TM 9-754

★ RESTRICTED

WAR DEPARTMENT

TECHNICAL MANUAL

MEDIUM TANK M4A4

JANUARY 21, 1943

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TM 9-754

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TECHNICAL MANUAL
No. 9-754

WAR DEPARTMENT
Washington, January 21, 1943

MEDIUM TANK M4A4

Prepared under the direction of the

Chief of Ordnance

(with the cooperation of the Chrysler Corporation)

★ ★

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PART ONE — Operating Instructions

PART TWO — Organization Instructions

*This technical manual supersedes TM 9-754, August 29, 1942.

MEDIUM TANK M4A4

PART TWO — Organization Instructions — (Cont.)

PART ONE — Operating Instructions

Section I

INTRODUCTION

1. SCOPE.

a. This manual is published for the information of the using arms and services.

b. In addition to a description of the Medium Tank M4A4 this manual contains technical information required for the identification, use, and care of the materiel.

c. Disassembly, assembly and such repairs as may be handled by using arm personnel may be undertaken only under the supervision of an officer or the chief mechanic.

d. In all cases where the nature of the repair, modification or adjustment is beyond the scope or facilities of the unit, the responsible ordnance service should be informed so that trained personnel with suitable tools and equipment may be provided, or proper instructions issued.

e. This manual differs from TM 9-754, Medium Tank M4A4, August 29, 1942, as follows:

(1) Preliminary illustrations, of various units have been replaced by revised illustrations. Additional illustrations have been added.

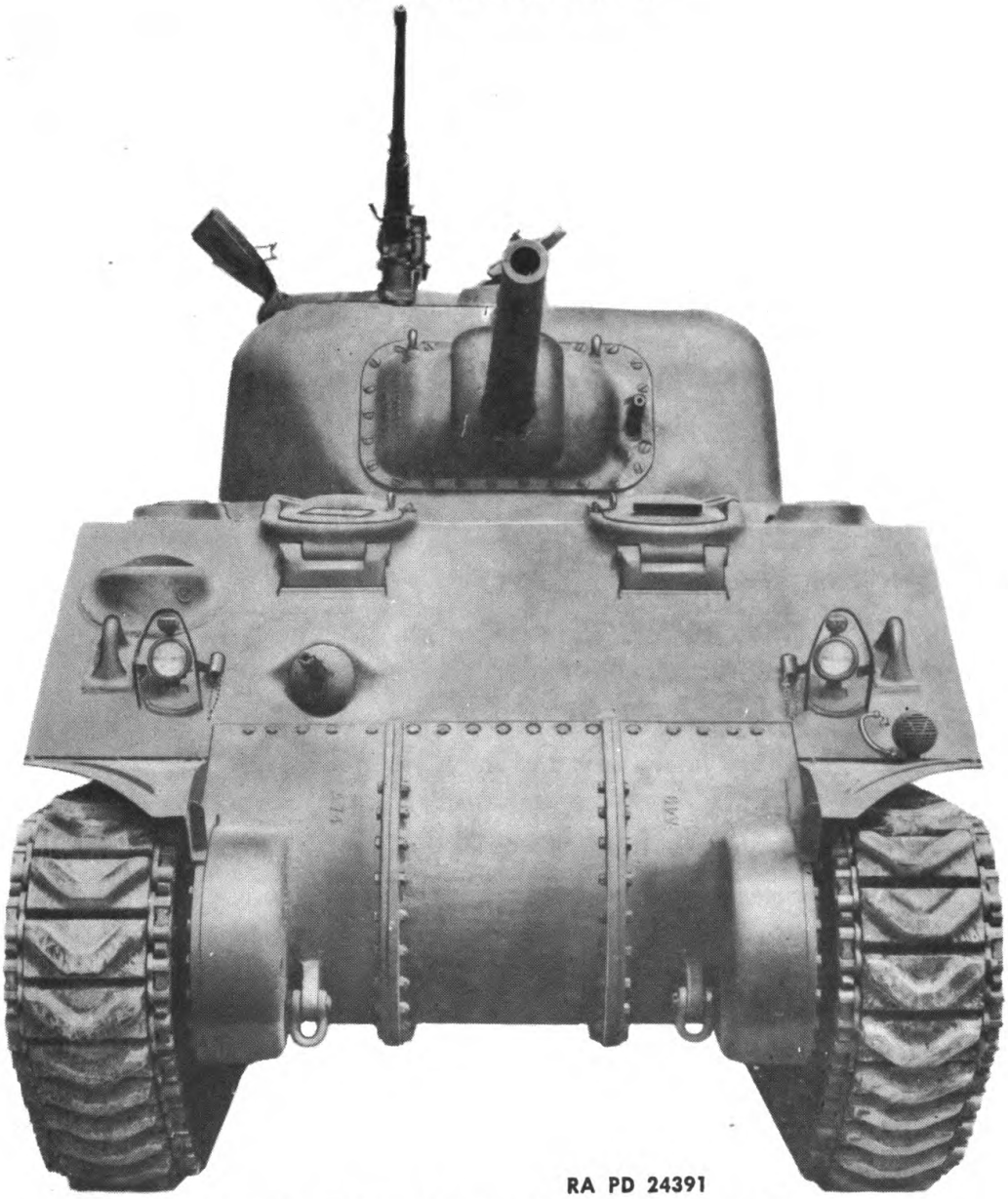
(2) More detailed information pertaining to various units has been added.

(3) New lubrication charts have been added and lubrication instructions have been revised.

2. CHARACTERISTICS.

a. The Medium Tank M4A4 is an armored, full track laying vehicle (figs. 1 through 8). The hull is of all-welded construction, and a cast turret is used which is identical with the turrets used on all M4 series tanks. The vehicle is powered by the "Chrysler Tank Engine" power unit, located in the rear of the hull. The vehicle serial number is

MEDIUM TANK M4A4



RA PD 24391

Figure 1 — Front View — Medium Tank M4A4

stamped on each boss (two front and two rear) to which the towing shackle is attached to hull. All references to serial numbers throughout this manual refer to this number.

3. DIFFERENCES AMONG MODELS.

a. Water Pump.

(1) MULTIPLE WATER PUMPS, mounted on the distributor end of each individual engine, were used in production from vehicle serial number 4805 to serial number 5803 (fig. 19).

Figure 2 — Rear View — Medium Tank M4A4

(2) SINGLE WATER PUMP, mounted on the distributor end of the power unit crankcase, entered production at vehicle serial number 5804 (fig. 20).

b. Fuel Pump. The fuel pump, mounted on the distributor end of crankcase, was used in production from vehicle serial number 4805 to serial number 5803 (fig. 52). Beginning with vehicle serial number 5804, the fuel pump is mounted on the distributor end of No. 4 engine (fig. 53).

c. Generator. The generator, mounted between engines Nos. 1 and 2, was used in production from vehicle serial number 4805 to serial number 5803 (fig. 20). Beginning with vehicle serial number 5804, the generator is mounted in the fighting compartment (fig. 153).

MEDIUM TANK M4A4

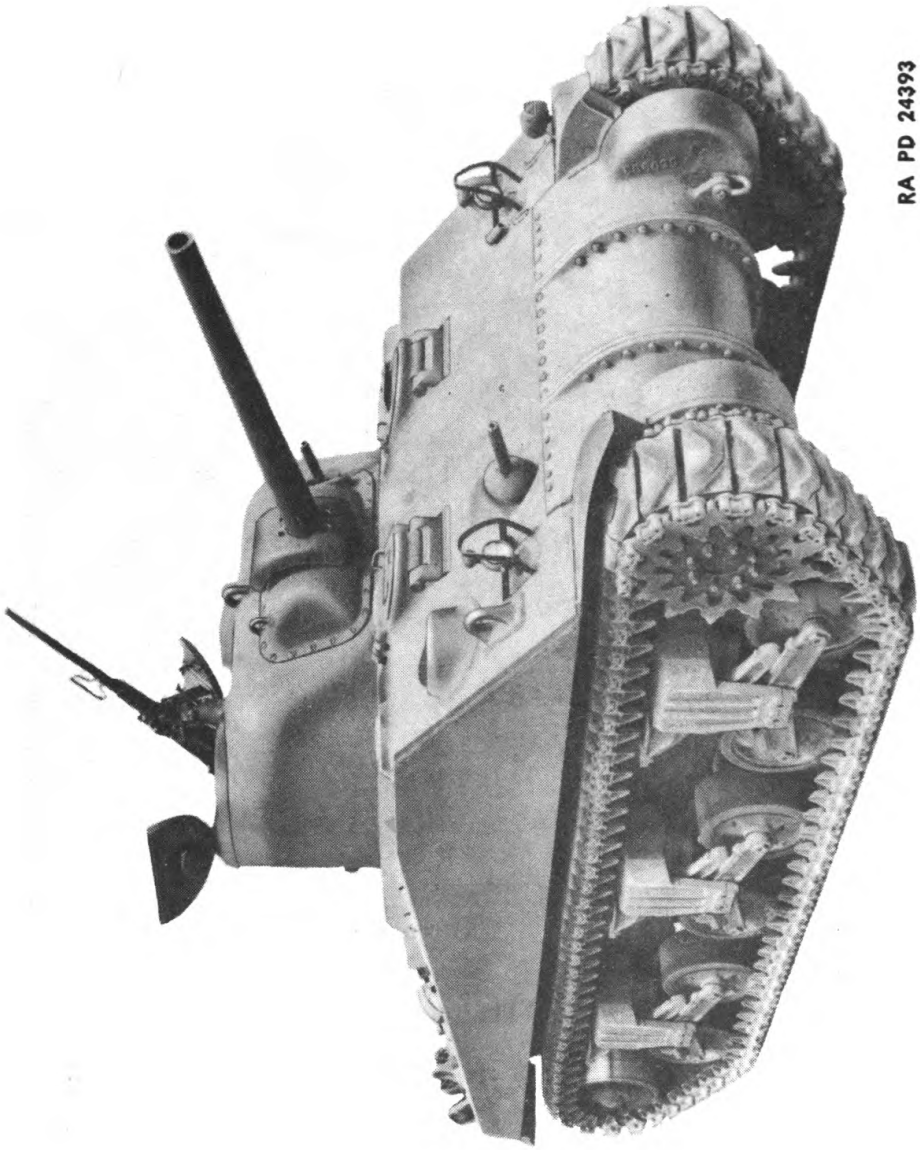


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Figure 3 — Three-quarter View — Right Front — Medium Tank M4A4

INTRODUCTION

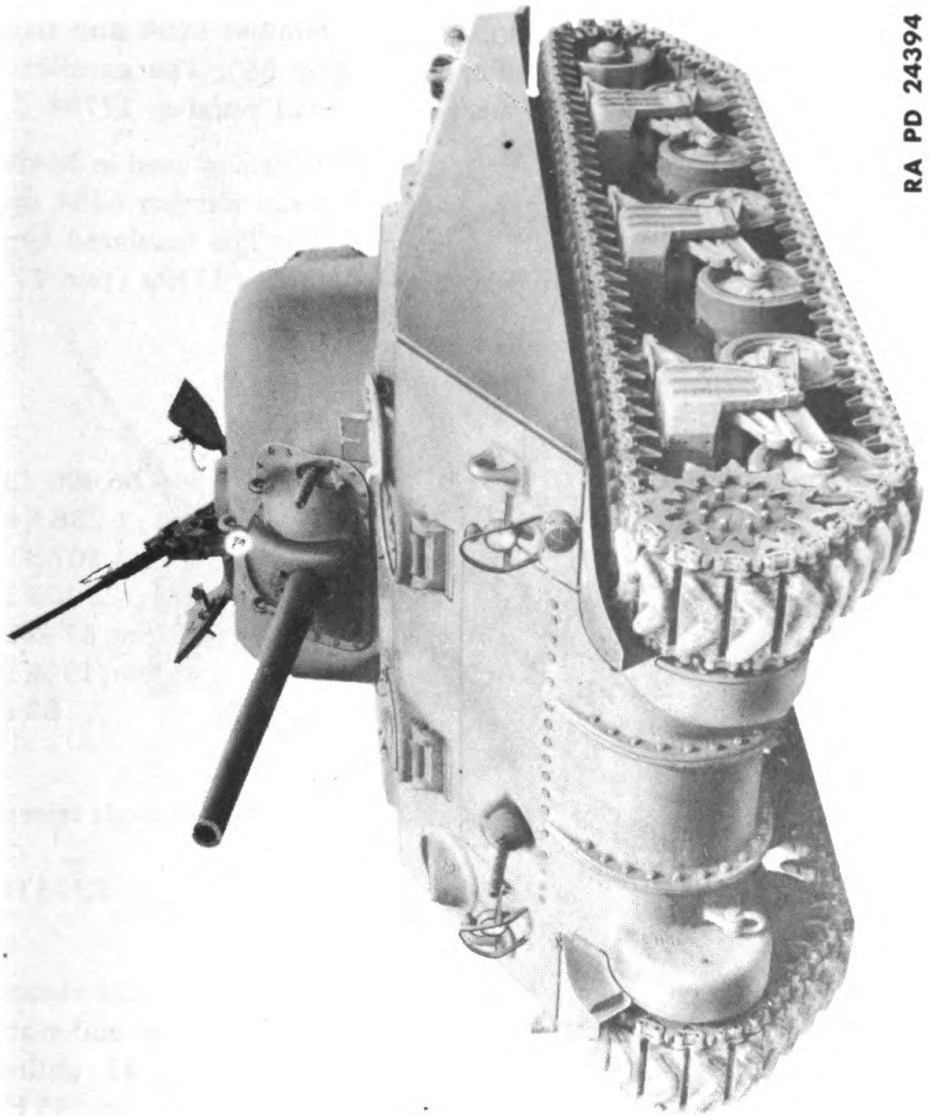

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Figure 4 — Three-quarter View — Left Front — Medium Tank M4A4

d. Thermostats. Thermostats, of the Choke Type, were used in production from vehicle serial number 4805 to vehicle serial number 6204 and from vehicle serial number 16555 to serial number 17112 (par. 88). Beginning with vehicle serial number 17113 thermostats of the bypass type are used (par. 88).

e. Clutch. A clutch, of the fully enclosed type, was used in production from vehicle serial number 4805 to serial number 6204 and from serial number 16555 to serial number 17793 (fig. 65). The ventilated type of clutch entered production at vehicle serial number 17794.

f. Fuel Tank. A non-insulated type of fuel tank was used in M4A4 production from vehicle serial number 4805 to serial number 6204 and from serial number 16555 to serial number 17793. The insulated type of fuel tank entered production at vehicle serial number 17793 (par. 77).

4. DATA.

a. General.

Starting vehicle serial number 4805

Weight with armament	approximately 66,000 lbs.
Over-all length	238.5 in.
Over-all height	107.5 in.
Over-all width	103 in.
Ground clearance	Front, 17 1/8 in.
	Rear, 19 1/8 in.
Tread (center to center of tracks)	83 in.

b. Power Unit.

Rated gross horsepower	445 at 2,400 rpm (prop. shaft speed)
Number of cylinders	30
Weight of power unit with accessories	5,375 lbs.

c. Cooling System.

Coolant (summer)	Water, plus rust resistor
Coolant (winter)	Prestone, and water
Capacity	32 gallons
Temperature	(minimum 145 F.)
	(maximum 235 F.)

d. Fuel and Oil.

Fuel capacity (main tanks, power unit)	160 gallons
Fuel capacity (auxiliary generating unit tank)	5 1/2 gallons
Number of hours without refueling	8 hours at 20 mph
Octane rating of fuel	72–80
Oil consumption	100 mi. per gal.

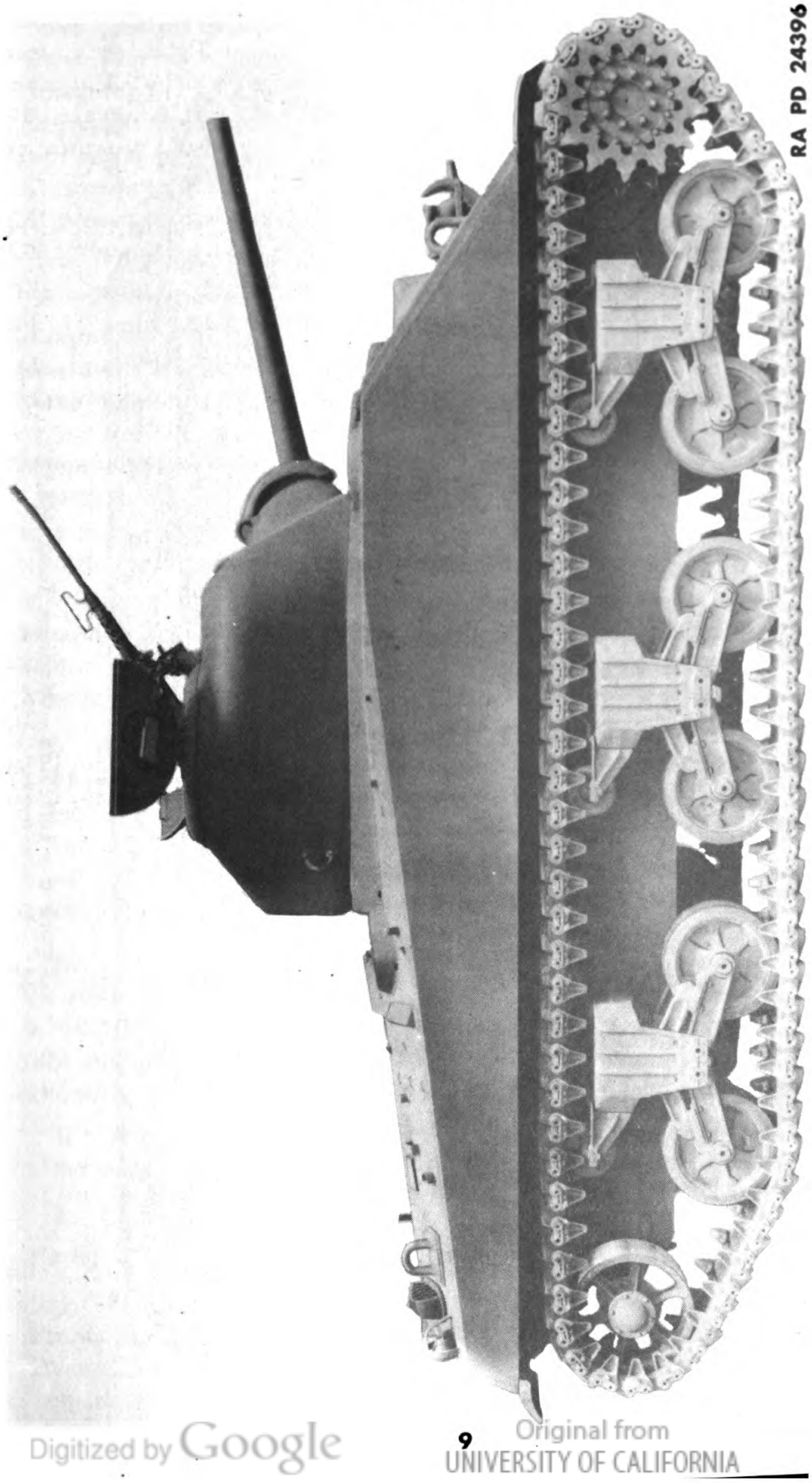

Figure 5 — Right Side — Medium Tank M4A4

MEDIUM TANK M4A4

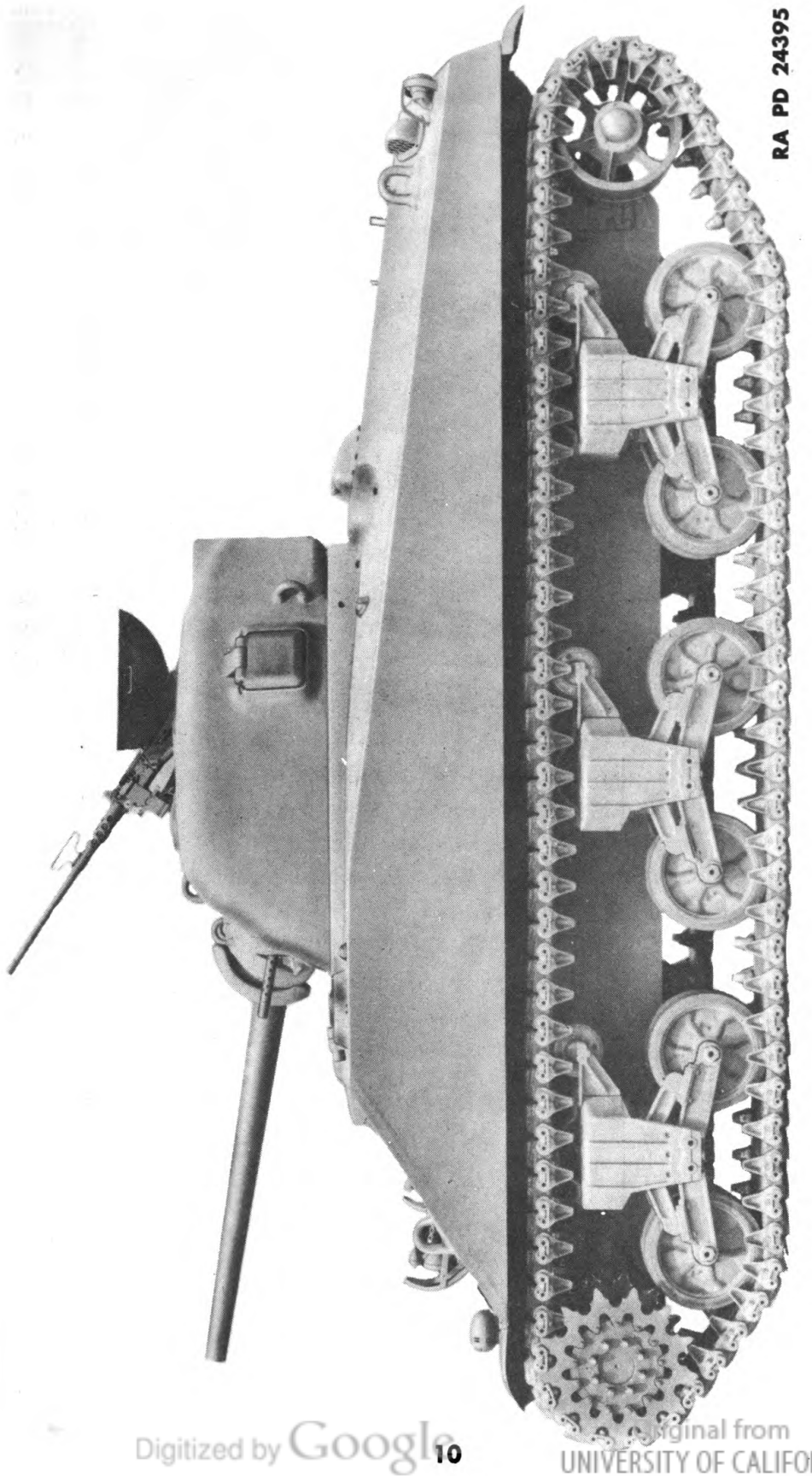

Figure 6 — Left Side — Medium Tank M4A4

INTRODUCTION

Power unit oil capacity	10 gallons
Power unit oil capacity (when refilling after draining)	8 gallons (par. 54., e.)
Lubricants (summer)	SAE 30 to 32 F.
Lubricants (winter)	SAE 10–W to –30 F.
Oil pressure (idling speed)	25 pounds per square inch at 750 rpm
Oil pressure (operating speed)	50–60 pounds per square inch
Oil temperature (power unit)	100 F. above outside air temperature

e. Performance.

Maximum sustained speed (hard road)	20 mph
Maximum speed (short intervals)	25 mph
Maximum allowable power unit speed	2,900 rpm short periods 2,500 rpm sustained
Minimum power unit idling speed	750 rpm

NOTE: Do not idle at this speed longer than five minutes. If necessary to idle power unit for periods longer than five minutes, adjust hand throttle to increase the idle speed to 950 – 1,000 rpm.

Maximum grade ascending ability	35 degrees
Maximum grade descending ability	35 – 45 degrees
Maximum vertical object vehicle will negotiate	24 in.
Maximum fording depth	42 in.

f. Armament.

1 75-mm gun in turret (360 degrees traverse).
1 cal. .30 machine gun in turret.
1 cal. .50 Browning antiaircraft in top of turret.
1 cal. .45 Thompson submachine gun in clip in turret.
1 cal. .30 machine gun in front end.

g. Ammunition Carried.

98 rounds, 75-mm ammunition.
6,750 rounds, cal. .30 ammunition.
300 rounds, cal. .50 ammunition.
596 rounds, cal. .45 ammunition.

h. Protected Vision. Protected vision is provided for the driver and other members of the crew by indirect vision devices.

i. Communication.

Radio	SCR 508

j. Armor Thickness.

Front	2 in.
Rear	1½ in.

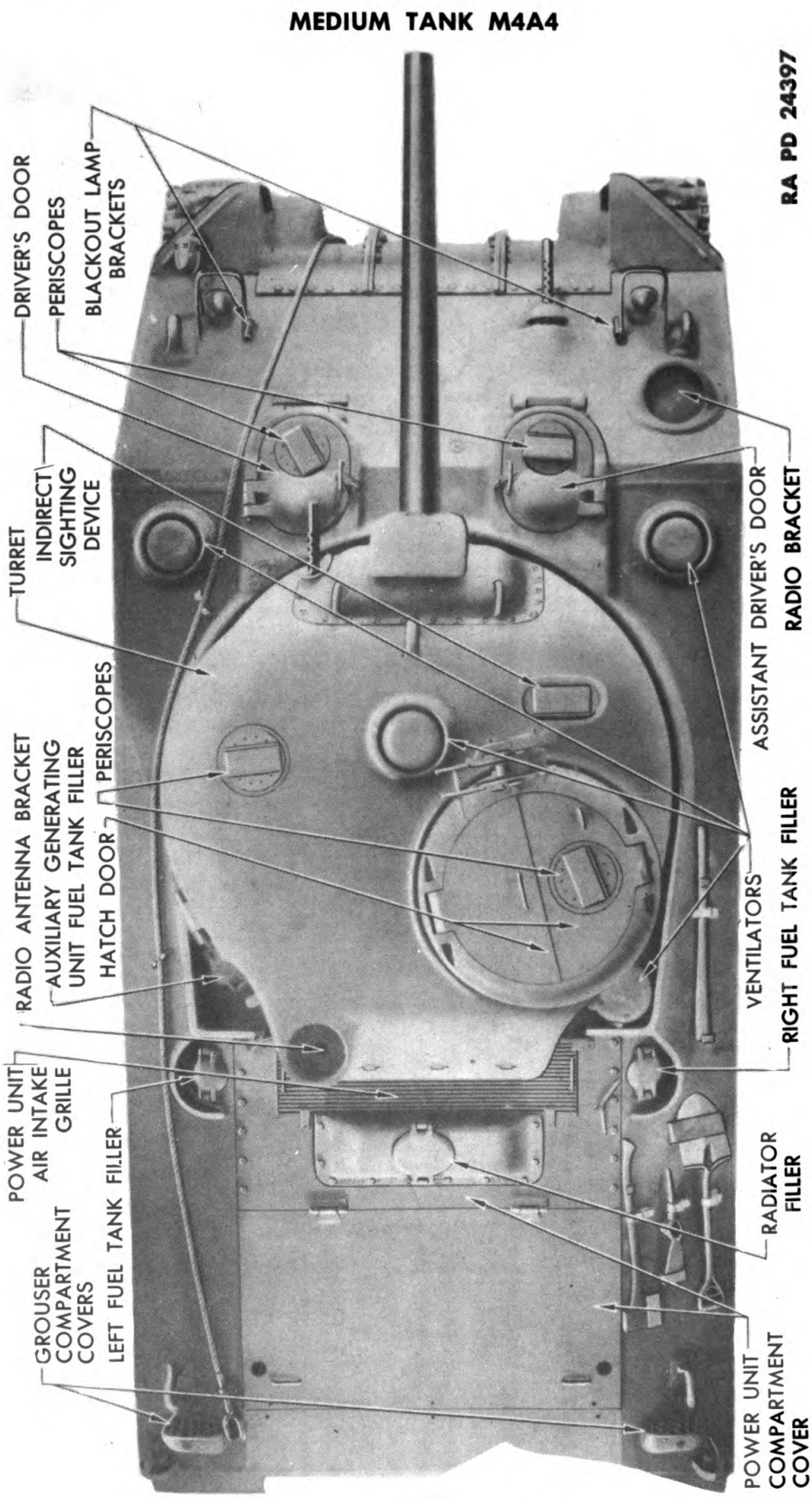

Figure 7 — Top View — Medium Tank M4A4

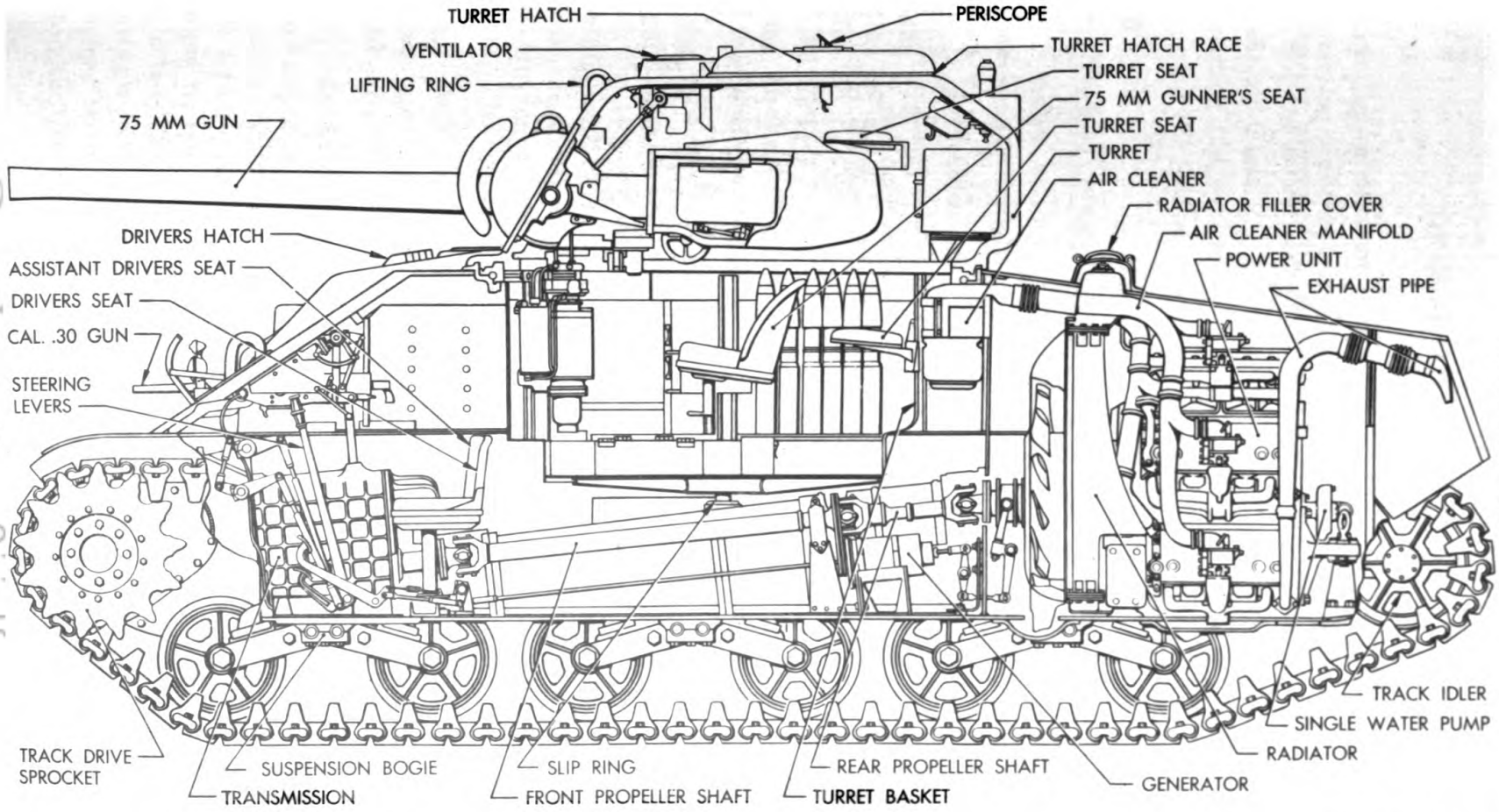

Figure 8 — Longitudinal Section of Vehicle — Medium Tank M4A4

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MEDIUM TANK M4A4

Sides	1½ in.
Top (Front)	2 in.
Top (Rear)	½ in.
Bottom	1 in. – 1½ in.

k. Turret. Cast armor 2-in.—3-in. thick, 360 degrees traverse.

l. Crew ..... 5 men

m. Tracks.

Number of blocks (each track)	83
Pitch	6 in.
Ground contact	3,589 – square inch

n. Capacities.

Cooling system	32 gallons
Final Drive (each unit)	9 gallons
Fuel tanks (main, each)	80 gallons
(Aux. gen. unit)	5½ gallons
Power unit (Dry power unit and supply tank)	10 gallons
(When refilling after draining)	8 gallons (Par. 54., e.)
Transmission and differential	16 gallons

o. Adjustments.

Distributor point gap	.020 in.
Spark plug point gap	.028 – .032 in.

Section II

OPERATION AND CONTROLS

5. GENERAL INFORMATION ON CONTROLS.

a. Spark Control. The spark control is entirely automatic and requires no attention by the operator of the vehicle.

b. Accelerator and Hand Throttle. A foot accelerator pedal is located to the left of the transmission housing, convenient to the driver's right foot. In conjunction with the foot pedal, a hand-operated throttle is provided, which is mounted on a bracket just forward of the gear shift lever (fig. 9). It is cable-operated through a push-pull control.

c. Choke. A choke control lever is bracket mounted to the left wall of the fighting compartment, convenient to the driver's left hand (fig. 9).

d. Steering Levers. Two steering levers are mounted on the floor of the vehicle just forward of the driver's seat (fig. 9). To steer the vehicle, pull the steering lever on the side toward which it is desired to turn. Pulling back either one of the levers slows down the track on that side, while the speed of the other track is correspondingly increased to assist the turning action. In all turns there is power on both tracks at all times. The levers are provided with rubber grips.

e. Fuel Shut-Off Valves. The control handles of the fuel shut-off valves are located on the front of the power unit compartment bulkhead directly above the propeller shaft housing (fig. 34).

f. Exhaust Stack Temperature Warning. Five red warning signals are located in a row on the instrument panel (fig. 10). Above each red signal a numeral 1, 2, 3, 4 or 5, indicates the engine referred to by the red signal directly below it. A red light indicates an engine operating below normal temperature. When normal temperature is reached, the light is automatically switched off. If one or more of these lights appear during a run which started with a normally functioning power unit, the engines indicated will be found to be operating poorly, or not at all. Stop the power unit at once and locate the trouble.

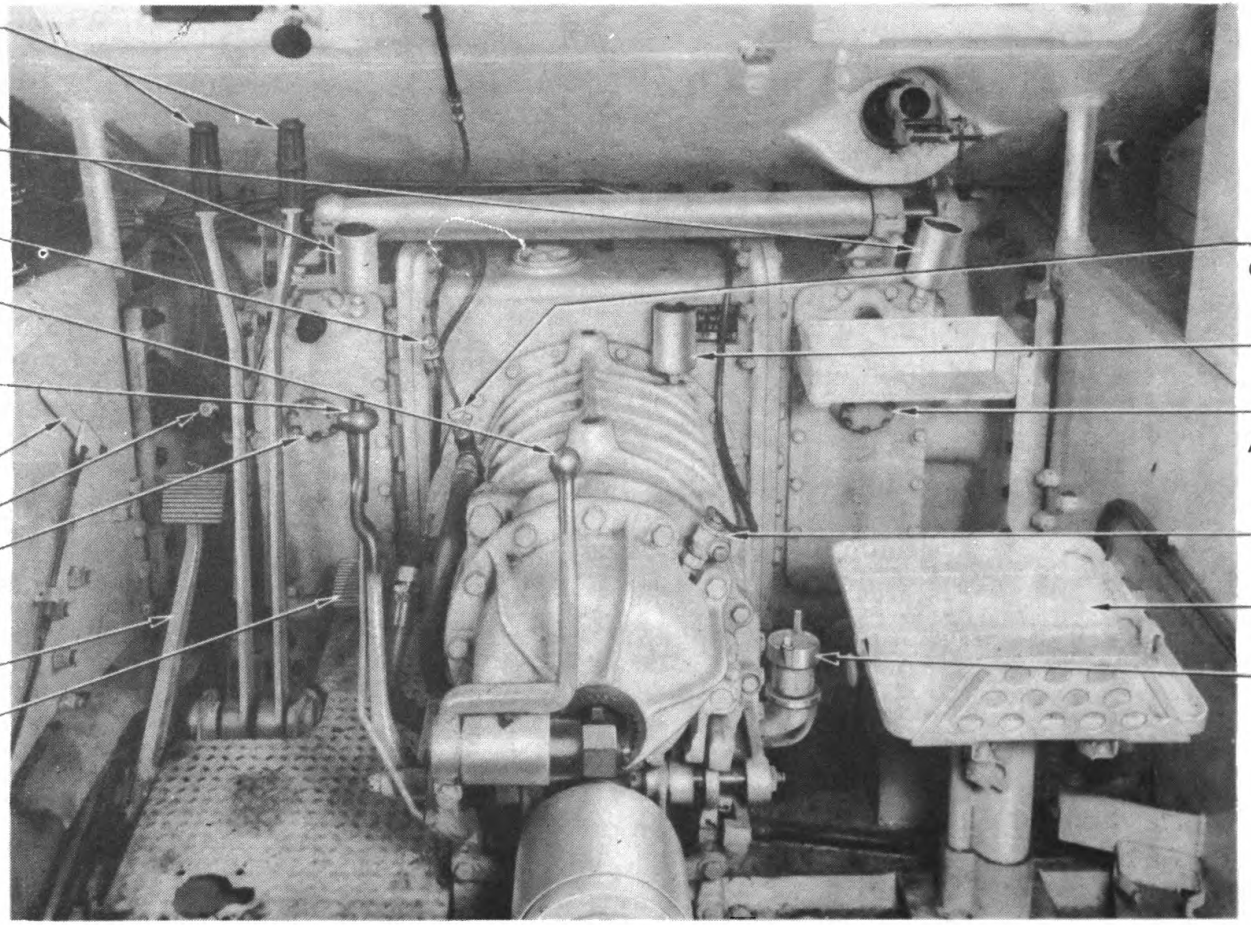

Figure 9 — Driver's Control Group

g. Water Temperature Signal. High water temperature in any engine will automatically cause the red signal on the instrument panel (marked "HIGH WATER TEMP.") to light and thereby warn the driver (fig. 10). Turn the water temperature gage selector switch (fig. 10) and check the temperature reading on the water temperature gage to determine from which engine the signal came. Stop the power unit and investigate the trouble in the engine indicated.

h. Ignition Switch (fig. 10). Ignition is "ON" when ignition switch is turned clockwise or to the right.

i. Starting Switch (fig. 10). A push button type switch located to the right of the ignition switch energizes the starting solenoid when depressed.

j. Brakes.

(1) SERVICE BRAKES. Pulling back simultaneously on both steering levers slows down or stops the vehicle, depending on the effort applied.

(2) PARKING BRAKE. The parking brake lever is located on the right side of the driver (fig. 9). It is a transmission type of brake. *Never use it for any other purpose than parking.*

k. Clutch Pedal. The clutch pedal is located to the left of the steering levers, convenient to the driver's left foot (fig. 9). To permit shifting of gears, the clutch is disengaged by depressing the clutch pedal. When the pedal is depressed, the power unit will run idle.

l. Gear Shifting.

(1) DESCRIPTION AND OPERATION. Shifting of gears in the transmission for speed changes is accomplished by the gear shift lever, located on the transmission to the right of the driver (fig. 9).

(2) The positions of the gear shift lever for the various speeds are shown in the diagram (fig. 12).

(3) The gear shift lever is equipped with a latch which prevents accidental shifting into first speed or reverse. The latch must be released by pressing down the button on top of the lever before shifting into first speed or reverse.

m. Fire Extinguisher Controls. Fire extinguisher controls (fig. 19), located to the left and to the rear of the driver, are within easy reach of the driver at all times. Controls located just to the rear of turret, provide for operation of fire extinguishers from outside of vehicle (fig. 27).

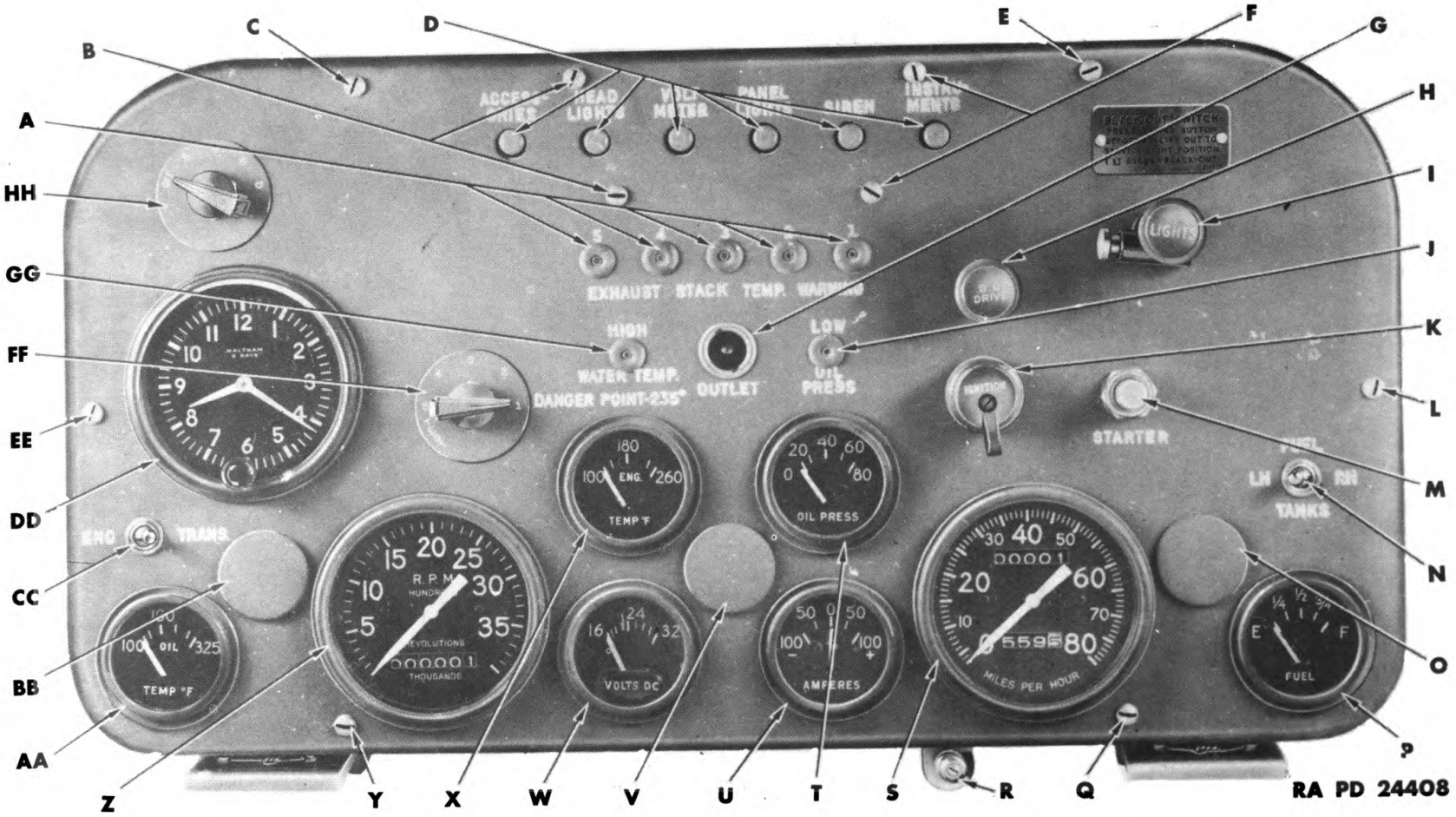

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Figure 10 — Instrument Box and Instruments

A—Exhaust stack temperature warning indicators
B—Circuit breaker mounting plate retaining screws
C—Cover attaching screw
D—Circuit breaker reset buttons
E—Cover attaching screw
F—Circuit breaker mounting plate retaining screws
G—Instrument box outlet socket
H—Black-out driving light switch
I—Light switch
J—Low oil pressure warning indicator
K—Ignition switch
L—Cover attaching screw
M—Starter switch
N—Fuel gage selector switch
O—Instrument box light cover
P—Fuel gage
Q—Cover attaching screw
R—Speedometer reset knob
S—Speedometer
T—Oil pressure gage
U—Ammeter
V—Instrument box light cover
W—Voltmeter
X—Water temperature gage
Y—Cover attaching screw
Z—Tachometer
AA—Power unit and transmission oil temperature gage
BB—Instrument box light cover
CC—Power unit and transmission oil temperature gage selector switch
DD—Clock
EE—Cover attaching screw
FF—Water temperature gage selector switch
GG—High water temperature warning indicator
HH—Instrument box light switch

RA PD 24408—B

Figure 11 — Legend for Fig. 10 — Instrument Box and Instruments

6. PRESTARTING PREVENTIVE MAINTENANCE.

a. NOTE: It is essential that the tank driver and every member of the crew be utilized to inspect the vehicle under the direction of the Commander. The inspection should cover the complete vehicle as well as power unit.

(1) See that oil supply tank and power unit are filled with the proper grade of oil as indicated in the lubrication guide (par. 23).

(2) Check fuel level. Refill as necessary.

(3) Open fuel shut-off valves and turn ignition switch "ON" and check for leaks at fuel tanks and fuel line connections.

(4) Check for fuel, oil and water leakage in the fighting and power unit compartments as well as on the ground under the vehicle.

(5) Check for any leakage in the fuel system and in oil lines.

(6) Check level of coolant in radiator and fill to bottom of filler cap tube. Inspect outside surface of radiator for dirt.

(7) Check all water manifolds and connections for leaks.

(8) Check water pump and generator drive belts for adjustment (par. 86), and serviceability.

(9) Check transmission oil level (par. 107., c.).

(10) Check oil level in final drive units (par. 107., e.).

(11) Check general conditions of sprockets, bogies, springs, guides, gudgeons, track supporting rollers and idlers.

(12) Check track for wear, tightness and tension, and check end connections for wear.

(13) Check for tightness and wear in track wedges and wedge nuts.

(14) Check radio antenna for breaks and general condition.

(15) Check for presence and condition of fire extinguishers and vehicle tools.

(16) Make sure that steering levers, clutch pedal, accelerator pedal, and gear shift lever operate freely over their full travel.

(17) Check instrument panel and see that ammeter reads zero with battery switch open and that other instruments indicate normal shut-off readings.

(18) Close battery switch (fig. 121) and watch ammeter and voltmeter. If ammeter shows excessive discharge, open battery switch immediately, locate and correct the trouble. Correct reading on the voltmeter is 26 or more volts.

(19) Check all vehicle lights and siren operation.

(20) Check fuel level in auxiliary generating unit fuel tank.

(21) Check operation of turret traverse mechanism and locking mechanism.

(22) Check gun elevating controls.

(23) Check firing mechanism on all guns.

(24) Check to see that ammunition supply, spare indirect vision device, flags, field equipment and rations, if carried, are properly loaded.

(25) See that all pioneer tools are present and properly secured.

(26) Check carburetor air cleaner oil level and hose connections.

7. STARTING THE POWER UNIT.

a. Close Battery Switch (fig. 121).

b. Open Fuel Shut-Off Valves (fig. 34).

c. Place Gearshift Lever in "Neutral", Center Position (fig. 12).

d. NOTE: If the power unit has been standing four hours, or longer, without running, check for hydrostatic lock before attempting to start. With the ignition switch in "OFF" position, crank power unit with the starter for at least two power unit revolutions. If any unusual resistance to the starting motor is noticed during this preliminary cranking, release the starting switch and check for hydrostatic lock (par. 51., **a.** (7)).

e. Push choke lever forward all the way (fig. 9). NOTE: Do not leave the choke lever in full choked position for more than two power unit revolutions. Always partially open the choke the moment the power unit fires.

f. Turn ignition switch "ON" and press starter switch.

g. As soon as the power unit fires, pull the choke lever backward to a point where the power unit operates smoothly and does not "load."

8. POWER UNIT TEST.

a. As soon as the power unit has started, watch the oil gage (fig. 10). Pressure at idling speeds should be between 25 and 60 pounds per square inch at 750 rpm and should be between 40 and 70 pounds per square inch at 3,000 rpm. If the oil gage does not indicate oil pressure within 10 seconds, shut off the power unit and investigate the cause. The "Low oil pressure" warning light will be automatically switched off as soon as minimum oil pressure is reached. Should this light appear while power unit is operating, stop power unit and investigate the cause.

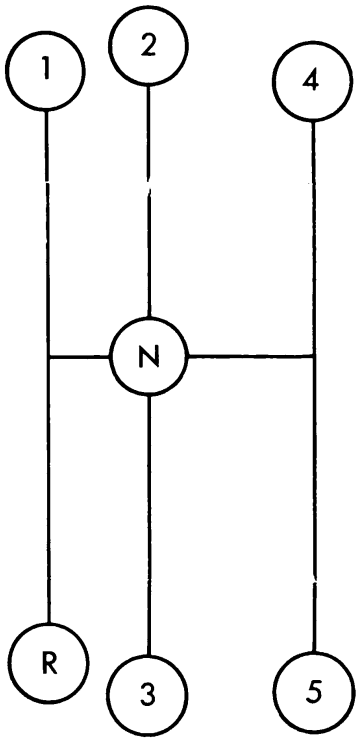
b. Check Exhaust Stack Temperature Warning Signals. If these

lights do not appear when ignition switch is turned "ON", check signal bulb on instrument box cover, and sending units on power unit (par. 184).

c. Set the hand throttle so that the power unit will operate at 1,200 – 1,500 rpm until the water temperature gage registers a minimum of 150 F.

d. Watch the ammeter (fig. 10) to see that the generator is charging. If the ammeter does not indicate "+" with power unit idling, speed up power unit by momentarily depressing the accelerator. If the ammeter does not move to "+" side, look for slipping generator drive belt or broken connections.

e. The water temperature gage (fig. 10) should register between 150 F. and 235 F. after power unit is warmed up. If temperature exceeds 235 F., shut off power unit and investigate for loss of coolant. CAUTION: When removing a filler cap from a hot radiator, always vent the radiator long enough to let all steam pressure escape before removing the cap, otherwise there is a possibility of serious personal injury. To vent radiator, loosen lock nut holding cap in place and allow pressure to escape before the cap is free to open.



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SHIFT LEVER POSITIONS

Figure 12 — Gearshift Lever Positions

f. When installing the radiator cap, always make certain it is properly secured, to assure of perfect sealing.

g. Check for loose parts.

h. With power unit operating, check for oil and coolant leaks.

i. Check for unusual noises in power unit and power train.

j. As long as the exhaust stack temperature warning indicators (fig. 10) remain lighted, the power unit must be operated at the low rpm (1,000 – 1,200). Drive the vehicle in third gear at this power unit speed until all lights in warning indicators are automatically switched off. NOTE: This power unit warm-up period with the vehicle in operation also warms the transmission oil and obviates the necessity of a second warm-up period for power train units.

9. OPERATING THE VEHICLE.

a. The driver must be thoroughly familiar with the function and operation of all the controls and instruments before attempting to operate the vehicle. Review paragraph 5 in case of doubt.

b. To Operate: With the driver in the driver's seat, the power unit at idling speed and all instruments showing normal readings, the driver is then ready to drive the vehicle.

(1) Release the parking brake (located on transmission to the right of driver's seat).

(2) Disengage the clutch by pressing clutch pedal down to the floor and holding it down.

(3) Move the gear shift lever into second gear as shown in (fig. 12).

(4) Gradually release the clutch pedal, at the same time depressing the accelerator pedal. Except when under fire, do not attempt to move the vehicle in or out of close quarters without the aid of personnel outside of the vehicle serving as a guide.

(5) When the vehicle has started and is moving at 2 mph, release the accelerator, depress the clutch pedal again and move the gear shift lever into the third gear position as indicated in (fig. 12). Release the clutch pedal and again depress the accelerator to pick up the load of the vehicle.

(6) Repeat the above operations until the highest gear is reached which will enable the vehicle to proceed at the desired speed without causing the power unit to labor. Do not ride the clutch. The driver's left foot must be completely removed from the clutch pedal while driving, to avoid unnecessary wear on the clutch.

(7) To place the vehicle in reverse gear, a complete stop must be made, the throttle closed until the tachometer (fig. 10) reads 750 rpm (minimum idling speed). NOTE: Do not idle power unit at this speed longer than five minutes. If necessary to idle power unit for periods longer than five minutes, adjust hand throttle to increase the idle speed to 950 – 1,000 rpm. Depress the clutch pedal and move the gear shift lever to reverse position (fig. 12). Never attempt to back the vehicle unless an observer is stationed in front to guide the driver.

(8) To steer, pull back the right hand steering lever (fig. 9) to make a right turn or the left hand lever to make a left turn. This action keeps one of the tracks from turning as fast as the other track and more power is needed. As the driver anticipates making a turn he must be ready to apply the accelerator to a greater extent, depending on the sharpness of the turn.

(9) To stop the vehicle, release the accelerator and pull back on both steering levers at the same time, depressing the clutch pedal when the vehicle has slowed down to approximately two to five miles per hour, depending upon which gear is being employed before stopping.

(10) The parking brake is located on the transmission to the right of the driver's seat (fig. 9). Use this brake only for parking and never while the vehicle is in motion.

(11) The tachometer, the oil temperature gage, the oil pressure gage and the water temperature gage (fig. 10) give the most satisfactory indication of the power unit's performance. Should the tachometer fail to register, investigate the cause and correct. The oil temperature gage should register approximately 120 F. above outside air temperature under normal operation. Should this gage fail to register, after power unit is at normal operating temperature, investigate the cause. The oil pressure gage should read between 25 and 60 pounds per square inch at 750 rpm and should read between 40 and 70 pounds per square inch at 3,000 rpm. The water temperature gage should register between 145 F. and 235 F. If the gage indicates either low or excessive water temperature, or if the "high water temperature" warning indicator light appears, stop the vehicle and investigate the cause. If steam comes from radiator, while water temperature gage does not register in excess of 212 F., check for faulty pressure vent valve.

(12) If power unit idles too fast, after it has reached normal operating temperature, and with hand throttle closed, investigate the cause and correct. NOTE: Power unit idle speed is 750 rpm. CAUTION: Do not idle at this speed longer than five minutes. If necessary to idle power unit for periods longer than five minutes, adjust hand throttle to increase the idle speed to 950 – 1,000 rpm.

10. STOPPING THE POWER UNIT.

a. To stop the power unit, allow it to operate at idling speed (750 rpm) for two minutes, turn off ignition switch, open battery switch (fig. 121) and close the main fuel supply valves (fig. 19). CAUTION: Do not idle at this speed longer than five minutes. If necessary to idle power unit for periods longer than five minutes, adjust hand throttle to increase the idle speed to 950 – 1,000 rpm. CAUTION: Do not stop power unit by opening battery switch.

b. If power unit continues to run after ignition switch is turned "OFF," open the carburetor throttle wide and continue to hold it open until the power unit stops.

11. CAUTIONS.

a. After initial warming, the power unit must not be operated continuously at idling speed. Continuous operation of the power unit at idling speed will shorten the useful life of the unit considerably by causing increased wear and over-heating. On no occasion, including military ceremonies, will idling of the power unit at less than 750 rpm be permitted. While the damage to the power unit is not immediately apparent, the total life of the power unit will be greatly reduced.

b. Avoid rapid movement of the accelerator since this causes a spray of gasoline to be injected into the engines. This gasoline washes oil from the cylinder walls and causes excessive wear.

c. Do not attempt to start the power unit by "TOWING" or "COASTING" the vehicle. To do so may cause serious damage to the power unit or transmission. To start the power unit, use the electric starter.

d. Care must be taken not to place any object in a position where it will block the flow of air to the radiator. Blocking off the flow of air will cause over-heating of the power unit.

MEDIUM TANK M4A4

Section III

ARMAMENT

12. DESCRIPTION.

a. The armament of the Medium Tank M4A4, includes the following mounts and guns:

(1) A combination mount in the turret which carries a 75-millimeter gun and caliber .30 machine gun (fig. 15); an antiaircraft mount on the turret ring carrying a caliber .50 machine gun; a ball mount in the assistant driver's compartment (or bow gunner) (fig. 15), mounting a caliber .30 machine gun and a caliber .45 submachine gun is carried in the turret.

13. OPERATION.

a. Combination Mount. The gunner sits at the right of the 75-millimeter and caliber .30 guns. Elevation of 25 degrees and depression of 10 degrees are obtained by rotating the handwheel of the elevating mechanism. 360 degrees traverse of the guns is obtained by traversing the turret manually or electrically. Both guns are fired electrically by means of switches operated by the gunner's left foot. These guns can also be fired manually. After aiming, the elevation of the guns is maintained by the gyrostabilizer. This equipment is described in paragraphs 138 to 159 inclusive.

b. The caliber .30 gun in assistant driver's compartment (or bow gunner) is manually fired and has both elevation and traverse within the limit of the ball mount (fig. 14).

c. The caliber .50 antiaircraft gun is manually traversed by rotating the turret hatch ring or by turning the gun on its mount.

d. The caliber .45 submachine gun can be used either through a pistol port or as an antiaircraft gun through the turret hatch.

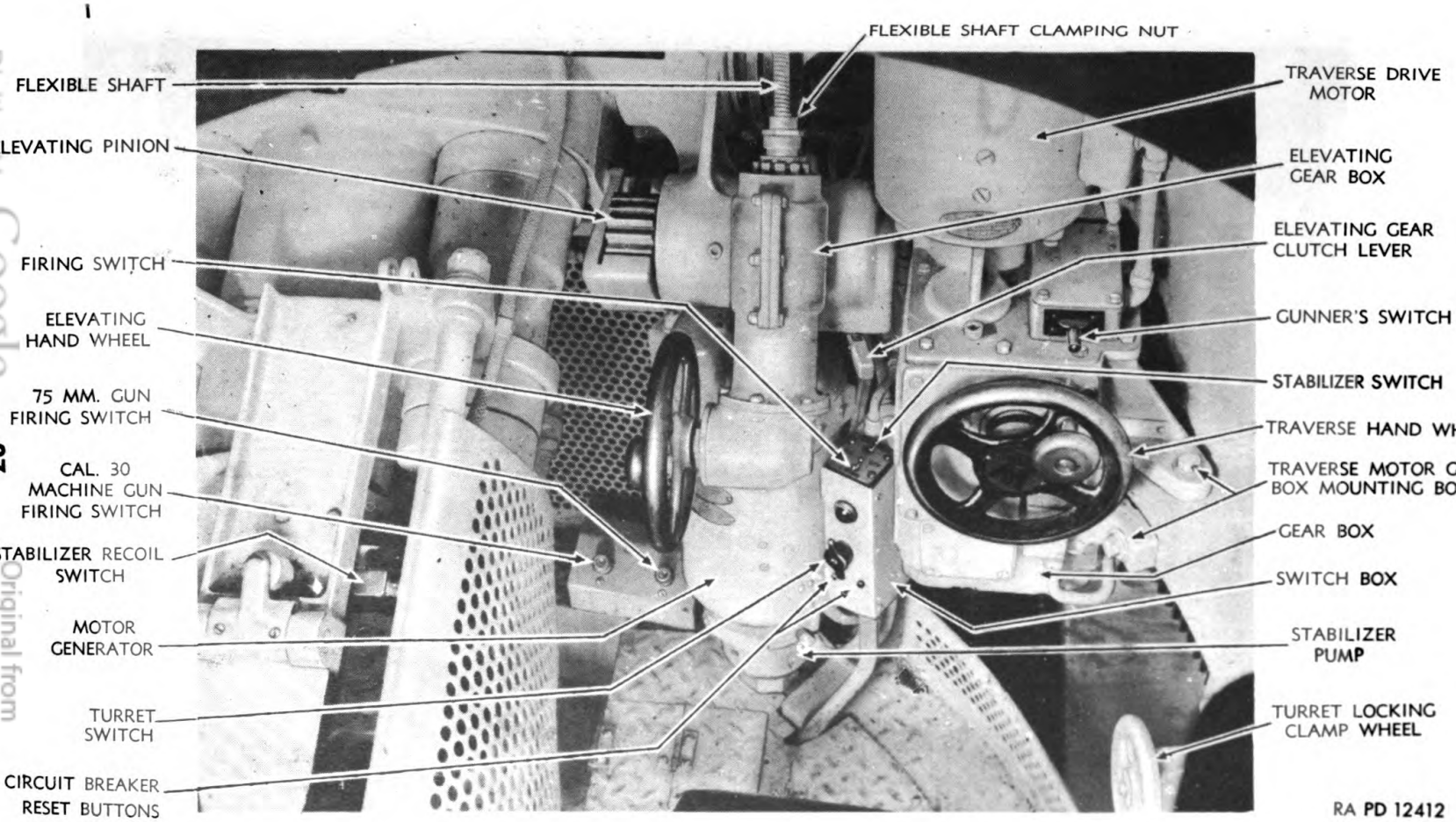


Figure 13 — 75 MM. Gunner's Controls

MEDIUM TANK M4A4

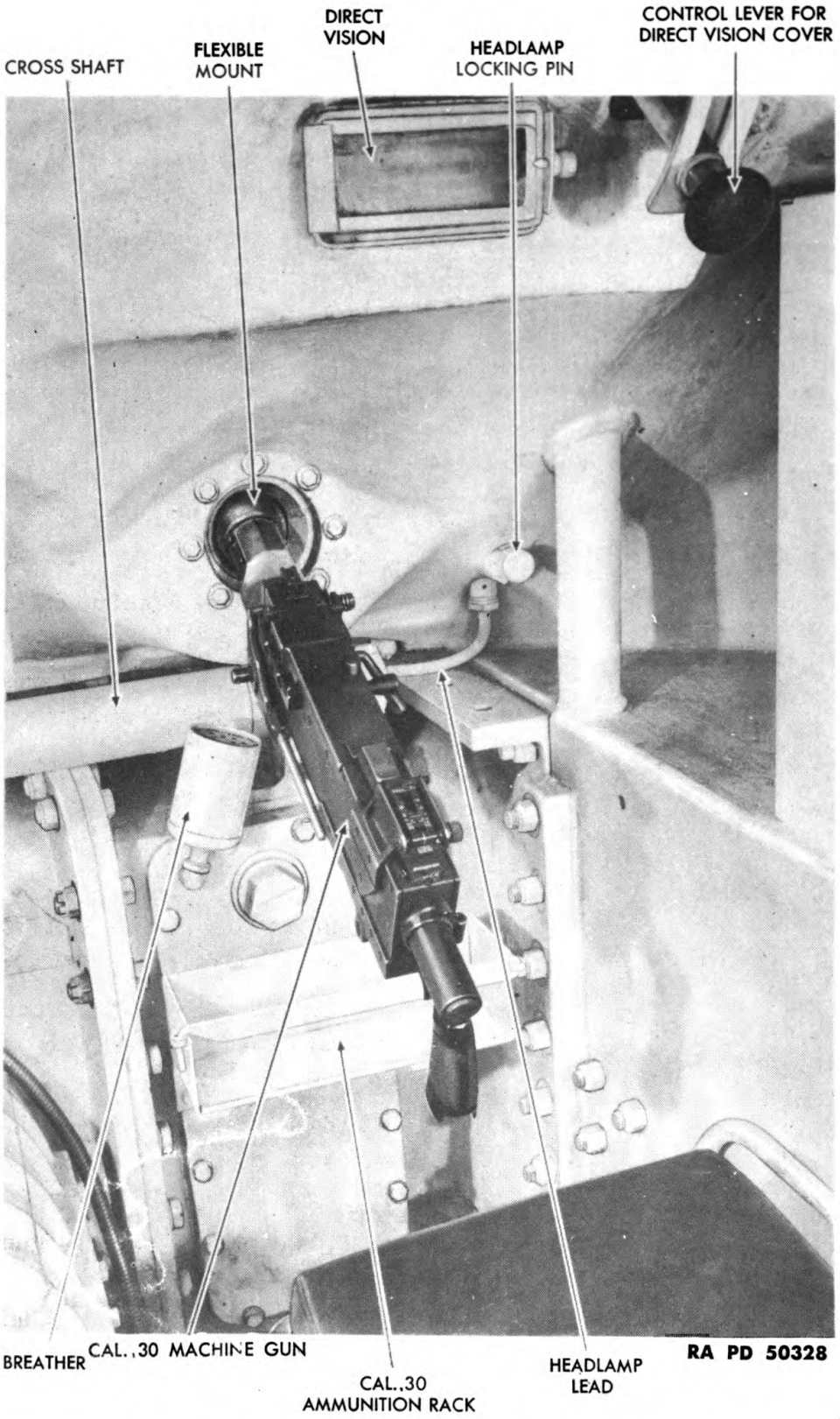


Figure 14 — Assistant Driver's Station in Right Bow

ARMAMENT

14. AMMUNITION STOWAGE.

a. Ammunition.

Item	Stowage Position
(1) 98 rounds—75-mm	16 rounds—left sponson forward of tool box.
	15 rounds—right sponson forward of .50 cal. ammunition boxes.
	17 rounds—right sponson to right of bow gunner.
	30 rounds—in chest under turret basket to rear of escape door.
	8 rounds—on turret basket floor.
	12 rounds—in ready clips around turret basket inside.
(2) 300 rounds cal. .50	150 rounds—in three 50 round boxes right sponson, right of bow gunner.
	150 rounds—in three 50 round boxes strapped to turret basket floor.
(3) 596 rounds cal. .45	540 rounds.
(20 30-round clips)	56 rounds (14 rounds on each individual armed with pistol).
(4) 6,750 rounds cal. .30	4,500 rounds—in eighteen 250 round expendable boxes, on floor, forward of battery box, under turret basket.
	1,750 rounds — in seven 250 round expendable boxes, on turret basket floor under 75-mm gun.
	250 rounds—one 250 round expendable box on feed rack on bow gun.
(5) 12 Grenades, hand: (a) 4 fragmentation M2 (b) 4 smoke	4 fragmentation, 2 offensive and 2 smoke in box under 75-mm gunner's seat.
(c) 2 offensive M3, w/fuse detonation, hand grenade, M6.	2 smoke and 2 thermite in box, left side turret wall.
(d) 2 thermite, incendiary	

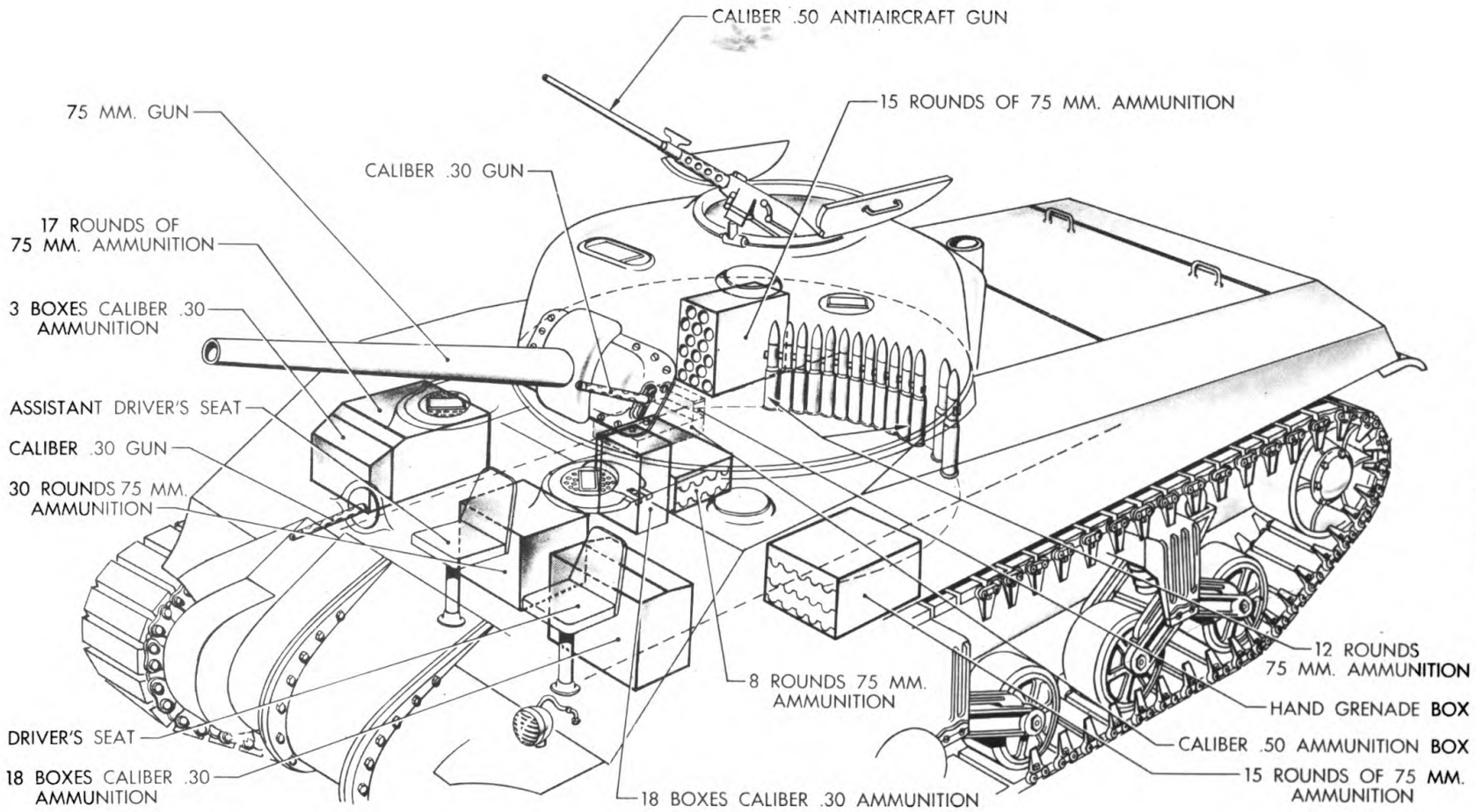


Figure 15 — Armament

Section IV

PREVENTIVE MAINTENANCE

15. PURPOSE.

a. To insure mechanical efficiency, it is necessary that vehicles be systematically inspected at intervals in order that defects may be discovered and corrected before they result in serious damage.

b. Cracks that develop in castings or other metal parts may frequently be detected through the medium of dust and oil deposits at the halt or upon the completion of a run.

c. Forward suggestions toward changes in design prompted by chronic failure or malfunction of a unit or group of units; pertinent changes in inspection or maintenance methods; and changes involving safety, efficiency, economy, and comfort, to the office of the Chief of Ordnance, through technical channels, at the time they develop. Such action is necessary, in order that other organizations may profit thereby.

16. PRESTARTING.

a. This inspection must be most carefully done, and is covered under paragraph 6.

17. DURING OPERATION.

a. During operation be alert to detect abnormal functioning of the power unit and power train. Note if any unusual noises appear in power unit or power train. Glance frequently at the instrument panel gages to see if the power unit is functioning properly. Low oil pressure will be indicated by the warning signal on the instrument panel, therefore, an investigation must be made if this warning light appears while the power unit is operating at a constant speed. Oil pressure will read at least 30 pounds at normal driving speeds when oil level is high enough. High water temperature will be indicated by the warning signal on the instrument panel, therefore an investigation must be

made if this warning light appears during a run. This is indicative of water pump drive belt failure or low coolant level in the radiator. Check the water temperature of each engine by turning the lever on the water temperature gage selector switch to the respective engine, as indicated by the numerals 1, 2, 3, 4, 5, directly above the switch, and note the reading on the water temperature gage.

b. Notice continuously the amount of clearance of the clutch pedal. For proper adjustment see paragraph 95. NOTE: This clearance must be maintained at the proper amount at all times. Check the steering mechanism for: Clearance before engagement, intensity of pull required for braking, etc. Check ammeter for proper charging rate (10 to 15 amperes if the battery is well charged; a maximum of 50 amperes if the battery is only partially charged).

c. Only under exceptional circumstances should a vehicle be operated after indications of trouble have been observed. When in doubt, stop the power unit, and obtain assistance. Inspection during operation applies to the entire vehicle. Emphasize this fact throughout the driving instruction period.

d. Check for abnormal vibration. This may be caused by accumulation of dirt in fan hub and clutch, or by broken or damaged blades in the power unit cooling fan.

18. AT THE HALT.

a. At each halt make a careful inspection of the vehicle to determine its general mechanical condition. Correct any minor defects detected during the march, together with minor defects discovered at the halt, before resuming the march. If the defects cannot be corrected during the halt, make proper disposition of the vehicle so that unnecessary delay may be avoided and major failure prevented.

b. A suitable general routing for inspection during the halt is as follows:

(1) Allow the power unit to run for not more than five minutes at idling speed (750 rpm). Listen for unusual noises. NOTE: Do not idle at this speed longer than five minutes. If necessary to idle power unit for periods longer than five minutes, adjust hand throttle to increase the speed to 950 – 1,000 rpm.

(2) Walk around the vehicle, looking carefully for fuel, water or oil leaks.

(3) Examine tracks for adjustment and for worn, loose, broken, or missing parts. Remove dirt or any foreign material lodged in the suspension units.

(4) Inspect hull and fittings for missing, worn, or loose parts.

(5) Feel steering brake housings and gear case for evidence of overheating.

(6) Inspect the lights for proper operation, if assignment permits use of lights.

(7) Check the amount of fuel in the tanks.

(8) Check level of coolant in radiator. If level of coolant is low, investigate the cause. Always observe precaution given in paragraph 8., e.

(9) Wipe all vision devices. Do not use an oily or dirty rag.

(10) Inspect all water pump drive belts (on power units so equipped).

(11) Inspect clutch throwout bearings.

19. AFTER OPERATION.

At the conclusion of each day's operation, have an inspection made, similar to that made at halts, but more thorough and detailed. Follow the inspection by preventive maintenance. If defects cannot be corrected, report promptly to the Chief of Section or other designated individual. Cover the following points:

a. Examine the tracks and bogies.

b. Check track tension.

c. Inspect idler and roller tires.

d. Examine the drive sprockets for worn or broken teeth.

e. Examine the track shoe units for unserviceable units.

f. Check transmission oil level (par. 23.).

g. Check oil level in final drive units.

h. Check and clean air cleaners (par. 75., f.). During extremely dusty operations do this at each halt.

i. Inspect lights, siren, and windshield wipers. Check for loss or damage of accessories.

j. Inspect the sighting and vision devices for breakage.

k. Inspect guns and mounts for defective performance.

l. Inspect guns, sighting equipment, and accessories to determine whether covers are properly installed.

m. Inspect ammunition and fighting compartments for cleanliness and orderly arrangement.

n. Replenish oil, fuel and ammunition.

o. Check fluid level in radiator, observing precaution in paragraph 8., **e.** In cold weather, check freezing point of solution (par. 83., **i.**).

p. During continuous operation in hot weather, check battery water level.

q. Check water pump and generator drive belt tension (on multiple pump type (par. 86.)).

r. Check exhaust connections.

s. Inspect electrical wiring for loose connections and abrasions.

t. Check to see that fuel shut-off valves are closed (fig. 19).

u. Check to see that battery switch is open (fig. 121).

20. AFTER 50 HOURS OR 500 MILES OF OPERATION.

a. This check is made without removing the power unit from the vehicle. Make a routine daily (prestarting preventive maintenance) (par. 6.) inspection in addition to the following:

(1) Check the operation of each individual engine, by shorting out four engines and noting operation of other engine.

(2) Inspect the power unit oil supply tank for leaks.

(3) Examine gasoline and oil lines for breaks, loose connections, and chafing. Carefully examine rigid and flexible lines having sharp bends.

(4) Drain fuel filter and clean (par. 80., **c.**). If excessive water is present, drain fuel tanks and clean outlet screens (par. 77., **e.**).

(5) Service air cleaners. Fill with new oil but do not overfill (par. 75., **f.**). Check all air induction pipes and flexible connections for leaks or missing fittings.

(6) Tighten power unit mounting bolts and check for loose bolts in power unit mounting brackets.

(7) Examine suspension system. Note condition of volute springs, track support rollers, rubbing blocks, suspension gudgeon pins and bogie wheel gudgeons.

(8) Examine track carefully for loose or missing wedges and wedge nuts, and mutilated, badly worn, or dead track blocks.

(9) Inspect sprocket tooth plates for excessive wear.

(10) Check propeller shaft flange nuts for tightness (fig. 90) NOTE: This necessitates the removal of that part of the propelle shaft tunnel housing which covers the rear propeller shaft, as wel as the part that covers the front propeller shaft front flange.

(11) Examine the propeller shaft center bearing support bracke and clamping bolts for tightness (fig. 91).

(12) Start power unit and allow to warm at 750 rpm. NOTE: D not idle at this speed longer than five minutes. If necessary to idle powe unit for periods longer than five minutes, adjust hand throttle to increas the idle speed to 950–1,000 rpm.

(13) Change power unit oil (par. 54., **c.**).

(14) Replace absorption type oil filter cartridge (par. 55., **c.**).

(15) Check oil level in final drive units, and add oil if necessar (par. 23.).

(16) Service battery.

(17) Check solenoids for proper operation.

(18) Check operation of turret traversing mechanism (par. 126.)

(19) Examine all oil lines for tightness and condition.

(20) Inspect for tightness all electrical connections in turret.

(21) Inspect all stabilizer and traversing mechanism mountin bolts for tightness.

(22) Check all accessories for presence or security of mounting.

(23) Clean fuel filter on auxiliary generating unit (par. 190., **c.**)

(24) Clean spark plug on auxiliary generating unit (par. 190., **a.**)

(25) Check auxiliary generating unit mounting bolts (fig. 172).

(26) Start auxiliary generating unit and check current output.

(27) Check transmission and power unit oil coolers. Clean if nec essary.

(28) Clean outside surface of radiator (par. 90., **d.**).

21. AFTER 100 HOURS OR 1,000 MILES OF OPERATION.

a. Do the 50-hour inspection and also the following:

(1) Clean power unit with SOLVENT, dry-cleaning.

(2) Check exhaust pipes for cracks or burned out spots.

(3) Tighten mounting nuts on intake and exhaust manifolds.

(4) Clean and reset, or replace, all spark plugs (par. 69., **a.**).

(5) Remove transmission and power unit oil coolers and remov all dirt and foreign material from air passages (pars. 58., **c.**, **d.**, an

110., 111.). Thoroughly flush inside of coolers. Great care must be used to completely remove flushing material.

(6) Inspect distributor and set distributor points to .020 inches (par. 66., **g.**). If points show ash-colored burning, replace condensers (par. 66., **h.** and **i.**).

(7) Inspect carburetors for flooding. Replace if necessary (par. 71., **a.**).

(8) Remove window straps of starter and generator and inspect brushes, commutator, and general appearance. If brushes are badly worn, or if other repairs are indicated, replace the starter or generator (pars. 162., **d., e., f., g.,** and 163., **d.,** and **e.**).

(9) Replace all water pump drive belts regardless of condition (par. 86., **b.** and **c.**). NOTE: This applies only on multiple water pump type power unit.

(10) Check all throttle and choke connections (par. 72.).

(11) Check operation of foot accelerator.

(12) Remove and clean magnetic plugs in transmission. Check magnetic ability.

(13) Inspect and blow out fire extinguisher lines (figs. 27 and 54).

(14) Check condition and operation of headlights, batteries, siren, generator, wiring harness, and all other such units and, where necessary, replace.

(15) Inspect, repair, and adjust tracks (par. 115., **i.**). NOTE: To do this, the track and suspension units must first be cleaned of all mud or other foreign material.

(16) Check sprockets, bogie wheels, idlers, gudgeons, gudgeon guides, track connectors, wedges, and wedge nuts for wear, breakage, and missing parts.

(17) Perform prestarting preventive maintenance operations (par. 6.).

(18) Replace all thermostats (par. 88., **d.** and **e.**).

(19) Clean radiator (par. 90., **d.**).

(20) Lubricate vehicle throughout in compliance with lubrication instructions (par. 23.).

(21) Road test.

Section V

LUBRICATION INSTRUCTIONS FOR MEDIUM TANK M4A4

22. GENERAL.

a. The following lubrication instructions for Medium Tanks M4A4 are published for the information and guidance of all concerned, and supersede all previous instructions. Materiel must be lubricated in accordance with the latest instructions contained in Technical Manuals and/or Ordnance Field Service Bulletins.

23. LUBRICATION GUIDE.

a. Lubrication instructions for all points to be serviced by the using arms are shown in Lubrication Guides (figs. 16 and 17), which specify the types of lubricants required and the intervals at which they are to be applied. The following lubrication instructions contain the same information as the guide. Guides from which data are reproduced are 10x15 inch laminated charts which are part of the accessory equipment of each piece of materiel. Data contained in the lubrication guides are taken from Technical Manuals, and are binding on using troops.

24. POINTS TO BE SERVICED AND/OR LUBRICATED BY ORDNANCE MAINTENANCE PERSONNEL.

a. Starter Reduction Gears. At least once each year, disassemble and pack starter reduction gears with GREASE, graphite, light.

b. Clutch Hub Bearing and Pilot Bearing. Every 6 months or whenever clutch is disassembled, clean and repack bearings with GREASE, ball and roller bearing.

c. Turret Generator and Motor Bearings. Whenever these units are disassembled for some other purpose, the bearings should be cleaned and repacked with GREASE, lubricating, special.

25. REPORTS AND RECORDS.

a. Reports. If lubrication instructions are closely followed, proper lubricants used, and satisfactory results are not obtained, a report will

MEDIUM TANK M4A4

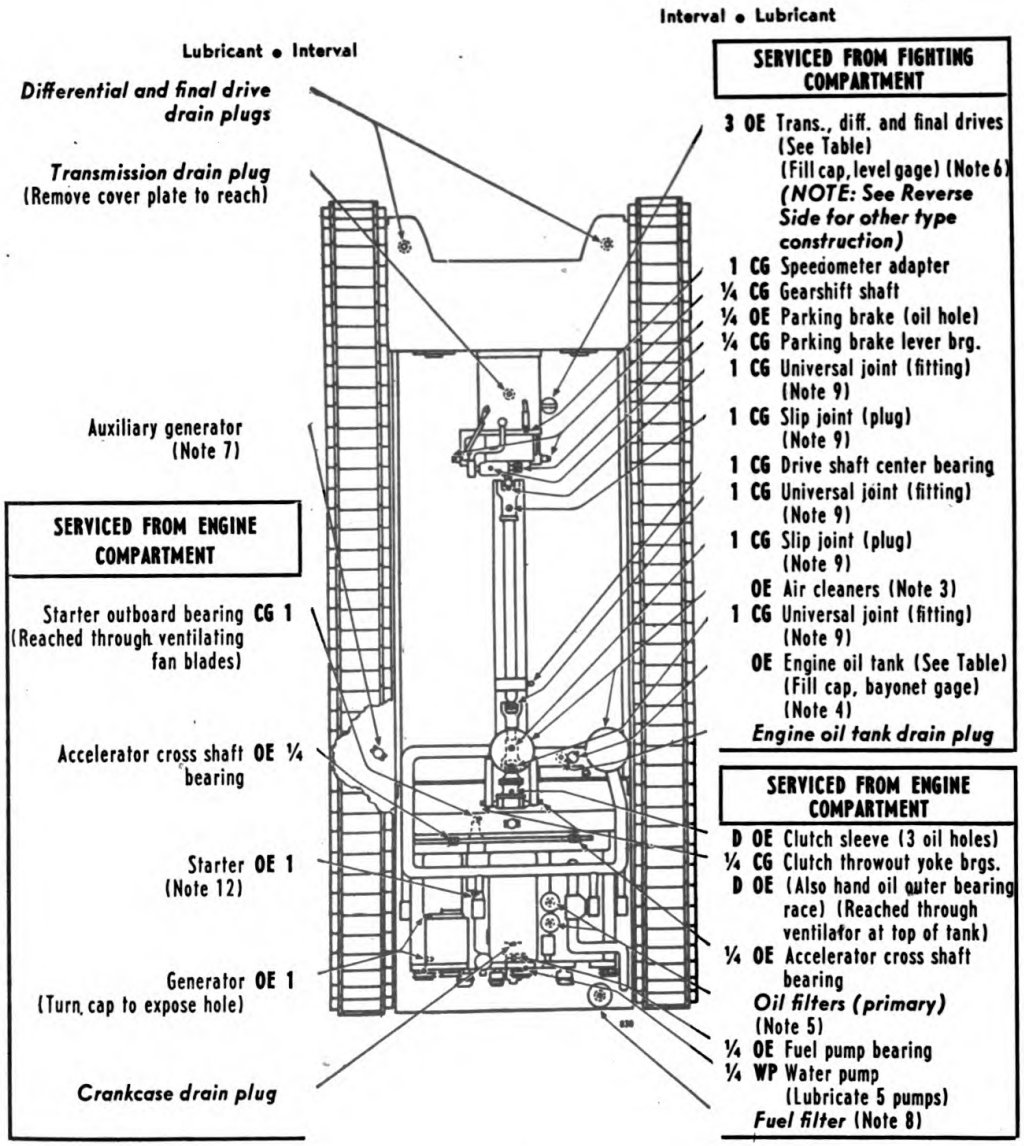
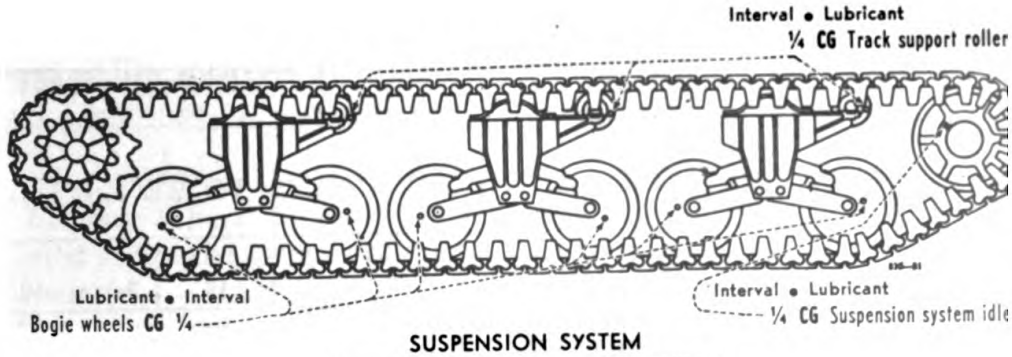


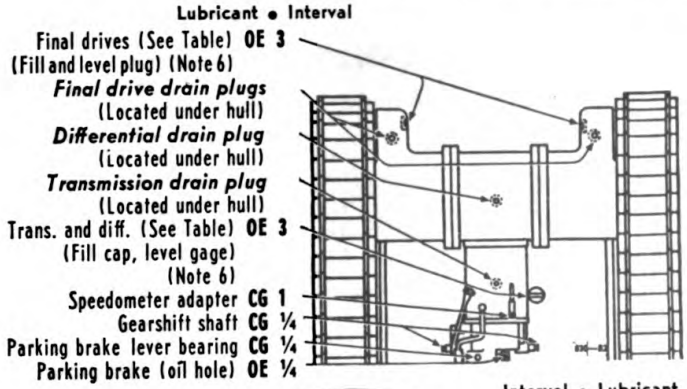
Figure 16 — Lubrication Guide

LUBRICATION INSTRUCTIONS FOR MEDIUM TANK M4A4

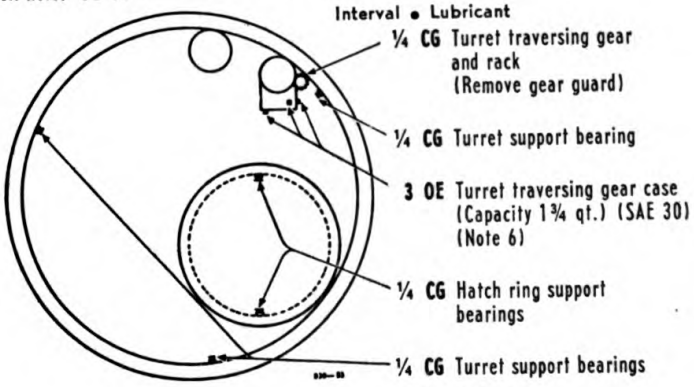


SUSPENSION SYSTEM

CAUTION—Lubricate SUSPENSION SYSTEM POINTS on BOTH SIDES of TANK



TRANSMISSION, DIFFERENTIAL AND FINAL DRIVES
(3-piece unit)
(See Reverse Side for oth type construction)



TURRET

KEY

LUBRICANTS	
OE—OIL, engine Crankcase grade (unless otherwise specified)	**CG**—GREASE, general purpose No. 1 (above +32°) No. 1 or No. 0 (+32° to +10°) No. 0 (below +10°)

INTERVALS
¼— 250 MILES
1—1,000 MILES
3—3,000 MILES

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Figure 17 — Lubrication Guide

be made to the ordnance officer responsible for the maintenance of the materiel.

b. Records. A complete record of lubrication servicing will be kept for the materiel.

TABLE OF CAPACITIES AND LUBRICANTS TO BE USED

	Capacity (Approx.)	Above +32°	+32° to +10°	+10° to −10°	Below −10°
Engine Oil Tank	36 qt.	OE SAE 30	OE SAE 30 or 10	OE SAE 10	*Refer to*
Trans., Diff. and Final Drives (single unit)	152 qt.	OE SAE 50	OE SAE 30	OE SAE 30	
Trans. and Diff. (3-piece unit)	64 qt.	OE SAE 50	OE SAE 30	OE SAE 30	
Final Drives (each) (3-piece unit)	36 qt.				

c. Lubrication Notes. The following are additional lubrication and service notes on individual units and parts:

(1) FITTINGS. Clean before applying lubricant. Lubricate bogie wheels, idler and track support rollers until new lubricant overflows relief valve. Lubricate other fittings until new lubricant is forced from the bearing, unless otherwise specified (pars. 84., **f.** and **e.**).

(2) INTERVALS. Indicated intervals are for normal service. For extreme conditions of speed, heat, water, sand, mud, snow, dust, etc., reduce interval by ⅓ or ½, or more if conditions warrant.

(3) AIR CLEANERS. Daily, when operating on dirt roads or cross country, or every 250 miles, when operating on paved roads or during wet weather, drain, clean and refill with used crankcase oil or OIL, engine, crankcase grade. Every 100 to 500 miles, depending on operating conditions, remove air cleaner and wash all parts (par. 75., **f.**). CAUTION: Keep all air pipe connections clean and tight. Inspect air outlet rubber hose connections for leaks and make sure pipes are in alinement. Replace connections if there is evidence of wear or deterioration. Proper maintenance of air cleaners is essential to prolonged engine life.

(4) ENGINE OIL TANK. Daily, check oil level, add oil if necessary. Every 500 miles or 50 hours, when operating on dirt roads or cross

country, or every 1,000 miles, when operating on paved roads or during wet weather, drain and refill. To completely drain lubricating system, remove both crankcase and oil tank drain plugs. Refill oil tank to "FULL" mark on bayonet gage under fill cap. CAUTION: Do not remove strainer when filling tank. Clean tank and fill tube strainer every 1,000 miles.

(5) OIL FILTERS.

(a) Primary Filters. Every 250 miles, remove drain plugs to drain accumulated sediment. Every 1,000 miles, or oftener if necessary, renew filter elements.

(b) Secondary Filter. This filter is of the self-turning type and is located under the engine. Every 250 miles, remove drain plug to drain accumulated sediment. To operate manually, remove the knurled nut at rear of the filter case and reverse on shaft. Then turn the nut.

(6) GEAR CASES. On some assemblies, the transmission, differential and final drives are combined in one unit. Fill through transmission filler to mark on bayonet gage with fill cap resting on top of fill pipe. Drain through transmission and final drive drain plug holes. Other assemblies use 3-piece units. Fill through transmission filler to mark on bayonet gage and through each final drive filler to 1 inch below fill plug hole. Drain through transmission, differential and final drive drain plug holes. Weekly, check level with tank on level ground if necessary, add lubricant to correct level. Drain, flush and refill at end of first 250 miles; thereafter as indicated at points on guide. When draining, drain immediately after operation. Every 3,000 miles, clean transmission filler strainer. CAUTION: Do not remove strainer when filling. To flush, fill cases to about one half capacity with OIL, engine, SAE 10. Operate mechanism within cases slowly for several minutes and redrain. Replace drain plugs and refill cases to correct level with lubricant specified on guide.

(7) AUXILIARY GENERATOR. Two-cycle air cooled engine, mounted on turret floor rear, is lubricated by engine oil mixed with fuel. Mix thoroughly ⅜ pint of OIL, engine, SAE 30, with each gallon of gasoline before pouring into tank. CAUTION: Do not pour gasoline and oil separately into tank. Keep fuel strainer clean. Every 200 hours, lubricate magneto cam follower by oiling felt with 1 or 2 drops OIL, engine, SAE 30.

(8) FUEL FILTER. Every 100 hours, open vent, drain and remove filter element. Wash element and case, replace element (par. 79., c.).

(9) UNIVERSAL JOINTS AND SLIP JOINT. Remove tunnel shield sections over universal joints and slip joint at ends of tunnel shield. To lubricate slip joint, remove plug and insert fitting. Apply GREASE, general purpose, seasonal grade, to universal joints until it overflows at relief

valve and to slip joint until lubricant is forced from end of spline. CAUTION: After lubricating, remove fitting and replace plug.

(10) OIL CAN POINTS. Every 250 miles, lubricate door and shield hinges, peep hole protector slides, pistol port cover hinges, door latches, throttle linkage, control rod pins and lever bushings, etc., with OIL, engine, crankcase grade.

(11) POINTS REQUIRING NO LUBRICATION SERVICE. Distributors, bogie wheel suspension linkage and slides, final drive sprocket bearings.

(12) POINTS TO BE SERVICED AND/OR LUBRICATED BY ORDNANCE MAINTENANCE PERSONNEL. Starter reduction gears, clutch hub bearing, clutch pilot bearing, turret generator and motor bearings.

Section VI

LUBRICATION INSTRUCTIONS FOR COMBINATION GUN MOUNT M34

26. GENERAL.

The following lubrication instructions for Combination Gun Mount M34, for Medium Tank M4A4, are published for the information and guidance of all concerned, and supersede all previous instructions. Materiel must be lubricated in accordance with the latest instructions contained in Technical Manuals and/or Ordnance Field Service Bulletins..

27. LUBRICATION GUIDE.

Lubrication instructions for all points to be serviced by the using arms are shown in War Department Lubrication Guide, which specifies the types of lubricants required and the intervals at which they are to be applied. The following lubrication instructions contain the same information as the guide. Guides from which data are reproduced are 10- by 15-inch laminated charts which are part of the accessory equipment of each piece of materiel. Data contained in the lubrication guides are taken from Technical Manuals, and are binding on using troops.

28. POINTS TO BE LUBRICATED BY ORDNANCE MAINTENANCE PERSONNEL.

a. Cradle Trunnion Bearings. Every six months, remove, clean and repack bearings with GREASE, general purpose, No. 2.

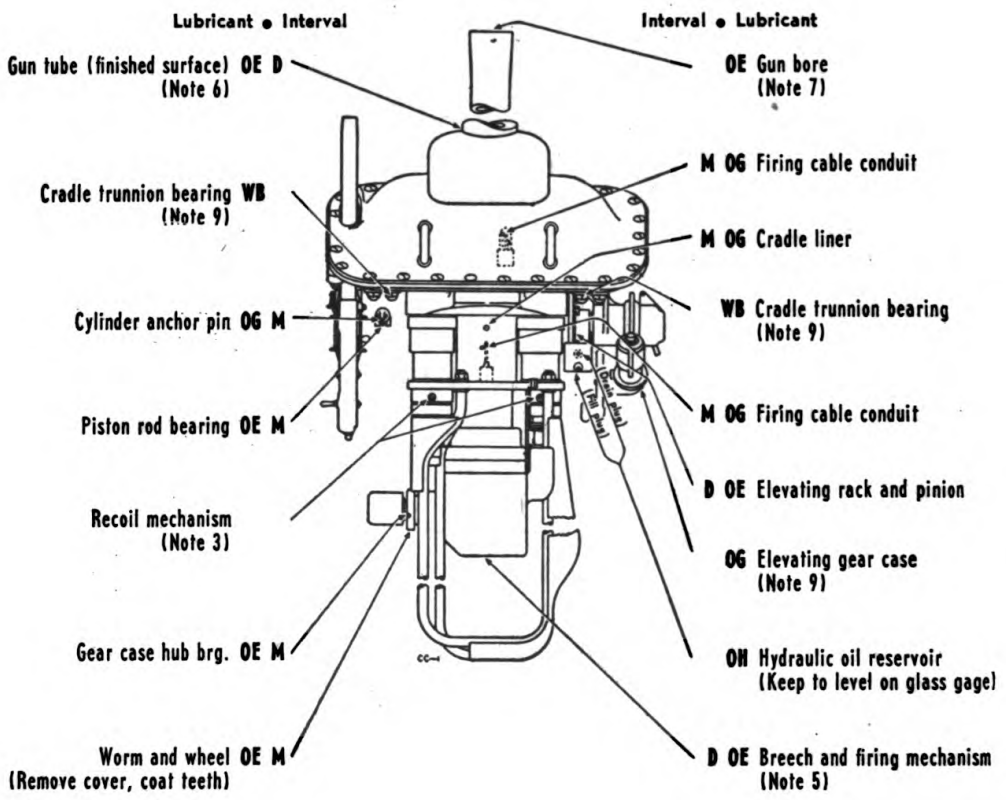
b. Elevating Gear Cases. Lubricate every six months with GREASE, OD No. 0, where temperatures above + 32 degrees prevail, and GREASE, OD No. 00, where continued temperatures below + 32 degrees are expected. Completely disassemble mechanism, clean and repack each individual bearing and case.

29. REPORTS AND RECORDS.

a. Reports. If lubrication instructions are closely followed, proper

MEDIUM TANK M4A4

COMBINATION GUN MOUNT, M34 FOR TANK, MEDIUM, M4



KEY

LUBRICANTS		INTERVALS
OE—OIL, engine SAE 30 (above +32°) SAE 10 (below +32°)	WB—GREASE, general purpose No. 2	D—DAILY
OG—GREASE, O.D. No. 0 (above +32°) No. 00 (below +32°)	OH—OIL, hydraulic	M—MONTHLY

RA PD 49681

Figure 18 — Lubrication Guide

lubricants used, and satisfactory results are not obtained, a report will be made to the Ordnance officer responsible for the maintenance of the materiel.

b. Records. A complete record of lubrication servicing will be kept for the materiel.

c. Lubrication Notes. The following are additional lubrication and service notes on the gun mount M34.

(1) FITTINGS. Clean before applying lubricant. Where bearings can be seen, lubricate fittings until new grease is forced from the bearing.

(2) INTERVALS. The intervals indicated are for normal services. For extreme conditions of heat, dust, etc., reduce interval on guide by one-third or one-half, or more, if conditions warrant.

(3) RECOIL FLUID. Use OIL, recoil, heavy.

(4) ELEVATING RACK AND PINION. Clean and apply OIL, engine seasonal grade, daily.

(5) BREECH AND FIRING MECHANISM. Clean and oil all moving parts and exposed metal surfaces with OIL, engine, seasonal grade, daily. Perform operation before and after firing. CAUTION: To insure easy breech operation and to avoid misfiring in cold weather, clean with SOLVENT, dry-cleaning, dry and lubricate with OIL, lubricating, for aircraft instruments and machine guns. To clean firing mechanism, remove and operate pin in solvent.

(6) GUN TUBE. (finished surface). Clean and oil exposed finished metal surface daily and before firing. Keep surface covered with thin film of OIL, engine, seasonal grade.

(7) GUN BORE. Clean and coat with OIL, engine, seasonal grade, after firing. Inspect daily, and oil, if necessary.

(8) OIL CAN POINTS. Lubricate the following points weekly with OIL, engine, seasonal grade: Handwheel handles, firing button, firing lever link, etc.

MEDIUM TANK M4A4

Section VII

CARE AND PRESERVATION

30. RECORDS.

a. Use. An accurate record must be kept of each motor vehicle issued by the Ordnance Department. For this purpose the Ordnance Motor Book (O.O. Form No. 7255), generally called "Log Book," is issued with each vehicle and must accompany it at all times. This book furnishes a complete record of the vehicle, from which valuable information concerning operation and maintenance costs, etc., is obtained, and organization commanders must insist that correct entries be made. Keep this book in a canvas cover to prevent it being injured or soiled.

b. Assignment Record. The page bearing a record of assignment must be destroyed prior to entering the combat zone. All other references which may be posted regarding the identity of the organization must also be deleted.

31. CLEANING.

a. Grit, dirt and mud are the sources of greatest wear to a vehicle. If deposits of dirt and grit are allowed to accumulate, particles will soon find their way into bearing surfaces, causing unnecessary wear, and if the condition is not remedied, will soon cause serious difficulty. When removing power unit parts or any other units, in making repairs and replacements, or if in the course of inspection working joints or bearing surfaces are to be exposed, all dirt and grit that might find its way to the exposed surfaces must first be carefully removed. The tools must be clean, and care must always be taken to eliminate the possibilities of brushing dirt or grit into the opening with the sleeve or other part of the clothing. To cut oil-soaked dirt and grit, hardened grit or road oil, use SOLVENT, dry-cleaning, applied with cloths (not waste) or a brush. The vehicle is so designed that the possibility of interfering with its proper operation by careless application of cleaning water is very small. However, take care to keep water from the power unit, as it might interfere with proper ignition and carburetion. Detailed information on cleaning is included in TM 9-850.

b. Open oil holes which have become plugged, with a piece of wire. Never use wood for this purpose, as splinters are likely to break off and permanently clog the passages. Take particular care to clean and decontaminate vehicles that have been caught in a gas attack. See paragraph 44., **c.** on "Decontamination," for details of this operation.

Section VIII

TOOLS AND EQUIPMENT ON THE VEHICLE

32. TOOLS AND EQUIPMENT.

a. General. The Medium Tank M4A4 comes complete with a set of pioneer tools, generally carried on the hull, a special set of repair tools, and a number of special equipment items which are stowed inside the vehicle. A list of these tools and equipment is given below.

b. Description.

Item	Stowage Position
(1) PIONEER TOOLS.	
AXE, chopping, single bit, 5-lb. (1)	Rear deck
CROWBAR, 5-ft. long (1)	" "
HANDLE, Mattock (1)	" "
MATTOCK, PICK, M1- (4-lb. head) w/o handle (1)	" "
SHOVEL, D. handle, round point (1)	" "
SLEDGE, blacksmith double face, 10-lb. (1)	" "
WRENCH, track adjusting 3.031 hexagon opening 44⅝-in. long (1)	In clips on rear deck
(2) VEHICLE TOOLS.	
ADAPTER, button head to bayonet type (1)	In tool box, left sponson, ahead of water can
ADAPTER, button head to hydraulic type (1)	"
BAG, tool (1)	"
FIXTURE, track connecting (1)	"

MEDIUM TANK M4A4

Item	Stowage Position
GUN, lub. high pressure lever type 1-lb. (1)	In tool box, left sponson, ahead of water can
HAMMER, machinist, ball peen, 2-lb. (1)	"
HOSE, lub. 15-in. heavy duty button head fitting (1)	"
PLIERS, comb. slip joint, 8-in. (1)	"
PLIERS, side cutting, 8-in. (1)	"
SCREWDRIVER, machinist extra heavy duty, ½ x 5-in. blade, 9½-in. long (1)	"
SCREWDRIVER, close quarter, ⅜ x 1¾-in. blade, 5-in. long (1)	"
SCREWDRIVER, wood handle, ¼ x 1½-in. blade, 3½-in. long (1)	"
SET, wrench, socket, heavy duty, alloy steel, 20 pieces complete, as follows:	"
Extension, handy grip, ½-in. sq. drive, 5-in. (1)	"
Extension, ½-in. sq. drive, 10-in. (1)	"
Handle, flexible, ½-in. sq. drive, 12-in. (1)	"
Joint, universal, ½-in. sq. drive (1)	"
Ratchet, ½-in. sq. drive, 9-in. (1)	"
Socket Head, ½-in. sq. drive, ⅜-in. hexagon (1)	"
Socket Head, ½-in. sq. drive, $\frac{7}{16}$-in. hexagon (1)	"
Socket Head, ½-in. sq. drive, ½-in. hexagon (1)	"
Socket Head, ½-in. sq. drive, $\frac{9}{16}$-in. hexagon (1)	"
Socket Head, ½-in. sq. drive, ⅝-in. hexagon (1)	"

TOOLS AND EQUIPMENT ON THE VEHICLE

Item	Stowage Position
Socket Head, ½-in. sq. drive, ¾-in. hexagon (1)	In tool box, left sponson, ahead of water can
Socket Head, ½-in. sq. drive, ⅞-in. hexagon (2)	"
Socket Head, ½-in. sq. drive, $1\frac{5}{16}$-in. hexagon (2)	"
Socket Head, ½-in. sq. drive, 1-in. hexagon (1)	"
Socket Head, ½-in. sq. drive, $1\frac{1}{16}$-in. hexagon (1)	"
Socket Head, ½-in. sq. drive, 1⅛-in. hexagon (1)	"
Socket head, ½-in. sq. drive, 1½-in. hexagon (1)	"
Speeder, 17-in. (1)	"
Tee, combination, ¾-in. sq. drive, 17-in. (1)	"
Tee, combination, ½-in. sq. drive, 11-in. (1)	"
WRENCH, adjustable, single end, 8-in. (1)	"
WRENCH, adjustable, single end, 12-in. (1)	"
WRENCH, engr. double head, alloy 5, sizes as follows: (6) $\frac{5}{16}$ x ⅜-in. $\frac{7}{16}$ x ½-in. $\frac{9}{16}$ x $1\frac{1}{16}$-in. ⅝ x ¾-in. $\frac{13}{16}$ x ⅞-in. $1\frac{5}{16}$ x 1-in.	"
WRENCH, safety screw, sizes as follows: (9) 3/32-in. hexagon ⅛-in hexagon $\frac{3}{16}$-in. hexagon $\frac{5}{16}$-in. hexagon ¼-in hexagon ⅜-in. hexagon	"

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Item	Stowage Position
5/8-in. hexagon 9/16-in. hexagon (transmission and oil tank drain plugs) 3/4-in. hexagon (for differential filler and drain plug).	

33. GUN TOOLS.

CAN, recoil oil (1)	In box, left, at feet of 75-mm gunner
CHISEL, machs. hand, cold, 3/4-in. (1)	"
DRIFT, brass, taper (2): 1 5/16-in. pt. 4-in. long 1 1/2-in. pt. 6-in. long	"
EXTENSION, oil gun (1)	"
EYEBOLT, breechblock removing (1)	"
FILE (2) hand, sm. 8-in. (1) three—sq. 6-in. (1)	"
HAMMER, mach. ball peen, 20-oz. (1)	"
PUNCH, drift, 1/4-in. pt. 10-in. long (1)	"
PUNCH, drive pin, std. 1/8-in. pt. (1)	"
ROD, push, breechblock removing (1)	"
ROLL, tool, M4 w/o contents (1)	"
TOOL, breechblock removing (1)	"
TOOL, assembly, firing pin retainer (1)	"
WRENCH, engrs. double head, 1 1/4 x 1 1/2-in. (breechblock removal) (1)	"
WRENCH, firing plunger retainer (1)	"
WRENCH, screw, adj. knf-hdl., 12-in. (1)	"

TOOLS AND EQUIPMENT ON THE VEHICLE

34. GUN—SPARE PARTS AND ACCESSORIES.

a. 75-mm Gun.

(1) SPARE PARTS.

Item	Stowage Position
FORK, cocking (1)	In right box, at feet of 75-mm gunner.
MECHANISM, percussion, assembly, (1) composed of:	"
Guide (1)	
Pin (1)	
Spring (1)	
Stop (1)	
Pin (1)	
PIN, firing (2)	"
PINS, cotter, split, s. (6)	"
PLUGS, recoil cylinder (2)	"
PLUNGER, cocking fork (1)	"
PLUNGER, firing (1)	"
RETAINER, firing plunger (1)	"
RETAINER, sear (1)	"
SPRING, compression (1)	"
STOPS, firing spring (3)	"

(2) ACCESSORIES.

BOOK ARTY., gun, O. O. Form 5825 (blank) (1)	In right box, at feet of 75-mm. gunner
BRUSH, bore, M10 w/staff (112-$\frac{3}{16}$-in. long) (1) consisting of:	
Brush, bore, M10 (1)	Cal. .30 spare parts box, right sponson.
Staff, end (1)	Right sponson above 75-mm ammunition rack.
Staff, middle (1)	"
CAN, oil, 1 qt. (oil, recoil, heavy, 1 qt.) (1)	In rack under bow gunner's seat.
CASE, carrying, gunner's quadrant, M1 (1)	In bracket right side of hull, forward of rear 75-mm ammunition rack.
COVER, breech (1)	On gun.

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Item	Stowage Position
COVER, muzzle (1)	On gun.
COVER, periscope (1)	On periscope.
COVER, bore brush, M516 (1)	On brush.
POUCH, spare parts roll w/o contents (1)	In right box, at feet of 75-mm gunner.
QUADRANT, gunner's M1 (1)	In case.
SETTER FUSE, M14 (1)	In left box, at feet of 75-mm gunner.
WRENCH, fuse (1)	"
TARGET, testing (6)	In cal. .30 spare parts box, right front sponson.
b. Cal. .50 Machine Gun.	
(1) SPARE PARTS.	
EXTRACTOR, assy. (1)	In center box, at feet of 75-mm gunner.
(2) ACCESSORIES.	
BOXES, ammunition (50 rounds—cal. .50) (6)	3 boxes in turret on floor. 3 boxes in right sponson.
BRUSH, cleaning, cal. .50 M4 (1)	In center box, at feet of 75-mm gunner.
COVER, gun and cradle M10 (1)	On gun.
ROD, jointed, cleaning (1)	In center box, at feet of 75-mm gunner.
WRENCH, combination, cal. .50, M2 (1)	"
c. Cal. .30 Machine Gun.	
(1) SPARE PARTS.	
ACCELERATORS (2)	2—cal. .30 spare parts boxes. 1 box by bow gunner, right sponson, 1 box center, feet of 75-mm gunner.
BARRELS, spare (2)	Left side of hull to left of cal. .30 ammunition rack.
BOLTS, assembly (2)	2—cal. .30 spare parts boxes.
BUSHING, belt feed lever pivot (1)	"
CAP, belt feed lever pivot (1)	"

TOOLS AND EQUIPMENT ON THE VEHICLE

Item	Stowage Position
COVER, assembly (1)	2—cal. .30 spare parts boxes.
EXTENSION, barrel, assy. (1)	"
EXTRACTORS, assembly (2)	"
LEVER, cocking (1)	"
LEVER, feed, belt (1)	"
LOCK, breech (1)	"
NUT, belt feed lever pivot bushing (1)	"
PAWL, feed, belt (2)	"
PIN, accelerator, assembly (2)	"
PIN, belt feed pawl, assembly (2)	"
PIN, belt holding pawl, split (2)	"
PIN, cocking lever (1)	"
PIN, driving spring rod (1)	"
PIN, firing, assembly (2)	"
PIN, trigger (1)	"
PIVOT, belt feed lever (1)	"
ROD, driving spring, assembly (1)	"
SEAR (2)	"
SLIDE, feed, belt, assembly (1)	"
SPRING, belt feed pawl (1)	"
SPRING, belt holding pawl (1)	"
SPRING, driving (1)	"
SPRING, cover extractor (2)	"
SPRING, locking barrel (1)	"
TRIGGER (1)	"

(2) ACCESSORIES.

BAG, empty cartridge, cal. .30 (flex. bow gun) (1)	On gun.
BAG, empty cartridge, cal. .30 (turret) (1)	On gun.
BRUSH, chamber cleaning M6 (1)	"
BRUSH, cleaning, cal. .30 M2 (6)	"
CAN, tubular, w/o contents (1)	"
CASE, spare bolt M2, w/o contents (2)	"

Item	Stowage Position
CHEST, ammunition, cal. .30 (27)	In hull and in turret.
COVER, tripod, mount, M2 (1)	On tripod.
COVER, muzzle, cal. .30 (flex. bow gun) (1)	On gun.
COVER, muzzle, cal. .30 turret (1)	On gun.
COVER, receiver, cal. .30 (flex. bow gun and turret, cal. .30) (2)	On gun.
ENVELOPE, spare parts, M1 w/o contents (2)	"
EXTRACTOR, ruptured cartridge MK IV (2)	"
OILER, reflector 12-oz. (1)	"
REFLECTOR, barrel, cal. .30 (1)	"
ROD, cleaning, jointed, cal. .30 M1 (2)	"
ROLL, spare parts, M13 w/o contents (1)	"
ROLL, tools, M12 w/o contents (1)	"
SCREWDRIVERS, combination M1 (2)	In 2—cal. .30 spare parts boxes.
WRENCH, combination M6 (2)	"
WRENCH, socket, front barrel bearing plug (1)	"

d. Cal. .45 Submachine Gun.

(1) SPARE PARTS.

DISCONNECTOR (1)	In case, accessory: stowed in cal. .30 center box, at feet of 75-mm gunner.
EJECTOR (1)	"

35. SPARE PARTS AND ACCESSORIES FOR VEHICLE.

a. Spare Parts.

CONNECTION, track shoe, end (12)	Tool box, under turret, right side.
LAMP, bulb, 3 CP., 24-28X (4)	"

TOOLS AND EQUIPMENT ON THE VEHICLE

Item	Stowage Position
BLOCK, track shoe, link (6)	"
NUT, safety, alloy 5, 5/8-18-NF-3 (16)	"
PIN, cotter, split, 5., 1/4 x 2 1/4-in. (2)	"
WEDGE, track shoe and connection (12)	"
b. Accessories.	
BOOK, O. O. Form 7255 (1)	In tool box, left sponson.
CABLE, towing (1)	Over left side of vehicle, outside.
CAN, oil, 1 qt. (engine oil, emergency) (8)	Brackets, engine compartment.
CAN, OIL, 1 qt. (traverse and stabilizer) (Oil, 1 qt. universal No. 47) (1)	In right box, at feet of 75-mm gunner.
CAN, oil, trigger type, 1 pt. (1)	On floor, under bow gunner's seat.
CHEK-CHART lubrication guide (1)	In bracket.
FIELD MANUAL for cal. .30 M.G. 1919A4, RM 23-50 (1)	In tool box, left sponson,
FIELD MANUAL for cal. .50 M.G. M2, FM 23-65 (1)	"
FIELD MANUAL for cal. .45 S.M.G. 1928A FM 23-40 (1)	"
FIELD MANUAL for hand grenades FM 23-30 (1)	"
GROUSER (not used with steel track) (26)	Grouser box near mufflers.
HOOD, hatch, driver's (1)	Inside on hull, between driver and bow gunner.
LAMP, inspection (1)	In tool box, left sponson.
LAMP BULB, inspection (1)	"
NET, camouflage, 45-ft. x 45-ft. (1)	Rear deck.
PADLOCK, 1 1/2-in., 2 keys (1)	On driver's door.
TAPE, friction 3/4-in. wide, 30-in. roll (1)	In tool box, left sponson.

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Item	Stowage Position
TARPAULIN, 12-ft. x 12-ft. (1)	Outside, rear of turret.
TECHNICAL MANUAL TM 9-M4A4 (Chrysler) TM (1)	"
TECHNICAL MANUAL for 75-mm gun M3 TM 9-307 (1)	"

c. Miscellaneous.

BAGS, canvas, field, OD M-1936 (5)	On battery box, under turret.
BINOCULAR, M3, complete, (1) composed of: Binocular M3 (1) Case, carrying (1) Strap, neck (1)	On turret wall, in bracket, right of 75-mm gunner.
CANTEENS, M1910, with cups and covers (5)	3 in turret bracket on left side, 2 in hull, 1 on right and 1 on left side.
FLASHLIGHTS (3)	Clip in hull on front plate between driver and bow gunner, 1 in turret right of radio bulge, 1 in turret above 75-mm gun.
GOGGLES, aviation type, model C (5)	On individuals.
HELMETS, tank (5)	On individuals.
RATIONS, type "C" (5 men for 2 days, 60 cans) (10)	In box under turret cage, right side of power tunnel.
RATIONS, type "D" (5 men for 1 day, 2 cans, 24 bars) (5)	"
RESPIRATOR, dust (5)	On individuals.
ROLL, blanket (5)	Inside, over escape hatch.

36. COMMUNICATIONS.

ANTENNA, complete (spare) w/cover (1)	In bracket, right side of sponson.
BASE, mast, w/cover MP 37 or MP 48 (1)	"

TOOLS AND EQUIPMENT ON THE VEHICLE

Item	Stowage Position
RADIO SET, type III (SCR-508) (1)	In turret bulge.
RADIO SET, type II (SCR-506) (1)	In right sponson (command tanks only).
SET, flag, M 238, (1) composed of: (1) Flag, MC-273 (Red) Flag, MC-274 (Orange) Flag, MC-275 (Green) Flag, MC-270 Case, CS-90	In turret, left of commander's seat.

37. FIRE FIGHTING AND ANTIGAS.

a. Miscellaneous.

APPARATUS, decontaminating, 1½ qt. (2)	Left side of hull to rear of driver's seat.
BUCKET, canvas, folding, w/spout, 8-qt. (1)	On 75-mm rear ammunition rack.
CAN, water, 5-gallon (2)	Left sponson in front of auxiliary generating unit.
EXTINGUISHER, fire, 4-lb. CO_2 (portable) (2)	1 in left sponson next to driver, 1 in turret in front of 75-mm loader's seat.
EXTINGUISHER, fire, 10-lb. CO_2 (fixed) (2)	Left rear fighting compartment.
HEADS, periscope, M6 and/or M4 (spare) (15)	Three spare heads in each spare periscope box, listed below.
KIT, first aid (24 unit) (1)	Right sponson next to gunner's quadrant.
MITTENS, asbestos, pair (2)	1 in oddment tray in turret; 1 in bow gunner's cal. .30 spare parts box.
PERISCOPE, M4 (w/telescope, M38) (spare) (1)	75-mm gunner's spare periscope, in box to right of seat on turret sub-floor.

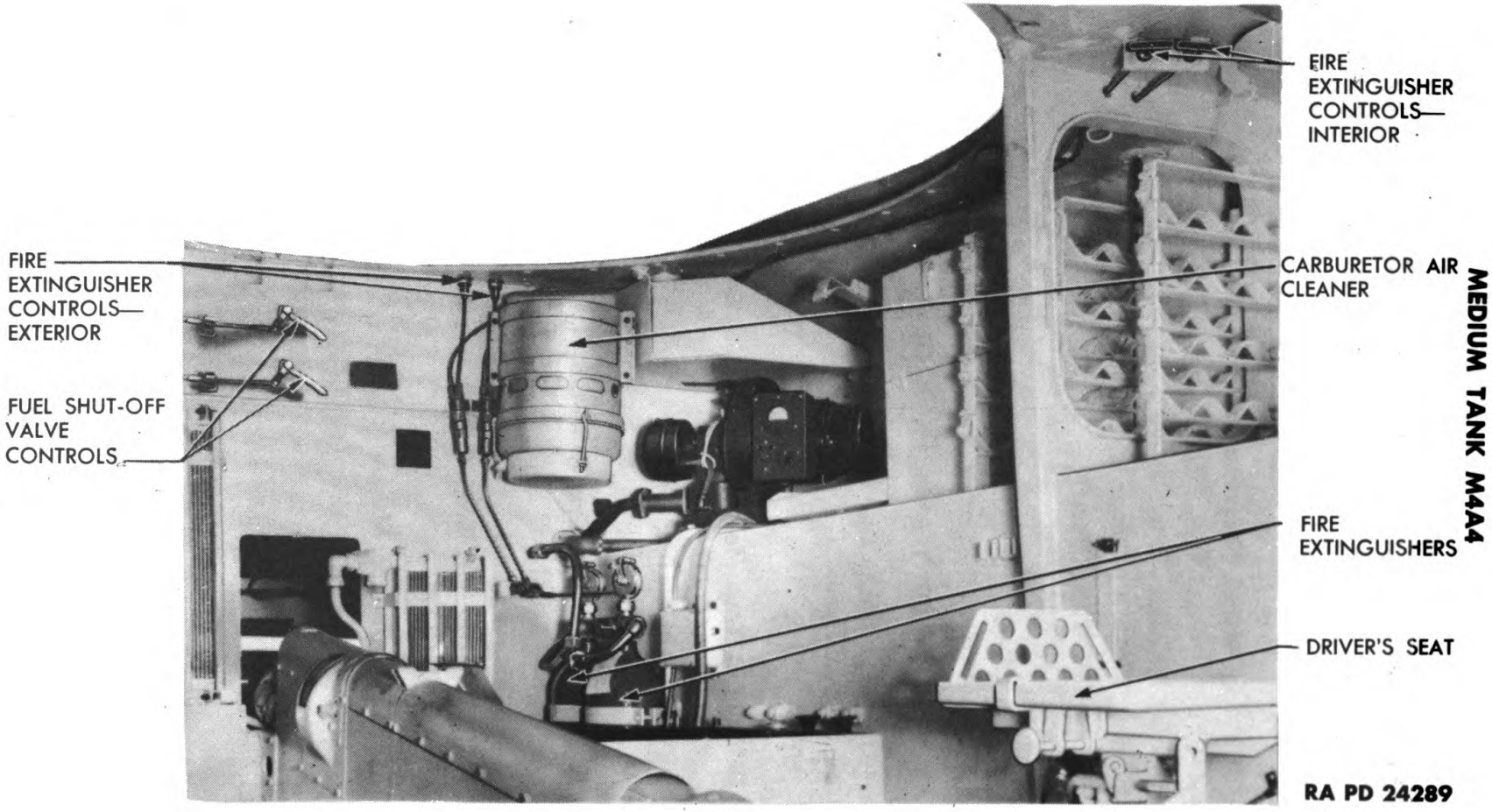

Figure 19 — Fire Extinguishers and Inside Controls

TOOLS AND EQUIPMENT ON THE VEHICLE

Item	Stowage Position
PERISCOPE, M6 (spare) (4)	Driver's spare periscope, in box left sponson near dash panel.
	Bow gunner's spare periscope, in box under seat.
	Commander's spare periscope, in box rear of 75-mm gunner's seat.
	75-mm loader's spare periscope, in box on basket wall, forward of seat.
STOVE, cooking, gasoline, M1941, 1 burner (Coleman Military Burner No. 520 with accessory cups) (1)	left sponson tool box.
TUBE, flexible nozzle (2)	Tool box, under turret cage.

38. USE OF SPECIAL EQUIPMENT (FIRE EXTINGUISHERS).

a. Fixed Fire Extinguisher System.

(1) Two ten-pound fire extinguishers are mounted in special brackets to the left rear of the fighting compartment. They are used solely for extinguishing fires in and around the power unit and are connected directly to lines and nozzles located in the front and rear of the power unit compartment (figs. 27 and 54). When put into action, they force carbon dioxide gas around the power unit, from top to bottom, and fill the power unit compartment, thus smothering the fire. If possible, the power unit should be stopped in case of fire.

(2) The fire extinguisher system can be put into operation from inside or outside the vehicle by pulling the control handles. The inside control handles are located on the hull, just above, and to the left rear of the driver (fig. 19). The outside control handles are located on the upper part of the hull, just ahead of the left side of the power unit air inlet grille (fig. 27).

b. Portable Fire Extinguishers.

(1) Two portable four-pound fire extinguishers are provided in the vehicle, one in the left sponson, beside the driver, and one at the left side of the turret.

(2) Portable extinguishers are operated by pulling the trigger while directing the discharge cone toward the fire. The position of the trigger determines the rate of discharge. The extinguisher should be carried in

the left hand, and the hose or cone in the right. Direct the discharge at the base of the flame, with the cone as close to the flame as the operator can safely hold it. Increase the rate of discharge from the extinguisher as the fire is put out.

c. **Handling.** Any cylinder containing gas under high pressure is as dangerous as a loaded shell. The extinguisher cylinders should never be dropped, struck, handled roughly, or exposed to unnecessary heat.

d. **Maintenance.**

(1) After use, the extinguisher should be immediately exchanged for one that is fully charged. Every four months, or preferably oftener, weigh each extinguisher. If the extinguisher weighs less than 3½ pounds (portable) or 9½ pounds (fixed) exchange it for a fully charged one.

(2) Take care to see that extinguishers are always securely fastened inside the vehicle, and that stowage is never allowed to be so placed as to interfere with the easy operation of the inside or outside control handles of the fixed fire extinguisher system.

Section IX

OPERATION UNDER UNUSUAL CONDITIONS

39. GENERAL.

a. The operation and maintenance of this vehicle at extreme temperatures, or over dusty terrain, involve factors which do not exist at normal temperatures or when operating over smooth terrain, and operator and maintenance personnel must spend more time in protective maintenance. Failure to give this extra service will result in actual damage and unnecessary and unwarranted expense.

40. COLD WEATHER OPERATION.

a. When the vehicle is being operated in extreme cold, great care must be used to prevent damage to the various units.

b. Antifreeze solutions must be checked before, and after each run and enough antifreeze solution must be kept in the power unit cooling system to provide a margin of safety against freezing (par. 83., **i.**).

c. Lubricating oils of the right weight must be used. For temperatures below 32 F. use OIL, SAE 10-W, or equivalent, in the power unit.

d. The fuel must be kept free from water, to insure proper functioning of the power unit. The following precautions should be followed to keep water out of the fuel tanks.

(1) Strain fuel through suitable strainer. CAUTION: A positive metallic contact must be provided between fuel container and fuel tank unless both fuel tank and container are independently grounded.

(2) So far as possible, always keep the tank full. This will reduce condensation of water from the free air space above the fuel.

(3) Add one-half pint of denatured alcohol to each tank of fuel. The alcohol will absorb the water and prevent it from freezing.

(4) Do not store fuel in old drums unless they have been thoroughly cleaned.

(5) Never pump fuel drums dry when filling vehicle fuel tanks; allow about four inches of fuel to remain. This residue can later be transferred to a settling tank. If time is not an urgent consideration, do not pump

fuel from drum to vehicle until it has settled for 16 hours after filling or moving. Keep portable fuel pumps clean and protected from snow and frost.

(6) When a drum has been opened, be sure that the opening is covered or the bung replaced to prevent snow, frost and other foreign matter from entering. Store drums in a covered building or cover them with tarpaulin.

e. Operate the vehicle in third gear, at a power unit speed of 1000 to 1200 revolutions per minute, until all stack temperature warning signals are automatically switched off. This will permit the lubricants in transmission, differential and final drives to circulate properly, thus resulting in proper lubrication of these units.

f. When lubricating the chassis, use **GREASE, general purpose No. 0** for temperatures below 10 F. Greases normally used cannot be applied at temperatures below 0 F. except in heated buildings. In an emergency, when heated buildings are not available, use **OIL, engine**, and inspect and oil frequently.

g. Check distributor points frequently and replace as necessary (par. 66., **e**, and **f.**). Test spark plugs and replace if necessary (par. 69.). See that the batteries are always fully charged, with the hydrometer reading between 1.275 and 1.300. If the vehicle has been exposed to temperatures below —30 F., warm up the batteries by running the auxiliary generating unit (par. 187.), before attempting to start the power unit.

h. Prior to attempting a start, see that everything is in readiness so that the power unit will start on the first trial. Try to avoid letting the power unit fire a few times and then stopping. Water is one of the products of gasoline combustion, and in a cold power unit this water may form a frost and make it impossible to start. Before cranking the power unit, push choke control lever forward to the limit of its travel. Pull the lever back as soon as the power unit starts, adjusting it to the best position for smooth power unit performance. **CAUTION**: Do not "pump" or depress the accelerator pedal swiftly to the floor before starting the power unit. This would force raw gasoline into the engines, causing flooding, decrease oil film in the cylinders, and would not aid starting.

41. HOT WEATHER OPERATION.

a. Keep water at correct level in radiator and be sure that all water pump drive belts (on multiple water pump type) are properly adjusted and serviceable. Drain and flush the cooling system every 250 hours or oftener.

OPERATION UNDER UNUSUAL CONDITIONS

b. Check outside surfaces of radiator daily. Clean if necessary (par. 90., **d.**).

c. Use OIL, SAE 30, or equivalent. Change power unit oil as recommended in lubrication guide or oftener, depending on the condition of the terrain over which the vehicle is being operated.

d. Watch the signaling devices on the instrument panel and be guided by the water and stack temperature signals and the power unit oil pressure and oil temperature readings.

e. Inspect and service carburetor air cleaners, as outlined in paragraph 75., **f.**

Section X

MATERIEL AFFECTED BY GAS

42. PROTECTIVE MEASURES.

a. When materiel is in constant danger of gas attack, unpainted metal parts will be lightly coated with engine oil. Instruments are included among the items to be protected by oil from chemical clouds or chemical shells, but ammunition is excluded. Care will be taken that the oil does not touch the optical parts of instruments or leather or canvas fittings. Ammunition will be kept in sealed containers.

b. Ordinary fabrics offer practically no protection against mustard gas or lewisite. Rubber and oilcloth, for example, will be penetrated within a short time. The longer the period during which they are exposed, the greater the danger of wearing these articles. Rubber boots worn in an area contaminated with mustard gas may offer a grave danger to men who wear them several days after the bombardment. Impermeable clothing will resist penetration more than an hour, but should not be worn longer than this.

43. CLEANING.

a. All unpainted metal parts of materiel that have been exposed to any gas except mustard and lewisite, must be cleaned as soon as possible with SOLVENT, dry-cleaning, or ALCOHOL, denatured, and wiped dry. All parts should then be coated with engine oil.

b. Ammunition which has been exposed to gas must be thoroughly cleaned before it can be fired. To clean ammunition use AGENT, decontaminating, noncorrosive, or if this is not available, strong soap and cool water. After cleaning, wipe all ammunition dry with clean rags. *Do not use dry powdered AGENT, decontaminating (chloride of lime) (used for decontaminating certain types of materiel on or near ammunition supplies)*, as flaming occurs through the use of chloride of lime on liquid mustard.

MATERIEL AFFECTED BY GAS

44. DECONTAMINATION.

a. For the removal of liquid chemicals (mustard, lewisite, etc.) from materiel, the following steps should be taken:

b. Protective Measures.

(1) For all of these operations, a complete suit of impermeable clothing and a service gas mask will be worn. Immediately after removal of the suit, a thorough bath with soap and water (preferably hot) must be taken. If any skin areas have come in contact with mustard, if even a very small drop of mustard gets into the eye, or if the vapor of mustard has been inhaled, it is imperative that complete first-aid measures be given within 20 to 30 minutes after exposure. First-aid instructions are given in TM 9-850 and FM 21-40.

(2) Garments exposed to mustard will be decontaminated. If the impermeable clothing has been exposed to vapor only, it may be decontaminated by hanging in the open air, preferably in the sunlight for several days. It may also be cleaned by steaming for two hours. If the impermeable clothing has been contaminated with liquid mustard, steaming for six to eight hours will be required. Various kinds of steaming devices can be improvised from materiels available in the field.

c. Procedure.

(1) Commence by freeing materiel of dirt through the use of sticks, rags, etc., which must be burned immediately after this operation.

(2) If the surface of the materiel is coated with grease or heavy oil, remove this grease or oil before decontamination is begun. SOLVENT, dry-cleaning, or other available solvents for oil should be used with rags attached to ends of sticks.

(3) Decontaminate the painted surfaces of the materiel with bleaching solution made by mixing one part AGENT, decontaminating (chloride of lime), with one part water. This solution should be swabbed over all surfaces. Wash off thoroughly with water, then dry and oil all surfaces.

(4) All unpainted metal parts and instruments exposed to mustard or lewisite must be decontaminated with AGENT, decontaminating, noncorrosive, mixed one part solid to fifteen parts solvent (acetylene tetrachloride). If this is not available, use warm water and soap. Bleaching solution must not be used, because of its corrosive action. Instrument lenses may be cleaned only with PAPER, lens, tissue, using a very small amount of ALCOHOL, ethyl. Coat all metal surfaces lightly with OIL, engine.

(5) In the event AGENT, decontaminating (chloride of lime), is not

available, materiel may be temporarily cleaned with large volumes of hot water. However, mustard lying in joints or in leather or canvas webbing is not removed by this procedure and will remain a constant source of danger until the materiel can be properly decontaminated. All mustard washed from materiel in this manner lies unchanged on the ground, necessitating that the contaminated area be plainly marked with warning signs before abandonment.

(6) The cleaning or decontaminating of materiel contaminated with lewisite will wash arsenic compounds into the soil, poisoning many water supplies in the locality for either men or animals.

(7) Leather or canvas webbing that has been contaminated should be scrubbed thoroughly with bleaching solution. In the event this treatment is insufficient, it may be necessary to burn or bury such materiel.

(8) Detailed information on decontamination is contained in FM 21-40, TM 9-850, and TB 38, 1941, Decontamination.

45. SPECIAL PRECAUTIONS FOR AUTOMOTIVE MATERIEL.

a. When vehicles have been subjected to gas attack with the power unit running, the air cleaners should be serviced by removing the oil, flushing with SOLVENT, dry-cleaning, and refilling with the proper grade of oil.

b. Instrument panels should be cleaned in the same manner as outlined for instruments.

c. Contaminated seat cushions will be discarded.

d. Washing the compartments thoroughly with bleaching solution is the most that can be done in the field. Operators should constantly be on the alert when running under conditions of high temperatures, for slow vaporization of the mustard or lewisite.

e. Exterior surfaces of vehicles will be decontaminated with bleaching solution. Repainting may be necessary after this operation.

PART TWO — Organization Instructions

Section XI

ORGANIZATION MAINTENANCE

46. SCOPE.

a. The scope of maintenance and repairs by the crew and other units of the using arms is determined by the ease with which the job can be accomplished. This depends, of course, upon the time and tools available to do the job, the nature of the terrain, weather conditions, temperatures, concealment, shelter, proximity to hostile fire, and skill of personnel. All of the conditions are variable and no exact system of procedure can be prescribed.

b. The definitions given below are included in order that the operation name may be correctly interpreted by those doing the work.

(1) SERVICE. Consists of cleaning, lubricating, tightening bolts and nuts, and making external adjustments of sub-assemblies or assemblies and controls.

(2) REPAIR. Consists of making repairs to, or replacement of a part, sub-assembly or assembly that can be accomplished without completely disassembling the sub-assembly or assembly, and does not require heavy welding or riveting, machining, fitting and/or alining.

(3) REPLACE. Consists of removing the part, sub-assembly or assembly from the vehicle and replacing it with a new, or reconditioned, or rebuilt part, sub-assembly or assembly, whichever the case may be.

(4) REBUILD. Consists of completely reconditioning and placing in serviceable condition any unserviceable part, sub-assembly or assembly of the motor vehicle including welding, riveting, machining, fitting, alining, assembling and testing. NOTE: The using arms are authorized to remove and install a power unit or power train assembly. However, the replacement of a power unit with ANOTHER power unit, or the replacement of a power train with ANOTHER power train assembly, MUST NOT BE DONE BY USING ARMS UNLESS AUTHORIZATION IS RECEIVED FROM ORDNANCE PERSONNEL.

c. The following are the maintenance duties for which tools and parts have been provided the using arms personnel. Other replacements and repairs are the responsibility of the other maintenance personnel, but may be performed by the using arms personnel, when circumstances permit, within the discretion of the pertinent ordnance officer.

MEDIUM TANK M4A4

POWER UNIT (CHRYSLER TANK ENGINE)

Unit	Operation
Power unit	Replace (See paragraph 46., **b.**, (4), Note).
Power unit	Clean and service.
Tachometer	Replace (par. 167., **b.** and **c.**).
Tachometer drive shaft assembly	Replace (par. 167., **d.**).

OILING SYSTEM

Oil coolers	Replace (par. 58., **c.** and **d.**, 110., and 111.).
Oil filters	Service or replace (par. 55., **c.** and **d.**).
Oil pump	Replace (par. 56., **d.** and **e.**).
Oil pressure gage	Replace (par. 172., **b.** and **c.**).
Oil tubes	Replace (par. 59., **a.**).
Oil pressure warning indicator	Replace (par. 173., **c.**).

COOLING SYSTEM

Radiator	Clean, repair or replace (par. 90., **b.** and **c.**).
Radiator pressure relief valve	Replace (par. 91., **d.** and **e.**).
Shroud	Replace (par. 90., **b.**, (1), (a), and **c.**, (1), (j) and (k)).
Thermostats	Replace (par. 88., **d.** and **e.**).
Water pump	Replace (par. 84., **d.** and **e.** and 85., **c.** and **d.**).
Water pump drive belt	Replace (par. 86., **b.** and **c.**).
Water temperature gage	Replace (par. 174., **c.** and **d.**).

FUEL SYSTEM

Air cleaner	Service or replace (par. 75., **d.**, **e.**, and **f.**).
Carburetor	Replace (par. 71., **b.** and **c.**).
Fuel tanks	Clean or replace (par. 77., **c.** and **d.**).
Fuel pump	Replace (par. 76., **d.** and **e.**).
Fuel lines	Repair or replace.
Fuel filter	Service or replace (par. 80., **a.**, **b.**, or **c.**).
Fuel gage	Replace (par. 176., **c.** and **d.**).

ORGANIZATION MAINTENANCE

ELECTRICAL SYSTEM

Unit	Operation
Ammeter	Replace (par. 171., b. and c.).
Battery	Charge and service or replace (par. 161., c. and d.).
Battery switch	Repair or replace (par. 161., e.).
Circuit breakers	Replace (par. 183., c., (2) and (3)).
Generator	Replace (par. 162., d., e., f. and g.).
Generator regulator	Replace (par. 162., k., (4) and (5)).
Ignition coil	Replace (par. 65., b. and c.).
Ignition distributor	Service or replace (par. 66., c. and d.).
Ignition switch	Replace (par. 63., b. and c.).
Ignition harness assembly	Replace (par. 68., b. and c.).
Lights, all	Aline, service or replace (par. 164., b., c. and d.).
Ignition filter	Replace (par. 64., b. and c.).
Light switch	Replace (par. 178., c. and d.).
Oil pressure warning indicator	Replace (par. 173., c.).
Oil pressure warning indicator sending unit	Replace (par. 173., d., e., f. and g.).
Spark plugs	Replace (par. 69., b. and c.).
Voltmeter	Replace (par. 170., b. and c.).
Water temperature gage sending unit	Replace (par. 174., g., h., i. and j.).
Water temperature warning signal sending unit	Replace (par. 175., d., (2) and (3)).

POWER TRAIN AND CLUTCH

Clutch	Adjust, clean and service (par. 93., 94. and 95.).
Clutch pedal	Adjust (par. 95., b.).
Clutch plate	Replace (par 93., 94.).
Final drive assembly	Replace (par. 108., 109.).
Gear shifting lever	Replace (par. 112., a., 113., a.).
Propeller shaft assembly	Service (par. 97., 98., 100., 101.).
Speedometer head and cable	Replace (par. 166., c., d. and e.).
Sprockets	Replace (par. 116., b., c.).
Steering brake	Adjust (par. 114., e.).

MEDIUM TANK M4A4

POWER TRAIN AND CLUTCH—(Cont.)

Unit	Operation
Steering brake band assembly	Replace (par. 114., **c.** and **d.**).
Steering lever	Replace (par. 105., **b.**, (12) and 106., **a.**, (12)).
Power train unit.	Replace (par. 105. and 106.).

SUSPENSION

Bearings (wheel, bogie and idler)	Replace (par. 117., **b.** and **c.** and 118., **d.** and **e.**).
Bogie wheel	Replace (par. 118., **b.** and **c.**).
Rollers (track supporting, with bracket)	Replace (par. 118., **j.** and **k.**).
Seals (wheel bearing and oil)	Replace (par. 118., **e.**, (1), (c)).
Track	Replace or rebuild (par. 115., **b.**, **c.**, or **e.**).
Idler wheel	Replace (par. 117., **b.** and **c.**).

HULL AND TURRET

Bolts, nuts and screws	Tighten.
Fire extinguisher system	Replace and reset (par. 38.).
Insulation	Replace or repair.
Mud guard	Repair or replace (par. 105., **b.**, (7) and 106., **a.**, (20)).
Pads	Replace.
Pistol port and peep hole covers	Service or replace (par. 122.).
Protectoscope windows, prisms or mirrors	Replace.
Seats	Replace.
Turret rollers	Adjust, service or replace.
Turret traversing mechanism	Replace.

GYROSTABILIZER UNIT

Bracket shaft, complete with worm and gearing	Replace (par. 155.).
Control box	Replace (par. 150.).
Electrical wiring	Repair or replace (par. 156.).
Flexible cable assembly and bracket	Replace (par. 158.).

ORGANIZATION MAINTENANCE

GYROSTABILIZER UNIT—(Cont.)

Unit	Operation
Grease fittings	Replace.
Gyro unit	Replace (par. 148.).
Oil cups	Repair or replace.
Oil lines and connections	Repair or replace (par. 159.).
Piston and cylinder assembly.	Replace (par. 152.).
Pump assembly	Replace (par. 149.).
Pump motor assembly	Replace (par. 154.).
Switch box	Replace.

ELECTRIC TRAVERSING MECHANISM

Clutch	Adjust (par. 126., c., (6)).
Commander's switch	Replace (par. 134.).
Disengaging switch	Replace (par. 137.).
Drive motor	Replace (par. 129.).
Drive motor brushes	Replace (par. 128.).
External wiring	Replace (par. 136.).
Flange and gear assembly	Replace (par. 133.).
Front cover, oil seal, handwheel	Replace (par. 132.).
Gear mesh	Adjust (par. 129., b., (6)).
Gunner's switch	Replace (par. 135.).
Handwheel and parts	Replace (par. 131.).
Hub, idler gear, or lock lever	Replace (par. 132.).
Motor gear box	Replace (par. 129.).
Motor generator	Replace (par. 127., b.).
Motor generator brushes	Replace (par. 128.).
Silverstat control	Replace (par. 130.).

MEDIUM TANK M4A4

Section XII

TOOLS AND EQUIPMENT

47. ORGANIZATION.

a. Tank Crew Tools and Equipment. The tools and equipment ordinarily required for operations performed by the using arms (first echelon) are included as regular equipment with each Medium Tank M4A4, and are listed in Paragraph 32.

b. Company Tools and Equipment. The tools and equipment ordinarily required for tank inspection and maintenance in the field include many items not used by the tank crew, and are not provided with each vehicle. They are a part of company equipment and materiel to be used on all M4A4 medium tanks in the company.

c. Battalion and Regimental Tools and Equipment. A still more extensive group of regular, and special, tools and special equipment is provided for use of the battalion and regimental maintenance units. They cover all requirements of first and second echelon maintenance.

d. Care of Tools and Equipment. Keep an accurate record of all tools and equipment, in order that their location and condition may be known at all times. Replace immediately, any items that have become lost or unserviceable. Clean and put in proper condition for further use all tools and equipment, before returning them to their location. Care must be used in fastening the tools carried on the outside of the vehicle, and frequent inspection and oiling is necessary to prevent corrosion.

e. List of Tools.

Tool	Location
MTM-A4-4 PULLER, clutch hub (also fitted with hoist hook for lifting clutch)	Regimental
MTM-A4-6 WRENCH, box, fuel pump housing to adapter plate attaching cap screw	Company, battalion and regimental
MTM-A4-7 WRENCH, spanner, closed, water pump hub holding	Company, battalion and regimental
MTM-A4-13 HOLDER, three-finger, flexible — (for lifting small parts from inaccessible and hard-to-get-at locations)	Company, battalion and regimental

TOOLS AND EQUIPMENT

	Tool	Location
	MTM-A4-18 SLING, power unit assembly hoist	Company and regimental
	MTM-A4-24 HANDLE, wrench, for A4-1, A4-25, A4-33	Company and regimental
	MTM-A4-25 WRENCH, engine crank	Company and regimental
	MTM-A4-30 METER, manifold vacuum checking	Company, battalion and regimental
	MTM-A4-31 SLING, radiator, lifting	Regimental
	MTM-A4-36 PLATE, pair, engine lifting	Battalion and regimental
	MTM-A4-46 PLATE, engine synchronizer	Company, battalion and regimental
	MTM-A4-48 WRENCH, power unit front support	Company and regimental
	MTM-M3-2A WRENCH, volute spring compressor, 1½ hex. extra long	Company, battalion and regimental
A174755	MTM-M3-3 COMPRESSOR, volute spring	Company, battalion and regimental
B247177	MTM-M3-5 GUIDE, gudgeon	Company, battalion and regimental
B248178	MTM-M3-6 PULLER, gudgeon (screw type)	Company, battalion and regimental
B248179	MTM-M3-7 WRENCH, track adjusting	Company, battalion and regimental
B248180	MTM-M3-8 PULLER, idler wheel	Company and regimental
B248181	MTM-M3-9 TOOL, idler, wheel 1st	Company and regimental
B248182	MTM-M3-10 WRENCH, volute spring plug	Company, battalion and regimental
	MTM-M3-13 DRIFT, bogie wheel bearing	Company, battalion and regimental
	MTM-M3-14 DRIFT, idler wheel small bearing	Company and regimental
	MTM-M3-15 DRIFT, idler wheel large bearing	Company and regimental

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	Tool	Location
B248185	MTM-M3-16A SET, wrench, 1-in. sq. drive.	Company, battalion and regimental
A191315	MTM-M3-129 WRENCH, socket, steering brake adjusting	Company, battalion and regimental
B248199	MTM-M3-130 WRENCH, plug, 3/4 hex.	Company, battalion and regimental
B248200	MTM-M3-131 WRENCH, plug, 9/16 hex.	Company, battalion and regimental
B248202	MTM-M3-133 PROTECTOR, gudgeon installing	Company, battalion and regimental
B248203	MTM-M3-135 CONE, idler wheel oil retainer installing	Company and regimental
B248204	MTM-M3-136 SLING, final drive and transmission	Regimental
B248205	MTM-M3-137 WRENCH, socket, 2 3/8, gudgeon head holding	Company, battalion and regimental
B248209	MTM-M3-497 EYE BOLT, engine hatch cover plate (2 req'd)	Company, battalion and regimental
	MTM-M3-502 DRIFT, bearing inner installing	Battalion and regimental
	MTM-M3-503 DRIFT, oil seal, inner, installing	Battalion and regimental
B248215	TK-7278 FIXTURE, adjustable track connecting	Company, battalion
A222908	EYE BOLT, 3/4" - 16 - turret front plate - rotor and shield	Regimental
A222909	EYE BOLT, 1" - 8 transmission	Regimental
A222910	EYE BOLT, 1" - 14 turret and cupola	Regimental
C84925	LIFT, bogie	Company, battalion and regimental
D47504	CARRIAGE, power train	Regimental

Section XIII

ORGANIZATION SPARE PARTS AND ACCESSORIES

48. ORGANIZATION SPARE PARTS.

a. A set of organization spare parts is supplied to the using arms for field replacement of those parts most likely to become broken, worn, or otherwise unserviceable. The set is kept complete by requisitioning new parts for those used. Organization spare parts are listed in pertinent SNL'S.

b. Care of organization spare parts is covered in paragraph number 49.

49. ACCESSORIES.

a. Accessories include tools and equipment required for such disassembling and assembling as the using arms is authorized to perform, and for the cleaning and preservation of the gun carriage, sighting and fire control equipment, ammunition, etc. They also include chests, covers, tool rolls, and other items necessary to protect the materiel when it is not in use, or when traveling. Do not use accessories for purposes other than as prescribed, and when not in use, keep them properly stored.

MEDIUM TANK M4A4

Section XIV

POWER UNIT (CHRYSLER TANK ENGINE)

50. GENERAL DESCRIPTION.

a. This vehicle is powered with the Chrysler Tank Engine power unit, with piston displacement of 1,253 cu. in. and rated gross horsepower of 445 @ 2,400 rpm. Each of the five banks of cylinders is in itself a conventional "L" head, water cooled engine, with a $3\frac{7}{16}$-in. bore and 4½-in. stroke, and in this text will be referred to as engines Nos. 1, 2, 3, 4 and 5. Facing the distributor end of the power unit (figs. 20 and 21), and with No. 1 engine at the top, the engines are numbered counterclockwise, with No. 2 engine to the left and below No. 1 engine.

b. In order to avoid confusion, reference will be made to the "DISTRIBUTOR" end, or rear end of the power unit, and the "RADIATOR" end, or front end of the power unit, as the unit is installed in the vehicle.

c. The five engines are geared together and operate as a single unit. This is accomplished as follows: A gear is bolted to the flanged or radiator end of each of the five engine crankshafts. These drive gears mesh with and drive a central or power unit driven gear. This gear in turn is connected to and drives the flywheel, clutch and finally the power train.

d. The power unit is supported at the radiator end by two brackets bolted to either side of the power unit drive gear case. These power unit brackets (fig. 22) are rubber insulated and rest on two mating brackets mounted by bolts to the side of the hull. The distributor end of the power

unit is supported by a rubber insulated single mount (fig. 29) centrally located at the extreme rear of the power unit compartment.

e. Except for variations in location of accessories, the five engines which comprise the power unit are identical in construction. Each engine is equipped with its individual down-draft carburetor, an ignition coil and distributor. A separate water pump for each individual engine is used on all vehicles up to and including vehicle number 5803, (fig. 20). After vehicle number 5803 a single water pump entered production (fig. 21). In view of this change in design, reference is made to the "MULTIPLE WATER PUMP TYPE" of power unit, and "SINGLE WATER PUMP TYPE" of power unit.

f. A single fuel pump is used, being located on the distributor end of the crankcase (fig. 52), on power units equipped with multiple water pumps, and located on the distributor end of No. 4 engine (fig. 53), on power units equipped with single water pump.

g. Only one generator is used. On power units of the multiple water pump type, the generator is located between engines Nos. 1 and 2 and is driven by the No. 2 engine water pump drive belt (fig. 20). On the power units of the single water pump type, the generator is located in the fighting compartment, below the turret and to the left of the propeller shaft and is belt driven by the propeller shaft (fig. 160).

h. A direct electric starter, mounted between the cylinder blocks of Nos. 1 and 2 engines, engages the flywheel ring gear to rotate the crankshafts of the five engines (fig. 162).

i. The cylinders of each individual engine are numbered, with No. 1 cylinder at the distributor end of the engine. Each engine revolves counterclockwise, when viewed from the distributor end of the power unit.

51. POWER UNIT TROUBLE SHOOTING.

a. General. Use the following charts as a guide to locate power unit troubles.

(1) STARTING MOTOR DOES NOT TURN POWER UNIT.

Probable Cause	Probable Remedy
Battery discharged.	Recharge (par. 187., a.).
Battery and/or starter terminals loose and/or dirty.	Clean, tighten, or replace terminals.
Incorrect oil viscosity.	Drain and refill with oil of proper viscosity (par. 23., a.).

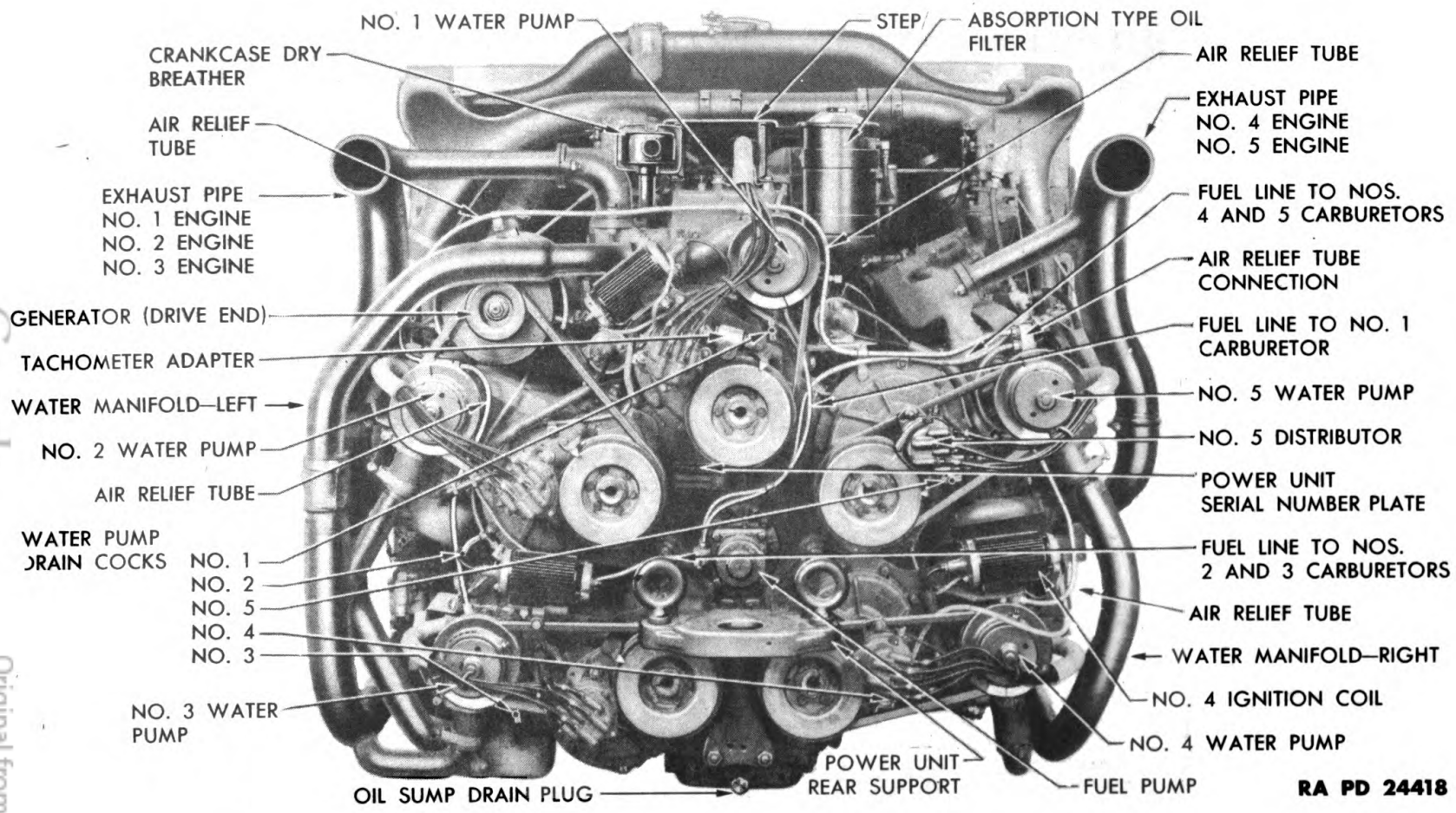

Figure 20 — Distributor End Power Unit — Multiple Water Pump Type

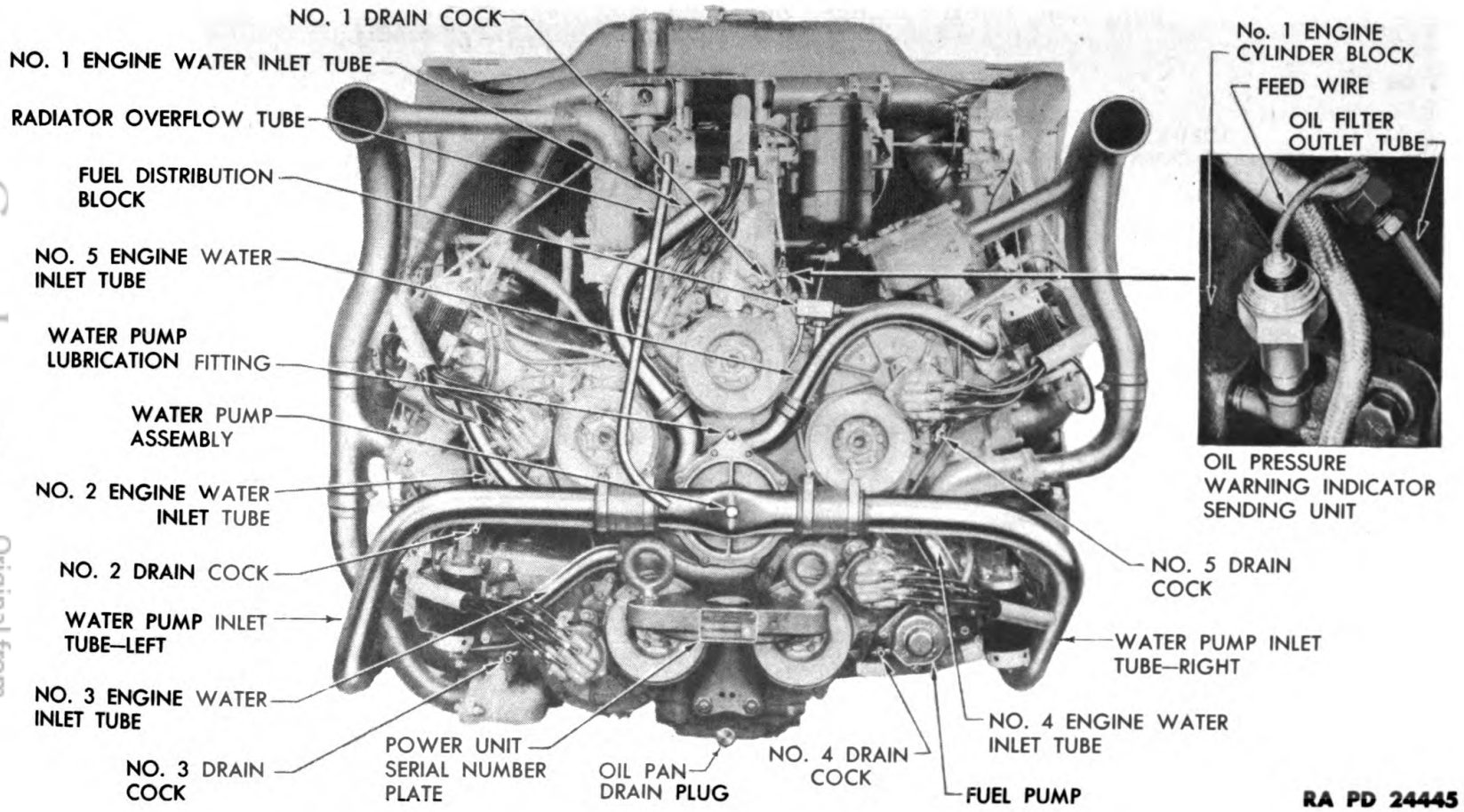

Figure 21 — Distributor End Power Unit — Single Water Pump Type

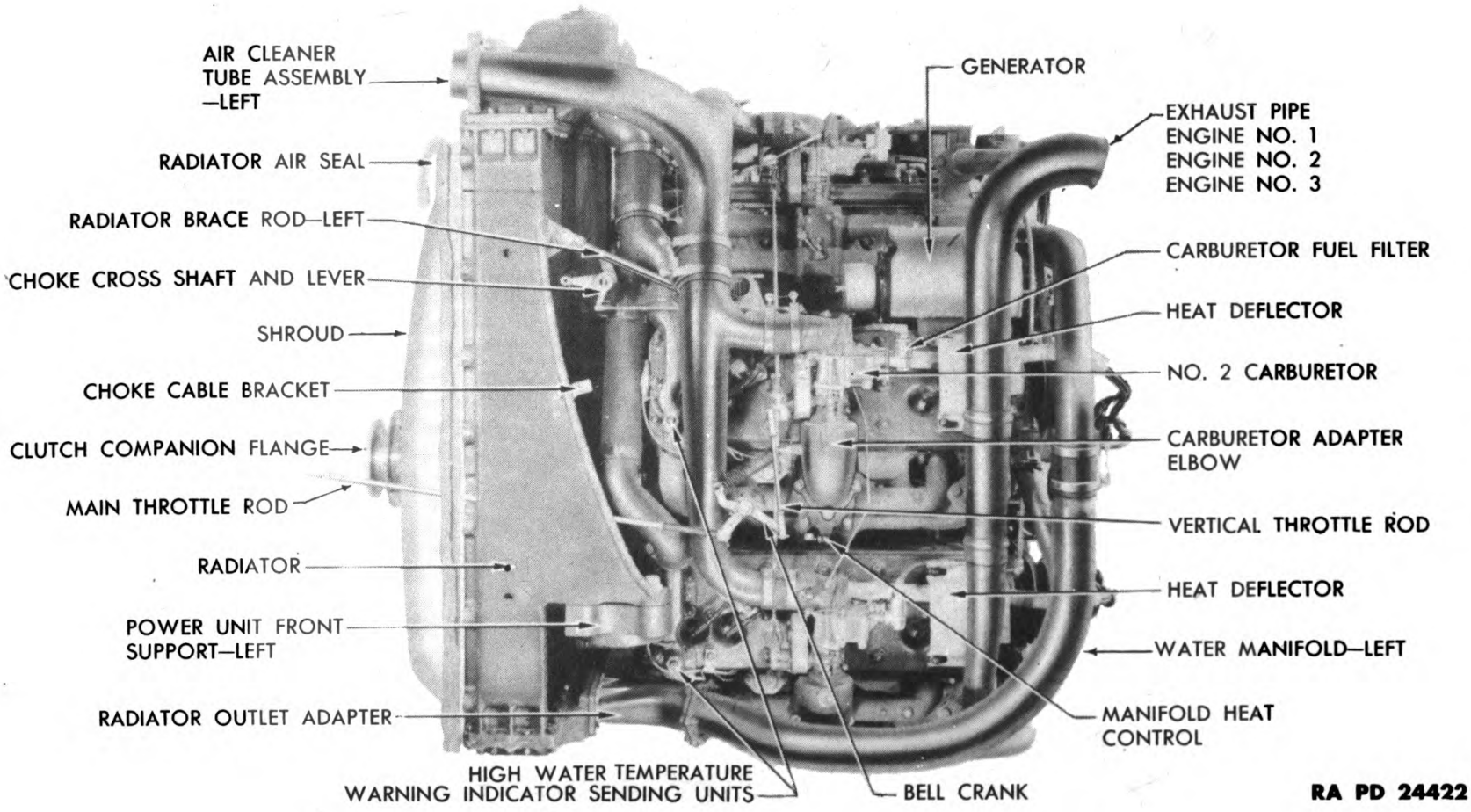

Figure 22 — Left Side Power Unit — Multiple Water Pump Type

POWER UNIT (CHRYSLER TANK ENGINE)

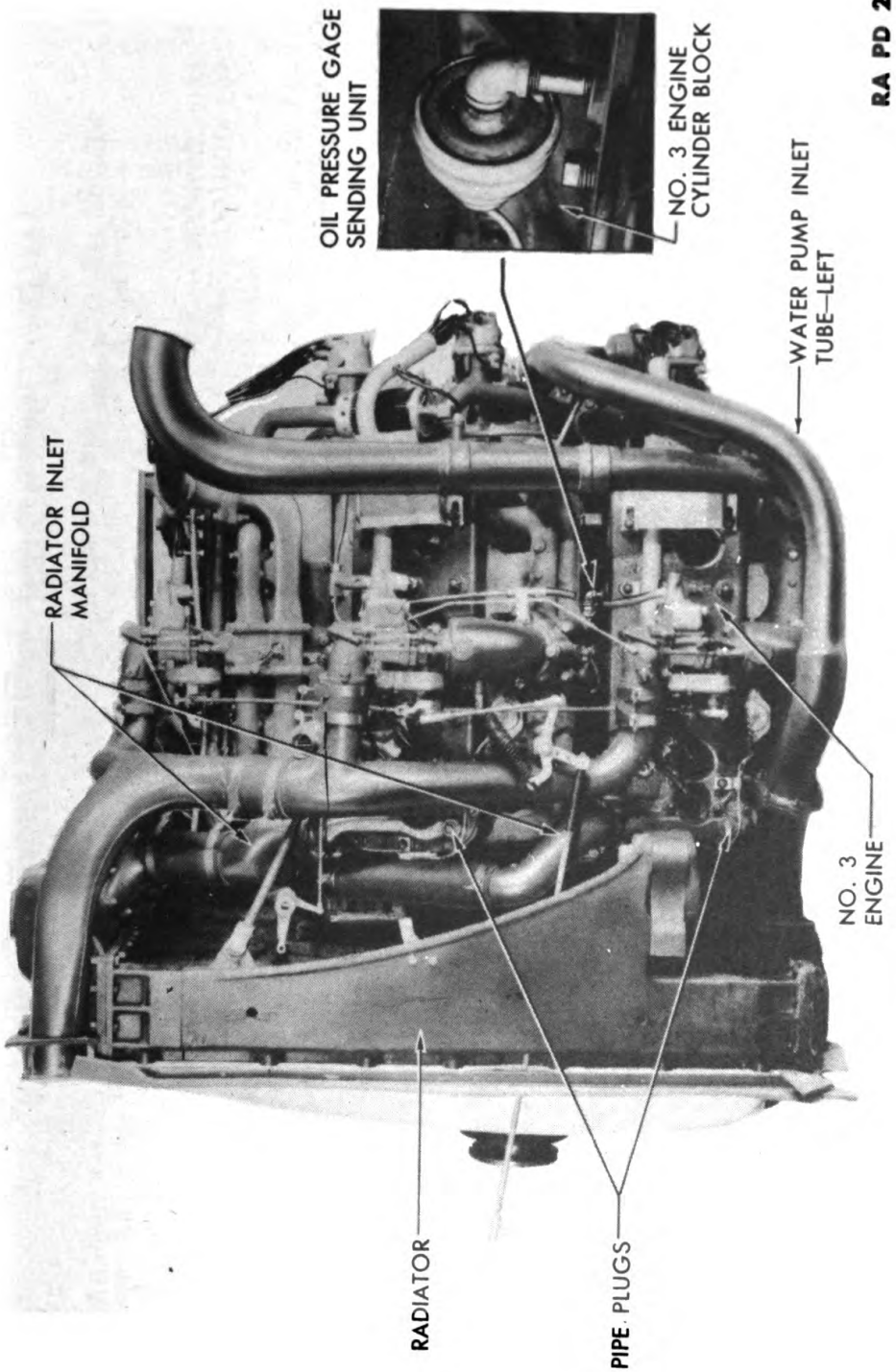

Figure 23 — Left Side Power Unit — Single Water Pump Type

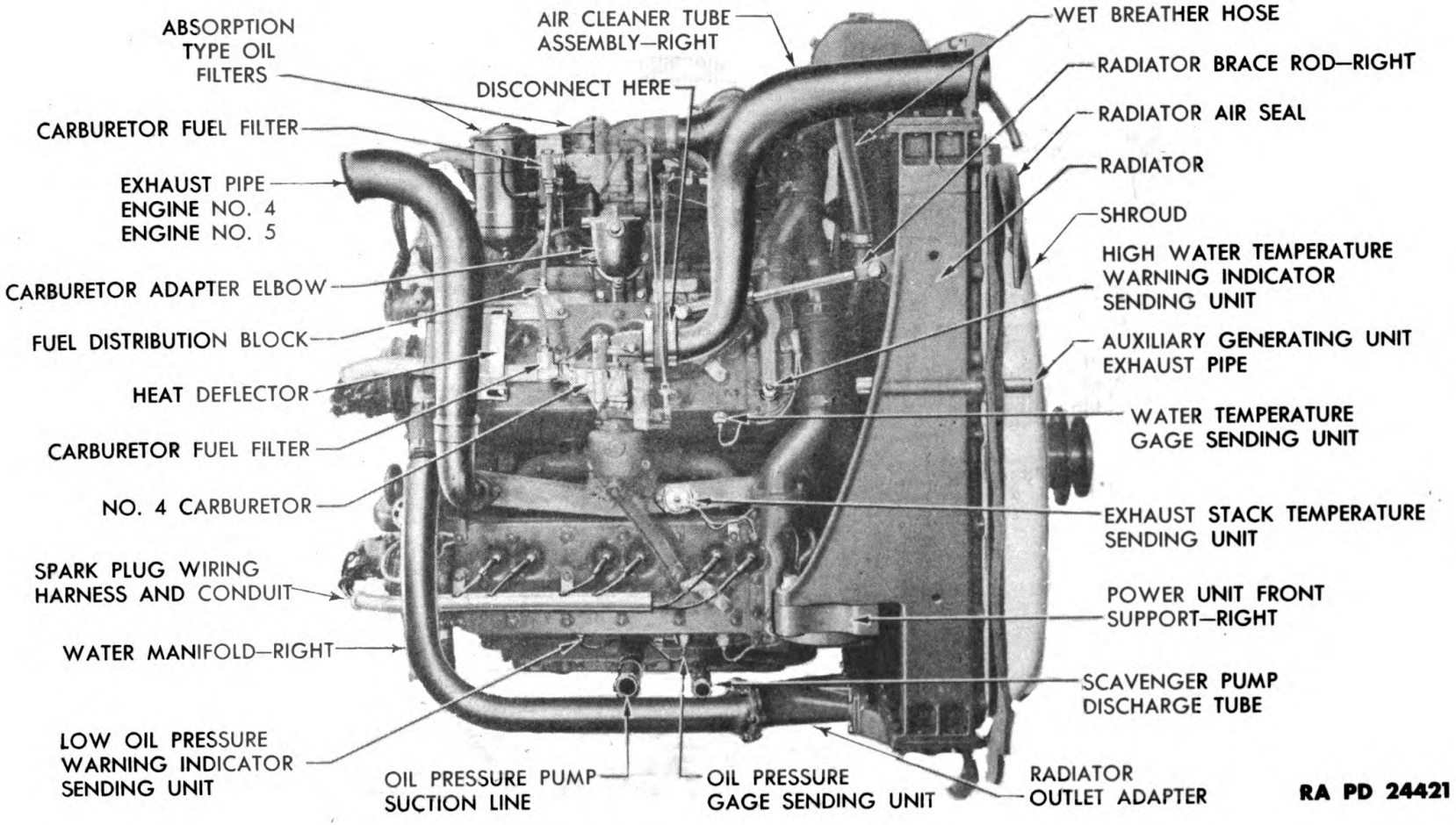

Figure 24 — Right Side Power Unit — Multiple Water Pump Type

POWER UNIT (CHRYSLER TANK ENGINE)

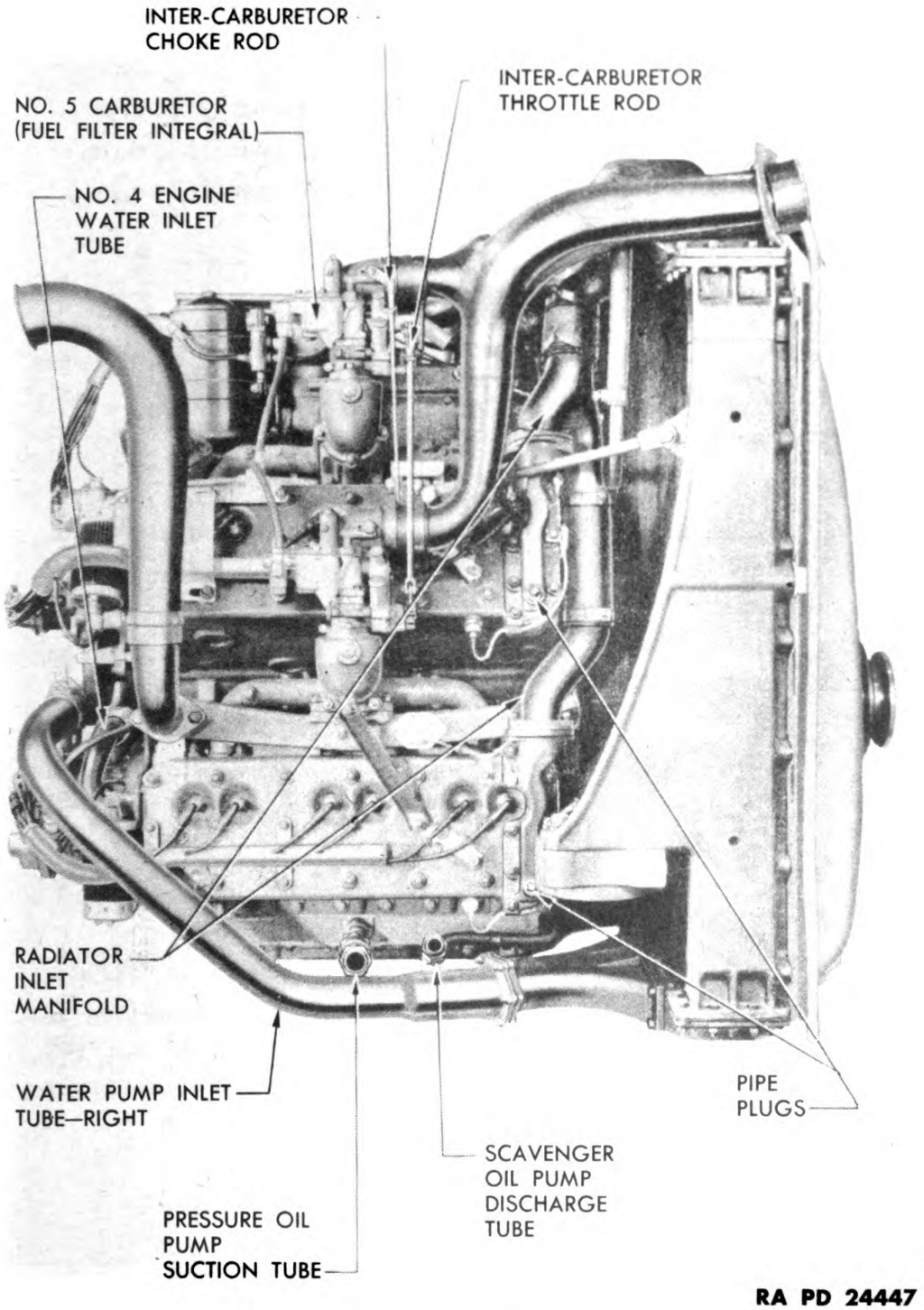

Figure 25 — Right Side Power Unit — Single Water Pump Type

MEDIUM TANK M4A4

Probable Cause	Probable Remedy
Power unit "seized".	Check oil and water, allow power unit to cool, then try starter. Check for hydrostatic lock (par. 51., **a.**, (7)).
Starter switch defective.	Replace switch (par. 177., **c.**).
Starter inoperative.	Replace starter (par. 163., **d.**, **e.**).
Starter drive bent or locked.	Replace starter (par. 163., **d.**, **e.**).
Ice frozen in recess below fan assembly.	Remove ice.

(2) POWER UNIT TURNS BUT DOES NOT START.

Lack of fuel.	Check tanks and fuel shut-off valves.
Fuel filter leaking or clogged.	Clean and tighten (par. 79., **c.**, (1)).
Fuel pump inoperative.	Replace (par. 76, **d.**).
Fuel line broken or leaking.	Replace.
Fuel pump inlet line plugged.	Disconnect at fuel pump and clean.
Fuel line plugged at distributor block (figs. 21 and 24).	Disconnect at fuel pump and clean.
Solenoid fuel shut-off valve inoperative or wires disconnected.	Connect wires or replace valve (par. 78., **e.**, (1), (a)).
Water in fuel.	Drain tank and refill with clean fuel (par. 77., **e.**).
Poor contact at ignition switch.	Replace switch (par. 180., **c.**).
Feed wire from ignition filter to ignition coils loose or broken.	Tighten or replace (par. 64., **b.**, (1), (a)).
Incorrect weight of engine oil.	See lubrication guide (par. 23., **a.**).
Starter turns power unit too slowly.	Replace or recharge battery or replace starter (par. 187. **a.**; 163., **d.**). Change power unit oil to proper grade (par. 23., **a.**).
Accumulation of moisture, dirt or oil on distributor cap, coil tower or spark plugs.	Clean.
Pitted or dirty distributor points.	Clean or replace and reset (par. 66., **f.** and **g.**).
Burned distributor points.	Replace points and condenser (par. 66., **b.**, (1) and 66., **i.**, (1)).

POWER UNIT (CHRYSLER TANK ENGINE)

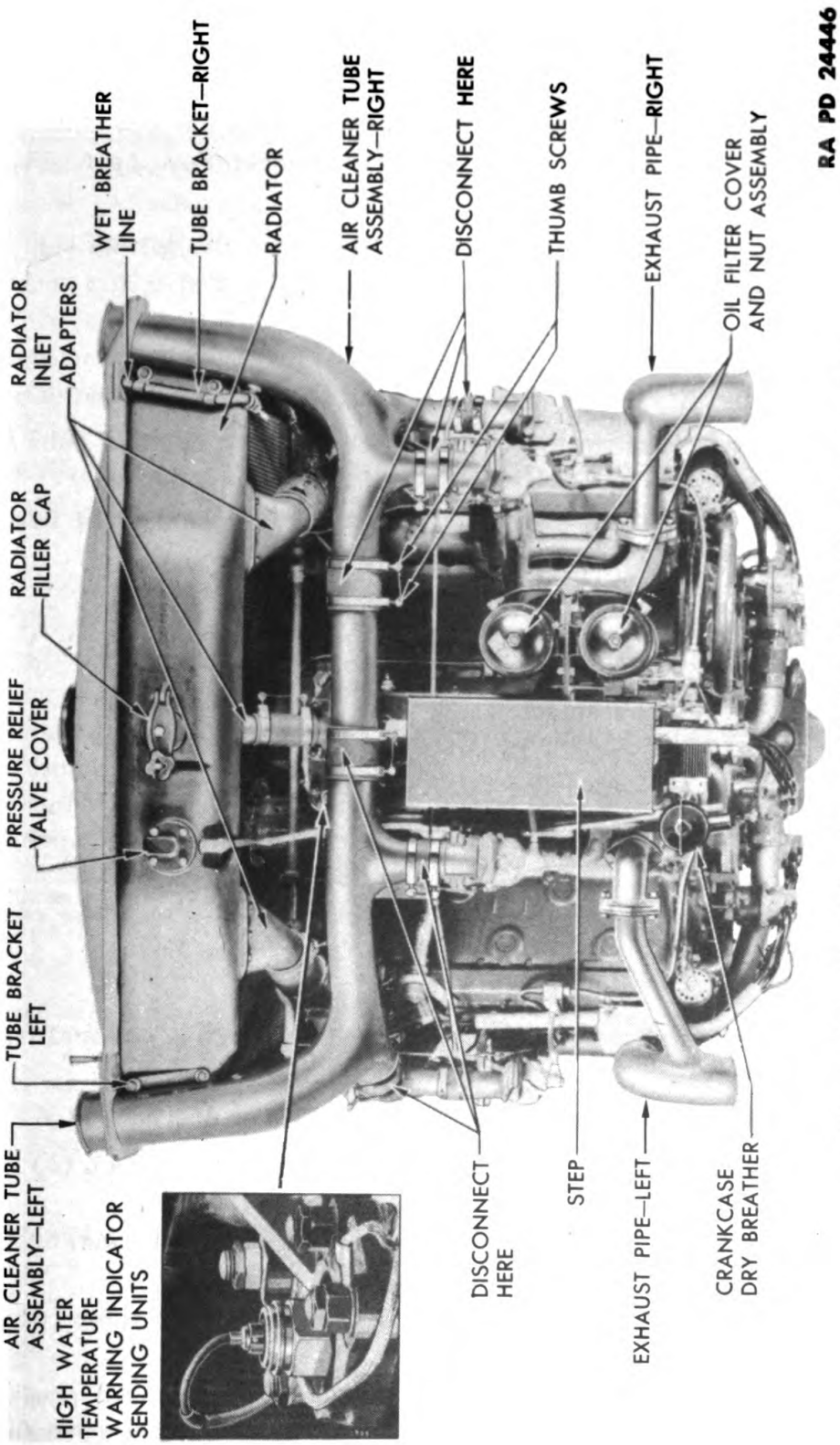

Figure 26 — Top View Power Unit — Single Water Pump Type

MEDIUM TANK M4A4

Probable Cause	Probable Remedy
Carburetors flooded.	Hold accelerator wide open while cranking power unit whenever flooded condition is suspected.
Choke lever improperly set.	Set choke lever for prevailing power unit temperature (par. 73., **b.**, (2)).
Ignition coil or coils defective.	Replace (par. 65., **b.** and **c.**).

(3) POWER UNIT RUNS BUT LACKS POWER.

Ignition timing late.	Reset (par. 67., **a.**).
Insufficient coolant.	Check cooling system (par. 83., **h.**).
Coolant not circulating.	Check water pumps and belts (par. 84., **a.**; 85., **a.**; 86., **a.**).
Incorrect grade of oil—lack of oil or oil badly diluted.	Check oil for quality and quantity (par. 23.).
Collapsed or obstructed water hose.	Replace hose.
Air inlet to radiator obstructed.	Remove obstruction.
One or more engines running too cold.	Check exhaust stack readings and investigate cause in engines indicated. Check water temperature reading on all engines (par. 184., **a.** and 174., **b.**).
One or more ignition distributors need new points or present points lack sufficient gap.	Replace defective points or reset to 0.020 in. (par. 66., **e.**).
One or more coils defective when hot.	Short out defective coil and replace (par. 65., **b.**, (1)).
Shorted condenser or condensers.	Replace (par. 66., **h.**, (1)).
Defective insulation on coil high tension cable.	Replace (par. 65., **b.**, (1), (c)).
Fuel filters dirty, passages obstructed.	Remove obstructions (par. 80., **c.**).
Cracked distributor cap or rotor.	Replace cap and/or rotor (par. 66., **c.**, (1), (c)).
Distributor rotor or rotors not turning.	Remove distributor and check distributor drive gears (par. 66., **c.**, (1) and **d.**, (1)).

POWER UNIT (CHRYSLER TANK ENGINE)

(4) POWER UNIT OPERATES UNEVENLY.

Probable Cause	Probable Remedy
Ignition coil wires (primary or high tension) broken or loose.	Tighten or replace, as necessary
Accumulation of moisture, dirt or oil on distributor cap, coil tower or spark plugs.	Clean.
Shorted condenser.	Replace (par. 66., **h.**).
Ignition coil defective.	Replace (par. 65., **b.**, (1)).
Defective insulation on coil high tension cable.	Replace (par. 65., **b.**, (1), (c)).
Cracked distributor cap or rotor.	Replace cap and/or rotor (par. 66., **c.**, (1), (c)).
Distributor rotor or rotors not turning.	Remove distributor and check distributor drive gears (par. 66., **c.**, (1) and **d.**, (1)).
Lack of fuel to individual engine.	Locate obstruction and remove.
Distributor points burned or improperly adjusted.	Clean and adjust, or replace as required (par. 66., **e.** and **f.**).

(5) POWER UNIT OVERHEATS.

Coolant level low.	Replenish coolant and check all water connections for leaks.
Water pump drive belt loose or broken (multiple water pump type).	Adjust or replace belt (par. 86., **a.**).
Low oil supply.	Replenish oil supply.
Distributor timing late.	Adjust as necessary (par. 67., **b.**, (1)).
Insufficient air to radiator.	Remove any obstruction from top of air inlet grille (fig. 7). Remove any accumulation of dirt from radiator fins (par. 90., **d.**).
Collapsed or obstructed water hose.	Replace hose.

(6) POWER UNIT STOPS.

Lack of fuel.	Replenish fuel supply or remove obstruction.
Ignition wires loose or broken.	Check wiring, tighten connections or replace, as necessary.

(7) NOTE: To eliminate hydrostatic lock, remove power unit air inlet grille (par. 52., **b.**, (4)) turn power unit fan in reverse direction one complete turn, to expel any fuel from engines.

(8) POPS BACK THROUGH CARBURETOR INLET OR OUT THE EXHAUST.

Probable Cause	Probable Remedy
Dirt in fuel filters.	Clean filters (par. 80., **c.**).
Carburetor flooding.	Replace carburetor (par. 71.).
Incorrect ignition timing.	Correct timing (par. 67.).
Crossed spark plug wires.	Check wires (par. 68., **c.**, (1), (b)).

(9) WATER TEMPERATURE GAGE READS HIGH.

Low coolant level.	Correct level (par. 83., **h.**, (1), (c)).
Air inlet obstructed.	Remove obstruction.
Water pump belt broken or slipping.	Replace belt (par. 86.).

(10) WATER TEMPERATURE GAGE READS LOW.

Faulty sending unit.	Replace unit (par. 174., **c.**).

(11) WATER TEMPERATURE LIGHT COMES ON.

Low coolant level.	Correct level (par. 83., **h.**).
Faulty sending unit.	Replace unit (par. 174., **c.**).
Loss of radiator coolant.	Refill cooling system and check for leaks.

(12) STEAM COMING FROM RADIATOR OVERFLOW, WATER TEMPERATURE NOT OVER 212 F.

Faulty pressure relief valve.	Replace valve (par. 91.).

(13) NO OIL PRESSURE INDICATED ON GAGE.

Low oil level.	Correct oil level (par. 54., **b.**).
Wires disconnected or faulty gage or sending unit.	Check wires or replace gage or sending unit (par. 172., **b.**, **c.**, **d.**, **e.**, **f.** and **g.**).

(14) "LOW" OIL PRESSURE WARNING INDICATOR COMES ON.

Low oil level.	Add oil (par. 54., **b.**).
Faulty sending unit.	Replace unit (par. 173., **d.**, **e.**, **f.** and **g.**).

(15) EXHAUST STACK TEMPERATURE WARNING INDICATOR LIGHTS DO NOT LIGHT WHEN IGNITION SWITCH IS TURNED "ON."

Loose or broken wires.	Check and repair wires.
Faulty sending unit or bulb.	Replace sending unit or bulb (par. 184., **d.** and **e.**).

(16) EXHAUST STACK TEMPERATURE WARNING INDICATOR LIGHTS STAY "ON" WHEN POWER IS WARMED UP AND OPERATING.

Faulty sending unit.	Replace unit (par. 184., **d.** and **e.**).

(17) TACHOMETER DOES NOT REGISTER.

Probable Cause	Probable Remedy
Faulty shaft or tachometer.	Replace (par. 167., b., c. and d.).

(18) SPEEDOMETER DOES NOT REGISTER.

Faulty shaft or tachometer.	Replace (par. 166., c., d. and e.).

52. REMOVE POWER UNIT.

a. General. The replacement of the power unit will be accomplished by the using arms personnel only when time, favorable terrain, available personnel and equipment are assured. Never attempt the operation unless a satisfactory power unit blocking is available. Use a hoist of at least four ton capacity which is capable of a thirteen foot lift. NOTE: Do not replace an unserviceable power unit by a new or rebuilt power unit unless authorization is received from ordnance personnel.

TOOLS.

HOIST, four ton capacity
PAN, for oil (capacity, ten gallons)
PAN for water (capacity, thirty-five gallons)
PLIERS, side cutting
SCREWDRIVER
SLING, power unit (MTM A4-18)
WRENCH, Allen, 3/8-in.
WRENCH, Allen, 1 1/8-in.
WRENCH, drain plug, 7/16-in. square
WRENCH, drain plug, 3/4-in. square
WRENCH, 1/4-in.
WRENCH, 9/16-in.
WRENCH, 3/4-in.
WRENCH, 15/16-in.
WRENCH, 1-in.
WRENCH, open-end, 1/2-in. (2)
WRENCH, open-end, 9/16-in.
WRENCH, open-end, 11/16-in.
WRENCH, open-end, 7/8-in.
WRENCH, open-end, 1 1/16-in.
WRENCH, open-end, 1 1/8-in.
WRENCH, open-end, 1 1/4-in.
WRENCH, open-end, 1 3/8-in.
WRENCH, open-end, 1 3/4-in.
WRENCH, socket, 3/8-in.
WRENCH, socket, 1/2-in.
WRENCH, socket, 9/16-in.
WRENCH, socket, 1 1/8-in.
WRENCH, socket, 1 5/8-in.
WRENCH, MTM A4-48

b. Procedure.

(1) OPEN RADIO SWITCH AND BATTERY SWITCH.

Rotate turret and lift up section of turret floor directly over battery box and pull up on switches and turn as directed on switch knobs (fig. 121).

(2) CLOSE FUEL SHUT-OFF VALVES.

Close fuel shut-off valves by raising the control handles, located on the bulkhead, to rear of turret basket, to the "UP" position (fig. 19).

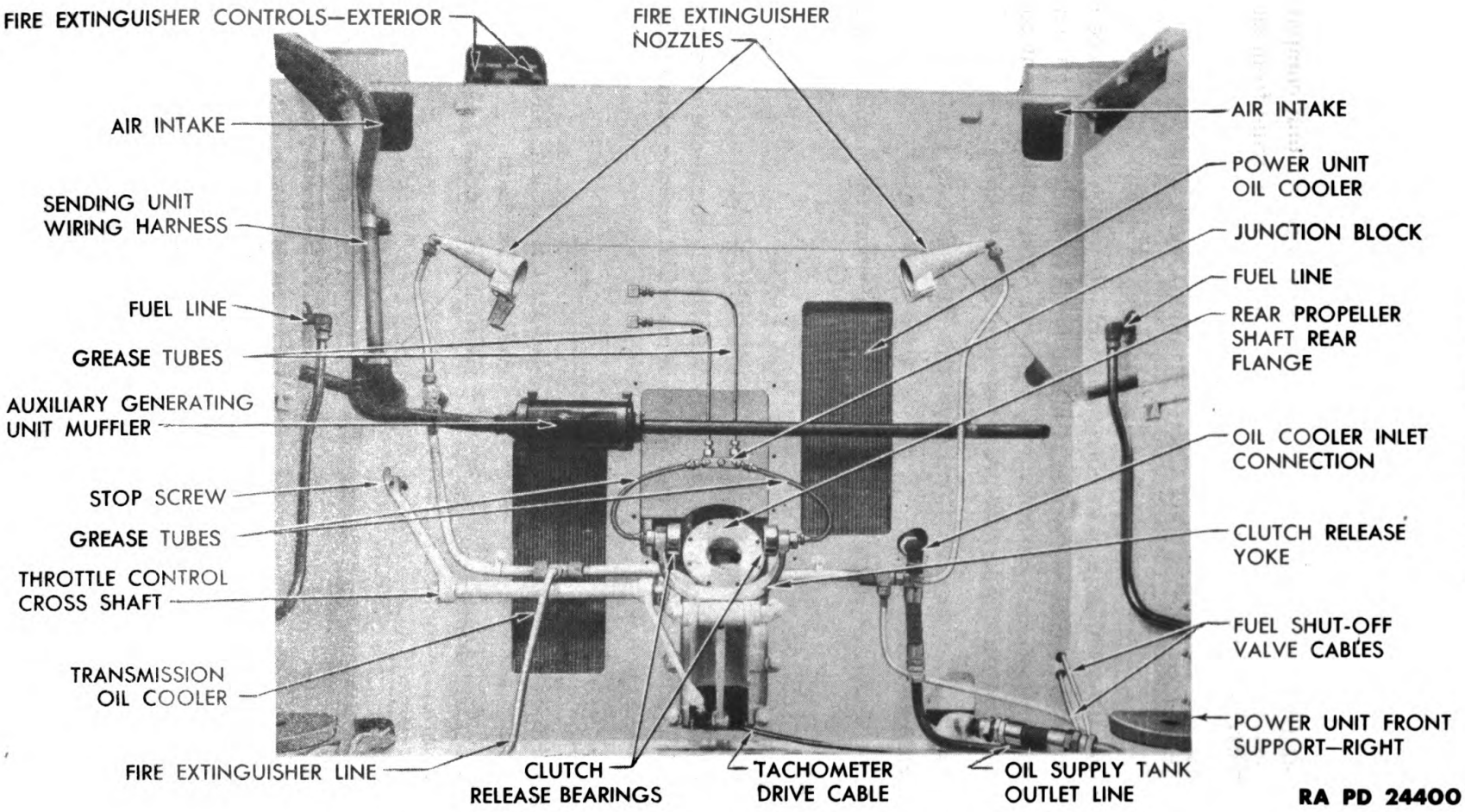

Figure 27 — Bulkhead — Power Unit Compartment

POWER UNIT (CHRYSLER TANK ENGINE)

(3) REMOVE PIONEER TOOLS FROM TOP OF SPONSON.

(4) REMOVE POWER UNIT AIR INLET GRILLE (fig. 7).

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

Rotate turret until the overhang of turret clears power unit compartment cover, remove the four cap screws and lift air inlet grille from side plates.

(5) REMOVE POWER UNIT COMPARTMENT COVER (fig. 7).

HOIST
WRENCH, $\frac{5}{16}$-in.

Remove three cap screws at both right and left front corners of cover, and three at rear end of cover ($\frac{5}{16}$-in. wrench) and lift cover off with hoist. Remove three cap screws from each side plate at both front corners of compartment and remove covers ($\frac{5}{16}$-in. wrench).

(6) OPEN POWER UNIT COMPARTMENT REAR DOORS.

WRENCH, 1⅛-in.

Remove cap screws at center of doors, where doors overlap, and open doors.

(7) REMOVE HULL FLOOR INSPECTION PLATES.

JACK
WRENCH, 1-in.

Place jack under plate and raise jack sufficiently to relieve weight of plate from attaching screws, lower jack and plate and remove plates under engines Nos. 3 and 4.

(8) DRAIN POWER UNIT LUBRICATION SYSTEM.

PAN, for oil (capacity, ten gallons)
SCREWDRIVER
WRENCH, Allen, ⅜-in.
WRENCH, ¾-in.
WRENCH, socket, 1⅛-in.

Refer to paragraph 54., **d.** for details.

(9) DRAIN COOLING SYSTEM.

PAN, for water (capacity thirty-five gallons)
PLIERS, side cutting
WRENCH, drain plug, $\frac{7}{16}$-in.
WRENCH, drain plug, ¾-in.
WRENCH, 1⅛-in.

Refer to paragraph 52. **g.** for details.

(10) DISCONNECT OIL LINES (fig. 36).

WRENCH, open-end, 1¼-in.
WRENCH, open-end, 1¾-in.

Reach through opening in hull floor, below No. 4 engine, and unscrew connection on pressure oil pump suction tube (turn counterclockwise) (1¾-in., open-end, wrench). Through this same opening, unscrew con-

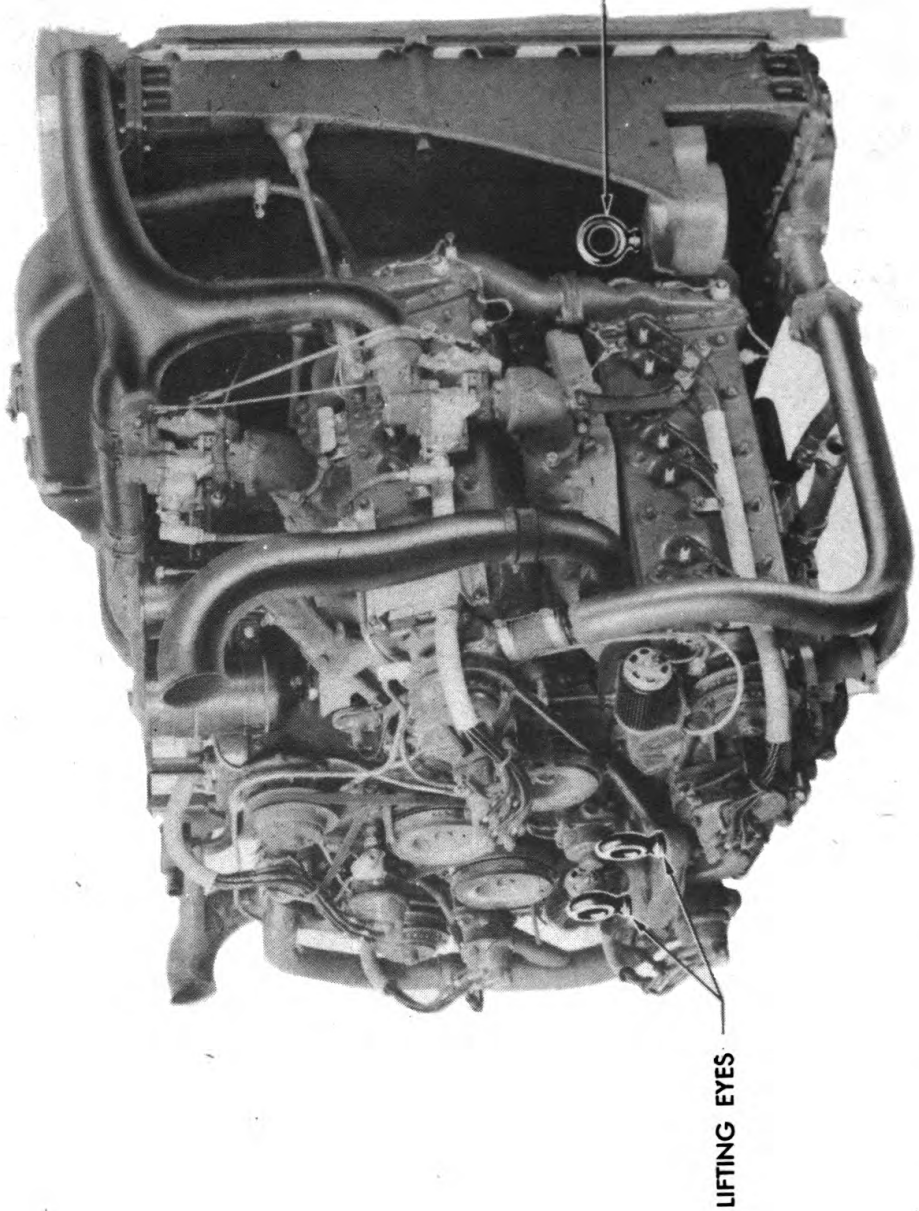

Figure 28 — Right Rear View Power Unit — Showing Lifting Eyes — Multiple Water Pump Type

POWER UNIT (CHRYSLER TANK ENGINE)

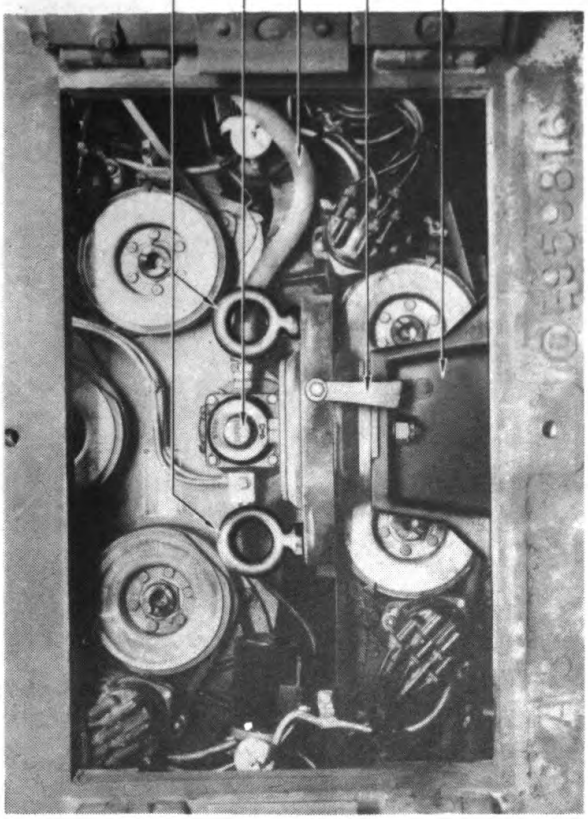

Figure 29 — Power Unit Rear Support and Lifting Eye Bolts — Multiple Water Pump Type

nection on scavenger oil pump discharge tube (turn counterclockwise) (1¼-in., open-end, wrench).

(11) DISCONNECT WET BREATHER LINE (fig. 59).

PLIERS

Remove locking wire, loosen thumb screw on hose clamp and remove rubber hose from metal tube at upper right hand corner of radiator, just forward of radiator.

(12) REMOVE AIR CLEANER TUBE ASSEMBLIES (fig. 26).

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

Remove locking wires, loosen thumb screws and disconnect tubes, as shown in figure 26. Remove locking wires and loosen thumb screws on hose clamps which secure flexible tubes to air cleaner tube assemblies, both right and left, and separate flexible tubes from metal tubes at each upper corner of radiator (side cutting pliers). Remove the tube bracket attaching screws, from both right and left corners of radiator ($\frac{9}{16}$-in., socket, wrench). Separate tubes from carburetors and remove from power unit.

(13) DISCONNECT CARBURETOR MAIN THROTTLE ROD

WRENCH, open-end, ½-in.

Unscrew from arm at left side of throttle control cross shaft (fig. 22), the screw in side of ball and socket joint (turn counterclockwise).

(14) DISCONNECT CHOKE CABLE.

PLIERS, side cutting WRENCH, open-end, ½-in.

Remove cotter pin and remove clevis pin which connects choke cable to lever on choke cross shaft (side cutting pliers). Loosen bolt which clamps choke cable housing in choke cable bracket (fig. 22) and remove cable from bracket (½-in. open-end wrench).

(15) REMOVE AUXILIARY GENERATOR UNIT EXHAUST PIPE.

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

Disconnect pipe from right side of muffler by removing two screws (screwdriver) at flange. Disconnect pipe at front of radiator, at flexible connection, by loosening hose clamp thumb screws (pliers) and removing connection from pipe. Disconnect two pipe clamps from bulkhead (½-in. open-end wrench) and remove pipe. Disconnect pipe at rear of radiator. by loosening thumb screw (pliers) and removing connection (pliers). Remove pipe clamp from side of hull (½-in. open-end wrench).

POWER UNIT (CHRYSLER TANK ENGINE)

(16) DISCONNECT REAR PROPELLER SHAFT AND CLUTCH RELEASE BEARING GREASE TUBE (IF SO EQUIPPED).

PUNCH, prick
WRENCH, open-end, 1/2-in. (2)
WRENCH, open-end, 11/16-in.
WRENCH, 9/16-in.

From inside fighting compartment, remove the cap screws which secure cover (over rear universal joint) to propeller shaft housing and bulkhead and remove cover (1/2-in. open-end wrench). Have man inside fighting compartment hold bolts while other man reaches through opening above power unit fan and removes the eight nuts and lock washers. NOTE: Removal of bolts and nuts can be facilitated by turning propeller shaft after removing bolts at upper portion of flanges (2 1/2-in. open-end wrenches). Prick punch both flanges to assist in alining when reassembling. Unscrew grease tube from side of clutch release bearing (11/16-in. open-end wrench). Unscrew connection at each end of the two metal grease tubes, both at upper end and at junction block and remove tubes (1/2-in. open-end wrench). Remove nut which secures junction block to bulkhead, (9/16-in. wrench). Have man inside fighting compartment unscrew bolt which secures junction block to bulkhead until end of bolt is flush with bulkhead. Lay junction block to one side where it will not interfere with clutch flange while removing power unit, (9/16-in. wrench).

(17) DISCONNECT SENDING HARNESS (fig. 162).

Unscrew large knurled nut and pull connector to separate.

(18) DISCONNECT STARTER FEED WIRE (fig. 162).

PLIERS, side cutting.
WRENCH, socket, 9/16-in.
WRENCH, 1/4-in.

Remove locking wires, remove two cap screws from top of cover and two from side of cover and lift cover off starter terminal box (side cutting pliers; 1/4-in. wrench). Unscrew nut which secures wire to terminal post and lift wire off terminal (9/16-in. socket wrench). Unscrew knurled nut on outside of terminal box and withdraw wire from box.

(19) DISCONNECT GENERATOR WIRES (ON POWER UNITS EQUIPPED WITH MULTIPLE WATER PUMPS ONLY).

WRENCH, socket, 3/8-in.
WRENCH, socket, 1/2-in.

Loosen wing nut and remove terminal box cover. Remove the two nuts which secure wires to terminal posts and lift wires off posts (3/8-in. socket wrench; 1/2-in. socket wrench). Unscrew knurled nut on outside of terminal box and withdraw wire from box.

(20) REMOVE IGNITION FILTER.

SCREWDRIVER
WRENCH, 1/2-in.

Remove four screws (screwdriver) and remove ignition filter cover

(fig. 162). Remove two screws and lift cables from filter unit (screwdriver). Unscrew knurled nuts from either end of filter box and remove conduits and wires. Remove four cap screws and remove filter from compartment wall (½-in. wrench).

(21) REMOVE FIRE EXTINGUISHER NOZZLES.

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

Disconnect the two center fire extinguisher spray nozzles ($1\frac{1}{16}$-in. open-end wrench) from tubing (turn counterclockwise) and remove two screws (½-in. open-end wrench) which secure each bracket to compartment wall.

(22) DISCONNECT FUEL PUMP INLET TUBE.

WRENCH, open-end, 1⅜-in.

Unscrew the fuel tube at the inlet side of the fuel pump (turn counterclockwise) and screw a cap on the end of the fuel line to prevent leakage.

(23) DISCONNECT SOLENOID FUEL SHUT-OFF VALVE WIRES.

WRENCH, ⅜-in. WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, ½-in

Remove nut from terminal on top of valve and lift cable off post (⅜-in. wrench). Reinstall nut with fingers. Remove valve mounting clamp bolt and disconnect ground wire (½-in. and $\frac{9}{16}$-in. open-end wrench).

(24) REMOVE DISTRIBUTOR CAPS OF NOS. 3 AND 4 ENGINES.

PLIERS, side cutting SCREWDRIVER

Remove locking wires (side cutting pliers) and two screws (screwdriver) and remove distributor caps from distributors of engines Nos. 3 and 4, to prevent damage to caps during removal of power unit.

(25) DISCONNECT TACHOMETER DRIVE CABLE (fig. 20).

PLIERS, adjustable.

Unscrew nut on end of tachometer drive cable housing from tachometer adapter on distributor end of No. 1 engine (turn counterclockwise).

(26) REMOVE EXHAUST PIPE FLEXIBLE TUBES AND EXTENSIONS.

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

Remove the bolts, two on each tube, which secure the clamps to exhaust pipes and flexible tubes, and separate tubes from pipes. Remove the two bolts and clamps which secure extensions to hull (just to rear of rear wall) and remove extensions.

POWER UNIT (CHRYSLER TANK ENGINE)

(27) REMOVE CRANKCASE DRY BREATHER PIPE.

PLIERS, side cutting

Remove locking wire and loosen thumb screw on hose clamp which secures hose to rear of breather (located on distributor end of No. 1 engine), remove locking wire and loosen thumb screw on hose clamp which secures hose to metal tube at rear end of hull, separate hose from breather and metal tube and remove.

(28) REMOVE RADIATOR OVERFLOW TUBE EXTENSION.

PLIERS, side cutting

Remove locking wire from thumb screw on hose, at distributor end of No. 1 engine, pull extension out of hose and remove from hull.

(29) DISCONNECT GROUND STRAP (fig. 29).

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

Remove the cap screw which attaches ground strap to power unit rear support and separate strap from support.

(30) REMOVE POWER UNIT SUPPORT BOLTS.

PLIERS, side cutting
WRENCH, open-end, 1⅛-in.
WRENCH, socket, 1⅝-in.
WRENCH, MTM-A4-48

Place wrench MTM-A4-48 on head of front support bolts (at both right and left sides of power unit, just back of radiator) to hold bolts from turning. Reach through opening in floor of hull, remove cotter pin and remove nut from bolt (turn counterclockwise) (1⅝-in. socket wrench). Repeat operation to remove nut from other front support bolt. Unscrew support bolts with (MTM-A4-48 wrench) and remove. Reach through rear opening in hull, remove cotter pin, (side cutting pliers) and unscrew nut which secures support to bracket (1⅛-in. open-end wrench).

(31) LIFT POWER UNIT OUT OF HULL.

HOIST, power unit
SLING

Attach hooks of sling to two lifting eyes at radiator end of power unit and two lifting eyes at distributor end of unit (fig. 28), and observe the following cautions while lifting unit:

(a) The power unit *must be kept level and must be guided all the way out of the compartment* to avoid binding and damage.

(b) Keep the clutch hub companion flange as close as possible to the bulkhead, to provide clearance for the distributor end of the power unit.

(c) Hold main throttle rod at the wide open position so that it will clear the flexible air inlet pipe.

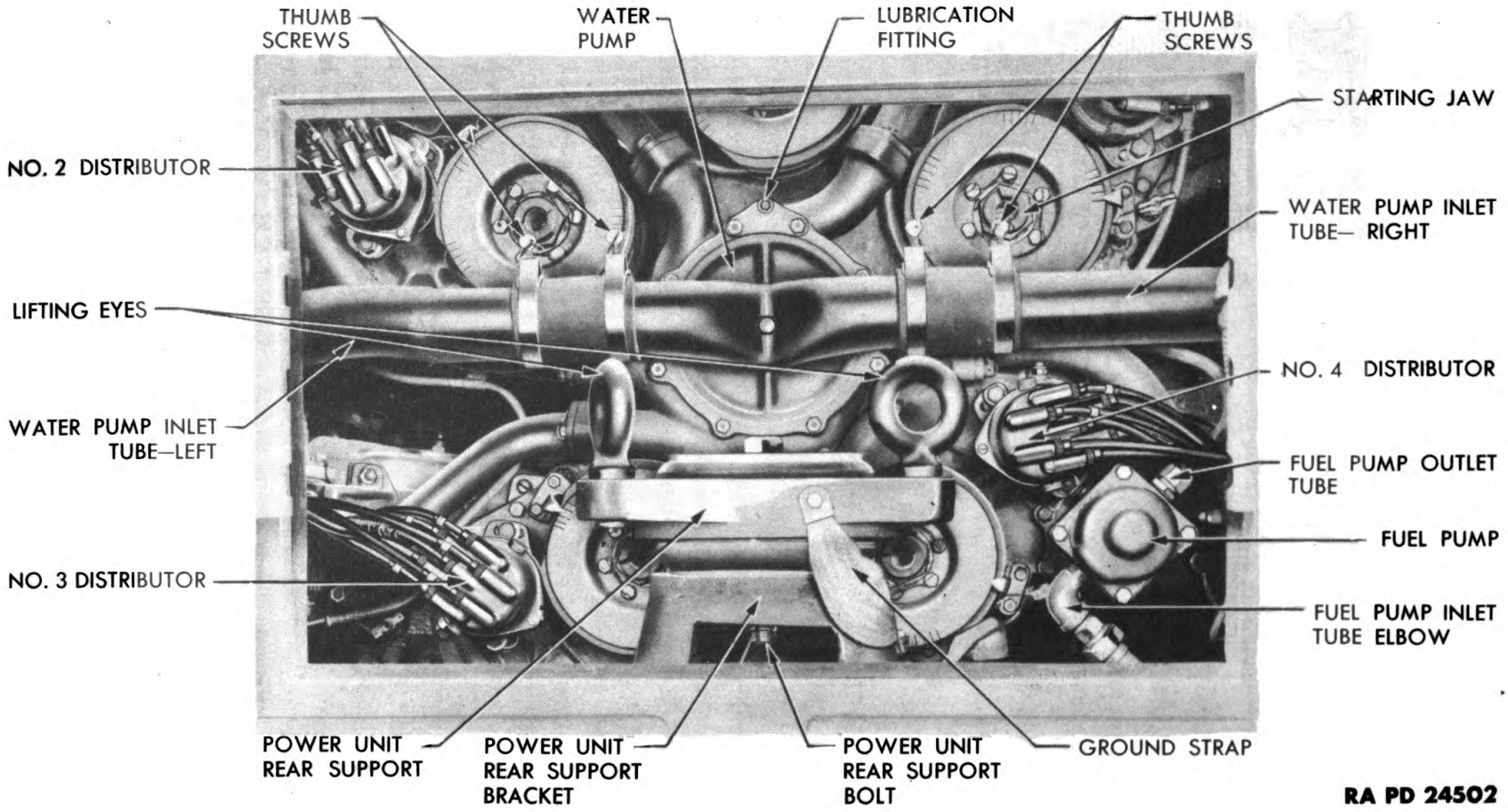

Figure 30 — Power Unit Rear Support and Lifting Eye Bolts — Single Water Pump Type

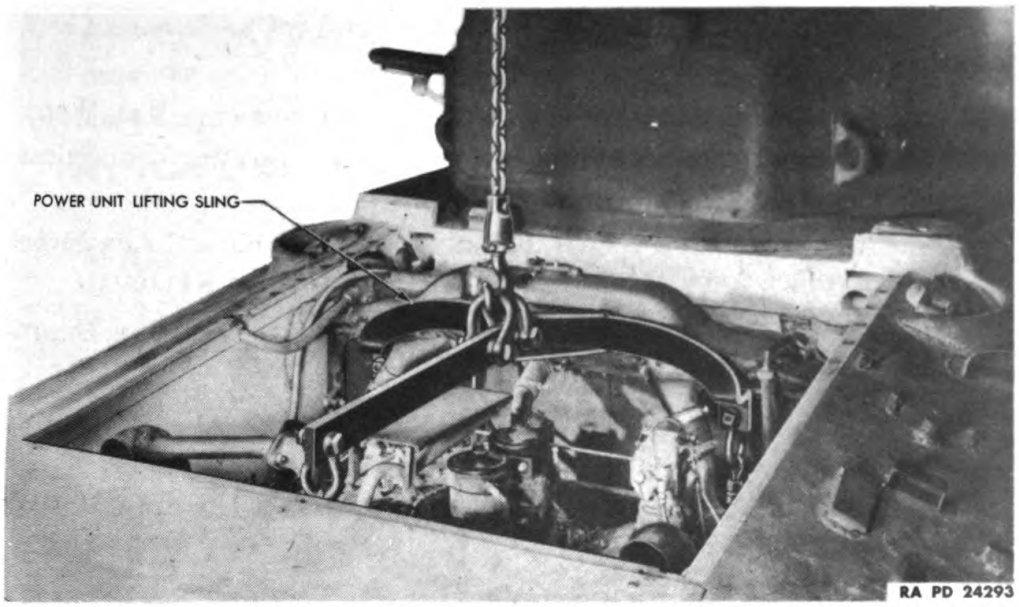

Figure 31 — Power Unit Lifting Sling Applied

53. INSTALL POWER UNIT.

TOOLS.

HOIST, four-ton capacity
JACK
PLIERS, side cutting
SCREWDRIVER
SLING, for the power unit
WRENCH, open-end, ½-in.
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{11}{16}$-in.
WRENCH, open-end, ⅞-in.
WRENCH, open-end, $\frac{15}{16}$-in.
WRENCH, Allen, $\frac{3}{16}$-in.
WRENCH, drain plug, $\frac{7}{16}$-in. square
WRENCH, drain plug, ¾-in. square
WRENCH, ¼-in.
WRENCH, $\frac{9}{16}$-in.
WRENCH, ¾-in.
WRENCH, 1-in.
WRENCH, 1⅛-in.
WRENCH, open-end, $1\frac{1}{16}$-in.
WRENCH, open-end, 1⅛-in.
WRENCH, open-end, 1¼-in.
WRENCH, open-end, 1⅜-in.
WRENCH, open-end, 1¾-in.
WRENCH, socket, ⅜-in.
WRENCH, socket, ½-in.
WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, socket, 1⅝-in.
WRENCH, MTM-A4-48

a. Procedure.

(1) CLEAN POWER UNIT COMPARTMENT THOROUGHLY (figs. 27 and 54).

(2) CHECK THE FUEL LINES FOR KINKS, ABRASIONS AND DENTS. This is important because during the power unit removal, the fuel lines

on either side of power unit compartment are subject to damage. Check for leaks around fuel line connections.

(3) CHECK OPERATION OF FUEL SHUT-OFF VALVES (figs. 54 and 56), making sure they are operating properly and that operating connections are properly secured.

(4) CHECK ALL FIRE EXTINGUISHER LINES FOR KINKS, ABRASIONS AND DENTS THAT MAY RESULT DURING POWER UNIT REMOVAL.

(5) CHECK ALL CONDUITS FOR ABRASIONS, WEAR OR TORN BRAIDING.

(6) CHECK FOR FREE TRAVEL OF THE CHOKE CABLE IN ITS HOUSING.

(7) CHECK FOR THE OPERATION OF THROTTLE CONTROL CROSS SHAFT.

(8) CHECK FOR THE FREE TURNING OF THE TACHOMETER CABLE IN ITS HOUSING.

(9) CHECK THE CLUTCH RELEASE BEARINGS FOR FREE ROTATION AND SERVICEABILITY.

(10) TIGHTEN POWER UNIT SUPPORT BRACKETS.

WRENCH, open-end, 7/8-in. WRENCH, open-end, 15/16-in.

Tighten front and rear support brackets to hull by holding bolts with 7/8-in. open-end wrench, and tightening nuts securely with 15/16-in. open-end wrench.

(11) LOWER POWER UNIT INTO POWER UNIT COMPARTMENT.

HOIST, four-ton capacity SLING, power unit (MTM-A4-18)

Secure the four hooks of the lifting sling to the power unit lifting eyes, two at the distributor end and one on each side of the power unit behind the radiator (fig. 28).

(12) LOWER THE POWER UNIT IN THE COMPARTMENT, OBSERVING THE FOLLOWING CAUTIONS:

(a) The power unit must be kept level and must be guided all the way into the compartment to avoid binding and damage.

(b) Keep the clutch hub companion flange as close as possible to the bulkhead, to provide clearance for the distributor end of the power unit.

(c) Hold the main throttle rod at the wide open position so that it will clear the flexible air inlet pipe.

(13) Center the power unit on three support brackets, one in the rear center of compartment and one on each side of power unit, just back of radiator.

(14) INSTALL MOUNTING BOLTS.

PLIERS, side cutting
WRENCH, MTM-A4-48
WRENCH, open-end, 1 1/8-in.
WRENCH, socket, 1 5/8-in.

Aline holes in power unit front support brackets as necessary and install bolts and nuts. Hold bolts from top of power unit with (MTM-A4-48 wrench) and have another man reach through openings in floor of hull and install nuts (1 5/8-in. socket wrench). Secure with cotter pins (pliers). Install nut on power unit rear support bolt. Tighten securely (1 1/8-in. open-end wrench) and lock with cotter pin (pliers) (fig. 29).

(15) CONNECT GROUND STRAP (fig. 29).

WRENCH, 9/16-in.

Place end of ground strap in position and attach to power unit rear support with lock washer and cap screw. Tighten cap screw securely.

(16) INSTALL RADIATOR OVERFLOW TUBE EXTENSION.

PLIERS, side cutting

Pass end of tubing through opening in grille; position end of rubber hose and slide it over tube which extends along the left side of No. 1 engine. Tighten thumb screw, insert locking wire through hole in thumb screw, pass wire around hose and twist ends of wire together.

(17) INSTALL CRANKCASE DRY BREATHER TUBE.

PLIERS, side cutting

Place tube in position, with rear end over elbow which is attached to grille in hull rear wall, slide other end of hose over opening in breather unit, located on distributor end of No. 1 engine, left side, and attach at both ends by tightening thumb screws on hose clamps. Pass locking wires through holes in thumb screws, pass ends of wires around hose and twist ends of wires together.

(18) INSTALL EXHAUST PIPE EXTENSIONS.

WRENCH, 9/16-in.

Place tail pipes in position on rear wall of compartment, both left and right sides, and attach with the two clamp bolts provided (9/16-in. wrench). Insert flexible pipes into elbows which extend through openings in grille and place in position (alining with openings on exhaust pipes on power unit). Assemble the clamps (two clamps to each pipe) around flange

on end of exhaust pipes and around flange on end of flexible pipe and secure with the bolts and nuts (two to each pipe). Tighten nuts securely ($\frac{9}{16}$-in. wrench).

(19) CONNECT TACHOMETER DRIVE CABLE (fig. 20).

PLIERS, adjustable

Insert end of cable in opening in center of adapter and screw cable housing nut onto adapter housing and tighten securely.

(20) INSTALL NOS. 3 AND 4 DISTRIBUTOR CAPS.

PLIERS, side cutting SCREWDRIVER

Install distributor caps on distributors of Nos. 3 and 4 engines, making sure they are seated firmly on distributor housing, securing with two screws each. Tighten screws securely (screwdriver). Pass locking wire through hole in head of one screw, then through head of other screw and twist ends of wire together to secure (side cutting pliers).

(21) CONNECT SOLENOID FUEL SHUT-OFF VALVE WIRES (fig. 56).

WRENCH, $\frac{3}{8}$-in. WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{1}{2}$-in.

Place end of wire, which leads from No. 4 ignition coil, over terminal post on top of valve and secure with lock washer and nut. Tighten nut securely ($\frac{3}{8}$-in. wrench). Insert bolt through mounting bracket and clamp, place end of ground wire over bolt and install lock washer and nut. Tighten both nuts securely ($\frac{1}{2}$-in. and $\frac{9}{16}$-in. open-end wrench).

(22) CONNECT FUEL PUMP INLET TUBE.

WRENCH, open-end, $1\frac{3}{8}$-in.

Remove cap from fuel pump inlet tube and screw connection on end of tube into elbow on left side of fuel pump. Tighten connection securely, to prevent leaks.

(23) INSTALL FIRE EXTINGUISHER NOZZLES.

WRENCH, open-end, $\frac{1}{2}$-in. WRENCH, open-end, $1\frac{1}{16}$-in.

Position the two center fire extinguisher nozzles (both right and left sides) between lines and screw connections onto nozzles ($1\frac{1}{16}$-in. open-end wrench). Place nozzles in position on side walls and attach bracket to walls with two cap screws and lock washers each. Tighten cap screws securely ($\frac{1}{2}$-in. open-end wrench).

(24) INSTALL IGNITION FILTER (fig. 162).

SCREWDRIVER WRENCH, $\frac{1}{2}$-in.

Place filter in position on left side wall and secure with the four

cap screws and lock washers. Tighten cap screws securely (½-in. wrench). Remove four slotted screws and lift cover off (screwdriver). Insert ends of wires through openings in both front and rear ends of filter, remove the two screws from filter unit, attach one wire to either side of filter unit and secure with the two screws. Tighten screws securely (screwdriver). Screw knurled nut onto ferrule at each end of filter, to secure wire conduit to filter, and tighten with fingers. Install cover and secure with the four screws. Tighten screws securely (screwdriver).

(25) CONNECT WIRES TO GENERATOR. (NOTE: This applies only on power units of multiple water pump type.)

SCREWDRIVER
WRENCH, socket, ½-in.
WRENCH, socket, ⅜-in.

Loosen wing nut on terminal box cover and remove cover. Pass ends of cables through opening in side of terminal box and connect to respective terminal posts. (NOTE: *This is determined by size of opening on end of wires.*) Install lock washers and nuts and tighten securely, (⅜-in. socket wrench) (½-in. socket wrench). Screw knurled nut onto ferrule on side of terminal box, with fingers, to secure wire conduit. Install cover and tighten wing

(26) CONNECT STARTER WIRE (fig. 162).

PLIERS, side cutting
WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, ¼-in.

Pass end of wire through opening in radiator end of terminal box and attach to terminal post, securing with lock washer and nut. Tighten nut securely ($\frac{9}{16}$-in. socket wrench). Screw knurled nut onto ferrule, with fingers, to secure wire conduit. Position cover on terminal box and secure with four cap screws (two on top and two on left side). Tighten screws securely (¼-in. wrench). Insert locking wires through heads of screws, locking screws in pairs, and twist ends of wires together (side cutting pliers).

(27) CONNECT SIGNAL SENDING UNIT HARNESS (fig. 162).

Aline key and keyway in connectors and insert connector on end of harness into connector on top of No. 2 engine and tighten knurled nut with fingers.

(28) CONNECT REAR PROPELLER SHAFT TO CLUTCH AND CONNECT CLUTCH RELEASE BEARING GREASE TUBE (if so equipped).

WRENCH, open-end, ½-in. (2)
WRENCH, open-end, $\frac{11}{16}$-in.
WRENCH, $\frac{9}{16}$-in.

Position flange on rear end of rear propeller shaft, alining prick punch

marks on flange with like marks on clutch hub flange, insert the eight bolts (from inside fighting compartment) through holes in flanges, install lock washers and nuts and, with one man inside fighting compartment holding bolts, have men tighten nuts securely from power unit side (½-in. open-end wrench (2)). Position clutch release bearing grease tube junction block on bulkhead and have man tighten bolt from fighting compartment to secure junction block to bulkhead. Install nut and tighten securely ($\frac{9}{16}$-in. wrench). Screw grease tube into opening in side of clutch release bearing ($\frac{11}{16}$-in. open-end wrench). Install the two metal grease tubes from junction block to fittings on bulkhead (½-in. open-end wrench).

(29) INSTALL PROPELLER SHAFT HOUSING INSPECTION COVER.

Position cover over propeller shaft housing and against bulkhead (inside fighting compartment). Attach cover to both propeller shaft housing and bulkhead with lock washers and cap screws and tighten screws securely.

(30) INSTALL AUXILIARY GENERATING UNIT EXHAUST PIPE.

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

Place pipe in position, with flange on end of pipe resting against flange on right side of muffler and attach with two screws (screwdriver). Connect pipe at front of radiator (at right side) to flexible connection and secure by tightening thumb screw on clamp. Pass locking wire through hole in the thumb screw, pass wire around tube and twist ends of wire together to secure (side cutting pliers). Position pipe on bulkhead and attach to bulkhead with clip and cap screw (½-in. open-end wrench). Insert pipe through opening in grille at rear of compartment and attach to tube which protrudes through rear of radiator right side support, securing with thumb screw. Insert locking wire through hole in thumb screw, pass wire around tube and twist ends of wire together to secure (side cutting pliers). Position pipe and attach to right compartment wall with two clips, lock washers and cap screws. Tighten cap screws securely (½-in. open-end wrench).

(31) CONNECT CHOKE CABLE (fig. 22).

PLIERS, side-cutting
WRENCH, open-end, ½-in.

Pass cable and housing through opening in choke cable bracket, position clevis on end of cable over end of arm on choke cross shaft lever, insert clevis pin through clevis and lever, insert cotter pin through hole in end of clevis pin and bend ends of cotter pin to secure (side cutting pliers). Insert bolt through holes in choke cable bracket, install lock washer and nut and tighten securely (½-in. open-end wrench).

POWER UNIT (CHRYSLER TANK ENGINE)

(32) CONNECT CARBURETOR MAIN THROTTLE ROD.

WRENCH, open-end, ½-in.

Place end of main throttle rod (fig. 22) in position and screw the ball joint screw into arm on end of throttle control cross shaft (fig. 50). Tighten screw securely (½-in. open-end wrench).

(33) CHECK CHOKE ROD ADJUSTMENT.

PLIERS.

Refer to paragraph 73., **c.** for details.

(34) CHECK CARBURETOR THROTTLE ADJUSTMENT.

PLIERS, side cutting. WRENCH, open-end, ½-in.
WRENCH, open-end, $\frac{7}{16}$-in.

Refer to paragraph 72., **a.** for details.

(35) CONNECT CARBURETOR AIR INLET TUBES (fig. 26).

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

Place air cleaner tube assemblies, both right and left, in position as shown in figure 26. Insert tube in rubber hose on carburetors at the points shown. Position hose clamps on hose and tighten thumb screws to secure. Pass locking wires through holes in ends of the two thumb screws on each hose connection and secure by twisting ends of wire together. Place left tube assembly on top of radiator and secure with two flat washers, lock washers and cap screws. Tighten cap screws securely ($\frac{9}{16}$-in. socket wrench). Place right tube assembly on top of radiator, insert cap screws (with flat washers and lock washers) through the two wet breather line retaining clips and secure tube assembly to radiator. Tighten cap screws securely ($\frac{9}{16}$-in. socket wrench).

(36) CONNECT WET BREATHER LINE.

PLIERS, side cutting

Slip hose over end of metal tube (at upper right hand corner of radiator) and tighten thumb screw. Pass locking wire through hole in thumb screw, then around hose and twist ends of wire together to secure.

(37) CONNECT OIL LINES.

WRENCH, open-end, 1¼-in. WRENCH, open-end, 1¾-in.

Place the oil tube which leads from bottom of oil supply tank in position and connect to tube which enters right side of crankcase (fig. 36). Turn clockwise and tighten securely (1¾-in. open-end wrench). Place the oil tube which leads from bottom of power unit oil cooler in position and con-

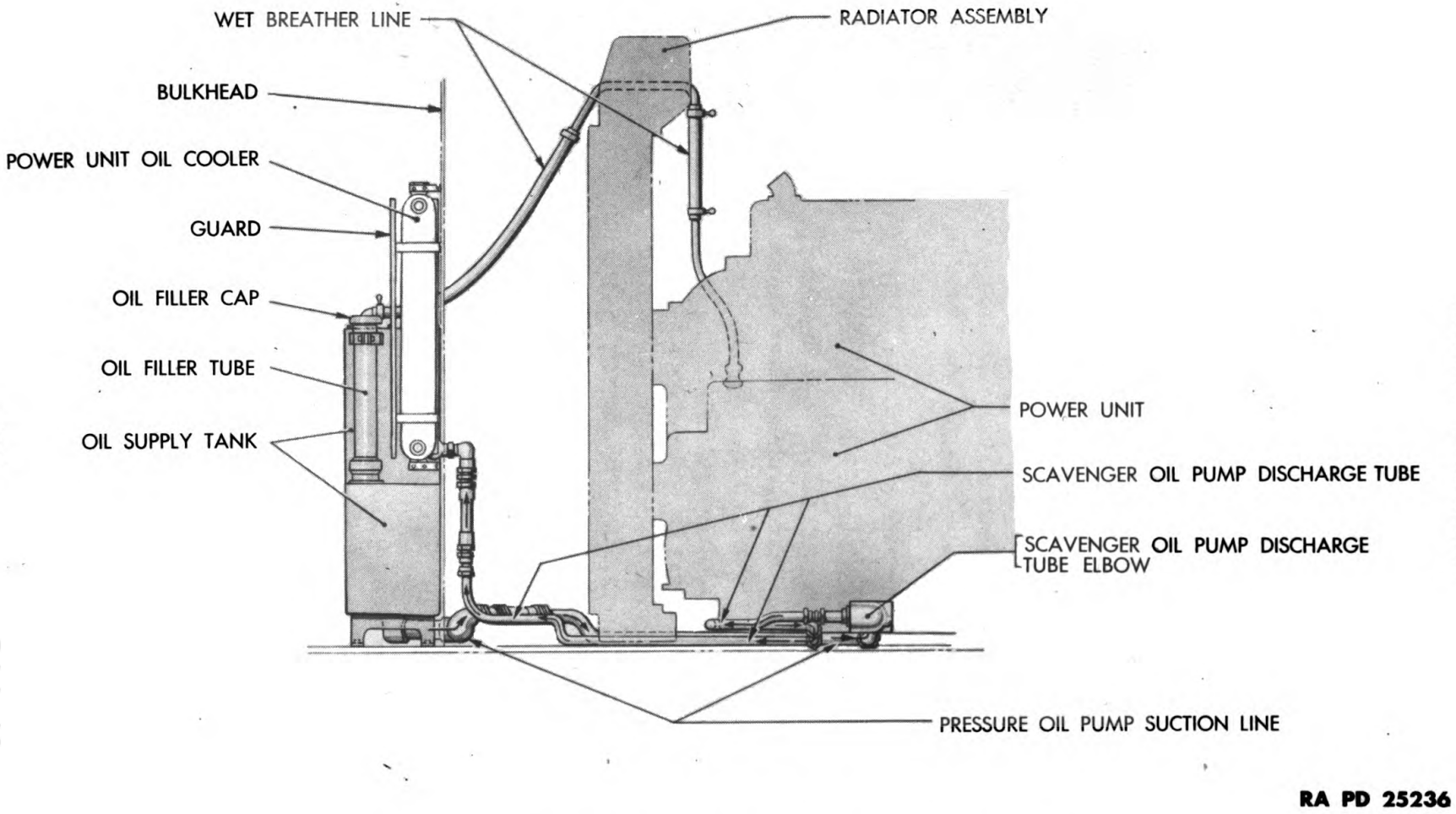

Figure 32 — Power Unit Lubrication System — Elevation View

POWER UNIT (CHRYSLER TANK ENGINE)

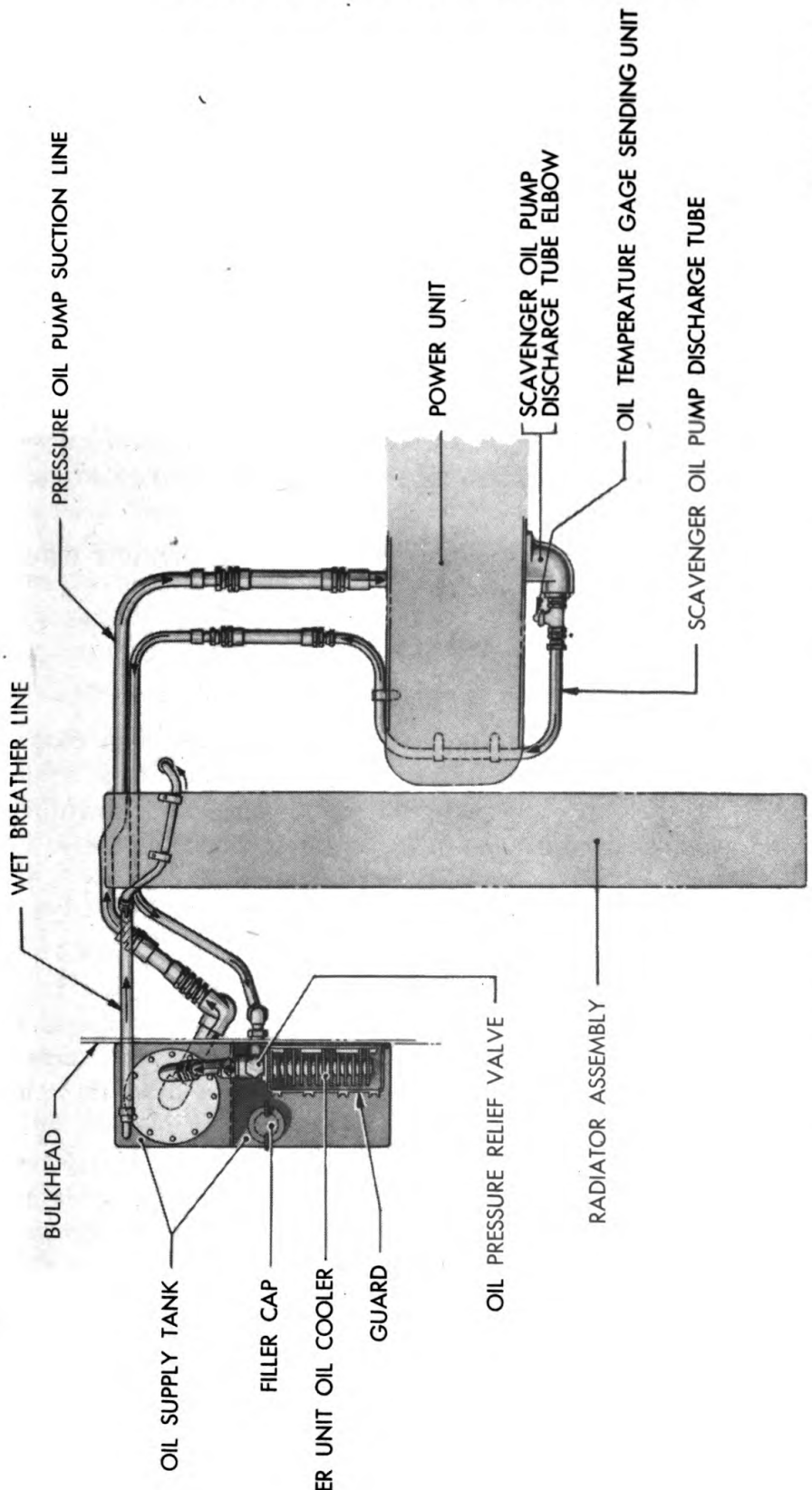

Figure 33 — Power Unit Lubrication System — Plan View

nect to tube (fig. 36). Turn clockwise and tighten securely (1¼-in. open-end wrench).

(38) FILL COOLING SYSTEM.

PLIERS, side cutting
WRENCH, drain plug, 3/4-in.
WRENCH, drain plug, 7/16-in.

Refer to paragraph 83., **h.** for details.

(39) FILL POWER UNIT LUBRICATION SYSTEM.

SCREWDRIVER
WRENCH, 3/4-in.

Refer to paragraph 54., **e.**, for details.

(40) CHECK FOR OPERATION OF POWER UNIT, AND FOR FUEL, OIL AND WATER LEAKS.

Operate power unit, allowing it to reach normal operating temperature, and check for leaks.

(41) INSTALL HULL FLOOR INSPECTION PLATES.

JACK
WRENCH, 1-in.

Remove all traces of torn gaskets and foreign matter from mounting faces of inspection plates and hull floor, below engines Nos. 3 and 4. Position *new* gasket on each plate and raise plates into position and secure with twelve cap screws each. Tighten cap screws securely.

(42) INSTALL POWER UNIT COMPARTMENT COVER (fig. 7).

HOIST
WRENCH, 15/16-in.
WRENCH, 9/16-in.

Lift cover with hoist and lower in place. Place side pieces at both right and left front corners of compartment and secure with three cap screws each (9/16-in. wrench). Place cover in position, aline three holes at both right and left front corners and install three cap screws at each corner (9/16-in. wrench). Install three cap screws at rear end of cover and tighten all cap screws securely (15/16-in. wrench). Place air inlet grille in opening just forward of radiator and secure with four cap screws and lock washers (9/16-in. wrench).

(43) INSTALL PIONEER TOOLS IN THEIR RESPECTIVE LOCATIONS ON SPONSON.

(44) CLOSE POWER UNIT COMPARTMENT DOORS.

WRENCH, 1⅛-in.

Close rear doors and secure with the cap screws at center of doors, where doors overlap.

(45) CLOSE RADIO SWITCH AND BATTERY SWITCH.

Rotate turret and close switches and lower section of turret floor directly over battery box.

54. POWER UNIT LUBRICATING SYSTEM.

a. Description. Oil is drawn from the oil supply tank (figs. 32 and 33) located in the right rear corner of the fighting compartment, through an external inlet line by the oil pressure pump (fig. 36), and forced through the drilled passages in the crankcase and individual engine cylinder blocks to the moving parts of the power unit. Part of this oil is forced from the oil gallery of No. 1 engine through the two absorption type oil filters (figs. 26 and 37), bracket mounted to the No. 1 engine, to the power unit drive gear housing. Oil is also forced through the oil galleries of engines Nos. 1, 2 and 5 to the power unit drive gear housing. The oil flows over the gears in the power unit drive gear housing and drains to the power unit oil sump. It is then directed through a tube to the power unit oil cooler (figs. 32 and 33) and back to the power unit oil supply tank by the scavenger oil pump.

b. Oil Level. Check the oil level every day. An oil level gage is fitted to the oil supply tank filler cap (fig. 34). To check oil level, operate the power unit at 1,200 rpm for approximately five minutes. While operating at this speed, turn ignition switch "OFF" and note the oil level as indicated on oil level gage. Add OIL, engine, specified on Lubrication Guide (fig. 16), to bring level to "FULL" mark on gage. CAUTION: Never add oil above the "FULL" mark.

c. Change Oil. Drain oil every 500 miles or 50 hours when operating on dirt roads or cross country; every 1,000 miles when operating on paved roads or during wet weather. Drain only when the power unit is at normal operating temperature.

d. Drain Power Unit Lubricating System.

TOOLS.

PAN, for oil (capacity, ten gallons)	WRENCH, Allen, $\frac{9}{16}$-in.
SCREWDRIVER	WRENCH, $\frac{3}{4}$-in.
	WRENCH, socket, $1\frac{1}{8}$-in.

(1) PROCEDURE.

(a) Open radio switch and battery switch (par. 52., b., (1)).

(b) Drain oil tank.

PAN, for oil (capacity, ten gallons)	SCREWDRIVER
	WRENCH, Allen, $\frac{9}{16}$-in.

Remove the four slotted screws (screwdriver), which secure the in-

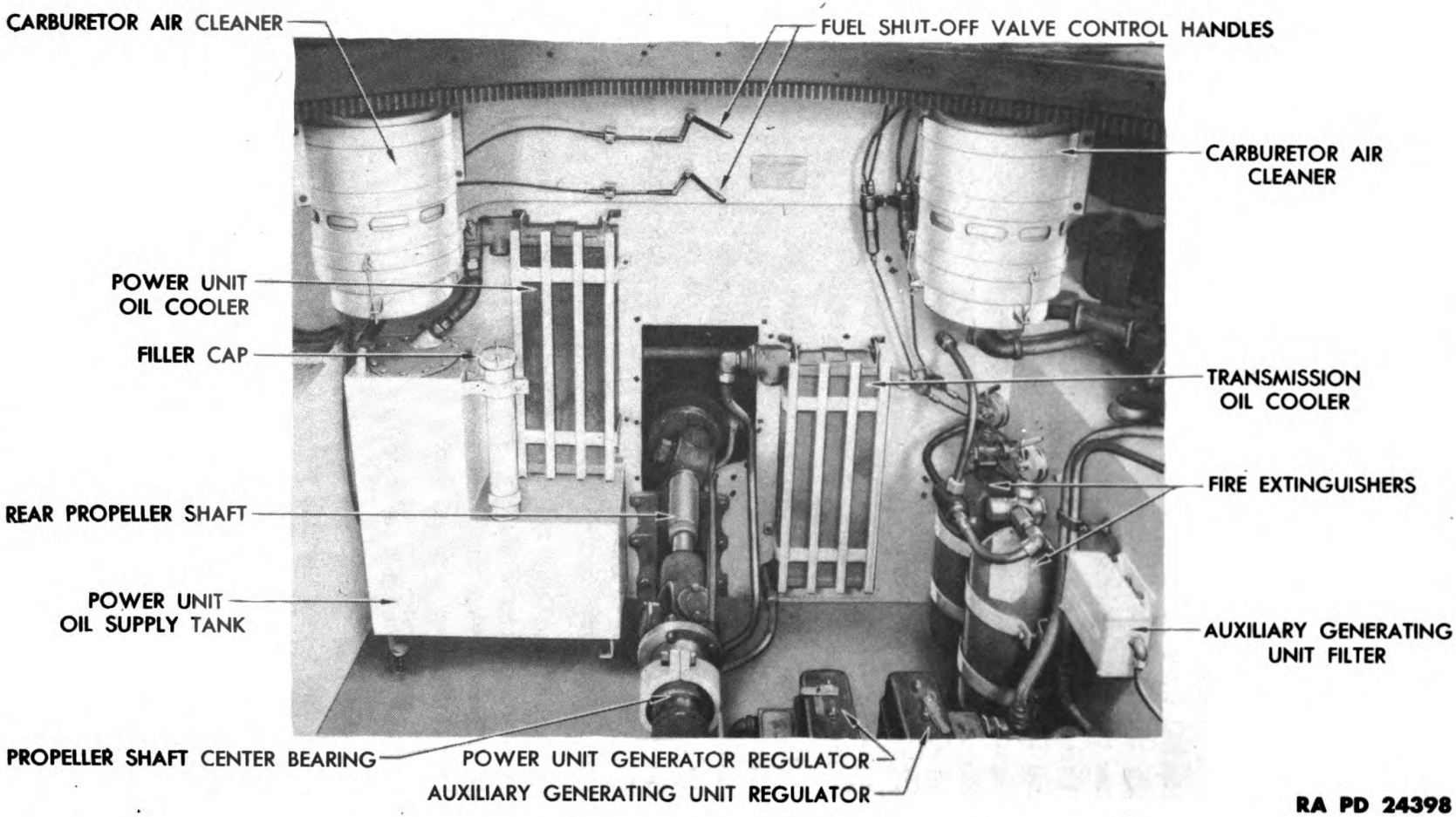

Figure 34 — Bulkhead — Fighting Compartment

spection plate to hull floor directly below the power unit oil supply tank. Reach through opening in hull floor and remove oil tank drain plug (turn counterclockwise) ($\frac{9}{16}$-in. Allen wrench). Replace drain plug after draining. Tighten plug securely.

(c) Drain power unit.

WRENCH, ¾-in. WRENCH, socket, 1⅛-in.

Remove four screws which secure the inspection cover to the large plate on hull floor, directly below the power unit oil pan (¾-in. wrench). Reach through opening in hull floor and remove drain plug in power unit oil pan (1⅛-in. socket wrench). Replace drain plug after draining. Tighten plug securely.

(d) Clean absorption type oil filters and replace cartridges (par. 55., e.).

e. Fill Power Unit Lubricating System.

TOOLS.

SCREWDRIVER WRENCH, ¾-in.

(1) PROCEDURE.

(a) Pour eight gallons OIL, engine, in oil supply tank (fig. 34).

(b) Start power unit, then, if oil gage indicates pressure, run at 1,200 rpm for five minutes before checking the oil level in the supply tank. With power unit operating at this speed, turn ignition switch "OFF" and note the oil level as indicated on oil level gage. Add oil as required with the power unit running at 1,200 rpm, to bring the oil level to the "FULL" mark, as indicated on the oil level gage in oil supply tank.

(c) Operate power unit and check for oil leaks at drain plugs, both in oil supply tank and oil pan.

(d) Install inspection cover on large plate on hull floor, directly under center of power unit oil pan and secure with four screws (¾-in. wrench).

(e) Remove all traces of torn gaskets and foreign matter from mounting face on the inspection cover under the oil supply tank and secure to hull with four slotted screws (screwdriver).

55. OIL FILTERS.

a. Description. Two absorption type oil filters, installed on the pressure side of the oil pressure pump, and bracket mounted to the No. 1 engine, serve to remove the dirt and foreign matter from the power

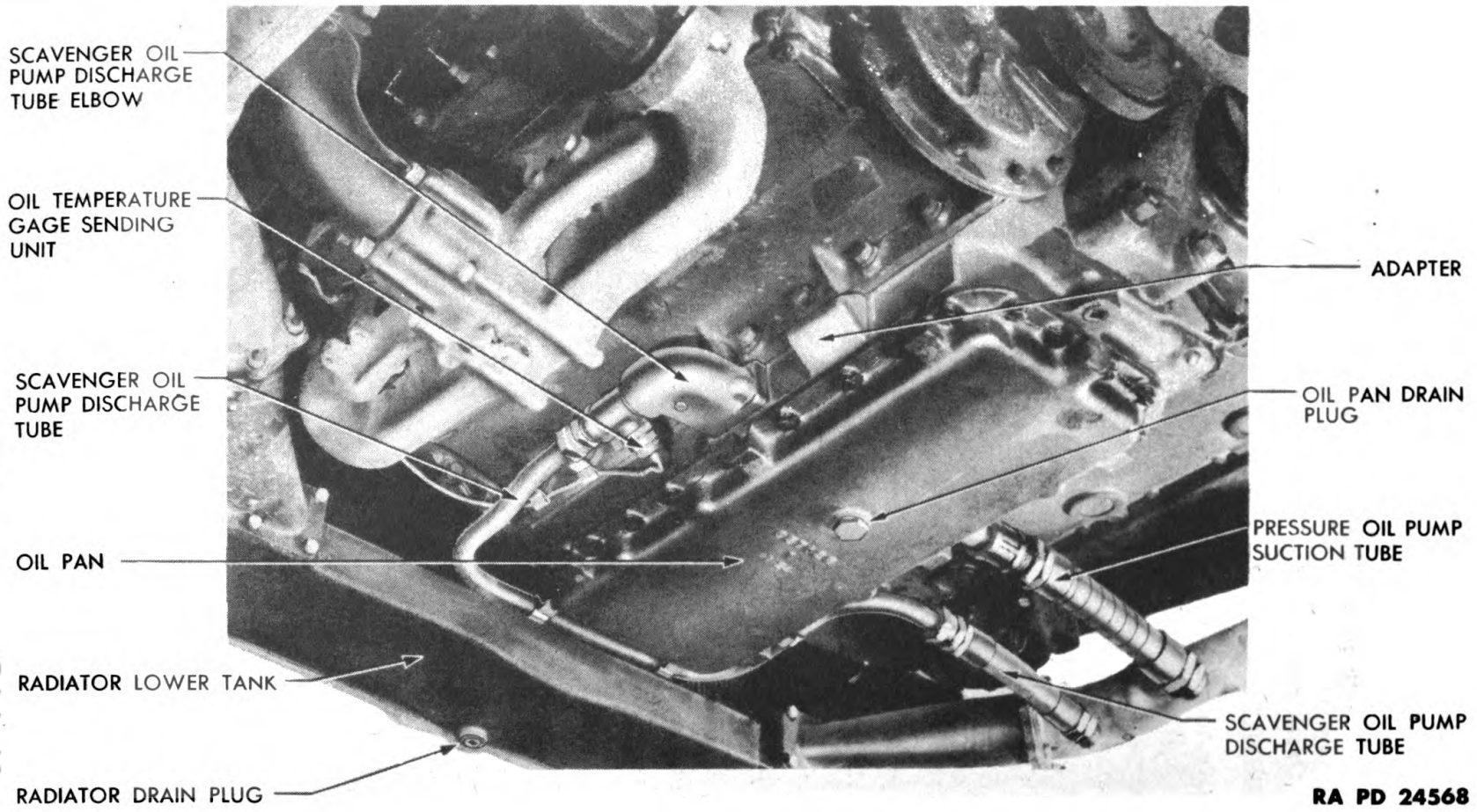

Figure 35 — Power Unit Oil Lines

POWER UNIT (CHRYSLER TANK ENGINE)

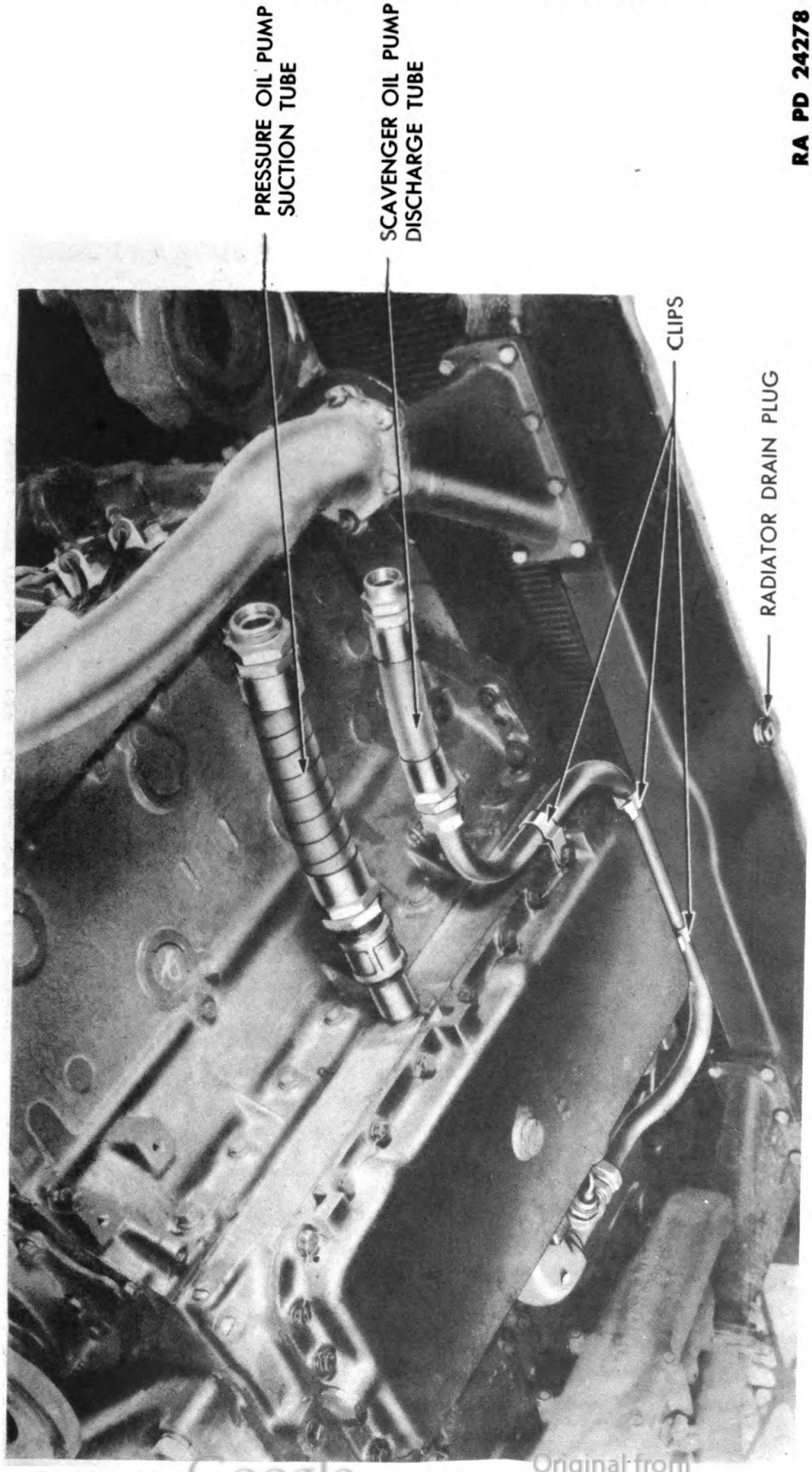

Figure 36 — Power Unit Right Side and Bottom — Single Water Pump Type

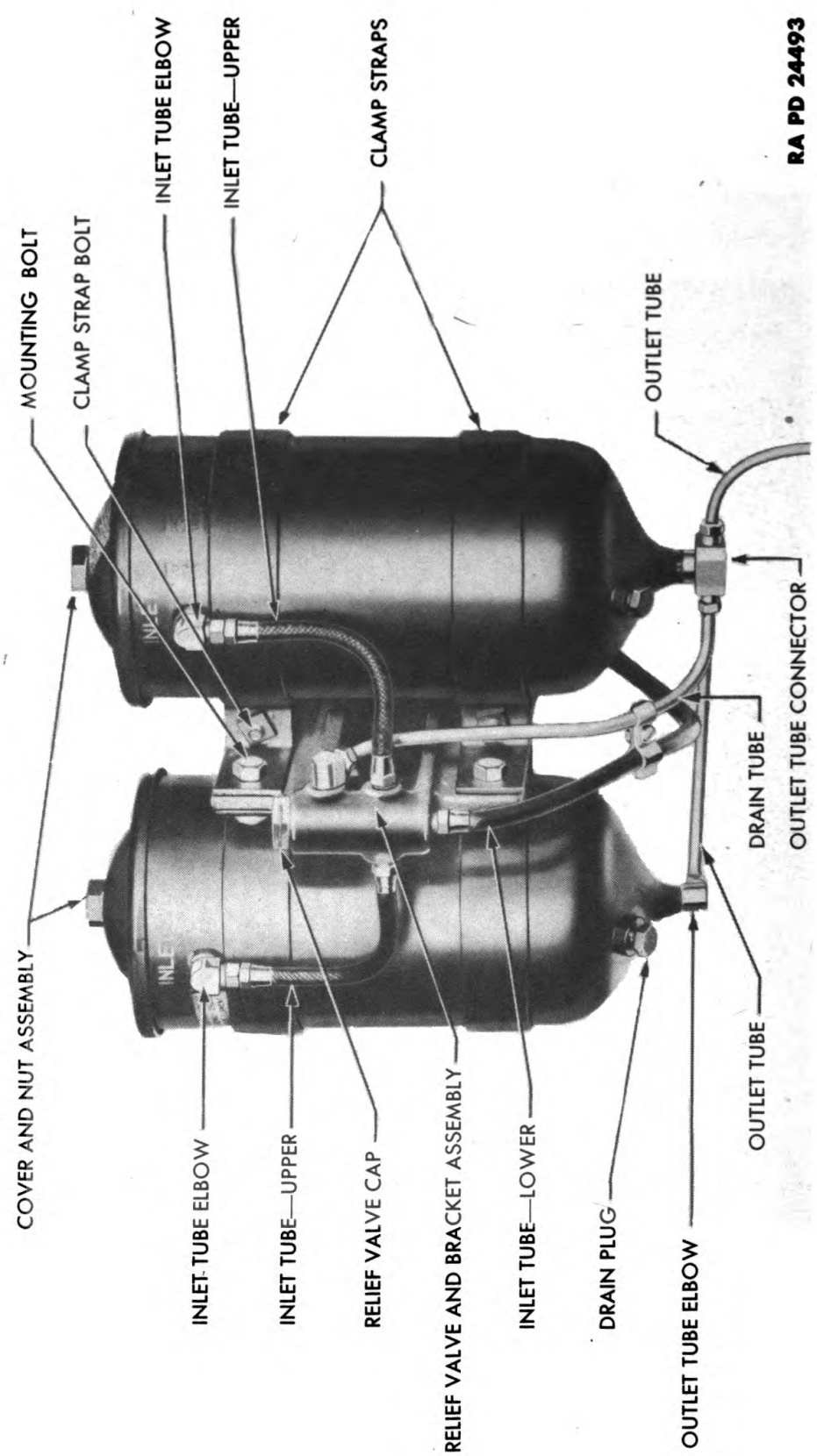

Figure 37 — Absorption Type Oil Filter and Lines

unit oil. A relief valve, incorporated in the support bracket, bypasses oil under 25-pounds per square inch to the power unit drive gear housing. Replace filtering cartridge every 100 hours or 1,000 miles of power unit operation. NOTE: Each oil filter shown in figure 37 contains a filtering cartridge, therefore, it is necessary to replace both cartridges at the period previously mentioned.

b. Preventive Maintenance.

(1) CHECK DAILY FOR OIL LEAKS AT CONNECTIONS.

c. Removal.

TOOLS.

SCREWDRIVER
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, ½-in.
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, 1-in.

(1) PROCEDURE.

(a) Open radio switch and battery switch (par. 52., b., (1)).

(b) Open power unit compartment cover.

WRENCH, $\frac{15}{16}$-in.

Remove three cap screws at rear end of cover, have two men raise cover, by means of two handles at rear end of cover, and rest it against turret.

(c) Disconnect inlet tube (fig. 38).

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

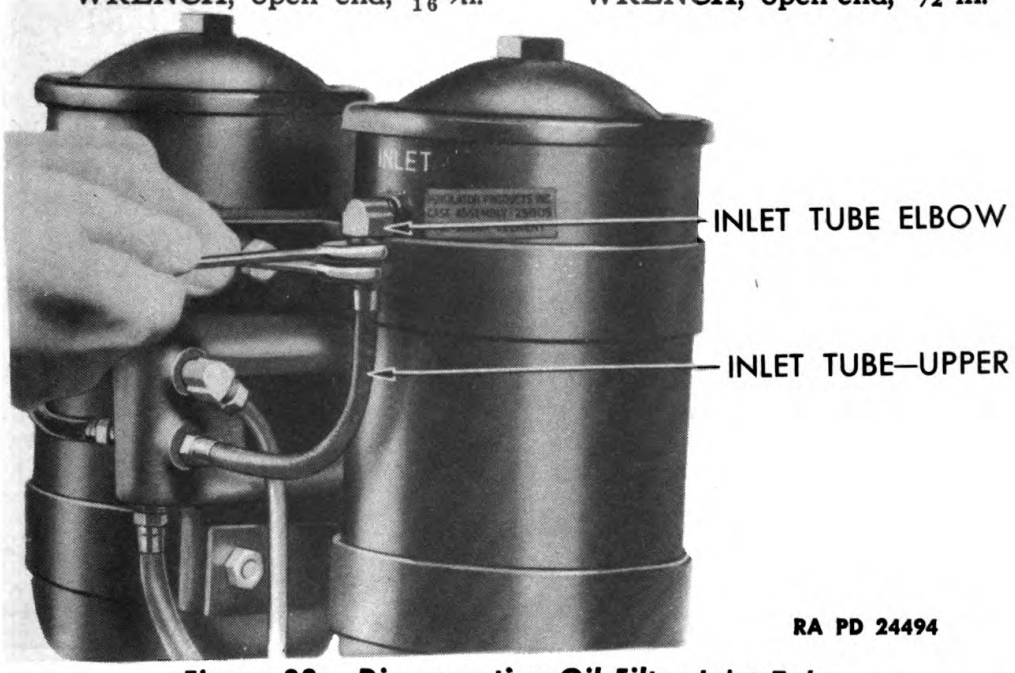

Figure 38 — Disconnecting Oil Filter Inlet Tube

Unscrew inlet tube at filter end (turn counterclockwise). **NOTE:** Hold the inlet tube elbow with wrench ($\frac{7}{16}$-in. open-end wrench) to guard against damaging elbow (fig. 38).

(d) Disconnect outlet tube (fig. 39).

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

Unscrew outlet tube at filter end (turn counterclockwise). **NOTE:** Hold the outlet tube connector with wrench (½-in. open-end wrench), so connector will not be removed from the filter.

(e) Remove filter assembly.

SCREWDRIVER **WRENCH**, open-end, $\frac{9}{16}$-in.

Loosen the clamp bolts (screwdriver) which secure the clamp strap around the filter body and the two bolts attached to bracket ($\frac{9}{16}$-in. open-end wrench) and remove filter assembly from bracket (fig. 37).

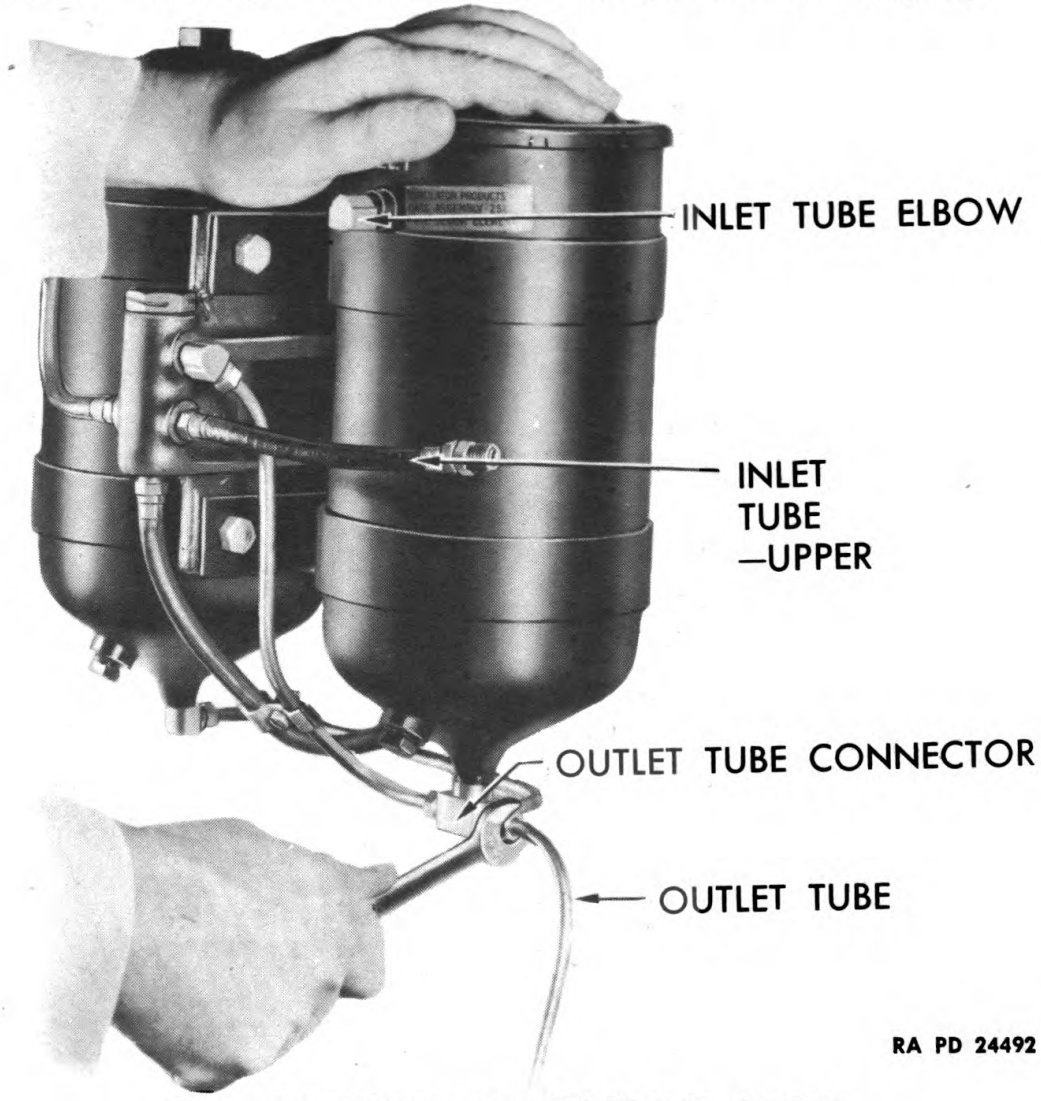

Figure 39 — Disconnecting Oil Filter Outlet Tube

d. Installation.

TOOLS.

SCREWDRIVER
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{1}{2}$-in.
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, 1-in.

(1) PROCEDURE.

(a) Mount filter assembly.

SCREWDRIVER
WRENCH, open-end, $\frac{9}{16}$-in.

Mount filter assembly in clamp straps (screwdriver) and to bracket ($\frac{9}{16}$-in. open-end wrench), *but do not tighten clamp strap bolts or bracket bolts.*

(b) Connect outlet tube.

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

Position tube in opening in connector at bottom of filter and screw connection on end of tube into connector (turn clockwise). CAUTION: Be very careful not to start connection cross threaded as this will cause an oil leak at this connection. Hold elbow with wrench ($\frac{1}{2}$-in. open-end) and tighten tube connection securely ($\frac{7}{16}$-in. open-end wrench) (fig. 39).

(c) Connect inlet tube.

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

Position tube in opening in inlet tube elbow and screw connection on end of tube into elbow (turn clockwise). CAUTION: Be very careful not to start the connection cross threaded, as this will cause an oil leak at this connection. Hold elbow with wrench ($\frac{1}{2}$-in. open-end) while tightening connection securely ($\frac{7}{16}$-in. open-end wrench) (fig. 38).

(d) Tighten filter assembly mounting bolts.

SCREWDRIVER
WRENCH, open-end, $\frac{9}{16}$-in.

Center filter assembly in clamp straps sufficiently to relieve any strain on the outlet tube and tighten clamp strap bolts (screwdriver) and bracket bolts ($\frac{9}{16}$-in. open-end wrench).

(e) Operate power unit and check for oil leaks.

(f) Close power unit compartment cover.

WRENCH, $\frac{15}{16}$-in.

Have two men lower cover in place and secure with three cap screws at rear end of cover.

MEDIUM TANK M4A4

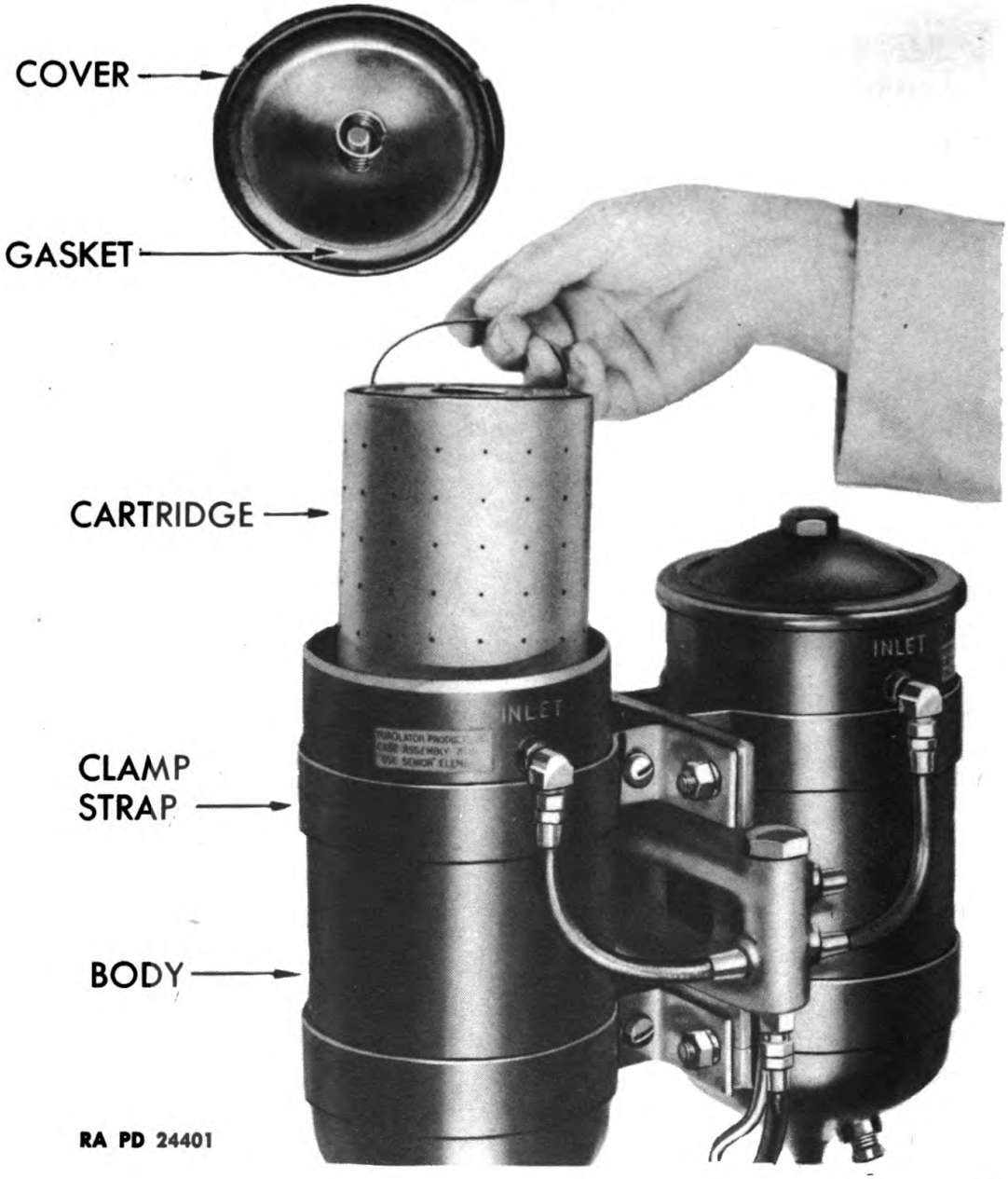

Figure 40 — Removing Absorption Type Oil Filter Cartridge

e. Replace Filtering Cartridge.

TOOLS.

PAN, for oil (capacity, 10 gallons)
PAN, for SOLVENT, dry-cleaning
SCREWDRIVER
WRENCH, Allen, $\frac{9}{16}$-in.
WRENCH, $\frac{3}{4}$-in.
WRENCH, $\frac{7}{8}$-in.
WRENCH, 1-in.
WRENCH, socket, $1\frac{1}{8}$-in.
WRENCH, $1\frac{1}{4}$-in.

(1) PROCEDURE.

(a) Open radio switch and battery switch (par. 52., **b.**, (1)).

(b) Open power unit compartment cover (par. 55., **c.**, (1), *(b)*).

(c) Remove filter cover.

WRENCH, 1¼-in.

Remove filter cover by unscrewing nut on top of filter cover, right hand threads.

(d) Lift filter cartridge out of filter body and discard (fig. 40).

(e) Remove drain plug.

WRENCH, ⅞-in.

Remove drain plug from filter body (turn counterclockwise).

(f) Remove and discard gasket from top of filter body.

(g) Wash filter body.

PAN, for SOLVENT, dry-cleaning.

Wash inside of filter body thoroughly with SOLVENT, dry-cleaning.

(h) Install new filter cartridge in filter.

Lower new cartridge into filter body, pressing into place and bend handle down so it will clear cover.

(i) Install filter cover.

WRENCH, 1¼-in.

Position *new* gasket on top of filter body and install cover. Tighten cover nut securely.

(j) Install drain plug.

WRENCH, ⅞-in.

Reinstall drain plug in bottom of filter body. Tighten securely.

(k) Drain power unit lubricating system (par. 54., **d.**).

(l) Refill power unit lubricating system (par. 54., **e.**).

(m) Operate power unit and check for oil leaks at connections.

(n) Close power unit compartment cover (par. 55., **d.**, (1), *(f)*).

56. PRESSURE AND SCAVENGER OIL PUMPS.

a. Description. Two gear type oil pumps are mounted in the crankcase, being held in place by six cap screws each and are driven by individual shafts, the drive shafts, in turn, being driven by the accessory shaft (fig. 42).

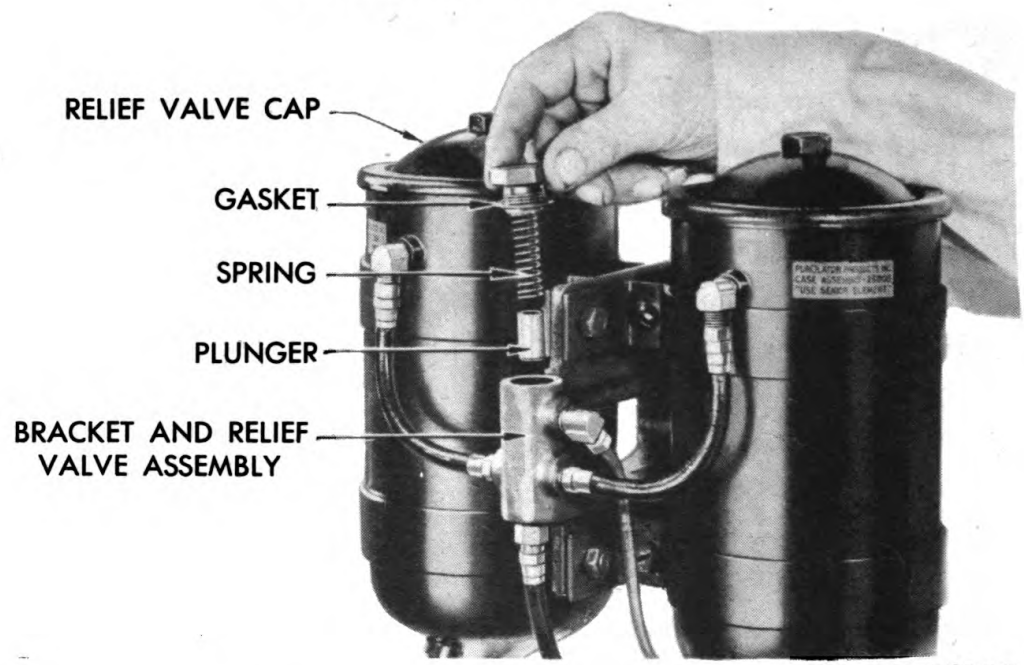

Figure 41 — Installing Absorption Type Oil Filter Relief Valve

b. Operation. The pressure oil pump, located at the distributor end of crankcase, (fig. 42), draws oil from the oil supply tank and forces this oil through drilled passages to the various working parts of the power unit. The scavenger oil pump (fig. 42) located at the radiator end of crankcase, directs oil that accumulates in the power unit oil pan through the power unit oil cooler and into the power unit oil supply tank (figs. 32 and 33).

c. Mounting. The same method of mounting is used for both pumps and, due to the fact that both pumps are interchangeable, insofar as mounting is concerned, care must be used in mounting pumps in their proper position (fig. 42). Should they be improperly located in the crankcase, they will not function as intended, resulting in damage to the power unit.

d. Removal.

TOOLS.

JACK
PAN, for oil (capacity, ten gallons)
PLIERS, side cutting
SCREWDRIVER
WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, 1-in.
WRENCH, Allen, $\frac{9}{16}$-in.
WRENCH, $\frac{3}{4}$-in.
WRENCH, 1-in.
WRENCH, socket, $1\frac{1}{8}$-in.

(1) PROCEDURE.

(a) Remove inspection plate in hull floor.

JACK — WRENCH, 1-in.

Place jack under plate directly below power unit oil pan and raise sufficiently to relieve weight of plate from attaching screws. Remove twelve cap screws, lower jack and remove plate from hull floor.

(b) Drain the power unit lubricating system (par. 54., d.)

(c) Remove power unit oil pan.

JACK — WRENCH, socket, $\frac{9}{16}$-in.
PLIERS, side cutting

Remove locking wires (side cutting pliers) from cap screws, place jack under oil pan and raise sufficiently to relieve weight of pan from attaching screws. Remove twenty-six cap screws ($\frac{9}{16}$-in. socket wrench), lower jack and remove pan from crankcase.

(d) Remove oil pump.

PLIERS, side cutting — WRENCH, socket, $\frac{9}{16}$-in.

Remove locking wires (side cutting pliers) and six cap screws ($\frac{9}{16}$-in. socket wrench) and remove oil pump from splined shaft.

e. Installation.

TOOLS.

JACK	WRENCH, Allen, $\frac{9}{16}$-in.
PAN, for SOLVENT, dry-cleaning	WRENCH, socket, $\frac{9}{16}$-in.
PLIERS, side cutting	WRENCH, $\frac{3}{4}$-in.
SCREWDRIVER	WRENCH, 1-in.
	WRENCH, socket, $1\frac{1}{8}$-in.

(1) PROCEDURE.

(a) Remove all traces of torn gaskets and dirt from mounting faces of crankcase and oil pump body, likewise from mounting faces of crankcase and oil pan.

(b) Place a shaft in opening in center of pump body and rotate shaft, to make sure the oil pump gears are operating freely and are not binding.

(c) Check oil pump cover to body attaching screws to make sure they have been tightened securely and that all screws have been wired in place, as shown in figure 42.

(d) Mount Pump Body.

PLIERS, side cutting — WRENCH, socket, $\frac{9}{16}$-in.

Position *new* gasket on mounting face of pump body and attach pump

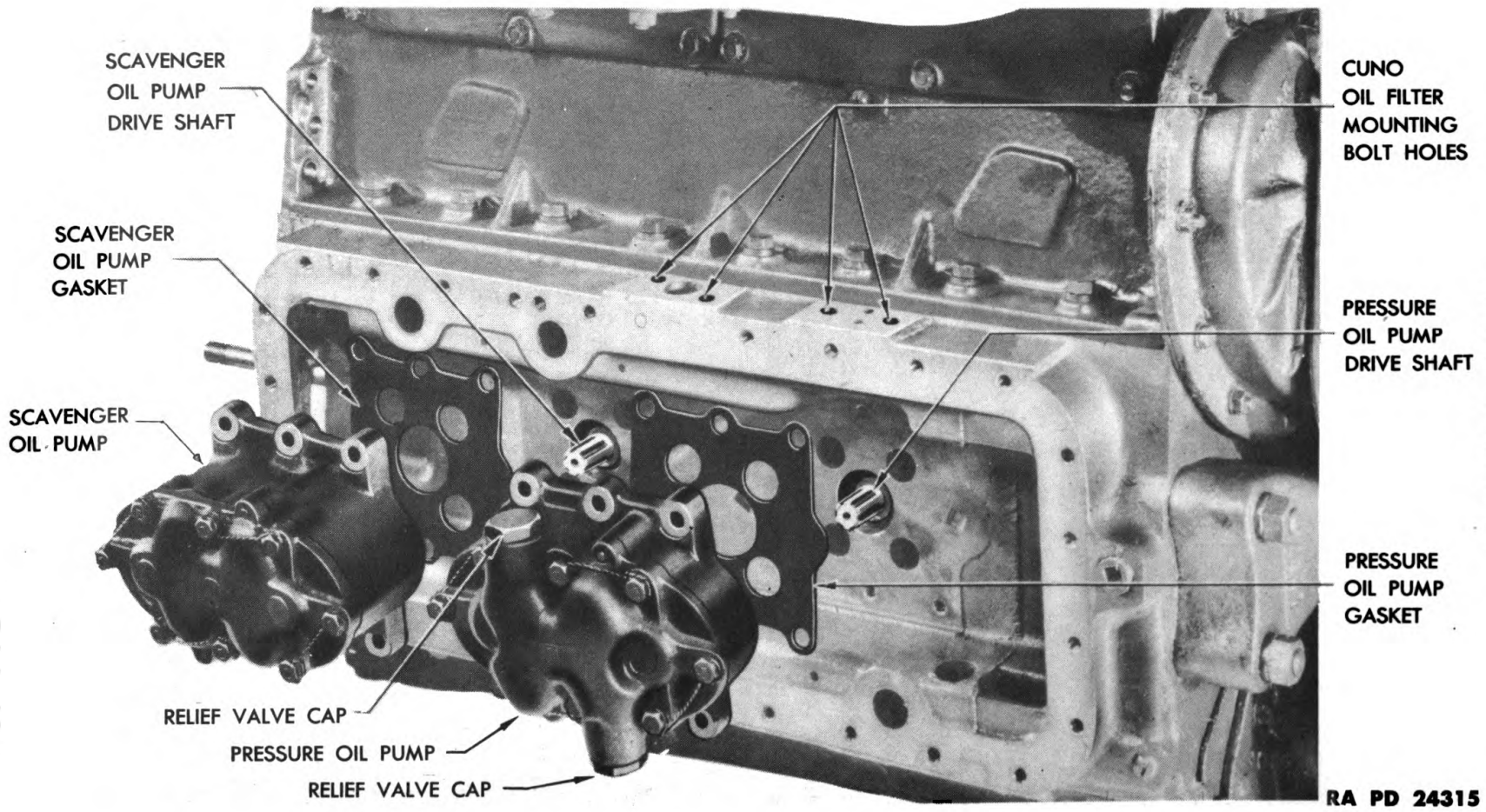

Figure 42 — Oil Pumps Removed — Showing Position

to crankcase, tightening the six cap screws, ($\frac{9}{16}$-in. socket wrench). NOTE: Use care in mounting pump on splined shaft, to avoid any damage to splines or shaft bearings (fig. 42). Wire cap screws in place (side cutting pliers).

(e) Clean Oil Pan.

PAN, for SOLVENT, dry-cleaning — SCREWDRIVER

Remove the twenty cap screws (screwdriver) and remove screen from oil pan and wash screen and pan thoroughly with SOLVENT, dry-cleaning, to remove all traces of torn gaskets and foreign matter. Place screen in position (as shown in figure 43) in oil pan and secure in pan with the twenty cap screws and lock washers.

(f) Install Oil Pan.

JACK — WRENCH, socket, $\frac{9}{16}$-in.
PLIERS, side cutting

Position *new* gasket on mounting face of oil pan, raise pan in place (with jack) and attach to crankcase with the twenty-six cap screws. Tighten cap screws securely and lock in place by passing locking wire through heads of cap screws and twisting ends of wire together. NOTE. When installing the power unit oil pan, be sure to attach the scavenger pump discharge tube clips to the three cap screws at the radiator end of the oil pan (fig. 36).

(g) Refill Power Unit Lubricating System (par. 54., e.).

(h) Operate Power Unit and Check for Oil Leaks and Operation of Oil Pressure Gage on Instrument Panel (fig. 166).

(i) Install Inspection Plate in Hull Floor.

JACK — WRENCH, 1-in.

Remove all traces of torn gaskets and foreign matter on mounting faces of inspection plate and hull floor. Position *new* gasket on inspection plate, raise plate (with jack) into position on hull floor and attach plate to hull floor, tightening twelve cap screws securely.

57. CRANKCASE BREATHER.

a. Description. Exhaust gases, which may accumulate in the crankcase, are expelled through a tube connected to the left side of No. 1 engine, at the radiator end, and extending through the rear wall of the power unit compartment (fig. 20).

58. POWER UNIT OIL COOLER.

a. Description. An oil cooler (figs. 27 and 34) is mounted in an opening in the bulkhead, to the right of the propeller shaft. Oil is forced

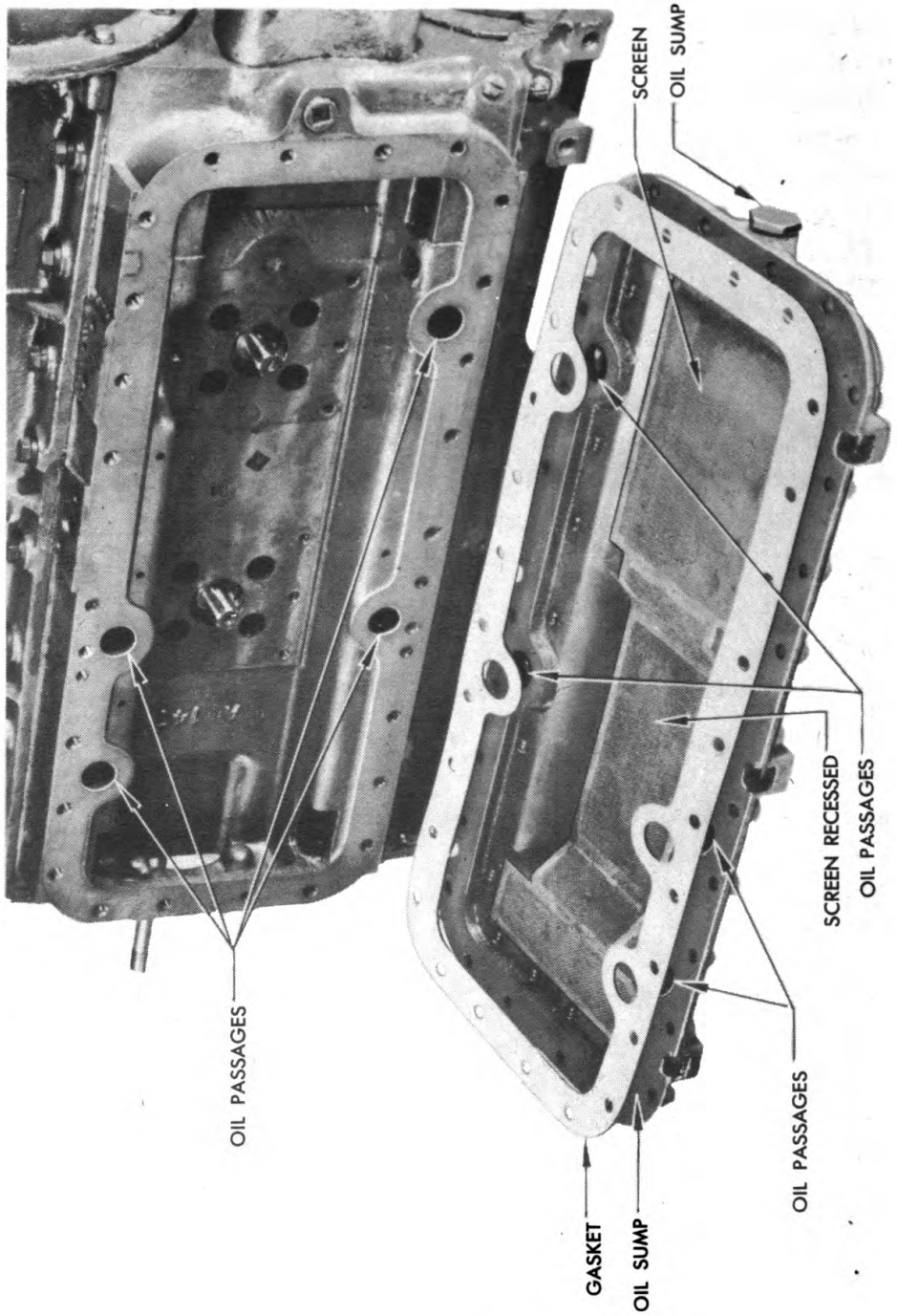

Figure 43 — Oil Pan and Gasket

by the scavenger pump through the oil cooler and then to the oil supply tank. Air is drawn by the power unit fan through this cooler, thus cooling the oil before it is delivered to the oil supply tank.

b. Preventive Maintenance.

(1) Remove any foreign matter from the radiator fins by applying compressed air in between the cooler fins (from the power unit side of bulkhead)

(2) Do not place any object in such position so that it will obstruct flow of air through cooler.

c. Removal.

TOOLS.

JACK
PAN, for oil (capacity, ten gallons)
PLIERS, side cutting
SCREWDRIVER
WRENCH, $\frac{7}{16}$-in.
WRENCH, $\frac{3}{4}$-in.
WRENCH, 1-in.
WRENCH, open-end, $1\frac{3}{8}$-in.
WRENCH, open-end, $1\frac{1}{2}$-in.
WRENCH, Allen, $\frac{9}{16}$-in.
WRENCH, socket, $1\frac{1}{8}$-in.

(1) PROCEDURE.

(a) Open Radio Switch and Battery Switch (par. 52., b., (1)).

(b) Remove Inspection Plate in Hull Floor.

JACK
WRENCH, 1-in.

Place jack under plate directly below radiator and raise jack sufficiently to relieve weight of plate from attaching screws. Remove the twelve cap screws, lower jack and plate and remove plate from hull floor.

(c) Drain Power Unit Lubricating System (par. 54., d.).

(d) Disconnect Bottom Oil Tube (fig. 27).

WRENCH, $1\frac{3}{8}$-in.

Reach through opening in hull floor and unscrew connection on end of tube from bottom of cooler (turn counterclockwise).

(e) Disconnect Top Oil Tube.

WRENCH, open-end, $1\frac{1}{2}$-in.

From inside fighting compartment, unscrew oil tube from upper right hand corner of cooler (fig. 34), (turn counterclockwise).

(f) Remove Oil Cooler Guard.

WRENCH, $\frac{7}{16}$-in.

Remove four cap screws, one at each corner of guard, and remove oil cooler guard from bulkhead.

(g) Remove Oil Cooler.

WRENCH, $\frac{7}{16}$-in.

Remove eight bolts, nuts and lock washers which secure oil cooler to brackets and remove oil cooler.

d. Installation.

TOOLS.

JACK
PLIERS, side cutting
WRENCH, Allen, $\frac{9}{16}$-in.
WRENCH, $\frac{7}{16}$-in.
WRENCH, $\frac{3}{4}$-in.
WRENCH, 1-in.
WRENCH, socket, $1\frac{1}{8}$-in.
WRENCH, open-end, $1\frac{3}{8}$-in.
WRENCH, open-end, $1\frac{1}{2}$-in.

(1) PROCEDURE.

(a) Make Sure All Connections Are Clean.

(b) Mount Cooler in Brackets.

WRENCH, $\frac{7}{16}$-in.

Position oil cooler in brackets and secure with eight bolts, nuts and lock washers. Tighten bolts securely.

(c) Mount Oil Cooler Guard (fig. 32).

WRENCH, $\frac{7}{16}$-in.

Position oil cooler guard on bulkhead and secure with four cap screws and tighten screws securely.

(d) Connect Top Oil Tube (fig. 34).

Position oil tube on relief valve (at upper right hand corner of cooler) and attach connection to relief valve (turn clockwise).

(e) Connect Bottom Oil Tube.

WRENCH, $1\frac{3}{8}$-in.

Reach through opening in power unit compartment floor, position end of oil tube on elbow and attach to connection at bottom of oil supply tank (turn clockwise) (fig. 27).

(f) Refill Power Unit Lubricating System (par. 54., e.).

(g) Operate Power Unit and Check for Oil Leaks.

(h) Install Inspection Plate in Hull Floor.

JACK
WRENCH, 1-in.

Remove all traces of torn gaskets from mounting faces on inspection plate and floor of hull. Position *new* gasket on plate, place plate on jack and raise to position on hull floor. Install twelve cap screws and tighten securely.

59. POWER UNIT OIL TUBES.

a. When installing oil tubes, make sure they are properly secured so as not to chafe.

b. Make sure all oil tubes are free from kinks, thus allowing free travel of oil.

60. CYLINDER HEAD GASKETS.

a. General. Cylinder head gaskets of engines Nos. 1, 2 and 5 can be replaced without removing the power unit from the vehicle. To replace cylinder head gaskets in engines Nos. 3 and 4, it is necessary to first remove power unit from the vehicle.

b. Removal.

TOOLS.

JACK
PAN, for water (capacity, 35 gallons)
PLIERS, side cutting
SCREWDRIVER
WRENCH, ½-in.
WRENCH, $\frac{9}{16}$-in.
WRENCH, ⅞-in.
WRENCH, $1\frac{5}{16}$-in.
WRENCH, 1⅛-in.
WRENCH, extension, 12-in.
WRENCH, drain plug, $\frac{7}{16}$-in.
WRENCH, drain plug, ¾-in.
WRENCH, socket, ⅝-in.
WRENCH, socket, ⅞-in.
WRENCH, socket, 1-in.
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, ½-in. (2)
WRENCH, open-end, $\frac{9}{16}$-in.

(1) PROCEDURE.

(a) Open Power Unit Compartment Rear Doors (par. 52., **b.**, (6)).

(b) Remove Power Unit Compartment Cover (par. 52., **b.**, (5)).

(c) Drain Cooling System (par. 83., **g.**).

(d) Remove Carburetor Air Cleaner Tube Assembly, Both Right and Left. (par. 52., **b.**, (12)).

(e) Remove Step From Cylinder Head (No. 1 Engine Only).

WRENCH, open-end, ⅝-in.

Remove four pal nuts and four cylinder head stud nuts and lift step off engine.

(f) Remove Absorption Type Oil Filters (No. 1 Engine Only).

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

Remove three pal nuts and three cylinder head stud nuts (⅝-in.

open-end wrench). Disconnect oil filter outlet tube (par. 55., c., (1), (d)).

Lay oil filter assembly on No. 5 engine manifold.

(g) Disconnect Water Temperature Gage Sending Unit Wire (par. 174., g., (1), (c)).

(h) Disconnect "High" Water Temperature Warning Indicator Sending Unit (No. 1) Engine Only on Single Water Type) (par. 175., d., (2), (a), 2.).

(i) Remove Heat Deflector (Nos. 2, 3 and 5 Engines Only) (figs. 22 and 24).

WRENCH, 5/8-in.

Remove four pal nuts and four cylinder head stud nuts and remove deflector.

(j) Remove Water Pump Inlet Tube (Right for No. 4 Engine Only; Left for No. 3 Engine Only).

PLIERS, side cutting WRENCH, ½-in.

Remove locking wire and loosen thumb screw which secures hose to water pump (side cutting pliers). Remove six bolts, nuts and lock washers which secure radiator outlet adapter to radiator lower tank, separate adapter from radiator and pull end of tube out of hose (½-in. wrench).

(k) Remove Radiator Brace Rod (Nos. 2 and 5 Engines Only) (Figs. 22 and 24)

WRENCH, 7/8-in. WRENCH, $\frac{15}{16}$-in.

Remove one bolt and nut at each end of brace and remove from engine.

(l) Remove Exhaust Pipe (Nos. 2, 3 and 5 Engines Only).

WRENCH, 5/8-in. (2)

Remove flexible exhaust pipe and extension (par. 52., b., (26)).

Remove two pal nuts, nuts and bolts which secure exhaust pipe to exhaust manifold and remove pipe. NOTE: On engine Nos. 2 and 3, it will be necessary to disconnect exhaust pipe from exhaust manifolds of engines Nos. 1, 2 and 3.

(m) Remove Spark Plug Wiring Harness and Conduit Assembly (par. 68., b.).

(n) Disconnect Carburetor Throttle Rods.

PLIERS, side cutting WRENCH, open-end, ½-in.

Remove cotter pins and clevis pins and separate throttle rod from carburetor throttle shaft lever. NOTE: When removing cylinder head

of No. 2 engine, push main throttle rod through opening in bell crank to expose cotter pin, remove cotter pin and washer and separate throttle rod from bell crank (side cutting pliers); remove cotter pin and flat washer and remove two cap screws (½-in. open-end wrench) and separate bell crank bracket from boss on manifold.

(o) Disconnect Choke Rods (Nos. 2, 3 and 4 Engines Only).

PLIERS, side cutting

Remove cotter pins and clevis pins and separate choke rods from choke levers. NOTE: Engine No. 2, it will be necessary to disconnect two rods. Engine No. 4, it will be necessary to disconnect choke rod at No. 5 carburetor only.

(p) Disconnect Fuel Pump to Carburetor Flexible Fuel Tubes (Nos. 2, 3 and 4 Engines Only).

WRENCH, open-end, ½-in. (2)

Unscrew flexible tube, *at end nearest fuel pump,* and separate.

(q) Remove Carburetor (Nos. 2, 3, 4 and 5 Engines Only).

Remove four pal nuts and nuts which secure carburetor inlet adapter to inlet manifold and lift assembly off manifold. NOTE: When removing cylinder head from No. 4 engine, it will be necessary to remove No. 5 carburetor.

(r) Disconnect Exhaust Stack Temperature Warning Indicator Send-in Unit Wire (fig. 24).

PLIERS, side cutting SCREWDRIVER

Remove locking wire, remove screw and disconnect wire.

(s) Remove Engine Water Outlet Tubes.

PLIERS, side cutting WRENCH, ½-in.
WRENCH, open-end, $\frac{9}{16}$-in.

1. On engine No. 1, remove two cap screws which secure radiator inlet adapter to radiator upper tank ($\frac{9}{16}$-in. open-end wrench). Remove locking wire, loosen thumb screw, separate hose from engine water outlet adapter and remove hose (side cutting pliers).

2. On engines Nos. 2 and 3, remove eight cap screws which secure radiator inlet adapter to radiator upper tank (½-in. wrench), remove two cap screws each which secure water tube to Nos. 2 and 3 engines water outlet adapters ($\frac{9}{16}$-in. open-end wrench), separate tube at both ends and remove.

3. On engines Nos. 4 and 5, repeat operation as outlined for engines Nos. 2 and 3, substituting engines Nos. 4 and 5 when disconnecting tubes from engine water outlet adapters.

(t) Disconnect Signal Sending Unit Harness Bracket (No. 2 Engine Only).

WRENCH, 5/8-in.

Remove two pal nuts and cylinder head stud nuts and lift bracket off studs.

(u) Disconnect Carburetor Fuel Feed Tubes (Nos. 1, 2 and 4 Engines Only).

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

1. No. 1 engine, unscrew connection which secures tube to fuel distribution block on right side of No. 1 engine, distributor end (1/2-in. open-end wrench).

2. No. 2 engine, unscrew connection which secures tube to fuel distribution block on top of No. 2 cylinder head (1/2-in. open-end wrench).

3. No. 4 engine, unscrew connection which secures tube to fuel distribution block on right side of No. 1 engine, distributor end (5/8-in. open-end wrench).

(v) Remove Ignition Filter (No. 2 Engine Only) (par. 64., **b.**).

(w) Remove Auxiliary Generating Unit Exhaust Pipe (No. 5 Engine Only (par. 52., **b.**, (15)).

(x) Remove Radiator (When Removing Nos. 3 and 4 Cylinder Head Only) (par. 90., **b.**).

(y) Remove Power Unit Front Support (Right Support When Removing No. 4 Cylinder Head; Left Support When Removing No. 3 Cylinder Head).

WRENCH, socket, 7/8-in.

Place a support under either right or left side of power unit (depending on which support is being removed) in order to permit removal o

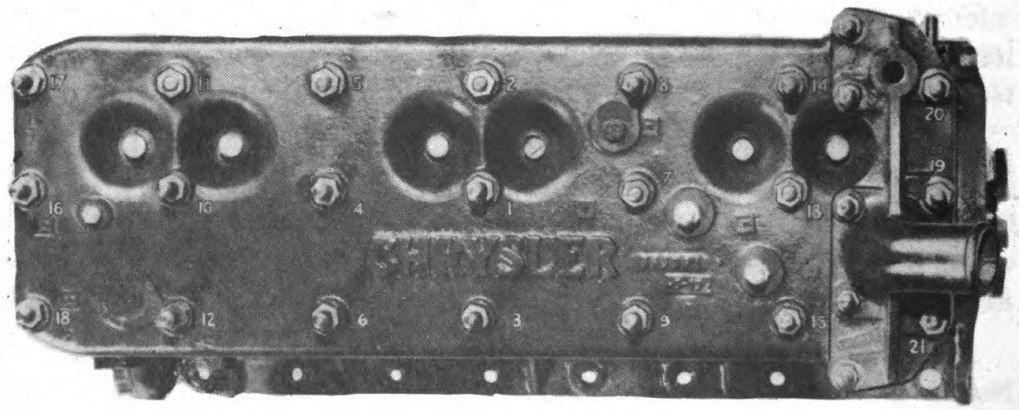

Figure 44 — Sequence for Tightening Cylinder Head Stud Nuts

support. Remove five cap screws and lock washers which secure power unit support to side of drive gear case (two cap screws from radiator side of support; two cap screws from under support which thread into gear case; one cap screw from gear case side, which threads into support).

(z) Remove Cylinder Head.

WRENCH, socket, 5/8-in., 12-in. extension.

Remove twenty-one pal nuts and cylinder head stud nuts and lift cylinder head from engine.

c. Installation.

TOOLS.

JACK	WRENCH, drain plug, 7/16-in.
PLIERS, side cutting	WRENCH, drain plug, 3/4-in.
WRENCH, 1/2-in.	WRENCH, socket, 5/8-in.
WRENCH, 9/16-in.	WRENCH, socket, 7/8-in.
WRENCH, 7/8-in.	WRENCH, socket, 1-in.
WRENCH, 15/16-in.	WRENCH, open-end, 7/16-in.
WRENCH, 1 1/8-in.	WRENCH, open-end, 1/2-in. (2)
WRENCH, extension, 12-in.	WRENCH, open-end, 9/16-in.

(1) PROCEDURE.

(a) Prepare Cylinder Head and Cylinder Block for Assembling.

Remove all traces of torn gaskets and foreign matter from cylinder block and cylinder head. Remove all traces of carbon from inside cylinder head and top of pistons and valves. CAUTION: Be very careful not to allow carbon or any foreign matter to drop into cylinders or to become lodged under valves.

(b) Install Cylinder Head and Gasket on Engine.

WRENCH, socket, 5/8-in., with 12-in. extension
WRENCH, torque

Position cylinder head gasket over studs, keeping gasket level and pressing gasket until it rests on cylinder block. Position cylinder head over studs, keep it level, and force it tight against the gasket. Install twenty-one cylinder head stud nuts and tighten nuts in the sequence shown in figure 44 to 60 torque pounds pressure when cold. Warm engine to normal operating temperature and tighten nuts to 60 torque pounds pressure.

(c) Install Power Unit Support, Either Right or Left (When Installing Either Nos. 3 or 4 Cylinder Head).

WRENCH, socket, 7/8-in.

Position support on side of gear case and secure with five cap screws and lock washers (two cap screws from radiator side of support; two cap

screws from under support, which thread into gear case; one cap screw from gear case side, which threads into support).

(d) Install Radiator (When Installing No. 4 Cylinder Head Only) (par. 90., c.).

(e) Connect Carburetor Fuel Feed Tubes (Nos. 1, 2 and 4 Engines Only).

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

1. No. 1 engine, position tube on fuel distribution block on right side of No. 1 engine, distributor end, and screw connection into distribution block (½-in. open-end wrench).

2. No. 2 engine, position tube on fuel distribution block on top of No. 2 cylinder head and screw connection into distribution block (½-in. open-end wrench).

3. No. 4 engine, position tube on fuel distribution block on right side of No. 1 engine, distributor end, and screw connection into distribution block (⅝-in. open-end wrench).

(f) Connect Signal Sending Unit Harness Bracket (fig. 162). *(No. 2 Engine Only).*

WRENCH, ⅝-in.

Position bracket over two cylinder head studs, install two nuts and pal nuts.

(g) Connect Engine Water Outlet Tubes.

PLIERS, side cutting WRENCH, ½-in.
WRENCH, open-end, $\frac{9}{16}$-in.

1. Remove all traces of torn gaskets and foreign matter from mounting faces of radiator upper tank and tubes and paint mounting faces of radiator upper tank and tubes with sealing compound.

2. Engine No. 1, position *new* gasket on radiator upper tank, place tube in position (with hose over engine water outlet adapter) and secure to radiator upper tank with two cap screws ($\frac{9}{16}$-in. open-end wrench).

3. Engines Nos. 2 and 3, position *new* gaskets on mounting faces of radiator upper tank and engine water outlet adapters, place tube in position and secure to radiator upper tank with eight cap screws and lock washers (½-in. wrench). Attach other end of tube to engine water outlet adapter with two cap screws ($\frac{9}{16}$-in. open-end wrench).

4. Engines Nos. 4 and 5, repeat operation as outlined for engines Nos. 2 and 3, substituting engines Nos. 4 and 5 when connecting tubes to engine water outlet adapters.

(h) Connect Exhaust Stack Temperature Warning Indicator Sending Unit Wire (fig. 24).

PLIERS, side cutting SCREWDRIVER

Attach wire to unit with screw (screwdriver). Insert locking wire through hole in head of screw, pass wire around terminal on end of unit wire and twist ends of wire together to secure (side cutting pliers).

(i) Connect Fuel Pump to Carburetor Flexible Fuel Tubes (Nos. 1, 2, 3 and 4 Engines Only).

WRENCH, open-end, ½-in. (2)

Screw connection on end of flexible tube into fuel distribution block.

(j) Connect Choke Rods (Nos. 2, 3 and 4 Engines Only) (fig. 49).

PLIERS, side cutting

Position end of rod on carburetor choke lever, insert clevis pin through rod and lever, insert cotter pin through hole in end of clevis pin and bend ends of cotter pin. NOTE: Engine No. 2, it will be necessary to connect two rods· engine No. 4, it will be necessary to connect choke rod at No. 5 carburetor only.

(k) Connect Carburetor Throttle Rods (fig. 49).

PLIERS, side cutting WRENCH, open-end, ½-in.

Place throttle rod in position on carburetor throttle shaft lever and secure with clevis pin. Insert cotter pin through hole in end of clevis pin and bend ends of cotter pin to secure. NOTE: If No. 2 engine cylinder head is being installed, position bell crank and bracket (fig. 47) on boss on No. 2 engine inlet manifold and secure with two cap screws (½-in. open-end wrench). Insert end of main throttle rod through opening in bell crank, force end of rod through opening in bell crank (against spring pressure), install flat washer, insert cotter pin through hole in end of rod and bend ends of cotter pin to secure (side cutting pliers).

(l) Install Spark Plug Wiring Harness and Conduit Assembly (par. 68., c.).

(m) Install heat deflector (Nos. 2, 3 and 5 engines only (figs. 22 and 24).

WRENCH, ⅝-in.

Position deflector on four cylinder head studs and secure with nuts and pal nuts.

(n) Install exhaust pipe (Nos. 2, 3 and 5 engines only).

WRENCH, ⅝-in. (2)

Remove all traces of torn gaskets, position *new* gaskets on mounting faces and secure exhaust pipe to exhaust manifold with two bolts, nuts

and pal nuts on each connection. Install flexible exhaust pipe and extension (par. 53., **a.**, (18)).

(o) Install radiator brace rod (Nos. 2 and 5 engines only (figs. 22 and 24).

WRENCH, $\frac{15}{16}$-in.

Place brace rod in position and secure to radiator side support and bracket on cylinder head with one bolt and nut at either end.

(p) Install water pump inlet tube (right for No. 4 engine only; left for No. 3 engine only).

PLIERS, side cutting WRENCH, ½-in.

Remove all traces of torn gaskets from mounting faces of adapter and radiator lower tank. Paint mounting faces with sealing compound. Position *new* gasket on radiator lower tank. Enter end of tube in hose at pump, and attach adapter to radiator lower tank with eight cap screws. Tighten thumb screws to secure hose clamp. Insert locking wire through holes in thumb screws and twist ends of wire together to secure (side cutting pliers).

(q) Connect "High" water temperature warning indicator sending unit wire (No. 1 engine only on single water pump type) (par. 175., **d.**, (3), (a), *1.*).

(r) Connect water temperature gage sending unit wire (par. 174., **h.**, (1), (a) and **j.**, (1)).

(s) Install absorption type oil filters (No. 1 engine only).

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

Position oil filter bracket over three cylinder head studs on No. 1 engine, install three nuts and pal nuts (⅝-in. open-end wrench). Screw connection on end of outlet tube into connection at bottom of filter. (Hold connection with ½-in. open-end wrench and turn tube connection with $\frac{7}{16}$-in. open-end wrench.)

(t) Install step on cylinder head (No. 1 engine only).

WRENCH, open-end, ⅝-in.

Place step in position on No. 1 cylinder head and secure with four nuts and pal nuts.

(u) Install ignition filter (par. 64., **c.**)

(v) Install auxiliary generating unit exhaust pipe (par. 53., **a.**, (30)).

(w) Install carburetor air cleaner tube assembly, both right and left (par. 53., **a.**, (35)).

(x) Fill cooling system (par. 83., **h.**).

(y) Install power unit compartment cover (par. 53., **a.**, (42)).

(z) Close power unit compartment rear doors (par. 53., **a.**, (44)). (44)).

61. EXHAUST AND INLET MANIFOLD GASKETS.

a. General. Manifold assemblies can be removed from engines Nos. 1, 3 and 5 with power unit in vehicle, after first opening power unit compartment cover for removal of manifold from engines Nos. 1 and 5 and after first removing inspection plate from hull floor, directly below No. 3 engine, for removal of manifold from engine No. 3. The manifold can be removed from engine No. 2 after first removing power unit from vehicle. The manifold cannot be removed from engine No. 4 without first removing No. 5 engine from crankcase, due to insufficient clearance.

b. Removal.

TOOLS.

PLIERS, side cutting
SCREWDRIVER
WRENCH, 3/8-in.
WRENCH, 9/16-in.
WRENCH, 5/8-in. (2)
WRENCH, 7/8-in.
WRENCH, 15/16-in.
WRENCH, 1-in.
WRENCH, socket, 9/16-in., 6-in. extension
WRENCH, open-end, 1/2-in. (2)
WRENCH, open-end, 9/16-in.

(1) PROCEDURE.

(a) Remove power unit compartment cover (Nos. 1 and 5 engines only) (par. 52., **b.**, (5)).

(b) Remove hull floor inspection plate (No. 3 engine only) (par. 52., **b.**, (7)).

(c) Remove carburetor air cleaner tube assembly (right or left as required) (par. 52., **b.**, (12)).

(d) Disconnect carburetor throttle rods (par. 60., **b.**, (1) (n)).

(e) Disconnect carburetor choke rods (par. 60., **b.**, (1) (o)).

(f) Remove exhaust pipe (par. 60., **b.**, (1) (L)).

(g) Disconnect carburetor flexible fuel tubes (par. 60., **b.**, (1) (p)).

(h) Disconnect exhaust stack temperature warning indicator sending unit (par. 60., **b.**, (1) (r)).

(i) Remove carburetor bell crank bracket (No. 2 engine only) (par. 60., **b.**, (1) (n)).

(j) Remove manifold assembly.

WRENCH, socket, $\frac{9}{16}$-in., 6-in. extension
WRENCH, open-end, $\frac{9}{16}$-in.

Remove thirteen lock nuts and retaining nuts and lift manifold off studs.

c. Installation.

TOOLS.

PLIERS, side cutting
SCREWDRIVER
WRENCH, $\frac{3}{8}$-in.
WRENCH, $\frac{9}{16}$-in.
WRENCH, $\frac{5}{8}$-in. (2)
WRENCH, $\frac{7}{8}$-in.
WRENCH, $\frac{15}{16}$-in.
WRENCH, 1-in.
WRENCH, socket, $\frac{9}{16}$-in., 6-in. extension
WRENCH, open-end, $\frac{1}{2}$-in. (2)
WRENCH, open-end, $\frac{9}{16}$-in.

(1) PROCEDURE.

(a) Prepare manifold and cylinder block for installation of manifold. Remove all traces of torn gaskets and foreign matter from mounting faces of cylinder block and manifold.

(b) Install manifold on cylinder block.

WRENCH, socket, $\frac{9}{16}$-in., 6-in. extension
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, torque

1. Position *new* gaskets over manifold attaching studs. Slide manifold assembly over studs and force tight against cylinder block.

2. Place brass washer over each end stud, both upper and lower, and install nut. Place clamp washer over each of the remaining upper studs, position washer so it will contact projections on manifolds, and install nuts on studs. Install nuts on the remaining five lower studs. Tighten all nuts lightly, then tighten nuts alternately, to 15 to 20 torque foot pounds of pressure. Install pal nuts on each stud and tighten finger tight and $\frac{1}{3}$ turn.

(c) Install carburetor bell crank bracket on No. 2 engine inlet manifold (No. 2 engine only) (fig. 47) (par. 60., **c.**, (1) (K)).

(d) Install exhaust stack temperature warning indicator sending unit (par. 60., **c.**, (1) (h)).

(e) Connect carburetor flexible fuel tube (par. 60., **c.**, (1) (i)).

(f) Connect carburetor choke rods (par. 60., **c.**, (1) (j)).

(g) Connect carburetor throttle rods (par. 60., c., (1) (k)).

(h) Install carburetor air cleaner tube assembly (right or left) as required (par. 53., a., (35)).

(i) Install exhaust pipe (par. 60., c., (1) (n)).

(j) Install hull floor inspection plate (No. 3 engine only) (par. 53., a., (41)).

(k) Install power unit compartment cover (Nos. 1 and 5 engines only (par. 53., a., (42)).

MEDIUM TANK M4A4

Section XV

POWER UNIT IGNITION SYSTEM

62. DESCRIPTION.

a. The ignition system consists of ignition switch (par. 180), ignition solenoid switch (par. 63), ignition filter (par. 64), ignition coil (par. 65), ignition distributor (par. 66), and spark plugs (par. 69), as shown in the ignition circuit wiring diagram (fig. 163).

63. IGNITION SOLENOID SWITCH.

a. Description. The ignition solenoid switch, located in the battery control box completes the circuit between the ignition switch and the distributor (fig. 163).

b. Removal.

TOOLS.

SCREWDRIVER
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{3}{8}$-in.
WRENCH, open-end, $\frac{1}{2}$-in.

(1) PROCEDURE.

(a) Remove battery box cover (par. 161, c., (1), (a)).

(b) Lift out the sliding partition between batteries and control box.

(c) Disconnect wires (fig. 163).

WRENCH, open-end, $\frac{3}{8}$-in.
WRENCH, open-end, $\frac{1}{2}$-in.

Using $\frac{3}{8}$-in. open-end wrench, remove the two nuts and disconnect the two wires. Using $\frac{1}{2}$-in. open-end wrench, remove the two large nuts and disconnect wires.

(d) Remove switch from control box.

b. Filling Engine Lubricating System. Remove lock pin and raise filler cover marked "Lubricating Oil" (fig. 8) at rear of turret on top of hull. Unscrew filler neck cap. Pour 32 quarts of engine oil seasonal grade into filler pipe. Operate engine for 3 minutes at 400 to 450 revolutions per minute. Stop engine and check oil level. Gage on instrument panel must read "FULL." Later production vehicles have a dipstick in filler pipe which can be used to check the accuracy of the instrument panel gage. Pull out stick, wipe clean and insert in tube as far as possible. Pull out dipstick which must show that oil level is up to "FULL" mark. Reinsert dipstick and screw filler cap on tightly. Lower the filler cover and lock in closed position with lock pin.

57. ENGINE LUBRICATING OIL TANKS.

a. Description. The two welded steel lubricating oil tanks are mounted, one on each side, on the floor at forward end of engine compartment. A long filler pipe on each tank extends to its filler opening on top of hull. Tanks in late model vehicles are equipped with a steel measuring tape (dipstick), fitted in a tube inside the filler pipe and accessible when filler cap is removed. These measuring tapes are used to check the accuracy or to supplement the electrically operated oil tank gages. Embossed figures on the tape indicate oil level in the tank. The tight fitting filler cap is non-vented. Creation of unequal pressure is prevented by using a breather hose on each lubricating oil tank. This hose connects the tank with the flywheel housing on its respective engine.

b. Lubricating Oil Tank Gage Units. See paragraph 211.

c. Removal of Lubricating Oil Tank. Remove engine compartment cover plates as a unit (par. 167 **e**). Raise and lock engine compartment splash panel (par. 168 **b**). Remove engine compartment floor plate under engine next to tank to be removed (par. 170 **b**). From below the vehicle, remove lubricating oil tank drain plug cover and remove the drain plug to drain the tank. After tank has drained, install the drain plug. Remove the four bolts, two at each end, which attach tank to hull floor (fig. 141). Remove bolts which attach lower end of tank straps to hull floor. Detach oil supply and return hoses from tank by removing bolts which attach elbows to tank. Disconnect lead wire from starter switch solenoid. From above in engine compartment, remove auxiliary water tank (par. 105 **b**). Disconnect lead wires from lubricating oil tank gage unit and emergency stop solenoid and tag wires. Remove bolt which attaches clip on conduit to sponson cover plate, and pull conduit with disconnected wires out of way behind sponson cover plate. Unscrew fitting on vent hose at top of tank and wire hose up out of way. Loosen lower hose clamp at tank inlet flange. Loosen filler pipe clamp bolt. Take out two bolts which attach filler pipe clamp to sponson cover

plate. Lift out clamp and remove filler pipe. Remove bolts from upper end of lubricating oil tank straps and lift out straps. Turn fuel tank selector valve off. When removing right tank, disconnect short fuel supply tube from fuel tank selector valve to tee connection, and the two tubes from the tee connection to the right and left primary fuel filters. Remove the three tubes. When removing left tank, it is necessary to disconnect and remove only the tube from the tee connection to the left primary fuel filter. Remove air inlet housing from blower (par. 89 **b**). Lift tank straight up, and then tilt toward engine to clear fire extinguisher tube and fuel return tube, as tank is removed from engine compartment.

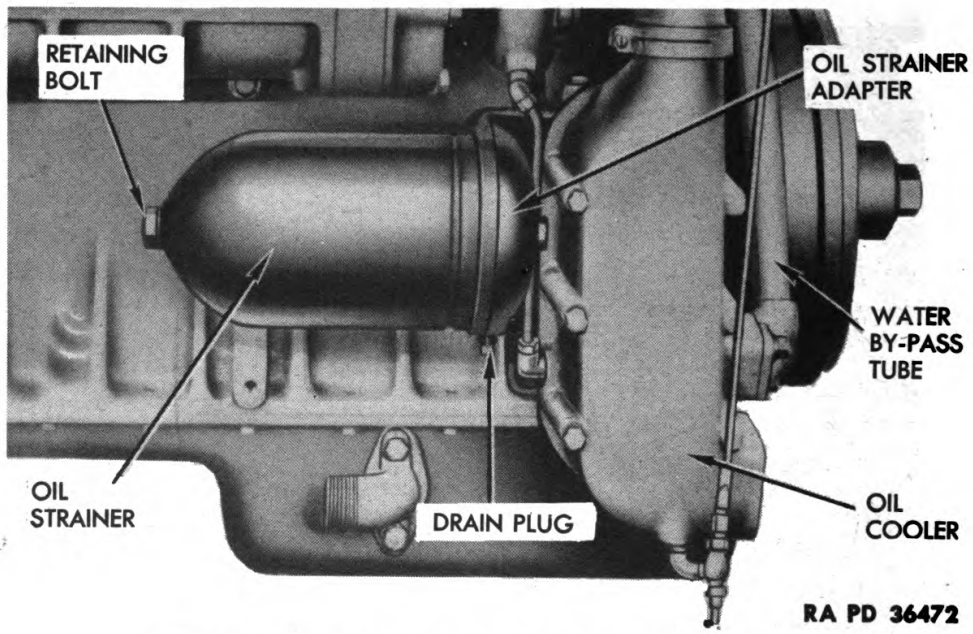

Figure 35—Engine Lubricating Oil Strainer

d. Installation of Lubricating Oil Tank. Install oil tank by reversing the removal procedure. See that spacer in back of tank at top and spacer underneath the tank are correctly positioned. Use new gaskets on both oil tank to oil pan hose elbows and position gaskets with raised edges against oil pan. Fill tank with lubricating oil (par. 56 **b**).

58. ENGINE LUBRICATING OIL STRAINERS.

a. Description. The oil strainer mounted on the oil cooler adapter on each engine (fig. 35) strains carbon particles and dirt out of the oil drawn from the supply tank before it is pumped through the engine oiling system (fig. 34). Oil enters around the outside of the element, is strained through a fine mesh screen and from the inside of the strainer element the oil flows into the oil cooler (fig. 36).

b. Removal of Oil Strainer. Remove engine compartment floor plates and drain lubricating oil tank (par. 55). Remove bolts which attach engine oil outlet hose elbow at side of oil pan to provide clearance to lower the oil strainer. Remove oil strainer drain plug in oil cooler adapter (fig. 36). Unscrew hexagon head retainer at tapered end of strainer housing and pull housing out of oil cooler adapter and remove strainer element.

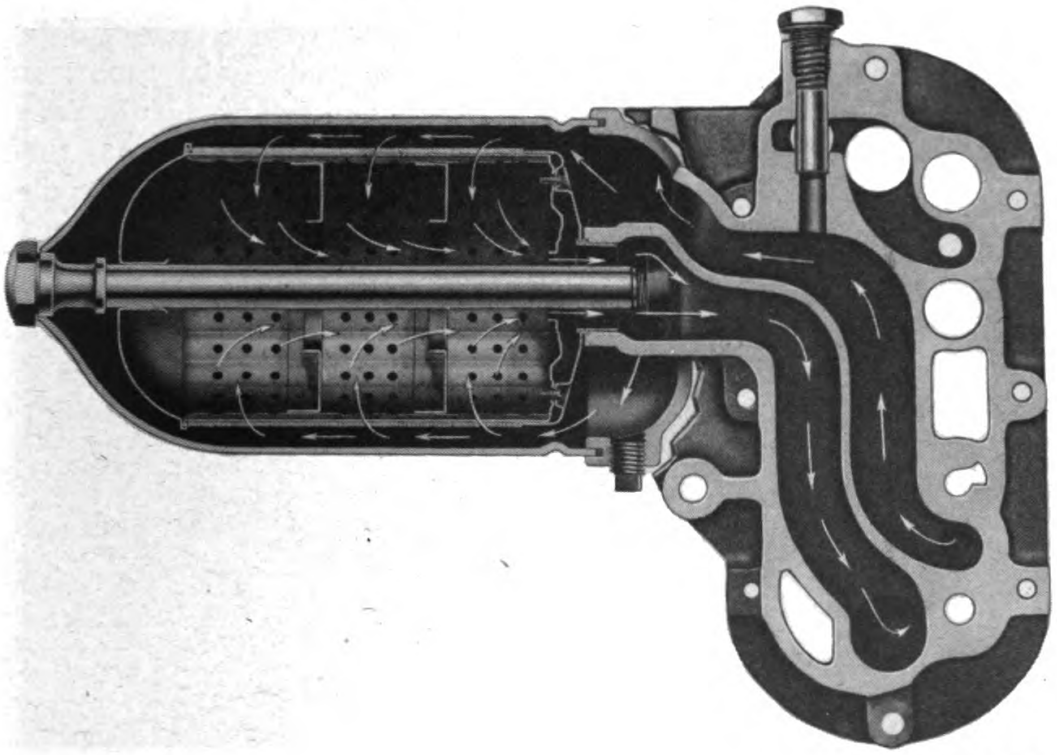

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Figure 36—Sectional View of Oil Strainer and Oil Cooler Adapter

c. Cleaning Oil Strainer. Wash strainer element clean in Diesel fuel. Use bristle brush if necessary but with caution to avoid damaging wire mesh. Remove sludge from oil cooler adapter and inside of housing. Wash housing and retainer clean in Diesel fuel. Install drain plug in oil cooler adapter, and tighten.

d. Installation of Oil Strainer. Examine condition of large gasket in the oil cooler adapter housing, and replace if necessary. Enter the tubular end of strainer element in hole in the oil cooler adapter, and push element in as far as possible. Install new gasket on retainer, and insert in housing. Position the housing in oil cooler adapter, and screw retainer in until gaskets are firmly compressed. Position new outlet elbow gasket on engine oil pan with raised edges against oil pan. Attach outlet elbow, and tighten bolts. Fill lubricating oil tank (par. 56 b). Start engine, and inspect for oil leaks.

59. ENGINE LUBRICATING OIL COOLERS.

a. Description. The oil cooler on each engine serves a dual purpose. It cools the hot engine oil when air temperature is high, and heats the cold oil during engine warm-up period and when the air temperature is low (fig. 45). The oil is forced through a multiple plate cooling unit which is surrounded by the cooling liquid circulating through the engine.

b. Removal of Oil Cooler. Drain cooling system (par. 103 **b**). Remove oil strainer (par. 58 **b**). Disconnect water inlet tube from cooler by removing two bolts in the lower flange on the cooler housing. Remove two bolts which hold the flange of the water bypass tube to the cooler. Loosen water pump inlet seal clamp at top of cooler

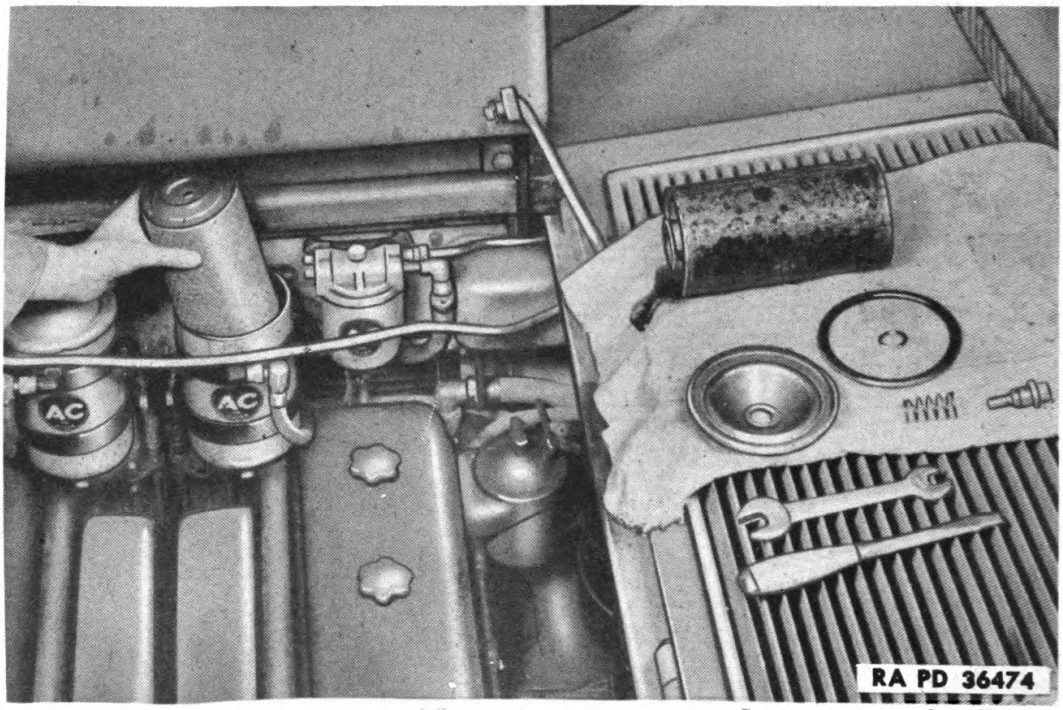

Figure 37—Replacing Engine Lubricating Oil Filter Element

and slide seal and clamp up on elbow. Disconnect water pump drain tube at water pump and cooler housing and carefully remove so as not to bend tube. Remove clip which holds water drain valve rod, remove cotter pin and rod. Unscrew drain valve with nipple and remove elbow. On the engine side of the oil cooler adapter, remove two bolts, one at top and one at bottom, which are screwed into the cooler housing. Remove six cooler housing bolts, holding the oil cooler housing in position while the last two bolts are removed. If cooler housing sticks to the adapter, tap lightly with a mallet. Withdraw cooler housing with care so the oil cooler unit will not drop out.

c. Installation of Oil Cooler. Remove old gaskets, and clean all surfaces. Replace water pump inlet seal, sliding the new seal up on water pump elbow and flush with lower edge. Cement new gasket to oil cooler housing, and install the oil cooler assembly in the housing. Cement new gasket to exposed flange of oil cooler assembly. Position the oil cooler housing on the adapter, and assemble by reversing the removal procedure.

60. ENGINE LUBRICATING OIL FILTERS.

a. Description. Two lubricating oil filters, one for each engine, are mounted at the center of the filter panel (fig. 69). Filter elements must be replaced whenever engine oil is changed to help keep the oil clean.

b. Replacing Engine Lubricating Oil Filter Element. Unscrew retainer nut, remove gasket and cover. Lift out spring and element. Place suitable container under filter to catch oil and remove drain plug. Wipe inside of filter shell clean with cloth soaked in Diesel fuel. Install and tighten drain plug. Install new element, and position the spring (fig. 37). Remove old cover gasket, and install new gasket. Position cover and new retainer nut gasket. Screw retainer nut on, and tighten it. Start engine, and inspect for leaks.

c. Removal of Engine Lubricating Oil Filter. Open engine compartment doors, raise and lock splash panel. Place suitable container under filter to catch oil, and remove drain plug. Disconnect inlet hose from elbow on side, near top (fig. 37). Remove elbow from oil filter shell. Install and tighten drain plug. Remove four bolts and washers attaching filter to filter panel. Lay filter on engine. Disconnect outlet hose from elbow at bottom of shell, and remove elbow from filter.

d. Installation of Engine Lubricating Oil Filter. Screw outlet elbow tightly into filter shell at bottom in correct position. Attach outlet hose and tighten. Hold filter in position on filter panel, and install the four attaching bolts with washers and tighten bolts. Install and tighten inlet elbow in correct position in filter shell on side near top. Attach inlet hose and tighten. Start engine and examine for leaks. Stop engines. Lower splash guard, and hook in place. Close and bolt engine compartment doors.

61. ENGINE LUBRICATING OIL PRESSURE GAGES AND WARNING LIGHTS.

a. See paragraph 201 for information on engine lubricating oil pressure gages. Information on low oil pressure warning lights is given in paragraph 193 and for low oil pressure switches in paragraph 206.

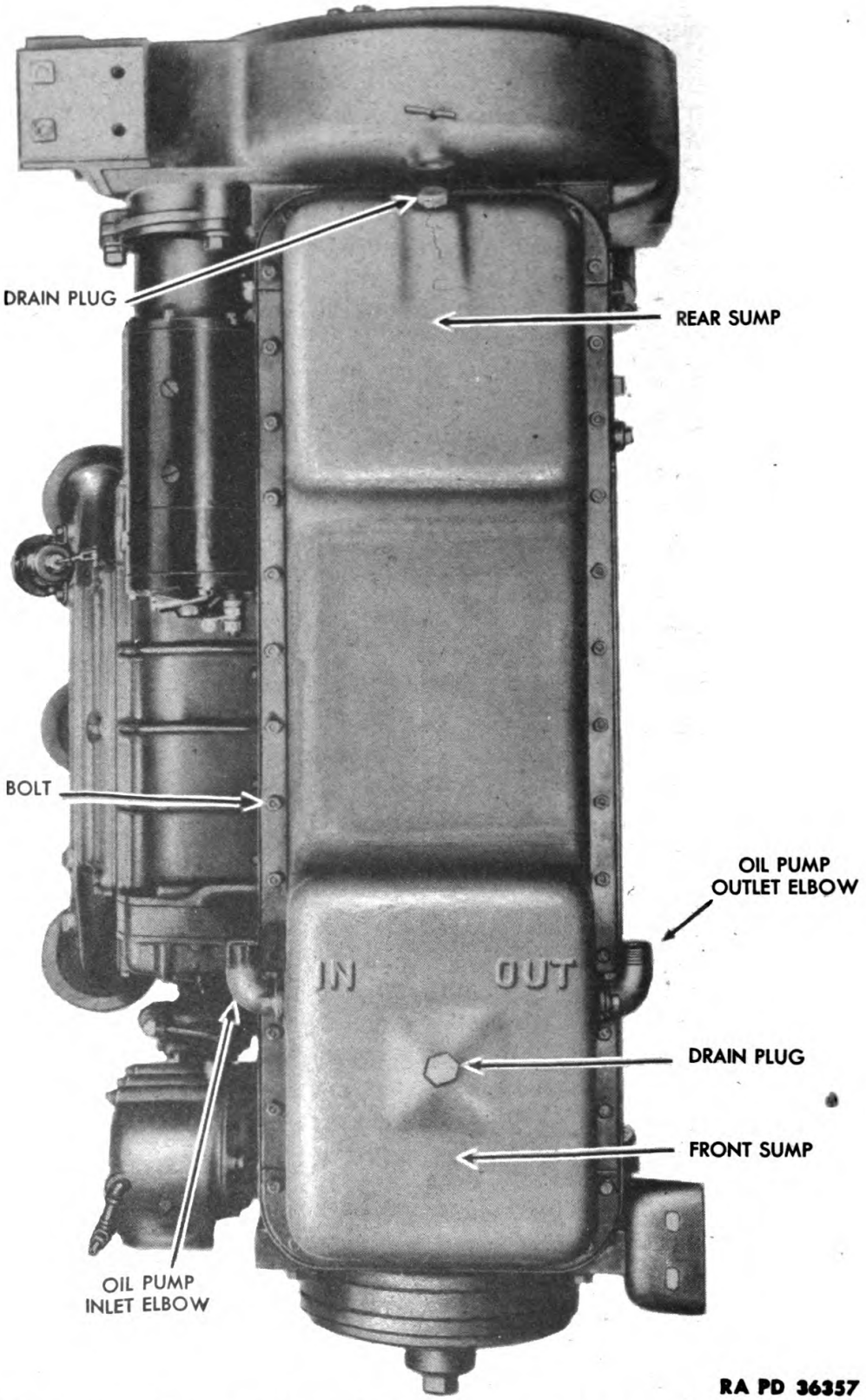

Figure 38—Bottom View of Engine Oil Pan (Dry Sump Engine)

POWER UNIT

62. ENGINE OIL PANS.

a. Description. A pressed steel oil pan with deep sumps, front and rear, is bolted to the crankcase of each engine (fig. 38). Supply and return connections from the oil supply tanks in the engine compartment are attached at sides of the oil pans.

63. ENGINE LUBRICATING OIL PUMP ASSEMBLIES.

a. Description. The oil pump assembly, located in the bottom of the engine crankcase, consists of three gear-type oil pumps, all driven by the same pump drive shaft. The pressure pump section of the assembly draws oil from the supply tank and forces it through the entire engine oiling system. The other two pumps are scavenging pumps which pump oil out of the two sumps in the oil pan and return it to the supply tank. The center pump draws oil out of the sump beneath the oil pump assembly. The end pump scavenges the sump at the flywheel end of the oil pan.

64. ENGINE LUBRICATING OIL PRESSURE REGULATOR VALVE.

a. Description. The oil pressure regulator valve is bolted to the bottom face of the engine block, inside the oil pan at flywheel end. If pressure in the main oil gallery exceeds 45 pounds per square inch, the regulator valve opens permitting oil to flow directly into the oil pan.

65. CRANKCASE VENTILATION.

a. Description. The engine ventilating system removes water and other vapors from the crankcase, timing gear case, and valve compartment. The condensation of water vapor helps form sludge. In cold weather the sludge freezes and this could block the circulation of the oil. Other vapors condense and form corrosive acids which are harmful to engine parts. A low pressure is maintained in the crankcase by slight leakage of air from the air box past the lower piston rings. From the crankcase the air and vapors pass through the gear train housing into and through the valve compartment and are removed at the governor control housing which is vented by a tube extending nearly to engine compartment floor.

66. ENGINE LUBRICATING OIL LINES.

a. Description. Flexible hoses instead of steel tubes are used where flexing is required in performing maintenance operations or where rigid tubes would be subject to considerable vibration. Brazed steel tubing is used for the more rigid installations (fig. 39).

b. Removal and Installation of Oil Lines. When loosening or tightening the compression fitting on the ends of the tubes or hoses,

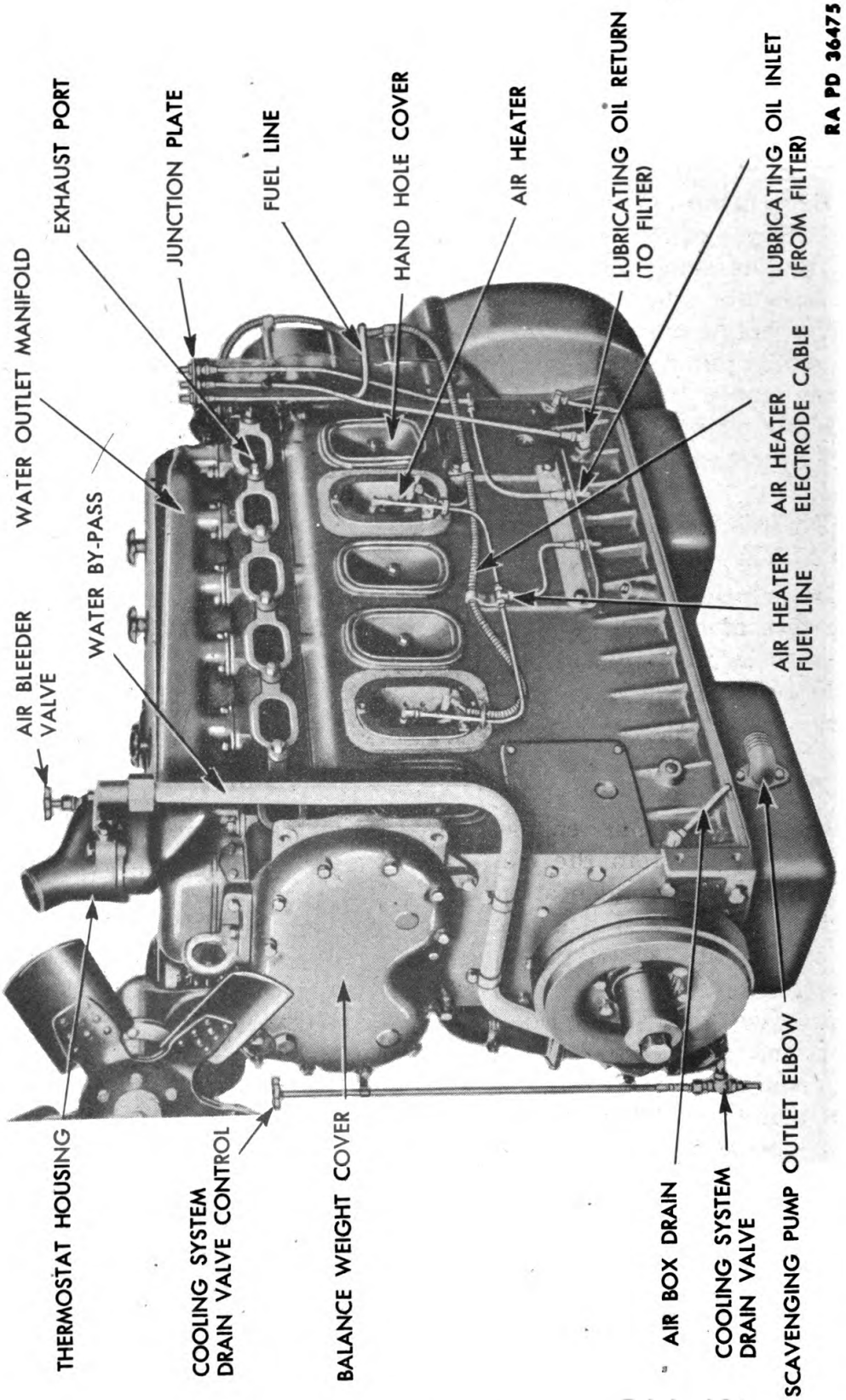

Figure 39—Inner Side of Left Engine

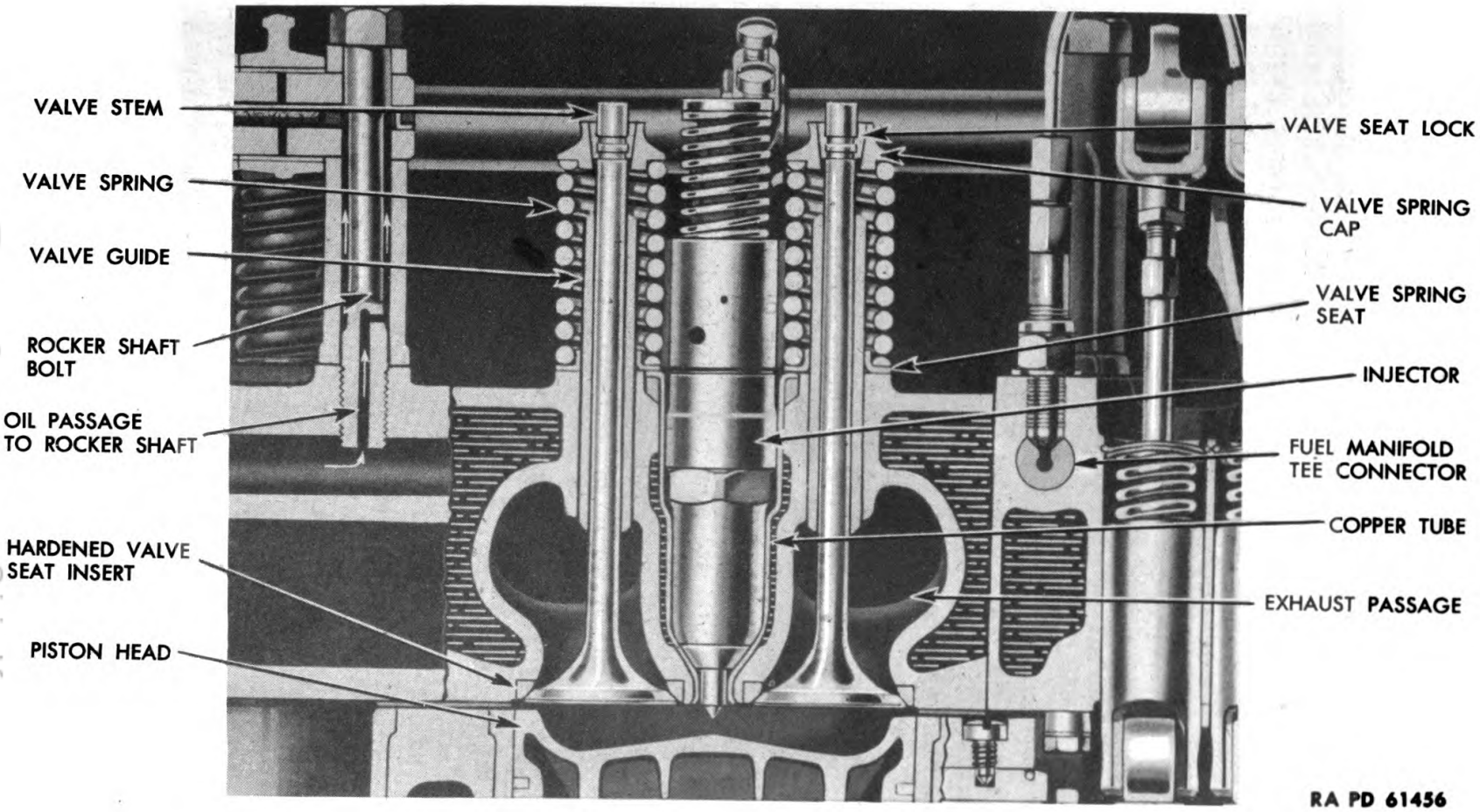

Figure 40—Sectional View of Cylinder Head Showing Injector and Exhaust Valves

hold the nipple, elbow or bushing from turning. Use tight fitting end wrenches to prevent rounding the corners on the connections. Protect the open fittings and ends of the disconnected lines with tape to prevent dirt from entering lubricating system or lines or getting into the threads on the fittings. Avoid bending the steel lines to provide access to other units by removing the line where practical. Before installation make sure the threads and packing glands are clean and free of dirt particles. Spring the tubes or bend the hoses to start the threads squarely to avoid cross threading. Use sufficient pressure when tightening connections to prevent leaks, but avoid overstressing the threads or connections.

c. Replacement of Oil Lines. Replace all damaged hoses as complete prefabricated assemblies. Tape may be used to effect temporary emergency repairs but is short-lived and may soon leak, and cause loss of oil. When possible, replace steel tubing with preformed tube assemblies. When necessary to make replacement from bulk lengths, first measure the developed length of the tube to be replaced. Cut the new tube of sufficient length to allow for bends. Use extreme care in bending new tubing to avoid kinking. In many cases bends can be made with a larger radius than used in forming the original tube. After the tube is fitted, dress both ends off squarely with a file. Remove burs on inside and outside of tube. Place the correct compression fittings or packing glands on each end of the tube. The ends of the tube are now ready to be double lap flared if this type of connection was originally used. The fuel line flaring tool (41-T-3140) is used to duplicate the original double lap flare. Follow specific instructions in the lid of the tool box.

67. FUEL INJECTION SYSTEM.

a. Description. Diesel fuel is supplied to the cylinders by a direct injection system with an injector mounted between the two exhaust valves in each cylinder (fig. 40). The injectors are operated by rocker arms similar to the exhaust valve rocker arms and actuated by push rods operated by the same camshaft. For the method of supplying fuel to the injectors refer to paragraph 87 **b**. The amount of fuel supplied to the cylinders is controlled by linking all six injector racks to levers on a single control tube (fig. 43). The control tube on each engine is connected, through a governor, to the throttle linkage and the speed of the engines is controlled by the single throttle or by the accelerator.

68. FUEL INJECTORS.

a. Description (fig. 41). The fuel injectors force accurately measured quantities of Diesel fuel into the cylinders under tremendous pressure at precisely the right time for the cylinders to fire.

POWER UNIT

The fuel is injected through small holes in the injector tip in finely atomized spray for instant combustion. The injector plunger has a helical groove near the lower end and a gear near the upper end which meshes with the teeth in the injector rack. Moving the rack

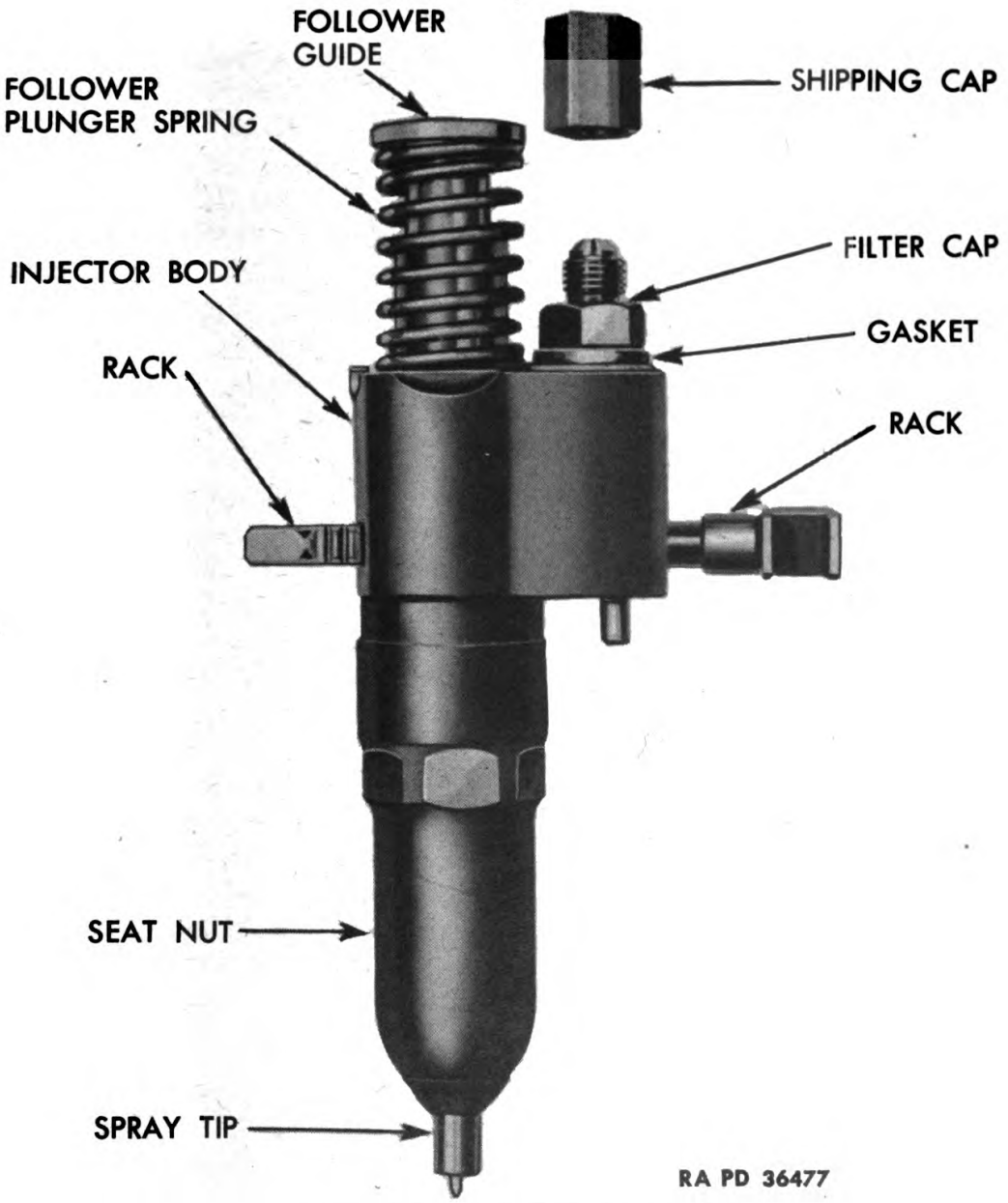

Figure 41—Fuel Injector

in or out changes the position of the helical groove in relation to the fuel ports in the injector plunger bushing and thus accurately controls the amount of fuel injected at each stroke. The maximum amount of fuel is injected when the control lever end of the rack is pushed into the injector body as far as possible. When the rack is

pulled all the way out no fuel is injected. The old type injector, with spherical check valve, identified by the letter M stamped in the body is being reworked, when overhauled, or replaced by the later type injector, with flat type check valve, identified by a small green enameled label with "Figure 80" pressed into the body of the injector. If the injector has a spray tip marked "7-006-155-0" it has the flat type check valve.

b. Testing Fuel Injectors. With engines stopped, place throttle in "IDLING" position and turn the fuel tank selector valve to LH or RH. Lock out both clutches. Remove rocker arm cover (par. 82 **b**). Start the test on the cylinders which have both exhaust valves closed. With a heavy screwdriver press down on the injector follower until the injector "pops." If the injector has a sharp, firm "pop," and produces a slight chirping noise it is probably in good condition. The later type injectors with the small green label will "pop" with much less effort and without the chirping sound. Crank the engine as required to close the exhaust valves in the other cylinders and complete the test. Replace any injectors that are unusually weak or fail to "pop." A small accumulation of carbon on the tip is normal, and does not denote a faulty injector. As a further check, which should be made on all cylinders, start and run the engine at idling speed. Hold down on the injector follower with a screwdriver to shut off the injector. If there is no change in the operation of the engine it is a further indication that the injector is not firing. Also completely loosen both adjusting nuts so the injector rack can be moved freely in and out. Hold the rack all the way in. This cylinder should then fire with a sharp loud fuel knock. If the injector in the cylinder being tested was found to be normal by the "popping" test and fails to fire with the injector rack all the way in, it indicates that the trouble is probably due to loss of compression caused by faulty valves, piston, rings or improper valve adjustment. Replace any defective injectors (par. 68 **f**). Correct the injector rack setting (par. 71 **b**) and if this is not the cause of the trouble refer to Trouble Shooting, Power Unit (par. 44 **b**). After injectors have been tested install the rocker arm cover (par. 82 **e**).

c. Timing Fuel Injector. Remove rocker arm cover (par. 82 **b**). Make sure throttle is in "NO FUEL" position. Crank engine with starter until exhaust valves in cylinder whose injector is being timed are fully open. Place injector timing gage (41-G-198-50) in timing gage hole in the top of the injector body, with shoulder on gage stem seated on injector body, and with one of the two milled flats on gage facing the injector follower guide (fig. 42). Use wrench to hold push rod from turning and loosen lock nut with push rod lock nut wrench (41-W-1986-200). Screw the push rod to adjust it so that when shoulder on gage stem is seated on injector body the bottom face of

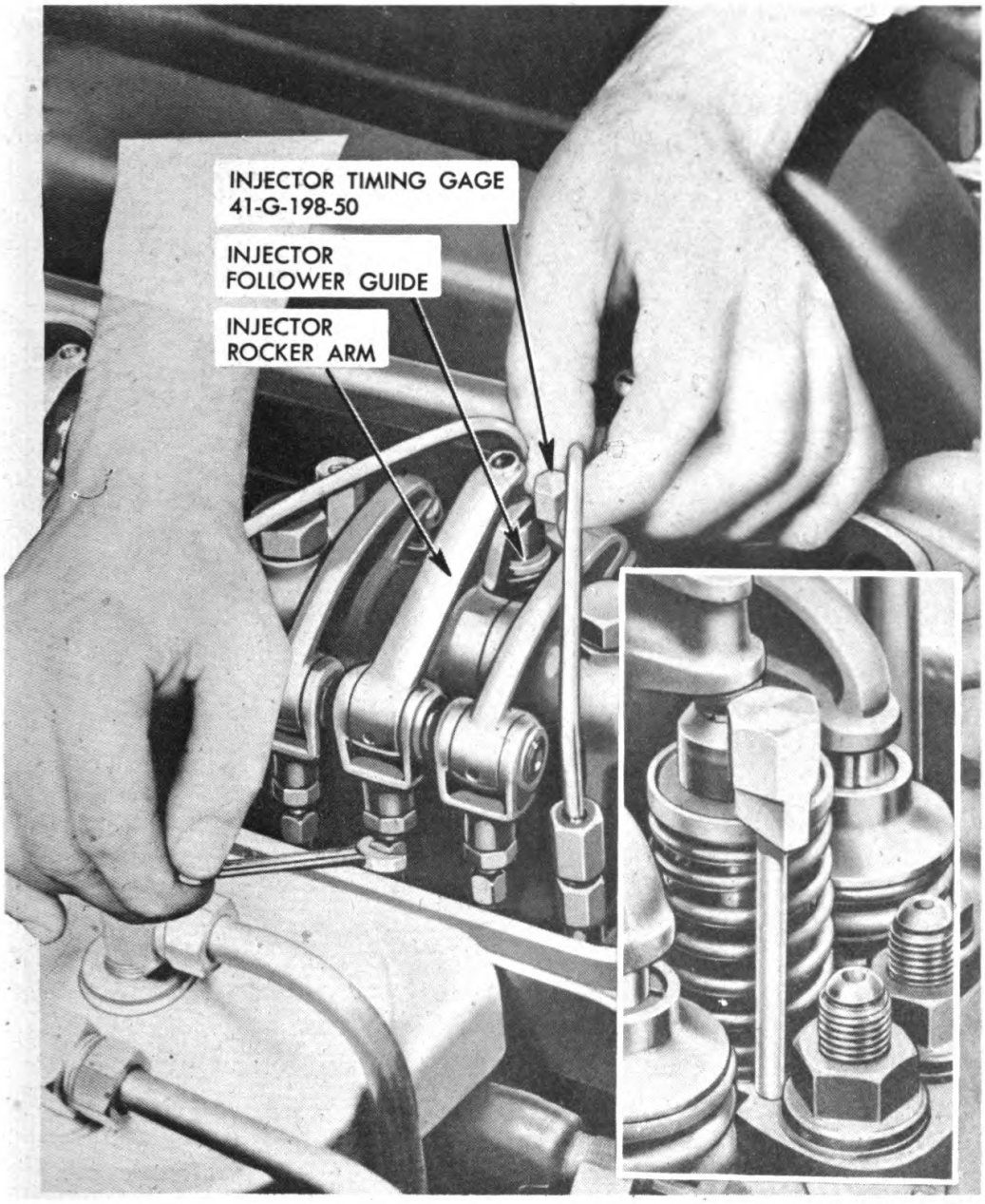

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Figure 42—Timing Fuel Injector—Inset Shows Injector Timing Gage (41-G-198-50) in the Checking Position

head on timing gage, when rotated, will just pass over the surface of the injector follower guide with no perceptible clearance (fig. 42). Tighten lock nut on push rod, and again check the setting with the timing gage. Repeat the above operations to time each injector. Install rocker arm cover (par. 82 c).

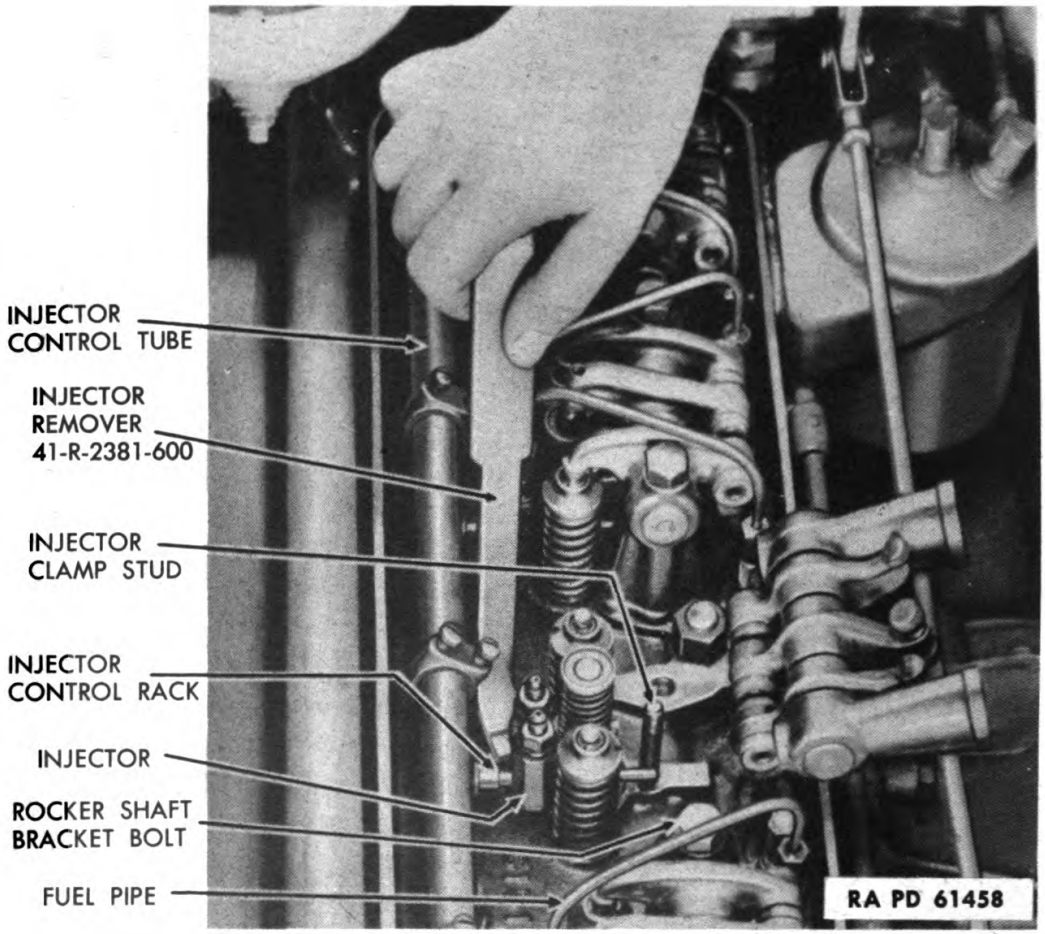

Figure 43—Removing Fuel Injector

d. Removal of Fuel Injector. Turn tank selector valve to "OFF". Remove rocker arm cover (par. 82 b). Disconnect both fuel lines from injector. Loosen fittings on fuel connectors and move fuel lines outward to clear the rocker arm shaft. CAUTION: *Cover the fuel feed openings on the injector with shipping caps if available, or with tape, to prevent dirt entering injector.* Loosen both rocker arm shaft bracket bolts evenly until they are free of cylinder head. Tip rocker arms and shaft over toward outside of engine. Remove nut, washer and injector clamp from hold-down stud. With injector remover (41-R-2381-600) pry injector up evenly while guiding rack over end of rack control lever (fig. 44). Remove injector and cover hole in cylinder head.

e. Inspection of Fuel Injector. Should a visual inspection reveal a burned injector tip, clogged holes, excessive wear or any other defect, replace the injector. If one or more injector tips have been burned due to a runaway engine, all the other tips will have enlarged holes or be weakened and the injectors should be replaced. All the injectors in any single engine should be of the same type unless in an emergency it is necessary to temporarily mix the two types which will cause a noticeable difference in power and performance at higher speeds and make it difficult to tune the engine. The injector rack must move freely in and out without excessive play. Blow-by or leaks around the injector body must be referred to higher authority as it may be necessary to replace the cylinder head assembly.

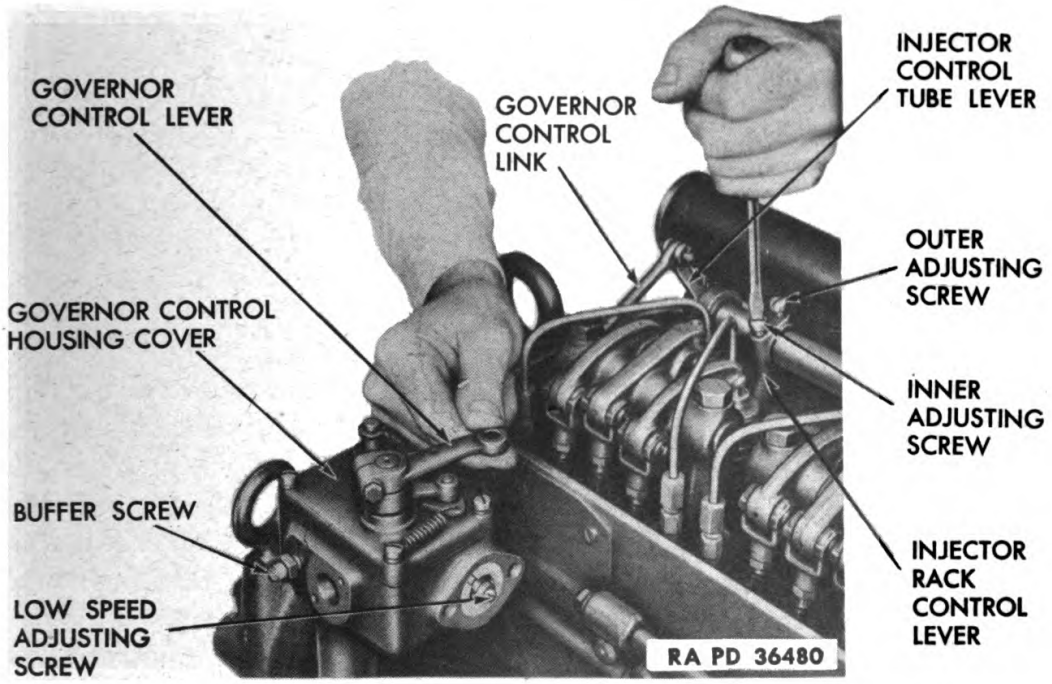

Figure 44—Positioning Injector Rack

f. Installation of Fuel Injector. Make certain the body nut of the injector to be installed and the copper injector hole tube are perfectly clean. Remove covering from injector hole. Insert injector in tube and position body so dowel pin in bottom of injector body enters hole in top of cylinder head and lightly tap injector into place while guiding injector rack over end of control lever. Install injector clamp, special washer and nut on hold-down stud and tighten nut, using not more than 25 foot-pounds pull on torque wrench. CAUTION: *Tightening the injector hold-down clamp more than the recommended amount can cause faulty injector operation.* Position rocker arm assembly, and tighten bracket bolts evenly so as not to spring the push rods. Remove caps or covering from injector fuel

line fittings. Connect both fuel pipes to injector and tighten fittings at injector and fuel connectors. CAUTION: *All fuel connections must be tight to prevent damage to engine resulting from Diesel fuel leaking into the crankcase and diluting the lubricating oil.* Position injector rack control lever (par. 68 g). Time the injector that was installed (par. 68 c). Start engine and warm up to 100°F and while engine is running inspect all fuel connections for leaks. Adjust exhaust valves on cylinder in which injector was installed (par. 83). Install rocker arm cover (par. 82 c).

g. Positioning Injector Rack. The following procedure covers the positioning of a single injector rack control lever when only one injector has been removed and installed in the engine. When more than one injector has been removed and installed, follow the procedure given in paragraph 71 b. Remove rocker arm cover (par. 82 b). Disconnect throttle lever link from governor control lever. Push against and hold the governor control lever to position the injector racks all the way in which is the "FULL FUEL" position. Slightly loosen both adjusting screws on top of injector rack control lever which operates the injector that was replaced. Screw down the inner adjusting screw, the one nearest rocker arms, until the injector rack moves in and strikes bottom and the other racks just start to move out (fig. 44). Next, tighten the outer adjusting screw on injector control tube lever, then lock the inner screw. After positioning the rack control lever, check to see that no other rack has moved out. This can be done by prying inward on each of the other injector racks with the tip of a screwdriver using the control tube as a fulcrum. If any of the injector racks can be moved in, the end of the lever being positioned was set too far toward the injector and must be readjusted by backing off on the inner adjusting screw and tightening the outer adjusting screw. Shoulders on all injector racks must extend approximately 7/8-inch away from injector bodies when governor control lever is held in the "NO FUEL" position and injector control tube lever is pushed down beyond its "NO FUEL" position (fig. 44). Connect throttle lever link to governor control lever.

69. INJECTOR CONTROL TUBES.

a. Description. The injector control tube is mounted on ball bearings in two control tube brackets, one at each end (fig. 45). The six rack control levers on each control tube which are linked to the injector racks are individually adjustable so that the rack setting for each injector can be adjusted independently of the others. A coil spring placed over the lever end of the control tube maintains a twisting force on the tube to hold the injector racks in "NO FUEL" position, unless the throttle is positioned otherwise. The injector control tube is operated by the control tube lever, at fan end of tube, which is linked to the governor control lever.

b. Removal of Injector Control Tube. Remove rocker arm cover (par. 82 **b**). Pull out cotter pin, and remove clevis pin and disconnect injector control tube link at injector control tube lever. Remove two bolts which attach each control tube bracket to cylinder head and lift out control tube and bracket assembly (fig. 45).

c. Disassembly of Injector Control Tube. If the control tube is to be replaced, the injector rack control levers must be taken off the tube removed and installed on the new tube. Slide bracket off

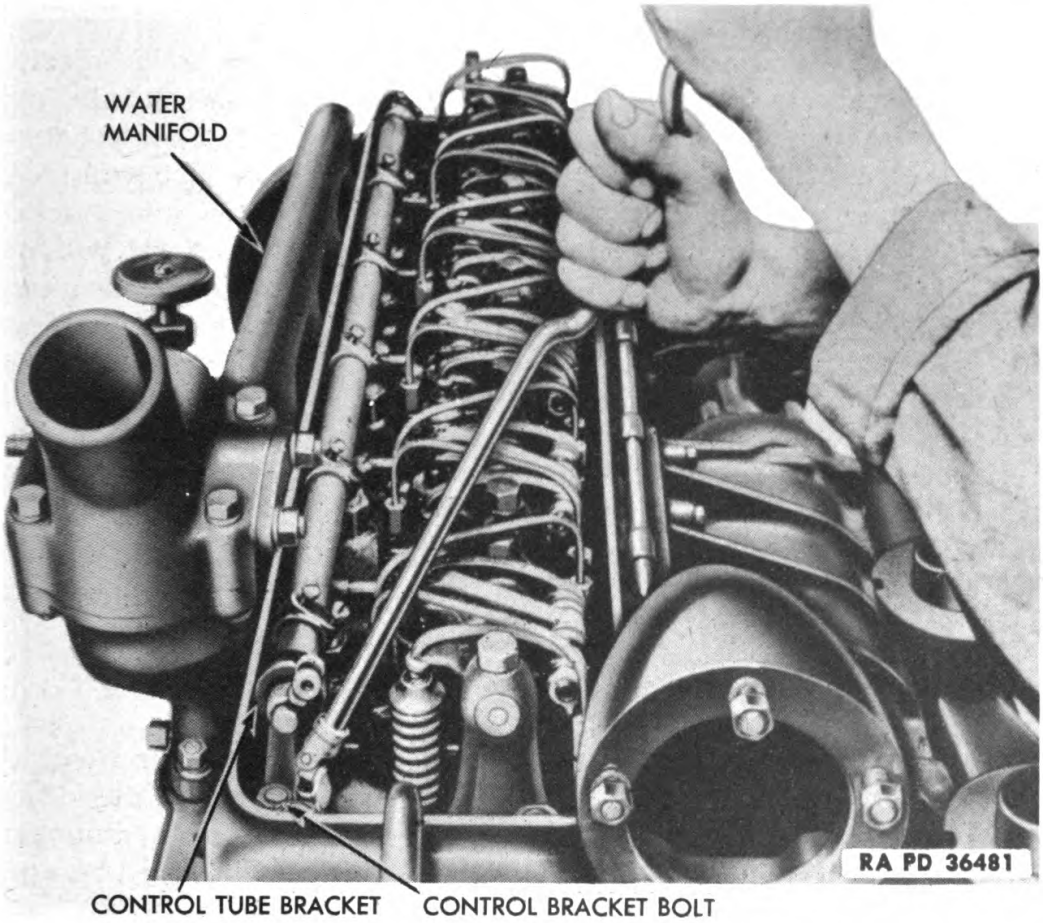

Figure 45—Removing Injector Control Tube

end of tube opposite control lever end. Unscrew the adjusting screws on top of each injector rack lever sufficiently to permit levers to slide but do not remove screws. Slide the levers, return spring and tube bracket off the tube. Remove bearing from each control tube bracket by tapping on bearing outer race.

d. Inspection of Injector Control Tube Parts. Clean and carefully inspect bearings and test for excessive play. Replace rough or worn bearings.

e. Assembly of Injector Control Tube. Install bearing in each control tube bracket by tapping on outer race. Slide bracket with

bearing over tube and against control tube lever with foot on bracket facing control tube lever. Position spring over tube and against bracket with long end of spring away from bracket. Slide levers on tube, one at a time, so that ends of levers will extend toward the injectors when assembly is installed on the cylinder head. Center the levers over the adjusting screw notches in shaft and move back and forth while turning down adjusting screws to make sure that screws enter the notches in tube. Do not tighten adjusting screws. Install other control tube bracket with foot extending toward flywheel end of engine.

f. Installation of Injector Control Tube. Work each injector rack in and out to make sure it works freely. Lower control tube and bracket assembly into position. Beginning at one end of control tube move each injector rack as required to engage each rack control lever in notch in rack. Install bolts with lock washers in control tube bracket bolts. Operate control tube by hand while tightening bracket bolts to make sure that there is no binding of control tube in the bearings after bracket bolts are tight. Pull on end of control tube return spring, and hook it over the adjacent rack control lever. Connect injector control tube link to injector control tube lever with clevis pin. Insert and spread cotter pin. After the control tube has been installed, it may be necessary to loosen the control lever adjusting screws slightly to permit shifting the levers on the tube. Each lever must be perfectly alined with its injector rack so as not to bind the rack. Adjust the fuel injector rack control levers (par. 71 **c**). Install rocker arm cover (par. 82 **c**).

70. GOVERNORS.

a. Description. Each engine is equipped with a spring and weight type mechanical governor (fig. 32). The governor controls the idling speed of the engine up to approximately 400 revolutions per minute and limits the maximum speed. The governor shaft is splined to, and driven by the blower upper rotor shaft.

b. Removal of Governor. The governor usually is removed as two subassemblies—the governor control housing and the governor weight housing. If their removal or adjustment is necessary, notify higher authority.

71. INJECTOR RACK ADJUSTMENTS.

a. Importance of Accurate Adjustments. The governor and injector racks must be accurately adjusted to obtain correct engine performance and maximum power output. Each fuel injector rack control lever must be accurately adjusted to position all injector racks uniformly so that equal power will be developed in each cylinder, and the positioning of the racks will be correct in relationship to the gov-

ernor. All adjustments must be made in the order given in the following procedure.

b. Adjustment of Fuel Injector Rack Control Levers.

(1) ADJUST RACK CONTROL LEVER FOR INJECTOR IN NO. 1 CYLINDER. Back off several turns on both adjusting screws on top of each injector rack control lever. CAUTION: *Examine the end of each rack control lever to see that face of boss does not touch the side of rack and bind the rack.* Tap the lever slightly to move it on control tube to provide sufficient operating clearance. Adjust rack control lever for injector in No. 1 cylinder, the one closest to the governor, as follows: Push against and hold the governor control lever to position the injector racks all the way in which is the "FULL FUEL" position. Screw down the inner adjusting screw, the one nearest the injector, on rack control lever and watch the idle adjusting screw which will move outward slightly when a definite increase is felt in the effort required to turn the control lever adjusting screw. Back off $\frac{1}{3}$ turn on the inner adjusting screw. Turn down the outer adjusting screw to lock, then lock the inner screw.

(2) CHECK ADJUSTMENT OF RACK CONTROL LEVER FOR INJECTOR IN NO. 1 CYLINDER. To check the rack control lever adjustment see that the governor control lever moves smoothly from idle to "FULL FUEL" position which is where the cam lever pin is at extreme end of slot farthest from control cam pivot. If suddenly increased effort is required to move the governor control lever as it nears the end of its travel, the rack control lever operating the injector in No. 1 cylinder is positioned too far toward the injector. Correct the rack control lever position, if necessary, by backing off slightly on inner adjusting screw and tightening the outer adjusting screw to lock. Recheck by again moving governor control lever from idle to "FULL FUEL" position. Next hold the governor control lever in "FULL FUEL" position with one hand and push down firmly on the injector control tube lever with the other hand. The rack on injector in No. 1 cylinder must move slightly outward ($\frac{1}{64}$ to $\frac{1}{32}$ inch) before an increase in force is required and before the idle adjusting screw on the governor housing begins to move outward. If the rack moves out more than $\frac{1}{32}$ inch, back off slightly on the rack control lever outer adjusting screw and tighten the inner screw to lock.

(3) ADJUST RACK CONTROL LEVERS FOR INJECTORS IN OTHER CYLINDERS. Pull injector control tube lever up to hold rack for injector in No. 1 cylinder all the way in "FULL FUEL" position and adjust rack control lever for injector in No. 2 cylinder by slowly turning the inner adjusting screw only until the injector rack moves in and is felt to "strike bottom" but does not cause perceptible outward movement of rack in injector in No. 1 cylinder. This method is used to insure uniform setting of all racks. Then tighten outer screw,

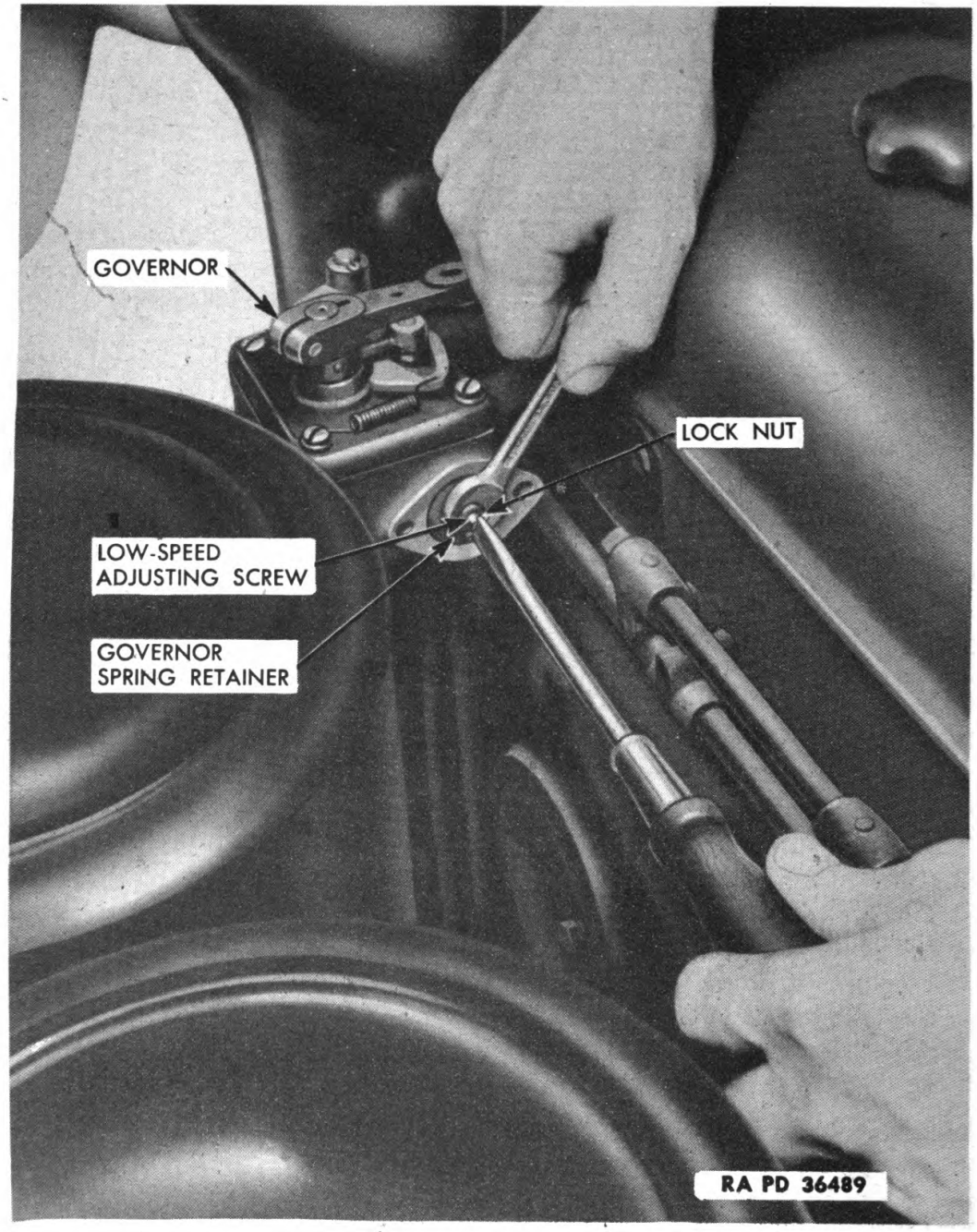

Figure 46—Adjusting Engine Idling Speed

and lock inner screw. Using the same procedure, adjust each of the remaining four rack control levers in turn always watching that rack in injector for No. 1 cylinder does not move outward when each rack control lever is being adjusted.

(4) CHECK "NO FUEL" POSITION OF INJECTOR RACKS. Hold the governor control lever in "NO FUEL" position. Watch the position of the injector racks and push down on the injector control tube lever. The racks must move outward $\frac{3}{16}$ of an inch and in this position the distance from the shoulder on the rack to the injector body must be approximately $\frac{7}{8}$ inch. Attach throttle control link to governor control lever, and hook retracting spring in position.

(5) ADJUST ENGINE IDLING SPEED. Loosen lock nut and back out the buffer screw on outer side of governor housing (fig. 46) until it projects $\frac{5}{8}$-inch from governor housing. Start engine and run at 800 to 1,000 revolutions per minute to warm to operating temperature. Set throttle in "IDLING" position. See that pin on governor cam lever is in idling notch in slot in control cam on governor housing. If engine runs unevenly or "rolls" when thoroughly warm, gradually turn buffer screw in until engine runs smoothly, or nearly so. Then turn the idle adjusting screw as required to obtain an average idling speed of 400 to 450 revolutions per minute and tighten lock nut. Reset buffer screw, if necessary, to bring the idle roll to a minimum. Do not turn buffer screw to increase idling speed more than 20 revolutions per minute or it may not be possible to stop the engine with the throttle. Tighten buffer screw lock nut (fig. 44).

(6) INSTALL ROCKER ARM COVER. Follow procedure in paragraph 82 **c** and install rocker arm cover.

72. THROTTLE AND ACCELERATOR LINKAGE ADJUSTMENT.

a. Description of Throttle and Accelerator Linkage Adjustment. The Diesel engines are stopped by moving the throttle into "NO FUEL" position. Therefore maximum travel is provided to move the governor control lever into "NO FUEL" position. A complete adjustment of the throttle and accelerator linkage must be made whenever it has been disassembled to make other repairs or when linkage parts are replaced, or when noticeable slack has developed in the linkage (fig. 47). In such cases only a major linkage adjustment will insure that all the rods and cables are adjusted to proper length to correctly position all levers when the throttle lever is in "NO FUEL" position. It is important that the adjustments be made in the order given.

b. Before Adjustment Procedure. Raise driver's and assistant driver's seats to uppermost position, or if additional working space is desired, remove driver's seat (par. 173 **b**). Remove covers from front and rear ends of propeller shaft housing (par. 123). Remove

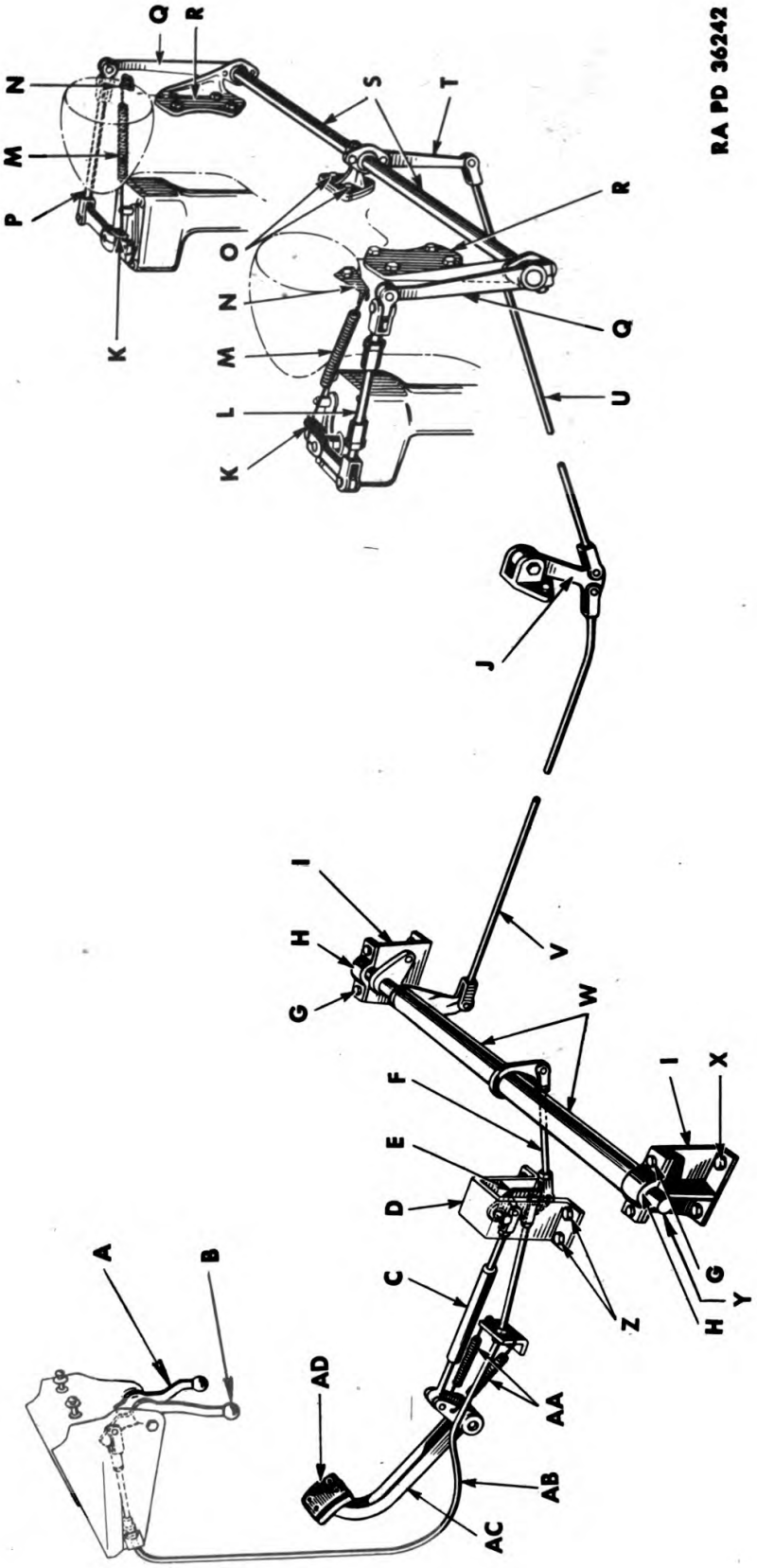

Figure 47—Throttle and Accelerator Linkage

A—THROTTLE LOCK
B—THROTTLE
C—THROTTLE CONTROL CYLINDER ASSEMBLY
D—THROTTLE CONTROL JUNCTION LEVER BRACKET
E—THROTTLE CONTROL JUNCTION LEVER
F—THROTTLE CONTROL LINKING ROD
G—BOLT
H—CLUTCH IDLER BRACKET CAP
I—CLUTCH IDLER SHAFT BRACKET
J—THROTTLE CONTROL ROD IDLER LEVER AND BRACKET ASSEMBLY
K—RETRACTING SPRING CLIP
L—THROTTLE ADJUSTABLE LINK ROD
M—GOVERNOR LEVER RETRACTING SPRING
N—GOVERNOR LEVER RETRACTING SPRING BRACKET
O—BOLTS
P—THROTTLE LINK ROD—FIXED
Q—ENGINE CROSS SHAFT GOVERNOR LEVER
R—ENGINE CROSS SHAFT BRACKET
S—ENGINE CROSS SHAFT ASSEMBLY
T—ENGINE CROSS SHAFT CENTER LEVER
U—THROTTLE CONTROL ROD ASSEMBLY—REAR
V—THROTTLE CONTROL ROD ASSEMBLY—FRONT
W—THROTTLE IDLER SHAFT ASSEMBLY
X—BOLT
Y—CLUTCH IDLER SHAFT
Z—BOLTS
AA—ACCELERATOR PEDAL RETRACTING SPRINGS
AB—THROTTLE CONTROL CABLE
AC—ACCELERATOR PEDAL
AD—ACCELERATOR PEDAL PAD

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Legend for Figure 47—Throttle and Accelerator Linkage

driver's seat floor plate (par. 174 b). Unbolt throttle junction lever bracket from hull floor. Remove cotter and clevis pins from throttle cable yoke, accelerator rod clevis and throttle idler shaft connecting rod clevis at junction lever. Temporarily bolt throttle junction lever bracket back into position on hull floor, tightening one bolt on each side. This will permit throttle cables and junction lever to be correctly positioned.

c. Adjust Throttle Lever Cable at Throttle Bracket.

(1) The following procedure applies to vehicles equipped with single throttle controls and to vehicles with dual throttle controls that have been converted to single throttle operation. On dual control linkage the same adjustments must be made on all dual parts in the linkage system.

(2) Pull throttle lever up into "NO FUEL" position and lock. Remove throttle lever housing from bracket on front slope (fig. 17). Adjust throttle lever cable clevis so that threaded end of cable extends 3 full threads inside the clevis. Tighten lock nut. Adjust position of throttle lever cable conduit in cable mounting bracket to provide at least 1/4-inch clearance on single throttle control, and 1/8-inch clearance on converted dual control, between end of cable conduit sleeve and cable clevis lock nut.

(3) Release throttle lock and operate throttle to make sure that low oil pressure indicator light switch operating arm roller is alined with end of throttle lever. See that electrical connections at switch are tight. Adjust position of arm, if necessary, so that the red low oil pressure indicator lights will light when throttle is moved into "IDLING" position. Battery master switch must be on. Return throttle to "NO FUEL" position and lock. Install throttle lever housing on front slope bracket.

d. Connect Throttle Lever Cable to Junction Lever. At junction lever end of cable adjust position of throttle lever cable clevis so threaded end of cable projects 3 full threads inside the clevis. Tighten lock nut. Connect clevis to throttle junction lever in lower slot (fig. 55). On converted dual type, adjust position of throttle lever cable conduit in mounting bracket on hull floor. Cable clevis pin in junction lever must contact rear end of slot in lever when slot is set 1/4-inch in from rear edge of junction lever bracket. On single throttle type adjust lock nuts which hold cable conduit in mounting bracket so cable clevis pin contacts rear end of slot in junction lever when slot projects 1/8 inch beyond rear edge of junction bracket.

e. Position Governor Control Lever. Open engine compartment doors, raise and lock engine splash panel. Disconnect governor control lever adjustable link from left engine governor control lever. Set right engine governor control lever in idling notch in governor control cam. Check position of governor control lever. The centerline of lever

must be parallel with front edge of the governor housing. If necessary to correctly position governor control lever on shaft, remove governor control lever link, disconnect retracting spring, and loosen lever clamp bolt (fig. 47). Then position lever correctly, tighten bolt, and attach spring. Move governor control lever into "NO FUEL" position and attach governor control lever link. On left engine move governor control lever into "NO FUEL" position. Check position of lever and adjust if necessary by following previous procedure for lever on right engine. Adjust link so hole in end of link lines up with hole in governor control lever and tighten lock nuts only handtight and install clevis pin and new cotter pin and spread. Lock nuts will be tightened after engine speeds have been synchronized (par. 73).

f. Adjust Throttle Idler Shaft Arm Positions.

(1) In the driver's compartment, disconnect the throttle idler lever rod from arm on throttle idler shaft (fig. 47). Test throttle idler shaft to make sure it does not bind on clutch idler shaft. Free up shaft if necessary and lubricate. Adjust length of single throttle idler shaft connecting rod to $7\frac{9}{16}$ inches—center to center of clevis pin holes.

(2) On converted dual type control, test both inner and outer throttle idler shafts. Free up shafts if necessary, and lubricate thoroughly. Adjust length of throttle idler shaft connecting rods to measure exactly $6\frac{3}{4}$ inches from center to center of clevis pin holes.

(3) Connect throttle idler shaft connecting rod to lower hole in throttle junction lever (fig. 47). Be sure rear end of rod is connected to the top hole in the throttle idler shaft arm.

(4) Gently push the throttle idler connecting rod toward front of vehicle to take up any slack in the throttle linkage. Then move throttle idler lever rod (long rod) back to take up any slack in the governor control linkage. Adjust throttle idler lever rod clevis so pin will slip freely into bottom hole in outer throttle idler shaft arm (fig. 55). Tighten all lock nuts, insert all new cotter pins and spread.

g. Adjust Accelerator Pedal and Linkage. Adjust accelerator pedal stop screw so there is $\frac{1}{2}$ inch clearance between bottom of accelerator pedal stop screw pad and driver's sub-floor plate. Tighten stop screw lock nut. Adjust accelerator connecting rod so clevis pin has at least $\frac{1}{16}$-inch and not more than $\frac{1}{8}$-inch clearance at front end of upper slot in throttle junction lever (fig. 47). Tighten clevis lock nut. On converted dual type throttle controls this adjustment must be made on both accelerator connecting rods. Remove junction lever bracket, and install new cotter pins in all clevis pins. Install throttle junction lever bracket on hull floor and tighten securely. Engine speeds must now be synchronized according to procedure in paragraph 73.

h. After Adjustment Procedure. All points of friction in the throttle and accelerator linkage should be lubricated with engine oil. To complete assembly and installation, reverse the procedure given in subparagraph b above.

73. SYNCHRONIZING ENGINE SPEEDS.

a. Importance of Synchronized Engine Speeds. Both engines must operate at the same speed and respond equally to throttle movement when the clutches are disengaged in order to develop full power under load as a unit with the clutches engaged. If the speeds of the engines when clutches are disengaged differ more than 100 revolutions

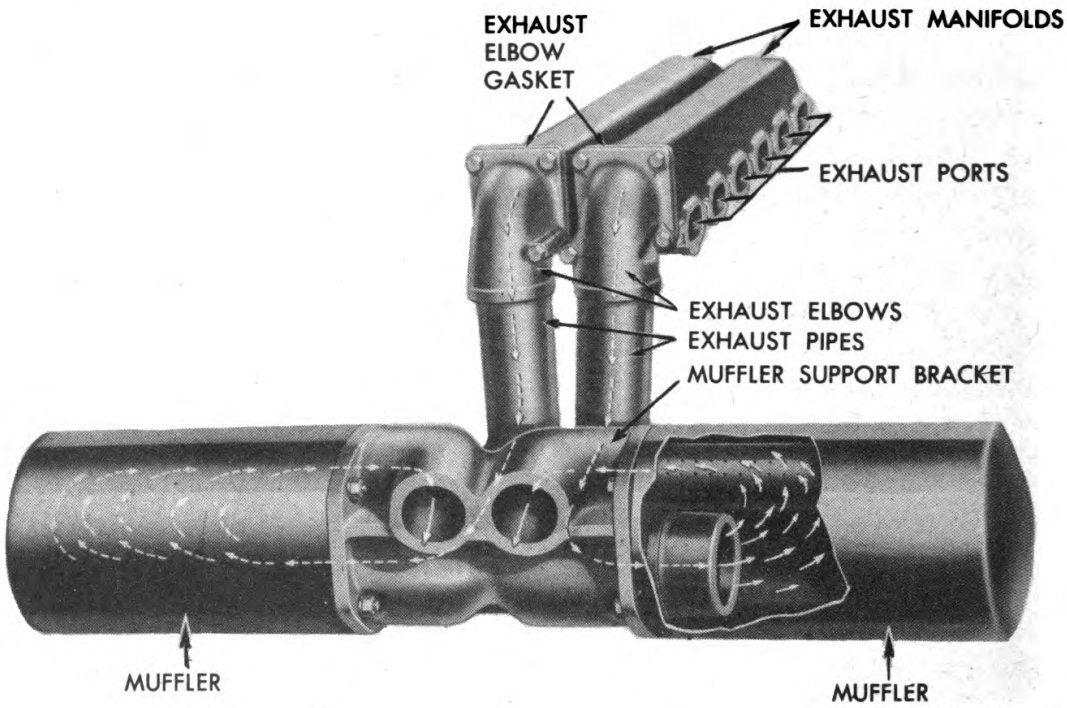


Figure 48—Exhaust System

per minute from 1,500 to 1,800 revolutions per minute, engine speeds must be synchronized according to the following procedure.

b. Test Accuracy of Tachometers. With the engines operating and warmed up to 100°F and the clutches engaged, the tachometer readings must not differ more than 100 revolutions per minute from 1,500 to 1,800 revolutions per minute (fig. 10). If a greater difference exists one of the tachometers is out of calibration and should be replaced or the variation noted and readings taken during tests or adjustments compensated accordingly.

c. Adjustment of Governor Control Lever Link. Open engine compartment door (par. 167 a), and raise and lock engine compart-

ment splash panel (par. 168 b). With engines warmed up to 100°F and clutches locked out, set and lock the hand throttles to operate engines at 1,500 revolutions per minute. Loosen lock nuts at both ends of adjustable governor control link on the left engine (fig. 47). Slowly turn the turnbuckle to increase or decrease speed of left engine as required to balance it within 100 revolutions per minute of the speed of the right engine. Tighten the lock nuts and recheck tachometer readings. Lower splash panel, and hook into place (par. 168 c). Close and bolt engine compartment doors (par. 167 b).

74. EXHAUST SYSTEM.

a. Description. Each engine has its individual exhaust system consisting of an exhaust manifold bolted to the cylinder head, an exhaust pipe connecting the manifold elbow to the muffler support bracket and a muffler for each engine.

75. REPLACEMENT OF EXHAUST MANIFOLD GASKETS.

a. General. The exhaust manifold gaskets can be replaced without completely removing the exhaust manifold as explained in the following procedure.

b. Removal of Exhaust Manifold Gaskets. Open engine compartment doors (par. 167 a). Raise and lock engine compartment splash panel (par. 168 b). Remove engine compartment floor plates (par. 170 b). Drain cooling systems of both engines (par. 103 b). Disconnect water bypass tube on each engine by unscrewing the union nuts on water bypass tube upper elbow. Remove attaching bolts from both upper elbows, and remove elbows and gaskets. Remove bolts on each engine attaching lower elbow to oil cooler housing, and remove gaskets. Loosen clips attaching each bypass tube to fan end of cylinder block. Push upper ends of both tubes down between the engines until they rest on the air heater covers. Unscrew four bolts which attach exhaust elbow to manifold on which the gaskets are to be replaced. From below, loosen nut on first stud at fan end of manifold with ratchet handle, 10-inch extension and 5/8-inch socket and back off nut flush with end of stud. From above, use ratchet handle with 5/8-inch socket to loosen six remaining manifold stud nuts and back off nuts until flush with ends of studs. Separate manifold from cylinder head. Use screwdriver to remove the exhaust manifold gaskets.

c. Installation of Exhaust Manifold Gaskets. Thoroughly clean all faces on exhaust manifold and cylinder head exhaust parts. Slot the stud holes in the new exhaust manifold gaskets at the bottom of the stud holes so gaskets can be dropped down over the studs (fig. 49). Carefully position all three gaskets on the studs. Push manifold into place against cylinder head, and tighten stud nu

evenly to compress gaskets uniformly. Reverse procedure in paragraph 75 **b** to reassemble remaining parts. Install new exhaust manifold elbow gasket, and tighten elbow bolts evenly. Fill engine cooling systems (par. 103 **d**). Install engine compartment floor plates (par. 170 **c**).

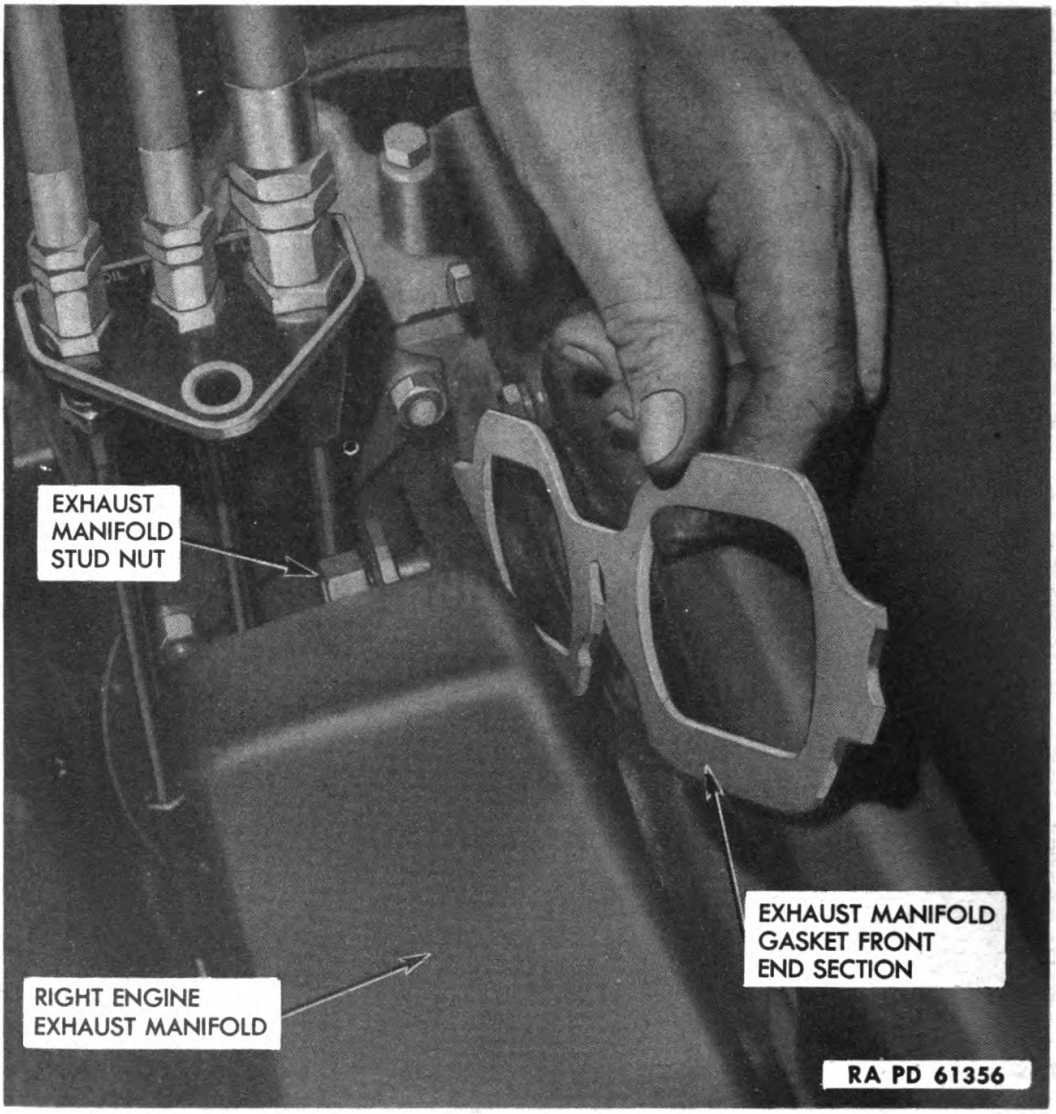


Figure 49—Sliding Exhaust Manifold Gasket Down on Studs

76. EXHAUST MANIFOLDS.

a. Description. The exhaust manifolds are made with slotted bolt holes to facilitate their removal.

b. Removal of Exhaust Manifold. Perform operations outlined in paragraph 75 **b**. Lift exhaust manifold off (fig. 50). Remove washers and nuts from all studs except No. 3 and No. 5 (counting from either end). Remove gaskets.

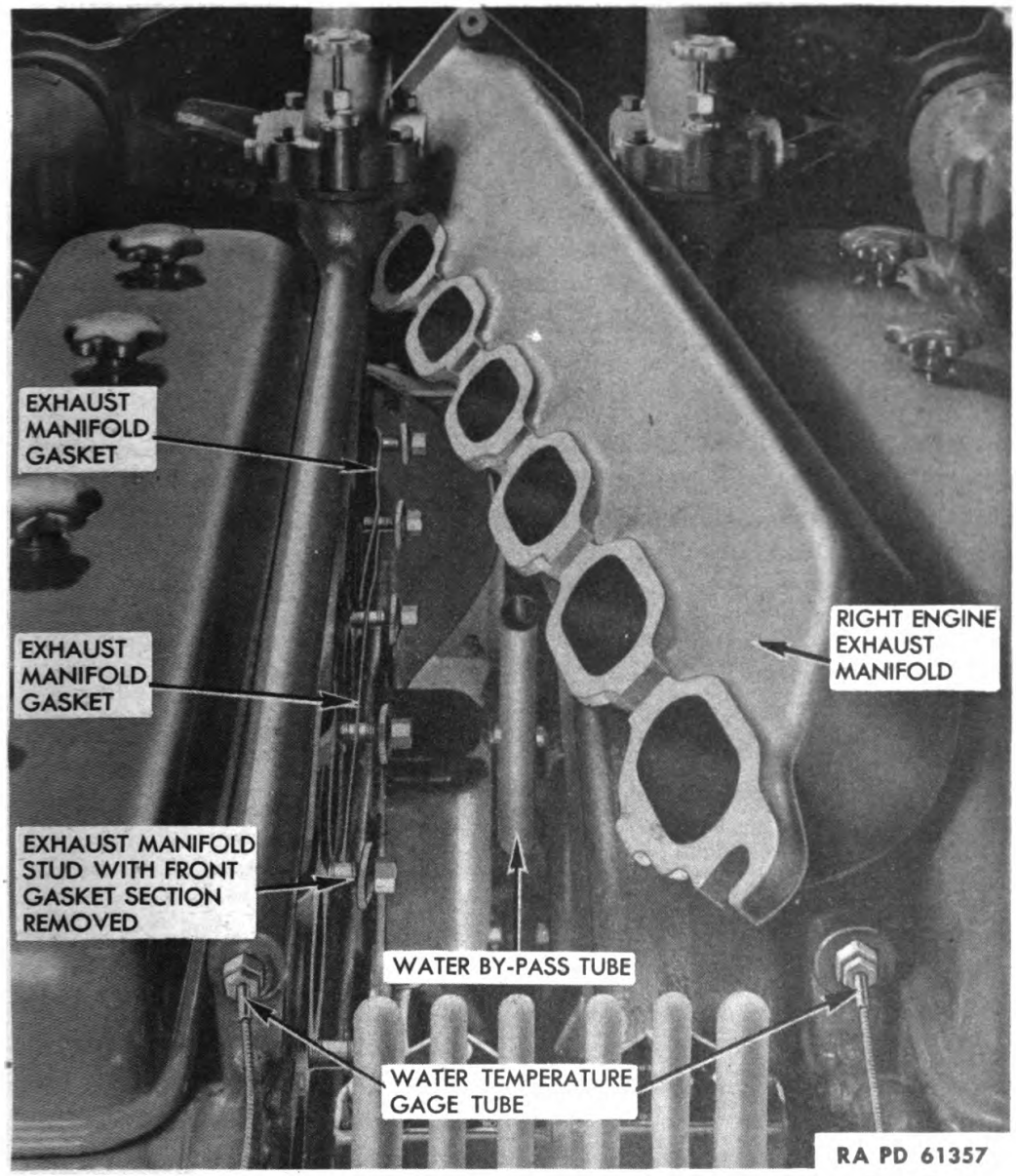


Figure 50—Exhaust Manifold Removed

c. Installation of Exhaust Manifold. Thoroughly clean gasket surfaces on cylinder head parts and the exhaust manifold. Install new manifold gaskets on studs. Do not slot bolt holes in the gaskets. Install manifold washers and nuts which were removed, and screw nuts on until flush with ends of studs. Position all washers against nuts. Carefully position manifold over studs making sure gaskets are not damaged. Tighten nuts evenly to compress gaskets uniformly. Carefully slide new gasket into position between elbow and end of exhaust manifold. Install four bolts with lock washers, and tighten bolts evenly. Complete the installation by reversing procedure in

paragraph 75 **b** to reassemble remaining parts. Make sure all nuts, bolts, and unions are tight. Fill engine cooling systems (par. 103 **d**). Install engine compartment floor plates.

77. EXHAUST PIPES.

a. Description. The two vertical exhaust pipes carry the exhaust gases from the manifolds, through openings in the muffler support bracket, to the mufflers (fig. 48). The upper ends of the pipes fit into the exhaust elbows. The lower ends fit into openings in the muffler support bracket. Because of the close fit of the pipes, no packing is required in either the exhaust elbows or muffler support bracket.

b. Removal of Exhaust Pipe. Remove radiator (par. 104 **b**). Remove fan shroud (par. 104 **b**). Remove the one long and three short bolts which attach elbow to end of exhaust manifold. Remove elbow gasket. Work elbow up and off end of exhaust pipe. Next remove exhaust pipe by working it toward engine and out of muffler support bracket.

c. Installation of Exhaust Pipe. Clean gasket surfaces on elbow and end of exhaust manifold. Install lower end of exhaust pipe in muffler support bracket. Work elbow down into position over end of exhaust pipe. Spring elbow slightly away from manifold and carefully insert new gasket. Install the four attaching bolts with lock washers and tighten bolts to compress gasket uniformly. Install fan shroud (par. 107 **c**). Install radiator (par. 104 **c**). Make sure all connections are tight, and engine cooling system is filled.

78. MUFFLERS.

a. Description. Two mufflers, one for each engine, are used to silence the exhaust noise. The two mufflers are bolted to a dual muffler support bracket (fig. 48).

b. Removal of Muffler or Muffler Support. Remove radiators (par. 104 **b**). Remove the muffler guard and deflector plate as a unit by first removing the two long brackets which attach the deflector plate to the hull. Next remove the four short brackets supporting the muffler guard and remove the bolts holding the muffler guard to the hull. Lift off the muffler guard and deflector plate. Either muffler can be disassembled from the muffler support by removing the four nuts and lock washers which attach muffler. If the muffler support is to be removed, it is not necessary to remove the exhaust pipes. Remove the six bolts and safety nuts which attach muffler support to lower rear hull plate and work muffler support off exhaust pipes.

c. Installation of Muffler or Muffler Support. The mufflers or muffler support are installed by reversing the removal procedure. When installing muffler support, make sure exhaust pipes enter support evenly and are firmly seated.

79. REMOVAL OF POWER UNIT.

a. General Instructions. Facilities for removing and installing a power unit should include: Adequate heavy-duty hoisting equipment—an A-frame equipped with two suitable differential chain falls or a wrecking truck capable of lifting the power unit so as to completely clear the vehicle, two heavy cable or chain slings, clean containers to hold drained cooling liquid and engine oil, twin motor assembly stand (41-S-4987-77), and clean receptacles for small subassemblies and attaching parts. The parts which are removed should be kept segregated and placed in related positions to make it easier to locate these parts readily for installation. Correct assembly is often made easier if bolts with washers or lock washers are temporarily screwed into their positions during disassembly or temporarily attached to parts removed with the necessary washers, lock washers and nuts. Tagging of wires, hoses, tubes and interchangeable parts frequently aids in correct positioning of parts during assembly and saves time. CAUTION: *All openings and ends of fuel and oil lines must be taped to prevent entrance of dirt. All parts removed should be protected against dust, sand and weather.*

b. Suggested Distribution of Procedure. Sequence of the following removal procedure is: Disassembly in fighting compartment. Disassembly in engine compartment from above. Disassembly in engine compartment from below. This makes it possible to divide personnel into groups so that disassembly operations can be carried on at the same time at all three locations.

c. Removal Procedure in Fighting Compartment.

(1) Turn tank selector valve to "OFF".

(2) DISCONNECT CABLES AND WIRES IN FIGHTING COMPARTMENT. Remove battery box cover (par. 186 **b**). Test battery voltage (par. 5 **a** (15)) and if batteries are not fully charged, remove batteries and recharge. If batteries are fully charged disconnect ground cable from rear battery. Slide baffle plate up out of battery box. Remove both starter cables from bus bar and put washers and nuts back on terminals. Disconnect conduits from battery box fittings and pull starter cables out of battery box to be later placed on engine in out-of-way position. Raise left generator compartment door and remove hose clamp from conduits.

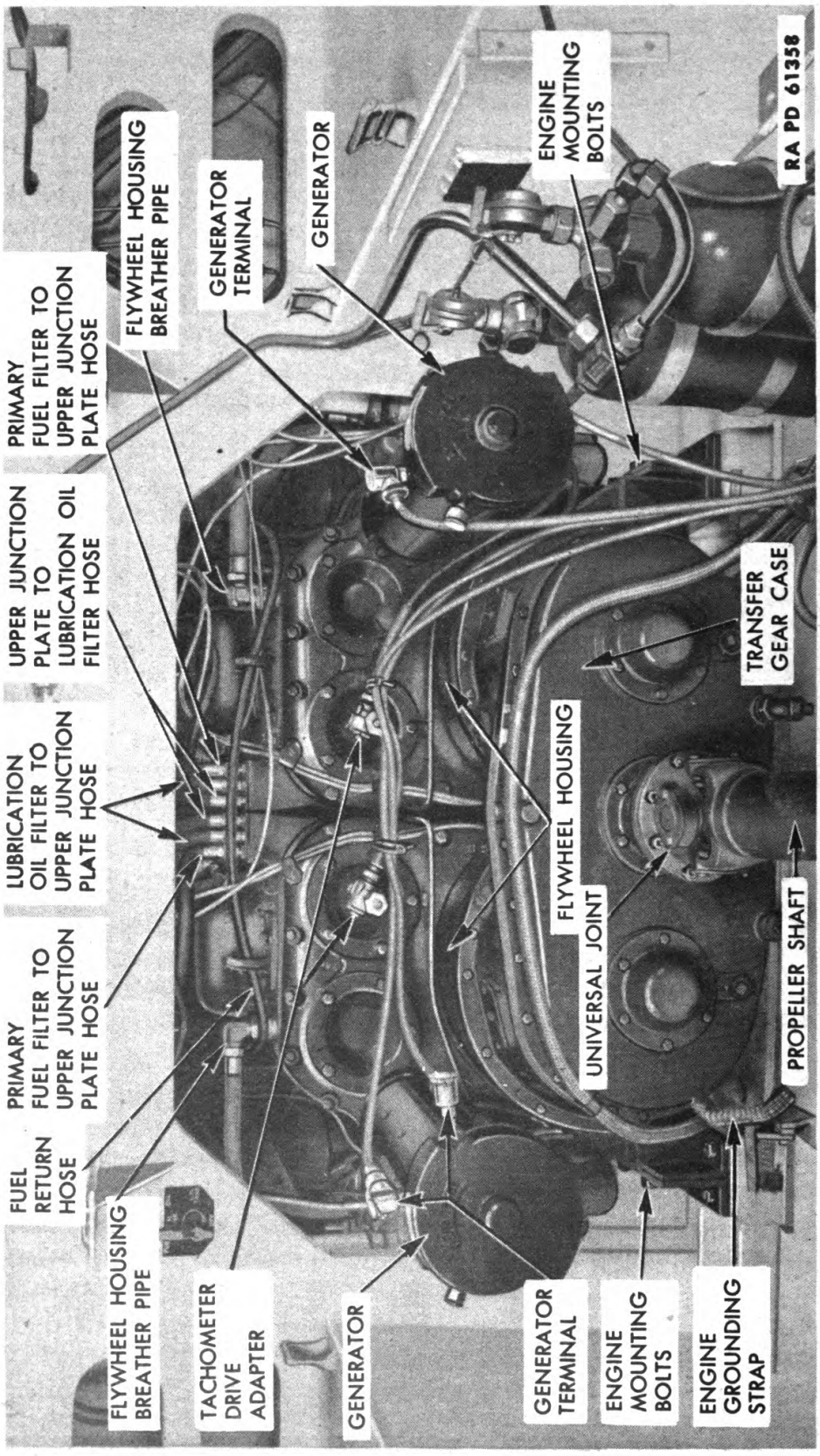
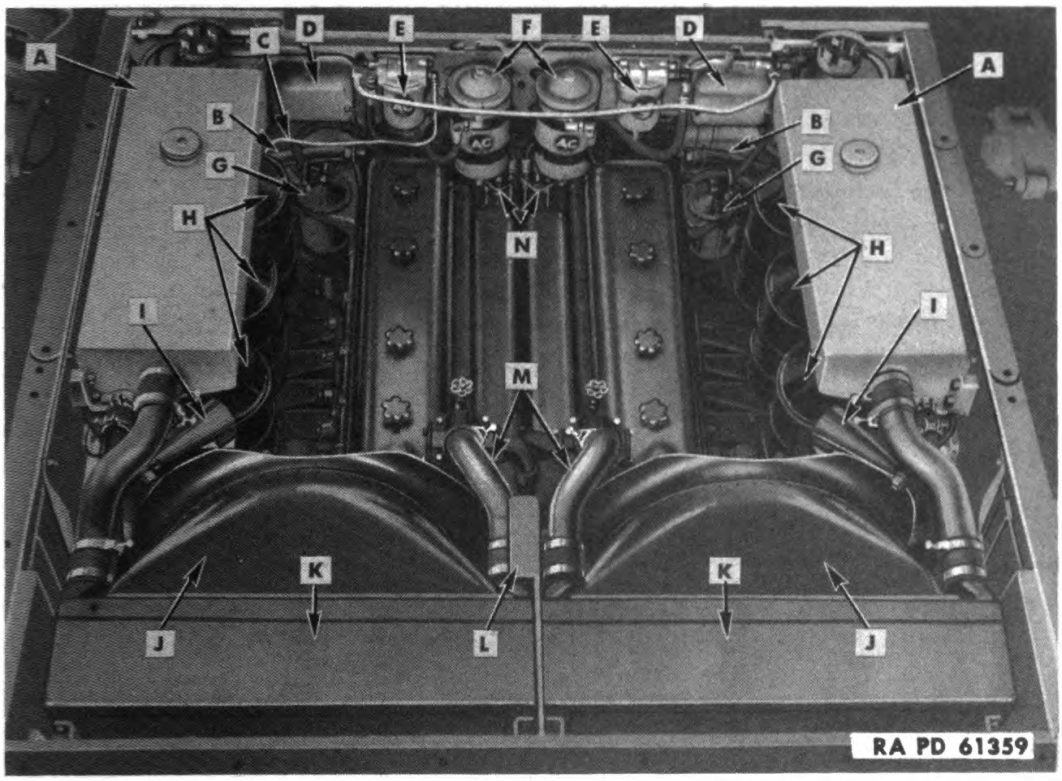


Figure 51—Flywheel End of Power Unit with Bulkhead Opening Covers Removed

POWER UNIT

(3) REMOVE LEFT AND RIGHT STEP AND DOOR ASSEMBLIES. Remove circuit breaker box for 3-inch gun from left step (par. 220 b) and lay it back against forward fixed fire extinguisher cylinder. Remove radio filter box, alongside transfer gear case filler opening, from its bracket and lay box on vehicle floor (fig. 88). Take out bolts which attach left step, and remove step and door assembly as one unit. Take out bolts and remove right step and door assembly.



A—AUXILIARY WATER TANK
B—FLYWHEEL HOUSING BREATHER HOSE
C—AIR HEATER PUMP INTAKE TUBE
D—AIR HEATER COIL BOX
E—PRIMARY FUEL FILTER
F—LUBRICATING OIL FILTER
G—SECONDARY FUEL FILTER
H—AIR CLEANERS
I—FIRE EXTINGUISHER NOZZLE
J—FAN SHROUD
K—RADIATOR
L—SUPPORT PLATE
M—RADIATOR INLET TUBES
N—UPPER JUNCTION PLATES
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Figure 52—Engine Compartment with Cover Plates Removed

(4) REMOVE UPPER BULKHEAD OPENING COVER. Disconnect the transmission oil cooler hoses from oil tubes. Remove bolts which attach the upper bulkhead opening cover and remove the cover with transmission oil cooler and guard attached.

(5) DETACH PARTS AT FLYWHEEL END OF ENGINE. Working through the bulkhead opening, disconnect two conduits and wires from each generator (fig. 51). Remove bolt which attaches engine

(1) PROCEDURE.

(a) Open power unit compartment rear doors (par. 52., **b.**, (6)).

(b) Close both fuel shut-off valves.

Raise valve control levers to limit of travel (fig. 34).

(c) Disconnect Fuel Pump Inlet and Outlet Tubes.

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

Unscrew fuel pump inlet tube (turn counterclockwise) (1 3/8-in. open-end wrench). Unscrew the three outlet tubes (turn counterclockwise) (applicable to fuel pump used with multiple water pumps) (fig. 52) (5/8-in. open-end wrench) or the one outlet tube (turn counterclockwise) (applicable to fuel pump used with single water pump) (fig. 53) (3/4-in. open-end wrench).

(d) Remove Attaching Screws.

PLIERS, side cutting
WRENCH, open-end, 1/2-in.

Remove locking wires from the four cap screws securing the lower body to fuel pump adapter (figs. 52 and 53). Remove the four lower body mounting screws (1/2-in. open-end wrench) and slide the pump off pump drive shaft.

(e) Remove Fuel Line Connection From Fuel Pump.

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

Unscrew connector from side of fuel pump (figs. 52 and 53) (turn counterclockwise) (7/8-in. open-end wrench for single water pump type; 1 1/16-in. open-end wrench for multiple water pump type).

e. Installation.

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

(1) PROCEDURE.

(a) Assemble Fuel Line Connection to Fuel Pump.

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

Attach fuel line connection to outlet side of fuel pump assembly by screwing connection into threaded opening (turn clockwise). Tighten connection securely to prevent leaks (7/8-in. open-end wrench for single water pump type; 1 1/16-in. open-end wrench for multiple water pump type) (figs. 52 and 53).

(b) Check Operation of Fuel Pump.

Turn fuel pump driving shaft by hand. Make sure shaft turns freely and does not bind.

(c) Mount Fuel Pump Assembly on Fuel Pump Adapter.

PLIERS, side cutting WRENCH, open-end, ½-in.

Remove all traces of torn gaskets and foreign matter from mounting faces of fuel pump and fuel pump adapter. Position *new* gasket on fuel pump body, slide pump assembly onto drive shaft splines and secure with cap screws (½-in. open-end wrench). Pass locking wires through holes in heads of cap screws and twist ends of wires together to lock cap screws in place (side cutting pliers).

(d) Connect Fuel Pump Inlet and Outlet Tubes.

WRENCH, open-end, ⅝-in. WRENCH, open-end, 1⅜-in.
WRENCH, open-end, ¾-in.

Connect fuel pump inlet tube to pump by screwing connection on end of fuel line into elbow in inlet side of pump (turn clockwise) (1⅜-in. open-end wrench). Connect fuel pump outlet tubes to pump by screwing connection on ends of the three tubes (applicable to fuel pump used with multiple water pump type) (⅝-in. open-end wrench) or the one tube (applicable to fuel pump used with single water pump type) (¾-in. open-end wrench) into threaded openings in connector. Tighten connections securely (figs. 52 and 53).

(e) Test for Fuel Leaks.

Open fuel shut-off valves by pushing valve control levers down to limit of travel (fig. 34). Turn ignition switch "ON", to permit opening of solenoid fuel shut-off valve (figs. 54 and 56).

(f) Close Power Unit Compartment Rear Doors (par. 53., **a.**, (44)).

77. FUEL TANKS.

a. Description. Two horizontal fuel tanks, located one in each sponson, are provided to supply fuel to the power unit. Beginning with vehicle serial number 17794, fuel tanks, insulated against heat from the power unit, entered production. This insulation consists of metal foil shielding entirely encircling the tank. Displacement of heat in the fuel tank compartment is accomplished through air being drawn by the power unit fan through the opening in the top of the sponson, at the rear end, around the fuel tank and into the fan compartment. The air is then directed through the radiator core (fig. 55.). CAUTION: The metal foil shielding must not be removed from the fuel tank. Each fuel tank has a

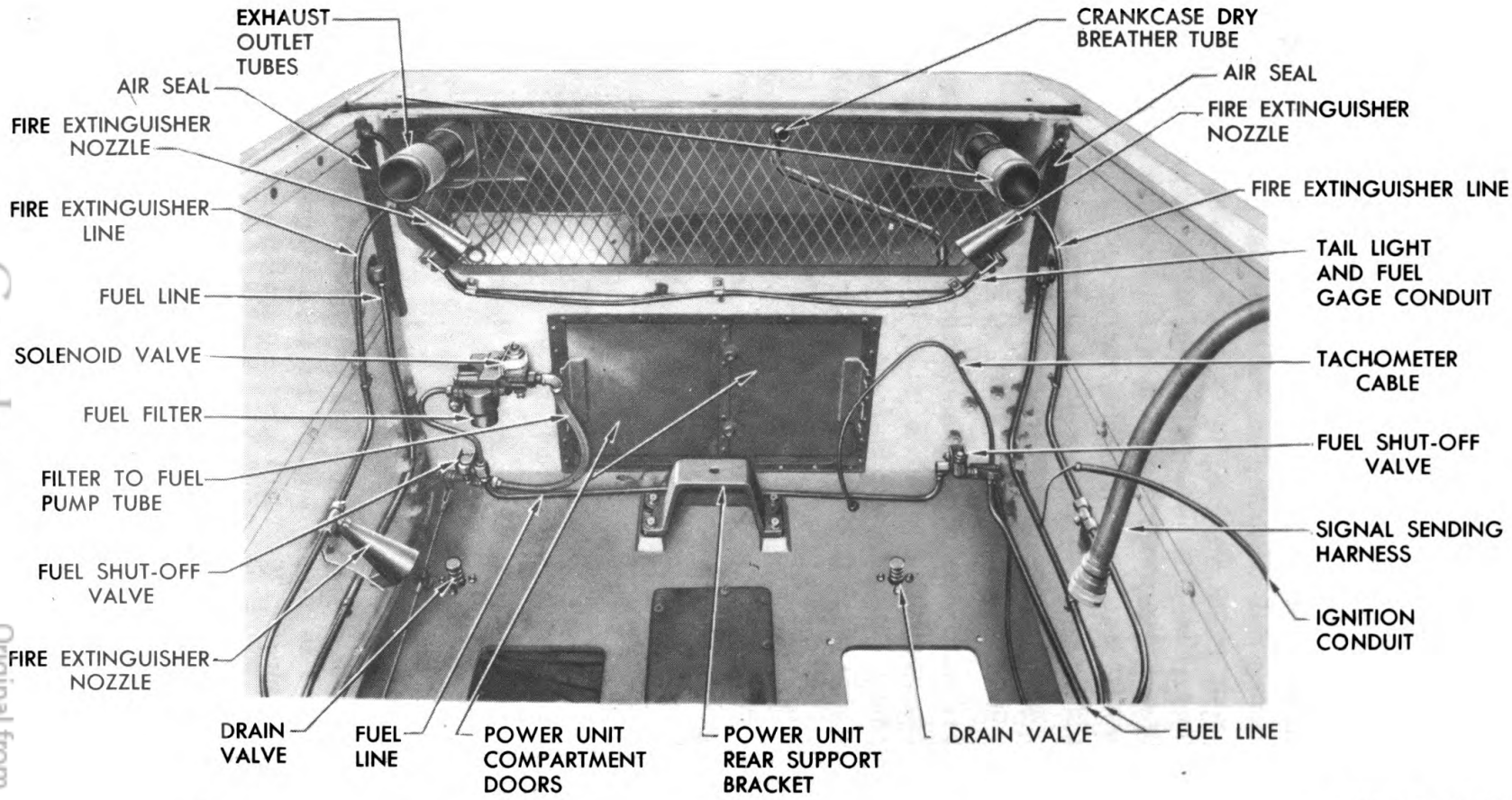

Figure 54 — Power Unit Compartment — Rear

FUEL SYSTEM

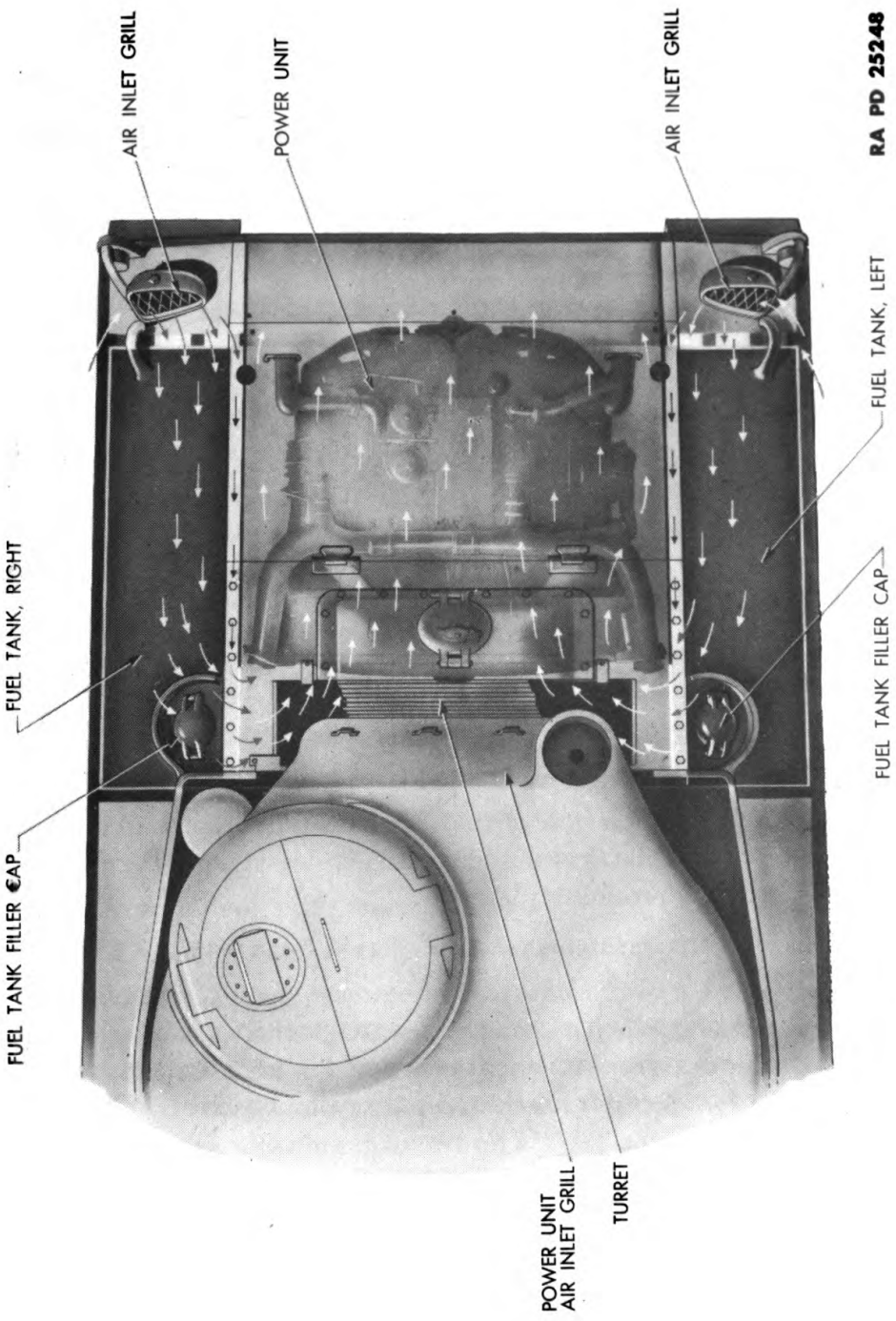

Figure 55 — Fuel Tank Ventilation

capacity of approximately 80 gallons. The fuel tank for the auxiliary generating units is located in the left sponson and has a capacity of approximately 5½ gallons.

b. Preventive Maintenance. Keep filler caps closed to exclude any foreign matter. Check connections for leaks. Keep fuel tank ventilating system air inlet grille openings open and free from all obstructions at all times.

c. Removal.

TOOLS.

PAN, for fuel (capacity, 80 gallons)
SCREWDRIVER
WRENCH, Allen, $\frac{5}{16}$-in.
WRENCH, $\frac{3}{8}$-in.
WRENCH, ½-in.
WRENCH, open-end, $\frac{7}{8}$-in.
WRENCH, open-end, $1\frac{1}{16}$-in.

Refer to paragraph 52 for tools.

(1) PROCEDURE.

(a) Drain Fuel Tank.

Refer to paragraph 77., **e.**

(b) Remove Power Unit.

Refer to paragraph 52., **b.**

(c) Disconnect Fuel Lines.

WRENCH, open-end, $\frac{7}{8}$-in.

Unscrew connections on end of fuel lines (one at front end of power unit compartment and one at rear end) from elbows which extend through openings in fuel tank retaining plate.

(d) Remove Fire Extinguisher Line (figs. 27 and 54).

WRENCH, ½-in.

Remove cap screw which attaches fire extinguisher line retaining clip to side of power unit compartment, at rear end of compartment, and bend fire extinguisher line away from side of compartment.

(e) Remove Air Seal.

WRENCH, ½-in.

Remove four cap screws and remove air seal from rear corner of power unit (fig. 54).

(f) Remove Fuel Tank Retaining Plate.

SCREWDRIVER
WRENCH, ½-in.

Remove slotted head screws along upper edge of retaining place (screwdriver), loosen nuts along lower edge of retaining plate (½-in. wrench), lift plate up and remove from sponson.

(g) Remove Fuel Tank From Sponson.

WRENCH, 3/8-in.

Slide fuel tank part way out of sponson. CAUTION: *Be careful not to damage metal foil shielding on tank.* NOTE: Two men will be required for this operation. Disconnect cable from terminal fuel gage by removing nut and lifting cable off terminal. Screw nut on terminal temporarily. Slide tank out of sponson and remove from vehicle.

(h) Remove Fuel Tank Outlet Elbows.

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

Unscrew elbows from fuel tank (turn counterclockwise).

d. Installation.

TOOLS.

SCREWDRIVER	WRENCH, 1/2-in.
WRENCH, Allen, $\frac{5}{16}$-in.	WRENCH, open-end, 7/8-in.
WRENCH, 3/8-in.	WRENCH, open-end, $1\frac{1}{16}$-in.

Refer to paragraph 53 for tools.

(1) PROCEDURE.

(a) Install Fuel Tank Outlet Elbows.

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

Screw elbows into threaded openings at either end of fuel tank (turn clockwise), tighten securely, with open end toward bottom of tank, in vertical position.

(b) Install Tank in Sponson.

WRENCH, 3/8-in.

Check vertical openings, one in rear end of compartment and one at front end of compartment, where air is drawn from fuel tank compartment into fan compartment, to make sure they are free from all obstructions. CAUTION: *Be careful not to damage metal foil shielding.* Slide tank part way into sponson, allowing it to rest on edge of sponson while connecting cable to fuel gage. Connect cable to terminal on gage and secure with nut. Slide tank into position in sponson. Make sure elbows are in correct position to receive fuel lines.

(c) Install Fuel Tank Retaining Plate.

SCREWDRIVER, WRENCH, 1/2-in.

Position plate over opening in sponson, sliding lower edge of plate over retaining screws at bottom of plate and alining so as to allow elbows to pass through their respective openings in plate. Secure plate in place

with slotted head screws at upper edge of plate (screwdriver). Tighten nuts along lower edge of plate (½-in. wrench).

(d) Connect Fuel Lines.

WRENCH, open-end, ⅞-in.

Aline fuel lines to elbows and connect by screwing connection on end of line into elbow. NOTE: Be careful not to start connection cross threaded as this will result in a leak at connection. Tighten connections securely.

(e) Test for Fuel Leaks.

SCREWDRIVER, WRENCH, Allen, $\frac{5}{16}$-in.

Tighten drain plug in bottom of tank ($\frac{5}{16}$-in. Allen wrench). Close fuel shut-off valve. Fill tank and check for leaks at connections. If no leaks are noted, install circular plate on bottom of sponson, directly below drain plug, securing with four slotted head screws (screwdriver).

(f) Install Air Seal (fig. 54).

WRENCH, ½-in.

Position air seal in corner of power unit compartment and attach with four cap screws. Tighten cap screws securely.

(g) Connect Fire Extinguisher Line (figs. 27 and 54).

WRENCH, ½-in.

Bend fire extinguisher line to original position and attach to side of compartment by inserting cap screw through opening in retaining clip and tightening cap screw securely to compartment wall, just below fuel tank retaining plate.

Tighten cap screw securely.

(h) Install Power Unit in Vehicle (par. 43., **a.**).

e. Drain Tank.

PAN, drain (capacity, 80 gallons)
SCREWDRIVER
WRENCH, Allen, $\frac{5}{16}$-in.
WRENCH, 1⅛-in.
WRENCH, open-end, 1⅜-in.

(1) PROCEDURE.

(a) Open Power Unit Rear Compartment Doors (par. 52., **b.**, (6)).

(b) Close Fuel Shut-Off Valve of Opposite Fuel Tank.

Raise valve control lever to limit of travel (fig. 34).

(c) Drain Excess Amount of Fuel From Tank.

PAN, drain (capacity, 80 gallons)
WRENCH, open-end, 1⅜-in.

Unscrew fuel pump inlet tube at inlet side of fuel pump (1⅜-in. open-end wrench) (fig. 34), and place end of tube in pan for draining. Turn ignition switch "ON" (fig. 10) to open solenoid fuel shut-off valve, thus allowing fuel to drain. *Turn ignition switch "OFF" as soon as fuel has drained.*

(d) Remove Fuel Tank Drain Plug.

SCREWDRIVER
WRENCH, Allen, $\frac{5}{16}$-in.

Remove four slotted head screws from the circular plate in the rear and bottom of sponson (screwdriver). Reach through opening in sponson and remove drain plug (turn counterclockwise) ($\frac{5}{16}$-in. Allen wrench).

(e) Install Fuel Tank Drain Plug.

WRENCH, Allen, $\frac{5}{16}$-in.

Screw drain plug into threaded opening in bottom of fuel tank, tightening securely to prevent leaks.

(f) Connect Fuel Pump Inlet Tube.

WRENCH, open-end, 1⅜-in.

Attach fuel tube to inlet side of fuel pump by screwing connection into elbow in side of fuel pump body (turn clockwise) (figs. 52 and 53).

(g) Test for Fuel Leaks.

Fill tank with fuel, open-fuel shut-off valve of opposite tank, turn ignition switch "ON" and check for leaks at connections. *Turn ignition switch "OFF" after completing check.*

(h) Close Power Unit Compartment Rear Doors (par. 53., **a.**, (44)).

(i) Install Circular Plate on Bottom of Sponson.

SCREWDRIVER

Clean mounting faces of circular plate and bottom of sponson, position plate over opening and secure with the four slotted head screws.

78. FUEL SHUT-OFF VALVES.

a. Description. Two manually operated valves control the flow of fuel from the fuel tanks to the fuel filter. Located in the rear corners of the power unit compartment, the valve in the right rear corner controls flow of fuel from tank in the right sponson, the valve in the left rear cor-

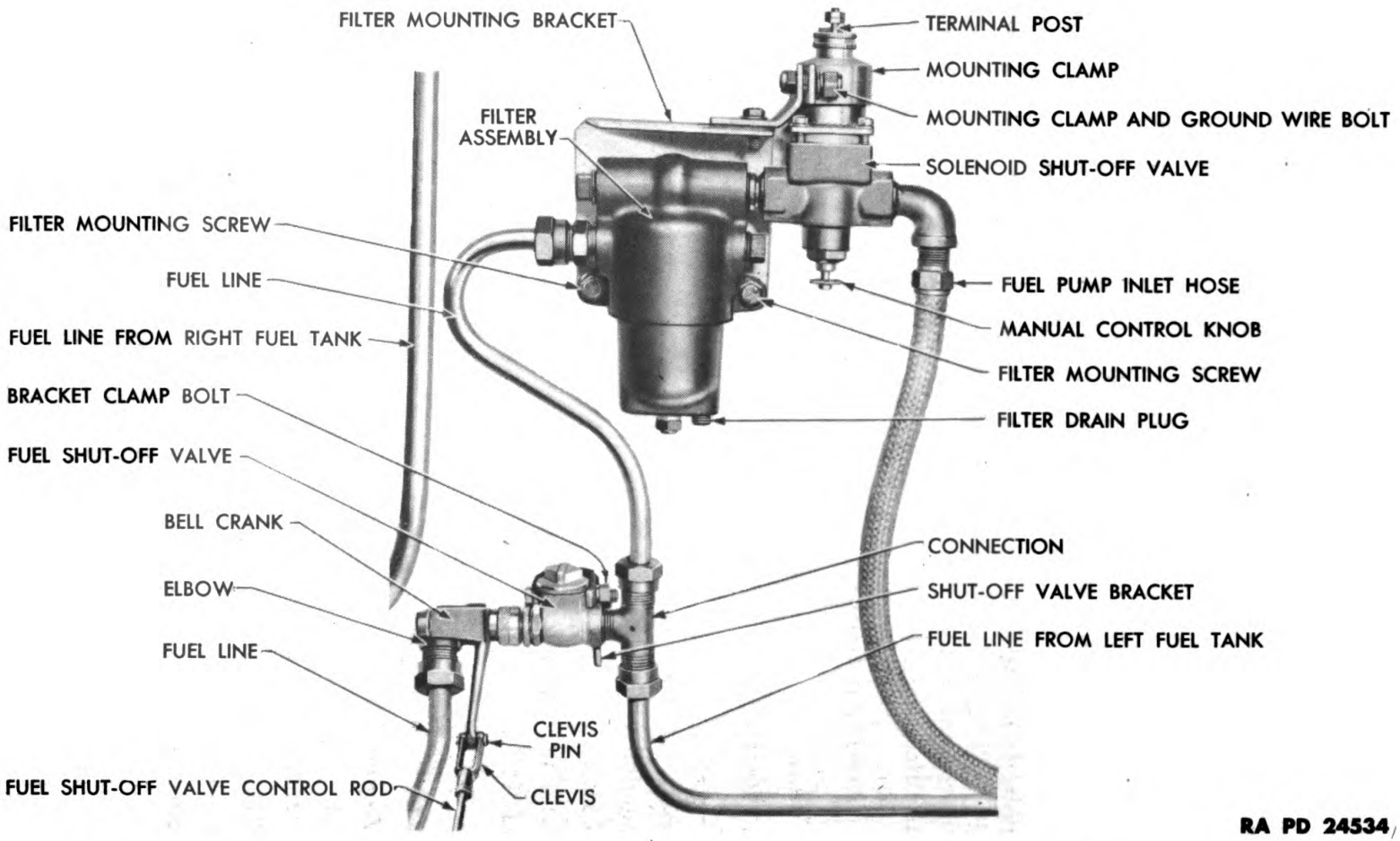

Figure 56 — Fuel Filter, Solenoid Shut-Off Valve and Manually Operated Fuel Shut-Off Valve

ner controlling the flow of fuel from tank in the left sponson (fig. 54). Controls for the operation of these valves are located inside the fighting compartment, on the bulkhead, to the rear of the turret basket (fig. 34). In addition to the fuel shut-off valves previously mentioned, a solenoid shut-off valve is mounted between the fuel filter and fuel pump. This valve is actuated electrically and requires no attention from the operator.

b. Operation. On manually operated shut-off valves, the valves are closed when the valve control levers are raised to the limit of their travel and are open when the control levers are pushed down to the limit of their travel (fig. 34). The solenoid shut-off valve is controlled electrically, through a cable from No. 4 ignition coil primary post to a terminal on the solenoid shut-off valve. When the ignition switch is turned "ON" the valve is automatically opened. When the ignition is turned "OFF" the valve is automatically closed (fig. 56).

c. Preventive Maintenance. Keep connections tight.

d. Manually Operated Valve.

(1) REMOVAL.

TOOLS.

PAN, for fuel (capacity, 80 gallons)
PLIERS, side cutting
SCREWDRIVER
WRENCH, 1⅛-in.
WRENCH, Allen, $\frac{5}{16}$-in.
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, 1-in.
WRENCH, open-end, $1\frac{1}{16}$-in.
WRENCH, open-end, 1⅜-in.

(a) Procedure.

1. Drain Fuel From Tank (par. 77., e.).

2. Remove Valve (fig. 56).

PLIERS, side cutting
WRENCH, open-end, 1-in.
WRENCH, open-end, $\frac{9}{16}$-in. (2)
WRENCH, open-end, ⅞-in.
WRENCH, open-end, $1\frac{1}{16}$-in.

Remove cotter pin and clevis pin and disconnect valve operating rod from valve (side cutting wrench). Disconnect fuel lines from shut-off valve by unscrewing connection on end of line from elbow (turn counterclockwise) (⅞-in. open-end wrench). Remove nut and bolt which clamps the shut-off valve bracket to shut-off valve and remove valve from bracket (2, $\frac{9}{16}$-in. open-end wrench). If right hand valve is being removed, remove fuel line connection from valve by holding nipple (1-in. open-end wrench) and unscrewing connection from nipple (turn counterclockwise) ($1\frac{1}{16}$-in. open-end wrench).

(2) INSTALLATION.

TOOLS.

PLIERS, side cutting
SCREWDRIVER
WRENCH, Allen, $\frac{5}{16}$-in.
WRENCH, open-end, $\frac{9}{16}$-in. (2)
WRENCH, open-end, $\frac{7}{8}$-in.
WRENCH, open-end, 1-in.
WRENCH, open-end, $1\frac{3}{8}$-in.
WRENCH, $1\frac{1}{8}$-in.

(a) Procedure.

1. Prepare Valve for Installation.

WRENCH, open-end, $\frac{7}{8}$-in.
WRENCH, open-end, 1-in.

Assemble elbow to fuel shut-off valve by screwing elbow into opening in valve body (turn clockwise). NOTE: On right hand valve, install elbow in right hand side of valve body only, as viewed from rear of vehicle (fig. 54). On left hand valve, install one elbow in either side of body ($\frac{7}{8}$-in. open-end wrench). Install connection in valve (right hand valve only), by screwing connection into opening in left hand side of valve body (turn clockwise) (1-in. open-end wrench) (fig. 56). Check operation of valve by operating bell crank by hand and make certain bell crank operates freely.

2. Install Valve on Bracket.

WRENCH, open-end, $\frac{9}{16}$-in. (2)

Position valve in bracket, with bell crank toward outside of compartment, by sliding valve assembly between forked bracket which extends from the hull (fig. 56). Install bolt through holes in bracket arms, install lock washer and nut and tighten securely (2) ($\frac{9}{16}$-in. open-end wrench).

3. Connect Fuel Lines.

WRENCH, open-end, $\frac{7}{8}$-in.

Connect fuel lines to shut-off valve by screwing connection on end of line into opening in elbows or connection, depending on which valve is being installed.

4. Connect Control Rod.

PLIERS, side cutting

Check operation of control rod by operating lever inside fighting compartment (fig. 34) and make sure rod is free and does not bind. Position clevis on end of control rod over lower arm of bell crank and secure with clevis pin (fig. 56). Secure clevis pin with cotter pin and bend ends of cotter pin to prevent loss. Check operation of shut-off valve by operating lever inside fighting compartment (fig. 34).

5. Install Fuel Tank Drain Plug.

SCREWDRIVER
WRENCH, Allen, $\frac{5}{16}$-in.

Reach through opening in rear and bottom of sponson and install drain plug in bottom of fuel tank (turn clockwise). Tighten plug securely ($\frac{5}{16}$-in. Allen wrench). Install circular plate over opening in bottom of sponson. Secure with four slotted head screws and tighten securely (screwdriver).

6. Connect Fuel Pump Inlet Tube.

WRENCH, open-end, 1⅜-in.

Connect tube from solenoid shut-off valve to fuel pump by screwing connection on end of tube into elbow in side of fuel pump (turn clockwise). Tighten securely to prevent leaks.

7. Check for Leaks at Connections.

Fill fuel tank. Open both fuel shut-off valves (fig. 34). Turn ignition switch "ON," to open solenoid shut-off valve, and check for leaks at connections. If no leaks are noted, close power unit compartment rear doors (par. 53., **a.**, (44)).

e. Solenoid Operated Valve.

(1) REMOVAL.

TOOLS.

PAN, for fuel (capacity, 2 gallons)
WRENCH, ⅜-in.
WRENCH, 1⅛-in.
WRENCH, open-end, ½-in. (2)
WRENCH, open-end, $\frac{5}{16}$-in.
WRENCH, open-end, 1⅛-in.
WRENCH, open-end, 1⅜-in.

(a) Procedure.

1. Open Radio Switch and Battery Switch (par. 52., **b.**, (1)).

2. Close Fuel Shut-Off Valves (par. 78., **b.**).

3. Open Power Unit Compartment Rear Doors (par. 52., **b.**, (6)).

4. Disconnect Solenoid Valve.

PAN, for fuel (capacity, 2 gallons)
WRENCH, ⅜-in.
WRENCH, open-end, ½-in.
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, ⅞-in.
WRENCH, open-end, $\frac{5}{8}$-in.
WRENCH, open-end, 1⅜-in.
WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, extension, 3-in.

Remove wire from valve terminal by removing nut (⅜-in. wrench) and lifting wire off terminal. Install nut on terminal after removing wire. Unscrew fuel pump inlet tube from elbow on side of fuel pump

(turn counterclockwise) (1⅜-in. open-end wrench). Place end of tube in pan provided, to permit surplus fuel to drain from valve. Unscrew tube from shut-off valve (turn counterclockwise) ($\frac{5}{16}$-in. open-end wrench). Remove the two bolts and nuts which secure the mounting clamp around the top of the valve and remove ground strap from mounting bolt (½-in. and $\frac{9}{16}$-in. open-end wrench) (fig. 56). Unscrew fuel line connection from right side of fuel filter (⅞-in. open-end wrench). Remove two cap screws which secure fuel filter to bracket ($\frac{9}{16}$-in. socket wrench, 3-in. extension) (fig. 56). Lift out fuel filter and solenoid fuel shut-off valve together.

5. Remove Solenoid Valve from Fuel Filter (fig. 56).

WRENCH, open-end, 1⅜-in.

Unscrew valve from filter (turn counterclockwise).

(2) INSTALLATION.

TOOLS.

WRENCH, ⅜-in.	WRENCH, open-end, $\frac{5}{16}$-in.
WRENCH, 1⅛-in.	WRENCH, open-end, 1⅛-in.
WRENCH, open-end, ½-in.	WRENCH, open-end, 1⅜-in.
WRENCH, open-end, $\frac{9}{16}$-in.	WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, open-end, ⅞-in.	WRENCH, extension, 3-in.

(a) Procedure.

1. Attach Valve Assembly to Fuel Filter.

WRENCH, open-end, 1⅜-in.

Paint threads, on nipple which protrudes from side of fuel filter, with a suitable commercial sealing compound (Gasola or Permatex, or equivalent). CAUTION: Use sealing compound sparingly, as excess will clog fuel line. Screw valve body onto nipple. NOTE: Be sure to mount valve with arrow pointing toward fuel pump. Tighten securely, with valve assembly in vertical position when tightened (fig. 56).

2. Connect Fuel Tube to Valve.

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

Paint threads, sparingly, with a suitable sealing compound and screw tube into opening in side of valve body. Tighten securely.

3. Mount Filter and Valve Assembly in Compartment (fig. 54).

WRENCH, socket, $\frac{9}{16}$-in., with 3-in. extension.
WRENCH, open-end, $\frac{7}{8}$-in.

Place assembly in position inside compartment and attach to mounting bracket with two cap screws and lock washers ($\frac{9}{16}$-in. socket wrench, with 3-in. extension). Screw connection on fuel line into right side of filter body ($\frac{7}{8}$-in. open-end wrench).

4. Connect Valve Wires (fig. 56).

WRENCH, $\frac{3}{8}$-in. WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{1}{2}$-in.

Place valve mounting clamp in position around top of valve, insert the two mounting bolts through bracket and clamp, place ground wire over bolt nearest power unit and secure with two lock washers and nuts. Tighten securely ($\frac{1}{2}$-in. and $\frac{9}{16}$-in. open-end wrench). Attach wire to terminal post on top of solenoid valve and secure with nut ($\frac{3}{8}$-in. wrench).

5. Connect Fuel Pump Inlet Tube (figs. 52 and 53).

WRENCH, open-end, $1\frac{3}{8}$-in.

Paint threads, sparingly, with a suitable sealing compound and screw tube into elbow on side of fuel pump.

6. Check Operation of Valve.

Open manually operated fuel valves (par. 78., **b.**). Place hand on side of valve body and have ignition switch turned "ON." If valve is operating, an internal action will be felt.

7. Close power unit compartment rear doors (par. 53., **a.**, (44)).

79. FUEL FILTERS.

a. Description. A filter, of the sediment bowl type, is bracket mounted in the right rear corner of the power unit compartment and is connected in the fuel line between the manually operated fuel shut-off valves and the solenoid controlled fuel shut-off valve. All fuel passes through this filter before entering the fuel pump (fig. 54). In addition to the fuel line filter, an individual filter is mounted in the fuel line to each carburetor, through which the fuel passes before entering the carburetor. On power units of multiple water pump type, this carburetor filter was attached to the carburetor bowl through a threaded connection (fig. 47). On power units of single water pump type, this filter is integral with the carburetor (fig. 48).

b. Preventive Maintenance. Keep all connections tight. Check for leaks.

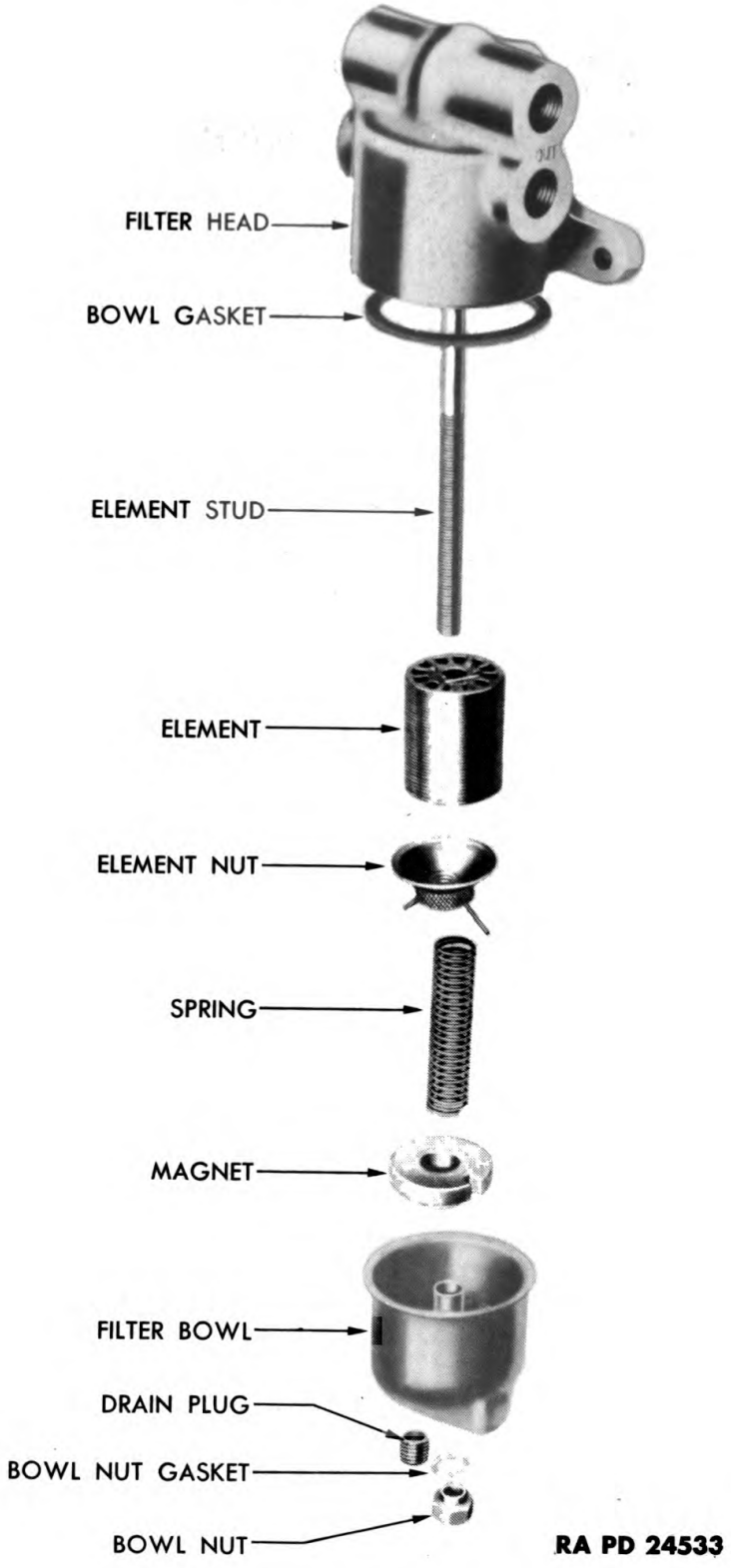

Figure 57 — Fuel Filter Disassembled

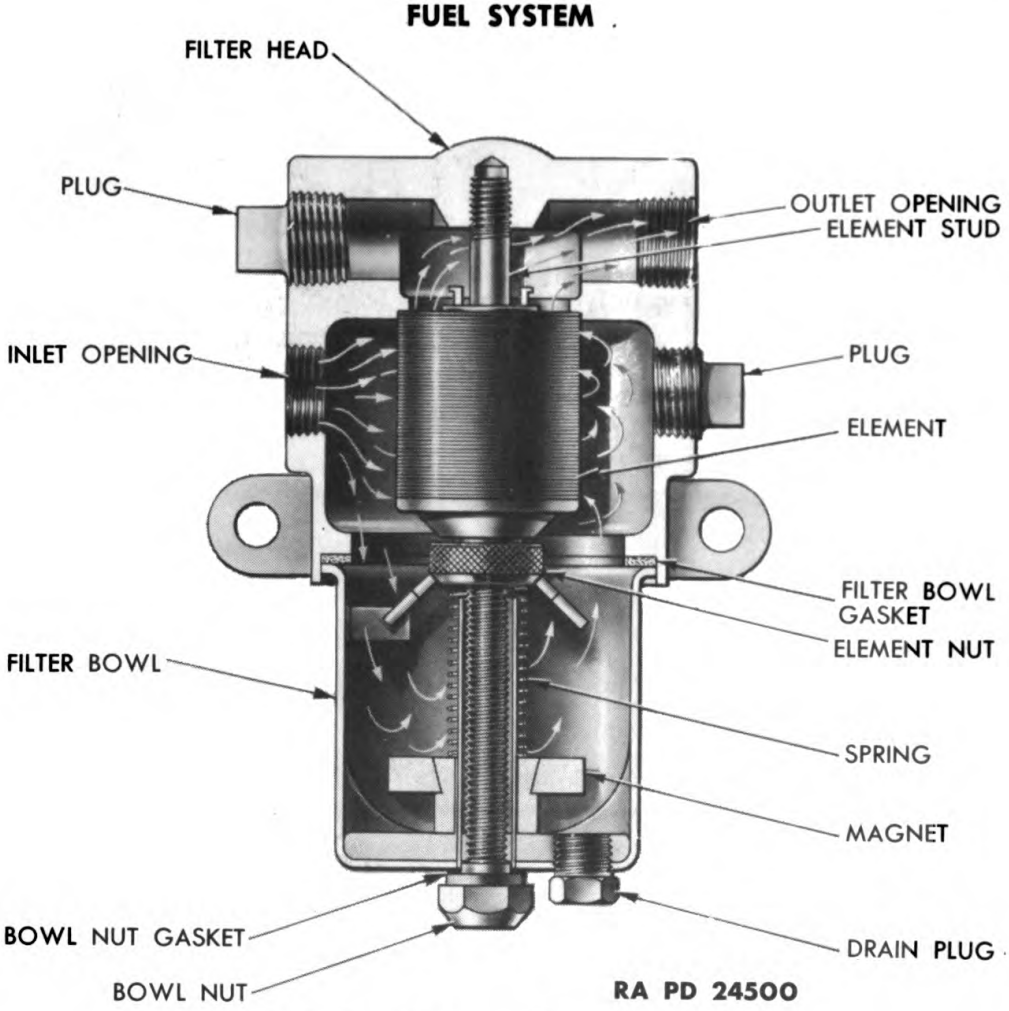

Figure 58 — Fuel Filter — Cross Sectional View

80. FUEL FILTER LINE.

a. Removal.

TOOLS.

WRENCH, 3/8-in.
WRENCH, 11/16-in.
WRENCH, open-end, 1/2-in. (2)
WRENCH, open-end, 9/16-in.
WRENCH, open-end, 7/8-in.
WRENCH, open-end, 15/16-in.
WRENCH, open-end, 1 1/8-in.
WRENCH, 1 1/2-in.

(1) PROCEDURE.

(a) Close Fuel Shut-off Valves (par. 78., b.).

(b) Open Power Unit Compartment Rear Doors (par. 52., b., (6)).

(c) Remove Filter and Solenoid Valve Assembly from Hull (par. 78., e., (1)).

(d) Remove Solenoid Valve from Filter (par. 78., e., (1), (a), 5.).

b. Installation.

TOOLS.

WRENCH, 3/8-in.	WRENCH, open-end, 1 1/2-in.
WRENCH, 1 1/8-in.	WRENCH, open-end, 1 1/8-in.
WRENCH, open-end, 9/16-in.	WRENCH, open-end, 1 3/8-in.
WRENCH, open-end, 7/8-in.	WRENCH, socket, 9/16-in.
WRENCH, open-end, 15/16-in.	WRENCH, extension, 3-in.

(1) PROCEDURE.

(a) Assemble Solenoid Valve to Filter (par. 78., **e.**, (2), (a), *1.*), (fig. 56).

(b) Install Filter and Valve Assembly in Power Unit Compartment (par. 78., **e.**, (2), (a), *3.*), (fig. 54).

(c) Connect Solenoid Valve Wires (par. 78., **e.**, (2), (a), *4.*).

(d) Connect Fuel Pump Inlet Tube (par. 78., **e.**, (2), (a), *5.*).

(e) Check Operation of Solenoid Shut-Off Valve (par. 78., **e.**, (2), (a), *6.*).

(f) Close Power Unit Compartment Rear Doors (par. 53., **a.**, (44)).

c. Clean Fuel Filter (on Vehicle).

TOOLS.

AIR, compressed, with hose and nozzle	PLIERS
PAN, open top (capacity, 1 gallon)	WRENCH, 11/16-in.
	WRENCH, 1 1/8-in.

(1) PROCEDURE.

(a) Open Power Unit Compartment Rear Doors (par. 52., **b.**, (6)).

(b) Close Fuel Shut-Off Valves (par. 78., **b.**).

(c) Remove Filter Element (fig. 57).

PLIERS	WRENCH, 11/16-in.

Remove bowl nut (turn counterclockwise) and lower filter bowl until it clears element stud (11/16-in. wrench) (fig. 57). Unscrew element nut from element stud (turn counterclockwise) (fingers). **CAUTION**: Since the disks of the element act like lock washers, pliers may be required to remove the element nut. Never twist the element when removing. Lower element until it clears element stud and withdraw it from power unit compartment.

(d) Clean Element and Filter Bowl.

PAN, open top (capacity, one gallon)
Air, compressed, with hose and nozzle.

Hold the element disks firmly together and rinse thoroughly in SOLVENT, dry-cleaning, to remove all loose dirt from the surface (pan). Separate the element disks, with fingers, and wash the element thoroughly in SOLVENT, dry-cleaning, to remove the dirt which has hardened on the surface. Hold the element nut over one end of the element and apply compressed air to the inside of the element, to remove any dirt which may have lodged between the element disks (air). Rinse spring, magnet and filter bowl thoroughly in SOLVENT, dry-cleaning, to remove all dirt which may have accumulated.

(e) Assemble Element to Filter Head.

Position element on element stud by sliding element over stud, screw element nut on stud and tighten securely (with fingers only) against bottom of element. CAUTION: Do not use tools to tighten the element nut. Finger tightness on the nut is sufficient. Never twist the element.

(f) Assemble Filter Bowl to Filter Head.

WRENCH, $\frac{11}{16}$-in.

Position *new* bowl gasket on flange of filter bowl, pass spring, magnet and filter bowl over element stud and raise filter bowl up until the gasket is seated firmly against the filter head. Hold filter bowl with one hand, position bowl nut gasket over element stud and screw bowl nut on element stud (turn clockwise). Tighten nut securely ($\frac{11}{16}$-in. wrench).

(g) Test for Leaks.

Open fuel shut-off valves by lowering shut-off valve control levers to limit travel (fig. 34), and examine all connections of filter for leaks.

(h) Close Power Unit Compartment Rear Doors (par. 53., **a.**, (44)).

81. CARBURETOR FUEL FILTER (REMOVABLE TYPE).

a. Removal.

TOOLS.

PLIERS, side cutting
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{13}{16}$-in.
WRENCH, $\frac{15}{16}$-in.

(1) PROCEDURE.

(a) Open Power Unit Compartment Cover (par. 55., **c.**, (1), (b)).

(b) Disconnect Flexible Fuel Tube.

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

Unscrew the flexible fuel tube at the end *nearest the fuel pump first* (turn counterclockwise) to permit swivel action in fuel line and to prevent damage to line. Disconnect flexible fuel tubes from carburetor fuel filter (turn counterclockwise).

(c) Remove Fuel Filter From Carburetor.

PLIERS, side cutting
WRENCH, open-end, $\frac{13}{16}$-in.

Remove locking wire which passes through holes in hexagon plug on bottom of filter and through hole in bracket on top of carburetor (side cutting pliers). Remove filter by unscrewing filter assembly from carburetor (turn counterclockwise) ($\frac{13}{16}$-in. open-end wrench).

b. Installation.

TOOLS.

PLIERS, side cutting
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{13}{16}$-in.
WRENCH, $\frac{15}{16}$-in.

(1) PROCEDURE.

(a) Install Fuel Filter on Carburetor.

PLIERS, side cutting
WRENCH, open-end, $\frac{13}{16}$-in.

Install filter by screwing it onto threaded nipple which protrudes through opening in side of carburetor (turn clockwise). Tighten securely, with filter in vertical position (fig. 47) ($\frac{13}{16}$-in. open-end wrench). Secure filter in place by passing a locking wire through holes in hexagon plug on bottom of filter and through holes in bracket on top of carburetor and twist two ends of wire together (side cutting pliers).

(b) Connect Flexible Fuel Tube.

WRENCH, open-end, $\frac{9}{16}$-inch.

Attach plain end of flexible fuel tube to filter by screwing the connection into fitting which is mounted on top of filter. Tighten connection securely. Tighten other end of fuel line to fuel distribution block.

(c) Test for Leaks.

Operate power unit and examine connections for leaks.

(d) Close power unit compartment cover (par. 55., **d.**, (1), (f)).

c. Clean Filter (on Vehicle) (Removable and Integral Type).

TOOLS.

AIR, compressed, with hose and nozzle
PAN, open-top (capacity, one gallon)
PLIERS, side cutting
WRENCH, open-end, $\frac{13}{16}$-in.
WRENCH, $\frac{15}{16}$-in.

(1) PROCEDURE.

(a) Open Power Unit Compartment Cover (par. 55., c., (1), (b)).

(b) Remove Filter Elements (figs. 47 and 48).

PLIERS, side cutting
WRENCH, open-end, $\frac{3}{16}$-in.

Remove locking wire which passes through holes in hexagon plug in bottom of filter and through holes in bracket on top of carburetor (side cutting pliers). Remove hexagon plug (turn counterclockwise) from bottom of fuel filter ($\frac{3}{16}$-in. open-end wrench).

(c) Clean Filter Element.

PAN, open-top (capacity, one gallon)
AIR, compressed, with hose and nozzle

Rinse element thoroughly in SOLVENT, dry-cleaning, to remove any dirt which may have accumulated on element (pan). Remove all dirt and SOLVENT, dry-cleaning, by applying compressed air to inside of filter element (air, compressed).

(d) Install Filter Element.

PLIERS, side cutting

Insert element through opening in bottom of filter (with plain end of element entering first). Position *new* gasket on hexagon plug and screw plug into opening in bottom of filter body (turn clockwise). Tighten nut with fingers only. Lock hexagon plug in place by passing locking wire through holes in plug and through holes in bracket on top of carburetor, and twist ends of wire together.

(e) Test for Leaks.

Operate power unit and examine all connections for leaks.

(f) Close Power Unit Compartment Cover (par. 55., d., (1), (f)).

82. FUEL GAGES.

a. Description. A fuel gage, mounted on the instrument panel, together with a gage mounted in each main fuel tank, registers the amount of fuel in each tank. The gage on the instrument panel is connected, through the fuel gage selector switch, also mounted on the instrument panel, directly above the fuel gage, to each fuel tank gage by means of a wire. The gage is put into operation when the ignition switch is turned "ON."

b. Operation. Pushing the lever on the fuel gage selector switch to side marked "RH," and noting reading on fuel gage, indicates the amount of fuel in right hand fuel tank. Pushing this same lever to side marked

"LH," and noting reading on fuel gage, indicates amount of fuel in left hand fuel tank.

c. Removal.

(1) INSTRUMENT PANEL. Refer to paragraph 176., **c.**, for detailed instructions.

(2) FUEL TANK.

TOOLS.

PAN, for fuel (capacity, 80 gallons)
SCREWDRIVER
WRENCH, Allen, $\frac{5}{16}$-in.
WRENCH, $\frac{3}{8}$-in.
WRENCH, $\frac{1}{2}$-in.
WRENCH open-end, $\frac{7}{8}$-in.
WRENCH, open-end, $1\frac{1}{16}$-in.

(a) Procedure.

1. Remove Fuel Tank (par. 77., **c.**).

2. Remove Fuel Gage Assembly.

SCREWDRIVER

Remove five screws and withdraw fuel gage assembly through opening in tank.

d. Installation.

(1) INSTRUMENT PANEL. Refer to paragraph 176., **d.**, for detailed instructions.

(2) FUEL TANK.

TOOLS.

SCREWDRIVER
WRENCH, Allen, $\frac{5}{16}$-in.
WRENCH, $\frac{3}{8}$-in.
WRENCH, $\frac{1}{2}$-in.
WRENCH, open-end, $\frac{7}{8}$-in.
WRENCH, open-end, $1\frac{1}{16}$-in.

(a) Procedure.

1. Install Fuel Gage in Tank.

SCREWDRIVER

Remove all traces of torn gaskets and foreign matter from mounting faces on both gage and tank. CAUTION: Be careful not to allow dirt to fall in tank. Position *new* gasket on gage mounting face of fuel tank, pass float of gage through opening in tank and position gage on tank. Aline holes in gage, gasket, and tank and secure with five screws. Tighten screws securely.

2. Install Fuel Tank in Sponson (par. 77., **d.**).

Section XVII

COOLING SYSTEM

83. COOLING SYSTEM.

a. Description. The water circulation is from the radiator lower tank through the water manifold to the water pump, being discharged from the water pump direct to the engine cylinder block. The coolant enters the cylinder block into a water distributor tube, located between the cylinders and valve ports, the tube directing coolant against the exhaust valve ports which are the hottest spots in the engine. The cooling solution is then circulated through the full length water jackets around the cylinder walls and out the radiator end of each individual engine and into the radiator where the heat in the solution is dissipated. Return of the coolant from the individual engines to the radiator is regulated by thermostats which are located in the water passages. The capacity of the cooling system is 32 gallons.

b. A pressure vent valve maintains a vapor pressure on the system which raises the boiling point of the coolant. It prevents loss of coolant through the overflow, and eliminates the possibility of a vacuum forming in the cooling system. An overflow pipe is provided and extends from the radiator upper tank, over the top of the power unit to the rear of the power unit compartment. The opening in this pipe must be kept open at all times as it also acts as the pressure relief line.

c. Drain Cocks (figs. 20 and 21) are provided for each cylinder block, except No. 2 engine, at the distributor end. The drain cock for No. 2 engine is located on the underside of the cylinder block.

d. A fan is mounted on the main power unit output shaft (fig. 59) and draws air through the power unit air inlet grille at the top of the power unit compartment back of the turret and from the fighting com-

MEDIUM TANK M4A4

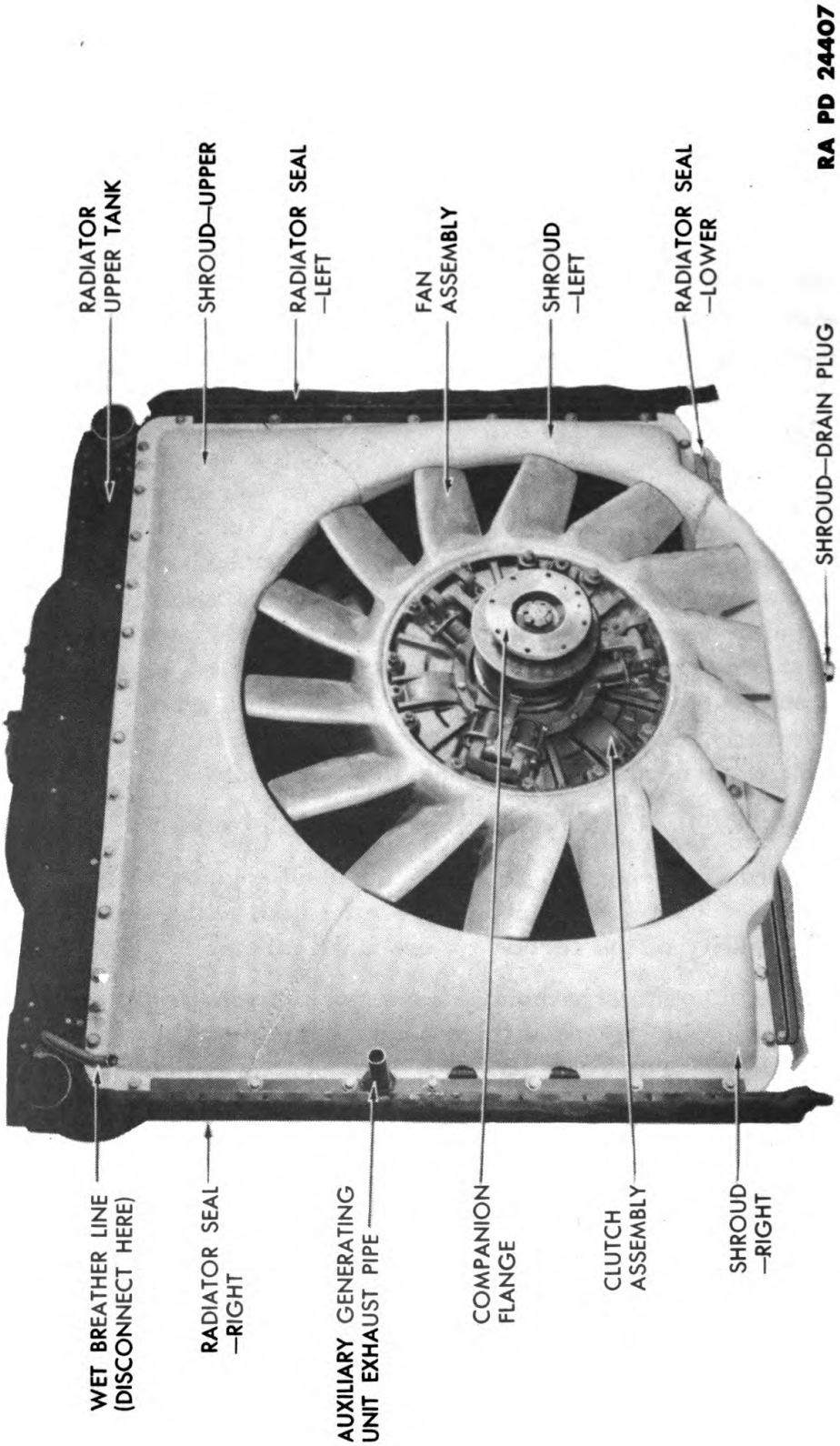

Figure 59 — Front View Power Unit

partment past the power unit oil cooler and transmission oil cooler. The air is forced by the fan through the radiator core and around the power unit.

e. Multiple Water Pump Type (up to and including vehicle serial number 5803). The power unit is water cooled by a system consisting of a single radiator, a single fan, two water manifolds and five individual water pumps (one for each engine). The water manifold at the right, as viewed from the distributor end of the power unit (fig. 20), supplies coolant to the water pumps of Nos. 4 and 5 engines. The water pumps of engines Nos. 1, 2 and 3 are supplied by the water manifold at the left of the power unit (fig. 20), as viewed from the distributor end of the power unit. The coolant from engines Nos. 4 and 5 is returned by a manifold connecting to the upper right hand corner of the radiator. The coolant from engines Nos. 2 and 3 is returned by a manifold connecting to the upper left hand corner of the radiator. The coolant from engine No. 1 is returned direct to the radiator by a tube connected to the radiator upper tank at the center. The five water pumps are inter-connected by means of metal tubing connected to the water pump body, in order to expel all air from the cooling system.

f. Single Water Pump Type (after vehicle serial number 5803) The power unit is water cooled by a system consisting of a single radiator, a single fan, two water manifolds and a single water pump. The two water manifolds, one entering the water pump from the right and the other from the left, supply the coolant to the water pump, which, in turn, discharges it to the individual engines by tubing direct to the cylinder blocks (fig. 21). The coolant from engines Nos. 4 and 5 is returned by a manifold connecting to the upper right hand corner of the radiator (fig. 25). The coolant from engines Nos. 2 and 3 is returned by a manifold connecting to the upper left hand corner of the radiator (fig. 23). The coolant from engine No. 1 is returned direct to the radiator by a tube connected to the radiator upper tank, at the center (fig. 26).

g. Drain Cooling System.

TOOLS.

PAN, for water (capacity, 35 gallons)
PLIERS, side cutting
WRENCH, 1⅛-in.
WRENCH, drain plug, $\frac{7}{16}$-in. square
WRENCH, drain plug, ¾-in. square

(1) PROCEDURE.

(a) Remove Drain Plug in Floor of Hull.

WRENCH, drain plug, ¾-in. square

Remove drain plug from plate in floor of hull, directly below center of radiator.

(b) Remove Radiator Drain Plug (fig. 36).

WRENCH, drain plug, $\frac{7}{16}$-in. square

Reach through opening in hull floor and remove radiator drain plug (turn counterclockwise).

(c) Open Power Unit Compartment Rear Doors (par. 52., **b.**, (6)).

(d) Open Drain Cocks (figs. 20 and 21).

PLIERS, side cutting

Remove locking wire and open cylinder block drain cocks (turn counterclockwise) located in distributor end of engines Nos. 1, 3, 4 and 5. NOTE: Drain cock of No. 2 engine is located on the underside of No. 2 engine, with tube extending to the rear of engine.

h. Fill Cooling System.

TOOLS.

PLIERS, side cutting
WRENCH, drain plug, $\frac{7}{16}$-in. square
WRENCH, drain plug, ¾-in. square
WRENCH, 1⅛-in.

(1) PROCEDURE.

(a) Install Radiator Drain Plug (fig. 36).

WRENCH, drain plug, $\frac{7}{16}$-in. square

Install radiator drain plug. Tighten securely.

(b) Close Drain Cocks.

PLIERS, side cutting

Close drain cocks in distributor end of engines. Tighten and lock in place with locking wire (figs. 20 and 21).

(c) Fill cooling system, capacity 32 gallons. NOTE: Use rust resistor in the cooling system. Apply twice a year—when antifreeze is added in the fall or after it has been removed in the spring. CAUTION: In cases where the label on an antifreeze solution package indicates that a rust inhibitive agent is already contained in the solution, do not add rust resistor until cooling system is drained for spring and summer operation. Pour one and one-half gallons of rust resistor in the cooling system, filling to level with clear water. NOTE: When the United States Specification 14108 antifreeze solution is used, no rust resistor need be added to

the cooling system. Sufficient rust inhibitor is put in the antifreeze to take care of the system needs.

(d) Check for Water Leaks.

(e) Install Drain Plug in Floor of Hull.

WRENCH, drain plug, 3/4-in. square

Install drain plug in plate on floor of hull, directly below center of radiator. Tighten securely.

(f) Close Power Unit Compartment Rear Doors (par. 53., a., (44)).

i. Antifreeze Solution.

(1) Protect the cooling system by using antifreeze in the cooling system at the approach of freezing weather. Make sure sufficient antifreeze is added to guard against any sudden drop in temperature.

(2) When an antifreeze is required, use an ethylene glycol and triethanolamine phosphate solution as outlined in U. S. Air Corps Specification No. 14108. The following table shows antifreeze requirements and the corresponding protection.

Freezing Point	Gallons of Antifreeze Required
0 F.	10.6
−10 F.	12.5
−20 F.	14.1
−30 F.	15.4
−40 F.	16.7
−50 F.	17.8
−60 F.	18.9

(3) Take the following precautions before installing the antifreeze solution.

(a) Flush cooling system thoroughly. Flush the radiator and individual engine cylinder blocks separately in order not to transfer any residue from one to the other.

(b) Check the system for leaks; tighten hose connections and replace, if necessary.

(c) Check the water pump drive belts (on multiple water pump type) for adjustment or weakness. Replace belts if necessary.

(d) Lubricate water pumps.

(4) Determine the freezing point of the cooling system solution by testing with a hydrometer made for this purpose. Test the solution at the temperature for which the hydrometer is calibrated. Test the solution after each run and add sufficient antifreeze to protect the system.

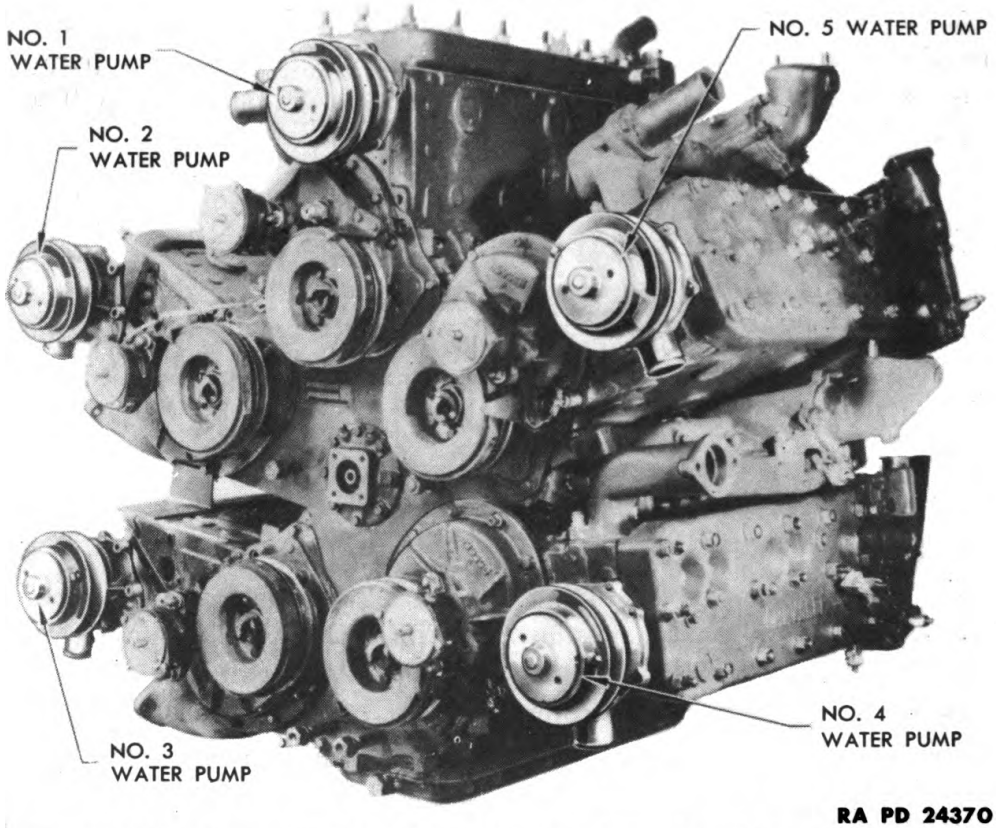

Figure 60 — Power Unit — Showing Location of Multiple Water Pumps

84. WATER PUMP (MULTIPLE TYPE).

a. Description.

(1) Each individual engine is equipped with a water pump, being bolted to the engine block at the distributor end of engine (fig. 20). Water enters the pump through a tube connected to the outer edge of the pump body, being discharged direct to the cylinder block.

(2) The water pumps are mechanically the same and of the centrifugal type, however, they are not interchangeable as complete assemblies. Three types of pumps are used on the power unit. The Nos. 2 and 3 engines use one body and the Nos. 4 and 5 engines a second type body (fig. 60). The difference in these pump bodies is the location of the inlet and the method of mounting on cylinder block. The water pump body of No. 1 engine differs in construction from either of the other two types. The water pumps of Nos. 2, 3, 4 and 5 engines are attached to the cylinder block as a complete assembly, while No. 1 engine water pump body plate is attached to the cylinder block and the body is then attached to the pump body plate (fig. 63).

(3) The pumps are driven by "V" type belts off the impulse neutralizer pulleys. The water pump drive belts on engines Nos. 3, 4 and

COOLING SYSTEM

5 are of the same length and interchangeable. The No. 2 water pump belt is longer and drives the generator as well as the water pump. The No. 1 water pump belt is the shorter (fig. 20).

b. Preventive Maintenance. Keep all hose connections and mounting screws tight. Keep drive belt properly adjusted (par. 86., **d.**).

c. Replacement. The water pumps can be removed with the power unit in the vehicle. Due to the different method used in attaching the water pump to No. 1 engine, it is necessary that instructions pertaining to the removal and installation of the respective water pumps be followed.

d. Removal.

TOOLS.

PAN, for water (capacity, 35 gallons)
PLIERS, side cutting
SCREWDRIVER
WRENCH, open end, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{1}{2}$-in.
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{5}{8}$-in.
WRENCH, open-end, $\frac{3}{4}$-in.
WRENCH, $1\frac{1}{8}$-in.
WRENCH, drain plug, $\frac{7}{16}$-in. square
WRENCH, drain plug, $\frac{3}{4}$-in. square
WRENCH, spanner, closed, No. MTM-A4-7

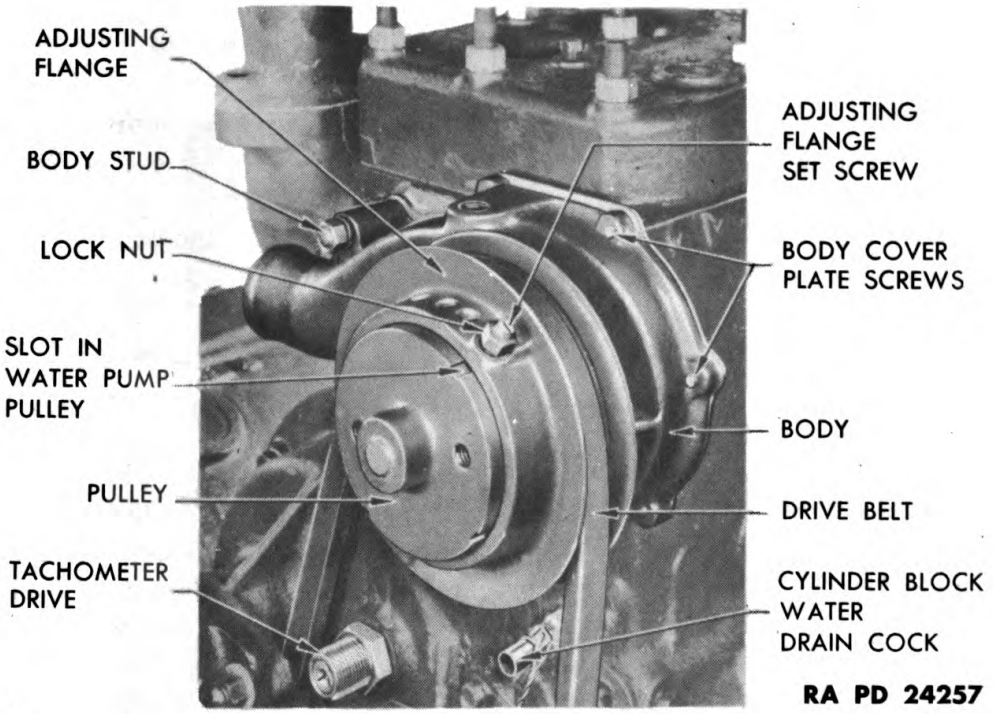

Figure 61 — Water Pump Complete — No. 1 Engine, Multiple Type

MEDIUM TANK M4A4

(1) PROCEDURE.

(a) Drain Cooling System (par. 83., *9.*).

(b) Open Power Unit Compartment Rear Doors (par. 52., **b.**, (6)).

(c) Disconnect Air Relief Metal Tubing from Water Pump Body (fig. 20).

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

Remove two nuts from air relief tubing, disconnecting tubing from connector in water pump body.

(d) Loosen Adjusting Flange Set Screw.

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

Loosen lock nut (1/2-in. open-end wrench) on set screw holding pulley flange and loosen set screw (screwdriver) sufficiently to permit turning of flange (fig. 61).

(e) Remove Adjusting Flange.

WRENCH, spanner, closed, No. MTM-A4-7

Unscrew adjusting flange from pulley hub (turn clockwise) (fig. 62).

(f) Remove Drive Belt from Pulley.

(g) Disconnect Hose Connections to Water Pump Body.

PLIERS, side cutting

Remove locking wire from hose clamp thumb screws, loosen and move hose clamp toward water pump body until it is clear of hose, twist hose and then remove hose from pump.

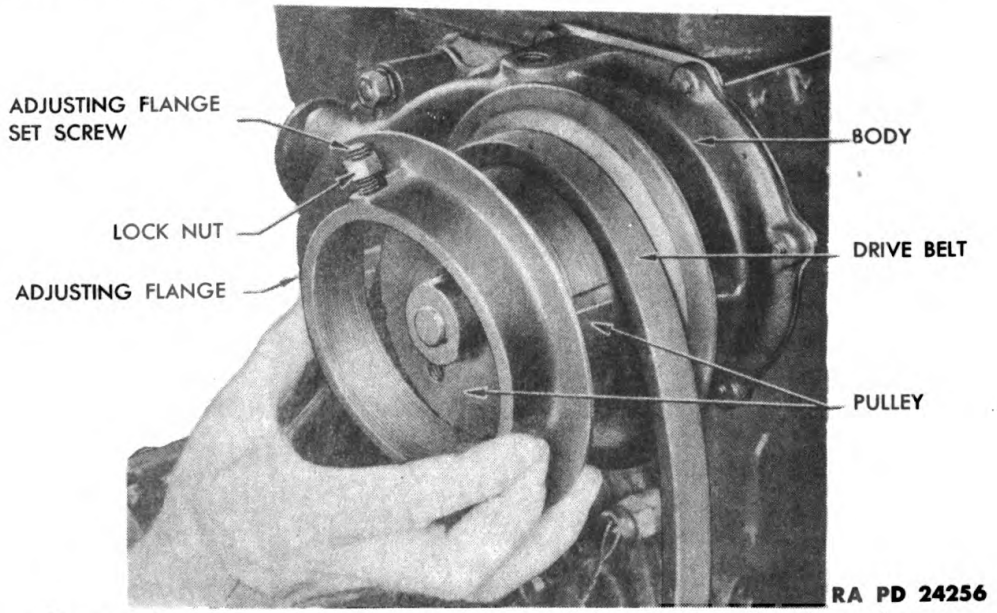

Figure 62 — Removing Water Pump Drive Belt Adjusting Flange — Multiple Type Pump

(h) Remove Two Nuts from Water Pump Body Mounting Studs (engine No. 1 only). Remove three cap screws which secure pump to engine (engines Nos. 2, 3, 4 and 5 only).

WRENCH, open-end, ¾-in.

Remove the two nuts and lock washers from studs which secure pump to cylinder block. CAUTION: Do not attempt to remove water pump from engine (figs. 61 and 63). (No. 1 engine only.)

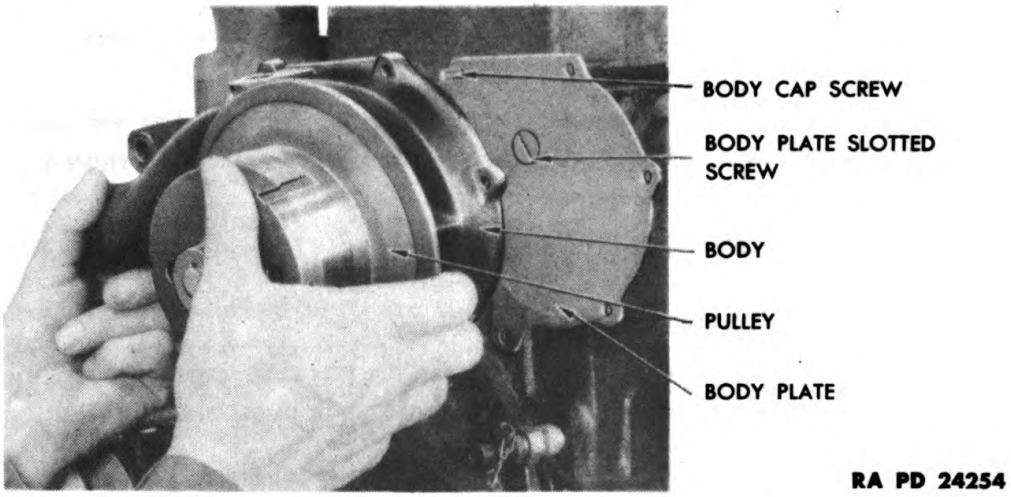

Figure 63 — Removing No. 1 Engine Water Pump — Multiple Type

(i) Remove Body Cover Plate Screws.

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

Remove four body cover plate cap screws which secure the water pump body to water pump body plate. Leave body plate on cylinder block (fig. 63). (No. 1 engine only.)

(j) Remove Water Pump from Engine.

All connections now being disconnected, remove water pump from engine.

e. Installation.

TOOLS.

GUN, grease
PLIERS, side cutting
SCREWDRIVER
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, ½-in.
WRENCH, open-end, ⅝-in.
WRENCH, open-end, ¾-in.
WRENCH, 1⅛-in.
WRENCH, drain plug, $\frac{7}{16}$-in. square
WRENCH, drain plug, ¾-in. square
WRENCH, spanner, closed, MTM-A4-7

MEDIUM TANK M4A4

(1) PROCEDURE.

(a) Remove All Traces of Torn Gaskets from Mounting Faces of Water Pump Body and Cover Plate.

(b) Lubricate Water Pump Bearings.

GUN, grease

Apply GREASE, general purpose, to the two lubrication fittings on water pump body until it is forced out through bearings.

(c) Mount Water Pump Body to Plate. (Engine No. 1 only.)

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

Paint both sides of *new* gasket with sealer, position gasket on water pump body and attach body to body plate with four cap screws and lock washers. *Do not tighten cap screws.*

(d) Mount Water Pump Body to Engine. (Engines Nos. 2, 3, 4 and 5 only.)

WRENCH, open-end, $\frac{3}{4}$-in.

Paint both sides of *new* gasket with sealer, position gasket to engine and attach body with three cap screws and lock washers and tighten securely.

(e) Install Nuts on Water Pump Body Mounting Studs.

WRENCH, open-end, $\frac{3}{4}$-in.

Install three nuts and lock washers on water pump body studs and tighten nuts securely (fig. 61).

(f) Tighten Body to Plate Screws. (No. 1 engine only.)

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

Tighten four body cover cap screws securely (fig. 61).

(g) Mount Hose Connection to Water Pump Body.

PLIERS, side cutting.

Place *new* hose clamp on water pump inlet tube before hose is connected. Cover outside of inlet tube with sealer, and force hose on tube a sufficient distance to permit installation of clamp on hose, beyond beading on end of tube. NOTE: Make sure the hose clamp is located on the hose in such position that end of hose extends approximately one-half inch beyond clamp. Tighten hose clamp screws securely, insert locking wire through holes in the two thumb screws and twist ends of wire together to secure.

(h) Install Water Pump Drive Belt.

Place belt in groove in neutralizer and over pulley on water pump body.

(i) Install Adjusting Flange.

SCREWDRIVER — No. MTM-A4-7
WRENCH, spanner, closed, — WRENCH, open-end, ½-in.

Screw adjusting flange (fig. 62) on pump hub (turn counterclockwise) (No. MTM-A4-7 closed spanner wrench). Adjust drive belt as outlined in paragraph 86., **d.**

(j) Connect Air Relief Metal Tubing to Water Pump Body.

WRENCH, open-end, ⅝-in.

Screw tubing nuts into connector mounted in water pump body.

(k) Fill Cooling System and Check for Leaks (par. 83., **h.**).

(l) Close Power Unit Compartment Doors (par. 53., **a.**, (44)).

f. Lubrication.

(1) Two lubrication fittings, located in the water pump body, are provided for lubricating the water pump bearings. CAUTION: Do not over-lubricate pump bearings. Over-lubrication of the bearings will force grease into cooling system. Three "SHOTS" of GREASE, general purpose, will ordinarily be sufficient.

85. WATER PUMP (SINGLE TYPE).

a. Description.

(1) A single water pump is mounted to the crankcase at the distributor end of the power unit (fig. 64). Water enters the pump through two water manifolds, one from the right side and the other from the left side, being discharged from pump directly to the cylinder blocks of the five engines by individual tubes. The water pump is of the centrifugal type and is driven off the accessory shaft.

b. Preventive Maintenance. Keep all connections tight, both hose clamps and mounting stud nuts.

c. Removal.

TOOLS.

PAN, for water (capacity, 35 gallons)
PLIERS, side cutting
SCREWDRIVER
WRENCH, socket, $\frac{7}{16}$-in.
WRENCH, open-end, ½-in.
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, 1⅛-in.
WRENCH, drain plug, $\frac{7}{16}$-in. square
WRENCH, drain plug, ¾-in. square

MEDIUM TANK M4A4

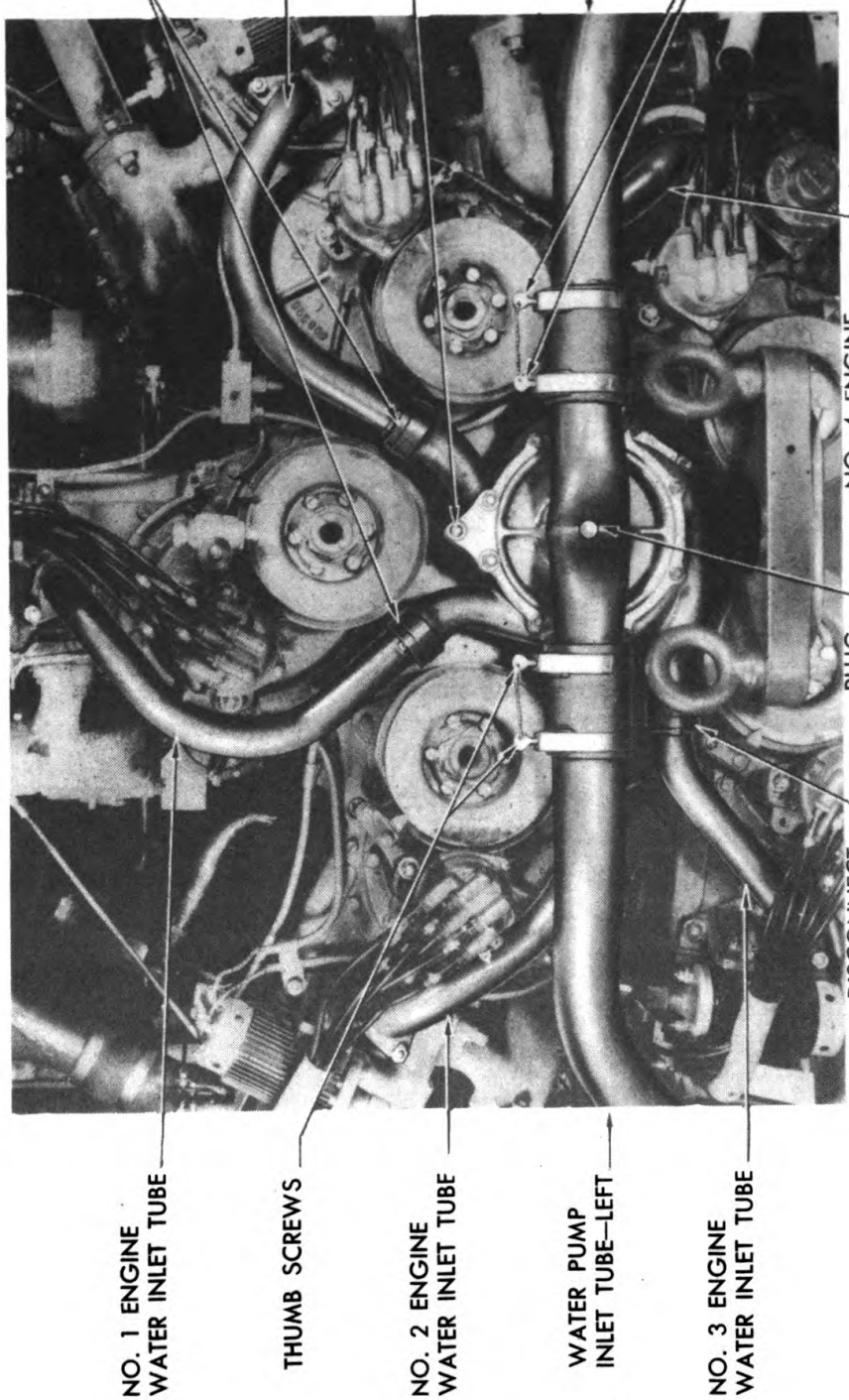

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Figure 64 — Water Pump and Connections — Single Type

(1) PROCEDURE.

(a) Drain Cooling System (par. 83., g.).

(b) Open Power Unit Compartment Rear Doors (par. 52., b., (6)).

(c) Remove Impulse Neutralizers from Engines Nos. 2 and 5.

PLIERS, side cutting **WRENCH**, socket, $\frac{7}{16}$-in.

Remove two cap screws and lift pointer off mounting boss. Remove locking wires from the six cap screws which secure neutralizer to crankshaft (side cutting pliers) and remove the cap screws ($\frac{7}{16}$-in. socket wrench).

Slide neutralizer over starting jaw on end of crankshaft and remove.

(d) Remove Lifting Eyes (fig. 28).

BAR, pinch

Place a pinch bar through opening in lifting eye, turn counterclockwise, and unscrew the two eyes from power unit rear support.

(e) Disconnect Water Pump Inlet Tubes—Right and Left (fig. 64).

PLIERS, side cutting

Remove locking wires, loosen thumb screws, and slide hose clamp on each tube toward pump, and clear of hose. Pull tube and hose off pump housing.

(f) Remove Engine Water Inlet Tubes (fig. 64).

PLIERS, side cutting **WRENCH**, open-end, $\frac{7}{16}$-in.

Remove locking wires (side cutting pliers) and remove the two cap screws which attach each of the five tubes to outlet tubes from water pump (near pump) ($\frac{7}{16}$-in. open-end wrench). Remove two nuts and lock washers, which attach each tube to engine ($\frac{7}{16}$-in. open-end wrench) and slide tubes off studs and remove.

(g) Remove Water Pump from Crankcase (fig. 21).

WRENCH, open-end, ½-in.

Reach back of water pump and remove the seven nuts and lock washers which attach water pump to crankcase. Remove water pump assembly from mounting studs.

d. Installation.

TOOLS.

BAR, pinch
GUN, grease
PLIERS, side cutting
SCREWDRIVER
WRENCH, socket, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, $\frac{11}{16}$-in.
WRENCH, $1\frac{1}{8}$-in.

MEDIUM TANK M4A4

(1) PROCEDURE.

(a) Prepare Parts for Assembly.

WRENCH, $\frac{11}{16}$-in.

Remove all traces of torn gaskets and foreign matter from mounting faces of water pump, crankcase, the five engine water inlet tubes (both ends) and engines, where tubes mount. Remove hexagon plug from center of water pump body ($\frac{11}{16}$-in. wrench) (fig. 64).

(b) Lubricate Water Pump Bearings.

GUN, grease

Apply gun, grease, to lubrication fitting on face of water pump (figs. 21 and 64) and force GREASE, general purpose, into fitting until it is forced through other side of bearing.

(c) Paint the Mounting Faces of Both Water Pump Body and Crankcase with Sealer.

(d) Install Water Pump on Crankcase (fig. 64).

SCREWDRIVER
WRENCH, $\frac{11}{16}$-in.
WRENCH, open-end, ½-in.

Position *new* gasket on mounting face of water pump, place pump in position to install, insert screwdriver through opening in center of pump housing to contact slot in end of impeller shaft, turn shaft to aline splines on end of shaft and slide pump into position on mounting studs. Install seven lock washers and nuts on mounting studs and tighten to 14 to 17 foot-pounds of torque (½-in. open-end wrench; torque wrench). Screw hexagon plug into opening in center of pump ($\frac{11}{16}$-in. wrench).

(e) Install Engine Water Inlet Tubes (fig. 64).

PLIERS, side cutting
WRENCH, open-end, $\frac{7}{16}$-in.

NOTE: It will be noted these tubes are not interchangeable, therefore it will be necessary to select the proper tube to be installed. Paint mounting faces of tubes, water pump and engines with sealer. Position *new* gasket on engine and *new* gasket on water pump opening flange, slide end of tube over mounting studs on engine and into position on water pump flange. Install two cap screws to attach tube to water pump. Install two nuts and lock washers on mounting studs on engine. Tighten nuts and cap screws securely ($\frac{7}{16}$-in. open-end wrench). Insert lock wire through holes in heads of the two cap screws, at pump end, and twist ends of wire together to secure (side cutting pliers). Repeat operation to install the other four tubes.

(f) Connect Water Inlet Tubes (Right and Left) (fig. 64).

PLIERS, side cutting

Remove all foreign matter from around openings on water pump and

inside hoses. Position *new* hose clamps over bosses of water pump and slide toward pump as far as possible. Paint hose mounting faces on pump with sealer. Force hoses over openings in water pump, slide hose clamps over end of hoses and position so that one-half inch of hose protrudes through clamp. Tighten thumb screws. Insert locking wire through holes in both thumb screws, on one hose, and twist ends of wire together to secure (side cutting pliers).

(g) Install Impulse Neutralizers on Engines Nos. 2 and 5 (fig. 45).

PLIERS, side cutting WRENCH, socket, $\frac{7}{16}$-in.

NOTE: The mounting holes of neutralizers are unevenly spaced, to simplify installation. Position neutralizer on mounting hub on crankshaft, install six cap screws and tighten securely ($\frac{7}{16}$-in. socket wrench). Insert locking wires through holes in heads of cap screws, locking cap screws together in pairs, and twist ends of wires to secure (side cutting pliers). Position pointer on boss adjacent to neutralizer and attach with two cap screws and lock washers. Tighten cap screws securely ($\frac{7}{16}$-in. socket wrench).

(h) Check for Water Leaks.

Fill cooling system (par. 83., **h.**). Operate power unit and check for water leaks.

(i) Install Lifting Eyes (fig. 28).

BAR, pinch

Screw lifting eyes into openings in power unit rear support.

(j) Close Power Unit Compartment Rear Doors (par. 53., **a.**, (44)).

e. Lubrication.

(1) A lubrication fitting, is provided for lubricating the water pump. On earlier model pumps, this fitting is located on the water pump cover, with a metal tube connecting the fitting to the water pump body (figs. 21 and 64). On later model pumps, this fitting is located on the water pump body, directly above the bearings (fig. 67).

CAUTION: Do not over-lubricate the bearings. Lubricate pump while power unit is running. Apply three "shots" of GREASE, general purpose, to fitting every 25 hours or 250 miles of operation.

86. WATER PUMP DRIVE BELT (MULTIPLE PUMP TYPE).

a. General. Adjust the drive belts when they have loosened sufficiently to permit "whipping" of belt when power unit is operating. Replace all belts, regardless of condition, after 100 hours or 1,000 miles of operation.

b. Removal.

TOOLS.

SCREWDRIVER
WRENCH, open-end, ½-in.
WRENCH, 1⅛-in.
WRENCH, spanner, closed, MTM-A4-7

(1) PROCEDURE.

(a) Open Power Unit Compartment Rear Doors (par. 52., **b.**, (6)).

(b) Loosen Adjusting Flange Set Screw.

SCREWDRIVER
WRENCH, open-end, ½-in.

Loosen lock nut (½-in. open-end wrench) on set screw holding pulley flange and loosen set screw (screwdriver) sufficiently to permit turning of flange (fig. 61).

(c) Remove Adjusting Flange.

WRENCH, spanner, closed, MTM-A4-7

Unscrew adjusting flange from pulley hub (turn clockwise) (fig. 62).

(d) Remove Drive Belt from Pulley.

c. Installation.

TOOLS.

SCREWDRIVER
WRENCH, open-end, ½-in.
WRENCH, 1⅛-in.
WRENCH, spanner, closed, MTM-A4-7

(1) PROCEDURE.

(a) Install Water Pump Drive Belt.

Place belt in groove in neutralizer and over pulley on water pump body.

(b) Install Adjusting Flange.

SCREWDRIVER
WRENCH, open-end, ½-in.
WRENCH, spanner, closed, MTM-A4-7

Screw adjusting flange (fig. 61) on pump hub (turn counterclockwise) (MTM-A4-7 closed spanner wrench). Adjust drive belt as outlined in par. 86, **d.**

d. Adjust.

TOOLS.

SCREWDRIVER
WRENCH, 1⅛-in.
WRENCH, open-end, ½-in.
WRENCH, spanner, closed, MTM-A4-7

(1) PROCEDURE.

(a) Open Power Unit Compartment Rear Doors (par. 52., b., (6)).

(b) Loosen Adjusting Flange Set Screw (fig. 61).

SCREWDRIVER
WRENCH, open-end, ½-in.
WRENCH, spanner, closed, MTM-A4-7

Loosen lock nut (½-in. open-end wrench) on set screw holding pulley flange and loosen set screw (screwdriver) sufficiently to permit turning of flange.

(c) Adjust Belt.

SCREWDRIVER
WRENCH, open-end, ½-in.
WRENCH, spanner, closed, MTM-A4-7

Turn flange counterclockwise (MTM-A4-7 closed spanner wrench) until there is between ½-inch and ⅝-inch slack in belt when measured by pushing inward midway between water pump and distributor. Tighten set screw (screwdriver) and lock nut (½-in. open-end wrench).

87. HOSE CONNECTIONS.

a. Description. The water tubes and fittings have a raised beading at the ends that are connected to rubber hose. The hose clamp is not of sufficient diameter to permit passing the clamp over the beading, with the hose in place on the beading. The hose clamp thumb screws are drilled to receive locking wires.

b. Removal.

TOOLS.
PLIERS, side cutting

(1) PROCEDURE.

(a) Remove Locking Wire from Hose Clamps.

PLIERS, side cutting

Remove locking wire from hose clamp thumb screws and loosen screws.

(b) Slide Hose Clamp Until It Clears End of Hose.

(c) Pull Hose Off End of Tubes.

c. Installation.

TOOLS.
PLIERS, side cutting

(1) PROCEDURE.

(a) Clean Outside Surface of Tube Thoroughly, Removing All Foreign Matter.

MEDIUM TANK M4A4

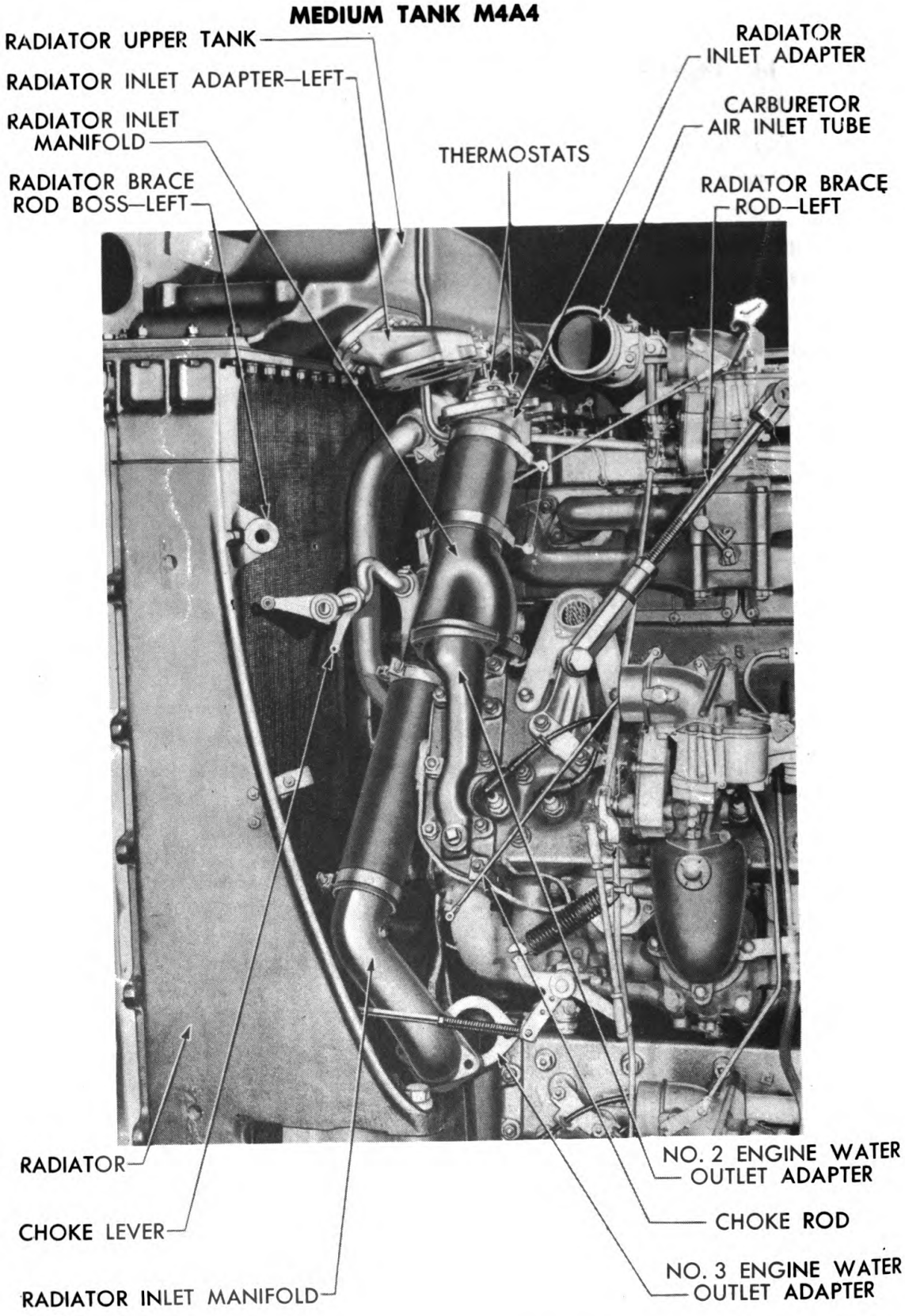

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Figure 65 — Bypass Thermostat Locations

(b) Make sure hose clamps are in good condition and have not been distorted.

(c) Position hose clamp on tube, a sufficient distance to permit installation of the hose.

(d) Paint outside surface of the tube with sealer and force hose on tube a sufficient distance to permit installation of clamp on hose, beyond beading on end of tube.

(e) Position clamp on hose and tighten thumb screws. NOTE: Make sure the hose clamp is located on the hose in such position that end of hose extends approximately one-half inch beyond clamp.

(f) Lock Thumb Screws.

PLIERS, side cutting

Tighten hose clamp thumb screws and lock with locking wire.

88. THERMOSTAT.

a. Description. Five thermostats are used to control the water temperature in the cooling system. Two types of thermostats are used, the choke type, and the bypass type. They maintain a constant power unit water temperature during operation and reduce the warm-up time of the power unit. They are set to maintain a power unit water temperature of 145 F. when the cooling system is at atmospheric pressure or 160 F. when the pressure on the cooling system is 8 pounds per square inch.

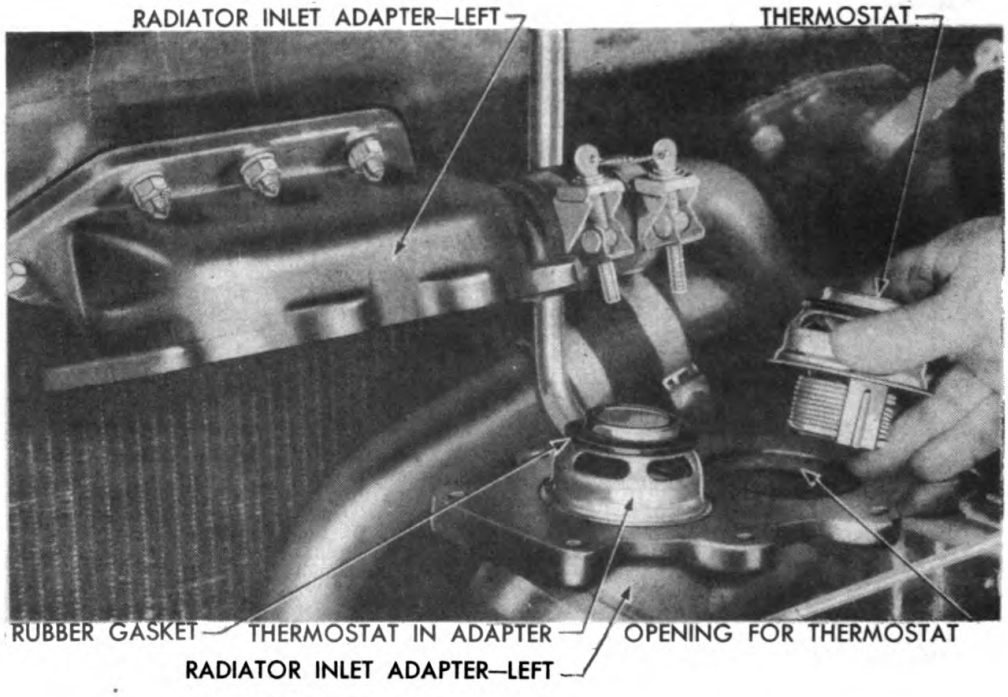
(1) The choke type thermostat, located, one in each individual engine, in top of cylinder head of No. 1 engine and in radiator inlet manifold for engines Nos. 2, 3, 4 and 5, was used in production from vehicle serial number 4805 to vehicle serial number 6204 and from vehicle serial number 16555 to vehicle serial number 17112.

(2) The bypass type thermostat, located in the top of cylinder head of No. 1 engine, in the radiator inlet adapter—left for engines Nos. 2 and 3 and in the radiator inlet adapter—right for engines Nos. 4 and 5 entered production at vehicle serial number 17112 although this bypass type of thermostat was used in several vehicles prior to vehicle serial number 17112.

b. Operation.

(1) GENERAL. During the warm-up period, the thermostat shuts off the flow of water through the system; thus, no coolant flows through the radiator, and all of the heat normally dissipated by it is used to warm up the coolant and power unit. As the coolant is warmed up and reaches

MEDIUM TANK M4A4



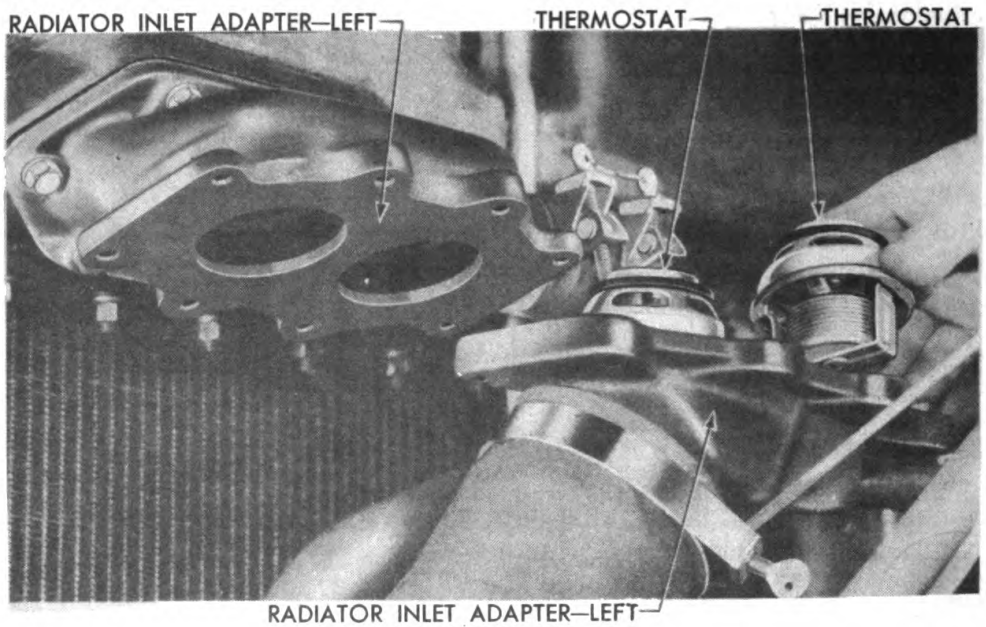


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Figure 66 — Removing Bypass Thermostat

approximately 160F. a valve in the thermostat opens, allowing coolant to flow to the radiator. The thermostat will regulate the flow of the coolant through the radiator so that the coolant temperature will be held at 160 F. In extremely hot weather, the thermostat will permit free flow of the coolant through the radiator. The thermostat valve will be open when the coolant temperature reaches 180 F. Under these conditions, the operating temperature of the coolant will be from 90 F. to 110 F. above the outside air temperature.

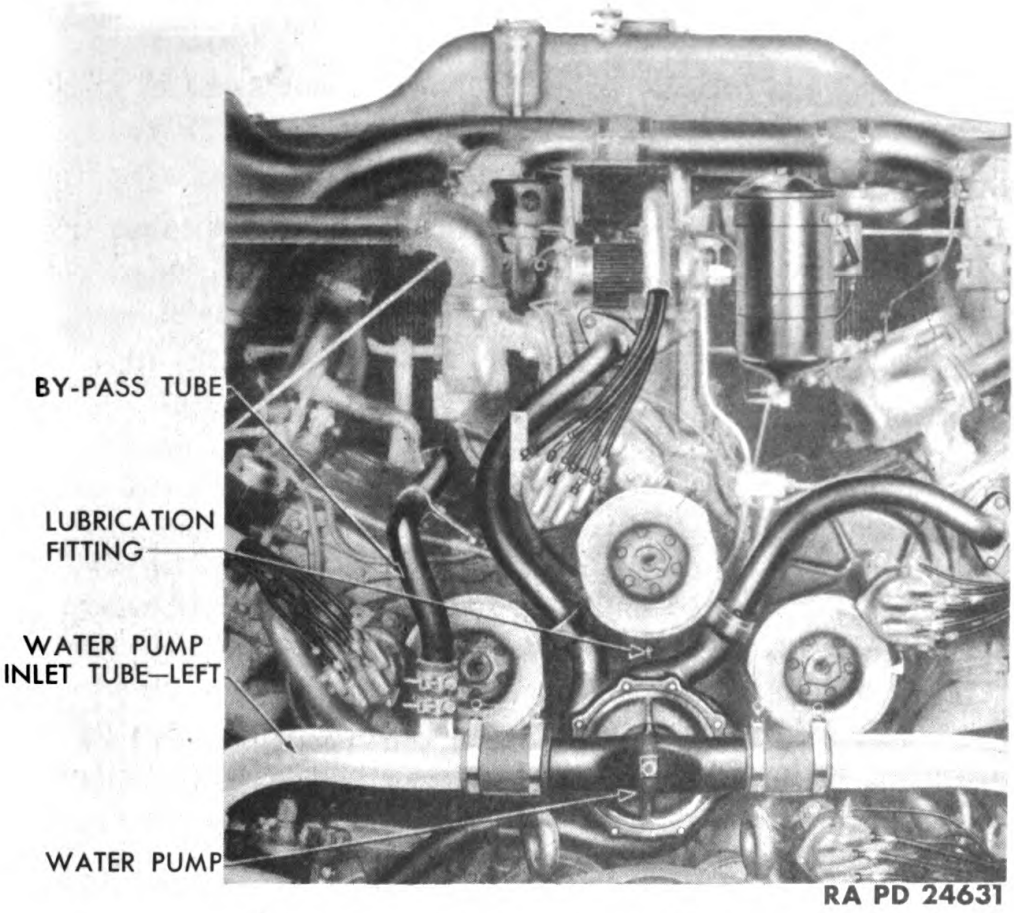

Figure 67 — Cooling System Bypass

(2) CHOKE TYPE. The choke type thermostat retains the coolant in the individual engine until the temperature of the coolant reaches 160 F. at which time the thermostat opens, allowing the coolant to circulate through the radiator.

(3) BYPASS TYPE. During the warm-up period, the thermostat directs all of the coolant through a bypass tube which connects the No. 1 engine water outlet adapter with the radiator inlet adapters, both right and left. In this manner, the coolant is circulated through the cooling

systems of each individual engine, thus decreasing the warm-up time. As soon as the temperature of the coolant reaches 160 F. the thermostat opens, permitting the coolant to circulate through the radiator.

c. General. A faulty thermostat will be indicated by slow power unit warm-up and low coolant temperature (indicated by water temperature gage) (fig. 10). When removed, and allowed to cool to air temperature, the valve will remain open. Due to method of installation, it is necessary that instructions pertaining to the removal and installation of the respective thermostat be followed.

d. Removal (Choke Type).

TOOLS.

PAN, for water (capacity, 35 gallons)
PLIERS, side cutting
WRENCH, drain plug, $\frac{7}{16}$-in. square
WRENCH, drain plug, ¾-in. square
WRENCH, $\frac{9}{16}$-in.
WRENCH, open-end, ½-in.
WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, socket, $\frac{11}{16}$-in.
WRENCH, $\frac{15}{16}$-in.
WRENCH, 1-in.

(1) PROCEDURE.

(a) Drain Cooling System (par. 83., g.).

(b) Remove Power Unit Compartment Cover (par. 52., b., (5)).

(c) Disconnect Hose. (Engine No. 1 only.)

PLIERS, side cutting

Remove locking wire, loosen thumb screws, slide hose clamp off hose and towards adapter on cylinder head. Twist hose and slide it over center radiator inlet adapter (fig. 26) until lower end of hose clears end of adapter on cylinder head.

(d) Remove Engine Water Outlet Adapter and Thermostat. (Engine No. 1 only.)

WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, socket, $\frac{11}{16}$-in.

Remove three pal nuts and three cylinder head stud nuts (toward radiator side of adapter) ($\frac{11}{16}$-in. socket wrench). Remove five nuts and lock washers which secure adapter to cylinder head ($\frac{9}{16}$-in. socket wrench). Lift adapter off studs and lift thermostat out of opening in cylinder head.

(e) Remove Radiator Inlet Manifold (figs. 23 and 25). (Engines Nos. 2, 3, 4 or 5.)

WRENCH, open-end, ½-in.
WRENCH, $\frac{9}{16}$-in.

COOLING SYSTEM

Remove eight cap screws which attach radiator inlet adapter to radiator upper tank (fig. 26) (½-in. open-end wrench). Remove two cap screws which attach manifold to adapter on Nos. 2 and 3 engine cylinder head, also two cap screws which attach manifold to adapter on Nos. 4 and 5 engine cylinder head ($\frac{9}{16}$-in. wrench). Separate manifold from radiator upper tank. Separate manifold from adapters on engines Nos. 2 and 3. Lift thermostat out of either No. 2, No. 3, No. 4 or No. 5 adapter.

e. Installation (Choke Type).

TOOLS.

PLIERS, side cutting
WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, socket, $\frac{11}{16}$-in.
WRENCH, 1-in.

(1) PROCEDURE.

(a) Clean Mounting Faces.

Remove all traces of torn gaskets and foreign matter from mounting faces of cylinder head and adapter.

(b) Install Thermostat and Adapter. (Engine No. 1 only.)

WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, socket, $\frac{11}{16}$-in.

Position thermostat in opening in cylinder head or with flange resting on seat in opening. Paint mounting faces of cylinder head and adapter with sealer. Position *new* gasket on cylinder head. Position adapter on cylinder head, install the eight attaching nuts and tighten securely ($\frac{11}{16}$-in. socket wrench, three nuts forward of adapter; $\frac{9}{16}$-in. socket wrench, five nuts on other side of adapter). Install pal nuts on three studs forward of adapter and tighten securely ($\frac{11}{16}$-in. socket wrench). Install pal nuts on five studs to rear of adapter and tighten ($\frac{9}{16}$-in. socket wrench).

(c) Connect Hose. (Engine No. 1 only) (fig. 26.)

PLIERS, side cutting

Position *new* hose clamp over adapter outlet. Twist holes and slide over this outlet, position clamp over end of hose, and tighten thumb screws securely. Insert locking wire through holes in ends of thumb screws and twist ends of wire together to secure (side cutting pliers).

(d) Install Thermostat in Adapter. (Engines Nos. 2, 3, 4 or 5.)

Position thermostat in engine water outlet adapter, with flange resting on seat in opening.

(e) Install Radiator Inlet Manifold. (Engines Nos. 2, 3, 4 or 5) (figs. 23 and 25.)

WRENCH, open-end, ½-in.
WRENCH, $\frac{9}{16}$-in.

Paint mounting faces of radiator upper tank, inlet manifold, and engine water outlet adapters of engines Nos. 2 and 3 or 4 and 5 with sealer.

Position *new* gaskets on the three mounting faces of inlet manifold. Position manifold on adapters on engines Nos. 2 and 3 or 4 and 5, and attach with two lock washers and cap screws each. Tighten cap screws securely ($\frac{9}{16}$-in. wrench). Position other end of manifold on radiator upper tank (fig. 26) and attach with eight lock washers and cap screws. Tighten cap screws securely (½-in. wrench).

(f) Test for Water Leaks.

Fill cooling system (par. 83., **h.**), operate power unit, allowing it to reach normal operating temperature, and check for water leaks.

(g) Install Power Unit Compartment Cover (par. 53., **a.**, (42)).

f. Removal (Bypass Type) (fig. 66).

TOOLS.

JACK
PAN, for water (capacity, 35 gallons)
PLIERS, side cutting
WRENCH, ½-in.
WRENCH, $\frac{5}{16}$-in.
WRENCH, 1-in.
WRENCH, drain plug, $\frac{7}{16}$-in. square
WRENCH, drain plug, ¾-in. square
WRENCH, extension, 4-in.
WRENCH, open-end, ⅞-in.
WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, socket, $\frac{11}{16}$-in.

(1) PROCEDURE.

(a) Drain Cooling System (par 83., **g.**).

(b) Remove Power Unit Compartment Cover (par. 52., **b.**, (5)).

(c) Disconnect Hose (Engine No. 1 only) (par. 88., **d.**, (1), (c)).

(d) Disconnect Bypass Hose (Engine No. 1 only).

PLIERS, side cutting

Remove locking wire, loosen thumb screws and slide hose toward radiator until it clears tube extending from engine outlet adapter.

(e) Remove Engine Water Outlet Adapter and Thermostat (Engine No. 1 only) (par. 88., **d.**, (1), (d)).

(f) Remove Carburetor Air Inlet Tube (Engines Nos. 2, 3, 4 or 5 only).

PLIERS, side cutting

Remove locking wires, loosen thumb screws and disconnect tube at upper corner of radiator, and at center, where tube assembly crosses power unit and where tube connects to carburetor (Nos. 2 and 3 or 4 and 5, depending on which thermostat is to be removed). Remove tube from power unit.

COOLING SYSTEM

(g) Disconnect Left Radiator Brace Rod (when removing No. 2 or 3 thermostat only).

WRENCH, $\frac{3}{8}$-in.

Loosen nut on bolt which secures rod to top of No. 2 engine cylinder head. Remove nut and bolt which attaches rod to radiator side support. Swing rod out of the way (fig. 65).

(h) Disconnect Choke Rods (to remove Nos. 2 and 3 thermostats only).

PLIERS, side cutting

Remove cotter pin and remove clevis pin which secures No. 2 carburetor choke rod to choke rod cross shaft. Allow choke rod to rest on top of No. 2 engine (fig. 65).

(i) Remove Hull Floor Inspection Plate (Engines Nos. 2, 3, 4 or 5 only).

JACK
WRENCH, 1-in.

If thermostats for engines Nos. 2 and 3 are to be removed, remove plate directly below No. 3 engine. If thermostats for engines Nos. 4 and 5 are to be removed, remove plate directly below No. 4 engine, to facilitate removal of water manifold from either No. 3 or No. 4 engine. Place jack under plate, to relieve strain from cap screws, remove cap screws and remove plate.

(j) Remove Radiator Inlet Manifold (Engines Nos. 2, 3, 4 or 5 only) (fig. 65).

PLIERS, side cutting
SCREWDRIVER
WRENCH, ½-in.
WRENCH, socket, $\frac{9}{16}$-in.; 4-in. extension

Reach through opening in hull floor and remove two cap screws which secure manifold to engine water outlet adapter, engines Nos. 3 or 4 ($\frac{9}{16}$-in. socket wrench, 4-in. extension). Reaching from top of power unit, remove two cap screws which secure manifold to engine water outlet adapter, engines Nos. 2 or 5 ($\frac{9}{16}$-in. socket wrench, 4-in. extension). Remove eight cap screws which secure the upper and lower sections of radiator inlet adapter, either right or left, depending on which thermostat is to be removed (½-in. wrench). Insert screwdriver between the two halves of the radiator inlet adapter, forcing the manifold towards the engines, at the same time forcing the two lower ends of manifold away from adapters, to provide clearance.

(k) Remove the Thermostat from Inlet Adapter (fig. 66).

Lift thermostat out of adapter.

g. Installation.

TOOLS.

JACK
WRENCH, ½-in.
WRENCH, $\frac{5}{16}$-in.
WRENCH, 1-in.
WRENCH, extension, 4-in.
WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, socket, $\frac{11}{16}$-in.

(1) PROCEDURE.

(a) Install Thermostat in Engine Water Outlet Adapter (Engine No. 1 only).

Remove all traces of torn gaskets from adapter and cylinder head, position thermostat in adapter so flange rests in counterbore. Position *new* rubber gasket on top of thermostat.

(b) Install Thermostat in Radiator Inlet Adapter (Engines Nos. 2, 3, 4 or 5 only) (fig. 66).

Remove all traces of torn gaskets and foreign matter from mounting faces of radiator inlet manifolds, engine water outlet adapters and radiator inlet adapters. Position thermostat in lower section of radiator inlet adapter, with flange of thermostat resting in counterbore in adapter.

(c) Install Engine Water Outlet Adapter (No. 1 engine only) (par. 88., e., (b)).

(d) Connect Bypass Hose (No. 1 engine only).

PLIERS, side cutting

Paint outside diameter of tube which extends from adapter with sealing compound, slide hose over tube and secure with hose clamp. Tighten hose clamp thumb screw. Insert locking wire through holes in the two thumb screws and twist ends of wire together to secure.

(e) Install Radiator Inlet Manifold (Engines Nos. 2, 3, 4 or 5) (fig. 65).

WRENCH, ½-in.
WRENCH, extension, 4-in.
WRENCH, socket, $\frac{9}{16}$-in.

Paint mounting faces of manifold, engine water outlet adapter and radiator inlet adapter with sealing compound. Position *new* gaskets on engine water outlet adapters and on radiator inlet adapter. Have one man hold upper end of manifold in position on radiator inlet adapter while other man reaches through opening in hull floor and positions lower end of manifold on engine water outlet adapters. Secure manifold to radiator inlet adapter with eight cap screws and lock washers (½-in. wrench). Secure manifold to the two engine water outlet adapters with two cap screws and lock washers each ($\frac{9}{16}$-in. socket wrench; 4-in. extension).

(f) Connect No. 2 Carburetor Choke Rod (if disconnected).

PLIERS, side cutting

Position choke rod on lever on choke cross shaft, insert clevis pin through clevis and lever. Insert cotter pin through hole in clevis pin and bend ends of cotter pin to secure.

(g) Connect Radiator Brace Rod (if disconnected).

WRENCH, $\frac{5}{8}$-in.

Swing rod into position, insert bolt through openings in rod and boss on radiator, install unit and tighten securely. Tighten nut on bolt which secures rod to No. 2 cylinder head.

(h) Install Carburetor Air Inlet Tube (fig. 26).

PLIERS, side cutting

Insert end of tube through opening at upper corner of radiator and insert in end of flexible tube which attaches to carburetor air cleaner. While making this connection, position tube to permit making connections at tube (across top of power unit) and at the respective carburetors. Position hose clamps and tighten thumb screws to secure. Insert locking wire through holes in thumb screws, twisting ends of wires to secure thumb screws in pairs.

(i) Test for Water Leaks.

Fill cooling system and check for leaks.

(j) Install Hull Floor Inspection Plate (if removed).

JACK WRENCH, 1-in.

Remove all traces of torn gaskets and foreign matter from hull floor and inspection plate. Place plate on jack and raise to proper position. Install cap screws and tighten securely.

(k) Install Power Unit Compartment Cover (par. 53., a., (42)).

89. FLUSH COOLING SYSTEM.

a. General. Flushing of the radiator and water passages in the power unit will be performed only when the power unit is removed from vehicle. The following instructions pertain to the cooling system when power unit is removed from vehicle.

b. Flush Radiator.

TOOLS.

GUN, flushing, MTM-C-311 WRENCH, $\frac{9}{16}$-in.
WRENCH, ½-in.

(1) PROCEDURE.

(a) Disconnect Water Inlet Manifolds (figs. Nos. 21, 22, 23 and 25).

WRENCH, ½-in. WRENCH, $\frac{9}{16}$-in.

Remove eight cap screws from each adapter (right and left) (½-in. wrench) and two cap screws from center ($\frac{9}{16}$-in. wrench), and separate the three radiator inlet adapters from radiator upper tank (fig. 26). Remove eight cap screws from each adapter (both right and left) (1½-in. wrench) and separate adapters from radiator lower tank (figs. 22 and 24).

(b) Apply Cooling System Cleaner.

GUN, flushing, MTM-C-311

Close one of the openings in radiator lower tank and attach flushing hose to other opening in lower tank. Flush, with cooling system cleaner until solution overflows through openings in upper tank. Remove hose and repeat procedure by attaching hose to other opening in lower tank.

c. Flush Power Unit Water Passages.

TOOLS.

GUN, flushing, MTM-C-311 WRENCH, $\frac{9}{16}$-in.
PLIERS, side cutting WRENCH, socket, $\frac{11}{16}$-in.

(1) PROCEDURE.

(a) Remove Thermostats.

WRENCH, $\frac{9}{16}$-in. WRENCH, socket, $\frac{11}{16}$-in.

Remove two cap screws at each flange, where radiator inlet manifolds (both right and left) attach to engine water outlet adapters, on engines Nos. 2, 3, 4 and 5 and remove manifolds (figs. 23 and 25) ($\frac{9}{16}$-in. socket wrench). Remove three pal nuts and three cylinder head stud nuts ($\frac{11}{16}$-in. socket wrench) from radiator side of No. 1 engine water outlet adapter. Remove five nuts ($\frac{9}{16}$-in. wrench) from reverse side of adapter and lift adapter from cylinder head. Remove thermostats (one from each engine).

(b) Disconnect Engine Water Inlet Tubes.

PLIERS, side cutting WRENCH, open-end, $\frac{7}{16}$-in.

Remove locking wires, loosen thumb screws, slide hose clamps off ends of hoses and separate water manifold from each of the five pumps (on multiple pump type) (fig. 20). Remove the five engine water inlet tubes (on single pump type) (par. 85., **c.**, (1), (f), (fig. 21).

(c) Apply Water Passage Cleaner.

GUN, flushing, MTM-C-311

Attach gun to openings in radiator end of engines and flush each engine until the solution overflows at distributor end.

(d) Install Engine Water Inlet Tubes.

PLIERS, side cutting WRENCH, open-end, $\frac{7}{16}$-in.

Clean all mounting faces and surfaces, removing all traces of torn gaskets and foreign matter. Position *new* hose clamps on ends of water manifolds (multiple pump type) (fig. 20). Position *new* hose clamps on water pumps, where hoses connect, paint inside diameter of *new* hoses with sealer, position hoses on water pumps, and insert manifolds into free ends of hoses. Position hose clamps on hose (just back of bead on tube) and tighten thumb screws securely. Insert locking wires through holes in thumb screws and wire together the two thumb screws on each hose. Install five engine water inlet tubes (on single water pump type) (par. 85., d., (1), (e), (fig. 21).

(e) Install Thermostats (par. 88., e., (1), (b) and (d); par. 88., g., (1), (a) and (b).

(f) Install Water Inlet Manifolds.

Remove all traces of torn gaskets and foreign matter from mounting faces of radiator inlet adapters and radiator upper tank. Paint mounting faces of engine No. 1 cylinder head and water outlet adapter, position *new* gasket on cylinder head and install adapter. Secure with three nuts on cylinder head studs and install pal nuts ($\frac{11}{16}$-in. wrench) and five nuts on opposite side of adapter ($\frac{9}{16}$-in. wrench). Paint mounting faces of water inlet manifolds and radiator upper tank, position *new* gaskets on ends of manifolds and adapters, attach manifolds to radiator upper tank, at right and left sides, and secure with eight cap screws each (½-in. wrench). Position *new* gaskets on water outlet adapters of engines Nos. 2, 3, 4 and 5 and attach manifolds to adapters, securing with two cap screws each ($\frac{9}{16}$-in. wrench). Paint mounting faces of radiator upper tank and radiator inlet adapter, center, with sealer, position *new* gasket on adapter and attach adapter to tank, securing with two cap screws ($\frac{9}{16}$-in. wrench).

90. RADIATOR.

a. Description.

(1) A fin and tube type radiator which consists of an upper tank, core, side supports and lower tank is bracket mounted to and in front of the power unit drive gear housing. An expansion joint is built into each side support to permit expansion and contraction of the radiator core. Two adjustable radiator struts attached to the Nos. 2 and 5

engines, provide additional support. Water pumped through the water passages of the individual engines passes into the upper tank and flows through the core to the lower tank from which it is drawn by the water pumps and re-circulated through the individual engines.

(2) A radiator filler cap of the hinged locking type, is located atop the upper tank (fig. 26). *Use caution when loosening the radiator cap to loosen the lock screw so that the pressure in the system may escape before the cap is free to swing back.*

(3) A pressure relief valve is mounted in the radiator upper tank (fig. 26). Discharge from this valve is through an overflow tube (fig. 21).

(4) A tube extends from the inside of the filler neck into the upper tank. Maintain the water level to the bottom of this tube at all times.

b. Removal.

TOOLS.

Tools for power unit removal (see par. 52).

Tools for clutch and flywheel removal (see par. 93).

BOLTS, ¾-10, 4-in. long (2)	WRENCH, $1\frac{5}{16}$-in.
HOIST	WRENCH, $1\frac{5}{16}$-in.
PLIERS, side cutting	WRENCH, socket, ½-in.
SLING	WRENCH, socket, $\frac{9}{16}$-in.

(1) PROCEDURE.

(a) Remove Power Unit from Vehicle (par. 52., b.).

(b) Remove Clutch and Flywheel Assembly (par. 93.).

(c) Remove Shroud (fig. 59).

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

Remove the cap screws holding the fan air shroud to the radiator assembly. Remove the upper section first. Both the top felt air seal and the lower felt air seal are mounted to the radiator assembly independently of the shroud and will not require removal if the same radiator is to be installed.

(d) Remove Radiator Outlet Adapter—Left (fig. 22).

WRENCH, socket, ½-in.

Remove the eight cap screws and lock washers which secure the radiator water outlet adapter to the radiator lower tank, just forward of No. 3 engine, and separate this adapter from the lower tank.

(e) Remove Radiator Outlet Adapter—Right (fig. 24).

WRENCH, socket, ½-in.

COOLING SYSTEM

Remove the eight cap screws and lock washers which secure the radiator water outlet adapter to the radiator lower tank, just forward of No. 4 engine, and separate this adapter from the lower tank.

(f) Remove Radiator Inlet Adapter—Left (fig. 26).

WRENCH, socket, ½-in.

Remove the eight cap screws and lock washers which secure the radiator water inlet adapter to the radiator upper tank, above No. 2 engine, and separate this adapter from the upper tank.

(g) Remove Radiator Inlet Adapter—Right (fig. 26).

WRENCH, socket, ½-in.

Remove the eight cap screws and lock washers which secure the radiator water inlet adapter to the radiator upper tank, above No. 5 engine, and separate this adapter from the upper tank.

(h) Remove Radiator Inlet Adapter—Center (fig. 26).

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

Remove the two cap screws and lock washers which secure the radiator water inlet adapter to the radiator upper tank, above No. 1 engine, and separate this adapter from the upper tank.

(i) Remove Radiator Brace Rods (figs. 22 and 24).

WRENCH, $\frac{15}{16}$-in.

Remove the bolt from each end of the radiator brace rods, which extend from the cylinder head of both Nos. 2 and 5 engines to the radiator side supports, and remove the rods.

(j) Remove Carburetor Main Throttle Rod (fig. 22).

PLIERS, side cutting

Push rod toward carburetor, compressing spring and exposing end of rod. Remove cotter pin and flat washer from end of rod and withdraw it through opening in radiator side support.

(k) Remove Radiator Assembly from Power Unit (fig. 68).

BOLTS, ¾-10, 4-in. long (2)
HOIST
SLING
WRENCH, $1\frac{5}{16}$-in.

Using a radiator sling and chain hoist, take weight off the radiator assembly (fig. 68). **NOTE**: One bolt, ¾-10, four inches long, in each radiator side support, as shown in figure 68 to receive sling. Then remove the four one-inch cap screws in the lower radiator supports ($1\frac{5}{16}$-in. wrench) and remove the radiator. **CAUTION**: Do not lift the radiator as it will strike the starter housing and damage the radiator, but take the weight of the radiator in chain hoist and then slide the assembly straight out away from power unit.

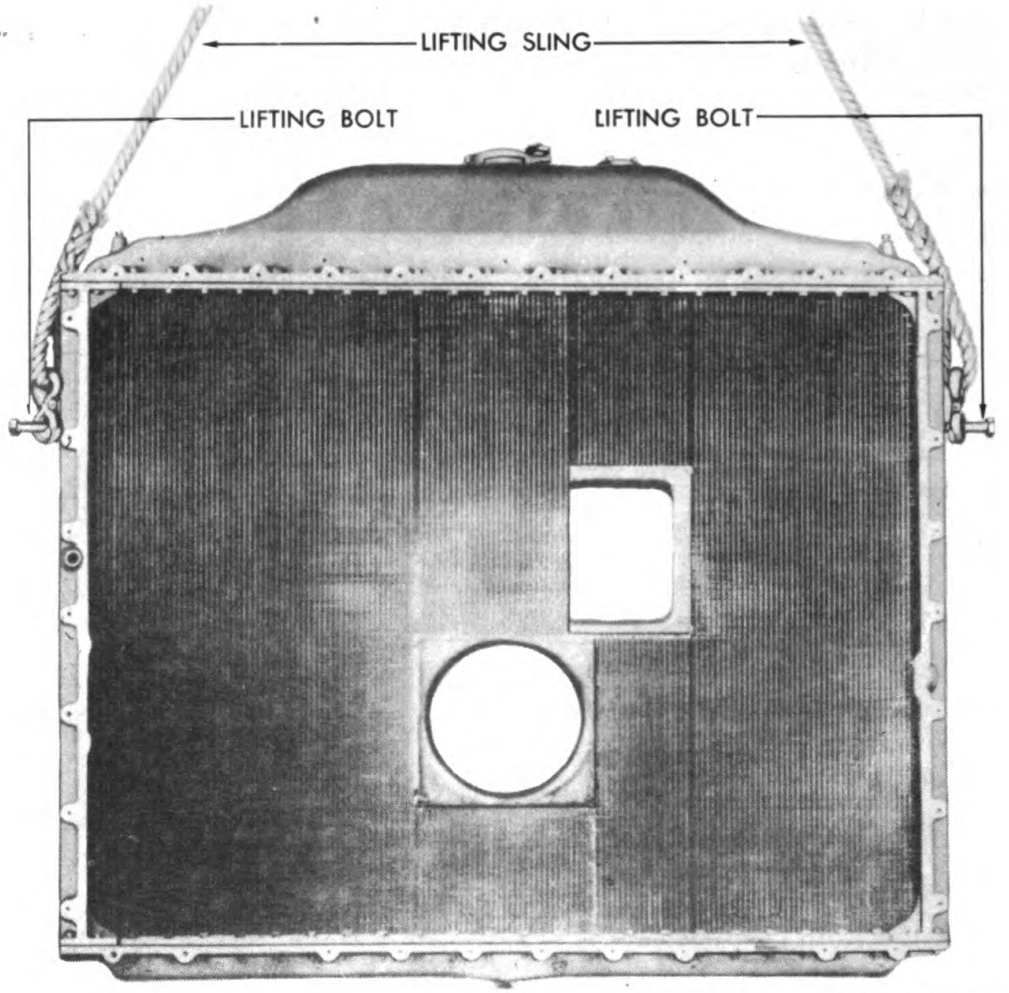

Figure 68 — Radiator Assembly in Lifting Sling

c. Installation.

TOOLS.

Tools for power unit installation (par. 53., a.).

Tools for clutch and flywheel installation (par. 94).

HOIST	WRENCH, socket, ½-in.
PLIERS, side cutting	WRENCH, socket, $\frac{9}{16}$-in.
SLING	WRENCH, $\frac{15}{16}$-in.

(1) PROCEDURE.

(a) Remove All Traces of Torn Gaskets and Dirt from All Water Connection Mounting Faces on Radiator Tanks, both upper and lower, and also from all water mounting faces on adapters.

COOLING SYSTEM

(b) Position Radiator Assembly for Reassembling to Power Unit.

HOIST SLING

Using a radiator sling and hoist, mount radiator assembly on radiator supports. CAUTION: Exercise care in mounting radiator on supports, alining the opening in radiator core for the starting motor so as not to strike the radiator core with the starting motor when installing radiator assembly, thus avoiding damage to the radiator core.

(c) Mount Radiator Assembly on Supports.

WRENCH, $1\frac{5}{16}$-in.

Aline mounting holes in radiator side supports with the holes in the radiator mounting brackets, and tighten the four one-inch bolts securely.

(d) Attach Radiator Brace Rods (figs. 22 and 24).

WRENCH, $\frac{15}{16}$-in.

Adjust the adjustable radiator brace rods so that attaching bolts at each end will enter freely and attach one rod from the cylinder head of No. 5 engine to the radiator side support and the other rod from the cylinder head of No. 2 engine to the radiator support. Tighten attaching bolts securely. Tighten clevis lock nuts on each brace rod securely.

(e) Install Radiator Inlet Adapter—Center (fig. 26).

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

Paint the mounting faces of both radiator and water inlet adapter with sealing compound, position *new* gasket on inlet adapter and attach adapter to radiator upper tank above No. 1 engine, securing with two cap screws and lock washers.

(f) Install Radiator Inlet Adapter—Right (fig. 26).

WRENCH, socket, ½-in.

Paint the mounting faces of both radiator and water inlet adapter with sealing compound, position *new* gasket on inlet adapter and attach adapter to radiator upper tank above No. 5 engine, securing with eight cap screws and lock washers.

(g) Install Radiator Inlet Adapter—Left (fig. 26).

WRENCH, socket, ½-in.

Paint the mounting faces of both radiator and water inlet adapter with sealing compound, position *new* gasket on inlet adapter and attach adapter to radiator upper tank above No. 2 engine, securing with eight cap screws and lock washers.

(h) Install Radiator Outlet Adapter—Left (fig. 22).

WRENCH, socket, ½-in.

Paint the mounting faces of both radiator and water outlet adapter with sealing compound, position *new* gasket on outlet adapter and attach adapter to radiator lower tank, just forward of No. 3 engine, securing with eight cap screws and lock washers.

(i) Install Radiator Outlet Adapter—Right (fig. 24).

WRENCH, socket, ½-in.

Paint the mounting faces of both radiator and water outlet adapter with sealing compound, position *new* gasket on outlet adapter and attach adapter to radiator lower tank, just forward of No. 4 engine, securing with eight cap screws and lock washers.

(j) Mount Side and Lower Section of Shroud (fig. 59).

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

Mount side and lower section of shroud on radiator, placing the side air seals on the outer face of the shroud and securing with the twenty cap screws, lock washers and plain washers provided.

(k) Mount Upper Section of Shroud (fig. 59).

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

Mount upper section of shroud to radiator, making sure the felt air seals are on the outer face of the shroud, securing temporarily with the fourteen cap screws, lock washers and plain washers provided. **NOTE:** Leave these cap screws loose to permit centering of the shroud to provide clearance for the fan blades, **NOTE:** If a new or rebuilt radiator is being installed, it will be necessary to transfer both the top and lower felt air seals to the radiator being installed.

(l) Connect Carburetor Main Throttle Rod (fig. 22).

PLIERS, side cutting

Pass the carburetor accelerator rod through opening in radiator side support and through opening in bell crank. Push rod, compressing spring and forcing end of rod through opening in bell crank. Install flat washer over end of rod and insert cotter pin through hole in end of rod and bend ends of cotter pin to secure.

(m) Install Clutch and Fan Assembly (par. 94., **a.**).

(n) Check for Sufficient Clearance for Fan Blades and Tighten Cap Screws.

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

Aline shroud to provide clearance for the fan blades, and tighten shroud attaching cap screws securely.

(o) Install Power Unit in Vehicle (par. 53., **a.**).

d. Clean Exterior of Radiator (on Vehicle).

(1) GENERAL. The need and frequency of cleaning radiator will depend upon the type of terrain over which the vehicle is being operated

TOOLS AND EQUIPMENT.

AIR SUPPLY, compressed
HOIST
HOSE, rubber (2), ½-in. inside diameter — 20 feet long
NOZZLE, spray
PAIL (capacity, 10 quarts)
PAIL (capacity, 5 gallons)
PLIERS, side cutting
POWDER, soap, 2 cups
SOLVENT, grease, 1½ gallons
WATER, hot
WRENCH, $\frac{9}{16}$-in.
WRENCH, drain plug, ¾-in. square
WRENCH, 1-in.

(2) PROCEDURE.

(a) Remove Power Unit Compartment Cover (par. 52., **b.**, (5)).

(b) Remove Power Unit Air Inlet Grille (par. 52., **b.**, (4)).

(c) Remove Shroud—Upper (fig. 59).

HOIST
PLIERS, side cutting
WRENCH, $\frac{9}{16}$-in.

Remove twelve cap screws, plain washers and lock washers from across top of shroud. Remove one cap screw, plain washer and lock washer from shroud, from either side, and loosen the two cap screws directly below, both right and left side (to permit removal of shroud). Remove locking wire, loosen thumb screw and disconnect carburetor air intake tube at upper left corner of radiator. Attach hoist to the two hooks near upper edge of shroud and remove shroud from vehicle. Connect carburetor air intake tube at upper left corner of radiator. (Do not tighten thumb screw.)

(d) Remove Drain Plug from Hull Floor.

WRENCH, drain plug, ¾-in. square

Unscrew drain plug (turn counterclockwise) from hull floor, directly below center of radiator.

(e) Clean Radiator.

AIR SUPPLY, compressed
HOSE, rubber (2), ½-in. inside diameter — 20 feet long
NOZZLE, spray
PAIL (capacity, 10 quarts)
PAIL (capacity, 5 gallons)
POWDER, soap, 2 cups
SOLVENT, grease, 1½ gallons
WATER, hot

MEDIUM TANK M4A4

1. Clean with SOLVENT, Grease.

Pour the SOLVENT, grease, into the PAIL, 10 quarts, and place the hose from the cleaning solution side of the NOZZLE, spray, in the pail. Connect the hose from the AIR, compressed, side of the NOZZLE, spray, to the AIR SUPPLY, compressed. The compressed air blowing through the NOZZLE, spray, will syphon the SOLVENT, grease, from the pail. Spray the SOLVENT, grease, on the fan side of the radiator until the dust and dirt is saturated. CAUTION: Do not attempt to blow through the radiator from the fan side to the power unit side until later. Spray the SOLVENT, grease, on the power unit side of the radiator until the dust and dirt on that side is saturated. Blow the SOLVENT, grease, through the radiator from the power unit toward the fan side of radiator until the solution coming through the radiator is clean. Clean off the remaining surface dirt on the fan side of the radiator by spraying SOLVENT, grease, on the surface and then blow through the radiator from the fan side to the power unit side until solution coming through the radiator is clean.

2. Clean with Soap and Hot Water Mixture.

Mix two cups of POWDER, soap, with four gallons of hot water in PAIL, five gallons capacity. Remove the hose from the SOLVENT, grease, pail and place it in the soap mixture pail. Spray the soap mixture through the radiator, from the power unit side, until the mixture coming through the radiator appears clean. Clean the dirt and foreign matter from the bottom of the shroud.

(f) Install Shroud—Upper (fig. 59).

HOIST
PLIERS, side cutting
WRENCH, $\frac{9}{16}$-in.

Disconnect carburetor air intake tube at upper left corner of radiator. Attach hoist to hooks on shroud and lower in place on radiator. Install twelve cap screws, plain washers and lock washers along top edge of shroud and one cap screw, plain washer and lock washer at either side. Tighten these cap screws, as well as the two cap screws on either side, directly below shroud, securely ($\frac{9}{16}$-in. wrench). Position carburetor air intake tube on metal tube at upper left of radiator and tighten thumb screw. Insert locking wire through hole in thumb screw, pass wire around tube and twist ends of wire together to secure (side cutting pliers).

(g) Install Power Unit Compartment Cover (par. 53., **a.**, (42)).

(h) Install Power Unit Air Inlet Grille (fig. 7). (Par. 53., **a.**, (42)).

(i) Install Drain Plug.

WRENCH, drain plug, ¾-in. square

Screw drain plug into opening in hull floor, directly below center of radiator.

COOLING SYSTEM

91. RADIATOR PRESSURE RELIEF VALVE.

a. Description. A pressure relief valve, located in the radiator upper tank, below the pressure relief valve cover (fig. 26) consists of a pressure valve to relieve pressure from the cooling system and a vent valve to admit air to the cooling system.

b. Function. The pressure valve maintains vapor pressure up to 8 pounds per square inch in the system. This pressure increases the boiling point of the coolant in the system to 235 F. The vent valve will admit air to the system if the pressure in the system is reduced to ¼ pound per square inch below atmospheric pressure. The pressure-vent valve prevents coolant loss by keeping the overflow line closed during normal operation of the unit.

c. Operation. The pressure-vent valve remains closed during normal operation of the power unit. If, during warm weather, the coolant temperature exceeds 212 F, the vapor pressure in the system will be higher than atmospheric pressure. At 235 F, the vapor pressure will be 8 pounds per square inch above atmospheric pressure. The pressure valve will relieve at 8 pounds per square inch. The vent valve opens to admit air to the radiator upper tank when the power unit is not operating and the temperature of the coolant is below normal. The pressure-vent valve discharges into the radiator overflow tube.

d. Removal.

(1) A faulty pressure relief valve will be indicated by coolant temperature not exceeding 212 F, and radiator emitting steam, through overflow tube, when coolant temperature is at 212 F.

TOOLS.

HOIST
WRENCH, ½-in.
WRENCH, 1-in.

(2) PROCEDURE.

(a) Remove Power Unit Compartment Cover (par. 52., b., (5)).

(b) Remove Pressure Relief Valve (fig. 26).

WRENCH, ½-in.

Remove four cap screws and lock washers and lift cover from radiator upper tank. Lift valve out of recess in tank.

e. Installation.

TOOLS.

HOIST
WRENCH, ½-in.
WRENCH, 1-in.

(1) PROCEDURE.

(a) Clean Mounting Surfaces.

Remove all traces of torn gaskets and foreign matter from mounting faces of cover and radiator upper tank.

(b) Install Pressure Relief Valve (fig. 26).

WRENCH, ½-in.

Position *new* radiator overflow pressure-vent valve gasket in bottom of recess in radiator upper tank. Position valve in recess in tank (with large diameter of valve down). Position *new* gasket on mounting face on radiator tank, install cover and secure with four cap screws and lock washers.

(c) Install Power Unit Compartment Cover (par. 53., **a.**, (42) (fig. 7).

Section XVIII

CLUTCH

92. DESCRIPTION.

a. A fully enclosed type of clutch was used in M4A4 production from vehicle serial number 4805 to serial number 6204, and from vehicle serial number 16555 to serial number 17794 (figs. 71 and 73). Beginning with vehicle serial number 17794, a ventilated type of clutch entered production (figs. 72 and 74). The ventilated type permits passage of air through openings provided in the flywheel ring gear, flywheel and fan assembly. Separator pins, providing a means of separating the driven disks and driving plate, are incorporated in the ventilated type of clutch. These clutch assemblies are interchangeable. However, if full ventilating results are to be obtained, it is necessary to replace the fan assembly with the ventilated type when using the ventilated type of clutch.

b. The clutch unit is of a multiple disk type, mounted inside the flywheel (fig. 59), and is located just forward of the radiator. It consists of two clutch driven discs (one outer and one inner), one driving plate, one pressure plate and six springs assembled to the flywheel ring.

c. The six springs are mounted in a carrier which is assembled to the flywheel ring. These springs are mounted flat to the flywheel ring (figs. 73 and 74).

d. The clutch used in the M4A4 Medium Tank is dissimilar to the clutch used in the previous Medium Tanks in that the clutch facings are riveted to the driven disks (both outer and inner) instead of being riveted to the flywheel, driving plate and pressure plate.

e. Clutch release bearings of the castor type are used in the early M4A4 production. An annular type release bearing entered production on the later model M4A4 vehicles. Both types of bearings are shown in figure 89.

f. Operation.

(1) The function of the clutch is to break the flow of power between the power unit and the transmission to facilitate shifting of gears. When the clutch is engaged, the entire load of the clutch springs presses the

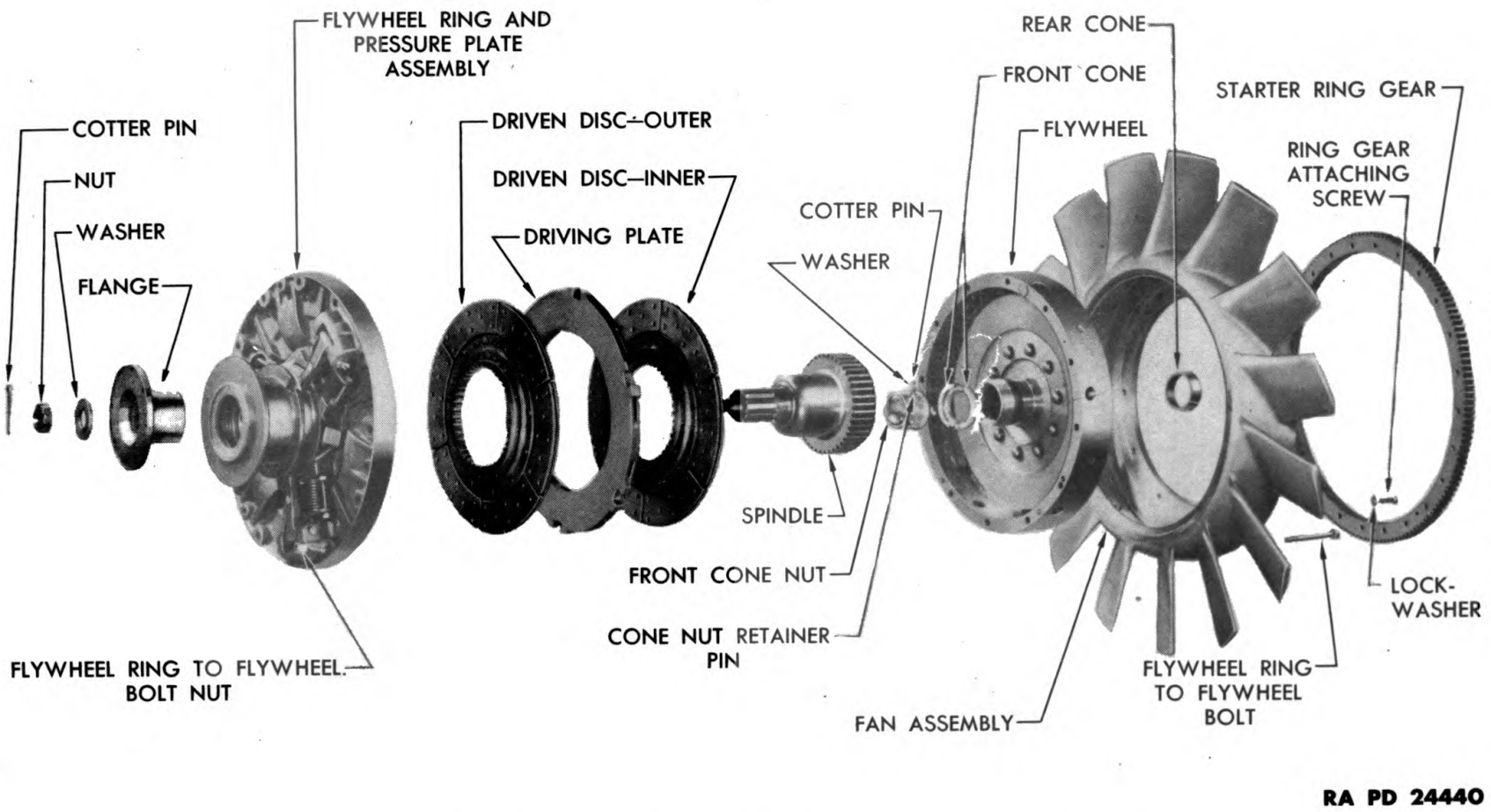

Figure 69 — Clutch and Fan Assembly — Exploded (Fully Enclosed Type)

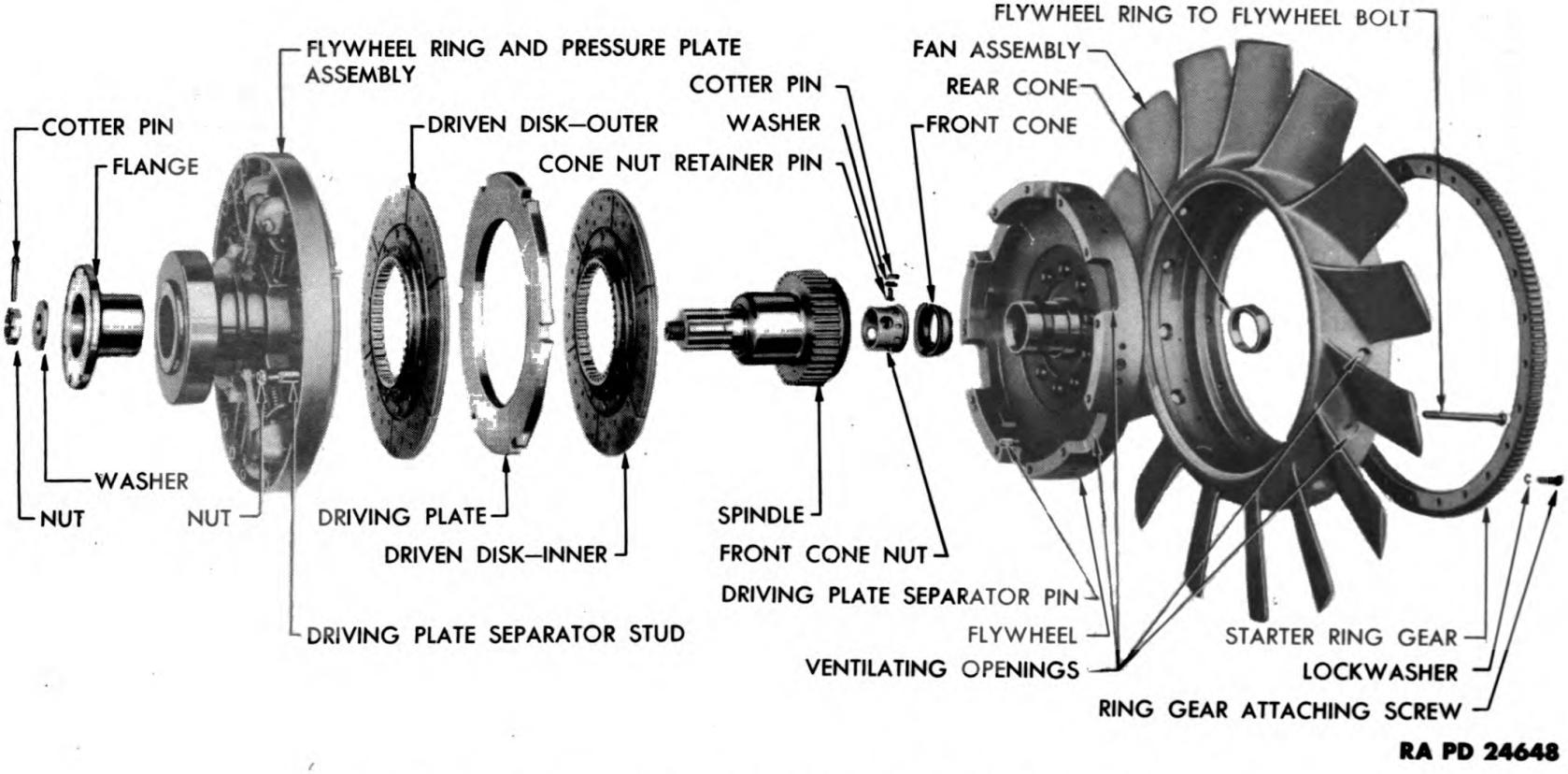

Figure 70 — Clutch and Fan Assembly — Exploded (Ventilated Type)

driving plates and the driven disks of the clutch together so that they rotate as a unit thus transmitting power from the power unit to the propeller shaft. When the clutch is disengaged, this spring load is released, allowing the driving plates to rotate independently of the driven disks, thus breaking the flow of power from the power unit.

g. Preventive Maintenance. Be sure the pedal has approximately 2¼-in. of free travel at all times. Do not rest foot on clutch pedal when clutch is engaged.

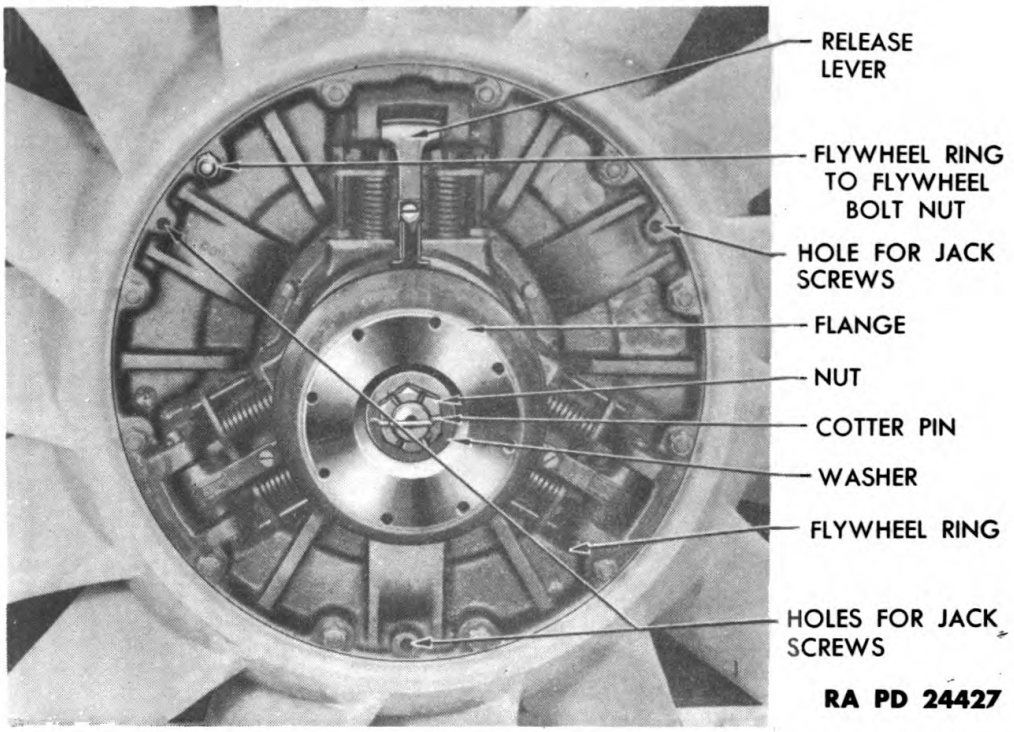

Figure 71 — Clutch and Fan Assembled (Fully Enclosed Type)

93. REMOVAL OF CLUTCH AND FLYWHEEL.

a. General. Due to the similarity of operations involved in the removal and installation of the clutch and flywheel, the following instructions cover both the fully enclosed type and the ventilated type clutch.

TOOLS.

TOOLS for power unit removal (par. 52., a.).
BAR, steel, tempered, ¾-in. x 72-in.
BLOCK, wood, 12-in. x 12-in. x 12-in.
BLOCK, wood, 2-in. x 4-in. x 18-in.
DRIFT, steel, ⅜-in. x 10-in.
HAMMER, brass
HAMMER, steel
HOIST
PLIERS, side cutting
PULLER, MTM-A4-4, clutch hub
PUNCH, prick

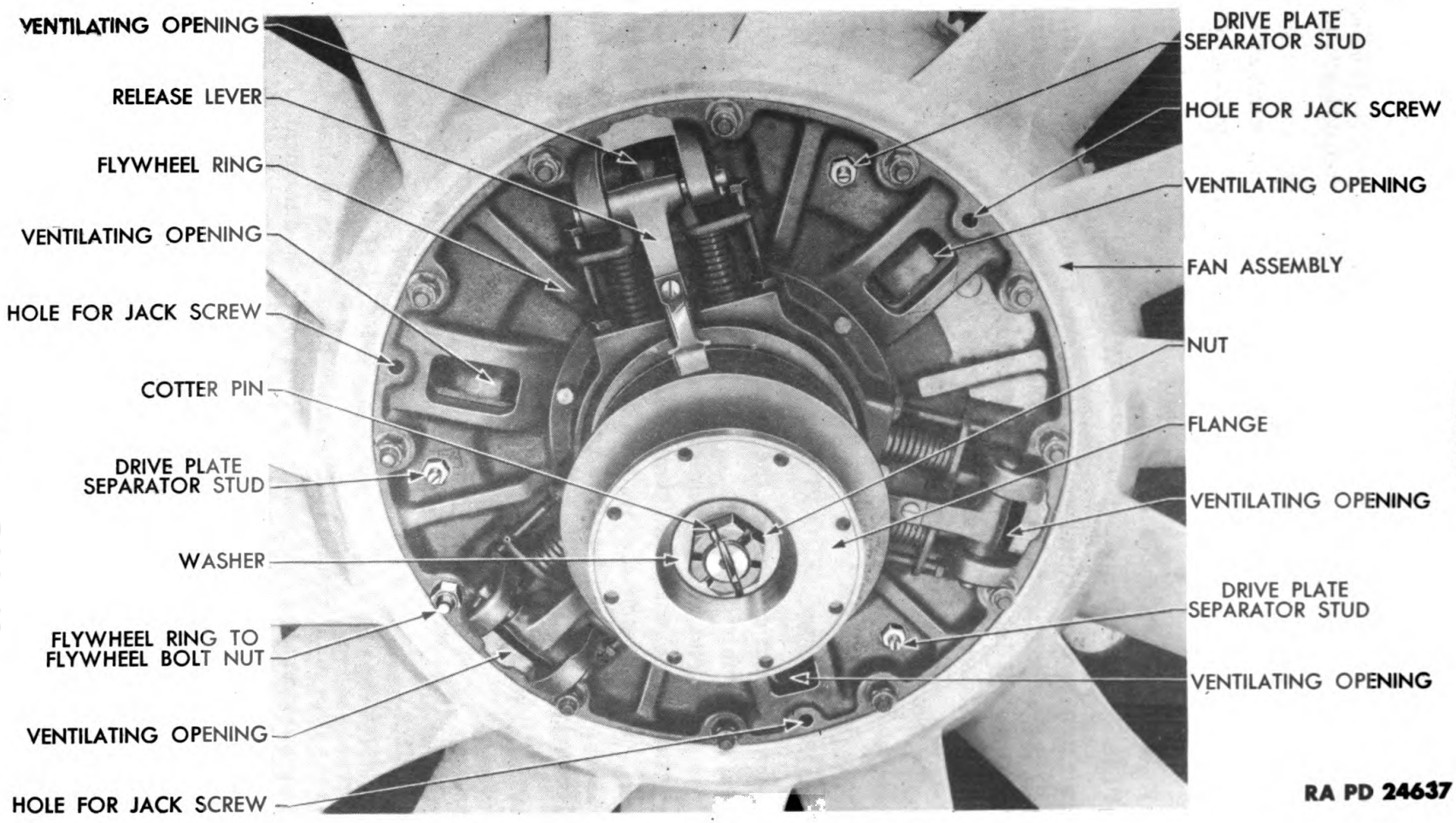

Figure 72 — Clutch and Fan Assembled (Ventilated Type)

SCREWS, jack $\frac{3}{8}$ - 16 x 4-in. long threads, 3-in. long (3)
SCREWDRIVER
SLING, rope
WRENCH, $\frac{3}{4}$-in.
WRENCH, $\frac{9}{16}$-in.
WRENCH, socket, $1\frac{3}{16}$-in.

b. Procedure.

(1) REMOVE POWER UNIT FROM VEHICLE (par. 52., **b.**).

(2) LOOSEN FLANGE NUT.

PLIERS, side cutting
WRENCH, socket, $1\frac{3}{16}$-in.

Straighten ends of cotter pin and remove from shaft (side cutting pliers). Loosen large nut in center of flange (turn counterclockwise) about three turns ($1\frac{3}{16}$-in. socket wrench). *Do not remove nut from shaft at this time.*

(3) REMOVE FLYWHEEL RING TO FLYWHEEL BOLT NUTS (figs. 71 and 72).

HAMMER, steel
PUNCH, prick
WRENCH, $\frac{11}{16}$-in.
WRENCH, $\frac{3}{4}$-in.

Loosen lock nut and loosen the three drive plate separator pins three turns (turn counterclockwise) ($\frac{11}{16}$-in. wrench; screwdriver) (fig. 72). Unscrew the twelve nuts around outer periphery of clutch flywheel ring (turn counterclockwise), relieving tension evenly around ring ($\frac{3}{4}$-in. wrench). Prick punch the flywheel and also the flywheel ring, at one point on each, for identification in reassembling of parts (steel hammer; prick punch).

(4) REMOVE FLYWHEEL RING AND PRESSURE PLATE ASSEMBLY FROM FLYWHEEL.

HAMMER, brass
HOIST
SLING, rope
SCREWS, jack, $\frac{3}{8}$ - 16 x 4-in. long, with 3-in. threads (3)
WRENCH, $\frac{9}{16}$-in.

Place a rope sling around clutch sleeve, attach sling to chain hoist and take up slack on sling, to assist in holding clutch in alinement. Tap edge of flywheel ring lightly, at various places, on outer edge of ring (to assist in loosening ring from flywheel) (brass hammer). NOTE: Should flywheel ring be difficult to remove, screw one jack screw in each of the three holes provided for this purpose (figs. 71 and 72), tightening them alternately until flywheel ring is forced away from flywheel. Remove jack screws from ring after removal from flywheel ($\frac{9}{16}$-in. wrench). Withdraw flywheel ring and pressure plate assembly slowly away from flywheel. CAUTION: When removing the assembly as outlined above, the spindle,

driving plate and the two driven disks are removed at the same time. Before withdrawing the assembly to a point where the spindle is free of the flywheel hub, note whether or not the driving plate and the two driven disks are following the spindle. If they are, be sure to hold in place to prevent dropping and damage. In the event the driving plate and two driven disks remain inside of the opening in the flywheel, lift them out of flywheel and place where they will not be damaged.

(5) REMOVE SPINDLE FROM FLYWHEEL RING.

HAMMER, brass
HAMMER, steel
PUNCH, prick

Remove the large nut in the center of drive flange, with fingers, and lift flat washer out of recess. Prick punch end of spindle, and flange to identify parts in reassembling (steel hammer; prick punch). Tap end of spindle lightly, with brass hammer, to force spindle out of both the flange and flywheel ring (brass hammer).

(6) REMOVE FRONT CONE NUT AND FRONT CONE (fig. 80).

BAR, steel, tempered ¾-in. x 72-in.
BLOCK, wood, 2-in. x 4-in. x 18-in.
PLIERS, side cutting

Remove the cotter pin from nut retaining pin, lift flat washer off retaining pin and withdraw pin from nut (side cutting pliers). Place a wood block (labeled brace in fig. 81) between one blade of the fan and the floor, to prevent turning of the fan while removing cone nut. Insert one end of the tempered steel bar through two of the ¾-in. round holes in cone nut, one hole in either side of nut, turn nut counterclockwise and remove. NOTE: This nut is tightened with 550 to 650 ft. lbs. torque, therefore it will be noted that considerable pressure will be required in its removal. CAUTION: When removing this nut, hold the two halves of front cone, to prevent falling and damage.

(7) REMOVE FAN AND FLYWHEEL FROM POWER UNIT DRIVEN SHAFT (fig. 78).

HOIST
MTM-A4-4 Puller, clutch hub

Screw puller MTM-A4-4 on threaded section of clutch hub and pull flywheel and fan assembly off power unit driven shaft. After removing from shaft, lay the assembly on a flat surface, to avoid any damage to the fan blades (hoist, puller, MTM-A4-4).

(8) REMOVE REAR CONE (fig. 77).

SCREWDRIVER

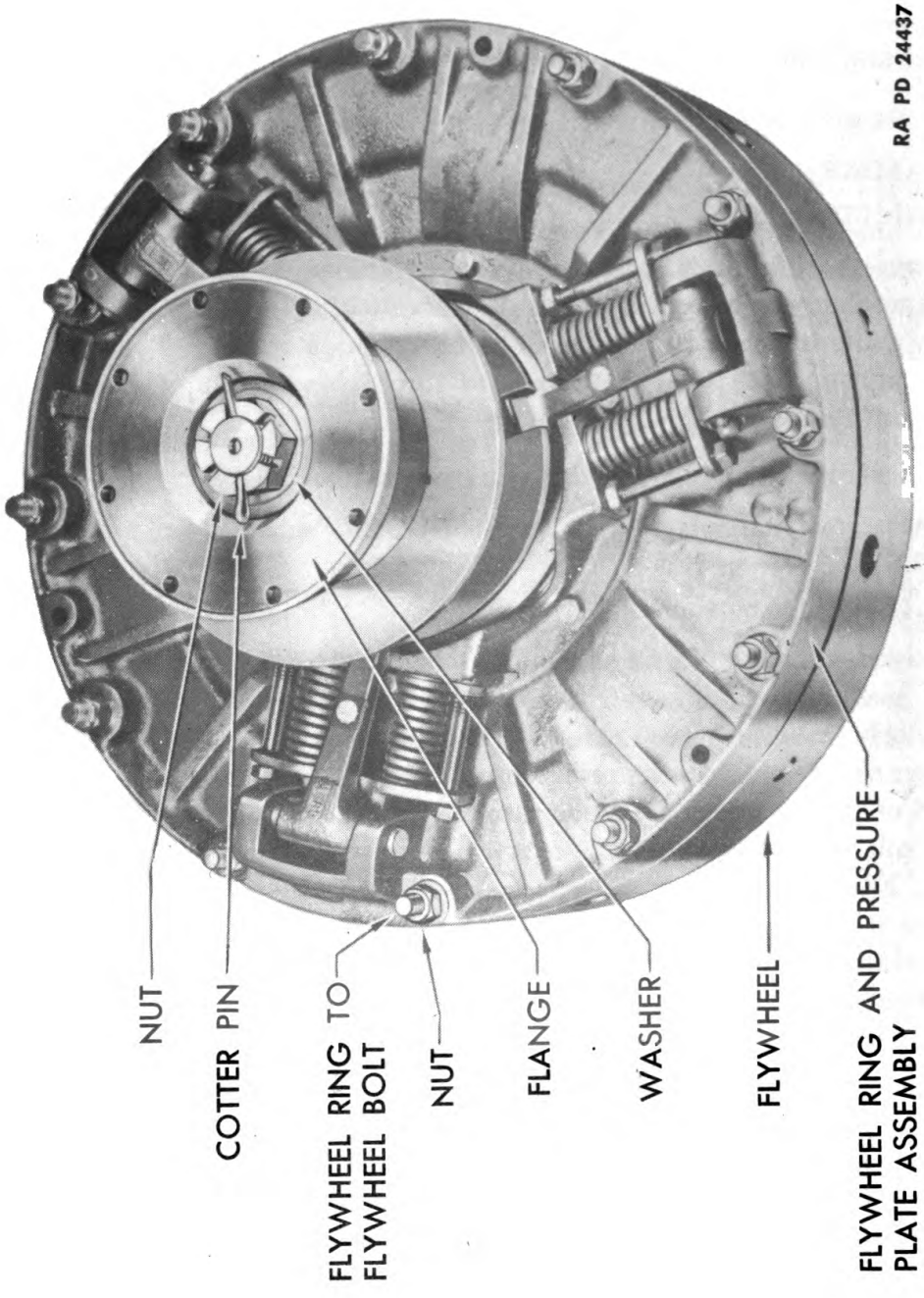

Figure 73 — Clutch Assembly (Fully Enclosed Type)

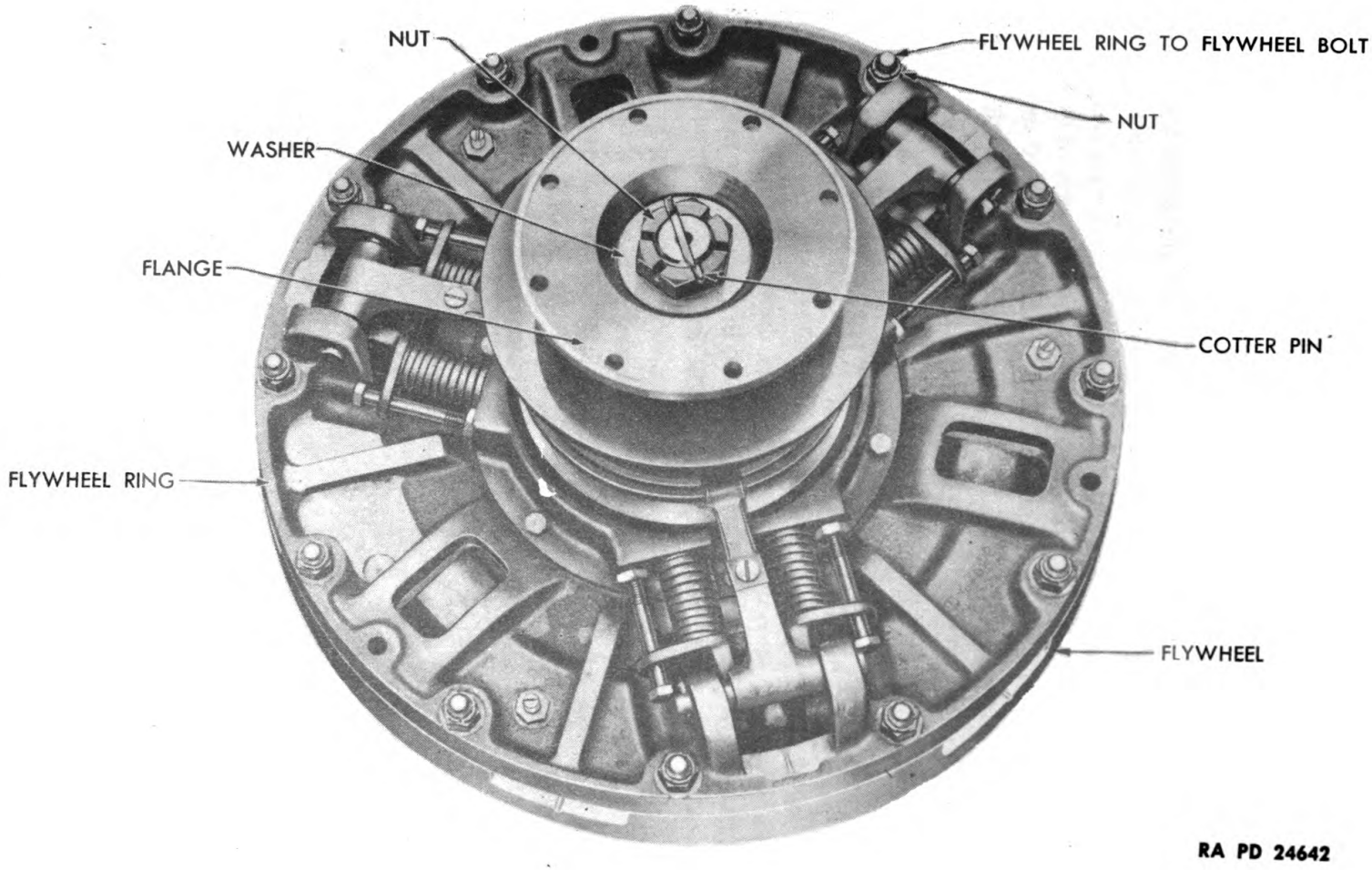

Figure 74 — Clutch Assembly (Ventilated Type)

Place a screwdriver in slot in cone and spread cone, very slightly, to facilitate removal, and slide cone off shaft.

(9) REMOVE FAN FROM FLYWHEEL.

BLOCK, wood, 12-in. x 12-in. x 12-in.	HAMMER, brass
DRIFT, steel, 3/8-in. x 10-in.	HAMMER, steel
	PUNCH, prick

Lay fan and flywheel assembly on flat surface, with opening in flywheel down. Prick punch flywheel and fan for identification purposes for reassembling. Turn assembly over and rest it on a wood block 12-in. x 12-in. x 12-in. (with wood block located inside opening in fan). Drive the twelve flywheel to flywheel ring bolts out of flywheel and fan assembly (brass hammer). It may be necessary to use the DRIFT, steel, 3/8-in. x 10-in. to remove the bolts completely. NOTE: Hold fan while bolts are being removed, to avoid any damage due to fan falling. Turn assembly over on bench and, keeping fan perfectly level, lift fan off flywheel (two men).

94. INSTALLATION OF CLUTCH AND FLYWHEEL.

TOOLS.

AIR, compressed	HACK saw
BAR, steel, tempered, 3/4-in. x 72-in.	HAMMER, brass
BAR, steel, 3/4-in. x 19-in.	HAMMER, rawhide
BLOCK, wood, 4-in. x 4-in. x 4-in.	HOIST
BLOCK, wood, 12-in. x 12-in. x 12-in.	PLIERS, side cutting
	SCREWDRIVER
	TANK, water
	WRENCH, open-end, 3/4-in.

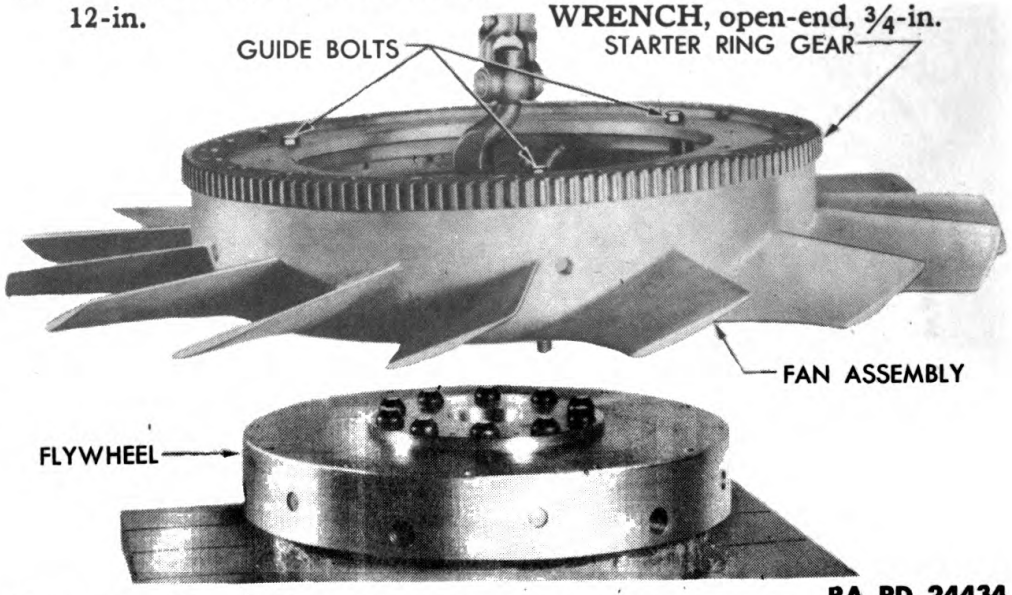

Figure 75 — Assembling Fan and Flywheel — Showing Method to Use

CLUTCH

BLOCK, wood, 2-in. x 4-in. x 18-in.
BLOW torch
FILE, mill
WRENCH, socket, 3/4-in.
WRENCH, socket, 1 3/16-in.
WRENCH, torque

a. Procedure.

(1) Be sure that all parts are clean and that all unserviceable parts have been replaced.

(2) INSTALL FLYWHEEL IN FAN ASSEMBLY.

BAR, steel, 3/4-in. x 19-in.
BLOCK, wood, 12-in. x 12-in. x 12-in.
BLOW torch
HAMMER, rawhide
HOIST
TANK, water

Lay flywheel on wooden block, 12-in. x 12-in. x 12-in., with opening down, and opening resting on block. Place a bar across the small opening in fan (fig. 75), attach hoist to bar and raise fan in position above flywheel (3/4-in. x 19-in. steel bar; hoist). Insert three flywheel to flywheel ring bolts through mounting holes in fan (evenly spaced around fan). Keep fan perfectly level and lower in place over flywheel, alining properly with prick punch marks on both fan and flywheel. NOTE: If fan is extremely cold, it may be difficult to lower fan completely over flywheel without expanding slightly. If this is necessary, give fan a *quick* heat by applying heat evenly around the fan with a blow torch or submerging in hot water (to expand fan slightly thus permitting flywheel to enter freely). NOTE: As soon as fan is in place on flywheel, remove hoist and bar. CAUTION: Do not attempt to force fan over flywheel without heating as described above (if necessary), however, it may be necessary

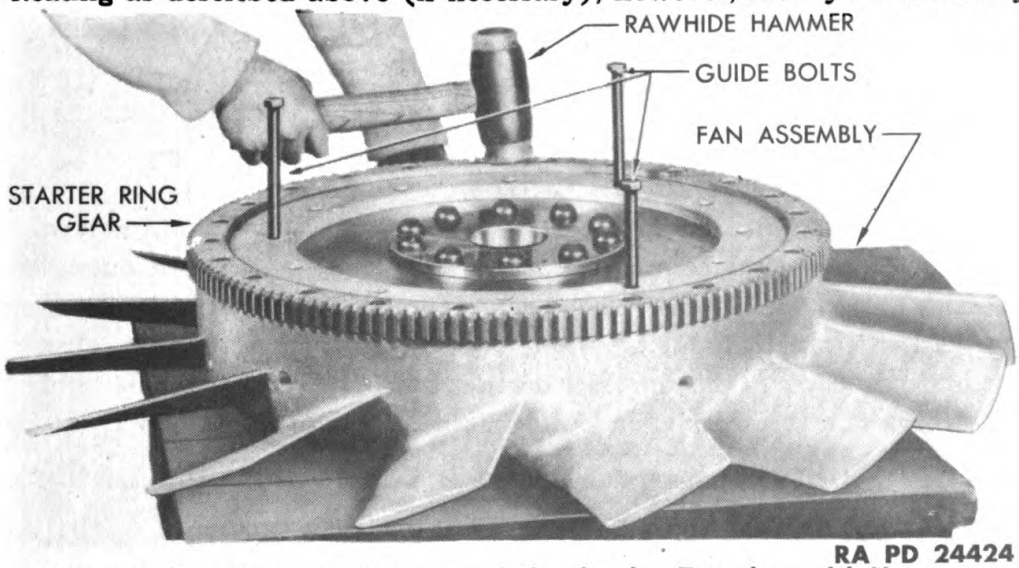

Figure 76 — Assembling Fan and Flywheel — Tapping with Hammer

to tap fan *lightly* with rawhide hammer, as shown in figure 76 to assemble flywheel full distance into fan. If necessary to tap with rawhide hammer, *be sure to tap on surface of flywheel ring gear only,* to avoid any possibility of damage to fan (blow torch; rawhide hammer). Tap the three guide bolts lightly until they are driven through the flywheel their full distance (rawhide hammer). Insert the other nine flywheel to flywheel ring bolts through holes in fan and tap into place.

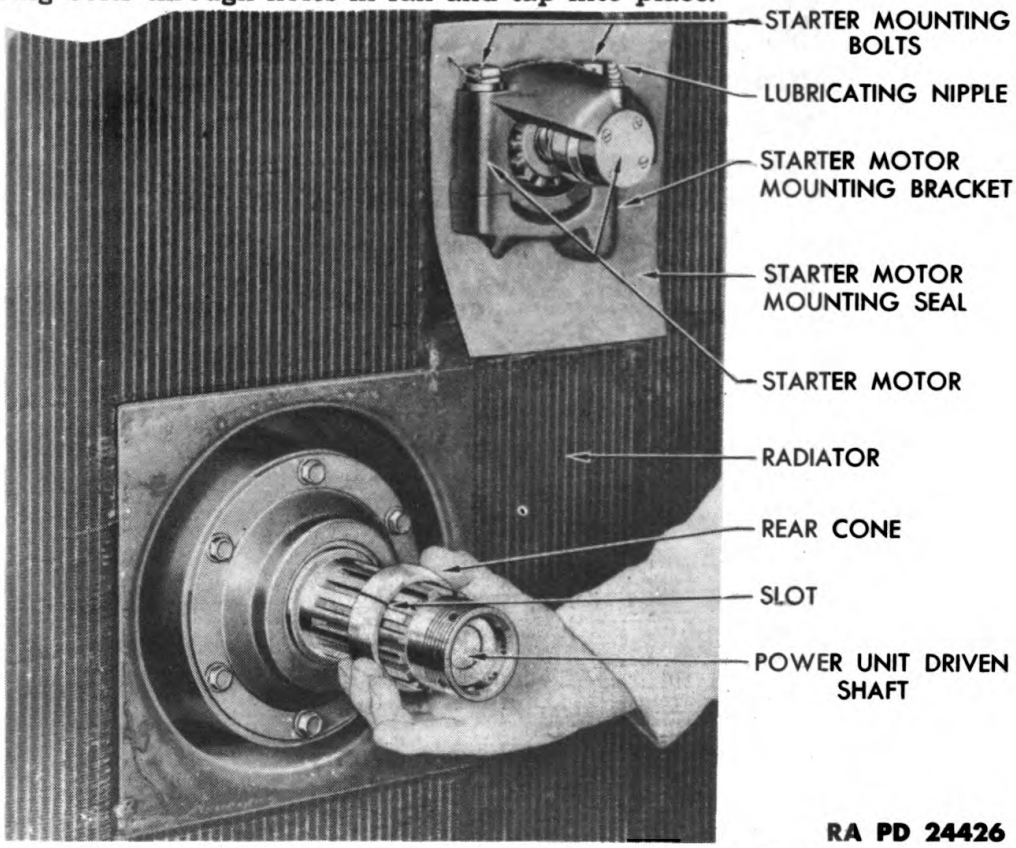

Figure 77 — Installing Clutch Hub Rear Cone

(3) INSTALL REAR CONE (fig. 77).

SCREWDRIVER

NOTE: Be sure all burs have been removed from power unit driven shaft and that the rear cone is clean and free from burs (both outside and inside). Position the one piece brass cone on the power unit driven shaft, with the small diameter of the cone away from the power unit, and slide cone back to the shoulder on the shaft. NOTE: If cone is tight on shaft, insert a screwdriver in slot and spread cone slightly.

(4) INSTALL FLYWHEEL AND FAN ASSEMBLY ON POWER UNIT DRIVEN SHAFT (figs. 78 and 80).

Wipe inside of flywheel hub clean and make sure there are no burs on

splines. Insert the three drive plate separator pins (on clutches so equipped) through holes in flywheel (with small end of pin entering first). Make sure these pins do not bind in holes and that they contact their respective leaf spring on back side of flywheel (fig. 80). Have two men lift assembly by the fan blades and, with another checking alinement of

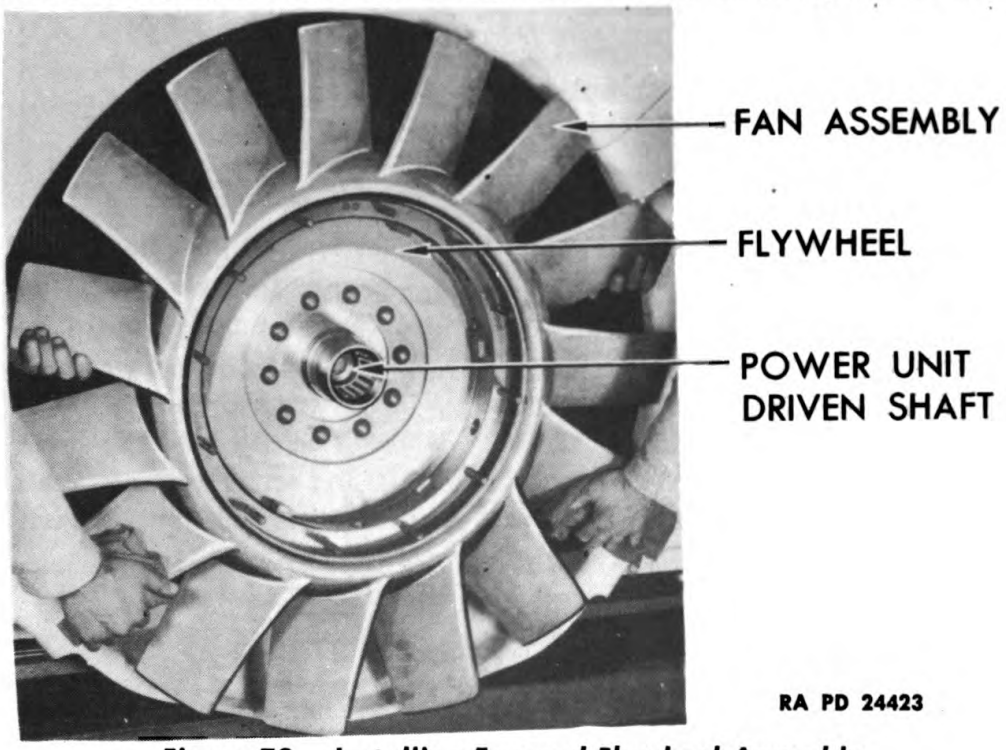

Figure 78 — Installing Fan and Flywheel Assembly

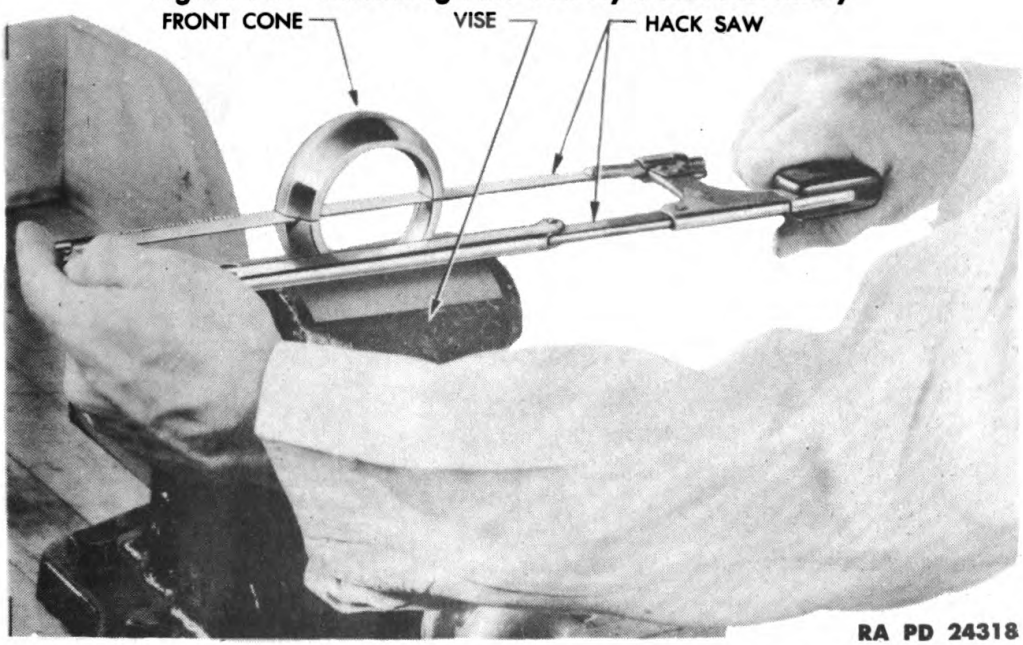

Figure 79 — Sawing Clutch Hub Front Cone

splines, mount assembly on power unit driven shaft, pushing assembly onto shaft its full distance (fig. 78). **NOTE:** When installing this assembly on power unit driven shaft, make sure the flywheel to flywheel ring bolt heads are tight against fan, to avoid any damage due to bolts striking radiator.

(5) INSTALL FRONT CONE AND NUT (fig. 80).

BAR, tempered steel, 3/4-in. x 72-in.
BLOCK, wood, 2-in. x 4-in. x 18-in.
FILE, mill
HACK saw

Wipe both the cone and nut clean and make sure all burs have been removed. **NOTE:** If a new cone is used, separate the two halves by cutting (hack saw) and dress tabs off flush with cone body (mill file) (fig. 79). Screw nut onto end of power unit driven shaft (turn clockwise), just a sufficient distance to hold nut in place. Place the two halves of cone (with grooves in cone assembled over flange on nut, and the small diameter of cone *toward* power unit) in position and screw nut onto shaft with fingers (fig. 80). Rest a wooden block, 2-in. x 4-in. x 18-in., between

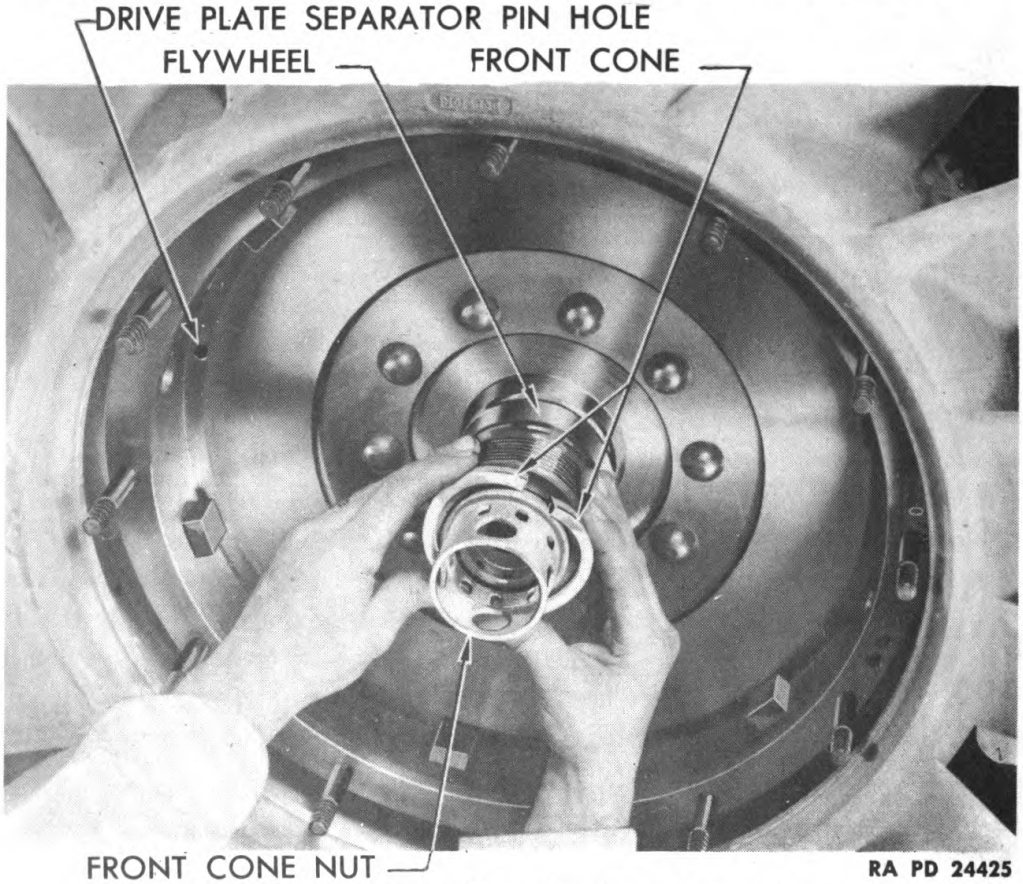

Figure 80 – Installing Clutch Hub Front Cone

one fan blade and floor (to prevent turning of fan in the clockwise direction). Insert bar through two of the large holes in nut, and, turning clockwise, tighten nut to 550 to 650-foot-pounds torque.

(6) INSTALL FRONT CONE NUT RETAINING PIN (fig. 82).

PLIERS, side cutting

Determine which holes in nut and power unit driven shaft aline and insert retainer pin, from inside diameter of shaft, through hole, position

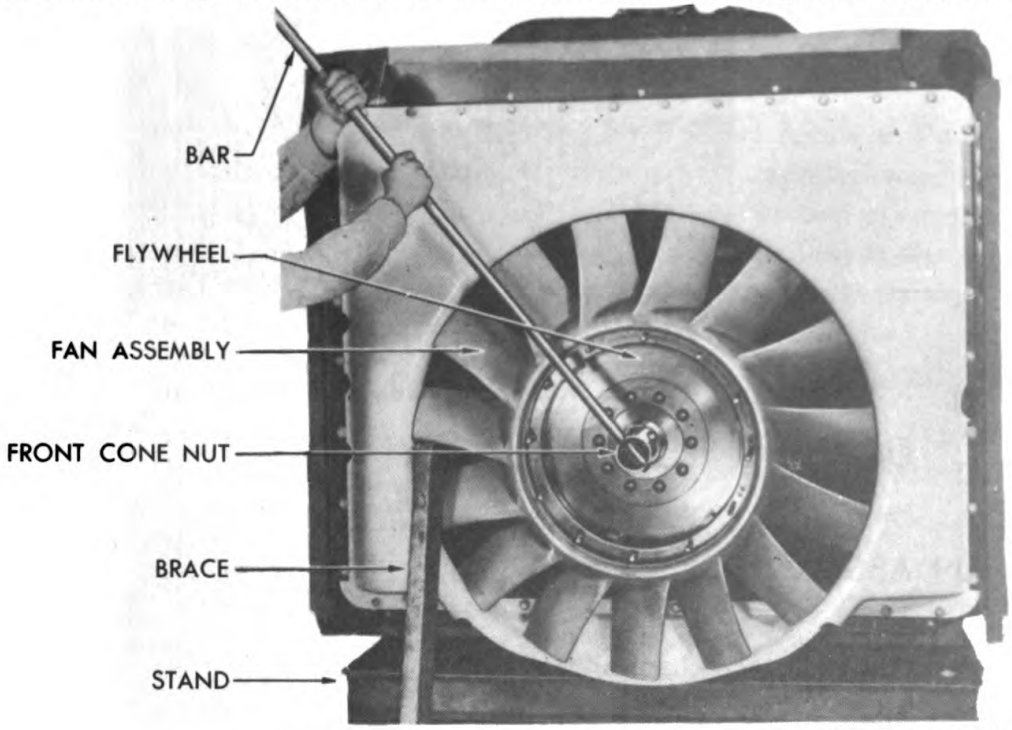

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Figure 81 — Installing Clutch Hub Front Cone Nut

flat washer on retainer pin, insert cotter pin through hole in retainer pin and lock by bending ends of cotter pin around retainer pin. CAUTION: Do not insert retainer pin from outside surface of nut as centrifugal force will tend to force retainer pin outward and shear the cotter pin.

(7) INSTALL SPINDLE ON FLYWHEEL HUB.

AIR, compressed

Wash spindle thoroughly in SOLVENT, dry-cleaning, and make sure that all foreign matter has been removed from the spindle bearing (inside the large opening of spindle). Apply compressed air to the large opening of spindle, removing all traces of SOLVENT, dry-cleaning. Wipe spindle dry. Make sure that all burs have been removed. Pack roller bearing in spindle with GREASE, Keystone No. 44 or equivalent. Fill cavity on either side of bearing approximately flush with inside diameter of bearing.

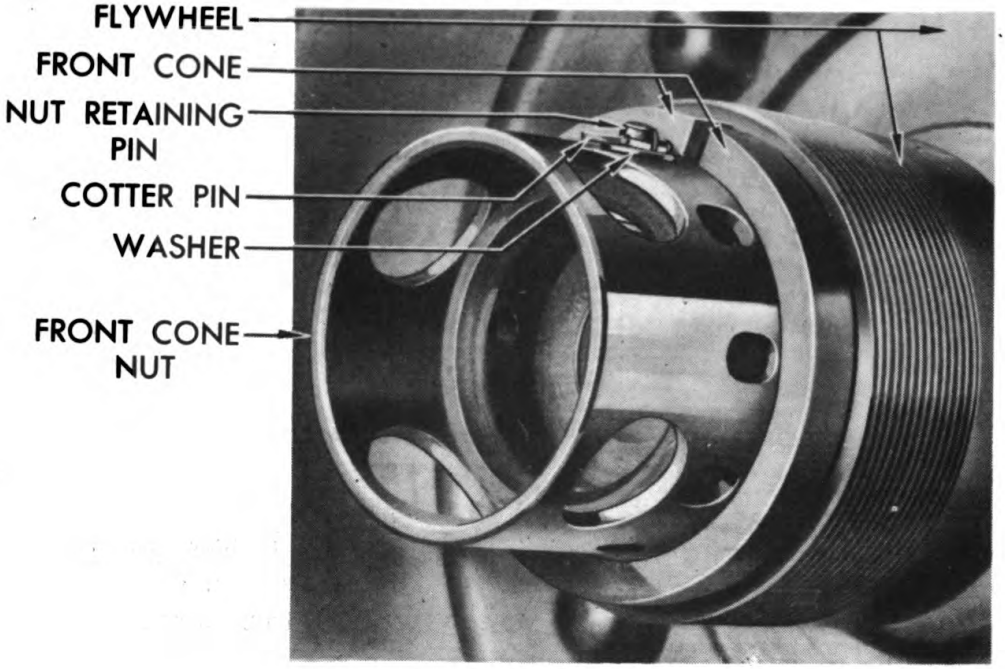

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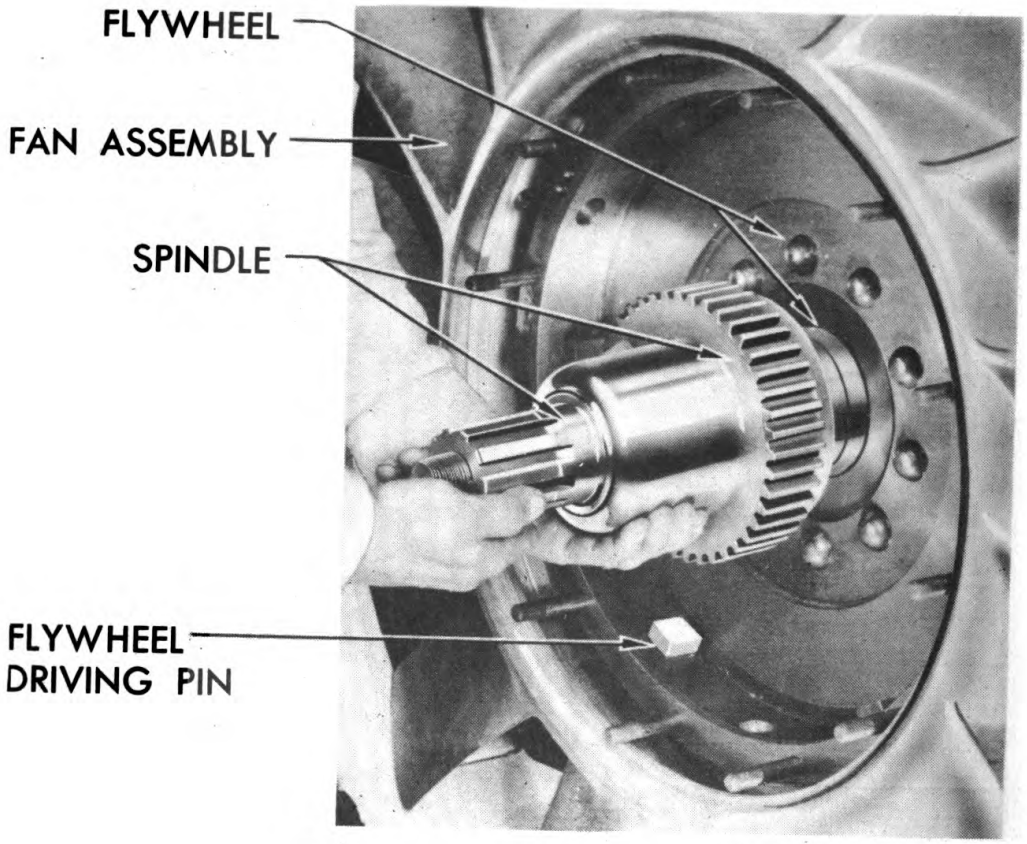
Figure 82 — Clutch Hub Front Cone Nut in Position



RA PD 24430

Figure 83 — Installing Clutch Spindle

CLUTCH

Place film of GREASE, Keystone No. 44, on grease seal leather. Position spindle on flywheel hub and push into hub the full distance.

(8) INSTALL INNER CLUTCH DRIVEN DISK IN FLYWHEEL (fig. 84).

Wipe all surfaces clean and make sure the splines in hub are free from burs. Check the three drive plate separator pins in flywheel and make sure they are in position. Position disk (with body of hub section away from flywheel) on splines of spindle and insert into flywheel the full distance.

(9) INSTALL DRIVING PLATE IN FLYWHEEL (fig. 85).

Wipe all surfaces clean and make sure all burs are removed. Position driving plate in flywheel, with arrows pointing in counterclockwise direction; aline the six slots in driving plate with the six flywheel driving pins in flywheel and press plate into flywheel until it rests against the three separator pins. Press on plate, then release pressure, to be sure the separator pins are returning the drive plate to position.

(10) INSTALL CLUTCH OUTER DRIVEN DISK IN FLYWHEEL (fig. 86).

Wipe all surfaces clean and make sure the splines in hub are free from burs. Position disk (with body of hub section away from flywheel) on splines of spindle and press tight against the clutch driving plate.

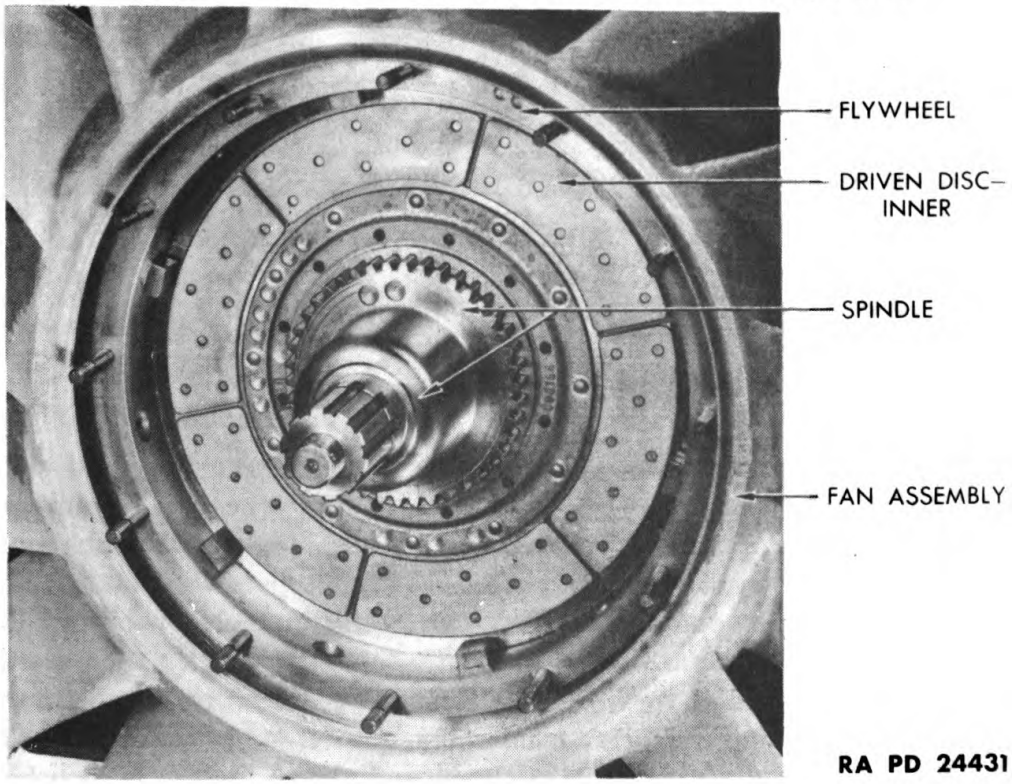


Figure 84 — Clutch Inner Driven Disk in Position

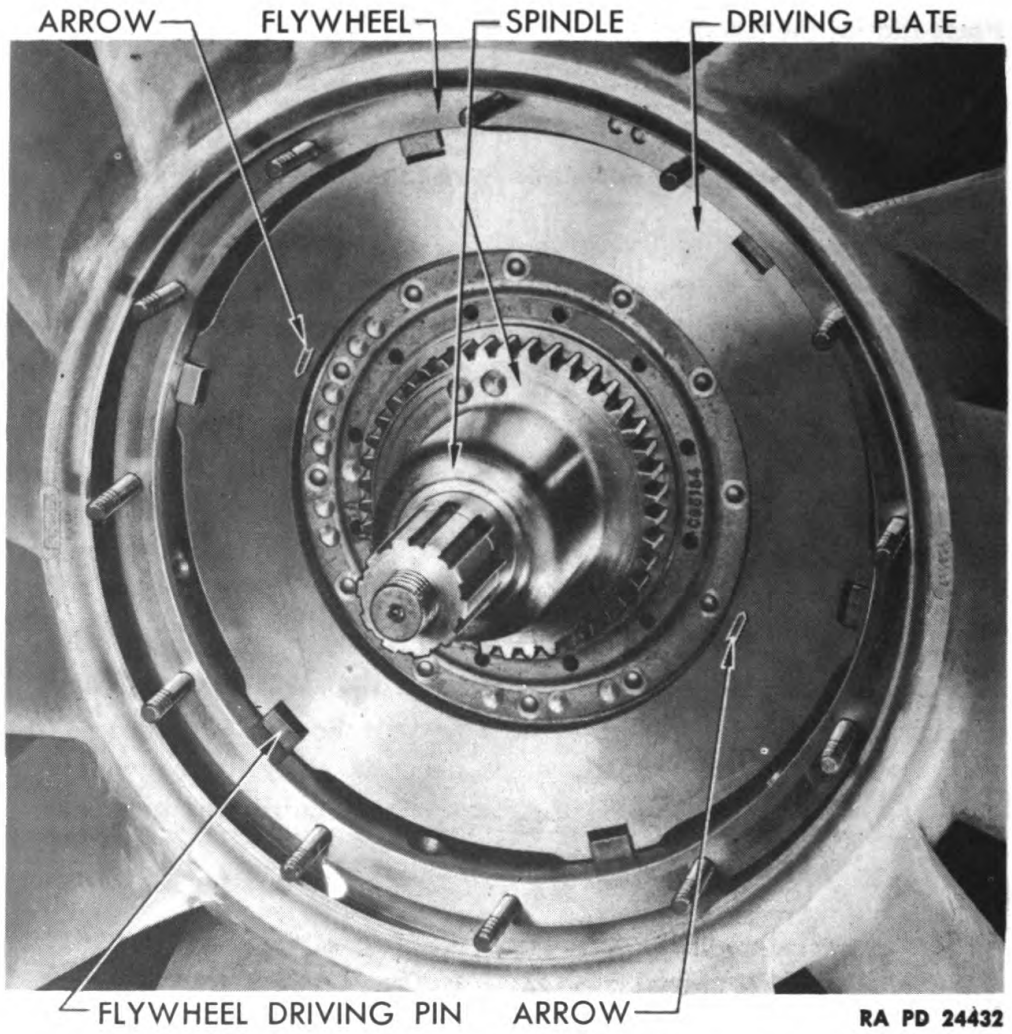


Figure 85 — Clutch Driving Plate in Position

(11) INSTALL FLYWHEEL RING AND PRESSURE PLATE ASSEMBLY (fig. 87).

SCREWDRIVER WRENCH, $\frac{11}{16}$-in.

Wipe all surfaces clean. Pack bearing in flywheel ring hub with GREASE, Keystone No. 44. Check flywheel to flywheel ring bolts and make sure none have been pushed toward radiator. Loosen lock nuts ($\frac{11}{16}$-in. wrench) and loosen the three drive plate separator studs at least three turns (turn counterclockwise) (screwdriver). Have two men lift assembly and position it on end of spindle, aline the prick punch marks on both flywheel and flywheel ring, and slide assembly onto spindle. CAUTION: When sliding this assembly onto spindle, make sure the bolts and bolt holes are properly alined and that bolts are not pushed against radiator.

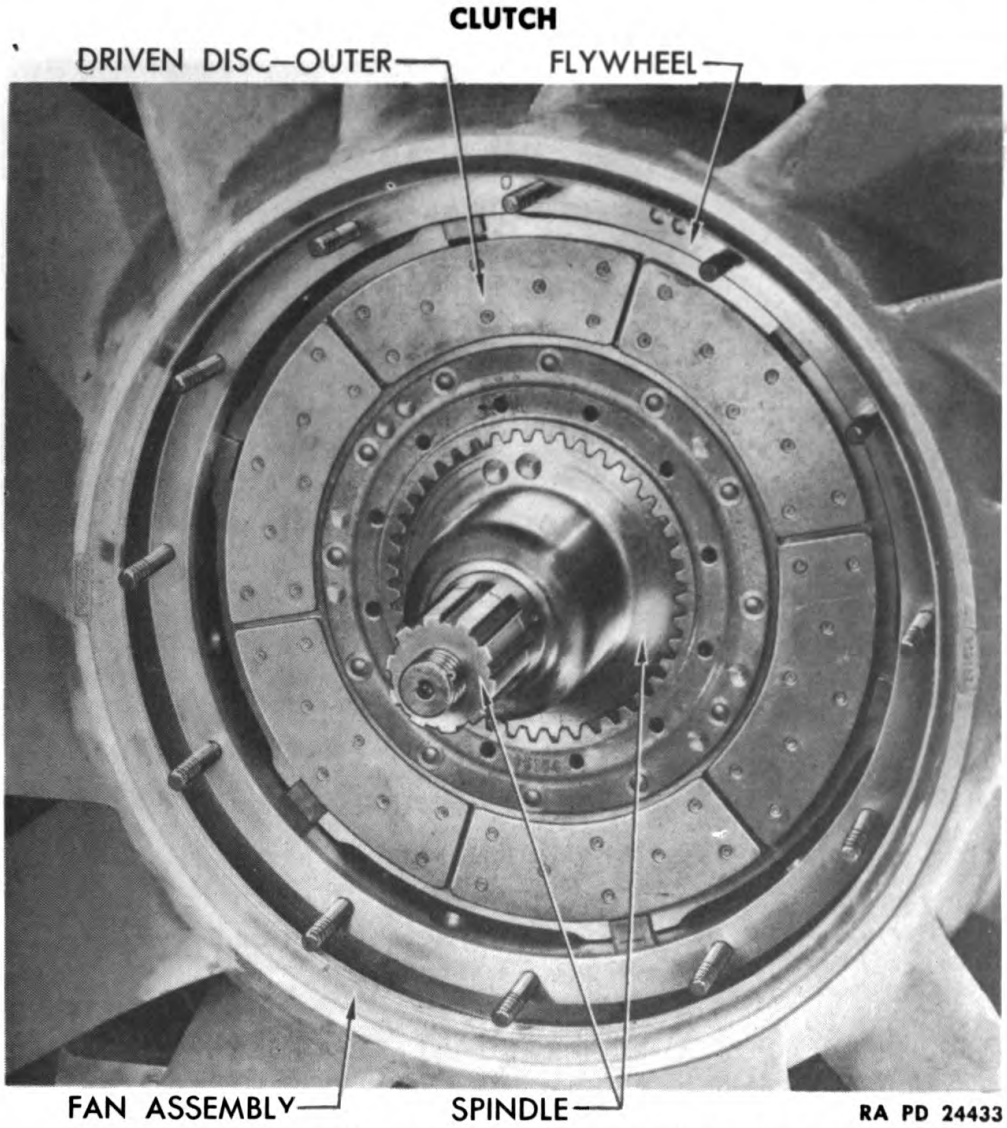


Figure 86 — Clutch Outer Driven Disk in Position

(12) INSTALL FLYWHEEL BOLT NUTS (fig. 88).

WRENCH, $\frac{11}{16}$-in.
WRENCH, socket, $\frac{3}{4}$-in.
WRENCH, open-end, $\frac{3}{4}$-in.
WRENCH, torque

Install the twelve flywheel to flywheel ring bolt nuts and tighten evenly with 75 to 85-foot pounds of torque, ($\frac{3}{4}$-in. socket wrench) (torque wrench). **NOTE**: It may be necessary to hold bolts from turning while tightening nuts. If so, reach through opening between fan blades and hold bolts ($\frac{3}{4}$-in. open-end wrench). Use a screwdriver and turn each of the three drive plate separator studs until they rest against plate, then loosen each one complete turn. Hold studs in this position and tighten lock nut ($\frac{11}{16}$-in. wrench).

(13) INSTALL PROPELLER SHAFT FLANGE.

HAMMER, brass

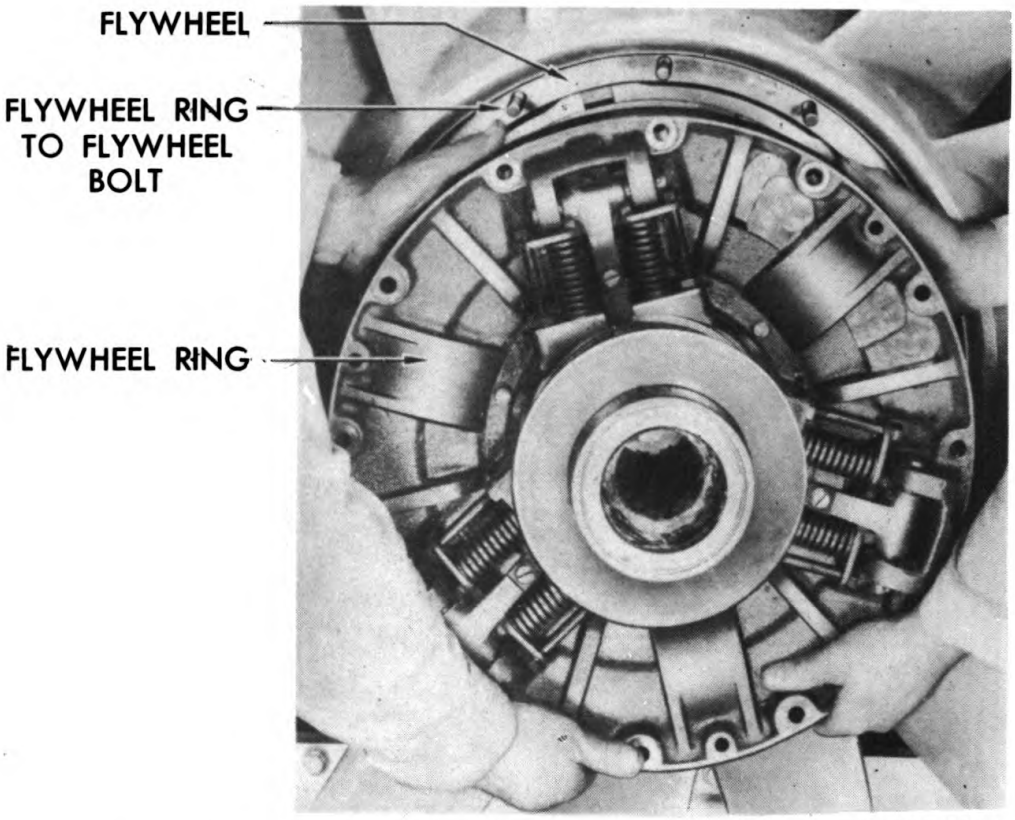


Figure 87 — Installing Clutch Flywheel Ring and Pressure Plate Assembly

Aline prick punch marks on flange and end of spindle, slide flange on spindle and tap lightly with brass hammer.

(14) INSTALL NUT AND WASHER.

PLIERS, side cutting — WRENCH, socket, $1\frac{3}{16}$-in.

Place flat washer on end of spindle and screw nut in place on spindle and tighten to 240 to 280-foot-pounds of torque ($1\frac{3}{16}$-in. socket wrench). Insert cotter pin through castellations of nut and through hole in spindle and bend ends over to secure (side cutting pliers).

(15) FINAL CHECK OF CLUTCH FOR PROPER RELEASE BEFORE INSTALLATION OF POWER UNIT IN VEHICLE.

BAR, steel, $\frac{3}{4}$-in. x 72-in. — BLOCK WOOD, 4-in. x 4-in. x 4-in.

Place end of a bar against front flange of clutch release sleeve, place wood block on outer periphery of flywheel ring, press bar against wood block and move release sleeve $\frac{1}{2}$-in. away from clutch. With sleeve in this position, flange should turn freely by hand.

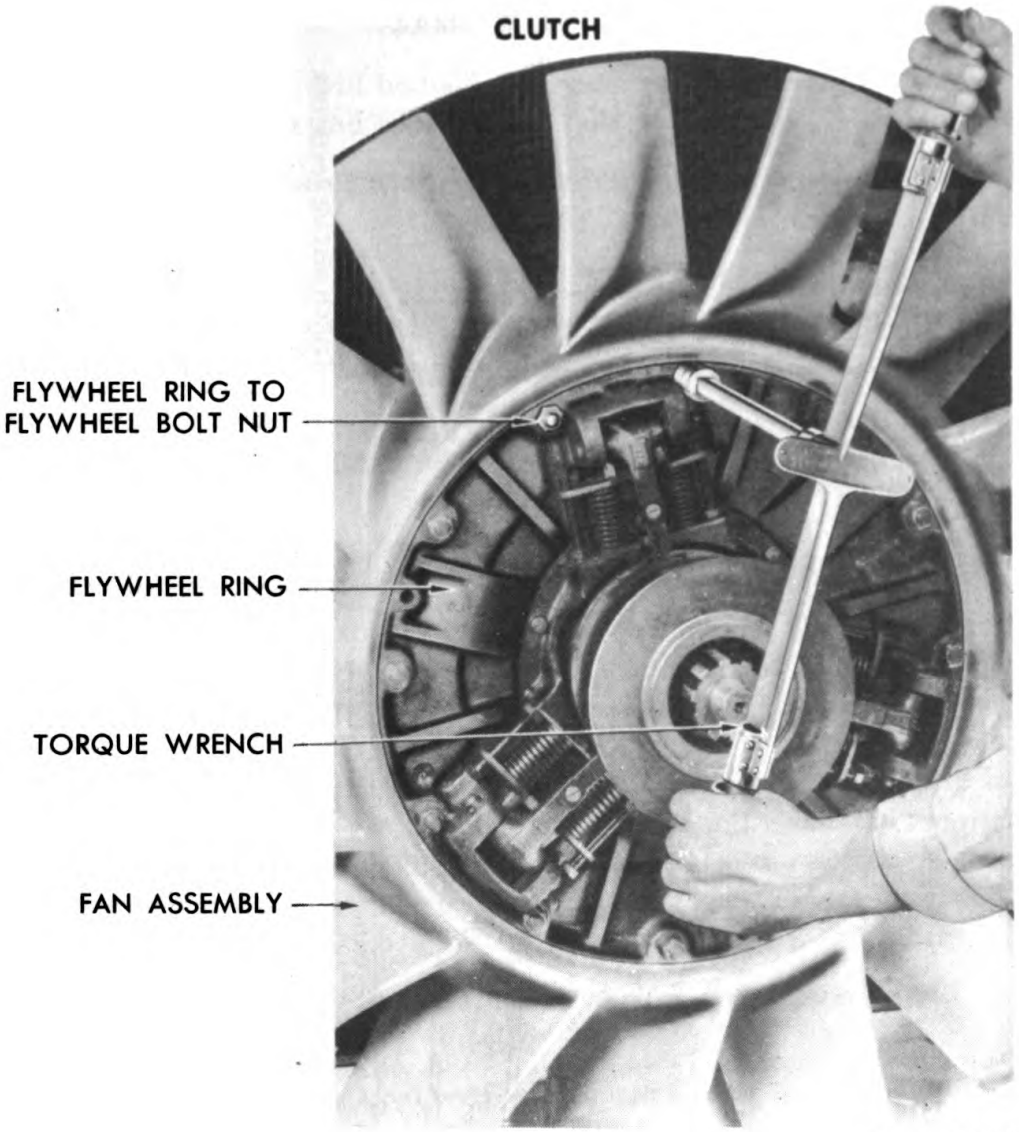


Figure 88 — Tightening Flywheel Ring to Flywheel Bolt Nuts with Torque Wrench

(16) CHECK CLEARANCE OF FAN ASSEMBLY.

Check clearance between ends of fan blades and radiator shroud and also between fan blades and end of starter housing.

(17) INSTALL POWER UNIT IN VEHICLE (par. 53., a.).

95. CLUTCH ADJUSTMENT.

a. General. In order to assure full spring load on the clutch driving plates and driven disks, it is necessary that the clutch pedal have free travel at all times. This free travel should be 2½-in. NOTE: As clutch facings wear, the amount of free travel is reduced. CAUTION: If the clutch facings wear to a point where no free travel of the clutch pedal is

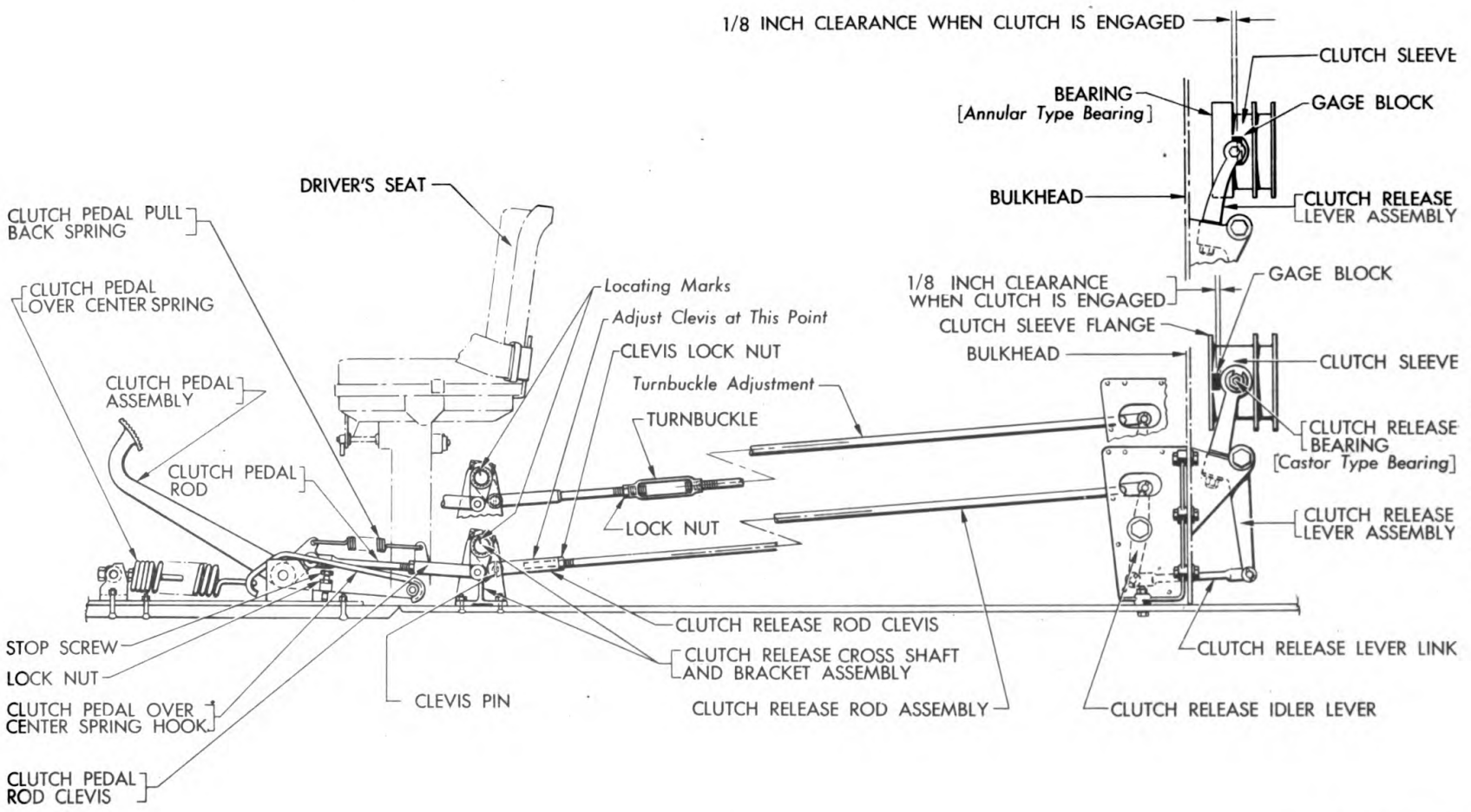


Figure 89 — Clutch and Choke Control Linkage

present, the clutch will be held partly disengaged, resulting in excessive wear of the clutch and rapid clutch failure.

b. Adjust Clutch Pedal (early models without turnbuckle) (fig. 89).

TOOLS.

BLOCKS, gage, 1/8-in. thick (2)
PLIERS, side cutting
WRENCH, 1/2-in.
WRENCH, open-end, 7/8-in.
WRENCH, open-end, 1-in.

(1) PROCEDURE.

(a) Disconnect Clutch Release Rod (Long rod running through tunnel).

BLOCKS, gage, 1/8-in. thick (2)
PLIERS, side cutting
WRENCH, 1/2-in.
WRENCH, open-end, 7/8-in.

Remove four cap screws from cover and remove the cover (forward right side of propeller shaft tunnel), directly below the front universal joint cover near the tank floor (1/2-wrench). NOTE: Do not remove the cover over top of front universal joint. Loosen the clevis lock nut by screwing it toward rear of vehicle, about two turns (7/8-in. open-end wrench). Pull cotter pin from clevis pin and pull clevis pin from clevis side cutting pliers). NOTE: Additional clearance for removing this pin can be obtained by holding foot accelerator down to swing throttle shaft lever out of way.

(b) Position Clutch Release Bearings for Pedal Adjustment.

BLOCKS, gage, 1/8-in. thick (2)

Place one gage block between each clutch release bearing and the front flange of the clutch sleeve (fig. 89). NOTE: Have one man hold these blocks in position while pedal adjustment is being made.

(c) Position Clutch Pedal for Proper Adjustment.

Pull clutch pedal back to fully engaged position (until it rests against the stop screw). NOTE: When assembled at time of manufacture, the clutch pedal cross shaft operating arm is mounted on the cross shaft by locating according to the index marks in both the arm and the end of the shaft (fig. 89). This is necessary to assure proper operation of clutch over center spring. *Due to the foregoing, it is vitally important that the length of the clutch pedal rod remain as set at time of manufacture.* When this arm is properly located on shaft, the center of hole in arm, to which the clutch pedal rod is attached, will rest eight degrees ahead of a vertical line drawn through the index marks on arm and shaft and to the hull floor below. This may be verified by rotating arm until index marks are in a vertical position and noting position of lower end of arm.

(d) Adjust Clutch Pedal Rod and Connect.

PLIERS, side cutting WRENCH, open-end, 7/8-in.

With gage blocks in position between clutch release bearings and forward flange of clutch sleeve, and clutch pedal in the fully engaged position, adjust length of clutch release rod, by screwing clevis forward or backward on rod, until the clevis pin openings in clevis aline with the hole in the clutch pedal operating arm and permit insertion of the clevis pin through clevis and operating arm (fig. 89). Recheck backlash clearance by removing gage blocks and reinserting them to make certain that clearance is 1/8-in. (fig. 89). Insert cotter pin through hole in clevis pin and bend ends of cotter pin over to secure in place (side cutting pliers). Screw clevis lock nut up tight against clevis (7/8-in. open-end wrench). Remove gage blocks from between clutch release bearings and release sleeve.

(e) Install Propeller Shaft Housing Cover Plate.

WRENCH, 1/2-in.

Position plate on side of housing directly below front universal joint on right side of propeller shaft housing and secure with four cap screws. Tighten cap screws securely.

c. Adjust Clutch Pedal. (Vehicles equipped with turnbuckle on clutch release rod) (fig. 89).

TOOLS.

BLOCKS, gage, 1/8-in. thick (2) WRENCH, open-end, 1-in.
WRENCH, 1/2-in.

(1) PROCEDURE.

(a) Loosen Turnbuckle Lock Nut.

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

Remove two cap screws and remove cover on right side of propeller shaft tunnel (forward end of tunnel) (1/2-in. wrench). Turn lock nut at front of turnbuckle counterclockwise until it is clear of turnbuckle (1-in. open-end wrench).

(b) Adjust Clutch Release Rod (fig. 89).

BLOCKS, gage, 1/8-in. thick (2) WRENCH, open-end, 1-in.

With clutch pedal in the fully engaged position, adjust turnbuckle until the two gage blocks can be inserted freely between the clutch release fork and clutch release bearing. With gage blocks in place, tighten turnbuckle lock nut and again check to see that gage blocks can be inserted between release fork and bearing (1-in. open-end wrench).

(c) Install Propeller Shaft Housing Cover Plate.

WRENCH, ½-in.

Position cover over opening in propeller shaft housing and secure with two cap screws.

d. Lubrication (figs. 27 and 89).

(1) Clutch release bearings are lubricated on the early production of the M4A4 tank by removing the power unit air inlet grille and applying GREASE, general purpose, through a lubrication fitting on each release bearing. On later model production, tubes are attached to each release bearing, these tubes leading to a junction block on the bulkhead, directly above the clutch yoke. Two lubrication fittings, accessible from inside the fighting compartment, are attached to this junction block by means of metal tubes, providing a means of lubricating the clutch release bearings from inside the fighting compartment.

MEDIUM TANK M4A4

Section XIX

PROPELLER SHAFT AND UNIVERSAL JOINTS

96. PROPELLER SHAFT.

a. Description. The propeller shaft in the M4A4 tank comprises a long front shaft, flange connected to a shorter rear shaft. The front propeller shaft has a universal joint at the transmission end and is connected to the transmission input shaft companion flange by eight bolts. The rear end of the front shaft rides in a rubber insulated propeller shaft center bearing which is supported by brackets from the hull floor. The short rear propeller shaft has two universal joints. The front universal joint flange, of the rear propeller shaft (fig. 90), is attached by four bolts to the flange at the rear of the front propeller shaft. (NOTE: In vehicles with the single water pump system the engine generator is installed in the fighting compartment. The generator, thus installed, is belt driven from a pulley attached to the front propeller shaft rear flange). A slip joint in the rear propeller shaft compensates for longitudinal movement between the power unit and the power train.

b. Preventive Maintenance. Remove propeller shaft housing covers at each universal joint and tighten bolts securing universal joint flanges, center bearing bracket bolt and center bearing support bolts every twenty-five hours.

c. Replacement.

It is unnecessary to remove the entire propeller shaft assembly when overhauling or replacing the universal joints or center bearing (unless the power unit has been removed, at which time the front or rear shaft or both assemblies can be removed from the vehicle through the power unit compartment).

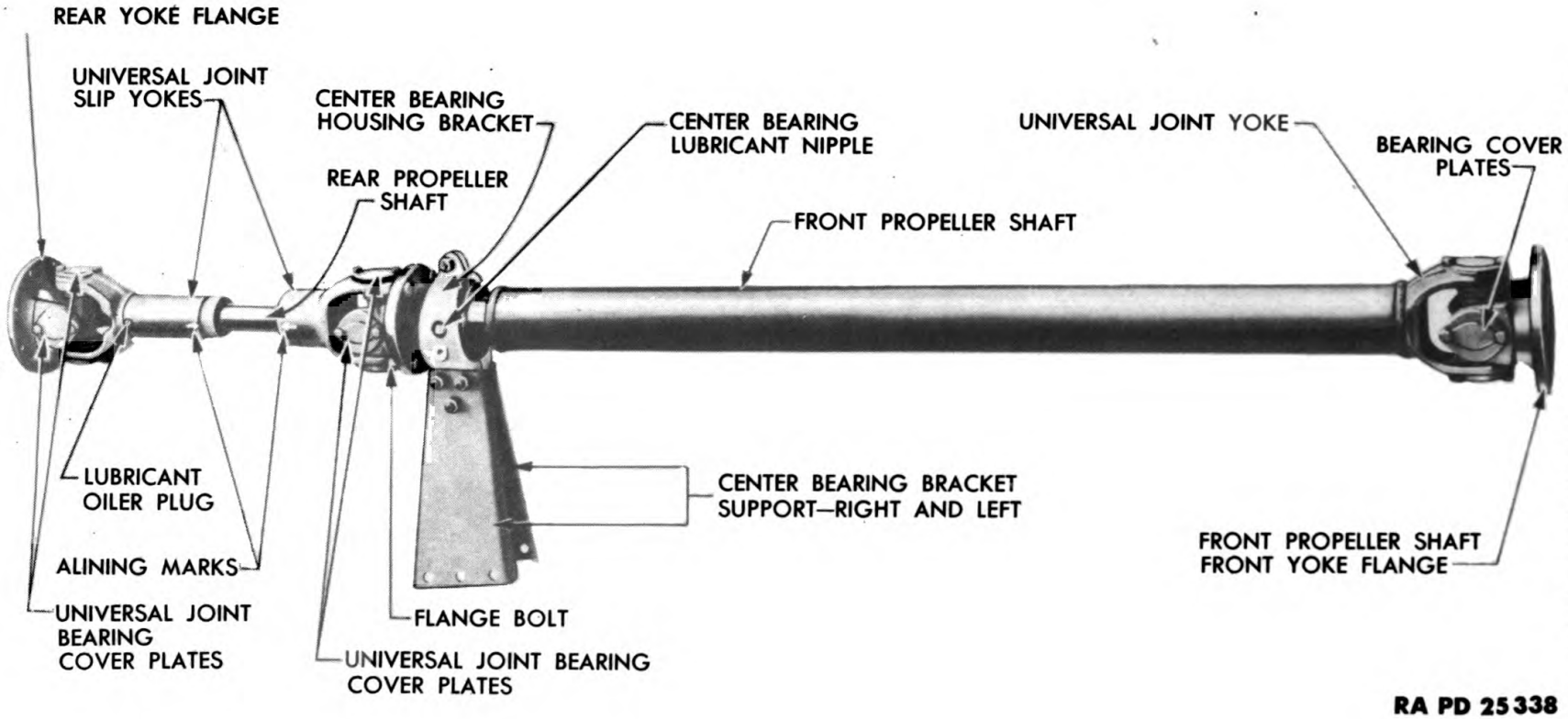


Figure 90 — Propeller Shaft and Universal Joints

7. DISASSEMBLE PROPELLER SHAFT CENTER BEARING.

TOOLS.

HAMMER
PAN, for solvent
PLIERS, side cutting
PULLER, bearing
PUNCH, prick
WRENCH, ½-in.
WRENCH, ¾-in.
WRENCH, socket, $1\frac{3}{16}$-in.
extension 8-in.

a. Procedure.

(1) REMOVE HOUSING COVER.

WRENCH, ½-in.

Remove two cap screws which secure propeller shaft housing cover.

(2) DISCONNECT UNIVERSAL JOINT FLANGES AT CENTER UNIVERSAL JOINT (fig. 91).

PUNCH, prick
WRENCH, ¾-in.

Prick punch edge of both flanges for proper location in assembly. Remove four bolts, nuts and lock washers which secure rear propeller shaft front flange to front propeller shaft rear flange at center bearing.

(3) SUPPORT REAR PROPELLER SHAFT.

Withdraw bolts from flange and support rear propeller shaft so it is out of way.

(4) REMOVE FLANGE FROM FRONT PROPELLER SHAFT (fig. 91).

PLIERS, side cutting
PUNCH, prick
WRENCH, socket, $1\frac{3}{16}$-in.,
extension, 8-in.

Prick punch flange and end of shaft, for proper location in assembly. Remove cotter pin (side cutting pliers), nut ($1\frac{3}{16}$-in. socket wrench, extension 8-in.) and washer and pull flange from shaft. (Use puller if necessary).

(5) REMOVE LUBRICANT NIPPLE (fig. 90).

PLIERS, side cutting

Unscrew lubricant nipple from center bearing housing (turn counterclockwise).

(6) REMOVE CENTER BEARING HOUSING BRACKETS (fig. 90).

WRENCH, ¾-in..

Remove three bolts at bottom and one at top of center bearing housing brackets. Preserve the insulator for reinstallation.

(7) REMOVE CENTER BEARING HOUSING (fig. 90).

HAMMER

Tap housing to remove it from shaft. One grease retainer will come out with the housing.

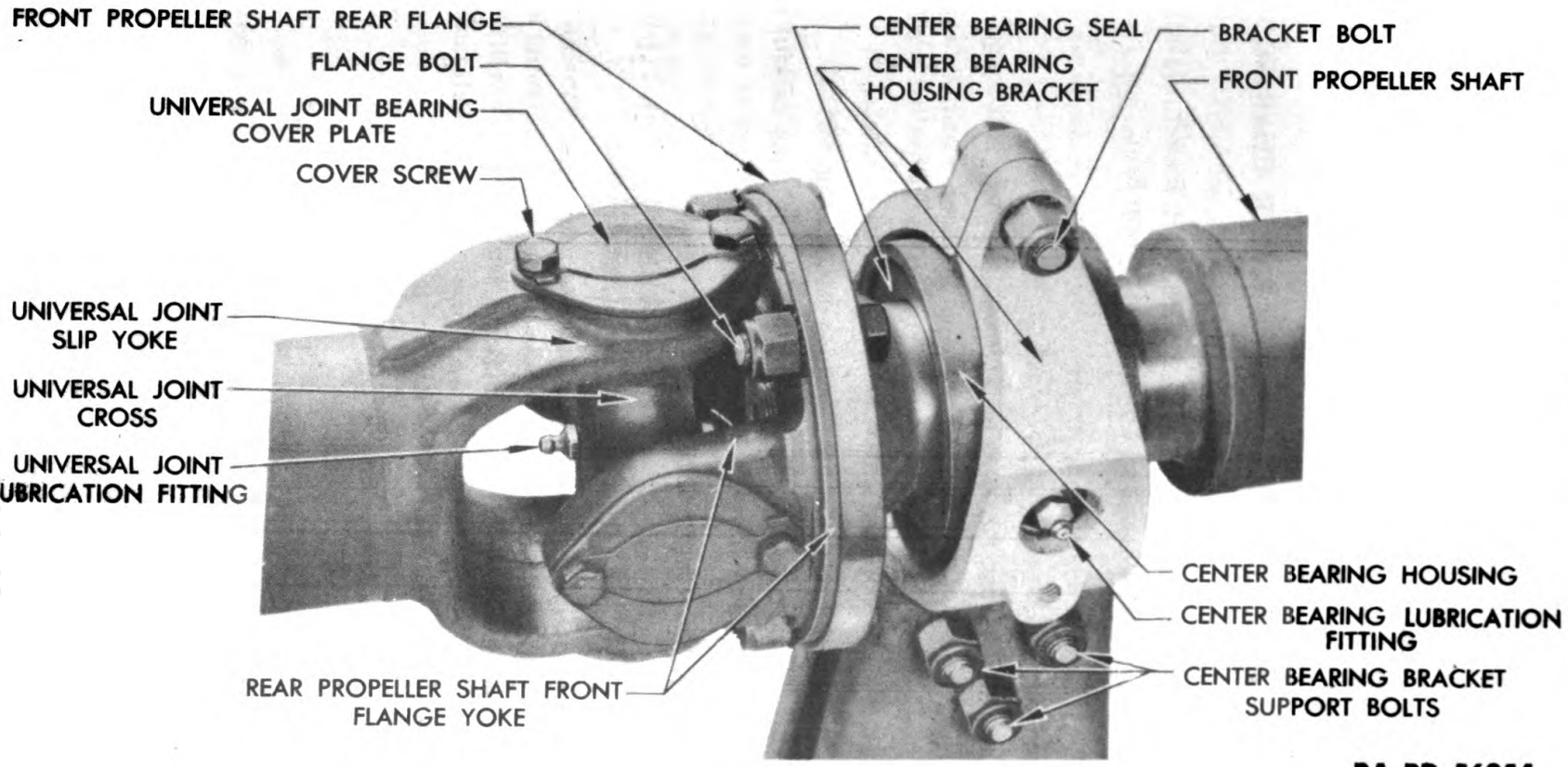


Figure 91 — Universal Joint and Propeller Shaft Center Bearing

(8) REMOVE CENTER BEARING (fig. 90).

PULLER, bearing

Pull center bearing and the remaining grease retainer off shaft.

(9) Inspect for roughness after properly cleaning and alining bearing. Check grease retainers. Replace damaged parts and prelubricate grease retainers before reinstallation.

98. ASSEMBLE PROPELLER SHAFT CENTER BEARING.

TOOLS.

PLIERS, side cutting
WRENCH, $\frac{9}{16}$-in.
WRENCH, $\frac{3}{4}$-in.
WRENCH, socket, $1\frac{3}{16}$-in., extension 8-in.

a. Procedure.

(1) INSTALL CENTER BEARING IN SUPPORT BEARING HOUSING.

Install center bearing in support bearing housing. Position a grease retainer in each side of housing. With "turned in" lips, be sure that grease retainers are properly seated in the housing.

(2) INSTALL BEARING AND HOUSING ON SHAFT (fig. 90).

Slide bearing and housing on the propeller shaft, being careful not to damage the grease retainers.

(3) INSTALL FLANGE ON PROPELLER SHAFT (fig. 90).

PLIERS, side cutting
WRENCH, socket, $1\frac{3}{16}$-in., extension 8-in.

Aline prick punch marks on end of shaft and flange and install flange on propeller shaft splines. Position washer and nut, tightening nut to force bearing against shoulder on propeller shaft ($1\frac{3}{16}$-in. wrench). Insert cotter pin through nut castellations and hole in end of shaft and bend ends of cotter pin, to secure (side cutting pliers).

(4) INSTALL LUBRICANT NIPPLE (fig. 90).

PLIERS, side cutting

Screw lubricant nipple into opening in side bearing housing.

(5) INSTALL CENTER BEARING HOUSING IN BRACKETS (fig. 90).

WRENCH, $\frac{3}{4}$-in.

Place rubber insulator in brackets and install center bearing housing in center bearing support brackets. Position bracket halves to aline attaching bolt holes, insert bolt (from left side) through upper hole, install lock washer and nut. Insert three bolts (from left side) through the three lower

holes, in both bracket halves and bracket supports, install lock washers and nuts and tighten all nuts securely (wrench, ¾-in.).

(6) ASSEMBLE FLANGES AT CENTER BEARING (fig. 91).

WRENCH, ¾-in.

Position flanges so as to aline prick punch marks, insert the four bolts, install lock washers and nuts and tighten securely.

(7) LUBRICATE BEARING (fig. 91).

GUN, grease

Apply GREASE, general purpose, to lubricant nipple until it is forced out around bearing.

99. LUBRICATION OF PROPELLER SHAFT CENTER BEARING.

a. General. A lubricant nipple, located in the right-hand side of the propeller shaft center bearing provides a means of lubricating the center bearing. Lubricate this bearing every 1,000 miles.

TOOLS.

GUN, grease WRENCH, ½-in.

b. Procedure.

(1) REMOVE PROPELLER SHAFT HOUSING COVERS.

WRENCH, ½-in.

Rotate turret to proper position and lift up section of turret floor directly above center bearing. Reach through opening in floor, remove cap screws, which attach cover to housing, and lift cover off housing.

(2) LUBRICATE BEARING (fig. 91).

GUN, grease

Apply GREASE, general purpose, to lubricant nipple until it is forced out around bearing.

(3) INSTALL PROPELLER SHAFT HOUSING COVER.

WRENCH, ½-in.

Position cover on housing and secure with the cap screws and lock washers.

100. DISASSEMBLE UNIVERSAL JOINT.

TOOLS.

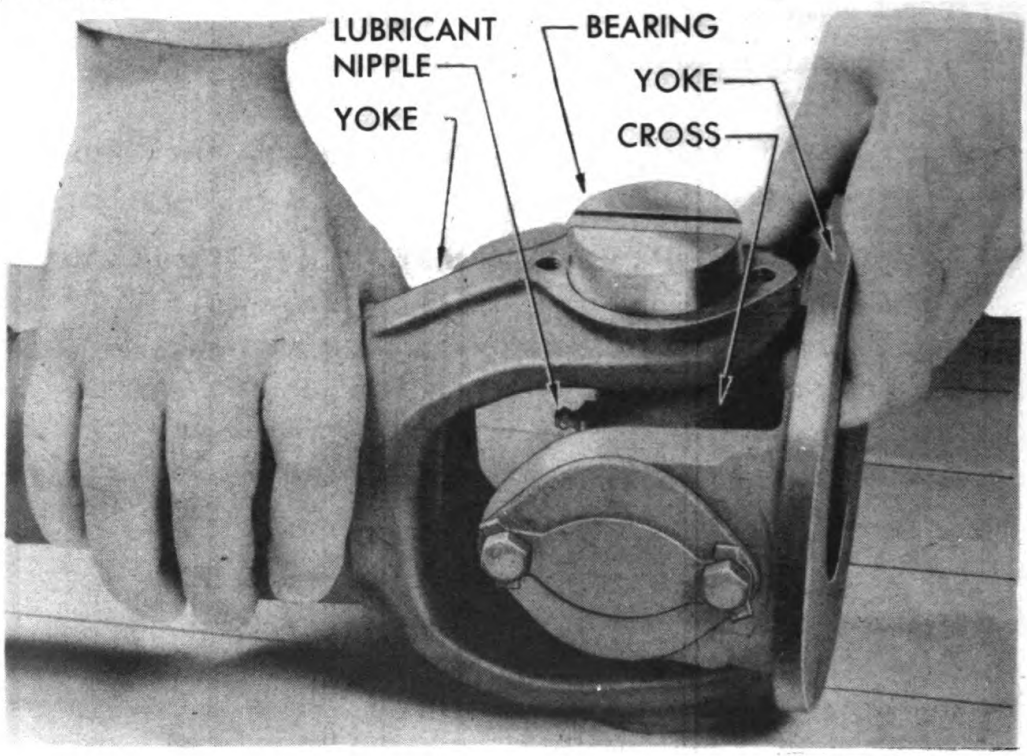
WRENCH, $\frac{7}{16}$-in. WRENCH, ½-in.

a. Procedure.

(1) REMOVE PROPELLER SHAFT HOUSING COVERS.

WRENCH, ½-in.

Rotate turret to proper position and lift up section of turret floor directly above center or rear universal joint. NOTE: This will not be necessary if front universal joint cover is to be moved. Reach through opening in floor and remove cap screws, on both right and left sides of propeller shaft housing, which secures cover to housing. Lift cover from housing.



RA PD 24416

Figure 92 — Pressing Universal Joint Bearing Out of Yoke

(2) REMOVE UNIVERSAL JOINT BEARING COVER PLATES (four covers to each universal joint (fig. 91)).

WRENCH, $\frac{7}{16}$-in.

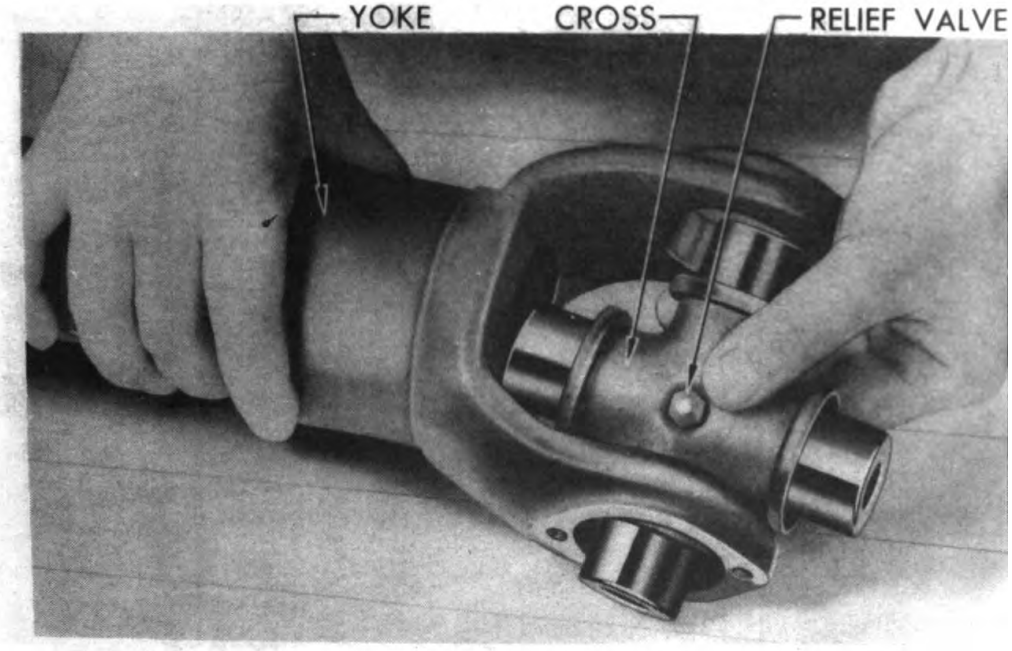
Bend tabs of locking plate flat and remove two cap screws from each cover. NOTE: It will be necessary to rotate propeller shaft in order to remove the four covers from one joint.

(3) REMOVE UNIVERSAL JOINT BEARINGS (fig. 92).

Move universal joint cross to one side of yoke to force bearing out of yoke, move cross to other side of yoke to force other bearing out.

(4) REMOVE UNIVERSAL JOINT CROSS (fig. 93).

Force cross to one side of yoke, sufficiently to provide clearance at opposite side of yoke to permit removal of cross. Lift cross from yokes.



RA PD 24415

Figure 93 — Removing Universal Joint Cross

101. ASSEMBLE UNIVERSAL JOINT.

TOOLS.

DRIFT
HAMMER
PAN, for solvent
WRENCH, $\frac{7}{16}$-in.
WRENCH, $\frac{1}{2}$-in.

a. Procedure.

(1) CLEAN PARTS.

PAN, for solvent

Clean all parts thoroughly. Inspect parts for damage or excessive wear.

(2) REPLACEMENT OF PARTS.

If replacements are necessary, it is advisable to replace completely with four new bearings, cross and grease seals.

(3) INSTALL UNIVERSAL JOINT CROSS (fig. 93).

Position universal joint cross between yokes by rotating propeller shaft until cross enters all yoke openings. NOTE: Position cross in yoke so lubricant nipple is on side of cross opposite flange.

(4) INSTALL UNIVERSAL JOINT BEARINGS (fig. 94).

Install bearings. Put grease in bearings to hold in position. Insert in openings in yokes, entering universal joint cross in bearings as they enter yokes.

MEDIUM TANK M4A4

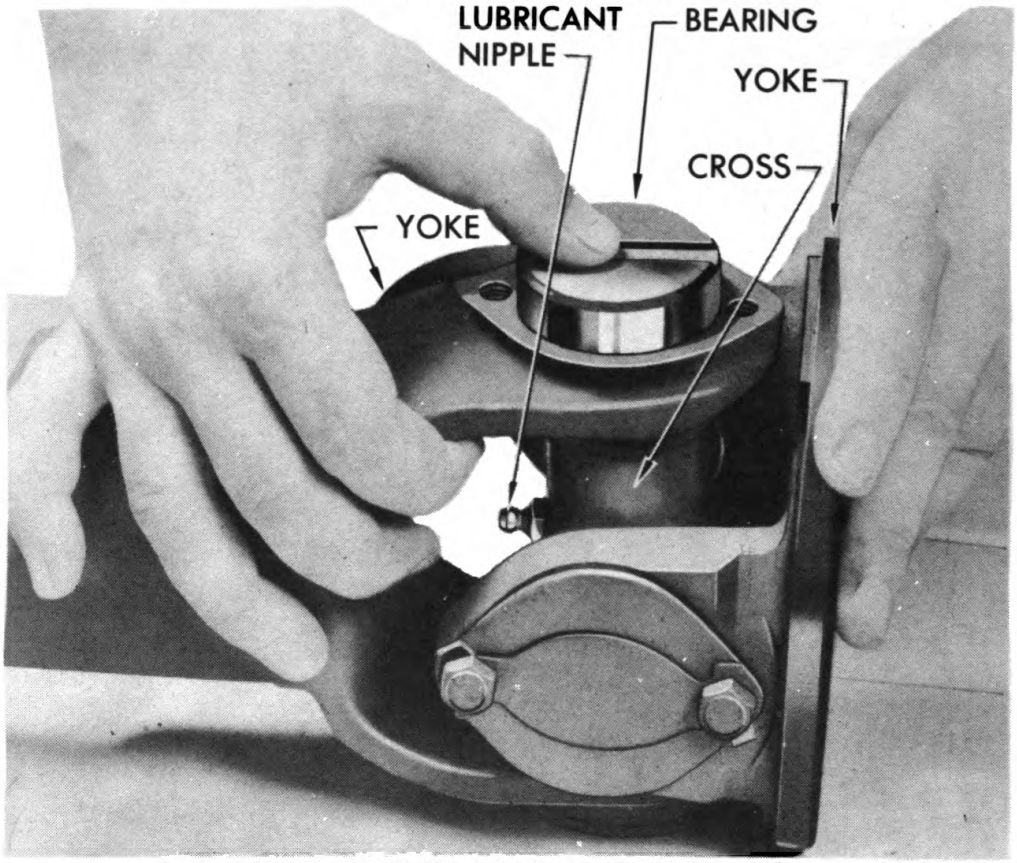


Figure 94 — Installing Universal Joint Bearing RA PD 24414

(5) INSTALL BEARING COVER PLATES (fig. 95).

DRIFT
HAMMER
WRENCH, $\frac{7}{16}$-in.

Aline groove in outer end of bearing so as to receive projection on inner side of retainer cover plate. Position retainer cover screw lock plate and attach plate with two cap screws, locking screws securely by bending tabs of locking plate around heads of cap screws.

(6) INSTALL PROPELLER SHAFT HOUSING COVERS.

WRENCH, ½-in.

Position cover, or covers (wherever removed) and secure with cap screws.

(7) LUBRICATE UNIVERSAL JOINTS (par. 102., **b.**).

102. LUBRICATION OF UNIVERSAL JOINTS.

a. General. Each universal joint is provided with a lubricant nipple, located in the universal joint cross (fig. 91). A relief valve, located on the opposite side of the cross, is provided to relieve pressure built up by forcing GREASE, general purpose, into the bearings. The one lubricant

nipple in each cross provides lubrication for the four bearings in each universal joint. Lubricate every 1,000 miles.

TOOLS.

GUN, grease

WRENCH, ½-in.

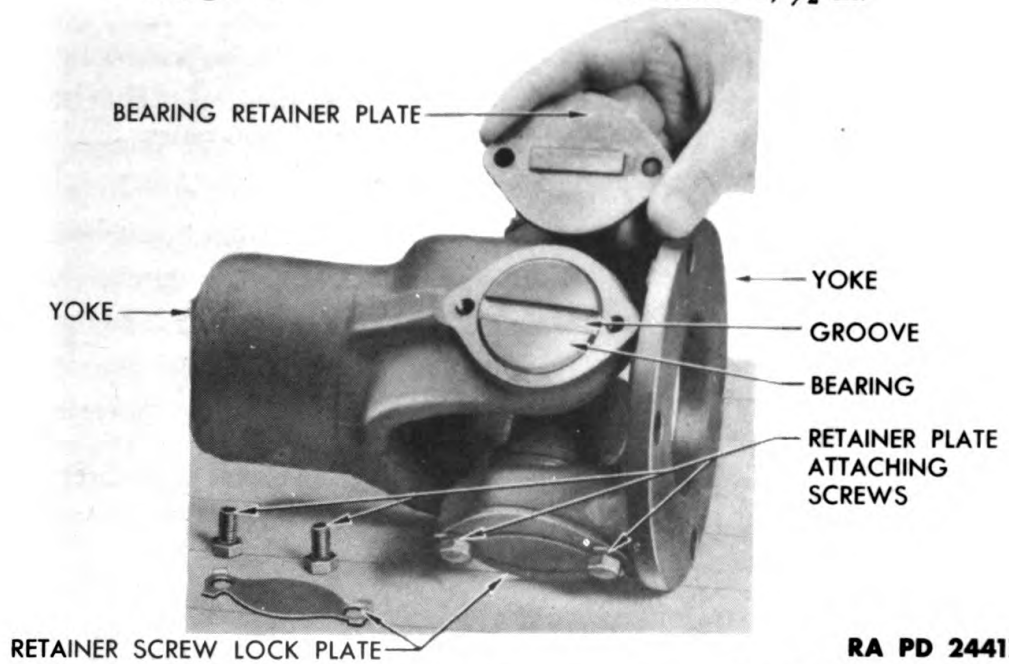


Figure 95 — Installing Universal Joint Bearing Cover Plate

b. Procedure.

(1) REMOVE PROPELLER SHAFT HOUSING COVERS.

WRENCH, ½-in.

Rotate turret to proper position and lift up section of turret floor directly above center or rear universal joint. NOTE: This will not be necessary if front universal joint cover is to be removed. Reach through opening in floor and remove cap screws, on both right and left sides of propeller shaft housing, which secure cover to housing. Lift cover from housing.

(2) LUBRICATE BEARINGS (figs. 90 and 91).

GUN, grease

Apply GREASE, general purpose, through lubricant nipple until it is forced out through relief valve on opposite side of cross.

(3) INSTALL PROPELLER SHAFT HOUSING COVERS.

WRENCH, ½-in.

Position cover on propeller shaft housing and secure with the lock washers and cap screws.

103. LUBRICATION OF PROPELLER SHAFT SLIP JOINT.

a. General. An opening in the rear propeller shaft rear slip joint yoke provides a means of lubricating the slip joint. At time of assembly of the vehicle, an oiler plug is screwed into this opening thus necessitating the removal of the plug and the installation of a lubricant nipple, when lubricating the slip joint (fig. 90). A grease retainer, to prevent loss of lubricant, is located at the front end of the rear slip joint yoke. It is held in place by a knurled nut. Lubricate slip joint every 1,000 miles.

TOOLS.

GUN, grease	SCREWDRIVER
PLIERS, adjustable	WRENCH, ½-in.

b. Procedure.

(1) REMOVE PROPELLER SHAFT HOUSING COVER.

WRENCH, ½-in.

Rotate turret to proper position and lift section of turret floor directly above propeller shaft. Remove cap screws which secure cover to housing and lift cover off housing.

(2) LUBRICATE SLIP JOINT (fig. 90).

GUN, grease	SCREWDRIVER
PLIERS, adjustable	

Unscrew plug from rear slip joint yoke (screwdriver) and install a lubricant nipple in this opening (adjustable pliers). Unscrew knurled nut from front end of rear slip joint plug (turn counterclockwise), apply GREASE, general purpose, through nipple until it is forced out front end of yoke (grease gun). Screw knurled nut on yoke, with fingers. Remove nipple from yoke (adjustable pliers), and install plug in opening. Tighten plug securely (screwdriver).

(3) INSTALL PROPELLER SHAFT HOUSING COVER.

WRENCH, ½-in.

Position cover on housing and attach with cap screws and lock washers.

Section XX

POWER TRAIN

104. GENERAL DESCRIPTION.

a. The power train consists of the transmission, differential, and final drive units (fig. 96).

(1) The transmission has five forward speeds and one reverse speed. A parking brake is built into the transmission and is operated by a lever to the right of the driver (fig. 9). *Use this brake only after the vehicle has been brought to a stop.*

(2) The differential is known as a "controlled differential" because it serves not only to transmit engine power to the final drive unit, but it also contains a brake system for the purpose of steering and stopping the vehicle.

(3) The final drive units transmit power from the controlled differential to the hub of the driving sprockets through a set of reduction gears. The final drive units are bolted to each side of the differential case and the driving sprockets bolted to the hub. The final drive units can be removed without removing the power train from the vehicle.

105. REMOVAL OF POWER TRAIN.

a. General. NOTE: The using arms are authorized to remove and install a power train. However, the replacement of a power train with another power train must not be done by using arms unless authorization is received from Ordnance Personnel. Removal of the power train from the vehicle is a major service operation that will require several hours. Two men are necessary for much of the operation. On many of the bolts to be removed, the nut must be held within the vehicle while

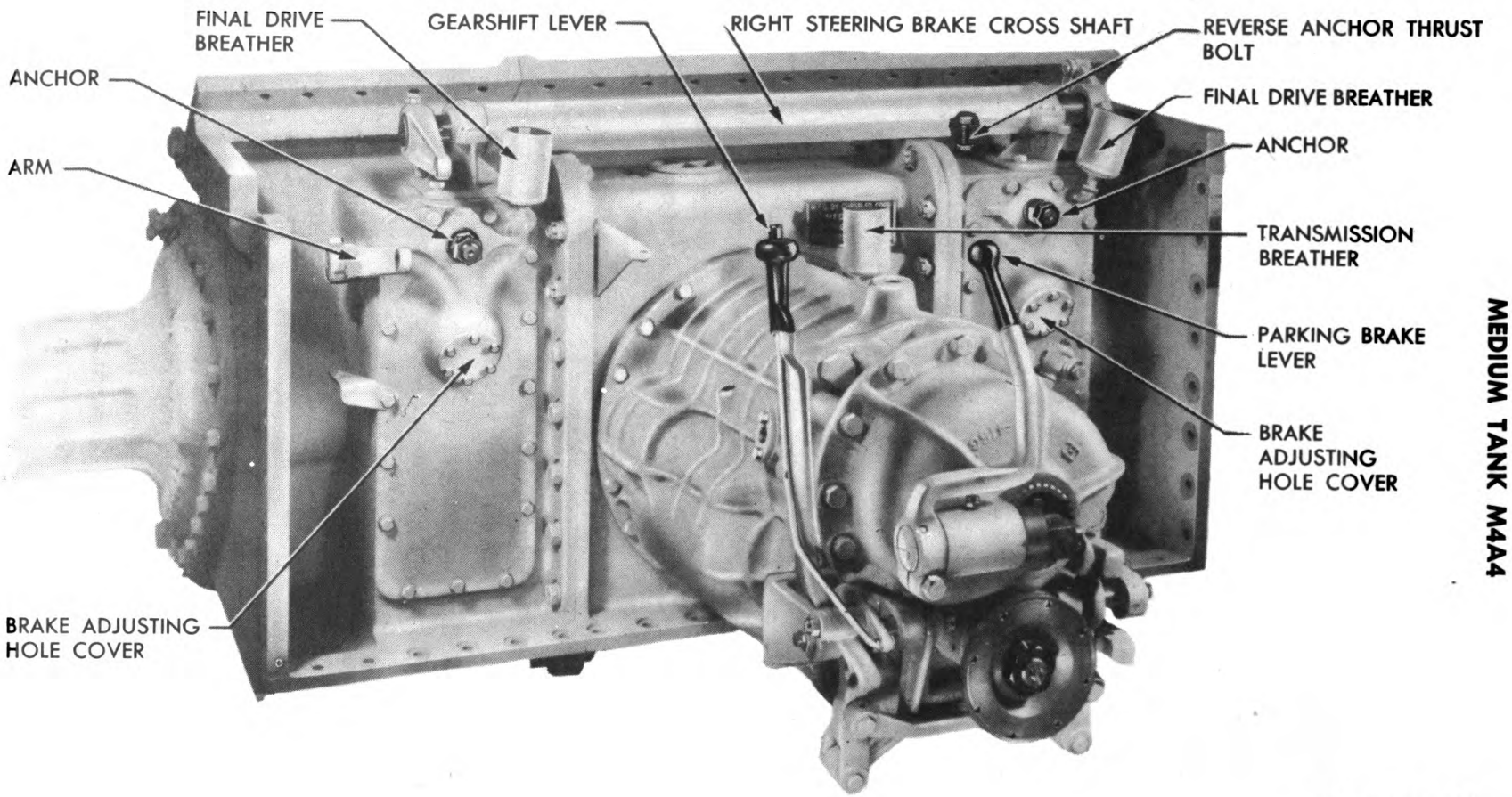


Figure 96 — Power Train

the bolt is being turned from the outside. No special tools are required to remove the assembly, but because of its size and weight (8,000 pounds), some sort of hoist or lifting mechanism is necessary. A specially designed carrier (fig. 97), has been found extremely helpful.

TOOLS.

BAR
BLOCKS, wood (2)
4-in. x 4-in. x 12-in.
CARRIAGE, power train, D 47504
CHAIN, 4-feet (2)
HAMMER, 1-lb.
HOIST
PAN, for oil (capacity, 40 gallons)
PLIERS, adjustable
PLIERS, side cutting
PUNCH, prick
SCREWDRIVER
TRUCK, towing
WRENCH, $\frac{7}{16}$-in.
WRENCH, $\frac{9}{16}$-in.
WRENCH, $\frac{3}{4}$-in.
WRENCH, $1\frac{1}{8}$-in. (2)
WRENCH, $1\frac{1}{2}$-in.
WRENCH, $1\frac{7}{16}$-in.
WRENCH, Allen, $\frac{5}{8}$-in.
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{3}{4}$-in. (2)
WRENCH, open-end, 1-in.
WRENCH, open-end, $1\frac{1}{8}$-in. (2)
WRENCH, open-end, $1\frac{3}{8}$-in.
WRENCH, pipe, 16-in.
WRENCH, socket, $\frac{3}{4}$-in.
WRENCH, MTM-M3-7

b. Procedure.

(1) OPEN RADIO SWITCH AND BATTERY SWITCH (par. 52., b. (1)).

(2) BLOCK BOGIE WHEEL AT BOTH SIDES OF VEHICLE.

BLOCK, wood, 4-in. x 4-in. x 12-in. (2)

Place blocks of wood just forward of bogie wheels of center volute suspension (between track and bogie wheel) to prevent movement of the vehicle while power train unit is being removed.

(3) DISCONNECT TRACKS, BOTH SIDES (par. 115., h.).

(4) DRAIN OIL FROM POWER TRAIN.

PAN, oil, (capacity, 40 gallons)
WRENCH, Allen, $\frac{5}{8}$-in.

Place pan under center of transmission and differential and remove drain plugs (one from center of each unit, at bottom) (turn counter clockwise) ($\frac{5}{8}$-in. Allen wrench). Allow to drain thoroughly, then install drain plugs. Place pan under final drive housing, locating pan directly below housing, and remove drain plug from underneath housing (turn counterclockwise). Allow unit to drain thoroughly, then install plug. Repeat this operation to drain the other final drive housing.

(5) REMOVE SIREN (par. 186., c.)

(6) REMOVE FINAL DRIVE SPROCKET AND HUB ASSEMBLIES (par. 6., b.).

(7) REMOVE FRONT FENDERS.

WRENCH, ¾-in. WRENCH, 1⅛-in.
WRENCH, $\frac{9}{16}$-in.

Remove three cap screws which secure fender to power train (1⅛-in. ·ench). Remove the three bolts and nuts which secure fender to flange hull ($\frac{9}{16}$-in. wrench). Remove two cap screws which attach fender power train (¾-in. wrench). NOTE: Repeat operation to remove nder from other side of vehicle.

(8) DISCONNECT PROPELLER SHAFT FRONT UNIVERSAL JOINT.

HAMMER, 1-lb. WRENCH, $\frac{7}{16}$-in.
PUNCH, prick WRENCH, $\frac{9}{16}$-in.

Remove two cap screws and remove cover over front universal joint $\frac{7}{16}$-in. wrench). Prick punch flange on end of transmission shaft and nge of universal joint for reassembly. Remove the eight bolts, nuts d lock washers and separate flanges ($\frac{9}{16}$-in. wrench).

(9) DISCONNECT SPEEDOMETER CABLE.

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

Unscrew knurled nut which secures cable housing to adapter at upper, ;ht rear of transmission and separate cable and housing from adapter djustable pliers). Remove cap screw from right-hand side of transssion, remove clip and release cable housing from transmission ($\frac{9}{16}$-in. ench).

(10) DISCONNECT TRANSMISSION TO COOLER OIL TUBES.

SCREWDRIVER WRENCH, open-end, 1⅜-in.
WRENCH, open-end, 1⅛-in. WRENCH, pipe, 16-in.

Unscrew tubes at connections at transmission end, (turn counterckwise) and separate oil tubes from connections (1⅜-in. open-end ench). Remove the two screws which secure the shield to the oil nperature sending unit, separate the two halves of the shield and l wire out of top unit (screwdriver). Unscrew connections from left e of transmission (to which the oil lines were connected) (turn nterclockwise) (1⅛-in. open-end wrench for front connection; 16-in. e wrench for rear connection).

(11) REMOVE THROTTLE SUPPORT AND BRACKET.

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

Remove the two cap screws and lock washers, which secure throttle

bracket support to left side of differential case and lay throttle and bracket toward rear of vehicle.

(12) DISCONNECT LINKAGE OF STEERING BRAKE LEVERS.

PLIERS, side cutting

Remove cotter pin from end of clevis pin and withdraw clevis pin from clevis at upper end of steering brake control rod (both right and left), where control rod connects to steering brake cross shaft lever (fig. 50).

(13) REMOVE BREATHERS.

PLIERS, adjustable

Unscrew the three breathers (one on top of transmission and one near the top of either steering brake housing cover), (turn counterclockwise).

(14) REMOVE SWITCHES AND BRACKET.

SCREWDRIVER
WRENCH, 1⅛-in.
WRENCH, open-end, $\frac{7}{16}$-in.

Remove two attaching screws and nuts which secure the two stop light switches to brackets (one directly forward of right steering lever, one below left steering brake shaft lever). Remove switches from brackets and lay on hull, just forward of instrument box (screwdriver, $\frac{7}{16}$-in. open-end wrench). Remove the two nuts which attach siren switch to side of hull, remove switch and bracket from hull and lay with stop light switches (1⅛-in. wrench).

(15) REMOVE BRAKE CROSS SHAFT ASSEMBLY.

PLIERS, side cutting
WRENCH, open-end, ¾-in.

Remove the cotter pin and remove clevis pin which attaches steering brake control rod—right to steering brake cross shaft lever—right (fig. 50), and separate rod from lever (side cutting pliers). Remove the four screws and lock washers which secure the cross shaft brackets (at each end of cross shaft) to steering brake housings and lift cross shaft and brackets assembly off power train unit (¾-in. open-end wrench).

(16) DISCONNECT WIRE FROM RIGHT HEADLIGHT.

PLIERS, adjustable

Unscrew knurled nut from connector (in right front corner of hull, just below right headlight) and separate conduit from connector.

(17) CONNECT WIRE CONDUIT AND SPEEDOMETER CABLE HOUSING FROM POWER TRAIN UNIT.

WRENCH, open-end, 1⅛-in.

Remove the three power train to hull bolt nuts which secure the

ıree wire and housing retaining clips to power train unit. Lay wires ıd speedometer cable on instrument box.

(18) REMOVE BOLTS FROM BOTTOM OF POWER TRAIN.

PLIERS, side cutting WRENCH, 1⅛-in. (2)

Have man, inside vehicle, hold nuts (1⅛-in. wrench) and remove ıe eighteen bolts which secure the power train to bottom of hull. (1⅛-ı. wrench). Remove the locking wire and remove the two cap screws from outside vehicle) directly below center of transmission (side cutting pliers; 1⅛-in. wrench).

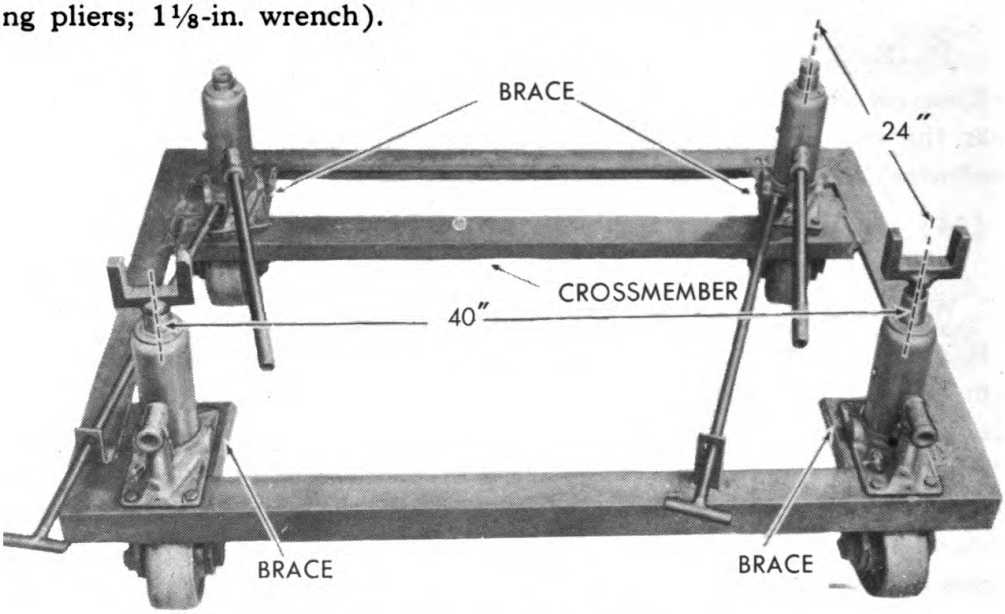


Figure 97 — Power Train Carriage

RA PD 11073

(19) PLACE POWER TRAIN CARRIAGE IN POSITION.

CARRIAGE, power train, D47504.

Position power train carriage under power train (fig. 98) and elevate ach of the four jacks until they support the weight of power train. AUTION: Do not attempt to raise power train above present posi-on, merely adjust jacks to remove weight of power train unit from :taching bolts.

(20) REMOVE BALANCE OF ATTACHING BOLTS.

WRENCH, 1⅛-in. (2)

Have man, inside vehicle, hold the nuts (1⅛-in. wrench) and remove ıe seventeen bolts across top and eight along each side of power train nit (1⅛-in. wrench).

(21) REMOVE POWER TRAIN UNIT FROM VEHICLE (fig. 98).

CHAIN, 4-feet (2) TRUCK, towing

Lower front jacks to allow clearance between rear of transmission and oil lines. NOTE: Special care must be exercised at this point to prevent serious damage to the unit. Push gear shift lever and parking brake lever forward to allow clearance. Attach truck to chains and attach chains to towing shackles at front of unit. Carefully pull power train unit from hull, keeping both sides even.

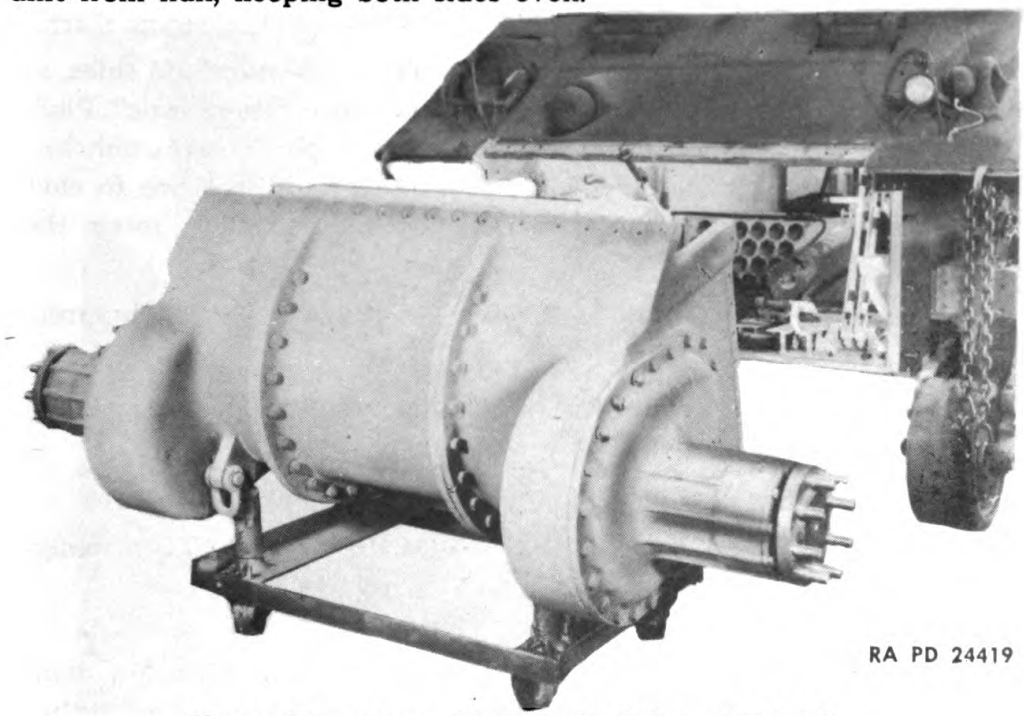


Figure 98 — Power Train Pulled Out of Vehicle

106. INSTALLATION OF POWER TRAIN.

TOOLS.

CARRIAGE, power train, D47504
CHAIN, 4-feet (4)
HAMMER, 1-lb.
HOIST
JACK, simplex
PIN, drive, ¾ ($\frac{1}{64}$-in. Undersize) (4)
PLIERS, adjustable
PLIERS, side cutting
PUL-LIFT
REAMER, tapered, ¾-in.
ROPE
SCREWDRIVER
STRAIGHTEDGE
TRUCK, towing
WRENCH, $\frac{7}{16}$-in.
WRENCH, $\frac{9}{16}$-in.
WRENCH, ¾-in.
WRENCH, 1⅛-in. (2)
WRENCH, 1½-in.
WRENCH, $1\frac{7}{16}$-in.
WRENCH, open, $1\frac{7}{16}$-in.
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, ¾-in. (2)
WRENCH, open-end, 1-in.
WRENCH, open-end, 1⅜-in.
WRENCH, pipe, 16-in.
WRENCH, MTM-M3-7

a. Procedure.

(1) POSITION POWER TRAIN UNIT ON POWER TRAIN CARRIAGE.

CARRIAGE, power train, D47504

Place power train unit on carriage and adjust carriage jacks to slightly elevate the rear of the power train.

(2) PREPARE OPENING IN HULL TO RECEIVE POWER TRAIN UNIT.

Paint all mounting flanges in hull opening, top, bottom and sides, as well as mounting surfaces on power train unit, with "alumilastic". Place the two side spacers (which fit between ends of power train unit and hull) in position and secure in place by inserting bolts (two to each spacer) through mounting holes in hull, just far enough to retain the spacers.

(3) MOVE POWER TRAIN UNIT INTO POSITION IN HULL OPENING.

CHAINS, 4-feet long (2)

Move unit into position in front of opening, with unit perfectly alined with opening.

(4) PULL POWER TRAIN UNIT INTO HULL (fig. 99).

CHAINS, 4-feet long (4)
HAMMER, 1-lb.
PIN, drive, ¾-in. (⅝-in. undersize) (4)
PUL-LIFT

Attach a chain to each front volute suspension bracket, attach a chain around each final drive housing, connect a Pul-lift to chains and, with a man inside vehicle to guide unit into opening, pull unit into opening as far as possible with Pul-lift. NOTE: Be sure that spaces at either end of power train unit, are in position when unit is pulled into hull. Raise or lower jacks to aline holes. Insert alining drifts through each bolt hole on top, and in a hole in each end of unit, as far down as possible. Drive drift in to properly aline holes.

(5) INSTALL ATTACHING BOLTS.

PLIERS, side cutting
REAMER, tapered, ¾-in.
WRENCH, 1⅛-in. (2)

NOTE: It may be necessary to ream holes slightly in order to install bolts (¾-in. tapered reamer). Install seventeen bolts across top of unit, with bolt heads on outside of vehicle. Start nuts from inside and install with fingers. Install one bolt (in each end hole) (from inside vehicle) through hull floor and power train and install nuts from outside. Install sixteen bolts from hull floor to bottom of power train unit, with bolt heads on outside of vehicle, and install nuts with fingers. Install two cap screws from hull floor to transmission (from outside vehicle, and directly below

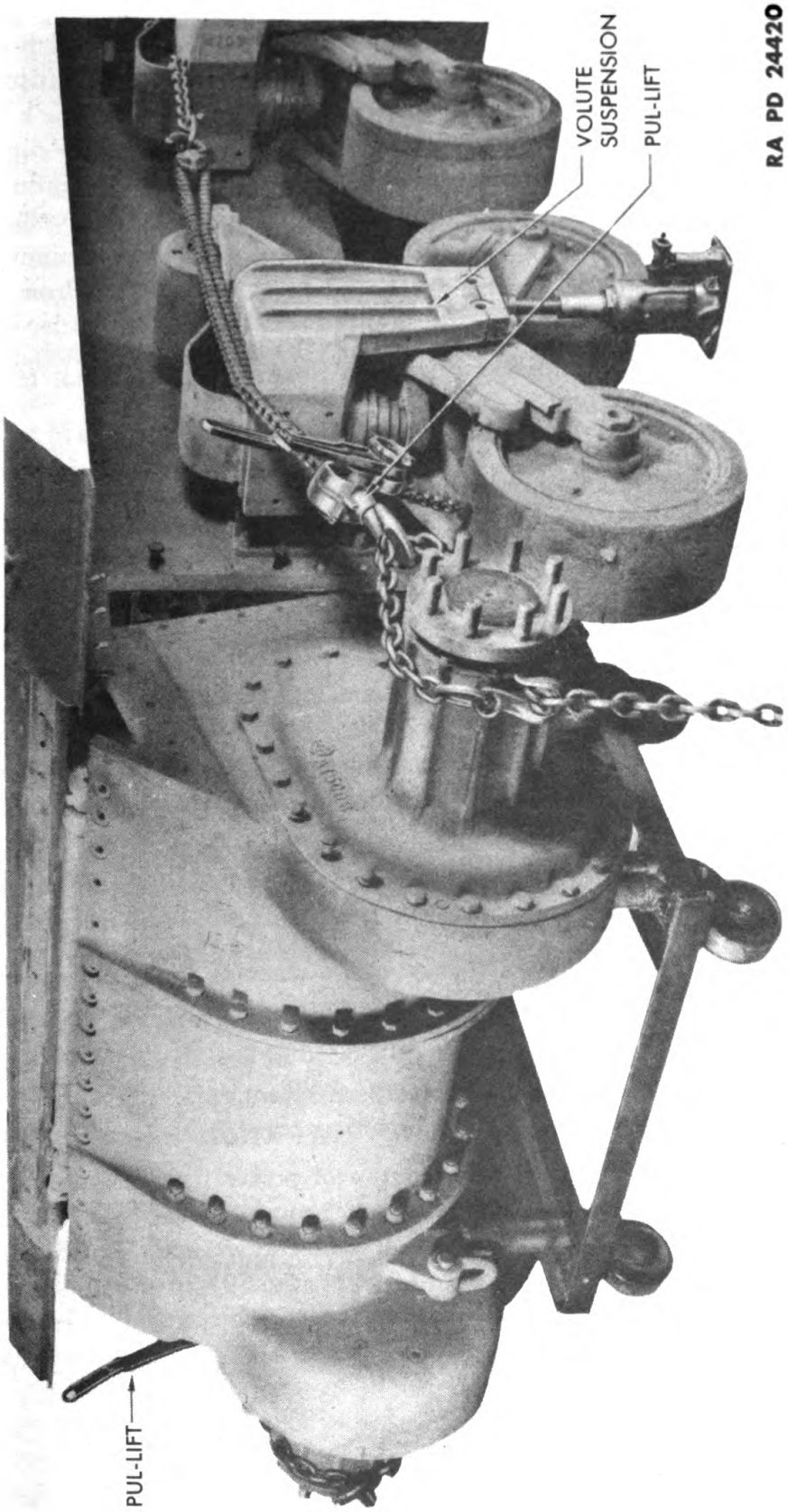


Figure 99 — Pulling Power Train Into Hull

center of unit). Install eight bolts along right side of unit (from outside vehicle) and install nuts from inside vehicle, with fingers. Install cap screw (from inside vehicle) in lower left hand corner, to attach unit to hull. Install five bolts (from inside vehicle) directly above this cap screw, installing nut (from outside vehicle) with fingers. Position siren switch over the next two holes above, insert two bolts from outside vehicle and install nuts, with fingers, from inside vehicle. Install the remaining three bolts (from outside vehicle) and install nuts, with fingers, from inside. Lower jacks until they clear unit and move carriage from under vehicle.

(6) CONNECT WIRE CONDUIT AND SPEEDOMETER CABLE HOUSING TO POWER TRAIN UNIT.

WRENCH, $\frac{7}{16}$-in.

Lay conduit and cable housing over top of unit and secure to hull by attaching the three retaining clips to three bolts which attach power train to hull (as indicated by location of clips).

(7) TIGHTEN BOLTS.

PLIERS, side cutting WRENCH, 1⅛-in. (2)

Tighten all bolts and nuts, with one man holding nuts with 1⅛-in. wrench, and other man tightening bolts (1⅛-in. wrench). Tighten the two cap screws directly below transmission, pass locking wire through holes in bolt heads and, with side cutting pliers, twist ends of wire together (1⅛-in. wrench).

(8) CONNECT RIGHT HEADLIGHT WIRE.

PLIERS, adjustable.

Insert connection on end of wire into connector in right front corner of hull (directly below right headlight) and screw knurled nut onto connection in hull.

(9) INSTALL BRAKE CROSS SHAFT ASSEMBLY.

PLIERS, side cutting. WRENCH, open-end, ¾-in.

Position cross shaft assembly on top of power unit assembly, insert the four cap screws and lock washers through holes in brackets and tighten the cap screws securely (¾-in. open-end wrench). Position clevis on end of steering brake control rod—right (fig. 50), over end of steering brake cross shaft lever—right, insert clevis pin through holes and insert cotter pin through hole in end of clevis pin and bend ends of cotter pin to secure (side cutting pliers).

(10) INSTALL STOPLIGHT SWITCHES.

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

Place the two stop light switches in position on brackets just forward of steering levers and attach them to brackets with the two attaching screws and nuts.

(11) INSTALL BREATHERS (fig. 9).

PLIERS, adjustable.

Screw the three breathers in place (one in top of transmission, and one each in the upper right hand corner of the steering brake housing cover).

(12) CONNECT LINKAGE OF STEERING BRAKE LEVERS (fig. 50).

PLIERS, side cutting.

Position steering brake control rods (both right and left) with clevis over end of steering brake cross shaft lever, insert clevis pin through clevis and insert cotter pin through hole in end of clevis pin and bend ends of cotter pin to secure.

(13) CONNECT THROTTLE SUPPORT AND BRACKET (fig. 9).

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

Place support and bracket in position on left side of differential case, insert the two cap screws and lock washers and tighten securely.

(14) CONNECT TRANSMISSION TO COOLER OIL TUBES (fig. 100).

SCREWDRIVER
WRENCH, open-end, $1\frac{3}{8}$-in.
WRENCH, open-end, $1\frac{1}{8}$-in.
WRENCH, pipe, 16-in.

Screw the "L" connection in the front threaded opening in left side of transmission. Tighten securely, with connection alined so as to receive connection on end of oil tube ($1\frac{1}{8}$-in. open-end wrench). Attach oil tube to this connection (turn clockwise) and tighten securely ($1\frac{3}{8}$-in. open-end wrench). Screw the "T" connection into the upper threaded opening in left side of transmission. Tighten securely, with connection on side of "T" pointing toward rear of vehicle (16-in. pipe wrench). Attach oil tube to this connection (turn clockwise) and tighten securely ($1\frac{3}{8}$-in. open-end wrench). Insert end of wire in opening in top of sending unit, position the two halves of shield around top of sending unit and secure with the two slotted head screws (screwdriver).

(15) CONNECT SPEEDOMETER CABLE.

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

Place end of speedometer cable in opening in speedometer adapter and secure by screwing knurled nut in place on adapter (adjustable pliers). Place cable housing in position along right side of transmission and attach housing clip to transmission with cap screw ($\frac{9}{16}$-in. wrench).

(16) CONNECT PROPELLER SHAFT AT FRONT UNIVERSAL JOINT.

WRENCH, $\frac{7}{16}$-in. WRENCH, open-end, $\frac{3}{4}$-in. (2)

Place flange of front universal joint in position, alining prick punch marks on flanges. Insert the eight cap screws through holes from rear of flange, install lock washers and nuts and tighten nuts securely (2, $\frac{3}{4}$-in. open-end wrench). Position cover on propeller shaft housing, over front universal joint, insert one cap screw on right side of housing and one cap screw on left side and tighten securely ($\frac{7}{16}$-in. wrench).

(17) FILL TRANSMISSION AND DIFFERENTIAL WITH OIL (par. 107., c.,).

(18) FILL BOTH FINAL DRIVE HOUSINGS WITH OIL (par. 107., e.,).

(19) INSTALL FINAL DRIVE SPROCKETS AND HUB ASSEMBLIES (par. 116., c.,).

HOIST
WRENCH, $1\frac{7}{16}$-in.

Lift assembly in place with hoist and mount on the eight mounting studs. Install the eight nuts and tighten securely ($1\frac{7}{16}$-in. wrench). Repeat operation for assembly on opposite side of vehicle.

(20) INSTALL FRONT FENDERS (both right and left).

SCREWDRIVER WRENCH, $\frac{9}{16}$-in.
WRENCH, $\frac{3}{4}$-in. WRENCH, $1\frac{1}{8}$-in.

Remove three cap screws which attach final drive housing to power train unit (directly above center of final drive). NOTE: These cap screws are purposely left loose on all new power train units shipped from manufacturer to facilitate installation of fenders. Position fender on hull (resting fender on top of hull flange) and power train unit, install the three cap screws which attach fender to power train unit and tighten with fingers. Install two cap screws, from fender to power train unit (from underneath fender) and tighten with fingers. NOTE: Teeth of sprocket may cover these bolts and it may be necessary to pry sprocket around with crowbar, until there is an opening in front of bolt. Insert three bolts through holes in fender and through flange of hull, install lock washers and nuts, hold bolts with screwdriver and tighten nuts securely ($\frac{3}{4}$-in. wrench). Tighten the three cap screws which secure fender to final drive housing ($1\frac{1}{8}$-in. wrench). Tighten the two cap screws which secure fender to power train unit ($\frac{9}{16}$-in. wrench). Repeat operation to install fender on other side of vehicle.

(21) INSTALL SIREN (par. 186., d.,).

(22) CONNECT TRACKS AND ADJUST (par. 115., i.,).

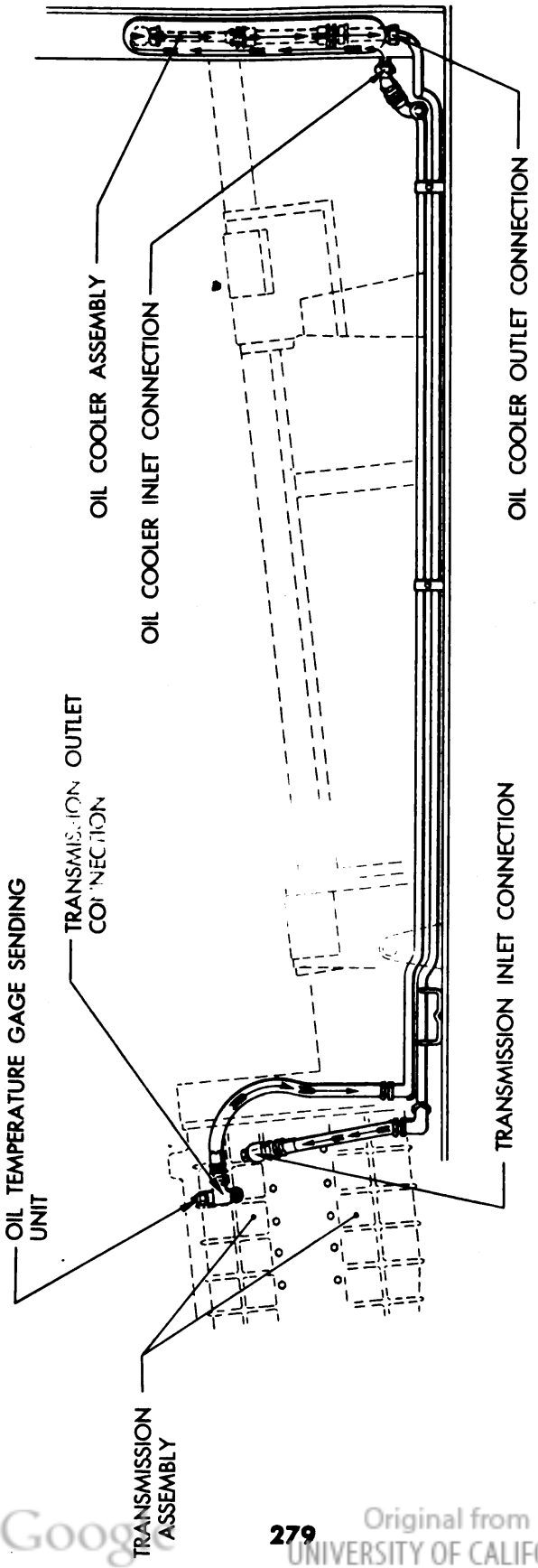


Figure 100 — Power Train Lubricating System

MEDIUM TANK M4A4

107. POWER TRAIN LUBRICATING SYSTEM.

a. Description. Oil flows from the differential through a tube to the sump in the bottom of the transmission case. From there it is drawn into the pump which forces it out through a hole in the left side of the transmission case into lines that carry it to the oil cooler (fig. 100). A sending unit is mounted in the oil outlet line leading from the transmission to oil cooler (fig. 100). This unit is connected to and actuates a gage located on the instrument box cover (fig. 10), thus providing a means of determining the temperature of the oil in the system at all times. The transmission oil cooler is located on the bulkhead (fig. 34), to the left of the propeller shaft, in such a position that air is drawn through it by the power unit fan while the power unit is operating. After entering at the bottom of this cooler, the oil circulates upward through an outer passage in the cooler until it reaches the top of the cooler. It then enters a passage in the center of the cooler and returns to the cooler outlet connection, located at the bottom of the cooler. It is then forced through tubing to re-enter the transmission, lubricating the gears and bearings, and into the differential. The final drive units are lubricated independently of the transmission, and differential, each unit being contained in a separate bushing, with drain plugs and filler plugs in each housing.

b. Drain Transmission and Differential.

TOOLS.

PAN, oil (capacity, 20 gallons) WRENCH, Allen, 5/8-in.

(1) PROCEDURE.

(a) Remove drain plugs.

WRENCH, Allen, 5/8-in.

Remove dirt from around drain plugs, located on underneath side of transmission (in center of units) and clean area adjacent to plugs. Place drain pan under center of transmission and differential. Remove drain plugs from both units (reached from underneath vehicle) (turn counterclockwise) (5/8-in. Allen wrench). Install drain plugs, after units have completely drained, and tighten securely.

c. Fill Transmission and Differential.

TOOLS.

WRENCH, Allen, 5/8-in.

(1) PROCEDURE.

(a) Check Drain Plugs.

WRENCH, Allen, 5/8-in.

Crawl under vehicle, at front end, and tighten drain plugs (one in center of differential and one in center of transmission) securely, to prevent oil leaks.

(b) Fill Transmission and Differential With Oil.

Pour oil through filler pipe on right hand side of transmission (fig. 9), for both transmission and differential, until oil level is brought to "FULL" mark on bayonet gage on filler pipe cap. NOTE: To check level of oil in transmission, rest filler cap on top of filler pipe, *but do not tighten cap in place, as this will trap air inside pipe and give an untrue reading on the gage,* and note when oil has reached the "FULL" mark on gage.

d. Drain Final Drive Unit.

TOOLS.

PAN, for oil (capacity, 10 gallon)
WRENCH, Allen, 5/8-in.

(1) PROCEDURE.

(a) Remove drain plug.

PAN, for oil (capacity, 10 gallon)
WRENCH, Allen, 5/8-in.

Remove dirt from drain plug (underneath center of steering brake housing and surrounding area). Place pan under housing and remove plug (turn counterclockwise). After unit has drained thoroughly, install drain plug, tightening securely (5/8-in. Allen wrench). NOTE: Repeat operation to drain final drive unit on opposite side of differential housing.

e. Fill Final Drive Unit.

TOOLS.
WRENCH, Allen, 5/8-in.

(1) PROCEDURE.

(a) Check drain plug (on underside of housing) with wrench and tighten securely. Remove plug from filler hole, located towards front and center of steering brake housing (turn counterclockwise). Fill unit until level of oil is one inch below filler hole. Install plug and tighten securely. NOTE: Repeat operation to fill final drive unit on the opposite side of differential.

108. REMOVAL OF FINAL DRIVE UNIT.

TOOLS.

BAR, pinch
CHAIN
HAMMER, 1-lb.
HOIST
PAN, for oil (capacity, 10 gallon)
SCREWDRIVER
WRENCH, $\frac{7}{16}$-in.
WRENCH, $\frac{9}{16}$-in.
WRENCH, $\frac{3}{4}$-in.
WRENCH, $1\frac{1}{16}$-in.
WRENCH, $1\frac{1}{8}$-in.
WRENCH, $1\frac{7}{16}$-in.
WRENCH, Allen, $\frac{5}{8}$-in.
WRENCH, open-end, 1-in.
WRENCH, MTM-M3-7

a. Procedure.

(1) DRAIN OIL FROM FINAL DRIVE UNIT as outlined in paragraph 107., **d.**

(2) DISCONNECT TRUCK (par. 115., **h.**,).

(3) REMOVE HUB AND SOCKET ASSEMBLY. Refer to paragraph 116., **b.**, for details.

(4) REMOVE SIREN (par. 186., **c.**,).

(5) REMOVE FRONT FENDERS.

WRENCH, $\frac{3}{4}$-in.
WRENCH, $\frac{9}{16}$-in.
WRENCH, $1\frac{1}{8}$-in.

Remove the three cap screws which secure fender to power train ($1\frac{1}{8}$-in. wrench). Remove the three bolts and nuts which secure fender to flange of hull ($\frac{9}{16}$-in. wrench). Remove the two cap screws which attach fender to power train ($\frac{3}{4}$-in. wrench). Repeat operation to remove fender on opposite side of vehicle.

(6) TAKE WEIGHT OFF ASSEMBLY WITH HOIST.

CHAIN
HOIST

Arrange hoist to support final drive while being removed, raising hoist sufficiently to take weight off attaching cap screws.

(7) REMOVE FINAL DRIVE.

BAR, pinch
WRENCH, $1\frac{1}{8}$-in.

Remove twenty-one cap screws which secure final drive housing to steering brake housing ($1\frac{1}{8}$-in. wrench). Pry final drive housing away from steering brake housing (pinch bar). NOTE: The assembly must be manipulated to remove it, since pinion gear encloses and meshes with compensating drive shaft.

POWER TRAIN

109. INSTALLATION OF FINAL DRIVE UNIT.

TOOLS.

BAR, bronze, bumping
CHAIN, track, (2)
HAMMER, 1-lb.
HOIST
JACK, simplex
ROPE
SCREWDRIVER
STRAIGHTEDGE
TRUCK, towing
WRENCH, $\frac{7}{16}$-in.
WRENCH, $\frac{9}{16}$-in.
WRENCH, $\frac{3}{4}$-in.
WRENCH, $1\frac{1}{8}$-in.
WRENCH, $1\frac{7}{16}$-in.
WRENCH, Allen $\frac{5}{8}$-in
WRENCH, open-end, 1-in.
WRENCH, MTM-M3-7

a. Procedure.

(1) INSTALL FINAL DRIVE ASSEMBLY ON STEERING BRAKE HOUSING.

BAR, bronze, bumping
CHAIN
HOIST

Remove all traces of torn gaskets and foreign matter from mounting faces of final drive housing and steering brake housing and cover these mounting faces with COMPOUND, sealing. Position *new* gasket on housing, alining all holes in gasket and housing. Place chain around final drive housing and raise with hoist to level of steering brake housing. Assemble final drive assembly to steering brake housing, meshing pinion gear and compensating gear and sliding in place over the two locating dowels.

(2) SECURE FINAL DRIVE ASSEMBLY TO STEERING BRAKE HOUSING.

Insert two cap screws and lock washers through two holes forward of final drive housing and two to rear of final drive housing and tighten finger tight, to secure in place. Remove hoist and chain.

(3) INSTALL FENDER.

WRENCH, $\frac{9}{16}$-in.
WRENCH, $\frac{3}{4}$-in.
WRENCH, $1\frac{1}{8}$-in.

Position fender on hull (resting fender on top of hull flange) and power train unit, install the three cap screws and lock washers which attach fender to final drive housing and tighten with fingers. Install the two cap screws from fender to end of power train unit (from underneath fender) and tighten with fingers. Insert three bolts through holes in fender and through flange of hull, install lock washers and nuts, hold bolts with screw driver and tighten nuts securely ($\frac{3}{4}$-in. wrench). Tighten the three cap screws, which secure fender to final drive housing, securely; install balance of the twenty-one cap screws, and lock washers, and tighten securely ($1\frac{1}{8}$-in. wrench). Tighten securely (from

underneath fender) the two cap screws which secure fender to end of power train unit ($\frac{9}{16}$-in. wrench).

(4) INSTALL SIREN (on left fender only) (par. 186., d.)

(5) INSTALL SPROCKET AND HUB ASSEMBLY (par. 116., c.)

(6) CONNECT TRACK AND ADJUST (par. 115., i.).

(7) FILL FINAL DRIVE UNIT WITH OIL.

Refer to paragraph 107., e., for details.

110. REMOVAL OF TRANSMISSION OIL COOLER.

TOOLS.

PAN, for oil (capacity, 20 gallons)
WRENCH, $\frac{7}{16}$-in.
WRENCH, open-end, $1\frac{3}{8}$-in.
WRENCH, Allen, $\frac{5}{8}$-in.

a. Procedure.

(1) DRAIN TRANSMISSION AND DIFFERENTIAL (par. 107., b.)

(2) DISCONNECT OIL LINES.

WRENCH, open-end, $1\frac{3}{8}$-in.

Unscrew oil lines from both top and bottom of cooler (turn counterclockwise).

(3) REMOVE COOLER GUARD.

WRENCH, $\frac{7}{16}$-in.

Remove four cap screws and remove cooler guard.

(4) REMOVE COOLER.

WRENCH, $\frac{7}{16}$-in.

Remove eight bolts, nuts and lock washers and remove cooler from brackets.

111. INSTALLATION OF TRANSMISSION OIL COOLER.

TOOLS.

WRENCH, $\frac{7}{16}$-in.
WRENCH, open-end, $1\frac{3}{8}$-in.
WRENCH, Allen, $\frac{5}{8}$-in.

a. Procedure.

(1) MOUNT COOLER IN BRACKETS.

WRENCH, $\frac{7}{16}$-in.

Position cooler in brackets and secure with eight bolts, nuts and lock washers.

(2) ATTACH GUARD.

WRENCH, $\frac{7}{16}$-in.

Attach cooler guard to bulkhead, securing with four cap screws and lock washers. Tighten nuts securely.

(3) CONNECT OIL LINES.

WRENCH, open-end, $1\frac{3}{8}$-in.

Connect oil lines to both top and bottom of cooler.

(4) FILL TRANSMISSION AND DIFFERENTIAL WITH OIL (par. 107., c.).

(5) OPERATE VEHICLE AND CHECK FOR OIL LEAKS.

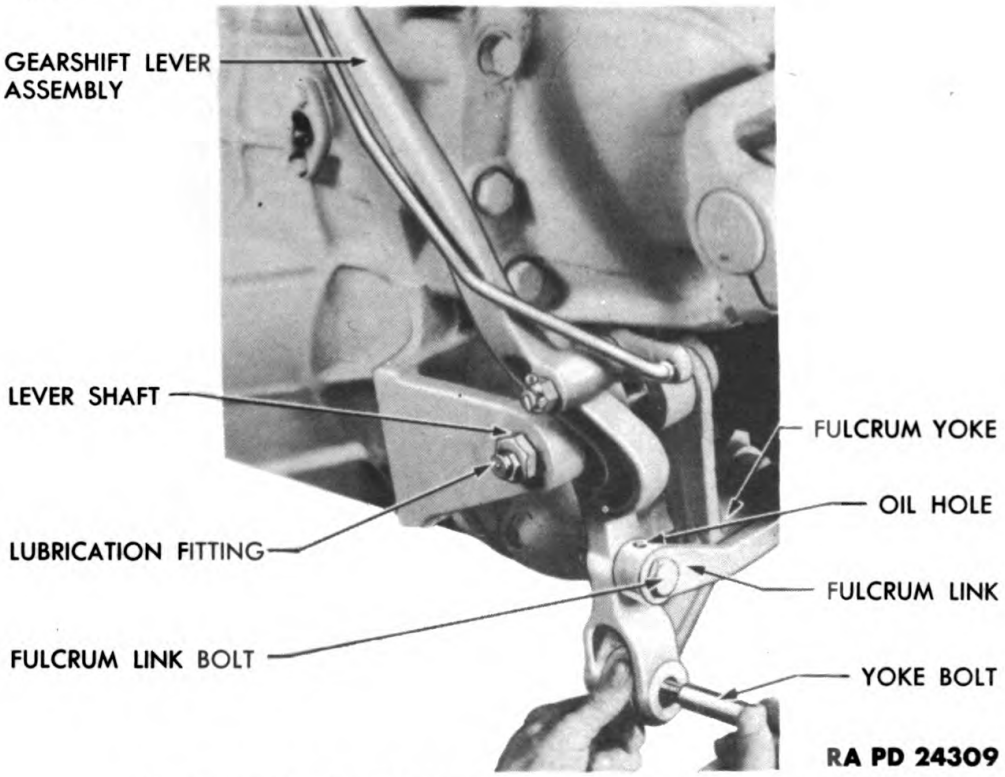


Figure 101 — Removing Gearshift Lever Yoke Bolt

112. REMOVAL OF GEAR SHIFT LEVER.

TOOLS.

PLIERS, side cutting
WRENCH, open-end, $\frac{7}{8}$-in. (2)
WRENCH, open-end, $1\frac{1}{8}$-in. (2)

a. Procedure.

(1) REMOVE YOKE BOLT (fig. 101).

PLIERS, side cutting
WRENCH, open-end, $\frac{7}{8}$-in.

Remove cotter pin (side cutting pliers), remove nut and withdraw bolt from yoke (⅞-in. open-end wrench).

(2) REMOVE FULCRUM LINK BOLT (fig. 102).

PLIERS, side cutting — WRENCH, open-end, ⅞-in. (2)

Remove cotter pin from bolt (side cutting pliers). Hold head of bolt with wrench and remove nut (turn counterclockwise) (2, ⅞-in. open-end wrench). Withdraw bolt from link.

(3) REMOVE LEVER SHAFT (fig. 103).

PLIERS, side cutting — WRENCH, open-end, 1⅛-in. (2)

Remove cotter pin from inner end of lever shaft nut (side cutting pliers). Hold outer end of lever shaft with wrench and unscrew nut from shaft (turn counterclockwise) (2, 1⅛-in. open-end wrench). Hold lower end of gear shift lever assembly (fig. 103), with one hand and withdraw shaft from lever and remove gear shift lever from transmission.

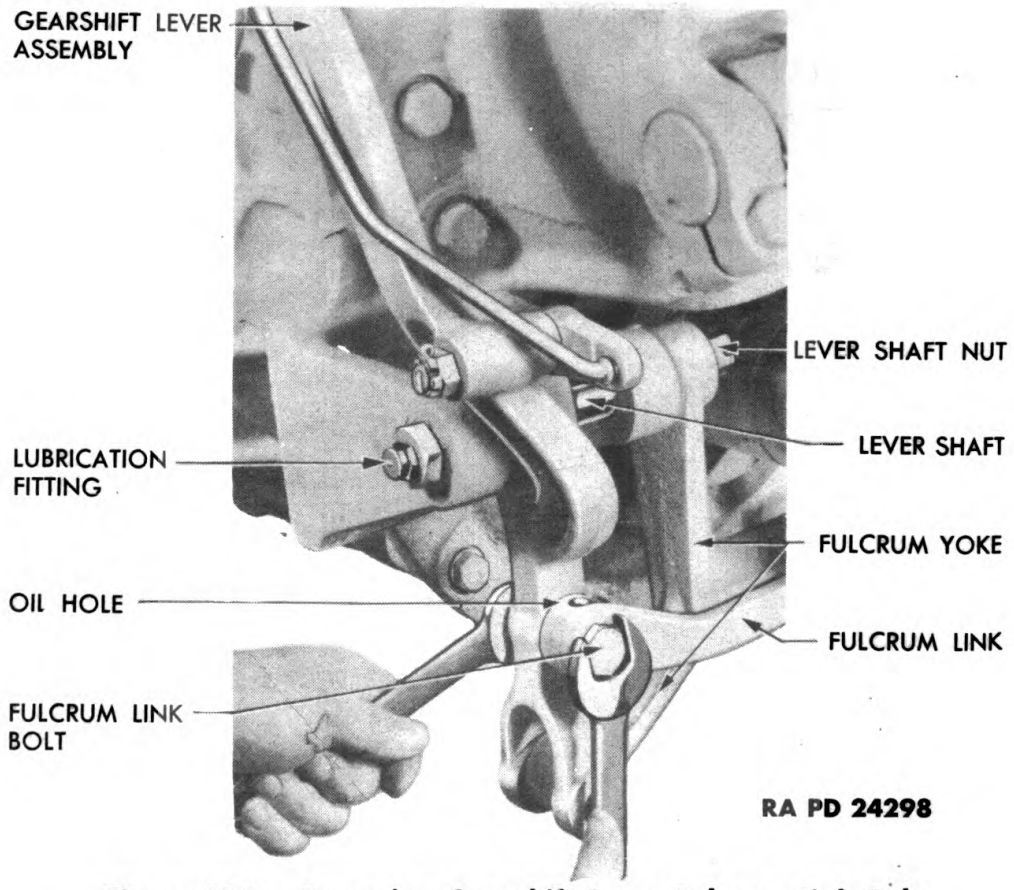


Figure 102 — Removing Gearshift Lever Fulcrum Link Bolt

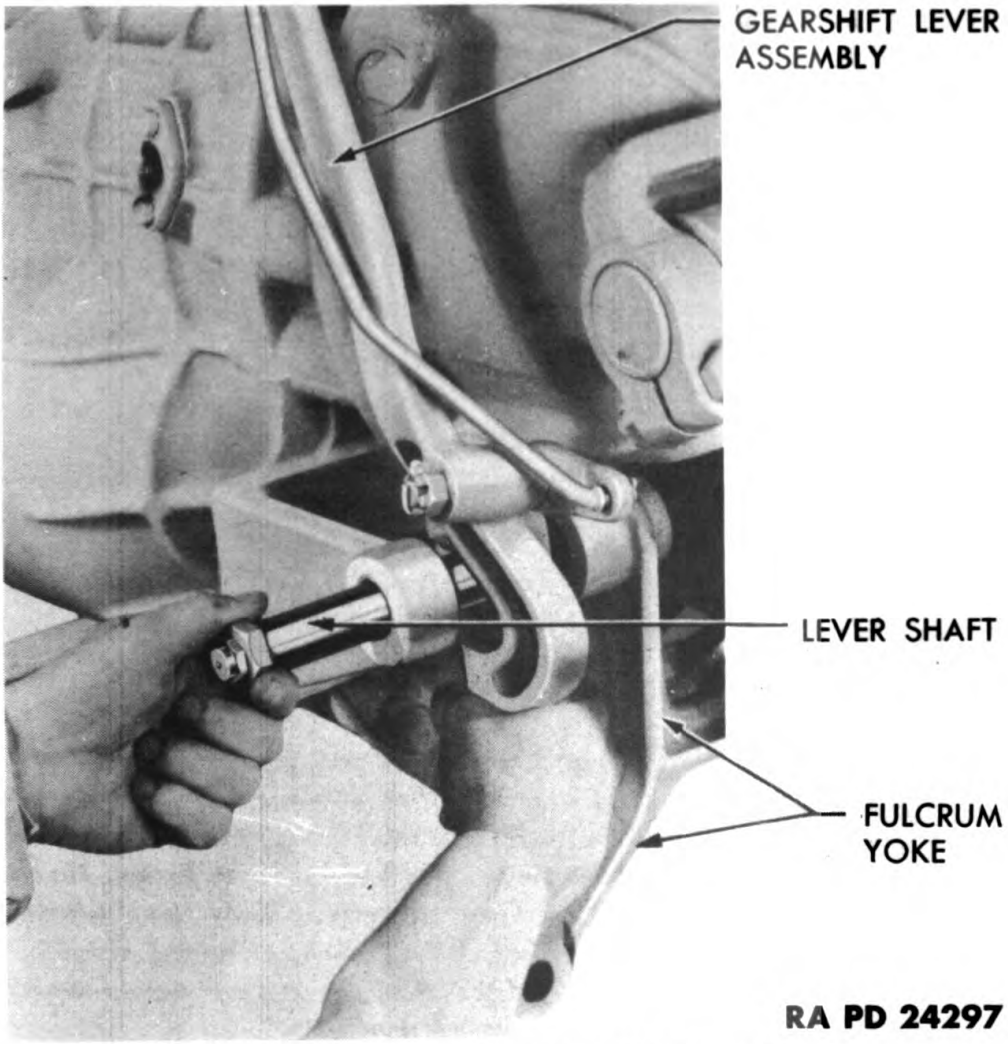


Figure 103 — Removing Gearshift Lever Shaft

113. INSTALLATION OF GEAR SHIFT LEVER.

TOOLS.

CAN, oil
GUN, lubricant
PLIERS, side cutting
WRENCH, box, 1⅛-in.
WRENCH, open-end, ⅞-in. (2)
WRENCH, open-end, 1⅛-in.

a. Procedure

(1) INSTALL GEAR SHIFT LEVER ON TRANSMISSION (fig. 96).

CAN, oil
GUN, lubricant
PLIERS, side cutting
WRENCH, box, 1⅛-in.
WRENCH, open-end, 1⅛-in.

Wipe surfaces of shaft clean. Cover bearing surfaces of shaft with OIL, engine. Position lever on left side of transmission (fig. 103), aline

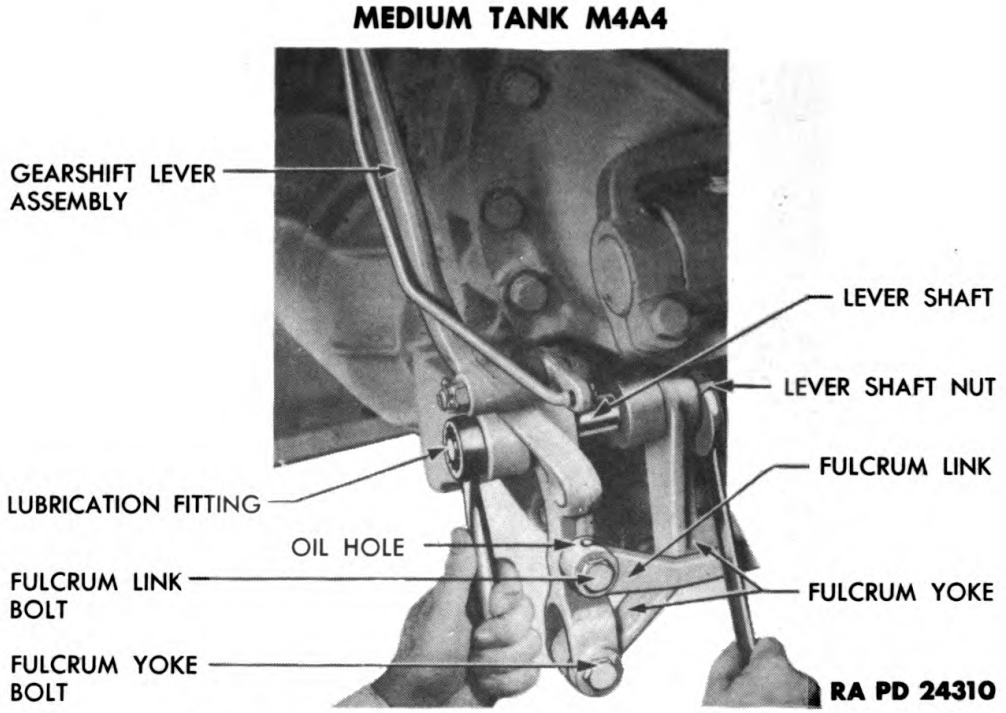


Figure 104 — Tighten Gearshift Lever Shaft Nut

holes and insert lever shaft through hole in bracket, gear shift lever and fulcrum yoke. Push shaft in full distance and screw nut on inner end of shaft (fig. 104). Apply lubricant gun to lubrication fitting and move gear shift lever back and forth while forcing lubricant into fitting. Hold end of bolt with wrench and tighten nut securely, alining castellations of nut with cotter pin hole in end of shaft (1⅛-in. open-end wrench, 1⅛-in. box wrench). Insert cotter pin through hole in inner end of shaft and bend ends of cotter pin over to secure in place.

(2) INSTALL FULCRUM LINK BOLT (fig. 102).

CAN, oil
PLIERS, side cutting
WRENCH, open-end, ⅞-in. (2)

Position fulcrum link so that hole in end of link alines with hole in gear shift lever, wipe bolt clean and cover bearing surface of bolt with **OIL**, engine, and insert bolt through holes, (from rear), install nut and tighten, alining nut castellation with hole in end of bolt (⅞-in. open-end wrench). Insert cotter pin through hole in end of bolt and bend ends of cotter pin to secure in place (side cutting pliers). Oil bolt through oil hole in end of fulcrum link (oil can).

(3) INSTALL YOKE BOLT (fig. 101).

CAN, oil
PLIERS, side cutting
WRENCH, open-end, ⅞-in.

Position end of fulcrum yoke in fork at lower end of gear shift lever and aline holes. Wipe bolt clean, cover bearing surface of bolt with

OIL, engine (oil can) and insert bolt through yoke and gear shift lever. Tighten nut securely, alining nut castellations with hole in end of bolt (⅞-in. open-end wrench). Insert cotter pin through hole in end of bolt and bend ends of cotter pin to secure in place (side cutting pliers).

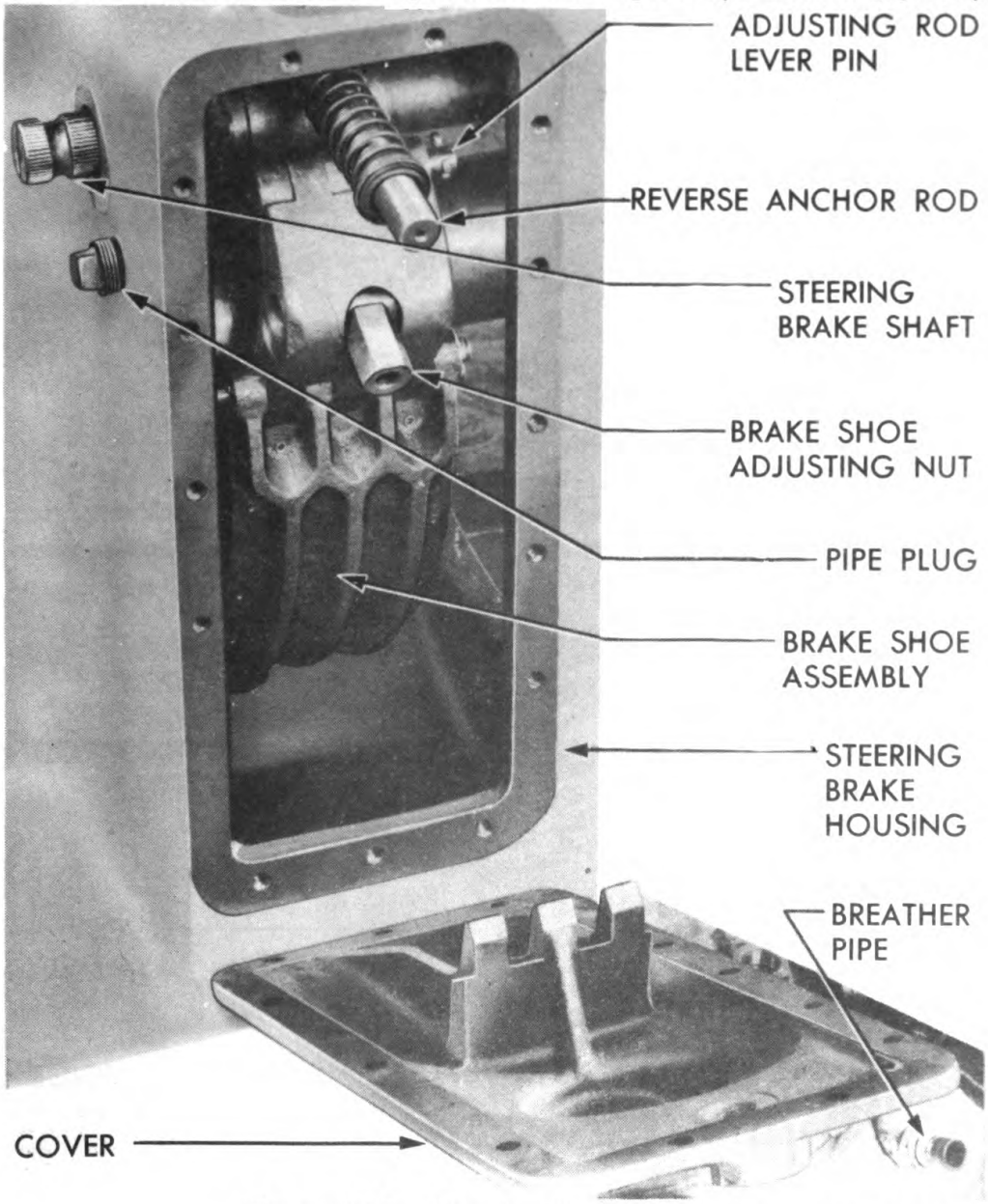


Figure 105 — Steering Brake Controls RA PD 24498

114. STEERING BRAKE.

a. Description. The steering brake, of "double anchor" design, is a three shoe external contracting differential steering brake operating in oil. A shoe assembly and brake drum are located in each final drive housing, the brake shoe assembly being actuated by the steering brake lever.

b. Operation. When the steering brake lever is pulled "BACK," the steering brake assembly is contracted.

c. Removal.

TOOLS.

PAN (capacity, 10 gallons)
PLIERS, side cutting
WRENCH, ¾-in.
WRENCH, Allen, ⅝-in.
WRENCH, open-end, $\frac{9}{32}$-in.
WRENCH, open-end, $\frac{15}{16}$-in.
WRENCH, open-end, 1-in.
WRENCH, open-end, 1½-in.
WRENCH, open-end, 1⅛-in. (2)
WRENCH, socket, 1⅛-in.

(1) PROCEDURE.

(a) Drain Final Drive Housing (par. 107., d.).

(b) Remove Anchor Lock Nut and Adjusting Nut (fig. 96).

PLIERS, side cutting
WRENCH, open-end, 1½-in. (2)

Remove locking wire (side cutting pliers) and unscrew lock nut from anchor (turn counterclockwise) (1½-in. open-end wrench) and remove adjusting nut from anchor rod (turn counterclockwise) (1½-in. open-end wrench).

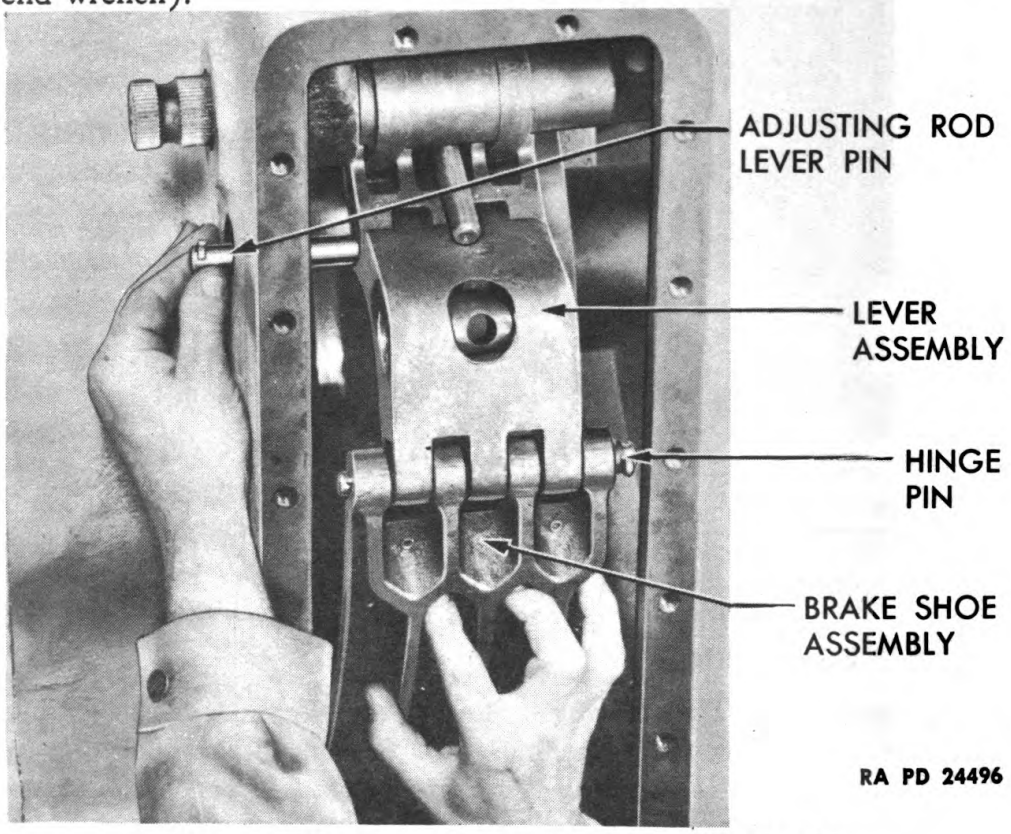


Figure 106 — Removing Adjusting Rod Lever Pin

(c) Remove Cover (fig. 105).

WRENCH, ¾-in.

Remove the fifteen cap screws which attach cover to housing and remove cover.

(d) Remove Reverse Anchor Spring and Seal (fig. 105).

PLIERS, side cutting **WRENCH**, open-end, 1-in.
WRENCH, open-end, 1⅛-in.

Remove lock wire (side cutting pliers), loosen reverse anchor thrust bolt lock nut (turn counterclockwise) (1⅛-in. open-end wrench) and loosen thrust bolt (turn counterclockwise) (1-in. open-end wrench) (fig. 96).

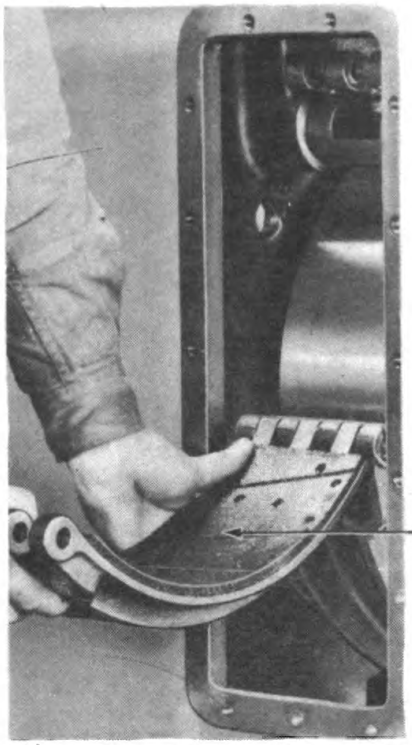
(e) Lower Brake Shoe Guide Screw.

WRENCH, open-end, 1-in.

Reach through opening in brake housing (below shoe) and loosen guide screw lock nut (located directly below center of shoe) (turn counterclockwise) (1-in. open-end wrench). Through this same opening, screw guide screw into bottom of housing (turn clockwise) (1-in open-end wrench).

(f) Remove Adjusting Rod Lever Pin and Hinge Pin (fig. 106)

PLIERS, side cutting **WRENCH**, open-end, $\frac{15}{16}$-in.



RA PD 24497

Figure 107 — Pulling Brake Shoes Out of Housing

Remove pipe plug (fig. 104) from side of housing ($\frac{15}{16}$-in. open-end wrench), remove cotter pins from either end of lever pin and withdraw pin from lever with fingers.

(g) Remove Brake Shoe Adjusting Nut (fig. 105).

WRENCH, socket, 1⅛-in.

Unscrew nut from adjusting rod (turn counterclockwise), lift lever (figs. 105 and 106) off rod and slide spring and thrust washers off rod.

(h) Remove Brake Shoe from Housing (fig. 107).

Take hold of end of lower section of shoe and pull shoe out of housing.

d. Installation.

TOOLS.

GAGE, feeler
PLIERS, side cutting
SCALE, graduated
STRAIGHTEDGE
WRENCH, $\frac{9}{16}$-in.
WRENCH, ¾-in.
WRENCH, open-end, $\frac{15}{16}$-in.
WRENCH, open-end, 1-in.
WRENCH, open-end, 1½-in. (2)
WRENCH, socket, 1⅛-in.

(1) PROCEDURE.

(a) Locate Brake Shoe Guide Screw.

WRENCH, open-end, 1-in.

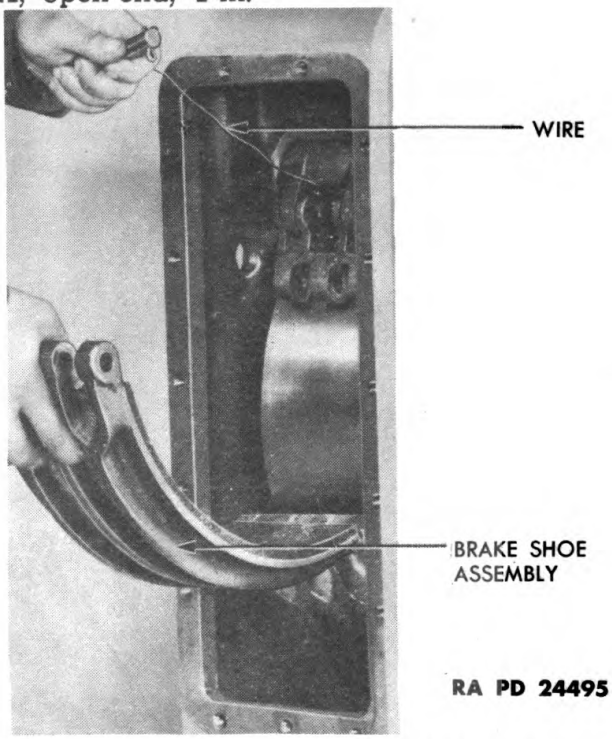


Figure 108 — Installing Brake Shoes in Housing

If the guide screw has not been removed from housing when brake shoe was removed, there will be no occasion to alter the location of the screw at this time. If the screw has been removed, screw it into opening in bottom of housing, directly below center of shoe, with lock nut in place between housing and head of screw.

(b) Install Shoe in Housing (fig. 108).

Attach a wire to end of shoe to which adjusting rod is attached, start wire and adjusting rod into bottom of housing opening, sliding shoe around drum until wire can be reached from upper part of housing opening. Pull shoe around drum and into place at upper part of housing.

(c) Connect Lever Assembly to Lower Brake Shoe.

PLIERS, side-cutting

Position lever assembly in lower brake shoe assembly, in such manner that holes in lever and shoe assemblies are alined. Insert hinge pin through mating holes, insert cotter pins through holes in ends of hinge pin and bend ends of cotter pins over to secure pin in place (side cutting pliers).

(d) Install Adjusting Rod Thrust Washers and Spring.

Slide one thrust washer over adjusting rod, slide spring over rod, slide second washer over rod and push assembly against shoulder on rod.

(e) Connect Upper Brake Shoe to Lever Assembly (fig. 105).

PLIERS, side cutting
WRENCH, open-end, $\frac{15}{16}$-in.
WRENCH, socket, $1\frac{1}{8}$-in.

Raise lever and shoe assembly into position, inserting end of adjusting rod through hole in center of lever assembly and screw adjusting rod nut on rod, with fingers, to hold in position. Raise lever and shoe assembly until holes in end of lever assembly aline with holes in end of shoe, insert adjusting rod lever pin through holes in lever and shoe, insert cotter pins through holes in end of adjusting rod lever pin and bend ends of cotter pins to secure in place (side cutting pliers). Screw pipe plug into opening in side of housing (fig. 105) ($\frac{15}{16}$-in. open-end wrench).

(f) Adjust Brake Shoe Guide Screw.

GAGE, feeler
WRENCH, open-end 1-in.

Lift shoe adjusting rod nut until the shoes are rotated to approximately their operating position. Pull steering brake lever "**BACK**" to tighten shoes against drum. Reach through lower part of opening (under shoe) and raise guide screw (turn counterclockwise) until there is

0.010-in. clearance between head of screw and brake shoe (feeler gage; 1-in. open-end wrench). Secure guide screw in position by tightening lock nut against bottom of housing (turn clockwise) (1-in. open-end wrench).

(g) Install Reverse Anchor Spring, Seal and Seal Retainer.

Slide spring into position on reverse anchor rod. Position seal on rod, against spring, and position seal retainer on rod against seal. Tighten reverse anchor thrust bolt (fig. 96) to hold assembly in place.

(h) Install Cover.

WRENCH, ¾-in.

Remove all traces of torn gaskets and foreign matter from mounting faces of cover and housing. Position *new* gasket on cover, place it in position in front of opening, moving it upward to seat lever on the cover pedestal. NOTE: Be sure to insert reverse anchor rod through opening in cover when positioning cover on housing. Install the fifteen cap screws and tighten securely.

(i) Install Anchor Adjusting Nut.

Position nut seat on anchor rod (with flat side of seat toward bushing cover), screw adjusting nut onto rod and follow by screwing lock nut onto rod (with fingers).

(j) Adjust Reverse Anchor Thrust Bolt (fig. 96).

WRENCH, $\frac{7}{16}$-in. WRENCH, open-end, 1⅛-in.

Remove the six cap screws and remove brake adjusting hole cover ($\frac{7}{16}$-in. wrench). Make sure lever assembly is contacting pedestal on cover. Tighten reverse anchor thrust bolt finger tight, then back off two complete turns, and tighten lock nut against housing to secure bolt in this position (1⅛-in. open-end wrench).

(k) Adjust Anchor (fig. 96).

WRENCH, open-end, 1½-in.
(2)

Tighten anchor adjusting nut (turn clockwise) until nut rests against seat. Loosen nut until there is $\frac{1}{16}$-in. slack in anchor assembly (1½-in. open-end wrench). Tighten lock nut to secure adjusting nut in place (1½-in. open-end wrench). NOTE: This setting will give approximately 0.010-in. between drum and lining.

(l) Adjust Shoe Adjusting Rod Nut (fig. 109).

SCALE, graduated WRENCH, socket, 1⅛-in.
STRAIGHTEDGE

Rest a straightedge on steering brake cross shaft bracket machined

mounting surface (adjacent to bracket), with outer end of straightedge above arm. Insert socket wrench through opening in cover and engage wrench over shoe adjusting nut. Turn nut until the distance from bottom of straightedge to center of clevis pin in steering brake shaft lever is $2\frac{1}{16}$-in. for left arm and $2\frac{15}{16}$-in. for right arm (graduated scale; $1\frac{1}{8}$-in. socket wrench).

(m) Install Brake Adjusting Hole Cover.

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

Remove all traces of torn gaskets from mounting faces of cover and housing, position *new* gasket on cover and attach cover to housing, securing with the six cap screws.

(n) Fill Final Drive Housing with Oil to the Proper Level (par. 107., e.).

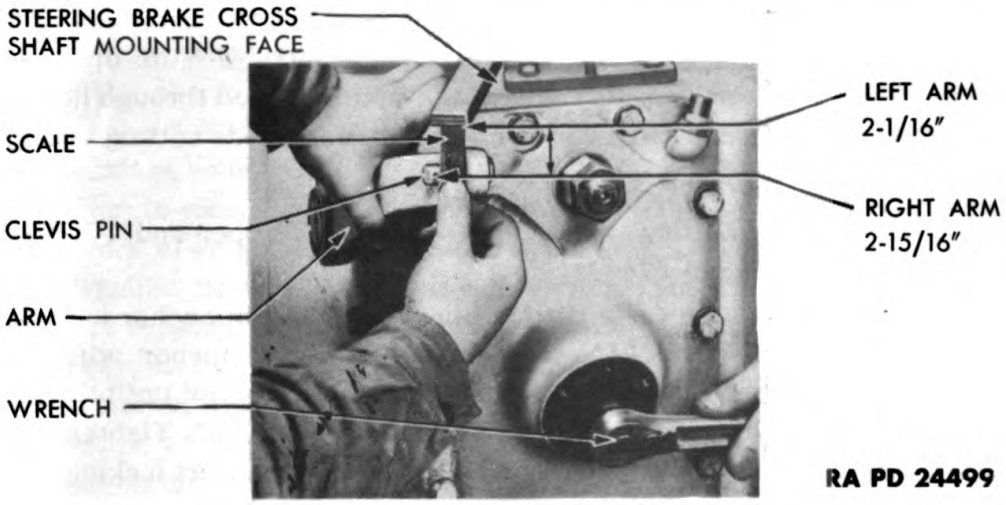


Figure 109 — Adjusting Brake

e. Steering Brake Adjustment.

TOOLS.

PLIERS, side cutting
SCALE, graduated
STRAIGHTEDGE
WRENCH, $\frac{9}{16}$-in.
WRENCH, $1\frac{1}{2}$-in. (2)
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, 1-in.
WRENCH, open-end, $1\frac{1}{8}$-in.
WRENCH, open-end, $1\frac{7}{16}$-in.
WRENCH, open-end, $1\frac{1}{2}$-in.
WRENCH, socket, $1\frac{1}{8}$-in.

(1) PROCEDURE.

(a) Disconnect Steering Brake Levers, Both Left and Right (fig. 50).

PLIERS, side cutting
WRENCH, open-end, 1-in.

Turn the nut which locks the clevis in place on the upper end of the

steering brake control rod (both left and right) until it is clear of the clevis and will permit turning of clevis (1-in. open-end wrench). Remove cotter pin from clevis pin and withdraw clevis pin from clevis (side cutting pliers).

(b) Remove Brake Adjusting Hole Cover (fig. 96).

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

Remove the six cap screws and remove cover.

(c) Check Location of Lever Assembly (figs. 105 and 106).

Make sure lever assembly is contacting pedestal on cover.

(d) Adjust Reverse Anchor Thrust Bolt (fig. 96).

PLIERS, side cutting
WRENCH, open-end, $1\frac{1}{8}$-in.

Remove locking wire and loosen lock nut ($1\frac{1}{8}$-in. open-end wrench). Tighten bolt finger tight (turn clockwise). Loosen bolt two complete turns and tighten lock nut to secure bolt in this position ($1\frac{1}{8}$-in. open-end wrench). Pass locking wire through hole in bolt head and through hole in cross shaft bracket, and twist ends of wire to secure (side cutting pliers).

(e) Adjust Anchor (figs. 105 and 109).

PLIERS, side cutting
WRENCH, open-end, $1\frac{7}{16}$-in.
WRENCH, $1\frac{1}{2}$-in (2)

Remove locking wire (side cutting pliers) and loosen anchor lock nut (turn counterclockwise) ($1\frac{1}{2}$-in. wrench). Tighten anchor adjusting nut (turn clockwise) until nut rests against seat. Loosen nut until there is $\frac{1}{16}$-in. slack in anchor assembly ($1\frac{1}{2}$-in. open-end wrench). Tighten lock nut to secure adjusting nut in place ($1\frac{1}{2}$-in. wrench). Insert locking wire through hole in nut and hole in cross shaft bracket and twist ends of wire to secure. NOTE: This setting will give approximately 0.010-in. clearance between drum and lining.

(f) Adjust Shoe Adjusting Rod Nut (fig. 109).

SCALE, graduated
STRAIGHTEDGE
WRENCH, socket, $1\frac{1}{8}$-in.

Rest a straightedge on steering brake cross shaft bracket machined mounting surface (adjacent to bracket), with outer end of straightedge above arm. Insert $1\frac{1}{8}$-in. socket wrench through opening in cover and engage wrench over shoe adjusting rod nut. Turn adjusting nut until the distance from bottom of straightedge to center of clevis pin in steering brake shaft lever is $2\frac{1}{16}$-in. for left arm and $2\frac{5}{16}$-in. for right arm (graduated scale; $1\frac{1}{8}$-in. socket wrench).

(g) Adjust Control Rod—Left (fig. 50).

PLIERS, side cutting
WRENCH, open-end, $\frac{9}{16}$-in.

Raise steering brake shaft lever by hand until all slack is taken up. Place steering lever in its extreme released position. Adjust length of steering brake control rod (adjust by turning clevis) until hole in clevis is approximately $\frac{1}{16}$-in. below hole in brake shaft lever. Position clevis on lever, insert clevis pin and secure by inserting cotter pin through hole in clevis pin and bending ends of cotter pin over (side cutting pliers). Screw clevis lock nut tight against clevis, to secure the assembly ($\frac{9}{16}$-in. open-end wrench).

(h) Adjust Control Rod—Right (fig. 50).

PLIERS, side cutting **WRENCH**, open-end, $\frac{9}{16}$-in.

Loosen clevis lock nut on steering brake control rod—front, until it is clear of clevis ($\frac{9}{16}$-in. open-end wrench). Remove cotter pin from clevis pin and withdraw clevis pin from clevis (side cutting pliers). Raise steering brake cross shaft lever—right, until the center line of the clevis pin hole is 4-21/32-in. above the top of the machined mounting surface on which the steering cross shaft bracket mounts. With the cross shaft lever in this position, adjust the steering brake control rod—front, until the clevis can be connected to the lever, with clevis pin entering freely. Insert clevis pin to secure clevis, insert cotter pin through hole in clevis pin and bend ends of cotter pin over (side cutting pliers). Screw clevis lock nut tight against clevis ($\frac{9}{16}$-in. open-end wrench). Place steering lever in its extreme released position. Adjust length of steering brake control rod, right, (adjust by turning clevis) until hole in clevis is approximately $\frac{1}{16}$-in. below hole in brake shaft lever. Position clevis on lever, insert clevis pin and secure by inserting cotter pin through hole in clevis pin and bending ends of cotter pin over (side cutting pliers). Screw clevis lock nut tight against clevis to secure the assembly ($\frac{9}{16}$-in. open-end wrench).

(j) Install Brake Adjusting Hole Cover (fig. 96).

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

Remove all traces of torn gaskets and foreign matter from cover. Position *new* gasket on cover and attach to steering brake housing cover with six cap screws and lock washers.

MEDIUM TANK M4A4

Section XXI

SUSPENSIONS AND TRACK

115. TRACKS.

a. General. Two individually driven tracks propel the vehicle forward and backward. Each track is composed of 83 separate steel shoes. Two-wheeled, rubber tired bogies or suspensions (six in all) bolted to the hull, support the vehicle on springs (fig. 110). Two drive sprockets at the front end of the vehicle pull the tracks from the rear and lay them down in the path of the advancing bogie wheels. An adjustable trailing idler wheel for each track is mounted at the rear of the hull for adjusting tension on the tracks (fig. 115). The weight of the upper portion of the track is carried by single track supporting rollers which are bracket mounted to the bogie frame (fig. 116).

b. Removal of Track.

(1) PLACE VEHICLE ON LEVEL TERRAIN, SO IT MAY BE MOVED AS REQUIRED.

TOOLS.

BAR
HAMMER, 1-lb.
SCREWDRIVER
TRUCK, towing
WRENCH, 1½-in.
WRENCH, MTM-M3-7
WRENCH, open-end, 1-in.

(2) PROCEDURE.

(a) Disconnect Track (fig. 111) (par. 115., **h.**).

(b) Remove Track from Vehicle.

TRUCK, towing

Attach truck to towing shackles, at either front or rear end of vehicle, and tow vehicle off track. NOTE: If a new track is to be installed, place new track on ground, at end of and alined with old track, and tow vehicle onto new track.

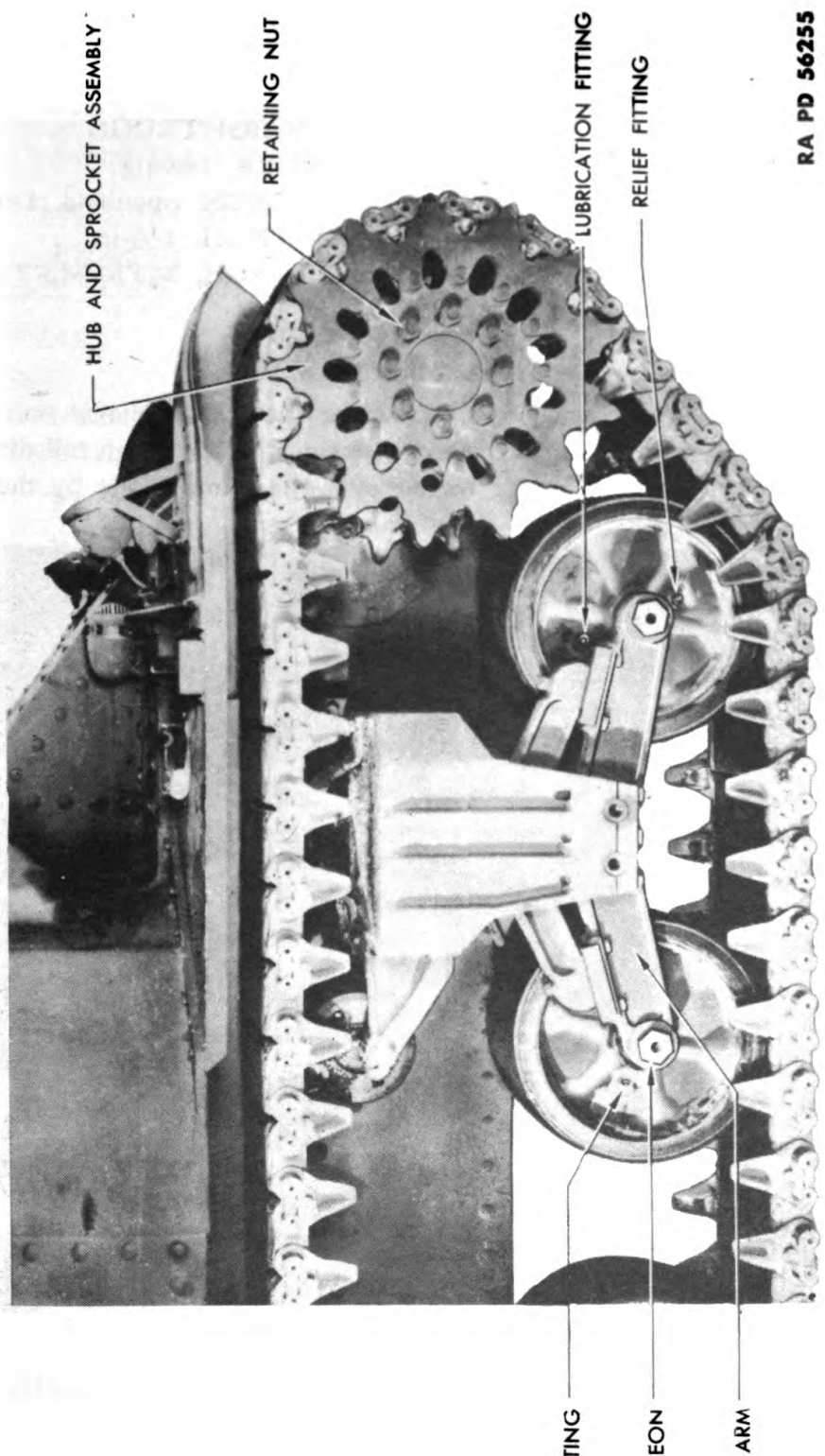


Figure 110 — Suspension and Drive Group

c. Installation of Track.

TOOLS.

CHAINS, track (2)	STRAIGHTEDGE
HAMMER	TRUCK, towing
JACK, simplex	WRENCH, open-end, 1-in.
ROPE	WRENCH, 1½-in.
SCREWDRIVER	WRENCH, MTM-M3-7

(1) PROCEDURE.

(a) Locate Track for Installation on Vehicle.

Lay the track out, with one end under the nearest bogie and with the same end in a trench deep enough so that the bogie can roll directly onto the track without having to rise over the bump made by the first block of the track.

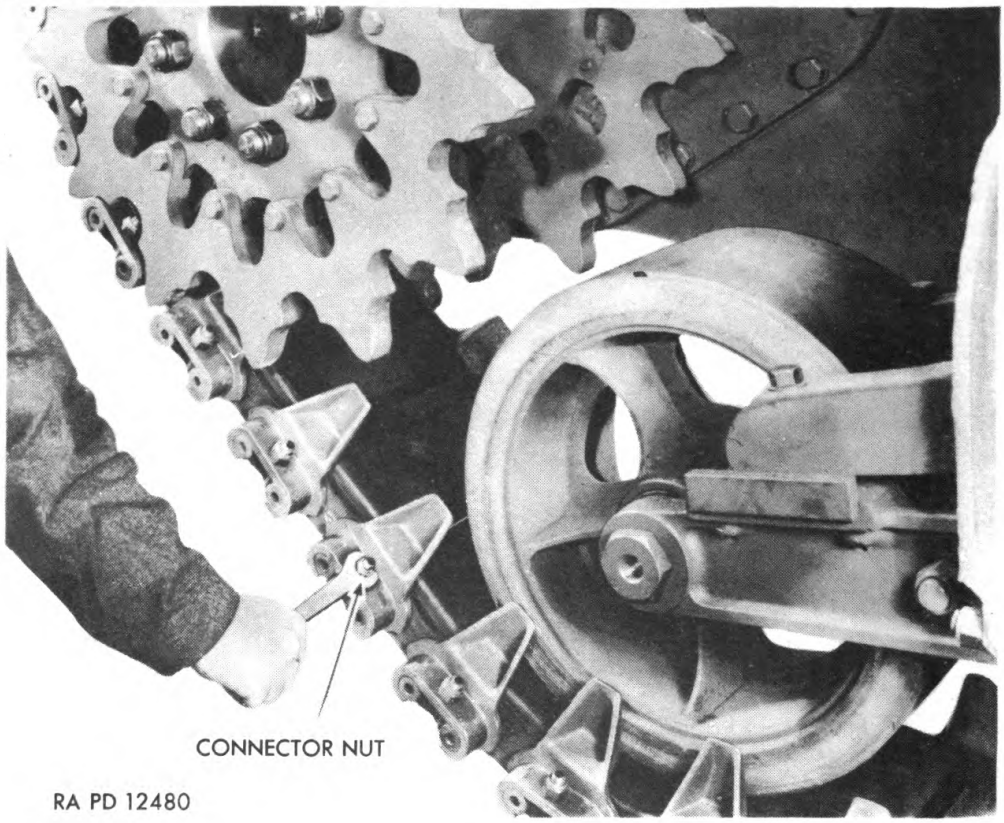


Figure 111 — Removing Track Wedge Nut

(b) Install Track on Idler, Supporting Rollers and Sprocket.

ROPE TRUCK, towing

Tow the vehicle onto the track until about 16 inches of one end of track protrudes beyond the front bogie wheel of the vehicle. Roll the track up over the idler and supporting rollers.

(c) Pull Track into Position on Drive Sprockets (fig. 112) (par. 115., i., (1), (a)).

(d) Connect Track (par. 115., i.).

(e) Adjust Track Tension (par. 115., g.).

d. Install New Track.

(1) Following is the procedure for installing a new track when the old track is still on the vehicle.

TOOLS.

BAR	WRENCH, 1½-in.
HAMMER, 1-lb.	WRENCH, MTM-M3-7
TRUCK, towing	WRENCH, open-end, 1-in.

(2) PROCEDURE.

(a) Disconnect Track (par. 115., h.).

(b) Attach New Track to Old and Position for Attaching.

BAR	TRUCK, towing
HAMMER	WRENCH, open-end, 1-in.

Lay out the new track in front of, and alined with, the old track. Drive connectors on ends of track block pins, install wedges and secure with nuts. Tighten nuts securely (1-in. open-end wrench). Tow vehicle onto new track until about 16 inches of the track protrudes beyond the front bogie wheel. Remove wedge nuts (1-in. open-end wrench), wedges and drive connectors off block pins (bar and hammer). Roll the new track up over the idler and the supporting rollers.

(c) Connect Track (par. 115., i.).

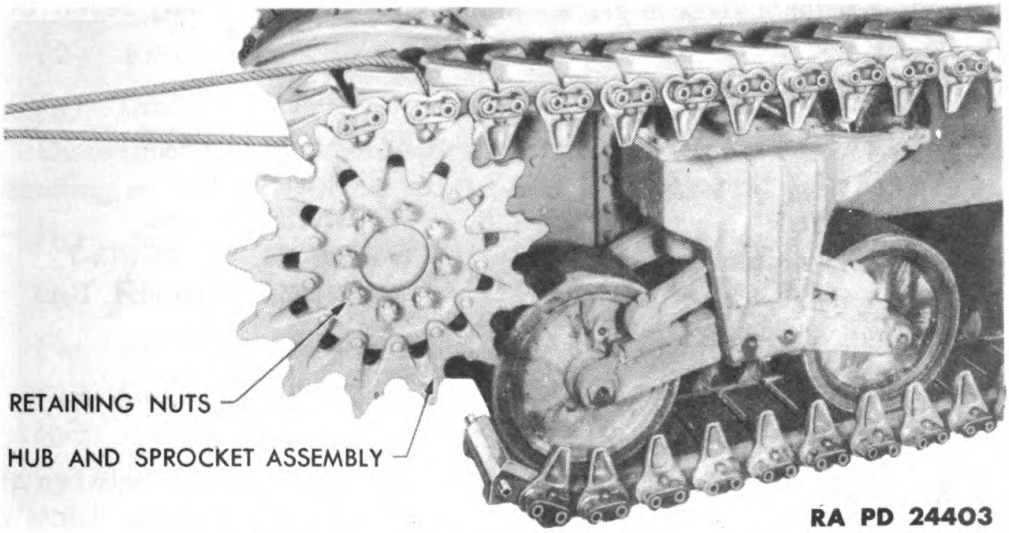


Figure 112 — Pulling Track Over Drive Sprockets

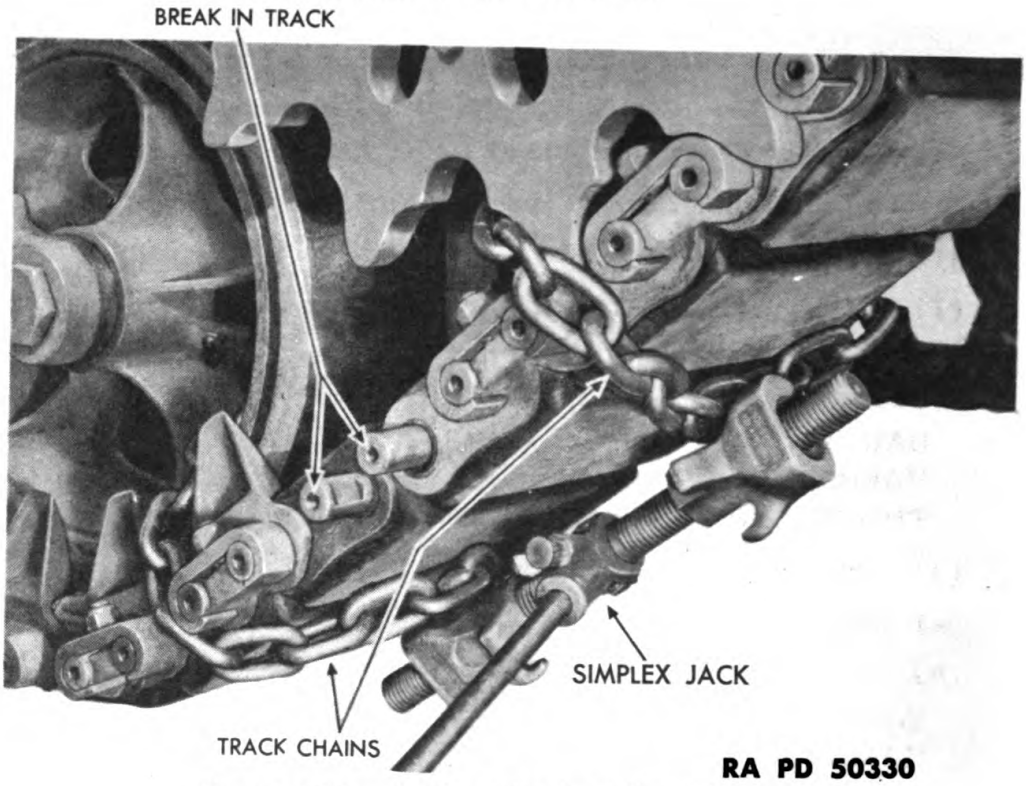


Figure 113 — Joining Track at Front Sprocket

e. Replace Dead Track Block.

(1) A dead track block is one in which the flexible bond between the pin and the forged frame of the block has failed, leaving the pin free to turn more than it should and tending to make the block travel straight instead of curving up sharply behind the rear bogie, around the idler and on around the sprocket. Dead blocks are easily recognizable and should be replaced immediately, as they may result in a broken track.

TOOLS.

BAR
CHAINS, track (2)
HAMMER
JACK, simplex
ROPE
SCREWDRIVER
STRAIGHTEDGE
TRUCK, towing
WRENCH, 1½-in.
WRENCH, MTM-M3-7
WRENCH, open-end, 1-in.

(2) PROCEDURE.

(a) Position Block for Removal.

Move vehicle so that block to be replaced is midway between the drive sprocket and the front bogie wheel. Set the parking brake on the vehicle.

(b) Disconnect Track (par. 115., **h.**).

(c) Remove Dead Track Block.

BAR
HAMMER
WRENCH, open-end, 1-in.

Remove two wedge nuts (one on either side of track) (1-in. open-end wrench), tap wedges loose from connectors (hammer) and, with bar and hammer, drive connectors off ends of block pins.

(d) Install New Track Block.

HAMMER
WRENCH, open-end, 1-in.

Position new block on end of track, drive wedges into position on block pins (hammer), install wedges on connectors and secure with wedge nuts (1-in. open-end wrench). Tighten nuts securely.

(e) Connect Track (par. 115., **i.**).

f. Replace Thrown Track.

(1) GENERAL. Because conditions under which a track may be thrown vary so greatly, there is no one procedure that can be set down as the best possible method for replacement of a thrown track. The following procedure can be used under the worst type of conditions and can be modified for different situations.

TOOLS.

CHAINS, track (2)
HAMMER
JACK, simplex
ROPE
SCREWDRIVER
STRAIGHTEDGE
TRUCK, towing
WRENCH, 1½-in.
WRENCH, MTM-M3-7
WRENCH, open-end, 1-in.

(2) PROCEDURE.

(a) Disconnect Track.

Disconnect track, underneath either the idler or drive sprocket, depending on which end has the least twist (par. 115., **h.**).

(b) Remove Track from Sprocket (par. 115., **h.**, (1), (c)).

(c) Remove Track from Vehicle (par. 115., **b.**, (2), (b)).

(d) Install Track on Vehicle (par. 115., **c.**).

(e) Sometimes the track may be thrown in such a manner that proper manipulation of the vehicle and the use of blocks make it possible to throw the track back on again.

g. Adjust Track.

(1) NOTE: The track should be checked daily for excessive sag.

If a pronounced sag is present, the correct tension should be restored to eliminate the possibility of the track being damaged or thrown off because of looseness. (With a straightedge placed on top of the track, between the track supporting rollers, the sag of the track, measured from the lower edge of straightedge to top of track, should be approximately ½-in.)

TOOLS.

HAMMER
SCREWDRIVER
STRAIGHTEDGE
WRENCH, 1½-in.
WRENCH, MTM-M3-7

(2) PROCEDURE.

(a) Spread Split Housing (fig. 114).

WRENCH, 1½-in.

Loosen two clamping bolts (turn counterclockwise). Turn spreading bolt, counterclockwise, to spread housing.

(b) Remove Collar Plate from Idler Spindle (fig. 114).

HAMMER
WRENCH, MTM-M3-7

Raise end of clip, with screwdriver and, using a hammer, tap collar

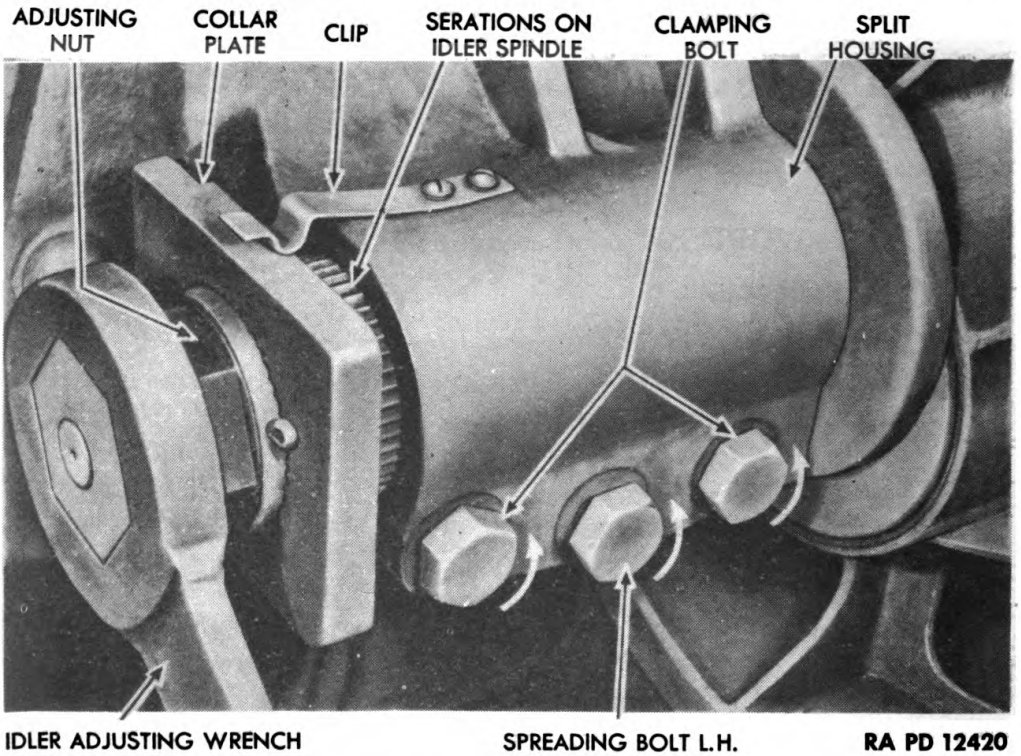


Figure 114 — Tightening Track with Idler Adjustment

plate off serrations on idler spindle, to permit turning of idler spindle. NOTE: It may be necessary to take up pull of track by using MTM-M3-7 wrench, on adjusting nut. Because of effort required to turn this nut, a pipe attached to the wrench may be helpful.

(c) Adjust Track to Correct Tension (fig. 114).

STRAIGHTEDGE WRENCH, MTM-M3-7

Lay a straightedge along top of track. Place idler adjusting wrench on adjusting nut and raise handle of wrench until there is ½-in. clearance between bottom of straightedge and top of track, measured midway between supporting rollers.

(d) Secure Adjustment (fig. 114).

HAMMER WRENCH, MTM-M3-7
WRENCH, 1½-in.

Hold adjusting nut in position with wrench and tap collar plate onto serrations on idler spindle and under clip (hammer). Turn spreading bolt clockwise, to close split housing. Tighten the two clamping bolts securely (turn clockwise). Turn spreading bolt counterclockwise sufficiently to hold it from jarring loose (1½-in. wrench). Remove straightedge from track.

(e) Repeat above operations to adjust track on opposite side of vehicle.

h. Disconnect Track.

TOOLS.

BAR WRENCH, 1½-in.
HAMMER, 1-lb. WRENCH, MTM-M3-7
SCREWDRIVER WRENCH, open-end, 1-in.

(1) PROCEDURE.

(a) Relieve Tension of Track (fig. 114).

HAMMER WRENCH, 1½-in.
SCREWDRIVER WRENCH, MTM-M3-7

Spread split housing (par. 115., **g.**, (2), (a)). Remove collar plate from idler spindle (par. 115., **g.**, (2), *(b)*).

(b) Remove Connectors (fig. 111).

BAR WRENCH, open-end, 1-in.
HAMMER

Remove the two connector nuts which secure wedges to track blocks (at a point between front bogie wheel and drive sprocket) (1-in. open-end wrench). Tap wedges, with hammer, to remove from connector, being careful not to damage threads. Place a bar against connector and,

with hammer, drive connectors off ends of pins. Repeat operation to remove connector from track on opposite side of vehicle.

(c) Remove Track from Sprocket.

Start power unit and operate vehicle in reverse gear until tracks have rolled back clear of drive sprockets. Track can be pulled farther back by hand.

i. Connect Track.

TOOLS.

CHAINS, track (2)	STRAIGHTEDGE
HAMMER, 1-lb.	TRUCK, towing
JACK, simplex	WRENCH, 1½-in.
ROPE	WRENCH, MTM-M3-7
SCREWDRIVER	WRENCH, open-end, 1-in.

(1) PROCEDURE.

(a) Pull Tracks into Position on Drive Sprockets (fig. 112).

ROPE	TRUCK, towing

Place a rope around end track block and, with rope resting on top of drive sprocket, pull track over sprocket a sufficient distance to permit attaching to other end of sprocket, meshing track into teeth on sprocket.

(b) Join Ends of Track (fig. 113).

CHAINS, track (2)	JACK, simplex
HAMMER	WRENCH, open-end, 1-in.

Attach chains to ends of track, attach simplex jack to chains and draw ends of track together with jack. Aline pins and drive connectors onto end of track block pins (both sides of track) (hammer). Position wedges on each connector and secure with wedge nuts. Tighten nuts securely (1-in. open-end wrench). Loosen jack and remove jack and chains.

(c) Adjust Track Tension (par. 115., g., (2), (c)).

116. DRIVE SPROCKETS.

a. Description. Hub assemblies are formed by bolting two sprockets to a hub, which in turn is bolted to the flange end of the final drive shaft. These sprockets and hub assemblies are interchangeable as units. Transpose sprockets between right and left final drive shafts when the teeth have been appreciably worn.

b. Removal.

TOOLS.

HOIST	WRENCH, $1\frac{7}{16}$-in.
SCREWDRIVER	WRENCH, MTM-M3-7
WRENCH, 1½-in.	WRENCH, open-end, 1-in.

(1) PROCEDURE.

(a) Disconnect the track below the sprocket (par. 115., **h.**,).

(b) Arrange hoist to take weight of sprocket and hub assembly.

(c) Remove hub and sprocket assembly.

WRENCH, $1\frac{7}{16}$-in.

Remove eight retaining nuts and lock washers and slide hub and sprocket assembly off the eight studs (fig. 112).

c. Installation.

TOOLS.

CHAINS, track (2)	STRAIGHTEDGE
HAMMER	TRUCK, towing
HOIST	WRENCH, $1\frac{7}{16}$-in.
JACK, simplex	WRENCH, 1½-in.
ROPE	WRENCH, MTM-M3-7
SCREWDRIVER	WRENCH, open-end, 1-in.

(1) PROCEDURE.

(a) Position hub assembly on final drive shaft.

HOIST

Lift hub and sprocket assembly with hoist, slide onto end of final drive shaft and over studs.

(b) Install Nuts and Lock Washers (fig. 112).

WRENCH, $1\frac{7}{16}$-in.

Install eight retaining nuts and lock washers and tighten securely.

(c) Connect Track (par. 115., **i.**).

117. IDLER WHEELS.

a. Description. Two large steel idler wheels are mounted on the end opposite the driving sprockets to support the tracks. They are provided with an eccentric adjustment for the purpose of adjusting the tension of the tracks (fig. 115).

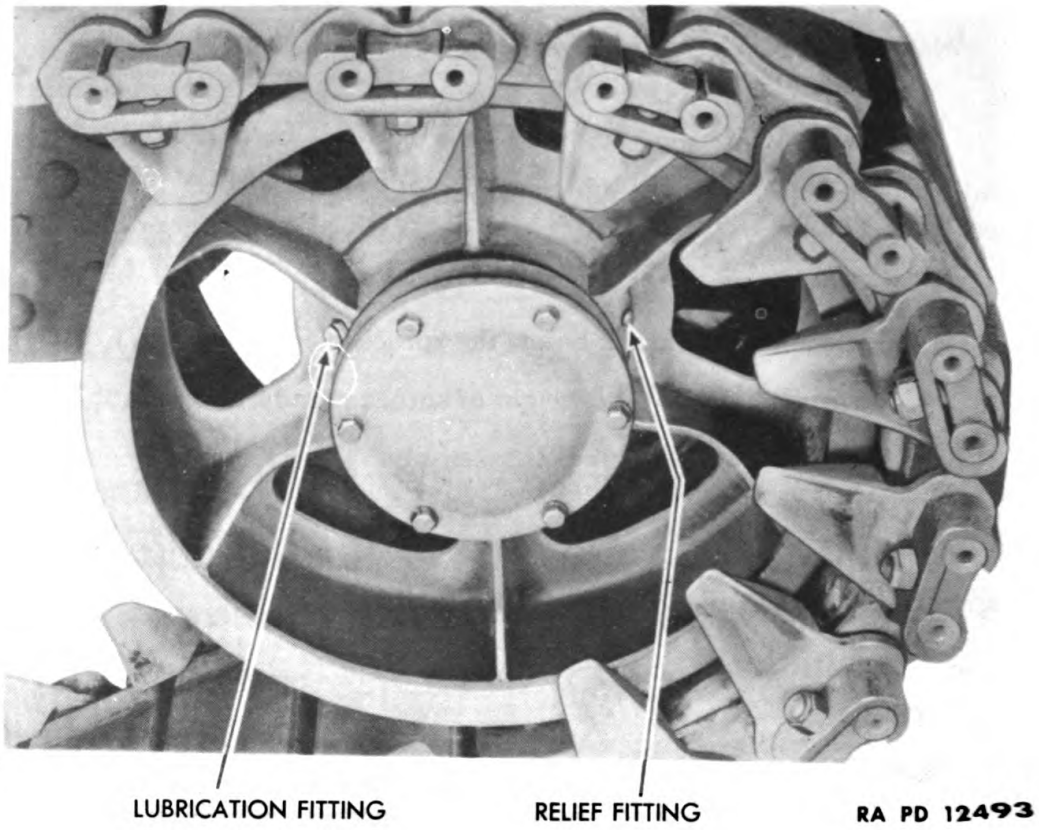


Figure 115 — Detail of Idler

b. Removal of Idler Wheel (With Track Removed).

TOOLS.

PLIERS, side cutting
PULLER, MTM-M3-8
WRENCH, $\frac{9}{16}$-in.
WRENCH, 2 5/8-in.

(1) PROCEDURE.

(a) Remove Idler Wheel Cap.

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

Remove six cap screws and remove cap.

(b) Remove Idler Wheel.

PLIERS, side cutting
PULLER, MTM-M3-8
WRENCH, 2 5/8-in.

Remove cotter pin (side cutting pliers) securing wheel nut, remove nut (2 5/8-in. wrench) and pull wheel from shaft (MTM-M3-8 Puller).

c. Installation of Idler Wheel (With Track Removed).

TOOLS.

PLIERS, side cutting
WRENCH, 2⅝-in.
WRENCH, $\frac{9}{16}$-in.

(1) PROCEDURE.

(a) Before Installing Wheel, clean bearings, oil retainers and spacer and, when worn or damaged, replace with new parts.

(b) Pack Inner and Outer Bearings with Grease.

(2) MOUNT WHEEL.

PLIERS, side cutting
WRENCH, 2⅝-in.

Place wheel in position, secure with nut (2⅝-in. wrench), insert cotter pin through nut castellations and through hole in end of shaft. Bend ends of cotter pin to secure (side cutting pliers).

(3) INSTALL CAP ON IDLER WHEEL.

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

Position *new* gasket on idler cap, install cap and secure with six cap screws and lock washers.

d. Lubrication.

(1) GENERAL. A lubrication fitting, located in the hub of idler wheel, provides a means of lubricating the idler wheel bearings. Any pressure which may be built up inside wheel hub is expelled through the relief fitting.

TOOLS.

GUN, grease

(2) PROCEDURE.

(a) Prepare for Lubricating.

Clean surface of fitting thoroughly, to eliminate forcing dirt into bearings.

(b) Apply GREASE, general purpose, to fitting until it is forced out of relief fitting.

118. BOGIES.

a. Description and Operation. The bogies are the supporting and conveying units, and are sometimes called trucks or suspensions. The movement is transferred from the wheels to the arms and levers, and is absorbed by springs. At the top of each bogie assembly is a single steel

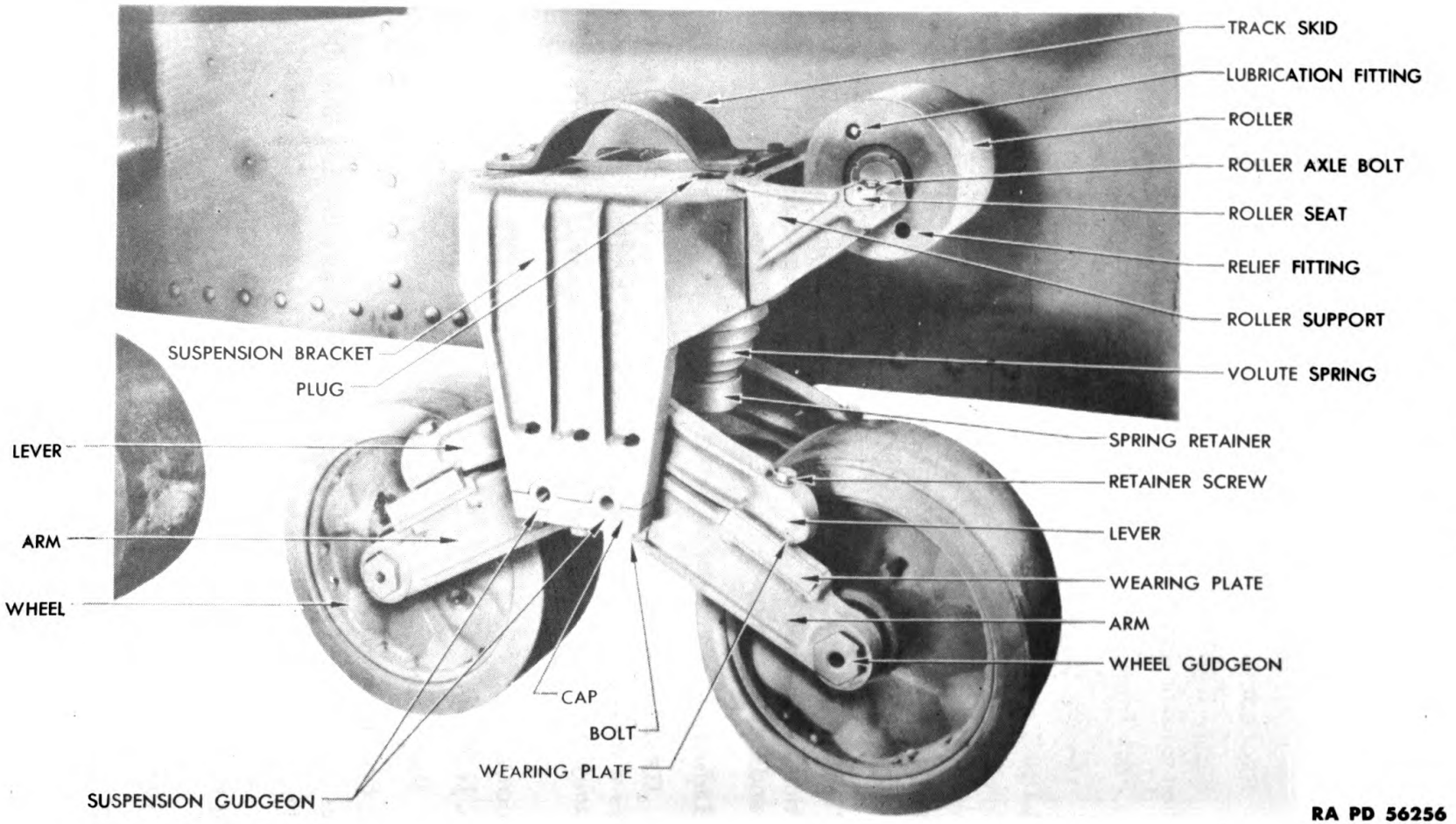


Figure 116 — Bogie Wheels and Supporting Roller

roller to support and carry the upper, returning portion of the track. The roller assemblies are bolted on the side of the bogie brackets. A track skid is bolted to the top of the bogie frame (fig. 116).

b. Removal of Bogie Wheel.

TOOLS.

JACK, hydraulic, 12-ton
PLIERS, side cutting
PULLER-gudgeon, MTM-M3-6
WRENCH, MTM-M3-137

(1) PROCEDURE.

(a) Take Weight from Wheel to Be Removed.

JACK, hydraulic, 12-ton

Remove weight from bogie wheel to be replaced, by placing a jack under bogie wheel arm (fig. 117) and raising arm until wheel is clear.

(b) Remove Gudgeon Nut.

PLIERS, side cutting
WRENCH, MTM-M3-137

Remove cotter pin (side cutting pliers) and nut (MTM-M3-137 wrench) on the back end of the bogie wheel gudgeon (fig. 117).

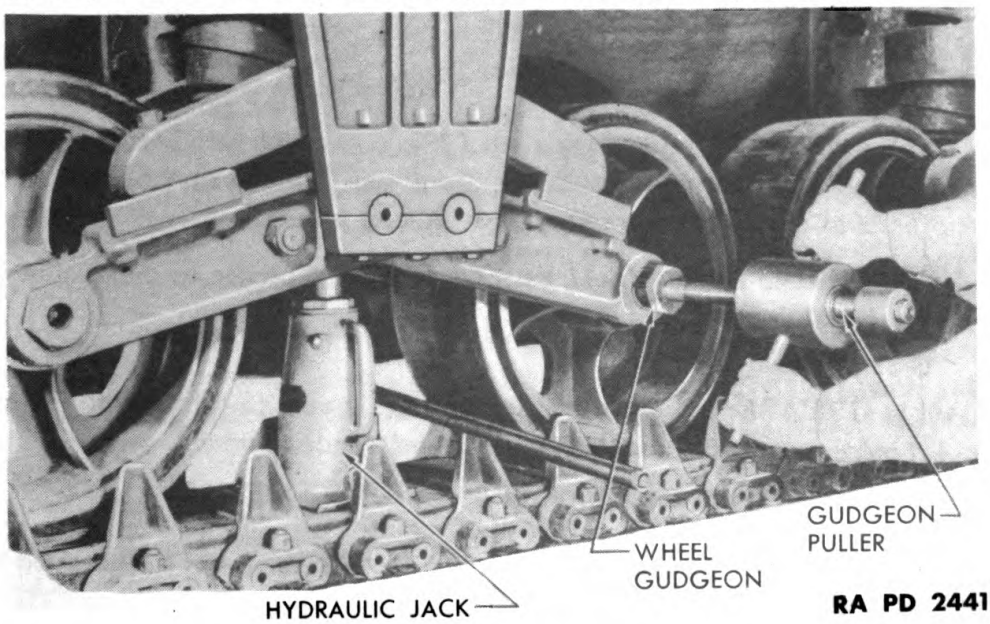


Figure 117 — Pulling Wheel Gudgeon Pin to Remove Bogie Wheel

(c) Remove Gudgeon.

PULLER, gudgeon, MTM-M3-6

Remove gudgeon with puller (fig. 117). Use care so as not to damage Woodruff key, used to prevent the spindle from turning, or the threads on the end of the spindle.

(d) Remove Wheel.

c. Installation of Bogie Wheel.

TOOLS.

GUN, grease
HAMMER
JACK, hydraulic, 12-ton
PLIERS, side cutting
WRENCH, MTM-M3-137

(1) PROCEDURE.

(a) Make Sure All Parts Are Cleaned Thoroughly.

(b) Place Wheel in Position in Bracket, with lubricant nipple away from vehicle.

(c) Dip gudgeon in GREASE, graphite, and insert in openings in bracket and wheel.

(d) Drive Gudgeon into Position.

HAMMER

Place Woodruff key in position in gudgeon and drive gudgeon into position. Use care not to damage Woodruff key or threads of spindle.

(e) Install Gudgeon Nut.

PLIERS, side cutting
WRENCH, 2 3/8-in.

Install nut on inner end of gudgeon (2 3/8-in. wrench), tighten securely, insert cotter pin through nut castellations and hole in end of gudgeon. Bend ends of cotter pin to secure (side cutting pliers).

(f) Lubricate Bogie Wheel, turning wheel on spindle to make sure it is sufficiently lubricated.

GUN, grease

Apply GREASE, general purpose, seasonal grade, to lubrication fitting until it is forced out of relief valve on opposite side of wheel.

(g) Remove Jack and Allow Wheel to Rest on Track.

d. Removal of Bogie Wheel Bearings (With Wheel Removed).

TOOLS.

PULLER, bearing

(1) PROCEDURE.

(a) Remove Bearings.

Place puller in position behind bearing and pull spacer, two retainers and bearing out of hub. Turn wheel around and repeat operation to pull like parts from other side of hub. Withdraw long tubular spacer from center of hub.

e. Installation of Bogie Wheel Bearings (With Wheel Removed).

TOOLS.

DRIFT, MTM-M3-13
HAMMER
PAN, for SOLVENT, dry-cleaning

(1) PROCEDURE.

(a) Prepare parts for installation.

PAN, for SOLVENT, dry-cleaning

Wash all parts thoroughly in SOLVENT, dry-cleaning, and remove all foreign matter.

(b) Install Bearings in Wheel.

DRIFT
HAMMER

Dip bearing in GREASE, general purpose, seasonal grade, and press into one side of opening in wheel hub. Tap bearing with copper drift and hammer until it is seated against shoulder near center of hub. Turn wheel around, dip long tubular spacer in GREASE, general purpose, seasonal grade, and insert spacer in opening in hub, tapping spacer with hammer, and copper drift, until it rests against bearing. Dip other bearing in GREASE, general purpose, seasonal grade, and press into opening in wheel hub. Tap bearing with copper drift and hammer until it is seated against shoulder near center of hub.

(c) Install Retainers.

Press two grease retainers into each side of wheel hub, forcing retainers tight against bearings. Press one flanged spacer into each side of hub, forcing spacer into opening until flange contacts hub.

f. Lubrication of Bogies.

(1) LUBRICATION OF THE WHEELS AND THE TRACK-SUPPORTING ROLLERS is through lubricant nipples. Relief valves are provided to prevent injury to oil seals (fig. 110).

TOOLS.

GUN, grease

(a) Procedure.

1. Prepare for Lubricating.

Wash vehicle, to remove all dirt and foreign matter from wheels and lubricant nipples, to eliminate forcing dirt into the bogie wheel bearings.

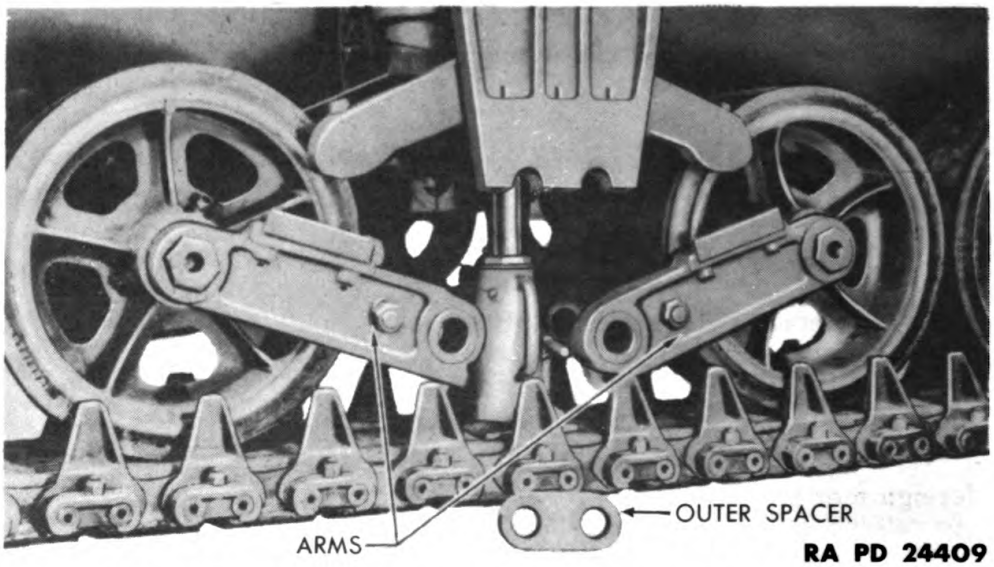


Figure 118 — Wheels and Arms Ready for Removal Preparatory to Removing Volute Springs

2. *Lubricate Wheel Bearings.*

GUN, grease

Apply **GREASE**, general purpose, to nipple until it is forced out of relief fitting.

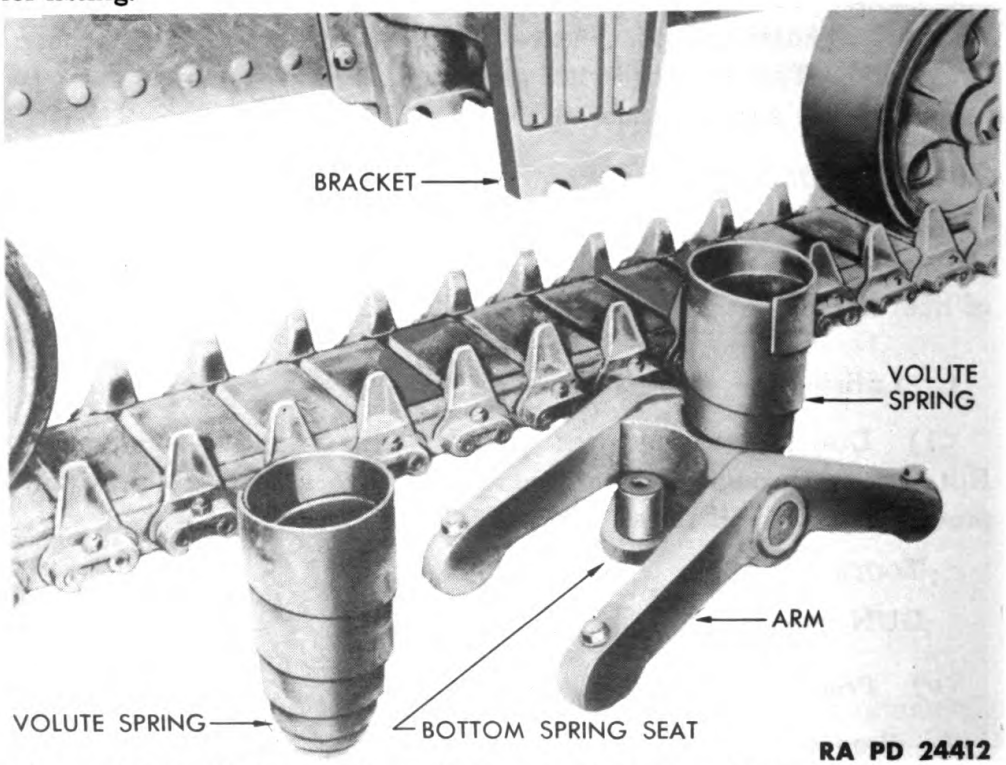


Figure 119 — Volute Springs, Levers, and Bottom Seat Removed and Partially Disassembled

g. Removal of Volute Springs.

TOOLS.

JACK, hydraulic, 12-ton
PLIERS, side cutting
JACK screws, 1-8 NC, 18-in. long (2)
WRENCH, 7/8-in.
WRENCH, $1\frac{7}{16}$-in
WRENCH, 1½-in.
WRENCH, open-end, $1\frac{7}{16}$-in.
WRENCH, MTM-M3-10

(1) PROCEDURE.

(a) Slacken and Disconnect Track (par. 115., **h.**).

(b) Remove Track Skid (fig. 116).

PLIERS, side cutting
WRENCH, 7/8-in.

Remove lock wires (side cutting pliers), four cap screws and washers (7/8-in. wrench) and remove track skid (fig. 116).

(c) Install Jack Screws.

JACK screws, 1-8 NC, 18-in. long (2)
WRENCH, MTM-M3-10

Unscrew plugs above and below volute spring and insert jack screws through these openings from top and screw into threaded plate at bottom of springs.

(d) Install Jack Nut.

WRENCH, open-end, $1\frac{7}{16}$-in.

Relieve tension on wheels by screwing jack nut on the screw against the suspension bracket.

(e) Remove Gudgeon Caps (fig. 116).

WRENCH, 1½-in.

Remove six suspension gudgeon cap bolts and remove caps.

(f) Raise Vehicle Off Wheels with Jack.

JACK, hydraulic, 12-ton

Place jack at edge of hull floor and raise vehicle off wheels. Wheels and arms are now free and can be removed.

(g) Release Springs.

WRENCH, $1\frac{7}{16}$-in.

Release springs by unscrewing jack nut. NOTE: When unscrewing jack nut to release spring, the wrench handle on jack screw should be held to prevent the jack screw from turning out of the spring plate. As an extra precaution, a jack placed under the spring plate can be used together with the jack nut, when releasing the tension of the spring.

When the tension is released, remove jack screw and spring will fall out (fig. 118).

h. Installation of Volute Springs.

TOOLS.

JACK, hydraulic, 12-ton
PLIERS, side cutting
JACK screws, 1-8 NC, 18-in. long (2)
WRENCH, 7/8-in.
WRENCH, 1 7/16-in.
WRENCH, 1½-in.
WRENCH, open-end, 1 7/16-in.
WRENCH, MTM-M3-10

(1) PROCEDURE.

(a) Raise Vehicle.

JACK, hydraulic, 12-ton.

Place jack at edge of hull and raise vehicle sufficiently to permit installation of bogie assembly.

(b) Install Springs.

JACK screws, 1-8 NC (2) 18-in. long
WRENCH, 1 7/16-in.

Place the two jack screws through the two openings in suspension bracket, directly above spring locations, position springs and spring plate in bracket and screw jack screws into spring plate. Screw nuts on jack screws against suspension bracket to compress springs.

(c) Install Gudgeon Caps (fig. 116).

WRENCH, 1½-in.

Place undercarriage in position, with the two suspension gudgeons resting in the recesses in lower ends of bracket, place the two caps in position and attach each cap with three cap screws and lock washers to suspension bracket. Tighten cap screws securely.

(d) Remove Jack Screws.

WRENCH, open-end, 1 7/16-in.
WRENCH, MTM-M3-10

Release tension on springs by unscrewing nuts on jack screws and, after tension has been released, unscrew jack screws and remove from bracket (1 7/16-in. open-end wrench). Install plugs above and below each volute spring (MTM-M3-10 wrench).

(e) Install Track Skid (fig. 116).

PLIERS, side cutting
WRENCH, 7/8-in.

Place track skid in position on top of bracket, install four cap screws and tighten securely (7/8-in. wrench). Insert locking wires through heads

of cap screws and twist ends of wires to secure (side cutting pliers). Remove jack from edge of hull.

(f) Connect Track and Adjust.

Refer to paragraph 115., i. for details.

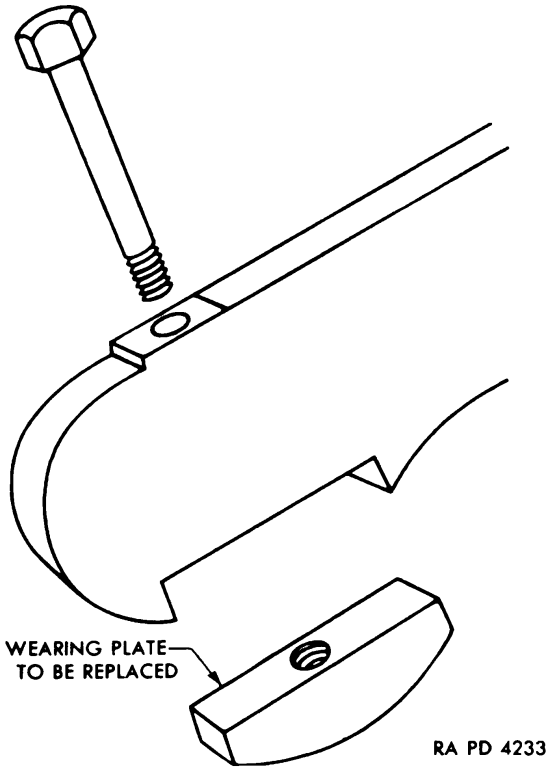


Figure 120 — Bogie Wheel Lever and Upper Rubbing Plate

i. Replacement of Wearing Plates.

TOOLS.

BAR, pinch

WRENCH, 3/4-in.

(1) PROCEDURE.

(a) Relieve pressure on wearing plate by placing pinch bar between lever and arm (fig. 116) and raising lever.

(b) Remove Plate.

WRENCH, 3/4-in.

Unscrew wearing plate retainer screw from plate, substitute new plate for old and tighten screws securely (fig. 120).

j. Removal of Roller.

TOOLS.

JACK

PLIERS, side cutting

WRENCH, socket, $\frac{13}{16}$-in.

(1) PROCEDURE.

(a) Raise Track to Permit Removal of Roller.

JACK, hydraulic, 12-ton.

Place jack in position and adjust to raise upper part of track to clear roller.

(b) Remove Roller from Bracket (fig. 116).

PLIERS, side cutting
WRENCH, socket, $\frac{13}{16}$-in.

Remove locking wires from roller axle bolts (side cutting pliers) and remove the four bolts, two on either side of roller. Lift roller off bracket.

k. Installation of Roller.

TOOLS.

GUN, grease
JACK, hydraulic, 12-ton
PLIERS, side cutting
WRENCH, $\frac{13}{16}$-in.

(1) PROCEDURE.

(a) Raise Track to Permit Installation of Roller.

JACK, hydraulic, 12-ton.

(b) Install roller (fig. 116).

PLIERS, side cutting
WRENCH, socket, $\frac{13}{16}$-in.

Clean roller seats and recess in bracket, position roller on bracket and secure with bolts. Tighten bolts securely ($\frac{13}{16}$-in. socket wrench). Insert locking wires through holes in bolt heads, through holes in ends of seats and twist ends of wires to secure (side cutting pliers).

(c) Lubricate Roller (fig. 116).

GUN, grease

Apply GREASE, general purpose, to lubricant nipple until grease is forced out through relief fitting.

Section XXII

HULL AND TURRET

119. GENERAL DESCRIPTION.

a. Ordinarily the hull and turret will require little attention other than careful checking to see that all parts are tight and that hinges and other moving parts are properly lubricated. The turret is a one-piece casting of two inch armor (varying in thickness to three inches), which rotates on a ball bearing race recessed and protected against direct hits and lead splash from enemy fire. The turret shield or basket is rigidly fastened to the cast turret, which projects above the roof of the vehicle, by means of a ring of bolts around its top circumference.

120. INSPECTION AFTER COMBAT.

a. Make the following inspections after vehicle has been in combat.

(1) Check hull and turret, inside and out, for evidence of cracks or damage from fire.

(2) Remove debris or bullet splash from turret race, from under turret hatch ring, and from behind gun shields.

(3) Check complete 360 degrees traverse of turret, using hand traversing wheel, to determine any obstruction or restricted movement.

(4) Check complete 360 degrees traverse of turret hatch ring.

(5) Inspect all periscope mounts for presence and conditions of covers, and free action of elevation and rotation.

(6) Elevate and depress the 75-millimeter gun to its full extent of travel, using the manual control to determine any restriction of movement.

(7) Inspect direct vision slots and covers.

(8) Test hatch covers and pistol port for free operation and correct closing and locking.

(9) Inspect and clean out ventilators.

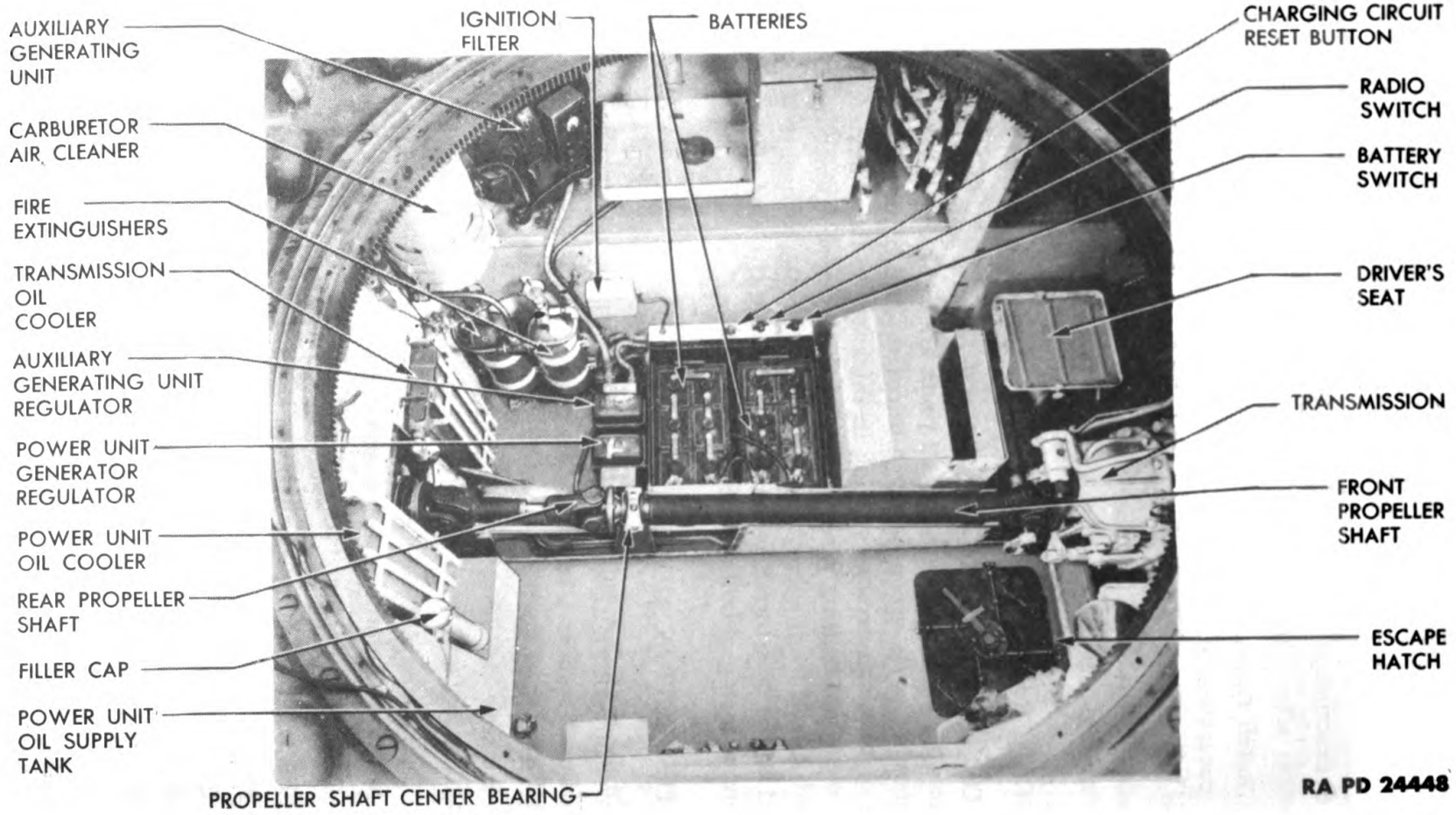


Figure 121 — Plan View Fighting Compartment — Turret Removed

121. TURRET HATCH RING.

a. Because the turret hatch ring acts as an aintiaircraft gun mount, it is essential that it always rotates freely and easily. If restriction of movement develops and no external cause can be discovered, the ring and cover assembly must be removed and inspected, and, if necessary, replaced (fig. 122).

b. Removal.

TOOLS.

SCREWDRIVER, heavy duty or drag link tool, and handle
WOOD blocks (3)
WRENCH, socket $\frac{9}{16}$-in.

(1) PROCEDURE.

(a) Remove Retaining Ring Cap Screws.

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

Remove all but the two opposite cap screws that hold the retaining ring and the lower half of the inside race to the upper half of the inside race (this is part of the turret hatch ring).

(b) Block Up Retaining Ring with Wood Supports.

WOOD blocks (3)

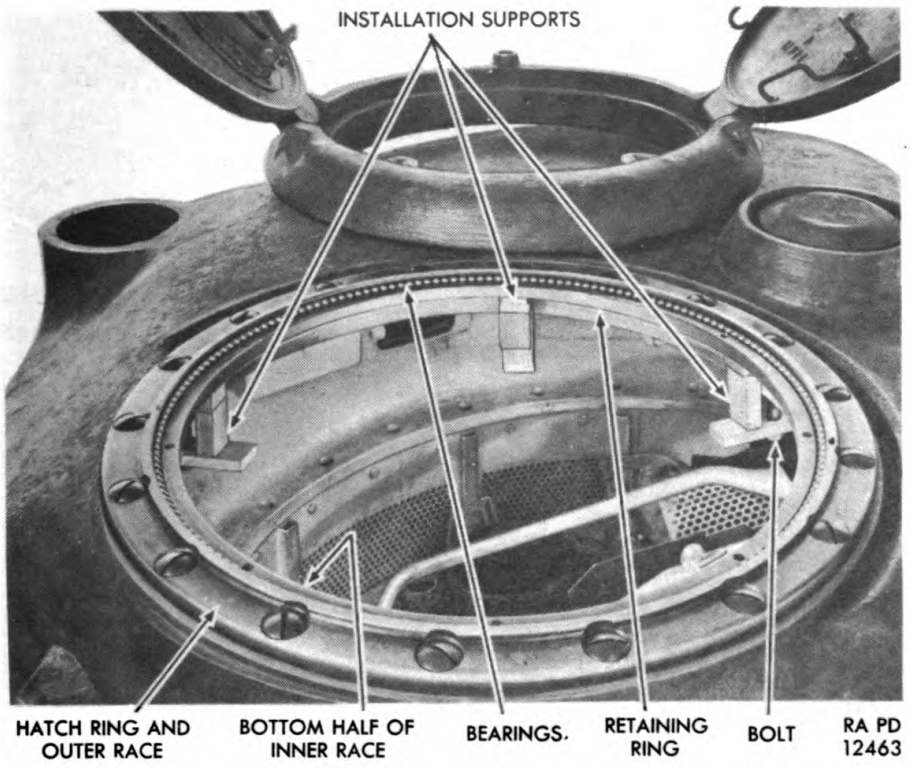


Figure 122 — Hatch Ring Inner Race Supported for Hatch Ring Removal

Before removing the last two cap screws from the retaining ring, provide some means of supporting the ring so that it will not drop down and release all the ball bearings from the race. Three wooden supports can be bolted into place on the left side of the ring, installing the bolts into the lower ends of the tapped holes for the outer race retaining bolts (fig. 122).

(c) Remove Ring and Cover Assembly.

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

Remove the two remaining cap screws from the retaining ring. Using two men, lift off the ring and cover assembly.

(d) If lower half of inner race has been damaged, remove ball bearings and lift out race.

(e) Remove Outer Race.

SCREWDRIVER, heavy duty or drag link tool, with handle

If outer race has been damaged, remove the eighteen screws and remove race.

c. Installation.

TOOLS.

SCREWDRIVER, heavy duty or drag link tool, and handle
WOOD blocks (3)
WRENCH, socket, $\frac{9}{16}$-in.

(1) PROCEDURE.

(a) Reinstall Outer Race.

SCREWDRIVER, heavy duty or drag link tool, with handle.

If outer race was removed, reinstall the race and install and tighten the eighteen screws, pulling them down gradually in rotation to seat the ring evenly.

(b) Set the retaining ring and lower half of inner race in place on three wooden supports and install and pack ball bearings with GREASE, general purpose.

(c) Mount Turret Hatch Ring and Covers.

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

Set the turret hatch ring and covers in place (two men). Line up bolt holes in retaining ring, race, and turret hatch ring and install and tighten the cap screws.

(d) Remove the Wooden Supports.

122. HATCH COVERS AND PISTOL PORT COVERS.

a. It is important that all hatch covers and the pistol port covers close tightly and latch easily. Damaged covers must be repaired or replaced immediately. To remove covers, it is necessary only to drive out hinge pin. If the periscope mount is undamaged, remove it before removing the hatch cover. Always replace any worn or torn gaskets so that covers will be weathertight when closed.

123. ESCAPE HATCH

a. The escape hatch is an important safe guard for members of the crew. Check frequently for easy and correct operation. At regular intervals, remove and clean all dirt and rust and lubricate all working parts thoroughly (fig. 121).

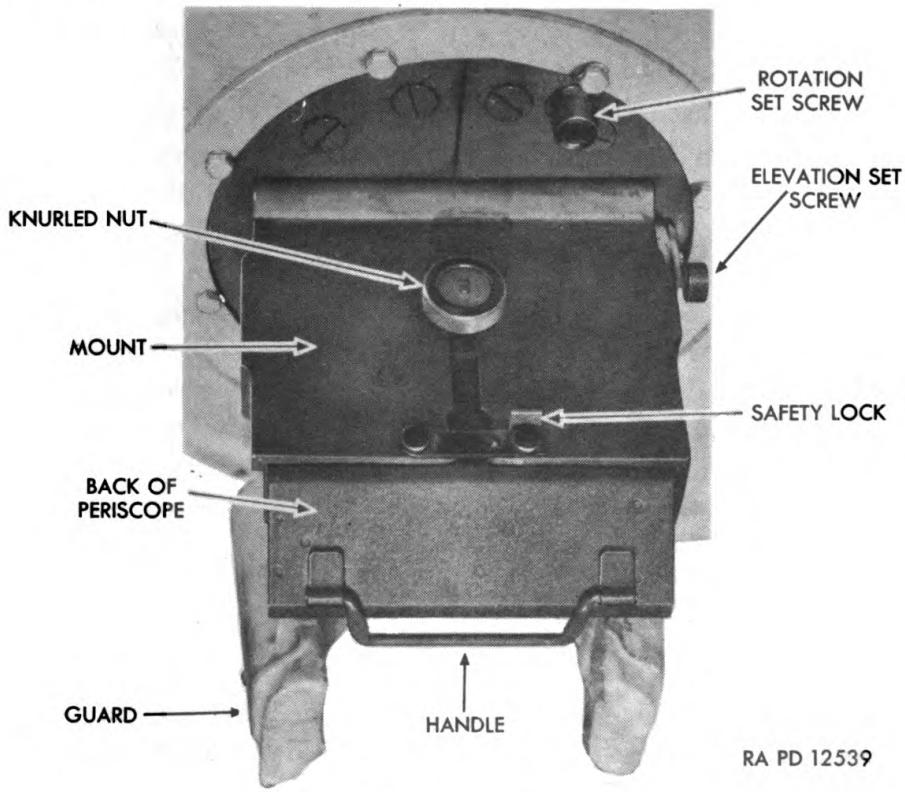


Figure 123 — M5 Periscope

124. VISION DEVICES.

a. Indirect Vision Devices.

(1) A periscope, M5 or M6, is provided for each crew member at his station (fig. 123). The mounting for each periscope, except that of the 75-millimeter gunner, includes a revolving plate which permits the

periscope to be aimed in any position. A rotation set screw can be tightened to hold the periscope at any azimuth desired. The mount can be tilted to change the elevation of the line of vision of the periscope. Another screw is provided to secure the periscope at any desired elevation. A knurled nut on the back of the periscope is used to hold it in place. A safety lock prevents the periscope from falling out when the knurled nut has become loosened.

(2) To replace an unserviceable periscope, M5 or M6, unlatch the safety lock, loosen the knurled nut and pull the periscope down by the handle. Install a new or serviceable unit, tighten the knurled nut and secure with the safety lock.

(3) The mount of the 75-millimeter gunner's periscope, M4, is linked to the 75-millimeter gun by an arm or rod linkage so that its position changes with any change in the position of the gun. This periscope has a telescopic sight built into the right side. The using arms will not attempt to synchronize the periscope of the gun.

b. Direct Vision Devices. The driver and assistant driver are provided with direct vision through narrow slits in the hull directly in front of each operator. A thick glass plate placed over the slit inside the vehicle prevents flying fragments from entering. A hinged direct vision cover is operated by a control lever to the side of the glass plate. To raise the direct vision cover above the slit and permit vision, pull out then push downward on the rubber knob of the control lever. To lower the direct vision cover to protect the slit, pull out and then raise the rubber knob of the control lever. On later production of the Medium Tank M4A4, the direct vision slits and covers are replaced by an auxiliary periscope for the driver and assistant driver.

125. COLLECTOR RING.

a. The purpose of the collector ring assembly is to transfer the electrical power from the main section of the vehicle to the turret. It consists of a cylinder which rotates with the turret and sets of fixed brushes.

Section XXIII

ELECTRICAL TURRET TRAVERSING SYSTEM

126. CHECKING TRAVERSE OPERATION (fig. 124).

a. Before operating the electric traverse in combat and at each 250 mile inspection, the following tests and inspections should be made with the tank standing still. In event of unsatisfactory operation after servicing, replace components as described in paragraphs 127 to 137. Check the equipment as follows:

b. Equipment.

BAR, 3/8-in., square
CHALK or paint
CLOTH, clean
GAGE, feeler
GREASE, chassis #1 and #0
OIL, engine, seasonal grade
RULE, 6-in.
SCREWDRIVER, 8-in.
STRAIGHTEDGE, 12-in.
WATCH (with second hand)
WRENCH, 3/8-in., box
WRENCH, 3/4-in., socket, with 8-in. extension

c. Procedure.

GAGE, feeler
WRENCH, 3/4-in. socket with 8-in. extension

(1) CHECK THE MESH BETWEEN THE TRAVERSE DRIVE GEAR AND THE TURRET RING GEAR WHILE MAKING ONE COMPLETE REVOLUTION OF THE TURRET WITH THE HANDWHEEL IN MANUAL OPERATION.

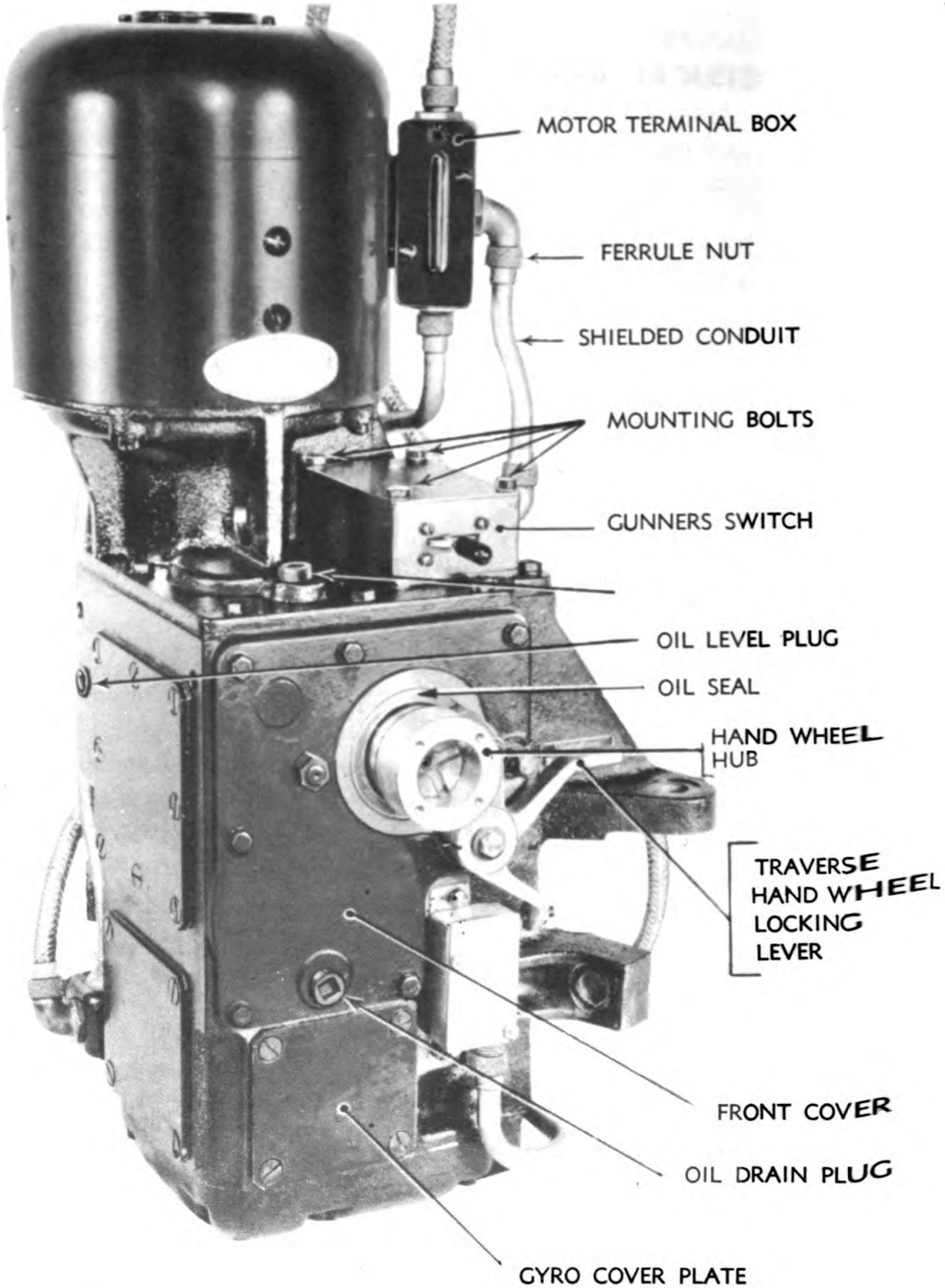
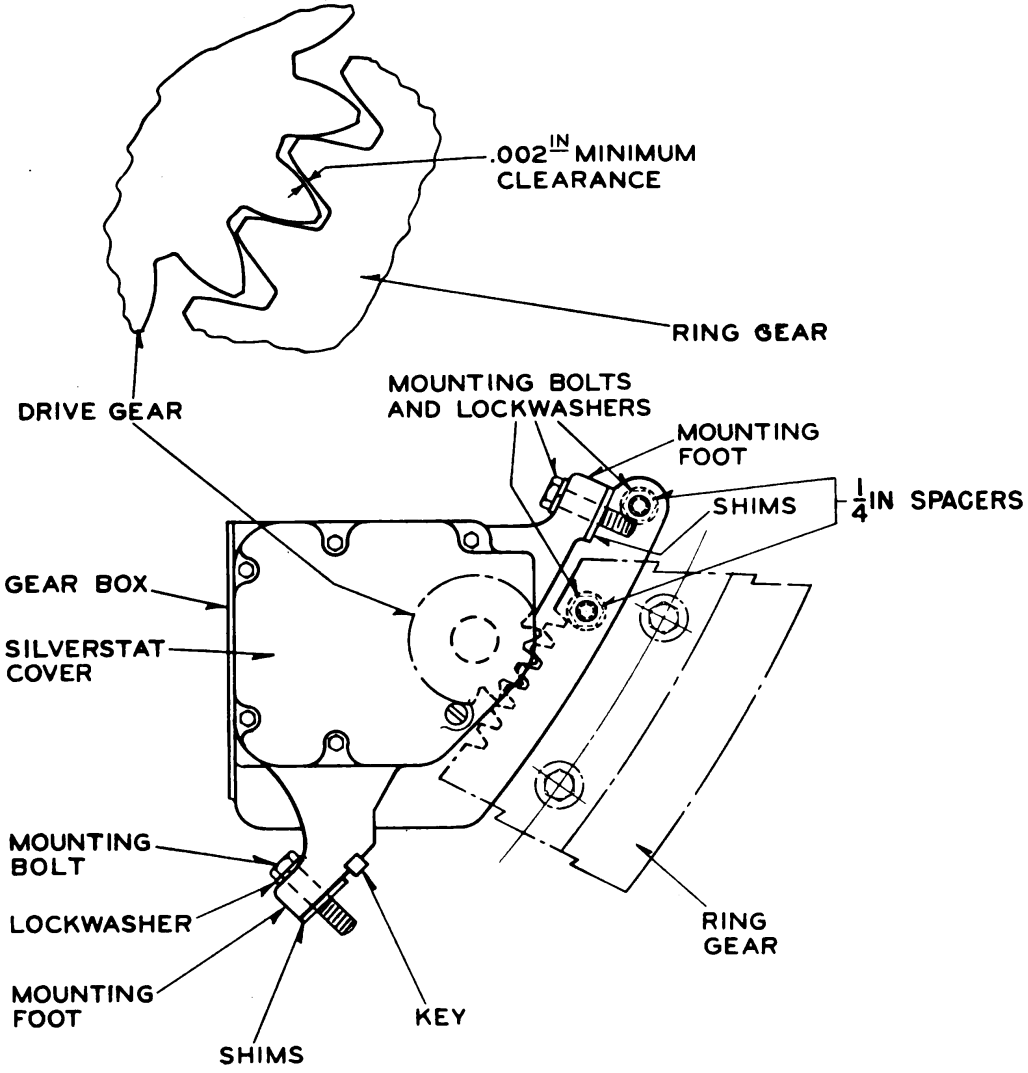


Figure 124 — Electric Traverse Mechanism

ELECTRICAL TURRET TRAVERSING SYSTEM

Minimum clearance between traverse drive gear and turret ring gear is 0.002-in. at the highest point (fig. 125). Rotate the turret showing a complete revolution in manual operation. Stop frequently to locate the point of minimum clearance. There must be no binding at minimum clearance and satisfactory mesh at maximum clearance. To adjust clearance between gears: Remove horizontal mounting bolts and loosen vertical mounting bolts (3/4-in. socket wrench with 8-in. extension). Correct shims on horizontal mounting bolts as necessary. Shim equally under each bolt, if possible. Reinstall and tighten mounting bolts.



BOTTOM VIEW OF GEAR BOX SHOWING MOUNTING AND MESH BETWEEN DRIVE GEAR AND RING GEAR.

RA PD 51183

Figure 125 — Bottom View of Gear Box Showing Mounting and Mesh Between Drive Gear and Ring Gear

(2) CHECK ANGULAR LAG BETWEEN THE HANDWHEEL AND THE TURRET RING GEAR.

RULE, 6-in. STRAIGHTEDGE, 12-in.

Maximum lag of the handwheel in power and in manual operation is 3 inches measured at the diameter of the handwheel. Turn handwheel in power position in one direction a quarter turn. Place straightedge over handwheel and parallel to gunner's switch. Mark handwheel along straightedge. Turn handwheel slowly in oposite direction until turret ring gear just begins to move. Replace straightedge in same position along gunner's switch and again mark handwheel along straightedge. Measure distance from first to second mark to determine lag. Repeat this procedure for opposite rotation of handwheel and for rotation of handwheel in both directions in power operation. If 3-in. limit is exceeded, replace the gear box.

(3) CHECK TURRET SPEED.

WATCH (with second hand)

With tank on level ground operate turret with gunner's or commander's switch. Minimum speed is 4 rpm or one revolution in 15 seconds. If equipment fails to operate or does not operate at proper speed notify Ordnance maintenance personnel. Check speed in both directions with both gunner's and commander's switches.

(4) CHECK LUBRICATION OF RING GEAR.

GREASE, chassis #1 above 32 F, chassis #0 below 32 F.

Grease should be adequate but not dripping. If necessary, add GREASE (chassis #1 above 32 F, chassis #0 below 32 F) while turning the turret one complete revolution. Three grease fittings are located around the ring gear.

(5) CHECK VEHICLE BATTERY VOLTAGE WHICH MUST BE BETWEEN 24 AND 28 VOLTS.

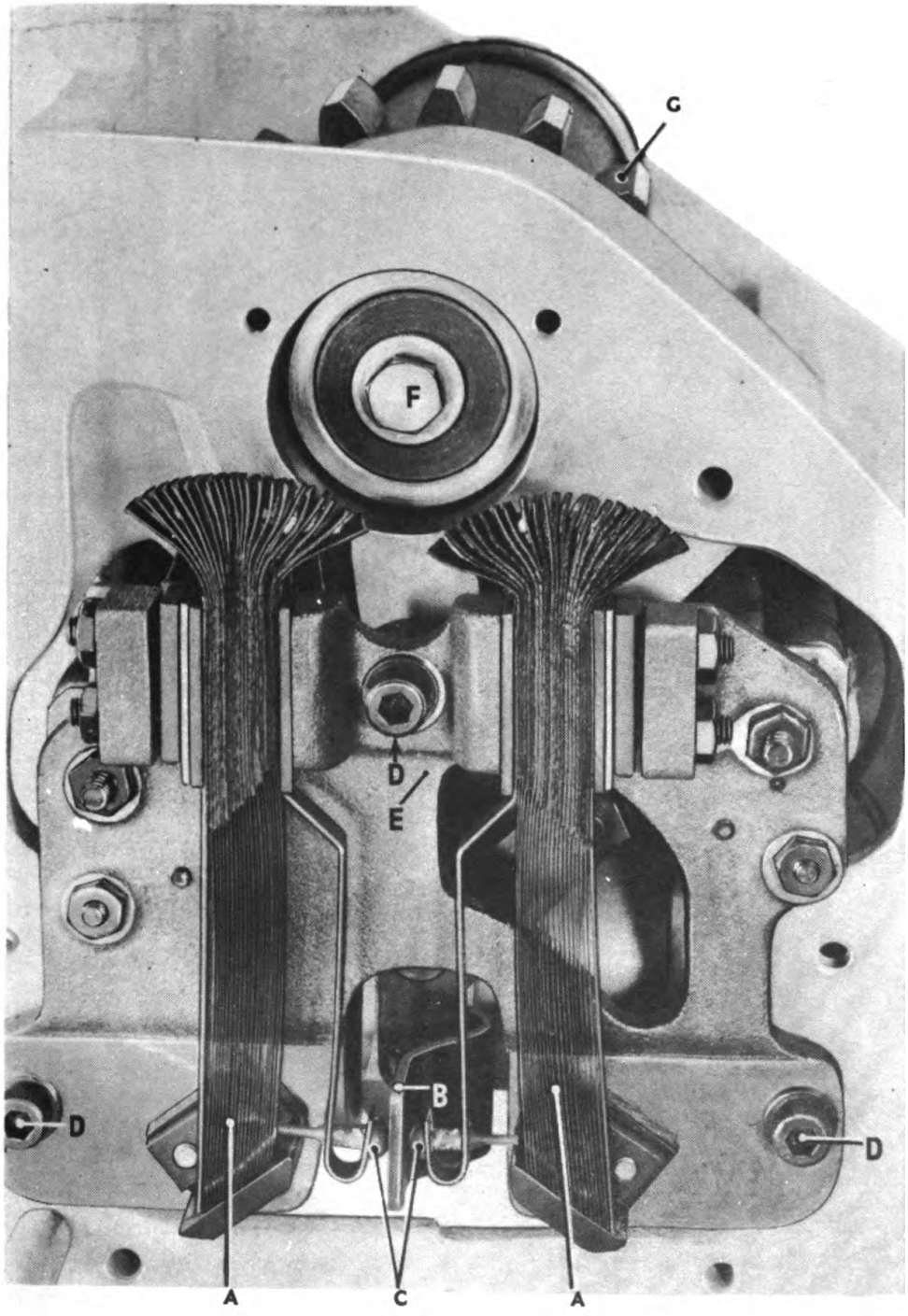
If voltage is low, recharge with Homelite auxiliary generator as necessary. If voltage is too high, voltage regulators need to be adjusted, notify Ordnance maintenance personnel.

(6) CHECK CLUTCH (fig. 126).

CHALK or paint SCREWDRIVER

Traverse the turret 45 degrees in either direction with gunner's or commander's switch. A gliding movement after the switch is released indicates a loose clutch. Rapid vibration of the turret when switch is released indicates a tight clutch. Adjust, if necessary, as follows: Remove six mounting screws from cover plate (screwdriver) from the bottom of the motor gear box. Remove clutch cover plate (screwdriver). If clutch is too loose, tighten elastic stop adjusting nut (fig. 126) ⅛ turn and recheck operation. Repeat until satisfactory operation is obtained. *Clutch adjust-*

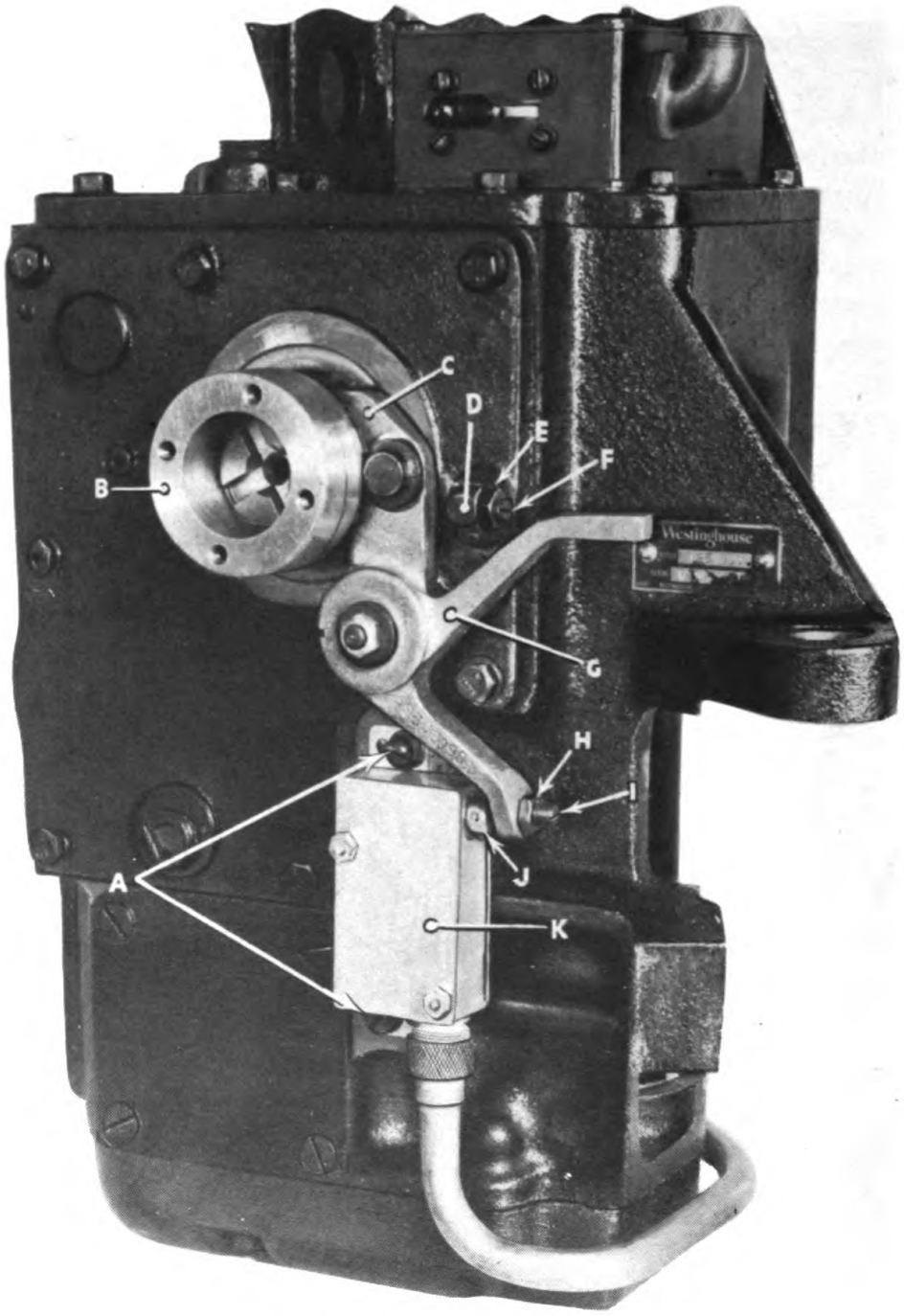
ELECTRICAL TURRET TRAVERSING SYSTEM



A — SILVERSTATS
B — SPACER
C — INSULATED BUTTONS
D — ALLEN MOUNTING BOLTS
E — SILVERSTAT CRADLE
F — CLUTCH ADJUSTING NU
G — DRIVE GEAR

RA PD 390

Figure 126 — Silverstat and Clutch Assembly



A — MOUNTING SCREWS
B — HAND WHEEL HUB
C — LOCK LEVER FLANGE
D — LOCK LEVER STOP
E — LOCK NUT
F — ADJUSTING SCREW
G — LOCK LEVER
H — LOCK NUT
I — ADJUSTING SCREW
J — PLUNGER
K — DISENGAGING SWITCH

RA PD 39053

Figure 127 — Front of Gear Case — Handwheel Removed

ments are critical and should be made very carefully. If clutch is too tight, loosen adjusting nut ⅛ turn and check. Repeat this operation until satisfactory operation is obtained. Reinstall clutch cover plate and bottom cover plate. Normal clutch slippage is from one to two teeth on the turret drive gear. This slippage may be accurately measured by marking clutch housing and turret drive gear and observing displacement after operating turret in both directions as described above.

(7) CHECK DISENGAGING SWITCH (fig. 127).

RULE, 6-in.

In manual operation the plunger should protrude no more than $\frac{1}{16}$-in. In electrical operation, the plunger should be as far out at is will go and the lock lever disengaging arm adjusting screw should not touch it. The lock lever stop must be adjusted so the locking arm will clear the handwheel hub when changing from one type of operation to another. Set the lock lever stop first, then set the locking arm adjusting screw.

(8) CHECK FOR OIL LEAKS IN GEAR BOX (fig. 127).

SCREWDRIVER, 8-in.

Visually inspect oil seal around hub, which is self-lubricating. If oil drips, replace oil seal. Refer to paragraph 132. Check the front cover and side cover gaskets on the gear box. Tighten screws or replace gaskets, if necessary (8-in. screwdriver). Remove front gyro cover and check for oil leaks around tapered shaft bearing and washer (8-in. screwdriver). If leaks are found, replace oil seals. The motor-gear box must be removed from the vehicle and partially disassembled to replace oil seals. Refer to paragraph 132 for these operations.

(9) CHECK OIL LEVEL IN GEAR BOX (fig. 127).

BAR, ⅜-in. square
WRENCH, ⅜-in., box
OIL, engine, seasonal grade

Remove oil level plug (⅜-in. square bar and ⅜-in. box wrench). Keep oil up to the level of this plug. To fill, remove filler plug and add oil as necessary (OIL, engine, seasonal grade). Replace filler and oil level plugs.

(10) CHECK CLEANLINESS.

CLOTH, clean

Remove all excess grease on turret ring gear. Clean dirt and grease from all exposed parts. Moving parts not protected from dust should be wiped daily.

(11) CHECK MOUNTING BOLTS.

WRENCH, socket, ¾-in. with
8-in. extension

Check for tightness of mounting bolts of motor generator and traverse motor gear box and be sure they are kept tight.

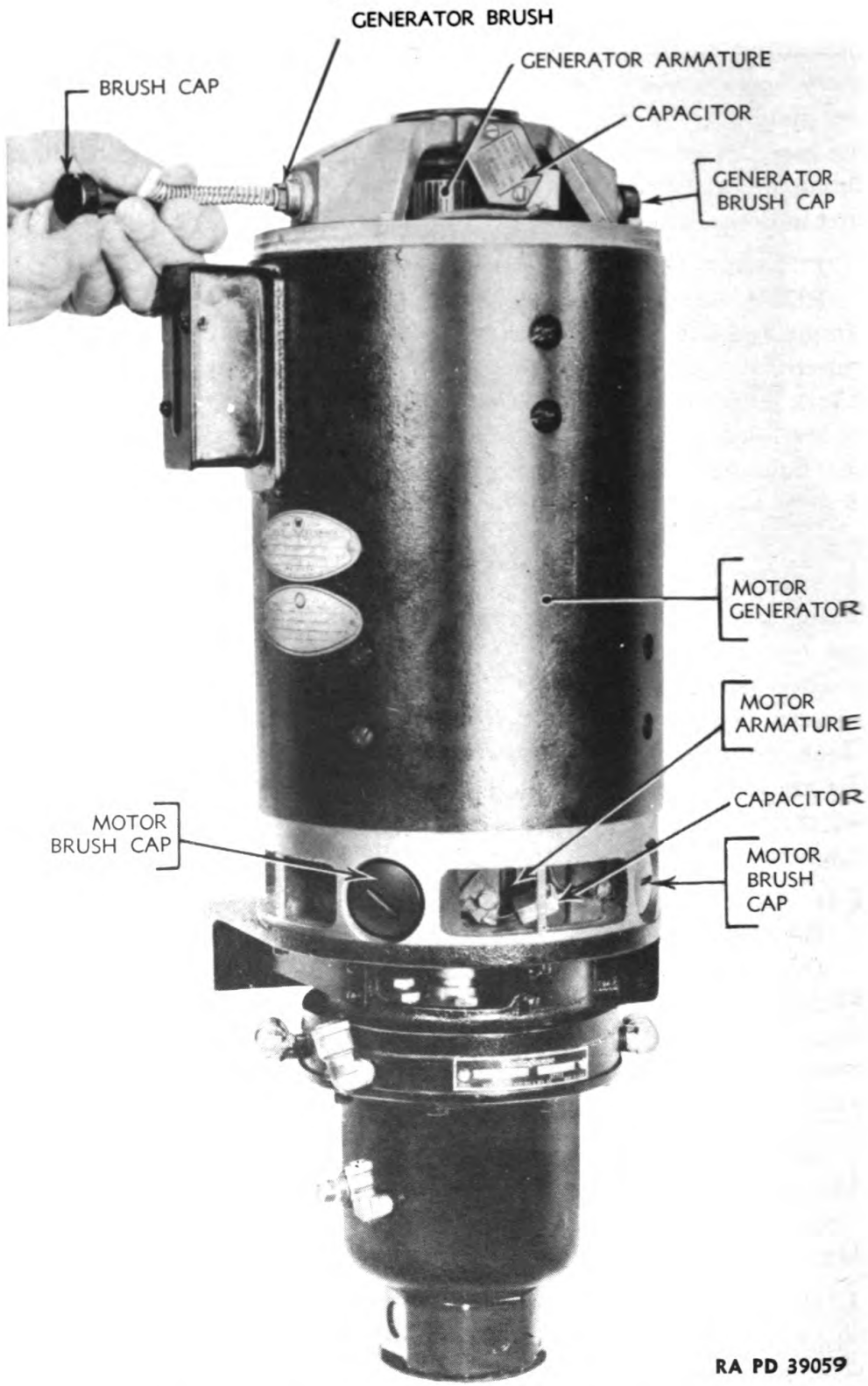


Figure 128 — Motor Generator and Oil Pump

ELECTRICAL TURRET TRAVERSING SYSTEM

127. TESTING, REMOVAL AND INSTALLATION OF MOTOR GENERATOR (fig. 128).

a. Testing. If all other checks have failed to locate the cause of faulty operation, check the motor generator as follows:

(1) Turn the turret switch off.

(2) Unsolder the wires A1 and A2 (fig. 137 or 138) in generator terminal box from the terminals with soldering iron.

(3) Check voltage output with voltmeter. Readings must be between 220 and 250 volts at full speed.

(4) If motor does not run or if voltage is not within the above limits, the unit must be replaced.

b. Removal from Vehicle.

COPPER, soldering
SCREWDRIVER, 6-in.
WRENCH, Allen, $\frac{3}{16}$-in.
WRENCH, box, $\frac{7}{16}$-in.
WRENCH, socket, $\frac{3}{4}$-in., with 8-in and 4-in extensions (2)
WRENCH, open-end, $\frac{15}{16}$-in.

Turn turret switch "OFF." Remove generator terminal box cover (6-in. screwdriver). Disconnect leads in generator terminal box (soldering copper). Remove motor terminal box cover (6-in. screwdriver). Disconnect 24 volt supply line ($\frac{15}{16}$-in. open-end wrench). Remove four screws ($\frac{3}{16}$-in. Allen or $\frac{7}{16}$-in. box wrench) holding stabilizer pump to motor. Do not disconnect stabilizer oil lines. Tie pump to side of basket to prevent damage to the oil lines. Hold motor generator in place and remove four mounting bolts ($\frac{3}{4}$-in. socket wrenches (2) with 8-in and 4-in extensions). This is a two-man operation. Lift motor generator out of vehicle, also a two-man operation.

c. Installation in the Vehicle.

COPPER, soldering
SCREWDRIVER, 6-in.
TAPE, friction
TAPE, rubber
WRENCH, Allen, $\frac{3}{16}$-in.
WRENCH, box, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{15}{16}$-in.
WRENCH, $\frac{3}{4}$-in. socket with 4-in. extension
WRENCH, $\frac{3}{4}$-in. socket with 8-in. extension

Place and hold the motor generator in position on the turrret wall with the generator on top. This is a two-man operation. Insert and tighten the four mounting bolts ($\frac{3}{4}$-in. socket wrenches (2) with 8-in. extension and with 4-in. extension). Connect the 24 volt supply line in motor terminal box ($\frac{15}{16}$-in. open-end wrench). Connect all wires in generator terminal box according to the wiring diagram with soldering copper (figs. 168 and

MEDIUM TANK M4A4

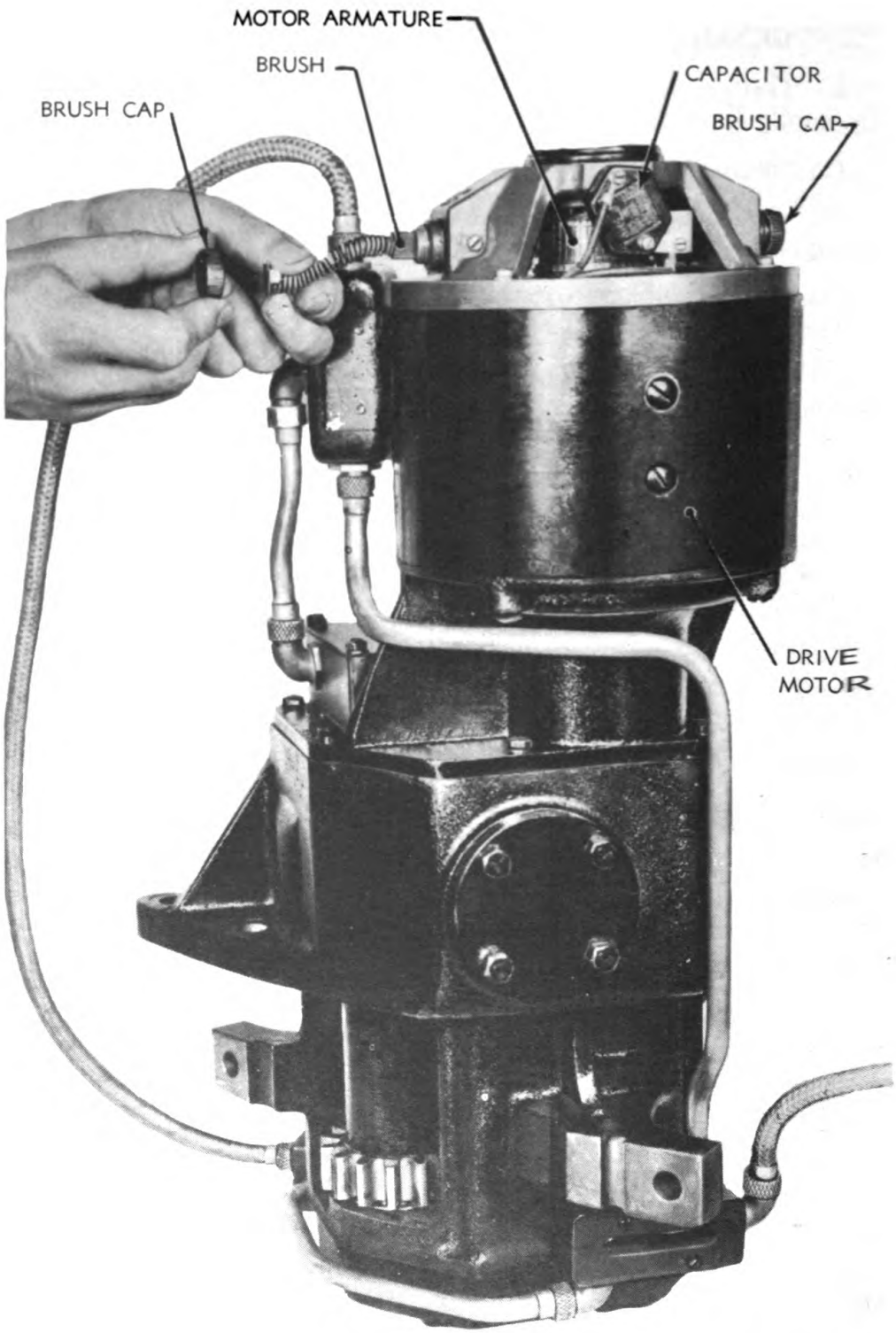


Figure 129 — Drive Motor Brush Replacement

169). Tape ends securely, first with rubber tape, then with friction tape. Replace terminal box covers (6-in. screwdriver). Install stabilizer oil pump with four screws ($\frac{3}{16}$-in. Allen or $\frac{3}{16}$-in. box wrench). Check the operation of the complete traverse (par. 126).

128. REPLACING MOTOR GENERATOR AND DRIVE MOTOR BRUSHES (figs. 128 and 129).

CLOTH, clean
SANDPAPER (No. 00 grade)
SCREWDRIVER, 8-in.

Turn turret and traverse switch to the "OFF" position. Check motor generator commutators for nicks, scores, and scratches. Clean generator armature with sandpaper (No. 00 grade) and a clean cloth. Remove brush caps with 8-in. screwdriver. Slide all motor and generator brushes in and out, to be sure they move freely and make contact with the commutators. Mark brushes so they can be replaced in the same holder and position. Remove brushes. Inspect for chips, breaks, and wear. New brushes are 1-in. long. Replace if more than half worn or if damaged in any way. Check the operation of the complete traverse (par. 126).

129. REMOVAL AND INSTALLATION OF DRIVE MOTOR OR GEAR BOX.

In event of failure of any parts of motor gear box which are not replaceable in the field, remove drive motor and gear box from the vehicle as a unit before removing the motor from the gear box. If drill for drilling dowel pin holes is available, either motor or gear box may be replaced separately. Otherwise motor and gear box must be replaced as a unit.

a. Removal of Motor Gear Box from Vehicle.

BAR, square, $\frac{3}{8}$-in.
COPPER, soldering
CONTAINER, oil, 2-qt.
PLIERS
SCREWDRIVER, 6-in.
WRENCH, box, $\frac{3}{8}$-in.
WRENCH, box, $\frac{7}{16}$-in.
WRENCH, socket, $\frac{3}{4}$-in. with 8-in. extension

(1) DRAIN OIL FROM GEAR BOX. IMPORTANT: The oil must always be drained before the gear box is removed from the vehicle. Otherwise the drive motor may be soaked with oil and seriously damaged.

BAR, square, $\frac{3}{8}$-in.
CONTAINER, oil, 2-qt.
WRENCH, box, $\frac{3}{8}$-in.

Turn turret switch to "OFF" position. Remove drain plug (fig. 124) and drain oil into suitable container which will hold at least two quarts. Replace drain plug.

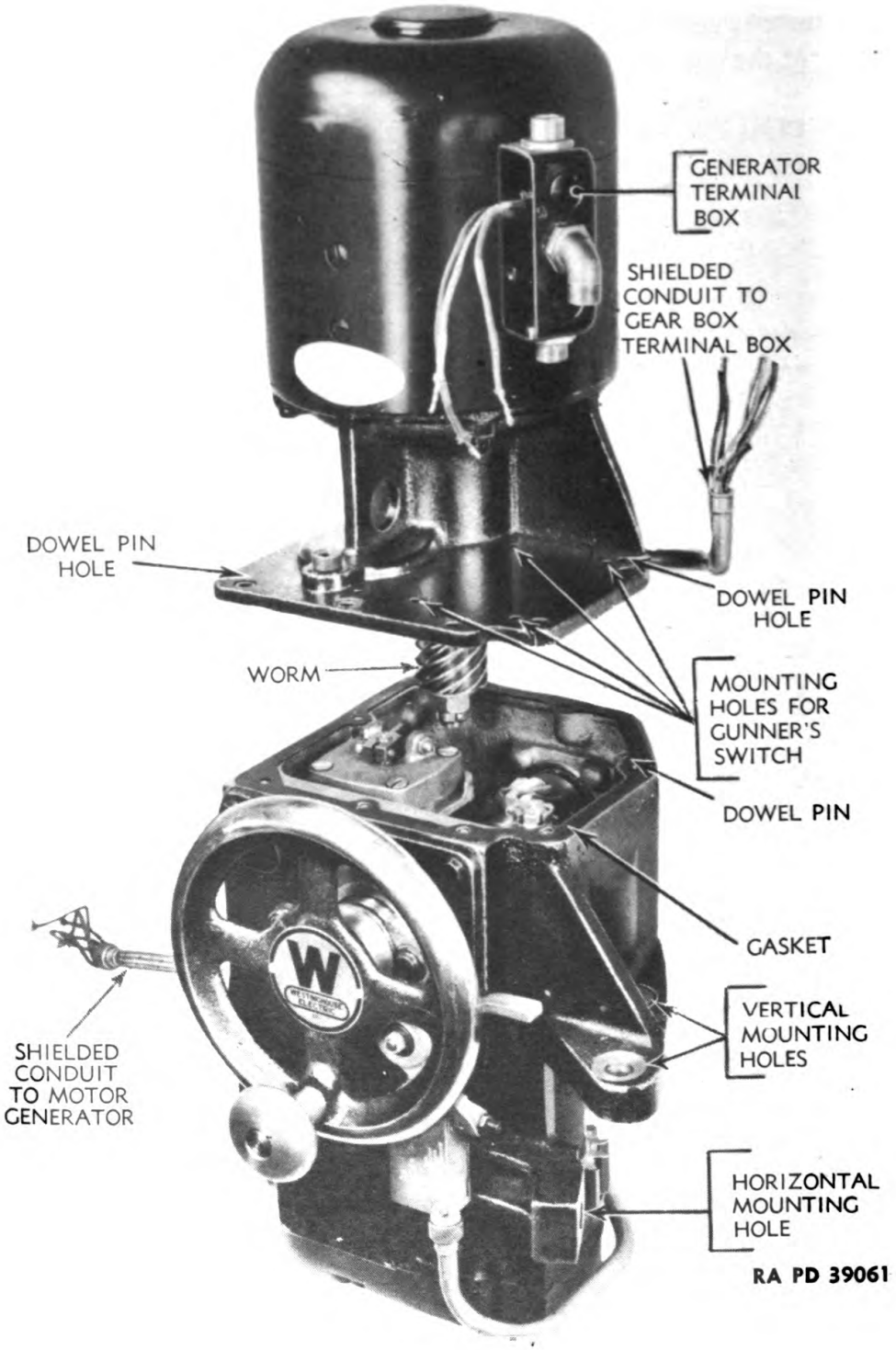


Figure 130 — Installation of Motor on Gear Box

(2) DISCONNECT WIRING (fig. 124).

COPPER, soldering
PLIERS
SCREWDRIVER, 6-in.

Remove three ferrule nuts on drive motor terminal box (pliers). Remove drive motor terminal box cover (6-in. screwdriver) and disconnect all wires (soldering copper). Remove cover from generator terminal box with 6-in. screwdriver and disconnect all wires (soldering copper). Remove ferrule nut on generator terminal box (pliers). Shielded cable from generator to gear box is removed with the motor gear box.

(3) REMOVE MOUNTING BOLTS.

WRENCH, socket, 3/4-in. with 8-in. extension

Loosen and remove horizontal mounting bolts (3/4-in. socket wrench with 8-in. extension), shims, and key while holding motor gear box in place by hand. Since the motor gear box weighs approximately 185 lbs., this is a two-man operation. Remove two vertical bolts (3/4-in. socket wrench with 8-in. extension). Lift unit carefully from vehicle. Remove 1/4-in. spacer washers from turret shelf.

(4) REMOVE DRIVE MOTOR FROM GEAR BOX (fig. 130).

PLIERS
WRENCH, 7/16-in., box

Remove eight mounting bolts (7/16-in. box wrench) and lift motor from gear box. Pull two dowel pins from gear box on motor (pliers).

b. Installation of Motor Gear Box in Vehicles.

BAR, square, 3/8-in.
CHISEL, cold
DRILL, D size (0.246-in. D.)
HAMMER
MALLET, rawhide
OIL, engine, seasonal grade (two quarts)
PLIERS
PUNCH, center
SCREWDRIVER, 8-in.
WRENCH, box, 3/8-in.
WRENCH, box, 7/16-in.
WRENCH, socket, 3/8-in., with 8-in. extension

(1) INSTALL MOTOR WORM.

MALLET, rawhide

Fit spacer and key on motor drive shaft. Fit worm on key and tap into place on shaft (rawhide mallet).

(2) INSTALL MOTOR TENTATIVELY (fig. 130).

Place gasket on gear box and line up holes in gasket with holes in gear box. A little grease between gasket and gear box housing will hold gasket in place. Carefully place motor in position on gear box. Insert mounting bolts finger tight.

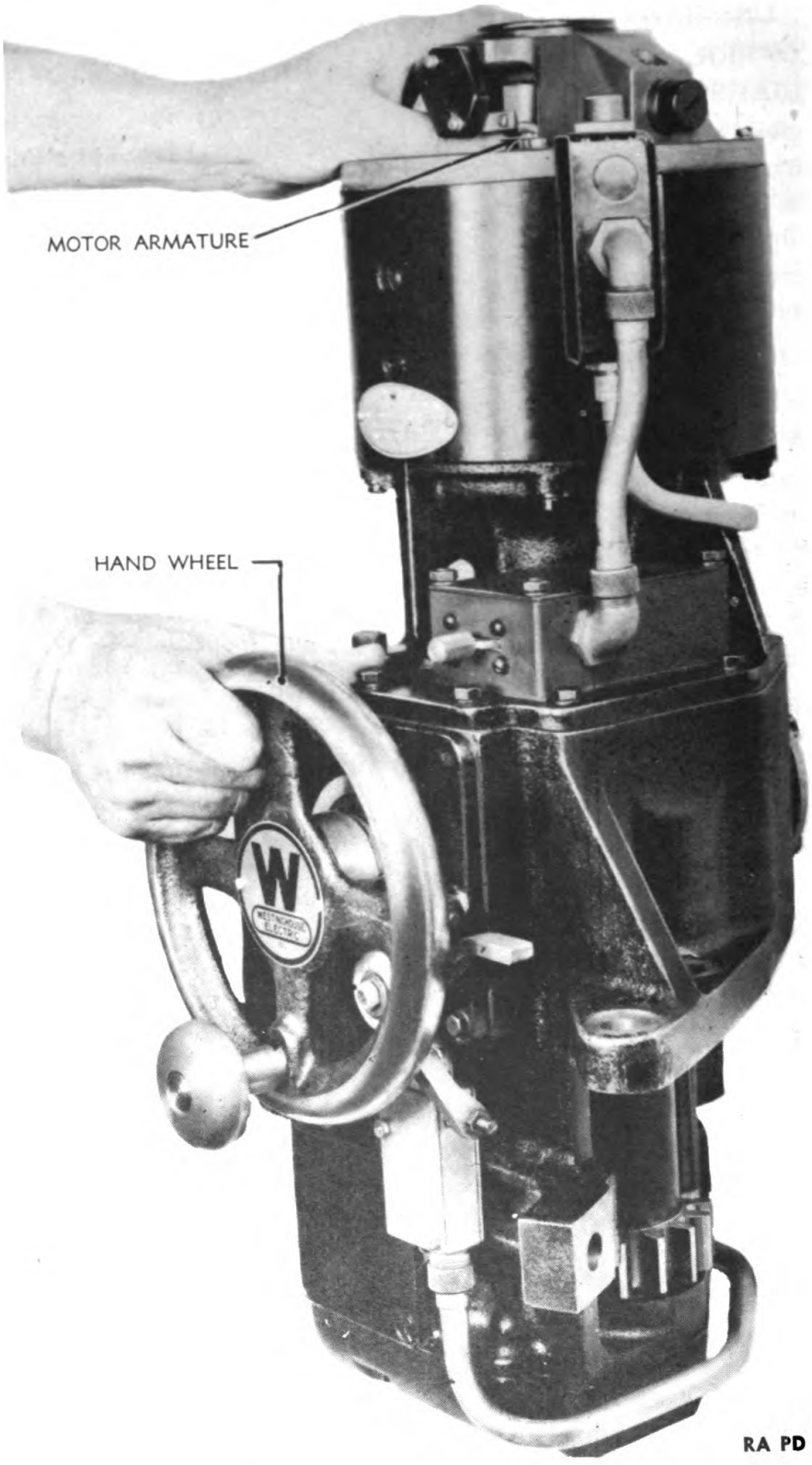


Figure 131 — Checking Backlash

ELECTRICAL TURRET TRAVERSING SYSTEM

(3) CHECK BACKLASH (fig. 131).

SCREWDRIVER, 6-in.

Remove motor brush cover. Check backlash between motor drive worm and shaft worm gear by holding handwheel with one hand and turning motor armature with the other. Move the wheel in steps of approximately 1-in. and recheck at each new position until the handwheel has made one complete revolution. Maximum allowable backlash is $\frac{1}{32}$-in. as measured at the circumference of the commutator. There must be no binding at any point. Shift the position of the motor until the backlash comes within the above limits. Check freedom of motor drive gear and worm shaft by rotating handwheel in manual operation. If binding exists, loosen mounting bolts and readjust.

(4) INSTALL DOWEL PINS.

CHISEL, cold
DRILL, D size
HAMMER
PUNCH, center

If the old dowel pin holes do not line up, remove drive motor. Pound the old dowel pins into the housing hole and cut them off flush with a chisel. Recheck backlash (see previous step). Start dowel pin holes with center punch. Drill new holes $\frac{3}{8}$-in. deep using holes in motor mounting bracket as a guide. Drive in two dowel pins (hammer). If new pins are required, use $\frac{5}{8}$-in. long by $\frac{1}{4}$-in. D. pins.

(5) INSTALL MOTOR GEAR BOX IN VEHICLE.

Place $\frac{1}{4}$-in. spacer washers over vertical mounting holes on turret ledge. Place key in keyway on turret ring shelf. Place motor gear box in position on turret ledge. This is a two-man operation. Fit keyway on mounting backet into place on key. Turn handwheel until proper mesh is obtained between traverse drive gear and turret ring gear. Insert vertical bolts and tighten finger tight.

(6) ADJUST DRIVE GEAR AND TURRET RING GEAR MESH (fig. 125).

WRENCH, socket, $\frac{3}{8}$-in. with
8-in. extension

Install 0.032 in. shim on each horizontal bolt and tighten bolts. Check mesh of traverse drive gear and turret ring gear for backlash and binding while making one complete revolution of turret with handwheel. There must be no binding and no noticeable backlash. The minimum clearance between drive gear and ring gear at the tightest point on the ring gear is 0.002 inch. Correct shims by trial and error until desired adjustment is secured, then tighten vertical bolts permanently ($\frac{3}{4}$-in. socket wrench and 8-in. extension).

(7) CONNECT WIRING (figs. 137, 138, 139 and 140).

COPPER, soldering
PLIERS
SCREWDRIVER, 6-in.
TAPE, friction
TAPE, rubber

Reconnect wiring at drive motor and generator terminal boxes. Solder connections securely, cut off excessive ends, and tape, first with rubber tape, then with friction tape. Replace ferrule nuts and terminal box covers.

(8) FILL GEAR BOX WITH OIL.

BAR, $\frac{3}{8}$-in. square
OIL, engine, seasonal grade
WRENCH, box, $\frac{3}{8}$-in.

Remove oil filler and oil level plugs ($\frac{3}{8}$-in. square bar and $\frac{3}{8}$-in. box wrench). Pour in OIL, engine, seasonal grade, until oil reaches level of oil check plug. Replace plugs.

(9) CHECK THE OPERATION OF THE COMPLETE TRAVERSE (par. 126).

130. REMOVAL AND INSTALLATION OF SILVERSTAT CONTROL (fig. 126).

a. Handle the silverstat control carefully and keep it clean at all times. If the control becomes defective, replace the complete unit. Repairs cannot be made on it.

b. Remove Silverstat Control.

WRENCH, Allen, $\frac{3}{16}$-in.

Remove six bottom cover mounting screws. Remove bottom cover and gasket. Remove three silverstat control Allen mounting screws. Remove silverstat control. IMPORTANT: Handle the silverstat control with care and keep it clean at all times. It is replaceable as a complete assembly only.

c. Install Silverstat Control.

FILE
FLASHLIGHT
GLASS, magnifying, 5 power
WRENCH, Allen, $\frac{3}{8}$-in.

Set spacer parallel to handwheel side of gear box by turning worm shaft. Feed silverstat control leads into terminal box while placing silverstat control into position. The leads cannot be inserted after control has been placed in position. Slide insulated buttons over spacer as silverstat control nears its final position. Place lock washers and mounting bolts in position and tighten bolts finger tight. Mounting holes in silverstat cradle are over-size. Using five power magnifying glass and flashlight, shift cradle until spacer centers with no leaves closed. File posts on insulated buttons,

if necessary, but be sure not to file posts any more than necessary to open closed contacts. Posts should touch one leaf on each side but not close any leaves with spacer in neutral. Tighten mounting screws (3/8-in. Allen wrench).

131. REMOVAL AND INSTALLATION OF HANDWHEEL (figs. 132 and 133).

a. Remove Handwheel (Westinghouse traverse style #1231700).

SCREWDRIVER,4-in. SCREWDRIVER, 8-in.

Early models were equipped with a metal handwheel, later models have a plastic handwheel with fold-away handle. The procedure for

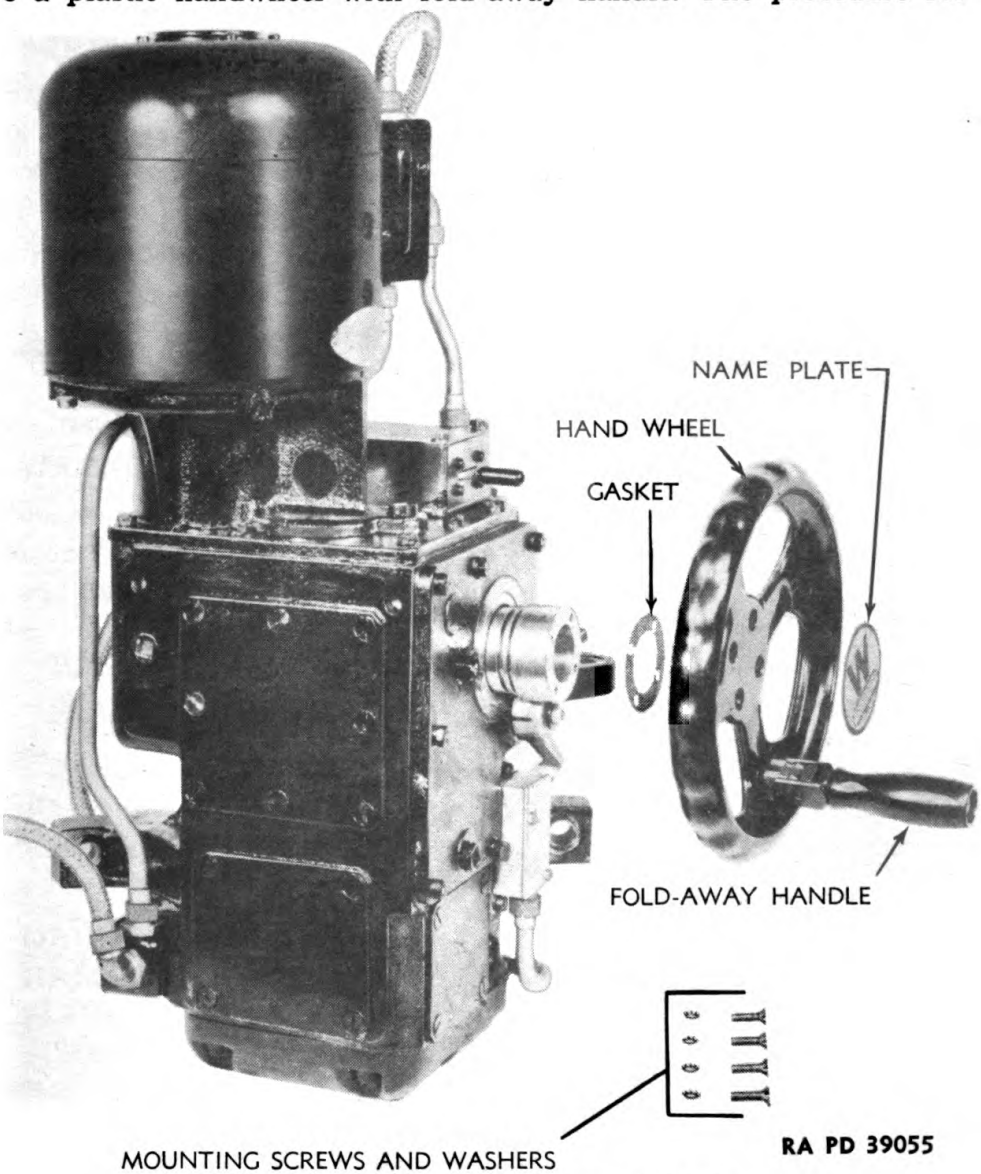
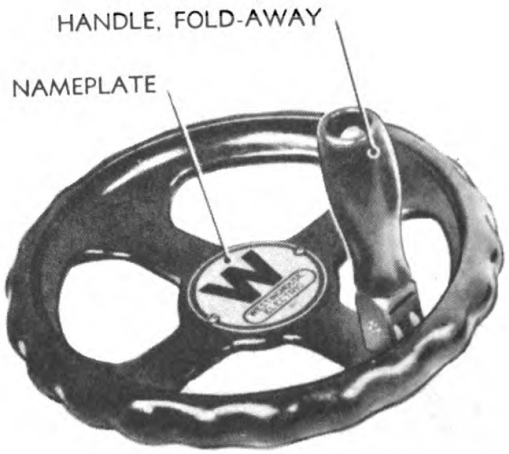


Figure 132 — Removal of Handwheel



HANDWHEEL, PLASTIC, WITH
DETACHABLE HUB
STYLE 1231700

HANDWHEEL, PLASTIC, WITH
ATTACHED HUB
STYLE 1234375

STYLE 1231700

RA PD 39102

Figure 133 – Three Types of Handwheels

removing both is the same. Remove screws and name plate on handwheel with 4-in. screwdriver. Remove four mounting screws, wheel, and gasket (8-in. screwdriver).

b. Remove Handwheel (Westinghouse traverse style #1234375).

WRENCH, box, 3/4-in.

This procedure is the same as that outlined above except the handwheel is attached by an elastic stop nut (3/4-in. box wrench) and there is no name plate.

c. Install Handwheel (Westinghouse traverse style #1231700).

HAMMER
PUNCH, center
SCREWDRIVER, 4-in.
SCREWDRIVER, 8-in.
WRENCH, open-end, 7/16-in.

Install wheel on hub with four mounting screws (8-in. screwdriver). Stake screws (center punch and hammer). Install name plate with two screws (4-in. screwdriver). Adjust lock lever disengaging arm adjusting screw so the plunger of the disengaging switch will protrude not more than 1/16-in. in manual operation (4-in. screwdriver and 7/16-in. open-end wrench). In electrical operation the adjusting screw must not touch the switch plunger. Adjust the lock arm adjusting screw so the lock arm will clear the hub when changing from one type of operation to the other.

d. Install Handwheel (Westinghouse traverse style #1234375).

WRENCH, socket, 3/4-in.

This procedure is the same as outlined in the preceding step except the handwheel slips over the short shaft and is fastened with one elastic stop nut, and there is no name plate.

132. REMOVAL AND INSTALLATION OF FRONT COVER, OIL SEAL, HANDWHEEL HUB, IDLER GEAR, OR LOCK LEVER.

a. Remove and Disassemble Front Cover with Detachable Hub (Westinghouse style #1231700) (figs. 134 and 135). IMPORTANT: Do not disassemble unless necessary. This complete assembly is interchangeable.

DRIFT, soft metal
HAMMER, light
PLIERS
SCREWDRIVER, 4-in.
SCREWDRIVER, 6-in.
WRENCH, box, 1/2-in.
WRENCH, box, 9/16-in.
WRENCH, open-end, 7/16-in.

Remove oil drain plug and drain oil into a clean container. Reinstall oil drain plug. Remove seven mounting bolts and lock washers with 7/16-inch open-end wrench. Remove front cover. If necessary to disassemble

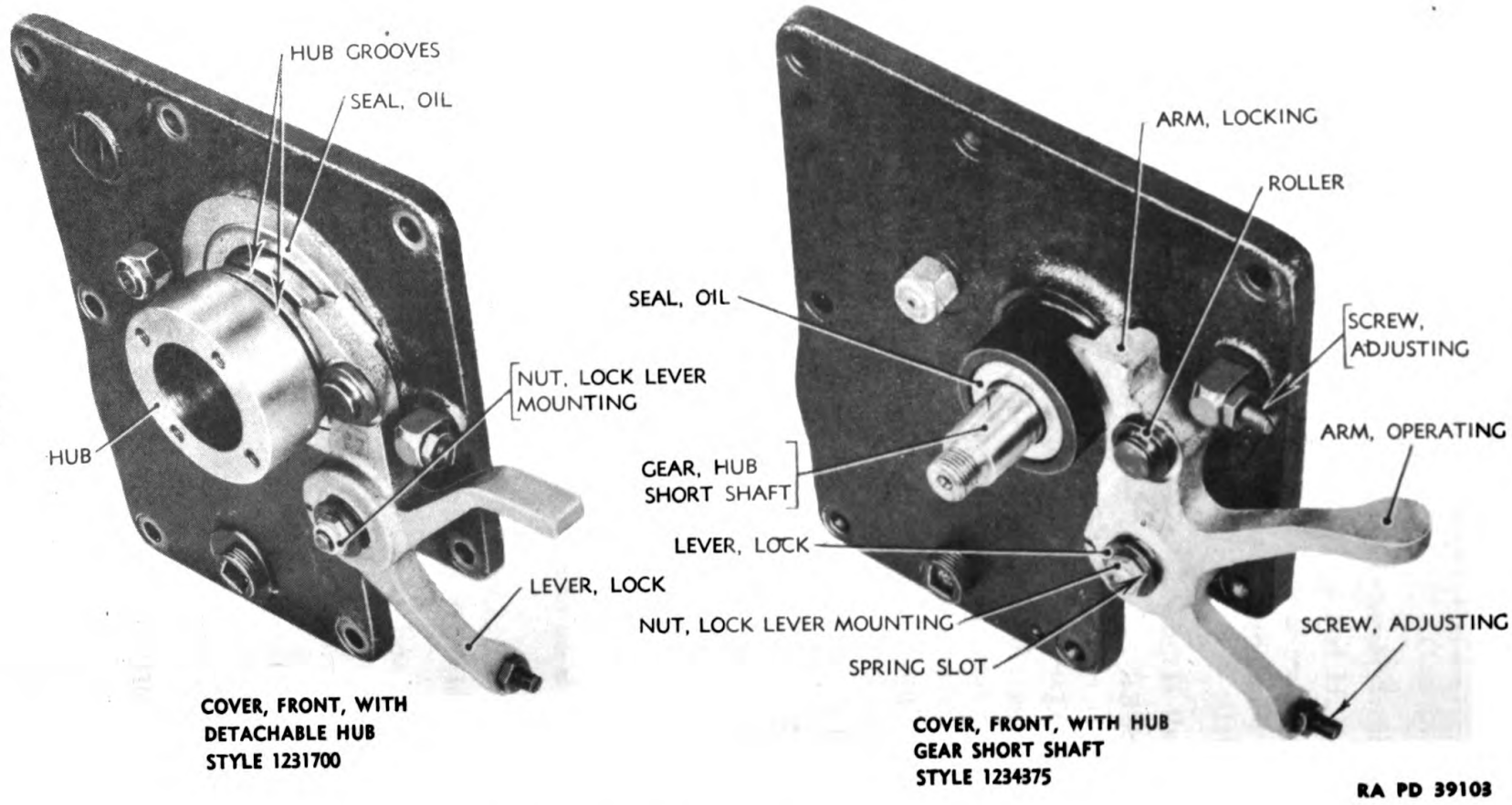


Figure 134 — Two Types of Front Cover (Front)

ELECTRICAL TURRET TRAVERSING SYSTEM

front cover proceed as follows: Remove lock lever mounting bolt nut, washer, and spacer (½-in. box wrench). Remove lock lever, spring, and spacer. Remove lock wire on hub gear mounting screws (pliers). Remove hub gear mounting screws (4-in. screwdriver). Remove hub gear and hub. Remove four screws from oil seal retainer (6-in. screwdriver). Remove retainer. Remove oil seal with soft metal drift and light hammer. Hold idler gear with screwdriver and remove nut ($\frac{9}{16}$-in. box wrench). Remove mounting bolt and idler gear.

b. Remove and Disassemble Front Cover with Hub Attached to Handwheel (Westinghouse style #1234375) (figs. 134 and 135).

This procedure is the same as that described in the preceding step except that the hub gear is a part of the short shaft and is free to be removed as soon as the handwheel and front cover are removed, and there is no oil seal retainer.

c. Assemble Front Cover with Detachable Hub (Westinghouse style #1231700) (figs. 134 and 135).

HAMMER	SCREWDRIVER, 4-in.
MALLET, rawhide	SCREWDRIVER, 6-in.
PLIERS	WRENCH, box, ½-in.
PUNCH, center	WRENCH, box, $\frac{9}{16}$-in.

Tap oil seal into position with rawhide mallet. Install idler gear, rounded tooth side away from cover (6-in. screwdriver and $\frac{9}{16}$-in. box wrench). Assemble lock lever. Place spring in recess on lever with straight end in lever slot and bent end in small hole near mounting stud. Install bolt, add spacer and washer, and tighten elastic stop nut (½-in. box wrench). Install oil seal retainer plate (6-in. screwdriver) and stake screws (center punch and hammer). Hold down lock lever and insert hub through hole in front cover with grooves on lever side. Place hub gear on hub with rounded teeth side next to cover. These rounded teeth facilitate meshing with the idler gear. Insert screws and tighten (4-in. screwdriver). Lock screws with locking wire (pliers). Be sure hub turns freely.

d. Install Front Cover with Detachable Hub (style #1234375) (fig. 127).

CHISEL, cold	PUNCH, center
DRILL, D size (0.246 in. D.)	WRENCH, box, $\frac{7}{16}$-in.
HAMMER	

Position front cover in oversize mounting holes so there is no binding between idler gear and flange spur gear. Turn hub to check. Screw in seven mounting bolts finger tight. If the original dowel pin holes do not

ELECTRICAL TURRET TRAVERSING SYSTEM

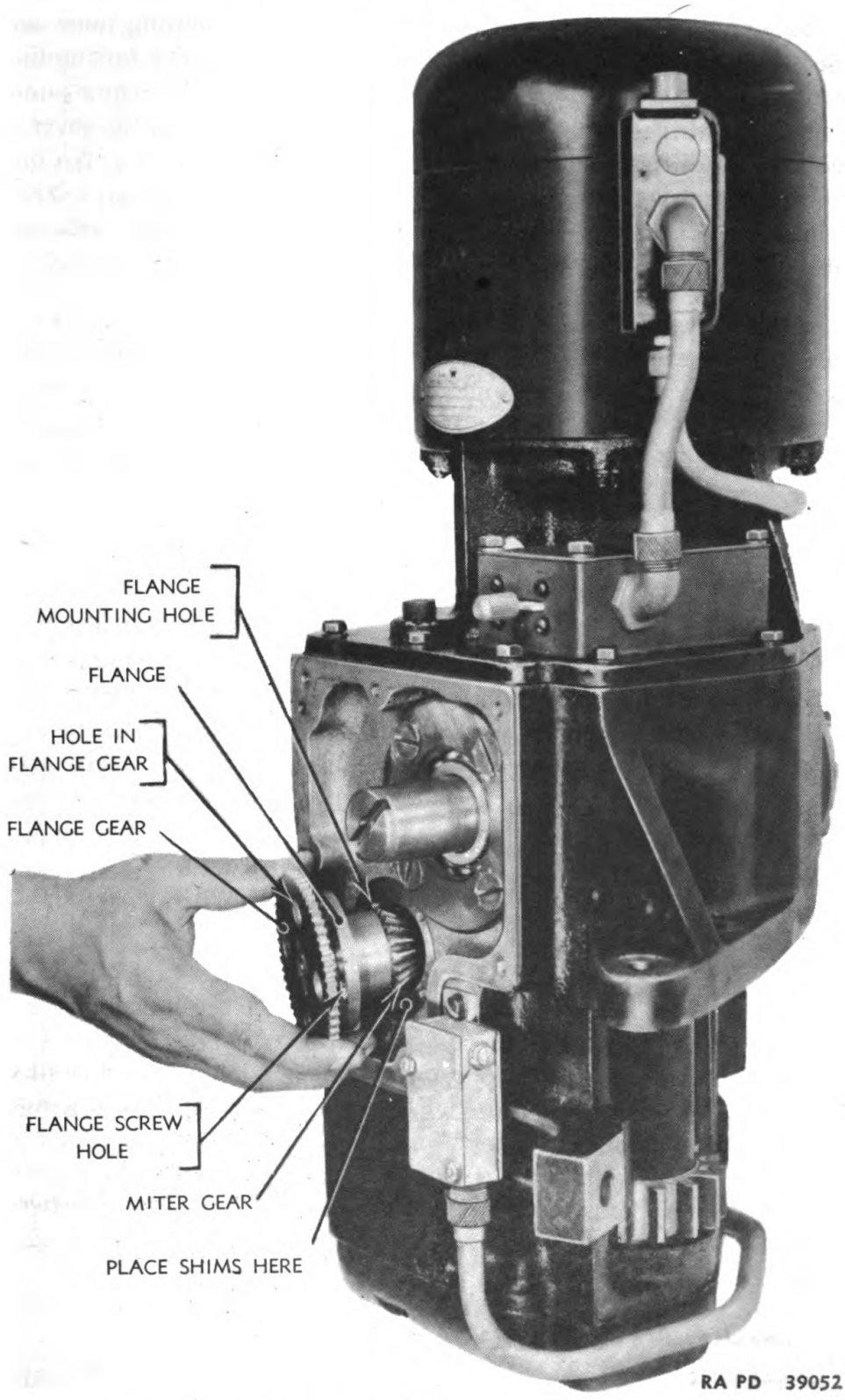


Figure 136 — Installing Flange and Gear Assembly

line up, remove front cover. Pound dowel pins into housing holes and cut them off with a chisel. Replace front cover and recheck for binding. When cover is properly adjusted start dowel pin holes with center punch and hammer. Drill new holes 3/8-inch deep using holes in front cover as a guide. If hub turns tight, put one drop of oil on oil seal. Tighten four front cover corner mounting bolts (7/16-in. box wrench). Tighten remaining three front cover mounting bolts. Recheck mesh of idler gear and flange spur gear to be sure tightening front cover did not make gears bind. Install 5/8-in. long by 1/4-in. D. dowel pins.

e. Assemble and Install Front Cover (with hub gear short shaft).

The procedure for assembly and installation is the same as that for models with detachable hub except as follows: The hub gear is attached to a short shaft on which the handwheel mounts. There is no oil seal retainer.

f. Install Side Cover and Gyro Side and Front Covers.

SCREWDRIVER, 8-in. WRENCH, crescent, 8-in.

Put gasket on cover. Stick gasket to cover with small spot of grease. Place countersinks of holes out. Put lock washers on screws, and screw cover to housing. Tighten screws firmly by turning screwdriver with 8-inch crescent wrench, or equivalent. Repeat above operation for gyro front and side covers. Remove oil filler and check plugs. Refill with OIL, engine, seasonal grade, until oil reaches level of oil check plug. Reinstall oil filler and check plugs.

133. REMOVAL AND INSTALLATION OF FLANGE AND GEAR ASSEMBLY (fig. 136).

a. Remove Gears and Flange.

SCREWDRIVER, 8-in. WRENCH, box, 7/16-in.

Remove oil drain plug and drain oil into clean container. Reinstall oil drain plug. Turn turret switch to "OFF" position. Remove seven mounting cap screws (7/16-in. box wrench) and front cover assembly. Line up holes in flange spur gear with screws in flange and remove four screws (8-in. screwdriver). Remove gears and flanges and shims, if any, between flange and gear box housing. Save and protect shims if parts are to be replaced.

b. Install Gears and Flange.

HAMMER SCREWDRIVER, 8-in.
PUNCH, center WRENCH, box, 7/16-in.

Check to be sure flange rotates freely on differential bevel gear shaft.

ELECTRICAL TURRET TRAVERSING SYSTEM

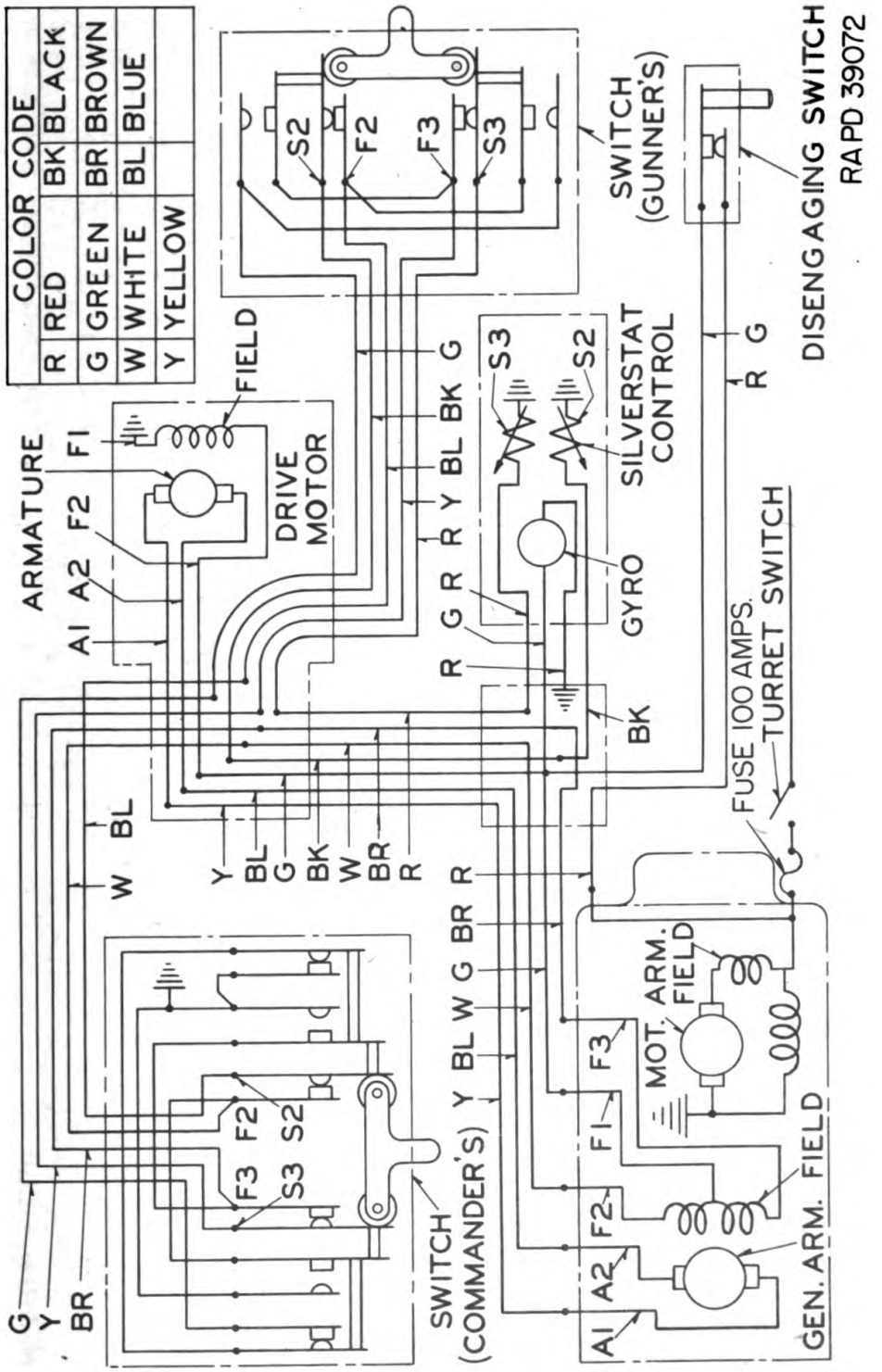


Figure 137 — Wiring Diagram for Traverse Style 1231700

MEDIUM TANK M4A4

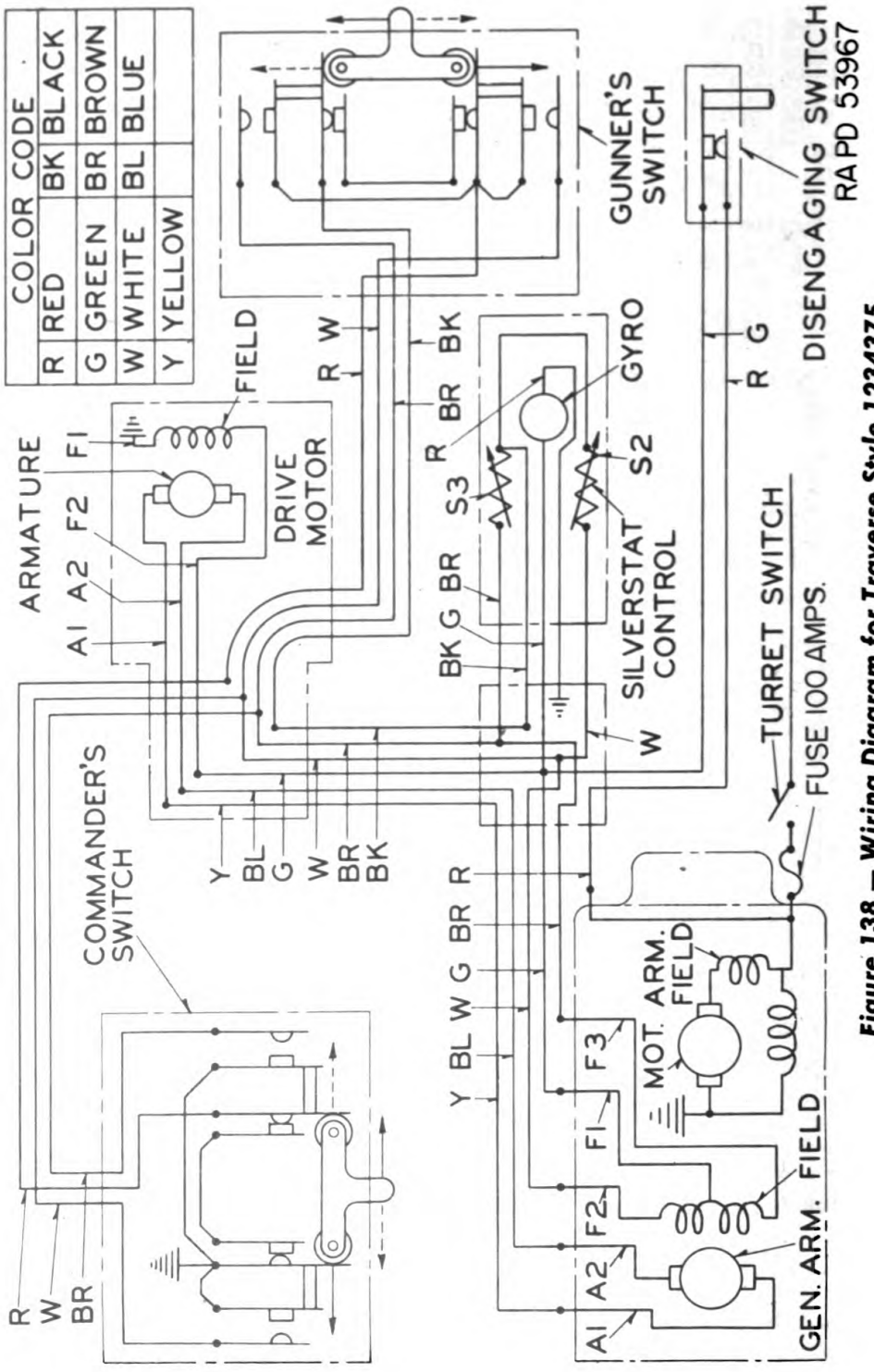


Figure 138 — Wiring Diagram for Traverse Style 1234375

If flange does not rotate freely and without looseness, replace it. Install assembly in housing (push fit) so flange is flush against housing. Check for backlash between differential bevel gear and flange bevel gear by holding one and rotating the other slightly. If tight, add 0.005-in. shims until slight backlash is obtained. Line up holes in flange straight gear, flange, and gear box. Insert four screws and tighten (8-in. screwdriver). Stake screws (hammer and center punch). Reinstall front cover assembly ($\frac{7}{16}$-in. box wrench). Remove oil filler and check plugs. Refill with OIL, engine, seasonal grade, until oil reaches level of oil check plug. Reinstall oil filler and check plugs.

134. REPLACING COMMANDER'S SWITCH (figs. 137 and 138).

a. Turn turret switch to "OFF" position.

b. Remove screws from cover of drive motor terminal box and remove cover.

c. Disconnect wires from commander's switch conduit.

d. Remove shielded conduit ferrule nut.

e. Remove mounting bolts and commander's switch. The switch and attached shielded conduit are replaceable as a unit.

f. To install replacement switch, reverse the above procedure. Follow wiring diagram and wiring chart for electrical connections.

g. Check operation of switch and complete traverse.

135. REPLACING GUNNER'S SWITCH (figs. 137, 138, 139 and 140).

a. Turn turret switch to "OFF" position.

b. Disconnect steel tube ferrule nut at drive motor terminal box.

c. Remove cover of terminal box and disconnect wires to switch.

d. Remove 4 mounting bolts in cover of gunner's switch and remove switch and steel conduit tubing as a unit.

e. Remove spacer washers between switch and gear box.

f. To install replacement unit, reverse the removal procedure. Follow wiring diagram and wiring chart for electrical connections.

g. Check operation of switch and complete traverse.

136. REPLACING WIRING (figs. 137, 138, 139 and 140).

a. The wiring and shielded conduit attached to the gunner's and commander's switches are replaceable as a unit with the switches. The wiring and steel tubing running from the traverse drive motor terminal box and

MEDIUM TANK M4A4

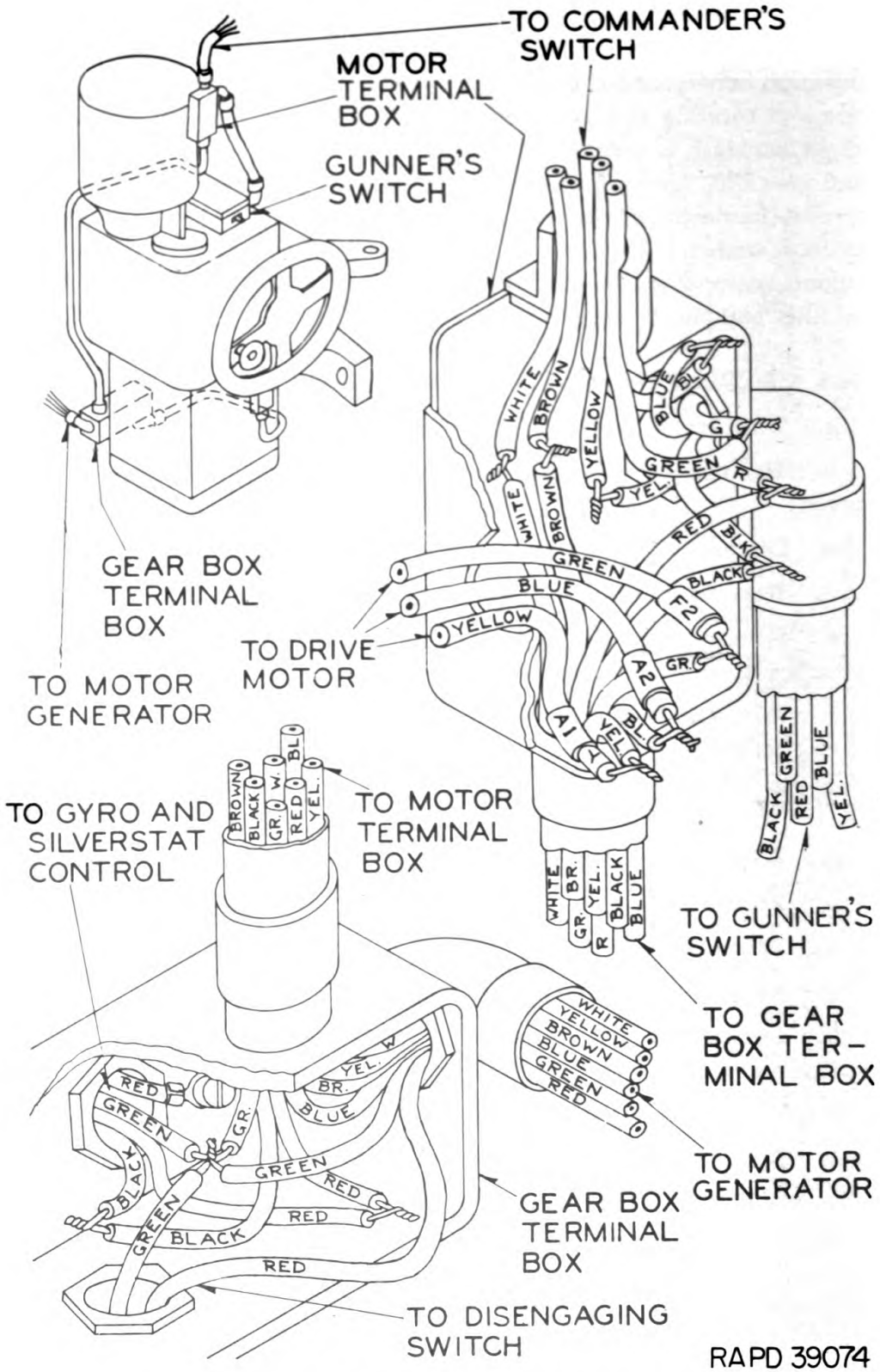


Figure 139 — Wiring Chart for Traverse Style 1231700

ELECTRICAL TURRET TRAVERSING SYSTEM

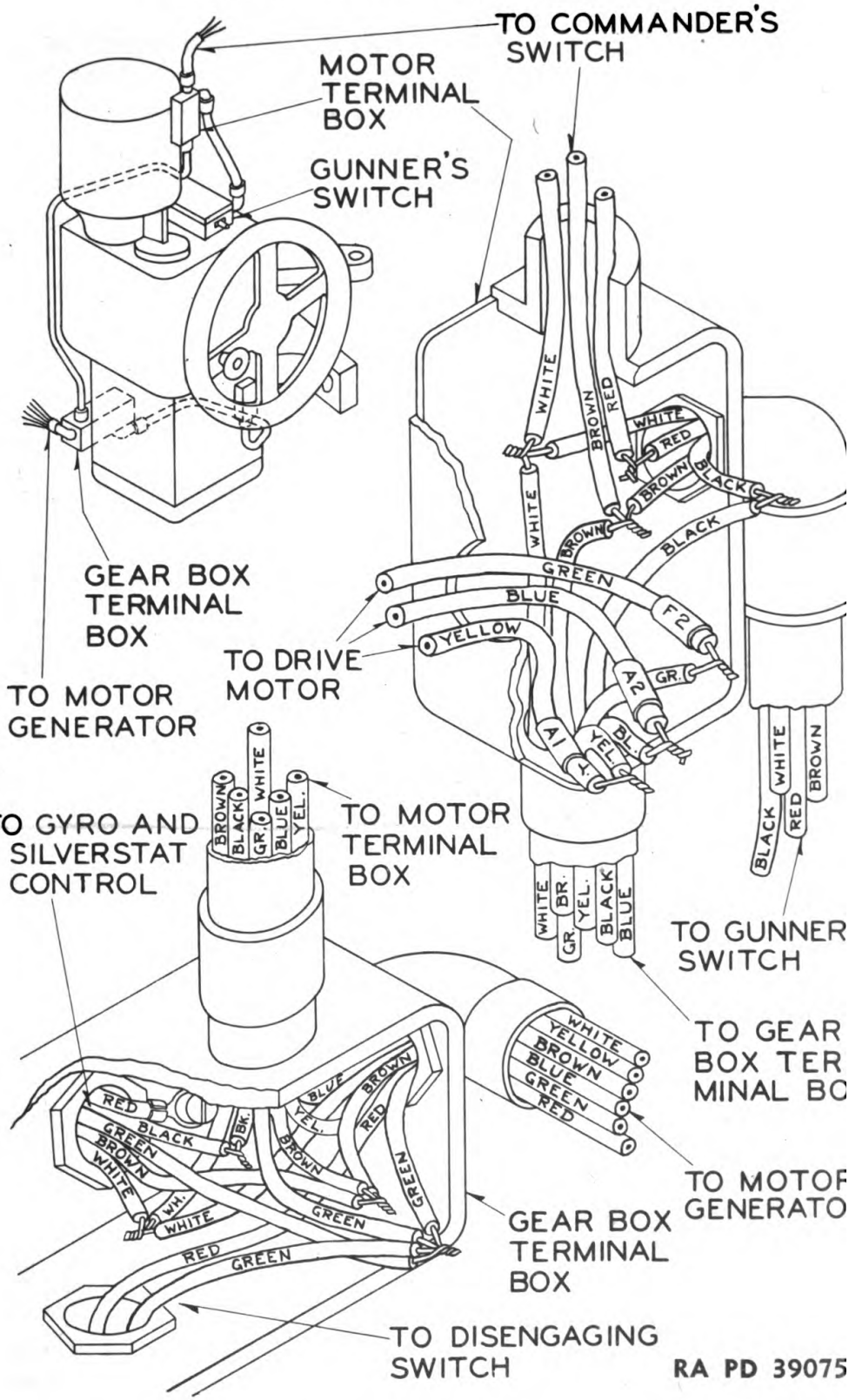


Figure 140 — Wiring Chart for Traverse Style 1234375

the gear box terminal box are replaceable as a unit. For all wiring connections see wiring diagram. For pictorial view of connections in the drive motor and gear box terminal boxes, see the wiring chart.

b. The shielded conduit between motor generator and gear box terminal boxes, and between commander's switch and traverse motor terminal box is flexible; all other conduit is rigid.

c. To replace wiring and shielded conduit.

(1) Remove ferrule nut at both ends of flexible or steel conduit terminal boxes.

(2) Remove terminal box covers.

(3) Disconnect both ends of damaged wire.

(4) Bare one end of replacement wire of its insulation and splice it to the wire which is to be replaced.

(5) Pull out faulty wire from conduit which automatically threads it with the new wire at the same time.

(6) Disconnect new wire from old.

(7) Cut new wire to proper length.

(8) Connect new wire to proper places in terminal boxes.

(9) Reinstall terminal box covers and ferrule nuts.

d. To Replace Damaged Conduit.

(1) Remove ferrule nuts from terminal boxes at both ends of conduit.

(2) Remove covers from terminal boxes.

(3) Disconnect wires of cable in both terminal boxes and remove conduit from unit.

(4) Replace new conduit in the reverse order of removal.

(5) Reinstall and reconnect wires (figs. 137, 138, 139, 140).

(6) Check the operation of the complete traverse.

137. REPLACING DISENGAGING SWITCH (fig. 124).

a. Removing Switch.

(1) Turn turret switch to "OFF" position.

(2) Remove switch cover and disconnect wires.

(3) Unscrew ferrule nut from switch.

(4) Remove mounting screws and switch.

b. Installing Replacement Switch.

(1) To install replacement unit reverse removal procedure.

(2) Adjust lock lever stop so lock lever flange will just clear handwheel hub flanges when lever is depressed.

(3) Adjust disengaging switch adjusting screw so plunger will be all the way out in power operation and not protrude more than $\frac{1}{16}$-in. in manual operation.

(4) Check the operation of the complete traverse.

Section XXIV

STABILIZER

138. TROUBLE SHOOTING.

a. If the gun does not fluctuate to any appreciable extent above or below the horizon, the stabilizer is operating satisfactorily. If the gun does not operate satisfactorily, proceed as follows:

(1) Check the oil level in the oil reservoir, which should be at least two-thirds full at all times.

(2) Check for air in the oil system.

(3) Check the tank voltage which must be maintained between 24 and 28 volts.

(4) Check for excessive friction in the gun mounting and unbalance in the gun.

(5) Check the external electrical connections for looseness or broken wires. Resolder loose connections and replace defective wiring.

(6) Check for lost motion between the gyro control and the hand-wheel. If necessary, adjust gear box (par. 146).

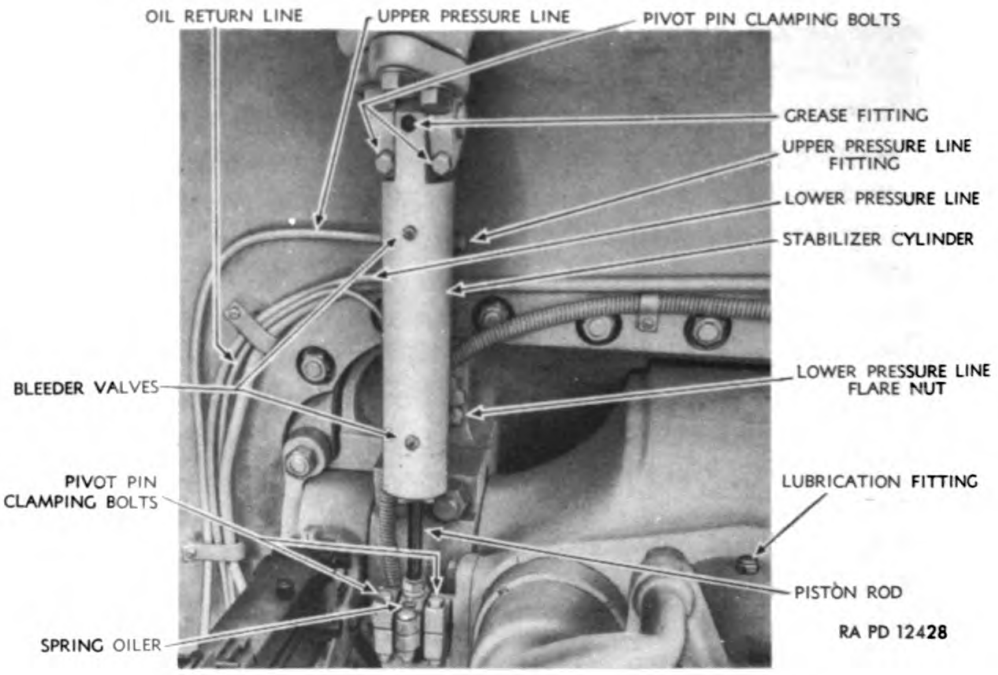


Figure 141 — Stabilizer Piston and Cylinder

(7) Check for loose mounting between gyro control, mounting bracket, and gun. Tighten all mounting bolts and screws.

(8) Check for excess looseness in the cylinder pivot pins and tighten if necessary.

(9) Check lubrication and, if necessary, add grease to the fittings on the stabilizer equipment and the turret assembly.

(10) If there is excessive oil leakage around the piston rod, replace piston and cylinder.

(11) Check the location and operation of the disengaging and recoil switches.

(12) Check clutch and replace parts, if necessary.

b. NOTE: One of the most common causes of unsatisfactory operation is the condition commonly called "hunting". This may be vigorous vibration of the gun or a slow movement up and down. Many of the above mentioned conditions will cause "hunting", the most common ones being air in the oil system, looseness in cylinder pivots, loose gyro control mounting, lost motion in gear box worm or worm bracket, excess friction in trunnion bearings, and high voltage.

c. If the trouble has not been corrected after the above checks, replace the various components in the following order, until the source of trouble is found: Gyro control, oil pump, piston and cylinder, recoil switch, disengaging switch, control box, and pump motor.

STABILIZER

139. CHARGING WITH OIL.

a. When charging the system with oil, it is very important for proper operation of the stabilizer that all air trapped in the system be removed. The following procedure, therefore, must be adhered to:

b. Equipment.

CAN, oil, pump type
OIL, hydraulic
WRENCH, box, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{5}{16}$-in.
WRENCH, open-end, $\frac{3}{8}$-in.
WRENCH, open-end, $\frac{3}{4}$-in.
WRENCH, open-end, $\frac{7}{8}$-in.

c. Procedure.

(1) Throw oil pump switch to "OFF" position.

(2) Use OIL, hydraulic (Univis No. 47, Gov't Spec. 2-79-A).

(3) Heat oil to 150 F. to 200 F. if possible.

(4) Oil may be poured directly into the reservoir or pumped in with pump type oil can by removing the filler plug, or it may be added under a small amount of pressure. To get this pressure, proceed as follows:

(a) Provide a filler can with three ft. feed line, shut-off valve at reservoir connection end, and $\frac{3}{8}$-in. union below shut-off valve.

(b) Remove oil supply line from reservoir ($\frac{7}{8}$-in. open-end wrench).

(c) Connect filler can feed line to oil reservoir line.

(5) Make certain that the turret switch is in the "OFF" position.

(6) Loosen the oil return line ($\frac{3}{4}$-in. open-end wrench), remove small hexagon plugs ($\frac{5}{16}$-in. open-end wrench) and loosen two bleeder valves on cylinder ($\frac{5}{16}$-in. and $\frac{3}{8}$-in. open-end wrenches) (fig. 142). The $\frac{5}{16}$-in. wrench for the top valve and the $\frac{3}{8}$-in. wrench for the bottom.

(7) Add oil to system until a flow, free of bubbles, is obtained from the return line. Tighten this connection permanently ($\frac{3}{8}$-in. open-end wrench).

(8) After a solid flow of oil is obtained from bleeder valves, tighten finger tight.

(9) Loosen top bleeder valve. Push breech slowly to extreme "UP" position and tighten bleeder valve after a solid flow of oil is obtained.

(10) Loosen lower bleeder valve. Push breech slowly to extreme "DOWN" position and tighten bleeder valve after a solid flow of oil is obtained.

(11) Repeat steps (9) and (10).

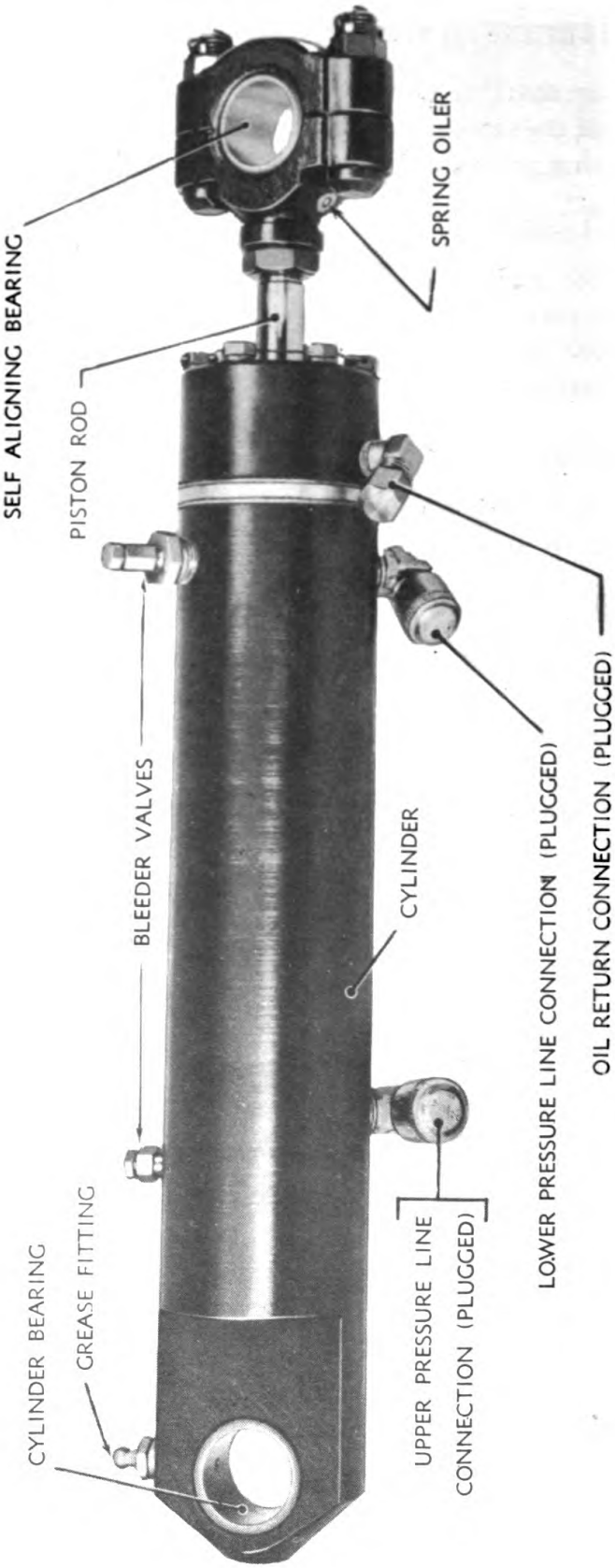


Figure 142 — Stabilizer Piston and Cylinder — Removed

(12) Remove pressure supply line and connections, if used, and reconnect oil reservoir supply line.

(13) Work gun up and down slowly until no more signs of air appear in oil reservoir.

(14) Run the pump approximately 10 minutes.

(15) Loosen both bleeder valves with pump running.

(16) After a solid flow of oil is obtained, tighten both valves permanently and stop motor.

(17) Recheck and fill oil reservoir approximately two-thirds full ($\frac{7}{16}$-in. box wrench).

140. REMOVING AIR FROM SYSTEM.

a. To determine if the system is free of air:

(1) Lock gun in fixed position.

(2) Turn turret switch "ON". If oil level drops, there is air in the system.

b. To remove air trapped in the system, turn the turret switch to the "OFF" position, disengage hand elevating mechanism and work gun slowly up and down from 5 to 10 minutes. Then repeat the check in **a.** above. If air still remains trapped in system, repeat purging procedure, paragraph 139 **b.**, steps (9) through (11).

141. MAINTENANCE.

a. The incorrect adjustment or defective operation of any part of the stabilizer will cause unsatisfactory operation of the equipment as a whole. It is therefore essential that the operating instructions be carefully read before attempting to install, operate, adjust, or repair any part of the stabilizer.

142. OIL LEVEL.

a. The oil reservoir should be approximately two-thirds full of OIL, hydraulic (Univis No. 47, Gov't Spec. 2-79-A), at all times. If the oil level drops from day to day, check for leaks in the system.

143. LUBRICATION.

a. One zerk type grease fitting and two spring oilers are provided on those parts of the equipment that require periodical greasing and oiling. One spring oiler is located on the piston rod end (figs. 141, 142, and 143)

and the other on the gyro control gear box (fig. 143). The grease fitting is located on the cylinder. Grease and oil approximately every 50 hours of operation, using GREASE and OIL, engine, seasonal grade, O.D. No. 0.

144. CLEANLINESS.

a. All parts of the stabilizer must be kept clean for satisfactory operation. Moving parts which are not protected from dust should be wiped daily. The filler hole cap must be kept on the oil reservoir to prevent the entrance of dust or other foreign material.

145. TRUNNION FRICTION AND GUN BALANCE.

a. The performance of the stabilizer will be impaired if the amount of friction in the trunnion bearings or the unbalance of the gun exceeds a predetermined value.

b. Inspection, to determine that gun mounts are within these limits, may be made as follows:

(1) Disconnect the piston rod end (fig. 143) from the mounting bracket by removing pivot pin ($\frac{9}{16}$-in. socket and $\frac{9}{16}$-in. open-end wrenches). It will be necessary to have machine gun out while removing this pin.

(2) Install machine gun and empty shell sack and fill machine gun ammunition tray with ammunition.

(3) Install the 75-mm shell guard.

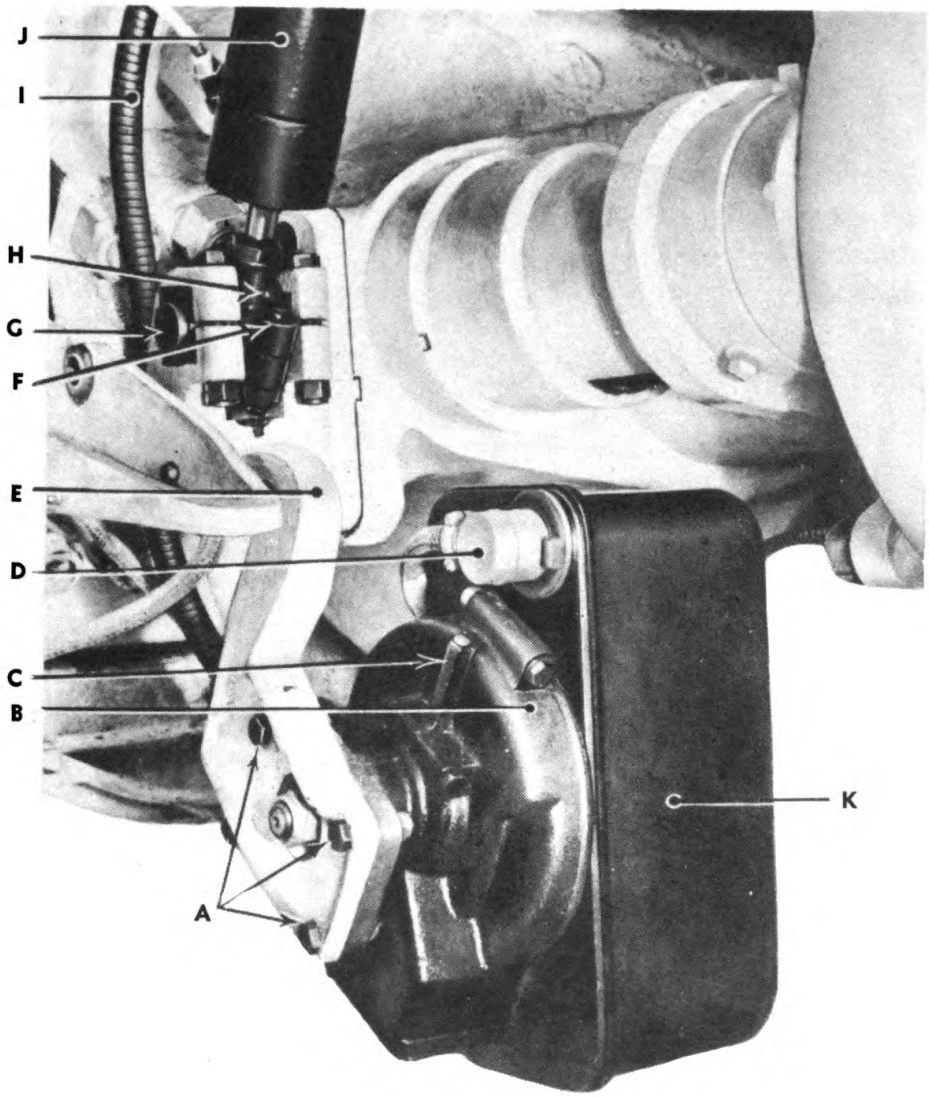
(4) Load the 75-mm gun or add weight equivalent to shell in breech.

(5) Disengage manual elevating mechanism by sliding knurled clutch release knob backward and moving elevating clutch lever to the left. It may be necessary to bear down on the shoulder guard to remove tension from the elevating pinion, due to the weight of the gun, before clutch lever can be moved.

(6) Attach a spring scale to the end of the muzzle of the gun and determine that the pull required to move the gun upward or downward does not exceed 4 lb. and that the difference in pull required to move gun upward and to move it downward does not exceed 2 lb.

c. Adjust balance by adding or removing laminations from counterweight. If excessive friction is encountered, notify Ordnance maintenance personnel.

STABILIZER



A — MOUNTING BOLTS
B — GEAR BOX
C — SPRING OILER
D — MULTI-PRONG PLUG
E — MOUNTING BRACKET
F — PISTON ROD END
G — PIVOT PIN
H — SPRING OILER
I — FLEXIBLE SHAFT
J — CYLINDER
K — GYRO CONTROL

RA PD 39049

Figure 143 — Gyro Control, Gear Box and Piston Rod End

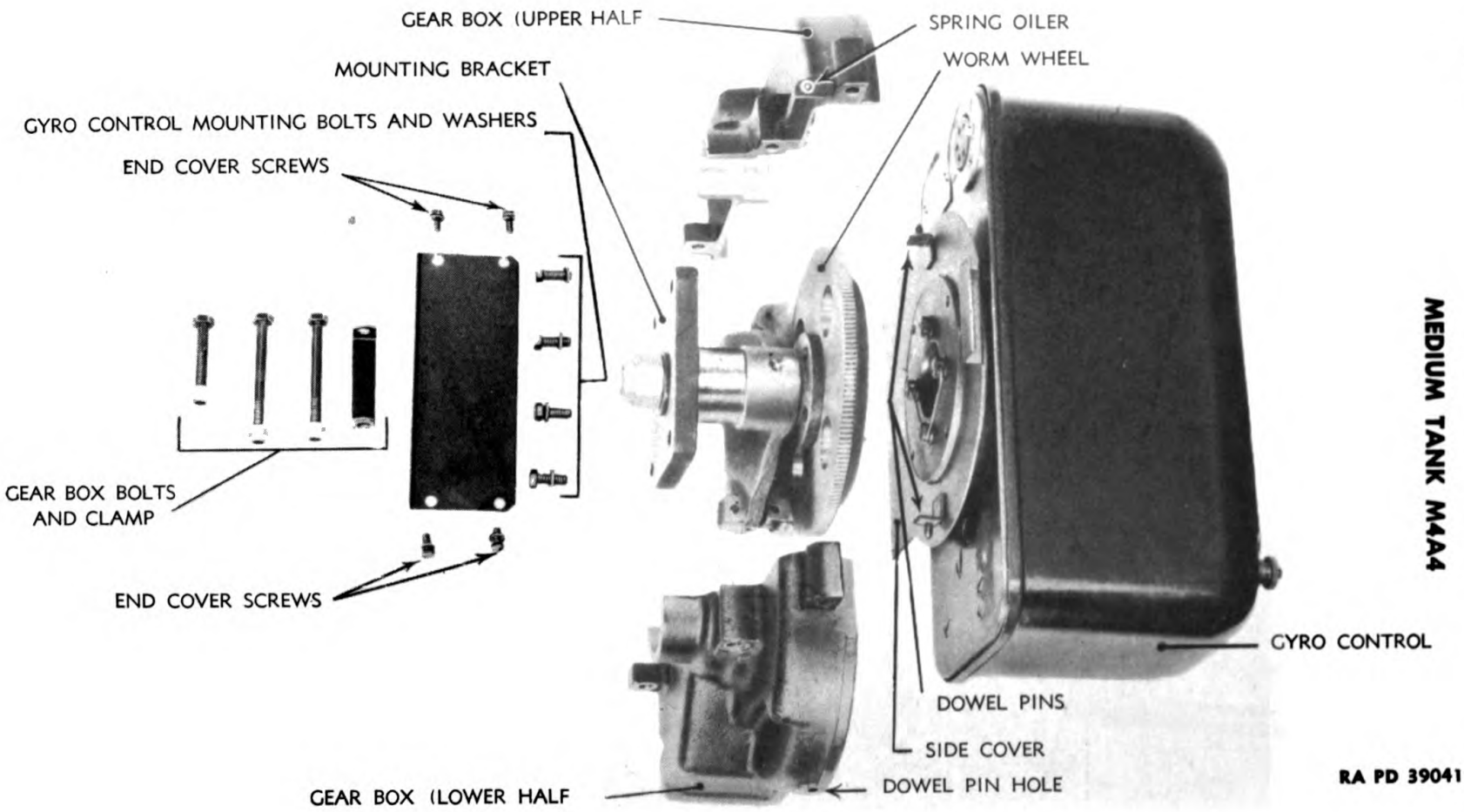


Figure 144 – Gyro Stabilizer Control Gear Box *Disassembled*

STABILIZER

146. GYRO CONTROL GEAR BOX ADJUSTMENTS (figs. 143 and 144).

a. Worm Bracket End Play Adjustment.

SCREWDRIVER, 6-in.

Remove gear box end cover (6-in. screwdriver). Loosen the clamping screw (6-in. screwdriver). Adjust the end play by moving the worm bracket mounting pin down. The bracket must work freely and without appreciable end play. Tighten the clamping screw securely after making adjustments.

b. Worm End Play Adjustment.

SCREWDRIVER, 6-in. WRENCH, spanner

Remove the gear box end cover (6-in. screwdriver). Loosen the clamping screw which locks the adjusting screw in the worm bracket (6-in. screwdriver). Adjust the screw to take out end play (spanner wrench). Relock in position by tightening the clamping screw.

147. PACKING GLANDS (figs. 145 and 146).

a. Oil Pump.

SCREWDRIVER, 4-in. WRENCH, Allen, 3/8-in.

Remove the packing access plate (4-in. screwdriver) on the oil gear traverse or the access plug (3/8-in. Allen wrench) for the Logansport hydraulic traverse. With the pump running, turn the packing nut with a spanner wrench or screwdriver in a clockwise direction until tight. The locking spring prevents the nut from becoming loose. During installation, this adjustment is necessary several times until the packing molds itself around the shaft and provides a perfect oil seal. It should also be tightened after every 24 hours of operation.

b. Piston Rod Packing. This packing, which is chevron type, is held in place by a spring and no external adjustment is provided. Little trouble from leaks at this point should occur, as the return line relieves the oil pressure on the packing. If a leak occurs around the piston rod, the oil return line should be checked to see that it is not pinched or otherwise restricted. If the leak persists, replace the piston and cylinder (par. 152).

c. New Packing. Later models of oil pump and piston and cylinder are equipped with a self-contained oil seal. If leaks occur, this oil seal must be replaced. It is not adjustable and cannot be repaired.

148. REPLACING GYRO CONTROL.

a. CAUTION: The gyro control should be handled with extreme care at all times. Severe shock by dropping or jarring may injure the inter-

nal parts and cause erratic operation of the system. Under no conditions are the ordnance seals to be broken without proper authority. In the event of malfunction in the field replace the gyro control as follows:

b. Equipment.

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

c. Procedure.

(1) Turn stabilizer and turret switches to "OFF" position.

(2) Press release lever and remove multi-prong plug from receptacle on gyro control base (fig. 143).

(3) Remove gear box and cover (fig. 144) (6-in. screwdriver).

(4) Remove flexible shaft (6-in. screwdriver).

(5) Remove gear box clamp and two halves of gear box (3/8-in. and 7/16-in. open-end wrenches).

(6) Remove the four gyro control mounting bolts on worm wheel and remove control (3/8-in. box wrench).

(7) Install replacement unit, reverse the removal procedure.

(8) Check the operation of the complete stabilizer.

149. REPLACING OIL PUMP.

a. Two types of stabilizer oil pumps are used on these medium tanks, high speed (3,600 rpm) with the Westinghouse electric traverse and standard speed (1,800 rpm) with the hydraulic traversing mechanisms supplied by the Oilgear Company and Logansport Valve Company. There are no external differences on these pumps except name plate readings. For this reason, be very careful to check the name plate before installing a replacement pump. Pumps to be used with Westinghouse electric traverse are marked "M4W," serial numbers 1 to 13,000. Those to be used with the Logansport traverse installations are marked "M4L," serial numbers 13,001 to 19,000. Those to be used with the Oilgear traverse installations are labeled "M4G," serial numbers 19,001 to 25,000. The two stabilizer oil pumps used with the two hydraulic traverse installations are interchangeable.

b. Certain early tank models lack sufficient room between the pump terminal box and the turret basket floor to remove the oil pump without taking out the motor with it. In such cases, remove the motor as described in paragraph 154, and the pump as described below, except that the pump and motor must remain connected until both have been

STABILIZER

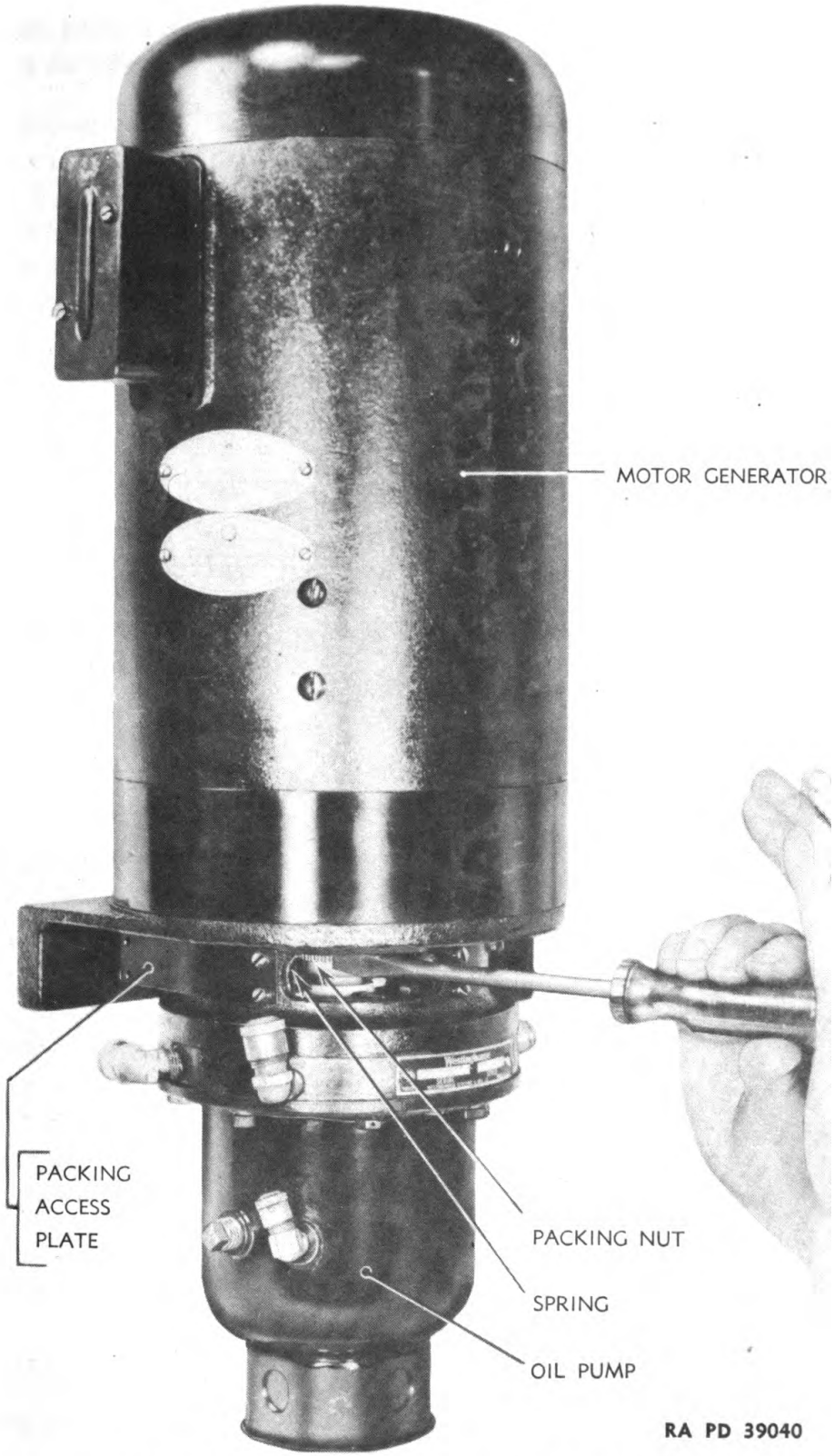
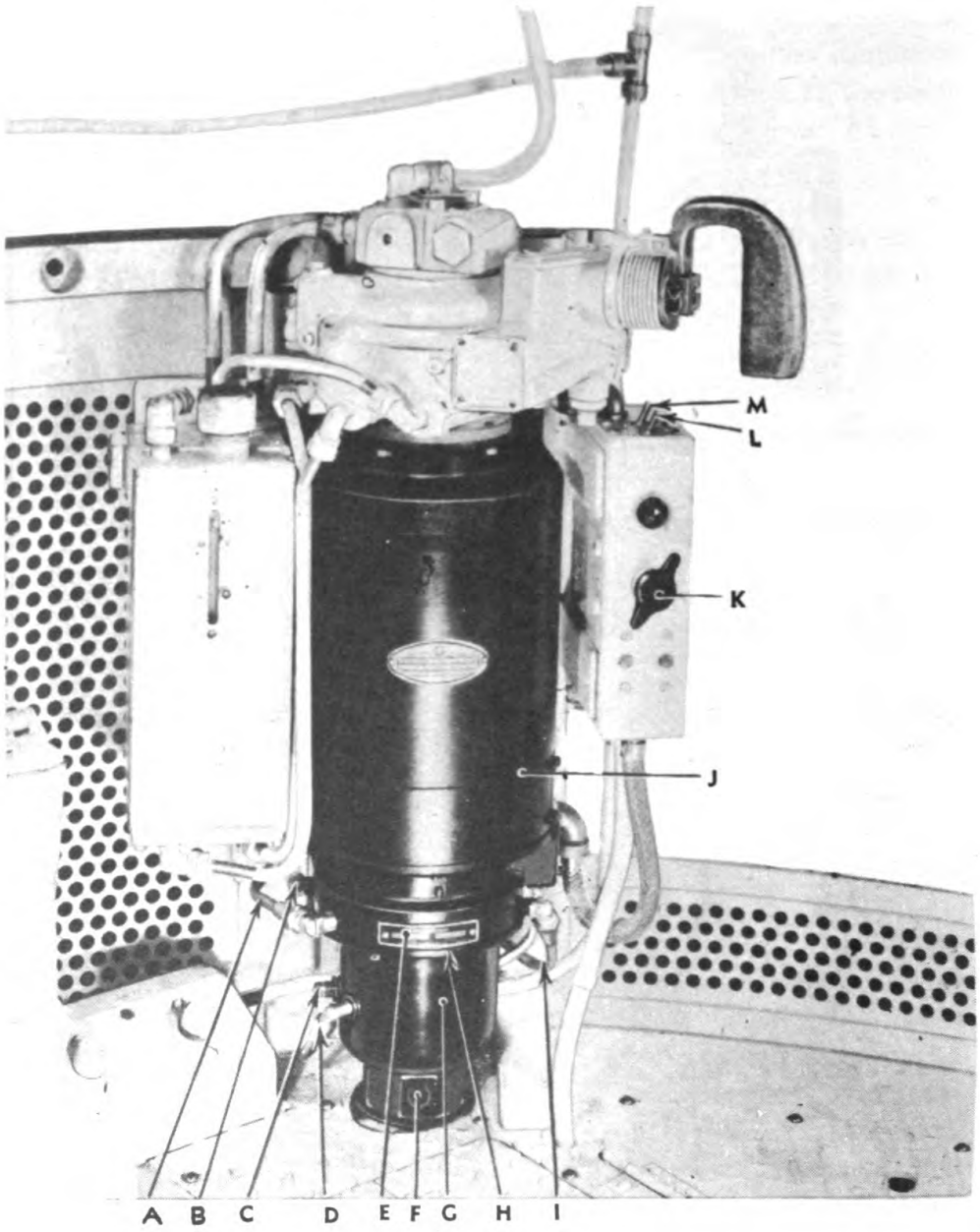


Figure 145 — Packing Gland Adjustment (Installation with Electric Traverse)

MEDIUM TANK M4A4



A — OIL RESERVOIR LINE
B — TOP PRESSURE LINE
C — COVER PLUG
D — OIL RETURN LINE
E — PARKING ACCESS PLATE
F — TERMINAL BOX
G — OIL PUMP
H — ALLEN BOLT
I — BOTTOM PRESSURE LINE
J — MOTOR
K — TURRET SWITCH
L — FIRING SWITCH
M — STABILIZER SWITCH

RA PD 39044

Figure 146 — Gyro Stabilizer Pump and Motor (Hydraulic Traverse Oil Gear)

removed from the tank. The replacement procedure for the oil pump alone is as follows:

c. Equipment.

MALLET, rawhide	WRENCH, open-end, $\frac{3}{16}$-in.
SCREWDRIVER, 4-in.	WRENCH, open-end, $\frac{5}{16}$-in.
WRENCH, Allen, $\frac{3}{16}$-in.	WRENCH, open-end, $\frac{3}{8}$-in.
WRENCH, box, $\frac{3}{8}$-in.	WRENCH, open-end, $\frac{3}{4}$-in.
WRENCH, box, $\frac{7}{16}$-in.	WRENCH, open-end, $\frac{7}{8}$-in.

d. Procedure.

(1) Turn turret and stabilizer switches to "OFF" position.

(2) Remove pump terminal box cover (4-in. screwdriver) and disconnect green, yellow, and white wires ($\frac{3}{8}$-in. box wrench) (figs. 146 and 153).

(3) Disconnect flare nut (fig. 142) on oil return line at the cylinder ($\frac{3}{4}$-in. open-end wrench).

(4) Open bleeders on cylinder to provide an air vent ($\frac{5}{16}$-in. and $\frac{3}{8}$-in. open-end wrenches).

(5) Remove filler plug from oil reservoir ($\frac{7}{16}$-in. box wrench).

(6) Make some provision to catch oil, remove plug from pump cover ($\frac{3}{8}$-in. box wrench) and allow oil to drain out.

(7) Disconnect four oil lines at pump elbows ($\frac{3}{4}$-in. and $\frac{7}{8}$-in. open-end wrenches).

(8) Cap oil connections on pump with flare nuts and dead heads.

(9) Remove bolts in pump cover rim ($\frac{7}{16}$-in. open-end or $\frac{3}{16}$-in. Allen wrench).

(10) While pulling pump out of mesh with drive motor, tap pump base plate with rawhide mallet. IMPORTANT: The pump cover must never be removed except by authorized persons.

(11) To install replacement unit, reverse the removal procedure observing the following precautions:

(a) Be sure the pump and motor shaft mesh properly.

(b) Be sure wiring is correct. Check with wiring diagram (fig. 153).

(c) Recharge the system with oil and check for air in the system.

(d) Check the operation of the complete stabilizer.

150. REPLACING CONTROL BOX.

a. Equipment.

COPPER, soldering	WRENCH, open-end, 11/32-in.
SCREWDRIVER, 4-in.	WRENCH, open-end, $\frac{7}{16}$-in. (2)

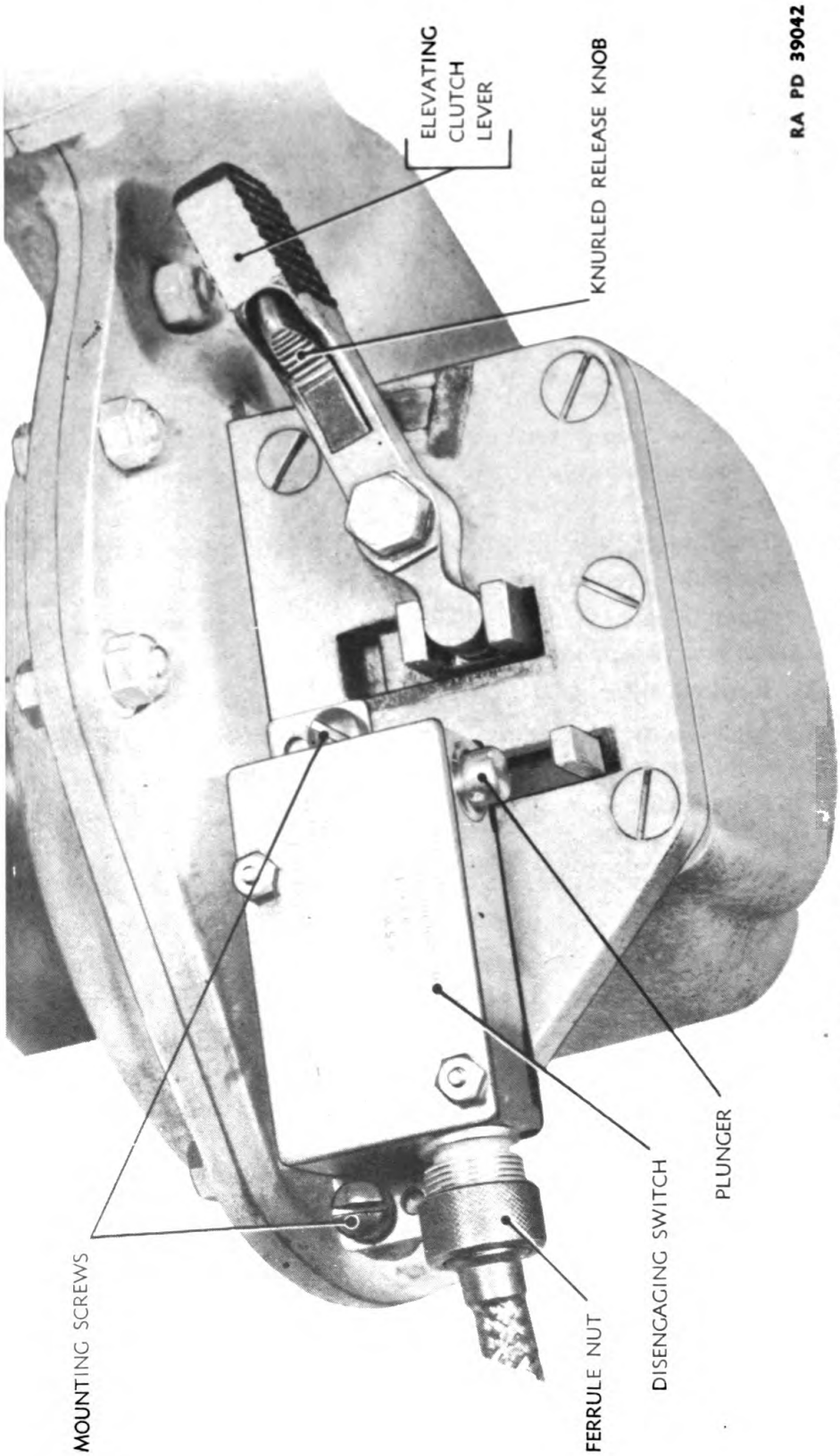


Figure 147 — Disengaging Switch and Elevating Clutch Lever

b. Procedure.

(1) Throw the turret and stabilizer switches to the "OFF" position.

(2) Remove top cover (4-in. screwdriver) and disconnect wiring (soldering copper or 11/32-in. open-end wrench).

(3) Remove mounting screws (two $\frac{7}{16}$-in. open-end wrenches) and remove control box.

(4) To install replacement unit, reverse the removal procedure. Be sure to reconnect the wires according to the wiring diagram (fig. 153).

(5) Check the operation of the complete stabilizer.

151. REPLACING DISENGAGING SWITCH (fig. 148).

a. Equipment.

FILE, rat tail
SCREWDRIVER, 4-in.
SCREWDRIVER, 6-in.
WRENCH, open-end, $\frac{5}{16}$-in.

b. Procedure.

(1) Throw the turret and stabilizer switches to the "OFF" position.

(2) Remove switch mounting screws (6-in. screwdriver) and switch from hand elevating mechanism.

(3) Remove switch cover plate ($\frac{5}{16}$-in. open-end wrench) and disconnect wiring (4-in. screwdriver).

(4) Unscrew switch from shielded conduit fitting (pliers).

(5) To install replacement switch, reverse the removal procedure.

(6) The disengaging switch is closed normally. The switch plunger must not protrude more than $\frac{1}{16}$-in. when the clutch lever is thrown to the left and the elevating gears are in mesh. Adjust by shifting the switch. If the switch mounting holes are not oversize, enlarge as necessary with rat tail file.

152. REPLACING PISTON AND CYLINDER (fig. 141).

a. If parts become damaged, bearings or pivot pins worn, or leaks occur around the piston rod, replace the unit as follows:

b. Equipment.

CAN, oil
SCREWDRIVER
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, ¾-in.
WRENCH, open-end, ⅞-in.
WRENCH, socket, $\frac{9}{16}$-in.
WRENCH, socket, ¾-in.

c. **Procedure.**

(1) Turn turret and stabilizer switches to "OFF" position.

(2) Disconnect and plug the three oil line connections (¾-in. and ⅞-in. open-end wrenches). Make provisions to catch oil lost when disconnecting lines.

(3) Remove the four pivot pin clamp bolts ($\frac{9}{16}$-in. open-end wrench and $\frac{9}{16}$-in. socket wrench)

(4) Remove two bottom bolts on rod end mounting bracket and loosen top bolt (¾-in. socket wrench). Tilt bracket so pivot pin will clear machine gun mounting bracket.

(5) Spring piston rod end mounting bracket with screwdriver and slide out pivot pin.

(6) Spring cylinder mounting bracket, remove pivot pin, and take out piston and cylinder.

(7) To install replacement unit, reverse the removal procedure, recharge the system with oil and remove air.

(8) Check the operation of the complete stabilizer.

153. REPLACING RECOIL SWITCH (fig. 148).

a. **Equipment.**

FILE, rat tail
PLIERS
SCREWDRIVER, 4-in.
WRENCH, open-end, $\frac{5}{16}$-in.
WRENCH, open-end, $\frac{7}{16}$-in. (2)

b. **Procedure.**

(1) Throw the turret and stabilizer switches to the "OFF" position.

(2) Remove the two mounting bolts (two $\frac{7}{16}$-in. open-end wrenches) and switch bracket.

(3) Remove switch cover plate ($\frac{5}{16}$-in. open-end wrench) and disconnect wiring (4-in. screwdriver).

(4) Unscrew switch from shielded conduit fitting (pliers).

(5) To install replacement switch, reverse the removal procedure.

(6) The recoil switch is normally closed and mounted so its plunger will be depressed by the breech of the gun. The plunger must not protrude more than $\frac{1}{16}$-inch when the gun is in battery position. Adjust by shifting the switch mounting bracket or the switch. If the switch mounting holes are not oversize, enlarge as necessary with rat tail file.

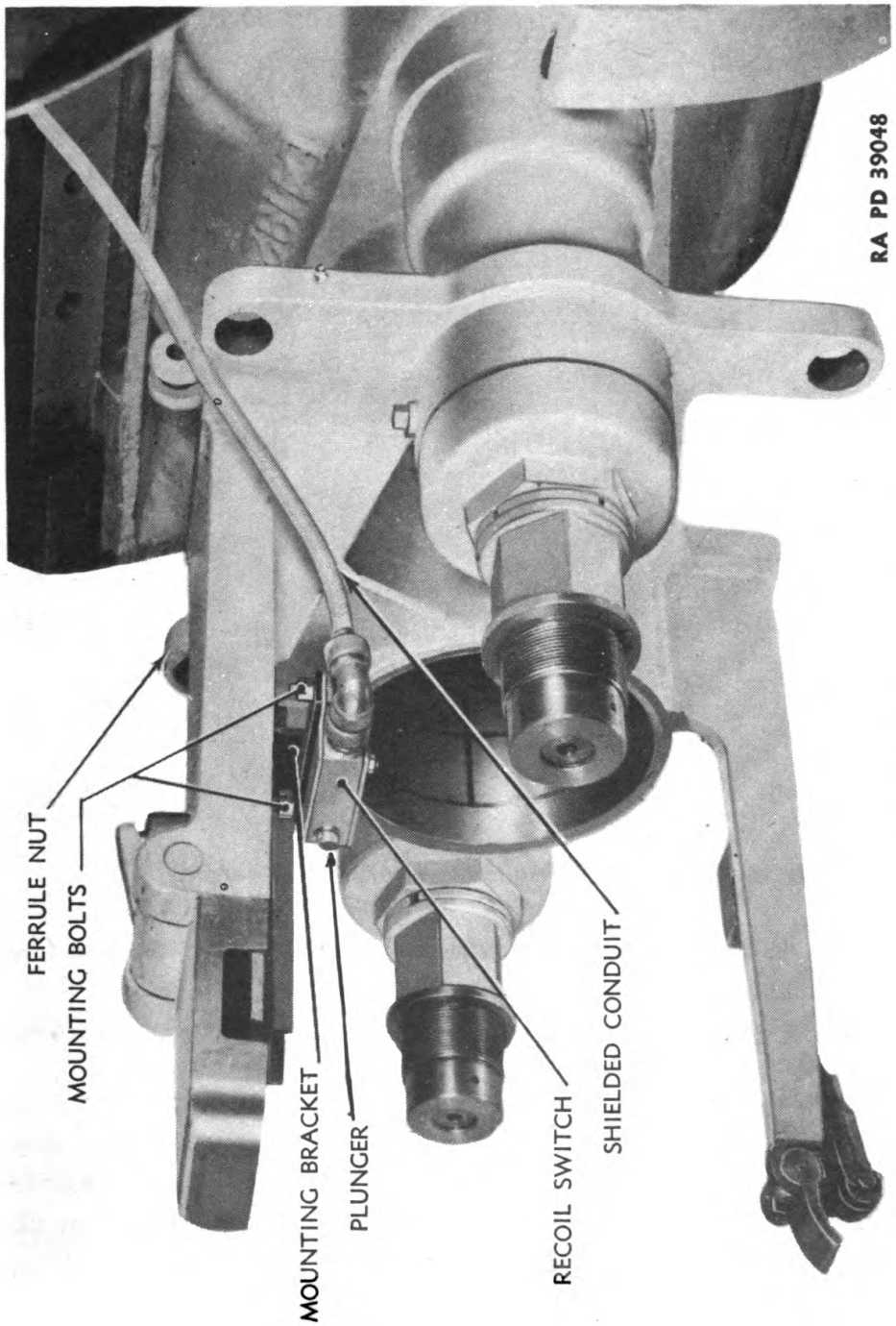


Figure 148 — Recoil Switch

154. REPLACING PUMP MOTORS.

a. Three types of motors are used on the stabilizer oil pump of these tanks. Each of these motors supplies power for both the stabilizer and the traverse.

(1) The Westinghouse motor generator with the electric traverse (fig. 149).

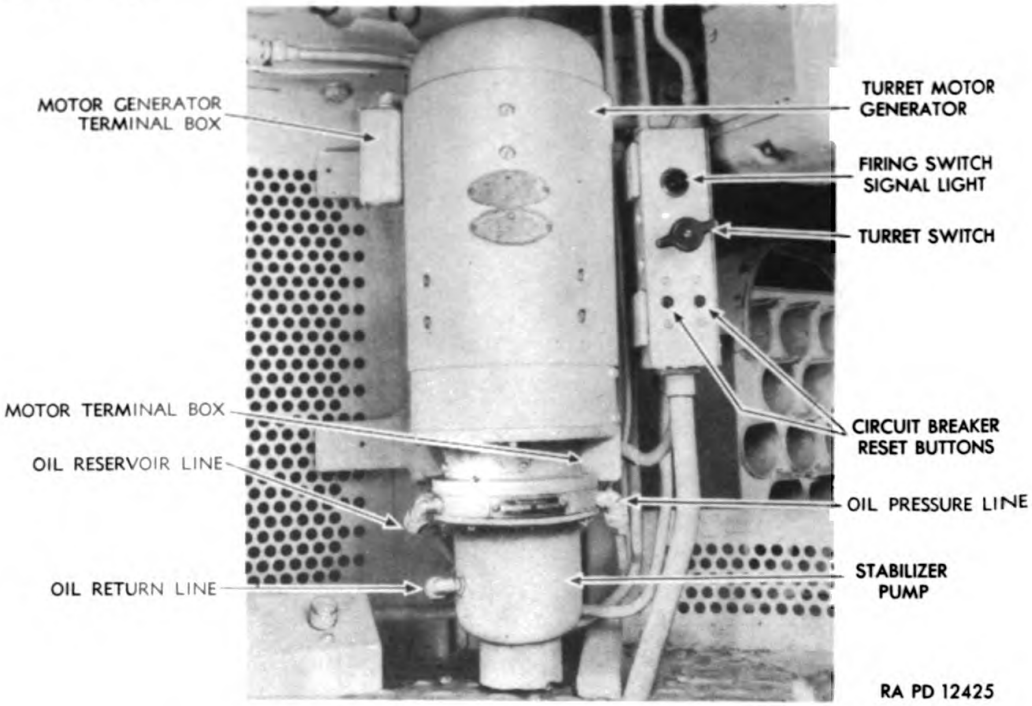


Figure 149 — Westinghouse Motor — Generator

(2) The Westinghouse motor with Oilgear hydraulic traverse (fig. 146).

(3) The Pioneer Pincor Motor with Logansport hydraulic traverse.

b. **Replacing Westinghouse Motor Generator** (fig. 149).

COPPER, soldering
SCREWDRIVER, 6-in.
WRENCH, Allen, $\frac{3}{16}$-in.
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, 15/16-in.
WRENCH, socket, ¾-in. with 8-in. and 4-in. extensions (2)

(1) Throw the turret switch to the "OFF" position.

(2) Remove mounting bolts from pump at cover rim and remove pump ($\frac{7}{16}$-in. open-end or $\frac{3}{16}$-in. Allen wrench).

(3) Suspend pump to prevent damage to copper tubing.

(4) Disconnect wires at generator terminal box (6-in. screwdriver and soldering copper).

(5) Disconnect the 24-volt supply line at motor terminal box (6-in. screwdriver and $\frac{15}{16}$-in. open-end wrench).

(6) Support motor with hands and remove the four mounting bolts, a two-man operation (two ¾-in. socket wrench with 8-in. and 4-in. extensions).

(7) Lift out motor generator, also a two-man operation.

(8) To install replacement unit, reverse the removal procedure. Check wiring with wiring diagram (fig. 153).

(9) Check the operation of the complete stabilizer and traverse.

c. Replacing Westinghouse Motor with Oilgear Traverse (fig. 146).

SCREWDRIVER, 6-in.
WRENCH, open-end, $\frac{7}{16}$-in. or
Wrench, Allen, $\frac{3}{16}$-in.
WRENCH, open-end, $\frac{15}{16}$-in.
WRENCH, socket, ¾-in. with
8-in. and 4-in. extensions (2)

(1) Turn turret switch to the "OFF" position.

(2) Remove mounting bolts from the cover of the oil pump and move pump out sufficiently to disengage drive shaft from motor ($\frac{7}{16}$-in. open-end wrench or $\frac{3}{16}$-in. Allen wrench).

(3) Suspend pump in its original position, being careful not to damage the flare connections or copper tubing.

(4) Remove traverse hydraulic pump from opposite end of motor. Suspend it in position to prevent damage to the oil lines.

(5) Disconnect the 24-volt supply line to motor (6-in. screwdriver and 15/16-in. open-end wrench).

(6) Remove four mounting bolts from mounting brackets of motor and remove motor (two ¾-in. socket wrenches with 8-in. and 4-in. extensions).

(7) To install replacement motor, reverse the removal procedure.

(8) Check operation of the complete stabilizer.

155. REPLACING GEAR BOX (fig. 143).

Adjustments for the gear box are given in paragraph 146. If parts are damaged or worn, replace the entire unit as follows:

a. Equipment.

SCREWDRIVER
WRENCH, box, ⅜-in.
WRENCH, box, ½-in.
WRENCH, open-end, ⅜-in.
WRENCH, open-end, $\frac{7}{16}$-in.

b. Procedure.

(1) Turn turret switch to "OFF" position.

(2) Press release lever and remove multi-prong plug from gyro control base (fig. 144).

(3) Remove gear box end cover (6-in. screwdriver) (fig. 144).

(4) Loosen flexible shaft clamping screw (6-in. screwdriver) and remove flexible shaft.

(5) Remove mounting bolts holding gear box to mounting bracket (two ½-in. box wrenches) and remove gear box and gyro control as a unit (fig. 143).

(6) Remove gear box bolts and clamp and two halves of gear box (⅜-in. and $\frac{7}{16}$-in. open-end wrench).

(7) Remove the four gyro control mounting bolts from the worm wheel and remove gyro control (⅜-in. box wrench).

(8) To install replacement unit, reverse the removal procedure.

(9) Adjust worm and worm bracket.

(10) Check the operation of the complete stabilizer.

156. REPLACING WIRING AND SHIELDED CONDUIT.

a. Equipment.

COPPER, soldering or torch
PLIERS
TAPE, friction
TAPE, rubber
SOLDER, 50-50

b. Procedure.

(1) Turn turret switch to "OFF" position.

(2) Measure new piece of shielded conduit to length and tin at least ½-inch on each side of cut using noncorrosive flux (torch or soldering copper).

(3) Cut with fine-toothed hacksaw.

(4) Tin inside of ferrule (solder 50-50, and soldering copper).

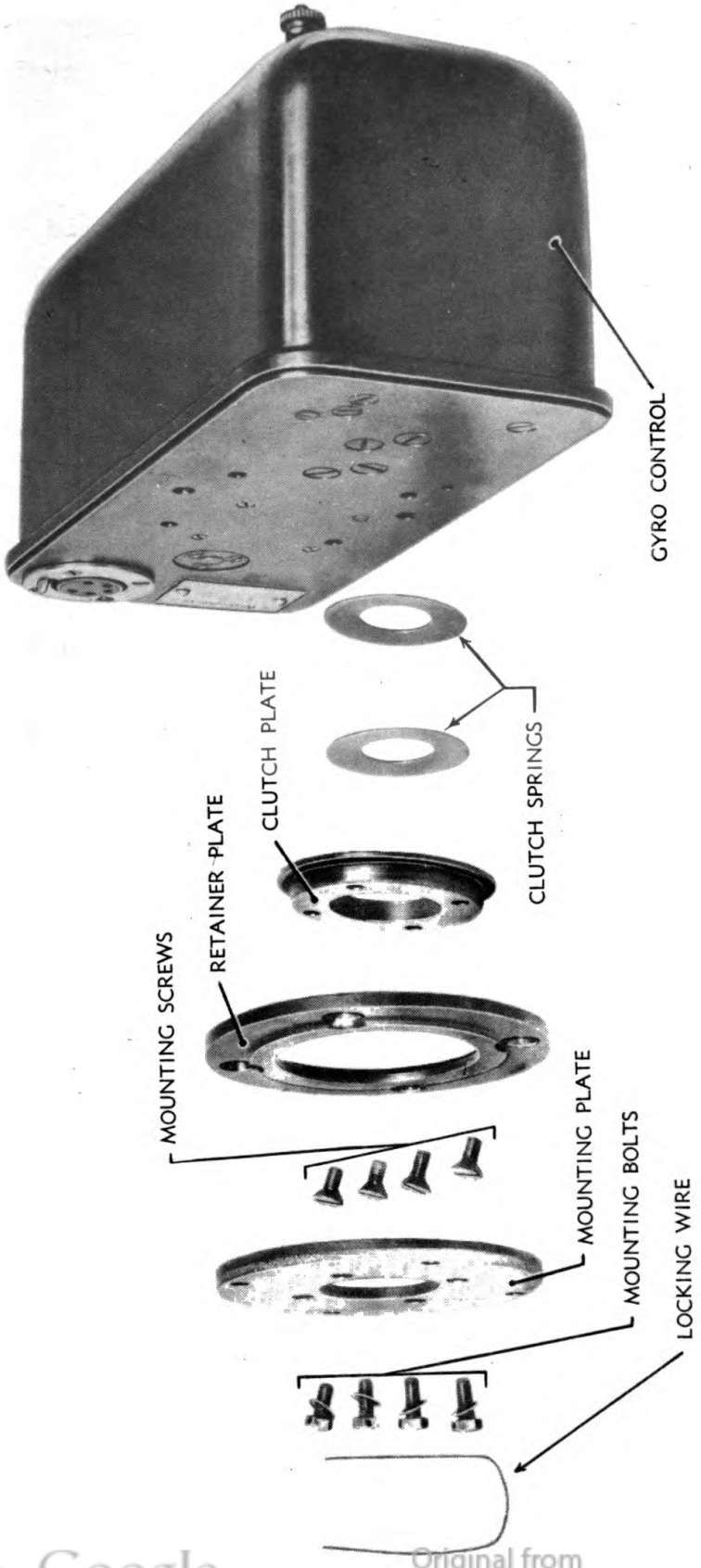
(5) Sweat solder cable into place. *If a torch is used, use flame on fitting only, never directly on cable.*

(6) Cut new wires to length and run them through shielded cable.

(7) When rewiring, follow the color scheme and connections shown in the wiring diagram (fig. 153).

(8) Reconnect wires and shielded conduit (soldering copper, friction tape, rubber tape and pliers).

STABILIZER



RA PD 39046

MEDIUM TANK M4A4

157. REPLACING CLUTCH PARTS (fig. 150).

The clutch is not adjustable. To replace:

a. Equipment.

HAMMER	PUNCH, center
PLIERS	WRENCH, open-end, 3/8-in.

b. Procedure.

(1) Turn the turret switch to the "OFF" position.

(2) Remove the gyro control (par. 150).

(3) Remove locking wire (pliers) from mounting plate bolts and remove mounting bolts (3/8-in. open-end wrench) and plate.

(4) Remove mounting screws (6-in. screwdriver) from retainer plate and remove retainer plate.

(5) Remove clutch plate and clutch springs

(6) Replace retainer plate, clutch plate, and two clutch springs. Add one spring if only one is present.

(7) To install, reverse the removal procedure. Stake the mounting screws on retainer plate (hammer and center punch).

(8) Retest clutch, and check the operation of the complete stabilizer.

158. REPLACING FLEXIBLE SHAFT.

a. Equipment.

SCREWDRIVER, 6-in.	WRENCH, open-end, 1 1/2-in.

b. Procedure.

(1) Remove end cover from the gear box (6-in. screwdriver).

(2) Loosen the flexible shaft clamping screw (6-in. screwdriver).

(3) Pull shaft out through felt packing.

(4) At opposite end of shaft, unscrew flange nut (1 1/2-in. open-end wrench) and remove flexible shaft from hand elevating mechanism.

(5) To install replacement shaft, reverse the removal procedure.

159. REPAIRING AND REPLACING DEFECTIVE OIL LINES.

a. Equipment.

CUTTER, tube	WRENCH, open-end, 3/4-in.
TOOL, flaring	WRENCH, open-end, 7/8-in.

STABILIZER

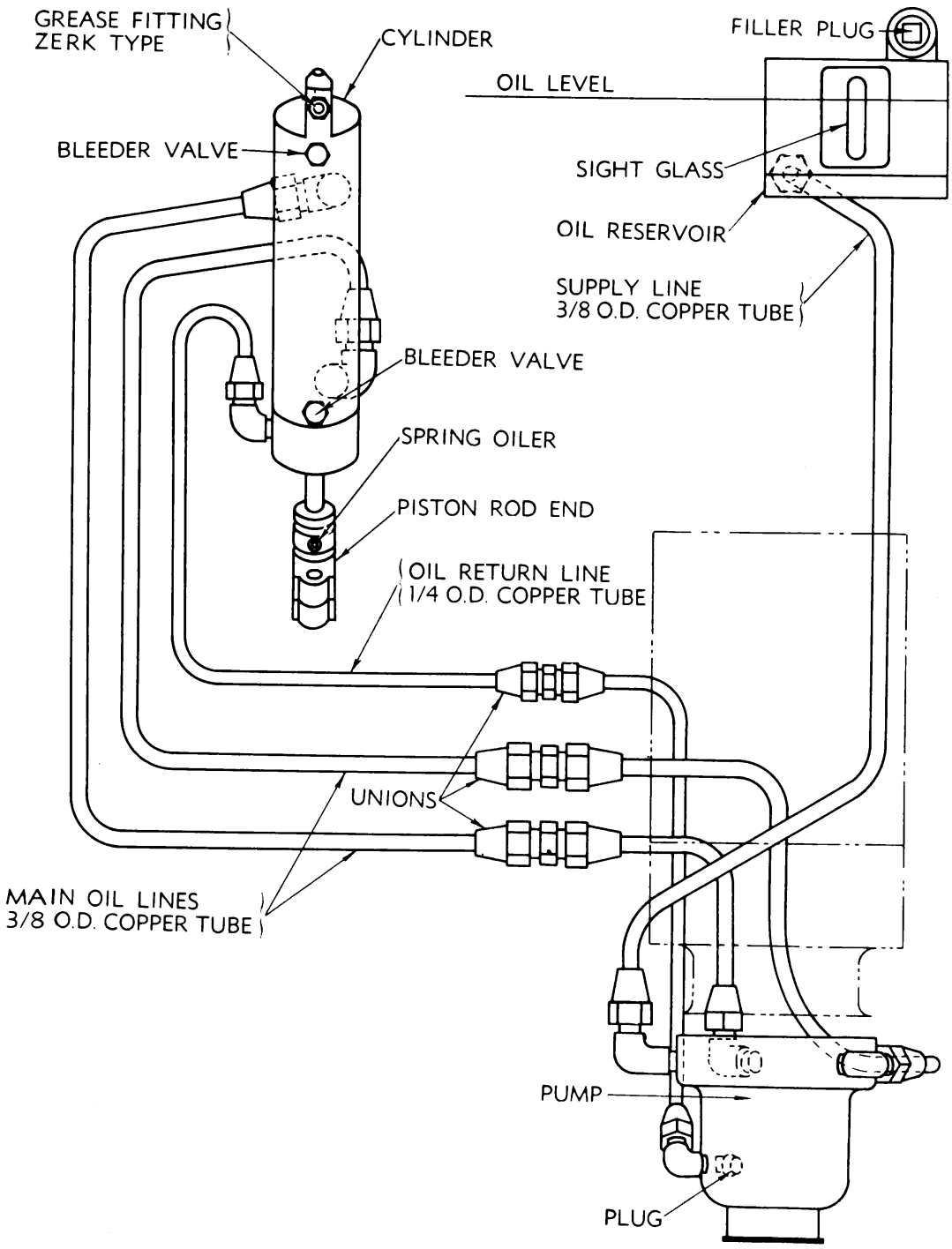


Figure 151 — Gyro Control Oil Lines

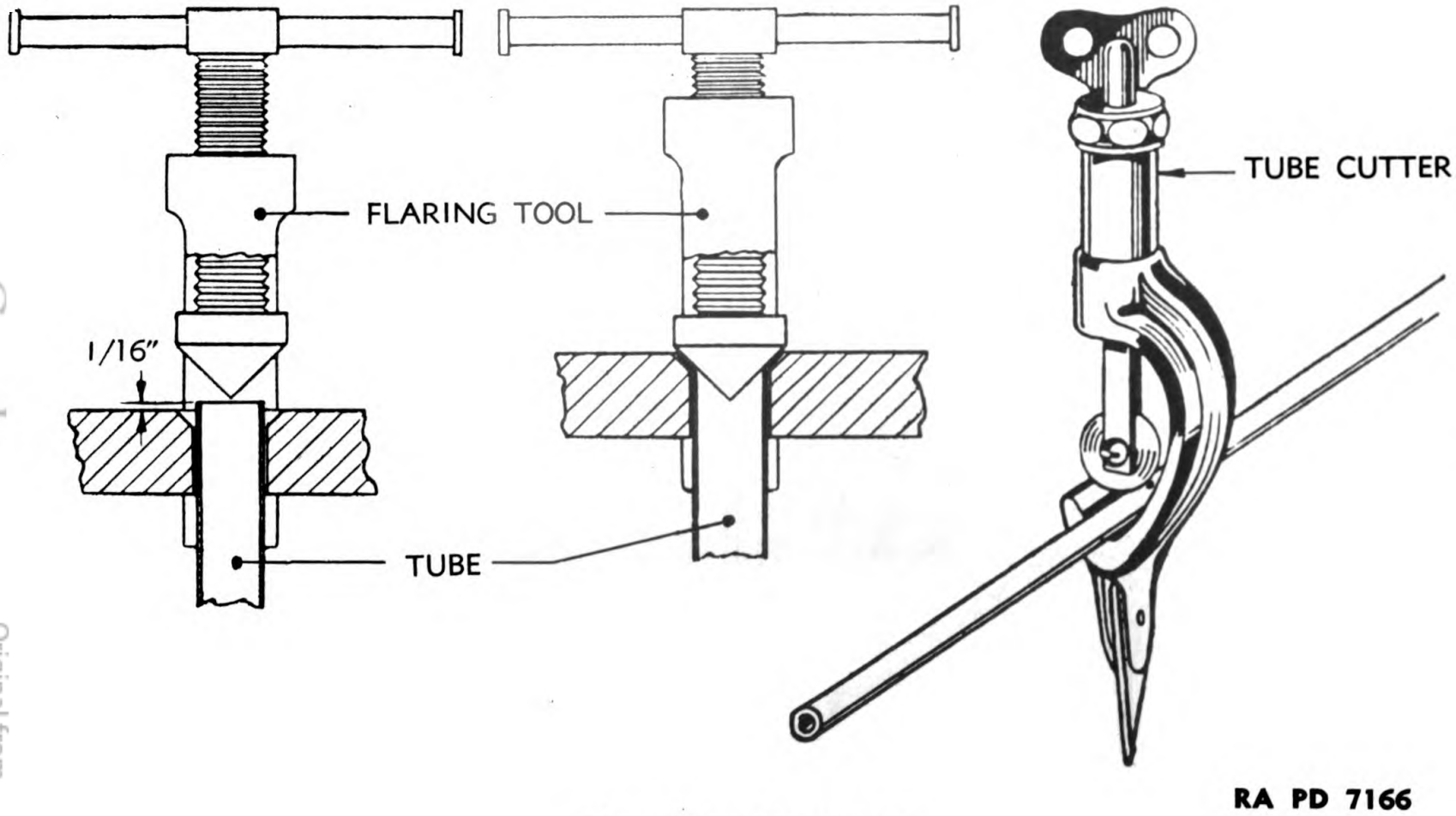


Figure 152 — Flaring Tools

b. Procedure.

(1) Turn turret switch to "OFF" position.

(2) Disconnect the defective oil line (¾-in. or ⅞-in. open-
wrench) and catch oil drainage from the affected part of the system.
place damaged lines completely (fig. 151).

(3) Use extreme care to keep dirt or other foreign material ou
the hydraulic system. For this reason, when making a flare, cut the t
ing with a tube cutter instead of a hacksaw. Feed the cutting wheel
152) a very small amount each time the tool is rotated 360 deg

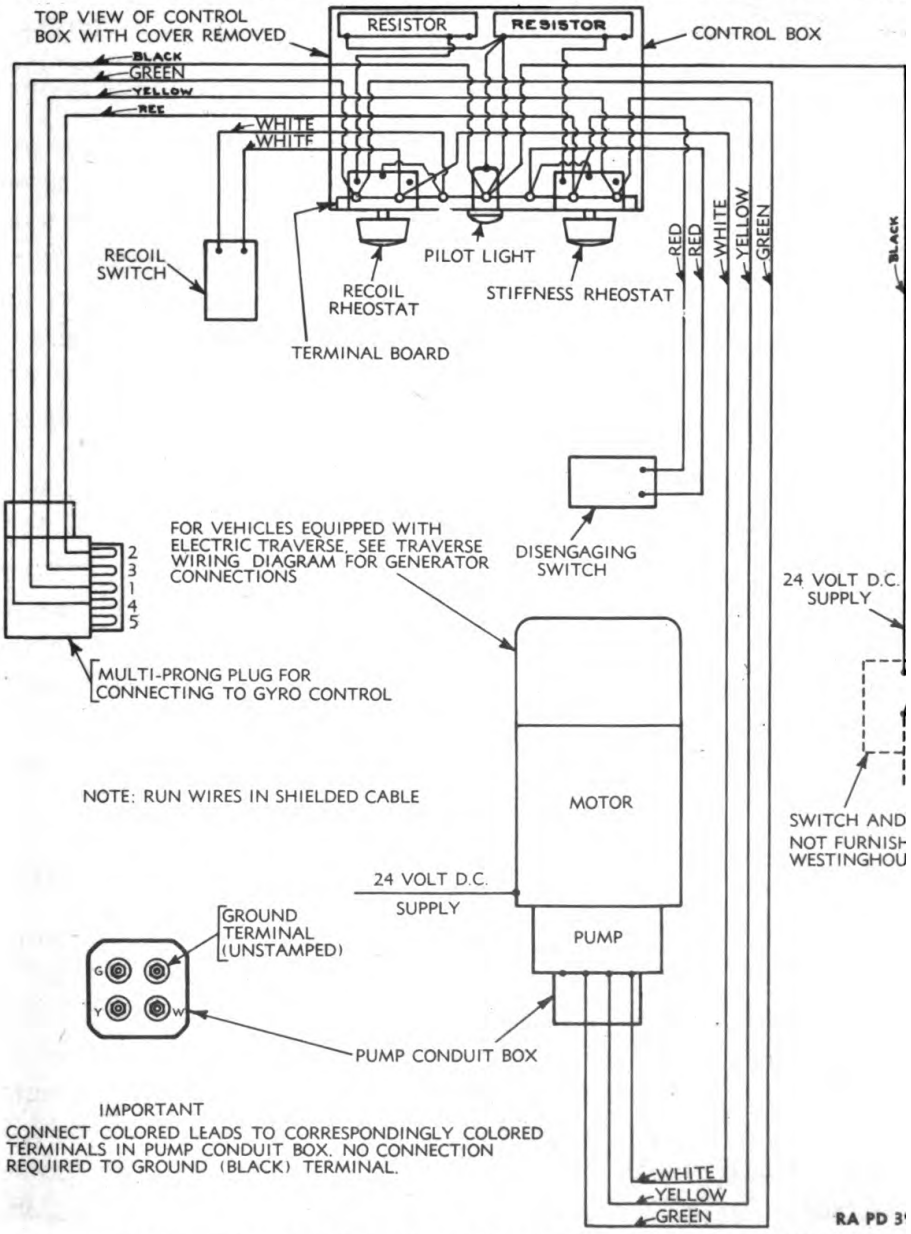


Figure 153 — Electrical Wiring Diagram for Gyro Stabilizer

until the tube is cut. If the cutter is fed too rapidly, the end of the tubing may be beveled inward. Slip the flare nut over the end of the tube and grip the tube in the flaring tool block, allowing the end to project approximately $\frac{1}{16}$-in. Do not turn it down too hard as the flared end will be thinned out and become brittle. The flared end of the tube should be sufficiently large to form a good seat on the male part of the flare connection, yet it must not be so large that it will not clear the threads of the flare nut. When making the connections, draw the flare nuts up tightly, but if they are forced too tightly the flare may be thinned out and consequently weakened.

(4) Reconnect the flare nut to its proper connection.

(5) Recharge the system with oil and check for air in the system.

(6) Check the operation of the complete stabilizer.

Section XXV

ELECTRICAL SYSTEM

160. DESCRIPTION.

a. General. The electrical system is operated throughout at 24 volts except for the radio which, in some cases, is 12 volts. The electrical circuit is a one wire or grounded type in which the negative side of the battery, generator and all current consuming devices are grounded to the frame of the vehicle, which acts as a return line. The system consists of two 12 volt batteries (par. 161.), generator (par. 162.), auxiliary generating unit (par. 187.), starter (par. 163.), ignition system (par. 62.), siren (par. 186.), lights (par. 164.), instruments (par. 165.) and gages (par. 169, 172 and 176).

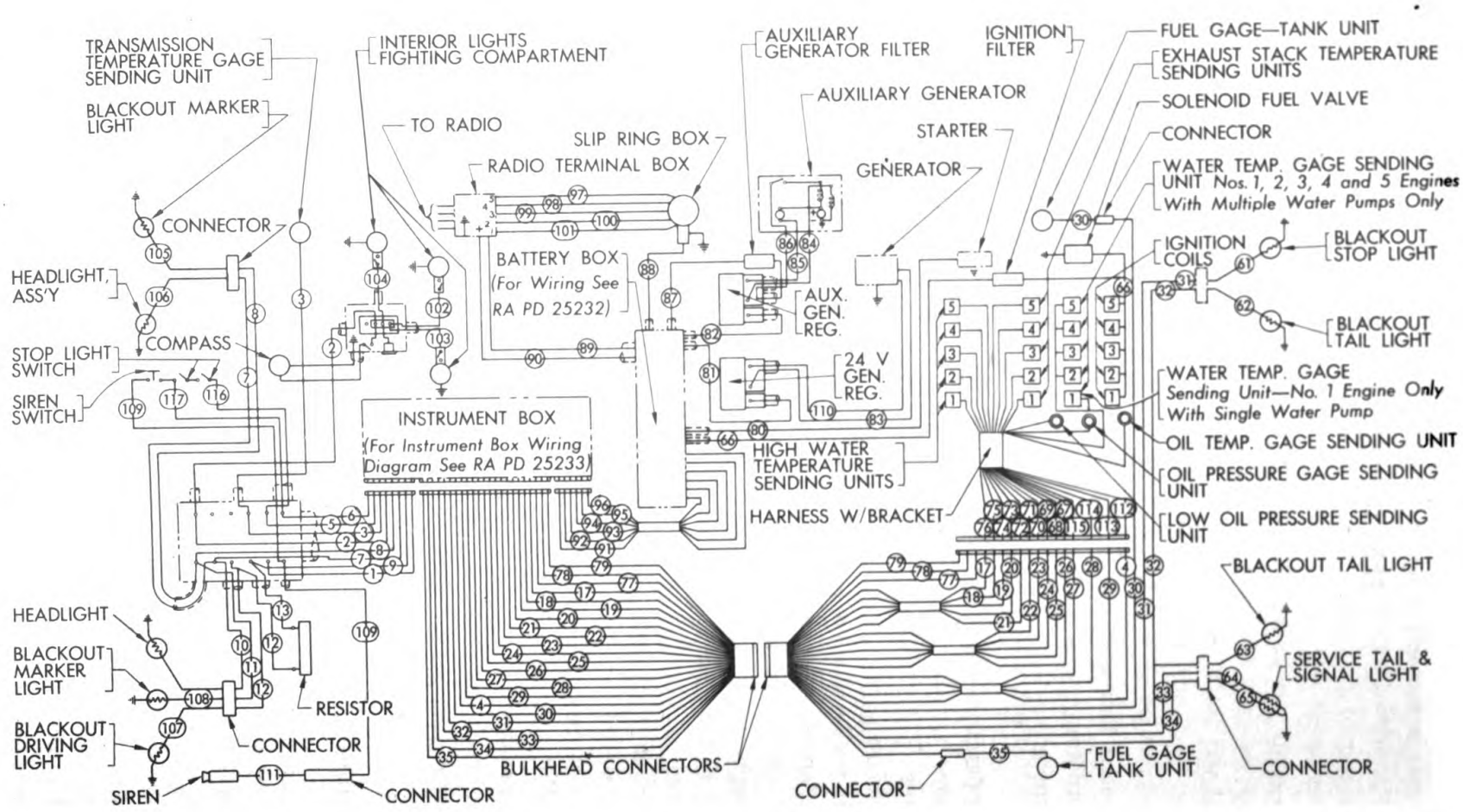


Figure 154 — Main Wiring Diagram

KEY	CABLE NO.	COLOR
1	NUMBER 14	BLUE
2	NUMBER 14	RED
3	NUMBER 14	WHITE
4	NUMBER 14	WHITE
5	NUMBER 14	GREEN
6	NUMBER 14	BLACK
7	NUMBER 14	ORANGE W/TRACER
8	NUMBER 14	ORANGE
9	NUMBER 14	TAN
10	NUMBER 14	ORANGE W/TRACER
11	NUMBER 14	ORANGE
12	NUMBER 14	TAN
13	NUMBER 14	TAN
17	NUMBER 18	BLACK
18	NUMBER 18	WHITE
19	NUMBER 18	GREEN
20	NUMBER 18	YELLOW
21	NUMBER 18	BLUE
22	NUMBER 18	BLUE
23	NUMBER 18	YELLOW
24	NUMBER 18	GREEN
25	NUMBER 18	WHITE
26	NUMBER 18	BLACK
27	NUMBER 18	GREEN
28	NUMBER 18	YELLOW
29	NUMBER 18	BLACK
30	NUMBER 14	BLACK W/RED
31	NUMBER 16	BLACK
32	NUMBER 16	BLUE
33	NUMBER 16	GREEN
34	NUMBER 16	RED
35	NUMBER 14	BLACK W/YELLOW
61	NUMBER 14	RED
62	NUMBER 14	ORANGE
63	NUMBER 14	ORANGE
64	NUMBER 14	ORANGE W/TRACER
65	NUMBER 14	BLACK
66	NUMBER 12	BLUE
67	NUMBER 16	WHITE
68	NUMBER 16	GREEN
69	NUMBER 16	GREEN
70	NUMBER 16	YELLOW
71	NUMBER 16	BLUE
72	NUMBER 14	BLUE
73	NUMBER 14	YELLOW
74	NUMBER 14	GREEN
75	NUMBER 14	WHITE
76	NUMBER 14	BLACK
77	NUMBER 18	RED
78	NUMBER 18	BLUE
79	NUMBER 16	BROWN
80	NUMBER 00	BLACK
81	NUMBER 6	BLACK
82	NUMBER 8	RED
83	NUMBER 6	BLACK
84	NUMBER 14	YELLOW
85	NUMBER 8	BLACK
86	NUMBER 8	RED
87	NUMBER 8	YELLOW
88	NUMBER 2	BLACK
89	NUMBER 6	BLACK
90	NUMBER 6	BLACK W/TRACER
91	NUMBER 12	BLACK
92	NUMBER 12	BLACK
93	NUMBER 14	BROWN
94	NUMBER 14	WHITE
95	NUMBER 14	YELLOW
96	NUMBER 16	BLUE
97	NUMBER 12	BLACK
98	NUMBER 18	GREEN
99	NUMBER 18	BLUE
100	NUMBER 18	YELLOW
101	NUMBER 18	RED
102	NUMBER 18	RED
103	NUMBER 18	BLACK
104	NUMBER 18	BLACK
105	NUMBER 16	BLACK
106	NUMBER 14	RED
107	NUMBER 16	BLACK
108	NUMBER 16	BLACK
109	NUMBER 14	YELLOW
110	NUMBER 10	BLACK
111	NUMBER 14	YELLOW
112	NUMBER 14	WHITE
113	NUMBER 18	BLACK
114	NUMBER 18	YELLOW
115	NUMBER 18	GREEN
116	NUMBER 14	GREEN
117	NUMBER 14	BLACK

Figure 155 — Legend for Figure 154 — Main Wiring Diagram

161. BATTERY.

a. Description. Two 12-volt storage batteries are connected in series to maintain the voltage of the system at 24 volts (figs. 121, 154, 156). The batteries are installed in the battery compartment, located on the left side of the floor in the fighting compartment, behind the driver and under the turret floor.

b. Periodic Inspection. The period of inspection will vary. In hot weather, once a week is ordinarily necessary to keep the electrolyte at proper level. However, when operating in extreme hot temperatures, as in the desert, inspections should be made more frequently. Keep the level of the electrolyte $^3/_8$-in. above the perforated baffle plates. These plates are visible through the opening in each cell, after removal of the filler cap.

c. Removal.

TOOLS.

SCREWDRIVER
WRENCH, open-end, $^5/_8$-in.
WRENCH, open-end, $^1/_2$-in.

(1) PROCEDURE.

(a) Disconnect Battery Cables.

SCREWDRIVER
WRENCH, open-end, $^1/_2$-in.

Rotate turret and lift up section of turret floor directly above battery box. Lift up on battery switch and turn as directed on knob (fig. 121). Unsnap, by hand, the four clamps (two on each side) which hold the battery box cover and lift cover off box. Loosen nuts which secure cable connector to post of battery (turn counterclockwise) ($^1/_2$-in. open-end wrench), insert screwdriver in opening in split connector, to spread connector, and lift cable free of battery post. CAUTION: Do not twist cable connector to loosen, as this is likely to twist the battery terminal off its connection to plates, thereby ruining the battery.

(b) Remove Batteries from Battery Box.

WRENCH, open-end, $^5/_8$-in.

Remove two nuts from battery hold down straps and lift battery out of box.

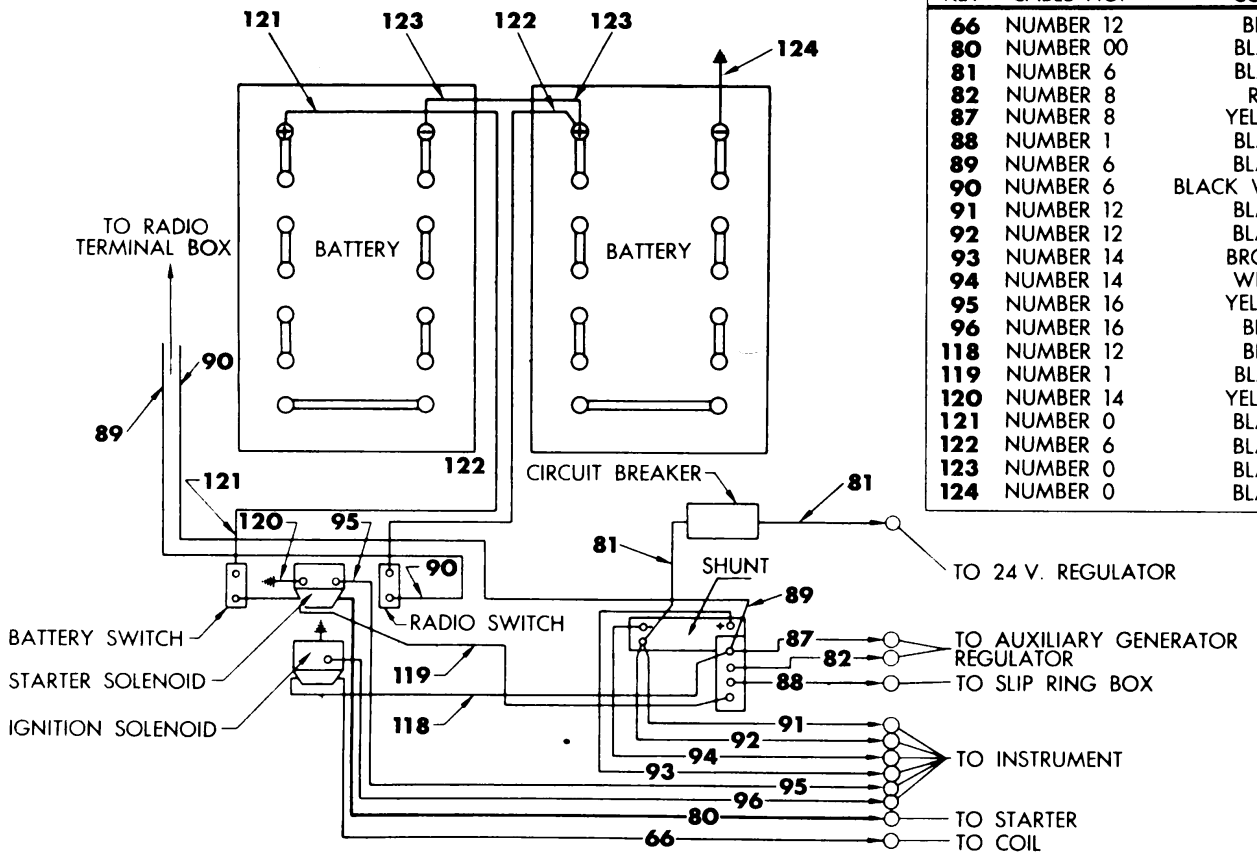
d. Installation.

TOOLS.

WRENCH, open-end, $^1/_2$-in.
WRENCH, open-end, $^5/_8$-in.

*NOTE—FOR FURTHER INFORMATION SEE RA PD 25234

KEY	CABLE NO.	COLOR
66	NUMBER 12	BLUE
80	NUMBER 00	BLACK
81	NUMBER 6	BLACK
82	NUMBER 8	RED
87	NUMBER 8	YELLOW
88	NUMBER 1	BLACK
89	NUMBER 6	BLACK
90	NUMBER 6	BLACK W/TRACER
91	NUMBER 12	BLACK
92	NUMBER 12	BLACK
93	NUMBER 14	BROWN
94	NUMBER 14	WHITE
95	NUMBER 16	YELLOW
96	NUMBER 16	BLUE
118	NUMBER 12	BLUE
119	NUMBER 1	BLACK
120	NUMBER 14	YELLOW
121	NUMBER 0	BLACK
122	NUMBER 6	BLACK
123	NUMBER 0	BLACK
124	NUMBER 0	BLACK



RA PD 25232

Figure 156 — Wiring Diagram — Battery Box

(1) PROCEDURE.

(a) Install Battery in Box.

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

Lower batteries in battery box, with posts to receive cables at end of box toward propeller shaft (fig. 121). Place battery hold down straps in position, install nuts and tighten.

(b) Connect Cables and Install Box Cover.

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

Coat battery posts and inside of connectors with petrolatum, to prevent corrosion, push connector over post and tighten nuts securely. Install cover on battery box and snap the four clamps in position.

e. Battery Switch.

(1) THE BATTERY SWITCH, located on the left side of the battery box, is provided to cut off the battery power at the source. A second switch is also provided in the same box for cutting off of the radio circuit.

(2) OPERATION. To open switch, pull up on handle and turn it to lock in position.

(3) REMOVAL.

TOOLS.

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

(a) Procedure.

1. Disconnect Battery Cables (par. 161, **c.** (1) (a)).

2. Remove Cables from Switch (figs. 121, 156, 161).

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

Lift out the sliding panel which separates batteries from battery controls. Remove the screw from center of switch knob (screwdriver) and lift knob off switch. Remove two nuts and remove cables and strap connections from terminals (5/8-in. open-end wrench).

3. Remove Switch from Box.

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

Remove the two bolts and nuts which attach the switch mounting bracket to the side of battery box (1/2-in. socket wrench on inside of box; 7/16-in. open-end wrench on outside of box). Remove the two bolts and nuts which secure switch to mounting bracket and separate switch from bracket (7/16-in. open-end wrench (2)).

(4) INSTALLATION.

TOOLS.

SCREWDRIVER
WRENCH, open-end, $\frac{7}{16}$-in. (2)
WRENCH, socket, ½-in.

(a) Procedure.

1. Install Switch on Battery Box.

SCREWDRIVER
WRENCH, open-end, $\frac{7}{16}$-in. (2)
WRENCH, socket, ½-in.

Remove screw in center of switch knob and remove knob (screwdriver). Mount switch on bracket and secure with two bolts and nuts ($\frac{7}{16}$-in. open-end wrench (2)). Insert shaft of switch through opening in battery box and attach bracket to box with two bolts and nuts (½-in. socket wrench on inside of box; $\frac{7}{16}$-in. open-end wrench on outside of box). Secure knob to switch with screw in center of knob (screwdriver).

2. Connect Cables to Switch.

WRENCH, open-end, ⅝-in.

Connect cables to the two terminal posts and secure with attaching nuts.

3. Connect Battery Cables and Install Box Cover (par. 161., d., (1), (b)).

162. GENERATOR.

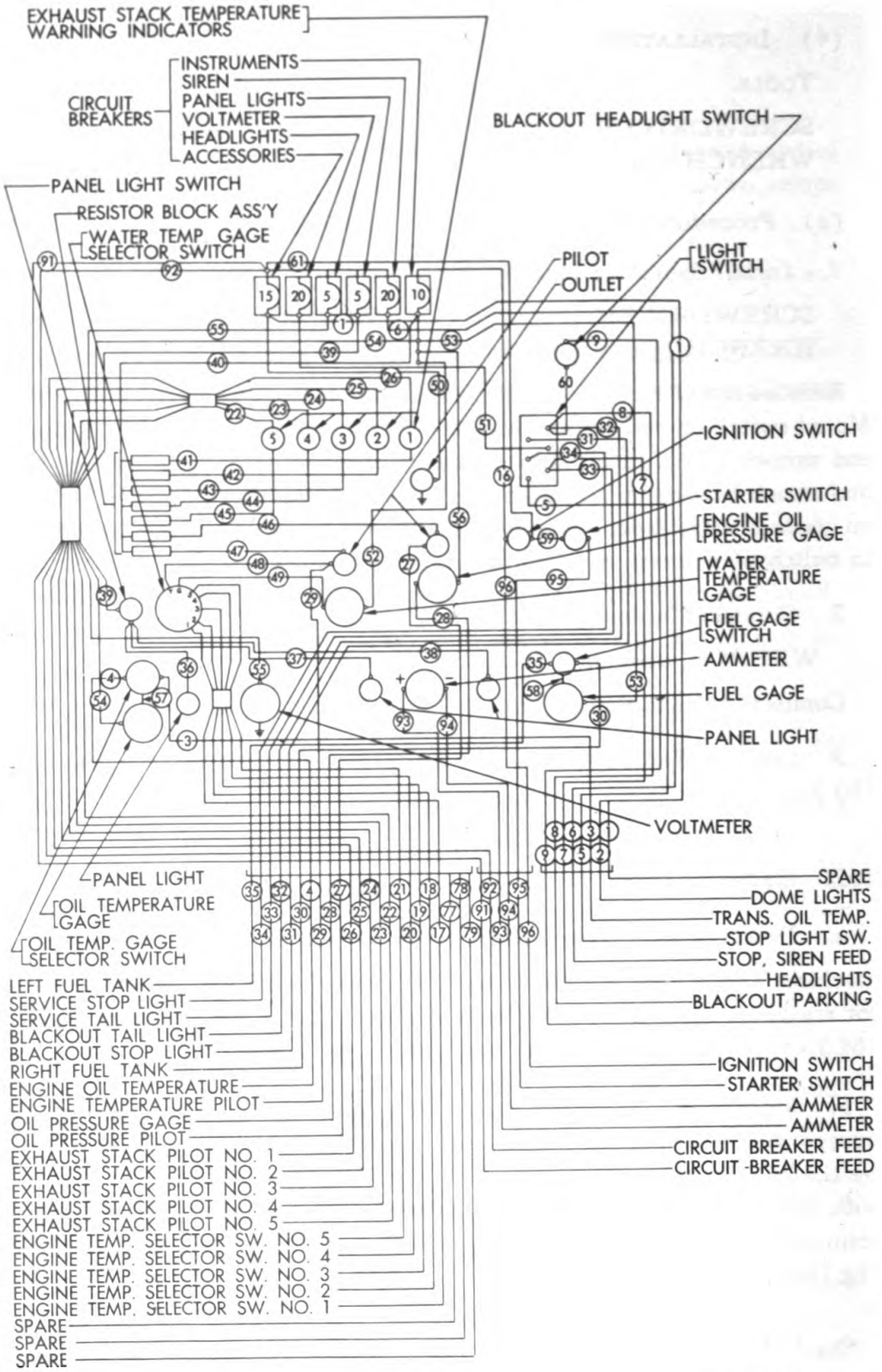
a. Description. The generator is a belt-driven straight shunt machine. The generator circuit (fig. 159) consists of the generator, generator regulator (par. 162., k.) circuit breaker (par. 162., j.) battery (par. 161.) ammeter (par. 171.) and voltmeter (par. 170.).

b. Mounting. On power units equipped with multiple type water pumps, the generator is bracket mounted to No. 2 engine and driven by the No. 2 water pump drive belt (fig. 20). On power units equipped with the single water pump, the generator is mounted in the fighting compartment and belt driven from a pulley on the propeller shaft flange (fig.160).

c. Preventive Maintenance.

(1) CHECK DRIVE BELTS FOR TENSION (pars. 86., d. and 162., h., (1), (a), 2.) and mounting bolts.

MEDIUM TANK M4A4



RA PD 25233

Figure 157 — Wiring Diagram — Instrument Box

ELECTRICAL SYSTEM

KEY	CABLE NO.	COLOR
1	NUMBER 14	BLUE
2	NUMBER 14	RED
3	NUMBER 14	WHITE
4	NUMBER 18	WHITE
5	NUMBER 14	GREEN
6	NUMBER 14	BLACK
7	NUMBER 14	ORANGE W/TRACER
8	NUMBER 14	ORANGE
9	NUMBER 14	TAN
16	NUMBER 14	BROWN
17	NUMBER 18	BLACK
18	NUMBER 18	WHITE
19	NUMBER 18	GREEN
20	NUMBER 18	YELLOW
21	NUMBER 18	BLUE
22	NUMBER 18	BLUE
23	NUMBER 18	YELLOW
24	NUMBER 18	GREEN
25	NUMBER 18	WHITE
26	NUMBER 18	BLACK
27	NUMBER 18	GREEN
28	NUMBER 18	YELLOW
29	NUMBER 18	BLACK
30	NUMBER 14	BLACK W/RED
31	NUMBER 16	BLACK
32	NUMBER 16	BLUE
33	NUMBER 16	GREEN
34	NUMBER 16	RED
35	NUMBER 14	BLACK W/YELLOW
36	NUMBER 18	BLACK
37	NUMBER 18	BLACK
38	NUMBER 18	BLACK
39	NUMBER 18	BLACK
40	NUMBER 14	RED
41	NUMBER 18	GREEN
42	NUMBER 18	GREEN
43	NUMBER 18	GREEN
44	NUMBER 18	GREEN
45	NUMBER 18	GREEN
46	NUMBER 18	GREEN
47	NUMBER 18	GREEN
48	NUMBER 18	BLACK
49	NUMBER 18	YELLOW
50	NUMBER 14	BLUE
51	NUMBER 12	WHITE
52	NUMBER 14	RED
53	NUMBER 14	RED
54	NUMBER 14	RED
55	NUMBER 16	GREEN
56	NUMBER 14	RED
57	NUMBER 16	GREEN
58	NUMBER 16	BLACK
59	NUMBER 16	BROWN
60	NUMBER 12	WHITE
61	NUMBER 12	BLACK
91	NUMBER 12	BLACK
92	NUMBER 12	BLACK
93	NUMBER 14	BROWN
94	NUMBER 14	WHITE
95	NUMBER 16	YELLOW
96	NUMBER 16	BLUE

Figure 158 — Legend for Figure 157 — Wiring Diagram — Instrument Box

d. Removal (multiple water pump type).

TOOLS.

PLIERS, side cutting
SCREWDRIVER
WRENCH, 3/8-in.
WRENCH, 9/16-in.
WRENCH, 5/8-in.
WRENCH, 1 1/8-in.
WRENCH, socket, 3/8-in., 3-in. extension
WRENCH, socket, 1/2-in., 3-in. extension
WRENCH, open-end, 5/8-in.
WRENCH, spanner, closed MTM-A4-7

(1) PROCEDURE.

(a) Open Power Unit Compartment Rear Doors (par. 52., **b.**, (6)).

(b) Open Power Unit Compartment Cover (par. 55., **c.**, (1), (b)).

(c) Open Radio Switch and Battery Switch (par. 52., **b.**, (1)).

(d) Disconnect Generator Wire (fig. 159).

PLIERS, side cutting
WRENCH, socket, 3/8-in., 3-in. extension
WRENCH, socket, 1/2-in., 3-in. extension

Remove four pal nuts and four generator mounting nuts and lift generator (side cutting pliers). Remove nuts which secure wires to terminals inside terminal box and disconnect wires (3/8-in. and 1/2-in. socket wrenches, each with 3-in. extension). Unscrew knurled nut which secures conduit to terminal box and withdraw wires from box.

(e) Remove Drive Belt (par. 86., **b.**,).

(f) Remove No. 2 Ignition Coil (par. 65., **b.**,).

(g) Remove Generator and Bracket from Engine.

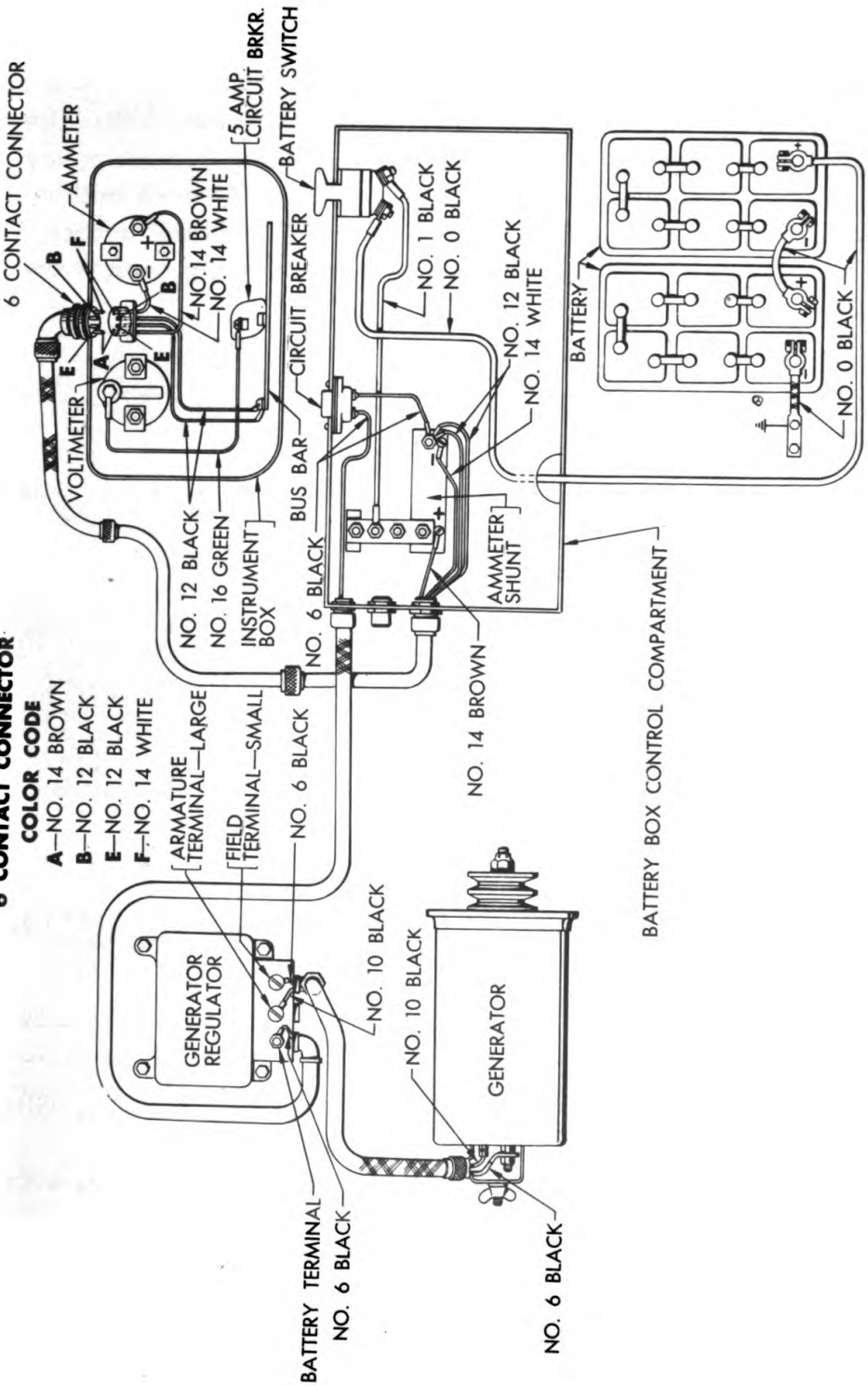
PLIERS, side cutting
SCREWDRIVER
WRENCH, open-end, 5/8-in.

Remove locking wire (side cutting pliers), remove screw (screwdriver) and remove screw which secures fuel line to top of generator. Remove four pal nuts and four generator mounting nuts and lift generator off engine (5/8-in. open-end wrench).

e. Installation (multiple water pump-type).

TOOLS.

PLIERS, side cutting
SCREWDRIVER
WRENCH, 3/8-in.
WRENCH, 9/16-in.
WRENCH, 5/8-in.
WRENCH, 1 1/8-in.
WRENCH, socket, 3/8-in., 3-in. extension
WRENCH, socket, 1/2-in. 3-in. extension
WRENCH, open-end, 5/8-in.
WRENCH, spanner, closed, MTM-A4-7



RA PD 25239

Figure 159 — Wiring Diagram — Generator Circuit

MEDIUM TANK M4A4

(1) PROCEDURE.

(a) Mount Generator and Bracket on Engine (fig. 20).

PLIERS, side cutting
SCREWDRIVER
WRENCH, open-end, 5/8-in.

Position generator and bracket on mounting studs and secure with the r mounting nuts. CAUTION: Aline generator pulley with drive pulley belt will not be under a side strain when operating. Tighten nuts se- ely and lock by installing the four pal nuts (5/8-in. open-end wrench). sition fuel line on end of generator shield and secure clip with screw rewdriver).

(b) Install No. 2 Ignition Coil (par. 65., c.,).

(c) Install Water Pump and Generator Drive Belt (par. 87., c.).

(d) Connect Generator Wires.

PLIERS, side cutting
WRENCH, socket, 3/8-in., with 3-in. extension
WRENCH, socket, 1/2-in., with 3-in. extension

nsert wires through opening in side of terminal box and tighten knurled to secure conduit. Connect small wire to terminal "F" and secure with sher and nut (3/8-in. socket wrench, with 3-in. extension). Connect large e to terminal "A" and secure with washer and nut (1/2-in. socket nch, with 3-in. extension). Install cover on box, tighten wing nut, in- t locking wire through holes in wing nut and stud and twist ends of e to secure (side cutting pliers).

(e) Operate Power Unit and Test for Operation.

(f) Close Power Unit Compartment Rear Doors (par. 53., a., (44)).

(g) Close Power Unit Compartment Cover (par. 55., d., (1) *(f)*).

. **Removal** (single water pump-type).

TOOLS.

PLIERS, side cutting
WRENCH, 1 1/8-in.
WRENCH, open-end, 7/16-in.
WRENCH, open-end, 7/8-in.
WRENCH, socket, 3/8-in., with 3-in. extension
WRENCH, socket, 1/2-in., with 3-in. extension

(1) PROCEDURE.

(a) Open Radio Switch and Battery Switch (par. 52., b., (1)).

(b) Remove Generator Cover.

Rotate turret until opening in turret floor is directly above generator. move bolt at top of generator cover (7/16-in. open-end wrench). Loosen two wing nuts at corner of cover, with fingers, and remove cover.

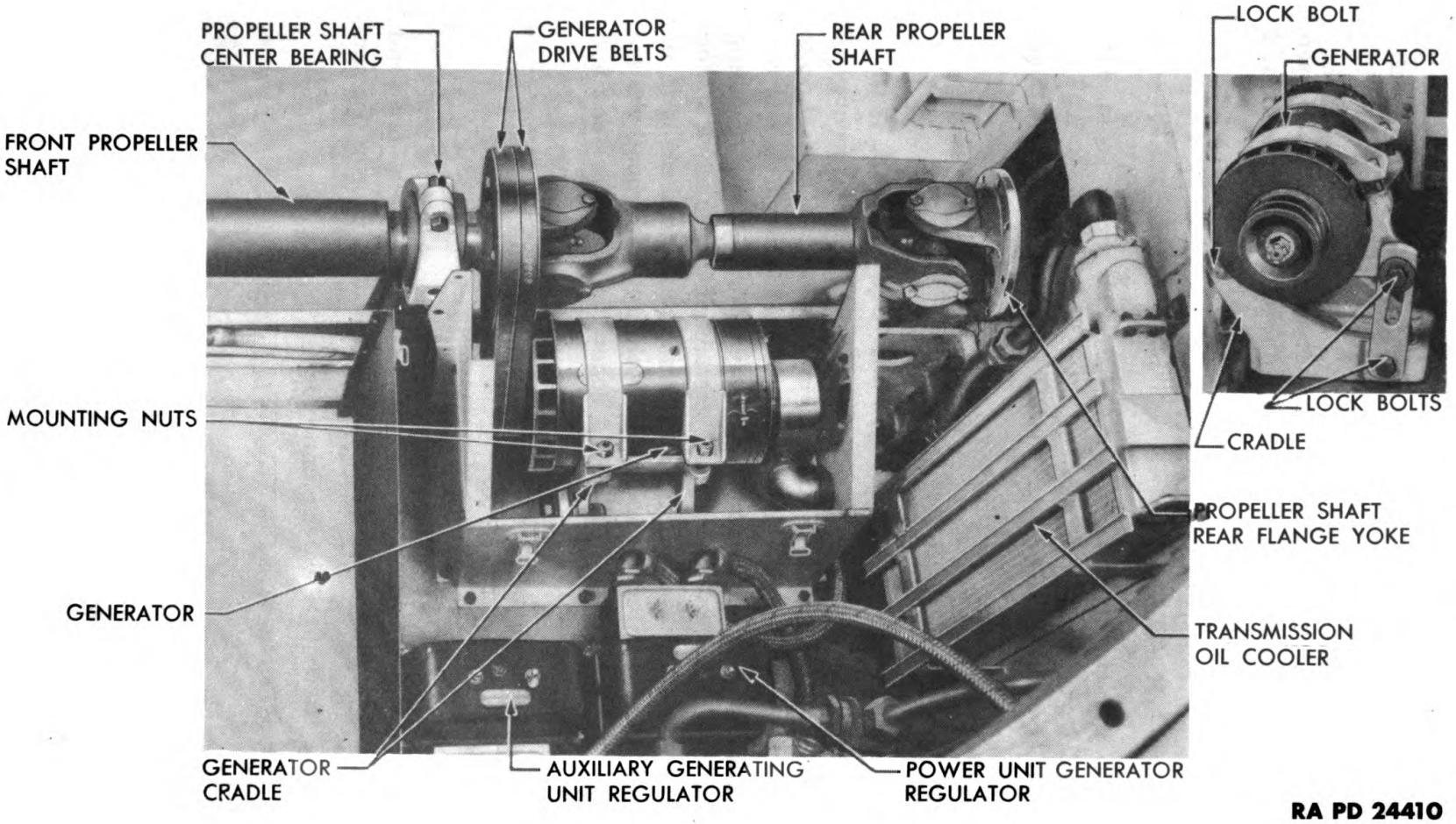


Figure 160 — Generator — Showing Drive Belts, Single Water Pump Type

(c) Disconnect Generator Wires (par. 162., **d.** (1) (d)).

(d) Remove Generator From Cradle (fig. 160).

WRENCH, 1⅛-in. WRENCH, open-end, ⅞-in.

Remove the two mounting nuts (⅞-in. open-end wrench), loosen adjusting bolt (1⅛-in. wrench), lift up on cradle, to disconnect belts, and lift generator from cradle.

g. Installation (single water pump-type).

TOOLS.

PLIERS, side cutting
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, ⅞-in.
WRENCH, socket, ⅜-in. with 3-in. extension
WRENCH, socket, ½-in., with 3-in. extension

(1) PROCEDURE.

(a) Mount Generator in Cradle (fig. 160).

WRENCH, 1⅛-in. WRENCH, open-end, ⅞-in.

Position generator in cradle (placing the drive belts in grooves of pulleys while generator is being lowered in position). NOTE: Locate generator so that dowel pin in cradle fits in hole in generator frame. Lower straps in position over generator and secure with the two mounting washers and nuts. Loosen adjusting bolt so cradle is free to move up and down (1⅛-in. wrench). Locate generator and cradle so there is ½-in. deflection of belts (measured midway between pulleys) when belts are placed under 8-lbs. to 10-lbs. pull. Hold generator in this position and tighten lock bolts (fig. 160).

(b) Connect Generator Wires (par. 162., **e.**, (1) (d)).

(c) Install Generator Cover.

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

Position cover over generator, secure with bolt ($\frac{7}{16}$-in. open-end wrench) and tighten wing nuts. Lower section of turret floor in position.

h. Drive Belts (single water pump-type).

(1) ADJUST TENSION OF BELT.

TOOLS.

SCALE WRENCH, 1⅛-in.

(a) Procedure.

(1) Remove Generator Cover (par. 162., **f.**, (1) (b)).

(2) Adjust Tension of Belt.

SCALE WRENCH, 1⅛-in.

Loosen lock bolts (fig. 160) until generator is free to move up and down. Position generator and cradle so that belts have ½-in. deflection (measured midway between pulleys) when belts are placed under 8-lbs. to 10-lbs. pull. Hold generator in this position and tighten lock bolts.

(3) Install Generator Cover (par. 162., **g.**, (1) (c)).

(2) REMOVAL OF BELTS.

TOOLS.

WRENCH, open-end, ½-in. **WRENCH**, 1⅛-in.
WRENCH, open-end, ¾-in.

(a) Procedure.

1. Remove Generator Cover (par. 162., **f.**, (1) (b)).

2. Relieve Belt Tension.

WRENCH, 1⅛-in.

Loosen lock bolts (fig. 160) until generator is free to move up and down.

3. Disconnect Propeller Shaft Flange (par. 97., **b.** (2)).

4. Remove Belts.

Slide rear propeller shaft (within slip joint) toward rear of vehicle until flanges are separate. Lift belts out of grooves in pulley and remove.

(3) INSTALLATION OF BELTS.

TOOLS.

SCALE **WRENCH**, open-end, ½-in.
WRENCH, 1⅛-in. **WRENCH**, open-end, ¾-in.

(a) Procedure.

1. Install Belts on Pulleys.

Place belts in grooves of pulleys, both on generator and propeller shaft.

2. Connect Propeller Shaft Flanges.

WRENCH, open-end, ¾-in.

Place generator drive pulley in position, slide rear propeller shaft forward (within slip joint) and connect the propeller shaft flanges with the four bolts, lock washers and nuts provided.

3. Adjust Tension of Belts (par. 162., **h.**, (1), (a), 2.).

4. Install Universal Joint Cover.

WRENCH, open-end, ½-in.

Position cover over housing and secure with cap screws.

5. Install Generator Cover (par. 162., **g.**, (1), (c)).

i. Lubrication. Multiple water pump type, apply 10 drops of OIL, engine, to each oiler every 100 hours or 1,000 miles. Single water pump type, no lubrication required.

j. Circuit Breaker.

(1) DESCRIPTION. The circuit breaker, located on the battery control box, protects the generator charging circuit in the event of an overload in the circuit (fig. 121).

(2) OPERATION. It normally carries 60 amperes and will open at 90 amperes of current, in less than one minute. It must be closed manually, pressing on the charging circuit reset button (fig. 121).

(3) REMOVAL.

TOOLS.

SCREWDRIVER, 10-in. WRENCH, open-end, $\frac{7}{16}$-in.

(a) Procedure.

1. Open Radio Switch and Battery (par. 52., b., (1)) (fig. 121).

2. Disconnect Wires from Circuit Breaker.

SCREWDRIVER, 10-in.

Unsnap the four clamps which secure cover to battery box and remove cover. Lift out sliding panel between battery box and controls. Remove the two screws and disconnect wires from terminals on circuit breaker.

3. Remove Circuit Breaker from Battery Box.

SCREWDRIVER, 10-in. WRENCH, open-end, $\frac{7}{16}$-in.

Hold the nuts at the bottom with $\frac{7}{16}$-in. open-end wrench and unscrew bolts with screwdriver. Lift circuit breaker out of battery box.

(4) INSTALLATION.

TOOLS.

SCREWDRIVER, 10-in. WRENCH, open-end, $\frac{7}{16}$-in.

(a) Procedure.

1. Mount Circuit Breaker on Battery Box and Connect Wires.

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

Position unit on battery box, insert the two bolts, hold nuts at bottom with $\frac{7}{16}$-in. open-end wrench and tighten with screwdriver. Attach the two wires (both black) to unit, securing with screws (screwdriver).

2. Install Sliding Panel and Battery Box Cover.

Slide panel into position between battery box and controls, install battery box cover and secure with clamps at each corner of box.

k. Generator Regulator.

(1) DESCRIPTION. Two generator regulators are used, one for the main generator, the other for the auxiliary generator. These regulators are identical in construction, therefore they will be treated as such in this manual. The regulator consists of three relays mounted on a common base, each with its own function to perform. These include the circuit breaker or reverse current relay, the current limit relay and the voltage regulator. It also contains a filter, built into the base of the regulator (fig. 121).

(2) PREVENTIVE MAINTENANCE.

(a) There is no attention required, other than to make sure that connections are kept tight.

(3) OPERATION.

(a) The circuit breaker, or reverse current relay, is an automatic switch between the generator and the battery which closes the charging circuit when the generator is charging and opens the circuit when it is not charging, thus preventing the battery discharging back through the generator.

(b) The current limit relay limits the generator output to 50 amperes.

(c) The voltage regulator maintains the circuit voltage fairly constant between 27 volts and 30 volts and controls the charge to the battery. As the battery becomes more completely charged, the charging rate will decrease.

(d) The filter suppresses electric oscillations which would, otherwise, cause harmful noise in the radio set.

(4) REMOVAL.

TOOLS.

PLIERS, side cutting	WRENCH, open-end, $\frac{7}{16}$-in.
SCREWDRIVER, 10-in.	WRENCH, open-end, ½-in.

(a) Procedure.

1. Open Radio Switch and Battery Switch (par. 52., **b.**, (1)).

2. Disconnect Wires.

PLIERS, side cutting	WRENCH, open-end, ½-in.
SCREWDRIVER, 10-in.	

Remove locking wires (side cutting pliers), loosen the two wing nuts and remove terminal box cover. Remove locking wires, remove screw (screwdriver) and disconnect wire from terminal. Remove nut

from other terminal and remove wire (½-in. open-end wrench). Unscrew knurled nut from side of terminal box and withdraw conduit and wires from box. Remove bolt holding clip to side of sponson and remove conduit from clip ($\frac{7}{16}$-in. open-end wrench).

3. Remove Regulator from Mounting Pads.

WRENCH, socket, ½-in., with 8-in. extension.

Remove the four mounting nuts and lift regulator off pads.

(5) INSTALLATION.

TOOLS.

PLIERS, side cutting	WRENCH, open-end, $\frac{7}{16}$-in.
SCREWDRIVER	WRENCH, open-end, ½-in.

(a) Procedure.

1. Mount regulator on mounting pads (fig. 121).

WRENCH, socket, ½-in., with 8-in. extension.

Position regulator on pads and secure with four nuts.

2. Connect Wires and Install Terminal Box Cover.

PLIERS, side cutting	WRENCH, open-end, $\frac{7}{16}$-in.
SCREWDRIVER, 10-in.	WRENCH, open-end, ½-in.

Insert wires through opening in side of terminal box and screw knurled nut on boss to secure conduit. Connect wires to respective terminal posts (governed by sizes of terminals and posts) and secure with screw (screwdriver) and nut. Attach cover to box and tighten wing nuts securely. Insert locking wire through holes in wing nuts and twist ends of wire to secure (side cutting pliers). Secure conduit to side of sponson with clip and bolt ($\frac{7}{16}$-in. open-end wrench).

163. STARTER.

a. Description. A geared direct electric starter, located between engines Nos. 1 and 2, extends through an opening in the radiator core and engages the ring gear on the power unit fan. The starter circuit (fig. 161) consists of the battery starter switch (fig. 166), starter solenoid switch (fig. 161) and the starter (fig. 161).

b. Preventive Maintenance. The inspection of the starter is largely a matter of inspection of connections, to see that they are kept clean and tight, and to make sure the starter drive gear does not become clogged with dirt or heavy oil on pinion screw.

c. Operation. Pushing of the starter switch button (fig. 166) actuates the solenoid and closes the solenoid switch, thus closing the circuit between the battery and the starter.

ELECTRICAL SYSTEM

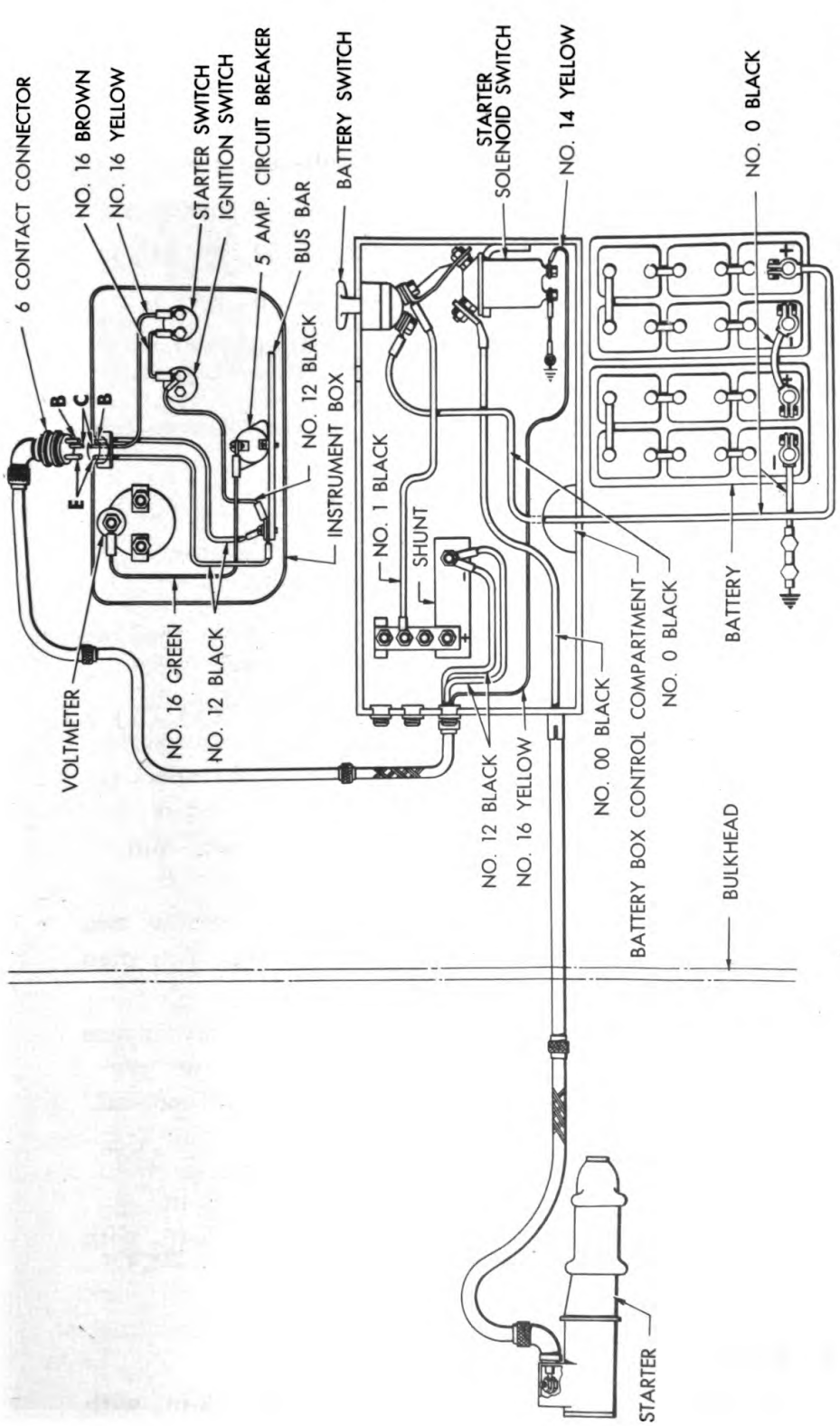


Figure 161 — Wiring Diagram Starter Circuit

d. Removal.

TOOLS.

PLIERS, side cutting
WRENCH, 9/16-in.
WRENCH, 15/16-in.
WRENCH, socket, 9/16-in.
WRENCH, socket, 7/8-in. with 6-in. extension

(1) PROCEDURE.

(a) Open Radio Switch and Battery Switch (par. 52., **b.**, (1)).

(b) Remove Power Unit Air Inlet Grille (par. 52., **b.**, (4)).

(c) Remove Shields on Either Side of Fan Compartment.

WRENCH, 15/16-in.

Remove three cap screws from each shield and lift shields from compartment.

(d) Remove Upper Section of Shroud (par. 90., **d.**, (2), (c)).

(e) Remove Starter Mounting Bolts, Forward of Radiator.

PLIERS, side cutting
WRENCH, 7/8-in.

Remove locking wires (side cutting pliers) and remove the two mounting bolts (7/8-in. wrench).

(f) Open Power Unit Compartment Cover (par. 55., **c.**, (1), (b)).

(g) Disconnect Starter Wire (par. 52., **b.**, (18)).

(h) Remove Starter from Power Unit.

PLIERS, side cutting
WRENCH, 7/8-in., with 6-in. extension

Remove locking wire (side cutting pliers) and remove the two mounting bolts (7/8-in. wrench, with 6-in. extension). Have two men lift starter from power unit.

NOTE: It will be necessary to raise starter 1/4-in., to clear dowel pins in bracket.

e. Installation.

TOOLS.

PLIERS, side cutting
WRENCH, 9/16-in.
WRENCH, 15/16-in.
WRENCH, socket, 9/16-in.
WRENCH, socket, 7/8-in., with 6-in. extension

(1) PROCEDURE.

(a) Install Starter on Power Unit.

PLIERS, side cutting
WRENCH, socket, 7/8-in., with 6-in. extension

Have two men hold unit 1/4-in. above bracket and slide unit through

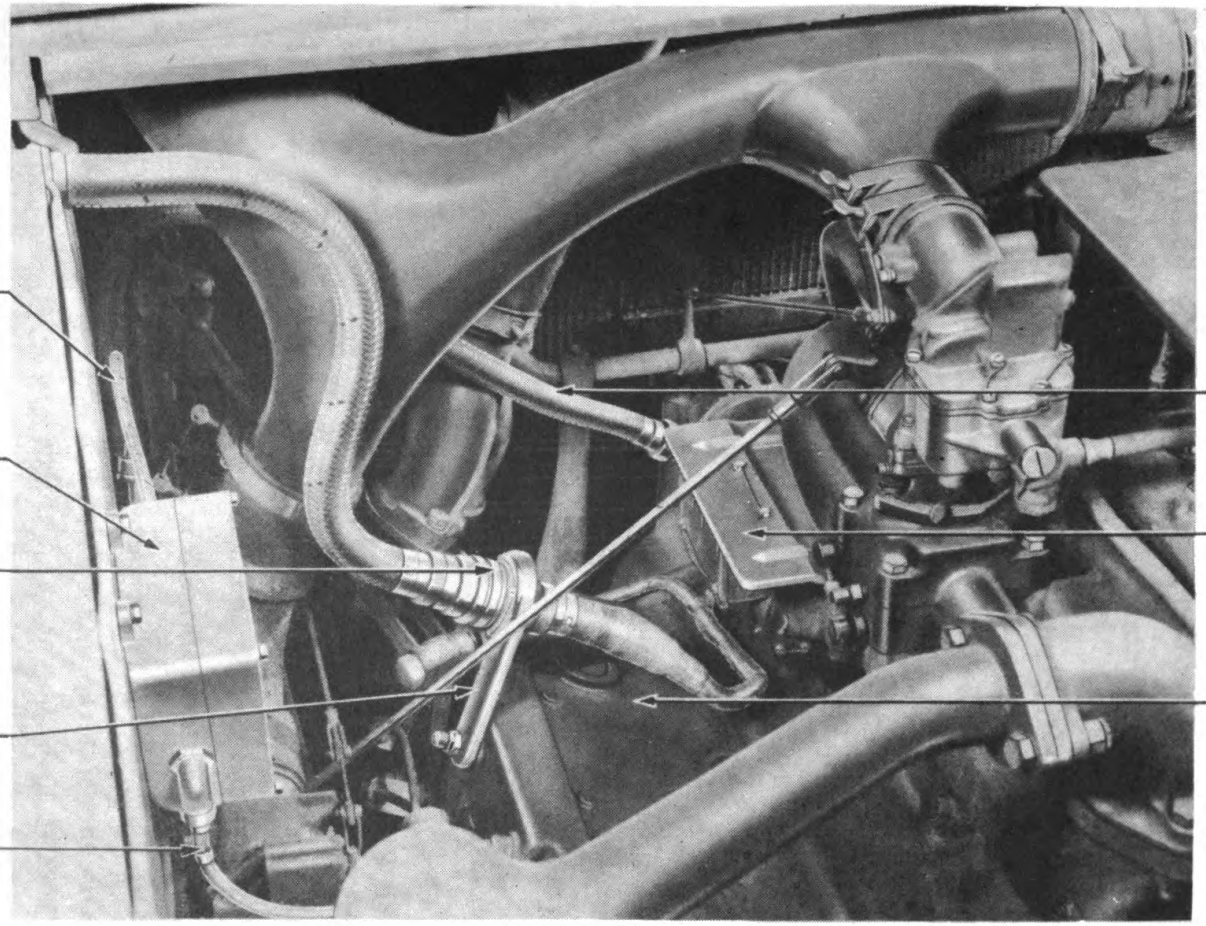


Figure 162 — Starter Motor and Ignition Filter Conduits

ning in radiator core. Lower in position until dowel pins are fully aged. Install the two mounting bolts on power unit side, tighten urely (7/8-in. socket wrench, with 6-in. extension), and insert lock- wire through holes in bolt heads and twist ends of wire to secure le cutting pliers).

b) *Connect Starter Wire* (par. 53., **a.**, (26)).

c) *Close Power Unit Compartment Cover* (par. 55., **d.**, (1), (f)).

d) *Install Starter Mounting Bolts, Forward of Radiator.*

PLIERS, side cutting WRENCH, socket, 7/8-in.

nstall the two bolts and tighten securely (7/8-in. socket wrench). ert locking wire through holes in heads of bolts and twist ends of together to secure (side cutting pliers).

e) *Test for Operation.*

lose battery switch, push starter switch button (fig. 166) and test ration of starter. Open battery switch after test.

f) *Install Shroud* (par. 90., **d.**, (2), (f)).

g) *Install Shields Over Fan Compartment.*

WRENCH, 15/16-in.

osition shields in opening, one on either side, and secure with three screws each.

h) *Install Power Unit Air Inlet Grille* (par. 53., **a.**, (42)).

Removal of Solenoid Switch (fig. 161).

TOOLS.

SCREWDRIVER, 10-in. WRENCH, open-end, 5/8-in.
WRENCH, open-end, 3/8-in.

1) PROCEDURE.

a) *Open Radio Switch and Battery Switch* (par. 52, **b.**, (1)) -

b) *Remove Batteries from Box* (par. 161., **c.**,).

c) *Lift Out Sliding Panel Between Battery Box and Control* -

d) *Disconnect Strap and Cables.*

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

emove nut from forward terminal on battery switch and disconnect e and strap from battery switch (5/8-in. open-end wrench). Remove from large terminal post on solenoid switch (toward rear of vehicle) disconnect cable (5/8-in. open-end wrench). Remove the two small from the two terminals, toward floor of vehicle, and disconnect s (3/8-in. open-end wrench).

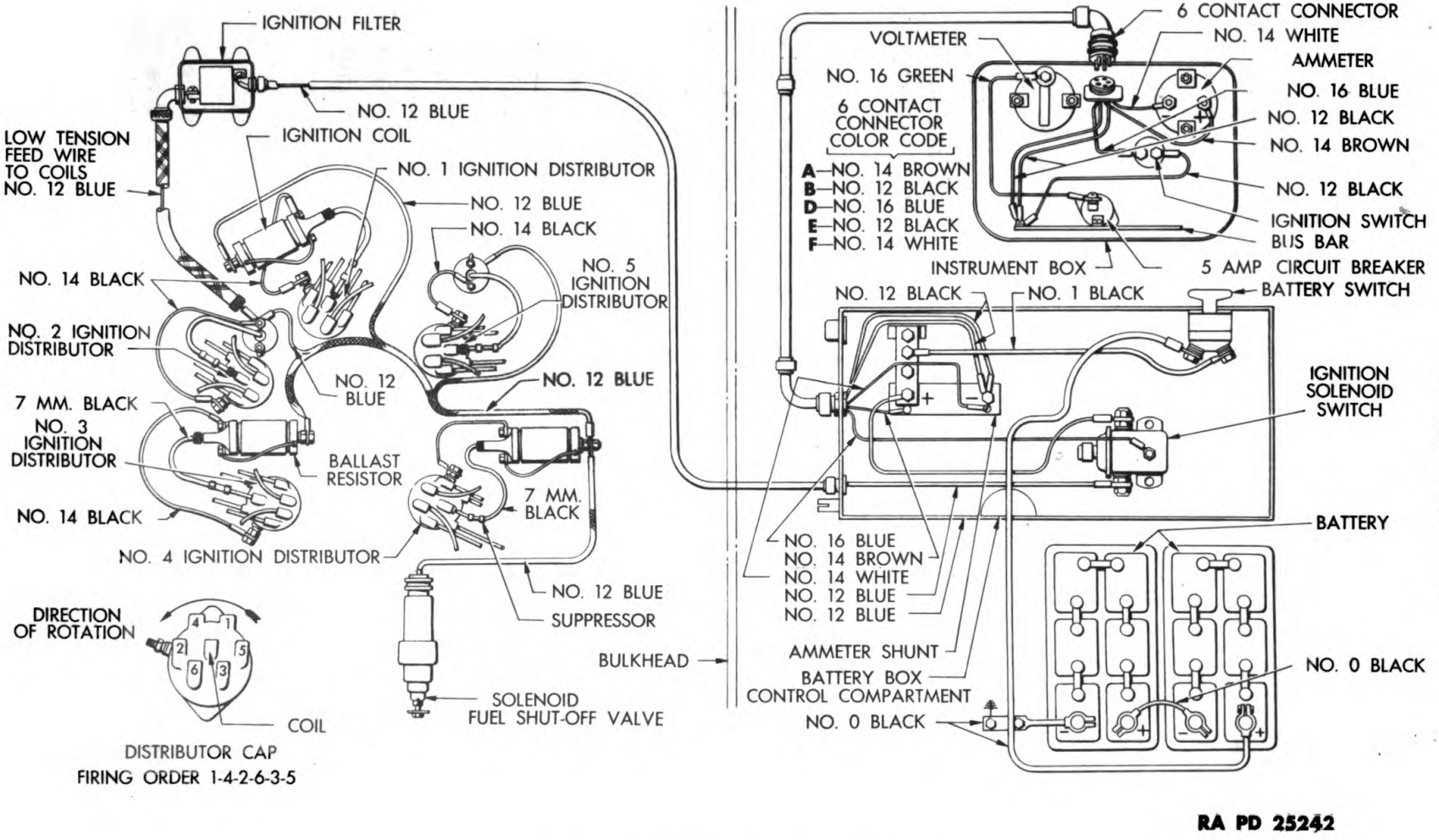


Figure 163 — Wiring Diagram — Ignition Circuit

(e) Remove Switch from Battery Box.

SCREWDRIVER, 10-in. WRENCH, open-end, 3/8-in.

Hold nuts with 3/8-in. open-end wrench, inside box, and remove the two bolts which secure switch to box.

g. Installation of Solenoid Switch (fig. 161).

TOOLS.

SCREWDRIVER, 10-in. WRENCH, open-end, 5/8-in.
WRENCH, open-end, 3/8-in.

(1) PROCEDURE.

(a) Connect Strap to Switch.

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

Position flat end of strap over large terminal post, toward switch bracket, place it in position to connect to battery switch terminal, when switch is installed in box, and secure with nut (5/8-in. open-end wrench).

(b) Mount Switch on Battery Box (fig. 161).

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

Position unit on end of battery box, insert bolts through holes from outside box, install nuts and hold with 3/8-in. open-end wrench and tighten bolts with screwdriver.

(c) Connect Cables and Strap.

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

Position end of short black wire over small terminal post (toward end of control box) and secure with lock washer and nut (3/8-in. open-end wrench). Position end of yellow wire over other small terminal post and secure with lock washer and nut (3/8-in. open-end wrench). Position end of black wire, which leads to shunt in opposite end of control box, together with strap leading from solenoid switch on battery switch terminal and secure with nut (5/8-in. open-end wrench). Position black wire, which is passed through opening in opposite end of control box, to terminal on solenoid switch and secure with nut (5/8-in. open-end wrench).

(d) Install Partition.

Slide partition into position between batteries and control box.

(e) Install Batteries (par. 161, **d.**).

164. LIGHTS.

a. Description. The lighting system consists of headlights, taillights and stop lights, for both service and blackout use, "BO" driving light, dome lights, compass light and instrument box lights (figs. 154, 164 and 165).

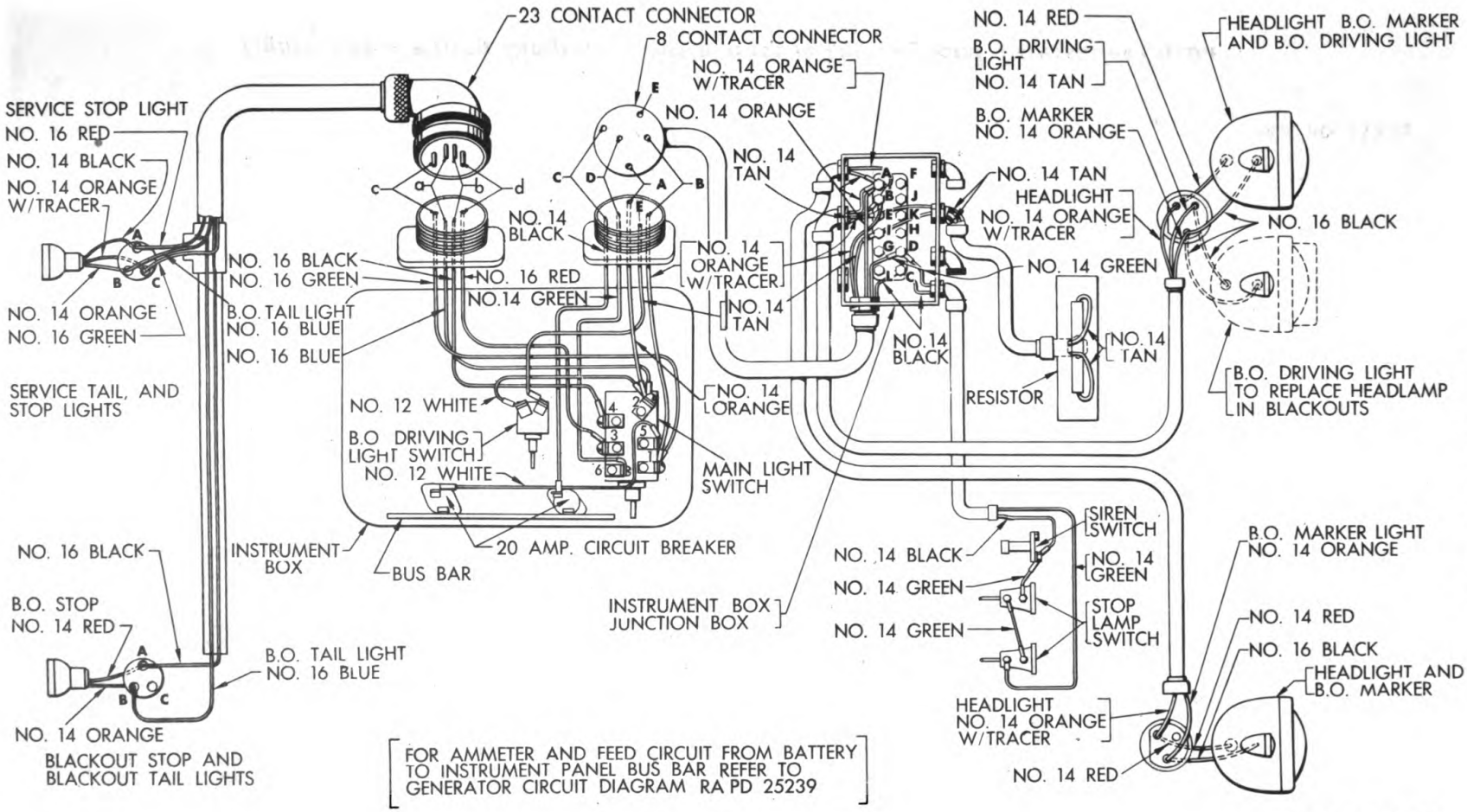
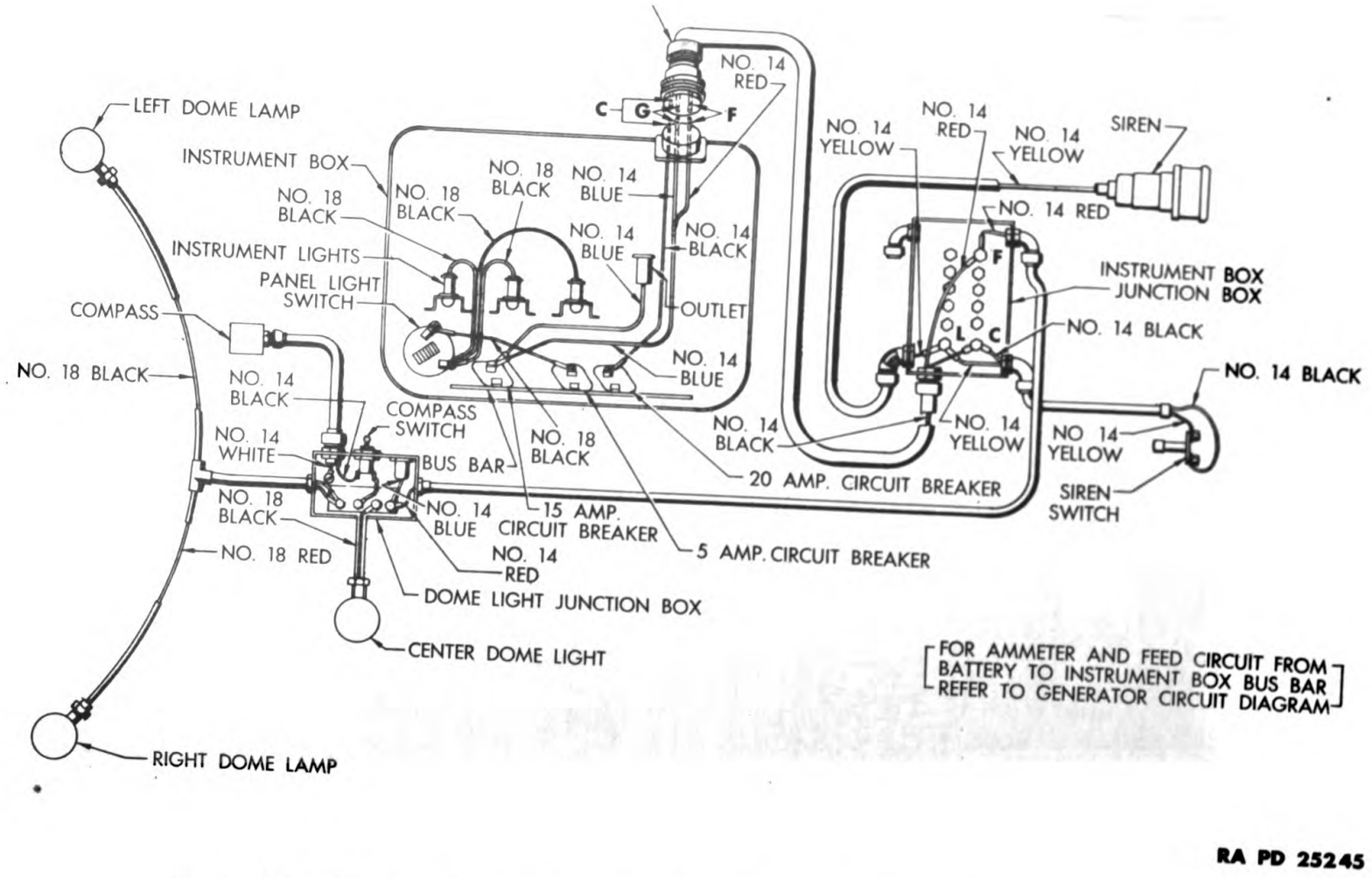


Figure 164 — Wiring Diagram — Main Lighting Circuit



RA PD 25245

Figure 165 — Wiring Diagram — Miscellaneous Lighting and Accessories Circuit

b. Headlights.

(1) REMOVAL.

(a) Procedure.

1. Pull out plunger (beneath headlight, inside vehicle) to length of travel and turn to right or left one quarter turn. With plunger in this position, have man lift headlight from socket.

(2) INSTALLATION.

(a) Procedure.

1. Place headlight in socket on outside of vehicle. Pull plunger (beneath headlight, inside vehicle) to length of travel and turn to right or left until headlight drops into place. Release plunger.

c. Taillights.

(1) REMOVAL.

TOOLS.

WRENCH, open-end, $\frac{5}{16}$-in. **WRENCH**, open-end, 1¼-in.

(a) Procedure.

1. Remove Grouser Cover (fig. 7).

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

Remove bolts which secure cover to sponson and remove cover.

2. Remove Light from Hull.

WRENCH, open-end, 1¼-in.

Unscrew knurled nut which secures wire conduit to light and pull plug from socket. Remove nut which secures light to hull, tip light slightly toward front of vehicle and lift out.

(2) INSTALLATION.

TOOLS.

WRENCH, open-end, $\frac{5}{16}$-in. **WRENCH**, open-end, 1¼-in.

(a) Procedure.

1. Mount Light on Hull.

WRENCH, open-end, 1¼-in.

Position light on hull, tip slightly toward front of vehicle and insert in mounting socket. Secure with mounting nut (1¼-in. open-end wrench). Place wire plug in socket and tighten knurled nut.

2. Install Grouser Cover (fig. 7).

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

Position grouser cover over opening in sponson and secure with attaching bolts.

MEDIUM TANK M4A4

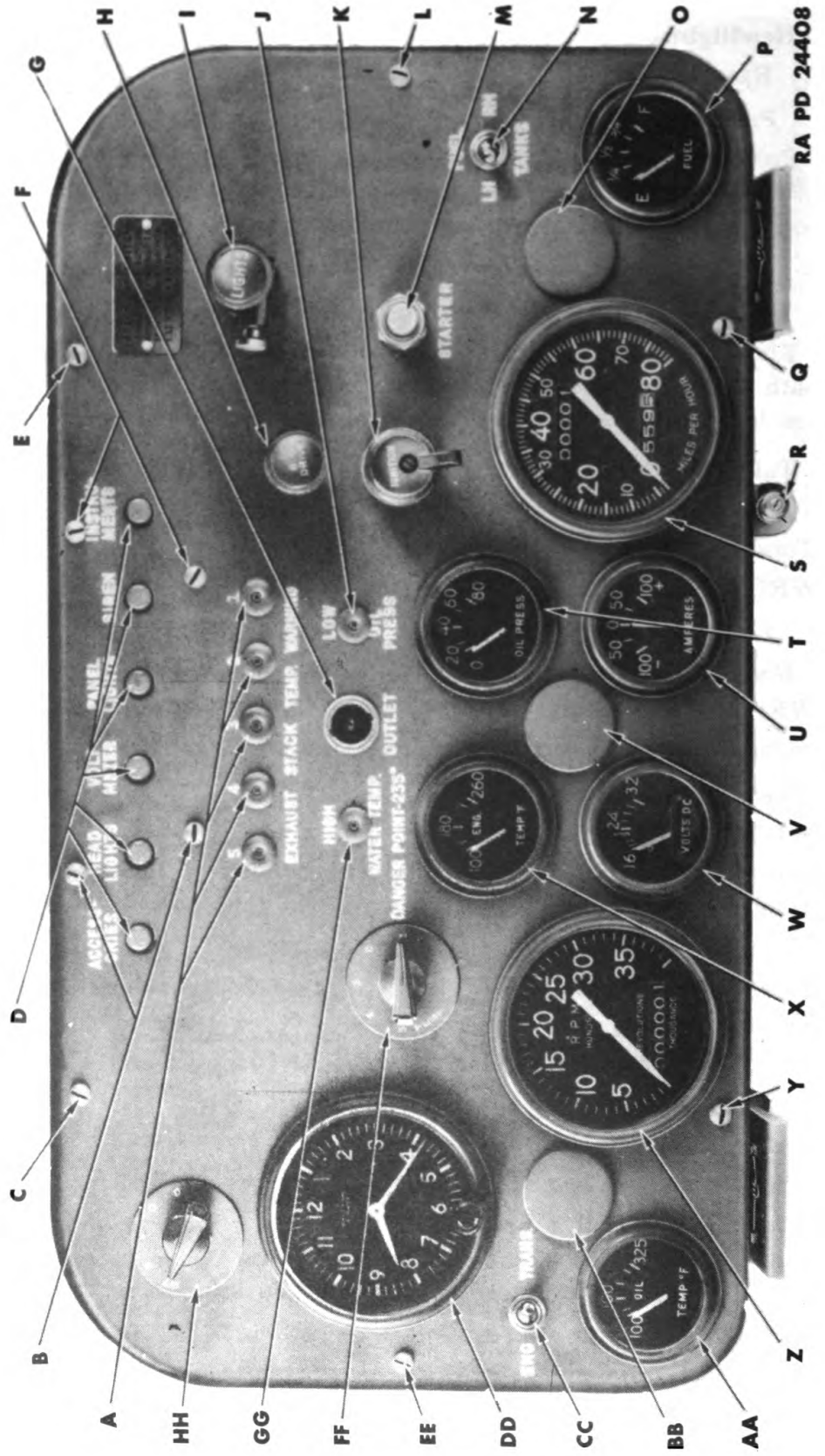


Figure 166 — Instrument Box and Instruments

ELECTRICAL SYSTEM

A—Exhaust stack temperature warning indicators
B—Circuit breaker mounting plate retaining screws
C—Cover attaching screw
D—Circuit breaker reset buttons
E—Cover attaching screw
F—Circuit breaker mounting plate retaining screws
G—Instrument box outlet socket
H—Black-out driving light switch
I—Light switch
J—Low oil pressure warning indicator
K—Ignition switch
L—Cover attaching screw
M—Starter switch
N—Fuel gage selector switch
O—Instrument box light cover
P—Fuel gage
Q—Cover attaching screw
R—Speedometer reset knob
S—Speedometer
T—Oil pressure gage
U—Ammeter
V—Instrument box light cover
W—Voltmeter
X—Water temperature gage
Y—Cover attaching screw
Z—Tachometer
AA—Power unit and transmission oil temperature gage
BB—Instrument box light cover
CC—Power unit and transmission oil temperature gage selector switch
DD—Clock
EE—Cover attaching screw
FF—Water temperature gage selector switch
GG—High water temperature warning indicator
HH—Instrument box light switch

RA PD 24408—B

Figure 167 — Legend for R.A.P.D. 24408

d. Dome Lights.

(1) REMOVAL.

TOOLS.

SCREWDRIVER, 6-in. WRENCH, open-end, ½-in.

(a) Procedure.

1. Disconnect Wires.

SCREWDRIVER, 6-in.

Remove nut which connects dome light to rigid conduit. Remove two screws which secure dome light cover (screwdriver). Remove screw which secures wire to dome light switch (screwdriver). Remove two screws which secure socket and switch shell (screwdriver) and lift dome light out.

2. Remove Switch from Shell.

WRENCH, open-end, ½-in.

Remove nut which secures switch to shell and separate.

(2) INSTALLATION.

TOOLS.

SCREWDRIVER, 6-in. WRENCH, open-end, ½-in.

(a) Procedure.

1. Assemble Switch to Shell.

WRENCH, open-end, ½-in.

Position switch in shell and secure with mounting nut.

2. Mount Dome Light and Switch.

SCREWDRIVER, 6-in.

Position dome light and switch and secure with two attaching screws.

3. Connect Wires.

SCREWDRIVER, 6-in.

Connect wire to dome light switch and secure with screw. Install dome light cover and secure with two screws. Connect rigid conduit to light and secure with knurled nut.

165. INSTRUMENT BOX AND INSTRUMENTS.

a. Description. Instruments pertaining to the operation of the vehicle are contained in the instrument box (fig. 166), located in front and to the left of the driver. All instruments are mounted on the instrument box cover, which is removable, being held in place by six screws (fig. 166). With the exception of the speedometer and tach-

ometer, it is necessary to first remove the cover from the box, before removal of the instruments. The speedometer and tachometer can be removed after first removing a cover, directly behind each instrument, held in place by three studs and nuts. In order to eliminate repetition in the removal and installation of the various instruments, the removal and installation of the instrument box cover is covered under "Cover Removal" (par. **d.**, below) and under "Cover Installation" (par. **e.**, below). NOTE: All references to right, left, upper and lower, used in the location of the various wires when installing instruments in the instrument box cover, refer to the locations as shown in fig. 168.

b. Removal.

TOOLS.

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

(1) PROCEDURE.

(a) Disconnect Wires.

Reach back of box and unscrew the knurled nuts on each of the three connectors and pull on connectors to separate.

(b) Remove Box Assembly.

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

Remove the six attaching cap screws and lift assembly from hull.

c. Installation.

TOOLS.

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

(1) PROCEDURE.

(a) Mount Box Assembly on Hull.

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

Position box on hull and secure with the six cap screws.

(b) Connect Wires.

Insert each of the three connectors into socket in back of instrument box (governed by size of connector) and press into socket. NOTE: When making these connections, be sure to aline the keyway in connector with key inside socket.

d. Cover Removal (fig. 166).

TOOLS.

SCREWDRIVER PLIERS, adjustable

(1) PROCEDURE.

(a) Remove Cover Attaching Screws.

SCREWDRIVER

Remove the six cover attaching screws and remove from cover (screwdriver) (fig. 166).

(b) Remove Cover From Instrument Box.

PLIERS

Loosen the knurled nut which secures the speedometer reset cable to a bracket at the lower right hand corner of the instrument box (turn counterclockwise) and slide the cable conduit to the right and out of the bracket, which is slotted (pliers).

Slide cover and instruments away from box.

e. Cover Installation (fig. 166).

TOOLS.

SCREWDRIVER

(1) PROCEDURE.

(a) Place Speedometer Reset Cable in Position to Install Cover.

Pass end of cable through large opening in cover directly back of speedometer, passing it through small hole in rubber grommet and insert grommet in opening in cover.

(b) Mount Cover on Instrument Box.

SCREWDRIVER

Place cover in position over opening in instrument box and slide flange of cover over outside of box. CAUTION: Be sure that all wires are inside box when making this installation, to eliminate any danger of cutting the wires. Secure cover to instrument box with six cover attaching screws.

166. SPEEDOMETER.

a. Description. The speedometer (fig. 166) is a magnetic type and is driven by a cable which is connected to an adapter mounted on the transmission (fig. 9). It registers the vehicle speed in miles per hour, as well as records the trip mileage and accumulated mileage. A reset knob, secured to a bracket at the lower right hand corner of the instrument box, and connected to the speedometer by a flexible cable, permits resetting of the trip.

b. Operation of Reset Knob.

(1) PUSH KNOB AND TURN TO RESET AS DESIRED.

c. Removal.

TOOLS.

PLIERS, adjustable
WRENCH, ½-in.
WRENCH, socket, ⅜-in.

(1) PROCEDURE.

(a) Remove Cover.

PLIERS, adjustable
WRENCH, ½-in.

Reach around back of instrument box and remove the three nuts which secure the small cover to instrument box, directly back of speedometer (½-in. wrench). Loosen knurled nut which secures speedometer reset cable to the bracket at the bottom of instrument box, at the right hand side, and slide cable to the right and out of the slotted bracket (pliers). Remove rubber grommet from the opening in the cover on back of instrument box and remove grommet from cable. Pull cover away from box and free of reset cable.

(b) Remove Speedometer from Box.

PLIERS, adjustable
WRENCH, socket, ⅜-in.

Reach through opening in instrument box and remove the two nuts and lock washers and remove bracket which secures speedometer to cover (⅜-in. socket wrench). Unscrew nut, in center of speedometer, which secures drive cable to speedometer (adjustable pliers). Push speedometer out through opening in cover and remove.

d. Installation.

TOOLS.

PLIERS, adjustable
WRENCH, ½-in.
WRENCH, socket, ⅜-in.

(1) PROCEDURE.

(a) Mount Speedometer on Cover.

WRENCH, socket, ⅜-in.

Pass reset cable through openings in cover and instrument box and position properly in cover. Reach through opening in box and place mounting bracket over the studs and secure with the two lock washers and nuts. Tighten nuts securely (⅜-in. socket wrench).

(b) Connect Drive Cable.

PLIERS, adjustable.

Pass drive cable through small opening in instrument box back cover and connect to speedometer inserting square end of cable in opening in

center of speedometer, screwing the nut on end of cable housing onto the threaded boss in center of speedometer. Tighten nut securely.

(c) Install Back Cover.

WRENCH, ½-in.

Position cover over the three studs and secure with the self-locking nuts. Tighten nuts securely. Insert rubber grommet in opening in cover around reset cable conduit, with conduit passing through small hole in grommet. Slide reset cable conduit into slotted bracket on lower side of instrument box, at right end, and secure to bracket by tightening knurled nut securely with pliers.

e. Replace Cable.

TOOLS.

PLIERS, adjustable WRENCH, ½-in.

(1) PROCEDURE.

(a) Disconnect Cable Housing from Transmission (fig. 9).

PLIERS, adjustable

Unscrew knurled nut which secures housing to adapter on right side of transmission housing and separate housing from adapter.

(b) Disconnect Cable Housing from Instrument Box.

PLIERS, adjustable WRENCH, ½-in.

Remove cover (par. 166., **c.**, (1), (a)). Reach through opening in back of instrument box and unscrew knurled nut, in center of speedometer, which secures cable housing to speedometer.

(c) Remove Cable from Housing.

PLIERS, adjustable

Grasp end of cable with pliers and withdraw cable from speedometer end of housing. CAUTION: If same cable is to be reinstalled, be very careful not to let cable contact any dirt.

(d) Install Cable in Housing.

Remove all dirt from cable and make sure cable is free of sharp kinks. Hold square end of cable and insert opposite end in housing, rotating cable to permit passing it through housing the full distance.

(e) Connect Cable Housing to Speedometer.

PLIERS, adjustable

Insert end of housing through small opening in back cover, insert square end of cable in square opening in speedometer, install knurled nut and tighten with pliers. Install cover on back of instrument box (par. 166., **d.**, (1), (c)).

(f) Connect Cable Housing to Transmission (fig. 9).

PLIERS, adjustable

Insert end of cable in opening in center of adapter, install knurled nut and tighten with pliers.

167. TACHOMETER.

a. Description. The tachometer is used to register power unit revolutions per minute. An odometer incorporated in the same unit records, in thousands, the total power unit revolutions (fig. 166). It is driven by a flexible encased shaft connecting to the tachometer drive on the distributor end of No. 1 engine (fig. 20).

b. Removal.

TOOLS.

PLIERS, adjustable
WRENCH, ½-in.
WRENCH, socket, ⅜-in.

(1) PROCEDURE.

(a) Remove Cover.

WRENCH, ½-in.

Reach around back of instrument box and remove the three nuts which secure the small cover to the instrument box, directly back of tachometer. Slide cover away from instrument box.

(b) Disconnect Drive Cable.

PLIERS, adjustable

Reach through opening in back of instrument box and unscrew knurled nut which secures housing to center of tachometer.

(c) Disconnect Tachometer from Instrument Box Cover.

WRENCH, socket, ⅜-in.

Reach through opening in back of instrument box and remove the two nuts and lock washers which secure the mounting bracket to tachometer, and withdraw tachometer from front of instrument box cover.

c. Installation (fig. 166).

TOOLS.

PLIERS, adjustable
WRENCH, socket, ⅜-in.
WRENCH, ½-in.

(1) PROCEDURE.

(a) Mount Tachometer on Instrument Box Cover.

WRENCH, socket, ⅜-in.

Insert tachometer through opening in instrument box cover (from front of cover) and aline properly. Reach through opening in back of instrument box and place mounting bracket over the two studs in tachometer body and secure with the two lock washers and nuts. Tighten nuts securely.

(b) Connect Drive Cable.

PLIERS, adjustable

Pass drive cable and conduit through small opening in the small cover which attaches to the back of instrument box, insert the square end of drive shaft in the square opening in center of tachometer and secure the drive shaft housing to tachometer with nut. Tighten nut securely.

(c) Install Cover.

WRENCH, ½-in.

Slide cover along drive cable housing and place in position over three mounting studs. Secure with the three self-locking nuts.

d. Replace Cable.

TOOLS.

PLIERS, adjustable
WRENCH, ½-in.
WRENCH, 1⅛-in.

(1) PROCEDURE.

(a) Disconnect Cable Housing from No. 1 Engine (fig. 20).

PLIERS, adjustable
WRENCH, 1⅛-in.

Remove cap screws at center of doors, where doors overlap and open power unit compartment rear doors (1⅛-in. wrench). Unscrew knurled nut which secures housing to tachometer adapter on distributor end of No. 1 engine (adjustable pliers). Slide knurled nut away from end of housing and remove "C" washer from end of cable (if so equipped).

(b) Disconnect Cable Housing from Instrument Box.

PLIERS, adjustable
WRENCH, ½-in.

Remove cover from back of instrument box (par. 167., **b.**, (1), (a)). Reach through opening in instrument box and unscrew knurled nut which secures housing to center of tachometer (adjustable pliers).

(c) Remove Cable from Housing.

PLIERS, adjustable

Grasp end of cable with pliers and withdraw it from tachometer end of housing. CAUTION: If same cable is to be reinstalled, be very careful not to allow it to come in contact with dirt.

(d) Install Cable in Housing.

Remove all dirt from cable and make sure cable is free from sharp kinks. Hold square end of cable and insert opposite end in housing, forcing it into housing the full distance.

(e) Connect Cable Housing to Instrument Box.

PLIERS, adjustable

Insert end of housing through small opening in back cover, insert end of cable in square opening in center of tachometer and secure housing by screwing knurled nut onto tachometer.

(f) Install Back Cover (par. 167., c., (1), (c)).

(g) Connect Cable Housing to No. 1 Engine (fig. 20).

PLIERS, adjustable WRENCH, 1⅛-in.

Install "C" washer in slot in end of cable (where so equipped), insert end of cable in opening in tachometer adapter and secure housing to adapter with knurled nut. Close power unit compartment rear doors and secure with cap screws (1⅛-in. wrench).

168. CLOCK.

a. Description. An eight day clock is mounted on the left side of the instrument box cover and is held in place by a mounting clamp and two wing nuts. A knob, for winding and resetting, protrudes through the face of the clock. To wind clock, turn knob clockwise. To reset clock, push in on knob and turn as necessary.

b. Removal (fig. 166).

TOOLS.

PLIERS, side cutting

(1) PROCEDURE.

(a) Remove Wing Nuts.

PLIERS, side cutting

Remove locking wire from the nuts and unscrew nuts from studs.

(b) Remove Clock from Cover.

Remove mounting clamp from studs and withdraw clock from front of cover.

c. Installation.

TOOLS.

PLIERS, side cutting

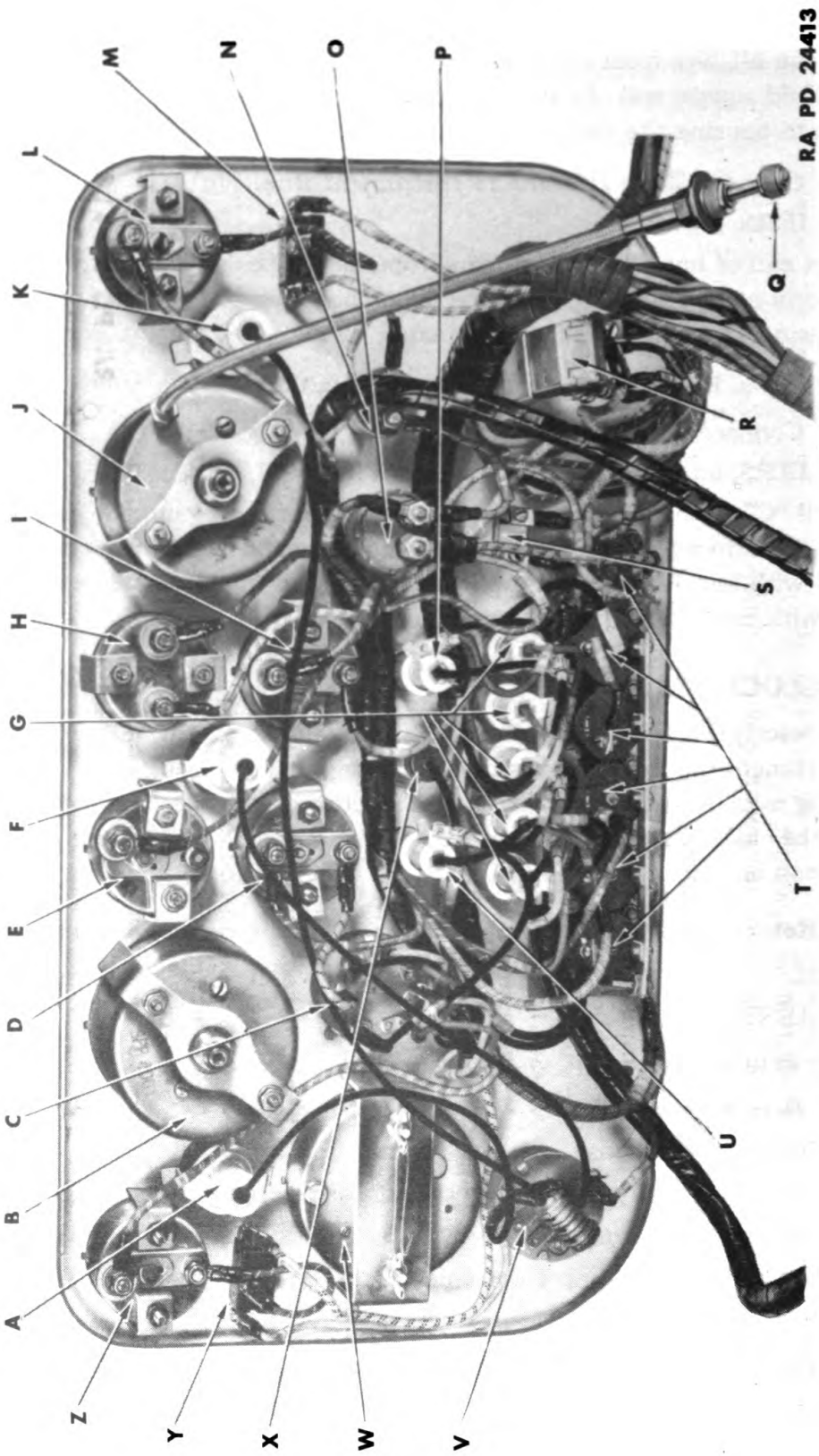


Figure 168 — Instrument Box Cover and Instruments — Back View

A—Instrument box light
B—Tachometer
C—Water temperature gage selector switch
D—Water temperature gage
E—Voltmeter
F—Instrument box light
G—Exhaust stack temperature warning indicators
H—Ammeter
I—Oil pressure gage
J—Speedometer
K—Instrument box light
L—Fuel gage
M—Fuel gage selector switch
N—Starter switch
O—Ignition switch
P—Low oil pressure warning indicator
Q—Speedometer reset knob
R—Light switch
S—Black-out driving light switch
T—Circuit breakers
U—High water temperature warning indicator
V—Instrument box light switch
W—Clock
X—Instrument box outlet socket
Y—Power unit and transmission oil temperature gage selector switch
Z—Power unit and transmission oil temperature gage

RA PD 24413—B

Figure 169 — Legend for R.A.P.D. 24413

(1) PROCEDURE.

(a) Mount Clock in Cover.

Insert clock through opening in instrument box cover, aline properly and place mounting clamp over the two studs. Secure mounting clamp with two wing nuts. Lock nuts in place by passing locking wire through holes in wing nuts and twisting ends of wire together.

169. OIL TEMPERATURE GAGE.

a. Description. An oil temperature gage, mounted at the lower left-hand corner of the instrument box cover, registers the temperature of the oil, both in the power unit and in the transmission (fig. 166). It works in conjunction with a sending unit mounted on the power unit scavenger oil pump discharge tube (figs. 33 and 35) and a similar unit mounted on the transmission to oil cooler oil tube (fig. 100). Selection for the respective readings is made through operation of the "Power Unit and Transmission Oil Temperature Gage Selector Switch" (fig. 166).

b. Operation. Push lever of power unit and transmission oil temperature gage selector switch (fig. 166) toward side labeled "ENG." and note reading on gage, to determine temperature of power unit oil. Push lever of this same switch toward side marked "TRANS." and note reading on gage, to determine temperature of transmission oil.

c. Removal.

TOOLS.
WRENCH, 3/8-in.

(1) PROCEDURE.

(a) Disconnect Wires from Switch (fig. 168).

WRENCH, 3/8-in.

Remove the two nuts from terminal posts and lift wires off posts.

(b) Remove Gage from Cover.

WRENCH, 3/8-in.

Remove the two nuts which secure the two mounting clamps to gage, remove lock washers and clamps and withdraw gage from front of instrument box cover.

d. Installation.

TOOLS.
WRENCH, 3/8-in.

(1) PROCEDURE.

(a) Mount Gage in Instrument Box Cover.

WRENCH, 3/8-in.

Insert gage through opening in cover, aline properly, place mounting clamps over the two mounting studs and secure with two lock washers and nuts. Tighten nuts securely.

(b) Connect Wires (fig. 168).

WRENCH, 3/8-in.

Place red wire, labeled "H," over upper terminal post and secure with self-locking nut. Place green wire, which leads to selector switch, over lower terminal post and secure with self-locking nut.

e. Power Unit and Oil Temperature Gage Selector Switch Removal.

TOOLS.

PLIERS, adjustable SCREWDRIVER

(1) PROCEDURE.

(a) Remove Switch from Instrument Box Cover.

PLIERS, adjustable

Unscrew knurled nut from switch, where boss of switch protrudes through cover, with a pair of pliers and withdraw switch from back of cover.

(b) Disconnect Wires (fig. 168).

SCREWDRIVER

Remove three screws and remove the three wires from switch.

f. Power Unit and Oil Temperature Gage Selector Switch Installation.

TOOLS.

PLIERS, adjustable SCREWDRIVER

(1) PROCEDURE.

(a) Connect Wires to Switch (fig. 168).

SCREWDRIVER

Remove the three wire attaching screws from the three switch terminals. Hold the switch in position above the opening in instrument box cover (with the three terminals, which are mounted off center on the switch) toward the oil temperature gage. Connect the large white wire, labeled "H," to the right terminal and secure with screw. Connect the small white wire, labeled "L," to the left terminal and secure with screw. Connect the short green wire to the center terminal and secure with screw.

(b) Mount Switch in Instrument Box Cover (fig. 166).

PLIERS, adjustable.

Remove knurled attaching nut from switch, insert switch through opening in cover, from back of panel and position switch so that the three terminals (which are mounted off center on the switch) are near the oil temperature gage and secure to cover by installing the knurled nut on the threaded section of the switch which protrudes through cover. Hold switch in position and tighten nut securely.

g. Power Unit Oil Temperature Gage Sending Unit.

(1) DESCRIPTION. A sending unit is mounted on the scavenger oil pump discharge tube from crankcase to power unit oil cooler (fig. 35).

(2) POWER UNIT OIL TEMPERATURE GAGE SENDING UNIT REMOVAL.

TOOLS.

SCREWDRIVER
WRENCH, 7/8-in.
WRENCH, open-end, 1-in.

(a) Procedure.

1. Remove Inspection Plate from Hull (par. 52., b., (7)).

2. Remove Sending Unit from Oil Tube (figs. 35 and 37).

SCREWDRIVER
WRENCH, open-end, 1-in.

Remove two screws from shield on end of unit (screwdriver), separate shield and pull wire out of center of sending unit. Unscrew unit from oil tube (turn counterclockwise) (1-in. open-end wrench).

(3) POWER UNIT OIL TEMPERATURE GAGE SENDING UNIT INSTALLATION.

TOOLS.

SCREWDRIVER
WRENCH, 7/8-in.
WRENCH, open-end, 1-in.

(a) Procedure.

1. Install Sending Unit in Oil Tube.

SCREWDRIVER
WRENCH, open-end, 1-in.

Cover threads on unit with sealing compound and screw sending unit into the "Tee," in the opening which faces toward crankcase (figs. 35 and 37) (turn clockwise). Tighten securely (1-in. open-end wrench). Connect wire to unit by inserting end of wire into opening in center of unit, install shield around end of unit and secure with two screws (screwdriver).

2. Test for Leaks.

Operate power unit and examine connection for oil leaks.

3. Install Inspection Plate (par. 53., a., (41)).

(4) TRANSMISSION OIL TEMPERATURE GAGE SENDING UNIT REMOVAL.

TOOLS.

SCREWDRIVER WRENCH, 1-in.

(a) Procedure.

1. Disconnect Wire from Sending Unit (fig. 100).

SCREWDRIVER

Disassemble shield by removing the screws and remove shield from unit. Disconnect wire from unit by pulling on wire.

2. Remove Unit from Oil Line (fig. 100).

WRENCH, 1-in.

Unscrew unit from oil line (turn counterclockwise).

(5) TRANSMISSION OIL TEMPERATURE GAGE SENDING UNIT INSTALLATION.

TOOLS.

SCREWDRIVER WRENCH, 1-in.

(a) Procedure.

1. Assemble Unit in Oil Line.

WRENCH, 1-in.

Cover threads of unit with sealing compound and assemble unit in oil line by screwing unit into transmission oil line outlet connection (fig. 100) (turn clockwise).

2. Connect Wire to Unit (fig. 100).

SCREWDRIVER

Insert wire into opening in center of unit and push all the way into opening (until it clamps into place). Bend wire so as to fit in opening in side of shield, assemble shield and secure with three screws.

170. VOLTMETER.

a. Description. A voltmeter, located at lower center of instrument box cover, indicates the voltage in the circuit. It is connected through a 5-ampere circuit breaker.

b. Removal (fig. 166).

TOOLS.

WRENCH, 3/8-in.

(1) PROCEDURE.

(a) Disconnect Wire (fig. 168).

WRENCH, 3/8-in.

Hold wire near terminal post with fingers (to prevent turning of post) and remove nut from post.

(b) Remove Unit from Cover.

WRENCH, 3/8-in.

Remove two nuts and lock washers and withdraw unit through face of cover.

c. Installation.

TOOLS.

WRENCH, 3/8-in.

(1) PROCEDURE.

(a) Install Unit in Cover (fig. 166).

WRENCH, 3/8-in.

Insert unit through opening in cover (from face of cover) and position in opening. Place a clamp over each mounting stud on unit and secure with lock washer and nut on each stud.

(b) Connect Wire (fig. 168).

WRENCH, 3/8-in.

Place the green wire (labeled "A") over the terminal post and secure with self-locking nut. Hold wire near terminal post with fingers (to prevent turning of post) and tighten nut securely.

171. AMMETER.

a. Description. The ammeter indicates the amount of current in amperes charging into or discharging from the battery. The amount of current will vary depending on the power unit speed and electrical units in use.

b. Removal (fig. 166).

TOOLS.

WRENCH, 3/8-in.

(1) PROCEDURE.

(a) Disconnect Wires (fig. 168).

Hold wires near terminal posts with fingers (to prevent turning of posts) and remove the two nuts which secure the two wires to terminal posts. Remove wires from posts.

(b) Remove Unit from Cover.

WRENCH, 3/8-in.

Remove the nuts and lock washers which secure the mounting clamps and remove clamps. Withdraw unit from front of cover.

c. Installation (fig. 166).

TOOLS.

WRENCH, 3/8-in.

(1) PROCEDURE.

(a) Install Unit in Cover.

WRENCH, 3/8-in.

Insert unit through opening in cover (from face of cover) and position in opening. Place a clamp over each mounting stud on unit and secure with lock washer and nut on each stud.

(b) Connect Wires (fig. 168).

WRENCH, 3/8-in.

Place the end of brown wire (labeled "A") over right-hand terminal post and screw nut on post with fingers to hold wire in place. Place the end of white wire (labeled "F") over left-hand terminal post and screw nut on post with fingers to hold nut in place. Hold wire with fingers in such position as to avoid contact with mounting stud or other instruments and tighten nuts securely.

172. OIL PRESSURE GAGE.

a. Description. The oil pressure gage registers the pressure of the oil in the power unit lubrication system (fig. 166). It is connected to, and actuated by, a sending unit mounted on the underside of No. 4 engine and connected to the oil gallery of No. 4 engine (on power units equipped with the multiple water pumps) (fig. 24). On power units equipped with the single water pump, this unit is mounted on the upper side of No. 3 engine and connected to the oil gallery of No. 3 engine (fig. 23). Connection between the sending unit on the engine and the oil pressure gage on instrument box cover is electrical.

b. Removal.

TOOLS.

WRENCH, socket, 3/8-in.

(1) PROCEDURE.

(a) Disconnect Wires (fig. 168).

WRENCH, socket, 3/8-in.

Hold wires near terminal posts with fingers (to prevent turning of posts) and remove the two nuts which secure wires to posts.

(b) Remove Unit from Cover.

WRENCH, socket, 3/8-in.

Remove the two nuts and lock washers which secure the clamps to the mounting studs, remove clamps and withdraw unit from front of cover.

c. Installation (fig. 166).

TOOLS.

WRENCH, socket, 3/8-in.

(1) PROCEDURE.

(a) Install Unit in Cover.

WRENCH, socket, 3/8-in.

Insert unit in opening in cover (from face of cover) and position in opening. Place the two mounting clamps over the mounting studs on unit and secure with two lock washers and nuts.

(b) Connect Wires.

WRENCH, socket, 3/8-in.

Place the end of red wire (labeled "H"), which enters loom near speedometer, over the upper terminal post and start self-locking nut with fingers, to hold wire in place. Place the end of yellow wire (labeled "K") over the lower terminal post and start self-locking nut with fingers, to hold wire in place. Hold the wires near terminal posts with fingers (to prevent turning of posts), and in such position that wires do not come in contact with mounting studs or other instruments, and tighten nuts securely.

d. Oil Pressure Gage Sending Unit Removal from Power Unit Equipped with Multiple Water Pumps.

TOOLS.

SCREWDRIVER
WRENCH, open-end, 7/16-in.
WRENCH, 1-in.

(1) PROCEDURE.

(a) Remove Inspection Plate (par. 52., b., (7)).

(b) Remove Unit from Engine (fig. 24).

SCREWDRIVER
WRENCH, open-end, 7/16-in.

Reach through opening in hull floor, remove two screws from shield on end of unit, separate shield and disconnect wire by pulling wire out of opening in center of unit. Unscrew unit from engine (turn counterclockwise) and withdraw unit through opening in floor ($\frac{7}{16}$-in. open-end wrench).

e. Oil Pressure Gage Sending Unit Installation on Power Units Equipped with Multiple Water Pumps.

TOOLS.

SCREWDRIVER
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, 1-in.

(1) PROCEDURE.

(a) Install Unit on Engine (fig. 24).

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

Clean area around opening in No. 4 engine to receive unit, to prevent any dirt entering the oiling system. Cover threads of unit with sealing compound and screw unit into opening in oil gallery of No. 4 engine (turn clockwise). Tighten unit securely. Connect wire to terminal in center of unit by inserting end of wire into opening in center of unit and pressing into place, position shield around end of unit and secure with two screws (screwdriver).

(b) Test for Leaks and Operation.

Operate power unit and examine connections for oil leaks. Note reading of oil pressure gage on instrument box (fig. 166).

(c) Install Inspection Plate (par. 53., **a.**, (41)).

f. Oil Pressure Gage Sending Unit Removal from Power Unit Equipped with Single Water Pump.

TOOLS.

SCREWDRIVER
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, 1⅛-in.

(1) PROCEDURE.

(a) Open Power Unit Compartment Rear Doors (par. 52., **b.**, (6)).

(b) Remove Unit from Engine (fig. 23).

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

Reach through opening in rear of power unit compartment, reach between Nos. 2 and 3 engines, remove two screws which attach shield to unit and disconnect wire from unit (fig. 23), by pulling wire out of open-

ing in center of unit (screwdriver). Place wrench over hexagon boss of unit and unscrew unit from elbow (right hand threads) ($\frac{7}{16}$-in. open-end wrench).

g. Oil Pressure Gage Sending Unit Installation on Power Units Equipped with Single Water Pump.

TOOLS.

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

(1) PROCEDURE.

(a) Install Unit on Engine (fig. 23).

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

Cover threads of unit with sealing compound. Reach through power unit compartment rear opening, and, reaching between engines Nos. 2 and 3, screw unit into elbow on end of tube extending from No. 3 engine cylinder block (right hand threads). Tighten unit securely ($\frac{7}{16}$-in. open-end wrench). Insert end of wire in opening in center of unit and press in place. Attach shield to unit with two screws (screwdriver).

(2) TEST FOR LEAKS AND OPERATION.

Operate power unit and examine connections for oil leaks. Note reading on oil pressure gage on instrument box.

(3) CLOSE POWER UNIT COMPARTMENT REAR DOORS (par. 52., a., (44)).

173. LOW OIL PRESSURE WARNING INDICATOR.

a. Description. A warning indicator is located in the center of the instrument box cover. It is indicated by "LOW OIL PRESS." (fig. 166).

b. Operation. Should the oil pressure in the power unit lubrication system drop below normal, a red light will appear in the oil pressure warning indicator on the instrument box (fig. 166). Should this red light appear while the power unit is running, stop power unit and investigate.

c. Low Oil Pressure Warning Indicator Removal.

(1) GENERAL. Due to construction of indicator, there will be no occasion to remove the indicator assembly from instrument box cover. Instead, only the bulb will require replacing.

(2) BULB REMOVAL (fig. 168).

(a) Procedure.

1. Grip base of socket, around small diameter tube, with fingers and

pull socket away from base of indicator. Press on bulb and turn counterclockwise and withdraw bulb from socket.

(3) BULB INSTALLATION (fig. 168).

(a) Procedure.

1. Insert bulb in opening in socket, press bulb and turn clockwise to clamp in place. Insert bulb in opening in indicator base and press on socket until it snaps in place.

d. Oil Pressure Warning Indicator Sending Unit Removal from Power Units Equipped with Multiple Water Pumps.

TOOLS.

SCREWDRIVER — WRENCH, 1-in.
WRENCH, 7/8-in.

(1) PROCEDURE.

(a) Remove Inspection Plate (par. 52., b., (7)).

(b) Remove Sending Unit from Engine.

SCREWDRIVER — WRENCH, 7/8-in.

Reach through opening in hull floor, remove two screws which attach shield to top of unit (screwdriver), separate unit and disconnect wire from sending unit by pulling wire out of opening in center of unit (fig. 24). Unscrew unit from No. 4 engine (turn counterclockwise) and remove from vehicle (7/8-in. wrench).

e. Oil Pressure Warning Indicator Sending Unit Installation on Power Units Equipped with Multiple Water Pumps.

TOOLS.

SCREWDRIVER — WRENCH, 1-in.
WRENCH, 7/8-in.

(1) PROCEDURE.

(a) Install Sending Unit on Engine (fig. 24).

SCREWDRIVER — WRENCH, 1-in.
WRENCH, 7/8-in.

Cover threads with sealing compound to prevent leaks. Reach through opening in hull floor and screw unit into underside of No. 4 engine (turn clockwise) (7/8-in. wrench). Connect wire to unit by inserting end of wire into opening in center of unit and pushing wire in until it is clamped in place. Position shield over top of unit and attach with two screws (screwdriver).

(b) Test for Leaks and Operation.

Operate power unit and examine connections for leaks. Note indicator on instrument box cover, with ignition switch turned "ON" and power unit not operating, a red light will appear in warning indicator.

(c) Install Inspection Plate (par. 53., a., (41)).

f. Oil Pressure Warning Indicator Sending Unit Removal from Power Units Equipped with Single Water Pump.

TOOLS.

SCREWDRIVER
WRENCH, 7/8-in.
WRENCH, 1 1/8-in.

(1) PROCEDURE.

(a) Open Power Unit Compartment Cover (par. 55., c., (1), (b)).

(b) Remove Unit from Engine (fig. 21).

SCREWDRIVER
WRENCH, 7/8-in.

Disconnect wire by removing two screws which secure shield to top of unit (screwdriver), separate shield and pull wire out of opening in top of unit. Unscrew unit from elbow (turn counterclockwise) (7/8-in. wrench).

g. Oil Pressure Warning Indicator Sending Unit Installation on Power Units Equipped with Single Water Pump.

TOOLS.

WRENCH, 7/8-in.
WRENCH, 1 1/8-in.

(1) PROCEDURE.

(a) Install Unit on Engine (fig. 21).

SCREWDRIVER
WRENCH, 7/8-in.

Cover threads with sealing compound and screw unit into elbow which extends from No. 1 engine oil gallery, on right-hand side toward radiator end (turn clockwise) (7/8-in. wrench). Connect wire to unit by inserting end of wire into opening in top of unit, pushing wire down until it snaps into place. Position shield on top of unit and secure with two screws (screwdriver).

(b) Test for Leaks and Operation.

Operate power unit and examine connections for leaks. Note indicator on instrument box cover, with ignition switch turned "ON" and power unit not operating, a red light will appear in warning indicator.

(c) Close Power Unit Compartment Cover (par. 55., d., (1), (f)).

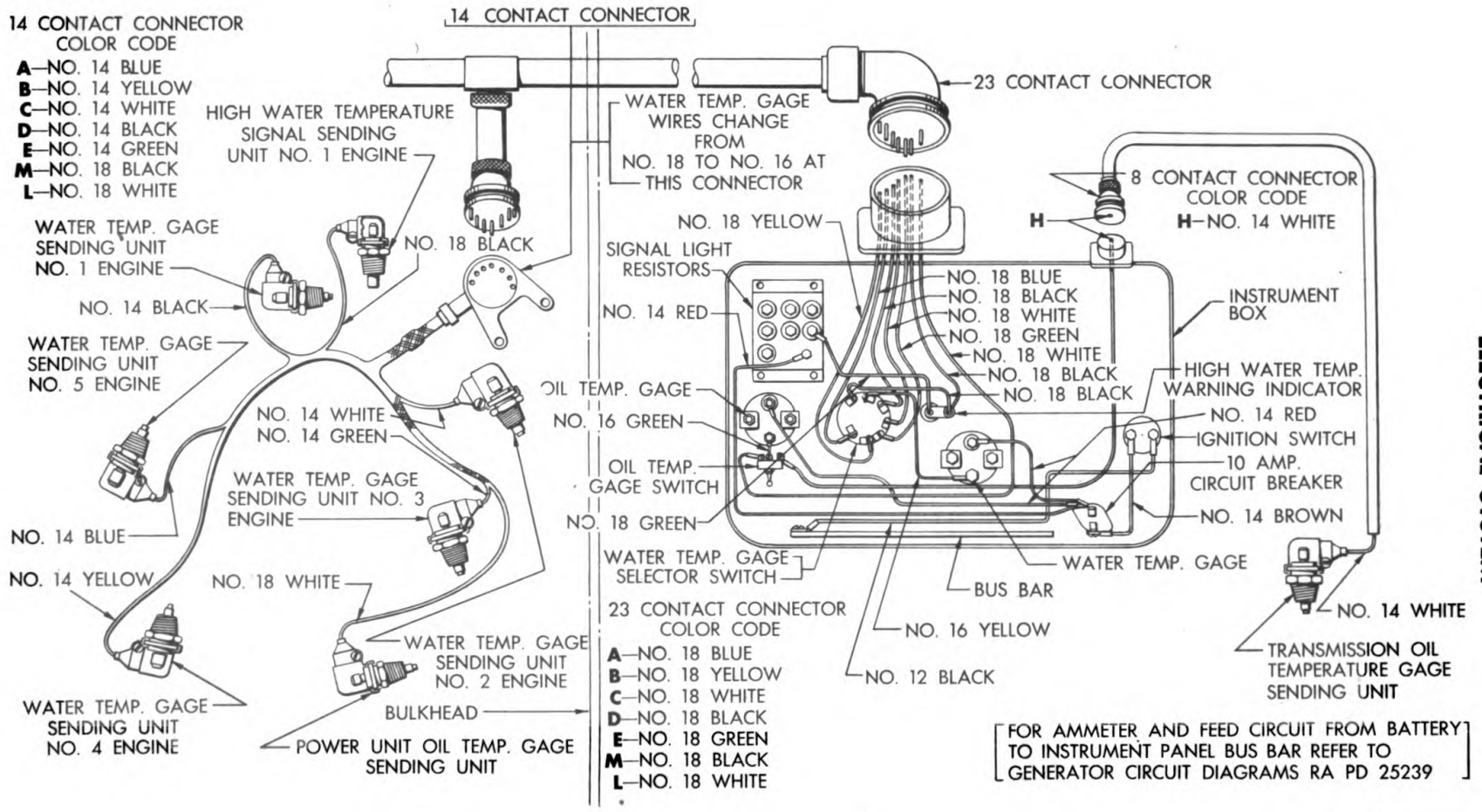


Figure 170 — Wiring Diagram — Oil and Water Temperature Gage Circuit

174. WATER TEMPERATURE GAGE.

a. Description. A water temperature gage, located in the center of the instrument box cover, registers the temperature of the solution in the power unit cooling system. It operates electrically, being actuated by sending units mounted, one in the top of the cylinder head of each engine on power units equipped with multiple water pumps, and in the top of the cylinder head of No. 1 engine only, on power units equipped with single water pump. The water temperature gage is connected to, and works in conjunction with, the water temperature gage selector switch (fig. 166).

b. Operation. To determine the temperature of the solution in any individual engine, turn the handle of the water temperature gage switch to the respective engine, as indicated by the numerals 1, 2, 3, 4 and 5 directly above the handle, and note the reading on the water temperature gage.

c. Removal.

TOOLS.

WRENCH, socket, 3/8-in.

(1) PROCEDURE.

(a) Disconnect Wires from Unit (fig. 168).

WRENCH, socket, 3/8-in.

Hold each wire with fingers, near where it connects to terminal post (to prevent turning of post), remove two self-locking nuts and lift wires from posts.

(b) Remove Unit from Cover.

WRENCH, socket, 3/8-in.

Remove the two nuts and lock washers which secure the two mounting clamps to unit and withdraw unit through front of instrument box cover.

d. Installation.

TOOLS.

WRENCH, socket, 3/8-in.

(1) PROCEDURE.

(a) Install Unit in Instrument Box Cover.

WRENCH, socket, 3/8-in.

Insert unit through opening in cover (from front of cover) and position properly in opening, place the two clamps over mounting studs (right and left) (fig. 166) and secure with the two lock washers and nuts.

(b) Connect Wires to Unit (fig. 168).

WRENCH, socket, 3/8-in.

Place end of red wire (labeled "H"), which enters loom directly belo unit, over upper terminal post and start self-locking nut with fingers, t hold wire in place. Place end of yellow wire (which connects to wate temperature gage selector switch) to lower terminal post and start sel locking nut with fingers, to hold wire in place. Hold each wire wit fingers, near where it connects to terminal post (to prevent turning c post), position wires so as to eliminate any interference with mountin studs or other instruments and tighten nuts securely.

e. Water Temperature Gage Selector Switch Removal.

TOOLS.

SCREWDRIVER, blade, 1/8-in. WRENCH, socket, 17/32-in.
SCREWDRIVER, blade, 1/4-in.

(1) PROCEDURE.

(a) Remove Unit from Instrument Box Cover (fig. 166).

Screwdriver, blade, 1/8-in. WRENCH, socket, 17/32-in.

Loosen slotted set screw in end of lever sufficiently to permit pullin lever off shaft (1/8-in. blade screwdriver). Remove nut from front c cover, which secures unit to cover (17/32-in. socket wrench), remov flat plate which carries numerals and withdraw unit from back of cove

(b) Disconnect Wires from Unit (fig. 168).

SCREWDRIVER, blade, 1/4-in.

Hold each wire with fingers, near terminal post, remove the seve screws and separate the wires from the unit.

f. Water Temperature Gage Selector Switch Installation.

TOOLS.

SCREWDRIVER, blade, 1/8-in. WRENCH, socket, 17/32-in.
SCREWDRIVER, blade, 1/4-in.

(1) PROCEDURE.

(a) Connect Wires to Unit (fig. 168).

SCREWDRIVER, blade, 1/4-in.

Place end of green wire (labeled "A") on terminal marked "5" (on bas of unit), fit lip of special lock washer into round hole below threade hole and secure with screw. Place end of yellow wire (labeled "B") o terminal marked "4" (on base of unit) and secure with special lock washe and screw. Place end of green wire (labeled "E") on terminal marked "3

(on base of unit) and secure with special lock washer and screw. Place end of yellow wire (labeled "C") on terminal marked "2" (on base of unit) and secure with special lock washer and screw. Place end of black wire (labeled "D") on terminal marked "1" (on base of unit) and secure with special lock washer and screw. Place end of short yellow cable (which leads from lower terminal of water temperature gage) on terminal marked "BAT" (on base of unit) and secure with special lock washer and screw. Place end of black wire (labeled "M") on terminal marked "TEST" (on base of unit) and secure with special lock washer and screw. NOTE: Tighten all screws securely by holding each wire with fingers, near where it connects to terminal, while tightening screws, to avoid any interference between connections.

(b) Install Unit on Instrument Box Cover.

SCREWDRIVER, blade, 1/8-in. WRENCH, socket, 17/32-in.

Insert shaft through opening in cover (from back of cover), position unit so terminals marked "TEST" and "5" are to the left, position flat plate with numerals over end of shaft (with numerals above shaft, and numeral "5" and letters "TEST" to the left) and secure with hexagon nut. Tighten nut securely (17/32-in. socket wrench). Push unit operating lever on shaft and position so as to have lock screw contact the flat surface of shaft. Tighten lock screw securely (1/8-in. blade screwdriver).

g. Water Temperature Gage Sending Unit Removal from Power Units Equipped with Multiple Water Pumps.

TOOLS.

PAN, 35 gallons capacity
PLIERS, adjustable
SCREWDRIVER
WRENCH, 15/16-in.
WRENCH, drain plug, 3/4-in. square
WRENCH, drain plug, 9/16-in. square

(1) PROCEDURE.

(a) Open Power Unit Compartment Cover (par. 55., **c.**, (1), (b)).

(b) Drain Cooling System (par. 83., **g.**).

(c) Remove Sending Unit from Engine (fig. 24).

SCREWDRIVER WRENCH, 7/8-in.

Remove wire from center of unit by removing two screws which attach shield to top of unit, separating shield, applying pliers to terminal on end of wire and pulling wire from unit (screwdriver). Unscrew unit from adapter on top of cylinder head (turn counterclockwise) (7/8-in. wrench).

h. Water Temperature Gage Sending Unit Installation on Power Units Equipped with Multiple Water Pumps.

TOOLS.

SCREWDRIVER
WRENCH, drain plug, $\frac{9}{16}$-in. square
WRENCH, drain plug, $\frac{3}{4}$-in. square
WRENCH, $\frac{15}{16}$-in.

(1) PROCEDURE.

(a) Install Sending Unit in Engine (fig. 24).

SCREWDRIVER
WRENCH, $\frac{7}{8}$-in.

Cover threads with sealing compound and screw unit into threaded opening in top of adapter on top of cylinder head. Tighten securely to prevent leaks ($\frac{7}{8}$-in. wrench). Connect wire to unit by inserting end of wire into opening in center of unit and pushing on wire until it snaps into place. Position shield on top of unit and secure with two screws (screwdriver).

(b) Test for Leaks.

WRENCH, drain plug, $\frac{9}{16}$-in. square
WRENCH, drain plug, $\frac{3}{4}$-in. square

Fill cooling system (par. 83., **h.**), and examine connection for leaks ($\frac{9}{16}$-in. and $\frac{3}{4}$-in. square drain plug wrenches).

(c) Close Power Unit Compartment Cover (par. 55., **d.**, (1), (f)).

i. Water Temperature Gage Sending Unit Removal from Power Units Equipped with Single Water Pump.

(1) Power units equipped with single water pump use sending unit in top of cylinder head of No. 1 engine only. Follow instructions outlined in paragraph 174., **g.**

j. Water Temperature Gage Sending Unit Installation on Power Units Equipped with Single Water Pump.

(1) Power units equipped with single water pump use sending unit in top of cylinder head of No. 1 engine only. Follow instructions outlined in paragraph 174., **h.**

175. HIGH WATER TEMPERATURE WARNING INDICATOR.

a. Description. An indicator, to warn of high water temperature, is mounted in the instrument box cover directly above the water temperature gage (fig. 166).

b. Operation. When a red light appears in warning indicator, it is a warning signal that the water temperature, in one or more engines, is

excessive. To determine the engine from which the signal came, use the selector switch (fig. 166) by turning lever pointer to the various numerals and noting reading on water temperature gage.

c. High Water Temperature Warning Indicator Removal.

(1) GENERAL. Due to construction of indicator, there will be no occasion to remove the indicator assembly from instrument box cover. Instead, only the bulb will require replacing.

(2) BULB REMOVAL (par. 173., c., (2)).

(3) BULB INSTALLATION (par. 173., c., (3)).

d. High Water Temperature Warning Indicator Sending Unit.

(1) GENERAL. Power units equipped with multiple water pumps use a sending unit mounted in the top of the cylinder head of each engine (figs. 22 and 24). Power units equipped with single water pumps use a sending unit mounted in the top of the cylinder head of No. 1 engine only (fig. 26). Units may be removed from engines Nos. 1, 2 and 5 after first opening the power unit cover (fig. 7). Units may be removed from engines Nos. 3 and 4 after first removing the inspection plates from the hull floor, directly below the respective engine.

(2) REMOVAL.

TOOLS.

PAN, 35 gallons capacity
PLIERS, adjustable
SCREWDRIVER
WRENCH, $\frac{15}{16}$-in.
WRENCH, 1-in.
WRENCH, drain plug, $\frac{9}{16}$-in. square
WRENCH, drain plug, $\frac{3}{4}$-in. square

(a) Procedure.

1. *Open Power Unit Compartment Cover* (par. 55., c., (1), (b)).

2. *Remove Sending Unit from Engine* (figs. 22, 24 and 25).

PLIERS, adjustable
WRENCH, 1-in.

Remove wire from center of unit by removing two screws which attach shield to unit, separating shield and applying pliers to metal terminal on end of wire. Pull wire from unit (adjustable pliers). Unscrew unit from cylinder head (turn counterclockwise) (1-in. wrench).

(3) INSTALLATION.

TOOLS.

SCREWDRIVER
WRENCH, $\frac{15}{16}$-in.
WRENCH, 1-in.
WRENCH, drain plug, $\frac{9}{16}$-in. square
WRENCH, drain plug, $\frac{3}{4}$-in. square

(a) Procedure.

1. Install Unit on Engine (figs. 22, 24 and 25).

SCREWDRIVER WRENCH, 1-in.

Cover threads with sealing compound and screw unit into threaded opening in side of cylinder head. Tighten securely, to prevent leaks (1-in. wrench). Insert end of wire in opening in center of unit and push wire into opening until it snaps in place. Position shield on top of unit and attach with two screws (screwdriver).

2. Test for Leaks.

WRENCH, drain plug, $\frac{9}{16}$-in. square WRENCH, drain plug, $\frac{3}{4}$-in. square

Fill cooling system and examine connections for leaks (par. 83., **h.**).

3. Close Power Unit Compartment Cover (par. 55., **d.**, (1), (f)).

176. FUEL GAGE.

a. Description. A gage, mounted at the lower right-hand corner of the instrument box cover, registers the amount of fuel in both the right-hand and left-hand fuel tanks (fig. 166).

b. Operation. Push switch handle to side marked "LH" and note gage reading, to determine the amount of fuel in left-hand fuel tank. Push switch handle to side marked "RH" and note gage reading, to determine the amount of fuel in right-hand fuel tank.

c. Removal.

TOOLS.

WRENCH, socket, $\frac{3}{8}$-in.

(1) PROCEDURE.

(a) Disconnect Wires (fig. 168).

WRENCH, socket, $\frac{3}{8}$-in.

Hold wires, near terminal posts, with fingers (to prevent turning of posts) and remove the two self-locking nuts and lift wires off terminal posts ($\frac{3}{8}$-in. socket wrench).

(b) Remove Unit from Instrument Box Cover.

WRENCH, socket, $\frac{3}{8}$-in.

Remove the nuts and lock washers from mounting studs, remove two mounting clamps and withdraw unit from face of cover.

d. Installation.

TOOLS.

WRENCH, socket, $\frac{3}{8}$-in.

(1) PROCEDURE.

(a) Install Unit in Instrument Box Cover.

WRENCH, socket, 3/8-in.

Insert unit through opening in cover (from front of cover), place mounting clamps over mounting studs, properly position unit in opening and secure with two lock washers and nuts.

(b) Connect Wires to Unit.

WRENCH, socket, 3/8-in.

Place end of red wire (labeled "H") over upper terminal post and start self-locking nut with fingers, to hold wire in place. Place end of short black wire (which is connected to fuel gage selector switch) over lower terminal post and start nut with fingers, to hold wire in place. Hold wire near terminal post (to prevent turning of post) and tighten nuts securely.

(c) Test for Operation.

Turn ignition switch "ON" and test for operation, as explained in paragraph 176., **b.**

e. Fuel Gage Selector Switch Removal.

TOOLS.

PLIERS, adjustable
SCREWDRIVER

(1) PROCEDURE.

(a) Remove Unit from Instrument Box Cover (fig. 166).

PLIERS, adjustable

From front of cover, unscrew knurled nut which secures switch to cover (turn counterclockwise) and withdraw switch from back of cover, only a sufficient distance to permit removal of the three wires.

(b) Disconnect Wires (fig. 168).

SCREWDRIVER

Hold wires, at a point near terminal (to prevent distortion of terminal) and remove the screws and wires from switch.

f. Fuel Gage Selector Switch Installation.

SCREWDRIVER

(1) PROCEDURE.

(a) Connect Wires to Switch (fig. 168).

SCREWDRIVER

Hold switch in position back of cover (with terminals, which are off center on switch, nearest the fuel gage), and connect black and yellow wire (labeled "F") to left terminal, connect black and red wire (labeled "E") to right terminal and connect short black wire (which is connected to fuel gage) to center terminal. Hold wires in upright position and tighten screws securely.

(b) Install Switch in Instrument Box Cover.

PLIERS, adjustable

Insert handle of switch through opening in cover, hold switch in position (with terminals toward fuel gage) and attach to cover with knurled nut. Tighten securely.

177. STARTER SWITCH.

a. Description. A starter switch, of the push button type, is mounted on the instrument box cover, near the right end (fig. 166). It is operative without turning ignition switch "ON."

b. Operation. Push button "IN" to operate. A spring returns button to normal, or "OFF" position.

c. Removal.

TOOLS.

WRENCH, socket, 3/8-in. WRENCH, socket, 3/4-in.

(1) PROCEDURE.

(a) Disconnect Wires (fig. 168).

WRENCH, socket, 3/8-in.

Hold wires with fingers (to prevent terminal posts from turning) and remove the two mounting nuts and lock washers.

(b) Remove Switch from Instrument Box Cover (fig. 166).

WRENCH, socket, 3/4-in.

From front of cover, remove hexagon nut and flat washer and withdraw switch from back of cover.

d. Installation.

TOOLS.

WRENCH, socket, 3/8-in. WRENCH, socket, 3/4-in.

(1) PROCEDURE.

(a) Install Switch on Instrument Box Cover.

WRENCH, socket, 3/4-in.

Remove small hexagon nut and flat washer from threads. NOTE: Leave large hexagon nut on threads, next to base of switch, and leave

internal lock washer on threads. Insert threaded section of switch through opening in cover (from back of cover), place flat washer over threads and secure with hexagon nut. Hold switch in position and tighten nut securely.

(b) Connect Wires.

WRENCH, socket, 3/8-in.

Place end of yellow wire (labeled "C") over right terminal post, install lock washer and start nut with fingers, to hold wire in place. Place end of brown wire (labeled "B") over left terminal post, install lock washer and start nut with fingers, to hold wire in place. Hold wires, near terminal post, with fingers (to position wires so as to prevent interference) and tighten nuts securely.

(c) Test for Operation.

Press starter switch button.

178. LIGHT SWITCH.

a. Description. A light switch, controlling all exterior lights of the vehicle, is located on the upper right-hand corner of the instrument box cover (fig. 166).

b. Operation.

(1) Pull button out to first stop. This turns on the blackout marker and taillights, and blackout stoplight.

(2) Press locking button (located on left side of switch) to release shaft and pull button out to second position. This turns on service headlights, and blackout stop light.

(3) Press locking button (located on left side of switch) to release shaft and pull button out to final stop. This operates service stop lights (with no other lights) for daytime driving.

c. Removal.

TOOLS.

SCREWDRIVER, blade, 1/8-in. wide.

SCREWDRIVER, blade, 1/4-in. wide.

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

(1) PROCEDURE.

(a) Remove button (fig. 166).

Loosen small set screw in side of button sufficiently to permit turning button. Unscrew button from shaft (turn counterclockwise) and remove button.

(b) Remove Switch from Instrument Box Cover.

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

Reach back of cover and unscrew hexagon nut (between spring on operating shaft and end flange on switch bracket) until nut is clear of threads (right hand threads). Press locking button, on side of switch (front of cover) and pull button and housing from shaft. Withdraw switch assembly from back of cover.

(c) Disconnect Wires (fig. 168).

SCREWDRIVER, blade, 1/4-in. wide

Remove screws and special lock washers and separate wires from the six terminals on switch.

d. Installation (fig. 168).

(1) GENERAL. Numerals referred to in installation of the various wires are stamped in the metal base of the switch (on side of switch).

TOOLS.

SCREWDRIVER, blade, 1/8-in. wide
SCREWDRIVER, blade, 1/4-in. wide
WRENCH, open-end, 5/8-in.

(2) PROCEDURE.

(a) Connect Wires to Switch, and Secure with Special Lock Washer and Screw, as Follows:

SCREWDRIVER, blade, 1/4-in. wide

1. Terminal No. 1. Orange with tracer, labeled "B," and green, labeled "c," assembly.

2. Terminal No. 5. White with black tracer, labeled "C," which enters loom just above "B. O. DRIVE" switch.

3. Terminal No. 2. Orange, labeled "A," and green, labeled "a," assembly and white with black tracer, labeled "C," which is connected to "B. O. DRIVE" switch.

4. Terminal No. 4. Black, labeled "b."

5. Terminal No. 3. Red, labeled "d."

6. Terminal No. 6. Green, labeled "D."

(b) Install Switch on Instrument Box Cover.

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

Place switch in position so that wires are pointing away from starter switch, insert shaft through opening cover. Place locking button and

housing over shaft, press locking button and slide assembly through opening in cover and secure with hexagon nut. Tighten nut securely.

(c) Install Button (fig. 166).

SCREWDRIVER, blade, ⅛-in. wide

Screw button on shaft to end of threads, aline so letters on face of button are in upright position. Tighten small set screw inside of button. NOTE: Aline button so that set screw will contact flat surface of shaft.

179. BLACKOUT DRIVING LIGHT SWITCH.

a. Operation. Remove left headlight (par. 164., **b.**, (1)). Insert blackout driving light in opening from which headlight was removed. Pull light switch button out to first stop. Pull out button of blackout driving light switch.

b. Removal.

TOOLS.

SCREWDRIVER, blade, ⅛-in. wide
SCREWDRIVER, blade, ¼-in. wide
WRENCH, socket, $\frac{9}{16}$-in.

(1) PROCEDURE.

(a) Remove Switch from Instrument Box Cover.

SCREWDRIVER, blade, ⅛-in. wide
WRENCH, socket, $\frac{9}{16}$-in.

Loosen small set screw inside of button sufficiently to allow turning of button (⅛-in. wide blade screwdriver). Unscrew button from shaft (turn counterclockwise) and remove from shaft. Remove hexagon nut from face of cover which secures switch to cover ($\frac{9}{16}$-in. socket wrench) and withdraw switch from back of cover.

(b) Disconnect Wires (fig. 168).

SCREWDRIVER, blade, ¼-in. wide

Remove two screws and separate the two wires from switch.

c. Installation.

TOOLS.

SCREWDRIVER, blade, ⅛-in. wide
SCREWDRIVER, blade, ¼-in. wide
WRENCH, socket, $\frac{9}{16}$-in.

(1) PROCEDURE.

(a) Connect Wires to Switch.

SCREWDRIVER, blade, ¼-in. wide

Hold switch in position above opening in cover, with terminals facing toward circuit breakers (fig. 168). Place end of tan wire (labeled "E") on right-hand terminal and secure with special lock washer and screw. Place end of white, with black tracer, wire on left-hand terminal and secure with special lock washer and screw (¼-in. wide blade screwdriver).

(b) Install Switch on Instrument Box Cover (fig. 166).

WRENCH, socket, $\frac{9}{16}$-in. SCREWDRIVER, blade, ⅛-in. wide

Insert mounting shaft of switch through opening in cover and secure with hexagon nut on front of cover ($\frac{9}{16}$-in. socket wrench). Screw button on shaft, to within $\frac{1}{16}$-in. of mounting shaft, aline button so letters "B. O. DRIVE" are in upright position and tighten small set screw inside of button (⅛-in. wide blade screwdriver).

180. IGNITION SWITCH.

a. Description. An ignition switch is located in the right center of instrument box cover.

b. Operation. Turn lever clockwise, to limit of travel, to turn ignition switch "ON."

c. Removal.

TOOLS.

PLIERS, adjustable
WRENCH, ⅜-in.
SCREWDRIVER, blade, ¼-in. wide

(1) PROCEDURE.

(a) Disconnect Wires (fig. 168).

WRENCH, ⅜-in.

Remove two nuts and lock washers and lift wires off terminal posts.

(b) Remove Switch from Instrument Box Cover (fig. 166).

PLIERS, adjustable SCREWDRIVER, blade, ¼-in. wide

Turn slotted screw in center of handle, on face of cover, ¼ turn counterclockwise and withdraw handle from switch (¼-in. wide blade screwdriver). Grip round nut on face of cover with pliers, adjustable,

turn counterclockwise, and unscrew from switch. Withdraw switch from back of cover.

d. Installation.

TOOLS.

PLIERS, adjustable
WRENCH, 3/8-in.
SCREWDRIVER, blade, 1/4-in. wide

(1) PROCEDURE.

(a) Install Switch in Instrument Box Cover.

PLIERS, adjustable

Insert switch through opening in cover (from back of cover) and position so that the two terminal posts are toward circuit breakers. Secure to cover with round mounting nut on cover. Tighten nut firmly (adjustable pliers). Insert switch operating lever in opening in switch, with handle pointing toward speedometer, push in to limit of travel and secure in place by turning slotted screw clockwise 1/4 turn (1/4-in. wide blade screwdriver).

(b) Connect Wires to Switch (fig. 168).

WRENCH, 3/8-in.

Place ends of black wire (labeled "D") and brown wire (labeled "B") over right terminal post, install lock washer on post and start nut with fingers, to hold wire in place. Place end of (brown wire, labeled "E," and blue wire, labeled "D") assembly over left terminal post, install lock washer and start nut with fingers, to hold wire in place. Hold wires, near terminal posts (to prevent turning of posts) and tighten nuts securely.

(c) Test for Operation.

Turn ignition switch lever clockwise and press starter switch button.

181. INSTRUMENT BOX LIGHT SWITCH.

a. Description. A switch, located in the upper left-hand corner of the instrument box cover, controls the three instrument box lights (fig. 166). Positions of the switch lever are indicated on a metal plate directly behind the lever.

b. Operation. With lever turned counterclockwise, to limit of travel, and with lever pointing to "OFF," all lights are off. With lever turned clockwise one notch, to "B," instrument box lights are on "BRIGHT." Turning lever farther clockwise, to points marked "D," gives various stages of dim lights.

c. Removal.

TOOLS.

SCREWDRIVER, blade, ⅛-in. wide
SCREWDRIVER, blade, ¼-in. wide
WRENCH, socket, $\frac{11}{16}$-in.

(1) PROCEDURE.

(a) Remove Switch from Instrument Box Cover (fig. 166).

SCREWDRIVER, blade, ⅛-in. wide WRENCH, socket, $\frac{11}{16}$-in.

Loosen small slotted set screw in side of lever sufficiently to permit pulling lever off shaft (⅛-in. wide blade screwdriver). Remove hexagon nut from front of cover, remove metal plate bearing letters and withdraw switch from back of cover ($\frac{11}{16}$-in. socket wrench).

(b) Disconnect Wires (fig. 168).

SCREWDRIVER, blade, ¼-in. wide

Remove the two screws and special lock washers and separate the four wires from switch.

d. Installation.

TOOLS.

SCREWDRIVER, blade, ⅛-in.
SCREWDRIVER, blade, ¼-in.
WRENCH, socket, $\frac{11}{16}$-in.

(1) PROCEDURE.

(a) Connect Wires to Switch (fig. 168).

SCREWDRIVER, blade, ¼-in. wide

Place end of black wire (labeled "G") on terminal marked "B" ("B" stamped on base of switch, adjacent to terminal), position special lock washer, with lip through hole in bottom of terminal, hold wire in upright position and secure wire with screw. Place ends of the three black wires (not labeled) which connect to the three instrument box lights on terminal marked "I" and secure with special lock washer and screw. Tighten screws securely.

(b) Install Switch on Instrument Box Cover.

SCREWDRIVER, blade, ⅛-in WRENCH, socket, $\frac{11}{16}$-in.

Insert switch through opening in cover, from back of cover, with terminal marked "I" toward clock, position metal disk over mounting post of switch and secure with hexagon nut. Tighten nut securely ($\frac{11}{16}$-in. socket wrench). Push operating lever on shaft and position lever so set

screw will contact the flat side of shaft. Tighten set screw in side of lever (⅛-in. blade screwdriver).

182. INSTRUMENT BOX LIGHTS.

a. Description. Three lights, mounted on the instrument box cover, are employed in lighting all instruments in the box (fig. 168). These lights are welded to the cover, therefore the light assembly is not removable. Provision is made for removing the bulb through an opening in the cover directly in front of the light. This opening is closed by a cover which snaps in place in the opening (fig. 166).

b. Bulb Removal.

SCREWDRIVER

(1) Insert a screwdriver between the light opening cover and instrument box cover and pry cover loose. Reach through opening in cover, push on bulb and turn counterclockwise and pull bulb from socket.

c. Bulb Installation.

(1) Insert bulb in light socket, push and turn clockwise to clamp in place. Place light cover in position over opening in instrument box cover and push until it snaps in place.

183. CIRCUIT BREAKERS.

a. Description. Six circuit breakers, to protect electrical circuits, are mounted on a plate, this plate in turn being mounted at the upper center of the instrument box cover and held in place by four bolts from the front face of the instrument box cover (fig. 166). Reset buttons, which protrude through openings in the instrument box cover, are provided to close the circuit, should the circuit be opened by a short circuit in the line. Instrument box cover is labeled, directly above each circuit breaker reset button, to indicate the circuit protected (fig. 166).

b. The amperage capacity of each circuit breaker is stamped on the back of each unit as follows:

(1) ACCESSORIES, 15 amperes

(2) HEADLIGHTS, 20 amperes

(3) VOLTMETER, 5 amperes

(4) PANEL lights, 5 amperes

(5) SIREN, 20 amperes

(6) INSTRUMENTS, 10 amperes

(7) CAUTION: Install only the circuit breaker indicated for any particular circuit.

c. Removal.

(1) NOTE: When removing circuit breakers, it is first necessary to remove the four circuit breaker mounting plate retaining screws and separate mounting plate from instrument box cover (fig. 166). The following instructions apply after removing mounting plate from instrument box cover. In order to eliminate repetitions in instructions, the removal and installation of the circuit breakers will be covered under their respective headings and wire connections will be covered as individual circuit breakers.

(2) REMOVE CIRCUIT BREAKERS (fig. 168).

SCREWDRIVER, blade $\frac{5}{16}$-in. wide WRENCH, open-end, $\frac{3}{8}$-in.

Remove wire retaining screw and lock washer and separate wire from terminal ($\frac{5}{16}$-in. wide blade screwdriver). Hold nut on base of circuit breaker ($\frac{3}{8}$-in. open-end wrench) and remove countersunk head bolt from opposite side of mounting plate ($\frac{5}{16}$-in. wide blade screwdriver). NOTE: On all circuit breakers except the one farthest to the right, protecting circuit labeled "INSTRUMENTS," it is necessary to remove screw and lock washer and disconnect the "Buss Bar" from circuit breaker.

(3) INSTALL CIRCUIT BREAKERS (fig. 168).

SCREWDRIVER, blade $\frac{5}{16}$-in. WRENCH, open-end, $\frac{3}{8}$-in.

Position circuit breaker on mounting plate and attach to plate with two countersunk head bolts and self-locking nuts. Tighten nuts securely ($\frac{3}{8}$-in. open-end wrench) ($\frac{5}{16}$-in. blade screwdriver).

(4) CONNECT WIRES.

SCREWDRIVER, blade $\frac{5}{16}$-in.

Connect wires to the upper terminals of circuit breakers (fig. 161) as follows:

(a) ACCESSORIES, two green wires (labeled "G").

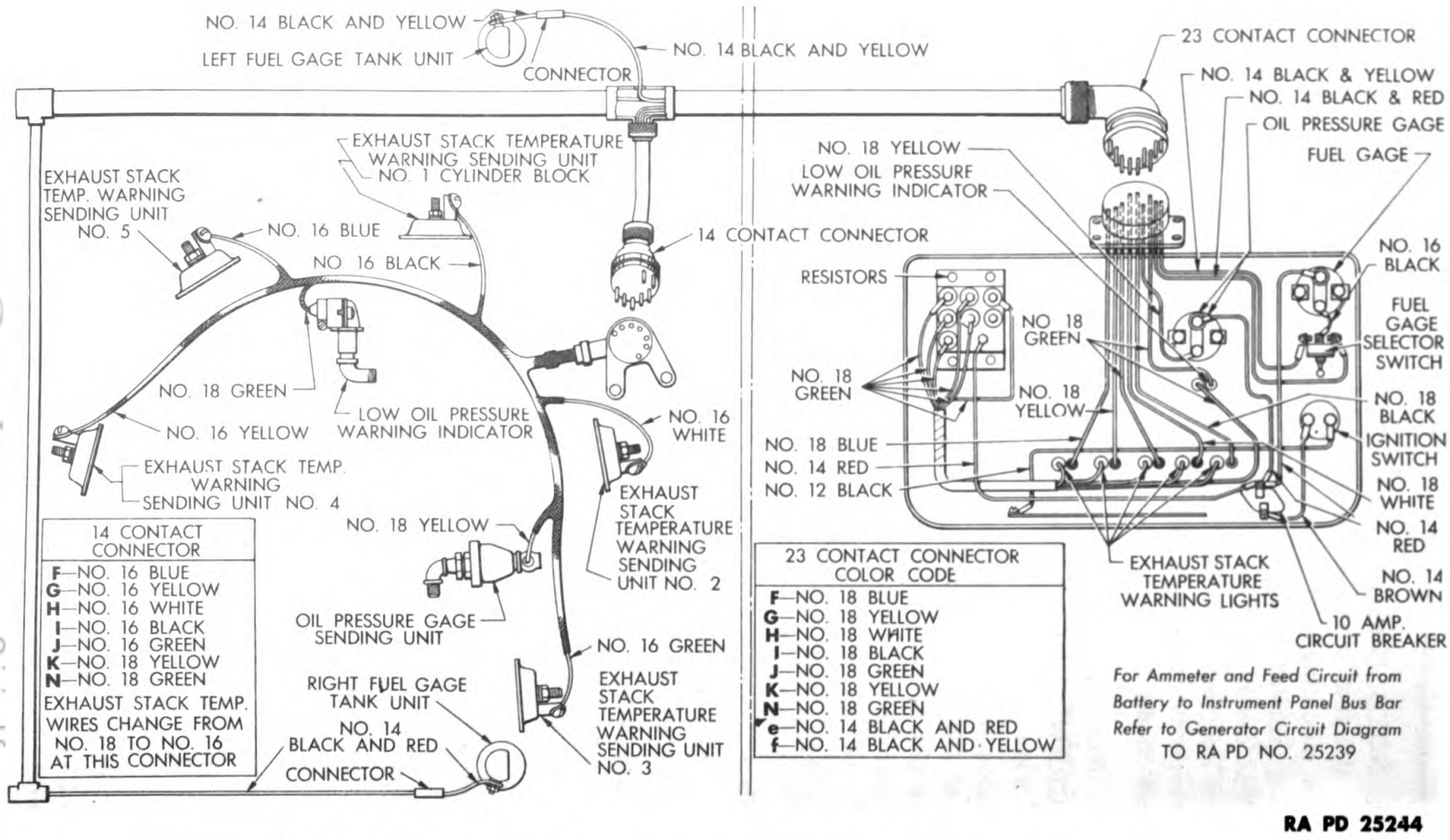
(b) HEADLIGHTS, white wire with black tracer (labeled "C").

(c) VOLTMETER, green wire (labeled "A").

(d) PANEL lights, black wire (labeled "G").

(e) SIREN, black wire (labeled "C").

(f) INSTRUMENTS, red wire with white tracer (labeled "H") and red wire with white tracer (labeled "E") to upper terminal. Brown wire with black tracer (labeled "B") to lower terminal.



RA PD 25244

Figure 171 — Wiring Diagram — Oil Pressure Gage, Fuel Gage and Exhaust Stack Temperature Circuits

184. EXHAUST STACK TEMPERATURE WARNING INDICATORS.

a. Description. Five warning indicators are located in the center of the instrument box cover (fig. 166). Above each indicator, numeral 1, 2, 3, 4 or 5 indicates the engine referred to. Each indicator is connected to, and actuated by, a sending unit mounted on the exhaust manifold of each engine (fig. 24). The warning indicators are operative only when the ignition switch is turned "ON".

b. Operation. While the engine is cold, a red light will appear in the warning indicator on the instrument box cover. When normal temperature of the engine is reached, the light is automatically switched off. If one or more of these lights appear during a run which started with a normally functioning power unit, the engines indicated will be found to be operating poorly or not at all. Stop the power unit at once and locate the trouble.

c. Removal.

(1) GENERAL. Due to construction of the indicator, there will be no occasion to remove the indicator assembly from instrument box cover. Instead, only the bulb will require replacing.

(2) BULB REMOVAL (par. 173., **c.**, (2)).

(3) BULB INSTALLATION (par. 173., **c.**, (3)).

d. Removal of Exhaust Stack Temperature Warning Indicator Sending Unit (fig. 24).

TOOLS.

PLIERS, side cutting	WRENCH, 3/8-in.
SCREWDRIVER	WRENCH, 15/16-in.

(1) PROCEDURE.

(a) Open Power Unit Compartment Cover (par. 55., **c.**, (1), (b)).

(b) Disconnect Wire.

PLIERS, side cutting	SCREWDRIVER

Remove locking wire (side cutting pliers), remove screw (screwdriver) and separate wire from unit.

(c) Remove Unit from Manifold.

WRENCH, 3/8-in.

Remove the two attaching nuts and lift unit off studs.

e. Installation of Exhaust Stack Temperature Warning Indicator Sending Unit (fig. 24).

(1) REVERSE REMOVAL PROCEDURE TO INSTALL.

185. INSTRUMENT BOX OUTLET SOCKET.

a. Description. A socket is mounted in the center of the instrument box cover. An opening in the front of the socket, of bayonet socket type, provides a quick means of attaching electrical devices to the electrical circuit (fig. 166).

b. Removal.

TOOLS.

SCREWDRIVER, blade ⅛-in. wide
WRENCH, open-end, ⅞-in.

(1) PROCEDURE.

(a) Loosen slotted head set screw in side of socket and pull wire out of opening in center of socket (⅛-in. blade screwdriver). Hold socket with fingers, to prevent turning, and remove hexagon nut, back of cover, which secures socket to instrument box cover (turn nut counterclockwise) and withdraw socket through front of cover (⅞-in. open-end wrench).

c. Installation.

TOOLS.

SCREWDRIVER, blade ⅛-in. wide
WRENCH, open-end, ⅞-in.

(1) PROCEDURE.

(a) Insert socket through opening in cover (from front of cover), place lock washer over socket and secure with hexagon nut. Tighten nut securely (⅞-in. open-end wrench). Insert green wire (labeled "G") in opening in center of outlet and secure in place by tightening screw in side of socket (⅛-in. blade screwdriver).

186. SIREN.

a. Description. The siren, located on the left fender, is motor driven and operates on 24 volts. The operation of the siren is controlled by a switch, located just forward of the driver's left foot and is bracket mounted to the side of the hull (fig. 9). A 20-ampere circuit breaker, located in the instrument box (fig. 166 and 168) protects the electrical circuit.

b. Preventive Maintenance. No attention is required except to make sure that the rotor is free from dirt, or other foreign matter, and is free to revolve. Should the rotor fail to revolve, due to an accumulation of dirt, remove dirt by revolving rotor with a tool inserted through openings in grille in siren.

c. Remove Siren.

TOOLS.

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

(1) PROCEDURE.

(a) Disconnect Wire and Conduit.

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

Remove nut which attaches conduit to hull and pull socket out of sleeve, with fingers.

(b) Remove Siren from Fender

SCREWDRIVER
WRENCH, open-end, 7/16-in.

Hold the two screws, which secure siren to fender, with screwdriver and remove the two nuts with a 7/16-in. open-end wrench. Lift siren off fender.

d. Install Siren.

TOOLS.

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

(1) PROCEDURE.

(a) Install Siren on Fender.

SCREWDRIVER
WRENCH, open-end, 7/16-in.

Position siren on fender, insert the two bolts from under fender and install nuts. Hold bolts with screwdriver and tighten nuts with 7/16-in. open-end wrench.

(b) Connect Wire and Conduit.

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

Insert socket in sleeve on hull and secure with nut.

e. Remove Switch.

TOOLS.

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

(1) PROCEDURE.

(a) Disconnect Wires.

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

Remove the two nuts and disconnect wires from switch.

(b) Remove Switch from Bracket.

WRENCH, open-end, $\frac{7}{16}$-in. (2)

Remove the two bolts and nuts which secure switch to bracket and remove switch.

f. Install Switch. Reverse removal procedure.

g. Remove Circuit Breaker (par. 183., c., (2)).

h. Install Circuit Breaker (par. 183., c., (3)).

Section XXVI

AUXILIARY GENERATING UNIT

187. GENERAL.

a. The auxiliary generator is a self-contained generating unit for charging the batteries in the vehicle. It may also be used for heating the crew compartment, utilizing the heat from the generator engine. The unit is located in the left rear corner of the fighting compartment on a level with the turret deck (figs. 172 and 173).

188. DESCRIPTION.

a. The unit consists of a single-cylinder air-cooled gasoline engine directly coupled to a 30-volt 1,500-watt generator.

b. The control box contains two control buttons, marked "START" and "CHARGING CIRCUIT RESET." The "START" button is used only for starting the unit electrically. The "CHARGING CIRCUIT RESET" button is a manual reset circuit breaker. The ammeter indicates the charging rate of the generator.

c. The fuel tank, located in the left sponson, holds approximately 5½ gallons of fuel. The fuel consists of a mixture of oil and gasoline. Use ⅜ pints of OIL, engine, SAE 30, mixed thoroughly with each gallon of gasoline. If SAE 30 oil is not available, oil from SAE 20 to 50 may be used. Lubrication for the entire engine is obtained by mixing the oil with the gasoline, and it is important that the oil be thoroughly mixed with the gasoline before pouring into the tank.

189. OPERATION.

a. Cold Weather Starting Below 32 F.

(1) Open shut-off cock on fuel filter. Full counterclockwise direction is open.

(2) Depress the starting button on the control box. Release the button as soon as the engine starts and immediately open the choke partially, easing to full open position as the engine warms up.

MEDIUM TANK M4A4

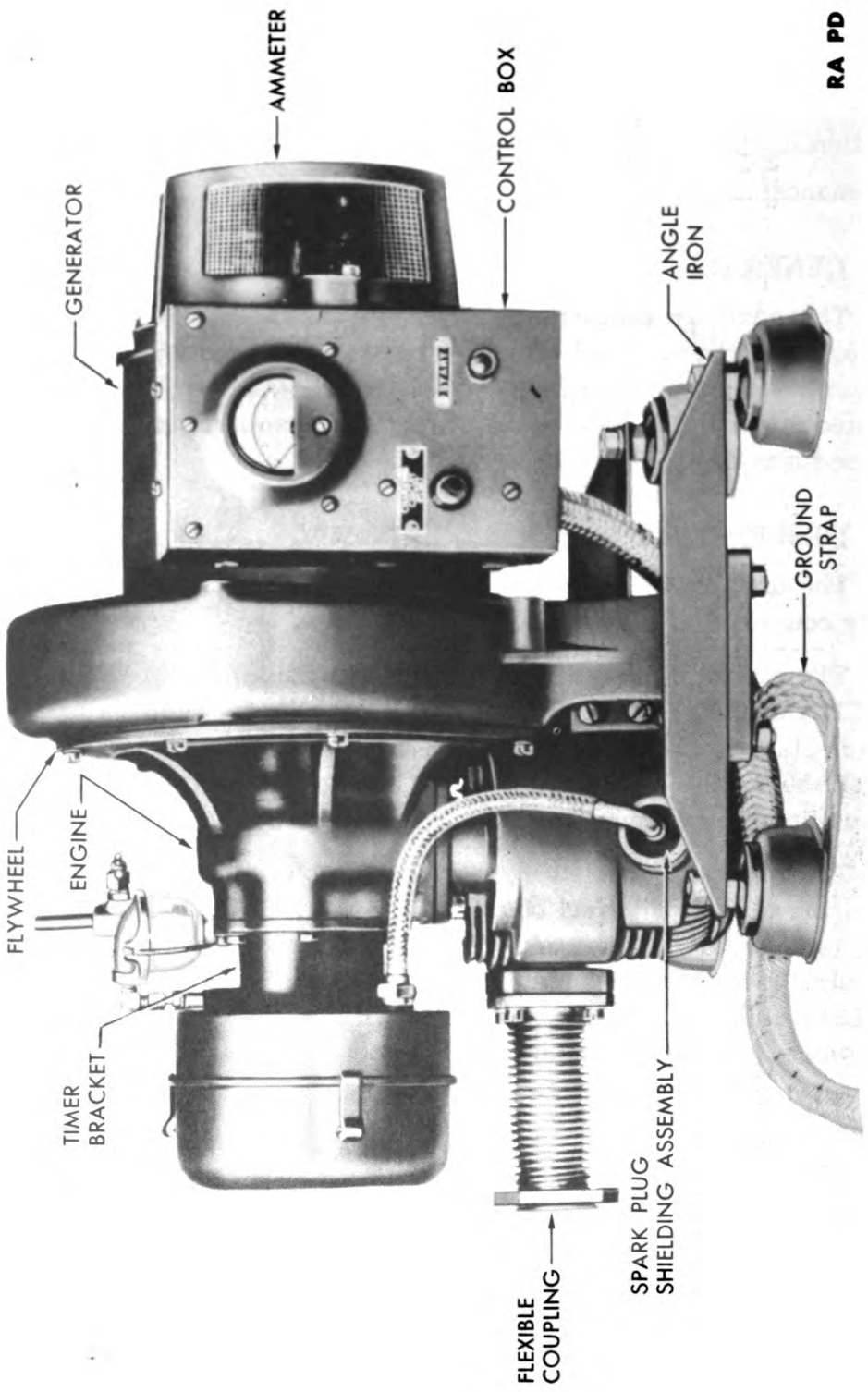
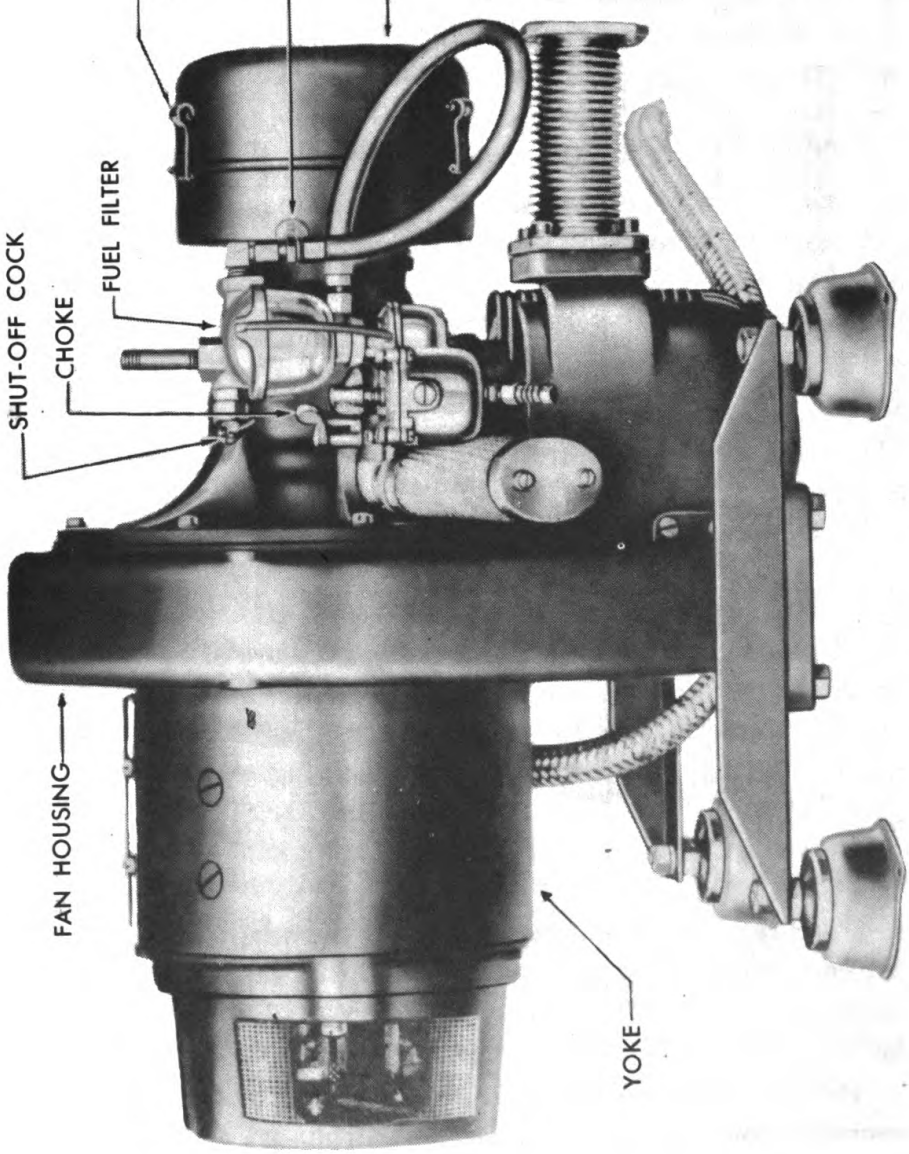


Figure 172 — Auxiliary Generating Unit — Front

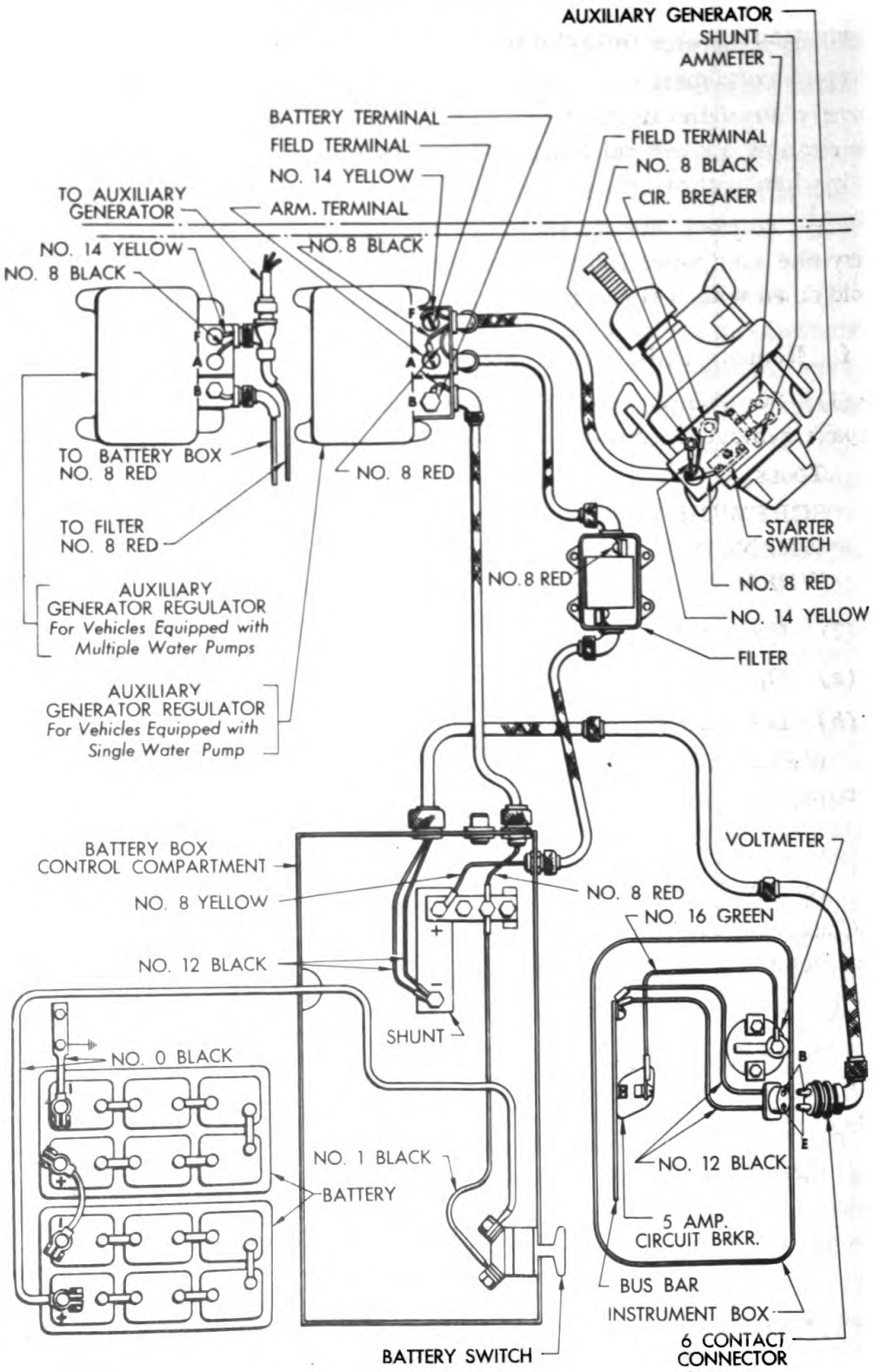
AUXILIARY GENERATING UNIT



RA PD 24404

Figure 173 — Auxiliary Generating Unit — Rear

MEDIUM TANK M4A4



RA PD 25238

Figure 174 — Wiring Diagram — Auxiliary Generating Unit Circuit

auxiliary generator to see that the gap is exactly 0.020 inch. To adjust, proceed as follows:

(1) Pry open the three magneto shield clips (fig. 172) with a screwdriver, and take off the front half of shield.

(2) Remove the magneto rotor by loosening the rotor puller nut. NOTE: Do not remove the three screws holding the starter plate to the rotor.

(3) Remove the spark plug as in the instructions above, to relieve compression and permit turning the flywheel.

(4) Rotate flywheel until gap reaches its maximum opening. Check gap with feeler gage.

(5) If it is necessary to adjust the gap to 0.020 inch, loosen the screw slightly which fastens the contact point assembly to the starter plate and move the entire breaker mechanism toward the cam to increase the gap, or away from the cam to decrease the gap.

(6) Tighten the contact point assembly fastening screw securely and recheck the gap with a feeler gage. Readjust if necessary. Tightening of the setscrew sometimes changes the adjustment.

(7) The entire contact point assembly pivots on the breaker lever bearing pin, which permits adjustment of the gap without altering the relationship between the contact point surface. If the breaker cam is removed from the intake valve shaft, replace with the arrow (indicating rotation) on the outside.

(8) Uneven or pitted contact points may be restored to a true, even condition by the use of a smooth carborundum stone, after which remove all dust particles with a dry cloth. Do not use a file on the contact surfaces. Stiff paper or cardboard will remove the oxide formation which results from long idleness.

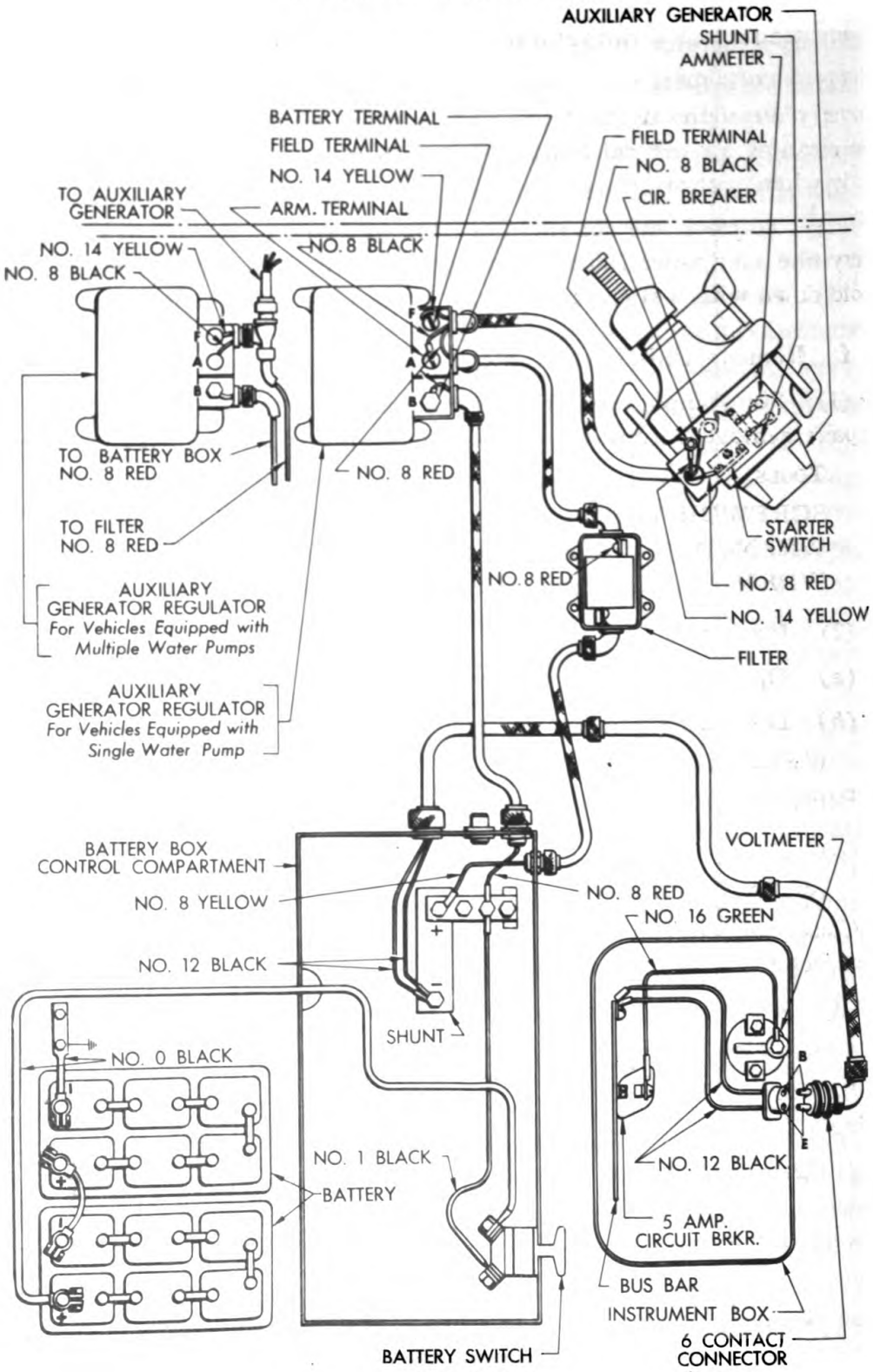
c. Carburetor. NOTE: Only trained ordnance maintenance personnel will make adjustments to carburetor.

(1) Keep the strainer in the fuel inlet connection on top of carburetor bowl free from sediment. When this strainer is being inspected, open the fuel line shut-off cock beneath the fuel tank, to make certain there is a free flow of fuel to the carburetor.

(2) If the fuel does not flow freely, remove the fuel filter sediment bowl beneath the fuel tank and clean the strainer in top of bowl.

d. Air Filter. Clean the air filter on the carburetor intake monthly. Take apart and rinse with dry cleaning solvent. Then dip the upper end of the screen in OIL, engine, SAE 30, and reassemble.

MEDIUM TANK M4A4



RA PD 25238

Figure 174 — Wiring Diagram — Auxiliary Generating Unit Circuit

e. Generator Commutator.

(1) To inspect the commutator, remove the accessible brush head cover plate with an offset screwdriver. The commutator should require no cleaning for several hundred hours of operation. It need be cleaned only when excessively carbonized.

(2) To clean the commutator, start the engine and place a strip of very fine sandpaper (00 to 8/10) (not emery) on the commutator and hold down with a stick of wood until the commutator is bright.

f. Remove Unit from Vehicle.

(1) For complete overhaul, or if unit fails to operate after minor repairs, remove it from vehicle. To remove, proceed as follows:

TOOLS.

SCREWDRIVER
WRENCH, $\frac{7}{16}$-in.
WRENCH, Allen, $\frac{1}{4}$-in.
WRENCH, $\frac{9}{16}$-in.
WRENCH, socket, $\frac{1}{2}$-in.

(2) PROCEDURE.

(a) Open radio switch and battery switch (par. 52., **b.**, (1).

(b) Disconnect engine exhause pipe.

WRENCH, Allen, $\frac{1}{4}$-in.

Remove the four screws which attach the exhaust pipe to flexible tubing.

(c) Disconnect fuel line.

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

Close shut-off valve on filter and unscrew fuel line connection from carburetor.

(d) Disconnect wires (fig. 174).

SCREWDRIVER
WRENCH, socket, $\frac{1}{2}$-in.

1. Remove two screws on top of control box and remove cover (screwdriver).

2. Remove nut and disconnect wire from field terminal ($\frac{1}{2}$-in. socket wrench). Remove screw and disconnect wire from starter switch (screwdriver). Remove screw and disconnect wire from circuit breaker (screwdriver).

3. Remove two screws which secure the control box to the generator yoke (just above the fiber panel in box). CAUTION: Use care not to drop these screws and washers in back of the panel board. If accidentally dropped, be sure to remove them before assembling, as they may cause a short circuit (screwdriver).

4. Push the three wires which were disconnected in preceding instructions *(3.)* through the hole in the box and remove the control box.

f. Remove Unit from Vehicle.

WRENCH, $\frac{7}{16}$-in. WRENCH, $\frac{9}{16}$-in.

Remove the four nuts and lock washers which secure the unit to sponson ($\frac{9}{16}$-in. wrench). Remove cap screw which secures ground strap to sponson ($\frac{7}{16}$-in. wrench). Lift unit from vehicle.

g. Install Unit in Vehicle.

TOOLS.

SCREWDRIVER
WRENCH, $\frac{7}{16}$-in.
WRENCH, $\frac{9}{16}$-in.
WRENCH, Allen, $\frac{1}{4}$-in.
WRENCH, socket, $\frac{1}{2}$-in.

(1) MOUNT UNIT ON SPONSON (fig. 121).

WRENCH, $\frac{7}{16}$-in. WRENCH, $\frac{9}{16}$-in.

Place unit in position on sponson and secure with four nuts and lock washers ($\frac{9}{16}$-in. wrench). Attach ground strap to sponson, securing with cap screw ($\frac{7}{16}$-in. wrench).

(2) INSTALL CONTROL BOX.

SCREWDRIVER WRENCH, socket, $\frac{1}{2}$-in.

(a) Insert the three wires through openings in box, position the box and secure with two screws and lock washers (just above fiber panel in box). CAUTION: Use care not to drop these screws and lock washers. If accidentally dropped, be sure to remove them before assembling, as they might cause a short circuit.

(b) Connect the three wires to terminals in control box, as shown in figure 174 (screwdriver, $\frac{1}{2}$-in. socket wrench).

(c) Place control box cover in position and secure with two screws at top of cover (screwdriver).

(3) CONNECT FUEL LINE.

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

Screw connection on end of fuel line onto carburetor connection.

(4) CONNECT EXHAUST PIPE.

WRENCH, Allen, $\frac{1}{4}$-in.

Position *new* gaskets on each end of coupling, place coupling in position and secure with four screws.

Section XXVII

PAINTING

191. GENERAL INSTRUCTIONS ON PAINTING.

a. Ordnance materiel is painted, before issue to the using arms, and one maintenance coat per year will ordinarily be ample for protection. With but few exceptions this materiel will be painted with ENAMEL, synthetic, olive drab, lusterless. The enamel may be applied over old coats of long oil enamel and oil paint previously issued by the Ordnance Department if the old coat is in satisfactory condition for repainting.

b. Paints and enamels are usually issued ready for use and are applied by brush or spray. They may be brushed on satisfactorily when used unthinned in the original package consistency, or when thinned no more than 5 percent by volume with THINNER. The enamel will spray satisfactorily when thinned with 15 percent by volume of THINNER. (Linseed oil must not be used as a thinner since it will impart a luster not desired in this enamel). If sprayed, it dries hard enough for repainting within one-half hour and dries hard in 16 hours.

c. Certain exceptions to the regulations concerning painting exist. Fire control instruments, sighting equipment, and other items which require a crystalline finish will not be painted with olive drab enamel.

d. Complete information on painting is contained in TM 9-850.

192. PREPARING FOR PAINTING.

a. If the base coat on the materiel is in poor condition, it is more desirable to strip the old paint from the surface, than to use sanding and touch-up methods. After stripping, it will then be necessary to apply a primer coat.

b. PRIMER, ground, synthetic, should be used on wood as a base coat for synthetic enamel. It may be applied either by brushing or spraying. It will brush satisfactorily as received or after the addition of not more than 5 percent by volume of THINNER. It will dry hard enough to touch in 30 minutes, and hard in 5 to 7 hours. For spraying,

it may be thinned with not more than 15 percent by volume of THINNER. Lacquers must not be applied to the PRIMER, ground, synthetic, within less than 48 hours.

c. PRIMER, synthetic, rust inhibiting, for base metal, should be used on metal as a base coat. Its use and application is similar to that outlined in paragraph (**b.**) above.

d. The success of a job of painting depends partly on the selection of a suitable paint, but also largely upon the care used in preparing the surface prior to painting. All parts to be primed must be free from rust, dirt, grease, kerosene oil, and alkali, and must be dry.

193. PAINTING METAL SURFACES.

a. If metal parts are in need of cleaning, wash them in a liquid solution consisting of one-half pound of SODA ASH in eight quarts of warm water, or an equivalent solution, then rinse in clear water and wipe thoroughly dry. Wood parts in need of cleaning should be treated in the same manner, but the alkaline solution must not be left on for more than a few minutes and the surfaces should be wiped dry as soon as they are washed clean. When artillery or automotive equipment is in fair condition and only marred in spots, the bad places should be touched with ENAMEL, synthetic, olive drab, lusterless, and permitted to dry. The whole surface will then be sandpapered with PAPER, flint, No. 1, and a finish coat of ENAMEL, synthetic, olive drab, lusterless, applied and allowed to dry thoroughly before the materiel is used. If the equipment is in bad condition, all parts should be thoroughly sanded with PAPER, flint No. 2, or equivalent, given a coat of PRIMER, ground, synthetic, and permitted to dry for at least 16 hours. They will then be sandpapered with PAPER, flint, No. 00, wiped free from dust, and a final coat of ENAMEL, synthetic, olive drab, lusterless, applied and allowed to dry thoroughly before the materiel is used.

194. PAINT AS A CAMOUFLAGE.

Camouflage is now a major consideration in painting ordnance vehicles, with rust prevention secondary. The camouflage plan at present employed utilizes three factors: Color, gloss and stenciling.

a. Color. Vehicles are painted with ENAMEL, synthetic, olive drab, lusterless, which was chosen to blend in reasonably well with the average landscape.

b. Gloss. The new lusterless enamel makes a vehicle difficult to see from the air or from relatively great distances over land. A vehicle painted with ordinary glossy paint can be detected more easily and at greater distances.

c. Stenciling. White stencil numbers on vehicles have been eliminated because they can be photographed from the air. A blue drab stencil enamel is now used which cannot be so photographed. It is illegible to the eye at distances exceeding 75 feet.

d. Preserving Camouflage.

(1) Continued friction or rubbing must be avoided, as it will smooth the surface and produce a gloss. Do not wash the vehicle more often than once a week, unless the terrain over which it is operating is such as to require more frequent washing. Take care to see that the washing is done entirely with a sponge or soft rag. Do not rub or wipe the surface except while wet, or a gloss will develop.

(2) It is not desirable that vehicles, painted with **ENAMEL**, lusterless, be kept as clean as vehicles were kept when glossy paint was used. A small amount of dust increases the camouflage value. Remove grease spots with **SOLVENT**, dry-cleaning. Whatever portion of the spot cannot be so removed should be allowed to remain.

(3) Continued friction of wax-treated tarpaulins on the sides of a vehicle will also produce a gloss. Remove such spots with **SOLVENT**, dry-cleaning.

(4) Tests indicate that repainting with olive-drab paint will be necessary once yearly, with blue-drab paint twice yearly.

195. REMOVING PAINT.

a. After repeated paintings, the paint may become so thick as to crack and scale off in places, presenting an unsightly appearance. If such is the case, remove the old paint by use of a lime-and-lye solution (see TM 9-850 for details) or **REMOVER**, paint and varnish. It is important that every trace of lye or other paint remover be completely rinsed off and that the equipment be perfectly dry before repainting is attempted. It is preferable that the use of lye solutions be limited to iron and steel parts. If used on wood, the lye solution must not be allowed to remain on the surface for more than a minute before being thoroughly rinsed off and the surface wiped dry with rags. Crevices or cracks in wood should be filled with putty and the wood sandpapered before refinishing. The surfaces thus prepared should be painted according to directions in paragraph 192.

196. PAINTING LUBRICATING DEVICES.

a. Oil cups, grease fittings, oil holes, and similar lubricating devices, as well as a circle about three-fourths of an inch in diameter at each point of lubrication, will be painted with **ENAMEL**, red, water-resisting, in order that they may be readily located.

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Section XXVIII

REFERENCES

197. 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, 75-mm, M2 and M3 (tank) and mount, gun, 75-mm, M1 ..... SNL C-34

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 semi-automatic cannon, and mortars ..... SNL A-35

Truck, small-arms repair, M1 ..... SNL G-72

c. Tank, medium, M4A4 ..... SNL G-104

Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained as the "Ordnance Publications for Supply Index" ..... OPSI

198. EXPLANATORY PUBLICATIONS.

a. Armament.

Browning machine gun, caliber .30, HB, M1919A4 (mounted in combat vehicles) ..... FM 23-50

REFERENCES

Browning machine gun, caliber .50, HB, M2 (mounted in combat vehicles)	FM 23-65
Grenades	FM 23-30
Instruction guide, small arms data	TM 9-2200
Thompson submachine gun, cal. .45, M1928A1	FM 23-40
75-mm gun materiel, M2 and M3 (tank)	TM 9-307

b. Communications.

Radio fundamentals	TM 11-455
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 lubrications instructions for 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
Electric 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. Ordnance Maintenance, stabilizers, all types (now published as TM 9-1798) ..... TM 9-1739A

f. **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 military motor vehicles	AR 850-18

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