TM 9-732B

WAR DEPARTMENT TECHNICAL MANUAL

75-mm Howitzer Motor Carriage M8

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WAR DEPARTMENT • *31 JANUARY 1944*

[redacted]

TM 9–732B
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TECHNICAL MANUAL

75-MM HOWITZER MOTOR CARRIAGE M8

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON 25, D. C., 29 May 1944.

TM 9–732B, 31 January 1944, is changed as follows:

97. BAND ADJUSTMENTS.

* * * * * * *

c. Adjusting Rear Band With Torque Wrench (41–W–3630).—Place transmission selector lever in neutral and start engine. Set brakes and set hand throttle so that engine is running at approximately 1,000 revolutions per minute. Loosen rear band * * * stationary. Stop engine.

* * * * * * *

[A. G. 300.7 (4 May 44).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

As prescribed in paragraph 9*a*, FM 21–6; R 9 (4); Bn 9 (2); C 9 (5); IBn 7, 17, (5); IC 2 (10).
IBn 7: T/O & E 7–25, Armed Inf Bn.
IBn 17: T/O & E 17–15, Tk Bn L.
IC 2: T/O & E 2–28, Cav. Assault Gun Tr, Mec.

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★This manual supersedes TM 9-732B, 11 Nov. 1942; TB 732B-1; 15 Mar. 1943; TB 732B-2, 24 Dec. 1942; TB 732B-3, 14 Jan. 1943; TB 732 B-4, 17 Mar. 1943; TB 732B-5, 18 Mar. 1943; TB 732B-6, 6 Apr. 1943; TB 732B-7, 23 Apr. 1943; TB 732B-8, 18 May 1943; TB 732B-9, 21 June 1943; TB 732B-10, 30 June 1943; TB 732B-11, 1 July 1943; TB 732B-12, 29 July 1943; TB 732B-13, 10 Aug. 1943; TB 732B-14, 27 Nov. 1943, and TB 732B-16, 22 Nov. 1943. All pertinent information from TC 44, 9 Apr. 1943; TB 700-1,-1 Jan. 1942; TB 700-15, 21 July 1942, as it pertains to this manual is cancelled. TB 700-37, 4 Mar. 1943; TB 700-51, 8 May 1943; TB 700-66, 11 June 1943; TB 700-73, 1 July 1943; TB 700-85, 28 July 1943; and TB 700-96, 28 Aug. 1943.

WAR DEPARTMENT
Washington 25, D. C., 31 January 1944

TM 9-732B, 75-mm Howitzer Motor Carriage M8, is published for the information and guidance of all concerned.

[A.G. 300.7 (28 Oct 43)
O.O.M. 461/Rar. Ars. (1 Feb 44)R]

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

CONTENTS

PART ONE—VEHICLE OPERATING INSTRUCTIONS

PART TWO—VEHICLE MAINTENANCE INSTRUCTIONS

CONTENTS – Cont'd

75-MM HOWITZER MOTOR CARRIAGE M8

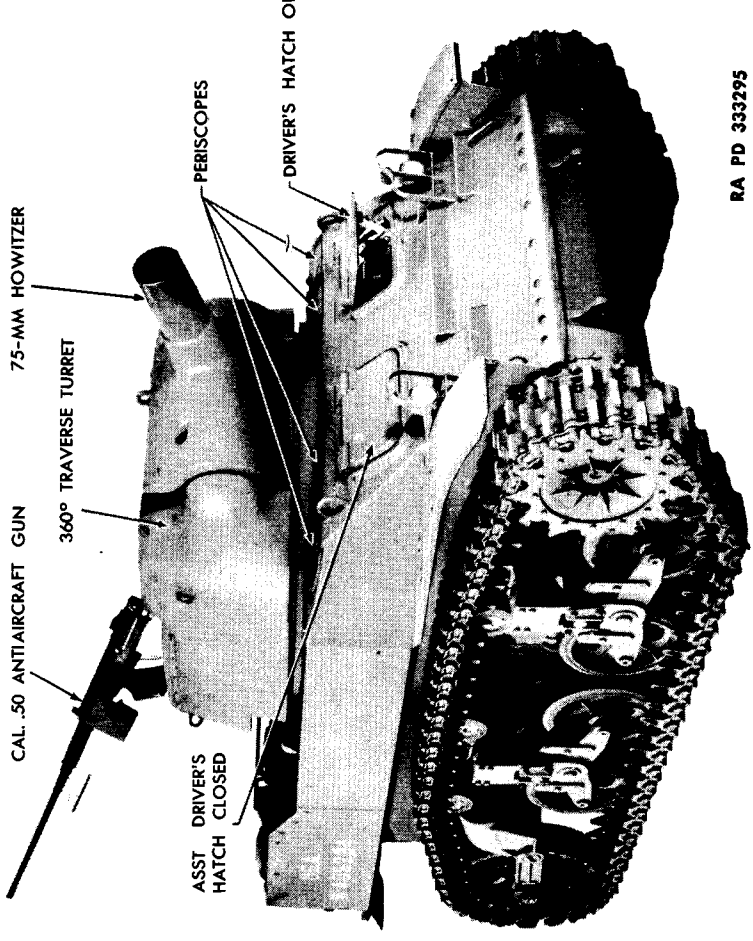


Figure 1 — 75-mm Howitzer Motor Carriage M8 (Without Sand Shields) — Three-quarter Right Front View

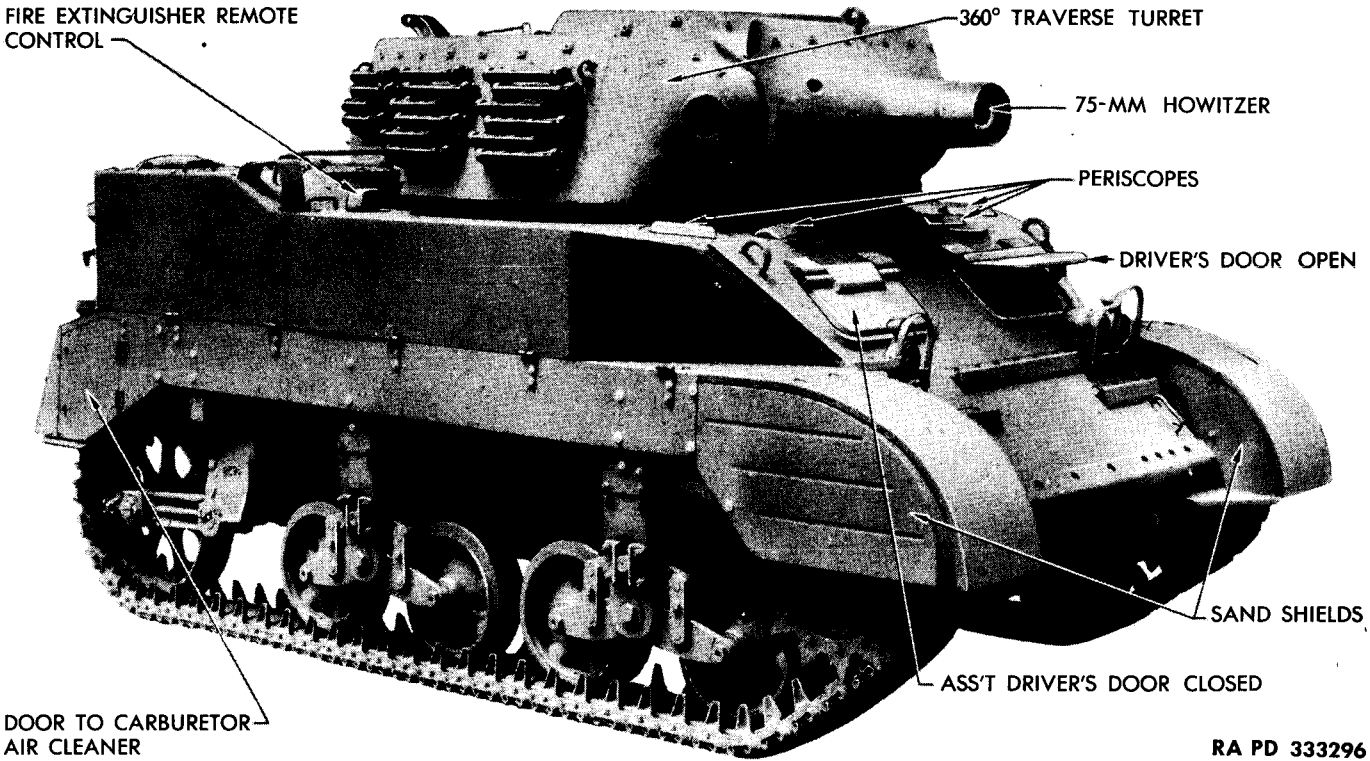


Figure 2 — 75-mm Howitzer Motor Carriage M8 (With Sand Shields) — Three-quarter Right Front View

75-MM HOWITZER MOTOR CARRIAGE M8

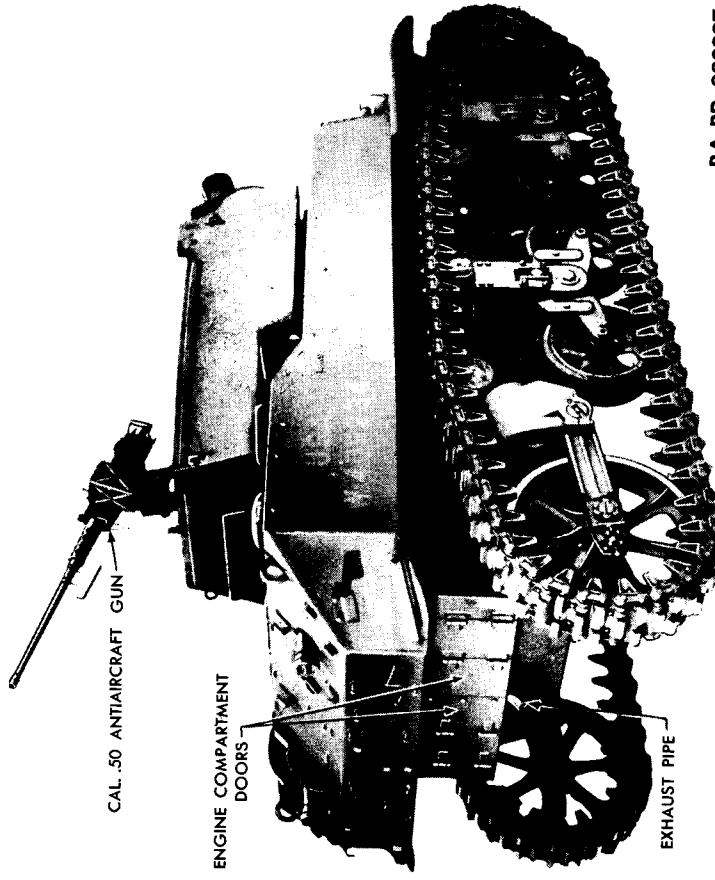


Figure 3 — 75-mm Howitzer Motor Carriage M8 (Without Sand Shields) — Three-quarter Right Rear View

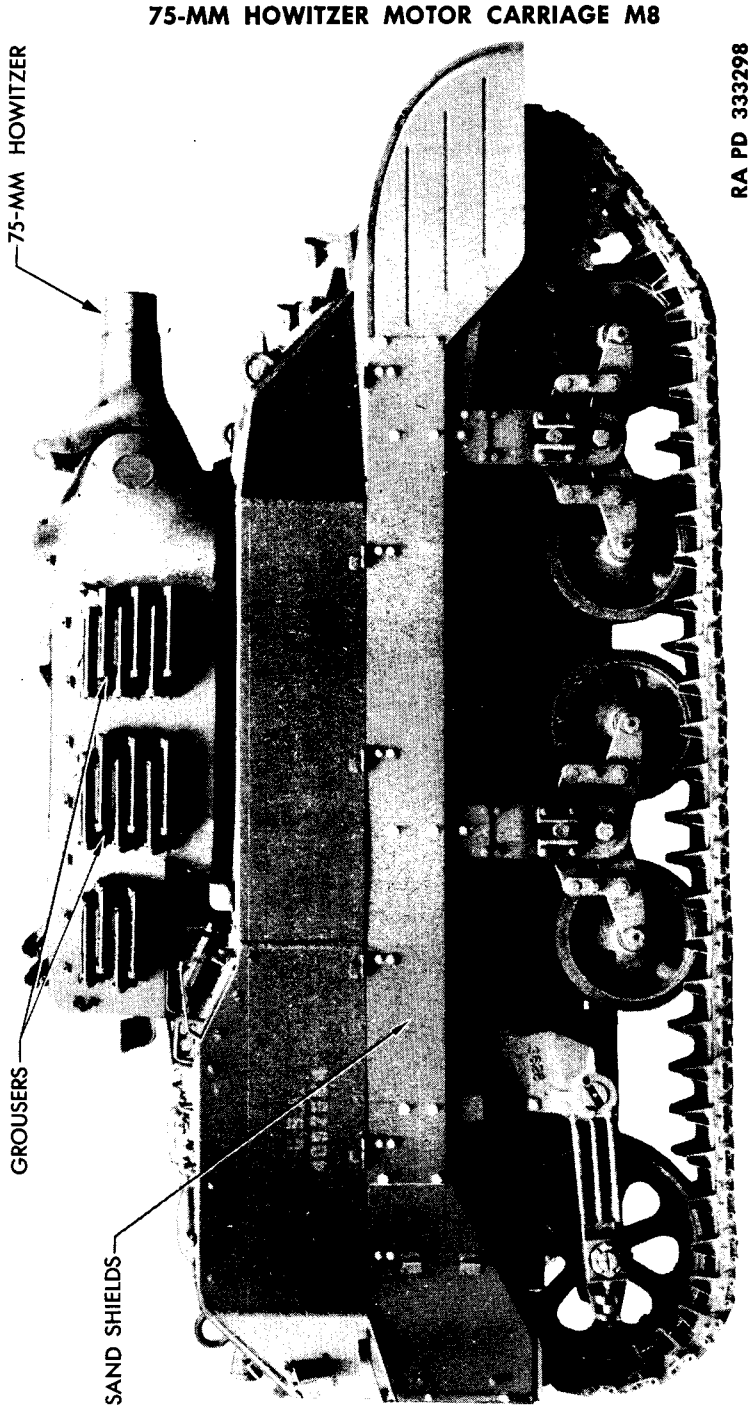


Figure 4 — 75-mm Howitzer Motor Carriage M8 (With Sand Shields) — Side View

75-MM HOWITZER MOTOR CARRIAGE M8

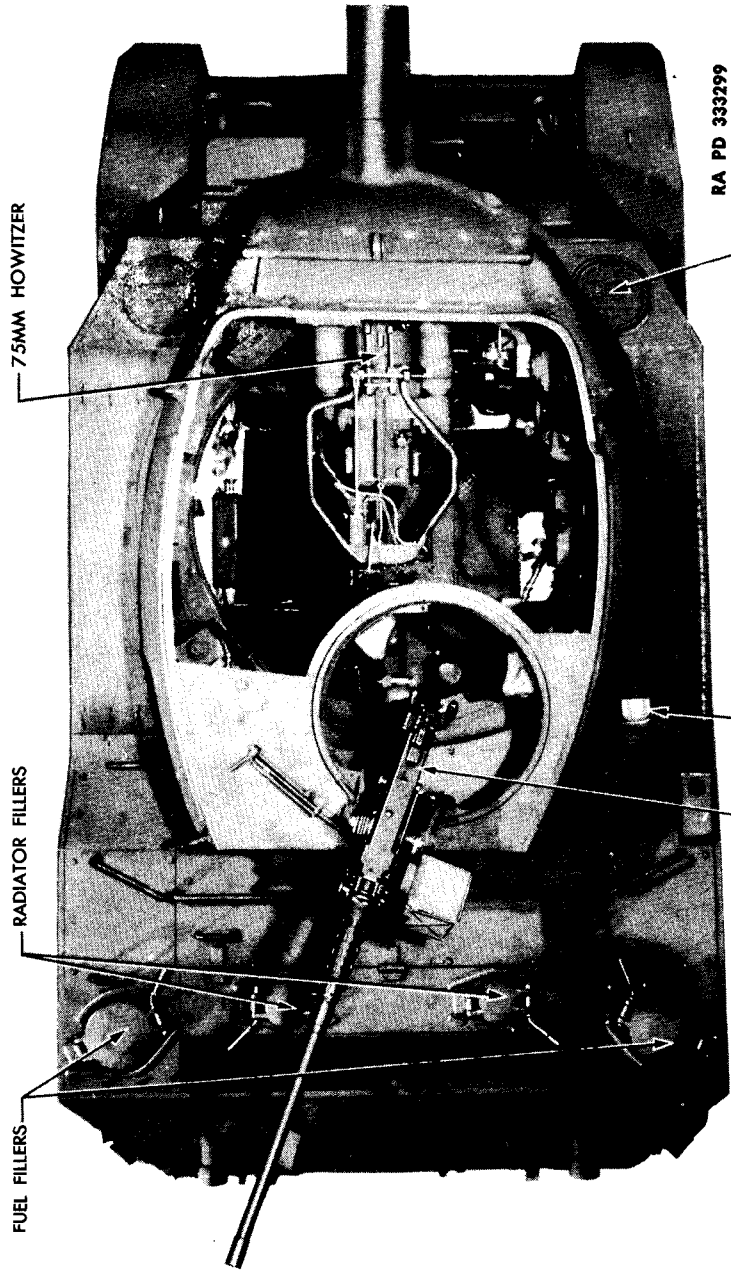


Figure 5 — 75-mm Howitzer Motor Carriage M8 — Top View

75-MM HOWITZER MOTOR CARRIAGE M8

PART ONE — VEHICLE OPERATING INSTRUCTIONS

Section I

INTRODUCTION

1. SCOPE.

a. This technical manual is published for the information and guidance of the using arm personnel charged with the operation and maintenance of this materiel.

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

2. ARRANGEMENT.

a. In addition to a description of the 75-mm Howitzer Motor Carriage M8, this manual contains technical information required for the identification, use, and care of the materiel. This manual is divided into four parts. Part One, section I through section IX, contains vehicle operating instructions. Part Two, section X through section XXV, contains vehicle maintenance instructions. Part Three, section XXVI through section XXVIII, contains operation instructions for armament on 75-mm Howitzer Motor Carriage M8. Part Four, section XXIX, contains instructions for shipment and temporary storage. Pertinent references are located immediately after Part Four, and precede the index to this publication.

Section II

DESCRIPTION AND TABULATED DATA

3. DESCRIPTION.

a. The 75-mm Howitzer Motor Carriage M8 is an armored, full track-laying combat vehicle carrying a four-man crew, and equipped with dual driving controls.

b. The vehicle is powered by two eight-cylinder, 90°, V-type, liquid-cooled engines, located in the rear of the hull. The flywheel end of each engine is connected to a Hydra-Matic transmission. The propeller shaft from each power plant runs forward through the fighting compartment to a transfer unit located at the right of the driver's seat. The transmissions, plus the two-speed transfer unit, provide six forward speeds and one reverse speed. Each vehicle is wired for radio installation, and for an intraphone system within the vehicle.

c. The basic hull armor plate is a completely welded structure, except for portions of front, top, and rear, which are removable for service operations. The armor on the front of the vehicle is 1⅛ inches thick, with the exception of the nose casting, which is 1½ inches thick; on the sides of the fighting compartment it is 1⅛ inches thick; on the sides and rear of engine compartment it is 1 inch thick, while the hull roof is ½-inch armor plate.

d. The turret is made of welded armor plates. The front plate is 1½ inches thick, and the side and rear plates are 1 inch thick. There is also a partial roof of ⅜-inch plate, and a gun shield of ½-inch plate.

4. DATA.

a. General.

Weight without armament, fuel, and crew:

Shipping weight	31,091 lb
Fighting weight	34,263 lb
Ground pressure, per sq in.	12.20 lb
Over-all width	88¼ in.
Ground clearance	13¾ in.
Tread (center to center of tracks)	73¼ in.
Over-all height, including turret	90 in.
Over-all length	170⅜ in.

b. Engine.

Rated net horsepower at output shaft: (each engine)	110 @ 3400 rpm
Number of cylinders (each engine)	8
Weight of engine w/accessories: (each engine)	949 lb
Firing order	1, 8, 7, 3, 6, 5, 4, 2

75-MM HOWITZER MOTOR CARRIAGE M8

c. Armament.

1 75-mm howitzer, pack (M1A1)
1 cal. .50 machine gun (D 51-70) in antiaircraft mount
1 cal. .45 Thompson submachine gun (M1928A1) carried in brackets in vehicle
3 cal. .30 carbines (MI) or cal. .30 rifles (MI)

d. Ammunition Carried.

48 rounds 75-mm high explosive and smoke
400 rounds cal. .50 in boxes (includes box on gun)
600 rounds cal. .45 in 30-round clips
200 rounds cal. .30 for carbine or rifle in crew members' ammunition belts

e. Protected Vision. Protected vision is provided for the driver and assistant driver by four periscopes, one in front of each driver and one toward each side of hull.

f. Seats, body supports, and safety belts are provided for each of the four members of the crew.

g. Communication.

Radio.....SCR-510 sending and receiving Voice communication
Intracrew ..... Telephone

h. Armor Thickness.

Front— 1⅛ inches on all front plates
Rear— 1 inch
Sides— 1⅛ inches on fighting compartment, 1 inch on engine compartment
Top— 1 inch
Floors—½ inch ahead of front dead axle, ⅜ inch behind this point

i. Turret. Front plate 1½ inches, side armor plate 1 inch thick, 360-degree hand traverse

j. Fuel, Oil and Coolant.

Fuel capacity (tank in each sponson).....89 gallons total

	Gasoline Economy in mpg	No. of miles without refueling
25 mph on straight improved roads.....	2	172
10 mph average cross country.....	1½	129
Octane rating of fuel.....	80 or above	
Oil consumption (approx.)	600 miles per gal (both engines)	

DESCRIPTION AND TABULATED DATA

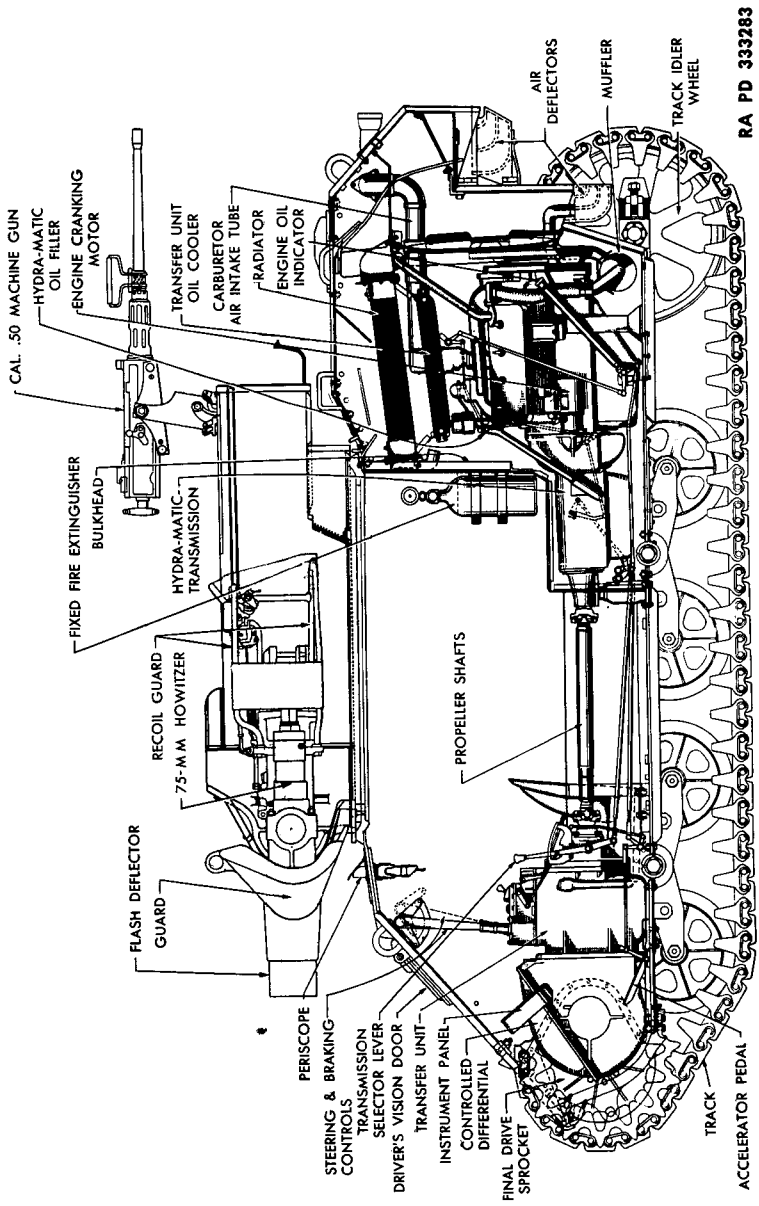


Figure 6 — 75-mm Howitzer Motor Carriage M8 — Sectional View

Engine oil capacity ..... 8 qt (each engine)
Lubricants ..... See Lubrication Guide
Coolant ..... Water or antifreeze
Cooling system capacity ..... 35 qt (each system)

k. Maximum Operating Characteristics.

Speed, sustained 35
Speed, short periods 40
Speed, cross-country ..... depending on terrain
Maximum allowable engine speed:
Short periods ..... 4,250 rpm
Sustained ..... 3,600 rpm
Maximum grade-ascending ability ..... 60 percent
Maximum grade-descending ability ..... 60 percent
Maximum width of trench vehicle will cross ..... 5 ft 5 in.
Maximum vertical obstacle, such as a wall, that vehicle will climb ..... 24 in.
Maximum fording depth (at slowest forward speed) ..... 30 in.

l. Crew ..... 4 men

m. Tracks ..... Rubber block

Track shoe width ..... 11⅝ in.
Track pitch ..... 5½ in.
Ground contact ..... 133 sq in. at 2-in. penetration
119 sq in. at 0 penetration
Ground pressure ..... 21.19 lb per sq in. at 0 penetration

Section III

DRIVING CONTROLS AND OPERATION

5. DOORS AND PERISCOPES.

a. General. There are two vision doors on the M8 vehicle, located in the hull directly in front of each driver, and an escape door in the floor of the hull

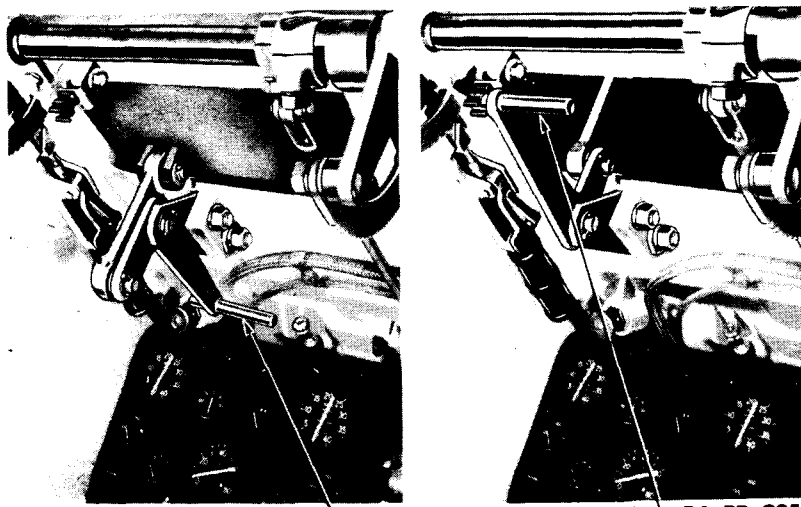


Figure 7 — Driver's Vision Door Controls

b. Vision Doors. The operation of each vision door is identical (fig. 7).

(1) OPENING. To open vision door, release latch on the inside, and swing door up until it rests in open position.

(2) CLOSING. Lower door to its closed position. Place latch link over hook on door and lock latch. CAUTION: *When driving with door closed, always make sure it is locked shut.*

c. Escape Door. An escape door is provided in the hull floor behind the assistant driver's seat (fig. 8).

(1) OPENING. To open the escape door, the auxiliary driver will reach back and raise the subfloor, raise lever on escape door, and allow entire assembly to drop to the ground.

(2) INSTALLATION. To install escape door, raise rear end of door through opening in hull floor and hook clips over edge of opening. Hold lever in vertical position and raise door into place, then swing lever downward toward door into its locking position.

d. Periscopes.

(1) All periscopes have a traverse of 360 degrees, an elevation of 26 degrees, and a depression of 27 degrees from the vertical.

(2) Periscopes are raised to the using position or lowered for complete protection by loosening the knurled knob, and moving the periscope to the desired position.

(3) Periscope units are replaced complete, in the event of damage, by turning back the latch (fig. 9), loosening the knurled knob, removing the damaged unit, and installing a new one.

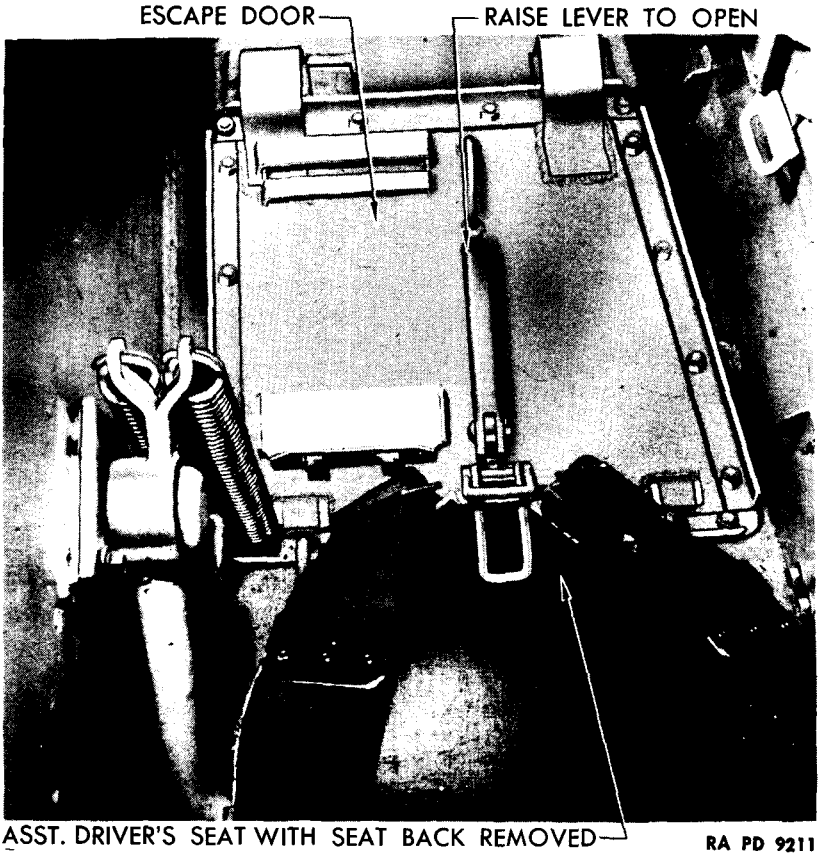


Figure 8 — Escape Door

e. Air cleaner doors, in the sponsons are equipped with paper gaskets to prevent sticking of rubber seals.

6. SWITCHES AND INSTRUMENTS.

a. **General.** Instrument panels of two different designs have been used on these vehicles. The first design is illustrated in figure 10. The second type panel (fig. 11), used on late type vehicles, has a lighting switch of different design, and a manually reset circuit breaker for the lights. The warning signals are rearranged, and the voltmeter is eliminated.

b. **Master Battery Switch.** The master battery switch is located on the front edge of the apparatus box on the left side of the hull. When in the "OFF" position, it disconnects all electrical circuits. Pull out and turn the switch handle to place in "ON" position. Turn and

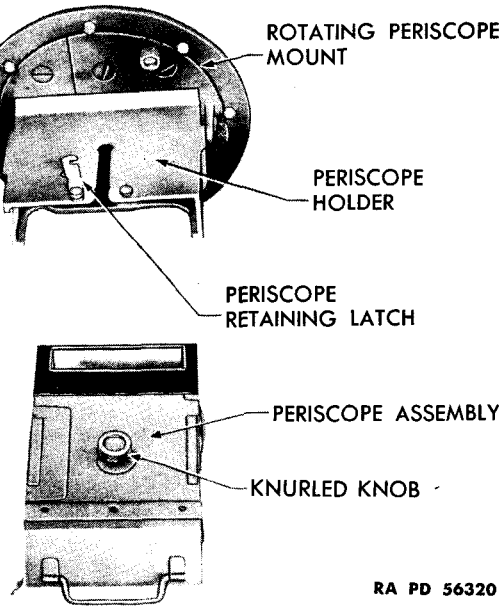


Figure 9 — Periscope and Mounting

release the handle to return to the "OFF" position. NOTE: *Never pull master switch to stop engines; always use ignition switches. If master switch is pulled, engines will not stop and generators will be damaged.*

c. Ignition Switches. The ignition switches are located on the outside corners of the instrument panel (figs. 10 and 11). There are two switches, one for each engine. NOTE: *In designating instruments, the instrument on the right-hand side of the instrument panel applies to the engine on the right-hand side of the vehicle, and the instrument on the left-hand side of the instrument panel applies to the engine on the left-hand side of the vehicle.*

d. Starting Button. The starting buttons are located in the lower area of each instrument panel. There are two buttons, one for each engine. The ignition must be "ON" when cranking the engine.

e. Oil Pressure Gages. There are two oil pressure gages, one for each engine, located one on each side of the instrument panel. The gages operate electrically with the circuits connected to oil pressure units on the engines.

f. Temperature Gages. There are two temperature gages, one for each engine, located above each ignition switch. These gages are connected electrically to the thermal units on the engines.

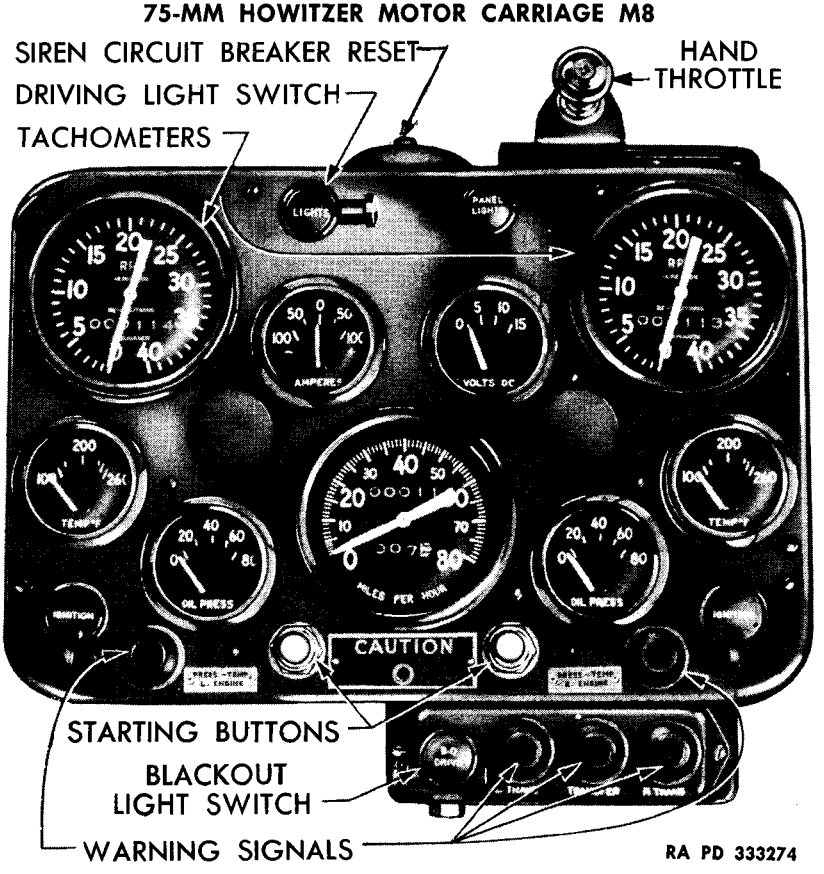


Figure 10 — Instrument Panel — First Type

g. Warning Signals. Warning signals on engine temperature and pressure are located, one on each side, in the lower area of the instrument panel. A red light flashes if oil pressure drops below 12 pounds, or if engine temperature increases above 240° F. Check the oil and temperature gages to determine exactly which system is at fault. Three other warning signals are located on the instrument panel (figs. 10 and 11), one for each transmission, and one for the transfer unit. A red light in one of these indicates dangerously low oil pressure (below 60 lb).

h. Tachometers. There are two tachometers, one for each engine, located in the upper outside corners of the instrument panel and geared to the distributor drive shafts. These instruments indicate the speed of each engine and the total revolutions each engine has been operated. Speed is indicated in hundreds, *i.e.*, 10 means 1,000 revolutions per minute and 25 means 2,500 revolutions per minute. Total revolutions are indicated in thousands.

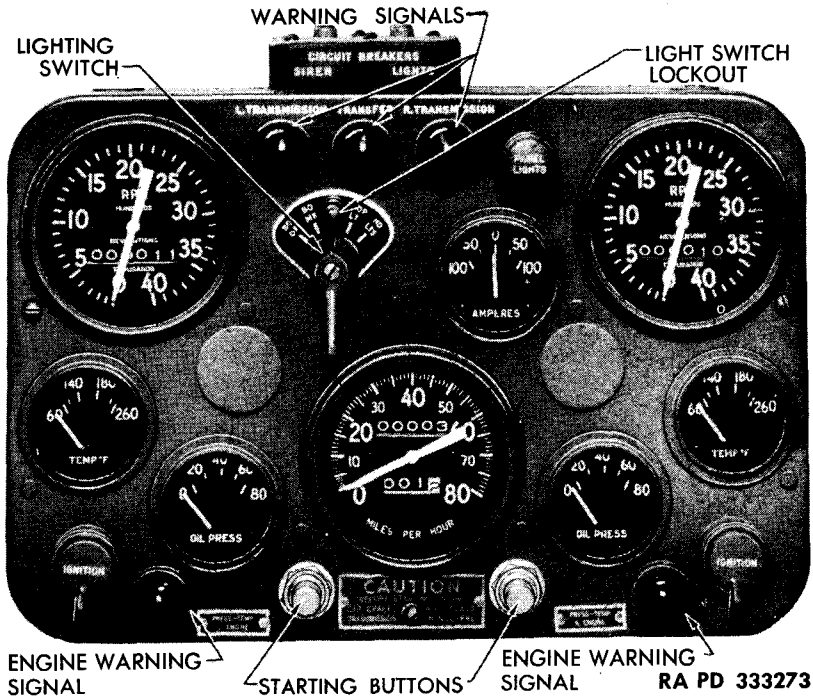


Figure 11 — Instrument Panel — Second Type

i. Ammeter. The ammeter is located in the left center of the instrument panel and connected so as to indicate the amount of charge or discharge in the main battery circuit.

j. Voltmeter. The voltmeter (if used) is located at the right center of the instrument panel. It indicates the voltage in the main battery circuit.

k. Speedometer. The speedometer is located in the lower center of the instrument panel. It indicates the speed of the vehicle and the mileage traveled.

l. Lighting Switches. The use of the lighting switches is covered in paragraph 14.

m. Siren Switch. The siren switch is located on the floor of the driving compartment (fig. 12). A reset button, for use in case the siren circuit breaker opens, is located on top of the instrument panel (figs. 10 and 11).

7. DRIVING CONTROLS.

a. General. The steering brake levers and the accelerator are duplicated to provide for dual control. Other controls are not duplicated.

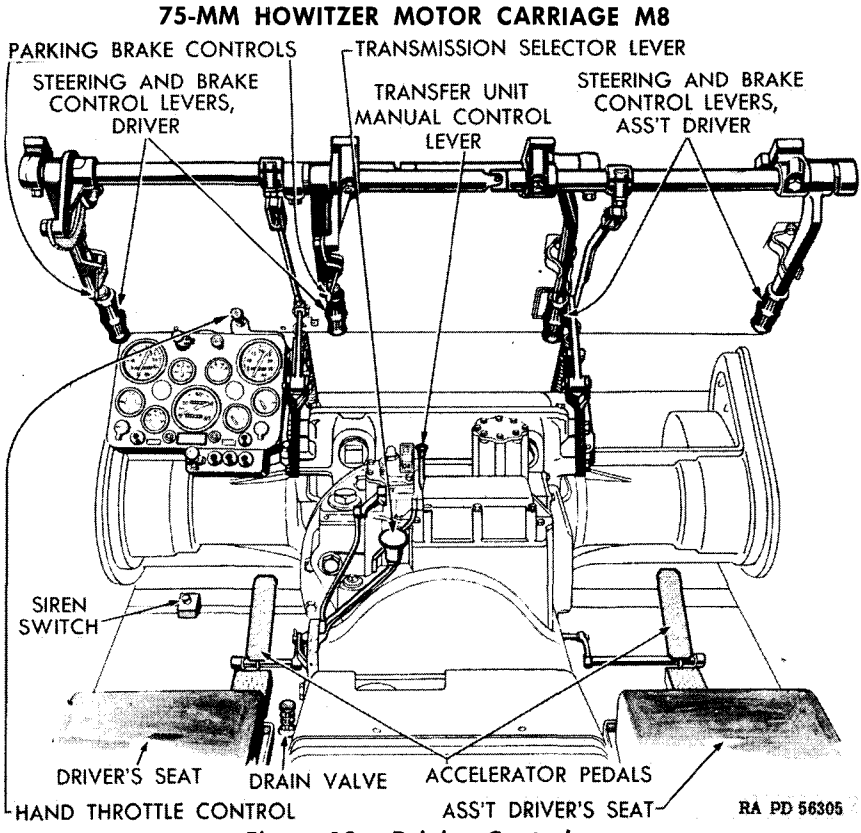


Figure 12 — Driving Controls

b. Accelerator. Individual foot accelerators are provided for the driver and assistant driver for dual control of the vehicle. Each accelerator controls both engines. The hand throttle is on the driver's side, located just above the instrument panel, where it can be reached by the assistant driver (fig. 12). The hand throttle is self-locking in any position, and is released by means of a spring button in the center of the control knob. CAUTION: *Turn assistant driver's accelerator pedal back when not in actual use.*

c. Choke. An automatic choke mechanism, located on the carburetors, provides the correct fuel mixture for starting the engines. This simplifies the starting procedure (par. 10).

d. Spark Control. The spark control is provided by means of centrifugal weights in the distributor. It is fully automatic and governed by engine speed. It requires no attention whatever from the driver.

e. Steering Levers. Dual steering levers for the driver and assistant driver are mounted on the upper front deck of the vehicle. To steer the vehicle, pull the lever on the side toward which it is desired

to turn. CAUTION: *Always grasp steering levers at the rubber grips, and not above this point, or the locking pawls may accidentally be moved into the locked position. See paragraph 11 for detailed information on steering.* Either set of levers may be swung forward when they are not being used.

f. Brakes. Pulling back simultaneously on both steering levers slows down or stops the vehicle, depending on the effort applied. The stop light goes on when both levers are pulled back, provided the lighting switch is in any position other than "OFF." Parking brake controls on the left-hand or driver's steering levers permit these levers to be locked in the "ON" position. Move the controls to the right for unlocking, and to the left for locking.

g. Clutch. There is no clutch pedal. Due to the fluid coupling between the engines and the transmissions and the automatic features of the transmissions, there is no need for a foot-operated clutch.

h. Shifting Controls.

(1) The driver does not shift gears with the Hydra-Matic transmissions. Gear changes are controlled by engine load and accelerator position, and are made automatically by hydraulic governors.

(2) Two controls are provided, however, for specific uses: a transmission selector lever and a transfer unit control lever. The transmission selector lever is provided so that the transmissions can be put in neutral, forward driving range, low range or reverse. The transfer unit control lever has driving and low range positions.

(3) The driving range positions, labeled "DR," on both the transmission and transfer unit quadrants are used for normal forward driving. With the controls in these positions, the vehicle will start from a standstill in low gear and the mechanism will shift up automatically through the successive gears to sixth speed (direct drive) as the vehicle speed increases. The mechanism will also downshift automatically to lower gears as vehicle speed is reduced, either because the accelerator pedal is released, or due to an upgrade.

(4) When the accelerator pedal is pushed down as far as it will go, it not only opens the throttle all the way, providing maximum engine power; it also forces the transmission control valves into the "detent" position, which causes the transmissions to downshift from sixth to fifth speed, provided the vehicle is traveling at less than 35 miles per hour. This downshift permits more rapid acceleration by providing a slightly lower gear ratio. This acceleration can be used to advantage in fast get-away, passing other vehicles, gaining additional speed over viaducts, and on turns.

8. SEAT ADJUSTMENT.

a. Seats for both the driver and the assistant driver have one horizontal adjustment. Directly in front of each seat, on the under side, is an L-shaped handle which controls forward and backward movement. Over-all travel is 3 inches, or 1½ inches either forward or backward from the center position. The seat is locked in the desired position when the handle is released.

9. FUEL REQUIRED.

a. Only gasoline with an octane rating of 80 or above can be safely used in this vehicle. Normal engines should not detonate (knock); if they do, it indicates either that the gasoline is of incorrect grade, or that the spark timing is incorrect. NOTE: *Turn the gasoline shut-off valve on before attempting to start the engine, and turn valve off when the engines are stopped.*

10. STARTING THE ENGINES.

a. **Before-operation Inspections.** Before the engines are started, the Before-operation Service (par. 30) must be completed.

b. **Normal Starting.** Under normal conditions, the engines should be started according to the following procedure:

(1) Set the brakes.

(2) Depress the accelerator pedal ¼ to ½ of full travel. CAUTION: *Do not pump accelerator.*

(3) Place transmission selector lever at neutral.

(4) Turn the ignition switches on for both engines.

(5) Press starting button for each engine until the engine fires. CAUTION: *Both engines should be started at the same time, except at subzero temperatures.*

(6) After engines are started, pull out throttle and set engine idling speed at 625 revolutions per minute until engine warms up, to prevent stalling.

c. **Engine Test.**

(1) As soon as the engines are started, the oil gages should be observed. Pressure at idling speed should be about 15 pounds, at operating speed about 30 pounds. If the gages do not indicate oil pressure within a few seconds, stop the engines and investigate. Do not drive vehicle while engine or transmission warning signals are red. NOTE: *The transfer unit signal will remain red until the vehicle has started to go forward. It remains lighted in reverse.*

(2) Watch the ammeter to see that the generators are charging. If the ammeter does not indicate "charge" with the engines idling, speed up engines by momentarily depressing accelerator. If ammeter needle

does not move to "charge" side, look for slipping generator belts or broken connections.

(3) The temperature gages should indicate between 165° F and 240° F after the engines are warmed up, depending on operating conditions. If temperature exceeds 240° F, at which temperature the warning signal lights, stop engines, and investigate for loss of coolant.

(4) 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, turn the cap to the left (counterclockwise) until the first stop is reached. After the cap has remained in this position one-half minute, or long enough to vent radiator thoroughly, press down on cap to clear stop, and turn further to left to remove it (fig. 59). When installing a radiator cap, be sure the gasket is in place and in good condition, and that the radiator cap is turned all the way to the right (clockwise) so that the entire cooling system will be sealed while operating.

(5) Check for unusual noises in each power train and engine.

d. Engine Warm-up. The engine does not require any warm-up period in mild weather, except the time required to check the gages mentioned above. At temperatures below freezing, the warm-up periods listed in subparagraph g, below, should be observed.

e. Flooded Engines.

(1) If the engines do not start readily in mild or warm weather, the most likely cause is a flooded condition in the carburetor or intake manifolds. This can be corrected by fully depressing the accelerator and then cranking the engine. As soon as the engines start, the throttle should be closed to prevent "racing" of the engines.

(2) Flooding usually occurs more severely in one engine, so that one engine starts and the other does not. In this case, the one engine that is operating should be shut off, the accelerator pressed all the way down, and the flooded engine cranked until it starts. The other engine can then be restarted with a minimum of "racing" either engine. The accelerator pedal should not be pumped.

f. Starting Hot Engines. When starting hot engines, hold the accelerator pedal halfway open, or wider.

g. Cold-weather Starting and Warm-Up.

(1) The procedure for starting the engine in cold weather (temperatures down to −30° F) is the same as the normal starting procedure, except that engines should be started one at a time. Engines will not start at the lower temperatures unless they are in good mechanical condition, lubricated with the proper grade of light engine oil, and unless the battery is fully charged.

(2) When the engines have started, allow them to run at 800 to 900 revolutions per minute for 4 or 5 minutes, to allow the oil to warm before depressing the throttle further. This should be done with the Hydra-Matic selector lever in neutral. Then shift the selector lever to "DR" and allow the engines to idle for several minutes more to warm up the oil in the transmissions. Do not drive the vehicle over 5 miles per hour for at least 10 minutes after starting, to permit the oil in the transfer unit and controlled differential to warm.

h. Starting One Engine with the Other. If only one engine starts readily, it can be used to start the other engine by simply driving the vehicle a short distance at low speeds with the ignition switch of the "dead" engine turned on. CAUTION: *First inspect "dead" engine to make sure it turns over freely before attempting to start it by use of other engine.*

11. DETAILED DRIVING INSTRUCTIONS.

a. Normal Shift Control.

(1) For driving on roads or on smooth, level terrain, move the transmission selector lever to the "DR" position (after the engines are started and while they are idling), and move the transfer unit control lever rearward to the "DR" position. Pull selector lever to the left to disengage lock-out before moving it out of neutral. The transmissions are then "in gear," but to start the vehicle moving forward, the parking brake controls on the driver's levers must be released and the accelerator pedal depressed. The amount the pedal is depressed will determine the speed with which the vehicle moves forward.

(2) With this arrangement of the controls, the vehicle will start in first gear and the transmission and transfer unit will automatically shift into second, third, fourth, and sixth as vehicle speed increases and engine load is reduced. As the vehicle loses speed, either because the accelerator pedal is released or due to upgrades, the transmissions and transfer unit will shift down automatically to a lower gear.

(3) When ascending moderate grades, pressing the accelerator all the way down not only allows the engines to develop full power but also causes the transmissions to downshift from sixth to fifth gear for better performance as soon as the vehicle speed drops below 12 miles per hour.

(4) The correct gear for normal forward driving is thus provided automatically by the transmissions and transfer unit. Manual shifts for better control under extreme conditions are covered in subparagraphs **d**, **e**, **f**, **g**, and **h** below. CAUTION: *Move selector lever from neutral to "DRIVE" or "LOW" only when engines are idling.*

b. Steering. To steer the vehicle, pull back on the right-hand steering lever to make a right turn, or on the left-hand for a left turn.

The lever that is being used should be applied firmly and then released fully, and this action repeated if necessary. The lever should not be held in a slightly applied position for long periods of time. CAUTION: *It is very important that the steering levers be held far enough forward to insure complete release of the bands at all times except when steering or stopping; otherwise the brake lining wear will be excessive and oil will become overheated.*

c. Stopping.

(1) To stop the vehicle, release the accelerator and pull back on both levers at the same time. There is no clutch to disengage. Pull both levers back and engage with heavy pressure, and then release fully. If the stop is to be made from relatively high speed, use heavy pressure intermittently rather than a continuous but lighter pressure.

(2) In stopping on downgrades, the transfer unit control lever may be moved forward to the "LO" position. This will shift the vehicle from sixth to fourth gear, increasing considerably the braking effect of engine compression. If this change in lever position is made when the vehicle is traveling at high speed, the mechanism will not downshift until the speed has been reduced (by use of the brakes) to a point where the shift can be made without undue strain on the transmissions or transfer unit (12 mph). CAUTION: *Do not use the transfer unit "LO" range for repeated stops on level ground, or for assisting brakes when stopping from high speed. Excessive use of transfer unit as a brake will cause premature wear of transfer unit bands, which cannot be replaced as easily as the steering brake bands.*

(3) Leave levers in "OFF" position when parking vehicle on level ground when controlled differential is hot. Use reverse position of selector lever on slight grade.

d. Reverse.

(1) To operate the vehicle in reverse, first bring it to a complete stop if it is in motion. Then move the transmission lever back into "LO" position, pause a moment, then move the lever to the left to disengage the lock-out, and pull the lever back into reverse with a firm, quick motion. CAUTION: *Make sure that the selector lever is moved all the way back so that both transmissions are definitely in reverse.*

(2) In backing up the vehicle, do not allow engine to exceed 3,600 revolutions per minute. Whenever possible, avoid backing the vehicle for any great distance, as there is no oil under pressure to the transfer unit at this time.

(3) The warning signal for low oil pressure in the transfer unit stays on when the vehicle is in reverse.

e. Ascending Hills.

(1) When ascending moderately steep hills from a running start on level ground, take as much advantage as possible of the momentum

acquired on the level. As the vehicle climbs the hill and loses speed due to the power demanded, the power train will automatically shift down from sixth to fifth, to fourth, etc., as required.

(2) When ascending very steep hills with a running start, shift the transfer unit control lever to "LO" before the vehicle speed drops below 12 miles per hour, and shift the transmission selector lever to "LO" before the speed drops below 6 miles per hour. Moving the transmission selector lever to "LO" causes the transmissions to shift down to second gear more quicky and assures more rapid ascent.

(3) In ascending steep hills from a standing start, it is recommended that both the transfer unit and the transmission selector levers be placed in "LO."

(4) Use steering brakes when ascending steep hills only in an emergency. Point tank in proper direction before ascending.

f. Descending Hills.

(1) In descending moderately steep hills, or long steep hills, move the transfer unit lever up into the "LO" position and slow the vehicle down with the brakes until the transfer unit downshifts into fourth gear (12 mph). This will provide adequate control of vehicle speeds on moderate downgrades. If possible, the downshift should be made before the vehicle starts downgrade.

(2) In descending short, very steep hills, the vehicle should be slowed down as much as possible before entering the downgrade, and both the transfer unit and the transmission control levers moved to "LO" range. Be sure to slow the vehicle with the brakes until both the transfer unit and the transmission downshift (6 mph), so that the mechanism will be in second gear to take full advantage of engine compression. CAUTION: *In rolling terrain, comprising a succession of short hills, shift the transfer unit into "LO" range and leave it there. Do not make frequent shifts back and forth between "LO" and "DR," as this will cause excessive transfer unit clutch and brake band wear.*

g. Rough or Sandy Terrain. In negotiating rough or sandy terrain, the selector levers for both the transfer unit and the transmissions should normally be kept in the "DR" position. If the speeds at which the vehicle must be driven, however, are such that the transfer unit continually shifts up and down between fourth and sixth, or fourth and fifth, the transfer unit lever should be moved to the "LO" position so that the vehicle will remain in fourth speed. If the vehicle is operated at low speeds (9 to 15 mph) over desert sands at high atmospheric temperatures, shifting the transfer unit into "LO" range will provide higher engine speeds and better cooling.

h. Heavy Mud or Sand. In operating the vehicle in heavy mud or sand, the selector levers for both the transfer unit and the transmissions should be kept in the "LO" position to hold the transmissions in

second gear, in order to obtain the benefit of a steady power pull and to prevent the transmissions from shifting back and forth from fourth to third, or third to second. If vehicle is stuck in mud or sand, avoid running engines faster than 3,600 revolutions per minute when spinning the tracks to work the vehicle free. If engines race, but tracks do not spin, transmission bands are slipping. Tighten bands, or have vehicle towed.

i. Operating Vehicle with One Engine. If one engine or transmission fails and facilities are not at hand to repair the engine, the vehicle can be operated for short distances with one engine by disconnecting the propeller shaft of the dead engine at the transfer unit. This will give better performance because the drag of the dead engine will be eliminated. The vehicle will not back up under any condition with one dead engine if the dead engine is not disconnected, because the rear band on the transmission of the dead engine is spring-applied, and will prevent rotation of the unit at this point. If the vehicle is to be driven for any distance with one dead engine, the fan shroud opening and the radiator for the dead engine should be covered to insure proper cooling of the operating engine.

12. STOPPING THE ENGINES.

a. To stop the engines, close the throttle until the engines are idling at approximately 425 revolutions per minute, and run at this speed for 3 or 4 minutes; then turn off both ignition switches. Finally, open master battery switch. CAUTION: *Always turn off ignition switches before opening master battery switch.*

b. If the vehicle is not to be started again within a very short time, close the fuel shut-off valve at the fuel filter. Shut-off valve is closed completely when it is in the vertical position and pointing up.

13. TOWING INSTRUCTIONS.

a. Equipment. A towing shackle is mounted on each corner of the hull of the vehicle about 20 inches from the ground. Two of these shackles are mounted in front and two in the rear. These shackles provide a quick method of attaching either the towing bar or cables. CAUTION: *The towing pintle is provided only for attaching ammunition trailers and not for towing other heavy vehicles.*

b. Precautions.

(1) When towing a vehicle that is disabled due to engine conditions only, and is known to have transmissions and transfer unit in good working order, the vehicle can be safely towed forward at speeds not exceeding 10 miles per hour, provided the transmission selector lever is in neutral.

(2) If the vehicle is disabled because of some difficulty with one transmission, the propeller shaft leading to that transmission must be disconnected at the front end before towing is attempted. In case of difficulty with the transfer unit, the tracks must be removed and the vehicle towed on the bogie wheels. In such cases, steel-rimmed trailing idlers should be tied up.

(3) A vehicle should never be towed backward, except for very short distances. The reason is that, when the vehicle is being towed backward, the oil pumps for the transfer unit and transmissions run backwards, and in consequence these units do not have the oil circulating under pressure, and can easily be damaged beyond repair. Furthermore, a vehicle which is towing another one should not be operated in reverse.

(4) Always check off level of oil in transfer unit and Hydra-Matic transmissions before towing.

c. Procedures. In towing a vehicle, changes in direction should always be made by a series of slight turns so that the vehicle being towed is, as nearly as possible, directly behind the one doing the towing. This will prevent the cable from contacting the track, which might ruin both the cable and the track blocks. If no operator is available to steer the disabled vehicle, it may be towed by using a towing bar, or in an emergency the "short hitch" method outlined in subparagraph d below. In cases where the tracks must be removed from the vehicle, the "short hitch" or towing bar greatly facilitates towing the disabled vehicle. If an operator is available to steer the disabled vehicle, one cable will be satisfactory.

d. Attaching Cables. Except in cases where the "short hitch" is necessary, the towing cable must be coupled to the other vehicle by means of the thimbled eyes provided at both ends of the cable. Doubling the cable causes sharp bends in the wire rope which will cause rapid failure of the strands and will leave the cable extremely dangerous to handle. When a "short hitch" is desired, the cable is threaded through both eyes on the vehicle to be towed and is then crossed and passed through both shackles of the towed vehicle. This provides an arrangement having a minimum of bending action and movement at the shackles, and furnishes clearance between cable and tracks.

e. Towing To Start Engines. The engines can be started in an emergency by towing the vehicle, provided the following procedure is observed:

(1) Release brakes.

(2) Put transmission selector lever at "N" and transfer unit lever at "LO."

(3) When speed reaches approximately 4 miles per hour, set automatic chokes by depressing accelerator ¼ of total travel; turn on

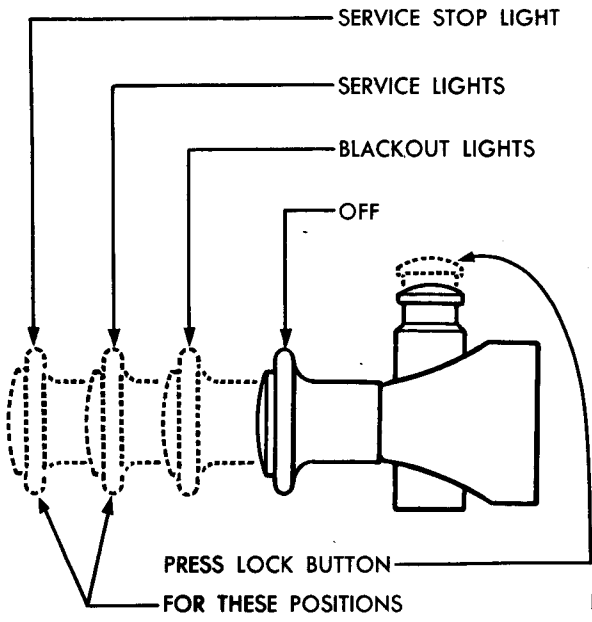


Figure 13 — Lighting Switch Positions

both ignition switches and move transmission selector lever to "DR."

(4) Continue towing until engines fire.

14. LIGHTING CONTROLS.

a. First Type Switch. Exterior driving lights on early M8 vehicles are controlled by a push-pull button on the instrument panel (fig. 10). The switch operates as follows:

(1) Pulling button out to first stop turns on blackout marker lights, and permits use of blackout driving light (par. 14 c).

(2) Depressing lock button and pulling switch button out to second position turns on service headlights, taillight and stop light.

(3) Depressing lock button and pulling switch out to third position operates service stop light only (for daytime driving).

b. Second Type Switch. Exterior driving lights on later M8 vehicles are controlled by a lever type switch handle (fig. 11). The switch operates as follows:

(1) Turning the switch lever counterclockwise to the first position turns on the blackout marker lights.

(2) Turning the switch lever counterclockwise to the second position keeps the blackout marker lights on, and in addition turns on the blackout driving light. NOTE: *Driving light must be in socket as explained in paragraph 14 c.*

(3) Depressing lock button and turning switch clockwise to first position operates service stop light only (for daytime driving).

(4) Depressing lock button and turning switch clockwise to second position turns on service headlights, taillight, and stop light.

c. Blackout Driving Light. The blackout driving light is a separate lamp which must be inserted in the socket in place of the left headlamp. On late type M8 vehicles, it is turned on simply by turning the main light switch lever counterclockwise to the second position. On early M8 vehicles, it is necessary first to pull the main light switch button out to the first (blackout) position, and then depress lock button and pull out blackout light switch button at the lower edge of the instrument panel.

d. Instrument Lights. Instrument panel lights are controlled by a simple push-pull switch on early M8 vehicles. On later M8 vehicles, a rheostat switch is used. This switch controls the intensity of illumination by rotation of the button.

e. Interior Lights. The driver's compartment on M8 vehicles is lighted by a single dome lamp on the hull roof.

Section IV

TURRET CONTROLS AND OPERATION

15. TURRET TRAVERSE.

a. Traversing Method. The 360-degree traverse of the turret is accomplished by means of a manually operated hand crank located on the right-hand side of the turret. Turning the traversing mechanism hand crank counterclockwise will rotate the turret and howitzer to the left. Turning the hand crank clockwise will rotate the turret and howitzer to the right.

b. Turret Lock. The turret is equipped with a lock in order that the turret and howitzer can be locked in any position. To lock the turret, turn the locking handle below the mechanism 90 degrees so that the locking handle is in a vertical position. Push the handle inward and rotate 90 degrees until the handle is in a horizontal position. To unlock the traversing mechanism, turn the locking handle 90 degrees

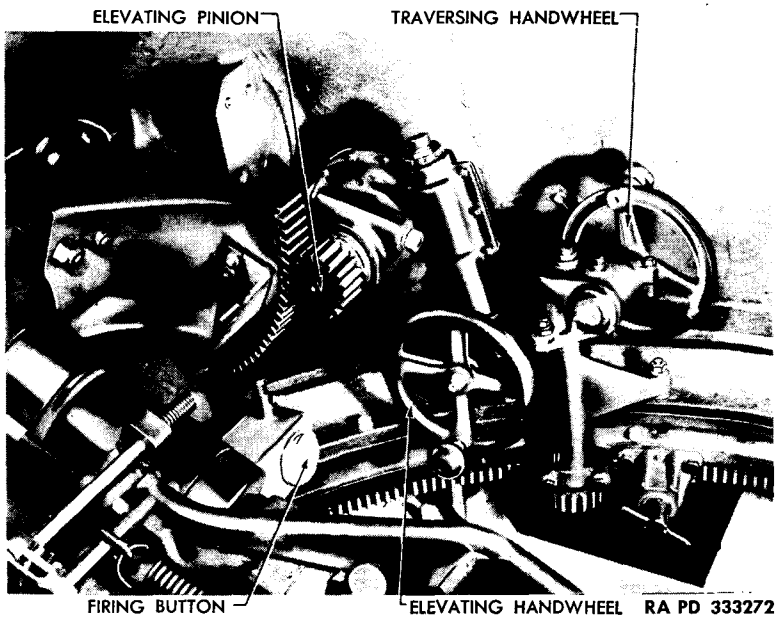


Figure 14 — Turret Controls

so that it is in a vertical position, pull the handle outward, and again turn the handle 90 degrees until it is in a horizontal position.

16. SIGHTING EQUIPMENT.

a. The sighting equipment used with the howitzer includes a panoramic telescope, a direct-vision telescope, and an open sight for emergency use.

b. The panoramic telescope is connected to the gun so that it is elevated or traversed with it. This telescope can also be operated in either a horizontal or vertical direction, independently from the gun (to permit indirect sighting).

c. A three-power telescope is rigidly mounted on the gun cradle for direct sighting. This telescope is not adjustable in use, although it can be adjusted slightly for the initial bore sighting operation. Various cross hairs in the reticle indicate range when sighting.

d. An open sight can also be installed if the telescope is damaged. The open sights, which consist of a tube with cross hairs on the front, are mounted in the same position and on the same mount as the telescope.

75-MM HOWITZER MOTOR CARRIAGE M8

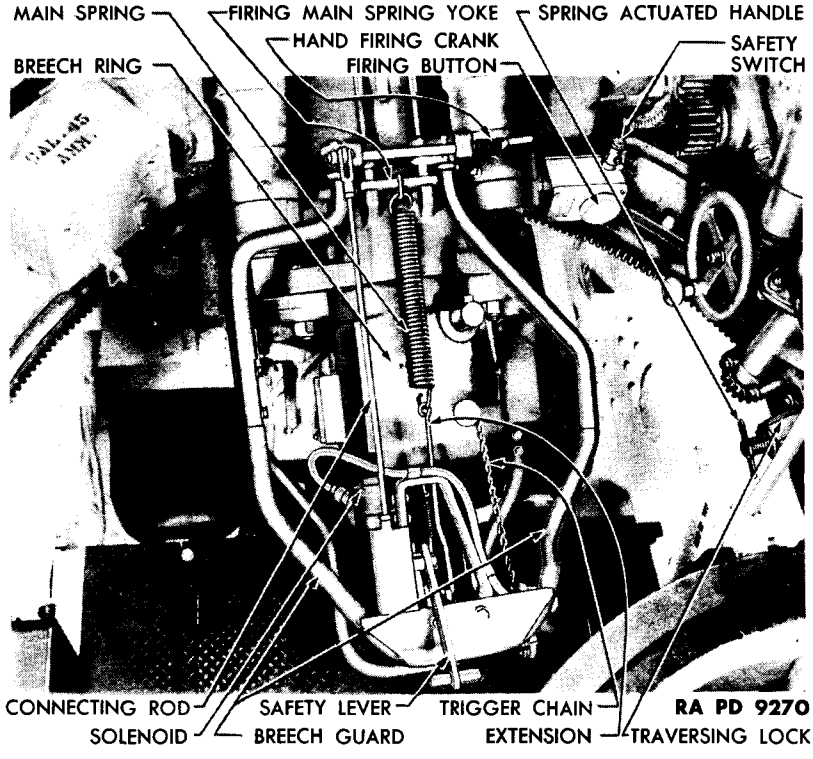


Figure 15 — Firing Controls

Section V

AUXILIARY EQUIPMENT

17. FLAME DETECTOR SYSTEM.

a. A flame detector system was included in early model M8 vehicles but has since been discontinued in production. The system consisted of seven detector units connected by conduits placed in the engine compartment and various other points in the hull and connected to a control box mounted on the inside of the hull in front of the driver. The control box contained a 21-candle power red warning lamp which lighted when a fire occurred. It also contained a 3-candle power green lamp and a toggle switch which were used to test the detector system

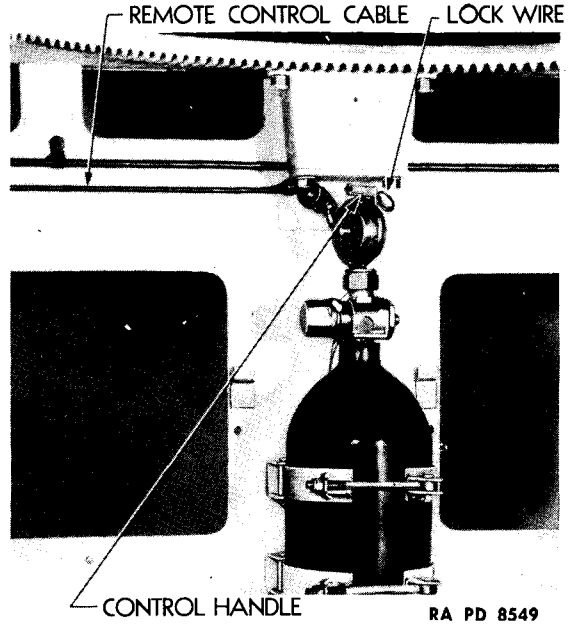


Figure 16 — Fire Extinguisher Controls

circuit. NOTE: *Since this system has proven unsatisfactory, a modification order has been issued to the effect that the entire system be removed from all vehicles at the time of arsenal overhaul. If a vehicle in the field is found to have this system it is to be disconnected at the control box and the control box removed.*

18. FIRE EXTINGUISHERS.

a. Installation.

(1) Two sizes of carbon dioxide fire extinguishers are carried in each vehicle. A fixed 10-pound unit is clamped in a vertical position on the bulkhead of the fighting compartment (fig. 16). This unit connects to tubes leading to the engine compartment, and is used for extinguishing fires in the engine compartment only. Its controls are accessible from the turret. In addition, a remote control lever on the top of the fighting compartment just ahead of the right sponson permits operation of the fire extinguisher from outside the vehicle.

(2) A 4-pound portable hand-operated extinguisher is strapped in a vertical position behind the transfer unit where it is easily accessible to both the driver and assistant driver.

(3) Inasmuch as the pressure of the carbon dioxide increases with increasing outside temperature, the fire extinguishers are equipped with

safety valves which releases pressure when pressure increases beyond safety limits.

b. Operation.

(1) The portable extinguisher should be held in the left hand and the hose in the right hand so that the nozzle is at right angles to the cylinder. The discharge should be directed at the base of the flame, not at the center of the flame, with the discharge cone as close to the flame as the operator can safely hold it. Continue the discharge for several seconds after the flames are out to prevent recurrence.

(2) In case of a fire in the engine compartment, the fixed extinguisher is set in operation by breaking lock wire, removing valve locking pin, and pulling control handle forward and down (fig. 16). The fire extinguisher can be set in operation from outside the vehicle by pulling the remote control handle. This floods engine compartment with carbon dioxide gas, and will extinguish a fire with the engines running up to 1,200 revolutions per minute. If conditions permit, however, the engines should be stopped.

c. Handling.

(1) Any cylinder containing gas under high pressure is as dangerous as a loaded shell. The extinguisher cylinders should never be dropped, struck, handled roughly, nor exposed to unnecessary heat.

(2) Red safety blow-off seal on valve head indicates if cylinder has been discharged due to high temperature. This should be examined regularly; if it is missing, the cylinder must be replaced.

Section VI

OPERATION UNDER UNUSUAL CONDITIONS

19. GENERAL.

a. The operation and maintenance of this vehicle at low temperatures involves factors which do not exist at normal temperatures; therefore, operators and maintenance personnel must spend more time in

protective maintenance. Failure to give this extra service will result in actual damage, unnecessary and unwarranted expense, and failure to start.

b. Low temperatures have been divided into two ranges: –10 F to –30° F, and below –30° F. Batteries and lubricants undergo changes in their physical properties below –30° F. In many cases, accessory equipment for supplying heat to engine, fuel, oil, and intake air is required.

20. FUELS.

a. A winter grade of motor fuel procured under U. S. Army Specification 2-103, latest issue, is to be used in the engines.

b. The formation of ice crystals from small quantities of water in the fuel sometimes causes considerable trouble. The following precautions should be followed to keep water out of 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 is possible, always keep the fuel 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 4 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 to prevent snow, frost, or other foreign matter from entering. Store drums in a covered building or cover them with tarpaulin.

21. CRANKCASE LUBRICATION.

a. Crankcase lubrication at temperatures above –10° F is covered in the Lubrication Guide. The following instructions are intended to supplement this information, and apply only to instances where the temperature falls below –10° F for long periods.

b. Several methods of keeping crankcase oil sufficiently fluid for proper lubrication at temperatures below –10° F are listed below. Preference should be given to the different methods in the order listed, according to the facilities available.

(1) Keep the vehicle in a heated enclosure when it is not being operated.

(2) When engine is stopped, drain crankcase oil while it is hot and store in a warm place until vehicle is to be operated again. If warm storage is not available, heat the oil before reinstalling. CAUTION: *Avoid overheating the oil. Heat only to the point where the bare hand can be inserted without burning.* Tag the vehicle in a conspicuous place in the driving compartment to warn personnel that crankcases are empty.

(3) If vehicle is to be kept outdoors, and if the crankcase cannot be drained, cover the engines with a tarpaulin. About 3 hours before engines are to be started, place fire pots under the tarpaulin.

(4) Dilute the crankcase oil. Crankcase oils may be diluted with the following materials according to their availability, with preference given in the order named: gasoline, kerosene, or Diesel fuel.

(5) The table given below shows the quantities of diluent to be added to the engine oils prescribed on the Lubrication Guides for use at −10° F. These quantities of diluent will form mixtures for satisfactory starting at the temperature indicated:

Diluent	−10° F to −30° F	Below −30° F
Gasoline	½ qt to each 4½ qt of engine oil	1 qt to each 5 qt of engine oil
Kerosene	½ qt to each 4½ qt of engine oil	1 qt to each 5 qt of engine oil
Diesel fuel	½ qt to each 3½ qt of engine oil	1 qt to each 4 qt of engine oil

(6) When crankcase oils are first diluted, turn the engine over several times to mix fuel and diluent thoroughly.

(7) The presence of a large percentage of light diluent will increase oil consumption, and for this reason, the oil level should be checked frequently.

22. TRANSMISSIONS, TRANSFER UNIT, AND DIFFERENTIAL.

a. The instructions given in the previous paragraph concerning engine oil apply equally to the oil used in the transmissions, the transfer unit, and the controlled differential. They also apply to the oil used for all oilcan lubrication points.

23. CHASSIS LUBRICANTS.

a. Chassis lubricants prescribed for use at −10° F will furnish satisfactory lubrication at temperatures as low as −30° F. For sustained temperatures below −30° F GREASE, lubricating, special, or GREASE, O.D., No. 00, should be used.

OPERATION UNDER UNUSUAL CONDITIONS

b. 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, and inspect and oil frequently.

24. PROTECTION OF COOLING SYSTEMS.

a. Ethylene glycol (Prestone) is the only antifreeze solution to be used. The following table gives the quantity to be added to prevent freezing at the indicated temperatures.

Freezing Point	Pints, Ethylene Glycol (Prestone) Per Gallon
10° F	2
0° F	2½
–10° F	3
–20° F	3½
–30° F	4
–40° F	4½
–50° F	4½
–60° F	5
–70° F	5

b. The following precautions should be taken before installing the antifreeze solution:

(1) Flush cooling system thoroughly. The radiators and cylinder blocks should be flushed separately in order not to transfer any residue from one to the other.

(2) Check the systems for leaks; tighten the hose connections and replace, if necessary.

(3) Recheck the fan belts for adjustment or weakness. Replace belts, if necessary.

(4) Be sure that the water pumps are properly lubricated.

c. Each cooling system (35-quart capacity) is drained at three points. A plug at the bottom of each transmission and two drain plugs at the fan end of each engine must be removed for complete draining of the system. Also remove the radiator cap for rapid and complete draining of the system.

25. ELECTRICAL SYSTEMS.

a. Generator and Cranking Motor. Check the brushes, commutators, and bearings. See that the commutators are clean. The large surges of current which occur in starting the cold engines require good contact between brushes and commutators.

b. Wiring. Check and clean all connections, especially battery terminal. Care should be taken that no short circuits are present.

c. Coils and Condensers. Check coils and condensers for proper functioning.

d. Distributors. Clean distributors thoroughly; check the points frequently and replace as necessary. In cold weather, the current is heavier and the points may pit and burn more than usual.

e. Spark Plugs. Test and replace, if necessary. If it is difficult to make the engines fire, reduce the gap 0.004 inch to 0.005 inch. This will make sparking easier at the reduced voltages likely to prevail.

f. Timing. Check carefully (par. 73).

g. Battery. The efficiency of a battery decreases sharply with decreasing temperatures, and becomes practically nil at –40° F. Do not try to start the engine with the battery when it has been exposed to temperatures below –30° F, without first warming up battery by running the auxiliary generator. See that the battery is always fully charged with the hydrometer reading between 1.275 and 1.300. A fully charged battery will not freeze at temperatures likely to be encountered even in Arctic climates, but a fully discharged battery will freeze at 5° F.

h. Lights. Inspect the lights carefully.

i. Starting. Before every start, see that there is no ice on the spark plugs, wiring, or other electrical equipment.

26. STARTING AND OPERATION.

a. Temperatures from –10° F to –30° F.

(1) It is possible to start gasoline engines with batteries at temperatures as low as –30° F if the engines are properly lubricated and in good mechanical condition. CAUTION: *Starting by towing should be attempted only in an emergency.*

(2) Prior to attempting a start, see that everything is in readiness so that the engine will start on the first trial. Try to avoid letting the engine fire a few times and then stopping. Water is one of the products of gasoline combustion, and in a cold engine this water may form a frost and make it impossible to start without heating the engine to above 32° F.

(3) Before cranking the engines, depress the accelerator pedal about one-quarter of total traverse and release. This will set the automatic choke correctly. No further choking is possible or necessary. CAUTION: *Do not pump or depress the throttle pedal swiftly to the floor before starting the engine.* This would force raw gasoline into the cylinders, causing flooding, decrease oil film in the cylinders, and would hinder starting.

(4) When the engines have started, allow them to run at 800 to 900 revolutions per minute for 4 or 5 minutes to allow the oil to warm up before depressing the throttle further. This should be done with the transmission selector lever in neutral. Then shift the selector lever to "DR" and allow the engine to idle for several minutes more to warm up the oil in the transmissions. Do not drive the vehicle over 5 miles per hour for at least 10 minutes after starting, to permit the oil in the transfer unit and controlled differential to warm.

b. Temperatures Below –30° F.

(1) Cover engine with tarpaulin, tent, or portable shed. Place oil stoves, fire pots, or four or five ordinary kerosene lanterns under the covering about 3 hours prior to the time the start is to be made.

(2) Keep the vehicle in sheltered areas shielded from wind. Cold winds increase starting difficulties.

(3) It is possible for ice to collect in the fuel lines. If the engines do not appear to be getting enough fuel, heat the fuel lines slightly, but be very cautious about fire.

c. Stopping. Increase engine speed just before turning off ignition; then turn off ignition switches and release accelerator at the same time. As the engine coasts to a stop, it will blow out all the residual products of combustion, and leave only air and gasoline vapor in the engine.

27. COLD WEATHER ACCESSORIES.

a. A number of the most commonly used accessories have been mentioned in the preceding sections. These, together with other accessories and attachments used successfully by tractor operators in northern climates, are listed below. The use of these accessories is not mandatory. They are given only as suggestions, and are to be employed at the discretion of officers in charge of the materiel.

(1) Tarpaulins, tents, or collapsible sheds are useful for covering vehicles, particularly the engines.

(2) Fire pots, ordinary blowtorches, oil stoves, or kerosene lanterns can be used for heating vehicles.

(3) Extra batteries and facilities for charging batteries quickly are aids in starting.

(4) Steel drums and suitable metal stands are useful for heating crankcase oil.

(5) Insulation of the fuel line will help prevent ice formation inside the line.

(6) Small quantities of denatured alcohol, about one-half pint to each tank of fuel, will reduce difficulties from water in fuel.

(7) Radiator covers can be improvised locally, and help to keep the engine running at normal temperatures.

(8) For track-laying vehicles, extra wide tracks, 18 to 24 inches wide, should be used if they are available.

(9) For operation in snow or ice, grousers should be used on rubber tracks.

28. DECONTAMINATION OF MATERIEL AFFECTED BY GAS.

a. Information on decontamination of materiel affected by gas is included in the armored force Field Manual 17-59.

Section VII

FIRST ECHELON PREVENTIVE MAINTENANCE SERVICE

29. PURPOSE.

a. To insure mechanical efficiency it is necessary that certain scheduled maintenance services be performed daily and weekly, so that defects may be discovered and corrected before they result in serious damage or failure. The services set forth in this section are those performed daily before operation, during operation, at halt, and after operation by driver or crew. Instructions are given for weekly services also.

b. Driver preventive maintenance services are listed on the back of "Driver's Trip Ticket and Preventive Maintenance Service Record," W.D. Form No. 48, to cover vehicles of all types and models. Items peculiar to specific vehicles, but not listed on W.D. Form No. 48, are covered in manual procedures under the items to which they are related. Certain items listed on the form, which do not pertain to the vehicle involved, are eliminated from the procedures as written into the manual. Every organization must thoroughly school each driver in performing the maintenance procedures set forth in manuals, whether they are listed specifically on W.D. Form No. 48 or not.

c. The items listed on W.D. Form No. 48 which apply to this vehicle are expanded in this manual to provide specific procedures for accomplishment of the inspections and services. These services are

arranged to facilitate inspection and conserve the time of the driver, and are not necessarily in the same numerical order as shown on W.D. Form No. 48. The item numbers, however, are identical with those shown on that form.

d. The general inspection of each item applies also to any supporting member or connection, and generally includes a check to see whether or not the item is in good condition, correctly assembled, secure, or excessively worn.

(1) The inspection for "good condition" is usually an external visual inspection to determine whether or not the unit is damaged beyond safe or serviceable limits. The term "good condition" is explained further by the following: not bent or twisted, not chafed or burned, not broken or cracked, not bare or frayed, not dented or collapsed, not torn or cut.

(2) The inspection of a unit to see that it is "correctly assembled" is usually an external visual inspection to see whether or not it is in its normal assembled position in the vehicle.

(3) The inspection of a unit to determine if it is "secure" is usually an external visual examination, a hand-feel, wrench, or á pry-bar check for looseness. Such an inspection should include any brackets, lock washers, lock nuts, locking wires, or cotter pins used in assembly.

(4) "Excessively worn" will be understood to mean worn close to, or beyond, serviceable limits, and likely to result in a failure if not replaced before the next scheduled inspection.

e. Any defects, or unsatisfactory operating characteristics, beyond the scope of first echelon to correct, must be reported at the earliest opportunity to the designated individual in authority.

30. BEFORE-OPERATION SERVICE.

a. This inspection schedule is designed, primarily, as a check to see that the vehicle has not been damaged, tampered with, or sabotaged since the After-operation Service was performed. Various combat conditions may have rendered the vehicle unsafe for operation, and it is the duty of the driver to determine whether or not the vehicle is in condition to carry out any mission to which it may be assigned. This operation will not be entirely omitted, even in extreme tactical situations.

b. Procedures. Before-operation Service consists of inspecting items listed below according to the procedure described, and correcting or reporting any deficiencies. Upon completion of the service, results should be reported promptly to the designated individual in authority.

(1) ITEM 1, TAMPERING AND DAMAGE. Look over vehicle, equipment, and armament for damage which may have occurred from falling

debris, shell fire, sabotage, or collision since parking vehicle. Open engine compartment rear doors and look for signs of tampering or sabotage, such as loosened or damaged accessories, loose fuel or oil lines, or disconnected throttle linkage. Dry the spark plugs, distributors and ignition wires, if wet, to facilitate starting.

(2) ITEM 2, FIRE EXTINGUISHERS. Examine cylinder of fixed system for tight mountings and closed valves. See that wire seal is present and intact. Look into engine compartment to examine extinguisher lines and nozzles for good condition and correct aiming. Inspect portable extinguisher for good condition and security. Make sure that wire seal is present and intact.

(3) ITEM 3, FUEL, OIL AND WATER. Check amount of fuel in each fuel tank, and add fuel as required. Check oil level in each engine. Add as much oil as is necessary to bring level to "FULL" mark. Check level of coolant in each radiator, and add water if necessary. In freezing weather, be sure to add antifreeze compound of proper strength when considerable water must be added.

(4) ITEM 4, ACCESSORIES AND DRIVES. Examine security of mountings of generator, fan, and fuel pump on each engine. Examine fan belt and generator belt for $\frac{5}{8}$- to $\frac{3}{4}$-inch deflection.

(5) ITEM 6, LEAKS, GENERAL. Look under vehicle for any indications of fuel, oil or water leaks. Inspect engine compartment for evidence of leaks, particularly at engine oil pan and at fuel and oil lines. Trace all leaks to their sources, and correct or report them to proper authority. Close engine compartment rear doors.

(6) ITEM 7, ENGINE WARM-UP. Start engines (par. 10). Note action of starting mechanism, particularly whether cranking motor has adequate cranking speed. If oil pressure gage does not indicate pressure within one-half minute after starting, or if low oil pressure warning light does not go out, engine should be stopped and trouble corrected or reported to designated authority. Inspect hand throttle for free operation; return it to idling position, and let engine idle while proceeding with the following Before-operation Service:

(7) ITEM 9, INSTRUMENTS.

(a) Warning Signals. The warning signals for engines and transmissions should go out as soon as engines are started. Transfer unit signal will remain lighted until vehicle is put into forward motion.

(b) Oil Pressure Gages. Both oil pressure gages should indicate at least 15 pounds while engines are idling, and at least 30 pounds at operating speeds.

(c) Tachometers. Observe both tachometers to see that they indicate approximate engine revolution per minute and that they register accumulating revolutions.

(d) Engine Temperature Gages. Observe engine temperature gages to determine whether or not they are functioning. Engine temperature should increase gradually to operating range of 160° F to 180° F.

(e) Ammeter. The ammeter should register zero or slight discharge (−) with the engines idling, or register zero or slight positive (+) charge with engines running at operating speeds. Any unusual drop or rise in reading should be investigated. A high charge reading for an extended period may indicate a dangerously low battery or faulty generator regulator.

(f) Voltmeter (if so equipped). Observe voltmeter to see that it indicates between 10 and 15 volts or *NORMAL* range.

(8) ITEM 10, SIREN. Test siren (unless tactical situation prohibits) for proper operation and tone.

(9) ITEM 12, LIGHTS (LAMPS) AND REFLECTORS. If tactical situation permits, turn on all switches to determine that all lamps light. See that lights are secure, and that lenses are clean and not broken.

(10) ITEM 14, TRACKS. Inspect tracks, track wheels, support rollers and sprockets for damage which may have occurred since last inspection. Look for loose wedge nuts, improper track tension, and for any foreign material in suspension linkage. Proper track tension requires ¾-inch sag midway between first and second support rollers.

(11) ITEM 15, SPRINGS AND SUSPENSIONS. Inspect volute springs for breakage or permanent set. Springs shall be considered to have taken permanent set if two or more coils are resting on bracket or plug. Look for broken, loose or damaged suspension arms, linkage, skids, wheels and idlers. See that suspension assembly, wheel, idler and support roller bolts, nuts and cap screws are present, and secure.

(12) ITEM 16, STEERING BRAKE LINKAGE. Inspect all steering brake lever linkage to determine that it is in condition for safe operation. Pull back on both steering levers (assistant driver's and driver's) and observe whether or not both meet firm resistance at 7 or 8 notches of lever travel. Check to determine that lever locking devices hold properly.

(13) ITEM 17, FENDERS. Observe condition of fenders and sand shields (if so equipped) to make sure that they are in good condition, secure, and do not interfere with tracks.

(14) ITEM 18, TOWING CONNECTIONS. See that four towing shackles are in good condition, and securely shackled.

(15) ITEM 20, DECONTAMINATOR. Examine for tight mounting, full charge and closed valve.

(16) ITEM 21, TOOLS AND EQUIPMENT. Make sure that tools and equipment belonging to vehicle are present, serviceable, and properly mounted or stowed.

(17) ITEM 22, ENGINE OPERATION. Engines should idle smoothly at 425 revolutions per minute. Accelerate engines several times after they have reached normal operating temperature (160° to 180° F), and note any unusual noises, or unsatisfactory operating characteristics.

(18) ITEM 23, DRIVER'S PERMIT, LUBRICATION GUIDE, FORM NO. 26 AND OPERATOR'S MANUAL. See that Accident Report Form No. 26, Lubrication Guide, and Operator's Manuals are present, legible, and safely stowed. Driver must have Operator's Permit present on his person.

(19) ITEM 25, DURING-OPERATION CHECK. The During-operation Service should start as soon as the vehicle is put into motion.

31. DURING-OPERATION SERVICE.

a. While vehicle is in motion, listen for such sounds as rattles, knocks, squeals, or hums that may indicate trouble. Look for indications of trouble in cooling system, and for smoke from any part of the vehicle. Be on the alert to detect any odor of overheated components or units such as generator or brakes, vapor from a leak in fuel system, exhaust gas, or other signs of trouble. Each time the brakes are used, or vehicle is turned, consider this a test and notice any unsatisfactory or unusual performance. Watch the instruments constantly. Notice promptly unusual instrument indications that may signify trouble in system to which the instrument applies.

b. **Procedures.** During-operation Services consist of observing items listed below according to the procedures following each item, and investigating any indications of serious trouble. Notice minor deficiencies, to be corrected, or reported, at earliest opportunity, usually at next scheduled halt.

(1) ITEM 26, STEERING BRAKES. Steering brakes should be in released position when vehicle is moving straight ahead. When stopping vehicle, levers should have a reasonably equal amount of travel. When vehicle is stopped and levers are pulled back for parking, the levers should start to hold at approximately 6 to 8 notches from released position.

(2) ITEM 29, TRANSMISSIONS. Vehicle should start satisfactorily from a standstill in either DR or LO range. Be on the alert for abnormal conditions in transmissions as indicated by excessive slippage and engine racing, unusually severe shifting, or shifting in wrong speed ranges.

(3) ITEM 30, TRANSFER UNIT. Be on the alert for unusual conditions in transfer unit, indicated by failure to upshift, by upshifting in wrong speed range, or by failure to downshift below 15 miles per hour when control lever is moved to LO.

(4) ITEM 31, ENGINE AND CONTROLS. Driver should be on the alert for deficiencies in engine performance such as lack of power, misfiring, unusual noises, or indications of overheating. Observe whether or not engines accelerate satisfactorily and controls operate freely.

(5) ITEM 32, INSTRUMENTS. Observe readings of all instruments frequently during operation to see whether or not they are indicating properly.

(a) Oil Pressure Gages. Oil pressure gages should indicate at least 15 pounds while engines are idling and at least 30 pounds at operating speeds. In case of unusual drop in oil pressure or lighting of oil pressure warning signal, vehicle should be stopped immediately and trouble corrected, or reported to designated authority.

(b) Engine Temperature Gages. Gages should always indicate below 240° F. If gages indicate more than this, or if warning signal lights, stop vehicle until correction is made.

(c) Ammeter. The ammeter will register zero or slight discharge (−) with the engines idling, or will register zero or slight positive (+) charge with engines running at operating speeds. Any unusual drop or rise in reading should be investigated. A high charge reading for an extended period may indicate a dangerously low battery or faulty generator regulator.

(d) Tachometers. Tachometers should indicate engine speed and accumulating revolutions.

(e) Speedometer and Odometer. Speedometer should indicate vehicle speed. Odometer should register accumulating mileage.

(f) Warning Lamps. Transmission oil pressure warning lamp should be off when engines are running. Transfer unit warning lamp should be off when vehicle is in forward motion, but on when standing or in reverse.

(6) ITEM 34, RUNNING GEAR. Listen for any unusual noise from tracks, and bogie suspension wheels and rollers.

(7) ITEM 36, GUNS, MOUNTINGS, ELEVATING, TRAVERSING, FIRING CONTROLS. While vehicle is in operation, but before it is used in combat, test manual turret traversing and gun-elevating controls, also operation of firing controls, to be sure that all mechanisms respond properly.

32. AT-HALT SERVICE.

a. At-halt Service may be regarded as minimum maintenance procedures and should be performed under all tactical conditions, even though more extensive maintenance services must be slighted or omitted altogether.

b. Procedures. At halt-Service consists of investigating any deficiencies noted during operation, inspecting items listed below according to the procedures following the items, and correcting any deficiencies found. Deficiencies not corrected should be reported promptly to the designated individual in authority.

(1) ITEM 38, FUEL, OIL, AND WATER. Check fuel supply to see that it is adequate to operate vehicle to next refueling point. Check oil level in engines and add oil if necessary. Check coolant supply in each cooling system, add clean water as necessary. In freezing weather antifreeze of proper strength should be added if considerable coolant is needed. CAUTION: *Be sure to vent pressure radiator caps before removing to avoid serious injury from steam and hot water.*

(2) ITEM 39, TEMPERATURES: HUBS, TRANSFER UNIT, DIFFERENTIAL AND FINAL DRIVES. Place hand on each track wheel and track support roller hub to determine whether or not they are abnormally hot. If wheel hubs are too hot to touch with the hand, bearings may be inadequately lubricated, damaged, or improperly adjusted. Examine transfer case, differential and final drives for excessive heat and leakage.

(3) ITEM 42, SUSPENSION. Look for broken, loose or damaged suspension arms, linkage, skids, rollers, wheels, and idlers. Inspect to determine that suspension assembly, wheel, idler and support roller bolts, nuts, and cap screws are present and secure. Inspect volute springs for breakage or permanent set.

(4) ITEM 43, STEERING BRAKES. Examine steering-brake linkage for damage or looseness, and investigate any irregularities noted during operation.

(5) ITEM 45, TIRES AND TRACKS. Examine tracks and bogie wheel tires, to see that they are secure, not damaged, and that track tension is satisfactory (¾-inch sag midway between first and second support rollers). Remove stones and trash from tracks and suspension system.

(6) ITEM 46, LEAKS, GENERAL. Look around and under vehicle and in engine compartment for indications of fuel, oil, or coolant leaks.

(7) ITEM 48, AIR CLEANERS. If operating under extremely dusty or sandy conditions, inspect air cleaners at each halt, to see that they are in condition to deliver clean air properly. Service as required. CAUTION: *Use extreme care to see that air cleaner bottom cover seals are intact, and serviceable when covers are closed.*

(8) ITEM 49, FENDERS. Examine fenders and sand shields (if so equipped) to see that they are secure and in good condition.

(9) ITEM 50, TOWING CONNECTIONS. Examine towing shackles to see that they are securely fastened. Examine tow cable for frayed or broken condition. Make sure that cable is mounted securely when not in use.

(10) ITEM 51, HULL AND CAMOUFLAGE NET. Inspect hull of vehicle for damage. Inspect camouflage net to see that it is properly secured and not damaged.

(11) ITEM 52, GLASS. Clean glass in vision devices and lights and inspect for damage.

33. AFTER-OPERATION AND WEEKLY SERVICE.

a. After-operation Service is particularly important, because at this time the driver inspects his vehicle to detect any deficiencies that may have developed and corrects those he is permitted to handle. He should report promptly, to the designated individual in authority, the results of his inspection. If this schedule is performed thoroughly, the vehicle should be ready to roll again on a moment's notice. The Before-operation Service, with a few exceptions, is then necessary only to ascertain whether the vehicle is in the same condition in which it was left upon completion of the After-operation Service. The After-operation Service should never be entirely omitted even in extreme tactical situations, but may be reduced to the bare fundamental services outlined for the At-halt Service if necessary.

b. Procedures. When performing the After-operation Service, the driver must remember and consider any irregularities noticed during the day in the Before-operation, During-operation, and At-halt Services. The After-operation Service consists of inspecting and servicing the following items. Those items of the After-operation Service that are marked by an asterisk (*) require additional Weekly Services, the procedures for which are indicated in subparagraph *(b)* of each applicable item.

(1) ITEM 55, ENGINE OPERATION. Before stopping engines, accelerate and decelerate, noting any unusual noise or irregular performance. Investigate any deficiencies noted during operation.

(2) ITEM 56, INSTRUMENTS. Inspect all instruments to see that they are securely mounted, properly connected, and undamaged.

(3) ITEM 54, FUEL, OIL, AND WATER. Inspect fuel supply in both fuel tanks, and refill as required. Check oil level in engines and replenish as required. Inspect level of coolant in both radiators and add as required, using antifreeze solution in freezing weather. CAUTION. *Be sure to vent pressure radiator caps before removing to avoid serious injury from steam and hot water.*

(4) ITEM 57, SIREN. If tactical conditions permit, test siren operation and tone.

(5) ITEM 58, GLASS. Clean all vision devices and glass and inspect for damage.

(6) ITEM 59, LIGHTS, LAMPS. Clean all light lenses. Examine for broken parts and security of mounting. If tactical situation permits, turn on all switches and see that all lamps operate properly.

(7) ITEM 60, FIRE EXTINGUISHERS. Inspect fixed fire extinguisher for tight mounting, damage and leakage of valves or lines. Inspect nozzles for proper aim, damage, and security of mountings and connections. See that wire seals are present and intact. Inspect portable extinguishers for good condition and security. See that wire seal is present and intact.

(8) ITEM 61, DECONTAMINATOR. Inspect decontaminator for full content, damage and security of mounting.

(9) ITEM 62, *BATTERY.

(a) Inspect battery for damage or leakage, and security of mountings and connections. Top of battery, cables, terminals, and vent caps should be clean.

(b) Weekly. Add distilled water as necessary to bring electrolyte level one-half inch above top of plates. If distilled water is not available, any clean water is preferable to allowing cells to run dry. NOTE: *In low temperatures, do not add water until vehicle is about to be operated.* Clean and tighten terminals if dirty or if loose, and give them a light coating of grease.

(10) ITEM 63, ACCESSORIES AND BELTS. Open engine compartment rear doors and inspect mountings of fan and generator on each engine for looseness. Correct belt tension is 5/8 to 3/4-inch deflection between pulleys.

(11) ITEM 64, ELECTRICAL WIRING. Examine all accessible wiring conduits to see that they are properly connected and supported to hull.

(12) ITEM 65, *AIR CLEANERS, BREATHERS AND VENTS.

(a) Inspect carburetor air cleaners for good condition and security of mountings. Inspect condition of oil and filter element. Clean and service if excessive dirt is present (par. 95). CAUTION: *Be sure to close air cleaner bottom doors securely after servicing. Be sure that door seals are in place, and that they do not leak air or dust.* Crankcase breather caps or oil bath air cleaners (as equipped) must be cleaned and serviced each time carburetor air cleaner is serviced.

(b) Weekly: Remove carburetor air cleaner reservoirs and elements. Clean thoroughly and service (par. 91). Clean and service crankcase breather cap or oil bath air cleaner (as equipped).

(13 ITEM 66, *FUEL FILTERS.

(a) Inspect filters to see that they are secure, in good condition, and not leaking.

FIRST ECHELON PREVENTIVE MAINTENANCE SERVICE

(b) Weekly: With gasoline tank shut-off valves closed, drain the main fuel filter (on bulkhead, fighting compartment, above left sponson). Open gasoline tank shut-off valve very briefly to flush out filter before replacing drain plug. CAUTION: *Use great care to observe safety precautions in draining filter. Drain filter content into small receptacle rather than allow fuel to drop into hull.*

(14) ITEM 67, ENGINE CONTROLS. Inspect accelerator controls for security, damage, excessive wear, and free operation.

(15) ITEM 68, *TRACKS.

(a) Examine tracks for damage, excessive looseness, broken or missing wedges, wedge nuts and connectors. Inspect track for ¾-inch sag midway between first and second support rollers.

(b) Weekly: Inspect track blocks, connectors and wedges for excessive wear. Tighten any loose wedge nuts. Adjust track to ¾-inch sag midway between first and second support rollers, if necessary.

(16) ITEM 69, *SUSPENSION.

(a) Inspect suspension arms and links for looseness or damage. Remove any foreign objects imbedded in the tracks or between the wheels and suspension arms. Examine rubber tires for cuts, breaks or separation from wheels. Inspect springs for breaks or abnormal sag.

(b) Weekly: Tighten suspension assembly bolts, cap screws, and nuts and see that all securing wires, or cotters are present, and in good condition. Inspect guides, support rollers, idlers, sprockets, and skids for excessive wear or damage.

(17) ITEM 70, STEERING BRAKES. Inspect brake levers for secure mounting and linkage for excessive wear or damage, and for free operation and secure holding of pawls.

(18) ITEM 72, VENTS AND BREATHERS. Examine the breathers in each final drive to make sure they are present, and not clogged. Examine vents in bogie wheel hubs (where used) to see that they operate freely.

(19) ITEM 73, LEAKS. Examine area beneath vehicle, and floor of fighting and engine compartments for oil, fuel, or coolant leakage.

(20) ITEM 74, GEAR OIL LEVELS. Check level of oil in transmissions, transfer unit and final drive housings, and fill to proper level. CAUTION: *In checking transmission level, be sure to use correct procedure.*

(21) ITEM 76, FENDERS. Examine fenders and dust shields to see that they are in good condition and secure.

(22) ITEM 77, TOWING CONNECTIONS. Examine four towing shackles to see that they are present, in good condition, and securely attached.

75-MM HOWITZER MOTOR CARRIAGE M8

(23) ITEM 78, HULL. Examine entire hull for damage from shell fire or collision. Inspect escape door for secure fastening and see that locking device is in good condition.

(24) ITEM 80, VISION DEVICES. Inspect the periscope prisms and windows to see that they are in good condition, clean, secure in the holders, and that the holders are securely mounted. Inspect the spare periscopes and their stowage boxes to see that they are in good condition, clean, and secure. CAUTION: *Periscopes should be cleaned only with a soft cloth or brush.*

(25) ITEM 81, TURRET AND GUN (MOUNTING, ELEVATING, TRAVERSING, FIRING CONTROLS). Be sure that all mounted guns are secure in their mounts, clean, lightly oiled, and in condition for immediate use. Test manual gun-elevating mechanisms and firing controls for proper operation. Determine that manual traversing mechanisms are in good condition and operate satisfactorily. Correct or report to designated authority any deficiencies noted during operation.

(26) ITEM 82, *TIGHTENING.

(a) Tighten all items which inspection indicates require tightening.

(b) Weekly: Tighten the following: Gun mounting attachments, tools and equipment mounted on vehicle, ammunition cases, or any other units that inspection or experience indicates require tightening.

(27) ITEM 83, *LUBRICATION.

(a) Lubricate all points of vehicle where inspection indicates oilcan or hand greasing is necessary.

(b) Weekly: Lubricate all points which vehicle Lubrication Guide indicates are necessary on a weekly or mileage basis, or any points that condition and experience indicate need for additional lubrication.

(28) ITEM 84, *CLEANING.

(a) Remove all empty shell cases and refuse from turret or sponsons. Clean all oil from driving compartment and floor of vehicle. Remove excessive mud and dirt from tracks and suspension system. See that grilles above, and at rear of engine compartment are not obstructed. On vehicle equipped with open hinged top over engine compartment, open cover and clean radiator core air passages if necessary.

(b) Weekly: Wash exterior of vehicle and remove all dirt and mud. If washing is impracticable, wipe as clean as possible and watch for bright spots that would cause glare. Wipe out all excess dirt, fuel, oil or coolant drippings from engine compartment. Open hinged top of engine compartment, or remove engine compartment cover, and clean out radiator core air passages.

(29) ITEM 85, *TOOLS AND EQUIPMENT.

(a) See that tools and equipment assigned to vehicle are present, in good condition, and properly stowed, or mounted.

(b) Weekly: Check tools and equipment against vehicle stowage list, Section IX. See that tools and equipment are in serviceable condition and properly mounted or stowed.

Section VIII

LUBRICATION

34. INTRODUCTION.

a. Lubrication is an essential part of preventive maintenance, determining to a great extent the serviceability of parts and assemblies.

35. LUBRICATION GUIDE.

a. General. Lubrication instructions for this materiel are consolidated in Lubrication Guides (figs. 17, 18, and 19). These specify the points to be lubricated, the periods of lubrication, and the lubricant to be used. In addition to the items on the guide, other small moving parts, such as hinges and latches, must be lubricated at frequent intervals.

b. Supplies. In the field it may not be possible to supply a complete assortment of lubricants called for by the Lubrication Guide to meet the recommendations. It will be necessary to make the best use of those available, subject to inspection by the officer concerned, in consultation with responsible ordnance personnel.

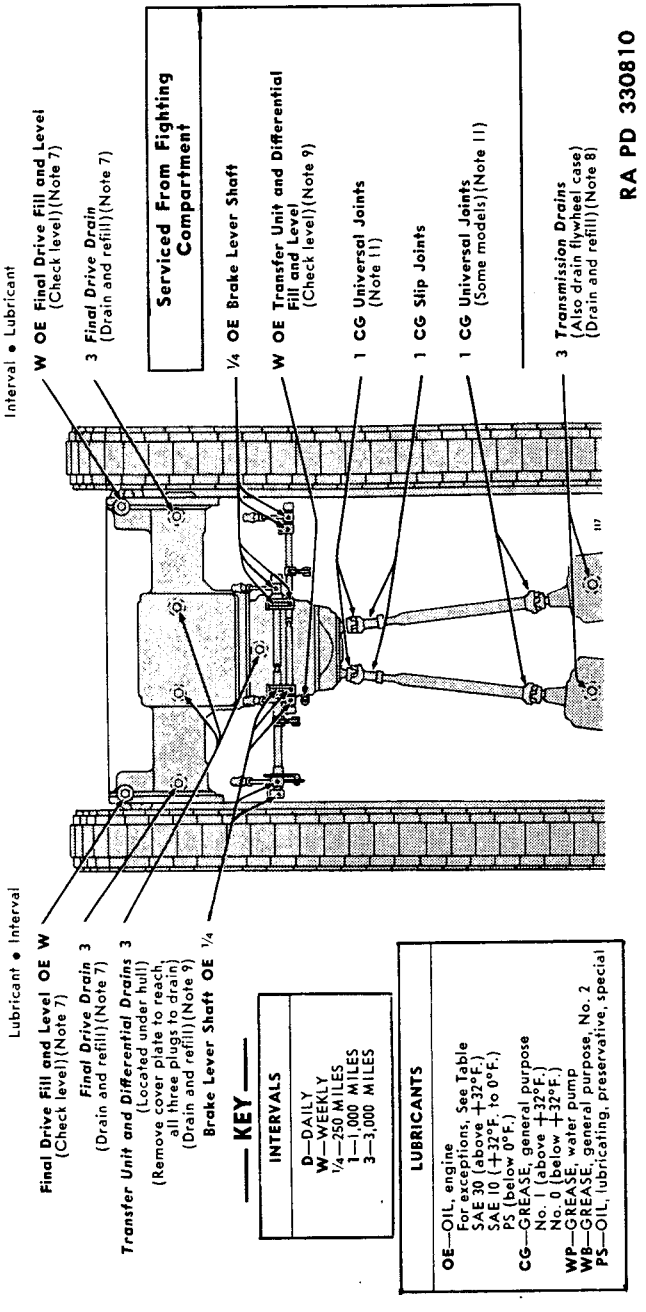
c. Lubrication Notes. The following notes apply to the Lubrication Guides (figs. 17, 18, and 19). All note references in the Guide itself are to the step below having the corresponding number:

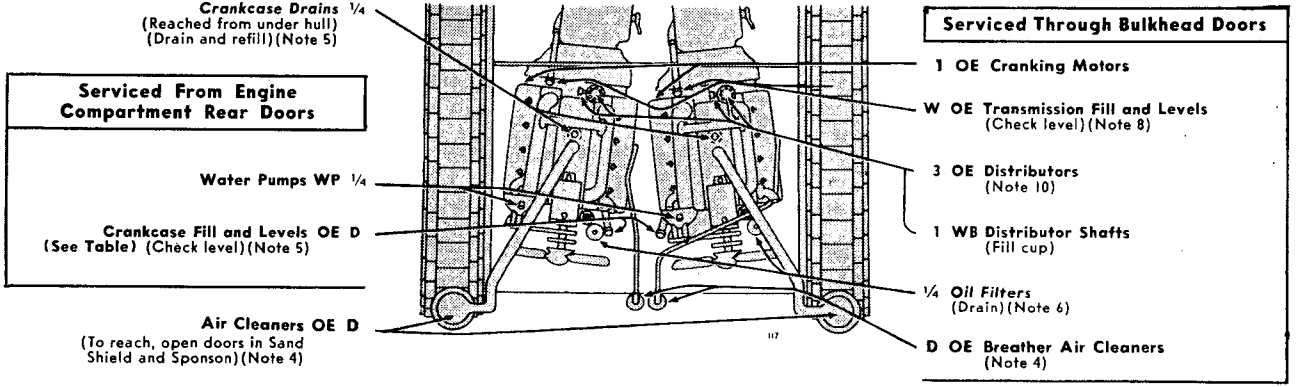
(1) FITTINGS. Clean before applying lubricant. Lubricate until new lubricant is forced from the bearing, unless otherwise specified. CAUTION: *Lubricate suspension points after washing tank.*

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

(3) CLEANING. Use SOLVENT, dry-cleaning, or OIL, fuel, Diesel, to clean or wash all parts. Use of gasoline for this purpose is prohibited. Dry all parts thoroughly before relubrication. Clean gun

75-MM HOWITZER MOTOR CARRIAGE M8





See Figs. 18 and 19 for lubrication of SUSPENSION SYSTEM and HOWITZER and MOUNT

TABLE OF CAPACITIES AND LUBRICANTS TO BE USED

UNIT	CAPACITY (Approx.)	LOWEST EXPECTED AIR TEMPERATURE		
		+32° F. and above	+32° F. to 0° F.	Below 0° F.
Crankcases (each)	8 qt.	OE SAE 30	OE SAE 10	Refer to OFSB 6-11
Transmissions (each)	15 qt.	OE SAE 30	OE SAE 10	OE SAE 10
Differential and Transfer	32 qt.			
Final Drives (each)	3 qt.			

117

RA PD 330810 B

Figure 17 — Lubrication Guide — Engine Compartment, Final Drive, and Additional Fighting Compartment Points

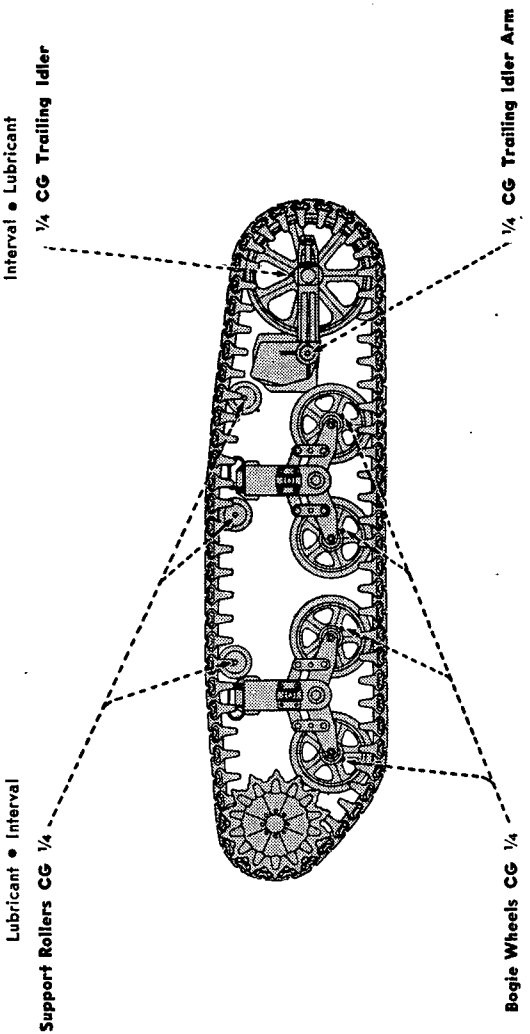
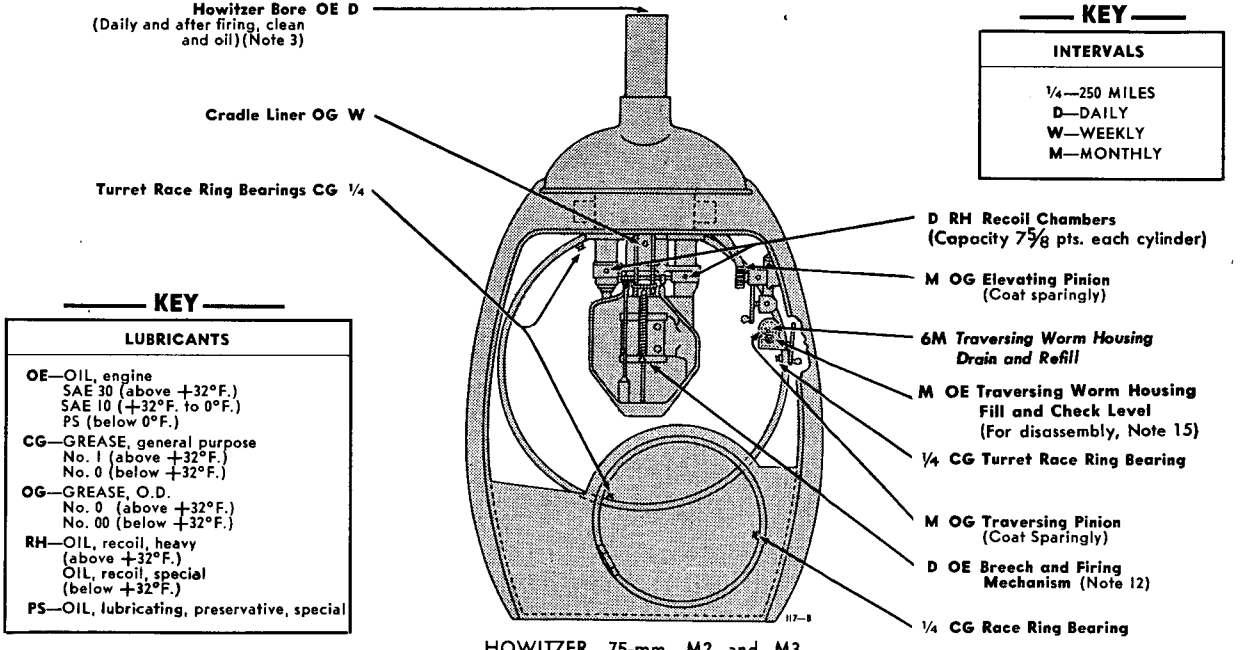


Figure 18 — Lubrication Guide — Suspension System



HOWITZER, 75-mm, M2 and M3
MOUNT, HOWITZER, 75-mm, M7

See Fig. 17 for lubrication of ENGINE COMPARTMENT, FINAL DRIVE and additional FIGHTING COMPARTMENT points.

RA PD 330812

Figure 19 — Lubrication Guide — Howitzer and Howitzer Mount

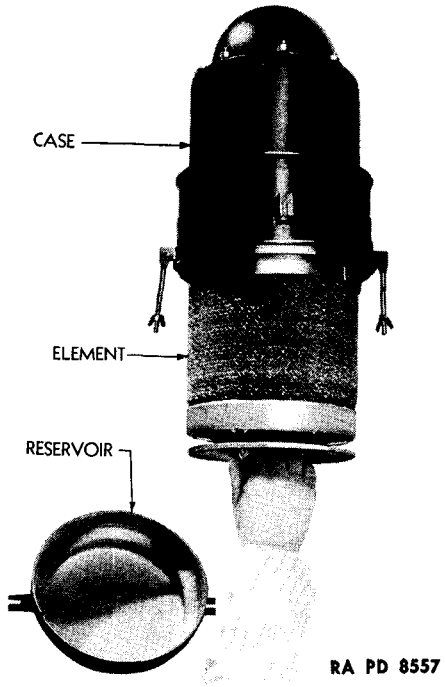


Figure 20 — Air Cleaner

bore with a solution of ½ pound of SODA, ash, to each gallon of water, or with a thick suds of issue soap and water. Rinse with clear water and dry thoroughly before reoiling.

(4) AIR CLEANERS. Daily, check level and refill engine and breather air cleaners with used crankcase oil or OIL, engine, SAE 30 above +32° F or SAE 10 from +32° F to 0° F. From 0° F to –40° F use OIL, hydraulic. Below –40° F remove oil and operate dry. Every 500 miles or daily, when under extreme dust conditions, remove air cleaners and wash all parts. CAUTION: *Keep all air pipe connections clean and tight.*

(5) CRANKCASES. Drain crankcase only when oil is hot. Refill to "FULL" mark on gage. Run engine a few minutes and recheck oil level. Drain plugs are reached by removing plate under floor of engine compartment. CAUTION: *Make certain pressure gage indicates oil is circulating.*

(6) OIL FILTERS. Every 250 miles, or more often if filter becomes clogged, drain sludge, clean housing, and renew element. Run engine a few minutes, check crankcase level, and add OIL, engine, to "FULL" mark on gage (SAE 30 above +32° F, and SAE 10 +32° F to 0° F. Below 0° F refer to OFSB 6-11).

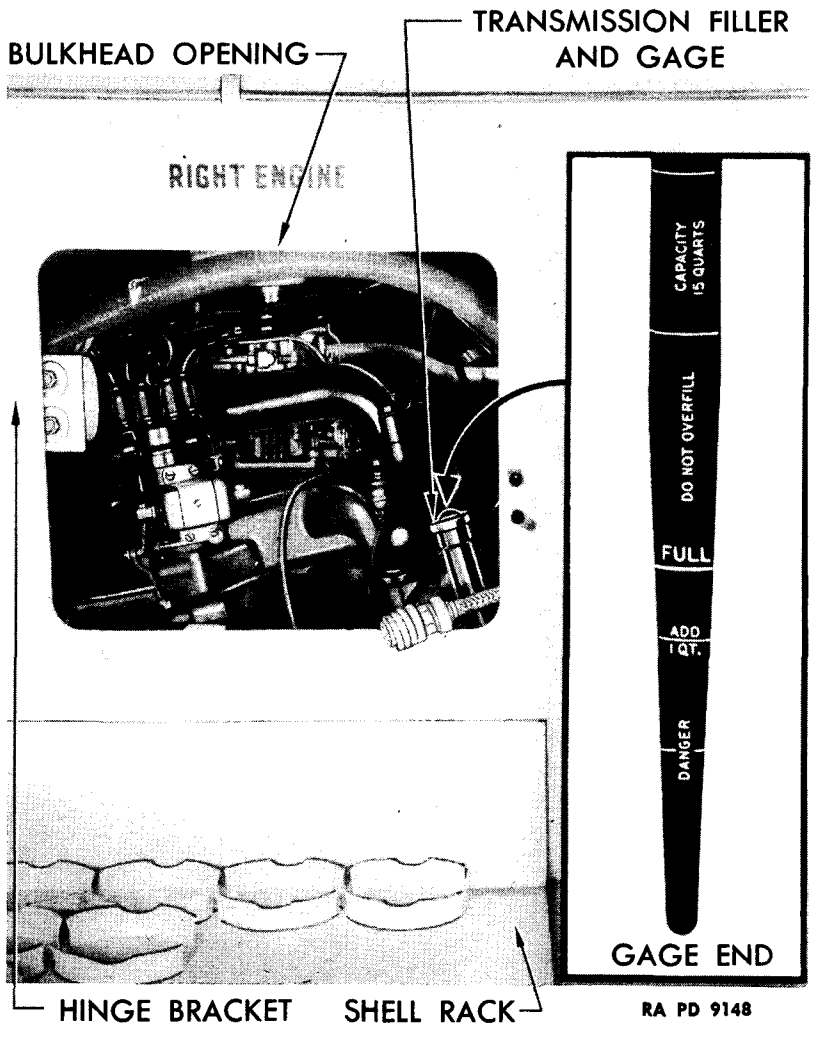


Figure 21 — Transmission Filler and Gage

(7) FINAL DRIVES. Weekly, check level with tank on level ground and, if necessary, add lubricant to plug level through hole in armor at front of tank. Use oil gun to fill. Drain and refill at end of first 250 miles; thereafter at intervals indicated on Guide. Drain only after operation.

(8) TRANSMISSIONS (HYDRA-MATIC). Weekly, run engines three to four minutes, check transmission oil level with tank on level ground and, if necessary, add lubricant to correct level. Every 3,000

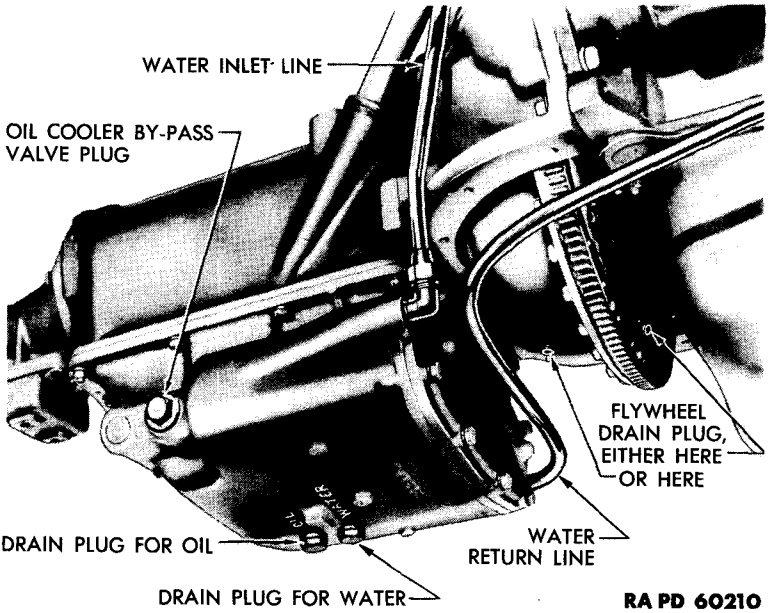


Figure 22 — Transmission Oil and Water Drain Plugs

miles, drain and refill (fig. 21). Drain only after operation. To service, remove two drain plugs (fig. 22) on each unit, one in front of flywheel and one in bottom of case. To refill, add 10 quarts of oil, run engine 3 to 4 minutes, then add oil to bring level to "FULL" mark on gage.

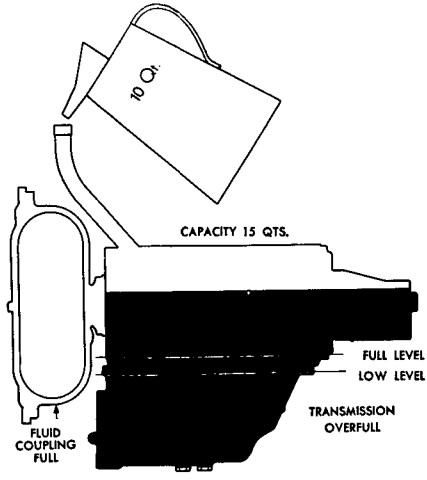
(9) TRANSFER UNIT AND DIFFERENTIAL. Weekly, check level with tank on level ground and, if necessary, add lubricant to correct level. Every 3,000 miles, drain and refill. Drain only after operation.

(10) DISTRIBUTORS. Every 3,000 miles, wipe distributor breaker cam lightly with GREASE, general purpose, No. 1 above +32° F, and No. 0 below +32° F, and lubricate breaker arm pivot and wick under rotor with one to two drops of OIL, engine SAE 30 above +32° F; SAE 10 +32° F to 0° F; OIL, lubricating, preservative, special, below 0° F.

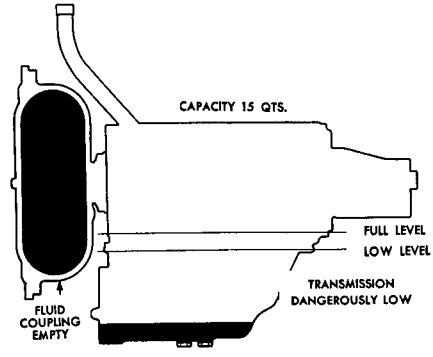
(11) UNIVERSAL JOINTS. Some models are equipped with pipe plugs. Every 1,000 miles, remove plug. Insert fitting, fill with GREASE, general purpose, No. 1 above +32° F, and No. 0 below +32° F. Remove fitting and replace plug. For models not equipped with plugs, disassemble, clean and repack with GREASE, general purpose, No. 1 above +32° F, and No. 0 below +32° F every 3,000 miles.

(12) BREECH AND FIRING MECHANISM. Daily, and before and

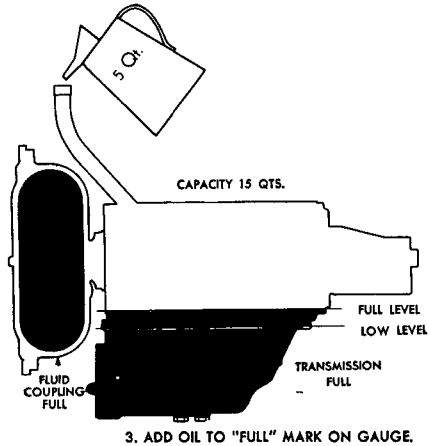
LUBRICATION



1. ADD 10 QTS. OF OIL



2. RUN ENGINE 5 MINUTES AFTER ADDING 10 QTS.



3. ADD OIL TO "FULL" MARK ON GAUGE.

RA PD 314987

Figure 23 — Filling Transmission

after firing, clean and oil all moving parts and exposed metal surfaces with OIL, engine, SAE 30 above +32° F; SAE 10 +32° F to 0° F; OIL, lubricating, preservative, special, below 0° F. CAUTION: *To insure easy breech operation and to avoid misfiring in cold weather, clean and lubricate with OIL, lubricating, preservative, special.* To clean firing mechanism, remove and operate pin in SOLVENT, dry-cleaning. Relubricate with OIL, lubricating, preservative, special.

(13) OILCAN POINTS. Every 250 miles, lubricate steering lever linkage, steering cross shaft, door and shield hinges, peep hole protector slides, door latches, engine control rod pins, levers, bushings, etc., with OIL, engine SAE 30 above +32° F; SAE 10 +32° F to 0° F; OIL, lubricating, preservative, special, below 0° F.

(14) POINTS REQUIRING NO LUBRICATION SERVICE. Generators, speedometer and tachometer adapters, bogie wheel suspension linkage and guides, volute springs, turret guide rollers, turret support bearings, thrust and hold-down bearing, hydraulic motor, and pump, require no lubrication service.

(15) POINTS TO BE SERVICED AND/OR LUBRICATED BY ORDNANCE MAINTENANCE PERSONNEL. These points are: traversing worm housing (for disassembly), elevating worm shaft housing, elevating trunnion bearings.

d. Reports and Records. If lubrication instructions are closely followed, proper lubricants used, and satisfactory results are not obtained, make a report to the ordnance officer responsible for the maintenance of the materiel. A complete record of seasonal changes of lubricants and recoil oils may be kept in the Artillery Gun Book for the armament. A record of lubrication service on the vehicle may be kept in the Duty Roster (W.D., A.G.O. Form No. 6).

Section IX

TOOLS AND EQUIPMENT STOWAGE ON VEHICLE

36. VEHICLE TOOLS.

a. Pioneer Tools. The following tools are located on the outside rear end of hull unless otherwise specified:

TOOLS AND EQUIPMENT STOWAGE ON VEHICLE

AXE, handled, chopping, single bit, 5-lb ..... (41-A-1279)
BAR, crow, pinch point, 5 ft long ..... (41-B-175)
HANDLE, mattock ..... (41-H-1286)
MATTOCK, pick, M1, without handle ..... (41-M-722)
SHOVEL, short handle ..... (41-S-3172)
SLEDGE, blacksmith, double face, 10-lb ..... (41-S-3726)

b. Vehicular Tools. The following tools are located in the hull floor tool compartment unless otherwise specified:

BAR, cross ..... (41-B-155)
BAR, socket, extension, ½-in. sq. drive, 5-in. long ..... (41-B-311-200)
BAR, socket, extension, ½-in. sq. drive, 10-in. long ..... (41-B-309)
BAR, jimmy, straight, ½- x 11⅞- x 1/16-in. point ..... (41-B-253)
CHISEL, cold, ¾-in. ..... (41-C-1124)
FILE, 3 sq., smooth, 6-in. ..... (41-F-1572)
FILE, hand, smooth, 8-in. ..... (41-F-1028)
FIXTURE, track connecting and link pulling, RH and LH ..... (41-F-2997-86)
HAMMER, machinists, ball-peen, 32 oz. ..... (41-H-527)
HANDLE, flexible, ½-in. sq. drive, 12-in. ..... (41-H-1502)
HANDLE, ratchet, reversible, ½-in. sq. dr., 9-in. ..... (41-H-1505)
HANDLE, socket wrench speeder, ½-in. sq. dr., 17-in. ..... (41-H-1508)
HANDLE, tee combination, ½-in. sq. dr., 11-in. ..... (41-H-1509-55)
JOINT, universal, ½-in. sq. drive ..... (41-J-380)
PLIERS, combination, slip joint, 8-in. ..... (41-P-1652)
PLIERS, side cutting, 8-in. ..... (41-P-1977)
SCREWDRIVER, common, 6-in. blade ..... (41-S-1104)
SCREWDRIVER, machinists, ½- x 5-in. blade, 9½ in. long ..... (41-S-1385)
SCREWDRIVER, compass, nonmagnetic ..... (41-S-1067-700)
SCREWDRIVER, close quarter, ⅜- x 1¾-in. blade, 5-in. long ..... (41-S-1063)
SCREWDRIVER, special purpose, 1½-in. blade ..... (41-S-1062-20)
WRENCH, adjustable, single-end, 8-in. ..... (41-W-486)
WRENCH, adjustable, single-end, 12-in. ..... (41-W-488)
WRENCH, brake adjusting ..... (41-W-642-200)
WRENCH, engineers, open-end, 5/16- x ⅜-in. ..... (41-W-990)
WRENCH, engineers, open-end, 7/16- x ½-in. ..... (41-W-1000)
WRENCH, engineers, open-end, 9/16- x 1 1/16-in. ..... (41-W-1005-5)
WRENCH, engineers, open-end, ⅝- x ¾-in. ..... 41-W-1008)
WRENCH, engineers, open-end, 1 3/16- x ⅞-in. ..... (41-W-1015)
WRENCH, engineers, open-end, 1 5/16- x 1-in. ..... (41-W-1021)
WRENCH, engineers, open-end, 1⅛- x 1⅜-in. ..... (41-W-1028-10)
WRENCH, idler nut, 3¾-in. ..... (41-W-3673)
WRENCH, safety screw, 3/32-in. hexagonal ..... (41-W-2444)

WRENCH, safety screw, 1/8-in. hexagonal ..... (41-W-2450)
WRENCH, safety screw, 5/32-in. hexagonal ..... (41-W-2451)
WRENCH, safety screw, 3/16-in. hexagonal ..... (41-W-2452)
WRENCH, safety screw, 1/4-in. hexagonal ..... (41-W-2454)
WRENCH, safety screw, 3/8-in. hexagonal ..... (41-W-2456)
WRENCH, safety screw, 1/2-in. hexagonal ..... (41-W-2457)
WRENCH, safety screw, 5/8-in. hexagonal ..... (41-W-2458-55)
WRENCH, safety screw, 9/16-in. hexagonal ..... (41-W-2458)
WRENCH, safety screw, 3/4-in. hexagonal .....
WRENCH, socket, 1/2-in. sq. drive, 7/16-in. hexagonal .. (41-W-3005)
WRENCH, socket, 1/2-in. sq. drive, 1/2-in. hexagonal .... (41-W-3007)
WRENCH, socket, 1/2-in. sq. drive, 9/16-in. hexagonal .. (41-W-3009)
WRENCH, socket, 1/2-in. sq. drive, 3/4-in. hexagonal .... (41-W-3017)
WRENCH, socket, 1/2-in. sq. drive, 7/8-in. hexagonal .... (41-W-3023)
WRENCH, socket, 1/2-in. sq. drive, 15/16-in. hexagonal .. (41-W-3025)
WRENCH, socket, 1/2-in. sq. drive. 1-in. hexagonal ..... (41-W-3027)
WRENCH, socket, 1/2-in. sq. drive, 1/16-in. hexagonal .. (41-W-3029)

37. VEHICLE EQUIPMENT.

a. Communication Equipment. The radio for the motor carriage M8 is mounted on the right sponson floor. All other communication equipment is carried in the hull or turret or on the rear hull exterior. Following is a list of communications equipment:

ANTENNA, complete with cover (spare)
FLAG SET, M238
FLARES, 3 white parachute M17, 3 white star cluster M18
PROJECTOR, ground signals, M4
RADIO SET, SCR-508, SCR-528, or SCR-538
RADIO-SET, SCR-506 (Command tanks only)

b. Fire-fighting Equipment. The following fire-fighting equipment is carried in the hull:

EXTINGUISHER, fire, carbon dioxide, 4-lb filled, D-37127
EXTINGUISHER, fire, carbon dioxide, 10-lb filled, B-183325

c. Rations. Rations are carried in the stowage compartment located in the hull floor between the propeller shafts. The following material is carried:

TYPE "C" 2 days rations for 4 men—48 cans
TYPE "D" 1 days rations for 4 men— 1 can

d. Water. A 5-gal water CONTAINER is carried on the turret floor, left rear.

TOOLS AND EQUIPMENT STOWAGE ON VEHICLE

e. Sighting Equipment.

List of Equipment	Where Carried
BINOCULAR, set, M3 (composed of: 1 BINOCULAR, M3 1 CASE, carrying, M17)	Turret floor, left side
CASE, panoramic telescope	Hull sub floor
HEAD, spares, for M9 periscope (8)	In sponsons
LIGHTS, aiming post, M14 set (composed of: 8 CELLS, flashlight, BA-30 1 CHEST, M14 2 LAMPS, electric, 3-volt 2 LIGHTS, aiming post, M14)	Turret floor, rear right side
MOUNT, telescope, panoramic, M44 (complete)	On gun in turret
PERISCOPE, M9 (4)	In hull roof and turret
PERISCOPE, M9 (spares), (5)	In sponsons
POST, aiming, complete (composed of: 1 COVER, aiming post 1 POST, aiming, M1)	On hull exterior, left side
SIGHT, telescope, M56 (M52 temporary)	Telescope mount on gun
SIGHT, telescope, M56 (spare)	Right sponson floor, front
TELESCOPE, panoramic, M12A5	In chest on hull sub floor

f. General Equipment.

AMMUNITION Cal. .30, rounds (735) Cal. .45, rounds (600) Cal. .50, rounds (400) 80% armor-piercing 20% tracer	In hull or turret
GRENADES, hand (8) 2 FRAGMENTATION, MK11 4 SMOKE, H.C. M8 2 THERMITE, Incendiary	In turret

75-MM HOWITZER MOTOR CARRIAGE M8

List of Equipment	Where Carried
APPARATUS, decontaminating, 1½ qt, M2 (3)	Right sponson and under subfloor
ARMAMENT	On hull wall or in turret
GUN, Thompson submachine, cal. .45 M1928A1	
GUN, machine, cal. .50, M2, HB (flexible)	
HOWITZER, 75-mm, M2 or M3	
CARBINE, cal. .30 (3)	
BAG, canvas, field, O.D. M1936, (4)	
BAG, tool, w/o contents	Tool compartment, hull floor
BELT, safety (4)	On seats in hull
BOX, spare bulb	Tool compartment hull floor
BUCKET, canvas, folding, 18-qt	In ration compartment, hull floor
CABLE, towing, 1-in.	Hull exterior, left side
CAN, oil, 2½-gal (Hydra-Matic and engine oil)	Hull floor, right side
CANTEEN, M1910 w/cup and cover M1910 (4)	2 in sponson and in turret
CATALOGUE, service parts, SNL G-127	In pamphlet box
COVER, turret, canvas	Turret rack, rear exterior
CRANK, engine-starting	Hull exterior, rear
FLASHLIGHT (specification 17197) (3)	In hull and turret
GROUSER (for use w/rubber track only) (32)	On turret exterior
GUIDE, Lubrication, War Dep't	In map clip
INSTRUCTION SHEET, compass	In map clip
KIT, first aid (24 units) (Spec. 1553)	Left sponson
LIST, organizational spare parts and equipment	In pamphlet box

TOOLS AND EQUIPMENT STOWAGE ON VEHICLE

List of Equipment	Where Carried
MANUAL, field, cal. .50 mach. gun M2, H.B. (flex)	In clips
MANUAL, technical, for 75-mm howitzer motor carriage, M8	Gun parts box, hull right wall
MITTENS, asbestos (2 pr)	Gun parts box, hull right wall
NET, camouflage, 30 ft x 30 ft	Hull exterior, rear
OIL, engine (in can D59897) 2½-gal	Hull floor, right side
OILER, trigger-type, 1-pt	Hull wall, rear, left
PAULIN, 12 ft x 12 ft	
PLUG, headlamp socket (2)	In hull on differential
ROLL, blanket (4)	Stowage box, hull rear
STOVE, cooking, gasoline M1941 one burner consisting of Coleman military burner No. 520, w/accessory cups	Right sponson rear
SUPPORT, turret cover	Turret wall, right rear
TAPE, adhesive, O.D. 4 inches wide	Tool compartment hull floor
TAPE, friction, ¾ inch wide x 30 ft (minimum)	Tool compartment hull floor
TUBE, flexible nozzle (2)	Tool compartment hull floor
WIRE, 14-gage, 10 ft	Tool compartment hull floor

38. VEHICLE SPARE PARTS.

a. The following vehicle spare parts are carried in the tool compartment on the hull floor unless otherwise specified:

BELT, fan, B226230

BELT, generator and water pump, C105552

BLOCKS, track, complete (spare) (steel, C100380 or rubber, C55574) (4) on hull exterior rear

CONNECTOR, end (to match track furnished) (8) on hull exterior rear

FITTING, lubricating, B.H. type, ⅛-27 NPT male, CLDX1A (3) in cal. .30 spare parts box

FITTING, relief, ½-27NPT male, A143824, (3) in cal. .30 spare parts box

LAMP BULB, 3 cp 12-16-V (Mazda No. 67) A213667B (2)

LINK, connector (to match track furnished) (4) on hull exterior rear

NUT, safety, alloy steel, ½ in. 30 NF3, BBSX4AE (8)

PIN, cotter, split (type B) ¼ in. x 2¼ in., BFAX2CC (2)
PIN, locking, A217344 (2)
PLUG and CHAIN, direct vision, C107594 (2)
WEDGE (to match track furnished) (8) on hull exterior rear

39. GUN TOOLS.

a. The following gun tools are available in the vehicle:

b. 75-mm Howitzer.

MALLET, Rawhide, 23 oz.
SCREWDRIVER, Common, 6-in. blade
SETTER, Fuse, M14

c. Cal. .50 Machine Gun.

WRENCH, combination, M2

40. GUN EQUIPMENT.

a. Accessories for the cal. .45 submachine gun, cal. .50 machine gun and 75-mm howitzer are carried inside the hull in the gun parts box unless otherwise specified. The following equipment is carried:

b. Cal. .45 Submachine Gun.

BRUSH, chamber-cleaning, M6
BRUSH, cleaning, cal. .45 M5
CASE, accessories and spare parts M1918 (w/o contents)
COVER, Thompson submachine gun (on gun)
ENVELOPE, fabric, one-button, 3 in. x 3⅛
MAGAZINE, 30-round clip (20) (in turret boxes)
OILER, Thompson submachine gun (in gun stock)
ROD, cleaning
SLING, gun M1923 (webbing) (on gun)
THONG (in gun stock)

c. Cal. .50 Machine Gun.

BAG, metallic, belt link
BOX, ammunition (50-round) in turret and left sponson (8)
BRUSH, cleaning, cal. .50, M4 (4)
CASE, cleaning rod, M15
CHUTE, metallic belt link, M1 (on gun)
COVER, gun and mount (A.A.) (on gun)
COVER, spare barrel, M13, 45 in. (on barrel)

TOOLS AND EQUIPMENT STOWAGE ON VEHICLE

OILER, filling, oil buffer

ROD, cleaning, jointed, M7

ENVELOPE, spare parts, M1 (w/o contents) (2)

EXTRACTOR, ruptured cartridge

d. 75-mm Howitzer, M2 or M3.

BAG, empty cartridge (on gun)

BAG, spare parts

BOOK, artillery gun 00 form 5825 (in map clips)

BRUSH, bore, M9, w/staff (turret floor, left)

CAN, ¼-gal (stencil "OIL-RECOIL" in black letters ¾ in. high on case)

COVER, breech (on gun)

COVER, muzzle (on gun)

CASE, carrying, gunner's quadrant, M1 (turret right front wall)

COVER, brush, M516 (on brush, turret floor, left)

HOSE, assembly

GUN, lubricating oil (2 oz) (under side hull, right subfloor)

LANYARD, M8

OIL, recoil, special (spec. AXS 808) 1 qt T (Can B101420)

QUADRANT, gunner's M1 (in case, turret wall, right front)

RAMMER, cleaning and unloading, M3

SETTER, fuse, M14

SIGHT, bore, 75-mm pack. how. composed of:

1 SIGHT, bore, breech RF11HA

1 SIGHT, bore, muzzle RF11AD

TABLE, firing (75-1-3) (in map clips)

TARGET, testing set, paper 75-mm how. (set of 4 in envelope)

WRENCH, fuse M7

41. GUN SPARE PARTS.

a. The following gun spare parts are available in the vehicle:

b. 75-mm Howitzer.

LOCK, firing assembly, M13

PIN, firing

SPRING, compression, firing

c. **Cal. .50 Machine Gun.**

BARREL, assembly
DISK, buffer
EXTENSION, firing pin assembly
EXTRACTOR, assembly
LEVER, cocking
PIN, cotter, 1/16- x 3/4-in. switch pivot
PIN, cotter, 1/8- x 5/8-in. cover pin
PIN, cotter, 3/32- x 3/4-in. belt feed lever pivot stud
PIN, firing
PLUNGER, belt feed lever
ROD, driving spring w/spring assembly
SLIDE, belt feed group
(Consisting of:
1 Arm, belt feed pawl item
1 Pawl, feed, belt assembly
1 Pin, belt feed pawl assembly
1 Slide, belt feed assembly
1 Spring, belt feed pawl)
SLIDE, sear
SPRING, belt feed lever plunger
SPRING, belt holding pawl
SPRING, cover extractor
SPRING, locking, barrel
SPRING, sear
STUD, bolt

d. **Cal. .45 Submachine Gun.**

DISCONNECTOR, 6D
EJECTOR, 4B (M1928A1 only)
EJECTOR, assembly (M1 only)
EXTRACTOR, 15A
PIN, firing 14A (not used w/M1A1)
ROCKER, 16D
SPRING, disconnector 9A
SPRING, firing pin 14C (not used w/M1A1)
SPRING, magazine catch 9D
SPRING, recoil 17C
SPRING, sear 9B

PART TWO — VEHICLE MAINTENANCE INSTRUCTIONS

Section X

NEW VEHICLE RUN-IN TEST

42. PURPOSE OF RUN-IN TEST, AND CORRECTION OF DEFICIENCIES.

a. When a new or reconditioned vehicle is first received at the using organization it is necessary for second echelon personnel to determine whether or not the vehicle will operate satisfactorily when placed in service. For this purpose, inspect all accessories, subassemblies, assemblies, tools, and equipment to see that they are in place, and correctly adjusted. In addition, they will perform a run-in test of at least 50 miles as directed in AR 850-15, paragraph 25, table III, according to procedures in paragraph 43 below. Deficiencies disclosed during the course of the run-in test will be treated as follows:

(1) Correct any deficiencies within the scope of the maintenance echelon of the using organization before the vehicle is placed in service.

(2) Refer deficiencies beyond the scope of the maintenance echelon of the using organization to a higher echelon for correction.

(3) Bring deficiencies of serious nature to the attention of the supplying organization.

43. RUN-IN TEST PROCEDURES.

a. Preliminary Service.

(1) FIRE EXTINGUISHERS. See that portable and fixed system cylinders are securely stowed, and inspect the operating valves. If valves appear to have been opened or are damaged, report to proper authority for exchange or refill. Examine lines, nozzles and control cables of fixed system to see if they are in good condition, and that nozzles are not clogged.

(2) FUEL, OIL, AND WATER. Fill fuel tanks. Check crankcase oil, and coolant supply, and add as necessary to bring to correct levels. Allow room for expansion in fuel tanks and radiators. During freezing weather, test value of antifreeze, and add as necessary to protect cooling system against freezing. CAUTION: *If there is a tag attached*

to crankcase filler caps concerning engine oil in crankcases, follow instructions on tags before driving vehicle.

(3) FUEL FILTER. Inspect filter for leaks, damage, and secure mountings and connections. Be sure selector and shut-off valve operates properly. Drain filter sediment bowl. If any appreciable amount of water or dirt is present, remove bowl, clean both bowl and strainer assembly in dry-cleaning solvent. Also drain accumulated dirt and water from bottom of fuel tanks. Drain only until fuel runs clean.

(4) BATTERY. Make hydrometer and voltage test of battery, and if necessary, add distilled or clean water to bring electrolyte to 3/8 inch above plates.

(5) AIR CLEANERS, AND BREATHER CAPS. Examine carburetor air cleaners and crankcase breather caps to see if they are in good condition and secure. Remove both air cleaner elements and wash in dry-cleaning solvent. Fill reservoirs to correct level with fresh oil. Wash breather cap elements, also apply a film of oil. If caps are oil-bath type, service same as air cleaners. Reinstall securely and make sure all gaskets are in good condition, and ducts and air horn connections are tight. Secure shield doors (if so equipped).

(6) ACCESSORIES AND BELTS. See that accessories, such as carburetors, generators, regulators, distributors, water pumps, fans on both engines are securely mounted, and that fan, water pump and generator drive belts are in good condition, and adjusted to have 5/8- to 3/4-inch finger-pressure deflection.

(7) ELECTRICAL WIRING. Examine all accessible wiring and conduits to see if they are in good condition, securely connected, and properly supported.

(8) TRACKS. Examine track blocks for damage, loose or damaged wedges, nuts, and connectors. See that tracks are correctly assembled and mounted, and that tension is adjusted so that there is a 3/4-inch sag midway between first and second support rollers. Be sure grousers are present and secure.

(9) WHEEL AND FLANGE NUTS. See that sprocket, idler, bogie wheel and support roller assembly, mounting and flange nuts are present and secure.

(10) FENDERS AND SHIELDS. See that fenders, brush guards and sand shields (if so equipped) are in good condition and secure, that shield hinges operate properly, and that welds are intact.

(11) TOWING CONNECTIONS. Examine tow loops for looseness and damage.

(12) HULL AND TARPAULIN. See that all hull attachments, hardware, lift loops, doors, hatches, and their release and locking mechanism are in good condition, secure, and operate properly. Examine

entire hull and turret for looseness or damage. Inspect tarpaulin or camouflage net to see that they are in good condition and mount or stow them securely.

(13) VISION DEVICES. Inspect periscope prisms and windows (mounted or spares) to see if they are in good condition and clean. See that mounted units are secure in holders, and that holders are properly mounted. Test each periscope to be sure it will elevate, traverse, and depress through full range. CAUTION: *Clean periscopes only with a soft cloth or brush.*

(14) LUBRICATE. Perform a complete lubrication of the vehicle, covering all intervals according to instructions on Lubrication Guide, (par. 35) except gear cases, and units lubricated or serviced in items (1) to (13). Check all gear case oil levels, and add as necessary to bring to correct levels; change only if condition of oil indicates the necessity, or if oil is not of proper grade for existing atmospheric temperature. NOTE: *Perform items (15) to (18) during lubrication.*

(15) SPRINGS AND SUSPENSIONS. Examine all suspension brackets, arms, links, and guides, to see if they are in good condition, correctly assembled, secure, and not leaking excessively at seals, or worn. Inspect roller tires for damage or separation from wheels. Examine volute springs for damage or excessive sag.

(16) STEERING LINKAGE. Inspect all shafts, arms, rods, connections, levers and grips to see if they are in good condition, correctly and securely assembled and mounted, and operate without excessive looseness or binding. Be sure driver's levers will lock in applied position, for parking.

(17) PROPELLER SHAFTS. Remove all propeller shaft covers and inspect shafts and universal joints to see if they are in good condition, correctly assembled, alined, secure, and not leaking excessively at seals.

(18) VENTS. Examine breathers in each final drive to be sure they are in good condition, secure, and not clogged.

(19) CHOKE. When starting engines in item (20), observe if action of automatic choke is satisfactory. Adjust choke setting if necessary, according to instructions, paragraph 91.

(20) ENGINE WARM-UP. Start engines, noting if cranking motor action is satisfactory, and shows tendency toward difficult starting. Set hand throttle to idle engines at 625 revolutions per minute during warm-up.

(21) INSTRUMENTS.

(a) Oil Gages. Immediately after engines start, observe if oil pressure is satisfactory. (Normal operating pressure, hot, is about 30 pounds, idle pressure is 15 pounds). Stop engines if pressure is not indicated in 30 seconds.

(b) Warning Signals. Do not drive vehicle while engine or transmission warning signals are red. NOTE: *Transfer unit signal will remain red until vehicle is moved forward. It remains lighted in reverse.*

(c) Ammeter. Ammeter should show slight positive (+) charge. High charge may be indicated until generator restores to battery, current used in starting.

(d) Engine Temperature Gage. Engine temperature should rise gradually during warm-up to normal operating range, 160° F to 180° F.

(e) Voltmeter. Voltmeter (if so equipped) should register the nominal battery voltage, 10 to 15 volts.

(f) Tachometers. These instruments should register engine speed in revolutions per minute, and record accumulating engine revolutions.

(22) ENGINE CONTROLS. Observe if engine responds properly to controls, and if controls operate without excessive looseness or binding.

(23) SIREN. See if siren is in good condition and secure. If tactical situation permits, test for proper operation and tone.

(24) LAMPS (LIGHTS) AND REFLECTORS. Clean lenses and inspect all units for looseness and damage. If tactical situation permits, open and close all light switches to see if lamps respond properly.

(25) LEAKS: GENERAL. Look under vehicle, and within engine and fighting compartments for indications of fuel, oil, or coolant leaks. Trace any found to source, and correct or report them to higher authority.

(26) TOOLS AND EQUIPMENT. Check tools and vehicle stowage lists (sec. IX) to be sure all items are present, and see that they are serviceable and properly mounted or stowed.

b. Run-in Test. Perform the following procedures (1) to (10) inclusive, during the road test of the vehicle. On vehicles which have been driven 50 miles or more before delivery to the using organization, reduce the length of the road test to the least mileage necessary to make observations listed below. CAUTION: *Avoid continuous operation of the vehicle at speeds approaching maximums indicated on the caution plate, during the road test.*

(1) DASH INSTRUMENTS AND GAGES. Do not move vehicle until engine temperature reaches 135° F. Maximum safe operating temperature is 240° F. Observe readings of oil gages, ammeter, tachometers, all temperature gages, and warning signal lights to be sure they are indicating the proper function of units to which they apply. Also see that speedometer registers vehicle speed and that odometer records accumulating mileage.

(2) BRAKES: STEERING AND PARKING. Test steering brakes to see if they will stop vehicle effectively with levers even, and that they start to meet resistance at approximately 6 to 8 notches from released

position. See that parking lock mechanism holds levers in applied position. Test levers separately to be sure vehicle steers properly with normal pull.

(3) TRANSMISSIONS AND TRANSFER UNIT. Vehicle should start satisfactorily in either DR or LO range. Be alert for abnormal conditions in transmissions indicated by excessive slippage and engines racing when under load, severe shifting, or shifting in wrong speed range. Also unusual conditions in transfer unit indicated by failure to upshift, by shifting in wrong speed range, or failure to downshift below 15 miles per hour when control lever is moved to LO. Gears should operate without unusual noise.

(4) ENGINES. Be on the alert for any unusual engine operating characteristics or unusual noise, such as lack of pulling power or acceleration, backfiring, misfiring, stalling, overheating, or excessive exhaust smoke. Observe if engines respond properly to all controls, and if control synchronization appears to be satisfactory.

(5) UNUSUAL NOISES. Be alert throughout road test for noise from hull or attachments, suspensions, running gear, or tracks that might indicate looseness, damage, excessive wear, or inadequate lubrication.

(6) HALT VEHICLE AT 10-MILE INTERVALS OR LESS, FOR SERVICE (STEPS (7) AND (8), BELOW).

(7) TEMPERATURES. Cautiously hand-feel each wheel, sprocket, idler, and support roller hub for abnormal temperatures. Examine transmission, transfer unit and controlled differential, and final drives, for indications of overheating or excessive leaks at seals, gaskets, or vents. CAUTION: *Transfer unit temperature will run considerably higher than other gear cases.*

(8) LEAKS. With engines running, and fuel, engine oil and cooling systems under pressure, look within engine and fighting compartments, and under vehicle for leaks.

(9) GUN ELEVATING AND TRAVERSING MECHANISMS. Inspect all mounted guns to see if they are in good condition, secure and clean; test elevating and traversing and firing mechanisms for proper operation. Place vehicle in position where it is tilted sidewise about 10 degrees, and traverse turret to see if it operates through full 360-degree range, and that turret gun can be elevated with hand control without binding, excessive lash or erratic action.

(10) TRACK TENSION. Recheck tracks to be sure they are adjusted to have approximately ¾-inch sag midway between first and second support rollers.

c. Upon completion of run-in test, correct or report any deficiencies noted. Report general condition of vehicle to designated individual in authority.

75-MM HOWITZER MOTOR CARRIAGE M8

Section XI

SECOND ECHELON PREVENTIVE MAINTENANCE

44. SECOND ECHELON PREVENTIVE MAINTENANCE SERVICES.

a. Regular scheduled maintenance inspections and services are a preventive maintenance function of the using arms, and are the responsibility of commanders of operating organizations.

(1) FREQUENCY. The frequency of the preventive maintenance service outlined herein is considered a minimum requirement for normal operation of vehicles. Under unusual operating conditions such as extreme temperatures, or dusty or sandy terrain, it may be necessary to perform certain maintenance services more frequently.

(2) FIRST ECHELON PARTICIPATION. The drivers should accompany their vehicles and assist the mechanics while periodic second echelon preventive maintenance services are performed. Ordinarily the driver should present the vehicle for a scheduled preventive maintenance service in a reasonably clean condition, that is, it should be dry and not caked with mud or grease to such an extent that inspection and servicing will be seriously hampered. However, the vehicle should not be washed, or wiped thoroughly clean, since certain types of defects, such as cracks, leaks, and loose or shifted parts, or assemblies, are more evident if the surfaces are slightly soiled or dusty.

(3) If instructions other than those contained in the general procedures in step (4) or the specific procedures in step (5) which follow, are required for the correct performance of a preventive maintenance service, or for correction of a deficiency, other sections of the vehicle Operator's Manual pertaining to the item involved, or a designated individual in authority, should be consulted.

(4) GENERAL PROCEDURES. These general procedures are basic instructions which are to be followed when performing the services on the items listed in the specific procedures. NOTE: *The second echelon personnel must be thoroughly trained in these procedures, so that they will apply them automatically.*

(a) When new or overhauled subassemblies are installed to correct deficiencies, care should be taken to see that they are clean, correctly installed, properly lubricated, and adjusted.

(b) When installing new lubricant retainer seals, a coating of the lubricant should be wiped over the sealing surface of the lip of the seal. When the new seal is a leather seal, it should be soaked in SAE

10 engine oil (warm, if practicable) for at least 30 minutes. Then, the leather lip should be worked carefully by hand before installing the seal. The lip must not be scratched or marred.

(c) The general inspection of each item applies also to any supporting member or connection, and usually includes a check to see whether or not the item is in good condition, correctly assembled, secure, or excessively worn. The mechanics must be thoroughly trained in the following explanations of these terms.

1. The inspection for "good condition" is usually an external visual inspection to determine whether or not the unit is damaged beyond safe or serviceable limits. The term "good condition" is explained further by the following: not bent or twisted, not chafed or burned, not broken or cracked, not bare or frayed, not dented or collapsed, not torn or cut.

2. The inspection of a unit to see that it is "correctly assembled" is usually an external visual inspection to determine whether or not it is in its normal assembled position in the vehicle.

3. The inspection of a unit to determine if it is "secure" is usually an external visual examination, a hand-feel, wrench, or pry-bar check for looseness. Such an inspection should include any brackets, lock washers, lock nuts, locking wires, or cotter pins used in assembly.

4. "Excessively worn" will be understood to mean worn close to, or beyond, serviceable limits, and likely to result in a failure if not replaced before the next scheduled inspection.

(d) Special Services. These are indicated by repeating the item numbers in the columns which show the interval at which the services are to be performed, and show that the parts, or assemblies, are to receive mandatory services. For example, an item number in one or both columns opposite a "TIGHTEN" procedure, means that the actual tightening of the object must be performed. The special services include:

1. Adjust. Make all necessary adjustments in accordance with the pertinent section of the vehicle Operator's Manual, special bulletins, or other current directives.

2. Clean. Clean units of the vehicle with dry-cleaning solvent to remove excess lubricant, dirt, and other foreign material. After the parts are cleaned, rinse them in clean fluid and dry them thoroughly. Take care to keep the parts clean until assembled, and be certain to keep dry-cleaning fluid away from rubber, or other material which it will damage. Clean the protective grease coating from new parts, since this material is not a good lubricant.

3. Special lubrication. This applies both to lubrication operations that do not appear in the vehicle Lubrication Guide, and to items that do appear in the Guide, but which should be performed in connection

with the maintenance operations if parts have to be disassembled for inspection or service.

4. Serve. This usually consists of performing special operations, such as replenishing battery water, draining and refilling units with oil, and changing or cleaning the fuel or oil filter cartridge or unit.

5. Tighten. All tightening operations should be performed with sufficient wrench torque (force on the wrench handle) to tighten the unit according to good mechanical practice. Use torque-indicating wrench where specified. Do not over-tighten, as this may strip threads or cause distortion. Tightening will always be understood to include the correct installation of lock washers, lock nuts, and cotter pins provided to secure the tightening.

(e) When conditions make it difficult to perform the complete preventive maintenance procedures at one time, they can sometimes be handled in sections, planning to complete all operations within the week if possible. All available time at halt and in bivouac areas must be utilized, if necessary, to assure that maintenance operations are completed. When limited by the tactical situation, items with special services in the columns should be given first consideration.

(f) The numbers of the preventive maintenance procedures that follow are identical with those outlined on W.D. A.G.O. Form No. 462, which is the Preventive Maintenance Service Work Sheet for Full Track and Tank-like Wheeled Vehicles. Certain items on the work sheet that do not apply to this vehicle are not included in the procedures in this manual. In general, the numerical sequence of items on the work sheet is followed in the manual procedures, but in some instances there is a deviation for conservation of the mechanic's time and effort.

(5) SPECIFIC PROCEDURES. The procedures for performing each item in the 50-hour (500-mile) and 100-hour (1,000 mile) maintenance procedures are described in the following chart. Each page of the chart has two columns at its left edge corresponding to the 100-hour and the 50-hour maintenance respectively. Very often it will be found that a particular procedure does not apply to both scheduled maintenances. In order to determine which procedure to follow, look down the column corresponding to the maintenance due, and wherever an item number appears, perform the operations indicated opposite that number.

ROAD TEST

NOTE: When the tactical situation does not permit a full road test, perform items 2, 3, 5, 9, 12, 13 and 15 which require little or no movement of the vehicle. When a road test is possible, it should be for preferably 3, and not over 5 miles.

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE		
1000-Mile	500-Mile	
1	1	**Before-operation Service.** Perform the Before-operation Service (par. 30) to determine whether or not vehicle is in satisfactory condition to make the road test safely, and to see that it has sufficient fuel, oil, and coolant.
2	2	**Instruments and Gages.** Observe readings of all instruments frequently during operation to see whether or not they are indicating properly. OIL PRESSURE GAGES. Oil pressure gages should indicate at least 15 pounds while engines are idling, and at least 30 pounds at operating speeds. In case of unusual drop in oil pressure, or lighting of oil pressure warning signal, vehicle should be stopped immediately and trouble corrected or reported to proper authority. ENGINE TEMPERATURE GAGES. Gages should always indicate below 240° F. If gages indicate more than this, or if the warning signal lights, stop vehicle until correction can be made. AMMETER. The ammeter will register zero or slight discharge (−) with the engines idling, or register zero or slight positive (+) charge with engines running at operating speeds. Any unusual drop or rise in reading should be investigated. A high charge reading for an extended period may indicate a dangerously low battery or a faulty generator regulator. TACHOMETERS. Tachometers should indicate engine speed and accumulating revolutions without excessive noise or fluctuation. SPEEDOMETER AND ODOMETER. Speedometer should indicate vehicle speed. Odometer should register accumulating mileage without excessive noise or fluctuation. WARNING LIGHTS. Transmission oil pressure warning lights should be "OFF" when engines are running. Transfer warning light should be "OFF" when vehicle is in forward motion, but "ON" when standing, or in reverse.
3	3	**Windshield, Windshield Wipers (if so equipped) and Siren.** If windshield is in use, inspect assembly and wipers to see that they are in good condition, secure, and whether or not wiper blades move

MAINTENANCE		
1000-Mile	500-Mile	
		through their full stroke and contact surface evenly. If tactical situation permits, test siren for proper operation and tone, and inspect for good condition and secure mounting.
5	5	**Brakes (Steering).** With vehicle stopped, pull back on steering brake levers; if brakes are properly adjusted, levers should start to take hold at 6 to 8 notches of travel on ratches. Accelerate vehicle to a moderate speed, release accelerator, apply both steering brakes, and observe whether or not they stop the vehicle effectively. Apply steering brakes independently and see that they steer vehicle properly. NOTE: *If vehicle tends to lead in either direction, it usually indicates either tight brake adjustment, which will cause drag and excessive wear of brake lining, or unequal track tension.* Apply parking brake with vehicle on reasonable incline. It should hold vehicle effectively, and locking device should hold levers in applied position.
7	7	**Transmission (Lever Action, Vibration, Noise).** Operate vehicle through each speed range of transmission. Observe whether or not control lever operates properly, and whether or not there are any unusual vibrations or noises in any speed range that might indicate damage, excessive wear, loose mountings, or improper operation.
9	9	**Engine (Idle, Acceleration, Power, Noise, Smoke, Oil Consumption).** IDLE. With the vehicle stopped observe if engines run smoothly at normal idling speed (425 revolutions per minute). Throughout road test, observe if there is any tendency of engines to stall when accelerator is released and hand throttle closed. ACCELERATION, POWER, VIBRATION AND NOISE. Test engines for normal acceleration and pulling power in each speed. While testing in driving range, accelerate from low speed with wide open throttle up to top speed, and listen for unusual engine noise, knock, whine, or vibration that might indicate loose, damaged, excessively worn, or inade-

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE		
1000-Mile	500-Mile	
		quately lubricated engine parts or accessories, or loose mountings or drive belts. SMOKE. During operation, observe if there is excessive smoke from exhaust. OIL CONSUMPTION. Upon completion of road test, a check should be made to determine whether or not either or both engines have been consuming an excessive amount of oil.
10	10	**Unusual Noises (Propeller Shafts and Universal Joints, Differential and Final Drives, Sprockets, Idlers, Bogie Wheels, Support Rollers and Tracks).** During road test, listen for any unusual noise from these units, indicating damaged, defective or loose parts, or inadequate lubrication.
11	11	**Temperatures (Transmission, Transfer, Differential and Final Drives, Hubs, Sprockets, Idlers, Bogie Wheels, and Support Rollers).** After operating, remove bottom inspection plate, and examine transmissions and transfer unit in fighting compartment for excessive heat. Check by hand-feel for any abnormal temperature in differential and final drives, hubs or sprockets, idlers, bogie wheels and support rollers. NOTE: *If location on grade is selected for this check, time will be saved in performing item 12.*
12	12	**Gun Elevating and Traversing Mechanism.** Place vehicle in a position where it will be tilted (sidewise) about 10 degrees. Traverse turret through its full 360-degree range, checking for indication of binding. With gun pointed forward, elevate it through its entire range with hand controls; check for binding, excessive lash, or erratic action.
13	13	**Leaks.** Look in engine compartment, and also beneath vehicle, for indications of fuel, oil or coolant leaks.
15	15	**Track Tension (Final Road Test).** Inspect for satisfactory track tension after final road test; track should have not more than ¾-inch sag midway between first and second support rollers.

75-MM HOWITZER MOTOR CARRIAGE M8

MAINTENANCE		MAINTENANCE OPERATIONS
1000-Mile	500-Mile	
16	16	**Engine Fuel Pump Test.** Make pump pressure test of each (2) fuel pump. Each should develop from 3½ to 5 pounds pressure at 425 engine revolutions per minute. CAUTION: *Before stopping engines for following services, allow to idle at 425 revolutions per minute for 3 minutes, then turn off both ignition switches, and finally, open master battery switch.*
17	17	**Engine Crankcase (Leaks and Level).** Observe both crankcases for indications of oil leaks, and inspect bayonet gages for indication of oil level. Add oil as necessary, or if oil change is due, drain and refill crankcases to proper level with specified oil. NOTE: *If oil is changed, do not start engines until new oil filter elements have been installed, as in item 54.*
54	54	**Engine Oil Filter (if used).** Inspect oil filters to see that they are in good condition, secure, and not leaking.
54		CLEAN AND SERVE. Remove oil filter elements, clean cases, and install new filter elements, using new gaskets and tightening covers securely.
18	18	**Side Armor (Fenders, Dust Shields, Guards, Paint and Markings, Shackles, and Siren).** Inspect these items to see that they are in good condition; that armor, fenders, dust shields (if so equipped), guards, shackles, and siren are secure, and that towing shackles are not excessively worn. Observe condition of paint for rust or polished surfaces that may cause reflections, and check all vehicle markings to see that they are legible.
19	19	**Bottom (Armor, Escape Hatch, Inspection Plates, and Drain Plugs).** See that these items are in good condition and secure, that the bottom escape hatch hinges and latches operate properly, and are adequately lubricated, and that bottom drain plugs are tight. Tighten all bottom inspection plates securely. Apply a few drops of oil to bottom escape hatch hinges and latches.
20	20	**Differential and Final Drives.** Inspect housings for good condition and leakage; check lubricant

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE		
1000-Mile	500-Mile	
		level. See that all assembly and mounting bolts are secure. NOTE: *If change of lubricant is due, drain and refill with specified oil at this time.*
20		TIGHTEN. Tighten all external assembly and mounting bolts securely.
21	21	*Track (Blocks, Connectors, and Wedges). Inspect tracks to see that these items are in good condition, correctly assembled, and secure. Pay particular attention to loose connectors, bottomed wedges, and tread blocks. Tighten wedge nuts.
21		*NOTE: Whenever the tracks are disconnected and removed from the sprockets, support rollers, and idlers, or at each third 100-hour maintenance service, the related items 22 and 25, marked on the Preventive Maintenance Service Work Sheet W.D. A.G.O. Form No. 462, should be inspected as described below in the asterisk-marked procedures. On the regular 50- and 100-hour maintenance services the tracks should not be removed unless repairs are needed. CAUTION: *Whenever tracks are removed for repair or replacement, do not reinstall tracks until the services followed by the asterisk (*) in items 22 and 25 have been completed.*
22	22	**Idler (Wheels, Arms, Guide Plates, Adjustment and Lock Nuts and Springs).** Inspect these items to see that they are in good condition, correctly assembled, secure, and that grease is not leaking excessively from wheel bearing seals. Be sure adjusting nut and adjusting pin nut are secure. Tighten all assembly and mounting bolts and nuts securely.
22		*NOTE: In addition to the above, at each third 100-hour maintenance service, or whenever the tracks are removed from the idlers, check the idler hub bearings for looseness or end play. Spin the idler wheels and listen for any unusual noise that might indicate a damaged, excessively worn or inadequately lubricated bearing.
23	23	**Bogie (Arms, Links, Gudgeons, Collars and Guides, Volute Springs, Seats, and Brackets).** Inspect these items to see that they are in good

MAINTENANCE		
1000-Mile	500-Mile	
		condition, correctly assembled, and secure; and that gudgeons, collars, and collars guides are not excessively worn. Note whether or not volute springs have taken a permanent set (two or more coils resting on seat); such a condition will be considered a standard for replacement.
23		TIGHTEN. Tighten all assembly and mounting nuts and screws securely.
24	24	**Wheels (Tires, Support Rollers, and Skids).** Inspect wheels, rollers, and skids for good condition, correct assembly, and secure mounting. Pay particular attention to see that tire rubber has not separated from rim, and that tires are not cut, torn, or excessively worn. Inspect for excessive lubricant leaks from bearings.
24		TIGHTEN. Jack up track wheels (par. 121) and examine bearings for looseness and end play. Spin wheels and listen for any unusual noise. Tighten assembly and mounting bolts securely.
24		*NOTE: Whenever the tracks are removed, the above operation should be performed before the tracks are reinstalled.
25	25	**Sprockets (Hubs, Teeth, and Nuts).** Inspect sprockets for good condition, correct assembly, and security of mounting bolts. Inspect sprocket teeth for excessive wear, and shaft flange gaskets, or oil seals for leaking lubricant excessively. If sprocket teeth are excessively worn, sprocket should be replaced or reversed. Tighten assembly and mounting bolts securely.
25		*NOTE: In addition to the above, at each third 100-hour operation, or whenever the track is disconnected and removed from the sprocket, check the sprocket teeth for excessive wear, see that sprockets are well secured to the hubs, and that the hub-to-final drive bolts are secure. Check the sprocket hub bearings for looseness and end play. After performing the above, reinstall the tracks and connect them securely.
26	26	**Track Tension.** Track should have ¾-inch sag midway between first and second support rollers. Adjust to this standard, and lock securely.

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE		
1000-Mile	500-Mile	
27	27	**Top Armor (Turret, Deck, Paint and Markings, Grilles, Doors, Hatches and Latches, and Antenna Mast).** Inspect these items to see that they are in good condition and secure, see that door and hatch hinges operate properly, and that they are not excessively worn and are adequately lubricated. Examine paint for rust spots, or polished surfaces that may cause reflections, and see that vehicle markings are legible.
28	28	**Caps and Gaskets (Fuel and Radiator).** Inspect to see that fuel tank and radiator caps and gaskets are in good condition, secure, and not leaking.
30		**Engine Removal (When Required).** SERVE: Remove engines on 100-hour maintenance service only if inspections made in items 9, 10, 13, and check of oil consumption, indicate a definite need.
30		CLEAN: Clean exterior of engine and dry thoroughly, taking care to keep dry-cleaning solvent away from electrical wiring, terminal boxes and equipment. NOTE: *In this and following services (items 32 to 60) the procedures should be followed in the best possible manner if engines are not removed from vehicle.*
32		SPARK PLUGS (CAPS AND DEPOSITS). Remove and clean spark plugs. Inspect insulators for cracks or breaks, and electrodes for excessive burning. Replace unserviceable plugs with new plugs. Adjust electrodes of all plugs to be installed to 0.030 inch by bending grounded electrode. Be sure to install new gaskets, and do not overtighten plugs. NOTE: *Perform item 33 before reinstalling plugs.*
33		COMPRESSION TEST (RECORD). When spark plugs are removed for performance of item 32, test compression of each cylinder and record gage readings on W.D. A.G.O. Form No. 462. If there is more than 10 pounds variation between cylinders, report to designated authority.
34	34	**Generator and Cranking Motor.** Satisfactory inspection can be accomplished only at times when engines are removed. At such times, inspect gen-

MAINTENANCE		
1000-Mile	500-Mile	
		erators and cranking motor for good condition, security of mounting and secure wiring connections. Remove commutator inspection covers and examine commutator for good condition, see that brushes are free in brush holders, clean, and not excessively worn; that brush connections are secure, and that wires are not broken or chafing. Clean commutator end of units by blowing out with compressed air. Tighten mounting bolts securely.
36	36	**Distributors.** Inspect distributor bodies and external attachments for good condition and secure mounting. Clean caps, rotors, and seals, and inspect for good condition and correct assembly. Look for cracks or burns. Inspect breaker points for good condition, good alinement and 0.015 gap. If the breaker plate assemblies are unserviceably dirty, remove the distributor, clean in dry-cleaning solvent, dry with compressed air, lubricate the parts as specified below for the 100-hour maintenance service, and reinstall the distributors in correct position for timing. When cleaning distributors, remove wicks and lubrication cups, clean and dry while removed, and reinstall them only after the distributor assemblies are cleaned and blown dry with compressed air. If the breaker points are pitted, burned or worn to an unserviceable condition, install a new set. If points are badly pitted, replace condenser also. If points are slightly pitted or burned, dress with point file and blow off filings with compressed air. SHAFT. Check shafts by hand-feel for looseness, and to determine whether or not the bushings are worn. CENTRIFUGAL ADVANCE. Test range of movement of centrifugal advance mechanism by rotating shaft and rotor by finger force. Observe whether or not shaft returns to original position without binding.
36		SPECIAL LUBRICATION. Lubricate cam surfaces, movable breaker arm pin, and camshaft sparingly with light grease, and the wick with a few drops of light engine oil. Take care to keep lubricant off the distributor points, not to apply more lubricant than is specified, and to wipe the cam clean before lubricating its surface.

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE		
1000-Mile	500-Mile	
36		ADJUST. Adjust breaker point gap to 0.015 inch, wide open.
38	38	**Ignition Wiring and Conduits.** Inspect accessible ignition wiring and conduits for cleanliness, good condition, correct assembly, secure mounting, and see that they are not chafing against other engine parts.
39	39	**Coils.** Inspect ignition coils for cleanliness, secure mountings, and tight connections.
42	42	**Breather Caps and Ventilators.** Inspect engine crankcase breather cap or oil-bath air cleaner (as equipped) for good condition and correct assembly. Clean breather cap or oil bath air cleaner, recoil and reinstall securely.
43	43	**Air Cleaners (Carburetors).** Disassemble, clean, reoil and reinstall carburetor air cleaners, following carefully the correct procedure (par. 95). CAUTION: *Tight sealing of the air cleaner bottom cover in each sponson is vital to safeguard engines against dust thrown up by tracks.*
44	44	**Carburetors (Automatic Chokes, Throttles, Linkage).** Inspect to see that these items are in good condition, correctly assembled, and securely installed; that carburetors do not leak; that control linkage, automatic choke and throttle shafts are not excessively worn. Inspect automatic chokes for closed position when engine is cool. See that throttle valves open fully when accelerator is fully depressed. Remove the fuel cleaner strainer from each carburetor fuel inlet, clean in dry-cleaning solvent, and reinstall.
45	45	**Manifolds (Intake and Exhaust).** Inspect accessible portions of manifolds for good condition, secure mountings, and for possible leaks.
45		TIGHTEN. On occasions when engines are removed, tighten manifold mounting and assembly nuts and cap screws securely.
46	46	**Cylinder (Heads and Gaskets).** Inspect cylinder heads for good condition and secure mounting. Note any indications of oil, coolant or compression leakage around cap screws, or gaskets. CAUTION:

75-MM HOWITZER MOTOR CARRIAGE M8

MAINTENANCE		
1000-Mile	500-Mile	
		Cylinder head cap screws should not be tightened unless there is a definite indication of looseness or leaks. If tightening is necessary, a torque-indicating wrench must be used, and screws tightened to 70-75 foot-pounds.
49	49	**Water Pumps, Fans, and Shrouds.** Observe whether or not these items are in good condition and securely mounted. See that the drive belts and pulleys are well-alined; belts not excessively worn, frayed, oil-soaked, improperly adjusted or bottoming in drive pulleys. Adjust belts to 5/8- to 3/4-inch deflection.
51	51	**Engine Compartment (Bulkhead and Control Linkage).** See that engine compartment including bulkhead is in good condition, clean and secure; and that control linkage in the engine compartment is in good condition, and securely connected and mounted.
51		CLEAN. Clean compartment as thoroughly as pospossible. Whenever engines are removed, clean out all fuel and oil drippings, dirt and refuse; swab out the engine compartment with cloths soaked in dry-cleaning solvent, and dry thoroughly.
53	53	**Fuel (Tanks, Lines, and Pumps).** Inspect accessible portion of those items for correct assembly, good condition, and secure mounting. Note whether or not there are indications of fuel leaks from tanks, lines, or pumps. Drain water and sediment from each tank by removing drain plugs and allowing fuel to drain briefly until it runs clean. Tighten the plugs and fuel tank drain hole cover securely to prevent fuel and dust leaks. CAUTION: *Catch drainings in container and use every precaution not to spill fuel. If fuel does spill, wipe up until dry before turning on the main battery switch.*
53		TIGHTEN. Tighten accessible fuel line support clips securely.
55	55	**Fuel Filters and Strainers.** Inspect engine, and fuel pump fuel filters for good condition, secure mounting and for leaks at gaskets or connections. Remove and clean strainers in dry-cleaning solvent. Inspect strainers for good condition. Clean filter bowls and reassemble units, using new gaskets.

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE		
1000-Mile	500-Mile	
56	56	**Oil Coolers (Transfer and Transmission).** Examine transfer unit oil cooler and lines and transmission coolant lines for good condition, secure attachment, and for leaks. Inspect transfer unit oil cooler to see that core is not clogged with dirt and trash; clean out foreign material.
57	57	**Exhaust Pipes and Mufflers.** Inspect for good condition, secure assembly and mounting of exhaust pipes and mufflers, and for indications of exhaust leaks.
57		TIGHTEN. Tighten all accessible mounting bolts and connections securely.
58	58	**Engine Mountings.** Inspect all engine mountings to see that they are in good condition and secure.
58		TIGHTEN. Tighten all mountings and brackets securely. When engines are removed, tighten the mount-to-engine and bracket-to-hull bolts securely.
60	60	**Fire Extinguisher System (Tank, Valve, Lines, Nozzles, and Mountings).** Inspect cylinder and valve of fire extinguisher system for good condition, secure mounting, and full charge. Full charge may be observed by presence of intact wire seal, but can be positively determined only by weighing. Examine control cables to see that they are in good condition and free to operate at a moment's notice. See that all lines and nozzles are in good condition, securely mounted and connected with nozzles properly aimed. If dirty or corroded nozzles are found, disconnect main feed line and blow out cautiously with compressed air. CAUTION: *Empty or partly empty cylinders should be reported for recharge or replacement immediately. Do not drop, strike or roughly handle extinguisher cylinder, nor expose to excessive heat.*
		SPECIAL LUBRICATION. Apply a few drops of oil to pulleys and guides through which control cables operate.
60		TIGHTEN. Tighten all assembly and mounting bolts and screws.

75-MM HOWITZER MOTOR CARRIAGE M8

MAINTENANCE		
1000-Mile	500-Mile	
61		**Engines (Install Mountings, Lines and Fittings, Wiring, Control Linkage, Oil Supply).** Reinstall removed engines according to instructions in paragraph 62. Take care to tighten mountings securely and to connect properly all fuel, oil and coolant lines, wiring and control linkage which were disconnected when engines were removed. Be sure to refill engine crankcases with specified oil.
62	62	**Radiators (Install Core, Mountings, Hose, Antifreeze, and Record).** Inspect these items for good condition, correct assembly, and for leaks. See that radiator mountings and hose and tubing connections are secure. Inspect external air passages of the cores for insects and refuse, and remove if necessary. Test value of antifreeze, if in use. Examine coolant to determine whether or not it is contaminated with rust, oil or other foreign matter to the extent that the cooling system should be cleaned. If cleaning is necessary, proceed only according to current directives, covering proper procedure and recommended cleaner neutralizer and inhibitor materials. Do not fill to top, but allow room for expansion. On radiators which are removed, perform this inspection partially while removed from the vehicle, and partially after replacement, as necessary to make the complete inspection properly. SERVE. Reinstall all removed radiators. Take care to tighten mountings and hose or tubing connections securely. Fill the cooling system afterward, adding antifreeze or inhibitor as required, and recheck the cooling system for leaks.
63	63	**Battery (Cables, Hold-downs, Battery Compartment, Record of Gravity and Voltage).** Inspect battery case for cracks and leaks. Clean top of battery. Inspect cables, terminals, bolts, posts, straps, and hold-downs for good condition. Test specific gravity and voltage and record on W.D. A.G.O. Form No. 462. Specific gravity below 1.225 indicates battery should be recharged or replaced. Electrolyte level should be above top of plates, and may extend one-half inch above plates. Replenish by adding distilled or clean water.

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE		
1000-Mile	500-Mile	
63		SERVE. Perform high rate discharge test according to instructions for "condition" test which accompany test instrument. Cell variation should not be more than 30 percent. NOTE: *Specific gravity must be above 1.225 to make this test.* CLEAN. Clean entire exterior of battery and interior of battery box. Repaint box if corroded. Clean battery terminals, terminal bolts and nuts, and battery posts, inspect bolts for serviceability, and grease lightly. Tighten terminals and hold-downs carefully to avoid damage to battery. NOTE: *Close main battery switch, and open fuel shut-off valve at this time.*
64	64	**Accelerators (Linkage and Dual-throttle Synchronization).** See that accelerators and all of their connecting linkage are in good condition and securely connected. Press the accelerators down fully to see whether the carburetor throttles open fully. Check synchronization of throttle linkage at each carburetor to see that throttle valves open and close together. Throttles should be so adjusted, that at idle speed (425 revolutions per minute) engine should not vary more than 50 revolutions per minute, and at 1000 revolutions per minute the engines should not vary more than 100 revolutions per minute. Inspect throttle-control linkage to see that it is properly adjusted.
64		ADJUST. Adjust throttle control linkage (par. 99).
65	65	**Cranking Motor, and Instruments.** Start engines, observing all precautions outlined in item 1. Note whether the general action of the cranking motor is satisfactory, particularly whether or not the cranking motor drives engage, operate properly without excessive noise, and have adequate cranking speed. Observe whether each engine starts readily. As soon as the engines start, observe whether or not all instruments operate properly, and particularly if the oil pressure gage and ammeter indications are satisfactory.
67	67	**Ignition Timing.** With engines running, determine whether or not ignition timing of each engine is correct (par. 73). Also observe whether or not

MAINTENANCE		
1000-Mile	500-Mile	
		automatic controls advance the spark as engine is accelerated gradually. When necessary, adjust ignition timing to specifications (par. 73), taking care to see that distributor is well secured when adjustment is complete. CAUTION: *Be sure that distributor timing is properly adjusted for efficient engine performance with grade of fuel being used (par. 69).*
68	68	**Regulator Unit (Connections, Voltage, Current, and Cut-out).** See that regulator units are in good condition, with mountings and connections secure.
68		Connect low-voltage-circuit tester to regulator, and observe whether or not voltage regulator, current regulator, and cut-out, control the generator output properly. Follow instructions in vehicle manual, or those which accompany test instrument. CAUTION: *Make test only after regulator has reached normal operating temperature.*
69	69	**Engine Idle.** Observe whether or not engines idle smoothly at 425 revolutions per minute.
69		ADJUST. Adjust engine mixture and throttle stop to obtain smooth operation at 425 revolutions per minute.
70	70	**Throttle Synchronization.** Depress accelerator slowly and observe whether tachometers of both engines indicate within 50 revolutions at 425 R.P.M. and within 100 revolutions at 1,000 revolutions per minute. At the conclusion of this maintenance service, allow engines to cool properly by operating at 425 revolutions per minute for 3 or 4 minutes, before stopping them.
71	71	**Fighting Compartment (Paint, Seats, Safety Straps, Crash Pads, Stowage Boxes, Ammunition Boxes, Clips and Racks).** Inspect to see that these items are in good condition, and securely assembled and mounted; that fighting compartment is clean, and paint is in satisfactory condition; that adjusting mechanisms of seats operate properly and are adequately lubricated. Pay particular attention to whether or not dividers and shell pads are all present and properly installed in ammunition boxes and racks, and that clips have sufficient tension to hold shells securely.

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE		
1000-Mile	500-Mile	
72	72	**Turret (Locks).** Inspect to see that these items are in good condition, securely assembled and mounted; that turret can be traversed easily when lock is released, and that locks operate properly.
73	73	**Periscopes.** Examine periscope prisms and windows to see that they are in good condition, clean, secure in holders, and that holders are securely mounted; that lever and locking devices operate freely and are not excessively worn; that their traversing, elevating, and locking devices are free and not excessively worn. Examine spare periscopes and their stowage boxes to see that they are in good condition, clean and secure. CAUTION: *Prisms should be cleaned with a soft cloth or brush only.*
75	75	**Brakes (Steering Levers, Linkage and Shafts).** Inspect steering brake levers, linkage and shafts to see that they are in good condition, securely mounted, properly connected and not excessively worn. Apply steering brake levers and observe whether they begin to take hold at 6 to 9 notches of travel on ratchet.
75		TIGHTEN. Tighten all assembly and mounting nuts and screws securely.
77	77	**Differential.** Examine accessible part of the differential case in driver's compartment to see that it is in good condition, that all mounting and assembly bolts and cap screws are secure; and that there are no oil leaks.
78	78	**Transmissions.** Inspect transmissions to see that they are in good condition and securely mounted, and not leaking. If an oil change is due, or condition of lubricant indicates necessity for oil change, drain and refill to correct level with specified oil.
78		ADJUST. Adjust both transmission unit bands.
79	79	**Transfer Unit (Seals and Leaks).** Inspect the transfer unit to see that it is in good condition, securely assembled and mounted. Note whether oil is leaking from the case or seals. If an oil change is due, or condition of lubricant indicate a necessity, drain and refill to correct level with specified oil.

75-MM HOWITZER MOTOR CARRIAGE M8

MAINTENANCE		
1000-Mile	500-Mile	
79		TIGHTEN. Tighten all external assembly and mounting bolts and cap screws securely. Adjust transfer unit bands.
80	80	**Transmission and Transfer Unit (Controls and Linkage).** See that control levers and linkage for these units are in good condition, correctly assembled, and securely connected and mounted. See that joints are adequately lubricated and not excessively worn.
81	81	**Propeller Shafts (Universal Joints, Alinement, and Yokes).** Inspect these items for good condition and correct and secure assembly. See that universal joints are not excessively worn. Inspect universal joints for adequate lubrication. Look for excessive leaks at seals of universal joints and at sliding joint.
81		TIGHTEN. Tighten all universal joint assembly and yoke cap screws securely.
84	84	**Compass (Fluid, and Lamp).** Examine compass to see that it is in good condition and secure; look for low level or indications of bubbles in fluid bowl. Fill fluid bowl with ethyl alcohol if needed. See that compass light and switch operate properly.
85	85	**Lamps (Lights) and Switches (Head, Tail, Blackout and Internal).** If tactical situation permits, test to see that switches and lamps operate properly. Inspect all lights for good condition and secure mounting, for broken lenses and discolored reflectors.
86	86	**Wiring (Junction and Terminal Blocks and Boxes).** Inspect to see that all exposed electrical wiring and conduits, terminal blocks and boxes are in good condition, well supported, and securely connected.
88	88	**Radio Bonding.** Inspect radio bonding and connections for good condition, cleanliness, and security. NOTE: *Any irregularities, except need for cleaning and tightening, should be reported through proper channels.*

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE		
1000-Mile	500-Mile	
		ARMAMENT
126	126	**Guns, A.A. cal. .30, 75-mm Howitzer (Mount, Traversing, and Elevating Mechanism, Firing Controls).** Inspect to see that they are in good condition, clean, well-lubricated, correctly and securely assembled, and not excessively worn. Check to see that manual and electric firing controls are in good condition and secure, paying particular attention to wiring, switches and connections. Operate each firing control, both manual and electric, to see that it functions properly. Operate hand elevating controls through entire range to see that they function properly. Traverse turret and A.A. gun by hand to see if there is any binding, and see if turret can be turned through its entire 360-degree range. See whether or not brake is effective when hand control brake latch is released. Tighten all assembly and mounting bolts and screws securely.
126		TIGHTEN. Tighten gun mounts securely. Check recoil cylinders to see that they are in good condition, and not leaking. NOTE: *Recoil operating tests must be made under firing condition in accordance with instructions in Part Three of this manual.*
126		TIGHTEN. Tighten all mounting and assembly nuts and screws securely.
128	128	**A.A. Gun and Mount.** Inspect to see that they are in good condition, clean, secure, adequately lubricated, and whether the mechanism operates freely.
128		TIGHTEN. Tighten all assembly and mounting bolts securely.
		TOOLS AND EQUIPMENT
130	130	**Tools (Vehicle Kit and Pioneer).** Check standard vehicle tools against stowage lists to see that they and pioneer tools are present, in good condition, and properly stowed or mounted. Any tools mounted on outside of vehicle, having bright or polished surfaces, should be painted or otherwise treated to prevent glare or reflections. Tools with cutting edges should be sharp and edges should be protected.

75-MM HOWITZER MOTOR CARRIAGE M8

MAINTENANCE		
1000-Mile	500-Mile	
131	131	**Equipment.** Check special equipment items against vehicle stowage list to see if they are all present, in serviceable condition, and properly stowed or mounted.
132	132	**Grousers and Spare Track Blocks.** Inspect to see if they are all present, in good condition and properly stowed or mounted.
133	133	**Spare Oil Supply (Recoil, Hydraulic, Engine).** Check to see that supply of listed spare oil is present and properly stowed. This supply should be maintained at all times.
134	134	**Decontaminator.** Examine decontaminator to see that it is in good condition, secure, and fully charged. Make latter check by removing filler plug. NOTE: *The solution must be renewed every 3 months as it deteriorates.*
135	135	**Fire Extinguisher (Portable).** Inspect to see that it is fully charged, in good condition, and securely mounted, and if seal on valve head is intact. Weigh cylinder to determine if it is fully charged.
136	136	**Publications and Form No. 26.** Check to see whether vehicle manuals, Lubrication Guide, and Accident Report Form No. 26 are present, legible, and properly stowed.
137	137	**Vehicle Lubrication.** Check lubrication of entire vehicle. On any unit where disassembly was necessary for inspection purposes, lubrication must be performed unless the vehicle is to be deadlined for repair of that unit. Lubricate all points of vehicle in accordance with instructions in vehicle manual, Lubrication Guide, current lubrication bulletins or directives, and the following instructions: Use only clean lubricant, and keep all lubricant containers covered; before applying lubricant, clean lubrication fitting or plug; replace missing or damaged fittings, lines, plugs or vents. On unsealed bushings or joints, the lubricant should be applied until it appears at openings. On units provided with lubricant retainer seals, do not force excess lubricant past seals. Drain oil from engines, transmissions, transfer unit and final drives while warm. Refill units to correct level as soon as draining is

MAINTENANCE		
1000-Mile	500-Mile	
		completed so units will not be operated without lubricant. Do not apply more than specified amount of lubricant to generator, or starter. To do so, may cause a failure of the unit. Wipe off excess lubricant that may soil clothes and equipment, or detract from the vehicle's appearance. Parts or assemblies that have been lubricated while disassembled for inspection, gear cases that have been drained and refilled as mandatory items in the procedures, and these parts which have been indicated in procedures for "special lubrication" may be omitted from the general lubrication of the vehicle.
138	138	**Modifications (Field Service Modification Work Orders Completed).** Inspect vehicle to determine that all Field Service Modification Work Orders have been properly completed.
139	139	**Final Road Test.** Make a final road test, rechecking items 2 to 15 inclusive. Recheck transmission and differential to see that lubricant is at correct level, and that there are no leaks. Confine this road test to the minimum distance necessary to make satisfactory observations. While testing vehicle operate it in a normal manner. NOTE: *Correct, or report any deficiencies found during final road test to designated authority.*

Section XII

ORGANIZATIONAL TOOLS AND EQUIPMENT

45. STANDARD TOOLS.

a. For standard tool sets used with Motor Carriage M8, refer to SNL N-19.

46. SPECIAL SERVICE TOOLS.

a. The following list contains the special tools employed by the using arms to service the vehicle, together with the Federal stock number.

75-MM HOWITZER MOTOR CARRIAGE M8

ENGINE

GAGE, valve stem length ..... (41-G-504)
GAGE, pins, set of 6, throttle controls, adj. ..... (41-G-249-50)
INSTALLER, valve lifter bracket ..... (41-I-144-250)
SLING, engine ..... (41-S-3832-70)
SLING, radiator, lifting ..... (41-S-3832-85)
WRENCH, box, dbl. end, 20° and 45°, 5/8-in. hexagonal ..... (41-W-619-600)

TRANSMISSION

GAGE, throttle, front relay ..... (41-G-426)
GAGE, throttle, intermediate relay ..... (41-G-426-20)
GAGE, transmission band, adj. low and reverse ..... (41-G-218)
GAGE, transmission pressure checking ..... (41-G-446)
WRENCH, spanner, oil cooler nut ..... (41-W-3252-75)
WRENCH, torque, 0-25 ft-lbs. trans. band adjusting.... (41-W-3629)

TRANSFER UNIT AND CONTROLLED DIFFERENTIAL

SLING, controlled differential and transfer unit ..... (41-S-3830-40)
WRENCH, brake adjusting, 1 1/16 in. ..... (41-W-642-200)
WRENCH, socket, w/out handle, dbl. sq. 5/16 in. opening, 3/8-in. sq. drive ..... (41-W-2996-150)

TRACKS AND SUSPENSION

ADAPTER, puller, hollow bogie gudgeon ..... (41-A-18-200)
ADAPTER, puller, solid bogie gudgeon ..... (41-A-18-250)
COMPRESSOR, suspension, volute spring ..... (41-C-2559-50)
COMPRESSOR, trailing idler spring, stud type .... (41-C-2555-835)
CONE, assembling, bogie wheel grease retainer..... (41C-2562-100)
CONE, assembling, track suspension roller grease retainer ..... (41-C-2562-430)
CONE, assembling, trailing idler grease retainer .... (41-C-2562-460)
FIXTURE, track conn. and link pulling, RH and LH, consisting of: Fixture, track conn. and link pulling, RH ..... (41-F-2997-86)
FIXTURE, track conn. and link pulling, LH..... (41-F-2997-389)
GUIDE, bogie wheel gudgeon ..... (41-G-2501)
LIFT, bogie wheel assembly..... (41-L-1358)
PULLER, bogie gudgeon, screw type w/out adapter (41-P-2905-63)
PULLER, slide-hammer type, bogie gudgeon .....(41-P-2957-27)
SLING, front decks, engine root and gun turret .....(41-S-3832-20)
WRENCH, box, bogie axle cap. 2 3/16 in..... (41-W-547)

WRENCH, engineers, 15° dbl. head, open-end,
$1\frac{1}{16}$- x 1¼-in. ..... (41-W-1024-5)
WRENCH, trailing idler shaft ..... (41-W-3670-950)
WRENCH, trailing idler wheel nut and track, adj.
$1\frac{1}{16}$- x 3¾-in. ..... (41-W-3673)

Section XIII

TROUBLE SHOOTING

47. GENERAL.

a. This section contains trouble shooting information and tests which can be made to help determine the causes of some of the troubles that may develop in tanks used under average climatic conditions (above 32° F). Each symptom of trouble given under the individual unit or system is followed by a list of possible causes of the trouble. The tests necessary to determine which one of the possible causes is responsible for the trouble are explained after each possible cause.

b. When trouble shooting, first turn to the subparagraph pertaining to the condition at hand, and then perform the various tests in the order listed. This is important because the tests that are easiest to perform, and conditions most likely to occur, are listed in their respective order.

48. ENGINE.

a. Cranking Motor Will Not Crank Engine.

(1) BATTERY MASTER SWITCH "OFF." Turn switch "ON."

(2) IGNITION SWITCHES OFF. Turn switches "ON." Starter solenoid circuit passes through ignition switches, so these switches must be "ON".

(3) BATTERY DISCHARGED. Test battery with voltmeter. If voltage reading is below 12 volts, test with hydrometer. Specific gravity should be at least 1.225. If battery will not take a charge readily, replace it.

(4) ENGINE OR TRANSMISSION SEIZED. Try to turn engine by hand, using hand crank on late type vehicles, or opening engine compartment rear doors on earlier vehicles, and using a one-inch wrench on the crankshaft pulley mounting screw. If engine will not turn, notify higher authority.

(5) BATTERY MASTER SWITCH INOPERATIVE. Test master switch according to procedure given in paragraph 125 **c**. Replace if defective.

(6) FAULTY WIRING IN STARTER CIRCUIT. Test and correct wiring according to procedure given in paragraph 125 **b**.

(7) DEFECTIVE SOLENOID, SWITCH, OR STARTER. If wiring tests indicate that trouble lies in these units, replace complete starter assembly.

b. Engine Cranks, But Will Not Start.

(1) SLOW CRANKING SPEED. Check for wrong grade of engine oil. Check battery state of charge, connections and ground strap. Replace starter.

(2) AUTOMATIC CHOKE NOT "ON". This condition may occur if accelerator is not depressed before attempting to start. Simply press accelerator one-quarter of full travel; then try again to start engine.

(3) FUEL LINES SHUT OFF. Open lines at filter. Use fuel from right-hand tank first.

(4) FUEL SUPPLY EXHAUSTED. Replenish fuel supply.

(5) CARBURETOR FLOODED. A flooded condition may occur after repeated cranking. Usually one engine starts and the other does not. If flooded condition is suspected, hold accelerator open while cranking engines (par. 10 **e**.).

(6) INOPERATIVE IGNITION SYSTEM. Working through bulkhead door, remove ignition wire from one spark plug and hold terminal ¼-inch from cylinder head. Turn on ignition and crank engine. If strong, blue-white spark jumps gap, ignition is satisfactory. If no spark appears, or spark is weak or red, proceed with tests in paragraph 9.

(7) INOPERATIVE FUEL SYSTEM. Check fuel pump output by loosening carburetor line at fuel pump and cranking engine. If fuel does not flow freely, proceed with tests in paragraph 51 **a**.

(8) CARBURETOR OPERATING IMPROPERLY. See paragraph 51 **b**.

c. Engine stops.

(1) BREAK IN IGNITION SYSTEM. Check all ignition wires and connections for looseness or breaks. Tighten, repair or replace as necessary. See paragraph 49.

(2) INOPERATIVE FUEL SYSTEM. Check all fuel pipes and connections for breaks and clogging, and reconnect, clean or repair as required (par. 51 a.)

d. Engine Operates Unevenly.

(1) IGNITION SYSTEM OPERATING IMPROPERLY. Check for inadequate ignition (par. 49).

(2) CARBURETOR OPERATING IMPROPERLY. Check carburetor adjustment and condition (par. 51 b).

(3) ENGINES NOT SYNCHRONIZED. Check tachometers for differences in engine speed, and readjust throttle linkage if required (par. 99).

(4) LEAKING INTAKE MANIFOLD OR CYLINDER HEAD GASKETS. Listen for air leaks, and test for leaks by applying light engine oil to suspected areas. Tighten or replace affected gaskets.

(5) VALVES STICKING, WARPED OR BURNED. Check compression pressure. Normal pressure is 116-121 pounds at cranking speed. If pressures vary considerably, or if all cylinders are low, notify higher authority.

(6) PISTONS, RINGS OR CYLINDERS WORN. Check compression pressure. If pressures vary considerably, or if all cylinders are low, notify higher authority.

e. Engine Overheats.

(1) LOW LEVEL OF COOLANT. Check level of coolant, and fill to correct level with water or antifreeze. Also check system thoroughly to determine cause of coolant loss (par. 50).

(2) MECHANICAL FAILURE IN COOLING SYSTEM. Check thoroughly as outlined in paragraph 50.

(3) IGNITION TIMING LATE. Check and reset ignition timing (par. 73).

(4) ENGINE OIL LEVEL LOW. Check oil supply, and add to the correct level.

f. Engine Operates Noisily.

(1) LIGHT KNOCK OR PING ON ACCELERATION. Check and reset ignition timing (par. 73). Remove cylinder heads and clean carbon.

(2) CLICKING NOISES SYNCHRONIZING WITH CAMSHAFT SPEED. Disassemble and clean valve lifter assemblies, or replace lifters. Blow out oil feed line to lifters.

(3) HIGH-PITCHED SQUEALS. Inspect fan, generator and distributor for under-lubricated or frozen bearings. Lubricate or replace unit, as required.

(4) HEAVY KNOCKS SYNCHRONIZED WITH CRANKSHAFT SPEED. Main or connecting rod bearings are burned out. Notify higher authority.

g. Engine Oil Pressure Low.

(1) LOW OIL LEVEL. Check oil supply and add oil to the correct level.

(2) OIL WORN OUT OR INCORRECT GRADE. Check log book entries for mileage of last oil change and oil used. Refill with correct seasonal grade of engine oil, Spec. 2-104A.

(3) BROKEN LINE TO VALVE LIFTERS. Inspect oil line from front of crankcase to valve lifters and replace if cracked or broken. Replenish oil.

(4) OIL GAGE DEFECTIVE. Check operation of electrical gage, preferably by substituting a mechanical gage. Install new electric gage (engine unit and instrument panel unit) if necessary.

49. IGNITION SYSTEM.

a. No Spark in One Cylinder.

(1) SPARK PLUG WIRING FAULTY. Make visual inspection of wiring to determine if wet, disconnected, broken, or shorted. Dry off, reconnect, repair, or replace as required. Check current to plug by cranking engine with wire disconnected, and terminal held ¼ inch from cylinder head. If no spark jumps, wiring is shorted or broken, and must be replaced.

(2) SPARK PLUG FAULTY. If strong spark jumps with above test, fault is in plug. Remove plug and inspect for cracks, broken electrodes, fouling, or incorrect gap. Clean, readjust, or replace as required.

b. No Spark to Any Cylinders.

(1) DISTRIBUTOR CAP FAULTY. Inspect distributor cap for loose mounting, moisture, dirt, or cracked or burned condition, and dry off, clean, or replace as necessary.

(2) WIRING DEFECTIVE. Inspect high-tension wire and low-tension wire from distributor to coil, coil to filter (on vehicles so equipped) and back through feed circuit (fig. 48). Use test procedures given in paragraph 125.

(3) CONTACT POINTS INOPERATIVE. Remove distributor cap and seal, and inspect contact points for gap, burnt condition and spring tension. Service or replace in accordance with instructions in paragraph 69.

(4) DEFECTIVE COIL OR CONDENSER. Check coil and condenser with instruments or by substitution, and replace one or both units as required.

50. COOLING SYSTEM.

a. Loss of Coolant.

(1) HOSE CONNECTION LEAK. Tighten connections or replace with latest type. Replace hoses, if necessary.

(2) LEAKAGE AT RADIATOR. Remove radiator and repair or replace.

(3) LEAKAGE OR LOSS OF SEAL AT RADIATOR CAP. Replace cap or gasket.

(4) LEAKAGE AT THERMOSTAT HOUSING. Replace housing gasket and tighten securely.

(5) LEAKAGE AT WATER PUMP. Replace pump gasket, and tighten as required. If leakage is at packings, notify higher authority.

(6) LEAKS AT TRANSMISSION WATER PIPE. Tighten connections or replace.

(7) LEAKS AT CYLINDER HEADS. Retighten head screws to 65-70 foot-pounds with torque wrench, or replace head gasket and retighten.

b. Engine Overheats.

(1) LOW LEVEL OF COOLANT. See paragraph 50 a, above.

(2) FAN BELTS LOOSE OR BROKEN. Readjust or replace.

(3) RADIATOR CORE AIR PASSAGES CLOGGED. Open engine compartment covers, clean cores by lifting out any large pieces of debris, and blow out with compressed air.

(4) RADIATOR THERMOSTAT STICKING. Replace thermostat (par. 84).

(5) LOW OIL SUPPLY. Check oil supply and add oil to the correct level.

(6) DISTRIBUTOR TIMING LATE. Check timing and adjust, if necessary (par. 73).

(7) NO WATER CIRCULATION. See subparagraph c, below.

c. No Water Circulation.

(1) WATER PUMP BELT LOOSE OR BROKEN. Readjust or replace.

(2) WATER PUMP IMPELLER SHEARED OR CORRODED. Replace pump or notify higher authority.

(3) COOLING SYSTEM BADLY CLOGGED. Flush system thoroughly.

51. FUEL SYSTEM.

a. Fuel Does Not Reach Carburetor.

(1) FUEL LINES SHUT OFF. Open valves at fuel filter.

(2) FUEL SUPPLY EXHAUSTED. Replenish fuel supply.

(3) FUEL PUMP STRAINER CLOGGED. Remove bowl, clean strainer screen and reinstall (par. 92).

(4) FUEL FILTER CLOGGED OR LEAKING. Clean filter, tighten lines, or replace filter, as required.

(5) FUEL LINES CLOGGED OR LEAKING. Inspect lines, and clean, tighten or replace as necessary.

(6) FUEL PUMP DEFECTIVE. If previous measures do not correct condition, replace fuel pump, if replacement pump is available, or notify higher authority.

b. Carburetor not Operating Properly.

(1) CARBURETOR CHOKE HOUSING OUT OF ADJUSTMENT. Reset choke housing to indicator mark and tighten carefully.

(2) CARBURETOR CHOKE STICKING. Free up by working lever on end of choke shaft. Notify higher authority if condition persists.

(3) CARBURETOR OUT OF ADJUSTMENT. Readjust carburetor (par. 91).

(4) CARBURETOR DIRTY, CLOGGED OR WORN. Replace carburetor.

52. TRANSMISSION.

a. Lubricant Leakage.

(1) LEAK AT DRAIN PLUG. Replace gasket; if necessary, replace plug.

(2) LEAK AT OIL PAN. Tighten attaching screws and nuts. If necessary, replace gasket.

(3) LEAK AT FLUID COUPLING. Notify higher authority.

b. Transmission Fails to Transmit Power.

(1) MANUAL CONTROL LINKAGE IMPROPERLY ADJUSTED. If engine speeds up and fails to drive vehicle, particularly when selector lever is in "LO" position, first check adjustment of manual linkage by moving lever midway between quadrant positions and accelerating. If this permits vehicle to move, readjust manual linkage (par. 98).

(2) MANUAL VALVE PIN DISENGAGED. Move selector lever to "LO", pause, and then firmly move into reverse. If severe clashing results, or if selector lever goes into reverse but vehicle locks up and fails to move backward, then pick-up pin is not operating manual valve. Remove transmission side cover and engage pin in manual valve.

(3) TRANSMISSION FRONT AND REAR BANDS LOOSE. Check and readjust both transmission bands (par. 97).

c. Transmission Shift Speeds Abnormal.

(1) ALL SHIFTS OCCUR AT EXCESSIVELY HIGH OR LOW ENGINE SPEEDS. Readjust throttle linkage to provide correct shift points (par. 99).

(2) ENGINE SPEEDS UP IN FIRST, THIRD, AND REVERSE. Front band out of adjustment. Readjust front band (par. 97).

(3) ENGINE SPEEDS UP IN FIRST AND SECOND. Rear band out of adjustment. Readjust rear band (par. 97).

(4) ALL SHIFTS ABOVE SECOND OCCUR AT EXCESS ENGINE SPEEDS. Manual control linkage improperly adjusted. Readjust manual linkage (par. 98).

d. One or Both Transmissions Jump Out of Reverse.

(1) MANUAL CONTROL LINKAGE. Manual control linkage improperly adjusted. Readjust manual linkage (par. 98).

e. Vehicle Creeps.

(1) ENGINE IDLING SPEED EXCESSIVE. Readjust carburetor to bring engine idling speed down to 425 revolutions per minute.

(2) THROTTLE LINKAGE STICKING OPEN. Eliminate binds in throttle linkage. Replace missing or weak throttle return springs.

53. PROPELLER SHAFT.

a. Vibration at Universal Joints.

(1) WORN NEEDLE BEARINGS. Replace universal joints (par. 104).

(2) RUNOUT AT JOINT YOKES. Replace yoke assembly.

b. Heavy Thumps on Rough Terrain.

(1) FROZEN SLIP JOINT. Replace propeller shaft (par. 103).

c. High Pitched Squeal.

(1) NO LUBRICANT IN UNIVERSAL JOINTS. Disassemble and lubricate, or replace universal joints.

d. Oil Leakage at Universal Joint.

(1) DEFECTIVE OIL SEALS. Replace universal joints (par. 104).

e. Oil Leakage at Propeller Shaft.

(1) DEFECTIVE DUST CAP. Replace propeller shaft (par. 103).

f. Click in Propeller Shaft.

(1) WORN SPLINES IN SLIP JOINT. Replace propeller shaft (par. 103).

54. TRANSFER UNIT AND CONTROLLED DIFFERENTIAL.

a. Transfer Unit Slips.

(1) IMPROPERLY ADJUSTED LOW GEAR BAND. If engines race in first, second, third and fourth speeds, low gear band or both bands are out of adjustment. Readjust bands (par. 110). Notify higher authority if condition is not corrected.

(2) IMPROPERLY ADJUSTED REVERSE BAND. If engines race in reverse, reverse band is out of adjustment. Readjust reverse band and check adjustment of low gear band. Notify higher authority if condition is not corrected.

(3) STICKING VALVE BODY. If transfer unit operates satisfactorily on pull, but slips when using engines as a brake, valve body is sticking. Replace valve body (par. 106).

b. Transfer Unit Shifts at Wrong Speeds.

(1) IMPROPERLY ADJUSTED THROTTLE LINKAGE. Readjust throttle linkage (par. 99).

(2) STICKING VALVE BODY. If throttle linkage adjustment does not correct condition, replace valve body.

(3) STICKING GOVERNOR. If linkage and valve body does not correct condition, governor is sticking. Notify higher authority.

c. Transfer Unit Does Not Respond to Control Lever.

(1) CONTROL LEVER DISENGAGED. Remove pipe plug from valve body to see if manual control valve is engaged with button on control lever. If not, remove valve body cover and engage manual control valve with lever (par. 106).

d. Differential or Transfer Unit Overheats.

(1) OIL LEVEL LOW. Add oil to proper level.

(2) OIL COOLER AIR PASSAGES CLOGGED. Clean oil cooler passages thoroughly with hose.

(3) STEERING BRAKES DRAGGING. Readjust steering brakes (par. 108).

(4) TRANSFER UNIT BANDS DRAGGING. Readjust transfer unit bands (par. 110).

(5) TRANSFER UNIT CLUTCH SEIZED. Notify higher authority.

(6) TRANSFER UNIT SERVO PISTON STUCK. Notify higher authority.

e. Vehicle Hard to Steer and Stop.

(1) STEERING BRAKES OUT OF ADJUSTMENT. Readjust bands.

(2) STEERING BRAKE LININGS WORN OUT. Replace brake shoes.

(3) STEERING BRAKE LININGS GLAZED. Replace brake shoes.

f. Steering Brakes Require Frequent Adjustment.

(1) INCORRECT USE OF BRAKES. Observe driving instructions (par. 11).

(2) BRAKE RIM ROUGHENED. Notify higher authority.

55. TRACKS AND SUSPENSION.

a. Bogie Wheel Tire Wear.

(1) TRACK CONNECTOR BENT, BROKEN OR MISSING. Replace connector (par. 119).

(2) DEAD TRACK SHOE. Replace track shoe.

(3) DAMAGED TRACK. Replace track (par. 119).

(4) MUD COLLECTING IN TRACK BETWEEN END CONNECTIONS. Remove mud from connectors.

(5) WORN GUDGEON BUSHINGS IN BOGIE WHEEL ARMS. Replace bogie assembly (par. 122).

b. Volute Spring Breakage.

(1) WORN GUDGEONS. Replace gudgeons (par. 122).

(2) WEAK SPRINGS. Replace both springs (par. 121).

(3) BROKEN OR CRACKED SPRING SEATS. Replace spring seats (par. 121).

(4) SEIZED LEVER BUSHINGS. Replace bushings.

c. Thrown Tracks.

(1) IMPROPER TRACK TENSION. Adjust track tension (par. 118).

(2) ROCK BETWEEN TRACK AND IDLER. Clean out.

(3) MISALINEMENT OF IDLER WHEEL. Tighten bracket bolts.

d. Inoperative Track Supporting Rollers.

(1) MUD BETWEEN ROLLERS AND TRACK. Remove mud.

(2) BEARINGS SEIZED. Replace roller assembly (par. 123).

(3) INSUFFICIENT LUBRICATION. Lubricate roller periodically (par. 35).

e. Inoperative Idler Wheel.

(1) INSUFFICIENT LUBRICATION. Lubricate bearings periodically (par. 35).

56. ELECTRICAL SYSTEM.

a. Inasmuch as electrical system trouble shooting and test procedures are closely related to the actual corrective work, these procedures are covered in paragraph 125 of the electrical section of this manual.

57. LIGHTING SYSTEM.

a. Trouble shooting and test procedures on the lighting system are included with electrical trouble shooting in paragraph 125.

58. TRAVERSING MECHANISM.

a. Damaged Gear Box Assembly. Replace complete assembly.

b. Damaged Turret Traversing Ring Gear. Replace ring gear.

c. Excessive Backlash. Reshim and adjust backlash.

75-MM HOWITZER MOTOR CARRIAGE M8

Section XIV

ENGINE

59. DESCRIPTION AND TABULATED DATA.

a. Description.

(1) These vehicles are powered with two 90-degree, V-type, 8-cylinder engines, mounted side by side in the engine compartment in the rear of the hull.

(2) The fan end of these engines is regarded as the front end, even though it faces the rear of the vehicle, and the flywheel end is considered the rear end. The right and left sides of each engine (and transmission) are determined by standing at the transmission and looking toward the fan end. Right- and left-hand engines in the vehicle, however, are designated according to their relation to the front of the vehicle. The engine on the right of the hull is the right-hand engine. Engine supports, cushions, and attaching brackets and bolts are considered with reference to their position in the hull rather than their relation to the engine. Thus, the support under the transmission is designated as the engine front support, although it attaches to the rear of the engine, and the two supports at the crankcase are the engine rear supports.

(3) The cylinder blocks and crankcase, made in one casting of gray iron, support the crankshaft and camshaft, and enclose the reciprocating parts. Cylinder heads are also of cast iron.

(4) Cylinders (fig. 54) are arranged in two banks of four each, located 90 degrees apart. Opposite connecting rod assemblies operate side by side on the same crankshaft throw.

(5) The fan, water pump, generator, and fuel pump are accessible through the engine compartment doors in the rear of the hull. The carburetor and manifolds, located on top of the engine, are also accessible through these doors. The distributor is accessible through the bulkhead doors.

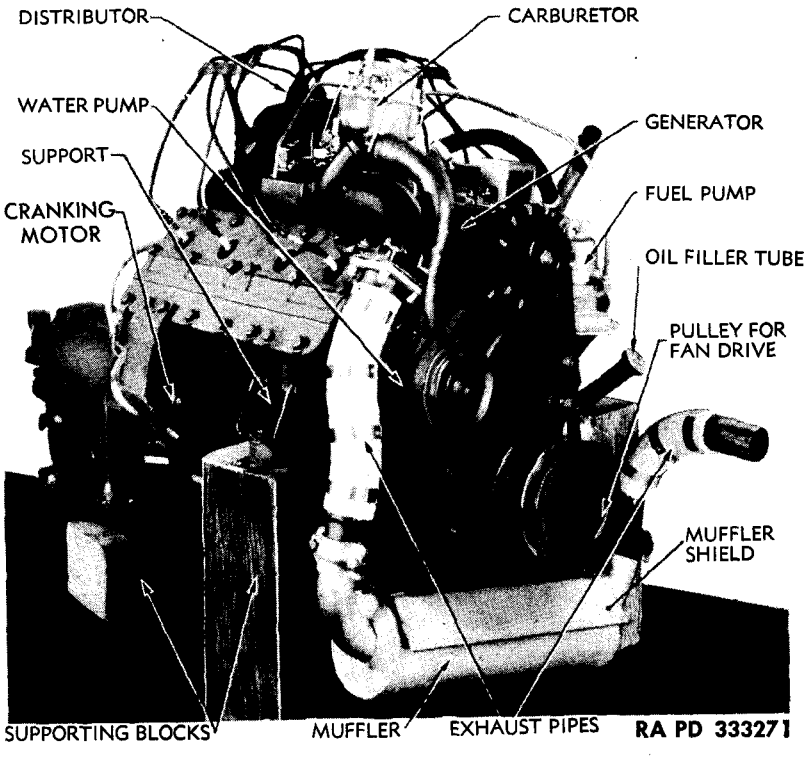


Figure 24 — Engine — Right Front View

(6) To guard against piston breakage when low octane fuel is used or when ignition timing is incorrectly adjusted, a strengthened piston is incorporated in the engine.

b. Tabulated Data.

Bore and stroke	3½ x 4½ in.
Compression ratio	7.06 to 1
Cylinder numbering	Refer to figure 54
Engine make	Cadillac
Engine supports, number of	3
Firing order	1, 8, 7, 3, 6, 5, 4, 2 (fig. 55)
Horsepower, net installed (each)	110 @ 3400 rpm
Piston displacement (each)	346 cu in.
Valve arrangement	L-head

60. ENGINE TUNE-UP.

a. Interval. The engines in this vehicle should be given a tune-up as a part of each 1000-mile inspection operation.

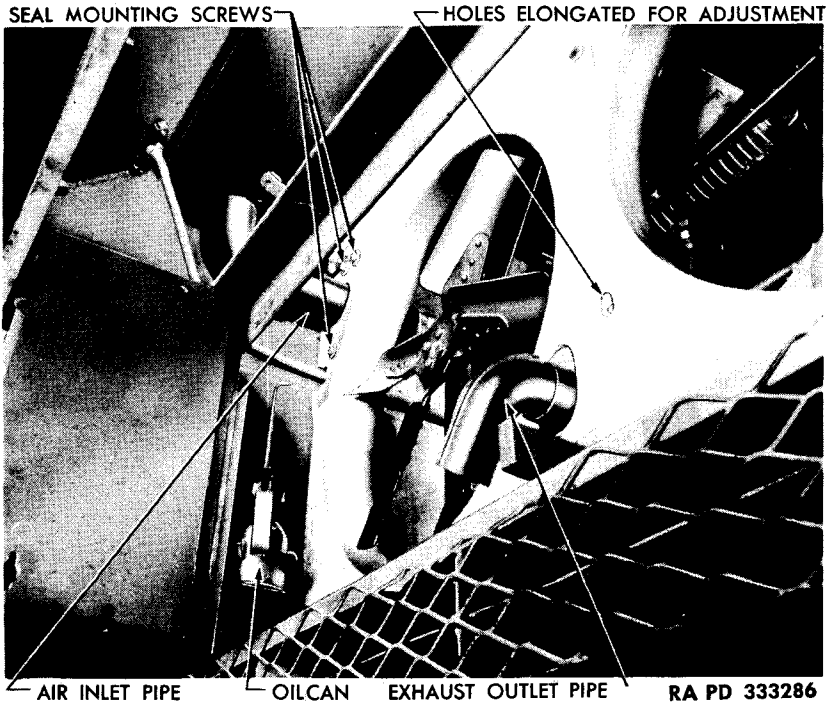


Figure 25 — Fan Shroud Mountings

b. Procedure. The tune-up procedure should include the following operations:

(1) SERVICE SPARK PLUGS. Remove, clean, inspect, regap and reinstall spark plugs (par. 74).

(2) SERVICE DISTRIBUTOR CONTACT POINTS. Remove distributor from engine. Inspect contact points and clean, file and readjust or replace as required. Reinstall distributor (par. 69).

(3) RETIME IGNITION. Check ignition timing, using detailed procedure given in paragraph 73.

(4) ADJUST CARBURETOR. Adjust carburetor idling speed and idling mixture (par. 91).

(5) CHECK BELTS. Check adjustment of fan and water pump and generator belts and readjust if necessary (par. 78).

61. ENGINE REMOVAL.

a. Equipment. The special tools required to remove the engine assembly from the vehicle are as follows:

GAGE, pins, throttle control adjusting (41-G-249-50)

GAGE, throttle intermediate relay (41-G-426-20)

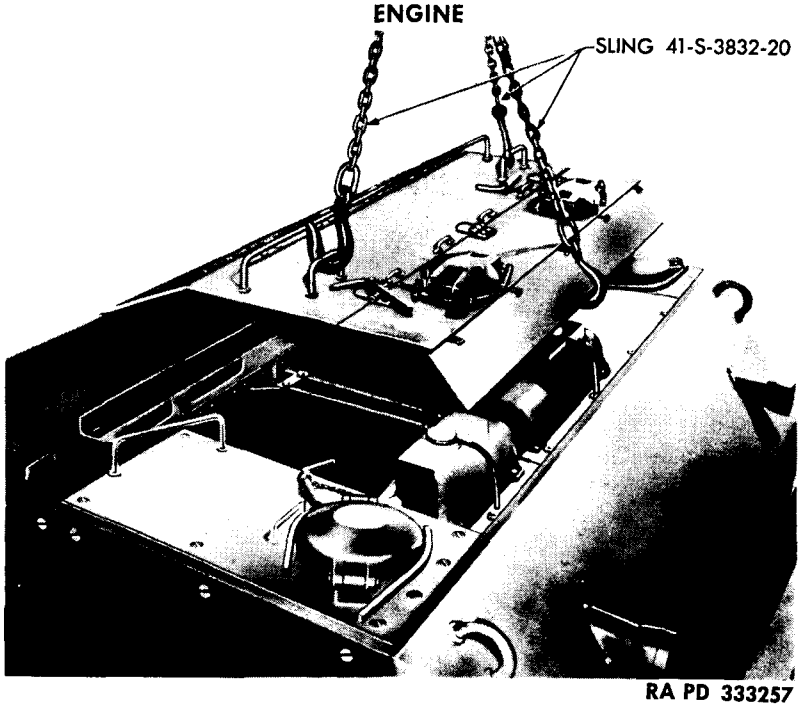


Figure 26 — Removing Engine Compartment Cover

SLING, engine (41-S-3832-70)
SLING, front deck, engine roof and turret (41-S-3832-20)
SLING, radiator-lifting (41-S-3832-85)

b. Procedure. CAUTION: *Before proceeding with this work, make sure that the master battery switch, located on the apparatus box on the left wall of the fighting compartment, is turned to the "OFF" position and that the fuel valve is closed.*

(1) OPEN ENGINE COMPARTMENT REAR DOORS. Remove center screw in engine compartment doors (late-type vehicle) so that deflector can be swung up and hooked over clip on rear hood. Remove remaining six screws and open doors. On the early type M8, which has no deflectors, it is necessary only to remove the seven cap screws and open doors.

(2) REMOVE FAN SHROUDS (early type M8). Loosen clamp bolts to disconnect exhaust outlet pipes and remove the pipes. Remove three screws from the seal around each carburetor intake pipe, and slide seals toward the rear. Remove screws from fan shrouds (fig. 25) and remove shrouds.

(3) REMOVE FAN SHROUDS (late type M8). Loosen clamp bolts to disconnect exhaust outlet pipes and remove pipes. Remove three

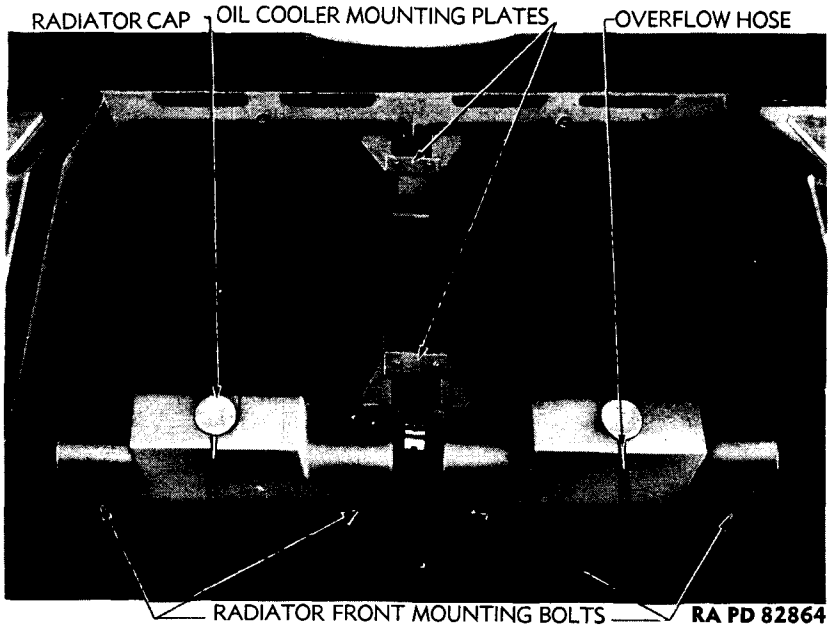


Figure 27 — Radiator and Oil Cooler Mounting

screws from seal around each carburetor intake pipe, and slide seals toward the rear. Loosen clamp and disconnect crankcase ventilator line. Remove four screws from brace holding oil-bath type air cleaners, and remove air cleaners and brace. Remove screws from fan shrouds and remove shrouds. NOTE: *Left-hand shroud can be removed without removing right-hand shroud by taking out only five of the screws, but right-hand shroud cannot be removed without removing left-hand shroud.*

(4) REMOVE ENGINE FAN, FAN BELT, AND BRACKET. Remove two nuts from fan bracket mounting studs, and remove fan, fan belt, and bracket (fig. 63).

(5) DRAIN COOLING SYSTEM. Remove small cover plate from opening in bottom of hull underneath transmission by removing four cap screws and lock washers. Remove water drain plug (fig. 22) from bottom of transmission, and remove the two plugs from the front of the crankcase by reaching through engine compartment doors. Remove radiator cap to speed drainage.

(6) REMOVE ENGINE COMPARTMENT COVER. Index turret 90 degrees from straight-ahead position. Remove five screws holding grille to engine compartment cover, and remove grille. Take out nine cover mounting screws. Attach sling (41-S-3832-70) (fig. 26) and lift engine compartment cover.

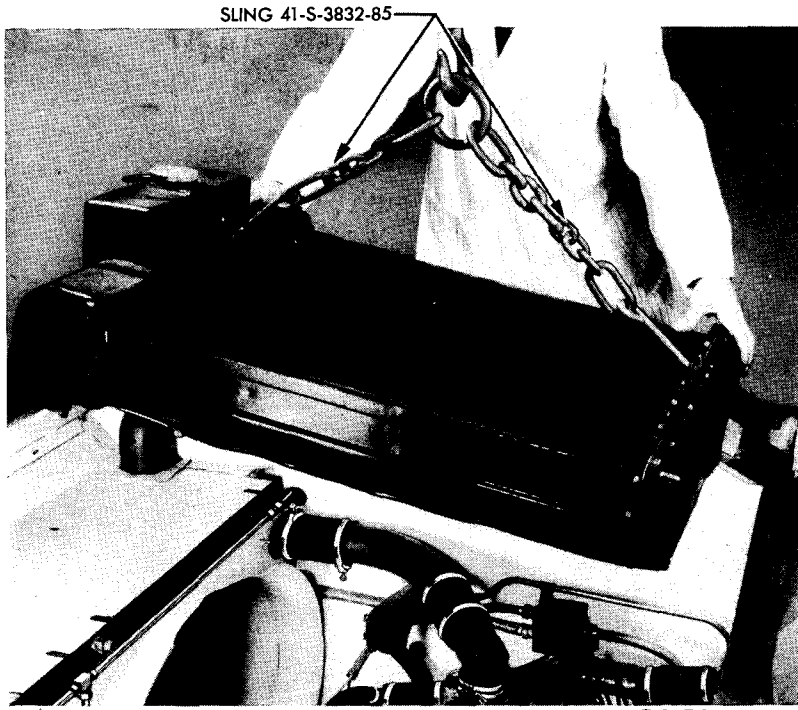


Figure 28 — Removing Radiator

(7) REMOVE BULKHEAD DOORS AND EXTENSION COVERS. Remove four screws and lock washers holding each 75-mm ammunition rack to fighting compartment walls and bulkhead, and remove ammunition rack. Rotate bulkhead door latches, tilt doors forward at top, and lift off hinges. Remove four screws and washers holding bulkhead extension cover to bulkhead and extension. Pry cover upward at front end and remove from vehicle.

(8) REMOVE RADIATOR HOSES (fig. 58). Disconnect the two radiator inlet hoses at the radiator thermostat housing and at the cylinder head outlet elbows, and remove hoses. Disconnect radiator outlet hose at radiator elbow and water pump inlet hose at pump; remove hoses complete with radiator-to-engine tube.

(9) REMOVE RADIATORS. Remove four screws from bottom of radiators at front, reaching through bulkhead doors. Remove four screws holding radiators to rear support (fig. 27). Remove four nuts supporting transfer unit oil cooler. Remove oil cooler mounting plates, and lower cooler until it rests on engines. Hook sling (41-S-3832-85) into sling holes in radiator and remove radiator (fig. 28).

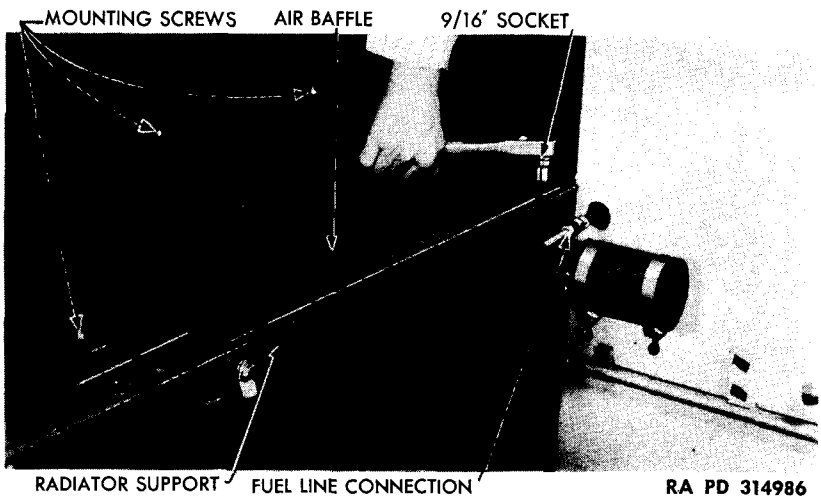


Figure 29 — Air Baffle and Fuel Line

(10) REMOVE TRANSFER UNIT OIL COOLER. Working through bulkhead doors, disconnect oil cooler hoses from connectors, and remove oil cooler from top of vehicle.

(11) REMOVE RADIATOR SUPPORT AND AIR BAFFLE. Disconnect fuel lines at fuel pumps. Disconnect fuel supply line where it passes through left engine compartment sidewall (fig. 29). Remove 10 screws from outer edges of air baffle, two self-tapping screws from center of baffle, and remove baffle. Remove two screws from ends of radiator support; remove support with fuel line attached.

(12) REMOVE REAR FIRE EXTINGUISHER NOZZLES. Unscrew pipe from fire extinguisher nozzle. Remove two screws holding brackets and nozzles to hull wall, and remove brackets and nozzles.

(13) DISCONNECT ELECTRICAL WIRING. Remove nut holding wire to oil pressure gage, and lift off wire. Remove nut holding wire to engine temperature gage, and lift off wire. Disconnect wires to engine oil pressure and heat signal units. Remove screws holding wires to generator filter (if used) or to generator, and lift off wires. Working through engine compartment doors, remove nut holding cranking motor feed cable and jumper cable to cranking motor on right-hand engine. Disconnect conduit for right-hand cranking motor relay at center junction box by unscrewing coupling nut. Disconnect conduit for left-hand cranking motor relay at outlet box on left-hand sidewall. Disconnect coil primary wire from distributor filter (if used) or distributor, and disconnect coil secondary wire from coil.

(14) DISCONNECT TACHOMETER CABLE. Disconnect tachometer cable at distributor support housing by unscrewing coupling.

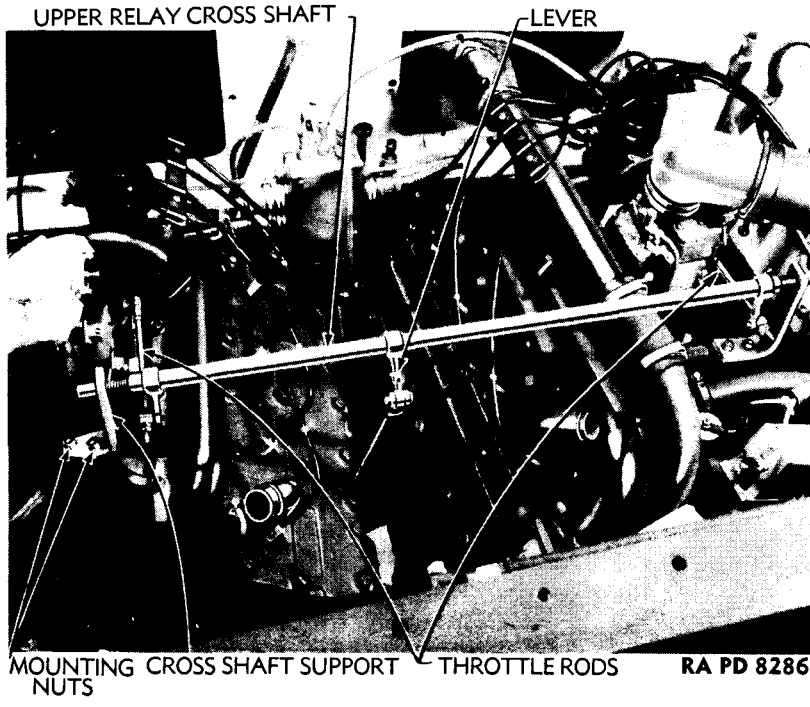


Figure 30 — Upper Relay Cross Shaft

(15) REMOVE CARBURETOR AIR INTAKE PIPE. Remove three screws that hold carburetor air intake pipe to engine compartment sidewall. Disconnect intake pipe at carburetor by loosening lower clamp. Disconnect choke stove intake line at both ends. Remove intake line.

(16) DISCONNECT TRANSMISSION CONTROL LINKAGE. Working from underneath vehicle, with cover plate under transmission removed, insert gage (41-G-426-20) over two intermediate relay cross shafts between manual lever and throttle lever. Insert gage pin (41-G-249-50) through curved manual lever and into hole in gage. Insert another gage pin (41-G-249-50) through straight throttle lever and into hole in gage plate. Disconnect transmission manual control rod from lever on transmission by removing cotter and clevis pins.

(17) REMOVE UPPER REAR RELAY CROSS SHAFT. Remove clevis pin from lever on center of relay cross shaft (fig. 30). Disconnect throttle rods at cross shaft levers. Remove four nuts from two relay cross shaft supports and remove shaft and supports as a unit. NOTE: *Do not lose springs from ends of cross shaft.*

(18) REMOVE PROPELLER SHAFT COVERS. Working in fighting compartment, loosen two screws on top, and remove two screws on side

75-MM HOWITZER MOTOR CARRIAGE M8

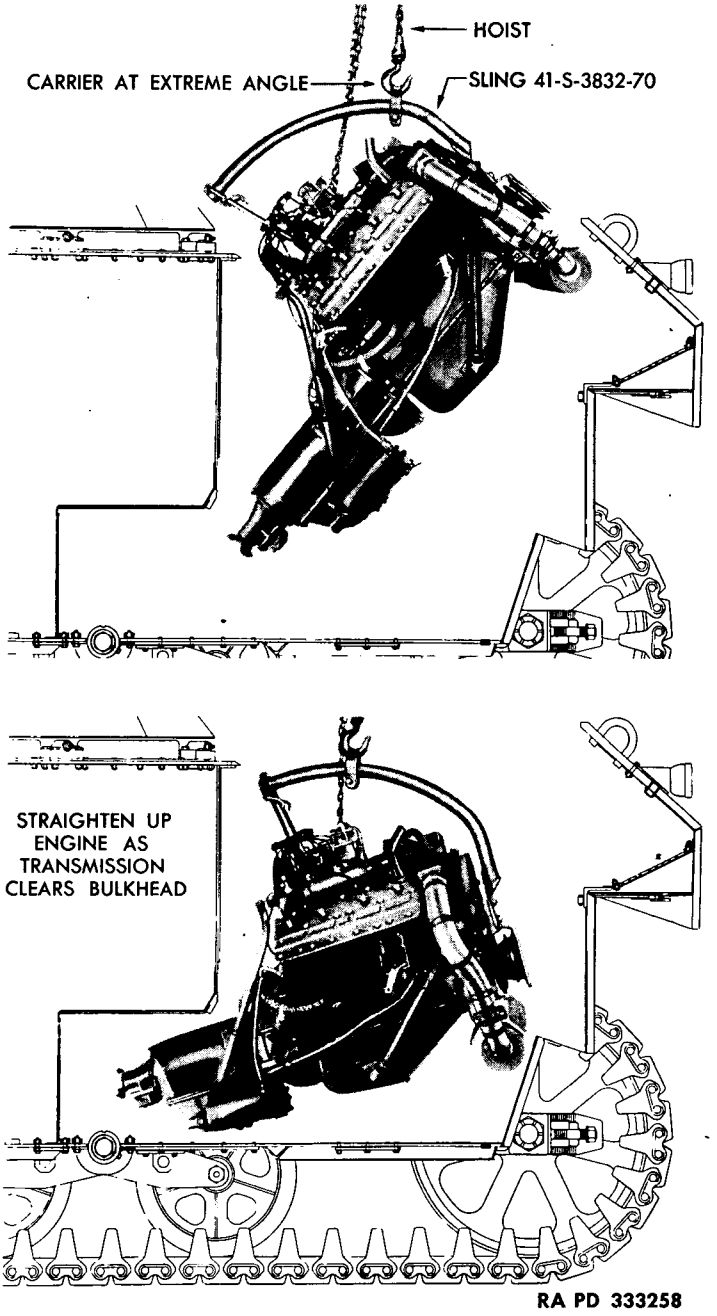


Figure 31 — Removing and Installing Engine

of propeller shaft housing cover. Slide cover toward outside of vehicle and remove. Remove six screws on propeller shaft housing outer wall, and remove wall.

(19) DISCONNECT PROPELLER SHAFT. Bend back locking plate, and remove screws that hold universal joint caps to yoke on rear end of transmission. Slide propeller shaft toward front of vehicle, compressing the slip joint.

(20) DISCONNECT ENGINE FRONT SUPPORT. Working in fighting compartment, remove two mounting screws from engine front support bracket beneath transmission.

(21) DISCONNECT ENGINE REAR SUPPORTS. Remove two bolts and nuts from bottom of each engine rear support. Disconnect screw holding ground strap to support bracket. NOTE: *Leave rubber cushions attached to engine.*

(22) INSTALL SLING ON ENGINE. Connect sling traveler to a hoist and lift engine sling (41-S-3832-70) into position over engine. Hook rear end of sling under exhaust manifold connection. Install front end of sling over fan support mounting studs on engine front cover, and install both fan support nuts and lock washers.

(23) REMOVE ENGINE FROM VEHICLE. Lift engine slightly until engine supports clear dowel pins on center engine support mounting bracket. Move engine toward rear of vehicle; raise front end, and lift engine from vehicle (fig. 31). Lower it onto a suitable engine stand and remove the sling. CAUTION: *Make sure that distributor cap does not strike edge of hull roof; that transmission filler pipe does not interfere with transfer unit oil cooler pipes; and that muffler does not strike lower edge of engine compartment door opening. Keep all wires and conduits as far back as possible. Keep engine toward sidewall rather than center of engine compartment.*

62. ENGINE INSTALLATION.

a. Equipment. The special tools required to install the engine assembly in the vehicle are as follows:
GAGE PINS, throttle control adjusting (41-G-249-50)
GAGE, throttle intermediate relay (41-G-426-20)
SLING, engine (41-S-3832-70)
SLING, front deck, engine roof and turret (41-S-3832-20)
SLING, radiator-lifting (41-S-3832-85)

b. Procedure.

(1) INSTALL SLING ON ENGINE. Connect sling traveler to hoist and lift sling (41-S-3832-70) into position over engine. Hook rear end of sling under exhaust manifold connection, and install front end over fan support mounting studs on engine front cover. Install both fan support mounting stud nuts and lock washers.

(2) INSTALL ENGINE IN VEHICLE. Index turret 90 degrees from straight-ahead position. Install two engine front support screws loosely in support on transmission extension housing. Lift engine into position over vehicle slightly to rear of engine compartment. Make sure that throttle rod from lower rear relay is swung backward so that upper end is next to engine compartment rear door opening. Lower transmission end of engine as much as possible until traveler is at extreme front of sling (fig. 31). Lower engine into engine compartment until universal joint yoke is even with center of engine compartment bulkhead opening. CAUTION: *Be certain that the throttle lever on side of transmission cover is not bent or out of alinement. Watch distributor cap to make sure that it does not strike edge of hull roof. Make sure transmission filler pipe does not interfere with transfer unit oil cooler pipes, and that muffler does not strike lower edge of engine compartment door opening. Keep all wires and conduits as far back on engine compartment wall as possible, and keep engine toward sidewall rather than toward center of engine compartment.*

(3) POSITION ENGINE ON ENGINE SUPPORTS. Continue lowering engine slowly, and begin to straighten it. Move it forward in vehicle by pulling on universal joint yoke through bulkhead opening. Line up engine front support screws on transmission extension housing with slots on engine support in fighting compartment, and pull engine forward until screws begin to enter slots. Line up engine support bracket with dowels on engine rear support and lower engine until support brackets engage dowels on support. Continue lowering engine until support brackets are resting on supports.

(4) CONNECT ENGINE SUPPORTS. Install two nuts and screws on each engine rear support and draw up fingertight. Tighten two engine front support mounting screws to bracket on hull floor beneath transmission. Tighten four nuts and bolts on engine rear supports.

(5) REMOVE SLING FROM ENGINE. Lower sling until hook on rear end can be disconnected from exhaust pipe connection. Remove the two fan support mounting stud nuts, and lift sling from vehicle. CAUTION: *Hold lower end of sling as it is being raised from vehicle to prevent its swinging and damaging spark plugs and other engine parts.*

(6) CONNECT PROPELLER SHAFT. Slide propeller shaft toward rear of vehicle until universal joint bearing housings aline with yoke on transmission. Install a new universal joint mounting screw lock plate on each joint housing, and install two screws to hold each housing to the yoke on rear of transmission. Bend locking plates up over mounting screws with a chisel and a light hammer.

(7) INSTALL PROPELLER SHAFT COVERS. Position propeller shaft housing outer wall in place and install six mounting screws. Position propeller shaft housing cover in place, install two outside screws, and tighten two top screws on cover.

(8) INSTALL AND CONNECT UPPER REAR RELAY CROSS SHAFT. Position upper rear relay cross shaft and lever assembly on intake manifold of both engines. Make sure springs are in place. Install two nuts and lock washers holding each relay shaft support to engine manifold.

(9) CONNECT AND ADJUST TRANSMISSION MANUAL CONTROL LINKAGE. Disconnect control rod that extends from transmission selector lever to intermediate relay at bottom of selector lever. Disconnect rod to transfer unit reverse servo at selector lever. Make sure that gage (41-G-426-20) and gage pins (41-G-249-50) are in place at intermediate relay levers. Move manual control lever on transmission into reverse position (all the way toward front of vehicle), making sure that reverse anchor is fully engaged. If necessary, adjust length of rod from intermediate relay to manual lever by loosening trunnion lock nut and rotating trunnion with pliers until clevis pin will enter hole in lever. Install clevis pin and cotter pin, and tighten clevis lock nut.

(10) CONNECT SELECTOR LEVER RODS. Move transmission selector lever to reverse position, and adjust length of rod from selector lever to intermediate relay by rotating clevis until pin will enter lower end of selector lever. Connect rod to selector lever and tighten clevis lock nut. Move selector lever as far past reverse position as it will go, and, while holding it in that position, adjust length of rod to reverse servo, so that when clevis is inserted, the stop on the reverse servo release lever just contacts the stop on the body. Remove gage pins and gage plate from intermediate relay.

(11) CONNECT AND ADJUST THROTTLE LINKAGE. Insert short gage pin (41-G-249-50) through hole in distributor relay lever and into pin hole in distributor support housing. Insert long gage pin through left-hand upper rear relay cross shaft bracket and lever. Check to see that carburetor throttle stop screw is against stop on carburetor body, and in slow idling position. Working from underneath vehicle, pull throttle valve lever on transmission side cover as far as possible toward front of vehicle. Check to see whether trunnion on throttle rod from bell housing relay will enter throttle valve lever freely. Adjust trunnion by rotating it until it will enter lever. Connect throttle rod to lever and install cotter pin. Adjust carburetor throttle rods so that they will enter the levers on the relay cross shafts, and install in levers. Remove gage pin from distributor support housing, and from upper rear relay support and lever.

(12) INSTALL CARBURETOR AIR INTAKE PIPE. Use a new gasket and position carburetor air intake pipe on mounting boss on sidewall and on top of carburetor. Install three screws and lock washers holding intake pipe to sidewall. Tighten clamps holding intake pipe to carburetor. Install carburetor choke stove intake line.

(13) CONNECT ELECTRICAL WIRING. Connect oil pressure unit wire to unit, and install retaining nut. Connect wire to engine temperature indicator, and install retaining nut. Connect wire to engine oil pressure and heat signal units. Connect wires to generator filter or to generator armature terminal if no filter is used, and install retaining screws. Connect cranking motor feed cable to cranking motor. NOTE: *Feed cable and jumper cable are always disconnected at cranking motor on right-hand engine.* Working through bulkhead doors, connect cranking motor relay conduit to junction box. Conduit for left-hand cranking motor connects at left junction box; for right-hand cranking motor, at center junction box. Connect coil primary and secondary wires to distributor.

(14) CONNECT TACHOMETER CABLE. Connect tachometer cable at distributor support housing.

(15) INSTALL REAR FIRE EXTINGUISHER NOZZLE. Install rear fire extinguisher nozzles and mounting brackets on engine compartment sidewalls by means of two screws and lock washers. Connect fire extinguisher pipes to nozzles.

(16) INSTALL RADIATOR SUPPORT AND AIR BAFFLE. Position radiator support, with fuel lines attached, in rear of engine compartment. Install two bolts holding ends to engine compartment sidewalls. Connect fuel lines to fuel pumps on both engines. Connect fuel line on radiator support to fuel supply line at left engine compartment sidewall. Position radiator air baffle on radiator support and install ten screws on outer edges and two self-tapping screws in center of air baffle.

(17) INSTALL TRANSFER UNIT OIL COOLER. Position transfer unit oil cooler between engines, and connect long hose at rear connector to cooler. Connect short transfer unit oil cooler hose at connector nearest bulkhead. NOTE: *Transfer unit oil cooler cannot be tightened in position until radiators have been installed.*

(18) INSTALL RADIATORS. Connect sling (41-S-3832-85) to one radiator, and place in hoist. Swing radiator over engine compartment, and lower into place on radiator support at rear and on radiator mounting brackets at front. Install two screws and lock washers holding radiator to mounting brackets at front, and two screws holding radiator to rear support. Remove sling and hoist from radiator. Repeat this procedure to install the other radiator. Position transfer unit oil cooler mounting plates between radiators, and tighten oil

cooler mounting nuts fingertight. Raise transfer unit oil cooler into position on mounting plates and tighten four nuts.

(19) CONNECT RADIATOR HOSES. Install water pump connecting tube and hoses on radiator outlet elbow and water inlet elbow. Tighten hose clamps on each end of assembly. Install cylinder head to radiator hoses and tighten hose clamps.

(20) INSTALL BULKHEAD DOORS AND EXTENSION COVERS. Position bulkhead doors on hinges, close doors, and rotate latch to hold in closed position. Place bulkhead extension cover on bulkhead extension, and fasten in place with four screws and lock washers. Place 75-mm ammunition racks in position, and fasten each in place with four screws and lock washers.

(21) INSTALL ENGINE COMPARTMENT COVER. Apply sealing compound liberally to cover attaching flanges. Hook sling (41-S-3832-20) under handles on engine compartment cover, and connect hoist to sling. Lift cover into position on vehicle and install nine mounting screws. Position grille on cover, and fasten with five mounting screws.

(22) FILL COOLING SYSTEM. Install water drain plug in bottom of transmission. Install cover plate under transmission. Install two drain plugs in front of crankcase. Fill both cooling systems with proper coolant. Capacity is 35 quarts for each cooling system.

(23) INSTALL FAN, FAN BRACKET, AND FAN BELT. Position fan and fan bracket on mounting studs, and install two fan bracket mounting stud nuts and lock washers fingertight. CAUTION: *Master battery switch must be off while working on fan.* Slip fan belt over fan pulley and crankshaft pulley, and adjust fan belt tension by raising or lowering fan support until there is $\frac{5}{8}$- to $\frac{3}{4}$-inch slack when measured by pressing inward on belt midway between fan pulley and crankshaft pulley (fig. 60). Tighten two fan support mounting stud nuts.

(24) INSTALL FAN SHROUDS. Position fan shrouds on rear of engine compartment and install screws and lock washers (fig. 25). Position plate around carburetor air inlet pipe, and install three screws. Center fan shrouds around fans. Connect exhaust outlet pipes to mufflers, and tighten clamps. Position oil-bath type crankcase ventilator air cleaner braces (late type M8) on fan shrouds, install four screws, and connect ventilator line to air cleaner. Close engine compartment doors; lubricate and install six screws, leaving center screw out. Swing deflector into place and install remaining screw. NOTE: *Early type M8's were not equipped with deflectors.* Install seven screws after closing doors.

63. CYLINDER HEADS AND GASKETS.

a. General. The cylinder heads mounted toward the center line of the vehicle can be removed and installed while the engines are in the vehicle. The two cylinder heads toward the engine compartment outer wall should not be removed unless the engines are out of the vehicle, as it is impossible to install them with correct mounting screw tension while the engines are in the vehicle.

b. Removal.

(1) OPEN ENGINE COMPARTMENT REAR DOORS. Refer to paragraph 61 **b.**

(2) DRAIN COOLING SYSTEM PARTIALLY. Drain cooling system of engine from which head is to be removed below the cylinder head level by removing the two drain plugs in the front face of the crankcase.

(3) REMOVE LEFT FAN SHROUD. Disconnect left exhaust outlet pipe and remove pipe. Remove three screws from the seal around carburetor intake pipe, and slide seal toward rear. Remove two screws on oil bath type crankcase ventilator air cleaner (late type M8), disconnect ventilator line, and remove cleaner. Remove screws from the left fan shroud and remove shroud.

(4) REMOVE FANS. Refer to paragraph 61 **b** (4).

(5) REMOVE CYLINDER HEAD HOSE. Disconnect cylinder head-to-radiator hose at cylinder head elbow, and remove hose from elbow.

(6) DISCONNECT RELAY ROD. Remove clevis pin from lever on center of upper relay cross shaft, and remove rod from lower relay to upper cross shaft back out of way.

(7) REMOVE SPARK PLUGS. Disconnect spark plug wires from suppressors and remove suppressors from spark plugs. Remove spark plugs and take out spark plug gaskets.

(8) REMOVE TEMPERATURE GAGE. Remove nut holding wire to engine temperature gage or signal unit (if used) and disconnect wire. Remove gage or unit from cylinder head.

(9) REMOVE WATER OUTLET ELBOW. Remove two screws holding water outlet elbow to cylinder head and remove elbow and gasket.

(10) REMOVE CYLINDER HEAD. Remove crankcase air cleaner and tube (early M8) on left engine. Remove remaining screws that hold cylinder head to engine, and remove head and gasket. CAUTION: *Be sure to support head so that it will not slide off block after last screw has been removed.*

c. Installation.

(1) INSTALL CYLINDER HEADS ON BLOCK. Coat a new cylinder head gasket with joint and thread compound, and position on cylinder head, making sure that holes line up. Place cylinder head on

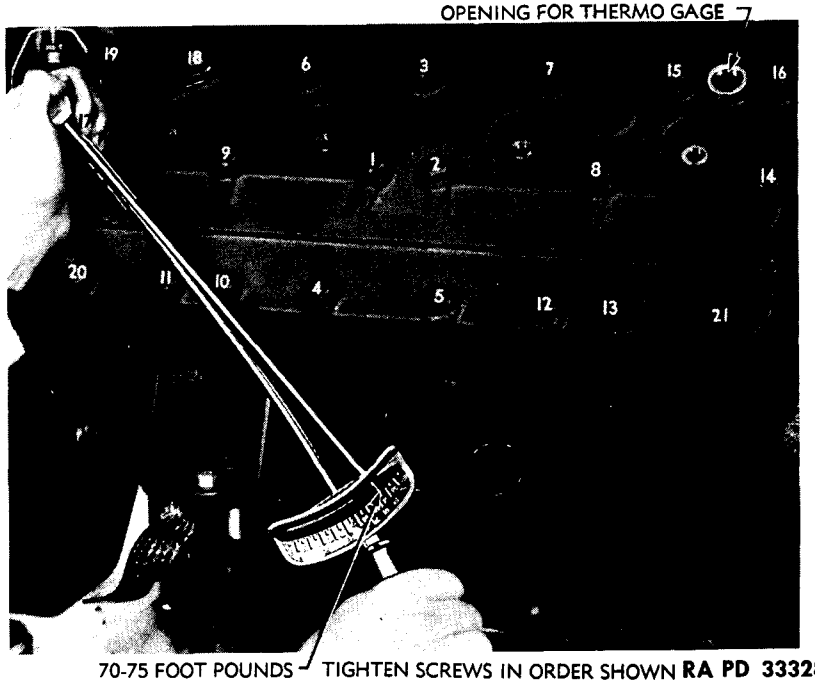


Figure 32 — Tightening Cylinder Head Screws

block and install mounting screws fingertight. Install crankcase air cleaner and tube (early M8) on left engine.

(2) INSTALL OUTLET ELBOW. Coat a new water outlet elbow gasket with joint and thread compound, and position gasket on mounting bolts on cylinder head. Position elbow on gasket and install mounting screws fingertight. CAUTION: *The mounting screws for the water outlet elbows are longer than other cylinder head screws and have 3/4-inch heads. Do not install these long screws anywhere else on cylinder heads, otherwise the cylinder block will be damaged.*

(3) TIGHTEN CYLINDER HEAD SCREWS. Using torque wrench (41-W-3630), tighten cylinder head mounting screws to 70-75 foot-pounds. CAUTION: *Cylinder head screws must be tightened evenly and in the order shown (fig. 32) to avoid injury to cylinder blocks.*

(4) INSTALL ENGINE TEMPERATURE GAGE. Install engine temperature gage on upper rear corner of left cylinder head, and tighten securely. Install temperature signal unit (if used) on right cylinder head. CAUTION: *Do not use gasket paste on temperature gage.* Connect temperature gage wire and tighten retaining nut.

(5) INSTALL SPARK PLUGS. Position new spark plug gasket on spark plugs. Install spark plugs and gaskets on cylinder heads, tight-

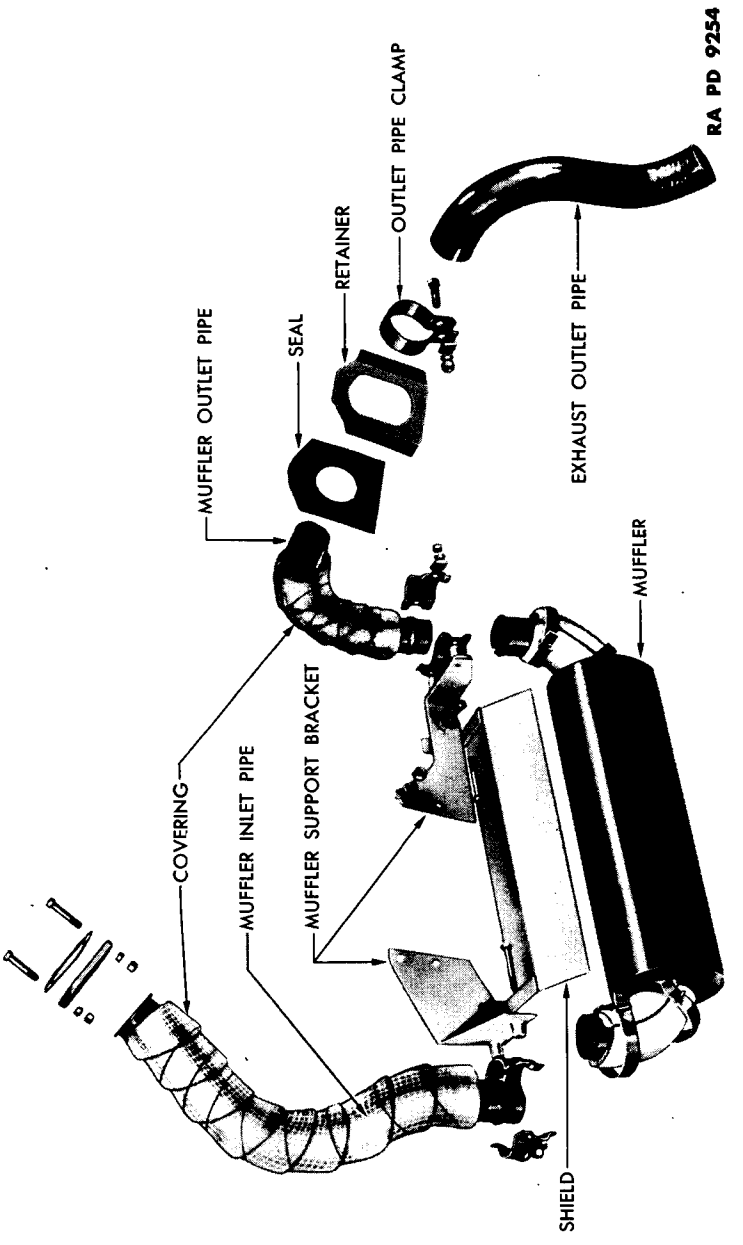


Figure 33 — Exhaust System Disassembled

ening plugs only enough to secure a good gasket seal. Install suppressors and connect spark plug wires.

(6) CONNECT RELAY ROD. Connect rod that extends from lower rear relay to upper rear relay at lever on upper relay, inserting clevis in lever and installing a new cotter pin.

(7) CONNECT CYLINDER HEAD HOSE. Connect cylinder head-to-radiator hose at cylinder head elbow. Tighten hose clamps securely.

(8) INSTALL FANS AND LEFT FAN SHROUD. Refer to paragraph 62 **b** (23) and (24).

(9) REFILL COOLING SYSTEM. Install the two drain plugs in the front of the engine crankcase. Add coolant as required to bring the cooling system up to the correct level.

(10) CLOSE ENGINE COMPARTMENT REAR DOORS. Refer to paragraph 62 **b** (24).

64. EXHAUST PIPES AND MUFFLER.

a. General. The exhaust system, consisting of the exhaust manifolds, manifold connection, muffler and exhaust pipes can be removed while the engine is in the vehicle. The removal of the exhaust manifolds and manifold connection is covered in paragraph 65. CAUTION: *Before proceeding with the removal of the exhaust pipes and muffler, make sure that the master battery switch on the left wall of the fighting compartment is turned to the "OFF" position.*

b. Removal.

(1) REMOVE FAN SHROUDS AND FANS. Open engine compartment rear doors and remove fan shrouds. NOTE: *If only the left-hand muffler is being removed, only the left-hand fan shroud need be removed. If the right-hand muffler is being removed, however, both fan shrouds must be removed.* Remove engine fan, fan belt, and fan bracket. NOTE: *Only the fan, fan belt, and fan bracket on the engine on which the muffler is being serviced need be removed.*

(2) REMOVE WATER PUMP ON LEFT ENGINE. If muffler on left engine is being removed, the water pump on that engine must be removed. Remove water pump as explained in paragraph 85.

(3) REMOVE FAN PULLEY. Remove fan pulley from end of crankshaft by removing mounting screw.

(4) REMOVE MUFFLER AND EXHAUST PIPES. Remove deflector from muffler by taking out two mounting screws (fig. 33). Remove four nuts and screws that hold the muffler inlet pipe to exhaust manifold flange. Remove four nuts that hold exhaust system mounting brackets to studs on crankcase. Lift muffler and pipe assembly from engine.

c. Installation.

(1) INSTALL MUFFLER AND EXHAUST PIPES. Position muffler and pipe assembly on front of engine so that studs on crankcase enter holes in support brackets. Using torque wrench, install nut on each of the four support bracket studs and tighten to 25-30 foot-pounds. Place a new gasket between flanges on exhaust manifold and muffler inlet pipe, and attach manifold and pipe by means of four screws and eight nuts. Position shield and muffler and fasten in place with two screws.

(2) INSTALL FAN PULLEY. Position fan pulley on end of crankshaft, install mounting screw, and tighten securely.

(3) INSTALL WATER PUMP ON LEFT ENGINE. If water pump on left engine was removed to service muffler on that engine, reinstall water pump as explained in paragraph 85.

(4) INSTALL FAN, FAN SHROUDS, AND CLOSE ENGINE COMPARTMENT REAR DOORS. See paragraph 62 b.

65. MANIFOLDS AND GASKETS.

a. General. The intake manifold, exhaust manifolds, exhaust manifold connection and gaskets can be replaced while the engine is in the vehicle. CAUTION: *Before proceeding with the removal of the intake and exhaust manifold assemblies, make sure that the master battery switch on the left wall of the fighting compartment is turned to the "OFF" position.*

b. Removal.

(1) REMOVE FAN SHROUDS AND FANS. Open engine compartment rear doors and remove fan shrouds. NOTE: *If the manifolds on left engine are being removed, only left-hand fan shroud need be removed. If the manifolds on right engine are being removed, however, both fan shrouds must be removed.* Remove engine fan, fan belt, and fan bracket from the engine on which the manifolds are being serviced.

(2) REMOVE UPPER REAR RELAY CROSS SHAFT. See paragraph 61 b (17).

(3) REMOVE GENERATOR FILTER (early M8). Remove wires from generator filter and remove filter by taking out four screws.

(4) REMOVE CARBURETOR. Remove carburetor in accordance with procedure given in paragraph 91.

(5) REMOVE EXHAUST MANIFOLDS AND CROSSOVER. Remove exhaust manifold crossover and gaskets by taking out four screws (fig. 34). NOTE: *Spark plug wire supports come off with this connection.* Disconnect exhaust manifold from muffler inlet pipe. Remove gasket. Remove eight nuts holding exhaust manifold clamps to

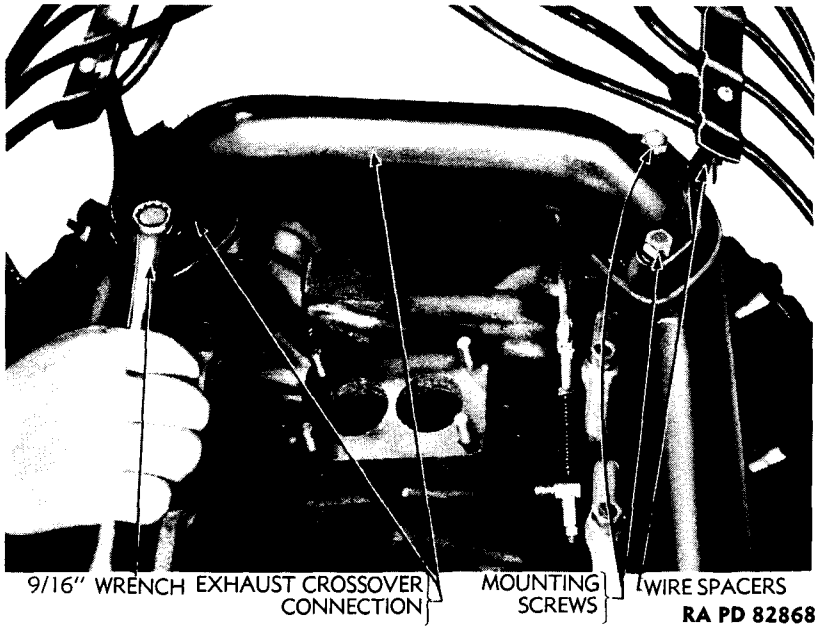


Figure 34 — Removing Exhaust Manifold Crossover

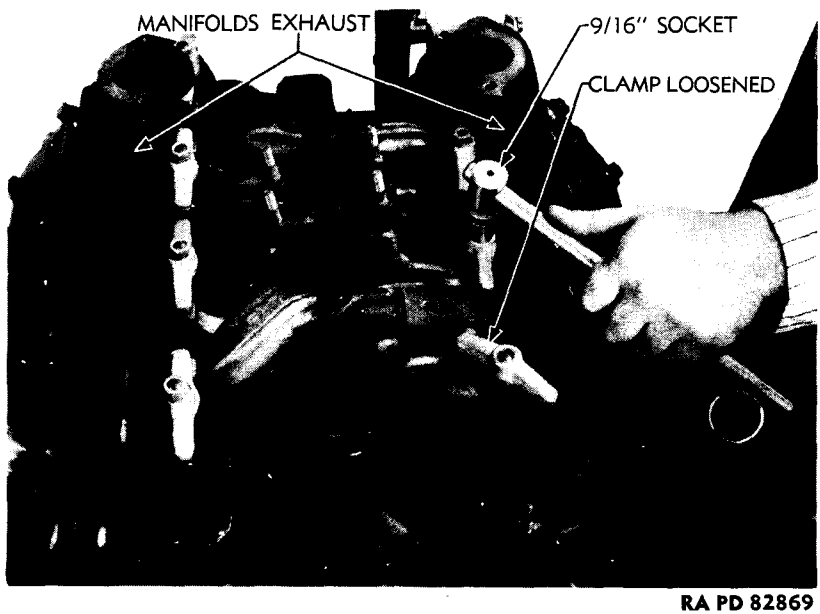


Figure 35 — Removing Exhaust Manifolds

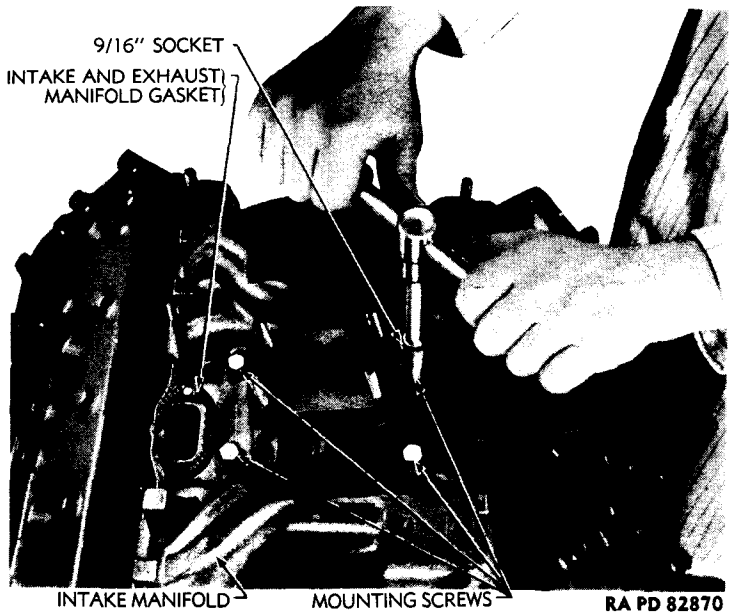


Figure 36 — Removing Intake Manifolds

cylinder assembly. Remove clamps and exhaust manifolds. Disconnect choke stove lines on manifold (fig. 35).

(6) REMOVE INTAKE MANIFOLD. Remove four screws holding intake manifold to crankcase and remove intake manifold, and intake and exhaust manifold gaskets.

c. Installation.

(1) INSTALL INTAKE AND EXHAUST MANIFOLD GASKETS AND INTAKE MANIFOLD. Position two new intake and exhaust manifold gaskets on crankcase. Position intake manifold over gaskets and install four screws. Using torque wrench, tighten screws to 25 to 30 foot-pounds.

(2) INSTALL EXHAUST MANIFOLDS AND MANIFOLD CONNECTIONS. Position both exhaust manifolds on gaskets and install intake and exhaust manifold clamps and clamp nuts. Using torque wrench, tighten nuts to 25 to 30 foot-pounds. Install two new exhaust manifold crossover gaskets on exhaust manifolds and install exhaust manifold cross over and four mounting screws. Using torque wrench, tighten screws to 25 to 30 foot-pounds. Connect exhaust manifold to muffler inlet pipe. Install choke stove lines.

(3) INSTALL CARBURETOR. Install carburetor as explained in paragraph 91.

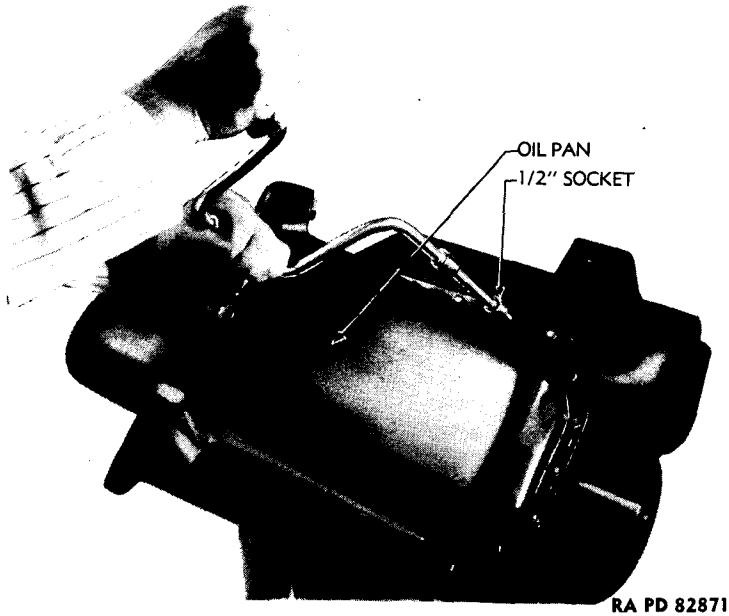


Figure 37 — Removing Oil Pan

(4) INSTALL GENERATOR FILTER (early M8). Position generator filter on generator, and install four screws and lock washers. Connect wires to generator filter.

(5) INSTALL UPPER REAR RELAY CROSS SHAFT. Slide end of upper rear relay cross shaft through mounting bracket on intake manifold. NOTE: *Make sure spring is on end of cross shaft before installing in bracket.* Position mounting bracket on opposite end of cross shaft, making sure spring is in position on end of cross shaft. Install mounting bracket on studs on intake manifold and install two mounting nuts and lock washers. Connect rod from upper rear relay to lower rear relay at upper rear relay by installing clevis pin, flat washer, and cotter pin. Connect throttle rods to upper rear relay. Adjust throttle linkage as explained in paragraph 62 **b** (11).

(6) INSTALL FAN AND FAN SHROUDS. Install fan, fan belt, and fan bracket; adjust fan belt. Install fan shrouds and close engine compartment rear doors.

66. OIL PAN AND GASKET.

a. General. The engine must be out of the vehicle in order to replace the oil pan and gasket, except on late type M8 vehicles, on which an access plate in the hull floor is provided. This plate should be removed, or the engine removed from the vehicle and mounted in a suitable disassembly stand.

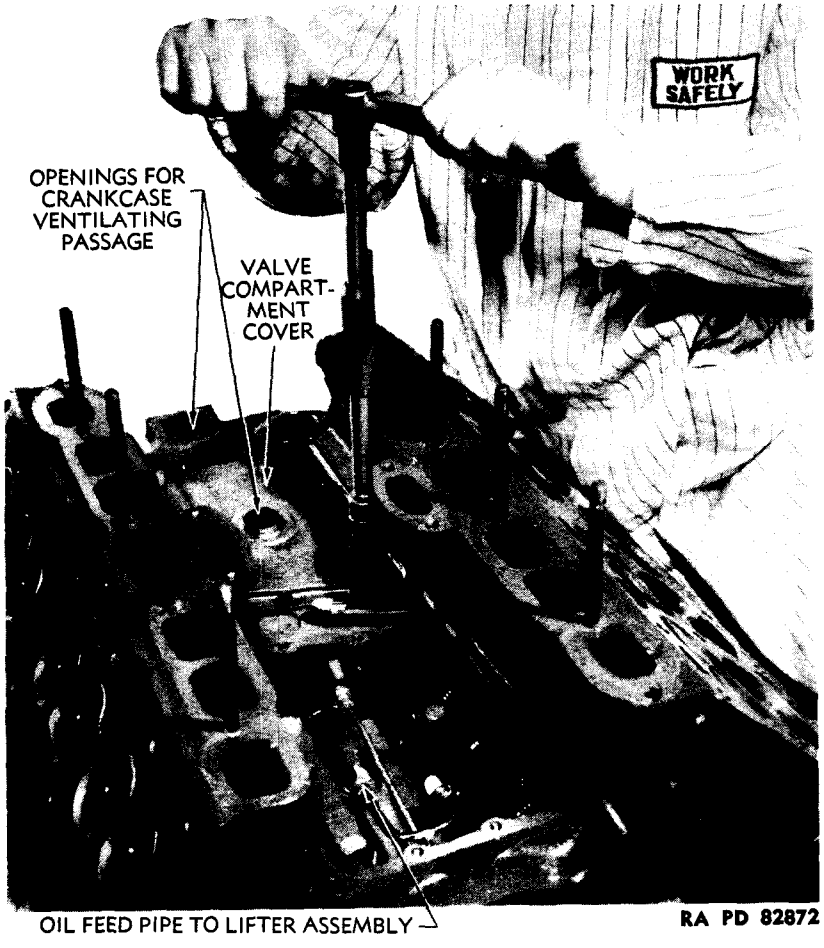


Figure 38 — Removing Valve Compartment Covers

b. Remove Oil Pan and Gasket. Drain oil, and remove screws holding oil pan to crankcase and rear main bearing cap (fig. 37). Remove oil pan and gasket.

c. Install Oil Pan and Gasket. Install a new oil pan gasket on bottom of crankcase. Position oil pan on gasket, and install 25 screws holding oil pan to crankcase and front cover. Add 8 quarts of seasonal grade engine oil and install engine in vehicle, or install access plate on hull floor.

67. VALVE SPRINGS AND VALVE LIFTERS.

a. General. The hydraulic valve lifters may be removed from the engine while the engine is in the vehicle. The engine must, however, be out of the vehicle to replace the valve springs.

Figure 39 — Removing Oil Feed Lines

b. Valve Lifter Removal (Engine in Vehicle).

(1) REMOVE FAN SHROUDS AND FANS. Open engine compartment rear doors and remove fan shrouds. NOTE: *If the hydraulic valve lifters on left-hand engine are being removed, only the left-hand fan shroud should be removed. If the hydraulic valve lifters on right-hand engine are being removed, however, both fan shrouds must be removed.* Remove engine fan, fan belt, and fan bracket from the engine on which the valve lifters are being serviced.

(2) REMOVE GENERATOR. Remove generator as explained in paragraph 88.

(3) REMOVE CARBURETOR AND MANIFOLDS. See paragraphs 65 and 91.

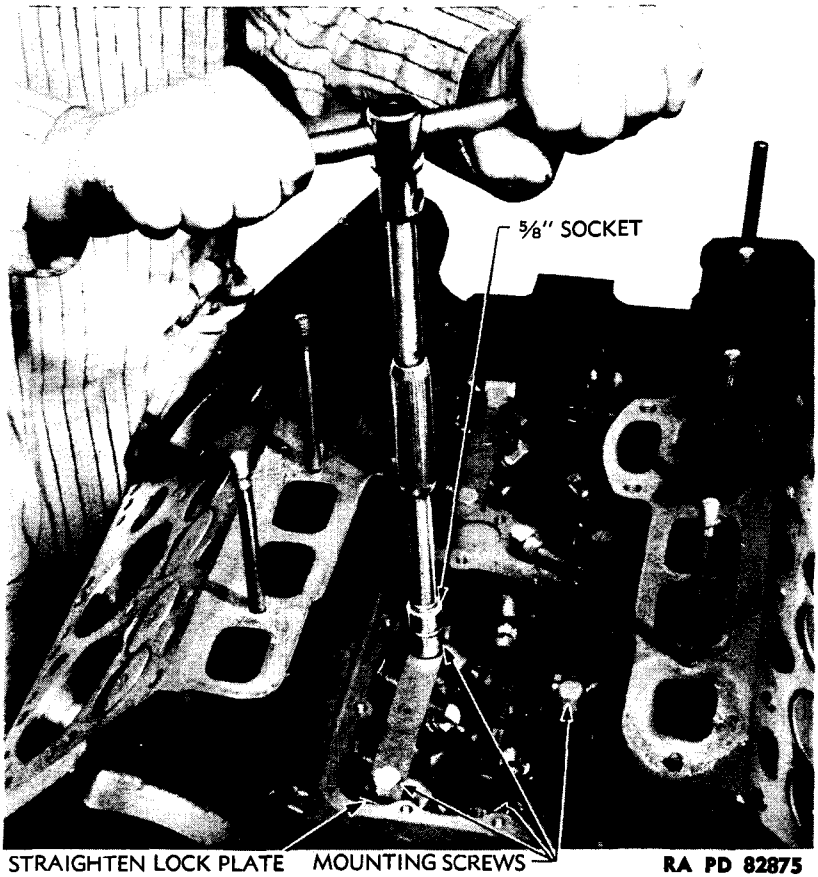


Figure 40 — Removing Valve Lifter Screws

(4) REMOVE WATER PUMP BYPASS HOSE. Disconnect water pump bypass hose from left cylinder head outlet elbow and water pump, and remove hose.

(5) REMOVE VALVE COMPARTMENT COVERS. Remove two screws holding crankcase ventilator conduit to valve compartment covers. Remove ventilator conduit and gasket. Remove 16 screws holding valve compartment covers to cylinder and crankcase. Remove valve compartment cover and valve compartment cover gaskets.

(6) REMOVE OIL LINES AND BAFFLES. Disconnect oil line from oil header on cylinder and crankcase to center bulkhead and remove line. Disconnect oil lines from lifter and guide assemblies, and elbow on center bulkhead, and remove lines (fig. 39). Remove four screws holding valve compartment baffles to valve lifter and guide assemblies, and remove baffles.

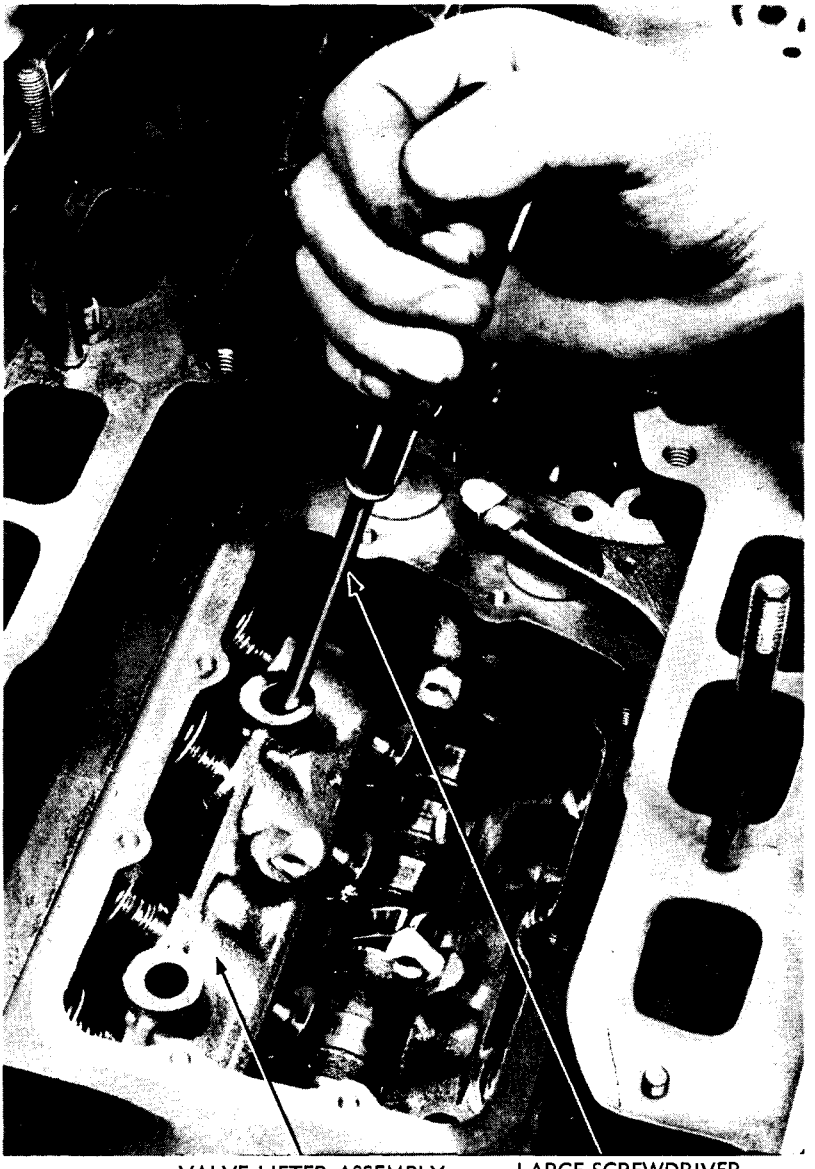


Figure 41 — Removing Valve Lifter Assemblies

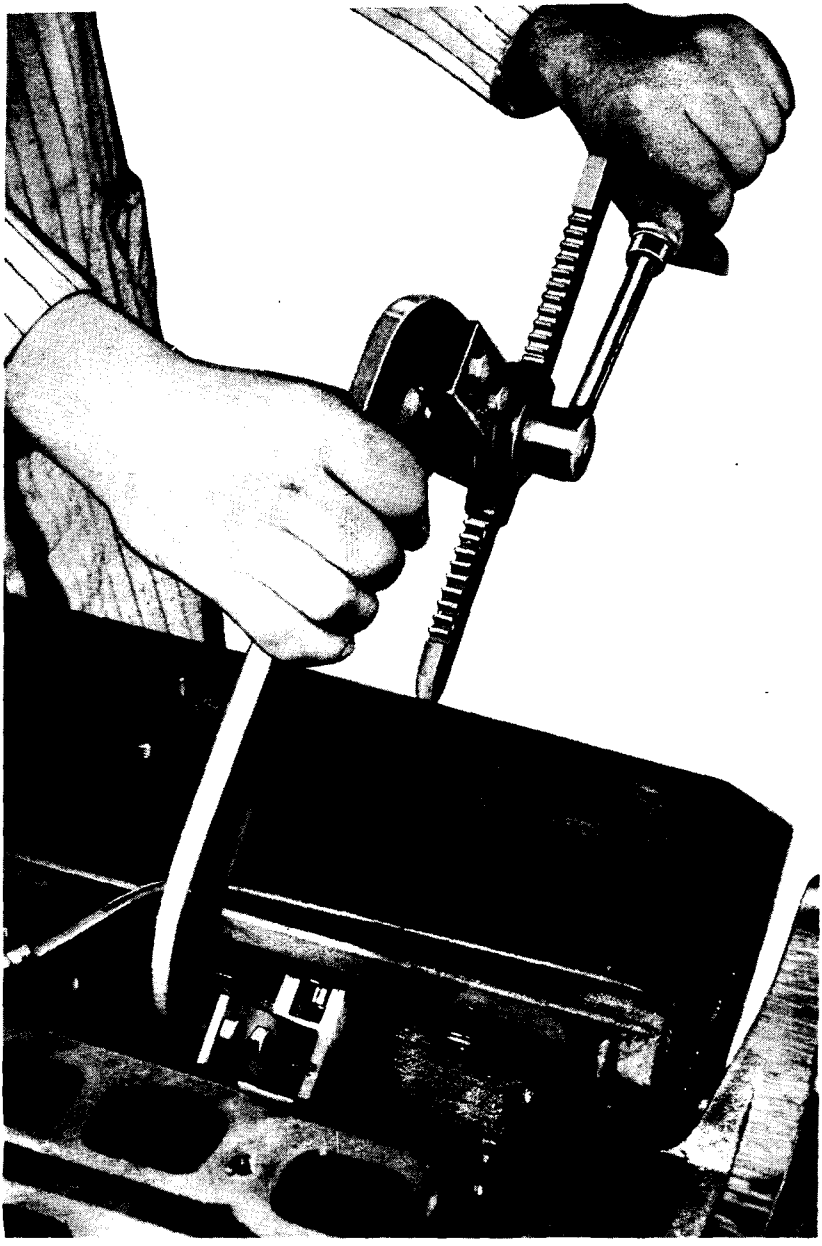


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Figure 42 — Removing Valve Springs

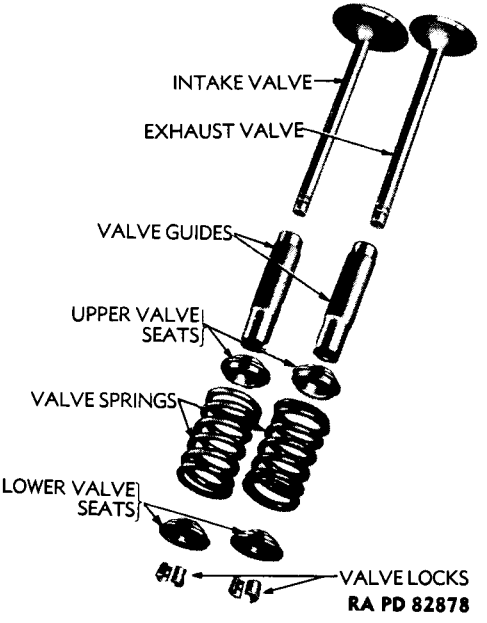


Figure 43 — Valve Assembly Disassembled

(7) REMOVE VALVE LIFTER ASSEMBLIES. Straighten each of the four valve lifter assembly lock plates. Remove eight screws holding the valve lifter and guide assemblies to crankcase (fig. 40). Pry valve lifter and guide assemblies out from under valve stems, and remove assemblies (fig. 41).

(8) REMOVE VALVE LIFTERS FROM BRACKETS. Expand lock ring in small end of valve lifter assembly, remove lock ring, and push assembly out of lower end of bracket.

c. Removal of Valve Springs with Engine Out of Vehicle.

(1) REMOVE VALVE LIFTERS AND CYLINDER HEADS. See b above, and paragraph 63.

(2) INSTALL VALVE REPLACER TOOL ON VALVE. Place wire mesh screen (4½ x 7 in.) in valve compartment below ends of valve stems to prevent dirt and valve parts from falling into engine. Insert valve remover adapter (41-L-1425) in hollow end of valve replacer. Install valve replacer on valve. Adjustable pointed end of valve replacer fits in center hole on valve head, and hollow end of valve replacer fits around valve spring lower seat.

(3) REMOVE VALVE LOCKS. Compress valve spring by rotating handle of valve replacer clockwise. Lock valve replacer with valve spring in compressed position by tightening valve replacer handle

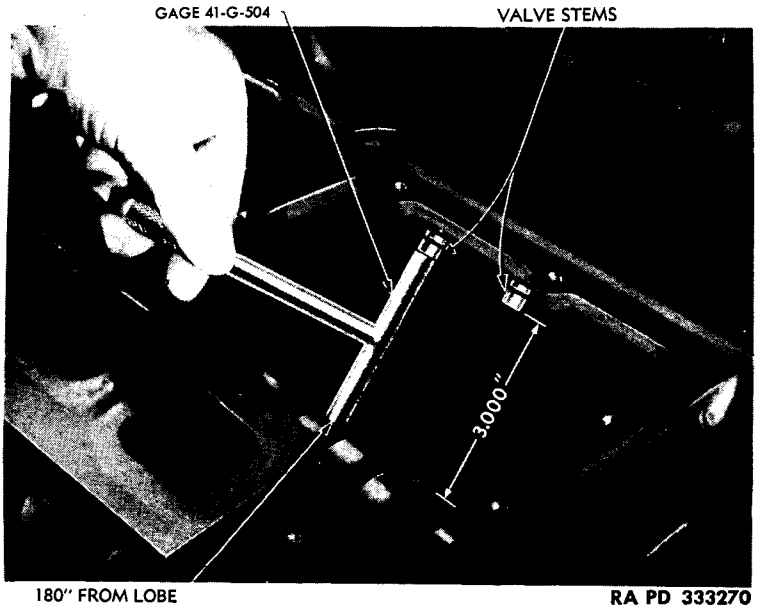


Figure 44 — Checking Valve Stem Length

lock nut. Insert a screwdriver through slot in hollow end of valve replacer, and knock valve locks off valve stem.

(4) REMOVE VALVE SPRINGS. Loosen valve replacer handle lock nut and release valve spring. Hold valve replacer underneath valve, and grasp valve spring and seats. Remove valve replacer, valve locks, spring, and seats from engine as a unit. NOTE: *Hold valve replacer in an upright position while removing to avoid dropping valve locks into engine.* Remove valve locks from valve replacer.

d. Installation of Valve Springs with Engine Out of Vehicle.

(1) CHECK VALVE STEM LENGTH. With No. 1 cylinder intake valve in valve guide, check distance from bottom end of valve stem to heel of lobe on camshaft, using valve stem length gage (41-G-504) (fig. 44). This distance should be exactly 3 inches. Check gage before using. If tool will not slide freely between lower end of valve stem and heel of camshaft lobe, notify ordnance personnel.

(2) INSTALL VALVE LOCKS IN VALVE REPLACER. Install valve stem lock installer adapter on valve replacer. Position two valve stem locks in installer adapter (fig. 45).

(3) POSITION VALVE COMPONENTS ON VALVE. With No. 1 cylinder intake valve in valve guide, place valve spring upper seat, valve spring and valve spring lower seat in position in crankcase around

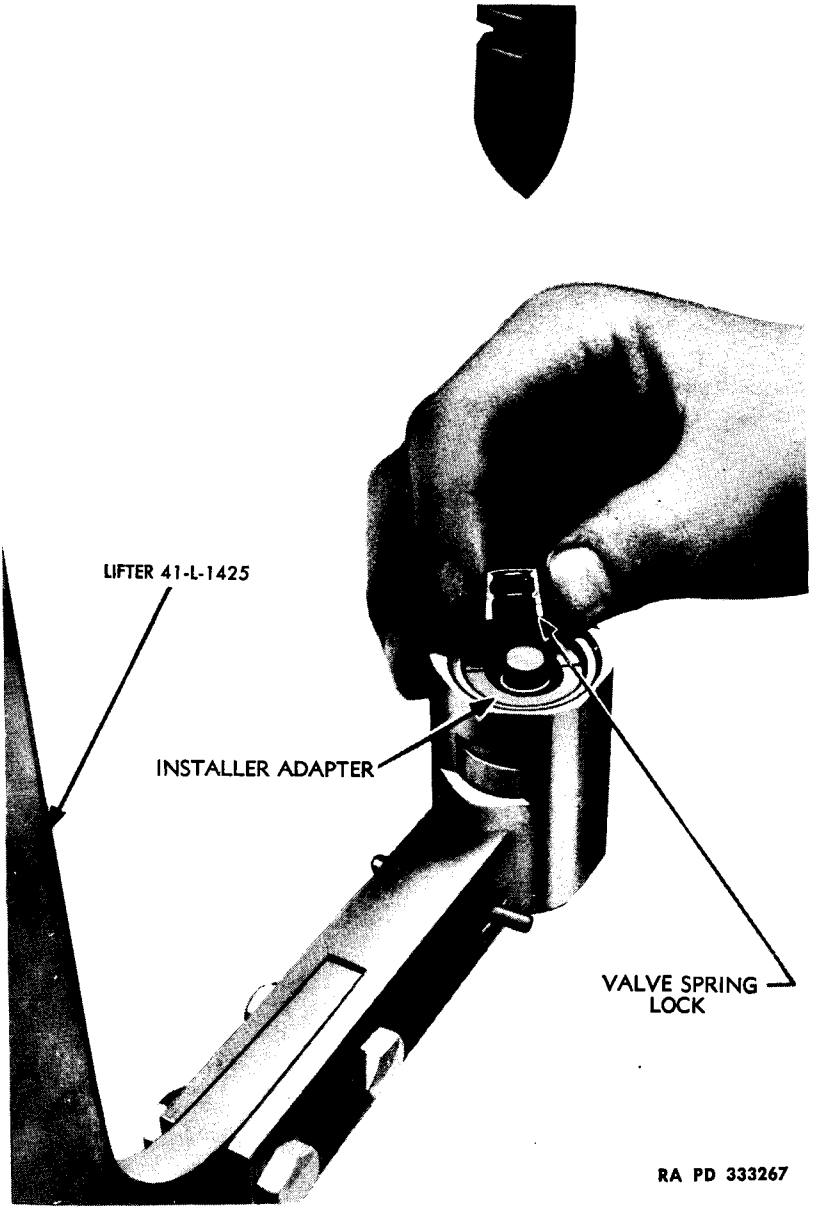


Figure 45 — Inserting Valve Stem Locks

valve stem (fig. 43). While supporting valve spring and upper and lower seats in place around valve stem, install valve replacer on valve. Pointed end of valve replacer should be positioned in center hole on valve head, and hollow end of tool should be positioned beneath lower end of valve stem.

(4) INSTALL VALVE LOCKS ON VALVE. Line up lower end of valve replacer so that value stem is directly over hole in installer adapter and compress valve spring slowly until valve locks snap into place in grooves in valve stem. CAUTION: *In order to facilitate valve installation, the following precautions should be observed: Keep tool in exact alinement with valve. A click will be heard when valve locks enter grooves in valve stem. Do not compress valve spring further after hearing click.*

(5) REMOVE VALVE REPLACER. Loosen valve replacer by rotating handle clockwise until valve spring pressure is released, and remove valve replacer from valve. Release valve replacer slowly, making sure valve spring is in proper position. Repeat steps (1) through (5) for each of the other 15 valve springs.

(6) INSTALL CYLINDER HEADS AND VALVE LIFTERS. See subparagraph e, below, and paragraph 63.

e. Installation of Valve Lifters with Engine in Vehicle.

(1) POSITION VALVE LIFTER INSTALLER TOOL IN CRANKCASE. Rotate crankshaft until eccentric camshaft lobes for intake and exhaust valves on cylinders No. 1 and No. 3 point away from ends-of valve stems; that is, so that all four valves will be closed after valve lifters are installed. Position valve lifter bracket installer (41-I-144-250) on crankcase so that flange on tool rests under intake and exhaust valve stems for cylinders No. 1 and No. 3.

(2) POSITION VALVE LIFTERS IN BRACKET. Fill each valve lifter body with clean engine oil, and push valve lifter cylinder and plunger assembly into valve body, allowing excess oil in body to leak out between cylinder and body. NOTE: *Do not depress valve lifter plunger after oil has been added to lifter body, because this will pump oil into valve lifter cylinder and prevent installation of valve lifter in engine.* Push valve lifter assembly into valve lifter bracket, and lock in place with lock ring.

(3) INSTALL VALVE LIFTER BRACKET. Install valve lifter bracket in crankcase, forcing lifters down under valve stems (fig. 46). Install valve lifter bracket mounting screw lock plate over mounting holes, and install the two valve lifter mounting screws. Bend mounting screw lock plate up around both screw heads. Repeat operations (1) through (3) to install the other three valve lifter bracket assemblies.

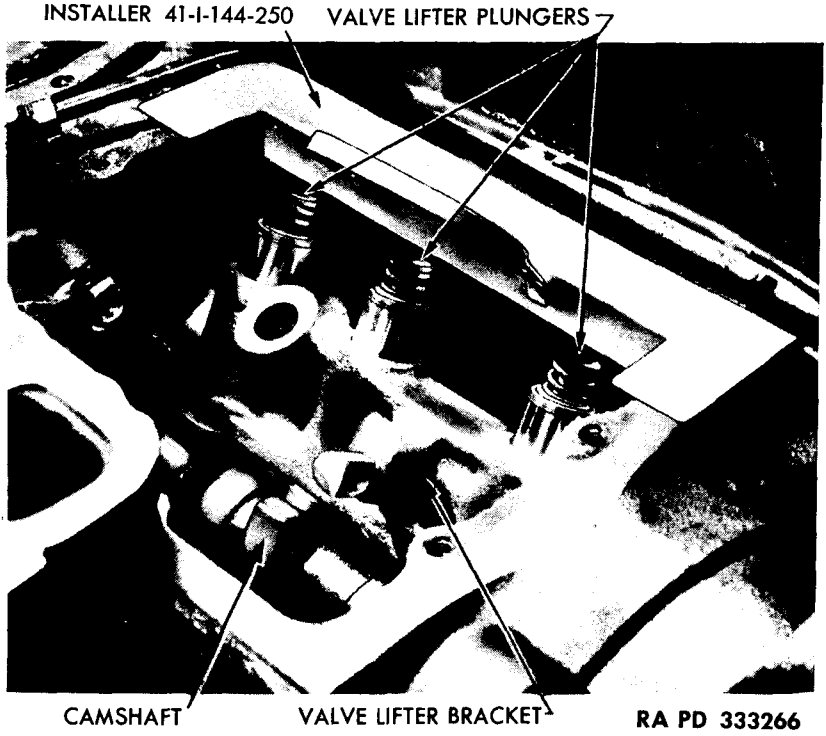


Figure 46 — Installing Valve Lifter Bracket Assembly

(4) INSTALL VALVE COMPARTMENT BAFFLES AND OIL FEED PIPES. Position front and rear valve compartment baffles over valve lifter bracket assemblies. Install four baffle mounting screws. Position both oil feed pipes from center bulkhead to all four valve lifter bracket assemblies, and connect feed pipes to bulkhead on valve lifter assemblies.

(5) INSTALL VENTILATOR CONDUIT AND VALVE COMPARTMENT COVERS. Position two *new* valve compartment cover gaskets on crankcase. Position valve compartment covers over gaskets, and install mounting screws. Install oil feed pipe from center bulkhead to oil header on side of crankcase, tightening fittings securely. Install two *new* crankcase ventilating conduit gaskets and install two mounting screws securely.

(6) INSTALL MANIFOLDS AND CARBURETOR. See paragraphs 65 and 91.

(7) INSTALL GENERATOR. See paragraph 88.

(8) INSTALL WATER PUMP BYPASS HOSE. Connect water pump bypass hose to outlet elbow on left-hand cylinder head and to water

pump inlet elbow. Tighten clamp screws securely.

(9) INSTALL FAN AND FAN SHROUDS. Install fan, fan belt and bracket, and adjust fan belt. Install fan shrouds and close engine compartment rear doors.

Section XV

IGNITION SYSTEM

68. DESCRIPTION AND TABULATED DATA.

a. Two identical, but completely independent ignition systems are used, one for each engine. Each system consists of an ignition coil mounted on the engine compartment side of the bulkhead; a timer inside the distributor housing which interrupts the low-tension (12-volt) current from the battery; a condenser, also located in the distributor housing, which, acting with the timer, produces a high-tension voltage in the secondary circuit of the coil; a distributor which directs the high voltage to each of the spark plugs in turn; the spark plugs themselves which ignite the fuel mixture; the resistors and filters which minimize electrical interference with the radio equipment; and the necessary wiring to connect these units. The wiring diagram of the ignition system is given in figure 47.

b. Tabulated Data.

(1) COIL.

Amperage draw, at idling speed	1½ amperes
Model number	DR-1115079
Voltage	12 volts

(2) CONDENSER.

Capacity	0.18—0.23 MFD
Model number	DR-1869570

(3) DISTRIBUTOR.

Contact point gap	0.013-0.018 in.

IGNITION SYSTEM

Contract spring tension	20-24 oz
Dwell angle	31 deg
Direction of rotation (viewed from top)	Clockwise
Model number	DR-1110609
Timing adjustment	Rotate on mounting

(4) SPARK PLUGS.

Gap	0.028-0.033 in.
Number used	8 per engine
Thread	10 mm
Model number	AC-104

(5) TIMING. (par. 73).

69. DISTRIBUTOR ASSEMBLY.

a. Removal. Remove bulkhead door by turning latch and lifting door from hinges. Remove distributor cap by unsnapping two springs that hold cap to distributor, and leave cap in engine compartment suspended by ignition wires. NOTE: *If cap is to be replaced, high-tension wires leading to coil and spark plugs must be disconnected.* Disconnect low-tension wire to distributor or distributor filter. Remove cap screw holding distributor clamp arm to base on distributor support, and lift distributor assembly from support (fig. 49).

b. Installation. Position complete distributor assembly in support, turning shaft from right to left until lower end of coupling meshes with inner drive shaft. Install cap screw holding clamp arm to base on distributor support. Install distributor cap, and lock in place with two cap springs. Check and reset ignition timing as explained in paragraph 73. Install bulkhead door. NOTE: *Contact points are most easily serviced by first removing the complete distributor from the engine. If engine is out of vehicle, it is only necessary to remove cap. In either case, rotor and seal must be removed.*

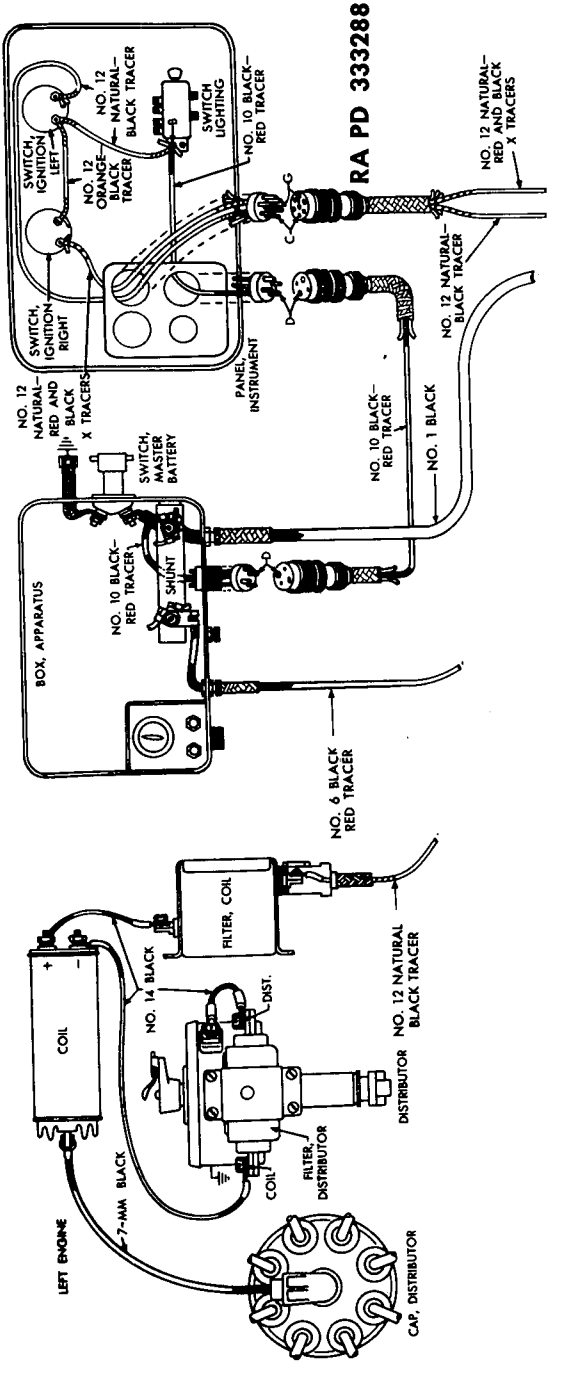
c. Inspecting Contact Points. The appearance of contact points must be understood in order to determine, first, whether the points require any service at all and, second, whether they should be cleaned or replaced. Contact point appearance can be classified into four groups, as follows:

(1) A rough, gray surface on the contact points is an ideal condition. Do not clean or replace points with this appearance.

(2) Oil-soaked points usually do not require filing. They should be cleaned thoroughly, however, and the source of oil leakage determined and corrected.

(3) Pitted contact points will not cause ignition failure unless the pitting is severe. Minor pits or projections do not necessitate replacement of points.

75-MM HOWITZER MOTOR CARRIAGE M8



IGNITION SYSTEM

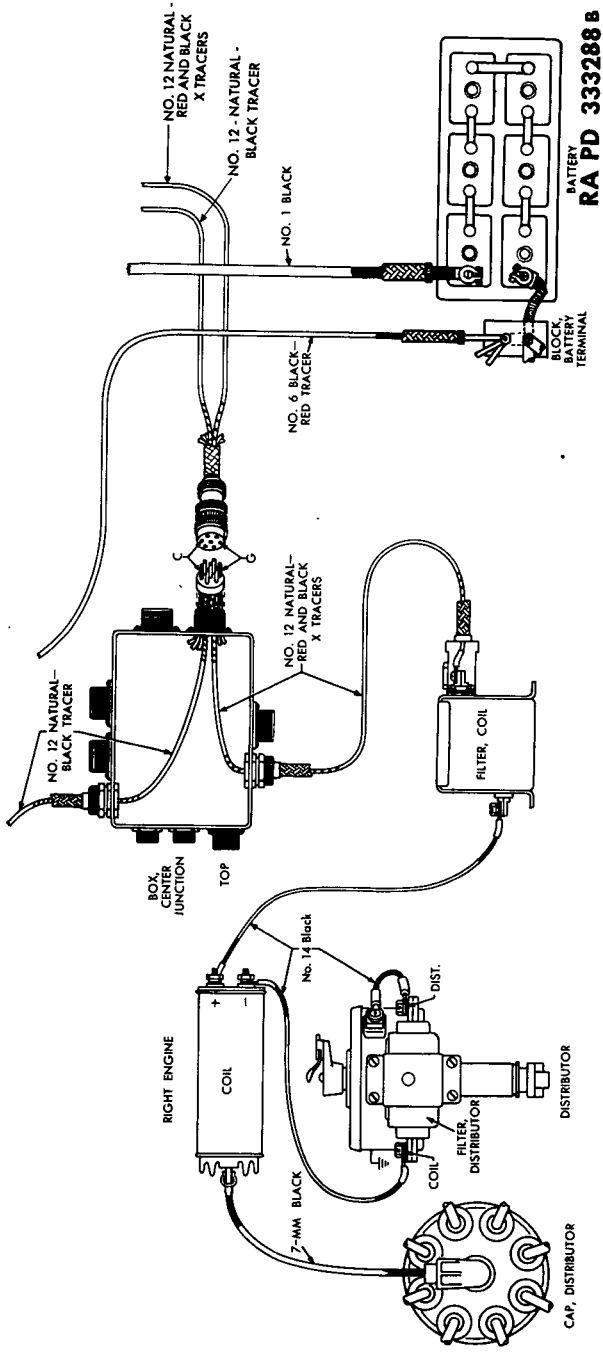


Figure 47 — Ignition System Wiring Diagram

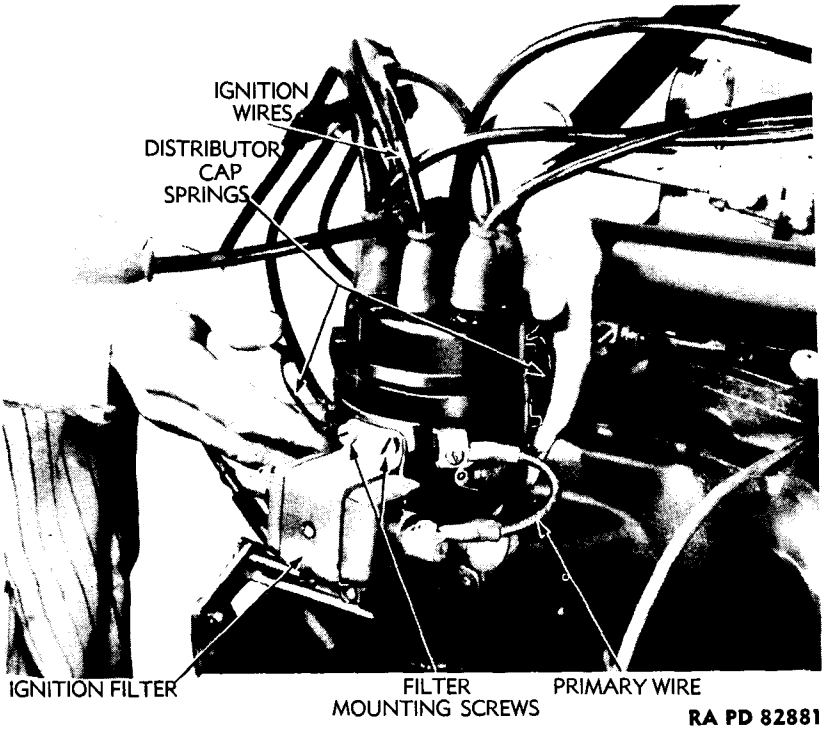


Figure 48 — Removing Distributor Cap

(4) Oxidized points which have a blue or black scale usually do not require replacement, but the scale must be cleaned off. Oxidized points are usually caused by a faulty coil or condenser. Replace these items if condition recurs frequently.

d. Cleaning Contact Points. If points are badly pitted, burned, or worn, clean up the flat surfaces with a fine cut file until all trace of corrosion or pitting is removed. CAUTION: *Never attempt to clean points with emery cloth or sandpaper.* Make sure that points line up squarely with each other and adjust gap.

e. Adjusting Contact Point Gap. Turn distributor drive shaft until cam is holding points at widest opening. Loosen contact support lock screw with screwdriver and adjust point opening to a clearance of 0.013 to 0.018 inch (0.015 is ideal) by turning eccentric screw (fig. 50) with a screwdriver and checking clearance with feeler gages. Tighten lock screw with screwdriver. CAUTION: *Clearance should be rechecked after distributor support lock screw has been tightened to make sure points remained in adjustment.*

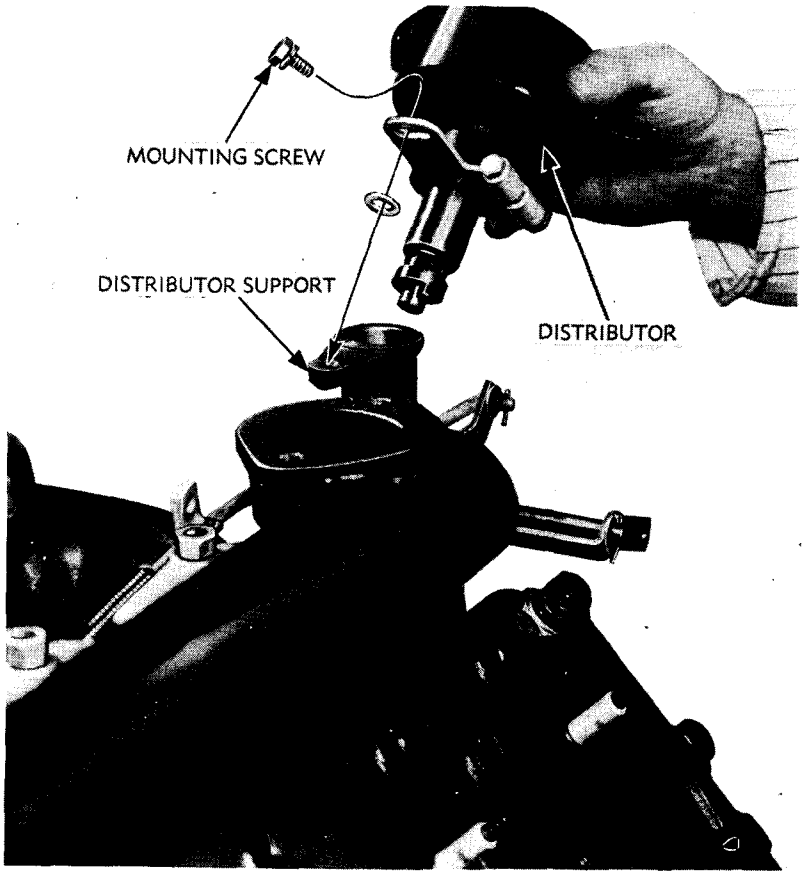


Figure 49 — Removing Distributor

f. Contact Arm Spring Tension. Check tension of contact arm spring with a spring scale held at right angles to the arm, and as close to the points as possible (fig. 51). Tension can be adjusted by loosening screw on breaker support fiber base, and either sliding the spring forward or backward, or bending spring. Correct tension is 20-24 ounces.

g. Replacing Contact Points. Remove lock screw from contact arm support (fig. 52). Loosen screw holding contact arm to connector. Remove retainer from contact arm support stud. Lift out breaker lever and contact point support. Place new parts in position, reinstall mounting screws and retainer, and adjust gap. Install bakelite seal and rotor. CAUTION: *Wipe new parts completely free of any oil with which they have been coated for protection.*

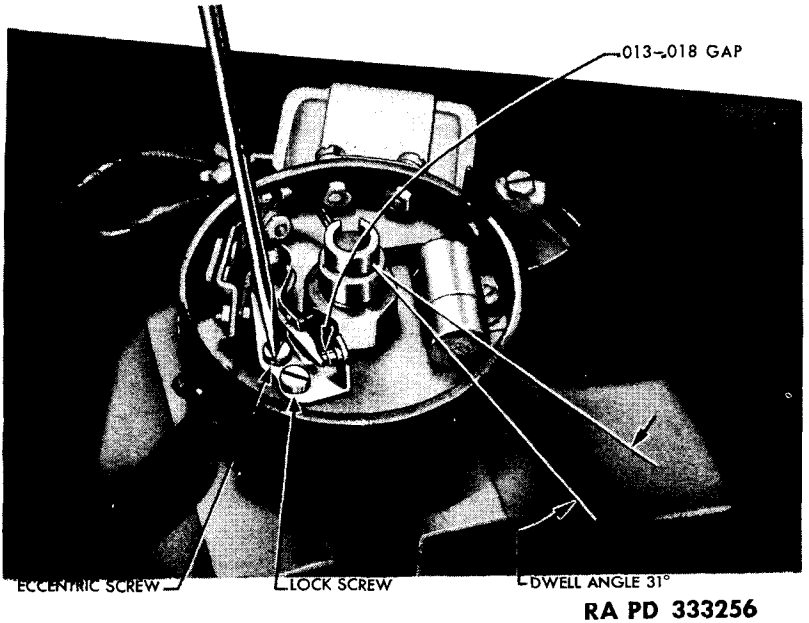


Figure 50 — Adjusting Contact Point Gap

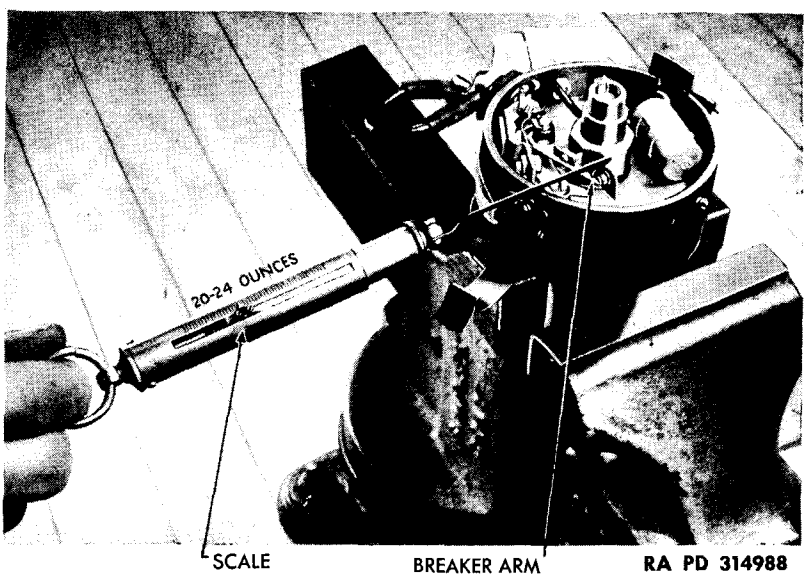


Figure 51 — Checking Contact Arm Spring Tension

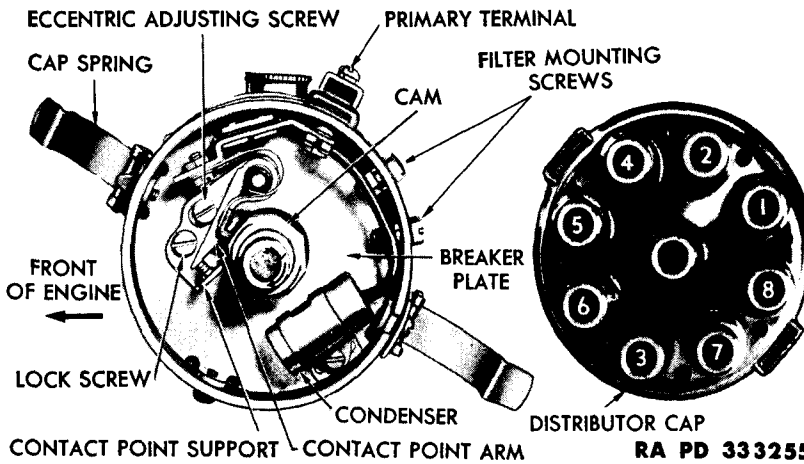


Figure 52 — Distributor Breaker Mechanism

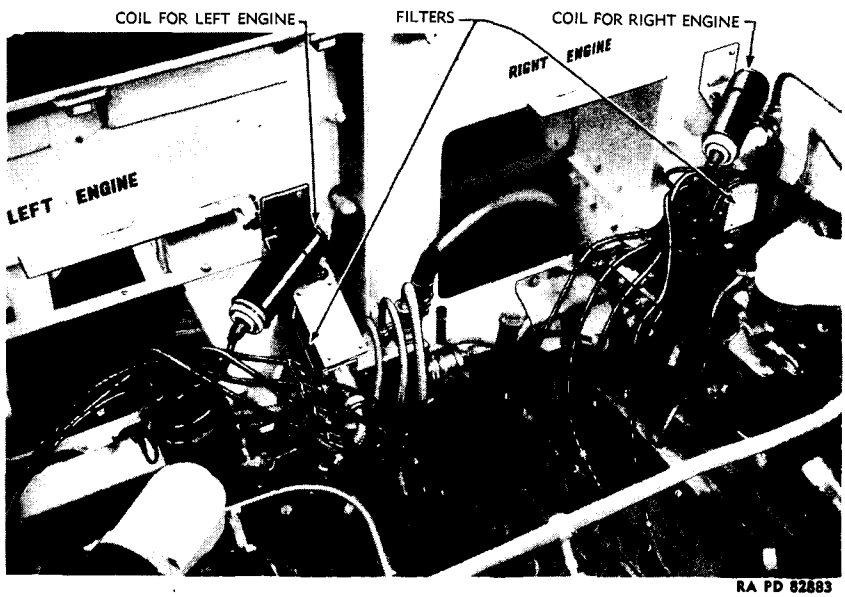


Figure 53 — Ignition Coil Mounting

70. IGNITION COIL.

a. The ignition coil is serviced only by replacement as a complete unit.

b. Removal. Disconnect wire leads to coil. On coils for right-hand engines, remove two cap screws and lock washers that hold coil

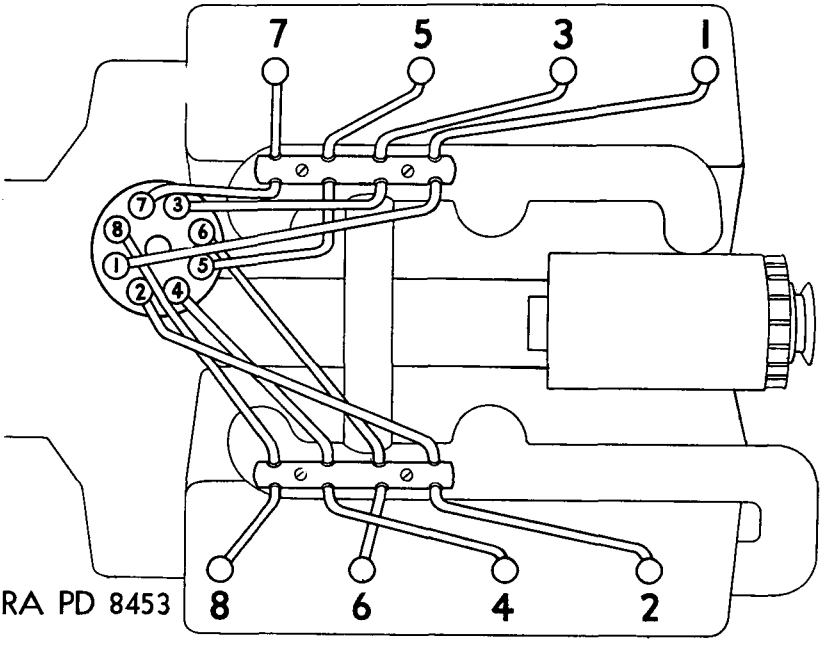


Figure 54 — Engine Cylinder Numbering

to bracket on bulkhead (fig. 53). On coils for left-hand engines, remove two cap screws and lock washers that hold bracket on which coil and filter are mounted to bulkhead, pull bracket around to accessible position, and then remove two cap screws and lock washers holding coil to bracket.

c. Installation. Position coil for right-hand engine on bracket, and attach with two cap screws and lock washers. Position coil for left-hand engine on bracket on which filter is also mounted, and attach with two cap screws and lock washers. Mount complete assembly, consisting of bracket, filter and coil, on bulkhead, and attach with two cap screws and lock washers. Connect wires.

71. IGNITION CONDENSER.

a. The condenser is serviced only by replacement as a complete unit.

b. Removal. Remove distributor cap, rotor, and seal. Disconnect condenser lead from primary wire terminal (fig. 52). Remove screw and lock washer holding condenser bracket to breaker plate and lift out condenser.

c. Installation. Position condenser and bracket on breaker plate (fig. 52) and tighten in place by installing screw and lock washer. Connect condenser lead to primary terminal. Install seal, rotor, and distributor cap.

72. IGNITION HARNESS.

a. Removal of Complete Ignition Wiring Harness. Open engine compartment rear doors and bulkhead doors. Disconnect spark plug wires at suppressors (fig. 56). Disconnect wires at distributor cap and coil. Remove screws at straps on support, loosen straps, and remove wires.

b. Installation of Complete Ignition Wiring Harness. Connect each of the spark plug wires in turn to the distributor cap, working from the wire markers and following the order indicated in figure 54. Install wires on support straps and connect to the spark plugs. Tighten screws for straps. Connect primary and secondary wires between distributor and coil.

c. Individual Wires. Replacement of individual wires can be performed by using the above procedure as a guide.

73. IGNITION TIMING ADJUSTMENT.

a. Method. The recommended method of timing ignition on these engines differs from conventional methods in several respects that should be thoroughly understood before proceeding.

(1) First, timing is done with the engine under load and not at idling speeds. (This is possible because of the fluid coupling of the Hydra-Matic drive.)

(2) Second, the setting is not made by the flywheel nor any other revolving part of the engine, but by the sound of the explosion. The method thus automatically compensates for variations from one engine or distributor to another and gives the best timing possible for the particular engine and the particular fuel used.

(3) Third, the running position of the distributor is not the same as the position in which it is set for timing, but is 3 degrees retarded from the timing position. *This final adjustment is important.*

b. Procedure, Early Type Distributors.

(1) Warm the engines until the temperature gages read between 185° and 200° F, either by driving the vehicle or by covering the radiator air intakes.

(2) Stop one engine. CAUTION: *Do not attempt to check both engines at the same time.*

(3) Set the brakes firmly and move the transmission selector lever to "DR." NOTE: *The driver will stay in his seat to operate the accelerator pedal as directed by the mechanic.*

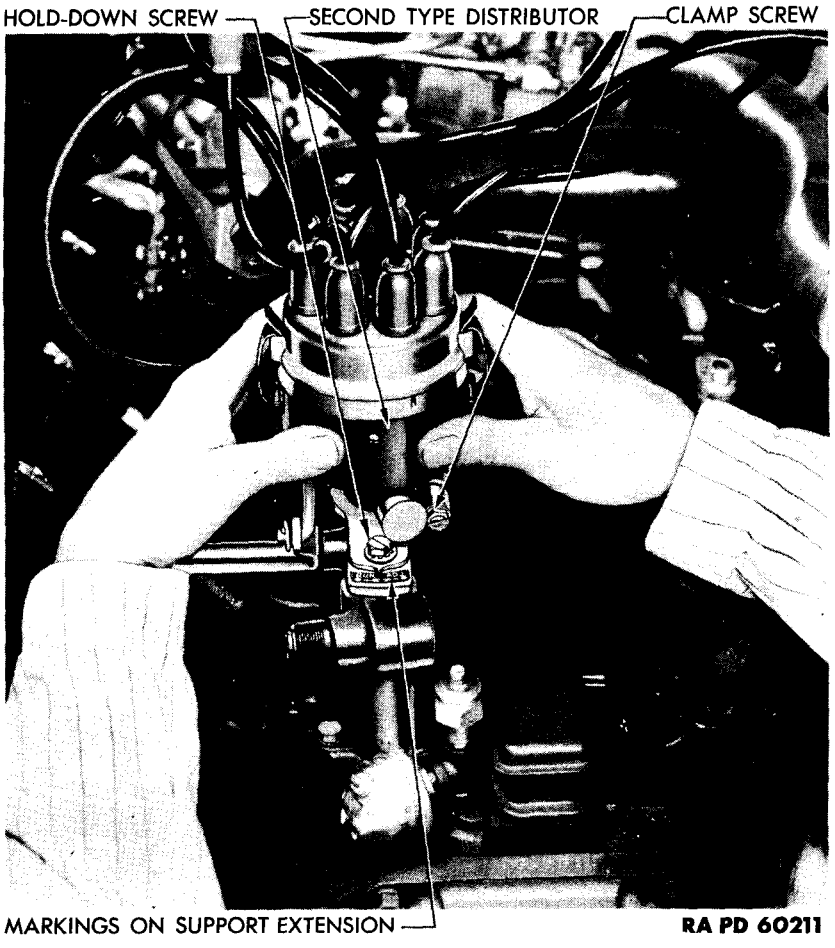


Figure 55 — Timing Ignition

(4) Remove the bulkhead doors.

(5) Loosen the clamp screw which clamps the arm to the distributor.

(6) While the driver holds the throttle wide open and the engine pulls against the fluid coupling, turn the distributor counterclockwise (advance) until the engine starts to detonate (spark knock); then retard by turning clockwise until detonation is barely perceptible. This timing is known as "borderline" detonation and is not the final setting. Tighten the clamp screw. Close throttle. WARNING: *Do not pull the engine against the coupling for more than one minute at a time, and allow at least three minutes for the oil to cool before repeating.*

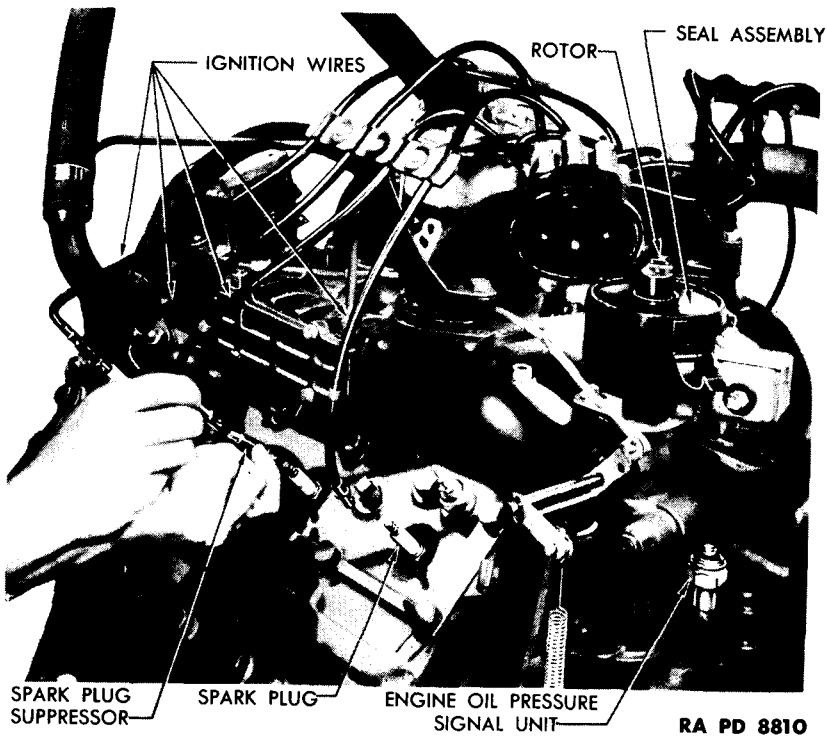


Figure 56 — Removing Spark Plug Suppressors

(7) Scratch two vertical marks $\frac{1}{16}$ inch apart on the side of the distributor. Hold a pencil or pointed instrument in line with the left-hand mark; then loosen the clamp screw and turn the distributor clockwise until the pencil lines up with the right-hand mark. This is equivalent to 3 degrees. Tighten clamp screw.

(8) Run the engine again to test the timing for indications of detonation. There must be no audible detonation.

(9) Stop the engine just timed and repeat the procedure on the other engine.

(10) Install bulkhead doors.

c. Procedure (Late-type Distributors). Later distributors used on M8 vehicles are designed to make easier the accurate setting of the 3 degrees retard. The hole for the hold-down screw in the clamp arm is elongated only enough to permit the distributor to be moved exactly 3 degrees, and the words "adjust" and "run" are stamped on the support extension. The adjustment procedure is as follows:

Figure 57 — Installing Spark Plug

(1) Perform steps (1) to (4) from paragraph 73 **b**, above.

(2) Loosen hold-down screw and move arm and distributor toward "adjust" (counterclockwise) as far as it will go (fig. 55). Tighten hold-down screw again.

(3) Set the timing at "borderline" detonation, as explained in steps (5) and (6) of paragraph 73 **b**.

(4) Loosen hold-down screw again and move arm and distributor toward "run" (clockwise) as far as it will go. This automatically gives a retard of 3 degrees. Tighten hold-down screw. Close throttle.

(5) Run engine again to test for indications of detonation. There must be no audible detonation.

(6) Stop the engine just timed and repeat the procedure on the other engine.

(7) Install bulkhead doors.

74. SPARK PLUGS.

a. Removal. Open engine compartment rear doors. Disconnect high-tension wires at suppressors and pull off suppressors. Loosen spark plugs by turning counterclockwise, using spark standard plug

wrench or wrench similar to wrench in figure 57. Remove plugs and gaskets.

b. Checking Gap. Spark plug gap should be checked with spark plug gage and not with a flat ribbon-type feeler gage. The correct gap is 0.028-0.033 inch (0.030 is ideal). Gap adjustments must be made by bending side electrode only.

c. Installation. Position a new gasket on spark plug. Insert plug in engine and tighten with standard spark plug wrench or wrench similar to that shown in figure 57. CAUTION: *Tighten plugs only enough to secure a good seal; overtightening will damage plugs.* Install suppressor, and connect the correct high-tension wire to each plug (fig. 54).

75. TACHOMETER CABLES.

a. Removal. Open bulkhead door and remove tachometer cables from distributor support by unscrewing connection. Remove single clip holding left tachometer cable to bulkhead extension. Remove single clip holding right cable to hull sidewall. Remove shell racks, bulkhead extension cover, and propeller shaft covers from right side of vehicle. Pull both tachometer cables through to fighting compartment. Remove four double clips holding cables to floor of vehicle. Remove six cap screws holding instrument panel to support brackets; lower instrument panel and unscrew cable connections to rear of panel. Remove cables from vehicle.

b. Installation. Lay cables on floor of hull. Connect cable ends to rear of instrument panel, inserting cable ends carefully into instruments and tightening connections securely. Attach instrument panel to support brackets with six cap screws. Position cables on right side of hull floor, keeping right cable to right and left cable to left, and install four double clips holding both cables to hull floor. Insert cable ends in engine compartment. Install propeller shaft covers, bulkhead extension cover, and shell rack on right-hand side of vehicle. Attach right cable to hull sidewall with single clip. Attach left cable to bulkhead extension with single clip. Insert cable end in distributor support and tighten connection securely.

75-MM HOWITZER MOTOR CARRIAGE M8

Section XVI

COOLING SYSTEM

76. DESCRIPTION AND TABULATED DATA.

a. Description.

(1) The vehicle is equipped with two identical, but completely independent cooling systems, one for each engine and transmission. Each system contains the following major units: radiator, water pump, thermostat and necessary connections, engine fan, and an oil cooler for the Hydra-Matic transmission.

(2) The coolant is drawn from the radiator by the water pump, and forced into the engine water jackets. After circulating through both cylinder blocks and cylinder heads, the hot fluid is forced up to the radiator. A thermostat located in the radiator inlet elbow permits free flow when the engine is hot, but causes cold water to recirculate through a bypass back to the water pump and through the engine until the engine reaches an efficient operating temperature.

(3) Cooling fluid is also pumped through an external pipe to an oil cooler located in the transmission oil pan, where it cools the transmission oil and then is returned to the water pump.

(4) The capacity of each cooling system is 35 quarts.

b. Tabulated Data.

(1) FAN.

Blades, angle	32 deg
Blades, diameter	
First type	22 in.
Second type	22¾ in.
Blades, number	4
Drive	Belt
Drive ratio	1 to 1

COOLING SYSTEM

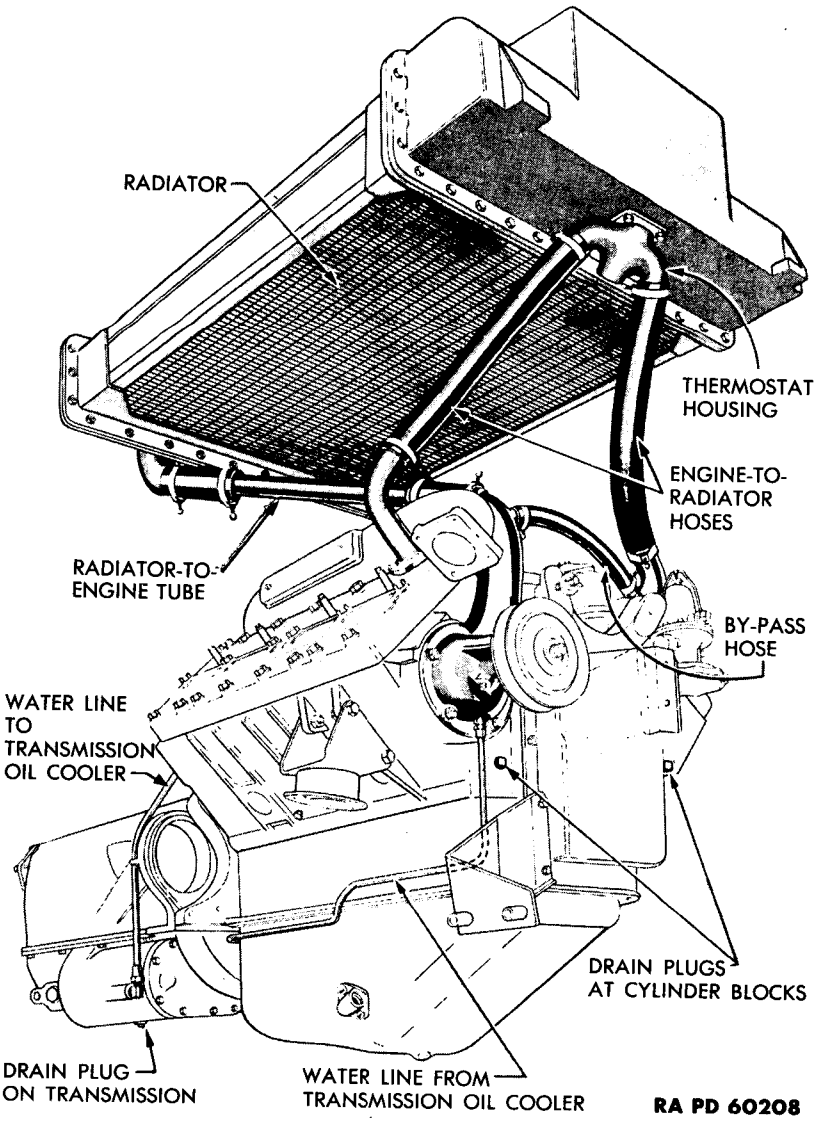


Figure 58 — Cooling System

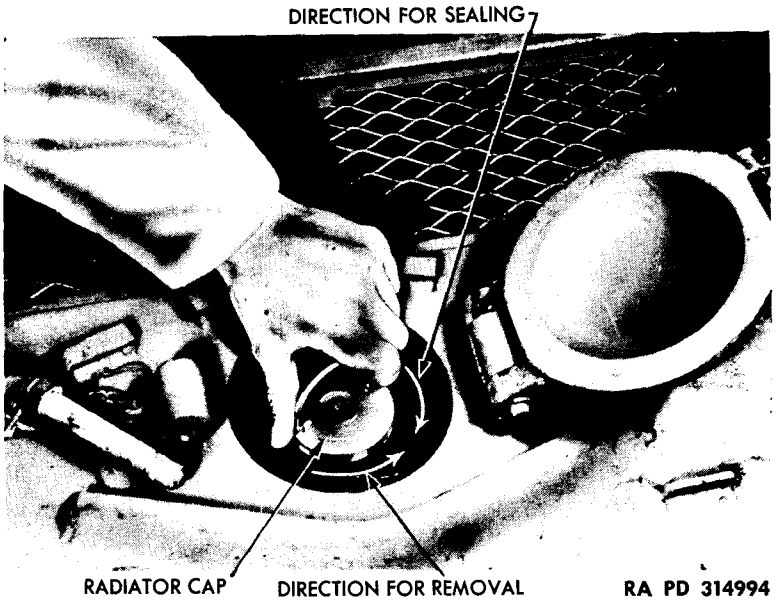


Figure 59 — Removing Radiator Cap

(2) RADIATOR.

Core, area	672 sq in.
Type	Tube and Fin

(3) THERMOSTAT.

Location	Radiator inlet housing
Opening temperature	
First type	161-166 F
Second type	141-146 F
Type	Bimetal

(4) WATER PUMP.

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

77. ADDING OR CHANGING FLUID.

a. Adding Fluid.

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

(2) VENT FILLER CAP BEFORE REMOVAL. Whenever removing the filler cap from a hot system, always vent the radiator long enough

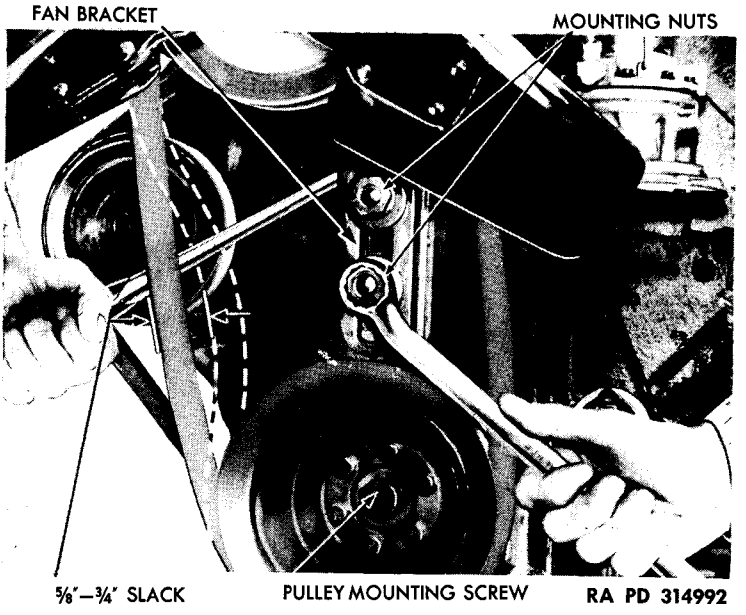


Figure 60 — Adjusting Fan Belt

to let all pressure in the system escape, otherwise there is a possibility of serious burns from steam and hot water. To vent the radiator, turn the cap to the left counterclockwise until the first stop is reached (fig. 59). Leave the cap in this position at least ½ minute, or long enough to vent the radiator thoroughly. Then press down on the cap to clear the stop and turn further to the left to remove.

(3) REINSTALL CAP SECURELY. After bringing the liquid to the proper level, install the radiator cap, and be sure to turn it all the way to the right so that the entire cooling system will be sealed while operating. If this is not done, there may be excessive loss of coolant while operating under heavy service. NOTE: *Make sure radiator cap gasket is in good condition and in place before installing radiator cap.*

b. Draining and Filling Cooling System.

(1) DRAIN SYSTEM. The cooling system should be drained and filled with fresh water or antifreeze every 1,000 miles. Each cooling system is drained at three points. A plug at the bottom of each transmission and two drain plugs at the fan end of each engine must be removed for complete draining of the system (fig. 58). Also remove the radiator cap for rapid and complete draining of the system. CAUTION: *Be sure to install all drain plugs before filling the cooling system.*

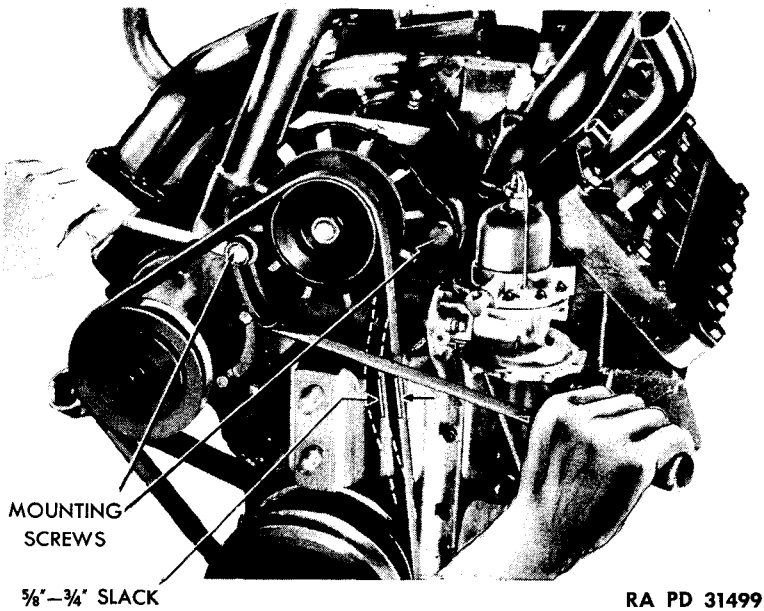


Figure 61 — Adjusting Generator and Water Pump Belt

(2) INSTALL COOLANT. Add water or antifreeze as required to the cooling system, pouring in at moderate speeds to avoid undue spillage. If hot water is available, it will partly open the blocking-type thermostat and permit immediate filling of the system. When cold water is used, however, it may be necessary to run the engine for a few minutes before the thermostat valve opens and permits the system to be completely filled. Be sure to perform this operation if the system seems full before 35 quarts have been added. CAUTION: *When water is used in cooling system, drain whenever there is danger of freezing.*

78. FAN AND WATER PUMP BELTS.

a. Test Belt Tension. The tension of the fan belt and the water pump and generator belt should be checked every 500 miles, and adjusted if either belt can be compressed more than ¾ inch between the pulleys. CAUTION: *Always turn master battery switch "OFF" before working on fan or water pump belts.*

b. Adjust Fan Belt. Reaching through engine compartment rear door, loosen mounting nuts holding fan bracket to engine front cover. Raise or lower fan and bracket assembly by prying with a large screwdriver between the front cover casting and fan bracket until there is between ⅝- and ¾-inch slack in belt, measured by pushing inward

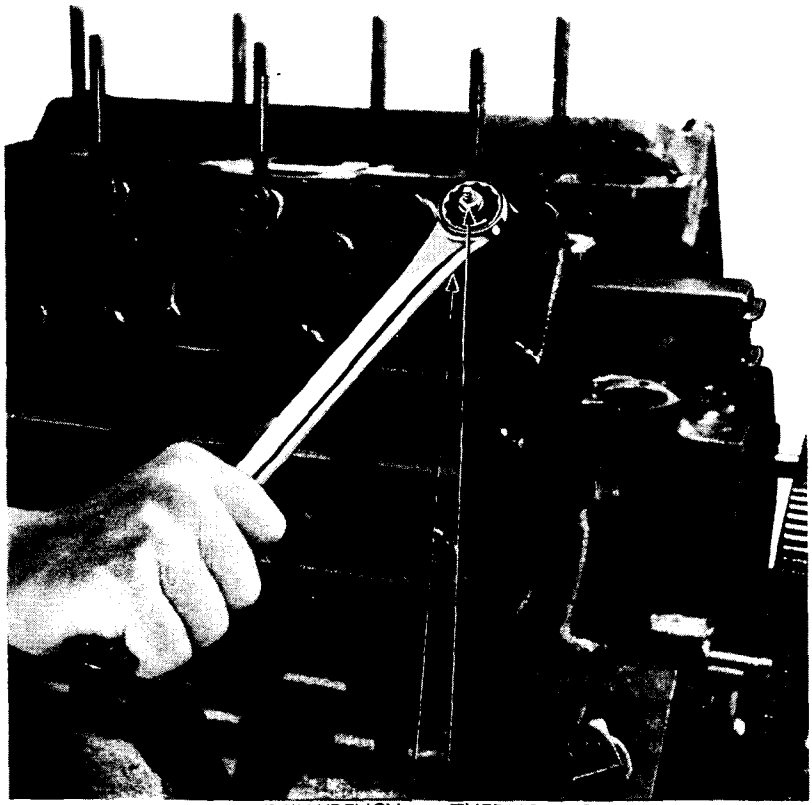


Figure 62 — Removing Engine Thermo Gage

midway between the two pulleys (fig. 60). CAUTION: *Do not pry on flywheel pulley.* Tighten mounting nuts securely and check adjustment. On vehicles with second type (22¾-inch) fans, be sure to loosen fan shroud mounting screws and readjust shrouds to provide uniform clearance for fan blades.

c. Adjust Generator and Water Pump Belt. Reaching through engine compartment rear doors, loosen generator mounting bolts. Raise or lower generator and support assembly by prying with a large screwdriver until there is between ⅝- and ¾-inch slack in belt, measured by pushing inward midway between the crankshaft and generator pulleys (fig. 61). Tighten generator mounting bolts and check adjustment. CAUTION: *Always turn master battery switch "OFF" before working on belts.*

d. Replacement of Belts. Replacement of belts is accomplished by loosening the mounting of fan or generator, lowering the assembly

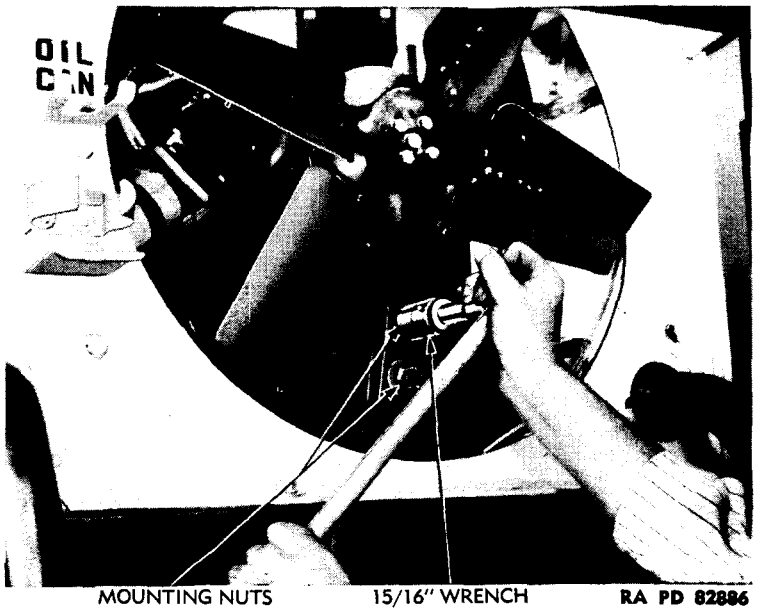


Figure 63 — Removing Fan

to its lowest position, and removing the belt from the pulleys by hand. NOTE: *Do not pry belts from pulleys with heavy tools.* Install new belts by hand and adjust as explained above.

79. ENGINE THERMO GAGE.

a. If an engine thermo gage becomes inoperative, correction call be made by replacement of the gage unit on the left-hand cylinder head of the engine. If this does not correct the condition, notify higher authority. This gage must not be confused with the heat signal unit which has a similar location but on the right cylinder head.

b. Removal. Open bulkhead doors, disconnect lead wire to gage, and unscrew gage unit (fig. 62).

c. Installation. Position thermo gage in opening at rear of left cylinder head and tighten in place. Connect electrical lead and tighten. CAUTION: *Never use sealer or gasket paste on threads of thermo gage.*

80. FAN.

a. Removal. Make sure master battery switch is "OFF." Open engine compartment rear doors. Remove two nuts from fan bracket mounting studs, and remove fan, fan belt, and bracket (fig. 63).

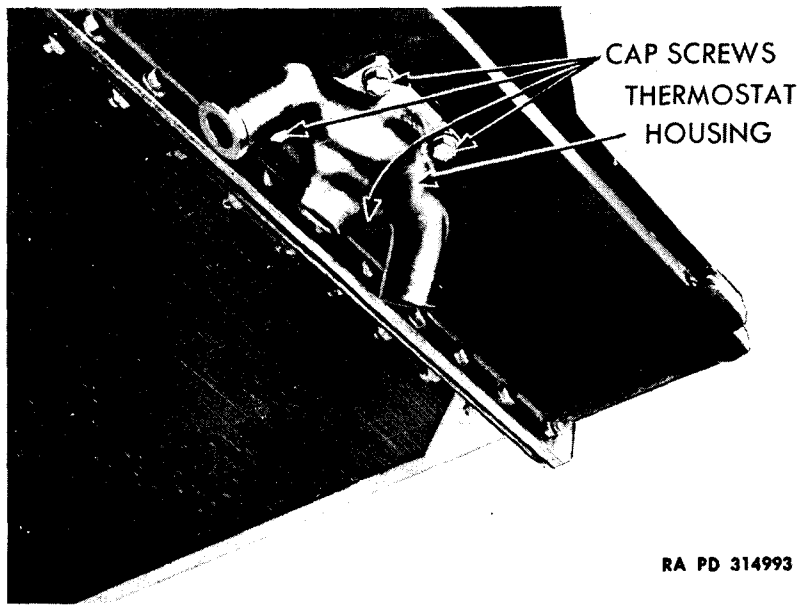


Figure 64 — Removing Radiator Thermostat

b. Installation. Position fan assembly, consisting of fan, belt, and bracket on mounting studs. Place lock washers and nuts on studs and tighten fingertight. Adjust fan belt. Close engine compartment rear doors.

81. FAN SHROUDS.

a. Removal. Open engine compartment rear doors, and disconnect exhaust outlet pipes. Remove two self-tapping screws from square seal around carburetor air inlet pipe and slide seal toward rear (fig. 25). Remove nine screws from fan shrouds and remove shrouds. NOTE: *Left-hand shroud can be removed without removing right-hand shroud by taking out five of the nine screws, but right-hand shroud cannot be removed without taking out left-hand shroud.*

b. Installation. Position fan shrouds against hull and install and tighten nine screws and lock washers. Move seal around carburetor air inlet pipe back against each shroud, and tighten three screws. Connect exhaust outlet pipes and close rear doors.

82. HOSE AND CONNECTIONS.

a. Tightening. The tightness of all hose connections should be regularly checked every 500 miles and tightened if necessary to keep connections leakproof.

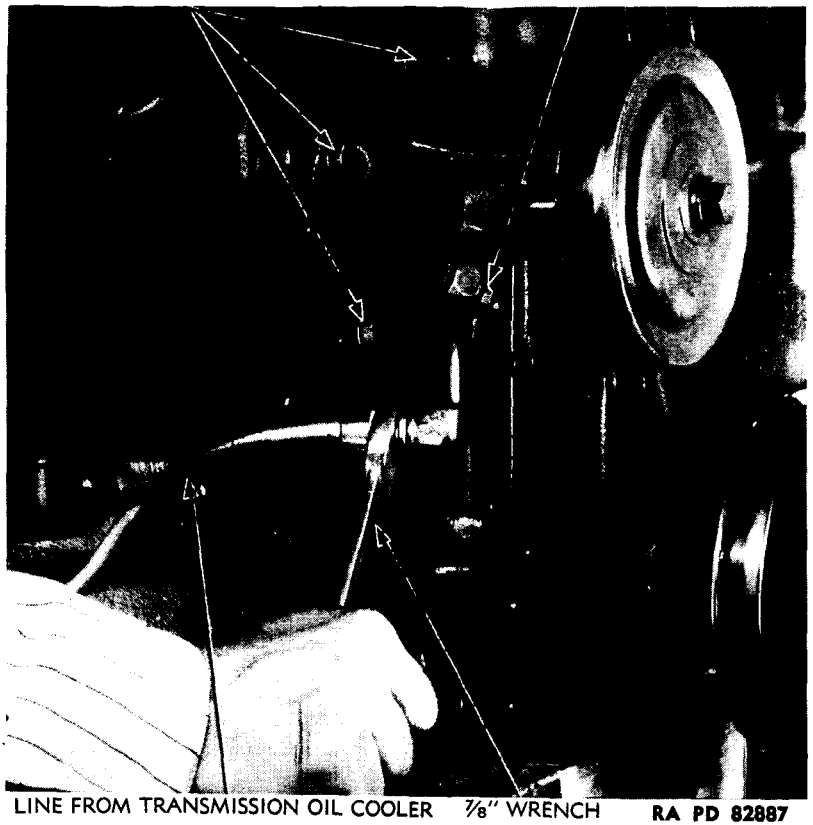


Figure 65 — Removing Water Pump

b. Removal. Drain cooling system. Loosen screws in hose clamps and slide hose off ends of radiator, cylinder blocks, and water pump elbows.

c. Installation. Hose is installed without gasket paste or sealer. Install clamps on hose, slide in place on connection elbows, and tighten clamp screws securely. When installing radiator-to-water pump connection, first attach the two short hose to the tube (fig. 58). Then insert hose and tube into engine compartment and attach, first to water pump, and finally to radiator outlet elbow. Refill cooling system.

83. RADIATOR REPLACEMENT.

a. Replacement of radiator is covered in detail as part of the engine removal procedure in paragraphs 61 and 62.

84. RADIATOR THERMOSTAT.

a. Removal. Open engine compartment rear doors. Drain cooling system. Remove fan assembly. Loosen two hose connections at thermostat housing and move hoses free of elbows. Remove four lock washers and nuts holding housing to radiator tank and remove housing and gasket. Remove thermostat from tank.

b. Installation. Place a new housing gasket on radiator tank, and position thermostat on gasket with valve and extending into radiator tank. Install housing and secure by tightening four screws and lock washers to a torque tightness of 18 foot-pounds. Connect hoses to housing. Fill cooling system. Install fan and adjust fan belt. Close rear doors.

85. WATER PUMP.

a. Removal. Open engine compartment rear doors. Remove fan assembly and drain cooling system. Remove generator and water pump belt by loosening generator mounting screws. Disconnect hose at water pump elbow. Disconnect water pump bypass hose. Disconnect transmission oil cooler line at bottom of water pump (fig. 65). Remove five water pump mounting screws and take water pump and gasket from engine.

b. Installation. Using new gasket, position water pump and gasket at opening on right front cylinder block, and tighten five mounting screws and lock washers. Connect transmission oil cooler line at bottom of water pump. Connect bypass hose and pump inlet hose to elbows on pump and tighten hose clamps securely. Install and adjust water pump and generator belt. Install fan and adjust fan belt. Close engine compartnient rear doors and fill cooling system.

Section XVII

ENGINE ELECTRICAL SYSTEM

86. DESCRIPTION AND TABULATED DATA.

a. Description. The engine electrical system is the same in every respect for each of the two engines. The engine electrical system consists of a generator, generator regulator, and cranking motor. The following explanations apply to both engines in the vehicle:

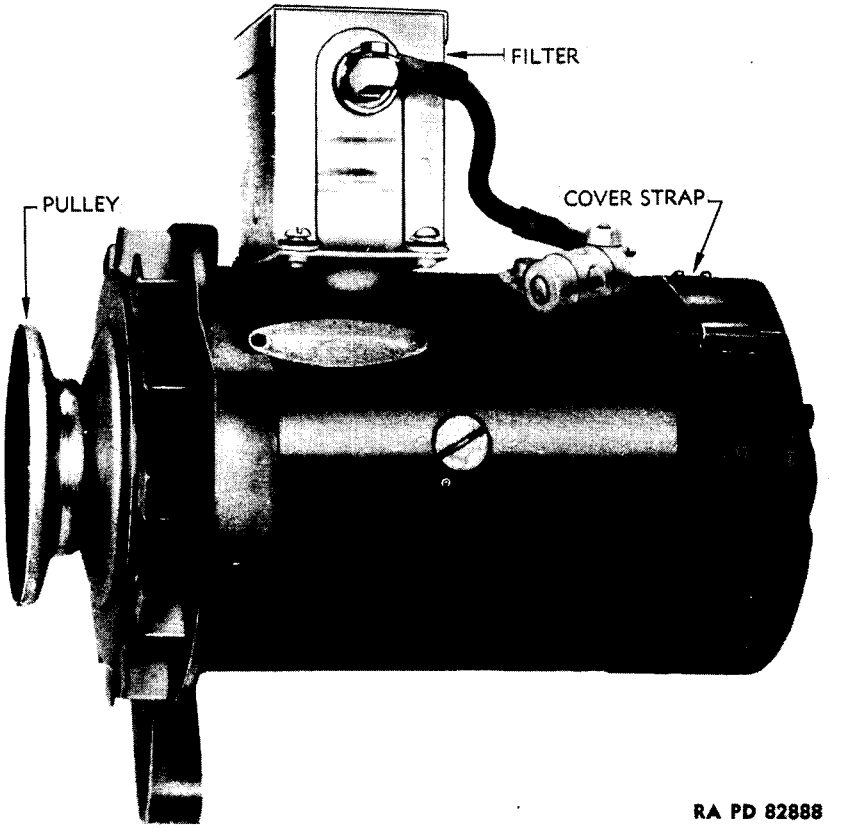


Figure 66 — Generator and Filter

(1) GENERATOR. The generator (fig. 66) is a device for converting mechanical energy (from the engine) into electricity. The unit is a two-brush, two-pole, shunt-wound, 12-volt type with sealed, self-lubricated ball bearings supporting the armature. The armature is belt-driven from the crankshaft; the generator belt pulley incorporates fan blades to permit cooling. The generator is mounted to the engine with two cap screws, one of which operates in a slot in the end frame for adjusting belt tension. The generator output is controlled in accordance with load requirements and battery state of charge by means of a generator regulator assembly.

(2) REGULATOR ASSEMBLY. The regulator assembly (fig. 67) is a three-unit, electromagnetic assembly for controlling generator output to meet all conditions of operation. The three separate units in the regulator assembly are the cut-out relay, voltage regulator, and current regulator. The complete assembly is enclosed by a dust- and

ENGINE ELECTRICAL SYSTEM

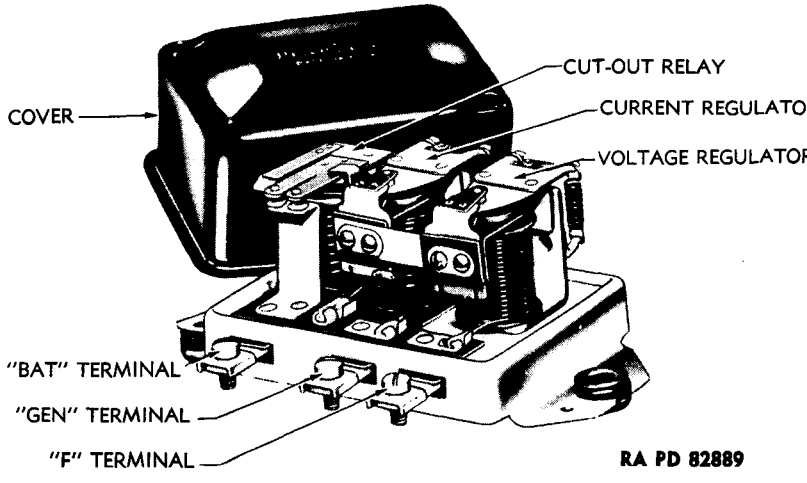


Figure 67 — Generator Regulator Assembly

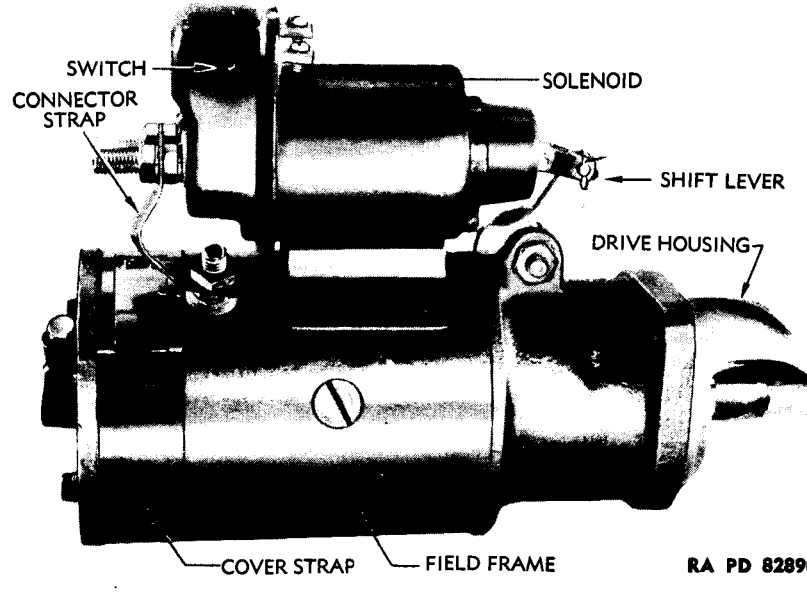
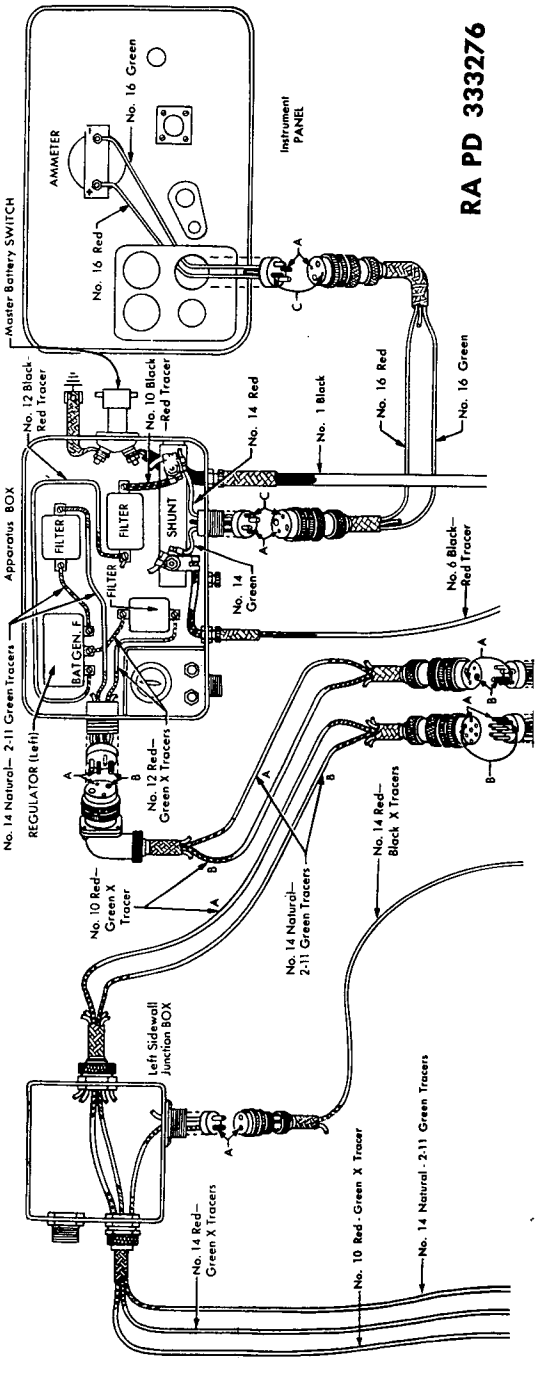


Figure 68 — Cranking Motor

moisture-proof metal cover and is located in the apparatus box on the left-hand side of the hull.

(3) CRANKING MOTOR. The cranking motor (fig. 68) is an electric motor used for cranking the engine in the vehicle. It is a 12-

75-MM HOWITZER MOTOR CARRIAGE M8



ENGINE ELECTRICAL SYSTEM

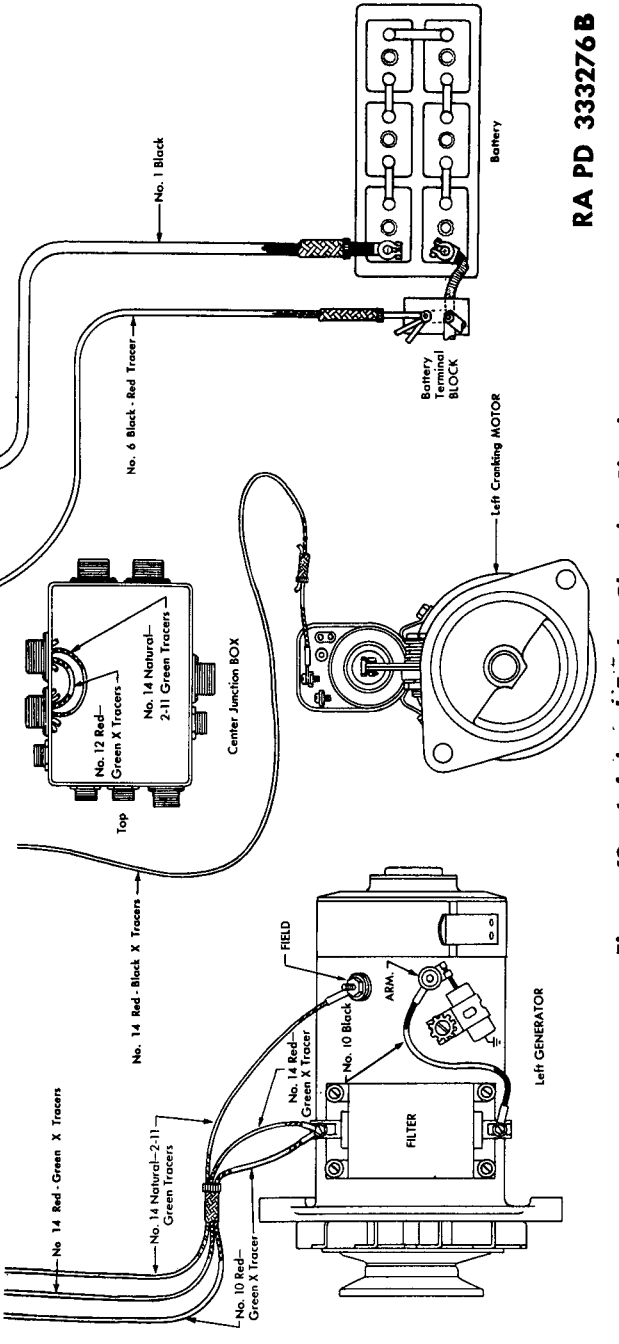
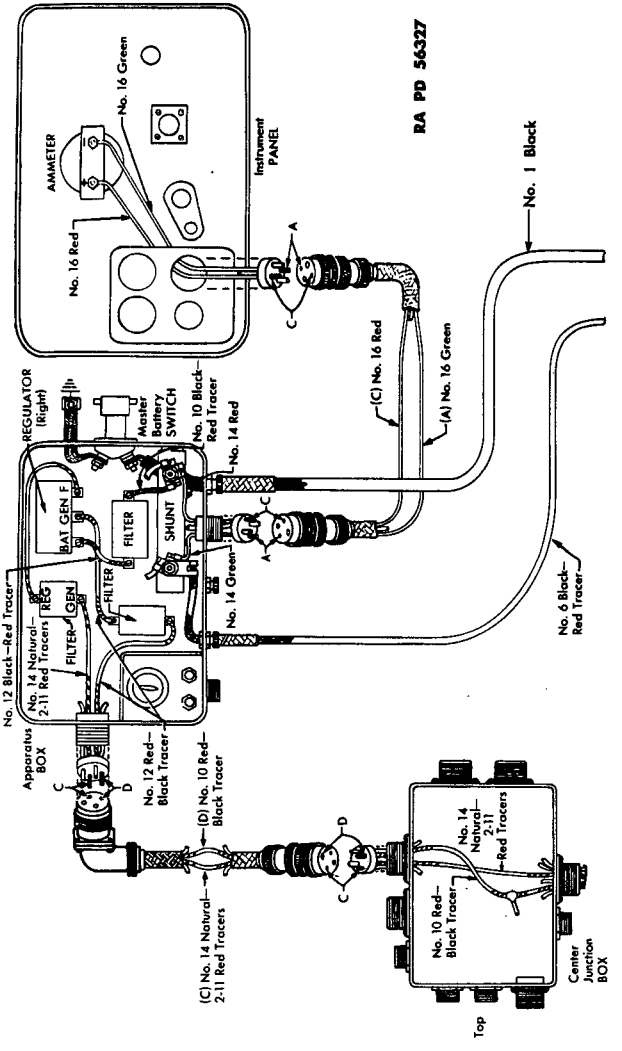


Figure 69 — Left-hand Engine Charging Circuit

75-MM HOWITZER MOTOR CARRIAGE M8



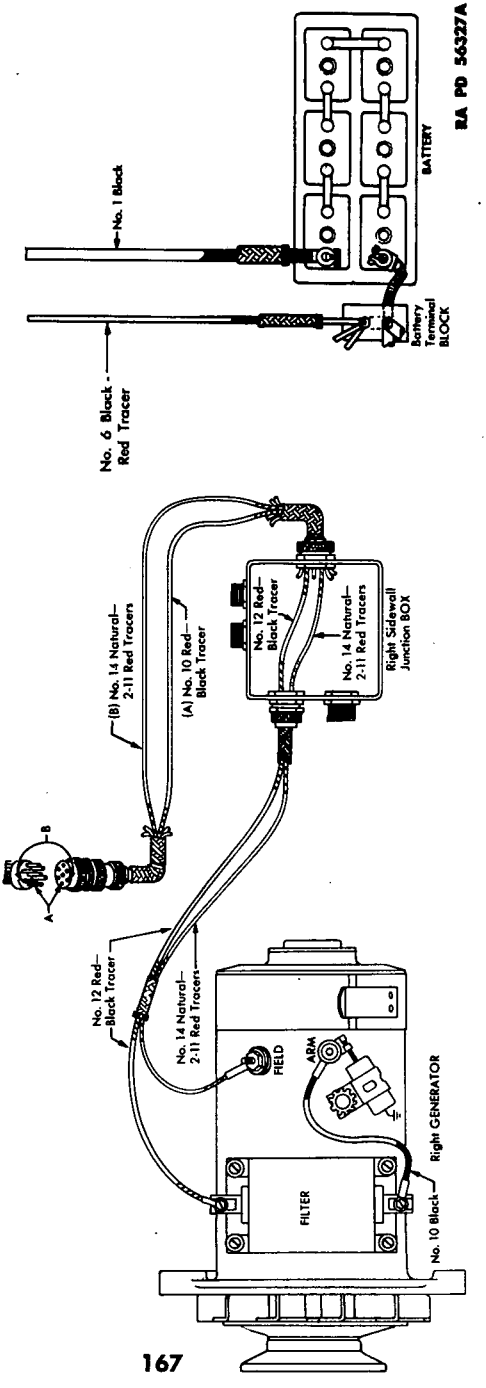


Figure 70 — Right-hand Engine Charging Circuit

Figure 71 — Removing Generator

volt, four-brush, four-pole unit. The armature shaft carries a pinion which is driven through an overrunning clutch mechanism and which is engaged with the flywheel ring gear. The cranking motor is operated through a solenoid-operated shifting mechanism.

b. Tabulated Data and Specifications.

Generator:
- Output, cold ..... 24 to 26 amperes at 15.0 volts at 1,500 rpm
- Rotation, drive end view ..... Clockwise
- Type number DR-1105902

Regulator:
- Type number DR-1118252

Cranking Motor:
- Rotation, drive end view ..... Clockwise
- Type number DR-1108114

87. GENERATOR REGULATORS

a. Removal. Rotate three screws holding cover of apparatus box one-half turn, and remove cover. Disconnect three wires to generator regulator. Remove three screws and washers holding generator regulator in place, and take assembly out of apparatus box.

b. Installation. Position generator regulator in apparatus box and secure in place by installing three mounting screws and washers. Connect three wires to regulator terminals (figs. 69 and 70). Install apparatus box cover and fasten in place by turning the three cover attaching screws one-half turn.

88. GENERATOR.

a. Removal. Turn master switch to "OFF" position. Open engine compartment rear doors, and remove fan, belt, and bracket. Disconnect wires at generator filter or armature terminal and at generator field terminal. Loosen generator mounting screws and remove generator belt (fig. 71). Remove mounting screws and remove generator and filter assembly.

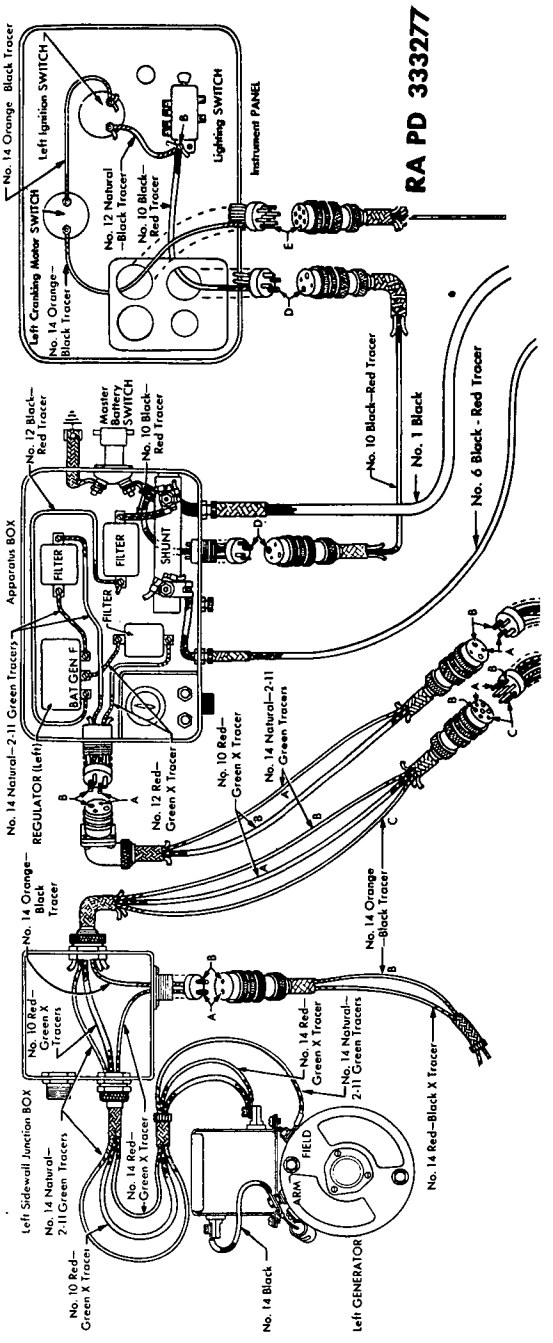
b. Installation. Place generator assembly in position and install mounting screws and lock washers fingertight. Connect wires at generator filter (or armature terminal) and at field terminal (figs. 69 and 70). Install and adjust generator and water pump belt. Install fan bracket and belt, and adjust belt. Close engine compartment doors. CAUTION: *After generator is installed and connected, always connect a jumper lead momentarily between the "GEN" terminal and the "BAT" terminal of the regulator in the apparatus box before starting the engine.* This allows a momentary surge of battery current to flow into the generator and polarize it correctly. NOTE: *Replace the generator regulator whenever a generator is replaced.*

89. CRANKING MOTOR.

a. Remove Right-hand Engine Cranking Motor. Turn master switch to "OFF" position. Open rear doors and remove conduits from post on solenoid switch. Remove floor plate under the transmissions, or floor plate under engines on late type vehicles. Remove two cap screws and lock washers holding cranking motor to flywheel housing, and disengage cranking motor drive end from flywheel housing. Allow cranking motor to drop down a few inches, being careful to support it while doing so, and remove two screws connecting conduit leads to top of solenoid switch. Cranking motor may now be removed from underneath vehicle.

b. Remove Left-hand Engine Cranking Motor. Remove floor plate from under the transmissions or from under engine on late type vehicles, and disconnect cable from solenoid switch. Remove two cap screws and lock washers holding cranking motor to flywheel housing, and disengage cranking motor drive end from flywheel housing. Allow cranking motor to drop down a few inches, being careful to support it while doing so, and remove two screws holding conduit leads to top of solenoid switch on cranking motor. Starter may now be removed from underneath vehicle.

75-MM HOWITZER MOTOR CARRIAGE M8



ENGINE ELECTRICAL SYSTEM

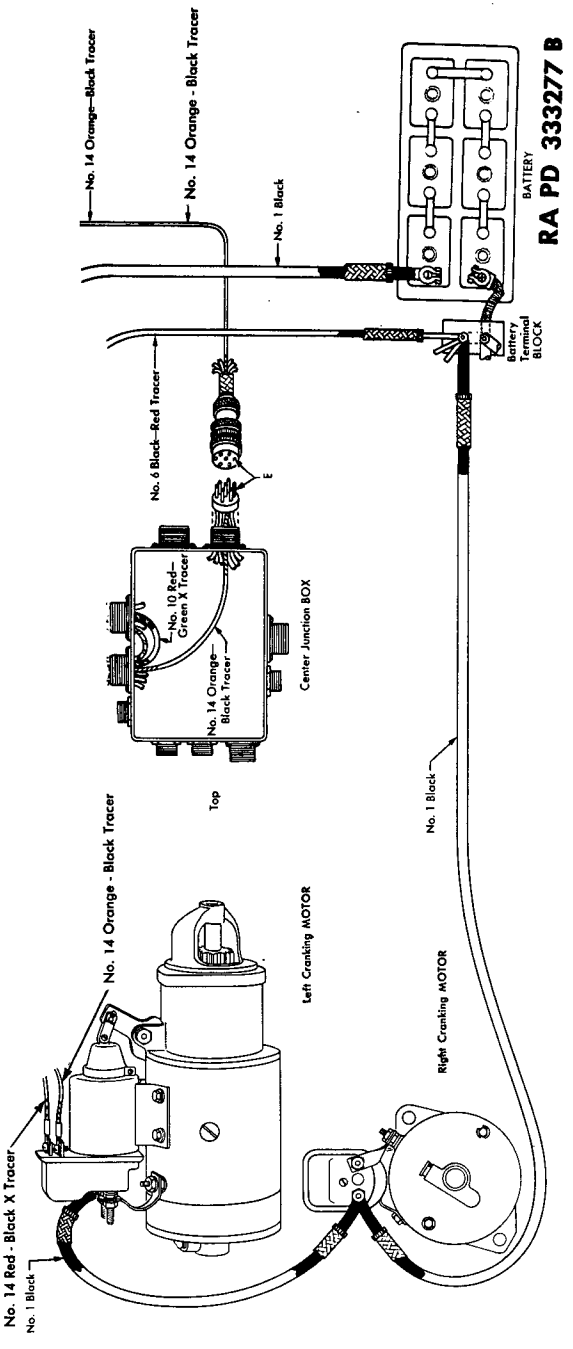
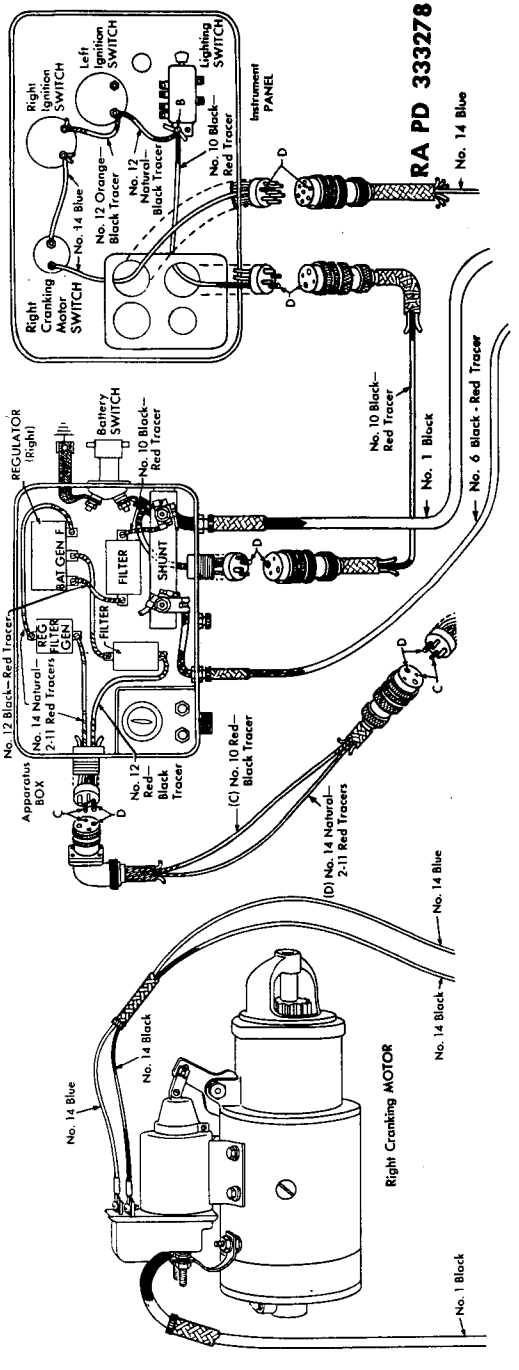


Figure 72 — Left-hand Engine Cranking Motor Circuit

75-MM HOWITZER MOTOR CARRIAGE M8



ENGINE ELECTRICAL SYSTEM

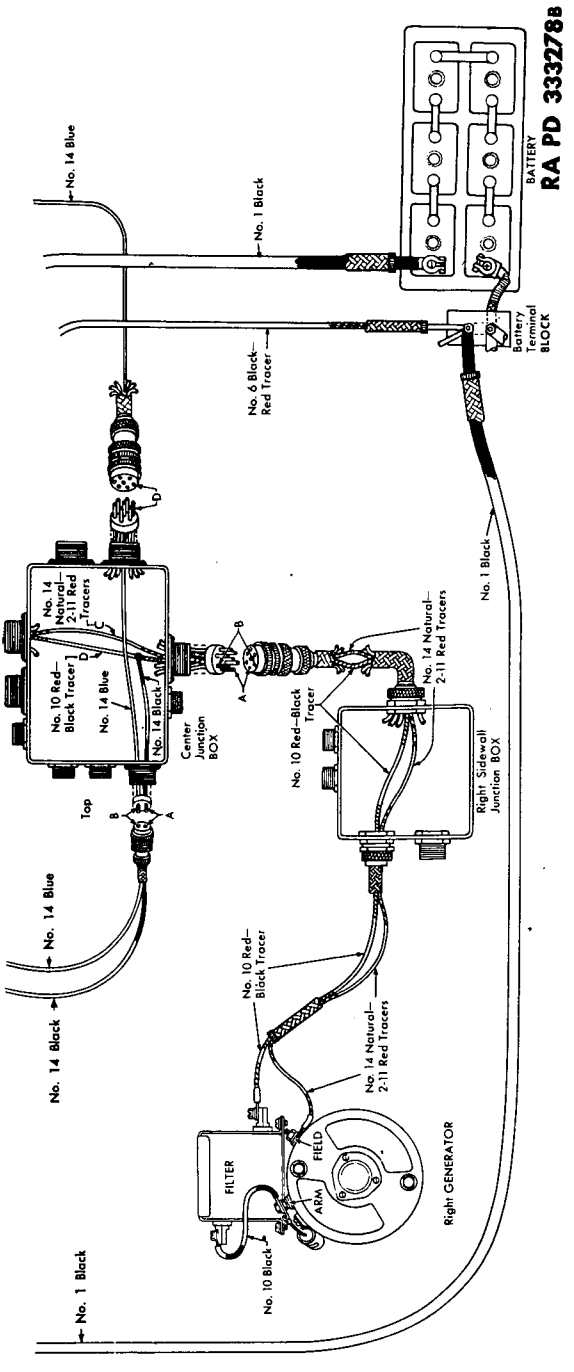


Figure 73 — Right-hand Engine Cranking Motor Circuit

c. Install Right-hand Cranking Motor. Working underneath vehicle, connect two conduit leads to back of solenoid on top of cranking motor (fig. 73). Connect right- and left-hand cranking motor cables at front of solenoid switch, and tighten lock washer and nut. Position cranking motor so drive gear meshes with flywheel teeth and tighten two screws and lock washers in place. Install floor plate.

d. Install Left-hand Cranking Motor. Working underneath vehicle, connect two conduit leads to back of solenoid on top of cranking motor. Connect conduit lead at front on solenoid switch and tighten lock washer and nut. Position cranking motor so that drive gear meshes with flywheel teeth and tighten two screws and lock washers in place. Install floor plate.

Section XVIII

FUEL SYSTEM

90. DESCRIPTION AND TABULATED DATA.

a. Description.

(1) The fuel system consists of two fuel tanks located in the sponsons just behind the bulkhead. A fuel line runs from the front of each tank to the main fuel filter on the left front of the bulkhead. The first type filter has a shut-off valve for each line, whereas the second type filter (fig. 74) has a combination shut-off valve. From the filter the gasoline feed line runs through the left-hand tank as shown, and out across the radiator support bracket. From here a line goes down to each fuel pump and thence up to each carburetor.

(2) Air for the engines is drawn from the fighting compartment through openings in the bulkhead leading to the fuel tank compartments. It cools the tanks in passing around them to the air cleaners which are located at the extreme rear of the sponsons. From the cleaners, the air passes through outlet elbows and hoses to the carburetors.

FUEL SYSTEM

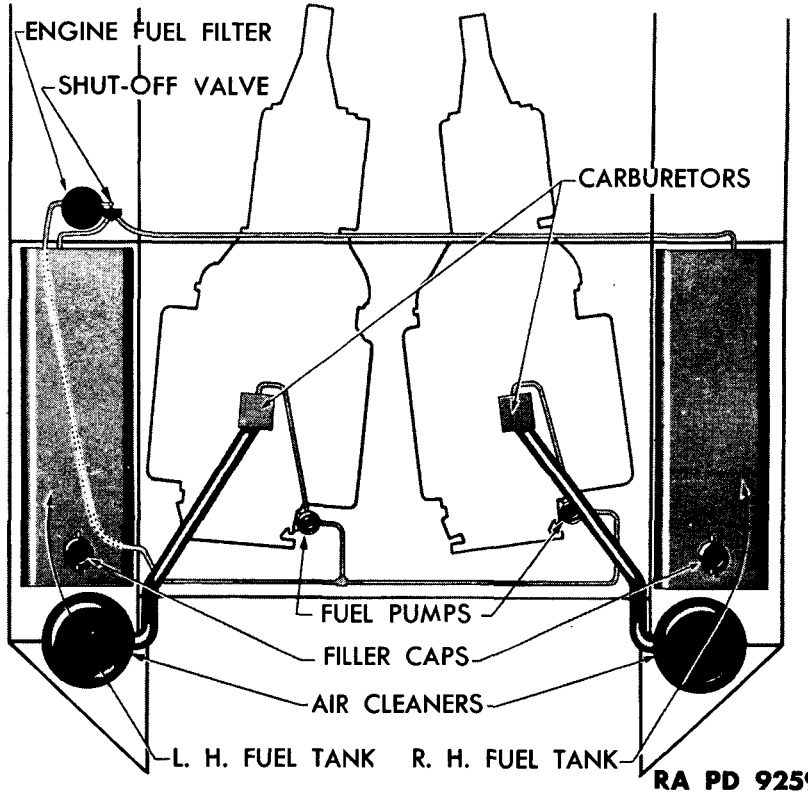


Figure 74 — Fuel System

b. Tabulated Data.

(1) CARBURETOR.

Make	Carter
Model	WCD-553 S
Gas line connection	3/8-in. elbow
Idle adjustment	Screw type
Choke type	Automatic climatic control

(2) FUEL PUMP.

Make	AC
Model	AC-BE
Diaphragms	Fabric
Number	5
Diameter	4 in.

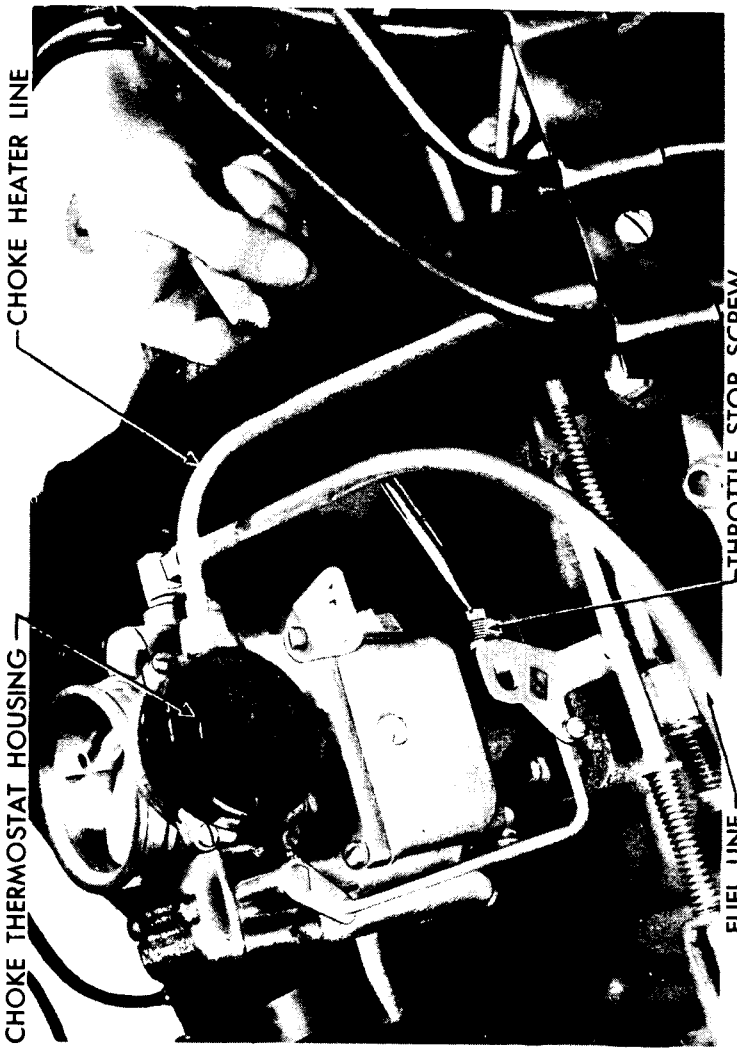
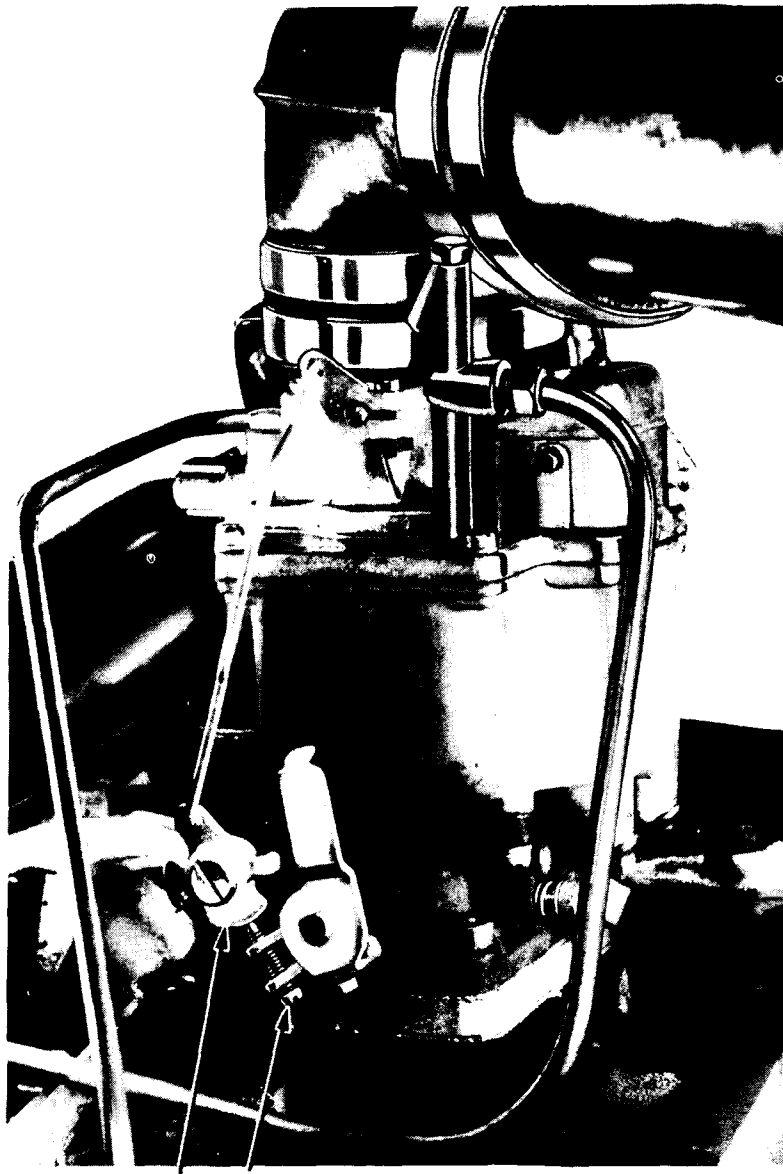


Figure 75 — Adjusting Throttle Stop Screw



RA PD 333259

Figure 76 — Fast Idle Linkage

(3) FUEL FILTER.

Type	Laminated strainer

(4) AIR CLEANER.

Type	Oil bath
Filter element type	Steel mesh
Type wire	Crimped tubular
Reservoir oil capacity (approx.)	3 pt

91. CARBURETORS.

a. Description. The carburetors are of the downdraft type with dual barrels, each barrel supplying the fuel mixture to four cylinders through the intake manifolds. There are four separate fuel circuits in the carburetor: the low-speed circuit; the high-speed circuit; the throttle pump circuit; and the float circuit.

b. Carburetor Adjustments.

(1) IDLING SPEED ADJUSTMENT. Run engines until temperature reaches 165° F. Remove bulkhead door and adjust throttle stop screw (fig. 75) so that engine speed is from 425 to 450 revolutions per minute as noted on the tachometer, with the transmission selector lever in "DR" position and parking brakes set. Stop engine, turn off master switch, and open engine compartment rear doors. Tighten two idling mixture adjusting screws as far as possible without forcing. Then loosen screws 1¼ turns. Start engine to see that it runs smoothly without loping or stalling. Stop engine and readjust screws if necessary.

(2) AUTOMATIC CHOKE ADJUSTMENT. Open engine compartment rear doors and check to see that choke setting mark on choke thermostat housing is opposite long mark on carburetor flange (fig. 75). Adjust choke setting, if necessary, by loosening three thermostat housing mounting screws and rotating housing until marks line up. Tighten mounting screws.

(3) FAST IDLING ADJUSTMENT (EARLY TYPE CARBURETOR ONLY). On carburetors equipped with the fast idle linkage (fig. 76), readjust this linkage when the engines are cold, as follows: Remove bulkhead doors and check to see that fast idle screw is resting on high lobe of fast idle cam. Start engine and note engine speed indicated on tachometer. Adjust engine speed to between 625 and 675 revolutions per minute by turning fast idle adjusting screw.

(4) CARBURETOR SYNCHRONIZING ADJUSTMENT. After adjusting both carburetors, check synchronization of engine speed while idling, and also at 1,000 revolutions per minute. Speed of engine should not vary more than 50 revolutions per minute at idling, or 100 revolutions per minute at 1,000 revolutions per minute. Equalize speed of engines as follows: Open rear doors and insert long gage pin (41-G-249-50)

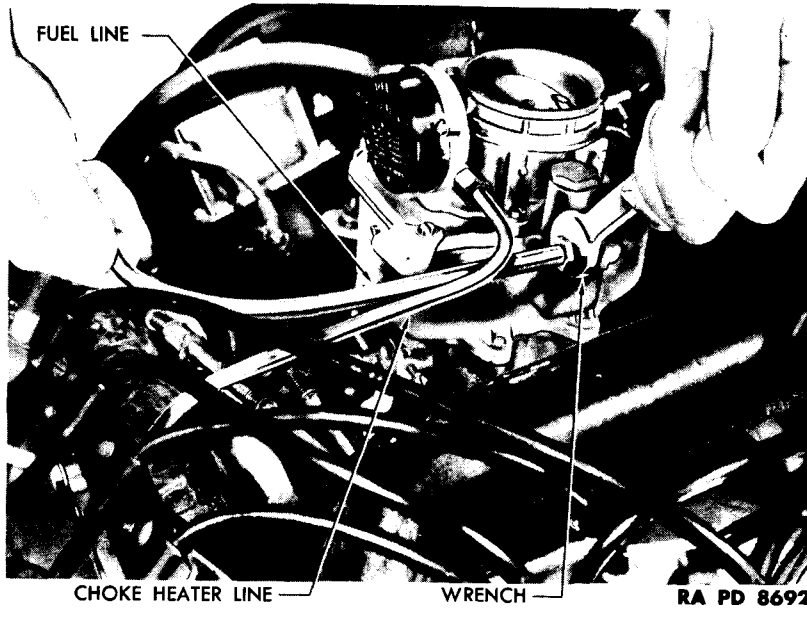


Figure 77 — Removing Fuel Line

through pin hole in left upper rear relay cross shaft lever, and into pin hole in support bracket. Remove bulkhead doors and check to see whether another gage pin can be inserted through pin holes in distributor relay on right-hand engine, and into pin hole in distributor support. If pin cannot be inserted, readjust length of right-hand cross shaft to carburetor throttle rod. This adjustment is made at the carburetor on early type engines, and at the cross shaft on later type engines. After readjusting rod for right-hand engine, check length of rod for left-hand engine in same manner. Remove gage pins and recheck synchronization of engines, making any slight adjustments as required. Close engine compartment rear doors and bulkhead doors.

c. Carburetor Removal. Open engine compartment rear doors. Remove fan, belt and support bracket. Disconnect carburetor air intake pipe at carburetor by loosening clamps. Disconnect fuel and choke heater lines from all carburetors (fig. 77), and drain line from early type carburetors. Remove cotter pin from truunion on carburetor and throttle rod, and remove washer from trunnion (fig. 78). Disconnect throttle rod and trunnion from carburetor. Remove four nuts holding carburetor to intake manifold mounting studs and remove carburetor, insulator, and gaskets.

d. Carburetor Installation. Position the lower carburetor gasket on studs on intake manifold. Position the carburetor insulator and top

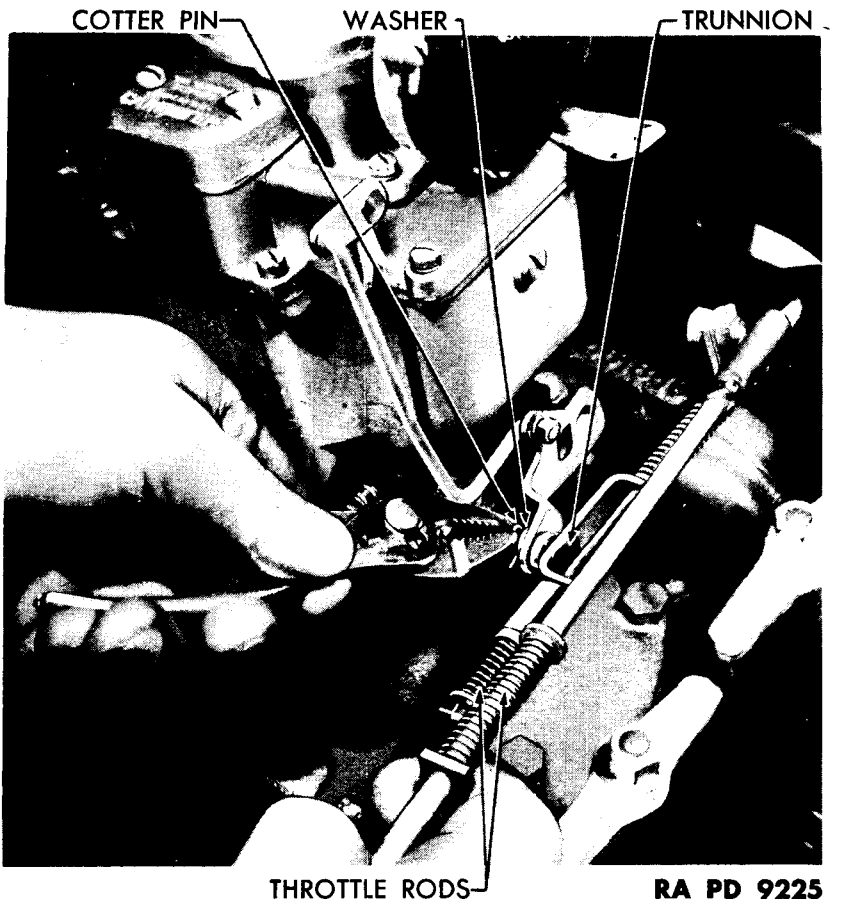


Figure 78 — Removing Throttle Rod

gasket on intake manifold stud (fig. 79). Install carburetor on intake manifold mounting studs, and install four lock washers and nuts. Position throttle rod trunnion on carburetor throttle valve shaft, and install washer and cotter pin. Position carburetor air intake pipe on upper end of carburetor, and tighten clamps. Connect fuel and heater lines to carburetor. Install fan, adjust fan belt, and close engine compartment rear doors.

92. FUEL PUMPS.

a. Description. Each engine is equipped with a diaphragm-type fuel pump. These fuel pumps have the dual purpose of pumping fuel from the tanks to the carburetors, and of further straining the fuel to remove any dirt or foreign matter in it. The fuel pumps are mounted

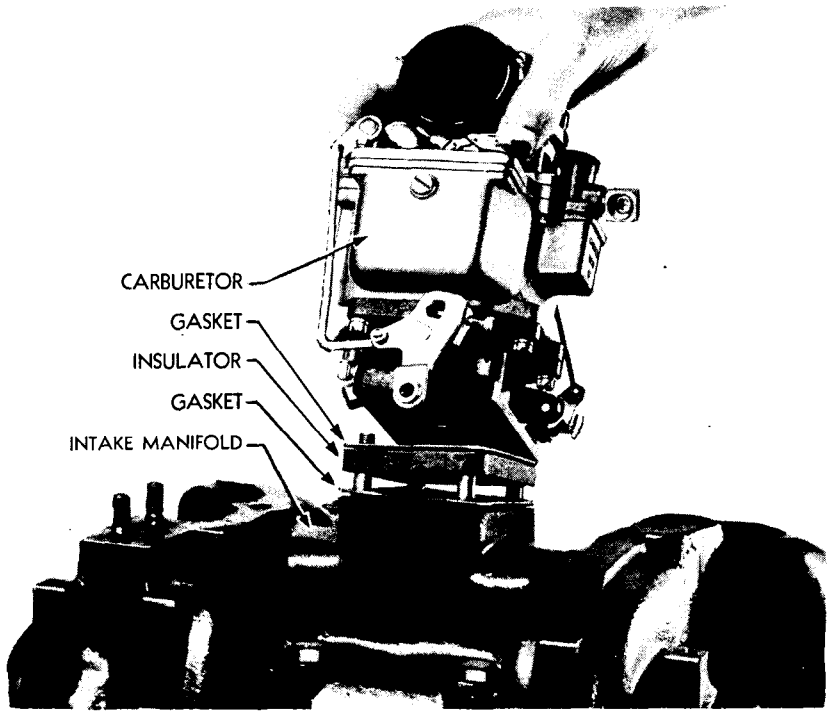


Figure 79 — Installing Carburetor RA PD 333260

on the left side of the engine front cover, and are driven by arms actuated by eccentrics on the front ends of the camshafts.

b. Cleaning Fuel Pumps. Close shut-off valve at fuel filter in fighting compartment. Open engine compartment rear doors and remove engine fan. Loosen fuel pump bowl bail nut, and swing bail to side. Lift bowl off fuel pump upper cover and remove bowl gasket. Lift strainer assembly off pump. Clean strainer assembly thoroughly with compressed air. Clean bowl with compressed air and dry-cleaning solvent. Plug fuel pump intake port on upper cover with a cork or rubber plug, and direct compressed air into the sediment chamber in the fuel pump upper cover (fig. 80). Install straining assembly on upper cover. Position a new bowl gasket on upper cover and install fuel pump bowl. Swing bail over bowl and tighten bowl nut. Install fan, adjust fan belt and close engine compartment rear doors.

c. Fuel Pump Removal. Shut off fuel line valve at main fuel filter and run engine until fuel in pump is exhausted. Open engine compartment rear doors and remove fan, belt and bracket. Disconnect fuel lines at fuel pump. Remove two screws holding fuel pump to left side of engine front cover (fig. 81). Remove fuel pump and gasket.

Figure 80 — Cleaning Fuel Pump

d. Fuel Pump Installation. Working through engine compartment rear doors, position a new fuel pump gasket on fuel pump mounting boss. Position fuel pump on mounting boss so that rocker arm is resting on camshaft eccentric. Install two screws and lock washers holding fuel pump to front cover. Connect fuel lines at fuel pump. Install fan, adjust fan belt and close engine compartment rear doors.

93. FUEL FILTERS.

a. Description.

(1) MAIN ENGINE FILTER. A disk-type fuel filter is incorporated in the fuel supply system to strain the fuel before it reaches the engines. This filter is located on the upper left-hand corner of the bulkhead in the fighting compartment. Shut-off valves at the filter permit the use of fuel from either tank or shut off the fuel from both tanks.

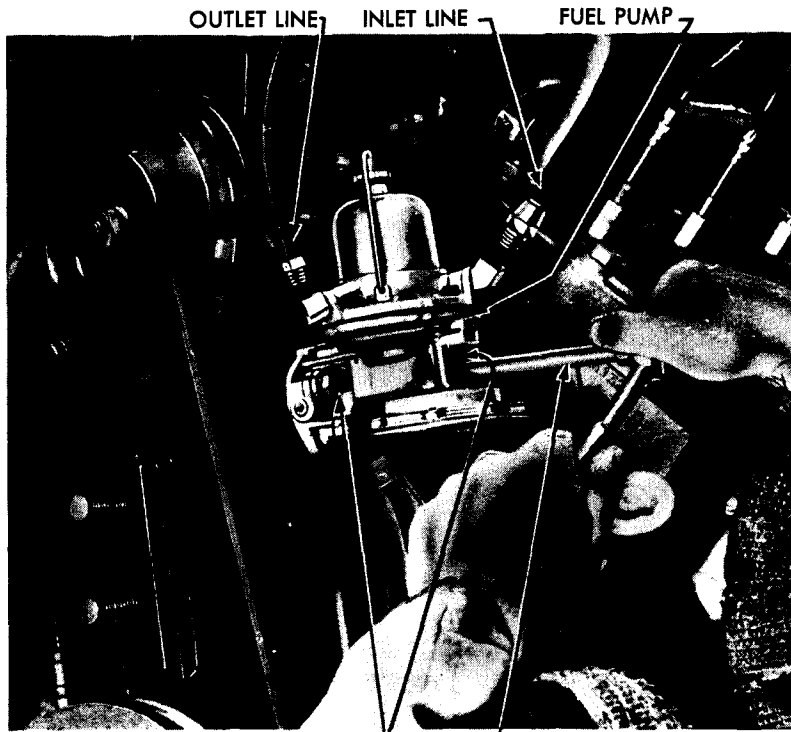


Figure 81 — Removing Fuel Pump

b. Cleaning Fuel Filters.

(1) MAIN ENGINE FILTER. To clean the main fuel filter, first shut off the gasoline either by closing both valves on early-type filters, or by turning the single valve so that the pointer is straight up on late-type vehicles (fig. 82). Place a small pan underneath the filter and remove bowl retainer plug and allow fuel to drain. Remove bowl from filter cover and clean thoroughly with compressed air and dry-cleaning solvent. Remove screw and lock washer from center of upper cover, and lower bowl stem, strainer spring, and strainer assembly from filter cover. Clean strainer assembly thoroughly with compressed air. Position a new strainer gasket on strainer assembly, and position on filter cover, inserting bowl stems with spring installed through the strainer assembly. Install stem retainer screw in upper cover. Position a new filter bowl cover gasket on cover, and install bowl. Install plug through bowl into stem.

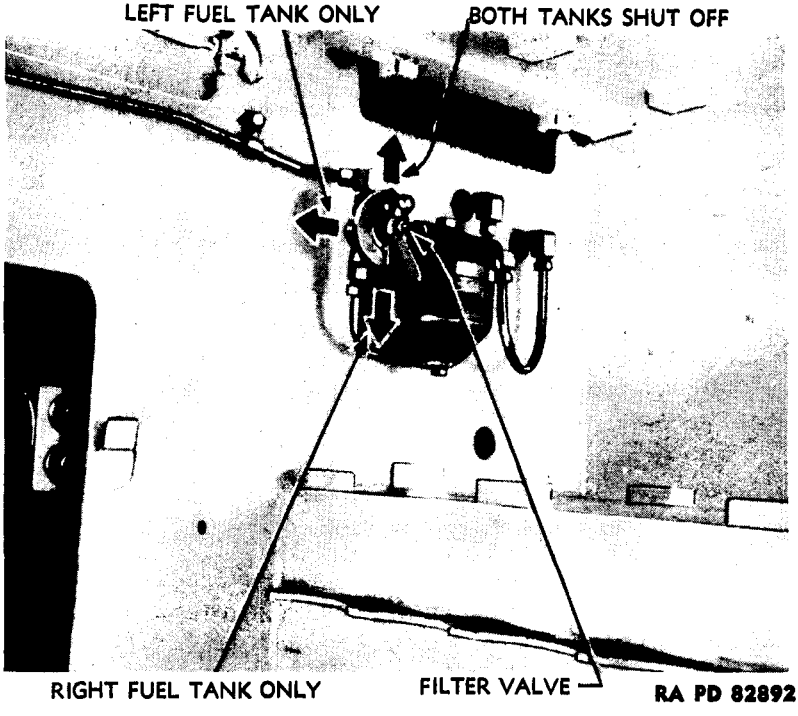


Figure 82 – Fuel Filters

c. Removal.

(1) MAIN ENGINE FILTER. To remove main fuel filter, drain both fuel tanks, and disconnect one outlet and two inlet lines at filter end. Remove two screws, lock washers and flat washers holding filter to bulkhead and remove filter.

d. Installation.

(1) MAIN ENGINE FILTER. To install main fuel filter, position filter on bulkhead and install two flat washers, lock washers, and screws. Connect fuel outlet line and two fuel inlet lines to fittings on filter. Install both fuel tank drain plugs and refill tanks.

94. FUEL TANKS.

a. Description. Two fuel tanks with a capacity of 43 gallons each are provided for the engine fuel system. These tanks are located in the sponsons just behind the bulkhead, and are wedged tightly in place by wooden and paper spacers. Fuel from each tank is drawn through a screened outlet pipe to a common fuel filter.

b. Draining Fuel Tanks. On late-type vehicles, open door in sand shield for air cleaner (fig. 2). On all vehicles, remove four nuts and lock washers holding fuel tank drain plug cover to sponson floor. Place a pan underneath the drain plug, resting pan on top of track. Remove drain plug and allow fuel to drain. Reinstall drain plug in tank and fasten drain plug cover to sponson floor.

c. Fuel Tank Removal.

(1) DRAIN FUEL TANK. Drain fuel tank as explained in previous subparagraph.

(2) REMOVE FUEL TANK COVER. Remove 14 screws holding fuel tank cover to brackets on top of hull; remove fuel tank filler caps, and remove fuel tank cover. Remove five screws holding forward hinged section of engine compartment cover at top of hull and swing forward section back over rear section.

(3) REMOVE MOUNTING BRACKETS. Remove three screws holding outer front fuel tank cover mounting bracket to outer sponson wall, and remove bracket. Remove three screws holding outer rear bracket to outer sponson wall, and remove bracket. Remove three screws holding inner rear bracket to inner sponson wall, and remove bracket.

(4) DISCONNECT FUEL LINES. Disconnect fuel line from fuel tank to fuel filter at tank end while holding fitting on tank. Remove fuel line nipple from front end of tank. Disconnect fuel lines from left fuel tank to fuel pumps, and fuel filter outlet line from front of left fuel tank. Remove nipples from front and side of left fuel tank.

(5) REMOVE REAR FUEL TANK SHIM. Loosen four screws and lock washers holding fuel tank rear shim retainer plate to brackets on sponson walls. Push retainer plate toward rear of vehicle, and lift shim out from behind tank.

(6) REMOVE FUEL TANK. Push fuel tank rearward slightly and lift out of sponson. Remove front, side and bottom fuel tank shims from sponson.

d. Install Fuel Tank and Connect Fuel Lines.

(1) INSTALL FUEL TANK. Position front, side and bottom fuel tank shims in sponson. Lower fuel tank into position in sponson, and push forward as far as possible. Position fuel tank rear shim behind tank, and tighten four lock washers and screws that hold shim retainer plate to bracket on sponson walls.

(2) CONNECT FUEL LINES. On left-hand tank, install nipple on left side of tank and connect fuel line from fuel pumps. On left-hand tank, connect outlet line from filter, using new type screw. Tighten to 13 to 14 foot-pounds. On right- and life-hand tanks, install nipple and connect fuel line to fuel filter.

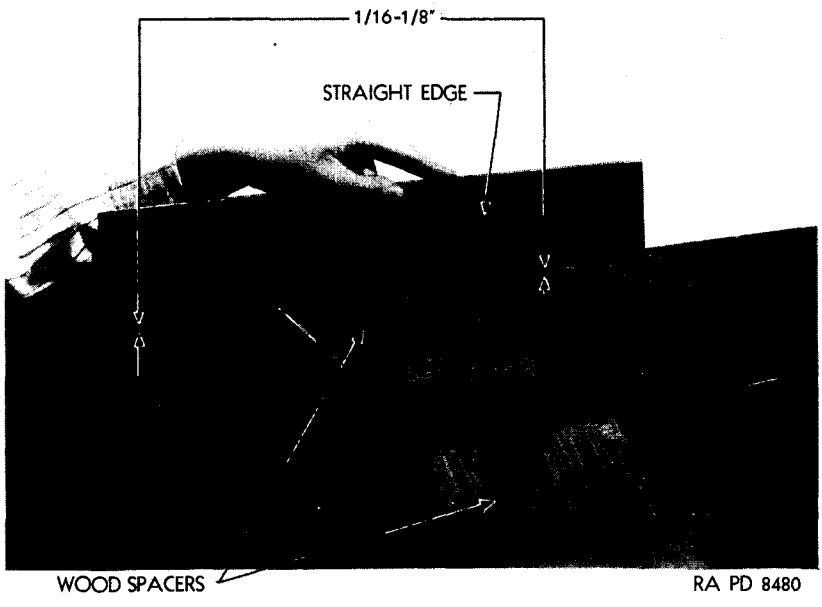


Figure 83 — Alining Fuel Tank Spacer

(3) INSTALL MOUNTING BRACKETS. Position inner rear cover mounting bracket on inner sponson wall and install lock washers and screws. Position inner front cover mounting bracket and outer front and rear mounting brackets in turn, installing the three lock washers and mounting screws for each bracket.

(4) CHECK ALINEMENT. Lay a straightedge across the inner and outer mounting brackets and over the top shim on the fuel tank. Straightedge should rest on shim and should have between $\frac{1}{16}$-inch and $\frac{1}{8}$-inch clearance between lower edge of straightedge and top of inner and outer mounting brackets (fig. 83). If clearance is incorrect, straighten clips holding top fuel tank wooden shim to tank and remove shim. Remove or install paper shims between top of fuel tank and wooden shim until proper clearance is obtained. Install wooden shim, bend over mounting clips and recheck tank alinement.

(5) INSTALL FUEL TANK COVER. Apply a liberal coating of caulking or sealing compound on cover mounting brackets and top of hull where cover rests. Lift fuel tank cover into position on vehicle. Install fuel tank filler caps. Install 14 mounting screws. Apply caulking or sealing compound to top of hull where forward hinged section of engine compartment cover rests. Swing hinged section into position and install five mounting screws.

95. AIR CLEANERS.

a. Description. Each engine is equipped with an oil-bath air cleaner mounted in the extreme rear of sponson behind the fuel tank. The cleaners draw air from the fighting compartment through small port holes in the bulkhead that open into the sponson, thus permitting air to flow around the fuel tank and back to the cleaners. The air from the cleaners flows through outlet connections into the engine compartments and down to the carburetors.

b. Cleaning. Wash the filter element in dry-cleaning solvent, and dry with compressed air.

c. Removal. On vehicles equipped with sand shields, turn screw holding the sand shield door ¼ turn, and open the doors. Remove screw and flat washer holding air cleaner cover plate to sponson floor. Remove fuel tank cover. Remove three screws holding air cleaner to inner sponson wall and remove screw holding air cleaner bracket to inner sponson wall. Lower air cleaner through opening in sponson floor.

d. Air Cleaner Installation. Insert air cleaner assembly through opening in rear of sponson floor and position on inner sponson wall. Install three lock washers and screws holding air cleaner elbow to sponson wall, and install lock washer and screw holding air cleaner bracket to sponson wall. Fill air cleaner with oil and install cover plate in sponson floor. Install fuel tank cover.

Section XIX

HYDRA-MATIC TRANSMISSION

96. DESCRIPTION AND TABULATED DATA.

a. Description. The Hydra-Matic transmission (fig. 84) consists of a fluid coupling and an automatic transmission having four forward speeds and one reverse speed. Slippage in the fluid coupling at idling speeds eliminates the need for a clutch. Gear changes are made by hydraulic pressure, and are governed by the speed of the

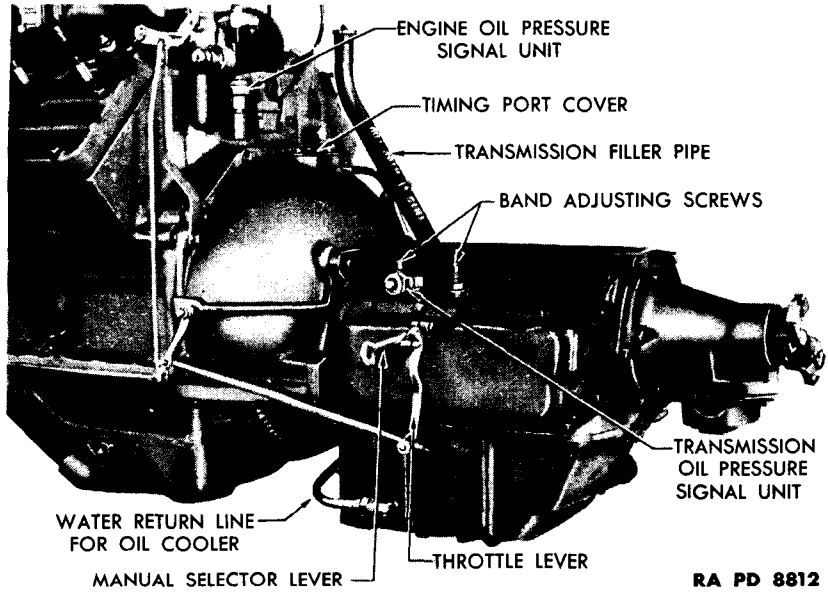


Figure 84 — Hydra-Matic Transmission

vehicle and the extent to which the driver depresses the accelerator. In this section, the fluid coupling end of the transmission will be referred to as the "front" end, and the propeller shaft end as the "rear" end.

b. Tabulated Data.

Clutch type	Fluid coupling
Number of speeds, forward	4
Number of speeds, reverse	1
1st speed gear ratio	3.26 to 1
2nd speed gear ratio	2.26 to 1
3rd speed gear ratio	1.44 to 1
4th speed gear ratio	1 to 1
Reverse gear ratio	3.81 to 1
Type gearing	Planetary

97. BAND ADJUSTMENTS.

a. General. The front band as designated in this manual is the bend toward the fluid coupling, while the rear band is the one toward the propeller shaft end of the transmission. Both bands may be adjusted while the transmission is in the vehicle after removing the shell racks and bulkhead extension cover. Early type transmissions require the use of a torque wrench (41-W-3630) in adjusting

HYDRA-MATIC TRANSMISSION

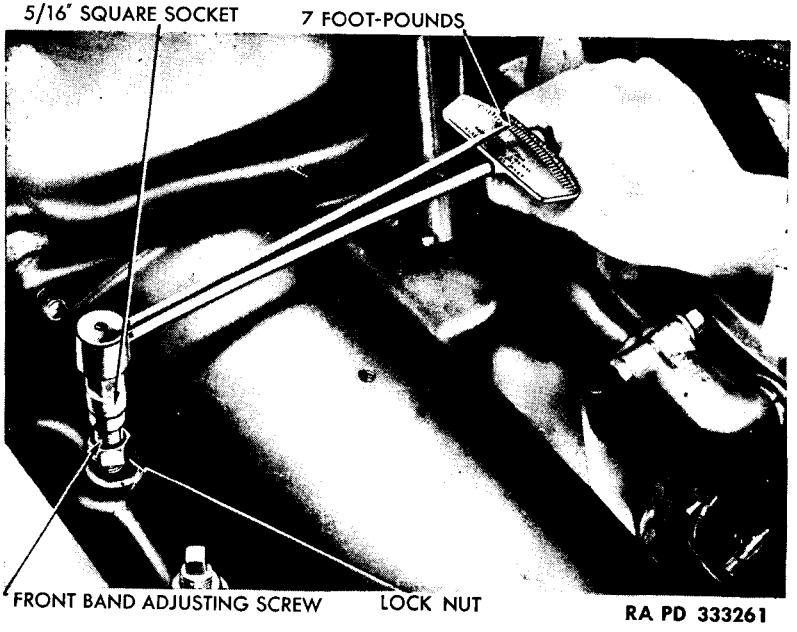


Figure 85 — Adjusting Front Band with Torque Wrench

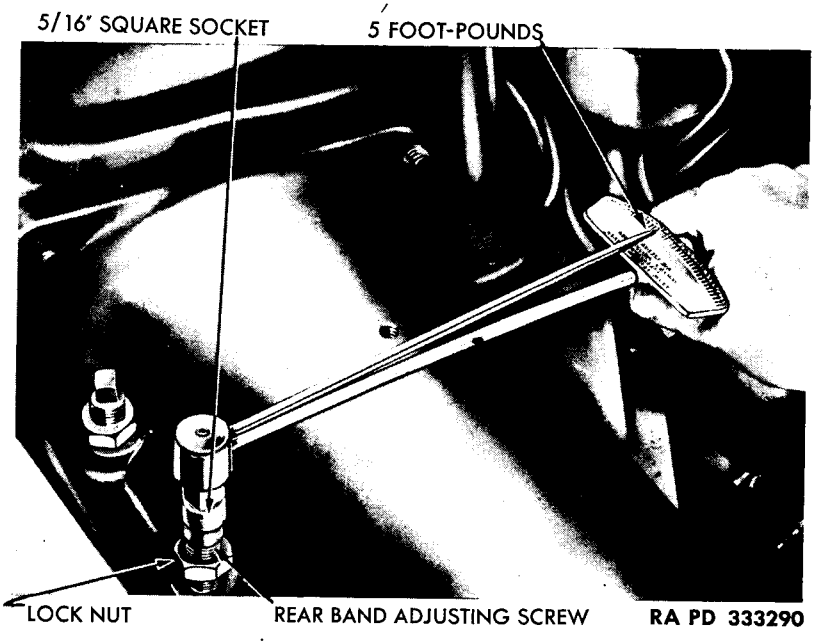


Figure 86 — Adjusting Rear Band with Torque Wrench

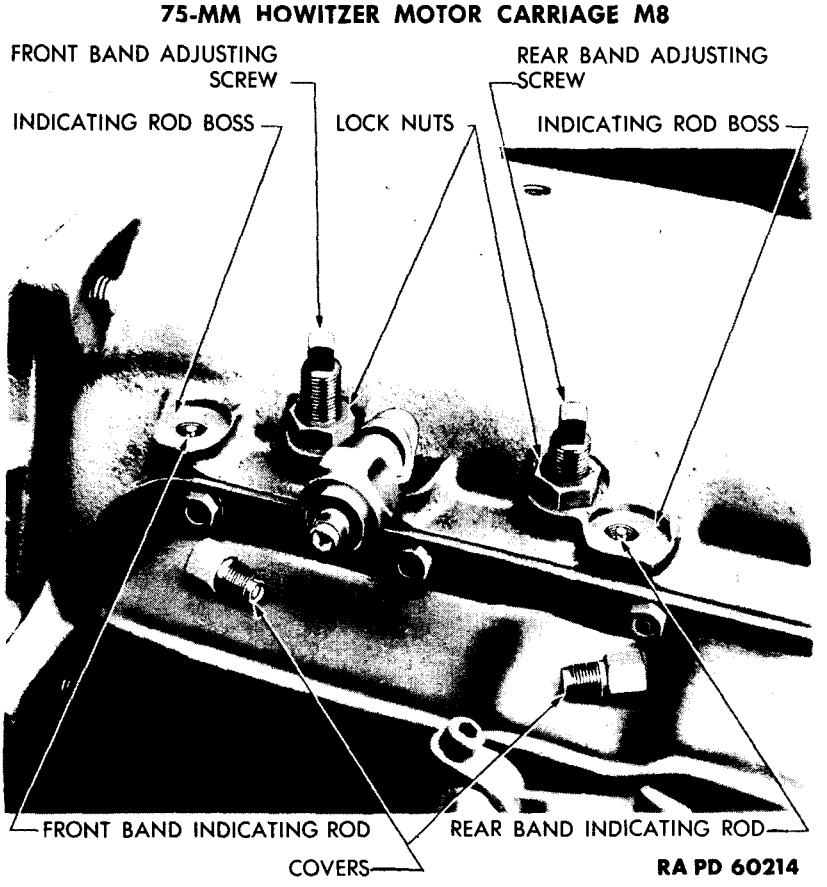


Figure 87 — Band Adjustment with Indicator Rods

bands, using procedures in subparagraphs **b** and **c** below. Late type transmissions fitted with indicator rods are adjusted according to subparagraph **d** below.

b. Adjusting Front Band with Torque Wrench. Loosen front band adjusting screw lock nut (toward rear of vehicle). Make sure that adjusting screw is free enough to turn with fingers. Tighten front band adjusting screw to a tightness of 7 foot-pounds using wrench (41-W-3630) (fig. 85). Back off front band adusting screw 8 full turns, and tighten adusting screw lock nut while holding adjusting screw stationary.

c. Adjusting Rear Band with Torque Wrench (41-W-3630). Place transmission selector lever in neutral and start engine. Set brakes, move selector lever to "DR", and set hand throttle so that engine is running at approximately 1,000 revolutions per minute. Loosen rear band adusting screw lock nut (toward front of vehicle).

Check adjusting screw to see that it is loose enough to be turned with fingers. Tighten rear band adjusting screw to a tightness of 5 foot-pounds (fig. 86). Back off rear band adjusting screw two full turns, and tighten band adjusting screw lock nut while holding adjusting screw stationary. Stop engine.

d. Adjusting Band with Indicator Rods. Place transmission selector lever in neutral and start engine. Loosen band adjusting screw lock nuts and remove indicating rod covers. Set brakes, move selector lever to "DR", and set hand throttle so that engine is running approximately 1,000 revolutions per minute. Check position of indicating rods for both bands (fig. 87). The rod ends should be exactly flush with the rod bosses on the case when checked with a straight edge or scale. Turn adjusting screws up or down as required to secure this adjustment. Lock adjusting screw lock nut and install indicating rod covers. Stop engine. CAUTION: *Do not allow engine to pull against fluid coupling for more than 1 minute, and allow at least 3 minutes for the oil to cool before repeating.*

98. MANUAL CONTROL LINKAGE ADJUSTMENT.

a. General. The complete manual control linkage adjustment is given in this paragraph. It is not necessary to make the complete adjustment if only the engines or the controlled differential are removed. In the case of engine removal, it is only necessary to make the adjustment from the intermediate relay rearward. In the case of controlled differential removal, it is only necessary to make the adjustment from the intermediate relay forward.

b. Equipment. The special tools required to make the complete manual control linkage adjustment are as follows:

GAGE PINS, throttle control adjusting..... (41-G-249-50)
GAGE, throttle, intermediate relay..... (41-G-426-20)

c. Adjustment Procedure.

(1) DISCONNECT RODS AT SELECTOR LEVER. Disconnect rod between selector lever and transfer unit reverse servo release lever at selector lever end (fig. 89). Place selector lever in "REV" position (make sure that it is in detent position shown on quadrant by the arrow) and disconnect rod at lower end of selector lever.

(2) REMOVE FLOOR PLATE. Remove floor plate in hull underneath transmission by taking out 28 screws and lock washers. CAUTION: *Floor plate weighs over 80 pounds; support with jacks while removing.*

(3) DISCONNECT CONTROL RODS. Disconnect manual control rod from right transmission at intermediate relay. Disconnect manual control rod for left transmission at manual control valve lever.

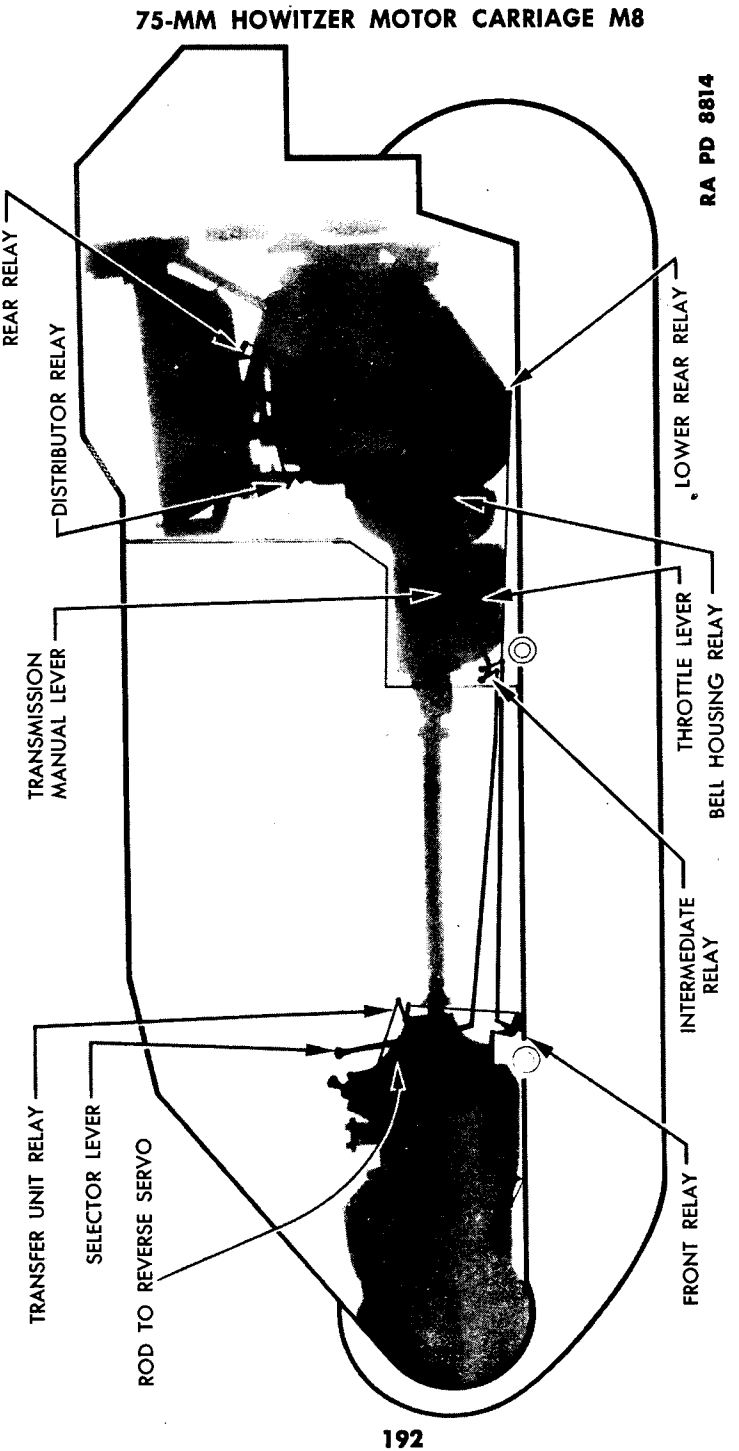


Figure 88 — Control Linkage Arrangement

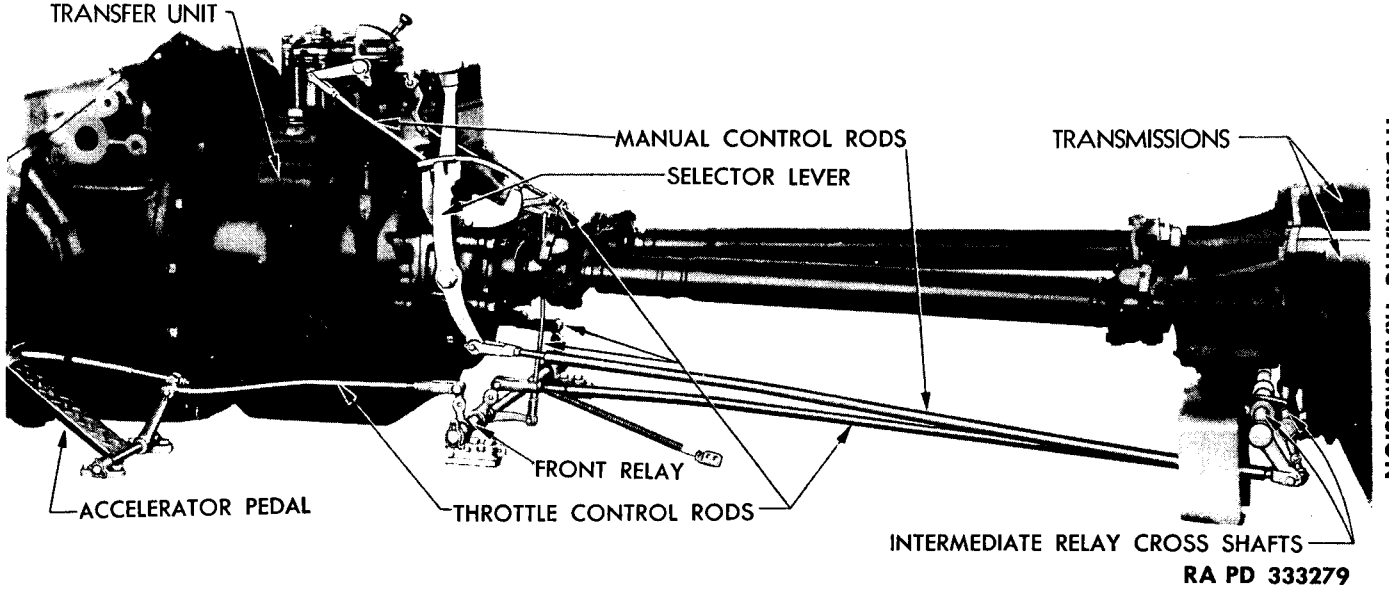


Figure 89 — Transfer Unit and Transmission Control Linkage

(4) INSTALL INTERMEDIATE RELAY GAGES. Install intermediate relay throttle gage (41-G-426-20) next to manual lever and throttle lever on left ends of intermediate relay cross shafts. Install two long gage pins (41-G-249-50) through pin holes on intermediate relay throttle and manual levers and into holes in throttle gage to lock levers in a fixed position.

(5) ADJUST RIGHT MANUAL CONTROL ROD. Place manual control lever on right transmission in reverse position (all the way forward toward front of vehicle) making sure that reverse anchor is fully engaged. Adjust length of rod at intermediate relay by loosening trunnion lock nut and rotating trunnion so that pin will slip into intermediate relay lever. Install trunnion clevis pin and cotter pin, and tighten lock nut.

(6) ADJUST LEFT MANUAL CONTROL ROD. Place manual control lever on left transmission in reverse position (all the way forward toward front of vehicle), making sure that reverse anchor is fully engaged. Adjust length of rod at transmission by loosening clevis lock nut and rotating clevis so that clevis pin will slip into manual control lever on transmission. Install clevis pin and cotter pin, and tighten clevis lock nut.

(7) ADJUST ROD AT SELECTOR LEVER. Adjust length of rod disconnected from lower end of selector lever by loosening clevis lock nut and rotating clevis with a pair of pliers until clevis pin slips into selector lever. CAUTION: *Selector lever must be in "REV" position.* Install clevis pin and cotter pin and tighten clevis lock nut. Remove gage pins and throttle gage from intermediate relay.

(8) ADJUST MANUAL ROD TO TRANSFER UNIT REVERSE SERVO. Working in fighting compartment, move transmission and transfer unit selector lever past "REV" position (toward rear of vehicle) as far as it will go. Hold selector lever in that position while adjusting length of rod from selector lever to reverse servo until, when clevis pin is inserted, stop on reverse servo just contacts stop on servo body. Release selector lever; install clevis pin and cotter pin, and tighten clevis lock nut.

(9) INSTALL FLOOR PLATE. Support floor plate with jacks and raise into position on hull floor. Install 28 screws and lock washers.

99. THROTTLE CONTROL LINKAGE.

a. General. The complete throttle control linkage adjustment is given in this paragraph. It is not necessary to make the complete adjustment if only the engine or the controlled differential is removed. In case of engine removal, it is only necessary to make the adjustment from the intermediate relay rearward. In the case of controlled differential removal, it is only necessary to make the adjustment from the intermediate relay forward.

b. Equipment. The special tools required to make the complete throttle linkage adjustment are as follows:

GAGE PINS, throttle control adjusting ..... (41-G-249-50)
GAGE, throttle front relay ..... (41-G-426)
GAGE, throttle intermediate relay ..... (41-G-426-20)

c. Adjustment.

(1) OPEN DOORS. Remove floor pan, open engine compartment rear doors and bulkhead doors, and remove shell racks.

(2) DISCONNECT THROTTLE RODS. Disconnect throttle rod from throttle levers on sides of transmission by removing cotter pin in trunnion shaft. Disconnect throttle rods extending from upper rear relay cross shaft lever to carburetors (second type at cross shaft relay lever end, first type at carburetor end).

(3) INSTALL GAGE PINS. Insert throttle linkage short gage pins (41-G-249-50) through pin holes in distributor relay levers, and into pin hole in distributor support housings. Insert long gage pin (41-G-249-50) through pin hole in left upper rear relay cross shaft lever, and into pin hole in left cross shaft support bracket.

(4) ADJUST CARBURETORS. Adjust carburetors on both engines (par. 91).

(5) ADJUST THROTTLE RODS AT TRANSMISSION. Place throttle valve lever on side of transmissions as far toward the front of the vehicle as it will go. Adjust length of throttle rod from bell housing relay to throttle lever by rotating trunnion until trunnion will slip into hole in lever when lever is held in its extreme forward position.

(6) ADJUST THROTTLE RODS AT UPPER REAR RELAY CROSS SHAFTS. Rotate adjusting nuts on throttle rods until trunnion pin will slip into holes in cross shaft levers, and install washers and cotter pins.

(7) INSTALL GAGE PIN IN LOWER REAR RELAY. Disconnect rod between upper rear relay cross shaft and lower rear relay at upper cross shaft lever. Remove eight screws and lock washers that hold right-hand engine oil drain plug cover to floor and remove cover. Reach through cover opening and install long gage pin through pin hole in lower relay lever and into mounting bracket.

(8) ADJUST THROTTLE ROD TO LOWER REAR RELAY. Loosen clevis lock nut on upper end of rod between lower relay and upper relay cross shaft, and rotate clevis until clevis pin can be installed in hole in cross shaft lever. Install clevis and cotter pins, and tighten lock nut.

(9) ADJUST THROTTLE RODS AT INTERMEDIATE RELAY. Disconnect rod between intermediate relay and lower rear relay at rear relay end. Install gage (41-G-426-20) and long gage pin (41-G-249-50) on intermediate relay throttle lever. Adjust length of rod

by loosening clevis lock nut and rotating clevis until pin can be inserted in lower rear relay. Install clevis pin and cotter pin, and tighten lock nut.

(10) INSTALL FRONT RELAY GAGE. Remove four screws and washers holding left propeller shaft front cover to supports, and remove cover. Disconnect throttle rod that connects front relay and intermediate relay at front relay end. Install front relay gage on lever and mounting bracket.

(11) ADJUST THROTTLE ROD FROM INTERMEDIATE TO FRONT RELAY. Adjust the length of this rod by loosening clevis lock nut at front relay end and rotating clevis until pin will slip into hole in lever. Install clevis pin and cotter pin, and tighten lock nut.

(12) ADJUST ACCELERATOR PEDAL ROD TO FRONT RELAY. Measure vertical distance from end of accelerator pedal to floor of vehicle. If distance is not 6 inches (plus or minus $\frac{1}{16}$-inch), disconnect rod from pedal to front relay at front relay end. Adjust length of rod by loosening clevis lock nut and rotating clevis until proper distance is obtained when clevis pin is installed in front relay lever. Install clevis and cotter pins, and tighten lock nut.

(13) ADJUST TRANSFER UNIT THROTTLE ROD. Disconnect throttle rod between the transfer unit relay and front relay at transfer unit relay end. Remove all gages and gage pins from front relay, intermediate relay, lower rear relay, upper rear relay cross shaft, and distributor relay on both engines. Adjust length of rod by loosening clevis lock nut and rotating clevis until pin will enter transfer unit relay when accelerator pedal is fully depressed. Install clevis pin, cotter pin, and tighten lock nut.

(14) CLOSE DOORS. Install floor pan, engine drain plug cover, shell racks, bulkhead doors, propeller shaft front cover, and close engine compartment rear doors.

100. OIL PAN AND OIL COOLER.

a. General. The oil pan and oil cooler can be replaced while the transmission is in the vehicle. However, to replace the oil cooler, the oil pan must be removed first. NOTE: *After engines have been removed from the vehicle (in freezing temperatures), remove transmission oil cooler water plug.*

b. Removal of Oil Pan and Oil Cooler from Transmission.

(1) REMOVE FLOOR PLATE. Remove floor plate in hull underneath transmission by taking out 28 screws and lock washers. CAUTION: *Floor plate weighs over 80 pounds; support with jacks while removing.*

(2) DRAIN COOLING SYSTEM. Vent radiator by turning cap; then remove water drain plug from bottom of transmission. Remove drain

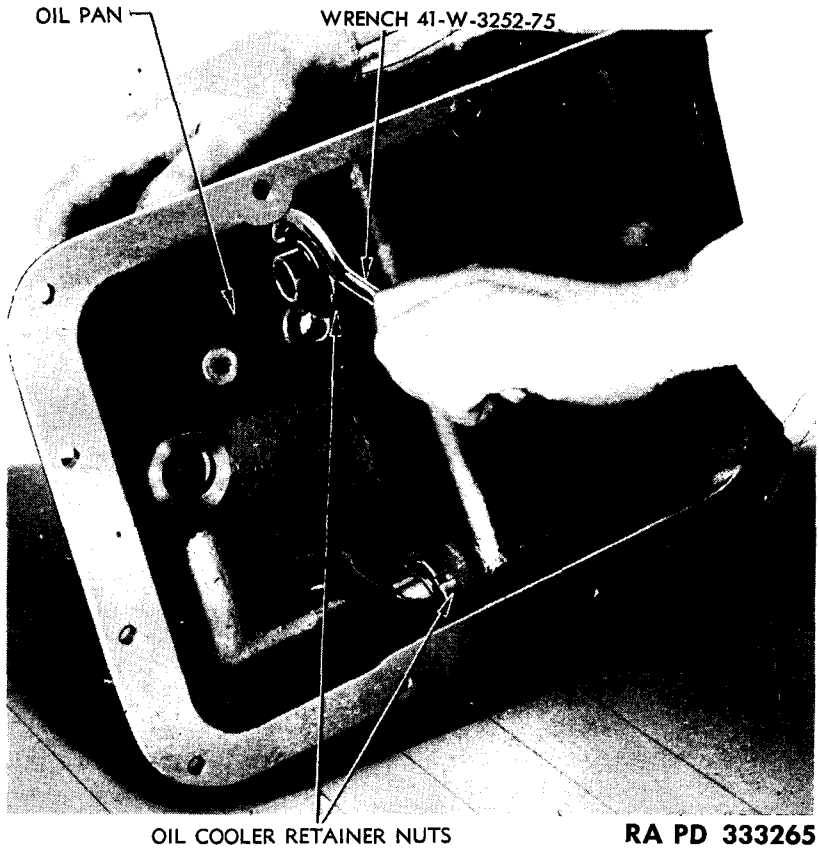


Figure 90 — Removing Oil Cooler Seals

plugs from front of engine and remove radiator cap for complete draining.

(3) DRAIN TRANSMISSION OIL. Remove drain plug from bottom of transmission and allow oil to drain. Remove flywheel bottom cover; remove plug from flywheel cover or front face and allow flywheel to drain (fig. 22).

(4) REMOVE OIL PAN AND OIL COOLER. Disconnect transmission oil cooler water pipes at oil pan. Remove nine screws and lock washers holding oil pan to transmission case. Remove two nuts and lock washers from oil pan mounting studs, and remove oil pan and gasket.

c. Removal of Oil Cooler from Oil Pan.

(1) REMOVE OIL SEAL SPANNER NUTS. Remove oil pan screen cover mounting screw and lock washer, and remove cover. Remove

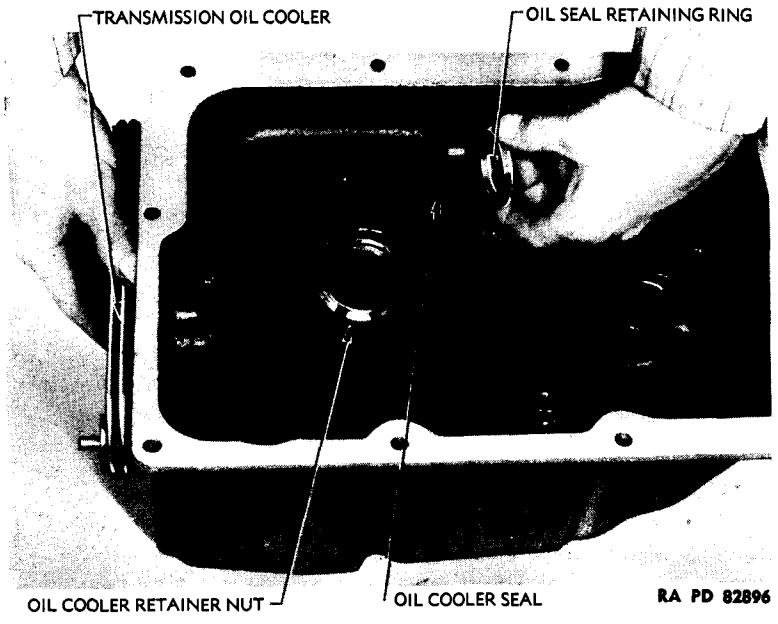


Figure 91 — Installing Oil Cooler Seals

oil pan screen mounting screw, and remove oil pan screen from oil pan. Remove two spanner nuts holding oil cooler unit to oil pan bulkhead, using spanner wrench (41-W-3252-75) (fig. 90). Pry oil cooler seals out of oil pan, using a screwdriver. Discard seals.

(2) REMOVE OIL COOLER. Remove eight oil cooler cover mounting screws and copper washers, and remove oil cooler cover and gasket from front end of oil pan. Pull oil cooler assembly out of front opening in oil pan. Remove water seals from oil cooler.

d. Installation of Oil Cooler in Oil Pan.

(1) POSITION OIL COOLER IN OIL PAN. Install rubber composition water seals on intake and outlet pipes on oil cooler. Install oil cooler through opening in front of oil pan until end of long oil cooler pipe protrudes slightly through hole in oil pan. NOTE: *Long oil pipe on cooler should be toward right side of oil pan.* Position oil seal, oil seal retainer, and spanner nut over end of long oil pipe (fig. 91). Push oil cooler the rest of the way into oil pan.

(2) INSTALL OIL COOLER COVER AND SPANNER NUTS. Install oil seal, oil seal retainer, and spanner nut on short oil seal pipe, tightening spanner nut fingertight. Tighten spanner nut fingertight on long oil cooler pipe. Position front oil pan cover and gasket on oil pan, lining up pin holes in cover with pins on front end of cooler. Install

eight screws and copper washers holding front cover to oil pan. Tighten spanner nut securely on each oil cooler pipe, using spanner wrench (41-W-3252-75).

(3) INSTALL INTAKE SCREEN IN OIL PAN. Install oil screen in oil pan, sliding pipe on screen into counterbore in side of oil pan, and short oil cooler pipe into large hole in screen. Install hollow head screw holding oil pan screen to oil pan. Position oil screen cover over oil screen and install mounting screw and lock washer.

e. Installation of Oil Cooler and Oil Pan on Transmission.

(1) INSTALL OIL PAN AND OIL COOLER. Position a new oil pan gasket on transmission case and install oil pan over studs on case. Install nine screws and lock washers holding oil pan to case. Install two nuts and lock washers on oil pan mounting studs. Connect oil cooler pipes to oil pan.

(2) INSTALL FLOOR PLATE. Raise floor plate into position and secure with 28 screws and lock washers.

(3) FILL COOLING SYSTEM. Install water drain plugs and fill cooling system with proper coolant.

(4) FILL TRANSMISSION. Install transmission and flywheel drain plugs, and fill transmission with proper grade lubricant (par. 35).

101. CONTROL VALVE BODY.

a. General. The control valve body is serviced by the using arms by replacement only. It can be replaced with the transmission in the vehicle.

b. Removal.

(1) REMOVE FLOOR PLATE. Remove floor plate in hull underneath transmission by taking out 28 screws and lock washers. CAUTION: *Floor plate weighs over 80 pounds; support with jacks while removing.*

(2) DRAIN TRANSMISSION OIL. Remove drain plug from bottom of transmission and allow oil to drain. Remove flywheel bottom cover; remove plug from flywheel cover or front face, and allow flywheel to drain (fig. 22).

(3) DISCONNECT CONTROL RODS. Disconnect manual and throttle rods from control levers on side of transmission by removing the cotter pins and washers.

(4) REMOVE CONTROL LEVERS. Loosen lock screw holding throttle valve lever and pull lever off shaft. Loosen lock screw holding manual lever and pull manual lever off shaft. Remove 11 cap screws holding side cover to transmission case and remove cover. NOTE: *All of these screws have copper washers to prevent oil leakage.*

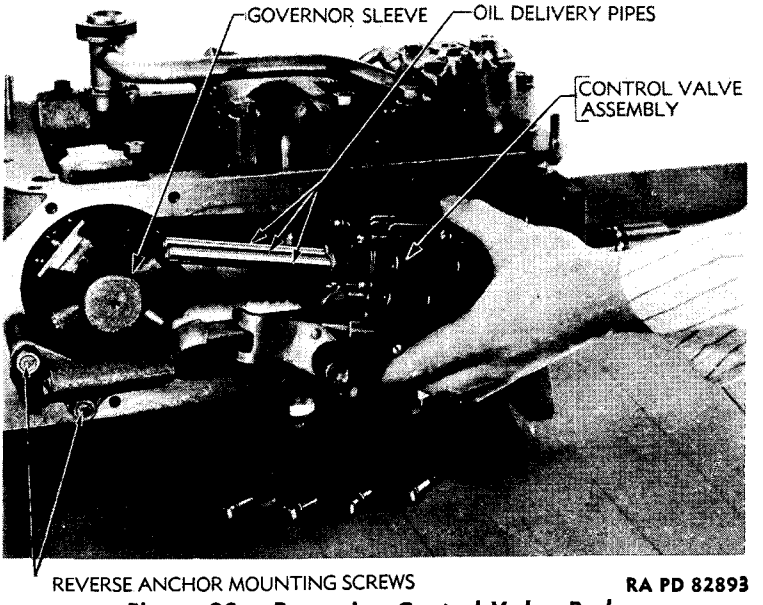


Figure 92 — Removing Control Valve Body

(5) REMOVE CONTROL VALVE BODY. Remove Neoprene seal from end of control lever shaft. Remove four control valve body mounting screws and lock washers, and remove control valve body by sliding forward along the transmission case (fig. 92). NOTE: *The oil delivery pipes from the governor to the valve body may come off with the valve body. However, if they do not, they may be left in the governor.*

c. Installation.

(1) INSTALL CONTROL VALVE BODY. Install three governor oil pipes in governor pipe casting on valve body, if these pipes were removed with control valve body. Position control valve body on side of transmission case, and line up pipe holes in valve body or in governor sleeve with pipes. Push valve body rearward, connecting pipes with governor sleeve, and install four screws and lock washers holding valve body to case. Install Neoprene seal on control lever shaft.

(2) INSTALL SIDE COVER AND CONTROL LEVERS. Position a new side cover gasket on transmission case, and install 11 screws and copper washers holding side cover to transmission case. Install manual control lever on control lever shaft, lining up serrations on lever and shaft. Tighten lever clamp screw. Install throttle control lever on control lever shaft, lining up serrations on lever and shaft. Tighten lever clamp screw.

(3) ADJUST LINKAGE. Adjust manual control linkage and throttle control linkage (pars. 98 and 99).

(4) FILL TRANSMISSION. Install drain plugs in flywheel cover and in flywheel housing and fill transmission with proper grade of oil (par. 35).

Section XX

PROPELLER SHAFTS

102. DESCRIPTION AND TABULATED DATA.

a. Description. The propeller shafts are equipped with a universal joint at each end and transmit the power from the transmission to the transfer unit at the front of the vehicle. The shafts have a hollow welded steel tube construction and a sliding joint on the front or transfer unit end (fig. 93). A universal joint yoke is welded to the propeller shaft at the rear, while another yoke is attached to the sliding joint, which in turn slides on spline ways in the propeller shaft tube at the front.

b. Tabulated Data.

(1) PROPELLER SHAFT.

Type	Hotchkiss
Construction	Welded tube

(2) UNIVERSAL JOINT.

Bearings	Needle
Number bearings (each cross)	18
Number oil seals	4
Lubrication	Only when disassembled

103. PROPELLER SHAFTS.

a. Removal.

(1) REMOVE PROPELLER SHAFT COVERS. Remove five screws and lock washers holding rear propeller shaft housing cover to inner and outer housing walls. Remove rear cover. Remove four screws holding front cover to support, and remove front cover. Remove two screws holding air baffle to support and remove baffle. NOTE: *Top of baffle is split to permit it to slip over propeller shaft.*

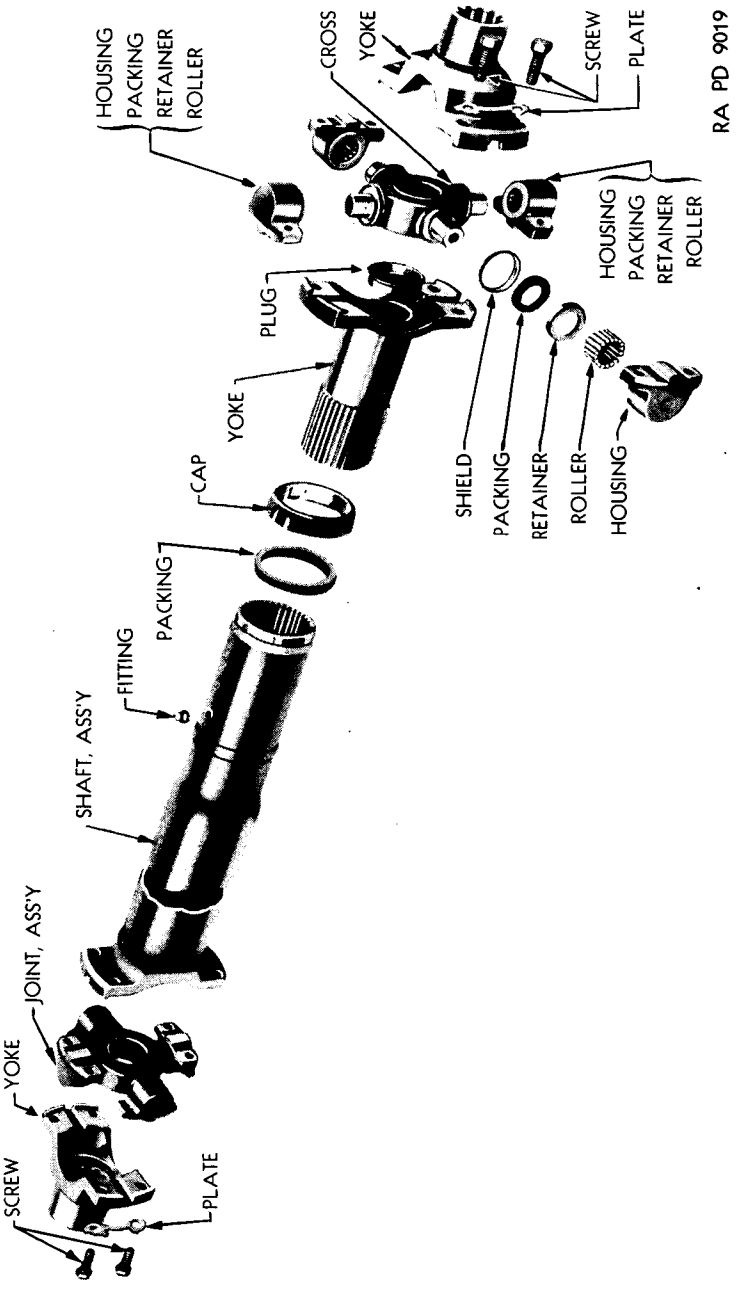


Figure 93 — Propeller Shaft Disassembled

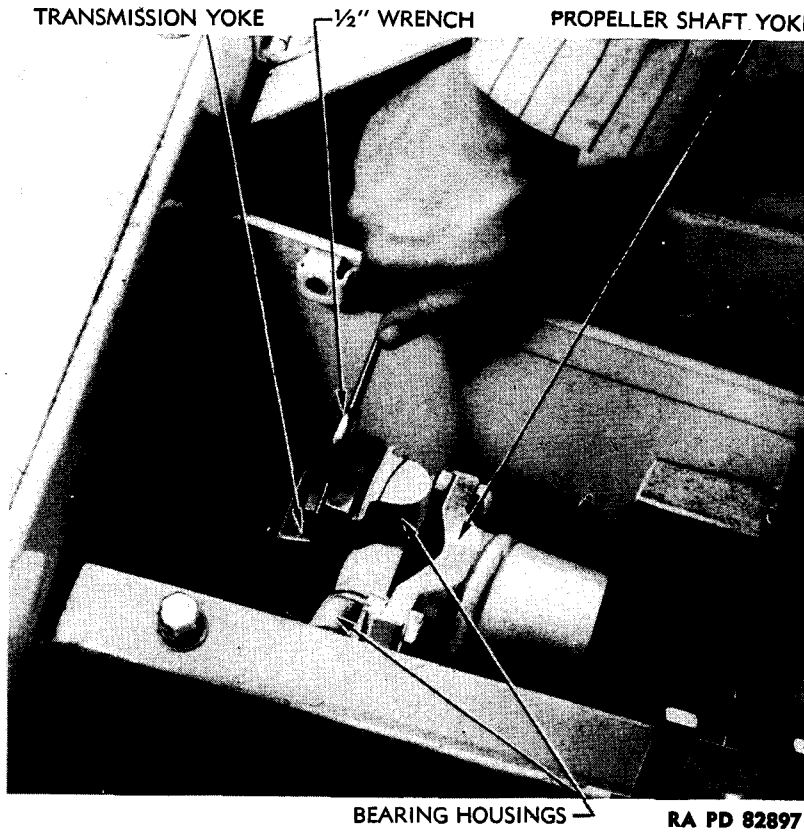


Figure 94 — Disconnecting Universal Joints

(2) REMOVE PROPELLER SHAFTS AND UNIVERSAL JOINTS. Tie a piece of wire around universal joint bearing housings that are connected to the transmission and transfer unit, to prevent housings from slipping off cross and possibly losing some of the needle bearings when disconnected. Straighten lock plate under each of the four universal joint bearing housings. Disconnect universal joints at transmission and transfer unit ends by removing eight bearing housing mounting screws (fig. 94). Push front universal joint yoke toward rear of vehicle to telescope sliding joint. Remove propeller shaft and universal joints.

b. Installation.

(1) INSTALL PROPELLER SHAFTS AND UNIVERSAL JOINTS. Position propeller shaft between yokes on transmission and transfer unit and expand sliding joint so that universal joints on propeller shaft are touching yokes. Install a new mounting screw lock plate on each of the four bearing housings which attach to the transmission and transfer

unit yokes, and install bearing housing mounting screws. Bend ends of lock plates up around each of the bearing housing mounting screws. Remove wires around the bearing housings, which were installed to prevent the housings from falling off universal joint crosses.

(2) INSTALL PROPELLER SHAFT COVERS. Position propeller shaft housing front cover over propeller shaft, and install four mounting screws. Install two screws holding propeller shaft housing air baffle to support. Position propeller shaft housing rear cover on propeller shaft housing inner and outer walls, and install five screws holding rear cover to walls.

104. UNIVERSAL JOINTS.

a. General. The propeller shafts must be removed from the vehicle in order to replace the universal joint yokes. The removal and installation of the propeller shafts are explained in paragraph 103.

b. Removal. Remove wires holding universal joint bearing housings which were disconnected from yokes on transmission and transfer unit. Straighten lock plates holding two universal joint bearing housings on yokes at each end of propeller shaft. Remove two screws holding each bearing housing to yoke, and remove bearing housing and universal joint crosses as a unit from propeller shafts.

c. Installation. Position universal joint cross and bearing housing assembly on propeller shaft yoke, and install mounting screws, being sure to use new lock plates. Bend up end of mounting screw lock plate around head of screws. Install wire around the two bearing housings which were not connected to propeller shaft yoke to hold them in position on cross until propeller shaft is installed.

Section XXI

TRANSFER UNIT AND CONTROLLED DIFFERENTIAL

105. DESCRIPTION AND TABULATED DATA.

a. Transfer Unit. The transfer unit, located at the front of the vehicle just behind the differential housing, combines the power output

TRANSFER UNIT AND CONTROLLED DIFFERENTIAL

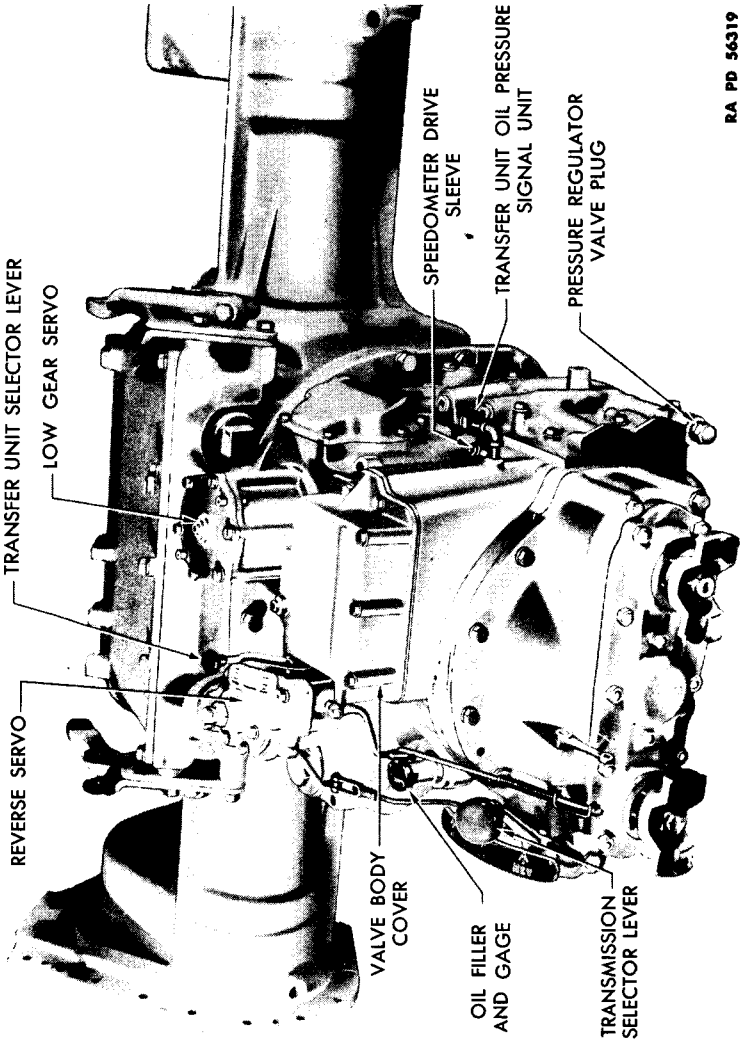


Figure 95 — Transfer Unit and Controlled Differential

of the two engines. It also provides a two-speed, hydraulic-controlled gear reduction which, combined with the transmission, provides a total of six forward speeds and one reverse speed.

b. Controlled Differential. The controlled differential, located at the front of the vehicle, not only transmits the engine power to the final drive units, but in addition contains the brake drums and bands that permit steering and stopping the vehicle.

c. Tabulated Data.

(1) TRANSFER UNIT.

Number of speeds forward	2
Number of speeds reverse	1
Gear ratio in reduction	2.37 to 1
Gear ratio in direct	1 to 1
Gear ratio in reverse	2.37 to 1
Type gearing	Planetary

(2) CONTROLLED DIFFERENTIAL.

Number of steering bands	2
Width of band	4 in.
Gear ratio	2.62 to 1

106. CONTROL VALVE BODY.

a. General. The transfer unit controlled valve body should not be serviced by the using arms. If the valve body is defective, however, it can be replaced by the using arms. The control valve body can be replaced while the transfer unit is in the vehicle.

b. Removal.

(1) REMOVE CONTROL VALVE BODY COVER. Disconnect throttle control rod from lever on control valve body cover by removing cotter pin and clevis pin. Remove 12 screws holding control valve body cover in position. NOTE: *Do not remove screw on cover holding manual selector lever detent spring to cover.* Pull control valve assembly cover and gasket off transfer unit case.

(2) REMOVE CONTROL VALVE BODY. Remove five screws and washers holding control valve body to transfer unit case. Remove control valve body from spacer.

c. Installation.

(1) INSTALL CONTROL VALVE BODY. Position control valve body assembly on transfer unit case spacer. Install five control valve body mounting screws, tightening them to 10 to 12 foot-pounds torque.

(2) INSTALL CONTROL VALVE BODY COVER. Position control valve body cover gasket and cover on transfer unit case over valve body. Remove sight plug from control valve body cover and check to see that button on end of selector lever shaft engages groove on end of

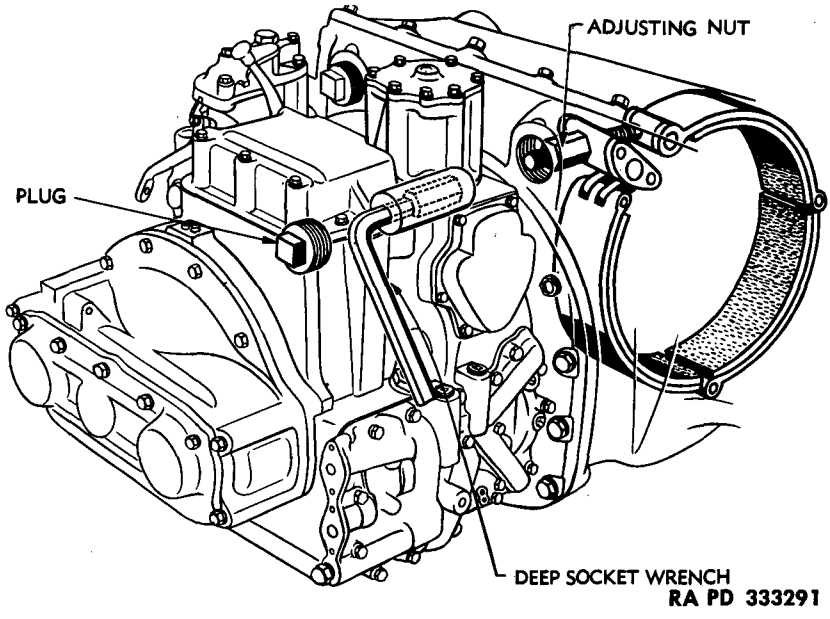


Figure 96 — Adjusting Steering Brake Bands

manual control valve. If button and valve are not engaged, remove cover and reposition manual control valve. Install plug. Using torque wrench, install nine short and three long control valve body cover mounting screws, tightening screws to 15 to 18 foot-pounds. Connect throttle control rod to lever on cover and install clevis pin, washer, and cotter pin.

107. PRESSURE REGULATOR VALVE.

a. General. The transfer unit pressure regulator valve assembly can be replaced while the transfer unit is in the vehicle.

b. Removal. The pressure regulator valve is located slightly below normal oil level; therefore, before attempting to replace valve, a pan should be placed to catch the oil that drains out. Loosen oil pressure regulator valve acorn plug in end of carrier (fig. 95). Take care to hold plug against spring pressure as it is being loosened. Remove acorn plug, valve spring, guide pin and oil pressure regulator valve. NOTE: *If valve is not forced out by oil pressure, reach into opening with a piece of bent wire and pull out valve.*

c. Installation. Install oil pressure regulator valve in end of carrier. Install regulator valve spring and guide pin in back of valve, allowing spring to protrude from end of carrier. Position regulator valve acorn plug on outer end of valve spring, compress spring, and

install acorn plug in carrier. Add oil to transfer unit to replace that lost when valve was removed.

108. STEERING AND BRAKE BAND ADJUSTMENT.

a. General. The steering and brake band adjustment compensates for lining wear. The steering and brake bands should be adjusted wherever the transfer unit and controlled differential are removed and reinstalled.

b. Adjustment procedure.

(1) REMOVE ADJUSTING PLUG COVERS. Remove band adjusting hole plug from brake drum housing cover on each side of controlled differential.

(2) ADJUST BAND. Insert socket wrench through plug hole and engage adjusting nut (fig. 96). Turn adjusting nut one-half revolution clockwise to tighten brake band. NOTE: *Brake band adjusting nut has a cylindrical surface on pressure side instead of the usual flat face. It is important that this adjustment be made by half-turns only, so that this cylindrical surface will always be seated firmly against cross pin when adjustment is completed.*

(3) CHECK ADJUSTMENT OF STEERING AND BRAKE BANDS. Check adjustment by pulling back on steering lever. The adjustment is correct when two conditions prevail; first, brake band must be free when lever is in full forward position. To make second check, place a spring scale on lower end of rubber grip on end of steering lever and pull back on lever until a force of 12 to 15 pounds is exerted. In this position, parking ratchet should be seven notches back from forward position. NOTE: *On new bands the ratchet should only move back six notches at a pressure of 12 to 15 pounds. Repeat check for other brake band.*

(4) INSTALL ADJUSTING HOLE PLUGS. Install band adjusting hole plugs in each brake drug housing cover.

109. STEERING LINKAGE ADJUSTMENT.

a. General. The steering brake linkage never requires readjustment if properly installed. When installing this linkage, however, it must be checked and adjusted as follows:

b. Adjustment Procedure.

(1) DISCONNECT ROD AND CHECK POSITION OF LEVERS. Move driver's steering levers forward against stops. The stops for these levers are the parking brake ratchet mounting screws nearest the upper front deck. Disconnect connecting rod from lever on cross shaft to lever on differential housing at cross shaft end. Make sure that edge of notch in lever is tight against dog on clamp to left of lever, by turning lever cross shaft.

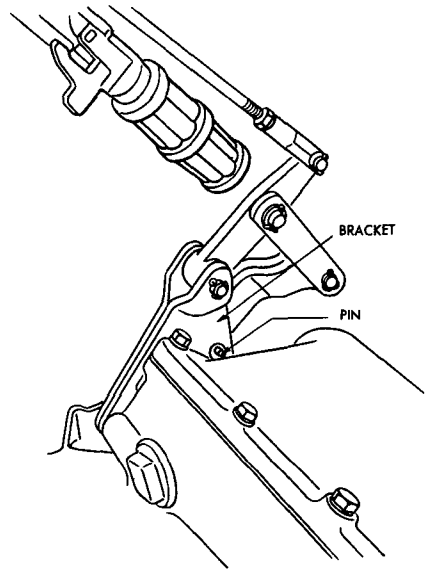


Figure 97 — Adjusting Steering Linkage

(2) ADJUSTING LINKAGE. Check to see that pull-back spring is holding lever on differential housing, so that pin in lever is tight against side of hole in holding bracket (fig. 97). Adjust length of connecting rod to permit free assembly of pin at steering lever by loosening lock nut and rotating clevis. Turn clevis one-half turn tighter to assure taking out all slack, and tighten lock nut. Connect rod to lever on cross shaft by installing clevis pin, cotter pin, and tighten lock nut.

110. TRANSFER UNIT BAND ADJUSTMENT.

a. General. Two bands are used in the transfer unit, namely, a low gear band (toward front of vehicle) and a reverse band (toward rear of vehicle). The bands can be adjusted while transfer unit is in vehicle. Both bands should always be adjusted whenever it becomes necessary to adjust one or the other. The low gear band should always be adjusted before the reverse band is adjusted.

b. Low Gear Band Adjustment.

(1) Before any adjustments are made, it is important to check position of reverse servo piston. To do this, remove acorn plug on top of reverse servo cover. Piston rod must be at least ½ inch above top of boss on servo cover. If piston rod is in this position, proceed with step (1), if not, install band adjusting gage (41-G-218) in top of rod and tighten pressure nut until piston rod is pulled up at least

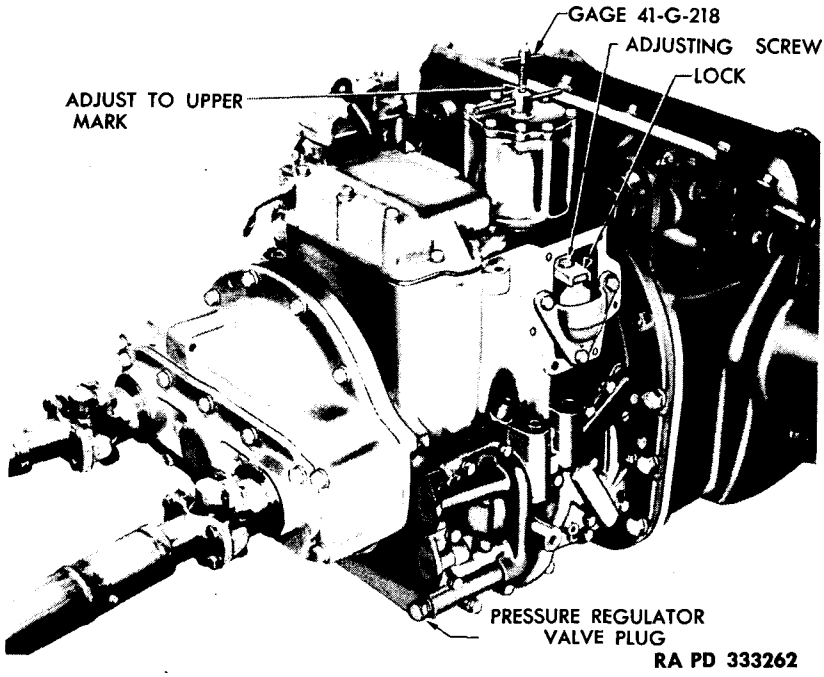


Figure 98 — Adjusting Low Gear Band

½ inch above top of boss. Place selector lever in any position other than reverse. This will hold the piston rod in the proper position for adjustment procedure.

(2) INSTALL ADJUSTING TOOL IN LOW GEAR SERVO. Remove plug from low gear servo cover and screw in gage (41-G-218) until it bottoms in tapped hole in upper end of low gear servo piston rod. Tighten pressure nut on band adjusting gage until "LO" mark on gage is flush with top of pressure nut (fig. 99).

(3) CHECK LOW GEAR BAND ADJUSTMENT. Note position of pressure nut. It should be just clear of servo cover if the low gear band is adjusted properly. There should be from 0.002-inch to 0.005-inch clearance between pressure nut and servo cover. If pressure nut is tight against servo cover, low gear band is too loose.

(4) REMOVE LEG GUARD AND ADJUSTING HOLE COVER. Remove assistant driver's leg guard by removing two mounting screws. Remove six screws holding low gear band adjusting hole cover on right side of transfer unit case and remove cover and gasket.

(5) ADJUST LOW GEAR BAND. Swing back lock plate (fig. 99) which keeps the low gear band adjusting screw from turning, and tighten adjusting screw. Continue tightening adjusting screw until

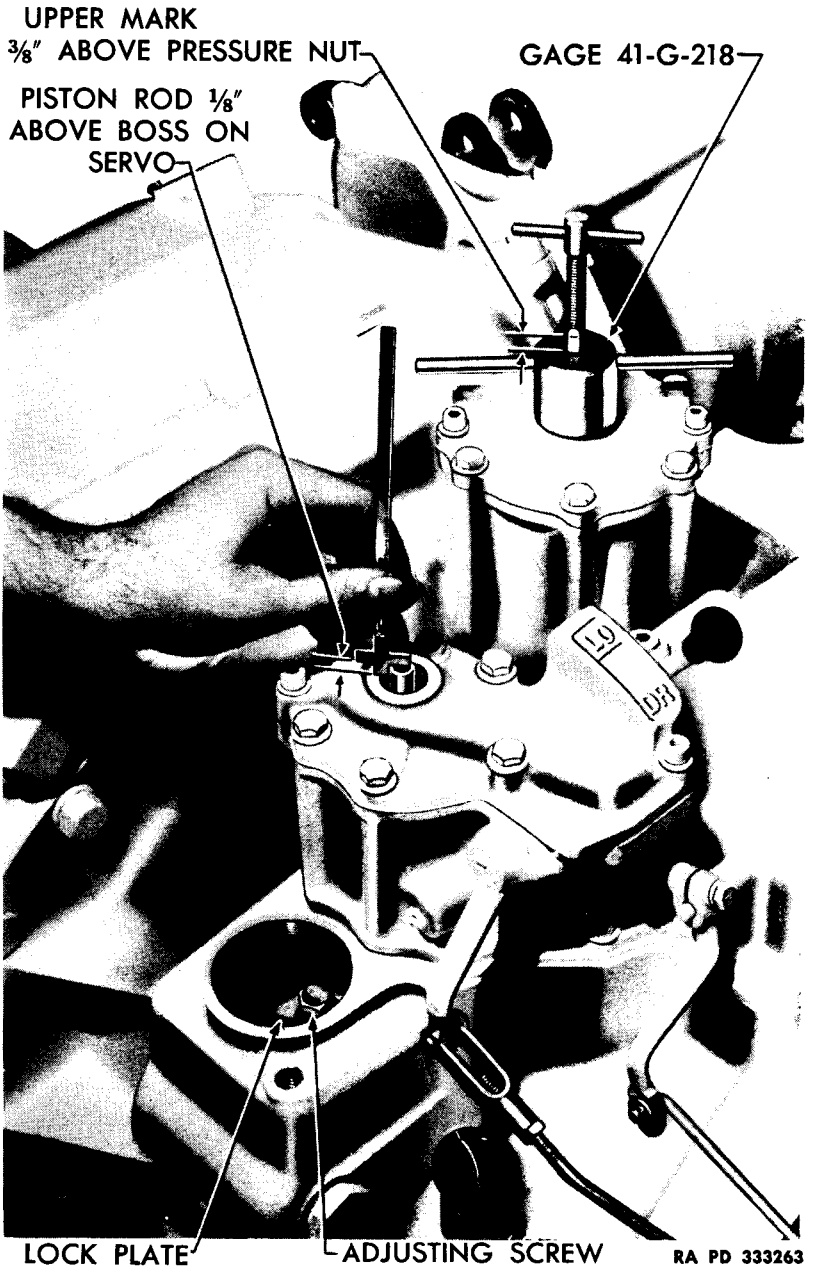


Figure 99 — Adjusting Reverse Band

pressure nut on the band adjusting gage is just lifting off low gear servo cover as explained in (3) above.

(6) INSTALL ADJUSTING HOLE COVER AND LEG GUARD. Position low gear band adjusting hole cover and a new gasket on side of transfer unit case and install six mounting screws. Position leg guard on side of transfer unit and install two mounting screws. NOTE: *Do not remove band adjusting gage from low gear servo until reverse band is adjusted.*

c. Reverse Band Adjustment.

(1) REMOVE PLUG IN REVERSE SERVO COVER. Tighten pressure nut on band adjusting gage (41-G-218) on low gear servo until "LO" mark on gage is $\frac{3}{8}$ inch above pressure nut. Place transmission selector lever in reverse ("REV") position. Remove acorn plug and gasket from reverse servo cover.

(2) CHECK BAND ADJUSTMENT. Apply both steering brakes and lock with ratchets. Start both engines and accelerate to 1,000 revolutions per minute with selector lever in reverse. Shut off engines. Check position of reverse servo piston rod. Upper end of rod should be $\frac{1}{8}$ inch $\pm$ $\frac{1}{32}$ inch above top of the boss on servo cover when reverse band is adjusted properly.

(3) ADJUST REVERSE BAND AND INSTALL PLUG. If reverse band requires adjustment, remove reverse band adjusting plug and copper gasket from top of transfer unit case (fig. 99). Lift up lock plate that keeps reverse band adjusting screw from turning, and tighten adjusting screw until servo piston rod is $\frac{1}{8}$ inch above boss on cover. Install reverse band adjusting plug and a new copper gasket on transfer unit case.

(4) REMOVE BAND ADJUSTING GAGE AND INSTALL COVERS. Install acorn plug and a new gasket on reverse servo cover. Loosen pressure nut on band adjusting gage; then unscrew gage from low gear servo piston rod. Install plug in low gear servo cover.

111. OIL COOLER.

a. Removal.

(1) OPEN ENGINE COMPARTMENT DOORS AND REMOVE FAN SHROUDS. Refer to paragraph 61.

(2) REMOVE ENGINE FAN, FAN BELT, AND BRACKET. Remove two nuts from fan bracket mounting studs and remove fan, fan belt, and bracket.

(3) LOWER OIL COOLER. Lift out bulkhead doors and remove four nuts and bolts holding front end of oil cooler to shroud which is mounted underneath and between radiators. Work through engine compartment rear doors and remove four nuts and bolts holding rear

end of oil cooler to shroud. Oil cooler may now be lowered to rest on top of upper rear relay cross shaft.

(4) REMOVE OIL COOLER UNIT. Remove clip holding fuel line to left engine fuel pump. Disconnect long oil cooler hose at elbow at rear of cooler unit and disconnect short hose at oil cooler line connection on bulkhead. Remove oil cooler unit, with short hose still attached, through rear doors.

b. Installation.

(1) INSTALL OIL COOLER UNIT. Raise oil cooler unit through rear doors into position over upper rear relay cross shaft. Connect long hose at elbow at rear of cooler unit. Support cooler and install four nuts and bolts which hold rear of oil cooler to shroud. Install clip holding fuel line to left engine fuel pump. Work through bulkhead doors and install four nuts and bolts holding front of oil cooler unit to shroud. Connect short hose to oil cooler line at bulkhead. Install bulkhead doors.

(2) INSTALL FAN, FAN BELT, AND FAN BRACKET. For detailed procedures on these operations, refer to paragraph 62.

(3) INSTALL FAN SHROUDS AND CLOSE ENGINE COMPARTMENT DOORS. See paragraph 62.

(4) CHECK LEVEL OF TRANSFER UNIT OIL. Place vehicle on level ground and check the oil level of the transfer unit. If necessary, add proper lubricant.

112. TRANSFER UNIT AND CONTROLLED DIFFERENTIAL REMOVAL.

a. General. The transfer unit and controlled differential should be replaced with new assemblies as a unit. The using arms should not separate the transfer unit from the controlled differential. NOTE: *To avoid premature failure of the transfer unit, clean oil cooler at first indication of overheating.*

b. Procedure.

(1) DISCONNECT TRACK. In order to remove the transfer unit and controlled differential, the front section of the track shields (on vehicles so equipped) must be removed, the track disconnected and pulled back off the drive sprocket. It need not to be completely removed. For the detailed procedure of this operation, see paragraph 119.

(2) DRAIN TRANSFER UNIT, CONTROLLED DIFFERENTIAL, AND FINAL DRIVES. Remove cover plates from under transfer unit and controlled differential drain plugs. Remove drain plugs and allow these units to drain. Remove drain plugs from under each final drive housing and allow to drain.

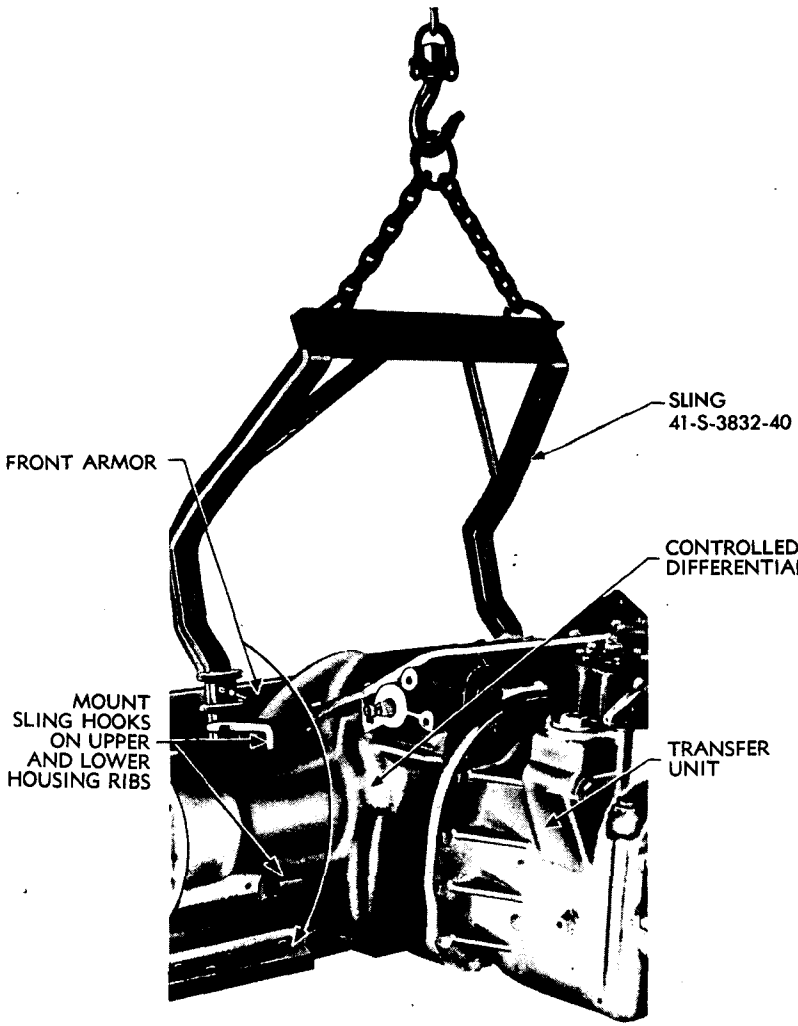


Figure 100 — Lifting Transfer Unit and Controlled Differential

(3) REMOVE DRIVE SPROCKETS. Remove the stud nuts holding each drive sprocket to the final drive hub, and pull the sprockets from the studs.

(4) REMOVE LOWER FRONT DECK. Remove the screws holding the lower front deck in place and install sling (41-S-3832-20) on the two lifting handles. Connect a hoist to the sling and remove the lower front deck.

(5) REMOVE CONDUITS AND CABLES. Remove the two headlamp stowage bracket mounting screws from the right side of the differential housing. Disconnect the electrical conduits, tachometer cables, and speedometer cable from the back of the instrument panel. Disconnect opposite end of speedometer cable from transfer unit, and remove cable. Remove cable clip retaining screws and pull cables and conduits out from under differential housing into the fighting compartment. Remove the two screws holding each stop light switch to the controlled differential cover. Disconnect wire from transfer unit oil pressure signal.

(6) DISCONNECT STEERING LINKAGE. Remove three cotter pins and clevis pins holding each of the two steering and brake lever assembly links to mounting brackets on differential housing. Disconnect links from mounting brackets. Remove left and right steering and brake lever retracting springs from differential housing.

(7) POSITION INSTRUMENT PANEL ON SIDEWALL. Remove two screws holding lower left instrument panel mounting bracket to hull wall. Remove two screws holding upper right instrument panel mounting bracket and hand throttle cable bracket to upper front deck and swing instrument panel backward next to fighting compartment sidewall. Lower hand throttle cable and bracket down on differential housing.

(8) REMOVE SIREN SWITCH AND HAND THROTTLE CABLE. Remove two screws holding siren switch to floor and disconnect lead to siren. Pull siren switch and cable out from under differential housing. Remove hand throttle cable nut next to web on bottom of differential housing while holding hexagonal-flange on cable stationary. Disconnect hand throttle cable trunnion at accelerator pedal relay, and remove throttle cable by pulling it forward through web on bottom of differential housing.

(9) DISCONNECT CONTROL LINKAGE. Disconnect throttle rod between floor and transfer unit at transfer unit relay. Disconnect transmission and transfer unit manual control rod from selector lever to intermediate relay at selector lever.

(10) DISCONNECT PROPELLER SHAFTS. Remove front propeller shaft covers and disconnect universal joints at transfer unit (par. 104).

(11) DISCONNECT OIL COOLER PIPES. Remove four screws holding oil cooler pipe mounting brackets to transfer unit case, and disconnect oil cooler pipes and brackets from transfer unit.

(12) REMOVE HULL FILLER BLOCKS. Remove two cap screws holding each filler block to each end of differential housing, and remove both filler blocks and filler block shims.

(13) INSTALL SLING. Install transfer unit and controlled differential assembly sling (41-S-3830-40) on differential housing. Sliding hooks on sling should extend under boss on bottom of housing. Lock hooks in position, using clevis pins and cotter pins provided (fig. 100). Connect a hoist on sling and tighten cable until it is taut.

(14) REMOVE NOSE-ARMOR SCREWS AND BOLTS. Remove 21 screws holding nose-armor casting to hull floor. Remove 11 bolts that hold each end of differential housing to hull. Tag bolts so that they may be installed in proper position. CAUTION: *Make final check to see that transfer unit, controlled differential, and nose-armor are completely disconnected from the rest of the vehicle.*

(15) REMOVE TRANSFER UNIT AND CONTROLLED DIFFERENTIAL. Tighten hoist cable until it is bearing weight of nose-armor casting, final drives, controlled differential and transfer unit assembly; push assembly forward and remove from vehicle. NOTE: *Remove differential housing-to-hull shims as assembly clears hull.* Keep left-hand separate from right-hand shims so that they may be installed on the same side as removed, if controlled differential and transfer unit are to be installed in the same vehicle.

113. TRANSFER UNIT AND CONTROLLED DIFFERENTIAL INSTALLATION.

a. Procedure.

(1) SELECT DIFFERENTIAL HOUSING SHIMS. NOTE: *If controlled differential and transfer unit are installed on vehicle from which they were removed, this step need not be performed.* Measure distance between inside edges of hull walls of vehicles, and measure total length of differential housing. Subtract the length of the differential housing from the inside width of the hull to obtain sizes of differential housing-to-hull shims required for installation of differential and transfer unit. Two types of differential housing-to-hull shims are available: First, there are base shims of which there are two thicknesses: ¼-inch and $\frac{7}{32}$-inch; second, there are adjustment shims of 0.010-inch, 0.015-inch, 0.020-inch, and 0.025-inch thicknesses to obtain the final adjustment of differential housing-to-hull wall clearance. Select first the correct-size base shims, and then the correct size of one or more adjustment shims, allowing not over 0.010-inch final clearance between differential housing and hull walls.

(2) INSTALL THICK DIFFERENTIAL HOUSING SHIM. Install base shims on sides of differential housing, tightening in place with three flat head screws.

(3) INSTALL TRANSFER UNIT AND CONTROLLED DIFFERENTIAL. Install transfer unit and controlled differential sling (41-S-3830-40) on differential housing. Sliding hooks on sling should extend under boss on bottom of housing (fig. 100). Lock hooks in position, using clevis pins and cotter pins provided. Connect a hoist to transfer unit and controlled differential assembly sling and lift assembly with hoist even with opening in front of vehicle. NOTE: *Make sure vehicle is in level position.* Push transfer unit and controlled differential assembly through opening in front of hull until cap screw holes on ends of housing line up with mounting holes in hull. CAUTION: *Be very careful not to let unit swing and damage accelerator rods or servos.*

(4) INSTALL DIFFERENTIAL CASE MOUNTING BOLTS. Install three differential housing-to-hull bolts through left end of differential housing and hull. NOTE: *One bolt should be installed in the third hole from the top of the differential housing, one bolt at the extreme front of the housing, and the third bolt in the third hole up from the bottom of the differential housing.* Install two bolts through right end of differential housing and hull, as explained above, omitting the bolt at the extreme front of the differential housing. NOTE: *Do not tighten bolts on right end of differential housing.*

(5) INSTALL SHIMS ON RIGHT SIDE OF DIFFERENTIAL CASE. Install as many thin shims as possible, between the thick shim previously installed and the side of the hull. NOTE: *It will be necessary to slot out the holes in the shims which mount around the two bolts installed in step* (4), *above.* Install a third bolt through bolt hole on extreme front on right end of differential housing and hole in hull, and tighten all three bolts on right end of differential housing.

(6) INSTALL SHIMS ON LEFT SIDE OF DIFFERENTIAL CASE. Remove three bolts holding left end of differential housing to hull, and measure clearance between left of differential housing and hull, using a feeler gage. If clearance exceeds 0.010 inch, a thin shim should be installed between left end of housing and hull wall. NOTE: *Occasionally, a clearance over 0.010 inch will be noted at one portion of the housing, while the other portions of the housing will have normal clearance.* If this occurs, a thin shim should be cut apart and a piece installed at the point of maximum clearance. Install remainder of bolts holding ends of differential housing to hull.

(7) INSTALL NOSE-ARMOR CASTING. Install screws holding nose-armor casting to hull floor. Disconnect hoist from sling, and disconnect sling from controlled differential housing by removing cotter pins and clevis pins which lock sling hooks in position.

(8) INSTALL FILLER BLOCKS. Position filler blocks and filler block shims, either ¼ inch or $\frac{7}{32}$ inch thick as required, above each end of differential housing, and position flange on each front fender over bolt holes in each filler block. Install two cap screws holding each of the two filler blocks and front fender mounting flanges to hull.

(9) CONNECT OIL COOLER PIPES. Position both transfer unit and controlled differential oil cooler pipes and mounting brackets on transfer unit case, and install four mounting screws. NOTE: *Install two new gaskets under each bracket.*

(10) CONNECT AND ADJUST CONTROL LINKAGE. Connect and adjust manual and throttle control linkage as explained in paragraphs 98 and 99.

(11) CONNECT PROPELLER SHAFTS. Connect propeller shafts and install propeller shaft covers (par. 103).

(12) INSTALL HAND THROTTLE CABLE AND SIREN SWITCH. Push rear end of hand throttle cable through differential web, and install mounting nut. Connect hand throttle cable to accelerator pedal relay. Slide siren cable underneath differential housing and connect to switch. Line up siren switch in position on hull floor, and install two siren switch mounting screws. Insert siren switch cable in clip on nose-armor plate casting.

(13) INSTALL INSTRUMENT PANEL. Swing instrument panel forward into position and install two screws holding upper right instrument panel mounting bracket to upper front deck. NOTE: *Hand throttle cable bracket should be installed between instrument panel and front deck before installing screws.* Install two screws holding lower left instrument panel mounting bracket to hull sidewall.

(14) CONNECT AND ADJUST STEERING LINKAGE. Working in fighting compartment, position each of the two steering and brake lever assembly links to mounting brackets on each side of differential housing and install clevis pins and cotter pins. Adjust steering and brake bands as explained in paragraph 108.

(15) INSTALL STOPLIGHT SWITCHES AND HEADLIGHT STOWAGE CASES. Position both stoplight switches on differential housing and install two mounting screws and lock washers holding each switch to differential housing. Position headlamp stowage case on differential housing and install stowage case bracket mounting screws.

(16) CONNECT CONDUITS AND CABLES. Connect all electrical conduits, speedometer cable, and two tachometer cables to instrument panel. Position two cable and conduit clips over cables and install retaining screws. Insert other cables into snap-type clips. Connect speedometer cable to transfer unit. Connect wire to transfer unit oil pressure signal.

(17) INSTALL LOWER FRONT DECK. Install sling (41-S-3832-20)

on two lower front deck lifting handles, connect a hoist to sling, and push front deck into position on hull. NOTE: *Before positioning front deck on hull, coat edges of hull and deck plates with sealer.* Install 27 lower front deck mounting screws.

(18) INSTALL DRIVE SPROCKETS AND POSITION TRACK ON SPROCKETS. Push track drive sprockets onto drive sprocket housing studs and install mounting stud nuts holding each drive sprocket to hull. Pull upper portion of each track onto drive sprockets. Take up slack in each track by revolving drive sprocket forward with a crowbar, or by careful application of engine power.

(19) CONNECT AND ADJUST TRACK. Mount track connecting fixture on inside and outside track connectors on shoes (fig. 106). Tighten adjusting screw on track-connecting fixture to bring track shoes together. Drive inside and outside end connectors on end track shoe links. Position wedges on end connectors, and install safety nuts. Loosen adjusting screws on the track-connecting fixture and remove track-connecting fixture. Install front section of track shields.

(20) INSTALL DRAIN PLUGS, AND COVER PLATES. Install drain plug in each final drive housing. Install both controlled differential drain plugs, and install transfer unit drain plug. Position drain plug cover plates on the under side of hull floor, and install four screws and lock washers holding each plate to floor. Fill transfer unit, controlled differential and final drive units with proper lubricant (par. 35). CAUTION: *Vehicle must be on level ground to avoid overfilling, which causes the oil to foam.*

Section XXII

FINAL DRIVE

114. DESCRIPTION AND TABULATED DATA.

a. The final drive housings are mounted on each end of the controlled differential case. The final drive shafts are splined at their inner ends, and fit into the differential compensating gears in the controlled differential. Splined on the outer end of this shaft is a small herringbone gear which meshes with a larger gear splined to the sprocket drive shaft. This provides a reduction of 2.57 to 1.

b. The ball and roller bearings for the drive shaft and sprocket

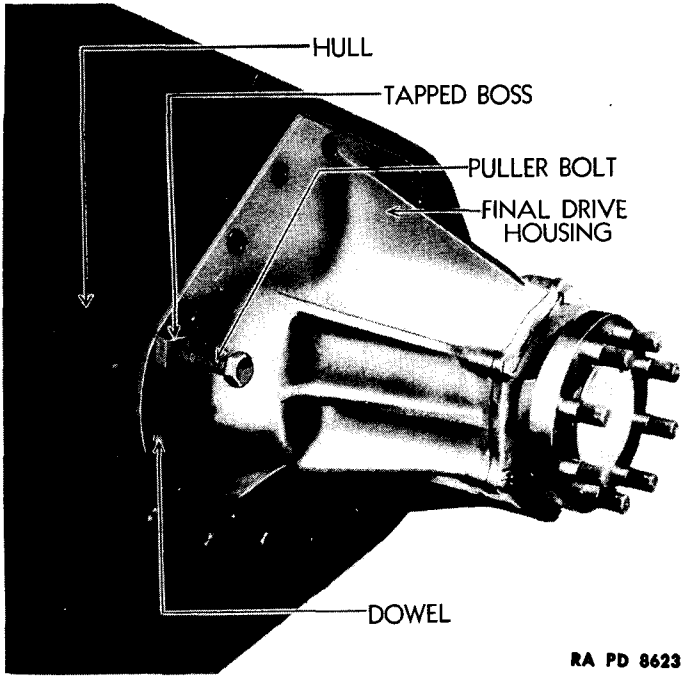


Figure 101 — Removing Final Drive

shaft are contained in the final drive housing, and are removed with the unit.

c. The track-driving sprocket and hub are mounted on studs on the end of the sprocket shaft.

d. Tabulated Data.

Gear ratio	2.57 to 1
Sprockets:	
Number of teeth	13
Sprocket hub	Cast

115. FINAL DRIVE REPLACEMENT.

a. General. The removal and installation procedure is the same for both left and right final drives.

b. Removal.

(1) DISCONNECT TRACK. Remove screws that hold front section of track shields in place on vehicles so equipped. Disconnect track midway between final drive sprocket and ground. Pull top section of track back off sprocket. For detailed procedure on disconnecting track, see paragraph 119.

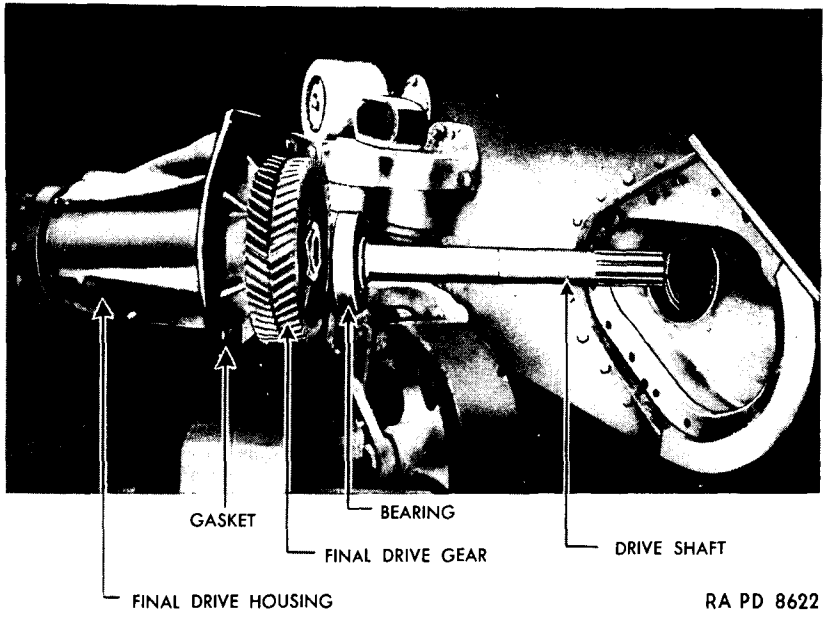


Figure 102 — Final Drive Removed

(2) DRAIN OIL FROM TRANSFER UNIT AND CONTROLLED DIFFERENTIAL. Remove three drain plug cover plates from bottom of front hull floor. Remove drain plugs and allow transfer unit and controlled differential to drain.

(3) DRAIN OIL FROM FINAL DRIVES. Remove drain plug from bottom of final drive housing and allow oil to drain.

(4) REMOVE DRIVE SPROCKET. Remove stud nuts holding sprocket hub to shaft, and pull hub with sprockets attached off shaft.

(5) REMOVE FINAL DRIVE. Remove lock wires from screws that hold final drive housing to controlled differential case, and remove screws. Pull final drive from its dowels by inserting one of the screws just removed into boss at rear of housing, turning it down against differential case until the final drive is free (fig. 101).

c. Installation.

(1) INSTALL FINAL DRIVE. Position a new final drive gasket on differential case. Slide final drive assembly into place, meshing driveshaft splines with compensating gear in differential, and lining up final drive housing on dowels. Install screws holding housing to differential case and tighten to 170 to 180 foot-pounds. Install lock wires. NOTE: *Final drive attaching screws should be checked and retightened fifty miles after installation.*

(2) INSTALL SPROCKETS. Position sprocket hub and sprockets over studs on shaft and install stud nuts.

(3) CONNECT AND ADJUST TRACK. Pull top portion of track over sprockets and connect track (par. 119). Install front section of track shields.

(4) FILL TRANSFER UNIT AND CONTROLLED DIFFERENTIAL. Replace drain plugs in transfer unit and controlled differential. Install cover plates for these plugs and fill unit with proper lubricant as explained in paragraph 35.

(5) FILL FINAL DRIVE. Replace drain plug in bottom of final drive housing. Remove filler plug from front of final drive housing and fill unit with lubricant until it runs out of filler hole. Install filler plug.

116. SPROCKETS.

a. When the teeth on the sprockets become worn from usage, the left and right side sprockets can be interchanged. This will present a new tooth surface to the track, and provide longer life.

Section XXIII

TRACKS AND SUSPENSION

117. DESCRIPTION AND TABULATED DATA.

a. Description.

(1) Two individually driven tracks provide the necessary traction to propel the vehicle. Each track is composed of separate track shoes fastened together with end connectors (fig. 103). Rubber track shoes are reversible for longer wear, but the steel track shoes are not. This is the only difference in service operations between the two types of tracks. Steel tracks should be replaced with rubber tracks at earliest opportunity.

(2) Two-wheeled, rubber-tired bogies or suspensions (four in all) are mounted on the protruding ends of the front and rear bogie

axles. These bogies support the vehicle on volute springs and convey it on the endless tracks. Two drive sprockets at the front of the vehicle pull the tracks from the rear and lay them down in the path of the advancing bogie wheels.

(3) An adjustable trailing idler wheel for each track is mounted at the rear of the hull. A spring, compressed by the idler arm, maintains constant, correct tension of the tracks. Slack in the track when passing over obstacles is provided by compression of the volute springs in the bogies and idler arms, and by articulation of the bogie links.

(4) Three rollers mounted on each side of the hull support the upper half of the track as it returns to the drive sprockets.

b. Tabulated Data.

	Rubber	Steel
(1) TRACK SHOES:		
Number per track	*66	66
Width	11⅝ in.	11⅝ in.
(2) TRACK.		
Pitch	5½ in.	5½ in.
Ground contact		
Zero penetration	120 in.	120 in.
2-in. penetration	133 in.	133 in.
(3) AXLES:		
Number	2	
Type	Solid steel	
(4) BOGIES.		
Number	4	
Type	Articulated	
Bogie wheels	Rubber-tired	
Number bearings	2 each wheel	
Type bearings	Ball, annular	
(5) SUPPORT ROLLERS.		
Number	6	

118. TRACK ADJUSTMENT.

a. General. It is important that the tracks be properly adjusted to prevent unnecessary wear and breakage.

b. Procedure.

(1) CHECK TRACK ADJUSTMENT. The idler wheels should be adjusted so that there is from ⅝- to ¾-inch slack in the track midway between the two front track-supporting rollers. Before making this check, insert a 4-foot crowbar between the track and the mudguard at the point of measurement, and press the track down with

*67 rubber shoes for first 75 miles, or until track has stretched.

Figure 103 – Adjusting Track

TRACK CONNECTING AND LINK PULLING FIXTURE (41-F-2997-86)

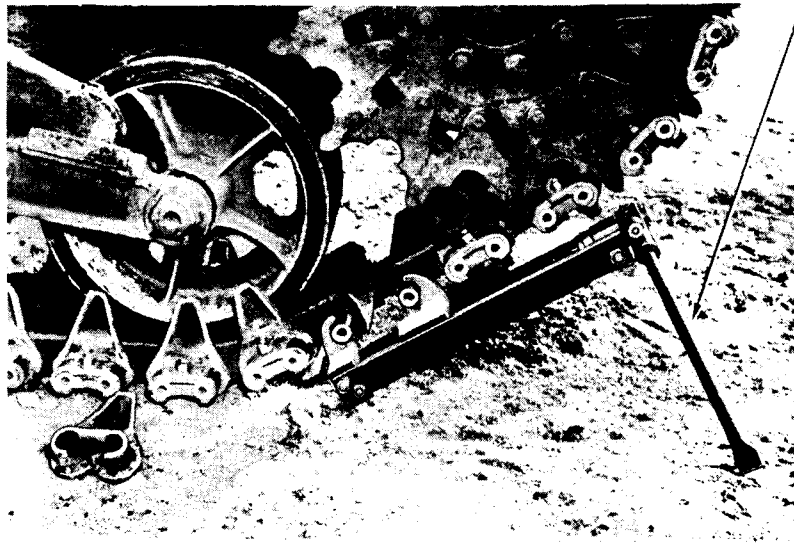


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Figure 104 — Connecting Track

at least 175-pounds pressure. Then release the crowbar and allow track to take its normal slack position. The amount of slack should be measured by laying a straightedge on the top track at the rollers and measuring the maximum deflection (fig. 103).

(2) ADJUST TRACK. Remove cotter pins and loosen nuts that hold serrated end of idler wheel arms to serrated idler arm guides, using trailing wheel nut wrench (41-W-3673). Turn idler arm guide adjusting nuts to draw idler wheels out to point of correct tension described in (1) above.

(3) TIGHTEN IDLER WHEEL NUTS. Tighten nuts holding idler arm guides to idler, using trailing wheel nut wrench (41-W-3673). NOTE: *The idler arm guides on the inner and outer sides of the idler wheel must be in exactly the same position.* First, make sure the two guides are in the same serrations on the arms, and then see that the two adjusting nuts are tightened a like amount. Install cotter pins.

119. TRACK REPLACEMENT.

a. The using arms are authorized to replace the vehicle tracks.

b. Removal.

(1) REMOVE TRACK SHIELDS. Place vehicle on level ground and remove track shields (late-type vehicles only).

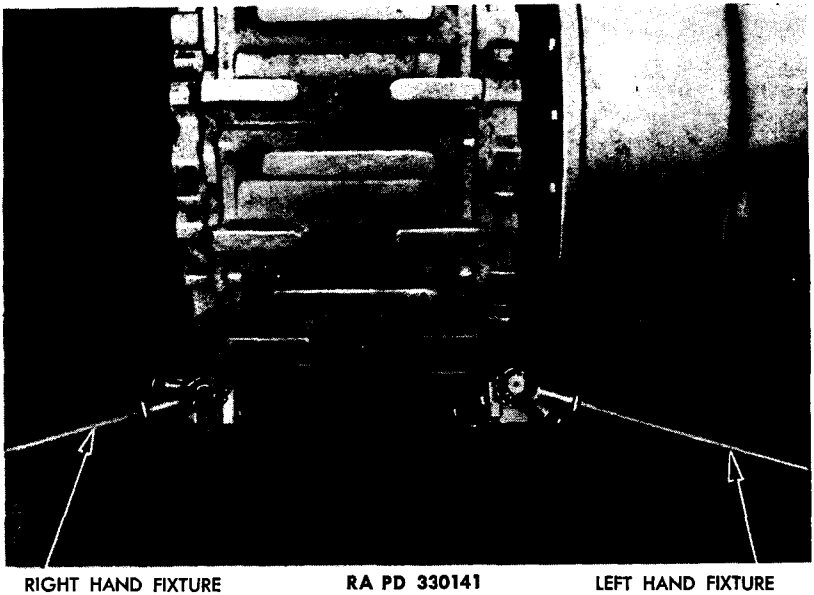

Figure 105 — Track Connecting Fixture in Place

(2) RELIEVE TRACK TENSION. Relieve the track tension by loosening nuts at idler wheel and moving wheel forward.

(3) REMOVE END CONNECTORS. Remove the wedge nut and wedge from opposite track connectors, midway between bottom of drive sprocket and ground. Install track connecting fixture (41-F-2997-86) on outside track connector (fig. 106) by inserting pin at front of fixture in hole in connector and positioning the fixture lugs against track shoe pins. Pull off track connector by cranking the fixture ratchet handle. (Lift tab.)

c. Installation.

(1) PLACE VEHICLE ON TRACK. Lay track on ground, and push or tow vehicle over it so that front end of track projects out beyond the front bogie wheel approximately 16 inches.

(2) POSITION TRACK. Pull other end of track up over idler wheel, support rollers, and sprocket. Take slack out of track by revolving sprocket with crowbar.

(3) CONNECT TRACK. Mount track connecting fixtures on track (figs. 104 and 105). Pull track together with the fixtures and drive end connectors part-way onto track shoe pins. Remove the track connecting fixtures and drive the end connectors the rest of the way into place. Install wedges and wedge nuts.

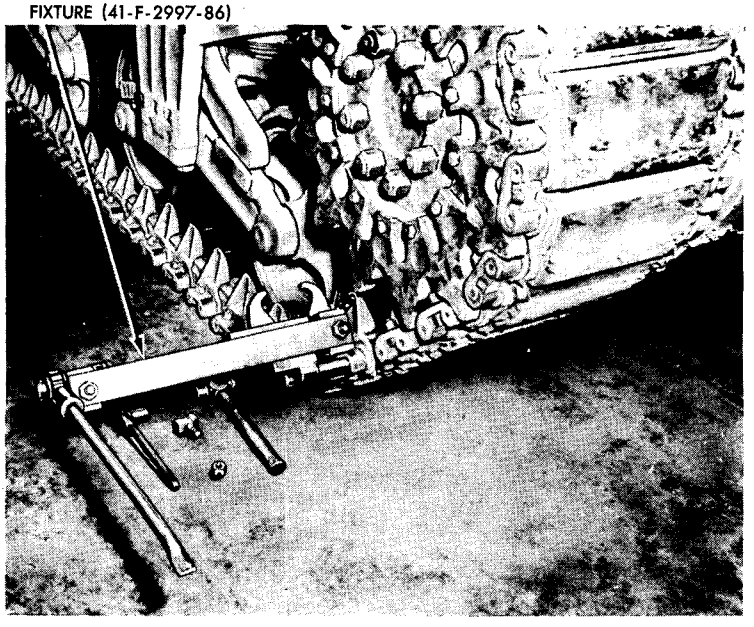

Figure 106 — Removing Track Connector

(4) ADJUST TRACK TENSION. Adjust track tension according to procedure in paragraph 118.

(5) INSTALL TRACK SHIELDS. Position shields on vehicle and install mounting screws and lock washers (late-type vehicles only).

120. IDLER WHEEL REPLACEMENT.

a. Two operations can be performed on the trailing idler assembly by the using arms: first, the complete trailing idler assembly can be replaced; second, the trailing idler wheel can be replaced separately. If steel idler wheels become unservicable, replace them with rubber-tired idler wheels.

b. Idler Assembly Removal.

(1) DISCONNECT TRACK. Remove shields if used, disconnect track, and pull track back off idler wheel.

(2) INSTALL SPRING COMPRESSOR. Remove idler spring plug in end of idler assembly mounting bracket, and install idler spring compressor (41-C-2555-835) through bracket and into spring seat. Tighten locking nut. Jack up rear end of hull and block securely so that the blocks support hull slightly above the normal position. Remove jacks.

(3) INSTALL IDLER SHAFT WRENCH. Remove screw and lock washer holding idler shaft locking plate on hub. Remove plate. Re-

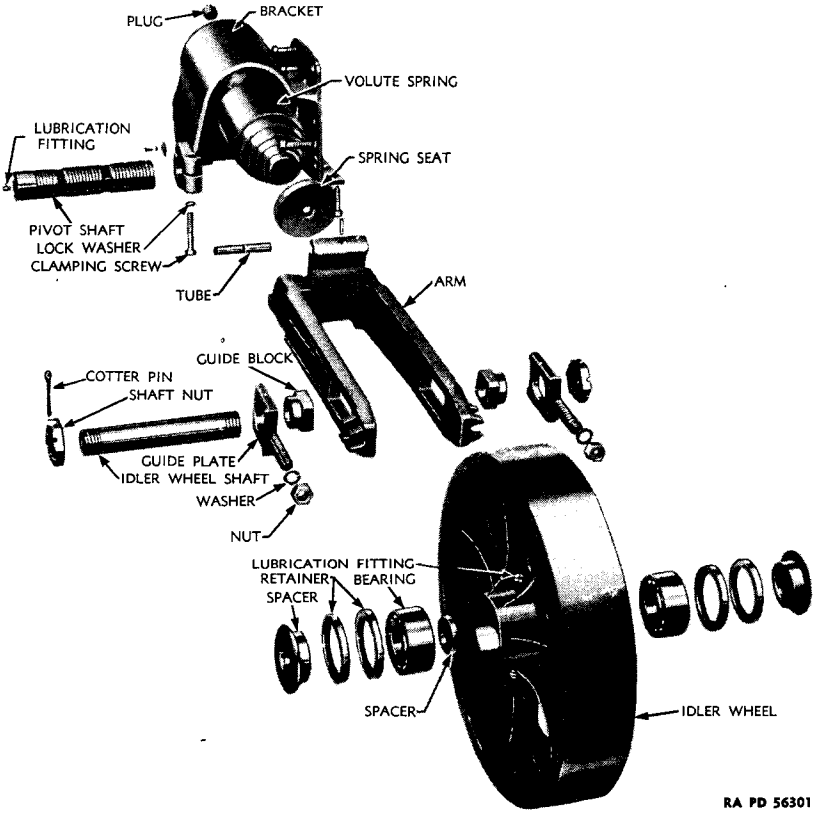

Figure 107 — Idler Assembly Disassembled

move lubrication fitting in end of idler shaft. Loosen idler shaft clamping bolt. Install idler shaft wrench on end of idler shaft and tighten pilot nut around end of shaft.

(4) REMOVE IDLER ASSEMBLY. Install ratchet on idler shaft wrench (41-W-3670-950) and turn idler shaft out of housing while supporting forward end of idler arm. Remove idler arm and loosen idler spring compressor (41-C-2555-835) until idler spring is free. Remove compressor, spring seat and spring.

c. Idler Assembly Installation.

(1) INSTALL IDLER ASSEMBLY. Position idler spring and spring seat in idler shaft housing and install idler spring compressor (41-C-2555-835). Position idler arm in housing and turn shaft through housing into idler arm. Install idler shaft wrench (41-W-3670-950) on end of shaft and attach ratchet to wrench. Tighten idler shaft all the way in place in housing.

(2) INSTALL IDLER SHAFT LOCK PLATE. Tighten idler shaft clamping bolt on housing, and install lubrication fitting in end of shaft. Position locking plate on hub over end of idler shaft, and install mounting screw and lock washer. Loosen idler spring compressor locking nut until it raises from idler housing. Unscrew compressor stud from spring seat, and remove idler spring compressor. Install idler spring plug in idler housing.

(3) REMOVE HULL BLOCK AND CONNECT TRACK. Jack up hull and remove support blocks. Lower hull to normal position and remove jacks. Connect and adjust track (par. 118). Install track shields, if so equipped.

d. Idler Wheel Removal.

(1) DISCONNECT TRACK. Remove shields if used, disconnect track, and pull back off idler wheel.

(2) INSTALL IDLER SPRING COMPRESSOR. Install idler spring compressor in trailing idler arm spring housing. Jack up rear end of trailing idler arm until trailing idler wheel is just free of lower section of track. Tighten locking nut on spring compressor until spring pressure on idler arm is released. Install blocks under trailing idler arm, and remove jacks.

(3) REMOVE IDLER WHEEL. Remove idler wheel shaft cotter pins and nuts, using trailing wheel nut wrench (41-W-3673). Remove serrated idler arm guides. While supporting idler wheel arm, drive out idler wheel shaft. Roll idler wheel backward off tracks.

e. Idler Wheel Installation.

(1) INSTALL TRAILING IDLER WHEEL. Roll trailing idler wheel into position on forked trailing idler arm and drive trailing idler wheel shaft through wheel so that shaft protrudes an equal distance each side of the wheel. Install serrated idler arm guides over end of wheel shaft and install wheel shaft nuts loosely. NOTE: *Wheel shaft nuts will be tightened when track is adjusted.*

(2) REMOVE IDLER SPRING COMPRESSOR AND BLOCKS. Remove idler spring compressor from idler housing and install plugs. Jack up trailing idler arm and remove blocks. Lower arm to its normal position and remove jacks.

(3) CONNECT AND ADJUST TRACKS. Connect and adjust track (par. 119). Install track shields.

121. BOGIE WHEEL ASSEMBLY REPLACEMENT.

a. The using arms are authorized to replace a complete bogie assembly.

b. Removal.

(1) REMOVE TRACK. Remove shields if used, and remove track completely (par. 119).

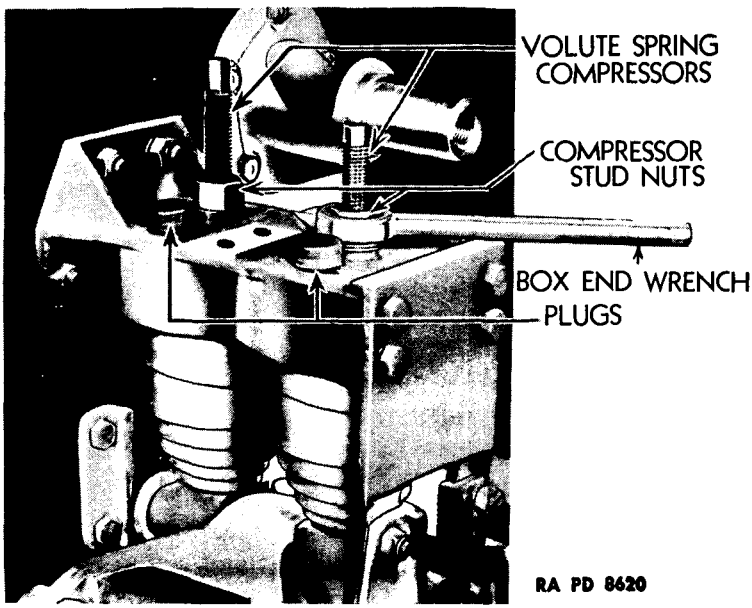

Figure 108 — Compressing Volute Springs

(2) INSTALL BOGIE SPRING COMPRESSORS. Remove volute spring plugs on top of bogie mounting bracket, and install both bogie volute spring compressors (41-C-2559-50) through mounting bracket and into volute spring seats. Tighten compressor lock nuts to lock springs in compressed position (fig. 108).

(3) REMOVE BOGIE SCREWS. Jack up hull underneath bogie being removed and install support blocks. The hull should be supported enough above its normal position so that the bogie is hanging on axle shaft and bogie wheels are clear of ground. Working in fighting compartment, remove six bolts holding bogie mounting bracket to side of hull while holding nuts on outside of vehicle. NOTE: *If either of the rear bogies is being removed, it will be necessary first to remove the shell rack and bulkhead extension cover on the side of the vehicle on which the bogie is being removed.*

(4) REMOVE BOGIE ASSEMBLY. Attach a hoist on bogie. Remove axle cap locking screw and remove axle cap, using wrench (41-W-547). Pull bogie assembly off end of axle shaft. Lower bogie to ground and remove hoist.

c. Installation.

(1) INSTALL BOGIE ASSEMBLY. Attach a hoist on bogie. Lift bogie next to end of axle, and slide into place on axle, making sure that bogie guide roller slides into place between roller guides on hull

sidewall. Install axle cap, using wrench (41-W-547). Install axle cap locking screw.

(2) INSTALL BOGIE MOUNTING BOLTS. Apply white lead anti-seize compound on six bogie mounting bolts, and install bolts so that nuts are on outside of vehicle. Working in fighting compartment, tighten bolts while holding nuts on outside of vehicle. Jack up hull, remove support blocks, and lower vehicle to normal position. Remove jacks.

(3) REMOVE BOGIE SPRING COMPRESSORS. Loosen bogie spring compressors until nut on compressor raises off bogie bracket. Unscrew compressor studs from lower bogie spring seats and remove compressor. Install volute spring plugs in bogie bracket.

(4) INSTALL AND ADJUST TRACK. Install and adjust track as outlined in paragraph 119. Install track shields, if so equipped.

122. BOGIE WHEEL BEARING REPLACEMENT.

a. The bogie wheels or the wheel bearings and oil seals can be replaced by the using arms.

b. Removal.

(1) LIFT BOGIE WHEEL. Position bogie wheel lift (41-L-1358) under bogie arm connecting link (fig. 109). Drive vehicle forward very carefully until lift has rotated to a vertical position and forced bogie wheel upward.

(2) REMOVE GUDGEON NUT. Remove cotter pin and nut on inner end of bogie wheel gudgeon.

(3) REMOVE BOGIE WHEEL. Insert end of slide hammer puller (41-P-2957-27) through hollow gudgeon, and install nut on end of puller protruding from inner end of gudgeon. While supporting wheel, remove gudgeon, and remove bogie wheel. Care should be exercised not to damage or lose Woodruff key in gudgeon. NOTE: *Occasionally, a gudgeon may be found that is so tight that it is impossible to remove it with the slide hammer puller.* In these cases, the screw type gudgeon puller (41-P-2905-63) should be used.

(4) REMOVE BOGIE BEARINGS AND OIL SEALS. Press spacers, oil seal retainers, and bearings out of bogie wheel hub.

c. Installation.

(1) INSTALL WHEEL BEARINGS. Push one wheel bearing into side of bogie wheel hub and install inner bearing spacer and other bearing from other side of bogie wheel hub.

(2) ASSEMBLE AND INSTALL OIL RETAINERS. Insert gudgeon through outer bearing spacer, and install oil retainer cone assembler (41-C-2562-100) on gudgeon next to oil retainer spacer. The large end of cone should be against small end of spacer. Push two oil

BOGIE WHEEL LIFT IN RAISED POSITION

BOGIE WHEEL LIFT DURING RAISING OPERATION

BOGIE WHEEL LIFT IN PLACE FOR RAISING WHEEL

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Figure 109 — Bogie Wheel Lift

retainers up on cone, and from there to outer bearing spacer. The sharp ends of leather oil retainers should be toward shoulder on outer bearing spacer. Remove gudgeon and cone assembler from spacer. Assemble oil retainers on other outer bearing spacer in the same manner. Tap spacers with oil retainers into place into each end of bogie wheel hub.

(3) INSTALL BOGIE WHEEL. Position bogie wheel on bogie arms and drive gudgeon in place, using slide hammer puller (41-P-2957-27). Install nut on inner end of gudgeon, and lock in place with cotter pin. Remove bogie wheel lift by driving vehicle backward slowly until wheel is lowered to track and lift is free.

123. SUPPORT ROLLER REPLACEMENT.

a. The only operation the using arms should perform on the track support rollers is complete replacement. The replacement of all six track support rollers is the same.

b. Removal. Remove sand shields if used, and disconnect track. Remove lock wires holding track support roller mounting screws in place. Remove five mounting screws and lock washers. Remove track support roller.

c. Installation. Position track support roller on hull sidewall and install five mounting screws and lock washers. Install locking wire through each of the five screws. Connect and adjust track (par. 119). Install track shields, if used.

Section XXIV

ELECTRICAL INSTRUMENTS AND EQUIPMENT

75-MM HOWITZER MOTOR CARRIAGE M8

124. DESCRIPTION AND TABULATED DATA.

a. Battery. A single, 6-cell, 12-volt storage battery is located in a compartment on the left side of the fighting compartment back of the driver.

b. Battery Switch. The battery switch, located on the front edge of the apparatus box, is provided to open the battery circuit at the source. To open the circuit, pull out and turn the switch handle. To close the circuit, turn handle and release.

c. Circuit Breakers. Three circuit breakers are included in the electrical system in place of the conventional fuse arrangement.

(1) SIREN CIRCUIT BREAKER. The siren circuit breaker is located on the top of the instrument panel. If the circuit opens, press red button on circuit breaker to complete the circuit.

(2) LIGHTING SYSTEM CIRCUIT BREAKER. Two types of circuit breakers have been used. The first type, used on early-type vehicles, is connected directly to the lighting switch inside the instrument panel. This type is thermostatically controlled, and vibrates as long as a short or overload exists in the circuit. The second-type circuit breaker, used on later-type vehicles, is of the manual reset type, the same as the siren circuit breaker. It is mounted on top of the instrument panel as shown in figure 11.

d. Electrical Filters. On early-type vehicles, there are 11 filters provided to keep the electrical system from interfering with radio operation. These filters are located as follows: one on each engine generator, one at each ignition coil, one on each ignition distributor, one for each field filter (combined in one unit) for the regulators in the apparatus box, one for the voltage regulators and one for each current regulator in the apparatus box. On late-type vehicles, these filters are not used.

e. Instrument Panel. The instrument panels used on these vehicles are illustrated in figures 10 and 11, and are described in detail in paragraph 6.

f. Lights. The two headlights, the taillights, and the stop light are all dual-purpose, in that they consist of both blackout, blackout marker, and service type. In addition, a single blackout driving light is provided for installation in the left headlight mount. For complete information on operation of the lighting system, see paragraph 14. All taillights, main headlights, and the blackout driving lights are composite assemblies of lamps, lenses, and reflectors, sealed against dirt and moisture. In case of failure, the complete lighting unit within the light shell is removed and replaced. Replacement units for each type of taillight are distinct in size and shape so that errors in installation are not possible.

g. Siren. A warning siren is mounted on the upper front deck of the vehicle. It is of the 12-volt type, controlled by a foot switch on the floor of the fighting compartment convenient to the driver. The siren is equipped wih a circuit breaker described in subparagraph c, above.

h. Tabulated Data.

(1) BATTERY.

Weight	182 lb
Volts	12
Ampere hours at 6-hour rate	168
Number of plates	25

(2) BATTERY SWITCH.

Type	single-pole, single-throw

(3) FILTERS.

Type (all)	Standard Signal Corps
Capacity (all)	50 amperes

(4) CIRCUIT BREAKERS.

Siren type	Bimetal disk
Capacity	15 amperes
Reset	Manual
Lighting switch type	Bimetal disk
Capacity	30 amperes
Reset	Automatic or manual

(5) LIGHTS.

Type (all)	Standard Quartermaster and Ordnance Corps
Blackout marker light	3-cp single-contact
Taillights	3-cp double-contact
Blackout stop lights	3-cp
Service headlights	40-watt
Type	Sealed-beam
Service stop light	21-cp double-contact
Instrument panel lights	3-cp single-contact
Signal lights	3-cp double-contact
Blackout taillights	3-cp
Blackout driving light	6-volt with resistor

(6) SIREN.

Switch, type	Singe-pole, momentary contact

(7) SPEEDOMETER CABLE.

Instrument panel end	0.104-in. square drive
Transfer unit end	0.152-in. keyed drive

125. TEST PROCEDURES.

a. General. This paragraph contains test procedures for all of the major electrical circuits in the vehicle that have not been previously discussed. Test procedures are simplified and designed to require only a minimum of test equipment.

b. Introduction to Testing Procedures. Since the equipment available in the field for electrical testing is limited, the testing devices are confined to three units: a test lamp, a jumper wire, and a voltmeter. In all tests, it will be assumed that all connections are tight and that the master battery switch is in the "ON" position. NOTE: *Always open master switch before disconnecting any wires.*

(1) TEST LAMP. Trouble in an electrical circuit may be in any one or more of the units in the circuit, and it is usually difficult to determine from the symptoms where the trouble lies. For this reason, the following method of using a test lamp has been chosen:

(a) The master battery switch must be in the "ON" position. All other switches in the circuit being tested must also be in the "ON" position. Then, one lead of the lamp should be placed on the negative battery post, and the other lead touched to the input terminal of the unit farthest from the positive battery terminal post in the circuit in question. This will eliminate any possibility of an improper ground.

(b) Following this, each successive terminal in the circuit towards the battery (including index plugs and sockets) should then be checked until the lamp lights. When this happens, it will show that the circuit is complete to this point; consequently, the unit between the previous terminal tested and the one where the lamp lights is the unit that should be replaced.

(c) There may be instances where more than one unit in a circuit is causing trouble. If the circuit does not function properly after replacing one unit, the same procedure of using the test lamp at successive terminals should be repeated until the other defective unit is found.

(2) JUMPER WIRE.

(a) In the event that a test lamp is not available for conducting tests, a jumper wire can be made to serve the same purpose. In using the jumper wire, connect one end of the wire to the positive battery terminal, and the other end to the input terminal of the unit in question farthest from the positive battery terminal. If the unit being tested does not operate, it should be replaced. If it does operate, this indicates that the defect exists in the circuit that is "jumped."

(b) The procedure then is to connect the end of the jumper at each successive terminal in the circuit toward the battery (including index plugs and sockets) until the unit fails to operate. This indicates

that that portion of the circuit between the point where the unit last operated and the point where it failed to operate is defective and the cause should be corrected.

(3) VOLTMETER. When a circuit functions normally at times and improperly at other times, the cause is likely to be loose or corroded connections, or switches that make improper contact. When a condition such as this arises, a voltmeter can be used to locate the trouble. In using a voltmeter for this type of checking, it should be connected from the input side of the switch or terminal in question to ground and a reading taken. Then the lead from the input side of the switch or terminal should be placed on the opposite side of the switch or terminal and another reading taken. If these readings reveal an excessive voltage drop, the switch should be cleaned, adjusted, or replaced.

c. Initial Check for Entire System. The electrical system of the vehicle is so designed that there are a number of elements which are common to the entire system, and which are, in consequence, a part of each of the circuits that are covered. For this reason, these common units should always be tested for defects first, after which the individual circuits can be checked.

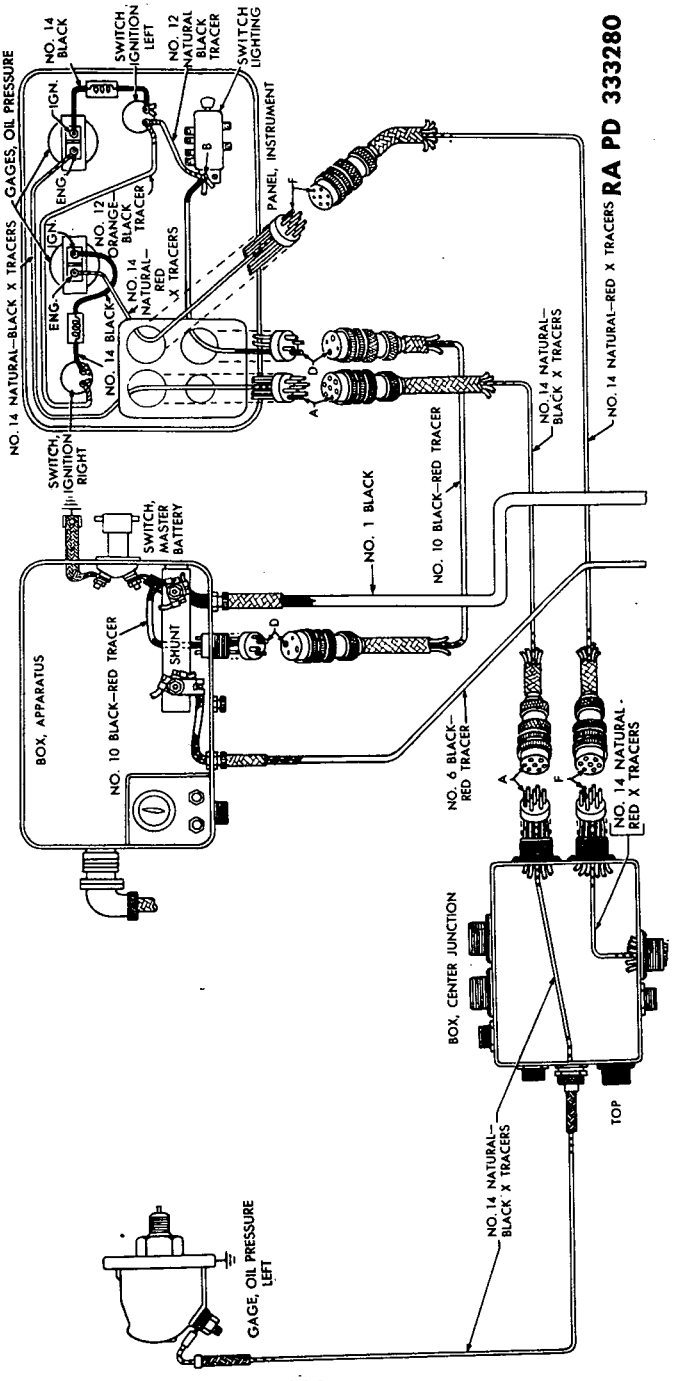
(1) TEST.

(a) When the master battery switch is turned to its "ON" position, the voltmeter in the instrument panel should register. (On panels without a voltmeter, this check must be made by turning the main light switch to all positions. If any lamps light, circuit is all right to the "B" terminal on the lighting switch). This test will indicate whether or not the circuit is complete thus far, and will eliminate checking the following units in any circuit for anything other than loose or corroded connections:

1. Battery-to-terminal block.
2. Terminal-block-to-shunt.
3. Shunt-to-"B" terminal on lighting switch.
4. Ground-to-master switch.
5. Master switch-to-battery.

(b) If the voltmeter does not register (or no lamps light) when the master switch is turned on, the first thing to check is the master battery switch. This may be done by attaching one lead of a test lamp to the positive battery post and grounding the other lead at any convenient unpainted place. If the lamp lights, this will indicate that the circuit is complete from the battery to ground through the master switch. However, if the lamp does not light, the test lamp lead should be tried on the battery side of the master switch. If the lamp lights at this point, the switch should be replaced; if it does not light, the cable from the negative battery post to the switch should be inspected

75-MM HOWITZER MOTOR CARRIAGE M8



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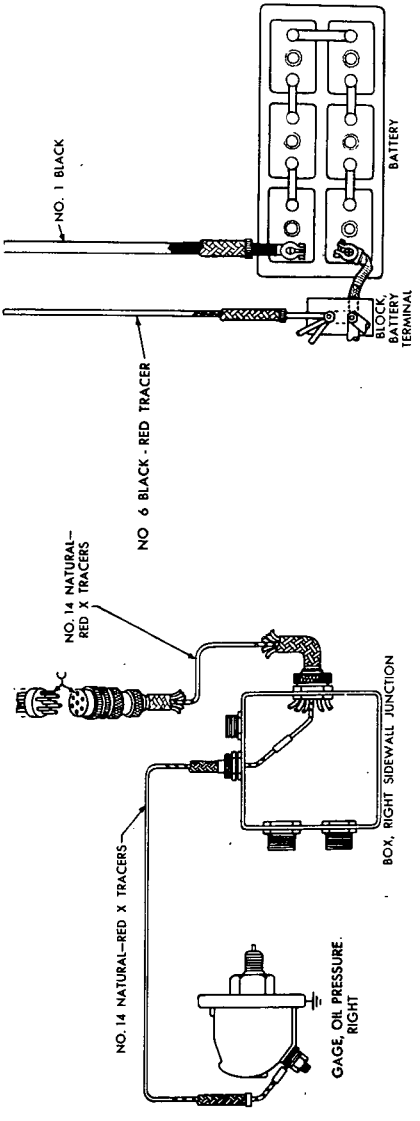

Figure 110 — Oil Pressure Gage Circuit

for breaks. It is also possible that the battery may be so low that the test lamp would not light if placed directly across the battery terminals, in which case the battery should be replaced.

(c) After making this check of the circuit from the battery to ground, fasten one end of a jumper wire to the positive battery post, and the other end to each successive terminal, working outward from the battery. If the trouble is not found before the "D" terminal of the index plug on the instrument panel is reached, the face of the instrument panel should be removed and the jumper wire placed on the "B" terminal of the lighting switch, and then to the post of the voltmeter.

(d) While the check of the voltmeter circuit will determine the exact cause of trouble, a quick check can be made of the voltmeter itself by merely trying any of the lights in the vehicle. If any of the lights work, but the voltmeter does not, the instrument should be replaced.

d. Oil Pressure Gage Circuit.

(1) OPERATION. Each engine oil pressure gage consists of two units: an operating unit on the engine crankcase, and an indicating unit on the instrument panel, connected by a single wire. The operating unit is fitted into the main oil header. It consists of a housing that encloses a diaphragm and linkage which moves a contact over a resistance coil in direct proportion to the oil pressure. The indicating unit consists mainly of two coils spaced 90 degrees apart, with an armature and pointer mounted at the axis of the coils, and a dial scale graduated in pounds per square inch. As the oil pressure builds up in the engine, the resistance in the engine unit varies and changes the relative strength of the coils in the panel gage, causing the pointer to indicate the amount of pressure.

(2) DIAGNOSIS.

(a) Instrument Gage Does Not Register. Since the indicating gage is grounded and fed from the ignition switch, the indicator should come up to "0" when the switch is turned on. When this condition does not occur, it is an indication that there is a break in the line between the switch and the indicating unit, or that the unit is defective and should be replaced. This situation can be quickly checked by using a jumper wire from the ignition switch to the ignition terminal on the gage, thus eliminating the connecting wiring.

(b) Gage Reads High Under All Conditions. When the gage reads high under all conditions, it means that there is a high resistance or break somewhere between the engine unit and instrument panel, or that the wires on the panel gage are reversed. The latter of these causes may be determined by inspection, while the former can be determined by the following method: Connect the lead at the engine unit and ground it directly at some convenient spot. If this brings

indicator back to "0", the engine unit is either burned out or improperly grounded. Check for sealer on threads, causing poor ground. If threads are grounded properly, unit should be replaced. If indicator still shows pressure, wiring is defective. Checking of the circuit from here should be continued by either the test lamp or jumper wire method, working from engine unit to gage in instrument panel.

(c) Gage Reads "0" Under All conditions. When it is found that the oil pressure gage reads "0" under all conditions, the first check should be made at the engine unit. When the lead at the engine unit is disconnected, the gage should show a high reading. If this occurs, the engine unit should be replaced. If this does not occur, there is either a ground somewhere in the circuit between the engine unit and the panel gage, or the panel gage should be replaced. This condition can be quickly located with the test lamp or the voltmeter by checking successive terminals. NOTE: *A low reading may be caused by road dirt around the engine unit terminal, causing a ground. For this reason, the terminals should be wiped clean.*

e. Temperature Gage Circuit.

(1) OPERATION. The temperature gage consists of an indicating unit in the instrument panel connected by a single wire to an operating unit in the left cylinder head. Separate set of gages are used for each engine. The indicating unit consists principally of two coils mounted 90 degrees apart, and an armature with a pointer at the intersection of the coils. The dial has a scale graduated in degrees Fahrenheit. The engine unit has no moving parts. It is essentially a resistor which changes resistance with variations in temperature, and thus modifies the strength of the coils in the indicating unit and causes the pointer to indicate the correct temperature.

(2) DIAGNOSIS.

(a) Gage Does Not Register. If the indicating unit in the instrument panel gives no indication of movement when the ignition switch is turned on, either there is a break in the wire from the switch to the gage or the indicating unit should be replaced. A broken feed wire can be determined by inspection or a jumper wire.

(b) High Reading Under All Conditions. If the gage has a high reading under all conditions, it may be due to the indicating unit not being grounded, a short to ground in the wire between the engine and indicating unit, a defective indicating unit, or a burned out engine unit. To determine the exact cause, disconnect the lead at the engine unit. If indicating gage drops to the low side, the engine unit should be replaced. If the indicating unit still reads high, a test lamp should be used to determine where the line between the units is grounded. If this line is all right, the indicating unit in the instrument panel should be replaced.

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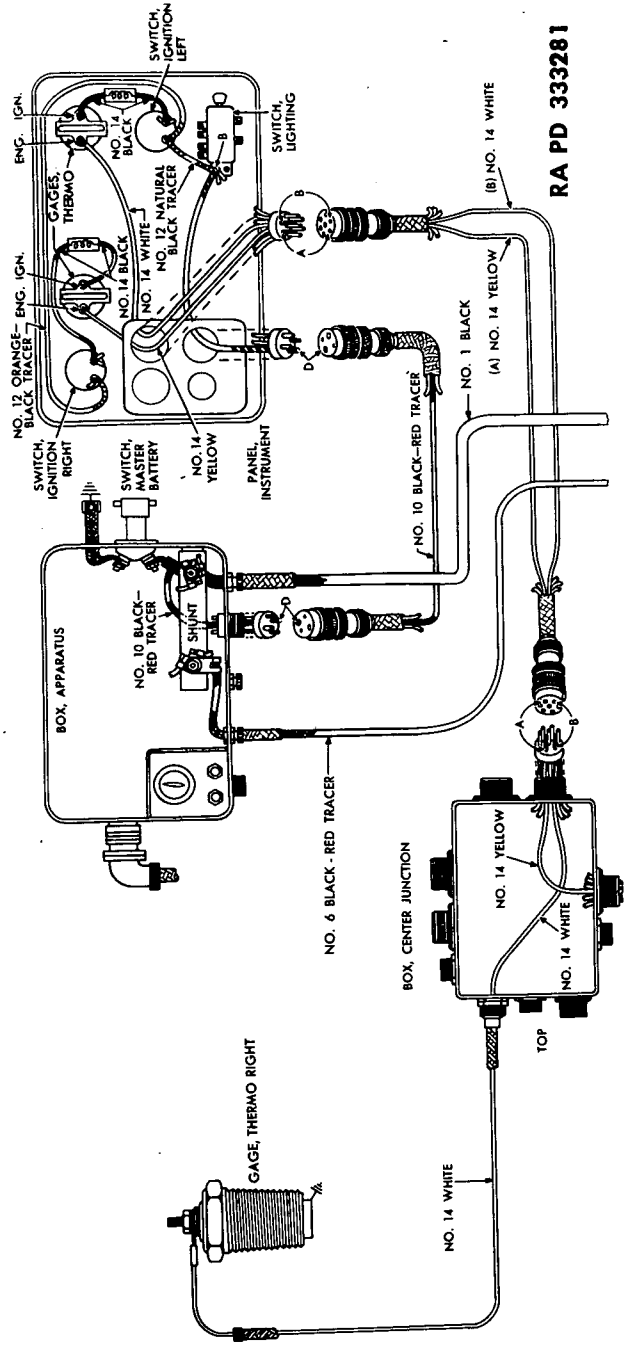

ELECTRICAL INSTRUMENTS AND EQUIPMENT

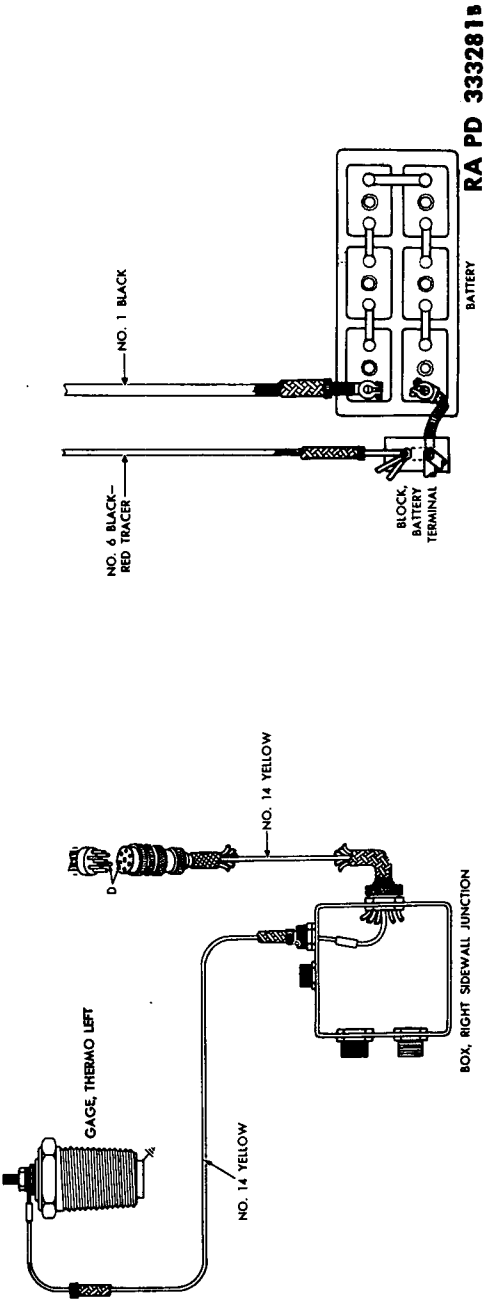

Figure 111 — Temperature Gage Circuit

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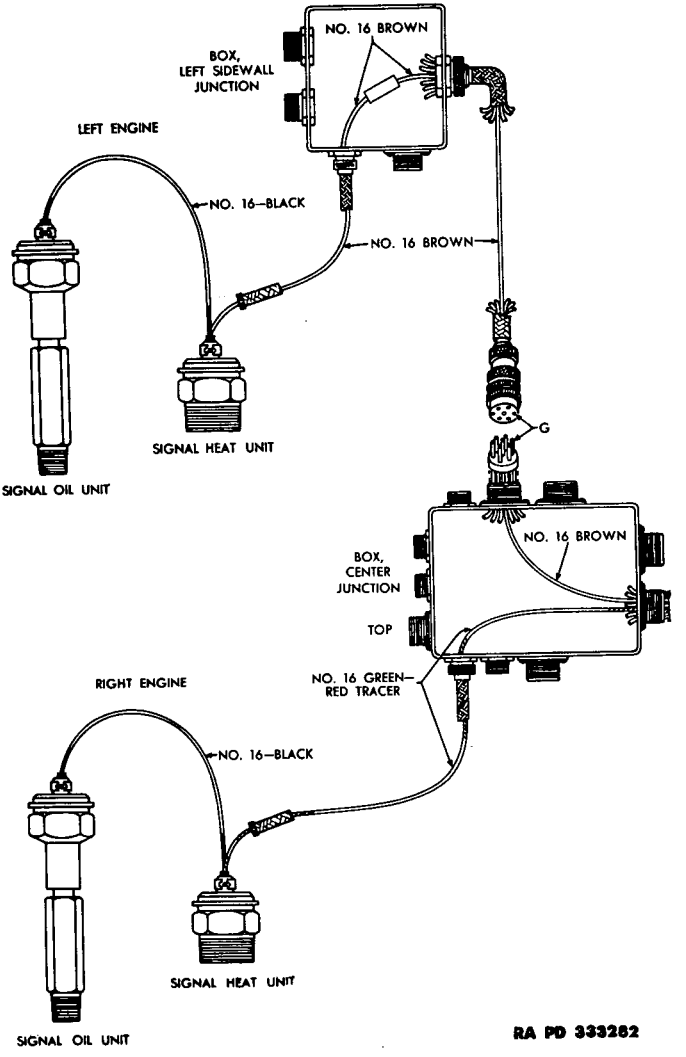
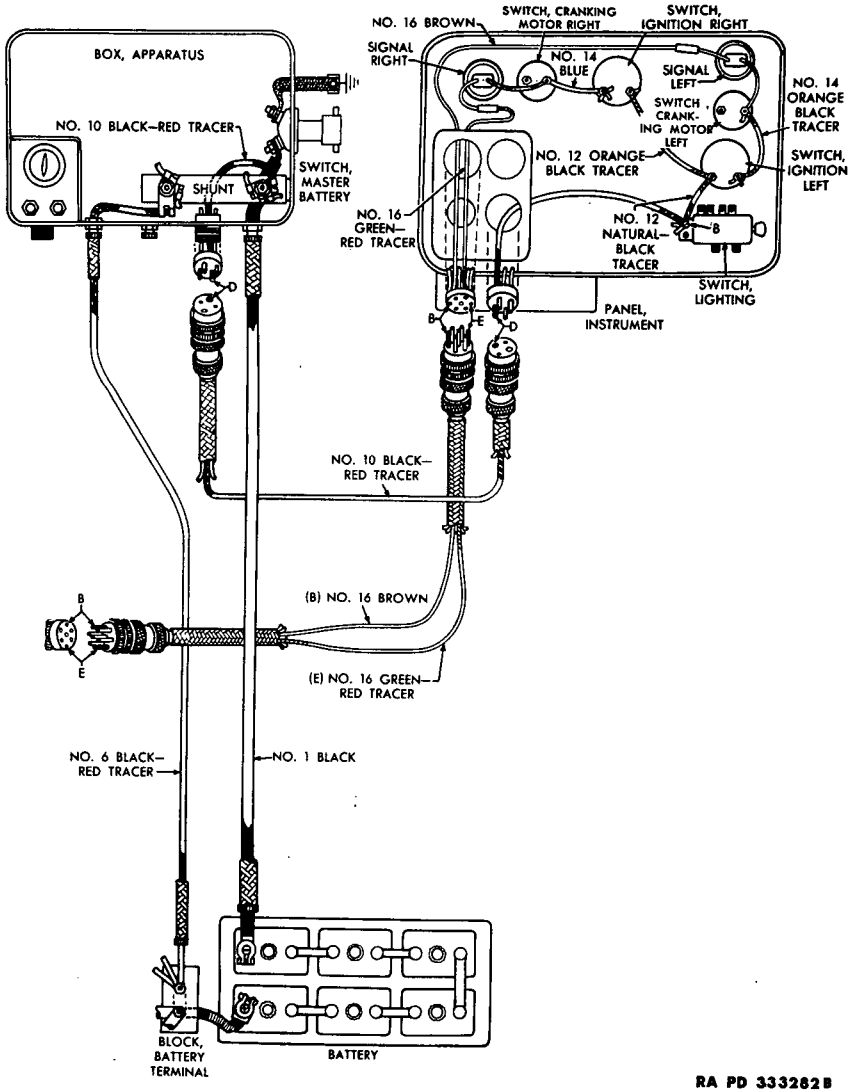


Figure 112 — Engine Oil Pressure

ELECTRICAL INSTRUMENTS AND EQUIPMENT



and Heat Signal Unit

(c) Low Reading Under All Conditions. If the indicating unit reads low under all conditions, place one lead of a test lamp on the engine unit terminal and ground the other lead. If lamp lights, the circuit is all right to the engine unit. After making this test to determine that there is no break in the circuit, disconnect the lead at the engine unit and ground it. This should cause the indicating unit to have a high reading. If it does, the engine unit should be replaced; if it does not, the indicating unit should be replaced.

f. Engine Oil Pressure and Heat Signal Circuit.

(1) OPERATION.

(a) The warning signal system consists of three separate units for each engine connected by a single wire. An oil signal unit, mounted into the rear camshaft bearing lubrication line, is a low-pressure switch operated by a bellows arrangement. When the oil pressure in the line is not sufficient to hold a set of contact points open, they close and form a completed circuit to ground. A heat signal unit is located at the rear of the right cylinder head on each engine, and is another bellows-operated switch. When the engine temperature reaches a predetermined maximum, a set of contact points are closed and the circuit grounded. The dash unit of the system is merely a light which flashes on when the circuit is completed through either the oil signal unit or the heat signal unit.

(b) Because of the way in which these units are hooked up, either low oil pressure or overheating will cause the warning light in the instrument panel to flash on. When the warning light is lit, it will then be necessary to look at the oil pressure gage and the temperature gage in the panel to determine where the trouble lies. Since the oil signal units are low pressure switches, the warning lights should light when the ignition switches are turned on and stay lit until the engine oil pressure builds up beyond the safe minimum for which the signals are set. The signals may or may not light at the slow idling speeds, but in any case they should go out before 500 revolutions per minute, providing the engine temperature is not above the maximum for which the heat signal is set (approximately 240° F).

(2) DIAGNOSIS.

(a) Warning Signals Do Not Light When Ignition Is Turned On. If warning signal lights do not come on when the ignition switch is turned on, it indicates that there is an "open" in the circuit, or that the bulb is burned out. Disconnect the lead at the oil signal unit and ground it at some convenient point. If light flashes on now, the unit should be replaced, but if lamp does not light, the circuit should be checked with a test lamp starting at the oil signal unit and working towards the light in the instrument panel.

(b) Warning Signals Light With Normal Oil Pressure and Temperature. If the warning signal is on, but the instrument gages show normal oil pressure and temperature, the first thing to check is the operation of the engine units. Disconnect lead at oil signal unit; if light goes out, the oil signal unit should be replaced. If light does not go out, reconnect this lead and disconnect lead at heat signal unit. If light goes out now, the heat signal unit should be replaced. If both engine units are all right, a test lamp or voltmeter should be used to locate the ground in the circuit between the engine units and the lights in the instrument panel.

g. Transmission and Transfer Unit Signal Circuit.

(1) OPERATION.

(a) The system is composed of a signal unit on each transmission, another signal unit on the right side of the transfer unit directly below the control valve body, and three signal lights mounted in a panel on the lower side of the instrument panel. The transmission and transfer case units are all low-pressure-operated switches which work on the bellows principle. When the oil pressure falls below the point for which the signals are set (60-65 pounds per square inch), a pair of contact points close, thus completing the circuit to the ground, and lighting the warning lights in the instrument panel.

(b) Since the signals are operated by low pressure, they will all light when the ignition switch is turned on. When the engines are started, the transmission signals should go out, but the transfer unit signal will not go out until the vehicle has started to move forward.

(2) DIAGNOSIS.

(a) Warning Signals Do Not Light When Ignition Is Turned On. If the transmission or transfer unit warning signal fails to light when the ignition switch is turned on, it indicates that there is an "open" somewhere in the circuit, or that the light is burned out. The first check to make is at the operating unit; disconnect the lead at the transmission or transfer unit, whichever the case may be, and ground it. If light flashes on when this lead is grounded, the operating unit should be replaced. If light does not go on when the lead is grounded, a test lamp should be used to determine the exact location of the trouble. Start at the operating unit and work toward lights in panel; the test lamp will light as soon as the defective spot in the line is passed. The leads and connectors from the ignition switches to the lights should also be checked.

(b) Warning Signal Lights Fail To Go Out. If the signal lights fail to go out when the vehicle is operating normally, it is an indication that there is a ground somewhere between the operating units and the lights, or that the operating units are defective. A quick check may be made on the operating unit by merely disconnecting the lead

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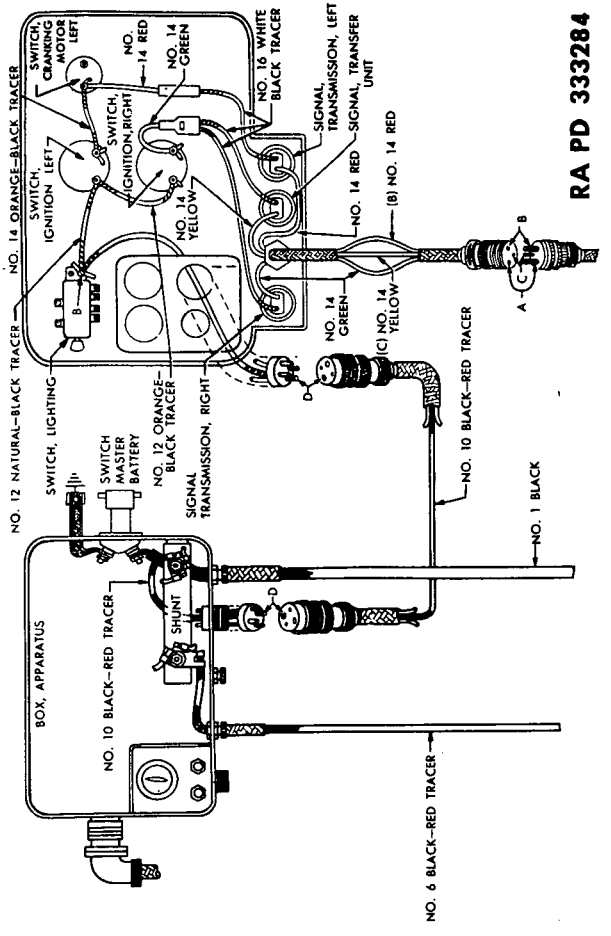

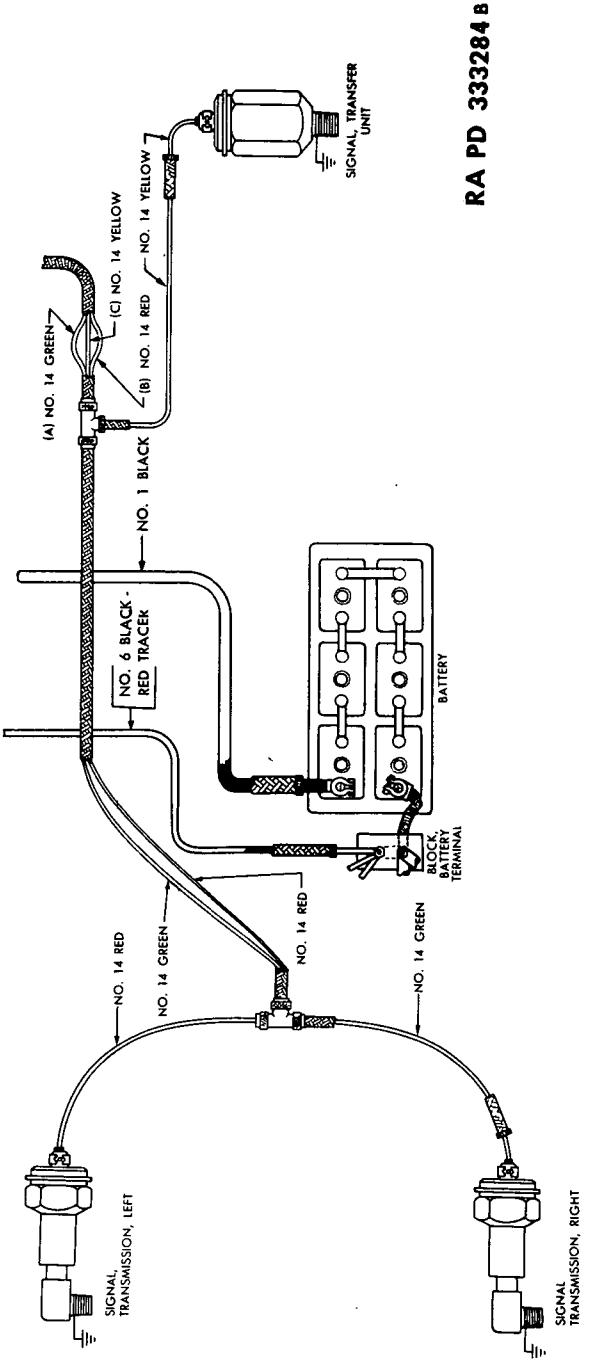

Figure 113 — Transmission and Transfer Unit Signal Circuit

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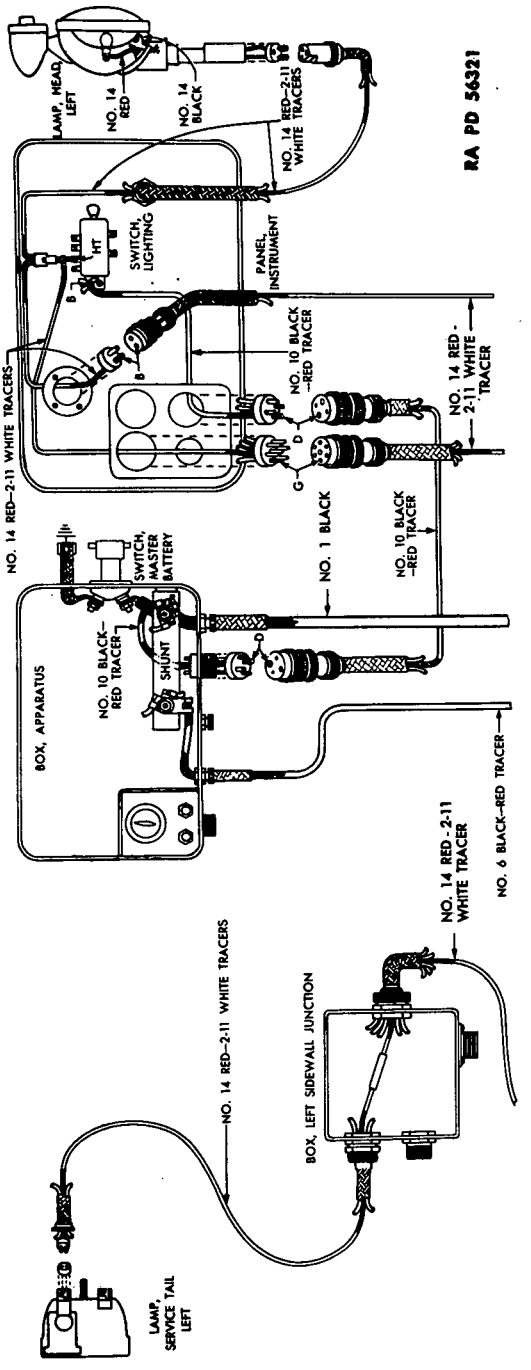


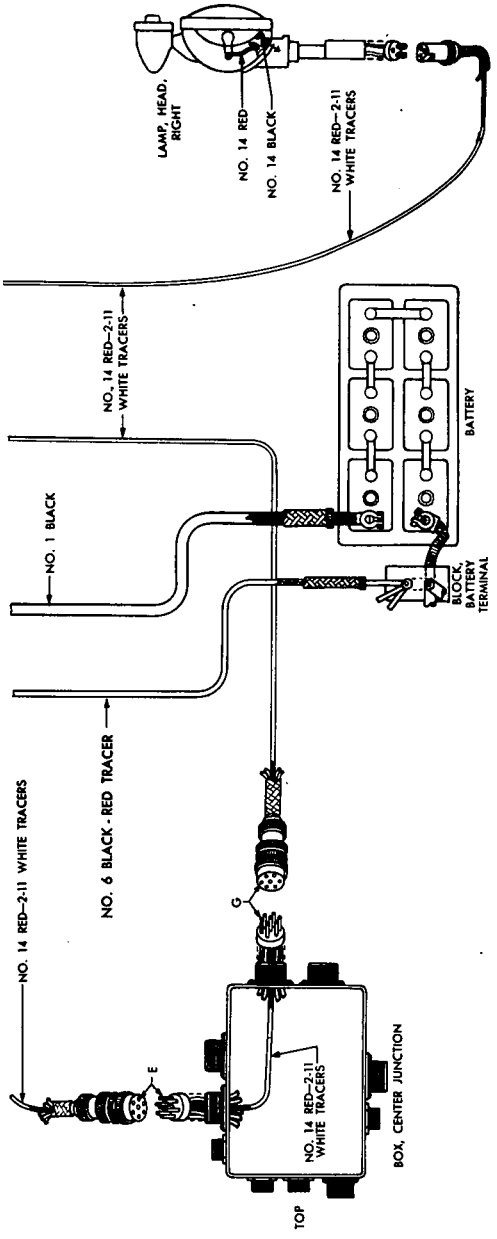


Figure 114 — Service Lamp Circuit

at the unit. If light goes out when the lead is disconnected, the operating unit is defective and should be replaced. If light does not go out when the lead is disconnected, a test lamp should be used to locate the grounded point in line.

(c) Warning Signals Light During Operation. Whenever the warning light flashes on, the oil level should be checked. If level is correct, a precision-type oil pressure gage should be attached to the transmission or transfer unit in place of the signal unit, and an actual oil pressure measurement made. If the pressure is below specifications, the transfer unit or the transmission should be replaced, as further operation may result in irreparable damage to the unit.

h. Service Lamp Circuit.

(1) OPERATION.

(a) The two head lamps are located on the front deck at each side of the vehicle and each lamp has a blackout marker light permanently mounted on the top of it. Although there are two taillights mounted on the sloping rear deck of the vehicle, only the one on the left side is in the service light circuit, the right side taillight being used for blackout purposes only. The taillight and stop light are combined in a double filament light in the upper socket of the left lamp. A blackout taillight is mounted in the lower socket, but will not be considered in this circuit because it is covered in a later diagram (fig. 116).

(b) The service taillight and both headlights are connected to the "HT" terminal of the lighting switch which is located in the instrument panel.

(2) DIAGNOSIS.

(a) No Lights. If neither the headlights nor taillight work, when the lighting switch is turned to their position, try the blackout lights (first position); and if it is found that none of the lights are working, yet the voltmeter registers, the lighting switch is probably defective and should be replaced. However, if other lights work, a jumper wire can be used from the "B" terminal on the lighting switch to the "HT" terminal; and if lights work with this jumper wire in place, the switch should be replaced. If lighting switch is found to be satisfactory, the wire from the "HT" terminal to the bakelite line connector and the connector itself should be checked.

(b) Dim Lights. An instance might occur when the battery voltage is normal, but the lights are very dim. Cases like this are usually due to a high resistance somewhere in the circuit, and can be located by the use of a voltmeter as outlined in the testing procedures.

(c) Taillight or One Headlight Inoperative. If one of the lights in the circuit does not work, the first thing to do is to check the bulb.

This may be done either by replacing the bulb with a new one, or by running a jumper wire from the battery terminal block directly to the bulb itself. In checking the headlights in this manner, be sure that the short ground wire is in good condition and tightly connected. If bulb is found to be satisfactory, the test lamp or jumper wire method should be used to check each terminal from the unit in question to the "HT" terminal on the light switch.

i. Blackout Lamp Circuit.

(1) OPERATION. A blackout marker lamp is permanently attached on top of each headlight for marking the front of the vehicle. In the lower section of each taillamp, the blackout taillight is located. These four units all work from the "BHT" terminal of the lighting switch in the instrument panel.

(2) DIAGNOSIS.

(a) No Lights. If none of the lights in the blackout circuit work when the lighting switch is turned to their position, yet the voltmeter registers, the other lights should be tested. If any of the other light circuits work, the line from the "BHT" terminal to the line connector and the connector itself should be checked. If this line is satisfactory, the lighting switch should be replaced.

(b) Taillight or Marker Light Inoperative. If one of the lights in the circuit does not work, the first thing to do is to check the lamp. This can be done by either replacing the lamp with a good one or running a jumper wire from the positive battery post or terminal block to the lamp itself. In checking lights in this manner, make sure that the lamp is tight in the socket and well grounded. If the lamp is found to be satisfactory, the test lamp or jumper wire method should be used to check each terminal from the unit in question to the "BHT" terminal on the lighting switch. NOTE: *If neither taillight works, but the marker lights operate, the trouble will probably be found between the center junction box and the instrument panel, because both blackout taillight leads are joined together in the center junction box.*

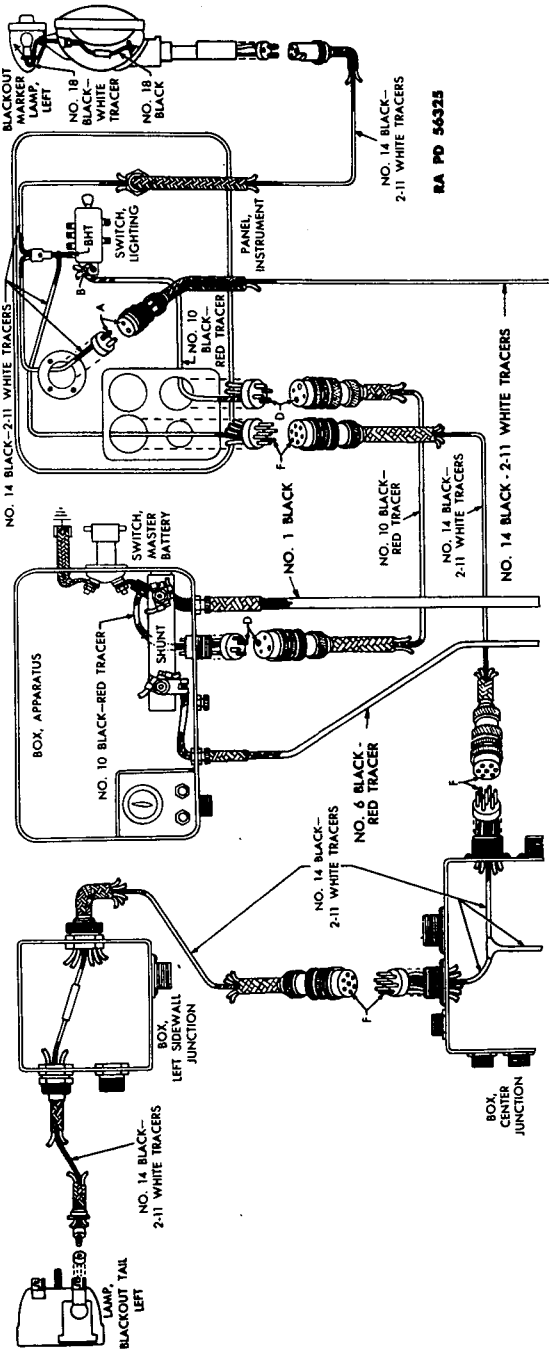
j. Stop Lamp Circuit.

(1) OPERATION.

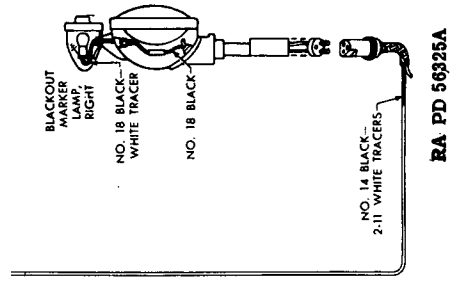
(a) The upper sockets in the taillights are the stoplights. Each is connected to the lighting switch in the instrument panel by a single wire. The service stop light (left) works off the "S" terminal on the lighting switch while the blackout stop light (right) works off the "BS" terminal.

(b) The operating mechanism for the stop lights consists of two switches connected in series and mounted on the controlled differential case cover. A linkage is hooked from each switch to the steering

75-MM HOWITZER MOTOR CARRIAGE M8



ELECTRICAL INSTRUMENTS AND EQUIPMENT



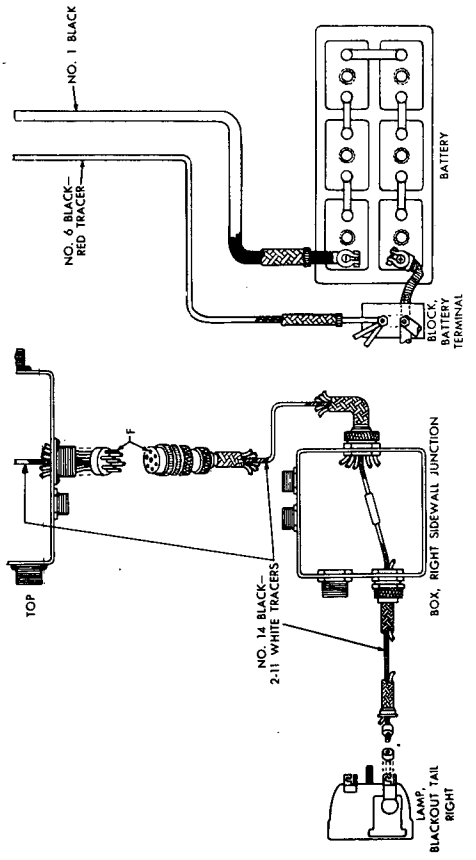
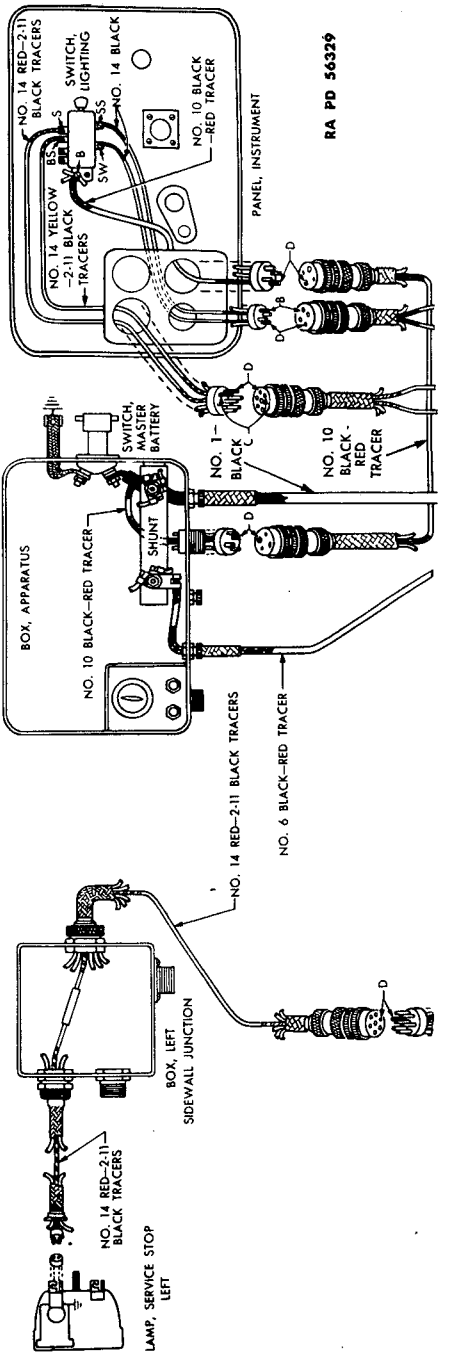


Figure 115 — Blackout Lamp Circuit

75-MM HOWITZER MOTOR CARRIAGE M8



ELECTRICAL INSTRUMENTS AND EQUIPMENT

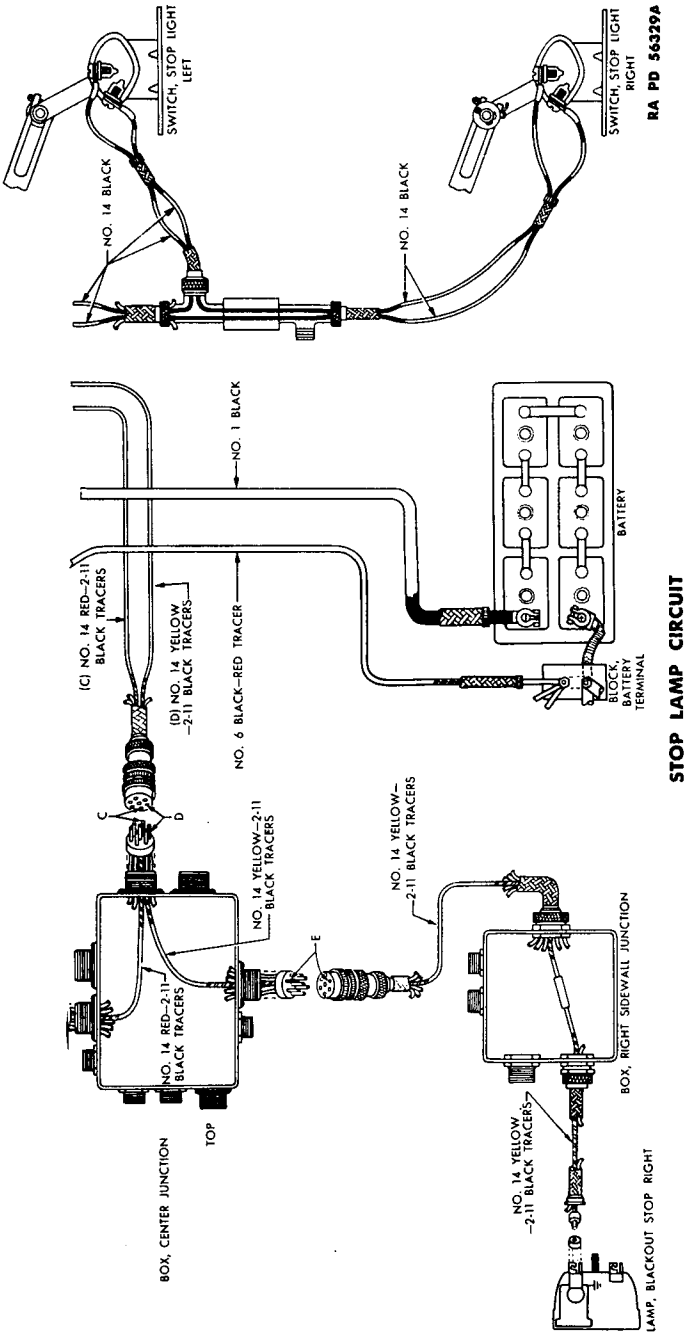


Figure 116 — Stop Lamp Circuit

75-MM HOWITZER MOTOR CARRIAGE M8

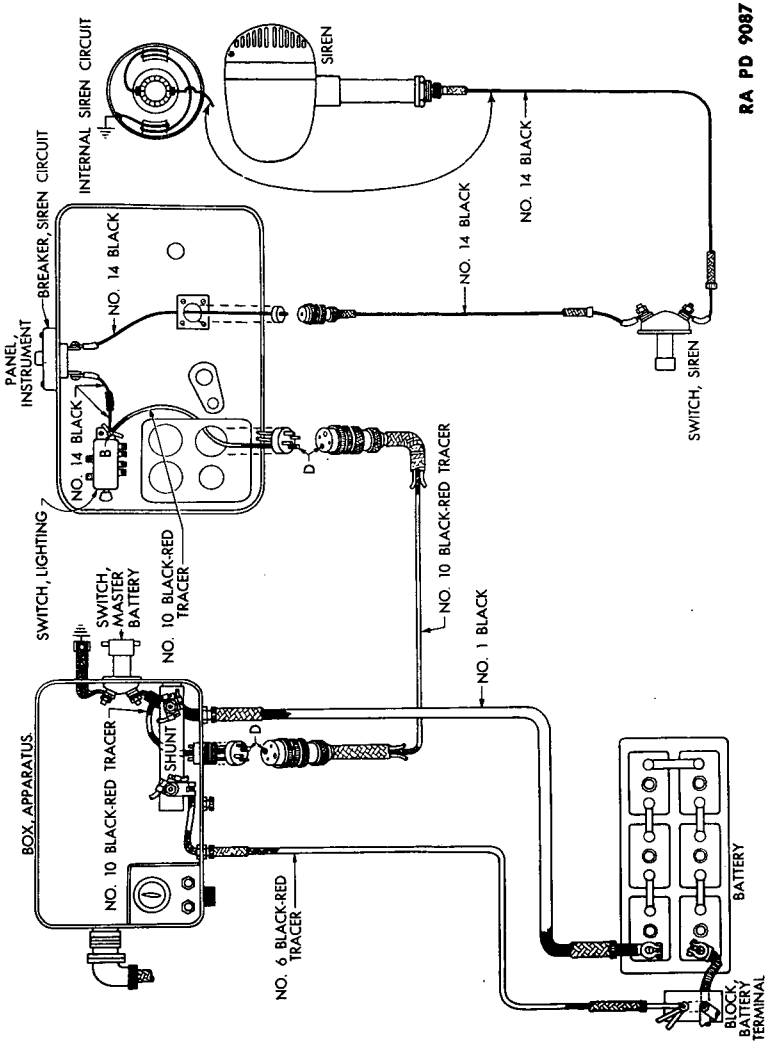


Figure 117 — Siren Circuit

levers so that when the levers are pulled back, the circuit is completed through the switches. This type of hook-up makes it necessary that both levers be pulled back at the same time in order to operate the stop lights.

(c) When the lighting switch is in its first position, the blackout stop light is connected in the circuit along with the other blackout lights. The second position of the switch connects the service taillight and stop light in the circuit with the headlights, and the third position connects the service stop light only in the circuit. Therefore, it must be remembered when referring to the diagram that there are two separate circuits shown.

(2) DIAGNOSIS.

(a) No Stop Lights. If neither the service stop light nor the blackout stop light works, the trouble probably lies in the stop light switches. This can easily be checked by running a jumper wire from the "SW" to "SS" terminal on the lighting switch. This will be the same as closing both stop light switches. If the stop lights work with this jumper in place, it will indicate that the circuit is all right up to the lighting switch, and that the trouble lies somewhere between the instrument panel and the switches on the differential case. However, if stop lights do not work with this jumper wire in place, disconnect the wires leading to the "BS" and "S" terminals on the lighting switch, and touch them to the "B" terminal. If the stop lights work now, the lighting switch should be replaced.

(b) When the trouble lies in the stop light switches, the following method can be used to determine the switch causing the trouble. Disconnect the wires at one switch and fasten leads together. If lights work when other switch is operated, the first switch should be replaced. If switches are both operating satisfactorily, a test lamp can be used to determine where the break in the wire is. (Both switches must be closed to complete the circuit.)

(c) One Stop Light Inoperative. If only one of the stop lights works, the trouble probably lies between that light and the lighting switch. First check for a burned out bulb, as outlined in service light circuit, and if this is not the trouble, each terminal in the circuit should be checked with a test lamp up to the lighting switch ("S" terminal for service stop, "BS" terminal for blackout stop). If trouble is not located by the time the lighting switch is reached, the switch should be replaced.

k. Siren Circuit.

(1) OPERATION. The siren is composed simply of a 12-volt motor and rotating parts necessary to create the desired sound. A spring-loaded switch is located on the floor to the left of the driver's accelerator pedal for the purpose of operating the siren. Instead of the conventional fuse-type safety device in the circuit, a circuit breaker is mounted

at the top of the instrument panel, and if a high load is set up in the circuit, this circuit breaker automatically opens the circuit and prevents damage to the units.

(2) DIAGNOSIS.

(a) Improper Operation. In any case where the operation of the siren is not normal because of not turning, turning too slowly, throwing out circuit breaker, smoking or overheating, a complete check of the entire circuit will have to be made.

(b) The first thing to be done in case the siren does not turn is to depress the circuit breaker button. If siren momentarily starts and then opens the circuit at the circuit breaker, the voltmeter method of testing should be used. Disconnect conduit at siren, and check voltage at this point (it should be approximately 12 volts). If circuit is satisfactory at this point, the siren assembly should be replaced; if not, proceed to each terminal, working toward instrument panel until defective unit is located.

126. BATTERY.

a. The service which the using arms can perform on the battery includes filling with water, checking specific gravity, cleaning, and replacement.

b. Checking Battery. The level and specific gravity reading of the battery fluid should be checked every week, and at the completion of every long run. Never use matches or a flame as a light when checking the battery. Distilled water should be added to bring the fluid level just above the battery plates. If the specific gravity of any cell is below 1.200, the battery should be recharged by running the auxiliary generator.

c. Battery Terminal Corrosion. Warm water poured slowly over the terminals will loosen any copper sulphate that has been deposited, so that it can be brushed off and flushed away. CAUTION: *This should never be done with the battery in the vehicle.* Battery posts and terminals should be wiped clean with a cloth saturated in a solution of soda ash and water. Corrosion can be retarded by coating with petrolatum. A good mixture is petrolatum and soda ash. If battery fluid has overflowed or has spilled, all affected metal parts should be flushed with an alkaline solution and wiped dry.

d. Removal. Open main battery switch located on the apparatus box. Remove screws holding battery box cover to battery box and remove cover. Remove seat back from driver's seat. Disconnect battery cables and swing cables out of the way. Loosen battery retainer bracket hold-down nuts, and swing hold-down bolts free of battery box frame. Remove retainer bracket. Lift battery out of battery box and remove from vehicle through turret.

e. Installation. Lower battery into vehicle through turret opening and into battery box so that the positive post is next to the propeller shaft and toward the rear. Be sure that posts and terminals are clean. Connect battery cables. Negative post is grounded through master switch in apparatus box directly above battery box on sidewall. Install battery retainer bracket. Swing bracket hold-down bolts over ends of bracket and tighten both nuts. Check battery terminals to be sure they are tight. Position battery box cover on box and install mounting screws.

127. BATTERY SWITCH.

a. The master battery switch, which is located on the forward end of the apparatus box, can be replaced without removing the apparatus box from the vehicle. Replacement is the only service operation which should be attempted on the master battery switch.

b. Removal. Rotate four locking screws holding apparatus box cover one-quarter turn each, and remove cover from apparatus box. Disconnect ground wire from battery at base of switch. Disconnect ground strap at base of switch and tape the end of the strap. Remove two bolts on switch plate outside of apparatus box and remove the switch.

c. Installation. Position master battery switch in forward end of apparatus box and install two mounting bolts and nuts securely. Connect ground strap to base of switch and install nut. Remove the tape and connect ground wire from battery to base of switch and install terminal nut. Position apparatus box cover on box and rotate four cover mounting screws one-quarter turn each to lock cover on box.

128. CIRCUIT BREAKERS.

a. Defective circuit breakers can be corrected by replacement only. They should not be disassembled.

b. Removal.

(1) REMOVE LIGHTING SWITCH CIRCUIT BREAKER. Make sure master battery switch is in "OFF" position. Remove instrument panel as explained in paragraph 131. Remove five screws holding instrument panel cover to panel, and lift panel off cover just enough to have room to work on lighting switch. Disconnect all wires to "A" and "B" terminals on the rear end of lighting switch, tagging wires to make sure they will be installed on proper terminals. Remove two screws holding circuit breaker assembly on rear end of lighting switch and remove circuit breaker assembly.

(2) REMOVE SIREN CIRCUIT BREAKER. Make sure master battery switch is in "OFF" position. Remove instrument panel as explained in paragraph 131. Remove five screws holding instrument

panel cover to panel and lift panel off cover just enough to have room to work on siren circuit breaker. Disconnect both wires leading to siren circuit breaker. Remove two screws and lock washers holding siren circuit breaker to bracket on instrument panel, and remove circuit breaker.

c. Installation.

(1) INSTALL LIGHTING SWITCH CIRCUIT BREAKER. Position circuit breaker and spacers on rear end of lighting switch, and install two mounting screws. Connect all wires, which were removed, to lighting switch, and install terminal screws securely. Check to make sure wires are installed on proper terminals, and remove tags installed when wires were disconnected. Position instrument panel on cover, and install five mounting screws and lock washers. Install instrument panel.

(2) INSTALL SIREN CIRCUIT BREAKER. Position siren circuit breaker in bracket on instrument panel, and install two mounting screws. Connect both wires to circuit breaker. NOTE: *It does not make any difference which wire is attached to either terminal on the circuit breaker.* Position instrument panel on panel cover, and install five mounting screws and lock washers. Install instrument panel.

129. CONDUITS AND WIRING.

a. The only service which the using arms should attempt on conduits or wiring is diagnosis of troubles (par. 125) and replacement.

b. When replacing conduits and wiring, the following precautions should be observed:

(1) When removing or installing conduits, make sure that the conduits do not twist or kink.

(2) Make sure that the conduits are connected to the proper terminal plugs. Follow the pertinent wiring diagrams for reference on connections.

(3) When installing plug connectors, particularly the seven-prong type, make sure that the letters on both halves of the connectors line up with each other and that the tongue and groove in the connectors line up without twisting.

(4) Make certain that all conduit retaining clips are installed and that cables are held securely in their proper position.

130. ELECTRICAL FILTERS.

a. Electrical filters are used on first type M8's only. Any of the electrical filters can be replaced by the using arms.

b. Removal.

(1) REMOVE DISTRIBUTOR FILTER. Remove bulkhead door.

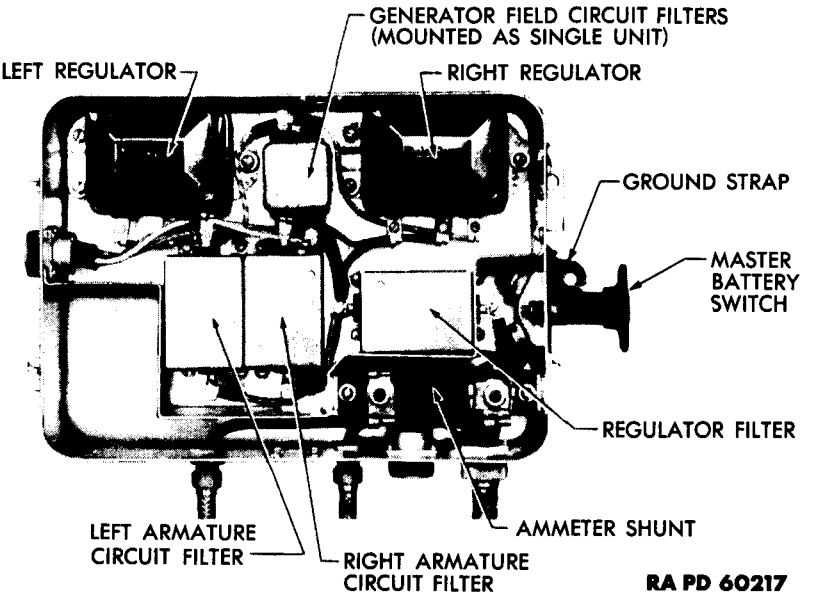


Figure 118 — Apparatus Box — First Type

Disconnect two wires at distributor filter. Remove four screws and lock washers holding filter to distributor body, and remove filter.

(2) REMOVE IGNITION COIL FILTER. Remove bulkhead door. Remove two screws and lock washers holding ignition coil filter to support on bulkhead on right-hand engine. Remove filter. To remove ignition coil filter on left-hand engines, remove two screws and lock washers holding filter to under side of bracket on which ignition coil is mounted. Disconnect both wires from each filter.

(3) REMOVE GENERATOR FILTER. Open engine compartment rear doors and remove fan, fan belt, and bracket. Disconnect wires at both filter terminals by removing terminal screws. Remove four screws and lock washers holding filter to filter bracket on generator, and remove filter. NOTE: *The removal of the generator filters on left- and right-hand engines is the same.*

(4) REMOVE GENERATOR REGULATOR FIELD FILTERS (fig. 118). Remove apparatus box cover. Remove two screws holding generator regulator field filters to apparatus box. Disconnect wires to left and right generator regulator field filters by removing terminal screws. Remove both generator regulator field filters and integral bracket.

(5) REMOVE GENERATOR REGULATOR BATTERY FILTER (fig. 118). Remove apparatus box cover. Disconnect wires at each end

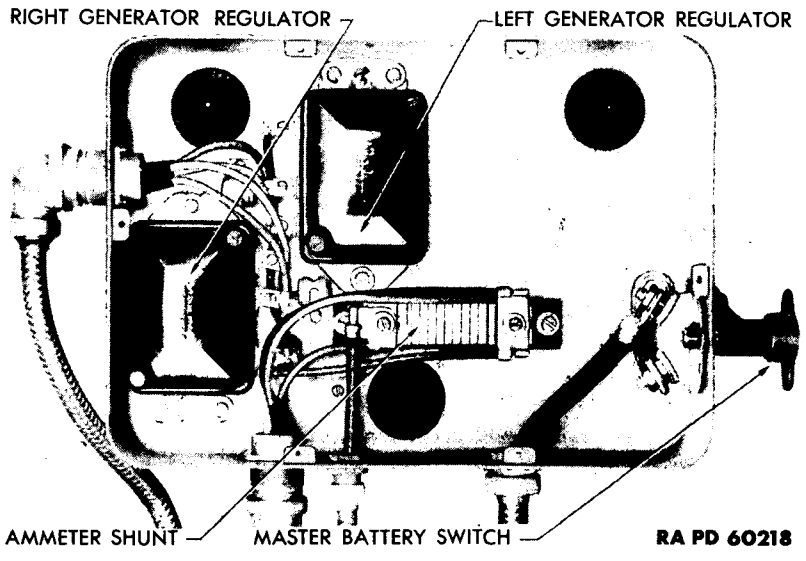


Figure 119 — Apparatus Box — Second Type

of generator regulator battery filter. Remove four screws holding filter to apparatus box and remove filter. NOTE: *One filter shields both of the regulator battery terminals.*

(6) REMOVE GENERATOR CURRENT REGULATOR FILTER (fig. 118). Remove apparatus box cover. Disconnect both wires to filter at filter terminals by removing terminal screws. Remove four screws holding filter to apparatus box and remove filter. NOTE: *The removal of the generator regulator current filters connected to both left- and right-hand generator regulators is the same.*

c. Installation.

(1) INSTALL DISTRIBUTOR FILTER. Position distributor filter on distributor, and install four mounting screws and lock washers. NOTE: *The "DIST" terminal on the filter should point toward the primary terminal on distributor body.* Connect both filter wires to filter. Wire from negative terminal on coil to filter must be attached to "COIL" terminal on filter. Wire from primary terminal on distributor to filter must be connected to "DIST" terminal. Install terminal screws. Install bulkhead door.

(2) INSTALL IGNITION COIL FILTER. Position right-hand coil filter on support on bulkhead, and install two mounting screws and lock washers. Connect wires to filter. Position left-hand ignition coil filter on under side of ignition coil bracket, and install two mounting

screws and lock washers. Connect both filter wires to filter, and tighten terminal screws. Install bulkhead doors.

(3) INSTALL GENERATOR FILTER. Position generator filter on bracket on generator, and install four mounting screws and lock washers. Connect leads. Install fan, fan bracket, and fan belt. Adjust fan belt, and close engine compartment rear doors. NOTE: *The filters for both left- and right-hand generators are installed in the same manner.*

(4) INSTALL GENERATOR REGULATOR FIELD FILTERS. Position both left and right generator regulator field filters with integral bracket in apparatus box, and install two mounting screws. Connect wires to filter terminals, making sure that wires are installed on proper terminals. NOTE: *Refer to wiring diagrams (figs. 69 and 70).* Install apparatus box cover.

(5) INSTALL GENERATOR REGULATOR BATTERY FILTER. Position generator regulator battery filter in apparatus box, and install four mounting screws. Connect wires from regulator "BAT" terminals to terminals on filter. Connect battery lead wire to other filter terminal. NOTE: *It makes no difference which wires are attached to either terminal except that both wires from the regulator "BAT" terminals should be installed on the same filter terminals.* Install apparatus box cover.

(6) INSTALL GENERATOR CURRENT REGULATOR FILTER. Position generator current regulator filter in apparatus box and install four mounting screws. Connect wire from generator terminal on regulator to top terminal on filter. Connect other filter wire to bottom terminal on filter. Install apparatus box cover. NOTE: *The filters for the left- and right-hand generator current regulator filters are installed in the same manner.*

131. INSTRUMENT PANEL.

a. The instrument panel may be replaced as a complete unit or it may be disassembled to replace component parts by the using arms.

b. Removal and Disassembly.

(1) LOWER INSTRUMENT PANEL. Remove two nuts and lock washers holding instrument panel to brackets above panel. Remove two screws and lock washers holding panel bracket to hull sidewall at lower left corner of instrument panel. Drop instrument panel as far as possible to permit working through space above panel.

(2) REMOVE AND DISASSEMBLE PANEL. Loosen two clamp mounting screws holding conduits and tachometer cables to inside of front hull. This will permit panel to be dropped further to allow more working space. Disconnect first the left-hand head lamp con-

75-MM HOWITZER MOTOR CARRIAGE M8

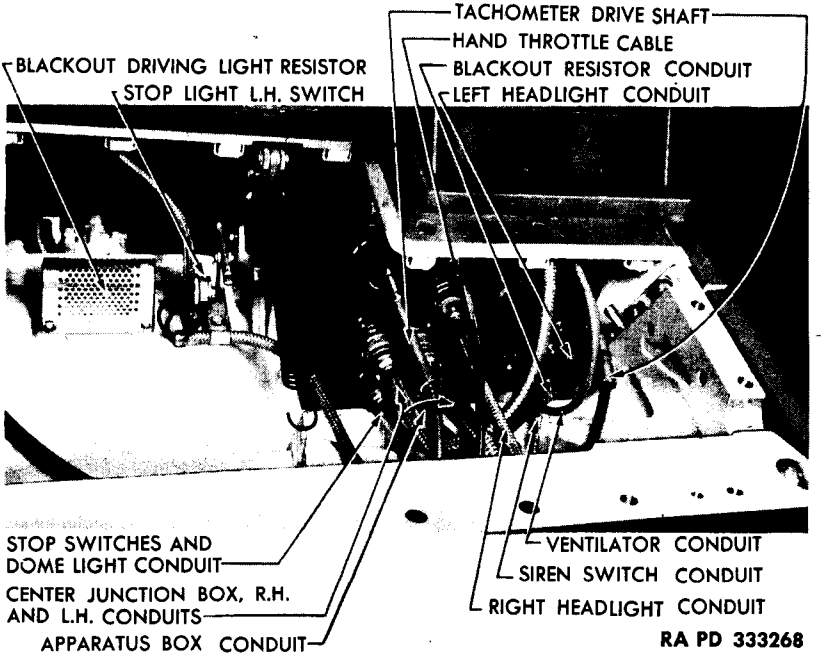


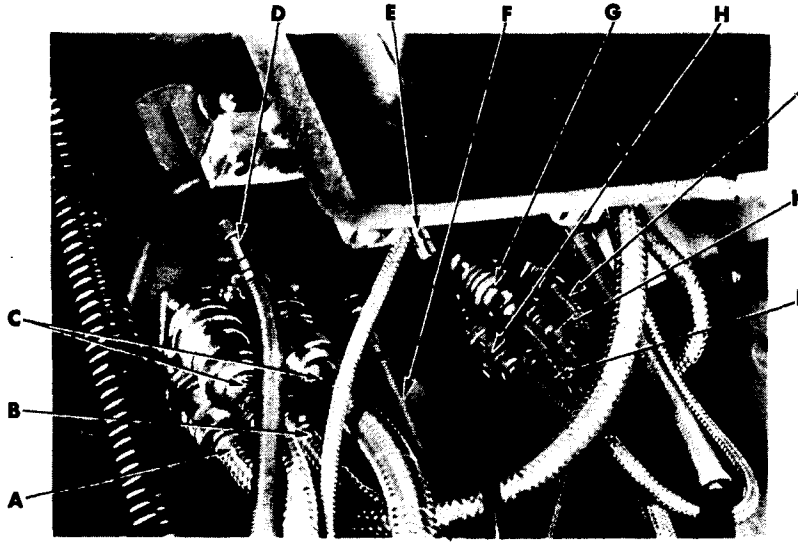
Figure 120 — Connections at Rear of Instrument Panel — First Type

duit at head lamp. Disconnect electrical conduits, speedometer and tachometer cables at back of instrument panel. Mark each conduit to insure its installation on the proper terminal. Remove instrument panel. Remove five screws and lock washers holding instrument panel to cover, and separate cover and panel.

c. Assembly and Installation.

(1) ASSEMBLE PANEL AND CONNECT CONDUITS. Position instrument panel on cover, and install five mounting screws and lock washers. Position instrument panel in fighting compartment, and connect electrical conduits, speedometer cable, and both tachometer cables to instrument panel (figs. 120 and 121). NOTE: *Connect left head lamp conduit to head lamp.* Position cables and two cable clamps against nose-armor casting and install two cable clamp mounting screws and lock washers.

(2) INSTALL INSTRUMENT PANEL. Raise instrument panel into position so that both panel studs on upper end of panel protrude through mounting brackets on upper front deck. Install two mounting stud nuts and lock washers. Install two mounting screws and lock washers holding lower left instrument panel bracket to left hull side wall.



A—STOP SWITCHES AND DOME LIGHT CONDUIT
B—CONDUIT TO APPARATUS BOX
C—CONDUITS TO CENTER JUNCTION BOX (R.H. & L.H.)
D— TACHOMETER DRIVE SHAFT
E— HAND THROTTLE CABLE
F—SPEEDOMETER CABLE
G—COMPASS LIGHT CONDUIT
H—HEADLIGHT CONDUIT (RIGHT)
J—HEADLIGHT CONDUIT (LEFT)
K—SIREN CONDUIT
L—SIGNAL LIGHT CONDUIT

RA PD 333292

Figure 121 — Connections at Rear of Instrument Panel — Second Type

132. LIGHTS.

a. General. All taillight and headlight assemblies are composite assemblies of lamps, lenses, and reflectors, sealed against dirt and moisture. Therefore, the only service operation on the lights is replacement of the sealed assembly. The complete headlight assemblies can be removed for safety in combat zones.

b. Removal of Complete Headlight. Pull out and turn release plunger for each light. These are located on forward wall of fighting compartment at end of extreme right and extreme left steering brake levers when they are in their full forward position. Lift out complete headlight casing and its tubular shaft which fits into socket in hull. Fit protective filler plug into opening to protect socket in hull against dirt and moisture.

c. Installation of Complete Headlight. Remove protective plug from headlight socket. Set headlight into socket and force down until connection is made with the plug at the bottom of shaft. Turn and release locking levers on inside forward wall of fighting compartment.

d. Removal of Head Lamp Sealed Assembly. Remove screw holding headlight door to headlight case. Swing lower end of door outward and lift door from case. Pull sealed assembly outward until terminal screws holding wires to sealed assembly can be removed. Disconnect wires and remove sealed assembly.

e. Installation of Head Lamp Sealed Assembly. Connect red wire in headlight case to terminal on center of sealed assembly. Connect black lead in headlight case to sealed assembly. Position headlight door on case by inserting lug on top of door through slot in top of case. Install screw holding headlight door to case.

f. Removal of Complete Taillight. Remove three screws holding base of taillight assembly to hull. Turn taillight assembly over and remove two nuts and lock washers holding body to base. Slide base away from body, and disconnect both wires from body by turning and pulling connections until they slip out of plugs.

g. Installation of Complete Taillight Assembly. Connect wires to taillight by inserting wires in sockets and turning them so that they will be locked in place. NOTE: *Be sure to connect wires to right sockets to assure proper operation of lighting system. Refer to wiring diagrams on figures 114, 115, and 116.* Slide taillight base on body and install two nuts and lock washers. Position taillight on hull, and install three screws holding base to hull.

h. Removal of Tail Lamp Sealed Assemblies. Remove two screws holding taillight cover to light body, and pull cover off body. On right-hand taillight units, pull the right blackout tail lamp-unit from the lower portion of the body, and the blackout stop lamp-unit from the upper portion of the body. These are sealed assemblies. On the left-hand taillight units, remove the blackout tail lamp-unit from the lower portion of the body, and the service tail and stop lamp-unit from the upper portion of the body.

i. Installation of Tail Lamp Sealed Assemblies. On right-hand taillight assemblies, position the blackout tail sealed lamp-unit in lower portion of body, and the blackout stop sealed lamp-unit in the upper portion of the body. On left-hand taillight assemblies, position the blackout tail lamp-unit in the lower portion in the body, and the service tail and stop lamp-unit in the upper portion of the body. Position taillight cover on body, and install two mounting screws and lock washers.

133. SIREN.

a. Replacement is the only operation which can be performed on the siren by the using arms.

b. Removal. Remove siren switch from bracket assembly (par. 134). Disconnect lead from siren switch to siren at switch by removing terminal nut. Loosen screw holding siren conduit clip to nose-

armor casting by reaching under differential housing. Slip siren conduit out of clip. Remove nut on lower end of siren mounting tube. Pull siren and conduit out of mounting hole in hull.

c. Installation. Slip siren conduit through siren mounting hole in front of hull and lower siren into position on hull. Slide siren mounting nut over conduit and tighten nut onto lower end of siren mounting tube. Position siren cable under clip on nose-armor casting by reaching underneath differential housing. Tighten siren conduit clip mounting screws. Connect siren cable to siren switch, and tighten terminal nut. Install siren switch and bracket assembly.

134. SIREN SWITCH.

a. The siren switch can be removed without removing the siren from the vehicle. The only service operation which the using arms should perform on the siren switch is replacement.

b. Removal. Remove two screws and lock washers holding siren switch bracket assembly to floor of hull. Turn siren switch and bracket assembly over, and remove two terminal nuts holding siren switch conduits to siren switch. Loosen siren conduit clip mounting nut, and slip both siren switch conduits out of clip. Remove two screws holding siren switch to bracket, and remove siren switch.

c. Installation. Position siren switch on bracket assembly, and install two mounting screws. Position both siren switch conduits on switch terminals, and install terminal nuts. NOTE: *Either of the two siren switch conduits may be installed on either of the switch terminals.* Position both siren switch conduits under conduit clip, and tighten clip mounting nut. Position siren switch and bracket assembly on floor of hull, and install two mounting screws and lock washers.

135. SPEEDOMETER CABLE.

a. The speedometer cable can be removed without removing the gear assembly on the transfer unit.

b. Removal. Remove instrument panel. Disconnect speedometer cable from instrument panel by loosening coupling nut. Disconnect speedometer cable from fitting on transfer unit by loosening coupling nut. Slip speedometer cable out of clip on top of transfer unit. Remove cable.

c. Installation. Connect speedometer cable to instrument panel, making sure that square end of cable is seated in square socket on speedometer coupling. Tighten coupling nut. Connect other end of speedometer cable to coupling on right side of transfer unit, making sure that keyed end of cable fits into keyed slot on transfer unit coupling. Tighten coupling nut. Slip speedometer cable into cable clip on top of transfer unit. Install instrument panel.

75-MM HOWITZER MOTOR CARRIAGE M8

Section XXV

HULL AND TURRET

136. DESCRIPTION AND TABULATED DATA.

a. Hull.

(1) GENERAL. The basic hull armor plate is a completely welded structure, except for portions which are removable for service operations. The driver and assistant driver occupy compartments at the front of the hull interior. The fighting compartment in the center of the hull is separated from the engine compartment at the rear by a partition or bulkhead. Sponsons at both sides bring the width of the upper half of the hull nearly even with the width across the tracks. On late-type vehicles, sand shields extend down from the sponsons and cover the top portion of the track.

(2) DOORS AND PERISCOPES. Two hinged double doors, located in the rear of the hull, provide access to the engine compartment. The driver and the assistant driver each have vision doors directly in front of them. These doors are hinged at the upper end and swing upward. Periscopes in the hull roof above each vision door provide protected vision through a 360-degree traverse. On late-type vehicles, an emergency escape door for all members of the crew is located in the floor of the hull behind the assistant driver.

b. Data, Hull.

(1) ARMOR THICKNESS.

Floors, ahead of front bogie axle	½ in.
Floors, behind front bogie axle	⅜ in.
Front, nose casting	1⅛ in.
Front, other areas	1⅛ in.
Rear	1 in.
Sides, fighting compartment	1⅛ in.
Sides, engine compartment	1 in.
Top	½ in.

(2) DIMENSIONS.

Height	52¼ in.
Length	167⅜ in.
Width	88¼ in.

c. Turret.

(1) The turret is of welded curved plate, homogeneous armor plate design. The sides are 1 inch thick. The front is covered by a heavy armor casting which serves as a mounting base for the 75-mm howitzer. The turret rotates on steel ball bearings that are enclosed for protection from direct hits and lead splash, and from dirt and water.

(2) The turret is open at the top, except for a partial protective roof, to provide access to both the fighting and driving compartments.

(3) The turret rotates through 360 degrees by means of a hand-operated traversing gear. The howitzer is mounted on trunnions and provided with manual elevating gears.

d. Turret Data.

(1) ARMOR THICKNESS.

Front	1½ in.
Sides	1 in.

(2) TRAVERSE.

Amount	360 deg
Type	Manual

137. SEALING HULL PARTS.

a. Caulking or sealing compound should be applied to detachable hull parts when they are assembled to the vehicle to prevent water, dust or fine sand from seeping through the joints and entering the hull. The parts to which this compound should be applied are:

(1) Engine compartment cover, including mounting brackets on inner sponson walls.

(2) Fuel tank covers, including mounting brackets.

(3) Lower front deck.

(4) Nose-armor casting.

(5) Filler blocks above ends of differential housing.

(6) Differential housing.

(7) Final drive housing.

(8) Front and rear dead axles, including extension flanges and suspension units that bolt to the side of hull.

(9) Fighting compartment drain valve flanges.

(10) All floor pans and drain plug cover plates.

(11) All bolts extenting through the sides of the hull below sponson level or through floor of hull.

(12) Air cleaner covers on sponson floor.

b. The only parts below the sponson level which need not be caulked are the engine compartment rear doors, and the sand shields.

138. BULKHEAD DOORS.

a. The bulkhead doors can be replaced or straightened, if damaged, by personnel of the using arms. To remove the bulkhead doors alone, it is only necessary to rotate the door latch, tilt the door forward at the top and lift it off its hinges.

139. PROTECTIVE PADS.

a. The protective pads which can be replaced by personnel of the using arms include the four periscope pads, and left and right transfer unit leg guard pads.

b. Periscope Pads. Remove two screws and lock washers holding periscope pad to holder and remove pad. To install pad, position it on holder and install two mounting screws and lock washers. NOTE: *The removal and installation of all four periscope pads are the same.*

c. Transfer Unit Leg Guards. Remove four mounting nuts and plain washers holding right-hand leg guard pad to guard and remove guard. To install the pad, position it on guard and install four mounting nuts and plain washers. Removal and installation of the left-hand leg guard pad is the same except that it has seven mounting nuts.

140. SEATS.

a. The only service operations which the using arms will be called upon to perform on the seats are the replacement of the seat back and seat cushions. To replace seat backs, unsnap fastener at rear of seat. Lift rear end of seat upward and backward to disconnect hook at front. Position the new seat back on frame, and snap fastener into place. Seat cushions are replaced merely by lifting the cushion out of the frame.

141. PROPELLER SHAFT HOUSING.

a. Replacement is the only service operation which can be performed on the propeller shaft housings by the using arms.

b. Removal. Remove five screws and lock washers holding rear housing cover to inner and outer housing walls. Remove rear cover. Remove four screws holding front cover to support, and remove front cover. Remove two screws holding air baffle to support, and remove baffle. NOTE: *Top of baffle is split to permit it to slip over propeller shaft.*

c. Installation. Position propeller shaft housing front cover over propeller shaft, and install four mounting screws. Install two screws holding propeller shaft housing air baffle to support. Position propeller shaft housing rear cover on propeller shaft housing inner and outer walls, and install five screws and lock washers holding rear cover to walls.

PART THREE — ARMAMENT

Section XXVI

INTRODUCTION

142. SCOPE.

a. Part III contains operating instructions for the 75-mm Howitzer M2 and M3, in the mount M7. It also lists the authorized ammunition and sighting equipment for the 75-mm howitzer. For detailed instructions on the care and preservation, malfunctions and corrections, disassembly, assembly, and maintenance of the howitzer and mount, refer to TM 9-318.

b. The other armament on the vehicle is as follows: One Browning cal. .50 antiaircraft machine gun M2, and a Thompson cal. .45 submachine gun M1928A1; a cal. .30 rifle M1, and a cal. .30 carbine M1.

143. CHARACTERISTICS.

a. The 75-mm pack Howitzer M1 or M1A1 was adapted for use in the howitzer motor carriage M8 by spot-welding and keying a howitzer tube mounting support in place over the howitzer tube. This howitzer tube mounting support increases the outside diameter of the tube to fit the central bore of the cradle. In this manner, the pack howitzer tubes that were not in use on mobile field carriages were modified and designated as the M2 howitzers. The quantity of these tubes was not sufficient to supply all the howitzer motor carriages required. To overcome this situation, new tubes were made with the howitzer tube mounting support integral with the tube. The outside diameter of the welded howitzer tube mounting support and the integral howitzer tube mounting support are identical. These tubes are designated as the M3 howitzer.

b. The cradle, elevating mechanism, and traversing mechanism are designed to permit use of the howitzer in the motor carriage M8.

c. The howitzer consists of the tube which screws into a breech ring, a breech mechanism, and firing mechanism. The firing mechanism may be operated manually or electrically.

d. The howitzer is mounted in a cradle which is installed in the forward end of the turret body. Two recoil assemblies are provided which are mounted in the cradle.

e. The cal. .50 antiaircraft machine gun is mounted at the rear of the turret body. It is secured in a mounting bracket by mounting pins. The mounting bracket is bolted to a base ring which rotates on bearings and is capable of a 360-degree traverse. A lock is provided to prevent rotation of this base ring during travel of the vehicle.

Section XXVII

OPERATING INSTRUCTIONS

144. PLACING HOWITZER IN FIRING POSITION.

a. Remove the howitzer covers and stow them in the proper place.

b. Engage the elevating mechanism as follows:

(1) Grasp the elevating mechanism locking lever, located beneath the elevating gear housing, and compress the locking lever trigger.

(2) Swing the locking lever to the right (toward the turret body) and release the locking lever trigger (fig. 122).

c. Depress the howitzer slightly, using the elevating handwheel, located at the right side of the turret, to take the strain off the breech traveling lock, and remove the breech traveling lock pin.

d. Push breech traveling lock forward to a horizontal position, and secure it in place by inserting the lock pin (fig. 123).

e. Disengage the traversing lock, located at the right of the traversing rack, by pulling out the spring actuated handle and turning it counterclockwise as far as it will go (fig. 124).

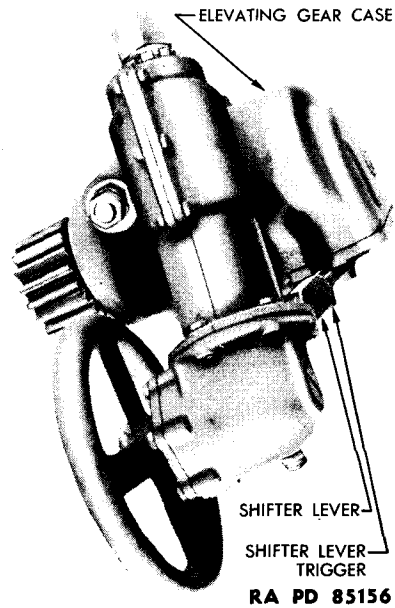


Figure 122 — Elevating Mechanism Locking Device in Disengaged Position

145. TRAVERSING MECHANISM.

a. The traversing handwheel is located on the right side of the turret body. Left traverse is accomplished by turning the handwheel counterclockwise and right traverse by turning the handwheel clockwise (fig. 125).

146. ELEVATING MECHANISM.

a. The elevating handwheel is located on the right side of the turret body. With the elevating mechanism engaged, elevation is accomplished by turning the handwheel clockwise (fig. 125).

147. BREECH MECHANISM.

a. To Open. Grasp the breech operating lever and squeeze the breech operating lever latch trigger to release the latch. Rotate the lever outward toward the right until the breech is fully open (fig. 126).

b. To Close. Grasp the operating lever and swing it forward (toward the breech) until the breech is fully closed (fig. 127). Make sure that the breech operating lever is locked in position in the breech by the locking latch.

75-MM HOWITZER MOTOR CARRIAGE M8

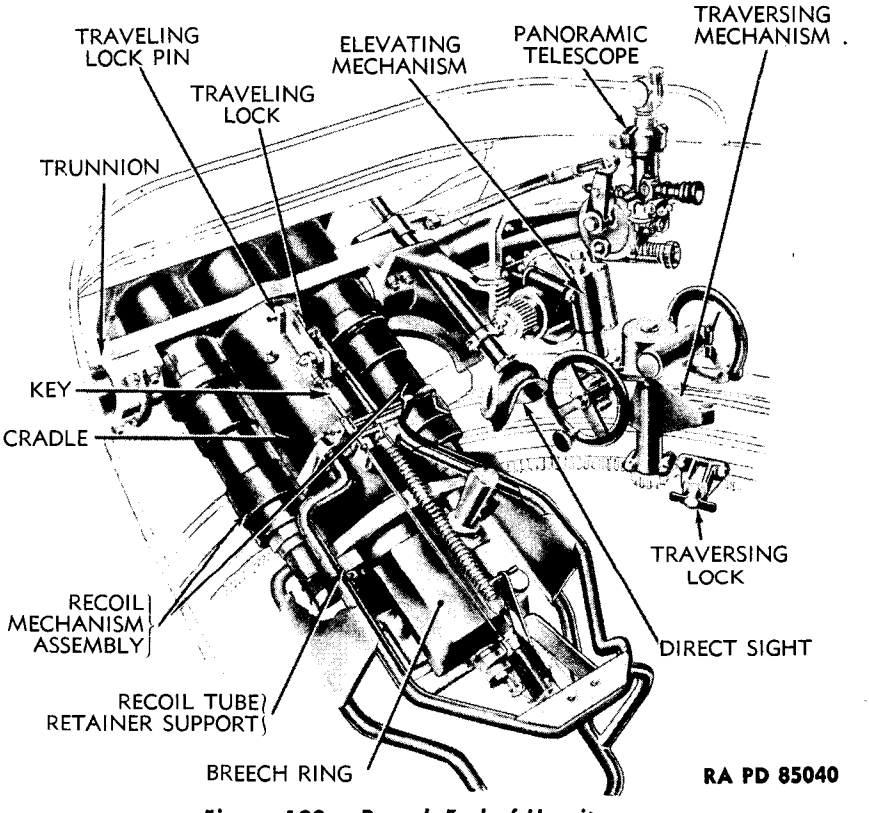


Figure 123 — Breech End of Howitzer

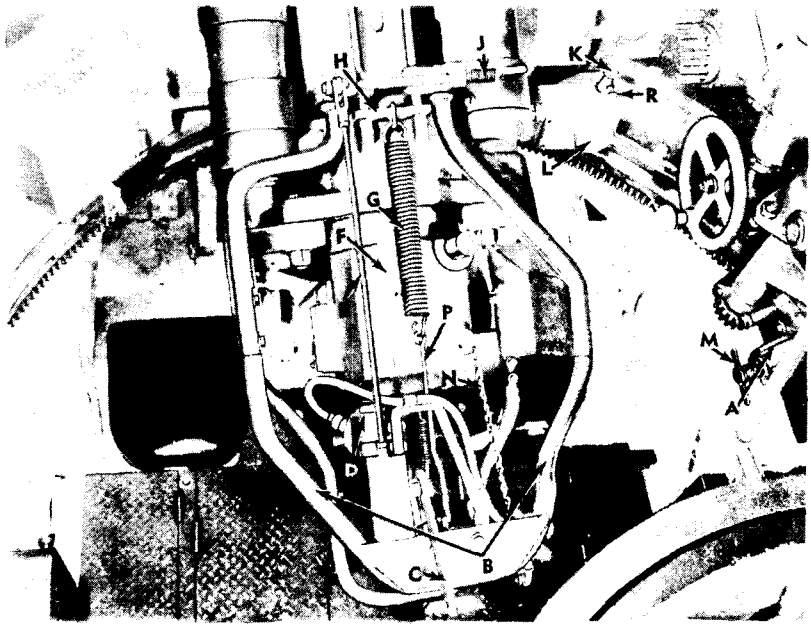
148. FIRING MECHANISM.

a. The howitzer is fired through the medium of the firing mechanism either electrically or manually. Actuating the firing mechanism by electricity is the method normally used. Should the vehicle battery fail, a hand firing mechanism handle is provided across the top to the rear end of the cradle (fig. 135).

149. SIGHTING EQUIPMENT.

a. **Characteristics.** The sighting equipment for the 75-mm howitzer motor carriage M8 consists of the telescope mount M44 (fig. 128), the panoramic telescope M12A5 (fig. 129), the telescope M56 (fig. 130), the periscope M9 (fig. 133), and the gunner's quadrant M1.

(1) TELESCOPE MOUNT M44. The telescope mount M44 (fig. 128), in conjunction with the panoramic telescope M12A5, is the element of the sighting equipment used for laying the 75-mm



A—TRAVERSING LOCK
B—RECOIL GUARD
C—SAFETY LEVER
D—SOLENOID
E—FIRING MECHANISM LINK
F—BREECH RING
G—FIRING MECHANISM MAIN SPRING
H—FIRING MAIN SPRING YOKE
J—HAND FIRING MECHANISM HANDLE
K—SAFETY SWITCH
L—FIRING BUTTON
M—SPRING ACTUATED HANDLE
N—TRIGGER CHAIN
P—EXTENSION
R - LOCKING LATCH **RA PD 85159**

Figure 124 — Breech Mechanism

howitzer M1A1 mounted on the 75-mm howitzer motor carriage M8 in elevation and direction. These instruments are designed primarily for indirect laying, but can be used for direct laying. The mount is designed to allow elevations to be set in from approximately −175 mils to +750 mils. The mount is bolted to the right side of the turret, above and back to the right trunnion, with the principal axis of the actuating arm parallel to the axis of the howitzer trunnions. The mount moves in direction with the howitzer as the turret is traversed. The link assembly is bolted to the right-hand side of the cradle and transmits motion of the howitzer in elevation to the mount so that the mount also moves in elevation with the howitzer. The mount carries a range drum, elevation scale, and angle-of-site scale and level which provide for laying the howitzer in elevation.

(2) PANORAMIC TELESCOPE M12A5. The panoramic telescope M12A5 (fig. 129) is a four-power, erect image instrument, having a

75-MM HOWITZER MOTOR CARRIAGE M8

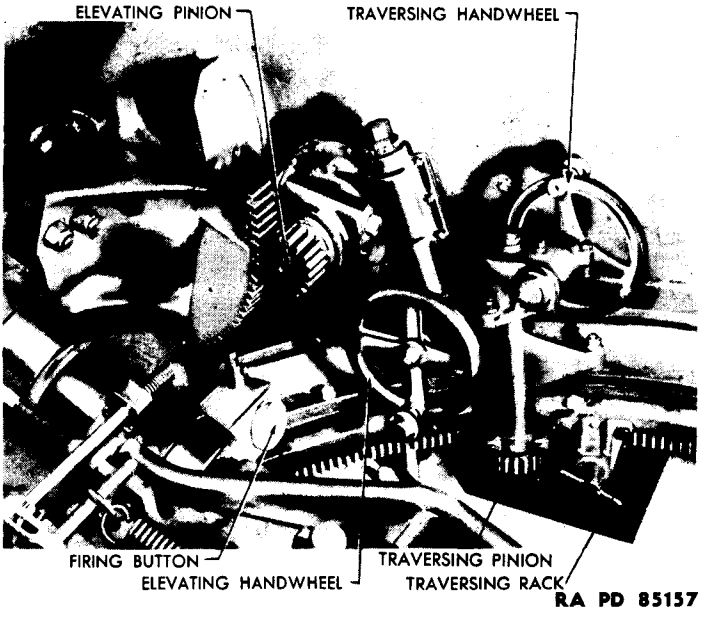


Figure 125 — Elevating and Traversing Mechanisms

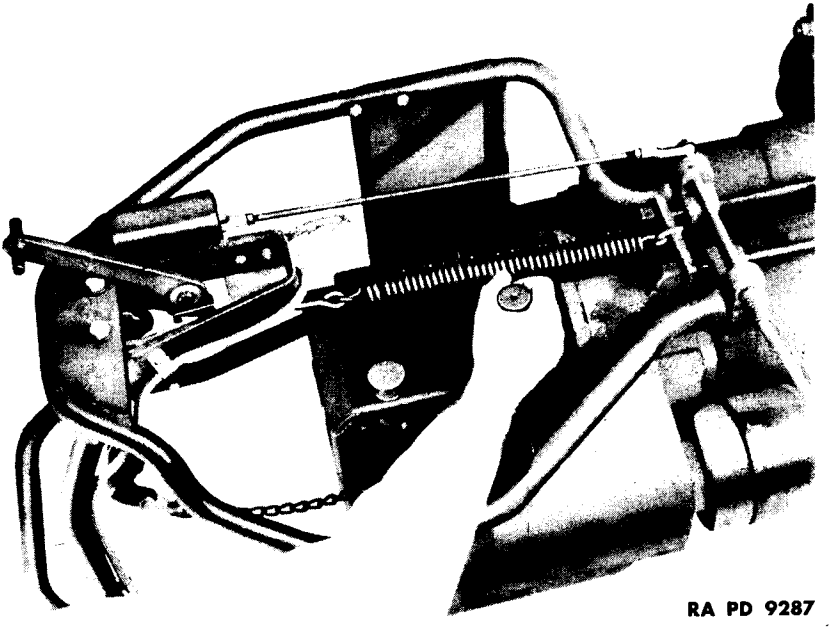


Figure 126 — Opening Breech

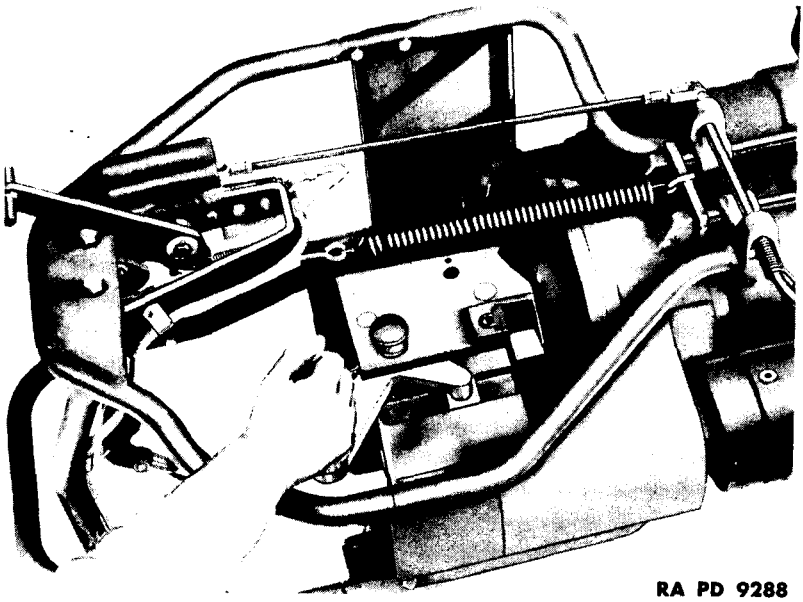


Figure 127 — Closing Breech

field of view of 10 degrees and an exit pupil diameter of 0.165 inch. The reticle (fig. 131) is provided with a grid scale, the vertical lines of which constitute a lateral deflection scale, and the horizontal lines a range scale. The range scale is graduated from the data contained in firing table 75-I-3, part 2a-4. These scales on the reticle permit the panoramic telescope, in conjunction with its mount, to be used as an optional direct-sighting instrument when firing the 75-mm high explosive shell M48, fuze M48, or M54, charge 4. The panoramic telescope is supported in the telescope socket of the telescope mount M44 on the right side of the howitzer.

(3) TELESCOPE M56. The telescope M56 (fig. 130) is a three-power, erect image instrument having a field of view of 12° 19 and an exit pupil diameter of 0.217 inch. The reticle is provided with a range scale and a lateral deflection scale as shown in figure 132. The range scale is graduated from the data contained in firing table 75-I-3, part 2a-4, as is the reticle for the panoramic telescope M12A5. These scales on the reticle permit the use of the telescope M56 as a direct-sighting instrument when firing the 75-mm high explosive shell M48, fuze M48 or M54, charge 4. The telescope M56 is mounted on the right side of the howitzer motor carriage by means of the spherical bearing and the collar on the telescope, which fit into the telescope mounting brackets provided in the turret. The rear bracket is fastened to the left

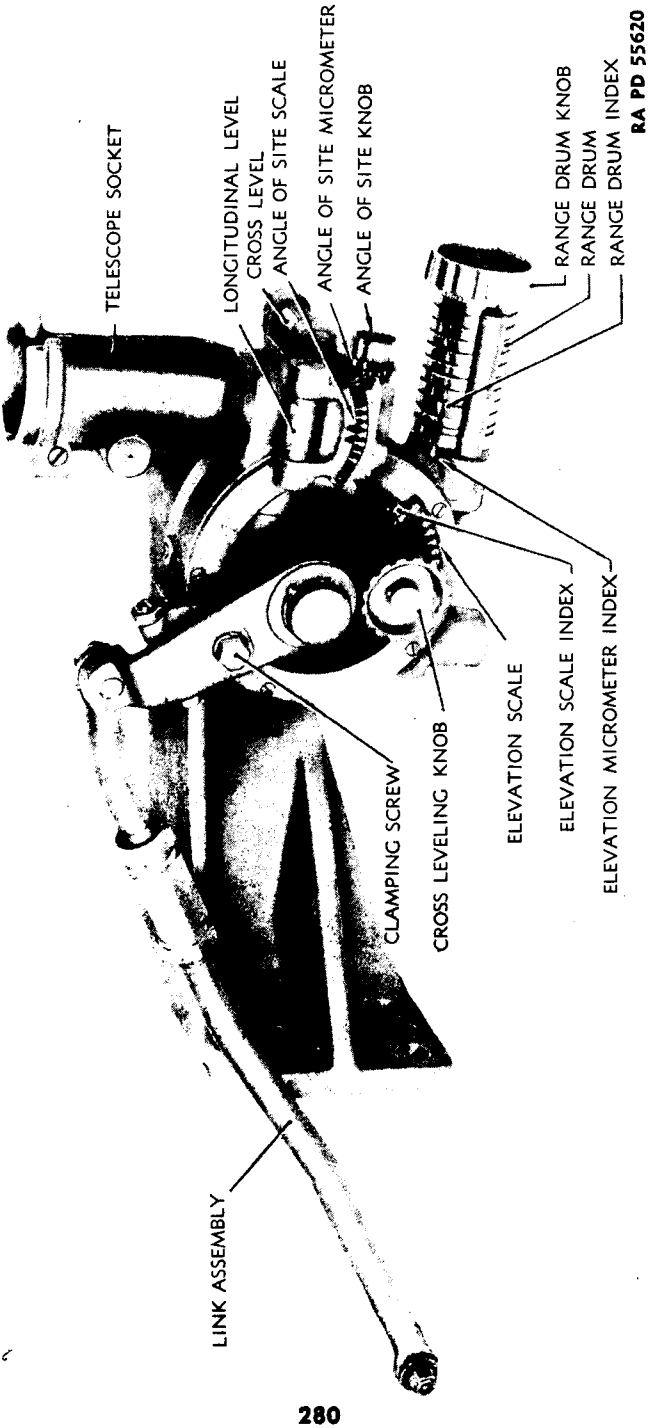


Figure 128 — Telescope Mount M44

OPERATING INSTRUCTIONS

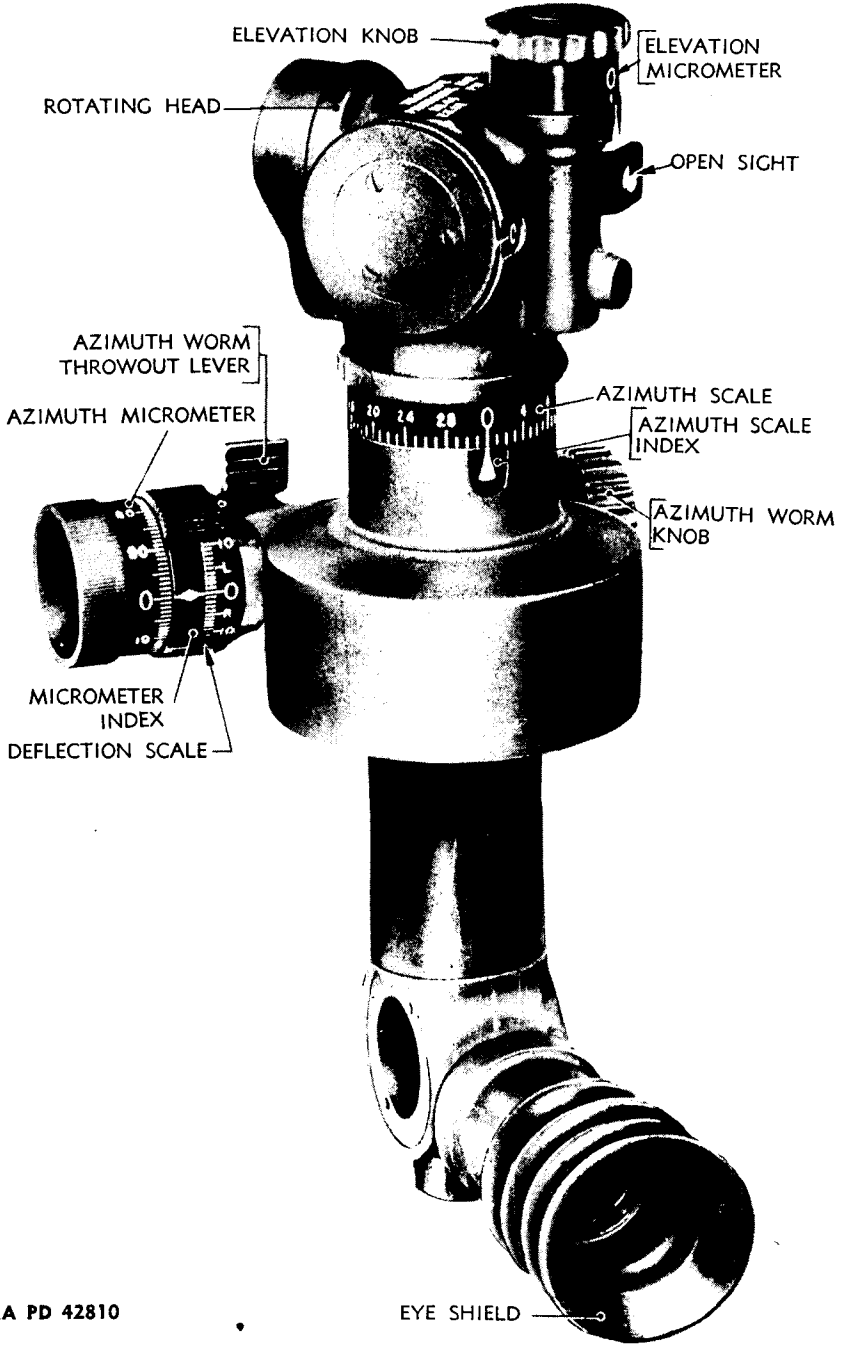


Figure 129 — Panoramic Telescope M12A5

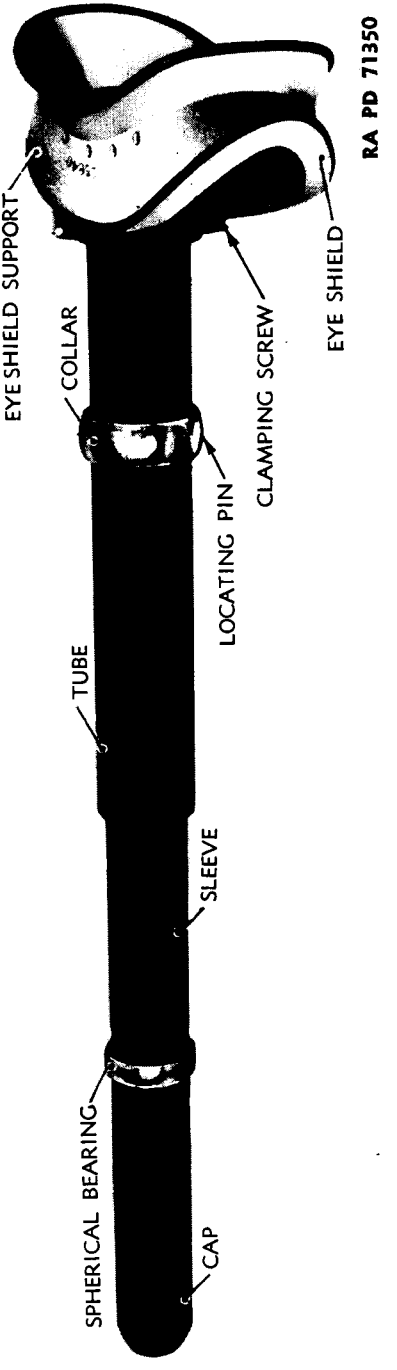


Figure 130 — Telescope M56

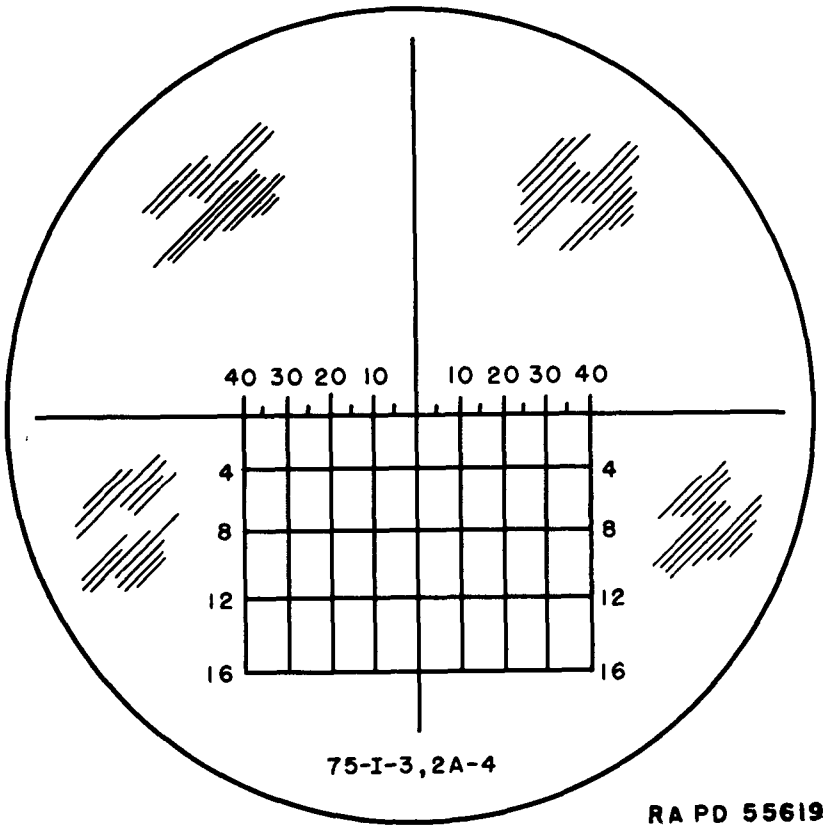


Figure 131 — Reticle Pattern for Panoramic Telescope M12A5

side of the elevation gear. The forward bracket is fastened to the tilting section of the howitzer cradle. The telescope M56 moves with the howitzer in elevation and direction.

(4) PERISCOPE M9. The periscope M9 (fig. 133) is a mirror-type, observation instrument used to provide protected vision. The head of the periscope is made of molded plastic so it will shatter, if hit, without damage to the rest of the periscope. The heads are replaced easily and quickly when damaged or destroyed. The periscope is not linked to the howitzer, but fits into a holder and its mount in the motor carriage. The holder and its mount allow the periscope to be traversel 6,400 mils, and elevated or depressed approximately 600 mils from the normal or level position. Four periscopes are mounted in the motor carriage.

(5) GUNNER'S QUADRANT M1. The gunner's quadrant M1 is provided for measuring the elevation or depression angles of the how-

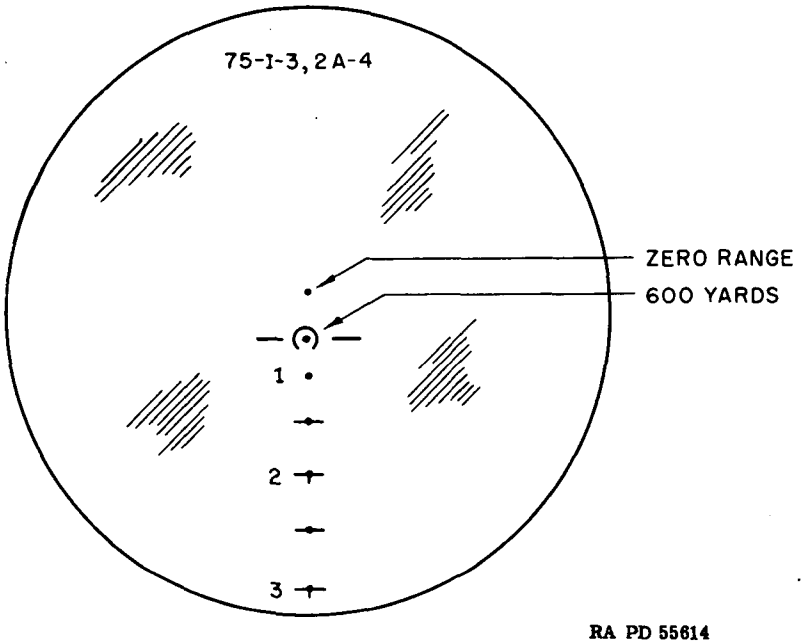


Figure 132 — Reticle Pattern for Telescope M56

itzer. The gunner's quadrant M1 can be used as an emergency means of laying the howitzer in elevation, provided the necessary firing tables are available.

150. LOADING HOWITZER.

a. The ammunition for this howitzer is fixed, and of a weight that can be handled entirely by hand. The ammunition is carried in the vehicle ready for loading (fig. 134). The shell is pushed into the breech recess of the howitzer by hand and the breech is then closed.

151. FIRING HOWITZER.

a. To Fire Electrically. Normally the howitzer is fired electrically.

(1) Depress the locking latch on the firing button safety switch and pull the firing button outward (fig. 124).

(2) Swing the safety lever toward the rear to the firing position (fig. 124).

(3) Depress the firing button located to the right of the howitzer on the turret body (fig. 124).

b. After firing, the safety lever should be pushed forward to the safe position until the howitzer is ready to be fired again. Depress

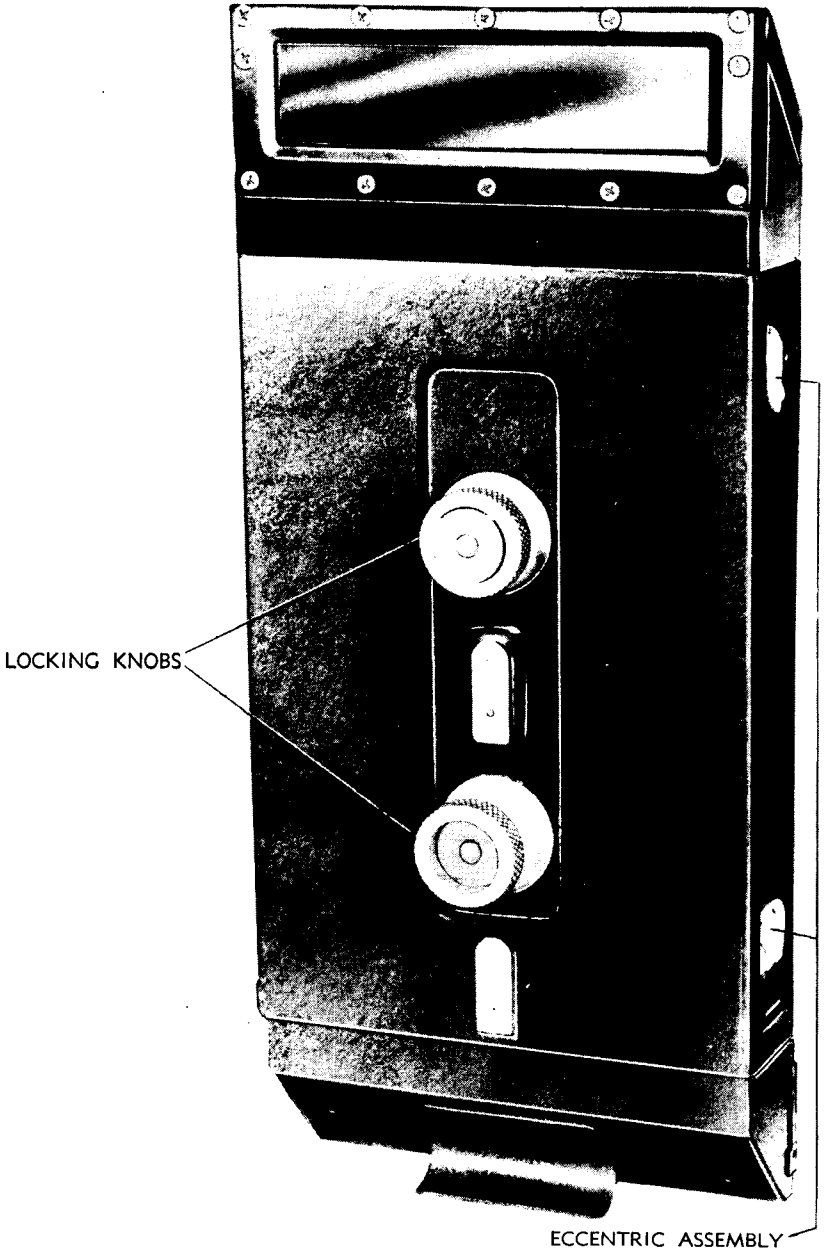


Figure 133 — Periscope M9 — Front View

75-MM HOWITZER MOTOR CARRIAGE M8

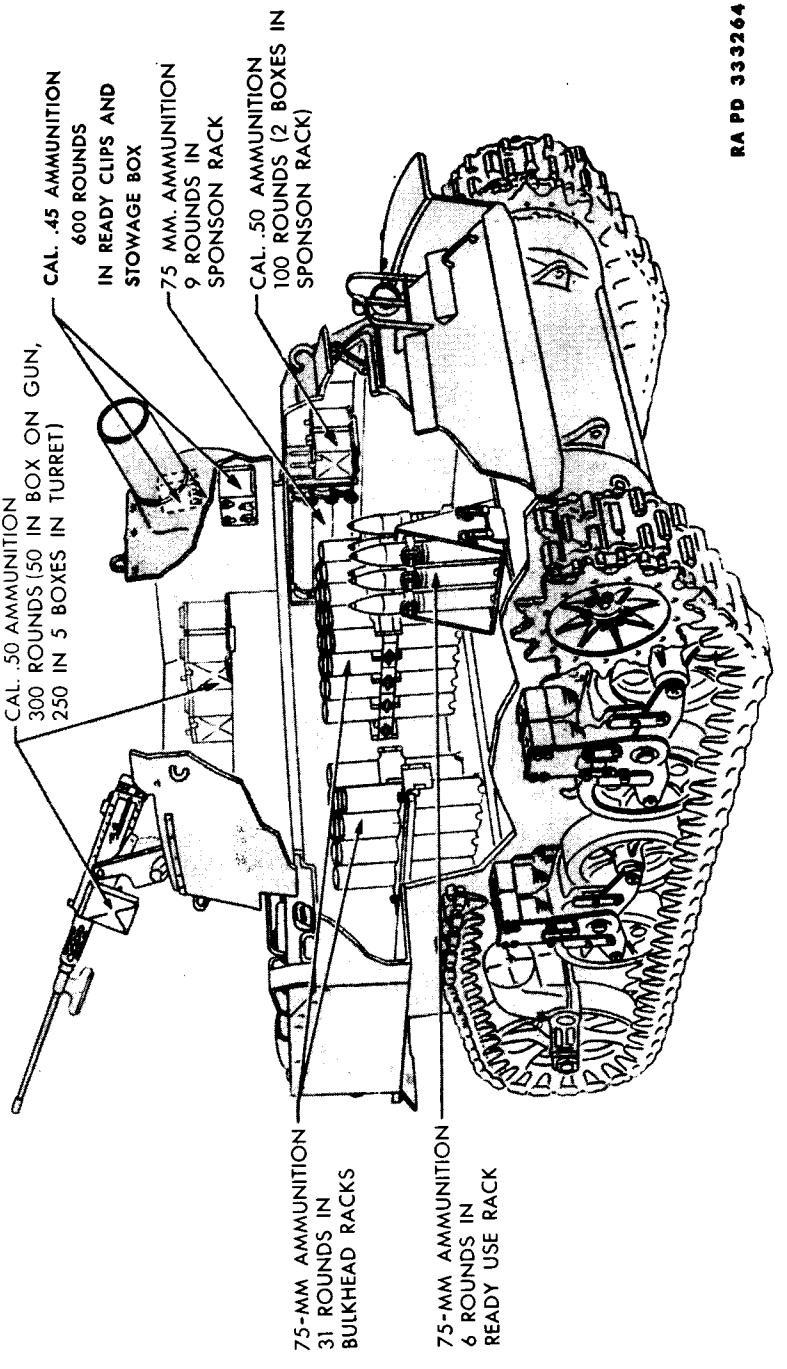
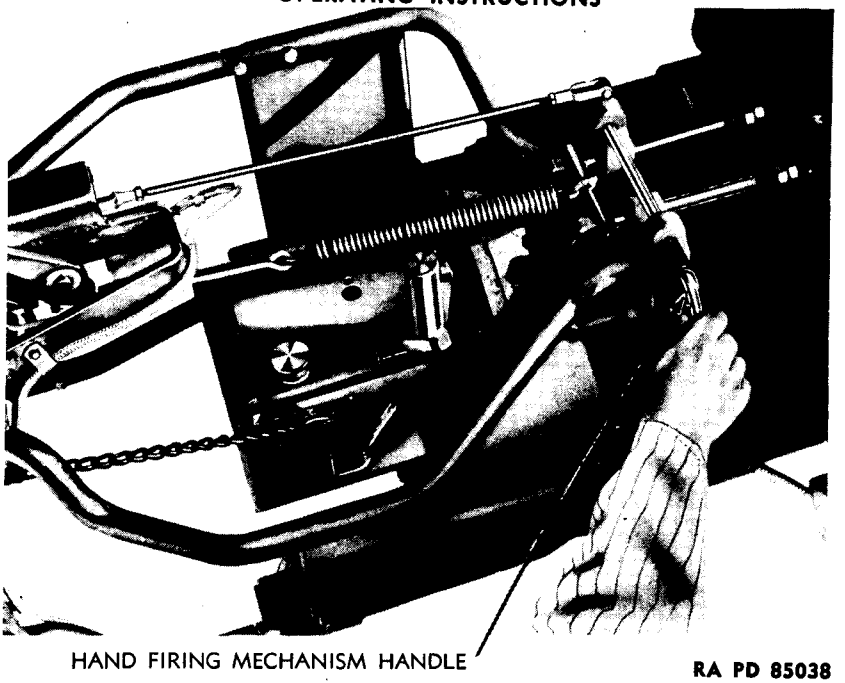


Figure 134 — Ammunition Stowage



RA PD 85038

Figure 135 — Howitzer Cocked, Ready to Fire

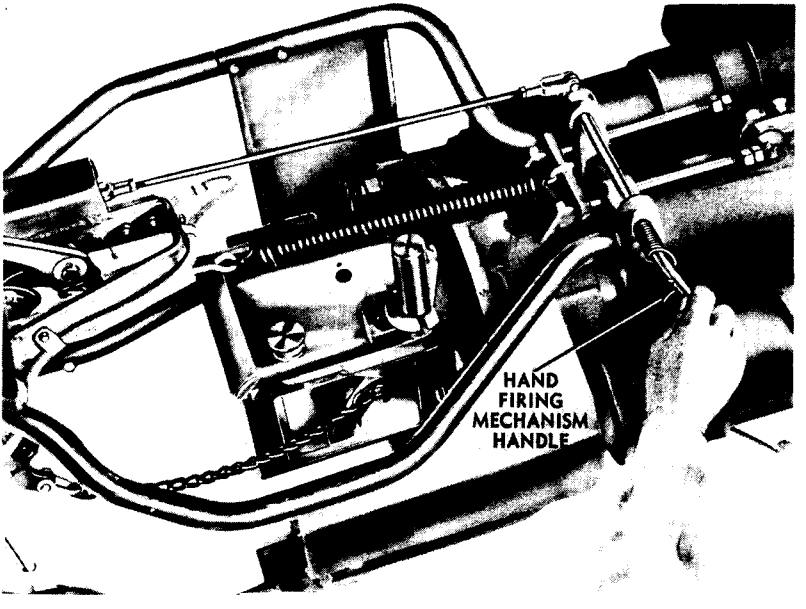
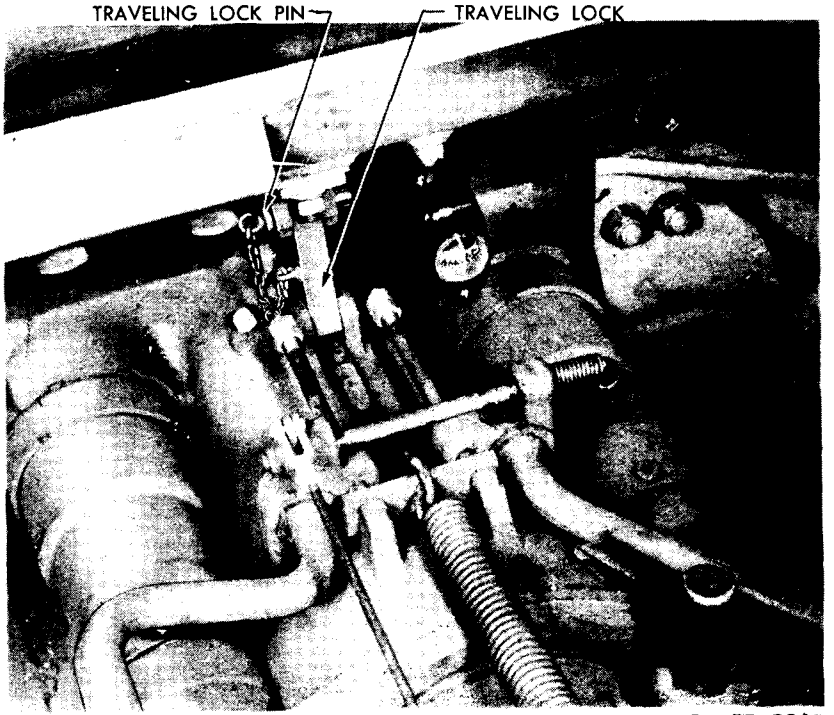


Figure 136 — Howitzer Fired Manually RA PD 85039



RA PD 9261

Figure 137 — Breech Traveling Lock Engaged

the locking latch on the safety switch and push the safety switch downward.

c. **To Fire Manually.** Manual firing of the piece is accomplished by rotating the hand firing mechanism handle clockwise (fig. 136).

152. RECOCKING FIRING MECHANISM.

a. In the event of a misfire, swing the safety lever on the firing mechanism to its safety, or forward position. Then pull the safety lever backward to the firing position (fig. 124).

b. Depress the firing button, and if the howitzer again misfires, wait two minutes and then unload (par. 153), during which time the safety lever should be in the safe or forward position, and the firing button made safe from accidental firing (par. 151 b).

153. UNLOADING HOWITZER.

a. To unload the howitzer, open the breech If the ejector does not force the shell out, grasp the shoulder on the cartridge case and withdraw it from the breech recess, allowing it to drop into the cart-

ridge bag suspended below the recoil guard. Then reload the howitzer. CAUTION: *The shell is too hot to handle with bare hands.*

154. PLACING HOWITZER IN TRAVELING POSITION.

a. With the howitzer in dead center, engage the traversing lock by turning the spring-actuated handle clockwise to allow the lock to engage the teeth of the traversing rack (fig. 123).

b. Remove the breech traveling lock pin, and raise the traveling lock to a vertical position.

c. By means of the elevating handwheel, depress the howitzer sufficiently to line up the holes of the traveling lock and insert the traveling lock pin (fig. 123).

d. Elevate the howitzer until its weight is supported by the breech traveling lock.

e. Disengage the elevating mechanism as follows:

(1) Grasp the elevating mechanism locking lever, and compress the locking lever trigger.

(2) Swing the locking lever to the left (away from the turret body) and release the locking lever trigger (fig. 122).

f. Replace all howitzer covers.

Section XXVIII

AMMUNITION

155. GENERAL.

a. Ammunition for the howitzer, 75-mm M2 and M3 (figs. 138 through 142), is issued in the form of fuzed complete rounds of fixed and semifixed ammunition. The term "fixed" signifies that the propelling charge is not adjustable and that the ammunition is loaded in the cannon as a unit. Fixed ammunition is characterized by the rigid crimping of the cartridge case, containing the primer and propelling charge, to the fuzed projectile. The propelling charge is assembled loosely in the cartridge case. Semifixed ammunition also is loaded into the cannon in one operation, but the propelling charge is adjustable. In semifixed ammunition the projectile fits freely in the neck of the cartridge case, permitting ready access to the propelling charge.

A complete round includes all the ammunition components required to fire the weapon once.

156. AUTHORIZED AMMUNITION.

a. Authorized ammunition for these howitzers is listed in Table I. It will be noted that the nomenclature completely identifies the ammunition. Identification by painting and marking is described in TM 9-1900.

TABLE I. AUTHORIZED AMMUNITION

Nomenclature†	Action of fuze	Weight of projectile as fired (lb)
SERVICE AMMUNITION		
SHELL, fixed, H.E., A.T., M66, w/FUZE, B.D., M62, 75-mm how., M1, M1A1, M2, and M3	Nondelay	13.10
SHELL, semifixed, H.E., M41A1, w/FUZE, P.D., M48A1, 75-mm how., M1, M1A1, M2, and M3	S.Q., or 0.15-sec delay	13.76
SHELL, semifixed, H.E., M41A1, w/FUZE, P.D., M48, 75-mm how., M1, M1A1, M2, and M3	S.Q., or 0.05-sec delay	13.76
SHELL, semifixed, H.E., M41A1, w/FUZE, P.D., M54, 75-mm how., M1, M1A1, M2, and M3	S.Q., or time to 25 sec	13.76
SHELL, semifixed, H.E., M48, w/FUZE, P.D., M48A1, 75-mm how., M1, M1A1, M2, and M3	S.Q., or 0.15-sec delay	14.60
SHELL, semifixed, H.E., M48, w/FUZE, P.D., M48, 75-mm how., M1, M1A1, M2, and M3	S.Q., or 0.05-sec delay	14.60

B.D.— base-detonating
B&I — base and increment
H.E.— high-explosive
H.E., A.T.— high-explosive antitank
P.D.— point-detonating
sec — second
S.Q.— Superquick

†Rounds shown are assembled with the brass cartridge case M5A1 (Type I or Type II). Rounds are also assembled with the substitute standard steel case; nomenclature is the same except that the words "steel case" are inserted after the model of the shell, e.g.—"SHELL, fixed, H.E., A.T., M66, steel case, w/FUZE, B.D., M62, 75-mm how., M1, M1A1, M2, and M3."

AMMUNITION

TABLE I. AUTHORIZED AMMUNITION – Cont'd

Nomenclature†	Action of fuze	Weight of projectile as fired (lb)
SERVICE AMMUNITION		
SHELL, semifixed, H.E., M48 w/FUZE, P.D., M54, 75-mm how., M1, M1A1, M2, and M3	S.Q., or time to 25 sec	14.60
SHELL, semifixed, smoke, phosphorous, WP, M64, w/FUZE, P.D., M57, 75-mm how., M1, M1A1, M2, and M3	S.Q.,	15.25
SHELL, semifixed, smoke, FS, M64, w/FUZE, P.D., M57, 75-mm how., M1, M1A1, M2, and M3	S.Q.	15.41
SHELL, semifixed, gas, persistent, H, M64, w/FUZE, P.D., M57, 75-mm how., M1, M1A1, M2, and M3*	S.Q.	14.94
BLANK AMMUNITION		
AMMUNITION, blank (double pellet charge), 75-mm guns, M1897-16-17, 75-mm how., M1 and M1A1, and 3-in. field guns, M1902-04-05	———	———
DRILL AMMUNITION		
CARTRIDGE, drill, M19, w/FUZE, dummy, M59, 75-mm how., M1, M1A1, M2, and M3	Inert	———
CARTRIDGE, drill, M2A2, 75-mm how., M1 and M1A1	Inert	———

B.D.— base-detonating
B&I — base and increment
H.E.— high-explosive
H.E., A.T.— high-explosive antitank
P.D.— point-detonating
sec — second
S.Q.— Superquick

———

†Rounds shown are assembled with the brass cartridge case M5A1 (Type I or Type II). Rounds are also assembled with the substitute standard steel case; nomenclature is the same except that the words "steel case" are inserted after the model of the shell, e.g.—"SHELL, fixed, H.E., A.T., M66, steel case, w/FUZE, B.D., M62, 75-mm how., M1, M1A1, M2, and M3."

*Previously listed in SNL R-1 as: "SHELL, semifixed, gas, persistent, HS., M64, w/FUZE, P.D., M57, 75-mm how., M1, M1A1, M2, and M3." Some rounds and their packing containers may still be found marked HS instead of H.

75-MM HOWITZER MOTOR CARRIAGE M8

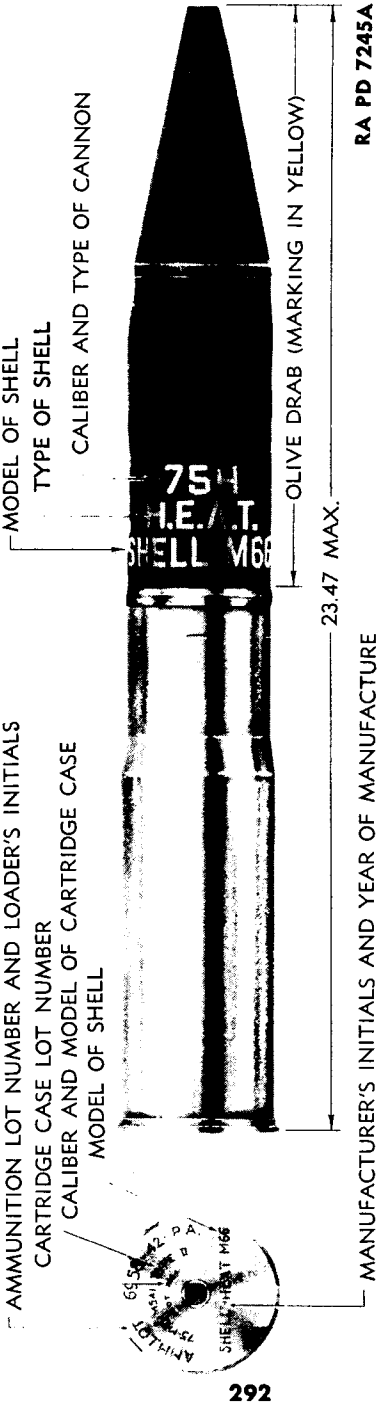


Figure 138 — Shell, Fixed, H.E., A.T., w/Fuze, B.D., M62, 75-mm Howitzer, M1, M1A1, M2, and M3

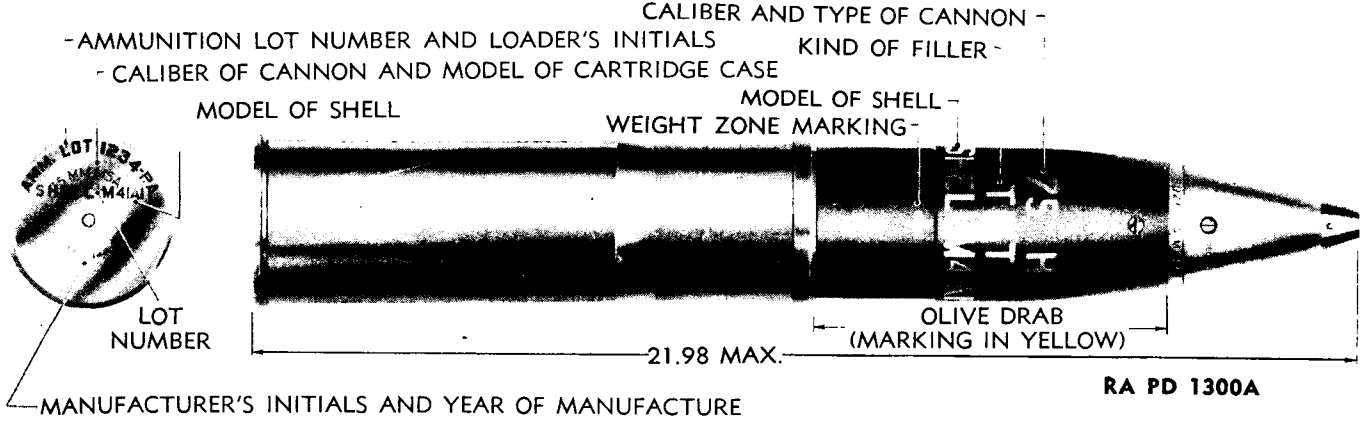


Figure 139 — Shell, Semifixed, H.E., M41A1, w/Fuze, P.D., M48A1, 75-mm Howitzer, M1, M1A1, M2, and M3

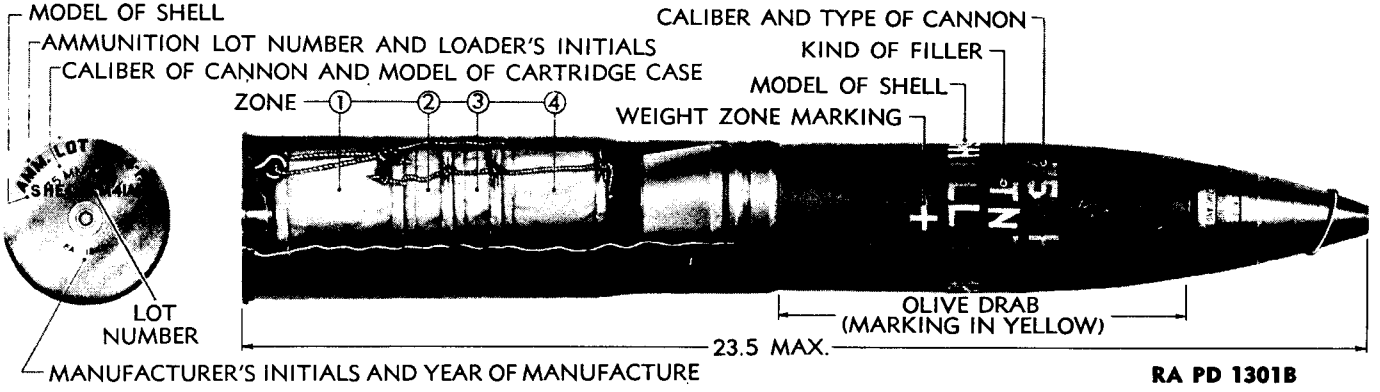


Figure 140 — Shell, Semifixed, H.E., M48, w/Fuze, P.D., M54, 75-mm Howitzer, M1, M1A1, M2, and M3

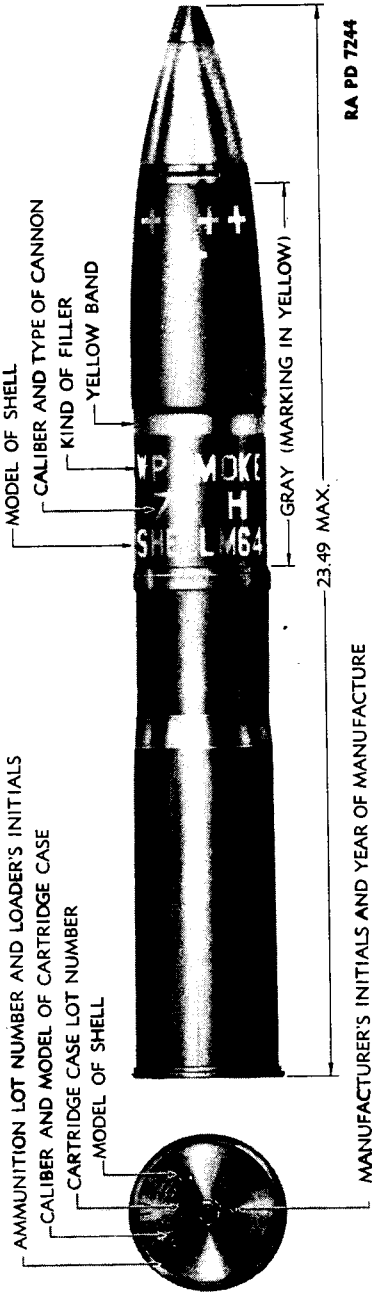


Figure 141 — Shell, Semifixed, Smoke, Phosphorus, W.P., M64, w/Fuze, P.D., M57, 75-mm Howitzer, M1, M1A1, M2, and M3

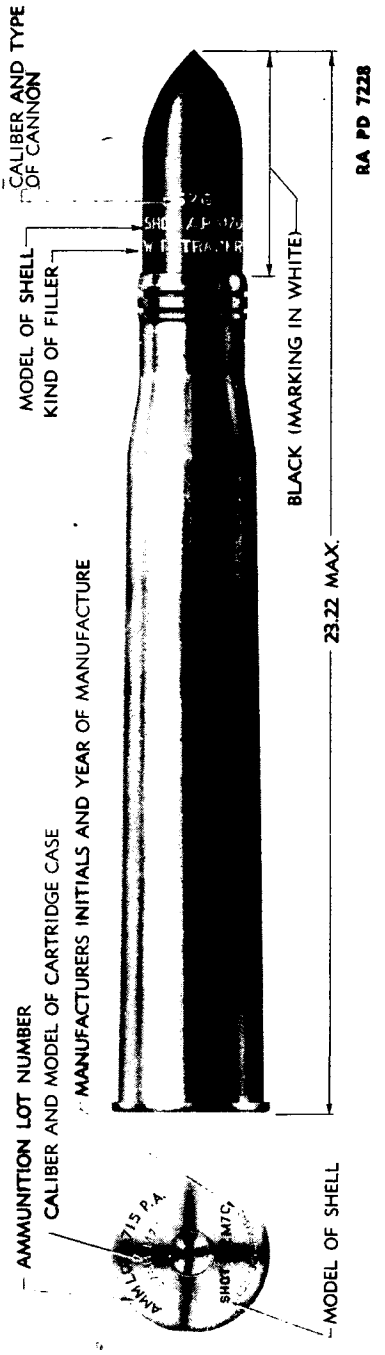


Figure 142 — Cartridge, Drill, M2A2, 75-mm Howitzer, M1, M1A1, M2, and M3

AMMUNITION

157. PREPARATION FOR FIRING.

a. The Fixed Round. SHELL, fixed, H.E., A.T., M66, w/FUZE, B.D., M62, 75-mm how., M1, M1A1, M2, and M3 is ready for firing upon removing the packing material.

b. Semifixed Rounds. Semifixed rounds are prepared for firing as follows:

(1) After removing the fuzed round from its fiber container, withdraw the U-shaped packing stop from the fuze wrench slots in the fuze. This stop, which is used to prevent the fuze from touching the end of the container, must be removed before firing or serious damage may result.

(2) Adjust the propelling charge and then adjust the fuze.

c. Propelling Charge. The propelling charge is adjusted by withdrawing the sections, except the base section, to the mouth of the cartridge case, and then removing the increments not required by breaking or cutting the connecting twine. The required increments are then reinserted in the cartridge case, in numerical order, with the increment bearing the number of the charge to be fired uppermost. To facilitate adjustment for zone firing, the propelling charge is divided into four sections, a base, and three increments. The powder for each section is assembled in cloth bags on which is marked the number of the charge. The increments are tied to each other by long twine, permitting their withdrawal to the mouth of the cartridge case. All sections from one up to and including the number of the particular charge to be fired are required for that charge. Thus, to fire charge three, the base charge which is marked "I" and the increments marked "2" and "3", in numerical order, are to be used. When firing charge four (the full charge), no adjustments are required. It will be noted that the increments are of unequal weight and therefore are not interchangeable.

d. Fuze, P.D., M48A1 or M48. These fuzes are fitted with a slotted "setting sleeve" and two registration lines, one marked "S.Q." and the other "DELAY" for fuze setting. As shipped, the fuze is set "S.Q." and the other "DELAY" for fuze setting. As shipped, the fuze is set "S.Q." and therefore requires no adjustment for this action. To set for delay action, it is only necessary to turn the setting sleeve so that the slot is alined with "DELAY". A delay pellet, 0.15 second for the M48A1 fuze and 0.05 second for the M48, provides for the delay action; this action is always operative and will function if the super quick action fails. The setting may be made or changed at will with a screwdriver or similar instrument at any time before firing. This can be done in the dark by noting the position of the

slot, parallel to the fuze axis for "S.Q.", at right angles thereto for "DELAY".

e. **Fuze, P.D., M54.** This fuze is fitted with a safety pull wire which must be withdrawn before firing with either super quick or time setting (pull lower end of wire from the hole and slide wire off the end of the fuze). If super quick action is required, the graduated time-train ring can be left as shipped, set at safe (S), or be set for a time greater than the expected time of flight. If time action is required, the graduated time-train ring is set for the required time by means of a fuze setter. NOTE: *To prevent extremely short time action, the fuze is fitted with an internal safety feature which prevents the time action from functioning should the fuze be set for less than 0.4 second.*

f. **Fuze, P.D., M57.** This is a single-action super quick type and requires no preparation for firing. NOTE: *Rounds prepared for firing but not fired should be restored to their orginal condition (including replacing fuze safety devices) and packing, and be appropriately marked. Such rounds should be used first in subsequent firings, in order to keep stocks of opened packings at a minimum.*

PART FOUR — SHIPMENT AND TEMPORARY STORAGE

Section XXIX

SHIPMENT AND TEMPORARY STORAGE

158. GENERAL INSTRUCTIONS.

a. Preparation for domestic shipment of the vehicle is the same with the exception of minor added precautions as preparation for temporary storage. Preparation for shipment by rail includes instructions for loading the vehicle, blocking necessary to secure the vehicle on freight cars, and other information necessary to properly prepare the vehicle for domestic rail shipment. For more detailed information and for preparation for indefinite storage refer to AR 850-18.

159. PREPARATION FOR TEMPORARY STORAGE.

a. Vehicles to be prepared for temporary storage are those ready for immediate service but not used for less than 30 days. If vehicles are to be indefinitely stored after shipment by rail, they will be prepared for such storage at their destination.

b. If the vehicles are to be temporarily stored, take the following precautions:

(1) LUBRICATION. Lubricate the vehicle completely (par. 35).

(2) COOLING SYSTEM. If freezing temperature may normally be expected during the limited storage or shipment period, test the coolant with a hydrometer and add the proper quantity of antifreeze to afford protection from freezing at the lowest temperature anticipated during the storage or shipping period. Completely inspect the cooling system for leaks.

(3) ROAD TEST. The preparation for limited storage will include a road test after the battery, cooling system, and lubrication service to check on the general condition of the vehicle. Correct any defects noted in the vehicle operation before the vehicle is stored, or note on a tag attached to the steering levers stating the repairs needed or describing the condition present. A written report of these items will then be made to the officer in charge.

(4) FUEL IN TANKS. It is not necessary to remove fuel from the vehicle tanks for shipment within the United States, nor to label the tanks under Interstate Commerce Commission Regulations. Leave fuel in the tanks except when storing in locations where fire ordinances or other local regulations require removal of all gasoline before storage.

(5) EXTERIOR OF VEHICLE. Remove rust appearing on any part of the vehicle exterior with flint paper. Repaint painted surfaces whenever necessary to protect wood or metal. Coat exposed polished metal surfaces susceptible to rust, such as winch cables and chains with medium grade preservative lubricating oil. Close all doors and latches. Equipment such as fire extinguishers will remain in place on the vehicle.

(6) INSPECTION. Make a systematic inspection just before shipment or temporary storage to insure that all the above steps have been covered, and that the vehicle is ready for operation on call. Make a list of all missing or damaged items, and attach it to the steering wheel. Refer to "Before-operation Service" (par. 30).

(7) BRAKES. Release brakes and chock the tracks.

c. Inspections in Limited Storage. Vehicles in limited storage will be inspected weekly for condition of battery and (in case of anticipated freezing weather), the cooling system. If water is added to battery when freezing weather is anticipated, recharge the battery with a portable charger, or remove the battery for charging. Do not attempt to charge the battery by running the engine. If freezing temperature is expected, add the proper quantity of antifreeze compound to cooling system to afford protection from freezing.

160. LOADING AND BLOCKING FOR RAIL SHIPMENT.

a. Preparation. In addition to the preparation described in paragraph 158 when ordnance vehicles are prepared for domestic shipment, the following precautions will be taken:

(1) EXTERIOR. Cover the body of the vehicle with the canvas cover supplied as an accessory, or available for use during rail shipment.

(2) BATTERY. Disconnect the battery to prevent its discharge by vandalism or accident. This may be accomplished by disconnecting the positive lead, taping the end of the lead, and tying it back away from the battery.

(3) BRAKES. The parking brake must be set and the transmission placed in neutral after the vehicle has been placed in position, with a brake wheel clearance of at least 6 inches (fig. 143). Locate

the vehicles on the car in such a manner as to prevent the car from carrying an unbalanced load.

(4) Move transmission selector lever either to "Dr" or "Lo" position to move the linkage away from the position stops, and to prevent it from being jarred out of adjustment.

(5) All cars containing ordnance vehicles must be placarded "DO NOT HUMP."

(6) Ordnance vehicles may be shipped on flat cars, end-door box cars, side-door box cars, or drop-end gondola cars, whichever type car is the most convenient.

b. Facilities for Loading. Whenever possible, load and unload vehicles from open cars under their own power, using permanent end ramps and spanning platforms. Movement from one flat car to another, along the length of the train, is made possible by cross-over plates or spanning platforms. If no permanent end ramp is available, an improvised ramp can be made from railroad ties. Vehicles may be loaded in gondola cars without drop ends by using a crane. In case of shipment in side-door box cars, use a dolly-type jack to warp the vehicles into position within the car.

c. Securing Vehicles. In securing or blocking a vehicle, three motions, lengthwise, sidewise, and bouncing, must be prevented. Two methods for blocking the 75-mm Howitzer Motor Carriage M8 on freight cars (fig. 143) are given below:

(1) METHOD 1 (fig. 143).

(a) Blocks (B). Place four blocks (B), one to the front and one to the rear of each track. The heel of the block must be nailed to the car floor with five 40-penny nails, and that portion of the block under the track must be toenailed to the car floor with two 40-penny nails.

(b) Blocks (C). Locate two blocks (C), one on each side of the vehicle, on the outside of both tracks. NOTE: *These cleats may be located on the inside of the tracks if conditions warrant.* Nail each cleat to the floor with three 40-penny nails.

(c) Strap (H). Four strands, two wrappings, of No. 8 gage, black annealed wire, must be used on each axle of each inside bogie wheel. Pass the wire over the axle to the nearest stake pocket, and tighten enough to remove slack (fig. 143).

(2) METHOD 2 (fig. 143).

(a) Blocks (F). Place four blocks (F), one to the front and one to the rear of each track (fig. 143). These blocks must be at least as long as the over-all width of the vehicle on the car floor.

75-MM HOWITZER MOTOR CARRIAGE M8

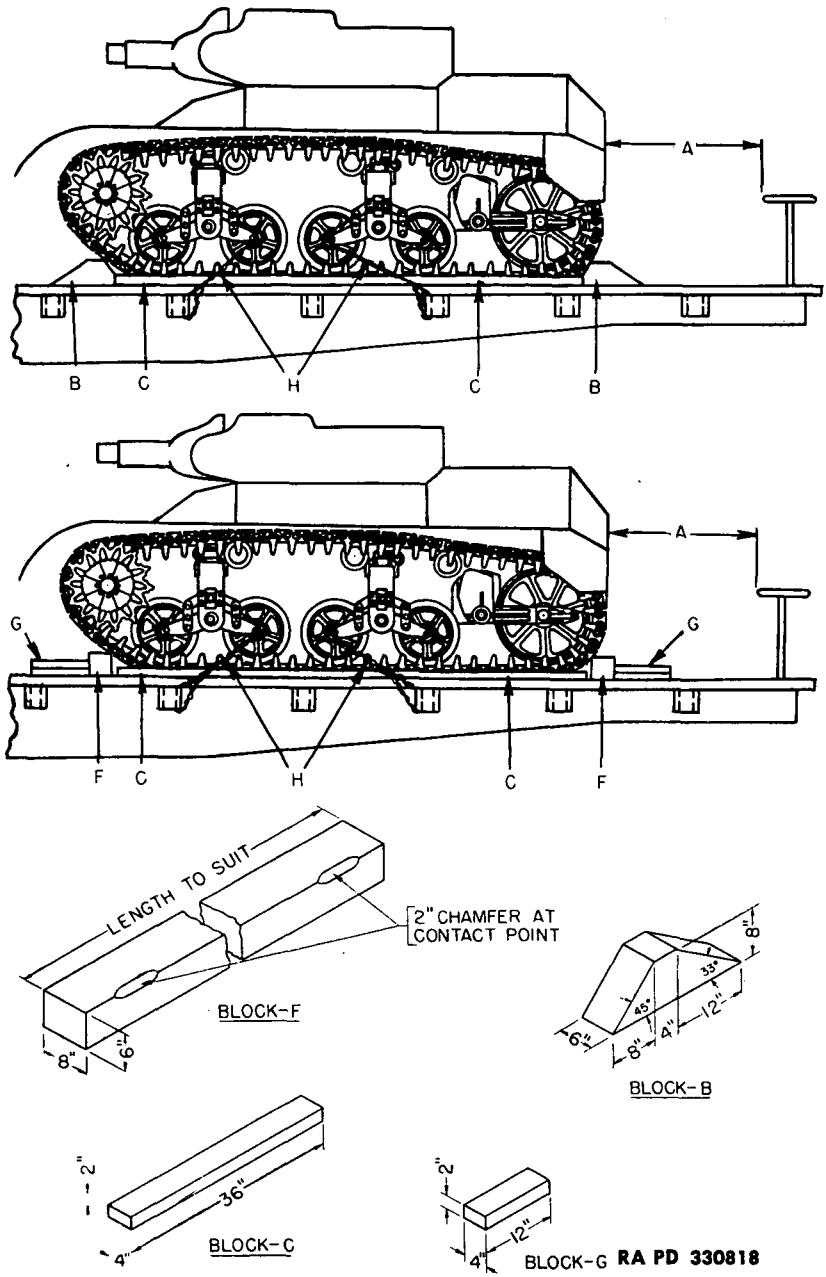


Figure 143 — Blocking Requirements for Securing Carriage to Railroad Car

(b) Cleats (G). Locate eight cleats (G) against the blocks (F) to the front and to the rear of each track. Nail the lower cleat to the car floor with three 40-penny nails, and the top cleat to the cleat below with three 40-penny nails.

(c) Blocks (C). Locate two blocks (C), one on each side of the tank, on the outside of each track. NOTE: *These cleats may be placed inside of the tracks if conditions warrant.* Nail each cleat to the car floor with three 40-penny nails.

(d) Strap (H). Four strands, two wrappings, of No. 8 gage, black annealed wire must be used on each axle of each inside bogie wheel. Pass the wire over the axle to the nearest stake pocket, and tighten enough to remove the slack (fig. 143).

d. Shipping Data.

Length of vehicle (over-all)	14.19 ft
Width of vehicle (over-all)	7.35 ft
Height of vehicle (over-all)	7.50 ft
Area of car floor occupied per vehicle	104.30 sq ft
Volume occupied per vehicle	782.25 cu ft
Shipping weight per vehicle	31,091 lb

REFERENCES

STANDARD NOMENCLATURE LISTS.

Carriage, motor, 75-mm howitzer, M8 ..... SNL G-127

Ammunition.

Ammunition, fixed and semifixed, all types, including subcaliber, for pack, light, and medium field artillery, including complete round data ..... SNL R-1

Ammunition, rifle, carbine, and automatic gun ..... SNL T-1

Ammunition, revolver, automatic pistol, and submachine gun ..... SNL T-2

Ammunition, blank, for pack, light, and medium field artillery ..... SNL R-5

Ammunition, instruction material for pack, light, and medium field artillery ..... SNL R-6

Packing materials used by field service for small arms service ammunition ..... SNL T-5

Service fuzes and primers for pack, light, and medium field artillery ..... SNL R-3

Firing tables and trajectory charts (Index) ..... SNL F-69

Grenades, hand and rifle, and fuzing components ..... SNL S-4

Armament.

Carbine, cal. .30, M1 and M1A1—Parts and equipment ..... SNL B-28

Gun, machine, cal. .50, Browning, M2, heavy barrel, fixed and flexible, and ground mounts—Parts and equipment ..... SNL A-39

Gun, submachine, cal. .45, Thompson, M1928A1 and M1—Parts and equipment ..... SNL A-32

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Gunner's quadrant M1918 ..... SNL F-13

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Telescope mount M44	SNL F-271

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Cleaning, preserving and lubricating materials, recoil fluids, special oils, and miscellaneous related items	SNL K-1
Interchangeability chart of organizational special tools for combat vehicles	SNL G-19
Soldering, brazing, and welding materials, gases and related items	SNL K-2
Ordnance maintenance sets	SNL N-21
Tools, maintenance, for repair of automatic guns and antiaircraft materiel, automatic and semiautomatic cannon and mortars	SNL A-35
Tools, maintenance, for repair of automotive vehicles	SNL G-27 Vol. 1
Interchangeability chart of ordnance maintenance tools for combat vehicles	SNL G-27 Vol. 2
Tools, maintenance, for repair of pack, light, and medium field artillery; and armament of these calibers for airplanes and combat vehicles	SNL C-18
Tool sets, motor transport	SNL N-19
Current Standard Nomenclature Lists are as listed above. An up-to-date list of SNL's and other publications is maintained in the Index to Ordnance Publications	OFSB 1-1

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General.

Basic maintenance manual	TM 38-250
Camouflage	FM 5-20
Camouflage painting of vehicles and equipment	FM 5-21
Cleaning, preserving, lubricating, and welding materials and similar items issued by the Ordnance Department	TM 9-850
Detailed lubrication instructions for ordnance materiel	OFSB6-series
Explosives and demolition	FM 5-25
Instruction guide, small arms data	TM 9-2200
List of publications for training	FM 21-6
Military motor vehicles	AR 850-15
Motor transport	FM 25-10
Standard military motor vehicles	TM 9-2800

75-MM HOWITZER MOTOR CARRIAGE M8

Armament and Ammunition.

Qualifications in arms and ammunition training allowances	AR 775-10
Browning machine gun, cal. .50, HB, M2 (mounted in combat vehicles)	FM 23-65
Grenades	FM 23-30
Thompson submachine gun, cal. .45 M1928A1	FM 23-40
U. S. Carbine, cal. .30, M1	FM 23-7
U. S. Rifle, cal. .30, M1	FM 23-5
Ammunition, general	TM 9-1900
Ammunition, small arms	TM 9-1990
Instruction guide, small arms accidents, malfunctions, and their causes	TM 9-2210
Instruction guide, small arms data	TM 9-2200
Ordnance maintenance—Browning machine gun, cal. .50—all types	TM 9-1225
Ordnance maintenance, Thompson submachine gun, cal. .45 M1928A1	TM 9-1215
Targets, target materials, and rifle range construction	TM 9-855
Thompson submachine gun, cal. .45 M1	TM 9-215
75-mm howitzer, M2 and M3 (mounted in combat vehicles)	TM 9-318
Auxiliary fire control instruments (field glasses, telescopes, eyeglasses and watches)	TM 9-575

Firing Tables.

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Automotive.

Automotive electricity	TM 10-580
Automotive lubrication	TM 10-540
Automotive power transmission units	TM 10-585
Driver's manual	TM 10-460
Electric fundamentals	TM 1-455
Fuels and carburetion	TM 10-550
Maintenance and care of pneumatic tires and rubber treads	TM 31-200
Motor vehicle inspections and preventive maintenance services	TM 9-2810
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Light tank, M5 and M5A1	TM 9-732
Ordnance maintenance: Controlled differential, final drive, tracks and suspension for light tanks M5, M5A1, and 75-mm howitzer motor carriage M8	TM 9-1727E
Ordnance maintenance: Electrical system, instruments, and auxiliary generator for light tanks, M5, M5A1, and 75-mm howitzer motor carriage M8	TM 9-1727F
Ordnance maintenance: Engine cooling, engine electrical, and engine fuel systems for light tank M5 and 75-mm howitzer motor carriage M8	TM 9-1727B
Ordnance maintenance: Engine, exhaust system and ignition system for light tank M5 and 75-mm howitzer motor carriage M8	TM 9-1732A
Ordnance maintenance: Hull and turret for light tanks M5, M5A1, and 75-mm howitzer motor carriage M8	TM 9-1727G
Ordnance maintenance: Hydra-Matic transmission and propeller shafts for light tanks M5, M5A1, and 75-mm howitzer motor carriage M8	TM 9-1727C
Ordnance maintenance: Transfer unit for light tanks M5, M5A1, and 75-mm howitzer motor carriage M8	TM 9-1727D

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Radio set SCR 510	TM 11-605
The radio operator	TM 11-454

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Chemical decontamination materials and equipment	TM 3-220
Decontamination of armored force vehicles	FM 17-59
Defense against chemical attack	FM 21-40
Military chemistry and chemical agents	TM 3-215

Storage and Shipment.

Ordnance field service storage and shipment chart, group G—major items	OSSC-G
Registration of motor vehicles	AR 850-10
Rules governing the loading of mechanized and motorized army equipment, also major caliber guns, for the United States Army and Navy, on open top equipment, published by Operations and Maintenance Department of Association of American Railroads.	
Storage of motor vehicle equipment	AR 850-18

75-MM HOWITZER MOTOR CARRIAGE M8

INDEX

INDEX

75-MM HOWITZER MOTOR CARRIAGE M8

INDEX

INDEX

75-MM HOWITZER MOTOR CARRIAGE M8

INDEX

INDEX

S

INDEX