Security Information

DEPARTMENT OF THE ARMY TECHNICAL MANUAL TM 9-1730F

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER TO 19-45-133

ORDNANCE MAINTENANCE:

AUXILIARY GENERATOR (DELCO PRODUCTS MODEL GM-A-8585) AND ENGINE (DETROIT DIESEL GMC TYPE A41-1)

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
JANUARY 1952

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UNCLASSIFIED

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AUXILIARY GENERATOR
(DELCO PRODUCTS MODEL GM-A-8585)
AND ENGINE
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DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *16 January 1952*

TM 9–1730 F/TO 19–45–133 is published for the information and guidance of all concerned.

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CONTENTS

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the information and guidance of personnel responsible for field and depot maintenance of this matériel. These instructions contain information on maintenance which is beyond the scope of the tools, equipment, or supplies normally available to using organizations. This manual does not contain information which is intended primarily for the using organization, since such information is available to ordnance maintenance personnel in the pertinent operators' technical manuals or field manuals.

b. This manual contains a description of and procedures for removal, disassembly, inspection, repair, rebuild, and assembly of the auxiliary generator (Delco Products, Model GM–A–8585) and engine (Detroit Diesel, GMC type A41–1). The appendix contains a list of current references, including supply catalogs, technical manuals, and other available publications applicable to the matériel.

c. The technical manuals pertaining to the vehicles incorporating this auxiliary generator and engine contain operating and lubricating instructions for the matériel and contain all maintenance operations allocated to using organizations in performing maintenance work within their scope.

d. TM 9–1825A contains service information on the Delco-Remy voltage regulator and rheostat.

e. TM 9–1825E contains service information on the Bendix-Scintilla magneto.

f. TM 9–1826A contains service information on the AC Spark Plug fuel pump.

g. This first edition is being published in advance of complete technical review of all concerned. Any errors or omissions will be brought to the attention of Chief of Ordnance, Washington 25, D. C., ATTN: ORDFM–Pub.

2. 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 the current ORD 8 supply catalog pertaining to those vehicles incorporating this auxiliary generator and engine. 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 supply catalogs 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.

3. Forms, Records, and Reports

a. General. Forms, records, and reports are designed to serve necessary and useful purposes. Responsibility for the proper execution of these forms rests upon commanding officers of all units maintaining this equipment. It is emphasized, however, that forms, records, and reports are merely aids. They are not a substitute for thorough practical work, physical inspection, and active supervision.

b. Authorized Forms. The forms generally applicable to units maintaining this equipment are listed in the appendix. No forms other than those approved for the Department of the Army will be used. Pending availability of forms listed, old forms may be used. For current and complete listings of all forms, refer to current SR 310–20–6. Additional forms applicable to the using personnel are listed in the operator's manual. For instructions on use of these forms, refer to FM 9–10.

c. Field Report of Accidents. The reports necessary to comply with the requirements of the Army safety programs 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 occur.

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 Equip-

ment 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. See also SR 700–45–5 and the printed instructions on DA AGO Form 468.

Section II. DESCRIPTION AND DATA

4. Description

a. ENGINE NOMENCLATURE. In making reference to the engine, the accessory end is designated as the "front" end and the diffuser end is the "rear" end. The "right" and "left" sides of the engine are as viewed from the rear of the engine looking towards the front.

b. GENERAL. The auxiliary generator and engine consists of a one-cylinder, four-cycle, air-cooled, gasoline-burning engine which is connected directly to a 300-ampere, 28.5-volt, shunt-wound, direct-current generator with built-in cranking winding by means of a flexible spline coupling at the front end of the generator armature and a mating spline coupling on the rear of the engine crankshaft. A special through bolt completes the coupling (fig. 3). The lubricating oil filter, fuel filter, oil filter tube, and governor are mounted on the front end of the engine (fig. 1). The generator and heat exchanger are mounted at the rear of the engine (fig. 2), while the exhaust manifold and cover are mounted at the right side of the engine (fig. 1). Battery and ground terminals are located at the rear of the engine at left and right sides of the generator, respectively. The entire engine is inclosed in shrouds (figs. 1 and 2). An engine identification number is die-stamped in a boss cast at the right side of the engine crankcase (fig. 6). A generator name plate is attached to the right side of the generator frame immediately behind the engine crankcase (fig. 7). Engine removal for service or maintenance is quickly accomplished by disconnecting electrical connections at the quick-disconnect points provided, disconnecting fuel and mounting connections and removing the complete unit from the vehicle.

c. COOLING SYSTEM. The cooling system consists of an impeller-type fan mounted on the rear end of the generator armature shaft (fig. 88), working in conjunction with the diffuser surrounding the fan. The diffuser spreads the air uniformly through the generator and the electrical components and is then directed by a series of shrouds and baffles (figs. 1, 2, and 8) to the engine crankcase, cylinder, and cylinder head. Vehicle heating is made possible by passing cooling air from the engine over a heat exchanger through which the engine exhaust gases pass.

d. FUEL SYSTEM. A diaphragm-type fuel pump supplies gasoline to an updraft-type, fixed-jet carburetor. A bowl-type strainer is

located in the suction line to the fuel pump to clean the incoming gasoline. A combination choke and throttle control is provided which manually controls the choke and properly positions the throttle opening for easy starting of the engine under all conditions.

e. LUBRICATING SYSTEM. Lubrication of the engine is accomplished partially by splash but primarily by the use of a constant-displacement gear-type pump. The crankcase is drilled with oil passages to provide oil under pressure to the various engine parts requiring pressure lubrication. The normal oil pressure is 35 to 45 pounds per square inch under normal operating conditions. The hollow push rods conduct oil, under pressure, from the hydraulic valve tappets to the valve rocker arm and shaft assembly. Oil spill from the rocker arms and shaft assembly is returned to the crankcase via an oil return tube. A full-flow, replaceable-element type, oil filter is incorporated in the lubrication system. Oil recommended for use in this engine should conform to US Army specification MIL–O–2104 for normal operating

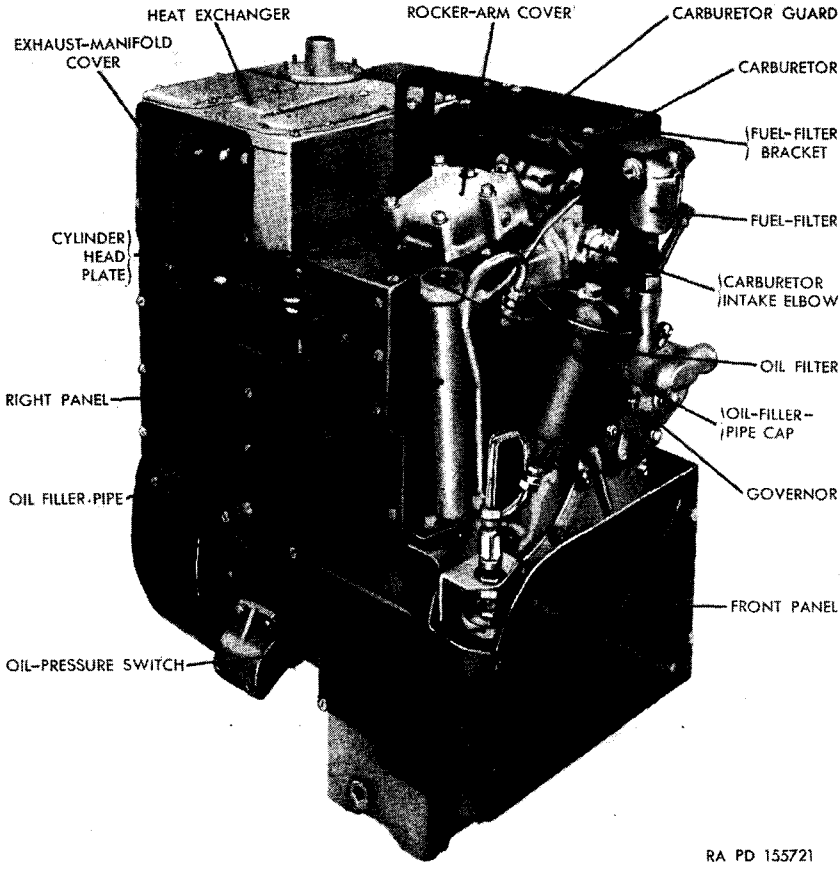


Figure 1. Auxiliary generator and engine—right-front view.

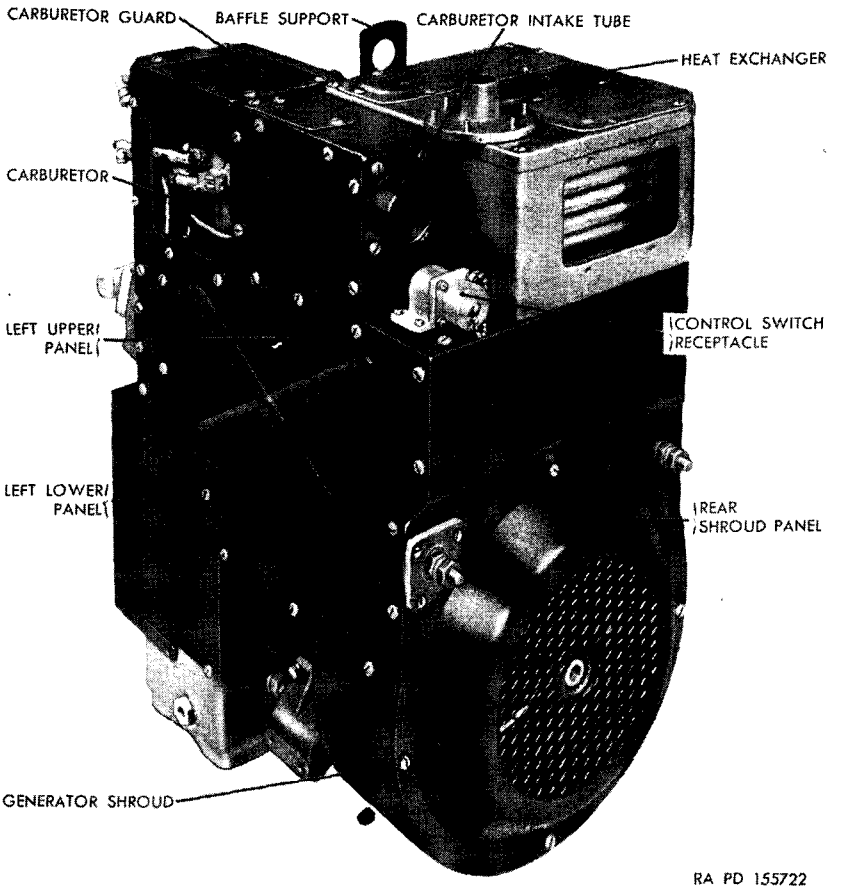


Figure 2. Auxiliary generator and engine—left-rear view.

conditions, and US Army specification MIL–O–10295 subzero motor oil for cold-weather operation.

f. Ignition System. A high-tension magneto, coupled to the governor with a fiber disk, provides the necessary voltage for the ignition system of the engine. The magneto is equipped with an impulse coupling, providing a hotter spark at the spark plug. An aviation-type spark plug and shielded cable are used.

g. Electrical System. The direct-current, shunt-wound starter generator connected to the engine crankshaft produces 28.5 volts and 300 amperes at 3,100 rpm. Series parallel windings are provided in the generator for engine cranking. Generator voltage output is automatically controlled by a carbon pile voltage regulator. Electrically-operated heating elements are located in the intake elbow and heat exchanger. Two 100-watt heating units extend into the intake elbow and are thermostatically controlled when the electrical system

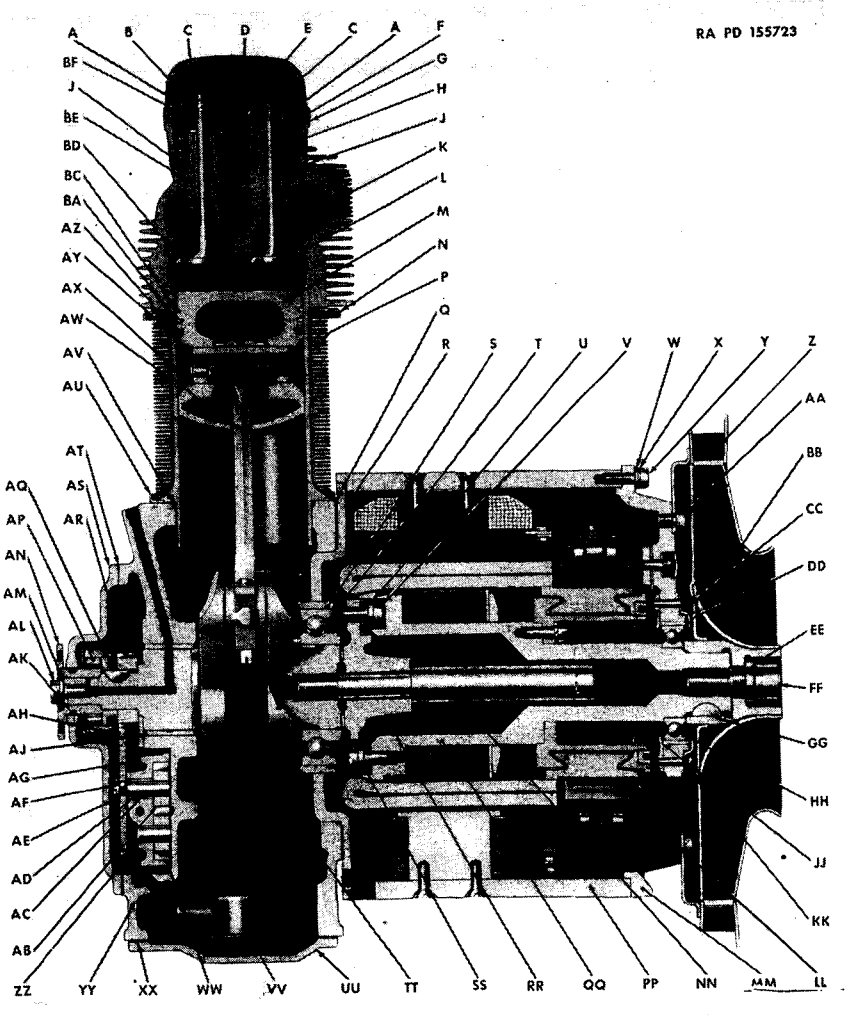


Figure 3. Auxiliary generator and engine—side-sectional view.

A—VALVE SPRING
B—INTAKE-VALVE-SPRING UPPER SEAT
C—VALVE-SPRING-UPPER-SEAT LOCK
D—ROCKER-ARM COVER
E—EXHAUST-VALVE-SPRING UPPER SEAT
F—EXHAUST VALVE
G—ROCKER-ARM-COVER GASKET
H—EXHAUST-VALVE GUIDE
J—VALVE-SPRING LOWER SEAT
K—CYLINDER HEAD
L—EXHAUST-VALVE SEAT INSERT
M—PISTON
N—CYLINDER-BAFFLE UPPER RETAINER
P—CYLINDER
Q—REAR-MAIN-BEARING-SUPPORT GASKET
R—REAR-MAIN-BEARING SUPPORT
S—REAR-MAIN-BEARING SEAL

T—CRANKSHAFT REAR BEARING
U—GENERATOR-DRIVE-DISK-BOLT WASHER
V—GENERATOR-DRIVE-DISK BOLT
W—GENERATOR-END-FRAME-BOLT PLAIN WASHER
X—GENERATOR-END-FRAME-BOLT LOCK WASHER
Y—GENERATOR-END-FRAME BOLT
Z—GENERATOR DIFFUSER
AA—GENERATOR-DIFFUSER BOLT
BB—GENERATOR IMPELLER FAN
CC—BEARING-RETAINING-PLATE SCREW
DD—BEARING-RETAINING OUTER PLATE
EE—IMPELLER-FAN-BOLT WASHER
FF—IMPELLER-FAN BOLT
GG—IMPELLER-FAN-TO-ARMATURE WOODRUFF KEY
HH—GENERATOR-ARMATURE BALL BEARING
JJ—BEARING-RETAINING INNER PLATE
KK—BEARING-RETAINING-INNER-PLATE SCREW LOCK WASHER
LL—BRUSH HOLDER
MM—GENERATOR END FRAME
NN—GENERATOR-TO-CRANKSHAFT BOLT
PP—GENERATOR FRAME W/COIL
QQ—GENERATOR ARMATURE
RR—GENERATOR-DRIVE-DISK HUB
SS—GENERATOR DRIVE DISK
TT—CRANKSHAFT
UU—CRANKCASE BOTTOM COVER
VV—OIL FLOAT
WW—OIL-PUMP DRIVEN GEAR
XX—CRANKCASE-BOTTOM-COVER GASKET
YY—CRANKCASE
ZZ—OIL-PUMP-DRIVEN-GEAR SHAFT
AB—OIL-PUMP DRIVE GEAR
AC—OIL-PUMP-DRIVE-GEAR SHAFT
AD—OIL-PUMP-BODY BUSHING
AE—OIL-PUMP-DRIVE-DRIVEN-GEAR NUT
AF—OIL-PUMP-DRIVE-DRIVEN-GEAR BALL
AG—OIL-PUMP BODY
AH—OIL-PUMP DRIVE-DRIVEN GEAR
AJ—CRANKSHAFT FRONT BEARING
AK—STARTING-PULLEY-HUB SEAL
AL—STARTING-PULLEY-HUB BOLT
AM—STARTING-PULLEY-HUB-BOLT WASHER
AN—STARTING-PULLEY HUB
AP—STARTING-PULLEY CAM
AQ—CRANKSHAFT-GEAR WOODRUFF KEY
AR—CRANKSHAFT GEAR
AS—CRANKCASE FRONT COVER
AT—CRANKCASE-FRONT-COVER GASKET
AU—CYLINDER-BAFFLE LOWER RETAINER
AV—CYLINDER-TO-CRANKCASE SEAL
AW—CONNECTING ROD
AX—PISTON-PIN RETAINING RING
AY—PISTON PIN
AZ—PISTON LOWER RING
BA—PISTON INTERMEDIATE RING
BC—PISTON UPPER RING
BD—INTAKE-VALVE SEAT INSERT
BE—INTAKE-VALVE GUIDE
BF—INTAKE VALVE

Figure 3.— Continued.

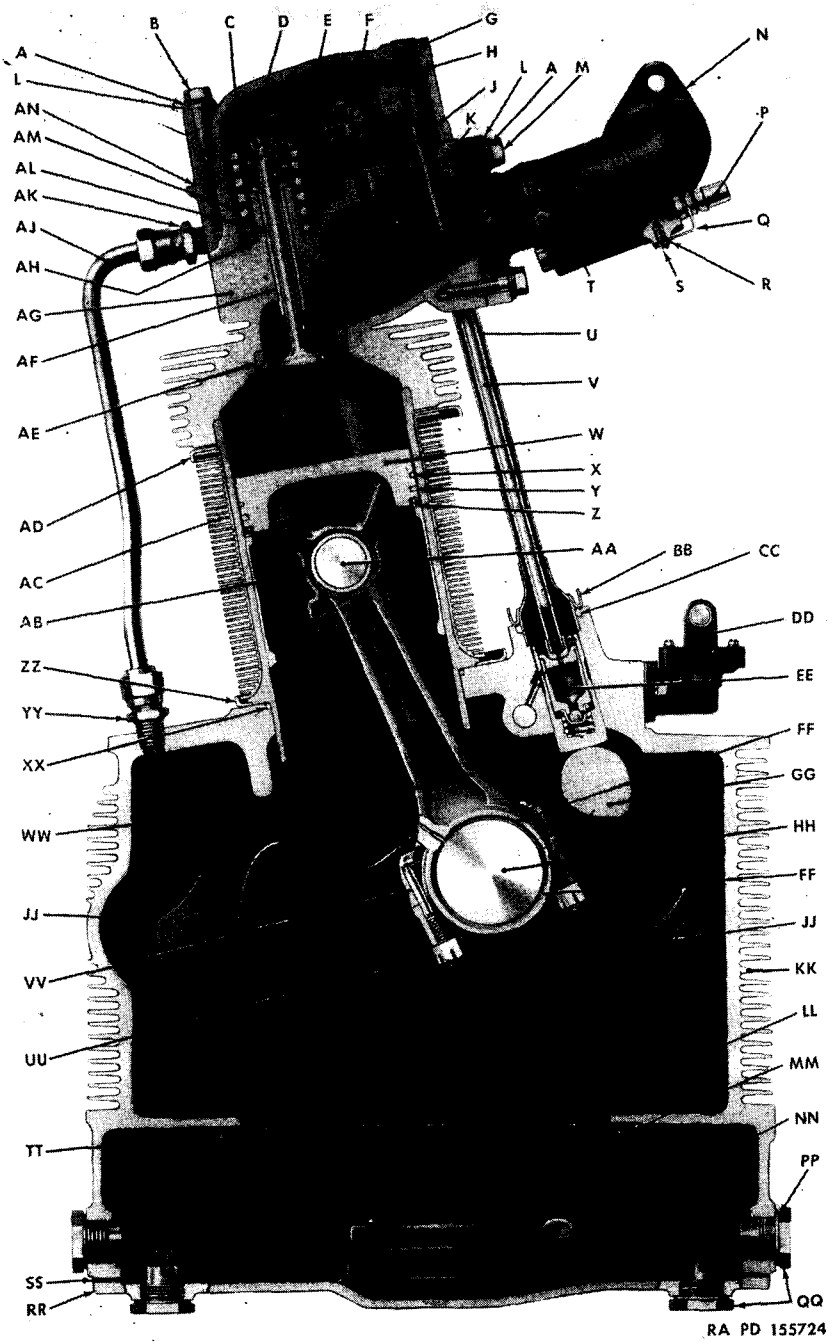


Figure 4. Auxiliary generator and engine—end-sectional view.

A—ROCKER-COVER-AND-INTAKE-ELBOW-BOLT LOCK WASHER
B—ROCKER-ARM-COVER BOLT
C—INTAKE-VALVE-SPRING UPPER SEAT
D—VALVE-SPRING-UPPER-SEAT-LOCK
E—INTAKE-VALVE ROCKER ARM
F—ROCKER-ARM SHAFT
G—ROCKER-ARM-COVER-VENT-HOLE PIPE PLUG
H—ROCKER-ARM COVER
J—CYLINDER-HEAD PIPE PLUG
K—PUSH-ROD-TUBE UPPER SEAL
L—ROCKER-COVER-AND-INTAKE-ELBOW-BOLT WASHER
M—INTAKE-ELBOW BOLT
N—INTAKE ELBOW
P—INTAKE-ELBOW-HEATER-ELEMENT CARTRIDGE
Q—INTAKE-ELBOW-HEATER-ELEMENT-CARTRIDGE CLIP
R—INTAKE-ELBOW-HEATER-ELEMENT-CARTRIDGE-CLIP-SCREW LOCK WASHER
S—INTAKE-ELBOW-HEATER-ELEMENT-CARTRIDGE-CLIP SCREW
T—INTAKE-ELBOW-THERMOSTAT COVER
U—PUSH-ROD COVER TUBE
V—VALVE-ROCKER-ARM PUSH ROD
W—PISTON
X—PISTON UPPER RING
Y—PISTON INTERMEDIATE RING
Z—PISTON LOWER RING
AA—PISTON PIN
BB—PUSH-ROD-COVER-TUBE CLAMP
CC—PUSH-ROD-COVER-TUBE SEAL
DD—FUEL PUMP
EE—HYDRAULIC VALVE TAPPET
FF—CONNECTING-ROD LOWER BEARING
GG—CAMSHAFT
HH—CRANKSHAFT
JJ—COUNTERWEIGHT
KK—CRANKCASE
LL—CRANKCASE OIL SCREEN
MM—CRANKCASE-OIL-SCREEN-SCREW LOCK WASHER
NN—OIL FLOAT
PP—OIL-DRAIN-PLUG GASKET
QQ—OIL DRAIN PLUG
RR—CRANKCASE BOTTOM COVER
SS—CRANKCASE-BOTTOM-COVER GASKET
TT—CRANKCASE-OIL-SCREEN SCREW
UU—CONNECTING-ROD-BOLT NUT
VV—CONNECTING-ROD BOLT
WW—CONNECTING ROD
XX—CYLINDER-TO-CRANKCASE SEAL
YY—CYLINDER-HEAD-DRAIN-TUBE CONNECTOR
ZZ—CYLINDER-BAFFLE LOWER RETAINER
AB—CONNECTING-ROD UPPER BEARING
AC—CYLINDER
AD—CYLINDER-BAFFLE UPPER RETAINER
AE—INTAKE-VALVE SEAT INSERT
AF—INTAKE-VALVE GUIDE
AG—CYLINDER HEAD
AH—VALVE-SPRING LOWER SEAT
AJ—CYLINDER-HEAD DRAIN TUBE
AK—CYLINDER-HEAD-DRAIN-TUBE CONNECTOR
AL—INTAKE VALVE
AM—VALVE SPRING
AN—ROCKER-ARM-COVER GASKET

Figure 4.—Continued.

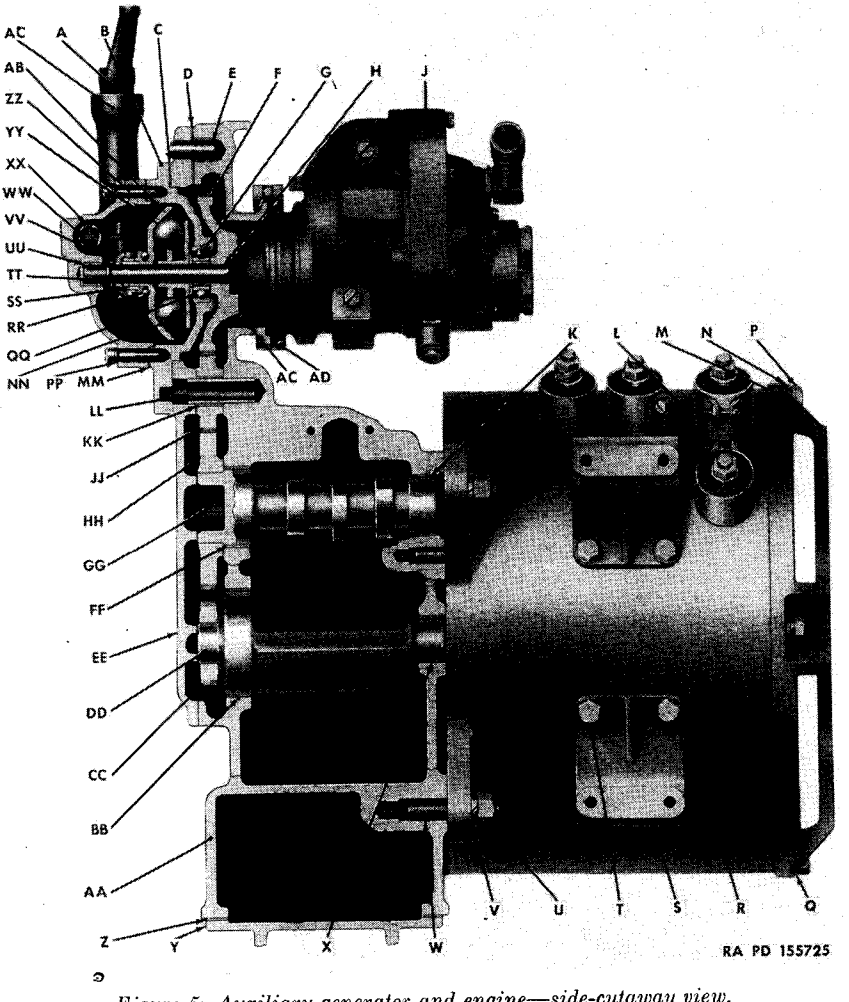


Figure 5. Auxiliary generator and engine—side-cutaway view.

A—GOVERNOR OPERATING LEVER
B—GOVERNOR BASE
C—GOVERNOR BASE-TO-CRANKCASE-FRONT-COVER GASKET
D—CRANKCASE-FRONT-COVER-GASKET
E—CRANKCASE-FRONT-COVER-TO-CRANKCASE DOWEL PIN
F—GOVERNOR DRIVE GEAR
G—GOVERNOR-DRIVE-SHAFT BALL BEARING
H—GOVERNOR DRIVE SHAFT
J—MAGNETO
K—CAMSHAFT REAR BEARING
L—GENERATOR FRAME W/COIL
M—GENERATOR END FRAME
N—GENERATOR-END-FRAME-BOLT WASHER
P—GENERATOR-END-FRAME BOLT
Q—GENERATOR-END-FRAME-BOLT LOCK WASHER
R—GENERATOR-MOUNTING-BRACKET-BOLT LOCK WASHER
S—GENERATOR MOUNTING BRACKET
T—GENERATOR-MOUNTING-BRACKET BOLT
U—GENERATOR-TO-CRANKCASE-STUD NUT
V—GENERATOR-TO-CRANKCASE-STUD-NUT LOCK WASHER
W—GENERATOR-TO-CRANKCASE STUD
X—COUNTERWEIGHT REAR BEARING
Y—CRANKCASE BOTTOM COVER
Z—CRANKCASE-BOTTOM-COVER GASKET
AA—CRANKCASE
BB—COUNTERWEIGHT FRONT BEARING
CC—COUNTERWEIGHT GEAR
DD—COUNTERWEIGHT
EE—CRANKCASE FRONT COVER
FF—CAMSHAFT FRONT BEARING
GG—CAMSHAFT
HH—CAMSHAFT GEAR
JJ—IDLER GEAR
KK—IDLER-GEAR BEARING
LL—IDLER-GEAR SHAFT
MM—GOVERNOR-HOUSING-TO-GOVERNOR-BASE GASKET
NN—GOVERNOR LOWER RACE
PP—GOVERNOR-HOUSING-BOLT LOCK WASHER
QQ—GOVERNOR-DRIVE-SHAFT-BALL-BEARING THRUST WASHER
RR—GOVERNOR THRUST BEARING
SS—GOVERNOR-OPERATING-FORK BASE
TT—GOVERNOR-SHAFT SPRING CLIP
UU—GOVERNOR-HOUSING BEARING
VV—GOVERNOR OPERATING FORK
WW—GOVERNOR-SPRING ANCHOR LEVER
XX—GOVERNOR ADJUSTING SCREW AND SPRING
YY—STEEL BALL
ZZ—GOVERNOR-HOUSING BOLT
AB—GOVERNOR UPPER RACE
AC—GOVERNOR HOUSING

Figure 5.—Continued.

Figure 6. Engine identification number.

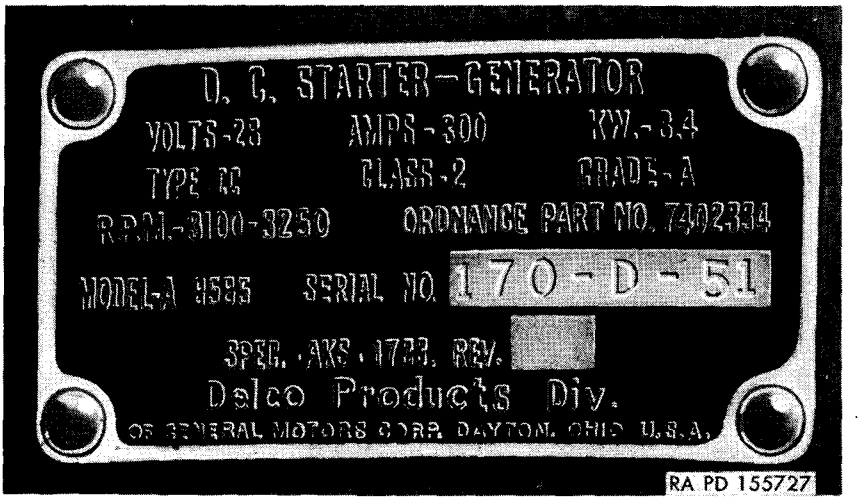


Figure 7. Generator name plate.

is energized. A 6-kilowatt heating element located inside the heat exchanger is controlled by a remote control manual switch.

h. GEAR TRAIN. An inclosed gear train is located at the front end of the engine. The crankshaft or driving gear is connected to the oil pump, governor, camshaft, and primary counterweight gears, through the use of five idler gears. The idler gears are supported by shafts extending from the crankcase. The crankshaft, magneto, camshaft, and counterweight gears are located in their correct position through the use of timing marks on the gears and engine crankcase.

i. WATERPROOFING. Because of watertight connections, gaskets, and machined surfaces, water submersion of the generator and engine

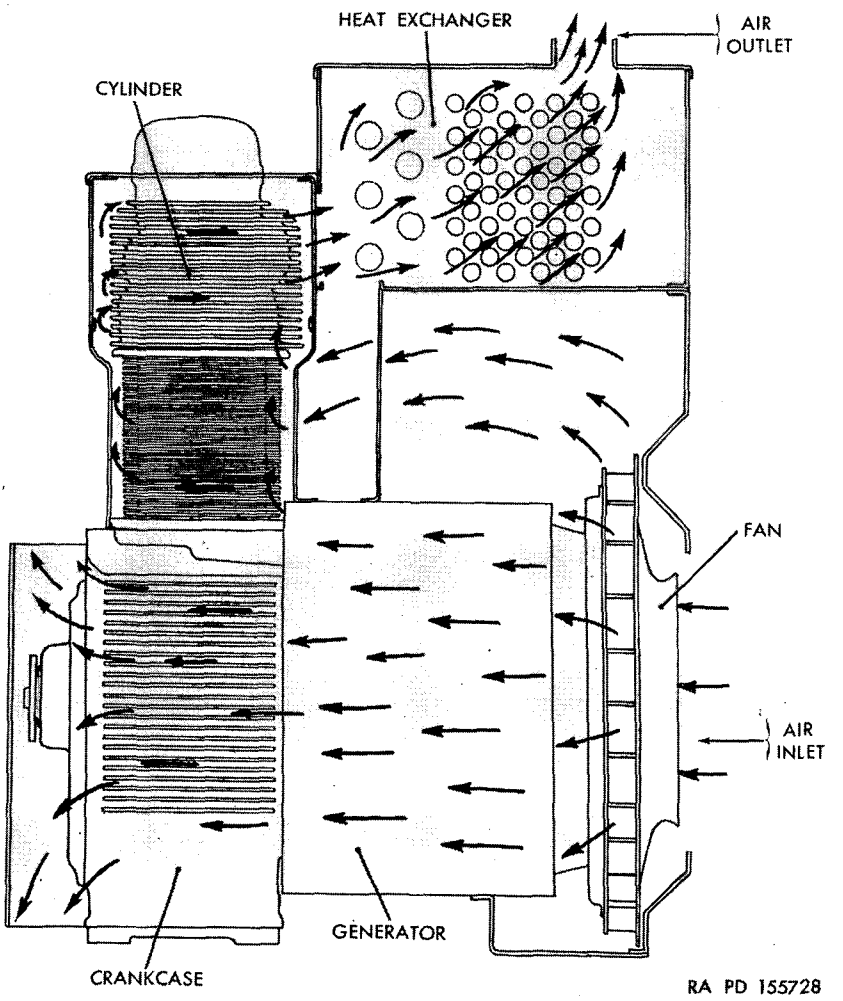


Figure 8. Air-flow system.

is possible. Both the crankcase and magneto are vented by tubes and fittings from the crankcase and magneto to the inlet and outlet sides of the carburetor.

j. Crankcase and Magneto Venting. Crankcase and magneto venting is accomplished by tubes and fittings connecting the inlet and outlet side of the carburetor to the crankcase and magneto.

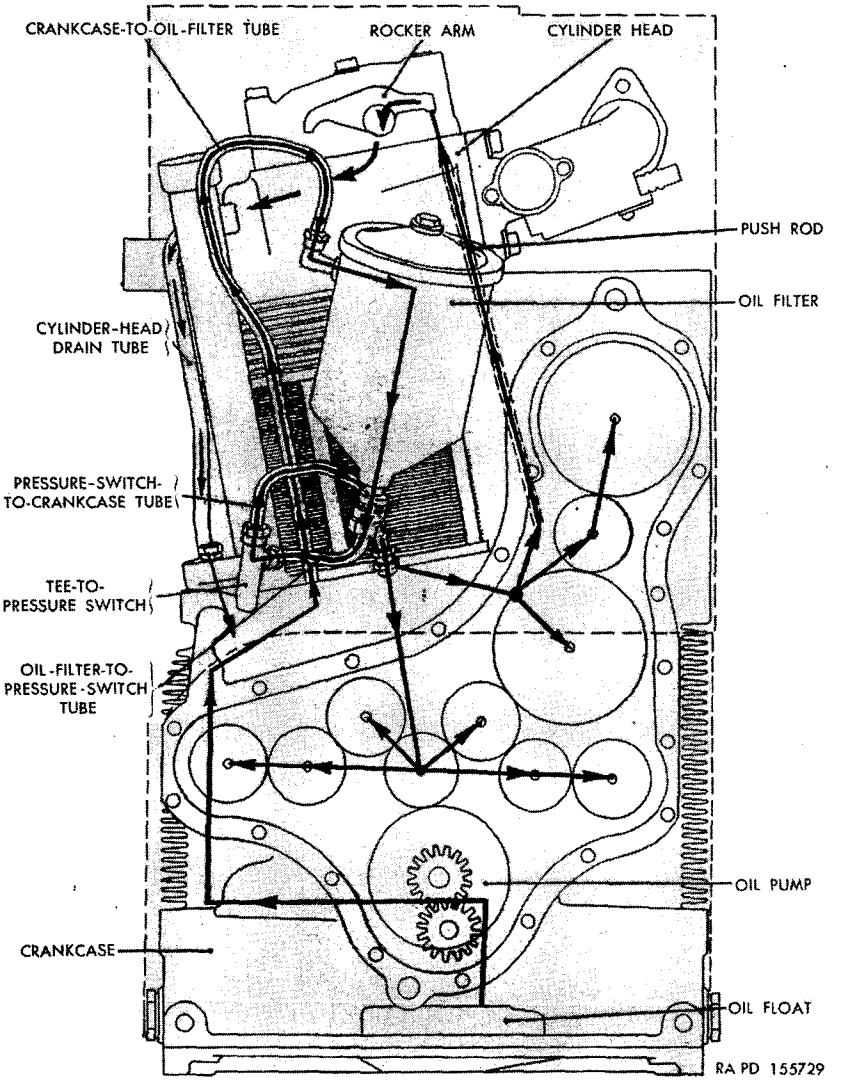


Figure 9. Lubrication system.

5. Data

a. AUXILIARY ENGINE.

(1) *General.*

Bore and stroke	3⅝ x 4 in.
Compression ratio	6.5 to 1
Cooling system	air-cooled by impeller-type fan
Direction of crankshaft rotation viewed from front end	clockwise
Height	29$\frac{3}{16}$ in.
Horsepower (nominal)	14.5
Length	23¼ in.
Make	General Motors Corporation
Model	A41–1
Number of cylinders	1
Ordnance number	7402328
Piston displacement	41 cu. in.
Speed (rated)	3,100 rpm
Type	4-cycle, gasoline
Weight (dry) (w/generator)	386 lb.
Width	16$\frac{13}{16}$ in.

(2) *Piston.*

Material	aluminum, anodized
Number of compression rings	2 top chrome-plated (upper and intermediate)
Number of oil rings	1, one-piece (lower)
Type	cam ground

(3) *Crankshaft.*

Ordnance number	7402060
Type	counterweighted

(4) *Thrust bearing.*

Material	bronze
Type	1, one-piece washer

(5) *Main bearings.*

Front	bushing-type
Rear	ball bearing, single-row

(6) *Valves.*

Exhaust	1, steel sodium-cooled
Intake	1, steel stellite-faced
Seat inserts	replaceable

(7) *Valve timing.*

Exhaust closes	25 deg after top dead center
Exhaust opens	56 deg before bottom dead center
Inlet closes	71 deg after bottom dead center
Inlet opens	14 deg before top dead center

(8) *Lubrication pump.*

Capacity (refill)	4 qt.

Sump ..... wet
Type ..... gear driven, gear type

b. ACCESSORIES.

(1) *Oil filter.*

Make ..... AC Spark Plug
Ordnance number 7402654
Type ..... full flow, replaceable element

(2) *Carburetor.*

Make ..... Rochester products
Ordnance number 7378898

(3) *Fuel filter.*

Make ..... AC Spark Plug
Ordnance number 7402346
Type ..... bowl

(4) *Magneto.*

Breaker-point gap ..... 0.018 in.
Make ..... Bendix-Scintilla
Model S4/IRN–32
Ordnance number 7402662

(5) *Governor.*

Full-load speed ..... 3,100 rpm
Make ..... Novi Products Company
Model 53753–B
No-load speed ..... 3,250 rpm
Ordnance number 7402467
Type ..... flyball mechanical

(6) *Fuel pump.*

Make ..... AC Spark Plug
Ordnance number 7378810
Type ..... diaphragm

(7) *Spark plug.*

Gap ..... 0.020 in
Make and model ..... Champion TAC2 or AC 5569413
Ordnance number 7525550

(8) *Starter.*

Type (hand starter) ..... manual starting through cable pull-type starter on front of crankshaft
Type (remote control) ..... integral with generator

(9) *Starter generator.*

Amperes (rated) 300
Bearing, front ..... rear crankshaft ball bearing, single-row, splash lubricated from engine sump
Bearing, rear ..... ball, factory packed, single-row
Kilowatt output (rated) (corrected) 8.4
Make ..... Delco Products
Model A–8585

Ordnance number 7402334
RPM (full load) 3,100
RPM (no load) 3,250
Type ..... type II, shunt-wound, automatic carbon stack regulator
Volts (regulator setting) 28

(10) *Generator regulator.*

Make ..... Delco-Remy
Ordnance number 7402586
Volts 24

CHAPTER 2

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

6. 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.

7. Parts

Maintenance parts are listed in the ORD 8 portion of the Department of the Army Supply Catalogs pertaining to the vehicles on which this matériel is used, which are the authorities 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 the corresponding ORD 9 catalog and will be supplied if available.

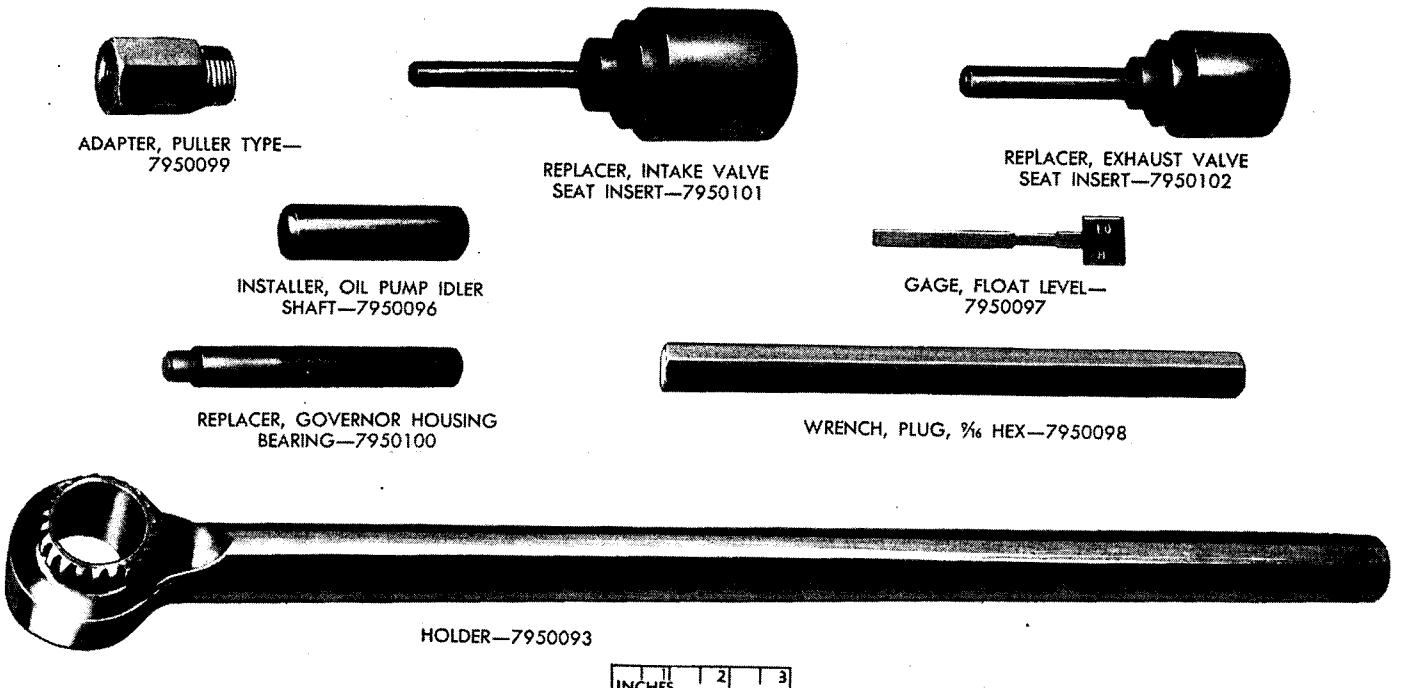
8. Common Tools and Equipment

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

9. Special Tools and Equipment

The special tools and equipment tabulated in table I will be listed in Department of the Army Supply Catalog ORD 6 SNL J–16, when published. 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 for requisitions.

Note. Special tool sets in ORD 6 SNL G–27, section I, in addition to special tools, also contain standard and commonly used tools and equipment specifically applicable to this matériel.



RA PD 155730

Figure 10. Special tools.

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

Item	Identifying No.	References		Use
		Fig.	Par.	
ADAPTER, puller type	7950099	10, 31	33	For pulling generator fan (Use with slide-hammer-type REMOVER).
BOLT, eye, ¾–16NF–2	41–B–1596–450	32	33	For lifting generator.
GAGE, float level	7950097	10, 86, 87	101	For measuring height of carburetor float.
HOLDER (fan-impeller hub)	7950093	10, 29, 30, 90	33, 102	For holding fan-impeller hub while tightening bolt.
INSTALLER, oil-pump driven gear shaft	7950096	10, 55	58	For installing oil pump driven gear shaft.
REMOVER, valve-seat-insert	7950045	73	76	For removing valve-seat-inserts.
REPLACER, exhaust-valve-seat insert	7950102	10, 74	76	For installing exhaust-valve-seat insert.
REPLACER, governor housing bearing	7950100	10, 78	93	For installing governor housing bearing.
REPLACER, intake-valve-seat insert	7950101	10, 74	76	For installing intake-valve-seat insert.
WRENCH, plug, 5/16 hex	7950098	10, 30	33, 105, 123	For removing generator-hub-drive bolt (Use with torque indicator WRENCH, and socket detachable WRENCH).

CHAPTER 3
TROUBLE SHOOTING

Section I. GENERAL

10. Purpose

Note. Information in this chapter is for use of ordnance maintenance personnel in conjunction with and as a supplement to the trouble-shooting section in the pertinent operators' manual. It provides the continuation of instructions where a remedy in the operators' 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 can often be determined without extensive disassembly.

11. General Instructions and Procedures

This chapter contains inspection and trouble-shooting procedures to be performed while a disabled component is still mounted in the vehicle and after it has been removed.

a. The inspections made while the component is mounted in the vehicle are for the most part 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 using organization. Check the trouble-shooting section of the pertinent operators' manual to be sure the trouble is not a defect normally corrected by the using organization, 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.

d. Trouble shooting a disabled component after it has been removed from the vehicle consists of subjecting it to tests on a test stand (par. 131). This chapter discusses those symptoms which can be diagnosed by using the testing equipment and interprets the results in terms of probable causes.

Section II. AUXILIARY GENERATOR AND ENGINE

12. Trouble Shooting before Removal from Vehicle and During Operation

a. GENERAL. If visual inspection does not reveal the causes of erratic operation although generator and engine are operable, trouble shoot it.

b. ENGINE FAILS TO START.

(1) *Insufficient fuel in tank.* Fill tank.

(2) *Discharged batteries.* Check batteries and recharge or replace as required.

c. GENERATOR WILL NOT TURN OVER ENGINE WHEN STARTER SWITCH IS TURNED TO "ON" POSITION.

(1) *Low voltage.* Check battery voltage across terminals 64 and negative ground (fig. 110), on rear shroud panel with a voltmeter. Disconnect control cable at rear of unit. Place starting switch in start position and check the voltage from "D" in female end of the connector to the negative ground on the generator (fig. 110). These voltages should be 24–25 volts.

(2) *No voltage.* If no voltage is indicated in (1) above, check to see that the master battery switch in "ON."

(3) *Discharged batteries.* Check for discharged batteries and replace if necessary.

(4) *Loose Cables.* Check all cables and terminals on generator and battery for tightness.

(5) *Grounded cable.* Check to see that positive cable is not grounded or that the insulation is not worn through to the bare wire.

d. GENERATOR WILL NOT PRODUCE CURRENT.

(1) *Charging-signal-light lamp burned out.* Replace charging-signal-light lamp in driver's compartment.

(2) *Low voltage.* Check voltage across terminals 64 and negative ground with voltmeter before starting engine (fig. 110).

Start engine and observe voltage increase. If there is an increase in voltage, it indicates that the circuit breaker in the regulator box has closed and the generator is producing some current. Adjust the voltage trimmer rheostat (figs. 108 and 110) to the desired voltage. If voltage cannot be raised, check the trimmer rheostat by disconnecting the master battery switch. No-load voltage should be 28.5 volts. Check circuit No. 456 with engine running. Disconnect control cable on rear of unit and check from "C" socket to negative ground on generator (fig. 110). There should be no voltage at this point.

e. DEFECTIVE OIL-PRESSURE-SWITCH CIRCUIT.

(1) *Open circuit.* Turn starting switch to start position. Disconnect control cable (cable 420) from control switch receptacle (fig. 2) and place a test cable in socket "B" of control switch receptacle (fig. 110). Place the other end of the test cable on the positive terminal of the battery. If the light does not burn, check for burned-out lamp or repair open circuit.

(2) *Defective oil-pressure-switch cable.* Check cable to oil pressure switch for open circuit. Replace oil pressure switch if open circuit is found.

f. HEATING ELEMENT IN HEAT EXCHANGER FAILS TO OPERATE.

(1) *Control switch not turned on.* Turn control switch in control compartment to "ON" position.

(2) *No voltage.* Disconnect control cable (cable 413) and check across socket "G" (fig. 110) to battery positive with heater switch on. The voltmeter should read battery voltage. If no voltage is indicated, removal of the complete unit will be necessary for further trouble shooting.

13. Trouble Shooting After Removal From Vehicle and Before Operation

a. GENERAL. After the component has been removed from the vehicle or if it has been received already removed, further inspection is necessary.

b. ENGINE FAILS TO START.

(1) *Sediment in carburetor.* Remove and clean carburetor float bowl (pars. 98 and 99).

(2) *Fuel pump-to-carburetor tube clogged.* Remove and clean fuel tube (par. 21).

(3) *Broken or defective high-tension cable.* Install new cable (fig. 110).

(4) *Improper carburetor setting.* Adjust carburetor (par. 16*n*).

c. Engine Hard To Start.

(1) *Improper carburetor setting.* Adjust carburetor (par. 16*n*).

(2) *Dirty or corroded breaker points.* Clean or replace breaker points and adjust (par. 5*b*).

(3) *Incorrect timing.* Check timing (par. 121).

(4) *Loose or defective wiring.* Check high-tension lead for breaks or loose connection (fig. 110).

(5) *Spark plug cracked.* Replace spark plug (pars. 37 and 118).

(6) *Spark plug fouled.* Clean plug and adjust gap (par. 5*b*).

d. Engine Missing.

(1) *Spark plug fouled.* Clean plug and adjust gap (par. 5*b*).

(2) *Spark plug cracked.* Replace spark plug (par. 118).

(3) *Incorrect spark-plug gap.* Adjust gap (par. 5*b*).

(4) *Loose magneto terminals.* Tighten terminals (pars. 121*g* and 130*p*).

(5) *Dirty or corroded breaker.* Clean points and adjust gap (par. 5*b*).

e. Engine Overheating.

(1) *Carburetor choke valve partially closed.* See that choke is wide open (par. 16*n*).

(2) *Insufficient lubrication.* Fill crankcase to proper level (par. 5*b*).

f. Engine Lacks Power.

(1) *Air-to-carburetor line clogged.* Remove restriction.

(2) *Muffler choked.* Clean or replace muffler.

g. Engine Fails to Respond to Changes in Load. Bent governor linkage. Repair linkage.

h. Engine Emits Black Smoke.

(1) *Carburetor choke valve stuck partially closed.* Open choke or free up mechanism (par. 16*n*).

(2) *Carburetor set too rich.* Adjust carburetor (par. 16*n*).

14. Trouble Shooting after Removal from Vehicle and During Operation

a. General. This paragraph discusses those symptoms which can be diagnosed by operating the auxiliary engine on a resistance-loaded test stand capable of handling 300 amperes at 28 volts or 8.4 kilowatts.

b. Engine Fails to Start.

(1) *No fuel in tank.* Fill tank.

(2) *Sediment in carburetor.* Remove and clean carburetor float bowl (par. 98).

(3) *Air leak in fuel tube.* Bleed fuel line.

(4) *Fuel pump-to-carburetor tube clogged.* Remove and clean fuel tube (par. 21).

(5) *Broken or defective high-tension cable.* Install new cable (fig. 110).

(6) *Improper carburetor setting.* Adjust carburetor (par. 16*n*).

c. Engine Hard to Start.

(1) *Improper carburetor setting.* Adjust carburetor (par. 16*n*).

(2) *Water in fuel.* Drain and refill entire fuel system.

(3) *Dirty or corroded breaker points.* Clean or replace and adjust breaker points (par. 5*b*).

(4) *Defective timing.* Check timing (par. 121).

(5) *Loose or defective wiring.* Check high-tension cable for breaks or loose connection (fig. 110).

(6) *Spark plug cracked.* Replace spark plug (par. 118).

(7) *Spark plug fouled.* Clean plug and adjust gap (par. 5*b*).

(8) *Poor compression.*

(*a*) *Loose spark plug.* Tighten plug (par. 118).

(*b*) *Warped valves.* Replace valves (par. 74).

(*c*) *Worn or broken piston rings.* Remove and replace piston rings (pars. 70 and 73).

(*d*) *Piston rings stuck from carbon.* Replace piston rings (pars. 70 and 73).

d. Engine Missing.

(1) *Spark plug fouled.* Clean or replace plug. Adjust gap (par. 5*b*).

(2) *Spark plug cracked.* Replace plug (par. 5*b*).

(3) *Incorrect spark plug gap.* Adjust gap (par. 5*b*).

(4) *Shorted high-tension lead.* Replace lead (fig. 110).

(5) *Loose magneto terminals.* Tighten terminals (pars. 121*g* and 130*p*).

(6) *Dirty or corroded breaker.* Clean points and adjust gap (par. 5*b*).

(7) *Valve warped, broken, or sticking.* Replace valve (par. 74).

e. Engine Overheating.

(1) *Carburetor choke valve partially closed.* See that choke is open (par. 16*n*).

(2) *Air flow obstructed.* See that all passages around the cylinder are free of obstructions.

(3) *Late spark.* Check timing (par. 121).

(4) *Insufficient lubrication.* Fill crankcase to proper level (par. 5*b*).

f. Engine Lacks Power.

(1) *Air to carburetor line clogged.* Remove restriction.

(2) *Improper gas mixture.* Adjust carburetor (par. 16*n*).

(3) *Muffler choked.* Clean or replace muffler.

(4) *Governor working improperly.* Clean, inspect, and adjust governor (par. 91).

(5) *Valves warped, broken, or sticking.* Replace valves (par. 74).

(6) *Piston rings worn or stuck.* Free up or replace rings (par. 72).

g. Engine Noisy.

(1) *Carbon in combustion chamber.* Remove and clean cylinder (par. 68).

(2) *Loose main and/or connecting rod bearings.* Replace bearings.

(3) *Worn piston.* Replace piston and rings (par. 70).

(4) *Worn gears in train.* Replace worn gears (par. 111).

h. Engine Fails to Respond to Changes in Load.

(1) *Bent governor linkage.* Repair linkage.

(2) *Governor operator lever binding in housing.* Lubricate.

(3) *Governor needle bearings stuck.* Free up or replace bearings (par. 90).

i. Engine Emits Black Smoke.

(1) *Carburetor choke valve stuck partially closed.* Open choke or free up mechanism (par. 16*n*).

(2) *Carburetor set too rich.* Adjust carburetor (par. 16*n*).

j. Engine Emits Blue Smoke.

(1) *Piston and piston rings badly worn.* Recondition engine.

(2) *Broken oil ring.* Remove piston and replace ring (par. 70).

k. Generator Will not Turn over Engine when Switch is Turned to "ON" Position.

(1) *Cables loose, broken, or burned.* Remove upper-left panel (fig. 16) and check for loose, broken, or burned cables between the positive battery terminal, starter relay, and series field terminal of the generator.

(2) *Low voltage.* Connect an extra battery to the positive and negative terminals on the rear shroud panel. Connect a voltmeter across the "Ser F" field terminal to a ground (fig. 110). Connect a jumper cable incorporating a switch across cable number 65 to the positive terminal on the starter relay (fig. 110). The voltage should read 24–25 volts.

Note. If no voltage is indicated with the above tests, replace the starter relay and repeat (1) and (2) above.

(3) *Generator fails to motor even though cable connections are correct (fig. 110) and tight.* Check the series field and the armature of the generator for an open circuit or ground (par 104 and table II).

15. Trouble Shooting Generator Removed from Engine

a. General. Remove generator from engine (par. 33).

b. Generator Fails to Motor Properly.

(1) *Shorted or open-circuited armature.* Check armature (par. 104).

(2) *Shorted, open-circuited, or grounded field coil.* Check field coil (par. 104).

(3) *Brush too short or sticking in holder.* Check brushes (par. 104).

c. GENERATOR FAILS TO GENERATE PROPERLY.

(1) *Shorted or open-circuited armature.* Check armature (par. 104).

(2) *Shorted, open-circuited, or grounded field coil.* Check field coil (par. 104).

(3) *Brush too short or sticking in holder.* Check brushes (par. 104).

CHAPTER 4
AUXILIARY GENERATOR AND ENGINE

Section I. DESCRIPTION AND OPERATION

16. Description

a. GENERAL. A general description of the auxiliary generator and engine is contained in chapter 1, section II, of this manual. Detailed description is contained in the following paragraphs.

b. CRANKCASE. The crankcase (fig. 96) is a one-piece aluminum casting incorporating integral cooling fins and shrunk-in bearings and idler-gear shafts.

c. CYLINDER. The cylinder (fig. 33) is a one-piece aluminum casting incorporating cooling fins.

d. CRANKSHAFT AND MAIN BEARINGS. A forged heat-treated crankshaft is supported at the front end by a bushing-type bearing and at the rear end by a single-row ball bearing. The front crankshaft bearing is shrunk into the engine crankcase (fig. 96). The single-row ball bearing is retained in the bearing support which is secured to the rear of the engine crankcase.

e. PISTON. A cast aluminum piston, with three piston rings in grooves above the piston pin, are used in this engine (figs. 3 and 4).

f. CONNECTING ROD. The forged steel connecting rod with the bushing-type wrist-pin bearing at the upper end and split bearing at the lower end (figs. 3 and 4) is attached to the crankshaft by two bolts and two self-locking nuts.

g. CYLINDER HEAD. A cast aluminum cylinder head (figs. 3 and 4) covers the top of the cylinder and contains the combustion chamber. Intake and exhaust valve seat inserts are pressed into the cylinder head.

h. ROCKER COVER. A cast aluminum rocker arm cover (figs. 3 and 4) containing the forged rocker arms mounted on a steel rocker shaft incloses the top of the cylinder head. A gasket prevents oil leakage from the rocker arm compartment and five long bolts secure the rocker cover rigidly to the cylinder head (figs. 4 and 76).

i. CAMSHAFT. A cast camshaft (figs. 5 and 61) with three integrally cast and machined cams, is driven by a gear pressed on the front end and is supported by a bushing-type bearing at both front and rear ends. The two outer cam lobes operate the intake and exhaust valves; the center cam lobe operates the fuel pump.

j. COUNTERWEIGHT. The two cast counterweights (figs. 5 and 58),

introduced into the engine to obtain engine balance, are supported at both front and rear ends by bushing-type bearings and are driven by a gear pressed on the front end.

k. HYDRAULIC VALVE TAPPETS. The plunger and body of the two hydraulic valve tappets (figs. 4 and 75) are selectively fitted to obtain free movement with the least possible clearance. In operation, the plunger is kept filled with oil being supplied through passages in the crankcase and the tubular push rod serves as a reservoir to maintain a head of oil above the tappet. When the valve tappet is on the camshaft base circle, the spring raises the plunger to eliminate all clearance between parts in the valve train.

l. VALVES. The engine contains one steel stellite-faced inlet valve and one steel sodium-cooled exhaust valve operating in valve-seat inserts which are pressed into the cylinder head (figs. 3 and 74).

m. OIL PUMP. The gear-type pressure lubricating oil pump consists of a drive and a driven gear running in mesh inside a cast housing (figs. 45 and 54) which in turn is secured to the front side of the engine crankcase with four bolts and lock washers (fig. 45). A thrust plate is used between the machined mounting face of the oil-pump housing and the crankcase. The oil-pump housing also contains a pressure relief valve and spring (fig. 54) which are retained by a plug and gasket. The relief valve retains an oil pressure of 35 to 45 psi under normal operating conditions. The oil-pump drive gear is pressed onto a drive shaft and the driven gear is bearing mounted on an idler shaft which in turn is pressed into the oil-pump housing. An oil-pump drive gear is secured to drive shaft with a steel ball, nut, and lock washer and meshes with the crankshaft gear.

Note. An oil float is hinged at the bottom of the crankcase (fig. 39) to supply clean oil to the oil pump.

n. CARBURETOR.

(1) *General.*

(*a*) The carburetor (figs. 11, 12, 13, and 14) is a concentric, balanced, sealed carburetor with a single horizontal barrel and is designed for use with a governed, single-cylinder engine. Its operation and design are similar to the conventional automotive type with the exception that some minor alterations have been made to make it more adaptable for the intended service.

(*b*) Since the carburetor is used on a governed engine, it is important that throttle movement requires a constant torque at all throttle positions. Therefore, governor control of this carburetor is simplified greatly through the substitution of an accelerating well for the conventional throttle actuated accelerator pump. The substitution eliminates pump actuation by the governor. This is often

standard practice on governed engines and is acceptable because governor accelerations are not usually as abrupt as those under operator control.

(*c*) The carburetor is a sealed unit designed to exclude from the engine all unfiltered air and any foreign liquid or solid materials. To accomplish this, the air intake and manifold flanges are provided with gaskets. The carburetor air duct is cast in one piece. All external adjustments or controls to the carburetor (throttle, choke, and in some cases, idle-mixture adjustment) are made through the body by means of rotating shafts. Water or air flow through these bearings is prevented by the use of a suitable rubber seal.

(*d*) The fuel inlet and float bowl are located in a separate casting which is attached to the remainder of the carburetor (fig. 11). The float bowl is of a concentric design so as to produce uniform mixture control as the carburetor assumes various angles of tilt in service. This control is obtained because the elevation of the nozzle relative to the fuel level remains constant with normal inclinations of the carburetor. The fuel nozzle is located over the center of gravity of both the float ponton and the fuel in the bowl.

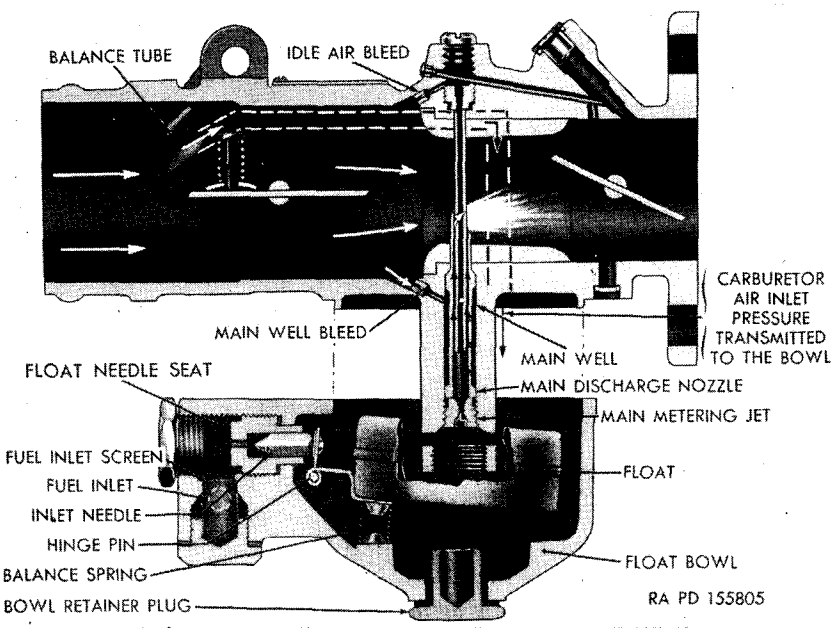


Figure 11. Float mechanism and main nozzle operation.

(*e*) The carburetor is balanced so that the air pressure producing air flow is picked up at the balance tube and transmitted through the passage to the bowl where it acts on the fuel (fig. 11). This type of balance compensates for any change in air cleaner restriction; for example, when the cleaner accumulates dirt. Any cleaner which tends to choke air flow will also cut down fuel flow proportionally to produce a uniform mixture. Choking is still possible since the balance tube is located ahead of the choke valve and thus this valve restricts air flow only.

(2) *Float mechanism.*

(*a*) Fuel enters the carburetor through the fuel inlet (fig. 11) and passes through the cylindrical screen. Fuel level in the bowl is controlled by the float which pivots on the hinge pin and forces the float needle against its seat when a predetermined level is reached. This level should be about 5/16 inch, or between 1/4 and 3/8 inch from the top of the bowl gasket surface. Since this measurement cannot easily be made, the level may be adjusted mechanically at time carburetor is assembled (par. 101). With this adjustment, the float should maintain the prescribed fuel level if the float does not bind in any position and has not lost its buoyancy through leakage.

(*b*) The float is provided with a balance spring which tends at all times to cause closure of the float needle valve. Under conditions of extreme vibrations, the fuel in the bowl tends to shift so as to produce a loss of float buoyancy force, and possible flooding of the carburetor. The balance spring force is sufficient, under such conditions, to prevent extreme float valve opening and resultant flooding.

(3) *Metering system.*

(*a*) The carburetor uses the restricted air-bled-jet operating principle. Fuel passes from the bowl into the main metering jet and nozzle support (fig. 11). Fuel flow is controlled by the accurately calibrated main metering jet as the fuel passes into the nozzle. Around the outside of the nozzle is the main well which communicates with the inner nozzle well through three radial holes in the nozzle. Any suction on the main well is bled to the air horn through the main well.

(*b*) Air flow through the venturi creates a suction on the nozzle which tends to draw fuel from the bowl in proportion to the rate of air flow. Therefore, as air flow increases, the suction on the inner well increases bringing about increased fuel flow. The fuel level in the air-bled main well reflects this suction which is producing the flow

of fuel through the metering jet. Therefore, the metering of the carburetor is controlled in part by the uncovering of successive nozzle air-bleed holes as the level in the outer well drops. These bleeds have an additional beneficial effect in that they emulsify the fuel. This aids fuel atomization and distribution by breaking up the fuel droplets as they are discharged from the nozzle.

(4) *Idle system.*

(*a*) During light-load operation, when air flow is relatively low, there is insufficient suction at the nozzle to produce fuel flow. During this operating condition, manifold vacuum

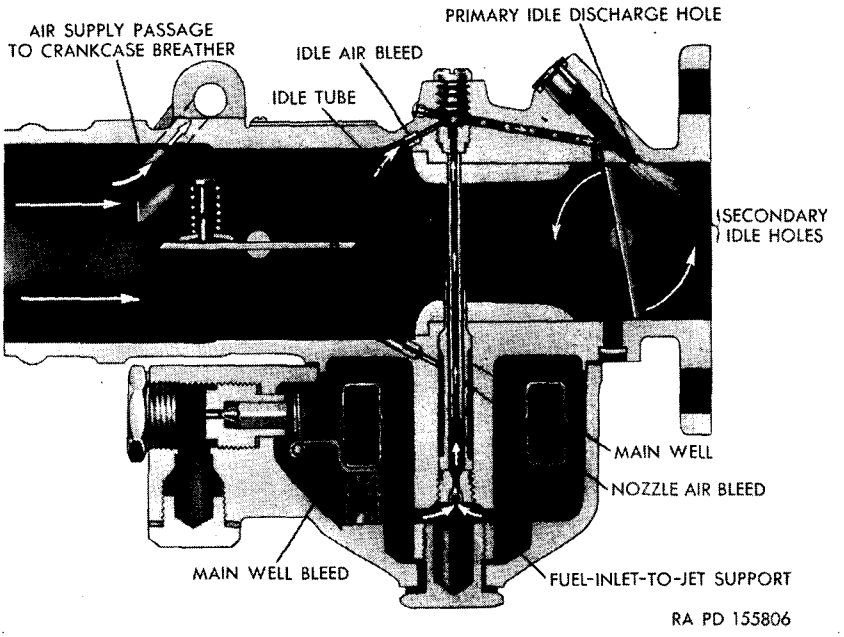


Figure 12. Idle system in operation.

is utilized to produce fuel flow through the use of the idle system. Suction on the idle ports varies as a function of throttle position and air flow. At closed throttle the primary idle discharge orifice is subjected to manifold vacuum while the secondary holes act as bleeds (fig. 12). The progressive opening of the throttle valve to increase air flow first eliminates the bleeding of the secondary idle ports and then places them under manifold vacuum to produce increased suction and fuel flow at higher air flows.

(*b*) Under light-load closed-throttle operation, fuel flows through the main metering jet and into the inner well. Fuel then flows upward through the idle tube where it is

calibrated and then mixed with air from the calibrated idle air bleed. The addition of air at the exit of the idle tube forms an air-fuel emulsion which becomes further atomized at the respective idle discharge ports. This produces a better vaporization and distribution of the fuel in the air stream during the lower air flows.

(5) *Accelerating well.*

(*a*) When there is no fuel flow from the carburetor, the fuel level in the main well is at the same elevation as that in the bowl. The supply of fuel to the engine by either the nozzle or the idle system tends to cause the level in the main well to drop due to the presence of the main well bleed. The drop in fuel level, in part, reflects the amount of fuel flow through the main jet and a definite relationship is maintained between the rate of metering jet fuel flow and the drop in level in the main well at all times.

(*b*) A condition of high vacuum at closed throttle causes all fuel in the manifold to evaporate. The lower vacuum at increased throttle openings will allow unevaporated fuel to puddle in the manifold. Therefore, at any time the throttle is rapidly opened, vacuum decreases and fuel is deposited in the manifold. The mixture supplied to the engine becomes correspondingly leaner. Conversely, when the throttle is closed, the puddled fuel evaporates causing richness. The accelerating or main well is designed primarily to counteract the leanness accompanying throttle opening. The increasing air flow, as manifold drops, will bring about a higher nozzle suction and a higher fuel flow, which in turn causes a drop in level in the accelerating well. The rate of depletion of fuel from the well is controlled by the radial bleed holes in the nozzle and is intended to compensate for the fuel puddled in the manifold. Conversely, the decrease in fuel flow as the throttle is closed causes the well to be filled and compensates for that fuel entering the engine from the puddles in the manifold.

(6) *Manual choke.*

(*a*) When the engine is cold, the tendency for fuel to evaporate is greatly reduced. Under such conditions, only a fraction of the normal quantity of fuel supplied to the engine will evaporate and that mixture of vaporized fuel and air in the engine combustion chamber is far too lean to burn. By supplying abnormally high quantities of fuel to the engine for cold starting, sufficient vaporized fuel is produced in the cylinder to start the engine. As the engine warms up, the percentage of liquid fuel which evaporates will increase and

the air-fuel ratio supplied by the carburetor is leaned out proportionally until normal operating temperatures are reached.

(*b*) The manual choke (fig. 13), produces the rich cold-starting mixture by restricting air flow and simultaneously increasing fuel suction when the choke is closed. The degree to which the choke must be closed will be found to vary with the temperature of the engine and the volatility of the fuel being used.

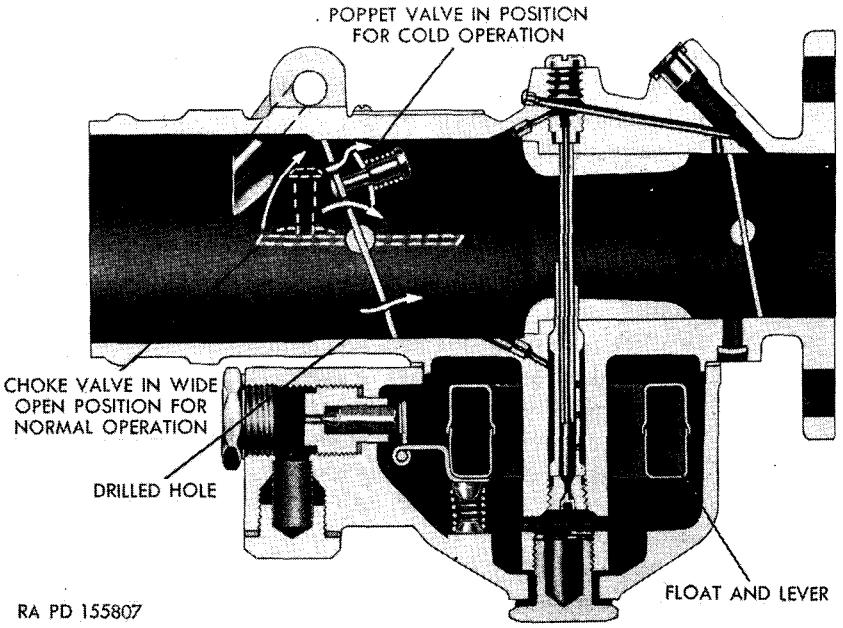


Figure 13. Manual-choke system.

(*c*) Before a cold start is attempted, the engine and manifold contain only a negligible quantity of evaporated fuel. Therefore, the mixture supplied during cranking must be additionally enriched in order to compensate for the air in the engine and produce a more rapid first firing. Once firing begins, manifold vacuum increases and the fuel required is not as great because the manifold has become saturated and higher vacuum causes a higher percentage to be evaporated. Cranking vacuum is relatively low and is insufficient to open the poppet valve in the closed choke. This produces the richest possible mixture for cranking. At the instant the engine fires and picks up speed, the manifold vacuum acts on the poppet valve to open it (fig. 13) and reduces the choking effect an amount sufficient to maintain the correct mixture for cold operation.

(7) *Ventilation system.*

(*a*) The engine and carburetor are intended to be a complete sealed unit. For this reason, the more common atmospheric crankcase ventilator cannot be used. Forced ventilation is produced by the carburetor to satisfy this need and to secure more efficient ventilation. The ventilation system is designed to remove water and fuel vapors from the crankcase. It also removes some corrosive gases caused by blowby and other sludge-forming vapors which are caused by oil deterioration. Another function of the system is to remove possible combustible vapors from the magneto. This accounts for the two connections at the ventilator valve housing and the two connections at the carburetor body (figs. 14 and 18).

(*b*) Crankcase vapors are drawn from the crankcase and from the magneto through the filler pipe-to-ventilator valve housing and the magneto-to-ventilator valve housing tubes respectively (fig. 18) into the carburetor body by manifold vacuum. These crankcase vapors pass into the engine with the fuel and air mixture supplied to the engine by the carburetor. Fresh filtered air in turn is supplied to the engine crankcase by means of two balance tubes (figs. 11, 12, and 14) incorporated in the intake side of the carburetor body, thence through carburetor-to-crankcase

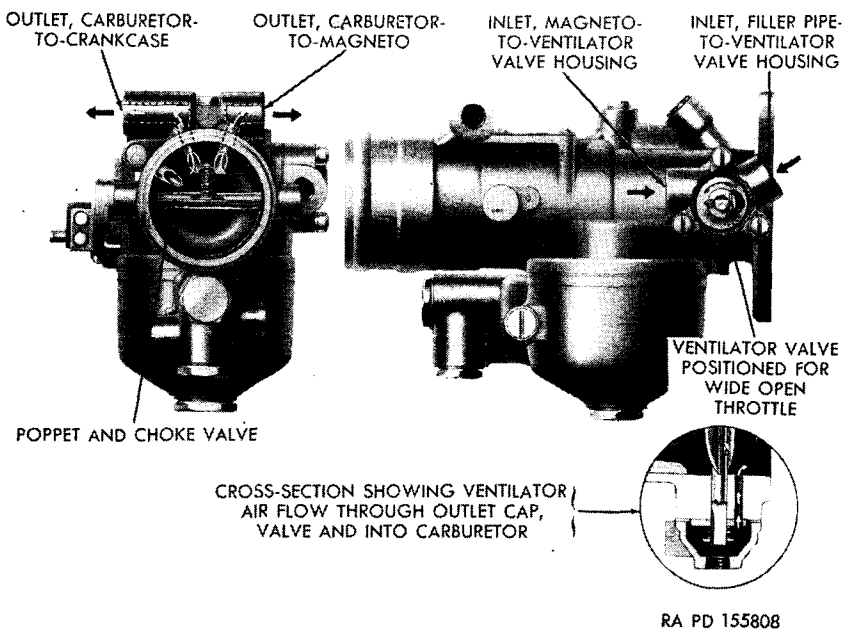


Figure 14. Ventilation system.

vent tube and through carburetor-to-magneto vent tube to the engine crankcase and magneto respectively.

(*c*) Ventilator air flow is regulated by the throttle-actuated ventilator valve. Since at closed throttle the required ventilation is not great but the forecausing flow, the manifold vacuum, is highest, at this point the ventilator valve is most nearly closed. As carburetor air flow increases, the ventilation requirement is greater and the valve opens to both increase ventilator flow and compensate for the loss of manifold vacuum.

(*d*) Since the ventilator adds air to the fuel mixture supplied by the carburetor, it is a part of the carburetor calibration. The carburetor and engine will function best only when the ventilation system is operating as intended.

o. GOVERNOR. Engine speed is controlled by a flyball weight and spring-type governor (figs. 20 and 77) which is gear driven from the main gear train. This governor controls the engine speed by varying the throttle opening to suit the load imposed on the engine. A vernier adjustment is provided on the spring for final speed adjustment.

p. HEAT EXCHANGER. A heat exchanger is provided for vehicle heating, and is composed of a series of steel tubes incased in a metal box. Hot exhaust gases from the combustion chamber pass through these tubes causing them to become heated. Air used for cooling the generator unit is directed over these heated tubes, thereby heating the air. The addition of an electrical element, using current supplied by the generator unit, can be used to further heat this air when desired.

q. GENERATOR. The direct-current shunt-wound starter generator consists of a rotating armature, a stationary frame and coil and end frame (figs. 3 and 93). The armature is supported at the front and rear ends by ball bearings (fig. 3) and the generator is coupled to the engine crankshaft by means of a hub and disk (fig. 3). A cooling generator impeller fan and diffuser are at the rear end of the generator and the whole assembly is secured to the engine crankcase by four mounting studs, nuts, and lock washers.

17. Operation

a. GENERAL. The engine is the four-cycle, internal-combustion, single-cylinder type and operates on gasoline. Refer to operators' technical manual pertaining to vehicle incorporating this engine and generator for operating instructions.

b. POWER APPLICATION. Smooth application of power is secured in the four-cycle engine by the momentum of the heavy generator and crankshaft. Power from the crankshaft is transmitted to the generator at the rear of the engine.

c. REMOTE CONTROL STARTING. The unit is provided with remote

control starting system. The system is operated by the driver. The driver's control energizes the series-wound starting windings in the generator causing the generator to act as a starter to crank the engine.

d. Low-temperature or Emergency Starting. A pull-type manual starter, intake manifold heating elements, and an integral choke and throttle control facilitate low-temperature or emergency starting.

e. Generator Voltage Regulation. Automatic generator regulation is provided through the use of a carbon-pile regulator which automatically controls the voltage rated output at 28 volts.

f. Mechanical Governor. A mechanical governor automatically controls engine speed to 3,100 rpm at full load and 3,250 rpm at no load.

Section II. REMOVAL OF ACCESSORIES FROM ENGINE

18. Side Panel Removal

a. Remove Carburetor Guard (figs. 2 and 16). Remove four ¼–20 x ½ bolts and lock washers securing carburetor guard to baffle support and fuel filter bracket (fig. 15).

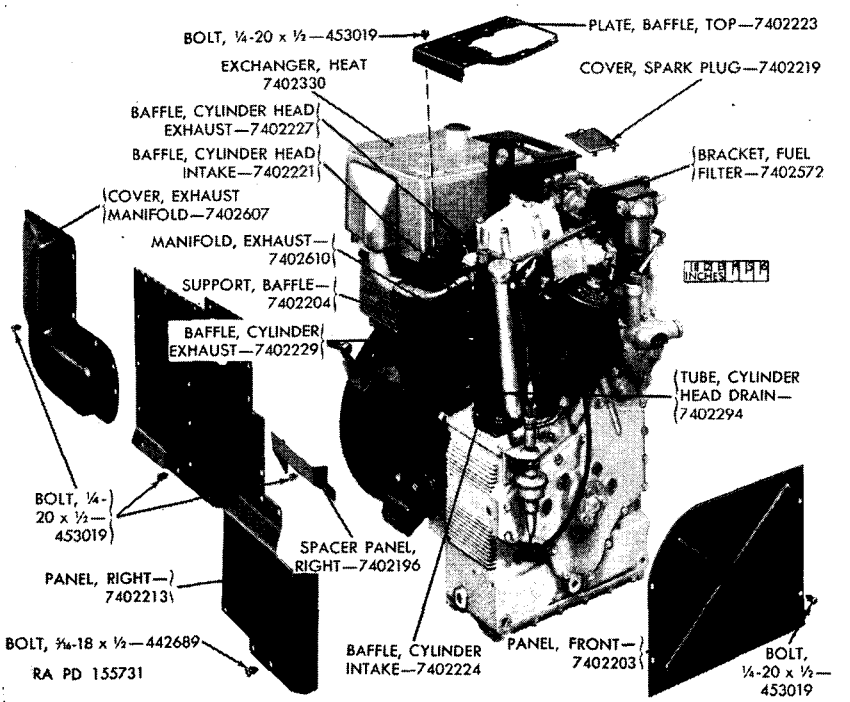


Figure 15. Panels—right-front exploded view.

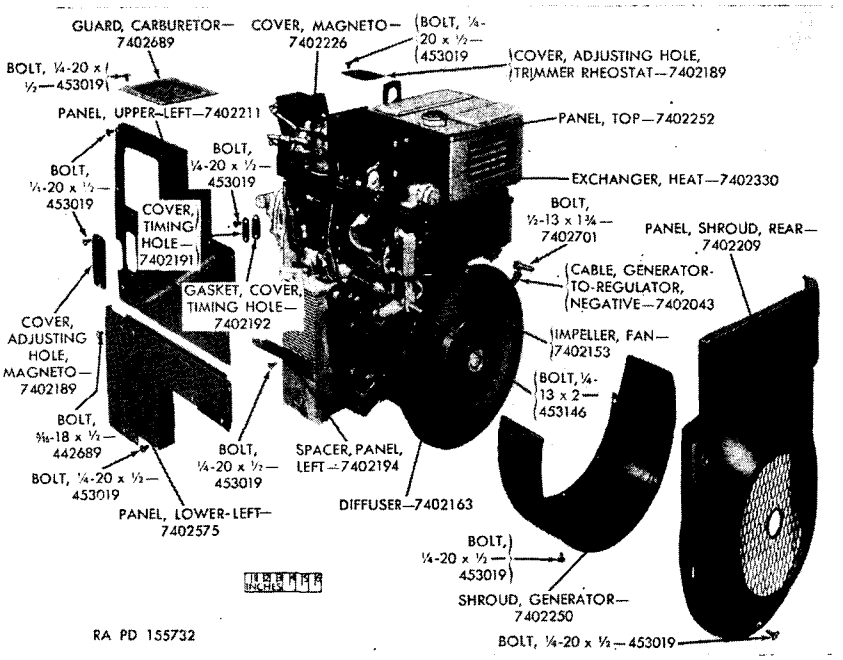


Figure 16. Panels—left-rear exploded view.

b. Remove Upper-left Panel (fig. 16). Remove eighteen ¼–20 x ½ bolts and lock washers and remove upper-left panel.

c. Remove Front Panel (fig. 15). Remove four ¼–20 x ½ bolts and lock washers securing front panel to lower-left and right panels.

d. Remove Mount Brackets. Remove rubber mount brackets from generator and engine unit.

e. Remove Lower-left Panel (fig. 16). Remove six ¼–20 x ½ and six 5/16–18 x ½ bolts and lock washers securing engine lower-left panel to crankcase, panel spacer, and rear shroud panel.

f. Remove Exhaust-manifold Cover (figs. 1 and 15). Remove nine ¼–20 x ½ bolts and lock washers securing exhaust-manifold cover to heat exchanger and right panel.

19. Heat Exchanger Removal

a. Remove four ¼–20 x 6¼ bolts attaching heat exchanger to baffle support and rear shroud panel (figs. 2, 15, and 16), and remove two ¼–20 x ½ bolts and lock washers securing heat exchanger to right panel. Remove heat exchanger from engine. The exhaust manifold will slide from the exhaust tube (fig. 15).

b. Remove exhaust manifold (fig. 15).

c. Remove remaining sixteen ¼–20 x ½ bolts and four 5/16–18 x ½ bolts and lock washers securing right panel to rear shroud panel, baffle support, panel spacer, and intake baffle (figs. 1, 15, and 16).

20. Fuel Filter Removal

a. Disconnect fuel-filter inlet tube at filter. Also remove fuel tube between filter and fuel pump (fig. 17).

b. Loosen vent tube between carburetor and oil filler pipe and disconnect at carburetor end (figs. 17 and 18).

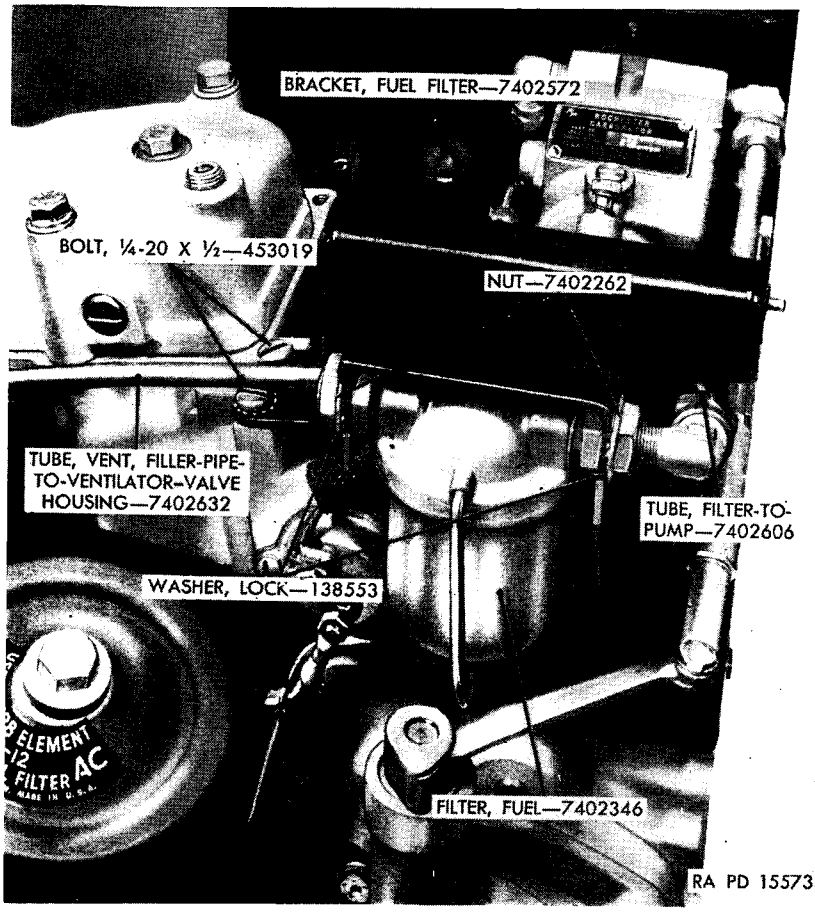


Figure 17. Fuel filter.

c. Remove fuel filter and fuel-filter bracket by removing carburetor-to-governor link (figs. 17 and 18) and removing two ¼–20 x ½ bolts and lock washers securing filter bracket to engine crankcase.

21. Vent Tube Removal

a. Remove vent tube between carburetor and engine front cover (fig. 18).

b. Loosen two vent tubes between carburetor and magneto at carburetor end (fig. 18).

c. Disconnect fuel-pump-to-carburetor tube (figs. 18 and 25) at both ends but do not remove from magneto cover.

d. Disconnect control-switch-receptacle-to-intake-elbow-thermostat cable from lower terminal of intake-elbow-thermostat cover (figs. 20 and 110) and control-switch-receptacle-to-oil-pressure-switch cable from bottom of oil pressure switch (figs. 26 and 110).

22. Carburetor Removal

a. Loosen carburetor-intake-hose clamps (fig. 21) and slide hose on pipe.

b. Remove two 5/16–18 x 1¼ carburetor-intake-elbow-to-cylinder-head attaching bolts, plain washers and lock washers (fig. 34); then lift carburetor and intake elbow from cylinder head.

c. Remove carburetor-intake-elbow-to-cylinder-head gasket (fig. 34).

23. Oil Filter Removal

a. Disconnect crankcase-to-filter tube (fig. 19) at crankcase and filter.

b. Disconnect filter-to-pressure switch tube (fig. 19) at filter and ⅜-tube tee.

c. Remove two ¼–20 x 1¾ bolts, lock washers, and plain washers and one ¼–20 x 1 3/16 bolt and lock washer (fig. 19) holding oil filter to governor. Remove filter.

24. Governor Removal

a. Remove one ¼–20 x 1⅛ bolt and three remaining ¼–20 x 1¾ bolts, lock washers, and plain washers securing governor to engine front cover (fig. 20) and remove governor and gasket (fig. 34).

b. Remove fiber magneto drive coupling.

25. Cylinder Top Baffle and Magneto Cover Removal

a. Remove ten ¼–20 x ½ bolts and lock washers retaining cylinder top-baffle plate (figs. 1 and 15) to cylinder head, magneto cover, and cylinder head baffles. Remove top baffle.

b. Disconnect two vent tubes from magneto (fig. 21).

c. Remove remaining two ¼–20 x ½ bolts and lock washers holding magneto cover to baffle support (fig. 16) and lifting eye and remove magneto cover, spark plug cover and tubes.

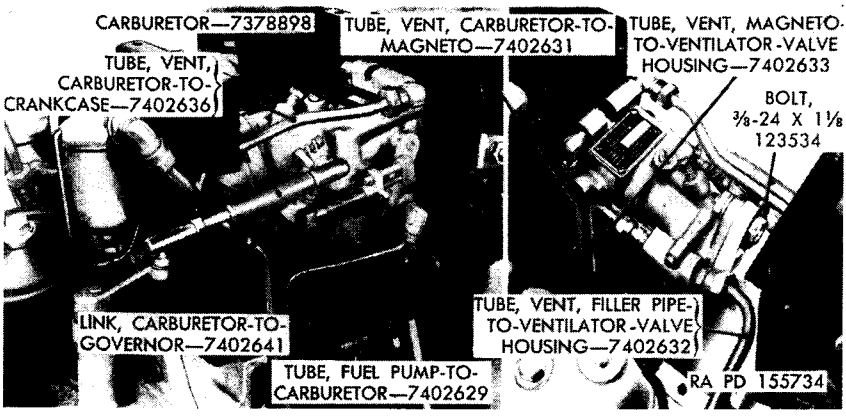


Figure 18. Carburetor.

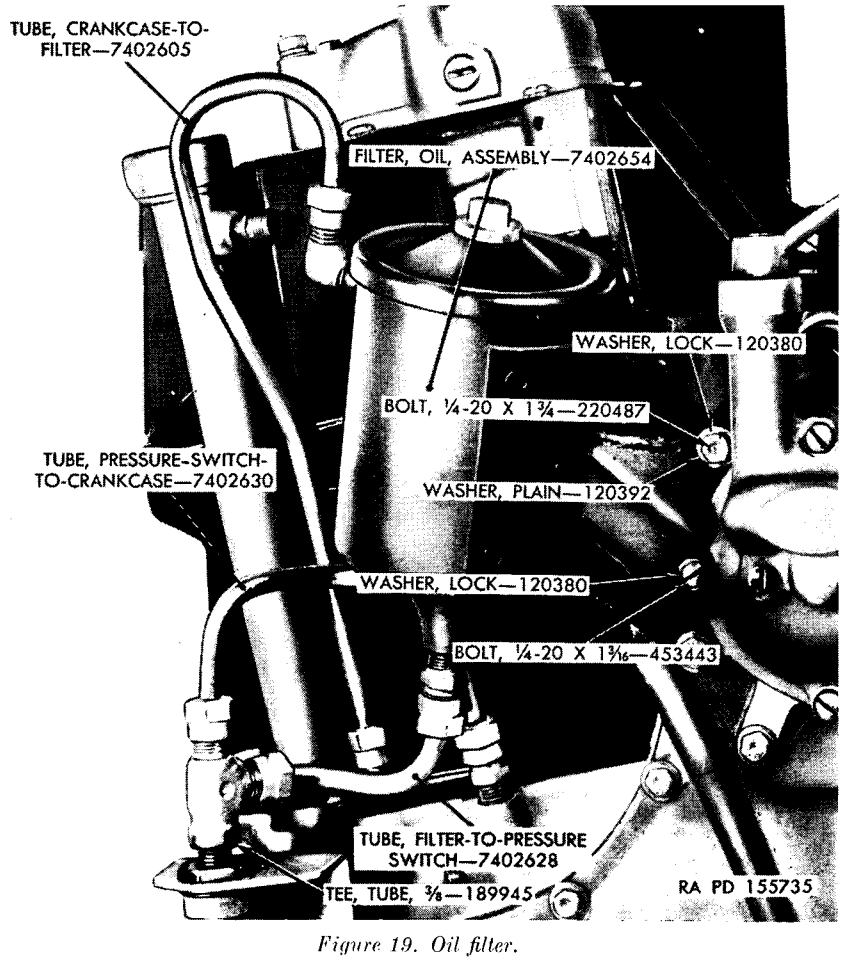


Figure 19. Oil filter.

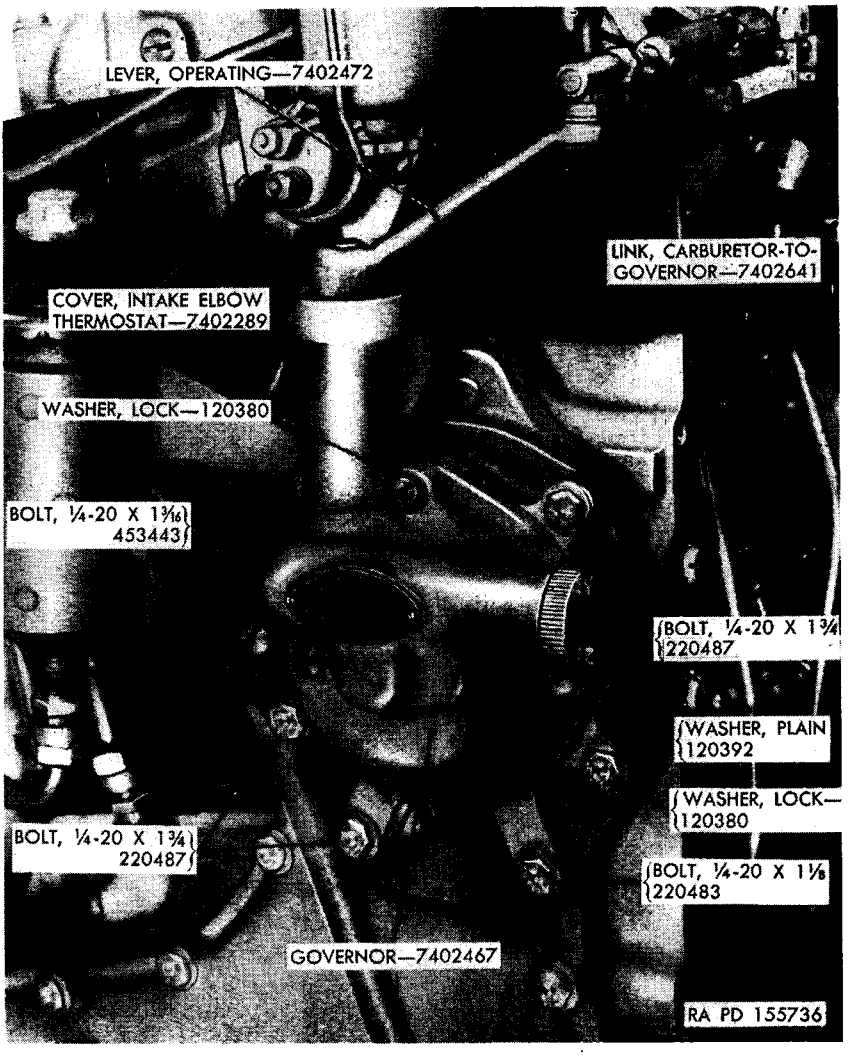


Figure 20. Governor.

26. Cable Removal

a. Disconnect generator-to-starter-relay cable from terminal "SER F" on generator and terminal "A1" on starter relay (figs. 21 and 110).

b. Disconnect terminal-block-to-starter-relay cable from "A2" terminal of starter relay. Disconnect terminal-block-to-regulator cable from "BATT" terminal on generator regulator and from terminal at rear shroud panel (figs. 21 and 110).

c. Pull oil-pressure-switch-to-control-switch-receptacle cable and grommet from cylinder baffle.

d. Remove magneto-to-radio-filter ground cable (figs. 21 and 110).

e. Disconnect control-switch-receptacle-to-radio-filter cable from right side of radio filter (fig. 110).

f. Remove two ¼–20 x ½ bolts and lock washers and lift radio filter from generator upper mounting bracket (fig. 21).

g. Disconnect control-switch-receptacle-to-generator-regulator cable from "SW" terminal of regulator (fig. 110).

h. Disconnect rheostat-to-generator-regulator cable from "R" terminal of regulator (fig. 110).

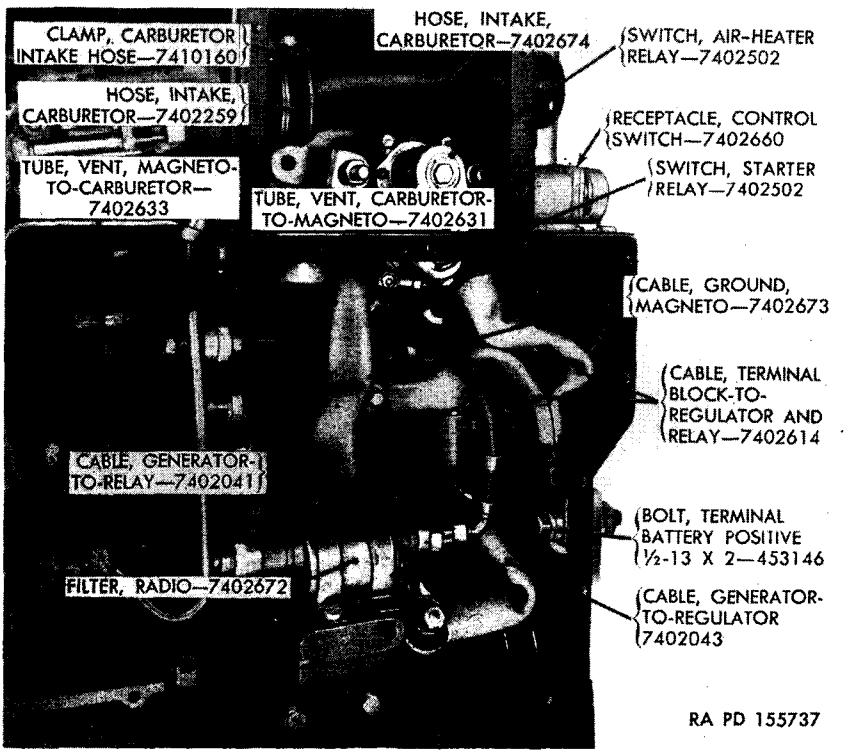


Figure 21. Cables.

i. Disconnect control-switch-receptacle-to-generator-regulator cable from "P" terminal of regulator (fig. 110).

j. Disconnect air-heater-switch-relay-to-generator-regulator cable from "E" terminal of regulator (fig. 110).

k. Disconnect generator "P" terminal-to-generator-regulator cable from "PG" terminal of regulator (fig. 110).

l. Disconnect generator "F" terminal-to-generator-regulator cable from "F" terminal of regulator (fig. 110).

m. Disconnect generator-to-generator-regulator cable and generator-to-control-switch-receptacle cable from "A+" generator terminal. Remove generator-to-generator-regulator cable from "A+ ARM" terminal of generator regulator (figs. 21 and 110).

n. Disconnect generator-to-generator-regulator cable from "P" generator terminal (fig. 110).

o. Disconnect generator-to-generator-regulator cable from "F" generator terminal (fig. 110).

p. Disconnect ground cable from generator-regulator ground terminal (fig. 110).

27. Top Panel and Rear Shroud Removal

a. Remove one ¼–20 x ½ bolt and lock washer securing top panel to rear shroud panel and remove three ¼–20 x ½ bolts and lock washers securing top panel to baffle support. Remove one ¼-20 x 6¼ bolt and lock washer securing top panel to baffle support and lift top panel wiring harness and control switch receptacle away from engine (figs. 16, 22, and 109).

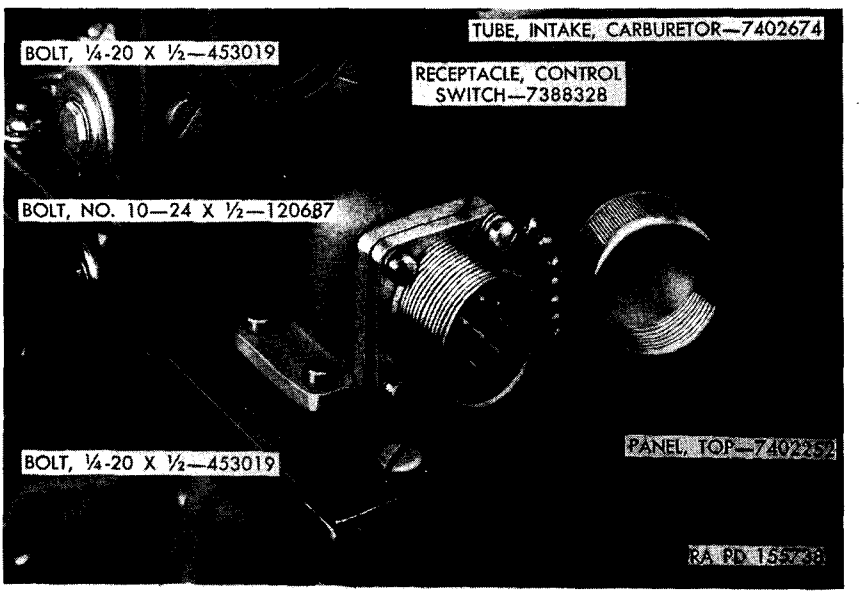


Figure 22. Control switch receptacle.

b. Disconnect cable from "GROUND" at right side of generator and from right side of rear shroud panel (fig. 110).

c. Remove four ¼–20 x ½ bolts and lock washers holding rear shroud panel to generator-regulator bracket and generator diffuser (figs. 2 and 16).

d. Remove rheostat from top panel.

e. Remove air-heater switch and starter relay switch from top panel.

f. Remove control switch receptacle from top panel.

28. Generator Regulator Removal

a. Remove two 5/16–24 x 9/16 bolts and lock washers holding generator regulator and bracket to generator (fig. 23).

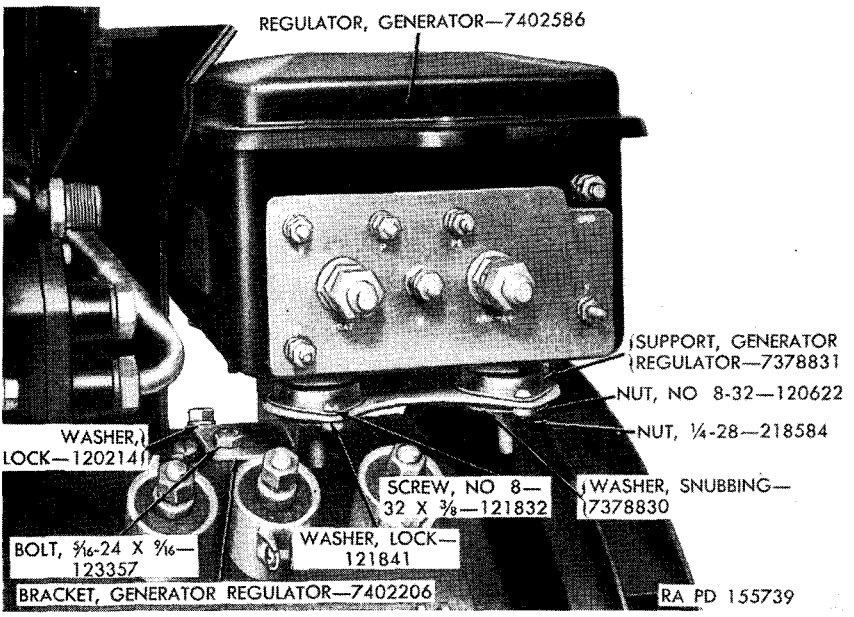


Figure 23. Generator regulator.

b. Disconnect pressure-switch-to-crankcase tube from pressure-switch-tube tee at crankcase and remove tube (fig. 19).

c. Remove three ¼–20 x ½ bolts and lock washers and three ⅜–24 x ⅝ bolts and lock washers which secure engine-baffle support to generator frame (fig. 15).

29. Magneto Removal

a. Disconnect spark-plug cable at spark plug (fig. 24).

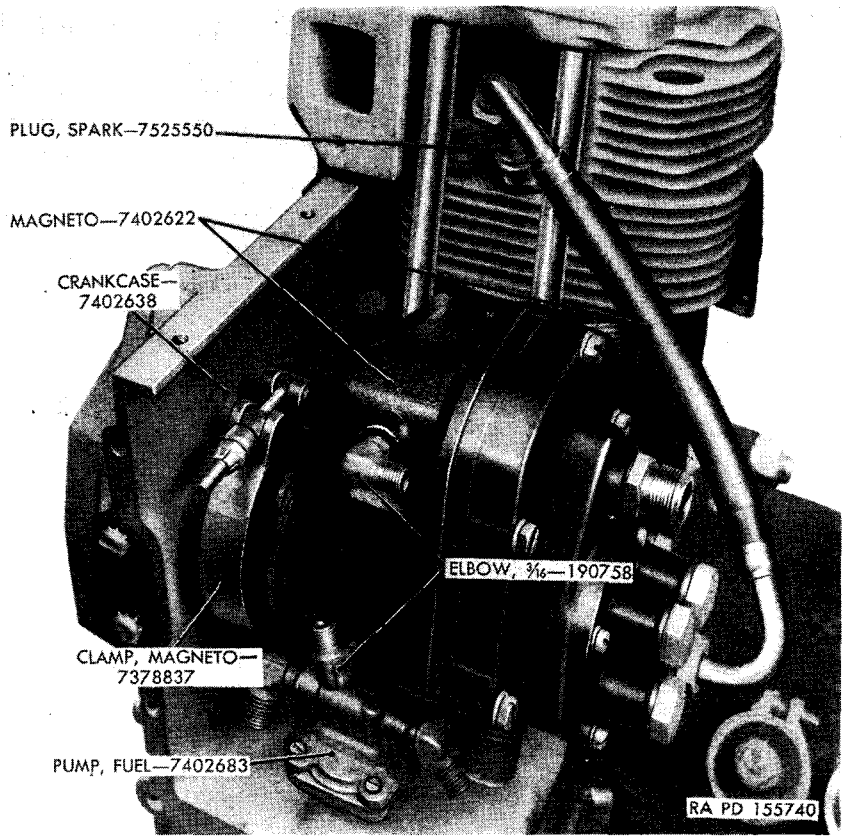


Figure 24. Magneto.

b. Loosen magneto clamp and remove magneto, gasket, and clamp from rear face of engine crankcase (fig. 24).

30. Fuel Pump Removal

a. Remove two ¼–20 x ⅞ bolts and lock washers securing fuel pump to crankcase (fig. 25).

b. Remove fuel pump and fuel pump gasket from crankcase.

31. Oil-pressure Switch Removal

a. Remove two ¼–20 x 9/16 bolts and lock washers securing oil-pressure-switch bracket to crankcase (fig. 26).

b. Remove switch and bracket.

32. Oil-filler Pipe Removal

a. Remove one 5/16–18 x 1½ bolt and lock washer securing oil-filler-pipe clamp to crankcase (fig. 27). Remove clamp.

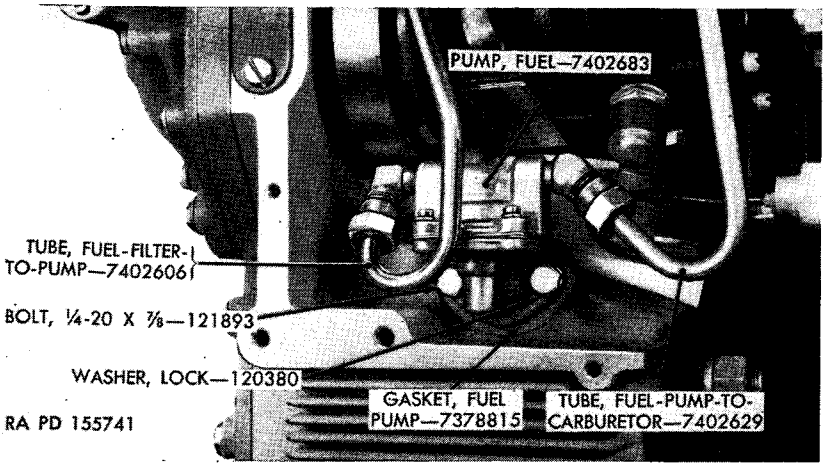


Figure 25. Fuel pump.

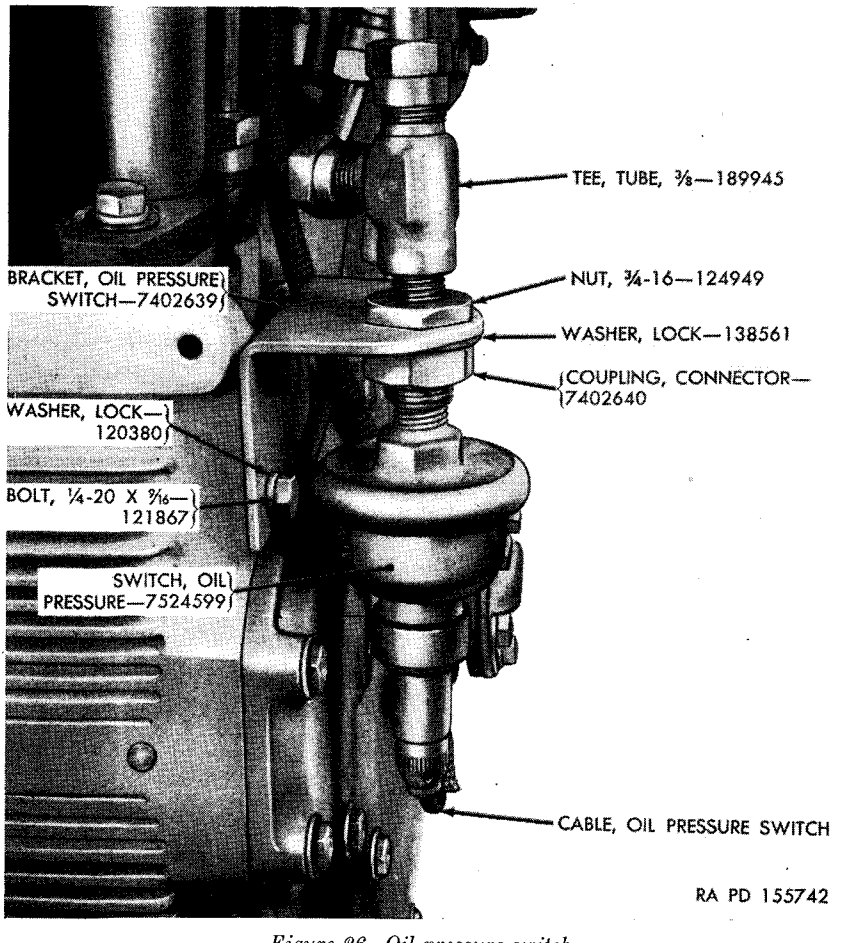


Figure 26. Oil-pressure switch.

b. Remove oil-filler pipe, seal ring, and filler cap from crankcase (figs. 27 and 37).

c. Remove cylinder-head intake and exhaust baffles (figs. 15 and 107).

d. Disconnect cylinder-head drain tube at cylinder head and crankcase. Remove drain tube (figs. 15 and 106).

e. Remove the 5/16–18 x 1½ bolt securing exhaust-pipe clamp to cylinder head and remove exhaust-pipe clamp, exhaust pipe, and gasket (fig. 35).

33. Disconnect Generator from Engine

a. Remove ¾–16 x 2 bolt and washer that secures impeller fan to generator-armature shaft (figs. 28 and 29).

b. Remove generator drive hub to crankshaft bolt using 5/16 hex plug wrench 7950098 and fan-impeller hub holder 7950093 (fig. 30).

c. Thread puller-type adapter 7950099 into tapped hub of generator fan; install slide-hammer-type remover to adapter and remove fan from armature shaft (fig. 31).

d. Upend engine and generator assembly and rest on wood blocks (figs. 28 and 32), then remove four ½–20 nuts and lock washers from generator-to-crankcase studs.

e. Thread ¾–16 eye bolt into tapped end of armature shaft, lift generator away from crankcase (fig. 32), and rest generator on floor in horizontal position. Block generator to prevent it from rolling.

f. Remove four ⅜–16 x ½ bolts securing diffuser to generator and frame and remove diffuser (figs. 3 and 32).

g. Remove three ¼–20 x ½ bolts and lock washers at each side of power generator and remove left and right panel spacers (figs. 15, 16, and 32).

h. Remove five ¼–20 x ½ bolts and lock washers securing generator shroud to generator (figs. 16 and 32).

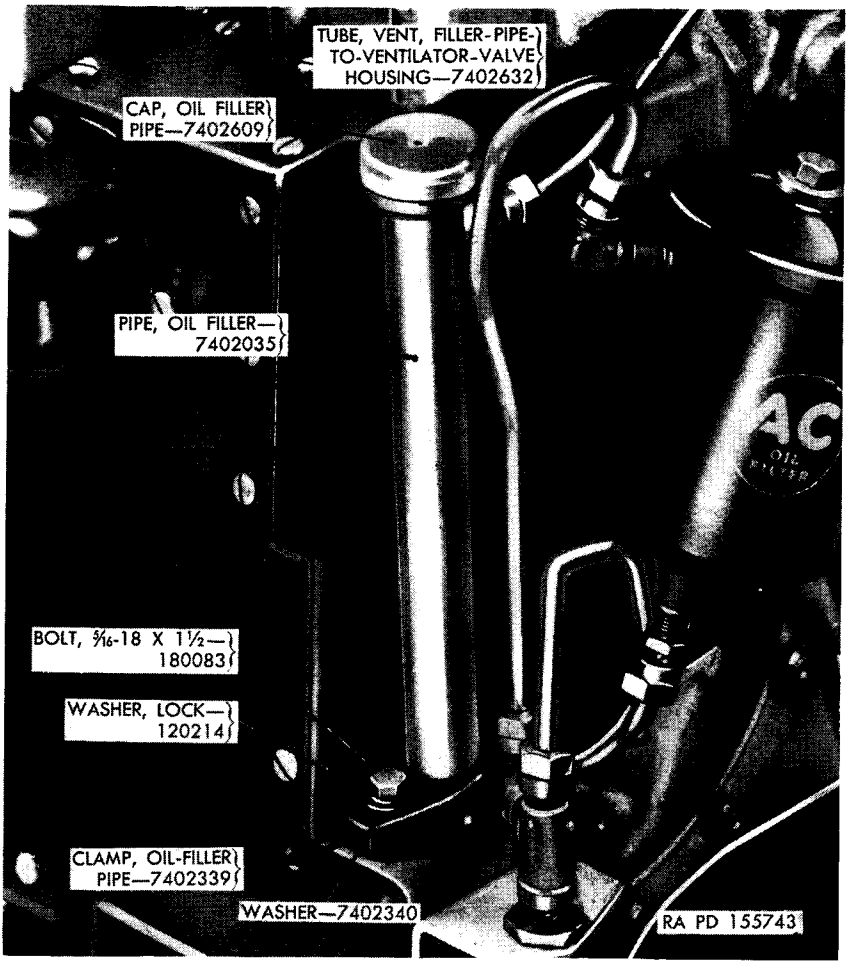


Figure 27. Oil-filler pipe and cap.

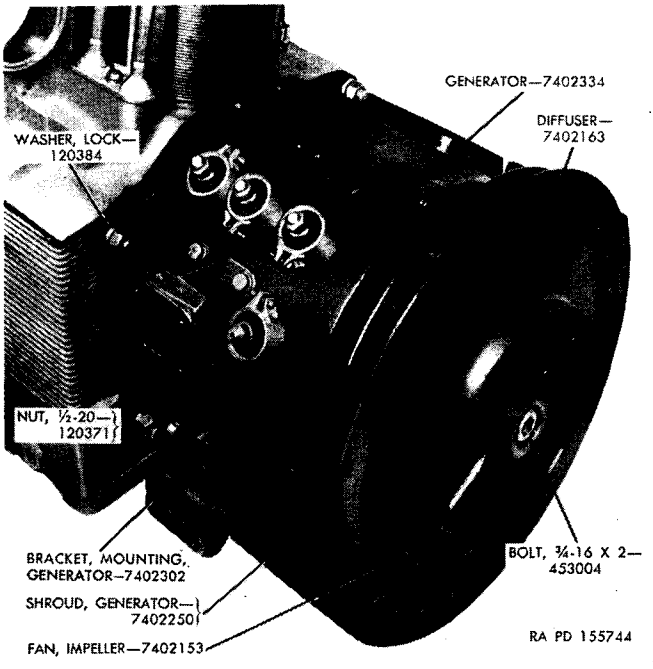


Figure 28. Generator.

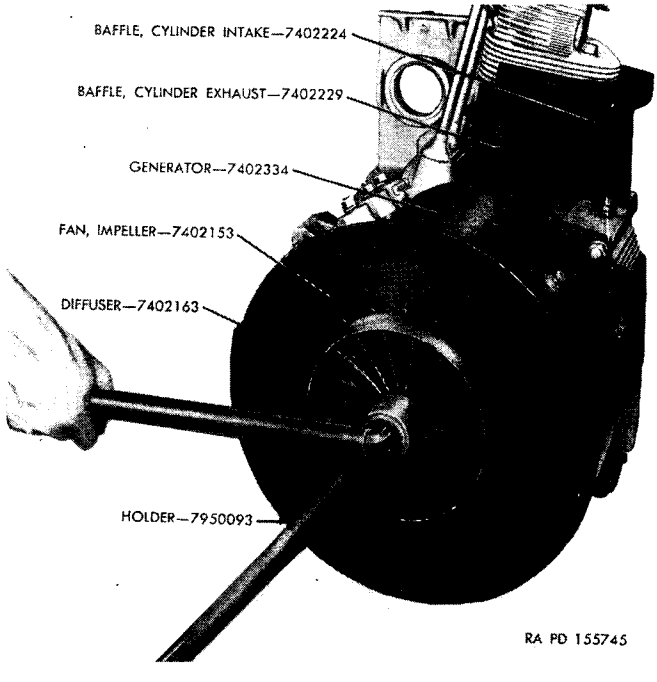


Figure 29. Removing generator fan bolt.

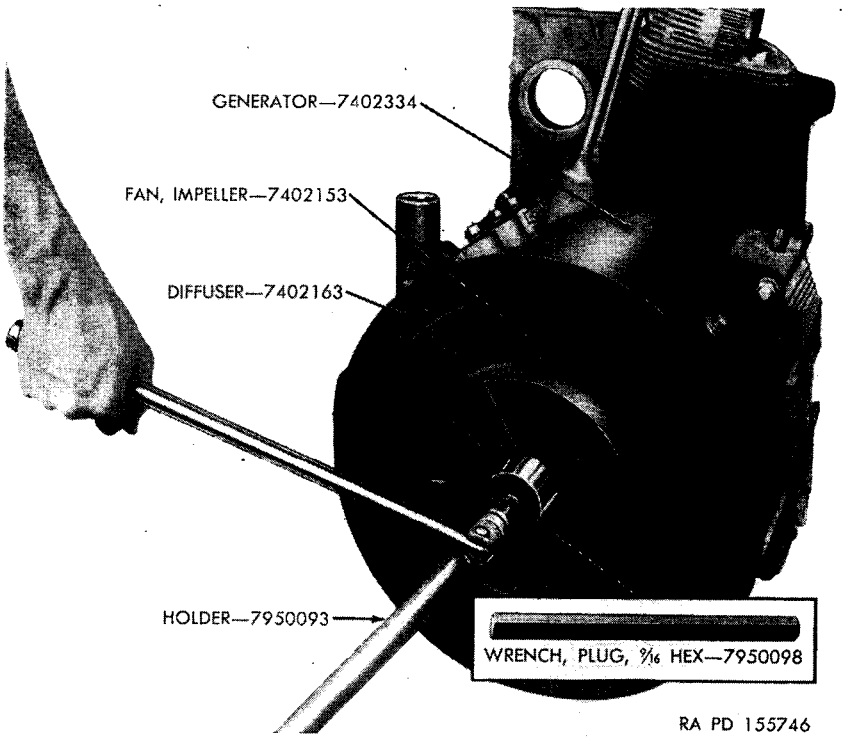


Figure 30. Removing generator drive hub bolt.

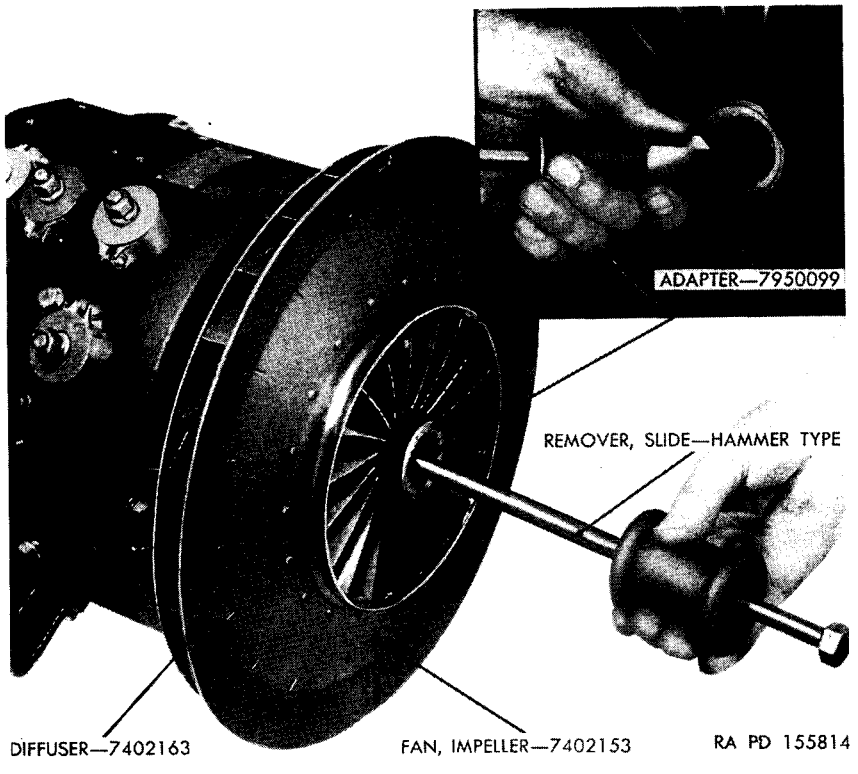


Figure 31. Pulling generator fan from armature shaft.

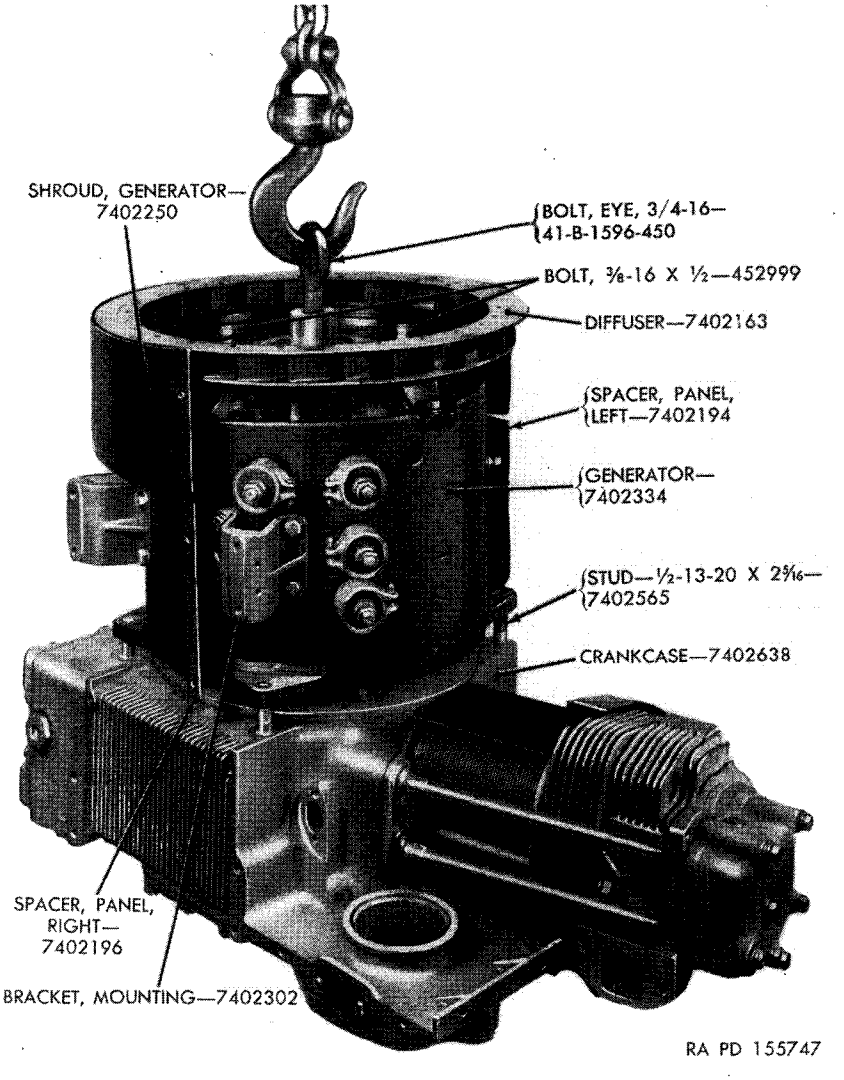


Figure 32. Lifting generator from engine.

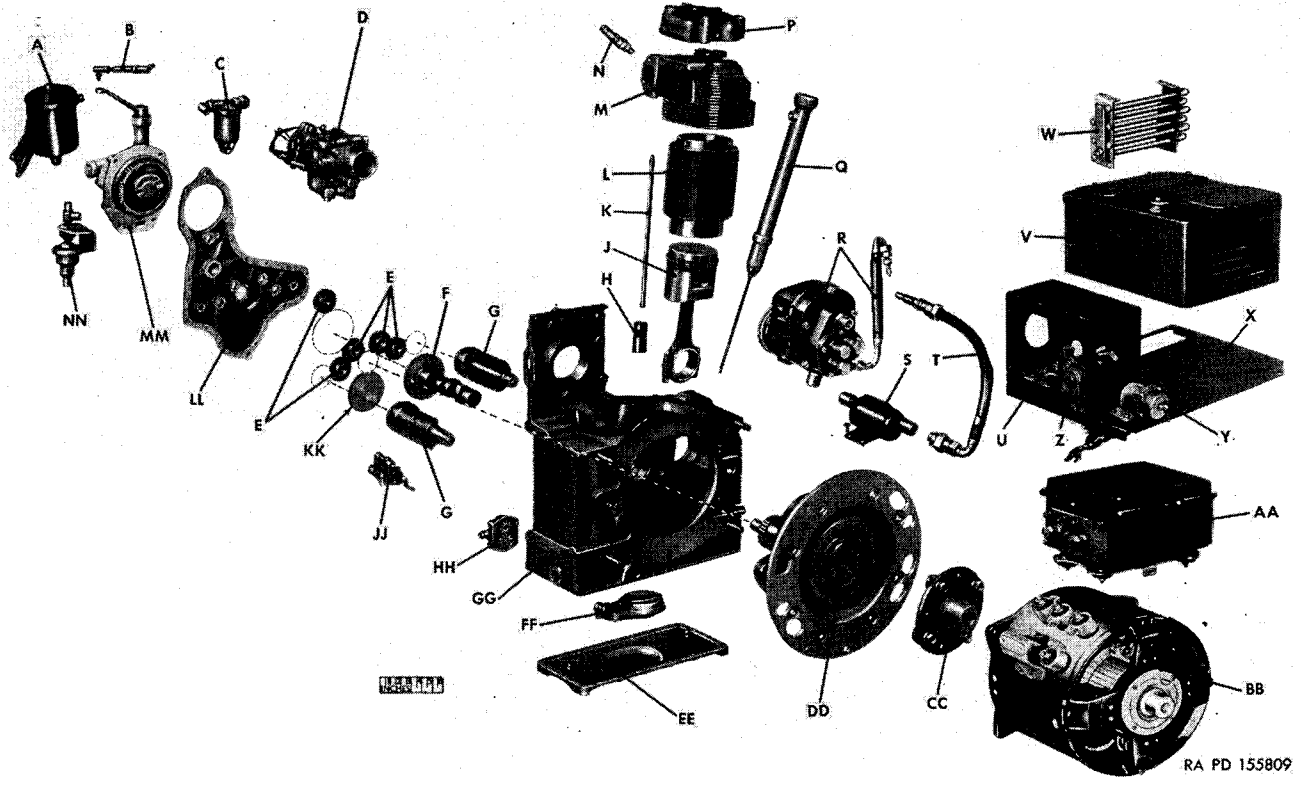


Figure 33. Auxiliary generator and engine—exploded view.

A—FILTER, OIL, ASSY—7402654
B—LINK, CARBURETOR THROTTLE—7402621
C—FILTER, FUEL, ASSY—7402346
D—CARBURETOR, ASSY—7378898
E—GEAR, IDLER—7402093
F—CAMSHAFT—7402059
G—COUNTERWEIGHT—7402058
H—TAPPET, HYDRAULIC VALVE—7402326
J—PISTON—7402026
K—ROD, VALVE, ROCKER ARM—7378904
L—CYLINDER—7402097
M—HEAD, CYLINDER—7402170
N—PLUG, SPARK—7525550
P—COVER, ROCKER ARM—7402152
Q—PIPE, OIL FILLER—7402035
R—MAGNETO, ASSY—7402662
S—FILTER, RADIO, ASSY—7402672
T—CABLE, MAGNETO GROUND—7402673
U—RHEOSTAT—7402587
V—EXCHANGER, HEAT, ASSY—7402330
W—HEATER, ELECTRIC—7402634
X—PANEL, TOP—7402252
Y—RECEPTACLE, CONTROL SWITCH—7402660
Z—SWITCH, AIR HEATER RELAY—7402502
AA—REGULATOR, GENERATOR, ASSY—7402586
BB—GENERATOR, ASSY—7402334
CC—HUB, GENERATOR DRIVE—7402464
DD—CRANKSHAFT—7402060
EE—COVER, CRANKCASE, BOTTOM—7402094
FF—FLOAT, OIL—7402137
GG—CRANKCASE, ASSY—7402638
HH—PUMP, OIL, ASSY—7402081
JJ—PUMP, FUEL, ASSY—7402683
KK—GEAR, DRIVE-DRIVEN—7402082
LL—COVER, CRANKCASE, FRONT—7402151
MM—GOVERNOR, ASSY—7402467
NN—SWITCH, OIL PRESSURE, ASSY—7524599

Figure 33.—Continued.

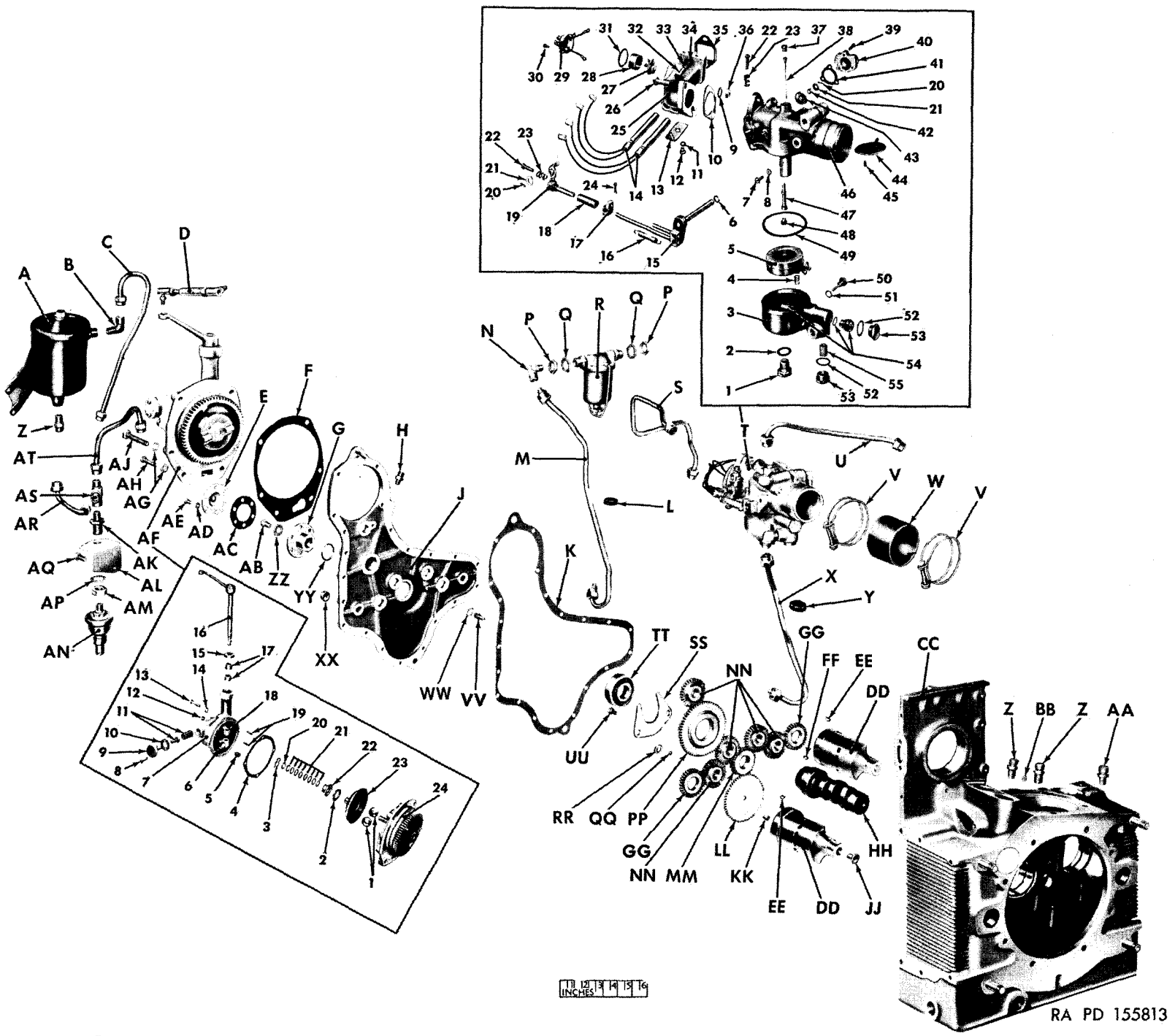


Figure 34. Auxiliary generator and engine—exploded view.

A—FILTER, OIL, ASSY—7402654
B—ELBOW, OIL FILTER, INLET TUBE—189929
C—TUBE, *INLET, OIL FILTER*—7402605
D—LINK, CARBURETOR THROTTLE—7402621
E—CAP, STARTING PULLEY HUB—7402627
F—GASKET, GOVERNOR-TO-COVER—7402491
G—HUB, STARTING PULLEY—7402091
H—CONNECTOR, TUBE, 5/16—420876
J—COVER, CRANKCASE, FRONT—7402151
K—GASKET, CRANKCASE FRONT COVER—7402063
L—GROMMET, FUEL FILTER, OUTLET TUBE—7402603
M—TUBE, OUTLET, FUEL FILTER—7402606
N—ELBOW, FUEL FILTER, OUTLET TUBE—423188
P—NUT, FUEL FILTER CONNECTOR—7402262
Q—WASHER, LOCK, 5/16—138553
R—FILTER, FUEL, ASSY—7402346
S—TUBE, VENT, CARBURETOR-TO-CRANKCASE—7402636
T—CARBURETOR, ASSY—7378898
1—PLUG, RETAINING, BOWL—7402386
2—GASKET, RETAINING PLUG—7402387
3—BOWL, FLOAT—7402500
4—SPRING, BALANCE, FLOAT—7402697
5—FLOAT—7402379
6—GASKET, PACKING, *"O" RING*—501218
7—SCREW, LOCATING, NOZZLE—7402583
8—GASKET, LOCATING NOZZLE SCREW—7402584
9—WASHER, PLAIN, 13/32—120394
10—GASKET, MANIFOLD—7378897
11—WASHER, LOCK, NO 10—120217
12—SCREW, RETAINING CLIP, NO 10-24 x 5/16—132825
13—CLIP, HEATER ELEMENT CARTRIDGE RETAINING—7402122
14—CARTRIDGE, HEATER ELEMENT—7402171
15—LEVER, CHOKE, ASSY—7402374
16—SPRING, RETURN, CHOKE LEVER—7402696
17—BLOCK, THROTTLE CONTROL—7402693
18—SPRING, THROTTLE CONTROL ROD—7402694
19—LEVER, THROTTLE, ASSY—7402695
20—*PIN*, COTTER—191598
21—WASHER, PLAIN, 0.031 THK—502220
22—SCREW, ADJUSTING, IDLE—7402362
23—*SPRING, IDLE ADJUSTING SCREW*—7402363
24—PIN, COTTER—119981
25—ELBOW, INTAKE—7402096
26—BOLT, 5/8-24 x1 1/2—123534
27—THERMOSTAT, INTAKE ELBOW HEATER, ASSY—7402247
28—INSULATOR, INTAKE ELBOW THERMOSTAT—7402248
29—COVER, INTAKE ELBOW THERMOSTAT, ASSY—7402289
30—SCREW, RETAINING, NO 10-24 x 5/16—132833
31—GASKET, THERMOSTAT COVER—501232
32—BOLT, 5/16-18 x 1 1/4—122027
33—WASHER, LOCK, 5/16—120214
34—WASHER, PLAIN, 5/16—120393
35—GASKET, INTAKE-ELBOW-TO-CYLINDER-HEAD—7402239
36—NUT, 1/2-24—219708
37—PLUG, IDLE TUBE HOLE—7402356
38—TUBE, IDLE, ASSY—7402355
39—SCREW, *RETAINING, VENT HOUSING*—7402692
40—HOUSING, VENT, CRANKCASE—7402369
41—GASKET, CRANKCASE *VENT HOUSING*—7402370
42—SPRING, TENSION, THROTTLE SHAFT—7402367
43—VALVE, VENT, CRANKCASE—7402366
44—VALVE, CHOKE, ASSY—7402372
45—SCREW, RETAINING, CHOKE VALVE—7402365
46—BODY, CARBURETOR—7402501
47—NOZZLE, MAIN DISCHARGE—7402353
48—JET, MAIN METERING—7402354
49—GASKET, FLOAT BOWL-TO-BODY—7402385
50—PIN, FLOAT HINGE—7402380
51—GASKET, FLOAT HINGE PIN—7402381
52—GASKET, FUEL STRAINER, AND FLOAT NEEDLE, PLUG—7402383
53—PLUG, FUEL STRAINER, AND FLOAT NEEDLE—7402384
54—VALVE, FLOAT, W/SEAT, ASSY—7402499
55—STRAINER, FUEL—7402382
U—TUBE, OIL FILLER PIPE-TO-CARBURETOR—7402632
V—CLAMP, *CARBURETOR INTAKE HOSE*—7410160
W—HOSE, INTAKE, CARBURETOR—7402259
X—TUBE, FUEL-PUMP-TO-CARBURETOR—7402629
Y—GROMMET, FUEL-PUMP OUTLET TUBE—7402600
Z—CONNECTOR, TUBE, 3/8—189921
AA—CONNECTOR, TUBE, 3/8—7402580
BB—PLUG, PIPE, 1/4—7402337
CC—CRANKCASE, ASSY—7402638
DD—COUNTERWEIGHT—7402058
EE—KEY, WOODRUFF, 1/4 x 3/8—427261
FF—KEY, WOODRUFF, 1/4 x 1/2—106749
GG—GEAR, COUNTERWEIGHT—7402025
HH—CAMSHAFT—7402059
JJ—BUTTON, COUNTERWEIGHT—7402177
KK—PLUG, COUNTERWEIGHT—7402013
LL—GEAR, DRIVE-DRIVEN—7402082
MM—GEAR, CRANKSHAFT—7402068
NN—GEAR, IDLER—7402093
PP—GEAR, CAMSHAFT—7402067
QQ—BALL, STEEL, 9/32—145636
RR—NUT, 5/16-24—451058
SS—PLATE, THRUST, CRANKSHAFT—7402040
TT—CAM, STARTING PULLEY, ASSY—7402453
UU—BOLT, 5/16-18 x 3/4—220493
VV—FITTING, BREATHER—7402647
WW—WASHER, 5/16—138538
XX—PLUG, 3/8—7402298
YY—SEAL, STARTING-PULLEY HUB—7402297
ZZ—WASHER, PLAIN—7378886
AB—BOLT, 3/8-24 x 3/4—221949
AC—GASKET, STARTING-PULLEY CAP—7378894
AD—WASHER, LOCK, 1/4—120380
AE—BOLT, 1/4-28 x 7/16—123308
AF—GOVERNOR, ASSY—7402467
1—BALL, STEEL, 3/4—7036616
2—BEARING, THRUST—7402489
3—CLIP, SHAFT SPRING—7402579
4—GASKET, HOUSING-TO-BASE—7402486
5—BEARING, HOUSING—7402469
6—FORK, OPERATING—7402474
7—*HOUSING*—7402468
8—SCREW, NO 8-32 x 3/4—453031
9—NUT, ADJUSTING, SPRING—7402476
10—GASKET, SPRING *ADJUSTING NUT*—7402477
11—SPRING, W/ADJUSTING SCREW, ASSY—7402475
12—PLUG, PIPE, 1/8—7402492
13—SCREW, 1/4-20 x 1 5/16—453443
14—WASHER, LOCK, 1/4—120380
15—SEAL, OIL, OPERATING SHAFT—500002
16—LEVER, OPERATING—7402472
17—BEARING, NEEDLE, BODY—186732
18—LEVER, ANCHOR, SPRING—7402473
19—PIN, GROOVE, 1/8 x 3/8—7402578
20—WASHER, STOP—7036615
21—WASHER, STOP—7402485
22—BASE, OPERATING FORK—7402484
23—RACE, DRIVE-SHAFT BEARING, OUTER—7402483
24—BASE, ASSY—7402478
AG—WASHER, PLAIN, 1/4—120392
AH—BOLT, 1/4-20 x 1 1/8—220483
AJ—BOLT, 1/4-20 x 1 1/4—220487
AK—*COUPLING, CONNECTOR*—7402640
AL—BRACKET, OIL PRESSURE SWITCH—7402639
AM—NUT, 3/8-16—124949
AN—SWITCH, OIL PRESSURE, ASSY—7524599
AP—WASHER, LOCK, 3/8—138561
AQ—BOLT, 1/4-20 x 5/16—121867
AR—TUBE, OUTLET, OIL FILTER—7402628
AS—TEE, TUBE—189945
AT—TUBE, PRESSURE SWITCH-TO-CRANKCASE—7402630

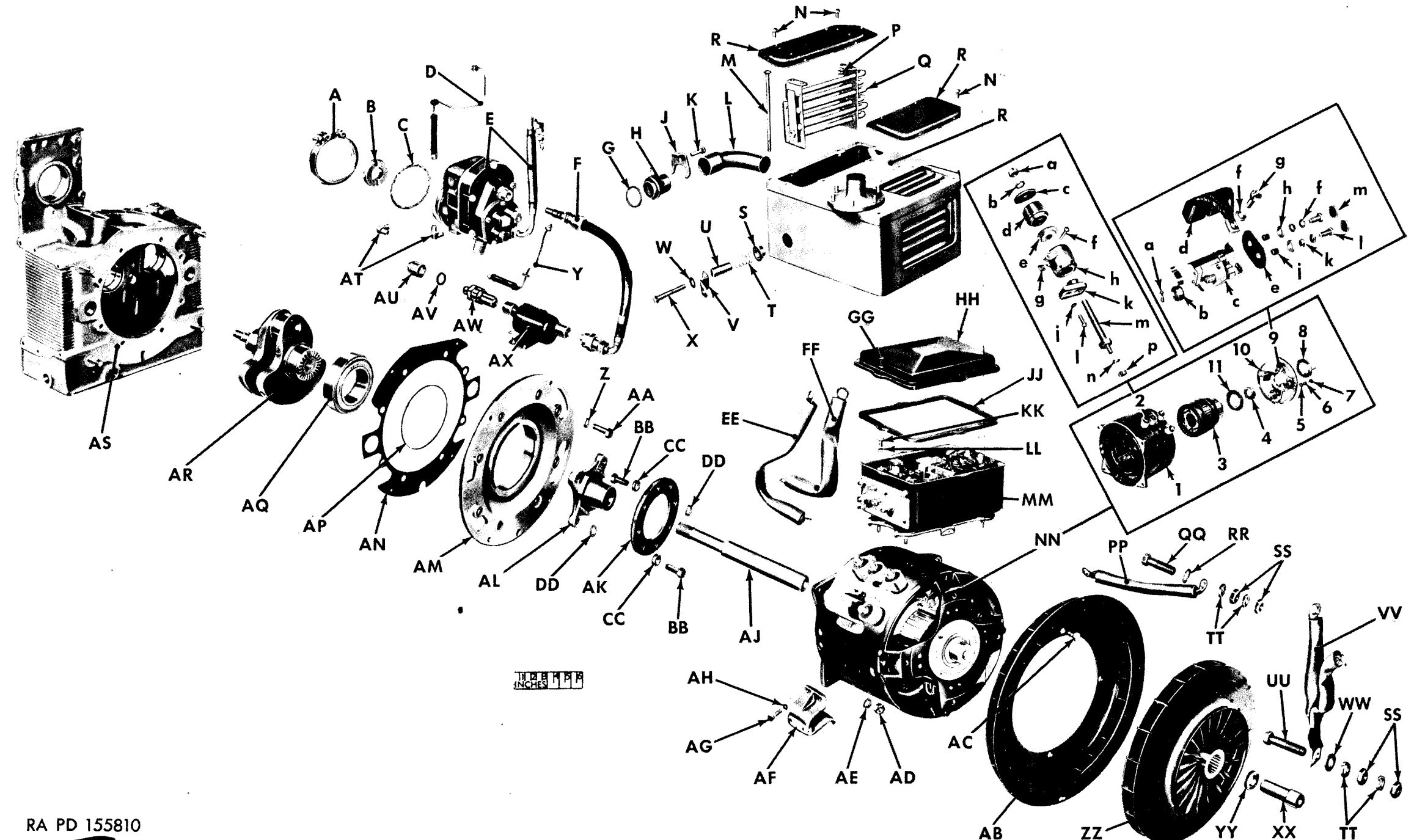


Figure 35. Auxiliary generator and engine—exploded view.

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RESTRICTED

A—CLAMP, MAGNETO—7378837
B—DISK, DRIVE, MAGNETO—7402528
C—GASKET, MAGNETO-TO-CRANKCASE—7378838
D—TUBE, VENT, MAGNETO-TO-CARBURETOR—7402633
E—MAGNETO, ASSY—7402662
F—CABLE, GROUND, MAGNETO—7402673
G—GASKET, EXHAUST PIPE—140375
H—PIPE, EXHAUST—7402176
J—CLAMP, EXHAUST PIPE—7402264
K—BOLT, 5/16-18 x 1½—7402185
L—MANIFOLD, EXHAUST—7402610
M—BOLT, ¼-20 x 6½—7402690
N—SCREW, ¼-20 x ½—453019
P—NUT, ¼-20—123179
Q—HEATER, ELECTRIC—7402634
R—EXCHANGER, HEAT, ASSY—7402330
S—BUSHING, INSULATOR—7402618
T—SPRING, INSULATOR, BUSHING—7402619
U—SPACER, TERMINAL—7402617
V—LINK, MAGNETIC - SWITCH - TO - ELECTRIC HEATER—7402593
W—WASHER, PLAIN, 13/32—120394
X—BOLT, 3/8-16 x 2½—180134
Y—TUBE, CARBURETOR-TO-MAGNETO—7402631
Z—WASHER, LOCK, 3/8—120382
AA—BOLT, 3/8-16 x 1½—453611
BB—BOLT, 3/8-24 x 7/8—453014
CC—WASHER, 3/8—7402027
DD—SPACER, DRIVE DISK—7402466
EE—CABLE, GENERATOR - TO - STARTER - RELAY—7402041
FF—CABLE, GENERATOR-TO-REGULATOR—7402043
GG—SCREW, REGULATOR COVER—7402408
HH—COVER, REGULATOR—7402456
JJ—GASKET, REGULATOR COVER—7402395
KK—BOLT, 5/16-24 x 9/16—123357
LL—WASHER, LOCK, 5/16—120214
MM—REGULATOR, GENERATOR, ASSY—7402586
NN—GENERATOR, ASSY—7402334
#1—FRAME, W/FIELD COIL, ASSY—7402520
2—TERMINAL, ASSY
a—NUT, 3/8-16—114547
b—WASHER, LOCK, 3/8—120382
c—WASHER, INSULATOR—5302662
d—CAPACITOR, RADIO NOISE SUPPRESSOR—7402546
e—INSULATOR, CAPACITOR MOUNTING—5516857
f—SCREW, NO 10-32 x 3/8—132124
g—NUT, NO 10-32—120611
h—CUP, CAPACITOR HOUSING—5516854
j—WASHER, LOCK, NO 10-32—120217
k—INSULATOR, TERMINAL STUD BUSHING—5516823
l—SCREW, NO 10-32 x 5/8—132119
m—STUD, TERMINAL—5516826
n—WASHER, LOCK, ¼—120380
p—NUT, ¼-28—114545
3—ARMATURE, ASSY—7402521
4—BEARING, BALL—7402522
5—WASHER, LOCK, 3/8—120382
6—WASHER, PLAIN, 3/8—7402561
7—BOLT, 3/8-16 x 1¼ (END FRAME MOUNTING)—180124
8—PLATE, RETAINING, BEARING, OUTER—5516803
9—HOLDER, BRUSH, ASSY—5516813
a—PIN, COTTER—190432
b—SPRING, TENSION—7402524
c—HOLDER, BRUSH—7402540
d—BRUSH, ASSY—7402523
e—WASHER, INSULATING—7402541
f—WASHER, LOCK, ¼—120380
g—SCREW, ¼-28 x 3/8—7402558
h—WASHER, INSULATING—7402545
j—SLEEVE, INSULATING—7402542
k—WASHER, MOUNTING—7402589
l—SCREW, MOUNTING—7402588
m—PLUG, EXPANSION—7402590
10—END FRAME AND BRUSH RIGGING, ASSY—5516899
11—PLATE, RETAINING, BEARING, INNER—5516802
PP—CABLE, NEGATIVE-GROUND-TO-GENERATOR—7402043
QQ—BOLT, ½-13 x 1¾—7402701
RR—WASHER, LOCK, ½—138549
SS—NUT, ½-13—422957
TT—WASHER, LOCK, ½—120384
UU—BOLT, ½-13 x 2—453146
VV—CABLE, REGULATOR - AND - RELAY - TO - TERMINAL BLOCK—7402614
WW—WASHER, PLAIN, ½—120396
XX—BOLT, ¾-16 x 2—453004
YY—WASHER, ¾, FAN IMPELLER—7402498
ZZ—FAN, IMPELLER—7402153
AB—DIFFUSER—7402163
AC—BOLT, 3/8-16 x ½—452999
AD—NUT, ½-13—120371
AE—WASHER, LOCK, ½—120384
AF—BRACKET, MOUNTING, GENERATOR—7402302
AG—BOLT, 5/16-24 x 7/8—181596
AH WASHER, LOCK, 5/16—120214
AJ—BOLT, GENERATOR-TO-CRANKSHAFT—7402028
AK—DISK, DRIVE, GENERATOR—7402465
AL—HUB, DRIVE, GENERATOR—7402464
AM—SUPPORT, MAIN BEARING, REAR—7402613
AN—GASKET, MAIN-BEARING REAR SUPPORT—7402186
AP—SEAL, MAIN BEARING, REAR—7402030
AQ—BEARING, CRANKSHAFT, REAR—7348703
AR—CRANKSHAFT—7402060
AS—CRANKCASE, ASSY—7402638
AT—ELBOW, 3/16—190758
AU—NUT, GROMMET—7723306
AV—GROMMET—7527631
AW—PLUG, ASSY—7720495
AX—FILTER, RADIO, ASSY—7402672

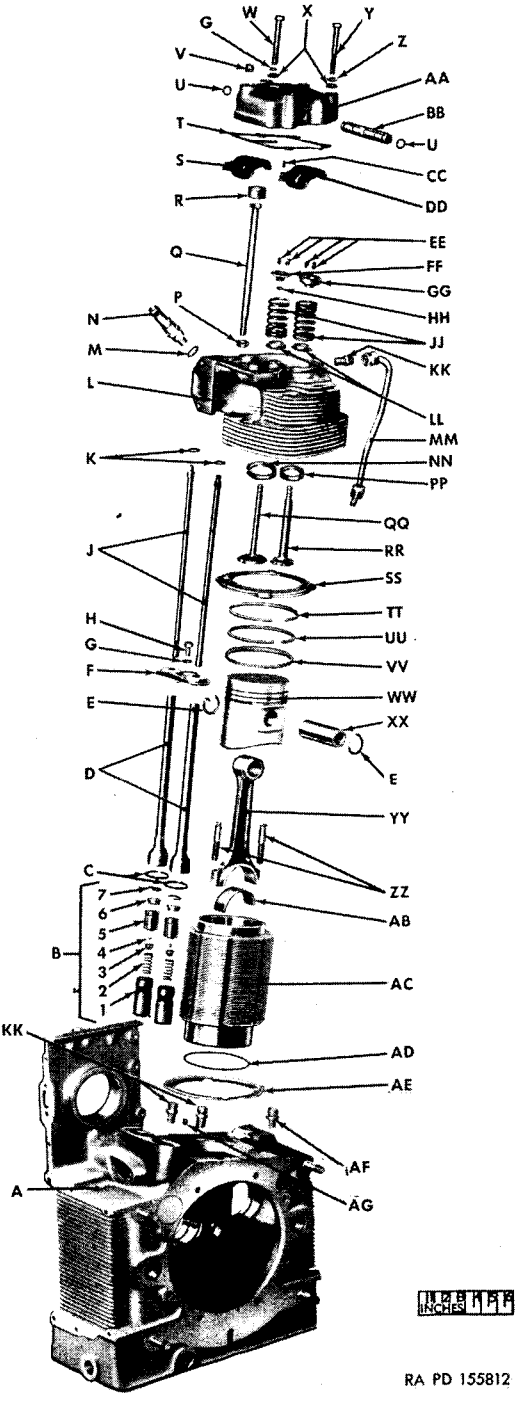


Figure 36. Auxiliary generator and engine—exploded view.

A—CRANKCASE—7402638
B—TAPPET, HYDRAULIC VALVE, ASSY—7402326
1—BODY, VALVE TAPPET
2—SPRING, PLUNGER
3—RETAINER, STEEL BALL
4—BALL, STEEL
5—PLUNGER
6—SEAT, PLUNGER
7—RETAINER, PLUNGER SEAT
C—SEAL, PUSH-ROD TUBE, LOWER—7378911
D—TUBE, COVER, PUSH ROD—7378907
E—RING, RETAINING, PISTON PIN—7378724
F—CLAMP, PUSH-ROD TUBE—7378909
G—WASHER, LOCK, 5/16—120214
H—BOLT, 5/16-18 x 5/8—120228
J—ROD, PUSH, VALVE ROCKER ARM—7378904
K—SEAL, PUSH-ROD TUBE, UPPER—7378910
L—HEAD, CYLINDER—7402170
M—GASKET, SPARK PLUG—A-281773
N—PLUG, SPARK—7525550
P—WASHER, CYLINDER-HEAD BOLT—7402235
Q—BOLT, CYLINDER HEAD—7402062
R—PLUG, PIPE, 3/4—7378999
S—ARM, ROCKER, INTAKE VALVE—7378905
T—GASKET, ROCKER-ARM COVER—7402129
U—SEAL, ROCKER-ARM SHAFT—7378908
V—PLUG, PIPE, 1/4—7402337
W—BOLT, 5/16-18 x 2 1/2—453112
X—WASHER, PLAIN, 5/16—120393
Y—BOLT, 5/16-18 x 2 3/4—453039
Z—GASKET, ANNULAR, 5/16—114622
AA—COVER, ROCKER ARM—7402152
BB—SHAFT, ROCKER ARM—7402293
CC—SCREW, LOCKING, ROCKER-ARM SHAFT—7402010
DD—ARM, ROCKER, EXHAUST VALVE—7402007
EE—LOCK, VALVE-SPRING, UPPER SEAT—B-244750
FF—SEAT, INTAKE-VALVE SPRING, UPPER—7520157
GG—SEAT, EXHAUST-VALVE SPRING, UPPER—7402039
HH—SEAL, INTAKE-VALVE STEM—7378854
JJ—SPRING, VALVE—7378858
KK—CONNECTOR, TUBE, 3/8—189921
LL—SEAT, VALVE SPRING, LOWER—7378859
MM—TUBE, DRAIN, CYLINDER HEAD—7402294
NN—INSERT, SEAT, INTAKE VALVE—7378882
PP—INSERT, SEAT, EXHAUST VALVE—7378883
QQ—VALVE, INTAKE—7378857
RR—VALVE, EXHAUST—7378855
SS—RETAINER, CYLINDER BAFFLE, UPPER—7402099
TT—RING, PISTON, UPPER—7402031
UU—RING, PISTON, INTERMEDIATE—7402008
VV—RING, PISTON, LOWER—7402009
WW—PISTON—7402026
XX—PIN, PISTON—7378828
YY—ROD, CONNECTING—7378829
ZZ—BOLT, CONNECTING ROD—7378827
AB—BEARING, CONNECTING ROD—7378825
AC—CYLINDER—7402097
AD—SEAL, CYLINDER-TO-CRANKCASE—7378975
AE—RETAINER, CYLINDER BAFFLE, LOWER—7402283
AF—CONNECTOR, TUBE—7402580

Figure 36.—Continued.

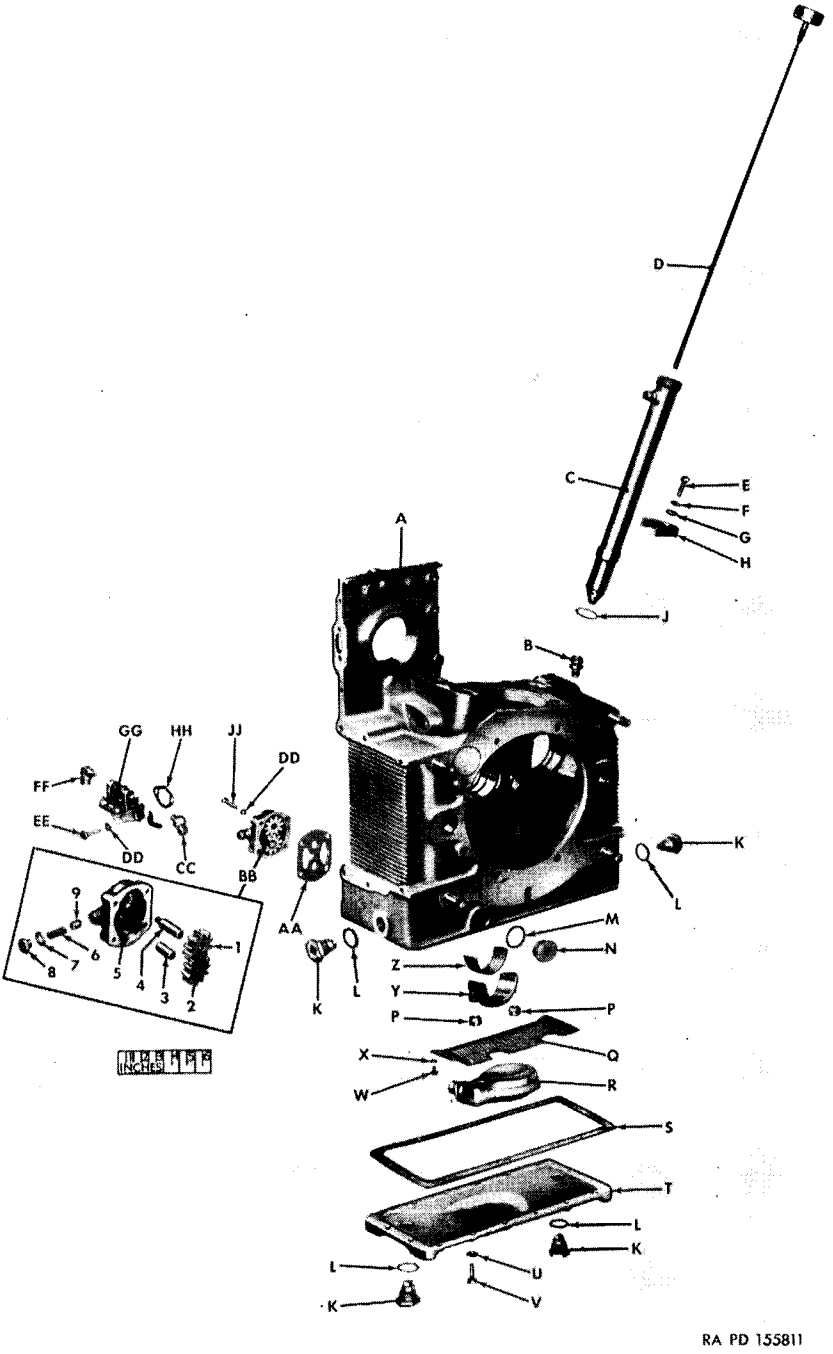


Figure 37. Auxiliary generator and engine—exploded view.

A—CRANKCASE, ASSY—7402638
B—CONNECTOR, TUBE—7402580
C—PIPE, OIL FILLER—7402035
D—CAP, OIL FILLER, W/GAGE, ASSY—7402609
E—BOLT, 5/16–18 x 1½—180083
F—WASHER, LOCK, 5/16—120214
G—WASHER—7402340
H—CLAMP, OIL FILLER PIPE—7402339
J—RING, SEAL—7402347
K—PLUG, DRAIN—7402344
L—GASKET, ⅞—105456
M—GASKET, CRANKCASE PLUG—120428
N—PLUG, CRANKCASE—453006
P—NUT, CONNECTING ROD BOLT—A281558
Q—SCREEN, OIL CRANKCASE—7402118
R—FLOAT, OIL—7402137
S—GASKET, CRANKCASE BOTTOM COVER—7402095
T—COVER, CRANKCASE, BOTTOM—7402094
U—WASHER, PLAIN, ¼—120392
V—BOLT, ¼–20 x 9/16—453007
W—SCREW, NO 10–24 x 5/16—112873
X—WASHER, LOCK, NO 10—120217
Y—CAP, CONNECTING ROD—7378829
Z—BEARING, CONNECTING ROD—7378825
AA—PLATE, THRUST, OIL PUMP—7402078
BB—PUMP, OIL, ASSY—7402081
1—GEAR, DRIVE, OIL PUMP—7402080
2—GEAR, DRIVEN, OIL PUMP—7378803
3—SHAFT, OIL-PUMP DRIVEN GEAR—7402079
4—SHAFT, OIL-PUMP DRIVE GEAR—7402072
5—BODY, OIL PUMP—7402083
6—SPRING, RELIEF VALVE—7402076
7—GASKET, RELIEF VALVE PLUG—7402073
8—PLUG, RELIEF VALVE—7402074
9—VALVE, RELIEF, OIL PUMP—7378805
CC—ELBOW, TUBE—423159
DD—WASHER, LOCK, ¼—120380
EE—BOLT, ¼–20 x ⅞—121893
FF—ELBOW, TUBE—190774
GG—PUMP, FUEL, ASSY—7402683
HH—GASKET, FUEL PUMP—7378815
JJ—BOLT, ¼–20 x 1⅜—180033

Figure 37.—Continued.

Section III. DISASSEMBLY OF ENGINE INTO SUBASSEMBLIES

34. Crankcase Bottom Cover Removal

a. Remove sixteen ¼–20 x 5/16 bolts, washers, and plain washers retaining crankcase bottom cover to crankcase (figs. 38 and 39). Remove bottom cover and bottom cover gasket.

b. Remove oil float; then remove four No. 1–24 x 5/16 screws and lock washers and lift oil screen away from crankcase (fig. 39).

35. Connecting-rod-bearing Cap and Lower-half Bearing Removal

a. Rotate crankshaft until connecting rod is all the way down. Remove two self-locking connecting-rod-bolt nuts.

b. Remove connecting-rod-bearing cap and lower half of bearing; then set engine in upright position.

36. Rocker Arm Cover Removal

Remove two 5/16–18 x 2½ bolts and three 5/16–18 x 2¾ bolts, five plain washers, four lock washers, and one "CU and ASB" gasket which hold rocker-arm cover to the cylinder head (figs. 40 and 76).

37. Cylinder Head Removal

a. Remove¾-inch pipe plug in top of cylinder head (figs. 36 and 40).

b. Loosen four 7/16–14 x 8 7/32 bolts securing cylinder head to crankcase (figs. 36 and 40) using ⅝-inch deep socket wrench and "L" handle.

c. Lift cylinder head away from crankcase (fig. 41).

d. Remove spark plug.

38. Cylinder, Piston, and Connecting Rod Removal

a. Remove upper baffle retainer (fig. 41).

b. Remove one ¼–28 x 3½ bolt, nut, lock washer, and bolt spacer from push rod side of cylinder baffles and one ¼–28 x 1½ bolt, nut, lock washer, and bolt spacer from opposite side and lift cylinder exhaust baffle away from cylinder (fig. 29).

c. Remove three ¼–20 x ½ screws and lock washers freeing cylinder intake baffle from crankcase.

d. Pull cylinder, piston, and connecting rod from crankcase (fig. 42). Assemble connecting rod bearing, connecting rod cap, and connecting-rod-bolt nuts temporarily to connecting rod (fig. 42).

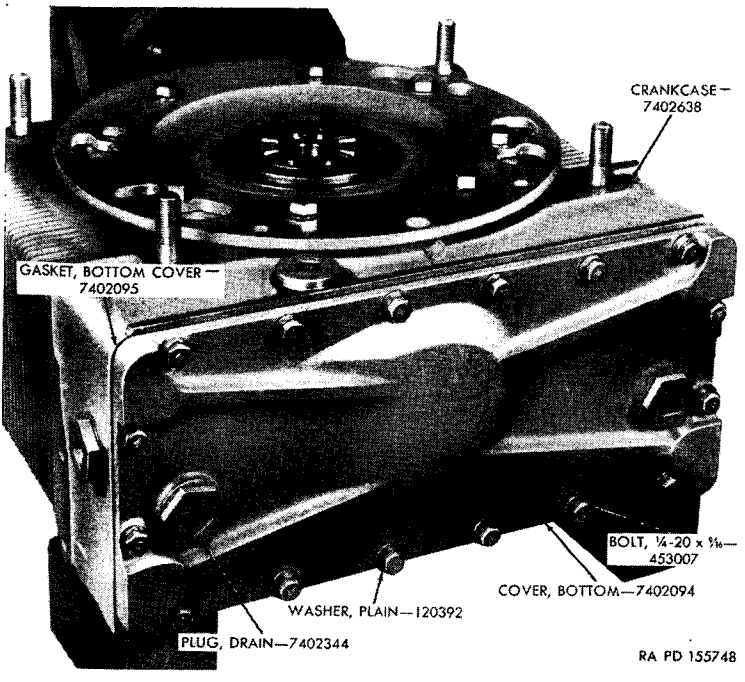


Figure 38. Crankcase bottom cover.

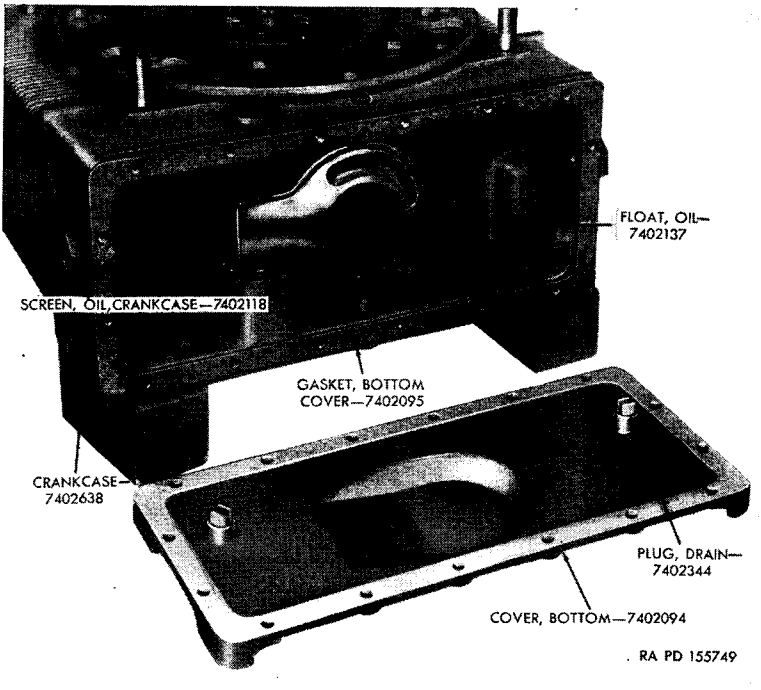


Figure 39. Crankcase oil float and oil screen.

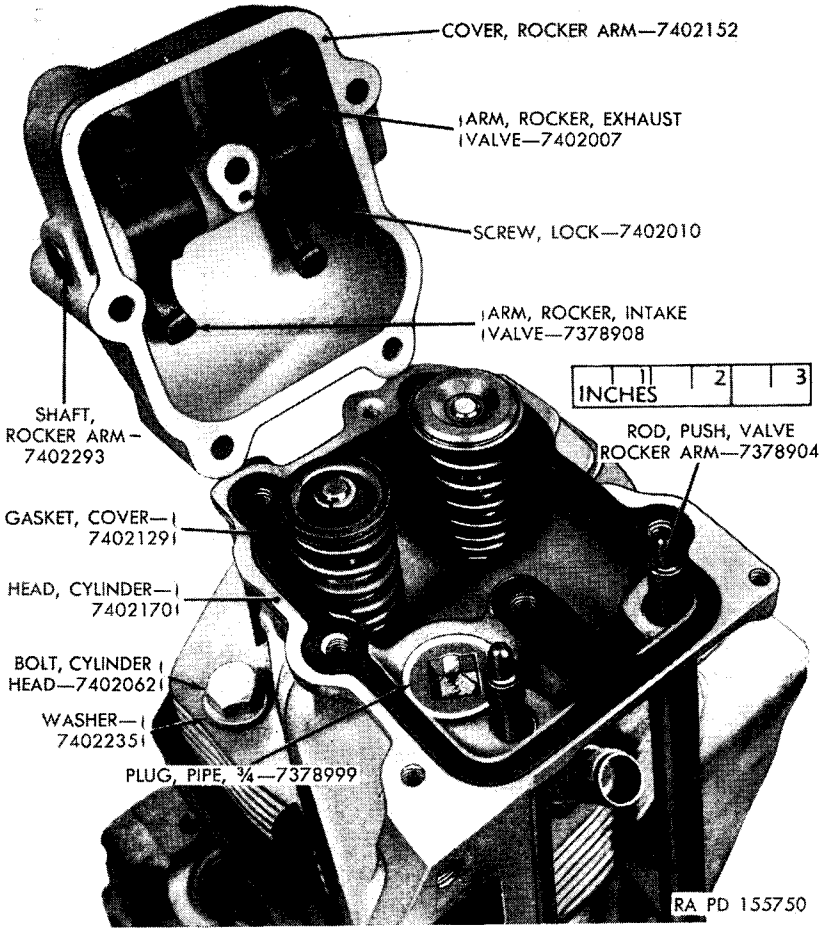


Figure 40. Rocker arm cover.

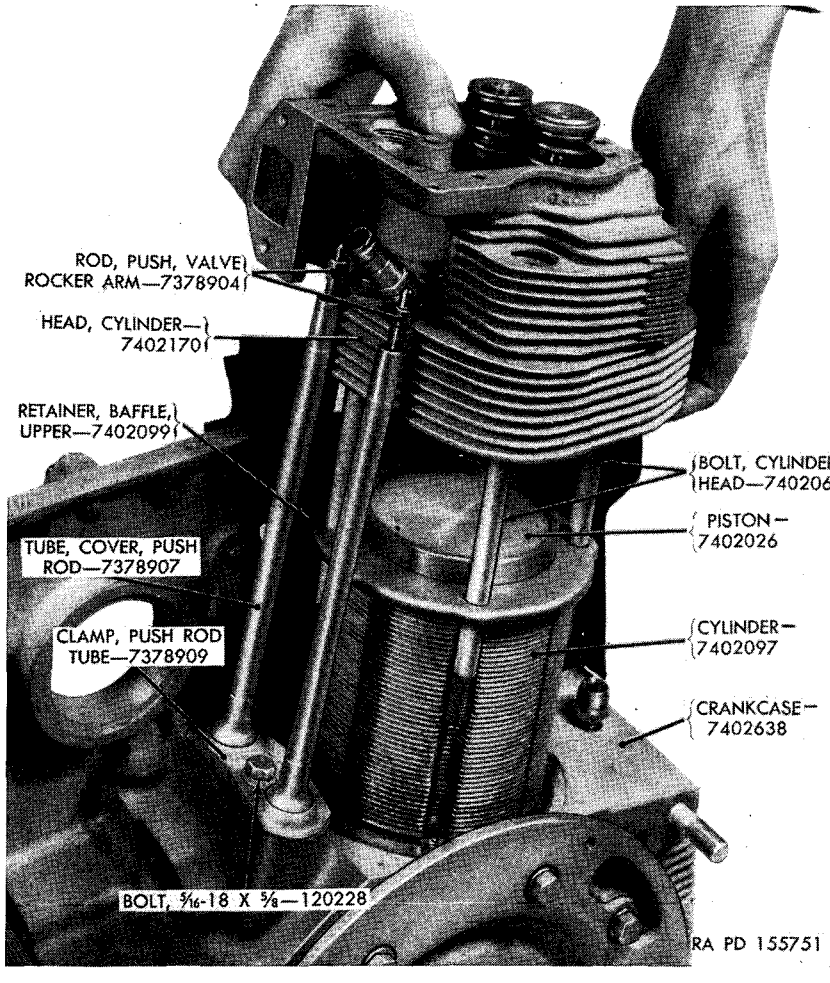


Figure 41. Removing cylinder head.

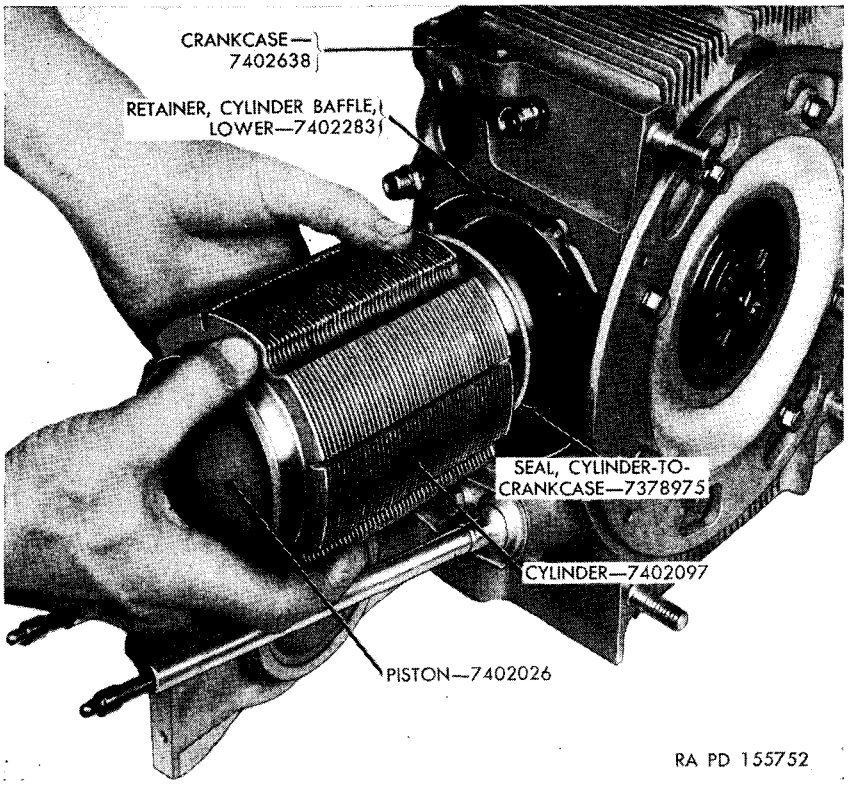


Figure 42. Removing cylinder, piston and connecting rod from crankcase.

39. Engine Front Cover Removal

a. Remove lower cylinder baffle retainer (fig. 42).

b. Remove six ¼–28 x 7/16 bolts and lock washers holding starting pulley cap to crankcase (fig. 43). Remove cap and cap gasket.

c. Remove one ⅜–2 x ¾ bolt and flat washer holding adapter to crankshaft (fig. 34). Slide adapter and seal ring out of engine front cover. Remove seal ring from adapter.

d. Remove sixteen ¼–20 x 1⅛ bolts and flat washers securing front cover to crankcase (fig. 43).

e. Remove front cover and gasket from two crankcase dowels.

40. Cam and Roller, and Idler Gear Removal

a. Remove clutch cam and roller from front end of crankshaft using cam puller (fig. 44).

b. Remove five idler gears and note that wide gear hub was toward crankcase. As it is desirable to install the idler gears in the same positions from which they were removed after an engine is run-in, identify each accordingly.

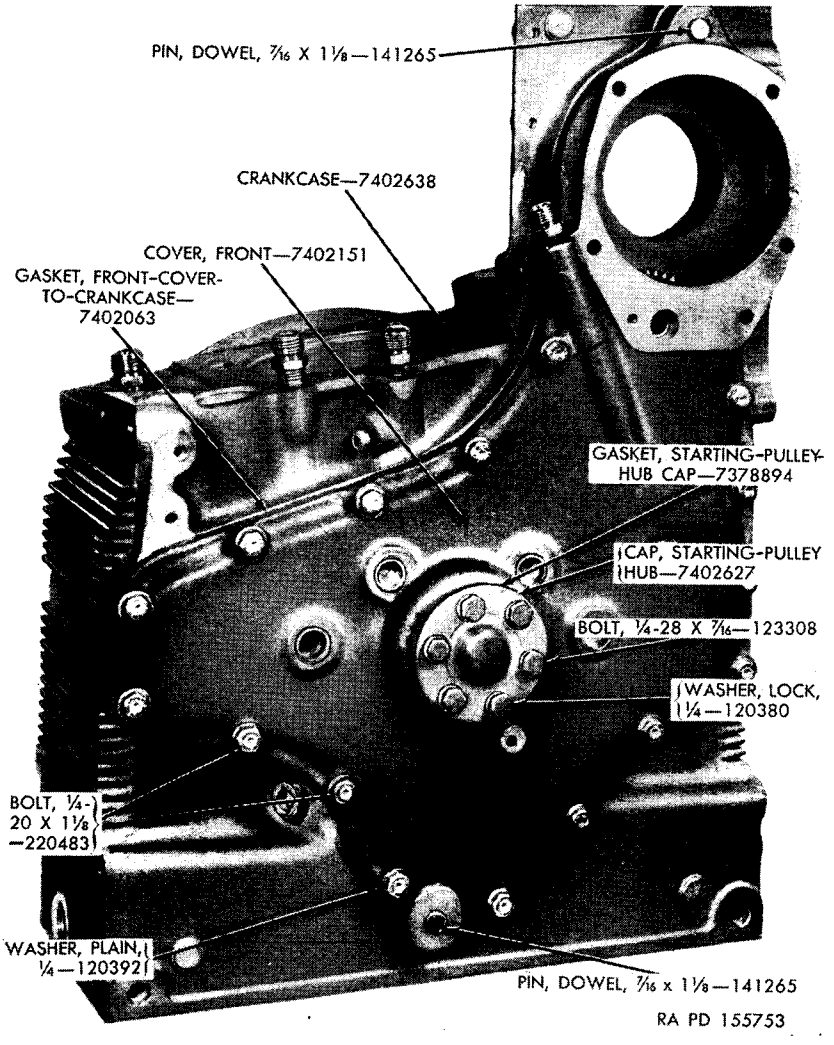


Figure 43. Engine front cover.

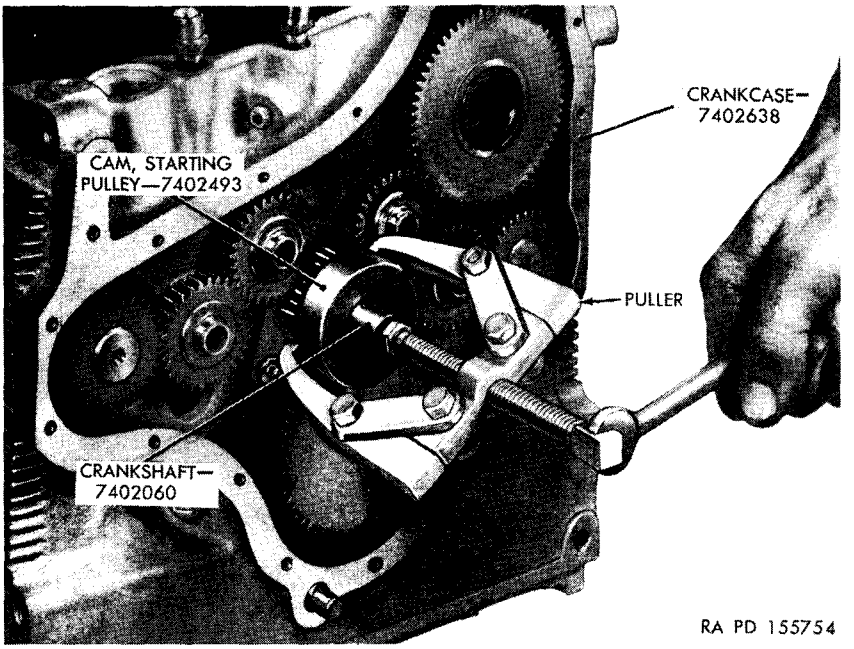


Figure 44. Removing clutch cam and roller.

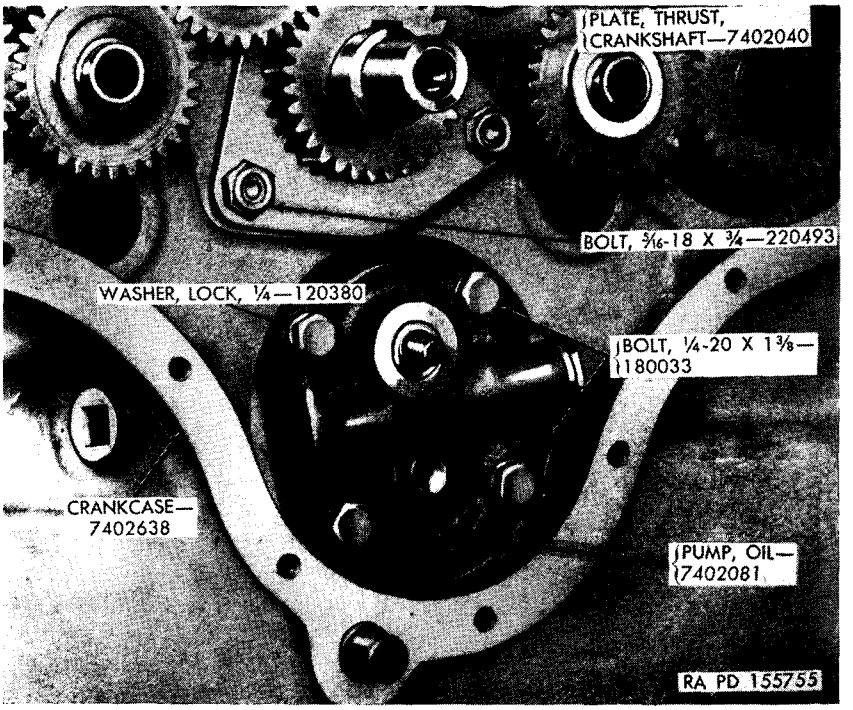


Figure 45. Oil pump.

41. Oil Pump Removal

a. Remove oil pump drive-driven gear retaining nut, then slide gear off end of shaft, being careful not to lose the 5/32-inch diameter steel ball.

b. Remove four 1/4–20 x 1 3/8 bolts and lock washers holding oil pump body to crankcase (fig. 45).

c. Remove oil-pump body and oil-pump thrust plate (fig. 37).

42. Push Rod Removal

a. Withdraw valve push rods from push-rod cover tubes (fig. 41).

b. Remove one 5/16–18 x 5/8 bolt and lock washer securing push-rod-cover-tube clamp to crankcase and remove push-rod cover tube including lower seals (fig. 41).

43. Valve Tappet Removal

a. Push hydraulic valve tappets part way out (fig. 46); then withdraw tappets from top of crankcase.

b. Tag valve tappets to insure each will be installed in same bore from which it was removed.

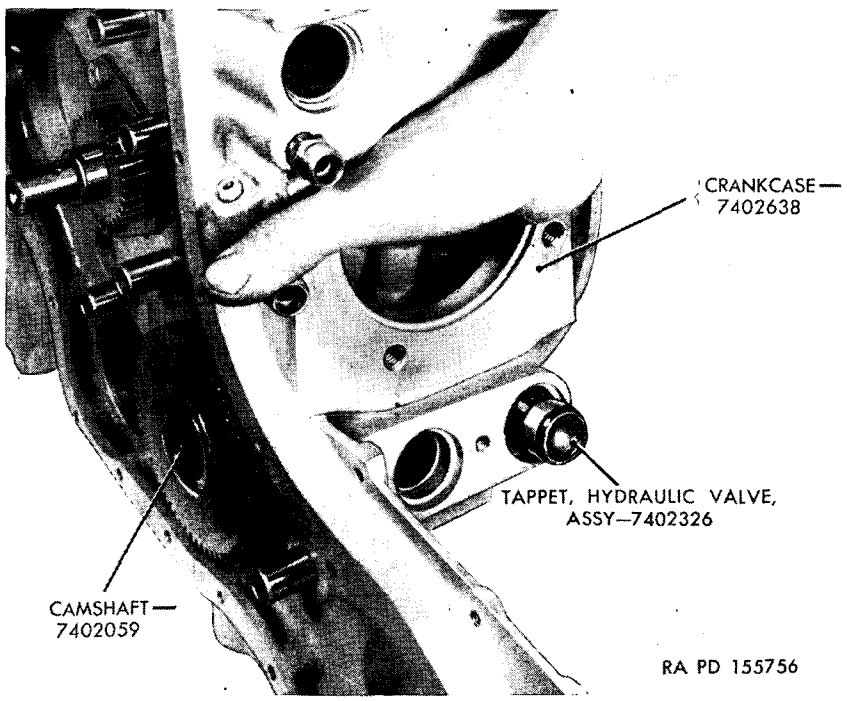


Figure 46. Removing valve tappets.

44. Camshaft and Counterweight Removal

a. Remove camshaft from front side of crankcase with care so as not to damage camshaft-bearing journals (fig. 33).

b. Remove counterweights from front side of crankcase with care so as not to damage camshaft-bearing journals (fig. 33).

45. Crankshaft Thrust Plate Removal

a. Remove two 5/16–18 x 3/4 crankshaft-thrust-plate attaching bolts (figs. 34 and 45).

b. Remove thrust plate.

Note. Thrust plate is marked "FRONT" on one side to insure correct assembly, concave side towards crankcase.

46. Crankshaft Removal

a. Wrap crankshaft gear with masking tape.

b. Remove eight 3/8–16 x 1 1/8 bolts and lock washers securing main-bearing support to crankcase (fig. 35).

c. Thread four 5/16–24 x 1 bolts into tapped holes provided in main-bearing support and, using these as jackscrews, pull main bearing support and crankshaft from crankcase by turning down alternately on jackscrews (fig. 47).

d. Tap crankshaft and bearing from main-bearing support.

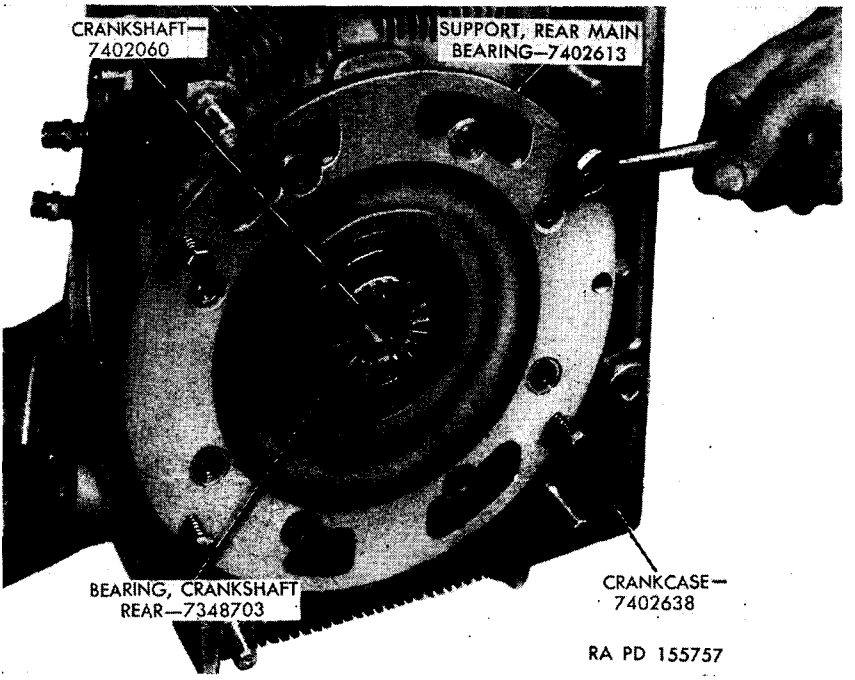


Figure 47. Withdrawing crankshaft and rear main bearing support from crankcase.

Section IV. REBUILD OF SUBASSEMBLIES

47. Crankcase Disassembly

a. Remove generator mounting studs if damaged (fig. 96).

b. If expansion plug at rear of crankcase is loose or damaged, remove, using soft drift through camshaft bore.

48. Crankcase Cleaning

a. Clean the crankcase with dry-cleaning solvent or volatile mineral spirits and dry with compressed air.

b. Make sure gasket and all gasket material has been removed from crankcase.

c. Clean oil galleries, expansion plug holes, and all bearing surfaces.

49. Crankcase Inspection

a. Inspect all casting surfaces and cooling fins for cracks or evidence of leakage. Replace crankcase if necessary.

b. Inspect all mounting surfaces for nicks, scratches, or other damage which would prevent a good seal. Remove small burs with whetstone.

c. Inspect tapped holes to assure threads are in good condition.

d. Inspect front cover dowel pins in front side and generator mounting studs in rear side of crankcase.

e. Check five idler gear shafts in front side of crankcase for wear or scoring (par. 144). Idler gear shafts must be tight in crankcase.

f. Inspect crankshaft, camshaft, and counterweight bearings in crankcase for excessive wear or scoring (par. 141). These bearings are frozen in crankcase and are not replaceable.

g. Inspect seat for cylinder.

h. Inspect hydraulic-valve-tappet bores in top of crankcase for burs or score marks which would prevent good tappet operation. Extreme care should be used in removing any small burs (par. 145).

i. Inspect oil-filler pipe bore in top of crankcase to assure proper seating of pipe when assembled.

50. Crankcase Assembly

a. Install new generator mounting studs (fig. 96).

b. Insert and drive new expansion plug into place using drift slightly smaller in diameter than OD of plug.

51. Crankshaft Disassembly

a. Pull crankshaft rear bearing from rear end of crankshaft using puller.

b. Invert crankshaft and pull crankshaft gear from front end of crankshaft using puller (fig. 48).

c. Remove $\frac{3}{16}$ x $\frac{3}{4}$ key from gear end of crankshaft.

52. Crankshaft, Crankshaft Rear Bearing, and Crankshaft Gear Cleaning

a. Clean crankshaft and crankshaft gear with dry-cleaning solvent or volatile mineral spirits and dry with compressed air.

b. Make sure all oil passages in crankshaft are absolutely free of dirt or any other obstruction which would prevent lubricating oil reaching connecting rod journal and clutch cam and roller.

c. Refer to TM 37–265 for procedures on care and maintenance of ball and roller bearings.

53. Crankshaft, Crankshaft Rear Bearing, and Crankshaft Gear Inspection

a. Check crankshaft journals for scoring, scratches, or fatigue. Also examine crankshaft rear bearing and front gear shoulders and Woodruff key slot for chips or other damage.

b. Check crankshaft allowable wear limits (par. 141); replace if necessary.

c. Inspect crankshaft gear for broken or chipped teeth.

d. Examine crankshaft rear bearing and replace if required (par. 141).

54. Crankshaft Assembly

a. Rest crankshaft on steel plate on bed of arbor press (fig. 50).

b. Insert 5/16 x 3/4 key in keyway. Locate crankshaft gear square on front end of crankshaft with gear keyway in line with key.

c. Center 1¼-inch ID sleeve against gear, apply to crankshaft, and press gear tight against shoulder on crankshaft (fig. 50).

d. Invert and rest crankshaft on steel plate on bed of press. Locate open side of crankshaft rear bearing toward crankshaft throw and square with shaft (fig. 51).

e. Apply oil to crankshaft and place 2⅜-inch ID hollow sleeve against crankshaft-rear-bearing inner race. Using steel plate between hollow sleeve and arbor, press bearing onto crankshaft until inner race is tight against shoulder (fig. 51).

55. Oil Pump Disassembly

a. Lift oil-pump drive gear, oil-pump-drive-gear shaft, and oil-pump driven gear from oil-pump body (fig. 37).

b. Remove relief-valve plug, gasket, spring, and relief valve from oil-pump body (fig. 37).

c. Rest face of oil-pump drive gear on bed of press and press drive gear shaft from drive gear (figs. 52 and 54).

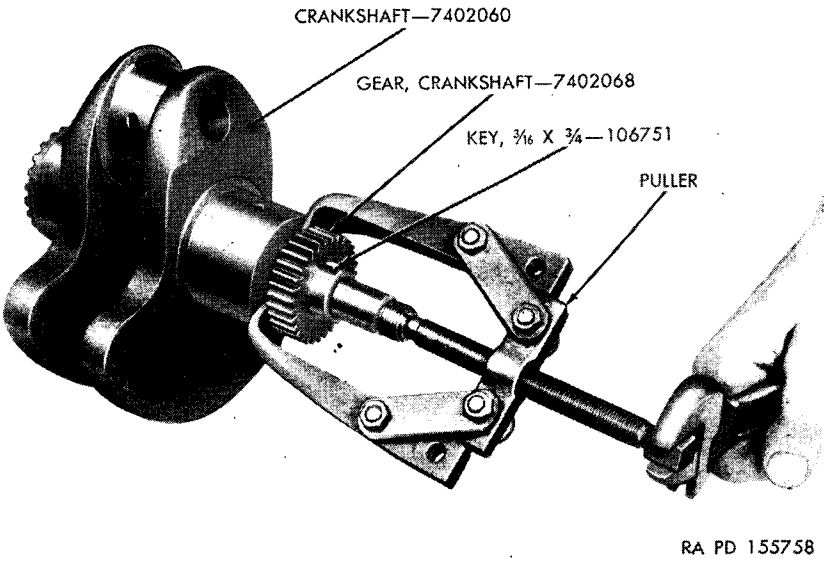


Figure 48. Pulling gear from front end of crankshaft.

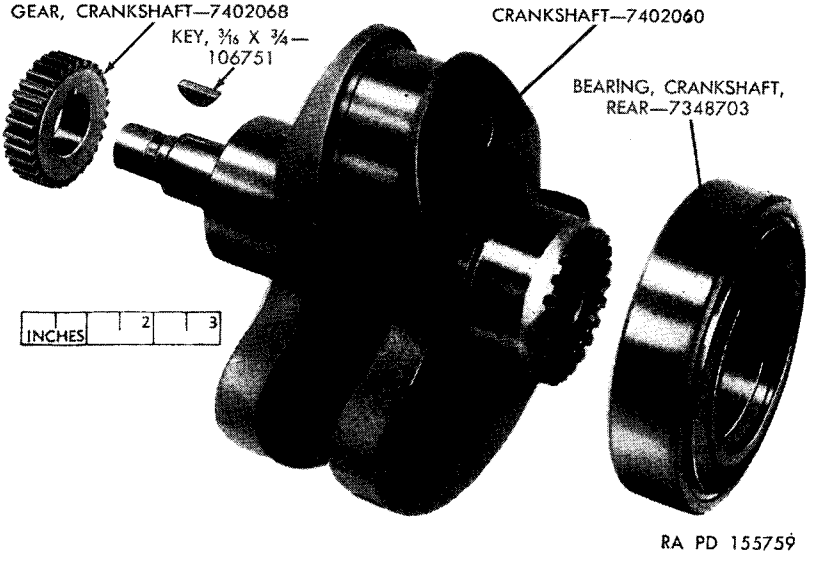


Figure 49. Crankshaft—exploded view.

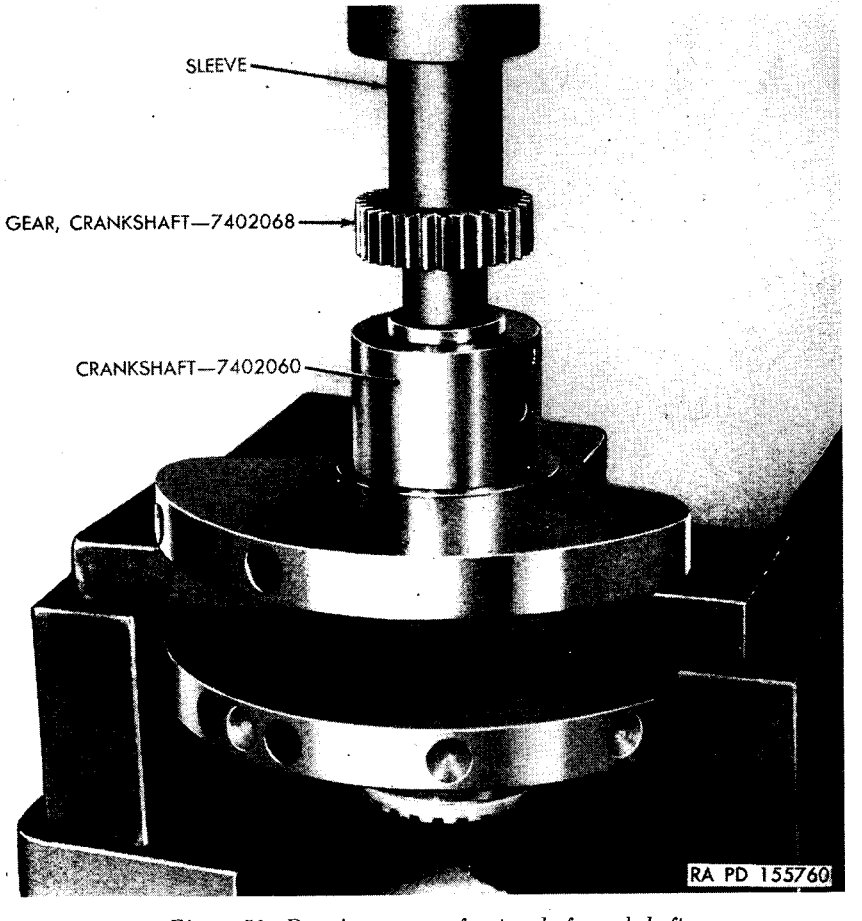


Figure 50. Pressing gear on front end of crankshaft.

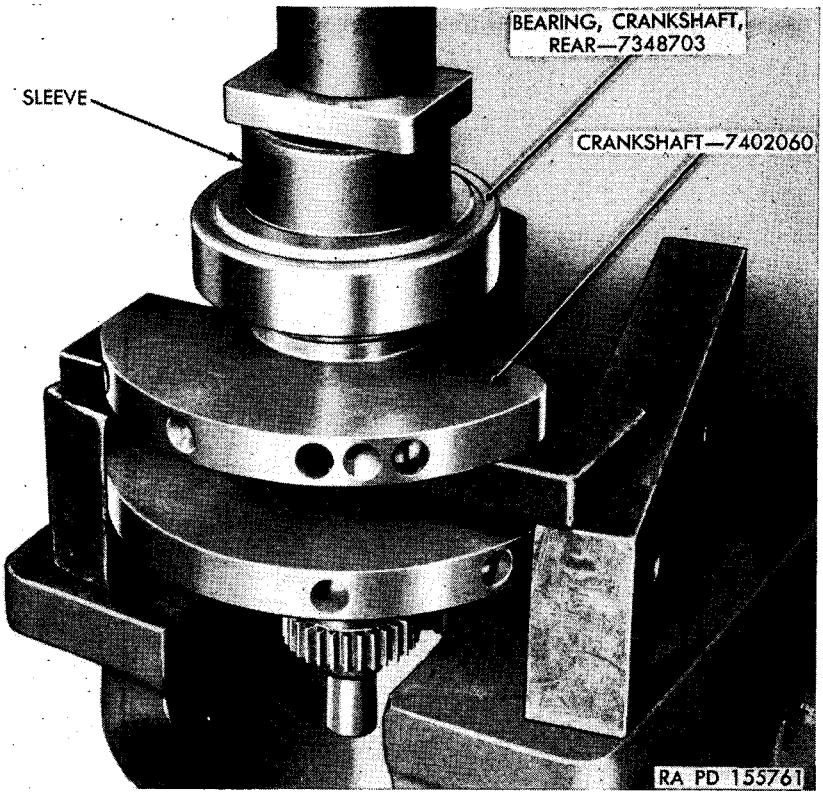


Figure 51. Pressing bearing onto rear end of crankshaft.

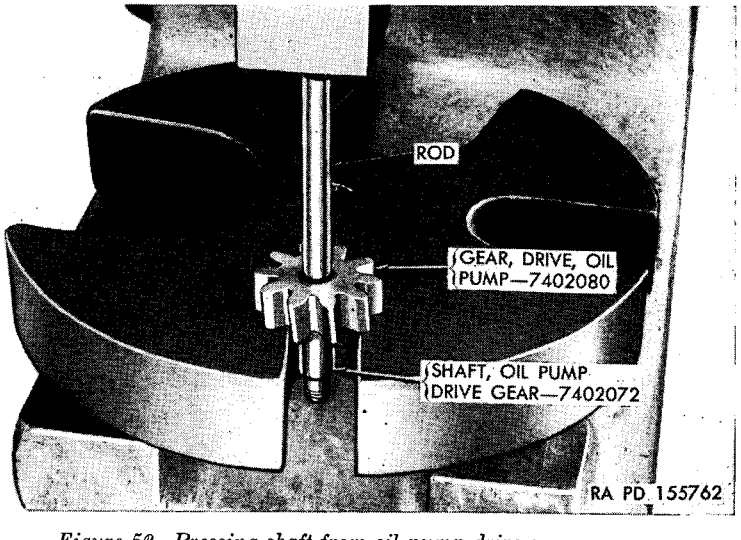


Figure 52. Pressing shaft from oil-pump drive gear.

d. Rest oil-pump body on bed of press and press the driven-gear shaft from oil-pump body (fig. 53).

56. Oil Pump Cleaning

a. Clean all parts thoroughly with dry-cleaning solvent or volatile mineral spirits.

b. Blow parts dry with compressed air.

57. Oil Pump Inspection

a. Check oil-pump drive and driven gears and oil-pump body cavity for nicks or scratches which might interfere with pump performance.

b. Inspect the drive-gear-shaft bearing in pump body and, if worn excessively, scratched, or scored beyond repair, replace pump body.

c. Damaged parts and those showing excessive wear must be replaced with new parts (par. 147).

58. Oil Pump Assembly

a. Support oil-pump body on bed of arbor press, cavity side up (fig. 55). Locate driven gear shaft in bore of housing and press shaft into position using oil-pump-driven-gear-shaft installer 7950096 (figs. 10 and 55).

b. Place oil-pump drive gear on bed of arbor press and press oil-pump-drive-gear shaft into gear flush with face of gear (fig. 56).

c. Assemble oil-pump relief valve relief-valve spring, and relief-valve plug and gasket in place in pump body (fig. 54).

d. Pilot threaded end of drive-gear shaft through shaft bearing in pump body (fig. 54).

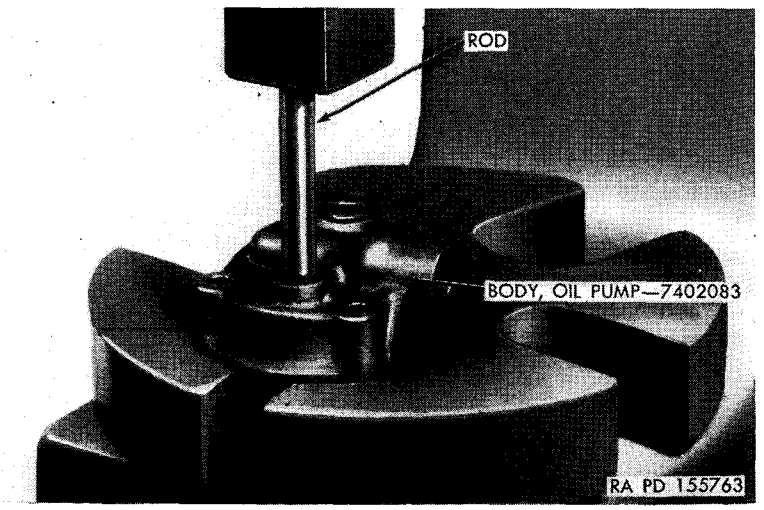


Figure 53. Pressing driven-gear shaft from oil-pump body.

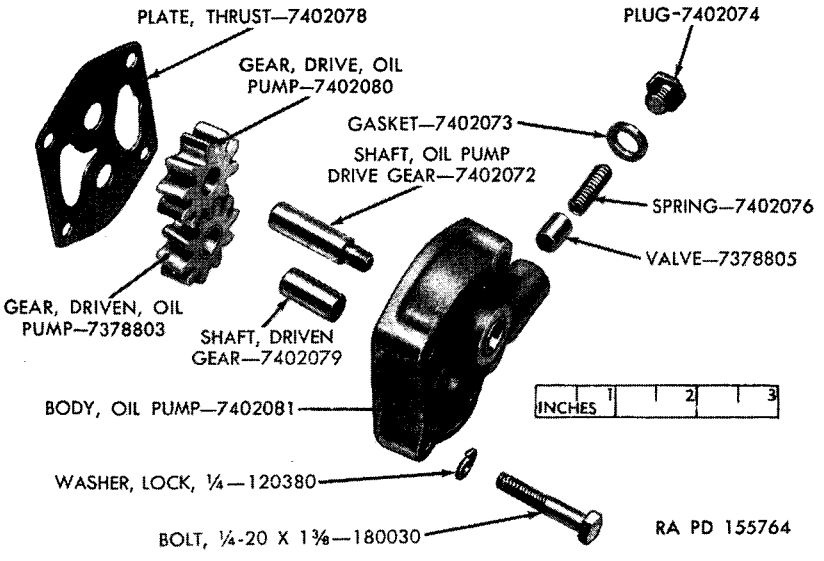


Figure 54. Oil pump—exploded view.

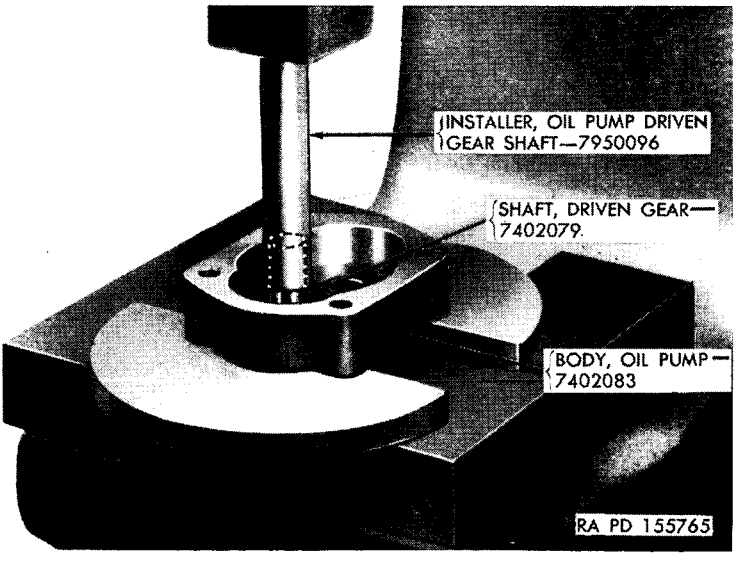


Figure 55. Installing oil-pump-driven-gear shaft in pump body.

e. Lower oil-pump driven gear over driven-gear shaft and into mesh with drive gear (fig. 37). The oil-pump drive gear, drive gear locking ball and self-locking nut are installed at time engine is assembled (par. 110).

59. Counterweight Disassembly

a. Rest counterweight gear on split plates on bed of arbor press (fig. 57).

b. Using ¾-inch rod, pipe or bar stock between end of counterweight and arbor, remove counterweight gear from counterweight (fig. 57).

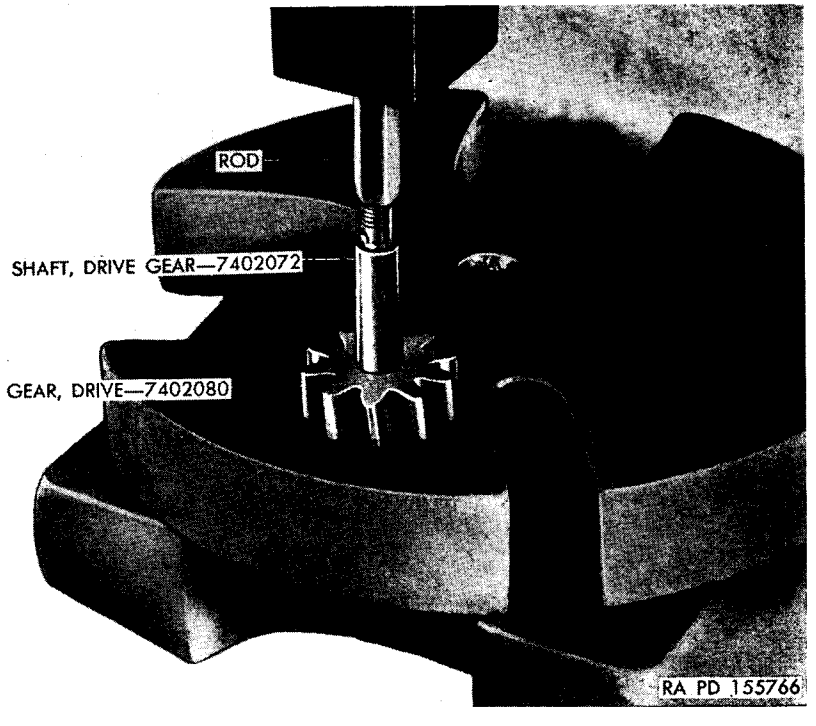


Figure 56. Pressing oil-pump-drive-gear shaft into drive gear.

c. Remove ⅛ x ⅜ key from counterweight.

d. Remove plug from gear end and thrust button from opposite end of counterweight (fig. 58).

60. Counterweight and Gear Cleaning

a. Wash counterweight and gear in dry-cleaning solvent or volatile mineral spirits and blow dry with compressed air.

b. Clean oil passage in counterweight.

61. Counterweight Inspection

a. Inspect bearing journal at each end of counterweight for scratches or scoring.

b. Oil passage in counterweight must be clean to assure rear-bearing journal of counterweight receives adequate lubrication.

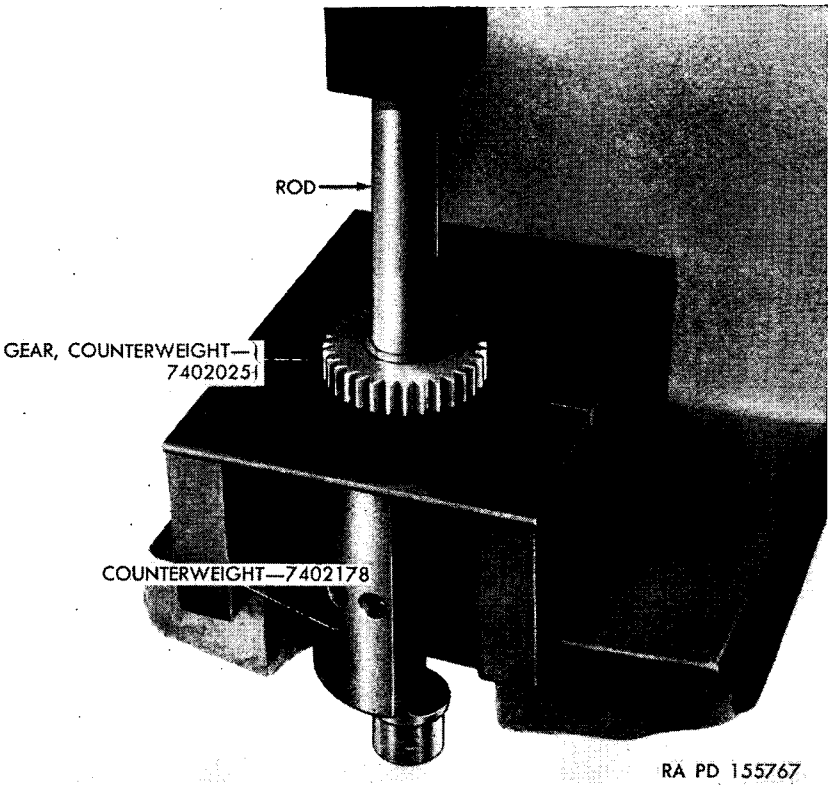


Figure 57. Pressing counterweight from gear.

c. Check keyway at gear end of counterweight and remove any burs.

d. Check counterweight gear for excessive wear, chipping, or any damage which would necessitate replacement (par. 143).

62. Counterweight Assembly

a. Install plug and thrust button in ends of counterweight (fig. 58).

b. Locate ⅛ x ⅜ key in keyway at gear end of counterweight (fig. 59).

c. Rest counterweight gear on bed of arbor press, apply engine oil to gear end of counterweight, and start straight into gear. Press gear tight against shoulder on counterweight (fig. 59).

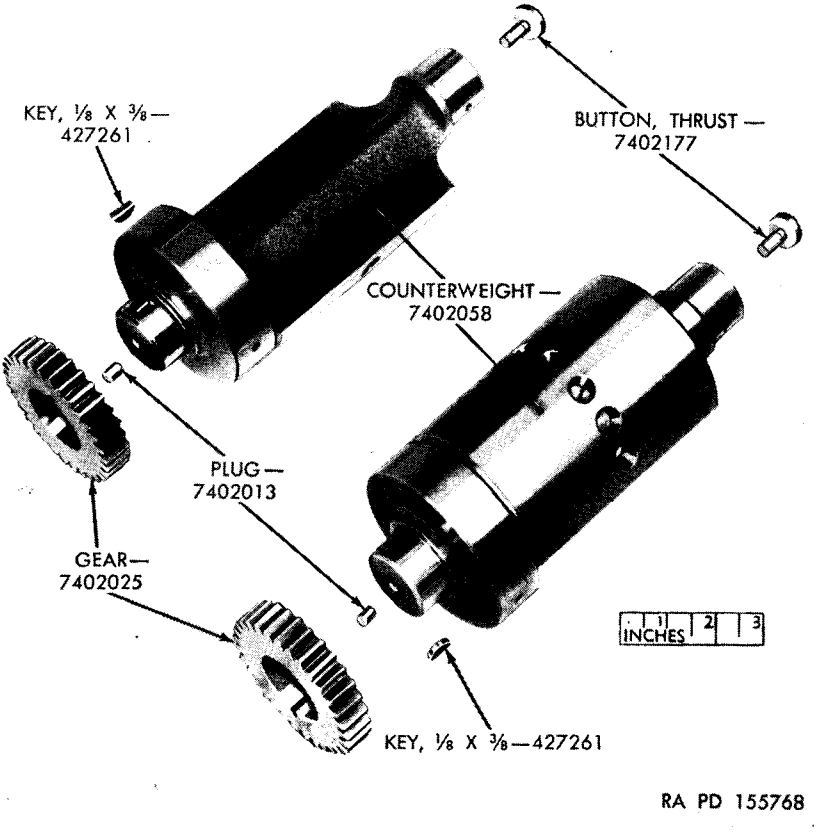


Figure 58. Counterweight—exploded view.

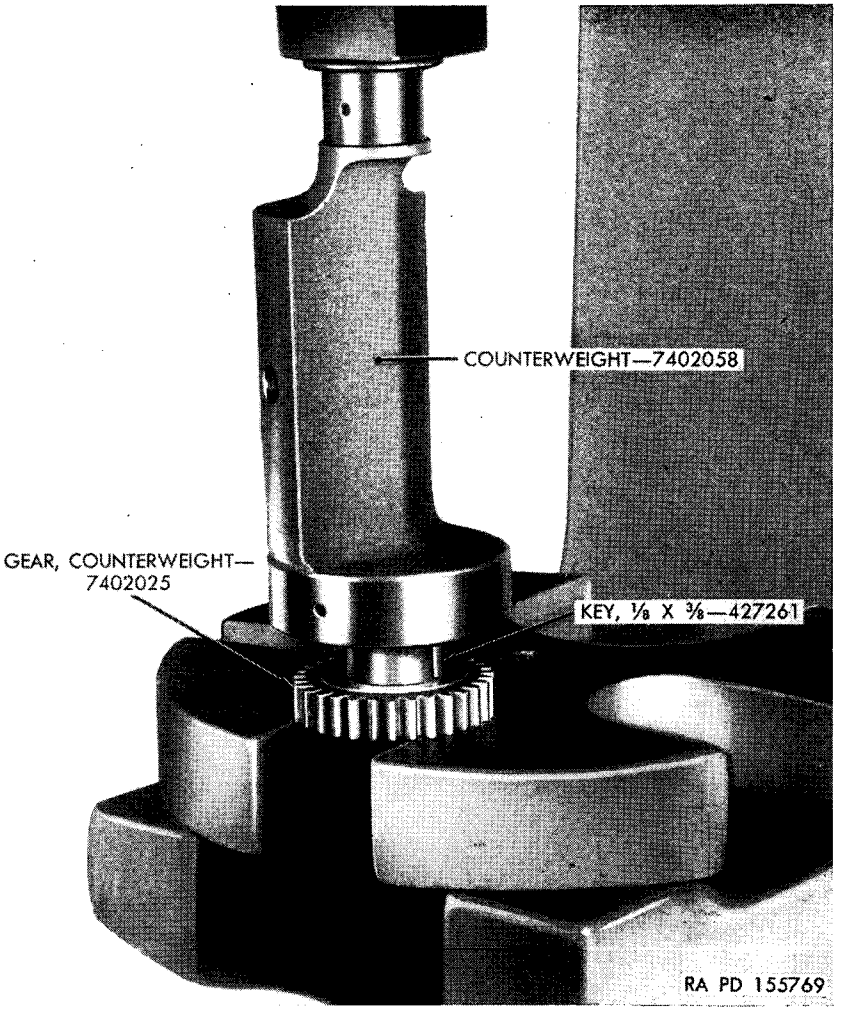


Figure 59. Pressing counterweight into gear.

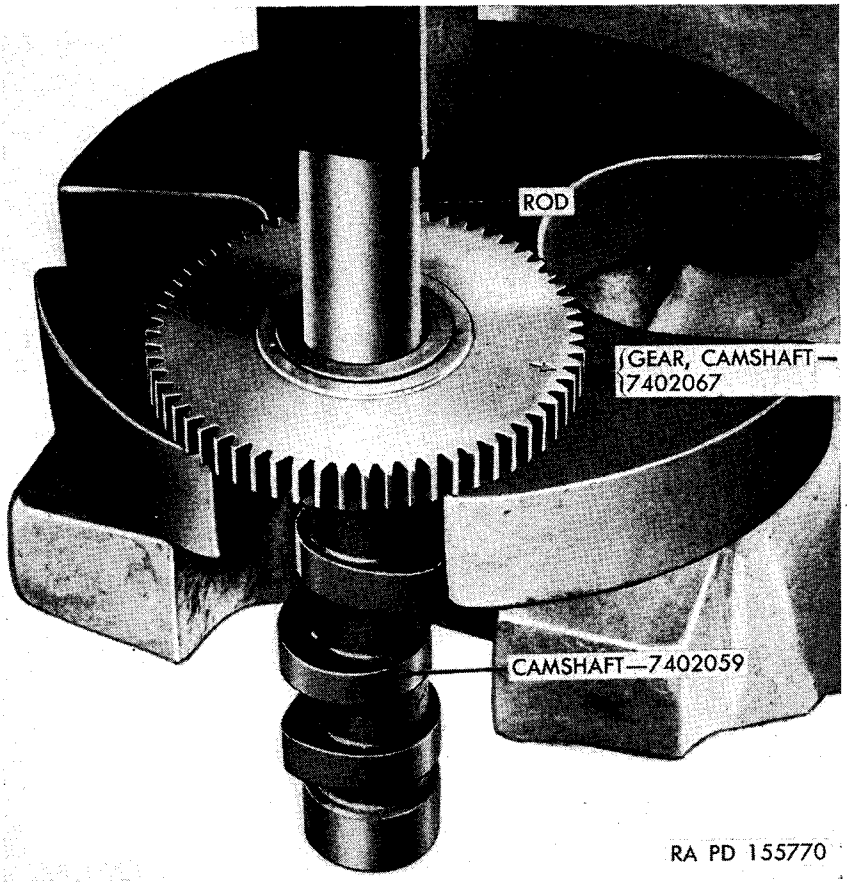


Figure 60. Pressing camshaft from gear.

63. Camshaft Disassembly

a. Rest camshaft gear on bed of arbor press (fig. 60).

b. Using short length of 1-inch OD rod between end of camshaft and arbor, press camshaft from gear (fig. 60).

c. Remove ⅛ x ½ key from keyway in camshaft.

64. Camshaft and Camshaft Gear Cleaning

a. Clean camshaft and gear with dry-cleaning solvent or volatile mineral spirits and dry with compressed air.

b. Journal at rear end of camshaft is lubricated from oil passage connecting with main longitudinal oil gallery; therefore, camshaft is not drilled as the counterweights are drilled.

65. Camshaft and Camshaft Gear Inspection

a. Inspect bearing journal at each end of camshaft for scratches or scoring.

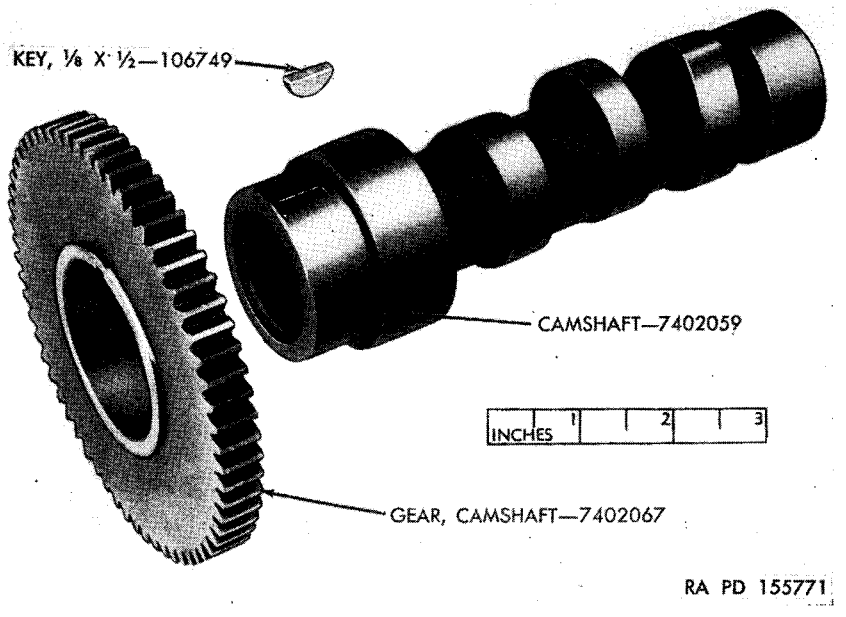


Figure 61. Camshaft—exploded view.

b. Check keyway at gear end of camshaft and remove any burs.

c. Check camshaft gear for excessive wear, chipping, or any damage which would require replacement (par. 142).

66. Camshaft Assembly

a. Locate ⅛ x ½ key in keyway at gear end of camshaft (figs. 61 and 62).

b. Rest camshaft gear on bed of arbor press, apply engine oil to gear end of camshaft, and using short length of 1-inch OD rod, start camshaft straight into camshaft gear. Press gear tight against shoulder on camshaft (fig. 62).

67. Idler Gear Cleaning and Inspection

a. Clean the five idler gears (fig. 34) in dry-cleaning solvent or volatile mineral spirits and dry with compressed air.

b. Inspect idler gear teeth for chipping or other damage and idler gear bore for wear (par. 144).

c. Inspect idler gear bushings for excessive wear or scoring.

d. Check idler gears for wear and replace gears in sets if worn beyond allowable wear limits (par. 144).

68. Cylinder Cleaning

a. Clean the cylinder thoroughly with dry-cleaning solvent or volatile mineral spirits and dry with compressed air.

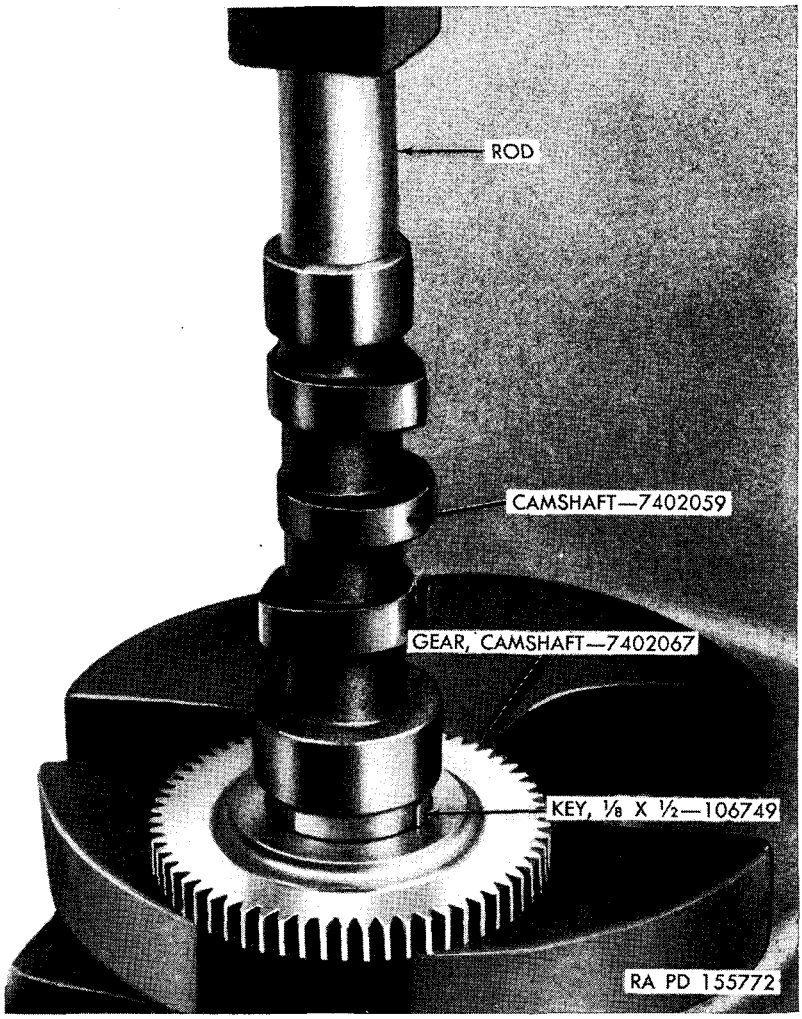


Figure 62. Pressing camshaft into gear.

b. Make sure all dirt and grease is cleaned from cylinder cooling fins.

69. Cylinder Inspection

a. Inspect all surfaces for cracks or evidence of leakage.

b. Inspect cylinder bore for scores or scratches.

c. Check cylinder diameter and replace if cylinder is worn beyond allowable wear limits (par. 139).

d. Inspect cylinder seating surfaces at bottom end for crankcase and top end for cylinder head to make sure they are not nicked or damaged in any way that will prevent a good seal. Remove small burs from these seating surfaces with whetstone.

70. Piston and Connecting Rod Disassembly

a. Remove piston and connecting rod from cylinder (fig. 36).

b. Remove three piston rings carefully so that rings will not be damaged or distorted during disassembly of connecting rod from piston (fig. 64).

c. Remove piston-pin retaining ring from each end of piston pin (fig. 64).

d. Remove piston pin with drift (fig. 63).

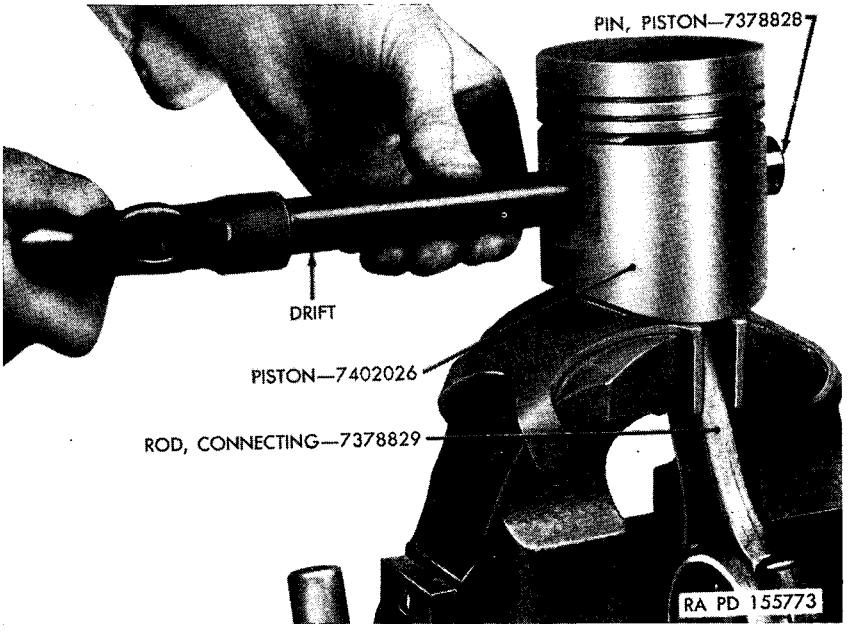


Figure 63. Removing piston pin from piston.

e. Remove connecting-rod-bolt nuts from connecting rod bolts (fig. 64). These nuts were replaced, finger tight only, when piston and connecting rod was removed from the engine (par. 38).

71. Piston and Connecting Rod Cleaning

a. Clean all parts of piston and connecting rod thoroughly with dry-cleaning solvent or volatile mineral spirits, using particular care in cleaning upper ring groove so as not to destroy keystone ("V" slot) machining.

Caution: Standard ring groove cleaning tool or broken piston ring must not be used to clean upper keystone machined ring groove.

b. Make sure lubricating oil holes at upper and lower ends of connecting rod are free of foreign material.

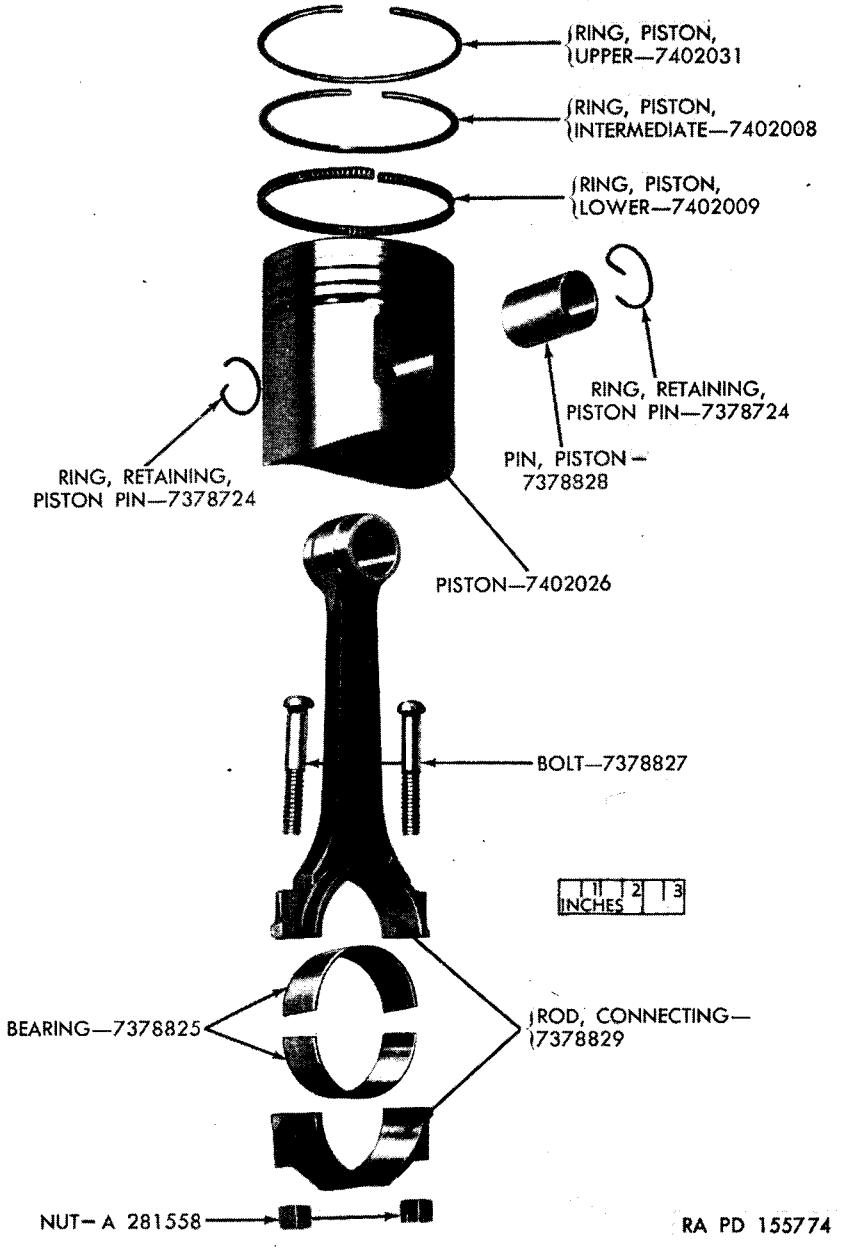


Figure 64. Piston and connecting rod—exploded view.

72. Piston and Connecting Rod Inspection

a. Inspect piston for cracks and condition of ring lands. Check outer diameter at top of piston and at bottom of skirt in line with piston pin holes and at 90 degrees from axis of piston pin. Refer to paragraph 140 for sizes and wear limits. Check piston pin bore in piston with a new pin for proper fit.

b. Check clearance between piston and cylinder with feeler gage at 90° from axis of the piston pin as well as in line with the pin (fig. 65).

c. Insert either new upper or lower ring in the cylinder to approximate position shown in figure 66, using piston head against ring to assure ring is horizontal to vertical center line of cylinder. Measure piston ring gap (par. 140).

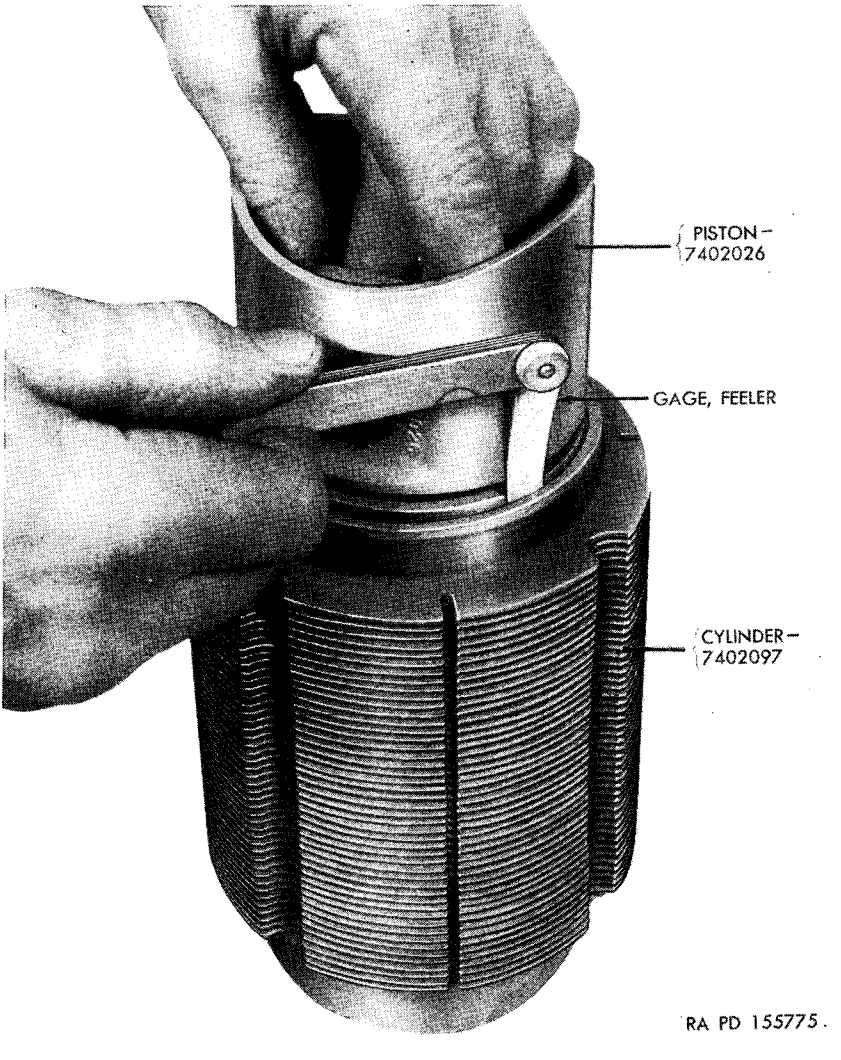


Figure 65. Checking piston clearance in cylinder.

d. Check other ring in similar manner.

e. Install new piston rings in their respective ring grooves and check clearance between the rings and piston lands (fig. 67). Upper ring must be held securely in ring groove to assure correct reading of clearance between ring and land (par. 140) due to keystone ("V" slot) machining of ring groove.

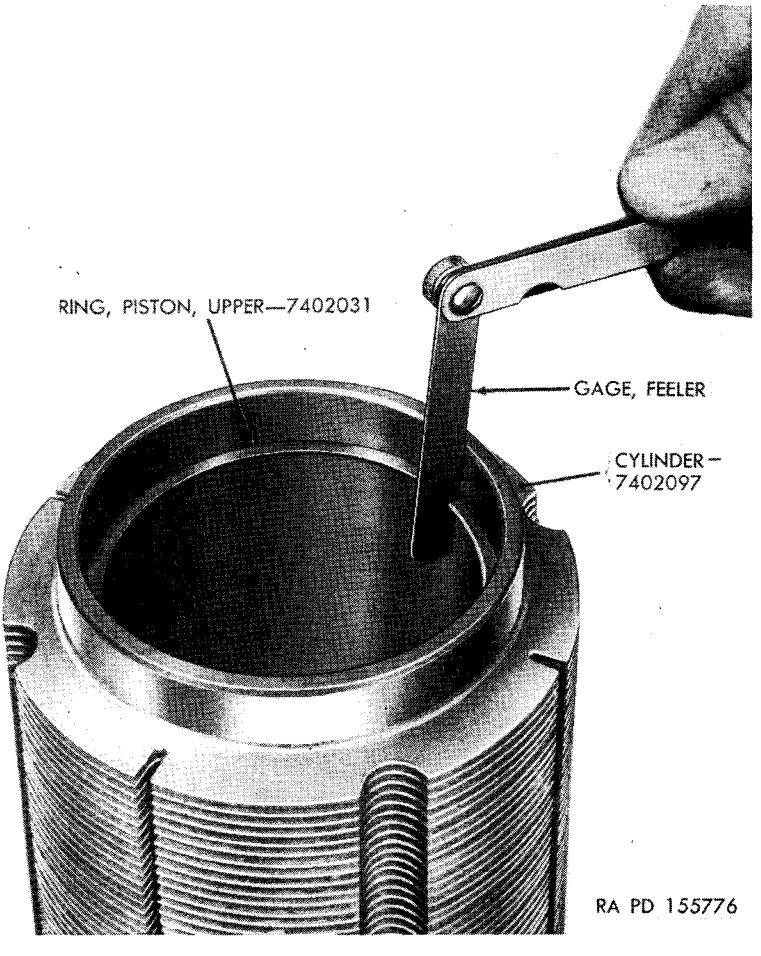


Figure 66. Checking ring gap.

f. Inspect piston pin for wear and score marks. If piston pin is worn beyond allowable wear limits (par. 140), replace with new pin.

g. Inspect both upper and lower connecting-rod bearings and piston-pin bushing for scoring and/or wear. Use a new piston pin and check piston-pin bushing for out-of-round wear and replace if wear is excessive. Replace connecting-rod bearings if worn or scored. Rod bearings are the replaceable type and can easily be removed.

73. Piston and Connecting Rod Assembly in Cylinder

a. Install piston-pin retaining ring in one side of the piston. Position piston over top of connecting rod and push pin through piston, rod, and up against retaining ring on opposite side of piston. Piston pin should be a hand push fit at room temperature of 70° F. However, if pin tightness is apparent, use drift (fig. 68). Install other retaining ring and locate ring tangs at bottom of pin holes.

b. Apply engine oil to ring grooves. Install lower ring in bottom groove; install intermediate ring, with step on inner diameter facing

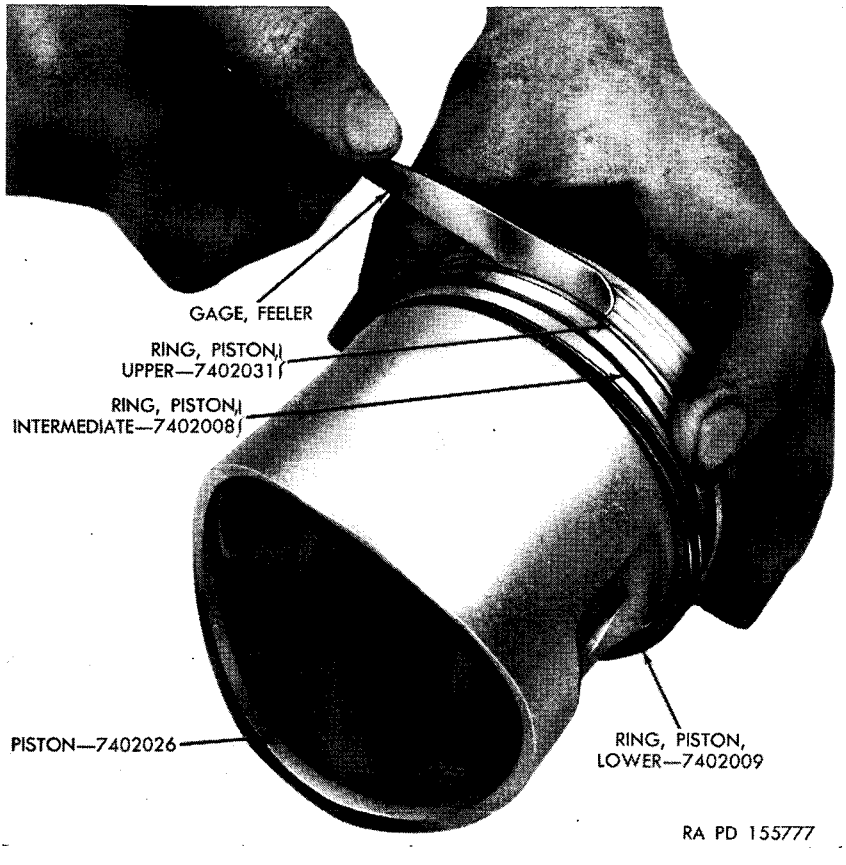


Figure 67. Checking clearance between ring and piston land.

up, in intermediate ring groove; then install upper ring in upper keystone ("V" slot) machined groove, and make certain side of ring marked "TOP" is in top position. Stagger ring gaps.

c. Support piston and connecting rod in soft jaws of bench vise. Apply liberal amount of engine oil to outer diameter of piston and inner surface of sleeve-type piston-ring compressor; then slide nonbeaded end of compressor down over piston and rings (fig. 69). Make

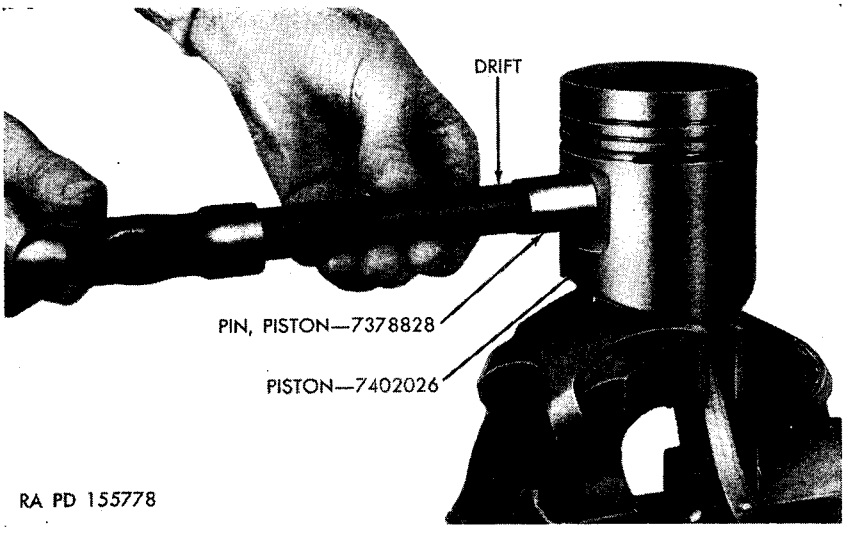


Figure 68. Installing piston pin in piston and connecting rod.

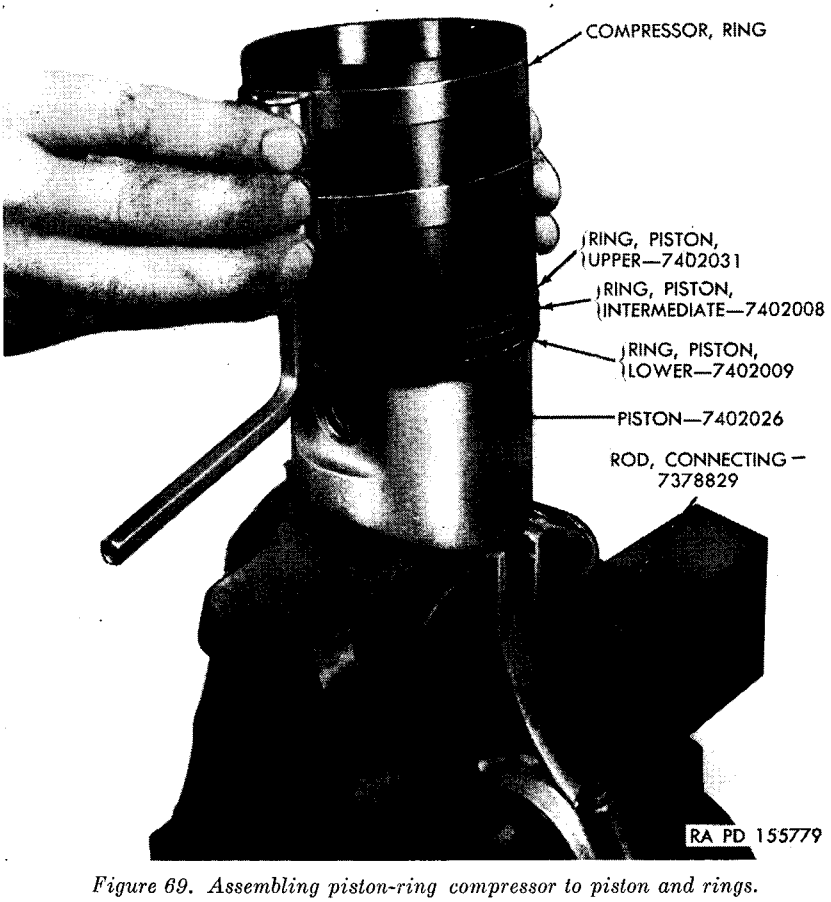


Figure 69. Assembling piston-ring compressor to piston and rings.

certain rings are fully entered in grooves and that ends do not lap when compressor tension is increased.

d. Rest cylinder upside down on bench; center piston, rod and ring compressor on bottom end of cylinder (fig. 70), and push piston and rod out of compressor and into cylinder. Exercise care during this operation to prevent scoring of piston or cylinder. Lift ring compressor away from cylinder.

74. Cylinder Head and Valve Disassembly

a. Rest cylinder head on work bench, compress intake-valve spring using valve-spring compressor (fig. 71), and remove valve-spring-seat locks. Remove valve-spring compressor and slide valve-spring upper seat, valve spring, inlet-valve stem seal, and valve-spring lower seat off end of valve.

b. Remove exhaust-valve-spring-upper-seat locks using valve-spring compressor. Then slide valve-spring upper seat, valve spring and valve-spring lower seat off end of valve (fig. 72).

c. Remove intake and exhaust valves from underside of cylinder head.

d. Remove cylinder-head-drain-tube connector.

75. Cylinder Head and Valve Cleaning

a. Scrape carbon from inside of cylinder head.

b. Clean cylinder head and valve parts in dry-cleaning solvent or volatile mineral spirits and dry with compressed air.

c. Make sure all old gasket material has been removed.

76. Cylinder Head and Valve Inspection

a. Inspect all casting surfaces for cracks or evidence of leakage.

b. Inspect mounting surfaces of cylinder head for nicks or other damage which will prevent a good seal and remove any small burs with whetstone. Lay cylinder head on a flat surface plate and check for warpage.

c. Inspect screw holes and spark plug hole to make sure that threads are in good condition.

d. Inspect valve guide in cylinder head for scoring or scratches. Replace cylinder head if valve guides are badly damaged or worn (par. 139).

e. Inspect intake- and exhaust-valve-seat inserts. If wear is not excessive, recondition inserts with grinding set. Replace inserts with new parts if wear of chamfered seating surfaces is beyond repair or if inserts are otherwise defective. To replace valve-seat inserts:

(1) Rest cylinder head on work bench bottom side up. Using valve-seat-insert remover—7950045, remove exhaust-valve-seat insert (fig. 73).

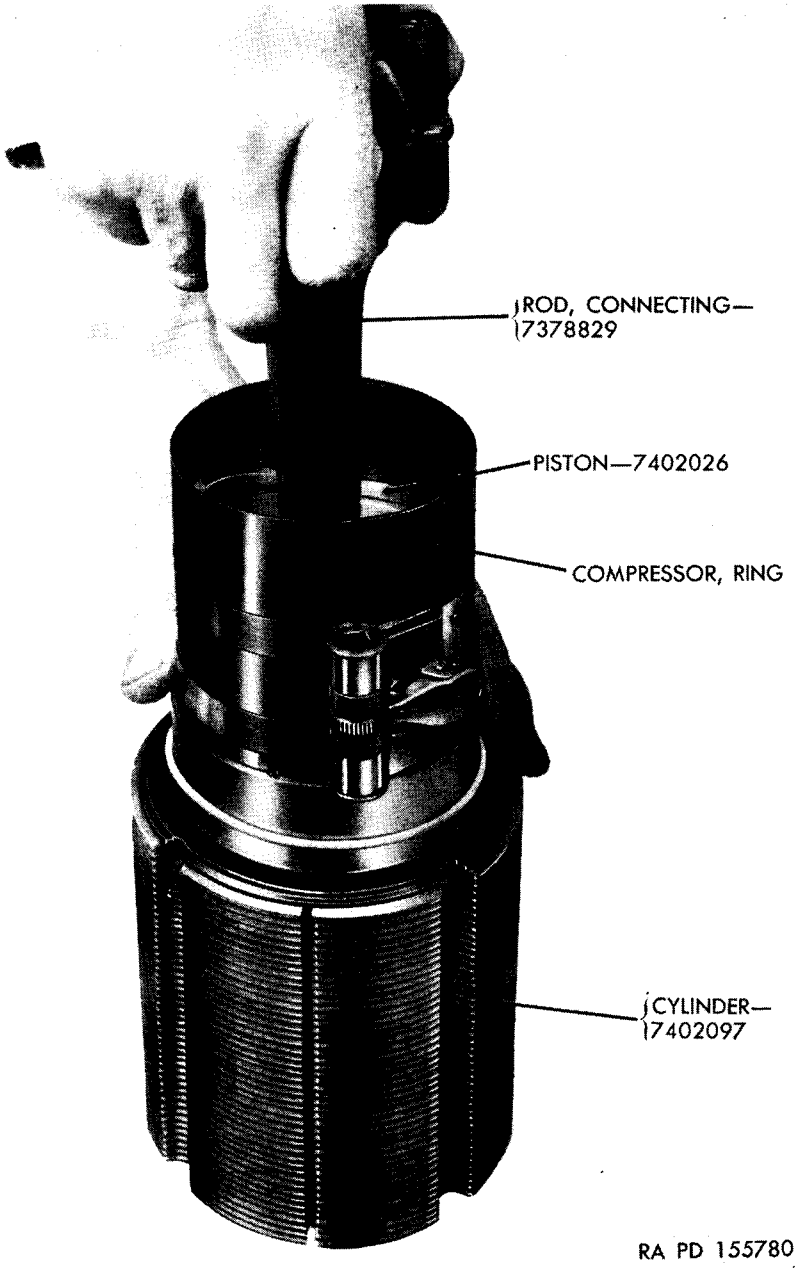


Figure 70. Inserting piston with rings into cylinder.

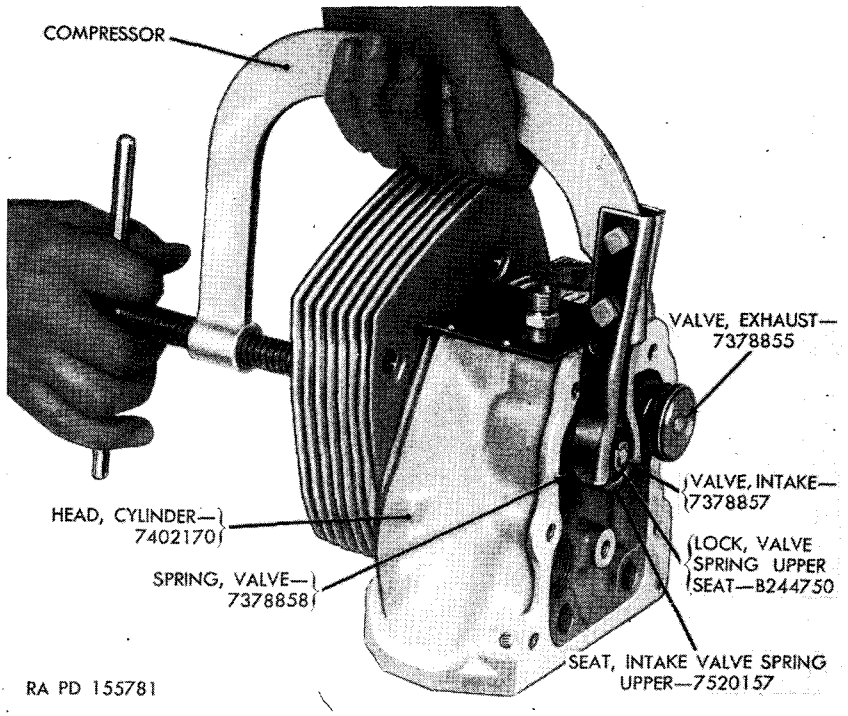


Figure 71. Removing valve spring seat locks.

(2) Remove the intake-valve-seat insert in the same manner.

(3) With cylinder head resting bottom side up on work bench, locate exhaust-valve-seat insert true in counterbore of head. Drive insert into place using exhaust-valve-seat insert replacer 7950102 (fig. 74). Cylinder head may be immersed for 30 minutes in water heated to a temperature of 180° to 200° F. and valve-seat inserts cooled in dry ice to facilitate assembly.

(4) Install intake-valve-seat insert in the same manner using intake-valve-seat insert replacer 7950101.

f. Check intake and exhaust valves:

(1) Check valve heads after all carbon has been removed for warpage, pitting, and wear. If a valve head is warped or pitted, replace valve. If seating surface of valve is too wide, narrow seat with relieving tools to dimensions given in serviceability standards (par. 139).

(2) Check diameter of valve stems and, if damaged or worn (par. 139), replace with new valves.

(3) If valve-seat inserts are cleaned up and valves are ground to specifications by rotating back and forth with a grinding tool, remove the valves and wash them and the inserts in the cylinder head with dry-cleaning solvent or volatile mineral

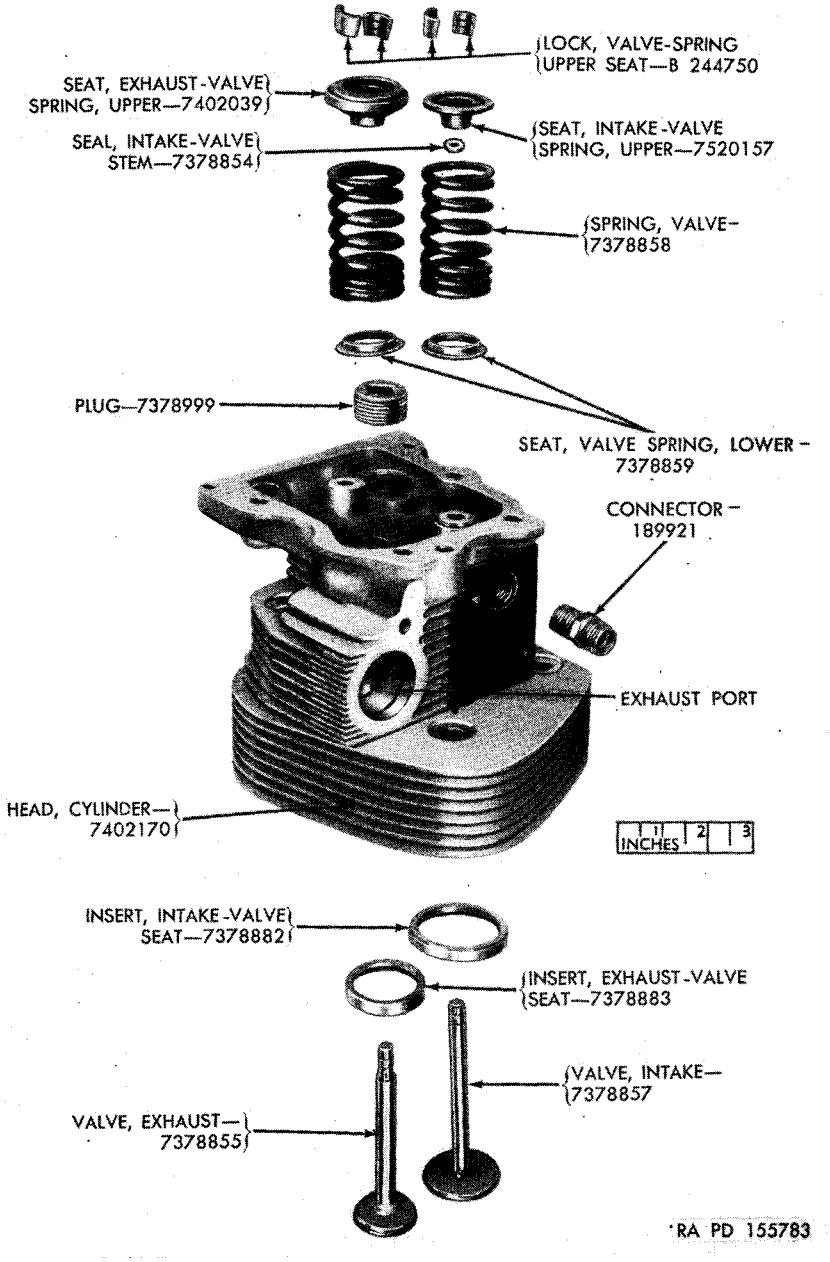


Figure 72. Cylinder head and valves—exploded view.

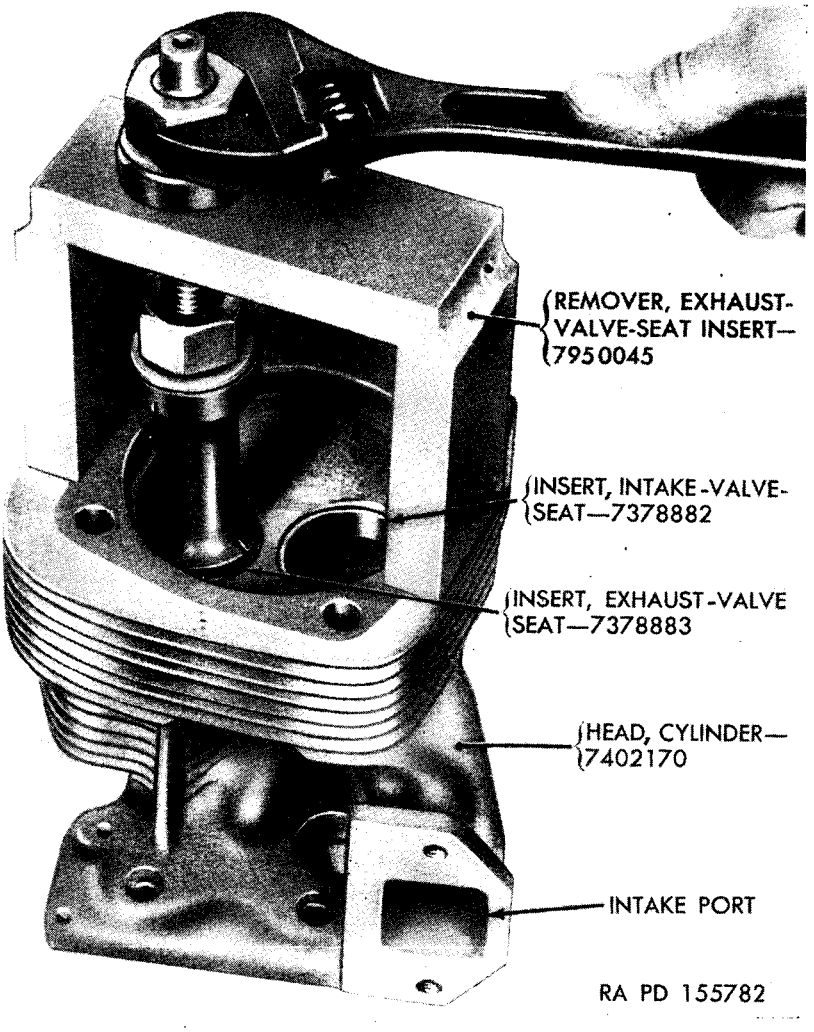


Figure 73. Removing valve-seat insert.

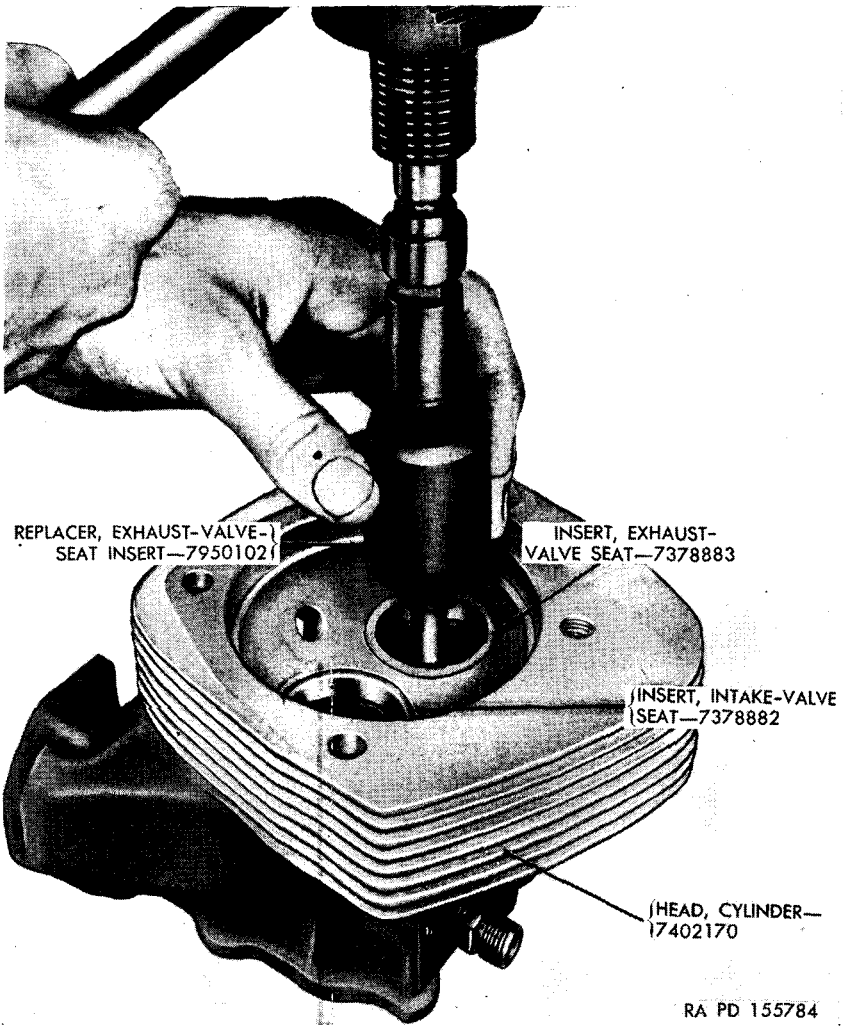


Figure 74. Installing valve-seat insert.

spirits. Do not leave any trace of grinding compound on the inserts or valves.

77. Cylinder Head and Valve Assembly

a. After the valve-seat inserts have been cleaned up or new ones have been installed, rest cylinder head on work bench.

b. Install cylinder-head-drain-tube connector.

c. Apply engine oil to intake and exhaust valves and insert them in their respective guides.

d. Slide a valve-spring lower seat, valve spring, valve-stem seal and valve-spring upper seat over stem of intake valve (fig. 72). Compress

valve spring with valve-spring compressor and insert valve-spring-seat locks in place.

e. Slide valve-spring lower seat, valve spring and valve-spring upper seat over stem of exhaust valve. Install valve-spring-upper-seat locks using valve-spring compressor.

78. Push Rod and Valve Tappet Disassembly

a. The valve-rocker-arm push rods, push-rod cover tubes, and push-rod-tube seals were removed as individual parts at the time the engine was disassembled (par. 43).

b. If the operation of the valve tappets is faulty due to excessive varnish deposits or presence of dirt, they may be disassembled and cleaned; however, as long as the valve tappets operate properly, they

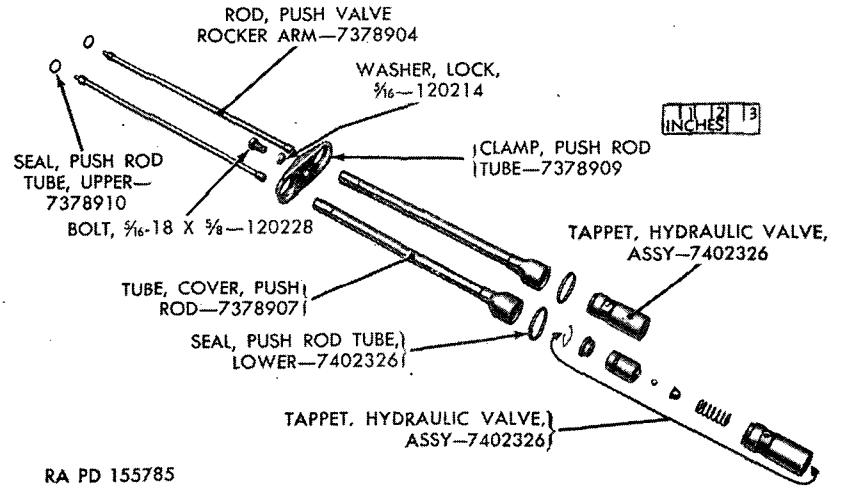


Figure 75. Valve push rods and tappets—exploded view.

should not be disassembled but wrapped in clean paper to avoid entrance of dirt while other engine parts are being rebuilt.

c. Disassemble each valve tappet by removing plunger retainer with a screwdriver and withdrawing push rod seat, plunger, ball, ball retainer, and spring from the body.

d. If body bore above the plunger is caked with hard carbon so that plunger cannot be removed easily, submerge valve tappet in a suitable carbon softener for a time and then remove carbon with a stiff bristle brush.

e. Use extreme care to avoid nicking or otherwise damaging the body and plunger. Keep parts of one tappet separate from the other as the plungers are selectively fitted to the bodies.

79. Push Rod and Valve Tappet Cleaning

a. Wash all parts in dry-cleaning solvent or volatile mineral spirits and dry with compressed air.

b. Passage through push rods must be thoroughly cleaned to insure lubrication to rocker arm mechanism.

c. Body bore and plunger must be free of dirt and varnish for proper operation.

80. Push Rod and Valve Tappet Inspection

a. Make sure push rods are not bent, that central oil passage is clean, and that upper and lower ends are not worn. Replace push rods if necessary with new parts.

b. Examine upper- and lower-push-rod-tube seals and replace if broken or stretched.

c. Carefully inspect outer surface and diameter of tappet body for scoring wear or other damage which would prevent free movement (par 145). Check lower end of tappet body for spalling, scoring, or radial scratch lines. If such damage exists, the tappet must be replaced as an assembly.

81. Push Rod and Valve Tappets Assembly

a. The rocker-arm push rods, push-rod cover tubes, and tube seals are installed when the engine is assembled (par. 115).

b. Assemble ball and ball retainer in spring (fig. 75); then insert this assembly into bore of tappet body. Slide plunger and push-rod seat into body bore and secure in place with retainer.

c. Tappets must be filled with correct seasonal grade of clean engine oil before installation in engine.

82. Rocker Cover Disassembly

a. Loosen 10–24 x 7/16 lock screw (fig. 76). Slide rocker-arm shaft out one side of rocker-arm cover just far enough to remove rocker-arm-shaft seal from rocker-arm shaft.

b. Rocker arms become loose parts upon removal of rocker-arm shaft.

Note. The intake and exhaust rocker arms are different.

c. Remove one-quarter pipe plug and 10–24 x 7/16 lock screw from rocker cover only if replacement is required.

83. Rocker Cover Cleaning

a. Clean rocker arms, shaft, and cover with dry-cleaning solvent or volatile mineral spirits. Be sure drilled oil passages in rocker arms are clean.

b. Clean off all gasket material from rocker cover.

c. Wipe rocker-arm-shaft seals with clean cloth.

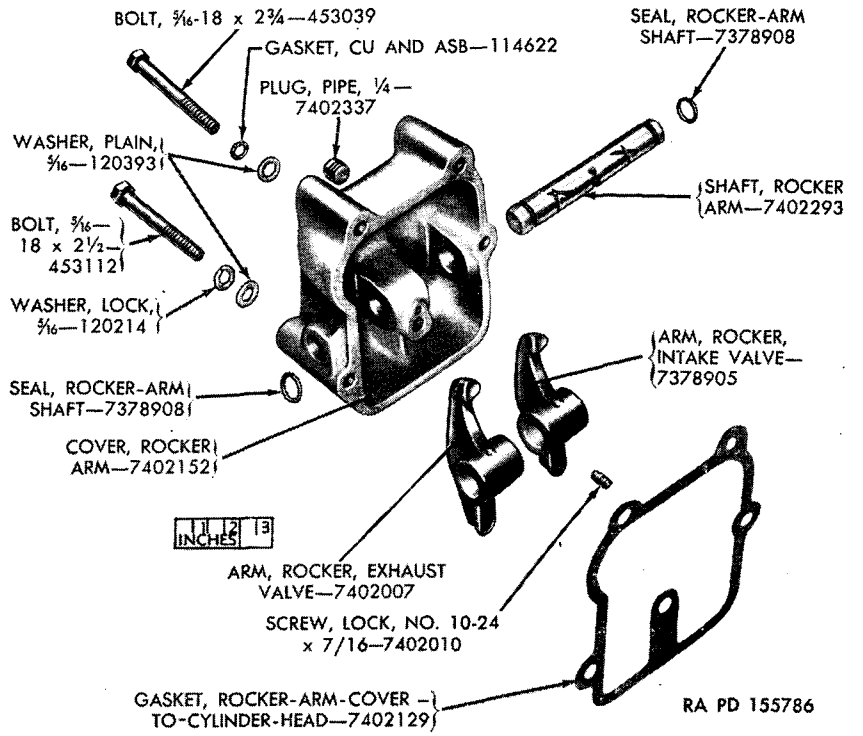


Figure 76. Rocker arms, shaft, and cover—exploded view.

84. Rocker Cover Inspection

a. Inspect rocker arms and shaft for cracks, scoring, or excessive wear (par. 146).

b. Inspect bearing bore in rocker-arm cover for scoring which would cause damage to rocker-arm-shaft seals.

c. Inspect drilled passages of rocker arms to insure there are no obstructions which might prevent lubricating oil from reaching the rocker-arm shaft via valve-rocker-arm push rods.

85. Rocker-cover Assembly

a. Note that the rocker arm shaft is drilled part way through at center point to receive a 10–24 x 7/16 lock screw, a slot is cut at one side of shaft for cover bolt, and slots are cut in shaft to facilitate lubrication along the shaft.

b. Apply white lead to ¼ pipe plug and install in rocker-arm cover.

c. Start 10–24 x 7/16 lock screw into tapped hole in cover (fig. 76). Aline rocker-arm-shaft lock screw hole with tapped hole in cover and aline slot in shaft for cover bolt with bolt hole in cover. Pilot rocker-arm shaft through bearing bore at one side of rocker-arm cover, on

through one rocker arm, through center-bearing boss of rocker-arm cover, then through other rocker arm.

d. Assemble rocker-arm-shaft seal in groove at exposed end of rocker-arm shaft and continue piloting shaft through bearing bore at opposite side of rocker-arm cover until other seal groove is exposed (fig. 76). Position other seal and slide rocker-arm shaft back into proper position. A cross slot is provided at one end of the rocker-arm shaft to permit use of screwdriver in turning shaft to correct position (fig. 4).

e. Secure rocker-arm shaft in place with 10–24 x 7/16 lock screw (figs. 4 and 76).

86. Engine Front Cover Cleaning

a. Clean engine front cover, previously removed (par. 39), with dry-cleaning solvent or volatile mineral spirits and blow dry with compressed air.

b. Blow out oil passages to make sure they are open and clean all gasket material from machined mounting surfaces.

87. Engine Front Cover Inspection

a. Inspect engine front cover for evidence of cracks (fig. 34). Check machined mounting surface for nicks or scratches which would prevent a good seal. Remove burs or rough edges with a whetstone.

b. Inspect finished machined bore in cover for starting-pulley-hub seal and remove any nicks or burs which would damage seal.

c. Make sure idler-gear-shaft-hole expansion plugs are tight in cover and that holes are clean to permit proper piloting of idler-gear shafts in holes when engine cover is assembled to crankcase.

88. Crankcase Bottom Cover, Oil Float, and Oil Screen Cleaning

a. Clean crankcase bottom cover, oil float, and oil screen, which were previously removed from crankcase (par. 34), in dry-cleaning solvent or volatile mineral spirits and dry with compressed air.

b. A bristle brush may be used to clean oil screen.

89. Crankcase Bottom Cover, Oil Float, and Oil Screen Inspection

a. Check oil drain plugs and gaskets in bottom cover and replace if necessary (fig. 37).

b. If oil screen (figs. 39 and 37) is damaged to extent of making it ineffective, replace with new part.

c. Make sure oil float hinge mechanism is in good operating condition (fig. 39).

Section V. REBUILD OF ACCESSORIES

90. Governor Disassembly

a. Remove three ¼–20 x 1 3/16 screws and lock washers securing governor housing to governor base. Remove housing and housing-to-base gasket from base (figs. 34 and 77).

b. Remove spring clip which secures stop washers, fork base, thrust bearing and governor (flyweight ball) upper race to governor base (fig. 77). Remove stop washers, fork base, thrust bearing, upper race and six flyweight balls. Note sequence of removal of these parts.

c. The spring adjusting nut is threaded onto adjusting screw and secured to governor housing with two No. 8–32 x ¾ screws (fig. 77). Turn spring adjusting nut counterclockwise to remove nut and gasket. Detach hook end spring from spring anchor lever and remove adjusting screw and spring from governor housing (fig. 77).

d. Note position of operating fork and position of spring anchor lever on governor operating lever (fig. 77). Remove pipe plug from governor housing and, using punch through plug hole, remove ⅛ x ⅝ groove pin securing operating fork to operating lever. Remove fork. Rotate operating lever approximately 180° and remove groove pin securing spring anchor lever to operating lever. Remove anchor lever from operating lever and lift operating lever from governor housing (fig. 77).

e. Remove needle inner bearing (fig. 77) with soft rod or drift; then, working through governor housing cavity, remove needle outer bearing and oil seal. Remove bearing from governor housing using a bearing remover.

91. Governor Cleaning

a. Clean governor parts with dry-cleaning solvent or volatile mineral spirits and dry with compressed air.

b. Remove all old gasket material from governor housing and base.

c. Refer to TM 37-265 for cleaning of bearings.

92. Governor Inspection

a. Inspect governor base (fig. 77). Remove any nicks or burs which will prevent a good gasket seal from governor base mounting surface with whetstone. Check governor drive shaft and remove burs or score marks with whetstone. Inspect governor drive gear for broken or chipped teeth. If governor base, drive shaft or drive gear is damaged, replace with new assembly.

b. Inspect flyweight balls (fig. 34) and replace if cracked or chipped.

c. Inspect governor body for cracks and machined surfaces for burs that will prevent a good gasket seal. Remove small burs with whetstone.

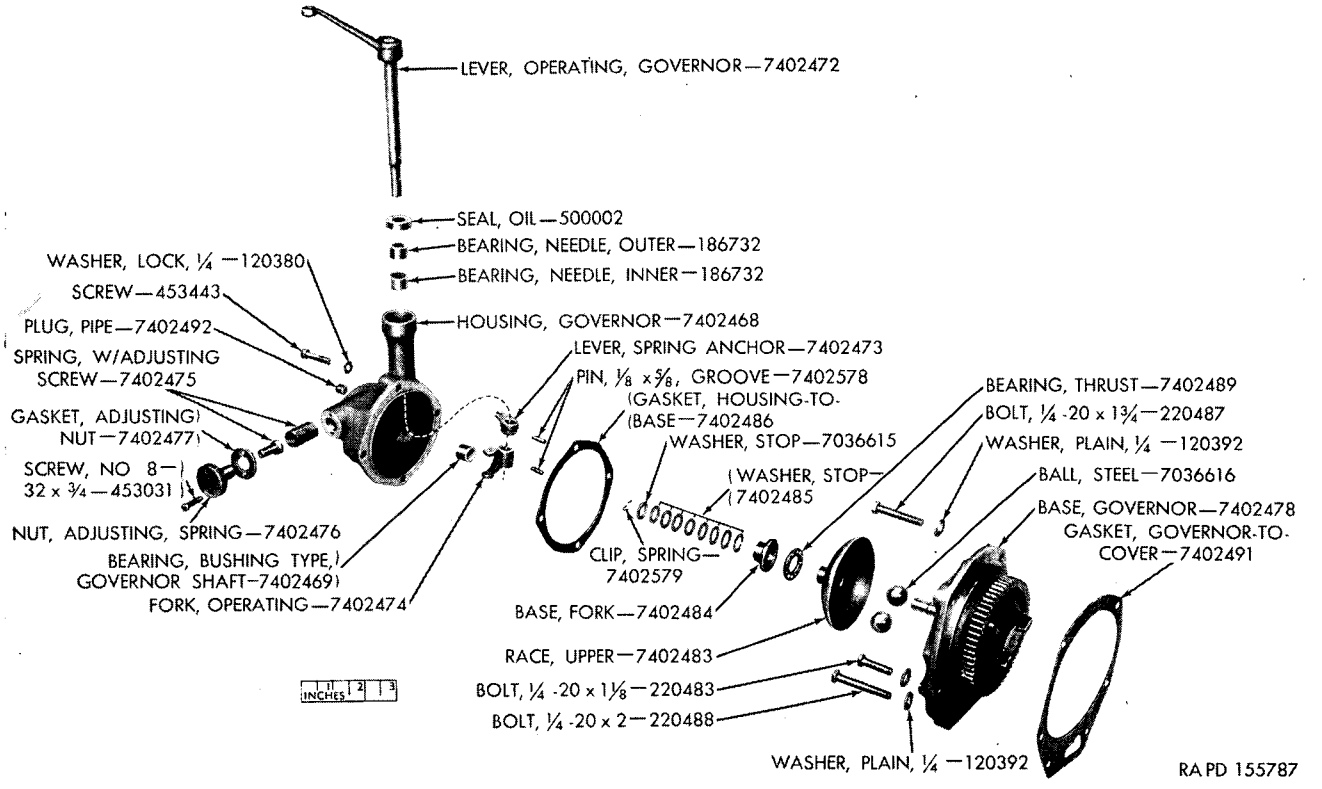


Figure 77. Governor—exploded view.

d. Inspect bearing bores for nicks or other damage which will in any way prevent proper assembly of bearings. Remove small nicks or burs with whetstone.

93. Governor Assembly

a. Rest governor housing on wood block (fig. 78), start governor-shaft bushing-type bearing true in bearing bore, and drive into place with governor housing bearing replacer—7950100.

b. Install new inner needle bearing (fig. 77) from cavity side of governor housing; then, install new outer needle bearing and a new oil seal in governor housing. Lip of oil seal must face away from bearing (fig. 77).

c. Insert shaft of operating lever (fig. 77) carefully through oil

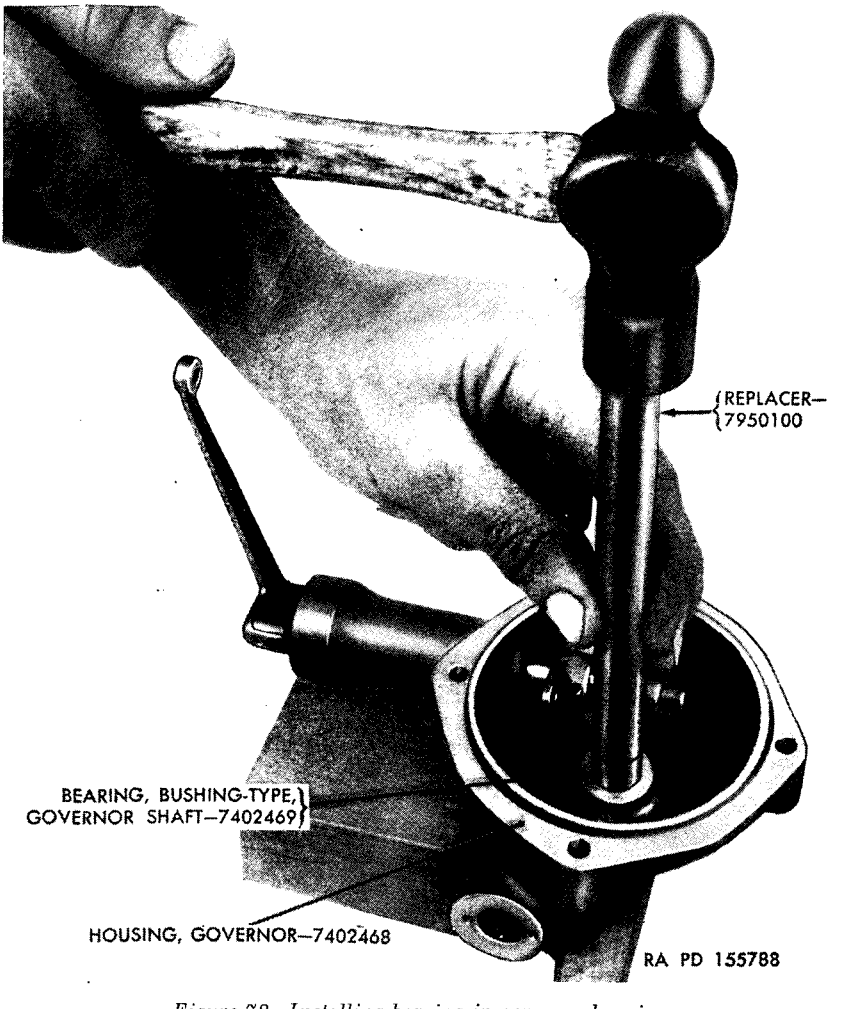


Figure 78. Installing bearing in governor housing.

seal and bearings so as not to damage lip of seal. Slide spring anchor lever on operating lever and secure with ⅛ x ⅝ groove pin. Spring attaching end of anchor lever must face toward cavity of governor housing. Slide operating fork (fig. 77) on operating lever with finished sides of fork ends facing out and secure with ⅛ x ⅝ groove pin. Install pipe plug in governor housing.

d. Insert adjusting screw and spring (fig. 77) in governor housing. Attach hook end of spring to spring anchor lever. Position gasket on spring adjusting nut and thread adjusting nut onto adjusting screw. Secure spring adjusting nut in place with two No 8–32 x ¾ screws (fig. 77).

e. Rest governor base on drive gear end and place six flyweight balls in slots provided. Assemble flyweight ball upper race, thrust bearing, fork base, and stop washers in that sequence on governor drive shaft (fig. 77). Secure parts to shaft and base with spring clip (fig. 77).

f. Assemble governor housing to governor base using new housing-to-base gasket (fig. 77) and secure with three ¼–20 x 1 3/16 screws and lock washers. A fourth governor-housing-to-base screw and lock washer is installed when governor is mounted on the engine (par. 114).

94. Heat Exchanger and Exhaust Manifold Disassembly

a. Remove exhaust manifold (figs. 15 and 79) from heat exchanger if not previously removed (par. 19).

b. Remove ⅜–16 x 2½ bolt, lock washer, plain washer, link, terminal spacer, insulator-bushing spring, and insulator bushing from side of heat exchanger (figs. 35 and 79).

c. Remove ten ¼–20 x ½ bolts securing element cover and electric heater cover (fig. 79) to heat exchanger and remove covers and electric heater.

d. Remove four bolts and disconnect electric heater from cover (fig. 79).

95. Heat Exchanger and Exhaust Manifold Cleaning

a. Immerse heat exchanger in a scale solvent consisting of one-third muriatic acid and two-thirds water, to which has been added one-half pound of oxalic acid to each 2½ US gallons of solution. Remove heat exchanger when foaming and bubbling stops, approximately 60 seconds. Flush heat exchanger with clean, hot water.

b. Clean electric heater parts with a bristle brush.

c. Clean heat exchanger covers and exhaust manifold parts in dry-cleaning solvent or volatile mineral spirits.

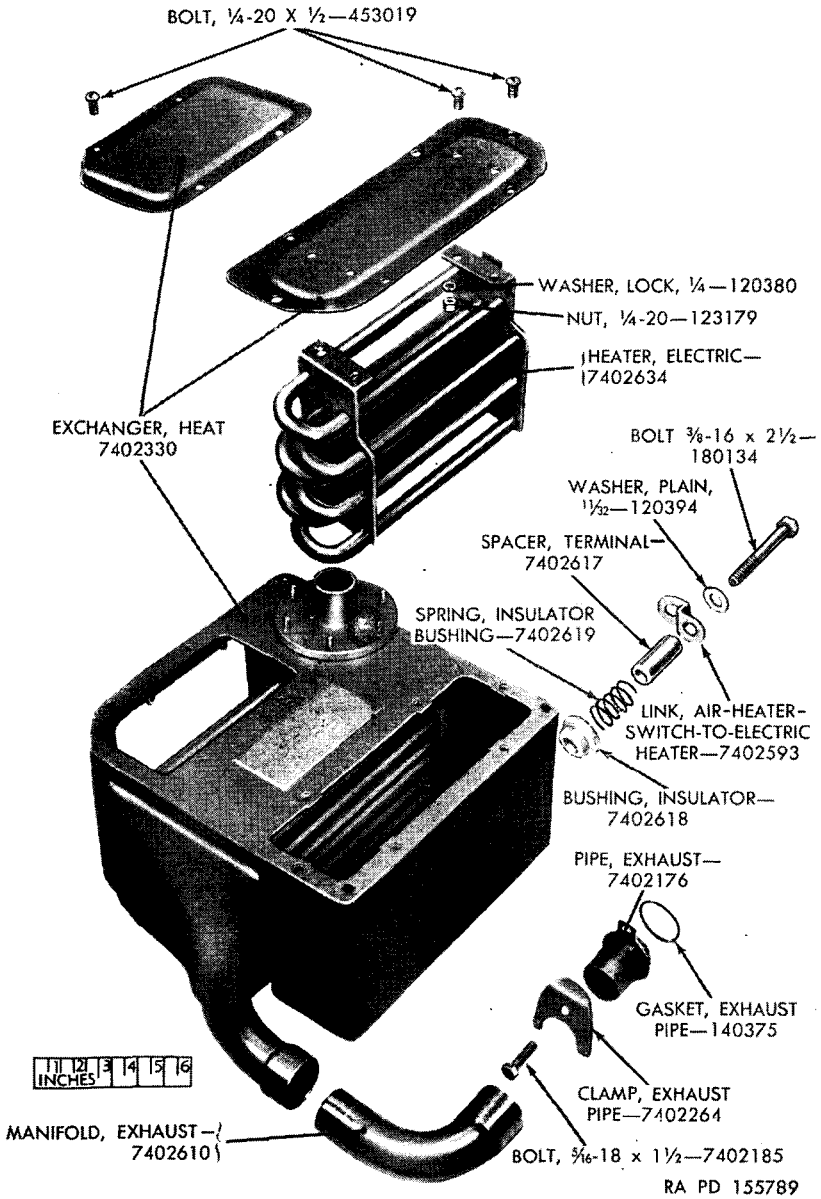


Figure 79. Heat exchanger and exhaust manifold—exploded view.

96. Heat Exchanger and Exhaust Manifold Inspection

a. Inspect heat exchanger for leaks, breaks in welding, or other damage; repair or replace with new part.

b. Inspect electric heater and replace damaged parts.

c. Inspect heat exchanger covers and exhaust manifold parts. Bent covers can be straightened. Repair or replace damaged exhaust manifold parts.

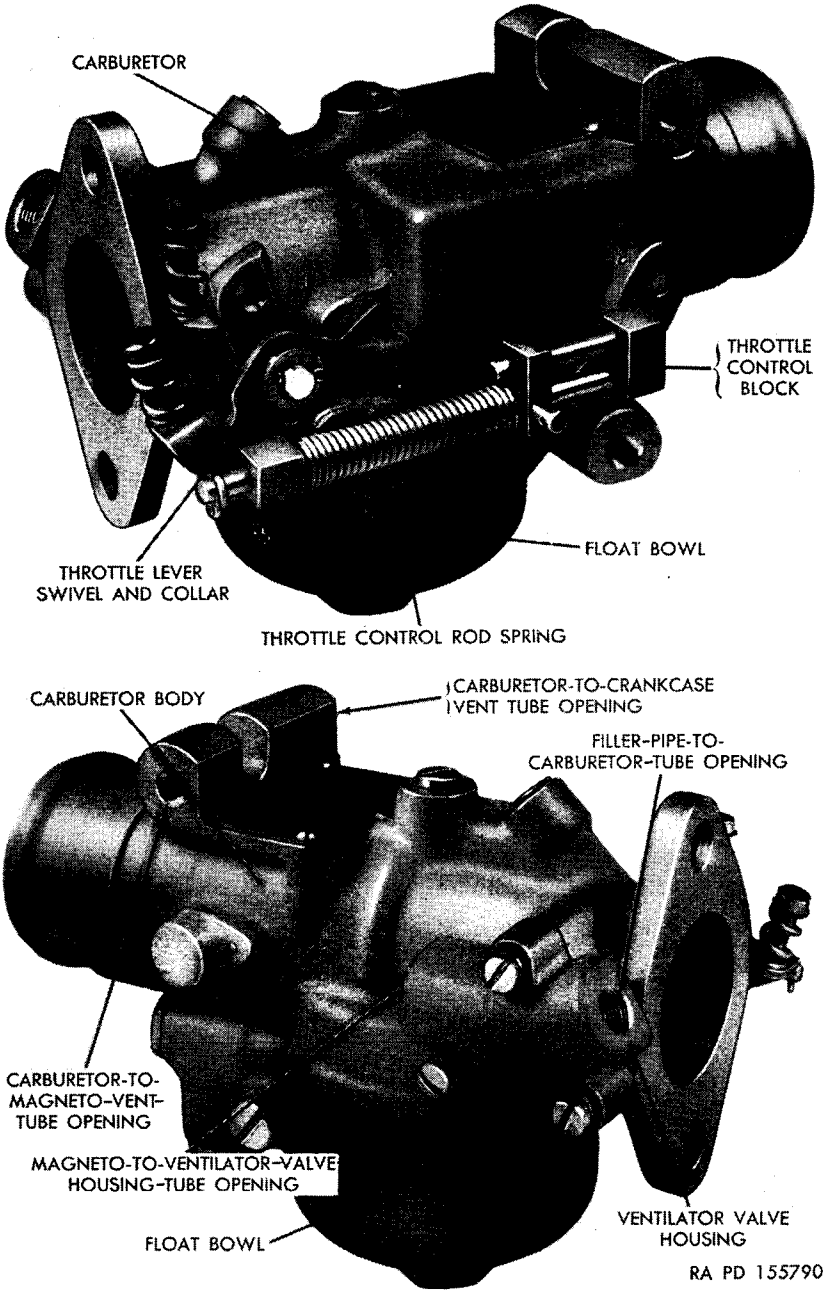


Figure 80. Carbureior.

97. Heat Exchanger and Exhaust Manifold Assembly

a. Attach electric heater cover (fig. 79) to heater with four ¼–20 x ½ bolts and insert heater into cavity of heat exchanger. Secure heater cover to heat exchanger with six ¼–20 x ½ bolts (fig. 79).

b. Assemble washers, link, terminal spacer, insulator-bushing spring, and insulator bushing on ⅜–16 x 2½ bolt (fig. 79). Insert bolt through hole in side of heat exchanger and thread into tapped hole in electric heater.

c. Secure element cover to heat exchanger with four bolts (fig. 79).

d. Exhaust manifold parts are installed when engine is assembled.

98. Carburetor Disassembly

a. Remove carburetor bowl retaining plug and gasket securing float bowl to carburetor body (figs. 80 and 82). Separate float bowl from carburetor body and lay body aside on clean bench.

b. Remove float hinge pin and hinge pin gasket (fig. 82) and lift float and float balance spring from float bowl.

CAUTION: Do not lose or distort balance spring when removing.

c. Remove float needle (figs. 81 and 82) from needle seat inside bowl. Remove needle seat plug and gasket, then remove needle seat and gasket from bowl, using one-half bit screwdriver.

d. Remove fuel strainer plug, gasket, and fuel strainer from float bowl (fig. 82).

e. Remove float-bowl-to-body gasket (fig. 82) from carburetor body.

f. Disconnect choke-lever return spring (fig. 82) from choke lever and carburetor body with long-nosed pliers. Remove cotter pin and

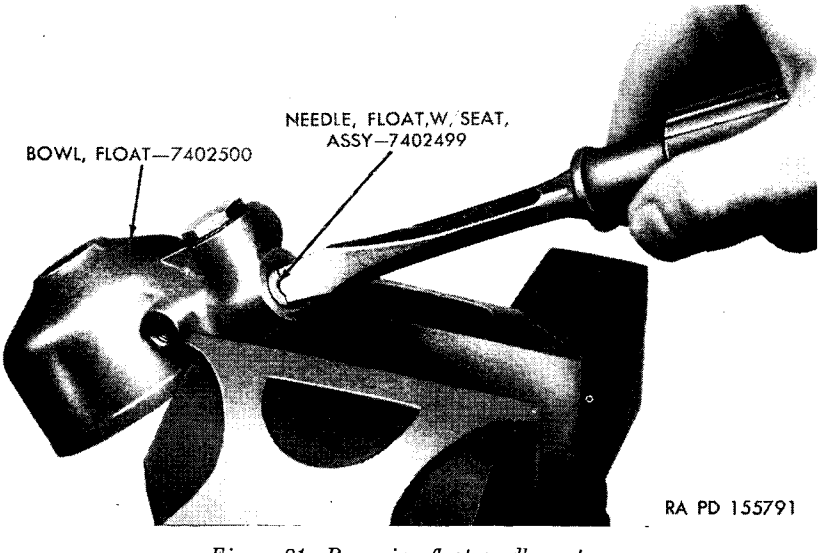


Figure 81. Removing float needle seat.

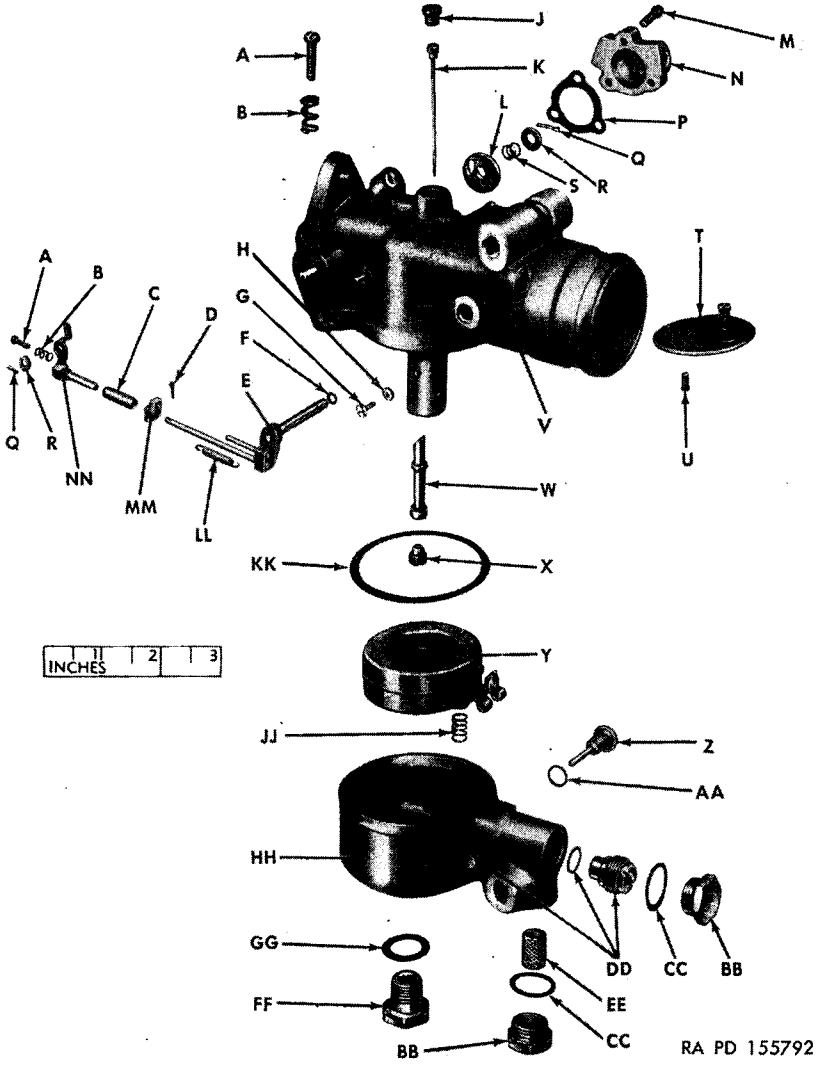


Figure 82. Carburetor—exploded view.

A—SCREW, ADJUSTING, IDLE—7402362
B—SPRING, IDLE ADJUSTING SCREW—7402363
C—SPRING, THROTTLE CONTROL ROD—7402694
D—PIN, COTTER—119981
E—LEVER, CHOKE, ASSY—7402374
F—GASKET, PACKING, "O" RING—501218
G—SCREW, LOCATING, NOZZLE—7402583
H—GASKET, LOCATING, NOZZLE SCREW—7402584
J—PLUG, IDLE TUBE HOLE—7402356
K—TUBE, IDLE—7402355
L—VALVE, VENT, CRANKCASE—7402366
M—SCREW, RETAINING, VENT HOUSING—7402692
N—HOUSING, CRANKCASE VENT VALVE—7402369
P—GASKET, CRANKCASE-VENT-VALVE HOUSING—7402370
Q—PIN, COTTER—191598
R—WASHER, RETAINING, GASKET—7402359
S—SPRING, TENSION, THROTTLE SHAFT—7402367
T—VALVE, CHOKE, ASSY—7402372
U—SCREW, RETAINING CHOKE VALVE—7402365
V—BODY, CARBURETOR—7402501
W—NOZZLE, MAIN DISCHARGE—7402353
X—JET, MAIN METERING—7402354
Y—LEVER, ASSY—7402379
Z—PIN, FLOAT HINGE—7402381
AA—GASKET, FLOAT HINGE PIN—7402381
BB—PLUG, FUEL STRAINER AND FLOAT NEEDLE—7402384
CC—GASKET, FUEL-STRAINER AND FLOAT-NEEDLE PLUG—7402383
DD—NEEDLE, FLOAT, W/SEAT, ASSY—7402499
EE—STRAINER, FUEL—7402382
FF—PLUG, RETAINING, CARBURETOR BOWL—7402386
GG—GASKET, RETAINING PLUG—7402387
HH—BOWL, CARBURETOR FLOAT—7402500
JJ—SPRING, FLOAT BALANCE—7402697
KK—GASKET, FLOAT BOWL-TO-BODY—7402185
LL—SPRING, RETURN, CHOKE LEVER—7402696
MM—BLOCK, THROTTLE CONTROL—7402693
NN—LEVER, THROTTLE, ASSY—7402695

Figure 82.—Continued.

washer from end of throttle shaft. Remove two choke-valve retaining screws securing choke valve to choke shaft, using one-eighth bit screwdriver; then remove choke valve from slot in choke shaft, being careful not to bind valve in air passage. Remove choke lever and throttle lever as an assembly. Remove seal ring from choke shaft.

g. Further disassembly of choke lever and throttle lever should not be made unless control rod spring, levers or rods (fig. 34) have been damaged. If disassembly is necessary, proceed by removing cotter pin from choke-lever guide rod. Remove throttle lever from guide rod. Unthread ends of control-rod spring from throttle-lever swivel block and control block and destroy spring. Remove adjusting screws and springs from throttle lever.

h. Remove three screws and washers securing crankcase vent housing to carburetor body and remove housing and housing gasket (fig. 82). Remove cotter pin, washer, spring, and vent valve from throttle shaft.

i. Remove idle tube plug (fig. 82); then remove idle tube with three-sixteenth bit screwdriver.

j. Remove main metering jet from carburetor body with one-fourth bit screwdriver. Remove main discharge nozzle locating screw and gasket (fig. 82). Tap main well cylinder of carburetor body lightly on wood block to remove main discharge nozzle.

99. Carburetor Cleaning

a. Clean carburetor parts in dry-cleaning solvent or volatile mineral spirits and remove any carbon or dirt with soft bristle brush.

b. Blow out all passages and dry parts with compressed air. Do not use wires or drills to clean jets or passages.

100. Carburetor Inspection

a. Inspect float-needle seat for wear. If wear is noted, both needle and seat must be replaced.

b. Check rubbing block on float hinge tang for wear and replace float if necessary. Check float for leaks by shaking.

c. Replace float balance spring with new part if distorted or lost.

d. Inspect idle tube and discharge nozzle for burs or other defects and replace with new parts as necessary.

e. Check poppet valve in choke valve. If poppet valve does not function properly, replace choke valve.

f. Check bore in body for choke shaft. Replace body if wear is noted.

g. Check for excessive wear on the throttle valve or wear of the bore in carburetor body. The close tolerance fit of the throttle valve in carburetor body, and the fact that the idle discharge hole is drilled

in relation to a proper fitting valve, requires that body be replaced if wear is noted.

101. Carburetor Assembly

a. Install adjusting screws and springs in throttle lever (fig. 82).

b. Install idle tube in carburetor body, using three-sixteenth bit screwdriver. Idle tube must be centered in nozzle cavity (figs. 11 and 83) to permit assembly of main discharge nozzle; bend as required. Place main discharge nozzle into main well of body so that tapped hole for nozzle locating screw is located between the two shoulders on nozzle. Use new gasket on locating screw and thread screw into tapped hole. Center main discharge nozzle in the carburetor body so that nozzle locating screw will index in key slot of nozzle. Use care to insure proper seal of locating screw gasket without stripping threads of nozzle locating screw.

c. Install main metering jet and idle tube hole plug securely (figs. 11 and 83).

d. Hold throttle valve wide open in bore of body, place crankcase vent valve on end of throttle shaft so that a full opening of valve passage in carburetor body may be observed (fig. 14), if passage cannot be observed, invert crankcase vent valve on shaft. Place throttle shaft tension spring and washer on throttle shaft and secure with cotter pin. Affix new gasket to crankcase vent housing and attach housing and gasket to carburetor body with three screws and washers (figs. 14 and 80). Tighten screws evenly.

e. Install new seal ring in counterbore of carburetor body for choke shaft (fig. 82). Apply "Aero-Lubricant" to inner circumference of seal after installing to permit assembly of shaft without damage to seal.

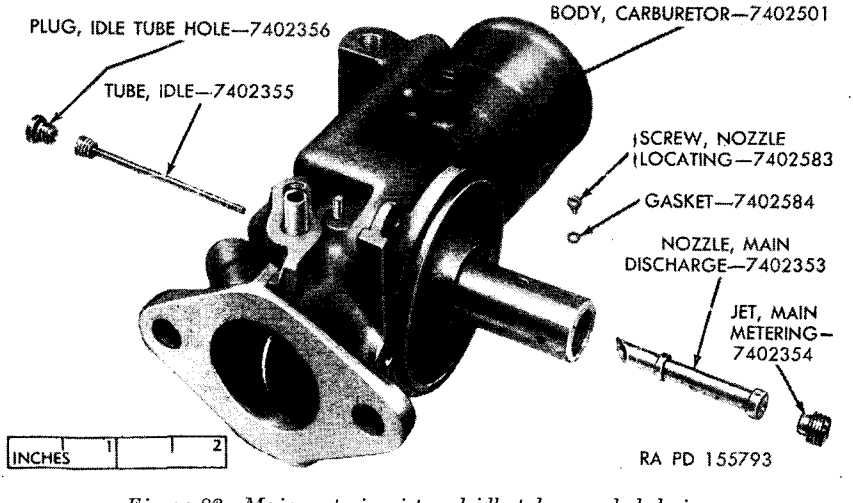


Figure 83. Main metering jet and idle tube—exploded view.

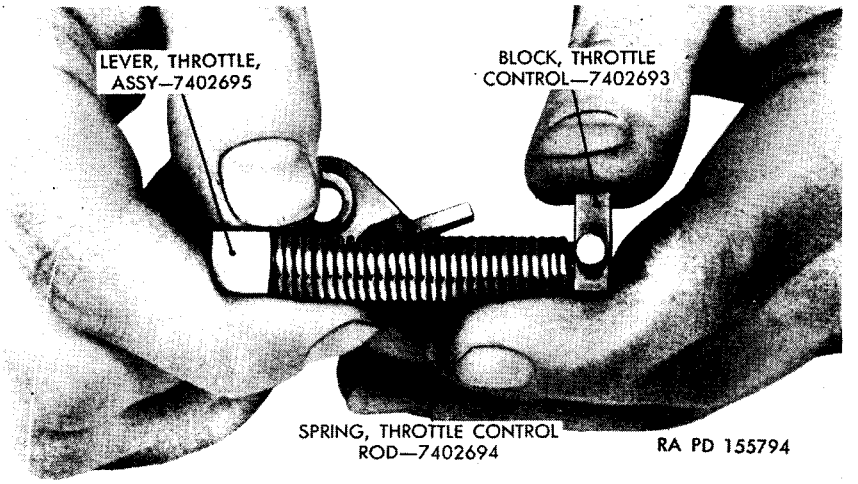


Figure 84. Relationship of loose lever, control spring, and control block.

f. Thread a new throttle-control-rod spring to the throttle lever on one end and to throttle-control block at the other end (fig. 82). First, thread throttle-control-rod spring three turns on both throttle lever and control block; then continue turning spring onto either throttle lever or control block to obtain proper relation (fig. 84) between the swivel block of loose lever and throttle-control block. Assemble complete throttle lever to choke-lever swivel guide rods. The long rod must pass through center of throttle-control spring (figs. 82 and 84) and be secured with a cotter pin. Install this assembly to carburetor body by inserting choke shaft carefully through seal ring in carburetor body at same time sliding throttle lever over end of throttle shaft. Secure throttle lever to exposed end of throttle shaft with retaining washer and cotter pin (fig. 80).

Note. Throttle must be in closed position when making above installation.

Caution: After making installation of control spring, blocks, and guide rods to carburetor, check to assure no bind exists in the action of the throttle-control block on the guide rods.

g. Rest carburetor in vertical position, hold guide rods down, and insert choke valve into slot of choke shaft with poppet valve stem facing away from bottom (float bowl) side of carburetor body (fig. 85). Center choke valve in bore of carburetor body and hold choke lever flush against body while securing choke valve in shaft with two screws. Install choke—lever return spring between choke lever and carburetor body (fig. 82).

h. Install new fuel strainer, fuel-strainer gasket, and plug in bowl and tighten plug securely (fig. 82). Place new gasket on needle seat; then using a one-half bit screwdriver, install needle seat and gasket in bowl (fig. 81)..

Note. Hold float bowl in such a position that gasket will remain in place on needle seat when making this installation.

Caution: Always use factory-matched float needle and seat as they are tested and inspected as a unit.

i. Install float-needle-seat plug using new gasket and tighten plug securely (fig. 82). Install float needle in seat with tapered seating end of needle pointing toward channel plug (figs. 11 and 82).

j. Press first coil of float balance spring over guide post on float and place float in bowl so that polished surface at hinge end of float faces end of float needle. The float balance spring must be positioned between guide post on float and guide post in float bowl (fig. 14).

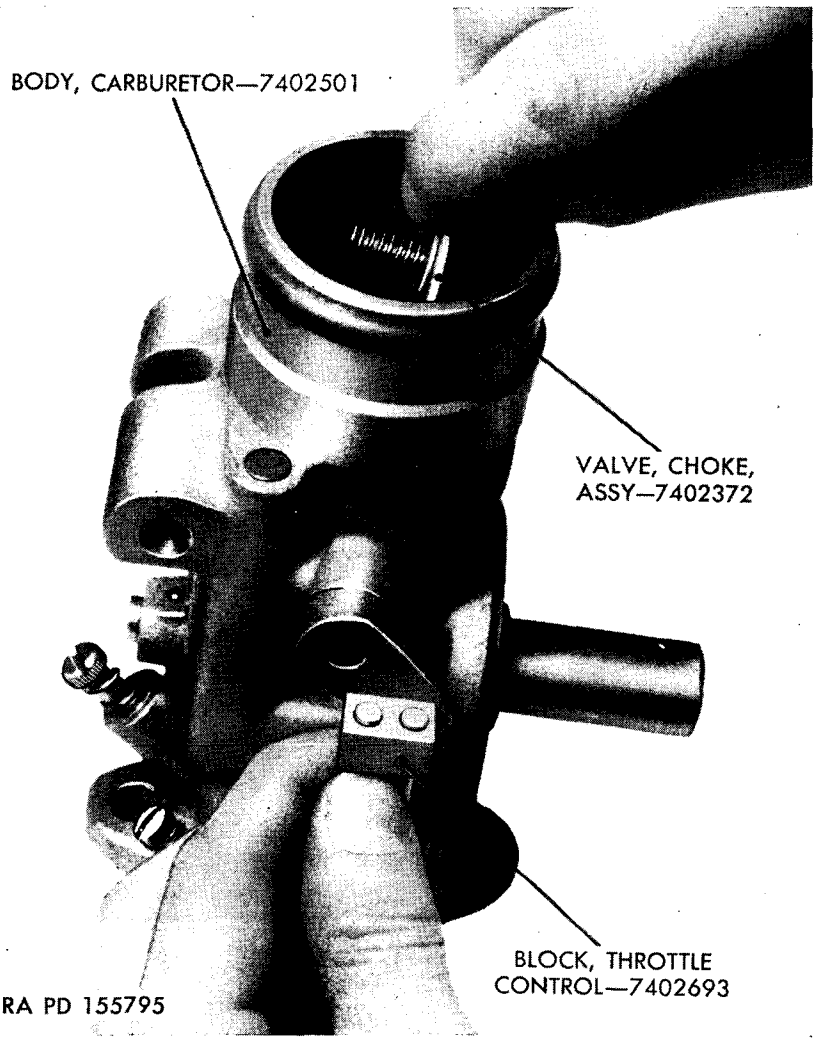


Figure 85. Installing choke valve.

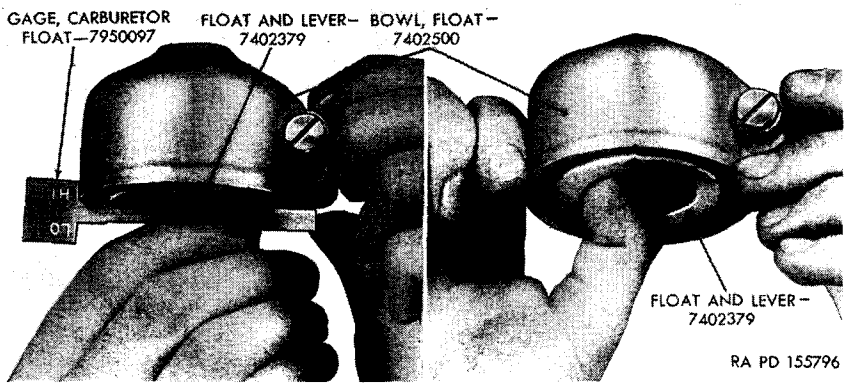


Figure 86. "Hi" step float check.

Install float hinge pin using new gasket and tighten hinge pin securely (fig. 82). Float must ride freely in float bowl.

k. Hold float bowl in inverted position and place float gage across float bowl (fig. 86); float should touch "HI" step of gage but must not touch the "LO" step. If float clears "HI" step, carefully pull toe of float down (fig. 86). If float touches "LO" step of gage, hold float down and bend tang in with screwdriver (fig. 87). Again check float with "HI" and "LO" steps of gage.

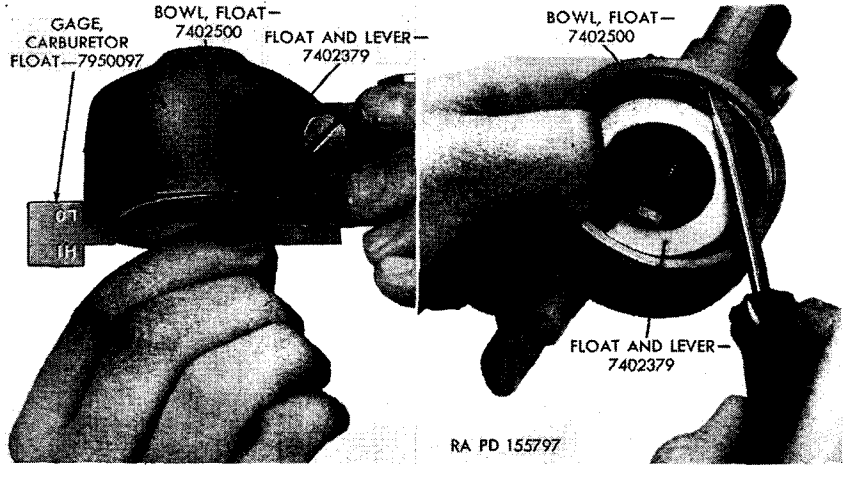


Figure 87. "Lo" step float check.

l. Place a new bowl-to-body gasket on carburetor body and assemble float bowl to carburetor body (figs. 11 and 82). Secure carburetor bowl to carburetor body with retaining plug and new plug gasket. Tighten plug securely with seven-eighth wrench.

m. If a new carburetor has been used, remove the name plate from old body and attach to new carburetor body with two screws.

102. Generator Disassembly

a. The generator fan and drive hub were removed when generator was disconnected from the engine (par. 33). Lay generator on side using care not to damage capacitors or terminal studs. Slip generator fan on shaft. Use holding tool engaged in internal splines of fan hub and remove four ⅜–24 x ⅛ coupling bolts (fig. 90), also remove flexible coupling and crankshaft coupling bolts (figs. 89 and 90). Remove fan and Woodruff key.

b. Clamp generator drive hub and disk in vise and remove four ⅜–24 x ⅞ bolts which hold drive hub to drive disk (fig. 89).

c. Place generator in vertical position. Insert a one-half socket wrench through the three-fourth holes in the commutator end of the generator frame and remove four ¼–28 x ⅝ brush and field lead terminal attaching bolts and lock washers (figs. 35 and 88).

d. Remove brushes by lifting the fingers of the brush tension springs and withdrawing brushes from the holders.

Note. If brushes are not excessively worn, they should be marked so they will be returned to their original holders.

e. Remove four No. 10–32 x ⅞ bearing retaining plate screws and lock washers. Remove bearing retaining outer plate (figs. 88 and 93).

f. Remove four ⅜–16 x 1¼ end frame bolts, lock washers, and flat washers (figs. 88 and 93).

Note. Before detaching end frame and brush holders, note the alinement marks located on the edge of end frame and main frame in line with generator terminals. Those marks must be in exact alinement when end frame is reassembled.

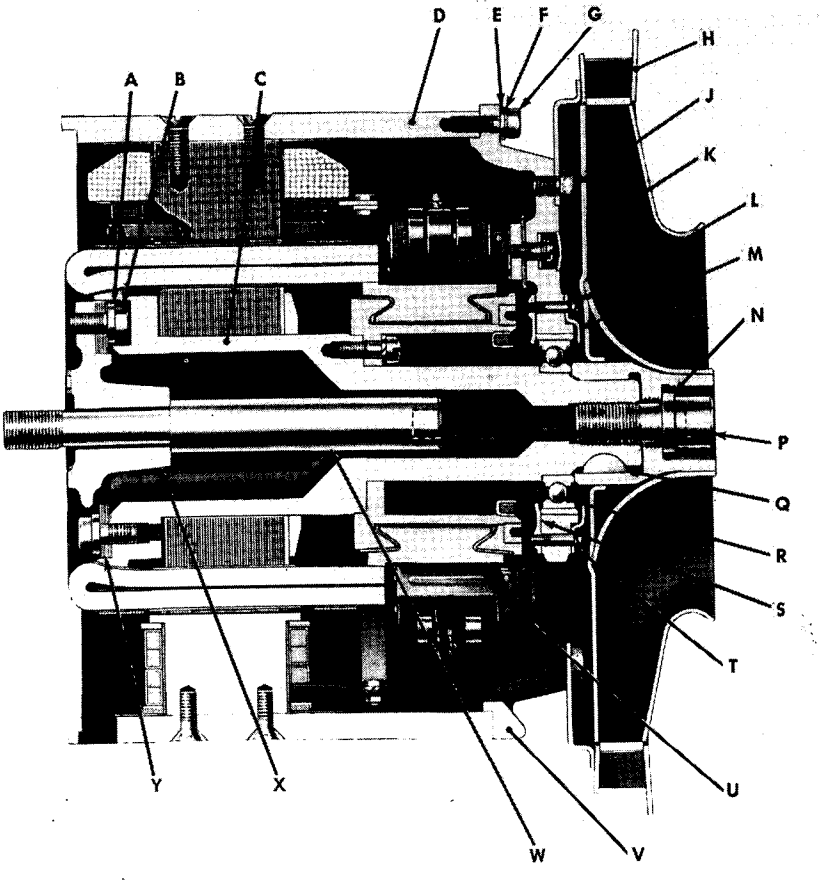
g. Tap end frame loose from generator frame and coil and withdraw from bearing using a two-jaw gear puller with the jaws engaged across the hub of end frame (fig. 91).

h. The brush holders should not be disturbed unless replacement is necessary. Brush tension springs may be removed by removing the retaining cotter pins and sliding the springs from the slotted pins (fig. 93). To replace a brush holder, remove the screw cover plugs by puncturing with a sharp punch and prying out; remove two ¼–28¾ mounting screws, washers and lock washers. Remove and discard insulating washers, insulating sleeves and insulating plates (figs. 88 and 93).

i. Remove ball bearing from armature shaft (fig. 92). Remove bearing retaining inner plate (fig. 88).

j. Withdraw armature from frame and field coil, using care not to damage insulation on windings.

k. If terminal studs or capacitors are damaged, they should be removed from frame and field coil. Remove terminal nut and lock washer and insulator washer. Unscrew capacitor, capacitor insulator, and capacitor housing cup from the terminal stud (fig. 93). Loosen



RA PD 155798

A—WASHER, ⅜—7402027
B—BOLT, ⅜-24 x ⅞—453014
C—ARMATURE, ASSY—7402521
D—FRAME, W/FIELD COIL, ASSY—7402520
E—WASHER, PLAIN, ⅜—7402561
F—WASHER, LOCK, ⅜—120382
G—BOLT, ⅜-16 x 1¼—180124
H—DIFFUSER—7402163
J—BOLT, ⅜-16 x ½—452999
K—FAN, GENERATOR IMPELLER—7402153
L—SCREW, No. 10-32 x ⅞—132128
M—PLATE, RETAINING, BEARING, OUTER—5516803
N—WASHER, ¾—7402498
P—BOLT, ¾-16 x 2—453004
Q—KEY, WOODRUFF—112139
R—BEARING, BALL—7402522
S—PLATE, RETAINING, BEARING, INNER—5516802
T—WASHER, LOCK, NO. 10—120217
U—HOLDER, BRUSH—7402540
V—FRAME, W/BRUSH HOLDERS, ASSY—5516899
W—BOLT, GENERATOR-TO-CRANKSHAFT—7402028
X—HUB, DRIVE, GENERATOR—7402464
Y—DISK, DRIVE, GENERATOR—7402465

Figure 88. Generator—sectional view.

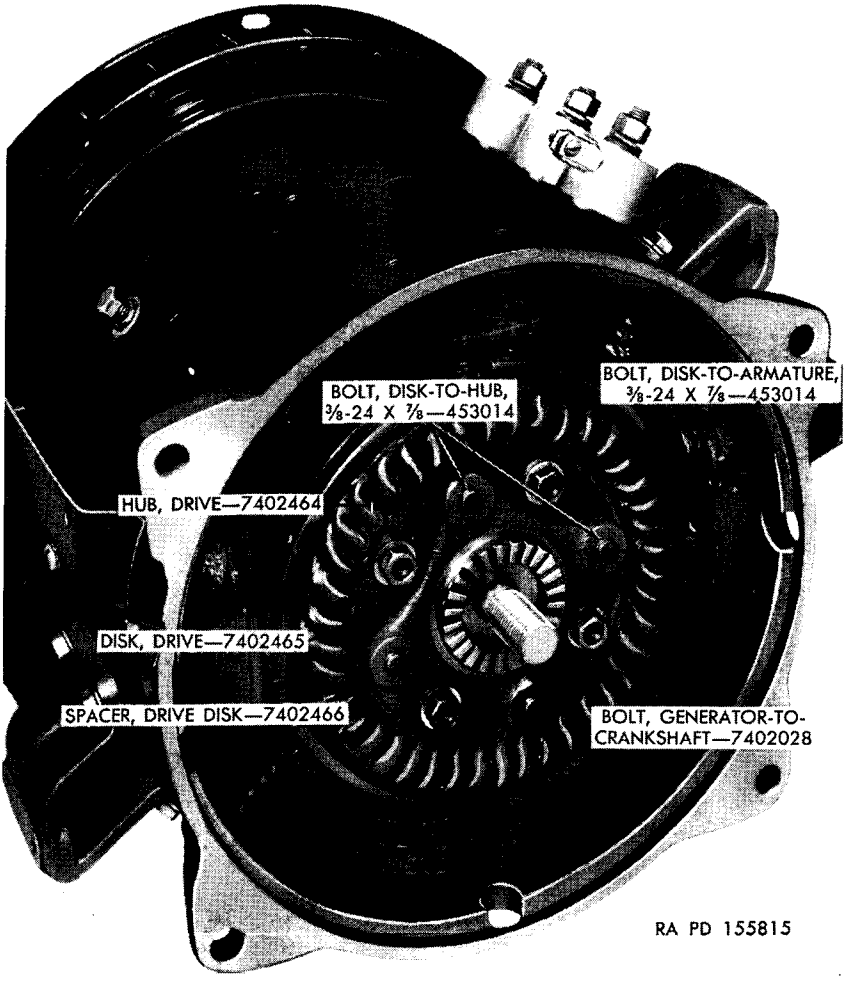


Figure 89. Generator drive.

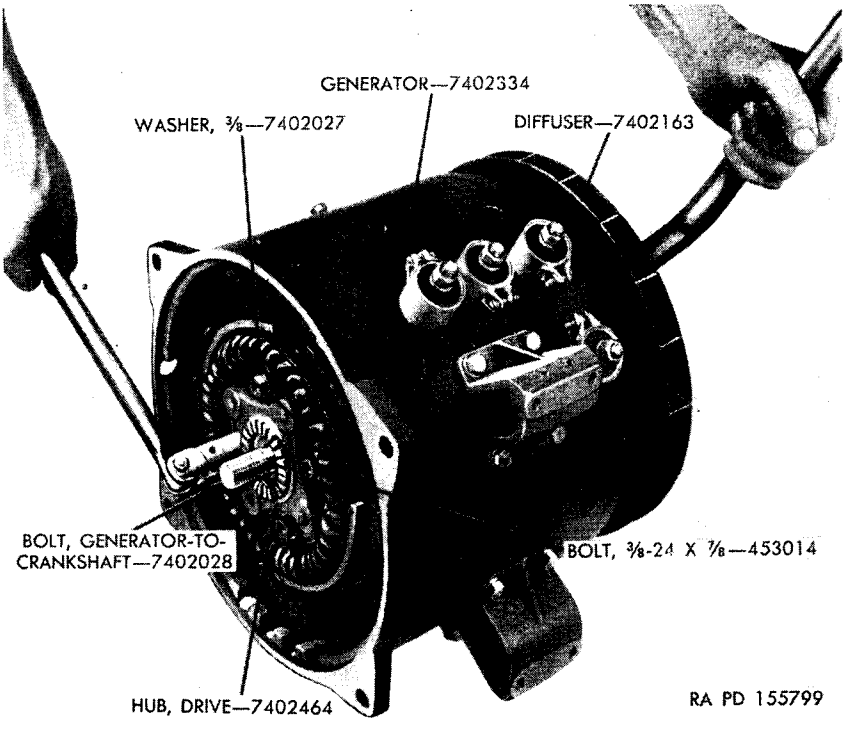


Figure 90. Removing generator drive hub.

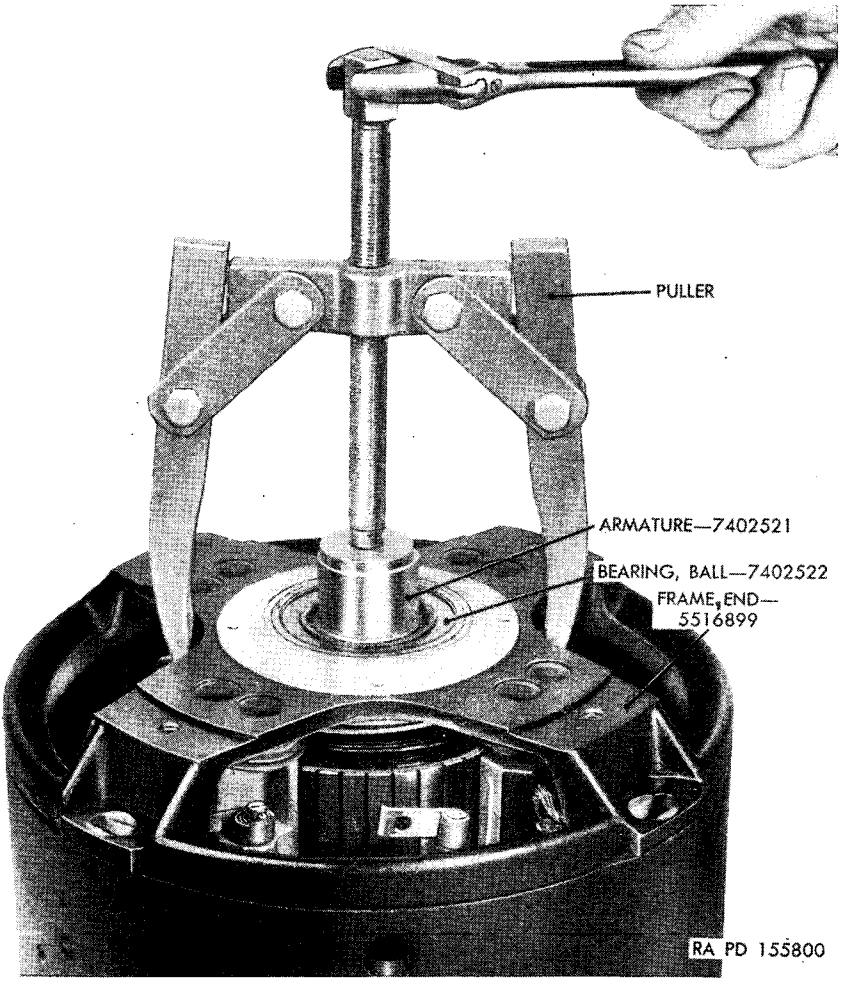


Figure 91. Pulling generator end frame.

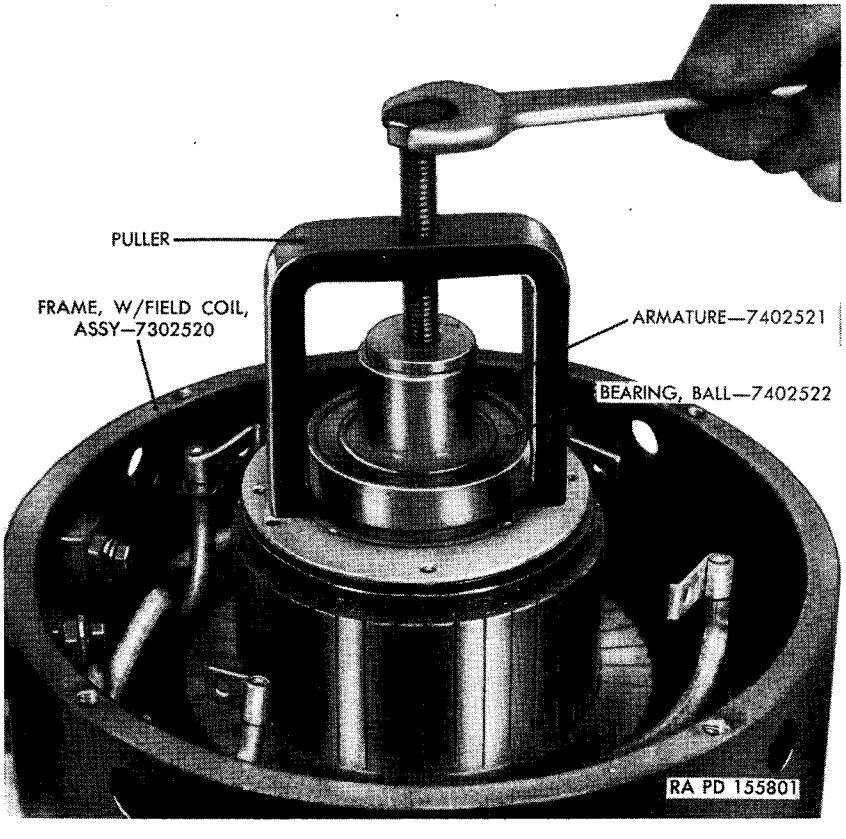


Figure 92. Pulling generator armature bearing.

capacitor housing cup clamp screw and remove capacitor and terminal stud bushing insulator.

l. Remove coil terminal nut and lock washer and detach coil connector from terminal stud (fig 93).

Note. "F +" terminal stud has a soldered connection to the shunt coil lead.

m. Withdraw terminal stud through frame from inside. Remove terminal stud insulating bushing by removing the retaining screw and lock washer (fig 35).

103. Generator Cleaning

a. Blow out loose dirt and dust from windings and brush holders with dry, low-pressure air (25 psi max).

b. Remove greasy dirt with a cloth moistened with dry-cleaning solvent or volatile mineral spirits.

Caution: Do not use carbon tetrachloride. Do not permit windings or ball bearing to become saturated with ANY type of solvent.

104. Generator Inspection

a. All mechanical parts should be examined for possible damage to threads and other machined surfaces which would affect operation of the generator. Inspect electrical windings and connections for looseness and mechanical damage from impact, abrasion, or overheating.

b. Inspect armature insulation for chipped or cracked areas. Repair insulation using air-dry insulating varnish.

c. The generator commutator should be smooth and free from dirt and oil. If the commutator is burned, grooved, or pitted, the armature should be properly mounted in a lathe and turned down until smooth. After cutting, the mica segment separators should be undercut with a 0.040 cutter to a depth of one thirty-second inch followed by a burring operation to remove copper burs and feather-edged mica. Final polishing of the commutator should be done with a commutator finishing stone mounted in tool holder of lathe and the shaft end of the armature supported by its own bearing, confined in a steady rest. Minimum diameter to which commutator may be machined is 5.125 inch. Maximum permissible eccentricity is 0.0005 (indicator reading equals 0.001).

d. Check for grounded armature with a 115- to 230-volt test lamp with test prods applied across commutator segments. If megger is available it should be used. The insulation resistance should not read below 10 megohms. If a ground is indicated, the armature should be rejected.

e. Check for open circuit by observing the condition of the commutator segments. An open-circuited coil will be evidenced by

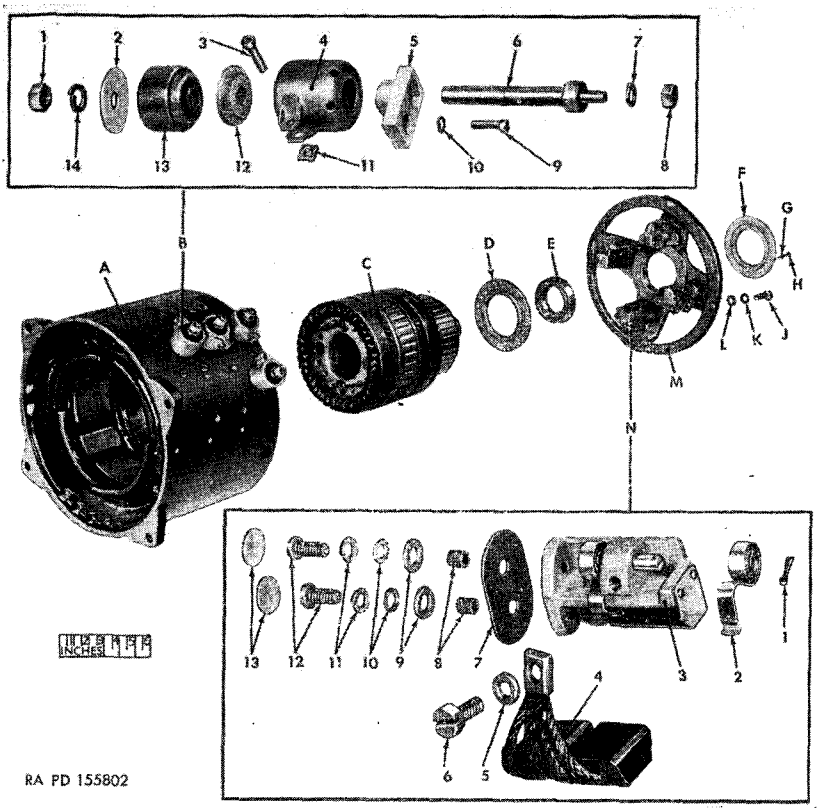


Figure 93. Generator—exploded view.

A—FRAME, W/FIELD COIL, ASSY—7402520
B—TERMINAL, ASSY
1—NUT, ⅜–16—114547
2—WASHER, INSULATOR—5302662
3—SCREW, NO 10–32 x ¾—132124
4—CUP, CAPACITOR HOUSING—5516854
5—INSULATOR, BUSHING, STUD—5516823
6—STUD, TERMINAL—5516826
7—WASHER, LOCK, ¼—120380
8—NUT, ¼–28—114545
9—SCREW, NO 10–32 x ⅝—132119
10—WASHER, LOCK, NO 10—120217
11—NUT, NO 10–32—120611
12—INSULATOR, CAPACITOR—5516857
13—CAPACITOR, RADIO NOISE SUPPRESSOR —7402546
14—WASHER, LOCK, ⅜—120382
C—ARMATURE, ASSY—7402521

D—PLATE, RETAINING, BEARING, INNER—5516802
E—BEARING, BALL—7402522
F—PLATE, RETAINING, BEARING, OUTER—5516803
G—WASHER, LOCK, NO 10—120217
H—SCREW, NO 10-32 x ⅞—132128
J—BOLT, ⅜-16 x 1¼—180124
K—WASHER, LOCK, ⅜—120382
L—WASHER, PLAIN, ⅜—7402561
M—FRAME, W/BRUSH HOLDERS, ASSY—5516899
N—HOLDER, BRUSH, ASSY—5516813
1—PIN, COTTER—190432
2—SPRING, TENSION—7402524
3—HOLDER, BRUSH—7402540
4—BRUSH, ASSY—7402523
5—WASHER, LOCK, ¼—120380
6—BOLT, ¼-20 x ⅝—7402558
7—WASHER, INSULATING—7402541
8—SLEEVE, INSULATING—7402542
9—WASHER, INSULATING—7402545
10—WASHER, MOUNTING—7402589
11—WASHER, LOCK, ¼—120380
12—BOLT, ¼-28 x ¾—7402588
13—PLUG, EXPANSION—7402590

Figure 93.—Continued.

severe burning of its commutator segment. The opening usually exists at the soldered junction of the coil to the segment riser. If the affected segments are not badly damaged, resolder the junctions and refinish commutator as directed above.

f. Check for short circuits with a "growler" or by measuring the resistance of the coils (table II). If a short is indicated, check for conducting particles between commutator segments; if not located, armature should be rejected.

Table II. Generator Coils Resistance Limits

Coil	Ohms	Test Prods at
	Note. Corrected to 25° C. (77° F.).	*Note.* Refer to generator internal wiring diagram (fig. 94).
Armature	0. 0026–0. 0028	Commutator segments 1 and 11.
Interpole and compensating	0. 0027–0. 0028	"P" terminal and ground.
Series	0. 0027–0. 0029	Series "F" and "A".
Shunt	2. 5 –2. 7	"F" and ground.

g. Remove field coil-to-frame terminal bolt and separate connector from any contact with frame (fig. 93). Check for grounded field coils with a 115- to 230-volt test lamp with test prods applied across generator terminals and frame. If a megger is available it should be used. The insulation resistance should not read below 10 megohms. If grounded winding is indicated, and not located and repaired, the assembly should be rejected.

h. Check for open and short circuits by measuring the resistance of coils as indicated in table II.

i. Make certain that brush holders are free from any dirt or gummy deposits which would interfere with the free movement of the brushes or provide an electrical creepage path to the end frame.

j. Check for grounded brush holders with 115- to 230-volt test lamp applied across each brush holder and the end frame. If megger is used, insulation resistance should be at least 10 megohms. If a grounded brush holder is indicated, it should be removed and new insulation parts installed.

k. Check brush holder springs for tension. Use a spring scale with a leather sling to accommodate spring tension finger. Correct tension should be 1¾ to 2 pounds at working position. Discard springs if not within limits.

l. Minimum usable length of brushes is ¾-inch. (measured on long side of brush). Original length is 1¼-inch. If length of brush at rebuild is less than 1⅛-inch, the brushes should be discarded.

m. Check the generator-armature ball bearing for wear (par. 148). Hold the inner race of generator-armature ball bearing and turn the

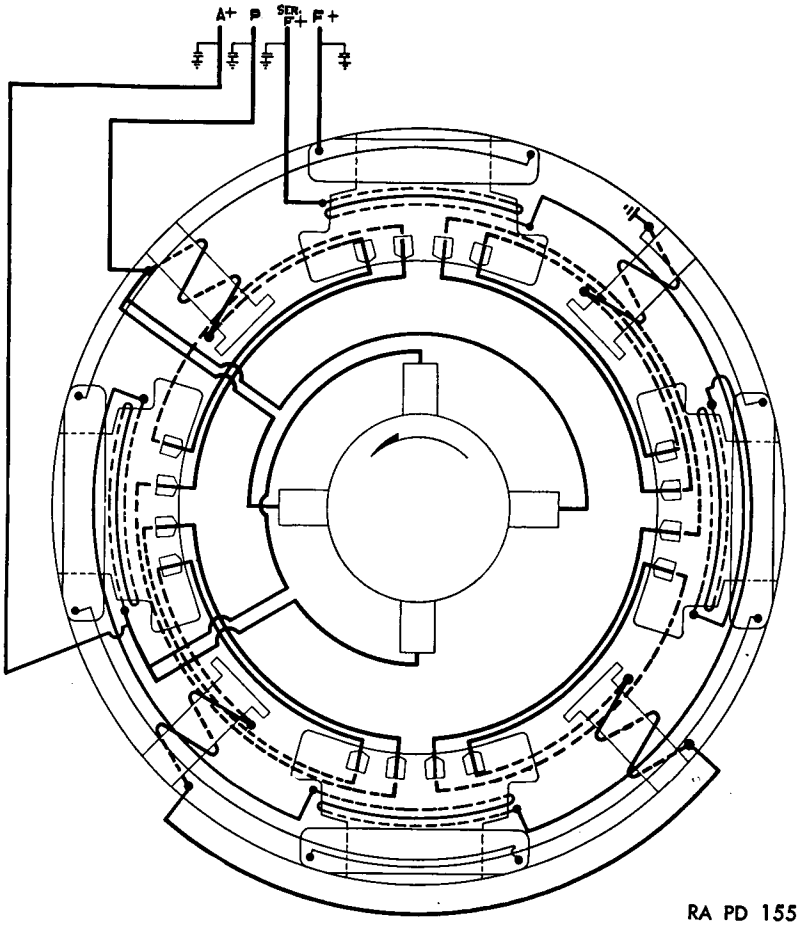


Figure 94. Generator internal wiring diagram.

outer race with fingers. If it turns hard or sticks in spots replace the bearing.

Caution: Do not attempt to flush or lubricate bearing.

105. Generator Assembly

a. If terminal studs of capacitors have been removed, they should be assembled. Insert a new terminal stud insulating bushing through hole in frame from inside and fasten with No. 10–32 x ⅝ mounting screw and lock washer (fig. 93). Insert terminal studs through insulating bushings from inside of frame. Fit coil connectors to terminal studs and secure each with ¼ x 28 brass nut and lock washer, except F + terminal which is a soldered connection (fig. 94). Insert capacitor insulator and capacitor in housing cup and thread the assembly on the terminal stud (fig. 93). Rotate housing cut to proper position; then tighten housing cup clamp screw.

b. Stand armature in upright position, shaft end up, on a smooth, clean surface. Use care not to damage coil insulation. Slip the armature bearing retaining inner plate over the shaft. Start armature ball bearing on shoulder of armature shaft with hand pressure; then, using a piece of pipe or tubing, with an inside diameter of 1⅞, drive the bearing on shoulder.

Caution: When driving on armature ball bearing, make certain that pressure is applied only to the inner race of the bearing.

c. Cut a piece of thin-backed No. 000 sandpaper approximately 2¼ x 18.

Caution: Do not use emery cloth. Wrap sandpaper around commutator in clockwise direction and secure the free end with a strip of cellophane tape.

d. If brush holders have been removed from end frame, they should be assembled, using new insulating washers, insulating sleeves, and insulating plate (fig. 93). Place new expansion plugs in position, partially flatten to lock them in position; then seal plugs around the edge with shellac or paint primer.

e. Assemble end frame to the armature by tapping it lightly over the armature ball bearing. Secure armature ball bearing with bearing retaining outer plate, bearing retaining plate screws, and lock washers (figs. 88 and 91).

f. Assemble brushes in brush holders with spring tension fingers.

g. Rotate end frame on armature in clockwise direction several revolutions to sand brushes to curvature of commutator. Inspect riding face of brushes to see if they are fully seated; if not, continue process until entire face indicates contact with sandpaper. Remove sandpaper from commutator.

h. Thread ¾–16 eye bolt into tapped hole in end of generator shaft. Insert hook of hoist in eye bolt and raise armature and end frame as an assembly and lower into frame and field coil using caution not to damage windings or insulation. Aline end frame with main frame (fig. 91) and secure in place with four ⅜–16 x 1¼ mounting bolts, lock washers, and flat washers.

i. Assemble four field leads (fig. 92) to their respective brush holders using four ¼–28 x ⅝ terminal bolts and lock washers (fig. 94).

j. Lay generator driving hub on bench, splines down, place thin washers on hub bolting bosses, and pilot six laminated driving disks onto hub with attaching bolt holes in alinement. Secure driving disks to hub with four spacers and four ⅜–24 x ⅞ bolts (par. 149).

k. Insert four ⅜–24 x ⅞ bolts with a spacer under head of each bolt in drive disk; then place a thin washer with dab of grease over each bolt. Insert drive hub-to-crankshaft long bolt through drive hub; then pilot long bolt, hub and disk into place at front end of generator armature (fig. 95). Start ⅜–24 x ⅞ bolts easily into armature so as to assure thin washers will not become separated from bolts.

l. Replace Woodruff key in generator shaft if removed. Slip generator fan onto shaft (fig. 88); then hold generator armature shaft from turning with nine-sixteenths hex plug wrench – 7950098 in fan splines and tighten ⅜–24 x ⅞ bolts (par. 149). Remove fan.

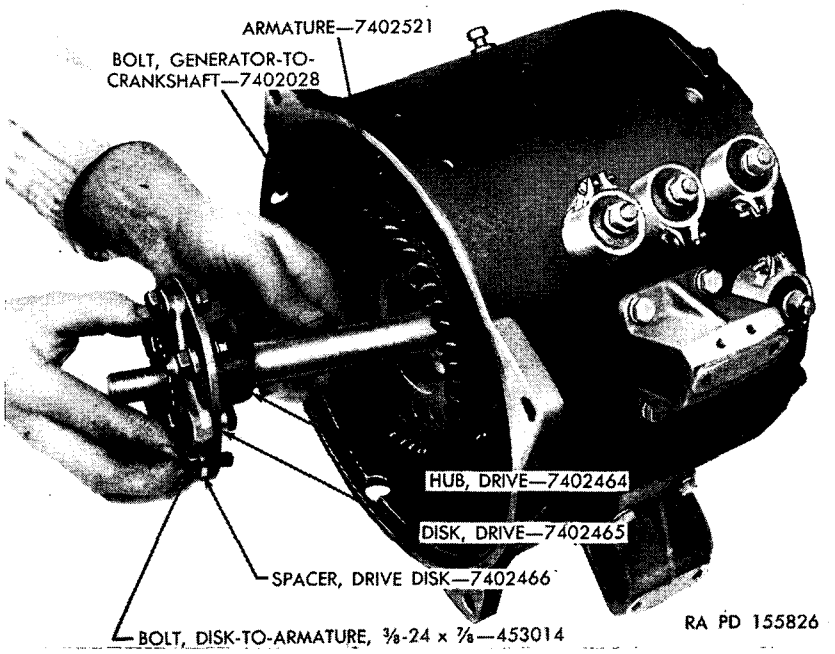


Figure 95. Installing generator drive hub-to-crankshaft bolt.

Section VI. ASSEMBLY OF ENGINE FROM SUBASSEMBLIES

106. Crankcase Tube Connector Installation

a. Set crankcase in upright position (fig. 96).

Caution: Use wood blocks under crankcase to prevent damage to bottom-cover mounting surface.

b. Install two three-eighths tube connectors in tapped holes at front top side of crankcase (fig. 97). Do not overtighten these connectors.

c. Install three-eighths tube connector in tapped hole at right top side of crankcase.

107. Crankshaft and Bearing Support Installation

a. Wrap masking tape around crankshaft gear. Apply engine oil to bearing journal at front end of crankshaft.

b. Pilot crankshaft into place (fig. 97).

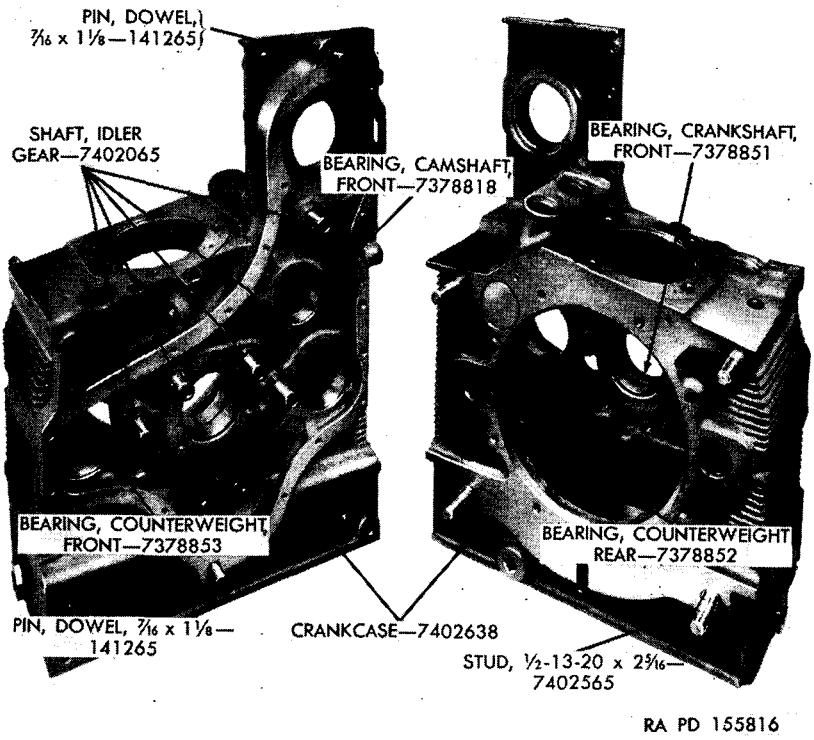


Figure 96. Crankcase.

c. Remove masking tape from crankshaft gear.

d. Insert crankshaft thrust plate in position with concave side facing toward crankcase and side marked "FRONT" away from crankcase. Secure thrust plate with two 5/16–18 x 3/4 bolts (fig. 98).

e. Rest crankcase on wood blocks, front side down. Affix gasket to rear main bearing support with engine oil (fig. 99). Straight edge of gasket must be alined with top of crankcase.

f. Install rear-main-bearing seal in groove provided in rear-main-bearing support (fig. 99).

g. Locate bearing support over bearing outer race with drain at bottom and top support part way on. Then secure bearing support in place with eight 3/8–16 x 1 1/8 bolts and lock washers. Draw down uniformly on bolts.

h. Raise crankcase to upright position. If binding of crankshaft is apparent, rap front end lightly with soft hammer to relieve binding.

108. Camshaft Installation

a. Apply engine oil to camshaft and camshaft bearings in crankcase.

b. Pilot camshaft into position in crankcase (fig. 5).

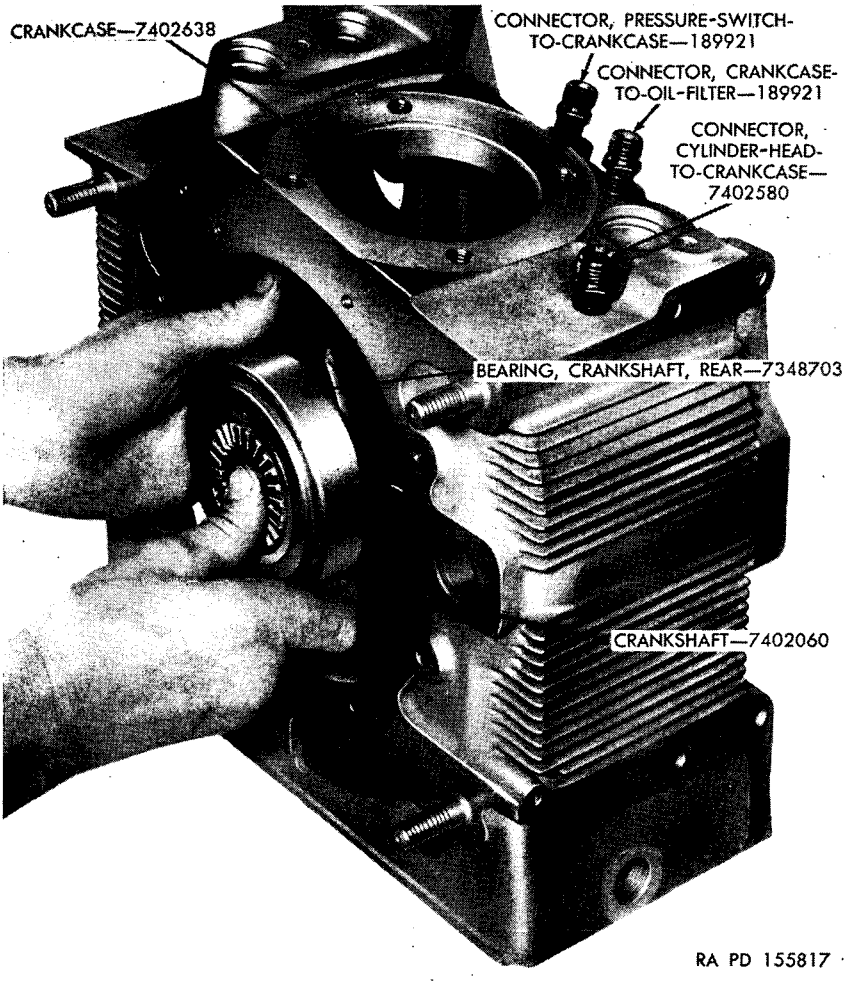


Figure 97. Installing crankshaft.

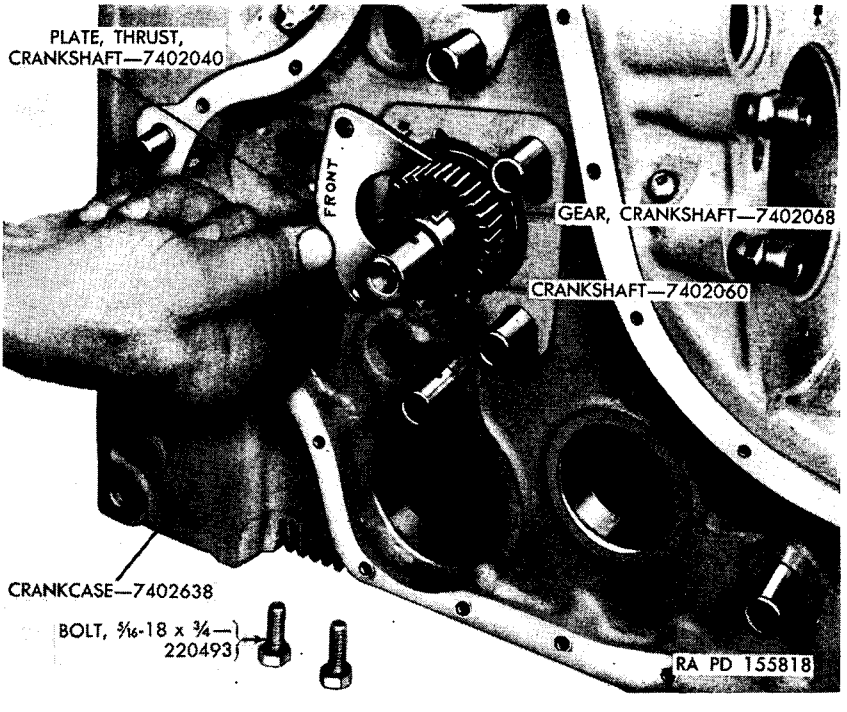


Figure 98. Crankshaft thrust plate installation.

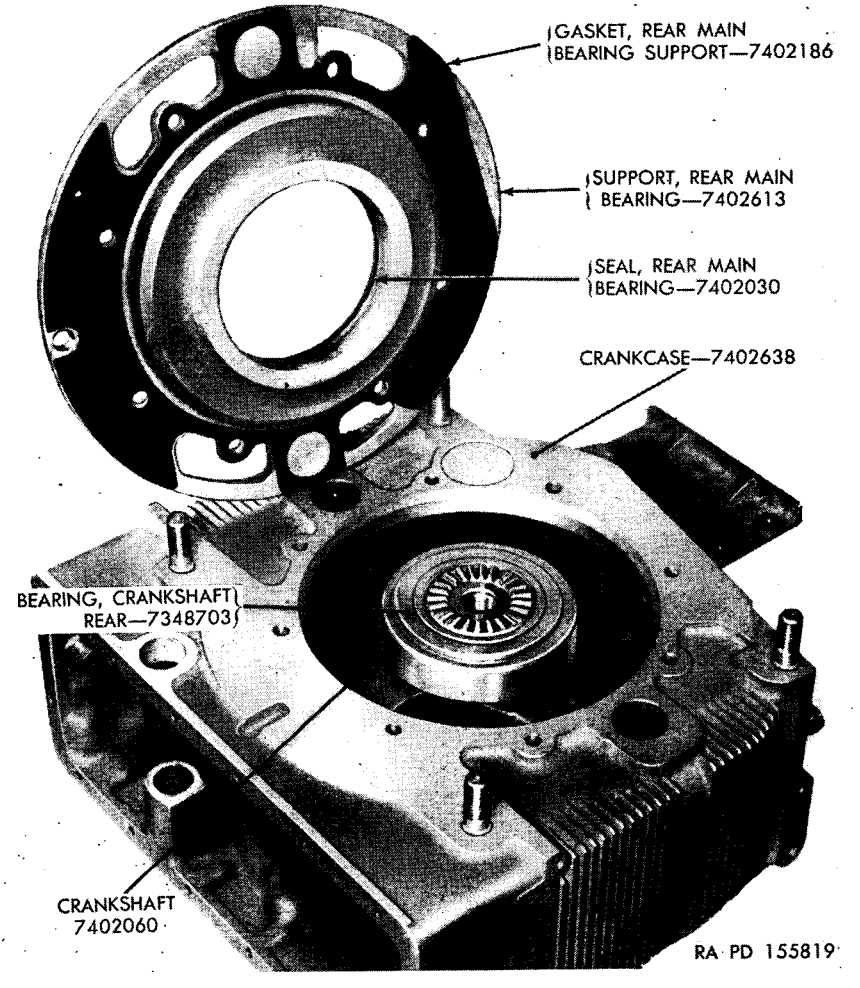


Figure 99. Crankshaft rear bearing support and gasket ready for assembly to crankcase.

109. Counterweight Installation

a. Apply engine oil to bearing surfaces and pilot primary counterweights into place in crankcase (fig. 5).

b. Install counterweights in same locations from which they were removed.

110. Oil Pump Installation

a. Position oil pump in place at front of crankcase (fig. 100).

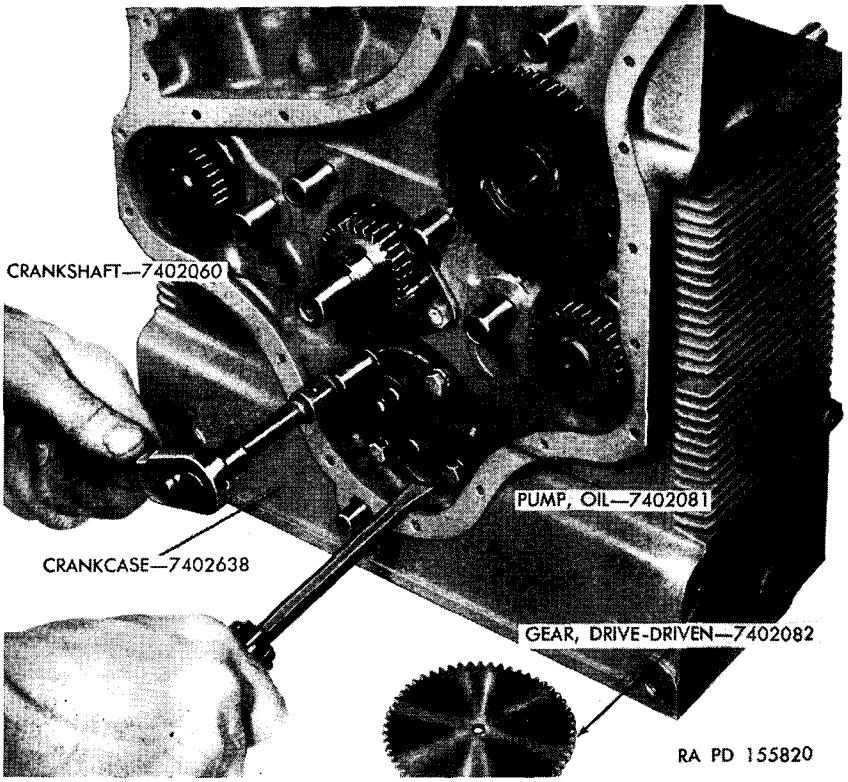


Figure 100. Attaching oil pump to crankcase.

b. Start four ¼–20 x 1⅜ oil pump retaining bolts with lock washers into tapped holes provided.

c. To obtain initial lash between oil-pump drive gear and crankshaft gear, raise oil pump with screwdriver while tightening four bolts (fig. 100).

d. Rotate oil-pump-drive-gear shaft until lock ball recess points up to top position; then slide oil-pump drive-driven gear onto shaft, making sure five-thirty-seconds diameter steel ball is in place.

e. Use wooden block to hold crankshaft while securing drive-driven gear with retaining nut to proper torque specification.

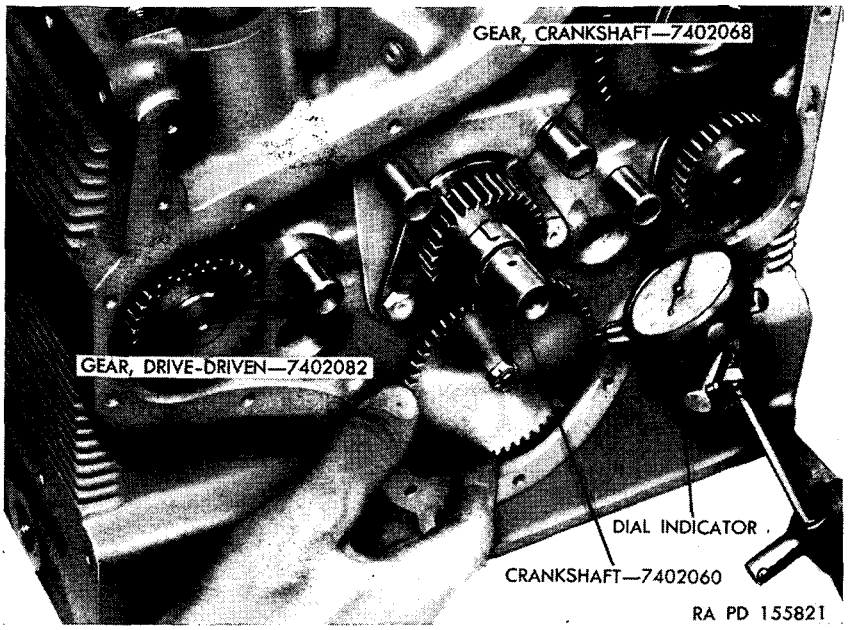


Figure 101. Checking back lash between oil-pump drive-driven gear and crankshaft gear.

f. Check gear back lash (fig. 101). If back lash is too tight, less than 0.002, remove drive-driven gear and adjust oil pump.

111. Timing Engine and Idler Gear Installation

a. Time engine by matching timing marks at crankshaft gear, both counterweight gears, and camshaft gear with marks on crankcase (fig. 102).

b. Apply engine oil to bearing surfaces and install five idler gears in same positions from which they were removed (fig. 102). Make sure wide shoulder of idler gears is toward crankcase.

Caution: Do not rotate gear train until after engine front cover and governor have been installed (pars. 113 and 114).

112. Starting Pulley Cam Installation

a. Apply engine oil on front end of crankshaft, aline keyway in starting pulley cam with Woodruff key and start extended hub end of cam true on end of crankshaft.

b. Slide a 1 1/16 ID x 1¼ OD x 1½ long sleeve over end of crankshaft and against cam. Place plain washer against sleeve, thread ⅜–24 x 1½ bolt into tapped end of crankshaft; then with block of wood inserted through cylinder port to prevent crankshaft from turning, draw cam starting pulley tight against crankshaft gear (fig. 103).

Caution: Do not drive starting pulley cam into place.

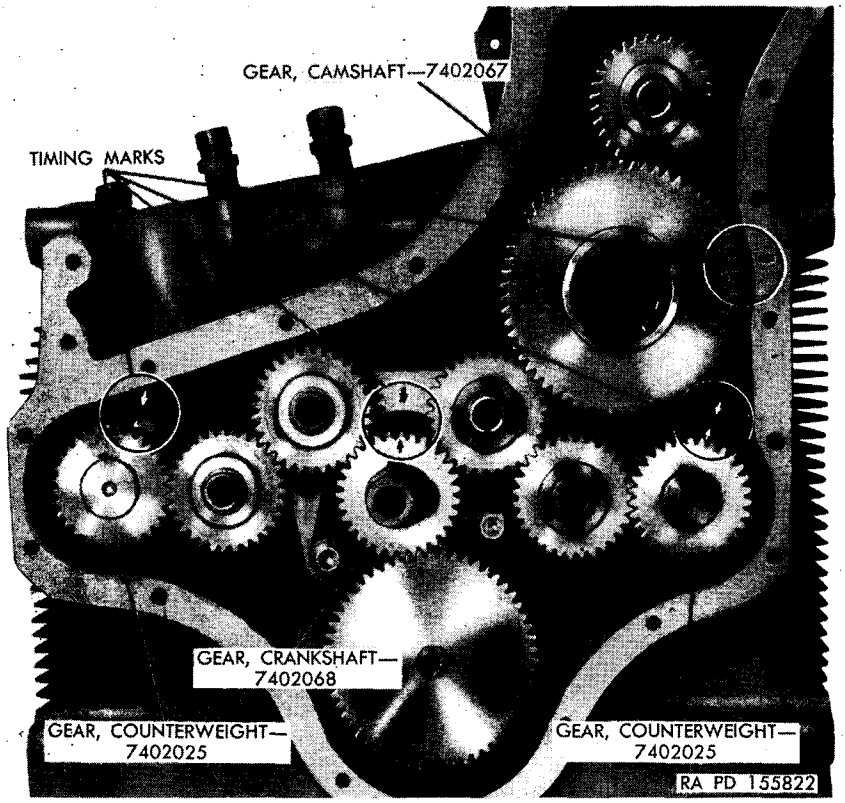


Figure 102. Engine timing diagram.

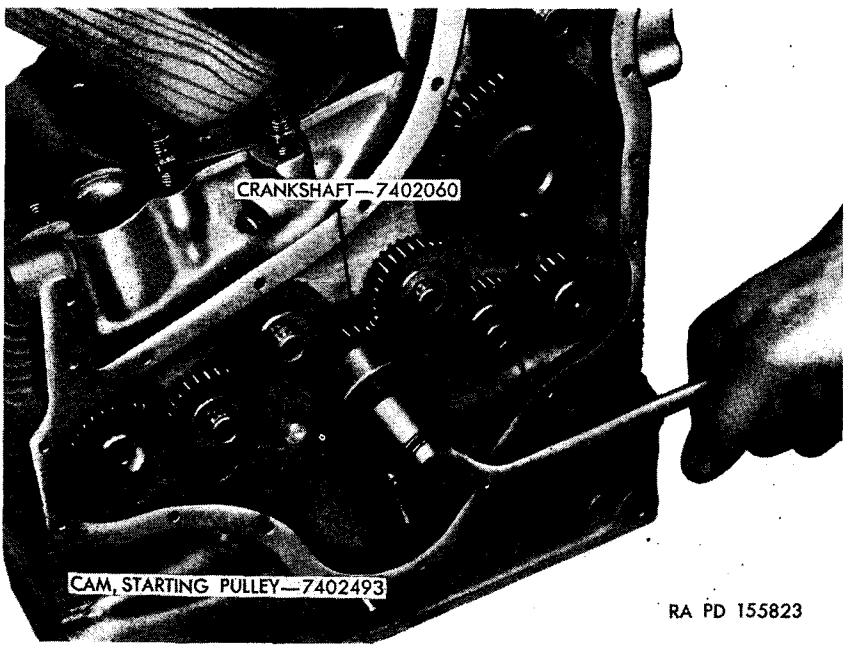


Figure 103. Installing starting pulley cam on front end of crankshaft.

113. Engine Front Cover Installation

a. Apply engine oil to all gear surfaces and install new front cover gasket to engine crankcase (fig. 34).

b. Check timing mark location and locate front cover on two dowels (fig. 43).

c. Secure front cover to crankcase with sixteen ¼–20 x 1⅛ bolts and washers (fig. 43).

114. Governor Installation

a. Use new gasket and mount governor in position at front side of crankcase with timing mark on governor drive gear in alinement with lower timing pin in crankcase (fig. 104). Timing pin on governor drive gear and timing pins in crankcase are easily observed through timing hole provided in side of crankcase (fig. 104).

b. Secure governor to crankcase with one ¼–20 x 1⅛ bolt and three ¼–20 x 1¾ bolts and one-quarter washers. Do not install two ¼–20 x 2 bolts and one ¼–20 x 1 screw at this time which secure oil filter to

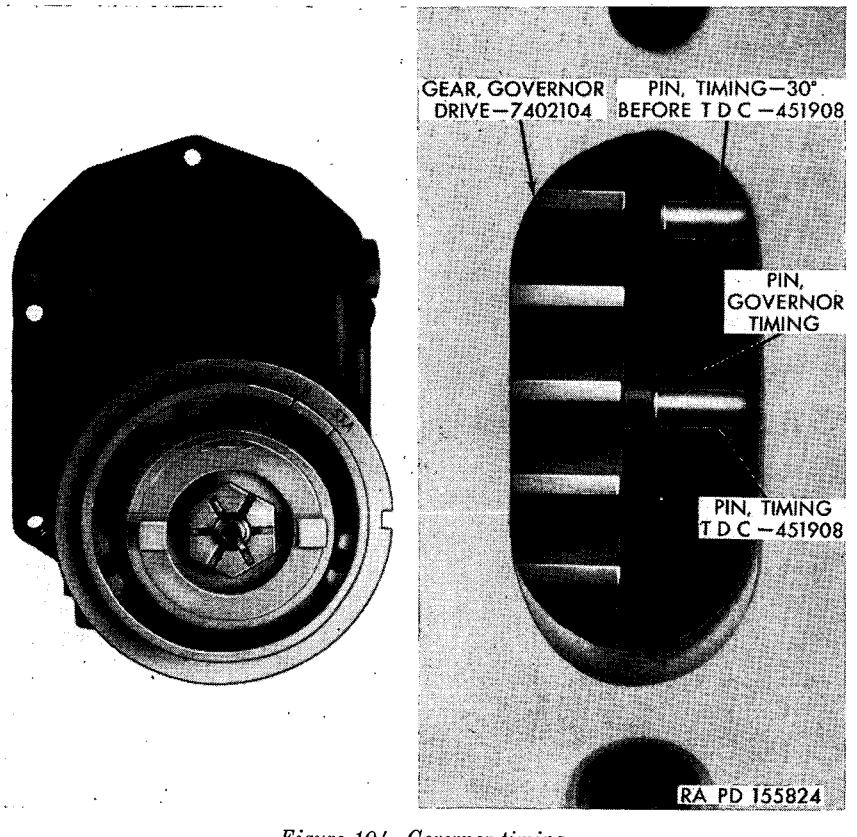


Figure 104. Governor timing.

engine (fig. 19). Engine may not be rotated without disturbing timing.

c. Install seal on starting pulley hub (fig. 34).

d. Apply engine oil to seal and outer diameter of starting pulley hub. Slide hub and seal over end of crankshaft, rotating hub at same time to ease seal into bore of cover without injury (fig. 3).

e. Secure starting hub to crankshaft with a ⅜–24 x ¾ bolt and plain washer (fig. 34). Draw bolt tight (par. 149).

f. Install starting pulley hub cap and gasket and secure with six ¼–28 x 7/16 bolts and lock washers (figs. 34 and 43).

115. Hydraulic Valve Tappet and Push-rod Cover Tube Installation

a. Apply engine oil to hydraulic valve tappets and slide tappets into crankcase with oil hole up (figs. 4 and 46).

b. Lubricate push-rod-cover-tube seals and install them in counterbores of crankcase (fig. 4). Insert cover tubes through seals and into position in counterbores (fig. 4).

c. Slide cover-tube clamp over tubes and secure in place with one 5/16–18 x ⅝ bolt and washer (fig. 41).

116. Piston, Connecting Rod and Cylinder Installation

Caution: When handling piston, rod and cylinder, care should be taken to prevent connecting rod from hitting cylinder walls.

a. Rotate crankshaft until connecting rod journal is in lowest position.

b. Remove connecting-rod-bearing cap and lower bearing half (fig. 64). Install rubber seal ring over lower end of cylinder (fig. 42).

c. Place lower cylinder baffle retainer in position on top of crankcase, flat side to rear (fig. 42).

d. Lay crankcase on left side, properly blocked (fig. 42). Position piston connecting rod and cylinder over cylinder port opening in crankcase with lubricating oil hole in connecting rod facing away from camshaft. Assemble connecting-rod-bearing cap and lower bearing half to rod, making certain bearing insert tangs are on same side of rod. Tighten bearing cap bolt nuts (par. 149).

117. Crankcase Bottom Cover and Oil Float Installation

a. Secure crankcase oil screen to crankcase with four No. 10–24 x 5/16 screws.

b. Slide shaft of oil float into bearing boss at bottom of crankcase (fig. 39).

c. Affix new gasket to bottom of crankcase (fig. 39). Secure bottom cover to crankcase with sixteen ¼–20 x 1 bolts and washers (fig. 38).

Note. Gasket and cover can be assembled in one way only.

d. Install crankcase-bottom-cover plugs and gaskets and drain plugs at sides and rear of crankcase (fig. 38).

118. Cylinder Head Installation

a. Set engine in upright position. Secure intake baffle to crankcase (fig. 29) with three ¼–28 x ½ screws and lock washers.

b. Place exhaust baffle around lower cylinder retainer (fig. 29) and secure in place with one ¼–28 x 3½ bolt, ¼–28 nut, lock washer, and bolt spacer at push rod side and one ¼–28 x 1½ bolt, ¼–28 nut, lock washer, and bolt spacer at opposite side.

c. Install upper cylinder baffle retainer with wide side toward governor and flange down (fig. 41).

d. Locate cylinder head over cylinder (fig. 41); start push-rod tubes through upper tube seals in cylinder head and lower head into place on upper cylinder baffle retainer.

e. Secure cylinder head to crankcase with four 7/16–14 x 8 7/32 bolts and washers (fig. 40). Tighten cylinder head bolts in crisscross sequence (fig. 105) (par. 149).

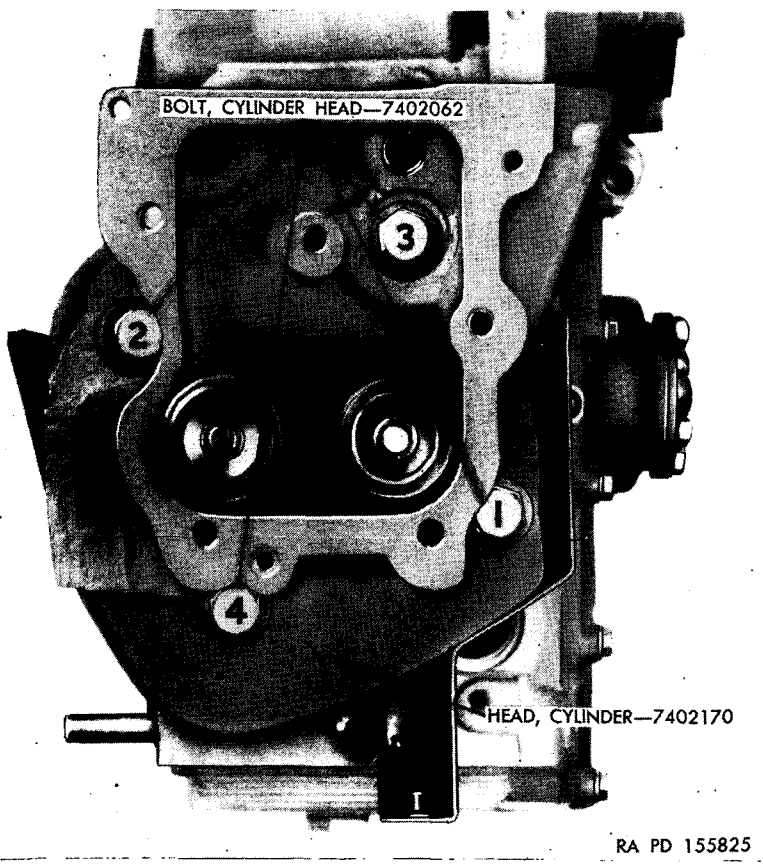


Figure 105. Cylinder head bolt tightening sequence.

Caution: First tighten each bolt to 2 lb-ft torque; then tighten all four bolts in increments of 5 lb-ft torque in accordance with tightening diagram (fig. 105) until a total of 27 lb-ft roque has been obtained.

f. Apply sealing compound to and install ¾-inch aluminum pipe plug in tapped hole in top of cylinder head (fig. 40).

g. Install spark plug (fig. 24).

h. Install drain-tube connector in cylinder head; then connect drain tube to connectors at head and crankcase (figs. 4 and 15).

119. Rocker Arms and Rocker-arm Cover Installation

a. Insert valve push rods in push-rod cover tubes with small ball end up (figs. 4 and 40).

b. Position rocker-arm-cover gasket in place on cylinder head (fig. 40).

c. Lower rocker-arm cover (fig. 40) into place, making sure rocker arms properly contact rocker-arm push rods. Secure rocker-arm cover to cylinder head with two 5/16–18 x 2½ bolts and three 5/16–18 x 2¾ bolts and five five-sixteenths washers. A copper gasket is used with bolt at center of cylinder head while lock washers are used with four remaining bolts (fig. 76).

Section VII. INSTALLATION OF ACCESSORIES ON ENGINE

120. Fuel Pump Installation

a. Insert two ¼–20 x ⅞ bolts with lock washers under bolt heads through fuel-pump bolt holes and slide new gasket over bolts (fig. 25).

b. Secure fuel pump to crankcase (fig. 25) and tighten bolts.

121. Magneto Installation

a. Rotate engine until pin on governor drive gear is in line with lower pin on crankcase (fig. 104).

b. Remove nut from clamp bolt and slide clamp over flange on rear face of crankcase with bolt of clamp on top and thread end facing out (fig. 24).

c. Install fiber magneto-drive coupling with notches in coupling matching bosses of magneto drive gear.

Note. Coupling will fit in one position only.

d. Time the magneto before installing on engine. Rotate coupling end of magneto clockwise past impulse; then rotate coupling counterclockwise until arrow on coupling is at top dead-center (TDC) (fig. 104).

e. Affix gasket to flange of magneto with small amount of cup grease and position magneto (fig. 24) with bosses on drive in line with notches in coupling. Then, while holding magneto in position, slide clamp

back over flange of magneto. Make sure the lug on clamp is in line with notch of magneto flange. Then install and tighten nut on clamp bolt, making sure magneto vent elbows will clear side panel.

f. Install two 90-degree elbows in side on magneto (fig. 24).

g. Connect spark-plug cable to spark plug (fig. 24).

122. Oil Filler Pipe Installation

a. Place seal ring on oil filler pipe; then lower oil filler pipe into place in crankcase (fig. 27).

b. Secure oil filler pipe to crankcase with clamp, washer (concave side down), lock washer and 5/16–18 x 1⅛ bolt. Do not tighten bolt until vent tube from filler pipe-to-carburetor has been installed (par. 127).

123. Generator Installation

a. Rest crankcase on front face properly blocked (fig. 32).

b. Thread a ¾–16 eyebolt into tapped end of armature shaft and lower generator into place (fig. 28), piloting four stud holes in generator frame onto studs. At the same time rotate armature to insure splines in generator driving hub come into mesh with splines at rear of crankshaft (fig. 3).

c. Draw generator drive hub bolt snug, using nine-sixteenths hex plug wrench 7950098 (fig. 30). Start four ½–20 generator-to-crankcase nuts with lock washers (fig. 5) by hand; then tighten nuts (par. 149). Tighten drive hub bolt (par. 149).

d. Secure shroud to generator with five ¼–20 x ½ screws and lock washers (fig. 16).

e. Secure diffuser to generator frame with four ⅜–16 x ½ bolts (fig. 32). Make sure diffuser pilots over generator rear frame and that elongated hole in outer flange of diffuser is at top for mounting of regulator.

f. With crankcase bottom cover resting on wood blocks upend engine and generator (fig. 106), and secure baffle support to generator frame with three ⅜–24 x ⅝ bolts and lock washers and three ¼–20 x ½ screws and washers. Engine and generator can now be mounted on a stand or dolly for further assembly operations.

g. Install key in armature shaft (fig. 3) and aline with keyway in fan hub. Slide generator-impeller fan onto armature shaft (fig. 3) and secure fan to shaft with washer and ¾–16 x 2 socket head bolt (par. 149).

124. Generator Regulator Installation

a. Position generator regulator on generator frame (fig. 23), and secure regulator support to generator with two 5/16–24 x 9/16 bolts and lock washers.

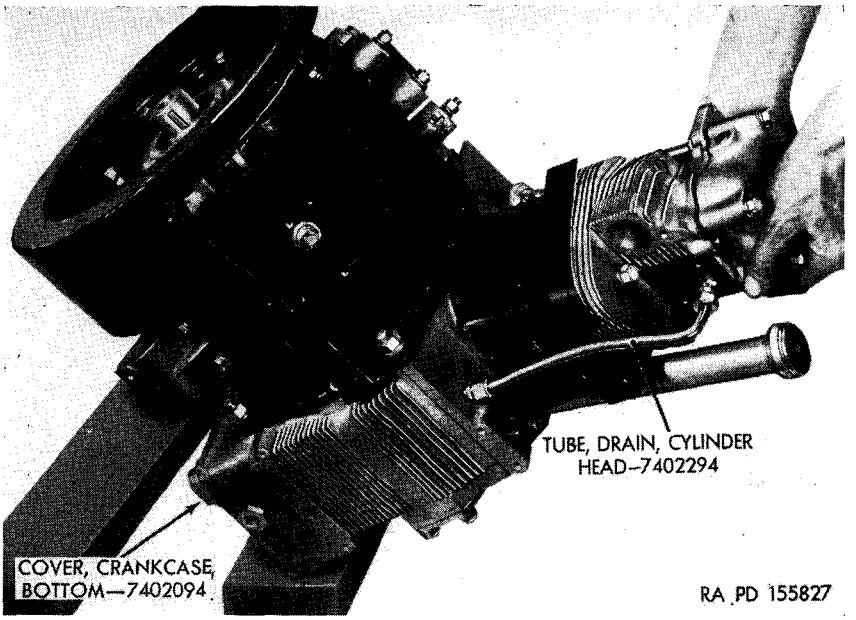


Figure 106. Raising engine and generator to upright position.

b. Secure rear shroud panel to generator diffuser with four ¼–20 x ½ screws with external tooth washers (figs. 2 and 16). Upper ¼–20 x ½ screw also supports rear of generator regulator.

125. Cylinder Baffles Installation

a. Locate intake and exhaust baffles at intake and exhaust sides of cylinder head respectively (figs. 15 and 107).

b. Install carburetor-to-magneto vent tube, magneto-to-ventilator-valve-housing vent tube, and fuel-pump-to-carburetor tube in magneto cover. Then secure magneto cover to baffle support with two ¼–20 x ½ screws and lock washers (figs. 16 and 18).

c. Slide cylinder top baffle plate down over rocker-arm cover and secure plate to the cylinder head, magneto cover and intake and exhaust baffles with ten ¼–20 x ½ screws and lock washers (figs. 15 and 107).

126. Top Panel Installation

a. Secure rheostat to under-side of top panel with two ¼–20 x ½ screws (fig. 108).

b. Secure air-heater relay and starter relay to top panel with two ¼–20 x 5/16 bolts, lock washers, and nuts (fig. 108).

c. Secure control-switch receptacle to top panel with four No. 10–24 x ½ screws, lock washers, and nuts (fig. 108).

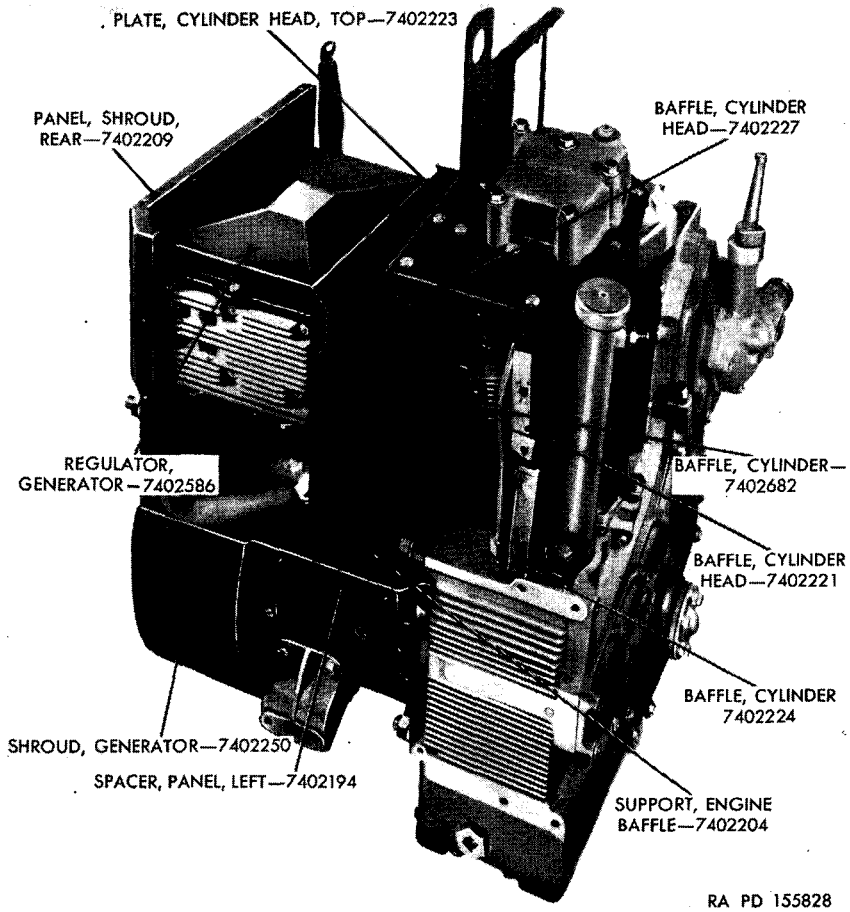


Figure 107. Partial installation of engine baffles and cables.

d. Place top panel in position (fig. 108), and secure to baffle support with three ¼–20 x ½ screws and washers and to rear shroud panel with one ¼–20 x ½ screw and lock washer (fig. 109).

e. Feed cables 487 and 420 (fig. 110) with grommet through hole in cylinder exhaust baffle. Removal of spark plug cover will facilitate entering these cables.

127. Oil Pressure Switch and Oil Filter Installation

a. Mount oil-pressure-switch bracket loosely to crankcase with two ¼–20 x ⅝ bolts and lock washers (fig. 26).

b. Install oil pipe between connector at crankcase and tee at top of pressure switch (figs. 9 and 19).

c. Connect filter-to-pressure switch tube to tee at pressure switch and connect crankcase-to-filter tube to crankcase but do not tighten tube nuts (fig. 19).

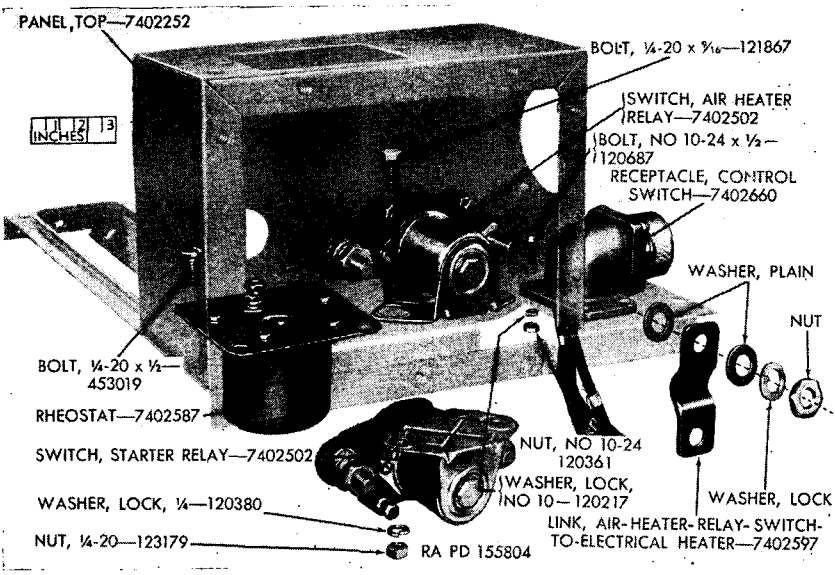


Figure 108. Location of air-heater and starter relays.

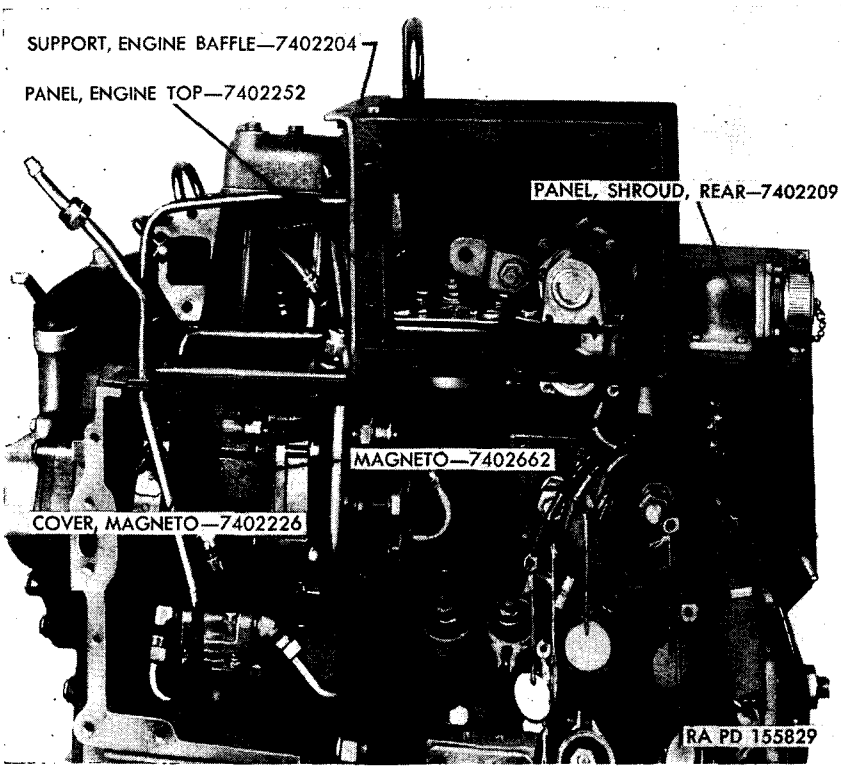


Figure 109. Fuel tubes, relays, and top panel installed.

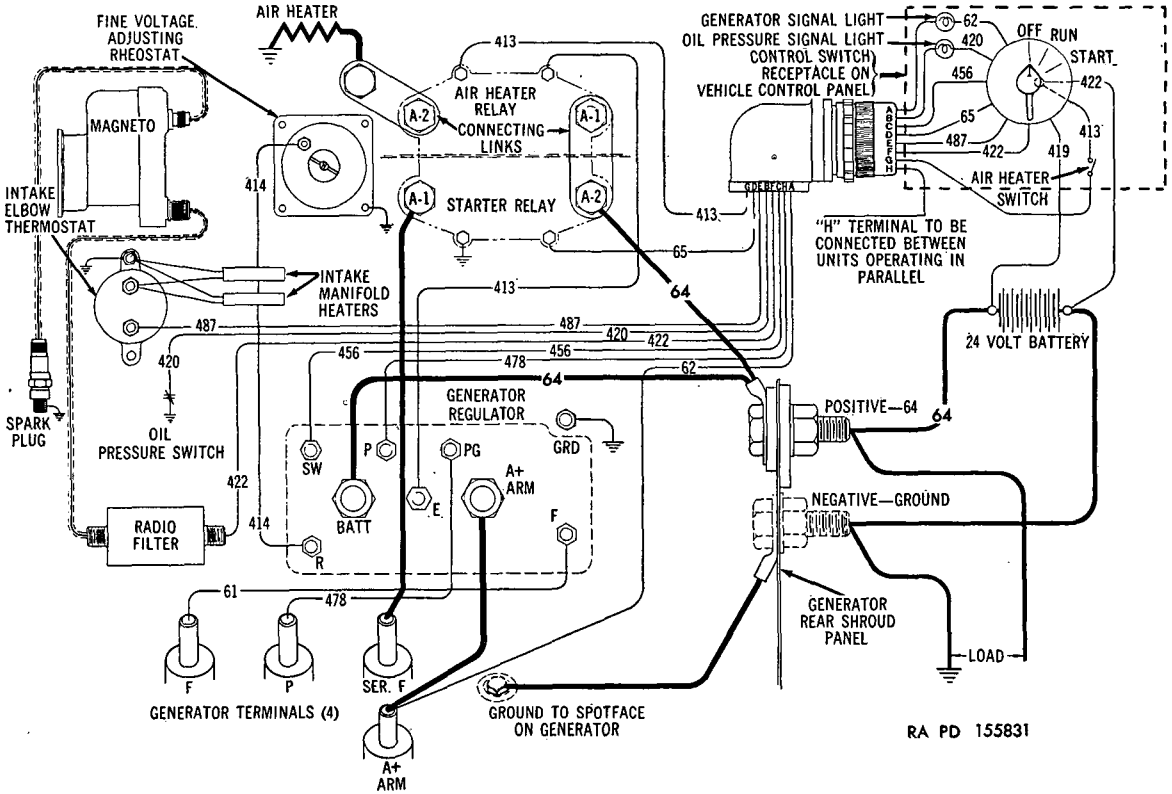


Figure 110. Auxiliary generator and engine wiring diagram.

d. Support oil filter with one hand in approximate mounting position (fig. 19) and start crankcase-to-filter-tube nut and filter-to-pressure-switch-tube nut to elbow at top and connector at bottom of oil filter respectively.

e. Secure oil filter to engine with two ¼–20 x 2 bolts and plain washers and one ¼–20 x 1 screw (fig. 19). The two ¼-20 x 2 bolts also serve to secure the governor to engine.

f. Tighten filter-to-pressure-switch-tube nuts and crankcase-to-filter-tube nuts; then tighten oil pressure switch bracket bolts (figs. 19 and 26).

128. Carburetor Installation

a. With new gasket in place at cylinder head, start lower 5/16–18 x 1¼ bolt with lock washer and plain washer into cylinder head (figs. 4 and 111).

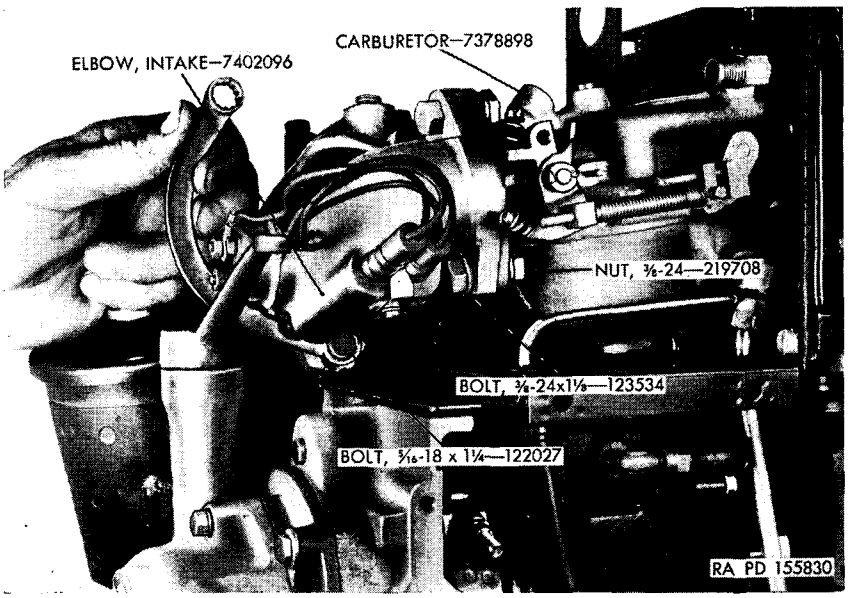


Figure 111. Tightening lower carburetor-intake-elbow bolt.

b. Lower carburetor and intake elbow into position (fig. 111) so that slot of intake-elbow flange alines with lower 5/16–18 x 1¼ intake-elbow bolt. It may be necessary to loosen the magneto cover at top baffle and readjust to facilitate carburetor installation.

c. Connect carburetor-to-magneto-vent-tube nut, magneto-to-ventilator-valve-housing-vent-tube nut, and fuel pump-to-carburetor-tube nut to carburetor (fig. 18).

d. Install upper 5/16–18 x 1¼ carburetor-intake-elbow bolt, lock washer, and plain washer (fig. 4). Then tighten both intake elbow bolts.

e. Install fuel-pump-to-carburetor tube (fig. 18).

f. Install carburetor-to-crankcase-vent tube (fig. 18).

g. Position fuel filter and bracket to engine front cover and secure in place with three ¼–20 x ½ screws and lock washers (fig. 17).

h. Install filler-pipe-to-ventilator-valve-housing tube (figs. 18 and 27).

i. Install fuel-filter-to-pump tube, inserting rubber grommet in magneto cover (fig. 17). Connect fuel-filter inlet tube to filter.

j. Connect carburetor-to-governor link (fig. 18) to governor operating lever.

129. Exhaust Manifold Installation

a. Connect cable between generator ground and right side of generator rear shroud panel (figs. 16 and 110). When installing ground cable to rear shroud panel, first slide large hole of cable over one-half bolt followed by lock washer; then insert bolt through panel from generator side and secure to panel with lock washer and nut.

b. Install carburetor intake tube and secure to top panel with four ¼–20 x ½ screws and lock washers (figs. 21 and 22).

c. Slide intake tube hose into place and tighten hose clamps (figs. 21 and 34).

d. Use new exhaust pipe gasket and secure exhaust pipe to cylinder head.

e. Place engine right panel and right panel spacer into position and secure to generator, baffle support, rear shroud panel, and cylinder exhaust baffle with sixteen ¼–20 x ½ screws and lock washers (figs. 15 and 16). Do not install five ¼–20 x ½ screws which secure the exhaust manifold cover to right panel or the two ¼–20 x ½ screws which secure heat exchanger to right panel at this time.

f. Install exhaust manifold over exhaust pipe; then assemble heat exchanger to exhaust manifold and lower heat exchanger into position (figs. 15 and 16). Secure heat exchanger to baffle support and rear shroud panel with four ¼–20 x 6¼ screws and to engine right panel with two ¼–20 x ½ screws and lock washers (figs. 1 and 35).

g. Secure exhaust manifold cover to right panel with five ¼–20 x ½ screws and lock washers and to heat exchanger with four ¼–20 x ½ screws and lock washers (fig. 15).

130. Connect Cables

Note: Refer to table III for circuit numbers and to figure 110 for wiring diagram.

a. Connect air heater to air-heater relay first by placing insulator in sheet metal opening. Install ⅜–16 x 2½ bolt, washer, and lock washer through connecting link. Place over the bolt the retaining spring and spacer. Insert bolt, spring, and spacer into threads of

Table III. Circuit Numbers

No.	Auxiliary generator and engine
61	Generator "F" terminal to generator-regulator "F" terminal.
62	Generator "A +" terminal to control-switch-receptacle "A" terminal to generator signal light to auxiliary-generator switch.
64	Generator regulator "BATT" terminal to battery positive (+) terminal and starter-relay "A–2" terminal.
65	Starter relay to control-switch-receptacle "D" terminal to auxiliary-generator switch.
413	Generator-regulator "E" terminal to air-heater relay to control-switch-receptacle "G" terminal to air-heater switch to auxiliary-generator switch.
414	Generator regulator "R" terminal to voltage-adjusting rheostat.
419	Battery to auxiliary-generator switch.
420	Oil pressure switch to control-switch-receptacle "B" terminal to oil-pressure signal light to auxiliary-generator switch.
422	Radio filter to control-switch-receptacle "F" terminal to auxiliary-generator switch to battery.
456	Generator-regulator "SW" terminal to control-switch-receptacle "C" terminal to auxiliary-generator switch.
478	Generator "P" terminal to generator-regulator "PG" terminal to generator-regulator "P" terminal to control-switch-receptacle "H" terminal.
487	Carburetor-intake-elbow thermostat to control-switch-receptacle "E" terminal to auxiliary-generator switch.

air heater and tighten to 8 to 10 lb-ft torque and at same time start other end of connector over "A2" terminal of air-heater relay and tighten to 8 to 10 lb-ft torque (fig. 110).

b. Connect generator-to-regulator cable (cable 61) to "F" terminal on generator and "F" terminal on generator regulator (fig. 110).

c. Connect generator-to-regulator cable (cable 478) to "P" terminal on generator and "PG" terminal on generator regulator (fig. 110).

d. Connect generator-to-regulator cable to "A+" terminal on generator and "A+" terminal on generator regulator (fig. 110).

e. Connect regulator-to-air-heater-relay cable (cable 413) to "E" terminal on generator regulator (fig. 110).

f. Connect regulator-to-control-switch-receptacle cable (cable 478) to "P" terminal on generator regulator (fig. 110).

g. Connect regulator-to-voltage adjusting rheostat cable (cable 414) to "R" terminal on generator regulator (fig. 110).

h. Connect regulator-to-control switch receptacle cable (cable 456) to "SW" terminal on generator regulator (fig. 110).

i. Secure radio filter to generator left mounting bracket with two ¼–20 x ½ screws and lock washers (fig. 21).

j. Connect radio filter to control switch receptacle cable (cable 422) to left side of radio filter (figs. 21 and 110).

k. Connect generator-to-starter-relay cable to "A–1" terminal on

the starter relay and to "SER-F" terminal on generator (figs. 21 and 110).

l. Connect terminal-block-to-regulator cable to "BATT" terminal generator regulator (figs. 21 and 110).

m. Connect terminal-block-to-starter-relay cable to "A-2" terminal of starter relay (figs. 21 and 110).

n. Connect thermostat-to-control-switch-receptacle cable (cable 487) to lower terminal of intake elbow thermostat (figs. 20 and 110).

o. Connect oil-pressure-switch-to-control-switch-receptacle cable (cable 420) to oil pressure switch (figs. 26 and 110).

p. Install magneto-to-radio-filter cable (figs. 21 and 110).

q. Connect ground cable to "GRD" terminal of generator regulator and rear shroud panel (fig. 110).

r. Connect terminal-block-to-regulator cable to rear shroud panel keeping cable in vertical position (figs. 21 and 110). First slide end of cable over ½–13 x 2 bolt; then insert bolt through insulator in panel and secure with flat washer and nut (fig. 21).

s. Secure lower-left panel and left-panel spacer to rear shroud panel and crankcase with ¼–20 x ½ bolts and lock washers (fig. 16).

t. Secure upper-left panel to rear shroud panel, top panel, magneto cover, fuel-filter bracket and crankcase with eighteen ¼–20 x ½ bolts and lock washers (fig. 16).

u. Secure front panel to left and right panels with four ¼–20 x ½ bolts and lock washers (fig. 15).

v. Install spark plug cover (fig. 15).

w. Secure carburetor guard to support baffle and fuel-filter bracket with four ¼–20 x ½ bolts (fig. 16).

x. Secure timing hole cover and gasket to crankcase with two ¼–20 x ½ bolts and washers (fig. 16).

y. Secure rheostat adjusting hole cover to upper-left panel with two ¼–20 x ½ bolts and washers and secure magneto adjusting hole cover to top panel with two ¼–20 x ½ bolts and washers (fig. 16).

Section VIII. TESTS AND ADJUSTMENTS

131. General

The procedures set forth in the following paragraphs will be performed after a generator and engine is rebuilt. The run-in test is to be performed prior to the release of the generator and engine for use in vehicles or forwarding to supply channels.

132. Requirements for Run-in Test

a. Purpose of Run-in. The purpose of an engine and generator run-in test of a rebuilt unit is to break in new parts; to detect deficiencies such as leaks or faulty assembly; to make final adjustments;

and to determine that the engine and generator will operate satisfactorily.

b. TYPE OF RUN-IN. The run-in schedules set forth in table IV (par. 135), are not to be construed as engineering or experimental laboratory procedures but rather as production methods for accomplishing those purposes set forth in *a* above. The adherence to these procedures will insure consistent reliability of units in military equipment commensurate with ordnance rebuild standards.

c. LENGTH OF RUN. The length of run required to break in the generator and engine unit is dependent upon the type of engine, the production tolerances maintained in the rebuild operation, and the type of replacement parts used in the case of rebuilt engines, the run-in procedure, and the type of ultimate service which will be imposed upon the new or rebuilt engine.

d. LOAD. During the break-in runs set forth herein, the load on the unit may be varied at will. This load may be imposed by use of the generator of the unit or by any other loading device which is equipped with instruments or devices to measure the varied loads and speeds imposed on the engine under test.

e. COOLING. Adequate provision must be made for cooling the engines during the break-in run. These units require unrestricted supplies of cooling air. Precautions must also be taken to provide adequate exhausting of the heated air. Recirculation of air must be prevented except under extreme low operating temperature conditions. Prevention of recirculation may require the use of false walls or partitions.

f. AIR INDUCTION SYSTEM. The air induction system must be so designed that recirculation of exhaust gases will be prevented. The air intake must provide the engine with fresh air, free from dust or contaminants resulting from nearby processing, manufacturing, painting facilities, or road dust.

g. EXHAUST SYSTEM. The exhaust system must be so arranged that back pressure will not exceed normal vehicular conditions. To accomplish this, the exhaust piping must be as short as possible and free from restrictions caused by sharp turns or reductions in piping diameter. Where required, silencers are permitted, provided back pressures are not introduced which would exceed vehicular conditions.

Caution: To prevent harmful, corrosive, and toxic vapors from returning to engines operated on common exhaust systems which are constructed to accommodate two or more engines, each engine will be disconnected from the exhaust system immediately after shut down. A cut-off valve for each individual engine-exhaust-lead-to-main-header pipe is required.

h. FUEL. Separate tanks must be provided for leaded and unleaded gasoline fuels. When installing test stands, provisions will be made for storage of unleaded gasoline in quantities commensurate with

procurement deliveries. These engines will be run-in on fuel conforming to Specification MIL–G–3056 with a minimum octane rating of 80 under lean-mixture conditions. This fuel is available through channels from the Quartermaster Corps.

i. OIL. These wet-sump engines will not require an external oil system. Oil-consumption data will be obtained from readings of bayonet-type gages. Magnetic-type drain plugs may be used for test purposes. Crankcases must be cleaned after test runs to insure removal of particles normally associated with engine rebuild and run-in. Engines will be operated on oil conforming to the latest revision to Specification MIL–O–2104, and of the grade prescribed for the engine for use between +40° and −10° F.

Note. Unsatisfactory operation with prescribed oil must be reported to Office, Chief of Ordnance, Washington 25, D. C., ATTENTION: ORDFM-Auto, for engineering consideration.

133. Preliminary Procedures

a. GENERAL. Install generator and engine unit on a suitable test stand in an adequately ventilated area (figs. 112 and 113).

Caution: To prevent serious damage to magneto, generator regulator, radio filter, or air intake heater, connect cables to proper terminals only and do not ground any cables unless instructed to do so by the procedures outlined herein.

b. SET-UP OF GENERATOR AND ENGINE UNIT.

(1) *Make test connections.*

(*a*) Connect positive battery cable (cable 64) to positive (+) terminal on rear shroud panel and connect negative battery (ground) cable to negative (−) terminal on rear shroud panel (fig. 113).

(*b*) Connect fuel inlet line to fuel filter (figs. 112 and 113).

(*c*) Connect air intake to carburetor and to air filter (figs. 112 and 113).

(*d*) Connect exhaust port to exhaust stack (figs. 112 and 113).

(*e*) Connect auxiliary control cable from instrument panel to control-switch receptacle at rear of engine (fig. 113).

(2) *Connect test instruments.*

(*a*) Place wet- and dry-bulb thermometers (psychrometer) near the test stand.

(*b*) Remove one-fourth plug from rocker-arm cover (fig. 76), install fitting, and connect crankcase manometer (fig. 113).

(*c*) Remove spark plug and gasket and connect spark-plug thermocouple. Install spark plug gasket and spark plug (figs. 112 and 113).

(*d*) Remove magnetic plug from crankcase bottom cover and connect oil sump thermocouple (fig. 113).

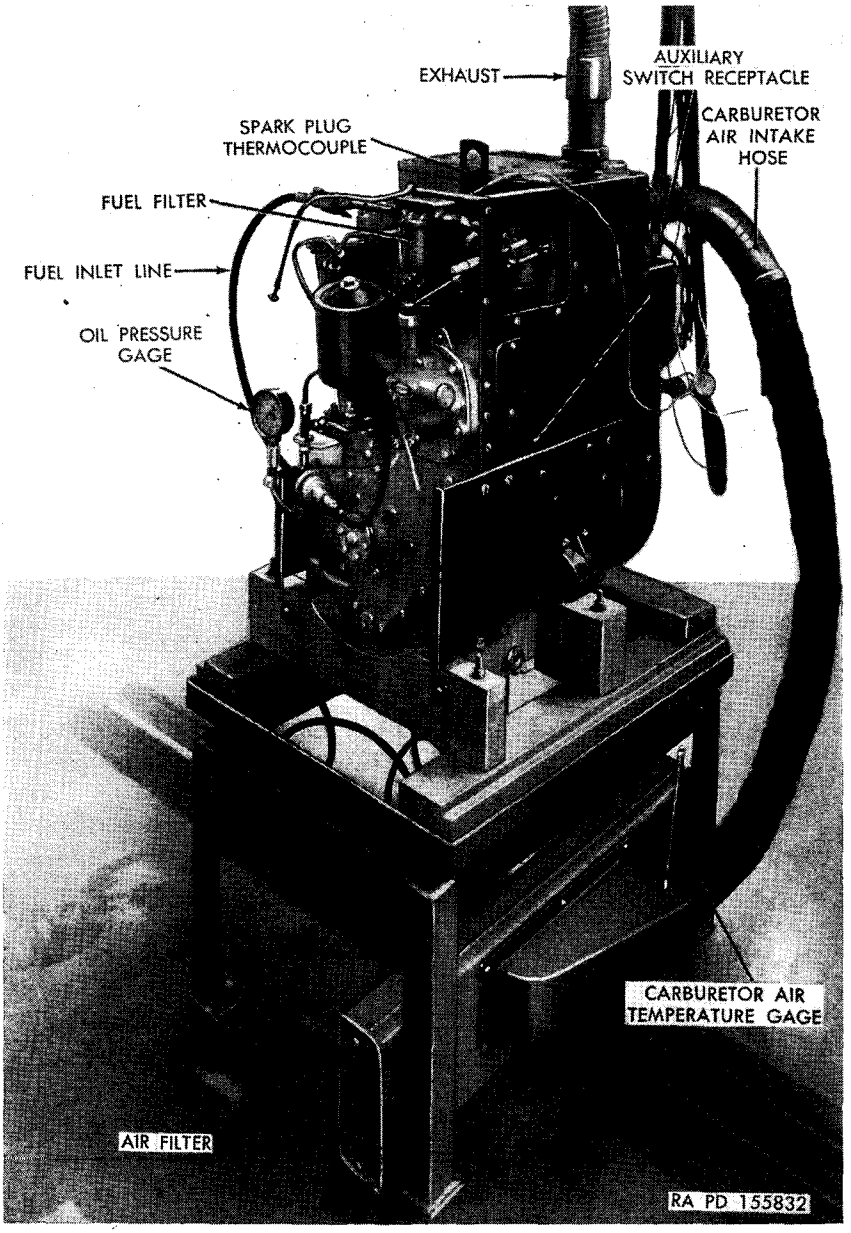


Figure 112. Run-in test set-up—left-front view.

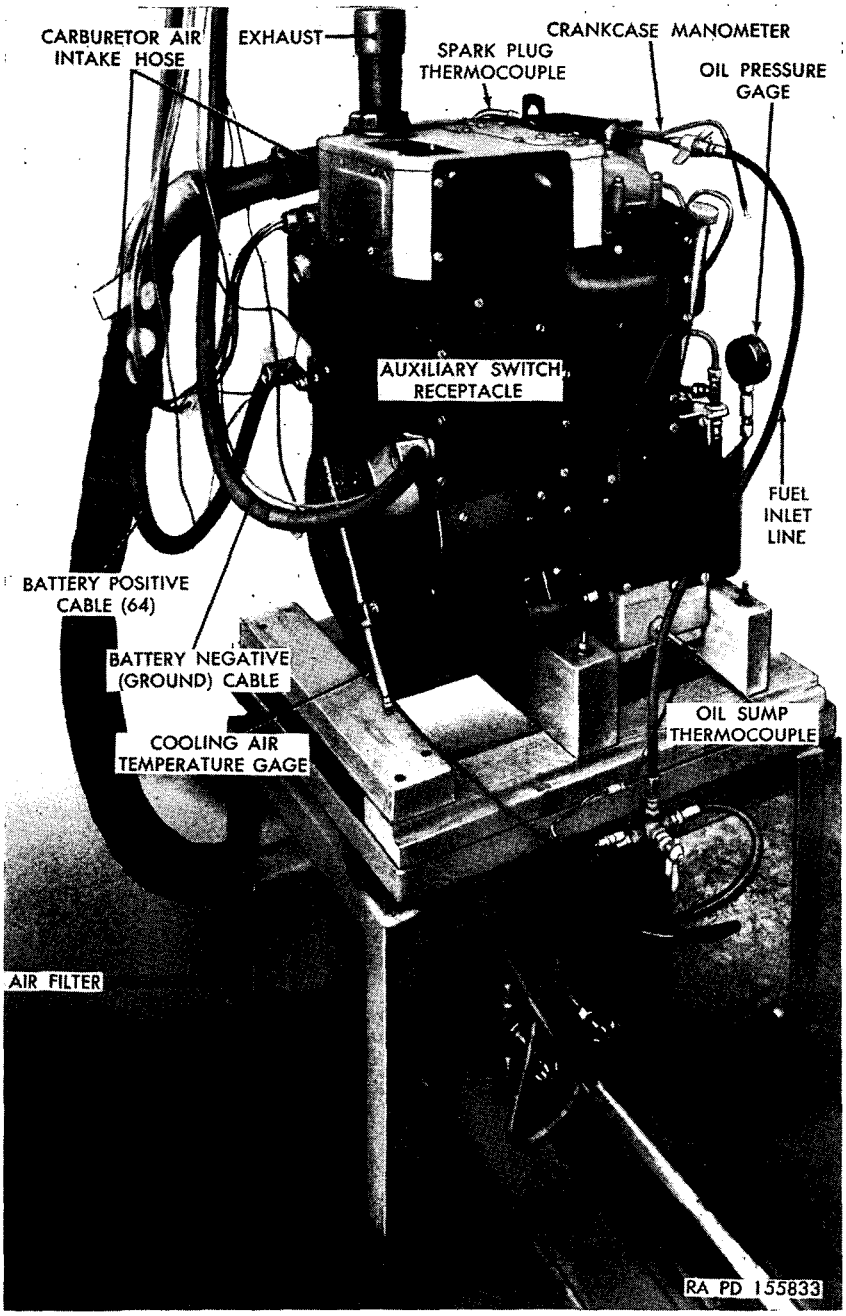


Figure 113. Run-in test set-up—right-front view.

(*e*) Disconnect oil pressure switch from three-eighth tube tee at front of engine oil pressure gage to tee (fig. 112).
(*f*) Clamp cooling air thermometer to fan impeller (fig. 113).
(*g*) Install carburetor air inlet thermometer at the inlet duct of the air filter (fig. 113).
(*h*) Connect a 0 to 400-ampere shunt in series with positive (+) terminal at rear shroud panel and external load.

Note. The ammeter must be matched with shunt.

(*i*) Connect a 0 to 50-volt voltmeter with the voltmeter positive (+) to positive (+) terminal at rear shroud panel and voltmeter negative (—) to negative (—) terminal at rear shroud panel.
(*j*) To obtain engine speed, hold a hand tachometer against end of generator-impeller-fan bolt or connect a tachometer to record magneto primary AC voltage calibrated in "RPM."

134. Adjustments Prior to Run-in Test

a. Preliminary Precautions.
(1) Check all items vital to safe engine operation and safety of personnel, oil level, coolant supply, electrical connections, air cleaners, exhaust lines, etc.
(2) Place voltage adjusting rheostat pointer at center of operating range.
(3) Adjust linkage so that carburetor throttle is just wide open when engine is stopped. Ball joint spring must not be compressed.
(4) Motor engine until an oil pressure reading of 35 to 45 psi is obtained from the oil pressure gage. If no pressure is obtained within 30 seconds, stop motoring, determine and correct cause of lack of oil pressure before proceeding with this test. When 35 to 45 psi oil pressure is obtained, continue motoring for 5 minutes and check for the following:
(*a*) Leaks in fuel connections or fuel lines.
(*b*) Any unusual knocks or noises.
(*c*) Oil leaks at all connections and at all gaskets.
(*d*) Loose bolts or loose screws.
(*e*) Leaks of cooling air past joints in sheet metal shroud.
(*f*) Load starter is pulling properly (125 to 165 amps and 20 to 23 volts).

b. Start Engine and Run Unit for 5 Minutes at 2,000 to 2,500 RPM and Check for the Following:
(1) Fuel and oil leaks.
(2) Unusual noises, knocks, or rattles.
(3) Exhaust leaks.

(4) Oil pressure (35 to 45 psi).
(5) Speed (2,000 to 2,500 rpm).

c. TIMING AND IGNITION.

(1) Timing of magneto was performed when magneto was installed on the engine (par. 121). Check spark plug for correct heat range (not to exceed 375° above ambient temperature in ° F.) and for gap setting (par. 5*b*).
(2) While engine is running, use timing light to see that timing marks are alined (fig. 104).

d. SPEED. Adjust governor to give no-load speed of 3,250 to 3,300 rpm.

e. VOLTAGE. With no load on engine, check to see that engine speed is 3,250 to 3,300 rpm. Set voltage at approximately 28.5 volts at this (no-load) speed. To set voltage, remove trimmer rheostat adjusting hole cover (fig. 16), and adjust by turning slotted screw at center of rheostat (fig. 108) with long-shanked screwdriver.

135. Run-in Test

a. GENERAL. The run-in procedure contained in this paragraph is applicable to this generator and engine unit. Data peculiar to this unit is indicated in engine test log (fig. 114).

b. LOG OR RUN-IN DATA. Data such as time, speed, load, pressures, etc., will be completed and recorded during the test run on an improvised engine test log (fig. 114), which may be reproduced locally by typewriter on 8 x 10½-inch paper. Each reproduced copy will include the form number, title, and date. Reproduced forms must be complete in detail and not consist of extracts. Engine test logs will be retained at the rebuild activity until the engine type is obsolete.

(1) Prepare engine test log (fig. 114) in accordance with information contained herein and such special data as is included in table IV.
(2) With throttle set to obtain an engine speed of approximately 3,250 rpm, check oil pressure gage (par. 134).
Caution: If oil pressure is not indicated within 30 seconds, shut down engine and determine cause.
(3) Enter starting data and subsequent readings on engine test log (fig. 114).
(4) Follow the test schedule for this engine as prescribed in table IV.
(5) Periodically check engine for leaks, unusual noises, misfiring, heating, or other unusual operating conditions.
(6) Oil pressure must be constantly checked during the run-in test. Adjust when required to specified pressures. Low oil pressure, or sudden drop in pressure, or sudden rise in oil temperature will be investigated and corrected prior to continuation of test.

GENERATOR
MAKE AND MODEL: Delco Products A-8585
SERIAL NUMBER: 39,675

ENGINE
MAKE AND MODEL: Detroit Diesel 1941-1
SERIAL NUMBER: 14081

IMPROVISED ENGINE TEST LOG

DATE: 25 Aug 51
OBSERVER: Burk
FUEL: MIL-G-3056 (80 Octane)
FUEL SP GR:
LUBE OIL: MIL-O-2104 (+40 to -10 °F)

OBJECT OF TEST: Run-in test after rebuild.

ITEM NO. PERIOD NO.	1	2	3	4	5	6	REMARKS
(1) STARTING TIME	11:30	11:50	12:20	12:50	13:20	14:20	
(2) STOPPING TIME	11:50	12:20	12:50	13:20	14:20	15:20	
(3) ELAPSED PERIOD TIME (MIN)	20	30	30	30	60	60	
(4) ELAPSED TEST TIME (MIN)	20	50	80	110	170	230	
(5) AMBIENT AIR TEMP (°F)	70	70	72	72	72	74	
(6) DRY BULB TEMP (°F)	70	70	72	72	72	74	
(7) WET BULB TEMP (°F)	65	65	66	66	66	67	
(8) BAROMETRIC PRESSURE (Inches Hg)	28.80	28.80	28.79	28.78	28.78	28.77	
(9) CARBURETOR AIR TEMP (°F)	75	76	76	78	79	81	
(10) SPARK PLUG TEMP (°F)	280	290	305	345	370	446	
(11) SUMP OIL TEMP (°F)	140	145	156	163	175	190	
(12) OIL PRESSURE (PSI)	46	48	49	50	48	49	
(13) CRANKCASE PRESSURE (Inches H0)	-2.0	-2.0	-3.0	-3.3	-2.2	-2.5	
(14) SPARK ADVANCE (Deg TDC)	30°	→	→	→	→	30°	
(15) ENGINE SPEED (RPM)	3280	3250	3230	3190	3150	3100	USED HAND TACHOMETER (REFER TO PAR 133 b)
(16) VOLTAGE (VOLTS)	29	28.7	28.3	* 28.5	28.0	27.5	* RESET VOLTAGE 28.5 @ NO-LOAD
(17) CURRENT (AMPS)	0	70	142	210	284	307	
(18) CHANGE IN SUMP OIL TEMP (°F)	70	75	84	91	103	116	Item 11 minus 5
(19) CHANGE IN SPARK PLUG TEMP (°F)	210	220	233	273	298	339	Item 10 minus 5
(20) BAROMETRIC VAPOR PRESSURE (Inches Hg)	0.56	0.56	0.58	0.58	0.58	0.59	Item 6 & 7 # Figure 115
(21) OBSERVED KILOWATTS (KW)	0	2.00	4.02	5.99	7.95	8.44	Items 16 times 17
(22) CORRECTED KILOWATTS (KW)	0	2.15	4.33	6.47	8.58	9.14	REFER TO PARAGRAPH 137 b

CONCLUSIONS: OK Burk

RA PD 155838

Figure 114. Improvised engine test log.

(7) Check oil temperature during each period. Temperatures must not exceed 240° F.
(8) Check oil gage and add oil to bring oil level to full mark.
(9) Pay particular attention to instrument readings during rated-load or full-throttle runs.

c. RUN-IN SCHEDULES.

Table IV. Run-in Schedule

Period	Length in minutes	Load (KW)	Approximate speed (rpm)
1	20	0	3, 250
2	30	2. 0	3, 215
3	30	4. 0	3, 180
4	30	6. 0	3, 145
5	60	8. 0	3, 110
6	60	Full 8. 4	3, 100

Note. During period 4, after generator and voltage regulator temperatures are stabilized, set voltage to 28.5±0.7 volts.

Caution: During period 6, carburetor throttle must be full open.

d. ADJUSTMENTS MADE DURING RUN-IN TESTS. During the entire run-in test make a visual and listening check of the unit and correct any minor irregularities when noted.

(1) Governor and engine idle speeds will be adjusted after completion of run-in test to the following specifications. Malfunctions noted during the test run will be corrected. In event of a major malfunction, a penalty run will be performed.
(2) Reset voltage if required by specifications in paragraph 134*e*(1).
(3) Reset governor if required by specifications in paragraph 134*d*.
(4) Check crankcase breathing system for proper operation. Crankcase pressure should be slightly negative at 2 to 5 inches of water.
(5) Check operation of electric heater (in heat exchanger).
Caution: Do not turn heater on while load is on engine.
Caution: For safety reasons, when stopping the engine, shut off the fuel and allow the engine to run until the fuel in the carburetor is completely used.

136. Inspection After Run-in Test

a. INSPECTION AFTER TESTING. Engine will be inspected externally, after testing, for leaks and visual defects. In addition, for purpose of quality control, engine will be disassembled periodically on a percentage basis for inspection. Such inspections will be frequent enough to assure disclosure of all imperfections or defects. Where

unsatisfactory conditions are encountered, additional engines will be disassembled and inspected. Corrective action must be taken to prevent recurrence of any unsatisfactory condition revealed by this inspection. Upon reassembly, engine will be given a run-under-load of sufficient duration to assure satisfactory performance.

Note. Report of unsatisfactory conditions encountered which are of importance will be forwarded to Office, Chief of Ordnance, Washington 25, D. C., ATTENTION: ORDFM-AUTO, for informational purposes. When requested, technical assistance will be furnished.

b. REJECTION. Engines that fail to develop the minimum rated output specified herein will be rejected.

c. PENALTY RUN. If the engine requires a major correction, repair, adjustment, or replacement of major components, it must be completely retested prior to release. Where minor corrections are made, such as valve-tappet adjustment, or replacement of items such as spark plugs, the engine must be run long enough to determine that it is operating satisfactorily.

137. Conversion Correction for Atmospheric Conditions

a. GENERAL. Tables contained in this section are designed to simplify and reduce to a minimum the mathematical calculations required for making corrections for atmospheric conditions.

b. CORRECTION FOR ATMOSPHERIC CONDITIONS. Kilowatt output is corrected for atmospheric conditions by substituting the values for T (table VII) and B (table V) in formula (*c* below). Thus, in order to obtain the corrected kilowatts (item No. 22, fig. 114), multiply the observed kilowatt (item No. 21, fig. 114) by the barometric comparison factor (table VI) and by the temperature correction factor (table VII).

c. USE OF TABLES AND CORRECTION FORMULA. The corrected kilowatt output is found by use of the following formula:

$$\text{Corrected } KW = \text{Observed } KW \times \frac{29.92}{B-E}\sqrt{\frac{460+T}{520}}$$

Where: B=Observed barometer reading corrected for temperature (table V).

E=Vapor pressure (fig. 115).

T=Carburetor air inlet temperature (fig. 112).

Note. For values of $\frac{29.92}{B-E}$ refer to table VI.

For values of $\sqrt{\frac{460+T}{520}}$ refer to table VII.

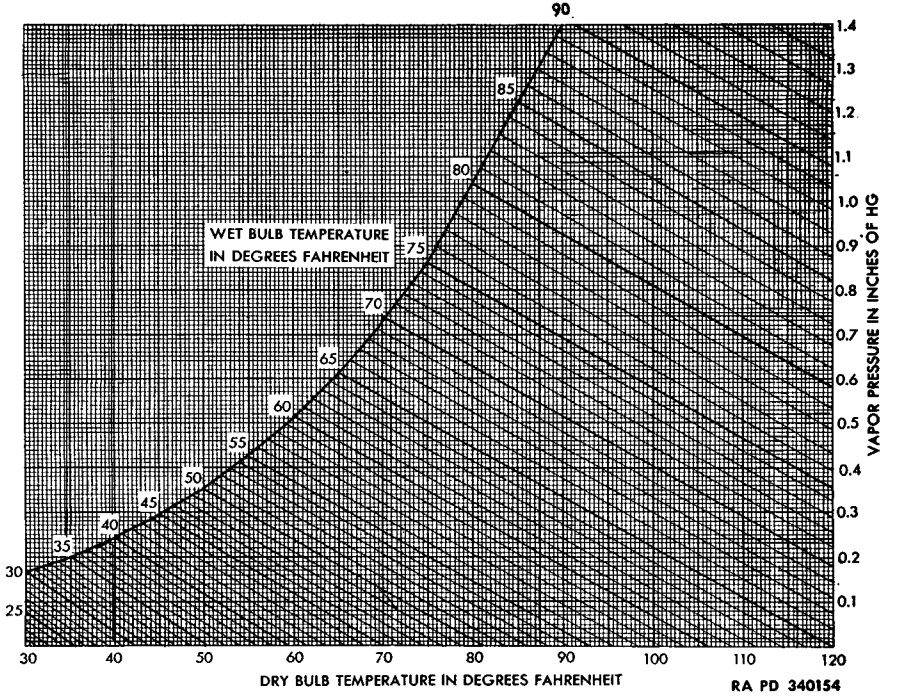


Figure 115. Vapor-pressure determination.

TABLE V. *Temperature Corrections for Barometer Mercury Column*

Temperature of column in °F	Observed reading of barometer in inches of mercury			
	26	28	30	32
	Add			
0	0. 07	0. 07	0. 08	0. 08
10	0. 04	0. 05	0. 05	0. 05
20	0. 02	0. 02	0. 02	0. 02
30	0. 00	0. 00	0. 00	0. 00
	Subtract			
35	0. 01	0. 02	0. 02	0. 02
40	0. 03	0. 03	0. 03	0. 03
45	0. 04	0. 04	0. 04	0. 05
50	0. 05	0. 05	0. 06	0. 06
55	0. 06	0. 07	0. 07	0. 08
60	0. 07	0. 08	0. 08	0. 09
65	0. 09	0. 09	0. 10	0. 10
70	0. 10	0. 10	0. 11	0. 12
75	0. 11	0. 12	0. 13	0. 13
80	0. 12	0. 13	0. 14	0. 15
85	0. 13	0. 14	0. 15	0. 16
90	0. 14	0. 15	0. 17	0. 18
95	0. 16	0. 17	0. 18	0. 19
100	0. 17	0. 18	0. 19	0. 20

Table VI. Barometric Correction Factors

B–E = Corrected barometer

$\frac{29.92}{B-E}$ = Barometric comparison factor

B–E	$\frac{29.92}{B-E}$	B–E	$\frac{29.92}{B-E}$	B–E	$\frac{29.92}{B-E}$
27. 80	1. 0763	28. 68	1. 0432	29. 56	1. 0121
27. 82	1. 0755	28. 70	1. 0425	29. 58	1. 0114
27. 84	1. 0747	28. 72	1. 0417	29. 60	1. 0108
27. 86	1. 0739	28. 74	1. 0410	29. 62	1. 0101
27. 88	1. 0732	28. 76	1. 0403	29. 64	1. 0094
27. 90	1. 0724	28. 78	1. 0396	29. 66	1. 0087
27. 92	1. 0716	28. 80	1. 0388	29. 68	1. 0080
27. 94	1. 0709	28. 82	1. 0381	29. 70	1. 0074
27. 96	1. 0701	28. 84	1. 0374	29. 72	1. 0067
27. 98	1. 0693	28. 86	1. 0367	29. 74	1. 0060
28. 00	1. 0686	28. 88	1. 0360	29. 76	1. 0053
28. 02	1. 0678	28. 90	1. 0352	29. 78	1. 0047
28. 04	1. 0670	28. 92	1. 0345	29. 80	1. 0040
28. 06	1. 0663	28. 94	1. 0338	29. 82	1. 0033
28. 08	1. 0655	28. 96	1. 0331	29. 84	1. 0026
28. 10	1. 0648	28. 98	1. 0324	29. 86	1. 0020
28. 12	1. 0640	29. 00	1. 0317	29. 88	1. 0013
28. 14	1. 0633	29. 02	1. 0310	29. 90	1. 0006
28. 16	1. 0625	29. 04	1. 0303	29. 92	1. 0000
28. 18	1. 0618	29. 06	1. 0295	29. 94	. 9993
28. 20	1. 0610	29. 08	1. 0288	29. 96	. 9986
28. 22	1. 0602	29. 10	1. 0281	29. 98	. 9979
28. 24	1. 0595	29. 12	1. 0274	30. 00	. 9973
28. 26	1. 0587	29. 14	1. 0267	30. 02	. 9966
28. 28	1. 0580	29. 16	1. 0260	30. 04	. 9960
28. 30	1. 0572	29. 18	1. 0253	30. 06	. 9953
28. 32	1. 0565	29. 20	1. 0246	30. 08	. 9946
28. 34	1. 0558	29. 22	1. 0239	30. 10	. 9940
28. 36	1. 0550	29. 24	1. 0232	30. 12	. 9933
28. 38	1. 0543	29. 26	1. 0225	30. 14	. 9927
28. 40	1. 0535	29. 28	1. 0218	30. 16	. 9920
28. 42	1. 0528	29. 30	1. 0211	30. 18	. 9913
28. 44	1. 0520	29. 32	1. 0204	30. 20	. 9907
28. 46	1. 0513	29. 34	1. 0197	30. 22	. 9900
28. 48	1. 0506	29. 36	1. 0190	30. 24	. 9894
28. 50	1. 0498	29. 38	1. 0183	30. 26	. 9887
28. 52	1. 0491	29. 40	1. 0176	30. 28	. 9881
28. 54	1. 0483	29. 42	1. 0169	30. 30	. 9874
28. 56	1. 0476	29. 44	1. 0163	30. 32	. 9868
28. 58	1. 0468	29. 46	1. 0156	30. 34	. 9861
28. 60	1. 0461	29. 48	1. 0149	30. 36	. 9855
28. 62	1. 0454	29. 50	1. 0142	30. 38	. 9848
28. 64	1. 0446	29. 52	1. 0135	30. 40	. 9842
28. 66	1. 0439	29. 54	1. 0128	30. 42	. 9835

Table VII. Temperature Correction Factors

T = Carburetor air inlet temperature

$\sqrt{\frac{460+T}{520}}$ = Temperature correction factor

T	$\sqrt{\frac{460+T}{520}}$	T	$\sqrt{\frac{460+T}{520}}$
60	1. 000	86	1. 025
61	1. 001	87	1. 026
62	1. 002	88	1. 027
63	1. 003	89	1. 028
64	1. 004	90	1. 028
65	1. 005	91	1. 029
66	1. 006	92	1. 030
67	1. 007	93	1. 031
68	1. 007	94	1. 032
69	1. 008	95	1. 033
70	1. 009	96	1. 034
71	1. 010	97	1. 035
72	1. 011	98	1. 036
73	1. 012	99	1. 037
74	1. 013	100	1. 038
75	1. 014	101	1. 039
76	1. 015	102	1. 040
77	1. 016	103	1. 041
78	1. 017	104	1. 042
79	1. 018	105	1. 043
80	1. 019	106	1. 044
81	1. 020	107	1. 045
82	1. 021	108	1. 046
83	1. 022	109	1. 047
84	1. 023	110	1. 048
85	1. 024	111	1. 049

CHAPTER 5
REPAIR AND REBUILD STANDARDS

138. General

The repair and rebuild standards included herein give the minimum, maximum, and key clearances of new or rebuilt parts. They also give wear limits which indicate 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. An asterisk (*) in the "Wear Limits" column indicates that the part or parts should be replaced when worn beyond the limits given in the "Sizes and fits of new parts" column. A plus sign (+) in the "Sizes and fits of new parts" column denotes a clearance between mating parts whereas a minus sign (—) in that column denotes an interference between mating parts. The judgment and skill of an experienced mechanic in inspecting worn engine parts is as necessary as the actual measurements, to determine the future usefulness of the part. A very good guide to follow in measuring used parts, is to use the *maximum* allowable new part clearances, since most new parts are manufactured to the mean dimension. The wear limits set up in the following paragraphs, provide for one-thousandths inch wear per inch diameter of the journal or shaft and are to be used where maximum use of parts is necessary.

139. Cylinder, Cylinder Head and Valves

(pars. 69 and 76)

a. CYLINDER.

Fig No.	*Ref letter*	*Point of measurement*	*Sizes and fits of new parts* *Min*	*Max*	*Wear limits*
116	A	Diameter of cylinder (at top)	3. 6250	3. 6270	3. 6305
116	LL	Diameter of cylinder (at bottom).	3. 6260	3. 6290	3. 6325

b. INTAKE-VALVE STEM AND GUIDE.

Fig No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
116	F	Diameter of intake-valve stem	0. 3415	0. 3425	0. 3395
116	E	ID of intake-valve guide	0. 3432	0. 3442	0. 3492
116	E–F	Fit between intake-valve stem and intake-valve guide.	+0. 0007	+0. 0027	

c. EXHAUST-VALVE STEM AND GUIDE.

Fig No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
116	L	Diameter of exhaust-valve stem	0. 4335	0. 4345	0. 4315
116	M	ID of exhaust-valve guide	0. 4380	0. 4390	0. 4440
116	M–L	Fit between exhaust-valve stem and exhaust-valve guide.	+0. 0035	+0. 0055	

d. INTAKE-VALVE SEAT INSERT AND CYLINDER BORE FOR INSERT.

Fig No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
116	G	OD of intake-valve-seat insert	1. 8770	1. 8780	(*)
116	H	Diameter of cylinder head bore for valve seat insert.	1. 8730	1. 8740	(*)
116	J	Valve seat insert angle	46°		
116	H–G	Fit between intake-valve-seat insert and bore in cylinder head.	−0. 0030	−0. 0050	
116	K	Width of valve seat insert	0. 0500	0. 0720	0. 0800

e. EXHAUST-VALVE SEAT INSERT AND CYLINDER BORE FOR INSERT.

Fig No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
116	N	OD of exhaust-valve-seat insert	1. 5650	1. 5660	(*)
116	P	Diameter of cylinder head bore for valve seat insert.	1. 5610	1. 5620	(*)
116	Q	Valve seat insert angle	46°		
116	P–N	Fit between exhaust-valve-seat insert and bore in cylinder head.	−0. 0030	−0. 0050	
116	R	Width of seat	0. 0500	0. 0720	0. 0800

140. Piston, Piston Pin, Piston Rings, and Connecting Rod
(par. 72)

a. PISTON.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
		Diameter of piston (at top of skirt):			
116	Y	90° to piston pin axis	3. 6235	3. 6240	3. 6200
116	Z	Piston pin axis	3. 6071	3. 6076	(*)

Fig No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
		Fit between piston and cylinder (at top of skirt):			
116	A–Y	90° to piston pin axis	+0.0010	+0.0035	
116	A–Z	Piston pin axis	+0.0174	+0.0199	
		Diameter of piston (at bottom of skirt):			
116	AA	90° to piston pin axis	3.6245	3.6250	3.6210
116	BB	Piston pin axis	3.6081	3.6086	3.6081
		Fit between piston and cylinder (at bottom of skirt):			
116	LL–AA	90° to piston pin axis	+0.0010	+0.0045	
116	LL–BB	Piston pin	+0.0174	+0.0209	

b. PISTON PIN.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
116	CC	Diameter of piston pin	0.9994	0.9997	0.9984
116	DD	ID of piston-pin-bearing bore (in piston).	0.9995	0.9998	1.0008
116	DD–CC	Fit between piston pin and piston bearing in piston.	−0.0002	+0.0004	
116	EE	Diameter of piston-pin-bearing bore (in connecting rod).	0.9997	1.0000	1.0010
116	EE–CC	Fit between piston pin and bearing in connecting rod.	+0.0000	+0.0006	

c. PISTON RINGS.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
		Piston ring gap (ring in cylinder):			
116	S	Upper	0.0050	0.0263	0.0050
116	T	Intermediate	0.0100	0.0263	0.0363
116	U	Lower	0.0300	0.0890	0.0990
		Piston-land-to-piston-ring clearance:			
116	V	Upper	0.0055	0.0075	0.0095
116	W	Intermediate	0.0030	0.0045	0.0065
116	X	Lower	0.0010	0.0030	0.0050

d. CONNECTING ROD.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
		ID of connecting-rod-bearing (installed in rod):			
116	FF	Connecting-rod axis	2.1247	2.1262	2.1282
116	GG	90° to connecting-rod axis	2.1255	2.1276	2.1296
116	HH	Diameter of connecting-rod journal (on crankshaft).	2.1238	2.1243	2.1218

Fig. No.	Ref. letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
		Fit between connecting-rod-bearing and connecting-rod journal:			
116	FF–HH	Connecting-rod axis	+0.0004	+0.0024	
116	GG–HH	90° to connecting-rod axis	+0.0012	+0.0038	
116	JJ	End play between connecting rod and connecting-rod-journal shoulders (on crankshaft).	+0.0020	+0.0060	

141. Crankshaft and Main Bearings

(pars. 49 and 53)

a. Crankshaft Front Bearing.

Fig No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
117	A	Diameter of crankshaft front-bearing journal.	2.2490	2.2495	2.2465
		Diameter of crankshaft-front bearing bore (in crankcase):			
117	B	Connecting-rod axis	2.2506	2.2519	2.2524
117	C	90° to connecting-rod axis	2.2510	2.2529	2.2554
		Fit between front bearing and crankshaft-front-bearing journal (with crush):			
117	B–A	Connecting-rod axis	+0.0011	+0.0029	
117	C–A	90° to connecting-rod axis	+0.0015	+0.0039	

b. Crankshaft Rear Bearing.

Fig No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
117	D	Diameter of crankshaft-rear-bearing journal.	2.3626	2.3630	(*)
117	E	ID of crankshaft-rear-bearing	2.3616	2.3622	(*)
117	E–D	Fit between rear bearing and crankshaft-rear-bearing journal.	−0.0004	−0.0014	
117	F	OD of crankshaft rear bearing	4.3301	4.3307	(*)
117	G	Diameter of bore for crankshaft rear bearing (in rear-main-bearing support.)	4.3306	4.3312	(*)
117	G–F	Fit between crankshaft rear bearing and rear-main-bearing support.	−0.0001	+0.0011	

c. CRANKSHAFT GEAR.

Fig No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
117	H	Diameter of crankshaft gear journal (on crankshaft).	1. 0010	1. 0015	(*)
117	J	Diameter of crankshaft gear bore.	0. 9990	1. 0000	(*)
117	J–H	Fit between crankshaft gear and journal.	−0. 0010	−0. 0025	
117	K	End play between crankshaft and thrust washer.	0. 0030	0. 0060	0. 0110

142. Camshaft and Gear

a. CAMSHAFT FRONT BEARING.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
117	L	Diameter of camshaft-front-bearing journal.	1. 8730	1. 8735	1. 8710
117	M	Diameter of camshaft-front-bearing bore.	1. 8745	1. 8760	1. 8780
117	M–L	Fit between camshaft front bearing and camshaft.	+0. 0010	+0. 0030	

b. CAMSHAFT REAR BEARING.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
117	N	Diameter of camshaft-rear-bearing journal.	1. 3725	1. 3730	1. 3710
117	P	Diameter of camshaft-rear-bearing bore.	1. 3740	1. 3750	1. 3765
117	P–N	Fit between camshaft rear bearing and camshaft.	+0. 0010	+0. 0025	

c. CAMSHAFT GEAR.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
117	Q	Diameter of camshaft-gear journal.	1. 6265	1. 6275	(*)
117	R	ID of camshaft gear	1. 6245	1. 6255	(*)
117	R–Q	Fit between camshaft gear and camshaft.	−0. 0010	−0. 0030	
117	S	End play between camshaft and engine front cover.	0. 0060	0. 0150	

143. Counterweight

(par. 61)

a. COUNTERWEIGHT FRONT BEARING.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Max	Wear limits
117	T	Diameter of counterweight-front-bearing journal.	2. 4970	2. 4975	2. 4945
117	U	ID of counterweight front bearing.	2. 4995	2. 5010	2. 5035
117	U–T	Fit between counterweight and front bearing.	+0. 0020	+0. 0040	

b. COUNTERWEIGHT REAR BEARING.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Sizes and fits of new parts Max	Wear limits
117	V	Diameter of counterweight-rear-bearing journal.	0. 9970	0. 9975	0. 9960
117	W	Diameter of counterweight-rear-bearing bore.	0. 9980	0. 9985	0. 9995
117	W–V	Fit between counterweight rear bearing.	+0. 0005	+0. 0015	

c. COUNTERWEIGHT GEAR.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Sizes and fits of new parts Max	Wear limits
117	X	Diameter of counterweight-gear journal.	1. 0010	1. 0020	(*)
117	Y	ID of counterweight gear_____	0. 9990	1. 0000	(*)
117	Y-X	Fit between counterweight gear and counterweight.	−0. 0010	−0. 0030	
117	Z	End play between counterweight and rear-main-bearing support.	+0. 0130	+0. 0360	

144. Idler Gears

(pars. 49 and 67)

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Sizes and fits of new parts Max	Wear limits
117	AA	Diameter of idler-gear shaft___	0. 6215	0. 6220	0. 6210
117	BB	Diameter of idler-gear bushing bore (in idler gear).	0. 6230	0. 6235	0. 6240
117	BB-AA	Fit between idler gear and shaft.	+0. 0010	+0. 0020	

145. Push Rod and Valve Tappet

(pars. 49 and 80)

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Sizes and fits of new parts Max	Wear limits
118	A	OD of valve-tappet body_____	0. 9975	0. 9985	0. 9965
118	B	Diameter of bore for valve tappet body (in crankcase).	0. 9990	1. 0000	1. 0010
118	B-A	Fit between valve-tappet body and crankcase.	+0. 0005	+0. 0025	

146. Rocker Cover

(par. 84)

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Sizes and fits of new parts Max	Wear limits
118	C	Diameter of rocker-arm shaft__	0. 6230	0. 6240	0. 6210
118	D	ID of rocker-arm-bearing_____	0. 6245	0. 6255	0. 6265
118	D-C	Fit between rocker-arm-bearing and shaft.	+0. 0005	+0. 0025	

147. Oil Pump

(par. 57)

a. Oil Pump Drive Gear.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Sizes and fits of new parts Max	Wear limits
118	E	Diameter of drive-gear shaft	0. 4355	0. 4360	(*)
118	F	ID of drive gear	0. 4335	0. 4345	(*)
118	F-E	Fit between drive gear and drive-gear shaft.	−0. 0010	−0. 0025	

b. Oil Pump Driven Gear.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Sizes and fits of new parts Max	Wear limits
118	G	Diameter of driven-gear shaft	0. 4385	0. 4390	0. 4380
118	H	ID of driven gear	0. 4400	0. 4410	0. 4415
118	H-G	Fit between driven gear and driven-gear shaft.	+0. 0010	+0. 0025	

c. Oil Pump Bearing.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Sizes and fits of new parts Max	Wear limits
118	J	ID drive-gear-shaft bearing (in pump body).	0. 4370	0. 4375	0. 4380
118	J-E	Fit between drive-gear-shaft and bearing.	+0. 0010	+0. 0020	
118	K	Diameter driven-gear-shaft bore (in pump body).	0. 4370	0. 4375	(*)
118	K-G	Fit between driven-gear-shaft and pump body.	−0. 0010	−0. 0020	
118	L	Backlash between crankshaft gear and drive-driven gear.	0. 0000	0. 0022	0. 0025

148. Generator and Governor

(pars. 92 and 104)

a. Generator Rear Bearing.

Fig. No.	Ref letter	Point of measurement	Sizes and fits of new parts Min	Sizes and fits of new parts Max	Wear limits
119	H	ID of rear-bearing-support bearing.	3. 1496	3. 1499	(*)
119	J	OD of rear bearing	3. 1491	3. 1496	(*)
119	H-J	Fit between rear bearing and rear-bearing-support bearing.	0. 0000	+0. 0008	
119	K	ID rear bearing	1. 9680	1. 9685	(*)
119	L	Diameter of armature shaft	1. 9684	1. 9689	(*)
119	K-L	Fit between rear bearing and armature shaft.	+0. 0001	−0. 0009	

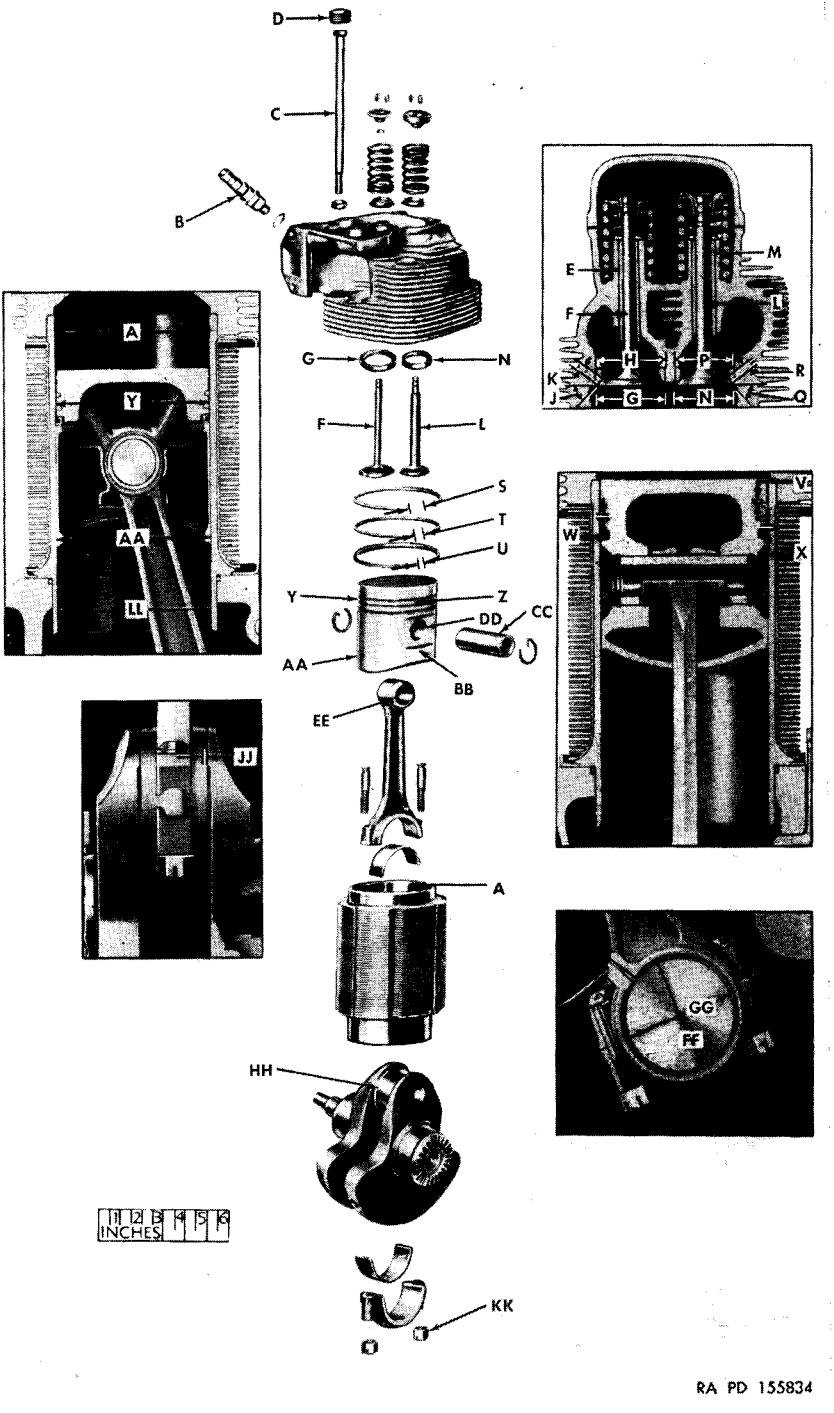


Figure 116. Repair and rebuild standard points of measurement for generator and engine.

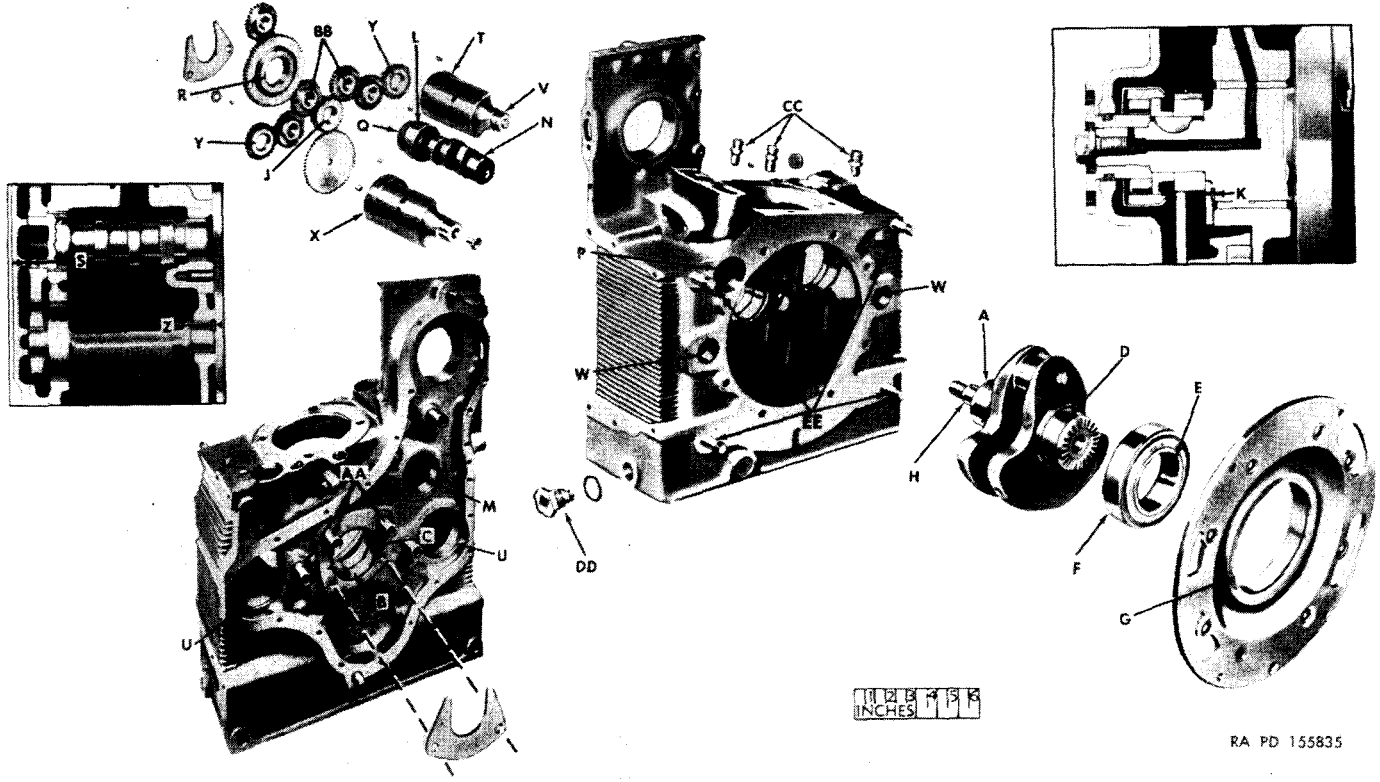


Figure 117. Repair and rebuild standard points of measurement for generator and engine.

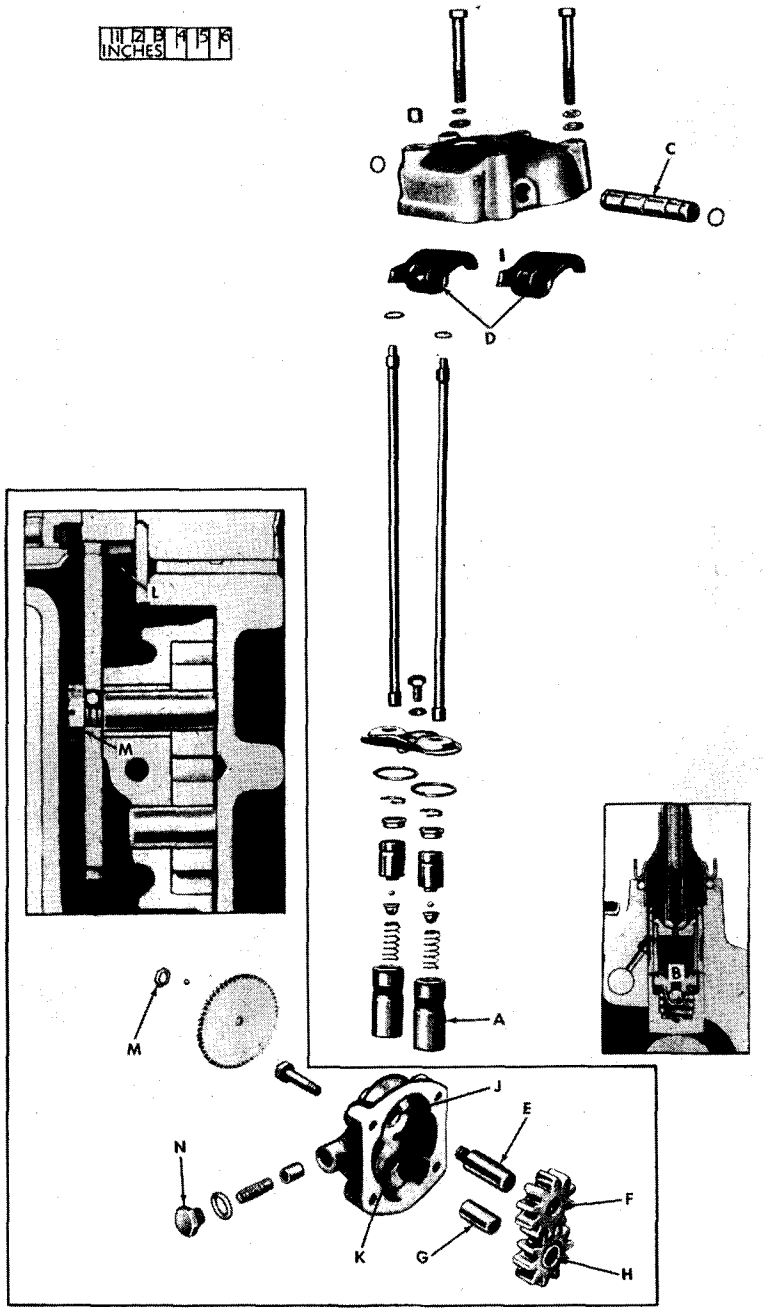


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Figure 118. Repair and rebuild standard points of measurement for generator and engine.

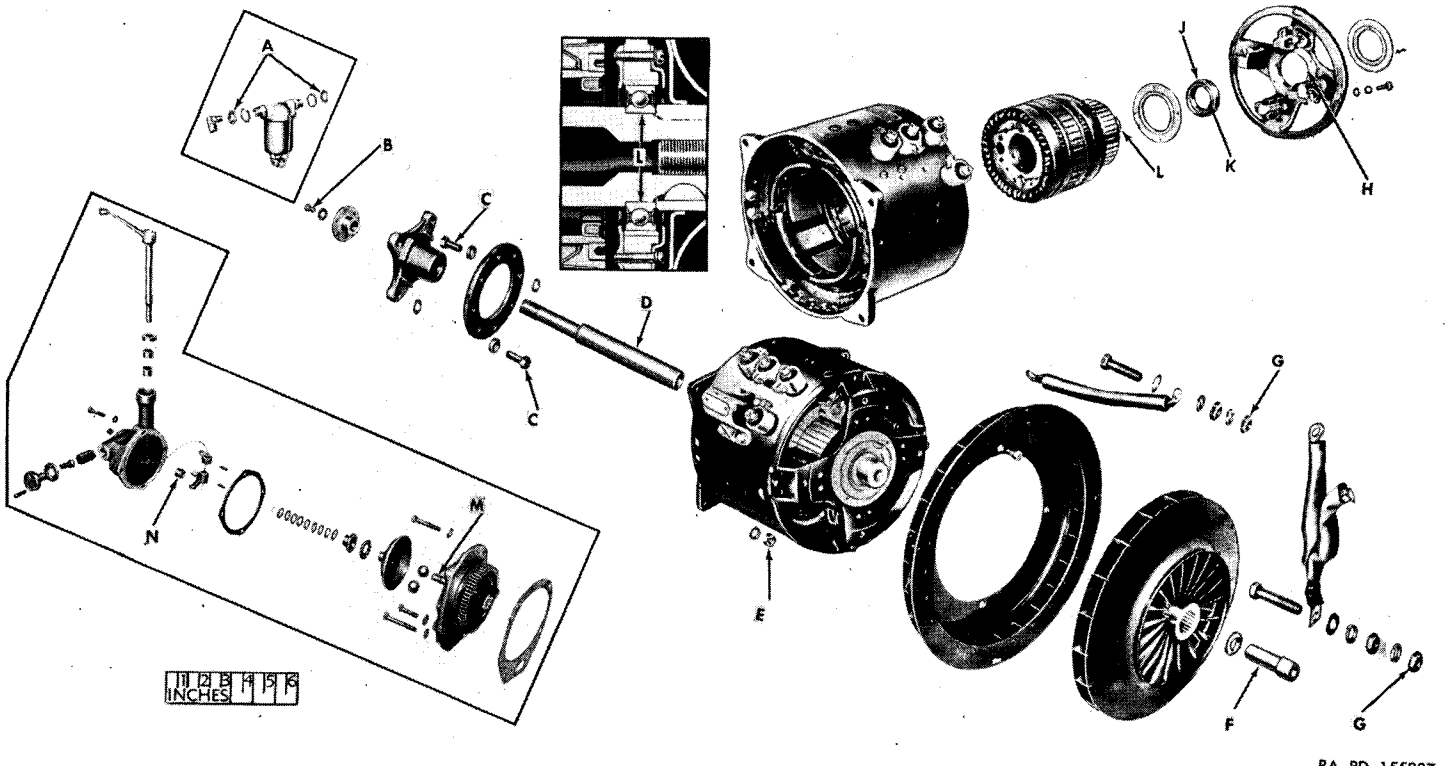

Figure 119. Repair and rebuild standard points of measurement for generator and engine.

b. GOVERNOR DRIVE SHAFT.

Fig. No.	*Ref letter*	*Point of measurement*	*Sizes and fits of new parts* *Min*	*Max*	*Wear limits*
119	M	Diameter of governor drive shaft.	0. 4340	0. 4350	0. 4335
119	N	ID of governor body bearing (bushing type).	0. 4390	0. 4400	0. 4405
119	N–M	Fit between bearing and drive shaft.	+0. 0040	+0. 0060	

149. Torque Wrench Specifications

Fig. No.	*Ref letter*	*Location*	*Size*	*Torque (lb-ft)*
119	G	Battery-terminal nuts (rear panel)	½–13	40–45
116	KK	Connecting-rod nut	⅜–24	45–50
117	DD	Crankcase drain plug	⅞–14	50–55
116	C	Cylinder-head bolt	7/16–14	27–30
116	D	Cylinder-head pipe plug	¾ pipe thd	20–25
119	F	Fan-to-generator bolt	¾–16	180–200
119	A	Fuel-filter nut	9/16–18	10–14
119	C	Generator-drive-disk bolt	⅜–24	45–50
119	D	Generator-hub-to-crankshaft bolt	¾–16	200–220
119	E	Generator-to-crankcase nut	½–20	25–60
117	EE	Generator mounting stud	½–13	25–60
118	M	Oil-pump-gear nut	¼–28	15–18
118	N	Oil-pump-relief-valve plug	7/16–14	20–24
116	B	Spark plug	14 mm	16–20
117	CC	Tube connectors	¼ pipe thd	18–22

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 material covered in this manual:

Index of Administrative Publications (Army Regulations, Special Regulations, Joint Army-Air Force Adjustment Regulations, General Orders, Bulletins, Commercial Traffic Bulletins, Joint Procurement Circulars, Department of the Army Pamphlets, and ASF Manuals ..... SR 310–20–5
Index of Army Motion Pictures 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, Graphic Training Aids, Joint Army-Navy Air Force Publications, and Combined Communications Board 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 Combination 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 Simulated Artillery and Grenade Fire ..... ORD 11 SNL R–7

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 Related Items ..... ORD 3 SNL K-2
Lubricating Equipment, Accessories and Related Dispensers ..... ORD (*) SNL K-3
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
Standard Hardware ..... ORD 5 SNL H-1
Tool sets (special), Motor Vehicles ..... ORD 6 SNL G-27, Sec 1

3. Forms

The following forms pertain to this matériel:
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 or Unit Identification Tag
WD AGO Form 460, Preventive Maintenance Roster
DA AGO Form 468, Unsatisfactory Equipment Report
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 Damaged or Improper Shipment

4. Other Publications

The following explanatory 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 Demolition ..... FM 5-25
Ordnance Service in the Field ..... FM 9-5

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

d. GENERAL.

Fuels and Carburetion ..... TM 10–550
Inspection of Ordnance Matériel ..... TM 9–1100
Ordnance Field Maintenance ..... FM 9–10
Principles of Automotive Vehicles ..... TM 9–2700
Report of Accident Experience ..... SR 385–10–40

e. REPAIR AND REBUILD.

Cleaning, Preserving, Sealing, and Related Materials Issued for Ordnance Matériel ..... TM 9–850
Hand, Measuring, and Power Tools ..... TM 10–590
Instruction Guide. Care and Maintenance of Ball and Roller Bearings ..... TM 37–265
Lubrication ..... TM 9–2835
Maintenance and Care of Hand Tools ..... TM 9–867
Maintenance Supplies and Equipment. Maintenance Responsibilities and Shop Operation ..... AR 750–5
Ordnance Maintenance. Electrical Equipment (Delco-Remy) ..... TM 9–1825A
Ordnance Maintenance. Fuel Pumps ..... TM 9–1828A
Ordnance Maintenance. Vehicular Maintenance Equipment, Grinding, Boring, Valve Reseating Machines, and Lathes ..... TM 9–1834A
Painting Instructions for Field Use ..... TM 9–2851
Preparation of Ordnance Matériel for Deep-Water Fording ..... TM 9–2853
Preventive Maintenance of Electric Motors and Generators ..... TM 55–405

f. 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 Packaging of Supplies and Equipment. Marking of Oversea Supply ..... SR 746–30–5
Ordnance Storage and Shipment Chart, Group G, Major Items and Major Combinations of Group G ..... TB 9–OSSC–G
Preparation of Unboxed Ordnance Matériel for Shipment ..... SB 9–4
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 Oversea Shipments 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

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