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WAR DEPARTMENT

TECHNICAL MANUAL

ORDNANCE MAINTENANCE

ENGINE COOLING, ENGINE ELECTRICAL AND ENGINE FUEL SYSTEMS FOR LIGHT TANK M5 AND 75-MM HOWITZER MOTOR CARRIAGE M8

JANUARY 4, 1943

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ENGINE COOLING, ENGINE ELECTRICAL AND ENGINE FUEL SYSTEMS FOR LIGHT TANK M5 AND 75-MM HOWITZER MOTOR CARRIAGE M8

Prepared under the direction of
the Chief of Ordnance
(with the cooperation of the Cadillac Motor Car Division,
General Motors Corporation)

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* This manual contains such information from TB 700-20, October 13, 1942, and TB 700-23, November 11, 1942, as is applicable to this materiel.

ORDNANCE MAINTENANCE — ENGINE COOLING, ENGINE ELECTRICAL AND ENGINE FUEL SYSTEMS FOR LIGHT TANK M5 AND 75-MM HOWITZER MOTOR CARRIAGE M8

Section I

INTRODUCTION

1. SCOPE.

a. This manual is published for the information and guidance of ordnance maintenance personnel charged with maintenance and overhauling of the Light Tank M5 and the 75-mm Howitzer Motor Carriage M8. It includes complete maintenance information on the engine cooling system, engine electrical system, and the engine fuel system. The other technical manuals covering these vehicles are listed in section V.

2. CHARACTERISTICS.

a. Light Tank M5. The Light Tank M5 (fig. 1) is an armored, full track-laying combat vehicle carrying a crew of 4 men. It is powered by 2 liquid-cooled, 90-degree, V-type, 8-cylinder Cadillac engines located in the engine compartment in the rear of the hull. Power is transmitted to the final drives and tracks through 2 Hydra-matic transmissions, 2 propeller shafts, a 2-speed, step-down transfer unit, and the controlled differential (fig. 3).

b. 75-mm Howitzer Motor Carriage M8, The 75-mm Howitzer Motor Carriage M8 (fig. 2) is an armored, full track-laying, self-propelled mount for a 75-mm howitzer. It carries a crew of 4 men. It is powered by the same type of equipment as the Light Tank M5.

3. ARRANGEMENT OF MANUAL.

a. Section II covers the inspection, disassembly, assembly, maintenance, repair, and shipping and storage of all components of the engine cooling system. Section III covers the components of the engine electrical system, and section IV covers the components of the fuel system in the same detail. Section V lists all standard nomenclature lists, technical manuals and other publications pertinent to the materiel described herein.

4. ORGANIZATION MAINTENANCE.

a. Scope. The scope of maintenance and repair by the crew and other units of the using arms is determined by the availability of suitable

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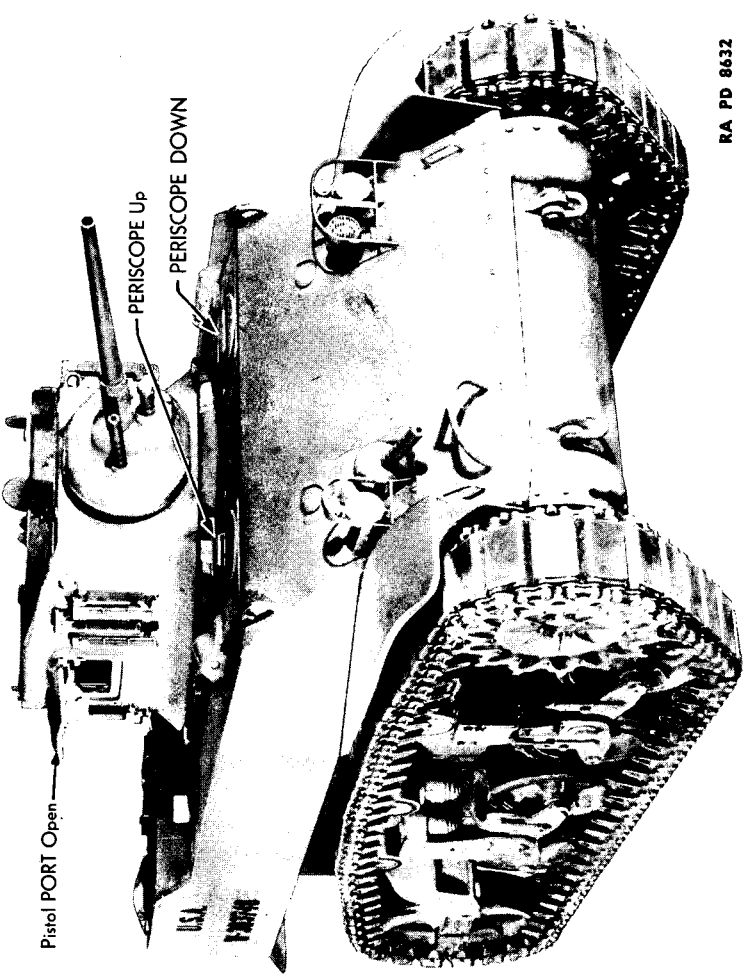

Figure 1 — Light Tank, M5 — Right Front View

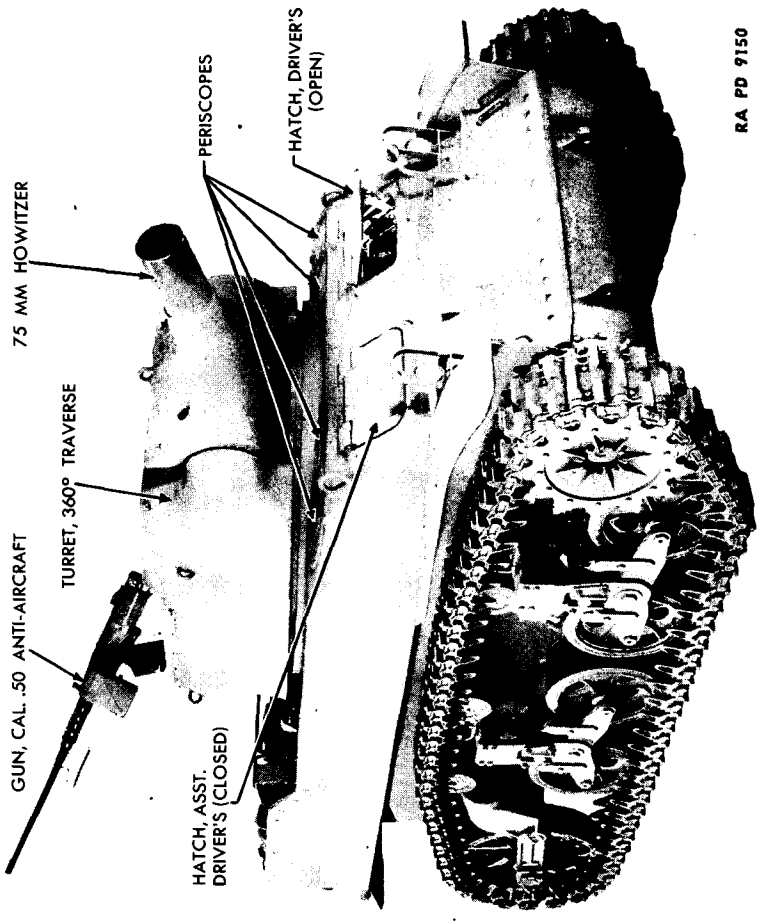

Figure 2 — 75-MM Howitzer Motor Carriage M8 — Right Front View

INTRODUCTION

tools, availability of necessary parts, capabilities of the mechanics, time available, and the tactical situation. All of these are variable and no exact system of procedure can be prescribed.

b. Allocation. Indicated below are the maintenance duties for which tools and parts have been provided for the using arm personnel. Other replacements and repairs are the responsibility of ordnance maintenance personnel but may be performed by using arm personnel when circumstances permit, within the discretion of the commander concerned. Echelons and words as used in this list of maintenance allocations are defined as follows:

SECOND ECHELON: Line organization regiments, battalions, companies, detachments, and separate companies.

THIRD ECHELON: Ordnance light maintenance companies, ordnance medium maintenance companies, ordnance divisional maintenance battalions, and post ordnance shops.

FOURTH ECHELON: Ordnance heavy maintenance companies, and service command shops.

FIFTH ECHELON: Ordnance base regiments, ordnance bases, arsenals, and manufacturers' plants.

SERVICE: (Including preventive maintenance.) Refer to AR 850-15, paragraph 23 **a** (1) and (2).	Consists of servicing, cleaning, lubricating, tightening bolts and nuts, and making external adjustments of subassemblies or assemblies and controls.
REPLACE: Refer to AR 850-15, paragraph 23 **a** (4).	Consists of removing the part, subassembly or assembly from the vehicles and replacing it with a new or reconditioned or rebuilt part, subassembly or assembly, whichever the case may be.
REPAIR: Refer to AR 850-15, paragraph 23 **a** (3) and (5), in part.	Consists of making repairs to, or replacement of the part, subassembly or assembly that can be accomplished without completely disassembling the subassembly or assemblies, and does not require heavy welding, or riveting, machining, fitting and/or alining or balancing.
REBUILD: Refer to AR 850-15, paragraph 23 **a** (5) in part, and (6).	Consists of completely reconditioning and replacing in serviceable condition any unserviceable part, subassembly or assembly of the vehicle, including welding, riveting, machining, fitting, alining, balancing, assembling and testing.

ORDNANCE MAINTENANCE — ENGINE COOLING, ENGINE ELECTRICAL AND ENGINE FUEL SYSTEMS FOR LIGHT TANK M5 AND 75-MM HOWITZER MOTOR CARRIAGE M8

ENGINE	ECHELONS 2nd	3rd	4th	5th
Bearing, transmission mainshaft, pilot—replace		X		
Bearings, camshaft—replace			E	X
Bearings, connecting rod—replace		E	E	X
Bearings, crankshaft, main—replace		E	E	X
Block, cylinder and crankcase assembly—rebuild (recondition)			E	X
Carburetor—replace	X			
Carburetor—repair		X		
Carburetor—rebuild			E	X
Chain, timing—replace		E	X	
Crankshaft, flywheel and flywheel cover—replace as a complete assembly			E	X
(NOTE: These parts must be balanced as a complete assembly.)				
Eccentric, fuel pump drive—replace		X		
*Engine transmission assembly—replace		X		
Engine transmission assembly—repair		E	X	
Engine transmission assembly—rebuild			E	X
Float and screen, oil pump—replace	E	X		
Gage, oil pressure, unit—replace	X			
Gaskets, cylinder head—replace	X			
Gear, idler, distributor drive—replace		E	X	
Generator—replace	X			
Generator—repair		X		
Generator—rebuild			X	
Heads, cylinder—replace	E	X		
Lifter assemblies, valve—replace	E	X		
Lifter assemblies, valve—repair		E	X	
Lifter assemblies, valve—rebuild			E	X
Lines, oil external—clean, repair and replace	X			
Manifold, exhaust, intake, and gaskets—replace	E	X		
Muffler, exhaust pipe, and gaskets—replace	E	X		

*The second echelon is authorized to remove and reinstall engine transmission assemblies, transfer unit controlled differential assembly, and other items marked by asterisk. When it is necessary, however, to replace an item marked by an asterisk with a new or rebuilt part, subassembly or unit assembly, the assembly marked by asterisk will not be removed from the vehicle by the second echelon until authorization is received from a higher echelon.

INTRODUCTION

ENGINE	ECHELONS 2nd	3rd	4th	5th
Pan, oil—clean and replace gaskets	X			
Pins, piston—replace		E	E	X
Pistons—replace		E	E	X
Pulley, crankshaft, fan, generator, and water pump drive—replace	E	X		
Pumps, fuel—replace	X			
Pumps, fuel—repair		X		
Pumps, fuel—rebuild			X	
Pump, oil—replace	E	X		
Pump, oil—repair		E	X	
Pump, oil—rebuild			E	X
Rings, piston—replace		E	E	X
Rods, connecting—replace		E	E	X
Shaft, oil pump, and distributor drive—replace		E	X	
Springs, valve—replace	E	X		
Sprockets, timing—replace		E	E	X
Starter, assembly—replace	X			
Starter, assembly—repair		X		
Starter, assembly—rebuild			X	
Valve, guide, bushings—replace		E	E	X
Valve, plunger unit assembly—replace		E	X	
Valve, plunger unit assembly—repair			E	X
Valves—replace		E	X	
Valves—reface		E	E	X
Valves, seat—reseat		E	E	X
Ventilator, crankcase, and lines—service or replace		X		
ENGINE COOLING SYSTEM				
Belts, generator, water pump, and fan—replace	X			
Fan and hub assembly—replace	E	X		
Fan and hub assembly—rebuild		E	X	
Fan shroud assembly—replace	X			
Fan shroud assembly—repair		X		
Pump, water—replace	X			
Pump, water—repair		X		
Pump, water—rebuild			X	
Radiator and connections—service (cleaning and flushing) and replace	X			

ORDNANCE MAINTENANCE — ENGINE COOLING, ENGINE ELECTRICAL AND ENGINE FUEL SYSTEMS FOR LIGHT TANK M5 AND 75-MM HOWITZER MOTOR CARRIAGE M8

	ECHELONS			
ENGINE COOLING SYSTEM	2nd	3rd	4th	5th
Radiator core and/or assembly—rebuild			E	X
Radiator assembly — repair (replace core and gaskets)		E	X	
Radiator thermostat—replace	X			
ELECTRICAL SYSTEM				
Apparatus box assembly (generator regulator) — replace	X			
Apparatus box assembly (generator regulator) — adjust, repair		X		
Apparatus box assembly (generator regulator) — rebuild			X	
Auxiliary generator—replace	X			
Auxiliary generator—repair		X		
Auxiliary generator—rebuild			E	X
Battery—replace, recharge, and service	X			
Battery—repair		X		
Battery—rebuild			E	X
Conduits and wiring, electrical—replace	E	X		
Conduits and wiring, electrical—repair		E	X	
Filters, electrical—replace	X			
Filters, electrical—repair		E	X	
Lights, all—service and replace	X			
Lights, all—rebuild		E	X	
Siren—replace	X			
Siren—repair		X		
Siren—rebuild			X	
Switch, battery—replace	X			
Switch, battery—repair		X		
Switch, siren—replace	X			
Switch, siren—repair		X		
IGNITION (ELECTRICAL SYSTEM)				
Coil, ignition—replace	X			
Condenser, distributor—replace	X			
Distributor and cap assembly—replace	X			
Distributor assembly—repair		X		

INTRODUCTION

	ECHELONS			
IGNITION (ELECTRICAL SYSTEM)	2nd	3rd	4th	5th
Distributor assembly—rebuild		E	X	
Distributor breaker points—replace	X			
Plugs, spark—service and replace	X			
Plugs, spark—(2-piece)—repair		X		
Wiring, ignition—replace	X			
EXTINGUISHER, FIRE SYSTEM				
Extinguishers, fire—service and replace	X			
Extinguishers, fire—repair and recharge, CO_2 type		X		
Extinguishers, fire—rebuild			E	X
FINAL DRIVE				
Final drive assembly—replace	X			
Final drive assembly—repair		X		
Final drive assembly—rebuild			E	X
Hub, sprocket—replace	X			
Hub, sprocket—rebuild			E	X
Sprockets—replace	X			
Sprockets—rebuild			E	X
FUEL SYSTEM				
Cleaner, air—service and replace	X			
Cleaner, air—repair		X		
Filter, fuel—service and replace	X			
Filter, fuel—repair		X		
Filter, fuel—rebuild			X	
Lines, fuel—repair and replace	X			
Tanks, fuel—clean or replace	X			
Tanks, fuel—repair		X		
HULL AND TURRET				
Antiaircraft gun ring (motor carriage only)—service and replace	X			
Antiaircraft gun ring (motor carriage only)—repair		E	X	
Antiaircraft gun ring (motor carriage only)—rebuild			E	X
Covers, pistol port and peep hole protectors—service or replace	X			

ORDNANCE MAINTENANCE — ENGINE COOLING, ENGINE ELECTRICAL AND ENGINE FUEL SYSTEMS FOR LIGHT TANK M5 AND 75-MM HOWITZER MOTOR CARRIAGE M8

	ECHELONS			
HULL AND TURRET	2nd	3rd	4th	5th
Cover, pistol port and peep hole protectors—repair	E	X		
Doors, grilles, and hood assemblies—replace		X		
Doors, grilles, and hood assemblies—rebuild			E	X
Hull—rebuild			E	X
Lifting eyes—replace			X	
Lifting hooks—replace			X	
Mechanism, turret traversing—replace	X			
Mechanism, turret traversing—repair		X		
Mechanism, turret traversing—rebuild			E	X
Pads—replace	X			
Plate armor—welding		E	X	
Plate armor—replace			E	X
Rollers, turret—adjust, service or replace	X			
Rollers, turret—rebuild			E	X
Safety belts—replace	X			
Safety belts—repair		X		
Seats—replace	X			
Seats—repair		X		
Subfloor (motor carriage only)—replace	X			
Subfloor (motor carriage only)—repair		X		
Turret ring and gear assembly—replace		E	X	
Turret ring and gear assembly—rebuild			E	X
HYDRA-MATIC TRANSMISSION				
Anchor, reverse—replace	X			
Bands—adjust	X			
Bands—replace			E	X
Body, control valve—replace	X			
Body, control valve—repair		X		
Body, control valve—rebuild			E	X
Linkage, Hydra-matic transmission—replace	X			
Linkage, throttle control—adjust or replace	X			
Pan, oil, and cooler assembly—replace	X			
Transmission assembly—replace		X		
Transmission assembly—repair			X	
Transmission assembly—rebuild			E	X

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INSTRUMENTS AND GAGES	ECHELONS 2nd	3rd	4th	5th
Compass—replace	X			
Compass—repair		X		
Instruments and gages—service and replace	X			
Instruments and gages—repair		X		
Instruments and gages—rebuild			E	X
MISCELLANEOUS				
Sheet metal, repair		X		
Welding, light		X		
Welding, medium			X	
Welding, heavy			E	X
PROPELLER SHAFTS AND UNIVERSAL JOINTS				
Shaft, propeller assembly, w/universal joints — replace	X			
Shaft, propeller assembly, w/universal joints — repair		X		
Shaft, propeller assembly, w/universal joints — rebuild			E	X
SUSPENSION SYSTEM				
Axle, front and rear—replace		X		
Axle, front and rear—rebuild			E	X
Bearings and seals, bogie wheel, and idlers—replace	X			
Bogie components—replace	X			
Bogie components—repair		X		
Bogie components—rebuild			E	X
Roller track, supporting w/bracket—replace	X			
Roller track, supporting w/bracket—repair		X		
Roller, track, supporting w/bracket—rebuild			E	X
Track—service and replace	X			
Track—reverse (rubber type)	X			
Wheels, bogie and idler—rebuild			E	X
Wheel, bogie—replace	X			
Wheel, bogie—repair and replace tire		X		
Wheel, idler—replace	X			
Wheel, idler—repair		X		
TRANSFER UNIT AND CONTROLLED DIFFERENTIAL				
Bands, transfer unit, reduction—adjust	X			
Bands, transfer unit, reduction—replace and reline			E	X
Body, control valve—replace	X			
Body, control valve—repair		X		
Body, control valve—rebuild			E	X
Cooler, oil, transmission unit—replace	X			

ORDNANCE MAINTENANCE — ENGINE COOLING, ENGINE ELECTRICAL AND ENGINE FUEL SYSTEMS FOR LIGHT TANK M5 AND 75-MM HOWITZER MOTOR CARRIAGE M8

TRANSFER UNIT AND CONTROLLED DIFFERENTIAL	ECHELONS 2nd	3rd	4th	5th
Cooler, oil, transmission unit—repair		X		
Cooler, oil, transmission unit—rebuild			E	X
*Differential, controlled, subassembly — replace D59695		X		
Differential, controlled, subassembly — repair D59695		E	X	
Differential, controlled, subassembly — rebuild D59695			E	X
Lever, brake and steering—replace	X			
Lever, brake and steering—repair		X		
Lever, Hydra-matic selector—replace	X			
Lever, transfer unit, manual control—replace	X			
Shoes, brake assembly, brake and steering—adjust and replace	X			
Shoes, brake assembly, brake and steering—repair and reline		X		
*Transfer unit and controlled differential assembly —replace		X		
Transfer unit and controlled differential assembly —repair		E	X	
Transfer unit and controlled differential assembly —rebuild			E	X
VEHICLE ASSEMBLY				
Tank assembly — rebuild (with serviceable assemblies)			X	E
Tank assembly—service, bolts, nuts and screws—tighten and replace	X			
Tank assembly—service, cleaning	X			
Tank assembly—service, lubrication	X			
Tank assembly—service, painting	X			
Tank assembly—service, tightening	X			

NOTE: Operations allocated will normally be performed in the echelon indicated by "X." Operations allocated to the echelons as indicated by "E" may be accomplished by the respective echelons in emergencies only.

*The second echelon is authorized to remove and reinstall engine transmission assemblies, transfer unit controlled differential assembly, and other items marked by asterisk. When it is necessary, however, to replace an item marked by an asterisk with a new or rebuilt part, subassembly or unit assembly, the assembly marked by asterisk will not be removed from the vehicle by the second echelon until authorization is received from a higher echelon.

INTRODUCTION

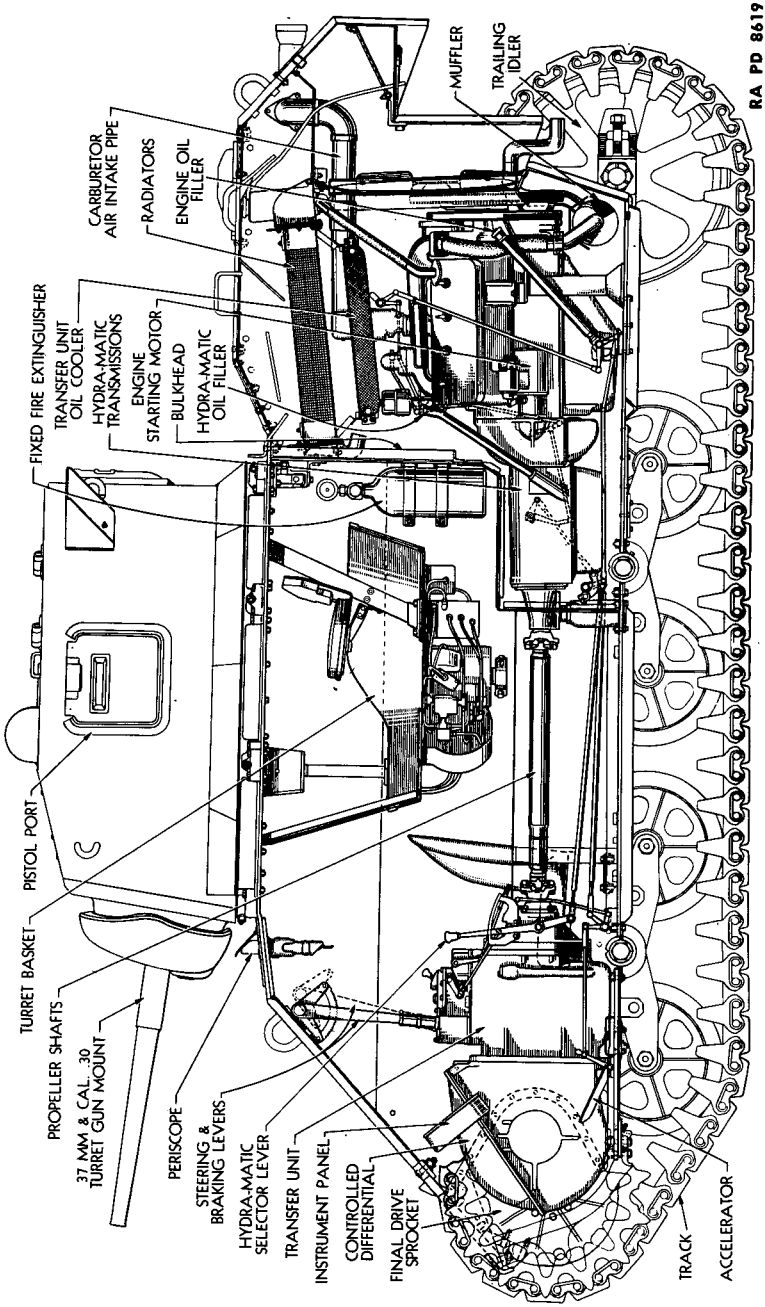


Figure 3 — Light Tank M5 — Cross Section

Section II

ENGINE COOLING SYSTEM

5. DESCRIPTION.

a. Two identical but completely independent cooling systems, one for each engine and Hydra-matic transmission, are used in the Light Tank M5 tanks and the 75-mm Howitzer Motor Carriage M8. Each system contains the following major units: radiator with pressure cap and overflow valve, water pump, thermostat and necessary connections and bypass, engine fan, and an oil cooler for the Hydra-matic transmission.

b. The radiators are each mounted in a horizontal position above their respective engines. Each radiator consists of a core of tube-and-fin construction, with an inlet and outlet tank bolted to the rear and the front of the core respectively. The inlet tank at the rear incorporates both the filler neck and the thermostat housing to which the engine-to-radiator hoses are connected. The forward or outlet tank incorporates the elbow to which the radiator-to-water pump hoses and tube are connected.

ENGINE COOLING SYSTEM

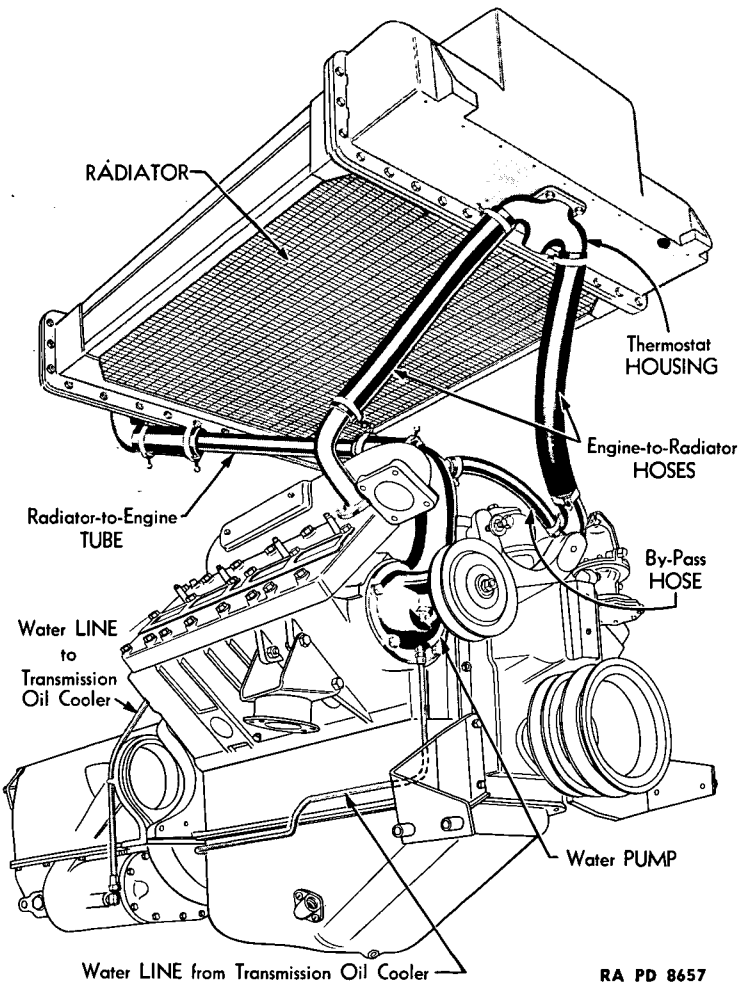
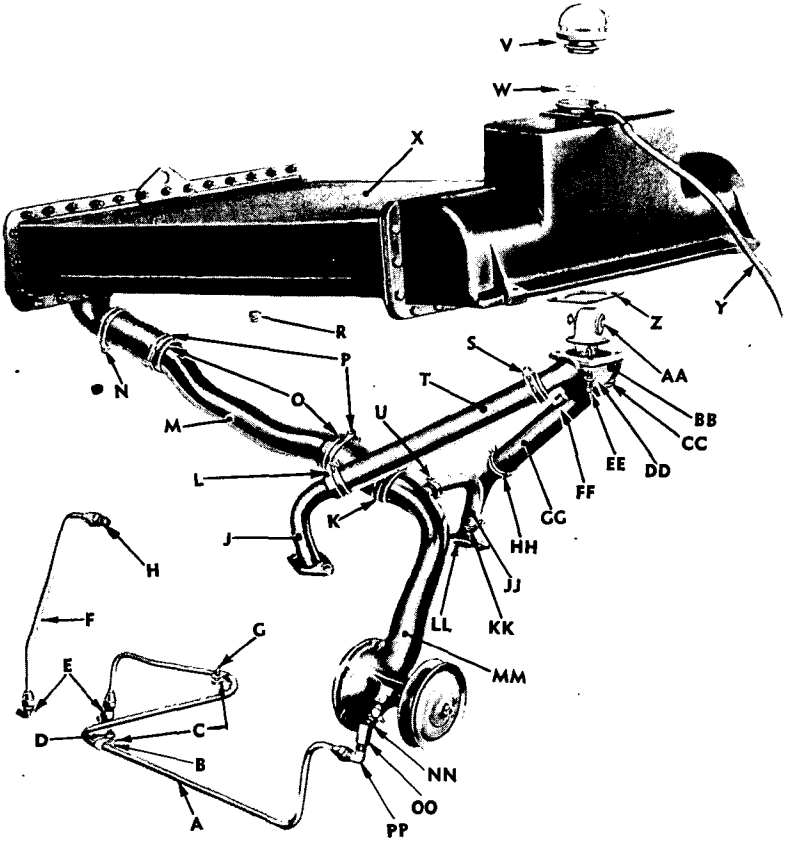


Figure 4 — Cooling System Connections



A — LINE, ASS'Y	**W** — GASKET
B — SCREW	**X** — RADIATOR, ASS'Y
C — CLEAT	**Y** — HOSE
D — SPACER	**Z** — GASKET
E — ELBOW	**AA** — THERMOSTAT, ASS'Y
F — LINE, ASS'Y	**BB** — HOUSING
G — SCREW	**CC** — CLAMP
H — NIPPLE	**DD** — WASHER, LOCK
J — ELBOW	**EE** — SCREW
K — CLAMP	**FF** — PLUG, PIPE
L — CLAMP	**GG** — HOSE
M — TUBE	**HH** — CLAMP
N — CLAMP	**JJ** — HOSE
O — HOSE	**KK** — CLAMP
P — CLAMP	**LL** — ELBOW
R — PLUG, PIPE	**MM** — PUMP, ASS'Y
S — CLAMP	**NN** — NIPPLE
T — HOSE	**OO** — COUPLING
U — CLAMP	**PP** — ELBOW
V — CAP	

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Figure 5 — Cooling System — Exploded View

ENGINE COOLING SYSTEM

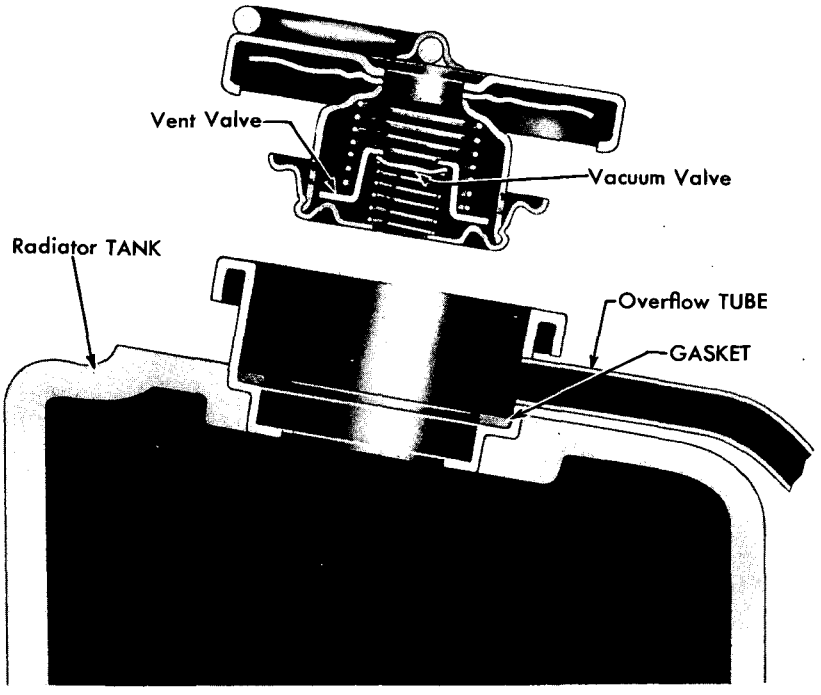


Figure 6 — Pressure Cap — Cross Section

c. A pressure-operated vent valve is contained in the radiator filler cap (fig. 6). Fluid must pass through this valve in order to reach the overflow pipe and pass out of the system. Since a pressure of 15 pounds is required to open this valve, the boiling point of the cooling solution is raised to approximately 250 F, making the loss of coolant, and particularly antifreeze, less likely under the most severe operating conditions.

d. The water pump (fig. 7) is mounted on the right front of the crankcase and driven from the crankshaft by a belt that also drives the generator. The water pump shaft carries a vaned impeller which forces water through the system by centrifugal action. Chevron type spring-loaded packings prevent leakage of coolant along the shaft.

e. A blocking-type, bimetal thermostat is mounted in the housing at the bottom of the radiator inlet tank (fig. 8). This thermostat is equipped with balanced, double poppet valves to control the water temperature by restricting or permitting flow of water from the cylinder heads to the radiator. A fixed bypass just ahead of the thermostat circulates the fluid back to the water pump when the thermostat is closed.

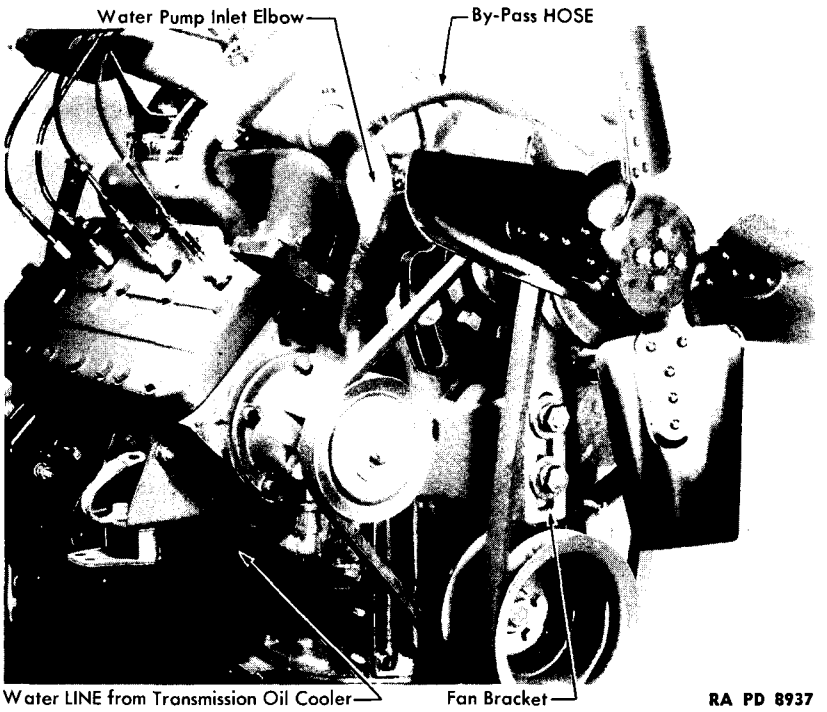


Figure 7 — Fan and Water Pump Mountings

f. The water pipes and connections for the system consist of hoses and connecting tubes and pipes (figs. 4 and 5).

g. The engine fan is mounted on an adjustable support on the engine front cover (fig. 7) and is driven at crankshaft speed by a V-belt direct from the crankshaft.

h. An oil cooler or heat transfer unit is mounted in the oil pan of each Hydra-matic transmission. Details of the construction and servicing of this unit are covered in Technical Manual No. 9-1727C, Ordnance Maintenance. Transmission for Light Tanks M5, M5A1 and 75-mm Howitzer Motor Carriage M8.

6. OPERATION.

a. When the engine is running, coolant is drawn from the forward tank of the radiator down through the water pump and forced into the engine water jackets. Part of this fluid circulates through the right-hand cylinder block and head, and part of it passes through a cored opening

ENGINE COOLING SYSTEM

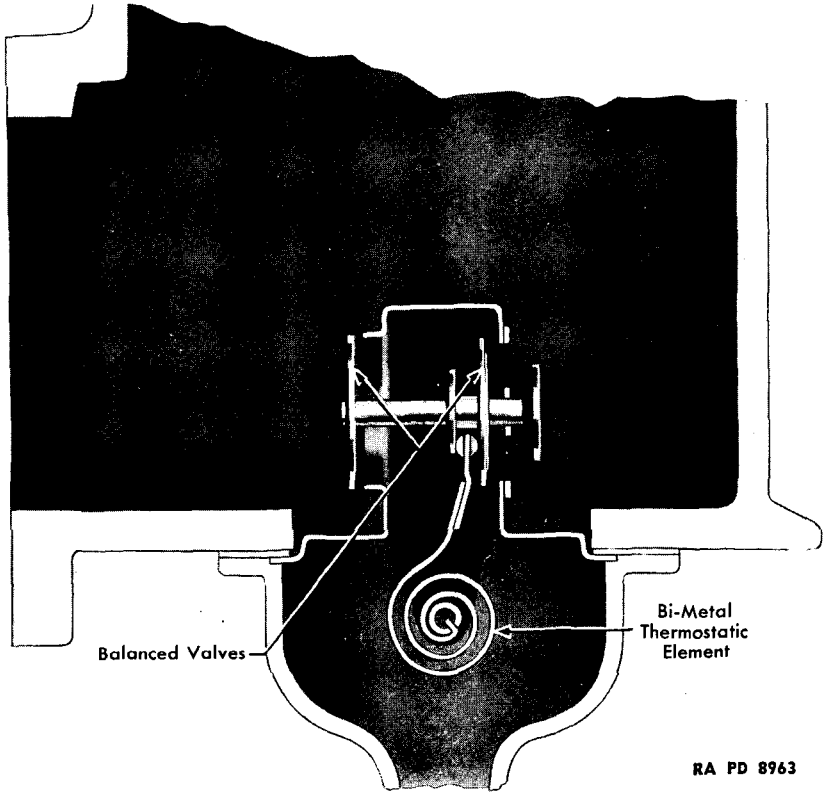


Figure 8 — Thermostat — Cross Section

in the crankcase to the left-hand cylinder block and head. After circulating through the cylinder blocks, around the valves and manifolds and through the cylinder heads, the heated liquid is forced up through the outlet hoses to the radiator.

b. When the engine is first started and the cooling liquid is cold, the thermostat located in the radiator inlet housing is closed and the pump pressure causes the liquid to flow across the bypass hose back to the water pump (fig. 10). With no circulation through the radiator, the engine is rapidly warmed to operating temperatures.

c. As the engine approaches operating temperatures, the heated liquid causes the thermostat to open and permit flow through the radiator. The thermostat opening increases as the temperature increases, until there is a full flow of cooling liquid through the radiator as the engine reaches normal operating temperature.

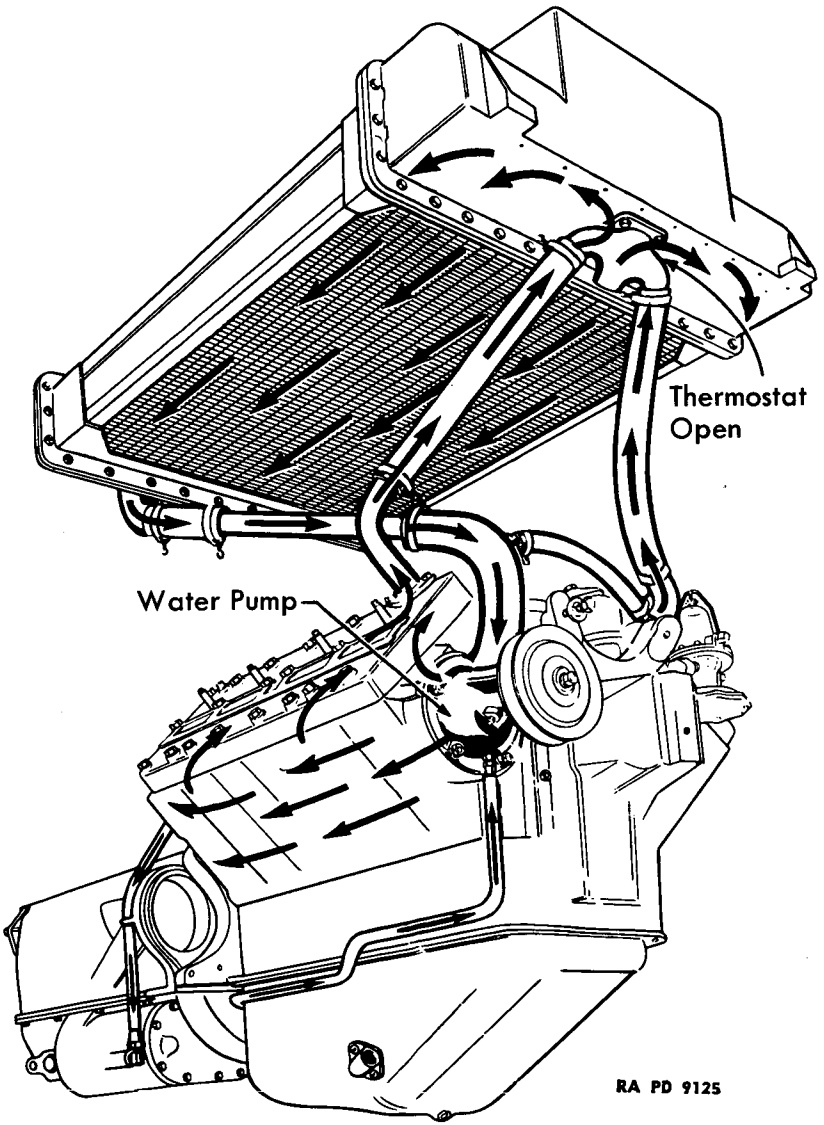


Figure 9 — Water Flow Diagram, Hot Engine

ENGINE COOLING SYSTEM

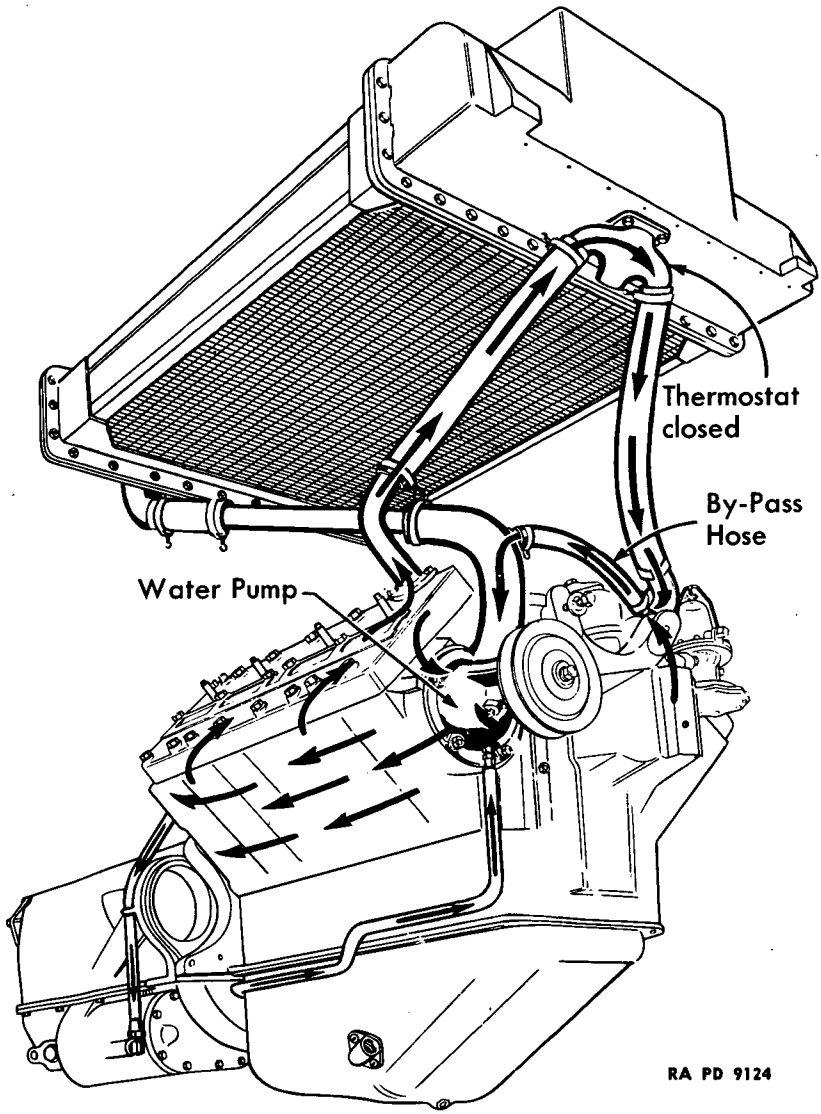


Figure 10 — Water Flow Diagram, Cold Engine

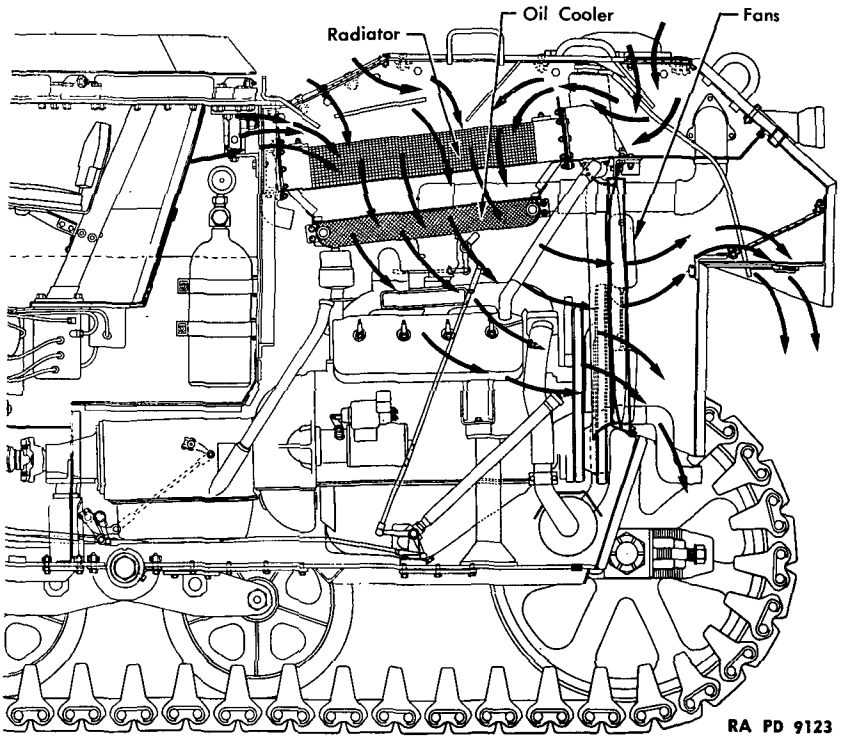


Figure 11 — Circulation of Cooling Air

d. Water pump pressure also forces some cooling liquid through an external pipe at the rear of the right-hand cylinder block to the transmission oil cooler, where it absorbs heat from the transmission oil and is then returned through an external pipe to the water pump (figs. 9 and 10).

e. Rotation of the fan causes air circulation as indicated in figure 11. Air is drawn in through grilled openings around the engine compartment top cover and through hinged openings from the fighting compartment. This air then passes down through the radiator cores, across the top of the engines, and out through the fan shrouds and the rear bulkheads.

7. TABULATED DATA AND SPECIFICATIONS.

a. Fan.

Blades, angle ..... 32°
Blades, diameter ..... 22 in.
Blades, number of 4

ENGINE COOLING SYSTEM

Drive ..... V-belt
Drive ratio ..... 1 to 1
Lubrication ..... None, sealed bearings
Manufacturer ..... Hayes Industries

b. Radiator.

Capacity, each complete system ..... 35 qt
Core, area ..... 672 sq in.
Manufacturer ..... Harrison
Type ..... Tube-and-fin

c. Thermostat.

Location ..... Radiator inlet housing
Manufacturer ..... Dole valve
Opening temperature
  First type ..... 161 to 166 F
  Second type ..... 141 to 146 F
Type ..... Bimetal

d. Water Pump.

Drive ..... Belt
Lubrication ..... Fitting
Packings ..... Spring-loaded, chevron-type
Type ..... Centrifugal

8. TECHNICAL INSPECTION IN VEHICLE.

a. Purpose. Technical inspections by ordnance personnel are a follow-up and check on organizational maintenance inspections and servicing. These inspections determine whether the vehicle should be continued in service or withdrawn from operation for overhaul.

b. Inspection Form. War Department Quartermaster Corps Form No. 260, Technical Inspection Report of Motor Vehicles, is the standard and official form for recording the inspection of all motor vehicles, including combat vehicles of the Ordnance Department. The extent to which use is made of this form or modifications depends entirely on the technical ability of available personnel, the time factor, and the test and shop equipment available.

c. Equipment Required.

CLOTH, clean	HYDROMETER, antifreeze
FLASHLIGHT	TOOL, vehicle (set)

d. Visual Inspection Procedure. Inspection includes both visual checkup and a checkup while the engines are running. Ordinarily, the

visual checkup of both cooling systems should be made first. This requires full opening of the engine compartment rear doors, and removing the two doors in the bulkhead.

(1) FANS. Inspect fan blades for cracks or breaks, loose mounting, or worn bearings, proper pitch and clearance with fan shroud.

(2) FAN SHROUD. Inspect each shroud for fit and tightness.

(3) BELTS. Inspect fan belt and water pump and generator belt on each engine for tension, and examine carefully for fraying or other indications of wear, and for presence of grease or oil. Check alinement of all belt pulleys.

(4) WATER PUMP. Inspect water pump for cracks and leaks at engine block or hose connections. Try shaft for end play or worn bearings.

(5) HOSES. Inspect condition of hoses leading from cylinder head outlets to radiator thermostat elbow, and from water pump up to radiator outlet elbow, also check for leakage at hose connections.

(6) RADIATOR LEVEL. Inspect level and condition of liquid in each radiator. If liquid appears dirty or rusty, clean cooling system as described in paragraph 10 **b.** In cold weather, check strength of antifreeze solution, as explained in paragraph 11 **a.**

e. Inspection During Operation. Inspection during engine operation is usually advisable to supplement the inspection made when the engines are not in operation. This is particularly important in the case of loss of cooling liquid.

(1) These inspections should be made with the engine rear compartment doors open, the bulkhead doors open, and the radiator caps removed.

(2) Visual inspection with a flashlight through the bulkhead door openings or the engine rear compartment door openings may reveal leakage in hose connections that is not apparent when the engines are not running. Inspections of the water pump and motor, in particular, may reveal conditions not otherwise apparent.

(3) Inspection of the flow of liquid as viewed through the radiator filler openings will be of value also. If no flow of liquid is apparent at speeds above 1,500 revolutions per minute, operation of the water pump should be investigated. If liquid surges up in the radiator tank and flows out through the overflow pipe, a clogged radiator condition is indicated.

f. For the allocation of maintenance duties, refer to the information on engine cooling system in the echelon breakdown of maintenance (par. 4).

ENGINE COOLING SYSTEM

9. TROUBLE SHOOTING.

a. Loss of Coolant.

NOTE: This condition requires investigation only if considerable amounts of coolant are required at frequent intervals.

Probable Cause	Probable Remedy
Hose connections leak.	Tighten connections or replace with latest type. Replace hoses, if necessary.
Leakage at radiator.	Remove radiator and repair or replace.
Leakage or loss of seal at radiator cap.	Replace cap or gasket.
Leakage at thermostat housing.	Replace housing gasket and tighten securely.
Leakage at water pump.	Replace pump packings or replace pump gasket and tighten as required.
Leaks at transmission water pipe.	Tighten connections or replace.
Leaks at cylinder heads.	Retighten heads to 65 to 70 foot-pounds with torque wrench, or replace head gasket and retighten.

b. Engine Overheats.

Low level of coolant.	See above.
Fan belts loose or broken.	Readjust or replace.
Radiator thermostat sticking.	Replace.
Low oil supply.	Add oil, if necessary.
Distributor timing late.	Check timing and adjust, if necessary.
No water circulation.	See subparagraph c.
Leaking radiator cap or filler neck gasket.	Replace cap or gasket.
Other engine not operating.	Repair other engine.

c. No Water Circulation.

Water pump belt loose or broken.	Readjust or replace.
Water pump impeller sheared or corroded.	Replace affected parts.
Cooling system badly clogged.	Flush system thoroughly (par. 10 f).

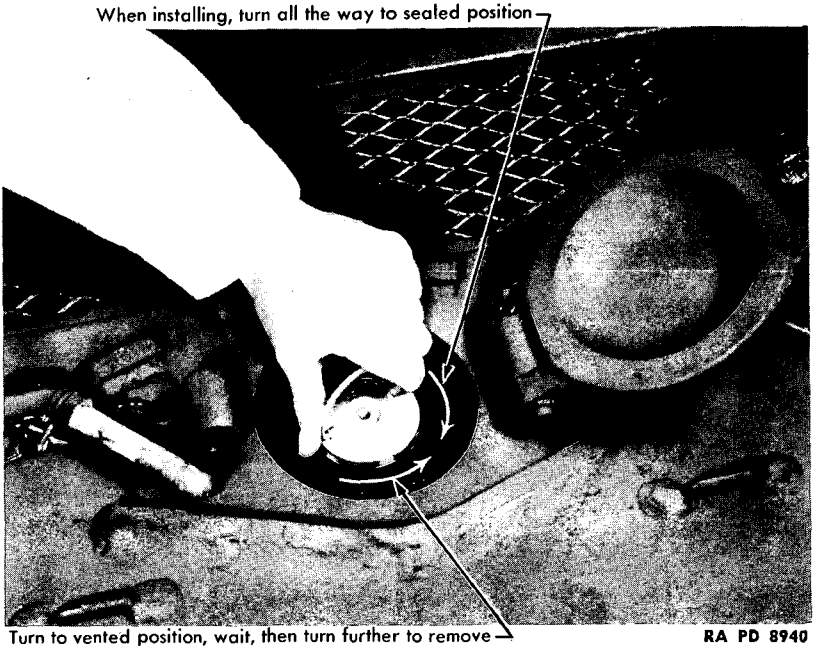


Figure 12 — Removing and Installing Radiator Cap

10. SERVICE IN VEHICLE.

a. Adding Fluid.

(1) The fluid level in each radiator should be checked at every halt and additional fluid added to keep the level up to the bottom of the filler neck.

CAUTION: Whenever removing the filler cap from a hot system, always vent the radiator long enough to let all pressure in the system escape; otherwise there is a possibility of serious burns from steam and hot water. To vent the radiator, turn the cap to the left counterclockwise until the first stop is reached. Leave the cap in this position at least one-half minute, and long enough to vent the radiator thoroughly; then press down on the cap to clear the stop and turn further to the left to remove (fig. 12).

(2) After bringing the liquid to the proper level, reinstall the radiator, making certain fiber gasket is in place in filler neck. Then turn radiator cap all the way to the right so that the entire cooling system will be sealed while operating. If this is not done, there may be excessive loss of coolant while operating under heavy service.

ENGINE COOLING SYSTEM

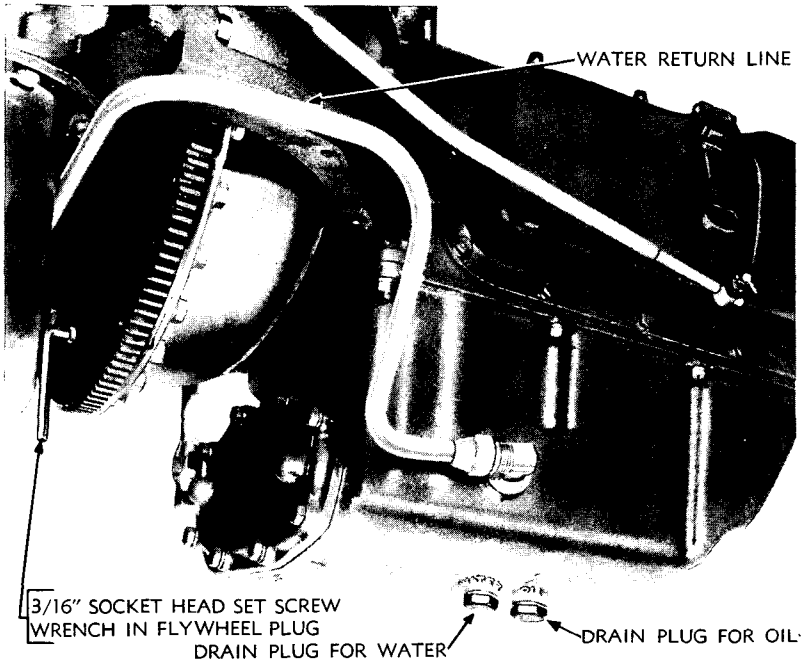


Figure 13 — Water Drain at Transmission

b. Draining and Refilling Cooling System.

(1) A cooling system should be drained and refilled with fresh water whenever the coolant appears rusty; then add fresh charge of inhibitor or antifreeze.

(2) The system can be partially drained by removing the water drain plug at the bottom of each Hydra-matic transmission (fig. 13), after removing the small plate underneath the transmission. The system can be drained completely when the two drain plugs in the fan end of each engine are also removed. It is necessary in every case to remove the radiator filler cap for rapid draining of the system.

CAUTION: Be sure to install all drain plugs before reinstalling liquid in cooling system.

(3) Add water or antifreeze as required to the cooling system, pouring it in at moderate speeds to avoid undue spillage. If hot water is available, it will partly open the blocking type thermostat and permit immediate filling of the system. When cold water is used, however, it may be necessary to run the engine for a few minutes before the ther-

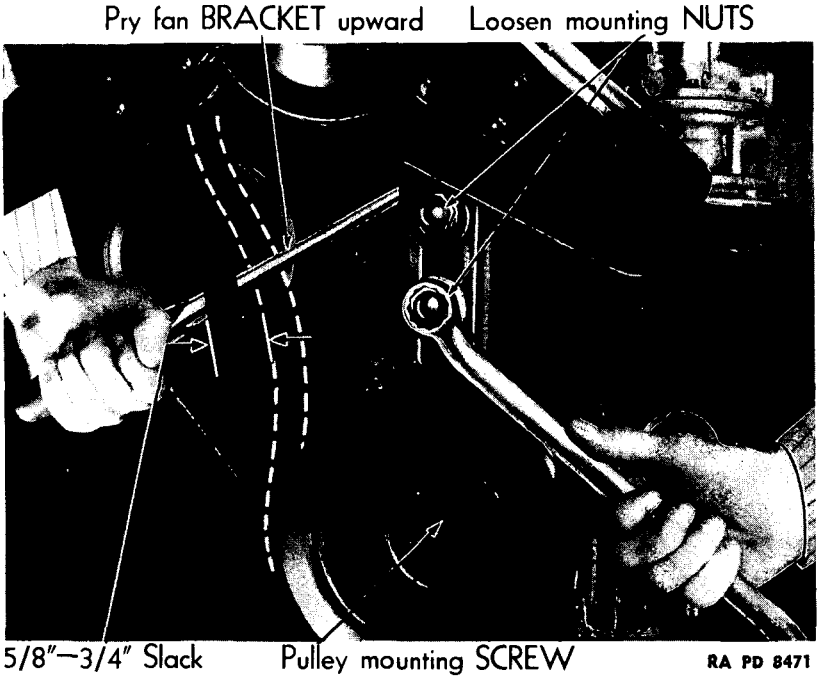


Figure 14 — Fan Belt Adjustment

mostat valve opens and permits the system to be completely filled. Be sure to perform this operation if the system seems full before 35 quarts have been added.

c. Tightening Hose Connections.

(1) In order to insure against leakage at the hose connections, it is recommended that these connections be retightened securely with a socket and torque wrench to a tightness of approximately 5 foot-pounds every 250 miles during the first 2,000 miles of use. Hoses stretch slightly under initial use during this period, and connections must be retightened until this set has been taken out.

d. Adjusting Fan Belt. The fan belt tension should be checked every 250 miles, and if the tension permits compressing the belt more than ¾ inch between the pulleys, it should be readjusted as follows:

(1) Reaching through engine compartment rear doors, loosen mounting nuts holding fan bracket to engine front cover, using a $^{15}/_{16}$-inch

ENGINE COOLING SYSTEM

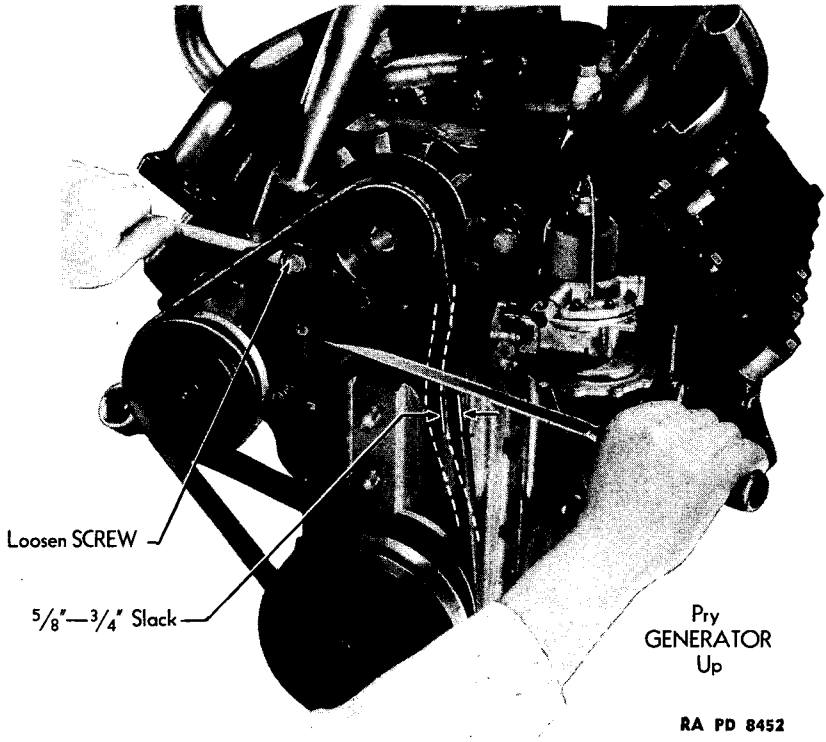


Figure 15 — Generator Belt Adjustment

box-end wrench. CAUTION: Always turn the master battery switch "OFF" before working on the fan or water pump belts.

(2) Raise or lower fan and bracket assembly until there is between 5/8- and 3/4-inch slack in belt when measured by pushing inward midway between the two pulleys (fig. 14).

(3) Fan shrouds must be adjusted for blade clearance.

(4) Tighten mounting nuts securely and recheck adjustment.

e. Adjusting Generator and Water Pump Belt. The tension of the belt that drives the water pump and generator should be checked every 250 miles, and if tension permits its being depressed more than 3/4 inch between the crankshaft and generator pulleys, the belt should be readjusted as follows:

(1) Loosen generator mounting bolts, using a 5/8-inch box-end or socket wrench.

(2) Raise or lower generator assembly by rotating on stationary bolt

until there is between 5/8- and 3/4-inch slack in belt, measured by pushing inward midway between the crankshaft and generator pulleys (fig. 15).

(3) Tighten generator mounting bolts and recheck adjustment.

f. Cleaning Cooling System. Drain solution from cooling system by removing two plugs at front of cylinder blocks and one water drain plug from bottom of Hydra-matic transmission. Refill system with fresh water and add 1½ pounds of sal soda. Run engine at medium speed for one hour at a temperature as hot as possible without boiling. Drain system by opening all three drain fittings. Flush entire system thoroughly with hot water to remove all cleaner. Reinstall drain plugs and refill cooling system.

11. SERVICE DURING COLD WEATHER.

a. ETHYLENE GLYCOL (Prestone) is the only antifreeze solution prescribed for use in vehicle radiators. The following table gives the quantity to be added per gallon of water, to prevent freezing at the indicated temperatures. To determine the total quantity necessary, multiply the cooling system capacity of each cooling system (8.75 gallons: 35 quarts), by the number of pints required per gallon at the prevailing temperature:

Freezing Point	Pints, ETHYLENE GLYCOL, (Prestone) Per Gallon
10 F	2
0 F	2½
−10 F	3
−20 F	3½
−30 F	4
−40 F	4½
−50 F	4½
−60 F	5
−70 F	5

NOTE: For additional information, see Ordnance Field Service Bulletin No. 6-11.

b. Precautions to be Taken Before Installing the Antifreeze Solution. Thoroughly flush the cooling system. Check the system for leaks; tighten the hose connections and replace hoses if necessary. Check thermostats. Partially cover air inlets of radiator to accelerate and maintain normal engine operating temperatures (during this period only). These covers may be improvised locally. Check the fan belt for adjustment or weakness. Replace the belt, if necessary. Be sure that the pump is properly lubricated.

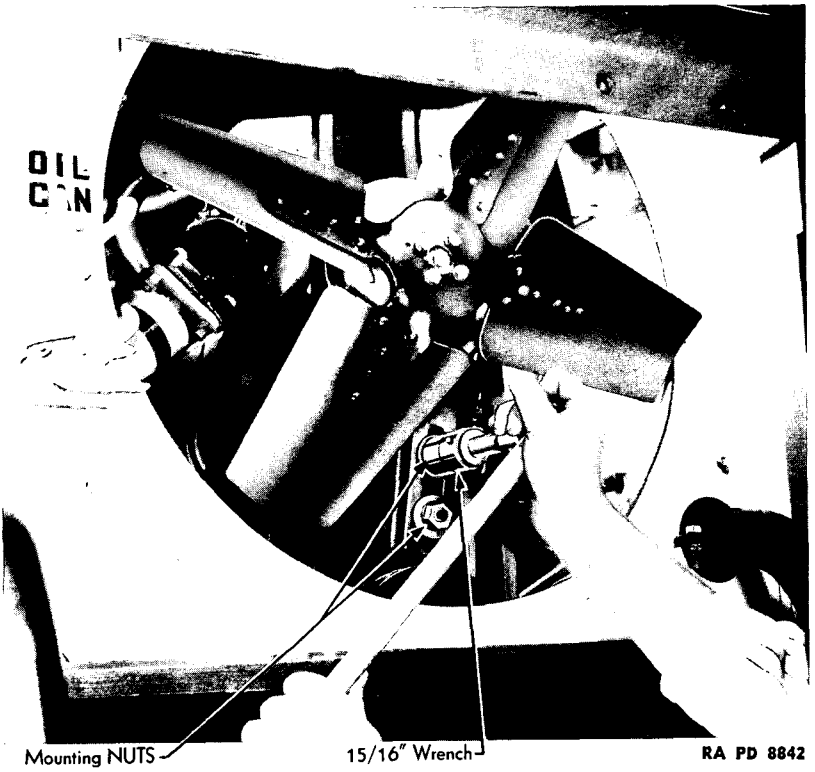


Figure 16 — Removing Fan

12. FAN AND FAN SHROUDS.

a. Equipment.

PLIERS
PRESS, arbor
WRENCH, open-end, 9/16-in.
WRENCH, socket, 5/16-in.
WRENCH, socket, 1/2-in.
WRENCH, socket, 3/4-in.
WRENCH, socket, 15/16-in.

b. Procedure.

(1) REMOVE FAN (fig. 16).

WRENCH, socket, 3/4-in.
WRENCH, socket, 15/16-in.

Remove 7 screws and lock washers from engine rear compartment doors, working from rear of vehicle, and open doors. CAUTION: Make sure master battery switch is in "OFF" position. Remove 2 nuts from fan bracket mounting studs. Remove fan, fan belt, and fan bracket.

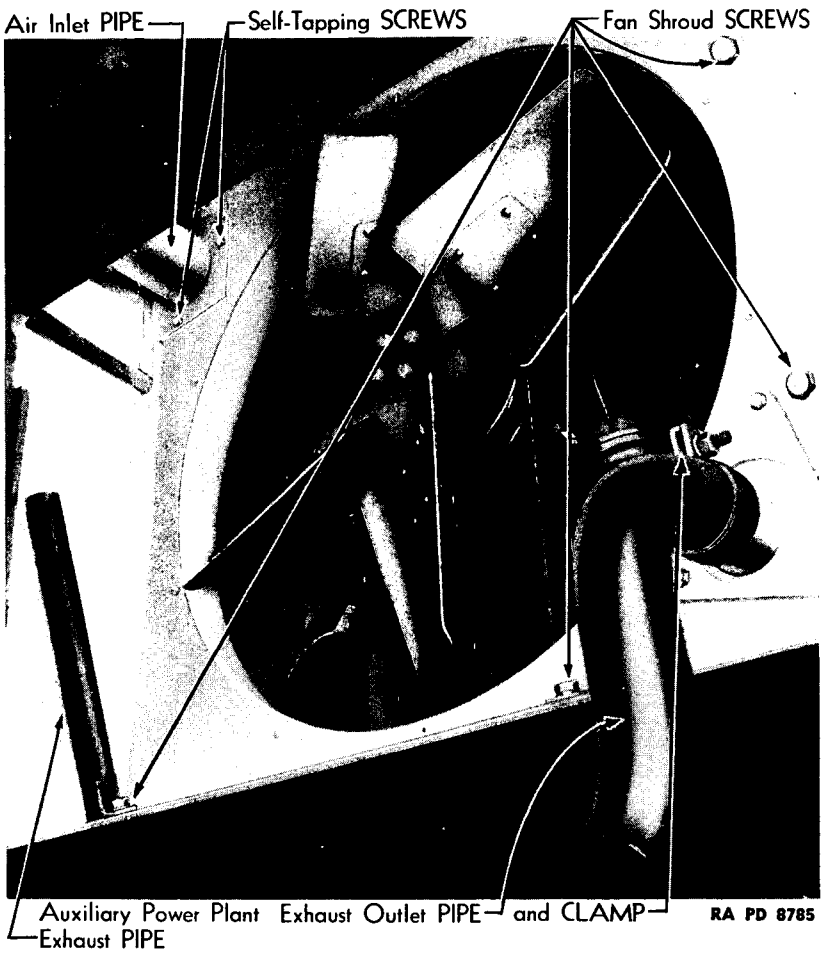


Figure 17 — Fan Shroud Mountings

(2) REMOVE FAN SHROUDS (fig. 17).

WRENCH, open-end, 9/16-in. **WRENCH**, socket, 9/16-in.
WRENCH, socket, 5/16-in.

Working through rear compartment doors, disconnect exhaust outlet pipes, using a 9/16-inch socket wrench and a 9/16-inch open-end wrench, one on each end of clamp. Remove 2 self-tapping screws from square seal around carburetor air inlet pipe and slide seal toward rear. Remove 9 screws from fan shrouds and remove shrouds. Left-hand shroud can be removed without removing right-hand shroud by taking out 5 of the

ENGINE COOLING SYSTEM

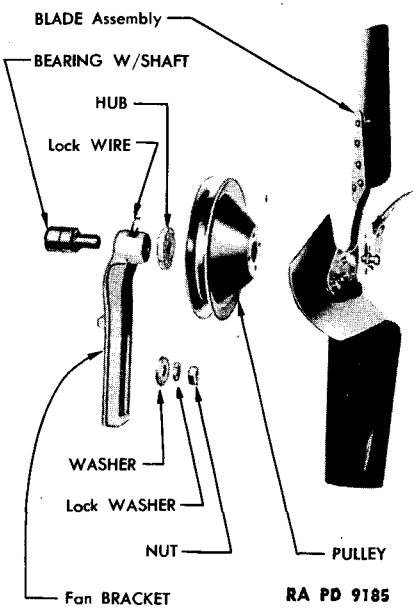


Figure 18 — Fan and Bracket — Exploded View

9 screws, but right-hand shroud cannot be removed without removing left-hand shroud. It is not necessary to remove oilcan bracket from left-hand shroud or triangular plate from either shroud.

(3) DISASSEMBLE FAN (fig. 18).

PLIERS — WRENCH, socket, ½-in.
PRESS, arbor

Remove 4 screws and lock washers, holding fan blade assembly and fan drive pulley to hub, using a ½-inch socket wrench. Remove lock ring holding fan drive shaft bearing in place in fan bracket, using a pair of pliers (fig. 19). Place fan bracket, shaft and bearing assembly in arbor press, resting fan bracket on bed of press, and press fan shaft and bearing assembly out of fan bracket. Install fan shaft and pulley mounting hub in an arbor press, supporting hub on bed of press and press fan shaft out of hub.

(4) FAN INSPECTION.

(*a*) *Inspect Fan Bracket.* Wash all fan parts (except bearings) thoroughly in SOLVENT, dry-cleaning. NOTE: Fan bearing is sealed and does not require cleaning or removal of grease. Inspect fan bracket, and, if bent or cracked, replace. Inspect bearing bore in fan bracket for

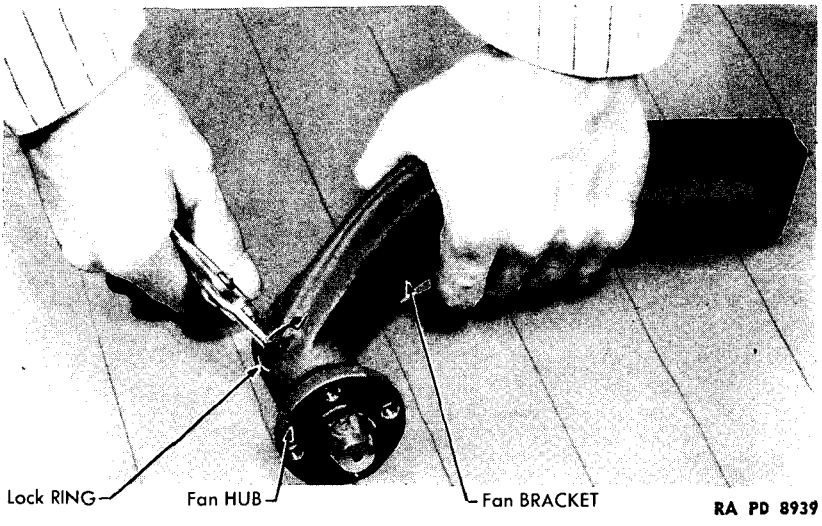


Figure 19 — Removing Lock Ring for Fan Drive Shaft

nicks or burs, which may be removed by using a small file or CLOTH, crocus.

(*b*) *Inspect Bearing and Shaft.* Check fan bearing carefully for roughness. Bearing should spin freely on inner race. Inspect fan shaft for nicks or burs, which may be removed with CLOTH, crocus.

(*c*) *Inspect Pulley and Hub.* Inspect fan shaft pulley mounting hub, and replace, if cracked. Place fan pulley on a flat surface and check to make certain that pulley is not warped. Check pulley for dents that might cause belt failure. Inspect hub of fan pulley to make sure that spot welds are in good condition.

(*d*) *Inspect Blade Assembly.* Place fan blade assembly on a flat surface with the front side of the fan down and note whether each inner corner of the 4 fan blades contacts the flat surface. To check for bends in the fan blades, turn the fan blades, turn the fan assembly over with the fan facing down and repeat the preceding inspection. Inspect rivets holding fan blades to fan blade spider.

(5) FAN SHROUD INSPECTION. Inspect fan shroud to make sure it is not bent so as to interfere with fan blades. Straighten, if necessary, or, if too badly damaged, replace.

(6) ASSEMBLE FAN.

PLIERS
PRESS, arbor
WRENCH, socket, ½-in.

Support fan shaft pulley mounting hub on bed of an arbor press and press fan shaft through hub until hub contacts ring welded to end of shaft. Install fan bracket on bed of an arbor press and press fan shaft and bearing assembly into fan bracket until groove on bearing lines up with slot in fan bracket. Install a new fan bearing lock wire through slot in fan bracket. Position fan pulley on mounting hub with concave side of pulley toward fan bracket so that mounting screw holes in pulley line up with tapped holes for mounting screws in hub. Position fan blade assembly over fan pulley, lining up mounting screw holes, and install 4 mounting screws and lock washers.

(7) INSTALL FAN.

WRENCH, socket, $^{15}/_{16}$-in.

Position fan assembly consisting of fan, fan belt and bracket on mounting studs. Place 2 flat washers, lock washers and nuts on studs. Adjust fan belt as explained in paragraph 10 **d.**

(8) INSTALL FAN SHROUDS.

WRENCH, open-end, $^{9}/_{16}$-in. WRENCH, socket, $^{9}/_{16}$-in.

WRENCH, socket, $^{5}/_{16}$-in.

Working from rear of vehicle, position fan shrouds and secure by tightening 9 screws and lock washers. Position square seal around carburetor air inlet pipe on each shroud and tighten 2 self-tapping screws, using $^{5}/_{16}$-inch socket wrench. Connect exhaust outlet pipes by tightening nut and bolt in clamp, using a $^{9}/_{16}$-inch open-end wrench and a $^{9}/_{16}$-inch socket wrench.

13. HOSE CONNECTIONS.

a. Equipment.

PLIERS

b. Procedure.

(1) REMOVE HOSE CONNECTIONS (fig. 20).

PLIERS

Use pliers and loosen screw in clamp at each hose connection. Remove hoses by sliding off ends of radiator and cylinder block connections.

(2) HOSE CONNECTION INSPECTION.

Inspect hose connections, making sure hoses are not cracked or punctured and fittings are tight enough to be leakproof. If hoses are defective, they should be replaced.

(3) ASSEMBLY HOSE CONNECTIONS.

PLIERS

Position clamps on hoses and tighten securely in place, using a pair of pliers.

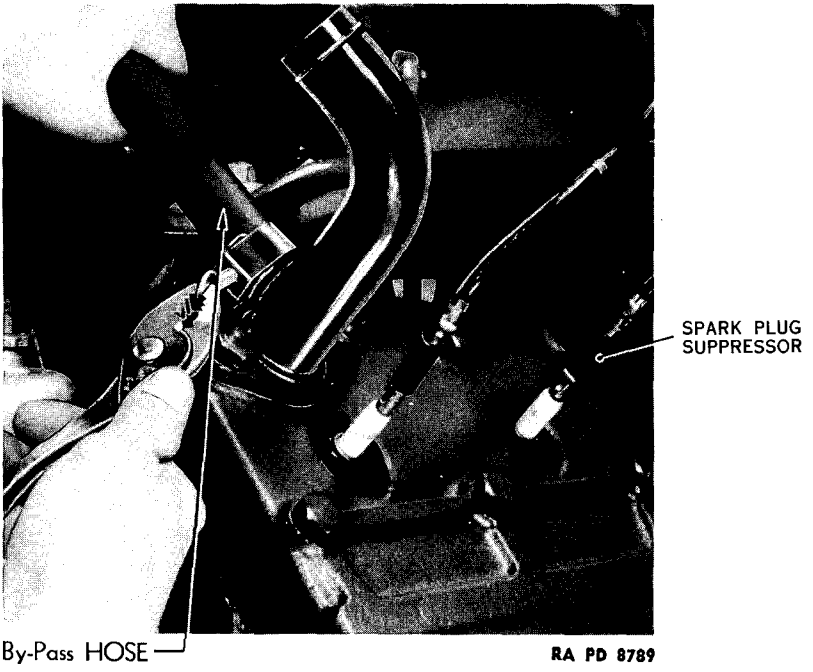


Figure 20 — Removing Water Pump Bypass Hose

14. RADIATOR.

a. Equipment.

HOIST
SCREWDRIVER
SCREWDRIVER, T-handle, 7/8- x 3/32-in. blade
SLING, B226796
WRENCH, open-end, 7/16-in.
WRENCH, open-end, 1/2-in.
WRENCH, socket, 1/2-in.
WRENCH, socket, 9/16-in.
WRENCH, socket, 3/4-in.
WRENCH, socket, 7/8-in.

b. Procedure.

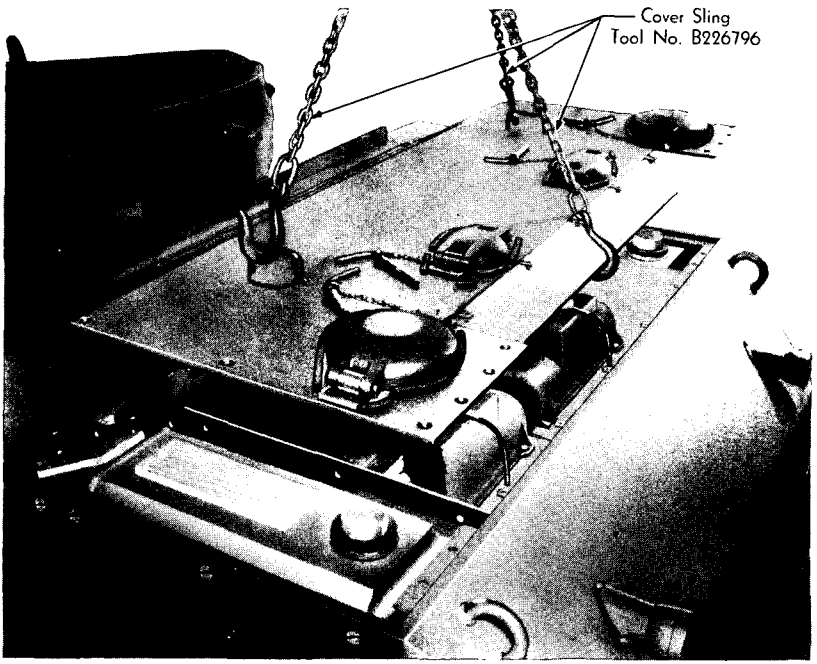
(1) REMOVE RADIATOR.

(*a*) *Drain Cooling System.*

WRENCH, socket, 9/16-in.
WRENCH, socket, 7/8-in.

Remove small plate from bottom of hull under Hydra-matic transmission, using 9/16-inch socket wrench, and remove water drain plug from bottom of transmission using a 7/8-inch socket wrench (fig. 13).

ENGINE COOLING SYSTEM



RA PD 8482

Figure 21 — Removing Engine Compartment Cover

(*b*) *Remove Engine Compartment Cover.*

HOIST
SCREWDRIVER, T-handle, $\frac{7}{8}$- x $\frac{3}{32}$-in. blade
SLING, B226796
WRENCH, socket, $\frac{3}{4}$-in.

Rotate turret 90 degrees from forward position. On first type M5 vehicles, remove 34 engine compartment cover mounting screws, using T-handle screwdriver, working from top of vehicle; then remove fuel tank filler caps. On second type M5 and M8 vehicles, remove 5 screws holding grille to engine compartment cover and remove grille; then take out nine engine compartment cover mounting screws, using $\frac{3}{4}$-inch socket wrench. Hook sling under handles shown in figure 21 and remove cover with hoist.

(c) *Remove Bulkhead Doors.*

WRENCH, socket, $\frac{9}{16}$-in.

On Light Tank M5, remove 6 screws, holding 37-mm ammunition racks, to hull and lift out racks (fig. 23). On M5 and M8 rotate latch, tilt bulkhead doors forward, and lift doors off hinges.

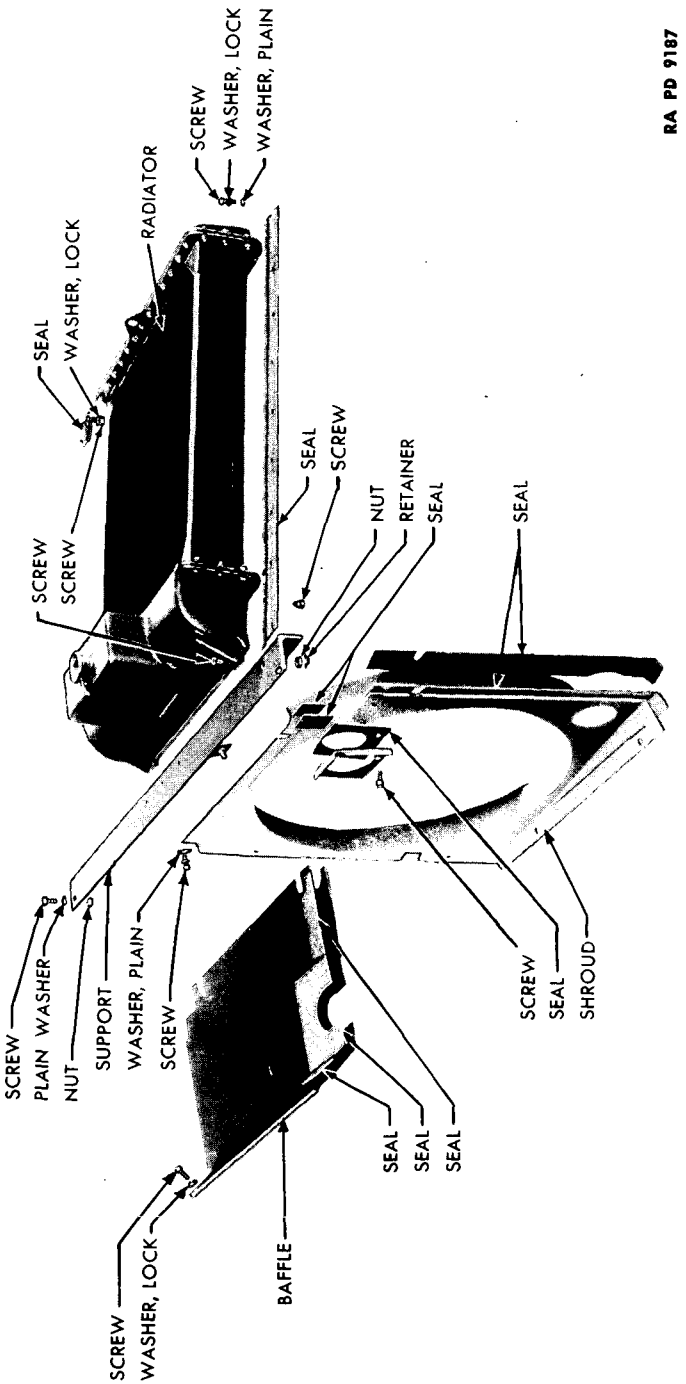


Figure 22 — Radiator Seals and Fan Shroud — Exploded View

ENGINE COOLING SYSTEM

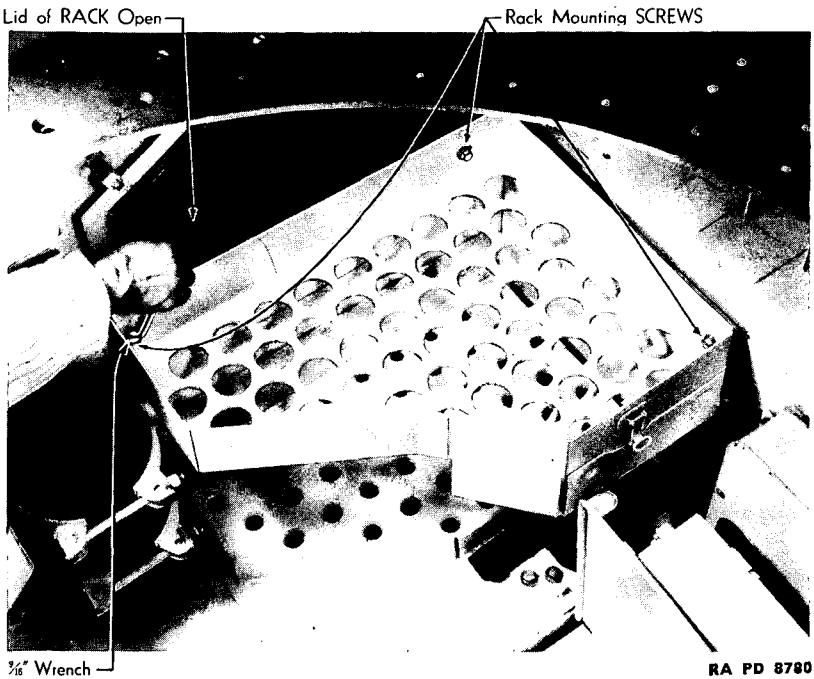


Figure 23 — Removing Ammunition Rack

(*d*) *Remove Radiator Hoses.*

PLIERS

Disconnect radiator inlet hoses at radiator water inlet housing and at cylinder head outlet elbows by loosening hose clamps with pliers while working through engine compartment doors, and remove hoses. Disconnect radiator outlet hose at radiator elbow and water pump inlet at pump inlet pipe by loosening hose clamps with pliers, and remove hoses complete with radiator to engine tube (fig. 4).

(e) *Remove Radiator.*

SLING, B226799

WRENCH, socket, 9/16-in.

WRENCH, open-end, 1/2-in.

Remove 2 screws from bottom of radiator at front by reaching through bulkhead doors, using a 1/2-inch open-end wrench. Remove 2 screws holding radiator to rear supports with 9/16-inch socket wrench, working from top of vehicle. Remove 4 nuts supporting transfer unit oil cooler, using a 1/2-inch open-end wrench, working from top of vehicle. Remove oil cooler mounting plates and lower cooler unit until it rests on

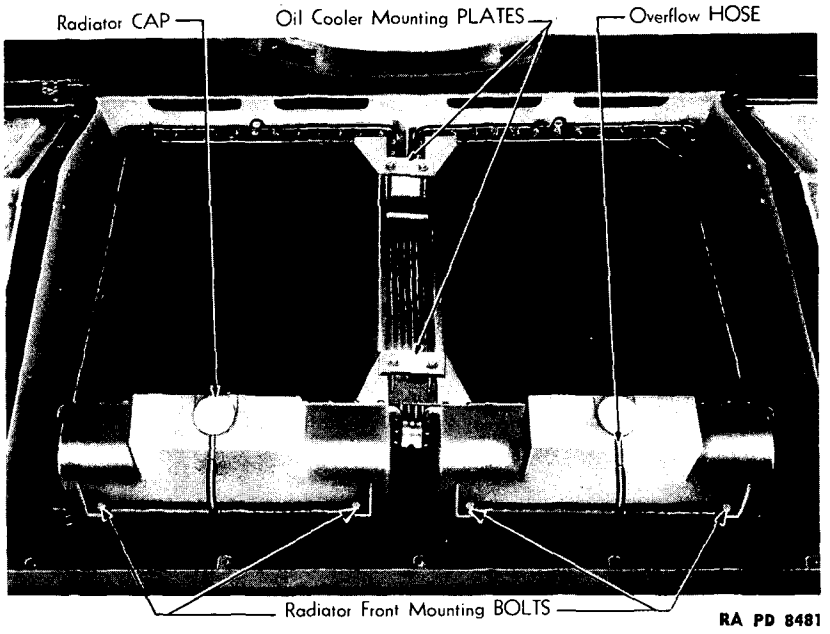


Figure 24 — Radiator Mountings

engine, working from top of vehicle. Hook sling B226799 on to sling holes in radiator and remove radiator.

c. Disassemble Radiator (fig. 26).

(1) REMOVE SEALS.

SCREWDRIVER WRENCH, socket, ½-in.

Remove large seal from hull side of radiator by removing 8 screws, and 3 cap screws and lock washers (fig. 22). Remove small seal from opposite side of radiator at outlet end by removing cap screw and lock washer.

(2) REMOVE INLET END RADIATOR TANK.

WRENCH, open-end, 7/16-in. WRENCH, socket, ½-in. (2)

Working at radiator inlet end, remove 19 nuts and lock washers from bolts, using two ½-inch socket wrenches; next, remove 13 nuts and lock washers from studs. Remove tank and gasket from radiator core. Remove drain plug from thermostat housing. Remove 4 screws and lock washers holding thermostat housing to radiator tank and remove housing and thermostat. Take thermostat out of housing.

ENGINE COOLING SYSTEM

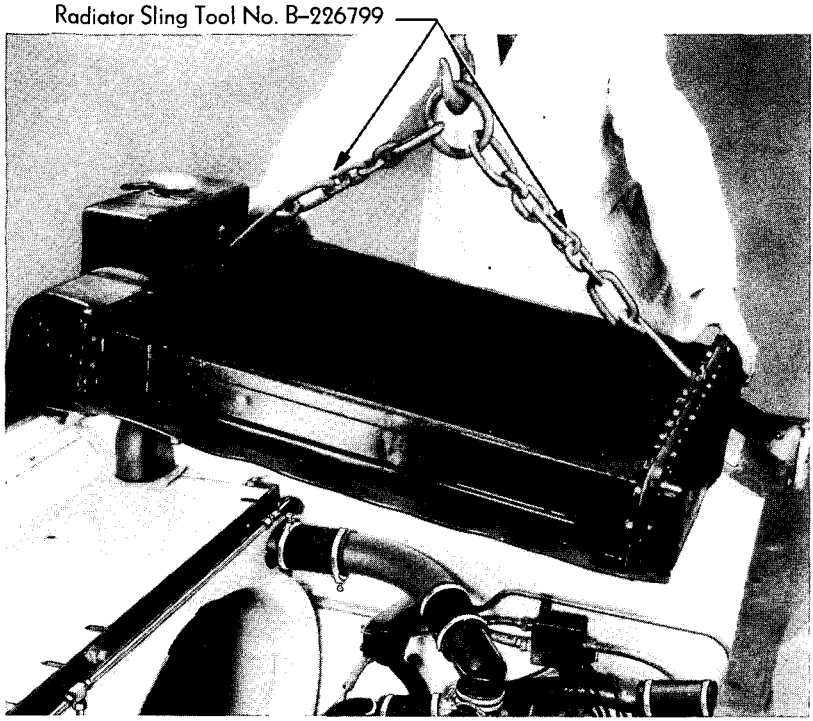


Figure 25 — Removing Radiator

(3) REMOVE OUTLET END RADIATOR TANK.

WRENCH, open-end, 7/16-in. WRENCH, socket, 1/2-in. (2)

Working at radiator outlet end, remove 28 bolts, lock washers and nuts, using two 1/2-inch socket wrenches. Then remove 4 nuts and lock washers from studs. Remove radiator tank and gaskets from radiator core. Remove drain plug from radiator tank.

d. Assemble Radiator.

(1) INSTALL OUTLET END RADIATOR TANK.

WRENCH, open-end, 7/16-in. WRENCH, socket, 1/2-in. (2)

Apply gasket sealer to gasket and position gasket and tank on radiator core at outlet end. Position flange reinforcement on tank and install 28 bolts, lock washers, and nuts. Tighten, using two 1/2-inch socket wrenches. Then place 4 lock washers and nuts on studs and tighten. Position drain plug in tank and tighten.

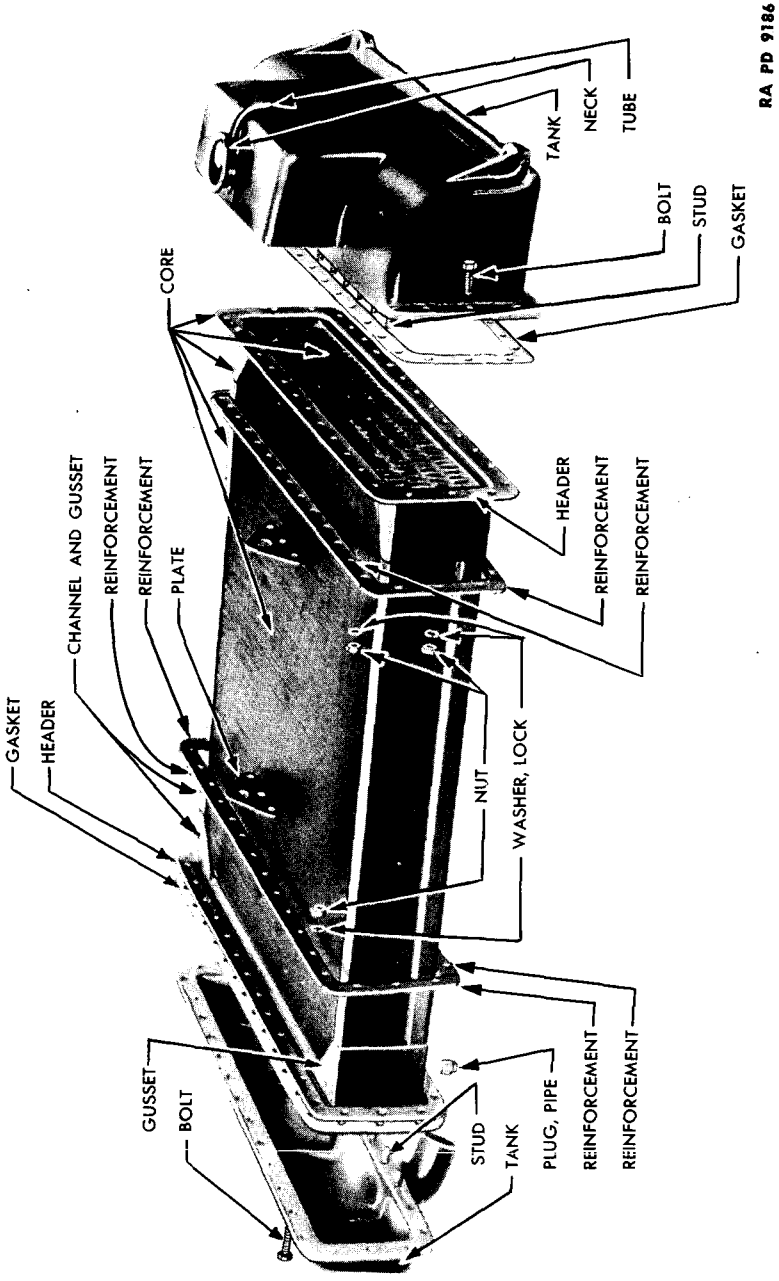


Figure 26 — Radiator — Exploded View

ENGINE COOLING SYSTEM

(2) INSTALL INLET END RADIATOR TANK.

WRENCH, open-end, 7/16-in. WRENCH, torque
WRENCH, socket, 1/2-in. (2)

Apply gasket sealer to gasket and position gasket and tank on radiator core at inlet end. Position flange reinforcements on tank and install 19 bolts, nuts and lock washers and tighten, using two 1/2-inch socket wrenches. Install 13 nuts and lock washers on studs and tighten. Apply gasket sealer to thermostat housing gasket and position gasket on radiator tank. Position thermostat on gasket and thermostat housing over thermostat and tighten 4 screws and lock washers to a torque tightness of 18 pounds. Position drain plug in thermostat housing and tighten.

(3) INSTALL SEALS.

SCREWDRIVER WRENCH, socket, 1/2-in.

Position large seal on hull side of radiator and secure by tightening 8 screws and 3 cap screws and lock washers. Position small seal at outlet end of radiator on opposite side from large seal and secure by tightening cap screw and lock washer.

e. Radiator Installation.

(1) LOWER RADIATOR INTO VEHICLE.

HOIST WRENCH, open-end, 1/2-in.
SLING, B226799 WRENCH, socket, 9/16-in.

Attach sling to one radiator and connect sling to a hoist, swing radiator over engine compartment and lower into place on radiator support at rear and mounting brackets at front. Install 2 screws and lock washers holding radiator to mounting brackets at front, working through bulkhead doors. Install 2 screws holding radiator to support at rear, working from above (fig. 24). If both radiators have been removed, repeat these steps.

(2) INSTALL TRANSFER UNIT OIL COOLER.

WRENCH, open-end, 1/2-in.

Position transfer unit oil cooler mounting plates between radiators and tighten mounting bolt nuts finger-tight, working from above. Raise cooler into position on mounting plates and tighten mounting nuts securely.

(3) CONNECT RADIATOR HOSES.

PLIERS

Position radiator outlet hoses and connection on top of engine and attach, first to radiator, then to water pump inlet elbow. Install radiator inlet hoses at inlet housing and cylinder head outlet elbows. Tighten all hose connections securely with a pair of pliers.

(4) INSTALL ENGINE COMPARTMENT COVER.

HOIST
SLING, B226799
SCREWDRIVER, T-handle, 7/8- x 3/32-in. blade
WRENCH, socket, 3/4-in.

Hook sling under lifting handles on engine compartment cover and connect sling to hoist. Lift engine compartment cover into position on vehicle. On first type M5 vehicles, install 34 engine compartment cover mounting screws. Tighten screws securely. Install fuel tank filler caps. On second type M5 and M8 vehicles, install 9 cover mounting screws and tighten securely, using 3/4-inch socket wrench. Install grille on cover and attach with 5 screws.

(5) INSTALL BULKHEAD DOORS.

WRENCH, open-end, 9/16-in. (M5 only)

Position bulkhead doors on hinges, close and lock in place with latches. On M5 vehicles, install 37-mm ammunition racks and fasten in place with six 9/16-inch screws and lock washers.

(6) REFILL COOLING SYSTEM.

WRENCH, open-end, 9/16-in.
WRENCH, open-end, 7/8-in.

Reinstall water drain plug in bottom of transmission, and reinstall hull plate. Then refill cooling system, observing precautions in paragraph **10 b.**

15. RADIATOR THERMOSTAT.

a. Equipment.

PLIERS
WRENCH, socket, 15/16-in.
WRENCH, socket, 1/2-in.
WRENCH, torque

b. Procedure.

(1) REMOVE RADIATOR THERMOSTAT (fig. 27).

PLIERS
WRENCH, socket, 15/16-in.
WRENCH, socket, 1/2-in.

Drain cooling system to below radiator level. Remove fan assembly as outlined under paragraph **12 b** (1). Loosen 2 hose connections at water inlet elbows at rear radiator tank under side, using pliers, and move hoses free of elbows. Remove 4 lock washers and cap screws holding thermostat housing to tank, using 1/2-inch socket wrench. Remove housing, thermostat and gasket.

(2) RADIATOR THERMOSTAT TEST (fig. 28).

Check radiator thermostat by placing it with bimetal coil down on a brick in a pan of water also containing a thermometer. CAUTION:

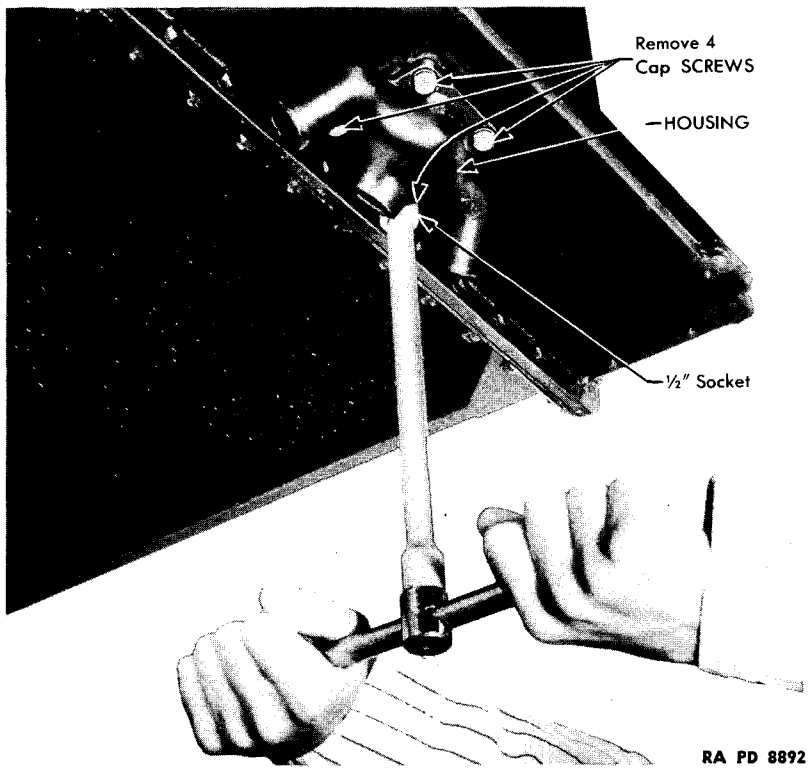


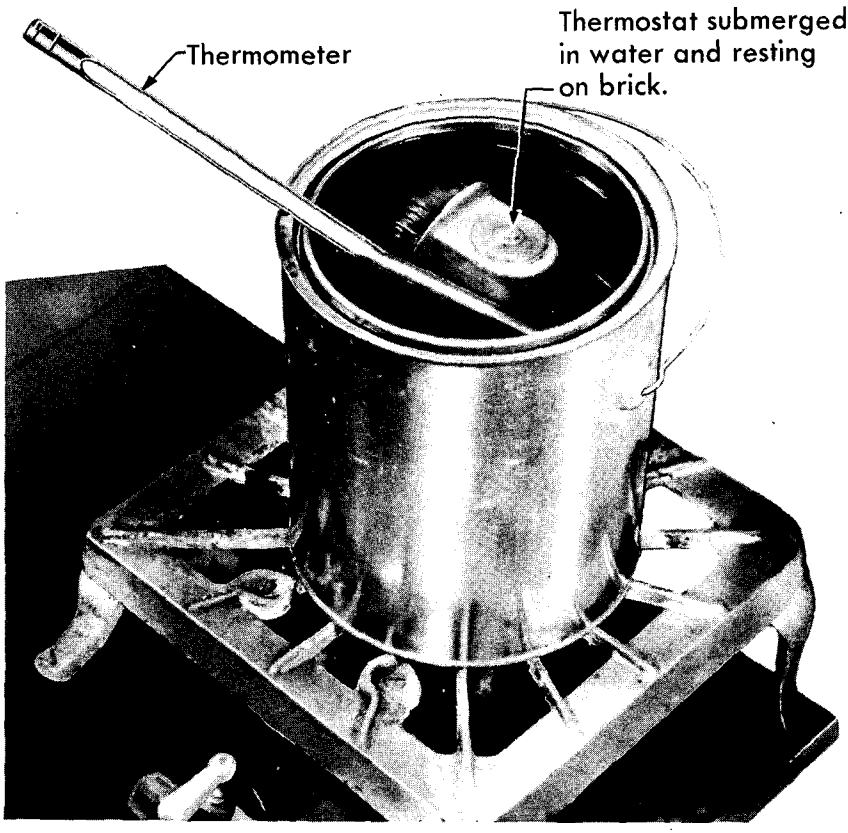
Figure 27 — Removing Thermostat and Housing

Do not place either the thermostat or the thermometer on the bottom of the pan because of the uneven concentration of heat at that point when the pan is heated over a burner. Heat the water until the thermostat valve begins to open. The temperature at which this occurs depends upon whether the thermostat is of first or second type. First type thermostats open at 161 to 166 degrees; second type open at 141 to 146 degrees. The operating temperature is stamped on the housing flange of most thermostats, but this identification is not essential, as the two types of thermostats are completely interchangeable.

(3) INSTALL RADIATOR THERMOSTAT.

WRENCH, socket, ½-in. WRENCH, torque

Position new gasket around radiator inlet opening on radiator inlet end tank and place thermostat on gasket with valve end extending into radiator tank. Position inlet housing on radiator, making sure that



RA PD 8938

Figure 28 — Testing Radiator Thermostat

thermostat flange fits into recess in housing. Install 4 screws and lock washers and tighten to 18 foot-pounds with torque wrench. Reconnect hoses and refill cooling system, observing precautions in paragraph 10 **b.**

16. THERMO GAGE.

a. Equipment.

WRENCH, box, $^{15}/_{16}$-in. WRENCH, open-end, $^{3}/_{8}$-in.

b. Procedure.

(1) REMOVE ENGINE THERMO GAGE (fig. 29).

WRENCH, box, $^{15}/_{16}$-in. WRENCH, open-end, $^{3}/_{8}$-in.

Working through bulkhead doors, disconnect lead on engine thermo gage, using $^{3}/_{8}$-inch open-end wrench. Remove gage, using $^{15}/_{16}$-inch box-end wrench.

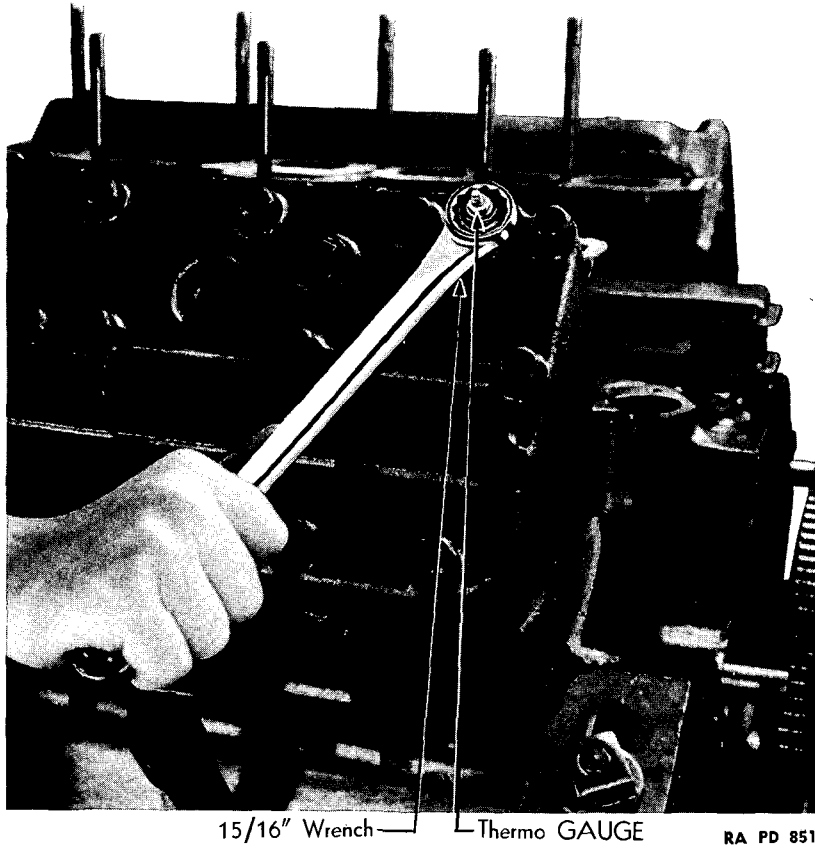


Figure 29 — Removing Thermo Gage

(2) INSTALL ENGINE THERMO GAGE.

WRENCH, box, $^{15}/_{16}$-in. WRENCH, open-end, $^{3}/_{8}$-in.

Insert thermo gage in opening in left cylinder head and tighten securely with $^{15}/_{16}$-inch box wrench. Connect lead wire from instrument panel to terminal on gage and tighten terminal nut.

17. WATER PUMP.

a. Equipment.

DRIFT, brass
HAMMER
PLIERS
PRESS, arbor
SCREWDRIVER
WRENCH, open-end, $^{5}/_{8}$-in.
WRENCH, open-end, $^{7}/_{8}$-in.
WRENCH, socket, $^{1}/_{2}$-in.

b. Procedure.

(1) REMOVE WATER PUMP (fig. 31).

PLIERS
WRENCH, open-end, $^{7}/_{8}$-in.
WRENCH, socket, $^{1}/_{2}$-in.

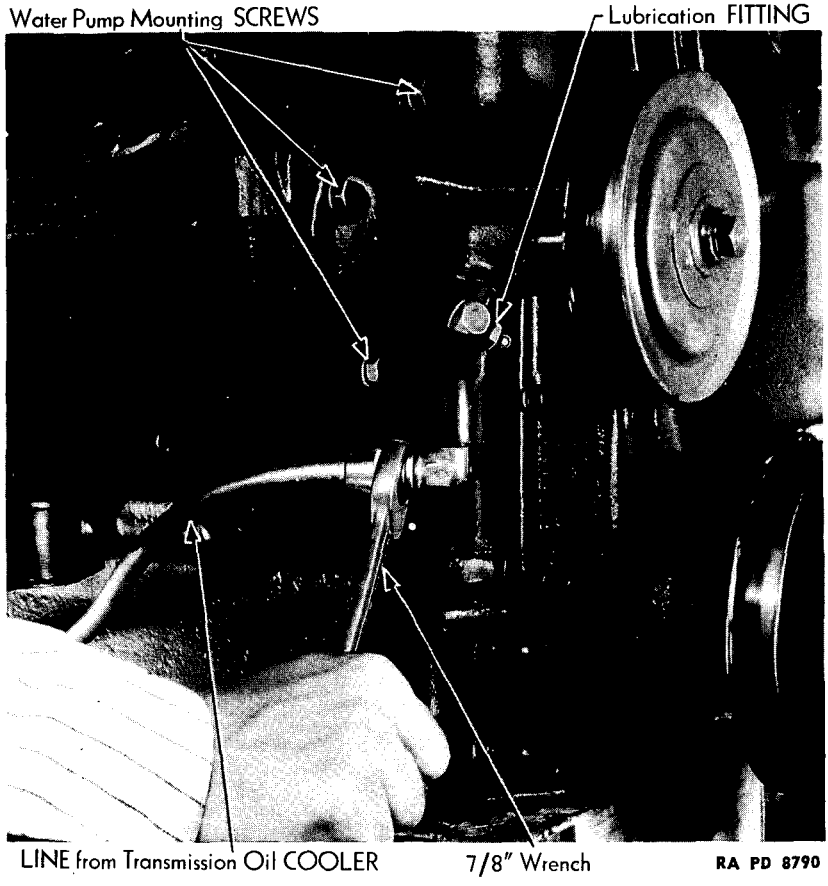


Figure 30 — Removing Water Line from Transmission

Disconnect water pump bypass hose from left cylinder outlet elbow (fig. 20) and water pump, using a pair of pliers and remove hose. Disconnect transmission oil cooler line at bottom of water pump, using a 7/8-inch open-end wrench (fig. 30). Remove 5 water pump mounting screws, using a 1/2-inch socket wrench. Remove water pump and gasket.

(2) DISASSEMBLE WATER PUMP.

DRIFT, brass
HAMMER, soft
PRESS, arbor
SCREWDRIVER
WRENCH, open-end, 5/8-in.

Remove water pump pulley retaining nut and lock washer, using a 5/8-inch open-end wrench. NOTE: Hold water pump drive shaft sta-

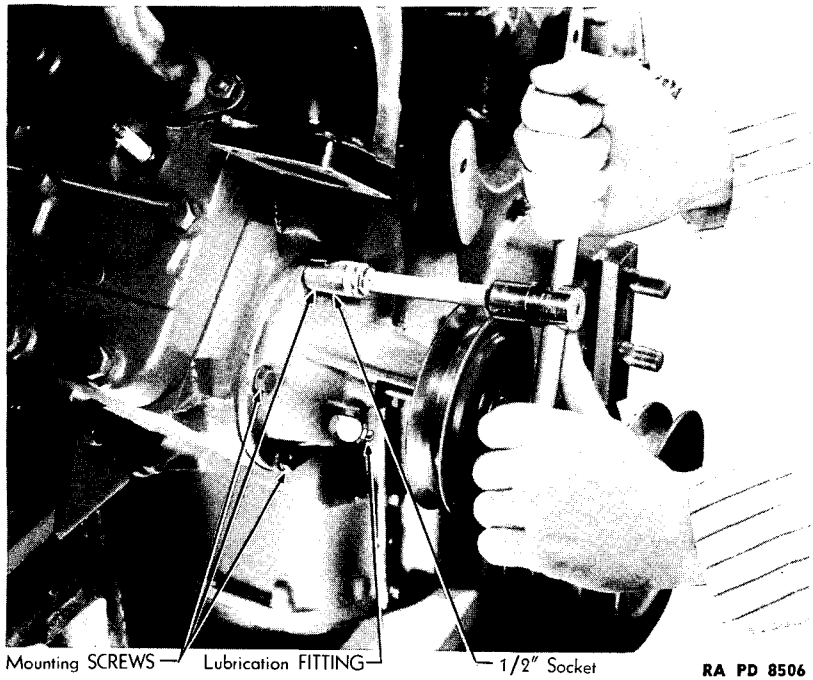


Figure 31 — Removing Water Pump

tionary by grasping impeller firmly (fig. 32). Tap pulley from drive shaft, using a soft hammer. Remove key from end of shaft. Remove lock wire, holding front drive shaft bearing in water pump body, using a small screwdriver (fig. 33). Push impeller and shaft away from water pump body enough to remove split retainers in back of front bearing on drive shaft. Slide impeller and drive shaft out of water pump body. Tap front bearing and collar out of front end of body, using a light hammer and a brass drift. CAUTION: Tap on outer race of bearing only. Place front bearing and collar assembly in an arbor press, supporting bearing on *inner* race and press collar out of bearing. Remove snap ring from front inner end of water pump body, using a small screwdriver. Tap water pump packing assembly, including chevron packings, packing rings, spacer and packing spring, out of water pump body, using a light hammer and a brass drift. Discard chevron packings.

(3) WATER PUMP INSPECTION (fig. 34). Clean all water pump parts, except the front bearing, in SOLVENT, dry-cleaning. The front water pump bearing is a sealed bearing and does not require cleaning or removing of lubricant. Inspect water pump body for cracks or evidence

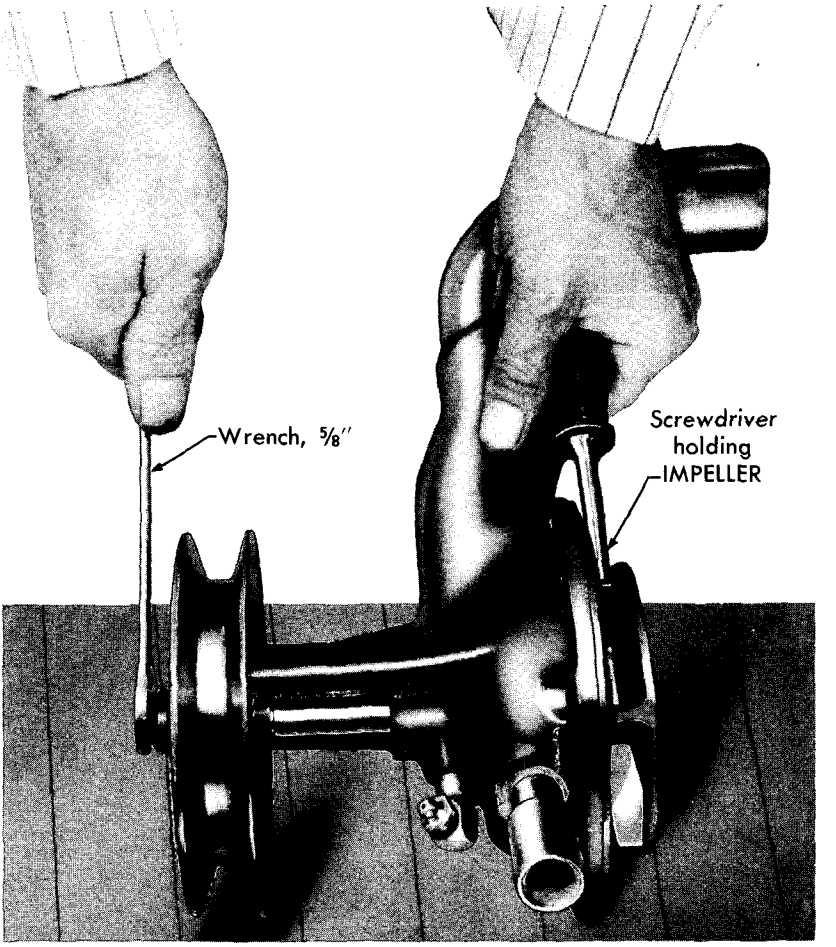


Figure 32 — Removing Water Pump Pulley Nut

of damage. Inspect machined surfaces of water pump body, particularly bearing and bushing bores, for nicks or burs which might cause water leakage. Small burs can be removed with a fine file or a whetstone. Inspect water pump impeller for corroded vanes. Inspect water pump drive shaft for bends, nicks or burs, or grooves from packing which might cause water leakage or roughness in the bushing.

(4) ASSEMBLE WATER PUMP (figs. 33 and 34).

(a) *Install Packings.*

DRIFT, brass
HAMMER
PLIERS
SCREWDRIVER

ENGINE COOLING SYSTEM

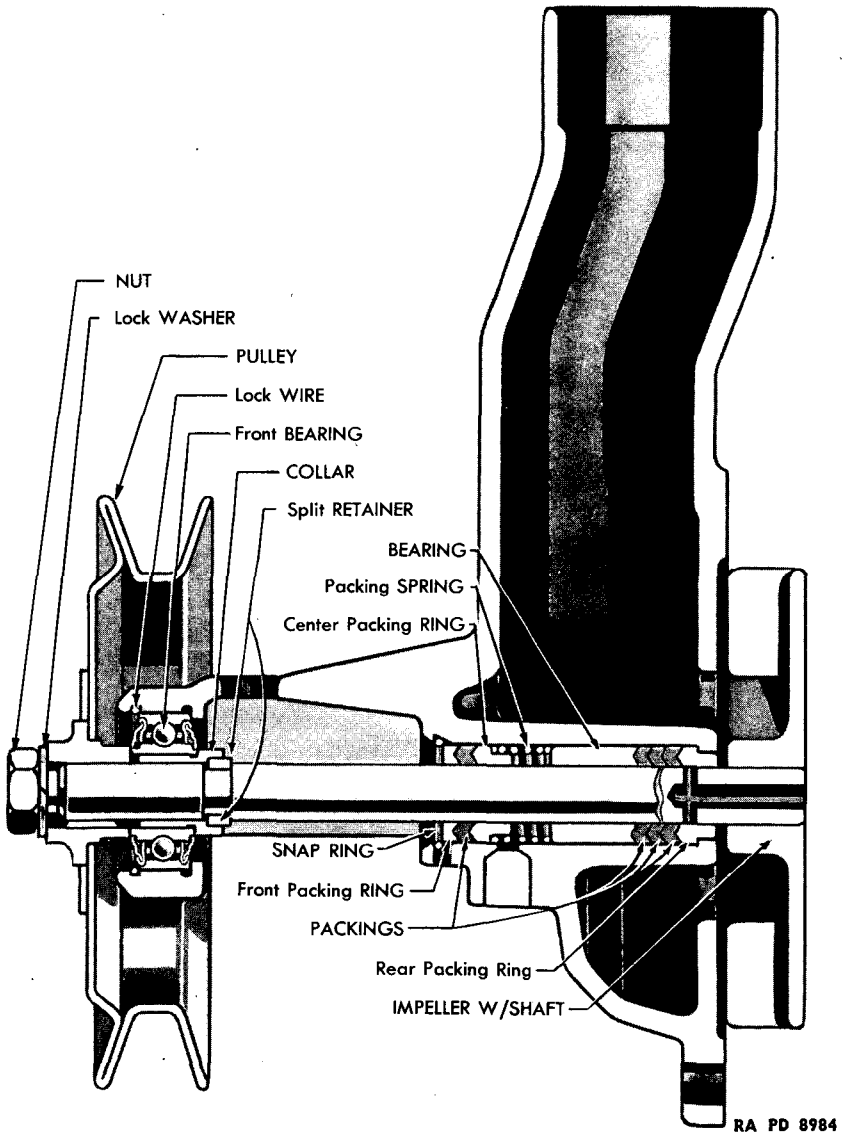


Figure 33 — Water Pump — Cross Sectional View

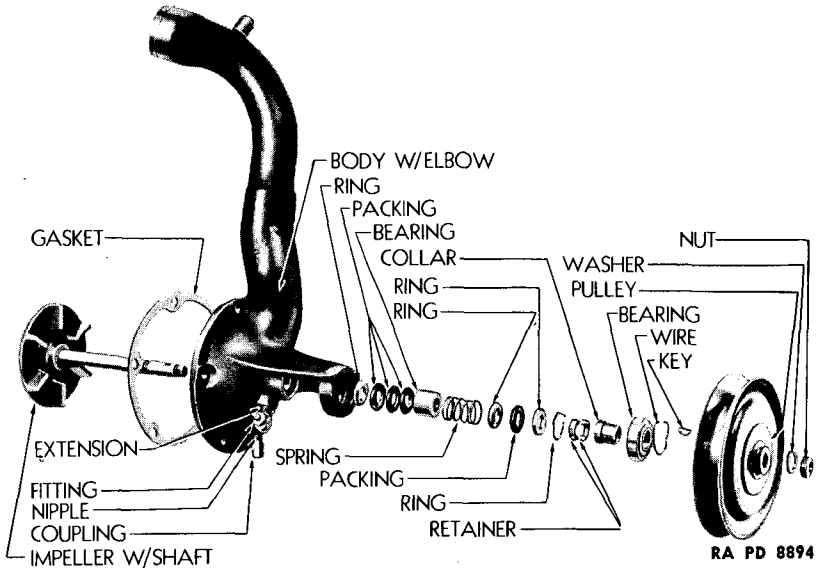


Figure 34 — Water Pump — Exploded View

Push inner impeller shaft packing ring into water pump body until it seats on shoulder of body. NOTE: Square end of ring should point toward impeller end of water pump body. Lubricate three *new* chevron packings, using GREASE, water pump, and install packings in pump body (fig. 34). Install bearing and packing retaining spring in water pump body. Install center packing ring in water pump body. NOTE: Square end of ring should point toward impeller end of water pump body. Install one chevron packing next to center ring after lubricating it with GREASE, water pump. Install front packing ring in water pump body. NOTE: Grooved edge of ring should be toward front chevron packing. Compress water pump packing assembly, using a brass drift and a light hammer, until groove in water pump body for snap ring appears ahead of packing assembly. Install snap ring holding packing assembly in water pump body, using a small screwdriver.

(*b*) *Install Front Bearing.*

PLIERS PRESS, arbor

Install front bearing and collar in an arbor press, and press bearing on collar until it seats on shoulder of collar. CAUTION: Spindle of press must be on *inner race* of bearing only. Slide bearing and collar assembly into place on front of water pump body, being careful not to damage bearing. Install large lock wire holding bearing in water pump body, using a pair of pliers.

ENGINE COOLING SYSTEM

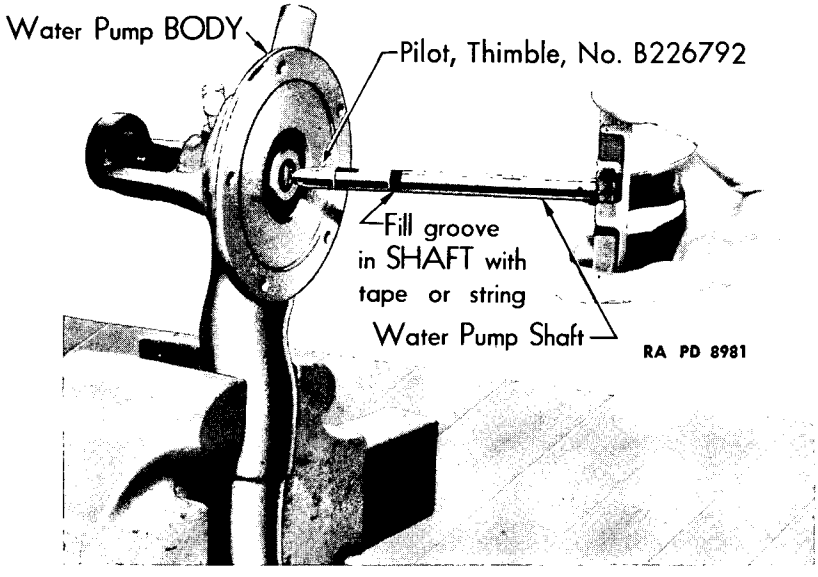


Figure 35 — Installing Water Pump Impeller and Shaft

(c) *Install Impeller.*

THIMBLE, pilot, B226792

Install pilot thimble B226792, on end of water pump shaft. Wrap groove in shaft where split retainers seat on shaft, with string or tape, to prevent damage to chevron packings while shaft is being installed. Install impeller and shaft assembly in water pump body from impeller end of body until pilot thimble protrudes from front of body. As soon as pilot thimble protrudes from end of pump body, remove thimble from end of shaft and string or tape from groove in shaft. Install split retainers on shaft and slide impeller and shaft into pump body until retainers are held in position by front bearing collar.

(d) *Install Pulley.*

HAMMER **WRENCH**, open-end, 5/8-in.

Install Woodruff key in front end of impeller shaft, using a light hammer. Slide drive pulley over front end of shaft and install lock washer and nut, using a 5/8-inch open-end wrench. Keep drive shaft from turning while tightening pulley retaining nut by holding impeller on opposite end of water pump shaft (fig. 32).

(5) INSTALL WATER PUMP.

PLIERS **WRENCH**, socket, 1/2-in.

WRENCH, open-end, 7/8-in.

Using a new gasket, position water pump assembly and gasket against cylinder block opening, and insert and tighten 5 mounting screws and

lock washers. Reconnect transmission oil cooler line to elbow at bottom of water pump. Position hose connections for bypass hose and water pump inlet hose on pump inlet elbow, and tighten screws on clamps securely with pliers.

18. PREPARATION FOR EXTREME CONDITIONS.

a. Heat. To prevent damage to the engine under extremely hot conditions, the cooling system should be tested frequently to make certain it is functioning correctly.

b. Cold. When the vehicle is to be operated in extremely cold climates, the cooling system should be filled with a suitable antifreeze solution and tested at frequent intervals to make certain that it does not freeze up and cause engine difficulties.

c. Sand and Underbrush. If the vehicle is to be operated under abnormally sandy conditions or through underbrush, the radiator cores should be inspected frequently and freed of sand, leaves, pine needles, or other foreign materials.

d. Salt Water. Since operation of the vehicle in salt water areas will have no effect on the cooling system, no special precautions are necessary.

19. PACKING, SHIPPING, AND STORAGE.

a. Fan. In packing fans for shipping or storing, it is necessary to wrap the fan in nonoxide cloth and then pack, braced securely in a wooden box.

b. Hose Connections. Hose connections should be wrapped in nonoxide cloth, packed in a cardboard box, and the complete package then packed in a wooden box.

c. Water Pump. Water pumps should be given a protective coating of OIL, lubricating, preservative, light, and wrapped in nonoxide cloth, then packed in a cardboard box and the complete package packed in a wooden box.

d. Radiator Thermostat. Radiator thermostat should be given a protective coating of OIL, lubricating, preservative, light, and wrapped in nonoxide cloth, then packed in a cardboard box and the complete package packed in a wooden box.

e. Radiator. In packing radiators for shipping or storing, all openings must be well taped to seal against moisture. Radiator must then be packed in a wooden box and braced securely before the box is closed to prevent damage in shipping or moving.

f. Engine Thermo Gage. Engine thermo gage should be given a protective coating of OIL, lubricating, preservative, light, and wrapped in nonoxide cloth, then packed in a cardboard box and the complete package packed in a wooden box.

Section III

ENGINE ELECTRICAL SYSTEM

20. DESCRIPTION.

a. The engine electrical system used in the Light Tank M5 and the 75-mm Howitzer Motor Carriage M8 is the same in every respect for each of the two engines. The engine electrical system consists of a generator, regulator assembly, and a starter. The following explanations apply to both engines in the vehicle.

(1) GENERATOR. The generator (fig. 36) is a device for converting mechanical energy (from the engine) into electricity. The unit is a 2-brush, 2-pole, shunt-wound, 12-volt type with sealed, self-lubricated ball bearings supporting the armature. The armature is belt driven from the crankshaft, and the generator belt pulley incorporates fan blades for cooling. The generator is mounted at the drive end on 2 cap screws, one of which operates in a slot in the end frame for adjusting belt tension. The generator output is controlled in accordance with load requirements, and battery state of charge by means of a generator regulator assembly.

(2) GENERATOR REGULATOR ASSEMBLY. The generator regulator assembly (fig. 37) is a three-unit, electromagnetic assembly for

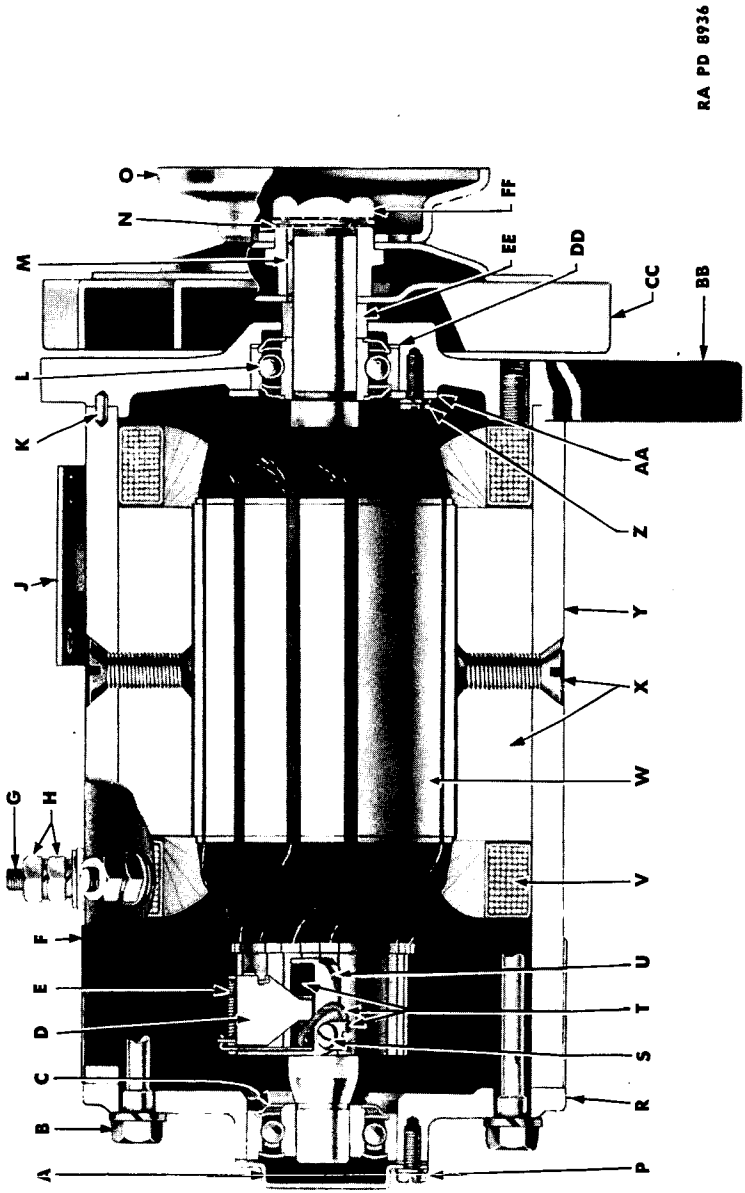


Figure 36 — Generator — Cross Section

A — COVER
B — {BOLT / WASHER, LOCK}
C — BEARING
D — ARM
E — SPRING
F — STRAP, ASS'Y
G — STUD, ASS'Y
H — NUT
J — BRACKET
K — PIN
L — BEARING
M — KEY
N — WASHER, LOCK
O — PULLEY, ASS'Y
P — {SCREW / WASHER, LOCK}
R — FRAME, ASS'Y
S — {SCREW / WASHER, LOCK}
T — BRUSH, ASS'Y
U — HOLDER
V — {COIL, ASS'Y. RH / COIL, ASS'Y, LH}
W — ARMATURE, ASS'Y
X — {SHOE / SCREW}
Y — FRAME, ASS'Y
Z — {SCREW / WASHER, LOCK}
AA — PLATE
BB — FRAME
CC — FAN, ASS'Y
DD — WASHER
EE — COLLAR
FF — NUT

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Legend for Figure 36 — Generator — Cross Section

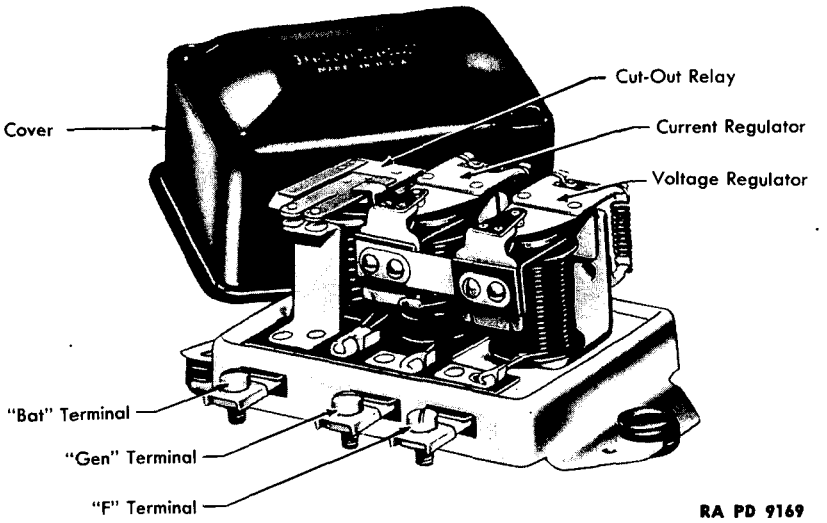

Figure 37 — Regulator Assembly

controlling generator output to meet all conditions of operation. The three separate units in the regulator assembly are the cut-out relay, voltage regulator, and current regulator. The complete assembly is enclosed in a dustproof and moistureproof metal cover, and is located in the apparatus box on the left-hand side of the hull (fig. 42).

(3) STARTER. The starter (fig. 38) is a special electric motor for cranking the engine in the vehicle. It is a 12-volt, 4-brush, 4-pole unit. The armature shaft carries a pinion which is driven through an overrunning clutch mechanism, and which is engaged with the flywheel ring gear by means of a solenoid-operated shifting mechanism.

21. OPERATION.

a. Generator. The generator is rotated by the pulley on the front end, which is in turn driven by the belt from the crankshaft drive pulley. The armature, revolving in the electromagnetic field within the generator housing, creates electrical energy which is picked up by the brushes at the rear end of the generator and transmitted to the battery through the regulator circuit. Generator cooling is secured by means of a fan integral with the pulley which draws air in and forces it out the rear of the generator. The generator output is controlled by the regulator assembly, which prevents damage due to overloading. The charging circuit includes three electrical filters, one mounted on the generator and two located in the apparatus box, which prevent the generator and

regulators from setting up electrical interference with radio operation (figs. 39 and 39A). NOTE: Always turn the ignition switches off before placing the master battery switch in the "OFF" position. If the engines were operated with the master battery switch in the "OFF" position, the generators would damage the electrical system.

b. Regulator Assembly. The three units of the regulator assembly have the following function:

(1) The cut-out relay in the regulator assembly closes the circuit between the battery and the generator when the generator voltage is sufficient to charge the battery, and breaks the circuit when generator voltage is less than the battery voltage. This prevents the battery discharging through the generator.

(2) The voltage regulator prevents the line voltage from exceeding a predetermined value, and thus protects the battery and other electrical units from high voltage.

(3) The current regulator controls the generator output by inserting a high resistance in the field circuit of the generator when its output approaches 26 amperes, thereby preventing damage due to overloading.

(4) The voltage and current regulators each consist of windings arranged to exert magnetic force on a set of contact points normally held closed by spring action. As line voltage or current begins to exceed the limits to which the regulators are set, the magnetism of the affected winding becomes great enough to separate the contact points. This inserts a resistance in the generator field circuit, which immediately reduces the generator output. This reduced output weakens the magnetic field due to the regulator winding enough so that the points close, removing the field resistance and permitting increased generator output again. This complete cycle occurs 50 to 200 times per second and limits the generator output to the value for which the regulator is set.

c. Starter.

(1) When the starter switch is depressed, the circuit through the solenoid relay is closed. This permits the solenoid to pull the plunger into the core, and this movement is transmitted through a shift lever to the pinion assembly, causing it to move endwise along the armature shaft splines so the drive pinion meshes with the flywheel teeth. Further movement of the shift lever closes the main contacts in the solenoid and connects the cranking motor directly to the battery, so that the armature revolves and cranking takes place.

(2) If the pinion teeth should butt instead of mesh, the overrunning clutch spring compresses, spring-loading the pinion against the flywheel teeth. Further movement of the shifting lever closes the main contacts

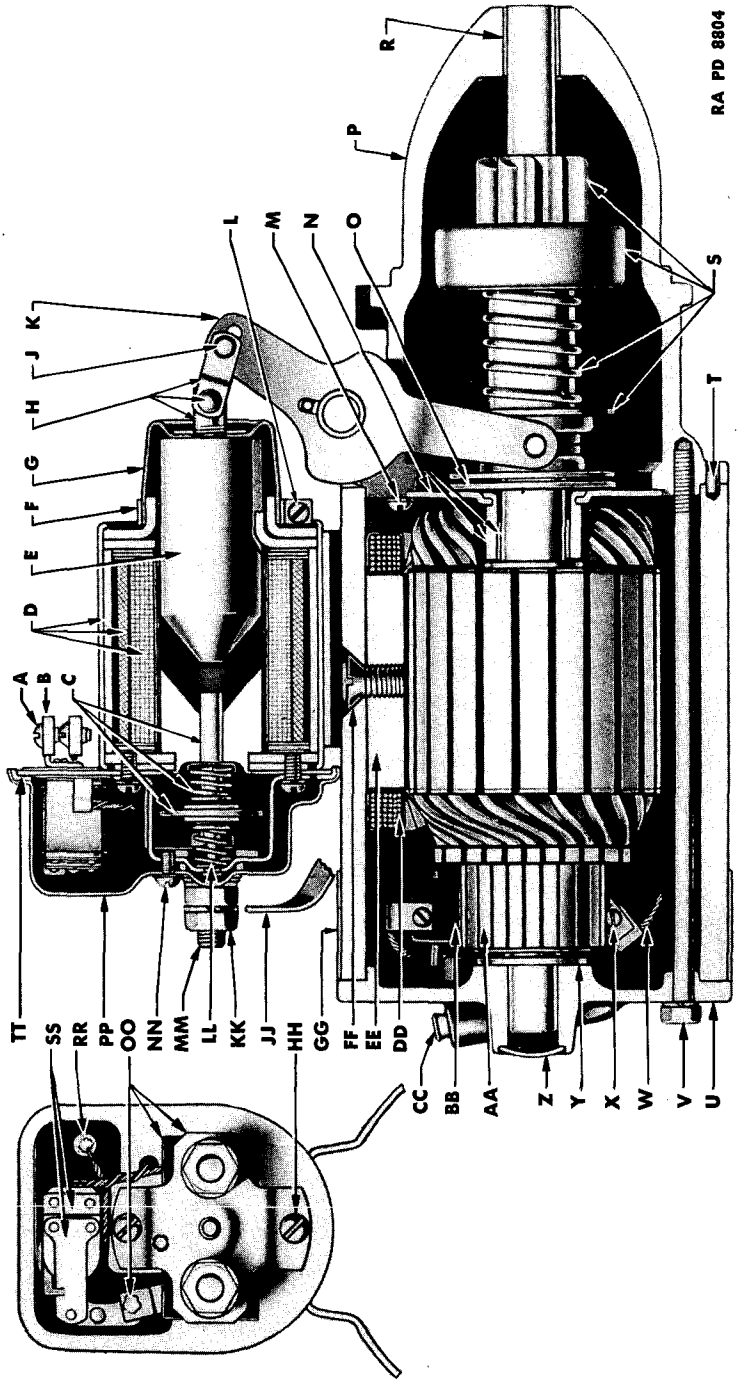

Figure 38 — Starter and Solenoid — Cross Section

A — SCREW
B — CLAMP
C — CONTACT, ASS'Y
D — COIL, ASS'Y
E — PLUNGER
F — CLAMP
G — BOOT
H — LINK, ASS'Y
J — PIN
K — LEVER, ASS'Y
L — SCREW
M — SCREW
N — {PLATE, ASS'Y / BUSHING}
O — WASHER
P — HOUSING, ASS'Y
R — BUSHING
S — DRIVE, ASS'Y
T — PIN
U — FRAME, ASS'Y
V — BOLT
W — LEAD, ASS'Y
X — SCREW
Y — WASHER
Z — PLUG
AA — ARMATURE, ASS'Y
BB — BRUSH
CC — CUP
DD — COIL, ASS'Y
EE — SHOE
FF — SCREW
GG — STRAP, ASS'Y
HH — SCREW
JJ — CONNECTOR
KK — NUT
LL — SPRING
MM — SCREW
NN — SCREW
OO — BRACKET, ASS'Y
PP — COVER
RR — BUSHING
SS — RELAY, ASS'Y
TT — GASKET

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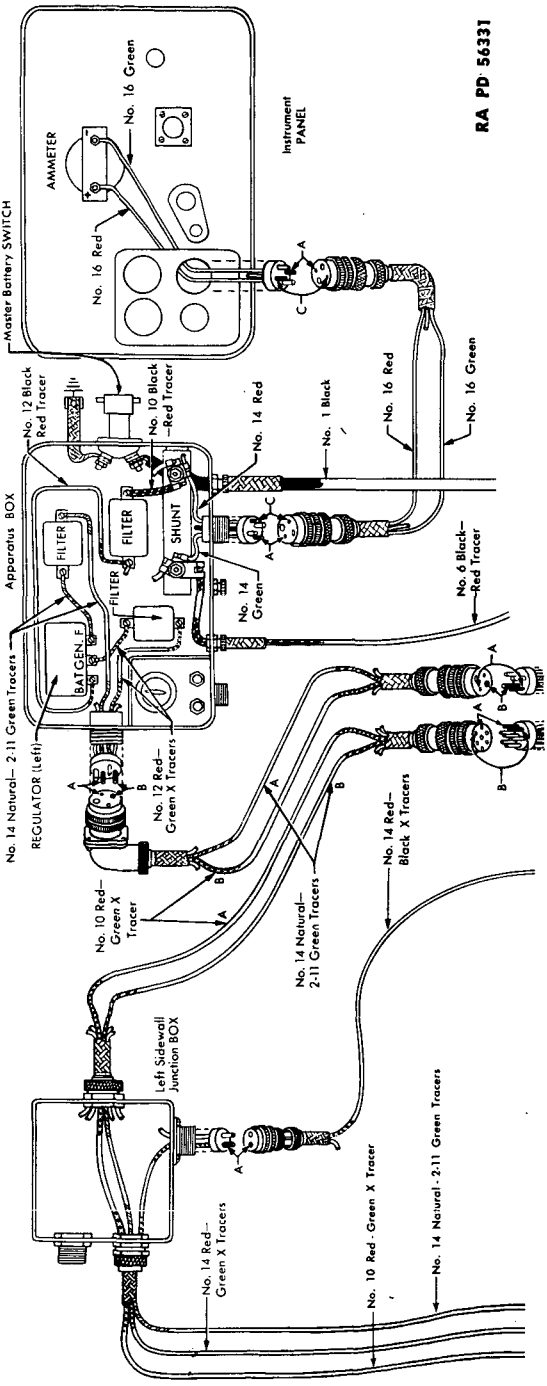
Legend for Figure 38 — Starter and Solenoid — Cross Section

ORDNANCE MAINTENANCE — ENGINE COOLING, ENGINE ELECTRICAL AND ENGINE FUEL SYSTEMS FOR LIGHT TANK M5 AND 75-MM HOWITZER MOTOR CARRIAGE M8



ENGINE ELECTRICAL SYSTEM

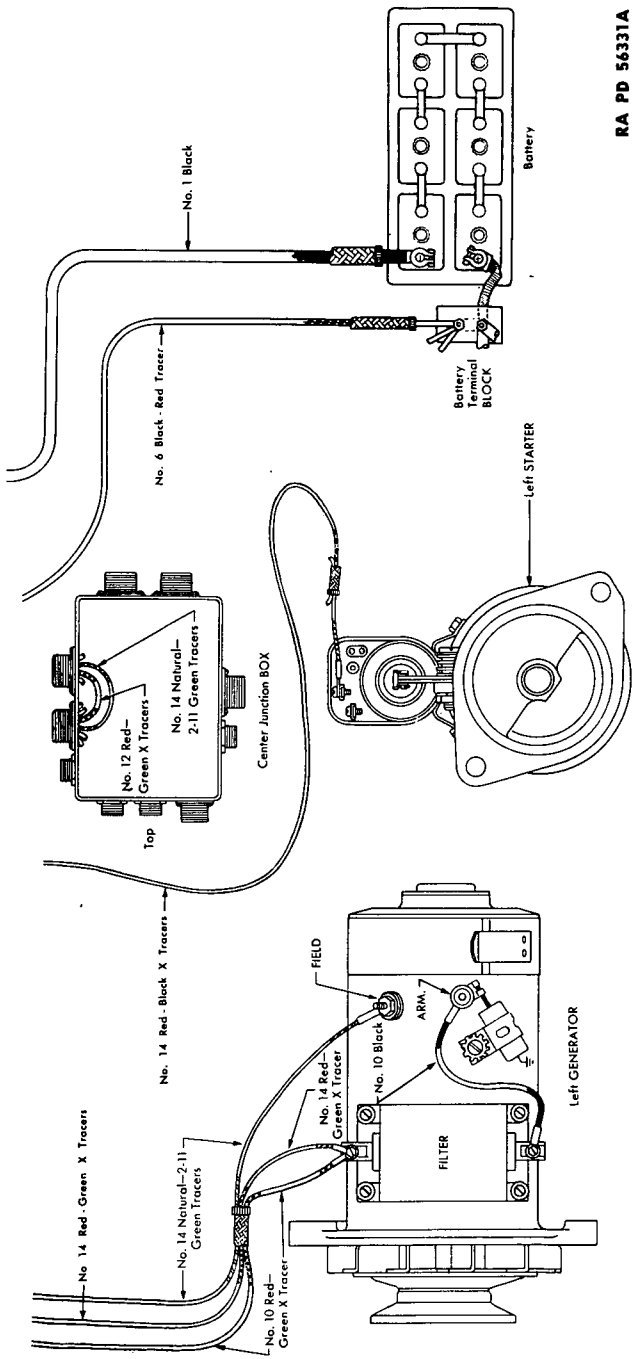
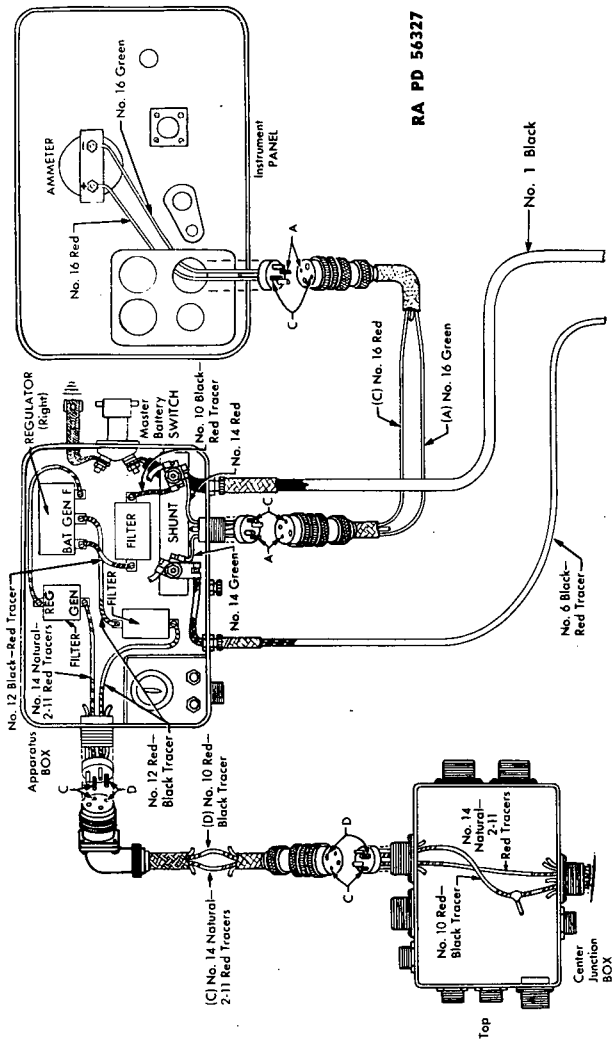


Figure 39 — Diagram of Charging Circuit — Left Generator

ORDNANCE MAINTENANCE — ENGINE COOLING, ENGINE ELECTRICAL AND ENGINE FUEL SYSTEMS FOR LIGHT TANK M5 AND 75-MM HOWITZER MOTOR CARRIAGE M8



ENGINE ELECTRICAL SYSTEM

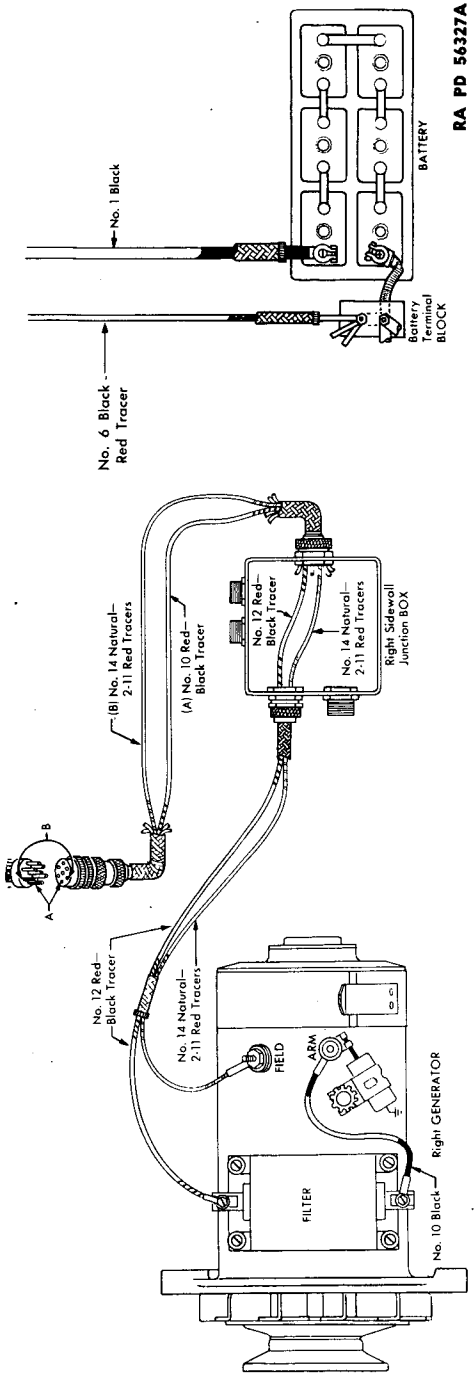
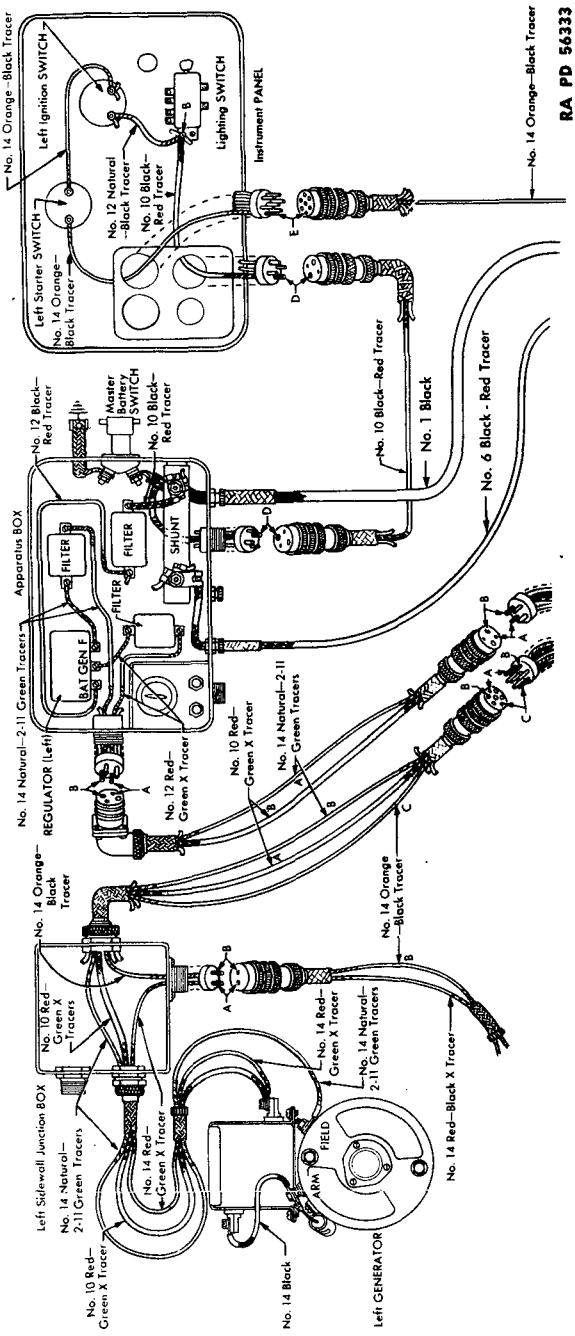


Figure 39A — Diagram of Charging Circuit — Right Generator


No. 14 Orange–Black Tracer
Left Ignition SWITCH
Left Starter SWITCH
No. 14 Orange–Black Tracer
No. 12 Natural –Black Tracer
No. 10 Black–Red Tracer
Lighting SWITCH
Instrument PANEL
No. 14 Orange–Black Tracer
RA PD 56333
No. 12 Black–Red Tracer
Master Battery SWITCH
No. 10 Black–Red Tracer
Apparatus BOX
FILTER
FILTER
FILTER
SHUNT
BAT GEN F
No. 14 Natural–2-11 Green Tracers
REGULATOR (Left)
No. 12 Red–Green X Tracer
No. 10 Red–Green X Tracer
No. 14 Natural–2-11 Green Tracers
No. 10 Black–Red Tracer
No. 1 Black
No. 6 Black - Red Tracer
No. 14 Orange–Black Tracer
No. 14 Orange–Black Tracer
No. 10 Red–Green X Tracers
No. 14 Red–Green X Tracer
No. 14 Natural–2-11 Green Tracers
Left Sidewall Junction BOX
No. 14 Natural–2-11 Green Tracers
No. 14 Red–Green X Tracer
No. 10 Red–Green X Tracer
No. 14 Red–Green X Tracer
No. 14 Natural–2-11 Green Tracers
No. 14 Red–Black X Tracer
FIELD
ARM
No. 14 Black
Left GENERATOR

ENGINE ELECTRICAL SYSTEM

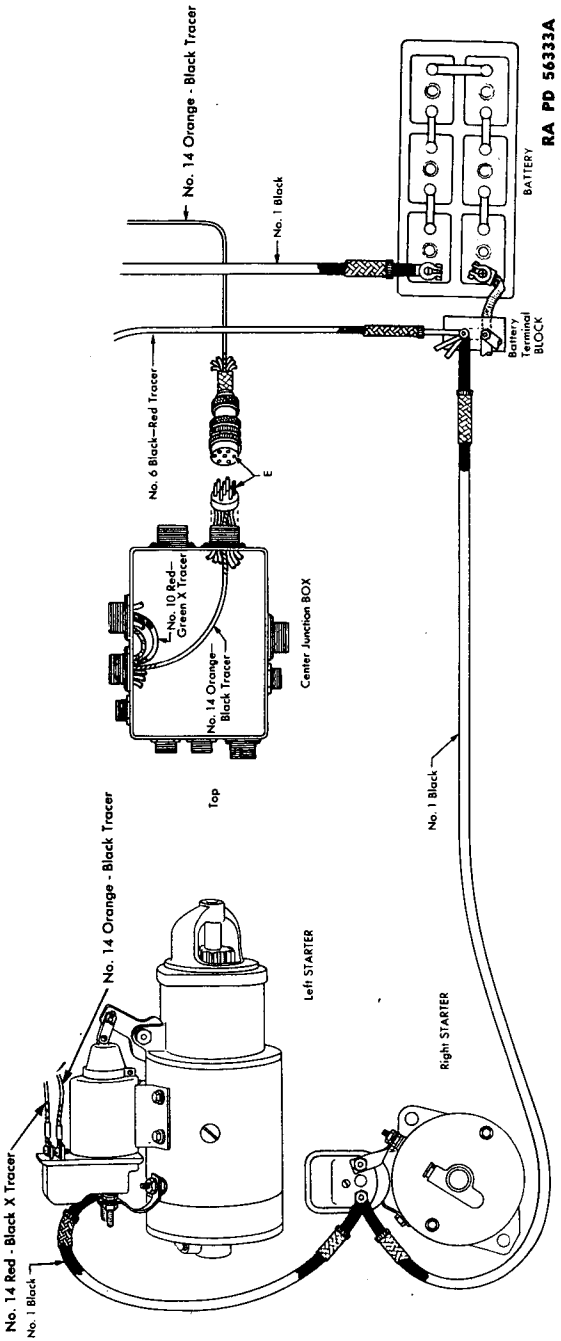
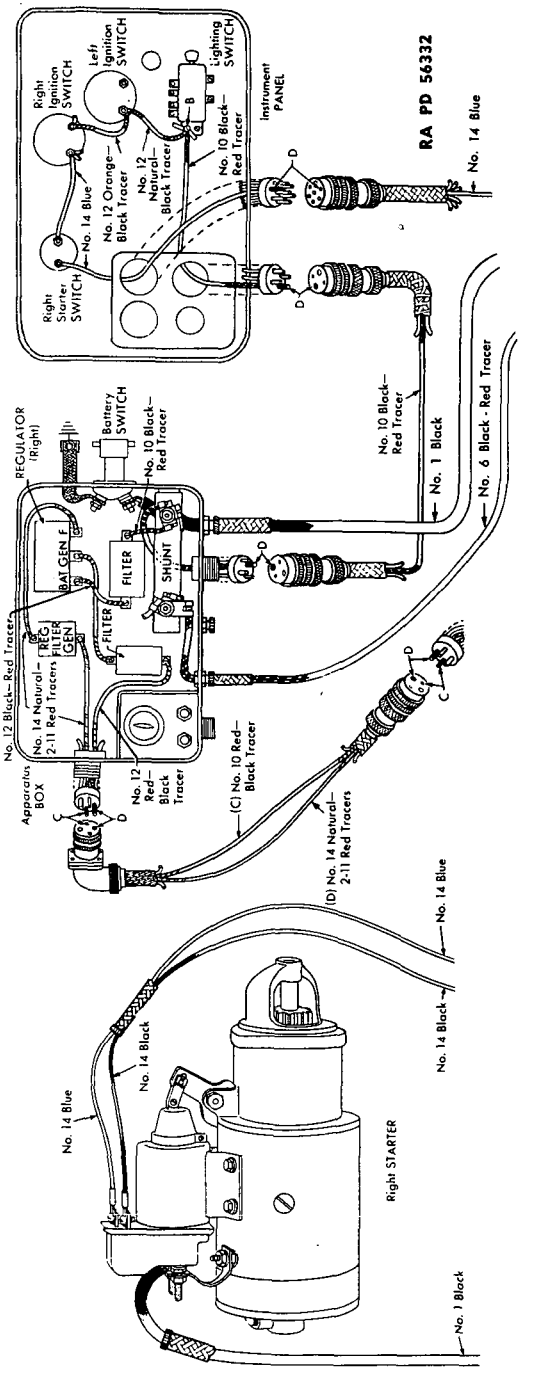


Figure 40 — Diagram of Starter Circuit — Left

ORDNANCE MAINTENANCE — ENGINE COOLING, ENGINE ELECTRICAL AND ENGINE FUEL SYSTEMS FOR LIGHT TANK M5 AND 75-MM HOWITZER MOTOR CARRIAGE M8



ENGINE ELECTRICAL SYSTEM

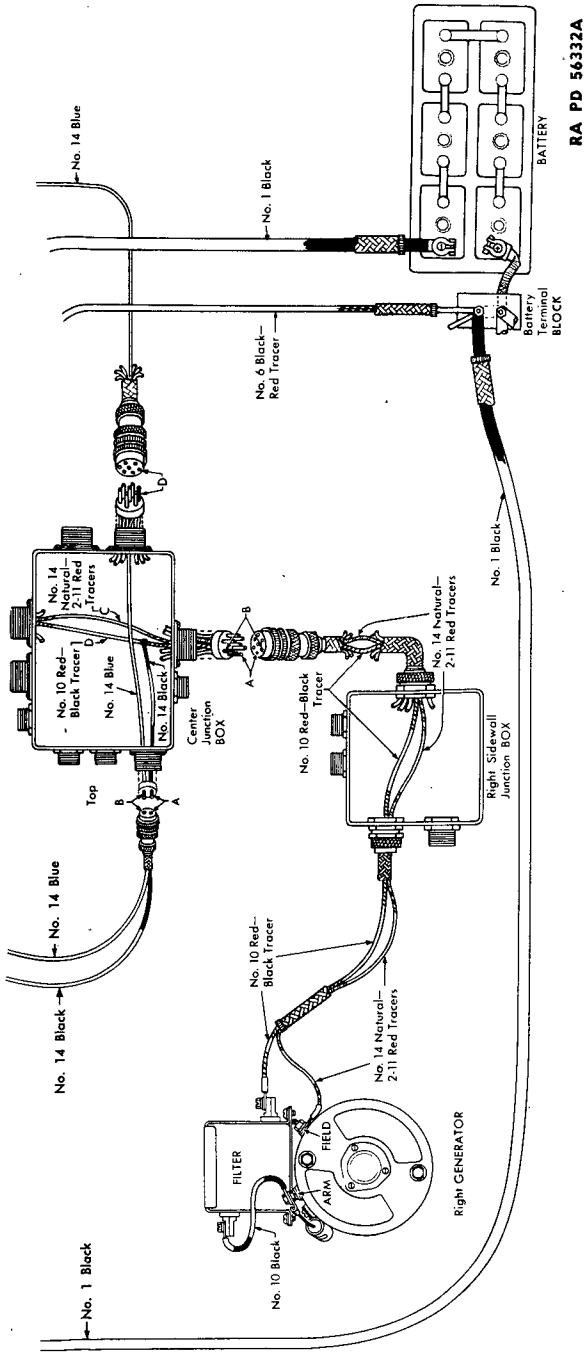


Figure 40A — Diagram of Starter Circuit — Right

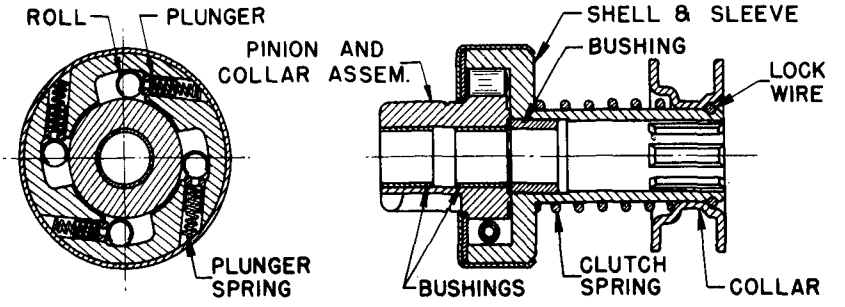


Figure 41 — Overrunning Clutch — Cross Section

in the solenoid and, as the armature starts to revolve, the teeth slip into mesh and cranking takes place.

(3) As soon as the engine starts, the overrunning clutch in the pinion assembly permits the pinion to run faster than the cranking motor armature. This protects the armature from excessive speed until the starter button is released, and the shift lever pulls the pinion from contact with the flywheel teeth.

(4) The overrunning clutch (fig. 41) contains four spring-loaded rollers which tighten between the outer shell and the pinion collar, so that the assembly rotates as a unit during cranking. When the pinion is driven at high speed by the flywheel, however, the rollers are rolled back toward the springs where there is enough room for them to spin freely. This relieves any pressure on the pinion collar and the pinion overruns the remainder of the assembly.

22. TABULATED DATA AND SPECIFICATIONS.

a. Generator.

Brush spring tension ..... 24 to 28 oz
Field current draw ..... 1.1 to 1.2 amp at 12 volts
Manufacturer ..... Delco-Remy
Output, cold ..... 24 to 26 amp at 15.0 volts and 1,500 rpm
Rotation, drive end view ..... Clockwise
Type number 1105902

b. Generator Regulator.

Type number 1118253

c. Cut-out Relay.

Closing voltage ..... 12.4 to 13.4 volts
Gap ..... 0.020 in.
Point opening ..... 0.020 in.

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d. Current Regulator.

Current setting ..... 24 to 26 amp
Gap ..... 0.080 in.

e. Voltage Regulator.

Gap ..... 0.070 in.
Voltage setting ..... 14.0 to 14.2 volts with regulator hot
Output ..... 8 to 10 amp

f. Starter.

Brush spring tension ..... 24 to 28 oz
No-load test ..... 7,000 rpm at 10 volts and 80 amp
Rotation, drive end view ..... Clockwise
Torque test ..... 16 ft-lb at 6.7 volts and 530 amp
Type number 1108114

23. ORGANIZATION MAINTENANCE.

a. For the allocation of maintenance duties, refer to the information on the engine electrical system in the echelon breakdown of maintenance (par. 4).

24. TECHNICAL INSPECTION.

a. Purpose. Technical inspections by ordnance personnel are a follow-up and check on organizational maintenance inspections and servicing. These inspections determine whether the electrical units should be continued in service or withdrawn from operation for overhaul.

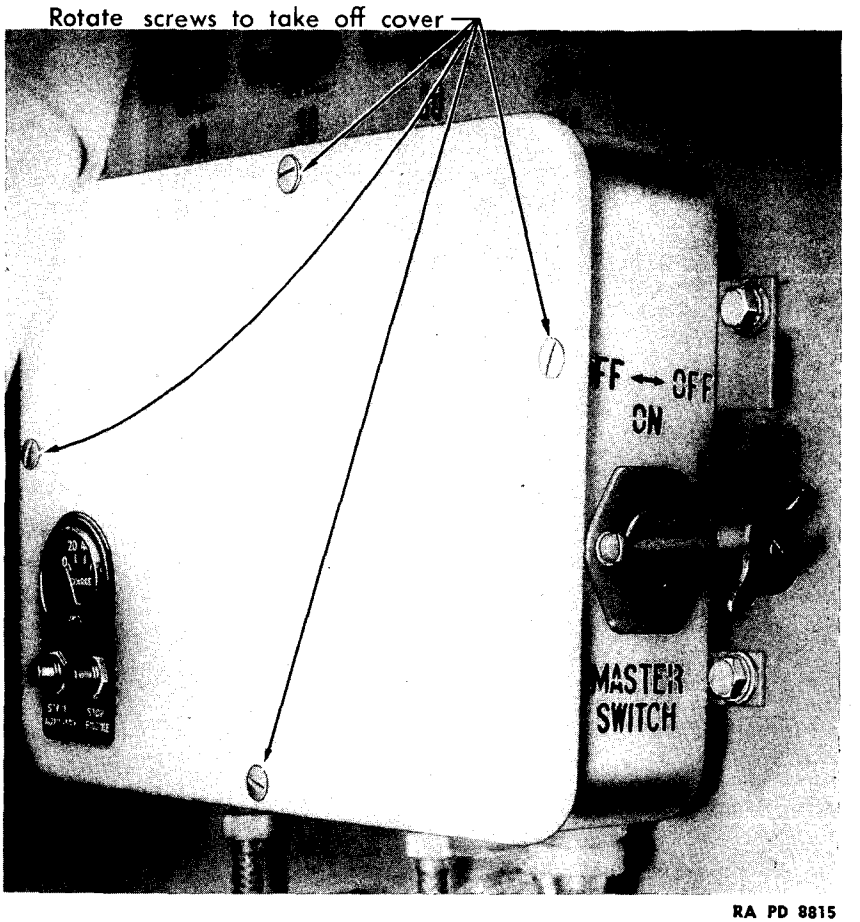
b. Inspection Form. War Department Quartermaster Corps Form No. 260, Technical Inspection Report of Motor Vehicles, is the standard and official form for recording the inspection of all motor vehicles and components, including combat vehicles of the Ordnance Department.

c. Equipment Required.

AMMETER, precision	TOOL, vehicle, (set)
FLASHLIGHT	UNIT, resistance, (either
HYDROMETER, battery	variable or 1½-ohm fixed)
PAPER, flint, No. 00	VOLTMETER, precision

d. Generator Inspection. The following inspections should be made at each overhaul period, normally after 3,000 miles of operation. NOTE: Open engine compartment rear doors and remove fans, belts, and fan supports to gain access to generators for inspection.

(1) Make sure that the mounting screws are tight and that the generator belt is adjusted to the correct tension, namely ⅝- to ¾-inch slack between pulleys (fig. 15).



RA PD 8815

Figure 42 — Apparatus Box

(2) Check the pulley nut to make sure that it is tight.

(3) Check the connections and wiring in the generator-to-regulator-to-battery circuit (figs. 39 and 39A).

(4) Remove cover band and inspect commutator and brushes.

(*a*) If brushes are worn, they should be replaced and brush spring tension checked (par. 27 d).

(*b*) If commutator is dirty, it can be cleaned with a strip of PAPER, flint, No. 00, held against it with a piece of soft wood while generator is operating. Blow out dust.

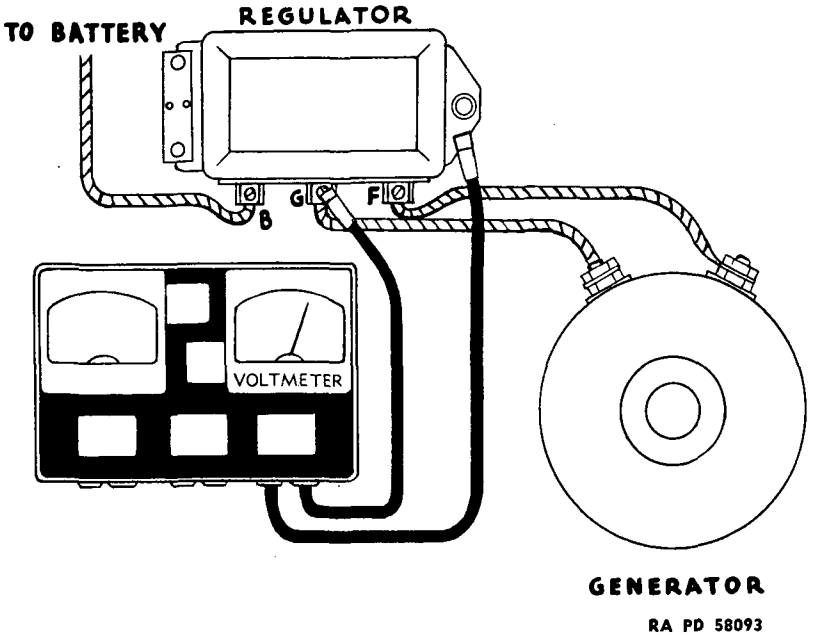


Figure 43 — Checking Cut-Out Relay Closing Voltage

(c) If commutator is rough, out of round, or has high mica, generator must be removed to have commutator repaired as explained in paragraph 27 b.

(*d*) If thrown solder is found on cover band, generator must be removed for overhaul as explained in paragraph 27.

(5) Since the generator output is dependent on the regulators, check regulators as outlined in paragraph 25.

e. Generator Regulator Inspection. Regulators are accessible from the fighting compartment after removing the turret basket shield which permits access to the apparatus box (fig. 42). The cut-out relay, current regulator, and voltage regulator connections and settings should be checked as follows:

(1) Check regulator mountings and lead connections to make sure they are tight. Cover must be assembled tightly, and rubber gasket between cover and regulator base must be in place.

(2) Check closing voltage of cut-out relay by connecting a voltmeter between the generator terminal and the generator regulator base (fig. 43), slowly increasing the generator speed and observing the voltage at which the relay points close. This should be from 12.4 to 13.4 volts.

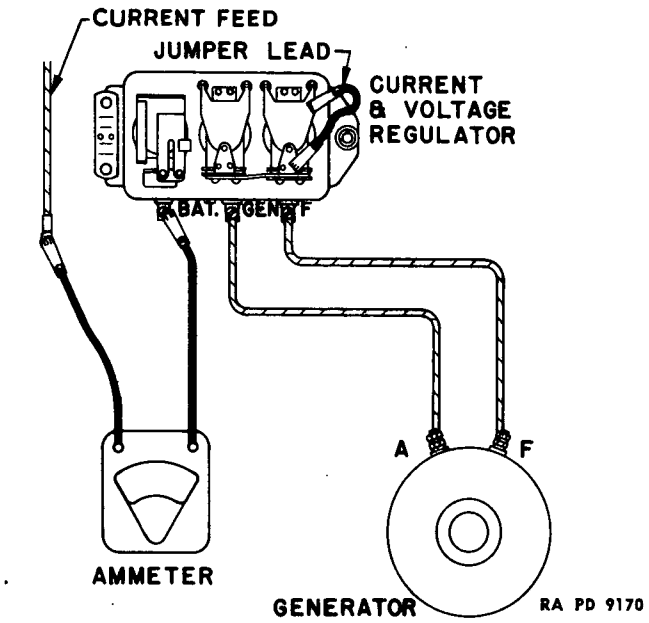


Figure 44 — Checking Current Regulator Setting

(3) Check current regulator setting by removing generator regulator cover, connecting a jumper lead across the voltage regulator contact points, and connecting a test ammeter in the circuit at the battery terminal of the regulator unit (fig. 44). With generator regulator at operating temperatures and lights turned on to prevent high voltage, run generator at medium speed and observe current setting. Current should be from 24 to 26 amperes.

(4) Check voltage regulator setting, either by the fixed resistance method or the variable resistance method, depending on the equipment available.

(*a*) With the fixed resistance method, disconnect the lead from the battery terminal of the generator regulator, and connect a 1½-ohm fixed resistance and a voltmeter from this terminal to the generator regulator base (fig. 45). The resistance unit must be capable of carrying 10 amperes continuously and must not change in value as its temperature changes. Observe voltage setting with the generator regulator at operating temperatures, the *generator regulator cover in place,* and the generator operating at medium speed. The correct setting is from 14.0 to 14.2 volts.

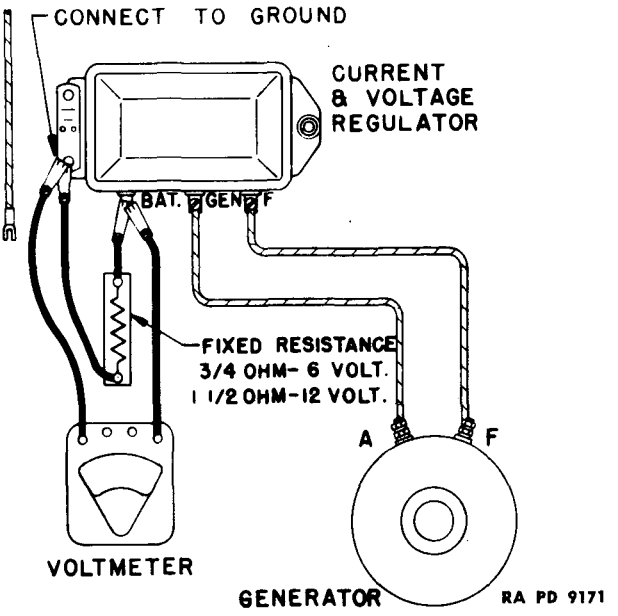


Figure 45 — Checking Voltage Regulator Setting — Using Fixed Resistance

(*b*) With the variable resistance method, a variable ¼-ohm resistance, an ammeter, and a voltmeter are required. A combination instrument such as shown in figure 46 is satisfactory. Connect the ammeter and variable resistance in series into the charging circuit at the battery terminal and connect the voltmeter from the battery terminal to the regulator base. Operate the generator at medium speed with the regulator at operating temperature and the generator regulator cover in place. If less than 8 amperes is obtained, turn on lights to increase generator output. Cut in resistance slowly until generator output is brought between 8 and 10 amperes; then slow generator to idling speed, bring it back to speed, and then observe voltage setting. NOTE: After any check or adjustment of the generator or generator regulator, always connect a jumper lead momentarily between the generator and battery terminals of the generator regulator, after the generator regulator has been reconnected and before the engine is started. The surge of current to the generator will polarize it correctly with respect to the battery.

(5) Readjust the generator regulator as required, in accordance with the instructions in paragraph 29.

f. Starter Inspection. Starter inspections are divided into two types: minor inspections, to be made every 1,000 miles, and major inspections,

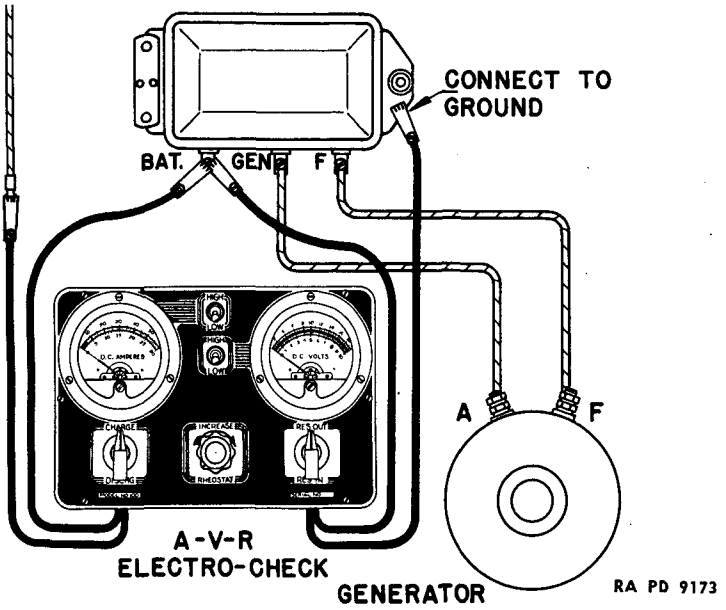


Figure 46 — Checking Voltage Regulator Setting — Using Variable Resistance

to be made only when the engines are removed from the vehicle or when there is evidence of starter trouble.

(1) Every 1,000 miles the starter cables and connections should be checked for tightness, and the tightness of the mounting screws should also be checked.

(2) Further inspection of the starter on the vehicle is not possible. The inspections that follow can be performed only when the engines are removed from the vehicle for overhaul, or when the starters are removed (procedure given in par. 33) because of unsatisfactory operation.

(3) Remove cover band and inspect commutator and brushes.

(*a*) If brushes are worn, they should be replaced and brush spring tension checked (par. 34).

(*b*) If commutator is dirty, the starter must be removed from the vehicle to clean it.

(c) If commutator is rough, out of round, or has high mica, starter must be disassembled to have commutator repaired as explained in paragraph 34.

(*d*) Starter should be given no-load and torque tests, explained in paragraph 25 **c** before reinstallation.

g. Cleaning. When using vapor and/or steam cleaning devices, proper protection must be made of all electrical equipment used on the engines, chassis, and bodies of the vehicle being cleaned. The jet of vapor from the cleaning nozzle must not be applied directly to electrical accessories. Steam or moisture forced into the equipment is sufficient to cause short circuits and corrosion of the internal parts. Clean generator regulators, generators, starters, distributors, etc., with SOLVENT, dry-cleaning.

25. TROUBLE SHOOTING.

a. Generator and Regulator. NOTE: Before attempting any repairs or adjustments to the generator or regulators, check the battery and the battery connections. If the battery and its connections are in proper order, proceed as follows:

(1) NO GENERATOR OUTPUT.

Probable Cause	Probable Remedy
Broken connections in charging circuit.	Repair connections.
Generator regulator points burned or incorrectly adjusted.	Ground "F" terminal of the generator regulator and slowly increase engine speed. If generator charges, generator regulator points are at fault; if not, proceed with tests. Clean and reset regulator points (par. 31).
Cut-out relay not operating.	Disconnect lead from "GEN" terminal of regulator, and strike it against a convenient ground while generator is operating at medium speed. If spark occurs, cut-out relay is at fault; if not, generator is at fault; proceed with tests. Clean cut-out relay points; readjust voltage setting, or replace cut-out relay. NOTE: Do not operate generator with "GEN" lead disconnected for any length of time, since this is open-circuit operation and units would be damaged.

Probable Cause	Probable Remedy
Generator brushes sticking or making poor contact.	Reseat brushes, or replace brushes or brush holders.
Dirty or burned commutator.	Disassemble generator and overhaul commutator.
Generator internal ground.	Insulate grounded brush from commutator and connect test lamp between "A" terminal and frame. If test lamp lights, a ground is indicated. Proceed with next test.
Grounded field coils.	Insulate the insulated brush from commutator and connect test lamp between "A" terminal and the generator frame. If the lamp lights, the fields are grounded. Repair or replace field coils, and check condition of regulator points.
Grounded armature windings.	Insulate both brushes from commutator and connect test lamp from generator frame to each segment of the commutator. (If 110 volts are used in the test lamp, contact with any segment of the commutator will do.) If the lamp lights it indicates a ground in the armature windings. Repair or replace the armature.
Open field coils.	Insulate the insulated brush from the commutator and connect a test lamp between the "A" terminal and the "F" terminal. If test lamp does not light, the field circuit is open. Repair or replace field coils.

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Probable Cause	Probable Remedy
Shorted field coils.	Disconnect field lead from the insulated brush holder. Momentarily connect a battery and a precision ammeter in series with the field, between "F" terminal on generator and the field lead which was disconnected from the brush holder. If field current is more than 1.1 to 1.2 amperes at 12 volts, the field coils are shorted and must be replaced. NOTE: Be prepared to break this circuit quickly, as a shorted field may draw an excessively high current.
Open circuit in armature.	Inspect commutator bars for burns or bad connections. Remove armature from generator and test between adjacent bars with test points and voltmeter. Open circuits will cause full battery voltage reading. Repair or replace armature.
Short circuit in armature.	Check armature on growler (fig. 47). To repair or replace armature, refer to paragraph 27 **b** (3).
(2) UNSTEADY OR LOW OUTPUT.	
Generator belt loose.	Readjust to 5/8- to 3/4-inch tension as shown in figure 15.
Loose connections, or frayed or damaged wires in charging circuit.	Reconnect or replace wires.
Regulator points burned or out of adjustment.	Ground "F" terminal of regulator and slowly increase engine speed. If output increases, regulator is at fault; if not, proceed with test. Clean and reset regulator points.
Generator brushes sticking or making poor contact.	Reseat brushes, or replace brushes or brush holders.

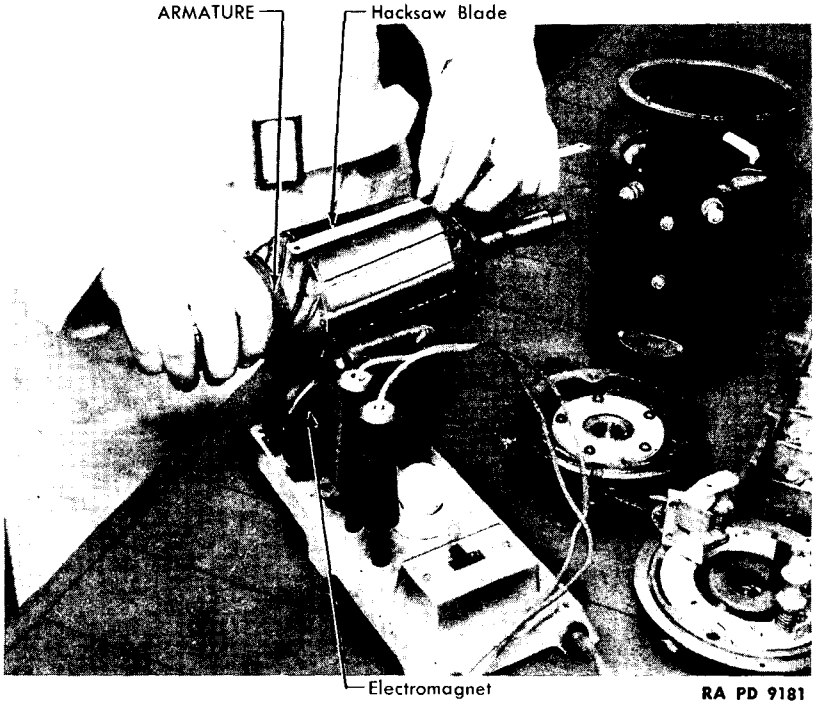

Figure 47 — Checking Armature on Growler

Probable Cause	Probable Remedy
Commutator rough, out-of-round, dirty or burned.	Inspect commutator through brush holder opening. Disassemble generator and overhaul commutator.
(3) EXCESSIVE GENERATOR OUTPUT.	
Grounded field coils	Disconnect lead at generator "F" terminal. If output remains high, field is grounded. Repair or replace field coils.
Regulator setting too high.	Readjust regulator as outlined in paragraph 31.
(4) NOISY GENERATOR.	
Loose mounting.	Readjust belt and tighten mounting screws securely.

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Probable Cause	Probable Remedy
Brushes improperly seated.	Remove brush cover and inspect. Reseat brushes.
Bent brush holder.	Remove brush cover and inspect. Replace brush holder.
Worn or dirty bearings.	Replace bearings.

b. Starter.

(1) STARTER DOES NOT OPERATE.

Dead battery.	Recharge or replace battery.
Broken connections.	Repair connections.
Defective solenoid or switch.	Repair or replace solenoid assembly.
Engine or transmission frozen or locked.	Test engine rotation by turning over with a 1-inch wrench applied to fan pulley mounting screw. Repair engine (see TM No. 9-1727A, now published as TM No. 9-1732A).
Starter frozen or locked.	Disassemble and repair starter.
Open in filter on left generator.	Test with test lamp, from each terminal to ground. Replace.

(2) STARTER CRANKS ENGINE VERY SLOWLY.

Low battery.	Recharge or replace battery.
Loose or high resistance connections.	Tighten connections or replace worn or damaged cables.
Engine cranks stiffly due to wrong grade of oil or some mechanical condition.	Test engine rotation by turning over with a 1-inch wrench applied to fan pulley mounting screw. Repair engine (see TM No. 9-1727A, now published as TM No. 9-1732A).
Dirty or worn brushes or commutator.	Replace or reseat brushes. Disassemble starter and overhaul commutator.
Tightness or drag in starter.	Remove starter and check rotation. Disassemble and repair starter.
Internal defects in starter.	Remove starter for no-load and torque tests. Repair starter.

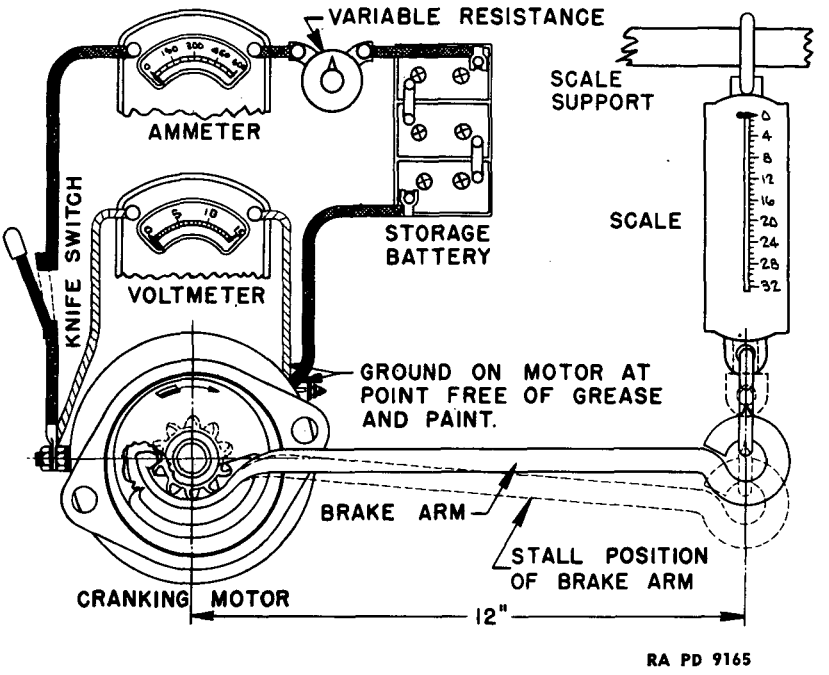

Figure 48 — Starter Torque Test

c. Starter No-load and Torque Tests.

(1) To make the no-load test, connect the starter in series with a battery of the specified voltage and an ammeter reading up to several hundred amperes. Connect a revolution-per-minute indicator to the armature.

(2) The torque test is made with the equipment illustrated in figure 48. A high current carrying variable resistance should be connected into the circuit so that the specified voltage at the starter may be obtained.

(3) On a no-load test, the starter should turn up to 7,000 revolutions per minute at 10 volts and 80 amperes. On a torque test, the starter should develop 16 foot-pounds at 6.7 volts and 530 amperes. Variations from these readings should be interpreted as follows:

(4) Low free speed and high current draw, with low torque, indicates:

(*a*) Tight, dirty or worn bearings, bent shaft or loose pole shoe screws.

(*b*) Grounded armature or field. Check as explained in paragraph 25 b.

(*c*) Shorted armature. Check armature on growler.

(5) Failure to operate, with high current draw, indicates:

(*a*) Direct ground in switch, terminal or fields.

(*b*) Frozen shaft bearings.

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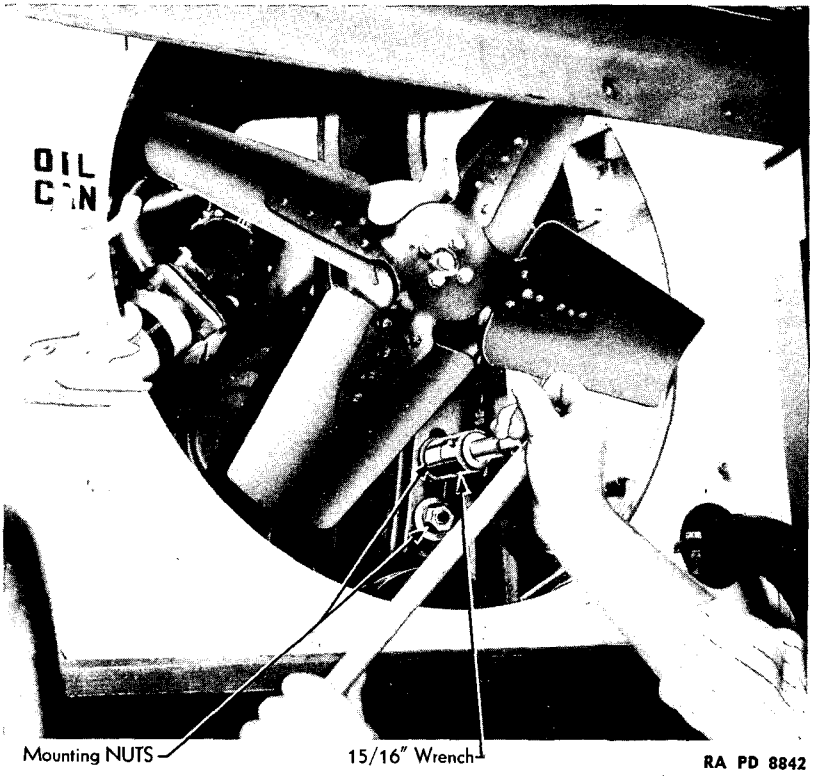

Figure 49 — Removing Fan

(6) Failure to operate, with no current draw, indicates:

(*a*) Open field circuit. Inspect connections and trace circuit with a test lamp.

(*b*) Open armature coils. Inspect commutator for badly burned bars.

(c) Broken or weak brush springs, worn brushes, high mica or other conditions which would prevent contact between brushes and commutator.

(7) Low no-load speed, with low torque and low current draw, indicates:

(*a*) Open field winding. Test as explained in paragraph 34 c (2).

(*b*) High internal resistance due to poor connections, defective leads, worn or dirty brushes or commutator.

(8) High free speed, with low developed torque and high current draw, indicates:

(*a*) Shorted field coils. Check by substitution.

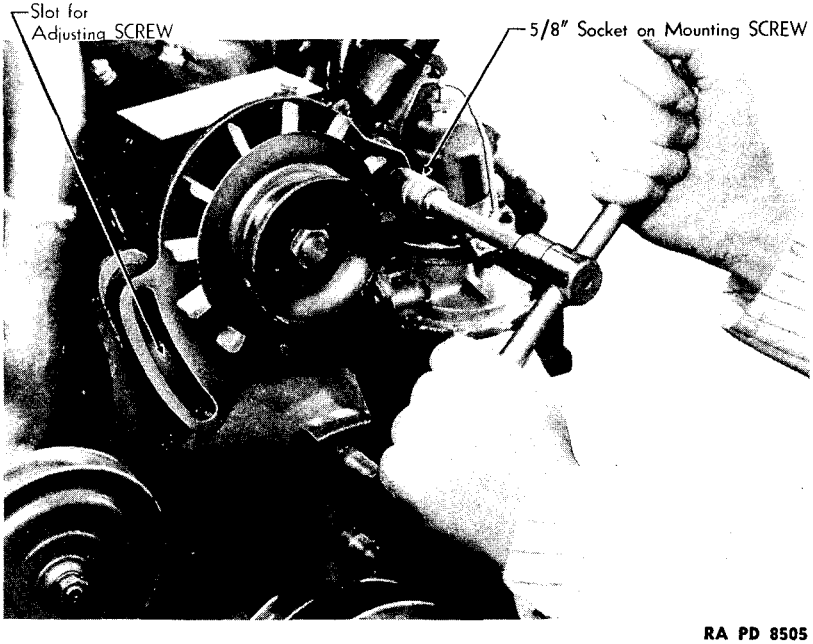

Figure 50 — Removing Generator

26. REMOVAL AND DISASSEMBLY OF GENERATOR.

a. Equipment.

AMMETER
BATTERY, 12-volt
CLOTH, clean
COMPOUND, insulating
COPPER, soldering
FLUX, rosin
HANDLE, wrench, universal
HAMMER, soft
PAN
PRESS, arbor
SCALE, spring
SCREWDRIVER
SCREWDRIVER, socket
SOLDER
SOLVENT, dry-cleaning
STONE, brush, seating
TAPE, insulating
WRENCH, box, 5/16-in.
WRENCH, box, 15/16-in.
WRENCH, open-end, 7/16-in.
WRENCH, socket, 7/16-in.
WRENCH, socket, 5/8-in.
WRENCH, socket, 3/4-in.
WRENCH, socket, 15/16-in.

ENGINE ELECTRICAL SYSTEM

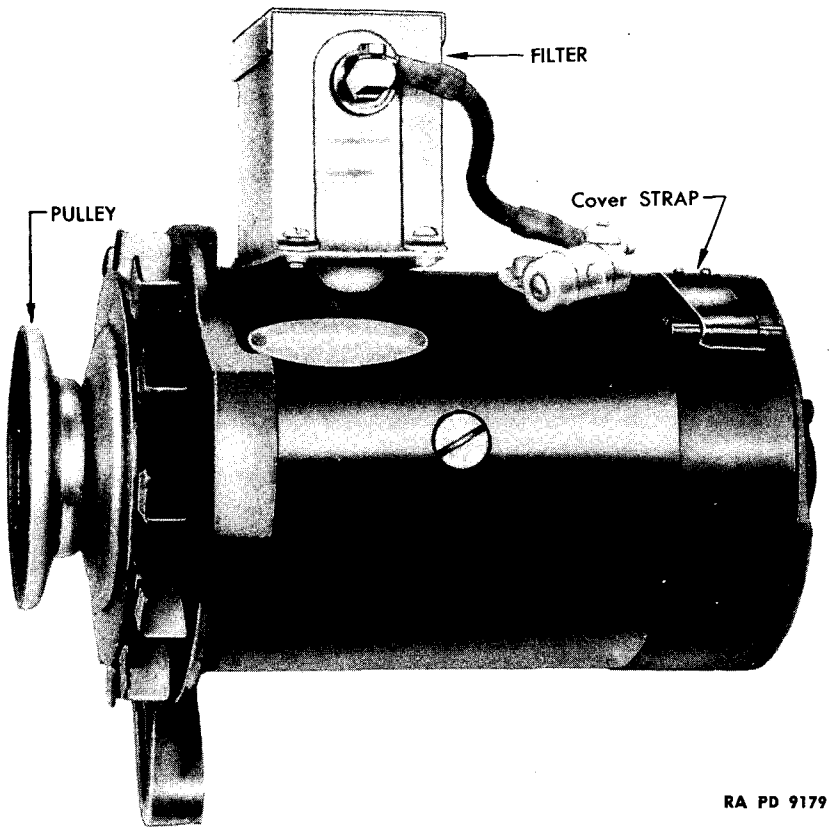

Figure 51 — Generator and Filter

b. Procedure.

(1) REMOVAL FROM VEHICLE.

WRENCH, socket, 5/8-in. WRENCH, socket, 15/16-in.
WRENCH, socket, 3/4-in.

Turn master switch to "OFF" position. Open engine compartment rear doors, using 3/4-inch socket wrench to remove 7 cap screws. Remove fan, belt and support by removing 2 nuts, washers and lock washers (fig. 49). Disconnect dual red wires at generator filter and one yellow wire at generator field terminal. Loosen generator mounting screws and remove generator belt. Remove mounting screws, and remove generator and filter as an assembly (fig. 50).

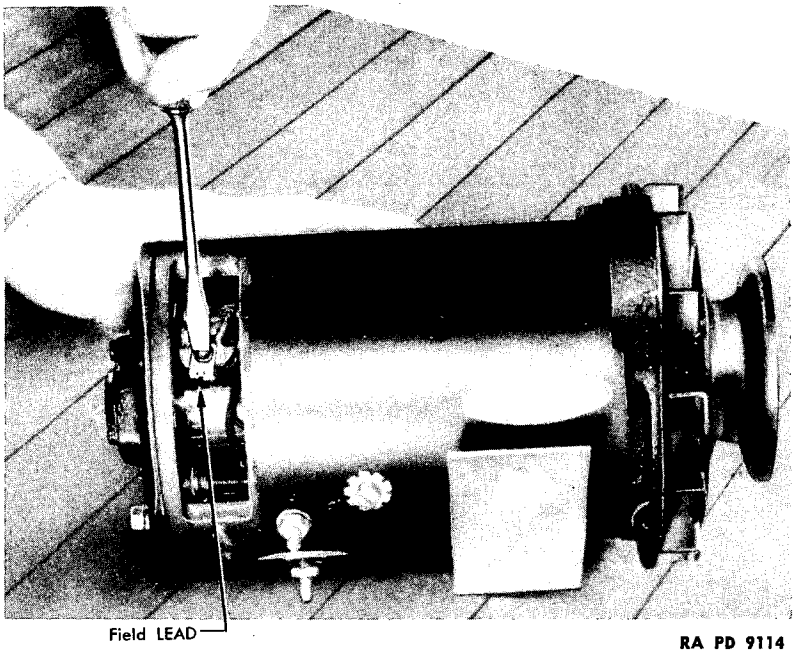

Figure 52 — Removing Field Lead from Brushes

(2) REMOVAL OF GENERATOR COMPONENTS.

HAMMER, soft
SCREWDRIVER
WRENCH, box-end, 5/16-in.
WRENCH, socket, 7/16-in.

Disconnect lead from generator to filter. Remove condenser from center frame. Remove 4 screws and lock washers holding filter to generator and remove filter (fig. 51). Remove strap over generator brush openings. Disconnect lead from center frame to brushes (fig. 52). Remove 2 bolts and lock washers holding commutator end frame assembly to center frame (fig. 53). Remove commutator end frame from center frame and center frame from drive end frame. NOTE: A soft hammer may be used to separate the frames if they fit too snugly.

(3) DISASSEMBLE COMMUTATOR END FRAME.

PRESS, arbor
SCREWDRIVER

Disconnect grounded brush lead by removing screw and lock washer. Remove brushes from arms. Remove 2 brush arms and springs (fig. 54).

Figure 53 — Removing Commutator End Frame

Remove 3 screws and lock washers holding cover and gasket to commutator end frame (fig. 55). Remove ball bearing from commutator end frame (fig. 56).

(4) DISASSEMBLE FIELD FRAME.

HANDLE, wrench, universal	SCREWDRIVER, socket
SCREWDRIVER	WRENCH, open-end, 7/16-in.

Remove 2 screws and lock washers holding filter mounting plate to field frame. Remove nut, lock washer, flat washer, and insulating washer from field terminal and armature terminal (fig. 57). Remove armature terminal stud and lead assembly from inside field frame. Remove 2 pole

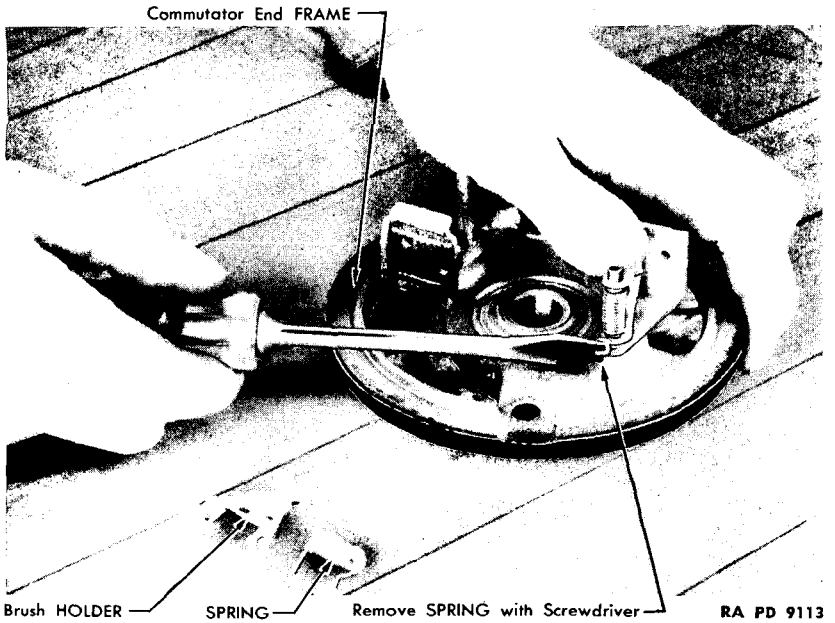

Figure 54 — Removing Brush Arms and Spring

shoe screws, pole shoes, and field coil assembly, using a universal wrench handle with socket screwdriver (fig. 58). Remove field terminal by pushing through to inside of frame.

(5) DISASSEMBLE DRIVE END FRAME.

PRESS, arbor
WRENCH, box-end, $^{15}/_{16}$-in.
SCREWDRIVER

(*a*) Place armature with drive end frame attached in a vise with copper jaws and remove pulley nut and washer (fig. 59). Remove pulley, fan, and Woodruff key from armature shaft. Remove space washer from armature shaft at bearing.

(*b*) Remove drive end frame from armature shaft (fig. 60). If drive end frame fits too snugly on shaft, an arbor press may be used. Remove 3 screws and lock washers holding ball-bearing retainer plate. Remove retainer plate, ball bearing and spacer, washer retainer, and felt washer (fig. 61). Use an arbor press to remove bearing if it sticks, being careful to press on outer race of bearing only.

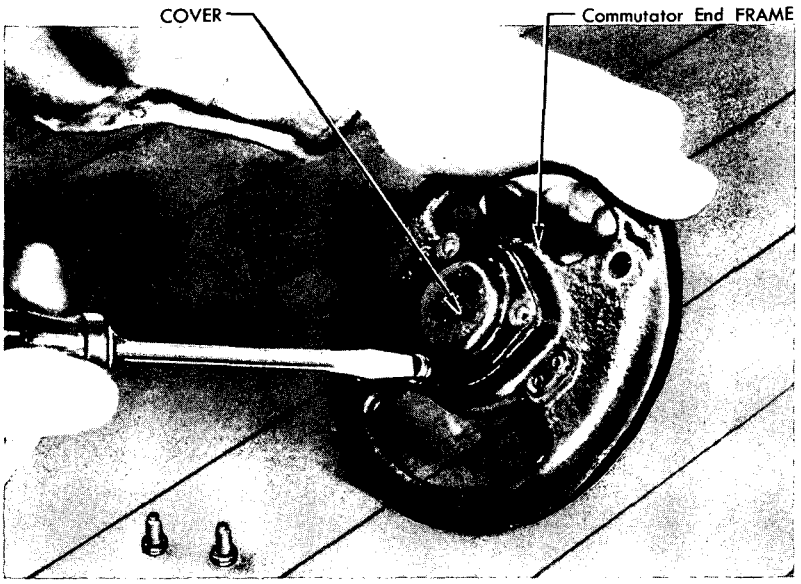

Figure 55 — Removing Cover from Commutator End Frame

27. INSPECTION AND REPAIR OF GENERATOR.

a. After disassembly, all parts should be cleaned, examined, and defective parts replaced. The procedure for cleaning and inspecting parts is given as follows:

b. Armature.

BLADE, hacksaw
CLOTH, clean
COPPER, soldering
FILE, riffle
FLUX, rosin
GROWLER
LIGHT, test and points
SOLVENT, dry-cleaning

(1) CLEAN ARMATURE.

Wipe with clean cloth slightly dampened with CARBON TETRACHLORIDE or a similar solvent. NOTE: Do not clean by any degreasing method as this will damage insulation.

(2) INSPECT ARMATURE FOR GROUND.

Use a test light and test points, and test from commutator to armature shaft or lamination. If test light lights, armature is grounded. If ground is not readily apparent and reparable, replace armature.

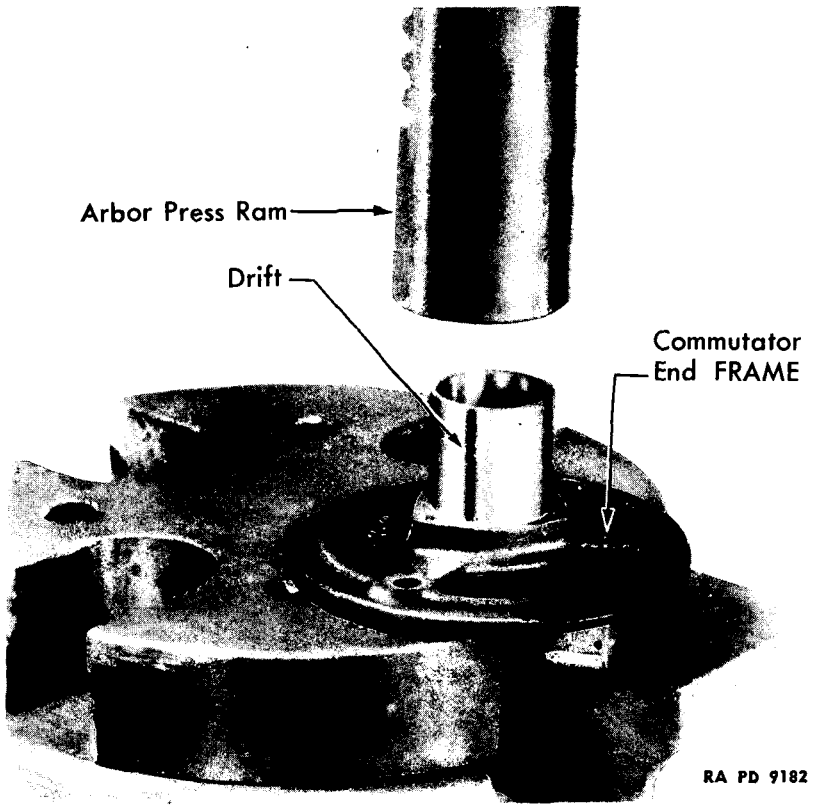

Figure 56 — Removing Bearing from Commutator End Frame

(3) INSPECT ARMATURE FOR SHORT.

Use a growler which is a strong electromagnet connected to a source of alternating current. When a shorted armature is placed on the growler and a hacksaw blade held above the shorted coils, the blade will be alternately attracted to and repelled from the armature, causing the blade to buzz against the armature (fig. 47). Rotate armature a complete turn on growler. NOTE: Before replacing an armature which appears to be shorted, inspect the commutator slots carefully since copper or brush dust sometimes collects in them, causing a shorted condition.

(4) INSPECT COMMUTATOR.

Check commutator, and if burned, worn rough, or out-of-round, place armature in lathe and turn down until it is perfectly round, being careful

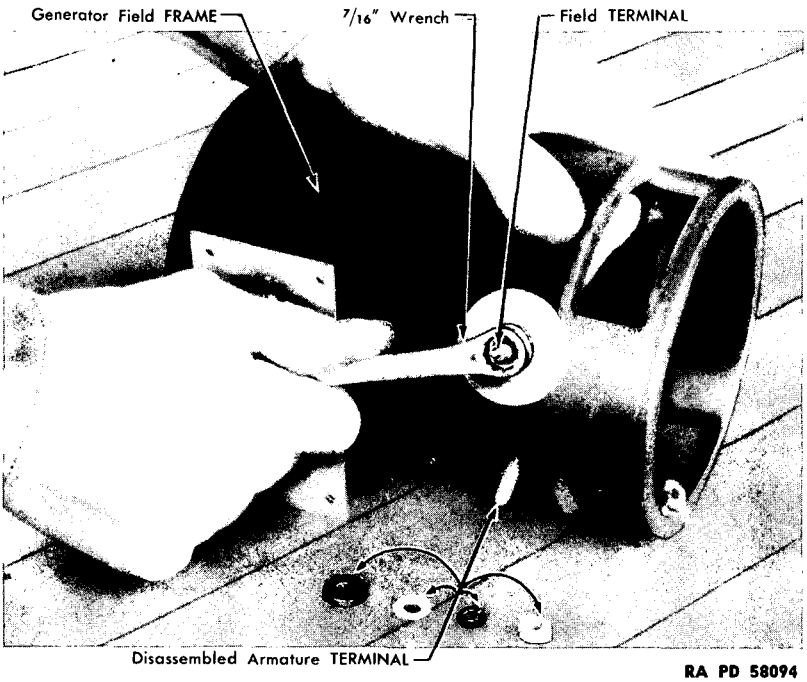

Figure 57 — Removing Armature and Field Terminals

not to cut deeper than necessary; then undercut mica as shown in figure 63.

(5) INSPECT FOR OPEN CIRCUIT.

If commutator bars are burned intermittently, this indicates an open circuited armature which is due to generator overloading, resulting from excessively high regulator settings. This condition is remedied by readjusting the voltage regulator as explained in paragraph 29.

NOTE: If the commutator is not too badly burned, the armature may be repaired by soldering all the leads with rosin flux and then turning down the commutator and undercutting the mica.

c. Fields.

AMMETER
BATTERY, 12-volt
CLOTH, clean
COMPOUND, insulating
COPPER, soldering
FLUX, rosin
SOLDER
SOLVENT, dry-cleaning

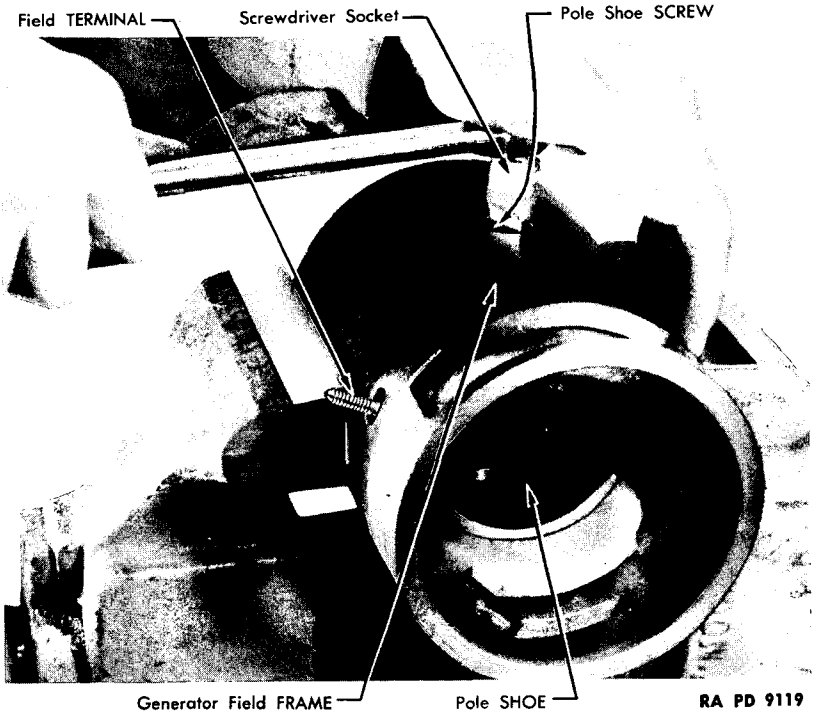

Figure 58 — Removing Pole Shoes

(1) CLEAN FIELDS.

Use a clean cloth dampened slightly with SOLVENT, dry-cleaning and wipe the fields clean. NOTE: Do not clean by any degreasing method as this would damage the fields.

(2) CHECK FIELD CURRENT DRAW.

Connect a 12-volt battery and an ammeter in series with the two field leads. The current draw should register 1.1 to 1.2 amperes. If the fields do not come up to the proper ampere reading, they should be replaced.

(3) INSPECT FIELD INSULATION.

Check field insulation and if windings are exposed, they may be rewrapped with insulating tape and painted with insulating compound.

(4) INSPECT TERMINAL STUD.

If field terminal stud is defective in any way, it should be replaced by unsoldering from lead and soldering lead to a new stud. CAUTION: All soldered connections should be made with *rosin* flux. *Acid flux should not* be used.

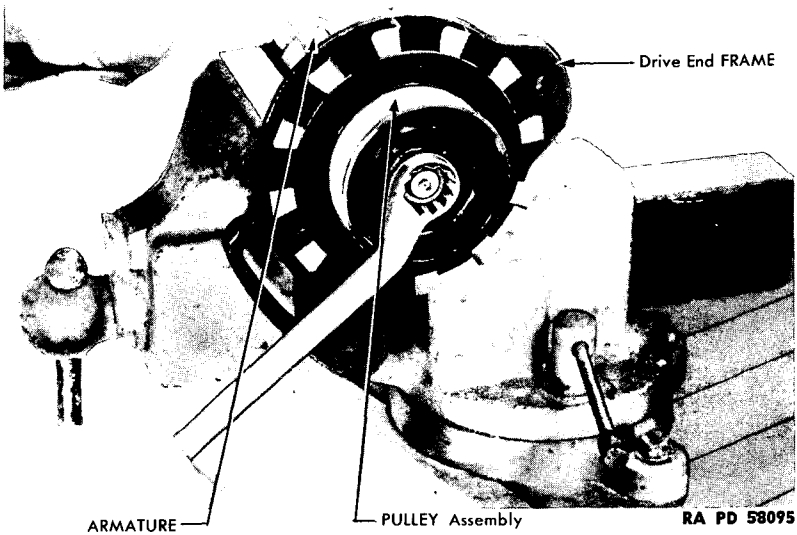

Figure 59 — Removing Generator Pulley

d. Brushes and Springs.

CLOTH, clean
PAN
SCALE, spring
SOLVENT, dry-cleaning
STONE, brush seating

(1) CLEANING.

Clean brushes and springs in pan of SOLVENT, dry-cleaning, and dry with compressed air if available, otherwise use clean cloths.

(2) INSPECT BRUSHES.

If brushes are worn down to $\frac{7}{16}$ inch, they should be replaced. When new brushes are installed, it is necessary to seat them properly by holding a brush seating stone against the commutator with armature revolving about 1,500 revolutions per minute. The seating stone must only be used for a few seconds. The seating stone disintegrates and the particles carry under the brushes and the proper seat results. Over use of seating stone will cause unnecessary wear on the brushes and commutator.

(3) CHECK BRUSH SPRING TENSION.

Brush spring tension is checked with a spring scale (fig. 64). It should be 24 to 28 ounces. The brush spring tension should be checked after

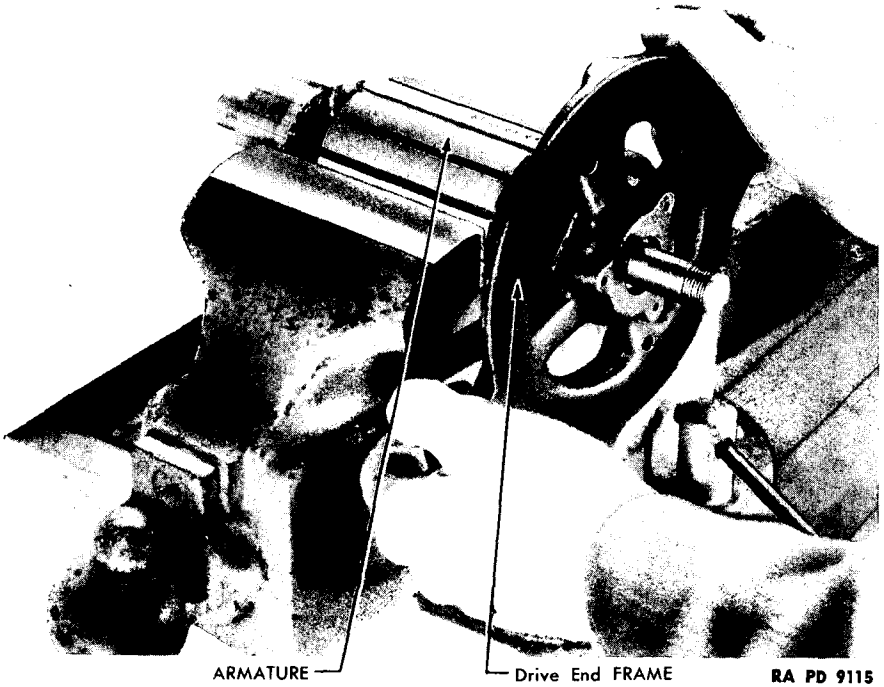

Figure 60 — Removing Drive End Frame

the armature is installed in place in the commutator end frame. The armature is placed in the end frame temporarily for this test. The reading is taken the instant the brush arm leaves the brush. If tension is low, springs should be replaced.

e. Commutator End Frame.

CLOTH, clean
PAN
SOLVENT, dry-cleaning

(1) CLEAN END FRAME.

Clean end frame parts with exception of the ball bearing, in pan of SOLVENT, dry-cleaning, and dry off with compressed air if available; otherwise use clean cloths. Ball bearing is of the sealed type and must never be cleaned in a grease solvent.

(2) INSPECT END FRAME.

Check brush holders and hinge pins, and if damaged in any way, the entire commutator end frame should be replaced as these parts are riveted to the frame.

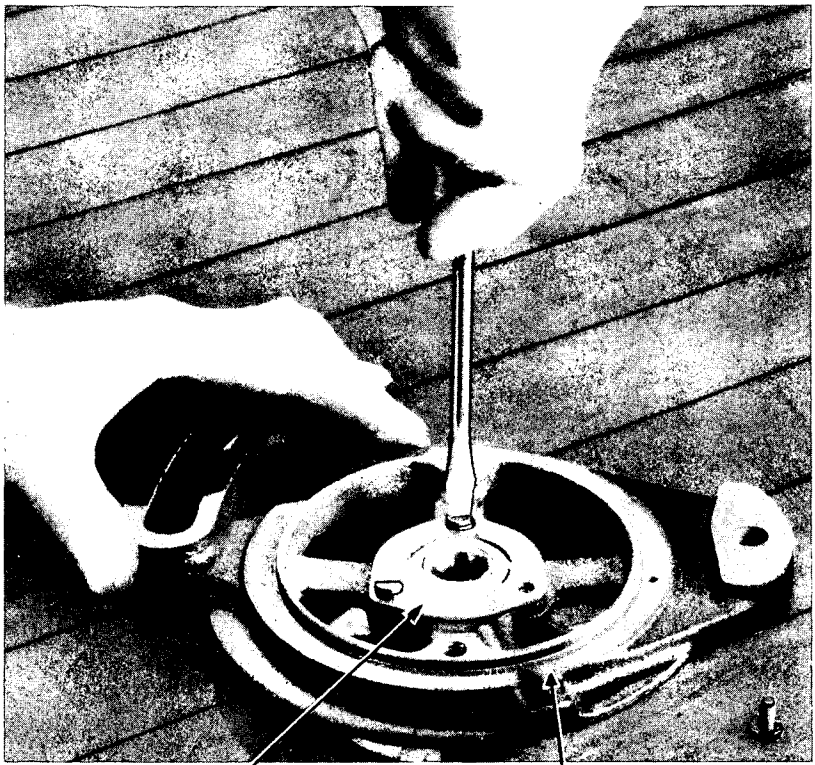

Figure 61 — Removing Retainer Plate from Drive End Frame

(3) INSPECT BEARING.

Inspect ball bearing, and if it is badly worn, it should be replaced.

f. Drive End Frame.

CLOTH, clean
PAN
SOLVENT, dry-cleaning

(1) CLEAN DRIVE END FRAME PARTS.

Drive end frame parts, with exception of ball bearing, may be cleaned in a pan of SOLVENT, dry-cleaning, and dried with compressed air, if available, or with clean cloths. Ball bearings are of the sealed type and must never be cleaned in a grease solvent.

(2) INSPECT DRIVE END FRAME PARTS.

Check ball bearing, and if it is badly worn, it should be replaced. Check condition of retainer plate, gasket, felt washer retainer, and felt

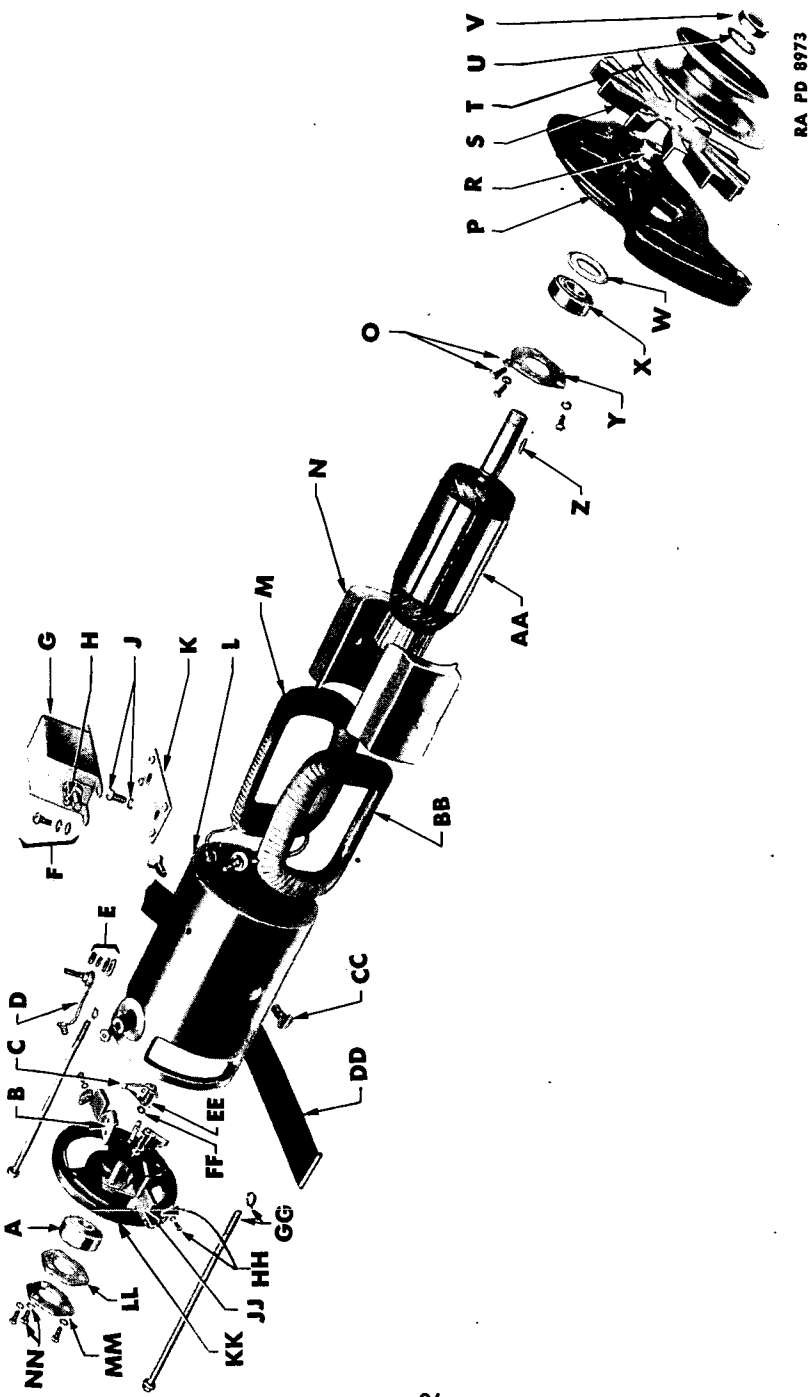

Figure 62 — Generator — Exploded View

A — BEARING
B — HOLDER
C — ARM
D — STUD, ASS'Y
E — NUT; WASHER, LOCK; WASHER, PLAIN; WASHER
F — SCREW; WASHER, LOCK; WASHER, PLAIN
G — FILTER, ASS'Y
H — SCREW; WASHER, LOCK
J — SCREW; WASHER, LOCK
K — BRACKET
L — FRAME, ASS'Y
M — COIL, ASS'Y
N — SHOE
O — SCREW; WASHER, LOCK
P — FRAME
R — COLLAR
S — FAN, ASS'Y
T — PULLEY, ASS'Y
U — WASHER, LOCK
V — NUT
W — WASHER
X — BEARING
Y — PLATE
Z — KEY
AA — ARMATURE, ASS'Y
BB — COIL, ASS'Y
CC — SCREW
DD — STRAP, ASS'Y
EE — SPRING
FF — WASHER
GG — BOLT; WASHER, LOCK
HH — SCREW; WASHER, LOCK
JJ — BRUSH, ASS'Y
KK — FRAME, ASS'Y
LL — GASKET
MM — COVER
NN — SCREW; WASHER, LOCK

RA PD 8973B

Legend for Figure 62 — Generator — Exploded View

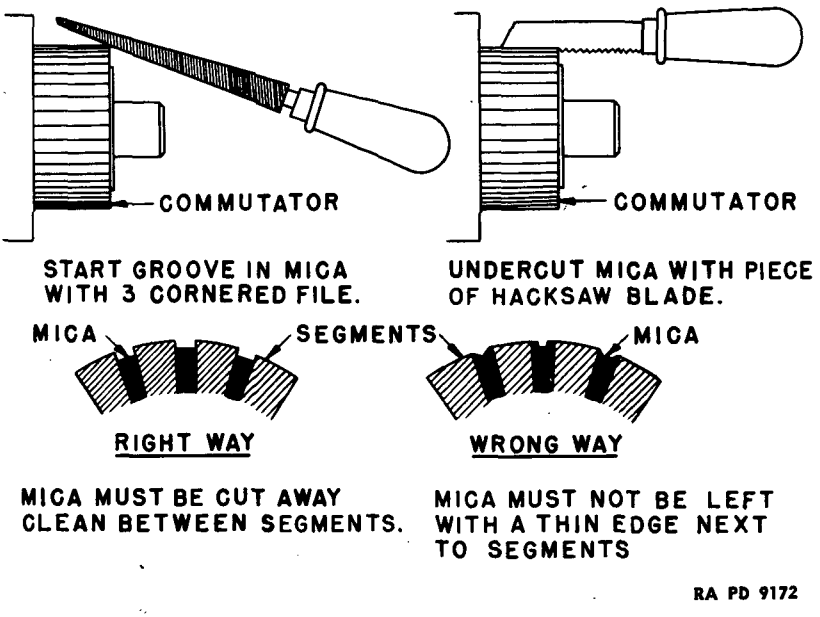

Figure 63 — Undercutting Mica on Commutator

washer. If any of these parts are bent or cracked, they should be replaced.

g. Inspect and Test Filter.

Test from each terminal to ground for shorts and from terminal to terminal for opens, using a test light.

28. ASSEMBLY AND INSTALLATION OF GENERATOR.

a. Equipment.

AMMETER
BATTERY, 12-volt
CLOTH, clean
COMPOUND, insulating
COPPER, soldering
FLUX, rosin
HAMMER, soft
HANDLE, wrench, universal
PAN
PRESS, arbor
SCALE, spring
SCREWDRIVER
SCREWDRIVER, socket
SOLDER
SOLVENT, dry-cleaning
STONE, brush, seating
TAPE, insulating
WRENCH, box, 5/16-in.
WRENCH, box, 15/16-in.
WRENCH, open-end, 7/16-in.
WRENCH, socket, 7/16-in.
WRENCH, socket, 5/8-in.
WRENCH, socket, 3/4-in.
WRENCH, socket, 15/16-in.

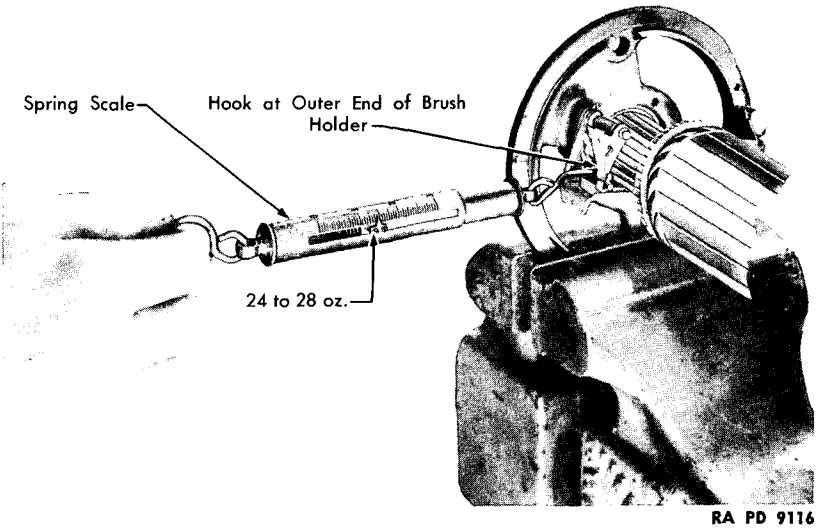

Figure 64 — Checking Generator Brush Spring Tension

b. Procedure.

(1) ASSEMBLE COMMUTATOR END FRAME.

SCALE, spring
SCREWDRIVER

Assemble end cover and new gasket to end frame with 3 screws and lock washers. Press ball bearing into commutator end frame. Assemble washers, brush arms and springs to hinge pins. Position brushes in holders and fasten grounded brush lead with screw and lock washer.

NOTE: Brush spring tension should be checked at this point, with armature in the commutator end frame. Correct tension is 24 to 28 ounces (fig. 64).

(2) REASSEMBLE FIELD FRAME.

HAMMER, rawhide
HANDLE, wrench, universal
SCREWDRIVER, socket
SPREADER, pole-piece
WRENCH, open-end, $\frac{7}{16}$-in.

Position armature terminal stud in field frame and secure with insulating washer, flat washer, lock washer and nut. Position field terminal stud in field frame with caution tag and tighten insulating washer, flat washer, lock washer and nut (fig. 57). Position field coils and pole shoes and secure with pole shoe screws, using a universal wrench handle with a screwdriver socket (fig. 58). Use a pole piece spreader to bring pole pieces up in place and tap field frame with a rawhide hammer while tightening pole piece screws.

(3) ASSEMBLE DRIVE END FRAME.

PRESS, arbor
SCREWDRIVER
WRENCH, socket, $^{15}/_{16}$-in.

Position thrust washer in drive end frame. Press ball bearing into position on arbor press. CAUTION: Be sure to exert pressure on *outside* race only to avoid damaging bearing races. Install retainer plate and secure in position with 3 screws and lock washers. Place armature shaft in vise with copper jaws and press drive end frame assembly down so it fits snugly on shoulder on armature shaft (fig. 60). Position collar on shaft and key in keyway. Assemble fan on shaft and press pulley down in place with arbor press. Position pulley lock washer and nut on shaft and tighten.

(4) ASSEMBLE COMPONENTS INTO GENERATOR.

SCREWDRIVER
WRENCH, open-end, $^{7}/_{16}$-in.

Assemble center frame to armature and drive end frame assembly, lining up dowel pin on center frame with hole in drive end frame. Install commutator end frame assembly to open end of center frame. To facilitate assembly, lift brushes up in brush holders and cock them so the brush arms hold them. Armature shaft will now slip into the commutator end bearing without brushes interfering. Move brushes from cocked position so that they contact commutator on armature shaft. Secure assembly with through bolts and lock washers and tighten. Install insulated brush clip, armature terminal stud lead clip, and field lead clip on insulated brush holder, and tighten screw and lock washer, using screwdriver. Replace cover band on commutator end of center frame. Place filter plate on center frame and tighten two screws and lock washers. Place filter in position on plate and tighten four screws and lock washers. Position condenser on center frame and tighten screw and lock washer.

(5) INSTALL GENERATOR.

WRENCH, socket, $^{5}/_{8}$-in.
WRENCH, socket, $^{3}/_{4}$-in.
WRENCH, socket, $^{15}/_{16}$-in.

(*a*) Place generator assembly in position and secure by installing 2 mounting screws and lock washers (fig. 50). NOTE: Do not tighten mounting screws until after generator belt has been adjusted. Position generator belt on pulley and adjust belt as shown in figure 15. Then tighten mounting screws and lock washers holding generator. Connect dual red wires at generator filter and one yellow wire at generator field terminal. Install fan support, fan belt, and secure in position by installing 2 nuts, washers, and lock washers. Adjust fan belt as shown in figure 14, and tighten mounting nuts securely, using a $^{15}/_{16}$-inch socket wrench.

ENGINE ELECTRICAL SYSTEM

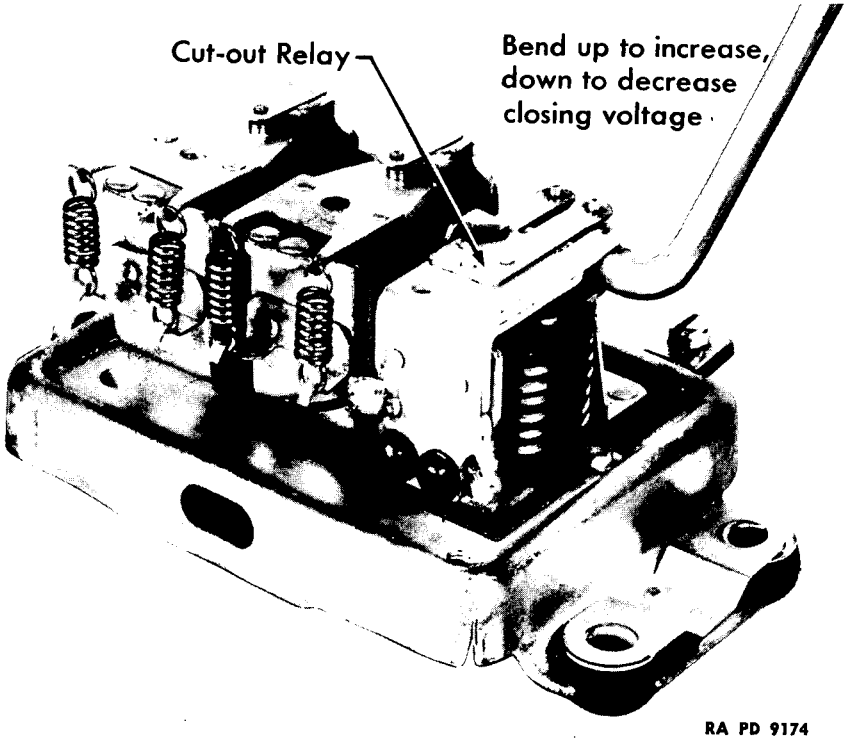

Figure 65 — Cut-out Relay Closing Voltage Adjustment

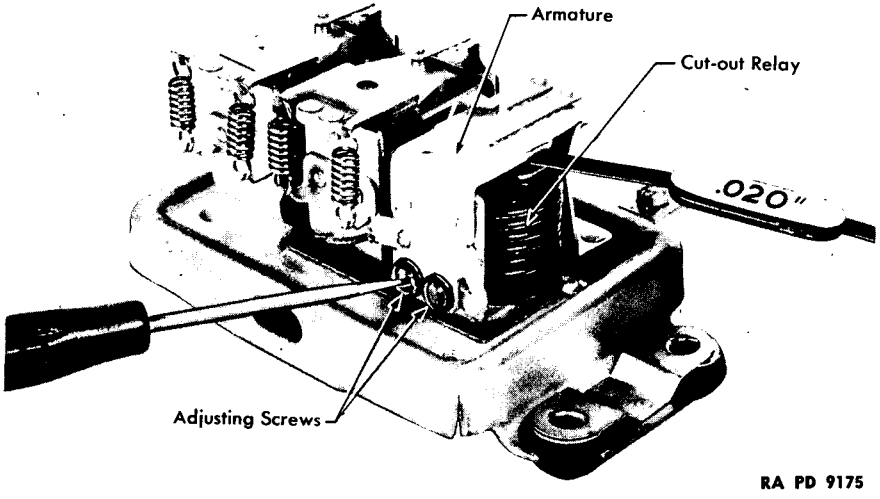

Figure 66 — Cut-out Relay Air Gap Adjustment

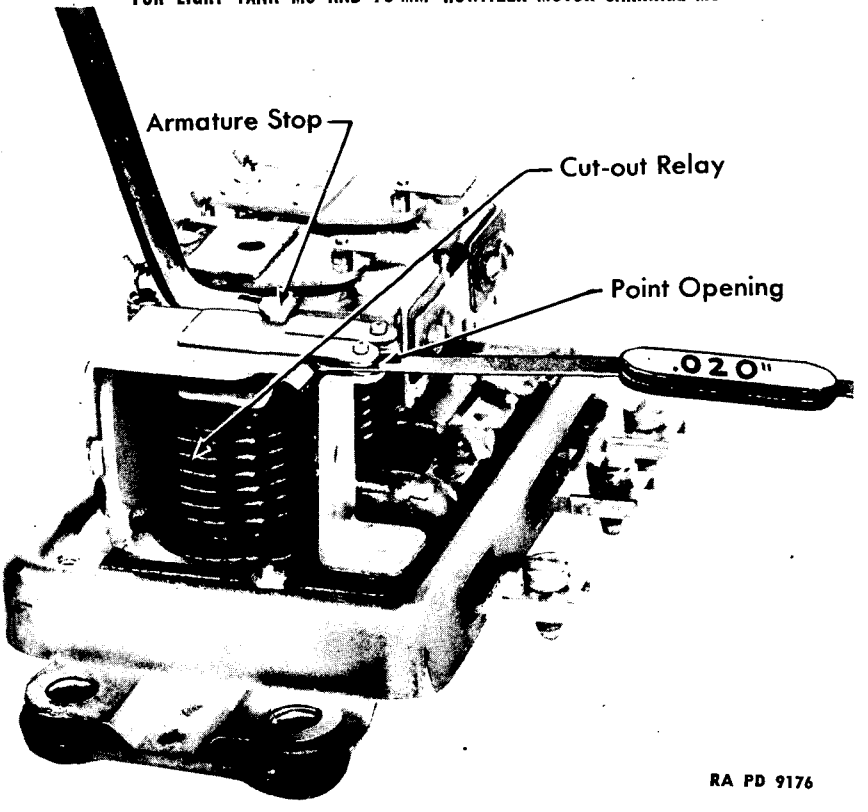

Figure 67 — Cut-out Relay Point Opening Adjustment

(*b*) Close engine compartment rear doors and secure with seven cap screws, using a ¾-inch socket wrench. CAUTION: After the generator is reinstalled and reconnected, always connect a jumper lead momentarily between the generator terminal and the battery terminal of the regulator in the apparatus box *before starting the engine.* This allows a momentary surge of battery current to flow into the generator and polarize it correctly.

29. GENERATOR REGULATOR ADJUSTMENTS.

a. The following adjustments can be made with the regulator assemblies in the apparatus box on the left-hand wall of the hull. Adjustments should be attempted only when tests (explained in par. 24) indicate the need. CAUTION: The main switch must be opened before making any adjustment to generator regulator while on the vehicle.

b. Cut-out Relay Closing Voltage. The cut-out relay closing voltage is adjusted by bending up on the flat spring post (fig. 65) to increase

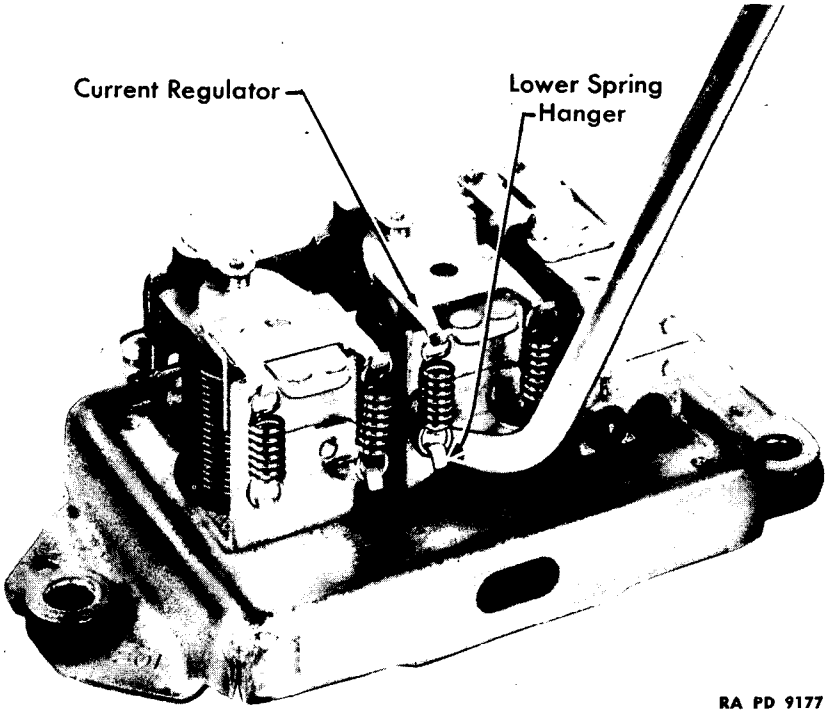

Figure 68 — Current Regulator Adjustment

the tension of the flat spring and raise the closing voltage, or bending down on the spring post to decrease the spring tension and lower the closing voltage. Correct setting is from 12.4 to 13.4 volts.

c. Cut-out Relay Air Gap. The cut-out relay air gap between the center of the winding and the armature should be measured with a feeler gage while the contact points are held closed. Correct gap is 0.020 inch. If both sets of contact points do not close at the same instant, bend the spring fingers until they do. Adjust by loosening the 2 adjusting screws shown in figure 66, and raising or lowering the armature as required.

d. Cut-out Relay Point Opening. The cut-out relay point opening is adjusted by bending the upper armature stop as shown in figure 67. The correct opening is 0.020 inch.

e. Current Regulator Setting. The current regulator setting is adjusted by bending the lower spring hanger of *one* of the two regulator springs (fig. 68). Bend the spring hanger *down* to increase the current setting or *up* to decrease the setting. The correct setting is 24 to 26 amperes.

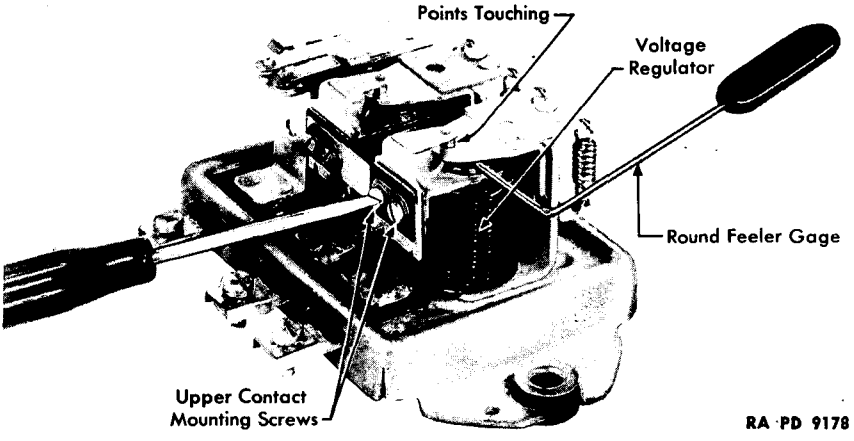

Figure 69 — Regulator Air Gap Adjustment

f. Voltage Regulator Setting. The voltage regulator setting is adjusted by bending the lower spring hanger of *one* of the two regulator springs in exactly the same manner as in adjusting the current regulator. Bending the spring hanger *down* increases the setting; bending the spring hanger *up* decreases the setting. After each change of adjustment, replace regulator cover, reduce generator speed until relay points open, then bring generator back to speed and note voltage setting. Correct setting is 14 to 14.2 volts at 8 to 10 amperes.

g. Voltage Regulator Air Gap. The voltage regulator air gap is measured between the center of the core and the armature with the points just touching. Push armature all the way down by hand, allow it to come back until points just touch, then measure gap, which should be 0.070 inch. Adjust by loosening 2 upper contact mounting screws (fig. 69) and moving contact mounting bracket up or down as required. Be sure points are lined up and screws are tightened after adjustment.

h. Current Regulator Air Gap. The current regulator air gap is measured and adjusted in exactly the same manner as the voltage regulator air gap, except that the correct setting should be 0.080 inch.

i. Regulator Spring Adjustment. When regulator spring replacement is required, or when the regulator is completely out of adjustment, readjustment must be made so that each spiral spring will carry one-half of the total spring tension. Proceed as follows:

ENGINE ELECTRICAL SYSTEM

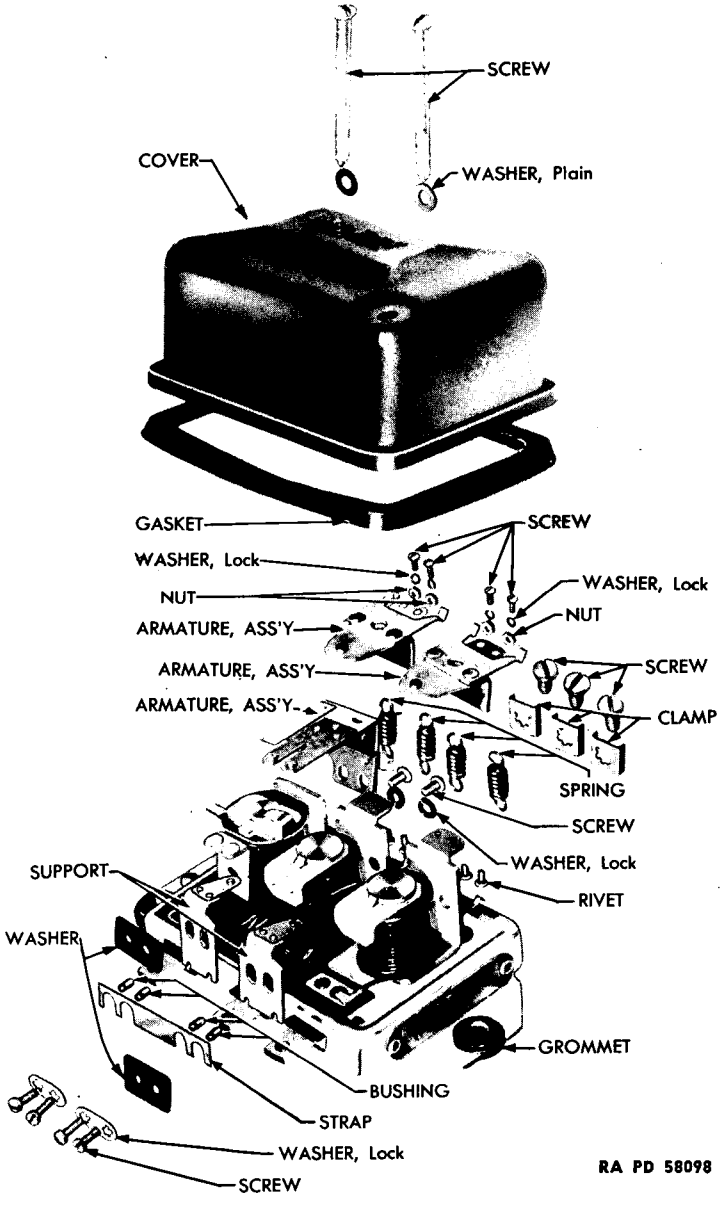

Figure 70 — Generator Regulator Assembly — Exploded View

(1) Install one spring on the current regulator and adjust it to one-half of the total current setting (12 to 13 amperes).

(2) Install the second current regulator spring and complete the adjustment of the current setting.

(3) Install one spring on the voltage regulator. Connect a voltmeter from the generator terminal to the regulator base, open the regulator points by hand, and slowly increase the generator speed until 6 volts are obtained. This establishes the generator speed at which adjustment of the first spring should be made.

(4) Release the points and adjust the spring to one-half of the total voltage setting at the generator speed as just determined, as indicated by the tachometer.

(5) Install the second spring. Connect meters and resistance as described in paragraph 24 e and complete the voltage setting adjustment on this spring.

30. REMOVAL AND DISASSEMBLY OF GENERATOR REGULATOR ASSEMBLY.

a. Equipment.

COPPER, soldering
DRILL, 3/32-in.
PLIERS
PUNCH, center
SCREWDRIVER

b. Procedure.

(1) REMOVAL FROM VEHICLE.

SCREWDRIVER

Remove apparatus box cover and place to one side any stowage boxes that might interfere. Disconnect the 3 wires that are connected to the regulator terminals. Remove 3 mounting screws and washers and take regulator assembly out of apparatus box.

(2) DISASSEMBLY OF GENERATOR REGULATOR.

COPPER, soldering
DRILL, 3/32-in.
PLIERS
PUNCH, center
SCREWDRIVER

Remove cover and gasket by removing 2 screws and lock washers. Remove 4 spiral springs on regulator armatures. Remove relay armature by unsoldering lead, using soldering copper, and then removing 2 screws and lock washers. Remove current regulator upper contact support by unsoldering lead and removing 2 screws, 2-hole lock washer (fig. 70), 2-hole insulator, 2 small bushings, upper contact support, and 2-hole insulator. The connector strap may be left in place if only one of the upper contact supports is removed. Remove voltage regu-

lator upper contact support in the same manner as the current regulator upper contact support was removed. When both voltage regulator and current regulator upper contact supports are removed, the connector strap will be removed with the voltage regulator upper contact support. Remove current regulator (or voltage regulator) armature by removing spiral springs and drilling out 2 rivets which mount armature spring hinge to regulator frame. Regulator frame should be supported to avoid bending. NOTE: It is only necessary to remove armature if it is damaged (bent, cracked spring, or if contact points are badly burned, pitted or worn).

31. INSPECTION AND REPAIR OF GENERATOR REGULATOR ASSEMBLY.

a. Check remaining soldered connections of regulator.

b. Make certain that insulators are in place and securely fastened on the under side of regulator base.

c. Check to make sure rubber mounting grommets are in place.

d. Check contact points and clean, if necessary, using a fine cut riffle contact file.

e. Inspect insulators for cracks and charred or burned appearance.

32. ASSEMBLY AND INSTALLATION OF GENERATOR REGULATOR ASSEMBLY.

a. Equipment.

COPPER, soldering — SCREWDRIVER
PLIERS

b. Procedure.

(1) ASSEMBLY.

COPPER, soldering — SCREWDRIVER

(*a*) *Install Armature.*

Install each armature that has been removed, securing in position with the screws, lock washers and nuts which are furnished with the replacement armature. CAUTION: Screws should be tightened down so that they will not ground against cover when it is replaced.

(*b*) *Install Voltage Regulator Upper Contact Support.*

Position a 2-hole insulator next to the regulator frame. Position the upper contact support. Position 2 new, small bushings and the connector strap for the voltage regulator and current regulator upper contact supports. Position 2-hole insulator with 2-hole lock washer on top and secure complete assembly with 2 screws (fig. 70).

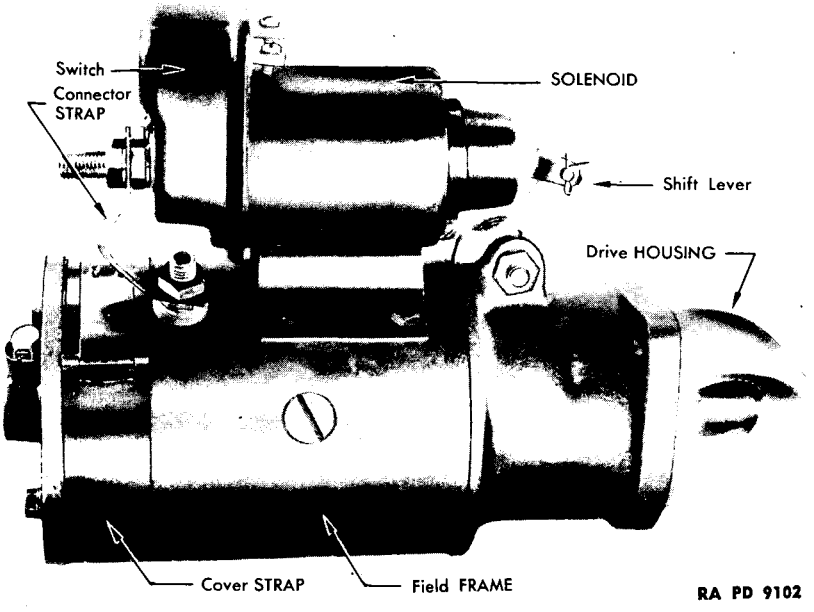

Figure 71 — Starter Assembly

(c) *Install Current Regulator Upper Contact Support.*

To install current regulator upper contact support, follow the same procedure as outline above covering the voltage regulator upper contact support. NOTE: Connector strap is insulated from the upper contact support on the current regulator only.

(*d*) *Connect Leads and Springs.*

COPPER, soldering SCREWDRIVER
PLIERS

Resolder lead to upper contact support. Install relay armature with 2 screws and lock washers, and resolder lead to armature. Install 4 spiral springs on regulator armatures. Install cover and gasket, using 2 screws and lock washers. Make all mechanical and electrical adjustment as explained in paragraph 29.

(2) INSTALLATION IN VEHICLE.

SCREWDRIVER

Position complete regulator assembly in apparatus box and secure in plate by installing 3 mounting screws and washers. Connect the wires to the regulator terminals, following the key given in figure 39. Readjust the regulator according to the procedures in pargraphs 24 and 29.

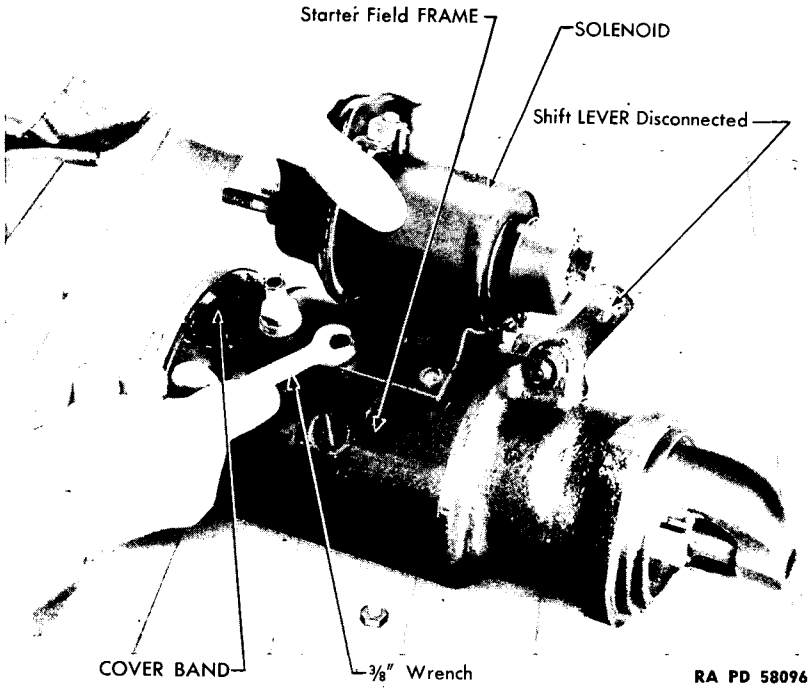

Figure 72 — Removing Solenoid from Field Frame

33. REMOVAL AND DISASSEMBLY OF STARTER.

a. Equipment.

COPPER, soldering	SCREWDRIVER
EXTENSION	SOCKET, 9/16-in.
HAMMER	WRENCH, box, 5/8-in.
HAMMER, soft	WRENCH, open-end, 3/8-in.
HANDLE, wrench, universal	WRENCH, open-end, 9/16-in.
JACK	WRENCH, open-end, 5/8-in.
PLIERS	WRENCH, socket, 1/2-in.
PUNCH, 3/32-in.	WRENCH, socket, 9/16-in.

b. Procedure.

(1) REMOVE RIGHT-HAND ENGINE STARTER FROM VEHICLE.

EXTENSION	SOCKET, 9/16-in.
HANDLE, wrench, universal	WRENCH, box, 5/8-in.
JACK	WRENCH, socket, 1/2-in.
SCREWDRIVER	WRENCH, socket, 9/16-in.

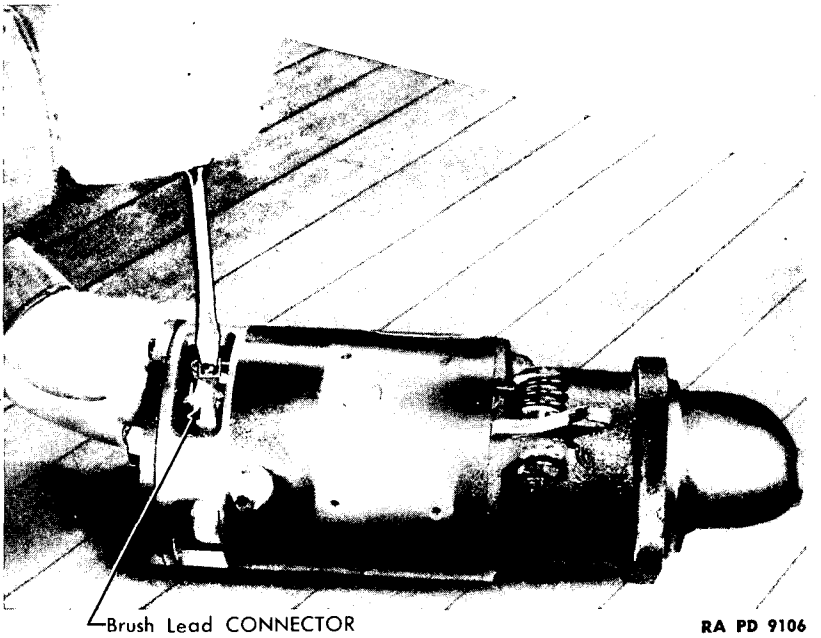

Figure 73 — Disconnect Brush Lead Connector

Turn master switch to "OFF" position. Remove conduit connector at front of solenoid switch on starter, working through rear compartment doors, using a universal wrench with an extension and a $\frac{9}{16}$-inch socket. Working from underneath vehicle, remove 27 screws and one nut holding floor pan underneath transmissions and remove pan. **CAUTION**: Be sure to support pan with jack or similar tool to prevent it from falling off and causing injury when screws are removed. Remove 2 cap screws and lock washers holding starter to flywheel housing, and disengage starter from flywheel housing. Lower starter slightly, being careful to support it while doing so, and remove 2 screws connecting conduit leads to top of solenoid switch. Starter may now be removed from underneath vehicle.

(2) REMOVE LEFT-HAND ENGINE STARTER FROM VEHICLE.

JACK	WRENCH, box-end, $\frac{5}{8}$-in.
SCREWDRIVER	WRENCH, socket, $\frac{1}{2}$-in.
WRENCH, box-end, $\frac{9}{16}$-in.	WRENCH, socket, $\frac{9}{16}$-in.

Working in fighting compartment, remove upper left-hand shell rack by removing three screws and lock washers and lower left-hand shell

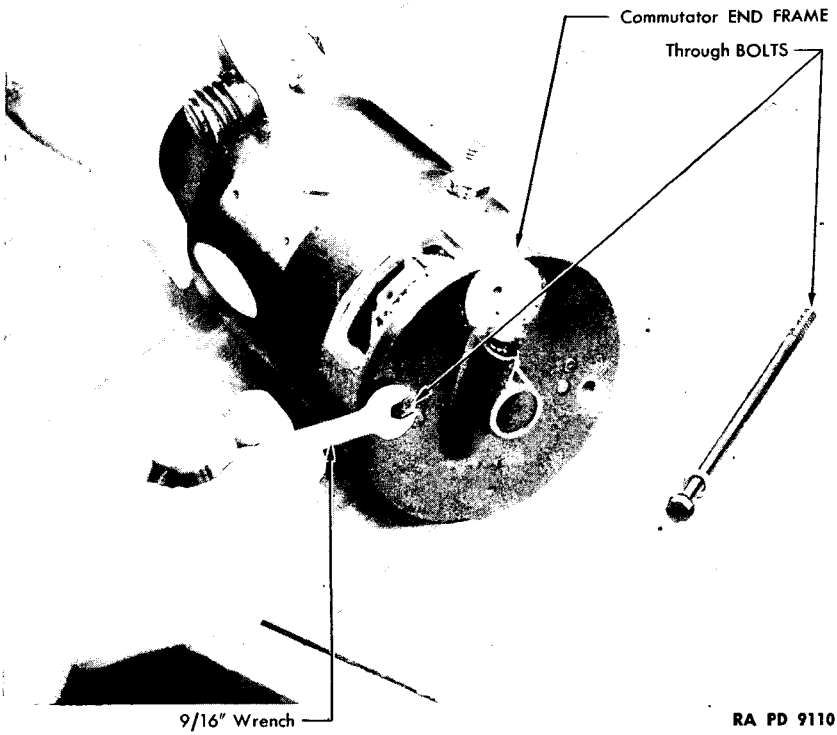

Figure 74 — Removing Commutator End Frame

rack by removing 4 screws and lock washers. Remove bolt and lock washer holding auxiliary power plant exhaust pipe bracket to support. Remove bolt and lock washer from brass elbow clamp holding exhaust pipe to auxiliary power plant. Turn exhaust pipe and muffler to one side to allow room to work on starter from underneath vehicle. NOTE: Operations up to this point are required on Light Tank M5 only. Working underneath vehicle, remove 27 screws and one nut holding floor pan underneath transmissions and remove pan. CAUTION: Be sure to support pan to prevent damage or injury. Remove conduit cable connection at front of solenoid switch, working underneath vehicle. Remove 2 cap screws and lock washers holding starter to flywheel housing, and disengage starter from flywheel housing. Lower starter slightly, being careful to support it while doing so and remove 2 screws holding conduit leads to top of solenoid switch on starter. Starter may now be removed from underneath vehicle.

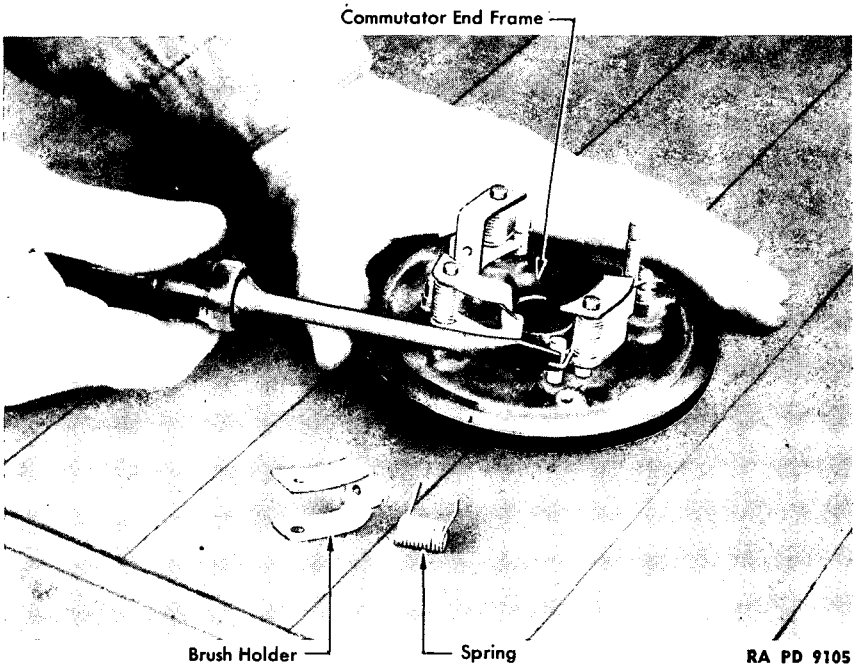

Figure 75 — Removing Spring and Brush Holders from Hinge Pins

(3) DISASSEMBLY OF STARTER.

HAMMER, soft	WRENCH, open-end, 3/8-in.
PLIERS	WRENCH, open-end, 9/16-in.
SCREWDRIVER	WRENCH, open-end, 5/8-in.

Remove nuts and lock washers holding connector strap to solenoid and center frame. Remove cotter pin and pin linking shift lever and solenoid plunger. Remove 4 screws and lock washers holding solenoid to field frame (fig. 72) and remove solenoid assembly. Remove cover band from commutator end of starter. Remove screw and lock washer holding connector to end frame (fig. 73). Remove 2 through bolts and lock washers holding commutator end frame to field frame (fig. 74), and remove commutator end frame. NOTE: Tap lightly with soft hammer if commutator end fits too snugly. Remove spacer washer from armature shaft. Separate field frame, armature and drive housing.

(4) DISASSEMBLE COMMUTATOR END FRAME.
SCREWDRIVER

Remove 4 screws and lock washers holding brushes and leads to brush holders. Remove brushes, being sure to note their position in

holders so that they may be reinstalled in the same position. CAUTION: Brush connector strap will be removed at this point and the position should be noted so that it may be reinstalled in the same position. Remove brush holders and springs from hinge pins by prying off (fig. 75). Disconnect 2 ground leads from end frame by removing 2 screws and lock washers.

(5) DISASSEMBLE FIELD FRAME.

COPPER, soldering	SCREWDRIVER, socket
HANDLE, wrench, universal	WRENCH, open-end, 5/8-in.
SCREWDRIVER	

Unsolder lead from terminal stud on inside of field frame. Remove terminal stud by removing nut, lock washer, flat washer, and insulating washer, and pushing stud through to inside of frame. Place field frame in vise and remove 4 pole shoe screws, using a universal wrench handle with a socket screwdriver.

(6) DISASSEMBLE DRIVE HOUSING.

SCREWDRIVER	WRENCH, open-end, 5/8-in.

Remove shift lever stud, spring retainer washer, and spring by removing nut and lock washer (fig. 77). Remove 2 screws and lock washers holding center bearing plate to drive housing and remove plate. Remove brake washer, shift lever, and starter drive assembly from drive housing.

(7) DISASSEMBLE SOLENOID.

COPPER, soldering	SCREWDRIVER
HAMMER	WRENCH, open-end, 9/16-in.

Remove cover screw, cover, and cover gasket. Remove nuts, lock washers, and flat washers from terminal studs. Unsolder lead clip under terminal stud from wire, marking wire so that it is reinstalled in the same position. Unsolder connector under remaining terminal from relay lower contact bracket. Remove 2 screws, lock washers, and terminal bracket. Remove studs, fiber plate clip, and connector. Unsolder 2 leads (wrapped together) from relay frame. Remove 4 insulating washers and felt gasket from terminal studs. Remove and disassemble contact assembly by removing the U-washers, contact disk, spring, and washers from the rod. Remove linkage stud and washer in solenoid plunger. Remove screw and nut from boot retainer clamp and remove clamp, boot, and plunger.

34. INSPECTION AND REPAIR OF STARTER.

a. After disassembly, all parts should be cleaned, examined, and all defective parts discarded. The procedure for cleaning, inspecting, and repairing parts is given in the following paragraphs:

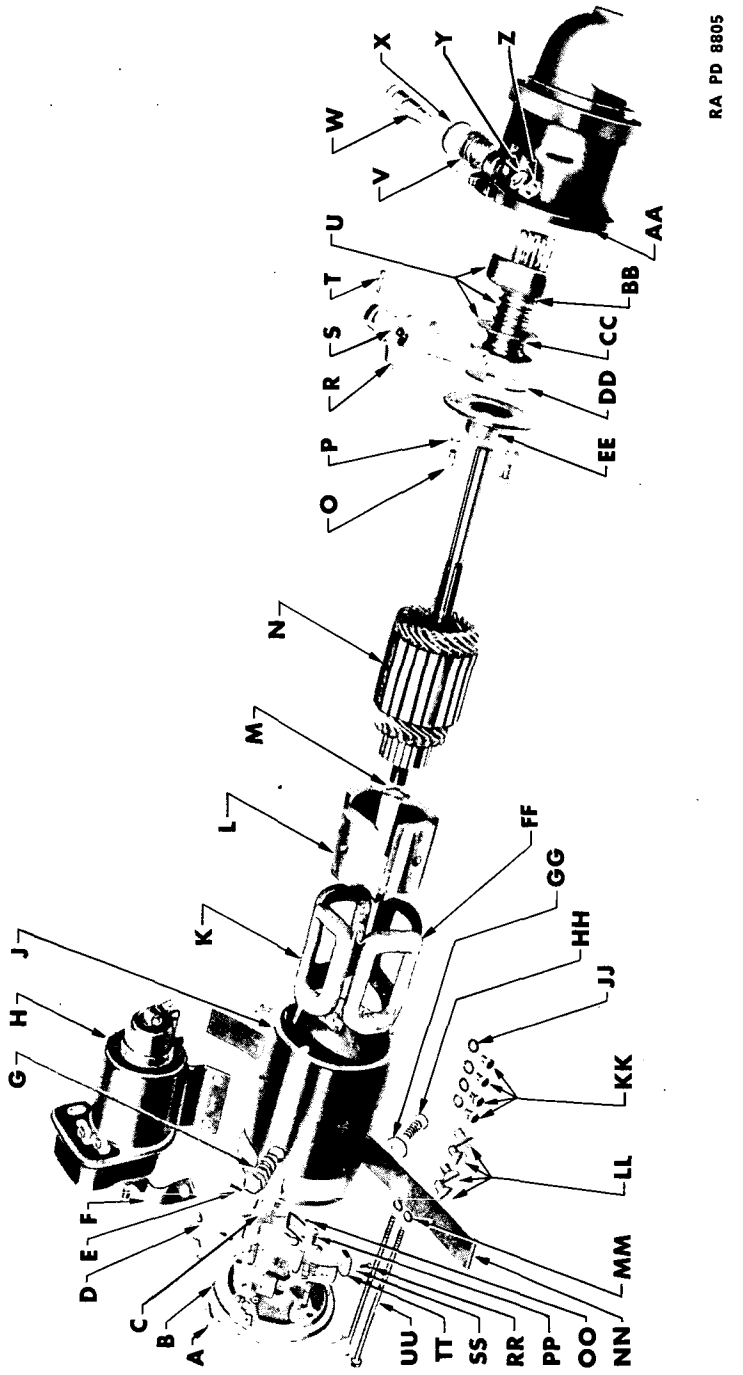

Figure 76 — Starter — Exploded

A — LEAD, ASS'Y
B — FRAME, ASS'Y
C — LEAD, ASS'Y
D — LEAD, ASS'Y
E — SCREW
F — CONNECTOR
G — NUT
H — SOLENOID, ASS'Y
J — FRAME
K — COIL, ASS'Y
L — SHOE
M — WASHER
N — ARMATURE, ASS'Y
O — SCREW
P — WASHER, LOCK
R — LEVER, ASS'Y
S — PIN
T — PIN
U — DRIVE, ASS'Y
V — SPRING
W — STUD
X — SUPPORT
Y — WASHER, LOCK
Z — NUT
AA — HOUSING, ASS'Y
BB — SPRING
CC — COLLAR
DD — WASHER
EE — PLATE, ASS'Y
FF — COIL, ASS'Y
GG — WASHER
HH — STUD
JJ — WASHER, LOCK
KK — SCREW
LL — SCREW
MM — WASHER, LOCK
NN — STRAP, ASS'Y
OO — HOLDER
PP — SPRING
RR — SCREW
SS — WASHER, LOCK
TT — BRUSH
UU — BOLT

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Legend for Figure 76 — Starter — Exploded View

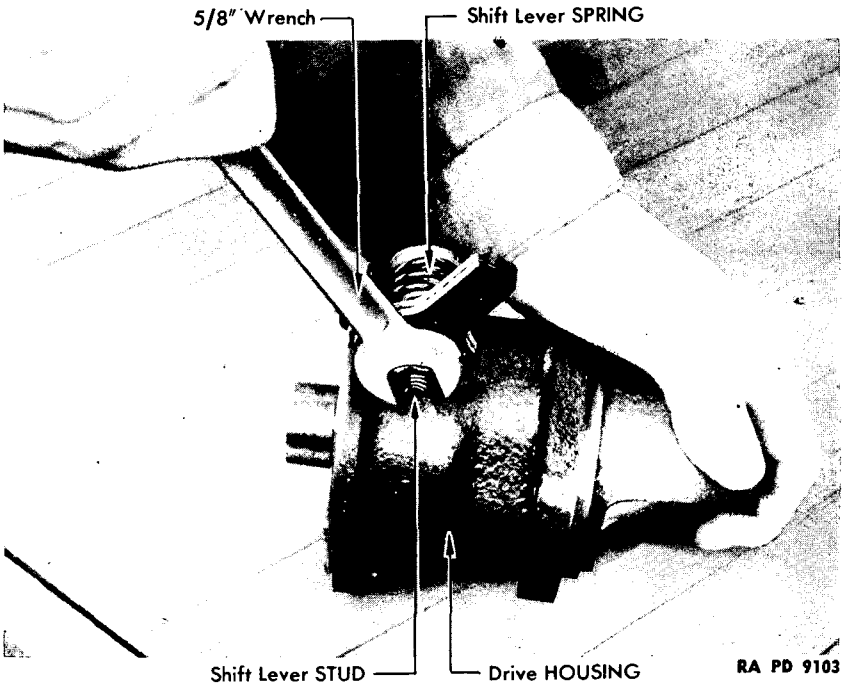

Figure 77 — Removing Shift Lever from Overrunning Clutch

b. Armature.

BLADE, hacksaw
CLOTH, clean
COPPER, soldering
FILE, riffle
FLUX, rosin
GROWLER
LIGHT, test, and points
PAN
SOLVENT, dry-cleaning

(1) CLEAN ARMATURE. Wipe clean cloth slightly dampened in SOLVENT, dry-cleaning. CAUTION: Do not clean by any degreasing method as this will damage the insulation.

(2) INSPECT COMMUTATOR. Check appearance and if commutator is rough, worn, or out-of-round, or has high mica or burned spots, it may be turned down on a lathe, being careful to cut no deeper than necessary. NOTE: After turning down, it will be necessary to undercut mica in a manner similar to that shown in figure 63.

(3) INSPECT ARMATURE BARS. Check bars and if some are burned and others are clean, this indicates an open circuited armature. The open circuit will normally be found at the commutator riser bars, and usually results from excessively long cranking periods. If the bars are

not too badly burned, the armature may be repaired by resoldering all the leads in the riser bars with rosin flux, and then turning down the commutator and undercutting the mica.

(4) INSPECT ARMATURE LEADS. Check armature for thrown leads caused by excessive armature speed due to a defective drive mechanism. The drive mechanism will become defective through abuse such as would result from excessive speed on original starting. Evidences of this type of abuse are galling of the drive bearing, depositing of bearing material on armature shaft, or bluing of the shaft where the pinion rides in the cranking position. When thrown leads are found, the armature and drive mechanism should both be replaced.

(5) INSPECT ARMATURE LAMINATION. Check armature lamination for possible rubbing against the pole shoes, indicating worn bushings, loose pole shoes or pole shoe screws, which necessitates replacing bushings or tightening pole shoes. If the lamination has rubbed at only one or two places, the armature shaft is probably bent and the armature should be replaced.

(6) INSPECT ARMATURE FOR GROUND. Check with test light and test points from the commutator to the armature shaft or lamination. If the test light lights, it indicates the armature is grounded and should be replaced.

(7) INSPECT ARMATURE FOR OPEN. An open circuited armature is easily detected, since this condition produces badly burned bars. The bars connected to the open coils soon burn, since they interrupt a flow of current each time they pass under the brushes and heavy arcing occurs. Instructions for repair are covered in step b (3) of this paragraph.

(8) INSPECT ARMATURE FOR SHORT. A shorted armature may be detected on a growler. When a shorted armature is placed on the growler and a hacksaw blade held above the shorted coils in the armature, the blade will be alternately attracted to and repelled from the armature, causing the blade to buzz against the armature (fig. 47). NOTE: Before discarding an armature which has been tested and found shorted, inspect the commutator slots carefully, since copper or brush dust sometimes collects in the slots between commutator bars, shorting them.

c. Fields.

CLOTH, clean	LIGHT, test, and points
COPPER, soldering	PAN
FLUX, rosin	SOLVENT, dry-cleaning

(1) CLEAN FIELDS. The fields may be cleaned by wiping with a clean cloth slightly dampened with SOLVENT, dry-cleaning. NOTE: Fields should not be cleaned by any degreasing method, since this would damage the insulation.

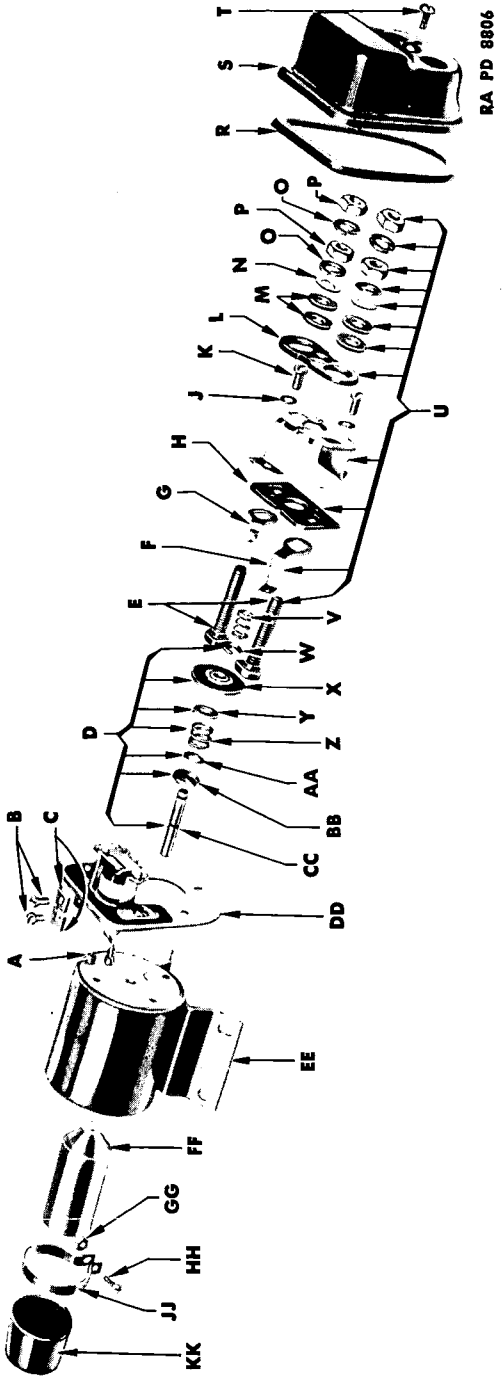

Figure 78 — Solenoid — Exploded

A — BUSHING	**N** — WASHER, PLAIN	**AA** — WASHER, PLAIN
B — SCREW	**O** — WASHER, LOCK	**BB** — WASHER
C — CLAMP	**P** — NUT	**CC** — ROD
D — CONTACT, ASS'Y	**R** — GASKET	**DD** — RELAY, ASS'Y
E — SCREW	**S** — COVER	**EE** — COIL, ASS'Y
F — CONNECTOR	**T** — SCREW	**FF** — PLUNGER
G — CLIP	**U** — BRACKET, ASS'Y	**GG** — NUT
H — PLATE	**V** — SPRING	**HH** — SCREW
J — WASHER, LOCK	**W** — WASHER	**JJ** — CLAMP
K — SCREW	**X** — DISC	**KK** — BOOT
L — GASKET	**Y** — WASHER	
M — WASHER	**Z** — SPRING	

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Legend for Figure 78 — Solenoid — Exploded

(2) Connect test light from field terminal post to field lead where it fastens to the main brush. If the lamp does not light, the field circuit is open and should be replaced.

(3) INSPECT FIELD INSULATION. Check to see that field insulation is in place and in good condition. If it is charred or worn away so that the field windings are exposed, the windings may be rewrapped with insulating tape and painted with insulating compound.

d. Drive Mechanism.

CLOTH, clean
SOLVENT, dry-cleaning

(1) CLEANING DRIVE MECHANISM. The pinion drive mechanism may be cleaned by wiping with a clean cloth slightly dampened with SOLVENT, dry-cleaning. NOTE: Never clean by any degreasing method since this would remove the lubricant originally packed into the clutch and cause it to fail.

(2) INSPECT OVERRUNNING CLUTCH ASSEMBLY. Check to make sure the pinion turns freely and smoothly in the clutch in the overrunning direction and does not slip in the driving direction. Make sure the pinion teeth are in good condition and not excessively chipped or otherwise damaged. If the unit is defective in any way, it should be replaced.

e. Commutator End Frame.

CLOTH, clean
PAN
PUNCH, $\frac{3}{32}$-in.
SCALE, spring
SOLVENT, dry-cleaning

(1) CLEANING COMMUTATOR END PARTS. Wipe all parts with clean cloth slightly dampened with SOLVENT, dry-cleaning, and dry with compressed air if available.

(2) INSPECT BRUSHES AND SPRINGS. Check brushes, and if worn down to $\frac{3}{8}$ inch they should be replaced. Check brush holder hinge pins and stop pins, and if they are worn excessively, they may be replaced by knocking out with a small punch and pressing new ones into position. CAUTION: Use care when installing new pins to avoid damaging insulation. Whenever brushes or springs are reassembled into commutator end frame, the spring tension should be checked with a spring scale to 24 to 28 ounces when armature is temporarily installed in commutator end frame. If tension is lower than 24 ounces, springs should be replaced.

(3) INSPECT BEARING. Check bearing, and if worn excessively, the commutator end frame should be replaced.

f. Bushings. Inspect bushings for wear, and if any one is worn so that armature lamination rubs against pole shoes, the bushing should be

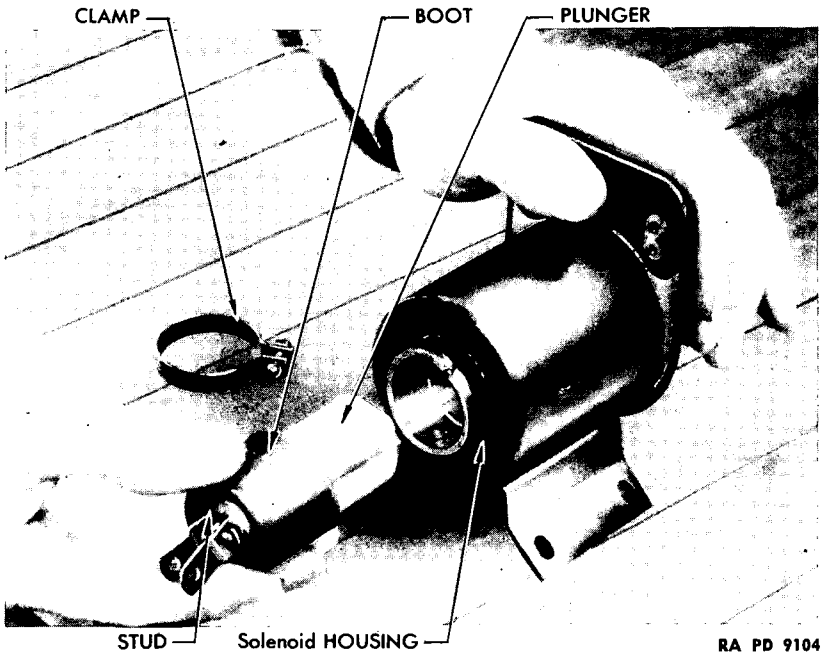

Figure 79 — Installing Plunger in Solenoid

replaced. New center bushing should be finished to 0.757 to 0.758 inch and end bushing finished to 0.562 to 0.564 inch.

g. Solenoid.

BATTERY, 12-volt
BRUSH, wire
CLOTH, clean
FILE, fine cut
PAN
RESISTANCE, variable, 10-ohm
SOLVENT, dry-cleaning
VOLTMETER

(1) CLEANING SOLENOID PARTS. Wipe parts with clean cloth slightly dampened with SOLVENT, dry-cleaning.

(2) INSPECT SOLENOID PARTS. Check stud contact faces and contact disk, and if not burned, they may be cleaned with a wire brush. Check rubber boot and if it is defective it should be replaced. Inspect relay points and if corroded they may be cleaned with a fine cut file. Check the two windings of the solenoid for open circuit. The fine winding (hold-in) is grounded at one end. The heavy winding has both leads insulated. Check all insulating washers and bushings, and if they are chipped, cracked, or burned, they should be replaced.

(3) TEST SOLENOID OPERATION. Test operation of solenoid relay by connecting a 12-volt battery and a 10-ohm variable resistance in series with the 2 relay terminals and connecting a voltmeter across the terminals. Increase the voltage slowly by cutting out resistance until relay points close. This should occur at 5.5 to 6.0 volts. If necessary, the armature tension may be adjusted by bending the spring support. Increasing the tension increases the voltage, and decreasing the tension decreases the voltage.

35. ASSEMBLY AND INSTALLATION OF STARTER.

a. Assemble Solenoid.

COPPER, soldering
SCREWDRIVER
WRENCH, open-end, 9/16-in.
WRENCH, open-end, 5/8-in.

(1) Assemble boot, washer, and stud to plunger, screwing stud about half-way into plunger. Position plunger in solenoid. Position boot retainer clamp and tighten screw and nut. Place relay assembly in position, threading wires and fitting bushings through proper holes in relay base. Bend wires above bushings to hold bushings in place. Resolder leads to relay. Assemble to contact plunger in following order the cup-shaped U-washer, flat washer, spring, cup-shaped washer, contact disk, and U-washer (fig. 78). NOTE: The U-washer should be positioned so that they fit on each end of the spring. Place contact disk and plunger assembly in position in solenoid (fig. 79).

(2) Install the 2 stud heads with the flat surfaces facing each other and assemble the clip on one and the connector strap on the other; then install on both studs the fiber strip, bracket, four insulating fiber bushings, 2 washers, lock washers, and nuts, and tighten in position. NOTE: The clip and connector strap must aline in order to solder the solenoid lead and the relay contact support. Hole on edge of fiber strip must aline with cover mounting hole in terminal stud bracket. Place spring in position over end of plunger; position terminal stud bracket assembly and secure with 2 screws and lock washers. Solder heavy lead clip and connector to relay contact support. Position felt gasket over insulating bushings, place cover gasket and cover in place, and tighten screw.

b. Assemble Commutator End Frame.

HAMMER, soft
SCALE, spring
SCREWDRIVER

Connect 2 brush ground leads to frame with screws and lock washers. NOTE: The round clips fasten to the frame. Position 4 brush holders and springs on hinge pins. Place brushes and lead clips on brush holders

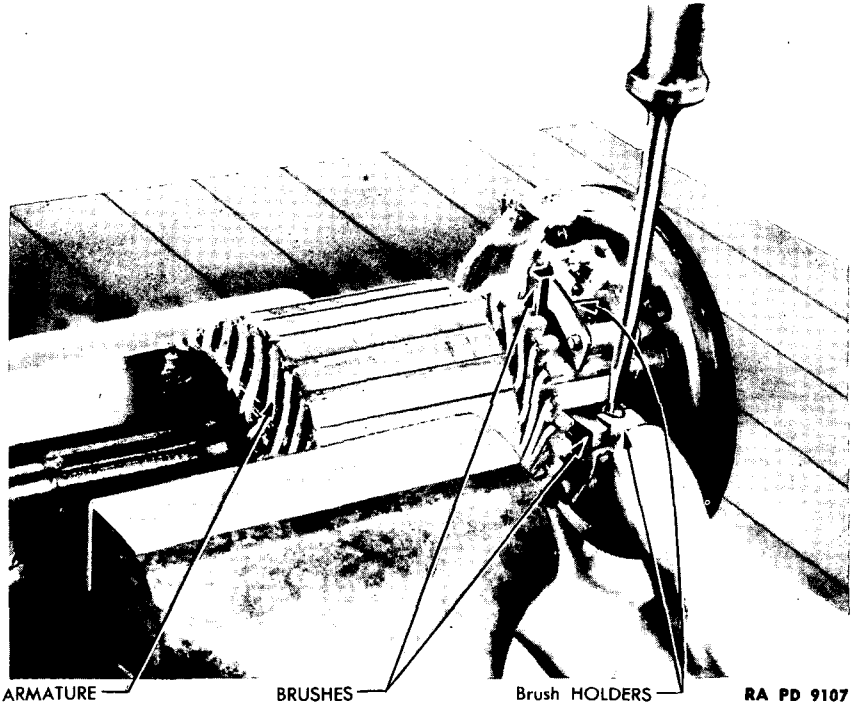

Figure 80 — Seating Brushes on Commutator

and fasten tightly in position with lock washers and screws. NOTE: The brush closest to the dowel pin should have the long insulated connector lead fastened to it. The opposite end of this lead will fasten to the field lead on final assembly. The other brush will also be connected to the field lead by means of the short lead. Place armature in vise. Position commutator end frame assembly on armature shaft by lifting brush holders up on commutator with end of shaft fitting into bearing in commutator end frame. Use soft hammer and gently tap brushes so that brushes seat squarely on commutator. Brushes may now be tightened in position, using a screwdriver (fig. 80). NOTE: At this point, the brush spring tension may be checked with a spring scale to 24 to 28 ounces. Remove commutator end frame from armature and armature from vise.

c. Assemble Field Frame.

COPPER, soldering
SCREWDRIVER
WRENCH, open-end, 5/8-in.

Place large insulator on terminal stud and position stud through field frame from inside with slot in stud head alined lengthwise to frame.

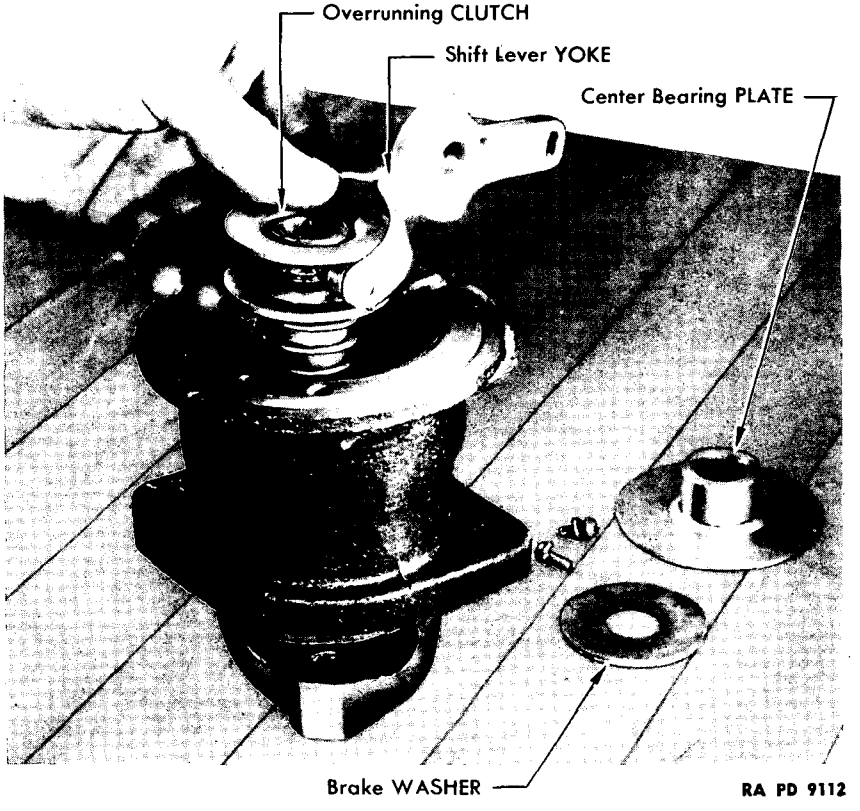

Figure 81 — Installing Shift Lever Spring Retainer Assembly

While holding stud from inside, place on outside two insulating bushings, insulating washer, steel washer, lock washer, and nut, and tighten. Place second lock washer and nut on stud and secure *finger-tight*. Solder 4 field coils together at leads, and place in position in the frame so the untapped lead with the insulating sleeve will aline with stud. Place pole shoes in frame and tighten with pole shoe screws. Solder field lead in slot in terminal stud head.

d. Assemble Drive End.

SCREWDRIVER WRENCH, open-end, 5/8-in.

Position yoke on shift lever on overrunning clutch and place assembly in drive end housing (fig. 81). Install shift lever assembly on drive housing with stud, spring retainer washer and spring, lock washer and

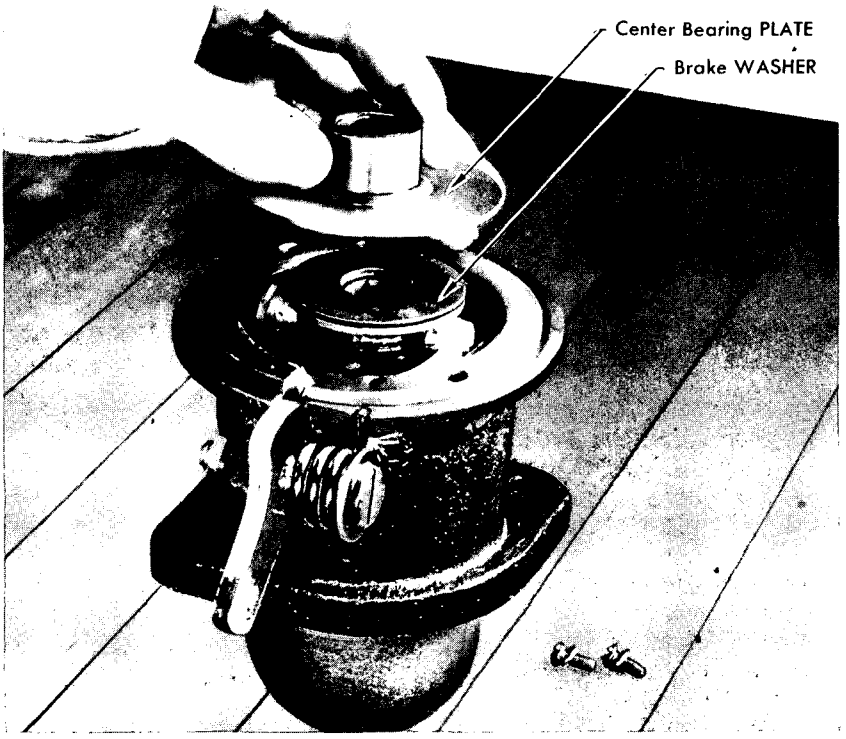

Figure 82 — Installing Center Plate Bearing and Brake Washer

nut, and tighten. NOTE: Be sure ends of spring engage properly in shift lever and housing. Position brake washer on overrunning clutch and place center bearing plate on washer (fig. 82). Press center bearing plate down in recess in housing and secure in position with two screws and lock washers.

e. Assemble Starter.

SCREWDRIVER WRENCH, open-end, 3/8-in.

Slide drive end of armature shaft through center bearing plate and into drive end housing. Position field frame over armature and aline dowel pin in field frame with hole in drive end housing. NOTE: Make sure steel washer is in place on commutator end of armature shaft. Position commutator end assembly on armature shaft, cocking brushes

over commutator. Secure drive housing, field frame and commutator end frame together with 2 through bolts and lock washers. CAUTION: Before tightening, make sure through bolts do not rub against leads. Connect 2 leads from two insulated brushes to field lead with screw and lock washer. Install cover band at commutator end of starter. Position solenoid on field frame and tighten in position with 4 screws and lock washers. Connect shift lever to solenoid plunger stud link temporarily with a pin.

f. Adjust Solenoid.

PLIERS WRENCH, open-end, 9/16-in.

Clearance of pinion should be 3/16 inch from the pinions face to the inside face of the drive housing end, when pinion is in cranking position, and may be adjusted as follows: Remove solenoid relay cover and connect a 12-volt battery between the relay frame and starter frame which energizes the solenoid hold-in winding. CAUTION: Connector strap between solenoid and starter terminals should not be connected. Push plunger into solenoid and measure clearance. Adjust to 3/16 inch by turning plunger stud in or out as required. Install cotter pin, using a pair of pliers, in shift lever and plunger stud link fastening pin. Solenoid cover may now be installed. Install connector on starter terminal stud and adjacent solenoid terminal stud, securing with 2 nuts, screws and lock washers. NOTE: Starter is ready to install in vehicle, but it should be submitted to the no-load and torque tests (par. 25) before installation.

g. Installing Right-hand Starter.

WRENCH, socket, 1/2-in. WRENCH, socket, 5/8-in.
WRENCH, socket, 9/16-in.

Working underneath vehicle, connect 2 conduit leads to solenoid on top of starter. Connect conduit lead at front of solenoid switch and tighten lock washer and nut. Position starter so drive gear meshes with flywheel teeth and tighten 2 screws and lock washers in place. Install pan under Hydra-matic transmission and tighten 27 screws and lock washers, and one self-locking nut.

h. Installing Left-hand Starter.

WRENCH, box-end, 9/16-in. WRENCH, socket, 9/16-in.
WRENCH, socket, 1/2-in. WRENCH, socket, 5/8-in.

Working underneath vehicle, connect 2 conduit leads to solenoid on top of starter. Connect conduit lead at front of solenoid switch and tighten lock washer and nut. Position starter so that drive gear meshes with flywheel teeth and tighten 2 screws and lock washers in place. Install pan under Hydra-matic transmissions and tighten 27 screws

and lock washers and one self-locking nut. On M5 vehicles, turn auxiliary power plant, exhaust pipe, and muffler back to proper position. Working in fighting compartment, tighten elbow clamp on exhaust pipe. Position bolt and lock washer in exhaust pipe bracket and tighten to support. Position left-hand shell racks and tighten 4 screws and lock washers holding lower one, and 3 screws and lock washers holding upper rack.

36. PREPARATION FOR EXTREME CONDITIONS.

a. Generator.

(1) HEAT AND COLD. Self-lubricated sealed bearings in the generator eliminate the necessity of special lubrication under any conditions of heat or cold.

(2) SAND. The generator brushes and commutator should be checked more frequently in sandy or dusty areas as they may wear down faster, and consequently may require replacing more often.

(3) SALT WATER. If the generator is subject to immersion in salt water, it will be necessary to disassemble it and clean all parts thoroughly to prevent rust or corrosion. NOTE: If vehicle is merely operated in salt water areas, it will be necessary to inspect more often, due to the corroding effect of salt air.

b. Generator Regulator Assembly. The regulator assembly is sealed and completely airtight, and requires no special attention under heat, cold or sand, or salt water conditions.

c. Starter.

(1) HEAT. Under extremely hot conditions, it is advisable to make certain that starter oiler wick is kept well saturated.

(2) COLD. Under abnormally cold conditions, the oiler wick should be saturated frequently with a light weight oil.

(3) SAND. In sandy or dusty areas, the starter brushes may wear faster than under ordinary usage and consequently may require replacement more often.

(4) SALT WATER. Operation of the vehicle in salt water areas will necessitate more frequent inspection, due to the corroding effect of salt air. If, however, the starter is immersed in salt water, it will be necessary to disassemble and clean all parts.

37. PACKING, SHIPPING, AND STORAGE.

a. Complete Assemblies. Due to the fact that many parts of the generator, starter and voltage regulator are made of copper or brass, and are, therefore, subject to weather corrosion, it is necessary, in the case of complete assemblies, to pack them for shipping or storage in the

following manner: Seal all openings with masking tape or a similar substitute. Wrap in nonoxide cloth. Pack in wooden box and support or block well before sealing.

b. Component Parts. When preparing component parts of the starter and generator for shipment or storage, handle them as follows: Wrap in nonoxide cloth. Place in cardboard containers if they are small parts, such as brushes, springs, or terminals, etc.; if large parts, such as housing or armature, pack in wooden or very heavy cardboard container.

c. Generator Voltage Regulator. These units are always shipped as a complete unit and should be handled as outlined in step **a** of this paragraph.

Section IV

FUEL SYSTEM

38. DESCRIPTION (figs. 83 and 84).

a. The functions of the fuel system are to store fuel for the engines, to pump this fuel to the engines, to mix it into a combustible form with clean, filtered air, and thus to supply the gasoline and air vapor to the engine intake manifolds. The system consists of the carburetor on each engine, which mixes the air and fuel; the fuel pump on each engine, which pumps the fuel from the two fuel tanks where the fuel is stored; a fuel filter, which cleans the fuel and removes any foreign matter; an air cleaner for each engine, which filters the air for the combustion mixture; and the necessary connecting fuel lines and air pipes to the various units.

b. The fuel system of the auxiliary power plant (used only on the Light Tank M5) is essentially the same as that for the engine; and includes a carburetor, air cleaner, fuel filter, and gasoline lines and air pipes. This sytem has no fuel pump as it operates on a gravity feed. It has no separate fuel tank, as it draws fuel from the left-hand main

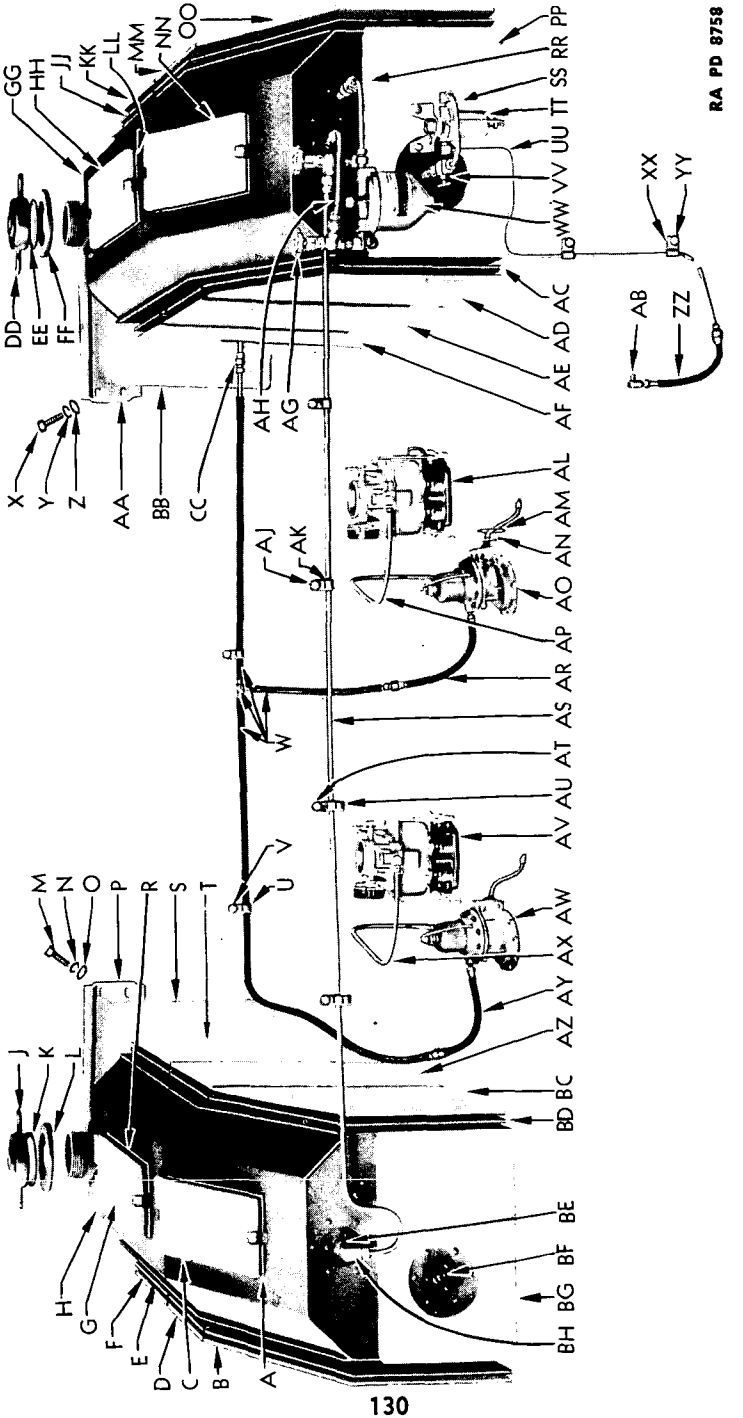

Figure 83 — Fuel System — Exploded View

A — SHIM
B — SPACER
C — SPACER
D — SPACER
E — SHIM
F — SPACER
G — SPACER
H — TANK, FUEL, ASS'Y
J — CAP, ASS'Y
K — GASKET
L — SEAL
M — SCREW
N — WASHER, LOCK
O — WASHER, PLAIN
P — RETAINER
R — SHIM
S — SPACER
T — SPACER
U — CLEAT
V — SCREW
W — LINE, ASS'Y
X — SCREW
Y — WASHER, LOCK
Z — WASHER, PLAIN
AA — RETAINER
BB — SPACER
CC — {CONNECTOR, NIPPLE}
DD — CAP, ASS'Y
EE — GASKET
FF — SEAL
GG — TANK, FUEL, ASS'Y
HH — SPACER
JJ — SHIM
KK — SPACER
LL — SHIM
MM — SPACER
NN — SPACER
OO — SPACER
PP — SPACER
RR — LINE, ASS'Y
SS — {LINE, ASS'Y, ELBOW}
TT — FILTER, ASS'Y
UU — LINE, ASS'Y
VV — COCK
WW — FILTER, ASS'Y
XX — CLEAT
YY — SCREW
ZZ — HOSE, ASS'Y
AB — ELBOW
AC — SHIM
AD — SPACER
AE — SPACER
AF — SPACER
AG — VALVE
AH — LINE, ASS'Y
AJ — SCREW
AK — CLEAT
AL — CARBURETOR, ASS'Y
AM — GASKET
AN — OIL SEAL, ASS'Y
AO — PUMP, FUEL, ASS'Y
AP — {LINE, ASS'Y, ELBOW}
AR — HOSE, ASS'Y
AS — LINE, ASS'Y
AT — SCREW
AU — CLIP
AV — CARBURETOR, ASS'Y
AW — PUMP, FUEL, ASS'Y
AX — {LINE, ASS'Y, ELBOW}
AY — HOSE, ASS'Y
AZ — SPACER
BC — SPACER
BD — SHIM
BE — NIPPLE
BF — PLUG
BG — SPACER
BH — ELBOW

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Legend for Figure 83 — Fuel System — Exploded View

fuel tank. Only the fuel filter, air cleaner, fuel lines and air pipes of the auxiliary power plant system are discussed in this section.

c. Carburetor (figs. 85, 86, and 87).

(1) The main engine carburetors are of the down-draft type, with dual barrels, each barrel supplying the fuel mixture to four cylinders through the intake manifolds. NOTE: Two types of carburetors are used interchangeably on the Light Tank M5 and the 75-mm Howitzer Motor Carriage M8. The first type carburetor is equipped with an automatic fast idle system as discussed under (5) below. Due to the arrangement of the engines in the vehicle, this feature was found to be unnecessary and, therefore, is not included on second type carburetors. The second type carburetors are sealed carburetors; that is, the carburetor is vented internally instead of to the outside of the carburetor as were the first types. A third difference in first and second type carburetors is in the air supply for the automatic choke mechanism. Only clean filtered air which has passed through the air cleaner is used on the second type carburetors. This feature is discussed under (4) of this paragraph.

(2) The carburetor assembly consists of four major units, namely, the upper body and climatic control assembly, the bowl cover, the bowl chamber body, and the throttle body. All of these parts are die-cast alloy except the throttle body, which is cast iron. Contained within these units are the various valves, jets, floats, seats, and other parts.

(3) There are four separate fuel circuits in the carburetor: the float circuit, the low speed circuit, the high speed circuit, and the throttle pump circuit.

(*a*) The float circuit controls the amount of fuel admitted to the carburetor to provide the best fuel mixture from a performance and an economy standpoint. The assembly consists of a needle valve and seat actuated by a lever from a dual float, and the float chamber.

(*b*) The low speed circuit, which operates at idling or low speeds, consists of two jets to meter the flow of fuel to the idling mixture needle valve screws. These screws, which are easily adjustable, further restrict the flow of fuel to the venturis, thus controlling the ratio of fuel to air at idling or low speeds.

(c) The high speed circuit is actuated by linkage from the throttle valve shaft so that it operates only at intermediate or high speeds. Two tapered metering rods, operating up and down in tapered seats, variably restrict the flow of fuel through the high speed jets into the venturis, according to the position of the accelerator pedal. A vacuumatic economizer unit is incorporated into the high speed circuit. This unit,

FUEL SYSTEM

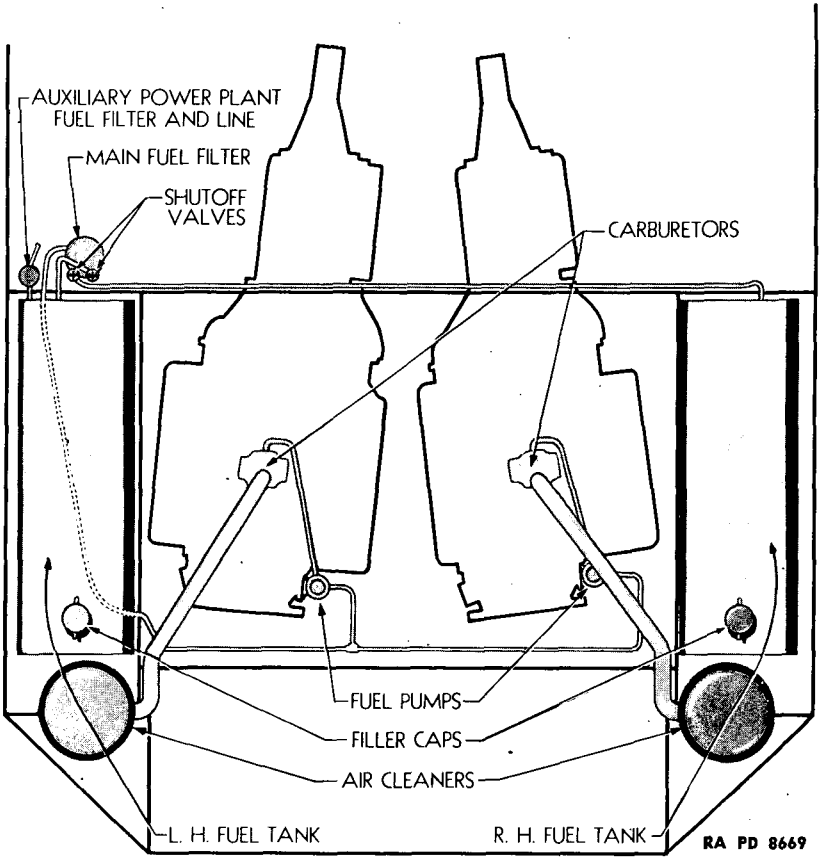


Figure 84 — Fuel System — Schematic

which is actuated by vacuum from the venturis, controls the operation of the metering rods in conjunction with the action of the accelerator pedal as explained above. By opening the metering rods an additional amount on acceleration, the unit causes leaner mixtures to be used at steady throttle openings.

(*d*) The throttle pump circuit includes a piston and cylinder assembly, an intake ball check valve, a discharge needle valve and seat, and jets opening into the venturis. The piston, which is actuated by linkage from the throttle shaft, supplies a momentarily rich mixture for fast acceleration when the accelerator is depressed suddenly.

(4) The carburetor is equipped with an automatic choke to facilitate starting when the engine is cold. The mechanism contains a thermostatic spring attached to the choke valve shaft, an air heater attached to the exhaust manifold, and a pipe connecting the above units. On second

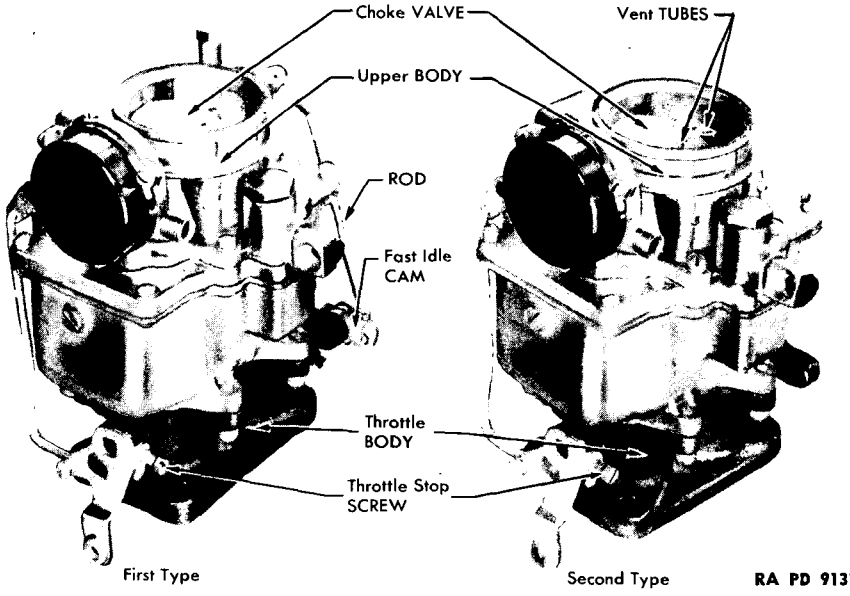


Figure 85 — Carburetor Assembly — Front View

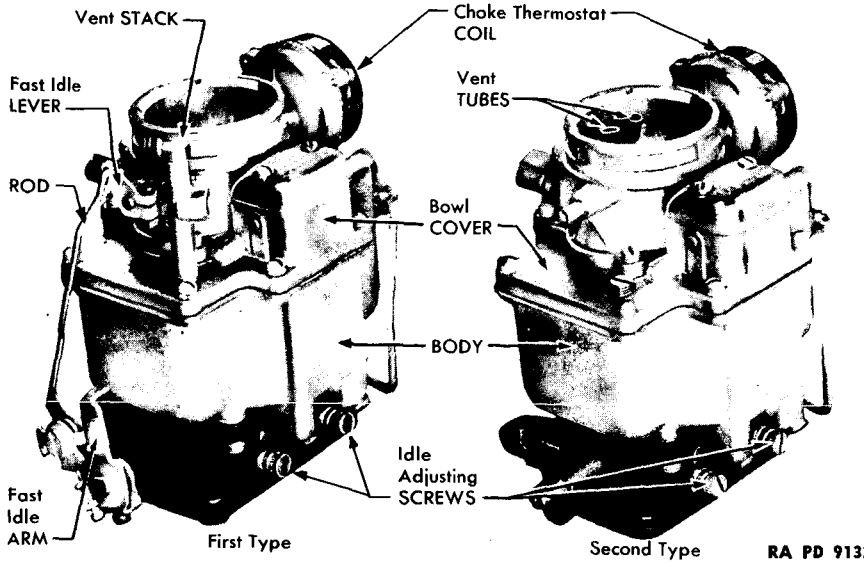


Figure 86 — Carburetor Assembly — Rear View

FUEL SYSTEM

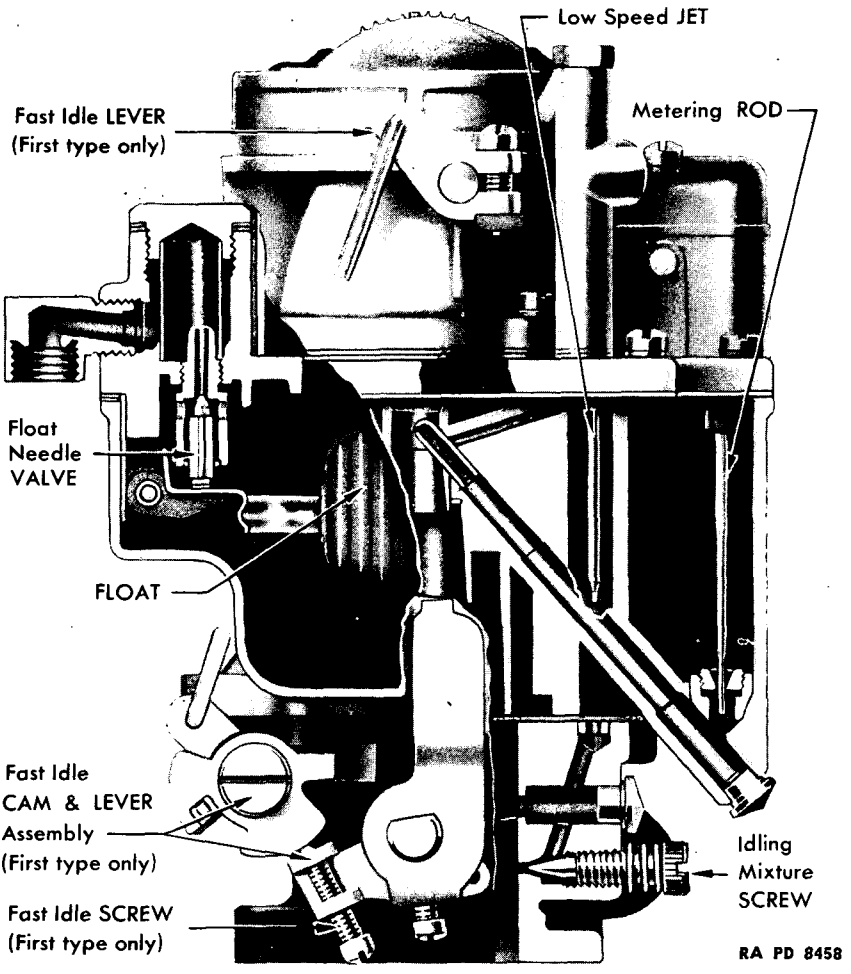


Figure 87 — Carburetor — Side Section

type carburetors the air supply to the heater on the exhaust manifold is drawn from the air pipe from the air cleaner to the carburetor, thus only clean filtered air enters the carburetor thermostat. A vacuumeter piston operated by vacuum from the venturis assists in the control of the automatic choke to combine performance and economy.

(5) An automatic fast idling system is built into the first type carburetors on the first vehicles built. This unit, operating in conjunction with the automatic choke, raises the idling speed of the engine to approximately 650 revolutions per minute until the engine warms up.

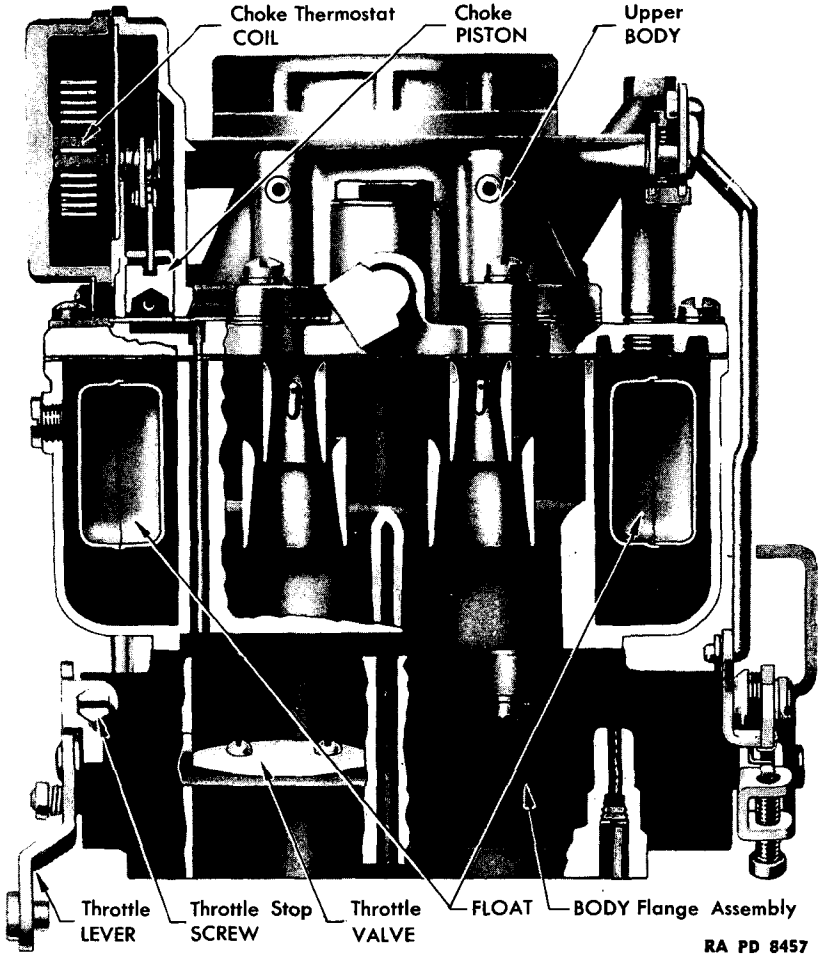


Figure 88 — Carburetor — Cross Section

d. Fuel Pump (figs. 89 and 90).

(1) The functions of the fuel pump are, first, to draw fuel from the fuel tanks and, second, to force this fuel up to the carburetor. The fuel pump, which is mounted on the engine front cover, is of the reciprocating diaphragm type. It is actuated by a rocker arm which rides on an eccentric attached to the camshaft. The major fuel pump assemblies include a bowl, upper cover, body and lower cover, all of which are die-cast alloy except the bowl, which is sheet metal.

(2) A laminated assembly is mounted in the beehive-type bowl. Inasmuch as fuel is sucked from the top of the bowl, any dirt or other

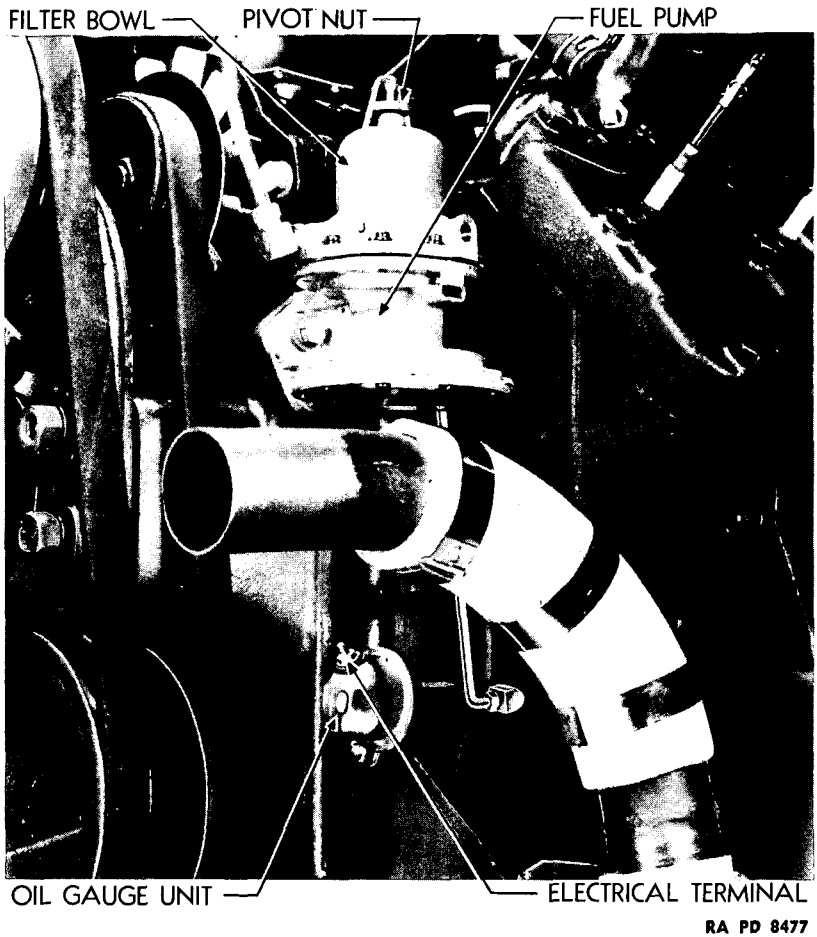


Figure 89 — Fuel Pump on Engine

heavy matter falls to the bottom of the chamber. Any floating matter is stopped by the laminated strainer.

(3) Intake and outlet disk-type valves are incorporated in the fuel pump. These valves are identical except that, due to the mounting arrangement, their operation is reversed.

(4) The circular fabric diaphragm assembly is mounted between the upper cover and the fuel pump body. A push rod attached to sheet metal reinforcements on either side of the diaphragm connects the assembly to the rocker arm. A return spring on the diaphragm assures a tight connection between the two units.

(5) The copper plated steel rocker arm pivots on a shaft mounted in the fuel pump body. The arm extends through a slot in the rocker

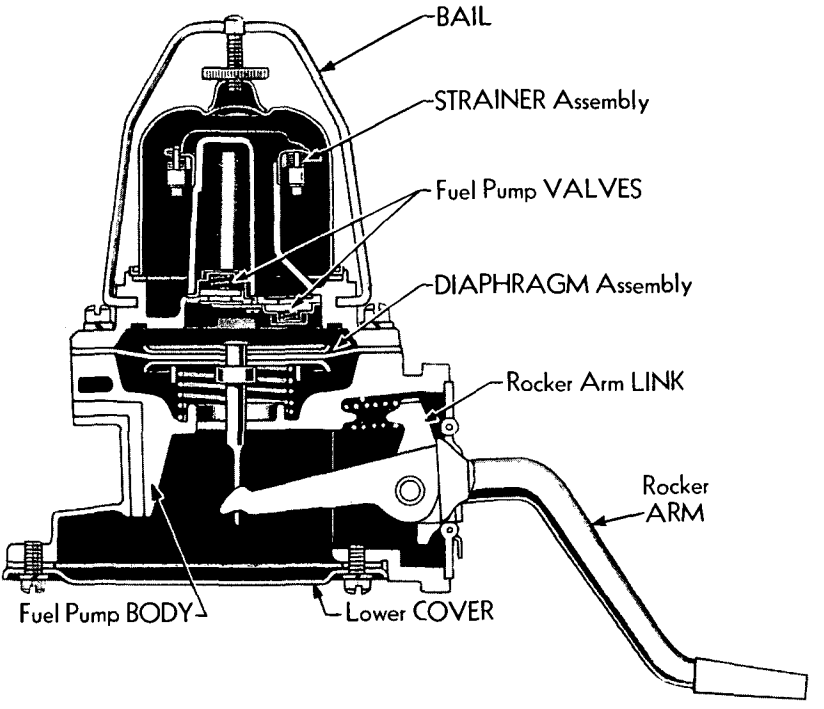


Figure 90 — Fuel Pump — Cross Section

arm link in such a way that the link operates with the rocker arm. The upper end of the link bears against a horizontal spring, thus tending to keep the upper end of the link pushed outward and the outer end of the rocker arm downward against the eccentric on the camshaft.

e. Engine Fuel Filter (fig. 91).

(1) The engine fuel filter provides a means of thoroughly straining the fuel before it reaches the fuel pumps. The filter, which is of the laminated disk-type, is mounted on the fighting compartment side of the bulkhead, just in front of the left-hand fuel tank. Two shut-off valves (first type M5) are mounted on the inlet openings of the filter so that fuel from either or both fuel tanks may be shut off. A large bowl on the filter acts as a settling chamber for the fuel and encloses the laminated strainers. These strainers are so mounted that the fuel must pass between them before it can be drawn out of the filter. A spring is mounted between the bowl and the bottom of the strainer assembly to keep the strainers tight together and to promote efficient cleaning.

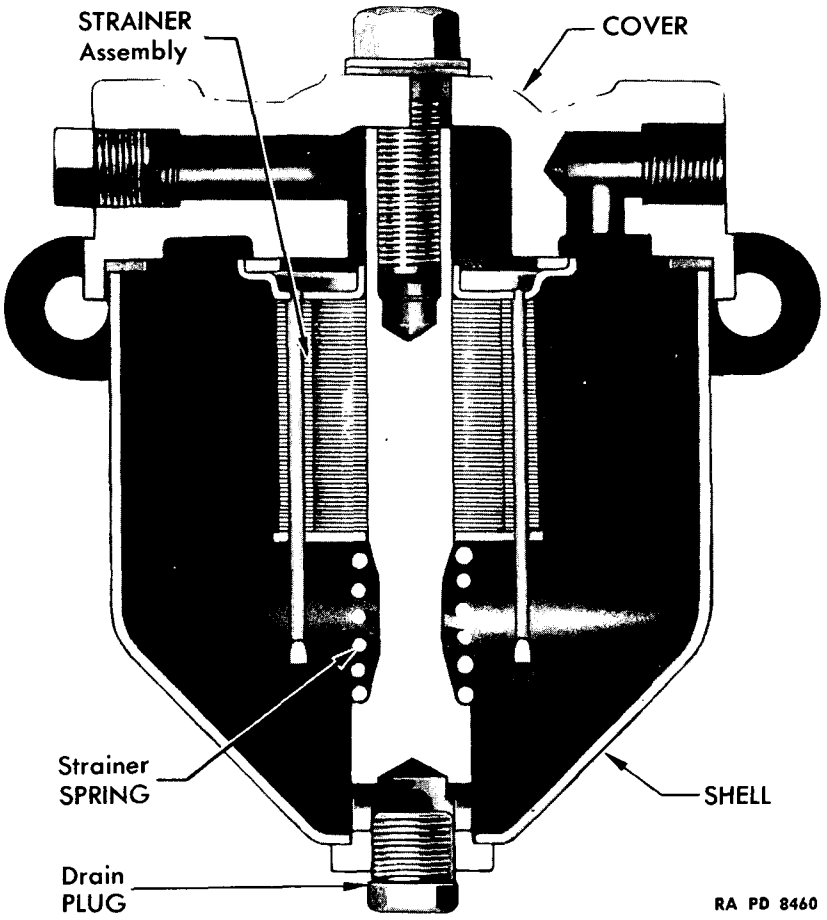


Figure 91 — Fuel Filter — Cross Section

(2) A second type fuel filter valve arrangement is used on all M8 and on later M5 vehicles. A single dial type valve is used as shown in figure 92. Turning the pointer of the valve upward will shut off fuel from both fuel tanks. Turning the pointer to a horizontal position (left) permits use of fuel from the left-hand tank only, while only fuel from the right-hand fuel tank is used when the valve pointer is turned downward. The right-hand tank should be used first.

f. Auxiliary Power Plant Fuel Filter (M5 only). A fuel filter is incorporated in the fuel line from the left-hand fuel tank to the carburetor on the auxiliary power plant. This filter is mounted on the bulkhead just below the fuel filter for the engines. It is of the same

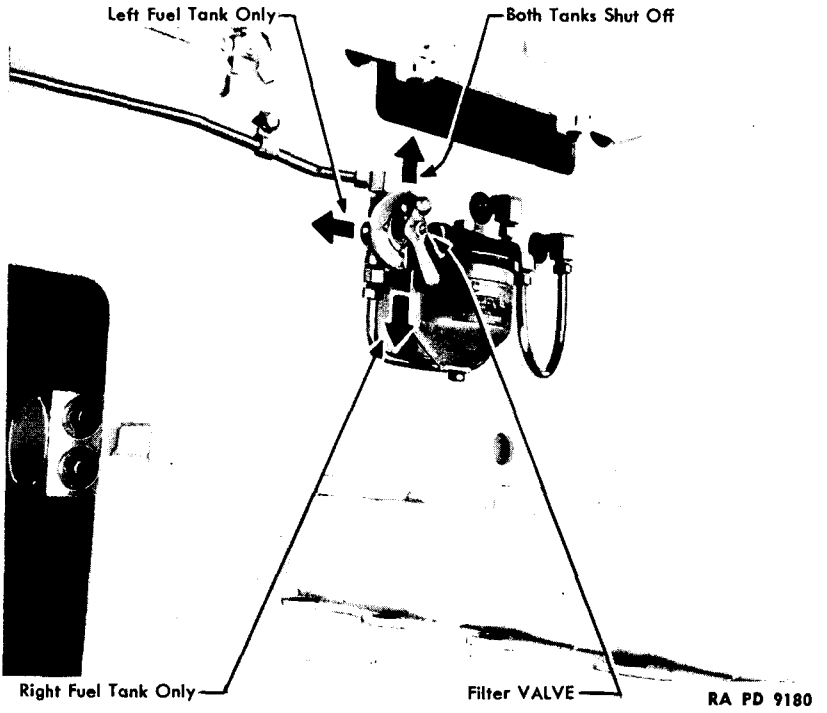


Figure 92 — Second Type Fuel Filter Valve

design as the main fuel filter described above except that it has a smaller capacity. A valve on the inlet side of the filter permits the fuel supply to be shut off.

g. Fuel Lines.

(1) The fuel lines in the engine fuel system are standard ⅜-inch soft steel tubing equipped with compression type fittings. The lines from the radiator rear support to the fuel pumps are flexible to absorb any vibrations of the engines. The line from the left-hand tank to the auxiliary power plant fuel filter is ⅜-inch tubing (M5 only). The line from the filter to the carburetor on the auxiliary power plant is ¼-inch tubing (M5 only). Wherever the location of the pipes is such that they are subject to heat or chafing, they are protected by a heavy cloth loom.

(2) A unique arrangement of the fuel line from the engine fuel filter to the fuel pumps minimizes the possibility of vapor lock. This line runs from the fuel filter back *through* the front of the left-hand fuel

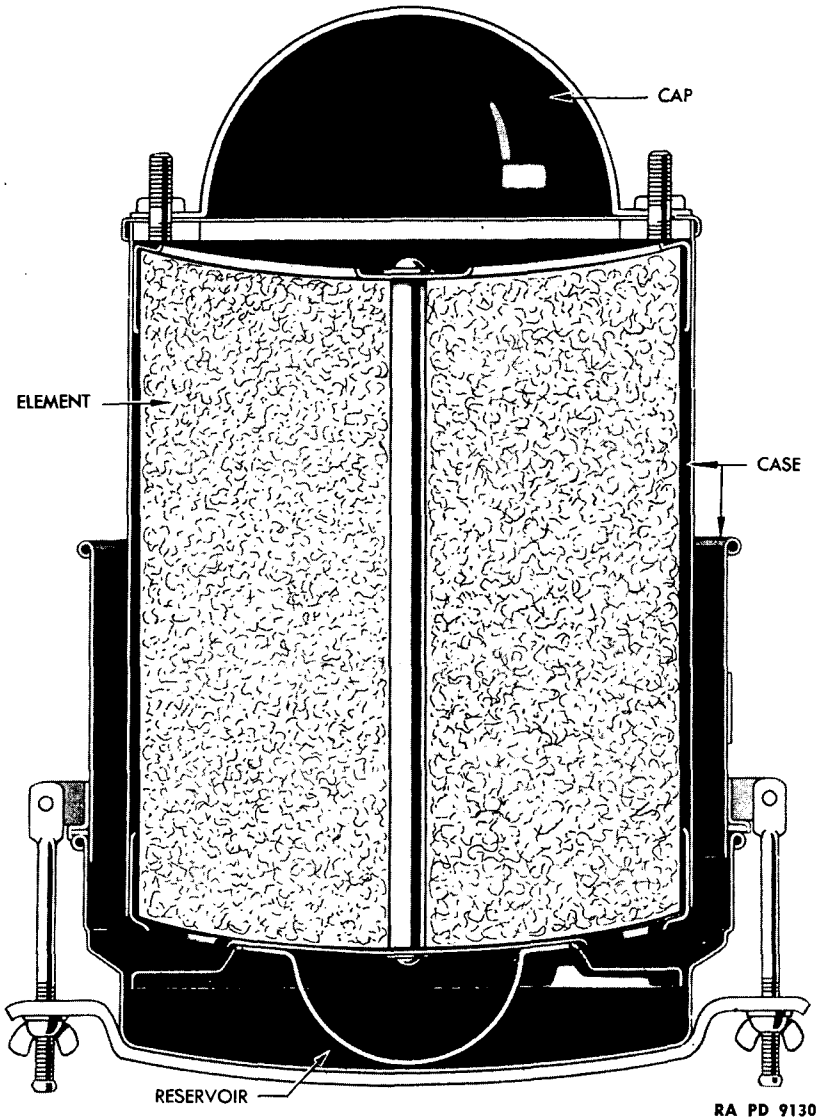
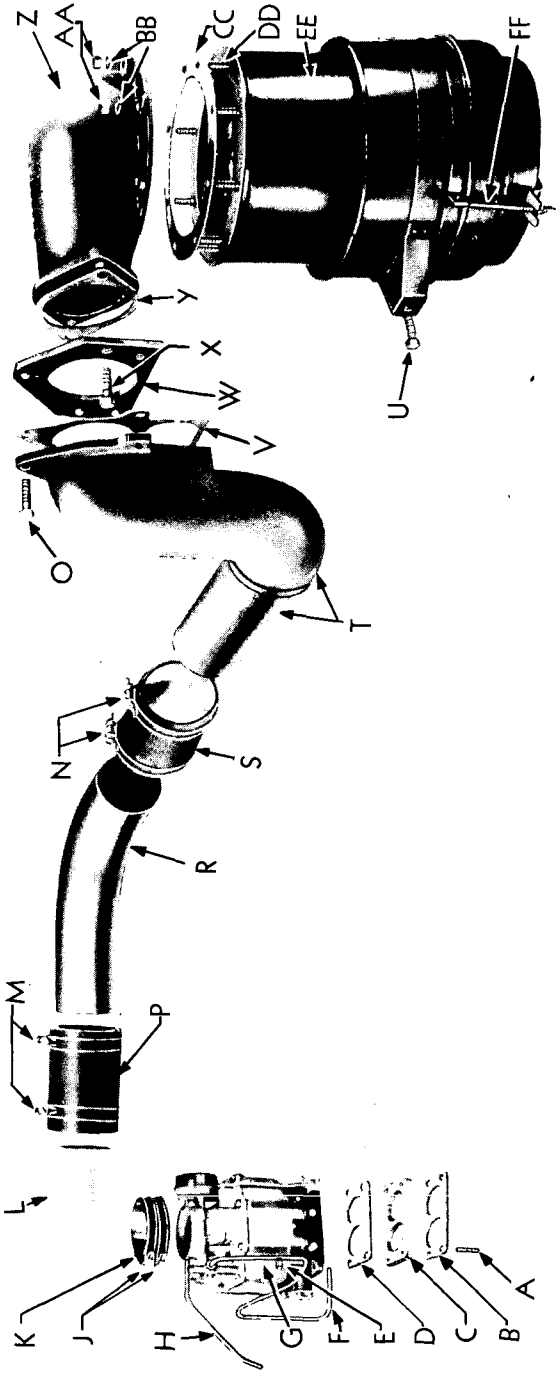


Figure 93 — Air Cleaner — Cross Section

tank, coming out on the inner side of the tank toward the rear. In this location the fuel in the line is kept cool by the fuel in the tank.

h. Fuel Tank. Two fuel tanks, each of 44½-gallon capacity, store the fuel until it is used by the engines. These fuel tanks, which are of heavy brazed steel construction, are mounted in the sponsons just



RA PD 8771

Figure 94 — Air Passage Parts

A — STUD
B — GASKET
C — INSULATOR
D — GASKET
E — NUT
F — LINE, ASS'Y
G — CARBURETOR, ASS'Y
H — {LINE, ASS'Y, R.H.
{LINE, ASS'Y, L.H.
J — CLAMP
K — HOSE
L — INLET, ASS'Y
M — CLAMP
N — CLAMP
O — SCREW
P — HOSE
R — TUBE
S — HOSE
T — {ELBOW, ASS'Y, R.H.
{ELBOW, ASS'Y, L.H.
U — SCREW
V — GASKET
W — PLATE
X — SCREW
Y — GASKET
Z — CAP
AA — NUT
BB — WASHER, LOCK
CC — GASKET
DD — STUD
EE — {CLEANER, AIR, ASS'Y, R.H.
{CLEANER, AIR, ASS'Y, L.H.
FF — BOLT

RA PD 8771B

Legend for Figure 94 — Air Passage Parts

behind the bulkhead. Wooden and fiber shims are provided on all sides and top and bottom of the tanks to wedge them firmly in position when they are installed. A large, perforated flame arrester is built into the filler tube of each tank on vehicles which are not equipped with pressure relief valves located on the top center of the gas tank. This minimizes the possibility of fire. All outlet pipes from the fuel tanks are screened at the lower end to prevent sucking up any settlings in the tank. A drain plug is incorporated in the bottom of each tank and is accessible after removing a cover plate on the sponson floor.

i. Air Cleaners (figs. 93 and 94).

(1) A heavy duty oil bath air cleaner is provided for each engine. Each air cleaner is mounted in the extreme rear section of the sponsons directly behind the fuel tanks. A large crinkled wire element in each air cleaner strains all dust and dirt from the air before it passes through the air pipes to the carburetor. A 3-pint oil reservoir is mounted on the bottom of the air cleaner. The oil is picked up by the air and is released in the wire element. The oil itself acts as a collector for the dirt in the air. Large metal pipes and rubber hoses convey the filtered air to the carburetor.

(2) The auxiliary power plant air cleaner (M5 only) is similar in design to the engine air cleaners but is, of course, much smaller. The wire element in this air cleaner is ring-shaped, being mounted around the outlet pipe in such a way that air must pass through the element before it passes through the air pipe to the auxiliary power plant carburetor. The air cleaner is mounted on the air pipe, which in turn is supported on a bracket attached to the bulkhead.

39. OPERATION OF FUEL SYSTEM.

a. Carburetor. The carburetor mixes the fuel with air in a ratio of 14 to 16 pounds of air to 1 pound of fuel and delivers this combustible vapor to the engine intake manifolds. The carburetor operates on the vacuum principle, in that the air is sucked through the carburetor by the vacuum in the engine cylinders when the pistons are on the intake stroke. The velocity of this air through the barrels is greatly increased by the triple venturis which restrict the opening in the barrels. The rush of air past the various fuel jets creates a vacuum in the end of the jets, thus sucking fuel out into the air stream. The amount of air and fuel flowing through the carburetor is regulated by the throttle valves, which open and close the barrels, thus regulating the speed of the vehicle and the ratio of fuel to air. The operation of the carburetor can best be explained by discussing the four fuel circuits covered in paragraph 38.

FUEL SYSTEM

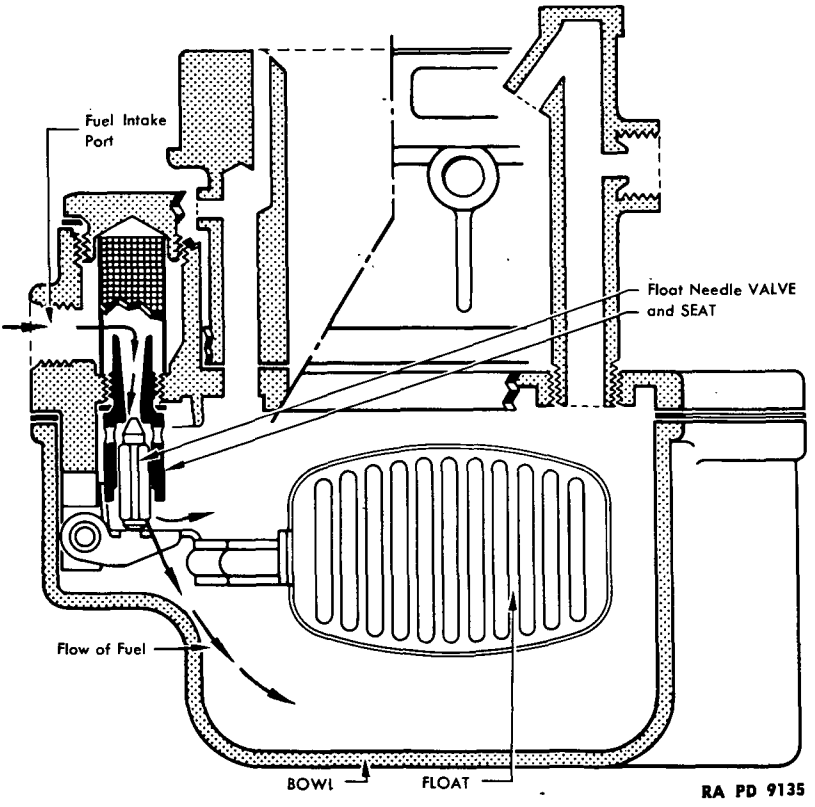


Figure 95 — Carburetor Float Circuit

(1) The float circuit regulates the amount of fuel in the float chamber. As the fuel level in the chamber rises above a predetermined amount, it forces the hinged float upward. An arm on the end of the float assembly bears against the lower end of the float needle valve which is mounted in the carburetor fuel intake. The movement of the float upward forces the needle valve against its seat, thus shutting off the fuel supply. As the fuel level in the float chamber drops, the float moves downward, opening the needle valve and permitting fuel to enter the carburetor (fig. 95).

(2) Fuel from the float chamber passes to the low speed circuit through drilled passageways in the carburetor body. It is sucked through this circuit by the vacuum in the venturis below the throttle valves. First the fuel is metered through the low speed jets and then past the idling mixture valve screws and into the venturis where it is vaporized with air (fig. 96).

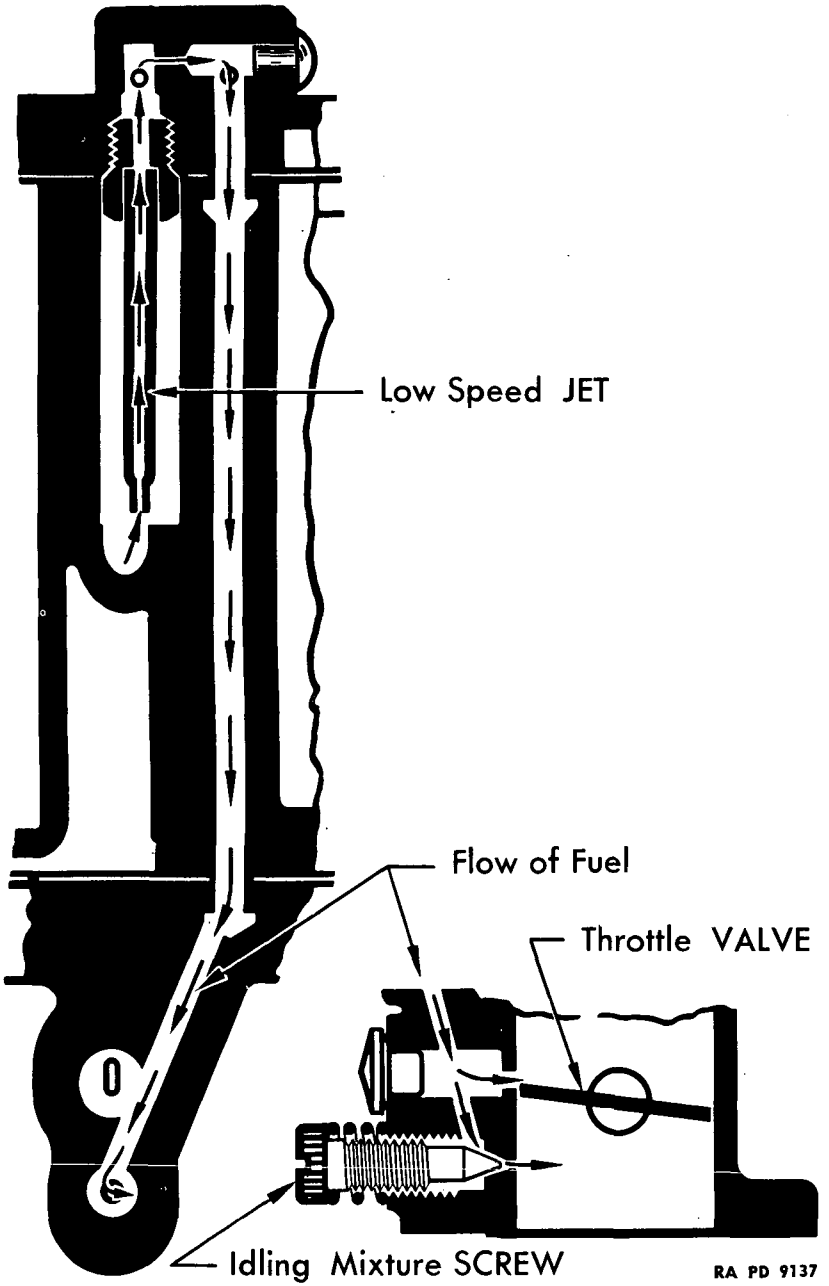


Figure 96 — Carburetor Low Speed Circuit

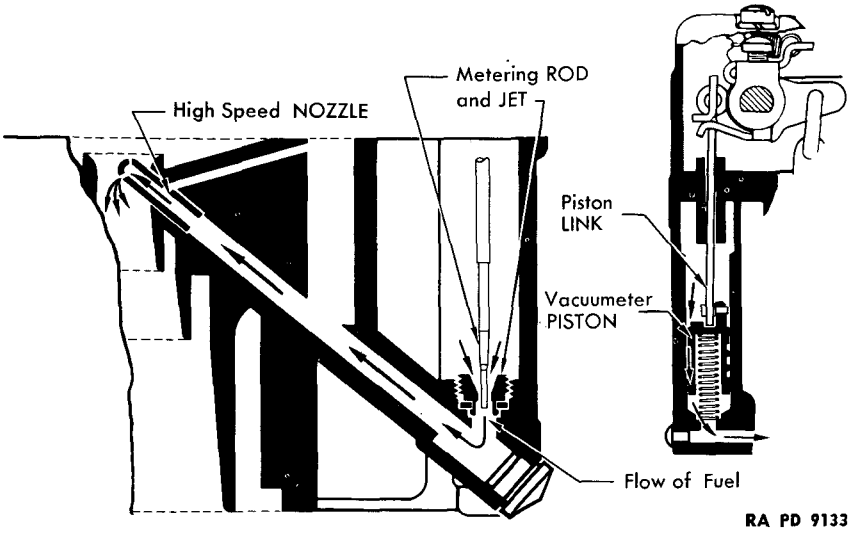


Figure 97 — Carburetor High Speed Circuit

(3) The high speed circuit is operated by linkage from the throttle shaft. At idling or low speeds the metering rods have their large step (large diameter) down against their seats, thus shutting off any flow of fuel through this circuit. As the throttle is partly opened, the metering rods are raised to the middle step, permitting a metered amount of fuel to be drawn through the valve seats and sucked out of the high speed jets into the venturis. As the throttle opening is increased, the metering rods are raised further, to the small step, thus allowing additional fuel to pass through the valve seats (fig. 97).

(4) The throttle pump is also operated by linkage from the throttle shaft. When the throttle is moved from the open toward the closed position, the pump piston is raised and the subsequent vacuum in the pump cylinder draws fuel through the intake check valve into the cylinder. Then, when the throttle is opened, the piston moves downward, forcing the fuel out through the exhaust check valve and through jets into the venturis (fig. 98).

(5) The automatic choke is operated by a thermostatic spring and by air from the heater on the exhaust manifold. When the engine is cold, the thermostatic choke spring on the choke shaft contracts and closes the choke valve, cutting down the air supply in the venturis. As the air supply is diminished, the ratio of fuel to air is increased and the resulting fuel mixture is richened. As the engine warms up, the air in the heater on the exhaust manifold is heated. When this

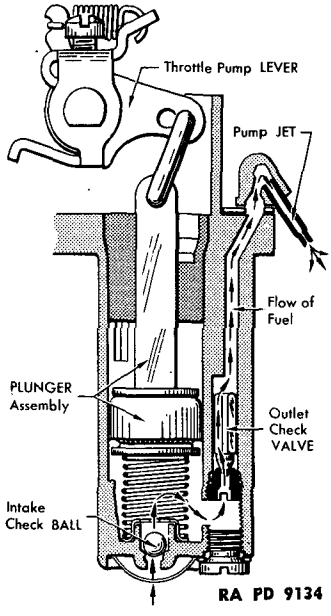


Figure 98 — Carburetor Throttle Pump Circuit

warm air contacts the thermostatic choke spring, the spring expands, opening the choke and increasing the proportion of air entering the carburetor.

b. Fuel Pump.

(1) The fuel pump is operated by a rocker arm, which rides on an eccentric attached to the camshaft (fig. 90). As the camshaft rotates, the cam of the eccentric forces the outer end of the rocker arm upward while the return spring on the rocker arm link pushes the outer end of the rocker arm downward when the high point of the eccentric has passed the arm. Inasmuch as the rocker arm is pivoted in the fuel pump body, the inner end of the arm moves up and down in inverse relation to the outer end of the arm. The inner end is connected by means of a rod to the center of the diaphragm assembly so that this also moves up and down with the inner end of the rocker arm.

(2) As the center of the diaphragm moves downward, a vacuum is created in the fuel pump body. This vacuum pulls the intake check valve off its seat and sucks fuel from the fuel lines into the pump body. The outlet valve meanwhile is pulled tightly closed by this same vacuum.

(3) When the diaphragm passes the end of its downward stroke and starts to move upward, a pressure is exerted on the fuel in the fuel

pump body. This pressure closes the intake check valve and, at the same time, opens the outlet valve. In this way the fuel is forced out of the fuel pump into the fuel line leading to the carburetor.

(4) When the fuel in the carburetor bowl chamber rises above a predetermined amount, the carburetor float valve shuts off the flow of fuel to the carburetor. This creates a back pressure on the fuel pump diaphragm stopping its reciprocating action. Rocker arm movement continues, however, but is absorbed by the diaphragm linkage. As the fuel in the carburetor drops, the float valve opens the fuel intake, the back pressure on the diaphragm drops, and it starts pumping fuel once more.

40. TABULATED DATA AND SPECIFICATIONS.

a. The specifications as given below are for one carburetor, fuel pump, or air cleaner. They apply to either right- or left-hand units unless otherwise specified.

b. Carburetor.

Make	Carter
Type	WCD dual down-draft
Model	553-S
Flange size	1¼ in.
Venturis, inside diameter	
Primary	11/32 in.
Secondary	19/32 in.
Main	1 3/16 in.
Gas line connection	3/8-in. elbow
Idling port type	
Upper port	Slot
Lower port	Round
Idling adjustment	Screw-type
Main jets	
Location	Primary Venturi
Angle	49°
Accelerating pump type	High pressure
Choke type	Automatic climatic control
Choke valve type	Offset butterfly valve

c. Fuel Pump.

Make	AC
Model	BE
Cam eccentricity	5/16 in.
Diaphragms	
Type	Canvas
Number	5
Diameter	4 in.

Drive ..... Rocker arm
Body and covers ..... Die-cast
Capacity ..... 20 to 24 cu cm per stroke
Pressure at idling speed ..... 3½ to 5 lb

d. Engine Fuel Filter.

Make ..... AC
Type ..... Laminated strainer
Strainers
  Surface area ..... 12.85 sq in.
  Filtering area ..... 4.48 sq in.
  Number ..... 358 or 359
Valves, shut-off
  Location ..... Inlet side
  Number 2
Location ..... Upper left rear corner of fighting compartment

e. Auxiliary Power Plant Fuel Filter.

Make ..... AC
Type ..... Laminated strainer
Strainers
  Surface area ..... 2.764 sq in.
  Filtering area ..... 0.96 sq in.
  Number 81
Valve, shut-off
  Location ..... Inlet side
  Number 1
Location ..... Upper left rear corner of fighting compartment

f. Engine Air Cleaner.

Make ..... AC
Type ..... Oil bath
Filter element
  Type ..... Steel mesh
  Weight ..... 4 lb of 0.011 wire
  Type wire ..... Crimped-tubular
Reservoir oil capacity ..... Approximately 3 pt
Air intake ..... From engine compartment
  Location ..... Extreme rear of each sponson
Number 2

FUEL SYSTEM

g. Auxiliary Power Plant Air Cleaner.

Make ..... AC
Filter element ..... Copper mesh
Reservoir oil capacity ..... Approx. ¼ pt
Location ..... Left front corner of fighting compartment
Number 1

41. ORGANIZATION MAINTENANCE.

a. For the allocation of maintenance duties, refer to the information on the engine fuel system in the echelon breakdown of maintenance (par. 4).

42. TECHNICAL INSPECTION OF FUEL SYSTEM IN VEHICLE.

a. Purpose. Technical inspections by ordnance personnel are a follow-up and check on organizational maintenance inspections and servicing. These inspections determine whether the vehicle should continue in service or be withdrawn from operation for overhaul.

b. Inspection Form. War Department Quartermaster Corps Form No. 260, Technical Inspection Report of Motor Vehicles, is the standard and official form for recording the inspection of all motor vehicles, including combat vehicles of the Ordnance Department. The extent to which use is made of this form or its modifications depends entirely upon the technical ability of available personnel, the time factor, and the test and shop equipment available.

c. Equipment Required.

CLOTH, clean	FLASHLIGHT
EQUIPMENT, motor analyzing	TOOL, vehicle (set)

d. Visual Inspection Procedure. Inspection includes both visual checkup of the complete fuel system and a check of the fuel pumps and carburetors while the engines are running. Ordinarily, the visual checkup of the fuel system should be made first. This requires full opening of the engine compartment rear doors, and removing the left-hand door in the bulkhead, then proceed with the inspection.

(1) CARBURETOR. Check carburetor mounting to see that it is tight. Try carburetor linkage for free movement. Check mounting of air inlet pipe to carburetor. Check fuel lines at carburetor for leakage. Inspect choke heater mounting on exhaust manifold and pipe to carburetor to see that they are tight.

(2) FUEL PUMP. Check fuel pump for secure mounting. Check fuel line connections at fuel pump for leakage. Remove fuel pump bowl by loosening bail nut and swinging bail aside, and check bowl for excessive

sediment. Clean if required. Check bowl bail for tightness. NOTE: Be sure to shut off fuel valves at engine fuel filter before removing fuel pump bowl.

(3) ENGINE FUEL FILTER. Inspect mounting of fuel filter to make sure it is tight. Check fuel line connections at filter for leakage. Check fuel filter valves for free operation. Inspect fuel filter bowl for tightness and leakage. Remove fuel filter bowl as explained in paragraph 44 d and check bowl for sediment.

(4) AUXILIARY POWER PLANT FUEL FILTER. Check mounting of auxiliary power plant fuel filter to make sure it is tight. Check fuel line connections at fuel filter for leakage. Check filter shut-off valve to make sure that it operates freely. Inspect filter bowl for leakage and tightness. Check filter bowl for excessive sediment as explained in paragraph 44 e.

(5) FUEL LINES. Check all fuel lines and connections to make sure they are tight and not leaking.

(6) FUEL TANKS. Check all fuel line connections at fuel tank to make sure they are tight and not leaking. Check tightness of flame arrester at fuel tank inlet. Remove cover plate under fuel tank drain plug and check plug for tightness and leakage. While drain plug cover is off, try to shake fuel tank to see whether or not it is wedged tightly in position.

(7) ENGINE AIR CLEANER. Remove cover plate as explained in paragraph 45, and check air cleaner mounting for tightness. Inspect reservoir for leakage. Remove reservoir as explained in paragraph 44 g, and check oil level in reservoir. Check oil for being excessively dirty. Check all air cleaner pipes from air cleaner to carburetor for tightness and air leakage (fig. 94).

(8) AUXILIARY POWER PLANT AIR CLEANER. Remove air cleaner cover as explained in paragraph 46, and check level of oil in cleaner. Check condition of oil to see whether it is excessively dirty. Check air cleaner mounting to see whether it is tight. Check air cleaner pipes from cleaner to auxiliary power plant carburetor to see that they are tight.

e. Operating Inspection. Inspection of the fuel pumps and carburetor with the engines running should ordinarily follow the visual inspection except in instances where a specific difficulty is to be located. The procedure is as follows:

(1) STARTING CONTROLS. In starting the engines, check the ignition switches, starter buttons, and accelerators for free and accurate operation and make certain hand brakes are applied and the transmission selector lever is in neutral detent position.

(2) INSTRUMENTS. As soon as the engines are started, observe the ammeter and the oil gages to see whether they indicate normal functioning of the engine.

(3) Check fast idling speed of engines so equipped. (Later engines do not have fast idling speed.) This speed should be from 625 to 675 revolutions per minute on each engine. Check to see when engines return to slow idling speed. This should be at least before the engine temperature reaches 165 degrees.

(4) CHECK SLOW IDLING SPEED OF EACH ENGINE. Slow idling speed should be from 400 to 425 revolutions per minute. Check to see that engine runs smoothly without loping or stalling at idling speed.

(5) SMOOTHNESS. Accelerate engine slowly to different speeds and check for smoothness of operation.

NOTE: If the engine does not meet all of the requirements listed above, adjust the carburetor as explained in paragraph 44 **a**, or refer to paragraph 43.

43. TROUBLE SHOOTING.

a. Fuel System.

(1) ENGINE WILL NOT START.

Probable Cause	Probable Remedy
Automatic choke on carburetor not "ON."	Depress accelerator ¼ to ½ of full travel and then release fully. Try again to crank engine.
Fuel lines shut off.	Open fuel valves at fuel filter.
Fuel supply exhausted.	Replenish supply.
Fuel tank vent in filler cap clogged.	Clean out.
Carburetor flooded. Usually occurs only after repeated cranking or when one engine starts and the other does not.	Hold accelerator wide open while cranking engines whenever flooded condition is suspected. Do not pump accelerator. If flooding persists, follow instructions given in **b** (1) below.
No fuel to carburetor.	Check fuel pump output as explained in paragraph 44 **b**.
Clogged or dirty fuel pump.	Remove bowl and inspect screen. Clean screen and reinstall. Also follow instructions given in 44 **c**.

Probable Cause	Probable Remedy
Fuel filter leaking or clogged.	Clean, tighten, repair, or replace filter as necessary (par. 44 **d**).
Fuel lines clogged or leaking.	Clean, tighten, repair, or replace fuel lines (par. 44 **f**).
Carburetor choke housing loose and out of adjustment.	Reset choke to indicator mark and tighten housing (par. 44 **a**).
Carburetor out of adjustment.	Check carburetor specifically for cause of trouble as explained in **b** below. Clean, repair, or adjust carburetor (par. 44 **a**).
(2) ENGINE STOPS.	
Check all fuel connections.	(See also **b** of this paragraph.) Repair or replace units as necessary.
(3) ENGINE OPERATES UNEVENLY.	
Carburetor incorrectly adjusted.	Check carburetor for specific cause of trouble as explained in **b** below. Adjust, repair, or replace carburetor (par. 44 **a**).
Carburetor choke sticking.	Readjust and free choke mechanism.
Dirt in carburetor or fuel pump.	Clean, repair, or replace carburetor or fuel pump.
b. Carburetor.	
(1) CARBURETOR FLOODING.	
High fuel pump pressure.	Test fuel pump (par. 44 **b**).
High float level.	Check and adjust (par. 47 **a**).
Float sticking on side of carburetor body.	Repair or replace float.
Loose needle valve seat or defective seat gasket.	Tighten needle valve seat or replace needle valve and seat and/or gasket.
Worn, sticky, or dirty float needle valve.	Clean or replace needle valve and seat.
Worn float lever pin or pin holes in float bracket.	Replace defective part.
Float punctured and filled with gasoline.	Replace float.

FUEL SYSTEM

Probable Cause	Probable Remedy
(2) CARBURETOR LEAKING.	
Leaking gasoline line or defective connections.	Tighten and/or replace line and connections.
Bowl cover warped or bowl gasket defective.	Replace gasket and/or cover (par. 47).
Cracked carburetor casting.	Replace defective part.
Passage plugs on parts not sealing gasoline in carburetor.	Clean, tighten or replace defective parts.
(3) CARBURETOR LEAN ON IDLE.	
Restricted metering hole in low speed jet.	Disassemble carburetor and clean low speed jet.
Oversized air bypass or bleed holes in casting.	Replace defective bypass bleed or casting.
Dirty or plugged economizer hole in casting.	Clean economizer hole.
Restricted or plugged fuel passage from low speed jet to port hole and idle screw.	Clean passage.
Restricted or plugged port hole.	Clean port hole.
Incorrect idling adjustment.	Adjust (par. 44 a).
Air leak at body flange gasket.	Replace gasket or casting if warped.
Burred idle screw.	Replace idle screw.
Throttle lever loose on throttle shaft.	Replace throttle shaft assembly.
Upper end of low speed jet not seating in carburetor casting.	Tighten or replace low speed jet.
(4) CARBURETOR RICH ON IDLE.	
Low speed jet leaking.	Tighten or replace low speed jet.
Worn metering hole in low speed jet.	Replace low speed jet.
Restricted or plugged air bleed or bypass hole in carburetor body.	Clean all passages.
Damaged idling port.	Replace casting.
Carbon around throttle valve seats, causing a rich port opening.	Clean throttle valve seats.
Throttle valve installed incorrectly.	Assemble correctly (par. 47).

Probable Cause	Probable Remedy
(5) CARBURETOR LEAN AT INTERMEDIATE AND HIGH SPEEDS.	
Low fuel pump pressure.	Replace fuel pump.
Restricted or plugged gas line connection to float needle valve seat.	Clean or replace line.
Low float level.	Adjust float level (par. 47).
Restriction between metering rod and high speed jet.	Clean high speed jet.
Incorrect metering rod adjustment.	Adjust metering rods (par. 47).
Restriction in carburetor body from metering rod jet to nozzle.	Clean passages in body.
(6) CARBURETOR RICH AT INTERMEDIATE AND HIGH SPEEDS.	
High float level.	Adjust float level (par. 47).
Metering rod spring disconnected from metering rod.	Assemble spring to metering rod.
Incorrect metering rod adjustment.	Adjust metering rods (par. 47).
Worn metering rods and jets.	Replace assembly.
Bent metering rods.	Replace metering rods.
Dirty or plugged air cleaner.	Clean air cleaner (par. 44 **h**).
Inoperative choke mechanism.	Free up and adjust (par. 44 **a**).
Air bleed in nozzles restricted.	Clean passages.
(7) CARBURETOR LEAN ON ACCELERATION.	
Weak pump plunger spring.	Replace spring.
Worn or cracked pump plunger leather.	Replace plunger assembly.
Throttle pump intake or discharge check valve seats not seating in carburetor body.	Tighten or replace.
Leaking or sticking pump intake or discharge valves.	Clean or replace valves.
Throttle pump passages restricted or plugged.	Clean passages.
Discharge passage plug leaking.	Repair or replace plug.
Incorrect throttle pump adjustment.	Adjust throttle pump (par. 47).
Worn or bent throttle pump linkage. Check throttle pump adjustment.	Check throttle pump adjustment (par. 47) and replace bent linkage.

FUEL SYSTEM

Probable Cause	Probable Remedy
(8) CARBURETOR CHOKE ACTION TOO RICH.	
Choke valve shaft binding.	Straighten or replace choke valve shaft.
Choke piston binding or stuck.	Clean or replace piston.
Choke air strainer gauze covered with dirt, preventing hot air from reaching thermostatic coil.	Clean.
Line from choke heater or exhaust manifold to choke assembly leaking.	Tighten or replace line.
Leaking choke gaskets.	Replace gasket.
Choke valve binding in air horn.	Adjust correctly.
c. Fuel Pump.	
(1) LOW OUTPUT.	
Plugged fuel lines.	Clean or replace lines.
Loose fuel line connections on suction side of pump.	Tighten connections.
Pump cover screws loose.	Tighten.
Pump plugs loose or cracked.	Tighten or replace.
Pump strainer screen clogged.	Clean screen.
Pump bowl gasket leaking.	Replace gasket.
Broken diaphragm.	Replace diaphragm.
Sticking or worn valves.	Clean or replace valves.
Rough or burred valve seats.	Replace casting.

44. FUEL SYSTEM SERVICE IN VEHICLE.

a. Carburetor Adjustment.

(1) FAST IDLING SPEED ADJUSTMENT (fig. 99).

SCREWDRIVER

NOTE: Only the first type carburetors were equipped with a fast idling system. Its adjustment is as follows: Remove bulkhead doors. Check to see that carburetor fast idling adjusting screw is resting against high lobe of fast idling cam. Start engine and note engine speed indicated on tachometer. The speed should be from 625 to 675 revolutions per minute. Adjust engine speed by rotating fast idling adjusting screw.

(2) SLOW IDLING SPEED ADJUSTMENT (fig. 100).

SCREWDRIVER

Run engine until it is thoroughly warm (at least 165 F) so that choke valve is wide open and throttle stop screw (on first type carburetors) is

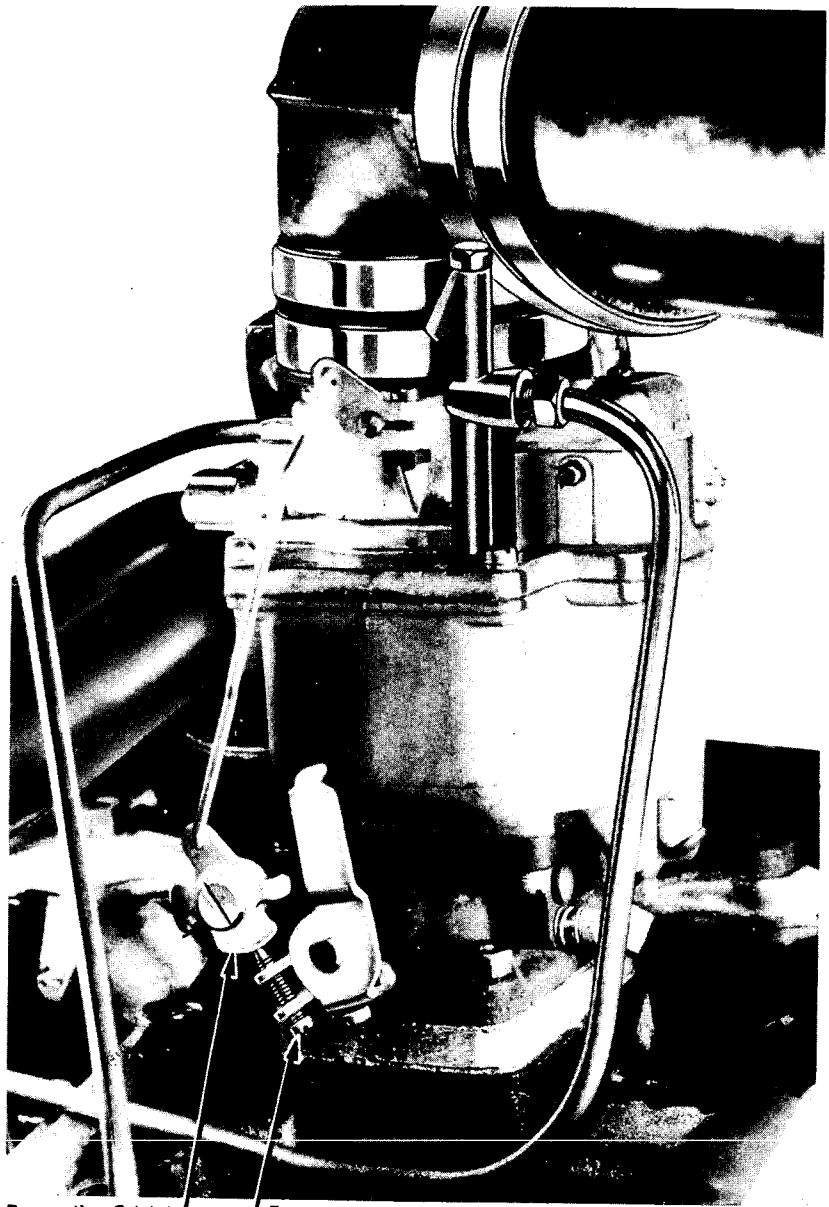


Figure 99 — Carburetor Fast Idling Adjustment

FUEL SYSTEM

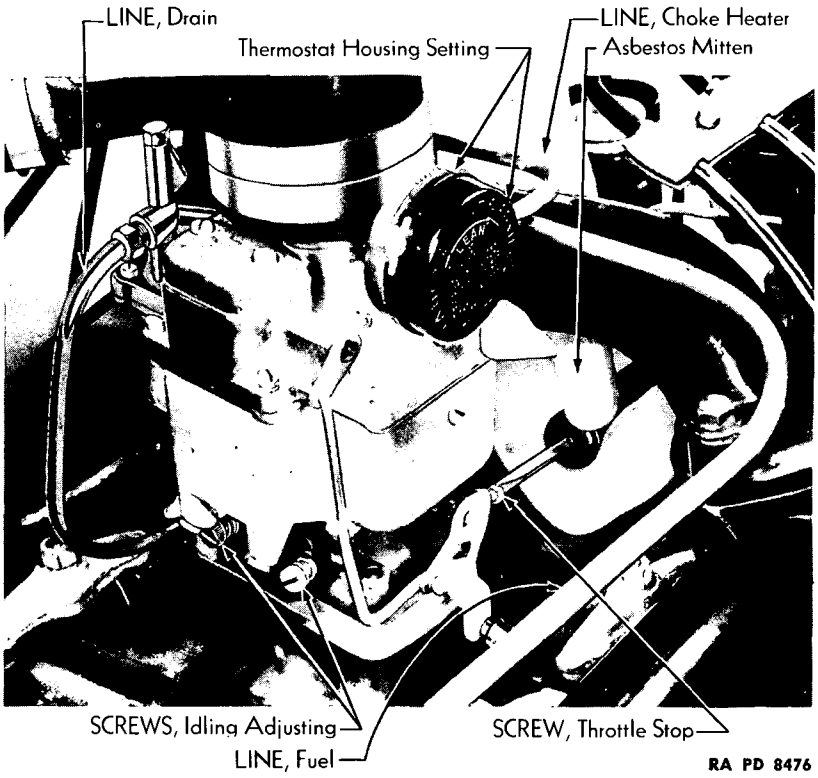


Figure 100 — Carburetor Slow Idling Adjustment

on slow idling cam. Adjust throttle stop screw so that engine speed is from 400 to 425 revolutions per minute as noted on the tachometer, with transmission selector lever in "DR" position and parking brakes set. Stop engine, shut off master switch, and open engine compartment rear doors. Tighten 2 idling mixture adjustment screws as far as possible without forcing, working through engine compartment rear doors. Then loosen screws ¾ to 1¼ turns. Start engine to see that it runs smoothly without loping or stalling. Stop engine and readjust screws if necessary.

(3) AUTOMATIC CHOKE ADJUSTMENT.
SCREWDRIVER

Check to see that choke setting mark on choke thermostat housing (fig. 100) is opposite large mark on carburetor flange, while working through engine compartment rear doors. Adjust automatic choke setting by loosening 3 thermostat housing mounting screws and rotating housing until marks line up. Tighten mounting screws.

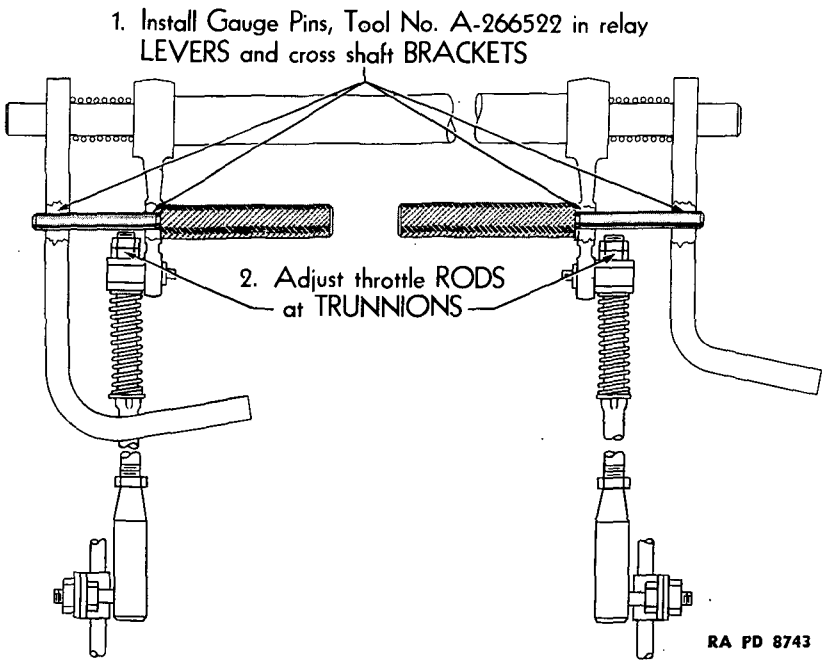


Figure 101 — Upper Rear Relay

(4) SYNCHRONIZATION OF CARBURETORS (figs. 101 and 102).

PIN, gage A266522 (4) WRENCH, open-end, 7/16-in. (2)

After adjusting both carburetors, check synchronization of engine speed at idling speed and 1,000 revolutions per minute. Speed of engines should not vary more than 50 revolutions per minute at idling speed or 100 revolutions per minute at 1,000 revolutions per minute. Equalize speed of engines as follows: Insert gage pin, A266522 (long), through pin hole in left-hand lever and bracket of upper rear relay cross shaft, working through engine compartment rear doors. Then. working through bulkhead door openings, check to see whether gage pins can be inserted through the pinholes in the distributor relay lever and distributor support, first on the right, and then on the left engine. If pin cannot be inserted, readjust the rod (for the affected engine) that extends from the upper rear relay to the carburetor-distributor rod until the gage pin can be inserted. Adjustment is made at the upper rear relay end by loosening the lock nut at the trunnion and turning the adjusting nut. NOTE: Second type rods do not have any lock nut, but adjustment is

FUEL SYSTEM

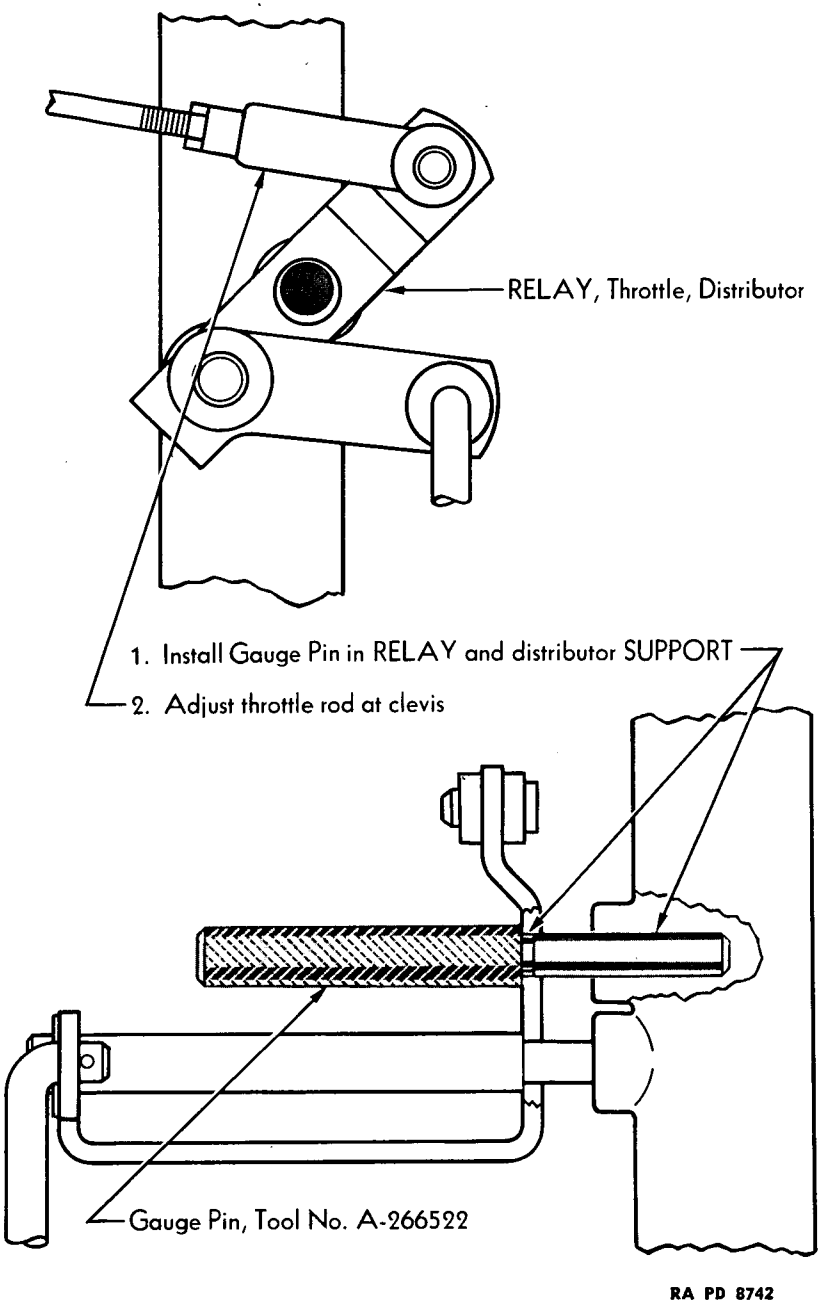


Figure 102 — Distributor Relay

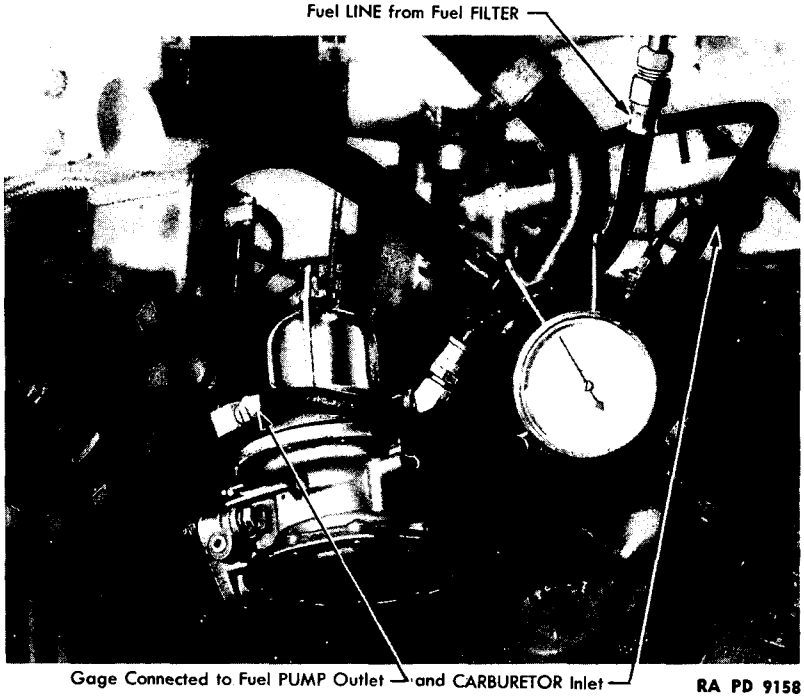


Figure 103 — Testing Fuel Pump

made in same manner. Recheck synchronization of engines and make any slight readjustments as required.

b. Checking Fuel Pump Pressure.

(1) INSTALL PRESSURE GAGE.

WRENCH, $15/16$-in. WRENCH, socket, $3/4$-in.
WRENCH, open-end, $1/2$-in.

Open engine compartment rear doors and remove fan from engine on which fuel pump is being tested (par. 12). Close shut-off valves on engine fuel filter in fighting compartment. Disconnect fuel pump-to-carburetor fuel line at carburetor and at fuel pump, and remove line through engine compartment doors. Construct a flexible gasoline line of approximately the same length as the fuel pump-to-carburetor fuel line with suitable fittings. A 25-pound pressure gage should be connected into the flexible fuel line at a point where the pressure can be read when the line is installed. Connect the flexible fuel line, with

pressure gage attached, to the carburetor and fuel pump, while working through engine compartment doors.

(2) CHECK FUEL PUMP PRESSURE.

Open shut-off valves on fuel filter, start engine, and run at idle speed (approximately 425 revolutions per minute). NOTE: Engine must run at *slow* idling speed on first type carburetors. The fuel pump should build up 3½ to 5 pounds pressure on a *cold* engine running *at slow idling speed* (fig. 103). If pressure is low, it is probably due to leakage through the fuel pump diaphragm or valves, and the fuel pump should be removed and disassembled for repair. Turn off engine and note whether the fuel pump will hold the pressure shown on the gage. A fuel pump which is operating satisfactorily will hold pressure several minutes. If the pressure drops immediately, the fuel pump discharge valve is leaking and the pump should be removed for disassembly and repair.

(3) REMOVE PRESSURE GAGE.

WRENCH, $^{15}/_{16}$-in. WRENCH, socket, ¾-in.
WRENCH, open-end, ½-in.

Close shut-off valves on fuel filter and remove flexible fuel line and pressure gage. Install fuel pump-to-carburetor fuel line at carburetor and fuel pump, while working through engine compartment rear doors. Install fan and close engine compartment rear doors. Open shut-off valves on fuel filter.

c. Fuel Pump Cleaning Procedure.

(1) REMOVE FUEL PUMP BOWL AND STRAINER ASSEMBLY.

PLIERS

Open engine compartment rear doors and remove fan from engine on which fuel pump is to be cleaned (par. 12). Close shut-off valves on fuel filter. Loosen fuel pump bowl bail nut and swing bail to side, while working through engine compartment rear doors. Lift bowl off fuel pump upper cover and remove bowl gasket. Lift strainer assembly off fuel pump upper cover.

(2) CLEAN FUEL PUMP AND REINSTALL STRAINER AND BOWL.

EQUIPMENT, compressed air PLIERS

Clean laminated strainer assembly thoroughly with compressed air by directing the air through the sides of the strainers. Clean bowl with compressed air and SOLVENT, dry-cleaning. Plug fuel pump intake port on upper cover with a cork or rubber plug, or with finger, and direct compressed air in the sediment chamber in the fuel pump upper

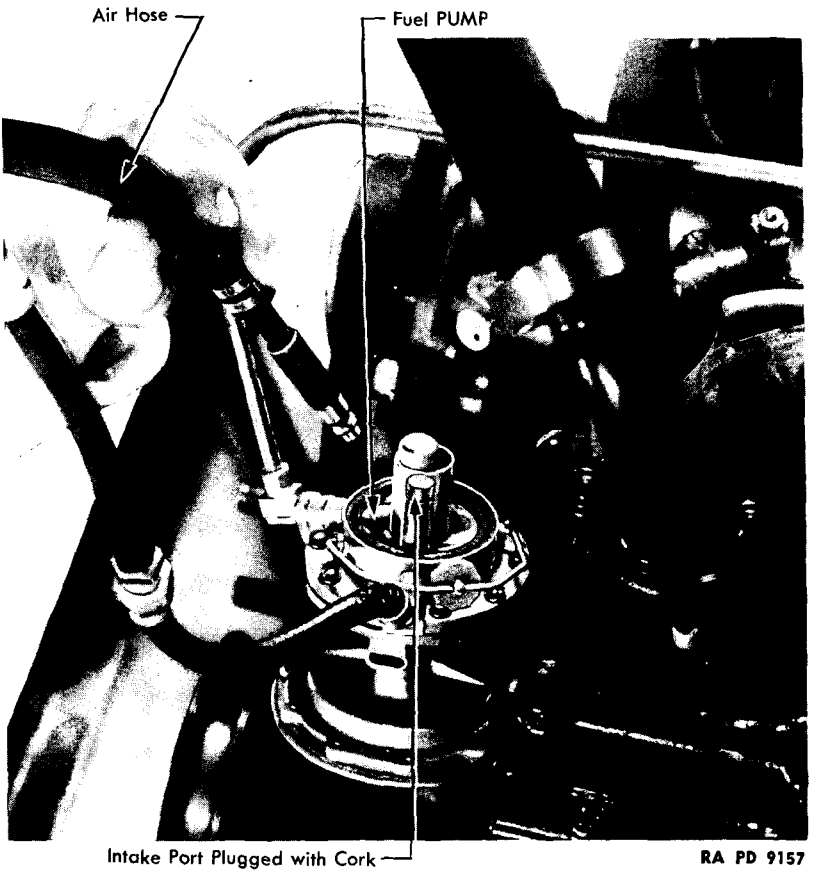


Figure 104 — Cleaning Fuel Pump

cover while working through engine compartment rear doors (fig. 104). *Intake port must be closed to prevent blowing sediment into fuel pump valve.* Install strainer assembly on upper cover. Position a *new* bowl gasket on upper cover. Install fuel pump bowl on upper cover. Swing bail over bowl and tighten bail nut. Install fan and close engine compartment rear doors. Open shut-off valves on fuel filter.

d. Engine Fuel Filter Cleaning Procedure.

WRENCH, open-end, 9/16-in. WRENCH, open-end, 3/4-in.

Close shut-off valves on fuel filter, while working in fighting compartment. Two separate valves are used on first type M5 vehicles; a

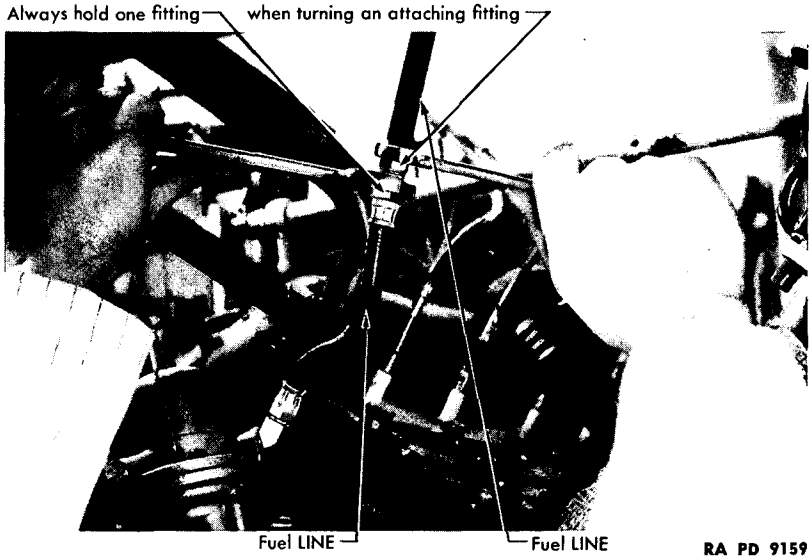


Figure 105 — Tightening Fuel Lines

single valve, which shuts off both inlets when pointed straight up, is used on later M5 and on M8 vehicles. Place a small pan underneath fuel filter to catch fuel as bowl retainer plug is removed. Remove shell drain plug and allow fuel to drain. Remove screw and gasket from center of fuel filter cover and lower screen and shell assembly, remove cover and screen gaskets and remove screen retaining spring from shell stem. Clean strainer and shell assembly thoroughly with SOLVENT, dry-cleaning, and compressed air. Insert strainer retaining spring and strainer on shell stem. Place a new gasket on strainer and cover and position shell assembly on filter cover. Install retaining screw and gasket. Install drain plug in shell stem, then open the shut-off valves.

e. Cleaning Auxiliary Power Plant Fuel Filter (M5 only).
PLIERS

Close inlet shut-off valve for auxiliary power plant fuel filter while working in fighting compartment. Remove left 37-mm shell rack and bulkhead extension cover on second type M5 vehicles. Place a small pan under filter to catch any fuel spilled when bowl is removed. Loosen bowl bail nut and swing bail downward while supporting bowl. Remove bowl and gasket from filter cover. Pull strainer assembly off filter cover. Clean both the bowl and the strainer assembly thoroughly with SOLVENT, dry-cleaning, and compressed air. Position strainer assembly on filter cover. Position a *new* bowl gasket on cover and install bowl on

cover. Swing bowl bail around bowl and tighten bail nut. Open inlet shut-off valve. Install bulkhead extension cover and left 37-mm shell rack on second type M5 vehicles.

f. Cleaning and Tightening Fuel Lines.

(1) The fuel lines, comprising the fuel system, include the following (fig. 83):

(*a*) Left-hand fuel tank line to engine fuel filter.

(*b*) Right-hand fuel tank line to engine fuel filter.

(*c*) Engine fuel filter to left-hand fuel tank connection.

(*d*) Fuel line through left-hand fuel tank.

(*e*) Left-hand fuel tank line to right-hand and left-hand fuel pump flexible fuel lines.

(*f*) Right-hand flexible fuel line to fuel pump.

(*g*) Right-hand fuel pump line to right-hand carburetor.

(*h*) Left-hand flexible fuel line to fuel pump.

(*i*) Left-hand fuel pump line to left-hand carburetor.

(*j*) Left-hand fuel tank line to auxiliary power plant fuel filter (first type M5 only).

(*k*) Left-hand fuel tank line to auxiliary power plant shut-off valve (second type M5 only).

(*l*) Auxiliary power plant fuel shut-off valve to fuel filter line (second type M5 only).

(*m*) Auxiliary power plant fuel filter to flexible fuel line (first type M5 only).

(*n*) Auxiliary power plant flexible fuel line to carburetor (M5 only).

(2) It is not necessary to remove any of the fuel lines from the vehicle in order to clean them, although any fuel line being cleaned should be disconnected at both ends. The tools required to disconnect or to remove the fuel lines are given in paragraph 51. To clean any line, apply compressed air to one end of the line while observing the other end to see that all sediment or dirt is removed. When tightening any fuel line connections, be sure to hold the fitting stationary on the unit to which the line is attached while tightening the fitting on the fuel line (fig. 105).

g. Draining Fuel Tanks (fig. 106).

CONTAINER, fuel	WRENCH, open-end, $\frac{9}{16}$-in.
PAN, drain	WRENCH, socket head set screw, $\frac{9}{16}$-in.

Remove 4 nuts and lock washers holding fuel tank drain plug cover plate to studs on sponson floor. Place a pan underneath the fuel tank

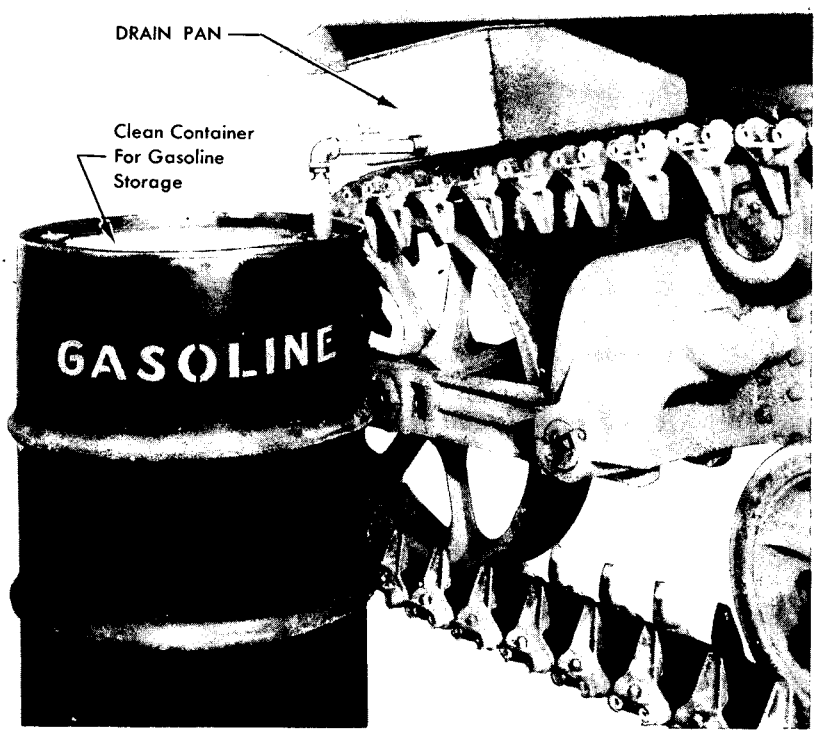


Figure 106 — Draining Fuel Tank

drain plug, resting the pan on the top of the track. Position container under drain outlet. Remove the fuel tank drain plug and allow fuel to drain. Install fuel tank drain plug in fuel tank. Position drain plug cover plate over studs on sponson floor. Install four nuts and lock washers.

h. Cleaning Engine Air Cleaners.

PLIERS
SCREWDRIVER
WRENCH, open-end, $^{11}/_{16}$-in.

Remove screw and flat washer holding air cleaner cover plate to sponson floor. Lower front end of plate, pull it forward out of mounting bracket and remove plate. Loosen reservoir mounting bolt wing nuts while supporting air cleaner reservoir and swing mounting bolts off brackets on reservoir. Lower reservoir through sponson floor and drain

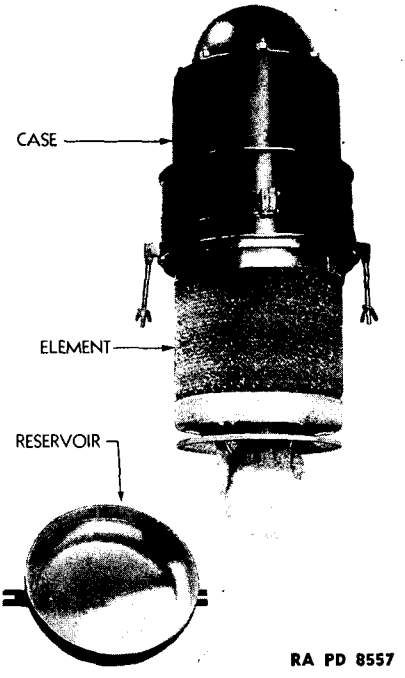


Figure 107 — Engine Air Cleaner

oil from reservoir. Grasp handle on lower end of air cleaner element and pull it downward through sponson floor (fig. 107). Clean reservoir and element thoroughly in SOLVENT, dry-cleaning, taking particular care to wash away all accumulated dirt. Dry the element and reservoir thoroughly with compressed air. Also clean out area between reservoir wall extension and air cleaner case thoroughly. Insert element through hole in floor of sponson and up into air cleaner case. Fill reservoir with approximately 3 pints of engine oil, but make sure that oil level does not exceed that level marked on reservoir. Position reservoir on lower end of air cleaner case. Swing reservoir mounting bolts onto brackets on reservoir and tighten mounting bolt wing nuts. Position air cleaner retainer and air cleaner cover plate on bracket on floor of sponson and place front end of cover plate into position. Install cover plate mounting screw and lock washer.

i. Removal and Cleaning Auxiliary Power Plant Air Cleaner (M5 Only).

SCREWDRIVER

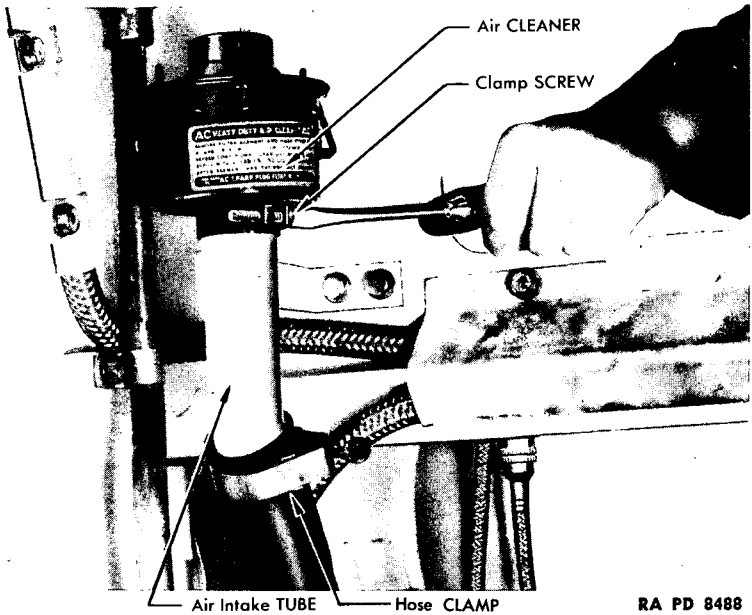


Figure 108 — Removing Air Cleaner for Auxiliary Power Plant

Rotate the release latch handle on left engine compartment bulkhead door 180 degrees while working in fighting compartment. Pull upper end of bulkhead door forward and lift lower end off hinges while working from turret basket. Loosen clamp screw holding auxiliary power plant air cleaner to air cleaner pipe (fig. 108). Lift air cleaner off pipe and remove from vehicle. Unsnap 2 clamps holding air cleaner cover to bowl and remove cover. Remove element from bowl. Wash all air cleaner parts thoroughly in SOLVENT, dry-cleaning, and dry with compressed air. Position element in bowl. Fill air cleaner bowl with engine oil up to oil level marked on bowl. Position cover on bowl and lock in place with 2 spring clamps. Position air cleaner on air cleaner pipes and tighten clamping screw. Position lower end of left-hand bulkhead door on hinges on bulkhead. Move upper end of door to closed position and rotate release handle 180 degrees.

45. ENGINE AIR CLEANER.

a. Equipment.

PLIERS
SCREWDRIVER
WRENCH, open-end, 7/16-in.
WRENCH, open-end, 1/2-in.
WRENCH, open-end, 9/16-in.
WRENCH, open-end, 11/16-in.

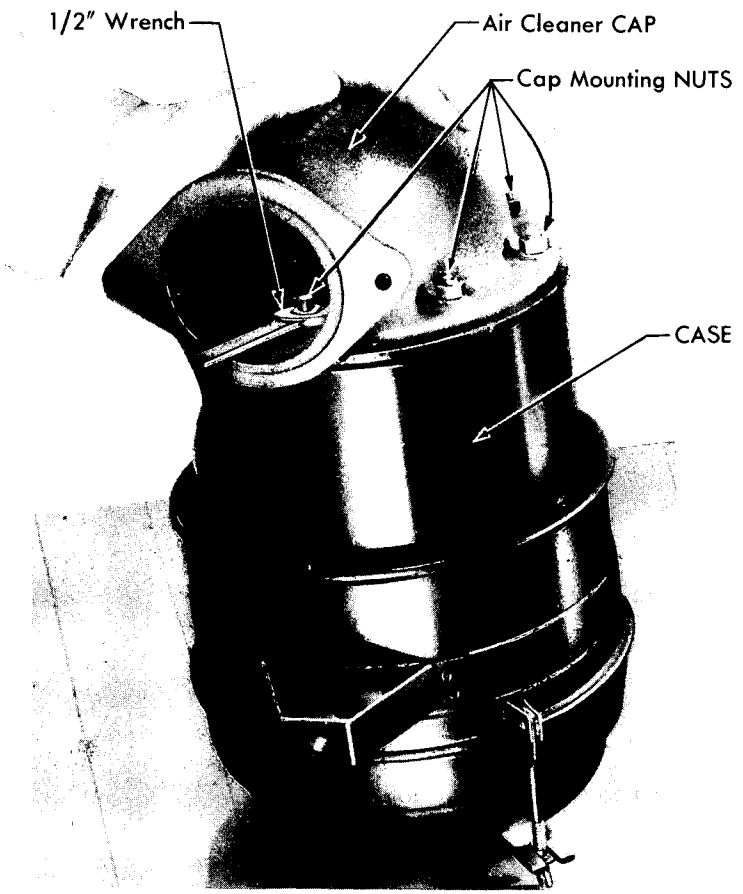


Figure 109 — Removing Air Cleaner Elbow

b. Procedure.

(1) REMOVE ENGINE AIR CLEANER AND TUBES.

WRENCH, open-end, 9/16-in. WRENCH, open-end, 11/16-in.

(*a*) *Remove Air Cleaner.*

Remove screw and flat washer holding air cleaner cover plate to sponson floor. Lower front end of plate, pull it forward out of mounting bracket, and remove plate. Remove engine compartment cover on first type M5 vehicles, or fuel tank cover on second type M5 and all M8 vehicles, as explained in paragraph 52. Remove 3 screws holding air cleaner to inner sponson wall, working from top of vehicle. Remove

FUEL SYSTEM

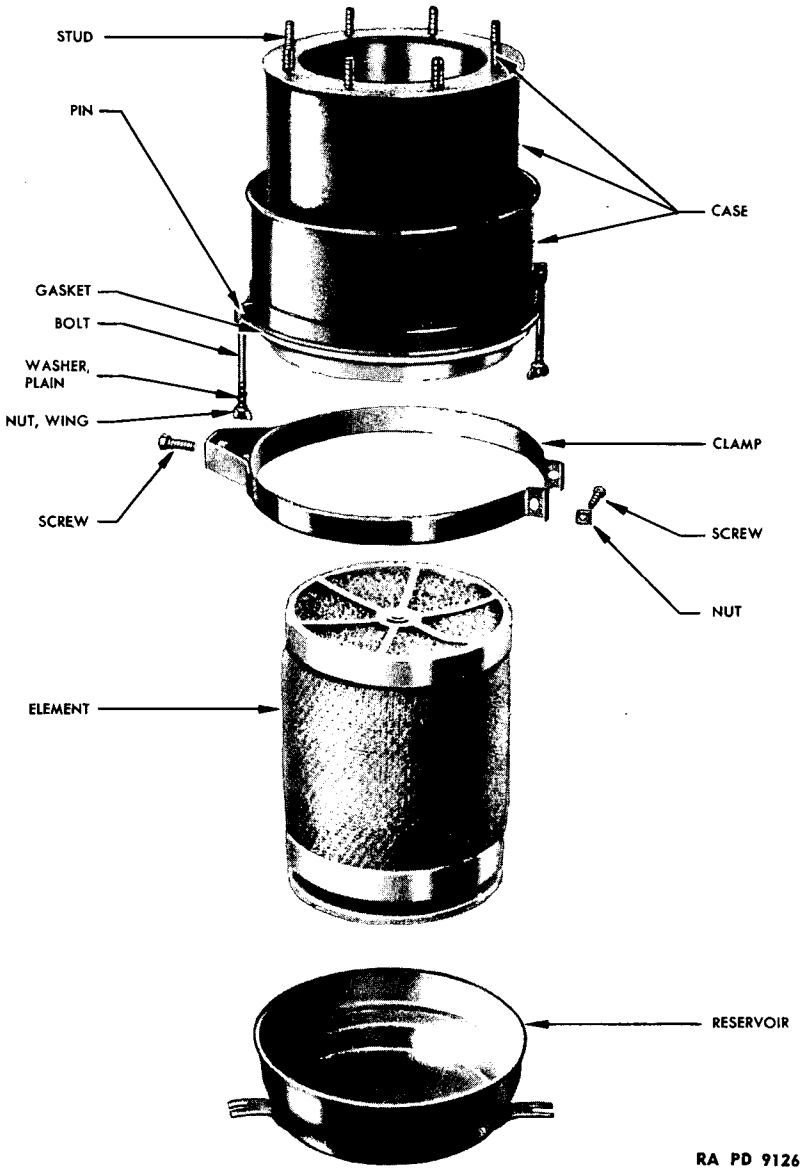


Figure 110 — Air Cleaner — Exploded View

screw holding air cleaner clamp to inner sponson wall. Lower air cleaner through hole in sponson floor.

(*b*) *Remove Air Cleaner Tubes.*

PLIERS
WRENCH, open-end, ½-in.
WRENCH, open-end, 7/16-in.
WRENCH, open-end, 9/16-in.

Remove 3 screws holding engine air cleaner tube elbow to inner sponson wall, working from top of vehicle. On vehicles with second type carburetors, disconnect choke heater line from air tube. Disconnect air tube from carburetor by loosening clamps with pliers. Lower elbow on rear end of pipe through hole in air baffle and remove through engine compartment rear doors.

(2) DISASSEMBLE ENGINE AIR CLEANER (fig. 110).

PLIERS
WRENCH, open-end, ½-in.
SCREWDRIVER

Remove 8 nuts and lock washers holding air cleaner elbow to air cleaner case (fig. 109). NOTE: One nut is located within the throat of the air cleaner elbow. Remove elbow and gasket from case assembly. Loosen both reservoir mounting bolt wing nuts and wing bolts off brackets on reservoir. Remove reservoir assembly from air cleaner case. Pull element assembly out of air cleaner case. Loosen clamp screw holding case bracket to case and pull bracket off top of air cleaner case.

(3) SERVICING AIR CLEANER.

Clean all air cleaner parts as explained in paragraph 44, paying particular attention to the filter element. Inspect the reservoir to see that it is not bent in such a way that it would position the filter element improperly in the cleaner case. Inspect area between air cleaner case and reservoir extension to see that it is clean. Inspect the element carefully to make sure that all dirt or grit is removed from the wire mesh. Check the rubber air cleaner pipes for cracks, swelling or other conditions which might cause air leakage.

(4) ASSEMBLE ENGINE AIR CLEANER.

PLIERS
WRENCH, open-end, ½-in.
SCREWDRIVER

Position air cleaner element assembly in air cleaner case. Install reservoir over end of element and on lower end of case. NOTE: Oil should not be added to the air cleaner reservoir until the cleaner is installed in the vehicle, to eliminate the possibility of oil leakage. Swing reservoir mounting bolts over brackets on reservoir and tighten wing nuts. Position a new air cleaner elbow gasket on air cleaner case and install air cleaner elbow over studs on case. Install 8 nuts and lock washers holding elbow to studs on case.

FUEL SYSTEM

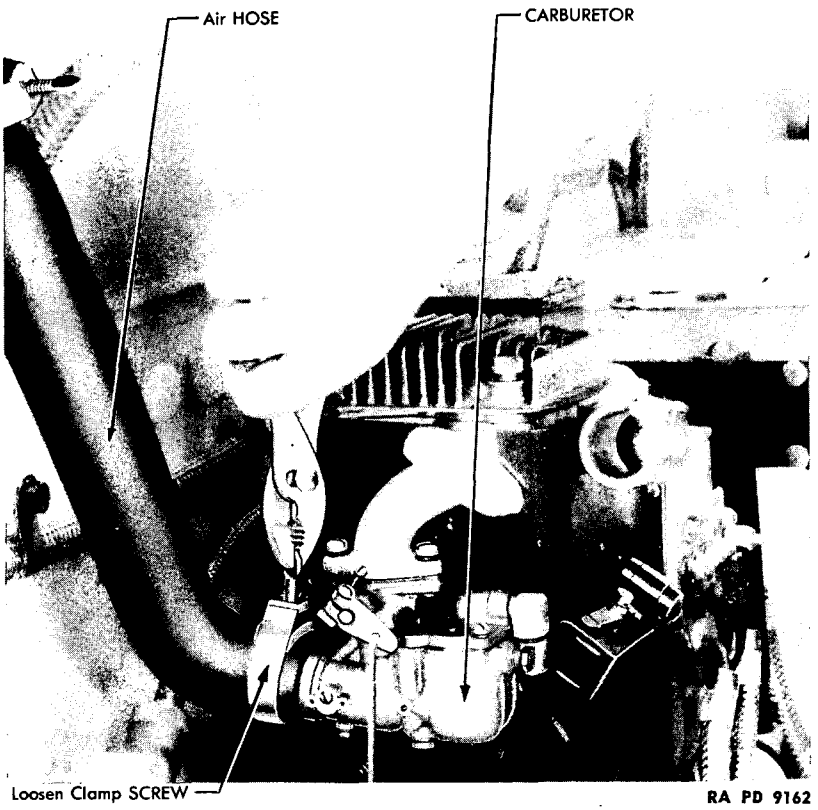


Figure 111 — Removing Air Cleaner Tube from Auxiliary Power Plant Carburetor

(5) INSTALL ENGINE AIR CLEANER AND TUBES.

PLIERS
WRENCH, open-end, 7/16-in.
WRENCH, open-end, 1/2-in.
WRENCH, open-end, 9/16-in.
WRENCH, open-end, 11/16-in.

Insert air cleaner assembly through hole in rear of sponson floor and position air cleaner in place on inner sponson wall. Install 3 screws and lock washers holding air cleaner elbow to inner sponson wall, while working through top of vehicle. Install screw and lock washer holding air cleaner bracket to inner sponson wall. Fill air cleaner with oil and install cover plate in sponson floor as explained in paragraph 44 **h**. Position air cleaner tube assembly on carburetor at front end and on engine compartment left-hand sidewall at rear end, while working through engine compartment rear doors. Install 3 screws and lock washers holding engine air cleaner tube elbow to engine compartment sidewall,

while working from top of vehicle. Install engine compartment cover on first type M5 vehicles or install fuel tank cover on second type M5 and all M8 vehicles, as explained in paragraph 52.

46. AUXILIARY POWER PLANT AIR CLEANER.

a. Equipment.

PLIERS	WRENCH, open-end, ½-in.
SCREWDRIVER	WRENCH, open-end, 9/16-in.

b. Procedure.

(1) REMOVE AUXILIARY POWER PLANT AIR CLEANER AND PIPE (M5 ONLY).

(*a*) *Remove Air Cleaner.*

SCREWDRIVER

Release latch holding left-hand bulkhead door closed, working in fighting compartment. Lift bulkhead door off hinges at top of door and remove door. Loosen clamp screw holding auxiliary power plant air cleaner to pipe, working through bulkhead doors. Pull air cleaner off end of pipe.

(*b*) *Remove Air Cleaner Pipes.*

PLIERS	WRENCH, open-end, ½-in.
SCREWDRIVER	WRENCH, open-end, 9/16-in.

Remove 4 screw and lock washers holding left-hand bulkhead extension cover to bulkhead extension and bulkhead, working in fighting compartment. Pry cover upward at front end and remove cover. Loosen clamp screw holding air tube to carburetor on auxiliary power plant (fig. 111). Push tube off carburetor. Remove 2 screws and lock washers holding air tube bracket to bulkhead, working through bulkhead door. Pull air cleaner tube assembly upward and rearward over engine, and then remove it through bulkhead door.

(2) DISASSEMBLE AUXILIARY POWER PLANT AIR CLEANER.

Unsnap both air cleaner cover spring clips from cover. Remove cover. Lift element assembly out of air cleaner case.

(3) ASSEMBLY AUXILIARY POWER PLANT AIR CLEANER.

Position air cleaner element assembly in cleaner case. Install air cleaner cover on case and lock it in place with spring clips. NOTE: Oil should not be added to the auxiliary power plant air cleaner case until the cleaner assembly is installed in the vehicle to eliminate the possibility of oil leakage.

(4) INSTALL AUXILIARY POWER PLANT AIR CLEANER AND TUBES.

PLIERS	WRENCH, open-end, ½-in.
SCREWDRIVER	WRENCH, open-end, 9/16-in.

FUEL SYSTEM

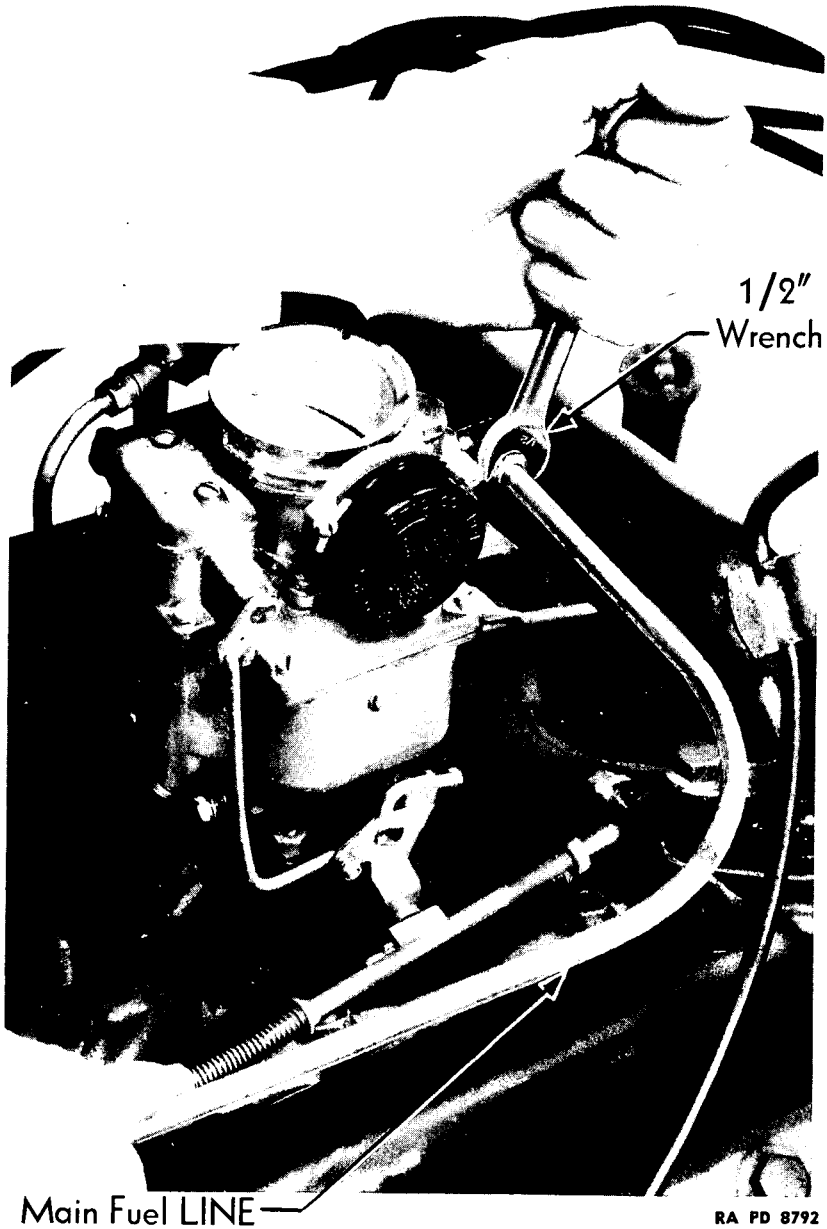


Figure 112 — Removing Fuel Line

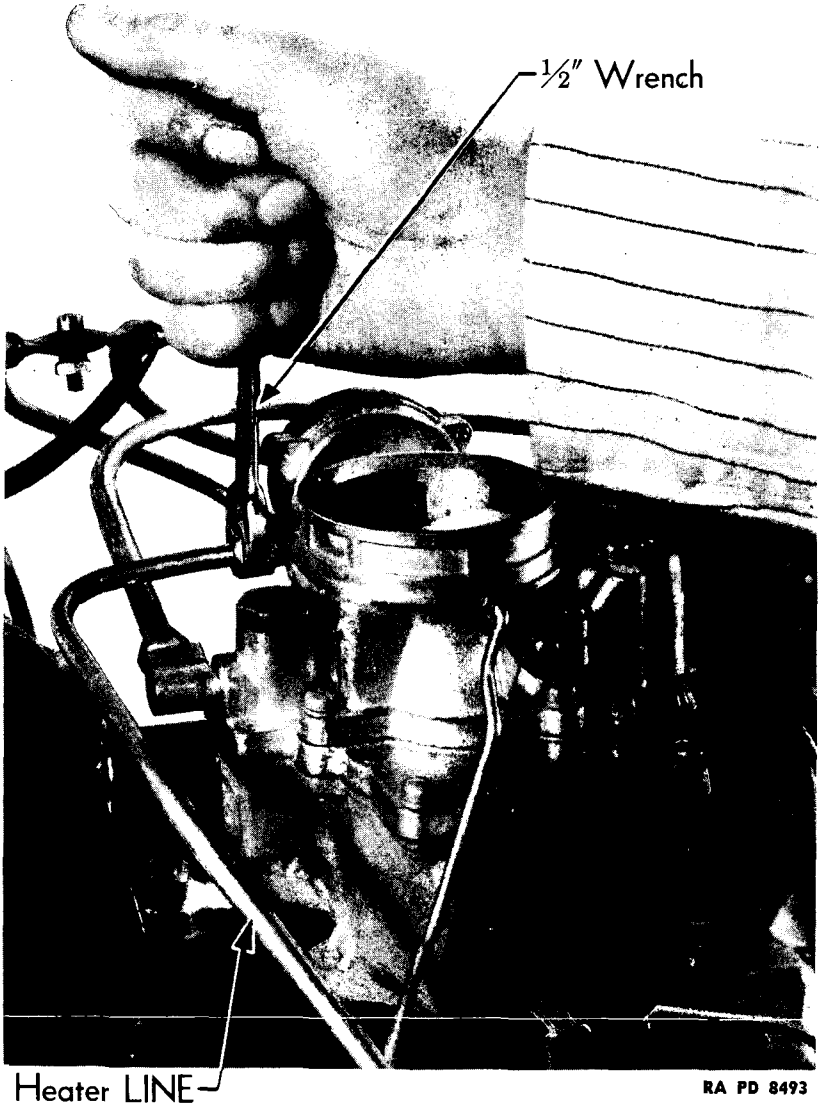


Figure 113 — Removing Heater Line

FUEL SYSTEM

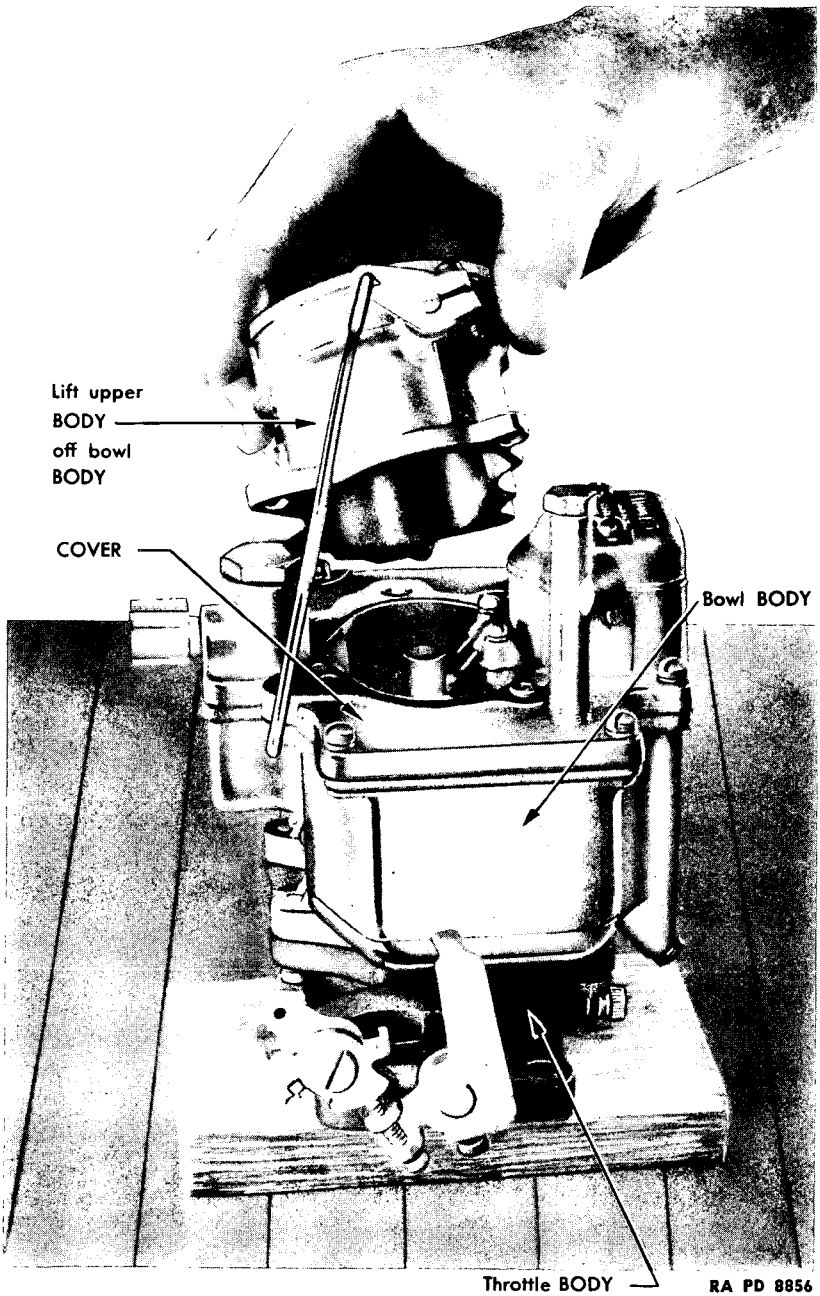


Figure 114 — Removing Carburetor Upper Body

Position auxiliary power plant air cleaner tube in place on rear side of bulkhead while working through bulkhead doors. Install 2 screws and lock washers which hold air tube bracket to bulkhead. Connect carburetor end of air tube to carburetor and tighten clamp screw, while working in fighting compartment. Position auxiliary power plant air cleaner on tube and tighten clamp screw, while working through bulkhead doors. Add oil to reservoir of cleaner. Install bulkhead doors, ammunition rack and bulkhead cover.

47. CARBURETOR.

a. Equipment.

PLIERS	WRENCH, jet, $1\frac{1}{32}$-in., A293002
PLIERS, long nose	WRENCH, jet, low speed, A293003
REMOVER, ball retaining ring, A293008	WRENCH, open-end, $\frac{7}{16}$-in.
WIRE, $\frac{1}{8}$-in. diam x 2-in. long	WRENCH, open-end, $\frac{1}{2}$-in.
WRENCH, jet, $\frac{1}{4}$-in, A293001	WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, jet, $\frac{3}{16}$-in, A293014	WRENCH, open-end, $\frac{5}{8}$-in.
	WRENCH, open-end, $\frac{3}{4}$-in.

b. Procedure.

(1) REMOVE CARBURETOR.

PLIERS	WRENCH, open-end, $\frac{1}{2}$-in.
WRENCH, open-end, $\frac{7}{16}$-in.	WRENCH, open-end, $\frac{5}{8}$-in.

Open engine compartment rear doors and remove fan, belt and support (par. 12). Disconnect choke heater air intake pipe from main air intake pipe elbow. Disconnect carburetor air intake pipe at carburetor by loosening clamps, working through engine compartment rear doors. Disconnect fuel, heater and drain lines (drain line on first type M5 only) from carburetor (figs. 112 and 113). Remove cotter pin from trunnion on carburetor end of throttle rod, and remove washer from trunnion. Disconnect throttle rod and trunnion from carburetor and remove rod. Remove 4 nuts holding carburetor to intake manifold mounting studs and remove carburetor insulator and gaskets.

(2) DISASSEMBLE CARBURETOR.

(*a*) *Remove Upper Body and Climatic Control Assembly (Upper Body).*

PLIERS, long nose	WRENCH, jet, $\frac{1}{4}$-in., A293001

FUEL SYSTEM

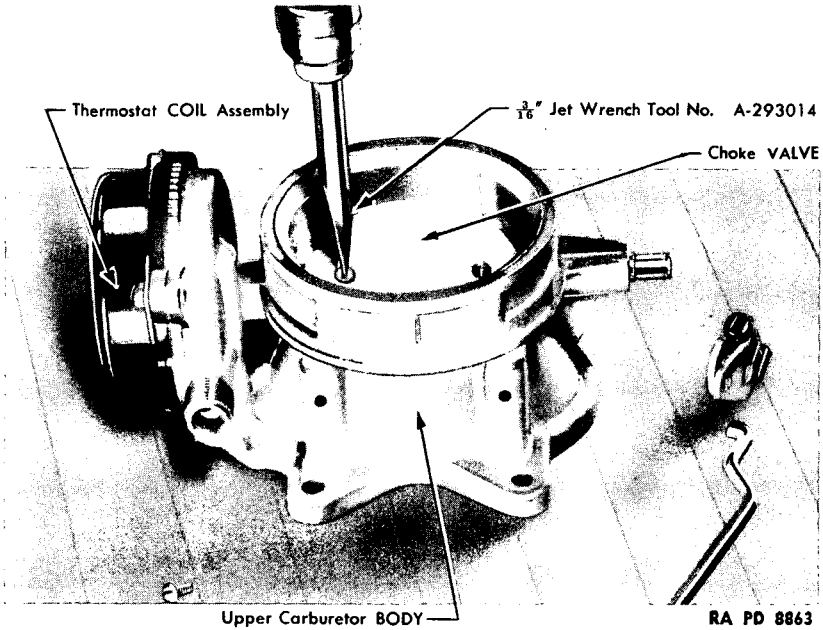


Figure 115 — Removing Choke Valve

Remove retaining spring from fast idling connector rod on first type carburetors and slide connector rod out of cam trip lever. Remove 4 screws and lock washers holding upper body and climatic control assembly (upper body) on bowl cover. Remove upper body and climatic control assembly from carburetor with all parts attached (fig. 114).

(*b*) *Disassemble Air Horn and Climatic Control Assembly* (*Upper Carburetor Body*).

PLIERS
WRENCH, jet, ¼-in., A293001
WRENCH, jet, 3/16-in., A293014

Loosen screw and nut on choke valve lever and screw assembly, and remove assembly from choke shaft. Remove fast idling connector rod on first type carburetor from choke lever by turning it 90 degrees until it slips out freely. Remove 2 screws holding choke valve on choke shaft and lift choke valve out of body (fig. 115). Remove 3 screws and retaining washers holding choke housing to body housing, and remove housing with thermostat coil and housing gasket. Remove choke housing baffle plate. Turn choke piston lever till piston pin shows above edge of cylinder. Invert assembly and shake piston pin out into hand. Remove choke piston by pulling it downward and out of cylinder. Remove choke piston lever, link, and shaft assembly (fig. 116).

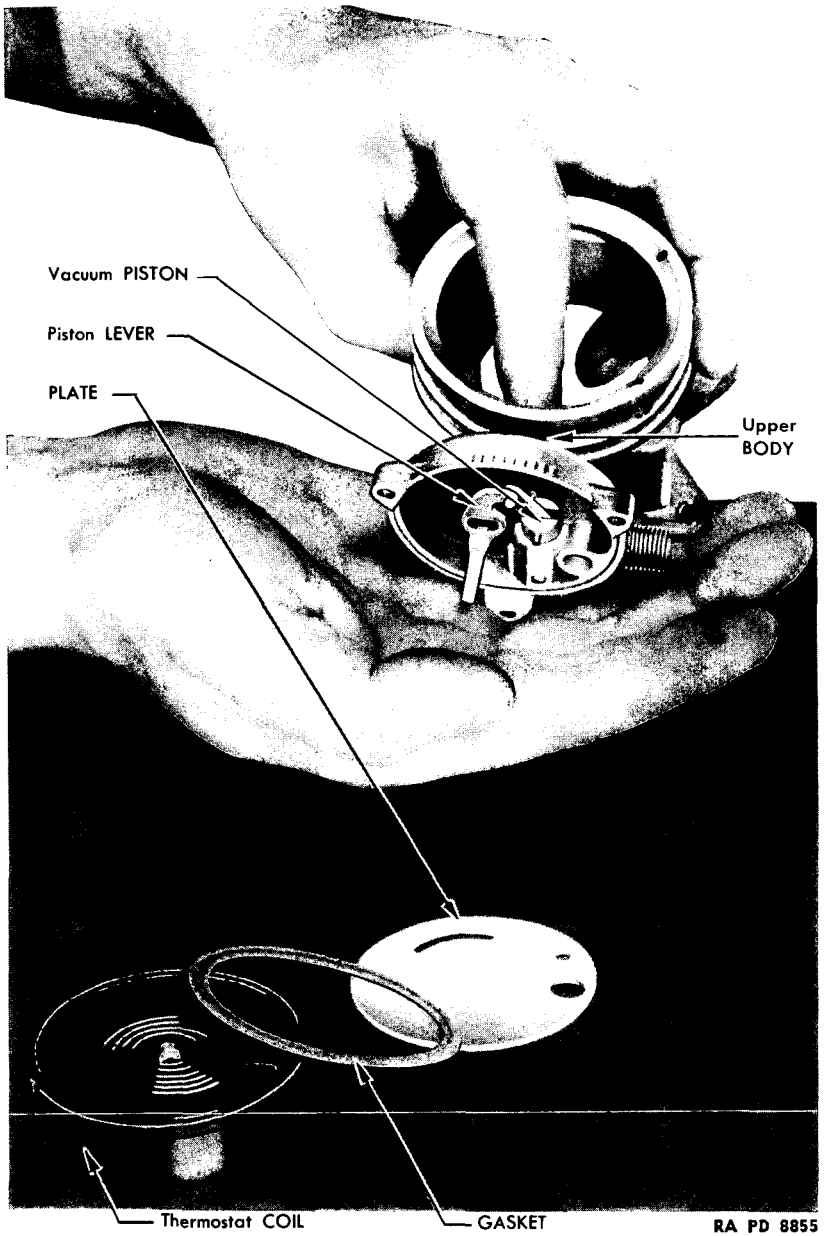


Figure 116 — Removing Choke Piston

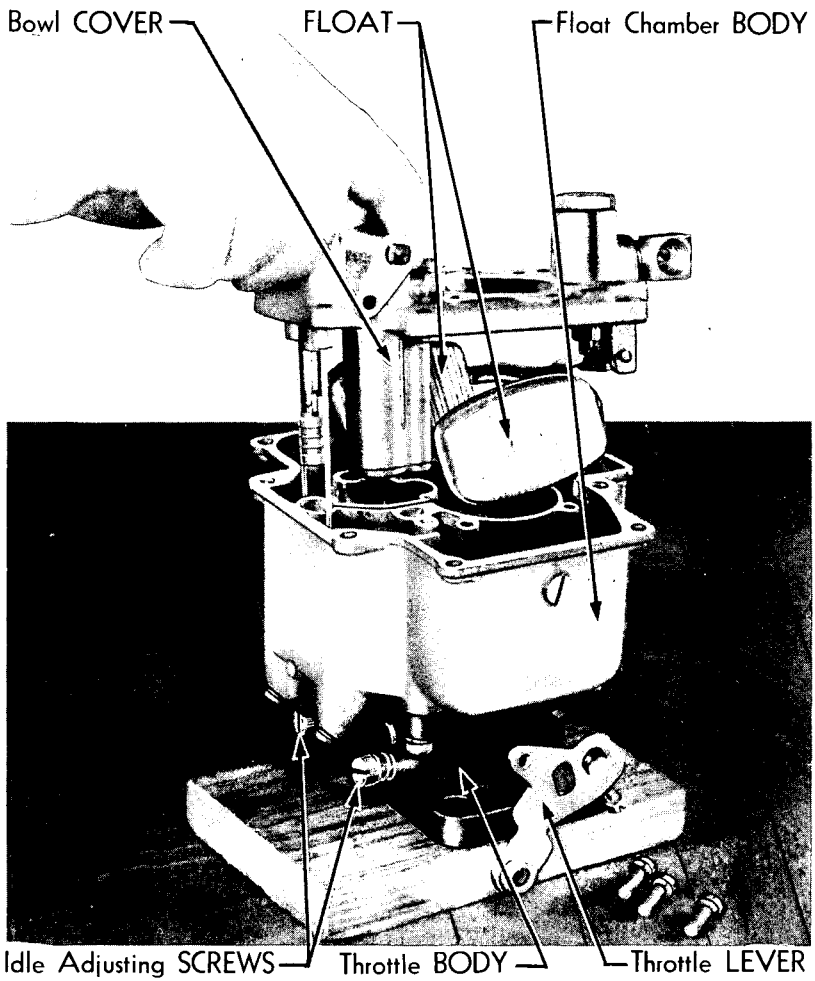


Figure 117 — Removing Bowl Cover

(c) *Remove Bowl Cover Assembly.*

WRENCH, jet, ¼-in., A293001

Pry retaining spring off throttle connector rod at throttle pump end. Slide throttle connector rod out of pump operating lever. Remove spring retainer and connector spring from throttle connector rod by turning spring retainer 90 degrees and slipping it off end of rod. Remove throttle connector rod and washer from throttle lever. Remove 6 screws and lock washers holding bowl cover on float chamber body and remove bowl cover with all parts attached (fig. 117).

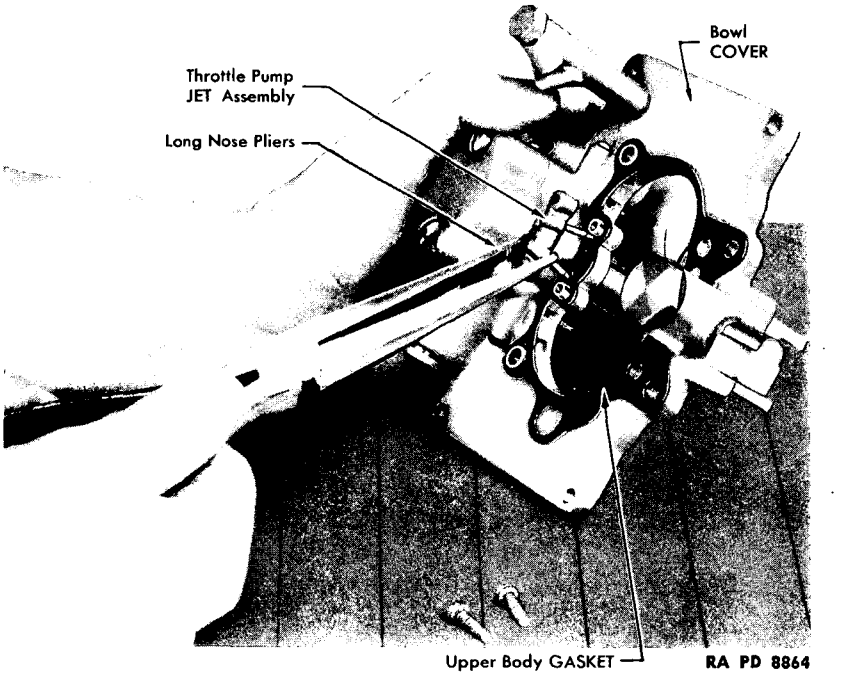


Figure 118 — Removing Pump Jets

(*d*) *Remove Vacuum Piston and Float and Lever Assembly.*

WIRE, 1/8-in. diam x 2-in. long

Invert carburetor float chamber body and shake out vacuumeter piston spring. Turn vacuum piston 90 degrees and slip retaining pin out of hole in vacuumeter piston link. Remove float lever pin. Remove float and lever assembly and remove bowl cover gasket. Invert bowl cover and remove needle valve from seat assembly.

(*e*) *Remove Jet Assembly, Throttle Pump Cover and Operating Arm and Lever Assembly.*

PLIERS, long nose
WRENCH, jet, 5/16-in., A293014
WRENCH, jet, 1/4-in., A293001
WRENCH, open-end, 7/16-in.

Remove 2 screws and lock washers holding pump jet cluster to bowl cover. Lift off pump jet cluster and remove gasket (fig. 118). Remove vent and drain stack from bowl cover on first type carburetors. Remove 2 screws and washers holding dust cover on bowl cover, and remove dust cover. Remove dust cover gasket on second type carburetors.

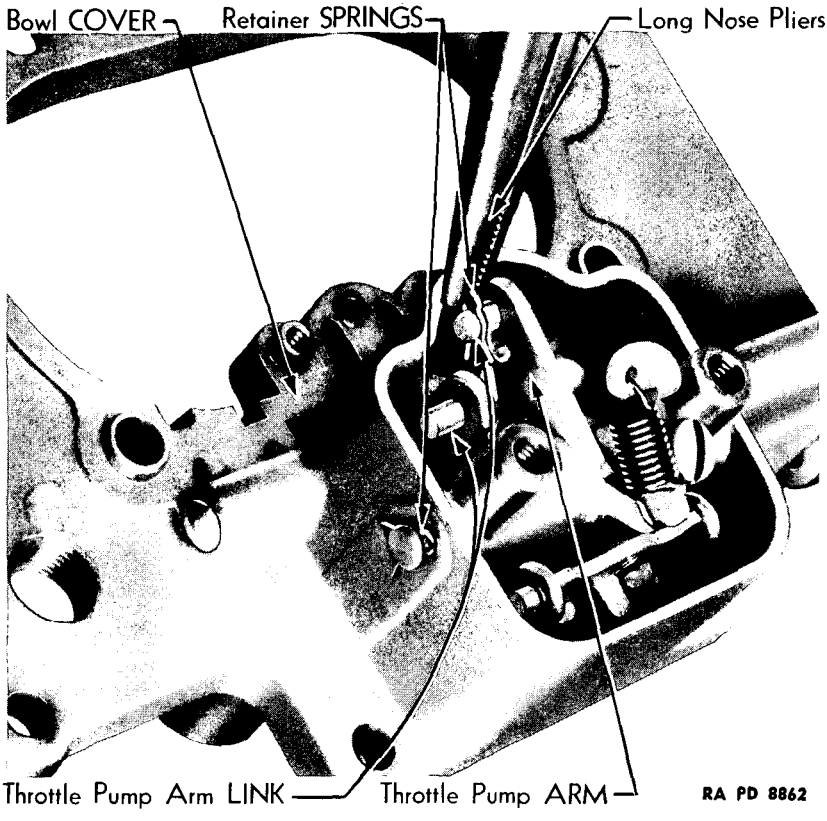


Figure 119 — Removing Retaining Pin

Remove retaining spring holding link to throttle pump arm (fig. 119). Remove throttle pump arm link. Pry countershaft retaining pin off shaft. Loosen metering rod arm set screw. Slide pump operating lever and countershaft assembly out of bowl cover. Remove pump arm and collar assembly from cover (fig. 120). Remove throttle pump lever spring by sliding end of spring off projection on pump lever and separate arm from collar.

(*f*) *Remove Metering Rods.*

Invert bowl cover while holding metering rod arm and lower the metering rod assembly from cover (fig. 121). CAUTION: Make sure metering rod disks come off with rods. Remove metering rod disks from rods. Remove spring holding metering rods on metering rod arm. Remove metering rods from arm.

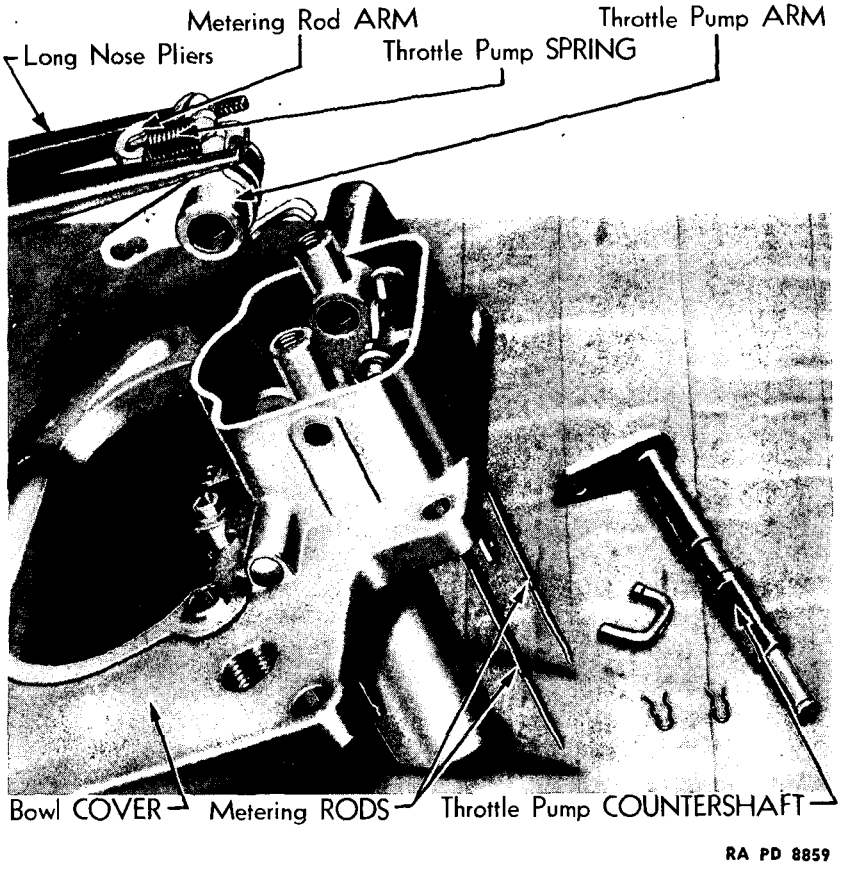


Figure 120 — Removing Pump Arm and Collar

(*g*) *Remove Throttle Pump Assembly.*

PLIERS, long nose	WRENCH, jet, $\frac{3}{16}$-in., A293014
REMOVER, ball retaining ring, A293008	WRENCH, jet, $\frac{1}{4}$-in., A293001
	WRENCH, jet, $\frac{11}{32}$-in., A293002

Remove pump intake, check plug and check plug gasket. Remove pump discharge check plug. Invert bowl cover and remove pump check needle valve. Remove pump strainer screen, being careful not to damage mesh of screen. Remove screw holding throttle pump plunger guide in seat. Remove throttle pump plunger guide, pump plunger, and shaft assembly from cover (fig. 122). Remove throttle pump spring. Pry intake ball check retainer loose in pump cylinder. Invert cover and remove pump intake check ball retaining ring and ball.

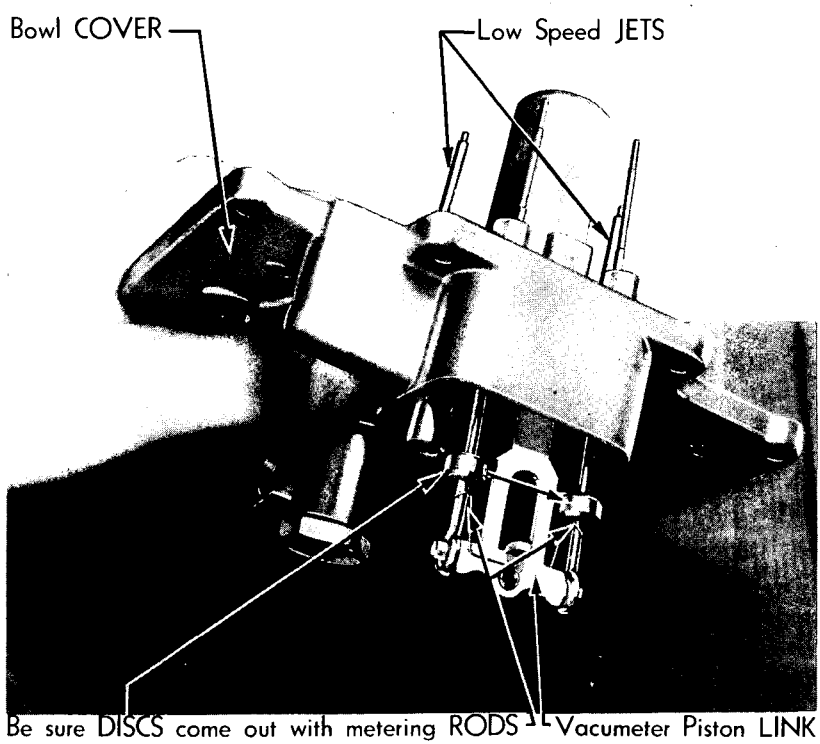


Figure 121 — Removing Metering Rods

(*h*) *Remove Jets, Strainer and Needle Valve Assembly.*

WRENCH, jet, $1\frac{1}{32}$-in., A293002
WRENCH, jet, low speed, A293003
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{3}{4}$-in.

Remove 2 low speed jet assemblies (fig. 123). Remove strainer mounting nut and gasket, and lift out bowl cover strainer. Remove needle valve seat and gasket assembly which is directly below bowl cover strainer. Remove gas line elbow.

(*i*) *Remove and Disassemble Throttle Body Assembly.*

WRENCH, jet, $\frac{3}{16}$-in., A293014
WRENCH, jet, $\frac{1}{4}$-in., A293001
WRENCH, jet, $1\frac{1}{32}$-in., A293002

Remove 4 screws and lock washers holding throttle body assembly on float chamber body. Remove throttle body and body flange gasket. Loosen fast idling arm clamp screw, and remove fast idling arm and screw assembly by sliding assembly off throttle shaft on first type

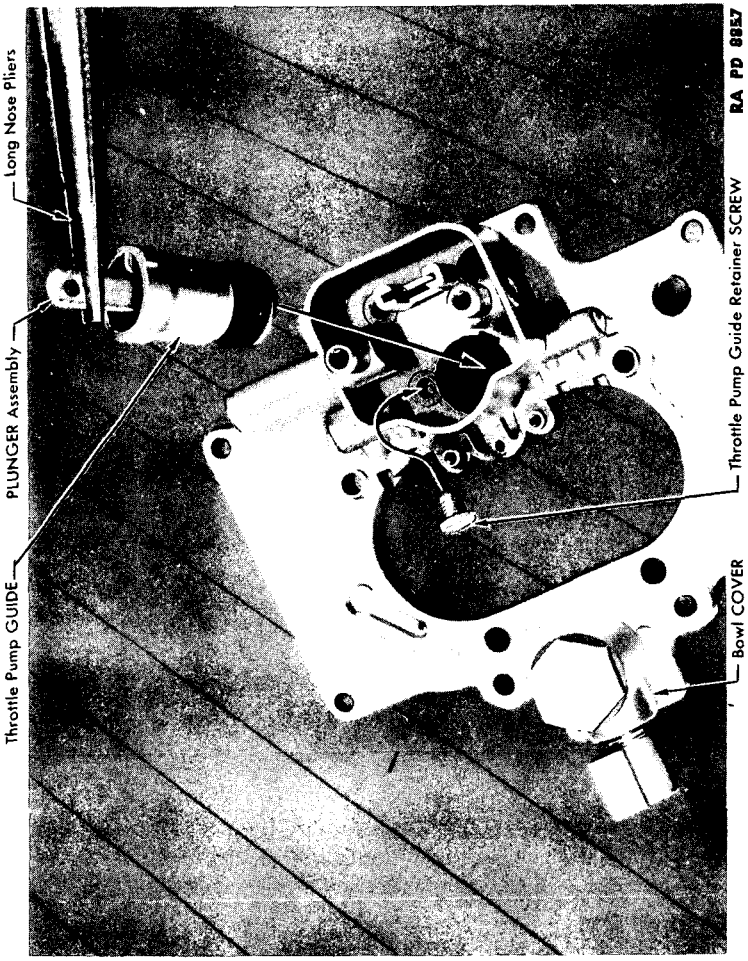


Figure 122 — Removing Pump Plunger

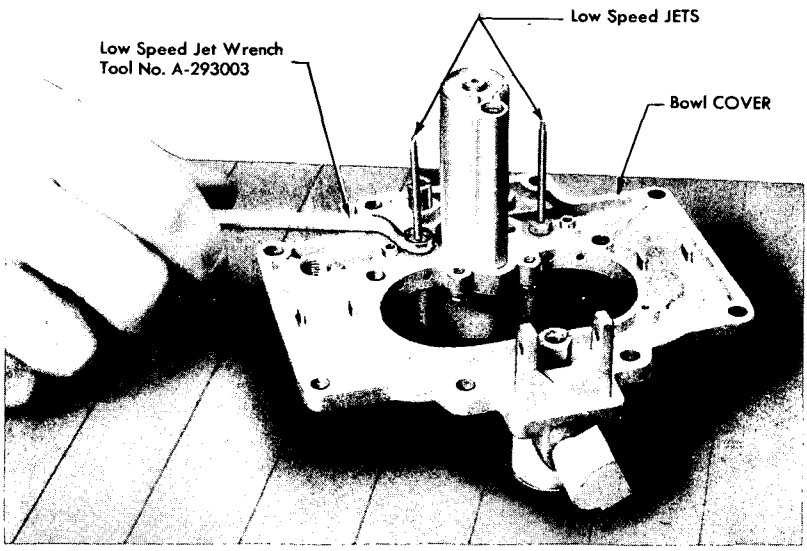


Figure 123 — Removing Low Speed Jets

carburetors. Remove 4 throttle valve mounting screws and remove 2 throttle valves from body (fig. 124). Remove throttle centering screw and slide throttle shaft and lever assembly from body flange. Remove screw holding fast idling cam assembly and cam trip lever to body. Remove 2 idling adjustment screws and lock springs. Pry out 2 idling port rivet plugs.

(*j*) *Disassemble Carburetor Float Chamber Body.*

WRENCH, jet, $^{11}/_{32}$-in., A293002

Remove 2 metering rod jet and gasket assemblies. Do not, under any circumstances, attempt to remove high speed nozzles from float chamber body casting.

(3) INSPECTION AND REPAIR OF CARBURETOR.

CLOTH, clean
GAGES, feeler
PAN
SOLVENT, dry-cleaning

(*a*) *Clean Carburetor Parts.*

Wash all carburetor parts thoroughly in SOLVENT, dry-cleaning, and dry with compressed air if available. CAUTION: Do *not* wash climatic control coil and housing assemblies in SOLVENT, dry-cleaning. These parts should be blown off with compressed air only. Clean and blow out all passages in carburetor body and housings, using compressed air. Remove any carbon or gum accumulation which may have collected on carburetor parts.

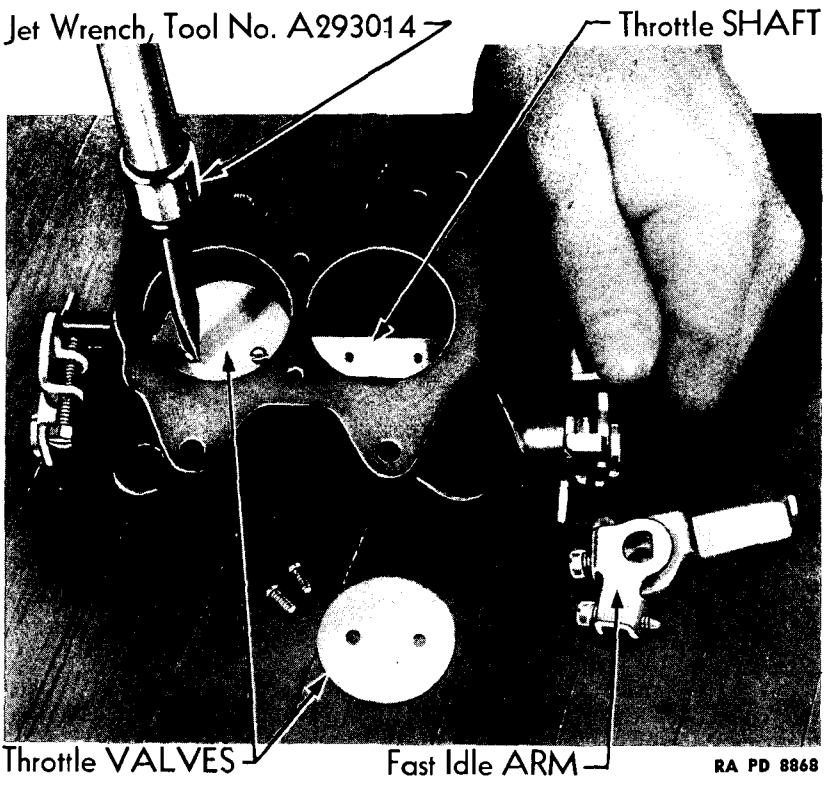


Figure 124 — Removing Throttle Valves

(*b*) *Inspect Carburetor Castings.*

Inspect carburetor upper body, bowl cover, carburetor bowl body and carburetor throttle body assembly thoroughly for cracks, nicks, burs, or other evidence of damage. Lay the flat machined surfaces of each of the above parts on a surface plate in turn and check for warpage, using a 0.005-inch feeler gage. If any part is warped more than 0.005-inch, it should be replaced (fig. 126). NOTE: This step is important both for performance and economy.

(*c*) *Inspect Shafts and Rods.*

Insert carburetor throttle valve shaft in throttle body and check for fit of shaft. If fit is excessively loose, carburetor throttle body should be replaced. Insert throttle pump and metering rod countershaft in bore in bowl cover, and check for fit of shaft in cover. If fit is excessively loose, bowl cover should be replaced. Insert choke valve shaft in upper body,

and check for fit of shaft in housing. If fit is excessively loose, body should be replaced. Inspect metering rods for bends. If rods are bent, they should be replaced, *not straightened.* Inspect throttle pump piston leather for wear or cracks and replace, if necessary.

(*d*) *Inspect Float and Bowl Cover.*

Shake carburetor float assembly, checking for noises which would indicate the presence of gasoline inside float. Leaky floats should be replaced. Insert automatic choke piston in upper body and check for a sticking condition. Remove any small burs which might cause sticking, using a fine piece of CLOTH, crocus. Insert vacuumatic piston in bowl cover and check for a sticking condition. Eliminate sticking condition as described in step (*d*) of this paragraph.

(4) ASSEMBLY OF CARBURETOR.

(*a*) *Assemble Carburetor Float Chamber Body.*

SCREW, holder, A293010

Install 2 metering rod jets and new gasket assemblies (fig. 127). NOTE: Jets must be installed snugly, but not so tight as to cause distortion.

(*b*) *Assemble Carburetor Throttle Body Assembly.*

HAMMER, light
HOLDER, screw, A293010
WRENCH, jet, 3/16-in., A293014
WRENCH, jet, 1/4-in., A293001
WRENCH, jet, 11/32-in., A293002

Tap 2 idling port rivet plugs in throttle body assembly. Install 2 idling adjustment screws and lock springs. Turn screws all of the way in by hand and back off 1½ turns. Assemble cam trip lever and fast idling cam assembly, installing fast idling attaching screw first through cam assembly and then through trip lever (first type only). Install trip lever and fast idling cam assembly on body flange assembly (first type only) (fig. 128). Slide throttle shaft and lever in flange assembly from left-hand side and install throttle centering screw (fig. 128). Install both throttle valves on throttle shaft and install 4 valve mounting screws loosely. NOTE: Each throttle valve has a letter "C" stamped on one side near the outer edge. The valves should be installed so that the "C" is toward the bottom of the throttle body assembly and toward the idling mixture adjusting screws (fig. 130). Back off throttle stop screw so throttle valves will close completely in throttle barrels. Open and close throttle valves several times to centralize valves on throttle shaft. Then, while holding valves closed, tighten screws. On first type carburetors, install fast idling arm and screw assembly on end of throttle shaft and tighten clamping screw.

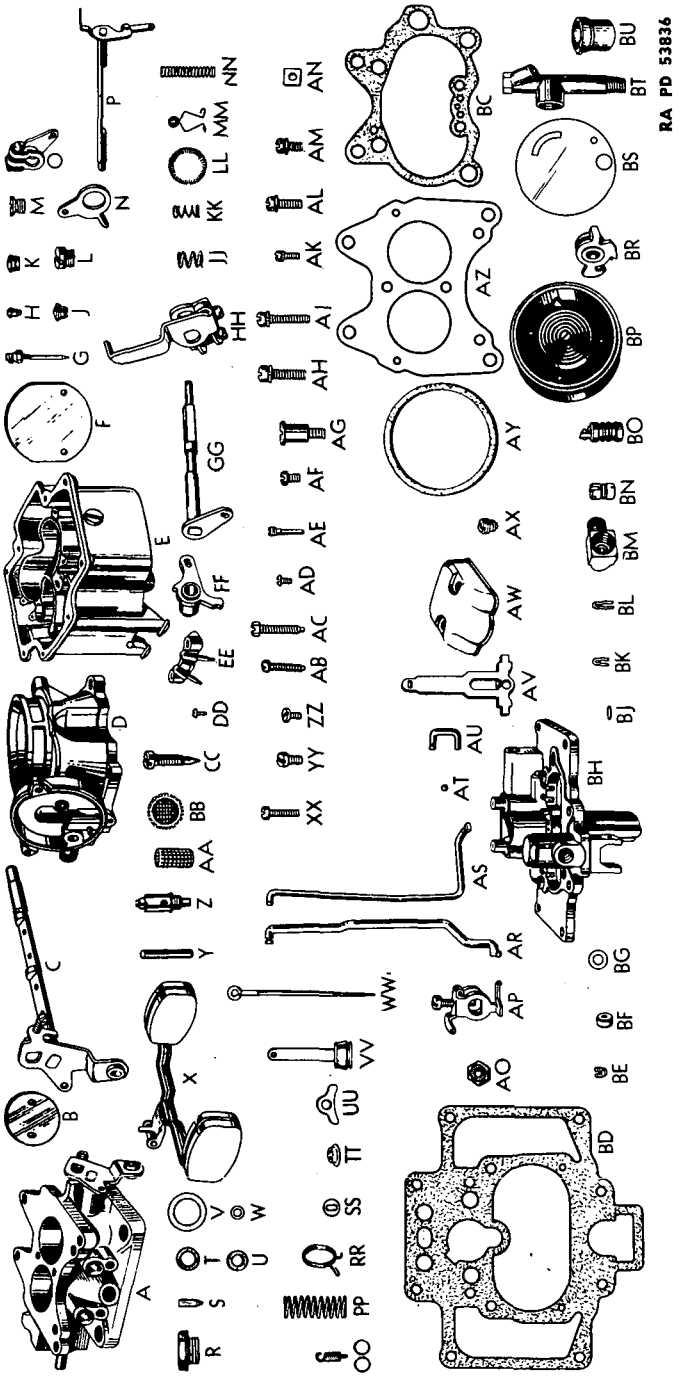


Figure 125 — Carburetor Parts

A — BODY, ASS'Y
B — DISC
C — SHAFT, ASS'Y
D — BODY
E — BODY, ASS'Y
F — VALVE
G — JET, ASS'Y
H — PLUG
J — PLUG
K — PLUG
L — PLUG, ASS'Y
M — PLUG
N — LEVER
O — LEVER, ASS'Y
P — LEVER, ASS'Y
R — NUT, ASS'Y
S — VALVE
T — GASKET
U — GASKET
V — GASKET
W — GASKET
X — FLOAT, ASS'Y
Y — PIN
Z — VALVE, ASS'Y
AA — STRAINER
BB — STRAINER
CC — SCREW
DD — SCREW
EE — JET, ASS'Y
FF — ARM, ASS'Y
GG — LEVER, ASS'Y
HH — ARM, ASS'Y
JJ — SPRING
KK — SPRING
LL — SPRING
MM — SPRING
NN — SPRING
OO — SPRING
PP — SPRING
RR — SPRING
SS — RETAINER
TT — RETAINER
UU — RETAINER
VV — PLUNGER
WW — ROD
XX — SCREW
YY — SCREW
ZZ — SCREW
AB — SCREW
AC — SCREW
AD — SCREW
AE — SCREW
AF — SCREW
AG — SCREW
AH — SCREW, ASS'Y
AJ — SCREW, ASS'Y
AK — SCREW, ASS'Y
AL — SCREW, ASS'Y
AM — SCREW, ASS'Y
AN — NUT
AO — NUT
AP — ARM, ASS'Y
AR — ROD
AS — ROD
AT — BALL
AU — LINK
AV — LINK
AW — COVER
AX — JET, ASS'Y
AY — GASKET
AZ — GASKET
BC — GASKET
BD — GASKET
BE — PLUG
BF — DISC
BG — WASHER
BH — COVER, ASS'Y
BJ — PIN
BK — SPRING
BL — SPRING
BM — ELBOW
BN — PISTON
BO — PISTON, ASS'Y
BP — COIL, THERMOSTAT, ASS'Y
BR — CAM, ASS'Y
BS — PLATE
BT — STACK
BU — GUIDE

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Legend for Figure 125 — Carburetor Parts

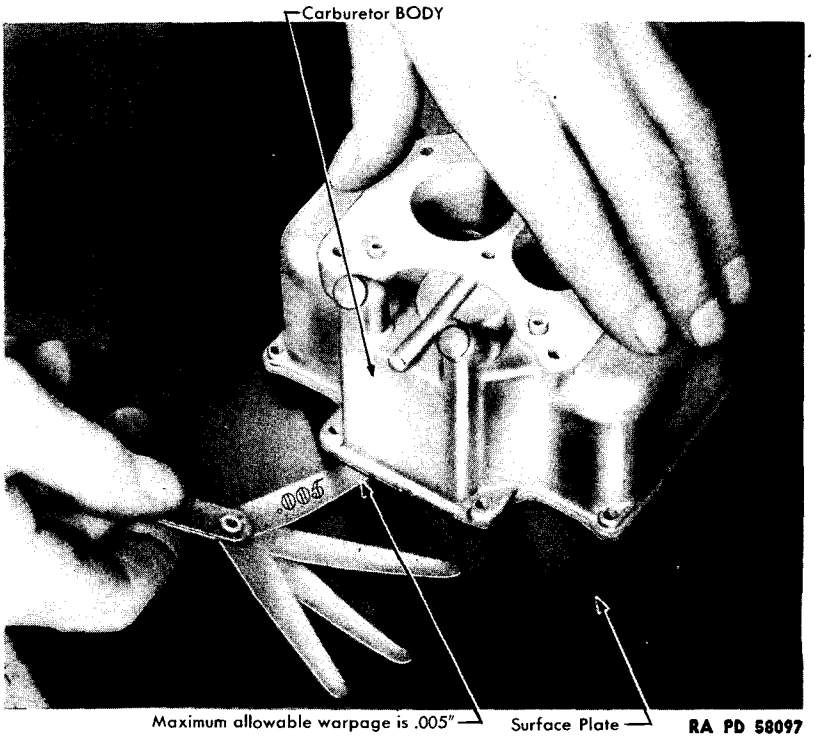


Figure 126 — Checking Carburetor Body

(c) *Install Float and Throttle Pump Assemblies on Bowl Cover.*

HAMMER, small	WRENCH, jet, $^{11}/_{32}$-in., A293002
INSTALLER, retaining ring, A293005	WRENCH, jet, low speed, A293003
WRENCH, jet, $^{1}/_{4}$-in., A293001	WRENCH, open-end, $^{9}/_{16}$-in.
	WRENCH, open-end, $^{3}/_{4}$-in.

Install gasoline line elbow. Install float, needle valve and seat and a new seat gasket. Position bowl cover strainer in cover and install mounting nut and gasket. Install 2 low speed jet assemblies. Install throttle pump intake check ball and intake check ball retainer (fig. 131). Install throttle pump spring, pump plunger, and shaft assembly. Install throttle pump plunger guide. Install pump retainer screw (fig. 132). CAUTION: Make sure that projection on pump plunger guide is seated in groove of cover before tightening retainer screw.

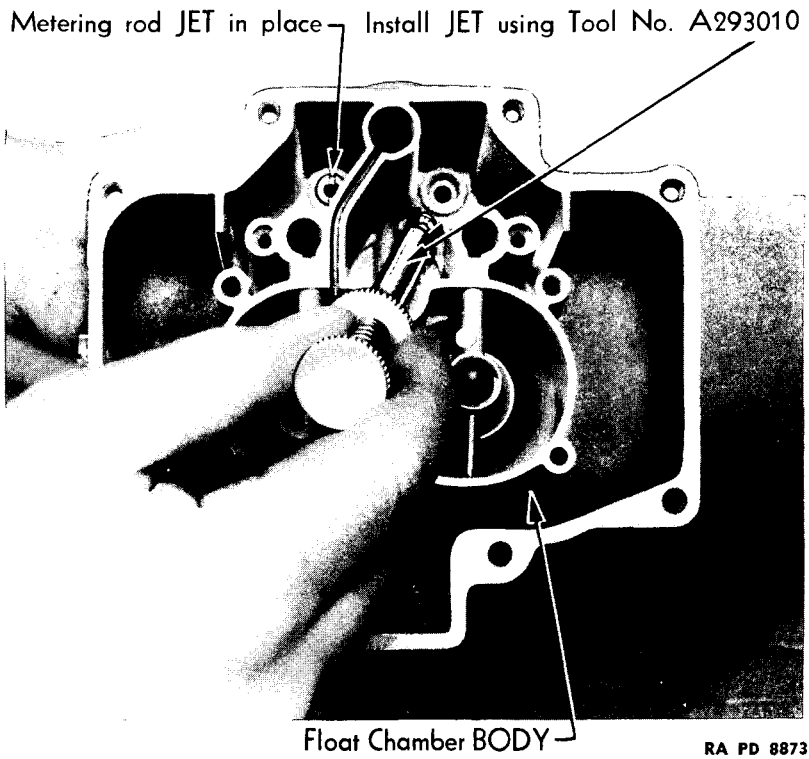


Figure 127 — Installing Metering Rod Jets

(d) Install Countershaft and Arm, and Collar Assemblies on Bowl Cover.

WRENCH, jet, ¼-in., A293001

Install metering rod spring on vacuumeter piston link (fig. 121). Install vacuumeter piston link in cover, making sure projection on side of link is facing outside of cover. Start pump countershaft assembly through cover until it just clears inside edge of support. Lubricate countershaft with GREASE, graphited, light, before installation. Install pump arm and collar assembly, metering rod arm and screw assembly with spring in place, on cover and push countershaft all the way through assembly and cover. CAUTION: Make sure tip of pump arm goes in slot in piston link. Install retaining ring on end of countershaft. Tighten metering rod arm clamp screw, making sure assembly is centered in bowl cover. Install throttle pump arm link in arm and piston rod. The grooved end of the link should point upward. Install retaining pin on upper end of pump arm link (figs. 119 and 120).

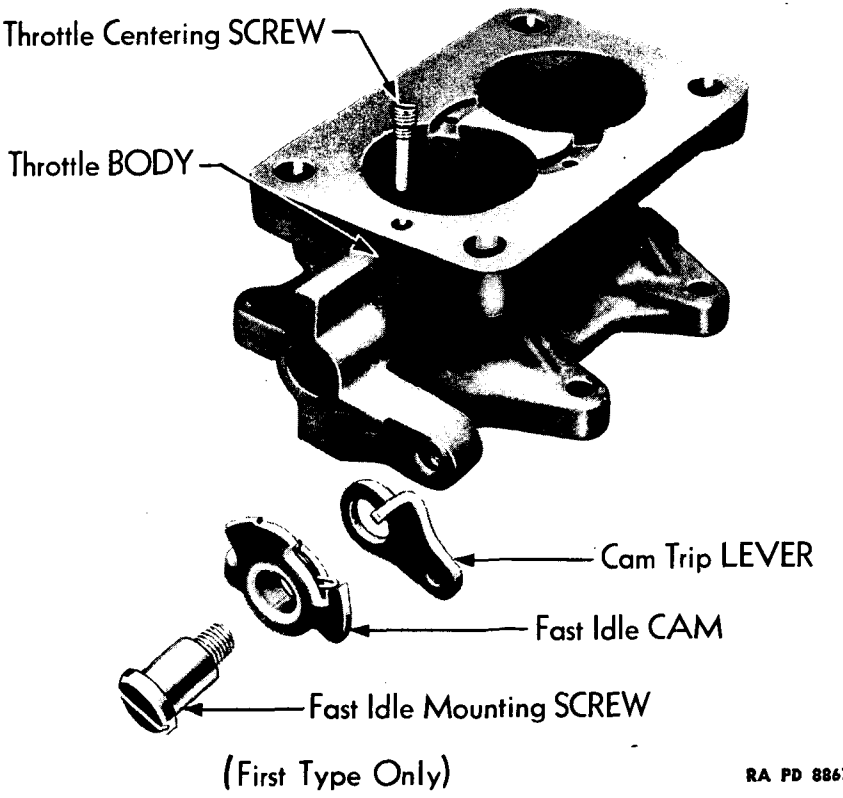


Figure 128 — Installing Fast Idling Cam and Lever

(e) *Install Throttle Pump Valves and Housing on Bowl Cover.*
WRENCH, jet, 3/16-in., A293014 WRENCH, jet 11/32-in.,
WRENCH, jet, 1/4-in., A293001 A293002

Install pump strainer screen. Install throttle pump check needle valve in cover, blunt end first. Install discharge check plug and a new gasket. Install intake check plug and a new gasket. Install pump jet and housing assembly on bowl cover (fig. 133). Position a new gasket and upper body casting on bowl cover and install four mounting screws and lock washers.

(f) *Adjust Float Level and Reinstall Assembly.*
BENDER, metering, A293007 GAGE, float level, A293011

Install float needle valve in seat directly beneath bowl cover strainer housing. CAUTION: Pointed end of valve must point toward bowl.

FUEL SYSTEM

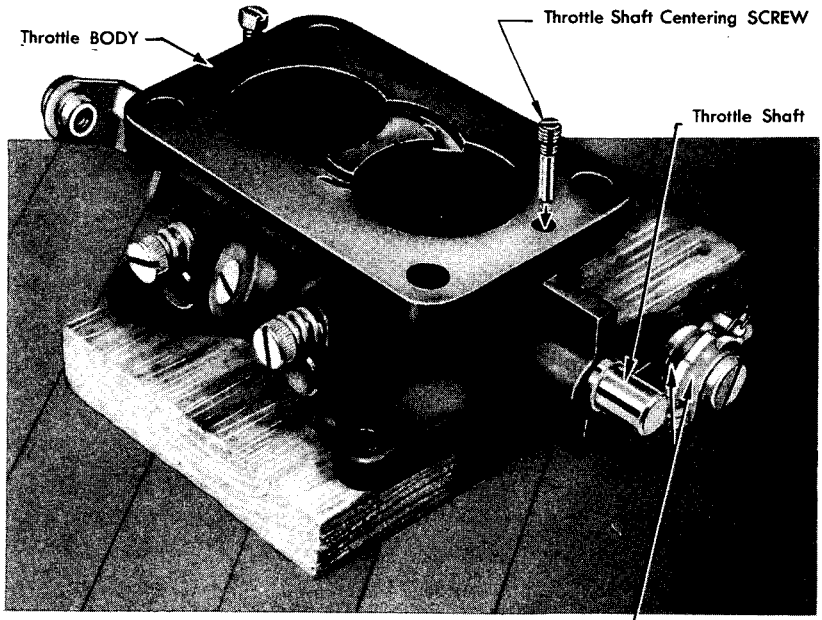


Figure 129 — Installing Throttle Centering Screw

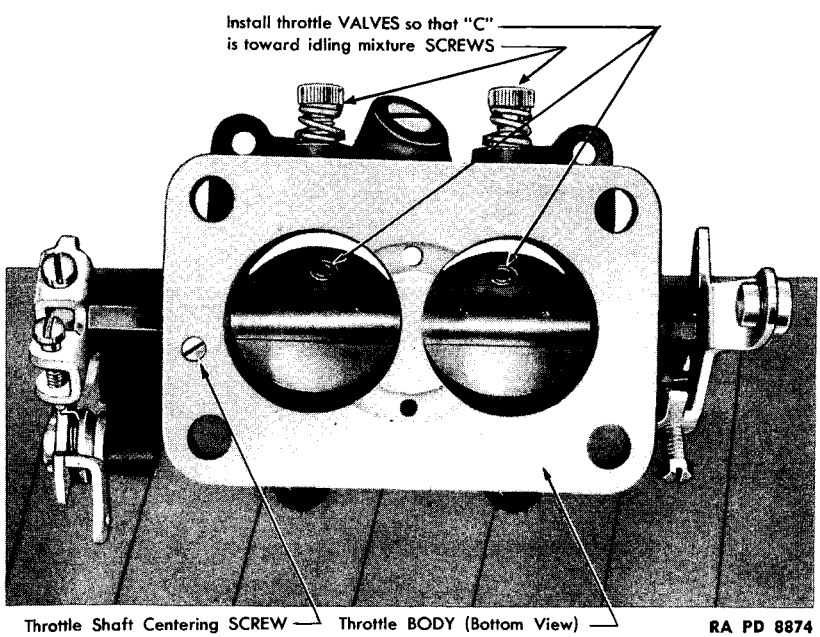


Figure 130 — Installing Throttle Valves

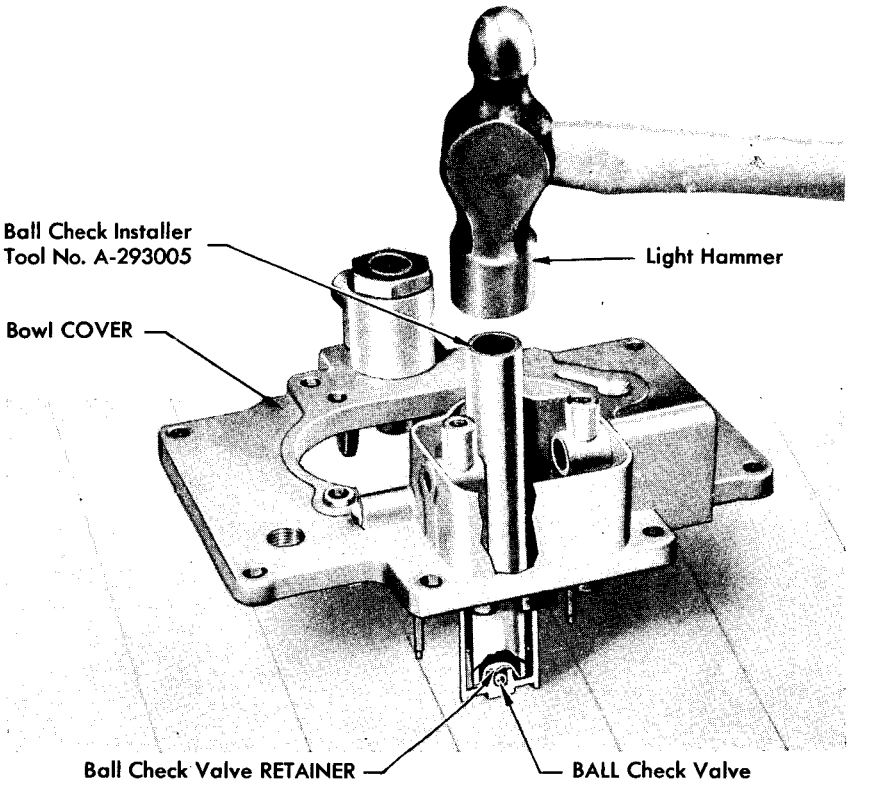


Figure 131 — Installing Intake Ball Check Valve Retainer

cover. Install float and lever assembly and install float lever pin holding float assembly on cover. Place float level gage directly under float, with notched portions of gage fitted over machined edge of bowl cover casting. Check position of float and gage. Float should just touch vertical sides of gage and just clear horizontal portion. Bend float arms as necessary. Remove float level gage and float assembly and install a *new* bowl cover gasket. Replace float assembly. Install vacuum piston and pin assembly on end of vacuum meter piston link.

(*g*) *Install Choke Assembly on Upper Body.*

WRENCH, jet, ¼-in., A293001

Install piston and pin on choke lever link. Install choke piston lever, link, and shaft assembly in body so that piston enters its bore. Install coil housing baffle plate and a *new* coil housing gasket. Position thermostatic coil and housing assembly on body with indicator marks at bottom,

FUEL SYSTEM

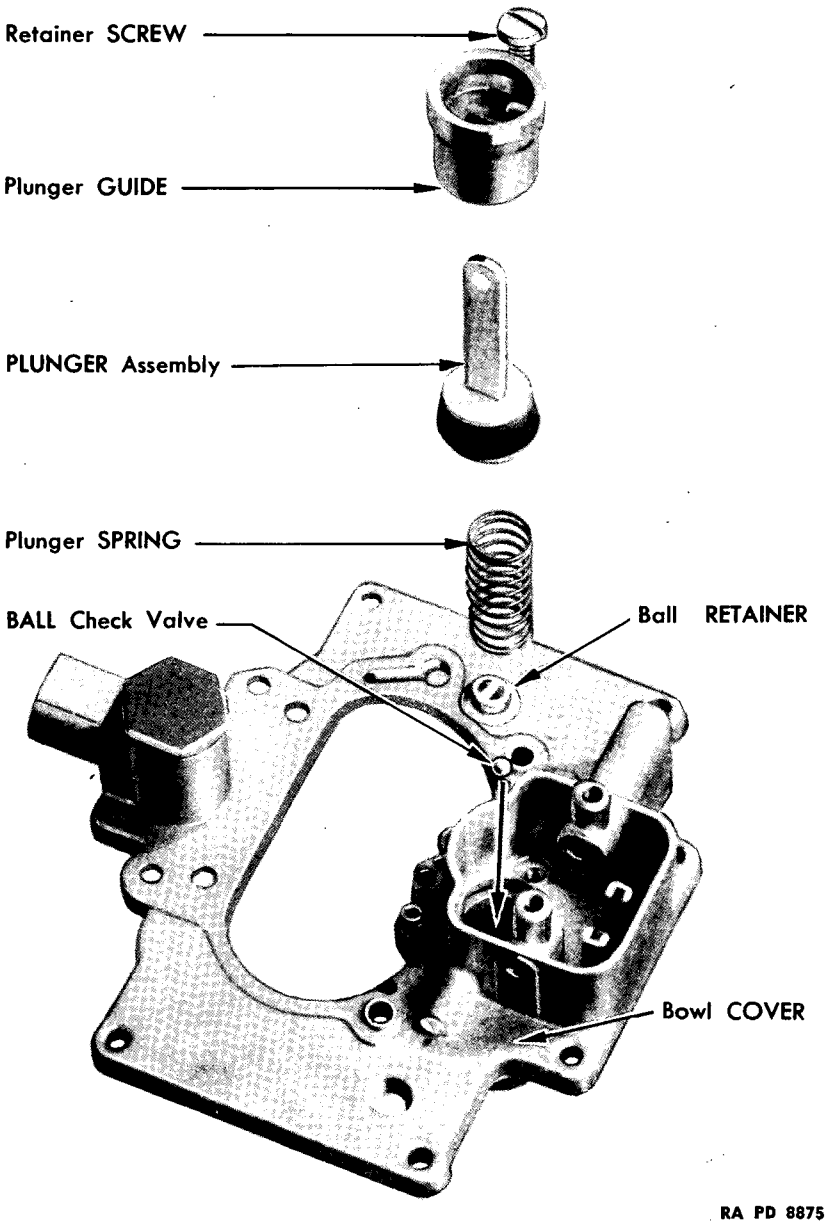


Figure 132 — Throttle Pump — Exploded View

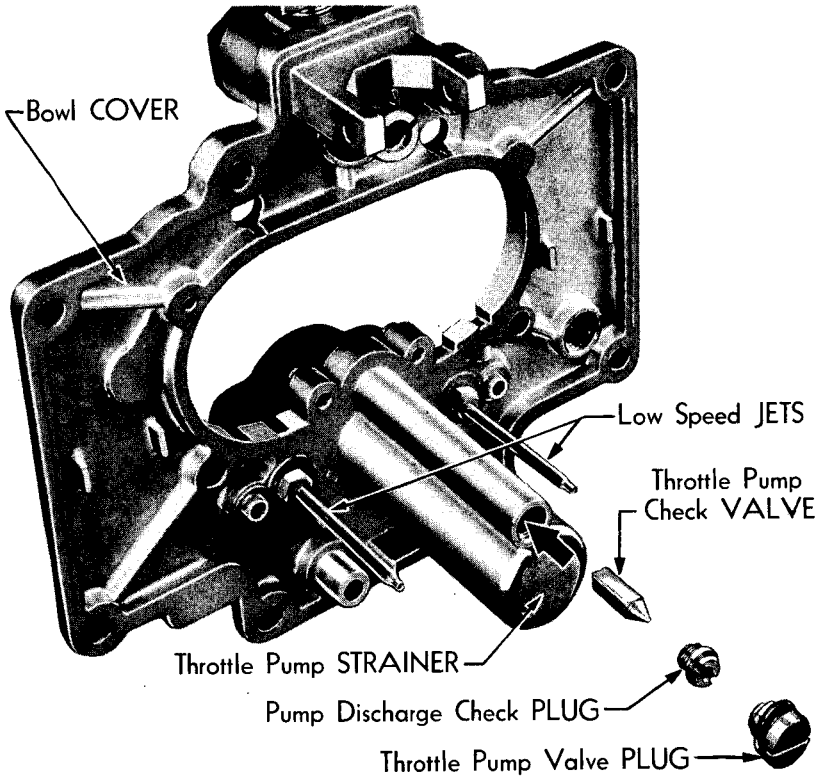


Figure 133 — Throttle Pump, Check Valve Assembly

and install mounting screws and retaining washers finger-tight. Revolve housing counterclockwise to engage hook on spring, set mark at center index point and tighten mounting screws. Position choke valve in upper body and install 2 screws which hold it on choke shaft. On first type carburetors install choke lever and screw assembly on end of choke shaft so that long arm is next to body. CAUTION: Do not tighten clamping screw (figs. 115 and 116).

(*h*) *Install Throttle Body Assembly, Bowl Cover and Rods on Body.*

WRENCH, jet, ¼-in., A293001 — WRENCH, jet, $^{11}/_{32}$-in., A293002

Position a *new* throttle body gasket and throttle body assembly on float chamber body and install 4 mounting screws and lock washers. Install washer on throttle connector rod and install throttle connector rod in throttle lever, starting it through hole from side next to flange assembly. Install connector rod spring and spring retainer. Position

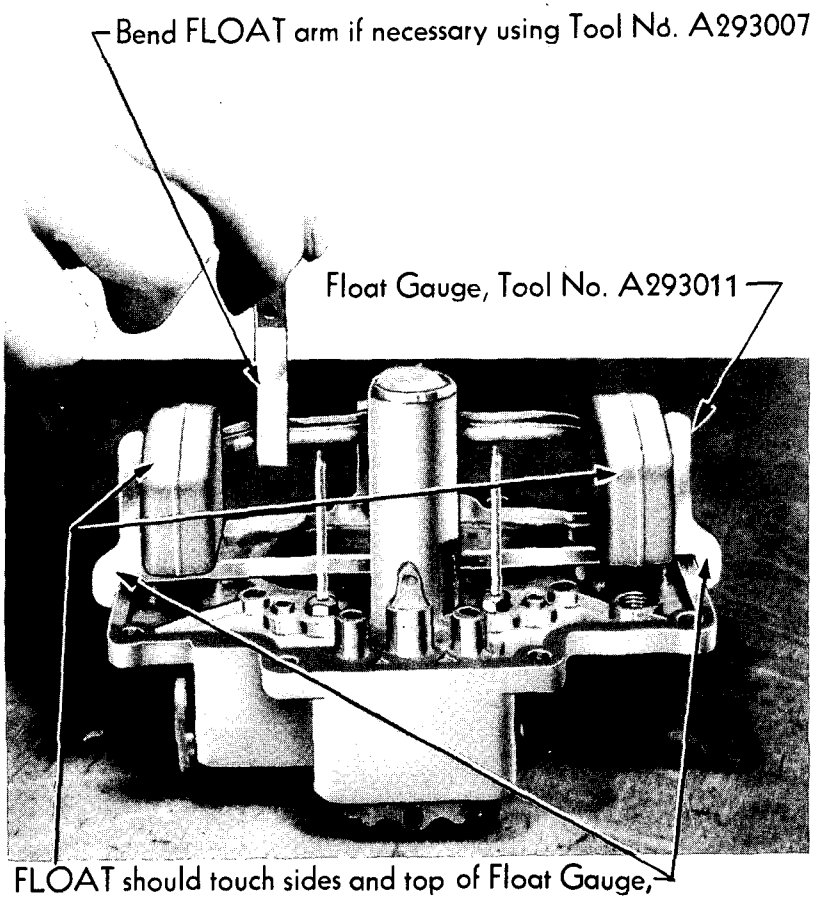


Figure 134 — Adjusting Float Level

bowl cover assembly on float chamber body and install 6 mounting screws and lock washers. Install throttle connector rod on countershaft and throttle shaft, and install retaining rings and screws.

(*i*) *Adjust Throttle Pump Travel.*

GAGE, throttle pump, A293013

Install throttle pump gage on carburetor so that lower (narrow) end of gage rests on upper arm of throttle pump link and upper step of gage rests on edge of dust cover (fig. 135). Turn throttle shaft until throttle is in wide-open position and note position of gage. Upper step of gage should be just touching edge of dust cover, indicating that throttle pump has ⅜-inch travel from the fully closed to the fully open throttle position (fig. 136). Bend throttle connector rod as required to

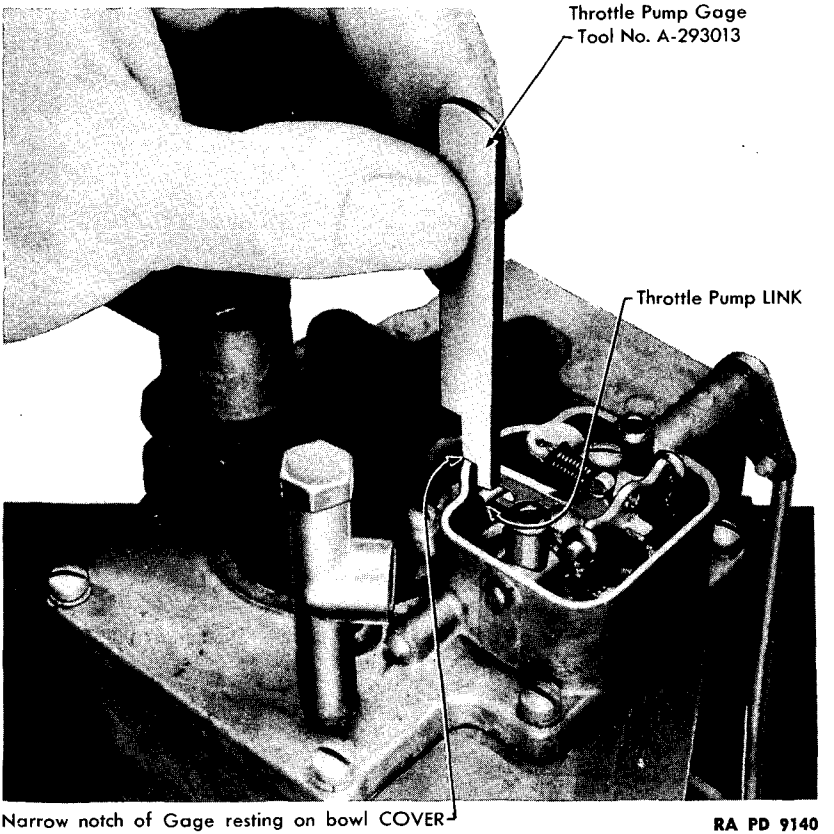


Figure 135 — Adjusting Throttle Pump (A)

obtain adjustment. CAUTION: Disconnect throttle connector rod at lower end before bending rod.

(*j*) *Install Vent Stack and Air Horn Assembly.*

WRENCH, jet, ¼-in., A293001 WRENCH, open-end, $\frac{7}{16}$-in.

Install vent stack on bowl cover (first type only). Position upper body assembly on bowl cover and install 4 cap screws and lock washers.

(*k*) *Adjust Metering Rod Arm and Install Metering Rods.*

BENDER, metering, A293007 GAGE, metering rod arm, A293012

Install metering rod gage in bowl cover and body in the same position that the metering rods are installed so that square notch on gage is under

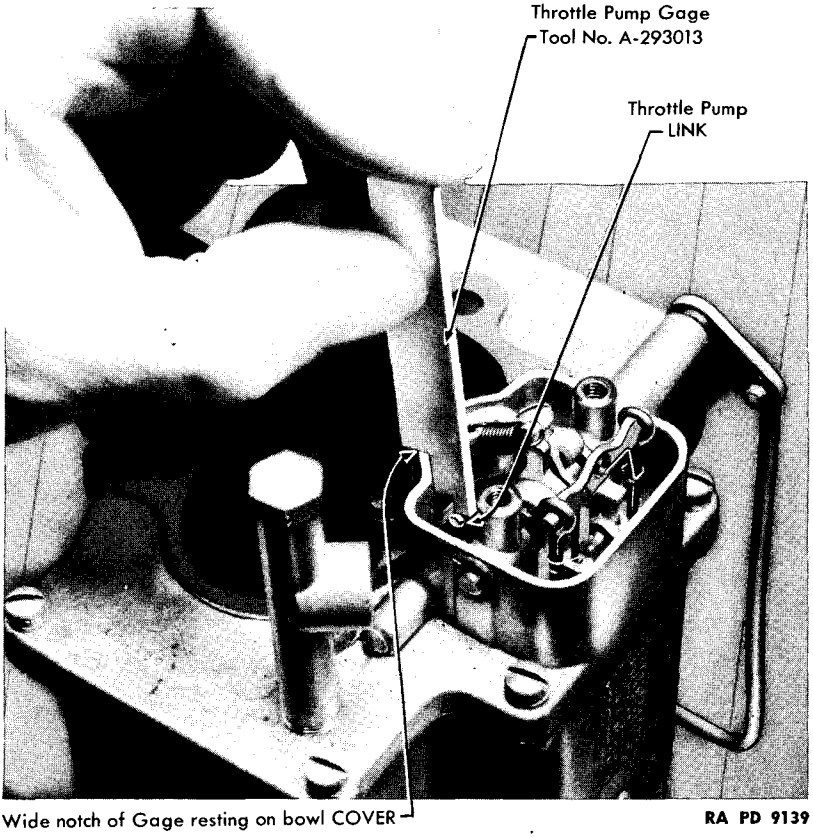


Figure 136 — Adjusting Throttle Pump (B)

metering rod arm. Back off throttle stop screw and check throttle valves to make sure they are fully closed. Press down on metering rod arm. Note position of metering rod gage. Edge of notch on gage should just touch lip on metering rod arm. Adjust position of metering rod arm, if necessary, to obtain above adjustment by bending accelerating pump piston link. Remove metering rod gage and install in same position in other metering rod jet to check adjustment. Position both metering rods in bowl by hooking metering rod spring in place on rods, pushing rods down into body, and engaging looped ends on metering rod arms.

(*1*) *Install Dust Cover and Adjust Choke Linkage.*

GAGE, feeler, 0.010-in., A293009 — WRENCH, jet, ¼-in., A293001

Install dust cover gasket on bowl cover on first type carburetors. Position dust cover on bowl cover and install 2 cap screws and lock

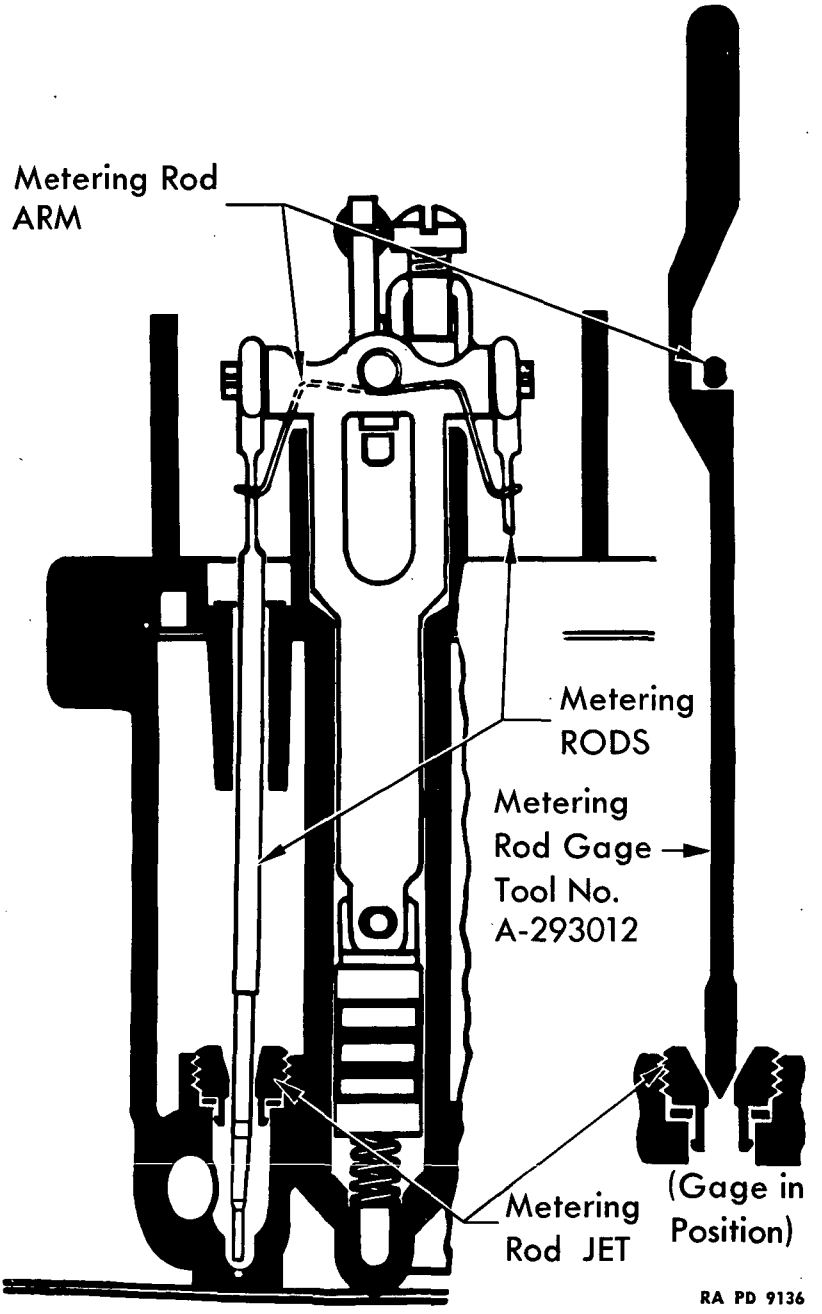


Figure 137 — Adjusting Metering Rods

FUEL SYSTEM

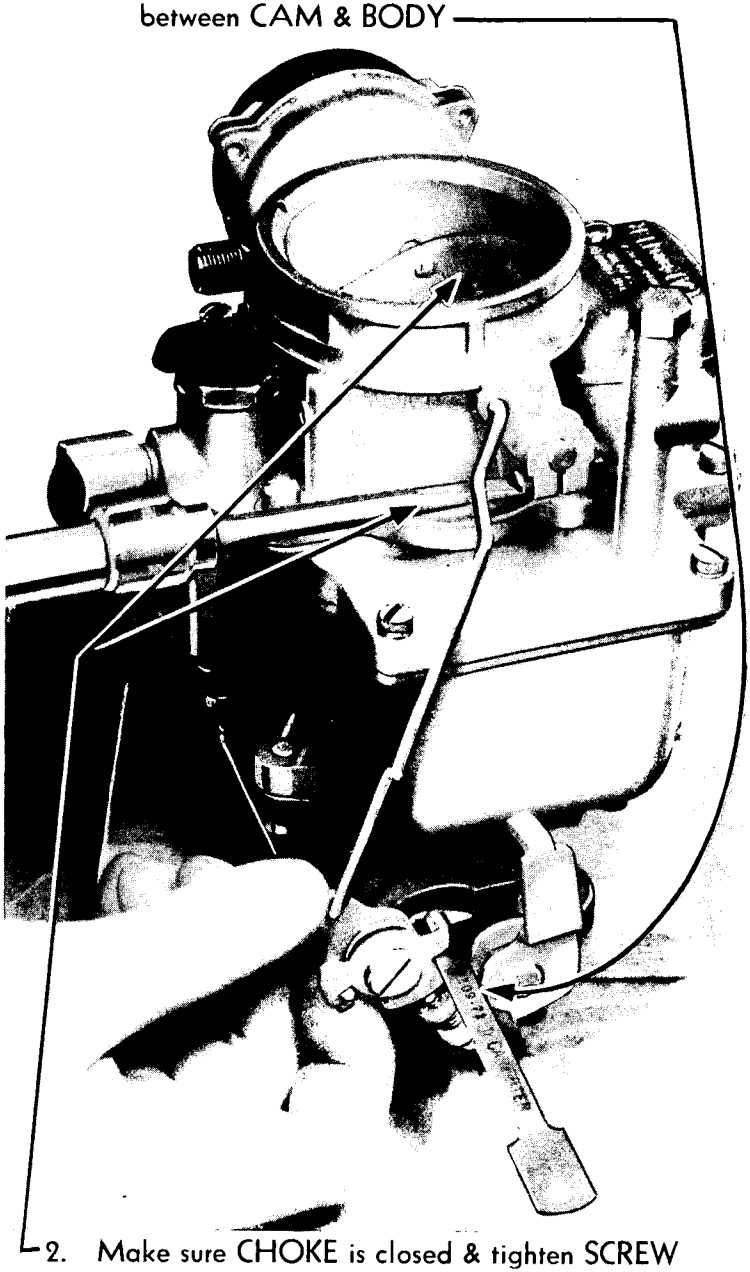


Figure 138 — Adjusting Choke Valve Linkage

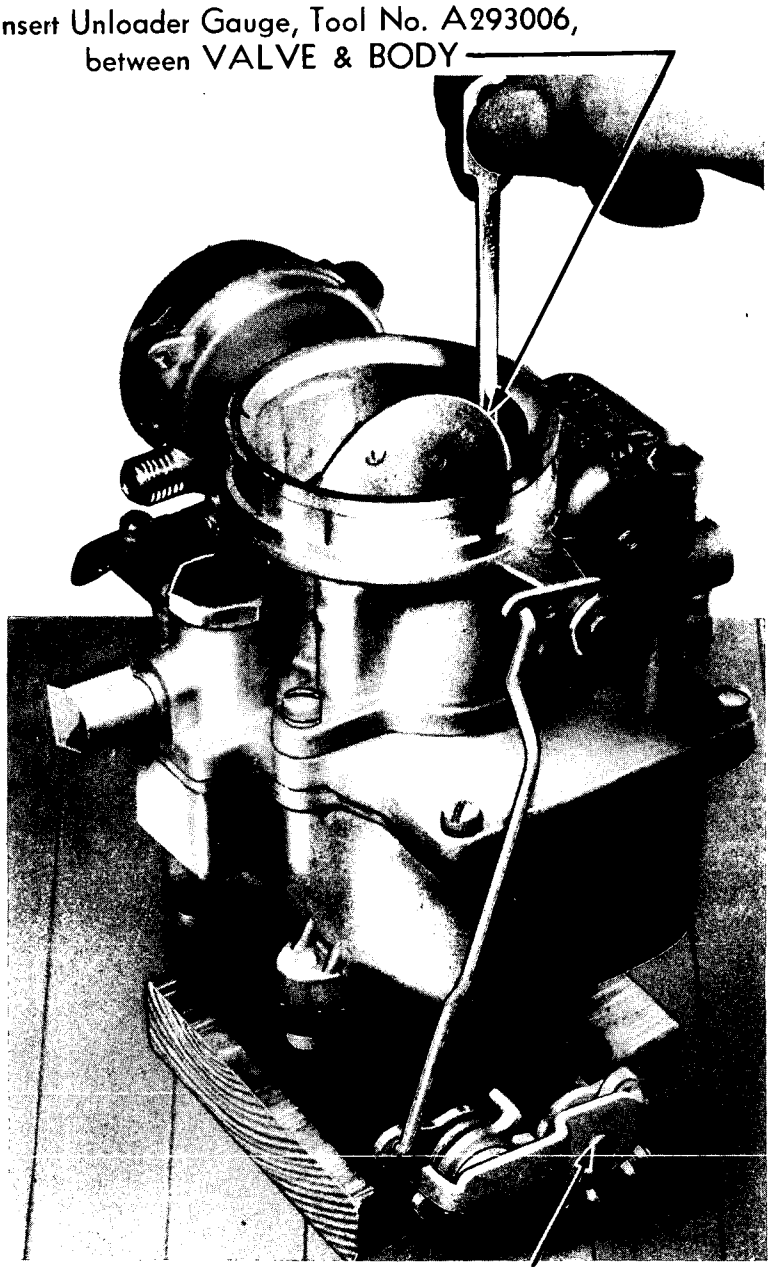


Figure 139 — Adjusting Choke Valve Clearance

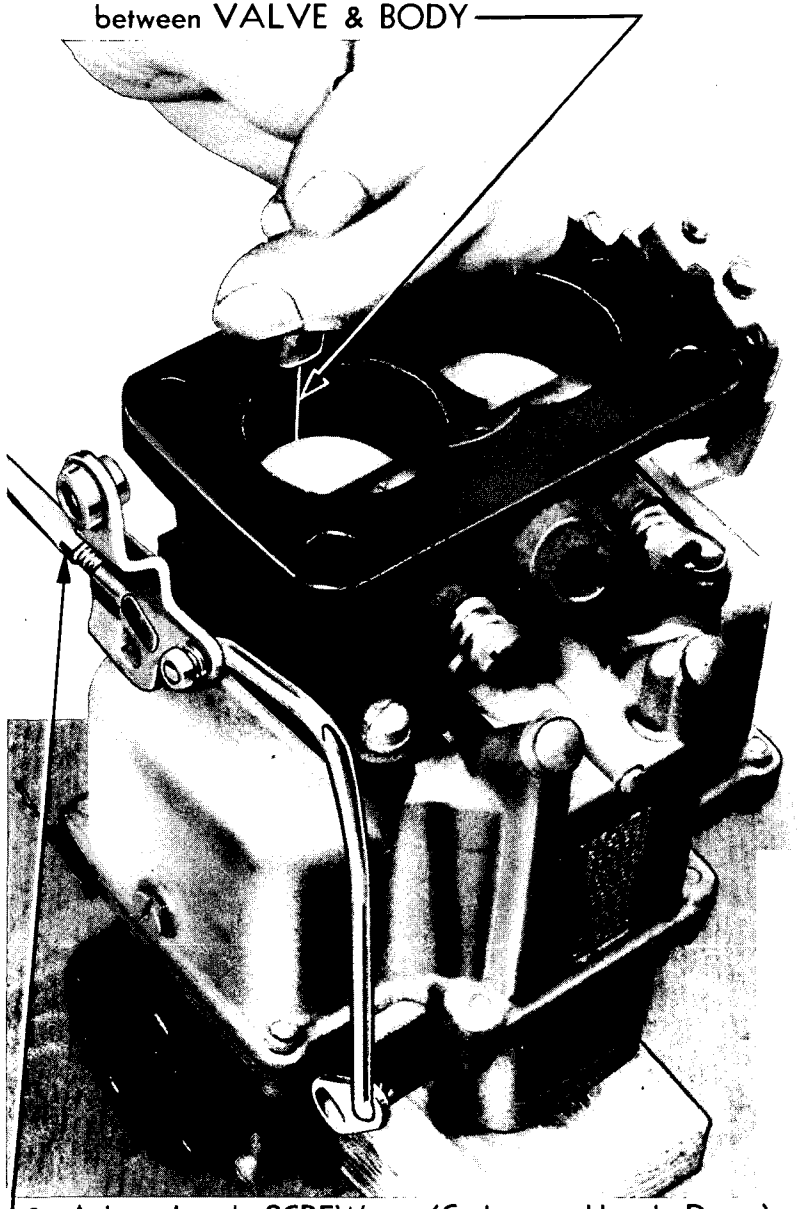


Figure 140 — Preliminary Idling Adjustment

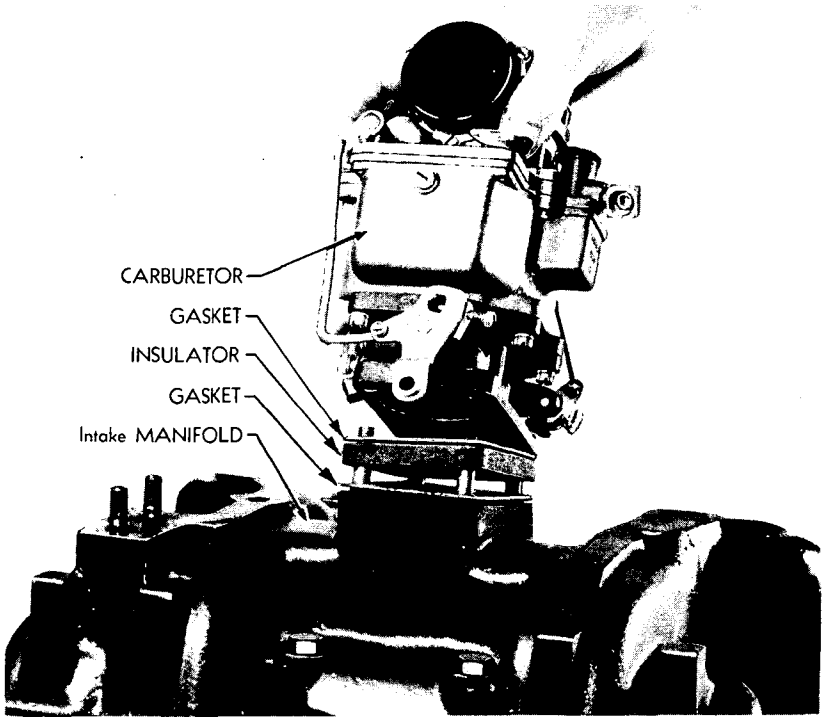


Figure 141 — Installing Carburetor

washers holding it to bowl cover. On first type carburetors install and adjust choke linkage as follows: Install fast idling connector rod on bowl cover and install rod retaining spring on lower end. Insert an 0.010-inch flat feeler gage between lip on fast idling cam and boss on flange casting. Making sure choke valve is tightly closed, tighten choke shaft arm in place, and remove feeler gage.

(*m*) *Adjusting Choke Valve Clearance and Fast Idling Speed.*

GAGE, unloader, 0.020-in. WIRE, A293006
PLIERS

Open throttle to wide-open position and insert unloader gage between upper edge of choke valve and inside wall of air horn (fig. 139). If there is either not enough, or too much clearance to insert gage, adjust position of unloading lip on throttle shaft as required, using a pair of pliers. To get temporary fast idling adjustment on first type carburetors invert carburetor and insert an 0.020-inch wire between throttle valve and bore of flange on side opposite idling adjusting screws (fig. 140).

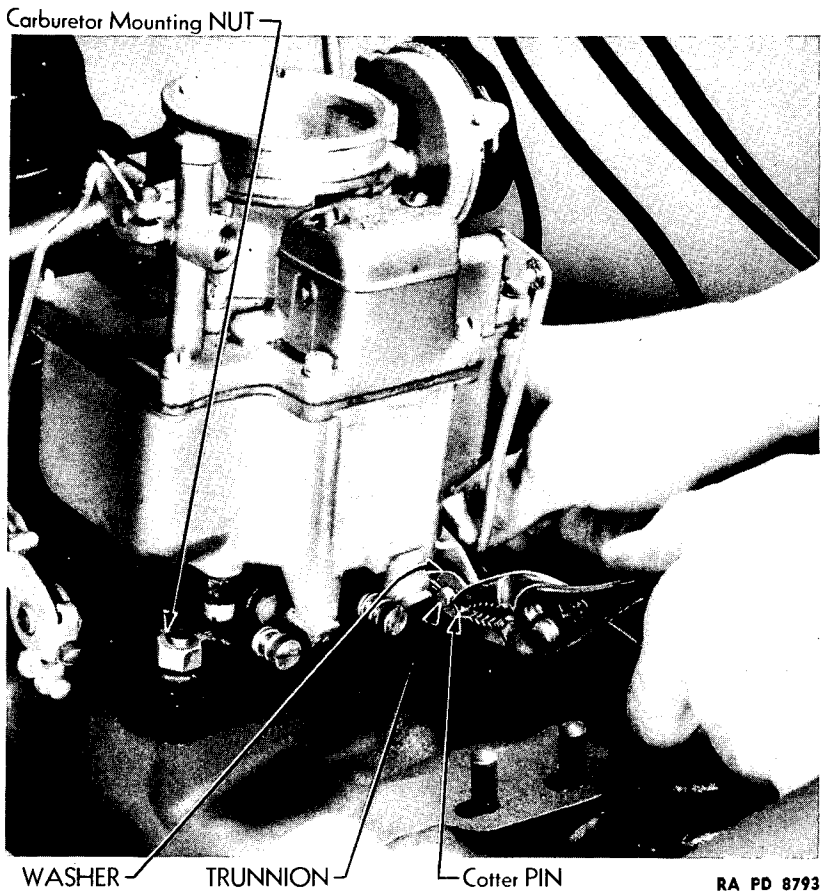


Figure 142 — Connecting Throttle Linkage

With choke valve closed, adjust fast idling stop screw until gage is free. NOTE: External carburetor adjustments are made when the carburetor is installed.

(5) INSTALL CARBURETOR.

PLIERS	WRENCH, open-end, ½-in.
WRENCH, open-end, 7/16-in.	WRENCH, open-end, 5/8-in.

Position the lower carburetor gasket on studs on intake manifold, while working through engine compartment rear doors. Position the carburetor insulator, and then the top gasket on intake manifold studs. Install carburetor on intake manifold mounting studs and install 4 nuts (fig. 141). Position throttle rod trunnion on carburetor throttle valve shaft and install washer and cotter pin (fig. 142). Connect fuel, heater

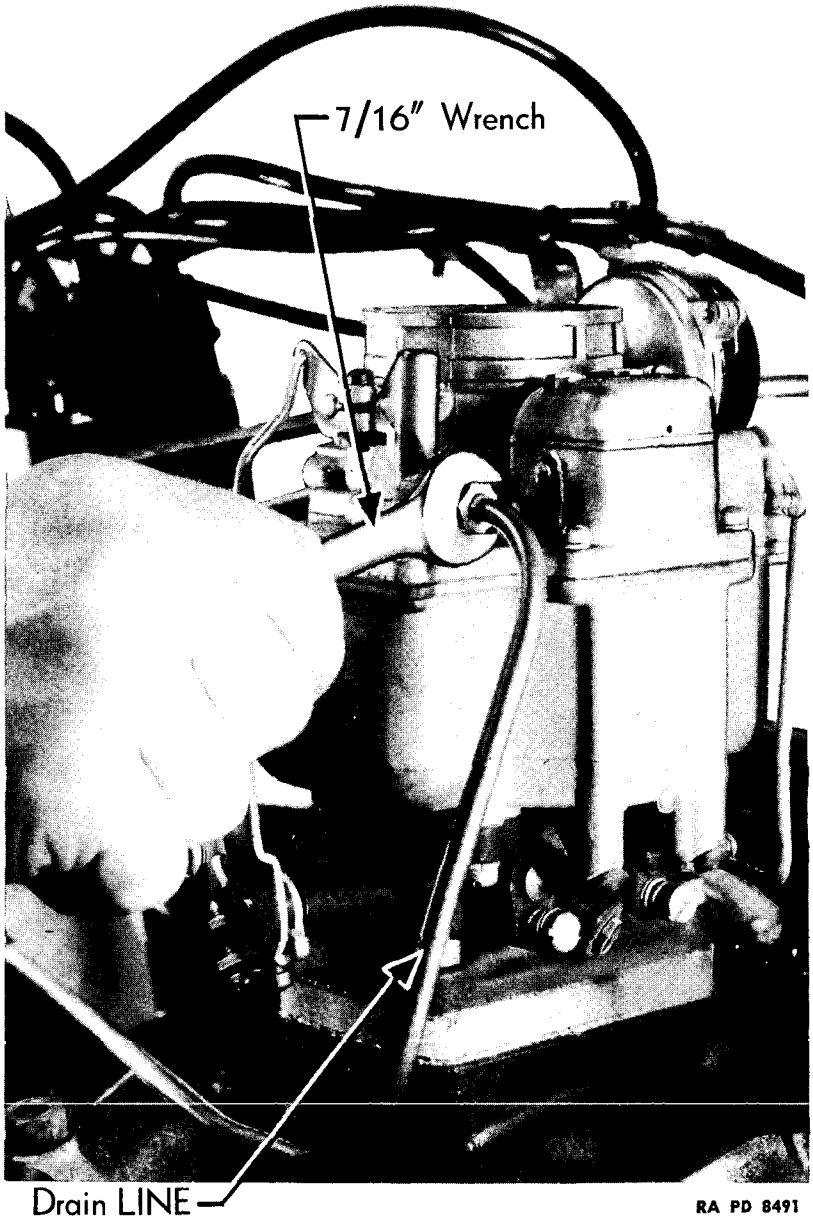


Figure 143 — Installing Drain Line

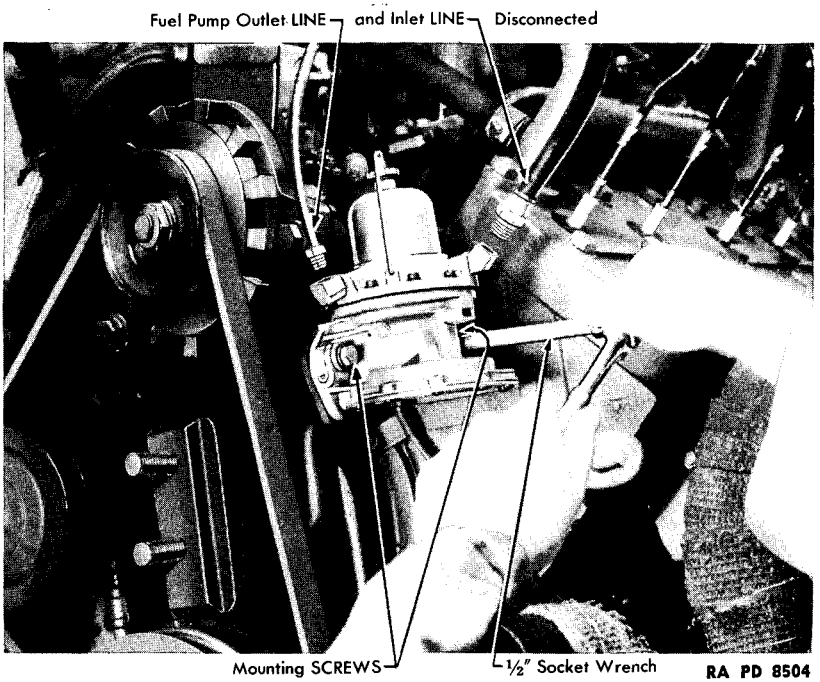


Figure 144 — Removing Fuel Pump

and drain lines to carburetor. Drain line used on first carburetors only (fig. 143). Position carburetor air intake pipe on upper end of carburetor and tighten clamps. Connect heater supply line to carburetor air intake pipe on second type carburetors. Adjust carburetor as explained in paragraph 43.

48. FUEL PUMP.

a. Remove Fuel Pump.

WRENCH, socket, universal, ½-in.

Open engine compartment rear doors and remove fan, belt, and bracket (par. 12). Shut fuel line valves at fuel filter and run engine until fuel in filter and pump is exhausted. Disconnect fuel pump inlet and outlet lines. Remove 2 screws holding fuel pump to left side of engine front cover, working through engine compartment rear doors. Support fuel pump while removing screws (fig. 144). Remove fuel pump and gasket.

b. Disassemble Fuel Pump.

(1) REMOVE UPPER AND LOWER COVERS.

PLIERS SCREWDRIVER

Remove 10 cap screws and lock washers holding bottom cover plate to fuel pump body, and remove cover and gasket. Loosen fuel pump

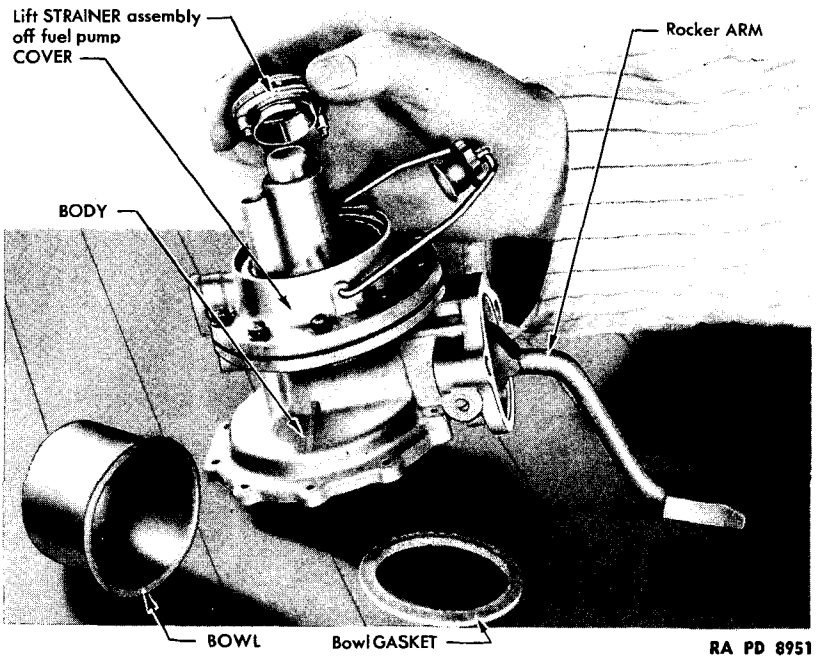


Figure 145 — Removing Fuel Pump Strainer

bowl retaining nut on top of fuel pump bowl. Swing nut and bail aside, and remove fuel pump bowl and gasket. Remove strainer assembly (fig. 145). Remove wire bail by pulling it out of holes in upper cover. Remove 10 screws and lock washers holding upper cover assembly to fuel pump body and lift cover off fuel pump body. CAUTION: Leave 2 opposite screws in place to avoid distorting diaphragm if the same diaphragm is to be reinstalled. Then, holding cover down, remove these 2 screws (fig. 146).

(2) DISASSEMBLE FUEL PUMP BODY (fig. 148).

FILE	PUNCH, 1/8-in.
HAMMER	SCREWDRIVER

Remove 2 screws holding retaining plate over fuel pump valve assemblies on upper cover and remove valve assemblies and gaskets (fig. 147). While pressing down on diaphragm, disconnect diaphragm

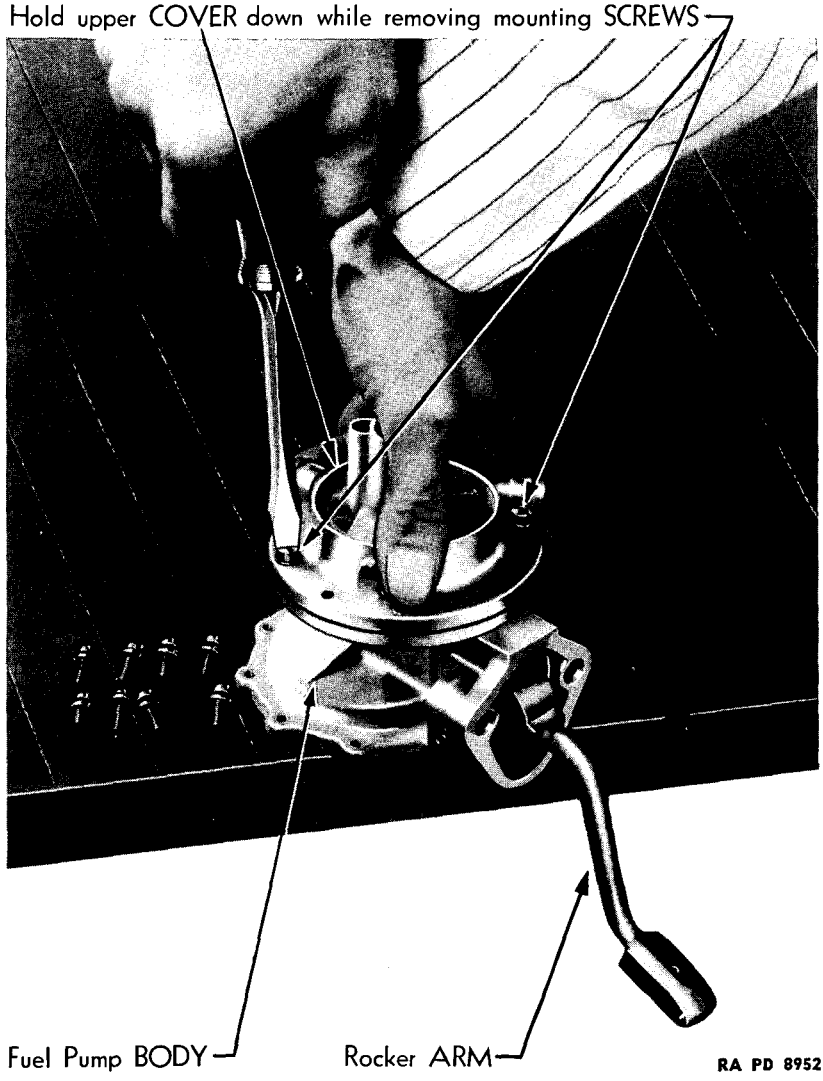


Figure 146 — Removing Fuel Pump Upper Cover

stem from rocker arm link and then remove diaphragm assembly. Remove diaphragm spring seat and spring. File down peened end of rocker arm shaft and remove thrust washer. Tap rocker arm shaft out of fuel pump body. Remove and disassemble rocker arm assembly. Remove rocker arm return spring.

c. Inspect Fuel Pump.

CLOTH, clean	PAN
GAGE, feeler	SOLVENT, dry-cleaning

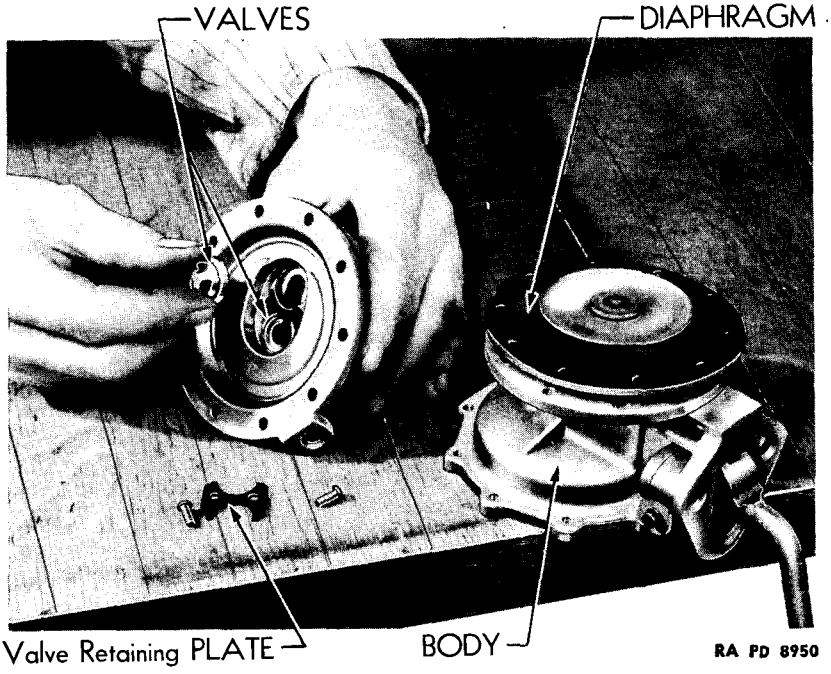


Figure 147 — Removing Fuel Pump Valves

(1) CLEAN AND INSPECT FUEL PUMP PARTS.

Clean all fuel pump parts thoroughly in SOLVENT, dry-cleaning, and dry with compressed air. Inspect fuel pump bowl, upper cover, body, and lower cover carefully for cracks which might cause air or fuel leakage. Lay above parts on a surface plate in turn and check for warpage of machined surfaces, using a feeler gage. If any part is warped more than 0.005 inch, it should be replaced or dressed down by laying a sheet of fine CLOTH, abrasive, aluminum-oxide, on a surface plate or a piece of plate glass and rubbing in a circular motion. Inspect fuel pump rocker arm thoroughly for cracks or evidence of damage.

(2) CHECK FIT OF ROCKER ARM PARTS.

Insert rocker arm shaft in fuel pump body and check for fit of shaft in body. If fit is excessively loose, body should be replaced. Install operating mechanism temporarily in fuel pump body and check for looseness due to wear. If excessive looseness is encountered, operating mechanism parts should be replaced.

(3) INSPECT FUEL PUMP SPRINGS.

Check free length of rocker arm return spring. Free length should be 1¼ inches. Check free length of diaphragm spring. Free length

FUEL SYSTEM

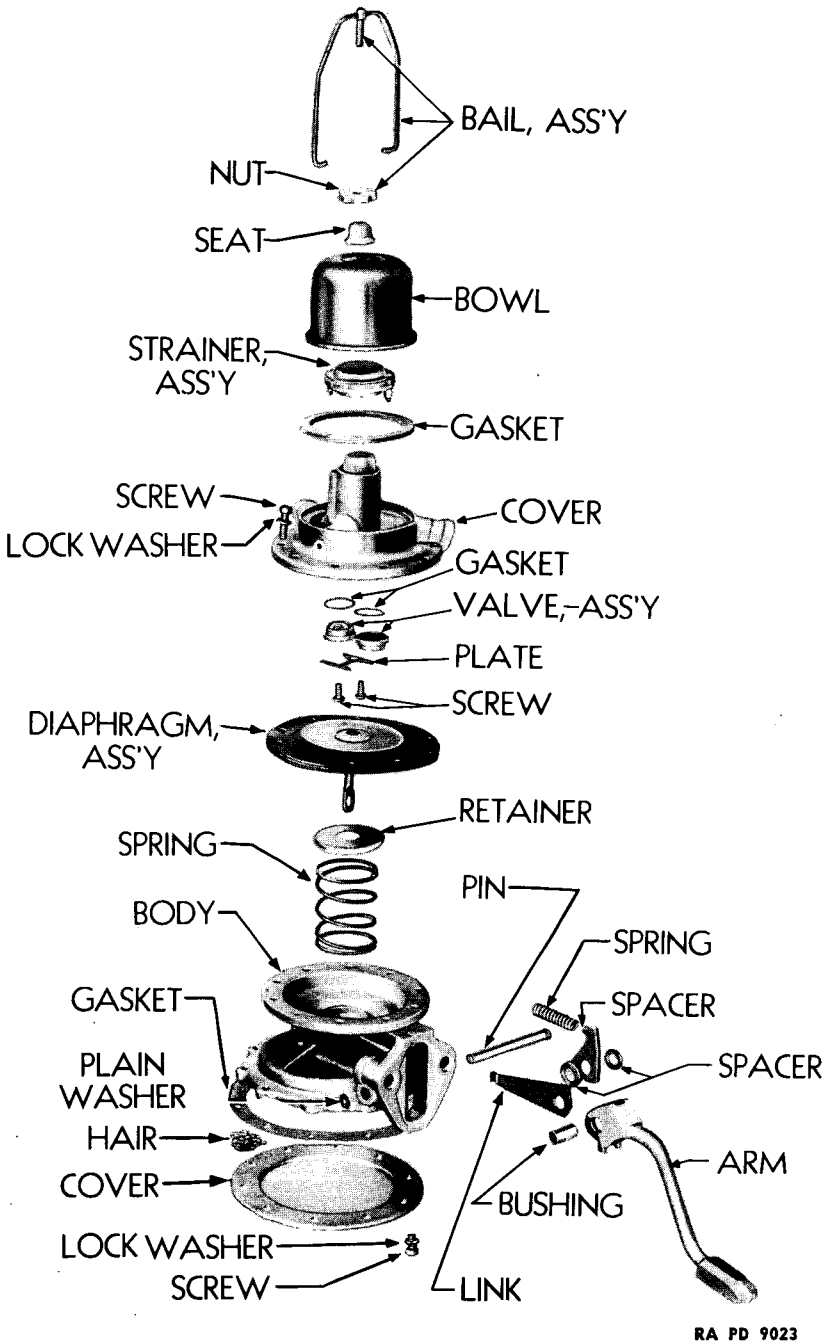


Figure 148 — Fuel Pump — Exploded View

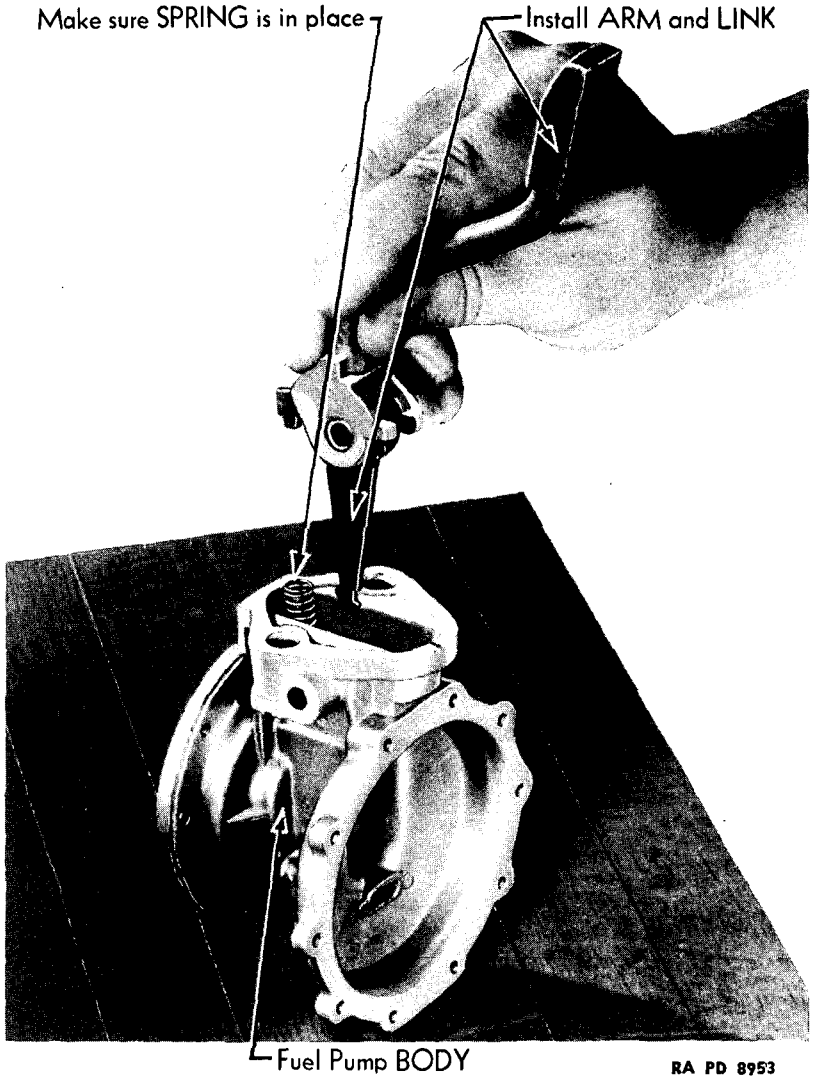


Figure 149 — Installing Fuel Pump Rocker Arm

should be 2 inches. Compress spring to $1\frac{1}{16}$ inch, and measure pressure while compressed. Pressure should be from 24 to 26 pounds. Inspect diaphragm and replace, if defective.

d. Assemble Fuel Pump.

(1) INSTALL DIAPHRAGM AND ROCKER ARM ASSEMBLIES IN FUEL PUMP BODY.

HAMMER, light SCREWDRIVER

FUEL SYSTEM

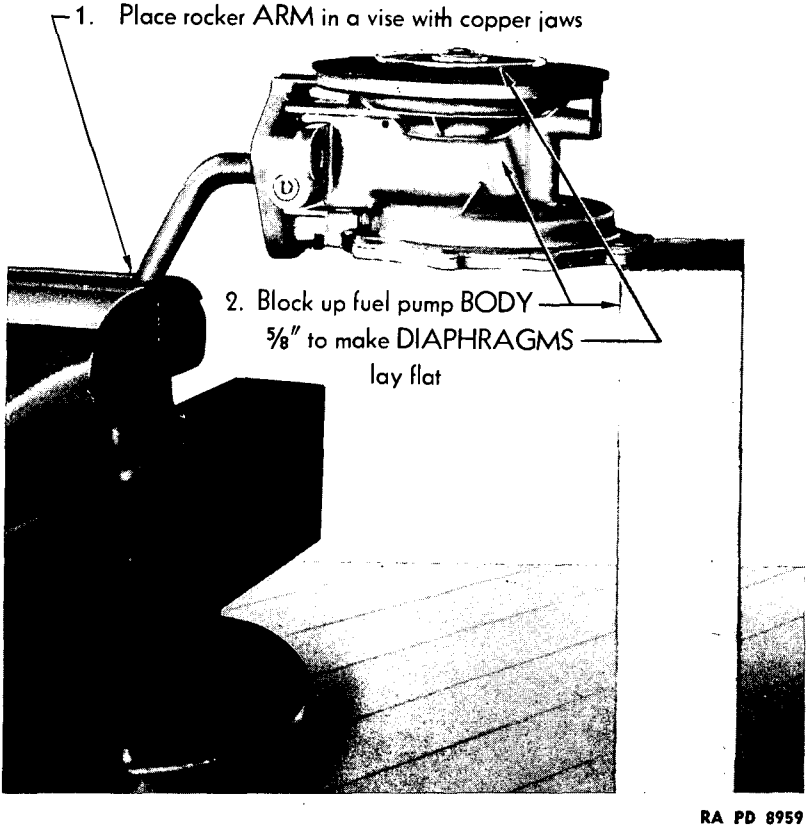


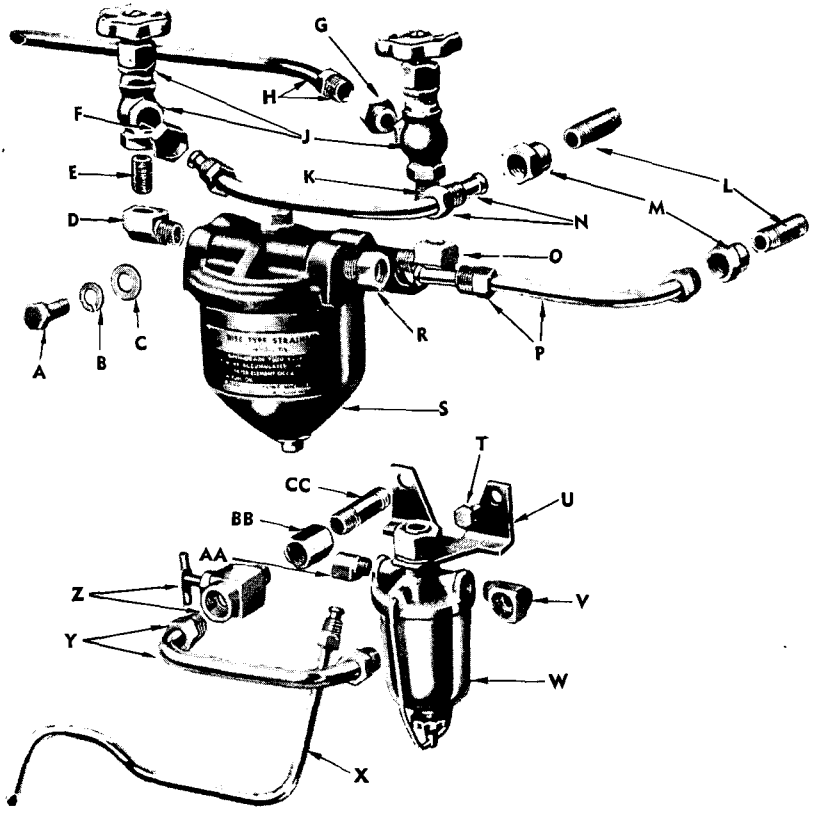
Figure 150 — Installing Diaphragms

Position rocker arm and spacers in slot in eccentric lever and insert bushing through link. Position rocker arm return spring and rocker arm assembly in fuel pump body (fig. 149). Install a new rocker arm shaft through body and rocker arm assembly, using a light hammer. Install thrust washer on end of rocker arm shaft and peen end of shaft over washer. Install diaphragm assembly in body. Press down on diaphragm and hook diaphragm stem on rocker arm link. Position fuel valve assemblies and new gaskets in upper fuel pump cover and install valve retaining plate and screws.

(2) INSTALL UPPER AND LOWER COVERS AND BOWL.

PLIERS VISE
SCREWDRIVER

Place fuel pump body assembly in a vise with copper jaws. Block up body 5/8 inch so that diaphragms will lie flat on body. Position upper



A — SCREW
B — WASHER, LOCK
C — WASHER, PLAIN
D — ELBOW
E — NIPPLE
F — CONNECTOR
G — CONNECTOR
H — LINE, ASS'Y
J — VALVE
K — NIPPLE
L — NIPPLE
M — CONNECTOR
N — LINE, ASS'Y
O — ELBOW
P — LINE, ASS'Y
R — CONNECTOR
S — FILTER, ASS'Y
T — SCREW
U — BRACKET
V — ELBOW
W — FILTER, ASS'Y
X — LINE, ASS'Y
Y — LINE, ASS'Y
Z — COCK
AA — ELBOW
BB — COUPLING
CC — NIPPLE

RA PD 50335

Figure 151 — Fuel Filter Connections

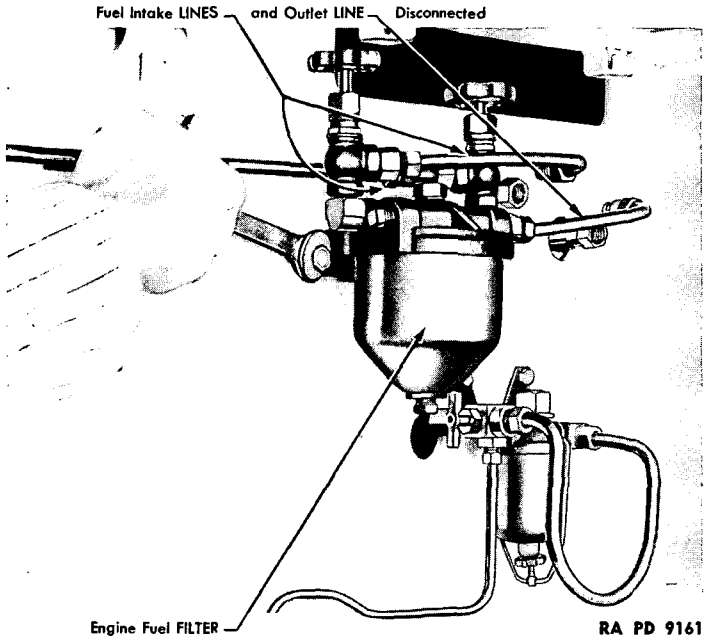


Figure 152 — Removing Engine Fuel Filter

cover on body over diaphragms and install 10 screws and lock washers. Install wire bail on upper cover by spreading it until ends slip into holes in cover. Install strainer assembly on upper cover. Install a new bowl gasket on upper cover and install bowl and cup washer. Tighten bail nut lightly. Replace pump body in vise, position a new bottom cover gasket and cover on body, and install 10 mounting screws and lock washers.

e. Install Fuel Pump.

WRENCH, open-end, ½-in.
WRENCH, socket, universal, ½-in.

Position a new fuel pump gasket on fuel pump mounting boss on engine front cover, while working through engine compartment rear doors. Position fuel pump on engine front cover so that rocker arm is resting on camshaft eccentric. Install 2 screws, heavy flat washers, and lock washers holding fuel pump to front cover. Connect fuel pump inlet and outlet lines to pump.

49. ENGINE FUEL FILTER.

a. Remove Engine Fuel Filter.

WRENCH, open-end, 9/16-in.
WRENCH, open-end, 5/8-in.
WRENCH, open-end, ¾-in.

(1) REMOVE FILTER.

Drain both fuel tanks (par. 44 g) before removing engine fuel filter. Disconnect pipe from right-hand fuel tank to fuel filter valve at fuel filter valve end, while holding fitting on valve, working in fighting compartment. Disconnect pipe from left-hand fuel tank to engine fuel filter valve at valve end, while holding fitting on valve. Disconnect pipe from outlet on engine fuel filter to connect through left-hand fuel tank at filter outlet end, while holding fitting on filter. Remove 2 screws, lock washers and flat washers holding engine fuel filter to bulkhead and remove filter (fig. 152).

b. Disassemble Engine Fuel Filter.

(1) REMOVE AND DISASSEMBLE INLET SHUT-OFF VALVES (FIRST TYPE M6 ONLY).

SCREWDRIVER
SCREWDRIVER, small
WRENCH, open-end, 3/4-in.
WRENCH, open-end, 1 11/16-in.
WRENCH, open-end, 1 3/4-in.

Screw both inlet valve assemblies off nipples and remove valve assemblies. Remove screw holding one inlet valve assembly handle on valve stem and remove handle from valve stem. Remove packing nut while holding stem and packing retainer from turning. Lift valve spring off valve stem. Unscrew valve stem and packing retainer from valve body while holding body. Screw stem out of packing retainer and remove packing from other end of retainer. Disassemble other inlet shut-off valve in same manner.

(2) REMOVE AND DISASSEMBLE INLET SHUT-OFF VALVE (SECOND TYPE M5 AND M8).

SCREWDRIVER
WRENCH, open-end, 9/16-in.
WRENCH, open-end, 11/16-in.
WRENCH, open-end, 3/4-in.
WRENCH, open-end, 1-in.
WRENCH, pipe

Remove inlet shut-off valve from fuel filter. Remove screw and lock washer holding dial valve pointer on valve. Remove pointer. Remove detent plunger and spring from pointer. Remove 2 screws and lock washers holding valve dial on valve. Remove valve stem packing nut. Remove packing from packing nut. Remove packing ring from valve stem. Remove valve stem retainer from valve. Remove valve tension spring from valve body. Remove valve and valve stem from valve body. Remove pin holding valve stem to valve. Remove fittings from valve body.

(3) DISASSEMBLE FUEL FILTER (fig. 154).

WRENCH, open-end, 9/16-in.
WRENCH, open-end, 11/16-in.
WRENCH, open-end, 3/4-in.

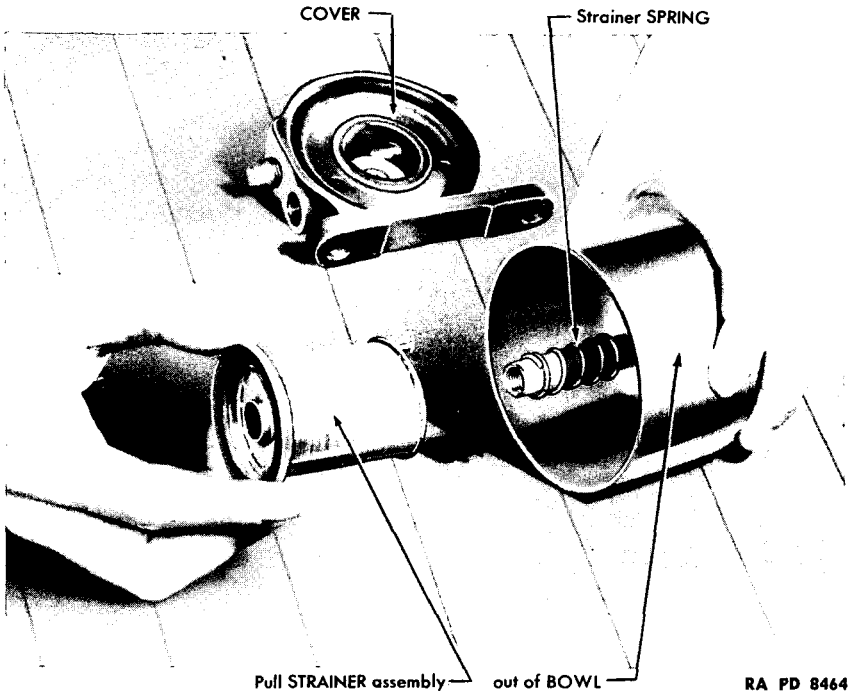


Figure 153 — Removing Fuel Filter Strainer

Remove inlet shut-off valve fittings from fuel filter body on first type M5 vehicles. Remove screw and gasket holding cover to bowl and remove cover and cover gasket. Remove plug from lower end of bowl. Lift strainer assembly and spring out of bowl (fig. 153). Remove strainer gasket from strainer assembly.

c. Inspect Engine Fuel Filter.

CLOTH, clean
PAN
SOLVENT, dry-cleaning

(1) CLEAN FUEL FILTER PARTS.

Clean all fuel filter parts thoroughly in SOLVENT, dry-cleaning, and dry with compressed air. Check all passages in filter cover for obstructions or dirt and clean as required.

(2) INSPECT FILTER PARTS.

Inspect filter cover for nicks, cracks, or burs. Inspect filter bowl for bends or damage on surface which contacts cover. Check laminated filter strainers to see that strainers are flat and form a close contact with each other.

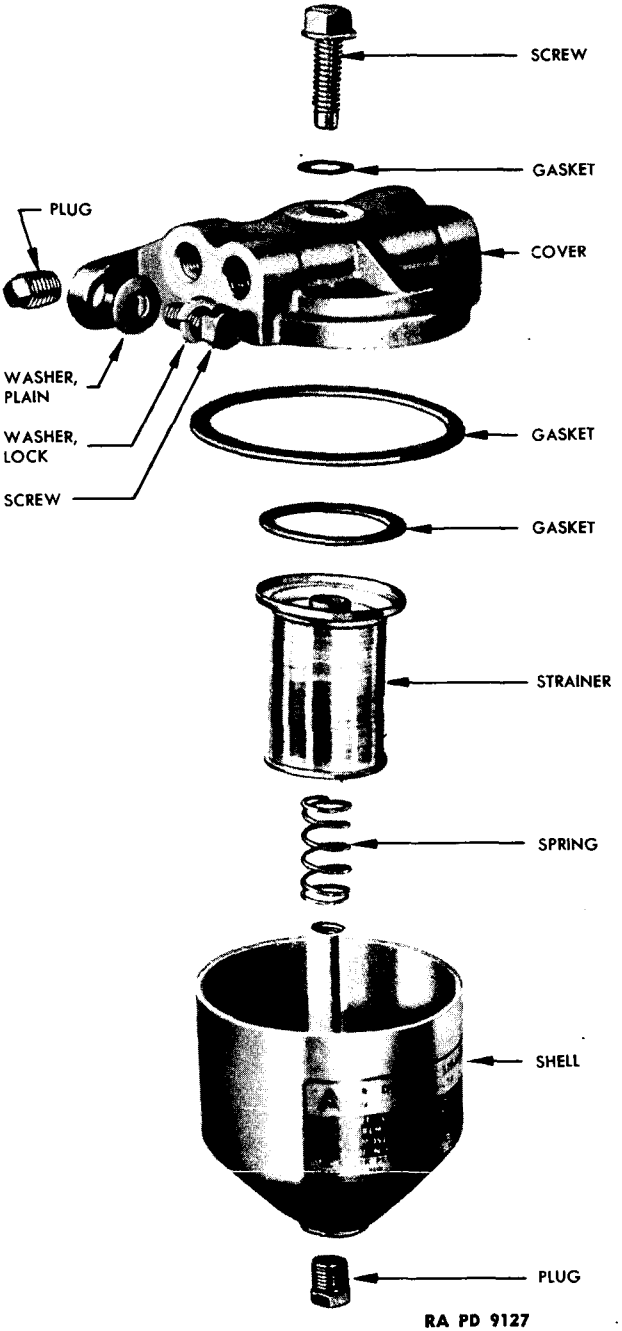


Figure 154 — Fuel Filter — Exploded View

FUEL SYSTEM

(3) INSPECT STRAINER SPRING.

Check free length of strainer spring. Free length should be 1½ inches. Compress spring to 1 1/16 inches, and measure pressure while compressed. Pressure should be 9.5 to 10.5 pounds.

(4) INSPECT FILTER VALVES.

Inspect valve stems and valve seats for evidence of damage or improper seating on first type M5 vehicles. Recut valve seat faces as required to obtain a good seal on first type M5 vehicles. Inspect tapered valve and valve seat on second type M5 vehicles. Check valve packing. If packing is worn and dried out, it should be replaced.

d. Assemble Engine Fuel Filter.

(1) INSTALL STRAINER ASSEMBLY AND BOWL ON FUEL FILTER COVER.

WRENCH, open-end, 9/16-in.
WRENCH, open-end, 11/16-in.
WRENCH, open-end, ¾-in.

Position a *new* strainer gasket on strainer assembly and install strainer assembly on fuel filter cover. Position spring over stems in bowl assembly. Position bowl on filter cover and install cover to bowl retaining screw and lock washers. Install drain plug in bowl.

(2) ASSEMBLE AND INSTALL INLET SHUT-OFF VALVES (FIRST TYPE M5 VEHICLES ONLY).

SCREWDRIVER
SCREWDRIVER, small
WRENCH, open-end, ¾-in.
WRENCH, open-end, 1 11/16-in.
WRENCH, open-end, 1¾-in.

Position a *new* inlet valve stem packing on packing retainer and screw valve stem into packing retainer assembly. Screw valve stem and packing retainer assembly into valve body while holding body. Install valve spring in body around valve stem and install packing nut while holding valve stem and packing retainer. Position valve assembly handle on valve stem and install mounting screw. Screw valve assembly on nipples on fuel filter. Assemble and install the other inlet shut-off valve in a like manner.

(3) ASSEMBLE AND INSTALL INLET SHUT-OFF VALVE (SECOND TYPE M5 AND ALL M8 VEHICLES).

SCREWDRIVER
WRENCH, open-end, 9/16-in.
WRENCH, open-end, 11/16-in.
WRENCH, open-end, ¾-in.
WRENCH, open-end, 1-in.
WRENCH, pipe

Install fittings on valve body. Elbow fitting to right fuel tank should be installed on upper end of valve when valve outlet points to right. Opening on elbow should point toward left. Position valve stem in valve and install lock pin. Install valve in valve body so that one

opening points *downward* and the other opening points toward *left* when valve outlet points toward *right*. Install valve tension spring on top of valve around valve stem. Install valve retaining nut. Install valve stem packing ring around valve stem. Install valve stem in packing nut. Install packing nut on valve retainer nut. Position dial on valve body and install 2 mounting screws and lock washers. Position valve pointer detent spring and plug in valve pointer. Position valve pointer on valve stem so that detent plug is in "OFF" position. Install valve pointer mounting screw and lock washer in valve stem. Install valve assembly on fuel filter.

e. Install Engine Fuel Filter.

WRENCH, open-end, 9/16-in. WRENCH, open-end, 3/4-in.
WRENCH, open-end, 5/8-in.

Position engine fuel filter on bulkhead and install 2 screws, lock washer, and flat washers holding filter to bulkhead, while working in fighting compartment. Connect fitting on filter outlet pipe to fitting on filter while holding filter fitting. Connect fitting on fuel line from left-hand fuel tank to filter valve at valve end, while holding valve fitting. Connect fitting on fuel line from right-hand fuel tank to valve on fuel filter at valve end while holding valve fitting. Install both fuel tank drain plugs and refill tanks.

50. AUXILIARY POWER PLANT FUEL FILTER.

a. Remove Auxiliary Power Plant Fuel Filter (M5 Only).

WRENCH, open-end, 7/16-in. WRENCH, open-end, 7/8-in.
WRENCH, open-end, 3/4-in.

Close fuel shut-off valve. Remove left 37-mm shell rack and bulkhead extension cover (on second type M5 vehicles only). Disconnect fuel line from auxiliary power plant carburetor to fuel filter at filter end, working in fighting compartment. Disconnect fuel line from fuel filter valve to filter at filter end. Remove 2 screws and lock washers holding filter mounting bracket to bulkhead (on first type M5) or to hull sidewall (on second type M5) and remove filter (fig. 55).

b. Disassemble Auxiliary Power Plant Fuel Filter (First Type M5 Only).

(1) REMOVE AND DISASSEMBLE INLET SHUT-OFF VALVE AND FUEL LINE.

WRENCH, open-end, 9/16-in. WRENCH, open-end, 11/16-in.
WRENCH, open-end, 5/8-in. WRENCH, open-end, 7/8-in.

FUEL SYSTEM

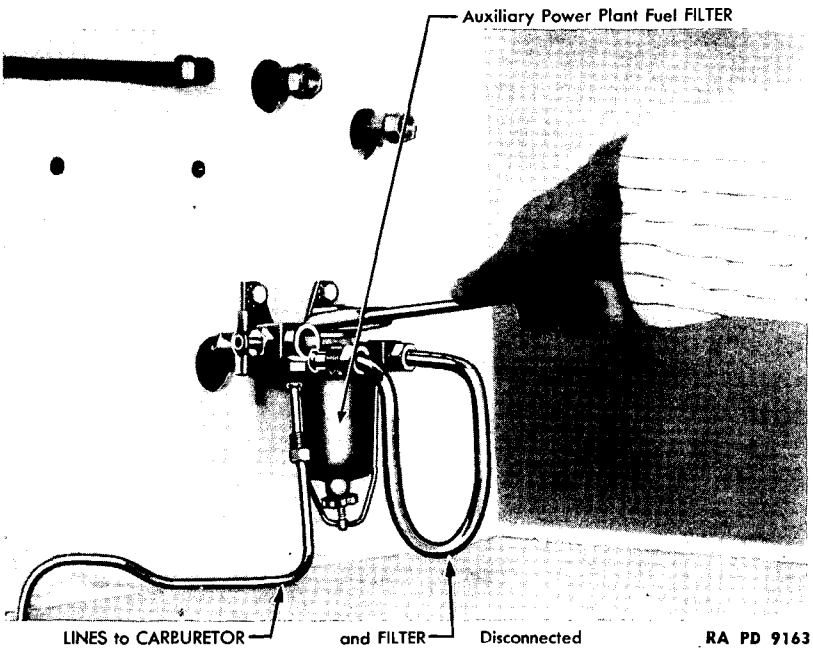


Figure 155 — Removing Filter for Auxiliary Power Plant

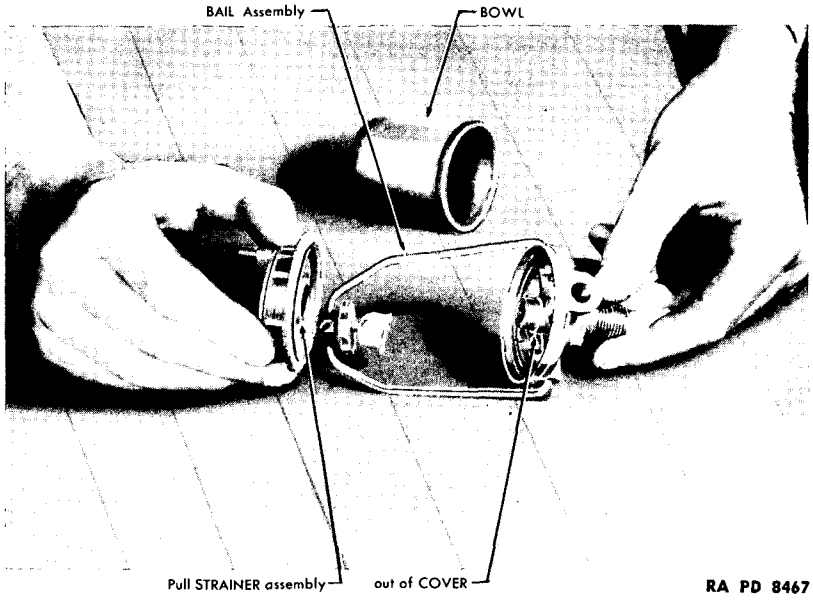


Figure 156 — Removing Strainer for Auxiliary Power Plant Filter

Close right-hand tank fuel valve and drain left-hand fuel tank as explained in paragraph 44. Remove coupling from inlet shut-off valve while holding fitting on filter line. Remove inlet shut-off valve stem retainer nut and remove valve handle and stem assembly. Disconnect fitting holding filter fuel line to elbow on filter body and remove fuel line.

(2) REMOVE AND DISASSEMBLE AUXILIARY POWER PLANT FUEL FILTER VALVE (SECOND TYPE M5 ONLY).

SCREWDRIVER
WRENCH, open-end, $^{11}/_{16}$-in.
WRENCH, open-end, $^{7}/_{16}$-in.
WRENCH, open-end, $^{3}/_{4}$-in.
WRENCH, open-end, $^{5}/_{8}$-in.

Disconnect fitting on fuel line from left-hand fuel tank to valve, at valve end, while holding fitting on valve, working in fighting compartment. Disconnect fitting on fuel line from valve to fuel filter at valve end while holding fitting on valve. Remove valve from valve block on sponson. Remove screw holding valve handle on valve stem and remove handle. Loosen packing nut lock nut and remove packing nut and lock nut. Remove valve packing spring. Remove valve stem retainer nut and valve assembly. Unscrew valve stem from retainer nut. Remove packing ring and packing from retainer nut.

(3) DISASSEMBLE FILTER.

WRENCH, $^{15}/_{16}$-in.
WRENCH, open-end, $^{11}/_{16}$-in.
WRENCH, open-end, $^{1}/_{2}$-in.

Remove inlet and outlet elbows from filter cover. Loosen bowl bail nut and swing bail to one side. Remove filter bowl from cover. Lift strainer assembly and gasket off filter cover (fig. 156). Spread upper end of bail where it is attached to cover until prongs of bail can be removed from holes in cover. Mark position of filter mounting bracket on cover and remove nut and lock washer holding mounting bracket to cover. Remove bracket.

c. Inspection, Auxiliary Power Plant Fuel Filter (M5 Only) (fig. 157).

CLOTH, clean
SOLVENT, dry-cleaning
PAN

Clean all fuel filter parts thoroughly in SOLVENT, dry-cleaning, and dry with compressed air. Inspect filter cover for nicks or burs. Check bowl for bends or irregularities which might cause poor contact with filter cover. Insert strainer assembly and gasket in filter cover to see that a good fit is obtained between strainer and cover. Inspect valve stem and seat for evidence of damage or poor valve seating. Recut

FUEL SYSTEM

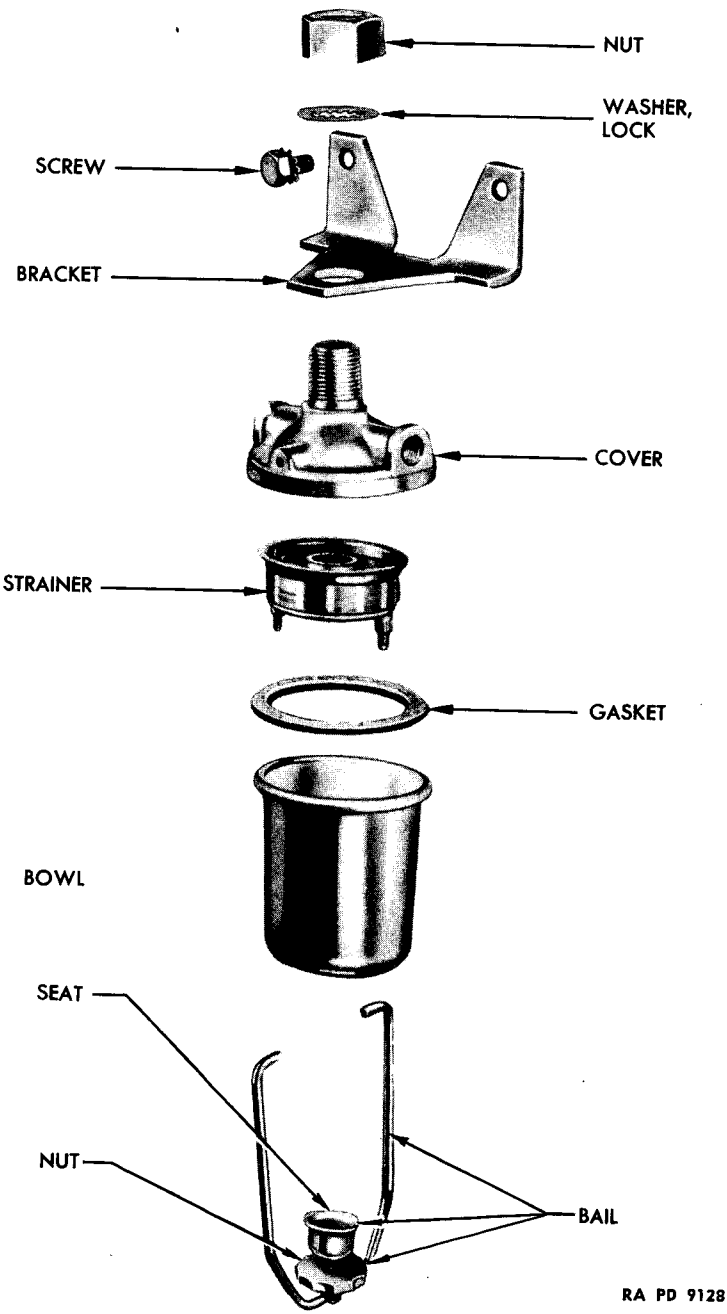


Figure 157 — Filter for Auxiliary Power Plant — Exploded View

valve stem seat as required. Check valve packing and replace if worn or dried out.

d. Assemble Auxiliary Power Plant Fuel Filter (M5 Only).

(1) ASSEMBLE FILTER.

PLIERS
WRENCH, open-end, ½-in.
WRENCH, open-end, $1\frac{1}{16}$-in.
WRENCH, open-end, $1\frac{5}{16}$-in.

Position filter mounting bracket on filter cover, lining up marks on cover and bracket which were made before bracket was removed. Install nut and lock washer holding bracket to filter cover. Spread prongs of bowl bail until prongs can be inserted in mounting holes in cover. Position a *new* strainer assembly gasket on filter cover and install strainer assembly on cover. Position a *new* filter bowl gasket on cover and install bowl on cover. Swing bowl bail over bowl and tighten bail nut. Install inlet and outlet elbows on filter cover.

(2) ASSEMBLE AND INSTALL INLET SHUT-OFF VALVE AND FUEL LINE ON FUEL FILTER.

WRENCH, $1\frac{1}{16}$-in.
WRENCH, ⅞-in.
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, ⅝-in.

Position inlet shut-off valve handle and stem assembly on valve body and install retainer nut. Install coupling on inlet shut-off valve while holding valve stationary on first type M5 vehicles. Connect fuel lines from inlet valve to filter cover at cover on second type M5 vehicles. Position inlet shut-off valve on fuel line and connect fitting.

e. Install Auxiliary Power Plant Fuel Filter (M5 Only).

WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, ¾-in.
WRENCH, open-end, ⅞-in.

Position auxiliary power plant fuel filter on bracket on bulkhead or on hull sidewall and install 2 screws and lock washers holding filter to wall, while working in fighting compartment. Connect fuel line from fuel filter valve to filter at filter end. Connect fitting on fuel line from auxiliary power plant carburetor to fitting on fuel filter. Open filter inlet shut-off valve. Install bulkhead extension cover and 37-mm shell rack.

51. FUEL LINES.

a. Remove Fuel Lines.

(1) REMOVE FUEL LINE FROM RIGHT-HAND FUEL TANK TO ENGINE FUEL FILTER VALVE.

WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, ½-in.
WRENCH, open-end, ⅝-in.
WRENCH, open-end, ¾-in.

Drain right-hand fuel tank as explained in paragraph 44 g until it is no more than ⅔ full. Remove 4 screws and lock washers holding

FUEL SYSTEM

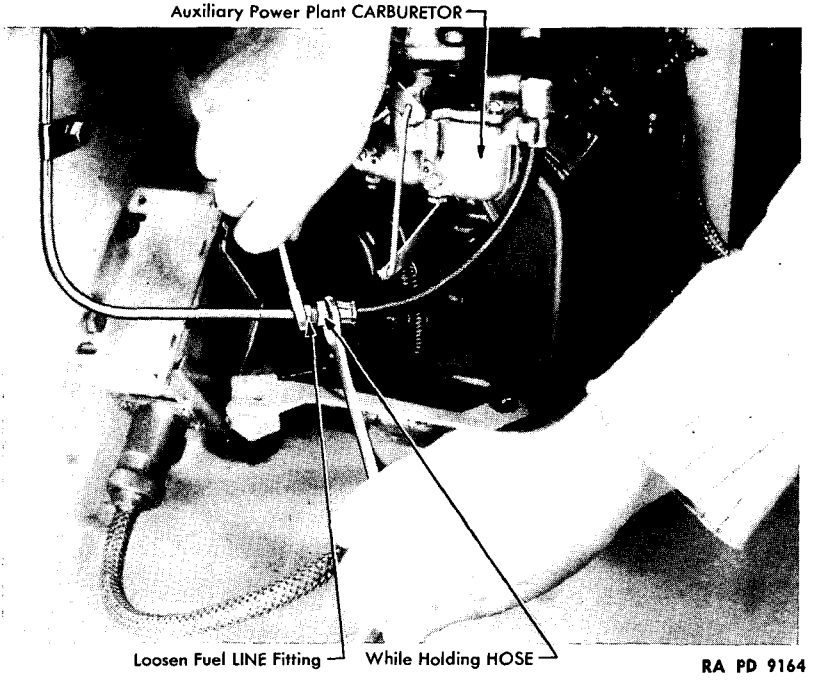


Figure 158 — Removing Fuel Line — Auxiliary Power Plant

radio cover plate over right-hand fuel tank outlet to bulkhead, working in fighting compartment. Disconnect fuel line from tank to filter valve at tank end, while holding fitting on tank. Disconnect fuel filter valve end of this line while holding fitting on valve. Remove 4 screws, lock washers and clips holding fuel line to bulkhead. Remove line.

(2) REMOVE FUEL LINE FROM LEFT-HAND FUEL TANK TO ENGINE FUEL FILTER.

WRENCH, open-end, 5/8-in. WRENCH, open-end, 3/4-in.

Drain left-hand fuel tank as explained in paragraph 44 g until it is no more than 2/3 full. Disconnect line from left fuel tank to valve on fuel filter at tank end, while holding fitting on tank outlet nipple, working in fighting compartment. Disconnect valve end of this line while holding fitting on valve. Remove line.

(3) REMOVE FUEL LINE FROM ENGINE FUEL FILTER TO LEAD THROUGH LEFT FUEL TANK.

WRENCH, open-end, 5/8-in. WRENCH, open-end, 3/4-in.

Close both filter shut-off valves on first type M5 vehicles or turn pointer of dial valve upward on second type M5 and all M8 vehicles.

Disconnect fuel line from engine fuel filter outlet to left fuel tank at tank end, while holding fitting on fuel tank inlet nipple, working in fighting compartment. Disconnect fuel filter outlet end of this line while holding fitting on filter. Remove line.

(4) REMOVE FUEL LINE FROM LEFT-HAND FUEL TANK TO FUEL PUMPS.

WRENCH, open-end, ½-in. WRENCH, open-end, ⅝-in.

Working through engine compartment rear doors, disconnect line leading down to right-hand fuel pump at pump, while holding fitting on pump. Disconnect line leading down to left-hand fuel pump at pump, in same manner. Disconnect upper end of this line at fitting at left-hand fuel tank, while holding fitting on tank. Remove 3 screws, lock washers, and clips holding line to radiator rear support. Remove screw, lock washer and clip holding line to engine compartment right sidewall. Remove fuel line.

(5) REMOVE FUEL LINES FROM FUEL PUMPS TO CARBURETORS.

WRENCH, open-end, ½-in.

Disconnect line from left-hand fuel pump to left-hand carburetor at fuel pump end, working through engine compartment rear doors. Disconnect carburetor end of this line. Remove line. Remove line from right-hand fuel pump to right-hand carburetor in the same manner.

(6) REMOVE FUEL LINE FROM LEFT-HAND TANK TO AUXILIARY POWER PLANT FUEL FILTER (FIRST TYPE M5 ONLY).

WRENCH, open-end, ⅝-in. WRENCH, open-end, ¾-in.

Disconnect fuel line from left-hand fuel tank to auxiliary power plant fuel filter at fuel tank end, while holding fitting on fuel tank outlet nipple, working in fighting compartment. Disconnect filter end of this line. Remove line.

(7) REMOVE FUEL LINE FROM LEFT-HAND FUEL TANK TO AUXILIARY POWER PLANT FUEL FILTER VALVE (SECOND TYPE M5 ONLY).

WRENCH, open-end, 7/16-in. WRENCH, open-end, ¾-in.
WRENCH, open-end, ⅝-in.

Remove fitting on fuel line from left-hand fuel tank to auxiliary power plant fuel filter valve at tank end, while holding fitting on tank nipple. Remove fitting on valve end of this line while holding fitting on valve.

(8) REMOVE FUEL LINE FROM AUXILIARY POWER PLANT FUEL FILTER TO AUXILIARY POWER PLANT CARBURETOR (FIRST TYPE M5 ONLY).

WRENCH, open-end, 7/16-in. WRENCH, socket, ½-in.
WRENCH, open-end, ½-in.

FUEL SYSTEM

Disconnect fuel line from auxiliary power plant fuel filter to auxiliary power plant carburetor at filter end, working in fighting compartment. Disconnect carburetor end of this line (fig. 158). Remove 2 screws, lock washers and clips holding line to fighting compartment sidewall. Remove fuel line.

(9) REMOVE FUEL LINE FROM AUXILIARY POWER PLANT FUEL FILTER VALVE TO FILTER (SECOND TYPE M5 ONLY).

WRENCH, open-end, 7/16-in. WRENCH, open-end, 5/8-in.
WRENCH, open-end, 1/2-in.

Disconnect fitting on fuel line from auxiliary power plant fuel filter valve to filter at valve end while holding fitting on valve. Disconnect fitting on filter end of this line while holding fitting on filter. Remove screws and washers holding fuel line mounting clips to hull sidewall and remove fuel line.

b. Inspect Fuel Lines.

Force compressed air through all fuel lines to make sure all dirt and grit is removed. Inspect flared ends on all fuel lines to make sure they are in good condition. If flares are cracked, rough or damaged so that a good seal cannot be obtained, the lines should be replaced. Check fuel line connections to make sure that threads are in good condition.

c. Install Fuel Lines.

(1) INSTALL FUEL LINE FROM RIGHT-HAND TANK TO FILTER VALVE.

WRENCH, open-end, 7/16-in. WRENCH, open-end, 5/8-in.
WRENCH, open-end, 1/2-in. WRENCH, open-end, 3/4-in.

Position fuel line on bulkhead and install 4 clips, screws and lock washers holding line to bulkhead, while working in fighting compartment. Connect fitting on tank end of line to fitting on right-hand fuel tank, while holding tank fitting stationary. Connect fitting on filter valve end of line to fitting on valve, while holding valve fitting. Position radio mounting plate on bulkhead over right-hand fuel tank outlet, and install 4 screws and lock washers holding plate to bulkhead.

(2) INSTALL FUEL LINE FROM LEFT-HAND FUEL TANK TO FILTER.

WRENCH, open-end, 5/8-in. WRENCH, open-end, 3/4-in.

Position line between filter and tank, while working in fighting compartment. Connect fitting on tank end of line to fitting on tank outlet nipple, while holding nipple. Connect fitting on valve end of line to fitting on filter valve, while holding valve fitting.

(3) INSTALL FUEL LINE FROM FILTER TO LEFT-HAND FUEL TANK.

WRENCH, open-end, 5/8-in. WRENCH, open-end, 3/4-in.

Position fuel line between filter and tank, while working in fighting compartment. Connect fitting on tank end of line to tank inlet nipple,

while holding nipple. Connect fitting on filter outlet end of line, while holding fitting on filter.

(4) INSTALL FUEL LINE FROM LEFT-HAND TANK TO FUEL PUMPS.

WRENCH, open-end, ½-in. WRENCH, socket, ½-in.
WRENCH, open-end, ⅝-in.

Position fuel line assembly on engine radiator rear support, while working through engine compartment rear doors. Install 3 clips, screws and lock washers holding line to support. Install clip, screw, and lock washer holding line to engine compartment right-hand sidewall. Connect fitting on fuel tank end of line to fitting on nipple at tank, while holding nipple fitting. Connect fitting on right-hand flexible line to fitting on right-hand engine fuel pump, while holding fuel pump fitting stationary. Connect flexible center line to fitting on left-hand fuel pump, while holding fuel pump fitting.

(5) INSTALL FUEL LINES FROM FUEL PUMPS TO CARBURETORS.

WRENCH, open-end, ½-in.

Position line from left-hand fuel pump to left-hand carburetor between pump and carburetor, while working through engine compartment rear doors. Connect fitting on carburetor end of line to fitting on carburetor, while holding carburetor fitting. Connect fitting on fuel pump end of line to fitting on fuel pump, while holding fuel pump fitting. Install line from right-hand fuel pump to right-hand carburetor in the same manner.

(6) INSTALL FUEL LINE FROM LEFT-HAND TANK TO AUXILIARY POWER PLANT FUEL FILTER VALVE (SECOND TYPE M5 ONLY).

WRENCH, open-end, 7/16-in. WRENCH, open-end, ⅝-in.
WRENCH, open-end, ½-in.

Connect fitting on fuel tank end of fuel line to fitting on fuel tank outlet nipple, while holding fitting, working in fighting compartment. Connect fitting on filter valve end of this line to fitting on fuel filter valve, while holding valve fitting.

(7) INSTALL FUEL LINE FROM AUXILIARY POWER PLANT FUEL FILTER VALVE TO FILTER (SECOND TYPE M5 ONLY).

WRENCH, open-end, 7/16-in. WRENCH, socket, ½-in.
WRENCH, open-end, ½-in.

Position fuel line between filter valve and filter, and install 2 clips, clip mounting screws and lock washers holding line to hull sidewall. Connect fitting on fuel line to fitting on fuel filter, while holding filter fitting. Connect fitting on fuel line to fitting on fuel filter valve, while holding fitting on valve block. Install bulkhead extension cover and 37-mm shell racks.

(8) INSTALL FUEL LINE FROM AUXILIARY POWER PLANT FILTER TO CARBURETOR (FIRST TYPE M5).

WRENCH, open-end, 7/16-in.
WRENCH, socket, 1/2-in.
WRENCH, open-end, 1/2-in.

Position fuel line in place on left-hand fighting compartment sidewall, and install 2 clips, screws and lock washers holding line to sidewall, while working in fighting compartment. Connect fitting on carburetor end of line to fitting on carburetor, while holding carburetor fitting. Connect fitting on filter end of line to fitting on filter, while holding filter fitting.

52. FUEL TANK.

a. Remove Fuel Tank.

(1) DRAIN FUEL TANK. Refer to paragraph 44 g.

(2) REMOVE ENGINE COMPARTMENT COVER.

HAMMER
HOIST
PUNCH
SCREWDRIVER, T-handle, 7/8- x 3/32-in. blade
SLING, B226796
WRENCH, socket, 3/4-in.

On first type M5 vehicles, remove 34 engine compartment cover mounting screws, working from top of vehicle. NOTE: Mounting screws with screwdriver slots can be loosened most effectively by using a hammer and punch before using screwdriver. Remove fuel tank filler caps. Hook sling B226796, under handles on cover and remove engine compartment cover. On second type M5 and all M8 vehicles, remove 14 screws holding fuel tank cover to mounting brackets on top of hull and lift off cover. Remove 6 screws holding forward hinged section of engine compartment to top of hull and swing forward section back over rear section.

(3) REMOVE FUEL TANK COVER MOUNTING BRACKETS.

SCREWDRIVER, T-handle, 7/8- x 3/32-in. blade
WRENCH, 3/4-in.

Remove 3 screws holding outer front fuel tank cover mounting bracket to outer sponson wall and remove bracket, working from top of vehicle. Remove 3 screws holding outer rear bracket to outer sponson wall and remove bracket. Remove 3 screws holding inner rear bracket to inner sponson wall and remove bracket.

(4) DISCONNECT FUEL LINES.

WRENCH, open-end, 7/16-in.
WRENCH, open-end, 3/4-in.
WRENCH, open-end, 5/8-in.
WRENCH, pipe

Remove 4 screws and lock washers holding cover plate over fuel tank outlet fitting, and remove plate, working in fighting compartment (right-hand fuel tank only). Disconnect fuel line from fuel tank to fuel filter

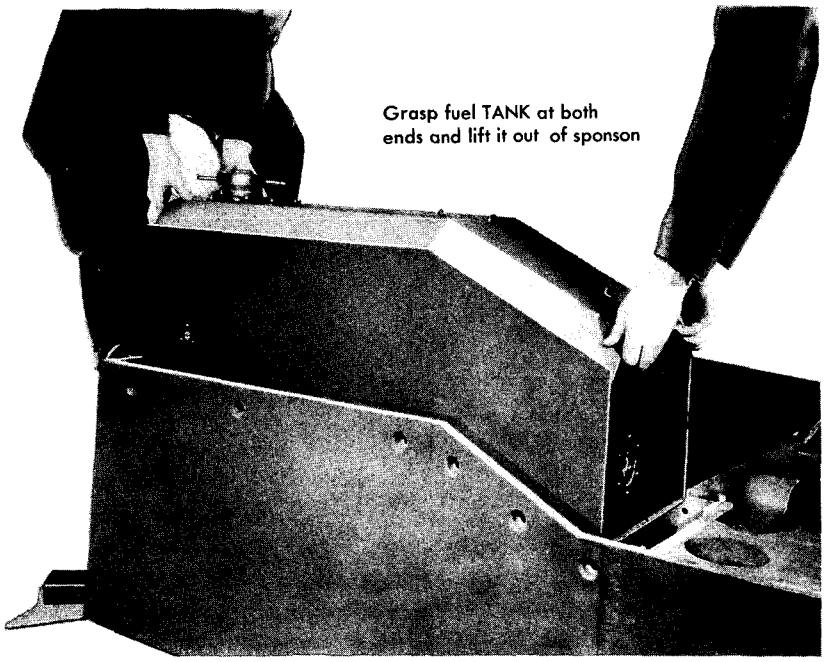


Figure 159 — Removing Fuel Tank

at tank end while holding fitting on tank. Remove fuel line nipple from front end of fuel tank. Disconnect fuel line from fuel filter outlet to fuel tank at tank end, while holding fitting on tank (left-hand tank only). Disconnect fuel line from left fuel tank to fuel pumps at tank end, while holding fitting on tank pipe, working from top of vehicle (left-hand tank only). Remove nipple from side of fuel tank (left-hand tank only).

(5) REMOVE REAR FUEL TANK SHIM.

WRENCH, $\frac{9}{16}$-in.

Loosen 4 screws and lock washers holding fuel tank rear shim retainer plate to brackets on sponson walls, working from top of vehicle. Push retainer plate toward rear of vehicle. Lift fuel tank rear shim out from behind fuel tank.

(6) REMOVE FUEL TANK.

Push fuel tank rearward slightly and lift out of sponson (fig. 159). Remove front, side, and bottom fuel tank shims from sponson.

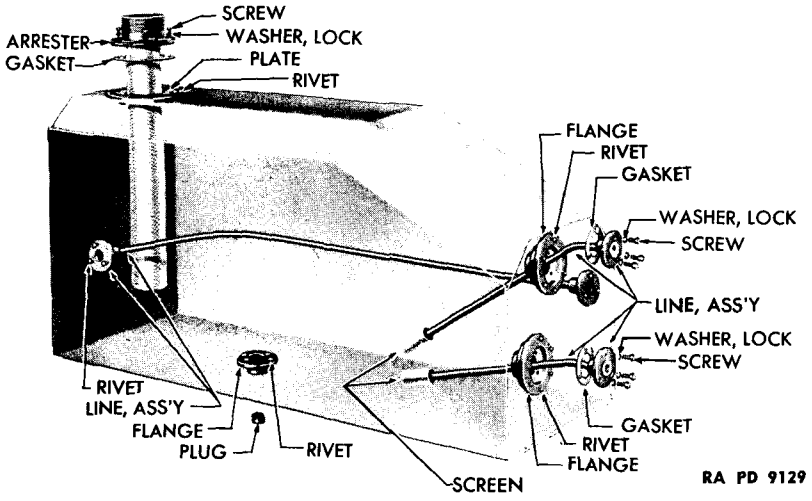


Figure 160 — Left-Hand Fuel Tank

b. Disassemble Fuel Tank.

NOTE: The fuel tanks are of brazed construction and, therefore, cannot be disassembled unless new plates are again brazed in place. The outlet lines, screens and drain plugs can be removed, however, as follows:

(1) DISASSEMBLE RIGHT-HAND FUEL TANK.

SCREWDRIVER
WRENCH, socket, 7/16-in.
WRENCH, socket head set screw, 9/16-in.

Straighten brackets holding both top fuel tank wooden shims in position and remove shims. Remove 3 screws and lock washers holding fuel tank outlet screen assembly and gasket and take out of fuel tank. Remove drain plug from bottom of fuel tank. Remove 6 screws and washers holding flame arrester and inlet assembly to plate on top of fuel tank. Remove flame arrester assembly and gasket.

(2) DISASSEMBLE LEFT-HAND FUEL TANK.

SCREWDRIVER
WRENCH, socket, 7/16-in.
WRENCH, socket head set screw, 9/16-in.

NOTE: The left-hand fuel tank is disassembled in exactly the same manner as the right-hand fuel tank with the following additions on Light Tank M5 fuel tanks: Remove 3 screws and lock washers holding auxiliary power plant outlet screen assembly and gasket from fuel tank (fig. 160).

c. Inspect Fuel Tank.

Inspect brazed joints of fuel tank to make sure that they are not leaking. Check screen on outlet pipe assembly and replace if broken or

damaged in such a way that sediment in the fuel tank could pass into the fuel lines. Inspect the vent in the fuel tank filler cap to make sure it is open. Inspect condition of mounting flanges on outlet pipe assembly and flame arrester inlet to make sure they are smooth and flat. Remove any nicks or burs with a fine file. For cleaning of tanks refer to Technical Manual No. 9-1726F, Ordnance Maintenance—Fuel and Lubrication Systems for Light Tanks M3 and M3A1 and Related Gun Motor Carriages.

d. Assemble Fuel Tank.

(1) ASSEMBLE RIGHT-HAND FUEL TANK.

HAMMER
WRENCH, socket, 7/16-in.
WRENCH, socket head set screw, 9/16-in.

Position a new flame arrester and inlet assembly gasket on top of fuel tank. Install flame arrester and inlet assembly in fuel tank and install 6 screws and washers holding assembly to tank. Install drain plug in bottom of fuel tank. Position a new fuel tank outlet screw assembly gasket on front end of fuel tank and install outlet screen assembly in front of tank. Install 3 screws and lock washers holding screen assembly to tank. Position both top fuel tank wooden shims in position on tank and bend brackets over notches in shims.

(2) ASSEMBLE LEFT-HAND FUEL TANK.

HAMMER
WRENCH, socket, 7/16-in.
WRENCH, socket head set screw, 9/16-in.

NOTE: The left-hand fuel tank is assembled in exactly the same manner as the right-hand fuel tank with the following additions: Position a *new* auxiliary power plant outlet screen assembly gasket on front end of fuel tank and position outlet screen assembly in fuel tank (M5 only). Install the 3 screws and lock washers which hold auxiliary plant outlet screen assembly to flange on fuel tank (M5 only).

e. Install Fuel Tank.

(1) INSTALL FUEL TANK AND TIGHTEN REAR SHIM RETAINER.

WRENCH, 9/16-in.

Position front, side and bottom fuel tank shims in sponson, while working from top of vehicle. Lower fuel tank into position in sponson and push forward as far as possible. Position fuel tank rear shim behind fuel tank and tighten 4 screws and lock washers holding fuel tank rear shim retainer plate to bracket on sponson walls.

(2) CONNECT FUEL LINES.

WRENCH, 7/16-in.
WRENCH, open-end, 5/8-in.
WRENCH, open-end, 3/4-in.
WRENCH, pipe

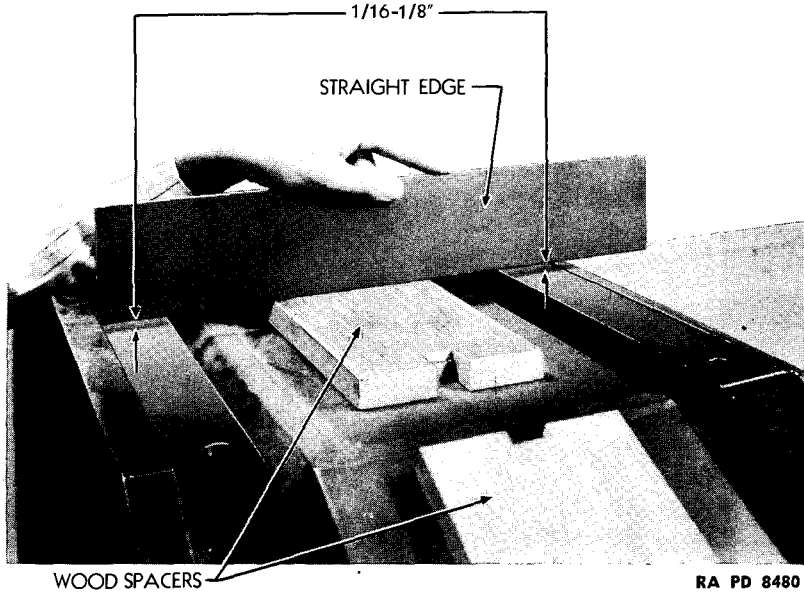


Figure 161 — Installing Fuel Tank Shims

Install nipple on left side of fuel tank, while working from top of vehicle (left tank only). Connect fuel line from left-hand fuel tank to fuel pumps at tank end, while holding fitting on nipple on left-hand side of tank (left tank only). Connect fitting on fuel line from engine fuel filter outlet to fuel tank at tank end, while holding fitting on tank, working in fighting compartment (left tank only). Install fuel line nipple on front end of fuel tank. Connect fuel line from fuel tank to auxiliary power plant fuel filter valve at tank end, while holding fitting on tank, on M5 vehicles only. Position radio mounting plate over right-hand fuel tank outlet fitting on bulkhead and install 4 screws and lock washers which hold plate to bulkhead (right tank only).

(3) INSTALL FUEL TANK COMPARTMENT COVER MOUNTING BRACKETS AND CHECK FUEL TANK ALINEMENT.

HAMMER
SCREWDRIVER
SCREWDRIVER, T-handle with 7/8- x 3/32-in. blade
STRAIGHTEDGE
WRENCH, open-end, 3/4-in.

Position inner rear fuel tank compartment cover mounting bracket on inner sponson wall and install 3 screws and lock washers holding bracket to wall, while working on top of vehicle. Position inner front cover mounting bracket on inner sponson wall and install 3 screws and lock washers holding bracket to wall. Position outer rear cover mounting

bracket on outer sponson wall and install 3 screws and lock washers holding bracket to wall. Position outer front cover mounting bracket on outer sponson wall and install 3 screws and lock washers holding bracket to wall. Lay a straightedge on inner and outer rear engine compartment cover mounting brackets and over top shim on fuel tank. Straightedge should rest on shim on top of fuel tank and should have between 1/16-inch and 1/8-inch clearance between lower edge of straightedge and top of inner and outer mounting brackets as shown in figure 161. If clearance is not correct, straighten clips holding top fuel tank wooden shim to fuel tank and remove wooden shim. Remove or install paper shims between top of fuel tank and wooden shim until the proper clearance is obtained. Install wooden shim, bend over mounting clips, and recheck fuel tank alinement.

(4) INSTALL BULKHEAD DOORS AMMUNITION RACK AND BULKHEAD COVER.

WRENCH, open-end, 9/16-in.

Position lower end of left-hand bulkhead door on brackets on bulkhead and move upper end of door to closed position, while working in fighting compartment. Turn release latch handle 180 degrees to lock bulkhead door in position. Install right-hand door in a similar manner. Position bulkhead extension cover in place on bulkhead extension walls. Install 5 screws and lock washers holding bulkhead extension cover to bulkhead extension and bulkhead. Position left-hand ammunition rack in place on bulkhead and left-hand engine compartment sidewall. Install 3 screws and lock washers holding ammunition rack to bulkhead in left fighting compartment sidewall.

(5) INSTALL ENGINE COMPARTMENT COVER (FIRST TYPE M5 VEHICLES).

HOIST SLING, B226796
SCREWDRIVER, T-handle with
7/8- x 3/32-in. blade

Apply a liberal coating of caulking or sealing compound on cover mounting brackets and top of hull where cover rests. Hook sling under lifting handles on engine compartment cover and connect a hoist to sling. Lift cover into position on vehicle and install 34 mounting screws, using a T-handle screwdriver, while working from top of vehicle. Install fuel tank filler caps.

(6) INSTALL FUEL TANK COMPARTMENT COVER (SECOND TYPE M5 AND ALL M8 VEHICLES).

WRENCH, socket, 3/4-in.

Apply a liberal coating of caulking or sealing compound on fuel tank cover mounting brackets and top of hull where forward hinged section

of engine compartment rests. Position fuel tank cover on top of hull and install 14 mounting screws. Swing forward hinged section of engine compartment cover into position and install 5 mounting screws.

53. LIMITS AND TOLERANCES.

a. Carburetor.

Float level bowl cover to float seam
- First type ..... 9/64 in.
- Second type ..... 1/4 in.

Air horn air vents
- Outside vents (first type only) ..... 0.1285 in. diam
- Inside vents (first type only) ..... 0.110 in. diam
- Inside vents (second type only) ..... 0.221 in. diam

Intake needle valve seat
- Opening diameter ..... 0.1015 in.

Low speed jet tube
- Jet size (first type) ..... 0.028 in.
- Jet size (second type) ..... 0.031 in.
- Bypass size (first type) ..... 0.052 in.
- Bypass size (second type) ..... 0.055 in.
- Economizer size (first type) ..... 0.042 in.
- Economizer size (second type) ..... 0.0465 in.
- Idling bleed size ..... 0.052 in.

Idle port, upper
- Length ..... 0.156 in.
- Width ..... 0.030 in.

Idling port opening ..... 0.100 to 0.106 (above closed throttle valve)

Idling port, lower ..... 0.0615 to 0.0655 in.

Throttle lever length ..... 1 1/4 in.

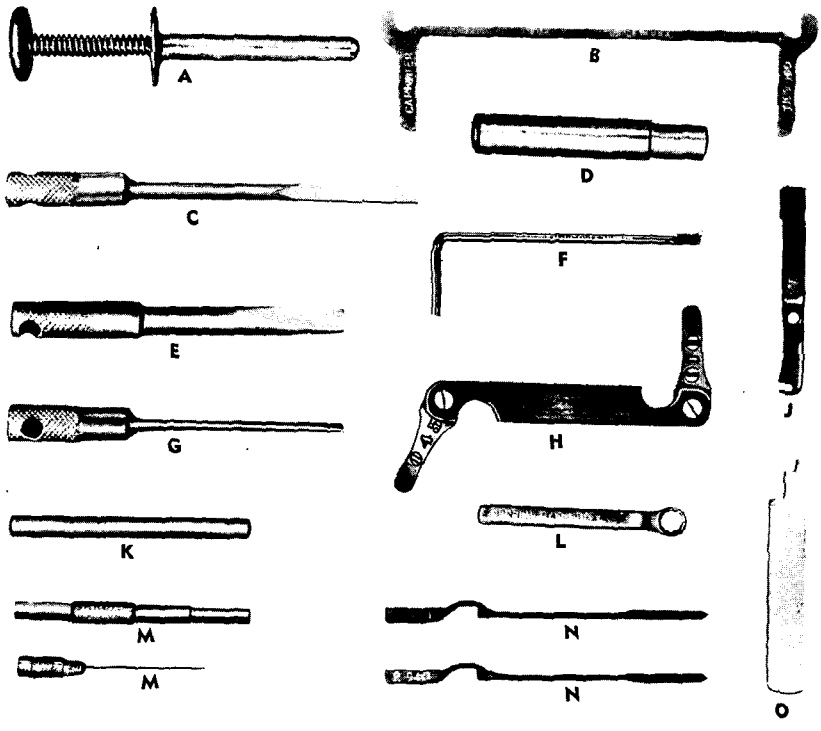
Metering rods
- Economy step size ..... 0.070 in.
- Middle step size ..... 0.0625 in.
- Power step size (first type) ..... 0.054 in.
- Power step size (second type) ..... 0.042 in.

Metering rod jet size (first type) ..... 0.089 in.

Metering rod jet size (second type) ..... 0.0935 in.

Metering rod setting (jet to arm) ..... 2.940 in.

Throttle pump
- Discharge jet ..... 0.028 in.
- Intake jet ..... 0.0595 in.
- Discharge needle seat ..... 0.0595 in.



A — HOLDER, CHOKE AND THROTTLE VALVE SCREWS
B — GAUGE, FLOAT LEVEL, 9/64-IN.
C — WRENCH, JET, 1/4-IN.
D — INSTALLER, BALL CHECK RETAINER
E — WRENCH, JET, 11/32-IN.
F — REMOVER, BALL RETAINING RING
G — WRENCH, JET, 3/16-IN.
H — GAUGE, FAST IDLE AND UNLOADER
J — TOOL, METERING ROD ARM BENDING
K — HANDLE, JET WRENCH
L — WRENCH, LOW SPEED JET
M — GAUGE, CHOKE VALVE AND FAST IDLE
N — GAUGES, METERING ROD
O — GAUGE, THROTTLE PUMP, CASE, LEATHERETTE (NOT ILLUSTRATED)

Figure 162 — Fuel System Tools RA PD 50336

Pump adjustment ..... 3/8 in.
Choke heat suction hole (first type) ..... 0.0935 in.
Choke heat suction hole (second type) ..... 0.098 in.

b. Fuel Pump.

Diaphragm spring
Free length ..... 2 in.
Pressure, compressed to 1 1/16 in. ..... 24 to 26 lb

FUEL SYSTEM

Rocker arm spring
- Free length ..... 1¼ in.
- Solid height ..... ⅝ in.

Rocker arm
- Pin hole ..... 0.346 to 0.3475 in.
- Length (center of pin hole to end of arm) ..... 4¾ in.

Body and covers
- Warped, not over ..... 0.005 in.

Diaphragm
- Airtight, under pressure of ..... 8 lb

c. Engine Fuel Filter.

Retainer spring
- Free length ..... 1½ in.
- Pressure, compressed to 1 1/16 in. ..... 9.5 to 10.5 lb

Cover warped, not over ..... 0.005 in.

Bowl, cover end bent, not over ..... 0.005 in.

Leakage
- Filter must not leak under pressure of ..... 10 lb

54. SPECIAL TOOLS.

a. The only special fuel system tools are a set of carburetor tools as follows:

KIT, tool, Carter carburetor repair, A266508, consists of 1 each of the following:

CASE, leatherette, B226892
GAGE, accelerator pump, A293013
GAGE, choke valve and fast idling, A293006
GAGE, fast idling (0.045) and unloader, A293009
GAGE, float level, 9/64-in., A293011
GAGES, metering rod (2 per kit), A293012
HANDLE, jet wrench, A293004
HOLDER, screw, butterfly valve, A293010
INSTALLER, ball check retainer, A293005
RING, ball retaining, A293008
TOOL, metering bending, A293007
WRENCH, jet, 3/16-in., A293014
WRENCH, jet, ¼-in., A293001
WRENCH, jet, 11/32-in., A293002
WRENCH, low speed jet, A293003

b. Other special tools are required, however, to remove various parts of the vehicle before servicing the fuel system. These include the following:

GAGE, pin, throttle control adjusting, A266522
HOOK, sling, B226799
SLING, engine compartment cover, B226796
THIMBLE, pilot, B226792

55. PREPARATIONS FOR EXTREME CONDITIONS.

a. Extreme Heat. The only special preparation that is necessary to protect the fuel system under conditions of extreme heat is to check the vents in the fuel tank filler caps frequently to make sure that they are open and clean. Use fuel of low vapor pressure.

b. Extreme Cold. Preparation of the fuel system for extreme cold includes use of correct fuel and correct oil in the air cleaners for low temperatures. Use high vapor pressure winter fuel. All of these items are covered in Technical Manual No. 9-732 Light Tank M5.

c. Extreme Sand or Dust. Under conditions of extremely sandy or dusty operation, frequent cleaning of the carburetor and auxiliary power plant air cleaners is necessary. These must be cleaned at every opportunity, as often as several times a day if possible. The fuel filters and the fuel tanks for the engines and auxiliary power plant should also be cleaned more frequently than during normal operation, because of the possibility of sand or dust entering the fuel tanks while fuel is being added.

d. Underbrush. When the vehicle is operated through heavy underbrush or is camouflaged with leaves, branches, or other materials, the filler tank vents should be checked frequently as explained in subparagraph **c** above.

e. Submersion. If any fuel system parts have been submerged in either salt or fresh water, the parts should be disassembled, cleaned, and dried thoroughly as soon as possible after submersion. Any metal parts, except those which are die-cast or made of copper or brass, should be coated with oil immediately in order to prevent corrosion.

56. PACKING, SHIPPING, AND STORAGE.

a. All component parts of the fuel system are packed in wooden boxes for shipment or storage. These boxes are lined with waterproof paper and made with tongue and groove boards to insure a good seal. Whenever possible, these boxes should be saved for use in reshipment of fuel system component parts.

FUEL SYSTEM

(1) Before parts are packed for reshipment or storage, the protective measures given for each part in step b below should be performed.

(2) All parts with the exception of fuel tanks should be individually wrapped in nonoxide cloth and packed in individual cardboard cartons. After the parts are wrapped and boxed individually, they should be labeled as to contents before being packed in large wooden boxes. When the individual cartons have been packed in large wooden boxes, the extra space should be filled with paper or other material to prevent the cartons from shaking around inside the box. The waterproof paper must then be closed over the contents and sealed with waterproof cement or scotch tape before installing cover on box.

b. When the component parts of the fuel system are to be removed from the vehicle and then packed for shipment or storage, the following measures should be taken:

(1) Drain all fuel from carburetor, fuel pump, fuel filters, fuel lines, and tanks.

(2) Clean parts as necessary.

(3) Dip carburetor and fuel pump in OIL, engine, SAE 10, and shake well. Allow parts to drain at least 30 minutes.

(4) Coat all unpainted parts with light oil.

(5) Cover all openings with waterproof tape.

(6) When packing fuel tanks, coat bare parts with COMPOUND, rust-preventive, heavy, rather than light oil. Place shims beneath and above tank to hold it in place before box is sealed.

c. When the carburetor and fuel pump are to be stored or shipped while on an engine, use the regular engine storing procedure, as explained in Technical Manual No. 9-1727A (now published as Technical Manual No. 9-1732A), Ordnance Maintenance — Engine, Exhaust System and Ignition System for Light Tanks M5 and M5A1, and 75-mm Howitzer Motor Carriage M8.

Section V

REFERENCES

57. STANDARD NOMENCLATURE LISTS.

a. Armament.

Gun, machine, cal. .30, Browning, M1919A4, fixed and flexible, and M1919A5, fixed, and ground mounts ..... SNL A-6

Gun, machine, cal. .50, Browning, M2, heavy barrel, fixed and flexible, and ground mounts..... SNL A-39

Gun, submachine, cal. .45, Thompson, M1928A1, and M1 ..... SNL A-32

Gun, 37-mm, M5 and M6, and cradle, tank, 37-mm, T2 ..... SNL A-45

Howitzer (pack), 75-mm, M1 and M1A1; and carriage, howitzer (pack), 75-mm, M1..... SNL C-20

b. Maintenance.

Cleaning, preserving and lubricating materials, recoil fluids, special oils, and miscellaneous related items ..... SNL K-1

Soldering, brazing and welding material, gases, and related items ..... SNL K-2

Tools, maintenance, for repair of automatic guns, automatic gun antiaircraft materiel, automatic and semiautomatic cannon, and mortars..... SNL A-35

Truck, small-arms repair, M1 ..... SNL G-72

c. Vehicle Materiel.

Carriage, motor, 75-mm, howitzer, M8..... SNL G-127

Tank, light, M5 ..... SNL G-103 Vol. II

Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained as the "Ordnance Publication for Supply Index" ..... OPSI

REFERENCES

58. EXPLANATORY PUBLICATIONS.

a. Armament.

Browning machine gun, cal. .30, HB, M1919A4 (mounted in combat vehicles)	FM 23-50
Browning machine gun, cal. .50, HB, M2 (mounted in combat vehicles)	FM 23-65
Grenades	FM 23-30
Instruction guide, small-arms data	TM 9-2200
Ordnance maintenance — 37-mm gun materiel (tank) M5 and M6	TM 9-1250
Thompson submachine gun, cal. .45, M1928A1	FM 23-40
37-mm gun, tank, M6 (mounted in tanks)	FM 23-81
75-mm howitzer materiel	TM 9-320

b. Communications.

Interphone equipment RC-39	TM 11-550
Radio fundamentals	TM 11-455
Radio set, SCR-506	TM 11-630
Radio set, SCR-510	TM 11-605
Radio sets SCR-210-A, -B, -C, -D, -E, -F, -G, -H, and -J; and Radio sets SCR-245-A, -B, -C, -D, -E, -F, -G, -H, -J, -K, -L, -M, -N, and -P	TM 11-272
Radio sets, SCR-508, SCR-528 and SCR-538	TM 11-600
The radio operator	TM 11-454

c. Maintenance.

Automotive brakes	TM 10-565
Automotive lubrication	TM 10-540
Automotive power transmission units	TM 10-585
Chassis, body, and trailer units	TM 10-560
Cleaning, preserving, lubricating, and welding materials and similar items issued by the Ordnance Department	TM 9-850
Defense against chemical attack	FM 21-40
Detailed lubrication instructions ordnance materiel	OFSB 6-Series
Echelon system of maintenance	TM 10-525
Fire prevention, safety precautions, accidents	TM 10-360
Motor transport inspections	TM 10-545
Sheet metal work, body, fender, and radiator repairs	TM 10-450
The motor vehicle	TM 10-510

d. Miscellaneous.

Automotive electricity	TM 10-580
Camouflage	FM 5-20
Electrical fundamentals	TM 1-455
Fuels and carburetion	TM 10-550
List of publications for training, including training films and film strips	FM 21-6
Military motor transportation	TM 10-505
Military motor vehicles	AR 850-15
Motor transport	FM 25-10
The internal combustion engine	TM 10-570

e. Storage and Shipment.

Rules governing the loading of mechanized and motorized Army equipment, also major caliber guns for the United States Army and Navy, on open top equipment — published by the Operations and Maintenance Department of the Association of American Railroads	
Storage of motor vehicle equipment	AR 850-18

f. Vehicle Materiel.

Light Tank M5	TM 9-732
Ordnance maintenance — engine, exhaust system and ignition systems for light tanks M5, M5A1, and 75-mm howitzer motor carriage M8 (now being published as TM 9-1732A)	TM 9-1727A
Ordnance maintenance — fuel and lubrication systems for light tanks M3 and M3A1 and related gun motor carriages	TM 9-1726F
Ordnance maintenance — transmission for light tanks M5, M5A1 and 75-mm howitzer motor carriage M8	TM 9-1727C
75-mm howitzer motor carriage M8	TM 9-727B

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

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