DEPARTMENT OF THE ARMY
TECHNICAL MANUAL
DEPARTMENT OF THE AIR
FORCE TECHNICAL ORDER

TM 9-1840A
TO 19-75B-15

ORDNANCE MAINTENANCE

ENGINE

(DODGE MODEL T-245)

CLUTCH

(BORG AND BECK MODEL 11828)

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
JUNE 1952

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DEPARTMENTS OF THE ARMY AND
THE AIR FORCE
WASHINGTON 25, D. C., *10 June 1952*

TM 9–1840A/TO 19–75B–15 is published for the information and guidance of all concerned.

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope and Maintenance Allocation

a. Scope.

(1) This manual is published for the information and guidance of personnel responsible for field and depot maintenance of this matériel, and contains information on maintenance which is beyond the scope of the tools, equipment, or supplies normally available to using organizations. (TM 9–840 contains operating and lubricating instruction for the matériel and contains all maintenance operations allocated to using organizations in performing maintenance work within their scope.)

(2) This manual contains a description of and procedures for removal, disassembly, inspection, repair, rebuild and assembly of the engine and clutch used in the ¾-ton 4 x 4 cargo truck M37, command truck M42, ambulance truck M43, and telephone installation, light maintenance, and cable splicing truck V41 ( ) GT. The appendix contains a list of current references, including supply catalogs, technical manuals, and other available publications applicable to the matériel.

(3) This first-edition manual is published in advance of complete technical review. Any errors or omissions will be brought to the attention of the Chief of Ordnance, Washington 25, D. C., ATTN: ORDFM-Pub.

b. Field and Depot Maintenance Allocation. The publication of instructions for complete disassembly and rebuild is not to be construed as authority for the performance by field maintenance units of those functions which are restricted to depot shops and arsenals. In general, the prescribed maintenance responsibilities will be reflected in the allocation of maintenance parts listed in the appropriate columns of ORD 8 SNL G–741. Instructions for depot maintenance

are to be used by maintenance companies in the field only when the tactical situation makes the repair functions imperative. Supply of parts listed in the depot guide column of ORD 8 SNL G–741 will be made to field maintenance only when the emergency nature of the maintenance to be performed has been certified by a responsible officer of the requisitioning organization. Those operations which can be performed as "emergency field maintenance" are specifically covered as such in this manual.

2. Forms, Records, and Reports

a. General. Responsibility for the proper execution of forms, records, and reports rests upon the officers of all units maintaining this equipment. However, the value of accurate records must be fully appreciated by all persons responsible for their compilation, maintenance, and use. Records, reports, and authorized forms are normally utilized to indicate the quantity, and condition of matériel to be inspected, to be repaired, or to be used in repair. Properly executed forms convey authorization and serve as records for repair or replacement of matériel in the hands of troops and for delivery of matériel requiring further repair to ordnance shops in arsenals, depots, etc. The forms, records, and reports establish the work required, the progress of the work within the shops, and the status of the matériel upon completion of its repair.

b. Authorized Forms. The forms generally applicable to units maintaining this equipment are listed in the appendix. For current and complete listings of all forms, refer to SR 310–20–6. For instructions on use of these forms, refer to FM 9–10.

c. Field Reports and Accidents. The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in the SR 385–10–40 series of special regulations. These reports are required whenever accidents involving injury to personnel or damage to matériel occurs.

d. Report of Unsatisfactory Equipment or Materials. Any suggestions for improvement in design and maintenance of equipment, safety and efficiency of operation, or pertaining to the application of prescribed petroleum fuels, lubricants, and/or preserving materials, will be reported through technical channels as prescribed in SR 700–45–5 to the Chief of Ordnance, Washington 25, D. C., ATTN: ORDFM, using DA AGO Form 468, Unsatisfactory Equipment Report. Such suggestions are encouraged in order that other organizations may benefit.

Note. Do not report all failures that occur. Report only **REPEATED** or **RECURRENT** failures or malfunctions which indicate unsatisfactory design or material. However, reports will always be made in the event that exceptionally costly equipment is involved. Refer to SR 700–45–5 and the printed instructions on DA AGO Form 468.

Section II. DESCRIPTION AND DATA

3. Description

a. The ¾-ton 4 x 4 cargo truck M37, command truck M42, ambulance truck M43, and telephone installation, light maintenance, and cable splicing truck V41 ( )GT are equipped with a 6-cylinder, 4-cycle, water cooled "L" head, internal combustion, gasoline engine (figs. 1 through 5). Lubrication of moving parts, in the engine, is accomplished through a "pressure type" lubricating system with pressure being supplied by a gear driven rotor type oil pump. The cooling system is of the pressurized type and circulation is accomplished by a belt driven centrifugal type water pump. Engine temperature is controlled by a thermostat located in the cylinder head water outlet elbow.

b. A down-draft carburetor provides the correct mixture of fuel and air for each of the cylinders. A governor is built integral with the carburetor, thus providing a means of limiting engine speed. The entire fuel system is equipped with adequate filtering elements to restrict dirt and other foreign particles from entering the combustion chambers.

c. A 24-volt electrical system supplies all electrically operated units with sufficient current to perform duties for which they are intended. The ignition system, generator regulator, starter, generator, and light switches are completely waterproofed by suitable seals and covered cables. The distributor is ventilated from the air cleaner elbow on the carburetor through the use of two lines.

d. All engine accessories are mounted in locations which permit easy accessibility. The generator is mounted on the left front side of the engine. The starter is mounted in the engine bell housing on the left rear side of the engine. The distributor is mounted on the left side of the engine along with the generator regulator, engine oil filter, fuel filter, oil filler pipe, oil pressure sending unit, and engine temperature sending unit. The carburetor, air cleaner, fuel pump, oil pump, intake, and exhaust manifolds are mounted on the right side of the engine.

e. The clutch is a single dry-plate type, Borg and Beck Model 11828, enclosed within a steel cover bolted to the flywheel housing.

f. The engine ventilation system for deep water fording consists of the standard crankcase ventilated system with the additional necessary external ventilating lines required for under-water operation or to prevent damage due to condensation.

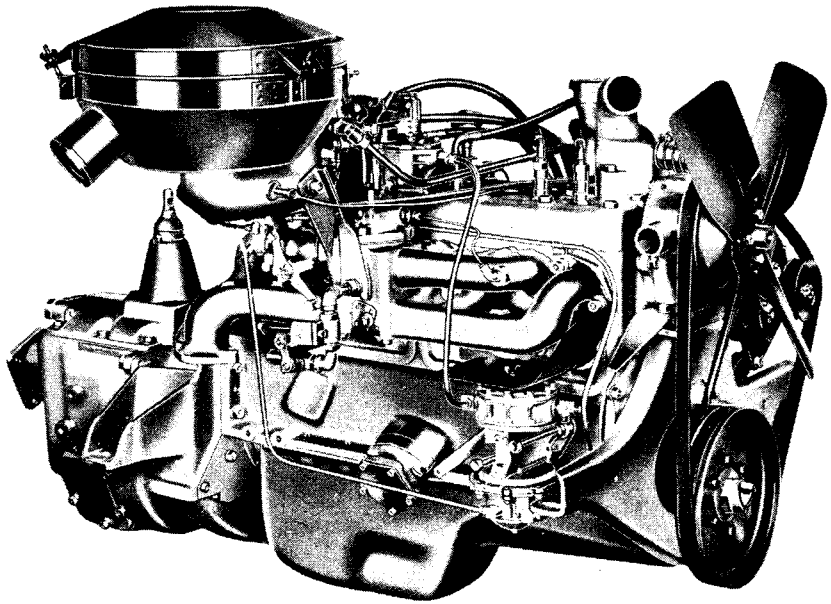

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Figure 1. Dodge ¾-ton 4 x 4 power plant—right side.

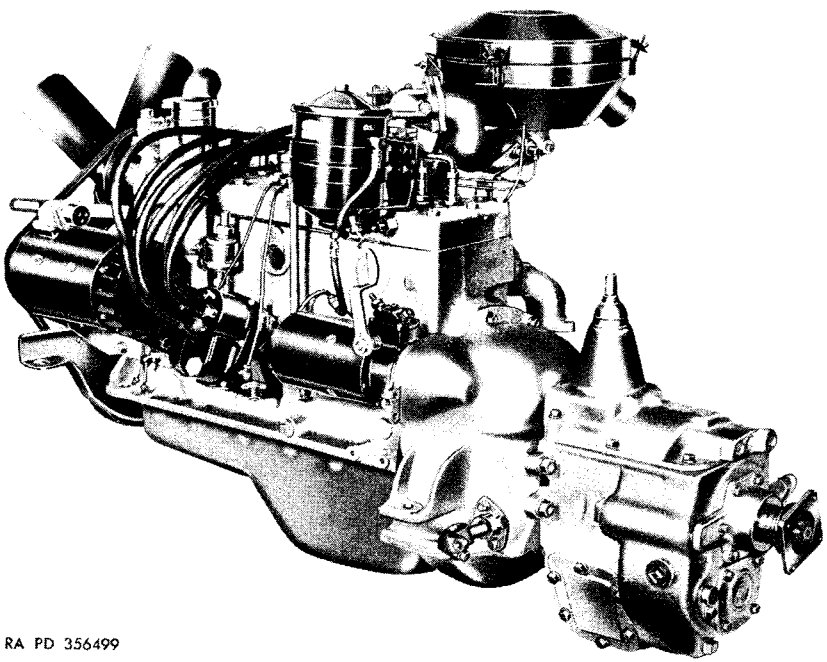

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Figure 2. Dodge ¾-ton 4 x 4 power plant—left side.

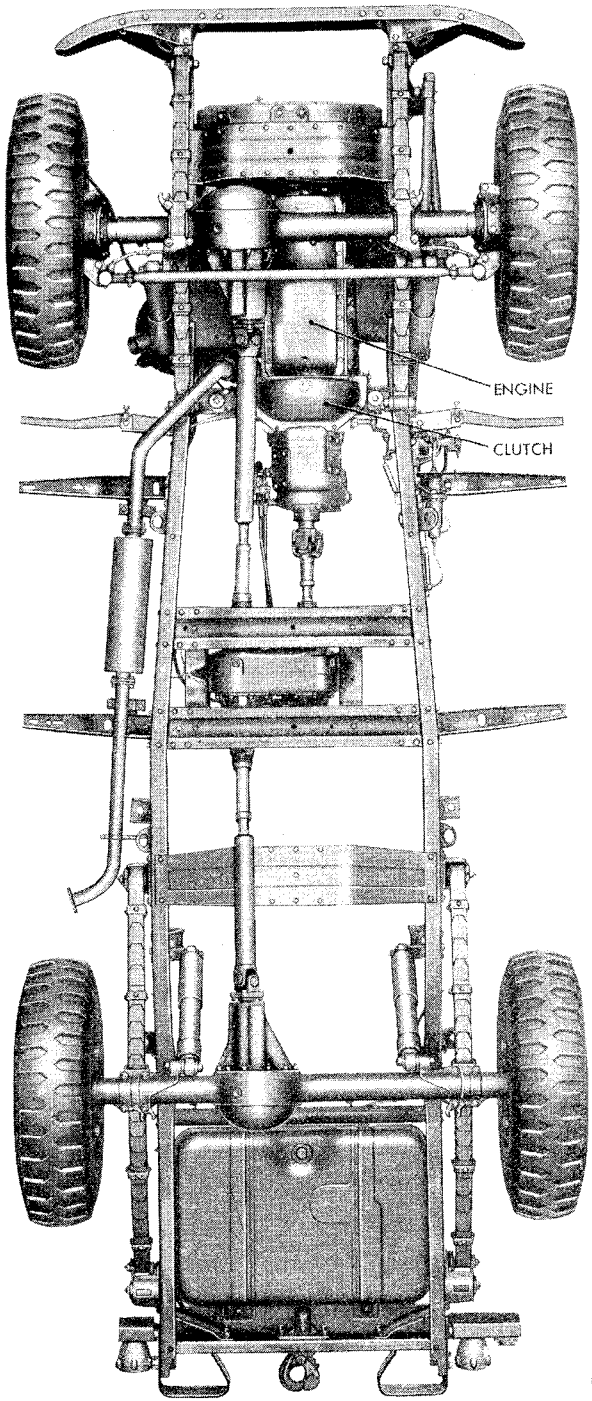
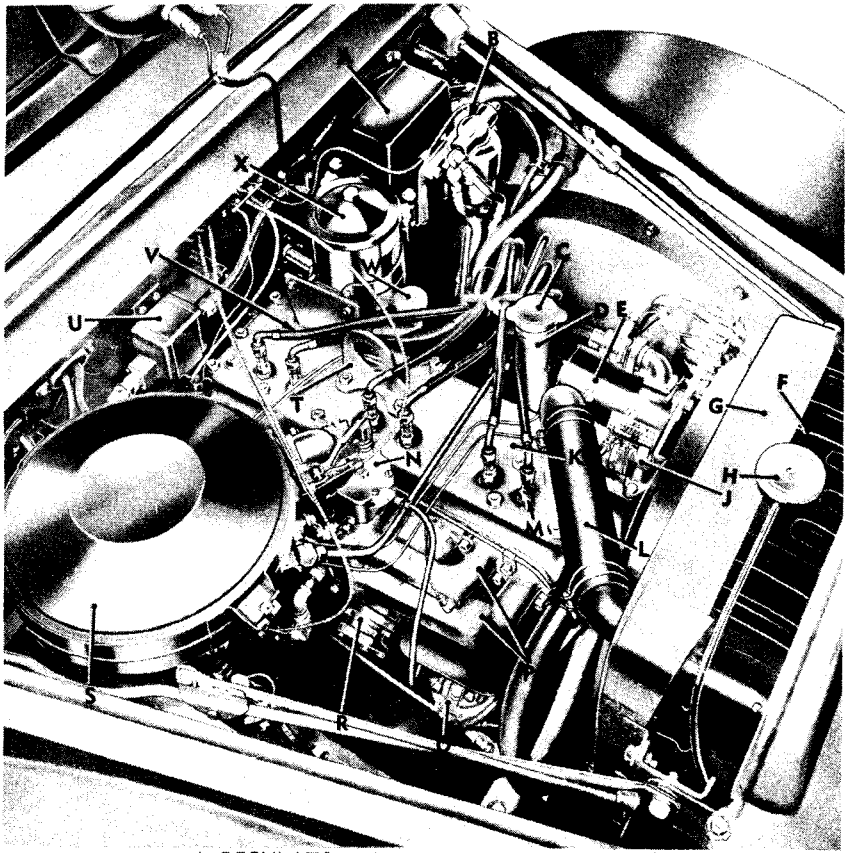


Figure 3. Vehicle with engine and clutch installed.



A–REGULATOR, GENERATOR, ASSY–7524309
B–FILTER, FUEL, ASSY–CC-1273852
C–CAP, OIL FILLER, ASSY–CC-1092771
D–PIPE, OIL FILLER, ASSY–7320616
E–GENERATOR, W/O PULLEY, ASSY–7374750
F–RADIATOR, ASSY–7373692
G–SHROUD, FAN–7373693
H–CAP, RADIATOR FILLER NECK, ASSY–B246293
J–ELBOW, WATER PUMP BY-PASS–7706211
K–HEAD, CYLINDER, W/PLUG, ASSY–7374761
L–HOSE, CYLINDER HEAD WATER OUTLET ELBOW TO RADIATOR–33-H-773
M–PLUG, SPARK–7524258
N–CARBURETOR, ASSY–7001053
P–MANIFOLD, EXHAUST AND INTAKE, W/HEAT CONTROL VALVE–CC-1067126
Q–PUMP, FUEL, ASSY–CC-1273865
R–PUMP, OIL, ASSY–7346936
S–SHROUD, AIR CLEANER, ASSY–7705788
T–BRACKET, ENGINE LIFTING–CC-1271277
U–FILTER, IGNITION, ASSY–CC-1268949
V–CABLE, SPARK PLUG, ASSY–7528172
W–GAGE, OIL LEVEL, W/CAP, ASSY–7320592
X–FILTER, OIL, W/CLAMP, ASSY–CC-1270046

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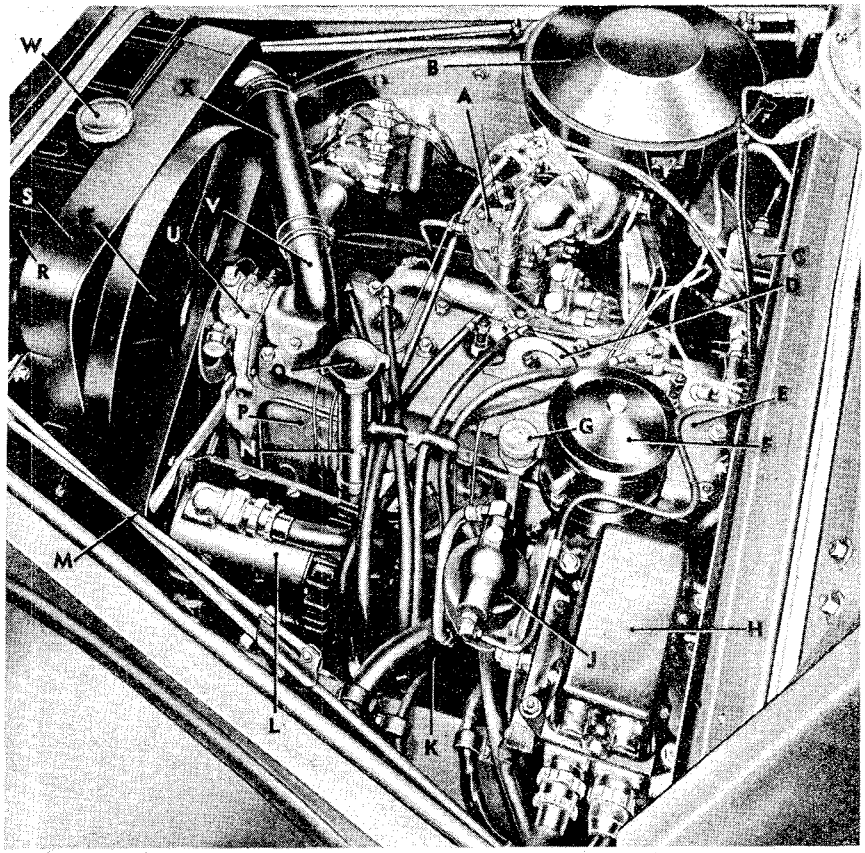
Figure 4. Engine compartment—right side.



A–CARBURETOR, ASSY–7001053
B–SHROUD, AIR CLEANER, CARBURETOR, ASSY–7705788
C–FILTER, IGNITION, ASSY–CC-1268949
D–BRACKET, ENGINE LIFTING–CC-1271277
E–HEAD, CYLINDER W/PLUG, ASSY–7374761
F–FILTER, OIL, W/CLAMP, ASSY–CC-1270046
G–GAGE, OIL LEVEL, W/CAP, ASSY–7320592
H–REGULATOR, GENERATOR, ASSY–7524309
J–FILTER, FUEL, ASSY–CC-1273852
K–DISTRIBUTOR, W/COIL, ASSY–7374884
L–GENERATOR, W/O PULLEY, ASSY–7374750
M–BELT, FAN AND GENERATOR–7706195
N–PIPE, OIL FILLER, ASSY–7320616
P–BLOCK, CYLINDER, W/PISTONS, ASSY–CC–1322330
Q–CAP, OIL FILLER, ASSY–CC-1092771
R–RADIATOR, ASSY–7373692
S–SHROUD, FAN–7373693
T–BLADE, FAN–7346790
U–PUMP, WATER, ASSY–7346788
V–ELBOW, CYLINDER HEAD WATER OUTLET–7706210
W–CAP, RADIATOR FILLER NECK, ASSY–B246293
X–HOSE, CYLINDER HEAD WATER OUTLET
ELBOW TO RADIATOR–33-H-773

RA PD 356595

Figure 5. Engine compartment—left side.

4. Data

Make and type	Dodge, 6-cylinder, "L" head, internal combustion, gasoline
Model	T-245
Number of cylinders	6
Cooling system	water
Governed speed	3,400 rpm
Maximum torque (gross)	188 lb-ft at 1,200 rpm
Brake horsepower (gross, less accessories)	94 at 3,200 rpm
Compression ratio	6.7 to 1
Weight	606 lb
Crankshaft rotation (viewed from fan (front) end)	clockwise
Firing order	1-5-3-6-2-4

CHAPTER 2

PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR FIELD AND DEPOT MAINTENANCE

5. General

Tools and equipment and maintenance parts over and above those available to the using organization are supplied to ordnance field maintenance units and depot shops for maintaining, repairing, and/or rebuilding the matériel.

6. Parts

Maintenance parts are listed in ORD 8 SNL G–741, which is the authority for requisitioning replacements. Parts not listed in the Ord 8 catalog, but required by depot shops in rebuild operations, may be requisitioned from the listing in ORD 9 SNL G–741 and will be supplied if available. Requisitions for ORD 9 parts will contain a complete justification of requirements.

7. Common Tools and Equipment

Standard and commonly used tools and equipment having general application to this matériel are authorized for issue by T/A and T/O & E.

8. Special Tools and Equipment

The special tools and equipment tabulated in table I are listed in the ORD 6 SNL J–16 series. This tabulation contains only those special tools and equipment necessary to perform the operations described in this manual, is included for information only, and is not to be used as a basis of requisitions.

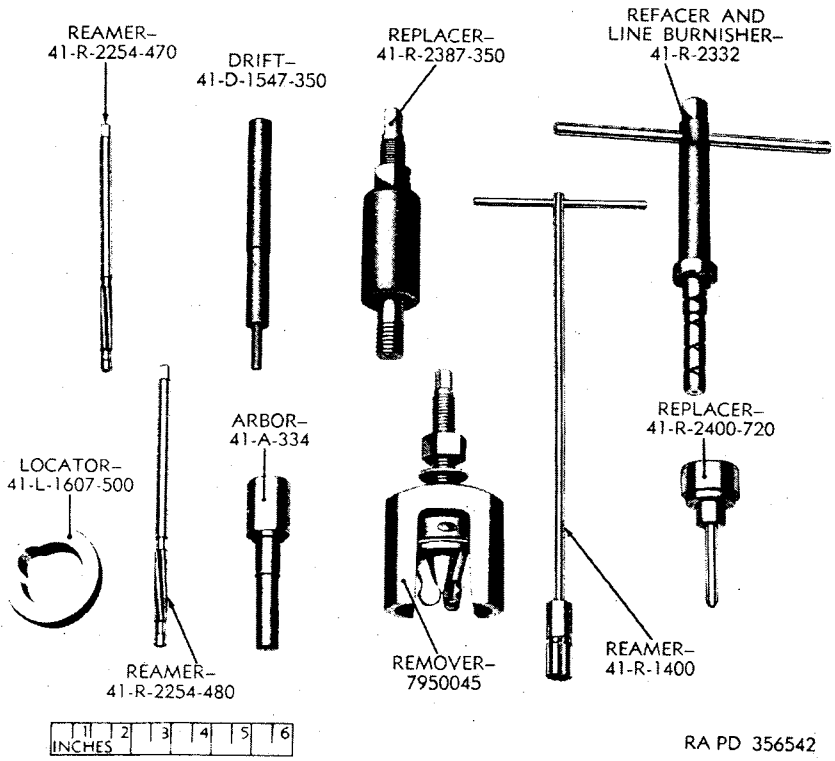


Figure 6. Special tools and equipment.

Table I. Special Tools and Equipment for Field and Depot Maintenance

Item	Identifying No.	References		Use
		Fig.	Par.	
ARBOR, bushing installing, water pump.	41–A–334	6, 81	46*b* (2)	To install water pump bearing.
DRIFT, valve guide removing and replacing.	41–D–1547–350	6, 67	42f	To remove and replace valve stem guides.
LOCATOR, timing gear cover.	41–L–1607–500	6, 90	49*h*	To locate timing chain case cover oil seal.
REAMER, carb S, hand, valve tappet, set of 2 with 0.343 pilot stem.	41–R–1400	6, 69	42*h*	To ream valve tappet guide holes.
REAMER, finishing, valve guide valve stem hole (exhaust), diam tapers from 0.337 to 0.3447 in, lgh 8 in.	41–R–2254–480	6, 67	42*g*	To ream exhaust valve stem guide holes.
REAMER, finishing, valve guide valve stem hole (intake), diam tapers from 0.337 to 0.3427 in, lgh 8 in.	41–R–2254–470	6, 67	42*g*	To ream intake valve stem guide holes.
REFACER AND LINE BURNISHER water pump housing seat.	41–R–2332	6, 83	46*b* (4)	To line burnish water pump housing to seat.
REMOVER, insert, valve seat.	7950045	6, 47	38*b* (7)	To remove valve seat inserts.
REPLACER, bushing, clutch shaft pilot.	41–R–2387–350	6, 53	39*b*	To replace and burnish clutch pilot shaft bearing.
REPLACER, valve seat insert, overall lgh 3½ in.	41–R–2400–720	6, 48	38*b* (7)	To install valve seat inserts.

CHAPTER 3

TROUBLE SHOOTING

Section I. INTRODUCTION

9. General

Note. Information in this chapter is for use of ordnance maintenance personnel in conjunction with and as a supplement to the trouble shooting section of TM 9–840. It provides the continuation of instructions where a remedy in the operator's manual refers to ordnance maintenance personnel for corrective action.

Operation of a deadlined vehicle without a preliminary examination can cause further damage to a disabled component and possible injury to personnel. By careful inspection and trouble shooting such damage and injury can be avoided and, in addition, the causes of faulty operation of a vehicle or component often can be determined without extensive disassembly.

10. General Instructions and Procedures

a. The inspections made while the component is mounted in the vehicle for the most part are visual and are to be performed before attempting to operate the vehicle. The object of these inspections is to avoid possible damage or injury and also to determine the condition of, and when possible, what is wrong with the defective component.

b. The trouble shooting performed while the component is mounted in the vehicle is that which is beyond the normal scope of the using organization. Check the trouble shooting section of TM 9–840, then proceed as outlined in this chapter. These trouble shooting operations are used to determine if the fault can be remedied without removing the component from the vehicle and also, when subsequent removal is necessary, to indicate when repair can be made without complete disassembly of the component.

c. Inspection after the component is removed from the vehicle is performed to verify the diagnosis made when the component was in the vehicle, to uncover further defects, or to determine faults if the component alone is received by the ordnance establishment. This inspection is particularly important in the last case because it is often the only means of determining the trouble without completely disassembling the component.

Section II. ENGINE

11. General

Engine noises and troubles are often incorrectly diagnosed. Frequently the generator, carburetor, or other engine accessories are at fault and may cause unnecessary work unless the trouble is correctly diagnosed (engine accessories are covered in the pertinent manuals listed in the appendix). The design and mounting of the engine to which this manual applies, permits thorough trouble shooting while the engine is mounted in the vehicle. Remedies and procedures for trouble shooting are discussed in detail in TM 9–840. A few corrective procedures, beyond the normal scope of the using organization, can be performed while the engine is mounted in the vehicle; others require the removal of the complete power plant from the vehicle.

12. Improper Ignition or Preignition

a. Check Installation of Distributor and Oil Pump. Refer to paragraph 50.

b. Excessive Carbon in Cylinder Head or on Piston. Remove cylinder head and remove all carbon from combustion chambers, pistons, valves, and cylinder block.

c. Improper Automatic Advance. Remove distributor and check spark advance against specifications. Refer to TM 9–1825B.

13. Excessive Oil Consumption

a. Oil Lines to Filter Leaking. Check visually with engine running. If leaks are present, tighten fittings or replace any fittings that are damaged.

b. Timing Chain Case Cover Gasket or Oil Seal Leaking. Replace timing chain case cover gasket. Inspect oil seal and replace if necessary.

c. Valve Compartment Cover, Fuel Pump, and Oil Pan Gaskets. Check visually with engine running. If leaks are present, replace gaskets.

d. Defective Oil Pressure Relief Valve. Remove valve and check for presence of dirt or lint between valve and seat. Do not attempt to stretch the relief valve spring if oil pressure is low. If oil pressure is still low, determine cause, such as excessive clearance of bearings, worn oil pump, or badly diluted lubricating oil.

e. Piston Rings. Check compression with a compression gage. Do not expect all cylinders to show the same compression, but any decided differences will indicate improperly seating valves, worn rings, worn cylinders, or leaky gasket. After taking an initial reading, seal the piston with a teaspoonful of engine oil poured through spark plug

hole, and take a second reading. If pressure does not increase, this will indicate that improperly seating valves are at fault. If pressure increases, this will indicate that worn rings, worn cylinders, or leaky gasket is at fault.

14. Poor Engine Performance

a. Carburetion Mixture Too Lean. Check for damaged or incorrect type or size of main metering jet. Check for damaged tip or bad top shoulder seat of main discharge jet. Step-up jet or accelerating pump not functioning. Refer to TM 9–1826A.

b. Incorrect Fuel Level. Check fuel level in carburetor as outlined in TM 9–1826A.

c. Governor Improperly Calibrated or Adjusted. Refer to TM 9–1826A.

d. Distributor Advance Mechanism Improperly Calibrated. Refer to TM 9–1825B.

e. Improper Valve Seating. Refer to paragraph 13*e* above.

15. Engine Stalls or Lacks Power

a. Manifold Heat Control Valve Frozen in Open Position. Free with penetrating oil or replace (par. 49*l*).

b. Intake Manifold Gaskets Leaking. Replace gaskets and check alinement of exhaust and intake manifold flanges. Refer to paragraph 49*l*.

c. Defective Ignition System. Refer to TM 9–1825A.

d. Governor Improperly Adjusted. Adjust governor. Refer to TM 9–1826A.

e. Engine Compression Low. Check each cylinder with compression gage.

f. Carburetor Step-Up Jet or Accelerating Pump Inoperative. Inspect carburetor and perform necessary repairs. Refer to TM 9–1826A.

Section III. CLUTCH

16. General

The trouble shooting procedures (par. 17) supplement the trouble shooting section in TM 9–840. Certain corrective procedures can be performed with the clutch in the vehicle; others require removal and disassembly of the clutch.

17. Clutch Trouble Shooting

a. Clutch Chatters.

(1) Check for worn splines on main shaft. Replace shaft if necessary.

(2) Examine the pressure plate compression springs, and replace any springs (par. 59*e*) which do not meet compression test specifications.

(3) Inspect clutch release linkage for binding. Replace bent or damaged parts. Aline and adjust linkage.

b. Clutch Grabs.

(1) Check the contact surface of the flywheel for roughness or grooving and repair or replace flywheel if either condition exists.

(2) Inspect the pressure plate release levers for correct adjustment, and for wear or binding. Free levers or replace if worn. Refer to paragraph 60*b* (1) for adjustment procedure.

(3) Examine the pressure plate compression springs; replace broken or weak springs.

c. Clutch Slips.

(1) Examine the pressure plate release levers for binding. Free or replace.

(2) Inspect the pressure plate compression springs; replace broken or weak springs.

d. Clutch Drags.

(1) Check the pressure plate release levers for correct adjustment (par. 60*b* (1)).

(2) Inspect the clutch pilot bearing, and replace bearing if rough or worn.

CHAPTER 4

ENGINE

Section I. DESCRIPTION AND DATA

18. Lubrication System

a. Engine Oiling System (fig. 7). The engine is lubricated by oil drawn from the oil pan by a rotor type oil pump and forced under pressure through drilled passages in the cylinder block to the crankshaft and camshaft bearings. Passages, drilled in the crankshaft, allow oil to be forced through the crankshaft bearings and to the connecting rod bearings. A limited amount of oil is forced from the camshaft front bearing to the timing chain case to lubricate the timing chain and sprockets. Cylinder walls, pistons, piston pins, and valve tappets are lubricated by oil spray from the connecting rod bearings. The camshaft thrust plate is lubricated through an oil passage in the camshaft.

b. Oil Filter (fig. 7). The engine is provided with an oil filter which has a replaceable element. This element should be replaced periodically, as prescribed, or more often, if there is dirt or sludge on the filtering element or in the engine oil.

c. Oil Pressure Gage (fig. 7). An oil pressure gage mounted on the instrument panel and calibrated in pounds per square inch, is provided to indicate whether the lubrication system is operating properly. The gage should register 15 psi or higher at idling speeds, and approximately 50 psi at higher speeds. The gage operates by electricity. The sending unit is mounted on the left side of the cylinder block.

d. Oil Pressure Relief Valve (fig. 7). Engine oil pressure is controlled by a relief valve mounted on the left side of the engine below the starter and consists of a plunger type valve, spring, gasket, and plug. The relief valve spring controls the maximum oil pressure to 50 psi and circulation through the oil filter starts at approximately 46 psi if the temperature of the oil is above 135° F. The design of the oil relief valve shuts off circulation to the oil filter at low pressure and permits circulation through the filter slightly before the valve

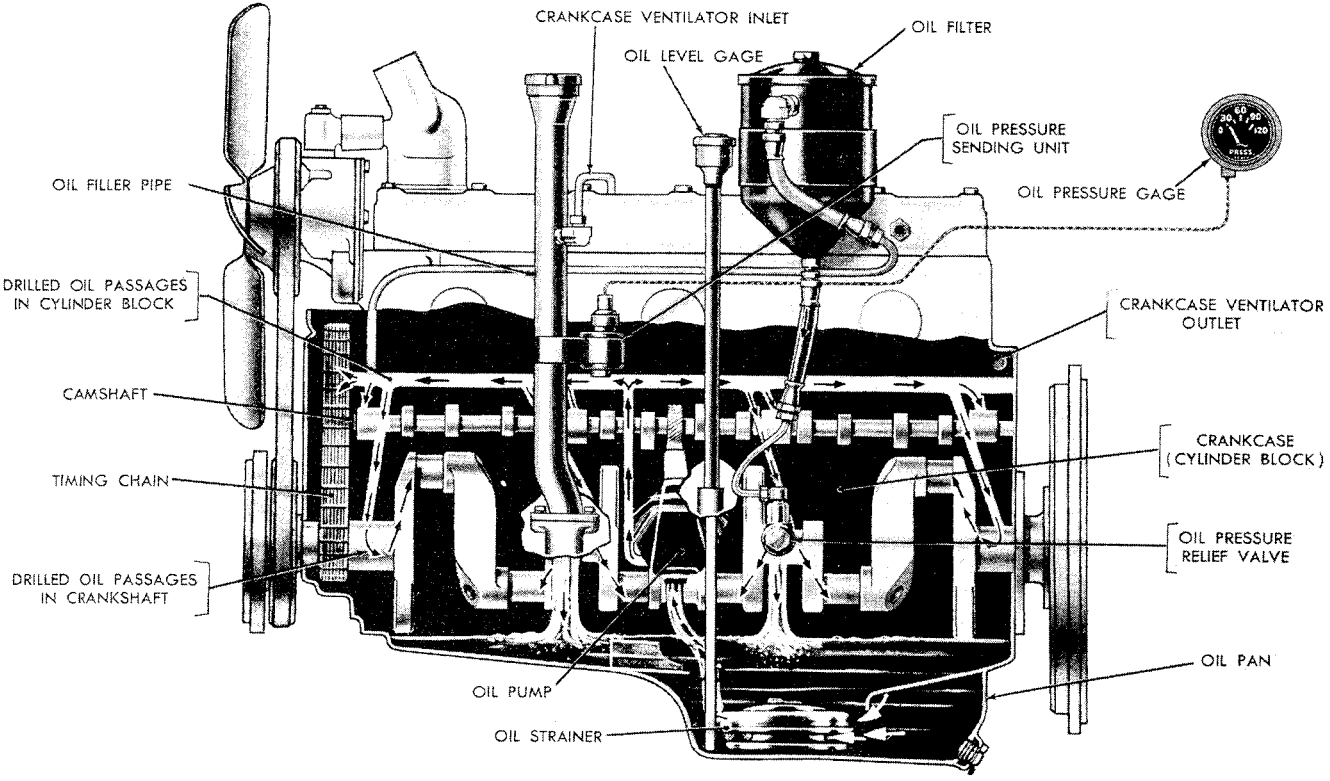


Figure 7. Engine oiling system.

discharge port is uncovered. Do not attempt to stretch the relief valve spring if oil pressure is low. Remove valve and check for presence of dirt or lint between valve and seat. If oil pressure is still low, determine cause, such as excessive clearance of bearings, worn oil pump, or badly diluted lubricating oil.

e. Oil Strainer (fig. 7). A floating type oil strainer, located at the lowest point in the oil pan, is attached to the oil pump suction pipe. The strainer is pivoted so that it is free to float near the top of the oil level. Due to the pivoting action of the strainer, clean oil is drawn from the top of the oil level, while sediment or other foreign particles settle to the bottom of the oil pan.

19. Crankcase and Oil Pan

a. Oil Pan (fig. 7). The oil pan is attached to the bottom flange of the cylinder block by cap screws. Gaskets are used at the front and rear of the oil pan and between the mating surfaces of the oil pan and the cylinder block. This prevents oil leakage and also possible entry of dirt or foreign matter into the crankcase.

b. Oil Level Gage (fig. 7). A bayonet type oil level gage is located on the left side of the cylinder block and provides a means of determining the amount of oil in the crankcase. The oil level should be checked at frequent intervals. In order to obtain a proper reading, the gage should be withdrawn, wiped off, reinserted carefully, and again withdrawn. A correct reading cannot be obtained if the gage is withdrawn while the engine is running, nor immediately after the engine is stopped, as sufficient time must be allowed for the oil in the various parts of the engine to drain down into the oil pan.

c. Capacity of Oil Pan. The capacity of the engine lubricating system is 5 quarts (refill) or 6 quarts if the oil filter has been drained or replaced. The oil pan is filled through the oil filler pipe (fig. 7) located at the left front side of the cylinder block.

d. Crankcase Ventilator. A crankcase ventilating system is provided to remove harmful fumes from the crankcase and to prevent condensation of the vapors resulting from combustion. Fresh air for the ventilating system enters the crankcase through a tube attached to the carburetor air cleaner elbow and extending to the oil filler pipe. Another tube, attached to the crankcase ventilator outlet (fig. 7) and extending to the intake manifold (at which point a one way check valve is located) completes the ventilation circuit. The controlled suction from the intake manifold causes the air to circulate through the crankcase from the air cleaner and thus remove the undesirable vapors.

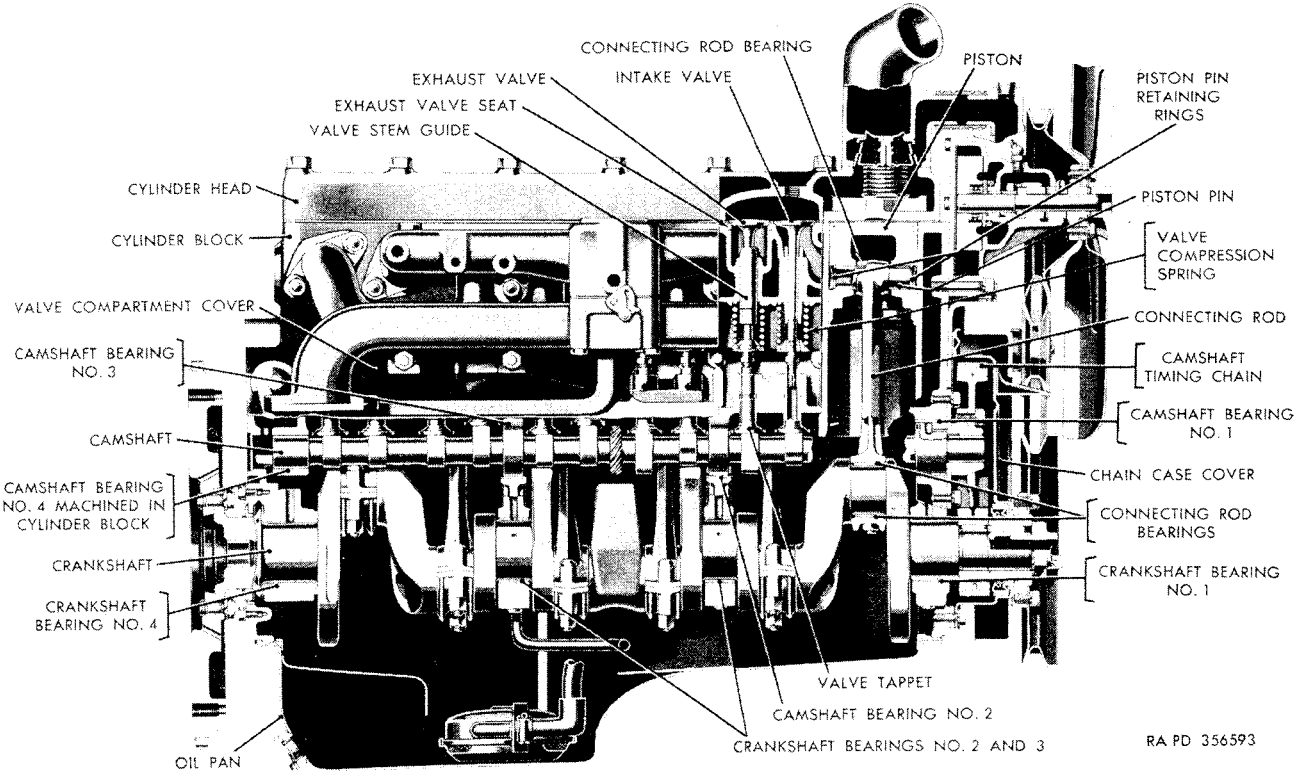


Figure 8. Side of engine—sectional view.

20. Crankshaft Bearings

The four crankshaft bearings (fig. 8) are of the precision insert type. Each bearing half consists of a steel back, coated with a thin layer of babbitt on the front surface.

21. Connecting Rods and Bearings

The drop forged connecting rods (fig. 8) are fitted with precision insert type bearings at the lower end. Each bearing half consists of a steel back, coated with a thin layer of babbitt on the front surface. A bronze bearing is installed in the upper end of the connecting rod for the piston pin.

22. Cylinder Block and Valve Seats

The cylinder block (fig. 8) is the foundation of the entire engine assembly. It houses the crankshaft, pistons, connecting rods, and in some manner affects the positioning of every unit that comprises the power plant. Cooling of the cylinder block is accomplished through the use of a liquid coolant which circulates through the block passages and is distributed to the valve ports and seats by means of a water distributor tube. Tapered seats are provided in the cylinder block for the valves and due to the extremely high temperatures that the exhaust valves and seats are subjected to, the exhaust valve seat is a replaceable insert. The intake valve seat is machined in the cylinder block and is repaired by reseating with a special high speed grinder.

23. Camshaft, Valve Tappets, and Timing Chain (fig. 8)

The camshaft is supported by four bearings, three of which are the steel backed replaceable type. The camshaft rear bearing is not replaceable, as it is machined in the cylinder block. The replaceable type bearings are finished to very close tolerances and do not require reaming, scraping, or burnishing, when replaced. Camshaft thrust is taken by a thrust plate which is mounted between the camshaft sprocket and the front bearing journal. The mushroom type valve tappets are provided with self-locking adjusting screws. A silent type timing chain is mounted on sprockets located at the front end of the camshaft and the crankshaft.

24. Crankshaft (fig. 8)

The drop forged crankshaft has seven counterweights and is balanced both statically and dynamically. Passages are drilled in the

crankshaft for the distribution of the lubricating oil to the main and connecting rod bearings. The timing chain sprocket and fan drive pulley are mounted on the front end of the crankshaft and the flywheel is attached to the flanged rear end.

25. Intake and Exhaust Valves, Valve Compression Springs, and Valve Stem Guides
(fig. 8)

a. Valves. The valves are forged of special steel that will withstand extremely high temperatures. The function of the valves is to permit fuel mixture to be drawn into the combustion chamber, compressed, ignited, and expelled. All valves are operated by the camshaft and seating clearance is provided by adjustable tappets.

b. Valve Compression Springs. The valve compression springs keep the valves seated and return them to their normal position after they are opened by rotation of the camshaft.

c. Valve Stem Guides. The cast iron valve guides are removable from the cylinder block. The guides insure proper alinement of the valves in the seats.

26. Pistons, Piston Pin Retaining Rings, and Piston Pins
(fig. 8)

a. Pistons. The pistons are cast of special aluminum alloy and are of the "U" slot type. All pistons are cam ground to allow for expansion and are tin plated as a protection against scuffing.

b. Piston Rings. Each piston is provided with four piston rings. These rings are required to seal in the compression pressures and prevent oil from entering the combustion chamber. There are two oil rings and two compression rings on each piston. The top compression ring is chrome plated to reduce cylinder wall and ring wear.

c. Piston Pins. The piston pins are provided for the attachment of the pistons to the connecting rods. They are made of high manganese steel and are of the floating type, free to rotate in both the connecting rod bearing and the piston.

27. Cooling System
(fig. 9)

The cooling solution is circulated by a centrifugal pump through water jackets around the cylinder bores and valve ports for the purpose of dissipating heat generated by combustion. From the cylinder block, the solution circulates through the radiator core tubes where heat is dissipated into the air drawn through the radiator by the fan. The circulation of the cooling solution is automatically controlled by a thermostat and by-pass located on the cylinder head. The water

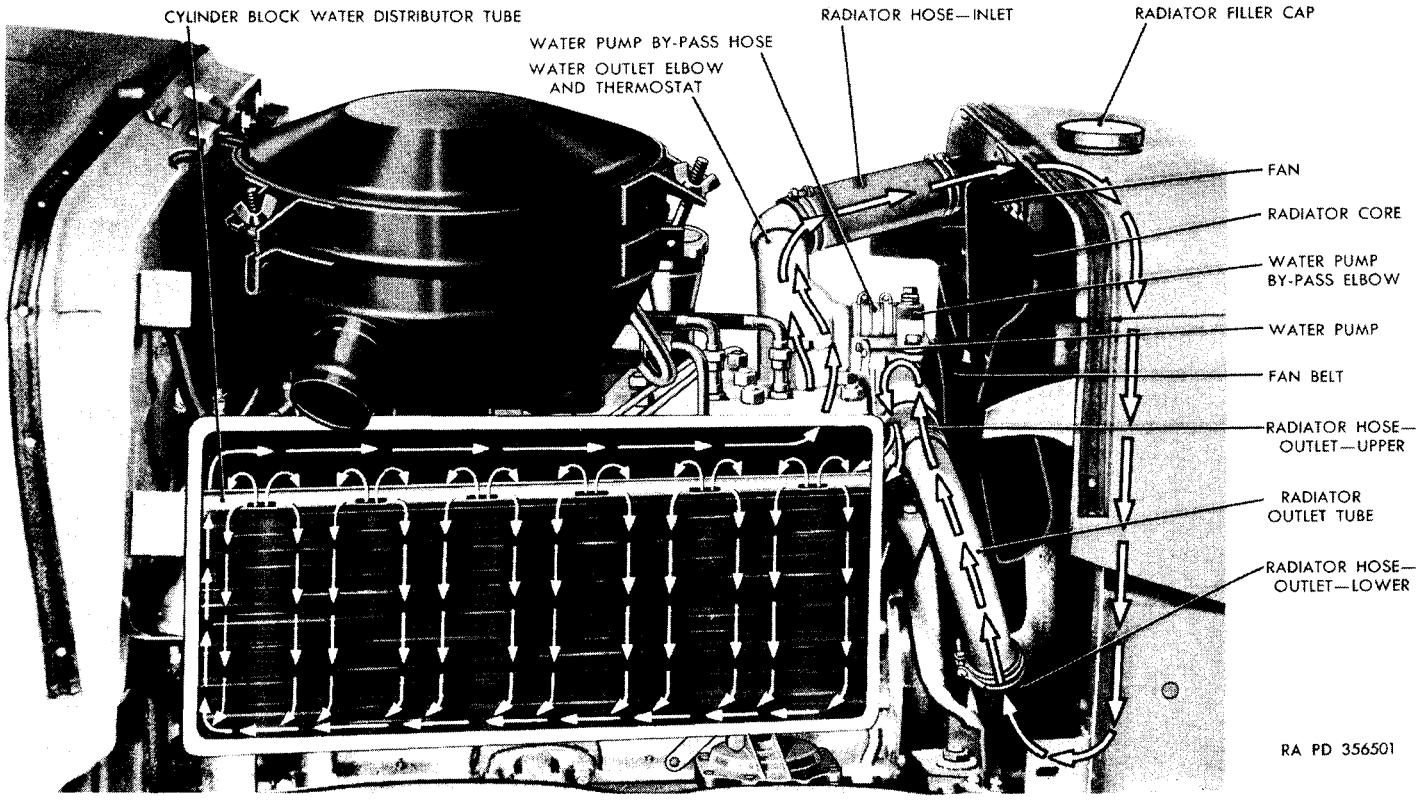


Figure 9. Cooling system.

pump and fan are mounted on the front of the engine and are belt driven. A pressure type radiator filler cap is used to seal the cooling system and prevent loss of cooling liquid.

28. Data

a. Engine.

Compression pressure at cranking speed ..... 120 to 130 psi
Compression pressure at 1,000 rpm ..... 150 to 160 psi
Cylinder bore ..... 3¼ in
Piston displacement ..... 230.2 cu in
Stroke ..... 4⅝ in

b. Oiling System.

Oil capacity:
- Refill (w/new oil filter element) 6-qt
- Refill (w/o new oil filter element) 5-qt

Oil pump:
- Drive ..... camshaft
- Normal pressure ..... 50 psi or higher
- Pump intake ..... floating screen
- Type ..... rotor

c. Crankcase and Oil Pan.

Method of oil pan attachment ..... ½ inch cap screws
Oil pan capacity:
- Without oil filter 5-qt
- With oil filter 6-qt

Size of oil pan drain plug ..... ½ in
Type of oil pan seal ..... cork gaskets

d. Crankshaft and Main Bearings.

Crankshaft length ..... 28¾ in
Crankshaft matériel ..... high carbon steel
Crankshaft thrust taken by ..... rear bearing
Diameter ..... 2½ in
Length (less chamfer):
- No. 1 ..... 1.1725 in
- No. 2 ..... 1.031 in
- No. 3 ..... 1.031 in
- No. 4 ..... 1.59 in

Material ..... babbitt face on steel back
Number of main bearings 4
Type ..... insert precision

e. Connecting Rods and Bearings.

Bearings:
- Diameter ..... 2 1/16 in
- Material ..... babbitt face on steel back

Number ---------- 6
Type ---------- precision insert
Length between centers ---------- $7\frac{13}{16}$ in

f. Cylinder Block and Valve Seat.

Cylinder block material ---------- cast iron
Exhaust valve seat insert material ---------- special alloy
Valve arrangement ---------- "L" head
Valve seat angle ---------- 45°

g. Camshaft, Valve Tappet, and Timing Chain.

Camshaft:
Bearing material ---------- babbit face on steel back except rear which is machined in cylinder block
Number of bearings ---------- 4
Thrust taken by ---------- thrust plate
Timing chain:
Number of links ---------- 48
Pitch ---------- 0.500 in
Type ---------- silent chain
Width ---------- 1 in
Valve tappets:
Adjusting screw ---------- self-locking type
Type ---------- mushroom

h. Valve, Valve Compression Spring, and Valve Stem Guide.

Valves:
Exhaust valve seat ---------- alloy insert
Head diameter:
Exhaust ---------- $1\frac{13}{32}$ in
Intake ---------- $1\frac{17}{32}$ in
Length ---------- $4\frac{27}{32}$ in
Seat angle ---------- 45°
Type of head:
Exhaust ---------- crown
Intake ---------- flat
Valve lift—intake and exhaust ---------- 0.364 in
Valve stem guides—length ---------- $2\frac{13}{16}$ in
Valve compression springs:
Length (free) ---------- 2 in
Valve stem guides:
Length ---------- $2\frac{13}{16}$ in

i. Valve Timing and Adjustment.

Clearance (hot) between tappet and valve stem:
Exhaust ---------- 0.014 in
Intake ---------- 0.010 in
Exhaust closes ---------- 7° ATC

Exhaust opens ..... 37° BBC
Intake closes ..... 36° ABC
Intake opens ..... 8° BTC

j. Pistons.

Length ..... $3\frac{11}{16}$ in
Matériel and type ..... al-alloy "U" slot
Weight ..... 16 oz

k. Piston Pins.

Diameter ..... 0.8592 in
Length ..... $2\frac{3}{4}$ in
Type ..... floating

l. Piston Rings.

Material ..... piston ring iron with chrome plated top compression ring
Number of rings per piston 4
Type ..... 2 compression—2 oil control
Width—compression rings ..... $\frac{3}{32}$ in
Width—oil control rings ..... $\frac{5}{32}$ in

m. Cooling System.

Belt type ..... "V" endless
Capacity of cooling system ..... 17 qt
Diameter ..... 18 in
Drive ..... belt
Fan—Number of blades 4
Frontal area ..... 395.06 sq in
Location ..... front of cylinder block
Pulley diameter ..... $6\frac{7}{8}$ in
Thickness ..... 3 in
Type ..... fin and tube
Type of bearings ..... self-lubricating bushings
Water pump—type ..... centrifugal

n. Fuel System.

Air cleaner:
- Capacity ..... 1 qt
- Manufacturer ..... AC
- Model D–82072
- Type ..... oil bath

Carburetor:
- Adjustment ..... idle only
- Manufacturer ..... Carter
- Model ETW1
- Size ..... $1\frac{1}{2}$ in

Fuel filter:
- Location ..... front of dash
- Manufacturer ..... Zenith
- Model F–363X2–2

Fuel pump:
- Drive ---------- camshaft
- Manufacturer ---------- AC
- Model ---------- AC 1539615
- Operating pressure ---------- 4 to 5¼ psi 16 inch above outlet at 1,800 rpm
- Type of primer ---------- hand

Fuel tank:
- Capacity ---------- 24 gal
- Filler cap—type ---------- pressure relief 1½ to 2½ psi
- Location ---------- rear of frame

o. Electrical System.

Batteries (two per vehicle):
- Capacity in ampere-hours ---------- 45 amp at 20-hr rate 80° F.
- Electrolyte (above plates) ---------- fill only to ledge
- Manufacturer ---------- Auto-Lite
- Model ---------- US 2HN
- Number of cells per battery ---------- 6
- Number of plates per battery ---------- 11
- Terminal grounded ---------- negative
- Voltage per battery ---------- 12

Condenser:
- Manufacturer ---------- Auto-Lite
- Model ---------- IAU–3076L

Distributor and coil:
- Firing order ---------- 1–5–3–6–2–4
- Manufacturer ---------- Auto-Lite
- Model ---------- IAU–4005–UT
- Type ---------- automatic advance

Distributor cap cover:
- Manufacturer ---------- Auto-Lite
- Model ---------- IAU–56

Generator:
- Drive ---------- belt
- Manufacturer ---------- Auto-Lite
- Model ---------- GHA–4802–AUT
- Pulley diameter ---------- 3¼ in
- Type of ventilation ---------- sealed

Regulator:
- Location ---------- left front side of dash
- Manufacturer ---------- Auto-Lite
- Model ---------- VBC–4002–UT
- Specified maximum charging amp ---------- 24.5 to 26 amps
- Specified operating voltage ---------- 28±1 v

Spark plugs:
- Manufacturer ..... Auto-Lite
- Model ..... AR5S (resistor type)
- Size 14-mm

Starter:
- Drive ..... mechanical shift to flywheel ring
- Manufacturer ..... Auto-Lite
- Model MCS–4301–UT
- Number of teeth in flywheel ring gear 146
- Number of teeth in starter gear 9
- Starter switch location ..... starter housing
- Starter switch—make and model MCS–1073

Section II. PREPARATION FOR ENGINE REBUILD

29. Removal of Power Plant From Vehicle

a. Preliminary Instructions. The vehicle power plant consists of the radiator, engine assembly (figs. 12 and 13) and accessories, clutch, and transmission. The power plant (figs. 10 and 11) is removed from the vehicle as a unit and can best be accomplished by two men. However, one man may perform all disconnect operations.

b. Removal of Power Plant. Refer to TM 9–840.

30. General Instructions

a. Preliminary Instructions. Before attempting to rebuild the engine assembly, certain procedures must be followed in order that proper disassembly of the unit can be made. All dirt and grease should be removed from engine assembly prior to removal of accessories and other components that are attached to the engine.

b. Safety Precautions. When the power plant has been removed, it should be placed in a safe position and blocks should be used to prevent tipping or falling. A suitable stand should be used to support the power plant, preparatory to removal of component units such as transmission, clutch, and radiator.

31. Cleaning and Draining

a. Cleaning Instructions. The following instructions should be adhered to when cleaning parts or mechanisms of the power plant:

(1) Use volatile mineral spirits or dry-cleaning solvent to clean or wash grease or oil from all parts of the vehicle that are to be worked on.

(2) A solution of one part grease-cleaning compound to four parts of volatile mineral spirits or dry-cleaning solvent may be used for dissolving grease and oil from the engine block.

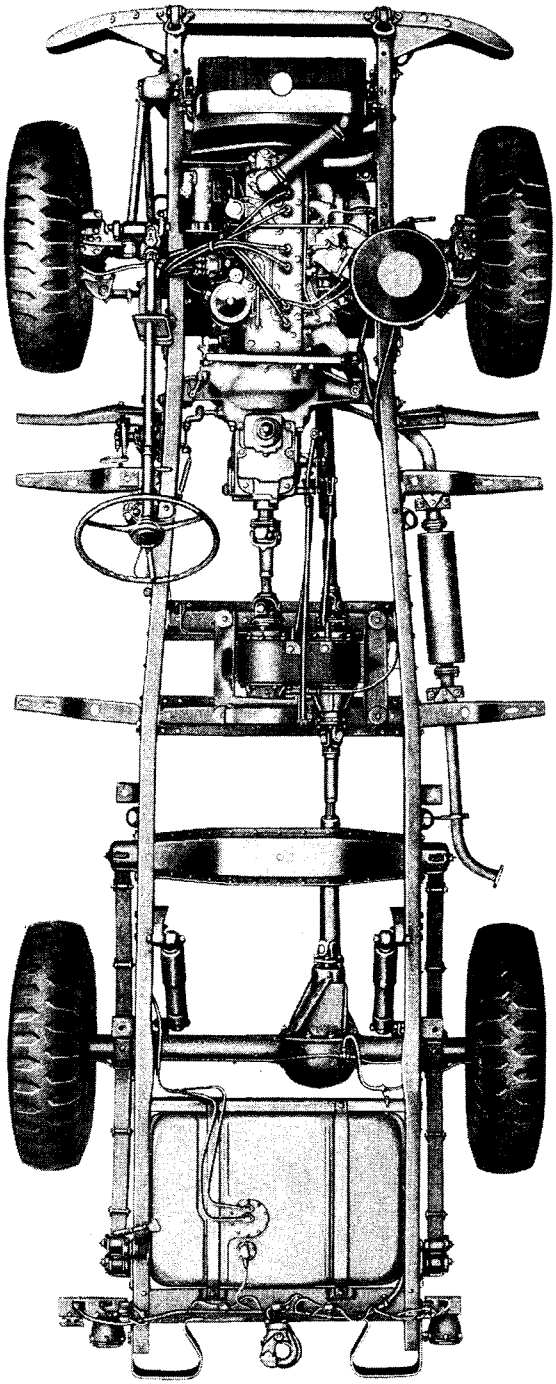


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Figure 10. Power plant mounted in chassis.

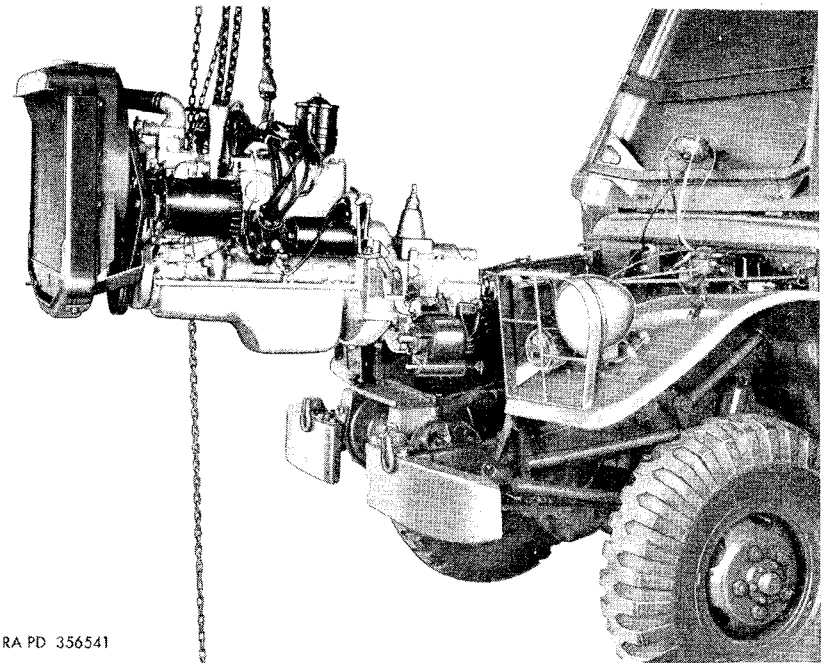


Figure 11. Removing power plant from vehicle.

After cleaning, use cold water to rinse off any solution which remains.

(3) After the parts are cleaned, rinse and dry them thoroughly. Take care to keep the parts clean. Apply a light grade of oil to all polished metal surfaces to prevent rusting.

(4) Before installing new parts, remove any preservative materials, such as rust preventive compounds, protective grease, etc.; prepare parts as required (oil seals, etc.); and for those parts requiring lubricating apply the lubricant prescribed in the lubrication order.

b. General Precautions in Cleaning.

(1) Volatile mineral spirits and dry-cleaning solvent are inflammable and should not be used near an open flame. Fire extinguishers should be provided when these materials are used. Use only in well ventilated places.

(2) These cleaners evaporate quickly and have a drying effect on the skin. If used without gloves, they may cause cracks in the skin and, in the case of some individuals, a mild irritation or inflammation.

(3) Avoid getting petroleum products such as dry-cleaning solvent, volatile mineral spirits, engine fuels, or lubricants on rubber parts as they will deteriorate the rubber.

(4) The use of gasoline, benzene (benzol), or Diesel fuel oil for cleaning is prohibited.

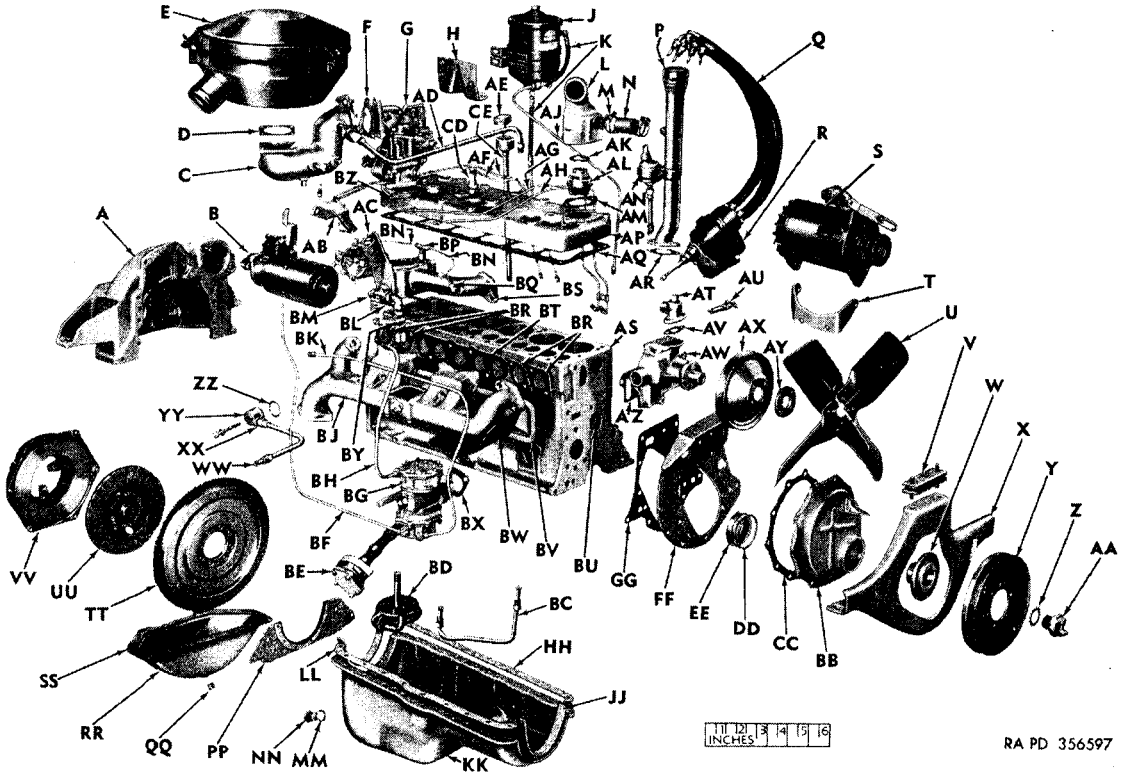


Figure 12. Engine and clutch—partial exploded view.

A—HOUSING, CLUTCH, W/BEARING, ASSY 7373384
B—STARTER, ASSY 7762617
C—ELBOW, AIR CLEANER, CARBURETOR, W/STUD, ASSY 7705789
D—GASKET, AIR CLEANER, ELBOW A282807
E—SHROUD, AIR CLEANER, CARBURETOR, ASSY 7705788
F—GASKET, CARBURETOR TO AIR CLEANER ELBOW 7001054
G—CARBURETOR, ASSY 7001053
H—BRACKET, MOUNTING, OIL FILTER 7705762
J—FILTER, OIL, W/CLAMP, ASSY CC–1270046
K—LINE FLEXIBLE, OIL FILTER, ASSY 7320632
L—ELBOW, CYLINDER HEAD WATER OUTLET 7706210
M—CLAMP, HOSE, WATER PUMP BY-PASS 502916
N—HOSE, WATER PUMP BY-PASS 33–H–771
P—CAP, OIL FILLER PIPE, ASSY 1092771
Q—CABLE, SPARK PLUG, ASSY 7528172
R—DISTRIBUTOR, W/COIL, ASSY 7374884
S—GENERATOR, W/O PULLEY, ASSY 7374750
T—BRACKET, MOUNTING, GENERATOR 7374870
U—BLADE, FAN 7346790
V—INSULATOR, FRONT SUPPORT, ENGINE 7373657
W—HUB, FAN DRIVE PULLEY 7705718
X—PLATE, FRONT SUPPORT, ENGINE 7373657
Y—PULLEY, FAN DRIVE 7705719
Z—WASHER, LOCK, CRANKING JAW 7702463
AA—JAW, CRANKING 7702761
BB—COVER, TIMING CHAIN CASE, ASSY 7373642
CC—GASKET, TIMING CHAIN CASE COVER 7373645
DD—GASKET, OIL SEAL, TIMING CHAIN CASE COVER CC–1088603
EE—SEAL, OIL, TIMING CHAIN CASE COVER CC–1088602
FF—PLATE, TIMING CHAIN CASE COVER 7351244
GG—GASKET, TIMING CHAIN CASE COVER PLATE 7351247
HH—GASKET, OIL PAN, LEFT CC–600759
JJ—GASKET, OIL PAN, FRONT AND REAR CC–866680
KK—PAN, OIL, W/PLUG, ASSY 7348986
LL—GASKET, OIL PAN, RIGHT CC–600758
MM—GASKET, OIL PAN DRAIN PLUG CC–105456
NN—PLUG, DRAIN, OIL PAN 7373671
PP—PLATE, PAN, W/DUST SEAL, CLUTCH HOUSING, ASSY 7351216
QQ—PLUG, PIPE, ¾-IN. PIPE THREAD 143968
RR—PAN, W/PLUG, CLUTCH HOUSING, ASSY 7373383
SS—GASKET, PAN, CLUTCH HOUSING 7373385
TT—FLYWHEEL, W/RING GEAR, ASSY 7744137
UU—DISK, DRIVING, CLUTCH, ASSY CC–921349
VV—PLATE, PRESSURE, W/COVER, ASSY CC–581666
WW—LINE, CRANKCASE VENTILATOR CC–1272090
XX—CONNECTOR, CRANKCASE VENTILATOR LINE CC–137408
YY—FITTING, VENTILATOR LINE TO CRANKCASE CC–928410
ZZ—GASKET, CRANKCASE VENTILATOR LINE FITTING TO CYLINDER BLOCK CC–301034
AB—BRACKET, ELBOW SUPPORT, CARBURETOR AIR CLEANER CC–1274315
AC—BRACKET, ELBOW SUPPORT FRONT, CARBURETOR AIR CLEANER 7705791
AD—LINE, BREATHER PIPE TO AIR CLEANER CC–127091
AE—GAGE, OIL LEVEL, W/CAP, ASSY 7320592
AF—LINE, VENT, AIR CLEANER ELBOW TO DISTRIBUTOR CC–63721
AG—LINE, VENT, MASTER CYLINDER TO AIR CLEANER ELBOW CC–861038
AH—LINE, VENT, FUEL TANK TO AIR CLEANER ELBOW CC–621629
AJ—LINE, ENGINE TO OIL FILTER, ASSY CC–1272120
AK—GASKET, THERMOSTAT 7702589
AL—THERMOSTAT, WATER TEMPERATURE, ASSY 7715997
AM—GASKET, WATER, OUTLET ELBOW 7702588
AN—UNIT, SENDING, OIL PRESSURE, ASSY 7728856
AP—HEAD, CYLINDER, W/PLUG, ASSY 7374761
AQ—GASKET, CYLINDER HEAD 7373653
AR—GASKET, OIL FILLER PIPE 7378241
AS—BLOCK, CYLINDER CC–1322329
AT—ELBOW, WATER PUMP BY-PASS 7706211
AU—COCK, DRAIN, CYLINDER BLOCK WATER JACKET 7373793
AV—GASKET, WATER PUMP BY-PASS ELBOW 7351074
AW—PUMP, WATER CC–1326279
AX—PULLEY, FAN 7706192
AY—SPACER, FAN HUB TO PULLEY 7706194
AZ—GASKET, WATER PUMP TO CYLINDER BLOCK 7351163
BC—LINE, OIL PUMP OUTLET CC–620045
BD—STRAINER, OIL 7036578
BE—PUMP, OIL, ASSY 7346936
BF—LINE, FUEL PUMP TO WINDSHIELD WIPER, ASSY CC–1274914
BG—PUMP, FUEL, ASSY CC–1273865
BH—LINE, FUEL PUMP TO CARBURETOR, ASSY CC–1272194
BJ—MANIFOLD, EXHAUST, W/HEAT CONTROL VALVE, ASSY CC–622497
BK—LINE, FUEL PUMP TO MANIFOLD, ASSY CC–1274913
BL—GASKET, INTAKE TO EXHAUST MANIFOLD CC–601420
BM—VALVE, METERING, CRANKCASE VENTILATOR, W/O FITTINGS, ASSY CC–928411
BN—LINE, MANIFOLD, ENGINE PRIMER CC–1324104
BP—TEE, PRIMER LINE CC–928515
BQ—ELBOW, MANIFOLD, ENGINE PRIMER CC–928517
BR—GASKET, MANIFOLD, END CC–318042
BS—MANIFOLD, INTAKE CC–1066051
BT—GASKET, MANIFOLD, CENTER CC–601275
BU—PLUG, EXPANSION, BLOCK CORE HOLE CC–1141854
BV—COVER, VALVE COMPARTMENT CC–600881
BW—SHIELD, HEAT, FUEL PUMP 7705736
BX—GASKET, MOUNTING, FUEL PUMP 7735782
BY—COCK, CRANKCASE VENTILATOR LINE SHUT-OFF CC–127897
BZ—GASKET, CARBURETOR TO MANIFOLD FLANGE 7702586
CD—PLUG, SPARK 7524258
CE—PIPE, OIL LEVEL GAGE, ASSY CC–1092734

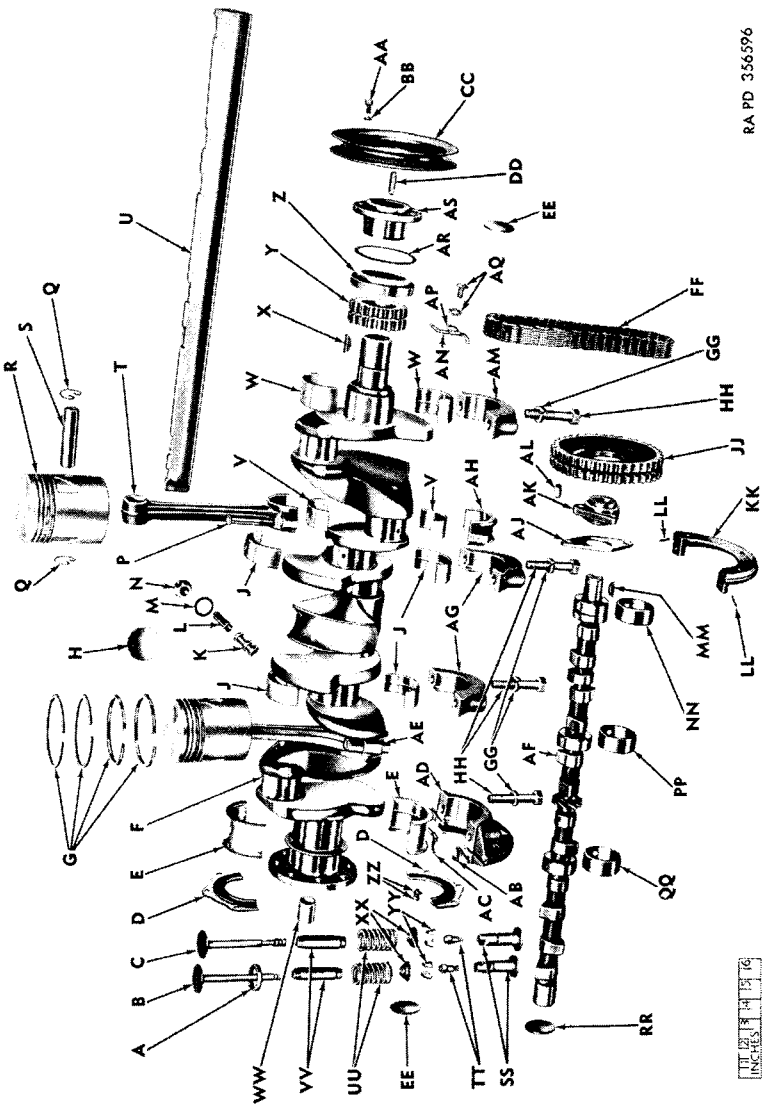


Figure 13. Engine internal parts—exploded view.

A—INSERT, EXHAUST VALVE SEAT (STANDARD) CC–868888–(0.010 OVERSIZE) CC–868889
B—VALVE EXHAUST CC–954302
C—VALVE, INTAKE CC–868886
D—RETAINER, REAR MAIN BEARING OIL SEAL CC–1325920
E—BEARING, TWO HALVES, MAIN, REAR (STANDARD) 7705716
F—CRANKSHAFT CC–868929
G—RING, SET, PISTON CC–1315460
H—PLUG, EXPANSION, CYLINDER BLOCK CORE HOLE CC–1141854
J—BEARING, TWO HALVES, MAIN, INTERMEDIATE (STANDARD) CC–1315513
K—PLUNGER, OIL PRESSURE RELIEF VALVE CC–677263
L—SPRING, OIL PRESSURE RELIEF VALVE CC–619057
M—GASKET, OIL PRESSURE RELIEF VALVE 7702587
N—CAP, OIL PRESSURE RELIEF VALVE 7702599
P—BOLT, CONNECTING ROD 7351231
Q—RING, RETAINING, PISTON PIN 7702467
R—PISTON, STANDARD CC–1241622
S—PIN, PISTON, STANDARD CC–320031
T—BEARING, PISTON PIN 7702594
U—TUBE, CYLINDER BLOCK WATER DISTRIBUTOR CC–687432
V—BEARING, TWO HALVES, CONNECTING ROD (STANDARD) 7705763
W—BEARING, TWO HALVES, MAIN, FRONT (STANDARD) CC–1315504
X—KEY, CRANKSHAFT SPROCKET 124551
Y—SPROCKET, CRANKSHAFT 7351240
Z—SEAL, OIL, TIMING CHAIN CASE COVER CC–1088602
AA—SCREW, CAP, HEX-HD 123473
BB—WASHER, LOCK 120638
CC—PULLEY, FAN DRIVE 7705719
DD—KEY, FAN DRIVE PULLEY 7702763
EE—PLUG, EXPANSION, BLOCK CORE HOLE, FRONT AND REAR CC–1316378
FF—CHAIN, TIMING 7351248
GG—WASHER, LOCK CC–120384
HH—SCREW, MAIN BEARING CAP 7702669
JJ—SPROCKET, CAMSHAFT 7351242
KK—PLATE, OIL PAN, FRONT SEAL 7005409
LL—SEAL, OIL, FRONT 7373672
MM—KEY, CAMSHAFT SPROCKET HUB 114813
NN—BEARING, CAMSHAFT, FRONT 7702615
PP—BEARING, CAMSHAFT, INTERMEDIATE CC–632466
QQ—BEARING, CAMSHAFT, REAR CC–632467
RR—PLUG, EXPANSION, CAMSHAFT REAR HOUSING BEARING HOLE 541404
SS—TAPPET, VALVE, W/SCREW, ASSY (STANDARD) CC–866886
TT—SCREW, ADJUSTING, VALVE TAPPET 7702641
UU—SPRING, COMPRESSION, VALVE CC–869449
VV—GUIDE, VALVE STEM 7705720
WW—BEARING, BUSHING TYPE, CLUTCH SHAFT PILOT CC–53298
XX—RETAINER, VALVE SPRING 7705761
YY—LOCK, VALVE SPRING RETAINER 7702762
ZZ—SCREW, CAP AND LOCK WASHER, REAR MAIN BEARING OIL SEAL RETAINER CC–871320
AB—GASKET, REAR MAIN BEARING CAP, RIGHT CC–863012
AC—GASKET, REAR MAIN BEARING CAP, LEFT CC–863013
AD—CAP, MAIN BEARING, REAR (NO. 4) CC–1141230
AE—NUT, HEX, CONNECTING ROD 7702657
AF—CAMSHAFT 7373641
AG—CAP, MAIN BEARING, INTERMEDIATE (NOS. 2 AND 3) CC–630477
AH—ROD, CONNECTING, W/BOLTS, ASSY—NOS. 1, 3, 5, 7351228, NOS. 2, 4, 6, 7351230
AJ—PLATE, THRUST, CAMSHAFT SPROCKET HUB 7351245
AK—HUB, CAMSHAFT SPROCKET 7351246
AL—PIN, TIMING CHAIN CASE COVER PLATE 7702600
AM—CAP, MAIN BEARING, FRONT (NO. 1) CC–630476
AN—NOZZLE, OIL CAMSHAFT SPROCKET CC–600787
AP—CLIP CC–51563
AQ—SCREW AND WASHER, NOZZLE CLIP 186410
AR—GASKET, TIMING CHAIN CASE COVER OIL SEAL CC–1088603
AS—HUB, FAN DRIVE PULLEY 7705718

c. Draining. When the desired amount of cleaning has been accomplished, the power plant is then ready for disassembly. The cooling system and oil pan should be drained. The cooling system is drained by opening the radiator drain cock (fig. 14) located on the lower section of the radiator. The cylinder block is drained by opening the cylinder block water jacket drain cock (fig. 14) located on the left side of engine between the distributor and oil filler pipe. The oil pan is drained by removing the drain plug in the bottom of pan. A ½-inch female plug is provided so that any ½-inch square plug wrench (fig. 15) can be used for removal.

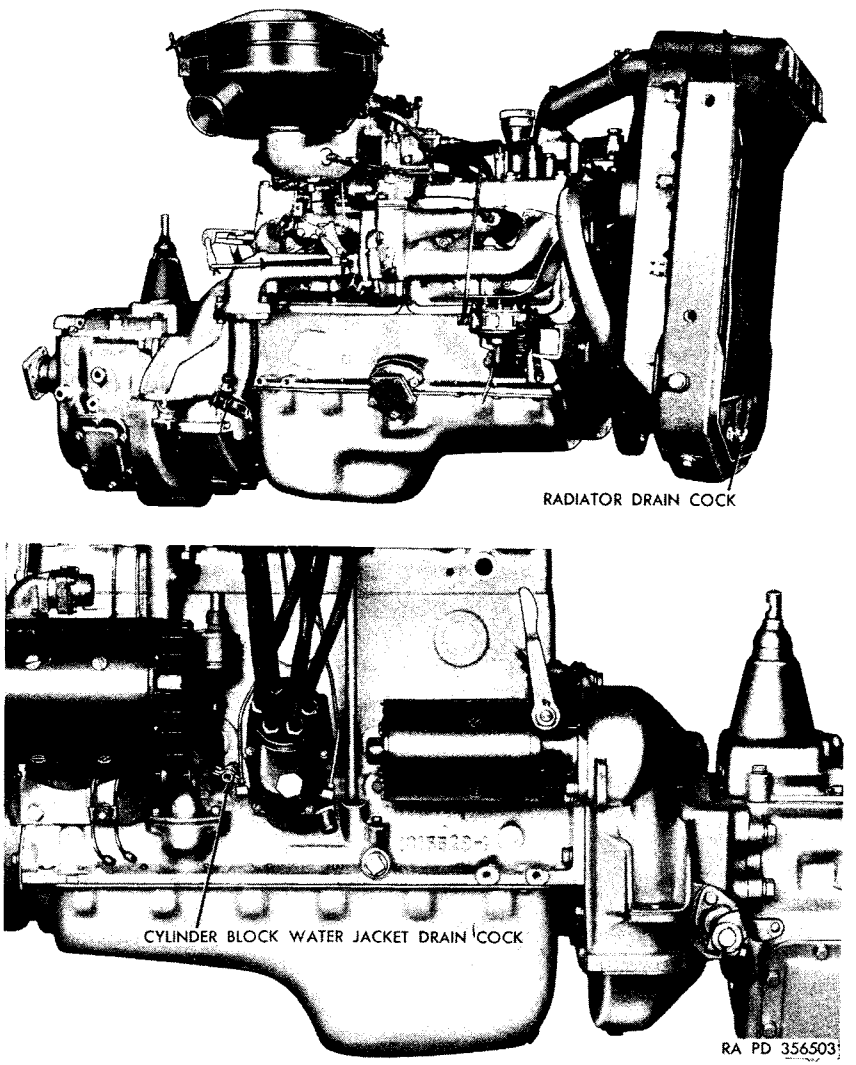


Figure 14. Cooling system drain cocks.

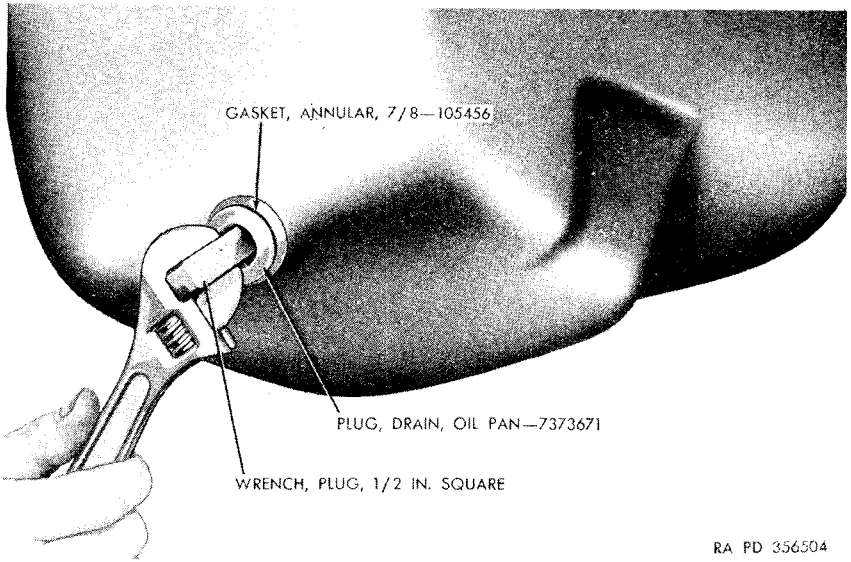


Figure 15. Removing oil pan drain plug.

32. Removal of Radiator

a. General. Remove power plant (par. 29).

b. Remove Radiator.

(1) Disconnect upper outlet radiator hose from water pump (fig. 9).

(2) Disconnect inlet radiator hose (fig. 9) from water outlet elbow and radiator inlet. Remove hose.

(3) Support the radiator assembly on a suitable stand or jack and remove both left and right radiator support brackets. Remove the radiator, the radiator support, and the radiator fan shroud.

(4) Place the radiator assembly in a suitable space where it will not interfere with further operations.

33. Removal of Transmission Assembly
(fig. 16)

a. General. Although there is no set procedure for disassembly of the power plant, removal of the transmission can be easily accomplished (*b* below).

b. Remove Transmission. Remove the four transmission mounting bolts and with the aid of a jack or a chain fall, lower the transmission to the floor. If a jack or chain fall is not available, a rope or other suitable support can be placed under the transmission pinion shaft, and with the aid of a helper, the transmission can be removed.

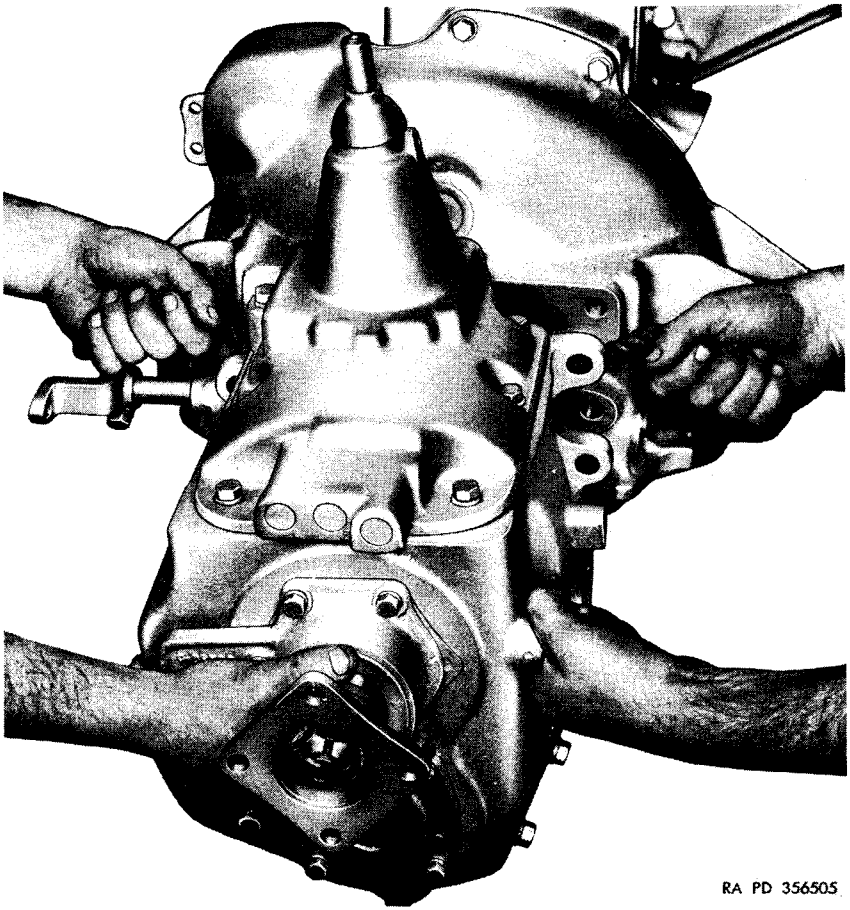


Figure 16. Removing transmission assembly.

34. Removal of Clutch Assembly
(fig. 18)

a. General. A dry disk-type clutch is used on all vehicles covered in this manual. Each clutch is composed of a driving disk assembly and a pressure plate and cover assembly. The entire assembly is bolted to the engine flywheel and is covered by the clutch housing. This housing is bolted to the rear of the engine block.

b. Remove Clutch.

(1) Disconnect pull back spring (fig. 17). Remove pull back spring screw from top of housing and remove release bearing with sleeve assembly.

(2) Remove the six cap screws from the clutch housing pan and remove pan.

(3) Remove the six cap screws from the clutch cover and lower the clutch assembly from the housing.

(4) Remove the clutch release fork lever and remove Woodruff key from the clutch release fork (fig. 19).

(5) Remove the screws securing the release fork flange and pull release fork out of the housing.

c. Removal of Flywheel and Clutch Housing.

(1) Remove flywheel.

(2) Remove clutch housing pan dust seal plate.

(3) Remove clutch housing.

35. Removal of Accessories

a. General. When the engine has been drained and cleaned, and the radiator, transmission, and clutch have been removed, remove accessories from engine assembly.

b. Generator Assembly (fig. 20).

(1) Remove cap screw securing generator to belt tension adjusting arm.

(2) Slip fan belt off generator pulley.

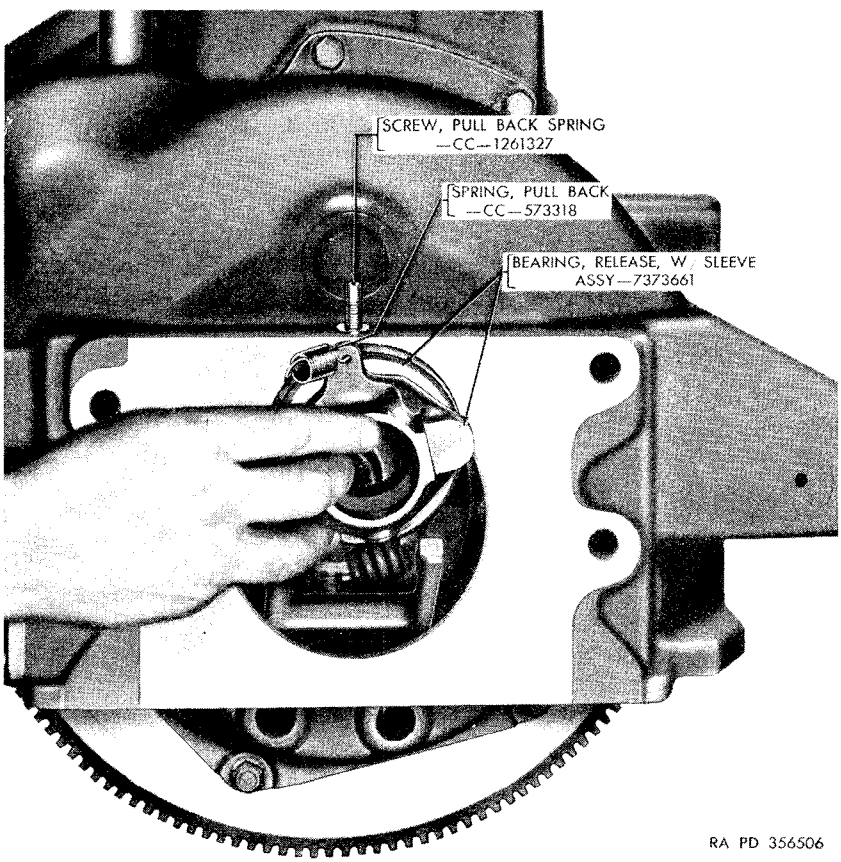


Figure 17. Removing clutch release bearing.

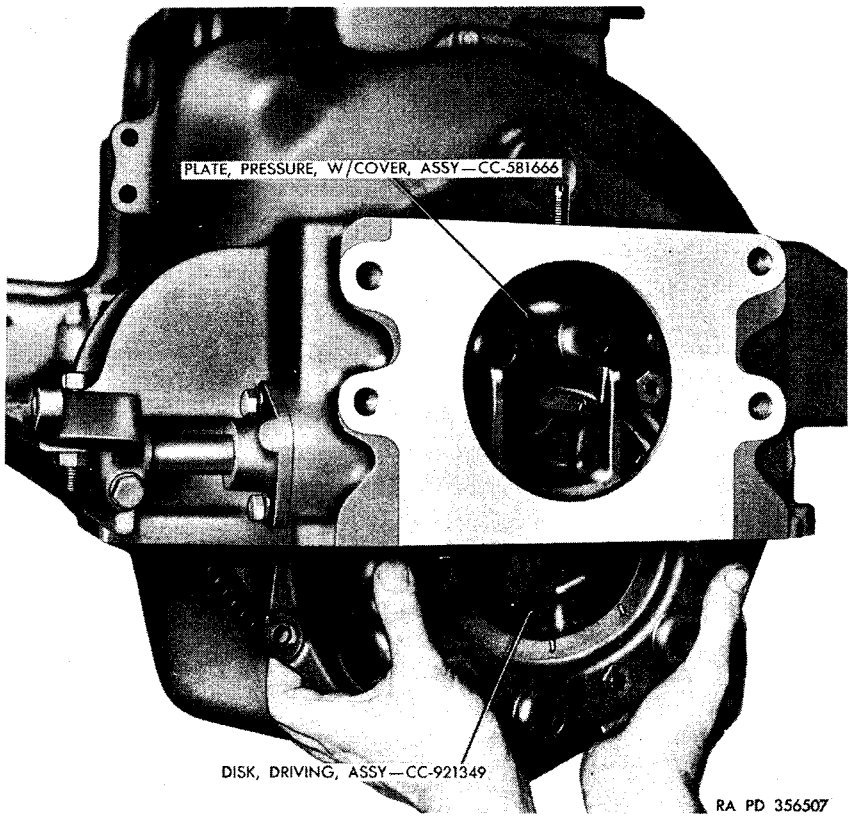


Figure 18. Removing clutch assembly.

(3) Remove bolts securing generator to mounting bracket and remove generator.

c. Distributor Assembly (fig. 21).

(1) Before disconnecting secondary cables from spark plugs, scribe a mark on the distributor housing at the No. 1 spark plug cable terminal, which will facilitate assembly as the firing order is 1–5–3–6–2–4 clockwise. Disconnect secondary cables from spark plugs.

(2) Disconnect air vent lines at distributor.

(3) Remove distributor adjusting lock screw.

(4) Pull distributor from cylinder block.

d. Starter Assembly (fig. 22).

(1) Unscrew oil level gage pipe assembly (CE, fig. 12) and remove from cylinder block.

(2) Remove nuts and lock washers securing starter.

(3) Lift starter assembly from engine assembly.

e. Carburetor Assembly (fig. 23).

(1) Remove air cleaner assembly.

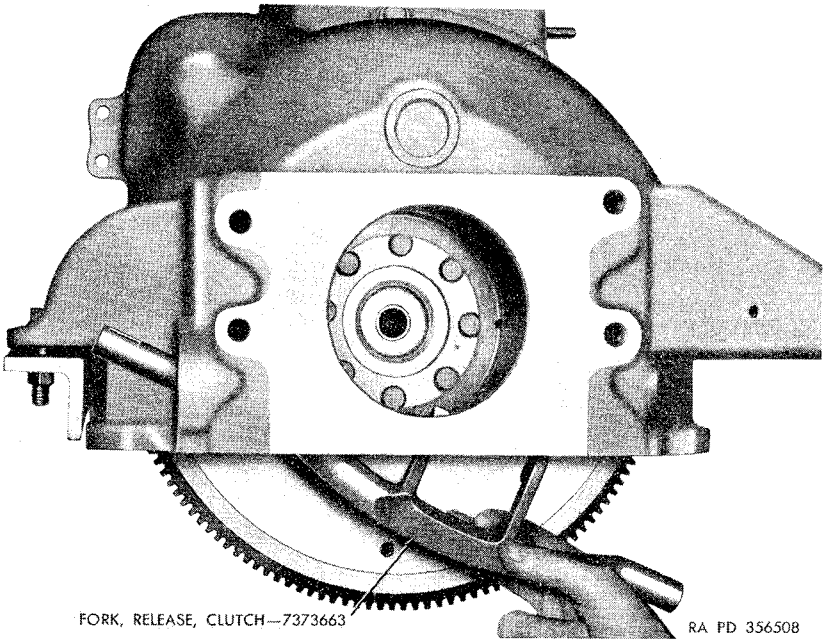


Figure 19. Removing clutch release fork.

(2) Disconnect all vent lines leading from carburetor air cleaner elbow and remove elbow.
(3) Disconnect throttle and choke control wires and accelerator control rod.
(4) Disconnect fuel pump-to-carburetor line at carburetor.
(5) Remove nuts and lock washers securing carburetor, and lift carburetor assembly from intake manifold. Discard carburetor-to-manifold flange gasket.

f. Oil Filter Assembly (fig. 24).
(1) Disconnect inlet and outlet lines from oil filter assembly.
(2) Remove machine screws from oil filter clamp, loosen mounting screws, and lift oil filter assembly from oil filter clamp.
(3) Remove oil filter clamp.

g. Fuel Pump Assembly (fig. 25).
(1) Remove fuel pump heat shield.
(2) Disconnect fuel pump-to-manifold, to-windshield wiper, to-carburetor, and fuel filter-to-fuel pump lines.
(3) Remove screws securing fuel pump to cylinder block and remove fuel pump.

h. Oil Pump Assembly (fig. 26).
(1) Remove oil pump mounting bolts.
(2) Pull oil pump out of cylinder block.
(3) Remove oil pump gasket.

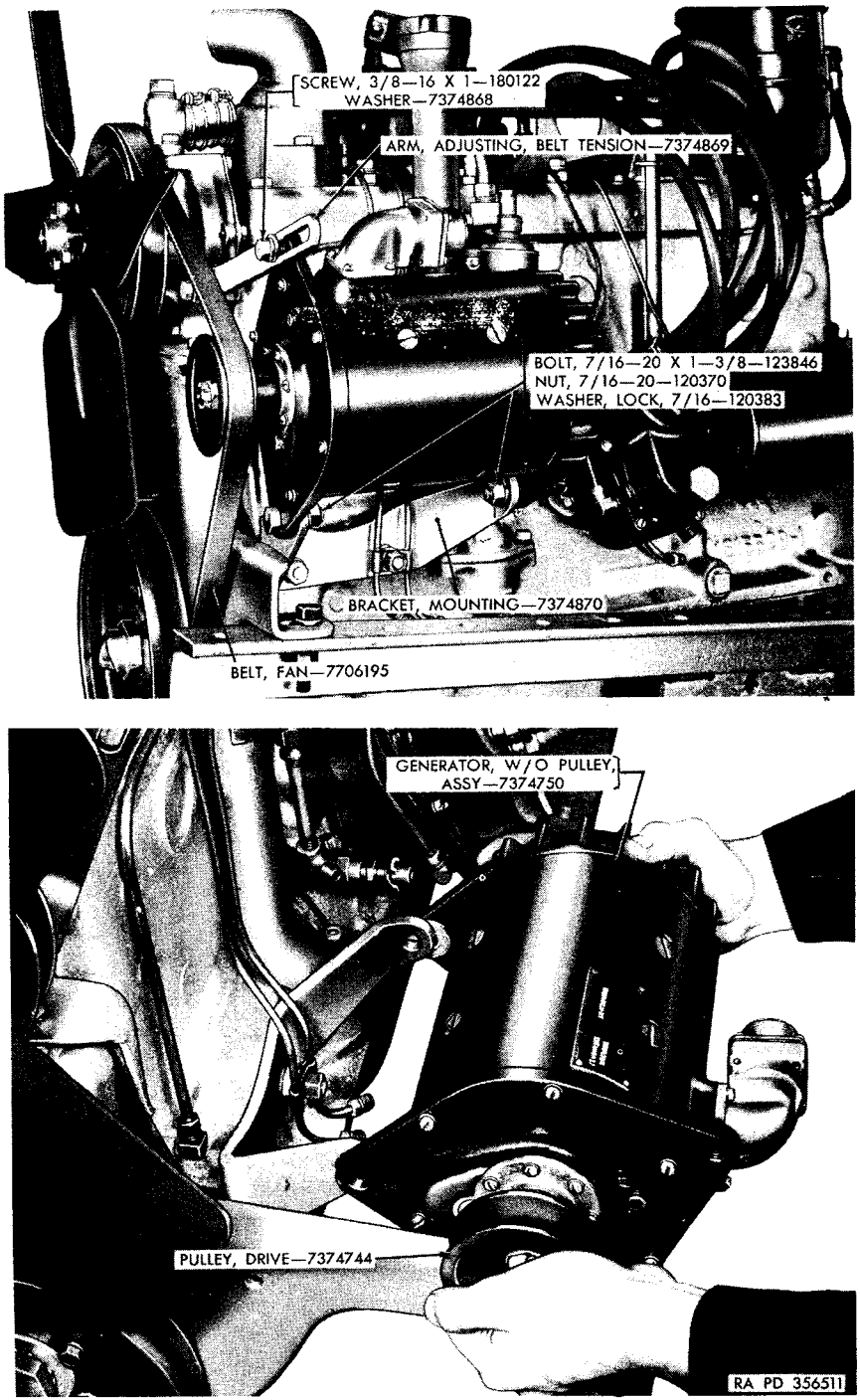


Figure 20. Removing generator assembly.

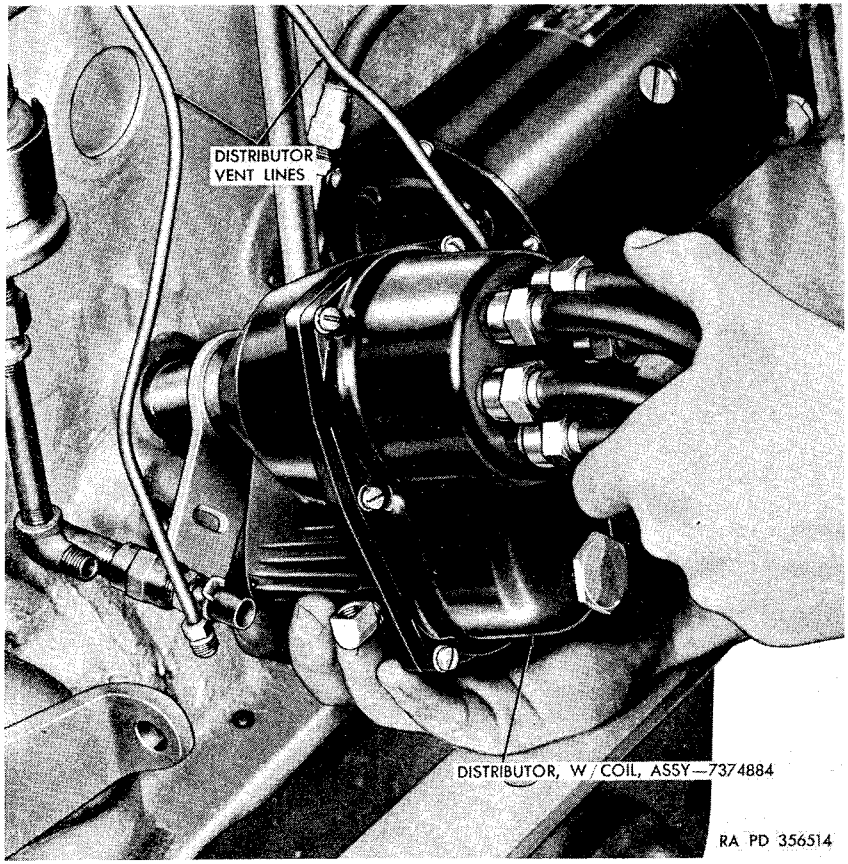


Figure 21. Removing distributor assembly.

i. Sending Units and Vent Lines.

(1) Remove oil pressure sending unit bracket from oil filler pipe and remove oil pressure sending unit assembly (AN, fig. 12).

(2) Remove water temperature gage sending unit from cylinder head.

(3) Remove brake master cylinder vent line and fuel tank vent line.

(4) Remove ignition distributor vent lines.

Section III. DISSASSEMBLY OF STRIPPED ENGINE INTO SUBASSEMBLIES

36. Removal of Engine Components

a. General. After the accessories have been removed from the engine, the subassemblies, such as the oil pan, manifolds, cylinder head, and other units can be removed.

b. Fan.

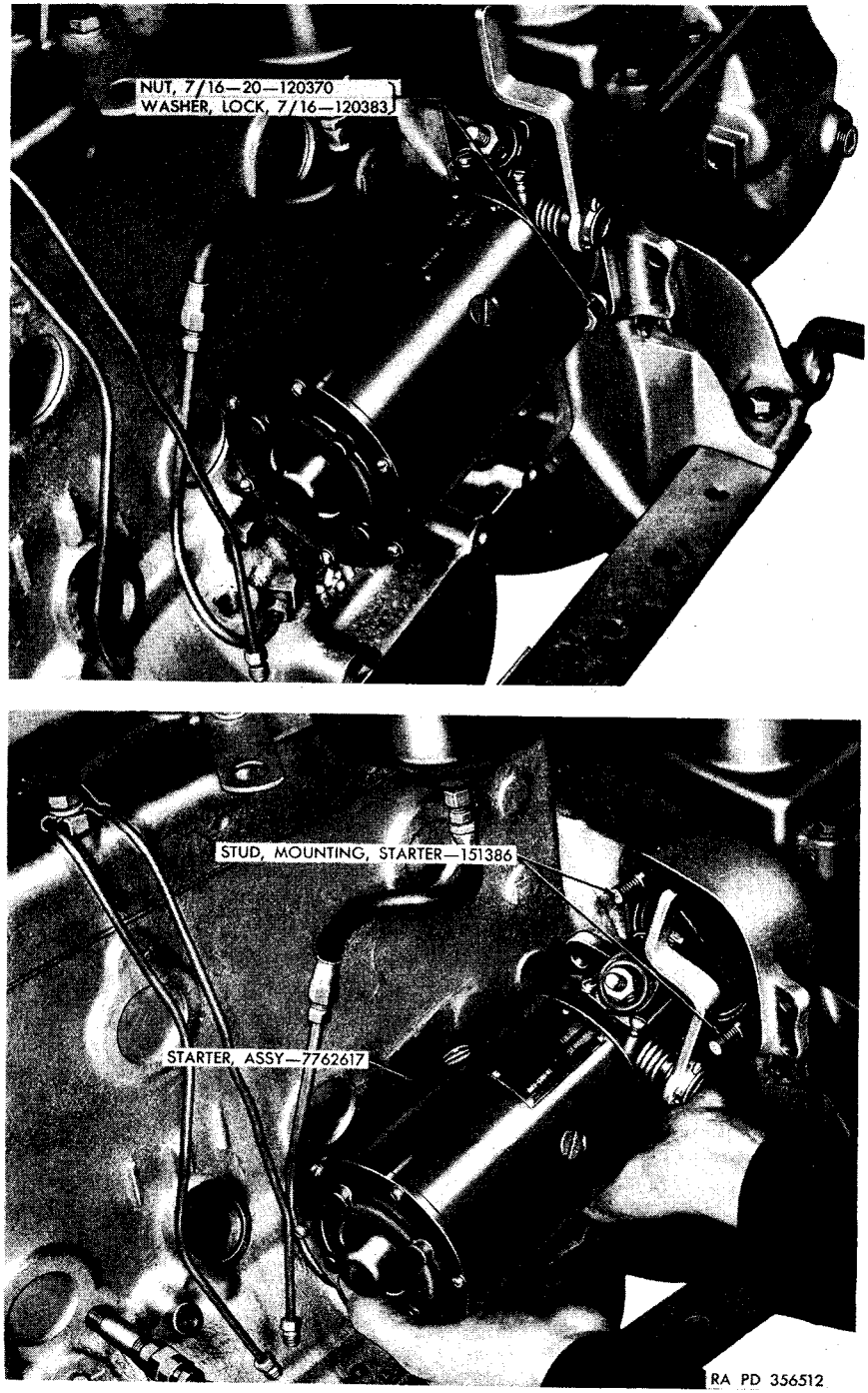


Figure 22. Removing starter assembly.

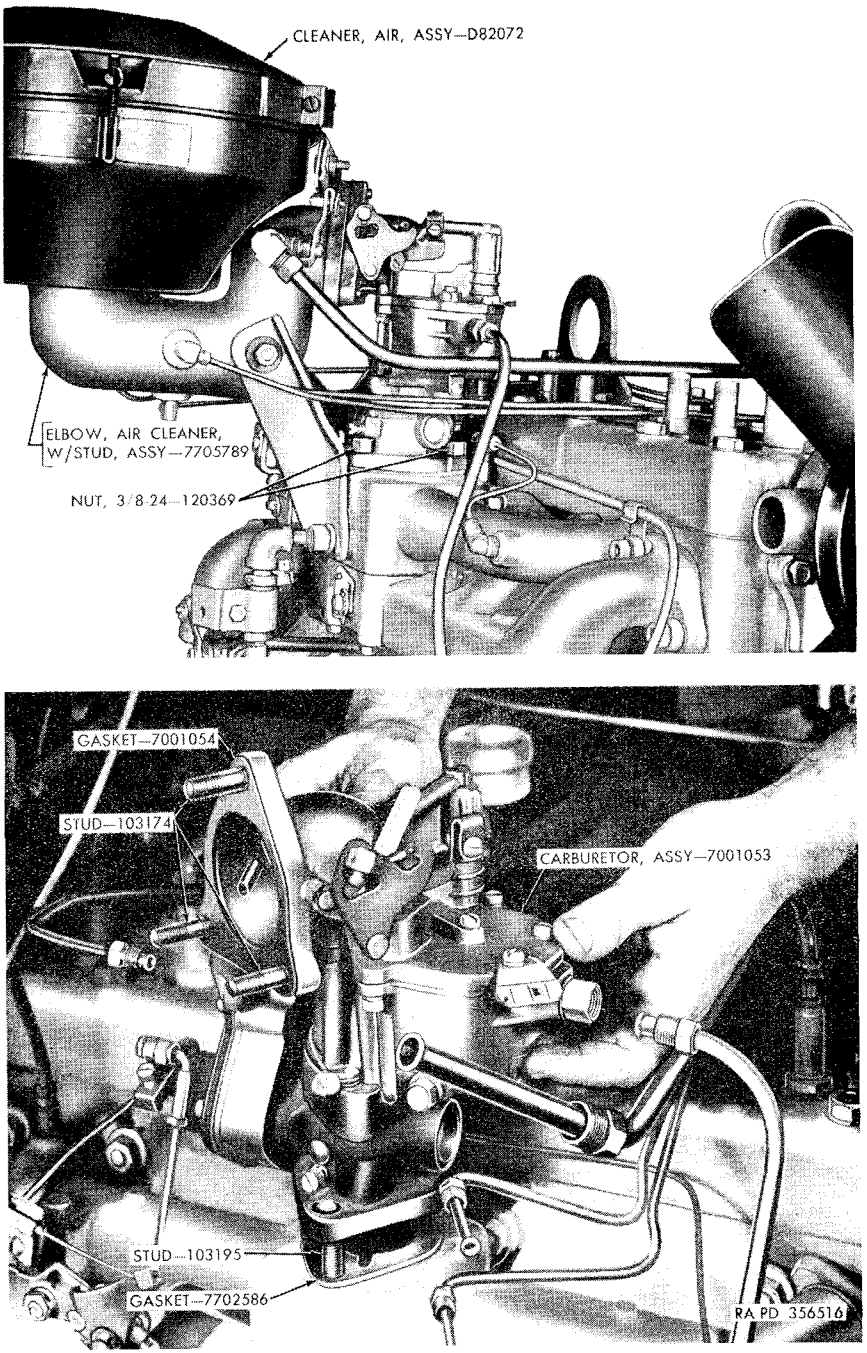


Figure 23. Removing carburetor assembly.

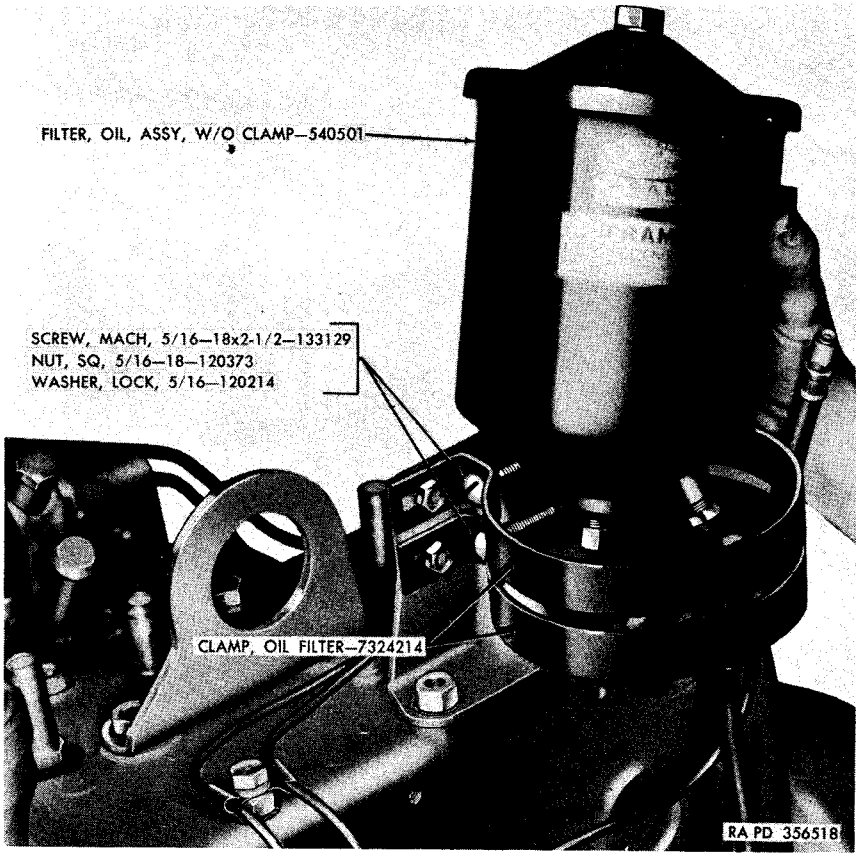


Figure 24. Removing oil filter assembly.

(1) Remove cap screws which attach the fan blades, fan hub-to-pulley spacer, and fan pulley to the water pump shaft hub.
(2) Remove fan blade, fan hub-to-pulley spacer, and fan pulley.

c. Water Pump.

(1) Remove water pump by-pass elbow screws.
(2) Remove mounting cap screws and lift pump from cylinder block.
(3) Pull the cylinder block water distributor tube from cylinder block. A hooked piece of heavy gage wire may be required if tube is badly corroded.

d. Manifolds.

(1) Remove crankcase ventilator valve from intake manifold.
(2) Remove nuts and lift intake and exhaust manifold assembly with heat control valve from engine (fig. 27).

e. Oil Filler Pipe and Oil Level Gage Pipe.

(1) Remove two cap screws and lift oil filler pipe from cylinder block.

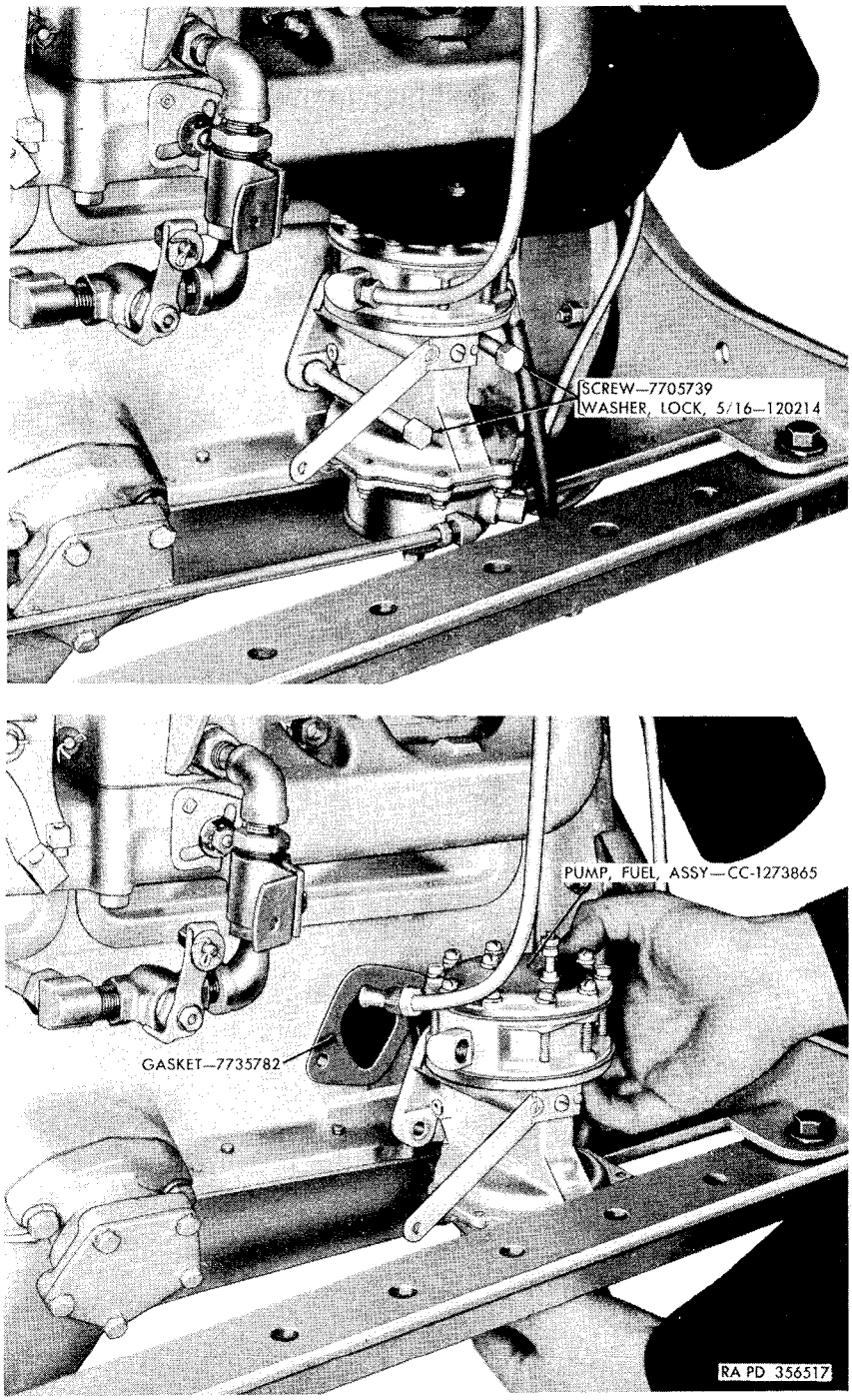


Figure 25. Removing fuel pump assembly.

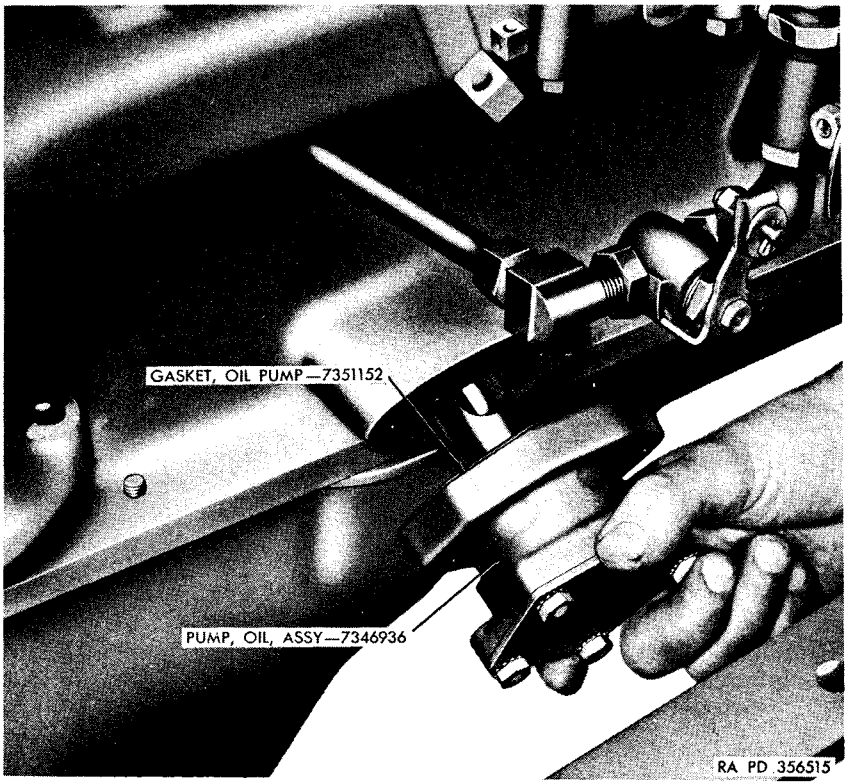


Figure 26. Removing oil pump assembly.

(2) Remove the oil level bayonet type gage, with cap assembly.
(3) Unscrew oil level gage pipe and remove from cylinder block.

f. Oil Pressure Relief Valve (fig. 28).
(1) Remove cap and cap gasket.
(2) Remove spring and oil pressure relief valve plunger.

g. Cylinder Head.
(1) Remove vent line clips from engine.
(2) Remove cylinder head bolts and lift cylinder head from cylinder block.
(3) Remove cylinder head gasket and discard.

h. Intake and Exhaust Valves and Valve Compression Springs.
(1) Remove valve compartment covers.
(2) Turn crankshaft until the front valve is all the way down on its seat and insert jaws of valve lifter between the lower end of the valve compression spring and the cylinder block, with the cupped jaws up. Hold the valve down and screw up the valve lifter until the valve spring is fully compressed. Remove the valve spring retainer locks (fig. 29) from the lower end of the valve stem. Remove the lifter and pull the valve

from the valve guide. Lift the lower end of the valve spring above the valve tappet adjusting screw and pull the spring valve retainer (fig. 30) and spring from between the tappet

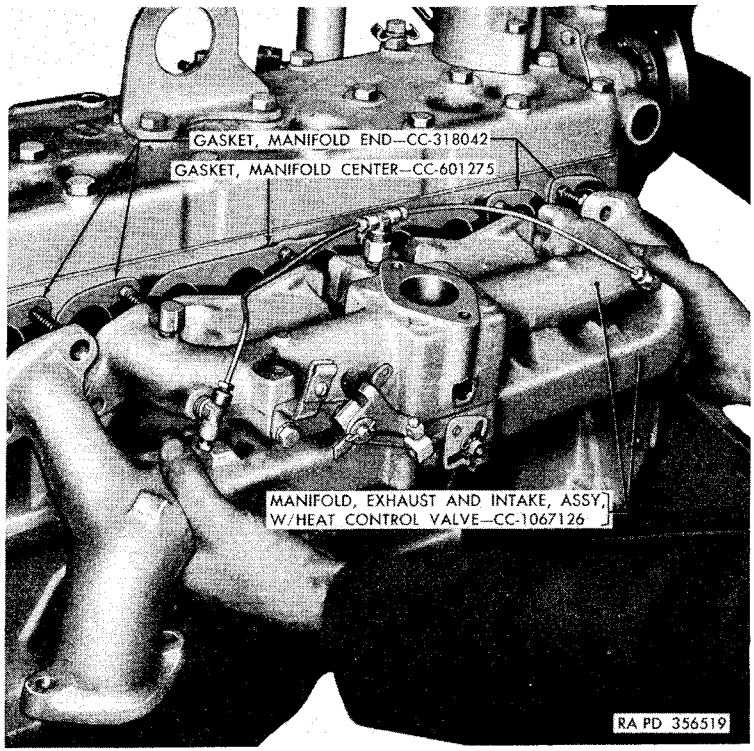


Figure 27. Removing manifold assembly.

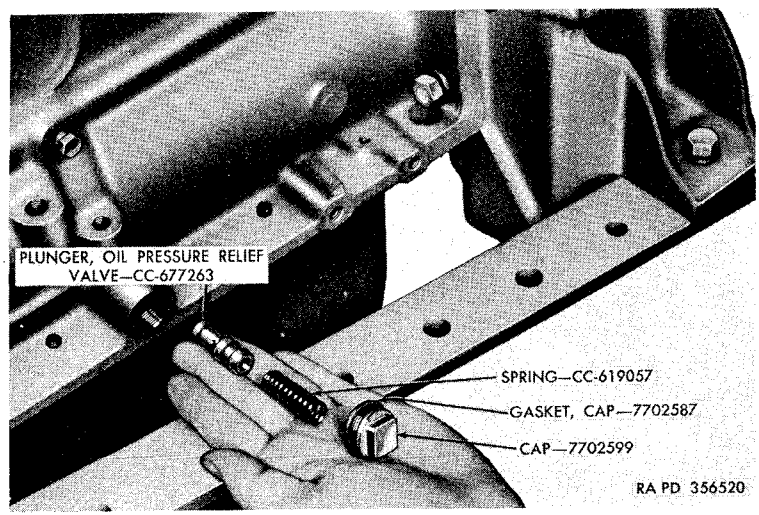


Figure 28. Removing oil pressure relief valve.

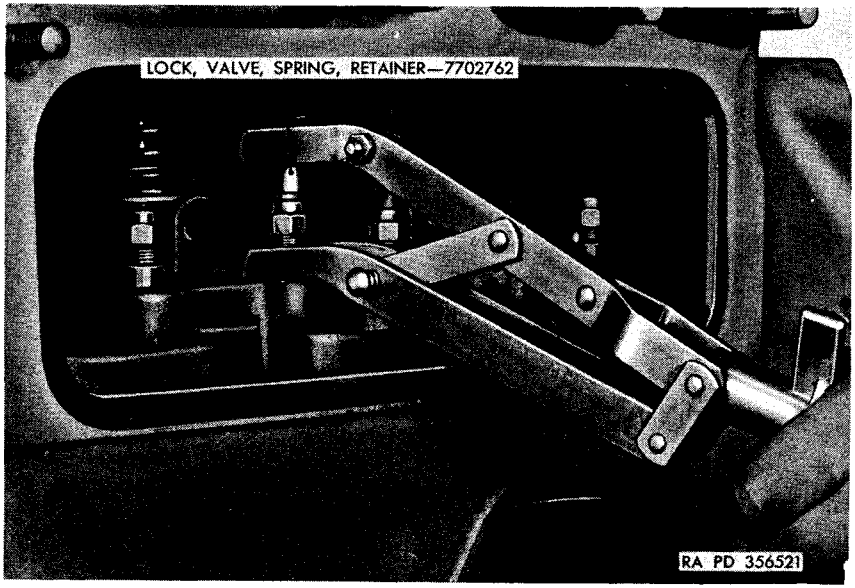


Figure 29. Removing valve spring retainer lock with valve lifter–41–L–1410.

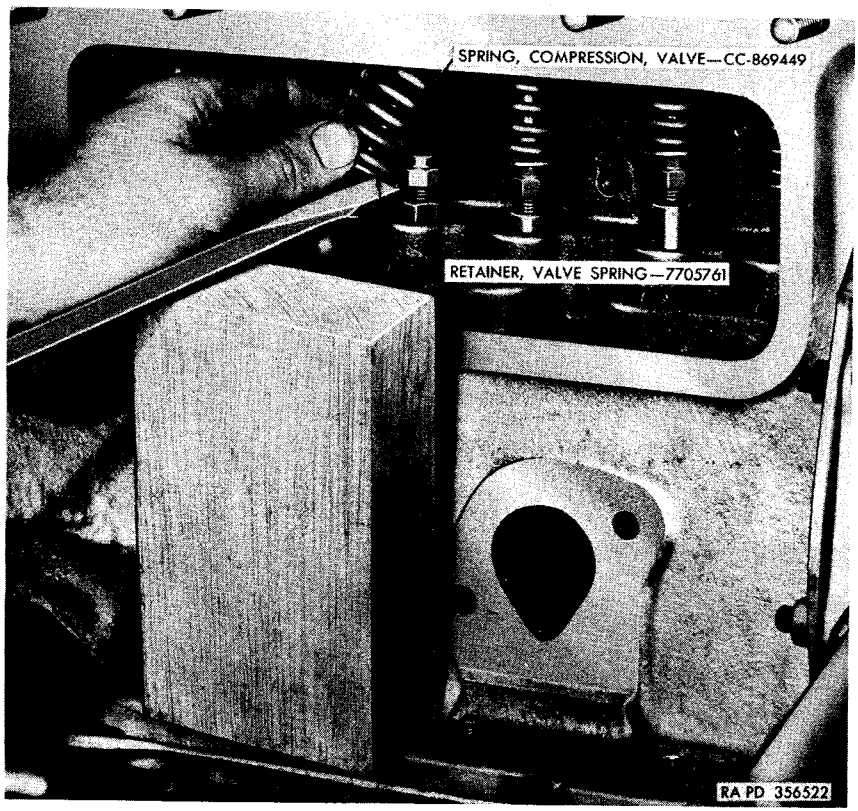


Figure 30. Removing valve compression springs.

adjusting screw and the valve stem guide. Remove all valves and springs in this manner and place the valves in a board or other device so that they can be identified with the port from which they were removed.

i. Oil Pan.

(1) Remove screws securing oil pan to cylinder block and remove oil pan.

(2) Remove all gasket material from oil pan and cylinder block.

j. Oil Strainer.

(1) Remove cotter pin securing oil strainer to oil pump inlet pipe and remove oil strainer.

(2) Remove oil pump inlet pipe and oil pump outlet line from cylinder block.

k. Timing Chain and Camshaft Sprocket.

(1) Remove the fan drive pulley (fig. 31). Remove the cranking jaw with a $1\frac{1}{16}$-inch socket wrench. Then, remove the fan drive pulley hub (fig. 31) with universal gear puller and two $\frac{5}{16}$–24 x 2 screws.

(2) Remove the engine front support plate.

(3) Remove the timing chain case cover.

(4) Turn the crankshaft clockwise so that the top span of the chain is tight. If the amount of slack in the lower span is greater than three-quarters of an inch, replace the timing chain (fig. 32).

(5) Remove the camshaft sprocket and timing chain.

(6) Remove camshaft sprocket oil nozzle, clip, and nozzle clip screw and washer.

(7) Remove timing chain case cover plate and gasket.

(8) Remove oil pan front seal plate and front oil seals.

l. Crankshaft.

(1) Remove ridge in cylinder bore with a ridge reamer. Use extreme care not to undercut bore. Keep pistons covered during this operation and clean cylinder bores thoroughly after reaming.

(2) Remove all pistons and connecting rod assemblies.

(3) Mark the two intermediate main bearing caps with punch marks (fig. 50). This will prevent replacing them in the wrong position.

(4) Remove all main bearing caps.

(5) Lift crankshaft (fig. 33) out of cylinder block.

(6) Remove rear oil seal retainers from both the cylinder block and the rear main bearing cap.

m. Camshaft and Valve Tappet With Screw Assemblies.

(1) With engine upside down, remove the cap screws securing the camshaft thrust plate.

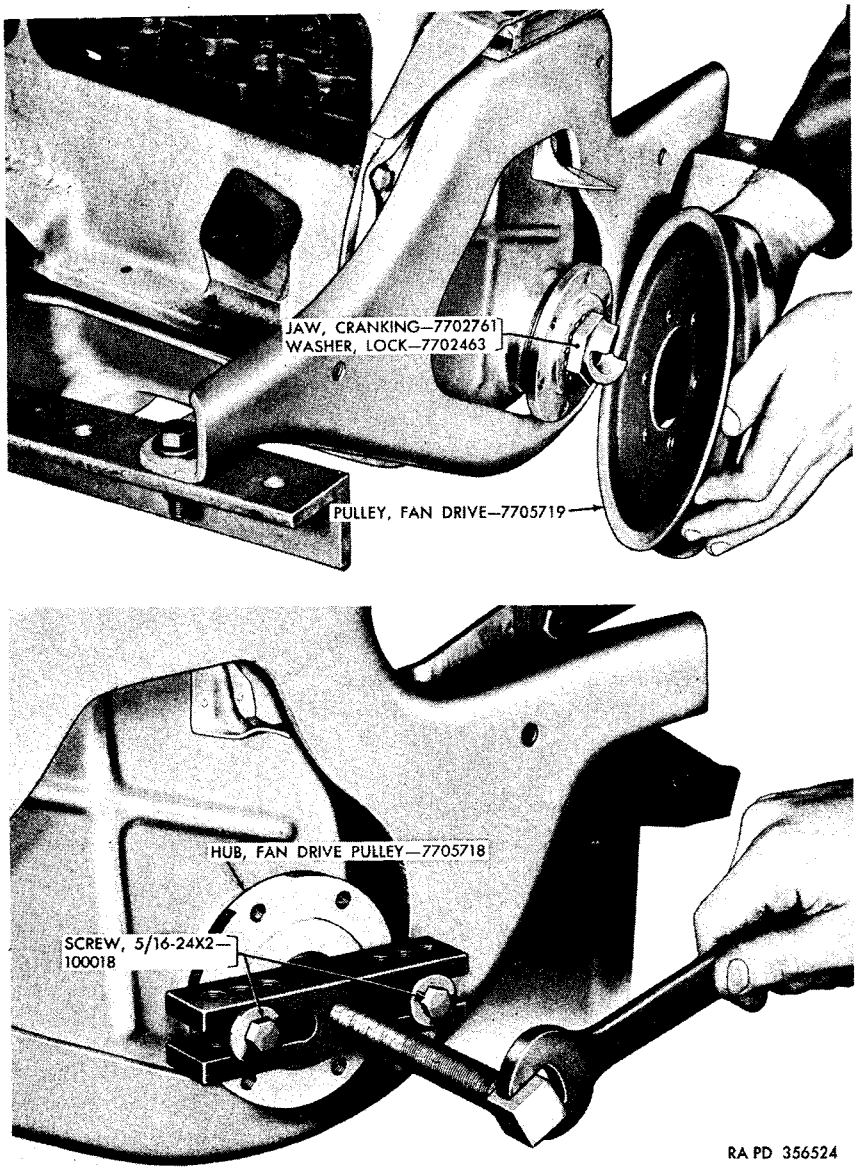


Figure 31. Removing fan drive pulley and hub.

(2) Pull camshaft (fig. 34) from cylinder block and rotate same to facilitate removal. Exercise care to prevent possible bearing damage. Wipe camshaft journals and bearings free of lubricant. Then install camshaft in cylinder block so that bearing clearance can be checked.

(3) Check camshaft bearing clearance by mounting a dial gage on the crankshaft main bearing support web and position

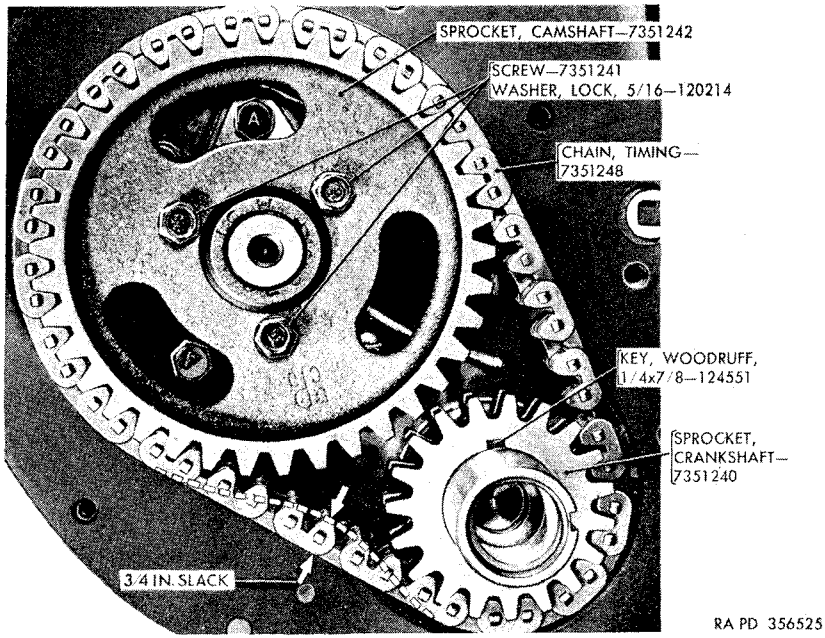


Figure 32. Testing slack in timing chain.

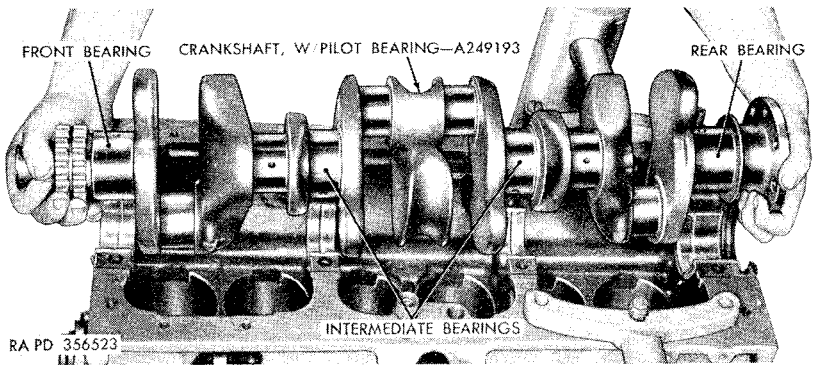


Figure 33. Removing crankshaft.

gage so that dial stem is against the camshaft. Move camshaft up and down with two small bars or screwdrivers to determine total clearance as indicated on the dial gage. Refer to repair and rebuild standards (par. 66) for proper clearances.

(4) Check camshaft end play by mounting a dial gage on front main bearing support web and position gage so that dial stem is against end of camshaft. Move camshaft back and forth with a bar to determine total amount of end play. If end play exceeds wear limits in repair and rebuild standards (par. 66), replace the camshaft thrust plate, camshaft

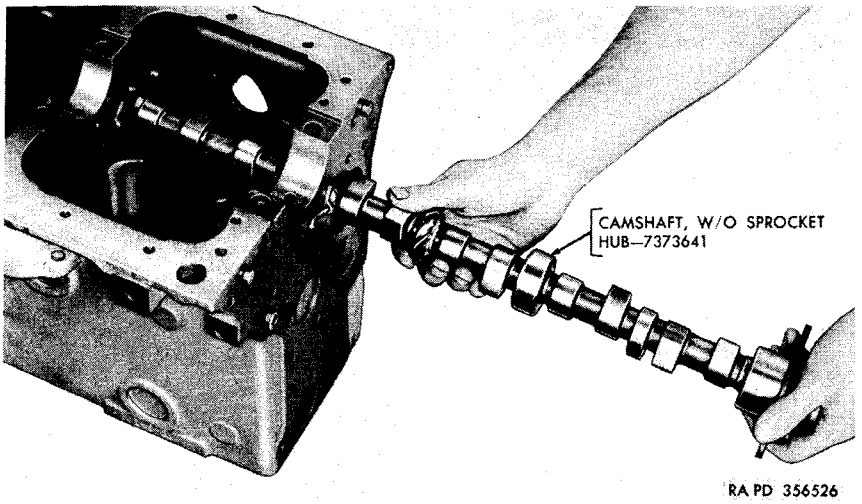


Figure 34. Removing Camshaft.

sprocket hub thrust plate or both.

(5) Remove two cap screws which hold the camshaft thrust plate to the cylinder block.

(6) Pull camshaft from engine.

(7) Lift the valve tappet with screw, assemblies from their guides and keep them tagged and in proper order so that they can be installed in their original position.

n. Camshaft Bearings.

(1) Use remover and installer—41–R–2386 (fig. 35) to remove the camshaft bearings.

(2) Select the proper size tool adapter for each of the three bearings to be removed.

(3) Insert the adapters into the bearings from the rear.

(4) Insert the puller shaft through the adapters and install one of the horseshoe collars behind one adapter.

(5) Slide the hammer of the tool against the outside nut on the driving rod with sufficient force to start the bearing and repeat the operation until the bearing is out of the bore. Leave the adapter in the block to guide the puller shaft and pull the other bearings in the same manner.

37. Identification of Cast and Forged Engine Parts

a. General. Certain parts of the engine assembly are either forged or cast when manufactured. These parts have identification numbers which are stamped or cast on each part and located as listed in table II.

Table II. Location of Casting Identification Number on Cast and Forged Engine Parts

Part name	Location of number	Identification No.
Cylinder block	Lower-rear—left side	1315529–1 (fig. 36).
Clutch housing	Lower-front—right side	1269427–1 (fig. 37).
Crankshaft	Adjacent No–3 main bearing journal.	868929 (fig. 38).
Camshaft	On nonmachined surface between front and second bearing surfaces.	1311807.
Exhaust manifold	Center bottom	620954.
Intake manifold	Center front	1066051.
Water pump	Shaft housing	637437.
Cylinder head	Stamped on machined water outlet boss.	1320136 (fig. 39).
Thermostat housing	Side of housing	1820130.
By-pass elbow	Side of elbow	1520137.
Connecting rod	Rod strut	954408.
Pistons	Inside of skirt	871345.
Timing gear	Outside of spoke	16460.
Oil pan front end oil seal plate.	Front—left side	1113161.
Oil pump	Housing (near top)	1314611.
Clutch release bearing sleeve.	Sleeve (near edge)	581500.
Carburetor air cleaner elbow.	Longest side of elbow	1268923.

b. Use of Table. The above table contains a list of the forged and cast parts on which casting identification numbers are used. These parts are primarily for use in the T–245 (DODGE) engine and by consulting this table when assembling the engine, mistakes can be avoided.

Note. The above numbers are not part numbers, and must not be used when ordering parts.

Section IV. REBUILD OF CYLINDERS, CRANKSHAFT, AND FLYWHEEL

38. Cylinder Block and Cylinder Head

a. General. Use volatile mineral spirits or dry-cleaning solvent to remove all oil and grease from the cylinder block. Remove all expansion plugs and flush sludge and corrosion particles from the water jackets. Remove all oil tube connectors and plugs and clean passages by forcing steam through each opening until it flows without restriction. Then, blow out passages with compressed air until thoroughly dry. Replace oil passage plugs and tube connectors. Inspect cylinder

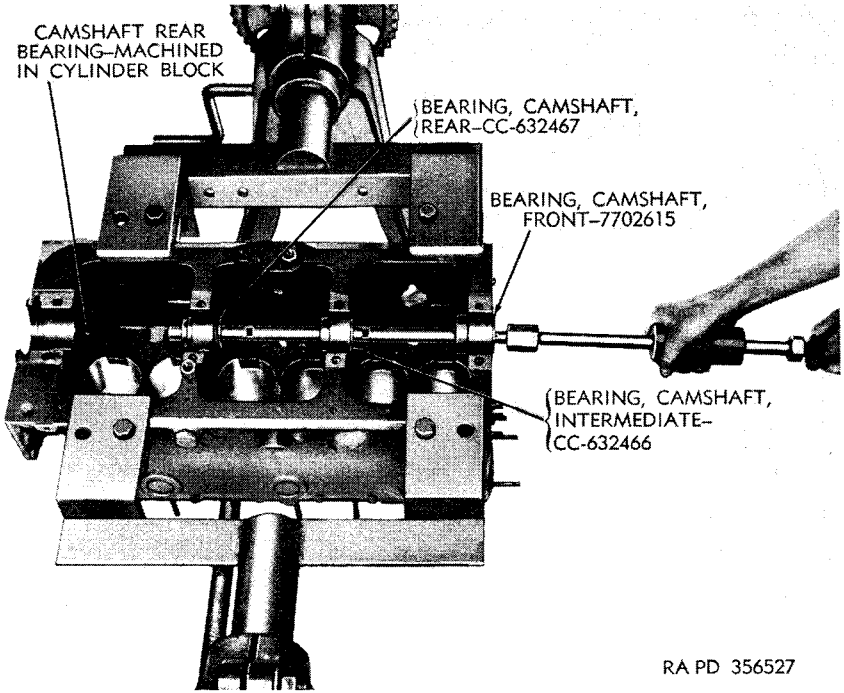


Figure 35. Removing camshaft bearings with remover and installer—41–R–2386.

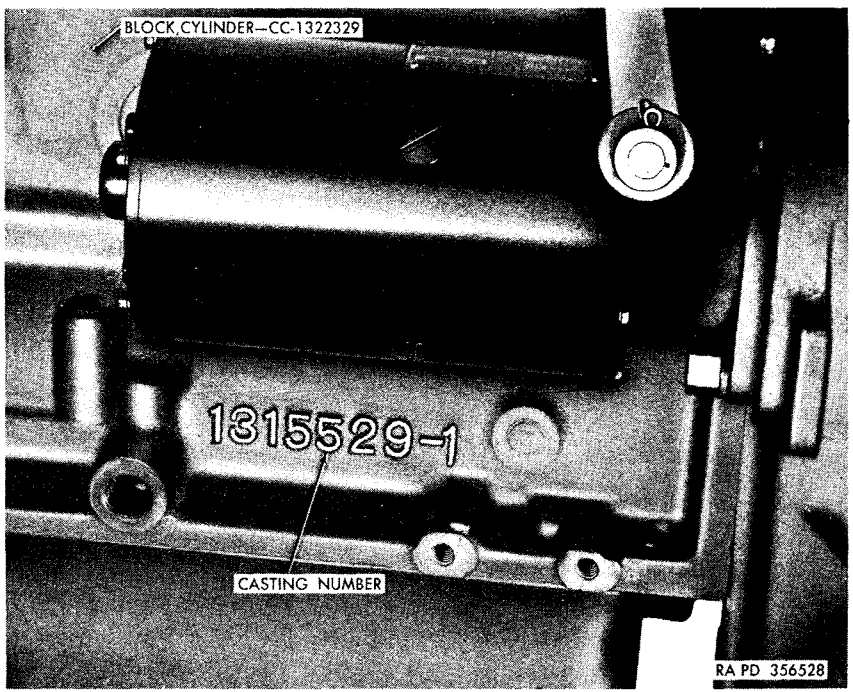


Figure 36. Cylinder block casting number.

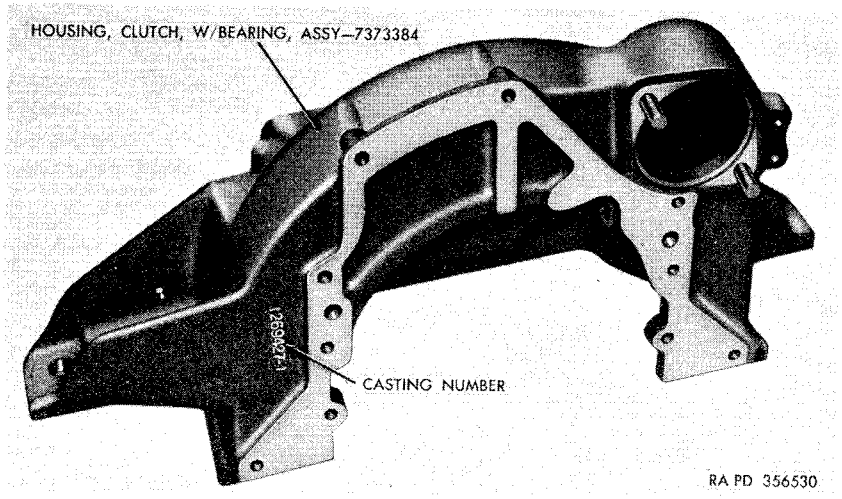


Figure 37. Clutch housing casting number.

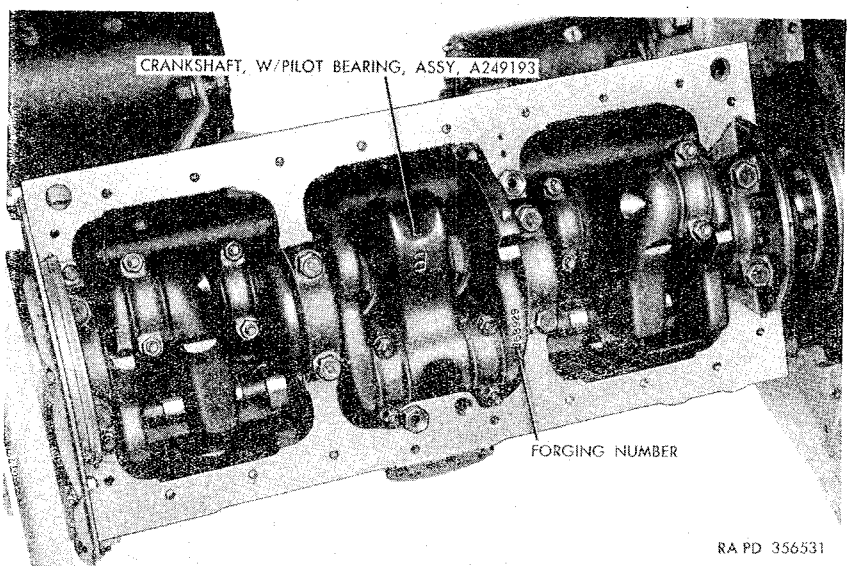


Figure 38. Crankshaft forging number.

block for cracks, including the main bearing supports. If crack is found in cylinder bore or valve seat, or in such a location that a satisfactory welding job cannot be done, replace the cylinder block (fig. 40).

b. Rebuild Cylinder Block.

(1) *Checking cylinder bores.* The cylinder bores should be checked for out-of-round and taper with cylinder gage dial type 41–G–122 (fig. 41). Check each cylinder bore at the top, bottom, crosswise, and lengthwise to determine if any

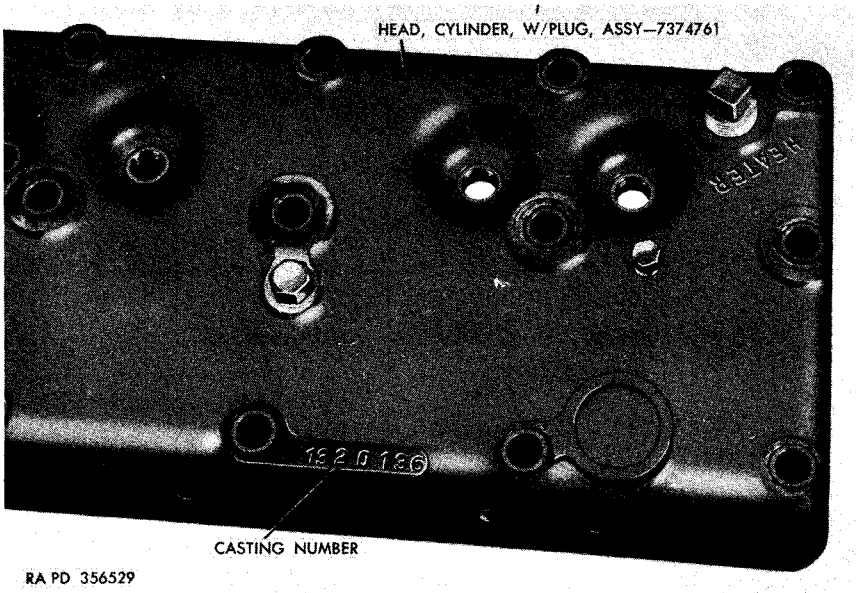


Figure 39. Cylinder head casting number.

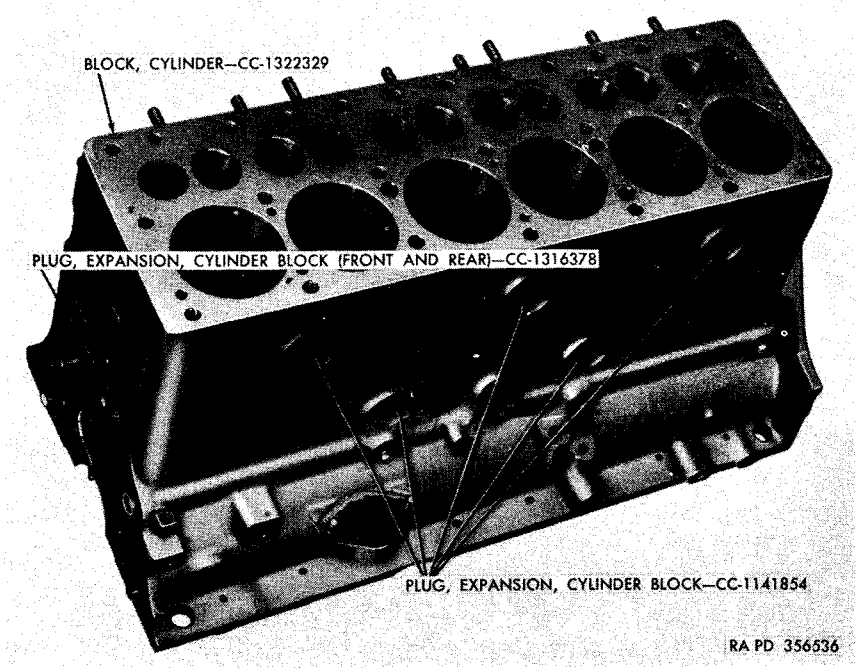


Figure 40. Cylinder block.

variation exists. If out-of-round or taper exceeds wear limits in repair and rebuild standards (par. 62), cylinders must be rebored.

(2) *Check crankshaft bearing bore diameter.* Install the main bearing caps and tighten the cap screws just enough to hold the caps snug. With a light composition hammer, tap each cap back and forth until the mating surface of the cylinder block and cap is exactly even. Then, tighten the cap screws to 80 to 85 pound-feet with a torque wrench and measure the diameter of the bearing bores with a micrometer caliper set 41–C–304 (fig. 41). If the diameter of a bearing bore is less than 2.6565 inch, replace the cylinder block as the bearing cap has been filed or excessively dressed down. Never dress down a bearing cap to reduce bearing clearance.

(3) *Inspect gasket surfaces of cylinder block and head.* Lay a straightedge across and lengthwise of the gasket surfaces of the cylinder block (fig. 42). With a 0.008-in. feeler gage, check for the low spots in the surface around the combustion chambers. If the feeler gage can be passed between the straightedge and the top surface of the cylinder block, resurface the part until it is just flat. Do not remove more than 0.010 inch, as metal removed from the gasket surface alters the compression ratio of the engine. Also lay a

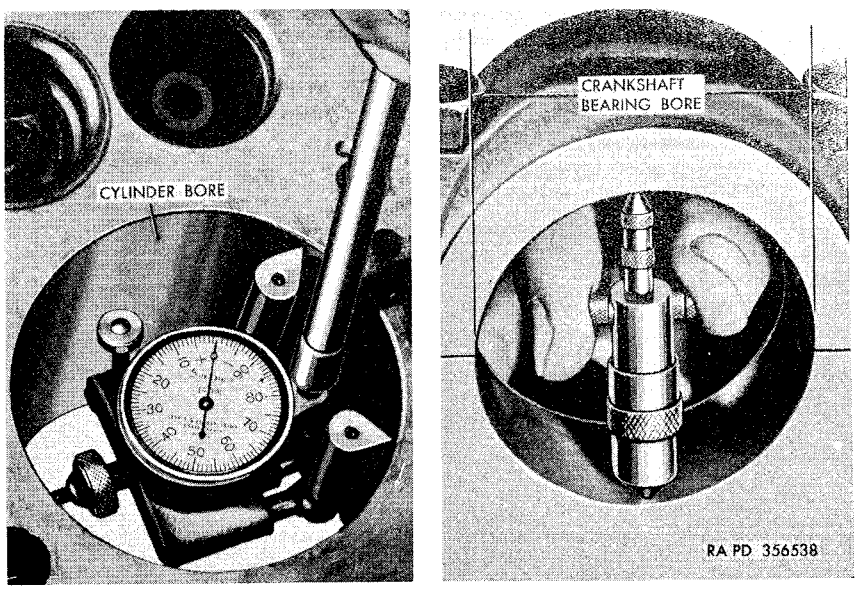


Figure 41. Checking cylinder bore using cylinder gage, dial type 41–G–122 and crankshaft bearing bore diameter using micrometer caliper set 41–C–304.

straightedge on the gasket surface of the cylinder head (fig. 43) and with a feeler gage, check for low spots. If variations exceed 0.004-inch per foot of length, resurface the head assembly, but remove a minimum amount of material only.

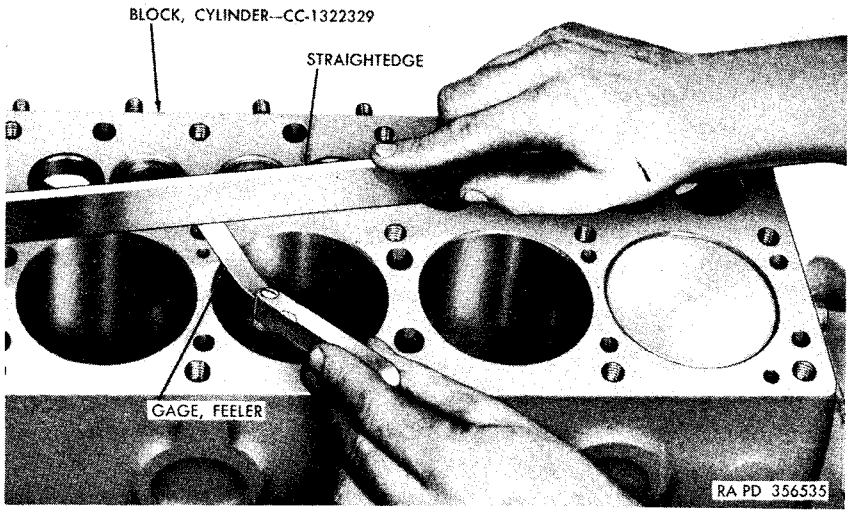


Figure 42. Checking cylinder block gasket surface.

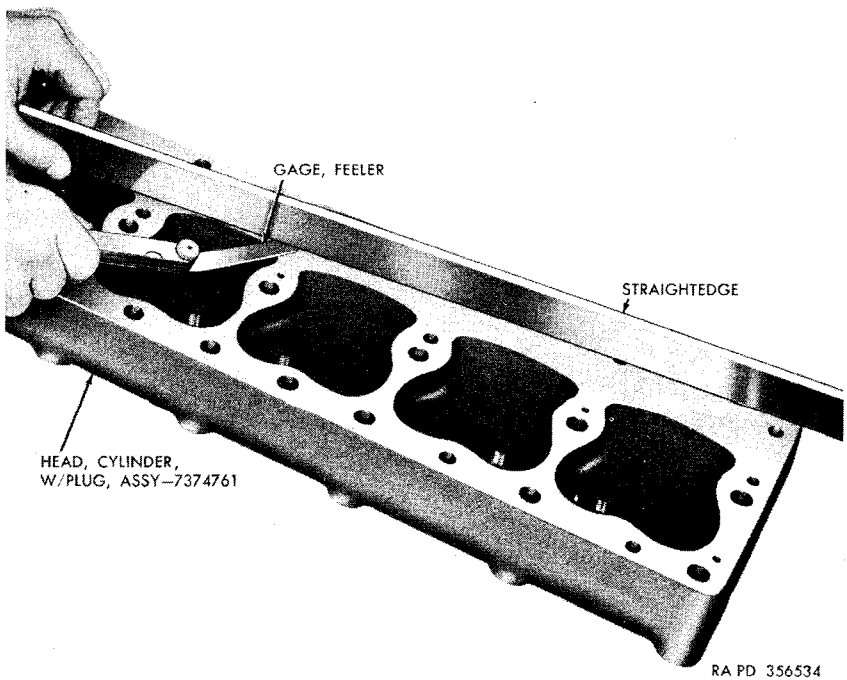


Figure 43. Checking cylinder head gasket surface.

(4) *Reboring cylinders* (fig. 44). If cylinder bore is out-of-round or taper exceeds wear limits in repair and rebuild standards (par. 62), or is scored, the bore should be reconditioned for an oversize piston. Cylinders may be rebored to 0.060-inch oversize, if required. If crankshaft has not been removed when reboring, the connecting rod journals

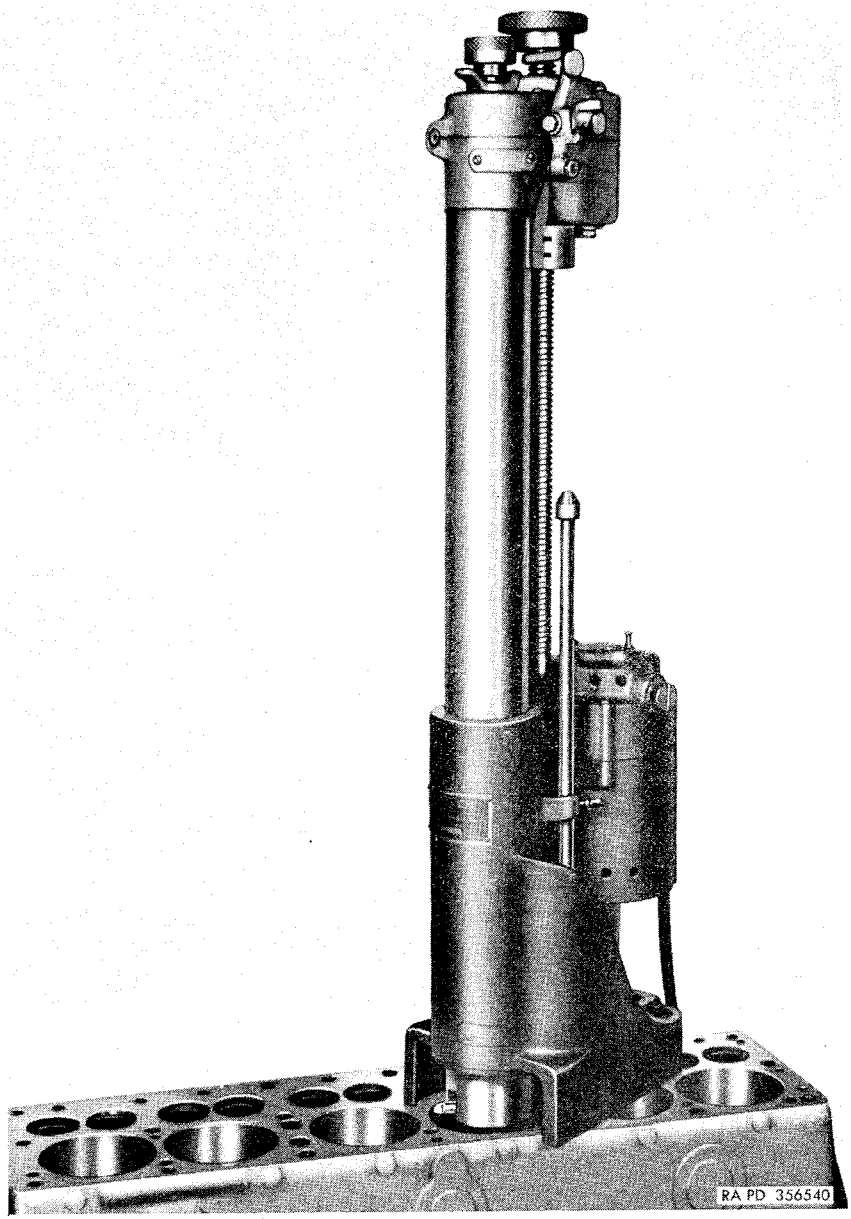


Figure 44. Reboring cylinders.

should be taped during the reboring operation. Bore to within 0.001 inch of the finished size; then hone to a smooth bright finish with a 400-grit stone to assure satisfactory ring life.

(5) *Honing cylinder bores.* To remove light scoring, scuffing, or scratches from the cylinder walls, a cylinder hone can be used with good results. Usually one or two passes will clean up a cylinder bore and maintain required limits. After using a hone, make sure that all trace of abrasive is cleaned from the engine.

(6) *Install expansion plugs* (fig. 45). Before installing a new expansion plug, clean the plug seat and remove any sharp edges or irregularities from the plug. Coat counterbore with plastic type gasket cement and install plug with curved face to the outside. Then, expand the plug in the counterbore with a blunt drift approximately the same diameter as the plug and a hammer, until it is firmly seated.

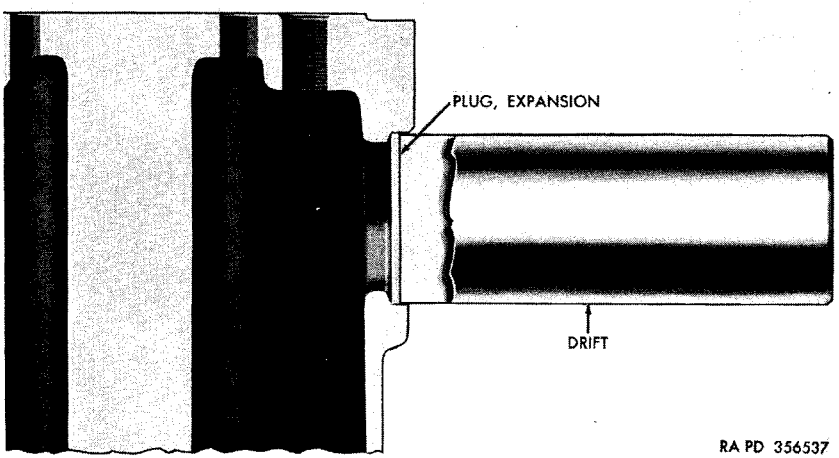


Figure 45. Installing expansion plug.

(7) *Exhaust valve seat inserts* (fig. 46). Because of the hardness of the special inserts used in the exhaust valve seats, it is impossible to recut them. They must be reground with a high speed valve grinder. Use a 45° angle high speed stone for grinding. The desired seat width is one-sixteenth of an inch. If greater than three-thirty-seconds of an inch, reduce with a 20° stone at the top or a 60° stone at the bottom, as seating surface must be in center of valve face. Always inspect the inserts for cracks, damage, or looseness in the cylinder block. If damaged or loose, the insert should be

removed with remover 7950045 (fig. 47). To remove an insert, place the remover assembly on the cylinder block and position the remover jaw head so that the top surface of the head will be exactly in line with the ¼-inch mark on the side of the remover body. Hold the remover jaw head in this position and turn the remover screw in a clockwise direction until the remover jaws are firmly embedded in position. It is essential that the remover screw be securely tightened. Then, pull the insert from the cylinder block by holding the remover screw in a stationary position with a wrench and turning the remover screw nut in a clockwise direction. Before installing a new insert, use a flat end drift and hammer to correct any roughness or mutilation of the counterbore in the cylinder block. The new insert should be installed with replacer 41–R–2400–720 (fig. 48). If an 0.010-inch oversize insert is to be installed, cut the counterbore with a valve seat insert replacing tool 41–T–3383, 0.002- to 0.004-inch smaller in diameter than the insert which is to be installed. The inserts must be fitted very tightly but can easily be installed in the cylinder block after chilling the insert and the replacer with dry ice to obtain maximum contraction.

Caution: Always wear gloves when handling insert and replacer after chilling with dry ice.

Valve seat inserts are available in standard and 0.010-inch oversize.

(8) *Intake valve seats.* The intake valve seats in the cylinder block should be reconditioned, when necessary, with a high

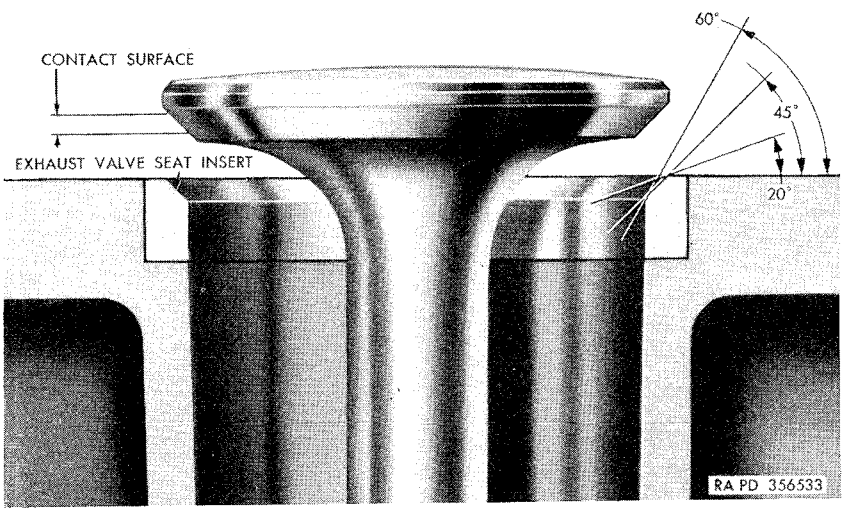


Figure 46. Exhaust valve seat insert.

Figure 47. Removing valve seat insert.

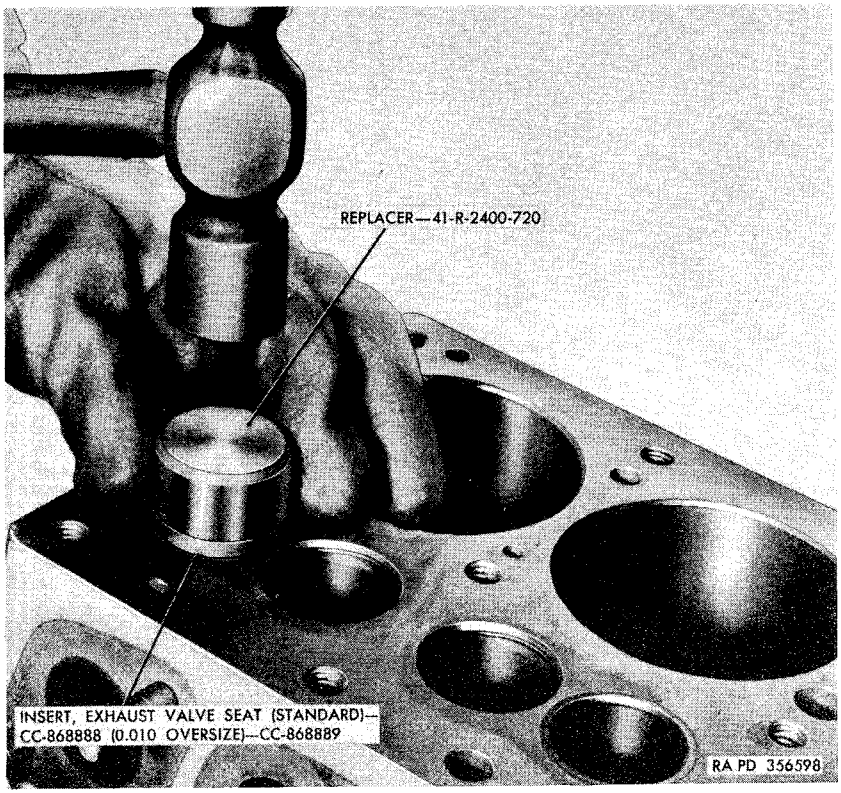


Figure 48. Installing exhaust valve seat insert.

speed grinder in the same manner as indicated for the exhaust valve seats. The seats should be ground only enough to remove pits or other depressions. Valves and seats should then be lightly lapped together with valve grinding compound.

Note. Care must be taken to make certain that all grinding compound is removed from the valve, valve seat, intake ports, and cylinder block. Valves should be refaced whenever reconditioning is required, to insure a smooth leak proof contact with the seat.

c. Installation of Cylinder Head. Always use a new cylinder head gasket when installing the cylinder head. Coat both sides of the gasket with a light, high temperature nonfibre grease. Make sure the cylinder head and block are clean. Install all brackets retained by cylinder head screws. Tighten cylinder head bolts in sequence (fig. 49), drawing all bolts down evenly with a torque wrench to 65 to 70 pound-feet. A final tightening and checking of tension should be made after the engine has reached its normal operating temperature. Install all clips and parts that are retained by screws in the tapped head cap screws.

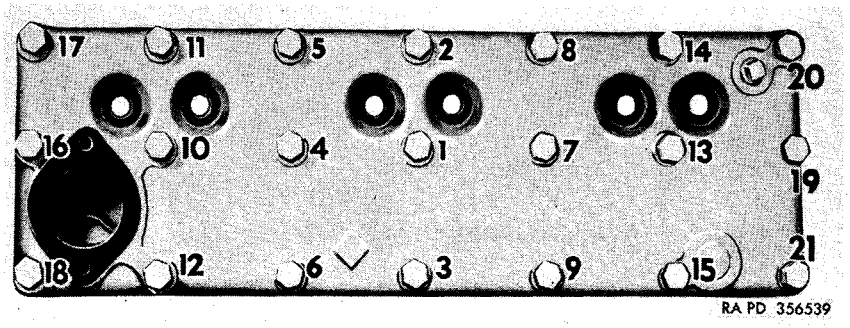


Figure 49. Cylinder head tightening sequence.

d. Cylinder Sleeves. If, for any reason, cylinder sleeves are to be installed in the cylinder bores, the instructions of the cylinder sleeve manufacturer should be followed. Sleeves made of hardened iron with $^{3}/_{32}$-inch wall thickness should be used. The sleeves must be installed with an approximate 0.001- to 0.002-inch interference fit, and finished to size after installation.

39. Crankshaft, Main Bearings, and Flywheel

a. Remove Crankshaft. Before removing the crankshaft, be sure to prick punch the two intermediate crankshaft bearing caps and the cylinder block (fig. 50) so that the caps can be installed in their original position. Remove crankshaft (par. 36*l*). If replacement of the

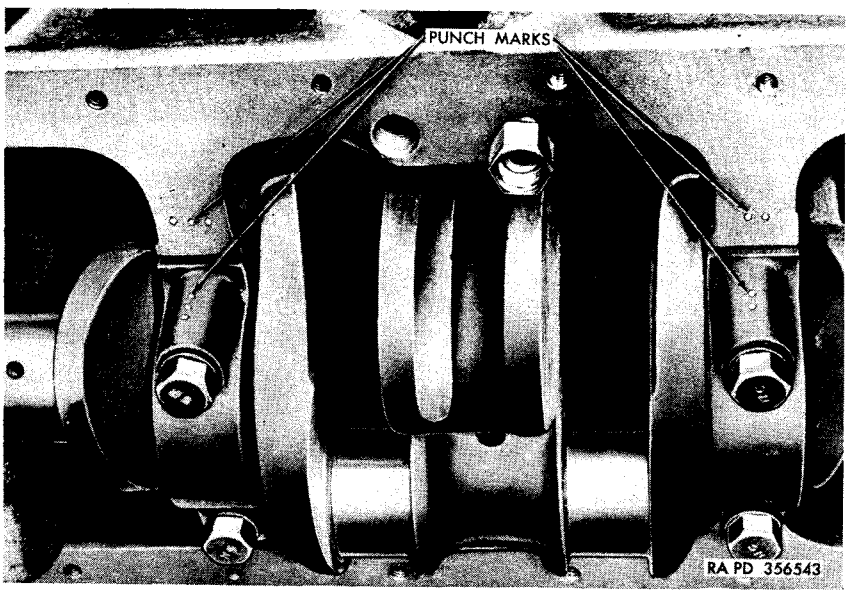


Figure 50. Punch marks on cylinder block and crankshaft bearing caps.

crankshaft sprocket (fig. 51) is necessary because of wear or damage, the sprocket can be removed with a universal puller or an arbor press.

b. Inspect and Repair Crankshaft. Thoroughly clean the crankshaft and use a micrometer to measure the main and connecting rod journals for wear. If one or more journals are tapered, out-of-round, or have run out in excess of wear limits in repair and rebuild standards (par. 64), regrind the journals for undersize bearings or straighten. In general, the crankshaft should not be reground in excess of 0.040-inch undersize. When regrinding the journals, maintain bearing fillets with a true radius of three-thirty-seconds of an inch to one-eighth of an inch for connecting rod bearing journals and crankshaft main bearing journals (fig. 52). Inspect the clutch pilot bearing, located in the rear end of the crankshaft, and replace the bearing if rough or badly worn. Use replacer 41–R–2387–350 (fig. 53), to burnish the new bearing to size. Never attempt to ream the bearing to size.

c. Inspect Main Bearings. Remove each main bearing half and check for scores or cracks in the bearing metal. If damaged in any manner, the bearing (two halves) should be replaced.

d. Install Upper Front and Rear Main Bearing Halves and Crankshaft, The upper front and rear main bearing halves have oil holes

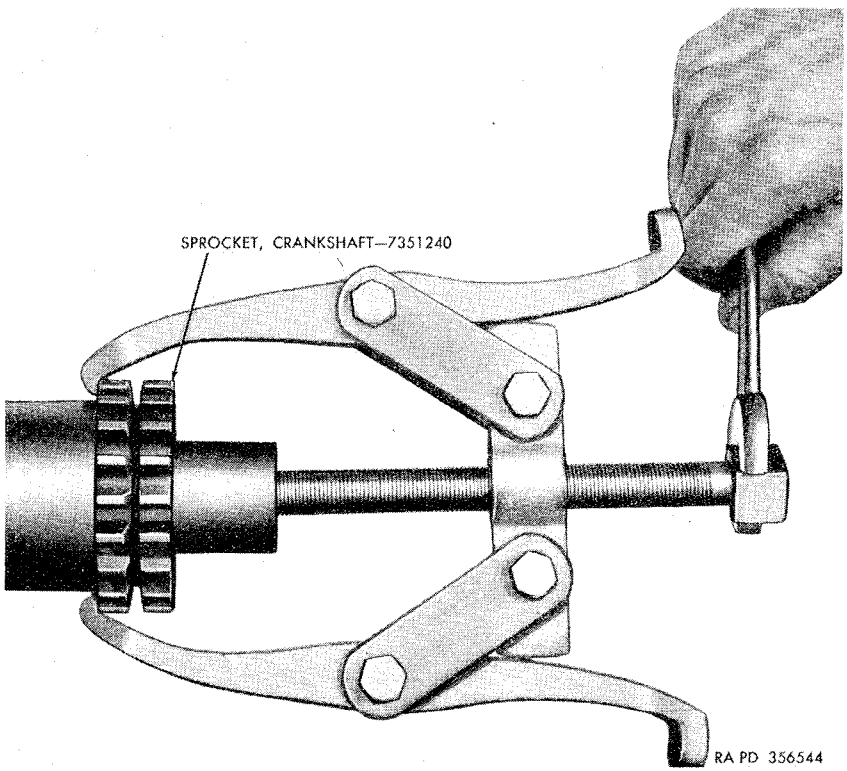


Figure 51. Removing crankshaft sprocket.

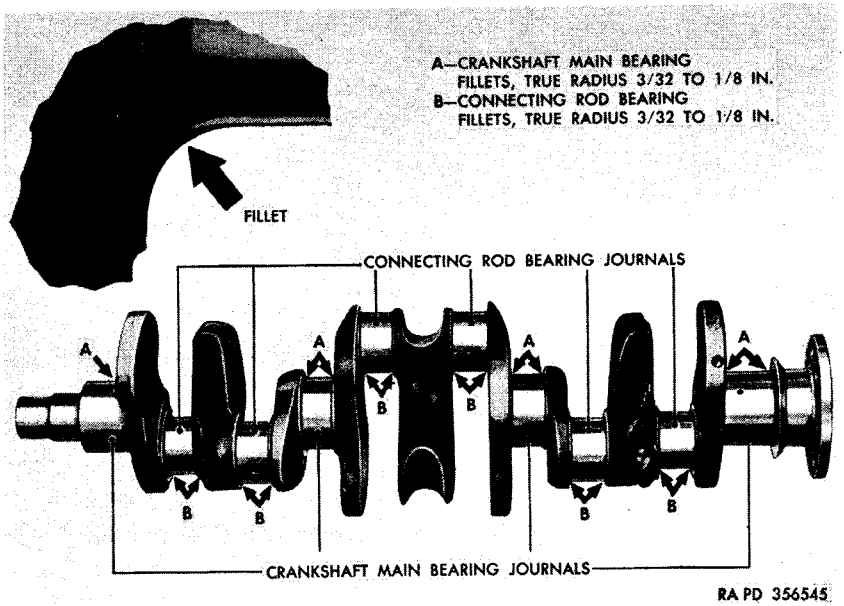


Figure 52. Chankshaft bearing fillets.

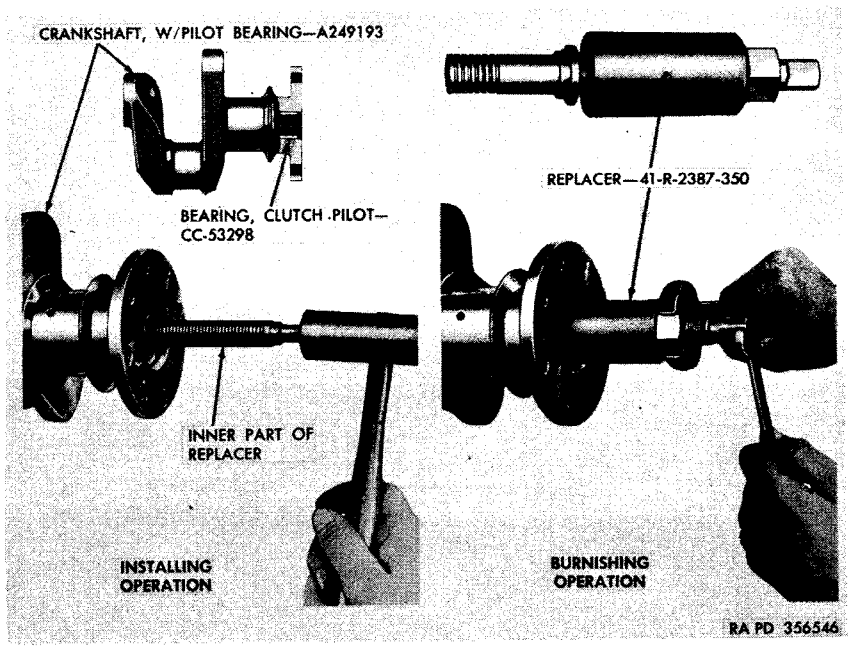


Figure 53. Installing clutch pilot bearing.

while the lower halves do not (fig. 54). Both halves of the intermediate bearings are the same. Install the upper halves of the bearing in the cylinder block and make certain that all bearing halves are

drilled for the distribution of oil. The bearing halves should snap into both the cylinder block and caps. If they are too loose or too tight, abnormal friction between the crankshaft and bearings may occur which will result in premature fatigue failure of the bearing metal. If necessary, reshape the bearing halves with a light composition or rubber hammer (fig. 55). Coat the bearings with engine oil and position the crankshaft in the cylinder block. Install new rear main bearing oil seals and rubber gaskets. Install bearing halves in caps, and install caps and attaching screws.

Note. The two intermediate bearing caps are machined off center and damage will result if they are installed wrong.

In the event that the intermediate caps were not prick punched when the crankshaft was removed, they can be properly installed by referring to the casting numbers on the caps. These numbers are located close to one side of the cap, and the cap must always be installed so that the numbered side will face toward the rear or flywheel end of the engine. Tighten screws until caps are just seated and tap caps from side to side with a light composition hammer until crankshaft rotates freely; then tighten screws to 80 to 85 pound-feet with a torque wrench.

e. Checking Main Bearing Clearance (fig. 56). Refer to repair and rebuild standards (par. 63) for desired main bearing clearance

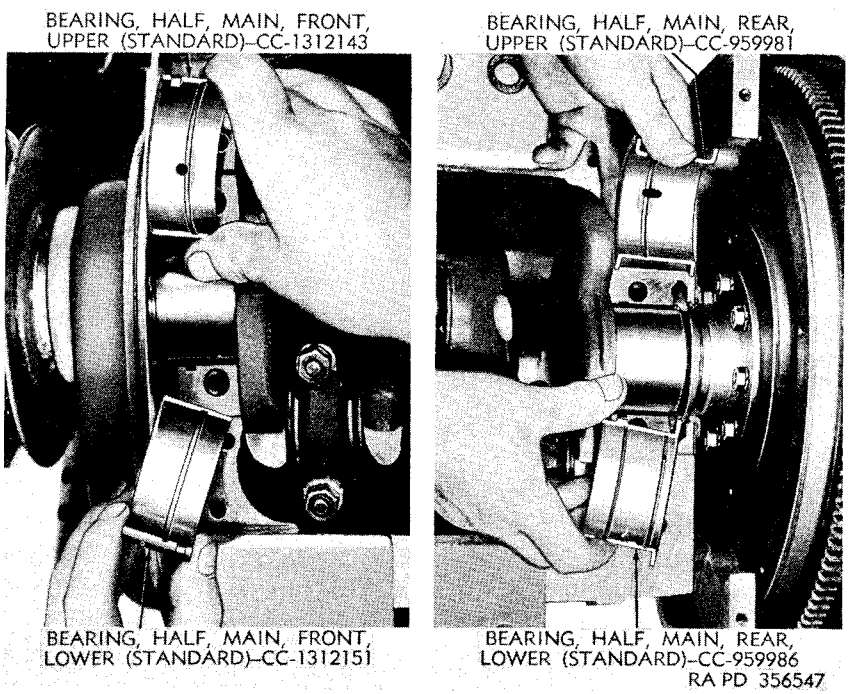


Figure 54. Front and rear main bearing halves.

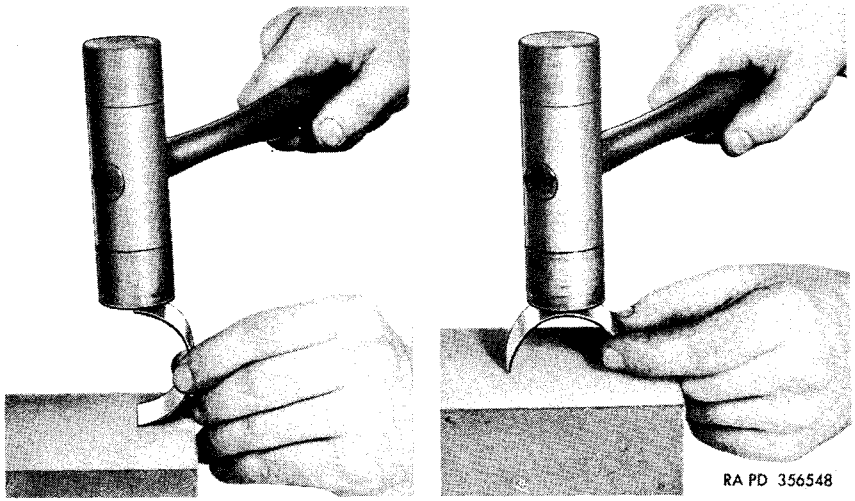


Figure 55. Reshaping bearing half.

and maximum allowable limit. Clearance should be checked by taking each main bearing, one at a time, and removing the bearing cap. Place a piece of 0.0015-inch brass shim stock, ¼-inch wide by 1-inch long, parallel or crosswise on the babbitt surface of the bearing. Make certain the shim does not interfere with the crankshaft journal fillet, and that the edges of the shim are smooth. With cap in position, tighten cap bolts to 80 to 85 pound-feet with a torque wrench.

Note. To avoid imbedding the shim in the bearing, thus causing distortion of the babbitt and resulting in bearing failure, always start the check with a shim no thicker than 0.0015 inch and do not rotate crankshaft more than one-quarter turn in either direction if a heavy drag is apparent.

However, if the drag is not excessive, the crankshaft may be rotated slowly by hand to determine if the amount of resistance varies. If there is a noticeable difference in the drag as the crankshaft is rotated, the journal should be measured to determine if it is within allowable repair and rebuild standards (par. 64). With oil on the crankshaft bearing journal and the 0.0015-inch thickness shim in place between the babbitt surface of the bearing and journal, a heavy drag indicates ideal clearance. If a heavy drag is not apparent, remove the 0.0015-inch shim and repeat the test with a 0.004-inch shim. With the 0.004-inch shim in place, if a heavy drag is not apparent as the crankshaft is rotated, thicker wall bearing inserts will be required to reduce the clearance until a heavy drag is evident with the 0.0015-inch shim test. Replacement bearings are available in the following undersizes: 0.002, 0.010, 0.020, 0.030, and 0.040 inch.

f. Checking Crankshaft End Play (fig. 57). The thrust of the crankshaft is taken by the rear main bearing, which also controls end play. Mount a dial gage so that it will rest against the crankshaft

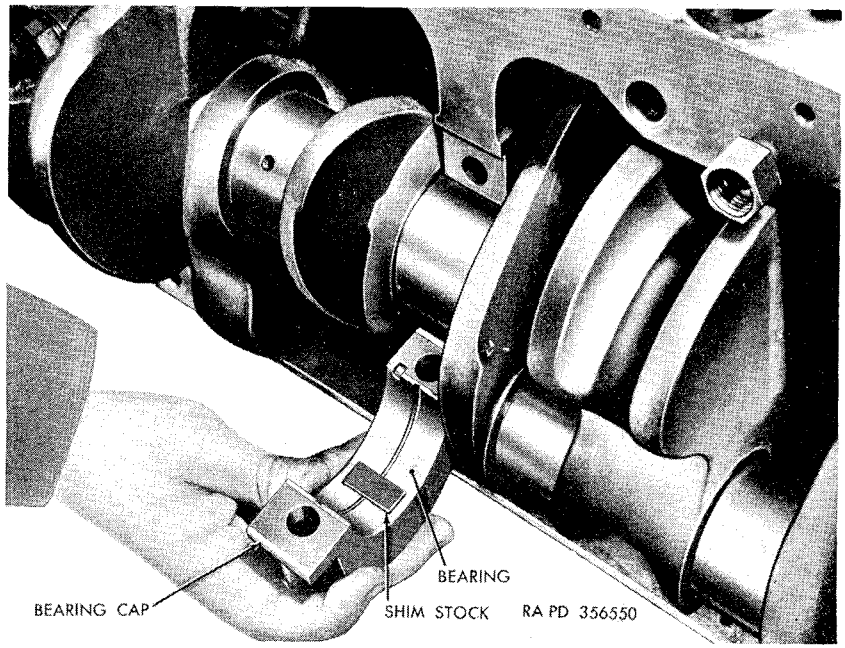


Figure 56. Checking main bearing clearance.

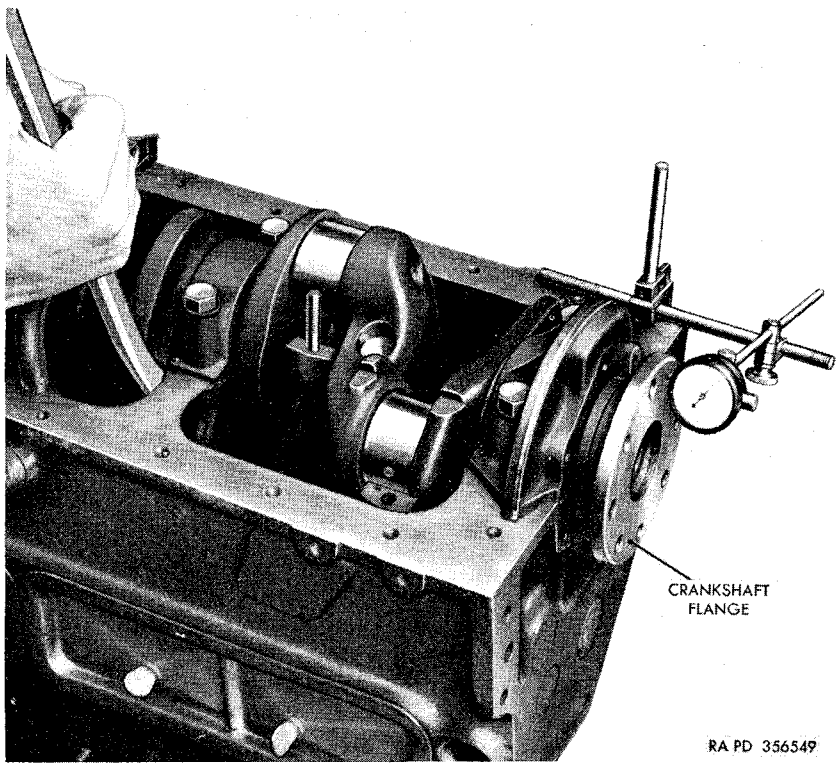


Figure 57. Checking crankshaft end play.

flange or vertical surface and check end play by prying the crankshaft back and fourth.

g. Inspect, Repair, and Install Flywheel (fig. 58). Inspect the teeth of the flywheel ring gear and, if damaged, replace the ring gear. Inspect the clutch surface of the flywheel and, if rough or damaged, replace the flywheel. If replacement of the ring gear is necessary, cut the old ring gear with a chisel and remove it from the flywheel. Clean ring gear recess in flywheel thoroughly. Heat the new ring gear to 600° F. Place the ring gear over the recess in the flywheel and allow it to shrink.

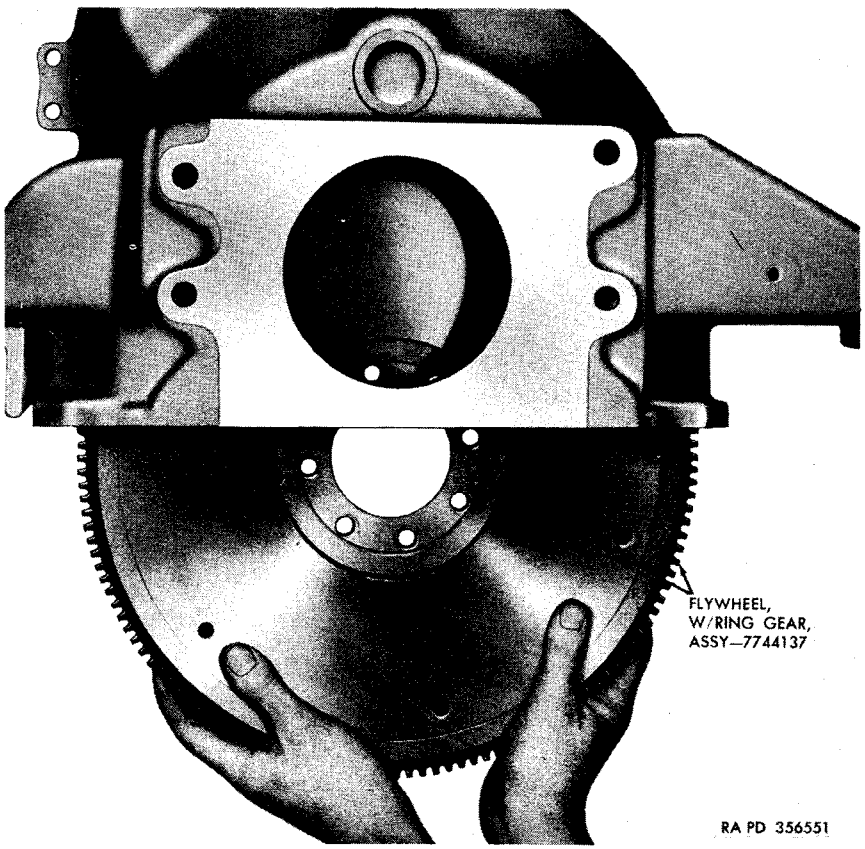


Figure 58. Installing flywheel.

Section V. REBUILD OF CONNECTING RODS, PISTONS, PISTON RINGS, PISTON PINS, VALVES, VALVE TAPPETS, AND CAMSHAFT

40. Connecting Rods and Bearings

a. Inspect Connecting Rods and Bearings. Remove the connecting rod cap bolt nuts and the bearing caps. Remove the bearing inserts

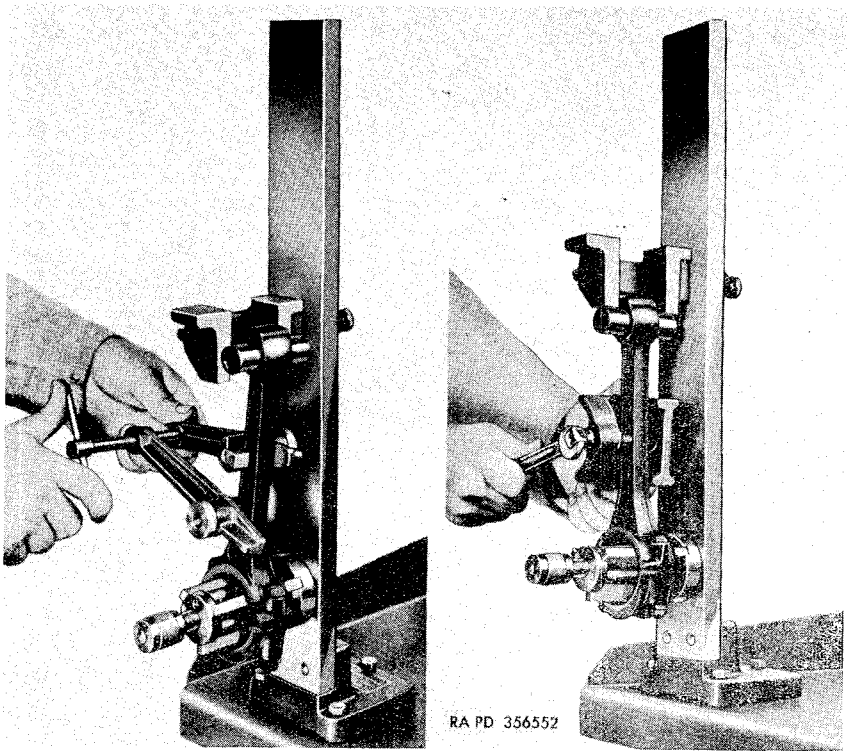


Figure 59. Connecting rod aliner 41–A–135.

and check for scores or cracks in the bearing metal. If bearing insert is damaged in any manner, it must be replaced. Check connecting rod with connecting rod aliner 41–A–135 (fig. 59). If rod is bent or twisted more than 0.0015 inch per inch of length, use a connecting rod press to straighten the rod.

b. Install Connecting Rod Bearings. Connecting rod bearing halves are easily replaced after removing the caps. Replacement bearing halves require no reaming or fitting. The inserts must always be installed so that the small formed lug on the insert lines up with the machined grooves in the connecting rods. This applies to both bearing halves. The bearing halves should snap into both the connecting rods and caps. If too loose or too tight, abnormal friction between the crankshaft and bearings may occur which will result in premature fatigue failure of the bearing metal. If necessary, reshape the bearing halves (fig. 55) with a light composition or rubber hammer.

c. Checking Connecting Rod Bearing Clearance. Refer to repair and rebuild standards (par. 69) for desired connecting rod bearing clearance and the maximum allowable limit. To determine if clearance is within these limits, take each connecting rod, one at a time, and remove cap. Place a piece of 0.0015-inch brass shim stock, ¼-inch

wide by 1-inch long, parallel or crosswise on the babbitt surface of the bearing. Make certain the shim does not interfere with the crankshaft journal fillet, and that the edges of the shim are smooth. With cap in position, tighten cap bolt nuts to 45 to 50 pound-feet with a torque wrench.

Note. To avoid imbedding the shim in the bearing, thus causing distortion of the babbitt resulting in bearing failure, always start the check with a shim no thicker than 0.0015 inch and do not rotate crankshaft more than one-quarter turn in either direction if a heavy drag is apparent.

However, if the drag is not excessive, the crankshaft may be rotated slowly by hand to determine if the amount of resistance varies. If there is a noticeable difference in the drag as the crankshaft is rotated, the journal should be measured to determine if it is within repair and rebuild standards (par. 64). With oil on the crankshaft bearing journal and the 0.0015-inch thickness shim in place between the babbitt surface of the bearing and journal, a heavy drag indicates ideal clearance. If a heavy drag is not apparent, remove the 0.0015-inch shim and repeat the test with a 0.004-inch shim. With the 0.004-inch shim in place, if a heavy drag is not apparent as the crankshaft is rotated, thicker wall bearing inserts will be required to reduce the clearance until a heavy drag is evident with the 0.0015-inch shim test. If journals are worn enough to increase bearing clearance beyond specifications, the crankshaft journals should be reground and fitted with new bearings, which are available in the following undersizes: 0.002, 0.010, 0.020, 0.030, and 0.040 inch.

Note. Never install an undersize bearing that will reduce the minimum clearance below specifications, listed in paragraph 69.

41. Pistons, Piston Rings, and Piston Pins

a. Inspect Piston and Piston Rings (fig. 60). Install piston in piston vise, and remove piston pin. Remove piston rings and thoroughly clean carbon from piston ring grooves. Also clean carbon from oil return holes. Replace piston if cracked or scored. Check ring side clearance in grooves with new piston rings. If the side clearance exceeds the maximum repair and rebuild standards clearance (par. 71) for oil rings, replace the piston.

b. Fitting Pistons to Cylinder Bores. If the cylinders have been rebored, select pistons and check the clearance using 0.002-inch feeler stock, ½-inch wide and long enough to extend down into the bore to the full length of piston travel. Insert the piston (fig. 61) in cylinder bore, upside down, with the feeler stock installed between the thrust side of the piston skirt and the cylinder wall. Draw out feeler stock with spring scale. The amount of pull required to withdraw feeler stock should be between five and seven pounds. Pistons should always be fitted at normal room temperature of 70° F. Fin-

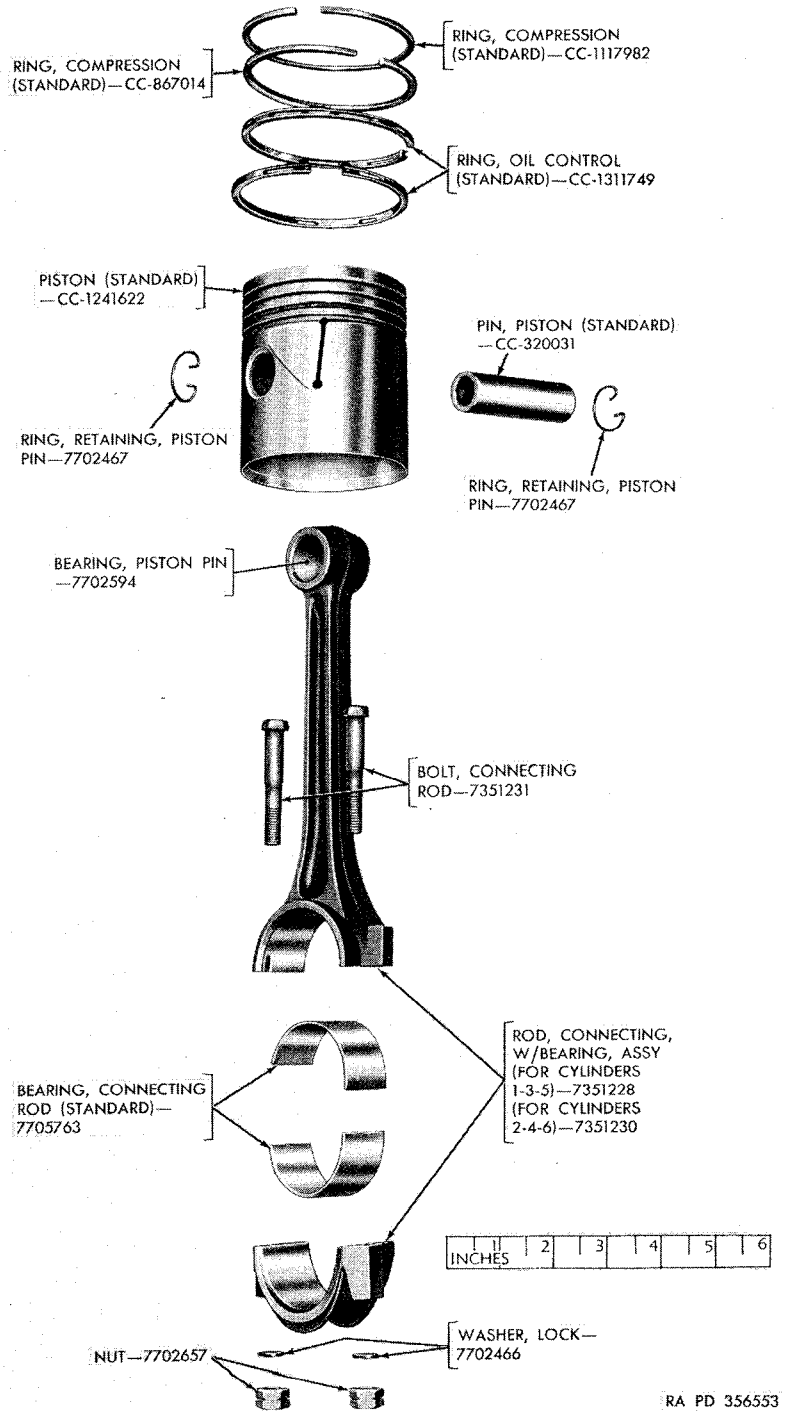


Figure 60. Piston and connecting rod assembly—exploded view.

Figure 61. Fitting piston to rebored cylinder.

ished pistons are available in standard size and oversizes of 0.020, 0.030, 0.040, and 0.060 inch.

c. Fitting Piston Rings. Piston rings are available in the following sizes: standard to 0.009, 0.020 to 0.029, 0.030 to 0.039, 0.040 to 0.049, and 0.050 to 0.060 inch. Select ring set to be used after measuring cylinder bore diameter with a dial gage. Place the ring squarely in the cylinder bore about two inches from the bottom, and measure the end gap with feeler gage. Refer to repair and rebuild standards (par. 71) for proper end gap clearance and clearance of rings in piston groove. Use a piston ring applier 41–A–329–500 (fig. 62) to install rings on piston, making sure that each piston ring (fig. 63) is installed in the proper groove.

d. Inspect and Fit Piston Pins. Measure the piston pin with a micrometer, and it the diameter exceeds that in repair and rebuild standards (par. 70), replace the pin. Fit piston pin in the piston pin bearing (fig. 60) and the piston with a tight thumb press fit at normal room temperature of 70° F.

Note. All replacement pistons are now supplied with properly fitted standard size piston pins. For this reason, when installing a new piston and pin, a new bearing should be installed in the connecting rod. Hone or diamond bore the new bearing until pin is a tight thumb press fit at normal room temperature. Always heat a new piston before removal or installation of the pin to prevent distortion of the piston skirt.

Figure 62. Installing piston rings with piston ring applier 41–A–329–500.

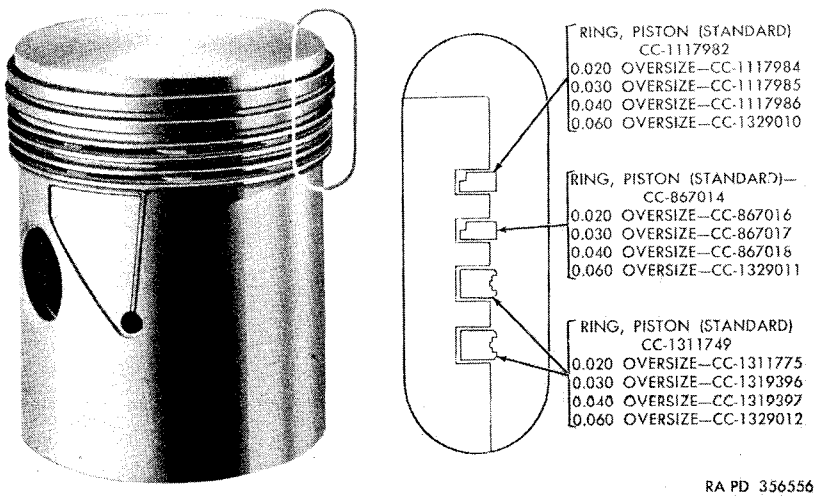


Figure 63. Piston rings installed on piston.

e. Assemble Pistons and Connecting Rods. The pistons and connecting rods should be assembled at normal room temperature of 70° F. Place the upper end of the connecting rod in the piston with the small oil hole in the lower end of the rod opposite the slotted side of the piston. Insert the piston pin through the piston and piston pin rod bearing. Install a *new* piston pin retaining ring in the piston at each end of the pin. Install the piston rings with piston ring applier.

f. Install Piston and Connecting Rod Assemblies. Coat the piston and rings with engine oil and space the ring gaps so that they are 90° apart. Install the piston ring compressor over the rings so that the flared edge of the compressor contacts the cylinder block. Install the piston in the cylinder with the oil hole in large end of the connecting rod toward the valve side of the engine. Connecting rods for numbers 1, 3, and 5 cylinders are offset in one direction and numbers 2, 4, and 6 are offset in the opposite direction. Each rod must, therefore, be installed in its original position, or if one or more new connecting rods are to be used, be sure each rod has the proper offset for the cylinder in which it is to be installed (fig. 64). Clean the bores of the connecting rods and the bearing caps thoroughly, install the bearing halves, and attach the connecting rods to the crankshaft using new lock washers. Tighten the nuts securing the bearing caps 45 to 50 pound-feet with a torque wrench.

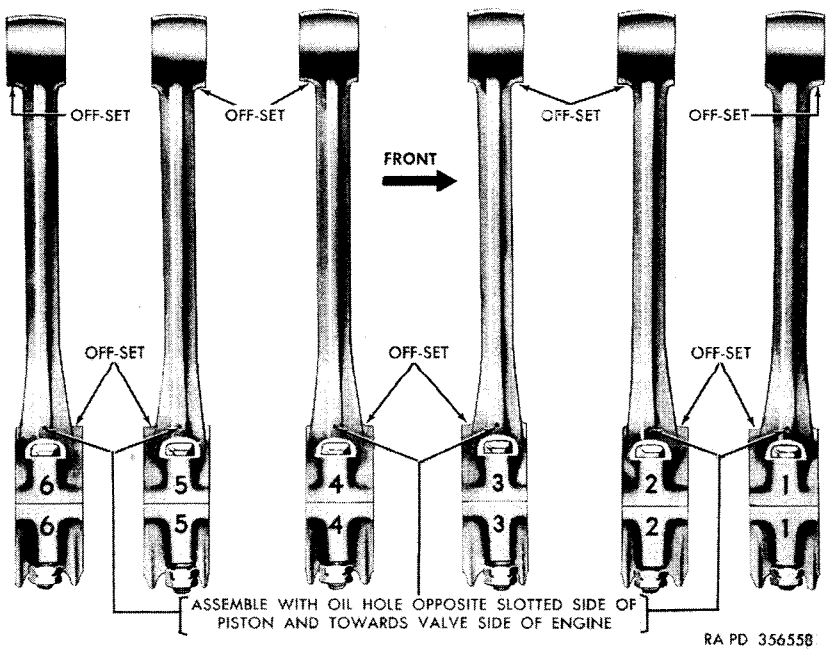


Figure 64. Connecting rod sequence.

42. Valves, Valve Compression Springs, Valve Stem Guides, Valve Tappets, and Camshaft

a. Inspect Valves. Whenever the cylinder head has been removed, check the condition of the valves; then replace or repair, as required.

b. Replace Valves. If the valve head is badly burned, checked or warped, replace the valve. The valve stem diameter must be measured in several places with a micrometer, and if it exceeds the repair and rebuild standards (par. 68) the valve must be replaced. The exhaust valve is relieved at the top of the stem to prevent the possibility of sticking in the guide. The intake valve is relieved at the bottom of the stem to prevent oil traveling up the stem.

c. Reface Valves. If the face of the valve is only slightly pitted or worn, and the stem diameter is within specified wear limits, the valve may be refaced. Set the valve refacer at an angle of 45°. Dress the abrasive wheel so that it is smooth and true. Install the valve in the chuck. Do not remove more metal than is necessary to get a smooth even surface. If after refacing, the outside edge of the valve head is less than $\frac{1}{32}$-inch thick, replace valve.

d. Inspect and Test Valve Compression Springs. Wash the valve compression springs in volatile mineral spirits, or dry cleaning solvent, and examine them carefully. If the spring is rusted or etched, it must be replaced. Test the spring for proper tension with a valve compression spring tester. Refer to repair and rebuild standards (par. 68) for spring data. Replace any spring which compressed to either specified length with less than the minimum specified pressure as such a spring will cause inefficient engine performance. All springs must be installed with closed coils at the top in order to prevent valve flutter at high speeds.

e. Inspect Valve Stem Guides. Clean the interior of the valve stem guide with a wire brush and dry cleaning solvent or volatile mineral spirits. Place the valve in the guide with the head five-sixteenths of an inch above the top of the cylinder block. Use dial indicator and adjust the plunger of the indicator against the edge of the valve head (fig. 65). Hold the valve so that it will not turn and move the valve toward and away from the indicator and note the amount of play shown by the indicator. This check should be made by moving the valve crosswise of the surface of the block. The clearance between the valve stem and the guide will be approximately one-half the dial indicator reading for the intake valves and 0.44 of the reading for the exhaust valves. If the calculated clearance exceeds the repair and rebuild standards (par. 68), replace the guides.

f. Remove Valve Stem Guides (fig. 66). The valve stem guides may be removed without removing the valve tappets with screw assemblies. Use drift 41–D–1547–350 and drive valve stem guide down until it just clears the valve tappet. Then, remove drift and break

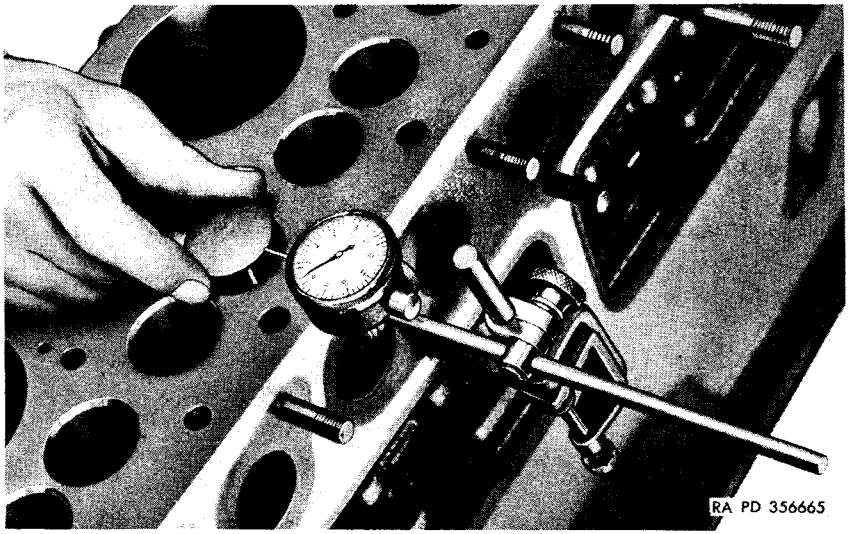


Figure 65. Checking valve stem clearance in guide.

off guide with a sharp blow of a hammer. Reinsert drift and drive out remainder of guide. Remove broken guide.

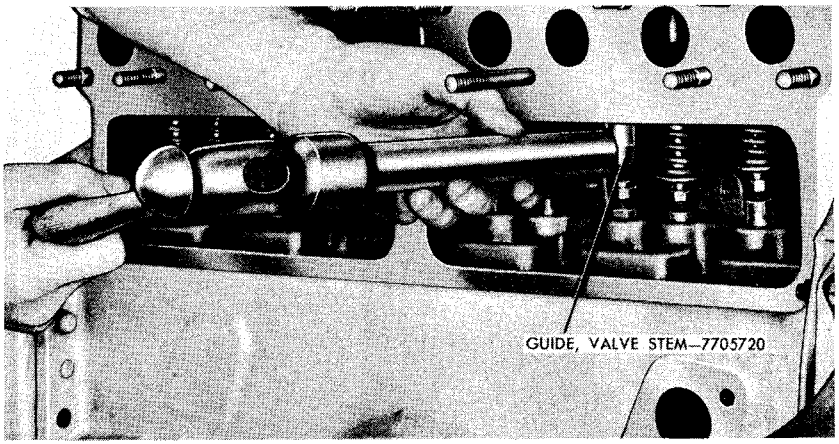
g. Install Valve Stem Guides (fig. 67). Wipe the exterior of the valve stem guide clean and blow out opening in the cylinder block with compressed air.

Note. It is important that exhaust valve guides be installed with the counterbore end up. Intake valve guides must be installed with the counterbore end down.

Use drift 41–D–1547–350 and drive the guide down until the top of the guide is located seven-eighths of an inch below the top surface of the cylinder block. Ream new intake valve guides with reamer 41–R–2254–470 to 0.342 to 0.343 inches and new exhaust valve guides with reamer 41–R–2254–480 to 0.343 to 0.344 inches.

h. Check Valve Tappets. Valve tappet clearance (fig. 68) in the cylinder block can be checked by placing a dial gage against the valve tappet head and moving the tappet back and forth. The gage reading will indicate the actual clearance, which should not exceed limits given in repair and rebuild standards (par. 67). If in excess of the above, replace with an oversize valve tappet. Before installing an oversize tappet, ream the tappet guide with reamer 41–R–1400 (fig. 69) to allow 0.0000 to 0.001-inch clearance for the tappet.

i. Inspect Camshaft (fig. 70). Measure each camshaft bearing journal with a micrometer and replace the camshaft if the journals are worn in excess of repair and rebuild standards (par. 65). Examine oil pump and distributor driving gear, and if damaged or worn to any noticeable extent, replace the camshaft. Check bearing clearance and end play (par. 36*m*).



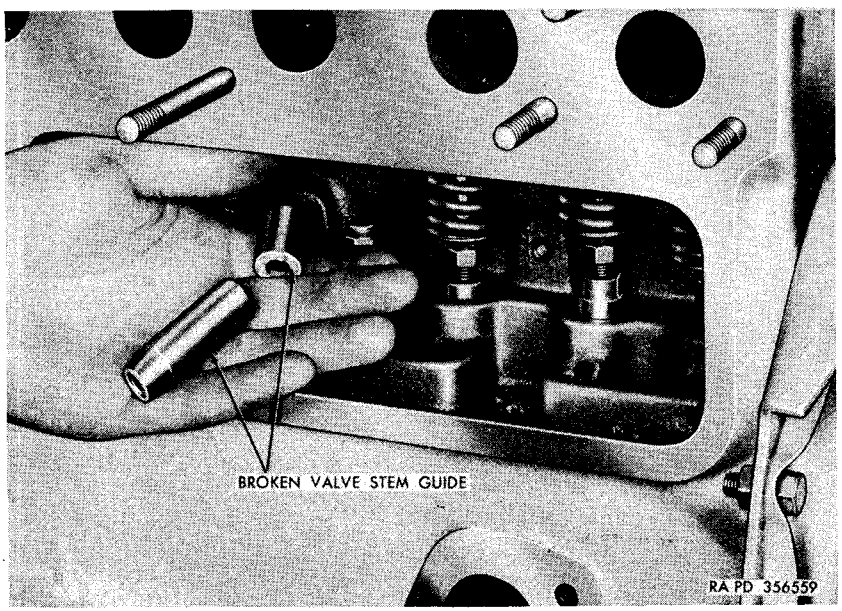


Figure 66. Breaking valve stem guide.

Section VI. REBUILD OF OIL AND WATER PUMPS

43. Inspect and Rebuild of Oil Pump

a. General. Proper lubrication of the engine depends on proper oil pump operation. If the oil pump is noisy or shows any indication of defect, it must be rebuilt or replaced.

b. Disassembly (fig. 71).

(1) Remove pump cover and gasket.

(2) Hold one hand over the open end of the body and turn the pump upside down. Twist the drive shaft until the outer rotor slips out of the body.

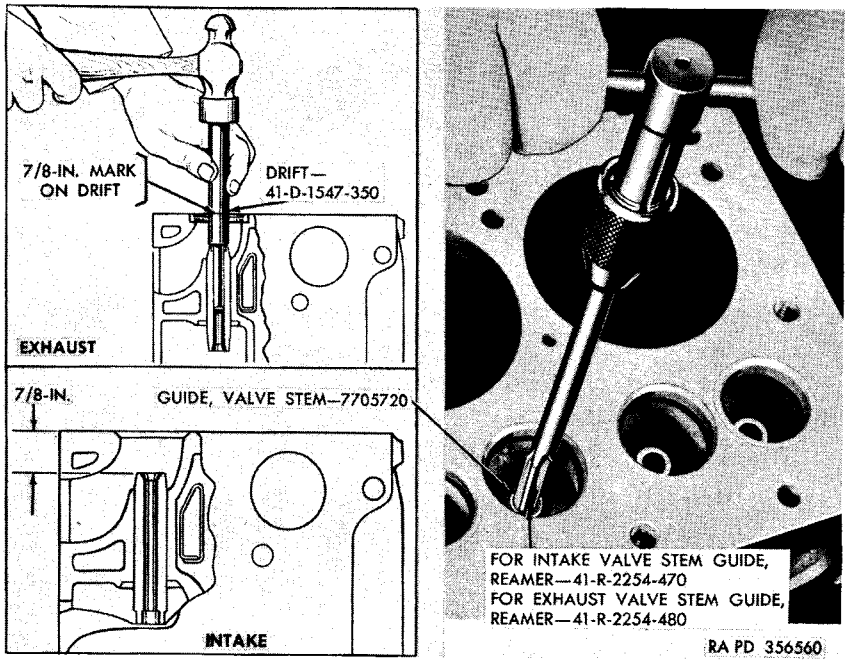


Figure 67. Installing and reaming valve stem guides.

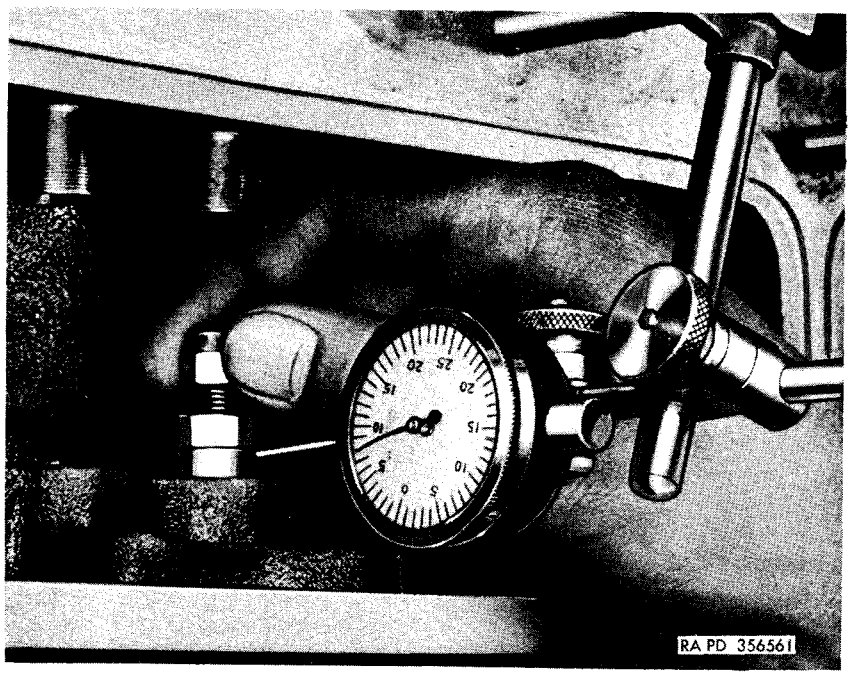


Figure 68. Checking valve tappet clearance.

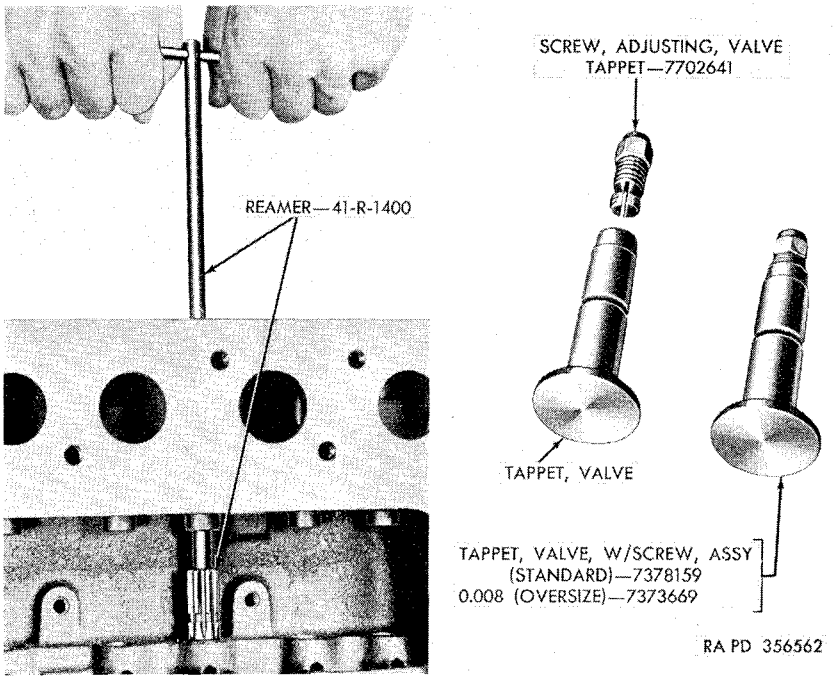


Figure 69. Reaming cylinder block for oversize tappet.

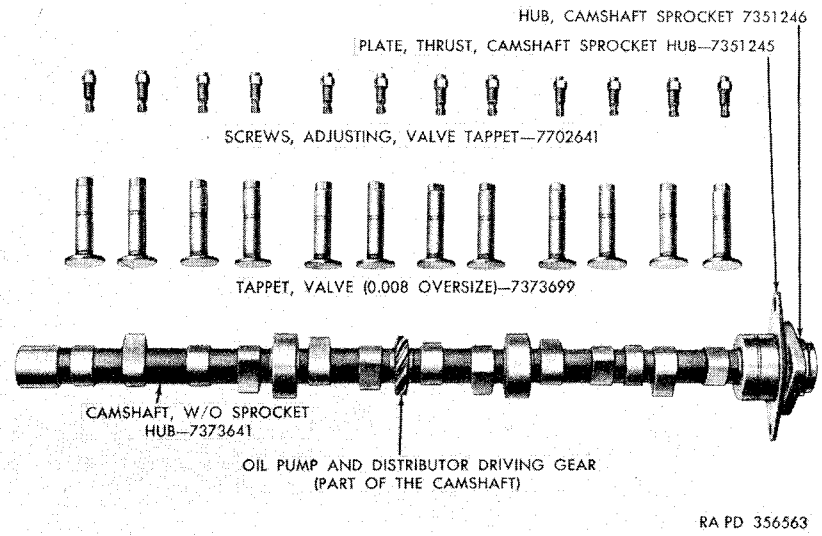


Figure 70. Camshaft and tappets.

(3) Check drive shaft end play by attaching a dial gage to pump body. Place the gage so that the button contacts the oil pump inner rotor. Move the drive shaft up and down to indicate the amount of end play on the dial. If the end

play exceeds limits in repair and rebuilt standards (par. 72) determine whether the end play is the result of wear at the distributor drive gear end of the shaft or at the oil pump inner rotor end of shaft. Replace worn part.

(4) Drive out the distributor drive gear pin which holds the distributor drive gear to the drive shaft. Press the shaft out of the drive gear and slide the inner rotor and shaft out of the pump body. Drive out the inner rotor pin and press inner rotor from shaft.

(5) Wash all component parts of pump assembly in volatile mineral spirits or dry cleaning solvent and dry with compressed air.

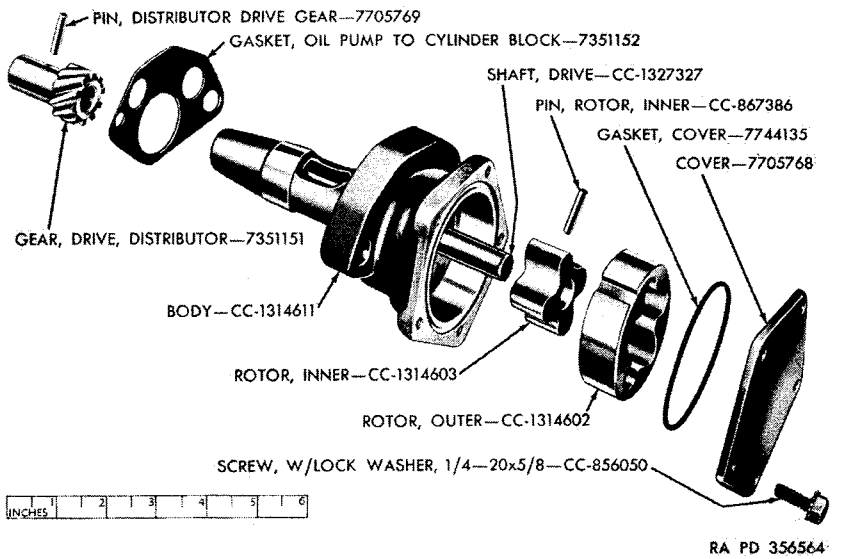


Figure 71. Oil pump—exploded view.

c. Checking and Inspecting Oil Pump Parts. When the pump has been disassembled, it is then ready to be inspected and checked.

d. Checking Rotors for Excessive Wear. To check rotors for excessive wear, slide both rotors into pump body, and measure the clearance between the inner and outer rotor lobes (fig. 72). If the clearance exceeds limits in repair and rebuild standards (par. 72), replace both rotors.

e. Measuring Clearance Between Outer Rotor and Body (fig. 73). To determine the clearance between the outer rotor and body, insert a feeler gage between the outer rotor and body. If this clearance is more than 0.012 inch, replace pump body only after measuring diameter and thickness of the outer rotor as described in *f* below.

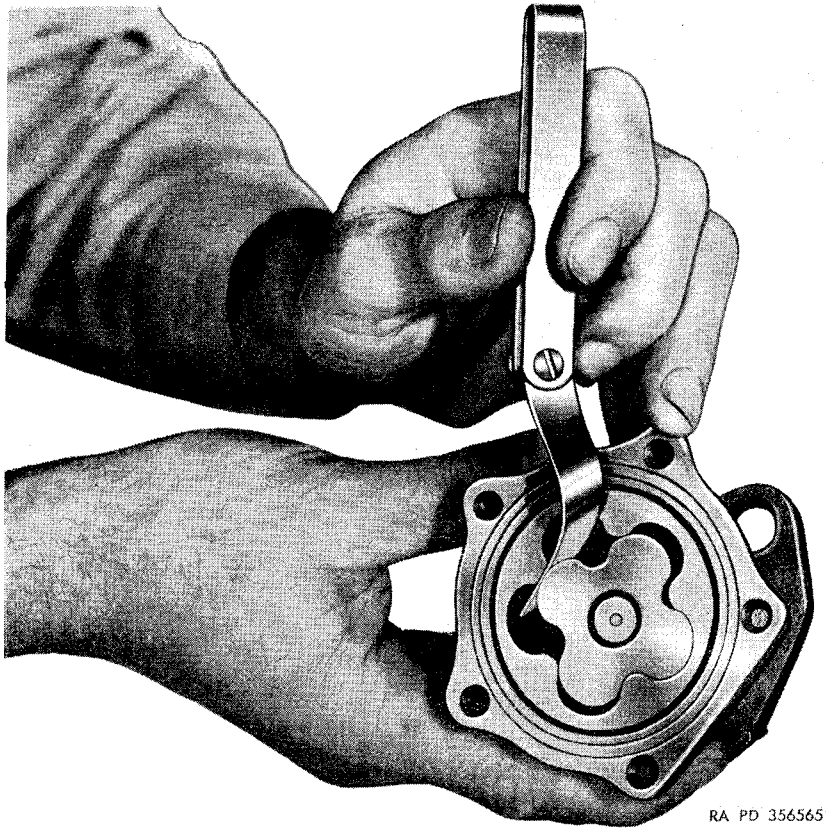


Figure 72. Measuring clearance between rotor lobes.

f. Measuring Outer Rotor Diameter. The diameter of the outer rotor should be measured with micrometer calipers. The outer rotor should measure 2.244 inch. The thickness of both inner and outer rotor should not be less than 0.748 inch. If the rotors show excessive wear as indicated by the wear tolerances, replace worn rotors.

g. Checking Inner and Outer Rotor Clearance (fig. 74) *to Cover.* With both inner and outer rotors in position, place a straightedge across pump body between bolt holes. With a feeler gage, check clearance between rotor surface and straightedge. If clearance exceeds repair and rebuild standards (par. 72), replace pump body.

h. Checking Cover. The cover must be smooth, free from scratches or groove marks. To check cover for excessive wear, place a straightedge across inner surface and check with a feeler gage. If a 0.001-inch feeler can be inserted, replace cover.

i. Installation of New Inner Rotor. When installing a new inner rotor, press the rotor on, until the end of the drive shaft is flush with the face of the rotor. When pressing rotor on, be sure it is square

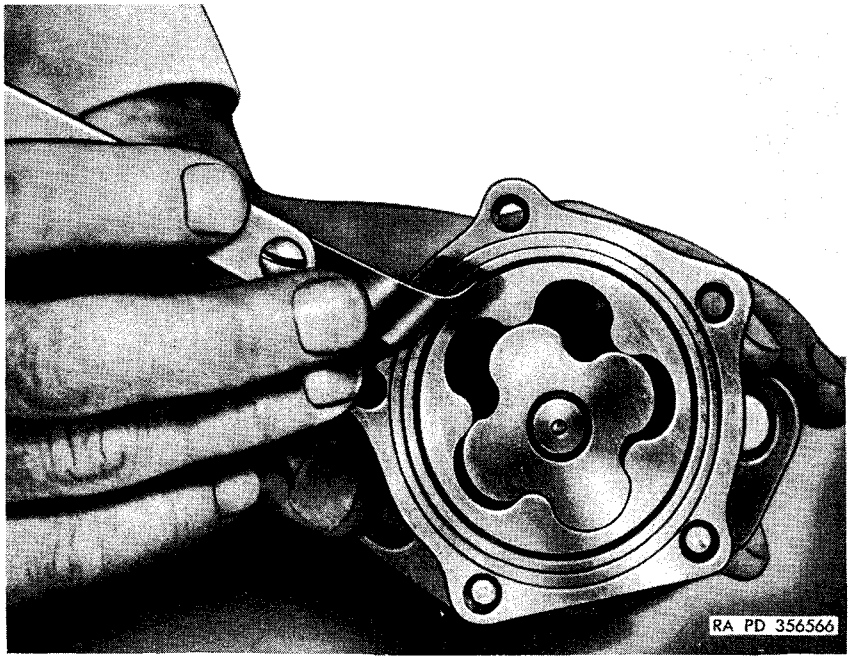


Figure 73. Checking clearance between outer rotor and body.

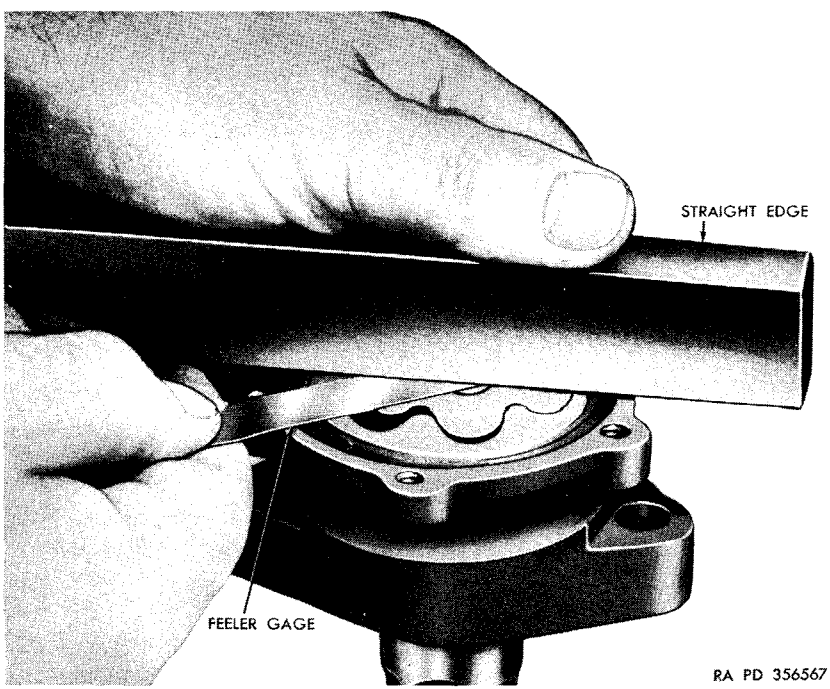


Figure 74. Checking inner and outer rotor clearance to cover.

with the shaft. Drill the inner rotor pin hole with a No. 22 drill, install new pin, and make certain it is peened at both ends.

j. Assembling Oil Pump. To assemble the oil pump, slide the drive shaft and inner rotor assembly into the pump body. Press the distributor drive gear on the shaft.

Note. If a new distributor drive gear is required, it must be properly located on the shaft to insure correct ignition timing. On all service gears, the distributor drive gear pin hole is drilled through one side of the hub and the new gear should be positioned on the shaft so that the distributor drive gear pin will be at right angles to the slot in the upper end of the shaft.

(1) Press inner rotor into the body with hand; then check clearance with feeler gage (fig. 75). Drive shaft end play clearance should not exceed limits in repair and rebuild standards (par. 72).

(2) If distributor drive gear pin holes do not line up, drill new hole through distributor drive gear and drive shaft using a $\frac{5}{32}$-inch drill, at right angles to other holes. Peen ends of pin after installation.

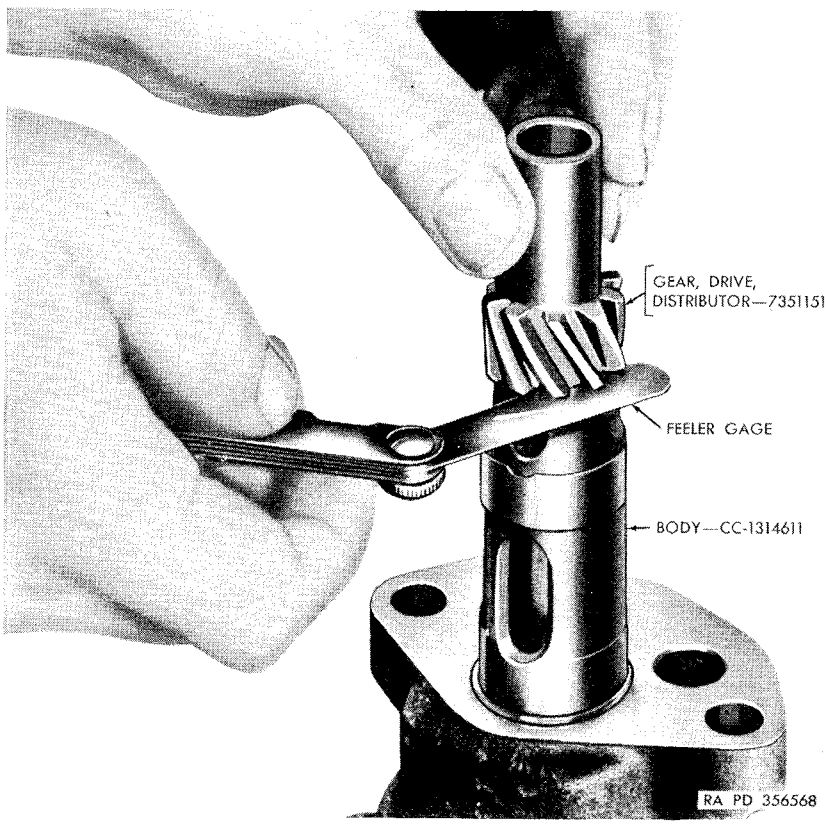


Figure 75. Checking oil pump shaft end play.

(3) Slide the outer rotor into place in the pump body; then install a new cover gasket.

(4) Install the cover and tighten 1/4–20 x 5/8 with lock washer screws evenly to insure uniform contact against cover gasket.

44. Repair and Install Water Pump

a. General. The water pump (fig. 76) should be rebuilt when bearings or seals become ineffective. The following procedure can be used to rebuild the water pump, provided the housing is not cracked or damaged.

b. Disassembly of Water Pump. Wash the pump in volatile mineral spirits or drycleaning solvent and dry with compressed air.

(1) Remove fan pulley hub (fig. 77) after driving out the 5/32 x 1 1/8 pin. Install puller 41–P–2912 on fan hub and remove hub.

(2) Remove the water pump cover plate attaching screws and cover plate.

(3) Pull the shaft, impeller, and seal assembly (fig. 78) out of pump body.

(4) Drive the pump bearing pin through the front bearing into the bore of the bearing. Install the bearing puller in a vise and assemble the pump on remover 41–R–2385. Tighten the puller screw nut until both front and rear bearings and thrust washer (fig. 79) and grease retaining washer are removed from the pump.

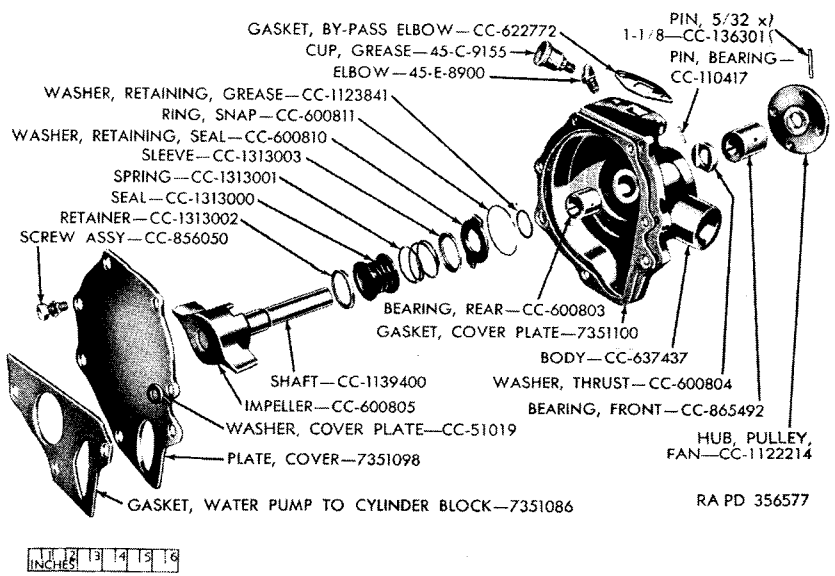


Figure 76. Water pump—exploded view.

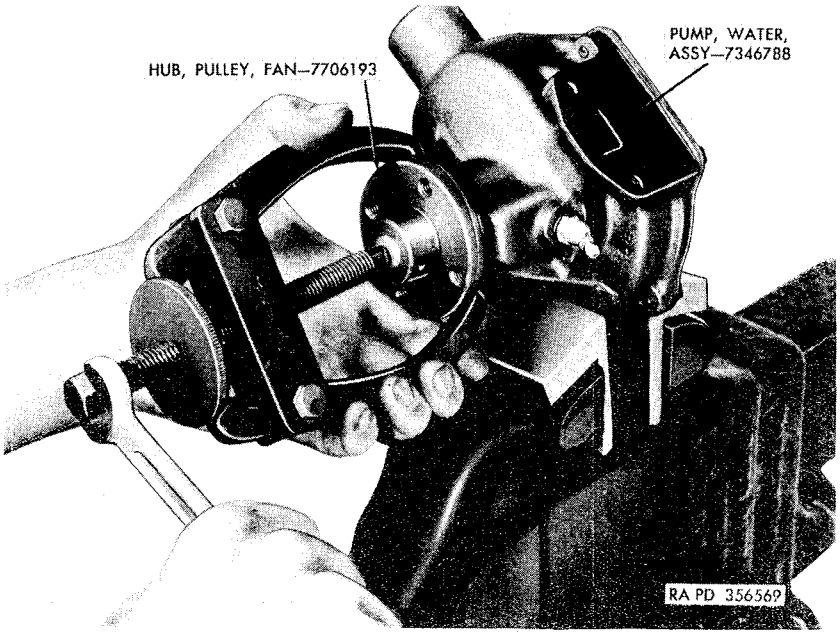


Figure 77. Removing fan pulley hub.

(5) Press down on the seal retaining washer and remove the snap ring from the impeller. Remove the seal washer and seal assembly.

45. Inspection of Water Pump Parts

a. General. When the water pump has been disassembled, all parts should be inspected for defects.

b. Inspect Water Pump Parts.

(1) The standard diameters of the pump shaft are given in repair and rebuild standards (par. 74). If the shaft exceeds limits in repair and rebuild standards (par. 74) or scored on the bearing surfaces, or if the impeller is damaged or corroded, replace the pump shaft and impeller assembly.

(2) Examine the pump body for cracks, sand holes, or corrosion. If damaged, install new body. Inspect the seal surface of the body and if when resurfaced, the distance between the seal surface and the face of the body is greater than $1\frac{1}{16}$ inch, replace the body (fig. 80).

(3) Regardless of condition, when rebuilding the pump, replace the front and rear bearings.

(4) Always replace water pump seal assembly when rebuilding a pump.

(5) Check fan pulley hub to see that it fits tight on the shaft. If any looseness is present, replace the hub.

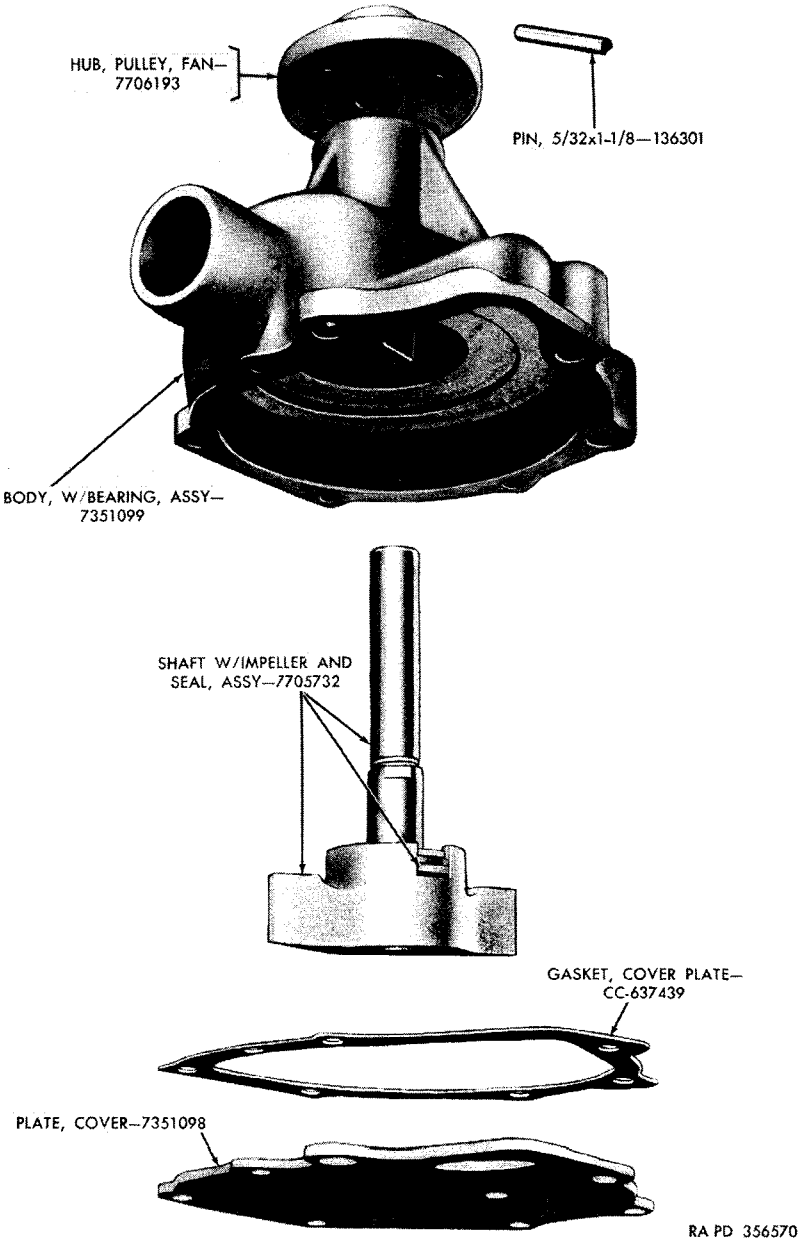


Figure 78. Water pump shaft and impeller removed.

46. Assembly of Water Pump

a. General. When the water pump parts have been inspected and all defective parts have been replaced, the pump is then ready for assembly.

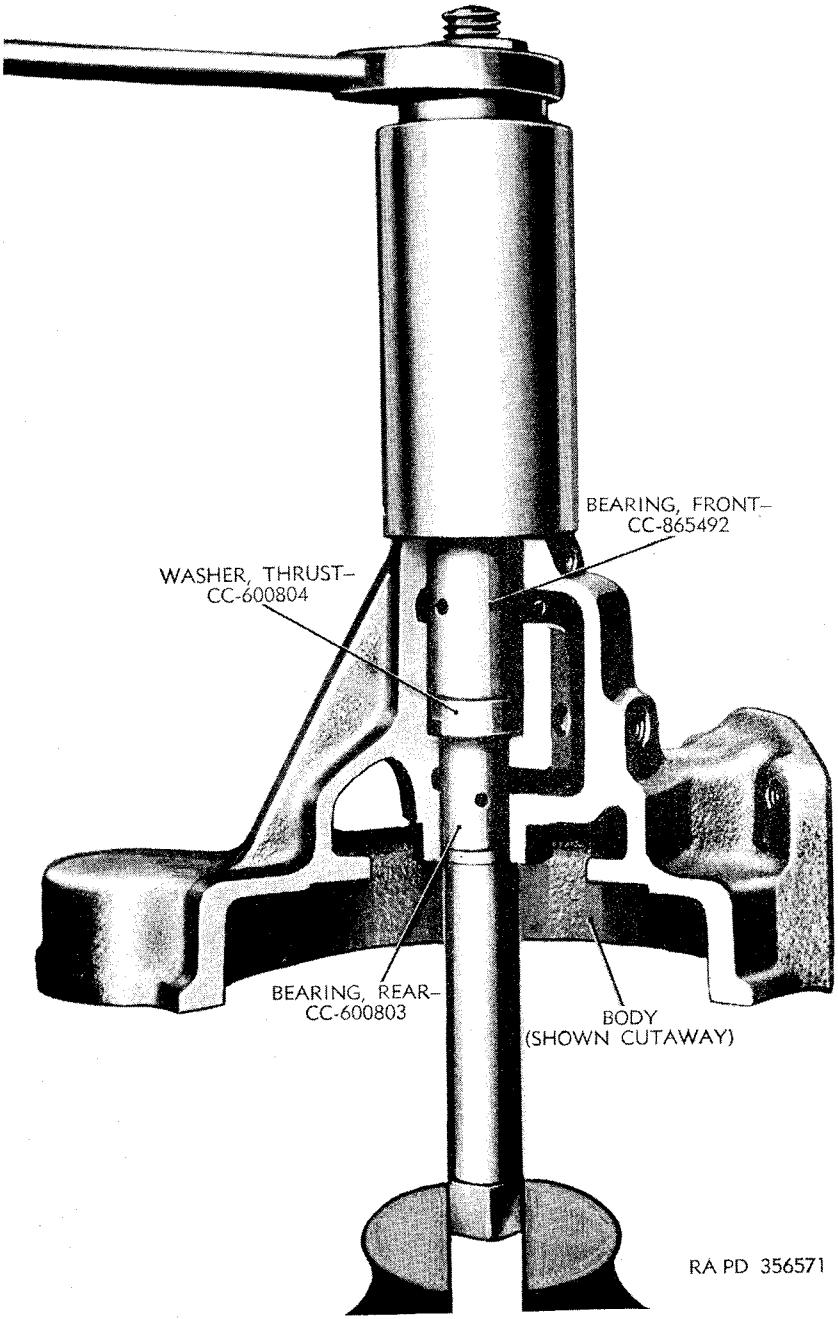


Figure 79. Removing water pump shaft bearings.

b. Assembly Procedure. The following procedure is recommended for the assembly of various water pump parts:

(1) Install the seal assembly on the shaft and push it into the im-

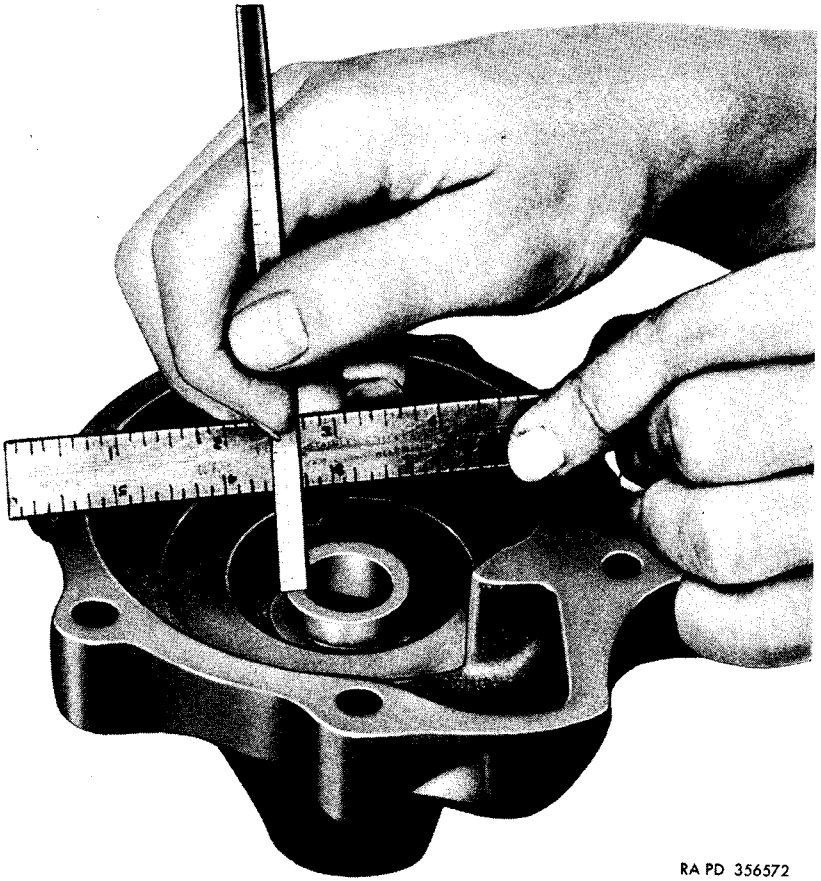
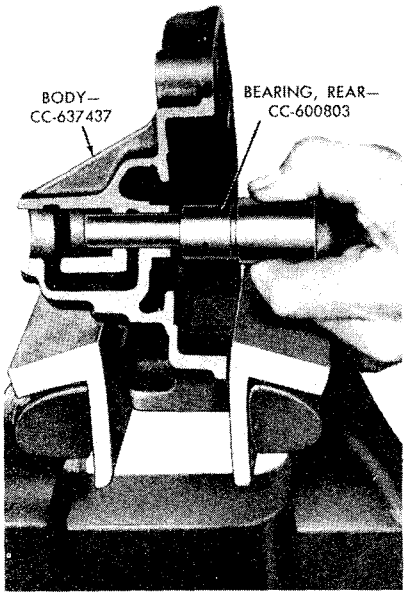


Figure 80. Checking seal seat dimensions.

peller counterbore. Install the seal retaining washer and compress the spring by pushing on the washer. Install and fit the snap ring into the groove in the impeller.

(2) Place the rear (small) bearing over arbor 41–A–334 (fig. 81) and insert the arbor through the body from the impeller side of the pump. Start the rear bearing in the body and press it into place with a vise or arbor press. Remove the body from the press but do not remove the arbor from the body. Slide the steel thrust washer over the arbor and into the body, slotted side first (slot toward rear of pump). Start the front (large) bearing in the body and over the arbor with the grooved end of the bearing out and with the longitudinal groove in line with the grease sump on the top of the pump body. Press the bearing into the body until both ends of the arbor contact the vise jaws or arbor press base. The rear and front bearings (fig. 82) will then be in position to provide



INSERTING REAR BEARING
IN WATER PUMP BODY

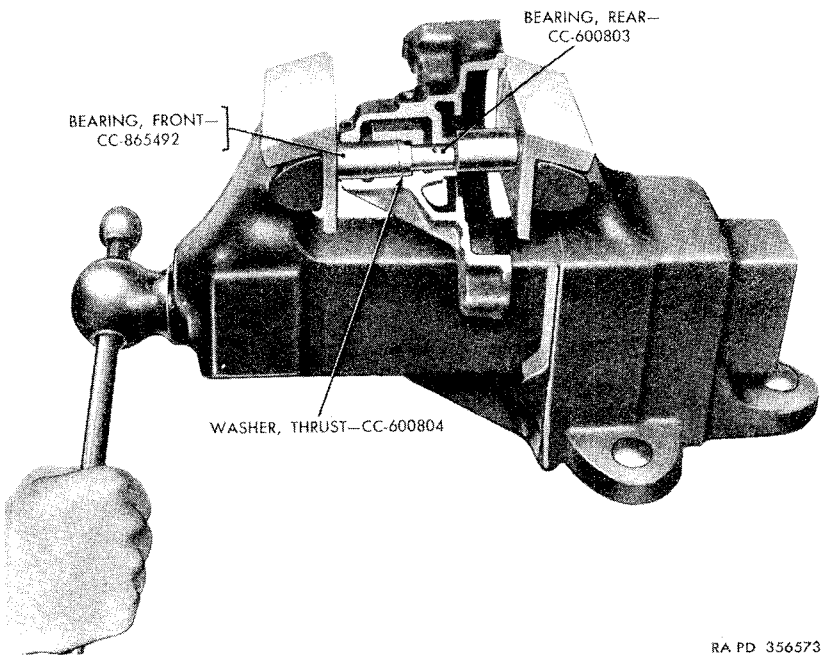


Figure 81. Installing water pump shaft bearings.

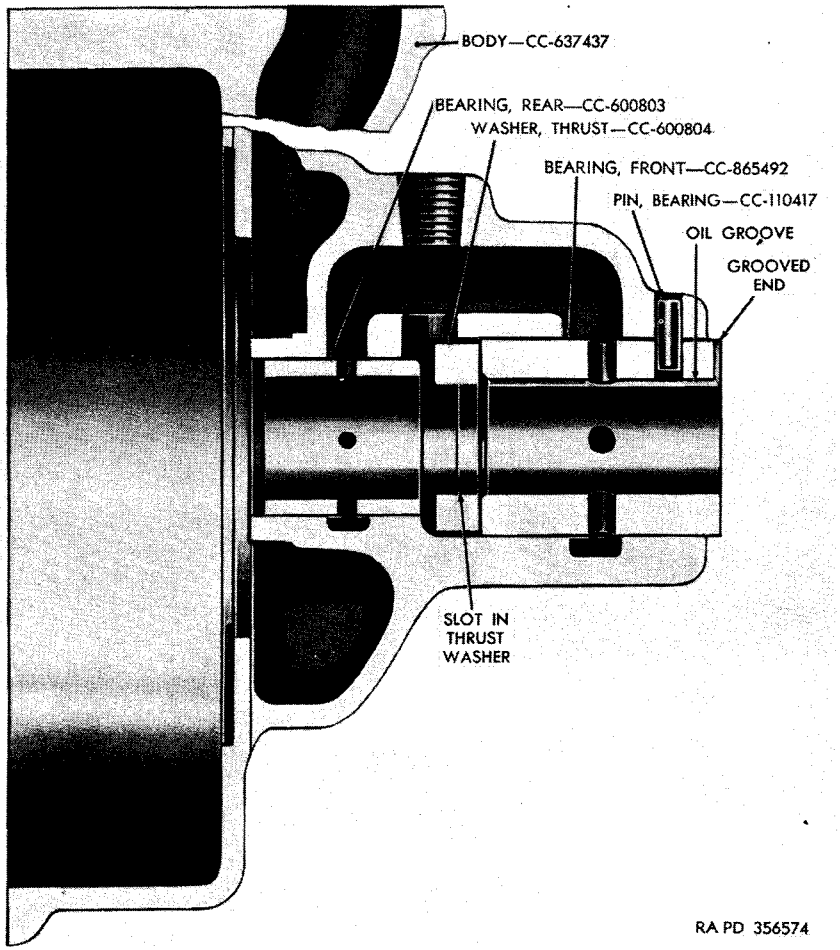


Figure 82. Water pump bearings installed.

proper location of the (water pump) seal and impeller. Remove arbor.

(3) Using a No. 14 drill, drill the front bearing for the bearing pin. The drilled hole in the body can be used as a guide. Drive a new pin into the bearing to lock it in place.

(4) Burnish the front bearing to 0.595 to 0.596 in. diameter, and the rear bearing to 0.670 to 0.671 in. with refacer and line burnisher 41–R–2332 (fig. 83). Clamp the refacer in a vise and install the body over the tool, impeller end down. Turn the body down on the tool slowly in a clockwise direction, until the refacing cutter of the tool contacts the body. Continue turning the body on the tool until a smooth, even cut has been taken on the seat. Continue turning the body

while lifting it off the cutter to prevent leaving a ridge on the seat. Examine the seat carefully and repeat the operation if the seat is not smooth and free of cutter marks or ridges.

(5) If the impeller and pump shaft is not being replaced, place a mark across the fan pulley hub end of the shaft, showing the location of the $\frac{5}{32}$ x $1\frac{1}{8}$ pin hole in order that the new pin hole can be drilled to cross the old hole at right angles. Install the pump shaft and seal assembly through the rear bearing, the thrust washer, and the front bearing. Aline the thrust washer with the pump shaft, so that the parts fit

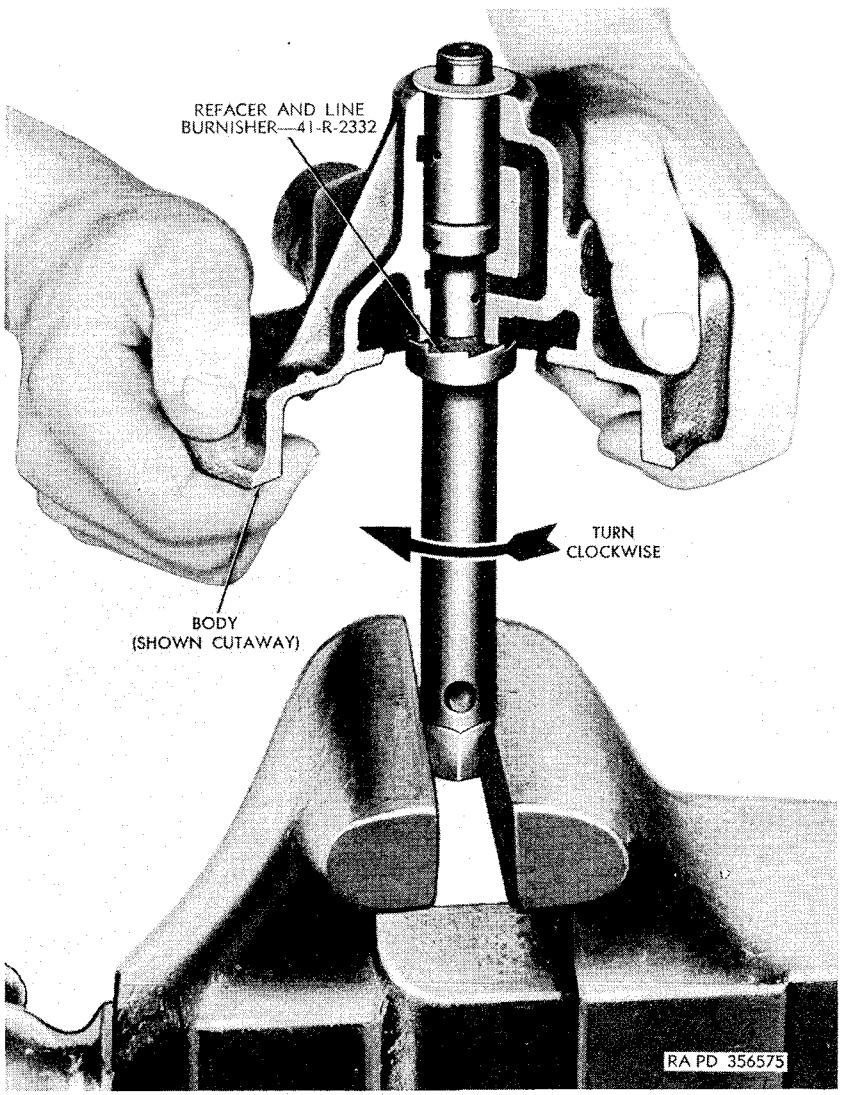


Figure 83. Burnishing bearings and refacing seal seat.

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together. Press the fan hub on the shaft until there is 0.003-inch clearance between the hub and the front bearing as measured by a feeler gage (fig. 84) between the parts. Drill through the hub and shaft with a No. 22 drill and install a new pin. Lubricate the bearing as outlined in TM–9–840.

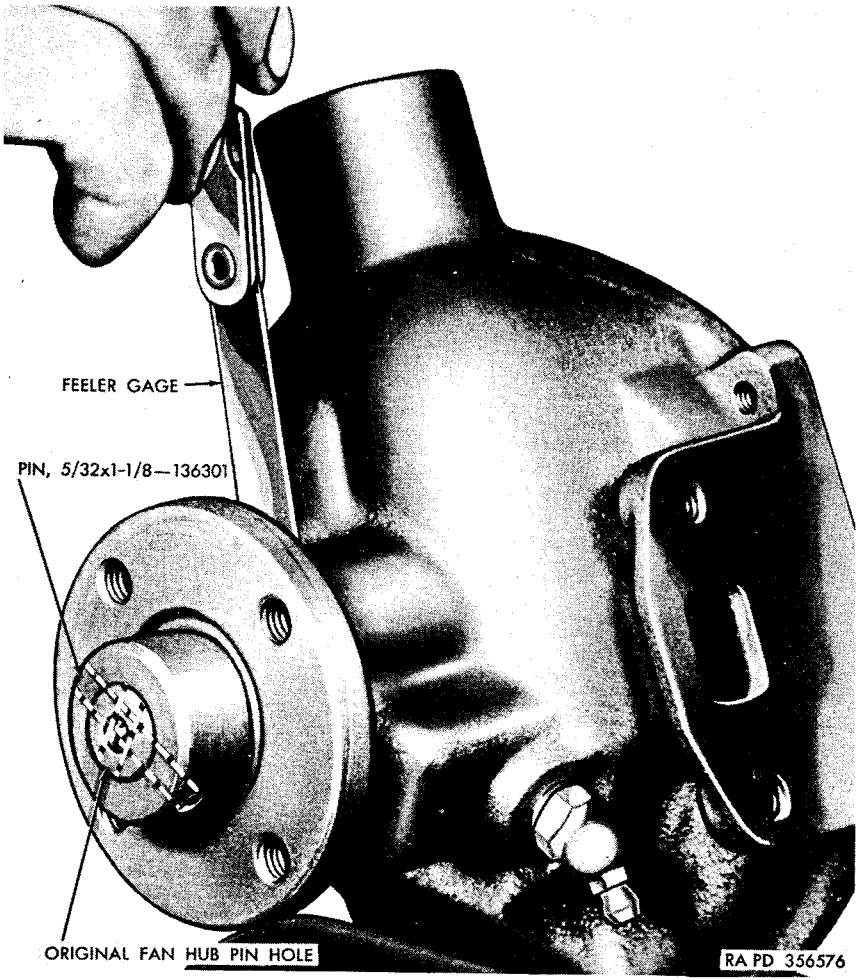


Figure 84. Checking shaft end play.

Section VII. REBUILD OF THROTTLE LINKAGE, OIL FILTER, AND OIL FILTER ASSEMBLY

47. Removal, Inspection, and Rebuild of Throttle Linkage (fig. 85)

a. General. When the vehicle has been in service for a considerable length of time, and the engine has been rebuilt, there is a possibility that the throttle linkage will be worn.

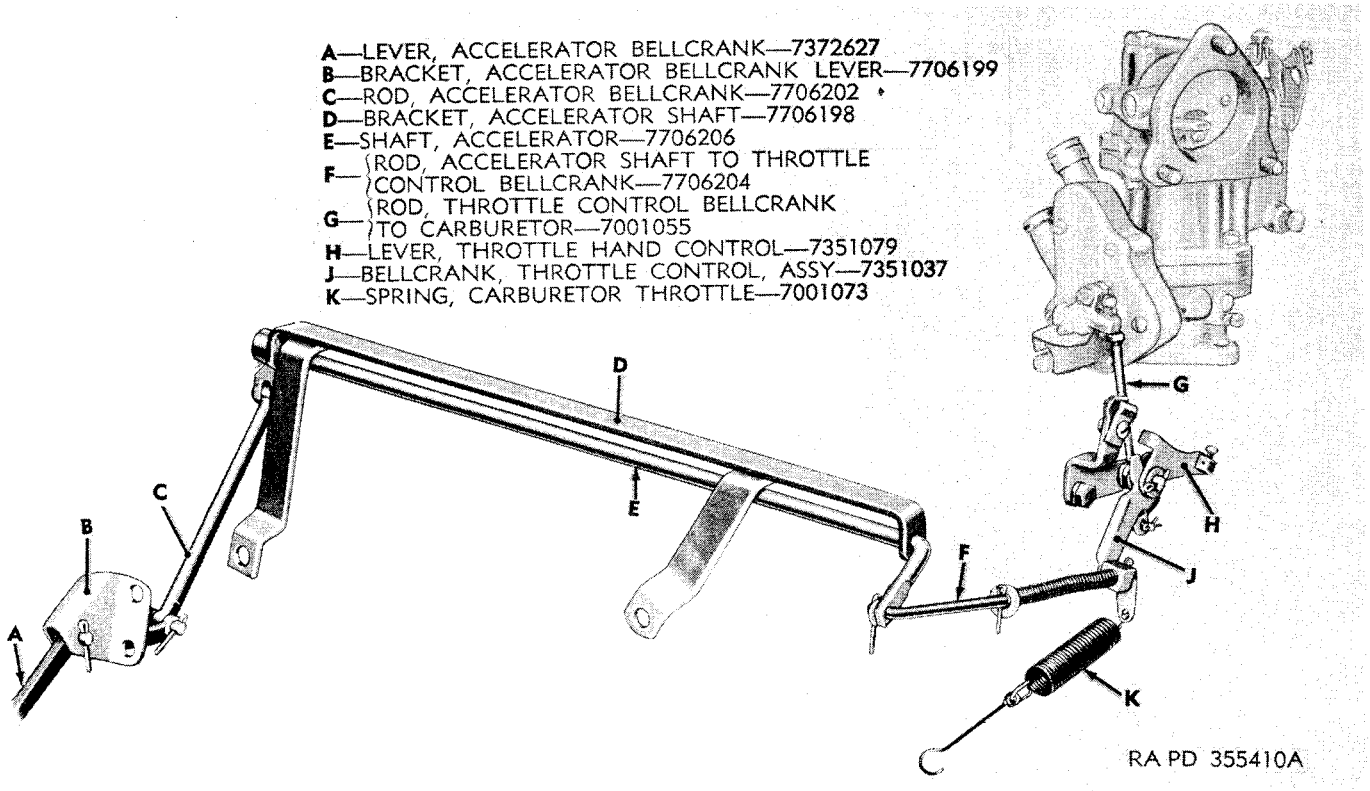


Figure 85. Accelerator and throttle linkage.

b. Inspection of Throttle Linkage. Visual inspection of the throttle linkage is not sufficient. The entire linkage arrangement must be checked for wear by grasping various rods and checking the free play. The linkage must be snug and have no excessive play at any point.

c. Disassembly of Throttle Linkage. Disconnect and remove carburetor throttle return spring. Remove cotter pin that holds throttle control bellcrank assembly and throttle hand control lever to manifold and pull bellcrank assembly and lever off. Disconnect accelerator shaft to throttle control bellcrank rod from accelerator shaft. Remove accelerator shaft bracket from clutch housing. Remove accelerator bellcrank lever bracket from clutch housing.

d. Assembly of Throttle Linkage. After checking the complete linkage arrangement for defective parts, replace any faulty or worn rods and levers. Install the accelerator shaft bracket. Install accelerator shaft to throttle control bellcrank rod, bellcrank assembly, and throttle hand control lever. Install accelerator bellcrank lever bracket.

48. Disassembly, Inspection, and Installation of Engine Oil Filter Assembly

(fig. 86)

a. General. The oil filter assembly seldom requires attention with the exception of changing the filter element at established intervals. However, if the oil filter body becomes damaged, plug hole threads become stripped, or any trouble occurs in the filter assembly, it will be necessary to rebuild the complete assembly.

b. Disassemble Filter Body. Remove cover from body and pull out element. Remove drain plug. Clean inside of body with volatile mineral spirits or dry cleaning solvent.

c. Inspect Filter Body. Inspect body assembly for cracks, dents, stripped threads in oil line holes or cover screw hole, and any other defect that would cause faulty operation.

d. Assembly of Filter Body. Insert washer and gasket over inner body tube. Install new element and install rubber washer over inner body tube. Install new cover gasket and install body cover. Install drain plug.

Section VIII. ASSEMBLY OF ENGINE, INSTALLATION OF ACCESSORIES, AND RUN-IN TESTS AND ADJUSTMENTS

49. Installation of Subassemblies

a. Install Valve Stem Guides. Refer to paragraph 42*g*.

b. Install Main Bearings and Crankshaft. Refer to paragraph 39*d*.

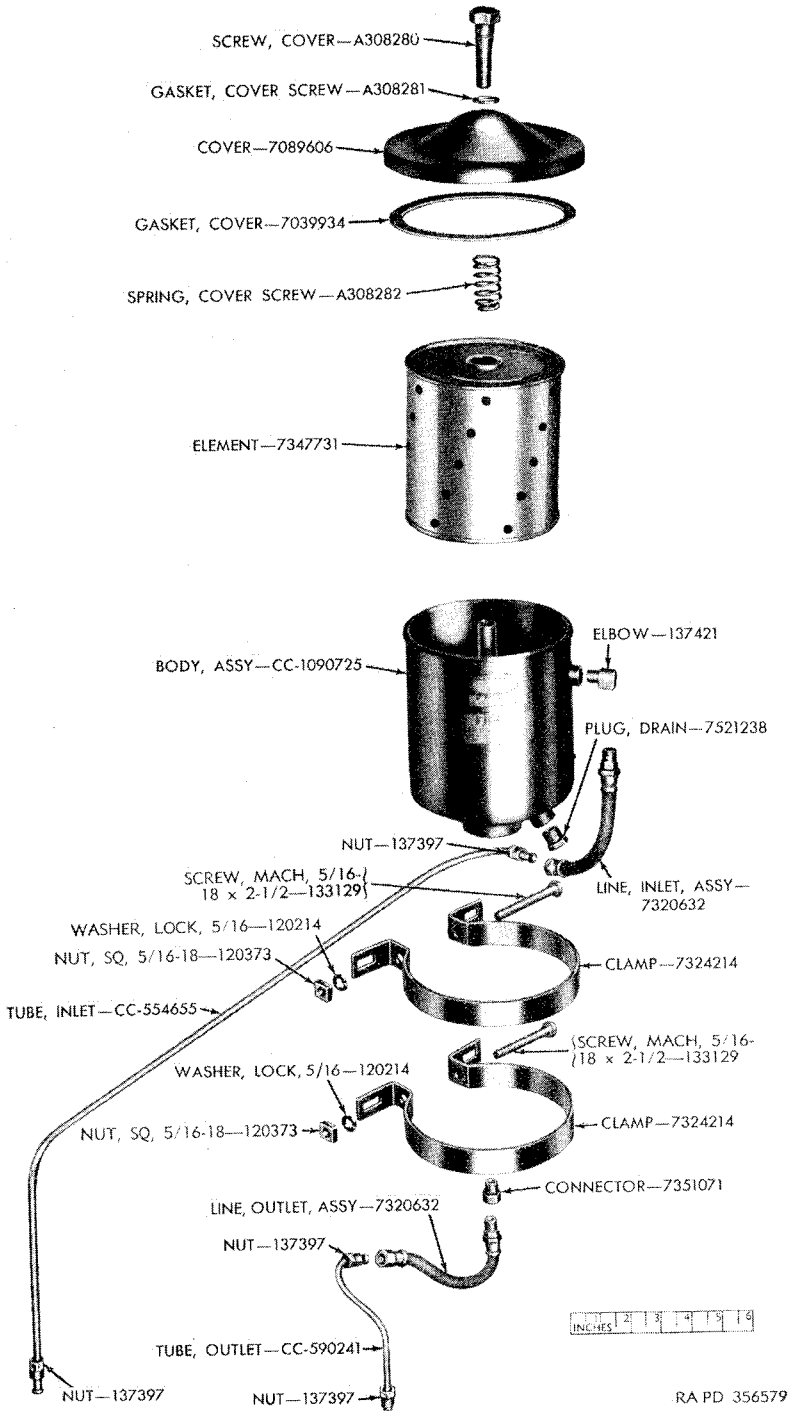


Figure 86. Engine oil filter assembly—exploded view.

c. Install Camshaft Bearings. Before proceeding with the installation of the camshaft bearings, note that an oil hole is machined in each bearing which must line up with an oil hole in the block. The camshaft front bearing has a second oil hole which must line up with the hole that supplies oil to the timing chain. The front bearing oil holes are drilled off center and it is important that this bearing be installed with the oil holes to the rear.

(1) Mount the cylinder block in an engine stand and install the correct size adapter for camshaft bearing remover and installer 41–R–2386 (fig. 87) in each of the two intermediate bores.

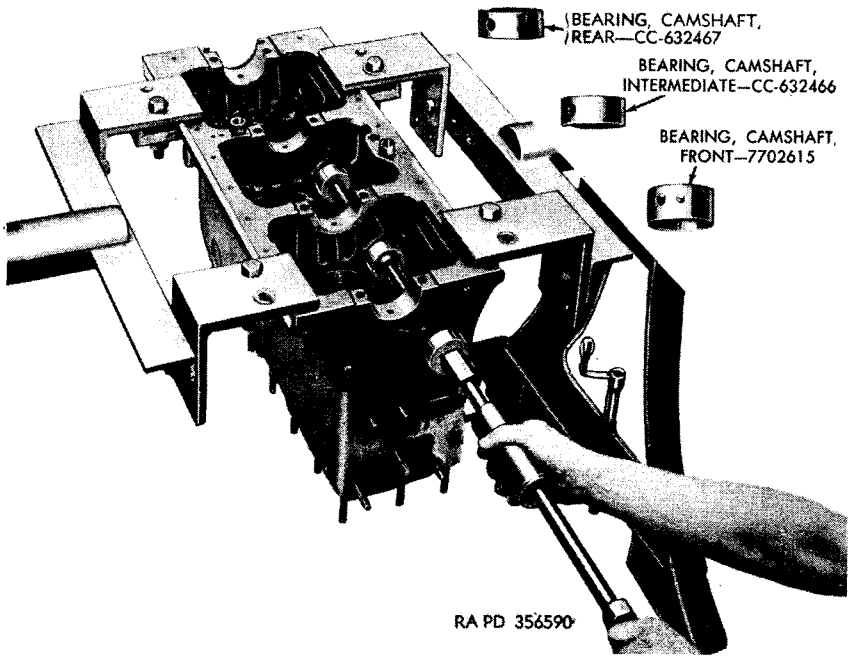


Figure 87. Installing camshaft bearings with remover and installer 41–R–2386.

(2) Install the correct adapter in the camshaft front bearing and start the front bearing in its bore.
(3) Insert the installer shaft through all three adapters and install a horseshoe collar forward to the front adapter.
(4) Drive the camshaft front bearing into place with the sliding hammer of the tool, making sure that the oil holes are in alinement.
(5) Remove the installer shaft but leave the front and rear adapters in the bores to guide the shaft when installing camshaft intermediate bearing.

(6) Place the adapter in the camshaft intermediate bearing and start the bearing in its bore. Install the horseshoe collar forward of the adapter and drive the bearing into place.
(7) Remove the installer shaft and number three adapter.
(8) Place camshaft rear bearing in the adapter and drive it into place with the same procedure used on the other bearings.

d. Install Valve Tappet With Screw Assemblies, Camshaft, and Timing Chain Case Cover Plate. Place the valve tappet with screw assemblies in the valve stem guides in which they were originally installed, or to which they have been fitted. Coat the camshaft journals with oil and insert the camshaft through the camshaft front bearing. Push it carefully into position, making sure not to damage the camshaft bearings with the edge of a cam or bearing journal. Install and tighten the cap screws which hold the camshaft thrust plate in place. Install oil pan front seal plate and new front oil seals. Coat new timing chain case cover plate gasket with plastic type gasket cement and install gasket and chain case cover plate. Install camshaft sprocket oil nozzle, clip and nozzle clip screw and washer, and oil pan front seal plate cap screw.

e. Install Camshaft Sprocket and Timing Chain (fig. 88). Turn the crankshaft so that the mark "O" on the face of the crankshaft sprocket is directly in line with the crankshaft and camshaft centers. Place the camshaft sprocket on its hub and install two cap screws tem-

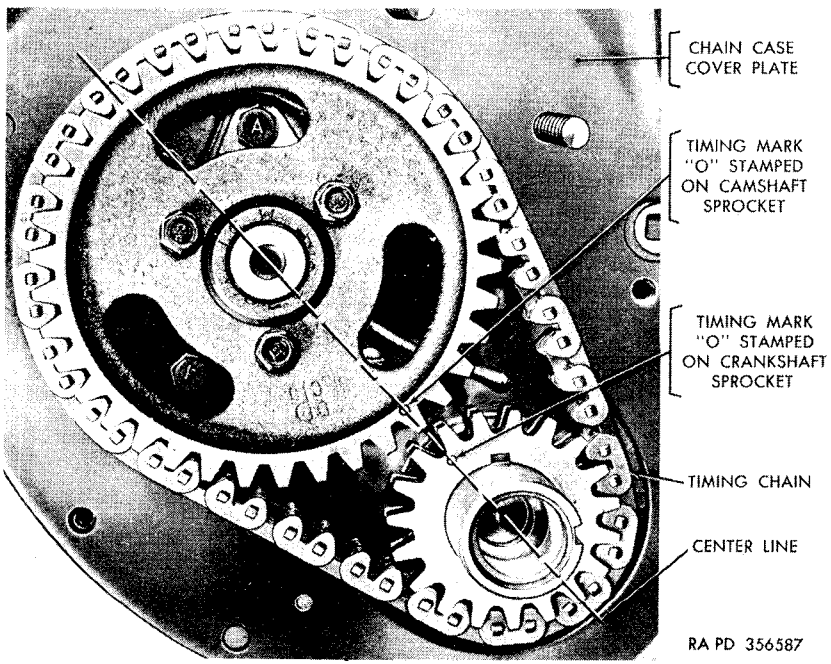


Figure 88. Timing chain and sprocket installation.

porarily. Turn the camshaft sprocket until the mark "O" on the sprocket is also directly in line with the crankshaft and camshaft centers; then remove the camshaft sprocket, install timing chain and sprocket. When installation is completed, the "O" marks on both sprockets must be directly between the crankshaft and camshaft centers.

f. Install Intake and Exhaust Valves and Valve Compression Springs. Before attempting to install an intake or exhaust valve and valve compression spring, rotate the camshaft until the valve tappet with screw assembly is in its lowest position.

(1) Use a block of wood and a heavy screwdriver to compress the valve compression spring and force it into position with the closed coil end up and the valve compression spring retainer in the lower end of the spring.
(2) Coat the intake or exhaust valve stem with oil and install in its proper valve stem guide.
(3) Insert the jaws of the valve lifter 41–L–1410 between the valve spring retainer and the cylinder block with the cupped jaw up.
(4) Hold the intake or exhaust valve on its seat and raise the valve lifter until the valve compression spring is fully compressed.
(5) Assemble the valve spring retainer locks in the valve lock replacer 41–R–2391–54 (fig. 89) and place the locks in position around the valve stem in line with the grooves on the stem.
(6) Lower the valve lifter and remove the lock replacer.
(7) Adjust valve tappet with screw assemblies with a thickness gage and special tappet wrenches so that they have a 0.010-inch clearance for the intake valves and 0.015-inch clearance for the exhaust valves.

Note. After the engine has been assembled and run-in, the tappet assemblies must be readjusted while the engine is hot to a clearance of 0.010 inch for intake valves and 0.014 inch for exhaust valves.

(8) Install valve compartment covers with new gaskets on covers, screws, and studs.

g. Install Connecting Rods and Pistons. Refer to paragraphs 40 and 41.

h. Install Timing Chain Case Cover, Engine Front Support Plate, and Fan Drive Pulley. When installing the timing chain case cover, care must be taken to center the oil seal on the crankshaft before tightening the cover bolts. A timing chain case cover oil seal gasket should be installed in the cover before the seal is pressed into place. Use a new gasket for the cover, install cover and tighten cap screws just enough to hold the cover in place. Install locator 41–L–1607–500

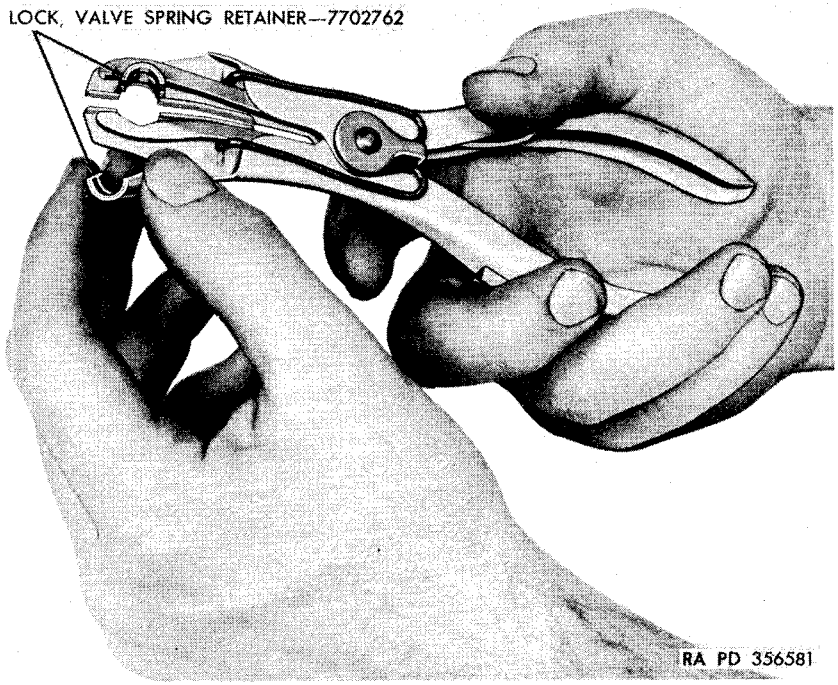


Figure 89. Valve spring retainer lock replacer 41–R–2391–54.

over crankshaft, with tapered end of tool against timing chain case cover and oil seal (fig. 90). Install cranking jaw and tighten finger-tight. Tighten cover bolts and at the same time, tighten cranking jaw with fingers to maintain tension between oil seal and centering tool. When bolts are drawn down securely, remove cranking jaw and locator. Install fan drive pulley hub key and install the fan drive pulley hub. Then, install cranking jaw with lock washer and tighten with torque wrench to 110 pound-feet minimum. Attach the engine front support plate to the timing chain case cover plate. Install fan drive pulley and tighten six cap screws securely.

i. Install Oil Strainer (fig. 91). Install the oil pump inlet pipe. Connect the oil strainer to the pipe and insert a new cotter pin. Position the strainer and elbow so that movement of the strainer is not restricted by the oil pan baffles. When properly positioned, the oil strainer and inlet pipe should be in line with the crankshaft rear bearing cap right screw.

j. Install Oil Pan. Place new end gaskets in position. Do not cut off the ends, as they will be compressed into place when the pan is installed. Place new side gaskets over the ends of the end gaskets. Hold the side gaskets in place with heavy grease or tie in place with light string through several screw holes while installing the oil pan. If string is used, remove string before tightening screws. Place oil

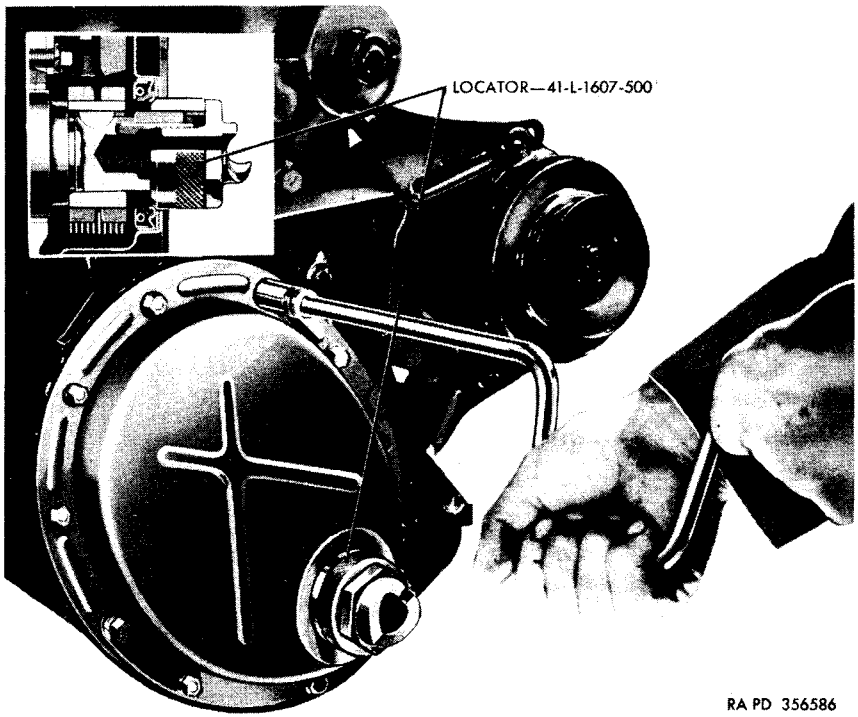


Figure 90. Centering timing chain case cover and oil seal.

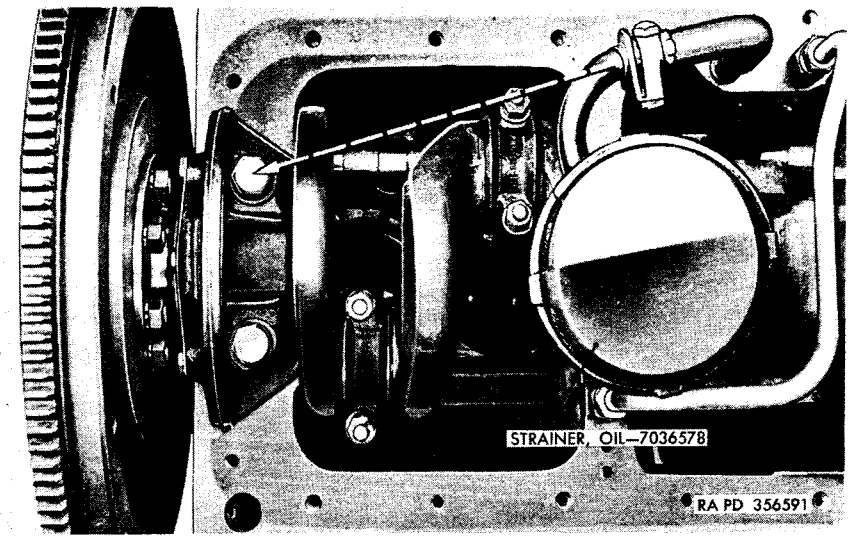
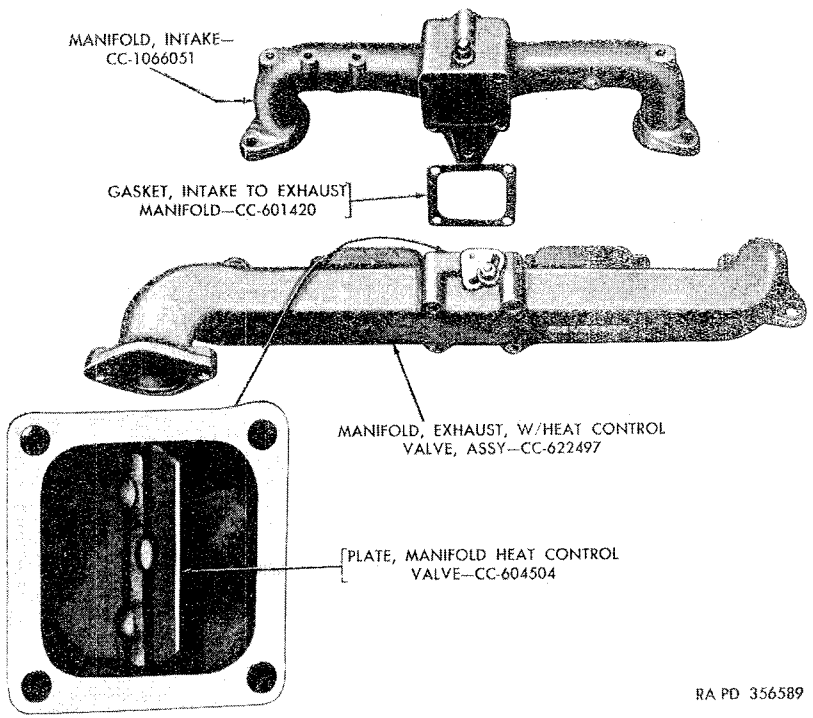


Figure 91. Oil strainer installation.

pan in position on the cylinder block. Install and tighten the attaching screws.

k. Install Cylinder Head. Refer to paragraph 38*c*.

l. Assembly and Installation of Manifolds. The intake and exhaust manifold assembly, with heat control valve (fig. 92) is assembled and machined as a unit in production and parts cannot be interchanged unless facilities are available to grind the flange surfaces as an assembly. Before starting to assemble the intake and exhaust manifold assembly, with heat control valve, inspect the heat control valve.



Figue 92. Intake and exhaust manifolds.

If the valve is burned or damaged or the valve shaft is excessively loose in the heat control valve seat bushings, it should be replaced. Use a chisel to break the welds which fasten the valve to the shaft and remove the valve, valve shaft, and bushings. Install new bushings, shaft, and valve. Place the valve against the flat side of the shart, bend the tabs around the shaft and weld the tabs to the shaft. Install manifold heat control valve plate on end of shaft and make seasonal adjustment. Adjustment must be "UP" for winter and "DOWN" for summer. When assembling the manifolds, always lay a straightedge lengthwise over the gasket surfaces of the port flanges to check for uniform height of the manifold flanges (fig. 93). If a

0.010-inch feeler gage will pass between the straightedge and any of the manifold flanges, loosen the cap screws which hold the manifolds together and shift the manifolds, if possible, to correct the uneven condition of the flanges. If necessary, grind the flanges just enough to make them even. Clean manifold flanges thoroughly. Install new intake and exhaust manifold gaskets. Place manifold assembly in position on cylinder block studs and tighten all nuts with a torque wrench to 15 to 20 pound-feet.

Note. The stud holes in the exhaust manifold end flanges are enlarged to allow for expansion and it is important that the four chamfered washers and tapered slotted nuts be installed on the end studs.

Then, install crankcase ventilator valve in intake manifold.

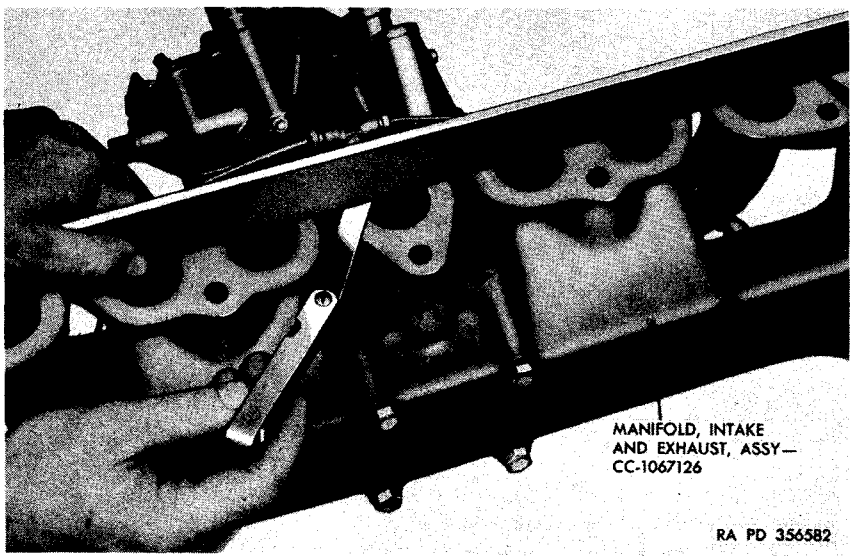


Figure 93. Checking manifold flanges.

m. Generator.

(1) Install mounting bracket and place generator in position on bracket.

(2) Install generator bolts, nuts, and lock washers, but do not tighten.

n. Install Water Temperature Thermostat Assembly (fig. 94). Install a new cylinder head water outlet elbow gasket on the cylinder head and place the water temperature thermostat assembly in position with openings at front and rear. The word "FRONT" on the thermostat must be installed toward the water pump. The gasket must be installed at the top of the thermostat before the water outlet elbow is assembled to the cylinder head. When the thermostat is operating properly, it should start to open at 157° to 162° F. and should be fully open at 183° to 187° F.

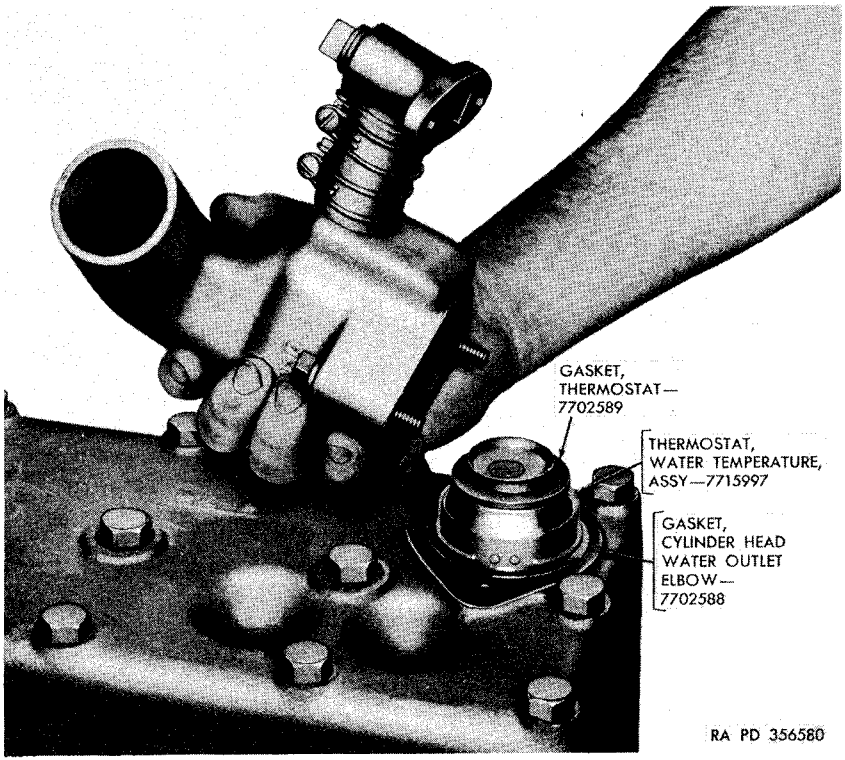


Figure 94. Installation of thermostat.

o. Install Cylinder Block Water Distributor Tube, Water Pump, and Fan Assembly. Insert the cylinder block water distributor tube in the cylinder block so that end of tube is flush with front surface of block. Install a new water pump gasket and place the water pump in position on the cylinder block. Place the generator belt tension adjusting arm in position and install the cap screw which holds it in place, but do not tighten until the fan belt is adjusted. Install the other screws for the water pump and tighten securely. Install the water pump by-pass elbow and hose assembly on the water pump, using new gaskets. Install the fan pulley, fan hub to pulley spacer, and fan blade, and tighten cap screws securely. Place fan belt in position on pulleys and adjust by pulling generator out until there in ½-inch deflection in the belt. Secure the belt tension adjusting arm and generator to mounting bracket bolts.

p. Install Oil Filler Pipe and Oil Level Bayonet Type Gage With Cap Assembly. Install the oil filler pipe with a new oil filler pipe gasket and tighten the two cap screws securely. Screw the oil level gage pipe into the cylinder block and place the oil level bayonet type gage, with cap, assembly in position in the pipe.

Note. Do not install oil level gage pipe if starter is to be installed on engine.

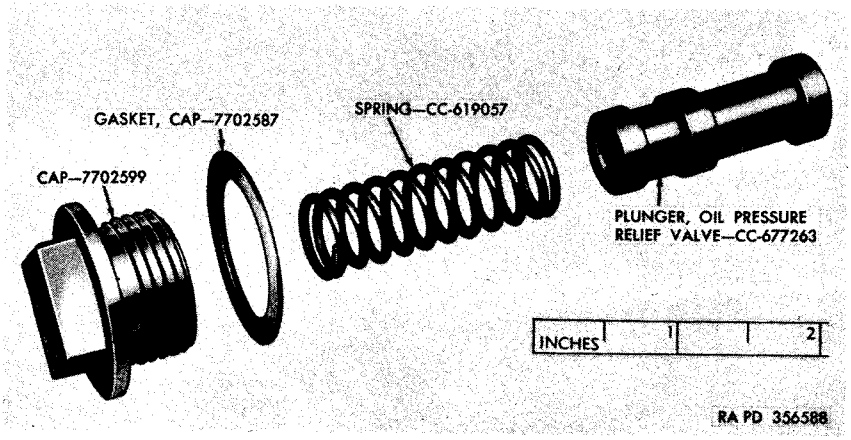


Figure 95. Oil pressure relief valve—exploded view.

q. Install Oil Pressure Relief Valve (fig. 95). Before installing the oil pressure relief valve, apply compressed air to the oil pressure relief valve opening to remove any dirt or foreign matter. The valve must be assembled with the small shoulder or solid end toward the seat and the large shoulder or drilled end toward the spring. Wash the oil pressure relief valve plunger, spring, and cap in engine oil, and install in that order with a new cap gasket under the cap.

r. Install Clutch Housing and Flywheel (fig. 58).

(1) Install clutch housing.

(2) Install clutch housing pan dust seal plate.

(3) Install flywheel.

s. Install Clutch. Refer to TM 9–840 for installation procedures for the clutch.

50. Installation of Accessories

This paragraph describes the procedures necessary to install the engine accessories. Various precautions must be taken when installing gaskets, seals, and other parts that act as sealing agents. All gaskets and seals should be replaced.

a. General. After the accessories have been cleaned, repaired, or replaced, they are ready for installation on the engine.

b. Distributor and Oil Pump.

(1) When the distributor and oil pump are installed, care must be taken to install these two units properly in order that ignition timing will be correct.

(2) Turn the crankshaft, with the aid of a wrench on the crankshaft cranking jaw, until the number one piston is in the firing position and at the exact "TDC" (top dead center) position. Top dead center is indicated on the fan drive pulley hub and the firing position of the piston is obtained by hold-

ing a finger over the spark plug hole, while turning the engine, and noting a pressure on the finger when the piston is coming up on the compression stroke.

Note. When obtaining this setting of the piston, do not back up on the crankshaft to place the indicator on "TDC." This will cause slack in the timing chain to be taken up and the piston will not be in the correct position in relation to the distributor drive gear position.

(3) Note that the slot in the distributor drive gear (fig. 96), is offset. This prevents incorrect positioning of the distributor. Place the distributor drive gear slot parallel with the oil pump mounting holes, with the narrow side of the offset placed

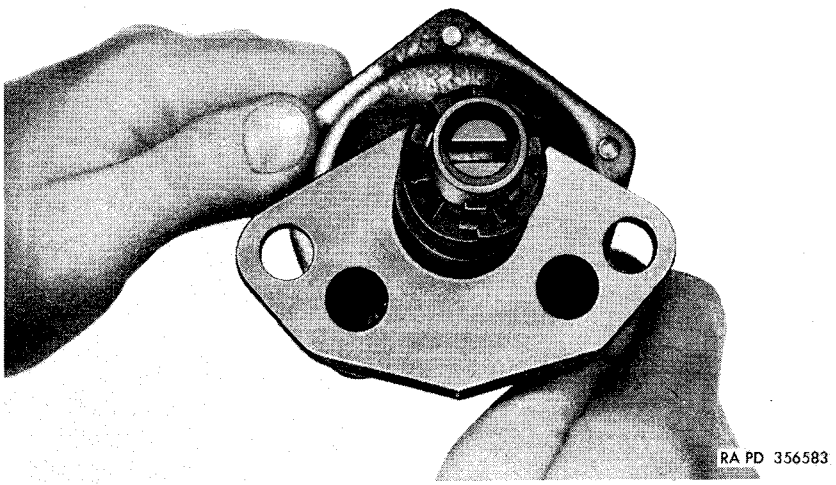


Figure 96. Alinement of distributor drive gear.

toward the heavy portion of the oil pump mounting flange. With the distributor drive gear (fig. 97) in this position, note that one tooth on the gear is directly in line with the opening in the oil pump shaft housing.

(4) With the fingers, turn the distributor drive gear (fig. 97) in a counterclockwise direction to the next tooth on the gear.

(5) Leave the distributor drive gear in this position and install the oil pump using new oil pump gasket.

(6) Remove distributor cap and place rotor in approximately the 7 o'clock position with the contact points just about to open. Make certain the cork oil seal washer is in place and position the distributor on the engine and push it into the cylinder block opening. If resistance is felt on the distributor and it will not go into place, turn the rotor slightly in one direction or the other and it will drop into place. Install distributor lock screw and time ignition so that the contact

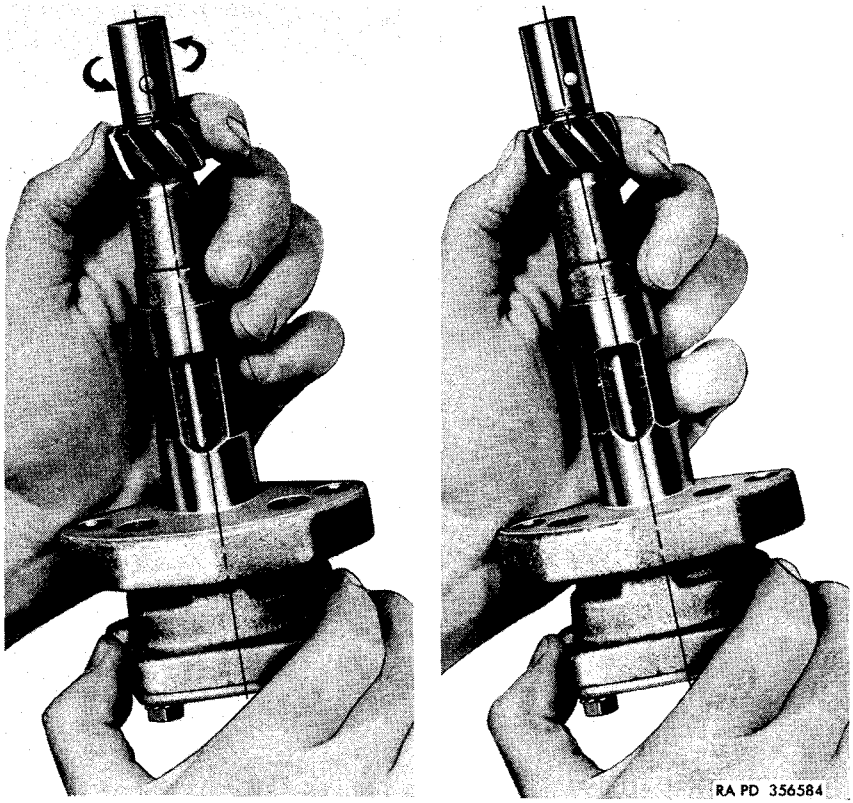


Figure 97. Positioning of distributor drive gear ready for installation of oil pump.

points are just about to open. Install distributor and coil cover.

c. Starter.

(1) Install new mounting seal on starter housing (fig. 98).

(2) When installing the starter some difficulty may be experienced due to interference with the distributor assembly. However, if the distributor is loosened and rotated clockwise, the starter will clear and can be easily installed. After locating the starter in its proper position, install nuts and lock washers and tighten securely. Retime ignition.

(3) Screw the oil level gage pipe into the cylinder block and place the oil level bayonet type gage, with cap, assembly in position in the pipe.

d. Fuel Pump.

(1) Place new gasket on fuel pump flange and position fuel pump on engine.

(2) Install special fuel pump mounting screws and tighten securely.

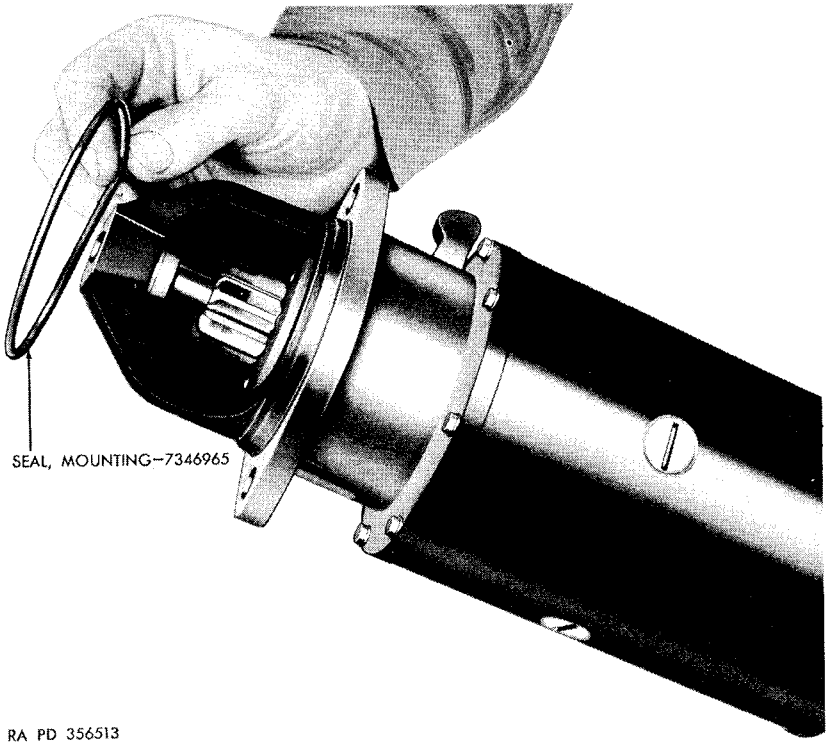


Figure 98. Installing mounting seal on starter housing.

(3) Connect fuel pump to manifold, to windshield wiper, to carburetor, and fuel filter to fuel pump lines.

(4) Install heat shield.

e. Oil Filter.

(1) Install oil filter clamp (fig. 24) to mounting bracket, but do not tighten mounting screws. Install oil filter assembly in mounting clamp and secure with $\frac{5}{16}$–18 x $2\frac{1}{2}$ machine screws, $\frac{5}{16}$-inch lock washer, and $\frac{5}{16}$ x 18 square nut. Tighten mounting screws.

(2) Connect inlet and outlet lines to oil filter assembly.

f. Carburetor.

(1) Use a new carburetor to manifold flange gasket and place carburetor in position on manifold studs. Install lock washers and nuts.

(2) Install carburetor air cleaner elbow.

(3) Connect throttle and choke control wires and accelerator control rod.

(4) Connect all vent lines to carburetor air cleaner elbow.

(5) Install air cleaner assembly.

(6) Connect fuel pump to carburetor line at carburetor.

g. Sending Units.

(1) Install oil pressure sending unit and install sending unit bracket on oil filler pipe.

(2) Install water temperature gage sending unit on cylinder head.

(3) Connect master cylinder vent line and fuel tank vent line.

(4) Connect distributor vent lines.

51. Preparation, Run-in, and Test

a. General. Check all oil connections for tightness, and see that cylinder head bolts are tight. Give complete engine assembly a general visual check to see that all accessories, components, and parts are in proper place and secure. When the above inspections have been made, install the engine on a dynamometer or test stand, following the manufacturer's instructions for the installation. If proper equipment is available, preoil the engine by forcing oil under pressure into the oiling system. If proper equipment is not available, fill the oil pan with the proper grade and amount of engine oil.

b. Run-in Schedules. Rebuilt engines should be started and run-in according to table III.

Table III.—Run-in Schedules

Period	Time*—minutes	Speed		Bhp load	Load, percent of rated bhp	Inches of vacuum
		Percent of rated, rpm	Engine, rpm			
1	20	30	960	0	0	19. 0
2	20	37. 5	1, 200	17. 6	22	16. 8
3	20	44	1, 400	24. 4	30	15. 6
4	20	50	1, 600	28. 4	35	14. 8
5	20	56	1, 800	34. 0	42	13. 6
6	30	62. 5	2, 000	37. 3	46	12. 8
7	30	75	2, 400	39. 7	49	12. 4
8	30	87. 5	2, 800	44. 5	55	11. 4
9	5	57	1, 800	26. 0	32	15. 2
10	10	32	1, 000	0	0	19. 0

*Total time: 3 hours 25 minutes.

c. Adjust Valves. Run engine at low speeds until it reaches normal operating temperature of 160° to 185° F. Adjust intake valves to 0.010-inch clearance. Refer to TM 9–840 for adjustment procedure.

d. Continue Run-in Procedure. Refer to *b* above.

e. Crankcase Pressure. When run-in procedure is complete, test the tightness of all engine connections for deep water fording. This test is made by closing the crankcase ventilator valves on the intake manifold and the air cleaner elbow. Disconnect the vent line from

the shut-off valve located on the air cleaner elbow and connect a low pressure gage to the end of the line. Run the engine at idling speed and watch gage reading. Pressure in the crankcase should build up to a minimum of 2½ psi in 2 minutes. If the pressure fails to reach this minimum, leakage in the system is evident. Leaks are possible at the crankcase oil filler pipe cap, valve covers, and oil pan. These points should be checked and gaskets replaced if necessary.

Section IX. ASSEMBLY OF POWER PLANT AND INSTALLATION IN VEHICLE

52. Installation of Clutch Assembly

a. General. When the power plant is ready for assembly, clean all mating surfaces free of dirt and foreign matter. If, for any reason, the clutch housing has been removed, check to see that both dowel pins are in position on the engine block.

b. Install Clutch Cover and Pressure Plate Assembly.

(1) Coat the bearing in the end of the crankshaft with general purpose grease GAA.

(2) Wipe the contact surfaces of the flywheel and pressure plate with a clean, dry cloth to remove all oil and dirt.

(3) Hold the driving disk assembly in place against the flywheel with the damper assembly to the rear and install the pressure plate and cover assembly over the disk.

(4) Attach the cover to the flywheel with the cap screws and lockwashers, but do not tighten.

(5) Insert the clutch plate alining tool 41–T–3085 through the clutch and aline the driving disk assembly with the tool centered in the crankshaft bearing.

(6) Tighten the clutch cover cap screws evenly to avoid distortion of the cover.

(7) Place the clutch release fork in the housing and install the release fork flange. Insert the Woodruff key in the release fork and install the clutch release fork lever.

(8) Install the clutch release bearing and sleeve, and connect the pullback spring to the pullback spring screw on the clutch housing. Install the clutch housing pan.

53. Installation of Transmission

a. General. After the clutch has been installed, the transmission can also be installed.

b. Install Transmission. With the aid of a jack, chain fall, or helper, raise the transmission into place and position it against the clutch housing. Install the four transmission mounting screws and tighten securely.

54. Installation of Radiator

a. General. Before installing the radiator, always replace old radiator hose, and bent or worn hose clamps Clean all hose connections on the radiator. Install the lower (outlet) radiator hose assembly on the radiator before proceeding with the radiator installation.

b. Install Radiator. Use a suitable support, or jack, and position the radiator in front of the engine assembly. Install both left and right radiator support brackets, and connect the lower (outlet) radiator hose to the water pump connection. Install the upper (inlet) radiator hose. Close both cooling system drain cocks and fill cooling system with correct amount of coolant.

55. Installation of Power Plant in Vehicle

a. General. Before installing the power plant, check to make sure that all parts and accessories have been properly installed in the same position as when removed.

b. Install Power Plant. Refer to TM 9–840.

CHAPTER 5

CLUTCH

Section I. DESCRIPTION AND DATA

56. Description

The clutch assembly (fig. 100) is composed of two major units; the pressure plate and cover assembly and driving disk assembly. The pressure plate and cover assembly consists of pressure plate, nine compression springs, three release levers, and cover. The driving disk assembly consists of disk, two facings, and a spring loaded center disk.

57. Data

Type ..... single dry disk
Torque capacity ..... 231 lb-ft
Driving disk:
  Make ..... Borg and Beck
  Facings ..... 2, molded, woven asbestos
  Facing diameter—inside ..... 6 in
  Facing diameter—outside ..... 10 in
  Facing thickness ..... 0.125 in
  Vibration damping method ..... spring loaded center disk
Pressure plate and cover assembly:
  Make ..... Borg and Beck
  Number of springs 9
  Total spring pressure ..... 1,504 lb
Release bearing—type ..... ball-prelubricated

Section II. REBUILD OF CLUTCH ASSEMBLY

58. Disassembly of Clutch

a. General. If the driving disk assembly shows signs of extreme wear, it should be replaced or rebuilt. If the clutch cover assembly is broken, worn, or shows signs of extreme wear, it must be replaced or rebuilt.

b. Disassembly of Clutch (fig. 100). The clutch can be disassembled by mounting the clutch on clutch rebuilder 41–C–2480 and compressing the cover in accordance with the instructions of the rebuilding tool manufacturer.

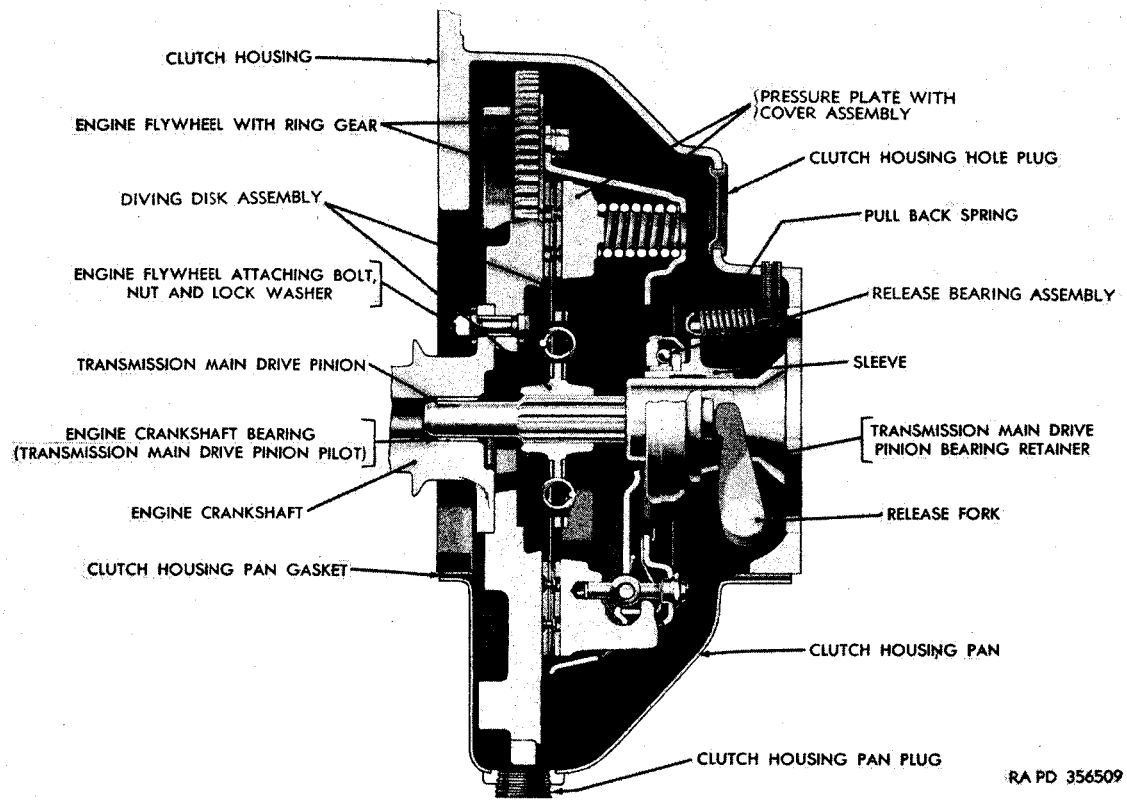


Figure 99. Clutch.

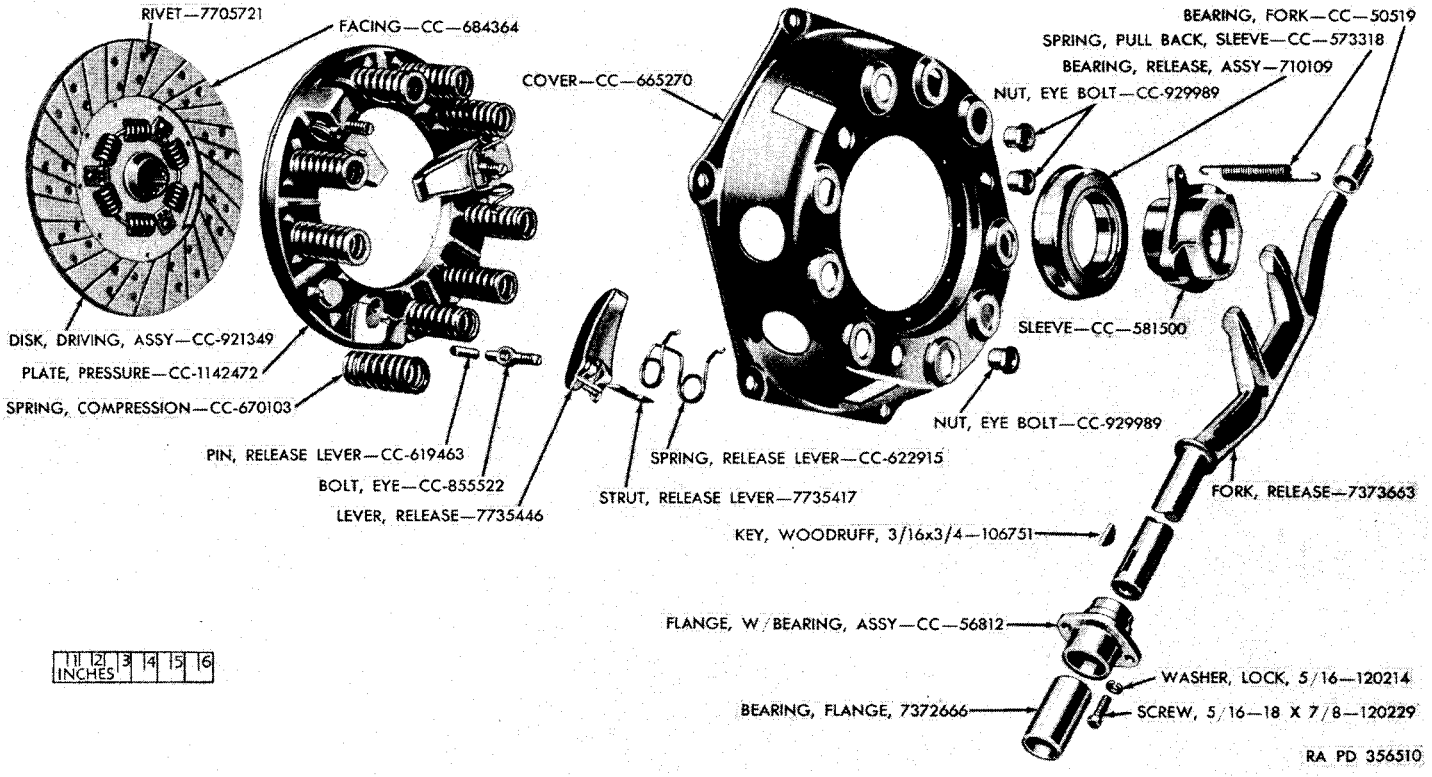


Figure 100. Clutch—exploded view.

c. Dissassembly of Pressure Plate and Cover. Remove the three eye bolt nuts. Release the cover with the clutch rebuilder 41–C–2480 according to the instructions of the tool manufacturer. Remove the cover and detach the release lever spring from the pressure plate. Remove the release levers (fig. 101) by holding the eye bolt, while lifting the inner end of the release lever as high as possible. Press down on the eye bolt to keep it in its socket and lift the release lever strut over the ridge at the outer end of the lever. Lift the eye bolt off

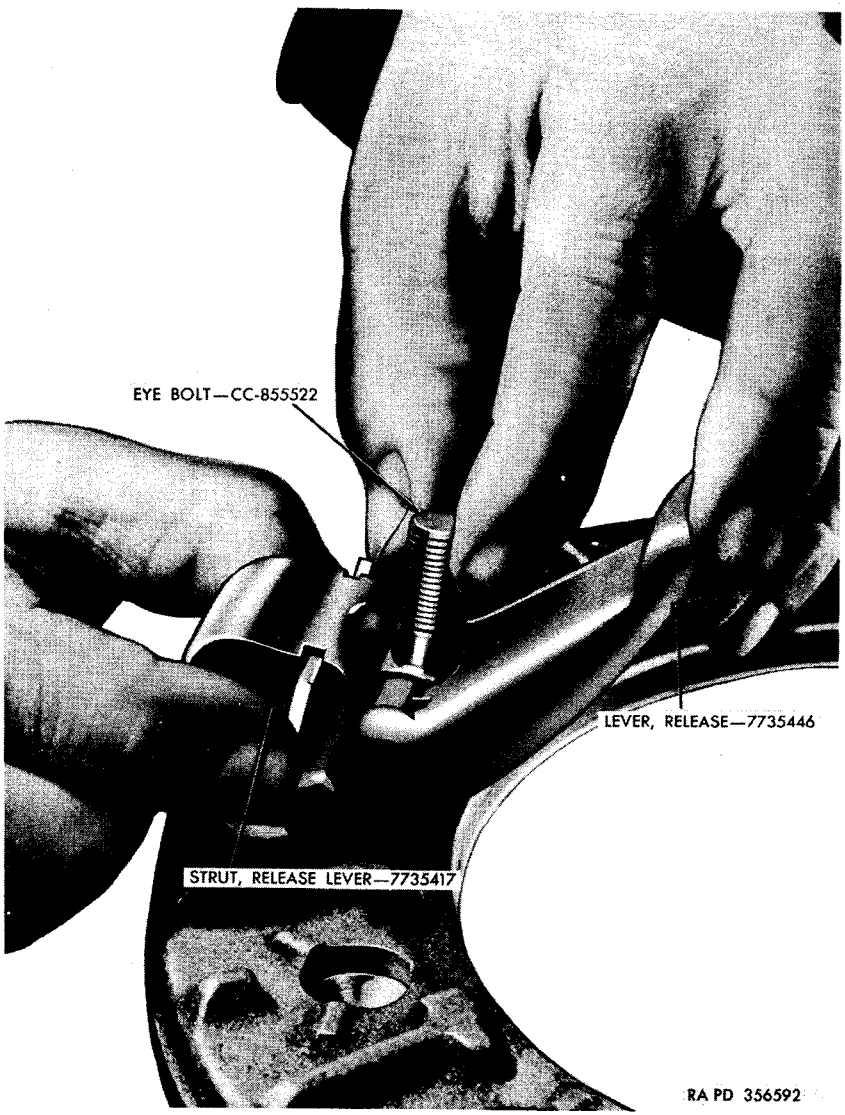


Figure 101.. Removing or installing release lever.

the pressure plate and remove the strut. Release the clutch from the rebuilder and remove the pressure plate.

59. Inspection, Cleaning, and Repair of Clutch Parts

a. General. After the clutch has been disassembled, inspect all parts for excessive wear or damage as outlined in *c* through *f* below.

b. Cleaning Parts. Wash all parts in volatile mineral spirits or dry cleaning solvent and dry with compressed air.

Note. The clutch release bearing is packed with lubricant when manufactured and requires no further lubrication.

c. Inspection of Driving Disk Assembly. Examine driving disk assembly for broken or loose compression springs, broken disk, loose or broken rivets. Try the fit of the driving disk hub on a transmission input shaft that is not worn in the splines. This will determine if it is too loose and unfit for further service. Check the surface of the disk and driving disk facings for wear and warpage. Replace the disk assembly if necessary. Inspect the facings for oil or grease, excessive wear, loose rivets, or damaged facings. If only the facings are worn, or damaged, replace the facings.

d. Inspection of Pressure Plate and Flywheel Surface. Examine the flywheel and pressure plate surfaces for scoring, ridges, or cracks.

e. Inspect Pressure Plate Cover, Pressure Plate, and Compression Springs. Inspect the driving slots in the pressure plate cover for wear. Examine the attaching flange or rim of the cover for warpage. Examine the cover carefully for cracks. If any of these conditions exist, replace the cover. Check the clutch compression springs with valve and clutch spring tester. Replace springs that exceed repair and rebuild standards (par. 73). Replace the release lever springs if distorted, stretched, or damaged by overheating.

f. Inspecting Release Levers, Eye Bolts, Release Lever Pins, Release Lever Struts, and Release Bearing Assembly. Carefully examine all parts and replace any that appear worn or damaged. Inspect the release bearing assembly for roughness, extreme looseness of the bearing races, and free fit on the bearing sleeve. Replace bearing if worn or damaged.

g. Refacing Driving Disk. Drill out the old rivets and remove the old facings from the driving disk. Do not punch the rivets out as the punch will damage the clutch cushion springs. After removing the old facings, clean the driving disk. Remove any burs or rough edges around the rivet holes or disk with a file. Rivet new facings of the proper thickness (0.125 in.) on the disk with a relining machine.

Note. Do not permit grease or oil to come in contact with clutch facings.

60. Assembly of Clutch

a. General. When the clutch has been inspected, cleaned, and repaired, it is then ready to be assembled.

b. Assembly. Remove all oil, grease, and dirt from the surface and accessories of the clutch rebuilder 41–C–2480. Install the pressure plate on the clutch rebuilder.

(1) *Installing eye bolts and release levers.* Place the pressure plate in a convenient working position and lightly coat the release lever pin, the plain end of the eye bolt, and the edges of the release lever strut with general purpose lubricant GAA. Install lever pin in the eye bolt. Place the release lever over the threaded end of the eye bolt so the groove of the lever fits over the lever pin. Hold the threaded end of the eye bolt (fig. 101) and raise the inner end of the lever as high as possible. Place the lever strut in the slot of the pressure plate lug. Lift the strut up into the lug slot and tilt it so it will pass the ridge on the lower end of the lever. Drop it into the groove in the lever. Follow this procedure with the other two eye bolts and lever parts.

(2) *Assembling cover to pressure plate.* Place the compression springs over the bosses of the pressure plate. Assemble the

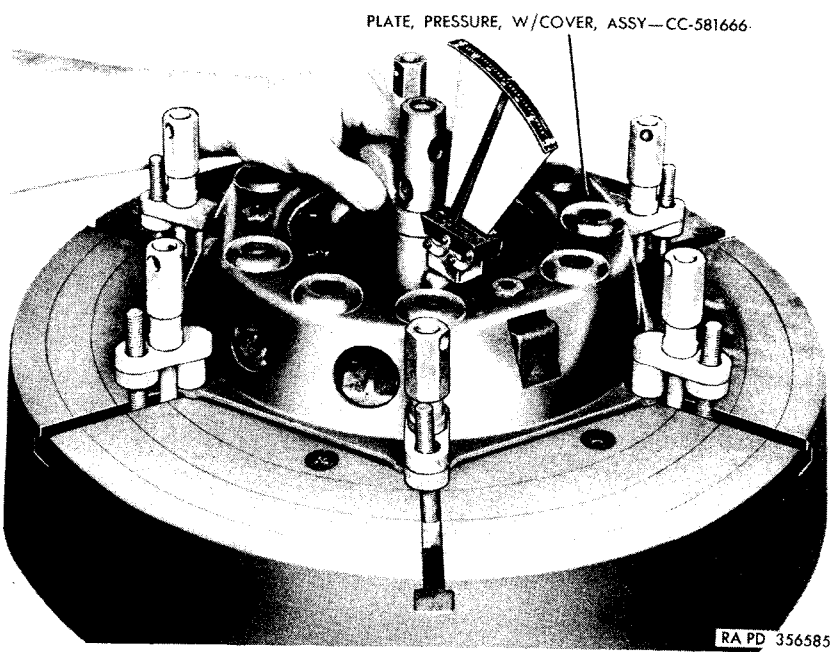


Figure 102. Checking release lever adjustment with clutch rebuilder 41–C–2480

release lever spring to the cover. Hook the free ends of the spring through the small holes in the inside rim of the top of cover and move the coils so they rest against the inside of cover. Coat the sides of the pressure plate driving lugs where they are fitted into the cover with graphite grease, as this will prevent squeaking. Place the cover carefully over the pressure plate so the ends of the compression springs fit into the seats in the cover and the ends of the eye bolts are in line with the holes in the cover.

(3) *Compressing cover on pressure plate.* Compress the cover on the pressure plate with clutch rebuilder 41–C–2480. Make sure the driving lugs of the pressure plate are lined up in the holes in the cover and that the compression springs are not cocked or off their seat while compressing the pressure plate assembly.

(4) *Installing eye bolt nuts.* Continue to compress the assembly until the cover flange rests against the rebuilder base. Screw the eye bolt nuts, large end toward the cover, on the eye bolts until the top of the nuts and end of eye bolts are flush. Slowly release the pressure on the compression springs.

(5) *Checking and adjusting release lever* (fig. 102). Adjust the release levers for proper position whenever the clutch is disassembled or whenever clutch parts are replaced or repaired. Install the rebuilder indicator gage and measure the position of the levers. Make lever adjustments carefully so that all levers will be adjusted evenly. Adjust the lever up or down by turning the eye bolt nut until the proper setting is obtained. Then, move the rebuilder gage to the other two release levers and adjust in the same manner. Stake the adjusting nuts to lock them in place.

Note. Adjust release levers so that measurement from ground surface of flywheel to top of release levers is 1.9375 inch±0.031 inch with 0.330-inch steel plate assembled in place of clutch driving disk.

CHAPTER 6

REPAIR AND REBUILD STANDARDS

61. General

The repair and rebuild standards included herein give the minimum and the maximum sizes and clearances of new or rebuilt parts as well as wear limits, which indicates that point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear limits" column or damaged from corrosion will be approved for service. Minimum, maximum, and wear limit dimensions are inches unless otherwise specified.

62. Cylinders

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts		Wear limits
			Min	Max	
103	F	Nominal bore diameter and maximum wear.	3. 250	3. 252	3. 260
41	----	Out-of-round	0. 000	0. 001	0. 0025
41	----	Taper	0. 000	0. 001	0. 010

63. Main Bearings

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts		Wear limits
			Min	Max	
56	----	Clearance of bearing to crankshaft (main).	0. 0002	0. 0022	0. 004
57	----	End play of crankshaft in bearings when installed.	0. 003	0. 007	0. 010

64. Crankshaft

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts		Wear limits
			Min	Max	
103	K	Main bearing journals, nominal diameter, and max wear.	2. 4995	2. 5005	2. 498
		Out-of-round	0. 0000	0. 0003	0. 0015
		Taper	0. 0000	0. 0005	0. 0015
		Run-out of nearest center main journal when supported at each end.	0. 0000	0. 003	0. 005
103	G	Connecting rod journals, nominal diameter, and max wear.	2. 0615	2. 0625	2. 0605
		Out-of-round	0. 0000	0. 0005	0. 0015
		Taper	0. 0000	0. 0005	0. 0015
		Run-out of crankshaft when supported at each end.	0. 000	0. 002	0. 004
		Run-out of flywheel mounting face	0. 000	0. 012	0. 018

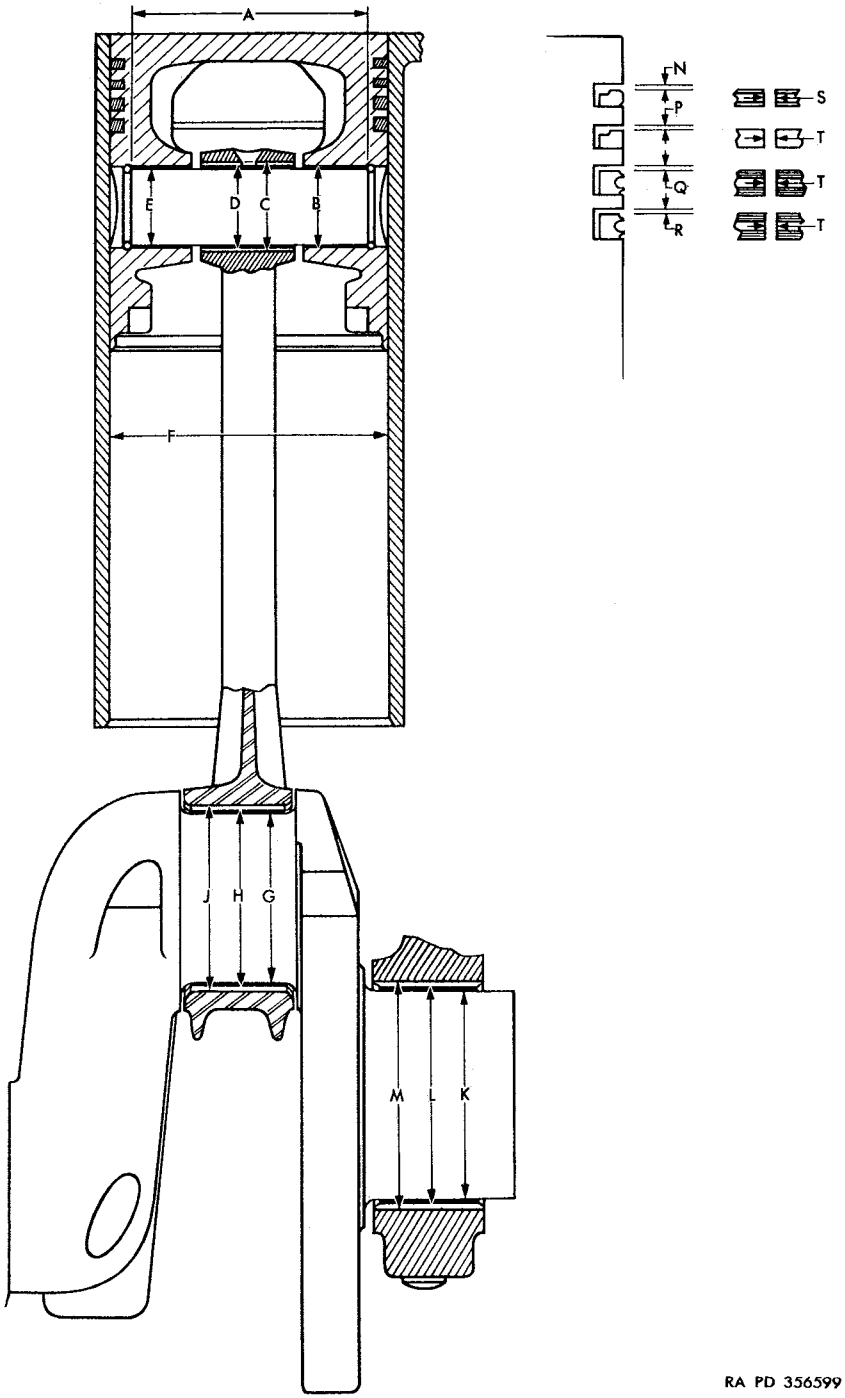


Figure 103. Crankshaft, connecting rod and piston tolerances.

65. Camshaft

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts: Min	Sizes and fits of new parts: Max	Wear limits
		Diameter of journals:			
104	H	No. 1 journal	1. 998	1. 999	1. 997
104	F	No. 2 journal	1. 9665	1. 9675	1. 9655
104	D	No. 3 journal	1. 935	1. 936	1. 934
104	A	No. 4 journal	1. 2475	1. 2485	1. 2465

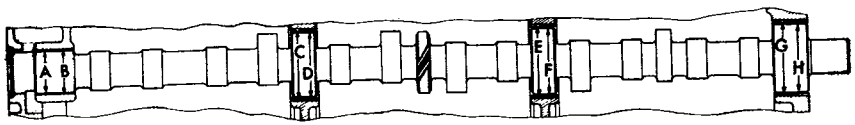


Figure 104. Camshaft tolerances.

66. Camshaft Bearings

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts: Min	Sizes and fits of new parts: Max	Wear limits
		Clearance between camshaft journal and bearing.			
		No. 1	0. 001	0. 003	0. 004
		Nos. 2, 3, 4	0. 0015	0. 0035	0. 004
		End play of camshaft when installed	0. 002	0. 006	0. 010

67. Valve Tappets

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts: Min	Sizes and fits of new parts: Max	Wear limits
68		Clearance, tappet to cylinder block	0. 0000	0. 001	0. 0015
69		Diameter, tappet	0. 6235	0. 624	0. 6225

68. Valves and Valve Springs

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts: Min	Sizes and fits of new parts: Max	Wear limits
13	C	Intake valve:			
		Stem diameter	0. 340	0. 341	0. 3435
		Stem to guide clearance	0. 001	0. 003	0. 005
13	B	Exhaust valve:			
		Stem diameter	0. 340	0. 341	0. 3385
		Stem to guide clearance	0. 002	0. 004	0. 007
		Valve springs:			
		Compressed length of 1¾ in	40 lb	45 lb	
		Compressed length of 1⅜ in	110 lb	120 lb	

69. Connecting Rods

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts: Min	Sizes and fits of new parts: Max	Wear limits
103	H–G	Clearances connecting rod bearing to crankshaft.	0. 0001	0. 0021	0. 004
		Side clearances of connecting rod bearing to crankshaft.	0. 0055	0. 0115	0. 021
103	D–E	Fit between piston pin and connecting rod bearing at 70° F.	−0. 0001	+0. 0004	0. 001

70. Pistons

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts: Min	Sizes and fits of new parts: Max	Wear limits
		Width of ring groove:			
		Groove No. 1—top	0. 096	0. 097	0. 099
		Groove No. 2	0. 0955	0. 0965	0. 0985
		Groove No. 3	0. 156	0. 157	0. 159
		Groove No. 4	0. 156	0. 157	0. 159
103	E	Piston pin diameter	0. 8591	0. 8593	0. 8589
103	B–E	Fit between pin and piston at 70° F	0. 0000	0. 0003	0. 001
		Clearance, piston to bore, thrust side, ¾-in from bottom of skirt with piston at proper cam dimensions.	0. 0002	0. 0012	0. 003

71. Piston Rings

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts: Min	Sizes and fits of new parts: Max	Wear limits
		Gap clearance (when fitted in cylinder):			
103	S	Upper compression ring	0. 007	0. 017	0. 030
103	T	Lower compression ring and oil rings.	0. 007	0. 015	0. 030
		Clearance of ring in groove of piston:			
103	N	Groove No. 1	0. 0025	0. 004	0. 008
103	P	Groove No. 2	0. 002	0. 0035	0. 006
103	Q	Groove No. 3	0. 001	0. 0025	0. 004
103	R	Groove No. 4	0. 001	0. 0025	0. 004

72. Oil Pump

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts: Min	Sizes and fits of new parts: Max	Wear limits
74	----	End play between rotor and cover	0. 001	0. 003	0. 004
75	----	End play drive shaft	0. 001	0. 003	0. 004
73	----	Clearance between rotor to body—radial.	0. 0045	0. 008	0. 008
72	----	Clearance between rotors (eccentricity of outside rotor in body considered).	0. 0041	0. 0106	0. 010

73. Clutch

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts: Min	Sizes and fits of new parts: Max	Wear limits
100	----	Diameter of clutch release fork:			
		Right end	0. 753	0. 755	0. 750
		Left end	0. 748	0. 750	0. 745
		Clutch compression springs, compressed length of 1 1/16 in.	150 lb	160 lb	

74. Water Pump

Fig. No.	Ref. ltr.	Point of measurement	Sizes and fits of new parts: Min	Sizes and fits of new parts: Max	Wear limits
76	----	Diameter of shaft:			
		Large diameter	0. 6688	0. 6694	0. 664
		Small diameter	0. 593	0. 594	0. 589
		Shaft end play	0. 003	0. 005	0. 020

75. Torque Specifications

Fig. No.	Ref. ltr.	Location	Torque lb-ft
13	HH	Main bearing cap screws	80–85
49	----	Cylinder-head bolts	65–70
13	AE	Connecting rod hex nuts	45–50
12	AA	Cranking jaw	110 min.
		Intake and exhaust manifold stud nuts	15–20

APPENDIX
REFERENCES

1. Publication Indexes

The following publication indexes and lists of current issue should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to matériel covered in this manual:

Index of Administrative Publications	SR 310–20–5
Index of Army Motion Pictures, Kinescope Recordings and Film Strips.	SR 110–1–1
Index of Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Army Training Tests, Graphic Training Aids, Joint Army-Navy-Air Force Publications, Combined Communications Board Publications, and Army Communications Publications).	SR 310–20–3
Index of Blank Forms and Army Personnel Classification Tests.	SR 310–20–6
Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.	SR 310–20–4
Introduction and Index (supply catalogs)	ORD 1
Military Training Aids	FM 21–8
Ordnance Major Items and Major Combinations and Pertinent Publications	SB 9–1

2. Supply Catalogs

The following catalogs of the Department of the Army Supply Catalog pertain to this matériel:

a. Destruction to Prevent Enemy Use.

Land Mines and Fuzes, Demolition Material, and Ammunition for Similated Artillery and Grenade Fire.	ORD 11 SNL R–7

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b. Repair and Rebuild.

Antifriction Bearings and Related Items	ORD 5 SNL H–12
Cleaners, Preservatives, Lubricants, Recoil Fluids, Special Oils, and Related Maintenance Materials.	ORD 3 SNL K–1
Electrical Fittings	ORD 5 SNL H–4
Items of Soldering, Metallizing, Brazing, and Welding Materials: Gases and Rlated Items.	ORD 3 SNL K–2
Lubricating Equipment, Accessories, and Related Dispensers.	ORD (*) SNL K–3
Lubricating Fittings, Oil Filters, and Oil Filter Elements.	ORD 5 SNL H–16
Major Items and Major Combinations of Group G.	ORD 3 SNL G–1
Miscellaneous Hardware	ORD 5 SNL H–2
Oil Seals	ORD 5 SNL H–13
Ordnance Maintenance Sets	ORD 6 SNL N–21
Pipe and Hose Fittings	ORD 5 SNL H–6
Shop Set, Auto Fuel and Electrical System, Field Maintenance.	ORD 6 SNL J–8, Sec. 12
Shop Set, Contact and Emergency Repair, Field Maintenance.	ORD 6 SNL J–8, Sec. 13
Shop Set, Engine Rebuild Company (Automotive) Depot Maintenance.	ORD 6 SNL J–9, Sec. 3
Shop Set, Headquarters and Service Company, Depot Maintenance Automotive or Armament.	ORD SNL J–9, Sec. 2
Shop Set, Maintenance (Field) Automotive.	ORD 6 SNL J–8, Sec. 13
Standard Hardware	ORD 5 SNL H–1
Tool Set, Auto Fuel and Electrical System Repairman (MOS 3912).	ORD 6 SNL J–10, Sec. 8
Tool Set, General Mechanics	ORD 6 SNL J–10, Sec. 4
Tool Set, Maintenance (Field), Motor Vehicle Assembly Company.	ORD 6 SNL J–8, Sec. 7
Tool Sets (Special), Motor Vehicles	ORD 6 SNL J–16 series

c. Vehicle.

Trucks ¾-Ton, 4 x 4, M37, M42, M43, and V41 ( ) GT.	ORD (*) SNL G–741

* See ORD 1 for published catalogs of the ordnance section of the Department of the Army Supply Catalog.

3. Forms

The following forms are applicable to this matériel:

DA Form 9–68, Spot Check Inspection Report for Wheeled and Half-Track Vehicles.
WD AGO Form 9–71, Locator and Inventory Control Card.
WD AGO Form 9–72, Ordnance Stock Record Card.
WD AGO Form 9–76, Request for Work Order.
WD AGO Form 9–77, Job Order Register.
WD AGO Form 9–78, Job Order.
DA AGO Form 9–79, Parts Requisition.
WD AGO Form 9–80, Job Order File.
WD AGO Form 9–81, Exchange Part of Unit Identification Tag.
DA Form 446, Issue Slip.
DA Form 447, Turn-In Slip.
WD AGO Form 460, Preventive Maintenance Roster.
DA AGO Form 461, Preventive Maintenance Service and Inspection for Wheeled and Half-Track Vehicles.
DA AGO Form 461–5, Limited Technical Inspection.
DA Form 468, Unsatisfactory Equipment Report.
WD AGO Form 478, MWO and Major Unit Assembly Replacement Record and Organizational Equipment File.
WD AGO Form 865, Work Order.
WD AGO Form 866, Consolidation of Parts.
WD AGO Form 867, Status of Modification Work Order.
DD Form 6, Report of Damage or Improper Shipment.

4. Other Publications

The following publications contain information pertinent to this matériel and associated equipment.

a. Camouflage.

Camouflage	TM 5–267
Camouflage, Basic Principles	FM 5–20
Camouflage of Vehicles	FM 5–20B

b. Decontamination.

Decontamination	TM 3–220
Decontamination of Armored Force Vehicles	FM 17–59
Defense Against Chemical Attack	FM 21–40

c. Destruction to Prevent Enemy Use.

Explosives and Demolitions	FM 5–25
Ordnance Service in the Field	FM 9–5

d. General.

Cooling Systems: Vehicles and Powered Ground Equipment.	TM 9–2858
Inspection of Ordnance Matériel in the Hands of Troops.	TM 9–1100
Lubrication Order	LO 9–840
Military Vehicles (Ordnance Corps Responsibility).	TM 9–2800
Motor Vehicles	AR 700–105
Precautions in Handling Gasoline	AR 950–20
Principles of Automotive Vehicles	TM 9–2700
Report of Accident Experience	SR 385–10–40
Storage Batteries, Lead-Acid Type	TM 9–2857

e. Repair and Rebuild.

Cleaning, Preserving, Sealing and Related Materials Issued for Ordnance Matériel.	TM 9–850
Disposal of Supplies and Equipment: Uneconomically Repairable Ordnance Vehicles.	SR 755–10–5
Hand, Measuring, and Power Tools	TM 10–590
Instruction Guide: Care and Maintenance of Ball and Roller Bearings.	TM 37–265
Instruction Guide: Welding Theory and Application.	TM 9–2852
Lubrication	TM 9–2835
Maintenance and Care of Hand Tools	TM 9–867
Maintenance of Supplies and Equipment: Main tenance Responsibilities and Shop Operations.	AR 750–5
Modification of Ordnance Matériel	SB 9–38
Motor Vehicle Inspection and Preventive Maintenance Services.	TM 37–2810
Ordnance Field Maintenance	FM 9–10
Ordnance Maintenance: Carburetors (Carter)	TM 9–1826A
Ordnance Maintenance: Electrical Equipment (Auto-Lite).	TM 9–1825B
Ordnance Maintenance: Electrical Equipment (Delco Remy).	TM 9–1825A
Ordnance Maintenance: Electrical Equipment (Bendix-Scintilla).	TM 9–1825E
Ordnance Maintenance: Hydraulic Brakes (Wagner-Lockheed).	TM 9–1827C
Ordnance Maintenance: Fuel Pumps	TM 9–1828A
Ordnance Maintenance: Speedometer, Tachometer, and Recorders.	TM 9–1829A
Ordnance Maintenance: Vehicular Maintenance Equipment, Grinding, Boring, Valve Reseating Machines, and Lathes.	TM 9–1834A

Painting Instructions for Field Use	TM 9–2851
Parts Reclamation from Tactical and Administrative Vehicles.	SR 750–130–10
Preparation of Ordnance Matériel for Deep-Water Fording.	TM 9–2853
Preventive Maintenance of Electric Motors and Generators.	TM 55–405
Supplies and Equipment—General: Unsatisfactory Equipment Report.	SR 700–45–5
f. Operation.	
¾-Ton 4 x 4 Cargo Truck M37, Utility Truck M42, Ambulance Truck M43, and Telephone Installation, Light Maintenance and Cable Splicing Truck, V–41 ( ) GT (Dodge).	TM 9–840
g. Shipment and Standby or Long-Term Storage.	
Army Shipping Document	TM 38–705
Instruction Guide: Ordnance Packaging and Shipping (Posts, Camps, and Stations).	TM 9–2854
Marking and Packing of Supplies and Equipment: Marking of Oversea Supply.	SR 746–30–5
Military Standard Marking of Shipments	MIL–STD–129 [1]
Ordnance Storage and Shipment Chart—Group G, Major Items and Major Combination of Group G.	TB 9–OSSC–G
Preparation of Unboxed Ordnance Matériel for Shipment.	SB 9–4
Preservation, Packaging, and Packing of Military Supplies and Equipment.	TM 38–230
Protection of Ordnance General Supplies in Open Storage.	TB ORD 379
Shipment of Supplies and Equipment: Report of Damaged or Improper Shipment.	SR 745–45–5
Standards for Overseas Shipment and Domestic Issue of Ordnance Matériel Other than Ammunition and Army Aircraft.	TB ORD 385
Storage, Inspection, and Issue of Unboxed Serviceable Vehicles; Preparation of Unserviceable Vehicles for Storage and Deprocessing of Matériel Prior to Operation.	SB 9–63

[1] Copies may be obtained from Aberdeen Proving Ground, Aberdeen, Md.

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