear.

(7) AUXILIARY FLUID PUMP. In nearly all cases, the pump will be serviced as a complete unit, as damage to, or failure of, any one part would probably make the other parts unusable except for salvage. The housing and rotors are held to very close tolerances, as damage or wear, on either rotors or housing, necessitates replacement of both.

Section III

ASSEMBLY AND TESTS

65. ASSEMBLY OF CONVERTER.

a. Install Seals and Bearings.

(1) INSTALLATION OF OIL SEALS. There are five seals in the converter. In the input bearing retainer there is a lip-type seal. On each side of the converter hydraulic chamber there is a ground joint seal on the inner side and a lip-type seal in the outer side. These four seals are pressed into suitable bores in the converter housings. Installation of all the seals is accomplished in essentially the same manner. To install the ground joint seals in the turbine housing and

Figure 171 — Placing Ground Joint Seal on Pressing Disk of Replacer 41-R-2393-750

TORQUE CONVERTER

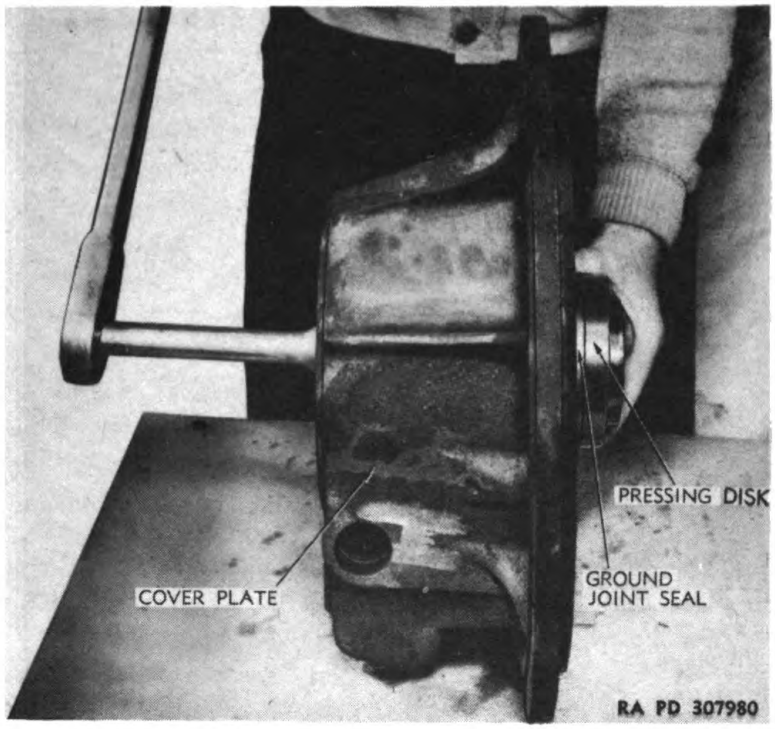


Figure 172 — Pressing Seal Into Converter Coverplate, Using Replacer 41-R-2393-750

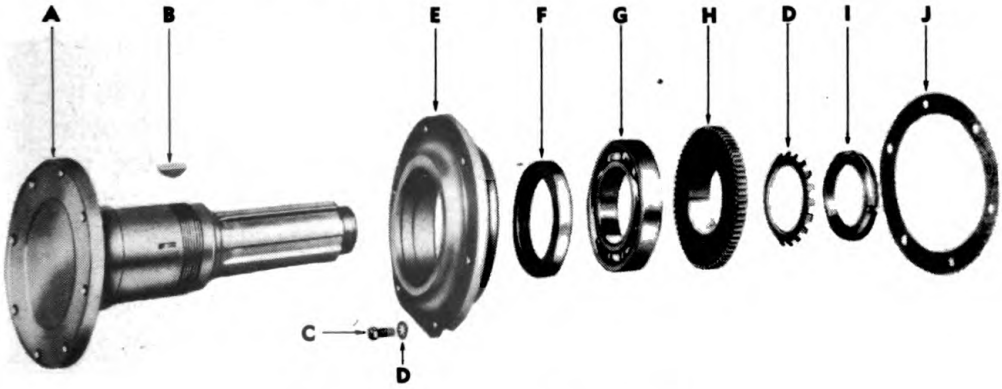


Figure 173 — Input Shaft Assembly Disassembled

cover plate, first place seal on the smaller of the two disks of the special oil seal replacer (41-R-2393-750) as shown in figure 171. This disk has a raised rim and is shaped to protect the face of the seal while it is being pressed into housing or cover plate. Then spread a thin coating of the hardening type joint and thread com-

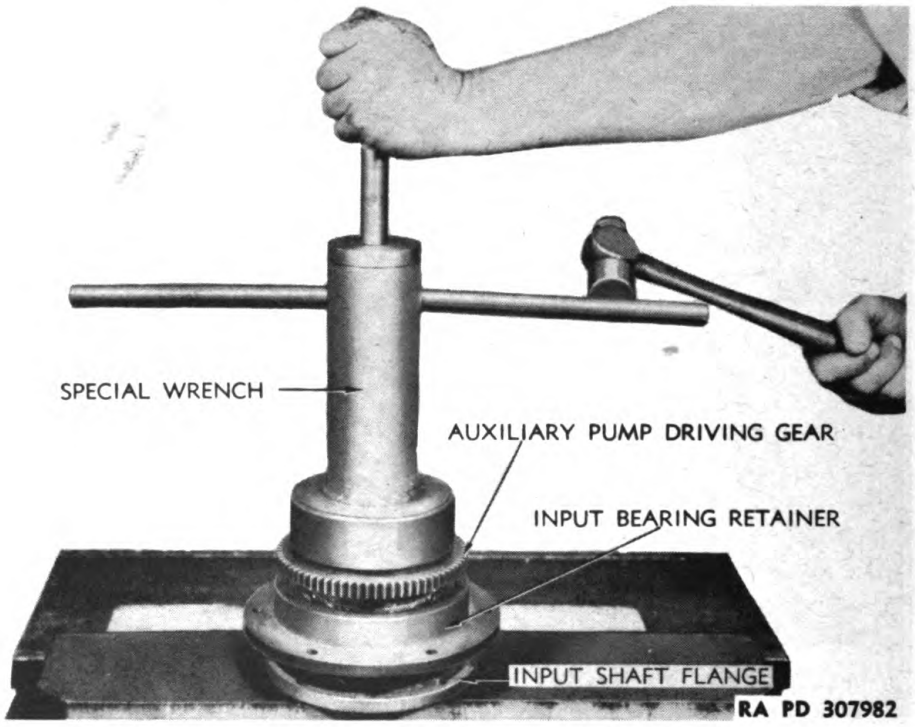


Figure 174 — Assembling Input Shaft Assembly, Using Wrench 41-W-3739-400

pound or like material on the surfaces in housing with which the seal will come in contact. Press seal into place by placing other disk of tool on opposite side of bore in housing and draw the two disks together with screw until seal is seated against contacting surface. Figure 172 shows seal being pressed into cover plate. After allowing a minute or two for the joint and thread compound to harden, withdraw the seal pressing disk. With a pocket knife or similar tool, carefully scrape off any excess joint and thread compound which has been squeezed out, exercising great care not to injure face of seal. Install lip seals in opposite sides of same housing (with lips of seal pointing away from ground joint seals) in same manner, using the larger disk to press seals into place. Press lip type seal into input bearing retainer in same manner with lip of seal towards open side of retainer.

(2) INSTALLATION OF BEARINGS. Press bearings into turbine housing, cover plate, and input bearing retainer next to lip type oil seals in usual manner. These three bearings are identical and are the same on both sides so there can be no mistake as to position. Anchor the two bearings in turbine housing and cover plate with snap rings inserted into grooves in bearing bores.

TORQUE CONVERTER

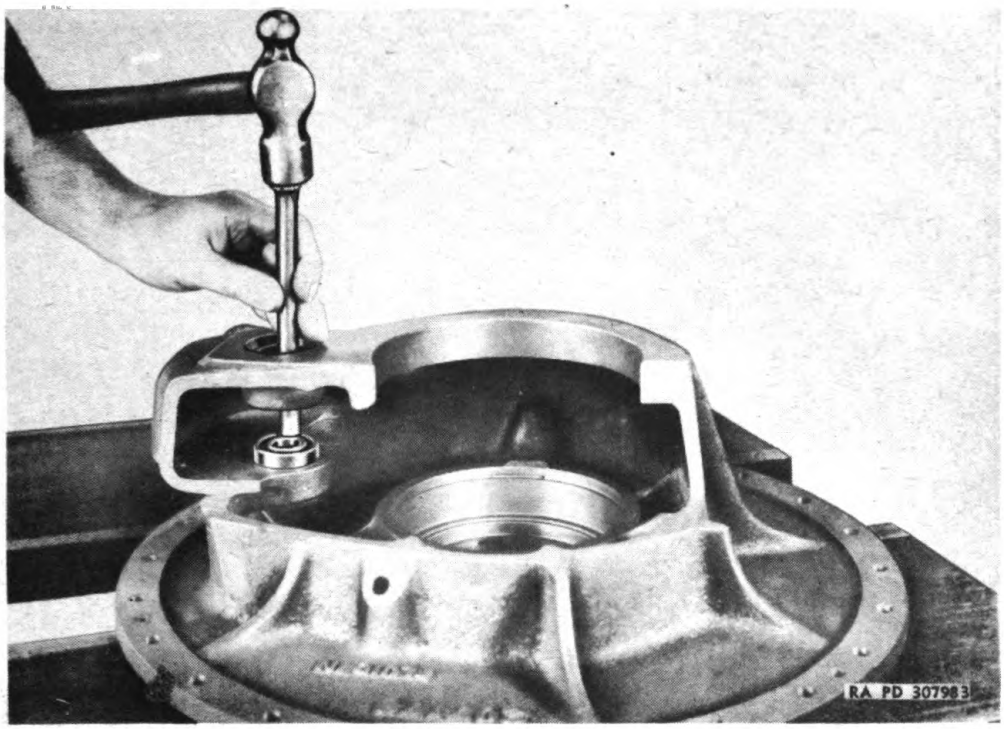


Figure 175 — Installing Inner Pump Drive Shaft Bearing

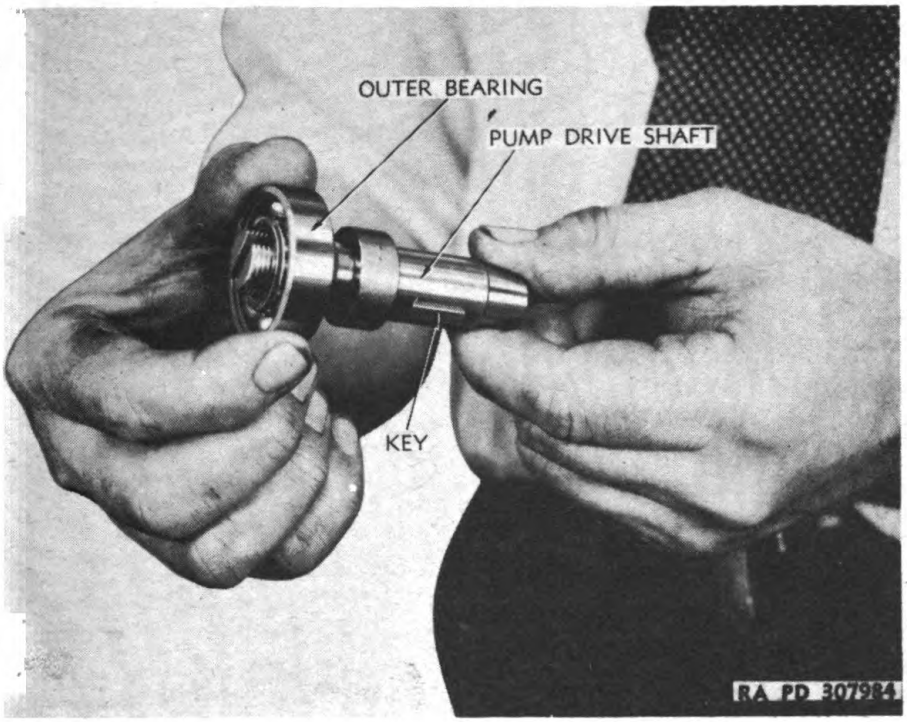


Figure 176 — Installing Outer Bearing on Pump Drive Shaft

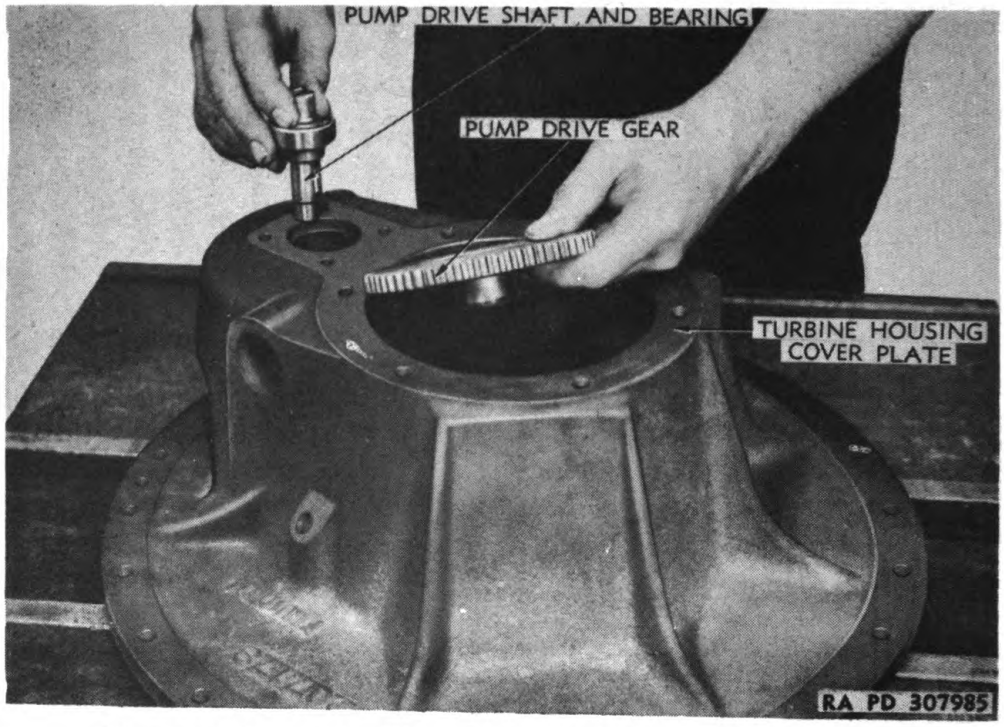


Figure 177 — Installing Pump Drive Gear and Shaft

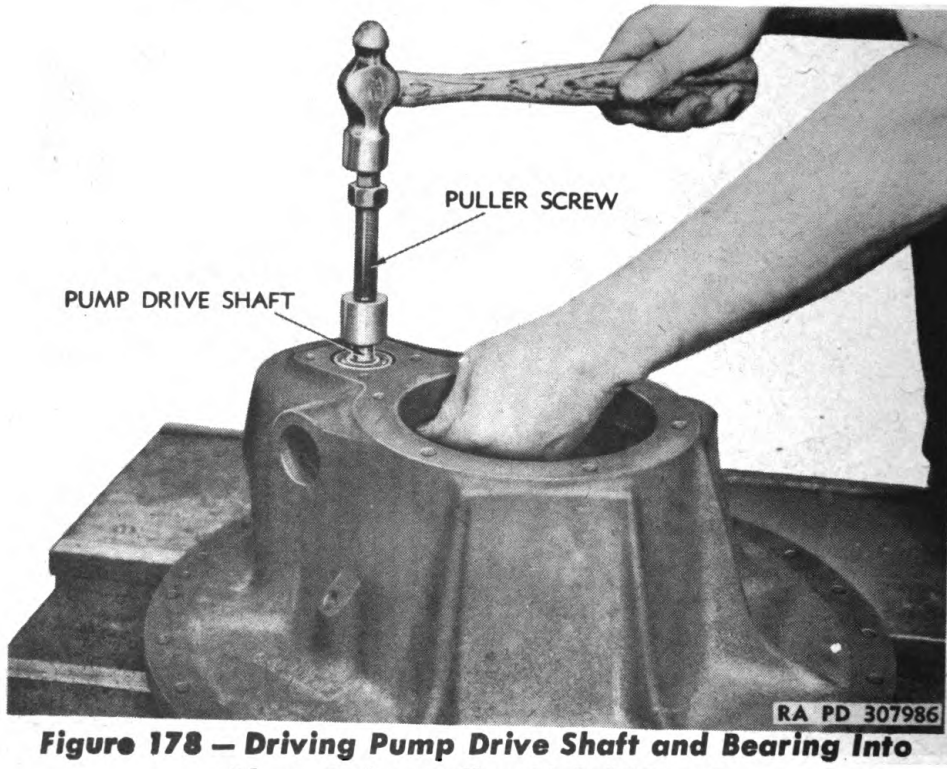
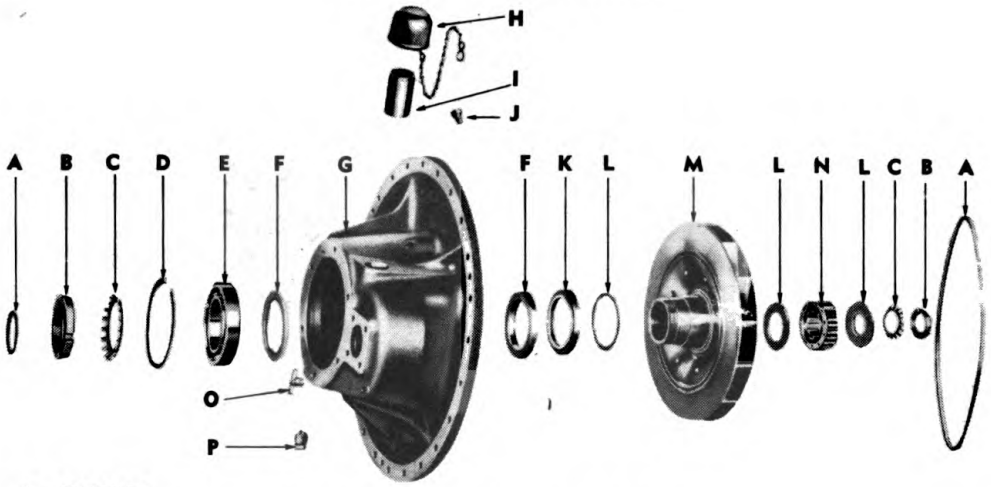


Figure 178 — Driving Pump Drive Shaft and Bearing Into Place, Using Puller 41-P-2951-49

TORQUE CONVERTER



A—GASKET
B—LOCK NUT
C—LOCK WASHER
D—SNAP RING
E—BEARING
F—OIL SEAL
G—HOUSING COVER
H—BREATHER CAP
I—BREATHER NIPPLE
J—BOLT
K—SEAL RING
L—WASHER
M—WHEEL
N—FREEWHEEL UNIT
O—OIL CHECK VALVE
P—DRAIN PLUG

RA PD 307987

Figure 179 — Turbine Housing Cover and Impeller Assembly Disassembled

b. Assemble Input Shaft Assembly. Set input shaft on end over pins in stand as shown in figure 164. Insert input shaft through input bearing retainer and bearing and press retainer and bearing into position shown in figure 174. Tap key into slot in shaft above bearing, and slip pump driving gear (flat side up) onto shaft and key. Place bearing nut locking washer on shaft next (prongs up), then install lock nut and tighten securely with special wrench (41-W-3739-400) and hammer (fig. 174). Bend lug of locking washer into slot in nut.

c. Assemble and Install Pump Drive Assembly. Install pump drive shaft outer bearing on threaded end of shaft and tap key for gear into slot in shaft as shown in figure 176. Drive or press inner bearing into lower bore in turbine housing cover plate (fig. 175). Insert pump drive gear through large opening in cover plate with projecting hub down, as shown in figure 177, aline gear with key in shaft, and insert end of pump shaft through upper bore in cover plate and through gear. Then screw puller screw of special tool (41-P-2951-49) onto end of shaft and drive shaft and bearing into place as shown in figure 178. Install snap ring in bore above outer bearing.

d. Install Impeller in Cover Plate. Lay impeller on a flat surface so that its hub projects upward. Place mating ring sealing washer in counterbore of seal mating ring. Snap ring and washer into position over impeller hub and against impeller by first engaging one side of washer as shown in figure 180, then push the other side

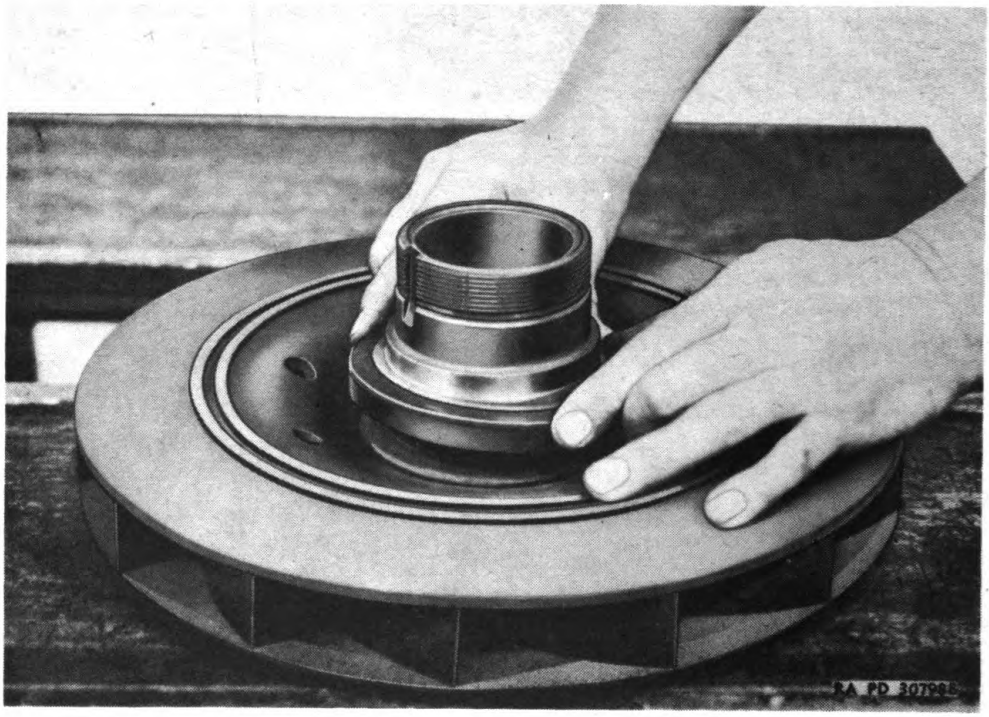


Figure 180 — Installing Seal Mating and Sealing Washer

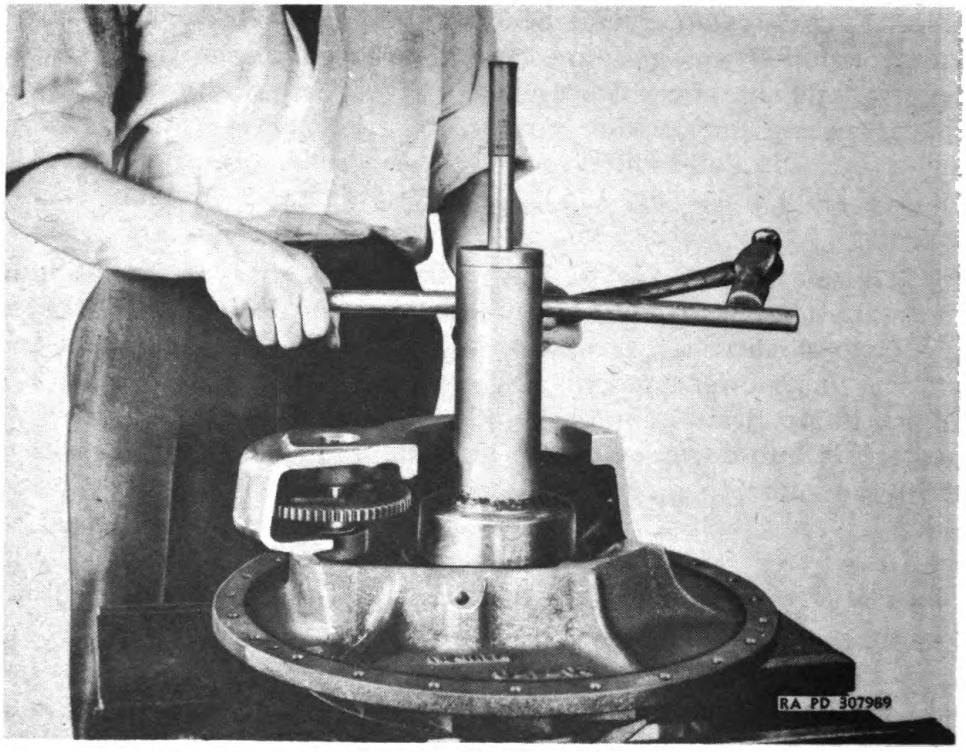


Figure 181 — Tightening Bearing Lock Nut, Using Wrench 41-W-3739-400

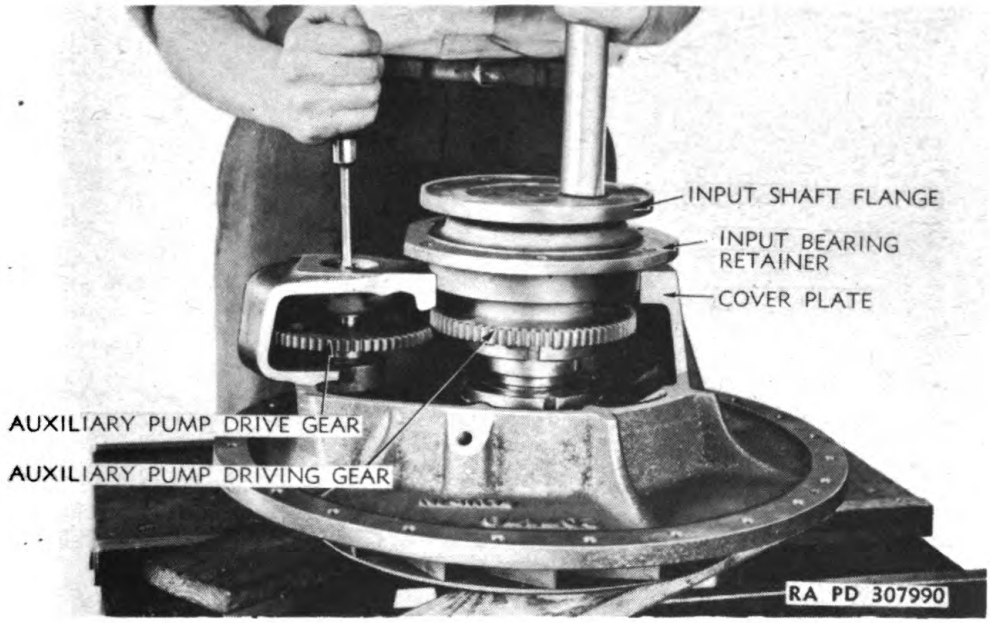


Figure 182 — Installing Input Shaft Assembly in Cover Plate

over and press ring and washer down squarely against impeller. Lower turbine housing cover plate over impeller hub. Place bearing nut locking washer on hub (prongs up), then install and tighten locking nut securely with special wrench (41-W-3739-400) as shown in figure 181. Bend lug of locking washer into slot in nut.

e. Install Input Shaft Assembly in Cover Plate. Slip input shaft sealing ring gasket onto input shaft and against shoulder of shaft. Cement flat gasket to machined face of input bearing retainer and lower input shaft assembly into impeller hub as shown in figure 182. Rotate auxiliary pump drive shaft with a screwdriver so gears will mesh. Tap on flange of input shaft until bearing retainer seats against cover plate. Attach retainer to cover plate with six cap screws with lock washers.

f. Install Free-wheel Inner Race and Roller Assembly on Input Shaft. Reverse the cover plate assembly to rest it on the input shaft flange, slip side washer onto shaft against impeller and drive or press inner race of free-wheel unit over splines on extension of input shaft as shown in figure 183. Assemble free-wheel cage, carrying rollers and sprags, in place over the inner race. CAUTION: ***Free-wheel cage must be placed right side out or converter cannot function when assembled.*** Observe that when properly placed, as in figure 192, the roller in each section is to the left of the sprag, and to the right of a section partition. Slip the other side washer and the lock washer

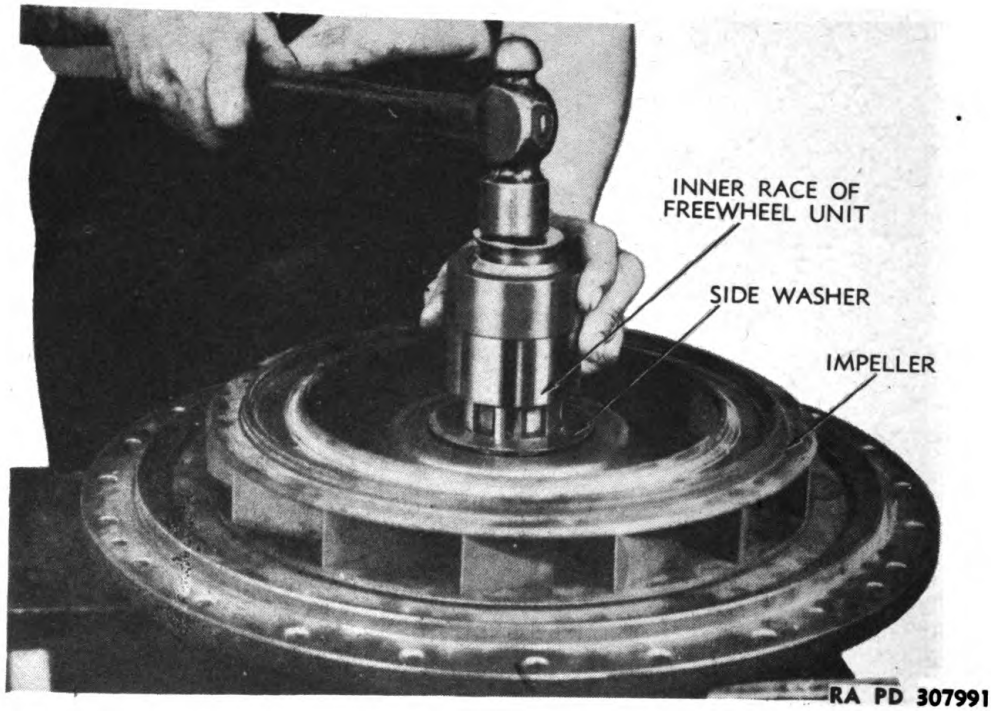


Figure 183 — Installing Free-wheel Inner Race

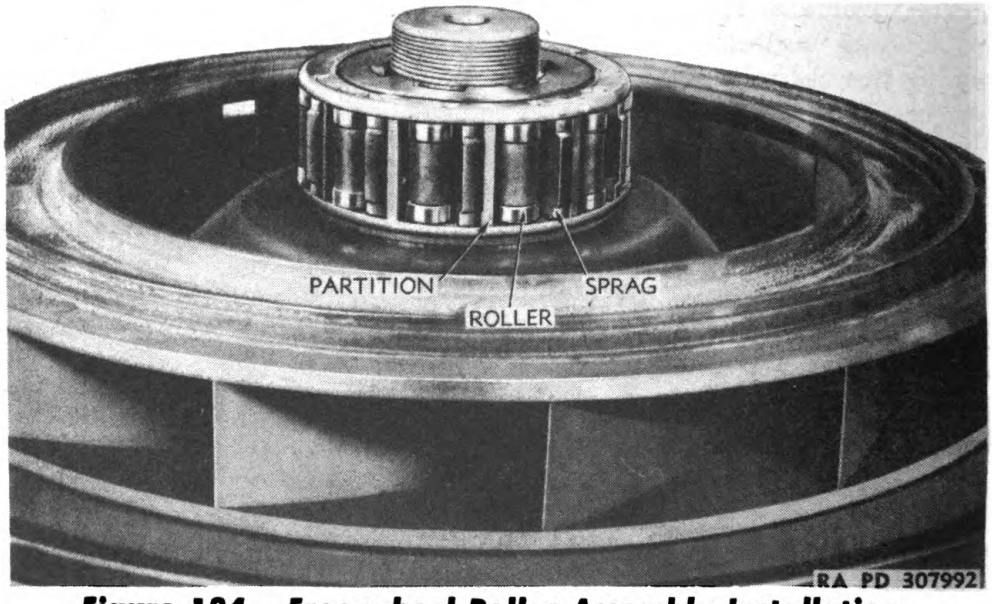
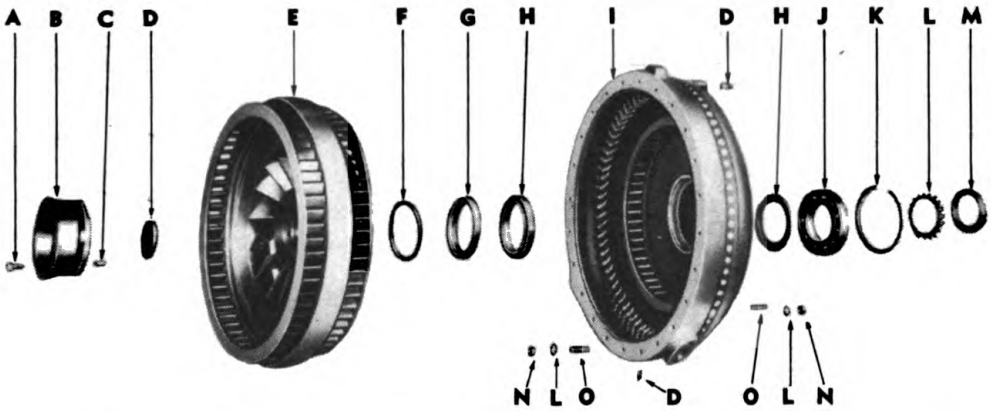


Figure 184 — Free-wheel Roller Assembly Installation

(prongs up) onto shaft and start the retaining nut. Tighten the nut with the special wrench (41-W-3160). To check the correctness of the free-wheel cage installation, take the outer race of the free-wheel unit and slip it over the cage and rollers. It should spin freely in a

TORQUE CONVERTER



A—SCREW
B—OUTER RACE
C—DOWEL
D—PLUG
E—WHEEL
F—WASHER
G—SEAL RING
H—OIL SEAL
I—HOUSING
J—BEARING
K—SNAP RING
L—LOCK WASHER
M—LOCK NUT
N—NUT
O—STUD

RA PD 307993

Figure 185 — Turbine Wheel and Housing Disassembled

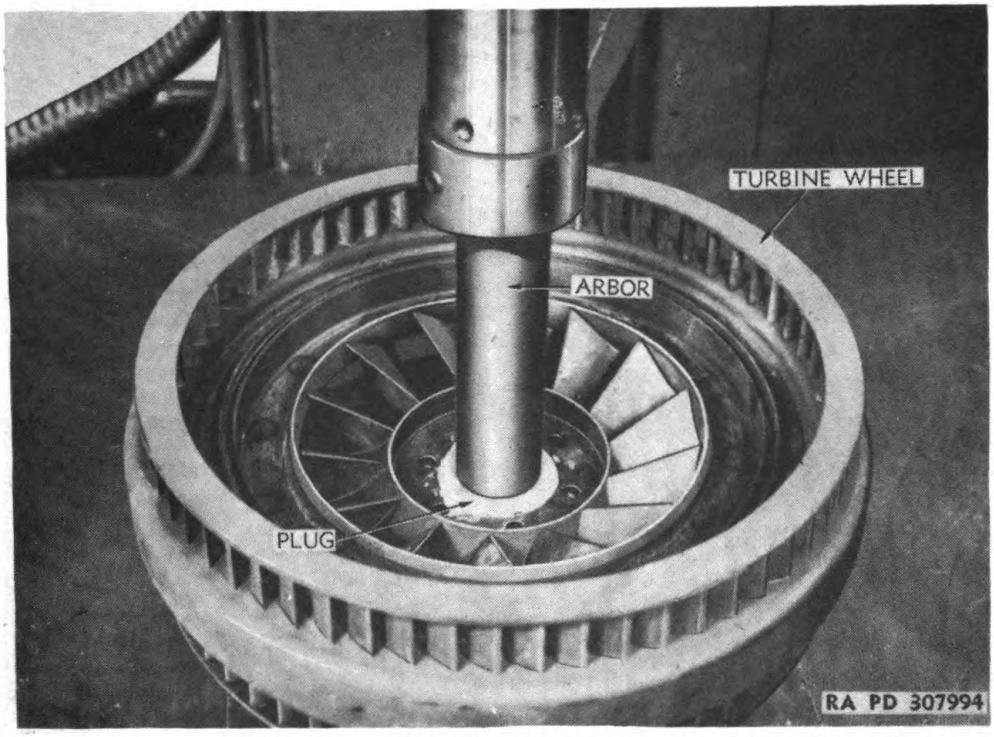


Figure 186 — Pressing Cup Plug Into Turbine Wheel

clockwise direction, as viewed from above, but should lock if you attempt to turn it counterclockwise. If it locks when turned clockwise, and spins freely when rotated counterclockwise, it means the roller cage has been assembled wrong side up. After this check is correctly made, bend lug of locking washer into slot in nut to lock the impeller hub retaining nut. The outer race is not assembled to the impeller, but to the turbine hub as described in step g.

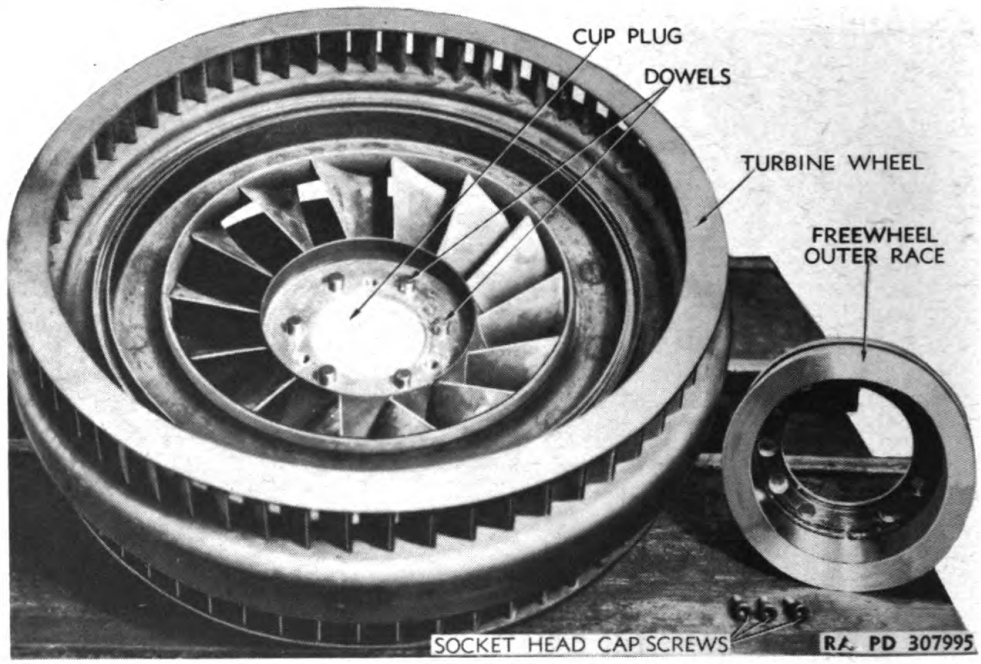


Figure 187 — Cup Plug and Dowels Installed in Turbine Wheel

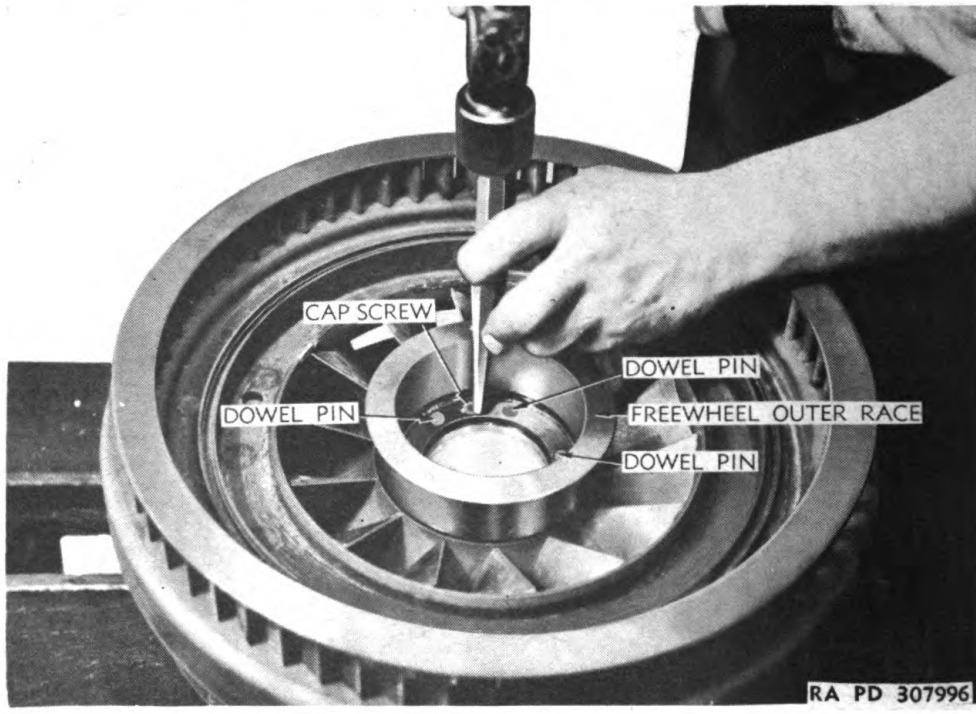


Figure 188 — Locking Free-wheel Outer Race Retaining Screws

Figure 189 — Installing Turbine Seal Mating Ring and Sealing Washer

g. Install Free-wheel Outer Race on Turbine Hub. Place turbine wheel on bench as shown in figure 186. Coat the edges of the turbine wheel cup plug with white lead and press plug into position shown in illustration. Wipe off excess white lead. Insert the six dowels in turbine hub to receive free-wheel outer race (fig. 187). Place race on the six pins as shown in figure 188 and secure it with the three knurled socket head cap screws. The race will fit in only one position, the holes having been spaced unequally to assure assembly in proper relationship. When cap screws have been completely tightened, use a punch to distort the metal adjacent to the screw heads, thus locking the screws.

h. Assemble Turbine Wheel and Housing. Turn turbine over and install mating ring sealing washer and seal mating ring on turbine hub as shown in figure 189, following the procedure outlined for placing these parts on the impeller hub, step **d**. Press turbine housing over turbine hub, as shown in figure 190, and install locking washer and nut. Tighten nut with special locking nut wrench and bend lug of locking washer into slot in nut.

i. Install Auxiliary Fluid Pump on Cover Plate (fig. 158). Cement gasket to pump and install pump on cover plate, engaging tongue on end of pump shaft in slot in pump drive shaft. Position pump so that the word "EATON" is right side up with the other words cast in the cover plate. Install the four lock washers and nuts and tighten.

j. Connect Cover Plate and Turbine Assemblies. Place gasket over the projecting ring of the cover plate and lower cover plate

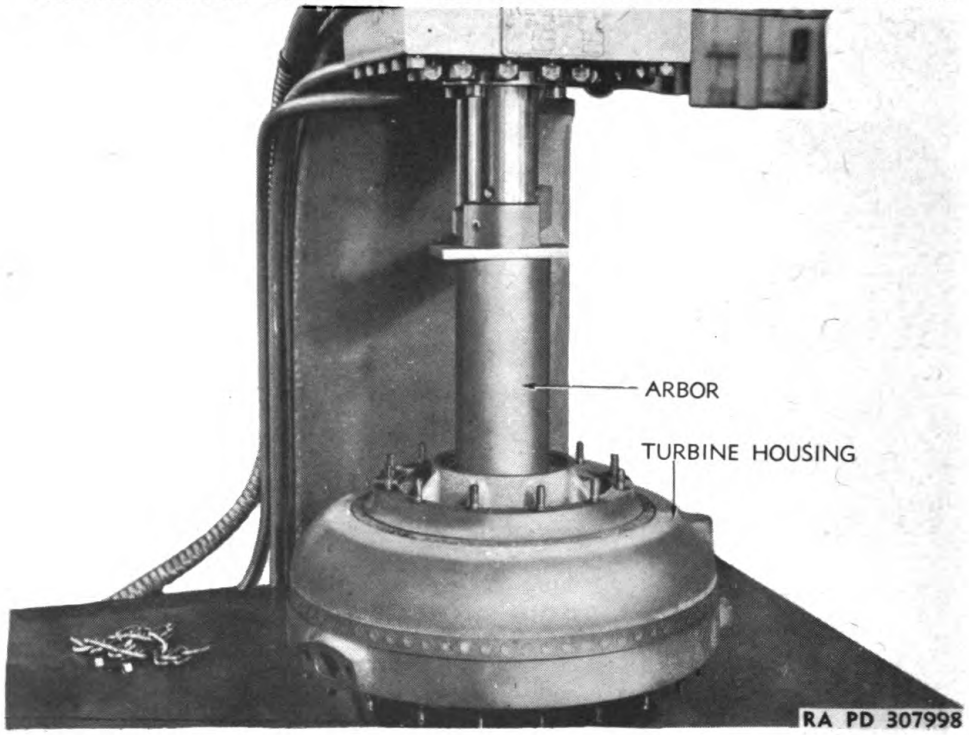


Figure 190 — Pressing Turbine Housing Onto Turbine Hub

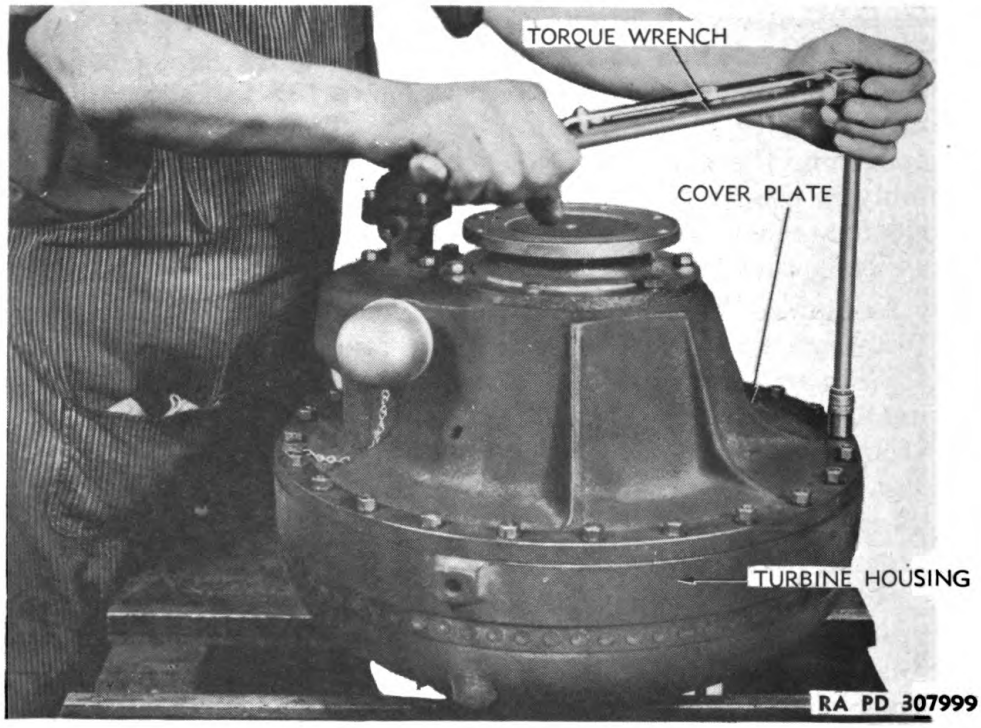


Figure 191 — Tightening Converter Housing Nuts, Using Wrench 41-W-3630

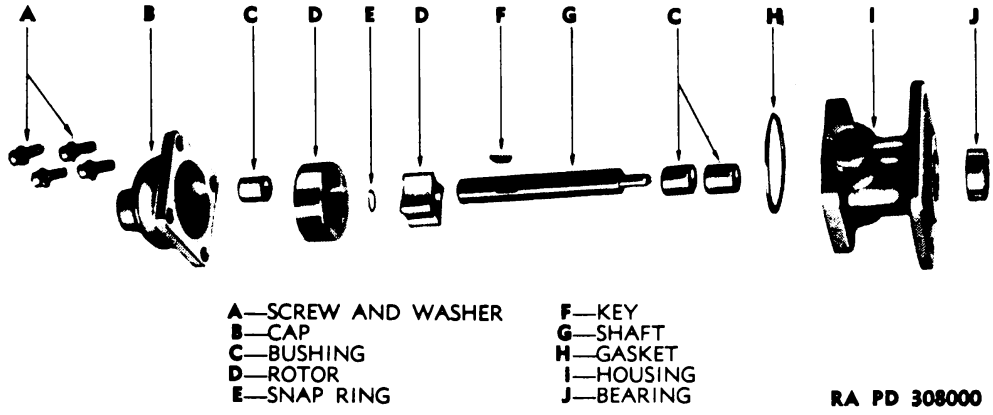


Figure 192 — Auxiliary Fluid Pump Disassembled

assembly carefully into the other half of the converter. The two holes above the cast number 207178 fit the two studs on either side of the tapped projection which marks the top of the turbine housing. Install lock washers and nuts on the 24 studs, tightening them evenly all around with an indicating, or releasing, torque wrench (41-W-3630) to apply a tension of 40 pounds to each nut (fig. 191).

66. ASSEMBLY OF AUXILIARY FLUID PUMP.

a. Insert the shaft upward through the base of the pump. Tap key into slot in shaft and slide inner rotor onto shaft and key. Place outer rotor in position, rotating shaft and rotors, as necessary, to center the outer rotor on the base (see figs. 169 and 170). Place the cover in position. It will fit only when applied right side up, the shaft being off center with reference to the holes for the cap screws. Insert cap screws with lock washers through cap and into housing and tighten.

67. TESTS.

a. Torque Converter. Testing the torque converter after assembly for proper operating would require that the converter be installed in a tractor or like installation. If parts are correctly and carefully assembled, there is no reason why the converter should not operate properly. However, a test can be made, to determine if turbine seals will leak, by closing all openings in converter housing with appropriate plugs, then filling converter with fluid, and with a maximum hydraulic pressure of from 35 to 40 pounds on fluid, observe if fluid leaks past seals and out of converter housing.

b. Auxiliary Fluid Pump. Use a test stand, if available, to test pump after it has been assembled. Pump should deliver 3½ gallons of fluid per minute at 2,500 revolutions per minute under 45-pounds pressure.

CHAPTER 5

SPECIAL TOOLS

68. SPECIAL ENGINE AND TORQUE CONVERTER TOOLS.

a. Special tools for maintenance of the engine and the torque converter, which are available to Ordnance personnel are listed below.

b. The list in this chapter is for information only. It is not to be used as a basis for requisition.

Name	Ord. No.	Federal Stock No.
Adapter, puller, fan shaft	A-346131	41-A-18-165
Bolt, 5/8-in. 18 NF 3	A-346153	41-B-1586-170
Nut, 5/8-in. 18 NF 3	A-346142	41-N-749-600
Puller, pump shaft and bearing, torque converter	B-283360	41-P-2951-49
Remover and replacer, exhaust valve guide remover, intake guide	B-283342-1	41-R-2377-600
Replacer, intake valve guide	B-283342-2	41-R-2390-480
Replacer, oil seal, torque converter	B-283357	41-R-2393-750
Sling, engine	C-139566	41-S-3831
Wrench, lug, internal, torque converter	C-139577	41-W-3739-400
Wrench, lug, internal, torque converter	B-283355	41-W-3160
Wrench, spanner, hook, adjustable	B-283343	41-W-3250-10

REFERENCES

PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes, or revisions of references given in this section and for new publications relating to materiel covered in this manual:

a. Introduction to Ordnance Catalog (explaining SNL system)	ASF Cat. ORD 1 IOC
b. Ordnance Publications for Supply Index (index to SNL's)	ASF Cat. ORD 2 OPSI
c. Index to Ordnance Publications (listing FM's, TM's, TC's, and TB's of interest to ordnance personnel, OPSR, MWO's, BSD, S of SR's, OSSC's, and OFSB's; and includes Alphabetical List of Major Items with Publications Pertaining Thereto)	OFSB 1-1
d. List of Publications for Training (listing MR's, MTP's, T/BA's, T/A's, FM's, TM's, and TR's concerning training)	FM 21-6
e. List of Training Films, Film Strips, and Film Bulletins (listing TF's, FS's, and FB's by serial number and subject)	FM 21-7
f. Military Training Aids (listing Graphic Training Aids, Models, Devices, and Displays)	FM 21-8

STANDARD NOMENCLATURE LISTS.

Cleaning, preserving and lubrication materials, recoil fluids, special oils, and miscellaneous related items	SNL K-1
General tools, and supplies, ordnance base automotive maintenance company (engine rebuild)	SNL N-327
Ordnance maintenance sets	SNL N-21
Soldering, brazing and welding materials, gases and related items	SNL K-2
Tools, maintenance for repair of automotive vehicles	SNL G-27 Vol. 1
Tool-sets, for ordnance service command automotive shops	SNL N-30
Tool-sets, motor transport	SNL N-19
Tractor, high speed, 18-ton, M4 (Allis-Chalmers)	SNL G150
Tractor, high speed, 38-ton, M6 (Allis-Chalmers)	SNL G184

ORDNANCE MAINTENANCE—ENGINE, ENGINE ACCESSORIES, AND TORQUE CONVERTER FOR 18-TON M4 AND 38-TON M6 HIGH SPEED TRACTORS

EXPLANATORY PUBLICATIONS.

Fundamental Principles.

Automotive electricity	TM 10-580
Basic maintenance manual	TM 38-250
Electrical fundamentals	TM 1-455
Fuels, lubricants, cleaners, and preservatives	TM 9-2835
Internal combustion engine, the	TM 10-570
Military motor vehicles	AR 850-15
Motor vehicle inspections and preventive maintenance service	TM 9-2810
Precautions in handling gasoline	AR 850-20
Standard Military Motor Vehicles	TM 9-2800

Maintenance and Repair.

Cleaning, preserving, lubricating and welding materials and similar items issued by the Ordnance Department	TM 9-850
Cold weather lubrication and service of combat vehicles and automotive materiel	OFSB 6-11
Maintenance and care of pneumatic tires and rubber treads	TM 31-200
Ordnance maintenance: Carburetors (Zenith)	TM 9-1826C
Ordnance maintenance: Electrical equipment (Delco-Remy)	TM 9-1825A
Ordnance maintenance: Fuel pumps	TM 9-1828A
Ordnance maintenance: Power brake systems (Bendix-Westinghouse)	TM 9-1827A
Ordnance maintenance: Power train, tracks, suspension, and equipment for 18-ton high-speed tractor M4 (Allis-Chalmers)	TM 9-1785B
Ordnance maintenance: 38-ton high-speed tractor M6	TM 9-1788
Ordnance maintenance: Tire repair and retread	TM 9-1868
Tune-up and adjustment	TM 10-530

Operation of Materiel.

18-ton high-speed tractor M4 (Allis-Chalmers)	TM 9-785
38-ton high-speed tractor M6 (Allis-Chalmers)	TM 9-788

Protection of Materiel.

Camouflage	FM 5-20
Chemical decontamination, materials and equipment	TM 3-220
Decontamination of armored force vehicles	FM 17-59

REFERENCES

Defense against chemical attack	FM 21-40
Explosives and demolitions	FM 5-25
Storage and Shipment.	
Ordnance storage and shipment chart, group G — Major items	OSSC-G
Registration of motor vehicles	AR 850-10
Rules governing the loading of mechanized and motorized army equipment also major caliber guns, for the United States Army and Navy, on open top equipment, published by Operations and Maintenance Department of Association of American Railroads.	
Storage of motor vehicle equipment	AR 850-18

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