DEPARTMENT OF THE ARMY
TECHNICAL MANUAL

DEPARTMENT OF THE AIR
FORCE TECHNICAL ORDER

TM 9-788
TO 19-75AJ-66

38-TON HIGH-SPEED TRACTOR M6

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
MAY 1952

TM 9-788/TO 19-75AJ-66

This manual supersedes TM 9-788, 25 July 1944; Changes No. 1, 30 November 1944; TB 9-788-3, 6 June 1945; and those portions of TB ORD FE 27, 13 February 1945; TB ORD FE 40, 8 May 1945; TB ORD 196, 2 January 1943; TB ORD 200, 20 September 1944; TB ORD 342, 8 July 1946; and TB ORD 380, 13 March 1950, pertaining to the matériel covered herein.

38-TON HIGH-SPEED TRACTOR M6

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DEPARTMENTS OF THE ARMY AND
THE AIR FORCE
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TM 9–788/TO 19–75AJ–66 is published for the information and guidance of all concerned.

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for information and guidance of the personnel to whom the matériel is issued. They contain information on the operation and organizational maintenance of the matériel as well as descriptions of major units and their functions in relation to other components of the matériel.

b. The appendix contains a list of current references, including supply catalogs, technical manuals, and other available publications applicable to the matériel.

c. This manual differs from TM 9–788, 25 July 1944, as follows:

(1) Adds information: Stowage boxes placed on top of tractor, compass mounted above right instrument panel, engine water temperature gages; forms, records and reports; name, caution, and instruction plates, and operation of tractor.

(2) Revises information on: Before operation, at the halt, after operation, and weekly service procedures; run-in procedure, track adjustment, stowage of equipment, operation under unusual conditions, lubrication under unusual conditions, second echelon preventive maintenance services, torque converter oil seal; organizational spare parts, tools and equipment; loading and blocking, and painting.

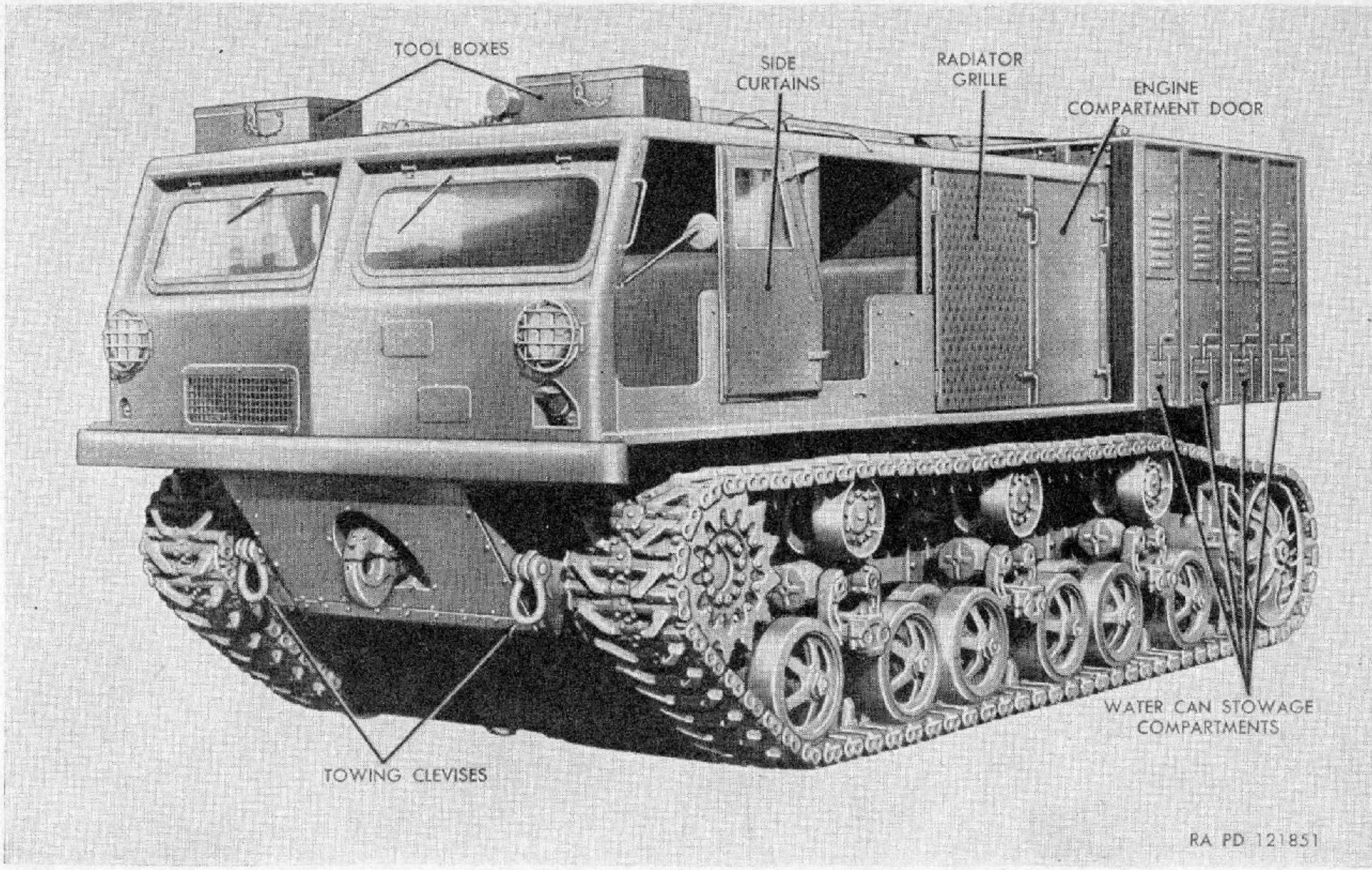


Figure 1. 38-ton high-speed tractor M6—left front view.

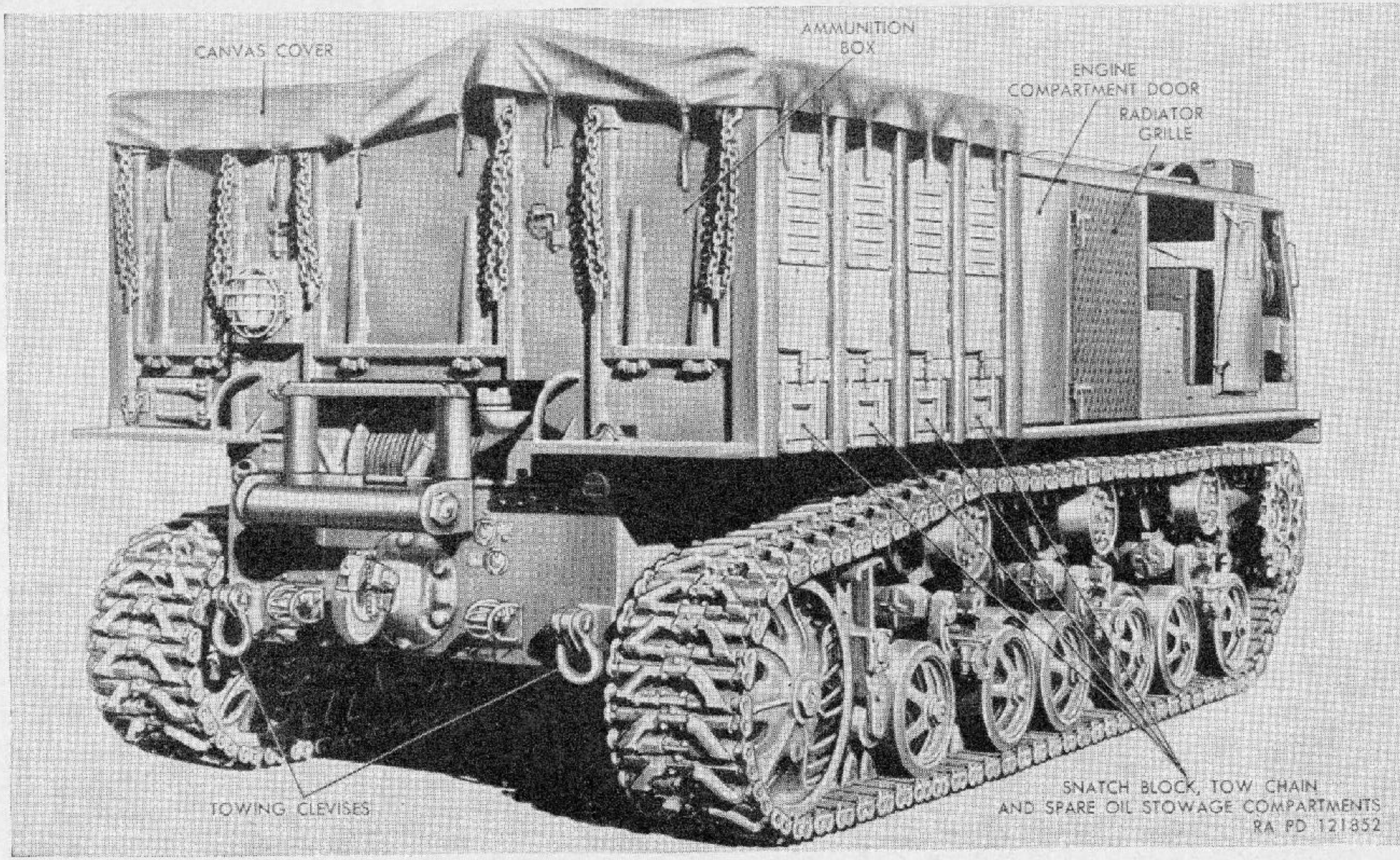


Figure 2. 38-ton high-speed tractor M6—right rear view.

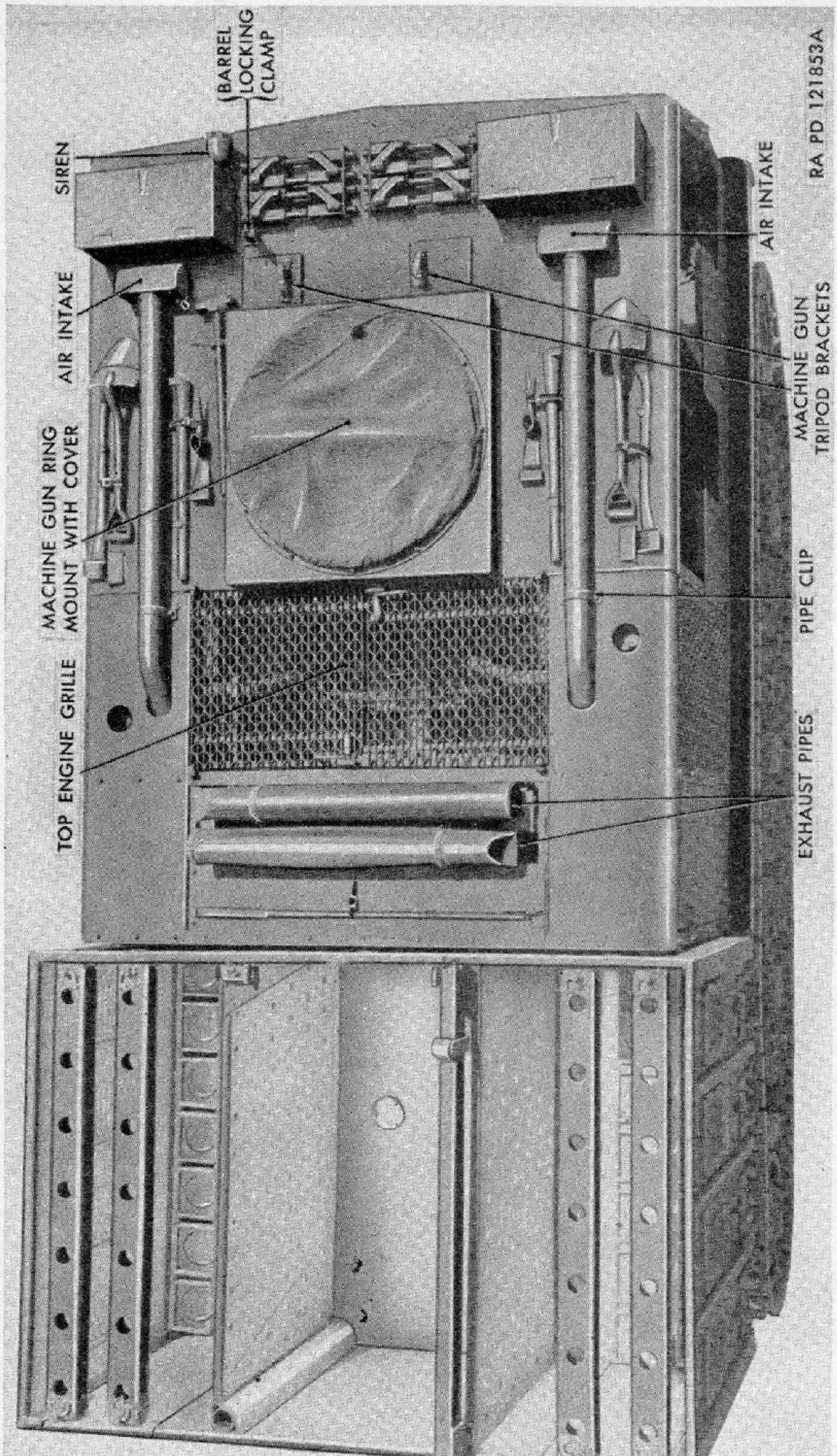


Figure 3. 38-ton high-speed tractor M6—top view.

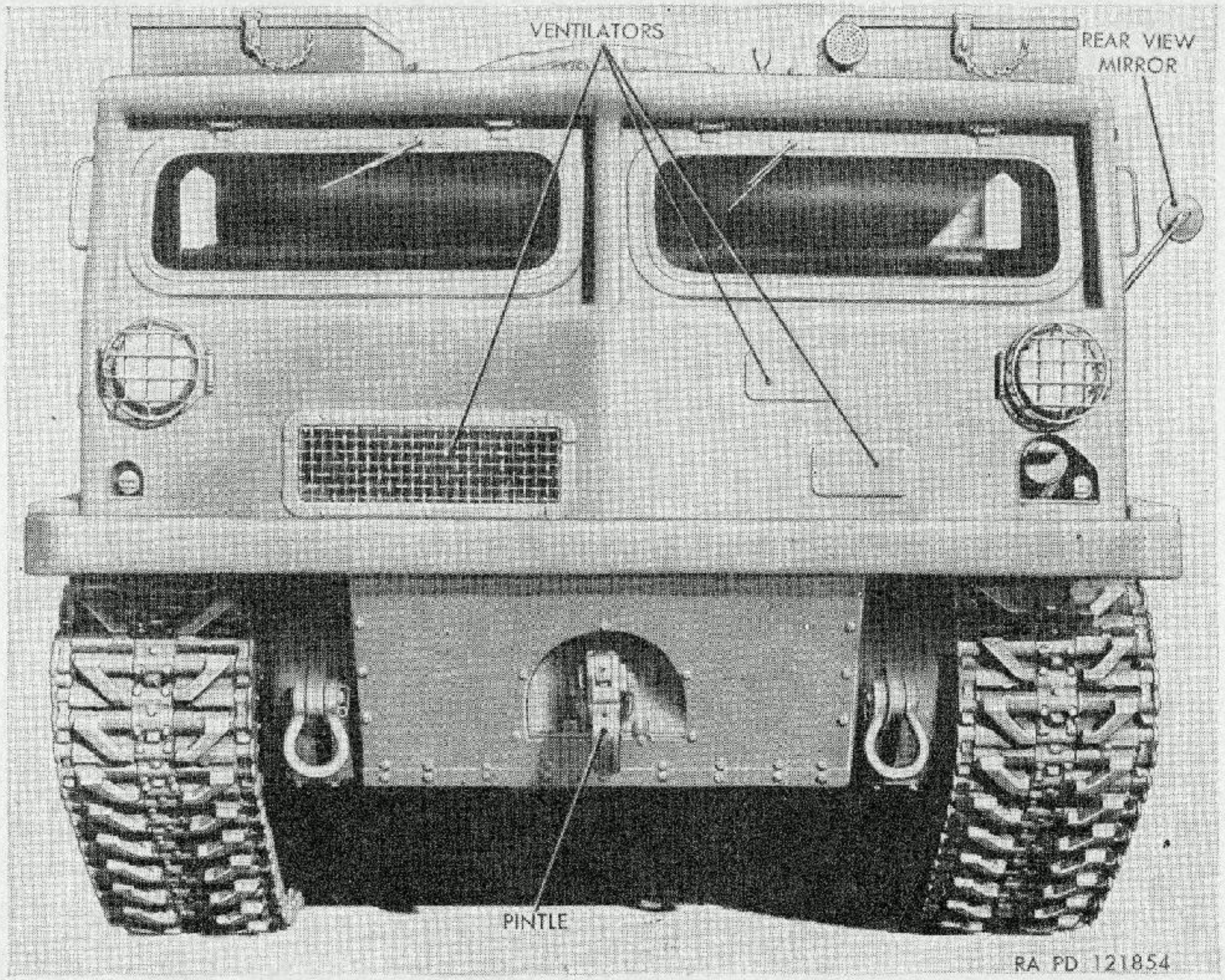


Figure 4. 38-ton high-speed tractor M6—front view.

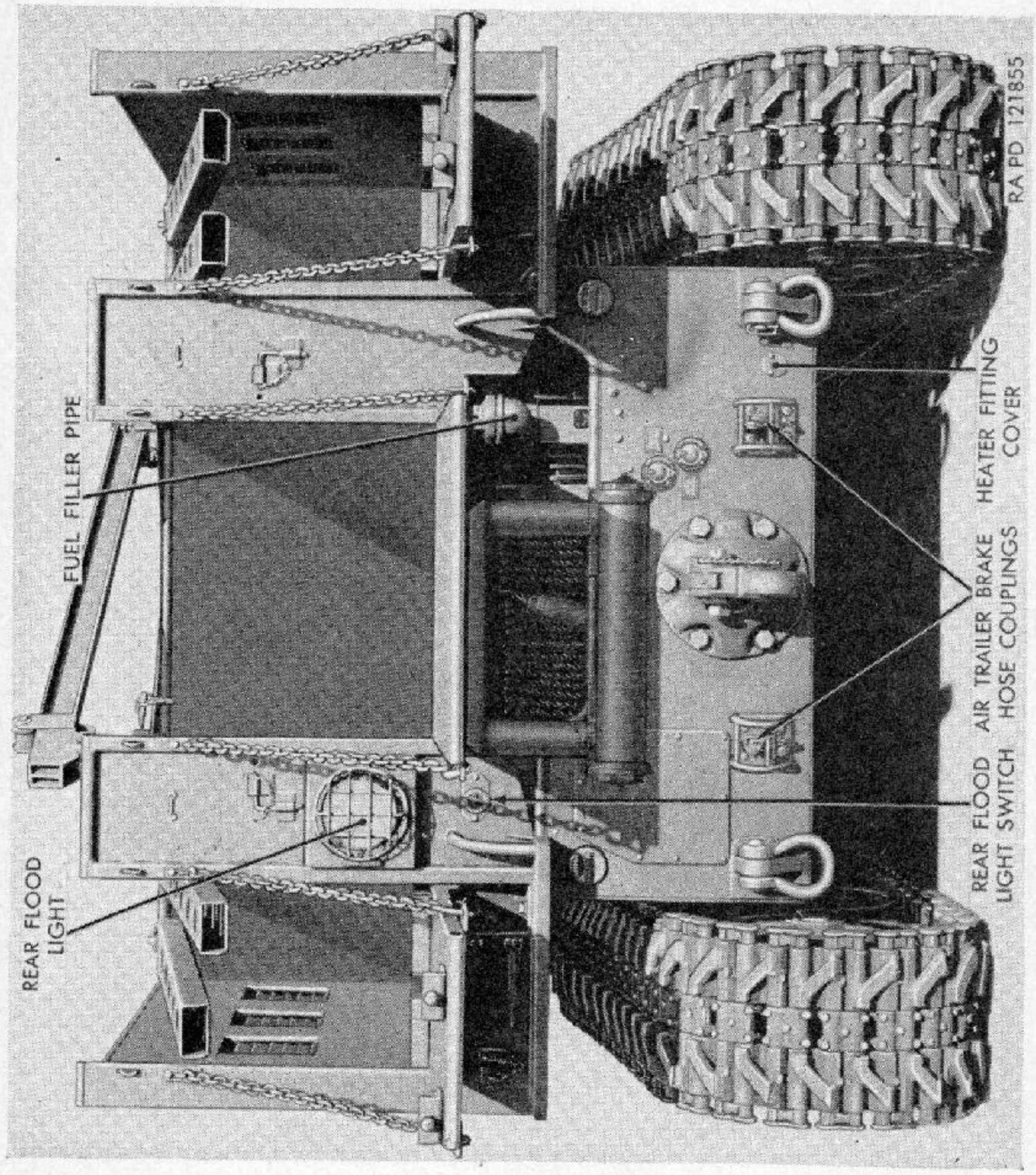


Figure 5. 38-ton high-speed tractor M6—rear view.

2. Forms, Records, and Reports

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

b. Authorized Forms. The forms generally applicable to units operating and maintaining these vehicles are listed in the appendix. No forms other than those approved for the Department of the Army will be used. For current and complete listing of all forms, see SR 310–20–6.

c. Field Report of Accidents.

(1) *Injury to personnel or damage to matériel.* The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in the SR 385–10–40 series of special regulations. These reports are required whenever accidents involving injury to personnel or damage to matériel occur.

(2) *Ammunition.* Whenever an accident or malfunction involving the use of ammunition occurs, firing of the lot which malfunctions will be immediately discontinued. Accident or malfunction will be reported as prescribed in SR 385–310–1.

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

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

Section II. DESCRIPTION AND DATA

3. Description

a. General. This tractor is a full-track vehicle designed primarily as a prime mover for the 120-mm gun M1, 8-inch gun, and the 240-mm howitzer M1. This tractor may be used for either highway or cross-country travel, or where mountains, swamps, sand, or small unbridged trenches may be encountered. The tractor has two forward speed ranges, one reverse speed, and an engine brake gear for descending hills. Because of its low center of gravity, the tractor is capable of climbing slopes which may be as steep as 30° depending on the kind of footing available and the load being pulled.

b. Engine. Power is supplied by two Waukesha 6-cylinder, water-cooled, 4-cycle, valve-in-head gasoline engines. Each engine has a minimum rated horsepower of 210 at 2,100 rpm.

c. Steering. Steering of the tractor is accomplished by means of two steering levers, located in the cab, which operate brakes in the differential assembly. To turn to the left, the left steering lever is pulled back. To turn to the right, the right steering lever is pulled back. With both steering levers at extreme forward position, vehicle will travel in a straight line.

d. Seats. The cab is divided into two compartments. The front compartment seats the driver and four other crewmen, while the rear compartment accommodates five or more men. The seat cushions are padded canvas zipper bags; the back cushions are leather covered.

e. Auxiliary Equipment. Equipment on the tractor includes two portable fire extinguishers, electric and air trailer brake controls, and winch. A gun ring in top of cab over the rear seating compartment provides for mounting of a cal. .50 machine gun. A combination ammunition and cargo box at the rear of the tractor provides for carrying of water, oil, ammunition, and miscellaneous items. Vehicle and gun tools are carried in stowage boxes on top of tractor. Pioneer tools and spare track blocks are carried in brackets on the roof of the cab.

4. Name, Caution, and Instruction Plates

a. General. Some plates are made of steel and coated with clear lacquer as a rust-preventive measure. If they are found to be rusty, they should be cleaned thoroughly and heavily coated with clear lacquer.

b. Name Plates.

(1) *Vehicle name plate* (fig. 6). The vehicle name plate is located on the right instrument panel. Stamped on this plate is the tractor serial number, maximum gross weight, maximum towing load, maximum speed, maximum emergency speed, fuel octane rating, and proper grade of engine oil for various temperatures.

(2) *Engine name plates* (fig. 34). The engine name plates are located on the cylinder block on the exhaust manifold side. Included on these plates are the engine serial number, model number, and some engine specifications.

(3) *Torque converter name plates.* The torque converter name, serial number, and model number are stamped on the converter housings.

(4) *Carburetor name plates.* The carburetor name, serial number, and model number are stamped on a plate located on the carburetor float bowl covers.

(5) *Distributor name plates.* The distributor name, serial number, and model number are stamped on a plate located on the distributor housing above the grease cups.

(6) *Ignition coil name plates.* The ignition coil name, serial number, and model number are included on a plate located at the bottom of ignition coil case.

(7) *Ignition switch name plates.* The ignition switch name, serial number, and model number are stamped on the mounting case.

(8) *Starter name plates.* The starter name, serial number, and model numbers are located on the starter housing.

(9) *Starter switch name plates.* The starter switch name, serial number, and model number are stamped on a plate located on the starter switch case.

(10) *Generator name plate.* This plate is located on the pulley end of the generator housing. The plate includes name, serial number, and model number of generator (fig. 83).

(11) *Generator regulator name plate.* The regulator name, serial number, and model number are located on the regulator cover (fig. 58).

(12) *Transmission name plate.* The transmission name plate is located on the differential housing at upper right-hand corner. Data on model number and serial number is furnished.

(13) *Electric brake controller name plate.* The electric brake controller name, serial number, and model number are stamped on a plate located on the brake controller case cover (fig. 128).

(14) *Air compressor name plate.* The air compressor name, serial number, and model number are located on the air compressor air cleaner (fig. 76).

(15) *Air brake foot valve name plate.* The name, serial number, and model number are cast into the foot valve cover.

(16) *Winch name plate.* The name, serial number, and model number are stamped on a plate attached to the top of the winch gear case cover.

(17) *Chain hoist name plate.* The name, serial number, and model number are cast into the top of hoist gear cover.

(18) *Vehicle data plate.* This plate specifies weights and dimensions of tractor and is located on the right-hand instrument panel (fig. 6).

(19) *Brake coupling socket name plates.* These plates are located at rear of tractor (fig. 126). The plates identify the 6- and 12-volt trailer coupling sockets.

c. Caution and Instruction Plates.

(1) *Engine thermostat caution plates.* This caution plate is attached to radiator outlet water pipes. This plate specifies if engines are equipped with thermostats (fig. 26).

(2) *Air cleaner instruction plate.* This instruction plate is attached to engine air cleaner body and specifies maintenance instructions.

(3) *Transmission and power take-off gearshift instruction plate.* This plate covers the instructions of transmission and power take-off shifting procedure. This plate is located on the left instrument panel in the cab (fig. 6).

(4) *Tractor operation instruction plate.* This instruction plate specifies general operation of the tractor. This plate is located on the right-hand instrument panel.

5. Tabulated Data

a. General.

Crew	9
Armament	1 cal. .50 machine gun M2
Weight (fully equipped)	76, 000 lb
Length	21 ft 5 13/16 in
Width	10 ft ½ in
Height	8 ft 8 5/16 in
Ground clearance	1 ft 9½ in
Ground pressure (fully equipped)	9.99 psi
Engines	Waukesha-145GZ (2)
Cylinders (in line)	6
Electrical system	6- and 12-volt
Number of batteries	2
Capacities:	
Fuel tank	300 gal
Engine cooling systems (each)	18 gal
Engine crankcase only (each engine)	5 gal
Engine crankcase with oil filter change (each engine)	6 gal
Transmission case	22 gal
Final drive cases (each)	6¼ gal
Winch gear housing	1 gal
Torque converter system (each)	9½ gal
Air cleaners (each)	4½ gal
Torque converter pump housing (each)	1 qt
Fan drive shaft housing (each)	1¼ qt
Fan drive gear housing (each)	1¼ qt

b. Performance.

Speeds and drawbar pull at 2,100 rpm (full throttle):

Low gear	6 mph	13,260 lb
High gear	21 mph	1,052 lb
Reverse gear	5 mph (max)	15,900 lb

Maximum drawbar horsepower at 2,100 rpm (full throttle):

Low gear	287.9 at 3 mph
High gear	240.4 at 8 mph

Maximum drawbar pull:

Low gear	50,000 lb
High gear	18,120 lb
Maximum trench crossing	8½ ft
Maximum fording depth	4½ ft
Maximum grade ascending ability	30 deg
Maximum grade descending ability	30 deg
Maximum list (side slope)	30 deg
Maximum vertical obstacle	2½ ft
Turning radius	26½ ft
Fuel consumption (loaded)	0.4 mpg
Cruising range (loaded)	120 miles

c. Detailed Data References. Additional detailed tabular data pertaining to individual components and systems may be located by consulting the index at the back of the manual.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATÉRIEL

6. Purpose

a. When a new or reconditioned vehicle is first received by the using organization, it is necessary for the organizational mechanics to determine whether the vehicle has been properly prepared for service by the supplying organization and to be sure it is in condition to perform any mission to which it may be assigned when placed in service. For this purpose, inspect all assemblies, subassemblies, and accessories to be sure they are properly assembled, secure, clean, and correctly adjusted and/or lubricated. Check all tools and equipment (pars. 67–69) to be sure every item is present, in good condition, clean and properly mounted or stowed.

b. In addition, perform a "run-in" of at least 50 miles on all new or reconditioned vehicles and a sufficient number of miles on used vehicles to completely check their operation, according to procedures in paragraphs 7 and 8.

c. Whenever practicable, the vehicle crew will assist in the performance of these services.

7. Preliminary Services

a. Perform the Commander's "C" (quarterly or 750-mile) preventive-maintenance service (table III, par. 77), with the following variations:

(1) Delete the other services (monthly or 250-mile and quarterly or 750-mile) on the work sheet (DA AGO Form 462) and substitute "New (or rebuilt) Vehicle Reception."

(2) Item 19 (lubrication). Perform this service item before starting the road test. If the processing tag on the vehicle states that the engine contains preservative oil that is suitable for 500 miles of operation, and of the correct seasonal viscosity, check the level but do not change the oil; otherwise change it. Lubricate all points, regardless of interval.

Check the levels of the lubricant in all gear cases. If the gear lubricant is known to be of the correct seasonal grade, do not change it; otherwise change it.

(3) Item 27 (spark plugs, distributor, coil, wiring, and timing). Inspect breaker points; dressing should not be necessary.

8. Run-In Test

a. Continue the road test (items 1 through 9, table III) for at least 50 miles, unless the vehicle has been driven to the using organization. In the latter case, make the road test only long enough to make the usual observation. Stop at least every ten miles and make external observations around the vehicle; look particularly for overheated sprocket, idler, suspension wheel, or support roller hubs and leaks from their lubricant seals.

b. Upon completion of the run-in test, change the engine and transmission oil and place the vehicle in normal service. It will be due for its first regular preventive-maintenance service after one month or 250 additional miles.

9. Corrections of Deficiencies

Deficiencies disclosed during the course of the servicing procedures will be treated as follows:

a. Any deficiencies within the scope of organizational maintenance will be corrected before the vehicle is placed in service.

b. Deficiencies beyond the scope of organizational maintenance will be referred to ordnance maintenance personnel.

c. Deficiencies of serious nature should be brought to the attention of the supplying organizations.

Section II. CONTROLS AND INSTRUMENTS

10. General

This section describes, locates, and illustrates the various controls and instruments provided for the proper operation of the vehicle.

11. Trailer Brake Controls

a. General. This tractor is equipped with complete controls and operating mechanism for air brakes and electric brakes and therefore can be connected to a trailing unit having either air or electric brakes. The brakes operate only when a unit is being towed behind the tractor and they have no control in stopping the tractor alone. Refer to paragraphs 195 through 202 for further information on trailer brake controls.

b. Trailer Brake Pedal. The trailer brake pedal, located on the floor to the left of accelerator pedal (fig. 6), when depressed, operates both air and electric brakes. Only one system at a time is used, depending on which type of brake the trailing vehicle is equipped with.

c. Trailer Air Brake Valve Lever. The air brake valve lever is located below the right instrument panel (fig. 6). This lever is used for operating the air brakes by hand, if so desired.

d. Connections.

(1) Two air hose couplings are provided at the rear of the tractor for connecting trailer air brake hose (fig. 5). The coupling on the left is marked "SERVICE" and the coupling on the right is marked "EMERGENCY." The corresponding hose on the trailer should be connected to these couplings. When the tractor is operated without a trailer, the cut-out cocks should be closed and the dummy coupling installed to keep dirt and dust out of the air brake system (fig. 12).

(2) The electric brake coupling sockets are located at the rear of the tractor (fig. 10) and are wired so that when the plug from a trailer equipped with electric brakes is inserted, all electric brake and light apparatus of the trailing unit will operate in conjunction with the tractor light switch and brake control.

e. Electric Brake Load Control. The electric brake load control is located on the left instrument panel (fig. 6) and is used to vary the braking effect according to the requirements of the trailing unit. If a light braking effect is desired, the knob on the load control should be set accordingly. Turning the knob to the left (counterclockwise) or toward number "1" printed on the plate, gives a light braking effect. Turning the knob to the right or toward number "4" increases the braking power. The brake is applied by pressing down on the trailer brake pedal.

12. Steering and Brake Levers

These levers are directly in front of the driver and used to steer and stop the tractor (fig. 6). These levers operate brakes in the differential assembly, enabling the vehicle to turn. The radius of turn desired can be controlled by the distance the steering lever is pulled back.

13. Steering Lever Locks

The steering lever locks are located on top of the steering levers (fig. 6). These locks are for shifting brake ratchets into or out of engagement. When the lock buttons are turned down, the ratchet pawls will not engage ratchet quadrants and will allow the steering levers to move freely back and forth over the quadrant. When buttons are turned up, the ratchets are operative and will hold the steering levers at whatever point they are pulled back and hold brakes applied. These lock buttons should be turned down when towing.

14. Throttle Control Lever

The throttle lever is a hand-operated throttle control, located under the instrument panel to the right of the steering levers (fig. 6). The throttle lever is used when starting the engines. When starting the engines, pull throttle lever one-quarter of the way out and leave in that position until engines are started and warm enough to be returned to idling speed.

15. Gearshift Lever

The gearshift lever is the control lever of the transmission and means of selecting the desired gear ratio. The gearshift lever has four positions and is located to the right of the operator (fig. 6). Refer to the gearshift lever diagram plates, which are attached to the left instrument panel, for proper gearshift lever selections.

16. Master Clutch Pedal

The master clutch pedal is located on the floor to the left of the steering levers (fig. 6). The master clutch pedal should be depressed each time the gearshift lever is shifted from one position to another. To prevent damage to the transmission gears, always depress the clutch pedal to the limit of its travel.

17. Power Take-Off Shifter Lever

The power take-off shifter lever is located between the steering levers (fig. 6). This lever controls the engagement of the power take-off gears to the transmission gears. The purpose of the power take-off is to supply the power needed to operate the winch. The lever has three positions: extreme forward, to unwind cable; center position is neutral; and extreme rear position, to wind cable.

18. Power Take-Off Range Shifter Lever

The power take-off range shifter lever is located between the steering levers (fig. 6). This lever controls the winding and unwinding speed of the winch. The lever has two positions: extreme forward position, for high speed range; and extreme rear position, for low speed range. In most cases, the lever will remain in the high speed range.

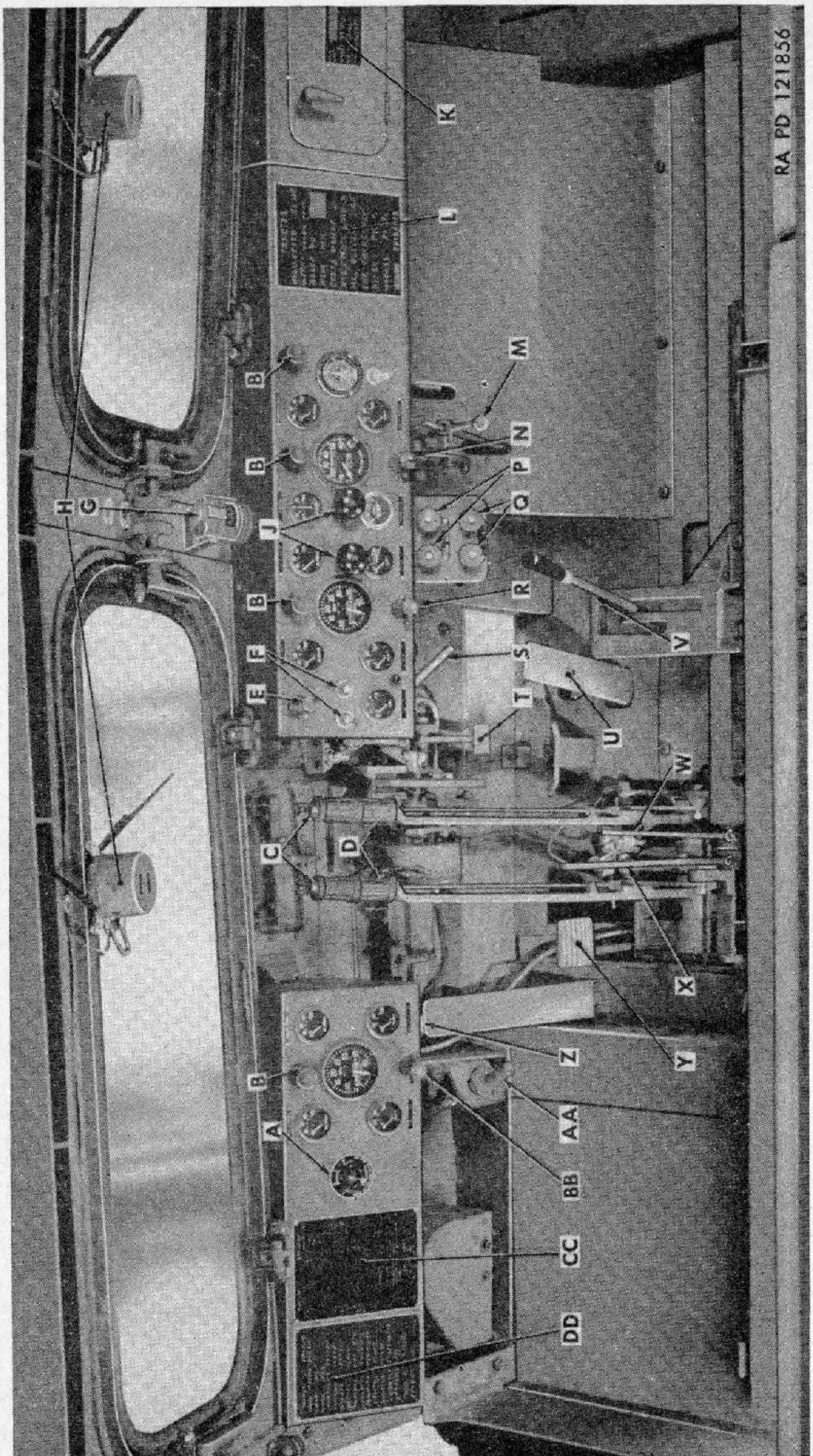


Figure 6. Operator's controls.

A—ELECTRIC BRAKE LOAD CONTROL
B—PANEL LIGHTS
C—STEERING LEVER LOCKS
D—STEERING LEVERS
E—MAIN LIGHT SWITCH
F—STARTER BUTTON SWITCHES
G—COMPASS
H—WINDSHIELD WIPERS
J—FUEL PRIMER PUMPS
K—VEHICLE DATA PLATE
L—VEHICLE NAME PLATE
M—THROTTLE CONTROL LEVER
N—WINDSHIELD WIPER SWITCH
P—ENGINE SHUT-OFF CONTROL KNOBS
Q—CHOKE CONTROL KNOBS
R—PANEL LIGHT SWITCH
S—TRAILER AIR BRAKE VALVE LEVER
T—TRAILER BRAKE PEDAL
U—ACCELERATOR PEDAL
V—GEARSHIFT LEVER
W—POWER TAKE-OFF RANGE SHIFTER LEVER
X-POWER TAKE-OFF SHIFTER LEVER
Y—CLUTCH PEDAL
Z—DIMMER SWITCH
AA—SIREN SWITCH
BB—BLACKOUT DRIVING LIGHT SWITCH
CC—GEARSHIFT LEVER DIAGRAM PLATE
DD—VEHICLE LUBRICATION IN-STRUCTION PLATE

Figure 6.—Continued

19. Accelerator Pedal

The accelerator pedal is located on the cab floor to the right of the steering levers and next to trailer brake pedal (fig. 6). This pedal regulates the speed of the tractor, depending upon what gear the tractor is being operated in. It also controls the speed of the winch drum.

20. Dimmer Switch

The dimmer switch is located to the left of the steering levers and below the left instrument panel (fig. 6). It is designed for operation by the left foot. The purpose of the dimmer switch is to dim the head light beam. To operate the dimmer switch, press inward with the foot and release when head light beam is dimmed. Repeat this operation to return head light beam to high.

21. Main Light Switch

The main light switch is located on the right instrument panel (fig. 6) and controls the head lights, service lights, and tail lights. This switch is provided with three positions and a spring stop to lock it in any of the three positions. Latch button must be depressed before operating the switch. The main light switch must be pulled out to the second position before the driving lights, tail lights, and dash lights will go on. The first position controls the marker lights when the blackout switch is pulled out.

22. Panel Light Switch

The panel light switch is located on the right instrument panel (fig. 6). This switch operates the panel lamps set above the instruments. The purpose of this switch is to illuminate the instruments at night.

23. Blackout Light Switch

The blackout light switch is located on the left instrument panel (fig. 6). This switch operates the blackout marker lights and the blackout driving lights. This switch is provided with only one position. To turn on blackout lights, pull switch out and push in switch to turn lights off. The main light switch must be pulled out to its first position to operate the blackout switch.

24. Siren Switch

This switch is located to the extreme left of the operator, close to the floor (fig. 6), and the siren is located on top of the tractor (fig. 3). To operate siren, step on switch with the left foot.

25. Windshield Wiper Switch

The windshield wiper switch is located on the right instrument panel (fig. 6). This switch is similar to the light switches. To start operation of windshield wipers, pull switch out; to stop the windshield wipers, push switch in.

26. Starter Button Switches

These switches are located on the right instrument panel (fig. 6). Each switch is used to start the engine (par. 45). To operate, press button until engine starts, then release.

Caution: Do not operate starter longer than 30 seconds at a time or damage to the starter may result.

27. Stop Light Switch

The stop light switch is located at the bottom of the steering levers. The switch is mounted at the bottom of each steering lever so that stop lights operate when either lever is pulled back. The main light switch must be pulled out to its first position before the tail lights will operate.

28. Engine Shut-Off Control Knobs (One for Each Engine)

The engine shut-off control knobs are located on a plate mounted just below the right instrument panel (fig. 6). The knobs are used to control the ignition switches which are located on the intake manifolds. The knobs on the panel are connected to cables that lead to the switches. When knobs are pulled out, the switches are "ON;" when pushed in, the switches are "OFF."

29. Choke Control Knob

The choke control knobs are located on a plate mounted just below the right instrument panel (fig. 6). The choke control knobs are mounted on the same plate as the engine stop control knobs and operate in the same manner to close and open the carburetor choke valves. The choke is used during the engine starting and warm-up period.

30. Primer Pumps (One for Each Engine)

The prime pumps are located on the right instrument panel (fig. 6). The purpose of the primer pump is to aid in starting engines in cold weather by forcing extra fuel to the primer manifolds. To operate primer pump, pump plunger in and out.

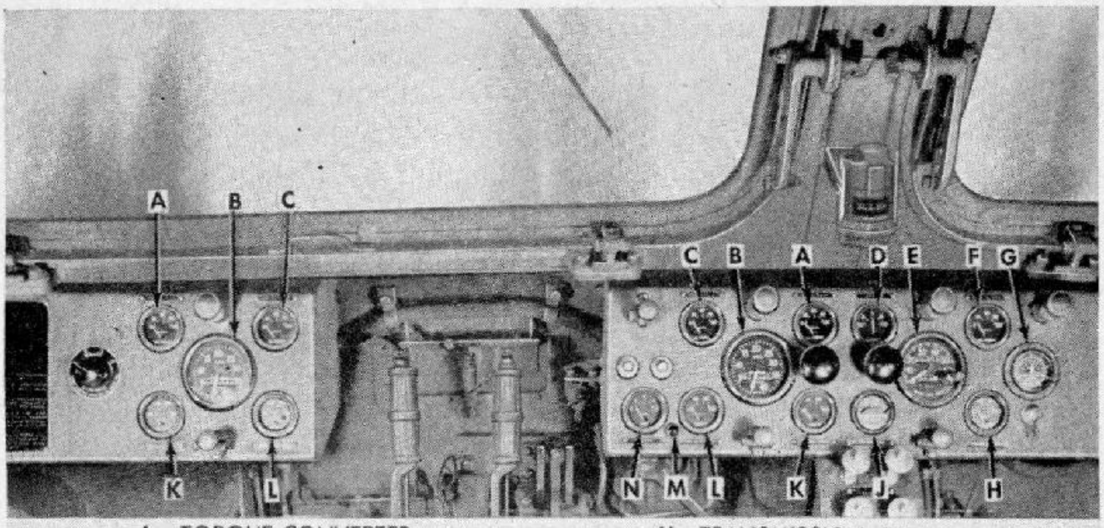


Figure 7. Instrument panel.

31. Engine Oil Pressure Gages

The engine oil pressure gages are located on the left and right instrument panel to correspond with the proper engines (fig. 7). Normal oil pressure, with engine warm, is 10 to 15 psi at idling speed and between 30 to 40 psi at operating speed. There is no need for alarm, however, unless pressure drops lower than 20 psi.

32. Transmission Oil Pressure Gage

This gage is located on the right instrument panel (fig. 7) and registers the pressure of the oil delivered to various units in the transmission, differential, and power take-off cases. It will be noticed that oil pressure will vary; however, there should be at least a 5 psi pressure maintained if tractor is being operated in low gear. Pressure gage may read zero while operating tractor in high gear. If pressure gage registers zero, but the transmission oil temperature gage shows a normal oil temperature, there is no need for alarm. Stop tractor if both gages fail to register properly and determine cause.

33. Transmission Oil Temperature Gage

This gage is located on the right instrument panel (fig. 7) and registers the temperature of the oil in the transmission, differential, and power take-off cases. Temperatures up to 250° F are allowable. If temperature continually registers higher than 250° F, the cause should be determined (par. 89*e*).

34. Torque Converter Oil Pressure Gages

These gages are located on the left and right instrument panels (fig. 7) and register the operating pressure of the oil in the torque converter assembly. Normal operating pressure under load is from 40 to 50 psi.

35. Torque Converter Oil Temperature Gages

These gages are located on the left and right instrument panels (fig. 7) and register the temperature of the oil used in the torque converters. If temperatures should rise above 220° F under normal operating and with a normal load, stop the tractor and inspect for cause of heating. In most cases, however, the torque converter oil temperature will remain fairly low.

36. Engine Temperature Gages

Thoses gages are located on the left and right instrument panels (fig. 7) and are electrically operated. The gage is actuated by a thermal unit mounted in top of engine water outlet manifolds. These gages register the temperature of the engine coolant in degrees Fahrenheit. Normal engine operating temperatures should be from 160° to 180° F. If temperatures continually register above normal reading while operating, cause should be determined (par. 83).

Note.—Do not move tractor until engine temperature has reached 145° F.

37. Speedometer and Odometer

The speedometer and odometer are located on the right instrument panel (fig. 7); the speedometer registering the speed of travel in miles per hour and the odometer registering the total number of miles traveled.

38. Tachometers

The engine tachometers are located on the left and right instrument panels (fig. 7) and register the speed of each engine crankshaft in hundreds of revolutions per minute.

39. Air Pressure Gage

The air pressure gage is located on the right instrument panel (fig. 7). It registers the pressure of the air in the reservoir of the air brake control system. The pressure is regulated by an air pressure governor which acts to maintain the pressure between 85 and 105 psi.

40. Low Air Pressure Indicator Light

This a red light located on the right instrument panel (fig. 7) which automatically comes on when the pressure drops below 60 psi.

Caution: Do not use air brakes when low air pressure indicator light is on.

If red low air pressure light flashes on while tractor is in motion, bring tractor to a halt until air pressure builds up.

41. Fuel Level Gage

The fuel level gage is located on the right instrument panel (fig. 7). It is an electrically operated gage with an actuating unit mounted in top of fuel tank. This gage registers the level of the fuel in the tank and operates only when the right ignition control is on.

42. Ammeter

This instrument is located on the right instrument panel (fig. 7). The ammeter registers the rate of current being delivered to the battery by the generator while the engines and generator are operating. If generator operation is normal, the needle should swing toward the plus (+) or charging side of the gage scale for just a short time after starting engines. Needle should return to a near-zero reading after engine has run a short time and battery is again fully charged. When the engines and generator are not operating and electrical equipment is in use, the battery is being discharged, and the needle should swing toward the minus (−) or discharge side of the gage scale. If, for any reason, the ammeter does not operate as described, inspect for short circuits or grounded out units of the electrical system (par. 84).

43. Hour Meter

The hour meter is located on the right instrument panel (fig. 7) and is electrically operated. The small hand at top left of the dial will start rotating as soon as the right engine ignition is turned on. This hand is only to indicate when the meter is operating. The three hands in center of dial record the number of hours the engines have operated (fig. 8).

Section III. OPERATION UNDER USUAL CONDITIONS

44. General

This section contains instructions for the mechanical steps necessary to operate the 38-ton high-speed tractor M6 under conditions of moderate temperatures and humidity. For operation under unusual conditions, refer to paragraphs 60–66.

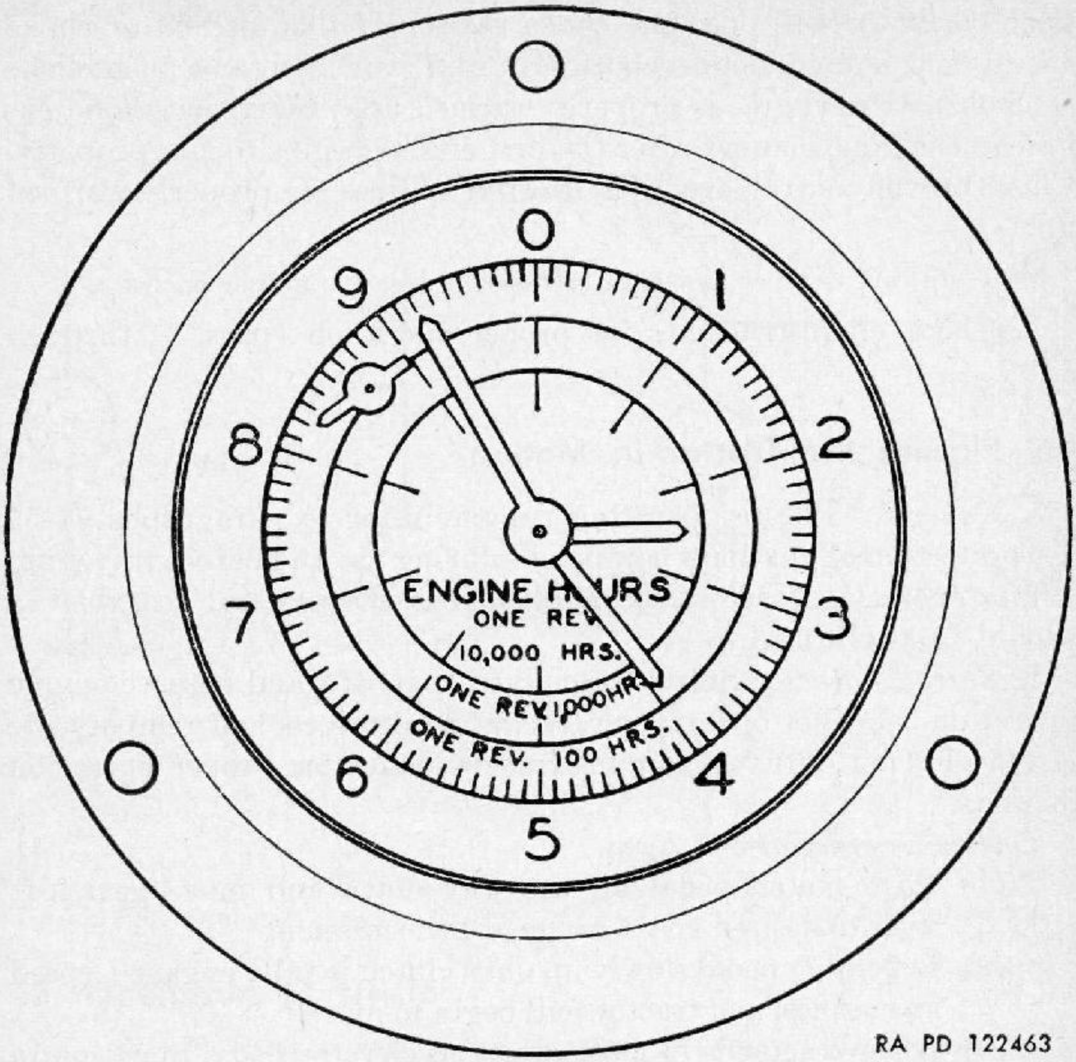


Figure 8. Hour meter.

45. Starting the Engines

a. Perform the before-operation services listed in table II before starting the engines.

b. Make certain that gear shift is in neutral position (refer to shifting diagram in fig. 9).

c. Open throttle control lever one-quarter of its travel.

d. Press in on button in center of choke control knob (fig. 6) and pull choke controls all the way out.

e. Press in on button in center of engine stop control knob (fig. 6) and pull engine stop controls all the way out.

f. Press starter button.

Caution: Do not operate starter longer than 30 seconds at a time as damage to the starter may result.

g. When engine starts, push choke control in part way; then, as engine warms up, gradually push choke control in until it is against stop. The choke control can be regulated more accurately during engine warm-up period by turning control knob. Turning control knob clockwise will open the choke valve. If this method of choke adjustment is used, depress button in center of knob and push choke control in after engine is properly warmed up. Start the second engine in the same manner after the first engine begins to run properly. Close throttle control lever (fig. 6) after engines are properly warmed up.

Note.—In cold weather it will be necessary to use the primer pumps.

h. Check all instruments for proper operation (pars. 31 through 43).

46. Placing the Tractor in Motion

a. General. Before operating tractor, refer to paragraphs 54–59 for protection of auxiliary equipment during use and before traveling. While operating tractor, the applicable services listed in table II should be performed.

b. Start Engines. Start the engines (par. 45) and observe engine operation. Do not operate the tractor until the coolant temperature is 145° F (par. 36). Check instrument panel for proper operation of units.

c. Run Engines at 500 Rpm.

(1) Push clutch pedal all the way down and move gearshift lever to desired speed range of transmission.

(2) Let clutch pedal slowly up until clutch is fully engaged, speed up engines, and tractor will begin to move.

(3) After tractor is in motion, use accelerator pedal to maintain desired speed of tractor.

47. Driving the Tractor

a. Shifting Gears. The gearshift lever has four positions (fig. 9). Shift the lever into "LOW" position if the slowest forward speed or greatest power is desired. Shift lever into "HIGH" position for highest forward speed. The "ENGINE BRAKE" position is to be used only to hold tractor and load to a slow speed when descending steep grades. To back tractor, shift lever in "REVERSE" position and move tractor slowly and carefully.

b. Steering the Tractor. Steering the tractor is accomplished by means of two steering levers which operate brakes in the differential assembly. To turn the tractor to the left, pull back on left steering lever. To turn tractor to the right, pull back on the right steering lever. The radius of a turn will depend upon the distance the levers are pulled back. To maneuver this tractor, it is not necessary to use both steering levers when negotiating a turn.

Caution: Decrease speed of tractor when turning to prevent the vehicle from spinning.

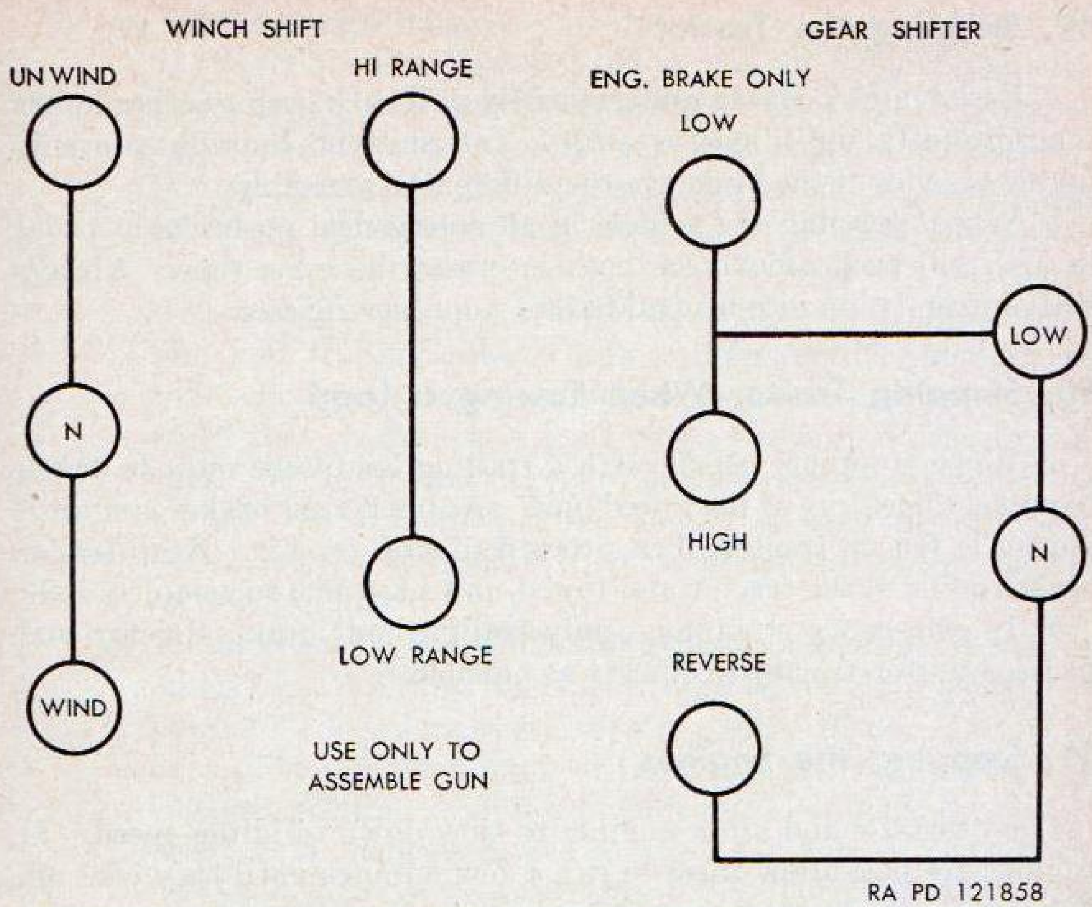


Figure 9. Diagram showing position of gearshift and power take-off levers.

48. Operation of Tractor

a. Operating in Correct Speed Range. It is desirable to operate the tractor in the speed range that will maintain a normal load on the engines. Operating the vehicle in low gear with a light load and a resultant light load on the engines, or operating in high gear with a heavy load and a resultant heavy load on engines, will cause excessive heating of the oil in the torque converters. If, when operating tractor in high gear, the load causes speed to drop 5 or 7 mph, shift into low gear. After speed of tractor has reached 9 mph, shift into higher gear. Operating tractor in the speed range that will maintain normal load on the engine will tend to maintain normal torque converter oil temperature.

b. Proper Operation of Clutch. Do not slip master clutch. If it is necessary to keep engine running with tractor stopped, make sure gear shift is in neutral position before removing foot from clutch pedal.

Caution: Do not "ride" clutch pedal while driving tractor as damage may result to the clutch assembly.

c. Do Not Attempt To Drive Tractor Beyond Limitations. Do not attempt to operate tractor on steeper inclines, deeper water, or over larger trenches and ditches than specified in paragraph 5.

49. Stopping the Tractor

a. Push clutch pedal in and gradually pull back both steering levers intermittently until tractor stops. Intermittent braking prevents undue heating of the brakes in the differential assembly.

b. When stopping the vehicle in an emergency, push clutch pedal in and pull back quickly on both levers at the same time. Always shift transmission into neutral before stopping engines.

50. Stopping Tractor When Towing a Load

a. When stopping vehicle with a trailing load, care must be taken to prevent buckling of the towed unit. Apply trailer brakes first until a drag is felt on tractor, then proceed to stop tractor. Keep trailer brakes on until the tractor and towed unit has come to complete halt.

b. In emergency stopping, apply trailing unit brakes quickly and proceed to stop tractor as quickly as possible.

51. Stopping the Engines

Close throttle and allow engines to slow down to idling speed. If engines are hot, allow them to run a few minutes until they cool off. Then push engine stop control knobs (fig. 6) all the way in against plate. Pushing in on the engine stop control knobs turns off the ignition and also opens the air valve mounted between the two carburetors of each engine and connected by hoses to the air cleaner outlet pipe. This valve allows air to be drawn into the intake manifold and cylinders and thus prevents fuel from being drawn in with the air. This safeguard prevents engines from running by self-ignition after the ignition is turned off. Leave the engine stop control knobs in against bracket until engines are started again.

52. Towing the Tractor

a. Towing of Vehicle To Start Engines. In the event the engines cannot be started with the starter, due to defective starter or discharged batteries, and it is necessary to move the vehicle before repairs can be made to the defective unit, the tractor can be pulled by another vehicle. Connect tow chains to clevises or pintle on front end of tractor. Pull engine stop control knobs and engine choke control knobs (fig. 6) out. Shift transmission gears of tractor into "HIGH" and depress clutch pedal until vehicles are moving. When moving at sufficient speed, let up on clutch pedal, and engines will be turned for starting. If engines do not turn fact enough in high gear, shift gears to engine brake position (fig. 6). Engine will then turn faster.

b. Towing Disabled Tractor.

(1) If the tractor is to be towed to a repair shop, due to inoperative engines, inoperative torque converter, stripped gears, or other similar causes, have the gearshift lever in neutral position while towing. If vehicle cannot be moved by towing, because a locked or broken transmission or differential prevent the tracks from turning, it will be necessary to remove the tracks (par. 204). Tractor can be moved with the suspension and trailing idler wheels rolling on the ground. If this is done, care must be taken to avoid deep holes or large rocks that might cause damage to suspension wheels and tires. With the tracks removed, the tractor brakes will be useless. A rigid towing bar should be used instead of a chain to prevent tractor from running into towing vehicle on down grades.

(2) If one engine is inoperative but the second engine is still in operating condition, the tractor may be driven a short distance to a location where repairs can be made. If this is done, first lock the clutch of the inoperative engine in disengaged position as follows: while one man holds the clutch pedal fully depressed, loosen the lock nut on the clutch throw-out lever stop screw (fig. 100). Turn the stop screw out of the clutch housing and against the lever to hold the clutch in disengaged position. Tighten lock nut. Remove the yoke pins that connect the short link rod to the lever and remove this rod.

53. Parking the Tractor

If tractor is to be parked on a slope where there is a possibility of the tractor moving, set the steering brakes by pulling steering levers back as far as possible and engaging ratchet locks to lock them in this position.

Section IV. OPERATION OF MATÉRIEL USED IN CONJUNCTION WITH MAJOR ITEM

54. General

This section explains, describes, and tells how to operate the auxiliary equipment used in conjunction with the 38-ton high-speed tractor M6.

55. Operation of Winch and Power Take-Off

a. General. The winch drum is driven by a two-speed power take-off mounted on the transmission case. A winch drive shaft with universal joints extends from the power take-off to the winch worm shaft. The drive shaft is connected to the power take-off shaft with a shear pin which will shear off before damage is caused to either winch or power take-off in case of overload (fig. 168).

Note.—The low range speed of the power take-off is to be used only when the winch is used to assemble the 8-inch gun or 240-mm howitzer. The high range speed can be used for all other winch work.

b. Operation. Disengage master clutch, lift lever lock, and shift the power take-off high-low range shifter lever (fig. 6) forward for high speed range or back for low speed range. Then shift the power take-off lever forward (fig. 6). Have another man engage the sliding jaw clutch or winch with the jaws on the drum by operating lever at rear of tractor to the right of the winch (fig. 10). Engage master clutch and winch will operate.

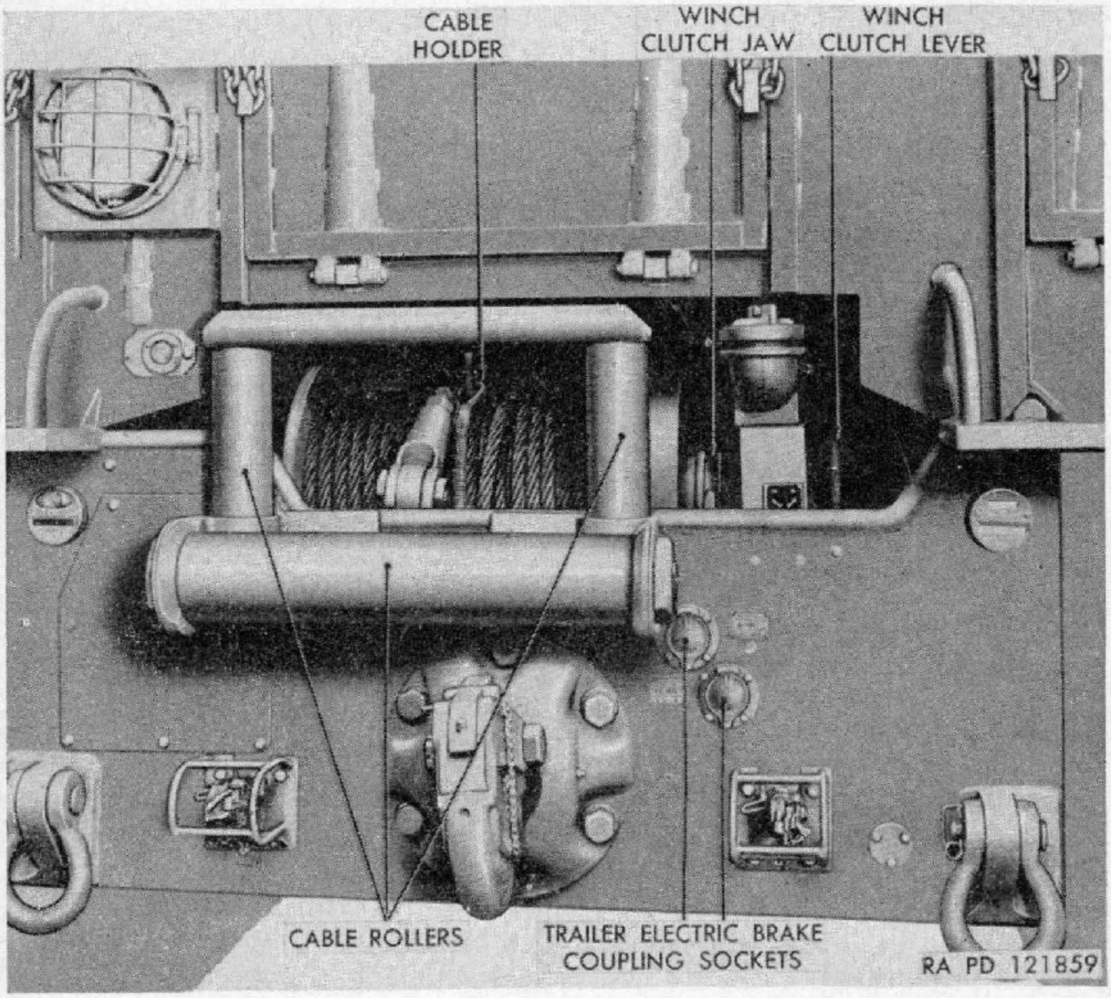


Figure 10. Rear view details of tractor.

c. To Pull Load. Unreel cable to allow hook to be attached to load, then disengage master clutch and shift power take-off lever into forward position. The steering brakes must be locked to hold tractor in position unless it is desired to drive tractor forward while winch is operating. Set hand throttle so engines will run at 1,000 rpm, then engage master clutch. If load attached to cable will not move, use snatch block to reduce pull. Always keep cable wound evenly and smoothly on the drum. Stop the winch by closing throttle and releasing master clutch. Wind cable, release winch clutch, and shift power take-off into neutral position. Secure lever in neutral position with lever lock. Disengage the sliding jaw clutch on winch from the jaws on the drum.

Caution: Do not run engines faster than 1,000 rpm during operation of winch. Engine speed higher than 1,000 rpm will result in shearing of shear pin connecting winch drive shaft to power take-off. Never attempt to disengage winch jaw clutch while winch is under load.

56. Fire Extinguishers

a. Description. Each 38-ton high-speed tractor M6 is equipped with two portable 4-pound CO_2 fire extinguishers (fig. 11). The fire extinguishers are mounted on a bracket fastened to the back of driver's seat in the rear compartment. The cylinders are held

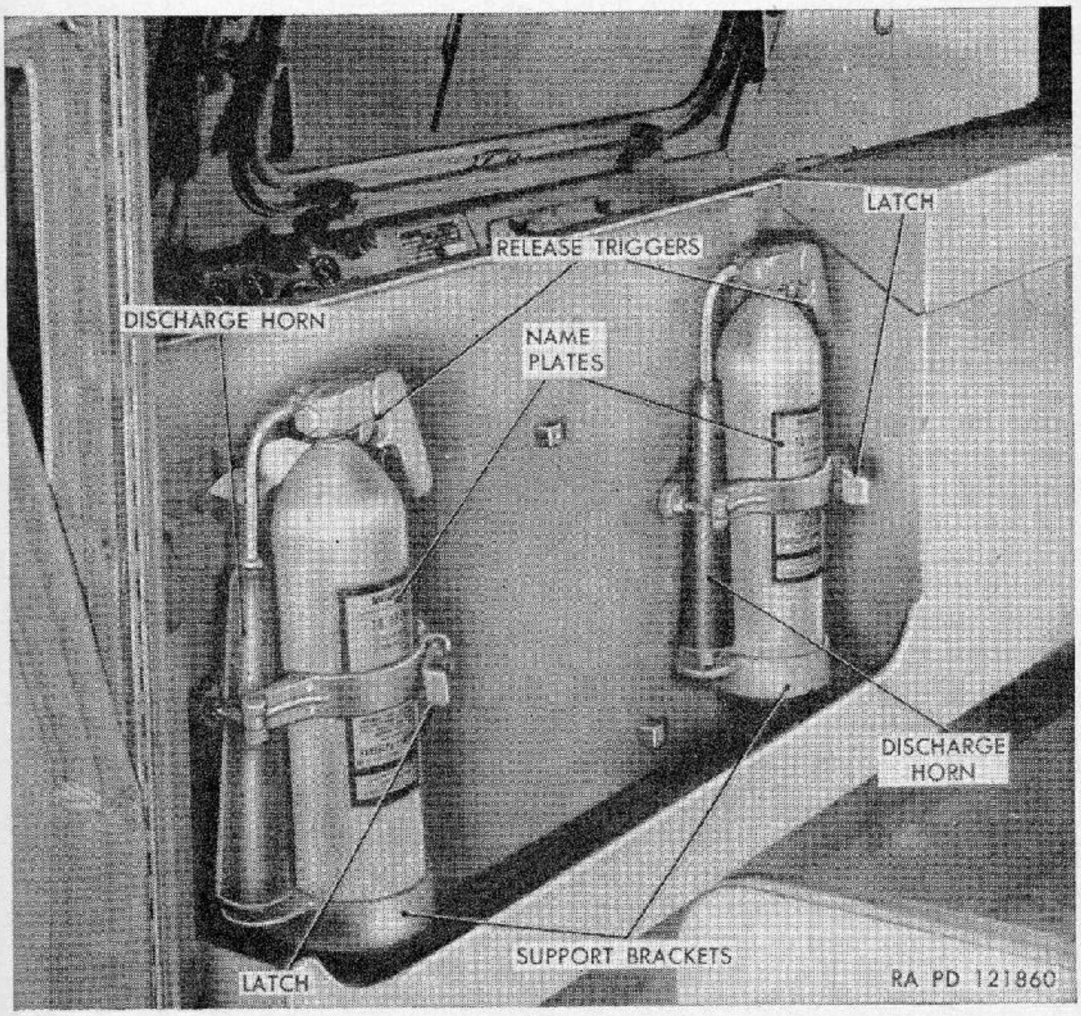


Figure 11. Fire extinguishers.

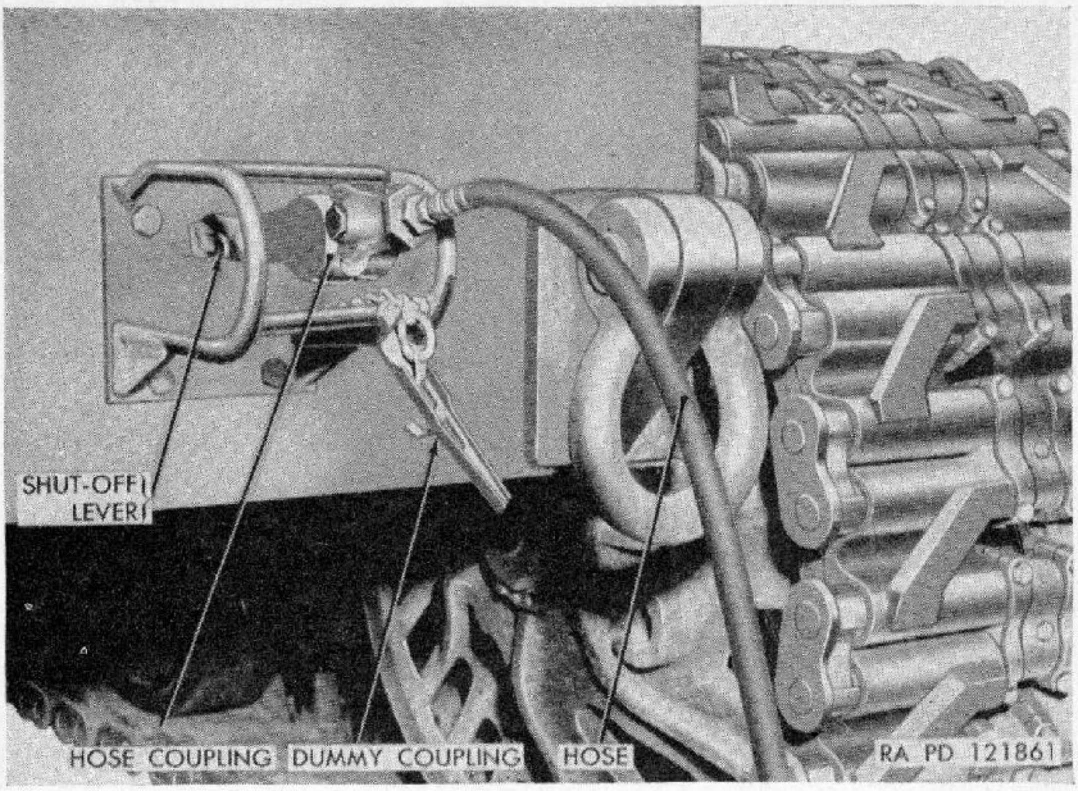


Figure 12. Tire-inflation hose.

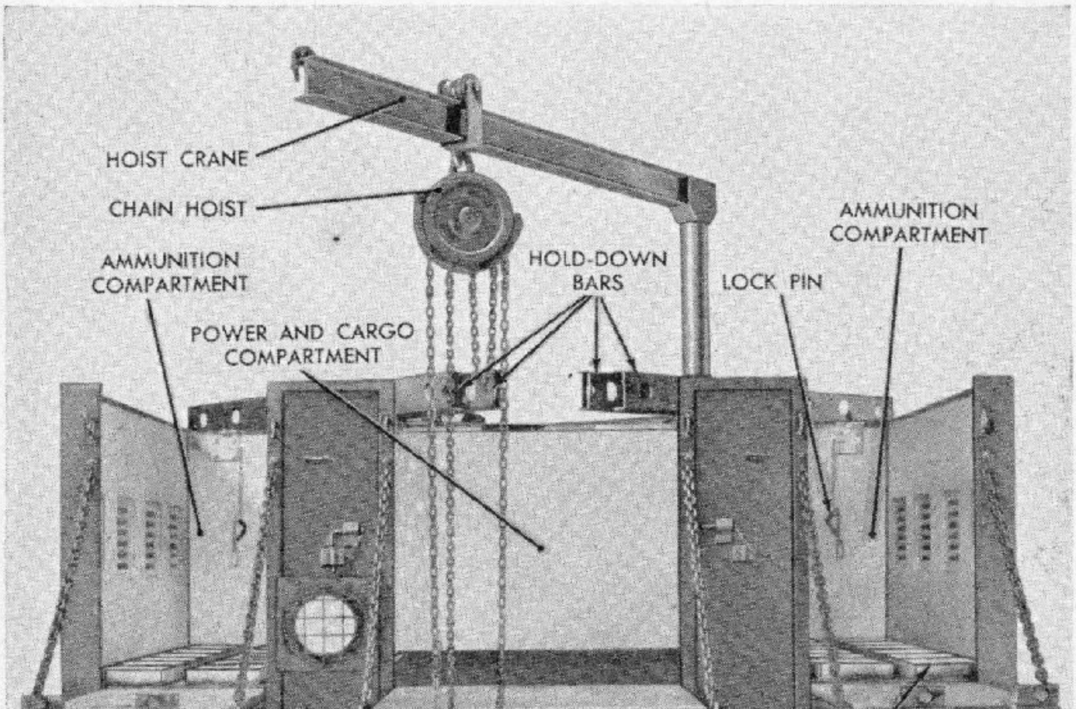


Figure 13. Ammunition box details.

by latches that permit quick removal when needed (fig. 11). The discharge of the contents is controlled by trigger operated valves. The discharge horns on the extinguisher permit spray to be directed at fire as desired.

b. Operation. After removing fire extinguisher from bracket, raise horn to right angle with body of extinguisher, and point nozzle toward base of flame. Pull trigger (wire seal on trigger will break) and contents will be discharged. After use, make sure fire extinguisher is recharged or replaced.

Note.—Every 4 months the control head must be removed from the cylinder to determine the weight of carbon dioxide. This weight should not be more than 6 ounces below the weight stamped on the valve foot or written on tag attached to the cylinder.

Caution: Avoid bodily contact with discharge controls of fire extinguisher as frostbite will result from continual contact.

57. Tire-Inflation Hose

A tire-inflation hose is included in the equipment carried in the tractor. For inflating tires, close shut-off cock lever in "EMERGENCY" trailor hose coupling at rear of tractor and remove dummy coupling (or disconnect trailer hose if a towed unit is connected to tractor). Connect tire inflation hose to coupling with adapter on hose, open shut-off cock lever, and then tire can be inflated (fig. 12). The air pressure gage on instrument panel can act as a tire pressure gage if desired.

58. Ammunition Box

a. Description. The ammunition box on the rear end of the tractor is divided into five compartments (fig. 13). The two outer compartments are equipped with shell racks and hold-down bars for carrying 240-mm shells in an upright position. The center compartment provides space for powder charges and dunnage. The lower compartment on the left side of the tractor (fig. 2) provides space to carry the snatch block, towing chains, hoist, and extra oil. The lower right compartment provides space to carry water cans (fig. 1).

b. Loading of Box. When 120-mm or 8-inch shells are to be loaded, they are to be laid horizontally in the two outer compartments. The 240-mm shells are to be set on end in the shell racks and held at the top by setting the hold-down bars over the ends of the shells and on pins, then securing hold-down bars with pins. Lower the rear doors of box, then load the powder charges and other dunnage in the large center compartment.

c. Stowage Facilities. Stowage facilities have been provided in the ammunition box for the following rounds of ammunition:

120-mm M1 (when towed):	
120-mm, propelling charge	32
120-mm, round	32
8-inch, M1 (when towed):	
8-inch fuze	25
8-inch primer	50
8-inch propelling charge	14
8-inch round	14
240-mm howitzer (when towed):	
240-mm fuze	25
240-mm primer	50
240-mm propelling charge	14
240-mm round	14

59. Shell Hoist

a. General. A swinging crane with a trolley hoist provides for hoisting ammunition or heavy dunnage into the box (fig. 13).

b. Installation and Operation. Set the part of the hoist crane in the most convenient socket in the corner of the center compartment, and use the pin provided to hold crane arm in raised position. Install the trolley hoist on the crane. Hoist the shells up to desired level, swing the crane into box, and lower ammunition into box.

c. Stowage and Shell Hoist. Remove hoist from crane, lower the crane, and secure the swinging arm with latch after loading operation has been completed. Place hoist in cargo compartment and install canvas cover.

Section V. OPERATION UNDER UNUSUAL CONDITIONS

60. General Conditions

a. In addition to the operating procedures described for usual conditions, special instructions of a technical nature for operating and servicing this vehicle under unusual conditions are contained or referred to herein. In addition to the normal preventive maintenance service, special care in cleaning and lubrication must be observed where extremes of temperature, humidity, and terrain conditions are present or anticipated. Proper cleaning, lubrication, and storage and handling of fuels and lubricants not only insure proper operation and functioning, but also guard against excessive wear of the working parts and deterioration of the material.

b. Refer to paragraph 72 for lubrication under unusual conditions, to table II, paragraph 76 and table III, paragraph 77 for preventive maintenance checks, and to paragraphs 229–232 for maintenance procedures.

c. TM 21–301 contains very important instruction on driver selection, training, and supervision, and TM 21–306 prescribes special driving instructions for operating full-track and tank-like vehicles under unusual conditions.

Caution: It is imperative that the approved practices and precautions be followed. A detailed study of these TM's is essential for use of this matériel under unusual conditions.

d. When chronic failure of matériel results from subjection to extreme conditions, report of the condition should be made on DA AGO Form 468 (par. 2).

61. Extreme Cold Weather Conditions

a. General Problems.

(1) Extensive preparation of matériel is necessary when it is scheduled for operation in extreme cold weather. Generally, extreme cold will cause lubricants to thicken or congeal, freeze batteries or prevent them from furnishing sufficient current for cold-weather starting, crack insulation and cause electrical short circuits, prevent fuels from vaporizing and properly combining with air to form a combustible mixture for starting, and will cause the various construction materials to become hard, brittle, and easily damaged or broken.

(2) For description of operations in extreme cold, refer to FM 70–15 and TM 9–2855.

Caution: It is imperative that the approved practices and precautions be followed. TM 9–2855 contains information which is specifically applicable to this vehicle as well as all other vehicles. It must be considered an essential part of this manual, not merely an explanatory supplement to it.

b. Winterization Equipment. Special equipment is provided for the vehicle when protection against extreme cold weather (0° to −65° F.) is required. This equipment is issued as specific kits. Each kit contains a technical bulletin which provides information on description, installation instructions, and methods of use. TM 9–2855 contains general information on winterization equipment and processing.

c. Fuels and Lubricants (Storage, Handling, and Use).

(1) The operation of equipment at arctic temperatures will depend to a great extent upon the condition of the fuels and lubricants used in the equipment.

(2) The manner in which the fuels and lubricants are stored, handled, and used greatly affects the service the fuels and lubricants will give.

(3) In arctic operations, contamination with moisture is the source of many difficulties. Moisture can be the result of snow getting into the product, condensation due to "breathing" of a partially filled container, or moisture condensed from warm air in a partially filled container when a product is brought outdoors from room temperatures. Other impurities will also contaminate fuels and lubricants so that their usefulness is impaired.

(4) Immediate effects of careless handling of fuels and lubricants are not always apparent, but any deviation from proper handling of these products is likely to bring trouble at the least expected time.

(5) Refer to TM 9–2855 for detailed instructions.

62. Extreme Cold Weather Operation

a. General.

(1) The driver and crew members must always be on the alert for indications of the effect of cold weather on the vehicle.

(2) The driver and crew members must be very cautious when placing the vehicle in motion after a shutdown. Congealed lubricants may cause failure of parts.

(3) Refer to TM 21–306 for special instructions on driving hazards in snow, ice, and unusual terrain encountered under extreme cold conditions.

b. At Halt or Parking.

(1) When halted for short shut-down periods, park the vehicle in a sheltered spot out of the wind. For long shut-down periods, if high dry ground is not available, effort should be made to prepare a footing of planks or brush. Chock in place, if necessary.

(2) When preparing a vehicle for shut-down period, place transmission gearshift lever in neutral to prevent it from possible freezing in an engaged position. Freezing may occur when water is present due to condensation.

(3) Clean all parts of the vehicle of snow, ice, and mud as soon as possible after operation. Refer to table II, paragraph 76, for detailed after-operation procedures. Be sure to protect all metal parts against entrance of loose, drifting snow during the halt. Snow flurries penetrating the engine compartment may enter the crankcase filler vent, etc. Cover and shield the vehicle but keep the ends of the canvas paulins off the ground to prevent them from freezing to the ground.

(4) If no power plant heating device is present, remove the batteries and store in a warm place.

(5) Refuel immediately in order to reduce condensation in the

fuel tanks. Prior to refueling, open fuel tank and drain off any water accumulated.

(6) When the vehicle is equipped with a power plant heater, as provided by the artic winterization kit, start the heater and check to be sure that it is operating effectively. This heater should avoid the necessity of removing the batteries to warm storage and is designed to operate unattended during overnight stops. Instructions for operation of winterization equipment will be found in pamphlet packed with the kit.

Note. This heater is used only while the vehicle is halted.

63. Extreme Hot Weather Conditions

a. General. Continuous operation of the vehicle at high speeds or long hard pulls in low gear positions on steep grades or in soft terrain may cause the vehicle engine and transmission to overheat. Avoid the continuous use of low gear ratios whenever possible. Continuously watch the temperature gages and halt the vehicle for a cooling-off period whenever necessary and the tactical situation permits. Make frequent inspections and servicing of radiators, oil filters, and air cleaners. If the engine temperature gages or the transmission or converter oil temperature gages indicate overheating of these units, look for dust, insects, or any other obstruction in radiator cores and remove. Flush cooling system, if necessary (par. 130).

b. At Halt or Parking.

(1) When practicable, park the vehicle under cover to protect it from sun, sand, and dust.

(2) Cover inactive vehicles with paulins if no other suitable shelter is available. Where entire vehicle cannot be covered, protect the engine compartment against entry of sand or dust.

64. Operation on Unusual Terrain

a. Mud. Select transmission low gear to move vehicle steadily without digging in. When a convoy of vehicles is operating over soft ground, in territory where circumstances permit, it is desirable to operate the vehicle so that the tracks overlap the trail of the preceding vehicle to avoid rutting. If the vehicle becomes stuck, arrange to be towed out of the mud instead of digging in. When a drop to below freezing temperature is anticipated, make sure that the vehicle is parked on solid ground or footing to prevent the tracks from being frozen in the mud and that accumulations of mud have been removed from track and wheel contacting surfaces.

b. Snow.

(1) *General.* Operation over snow does not require any special driving technique; however, it is desirable to have knowledge

of the various types of snow formations and the individual characteristics and supporting qualities of each. The combination of such information with actual snow-driving experience will improve judgment on the selection of a trail and minimize the difficulties which might be encountered.

(2) *Selecting course of travel.* Before proceeding, view the overall terrain and snow formations. Unless circumstances prevent, it always is preferable to travel around rather than up and down ridges, slopes, or hills. This is particularly true when operating in areas of heavy snowfall with accompanying high drifts and dangerous crevices. Sometimes it is possible to detect drifts in deep wind-blown snow by variations in shading of the snow. Avoid traveling close to trees and stumps because of uncertain snow adjacent to them. Whenever the route involves an unavoidable grade, drive as nearly straight up and down as possible. This equalizes track load and prevents loss of traction from sideslip. Do not make abrupt turns. When the course of travel involves unavoidable hill operation at an angle and where traction and steering become impaired by the tracks on the low side breaking through the surface, reverse the vehicle for a short distance and maneuver into position to approach the grade at a slightly steeper angle. If necessary, repeat this procedure until proper traction is restored.

(3) *Soft or fine snow driving.* As in other types of driving, select the transmission gear shift position which gives good traction for satisfactory operation. Whenever track slippage occurs, modify operation as required to obtain a slow, steady track speed involving the least possible disturbance to snow bed.

(4) *Crusted or melting snow driving.* Snow operation may be encountered in areas involving freezing temperatures at night but higher melting temperatures throughout the course of the day. In regions of heavy snow, the crust may very likely support the weight of the vehicle during the night and early morning hours; but by noon, and thereafter, the rising temperatures and melting snow may present the possible hazard of breaking through. If this occurs, do not speed up the engine in an attempt to climb back onto the surface of the crust. Instead, reduce engine speed instantly and shift into transmission low range to achieve very low track speed for forward movement without slippage.

65. Unusual Climatic Conditions

a. High Humidity. Vehicles inactive for long periods in hot humid weather are subject to rapid rusting and accumulation of fungi growth. Make frequent inspections and clean and lubricate to prevent excessive deterioration.

b. High Altitude. At high altitudes, coolant in vehicles boils at proportionately lower temperatures than 212° F, thus it will be necessary to keep a close watch on the engine temperature especially during hot weather. During extreme cold weather at high altitude, the instructions given for extreme cold weather and unusual terrain conditions will govern.

c. Ice. Skidding is the general hazard encountered on ice. Select the proper gear ratio to move the vehicle steadily, without imposing undue strain on engine. When skidding occurs, decelerate the engine and proceed with caution.

d. Sand. The main objective when driving in sand is to avoid spinning the tracks. Reduce speed and use a gear low enough to move the vehicle steadily. Do not allow the engine to labor.

66. Fording Operations

a. General. In fording, vehicles may be subjected to water varying in depth from only a few inches to depths sufficient to completely submerge the vehicle. Factors to be considered are spray-splashing precautions, normal fording capabilities, deep-water fording using fording kits, and accidental complete submersion.

b. Normal Fording. Fording of bodies of water up to maximum vehicle fording depth of 54 inches is based on the standard vehicle with waterproofing protection provided for critical units when manufactured, but without deep-water fording kit. Observe the following precautions:

(1) Do not exceed the known fording limits of the vehicle.

(2) The engine must be operating at maximum efficiency before attempting to ford.

(3) Shift transmission into low range. Speed up engine to overcome the possibility of a "stall" when the cold water chills the engine. Enter the water slowly. Should the engine stall while submerged, it may be started in the usual manner.

(4) All normal fording should be at speeds of from 3 to 4 mph to avoid forming a "bow wave."

(5) Avoid using the clutch if possible, because frequent use while submerged may cause the clutch to slip.

(6) If accidental complete submersion occurs, the vehicle will be salvaged, temporary preservation applied as outlined in paragraph 231, and then sent to the ordnance maintenance unit as soon as possible for necessary permanent maintenance.

c. Deep-Water Fording. Refer to TM 9–2853 for general information, descriptions, and methods of use of deep-water fording kits, and for general procedure for the operation of vehicles so equipped.

d. After Fording Operations. Open all drain holes in body. Also, at the earliest opportunity, check the engine oil level and check for presence of water in the crankcase. Heat generated by driving will evaporate or force out most water which has entered at various points. Refer to paragraph 231 for maintenance operations after fording.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR ORGANIZATIONAL MAINTENANCE

67. General

Tools and equipment are issued to the using organization for maintaining the matériel. Tools and equipment should not be used for any purpose other than prescribed and, when not in use, should be properly stored in the chest and/or roll provided for them. Spare parts are supplied to the using organization for replacement of those parts most likely to become worn, broken, or otherwise unserviceable when such operations are within the scope of organizational maintenance functions. Organizational spare parts, tools, and equipment supplied for the 38-ton high-speed tractor M6 are listed in Department of the Army Supply Catalog ORD 7 SNL G–184, which is the authority for requisitioning replacements.

68. Common Tools and Equipment

Standard and commonly used tools and equipment having general application to this matériel are authorized by ORD 7 SNL G–184 catalog and by T/A and T/O & E.

69. Special Tools and Equipment

Certain tools and equipment specially designed for organizational maintenance, repair, and general use with the matériel are listed in table I for information only. This listing is not to be used for requisitioning replacements.

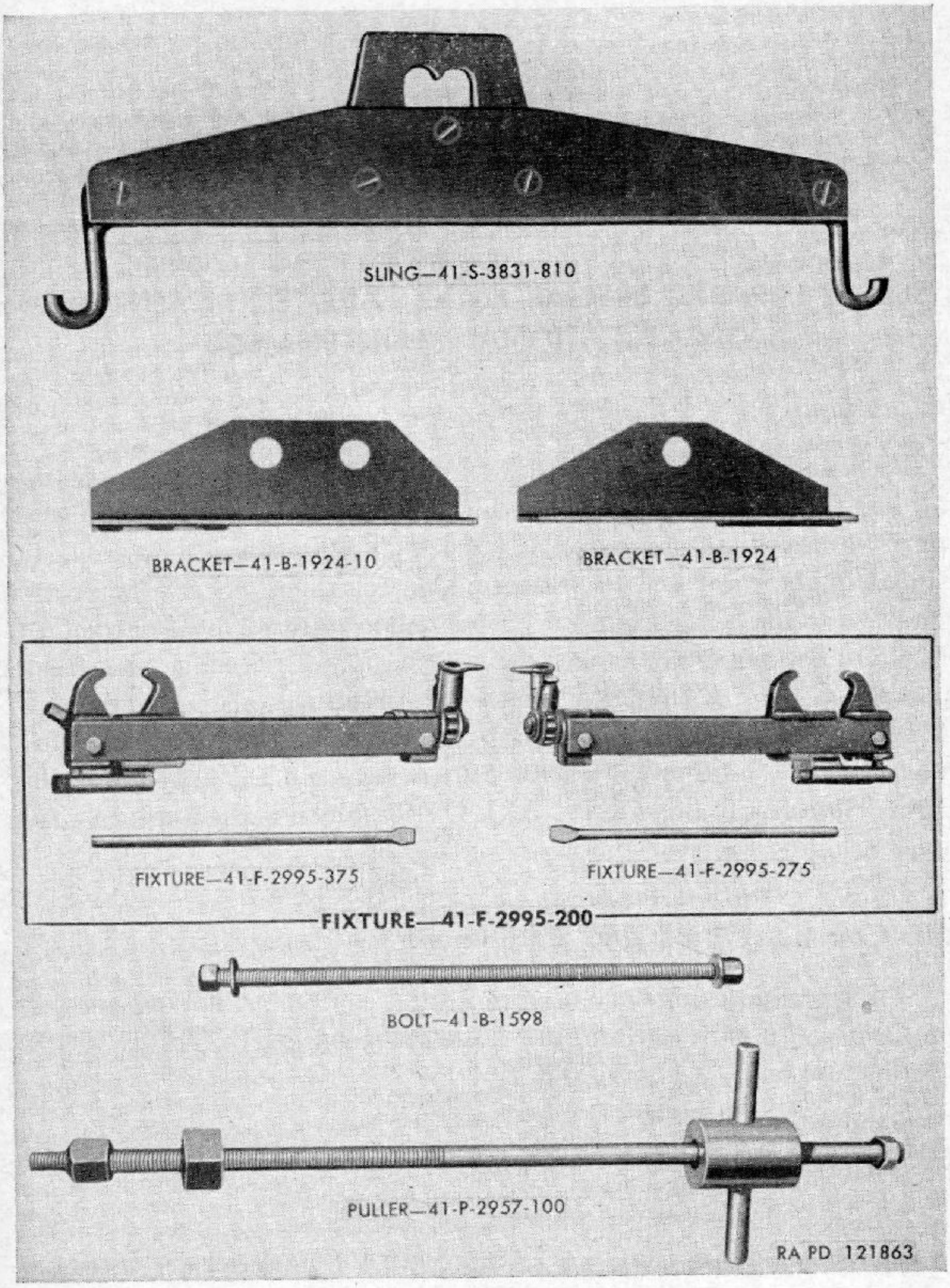


Figure 14. Special tools.

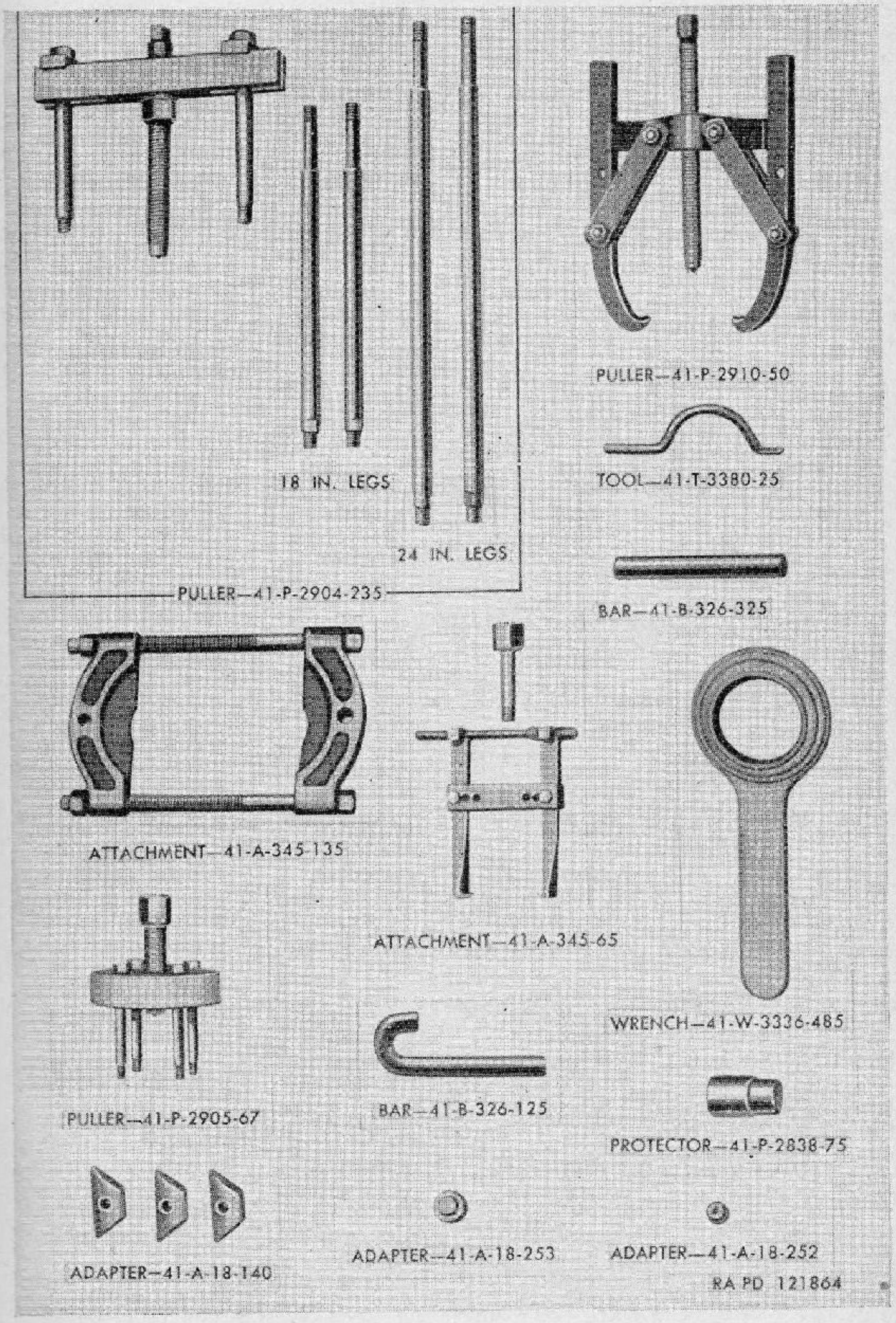


Figure 15. Special tools.

Item	Identifying Number	Reference Fig.	Reference Par.	Use
ADAPTER, puller, block (3 required).	41-A-18-140	15, 148	207	Used with PULLER 41-P-2905-67 for removal of suspension wheel and trailing idler wheel.
ADAPTER, puller, step plate.	41-A-18-252	15, 140, 152	207	Used with PULLER 41-P-2905-67 for removal of suspension wheel and trailing idler wheel. Also used with PULLER 41-P-2904-235 for removal of suspension wheel seal guard.
ADAPTER, puller, step plate.	41-A-18-253	15, 156	210	Used with PULLER 41-P-2904-235 for removal of suspension roller bearings and shafts.
ATTACHMENT, puller, brg cups.	41-A-345-65	15, 145	206	Used with PULLER 41-P-2904-235 for removal of bearing cup.
ATTACHMENT, puller, brg splitter, cap 9 in.	41-A-345-135	15, 152	208	Used with PULLER 41-P-2904-235 for removal of suspension wheel seal guard.
BAR, track adj, hooked end, diam 1¾ in, lgh 10 in.	41-B-326-125	15, 131	204	To adjust track tension.
BAR, track adj, stght, rd, diam 1½ in, lgh 12 in.	41-B-326-325	15, 131	204	To adjust track tension.
BOLT, volute spring compressor.	41-B-1598	14, 149	207	Remove volute spring and seat.
BRACKET, lifting, engine (twin), front.	41-B-1924	14, 44	104	Engine removal and installation.
BRACKET, lifting, engine (twin), rear.	41-B-1924-10	14, 43	104	Engine removal and installation.
FIXTURE, track connecing and link pulling, LH and RH (in pairs). Consisting of:	41-F-2995-200			
FIXTURE, track connecting and link pulling, LH.	41-F-2995-275	14, 132	204	Disconnecting tracks.
FIXTURE, track connecting and link pulling, RH.	41-F-2995-375	14, 132	204	Disconnecting tracks.

Item	Identifying Number	Reference		Use
		Fig.	Par.	
PROTECTOR, bogie wheel shaft, removing and replacing.	41-P-2838-75	15, 153	208	Used to remove suspension wheel shaft and bearings.
PULLER, bearing yoke type, push and pull with 8, 18, and 24 in legs.	41-P-2904-235	15, 156	208	Used with ATTACHMENT 41-A-345-65 for removal of idler wheel bearing cup and with ATTACHMENT 41-A-345-135 for removal of suspension wheel oil seal guard.
PULLER, bogie wheel and trailing idler wheel removal.	41-P-2905-67	15, 148	206, 207	Removing trailing idler and suspension wheel with ADAPTERS 41-A-18-140 and 41-A-18-252.
PULLER, gear, univ, cap 0 to 16 in diam, 15½ in reach.	41-P-2910-50	15, 144	206	Removing idler wheel shaft and bearings from hub.
PULLER, slide hammer type, final drive sprocket pinion and trailing idler pivot shaft, w/adapter.	41-P-2957-100	14, 136	205	Removing idler wheel arm and hinge shaft.
SLING, engine lifting, lgh 41¼ in.	41-S-3831-810	14, 43	104	Engine replacement.
TOOL, unlocking, idler wheel.	41-T-3380-25	15, 142	206	Unlocking idler wheel bearing retainer.
WRENCH, bogie wheel bearing and seal nut.	41-W-3336-485	15, 143	206	Removing idler wheel bearing retainer.

Section II. LUBRICATION AND PAINTING

70. Lubrication Order

LO 9-788 prescribes cleaning and lubrication procedures as to locations, intervals, and proper materials for this vehicle. This order is issued with each vehicle and is to be carried with it at all times. In the event the vehicle is received without a copy, the using organization will immediately requisition a replacement (see SR 310-20-4). Lubrication that is to be performed by ordnance maintenance personnel is listed on the lubrication order in the NOTES.

71. General Lubrication Instruction

a. Usual Conditions. Service intervals specified on the lubrication order are for normal operation and where moderate temperatures, humidity, and atmospheric conditions prevail.

b. Lubrication Equipment. Each vehicle is supplied with lubrication equipment adequate for its maintenance. This equipment will be cleaned both before and after use. Lubricating guns will be operated carefully and in such a manner as to insure a proper distribution of the lubricant.

c. Points of Application.

(1) Lubricating fittings, grease cups, oilers, and oilholes are shown in figures 18 through 24, and are referenced to the lubrication order. Wipe these devices and surrounding surfaces clean before lubricant is applied.

Note.—Steering lever shaft (B, fig. 18) should be serviced every 50 hours with general purpose grease CG.

(2) A ¾-inch red circle should be painted around all lubrication fittings and oilholes.

d. Reports and Records.

(1) Report unsatisfactory performance of matériel or defects in the application or effect of prescribed petroleum fuels, lubricants, and preserving materials, using DA AGO Form 468, Unsatisfactory Equipment Report.

(2) Maintain a record of lubrication of the vehicle on DA AGO Form 462, Work Sheet For Full-Track and Tank-Like Wheeled Vehicles—Preventive Maintenance Service and Technical Inspections.

72. Lubrication Under Unusual Conditions

a. General.

(1) Reduce service intervals, specified on the lubrication order, i. e., lubricate more frequently, to compensate for abnormal or extreme conditions, such as high or low temperatures, prolonged periods of high speed operation, continued operation in sand or dust, immersion in water, or exposure to moisture. Any one of these operations or conditions may cause contamination and quickly destroy the protective qualities of lubricants. Intervals may be extended during inactive periods commensurate with adequate reservation.

(2) Lubricants are prescribed in the "Key" in accordance with three temperature ranges; above + 32° F, + 40° to −10° F, and from 0° to −65° F. Change the grade of lubricants whenever weather forecast data indicate that air temperatures will be consistently in the next higher or lower tempera-

ture range or when sluggish starting caused by lubricant thickening occurs. No change in grade will be made when a temporary rise in temperature is encountered.

b. Lubrication During Extreme Cold Weather. Refer to TM 9–2855 for information on lubricants to be used and detailed information on extreme cold weather lubrication.

c. Lubrication After Fording Operations.

(1) After any prolonged fording operation, lubricate all chassis points to cleanse bearings of water or grit as well as any other points required in accordance with paragraph 231 which covers maintenance operation after fording.

(2) If the vehicle has been in deep water for a considerable length of time or was submerged beyond its fording capabilities, precautions must be taken as soon as practicable to avoid damage to the engine and other vehicle components as follows:

(*a*) Perform a complete lubrication service (par. 70).

(*b*) Inspect engine crankcase oil. If water or sludge is found, drain the oil and flush the engine with preservative engine oil PE–30. Before putting in new oil, drain the oil filter and install a new filter element (par. 102).

Note.—If preservative engine oil is not available, engine lubricating oil OE–30 may be used.

(3) Operation in bodies of salt water increases the formation of rust and corrosion, especially on unpainted surfaces. It is most important to remove all traces of salt water and salt deposits from every part of the vehicle. For assemblies which have to be disassembled, dried, and relubricated, perform these operations as soon as the situation permits. Wheel bearings must be disassembled and repacked after each submersion. Regardless of the temporary measures taken, the vehicle must be delivered as soon as practicable to the ordnance maintenance unit.

d. Lubrication After Operation Under Dusty or Sandy Conditions. After operation under dusty or sandy conditions, clean and inspect all points of lubrication for fouled lubricants and relubricate as necessary.

Note.—A lubricant which is fouled by dust and sand makes an abrasive mixture that causes rapid wear of parts.

73. Painting

Instructions for the preparation of the matériel for painting, methods of painting, and materials to be used are contained in TM 9–2851. Instructions for camouflage painting are contained in FM 5–20B.

995581°—52——4

LUBRICATION ORDER

LO 9-788

23 April 1951 (Supersedes LO 9-788, 8 Nov 48)

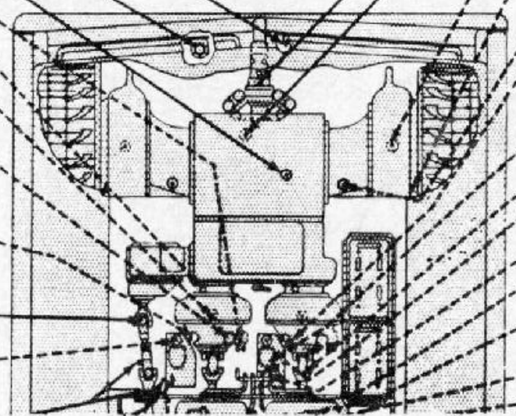
TRACTOR, HIGH SPEED, 38-TON, M6

References TM 9-788, ORD 7 SNL G-184

Intervals are based on normal operation. Reduce to compensate for abnormal operation and severe conditions or contaminated lubricants. During inactive periods, intervals may be extended commensurate with adequate preservation. Relubricate after washing or fording.

Clean fittings before lubricating. Clean parts with THINNER, paint, volatile mineral spirits (TPM) or SOLVENT, dry cleaning (SD). Dry before lubricating. Lubricate dotted arrow points on both sides of the equipment

		Lubricant	Interval
	Serviced From Cab		
A, Fig 18	**Throttle Control Brake** (To lubricate, remove plug, install fitting) (Replace plug after lubricating)	CG	50
C, Fig 18	**Air Brake Control Valve Lever**	CG	50
D, Fig 18	**Trans. and Diff. Fill and Level** (Check level)	OE	8
	Torque Converter Pump Drive Housing Level (Check level)		8
F, Fig 18	**Transmission Breather** (Remove, wash and reoil) (See note 1)	OE	100
	Torque Converter Drain (Drain and refill, Cap. approx. 38 qt. each) (Reached from under tractor) (See note 8)		100
G, Fig 19	**Torque Converter Pump Drive Housing Fill and Breather** (Wash and reoil breather every 100 hrs) (See note 1)	OE	
	Torque Converter Fluid Reservoir Drain (Drain sediment) (See note 8) (Drain and refill every 100 hours)		8
N, Fig 19	**Winch Drive Shaft Universal Joint**	CG	50
L, Fig 19	**Torque Converter Fluid Reservoir Fill and Level** (Use oil, fuel, diesel. Check level)		8



A B C D E

Interval	Lubricant		
8	CG	**Pintle Shaft**	AB, Fig 22
100		**Transmission and Differential Drain** (Drain and refill, Cap. 22 gal) (See note 4)	AK, Fig 24
100		**Final Drive Drain** (Drain and refill, Cap. approx. 25 qt. each) (See note 4)	AJ, Fig 24
8		**Final Drive Level** (Check level)	AC, Fig 22
		Serviced From Cab	
	OE	**Final Drive Fill**	E, Fig 18
100		**Torque Converter Pump Drive Housing Drain** (Drain and refill, Cap. approx. 1 qt. each) (Reached from under tractor)	AL, Fig 24
100		**Torque Converter Fluid Filter** (Remove and renew element) (See note 7)	M, Fig 19
100	CG	**Universal Joints**	H, Fig 19
8	CG	**Master Clutch Release Brg.** (Sparingly)	J, Fig 19
8	CG	**Master Clutch Shaft Brg.**	K, Fig 19
100		**Torque Converter Radiator Vent Line Filter** (See note 7)	T, Fig 19
8	CG	**Fan Drive Belt Tightener Pulley**	R, Fig 19
8	CG	**Fan Drive Belt Tightener Arm**	U, Fig 19
8	CG	**Fan Drive Shaft Bearing**	S, Fig 19

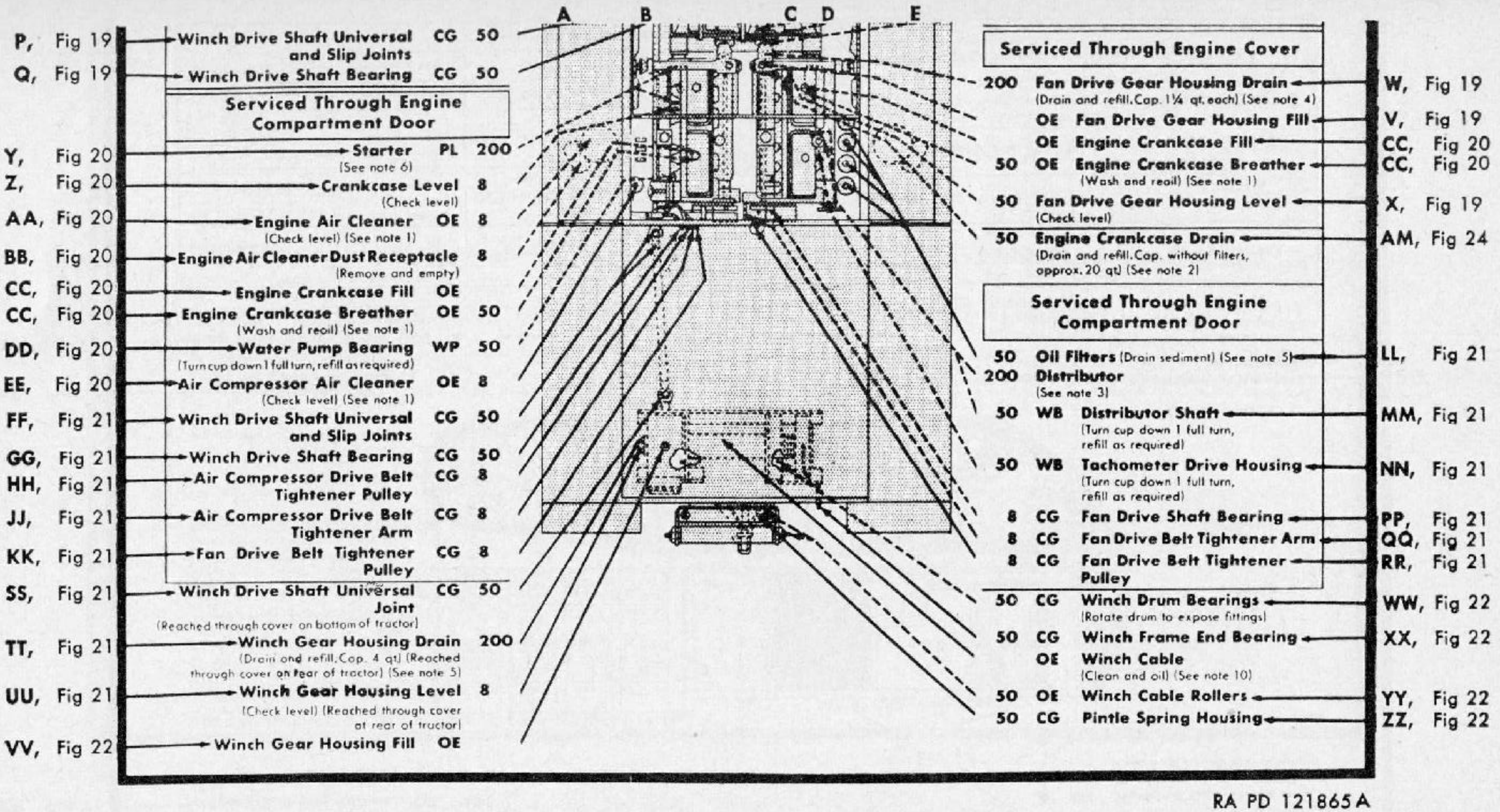
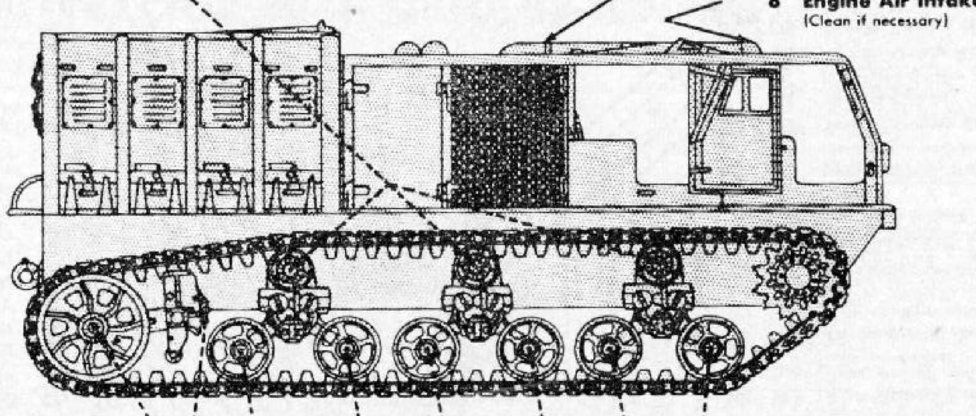


Figure 16. LO 9–788 (front).



KEY

LUBRICANTS	EXPECTED TEMPERATURES above −32° F	−40° F to −10° F	0° F to −65° F
OE—OIL, lubr, engine Winch gear housing	OE 50 or N.S. 9500	OE 30 or N.S. 9250	OE 30 or N.S. 9250
Crankcase, fan and torque converter pump drive housings, other gear housings and suspension system	OE 30 or N.S. 9250	OE 10 or N.S. 9110	OES
CG—GREASE, lubr, general purpose	CG 1	CG 0	OG 00
WB—GREASE, lubr, general purpose, No. 2	WB	WB	OG 00
PL—OIL, lubr, preservative	PL (Med)	PL (Special)	PL (Special)

LUBRICANTS	INTERVALS
OES—OIL, lubr, engine, sub-zero	8—8 Hours
OG—GREASE, lubr, Ord Dept	50—50 Hours
WP—GREASE, lubr, water pump	100—100 Hours
CW—LUBRICANT, chain, exposed gear and wire rope	200—200 Hours

NOTES

1. AIR CLEANERS AND BREATHERS—(Oil bath type) Every 8 hours replenish to bead level with OE, crankcase grade. Every 50 hours clean oil reservoir and refill. Every 200 hours or semiannually, disassemble, clean all parts. For desert or extremely dusty operations, reduce interval to meet conditions. (Mesh type) For normal operation, clean and reoil at indicated intervals. For desert or extremely dusty operation reduce intervals to meet conditions.

2. CRANKCASE—To fill, remove one crankcase breather. Drain only after operation. Refill to FULL mark on gage. Run engine a few minutes and recheck oil level. For proper operation on heavy duty oils, engine thermostats must be functioning properly to maintain engine coolant temperature of 140° F min.

3. DISTRIBUTOR—Every 200 hours, wipe distributor breaker cam lightly with CG and lubricate breaker arm pivot and wick under rotor with 1 or 2 drops of PL.

4. GEAR CASES—Drain only after operation. After refilling transmission and differential, operate vehicle a short distance, check level and add lubricant to FULL mark. Fill gear cases to plug levels before operation and after draining.

5. ENGINE OIL FILTERS—Every 50 hours, remove plug in bottom of case and drain sediment. Every 100 hours, or every second oil change, while crankcase is being drained, remove element, clean inside of case, install new element.

6. STARTER—When the starter is removed, lubricate the outboard bearing with OE and repack the starter reduction gear case with CG.

7. TORQUE CONVERTER FLUID FILTER AND VENT LINE FILTER—Every 100 hours or more often, if filters become inoperative, remove and renew filter element. Check to be sure that orifice in vent line filter is open. Install new gaskets when elements are replaced.

8. TORQUE CONVERTER—Drain each converter system through the drain plugs in bottom of converters and reservoir drain cocks. After systems have been completely drained, fill fluid reservoir with OIL, fuel, Diesel, and run engines at half throttle with master clutches engaged to operate torque converters. Add fluid to the reservoir as it is pumped into the systems until the levels in the reservoir remain constant at the FULL level marks on gage rods and the converter pressure gage shows normal pressure without the needle fluttering.

9. TRAILING IDLERS, BOGIE WHEELS AND TRACK SUPPORT ROLLERS—Clean nozzle of lubricating gun and ends of shafts. Remove plugs, insert nozzle as far as it will go into shaft and hold firmly. Lubricate slowly with quantity specified at points. Clean and replace plugs and plug gaskets.

10. WINCH CABLE—After each use, clean and oil with OE. Semiannually, if cable is not generally used, unwind entire cable and soak by means of a brush with PL(Special). Wipe off excess and coat cable with CW. Coat winch drum also with CW before rewinding cable on drum.

11. OIL CAN POINTS—Every 50 hours, lubricate winch control rod, yoke pins and control lever, steering lever shafts, air and electric brake control linkage, throttle control linkage, yoke pins, foot accelerator, carburetor linkage, engine shut-off mechanism, air compressor unloader rocker arm fulcrum pin, pintle, hinges and latches, with PL.

12. DO NOT LUBRICATE—Air compressor, clutch pilot bearing, governor, tracks and bogie pivots.

13. LUBRICATED AT TIME OF DISASSEMBLY BY ORDNANCE PERSONNEL—Generator, tachometer and speedometer flexible shafts.

Copy of this lubrication order will remain with the equipment at all times; instructions contained herein are mandatory and supersede all conflicting lubrication instructions dated prior to the date of this lubrication order.

BY ORDER OF THE SECRETARY OF THE ARMY:

J. LAWTON COLLINS
Chief of Staff,
United States Army

Official:
EDWARD F. WITSELL
Major General, USA
The Adjutant General

TechSvc(2); Arm & Svc Bd(2); AAF(2); AA Comd(2); OS Maj Comd(10); Base Comd(2); MDW(3); Log Comd (5); A (20); CHQ (2); D (2); R 9 (2); Bn 9 (2); C 9 (2); FC (2); Sch (5) except 9 (50); Gen Dep (2); Dep 9 (10); PE (Ord O) (5), OSD (2); PG 9 (10); Ars 9 (10); Dist 9 (10); T/O & E 5-412 (1); 6-397 (1); SPECIAL DISTRIBUTION.

For explanation of distribution formula see SR 310-90-1

RA PD 121866 A

Figure 17. LO 9-788 (back).

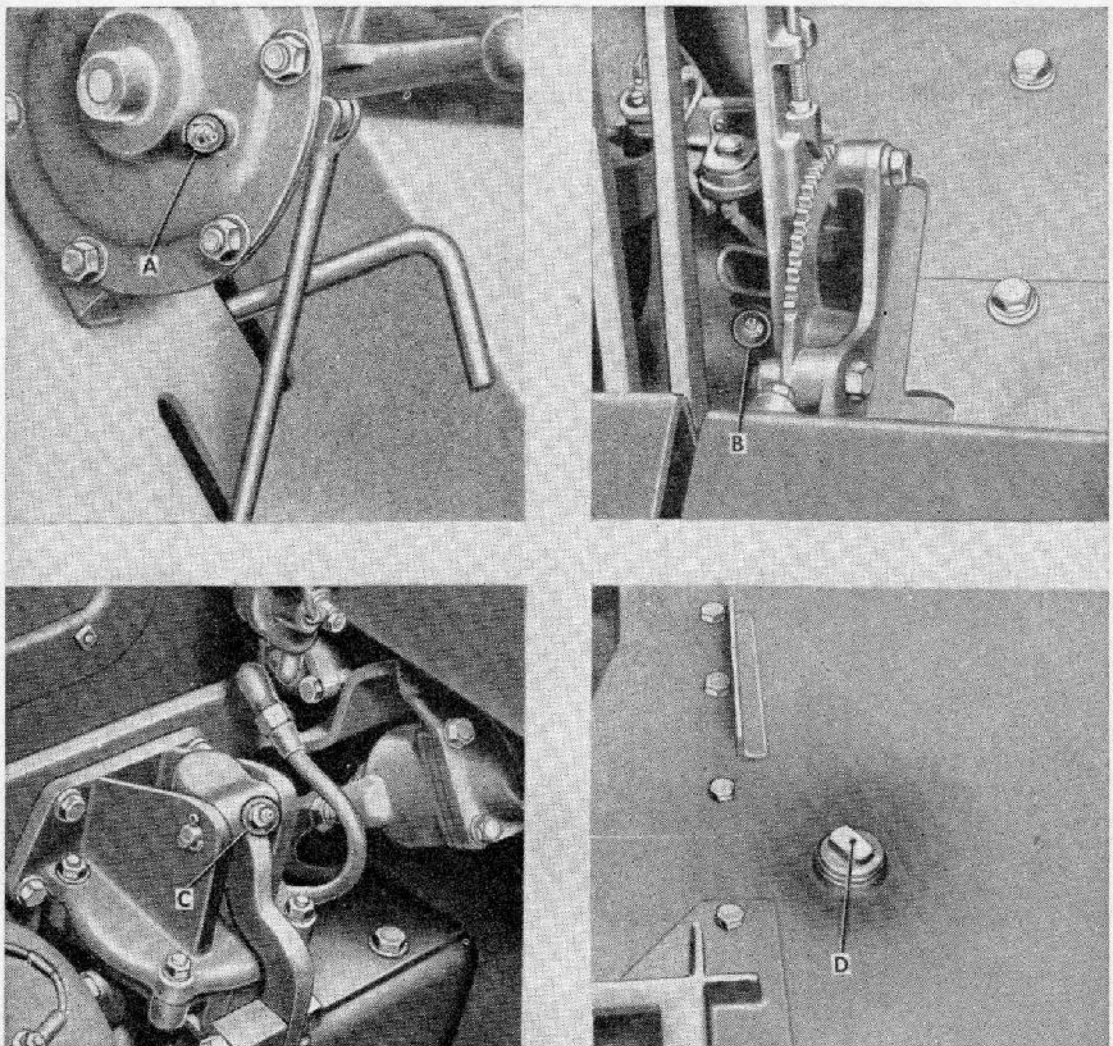


Figure 18. Localized lubrication points (points A through F).

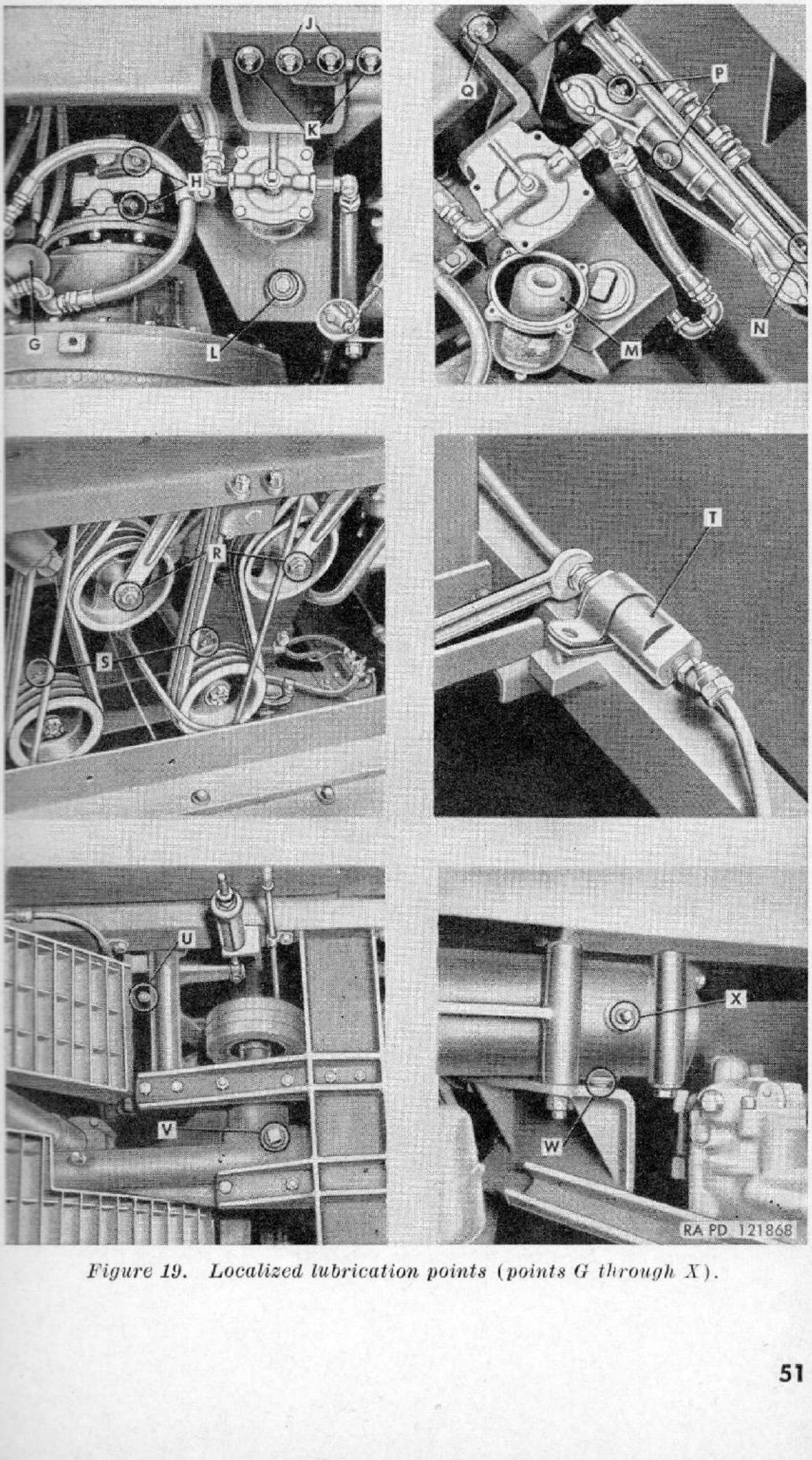


Figure 19. Localized lubrication points (points G through X).

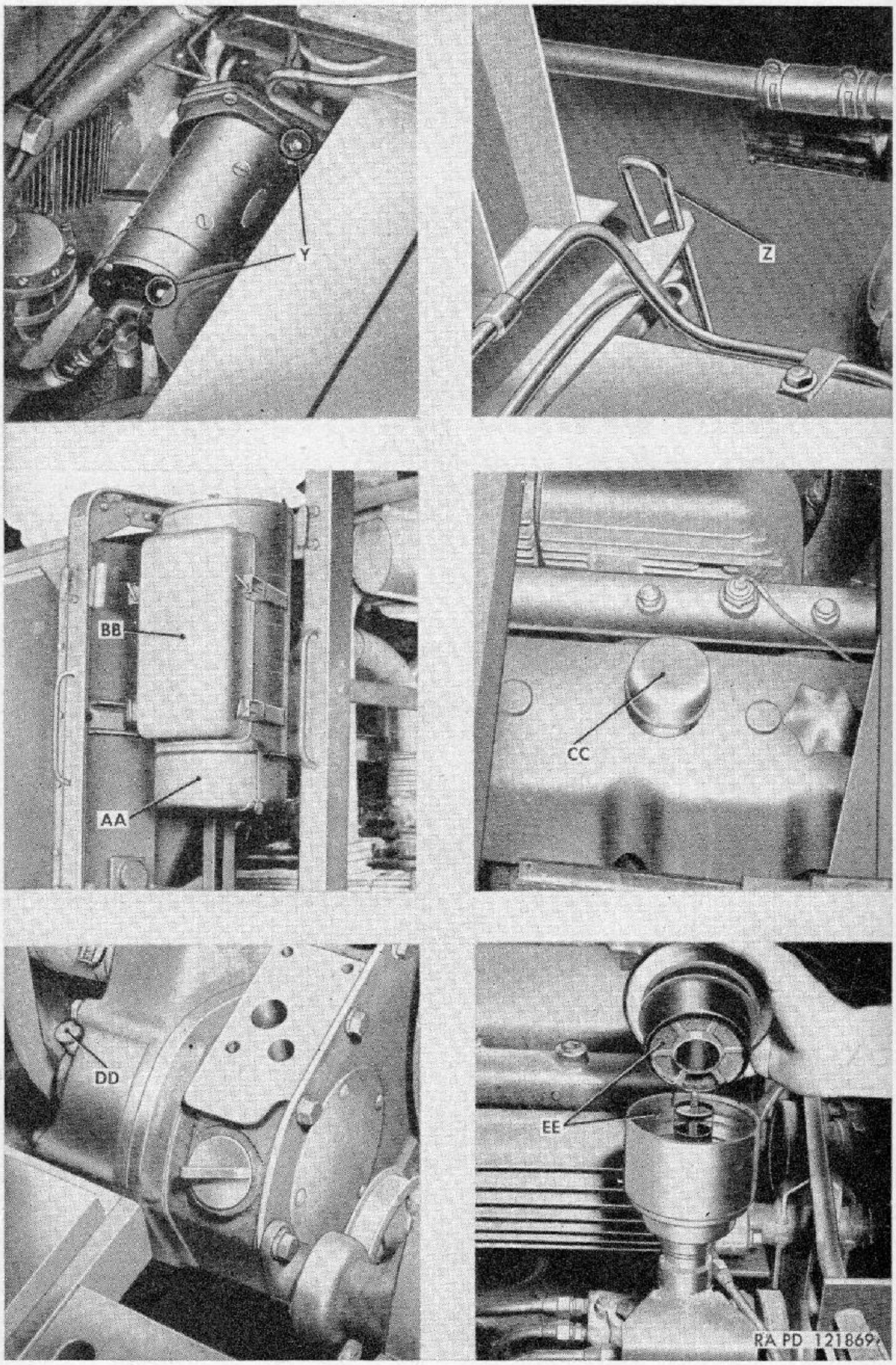


Figure 20. Localized lubrication points (points Y through EE).

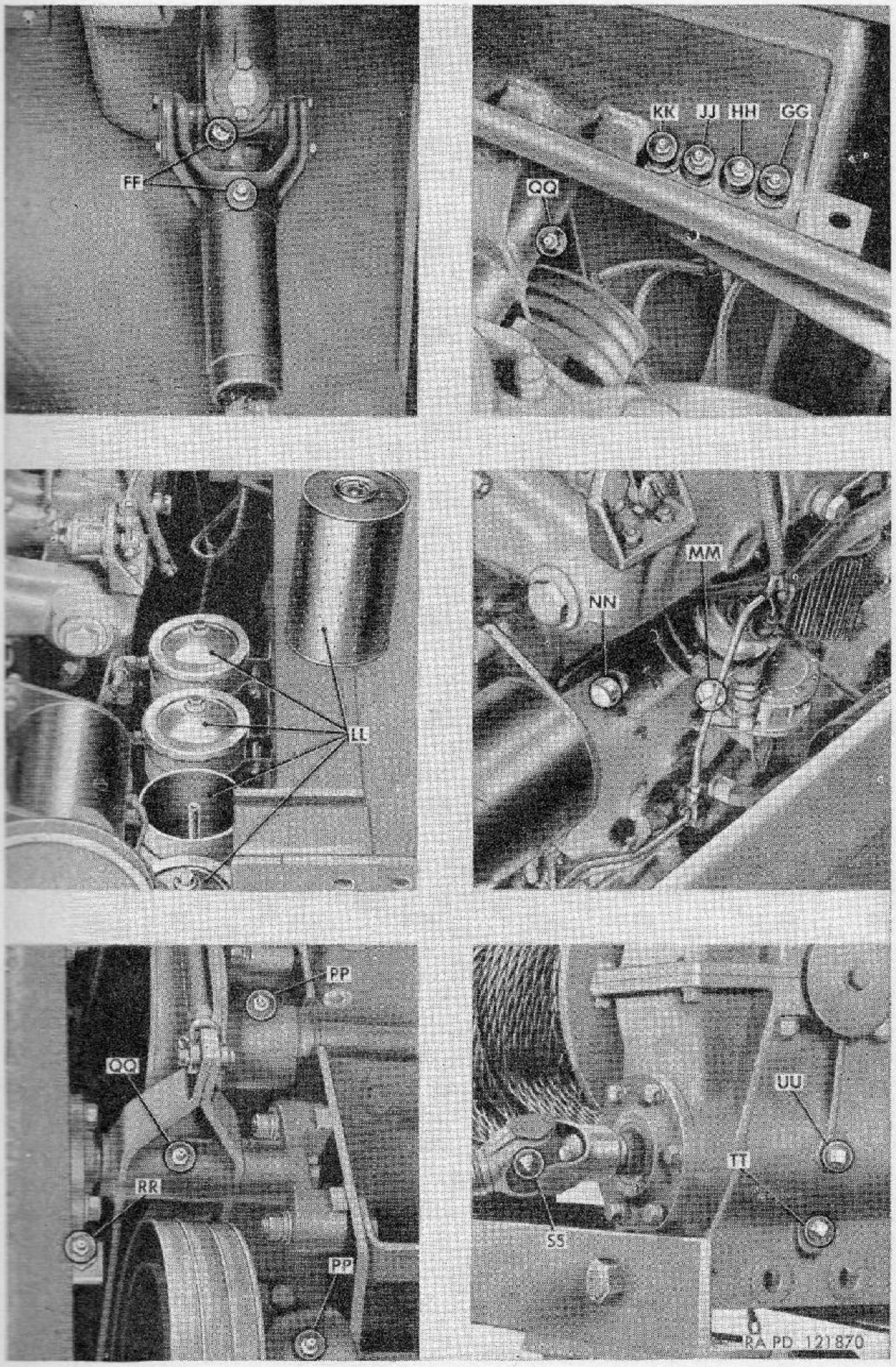


Figure 21. Localized lubrication points (points FF through UU).

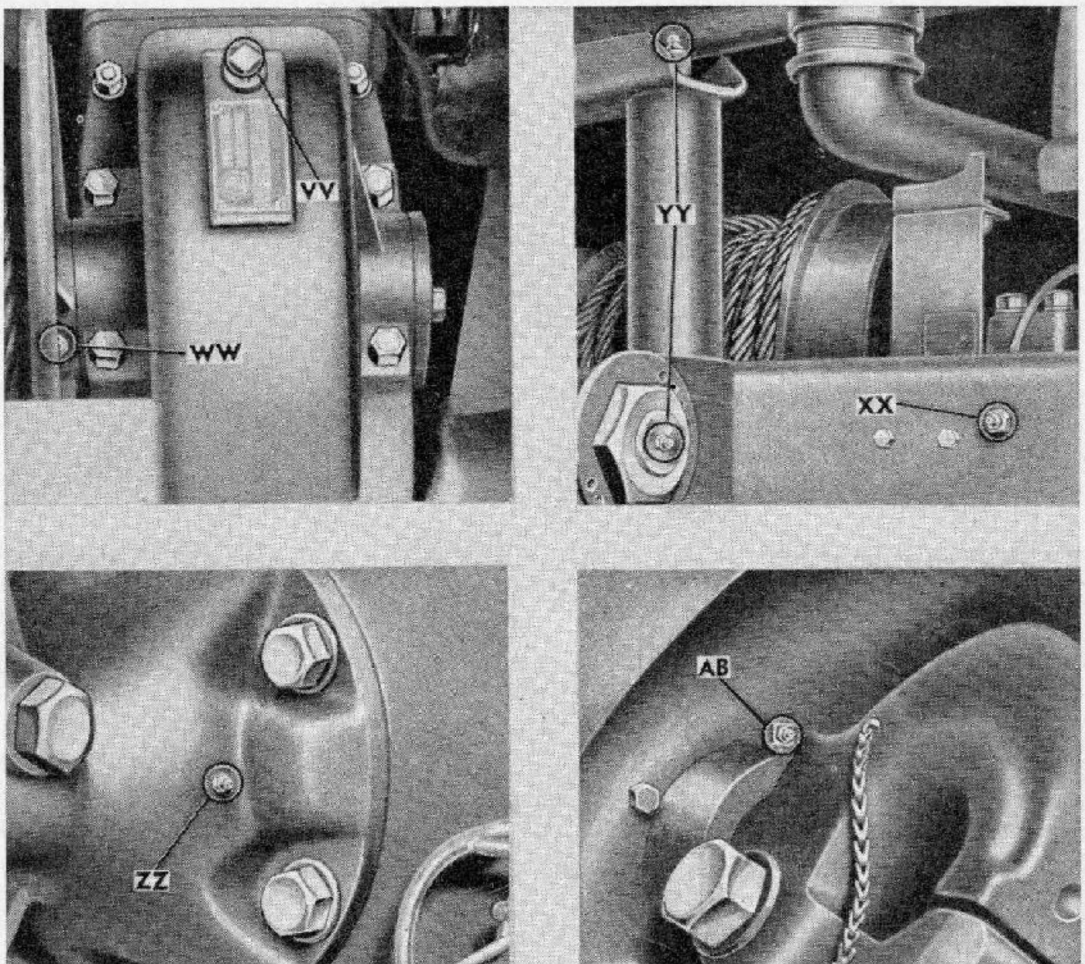


Figure 22. Localized lubrication points (points VV through AD).

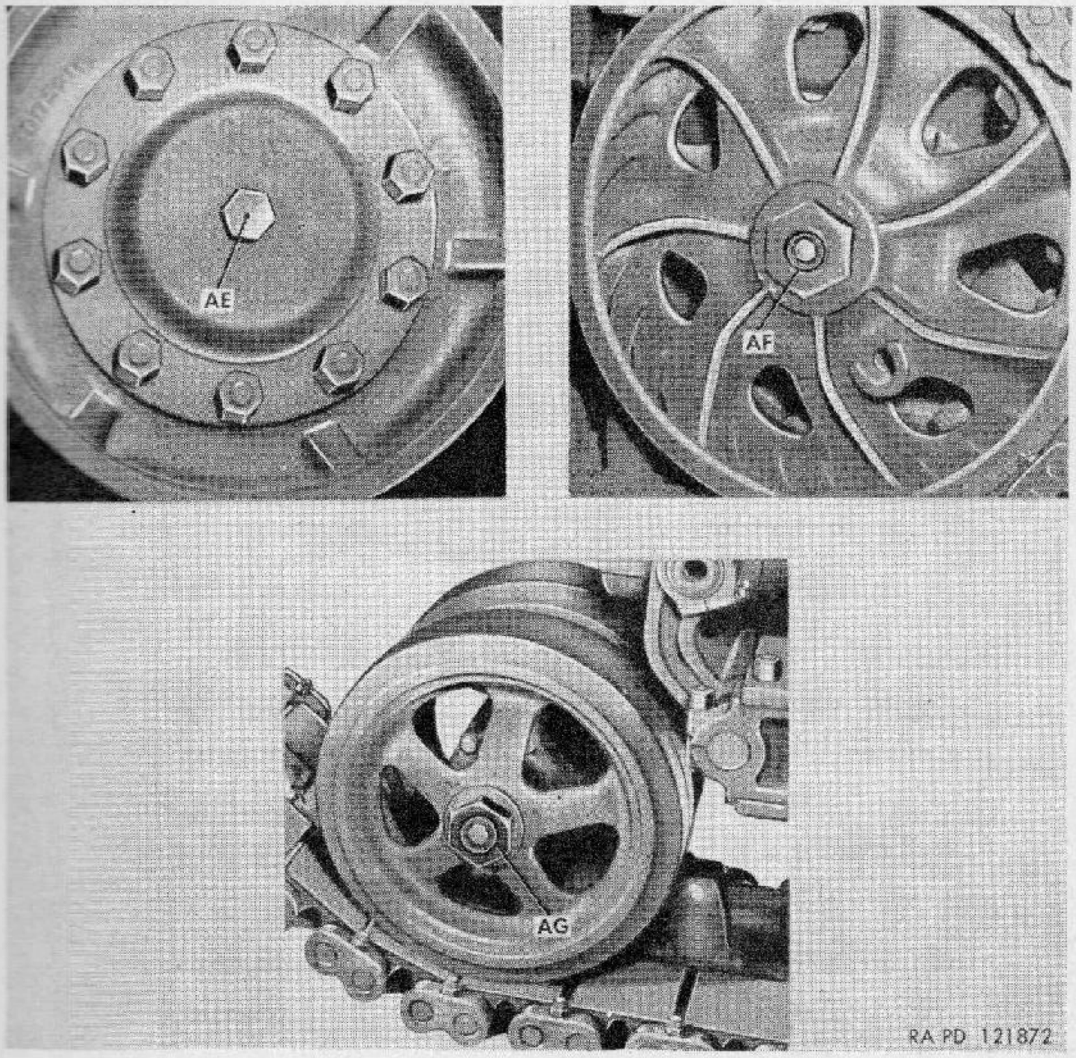


Figure 23. Localized lubrication points (points AE through AG).

Section III. PREVENTIVE MAINTENANCE SERVICES

74. General

a. Responsibility and Intervals. Preventive maintenance services are the responsibility of the using organization. These services consist generally of before operation, during operation, at the halt, after operation, and weekly (leader's "A") services performed by the operator or crew under the supervision of the squad, section, or platoon leader and the scheduled commander's "B" and "C" services to be performed at designated intervals by organization mechanic or maintenance crews (tables II and III). Intervals are based on normal operations. Reduce intervals for abnormal operations or severe conditions. Intervals during inactive periods may be extended accordingly.

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

(1) Inspection for "good condition" is usually an external visual inspection to determine whether 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 burred, not broken or cracked, not bare or frayed, not dented or collapsed, not torn or cut, and not deteriorated.

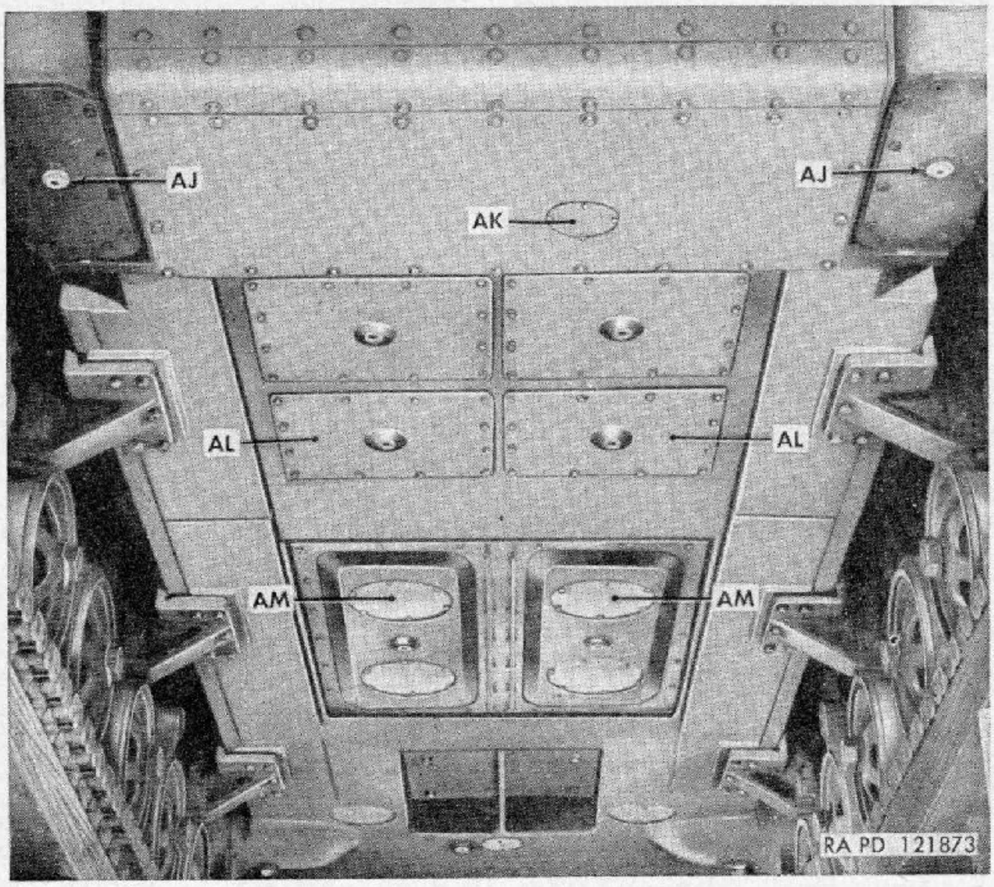


Figure 24. Localized lubrication points (hull bottom drain plugs) (points AJ through AM).

(2) The inspection of a unit to see that it is "correctly assembled" is usually an external visual inspection to see whether it is in its normal assembled position in the vehicle.

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

(4) By "excessively worn" is meant worn beyond serviceable limits or to a point likely to result in failure if the unit is not replaced before the next scheduled inspection.

75. Cleaning

a. General. Any special cleaning instructions required for specific mechanisms or parts are contained in the pertinent section. General cleaning instructions are as follows:

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

(2) A solution of one part grease-cleaning compound to four parts dry-cleaning solvent or volatile mineral spirits may be used for dissolving grease and oil from engine blocks, chassis, and other parts. Use cold water to rinse off any solution which remains after cleaning.

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

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

b. General Precautions in Cleaning.

(1) Dry-cleaning solvent and volatile mineral spirits are inflammable and should not be used near an open flame. Fire extinguishers should be provided when these materials are used. In addition, they evaporate quickly and have a drying effect on the skin. If used without gloves, they may cause cracks in the skin and in the case of some individuals, a mild irritation or inflammation may result. Use only in well ventilated places.

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

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

76. Operator and Leader's "A" Preventive Maintenance

a. Purpose. To insure mechanical efficiency, it is necessary that the vehicle be systematically inspected at intervals each day and week that it is operated, so defects may be discovered and corrected before they result in serious damage or failure. Certain scheduled maintenance services will be performed at these designated intervals. Any defects or unsatisfactory operating characteristics beyond the scope of the operator or crew to correct must be reported at the earliest opportunity to the designated individual in authority.

b. Services. Table II lists the services to be performed by the operator or crew at the designated intervals.

Table II. Operator's Preventive Maintenance Services and Leader's "A" Preventive Maintenance Services

Intervals					
Operator's				"A"	
Before operation	During operation	At the halt	After operation	Leader's (weekly)	Procedure
X	----	X	X	X	*Fuel, oil, and water.* Check the amount of fuel in the tank and note any indications of leaks. Add fuel if necessary. Check the spare fuel containers. Check each engine oil level and add oil if necessary. Check water level in the cooling systems and note any leaks. During the period that antifreeze is in use and ethylene glycol is the prescribed type of antifreeze, a hydrometer test must be made. Add ethylene glycol and/or water as required to provide safe operation to meet lowest anticipated temperature. Check fluid level in torque converter system (par. 181). Check oil in transmission and differential. ***Caution:*** Place all tags describing vehicle condition in the driver's compartment in a conspicuous location so that they will not be overlooked.
X	----	X	X	X	*Tracks.* Inspect the tracks, suspension wheels, suspension arms, support rollers, sprockets, and trailing idlers for any damage that may have developed since the last operation.
----	----	----	X	X	Examine tracks for worn or bent guides, loose wedge nuts, and proper track adjustment. Adjust if necessary (par. 204). Wheel tires must be kept free from acids, oil, and grease.
----	----	----	----	X	Check track blocks, connectors, and wedges for excessive wear. Inspect tracks for dead blocks.
X	----	X	----	X	*Leaks, general.* Check under the tractor and in the engine compartment for any indications of fuel, oil, or water leaks.
X	----	X	X	X	*Visual inspection of equipment.* Determine if lamps and reflectors, siren, fire extinguishers, mirrors, paulins, winch, tools, and spare parts are in their proper place and in good operating condition. Check for any damage prior to inspection.
X	X	----	----	----	*Instruments.* With engines running check all instruments and gages for normal readings (pars. 31 through 43). ***Caution:*** If oil pressure is zero or excessively low, shut off engine immediately and investigate cause.

Intervals					Procedure
Operator's				Leader's "A" (weekly)	
Before operation	During operation	At the halt	After operation		
----	X	----	----	----	*Operation observation.* While the tractor is in operation, the driver or operator should be alert for any sounds that may be a sign of trouble such as rattles, knocks, squeaks, or hums. The instruments and gages should be checked and any unusual reading noted, for it would indicate improper functioning of any part of the tractor. Every time the vehicle is turned, gears shifted, or controlled differential brakes applied, the driver should instinctively consider it a test and note any unusual or unsatisfactory performance.
----	----	----	X	----	*Clean equipment.* Clean dirt and trash from inside the tractor. Clean windshield and headlight glass and, when practicable, wipe off exterior of equipment.
----	----	----	----	X	Wash the tractor when possible. If it is not possible, wipe when practicable. Thoroughly clean engines and engine compartment of all excess dirt, trash, fuel, and oil.
----	----	----	----	X	Clean tracks and suspension of all mud, dirt, or snow.
----	----	----	----	X	*Batteries.* Clean and add necessary water. Check terminal connections to see that they are securely fastened and properly coated with grease. Check battery cables for good condition.
----	----	----	----	X	*Assemblies and belts.* Check all assemblies such as carburetors, generator, starters, and water pumps for loose connections or mountings. Check adjustment of fan and all drive belts (par. 99).
----	----	----	----	X	*Electrical wiring.* Check all accessible wiring and ascertain that it is securely connected and supported, that insulation is not cracked or chafed, and that conduits and shielding are in good condition and secure. Report any unserviceable wiring.
----	----	----	X	X	*Tools and equipment.* Check to see that all tools and equipment are serviceable and in the proper place. Clean tools and equipment weekly.
----	----	----	X	----	*Fuel filters.* Check all fuel filters for leaks.
----	----	----	----	X	Remove the drain plug at sediment bowl and drain all water and sediment from the filter.
X	----	----	X	X	*Lights.* Observe whether the lights operate properly. Inspect all lenses and warning reflectors for dirt or damage; clean and replace if necessary.
X	----	----	X	X	*Siren and windshield wipers.* Test siren for proper operation. Test windshield wipers to insure proper functioning and cleaning actions.

Table II. Operator's Preventive Maintenance Services and Leader's "A" Preventive Maintenance Services—Continued

Intervals					Procedure
Operator's					
Before operation	During operation	At the halt	After operation	Leader's "A" (weekly)	
				X	*Towing connections.* Inspect towing hooks, pintles, and safety chains for looseness or damage. Clean and lubricate as required and inspect for abnormal wear. Test to be sure that latching mechanism closes completely and latches securely (par. 213).
				X	*Springs and suspension.* Check for broken or shifted parts as outlined in paragraph 207.
				X	*Torque converter and final drive vents.* Check transmission, torque converter, pump housing, breather caps, and filler caps for good condition, secure, and not clogged.
	X			X	*Air brake air reservoir and couplings.* Inspect trailer air brake valve assemblies for leaks with trailer brakes applied and released. Check to see that dummy couplings are in place if no towed vehicle is attached. Check hose connections if towed vehicle is connected to tractor.
			X	X	Check air brake reservoir to see that it is mounted securely and not damaged. Drain water (condensation) from air reservoir. **Caution:** Close pet cock after draining reservoir. *Note.* Complete draining of reservoir is obtained only with air pressure in reservoir. Drain after starting engine if no pressure is left from previous operation.
				X	*Gun mount.* Make sure gun mounting is secure and in good condition.
				X	*Publications.* Check to see that all appropriate publications concerning the operation and maintenance of the equipment are on hand and in good order.
			X	X	*Lubrication as needed.* Lubricate equipment in accordance with instructions contained in lubrication order (par. 70).
					UNUSUAL CONDITIONS
					Preventive maintenance services for usual conditions will apply, with emphasis on servicing by the operator and crew to combat the effect of unusual conditions of extreme cold, extreme heat, unusual terrain, and fording. The services described below are those required to assure best results under unusual conditions.

Intervals					Procedure
Operator's				Leader's "A" (weekly)	
Before operation	During operation	At the halt	After operation		
					EXTREME COLD (pars. 61, 62, and 229 and TM 9–2855)
----	----	----	X	----	*Fuel system.* Refuel and add denatured alcohol as required.
----	----	----	----	X	Drain fuel tank and clean sump of collected water and sludge. Refuel tank.
----	----	----	----	X	*Lubrication* (par. 72). Check and, if necessary, change lubricants and special oils to conform with the lubrication order.
----	----	----	----	X	Check gear cases for collections of sludge and water. Whenever either is present, clean out and refill cases with correct lubricant. *Note.*—It is necessary to have lubricant warm and fluid for draining and refilling.
X	----	----	X	X	*Cooling system.* Check level and specific gravity of coolant. Add ethylene glycol and/or water if needed. *Note.*—if system contains arctic antifreeze compound, make a warning tag and place it on or near the radiator filler neck. The tag should read: "THIS COOLING SYSTEM IS FILLED WITH ARCTIC ANTIFREEZE COMPOUND. CAUTION: DO NOT ADD WATER OR ETHYLENE GLYCOL ANTIFREEZE—USE ARCTIC ANTIFREEZE ONLY".
----	----	----	X	X	*Winterization equipment* (if so equipped). Check winterization equipment for proper operation and to see that all parts are securely mounted.
X	----	----	----	X	Check personnel heater and windshield defrosters for proper operation. **Caution:** Do not apply defroster heat fully on an extremely cold windshield as the sudden change in temperature will crack the glass.
----	----	----	X	----	Fill power plant heater fuel tank.
----	X	----	----	----	*Operating observations.* Check for the feel of stiffness of lubricant in final drives and suspension components. This will be indicated by unusual power demand when putting vehicle in motion. Listen for signs of malfunctions and inspect immediately to determine causes.
----	----	----	X	----	*Batteries.* If no power plant heater is available, take batteries out and store in a warm place.
----	----	----	----	X	Check for proper charge and electrolyte level.
----	----	X	X	----	*Control levers.* Position levers in neutral position.
X	----	----	X	X	*Clean.* Clean snow, ice, and mud from all parts of vehicle.

Table II. Operators' Preventive Maintenance Services and Leader's "A" Preventive Maintenance Services—Continued

Intervals					
Operator's					
Before operation	During operation	At the halt	After operation	Leader's "A" (weekly)	Procedure
					EXTREME HEAT (pars. 63 and 230)
X	----	X	----	X	*Cooling and fuel systems.* Check air cleaners, fuel and oil filters, cooler fins, radiator cores, radiator grilles and screens, and clean as often as necessary to keep them in good condition
X	----	----	----	X	*Batteries.* Check battery water level, and add distilled water as necessary to maintain ⅜-inch above plates.
----	----	----	----	X	Check for proper charge.
----	----	----	X	----	If necessary to park for extended periods, remove batteries and store in cool place.
					UNUSUAL TERRAIN (pars. 64 and 232)
X	----	----	----	X	*Cooling and fuel systems.* Check air cleaners, fuel and oil filters, cooler fans, radiator cores, radiator grilles and screens, and clean as often as necessary to keep them in good condition. ***Caution:*** Under extremely dusty or sandy conditions, it will be necessary to service the air cleaners several times daily during operation to prevent the entry of dust or sand into the engines. Failure to do this may wear out engine parts in a short time.
----	----	----	X	----	*Lubrication.* Check for fouled lubricants and lubricate as necessary (par. 72).
X	----	----	X	----	*Vents.* Check engine vents and other exposed vents and keep them covered with cloth to prevent entry of dust, sand, or drifting snow.
X	----	----	X	X	*Clean.* Clean all parts of vehicle of snow, ice, mud, dust, and sand, especially all suspension components. After cleaning, lubricate suspension components as prescribed in the lubrication order (par. 70).
----	----	----	----	X	Check for any sand blasted surfaces and touch up paint as required.
----	----	----	----	X	Check for etched (sand blasted) glass and replace as necessary.
					FORDING (pars. 66 and 231)
----	----	----	X	----	*Cooling and fuel systems.* Check air cleaners, fuel and oil filters, and clean or replace if necessary. Drain any accumulation of water or sludge from fuel tank.

Intervals					Procedure
Operator's					
Before operation	During operation	At the halt	After operation	Leader's "A" (weekly)	
----	----	----	X	----	*Clean.* Remove water and sludge from all parts of the vehicle. If fording was in salt water, wash with fresh water.
X	----	----	----	----	*Fording limits.* Check vehicle fording limits.
X	----	----	----	----	*Batteries.* Check vent caps on batteries for tightness to prevent entrance of water.
----	----	----	X	----	Check for seepage of water into batteries. Check for specific gravity and voltage.
----	----	----	X	----	*Lubrication.* Immediately after fording operation, lubricate as specified in paragraph 72.
----	----	----	X	----	*Drain hull.* Immediately after fording, open hull drain valves to remove accumulated water.
----	----	----	X	----	*Engine and transmission.* Inspect engine and transmission oil for evidence of water or grit and replace oil, if necessary. If engine oil must be replaced, flush before adding new oil.

77. Commander's "B" and "C" Preventive Maintenance

a. Intervals. The frequency of the preventive maintenance services prescribed is considered a minimum requirement for normal operation of the vehicle. Under unusual operating conditions, such as extreme temperatures, dust or sand, or extremely wet terrain, it may be necessary to perform certain maintenance services more frequently.

b. Driver or Operator Participation. The operators should accompany their vehicles and assist the mechanics while periodic commander's "B" and "C" preventive maintenance services are performed. Ordinarily, the driver should present the vehicle for a scheduled preventive maintenance service in a reasonably clean condition, however, do not wash the vehicle since defects like loose parts and oil leaks are not easily detected after washing.

c. 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 certain 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 are as follows:

(1) *Adjust.* Make all necessary adjustments in accordance with the pertinent section of this manual, technical bulletins, or other current directives.

(2) *Clean.* Clean the unit as outlined in paragraph 75 to remove old lubricant, dirt, and other foreign material.

(3) *Special lubrication.* This applies either to lubrication operations that do not appear on the vehicle lubrication order or to items that do appear on such orders 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 oil filter, air cleaner, or cartridges.

(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 a torque-indicating wrench where specified. Do not overtighten, as this may strip threads or cause distortion. Tightening will always be understood to include the correct installation of lock washer, lock nuts, lock wire, or cotter pins provided to secure the tightening.

d. Special Conditions. When conditions make it difficult to perform the complete preventive maintenance procedures at one time, they can sometimes be handled in sections. Plan to complete all operations within a week if possible. All available time at halts 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.

e. Work Sheet. The numbers of the preventive maintenance procedures that follow are identical with those outlined on DA AGO Form 462, 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 sequence of items on the work sheet is followed, but in some instances there is deviation for conservation of the mechanic's time and effort.

f. Procedure. Table III lists the services to be performed by the organizational mechanic or maintenance crew at the designated intervals. Each page of the table has two columns at its left edge corresponding to quarterly (or 750 miles) and monthly (or 250 miles) 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 procedure and wherever an item number appears, perform the operation indicated opposite the number.

Table III. Commander's "B" and "C" Preventive Maintenance Services

Intervals: Commander's "B" (Monthly or 250 Miles)	Intervals: Commander's "C" (Quarterly or 750 Miles)	Procedure
		ROAD TEST
		Note.—If the tactical situation does not permit a full road test, perform only those items which require little or no movement of the vehicle. When road test can be made, it should be approximately 3 miles, but not over 5 miles.
		BEFORE OPERATION: Oil, water, fuel, antifreeze, track leaks, general visual inspection of vehicle and equipment. Perform the *before operation* services (table II).
1	1	*Dash instruments, switches, and gages—oil pressure, engine temperature, torque converter oil pressure and temperature, transmission oil temperature and pressure, speedometer, odometer, tachometer, ammeter, fuel gage, hour meter, air pressure gage, and low air pressure indicator.* Immediately after starting the engine, before the generator regulator has reduced the charging rate, notice if the ammeter is registering full charging rate. Observe all the instruments for normal reading (pars. 10 through 43).
2	2	*Sirens, windshiled wipers.* If the tactical situation permits, sound siren to see if signal is normal. Test windshield wipers for satisfactory operation.
3	3	*Lamps—head, blackout, tail, flood, and panel lights.* While the vehicle is stopped, if the tactical situation permits, test the operation of all lights, external and internal, and light switches. Note condition of lights and safety reflectors. Notice if the head lights appear to be correctly aimed.
4	4	*Engine—idle, acceleration, power, noise, smoke, and governed speed.* In warming up the engine, observe if it starts easily and if the operation of choke and hand throttle is satisfactory. Notice if idling speed is correct. Note any unusual noises or excessive vibration, at idle or higher speed. When operating the vehicle, notice if it has normal power and acceleration in each speed, or any tendency to stall. Listen for any unusual noises when engine is under load. Look for excessive black or blue smoke issuing from the exhaust. Speed up the vehicle on a level stretch and see if the engine will reach, but not exceed, the governed speed of 2,100 rpm under load.
5	5	*Suspension—track, suspension (bogie) wheels, idlers, sprockets, volute springs, and arms.* Inspect these items. In the track, look particularly for dead track blocks and bottomed edges; notice if tension appears to be satisfactory (par. 204). Inspect suspension (bogie) wheels, sprockets, idlers, and support rollers, paying particular attention to lubricant leaks from the bearing seals and rubber tires separated from rims. Inspect springs visually noting if the lighter volute spring shows indication of a permanent set.

Intervals: Commander's "B" (Monthly or 250 Miles)	Intervals: Commander's "C" (Quarterly or 750 Miles)	Procedure
6	6	*Brakes—steering, parking, levers, braking effect, steering action, and air.* Inspect these items. Pull steering brake levers back together and notice if they meet resistance when they reach the vertical position or a little before. Stop tractor, apply the brakes and lock in position. Notice if brakes will hold tractor stationary on incline. Apply trailer air brakes (par. 11*b* and *c*) to see if they operate properly. Observe if the air pressure builds up at a normal rate and if the control system operates properly (par. 195). Reduce the air pressure sufficiently to see if the low air pressure indicator light is operating (par. 40). Inspect for leaks in the air system by stopping the engine and compressor when the air pressure is at its maximum (par. 200). Apply tractor electric brakes (par. 11*b*) to see if they operate properly and check operation of load control.
7	7	*Clutch—free travel, drag, noise, chatter, grab, and slip.* See if clutch pedal has specified free travel (1½ to 2-in) before meeting resistance and whether it is released completely before it is fully depressed, or has a tendency to drag. Observe if clutch engages smoothly without chatter, grab, or squeal and if it slips when fully engaged. With transmission in neutral, depress and release clutch pedal, listening for a dry or defective release bearing.
8	8	*Transmission, torque converter, differential, and final drive—lever action, vibration, noise, control, and shifting action.* Inspect these items, looking particularly for clogged vents or breathers. Shift through entire gear range of the transmission and torque converter. Observe for any unusual vibrations, noises, and if vehicle response is satisfactory. Examine levers, shafts, and linkage for freedom of action and correct adjustment. Check vent in oil reservoir (par. 177*a*) to see that it is not clogged and that crankcase breathers in rocker arm covers are not obstructed. Check pressure relief valve and adjust if necessary (par. 184*b*).
----	8	Tighten all assembly and mounting bolts of these units.
9	9	*Unusual noises—propeller shafts and joints, differential, final drives, bogie (suspension) wheels, and idlers.* Listen, both from inside and from outside the vehicle, for unusual noises emanating from these components, or others, that would indicate lack of lubrication, maladjustment, or damage. Be alert for unusual noises throughout the road test.
10	10	*Air compressor.* Inspect compressor for loose mounting and leaks, adjust belts to ¾-inch pressure deflection. Check and adjust unloader valve (par. 197).
----	10	Test governor operation and adjust as described in paragraph 198.

Intervals		
Commander's "B" (Monthly or 250 Miles)	Commander's "C" (Quarterly or 750 Miles)	Procedure
11	11	*Temperatures—bogie (suspension) wheels, shock absorbers, transmission final drives, and differential.* Immediately after the road test, feel these components cautiously, except those having temperature gages or warning signals. Feel the latter components also if there is doubt that the indicating devices are functioning properly. Include sprockets, idlers, and rollers. An overheated wheel, sprocket, idler, or roller hub indicates a maladjusted, dry, or damaged bearing. An overheated gear case indicates internal maladjustment, damage, or inadequate lubrication.
13	13	*Leaks—engine oil, fuel, water, transmission, final drive, bogie (suspension) wheels, idlers, support rollers, grease seals, and differential.* Make general observations inside and outside the vehicle for fuel, coolant, lubricant leaks from seals, gaskets, loose connections, radiator, tanks, or other sources.
14	14	*Hull—paint, cab, ventilators, and drain plugs.* Inspect these items for good condition and secure mounting. Check operation of hinges and latches. Examine hull for rust and bare spots. Be sure engine compartment grilles are not clogged. See that inspection plates and drain plugs are secure.
16	16	*Armament—mount.* Examine gun ring mount for cleanliness, good condition, firm mounting, and necessary lubrication.
----	16	Tighten all gun mount assembly and mounting bolts.
17	17	*Stowage boxes—ammunition stowage, and racks.* Inspect these items, observing particularly if ammunition is securely and safely stowed, or if ammunition stowage boxes are empty. Observe if they are ready for use.
18	18	*Winch, tow shackles, and pintles.* Inspect winch for good condition, correct assembly, and secure mounting. See that clutch moves freely and engages securely. Inspect the winch worm automatic brake lining for condition and adjustment (par. 217). See that shear pin in winch drive is in good condition (par. 223). Check oil level (even with level plug). If high, drain to level plug. Check clutch for proper operation.
----	18	Clean entire cable and lubricate in accordance with lubrication order (par. 70).
19	19	*Lubrication.* Lubricate vehicle and armament in accordance with lubrication order—except those items that are to be disassembled later and lubricated before assembly.
		MAINTENANCE OPERATION
21	21	*Battery—specific gravity.* Make a hydrometer test of the electrolyte in each cell and record specific gravity in space provided on DA AGO Form 462.

Intervals		Procedure
Commander's "B" (Monthly or 250 Miles)	Commander's "C" (Quarterly or 750 Miles)	
22	22	*Battery—voltage.* Perform a high-rate discharge test according to instructions supplied with the test instrument. If variation is more than 30 percent, replace battery. *Note.*—Specific gravity must be above 1.225 to make this test. A fully charged battery will have a specific gravity reading 1.285. Record voltage of each cell in space provided on DA AGO Form 462.
----	22	After battery tests, clean top of battery, coat terminals lightly with rust-preventive compound (light), and repaint carrier, if corroded. Look to see if battery requires water. *Note.*—If distilled or approved water is not available, clean water, preferably rain water, may be used.
----	23	*Engine compression.* Test compression in each cylinder, with all plugs removed and throttle and choke wide open, and record in space provided on DA AGO Form 462. It is preferable to make compression test with engine at operating temperature. Compression at starting speed is 110 to 130 psi. Variations between cylinders of not nore than 10 psi is normal.
----	24	*Breather caps, ventilators, fuel filters, oil filters, filler caps, and air cleaners.* Remove bowls, filter elements, and air cleaners. Wash in volatile mineral spirits or dry-cleaning solvent and blow out elements with compressed air. Fill air cleaner to proper level with oil specified in lubrication order. If fuel filters show signs of contaminated fuel, drain water and sediment from fuel tanks by opening drain valve (fig. 48), using a suitable container to catch the drainings.
----	27	*Spark plugs, distributor, coil, wiring, and timing.* Remove and inspect spark plugs. Inspect distributor cap, rotor, and breaker points and test centrifugal and vacuum advance mechanisms by hand for freedom of movement. Test distributor shaft for looseness by hand feel. Test ignition coil, and capacitor with high-tension ignition-circuit tester accompanying test instrument. Using a neon timing light, observe if timing is correct and if spark advances automatically as engine is accelerated (par. 119). Test generator regulator with low-voltage circuit tester, following instructions in accompanying test instrument.
----	27	Clean spark plugs and adjust gap (0.025 in). Dress distributor and adjust gap (0.016 in). If points are badly pitted, replace both points and capacitor. Examine generator brushes and clean commutator.
----	28	*Valve mechanism—clearance and cover gaskets.* Inspect valve mechanism, looking particularly for weak or broken valve springs. Gage valve-tappet clearance. Inspect valve covers and gaskets.

Intervals: Commander's "B" (Monthly or 250 Miles)	Intervals: Commander's "C" (Quarterly or 750 Miles)	Procedure
----	28	Adjust valve-tappet clearance to specification. Use new gaskets when replacing valve covers. Valve stem and rocker arm clearances; intake 0.016 inch, exhaust 0.022 inch.
----	25	*Radiators—core, shell, hose, and cap.* Inspect these items, noticing particularly if the radiator core is clogged with foreign matter. Observe coolant level and examine coolant for contamination. In cold weather, test coolant with a hydrometer to see if it contains sufficient antifreeze.
----	25	If need is indicated, drain coolant radiator and block, clean, flush, and refill, adding inhibitor, unless antifreeze, which contains inhibitor, is used (par. 130).
----	26	*Water pump, fan, and drive belts.* Inspect pulleys and fans for alinement and belts for tension (par. 99). Notice particularly if water pump is adequately lubricated and if packing gland is leaking. Test the operation of fan clutch.
----	29	*Carburetor, fuel pump, choke, and carburetor control linkages.* Inspect these items, noticing particularly if carburetor shafts and linkage operate freely and are not excessively worn. Observe if the choke valve opens fully when the control is released and if the throttle valve opens fully when the accelerator is fully depressed. Note particularly if the throttles are synchronized (par. 114). Test fuel pump pressure by attaching a fuel pump test gage to outlet side of each pump. Normal pressure at outlet should be 3½ to 4 psi with engine running at normal idling speed. Make an engine vacuum test as follows, and adjust idle mixture: With a vacuum gage connected to the intake manifold and the engine running at normal idling speed, the vacuum gage should read about 18 inches and the pointer should be steady. A badly fluctuating needle between 10 and 15 inches may indicate a defective cylinder head gasket or valve. An extremely low reading indicates a leak in the intake manifold or gaskets. Accelerate and decelerate the engine quickly. If the gage indicator fails to drop to approximately 2 inches as the throttle is opened and fails to recoil to at least 24 inches as the throttle is closed, it may be an indication of diluted oil, poor piston ring sealing, or an abnormal restriction in the exhaust, carburetor, or air cleaner. Repeat this test on each engine. *Note.*—The above readings apply to sea level. There will be approximately a 1-inch drop for each 1,000 feet of altitude.
----	29	If need was indicated in the road test, adjust the engine governed speed at this time (par. 115).
----	30	*Exhaust pipe and mufflers.* Inspect; listen for excessive or unusual noises and look for exhaust leaks.
----	30	Tighten mountings.
----	31	*Manifold.* Inspect this item looking particularly for signs of leakage at the manifold gaskets.

Intervals		
Commander's "B" (Monthly or 250 Miles)	Commander's "C" (Quarterly or 750 Miles)	Procedure
----	32	*Steering—adjustment, and linkage.* Inspect this item observing particularly cross shafts, linkage, and locking device for parking.
----	32	Adjust linkage (par. 191), if need was indicated in the road test. Tighten assembly and mounting bolts.
----	33	*Engine fan, shrouds, and cylinder air deflectors.* Inspect these items looking particularly for interference, looseness, and adjustment of fan drives.
----	34	*Track tension.* Test track tension to see if it is within specified limits (par. 204).
----	34	Adjust track tension, if it is not within permissible limits (par. 204). Tighten all track wedge nuts and all assembly and mounting bolts of the suspension components. Whenever the track has been removed for replacement or repair, examine wheels, sprockets, idlers, and support rollers for end play and bearing looseness or damage. Spin each wheel and listen for a damaged bearing. Pull outward and push inward on the wheel to determine if end play is excessive. Test for bearing looseness with a pry bar. Test for end play and bearing looseness or damage should be performed at least every third quarter. If the tracks have not been removed within that time, these tests can be performed without removing the tracks by the use of road wheel lifters, jacks, blocks, and other means.
----	35	*Electrical controls, wiring, and suppressors.* Inspect all exposed electrical control, junction, and terminal boxes and connecting wiring, cables, and conduits. Inspect all visible radio noise-suppression bond straps, suppressors, and shields and radio mountings, radio controls, headsets, microphones, antenna mast and insulators.
----	35	Clean these items with a dry, soft cloth. If objectionable radio noise from the vehicle has been reported, check, radio interference suppression (pars. 173–176) to determine the source. Clean contacting surfaces, tighten bonds, internal-external-toothed lock washers, and mountings of units bonded together. Replace noise-suppression units as required. If these procedures do not eliminate the trouble, the radio operator will report the condition to the designated authority.

Section IV. TROUBLE SHOOTING

78. General

a. This section contains trouble shooting information and tests for locating some of the troubles which may develop in the vehicle. Trouble shooting is a systematic isolation of a defective component by means of an analysis of vehicle trouble symptom. Testing to determine the defective component and applying the remedies. Each symptom of trouble given for an individual unit or system is followed by a list of probable causes of the trouble and suggested procedures to be followed.

b. This manual cannot cover all possible troubles and deficiencies that may occur under the many conditions of operation. If a specific trouble, test, and remedy therefore is not covered herein, proceed to isolate the system in which the trouble occurs and then locate the defective component. Do not neglect use of any test instruments such as voltmeter, ammeter, test lamp, hydrometer, and pressure and vacuum gages, that are available. Standard automotive theories and principles of operation apply. Question vehicle crew to obtain maximum number of observed symptoms. The greater the number of symptoms of troubles that can be evaluated, the easier will be the isolation of the defect.

79. Engines

a. Engine Will Not Turn.

(1) *Battery.* Check for loose or broken battery or ground cables, clean cables and terminals, and tighten or replace the cable if necessary. Take a hydrometer reading of the battery solution.

(2) *Starter inoperative.* Refer to paragraph 82.

(3) *Incorrect oil viscosity.* Inspect the oil. If improper grade is being used, drain crankcase and refill with correct grade of oil. Refer to paragraph 70.

(4) *Piston lock or seizure.* This is due to the seizure of pistons, broken rings, or rusted or corroded engine parts which will cause locking of the engine. Remove spark plugs from engine (par. 121), place transmission in neutral, and turn engine with the starter. If the engine does not turn, seizure due to internal damage is indicated. Notify ordnance maintenance personnel.

b. Engine Turns But Will Not Start.

(1) *Inoperative fuel system.* Remove the inlet fuel line at the carburetor and with the ignition knob "OFF," turn the engine with the starter. If free flow of fuel is not evident, fuel is not reaching the carburetor. Refer to paragraph 80.

(2) *Inoperative ignition system.* Pull ignition knob "ON." Remove a cable from one of the spark plugs, hold the cable one-quarter inch from the cylinder block, and crank the engine with the starter. If a spark does not jump the 1/4-inch gap, the ignition system is inoperative. Refer to paragraph 81.

(3) *Slow cranking speed.* Refer to paragraph 82.

(4) *Engine air shut-off valve open.* Adjust valve so that it will close completely when starting engines. Refer to paragraph 111.

c. Engine Does Not Develop Full Power.

(1) *Faulty ignition.* Refer to paragraph 81.

(2) *Oil temperature too high.* Check oil cooler for proper operation. Replace, if necessary (par. 102).

(3) *Engine overheats.* Check cooling system (par. 83).

(4) *Improper valve adjustment.* Check clearance and adjust if necessary. Refer to paragraph 101.

(5) *Use of improper type of fuel.* Use fuel having octane rating of 70–72.

(6) *Preignition.* If the proper octane fuel is being used, the ignition system is functioning satisfactorily, and spark plugs of proper heat range are being used, then internal engine troubles are indicated. Notify ordnance maintenance personnel.

(7) *Clogged fuel filter.* Remove fuel filter and clean. Refer to paragraph 108.

(8) *Air leaks at carburetor or manifold flanges.* With the engine running at 800 rpm, apply a small amount of oil at carburetor gaskets and manifold flanges. If oil is sucked in, there is evidence of a leak. Replace gaskets (par. 98) or notify ordnance maintenance personnel.

(9) *Low engine compression or improper valve timing.* If the engine does not develop full power with fuel reaching the combustion chambers, with adequate ignition, and sufficient oil in the engine lubrication system, then low compression or improper valve timing is indicated (par. 101). Notify ordnance maintenance personnel.

(10) *Incorrect governor setting.* Disconnect governor linkage at the carburetor and check for sprung linkage or stuck throttle. If the throttle and linkage operate freely, start the engine and accelerate. If engine speed of 2,300 rpm is not reached with the clutch disengaged, the governor is faulty. Adjust or replace governor. Refer to paragraph 115.

d. Engine Misfires.

(1) *Faulty ignition system.* Refer to paragraph 81.

(2) *Low engine compression.* Test engine compression (par. 77, table III, item 23). If compression is low, notify ordnance maintenance personnel.

(3) *Incorrect carburetor adjustment.* Adjust carburetor. Refer to paragraph 114.

(4) *Clogged fuel tank cap vents.* Clean vents or replace cap.

(5) *Restricted fuel flow.* Remove fuel filters and clean (par. 108).

(6) *Water in fuel.* Remove the two drain plugs at the bottom of the carburetor and inspect for water.

(7) *Weak or broken valve springs.* Remove valve cover plates and observe action of valve springs (engine running). Report faulty parts to ordnance maintenance personnel.

(8) *Improper valve adjustment.* Check clearance and adjust if necessary (par. 101).

(9) *Early valve timing.* If valve spring operation is satisfactory and the engine continues to misfire, it indicates early valve timing. Notify ordnance maintenance personnel.

e. Engine "Knocks" or "Pings."

(1) *Improper distributor setting.* A sharp "knock," heard upon quick acceleration, indicates improper setting of the distributor for the fuel being used. Check distributor spark setting (par. 120). If the distributor is properly set, the knock indicates excess carbon in the combustion chamber.

(2) *Worn or faulty internal parts.* A sharp, hollow, slapping sound, when pulling on level ground or when starting a cold engine indicates a worn piston or piston pin. A dull regular knock indicates loose or burned connecting rod or main bearings. Notify ordnance maintenance personnel.

f. Engine Overheats.

(1) *Lack of coolant in system.* Fill the cooling system. Refer to paragraph 131*a*.

(2) *Clogged cooling system.* Refer to paragraph 130.

(3) *Improper carburetor adjustment.* A too lean mixture of fuel in the carburetor will cause slow overheating of the engines. Check and adjust the fuel mixture (par. 114*d*).

(4) *Use of improper type of fuel.* Use proper grade of fuel.

(5) *Air inlet radiator grille obstructed.* Remove any dirt, covers, or foreign materials from grille.

(6) *Late ignition timing.* Check timing and reset if necessary (par. 119).

(7) *Loose fan belts.* Tighten or replace belts (par. 99).

(8) *Inoperative thermostat.* Replace thermostat (par. 132).

g. Low or No Oil Pressure.

(1) *Lack of oil.* Replenish oil supply with proper grade of oil (par. 70).

(2) *Leaking oil lines or fittings.* Tighten or replace lines.

(3) *Pressure gage inoperative.* Replace gage with test gage. If test gage registers normal pressure with engine running at full throttle, replace defective gage (par. 148).

(4) *Pressure relief valve stuck.* Notify ordnance maintenance personnel.

h. Excessive Oil Consumption.

(1) *Oil viscosity too low.* Drain crankcase and refill with proper grade of oil (par. 70).

(2) *External oil leaks.* Inspect all oil line connections and surfaces around engines, oil filter gaskets, and oil drain plugs after engine has been warmed up to normal operating temperature. If excessive oil is found under vehicle after parking, notify ordnance maintenance personnel.

(3) *Piston, cylinders, and piston rings worn.* Test for mechanical condition of engine and make test for compression. Refer to paragraph 77, item 23, table III. If compression is low, notify ordnance maintenance personnel.

(4) *Leaking oil cooler element.* If a leak develops in the oil cooler element, oil may pass into cooling system. Inspect coolant for presence of oil. If oil is found, replace oil cooler element (par. 102*b*).

i. Engines Will Not Stop.

(1) *Faulty shut-off controls.* Examine for bent or broken cable or link rod or disconnected linkage.

(2) *Ignition switch or engine air shut-off valve improperly adjusted.* Refer to paragraphs 123 and 111.

(3) *Overheated combustion chambers.* When the engine continues to run after the ignition switch is turned off, it indicates excessive heat in the combustion chambers, caused by improper fuel adjustment or carbon deposit. Clean carbon (par. 100*b*) and adjust fuel mixture (par. 114*d*).

(4) *Faulty ignition switch.* After engines are stopped, turn ignition controls "ON" and "OFF" and observe ammeter and fuel gage. A defective switch will not affect these pointers. If this condition exists, replace switch (par. 123).

j. Abnormal Noise.

(1) If the noise occurs with each revolution of the crankshaft, it is at some points driven by the crankshaft, such as pistons, rings, pins, connecting rods, main bearings, or some member of the engine which is driven at crankshaft speed. A loose main bearing knock is usually a dull thud, more noticeable on a hard pull or quick acceleration.

(2) If the noise occurs once with each two revolutions of the engine crankshaft, the source is at some point driven by the camshaft, such as valves, tappets, and valve springs.

80. Fuel, Air-Intake, and Exhaust System

a. Fuel Does Not Reach Carburetor.

(1) *Lack of fuel.* Check gage on instrument panel and replenish fuel if necessary.

(2) *Fuel valves not turned on.* Turn on fuel valves (par. 108).

(3) *Clogged gas tank vents.* Clean gas tank vents.

(4) *Inoperative fuel pump, clogged fuel filters, or lines.* Check leakage around sediment bowl gasket in fuel filter. Remove and clean bowl of all dirt and water. Replace gasket if worn or torn. Remove drain plug from the fuel filter and check fuel flow from the tanks. If the fuel does not flow freely at filter, clean lines back to fuel tank. Service fuel filter (par. 108). If fuel flows freely through filter but does not reach carburetors, the fuel pump is inoperative. Replace fuel pump (par. 109).

(5) *Bent or damaged fuel line.* If fuel line is bent or damaged to prevent free flow of fuel, replace fuel line.

b. Fuel Reaches Carburetor But Does Not Reach Intake Manifold.

(1) *Carburetor jets clogged.* Replace carburetor (par. 113).

(2) *Throttle not opening.* Adjust throttle (par. 114*b*).

(3) *Low fuel pump pressure.* Install a fuel pump pressure gage in the outlet side of the fuel pump. Pressure should read from 3½ to 4 psi. If pressure is below 3½ psi and the system is clean and adjusted, replace the fuel pump (par. 109).

c. Inoperative Primer Pump. Remove primer pump line from intake manifold and operate the primer pump. Check for flow of fuel at disconnected end. If flow of fuel is not evident, check for faulty pump, clogged fuel line, or damaged suction fuel line.

d. Faulty Exhaust System.

(1) *Excessive noise.* Excessively noisy operation is caused by leaking manifold gaskets or broken manifolds, muffler, or tail pipe. Inspect and replace as required.

(2) *Odor of exhaust fumes in driver's compartment.* Leaky gaskets or broken exhaust manifold, muffler, or tail pipe will allow excessive fumes to reach driver's compartment.

Caution: Replace defective parts as soon as possible.

81. Ignition System

a. No Spark to Any Cylinder. Ammeter shows zero reading.

(1) *Ignition switch off.* Turn ignition control "ON."

(2) *Defective ignition switch.* Test switch and replace if necessary (par. 123).

(3) *Broken primary circuit cable from battery to coil or from coil to distributor.* A zero reading on ammeter while ignition is turned on and engine is being cranked indicates that no current is flowing in the primary circuit.

(*a*) Disconnect wire at battery side of ammeter and make flash tests to determine if current is flowing to ammeter. If no flash is noted, check connections and cables.

(*b*) Check continuity of circuit from ammeter to ignition switch and through ignition switch. The switch must be turned on.

(*c*) Check continuity of circuit through primary cable from ignition switch to coil and from coil to distributor. If current flows through primary cable from switch to coil but not from coil to distributor, replace ignition coil (par. 122). If current flows through primary cable and coil to the distributor, the trouble lies within the distributor.

(*d*) Remove distributor cap and inspect condition of breaker points and point opening (par. 120).

(4) *Defective ignition coil.* Check coil (*a* (3) (*c*) above). Replace coil if defective (par. 122).

(5) *Defective ignition capacitor.* Check capacitor and replace if necessary (par. 120).

b. No Spark, Ammeter Reading Normal. If ammeter shows normal discharge with ignition switch on (2 to 4 amps), the primary circuit is functioning correctly and the trouble is in the secondary circuit.

(1) *High tension cable from coil to distributor broken or grounded.* Remove coil-to-distributor high tension cable from distributor cap. Hold end of cable three-eighths of an inch from cylinder block while cranking engine. If proper spark results, reconnect cable to distributor. If weak spark results, replace capacitor (par. 120). If weak spark persists, replace ignition coil (par. 122). If no spark results, check continuity of high tension cable from coil to distributor.

(2) *Defective distributor cap.* Inspect cap for current leaks, worn carbon tips, or looseness of cap. Replace as necessary.

(3) *Defective distributor rotor.* Replace rotor as necessary (par. 120).

(4) *Faulty spark plug wiring.* Make visual inspection of wiring to determine if disconnected, broken, or shorted. Connect, repair, or replace as required. Remove cable from spark plug and hold end of cable one-quarter inch from cylinder block while cranking engine. If no spark or a weak spark results, replace cable.

(5) *Faulty spark plugs.* If strong spark jumps with above test, fault is in plug. Remove plug and inspect for cracked insulator, broken electrodes, fouling, or incorrect gap. Clean, adjust, or replace as required (par. 121).

c. Weak Spark.

(1) *Defective distributor points.* Adjust point opening (par. 120*a*) or replace points if burned or pitted (par. 120).

(2) *Defective distributor cap.* Refer to *b*(2) above.

(3) *Defective capacitor (condenser).* Replace capacitor (par. 120).

(4) *Loose electrical connections.* Clean and tighten all connections from starter to distributor.

(5) *Defective high tension cables.* Check cables in *b*(1) above. Replace as required.

(6) *Defective ignition coil.* Replace coil (par. 122).

d. Engine Backfires.

(1) *Crossed spark plug cables.* Check cables to be sure they are connected in proper firing order sequence 1–5–3–6–2–4.

(2) *Cracked distributor cap.* Check distributor cap and replace as required.

e. Engine Misfires at High Speed Under Load.

(1) *Incorrect spark plug gap.* Adjust gap (par. 121*b*).

(2) *Distributor point opening incorrect.* Adjust points (par. 120*b*).

(3) *Defective ignition coil.* Replace coil (par. 122).

(4) *Defective distributor capacitor (condenser).* Replace capacitor (par. 120).

f. Satisfactory Spark Delivered to Spark Plugs, but Engine Backfires or Does Not Start.

(1) *Crossed spark plug cables.* Check cables to be sure they are connected in proper firing order sequence 1–5–3–6–2–4.

(2) *Ignition timing.* Check for proper ignition timing (par. 119).

(3) *Engine compression.* Test for engine compression (par. 77, table III, item 23). If compression does not meet minimum requirements, notify ordnance maintenance personnel.

g. Engine Idles Unevenly. Remove the spark plugs, clean, and reset the gaps (par. 121). Replace defective plugs with serviceable ones. Make certain the spark plugs used have the correct heat range.

h. Lack of Power When Engine Fires on All Cylinders.

(1) *Ignition timing.* Check for proper ignition timing (par. 119).

(2) *Weak spark.* Refer to *c* above.

(3) *Distributor.* As a last resort, replace the distributor since something might have happened to the automatic spark advance to prevent this device from functioning in its intended manner.

82. Starting System

a. Starter Fails to Operate.

(1) *Defective battery.* Check battery level and specific gravity (par. 136*a*), and clean and tighten battery terminals. Recharge or replace battery as required.

(2) Loose battery ground cable. Clean and tighten battery ground terminal connections.

(3) *Defective battery cables.* Examine all cables for grounded circuit, loose connections, or corroded cables. Replace cables as necessary.

(4) *Defective starter or push button switch.* Unscrew plug from bottom of starter solenoid. Press up for an instant on solenoid plunger to force the contact disk against the contact terminals by inserting finger in bottom of solenoid. If starter cranks the engine, the push button switch or circuit between batteries and switch or switch and starter solenoid are defective. By-pass the starter solenoid with a jumper wire. If starter cranks engine, the solenoid is defective. Replace solenoid (par. 126). If the starter does not crank the engine, replace starter switch (par. 157).

(5) *Defective starter.* If starter still does not operate after above tests, it must be replaced (par. 125).

b. Starter Is Noisy.

(1) *Loose starter mountings.* Tighten mounting cap screws.

(2) *Defective drive assembly.* Replace starter (par. 125).

(3) *Worn commutator or bushings.* Replace starter (par. 125).

(4) *Lack of lubrication.* Lubricate starter according to lubrication order (par. 70).

c. Slow Cranking Speed of Starter.

(1) *Weak batteries.* Replace or recharge batteries (par. 136).

(2) *High electrical resistance.* Clean and tighten all connections from battery to starter. Replace defective cables or switches.

(3) *Engine oil too heavy.* Use proper viscosity of oil for different temperatures (par. 70).

(4) *Defective starter.* Worn parts in starter will cause slow cranking speed of motor. Replace starter (par. 125).

83. Cooling System

a. Overheating Not Due to Loss of Coolant. Remove radiator cap. If cooling system is full and engine is at a dangerous operating temperature and there is no circulation of water, inspect for clogging lines or radiator, inoperative water pump, broken fan belts, thermostat stuck in closed position, or lack of oil in crankcase. Replace water pump if found inoperative (par. 134), flush radiator if clogged (par. 129). Clean out water lines if clogged or replace them. Replace fan belts if necessary (par. 99).

Caution: Belts must be replaced in matched sets, except in extreme emergency. If individual belts are replaced, the other belt must be installed as soon as conditions permit.

If water is circulating properly and engine overheats, check the following possible causes:

(1) *Clean radiator core.* Remove any foreign obstruction which would tend to retard the passage of air through the core of the radiator. If insects or dirt have plugged a large number of the air passages through the core, remove these obstructions with compressed air or a stream of warm water, working from the inner side of the radiator core.

(2) *Check the condition and adjustment of the fan belts.* If necessary adjust or replace (par. 99).

(3) *Check the ignition timing.* If necessary, adjust (par. 119).

(4) *Check for damaged radiator core.* Radiator cores may be bent enough to prevent free circulation of water, causing overheating of engines. Replace radiator (par. 129).

b. Overheating Due to Loss of Coolant.

(1) After the engine returns to its normal operating temperature, fill the radiator (par. 131*b*). If loss of coolant is too great reduce engine temperature with tractor standing, idle engine at slowest speed possible, and slowly refill radiator at intervals until full.

Caution: Do not quickly fill radiator with water when engine temperature gage reads over 200° F. Serious damage to engine may result.

(2) Inspect and remedy all external leaks of the cooling system, such as hoses, gaskets, connections, and water pump. If the radiator leaks, replace it with a serviceable unit.

(3) If no external leaks are present, a cracked cylinder head or block, defective cylinder head gasket, defective cylinder sleeve sealing ring, or ruptured oil cooler element may be the cause. Installation of new parts will be necessary to correct leak, if due to any of the above causes.

(4) Loose or open drain valves and plugs may be a cause of leaks.

c. Loss of Coolant When Tractor Stands. If the cooling system loses coolant when the vehicle is idle and no external leaks are present, inspect oil in crankcase for presence of water due to leaking cylinder head gasket, ruptured oil cooler element, defective cylinder sleeve sealing ring, or cracked head or block. If water is found in crankcase, notify ordnance maintenance personnel.

d. Over Cooling. If thermostat remains open, the system will operate at too low temperature in cold weather. Replace defective thermostats (par. 132).

84. Batteries and Generating System

a. Batteries Do Not Stay Charged.

(1) *Excesive use of electrical equipment.* Turn off equipment immediately after use. Do not leave lights or ignition switches on when vehicle is parked.

(2) *Low generator charging rate.* Refer to paragraph 137.

(3) *High resistance in battery circuit.* Clean and tighten all connections between starter and batteries, battery terminals, switches, and battery ground cable connection to hull.

(4) *Circuit breaker sticking closed.* If circuit breaker is sticking closed, ammeter will show heavy discharge when generator is not running. Replace generator regulator (par. 138).

(5) *Defective batteries.* Test with high rate discharge tester and replace, if necessary.

b. Generator, Regulator, and Circuit Breaker Units.

(1) *Circuit breaker faulty.* If the ammeter on the instrument panel shows a heavy discharge when generator is not running and all switches are off, disconnect battery lead marked "B" on the regulator. If the condition is corrected, the regulator circuit breaker contact points are stuck. If generator must run at high speed to show charge, the circuit breaker regulator is adjusted to operate at too high a voltage. In either case, replace the regulator (par. 138).

(2) *Regulator inoperative.* Start the engines and observe ammeter on the instrument panel. If no charging rate is indicated, connect the battery and armature marked "B" and "A" on the regulator, using a short piece of insulated wire. Hold jumper wire across the two terminals and watch ammeter. If reading is obtained, the regulator is not connecting the generator to the batteries. If this test does not reveal the trouble, connect the battery and field terminals together with the jumper wire. If a reading is obtained, the regulator is not allowing current to reach the generator field coils, preventing charge. Excess charge is caused by improper regulator adjustment. In either case, replace the regulator (par. 138).

(3) *Generator inoperative.* If regulator tests have been made and no charge is obtained, connect a test voltmeter between armature terminal marked "A" on the regulator and ground (hull). This test will show if generator is charging. If no voltage reading is shown, connect the battery and field terminals marked "B" and "F" together with a jumper wire. A flash will be seen and the test voltmeter will show a reading when the jumper wire is connected if the circuit is completed.

Check the ammeter on the instrument panel. If a charge is shown, the trouble has been corrected by flashing the fields which has increased the magnetism or properly polarized the field coil shoes. If no reading is obtained on the voltmeter, inspect the terminals at the regulator for loose or broken connections. If no trouble is observed in the connections or leads, the generator is inoperative. Replace generator if necessary (par. 137).

c. Ammeter Does Not Show Charge.

(1) *Generator circuit breaker open.* Refer to *b*(1) above.

(2) *Ammeter inoperative.* If the ammeter fails to register a charge, turn on all lights and see if a discharge is shown. If no discharge is observed, connect a new ammeter temporarily to the leads in the instrument panel. If a reading is obtained, the ammeter is faulty. If no reading is obtained, test wiring from ammeter to shunt for open circuit.

(3) *Regulator inoperative.* Refer to *b*(2) above.

(4) *Generator inoperative.* Refer to *b*(3) above.

(5) *Loose or corroded connections.* Clean and tighten connections.

(6) *Generator ground strap loose or broken.* Inspect ground strap. Tighten or replace.

(7) *Generator drive belts slipping.* Inspect drive belts. Tighten or replace (par. 99).

d. Ammeter Shows Excessive Charge.

(1) *Current regulator improperly adjusted.* Refer to *b*(2) above.

(2) *Batteries run down.* Test batteries (par. 136). Recharge or replace batteries.

(3) *Batteries shorted internally.* Test batteries and replace if faulty (par. 136).

e. Ammeter Shows Discharge With Engine Running.

(1) *Generator not operating.* Refer to *b*(3) above.

(2) *Regulator circuit breaker cut-in voltage too high.* Refer to *b*(1) above.

(3) *Shorted circuits.* Check for frayed wiring in the generating system.

(4) *Generator drive belt loose or broken.* Tighten or replace belts (par. 99).

f. Ammeter Shows Heavy Discharge With Engines Stopped.

(1) *Shorted circuit.* Check for shorted or frayed wiring in the generating system.

(2) *Regulator circuit breaker points stuck.* Refer to *b*(1) above.

(3) *Ammeter hand sticking or ammeter burned out.* Refer to *c*(2) above.

g. Ammeter Hand Fluctuates Rapidly.

(1) *Generator drive belts loose.* Tighten or replace belts (par. 99).

(2) *Generator ground strap loose or broken.* Tighten or replace ground strap.

(3) *Regulator circuit breaker cut-in voltage too low or contacts burned.* Refer to (5) below.

(4) *Regulator loose, not properly grounded, or vibrating against other equipment.* Tighten regulator on mountings, inspect ground straps, and relieve interference.

(5) *Generator or regulator faulty.* If ammeter needle fluctuates rapidly while generator is running, test all regulator and generator mountings to see if they are tight and inspect for broken ground straps. If ground straps and mountings are satisfactory, the condition is caused by incorrect setting of regulator circuit breaker, worn generator brushes, faulty generator drive belts, or regulator bumping against other equipment. If inspection reveals that the generator drive belts are properly adjusted and there is no interference from the regulator, connect a jumper wire between battery terminal marked "B" and armature terminal marked "A" on the regulator. If the fluctuation stops with the jumper wire connected, indicating that the regulator circuit breaker points have been vibrating, replace the regulator (par. 138). If fluctuation continues, indicating that the generator is at fault, replace the generator (par. 137).

85. Instrument Panel, Sending Units, Switches, and Gages

a. Engine Tachometer Inoperative.

(1) *Defective tachometer head.* Disconnect flexible shaft assembly from tachometer by unscrewing retaining nut on assembly. Install serviceable tachometer, start engine, and check tachometer for proper operation. Replace tachometer if necessary (par. 146).

(2) *Broken, frayed, or kinked cable.* Disconnect front end of flexible shaft assembly from tachometer and rear end from tachometer drive below distributor. Check for broken, kinked, or frayed core. Replace if necessary (par. 146).

b. Engine Oil Pressure Gage Inoperative.

(1) *Defective gage.* Replace with serviceable gage and check for proper operation of unit. If gage is defective, replace (par. 148*a*).

(2) *Sending unit defective.* If the oil pressure gage and electrical wiring are in good operating condition, the sending unit may be inoperative. Replace sending unit (par. 161).

(3) *Defective electrical wiring.* Use voltmeter to check for continuity of wire. Replace wiring if defective. Tighten all loose connections.

(4) *Incorrect oil viscosity.* Check for correct viscosity of engine oil. Drain and refill crankcase with proper grade of oil (par. 70).

(5) *No engine oil.* Check the amount of engine oil. Replenish with correct grade if necessary (par. 70).

c. Engine Temperature Gage Inoperative.

(1) *Defective temperature gage.* Replace with serviceable gage and check for proper operation of unit. Replace gage if necessary (par. 147).

(2) *Defective sending unit.* If the temperature gage and wiring are in good operating condition, the sending unit may be inoperative. Replace if necessary (par. 160). Replace wiring if defective. Tighten all loose connections.

d. Speedometer Inoperative.

(1) *Defective speedometer head.* Disconnect flexible shaft assembly from speedometer by unscrewing retaining nut on assembly. Install serviceable speedometer and check for proper operation. Replace speedometer head if necessary (par. 145).

(2) *Broken, frayed, or kinked cable.* Disconnect front end of flexible shaft assembly from speedometer and rear end from speedometer drive at the transmission by unscrewing the retaining nuts on the assembly. Check for proper rotation, broken, frayed, or kinked core. Replace as necessary (par. 145).

e. Torque Converter and Transmission Oil Pressure Gage Inoperative.

(1) *Defective gage.* Replace with serviceable gage and check for proper operation of unit. If the gage is inoperative, replace unit (par. 150).

(2) *Defective sending unit.* If the gage and electrical wiring have been found in good operating condition, the sending unit may be inoperative. Replace sending unit (par. 161).

(3) *Defective sending unit wire.* Use voltmeter to check continuity of sending unit wiring. Replace defective wire.

(4) *Incorrect oil viscosity.* Check oil viscosity. Drain and refill transmission and torque converter with the proper viscosity of oil if it has been found that improper oil is being used in tractor (par. 70).

(5) *Lack of transmission and torque converter fluid.* Check for proper amount of oil in transmission and torque converter. Replenish with correct grade of oil if necessary (par. 70).

(6) *Leak in system.* Check for leaks and correct.

(7) *Clogged lines.* Check line from oil reservoir to auxiliary oil pump for dirt or smashed tubing. Clean or replace as necessary.

(8) *Filter clogged, bypass valve stuck.* Remove filter and replace (par. 184). Check bypass valve for sticky plunger.

f. Torque Converter and Transmission Oil Temperature Gage Inoperative.

(1) *Defective gage.* Replace with serviceable gage and check for proper operation of unit. If gage is defective, replace (par. 151).

(2) *Defective sending unit.* If gage and electrical wiring are in proper operating condition, the sending unit may be at fault; replace if necessary (par. 162).

(3) *Defective electrical wiring.* Use voltmeter to check continuity of wiring. Replace defective wire. Tighten connections if necessary.

g. Hour Meter Inoperative.

(1) *Defective hour meter.* When the right ignition switch is turned on, the hour meter should operate. If hour meter fails to operate, replace unit (par. 144).

(2) *Defective wiring.* Use voltmeter to check continuity of wire from hour meter to ignition switch. Replace wire if necessary.

(3) *Loose connections.* Check all wire connections for tightness. Tighten if necessary.

h. Fuel Gage Inoperative.

(1) *Defective fuel gage.* Replace with serviceable gage and check for proper operation of unit. If gage is defective, replace (par. 149).

(2) *Defective sending unit.* If gage and electrical wiring is in operating condition and fuel in tank, the sending unit may be at fault. Replace if necessary (par. 159).

(3) *Defective wiring.* Use voltmeter to check continuity of wiring. Replace defective wiring. Tighten connections if necessary.

i. Ammeter Inoperative.

(1) *Defective ammeter.* Refer to paragraph 84*c*.

(2) *Defective electrical connections.* Clean and tighten connections.

(3) *Inoperative regulator.* Refer to paragraph 84*b*.

(4) *Inoperative generator.* Refer to paragraph 84*b*.

j. Air Pressure Gage Inoperative.

(1) *Defective air pressure gage.* Release air from reservoir. Replace with serviceable gage and check for proper operation. Replace gage if necessary (par. 141).

(2) *Defective air line.* Check for leak in air pressure line and connections. Tighten or replace if necessary.

(3) *Air reservoir.* Check for proper operation of tank units.

k. Low Air Pressure Lamp Inoperative (fig. 89).

(1) *Defective indicator.* Replace indicator lamp if necessary (par. 142).

(2) *Defective air pressure sending unit.* Check sending unit for proper operation. If indicator lamp, gage, electrical wiring, and air pressure line are in normal operating condition, sending unit may be inoperative. Replace if necessary (par. 158).

86. Electrical Equipment

a. Inoperative Siren.

(1) *Defective siren.* Place jumper wire across siren switch terminals. If siren fails to operate, check for loose wire connections and defective wires. If connections are found secure and wires in good condition, replace siren (par. 165).

(2) *Defective siren switch.* Place jumper wire across siren switch terminals. If siren operates, switch is at fault. Replace switch (par. 154).

(3) *Loose or corroded terminals.* Clean, tighten, or replace wires or terminals (par. 172).

(4) *Discharged batteries.* Refer to paragraph 136*a*.

(5) *Short circuit in wire between siren and switch.* Examine wire. Use ohmmeter to test for continuity. Replace defective wiring.

b. Inoperative Windshield Wipers.

(1) *Discharged batteries.* Refer to paragraph 136*a*.

(2) *Defective windshield wiper assembly.* Connect jumper wire across terminals of switch. If wiper does not operate with jumper wire connected, replace windshield wiper assembly (par. 166).

(3) *Defective windshield wiper switch.* Make the above mentioned test (*b* (2) above) and if windshield wiper operates with jumper wire connected, replace wiper switch (par. 155).

(4) *Defective wires or terminals.* Use ohmmeter to check for continuity of wiring. Inspect, clean, tighten, or replace wires and terminals.

(5) *Frozen wiper blades.* When tractor has been operating in temperatures below freezing, the wiper blades may be stuck to the windshield due to freezing weather. Remove ice from wiper blades and clean. If the rubber of the wiper blade has been damaged by the freezing temperature, replace the blade.

c. Wiper Blade Fails to Clean Glass Properly.

(1) *Worn wiper blades.* Replace wiper blade.

(2) *Wiper blade arm sprung.* Bend blade arm in toward glass or replace arm.

d. All Lights Fail to Burn When Switches are Turned On.

(1) *Discharged batteries.* Test batteries; replace if discharged. Refer to paragraph 136*a*.

(2) *Defective main light switch.* The main light switch controls the service lights, blackout driving light, rear flood light, and blackout marker lights. If lights fail to operate when main light switch is pulled out, replace switch (par. 155).

(3) *Broken or loose wires or terminals.* Check for broken or loose wires and terminals. Replace, clean, and tighten wires and terminals.

(4) *No current in feed circuit.* Use voltmeter to check feed to main light switch "battery" terminal. If there is no current to this point, check back through feed circuit until defective wire is located, and repair or replace wiring as required (par. 172).

e. All Lights Burn Dim.

(1) *Battery voltage low.* Test battery and charge; replace if necessary (par. 136).

(2) *High resistance in feed circuit.* Check main light switch feed circuit with voltmeter and correct high resistance condition. Clean, tighten, or replace wiring. Refer to *d*(4) above.

(3) *High resistance in main light switch.* If circuit checks satisfactorily and all connections are tight, replace main light switch (par. 155).

(4) *Short circuit in wires.* Check all wiring with voltmeter to locate short circuit. Replace defective wiring.

f. One Tail Light, Head Light, or Marker Light Does Not Burn.

(1) *Burned out lamp.* Replace lamp (par. 167).

(2) Loose or corroded lamp contacts. Clean, tighten, or replace lamp.

(3) *Open circuit to light.* If replacement of lamp does not correct the condition, use voltmeter to locate the trouble in the wires. Replace broken or frayed wires (par. 172).

(4) *Defective light switch.* If circuit checks satisfactorily to light switch, check for loose or corroded terminal or defective light switch. Use jumper wire between "battery" terminal switch and affected terminal. If light burns, clean, tighten, or replace switch (par. 155).

g. Stop Lights Do Not Operate.

(1) *Burned-out lamp.* If only one stop light fails to operate, check for burned-out lamp. Replace lamp if necessary (par. 170*a*).

(2) *Open circuit to one light.* Refer to *f*(3) above.

(3) *Defective main light switch.* Refer to *e*(2) above.

87. Radio Interference Suppression System

a. Instructions. The tractor is not a radio-equipped vehicle but, nevertheless, it has a suppression system. When checking suppression system of the tractor, it will be necessary to use a receiver located in an adjacent radio-equipped vehicle. This can be done by having the operator of the radio-equipped vehicle check to see if the amount of interference in radio reception increases or decreases when the engines of the tractor are accelerated and decelerated. If it does, tractor is causing the interference.

b. Interference by Tractor is Indicated by a Clicking Sound From Radio. The clicking indicates faulty ignition system interference suppression. Start and run each engine separately to determine whether the ignition system of left-hand or right-hand engine is causing the interference. Check mounting bolt of capacitor and ignition coil mounting bracket. If this bolt is loose, interference will result. If bolt is tight, either the capacitor or the resistor suppressor in wire leading from distributor to center socket in distributor cap or the resistor suppressors on the spark plugs are defective and must be replaced. Replace these units in above order with tested units and run engine after each one is replaced until the unit causing the interference has been located and interference is eliminated by its replacement.

c. Interference Is Indicated by a Humming Sound From the Radio. The humming sound indicates faulty suppression in the charging circuit through the generator and generator regulator or by operation of windshield wiper motors. If interference occurs only when windshield wipes are operated, test each of the capacitors mounted on windshield frame and connected to wiper motors by replacing them one at a time with tested capacitors. Loose attaching bolts on these capacitors can also be the cause. If the interference occurs when windshield wipers are not operating, replace the capacitor on the generator and those mounted on generator regulator one at a time until the defective capacitor is located and replaced. Make sure the interference is not cause by loose mounting bolts on regulator or capacitors.

Caution: Do not run the engines above fast idle speed or allow generator to charge above 25 amperes. If the noise is again evident and increases in amplitude as the generature builds up, capacitors in the generator are faulty. Replace generator.

88. Master Clutch, Torque Converter, and Universal Joint

a. Clutch Drag. Idle the engines at 500 rpm. Push the clutch pedal to the fully released position and allow time for the clutches to stop. Shift the transmission into low or reverse gear. If the shift cannot be made without a severe clash of the gears or if, after engagement of the gear, there is a jumping or creeping movement of the tractor with the clutch still fully released, the clutch is at fault.

(1) *Excessive pedal clearance.* Adjust clutch linkage (par. 178*b*).

(2) *Incorrect release lever adjustment.* Adjust release lever (par. 179*e*).

(3) *Damaged or missing pins or separator pin spring.* Replace clutch (par. 179).

(4) *Warped or cracked driven disk.* Replace damaged parts (par. 179).

(5) *Excessive dirt in clutch assemblies.* Disassemble clutch and clean dirt out of clutch and surrounding area.

(6) *Damaged or worn drive spline or bearing.* Disassemble and replace damaged or worn parts (par. 180).

b. Clutch Slips.

(1) *Improper adjustment of clutch release lever yoke plate.* Adjust clutch linkage (par. 178*b*).

(2) *Loss of spring load caused by excessive heat or broken spring.* Notify ordnance maintenance personnel.

(3) *Dirt in clutch causing binding of driven plate.* Disassemble and clean (par. 179).

(4) *Clutch driven plate facing worn.* Replace driven disk (par. 179).

(5) *Oily driven facings.* Clean and correct cause. Inspect oil seals for leaks. Inspect for overlubrication of pilot bearing. Replace driven plate assembly, if proper condition cannot be restored (par. 179).

(6) *Sticking clutch sleeve.* Inspect pull-back springs.

c. Complete Failure of Clutch to Engage or Release.

(1) *Disconnected clutch linkage or binding of clutch linkage.* Inspect linkage. Replace or connect parts.

(2) *Damaged clutch spindle or release bearing.* Replace damaged parts (par. 180).

(3) *Broken or damaged clutch plates.* Replace damaged plates (par. 179).

(4) *Excessive pedal free play.* Adjust pedal free play (par. 178*b*).

d. Clutch Rattles.

(1) *Loose release yoke.* Tighten or replace release yoke (par. 179).

(2) *Weak or broken pull-back springs.* Replace clutch assembly (par. 179).

(3) *Improper pedal adjustment.* Adjust pedal (par. 178*b*).

e. Chattering Clutch.

(1) *Broken pull-back spring.* Replace clutch assembly (par. 179).

(2) *Oily or burned facings.* Clean or replace drive or driven plates.

(3) *Sticking clutch sleeve.* Inspect pull-back spring for proper operation. Inspect sleeve for worn or unserviceable condition. Replace sleeve if necessary (par. 179).

f. Irregularities in Torque Converter Operation. Because the torque converters are completely enclosed with no moving parts visible from the outside, proper performance can be determined only by watching the gages in the instrument panel. Even though the vehicle seems to operate normally, there may be trouble which the gages will reveal. When performance seems to be faulty, the gages will indicate the nature of the trouble, in practically every case, short of damage to the converters.

(1) *Basic pressure too low.* With the engines turning at a speed of 1,000 to 1,200 rpm, the pressurge gage for each converter should indicate approximately 35 psi minimum pressure. The pressure should respond almost instantly when the engine is started. If pressure fails to reach 35 psi, check the following possibilities:

(*a*) *Insufficient oil supply.* When temperature of oil is 100° F, level in reservoir should come to "FULL" mark on bayonet gage. Fill if necessary (par. 70).

(*b*) *Leak in system.* Examine for leaks.

(*c*) *Filter badly clogged.* Remove body of filter and inspect filter elements; replace if clogged or extremely dirty (par. 184).

(*d*) *Defective auxiliary oil pump.* Disconnect line between pump and filter, and check flow of oil with engines operating. Replace oil pump if defective.

(*e*) *Clogged lines.* Check line from oil reservoir to auxiliary oil pump for dirt or mashed tubing. Clean or replace oil line.

(2) *Basic pressure too high.* If at any speed oil pressure exceeds 70 psi on the gage, it indicates faulty operation or failure of the pressure relief valve (par. 184*b*) or a clogged orifice in filter (par. 184*a*). A poorly grounded pressure gage will also cause the gage to register a maximum reading. Replace gage if necessary (par. 150).

(3) *Excessive temperature.*

(*a*) *Long continued operation under heavy pull.* Under extreme conditions of load (especially complete stall under full throttle), the converter is forced to "slip," which means the entire power input is being converted into heat. Stop tractor and let converters and oil cool.

(*b*) *Faulty cooling.* Check for proper circulation of air through oil radiator. Clean radiator cooling lines if necessary (par. 184*c*). Replace radiator, if circulation is inadequate after cleaning (par. 129).

(*c*) *Continued operation at no load.* If the engines and converter are operated at relatively high speed with the transmission in high gear, excessive temperature may prevail as the power absorbed from the engine is transformed into heat by the converter. Reduce the speed of the engines to 1,200 rpm until temperatures reduce.

(*d*) *Air in system.* Check for air in system. If oil supply in reservoir is low or vents are clogged, air may enter the circulatory system. This causes heating by oil "slip." Clean vents and fill reservoir (par. 181*b*).

(*e*) *Loss of oil.* Run engines and converter at idling speed and check for leaks. Tighten lines and connections or replace as necessary. Replenish torque converter oil if necessary (par. 181*b*).

(4) *Slow pressure response.* Failure of pressure to respond almost instantly when engine is started or sluggish, slow return of pressure to zero when engines are stopped, indicates air in the oil system. Check orifice at the connection of the radiator vent line to reservoir for proper venting. Replace vent line filter if necessary (par. 184).

g. Universal Joint Abnormal Backlash.

(1) *Worn or damaged universal joint cross bearing.* Check for worn or damage universal joints. Replace if necessary (par. 185).

(2) *Loose bolts at universal joint companion flanges.* Tighten bolts.

(3) *Universal joint companion flanges loose on transmission input shaft.* Tighten flange bolts.

h. Vibration in Universal Joints.

(1) *Worn or damaged universal joints.* Replace if necessary (par. 185).

(2) *Loose bolts at universal joint companion flanges.* Tighten flange.

89. Transmission, Differential, and Final Drive

a. Lack of Transmission Oil Pressure.

(1) *Insufficient oil.* Check oil level and add as necessary (par. 70).

(2) *Defective oil pressure gage.* Replace gage (par. 150).

(3) *Clogged oil screen.* Notify ordnance maintenance personnel.

(4) *Inoperative oil pump.* Notify ordnance maintenance personnel.

(5) *Oil leaks at filler or drain plugs.* Check for loose plugs and damaged gaskets. Replace gaskets and tighten plugs.

(6) *Oil leakage at cooling radiators or lines.* Replace cooling radiators (par. 129). Tighten or replace oil lines.

(7) *Oil leakage between transmission and differential housing.* Check for damaged gaskets or loose mountings. Notify ordnance maintenance personnel.

(8) *Worn or damaged output oil seals.* Notify ordnance maintenance personnel.

(9) *Damaged gasket at transmission case cover.* Replace gasket (par. 193).

b. Hard Shifting (Severe Gear Clash).

(1) *Incorrect clutch linkage adjustment.* Refer to paragraph 178*b*.

(2) *Binding of transmission gearshift lever.* Free up on lever. If shifter shaft locking mechanism is defective, notify ordnance maintenance personnel.

(3) *Clutch dragging.* Check for clutch drag. Adjust if necessary (par. 178*b*).

(4) *Damaged transmission parts.* If transmission fails to operate, notify ordnance maintenance personnel.

c. Tractor Fails To Move With Clutch Fully Engaged. Internal damage to the transmission, differential, or final drive assembly is indicated. Notify ordnance maintenance personnel.

d. Transmission Cannot Be Shifted. Check for damaged or broken shifter fork, locked shifter shaft, or shaft extension loose on shaft (par. 180). Notify ordnance maintenance personnel if any of the above items are damaged or broken.

e. Excessive Transmission Oil Temperature.

(1) *Insufficient or excessive oil supply.* Check oil level (par. 70).

(2) *Tight or dragging steering brakes.* Adjust brakes (par. 191*b*).

(3) *Clogged or damaged oil lines.* Notify ordnance maintenance personnel.

(4) *Clogged cooling radiator.* Replace cooling radiator (par. 129).

(5) *Inoperative cooling fan.* Check for loose or broken fan belts. Adjust or replace fan belts (par. 99).

(6) *Inoperative temperature gage.* Replace temperature gage with a test gage. If the gage is found defective, replace (par. 151).

f. Excessive Noise in Transmission and Differential. Check for loose mountings and tighten if necessary. If transmission or differential is damaged, notify ordnance maintenance personnel.

g. Excessive Noise or Backlash in Final Drive Assembly.

(1) *Loose mountings.* Check final drive assembly for loose mountings. Tighten if necessary.

(2) *Worn or damaged final drive assembly.* If final drive assembly is damaged, notify ordnance maintenance personnel.

h. Track Will Not Move on One Side (Engines Running and Transmission in Gear).

(1) *Broken final drive shaft or compensating gear.* Notify ordnance maintenance personnel.

(2) *Tooth stripped on final drive shaft gear or compensating gear.* Notify ordnance maintenance personnel.

(3) *Broken final drive assembly parts.* Notify ordnance maintenance personnel.

i. Final Drive Overheats. Check oil supply. Replenish if low (par. 70). Check for oil leaks.

90. Steering Brakes

a. Steering Brakes Do Not Hold.

(1) *Broken linkage.* Inspect for broken linkage, if tractor will not turn while in operation. Replace broken linkage if necessary (par. 192).

(2) *Lining worn out.* If linkage is in good operating condition, inspect brake lining for proper operation. If brake lining is defective, replace (pars. 193 and 194).

(3) *Loosely adjusted brakes.* Inspect brake adjustment. Adjust if necessary (par. 191*b*).

(4) *Brake drums worn excessively.* If brakes chatter when engaged, the cause is likely to be due to brake drums being worn, which allow excessive clearance between brake drum thrust and differential end covers. Notify ordnance maintenance personnel.

b. Parking Brakes Do Not Hold.

(1) *Brakes do not hold.* Refer to *a* above.

(2) *Locking pawl or quadrant worn or improperly adjusted.* Check locking pawl and quadrant for proper operation. Adjust or replace if necessary.

c. Brakes Too Tight. If brakes are tight, high transmission oil temperature is likely to result. Adjust brakes (par. 191*b*).

d. Tractor Pulls to One Side.

(1) *Brake linkage binds.* Lubricate and adjust (par. 192).

(2) *Improperly adjusted brakes.* Adjust steering brakes (par. 191*b*).

(3) *Defective tracks or suspension.* Refer to paragraph 93.

91. Trailer Air Brake

a. Slow Pressure Build-Up in Reservoirs or Loss of Pressure.

(1) *Application valves or fittings leaking.* Examine air lines, fittings, and valve for leaks. Replace valve (par. 199) or leaking unit, or tighten connections.

(2) *No clearance at compressor unloader valves.* Check adjustment of valves (par. 197).

(3) *Clogged air cleaner.* Inspect air cleaner for proper operation. Clean compressor air cleaner (par. 197).

(4) *Worn compressor.* Inspect compressor for proper operation. Replace faulty compressor (par. 197*b*).

b. Pressure Rises Above 105 Psi.

(1) *Broken compressor unloading diaphragm.* Inspect compressor unloading diaphragm. Replace compressor if defective (par. 197*b* and *c*).

(2) *Excessive clearance at unloader valve.* Inspect for excessive clearance and adjust if necessary (par. 197).

(3) *Air pressure governor inoperative.* Check for proper operation (par. 198). Replace if necessary. Refer to paragraph 198 for further information.

(4) *Restriction in pipe from governor to compressor unloading mechanism.* Clean or replace tubing or hose as necessary.

c. Slow Brake Operation.

(1) *Restriction in tubing or hose.* Clean or replace tubing or hose as necessary.

(2) *Leaking valve diaphragm or piston packing cup.* Inspect for proper operation of unit. If defective, replace valve (par. 199) or compressor (par. 197).

(3) *Valves, connections, couplings, and lines leaking.* Inspect the above units for leaks. Tighten, clean, or replace any units as necessary.

(4) *Inoperative compressor.* Inspect compressor for proper operation (par. 196). Compressor may be operating but not efficiently. Replace if necessary (par. 197).

d. Slow Brake Release.

(1) *Restriction in tubing or hose.* Inspect tubing and hose for proper operation. Clean or replace hose or tubing if necessary.

(2) *Faulty brake valve.* Test brake valve for proper operation (par. 200). Replace valve if found to be defective (par. 199).

e. *Insufficient Braking Power.*

(1) *Restriction in tubing or hose.* Clean or replace tubing or hose as necessary.

(2) *Trailer brake lining worn.* Replace or reline defective trailer brakes if necessary.

(3) *Air leaks.* Inspect hose, lines, air reservoir connections, couplings, and valves for leaks. Replace or tighten units if found to be defective or loose.

(4) *Compressor fails to maintain adequate pressure.* Inspect compressor for proper operation (par. 196). Replace compressor if defective (par. 197*b* and *c*).

92. Trailer Electric Brake Controls

a. *Instructions.* Since there are no working parts to the electric brake control units other than the operating linkage for the brake controller, inspection for inoperative units will consist merely of testing for delivery of current from unit to unit. If brakes fail to operate due to faulty control units, proceed with following steps to determine which is inoperative.

Note.—To test for operation of brakes, it will be necessary in most cases to have vehicle connected.

b. *Trailer Brakes Inoperative.*

(1) Inspect wires from ammeter to resistor, resistor to load control, load control to brake controller, and from brake controller to coupling socket for loose connections and broken or grounded wires.

(2) Clean contacts on load control unit.

(3) If further checking is necessary, check resistor, load control, and brake controller by replacing them with serviceable units, in the order named, until inoperative unit is eliminated (par. 202).

(4) If the above units are in good operating condition, inspect trailer wiring, connections and couplings for loose connections and broken or grounded wires. If this does not eliminate the trouble, check trailer brake unit for proper operation. Adjust or replace any defective wires or trailer brake unit.

93. Tracks and Suspension

a. *Vehicle Leads to One Side.*

(1) *Unequal track tension.* Check for proper track tension. Adjust both tracks if necessary (par. 204*b*).

(2) *Worn or distorted drive sprockets or tracks.* Replace worn parts as required.

(3) *Crowned road.* A crowned road will tend to cause the tractor to pull to the low side of the road. Do not mistake this for the above causes. It is a normal tendency.

(4) *Improper brake adjustment.* Adjust brakes (par. 191).

b. Thrown Track.

(1) *Improper track tension.* Adjust track tension (par. 204*b*).

(2) *Dirt, snow, or rocks between track and trailing idler.* Clean tracks of dirt, snow, or rocks.

(3) *Idler shaft loose in bracket.* Check alinement of idler wheel. If loose, tighten bracket bolts (par. 205).

(4) *Worn track.* Replace track (par. 204).

(5) *Improper driving.* If track is thrown as a result of improper handling of tractor, further instructions and review of driving methods is required (pars. 44–53).

c. Tractor Sags to One Side.

(1) *Broken or "set" volute spring.* Replace volute spring (par. 205).

(2) *Excessively loose or worn track.* Adjust track tension (par. 204*b*) or replace track (par. 204).

d. Suspension Wheels or Support Rollers Do Not Operate.

(1) *Bent or damaged wheels.* Check for bent or damaged wheels and shafts. Replace if necessary (pars. 207 and 209).

(2) *Bearing seizure.* Replace bearings (pars. 208 and 210).

(3) *Frozen dirt or snow.* Remove frozen dirt or snow from suspension wheels or support rollers.

e. Oil Leaks.

(1) *Shaft plugs.* Inspect for loose shaft plugs or damaged shaft plug gaskets. Replace damaged gaskets or tighten shaft plugs.

(2) *Oil seals.* Inspect for oil leaks around the oil seals. Replace defective oil seals (pars. 206, 208, and 210).

94. Hull, Pintles, Ammunition Boxes, and Fire Extinguishers

a. Hull.

(1) *Unusual noise or rattles.* Inspect hull for cracks, broken welds, loose bolts, and proper mounting of engine compartment doors, stowage boxes, grilles and ventilation doors. Tighten bolts if necessary. Notify ordnance maintenance personnel of broken welds or cracks.

(2) *Excessive water leakage.* Inspect hull bottom for loose hull bottom inspection plates, drain plugs, or defective gaskets.

Replace gaskets, tighten drain plugs on hull bottom inspection plate cap screws (par. 212).

b. Pintles.

(1) *Loose pintle.* Inspect for loose pintle mounting cap screws or worn pintle shaft. Tighten mounting cap screws if loose or replace pintle if worn (par. 213).

(2) *Pintle latch inoperative.* Pintle latching mechanism may be bent. Replace pintle (par. 213).

c. Ammunition Boxes.

(1) *Unusual noise and rattles.* Inspect for cracks, broken welds, loose bolts, proper mounting of ammunition compartment doors, lower compartment doors, and hoist track. Check for proper operation of compartment door latches. Tighten loose bolts. Notify ordnance maintenance personnel of broken welds or cracks in ammunition box, doors, or hoist.

(2) *Inoperative chain hoist.* Inspect for indicated trouble. Repair or replace hoist if necessary.

(3) *Defective lock pins and shell racks.* Inspect for bent or broken lock pins and shell racks. Check for secure mountings. Replace or tighten all mountings and pins or racks.

d. Fire Extinguishers.

(1) *Inoperative extinguishers.* Check weight of extinguisher and replace if not within 6 ounces of weight stamped on valve foot or tag (par. 56). Inspect proper operation of trigger valves and nozzle. Replace if faulty.

(2) *Loose mountings.* Inspect for proper and secure mounting of fire extinguisher. Check for proper operation of bracket release catch. Replace bracket if necessary (par. 215*b*).

e. Tire Inflation Hose.

(1) *Inoperative emergency hose coupling.* Inspect cut-out cock for proper operation. Check for air pressure at cock. If inoperative, check air pressure line and compressor (par. 200).

(2) *Leaking hose.* If tire inflation hose leaks, repair or replace hose as necessary. Inspect adapter for proper operation.

95. Winch and Power Take-Off

a. Winch Drum Wobbles.

(1) *Drum shaft bent.* If the drum shaft is bent or damaged, replace winch (par. 217).

(2) *End frame or gear case wobbles.* Drum shaft is bent or pivot in end frame or gear case are loose. Tighten bolts or replace winch if necessary (par. 217).

b. Clutch Disengages While in Operation. Jaws of clutch are rounded. Replace winch (par. 217).

c. *Winch Brake Overheats.* Inspect the brake band for tightness. Adjust brake as necessary (par. 217*a*).

d. *Winch Brake Fails to Hold Load.*

(1) *Brake lining worn.* Replace brake band assembly (par. 218).

(2) *Oil on brake lining.* Wash oil from lining. If brake fails to hold after cleaning, replace brake lining (par. 218).

(3) *Brake out of adjustment.* Adjust brake (par. 217*a*).

e. *Excessive Noise in Power Take-Off.*

(1) *Insufficient lubricant.* Check fluid level of transmission oil level gage. Fill tank with oil to "FULL" mark if necessary (par. 70). Inspect for leaks.

(2) *Improper grade of lubricant.* Check for proper grade of oil. Drain and refill with proper lubricant if necessary (par. 70).

(3) *Installation out of line.* Check for alinement of power take-off. Relocate unit and tighten bolts.

(4) *Excessive gear lash.* Notify ordnance maintenance personnel.

(5) *Loose or defective gears.* Notify ordnance maintenance personnel.

(6) *Worn bearings.* If bearings are defective, notify ordnance maintenance personnel.

f. *Power Take-Off Will Not Operate.*

(1) *Disconnected shift control rods.* Inspect for proper operation of shift control rods. Connect and adjust control rods if necessary (par. 224). Check range shifter lever for proper operation.

(2) *Seized bearings.* Inspect for seized or excessively worn bearings in power take-off. Notify ordnance maintenance personnel.

(3) *Broken gears.* Notify ordnance maintenance personnel.

g. *Power Take-Off Slips Out of Gears.*

(1) *Shifting fork worn.* Notify ordnance maintenance personnel.

(2) *Gears worn or damaged.* Notify ordnance maintenance personnel.

h. *Power Take-Off Operates But Winch Shaft Fails to Turn.* Replace winch shear pin if found to be "sheared off" (par. 223).

i. *Overheating.* Inspect for sufficient and proper grade of lubricant. Refill if necessary (par. 70).

j. *Loss of Lubricant.*

(1) *Improper grade of lubricant.* Drain and fill with the proper grade of oil (par. 70).

(2) *Defective gaskets or seals.* If oil leaks are noted at power take-off, notify ordnance maintenance personnel.

(3) *Cracked or broken housing.* Notify ordnance maintenance personnel.

Section V. ENGINE DESCRIPTION AND MAINTENANCE IN VEHICLE

96. Description and Data

a. General Description. The two engines used in the tractor are 6-cylinder Waukesha Model 145 GZ gasoline engines (fig. 43). They are high-compression, 4-cycle, valve-in-head, water-cooled engines with dual carburetion. The engines are mounted in the center of the tractor with their flywheel ends toward front of tractor. The flywheel ends of engines are mounted in a common clutch housing (fig. 44).

Note.—Throughout this manual, unless otherwise noted, the flywheel end of engines will be referred to as the front end of the engines.

b. Lubrication. All moving parts of each engine are lubricated by a positive pressure system. There are few outside oil lines, the oil being delivered by a gear-type pump to the various operating parts through drilled passages in the cylinder block and head, crankshaft, connecting rods, camshaft, and rocker arm assemblies. Oil pressure is regulated by pressure relief valves located in the oil pump, at oil cooler inlet, and cylinder block oil gallery (fig. 31). Lubricating fittings are provided where necessary on the attached accessories. Oil drain plugs are located at bottom of oil pan (fig. 62) and oil filters (fig. 32).

c. Engine Accessories. Each engine is equipped with an electric starter, water pump, oil cooler, fuel pump and carburetors, governor, and separate ignition system. An air compressor to supply air for the operation of air brakes on trailer vehicle is mounted on the left engine, and the generator is mounted on the right engine. Connecting linkage provides for the operation of both master clutches by one clutch pedal and for operation of engines by common throttle controls. A separate cooling system and air supply system is provided for each engine. Either engine can be operated independently of the other.

d. Tabulated Data.

Make and model	Waukesha 145 GZ
Fuel used	Gasoline (70 octane)
Number of cylinders	6
Bore and stroke	5¾ x 6 in
Piston displacement	818 cu in
Compression ratio	5.95 to 1
Maximum torque	500 ft-lb at 1,700 rpm
Maximum governed speed (full throttle)	2,100 rpm
Firing order (from rear of engine)	1–5–3–6–2–4
No. 1 cylinder location	At end opposite flywheel
Weight (including accessories)	Aprx 2,150 lb
Overall length	55¼ in
Overall height	48 in

Overall width	35 in
Crankcase capacity	5 gal
Developed horsepower	210

97. Organizational Maintenance Operations

Listed below are the services that can be performed on and around the engines with the engines installed in tractor, ammunition box installed, hood and frame installed, and engine compartment doors open.

a. Intake Manifold. Replace (par. 98).
b. Exhaust Manifold. Replace (par. 98).
c. Exhaust Pipes. Replace (par. 116).
d. Drive Belts. Adjust or replace (par. 99).
e. Cylinder Head and Gasket. Replace (par. 100).
f. Valve Adjustment. Refer to paragraph 101.
g. Engine Lubrication Service. Refer to paragraph 102.
h. Engine Oil Cooler Element. Replace (par. 102).
i. Engine Oil Cooler. Replace (par. 102).
j. Engine Oil Filter and Element. Replace (par. 102).
k. Fuel Tank Service. Refer to paragraph 107 *c*.
l. Fuel Filter and Element. Replace (par. 108).
m. Fuel Pump. Replace (par. 109).
n. Carburetor. Adjust and replace (pars. 113 and 114).
o. Primer Pump. Replace (par. 110).
p. Engine Shut-Off Valve. Adjust and replace (par. 111).
q. Oil-Bath Air Cleaner. Service and replace (par. 112).
r. Muffler. Replace (par. 117).
s. Distributor. Adjust (par. 120).
t. Distributor Contact Point. Replace (par. 120).
u. Spark Plug. Adjust and replace (par. 121).
v. Ignition Coil. Test and replace (par. 122).
w. Ignition Switch and Wiring. Replace (par. 123).
x. Starter. Replace (par. 125).
y. Starter Solenoid. Replace (par. 126).
z. Starter Button Switch. Replace (par. 157).
aa. Cooling System. Service (par. 131).
ab. Thermostat. Replace (par. 132).
ac. Fan and Fan Drive. Replace (par. 133).
ad. Batteries. Service or replace (par. 136).
ae. Generator. Replace (par. 137).
af. Generator Regulator. Replace (par. 138).
ag. Engine Coolant Temperature Sending Unit. Replace (par. 160).
ah. Engine Oil Pressure Sending Unit. Replace (par. 161).

98. Intake and Exhaust Manifolds

a. Intake Manifold Removal.

(1) *Disconnect wires and linkage.* Drain engine cooling system (par. 131*a*). Raise engine top grilles, remove air deflectors from above engine and open engine compartment door. Loosen hose clamps at each end of large air pipe connected to air cleaner (fig. 36) and carburetor air inlet (fig. 61). Remove the two bolts attaching bracket on pipe to radiator supporting frame, and remove air pipe. Disconnect wires from ignition switch (fig. 66), and tape the ends of wires. Remove nut from carburetor mounting stud, and lift wire clip from stud. Remove yoke pins to disconnect rear ends of choke and ignition switch control cables from bellcranks on throttle shaft bracket. Remove two cap screws that attach the cable support bracket to lower side of manifold. Disconnect throttle cross shaft and throttle vertical control shaft from bellcrank on front end of carburetor throttle shaft bracket (fig. 56). Disconnect lower end of governor to carburetor rod from governor lever (fig. 52).

(2) *Remove manifold and carburetor assembly.* Disconnect lower end of fuel discharge hose from fuel pump. Disconnect lower ends of carburetor fuel supply hoses from top of Y-fitting (fig. 52) and then remove the two bolts that attach Y-fitting and hose.

Note.—Removal of the Y-fitting and hose is necessary only for removal of manifold from the right hand engine.

Disconnect primer fuel pipe from primer manifold. Remove the two cap screws that attach center of intake manifold water pipe to cylinder block. Remove nuts and washers from the manifold attaching studs, then lift manifold and carburetor assembly from engine. Remove manifold gasket.

(3) *Remove attached parts from manifold.* Remove the two cap screws and lock washers that attach each carburetor mounting adapter to the manifold. Remove two cap screws and lock washers that attach engine shut-off valve (fig. 51) to the manifold. Remove two cap screws that attach throttle shaft bracket to manifold and two cap screws that attach ignition switch to (fig. 52) manifold. Remove carburetor and air inlet assembly, throttle shaft bracket, and ignition switch. Remove two nuts and lock washers from each elbow on water pipe, and remove water pipe from manifold.

b. Intake Manifold Installation.

(1) *Install attached parts on manifold.* Clean all attaching faces of manifold and attaching parts. Cement new gasket

to attaching flanges on elbows of manifold water pipe and attach elbows to bottom of manifold with two nuts and lock washers in each flange. Cement new gaskets to attaching face of carburetor mounting adapters. Cement new gaskets to both sides of support bracket for Y-fitting (fig. 52). Set carburetors and air inlet assembly in place. Install two lock washers and cap screws attaching each carburetor mounting adapter to manifold. Install two cap screws and lock washers to attach engine shut-off valve to manifold. Position ignition switch and throttle shaft bracket on manifold and attach with two cap screws and lock washers on each.

(2) *Install intake manifold assembly on engine.* Place new gaskets on the manifold studs in cylinder head. Set manifold on the studs and install a flat washer and nut on each stud. Tighten the nuts evenly, starting from the center, working up and down toward each end. Connect center attaching flange of manifold water pipe to cylinder block with two cap screws and lock washers. Connect primer fuel pipe to fitting at front end of primer manifold. Install Y-fitting (fig. 52) on support bracket at center of manifold with two bolts and lock washers (if removed). Connect carburetor fuel hoses to Y-fitting (fig. 52), and connect lower end of discharge hose to the fuel pump. Connect lower end of governor-to-carburetor rod (fig. 52) to the governor lever with yoke pin and cotter pin. Connect the long throttle connecting rod and vertical throttle control rod (fig. 44) to bellcrank at front of manifold. Connect choke and ignition switch control cables to bellcranks that operate the choke and throttle rods, then connect cable bracket to lower side or manifold with two cap screws and lock washers. Connect wires to the two ignition switch terminals (fig. 66) and attach intake pipe to air cleaner and carburetor air inlet (fig. 61) and tighten hose clamps. Install bolts with lock washers in bracket on pipe and radiator. Test operation of carburetor controls, adjust if necessary (par. 114*b*). Fill cooling system, start engines, and check for fuel or water leaks at connections. Install air deflectors, close engine top grille doors and engine compartment door.

c. Exhaust Manifold Removal. Open the left engine compartment door (fig. 1) or right engine compartment door (fig. 2), depending from which engine the exhaust manifold is to be removed. Remove four cap screws attaching the exhaust elbow to the manifold (fig. 60). Remove four cap screws from the muffler end of the exhaust elbow (fig. 61) and remove the exhaust elbow from the engine compartment. Remove 18 nuts and washers from mounting studs (fig. 25) and lift

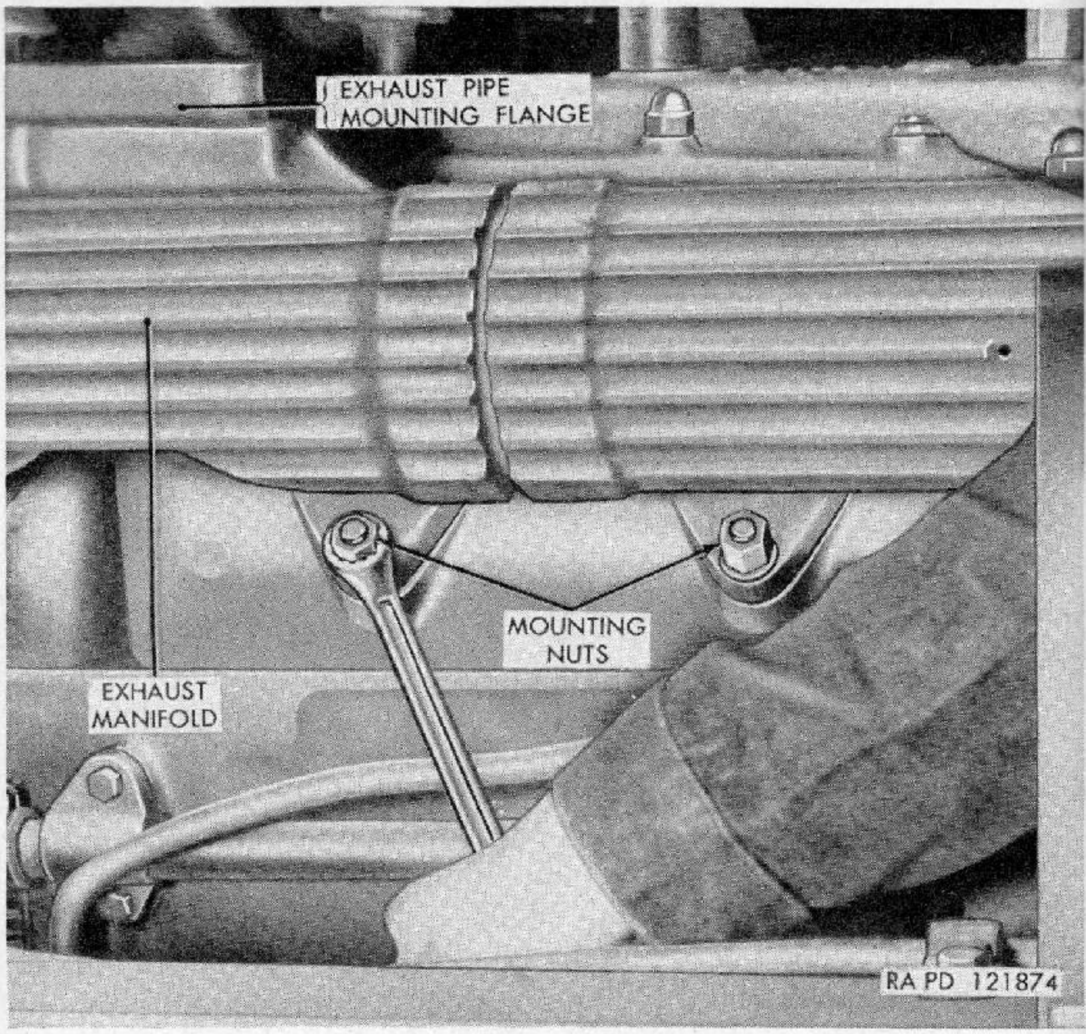


Figure 25. Engine exhaust manifold removal.

manifold from engine. If replacing only one section of the manifold, tap end section of manifold off the center section with a soft hammer.

d. Exhaust Manifold Installation. Clean all particles of old gaskets from attaching faces of manifold and cylinder head. Place new gaskets on studs in cylinder head, then set manifold on studs and install a flat washer and nut on each stud. Tighten all nuts evenly to prevent cracking manifold flanges. If sections of manifold have been separated, assemble by tapping each end section onto connecting sleeve with fins and flanges alined with center section. Using new gaskets between mounting flanges, install exhaust elbow with four cap screws at manifold flange (fig. 60) and four cap screws at the muffler flange (fig. 61). Close engine compartment doors.

99. Belt Adjustment and Replacement

a. Cooling Fan Belt and Fan Drive Belt Adjustment. The cooling fan drive belts are held at proper tension by means of belt tightener pulleys which are attached to adjusting rods (fig. 79). The front fan belt adjusting mechanism is reached through the engine top grille doors (fig. 26). Loosen lock nut and turn adjusting nut clockwise (fig. 26) until the bottom of sleeves are compressed over the springs approximately one-quarter inch from the stop plate. The fan belts are properly adjusted when a ¾-inch finger pressure deflection is obtained when pressure is applied to the belt. The fan drive belts at rear of engines are reached through the left engine compartment door (fig. 27). Loosen lock nut and turn adjusting nut clockwise until five-eighths of an inch clearance between end of sleeves and rod brackets is obtained, or a ¾-inch finger pressure deflection is obtained when pressure is applied to the drive belts. The belts that drive the cooling fans, the generator, and the air compressor are interchangeable.

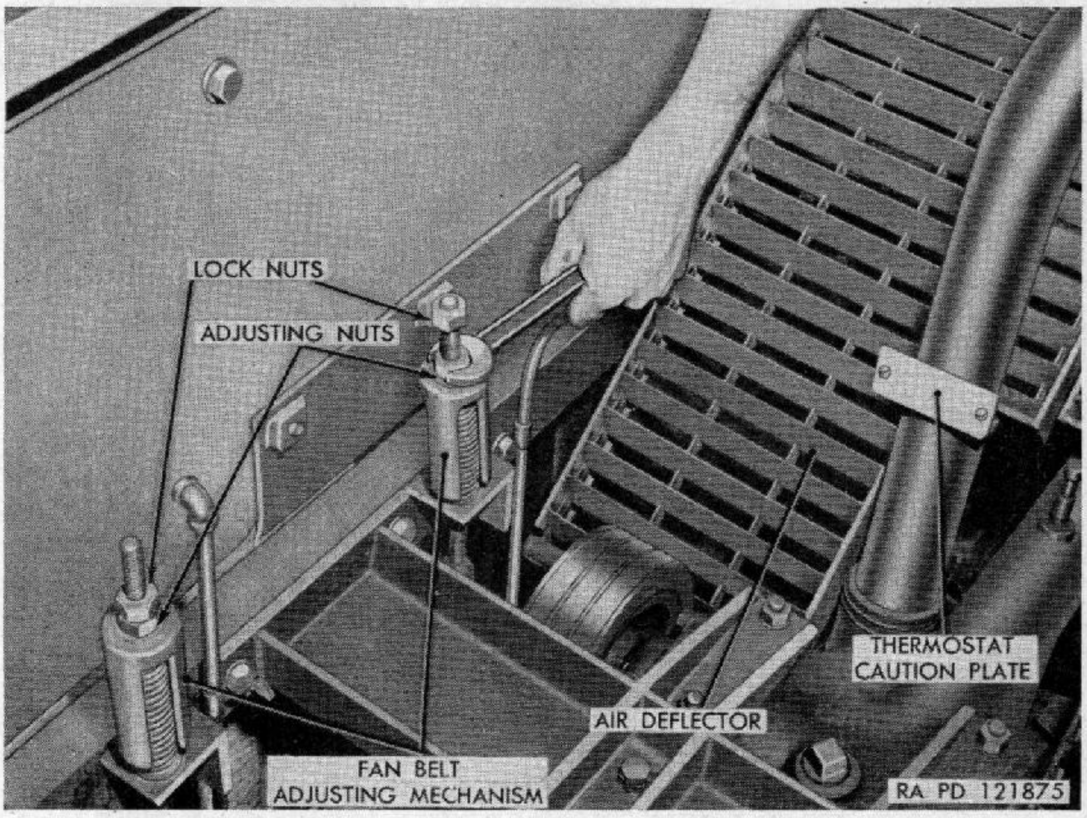


Figure 26. Adjusting fan belt tension.

b. Replacement of Cooling Fan Belt and Fan Drive Belts. To remove the cooling fan belts, open engine top hood grille door and release adjusting rod tension by removing lock nut (fig. 26). Turn the adjusting nut counterclockwise until there is no tension on the belts. Remove the rear compartment seat backs and rotate the fan assembly while the belts are being slipped off the pulleys (fig. 63). Install new fan belts on the drive pulley and, while rotating the fan assembly, install the belts on the fan drive pulley. To remove the cooling fan drive belts, open left engine compartment door and release adjusting rod tension by loosening lock nut and adjusting nut (fig. 27). Rotate the fan drive pulley while the belts are being slipped off the pulleys. Install new belts on the lower drive pulley and, while the drive shaft

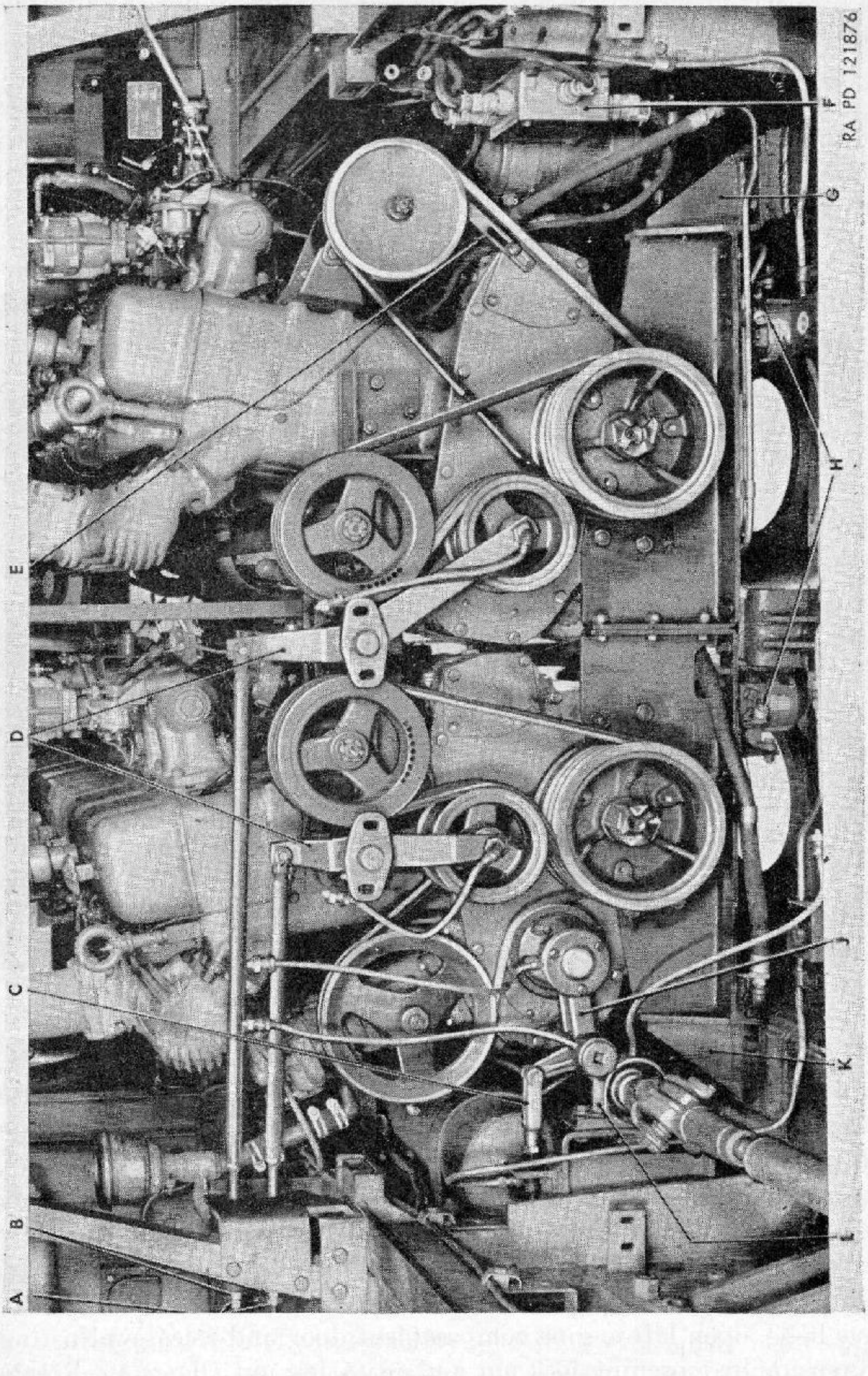


Figure 27. Fan, air compressor, and generator drive belt arrangement.

pulley is being rotated, slide belts on the pulley. Adjust the fan and fan drive belts as outlined in *a* above. Reinstall rear compartment seat backs and close engine compartment door.

Note.—When installing new fan and drive belts, always replace belts as a complete set.

c. Generator Belt Adjustment. The generator is located at the rear of the right engine (fig. 44), near the right engine compartment door. To adjust generator drive belt, loosen cap screw on adjusting link below the generator (fig. 27) and apply pressure on generator until a ¾-inch finger pressure deflection is obtained by using a straightedge across the two pulleys.

d. Generator Belt Replacement. Remove cap screw from belt adjusting link, and remove belt from generator pulley. Remove cooling fan drive belts from drive pulley (*b* above). Remove generator belt from drive pulley. Install a new belt on inner cooling fan drive pulley and position cooling fan drive belts on outer pulleys (*b* above). Position generator drive belt on generator pulley, install cap screw in adjusting link, and adjust generator belt (*c* above).

e. Air Compressor Drive Belt Adjustment. The air compressor drive belt is adjusted by a spring tension link. The adjusting link is located to the rear of the left engine near the left engine compartment door (fig. 27). To tighten belt, loosen lock nut at end of adjusting link and turn adjusting nut clockwise. A ¾-inch finger pressure deflection indicates that belt is properly adjusted.

f. Air Compressor Drive Belt Replacement. Open left engine compartment door. Remove cooling fan drive belts from drive pulley (*b* above). Release adjusting rod tension by turning adjusting nut counterclockwise until belt can be slipped off the air compressor pulley. Then remove air compressor belt from inner drive pulley. Install new belt on inner pulley and air compressor pulley. Install cooling fan drive pulley belts (*a* above). Adjust air compressor drive belt (*e* above).

A—LOCK NUTS
B—BELT ADJUSTING NUTS
C—AIR COMPRESSOR BELT ADJUSTING LINK
D—FAN DRIVE BELT TIGHTENER
E—GENERATOR BELT ADJUSTING LINK
F—ELECTRICAL JUNCTION BOX
G—ENGINE REAR SUPPORT
H—FUEL FILTERS
J—AIR COMPRESSOR DRIVE BELT TIGHTENER
K—ENGINE REAR SUPPORT
L—WINCH DRIVE SHAFT BEARING

Figure 27.—Continued.

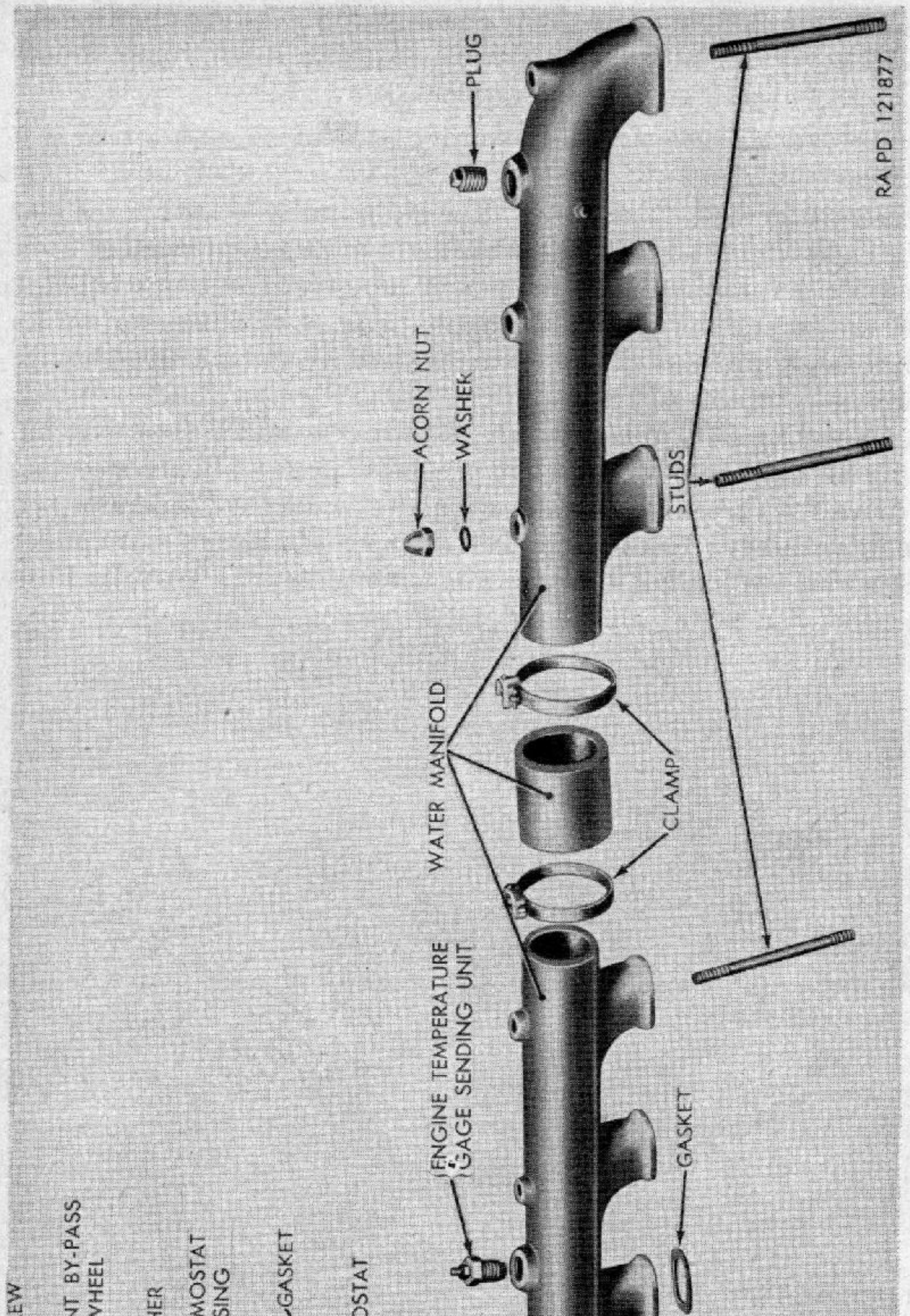


Figure 28. Engine water outlet manifold.

100. Cylinder Head and Gaskets

a. Removal.

(1) *Drain cooling system.* See paragraph 131.

(2) *Remove exhaust manifold assembly.* See paragraph 98.

(3) *Remove intake manifold assembly.* See paragraph 98.

(4) *Remove water outlet manifold.* Loosen hose clamps and slide hose connecting water pipe to thermostat housing up on pipe. Remove two bolts and lock washers to disconnect bypass pipe from housing (fig. 78). Pull end of wire out of temperature gage sending unit at rear end of manifold (fig. 37). Remove the six acorn nuts from manifold studs (fig. 28) and lift manifold assembly off studs.

(5) *Remove cylinder head assemblies.* Remove spark plug wires from spark plug connections (fig. 29). Unscrew handwheel nuts in rocker arm cover from studs (fig. 66) and lift covers and cover gaskets from cylinder heads. Disconnect lower

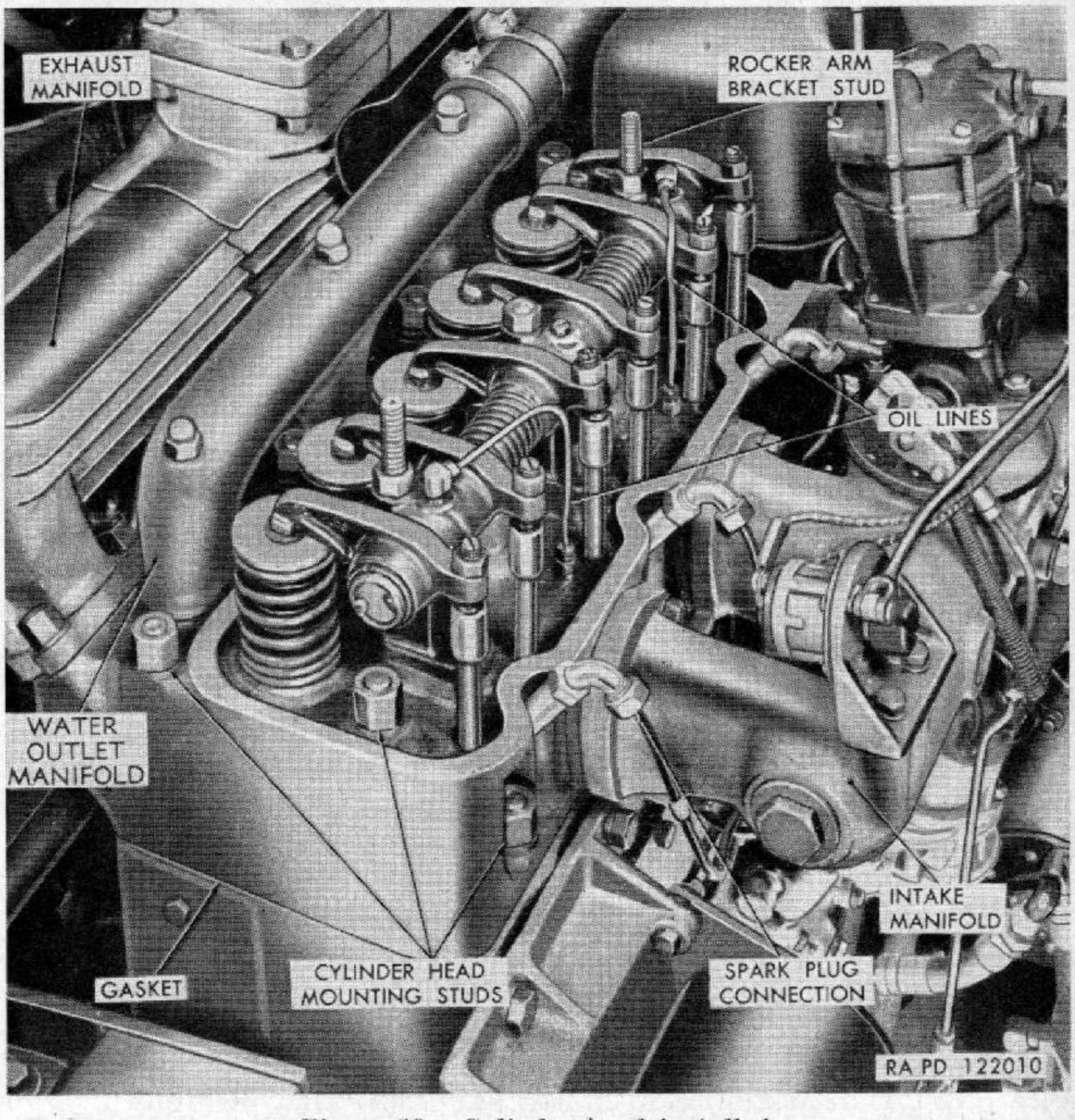


Figure 29. Cylinder head installed.

ends of rocker arm lubricating oil lines (fig. 29). Remove three nuts from the rocker arm bracket studs (fig. 29) and lift rocker arm assemblies off the studs. Remove 13 nuts from the cylinder head studs and lift cylinder heads and cylinder head gaskets off the studs.

b. Installation.

(1) *Install cylinder heads.* Clean all particles of carbon, rust, or corrosion from top of cylinder block and bottom of cylinder heads. Use compressed air to blow dust and dirt from cylinders and tops of pistons, and wipe off top of cylinder block and lower surface of heads. Lay new cylinder head gaskets on block over studs with crimped edges around holes downward (top side of new gaskets are marked "THIS SIDE UP"). Do not use any gasket cement on cylinder head gaskets. Install cylinder head and stud nuts, then working from center toward ends, tighten nuts evenly with a torque wrench to 175 foot-pounds torque.

(2) *Install rocker arm assemblies.* Install new gasket and set rocker arm assemblies over studs in heads, and install and tighter rocker arm bracket stud nuts (fig. 29). Connect rocker arm lubricating oil lines (fig. 29).

(3) *Adjust valves and install rocker arm covers.* Adjust valves as explained in paragraph 101. Install new cover gaskets and position rocker arm covers over cylinder heads and install the four handwheel nuts to secure the rocker arm covers to the cylinder head.

(4) *Install manifold assemblies.* Cement new gaskets to attaching faces of water outlet manifold and set manifold on studs in cylinder head (fig. 29). Install and tighten the six acorn nuts on studs. Connect water bypass pipe to side of thermostat housing, and connect large water pipe to housing with hose clamps (fig. 78). Insert end of wire in temperature gage sending unit (fig. 37). Install exhaust manifold and intake manifold (par. 98). Fill cooling system (par. 131), start engines (par. 45), and inspect for water or oil leaks from assembled units.

101. Valve Adjustment

a. General. Correct valve clearance is important to insure correct and efficient operation of the engines. Too much valve clearance causes excessive wear on all parts of the valve operating mechanism and also retards valve opening and advances valve closing. Too little valve clearance causes a loss of compression, missing, and eventual burning of the valves and valve seats.

b. Adjustment Procedure.

(1) *Rotate engine to "closed valve position."* Open right engine compartment door (fig. 2) and remove distributor cap from distributor (fig. 64). Turn engine (crankshaft), by inserting a bar between the universal joint cap screws and applying leverage, until the rotor arm of distributor corresponds to segment of distributor cap connected by spark plug ignition wire to No. 1 cylinder (closest to rear of tractor) and points are open, then turn engine one-quarter turn in direction of rotation of crankshaft. This will insure that both valves of that cylinder are closed.

Note.—Valves may also be adjusted on a cylinder when the exhaust valve on the companion cylinder is closing and oil intake valve starts to open (companion cylinder method of adjusting valves). At this time, both pistons are at approximate top center, one between compression and power and the other between exhaust and intake. This can be determined by holding a rotating pressure with fingers on the push rod of the exhaust valve of the companion cylinder. When pressure on the push rod, exerted by the camshaft, is released, the push rod will rotate freely indicating that the exhaust valve for that cylinder has just closed. Piston of the companion cylinder is now at top dead center of the exhaust stroke, and the piston of the cylinder whose valves are to be adjusted is at top dead center of power stroke.

(2) *Remove rocker arm covers.* Remove handwheel nuts, and lift rocker arm covers and gaskets from engine cylinder heads.

(3) *Adjust valves on No. 1 (rear) cylinder* (fig. 30). Check clearance between rocker arms and ends of valve stems on both intake and exhaust valves with a feeler gage. Intake valve should have 0.016-inch clearance, and exhaust valve should have 0.022-inch clearance at this point with engine cold. Adjustment for this clearance is made by loosening lock nuts on adjusting screws in rocker arms and turning screws in (clockwise) with screw driver to decrease the clearance or out (counterclockwise) to increase the clearance. Check again with feeler gage after screws are adjusted and lock nuts tightened. There must be a slight drag on 0.016-inch and 0.022-inch feeler gages inserted after lock nuts are tightened. Adjust valves for each remaining cylinder by turning the engine each time to close valves on that cylinder, as explained in (1) above, and using same adjustment procedure.

(4) *Install rocker arm covers and distributor cap.* Position new gaskets on cylinder head and install rocker arm covers with handwheel nuts. Tighten handwheel nuts firmly. Replace distributor cap in its proper position on distributor. Start engines (par. 45) to see that it operates satisfactorily. Inspect for oil and water leaks.

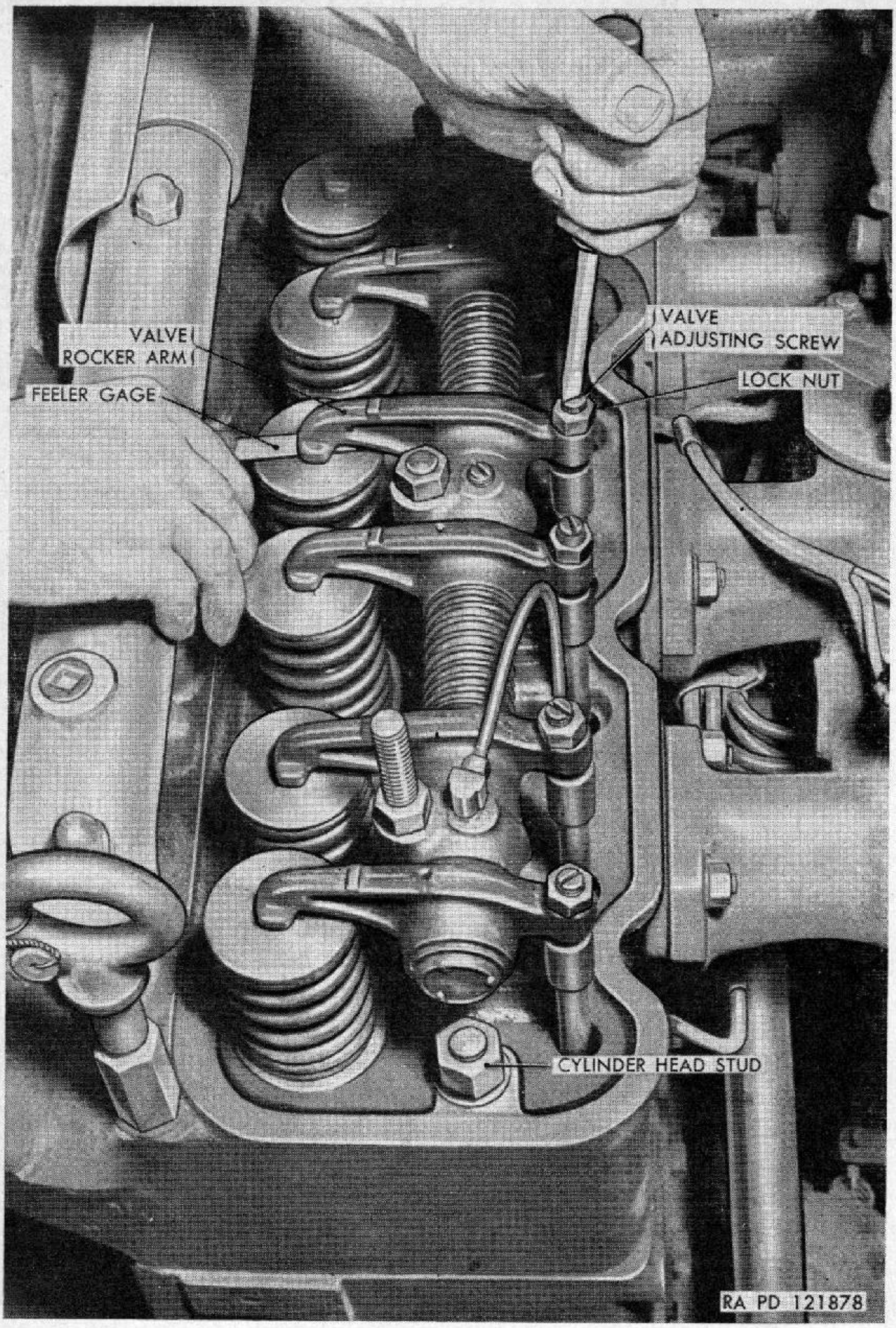


Figure 30. Engine valve adjustment.

102. Engine Oil Filters and Oil Coolers

a. Engine Oil Filters.

(1) *Description* (fig. 32). Four replaceable cartridge-type oil filters are mounted on brackets inside hull on right side of

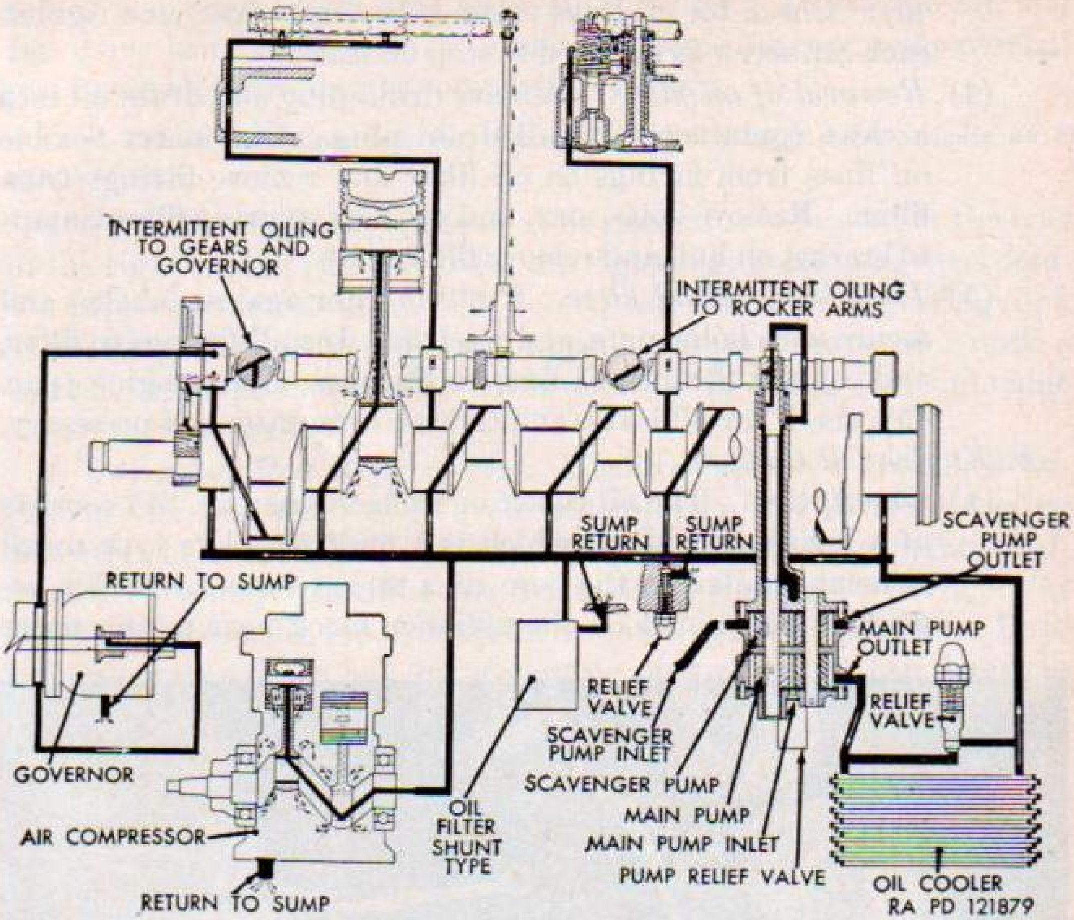


Figure 31. Engine oil flow diagram.

engines. Each pair is connected in parallel. Oil from the left hand engine passes through the two rear filters. Oil from the right hand engine passes through the two front filters. Dirt, sludge, and other foreign material harmful to the engines is removed from the oil by the elements contained in the filter cases as the oil circulates through them.

(2) *Removal of oil filter element* (fig. 33). Remove cover screw from oil filter cover and remove the cover and gasket. Remove the oil filter element from case.

(3) *Installation of oil filter element.* When installing new oil filter element in filter case, thoroughly remove any wax coating with a clean cloth and dry-cleaning solvent or volatile mineral spirits. Unless the wax coating is completely removed, it will be dissolved by the passage of oil through the element and be carried into oil lines where it will cause clogging. Insert new filter elements after each case has been drained and thoroughly cleaned. Install a new gasket on the cover (fig. 33) and new filter gaskets at the bottom and top of the oil filter mounting bolt. Install oil filter cover and screw. Tighten screw securely and start engine (par.

45). Check for oil leaks around the filter covers and tighten each cap screw as required to stop oil leaks.

(4) *Removal of oil filter.* Remove drain plug and drain oil into a clean container. Install drain plug. Disconnect flexible oil lines from fittings on oil filter and remove fittings from filter. Remove bolts, nuts, and washers securing filter clamps to bracket on hull and remove filter.

(5) *Installation of oil filter.* Position filter against bracket and secure with bolts, nuts, and washers. Install fittings to filter, and connect flexible oil lines to fittings. Start engine (par. 45), check for oil leaks, and tighten connections, if necessary.

b. Engine Oil Coolers.

(1) *Description.* The oil cooler on each engine (fig. 34) consists of a housing inside of which is a multiple plate type metal element similar to the core of a steam radiator. This assembly is mounted on the cylinder block next to the water

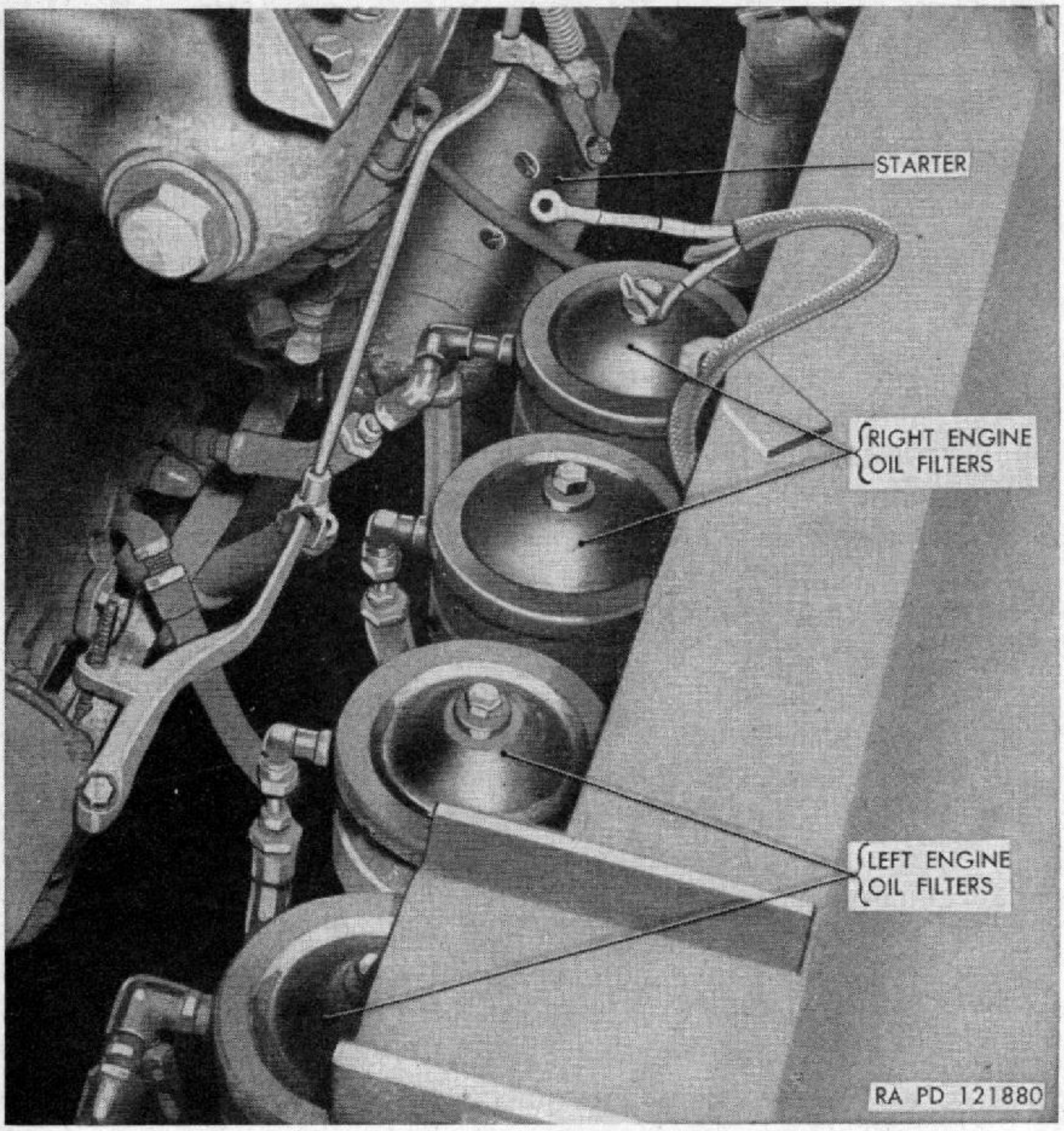


Figure 32. Engine oil filters.

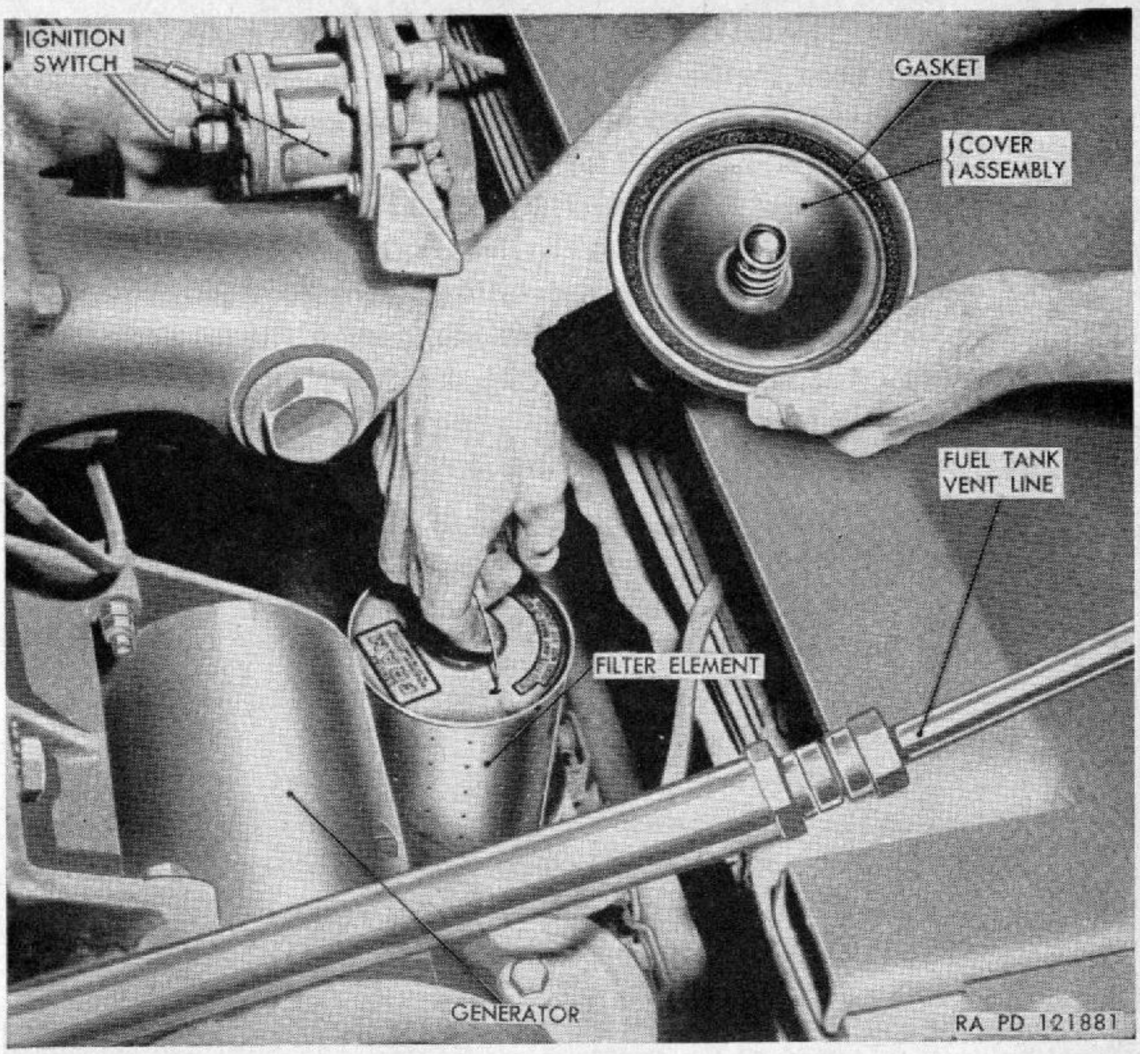


Figure 33. Removing engine oil filter element.

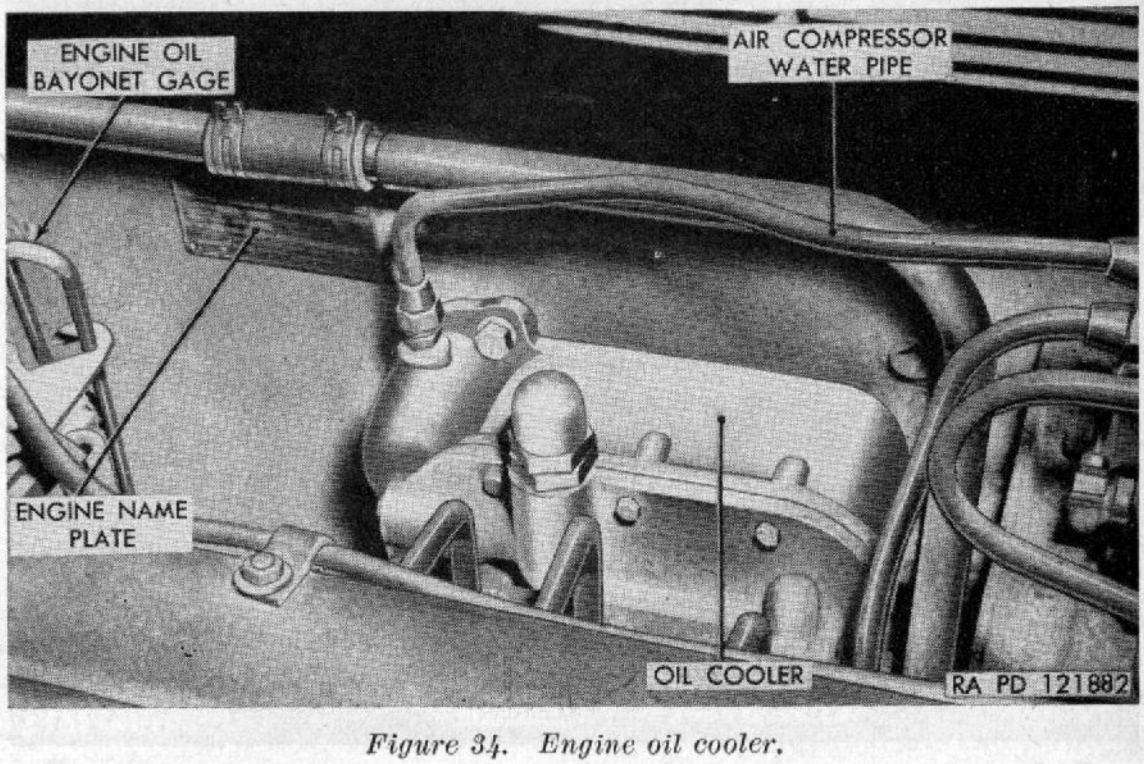


Figure 34. Engine oil cooler.

pump. The oil passes through the cooler element just before it delivered to the engine. Water from the engine cooling system circulates around the element as it passes through the cooler housing. The fins of the element dissipate the heat from the oil inside the element into the cooling water which surrounds it. A bypass valve is provided in the housing cover which opens to allow the oil to bypass the cooler in the event the cooler becomes clogged, or the oil is too thick to flow through the cooler element when the engine is first started in cold weather.

(2) *Removal.*

(*a*) *Remove cooler element.* Drain cooling system of engine from which cooler is to be removed (par. 131). Drain engine crankcase. Disconnect cooler-to-crankcase oil pipes by removing two cap screws that attach each lever pipe flange to crankcase. Remove eight cap screws that attach cover to cooler housing and remove cover (fig. 35). Remove element and gaskets.

(*b*) *Remove cooler housing.* Disconnect air compressor water pipe from fitting on top of cooler housing (if removing cooler from left hand engine (fig. 34)). Loosen clamp on hose connected to cooler inlet at rear of housing; remove

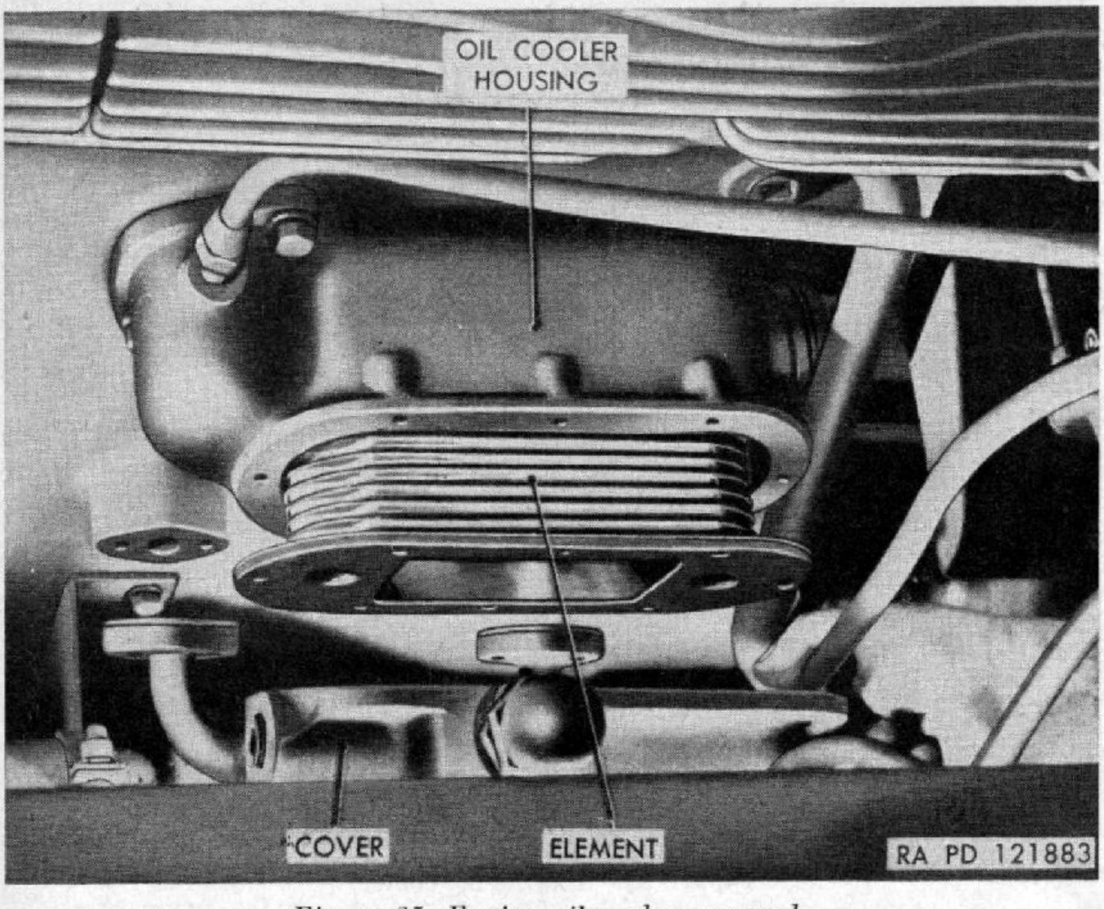


Figure 35. Engine oil cooler removal.

the two cap screws that attach housing to cylinder block, work inlet from hose, and remove the housing.

(3) *Installation.*

(*a*) *Install cooler housing.* Clean old gasket from attaching surfaces of cooler and crankcase. Cement gaskets to mounting flange of housing. Insert cooler inlet into hose on water pump and tighten clamp. Attach housing to cylinder block with two cap screws and lock washers. Connect air compressor water pipe to fitting on top of housing (if installing cooler on left hand engine) (fig. 34).

(*b*) *Install cooler element and cover.* Cement new gasket to each side of outer rim of element. Coat outer sides of gaskets with cement and insert element into housing. Cement gasket to flanges of cooler-to-crankcase oil pipes. Install cover with eight cap screws and lock washers. Install two cap screws with lock washers in each of the cooler-to-crankcase oil pipe flanges. Fill engine crankcase with oil (par. 70). Fill cooling system (par. 131).

Section VI. ENGINE REMOVAL AND INSTALLATION

103. Coordination With Ordnance Maintenance Unit

Replacement of the engines with new or rebuilt engines is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, provided authority for performing this replacement is obtained from the appropriate commander. Tools needed for the operation which are not carried in the using organization may be obtained from the supporting ordnance maintenance unit.

104. Engine Removal

a. General. Although it is quite possible to remove either engine singly from the tractor, the removal operation can be made quickly and easily by removing both engines and clutch housing from the tractor as a unit, then separating the one engine to be replaced from the other. It is important to pay particular attention to all quick disconnect points for fuel, oil, water, and electrical lines and all mounting bolts of assemblies for removal of the engines as outlined below.

b. Remove Ammunition Box and Fuel Tank. Refer to paragraphs 214*a* and 107*a*.

c. Remove Air Intake Pipes and Engine Hood Grilles from Roof of Cab. Loosen clamps on hoses connecting rear end of pipes to air cleaners (fig. 36). Remove the two cap screws from each clip attaching air intake pipes to top of cab (fig. 3). Remove four cap screws from each air intake at front end of pipe, then raise front ends and remove air intake pipes. Remove two pins from each engine hood top grille and remove grilles (fig. 3). Remove air deflectors from above the engines (fig. 61). Remove rear seats and raise hinged floor plate. Remove cap screw connecting ends of battery ground cables to inside of battery support. Tape ends of cable to prevent sparking.

d. Remove Engine Hood, Air Cleaners, and Mufflers As One Unit (fig. 38). Loosen clamps on hoses connecting air pipes to carburetor air intake, and slide clamps up on pipes (fig. 61). Remove four bolts that attach lower end of each exhaust elbow to exhaust manifolds (fig.

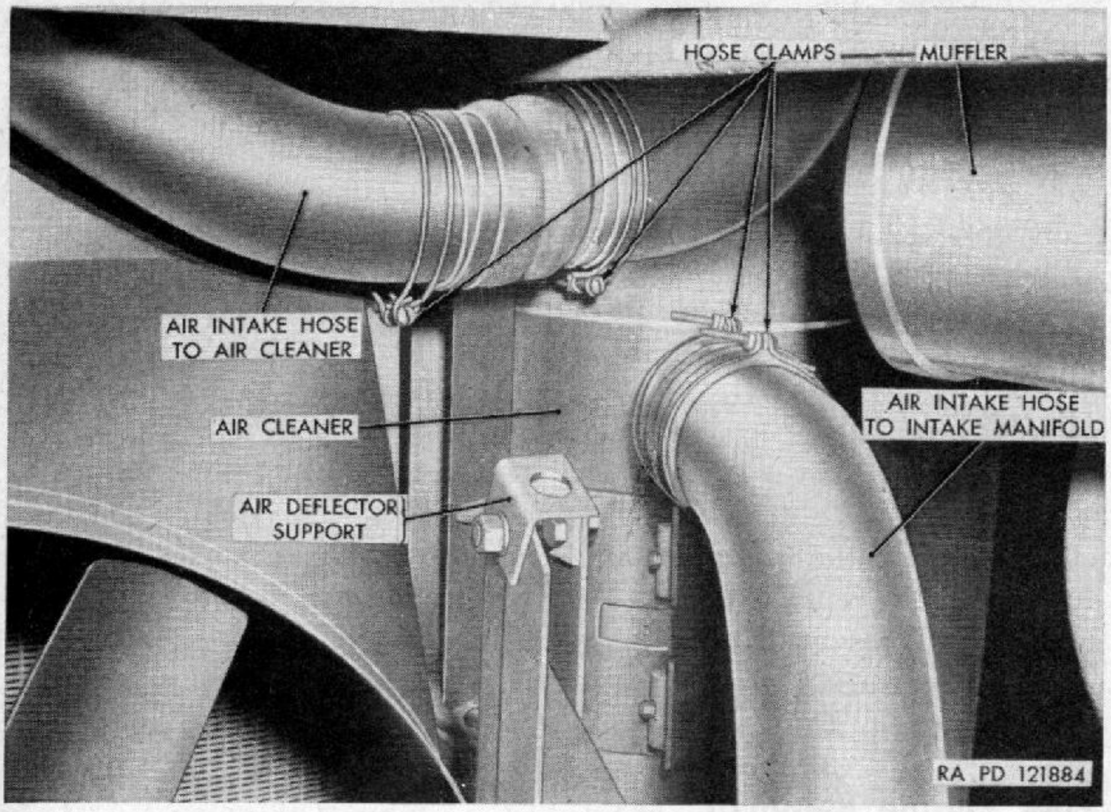


Figure 36. Air intake hose connections.

60). Relieve tension from fan drive belts at rear of engines, by loosening lock nuts and adjusting nuts (fig. 27). Remove yoke pins connecting the tightener rods to belt tightener arms (fig. 39). Working in rear seat compartment, remove three cap screws on each side of the cab that attach side engine hoods to top of cab. Remove four cap screws on each side of tractor to disconnect supporting frame from rear sides of radiator shells. Remove six bolts that attach rear ends of the three fan drive gear housing supports to rear cross-member of radiator supporting frame. Remove two cap screws and two bolts on each side of tractor that attach rear side of radiator supporting frame to hull and fenders and three bolts on each side that attach engine hood frame to hull and fenders. Disconnect the three wires from generator regulator terminals (fig. 84) and remove bolts from clip on largest wire. Remove engine oil gages (fig. 34). Disconnect air pipes from air compressor air pressure governor at the governor and remove cap screw and bolt from clips on these pipes attached to radiator supporting frame. Disconnect the other end of these pipes that lead to the compressor (fig. 121). Remove two cap screws from clips that secure pipe to side of hull and remove the pipe. Attach lifting chain to top angles and raise assembly a few inches, prying radiator supporting frame away from radiator as it is raised. Move assembly back off the rear end of tractor (fig. 38).

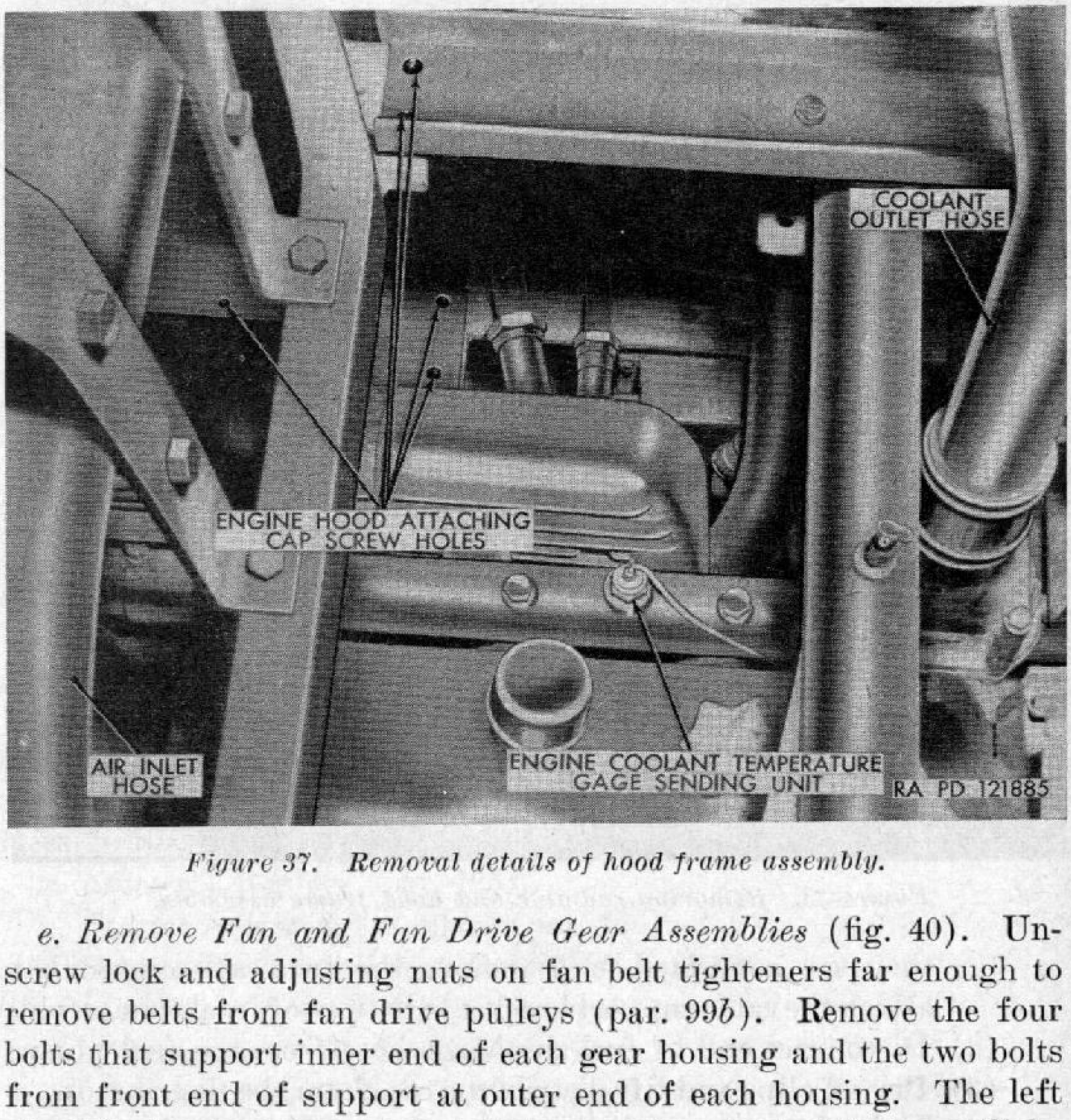


Figure 37. Removal details of hood frame assembly.

e. Remove Fan and Fan Drive Gear Assemblies (fig. 40). Unscrew lock and adjusting nuts on fan belt tighteners far enough to remove belts from fan drive pulleys (par. 99*b*). Remove the four bolts that support inner end of each gear housing and the two bolts from front end of support at outer end of each housing. The left air deflector lower support and support for right deflector will be removed by this operation. Remove two bolts that attach right rear air deflector lower support to air baffle plate between engines and remove deflector support. Remove each fan and fan drive assembly as a unit (par. 133*a*).

f. Remove Upper Coolant Pipes. Drain cooling systems (par. 131*a*). Remove bolts from clips and brackets on radiator expansion tanks supporting upper ends of coolant pipes (fig. 68), loosen hose clamps at both ends of pipes, and remove the two pipes (fig. 40).

g. Remove Fan Drive Shaft Assemblies. Remove the two fan drive belt tighteners (fig. 40) from rear of engines by removing two bolts from each mounting bracket. Remove remaining bolt from the front end of air baffle plate between engines and remove baffle plate (fig. 40). Remove the bolts from bearing brackets at each end of righthand shaft assembly as follows:

(1) Remove yoke pins to disconnect ends of choke and engine shut-off (switch) control cables (fig. 6) from levers to which

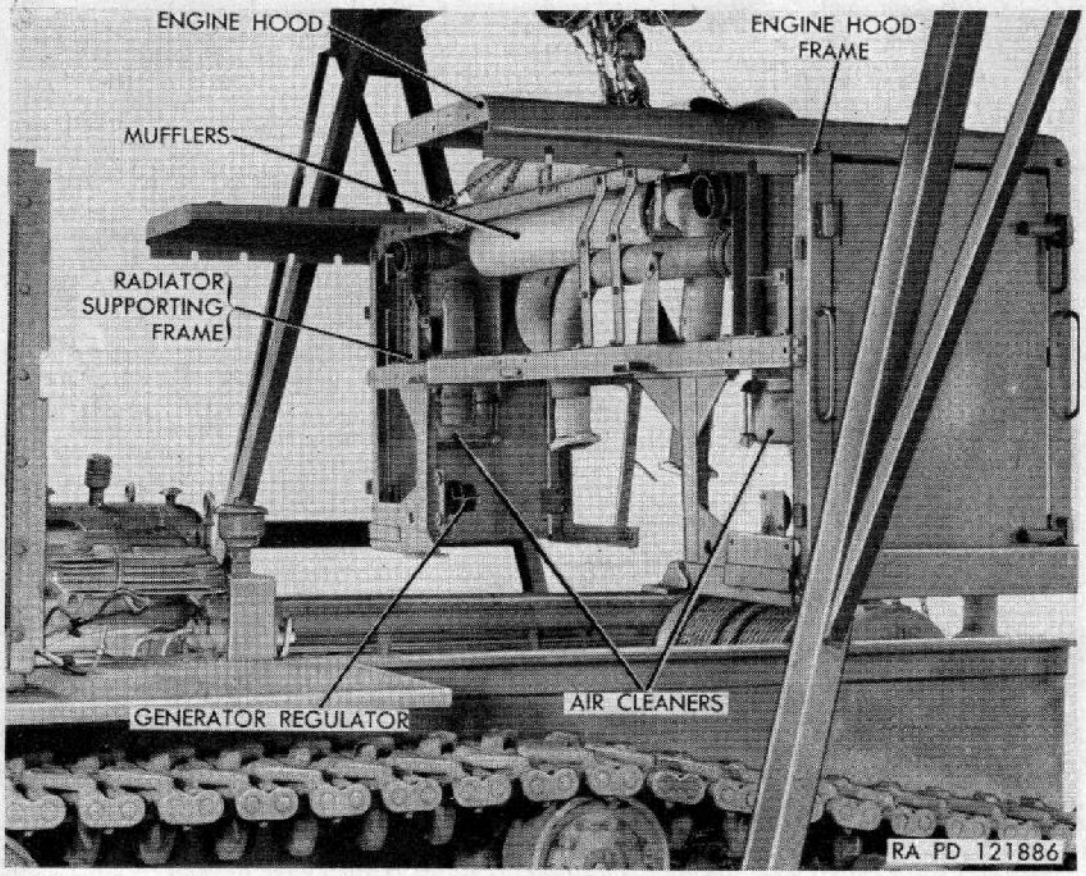


Figure 38. Removing radiator and hood frame assembly.

they are connected, and remove the two cap screws that attach the cable support bracket to bottom of intake manifold.

(2) Disconnect end of fuel discharge hose from the fuel pump.

(3) Pry off clips and lift distributor cap from the distributor.

(4) Unhook spring and disconnect the upper end of governor to carburetor rod from the lever on carburetor.

(5) Disconnect capacitor wire from front terminal of ignition coil. Remove rear mounting cap screw from coil and tip coil.

(6) Remove the two bolts from each of the fan drive shaft bearing brackets and remove drive shaft assembly from engines.

h. Disconnect Parts Attached to Outer Side of Left Hand Engine.

(1) Relieve tension on air compressor drive belt (par. 99*e*), and remove yoke pins connecting belt adjusting rod to tightener arm. Loosen hose clamps on hose connecting compressor to compressor air cleaner, and slip hose up on pipe. Disconnect air discharge pipe (fig. 123) from air compressor.

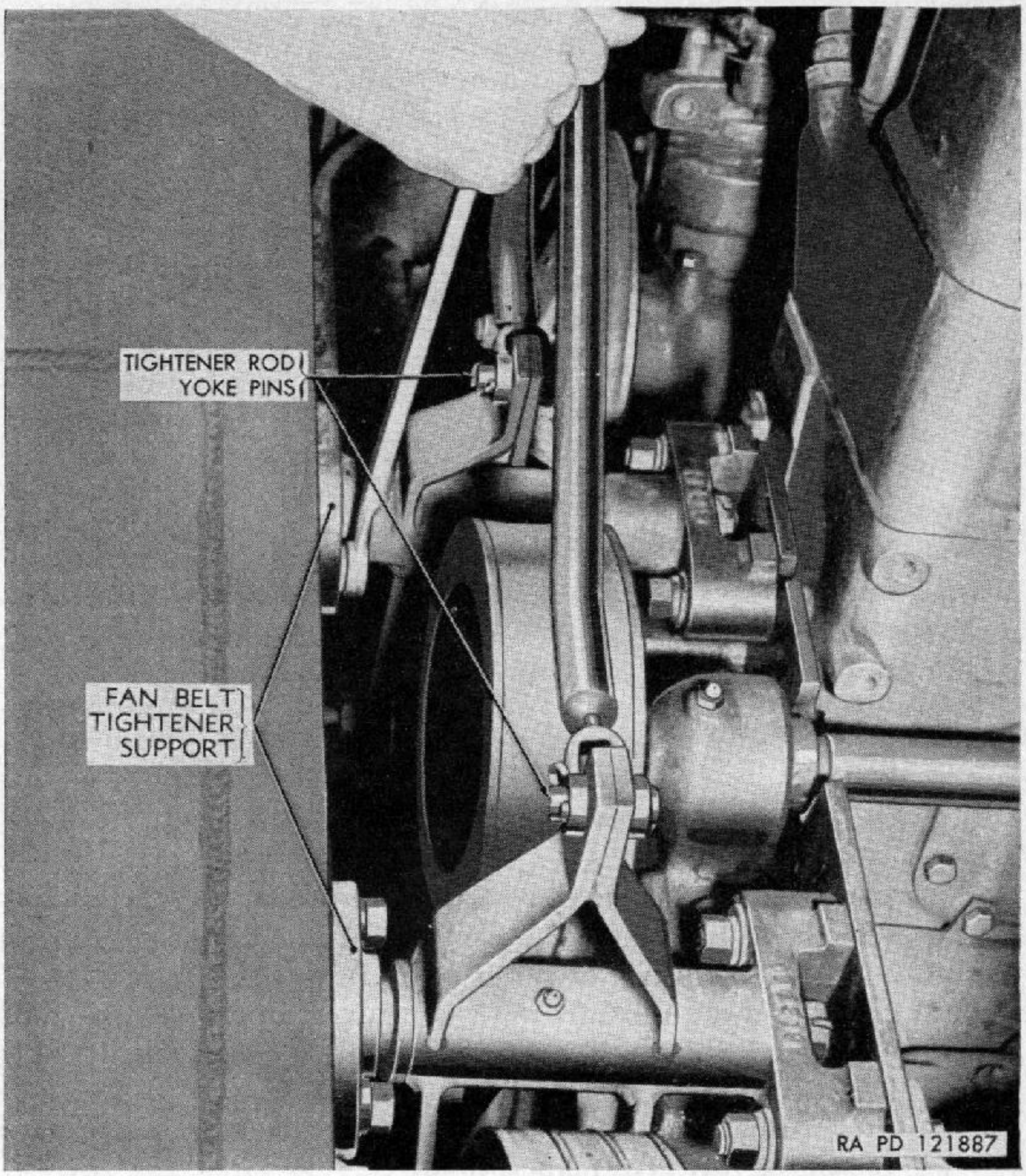
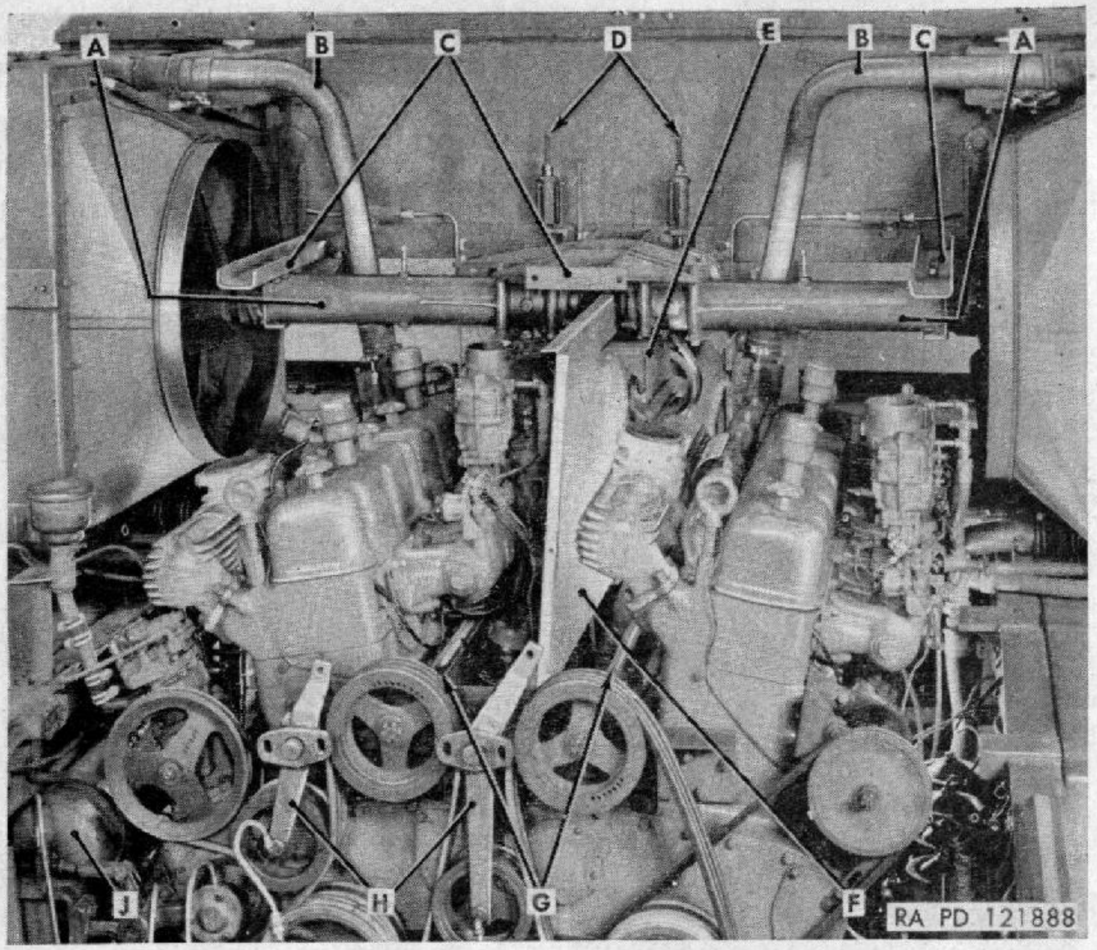


Figure 39. Removal details at rear of engines.

(2) Remove bolts from clips and brackets, and loosen hose clamps on hoses at each end of coolant pipe leading from water pump to bottom of radiator. Remove attaching cap screws and drop hull bottom plates (fig. 62) below engines. Disconnect water drain hoses from fittings below water pump at left of engine (fig. 46). Unscrew retaining nut and pull end



A—FAN DRIVE GEAR ASSY
B—WATER PIPES
C—FAN DRIVE SUPPORTS
D—FAN BELT ADJUSTING BOLTS
E—AIR DEFLECTOR SUPPORT
F—AIR BAFFLE PLATE
G—FAN DRIVE SHAFTS
H—FAN DRIVE BELT TIGHTENERS
J—UPPER AIR COMPRESSOR AIR RESERVOIR.

Figure 40. Fan and drive gear assemblies installed.

of wiring harness from bottom of the electrical junction box ahead of and above air reservoir.

i. Make Disconnections at Front of Engines.

(1) Remove yoke pins from front end of clutch control rods connected to the clutch release levers and clutch shaft (fig. 42).

(2) Remove jam nuts and pull ends of the five lubricating hoses out of the rear floor plate support.

(3) Remove cap screws attaching clamps to the clutch housing.

(4) Remove four cap screws to disconnect each of the two clutch shaft mounting brackets from the clutch housing (fig. 42).

(5) Remove cap screws from torque converter pressure relief valve supporting clamp (fig. 42).

(6) Remove cap screw that attaches clip on primer fuel pipe to choke and engine shut-off cable support of left hand engine. Remove the two cap screws from coolant pipe support (fig. 43)

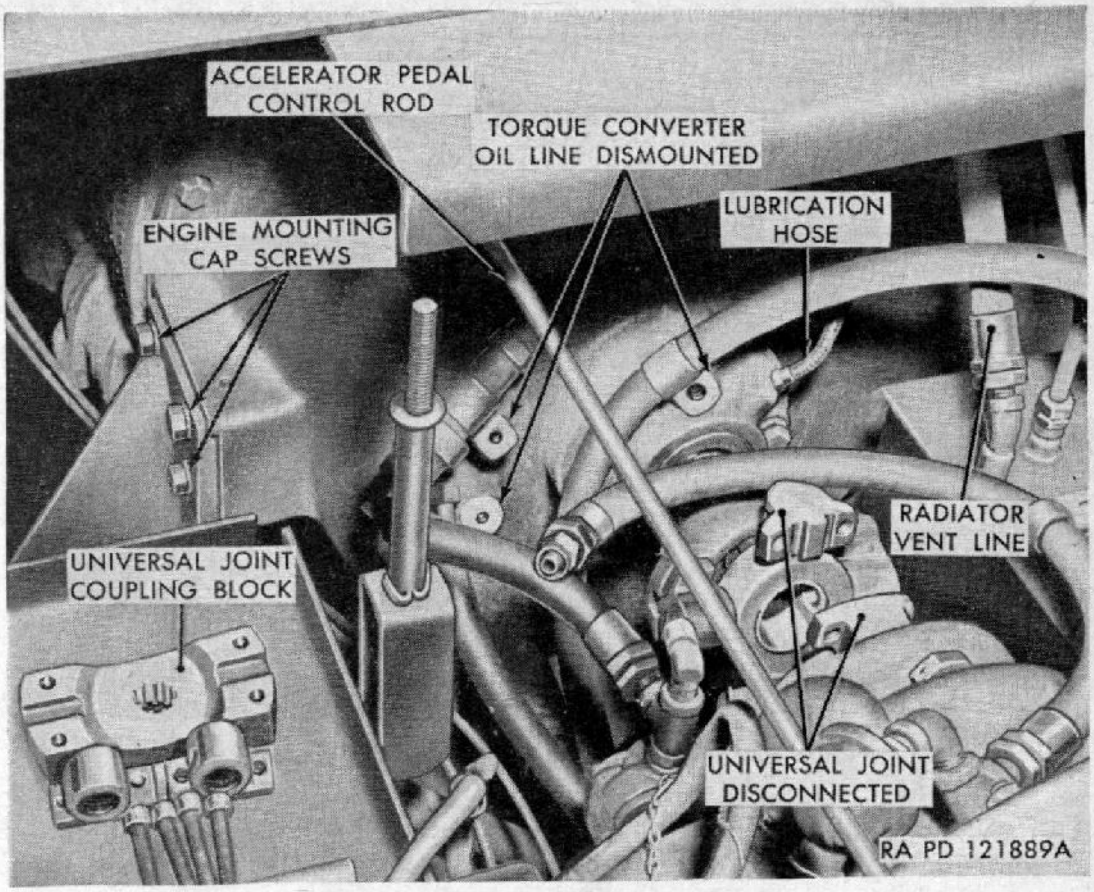


Figure 41. Connections at right front of engine.

that secures the water pump inlet pipe to left side of cylinder block of left hand engine, loosen hose clamps on both ends of pipe and remove the pipe.

(7) Remove pin from bellcrank and rear end of accelerator pedal control rod (fig. 41). Remove the pin to disconnect left end of throttle shaft connecting link from lever on throttle shaft on intake manifold of the left hand engine.

(8) Remove four cap screws on clutch drive shafts and remove universal joint coupling block (fig. 41). Removing this block will aid when installing engines because it is not necessary to line up the splines.

j. Disconnect Parts Attached to Outer Side of Right Hand Engine.

(1) Disconnect positive battery cable from starter solenoid on the right hand engine (fig. 44). Disconnect the upper end of choke and engine shut-off control cables from bellcranks at rear of intake manifold. Remove the two cap screws to disconnect cable support bracket from manifold.

(2) Disconnect engine primer fuel line from primer manifold (fig. 52).

(3) Disconnect tachometer flexible shaft assemblies from tachometer drives of both engines located below and to the front of the distributor shaft.

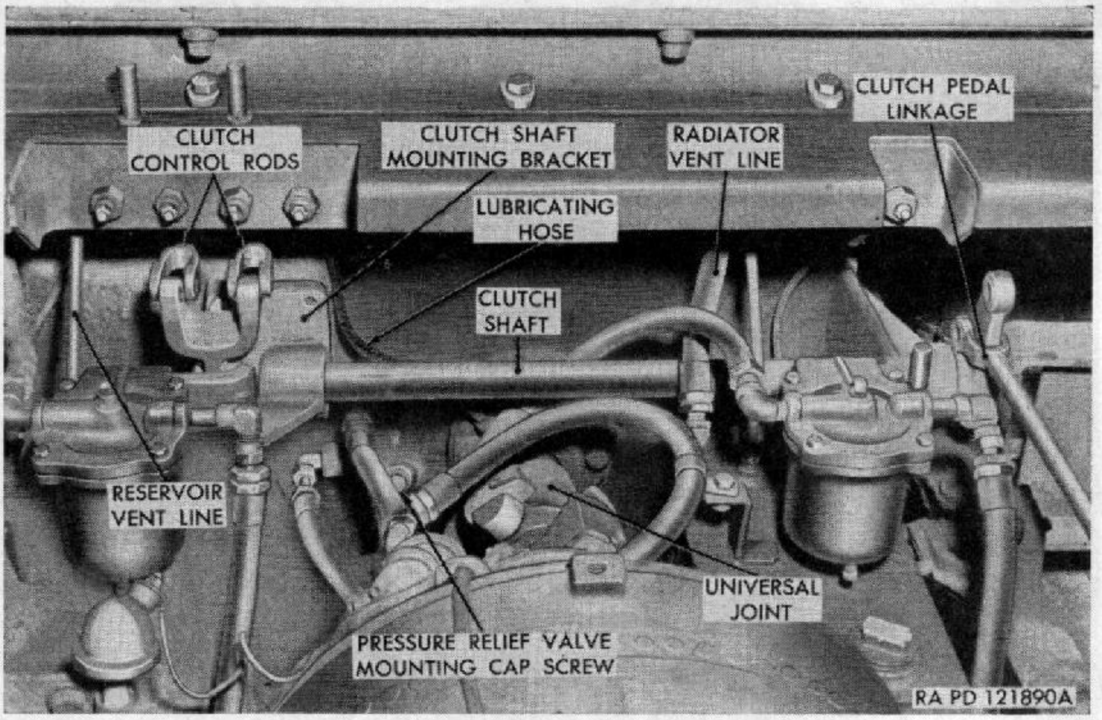


Figure 42. Connections at left front of engine.

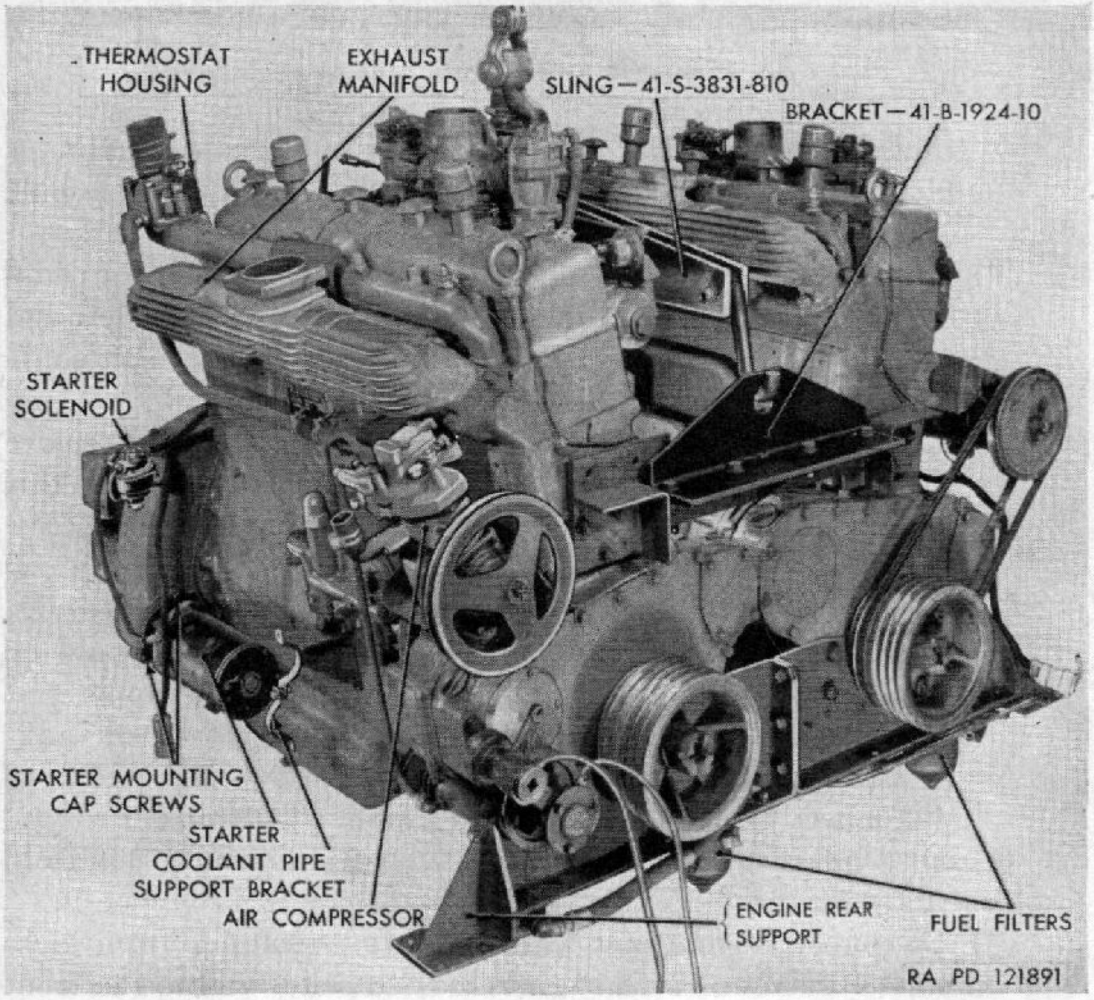


Figure 43. Left rear view of engines.

(4) Disconnect engine oil filter hose near the fuel pump. Disconnect oil hoses at base of filters; disconnect oil pipes below electrical junction box at the rear of engine.

(5) Unscrew retaining nut and pull end of engine wiring harness from bottom of electrical junction box (fig. 46). Disconnect the two wires from generator terminals (fig. 44).

k. Install Engine Sling and Brackets.

(1) The engine lifter assembly consists of front bracket 41–B–1924 (fig. 44), rear bracket 41–B–1924–10 (fig. 43), and a

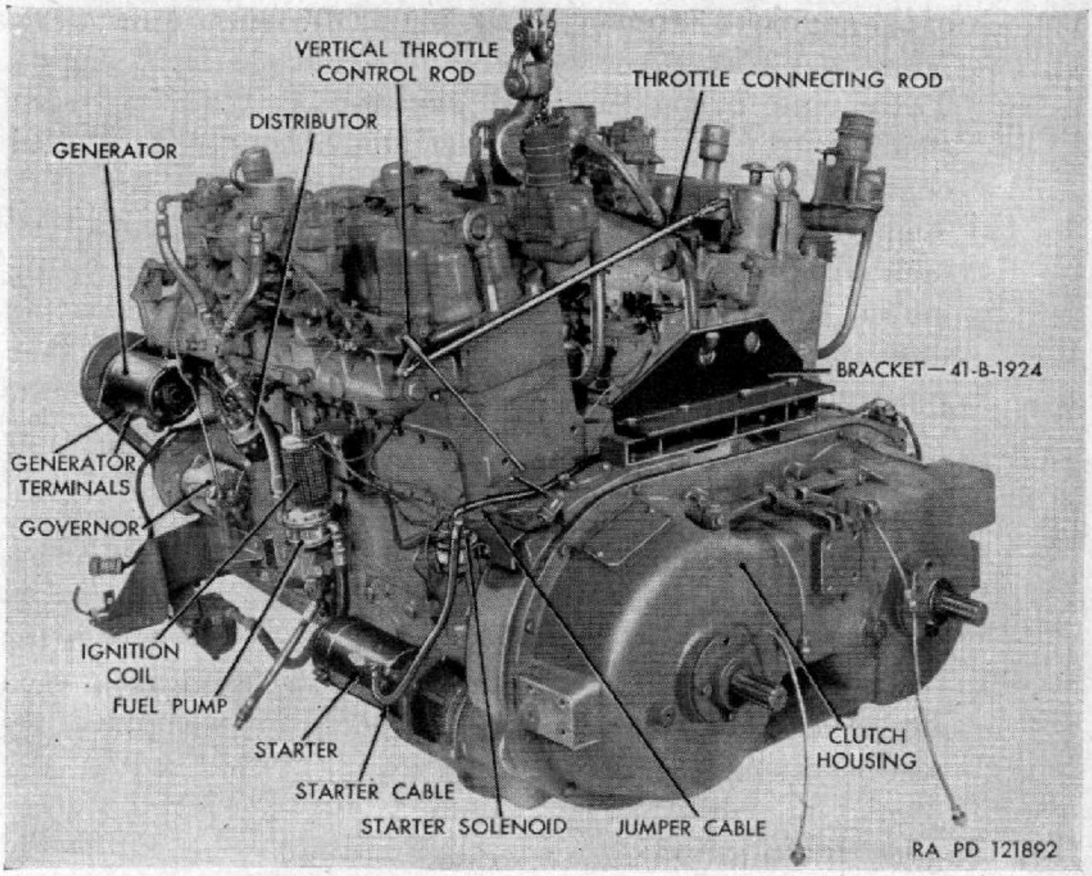


Figure 44. Right front view of engine.

lifting sling 41–S–3831–810 (fig. 43). Bolt the front bracket to the fan drive shaft support connected to the two flywheel housings, using the four bolts removed from the fan drive shaft bearing brackets.

(2) Bolt the rear bracket to the fan drive shaft support at rear of engines in the same manner; then install the lifting sling with the shortest end of sling toward flywheel end of engine. Connect hoisting chain to lifter bar and take up the slack, being careful not to allow bar to catch on parts connected to intake manifold of the left engine.

l. Lift Engines From Tractor.

(1) Remove the four engine mounting cap screws that attach each of the engine front supports to sides of clutch housing

(fig. 41) and the eight cap screws and two bolts that attach engine rear supports to hull (fig. 27). Hoist engines and work them toward rear of tractor until clutch shafts slip out of universal joints.

(2) Raise engines so that fuel filters will clear bottom of hull and move them back slowly, turning and raising engine to miss parts attached to sides of the hull until they can be hoisted out of hull.

m. Lift One Engine From Clutch Housing (fig. 45).

(1) Disconnect jumper cable from terminal of starter solenoid of the engine to be removed (fig. 44). Disconnect water drain hose from inlet elbow of water pump of the right engine. Tilt engines to one side until engine to be removed stands straight up. Place blocks under clutch housing and other engine.

(2) Remove two cap screws from fan drive shaft support. Attach sling 41–S–3831–810 to lifter eye of engine to be removed, and take weight of engine on chain. Remove six nuts and lift fan drive shaft rear support off studs; then remove the three bolts that connect the engine rear supports and the cap screws that attach clutch housing to engine flywheel housing. Pull engine straight forward until it is free of clutch shaft (fig. 45). If second engine is to be removed from clutch housing, suspend engine with sling and hoist, then block up under clutch housing, disconnect clutch housing from engine, and lift engine away from it. Remove the fuel filters (par. 108). Remove four cap screws from each engine support which attaches support to the engine if replacement engines are to be installed.

105. Engine Installation

a. Assemble Engines.

(1) *Install clutches and engine supports.* If installing replacement engines, the clutch, fuel filters, fuel filter hoses, coolant drain hose, rear support, and oil pipes must first be installed on each engine. Install the two engine rear supports to the engine with four cap screws. Install fuel filters (par. 108). Install the fuel pump lines. Install clutches on flywheels as explained in paragraph 179.

(2) *Assemble engines and clutch housing* (fig. 45). Block up one end of clutch housing so the engine can be held straight up and holes for cap screws in clutch housing will line up with holes in engine flywheel housing. Raise engine with lifting sling 41–S–3831–810 so that clutch shaft is in line with splined hub of clutch, and move engine back against clutch

housing. Install 10 cap screws and lock washers to attach clutch housing. Block up the engine and tilt it so the second engine can be held straight up while it is installed. Attach the second engine to clutch housing in the same manner as the first, then install and tighten three bolts with lock washers to connect the engine rear supports.

(3) *Install and connect throttle linkage and hoses.* Install hose leading from fuel filter to fuel pump on each engine (fig. 45). Install and connect coolant drain hose that leads from elbow in rear support for the left engine to inlet elbow of water pump on right engine (fig. 45). Connect oil hoses

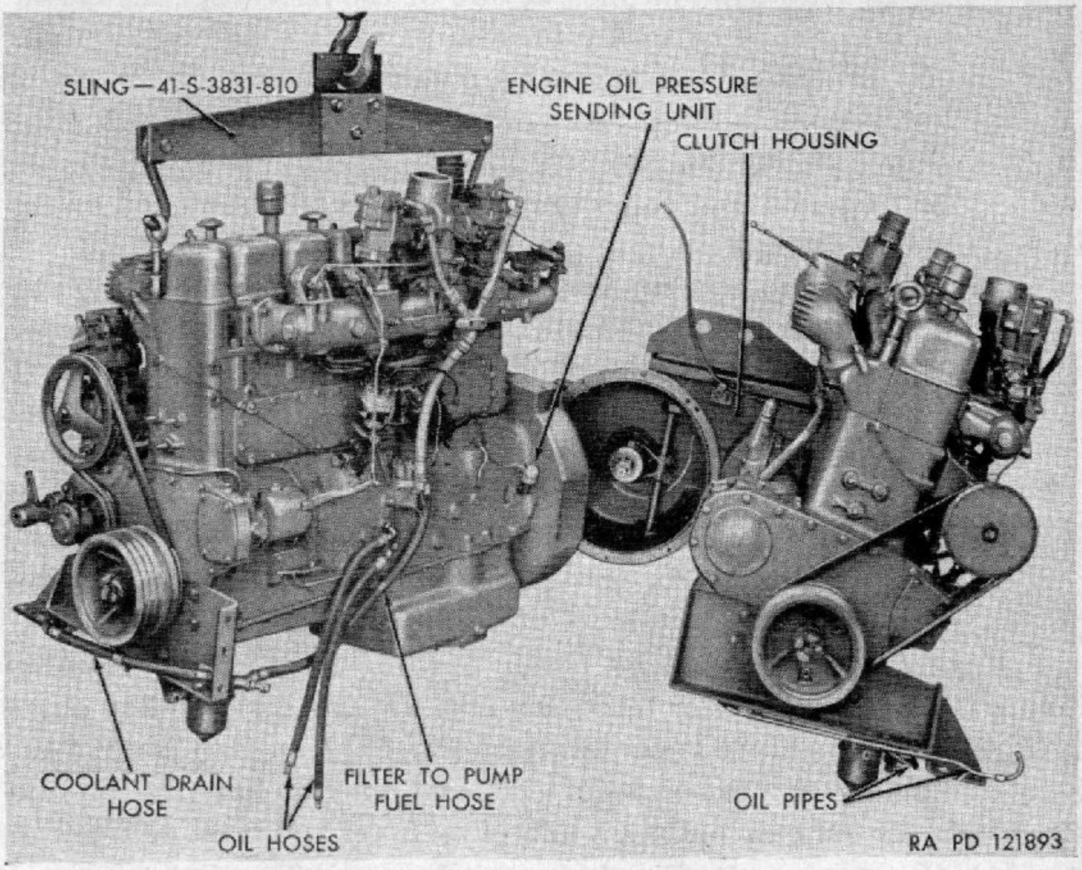


Figure 45. Separating left engine from right engine.

leading from left hand engine to pipes at bottom of rear support of right hand engine. Install brackets with assembled throttle shafts and links on each engine on front ends of intake manifolds with two cap screws and lock washers (fig. 52). Connect link rods to choke valve and engine shut-off air valve levers. Make sure all control linkage is attached securely and is not damaged. Connect vertical throttle control rod to lever at front end of throttle shaft of right engine (fig. 44). Install and connect jumper cable to rear terminals of starter solenoids (fig. 44), and attach clips on this cable to timing cover cap screws.

(4) *Install fan drive shaft supports.* Install front support on flywheel housing, using four cap screws and lock washers. Place rear support on the three studs in front ends of cylinder blocks and secure with nuts and lock washers.

b. Install Engines in Tractor.

(1) *Install engine lifting brackets.* Install front bracket 41–B–1924 and rear bracket 41–B–1924–10 to the fan drive shaft supports (par. 104*k*).

(2) *Set engines in tractor.* Using engine lifting sling 41–S–3831–810 (fig. 43) and hoist, raise engines high enough to swing them over hull. Lower them in hull until the fuel filters are within an inch or two of the floor, then maneuver them forward carefully to miss parts attached to the sides of the hull. After engines are moved forward far enough, lower them so the propeller shaft universal joints will aline (fig. 41). Install universal joint coupling block, yoke cross bearing, and four cap screws. Tighten cap screws and secure with locking wire.

(3) *Attach engines to support.* Install four engine mounting cap screws (fig. 41) and lock washers through each engine front support and into sides of clutch housing. Install shims, if necessary, between center of rear engine support and hull (as many as can be crowded in), and attach rear engine support (fig. 27) to hull with four cap screws and lock washers at each end and two bolts with lock washers at center support. Remove engine lifting sling and brackets. Install oil level (bayonet) gages in sides of crankcase (fig. 34).

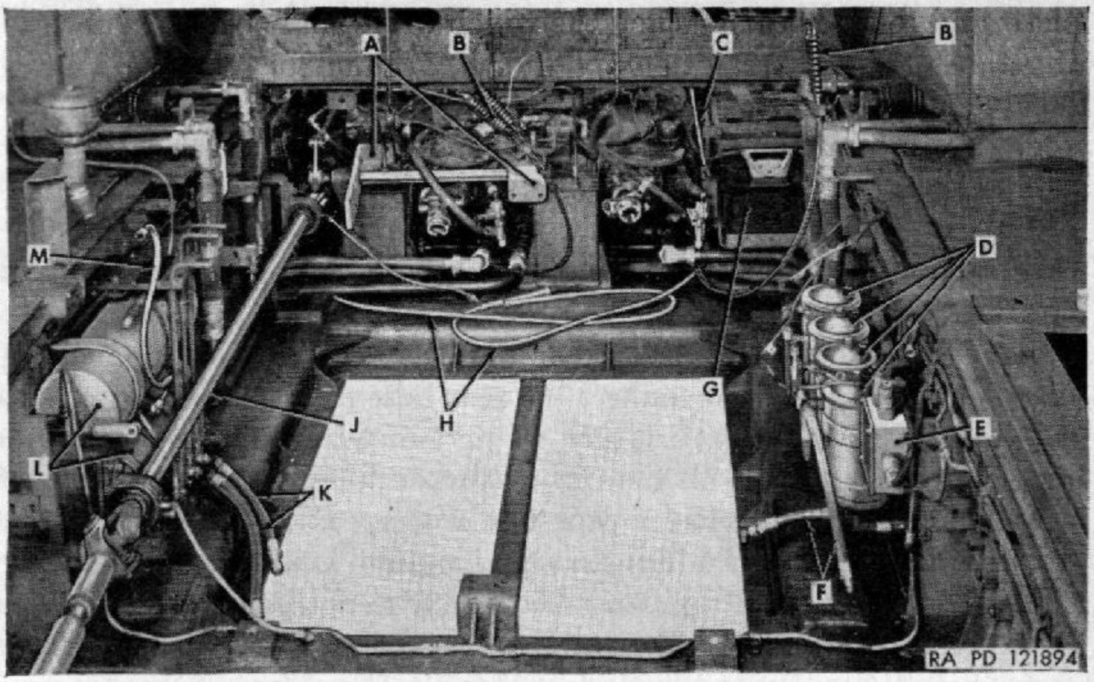
c. Make Connections Along Outer Side of Right-Hand Engine. Connect wires to generator terminals (fig. 44) (No. 41 cable to outer terminal, No. 42 cable to lower terminal (fig. 98)). Insert plug of engine wiring harness into bottom of electrical junction box (fig. 27) and screw retainer nut onto outlet. Connect oil hoses and pipes as follows:

(1) Connect hose leading from top of rear oil filter to longest end of pipe at rear of engine; connect hose leading from bottom of rear filter to pipe alongside fuel filter; connect the shortest of the two hoses leading from side of cylinder block to upper fittings of front filter, and the longest of the two to fittings at lower end of filter. Tighten connections securely.

(2) Connect ends of tachometer flexible shaft assemblies to tachometer drives on each engine located at lower front of each distributor shaft.

(3) Connect end of primer fuel lines to primer manifold on each engine (fig. 52).

(4) Attach choke and engine shut-off cable support bracket to bottom of intake manifold of right hand engine with two cap



A—CLUTCH CONTROL SHAFT MOUNTING BRACKETS
B—CHOKE AND ENGINE SHUT-OFF CABLES
C—THROTTLE CONTROL ROD
D—OIL FILTERS
E—ELECTRICAL JUNCTION BOX
F—OIL HOSES
G—BATTERY
H—TACHOMETER DRIVE SHAFTS
J—WINCH DRIVE SHAFT ASSY
K—WATER DRAIN HOSES
L—AIR RESERVOIRS
M—AIR COMPRESSOR DISCHARGE PIPE

Figure 46. View of engine compartment with engines removed.

screws and lock washers (fig. 51). Connect choke valve cable to the front bellcrank (choke) and the engine shut-off cable to the rear bellcrank (engine shut-off) with yoke pins and cotter pins (fig. 56).

(5) Connect battery cable to terminal of the starter solenoid of the right hand engine (fig. 44).

d. Make Connections at Front of Engines. Install the accelerator pedal control rod to connect the accelerator pedals of the two engines (fig. 41). Secure yoke pins with cotter pins. Connect rear end of throttle control rod leading from accelerator and hand throttle to lever of bellcrank on clutch housing with yoke pin and cotter pin. Install the coolant pipe that connects to the water pump and radiator. Coat inside surfaces of ends of hoses with shellac. Tighten hose clamps at each end and install clamp on coolant pipe support bracket (fig. 43) at center of cylinder block with two bolts and lock washers. Install cap screws to attach torque converter pressure relief valves to the clutch housing (fig. 42). Attach clamp of the converter oil hoses with a cap screw to clutch housing bearing retainer. Connect each of the two clutch shaft mounting brackets to the clutch housing with four cap screws with lock washers (fig. 42). Insert ends of the four clutch shaft and release bearings and the winch drive shaft bearing lubricating tubes through rear floor plate support and install jam nuts to secure them. Install yoke pins and cotter pins to connect clutch control rods on clutch release levers to levers on clutch control shaft (fig. 42). Connect clutch shaft universal joint with four cap screws (fig. 42).

e. Make Connections Along Outer Side of Left Hand Engine. Insert plug of wiring harness into socket in bottom of electrical junction box, and screw retaining nut onto outlet (fig. 70). Connect the end of the front water drain hose to fitting on inlet elbow of water pump of left hand engine, and connect the rear hose to fitting in engine rear support (fig. 27). Install larger water pump-to-radiator water pipe in the same manner as on the right hand engine (*d* above). Connect air compressor air discharge pipe to air compressor (fig. 123). Connect the air compressor air cleaner and tighten hose clamps. Connect compressor drive belt tightener rod to tightener arm with yoke pin and cotter pin (fig. 27). Adjust air compressor drive belt (par. 99*e*).

f. Install Fan Drive Shaft Assemblies. Disconnect capacitor lead from distributor and pull end of wire out of center socket of distributor cap. Remove distributor cap and remove rear mounting bolt from ignition coil and tip the coil. The left hand fan drive shaft can now be placed on the supports at ends of engines (fig. 40). Install two bolts with lock washers in each bearing bracket at ends of shaft. Install coil mounting bolt, and connect capacitor lead to distributor. Replace distributor cap and wire in center of cap. Connect governor to carburetor rod to lever on throttle shaft and drive shaft.

g. Connect Choke and Engine Shut-Off Control Cables. Attach support bracket for choke and engine shut-off control cables to bottom of intake manifold on left hand engine with two cap screws and lock washers (fig. 51). Place cables against bracket (choke cable to rear), place clamp block against cables, then insert cap screw through clip on engine fuel primer line and through cable clamp. Tighten cap screw after connecting primer line to primer manifold. Connect cables in the same manner for the right hand engine.

h. Install Fan and Fan Drive Gear Assemblies. Place the fan and fan drive gear assemblies in the positions shown in figure 40. Secure each of the assemblies to center support with four bolts with lock washers at inner ends (bolts to be inserted through housing and support from bottom and with air deflector supports installed below housings on these same bolts). If outer end supports were removed, attach front ends of these supports to front cross member of radiator supporting frame with two bolts and lock washers, then attach outer ends of housing to center of supports with two bolts and lock washers. Do not tighten any of the above bolts until radiator and hood frame assembly has been installed (fig. 38).

Note.—The air deflector lower supports are not alike. The difference in the lower supports is the length of each support and the method of attachment.

Either fan and fan drive assembly can be used on either side of the tractor; however, in order to change one from one side to the other, the housing must be turned so that the drive belt pulley is toward the cab; this necessitates changing the drain plug and breather to opposite sides of the housing. Install air baffle plate between engines, attaching bottoms of plate to engine attaching cross brackets with two bolts, and attach top of plate to air deflector lower support bracket with two bolts.

i. Install Upper Coolant Pipes. Coat inner sides of ends of connecting hoses with shellac and connect coolant pipes to radiators and thermostat housings (fig. 40). Tighten hose clamps; then install bolts to attach support brackets on these pipes to radiator expansion tanks (fig. 68).

j. Install Radiator and Engine Hood Frame Assembly. Lift assembly onto tractor with hoist and move it into position against rear sides of radiators (fig. 38). Attach radiator supporting frame to rear sides of radiator shells with two cap screws and lock washers in each upper and lower mounting pad. Attach bottom angles of radiator supporting frame to fenders and hull with two cap screws and lock washers, and two bolts on each side of vehicle. Attach bottom angles of engine hood frame to hull and fender with three bolts on each side of tractor. Attach front end of each engine side hood to back of cab with three cap screws and lock washers. Connect rear ends of the three fan drive gear supports to radiator supporting frame with two bolts in each. Securely tighten all fan drive gear housing mounting bolts and bolts that attach housing supports to radiator supporting frame. Connect air pipe leading from air reservoir to upper fitting on air pressure governor, and install cap screws to attach pipe clip to radiator supporting frame. Install air pipe leading from air compressor to lower fitting on governor, and install two bolts in clips that secure this pipe to side of hull. Connect each exhaust elbow to exhaust manifold with four bolts (fig. 60) (loosen muffler mounting bolts, if necessary, to aline elbow with manifold mounting flange and tighten them again after connections have been made). Adjust hoses to connect lower ends of air pipes to carburetor air inlets, and tighten hose clamps (fig. 61). Connect ends of three wires to generator regulator with No. 41 cable to center terminal, No. 42 to outside terminal, and large cable to inside terminal (fig. 98). Remove tape from end of battery ground cables and connect them to inside of battery support with cap screws and lock washers.

k. Install Fan Drive Belts, Air Intake Pipes, and Hood Grilles. Install fan drive belts on pulleys at front end of engine (par. 99*b*). Adjust cooling fan drive belts (par. 99*a*). Install belt tightener rods, yoke pins, and cotter pins at rear end of engines (fig. 39). Install belts on fan drive shaft and crankshaft pulleys (par. 99*b*). Position engine top grille doors on hinges, install hinge pins, and cotter pins. Insert ends of the large air intake pipes through holes in engine side hoods and into hoses that connect them to air cleaner (fig. 36). Install four attaching cap screws to attach intake at front of each pipe to cab roof (fig. 3); then install a pipe clamp (fig. 3) over each pipe with two cap screws in each. Tighten clamps on hoses connecting these pipes to air cleaners (fig. 36).

l. Install Fuel Tank. Refer to paragraph 107. Adjust fan drive belts at rear of engines (par. 99*a*).

m. Start Engines and Test For Operation. Fill cooling system (par. 131*b*). Adjust choke and carburetor controls (par. 114). Check master clutch adjustment (par. 178*b*). Lubricate and service all units concerned in replacement of engines, and check crankcase oil levels; fill if necessary (par. 70). Examine all connections for fuel, oil, air, or water leaks, and correct any leaks found. Make sure all bolts are tight and cotter pins have been installed where required. After the above service and inspections, start engines (par. 45) and observe all instruments for proper functioning of units to which they apply. Test for proper operation and adjustment of engine throttle controls (par. 114). Examine vehicle again for leaks with engines running. If no leaks are evident and engines perform satisfactorily, install ammunition box (par. 214*b*) and hull bottom plates; then lower floor plate in rear seat compartment and install seats and backs.

n. Record of Replacement. Record the replacement on DA AGO Form 478, MWO and Major Unit Assembly Replacement Record, and Organization Equipment File.

Section VII. FUEL, AIR-INTAKE, AND EXHAUST SYSTEMS

106. Description and Data

a. Description.

(1) *Fuel system.* The fuel supply is carried in the 300-gallon fuel tank underneath the ammunition box (fig. 49). The fuel is drawn from the tank and delivered to the carburetors by two fuel pumps, one on each engine (fig. 58), which are operated by cams on the engine camshafts. The fuel is strained through fuel filters (fig. 27) as it passes to the fuel pumps to remove dirt or foreign material that may be in the fuel tank. A single discharge hose connected to each fuel pump leads to a **Y**-fitting on the intake manifold from which two hoses lead to the carburetors (fig. 52). Air is mixed with the fuel in the carburetors and the mixture of fuel and air is drawn into the cylinders through the intake manifold. The amount of fuel delivered to the cylinder for desired speed

or power is controlled by the carburetor throttle controls connected to the accelerator and hand throttle lever.

(2) *Air-intake system.* The air-intake system for each engine consists of two air intake pipes with cover and screen, two oil bath air cleaners (fig. 54), and connecting hoses (fig. 61). The air is drawn from the atmosphere through the air pipes, then through the oil bath air cleaners, where it passes through oil filled mats. The dust and foreign material drawn in with the air is removed before the air passes through the connecting hose to the carburetor. Fuel from the carburetors mix with the air as it is drawn through the carburetors, forming a combustible mixture which is drawn into the cylinders of the engine through the intake manifold and intake valves.

(3) *Exhaust system.* After the combustible mixture of air and gasoline is ignited and burned on the power stroke of the pistons, the burned gases are discharged from the cylinders through the exhaust valves into each individual exhaust manifold (fig. 60). The exhaust gases then pass through individual exhaust pipes and mufflers to the atmosphere (fig. 61).

(4) *Fuel tank.* The fuel tank with a capacity of 300 gallons is mounted in the bottom of the hull under the ammunition box (fig. 49). A sediment sump with drain valve at rear bottom of tank allows water and sediment to settle from tank and be drained out with a minimum waste of fuel (fig. 48). Two flexible hoses lead from the tank to the engines; two other outlet hoses on right side of tank are connected to the engine primer pump fuel lines (fig. 49). Two valves with hoses leading to fittings at side and rear of hull provide for supplying fuel to heaters that can be connected to these fittings if necessary during cold weather operation (figs. 47 and 49).

(5) *Fuel filters.* Two fuel filter assemblies are used in the fuel system. They are located just ahead of the engine supports (fig. 27) and are reached through inspection holes in bottom of hull (fig. 62). Each filter consists of a disk type strainer element contained in a case held against the filter head by a cap screw (fig. 50).

(6) *Fuel pumps.* Each engine has a fuel pump mounted on the lower right side of the cylinder block (fig. 44). The purpose of these pumps is to draw fuel from the fuel supply tank and pump it into the carburetors as required. The pumps are operated by rocker arms in the pumps contacting eccentrics on the engine camshafts. Normal fuel pressure is from $3\frac{1}{2}$ to 4 psi.

(7) *Primer pumps.* Two primer pumps are mounted in the instrument panel, one for each engine (fig. 6). They are piston type pumps with a plunger and leather diaphragm for drawing fuel through lines connecting them to the fuel tank and pumping it through other lines to the primer manifolds on the intake manifolds. The purpose of the pump is to deliver extra amount of fuel to the intake manifold to aid in starting the engines.

(8) *Engine shut-off valves.* Each engine shut-off valve assembly consists of a butterfly-type air valve assembly located on intake manifold between the carburetors (fig. 51). Both the engine shut-off valve and the ignition switch are operated by the same cable from the engine shut-off control knob on the instrument panel (fig. 6). Pushing in on knob opens the air valve and opens ignition switch at the same time. The air valve is provided and used in conjunction with the ignition switch to prevent the engine from continuing to run through self ignition. Pushing in on knob allows air to be drawn into the engine directly from the atmosphere, instead of being drawn through the carburetors and being mixed with fuel.

(9) *Air cleaners.* The air cleaners, mounted at rear sides of the radiators (fig. 54), filter all dust from the air before it is delivered to the engines. Air enters the top of each cleaner through the intake tube on the roof of the cab (fig. 3). The air is given a swirling motion and most of the dust in the air is thrown to the outside and deposited in a large dirt receptacle attached to side of cleaner body (fig. 54). The air is then drawn through the screen mats in the cleaner body. An oil cup, suspended from the lower end of the air cleaner, is filled with oil. As the air is drawn through the cleaner, a portion of this oil is whipped up into the screen mats in the main body of the cleaner. The dust in the air collects on these oily screen mats as the air passes through; as a result, only clean air reaches the engine. The oil dripping back into the cup from the screen mats carries the dirt with it and deposits it in the cup.

(10) *Carburetors.* Two Zenith downdraft carburetors are mounted on the intake manifold of each engine and connected to a single air inlet connection (fig. 52). The carburetors are of the "set" main jet type needle valve and with adjustable idling screw. Synchronization of the carburetors and throttles is accomplished by adjustment of the connecting rods and linkage (fig. 56). The fuel and air is mixed in the carburetors and metered to the engines according to

load and speed requirements. The speed of the engines is controlled by the hand throttle or accelerator pedal. The governors, which are connected by linkage to the throttle shaft levers of the carburetors, limit the top speed of the engine (fig. 58).

Note.—The front carburetors have left hand bodies and the rear carburetors have right hand bodies which prevent their being interchangeable from front to rear of engines or vice versa.

(11) *Governor.* The governor on each of the engines is of the mechanical nonhunting flyball or flyweight type connected by linkage to the throttle control (fig. 59). The purpose of the governors is to prevent overspeed of the engines. The governor lever does not move until the engine speed is above 2,100 rpm. With the throttle fully opened, the engine should run at 2,100 rpm with clutch engaged and 2,300 rpm with the clutch disengaged. The governor-to-carburetor control rod (fig. 58) and the governor spring adjusting screw (fig. 59) must be adjusted correctly to maintain the correct engine speeds.

Note.—Many governors are adjusted unnecessarily because operators fail to realize that irregularities in engine performance are more often due to causes other than faulty governors.

A governor, when correctly adjusted, will seldom require attention. All other possible causes or irregular engine performance should be eliminated before adjusting or replacing the governor.

(12) *Intake manifold* (fig. 52). The intake manifold of each engine is of cast iron with jacketing which permits circulation of hot water from the engine over the entire inner casting. The carburetors and their controls are carried on the manifold. A primer manifold is located on the side of the manifold so that in cold weather fuel can be injected into the manifold by the primer pump to aid starting. The engine ignition switch and engine shut-off valves are also mounted on the manifold and are connected to a control cable operated by the engine shut-off control knob.

(13) *Exhaust manifolds.* The exhaust manifold on each engine is a three section iron casting with finned outer surfaces from which exhaust heat is rapidly dissipated. An exhaust elbow connection is provided in the center section (fig. 60). The front, center, and rear manifold sections are counterbored to receive heavy cast iron ferrules which, when the manifold becomes heated, expand and form exhaust tight joints.

(14) *Exhaust elbows and muffiers.* Two elbows, one for each engine, are attached to the exhaust manifold and mufflers

(fig. 61). The two mufflers, one for each engine, are suspended from the top of the engine hood frame (fig. 61). Exhaust gases are expelled from the top of muffler through a narrow slot which extends the entire length of the muffler. A hood with an opening at one end covers this slot.

b. Data.

Fuel filters (two):	
Make	A–C.
Model	T–2.
Type	Laminated disk.
Fuel pumps (two):	
Make	A–C.
Model	D–8274.
Pressure at outlet end of pump	3½ to 4 psi.
Air cleaners (two):	
Make	Donaldson.
Model—Left air cleaner	DN–AH 1224L.
Right air cleaner	DN–AH 1224R.
Type	Oil bath.
Carburetors (four):	
Make	Zenith.
Model—Front carburetor	29 BW–14.
Rear carburetor	29 BBW–14.
Type	Down-draft, fixed jet.
Governors:	
Make	Waukesha.
Type	Mechanical-centrifugal.
Setting	Spring tension.

107. Fuel Tank

a. Removal.

(1) *Disconnect fuel filler pipe and fuel lines.* Remove ammunition box (par. 214*a*). Remove two cap screws from fuel filler pipe support bracket (fig. 47). Remove cotter pins from prong at lower end of heater supply valve and detach lever from the supply valve (fig. 47). Remove cap screw from hose clamp (fig. 47). Disconnect rear end of rear heater fuel supply hose from fitting inside rear of hull. Disconnect second heater fuel supply line hose at lower right front corner of tank (fig. 49). Disconnect the two primer fuel hoses from fittings on fuel pipes to the right of generator drive pulley (fig. 49). Disconnect end of hose from lower end of fuel tank vent line (fig. 49). Remove fuel filter drain plug access plate (fig. 62) from bottom of hull. Reach through the holes and turn the two handwheel valves clockwise to close the fuel shut-off valves. Remove the two fuel lines at bottom

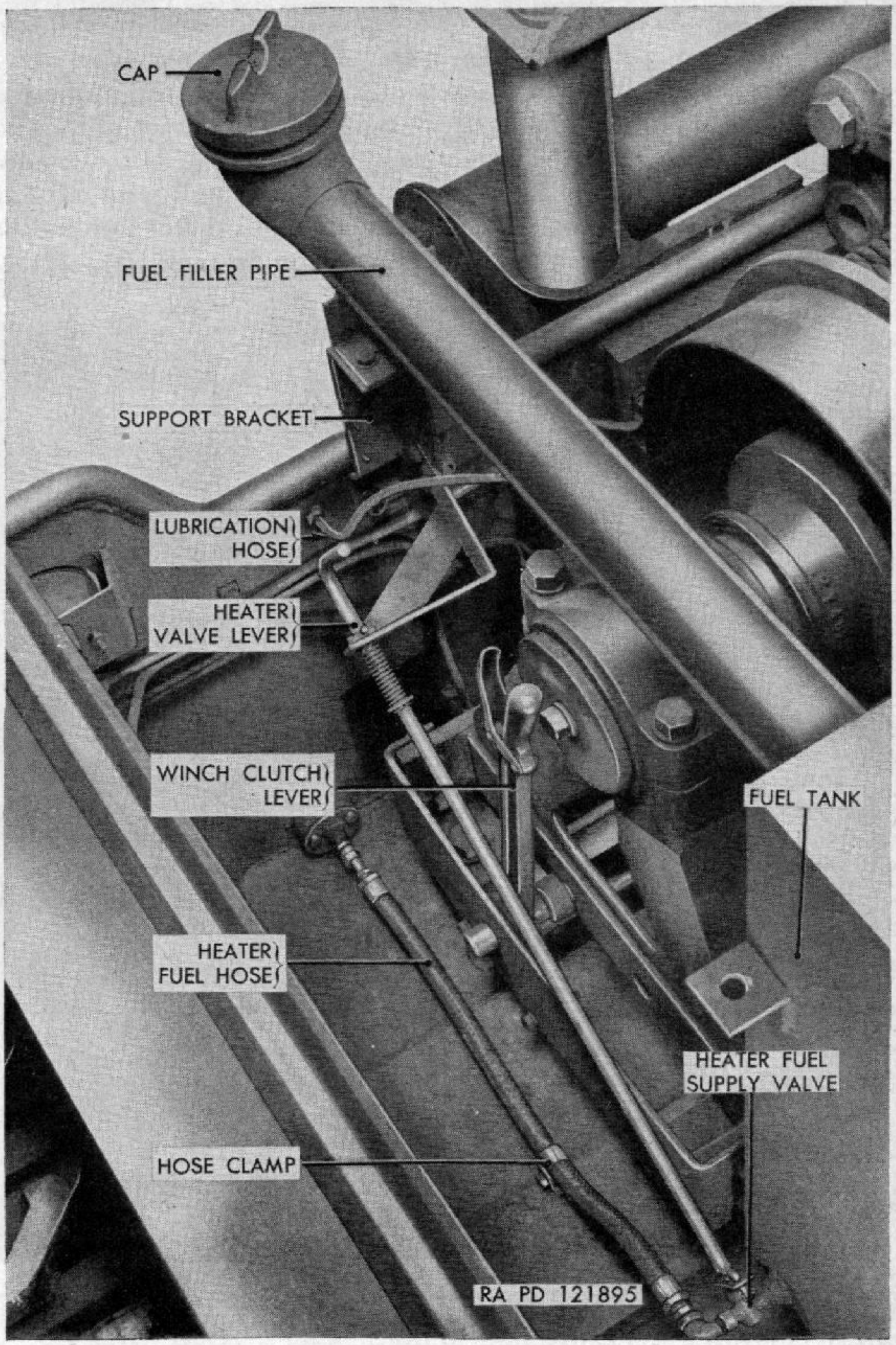


Figure 47. Fuel tank removal details.

of tank near the shut-off valves. It may be necessary to loosen packing nuts on valves to turn valve handwheel. (Some vehicles are equipped with a valve on which a wrench can be used.)

(2) *Disconnect fan drive belt tightener supports from tank.* Remove jam nuts from upper ends of the five lubricating tubes supported in brackets on front of tank, and pull tubes out of bracket. Remove two cap screws from each of the two rear fan drive belt tightener supports (fig. 39). Remove four cap screws from fuel gage sending unit wire clips at left side and top of fuel tanks and then disconnect end of wire from fuel level gage sending unit on tank (fig. 137).

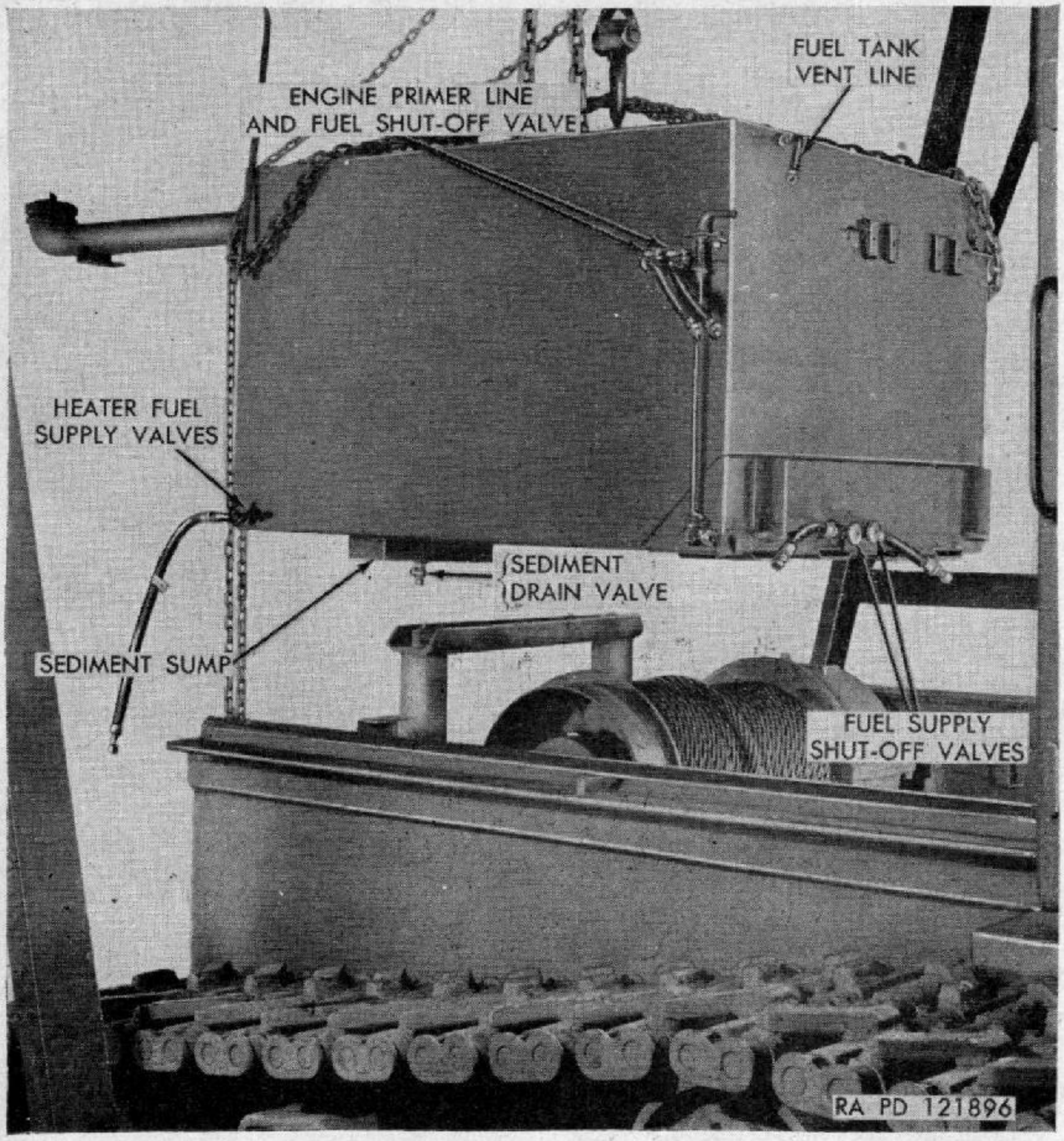


Figure 48. Removing fuel tank.

(3) *Remove tank.* Remove four attaching cap screws that extend up through bottom of hull into bottom of tank and two cap screws at front of tank; place rope or chain sling on tank and, with hoist, lift tank from vehicle (fig. 48).

Caution: Maneuver tank so that shut-off valves do not catch on fan drives.

b. Installation.

(1) *Install tank in hull.* Lift tank with hoist, and lower it carefully into the hull. Secure tank in place with four cap screws and lock washers inserted through bottom of hull into bottom of tank and two cap screws with washers in loops at front of the fuel tank. Connect end of fuel gage wire to fuel level

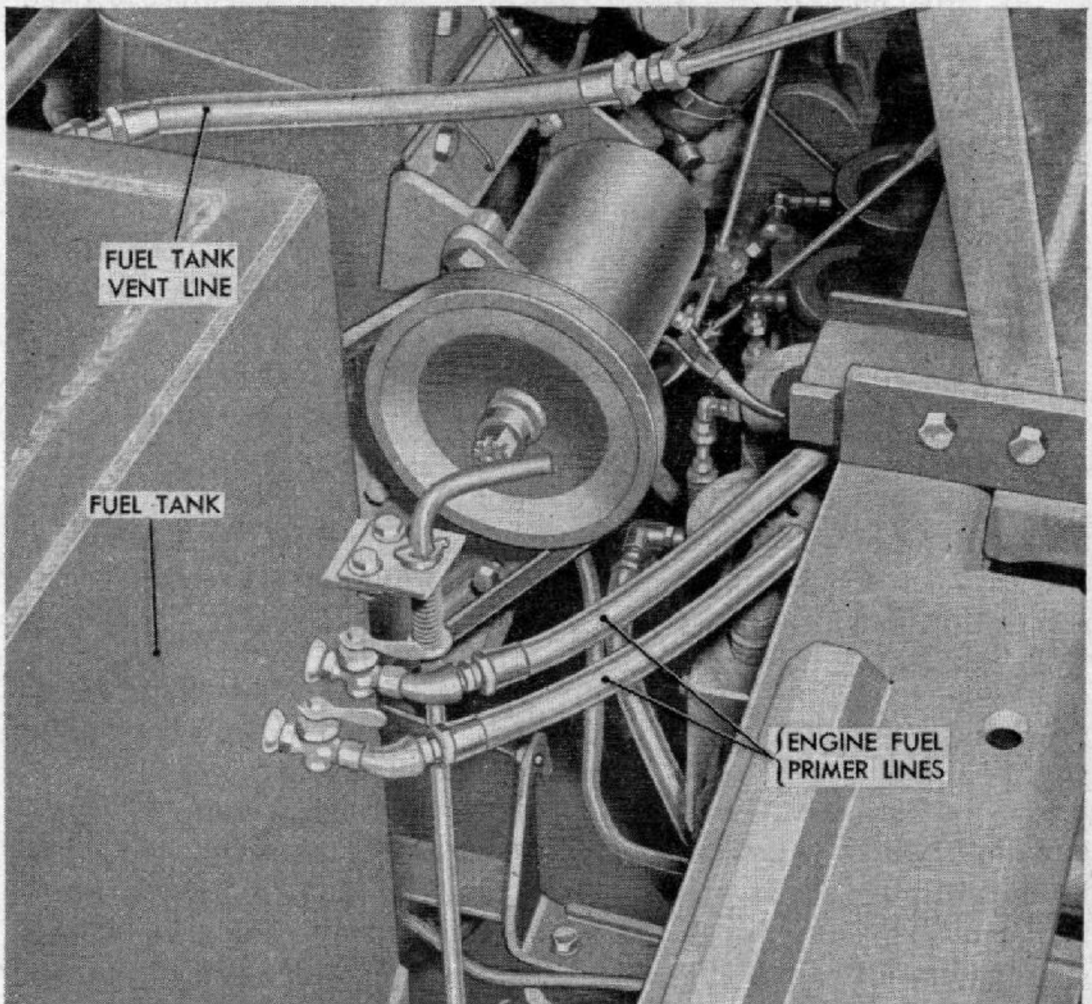


Figure 49. Fuel tank installed.

gage sending unit in top of tank, and secure the four wire clips on this wire to top and side of tank (fig. 137).

(2) *Connect fan drive belt tightener supports and lubricating hoses to front of tank.* Install two cap screws with lock washers to connect each of the rear tightener arm shaft supports to tank (fig. 39). Insert ends of the five lubricating tubes for the winch drive shaft bearings and fan drive belt

tightener arms and pulleys up through the holes in brackets welded to front of tank, and install jam nuts on these tubes.

Caution: Be careful not to twist tubes while tightening jam nuts.

(3) *Connect fuel lines and install ammunition box.* Working through fuel filter drain plug access holes (fig. 62), connect fuel hoses to fuel filters, then open fuel shut-off valves at front of tank. Tighten packing nuts on valves if fuel leaks from valves. Connect hose at right top corner of tank to vent line on engine hood frame, primer line hoses on tank to primer lines, and heater fuel supply hose at lower right corner of tank to heater supply line (fig. 49). Connect end of rear heater fuel supply hose to fitting at rear of hull, and attach hose clamp to hull with cap screw and lock washer (fig. 47). Set prongs in heater valve lever in linkage plate at top of valve, and install cotter pins. Connect fuel filler pipe support bracket, with two bolts and lock washers (fig. 47). Install ammunition box (par. 214*b*).

c. Fuel Tank Service. Remove fuel filler cap at rear of tractor and fill fuel tank until fuel is seen in filler pipe (fig. 5). To drain water and sediment from fuel tank, remove drain plug access plate (fig. 62) and drain about two quarts from sediment sump (fig. 48). Close drain valve and install plate.

108. Fuel Filters

a. Removal. The two fuel filters are located just ahead of the rear engine supports (fig. 27). Remove six cap screws from each of the two drain plug access plates in bottom of hull (fig. 62) and remove the plates. Reach through the inspection holes and close the two fuel supply shut-off valves (fig. 48). Remove cap screw from top of fuel filter and remove filter case from filter head (fig. 50).

b. Cleaning. Extreme care must be used when washing elements to prevent damage to the disks. Wash filter element in dry-cleaning solvent or volatile mineral spirits and dry with compressed air.

c. Installation. Install spring and filter element in case and position filter case at the bottom of the filter head after installing a new gasket. Install cap screw at top of fuel filter head and tighten securely. Turn on the fuel supply shut-off valves. Start engines (par. 45) and inspect for fuel leaks. Install access plates in bottom of hull with six cap screws and lock washers (fig. 62).

109. Fuel Pump

a. Removal. Remove 18 cap screws from hull bottom plate under engine (fig. 62). Working under tractor, reach up and close fuel shut-

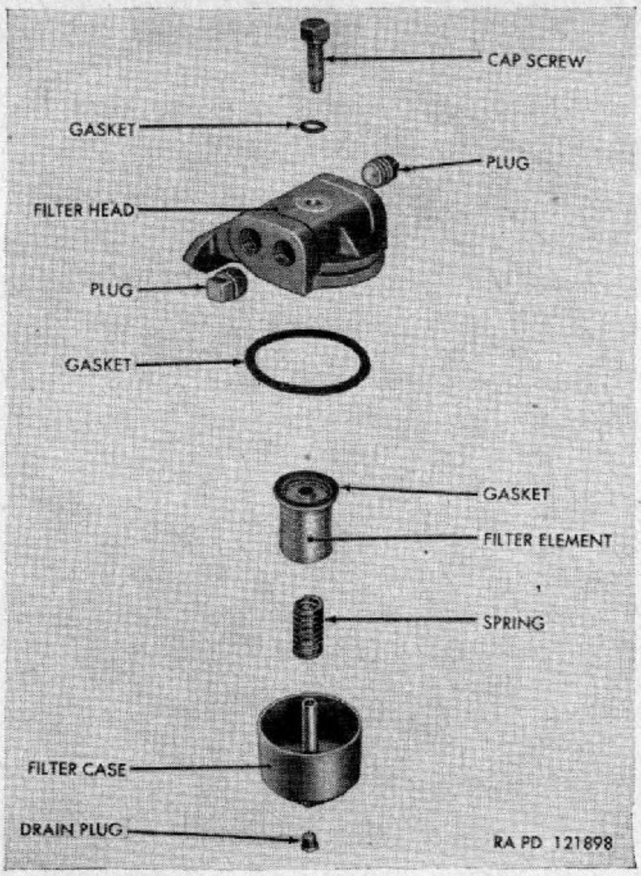


Figure 50. Fuel filter disassembled.

off valves. Disconnect inlet and outlet fuel hoses from pump. Remove two cap screws attaching fuel pump to cylinder block, and pull pump away from engine (fig. 58).

b. Installation. Install new gasket and attach fuel pump to engine cylinder block with two cap screws. Connect fuel inlet and outlet hoses to fuel pump. Turn on fuel shut-off valves. Start engine and test for proper operation of the fuel pump. Inspect for fuel leaks around hose connections. Install hull bottom plate with 18 cap screws and lock washers.

110. Primer Pumps

a. Removal. Disconnect suction and discharge lines from pump (fig. 89). Hold pump body with wrench or pliers and unscrew nut ahead of pump knob. Pull plunger out of pump body and remove the pump body from instrument panel.

b. Inspection. Inspect leather diaphragm for stiffness, cracks, or wear. Wash pump body with dry-cleaning solvent or volatile mineral spirits and dry with compressed air.

c. Installation. Place pump body in instrument panel. Install pump plunger in body of pump and install screw nut ahead of pump knob. Connect suction and discharge lines to pump. Operate pump and inspect for fuel leaks.

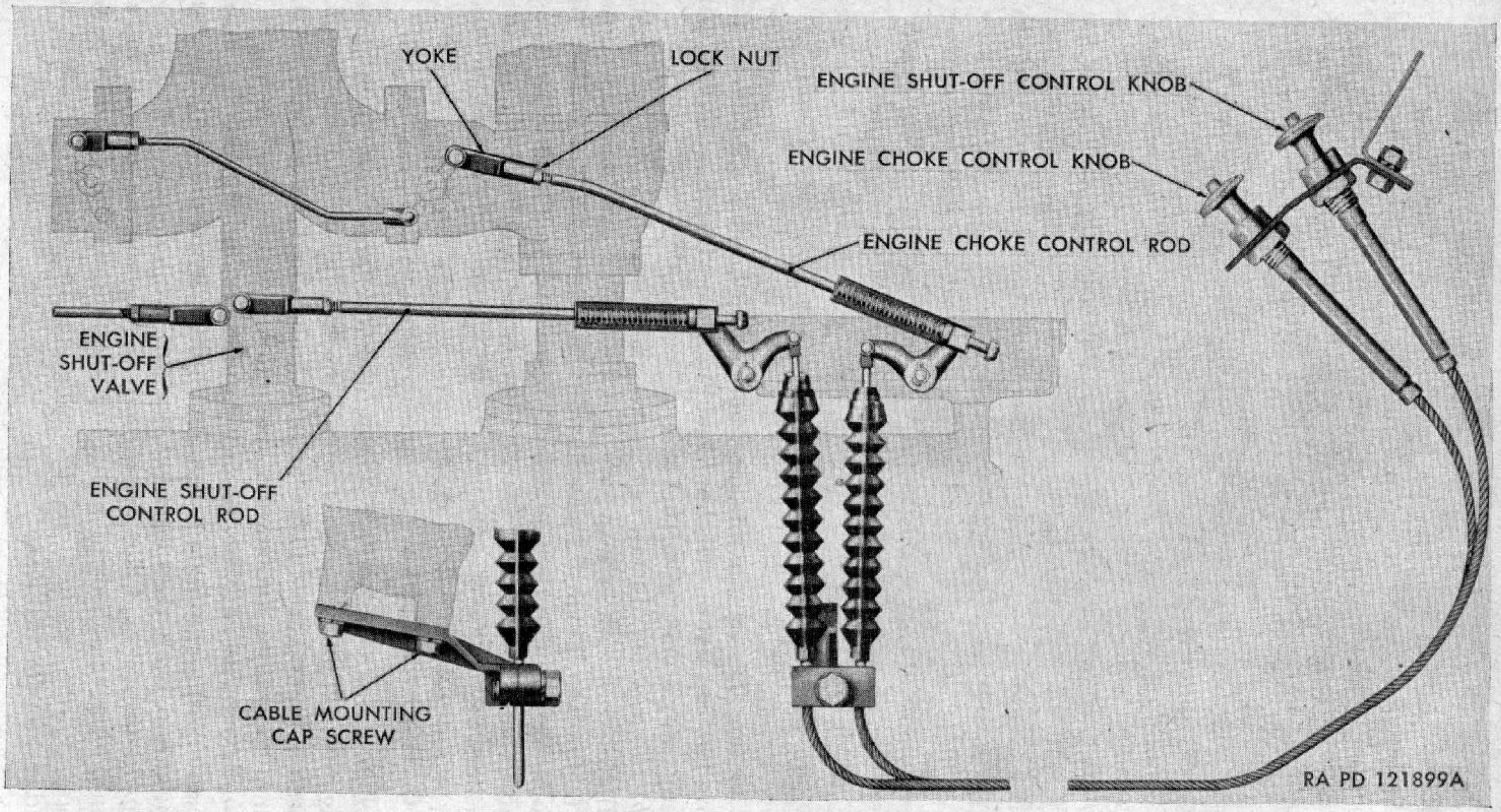


Figure 51. Choke and engine shut-off controls—assembled view.

111. Engine Air Shut-Off Valves

a. Adjustment. Push engine shut-off control knob against bracket on instrument panel (fig. 6). The air valve in the air inlet should be vertical (parallel with carburetor air inlet). If the valve is not vertical with the control knob against the bracket or fully closed when the knob is pulled out, loosen screw at front end of the engine shut-off control rod (fig. 51). Turn shut-off control rod until air valve is fully closed and tighten screw. This rod should measure 16½ inches between centers of yoke pin holes after adjustment is made. Replace yokes or yoke pins if worn.

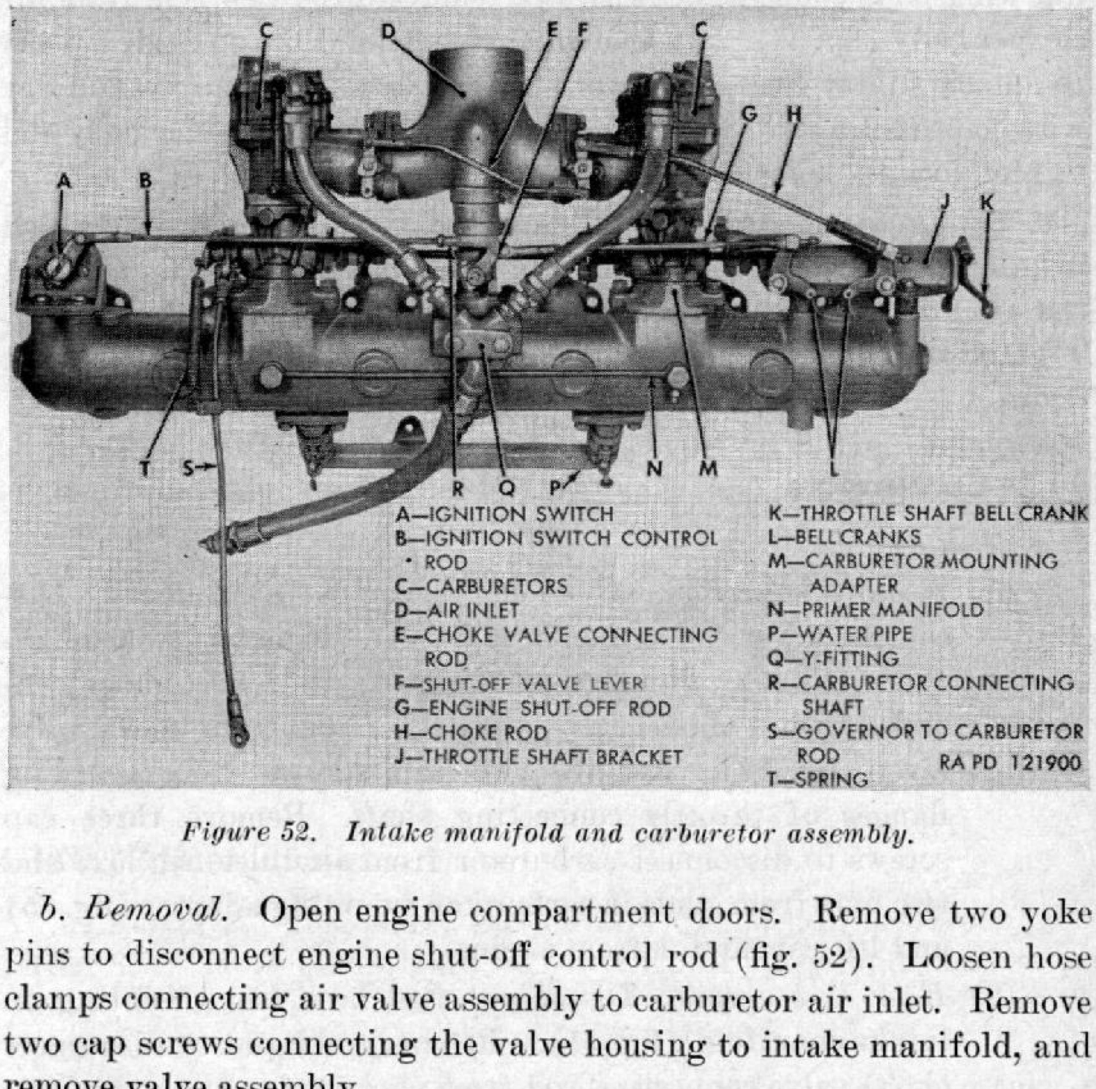


Figure 52. Intake manifold and carburetor assembly.

b. Removal. Open engine compartment doors. Remove two yoke pins to disconnect engine shut-off control rod (fig. 52). Loosen hose clamps connecting air valve assembly to carburetor air inlet. Remove two cap screws connecting the valve housing to intake manifold, and remove valve assembly.

c. Installation. Install valve housing to intake manifold with two cap screws. Install and tighten hose clamp connecting the air valve assembly to the carburetor inlet. Connect engine shut-off control rod with two yoke pins. Start and stop engines to check for proper operation of the air shut-off valves. Adjust if necessary (*a* above). Close engine compartment doors.

112. Air Cleaners

a. Removal. Replace a damaged air cleaner immediately. Each air cleaner assembly is supported on a bracket and held by two clamp bands around the air cleaner body (fig. 53). Loosen hose clamps and disconnect air hoses from cleaner body (fig. 36). Unscrew two clamp studs from each of the two clamp bands (fig. 54) and remove air cleaner.

b. Cleaning. Loosen wing nuts at bottom of oil cup and remove cup (fig. 54). Pour oil out of cup, wash in dry-cleaning solvent or volatile mineral spirits and replenish with oil according to lubrication order (par. 70). Install oil cup and tighten wing nuts. Turn locking wing bolts counterclockwise and remove dirt receptacle from air cleaner body (fig. 53). Clean dirt receptacle of dirt and dust. Wash receptacle in dry-cleaning solvent or volatile mineral spirits and dry with compressed air. Position dirt receptacle on air cleaner body and tighten locking wing bolts.

c. Installation. Position air cleaner on mounting brackets and install the two clamp studs in the two clamp bands (fig. 54). Connect the air hoses to the air cleaner and tighten hose clamps (fig. 36). Tighten all mounting clamp studs firmly. Close engine compartment doors.

113. Carburetors

a. Removal.

(1) *Front carburetors.* Open engine compartment doors. Disconnect lower end of fuel hose from Y-fitting on intake manifold (fig. 55). Remove yoke pins to disconnect choke control rod and choke valve connecting rod from choke valve lever (fig. 52). Remove two cap screws from coupling flanges of throttle connecting shaft. Remove three cap screws to disconnect carburetor from air inlet (fig. 52) and two nuts from studs in carburetor mounting adapter (fig. 55) and lift carburetor from engine.

(2) *Rear carburetors.* Disconnect fuel hose from Y-fitting on intake manifold (fig. 55). Remove yoke pin to disconnect choke valve connecting rod from choke valve lever (fig. 52). Unhook lower end of spring from governor-to-carburetor rod, and remove yoke pin to disconnect rod from lever on carburetor. Remove three cap screws to disconnect carburetor from air inlet. Remove two nuts from studs in carburetor mounting adapter (fig. 55), and lift carburetor from engine.

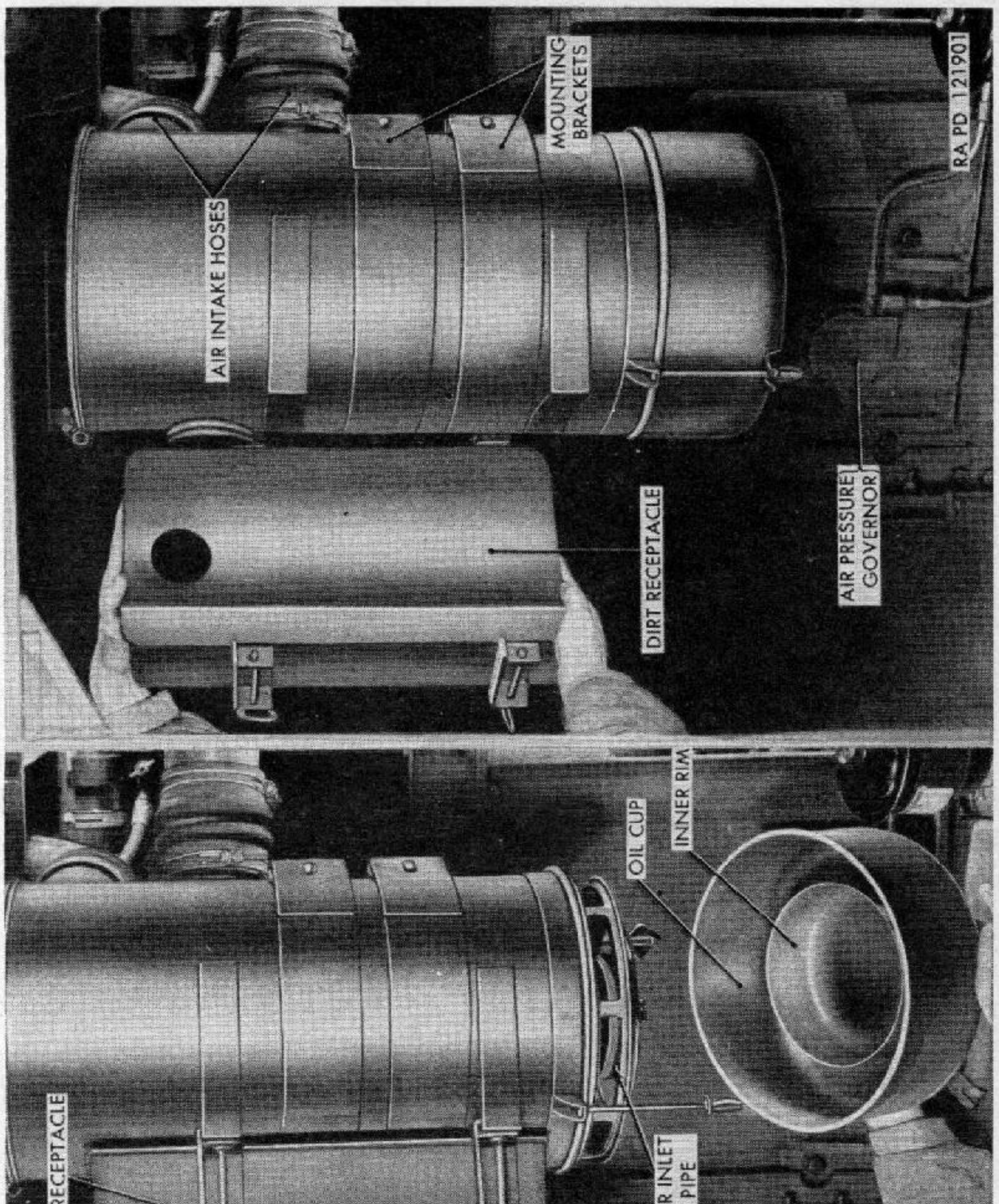


Figure 53. Servicing air cleaner.

b. Installation.

(1) *Front carburetor.* Position gaskets on carburetor air inlet and carburetor mounting adapter. Install carburetor on adapter and attach to air inlet with three cap screws and

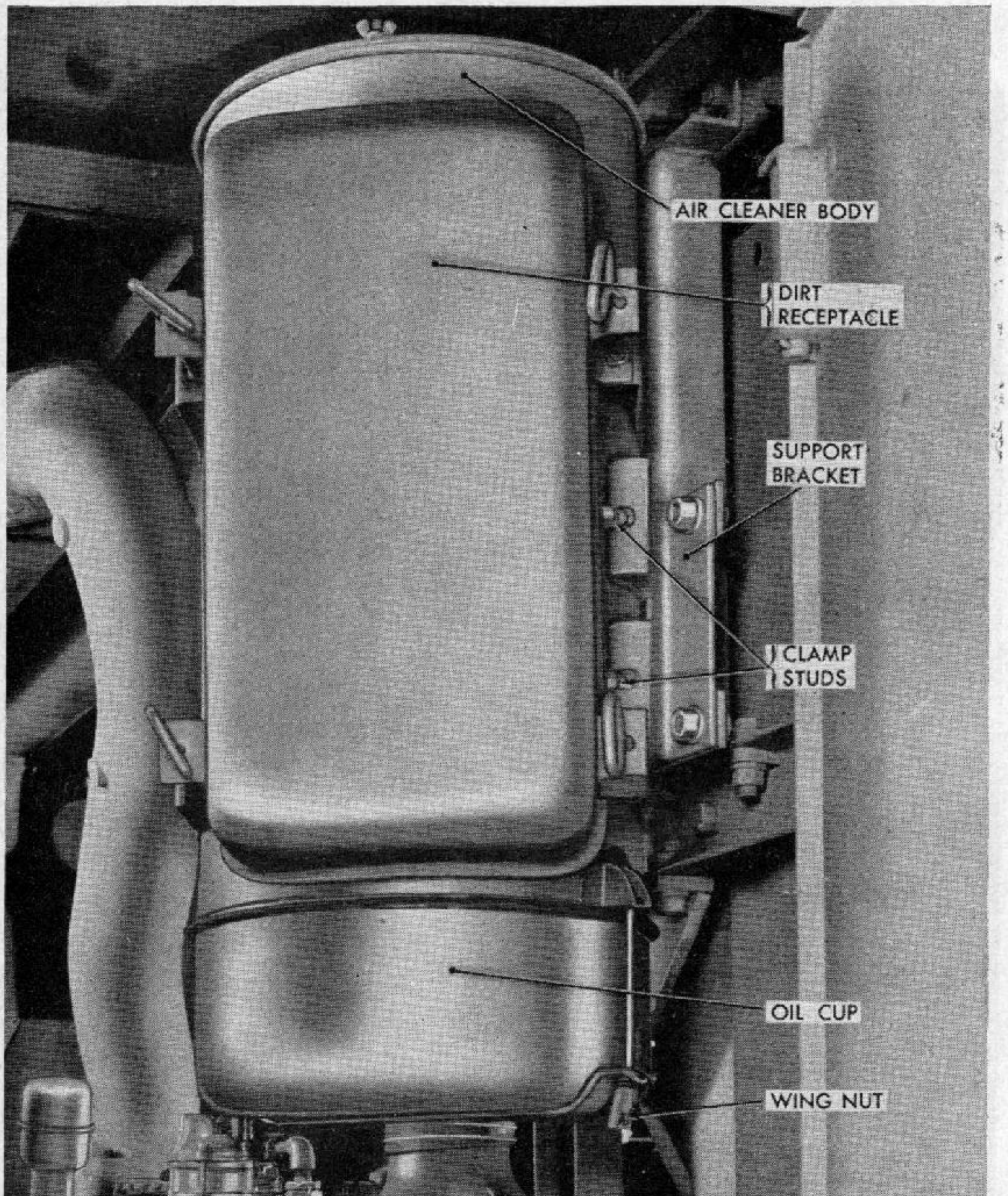


Figure 54. Air cleaner installed.

lock washers. Install two lock washers and nuts on the studs in mounting adapter (fig. 55). Connect throttle connecting shaft to carburetor with two cap screws and lock washers. Connect lower end of fuel hose to **Y**-fitting on intake manifold (fig. 52). Connect choke control rod to top of choke valve lever and choke valve connecting rod to lower end of lever with yoke pins and cotter pins (fig. 52). Adjust carburetor and controls as explained in paragraph 114.

(2) *Rear carburetors.* If installing rear carburetor, follow same procedure as outlined in ((1) above). Also connect governor-to-carburetor rod, install yoke pin, and hook lower end of spring on rod. Close engine compartment doors.

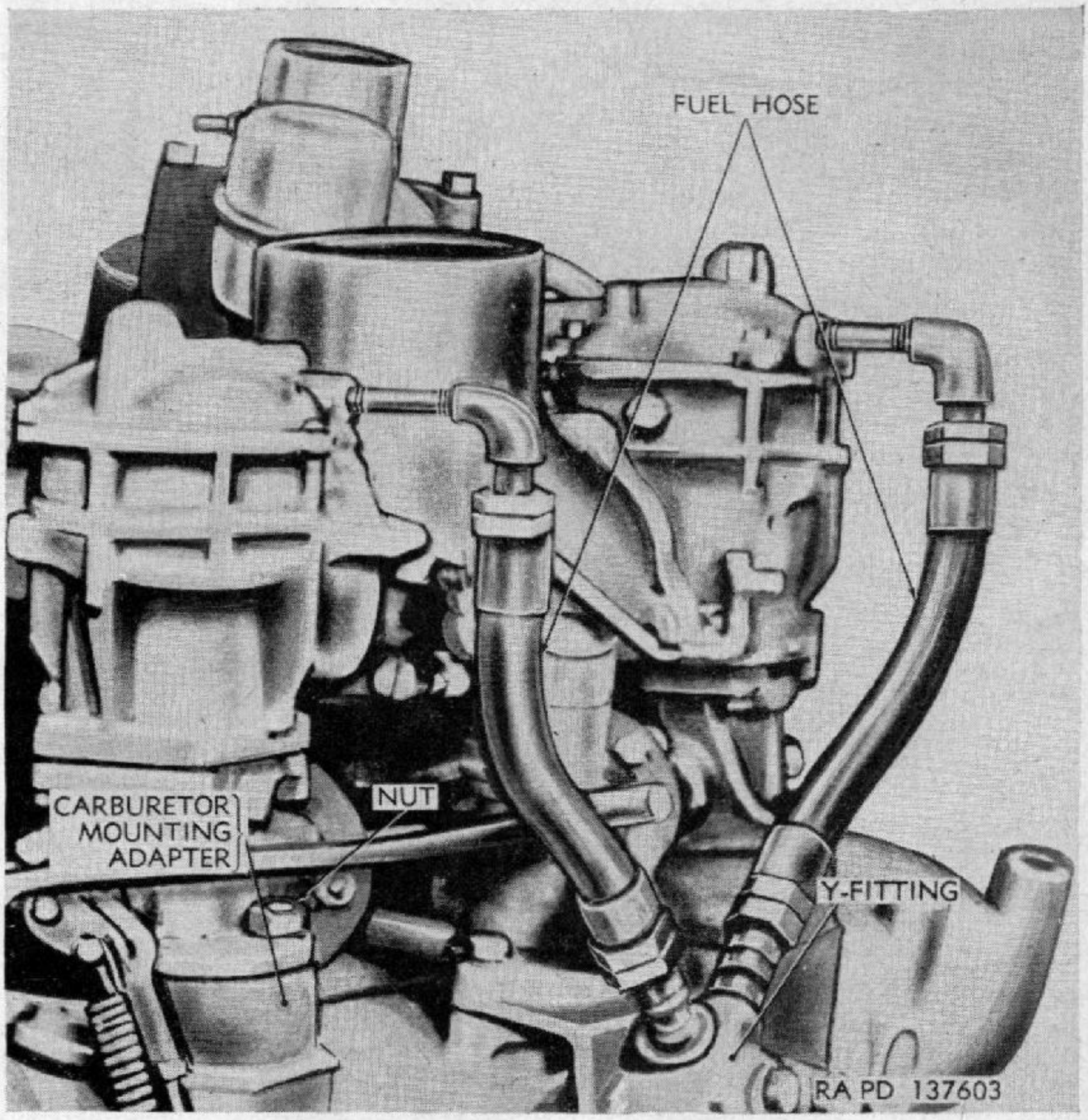


Figure 55. Carburetors installed.

114. Carburetor Control Adjustment

a. Choke Controls (Each Engine). Open engine compartment doors. Disconnect the adjustable yoke on end of choke control rod from the valve lever (fig. 51). Make sure the choke control knob for that engine is all the way in against bracket on instrument panel (fig. 6) and that springs on choke valve levers are holding the valves against their stops. Adjust yoke end of rod so that rod can be connected again to lever without changing the position of lever, and

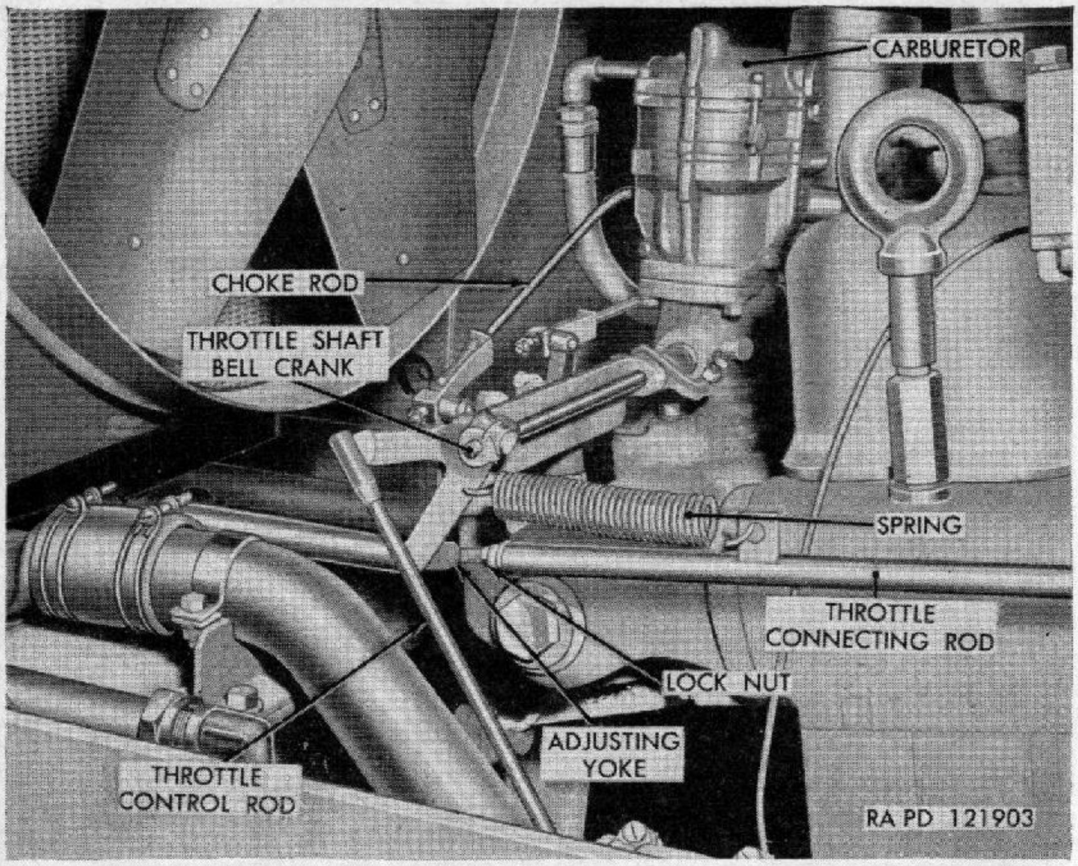


Figure 56. Right front carburetor throttle control linkage.

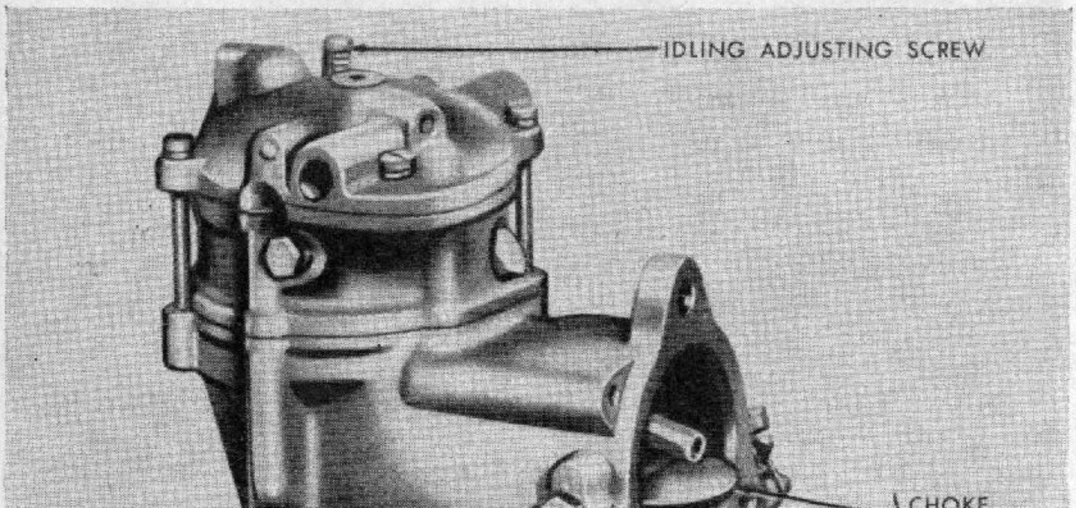


Figure 57. Carburetor assembly.

install yoke pin and cotter pin. Tighten lock nut against yoke, then make sure the valves and linkage work freely and that choke control fully closes and opens valves. Lubricate linkage for free operation.

b. Carburetor Throttle Controls (Each Engine). Unscrew throttle stop screws at each carburetor until throttle shaft arm is against the stop pin (fig. 57). Throttle shaft movement will now be the same for both carburetors. Turn throttle stop screw on front carburetor in (clockwise) against the stop pin to hold the throttle slightly open. Turn stop screw on rear carburetor in even with the first so that both will contact their stop pins. This adjustment will synchronize the throttle controls.

c. Throttle Control Linkage. Remove seat backs in rear crew compartment. Unhook spring from the rod connecting the throttle controls of the two engines (fig. 56). Remove yoke pins at both ends of rod to remove rod from throttle levers (fig. 56). Adjust the length of this rod by means of the adjustable yoke on rod so that the rod can be set on the projecting ends of the throttle shafts with the ends of the throttle shaft entering holes in rod yokes (fig. 56). Tighten jam nuts; then connect ends of rod to throttle shaft levers again and hook return spring. With hand throttle in closed position, adjust the throttle control vertical rod to remove all slack in the rod. After all linkage is adjusted and connected, test to make sure throttle moves from closed to fully opened positions when hand throttle lever and foot accelerator are operated. Install seat backs in rear crew compartment.

d. Idling Screw (fig. 57). Turn idling adjusting screw in (clockwise) against its seat. Then turn idling screw from 1 to 1½ turns off its seat. Start engines and allow them to reach operating temperature, then close throttle. Idling adjusting screws can now be adjusted for smooth idling of engines. Turning the screws "IN" cuts off air, making the idling mixture richer, turning them "OUT" admits more air, making the mixture leaner. If it is necessary to turn the screws in to within less than one-half turn off their seats to obtain good idling of engines, it would indicate either an air leak or a restriction in the flow of fuel for idling. Look for air leaks at the manifold flanges, at carburetor throttle body to intake gaskets, and at carburetor bowl cover gaskets due to loosened assembly screws or damaged gaskets. A badly worn throttle shaft will produce sufficient air leakage to affect the idling mixture. Dirt or other foreign matter in the idling jet will restrict the flow of fuel for idling and affect the mixture.

115. Governor

a. Adjustment.

(1) *Governor spring adjustment.* Run the engine with the clutch disengaged. Turn the wing nut on governor spring adjust-

ing screw to adjust the tension on spring so that movement of the governor lever starts when the engine speed is increased above 2,100 rpm (fig. 59). The governor lever should have sufficient travel to limit the high idler speed to approximately 2,300 rpm. Increasing the spring tension increases the high idler speed, decreasing spring tension decreases high idle speed. The wing nut locks every half turn.

(2) *Linkage adjustment.* If the engine speed does not reach 2,100 rpm with clutch engaged, make the following adjustments:

(*a*) Remove the governor-to-carburetor rod spring, and disconnect both ends of rod (fig. 58). Turn yoke on rod to adjust distance between center of yoke pin holes to 18⅛ inches measured on a straight line. After rod has been adjusted, connect rod to governor and throttle levers and install spring; then check to make sure there is no interference between upper yoke and the intake manifold or carburetor mounting adapter. Make this check with the governor lever at its rest position. If necessary, cut a small portion away from adapter or manifold to make clearance and prevent preloading the throttle shaft.

(*b*) Loosen clamp screw in throttle lever that is contacted by governor-operated floating lever. Hold throttle in full open position against stop. Rotate throttle lever on shaft to obtain from 0.010- to 0.020-inch clearance between the flat faces of the floating lever and the throttle lever, then tighten clamp screw in throttle lever.

(*c*) Using screw driver or small pry bar, raise governor until shifter lever in governor contacts the stop screw in governor cover, which limits the upward travel of the lever (fig. 59). Hold lever against stop screw. With throttle in closed position, adjust governor stop screw to allow from 0.010- to 0.020-inch clearance between flat surfaces of throttle lever and floating lever when governor lever is at its upper limit of travel.

Caution: Use only enough pressure on lever to hold it against stop, as additional pressure will spring the lever and a false setting will result.

(*d*) Check high idler speed and reset if necessary as outlined in (1) above. With throttle in closed position, check again for interference of throttle levers or governor-to-carburetor rod with intake manifold or carburetor mounting adapter. Remove material from levers if necessary to eliminate interference.

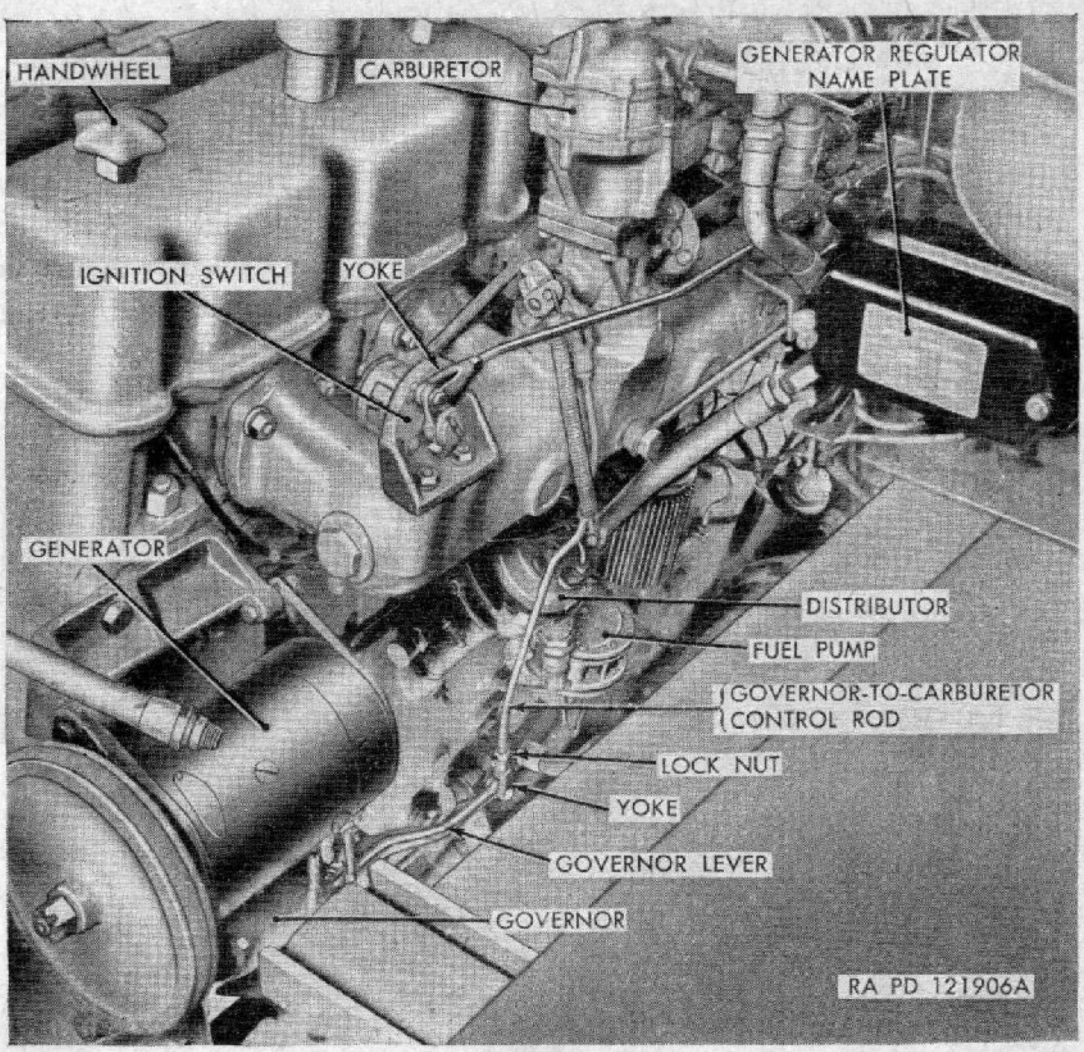


Figure 58. Governor linkage controls.

b. Removal.

(1) *Remove generator.* Open right engine compartment door and remove generator (par. 137*b*).

(2) *Remove governor* (fig. 59). Disconnect oil pipe from upper fitting at lever end of governor and from fitting on timing gear housing. Remove cap screw from clip supporting this pipe and remove the oil pipe. Disconnect oil pipes from lower fitting on lever end of governor. Remove wing nut from spring adjusting screw and drop screw out of lever. Remove yoke pin to disconnect lever end of governor-to-carburetor control rod from governor lever. Remove nuts from stud bolts on lower and upper sides of governor that attach governor housing to timing gear housing, and pull governor straight forward from timing gear housing.

c. Installation.

(1) *Install governor in timing gear case.* Cement gasket to governor housing. Insert drive gear end of governor into timing gear case, meshing drive gear with timing gear. Attach

governor with lock washer and nut on stud bolt on bottom side and mounting clamp, lock washer, and nut on upper side. Install governor lubricating oil pipe (fig. 59), connecting front end of pipe to upper fitting at lever end of governor and rear end of pipe to fitting in timing gear housing. Connect end of second oil pipe to lower fittings at lever end of governor. Install cap screw and lock washer to attach pipe clip to cylinder block. Slip end of governor spring

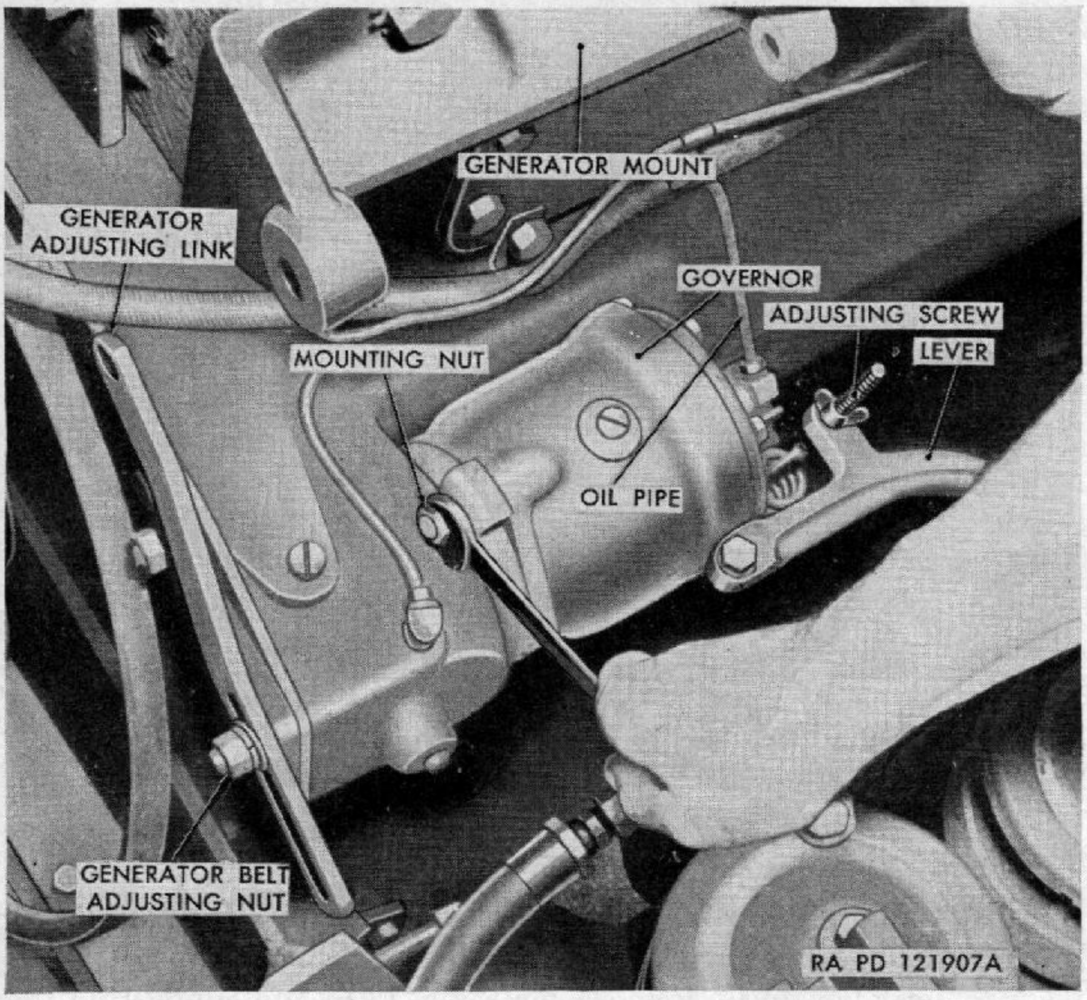


Figure 59. Governor removal.

adjusting screw up through governor lever and install wing nut. Place governor-to-carburetor rod in yoke of governor lever and install yoke pin.

(2) *Install generator.* Refer to paragraph 137*c* for generator installation.

(3) *Adjust governor.* Adjust governor as explained in *a* above.

116. Exhaust Pipes

a. Removal. Open engine compartment doors and top engine grilles. Remove four lower cap screws from exhaust manifold and exhaust elbow connecting flange (fig. 60). Remove four upper cap screws from mufflers and exhaust elbow connecting flange and remove the exhaust pipe.

b. Installation. Install new gaskets at both ends of the exhaust elbow. Install the four upper cap screws and lock washers attaching the exhaust elbow to the muffler. Install the four lower cap screws and lock washers attaching the exhaust elbow to the exhaust manifold. Tighten cap screws firmly. Start engines (par. 45) and check for exhaust leaks. Close top engine grilles and engine compartment doors.

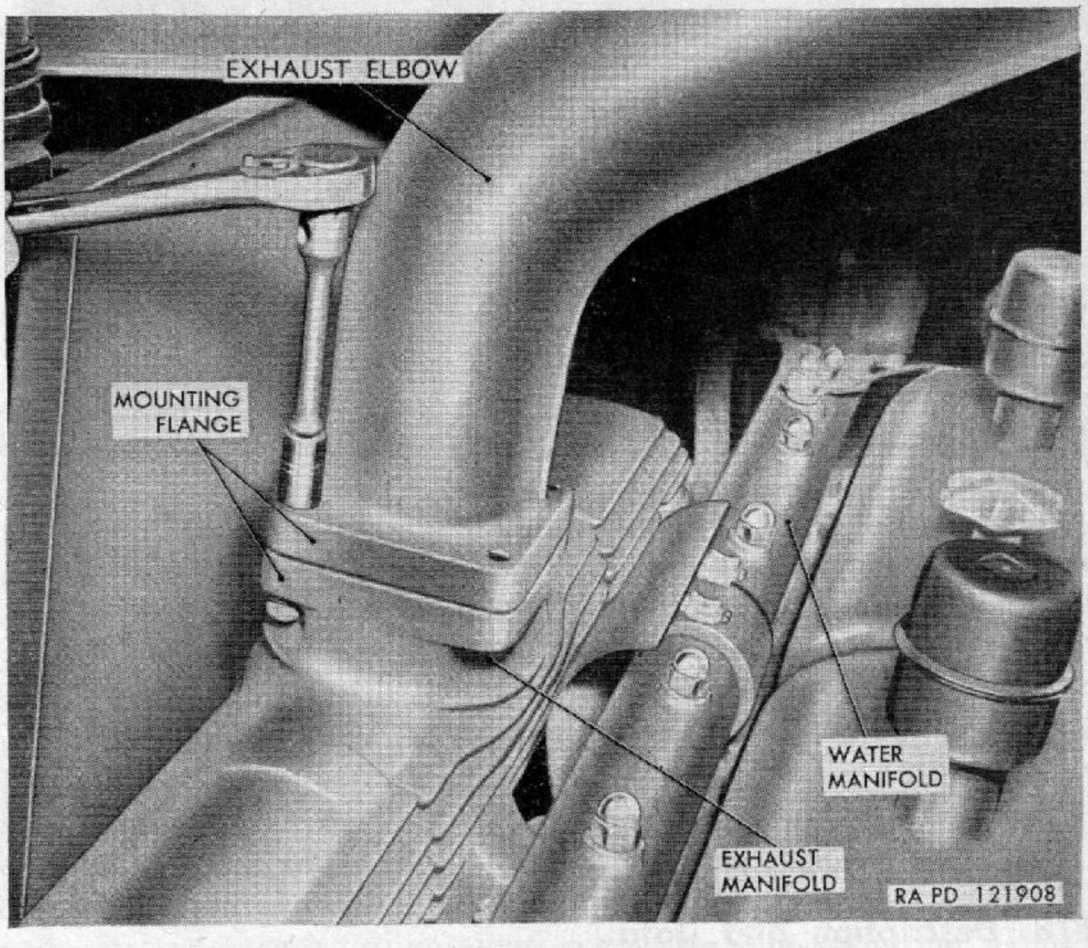


Figure 60. Engine exhaust pipe removal.

117. Mufflers

a. Removal (fig. 61). Open top engine grilles. Remove four cap screws from attaching flanges of each muffler to disconnect ends of mufflers from upper end of exhaust elbows. Remove the bolts at each end of hood frame cross member from which the mufflers are suspended. Lift mufflers from hood. Remove bolt at each end of muffler to separate the mufflers from mounting channel. The clamp can then be loosened to remove attaching flange from end of muffler.

b. Installation (fig. 61). Install flanges at end of mufflers and tighten clamp. Position the two mufflers together and install a bolt

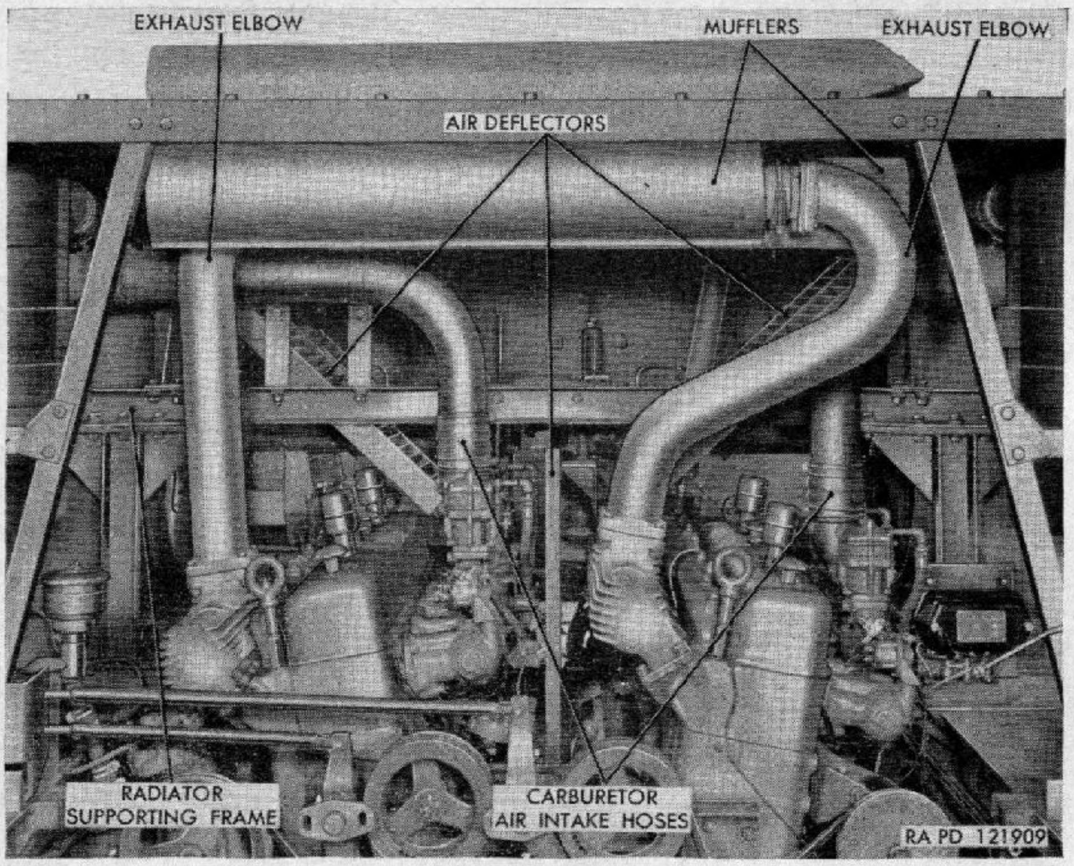


Figure 61. Exhaust manifolds and mufflers.

and lock washer at each end to secure mufflers to mounting channel. Install and tighten the four upper cap screws and lock washers to the exhaust pipes before tightening the bolts at ends of mounting channel. The holes in the hood frame are slotted to allow alinement of mufflers with the exhaust pipes. Start engines (par. 45) and check for exhaust leaks. Close top engine grilles.

Section VIII. IGNITION SYSTEM

118. Description and Data

a. Description.

(1) *Ignition system.* The ignition system for each engine consists of two batteries as a source of electrical energy, the distributor, ignition coil, ignition switches, ignition switch control knobs, wiring, and spark plugs. Radio interference suppression capacitors and resistors are installed on these units to prevent electrical disturbances created by the ignition systems from interfering with radio reception in adjacent vehicles (par. 174). The two ignition harnesses, one for each engine, are connected to junction boxes located on the hull sides. The right engine junction box is located on the right side of hull to the rear of the engine oil filters (fig. 46). The

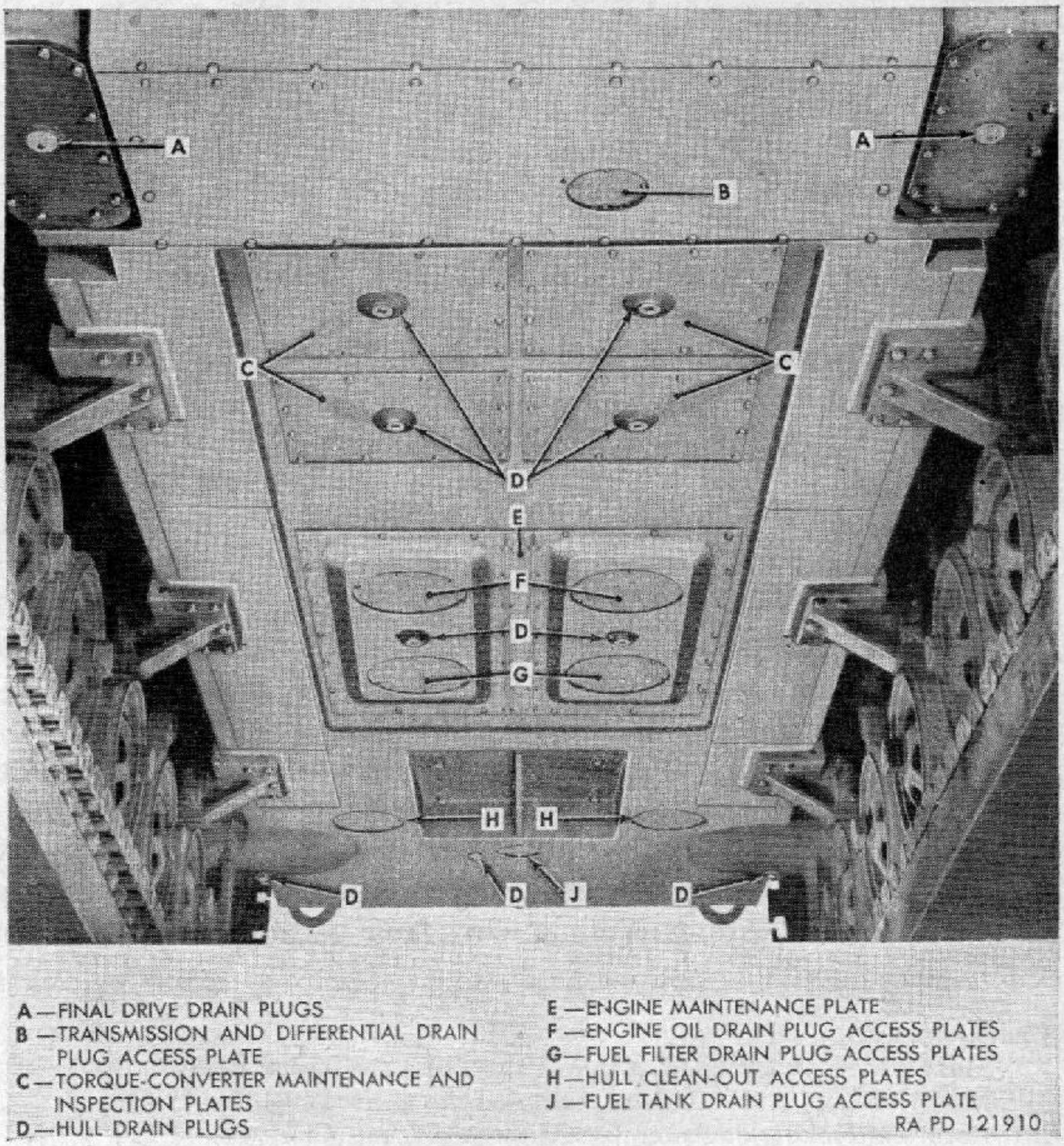


Figure 62. Hull bottom details.

left engine junction box is located on the left side of hull above the engine starter (fig. 70). Each harness has six high tension ignition cables inclosed in the conduit. Each engine has its own complete ignition system. The ignition switches are located on top of the intake manifolds (fig. 66). When the engine shut-off control knob (fig. 6) is pushed in against its top, the ignition switch prevents the engine from continuing to run through self ignition. The engine air shut-off valves are also operated by the engine shut-off control knobs.

(2) *Distributor.* The distributor is located on the right side of each engine (fig. 58). It is a dust sealed type unit with automatic centrifugal advance mechanism. The distributor shaft and rotor are rotated by a drive operating off the engine camshaft. A capacitor is held in position by a cap screw inside the distributor.

(3) *Spark plugs.* Six spark plugs are located on the right side of each engine cylinder head and are of the 18-mm automotive type, with single ground electrodes. The spark plugs are connected to the ignition cables with terminal nuts to prevent accidental disconnection of the ignition cables (fig. 29).

(4) *Ignition coils.* The ignition coil on each engine is similar to coils used on automobiles and trucks. The coil is mounted on a bracket attached to the right side of the engine and connected by wires to the distributor (fig. 44).

(5) *Ignition switches and wiring.* Each engine ignition switch is mounted on a bracket to the rear and on top of each intake manifold (fig. 66). The ignition switch is used in conjunction with the engine air shut-off valve to prevent the engine from running by self ignition when the engine shut-off control knob is pushed in. Wires for each engine are contained in a separate wiring harness connected to electrical junction boxes on each side of the hull sides. The right engine junction box is located to the rear of the engine oil filters (fig. 46) and left engine junction box is located above the engine starter (fig. 70). When removing the engines, these connections are disconnected at the junction boxes. The spark plug terminal cables are grouped together with a bracket to prevent the plug terminal wires from getting damaged.

b. Data.

Distributors (2):	
Make	Delco-Remy
Model	1110162
Rotation (looking down on distributor)	Clockwise
Centrifugal advance	Starts at 400 rpm of engine
Maximum advance	24 deg at 2,100 rpm of engine
Point opening	0.016 in
Contact point spring tension	17 to 21 oz
Cam angle	35 deg
Spark plugs (12):	
Size	18 mm
Gap	0.025 in
Ignition coils (2):	
Make	Delco-Remy
Model	1115252

119. Ignition Timing

a. General. Ignition timing consists of adjusting the distributor of each engine so that, with engine running at 2,100 rpm, ignition will take place 27° before the piston reaches top dead center on its compression stroke. This is required for maximum power and most efficient engine operation. If ignition takes place earlier when using 70 octane gasoline, detonation, heating, and burning of pistons will result. Late timing will result in lack of power and speed and overheating of the engines. A pointer in top of flywheel housing of each engine (fig. 63) and marks on the outer rim of flywheel are provided for ignition timing purposes. One mark "DIS" is at a point on the flywheel 3° before top dead center, which is the point at which the distributor breaker points should start to open. The automatic advance mechanism in the distributor will cause a nominal advance of 22°; however, the distributors have a manufacturing tolerance of

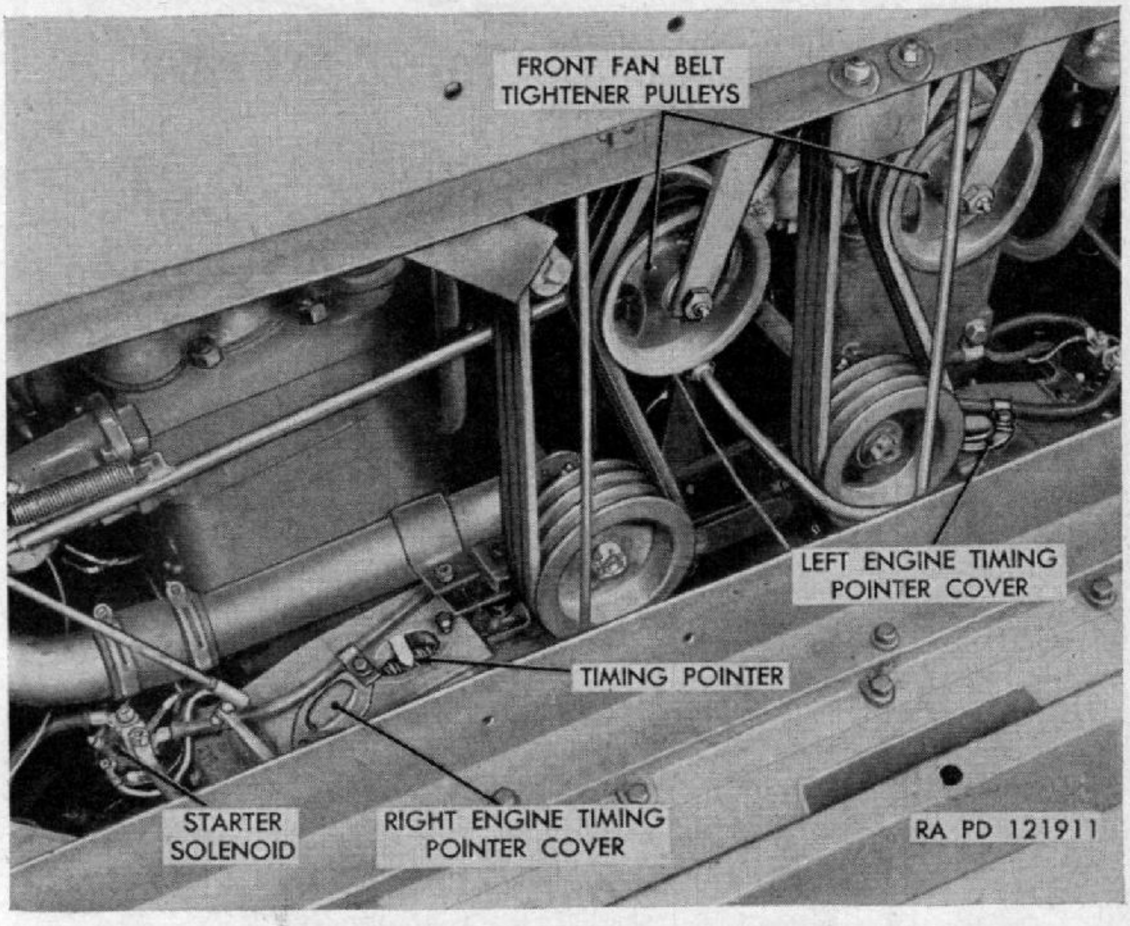


Figure 63. Engine timing pointer and fan drive belts.

plus or minus 2° and in most cases lean toward the maximum. A normal automatic advance will be approximately 24°. Time each engine separately.

b. Timing Procedure (Engines Not Running). Remove seat backs in rear crew compartment and open engine compartment doors. Remove timing pointer cover from top of flywheel housing at front of engine (fig. 63). Rotate engine crankshaft with starter until No. 1 piston is near top of its compression stroke and "DIS" mark on flywheel is directly under pointer in top of flywheel housing. Both valves of No. 1 cylinder will be closed and the exhaust valve of No. 6 cylinder will be nearly closed at this time. Remove distributor cap.

If timing is correct, the distributor points will be starting to open sufficiently to insert a 0.0015-inch feeler gage between them. If points are not open or are open too far, loosen cap screw in distributor clamping arm and turn distributor body until points are open 0.0015 inch; then tighten cap screw and recheck. When the points are ad-

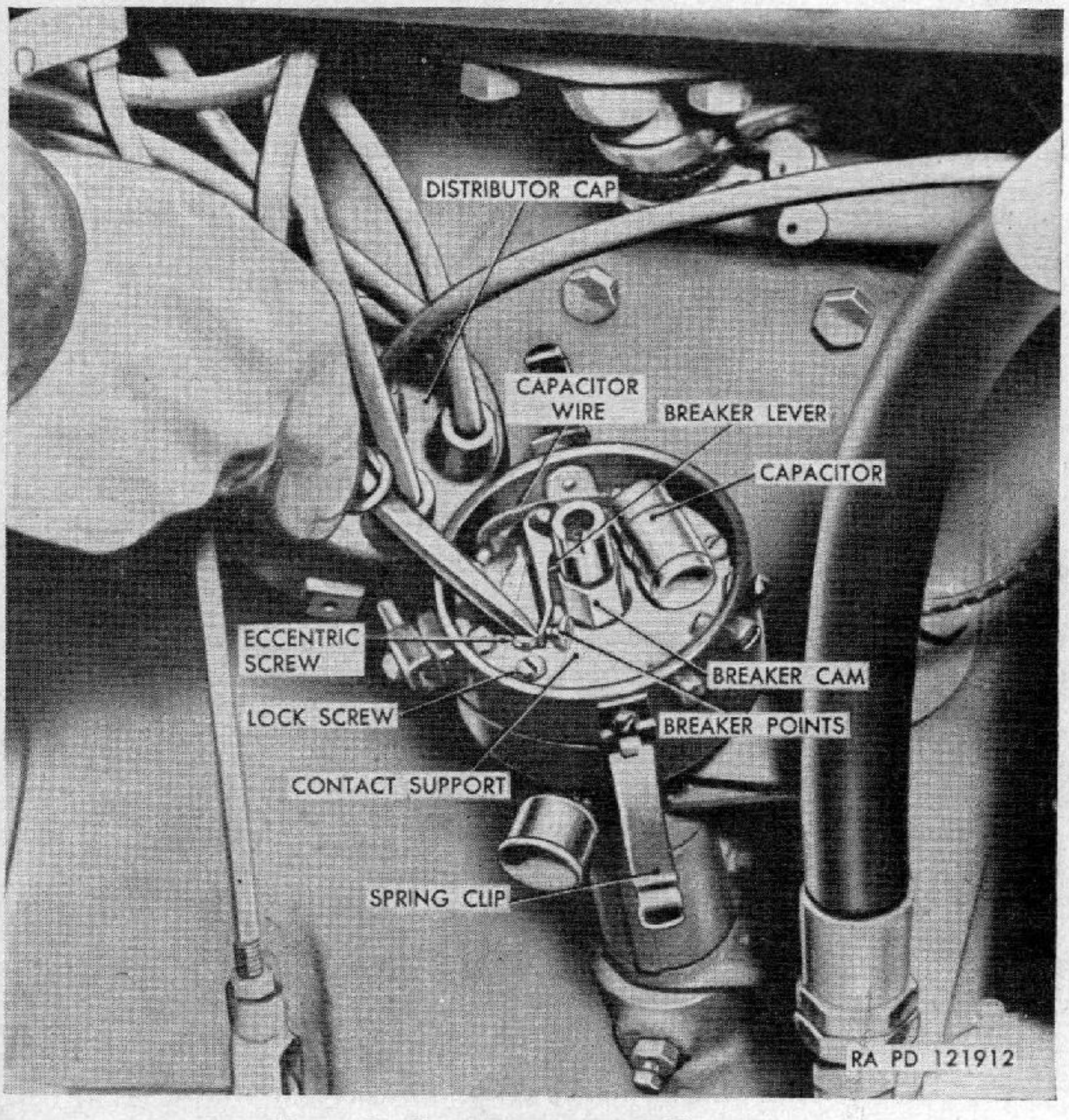


Figure 64. Distributor point adjustment.

justed for this clearance, timing should be correct. Replace distributor cap, then check timing with a neon timing light as explained in *c* below.

c. Timing Procedure (Engines Running). The timing marks will be found on flywheel 4½ inches before the top dead center marks. If engines do not have this mark, make one ⅛-inch wide mark with white chalk or like material. Start engines and allow them to warm up, then attach timing light according to instructions furnished with the light. Adjust throttle to maintain an engine speed of 2,100 rpm. Hold light over pointer in top of flywheel housing. The white line or mark $4\frac{1}{2}$ inches from top dead center mark on flywheels should now be seen under pointer as light flashes, providing the automatic advance in distributors is functioning normally. Advance timing of either engine, if necessary, by loosening cap screw in distributor clamping arm and turning distributor body counterclockwise. Retard timing by turning distributor clockwise. After most satisfactory performance of engine is effected, tighten clamp cap screws and install covers on flywheel housing. Install seat backs in rear crew compartment and close engine compartment doors.

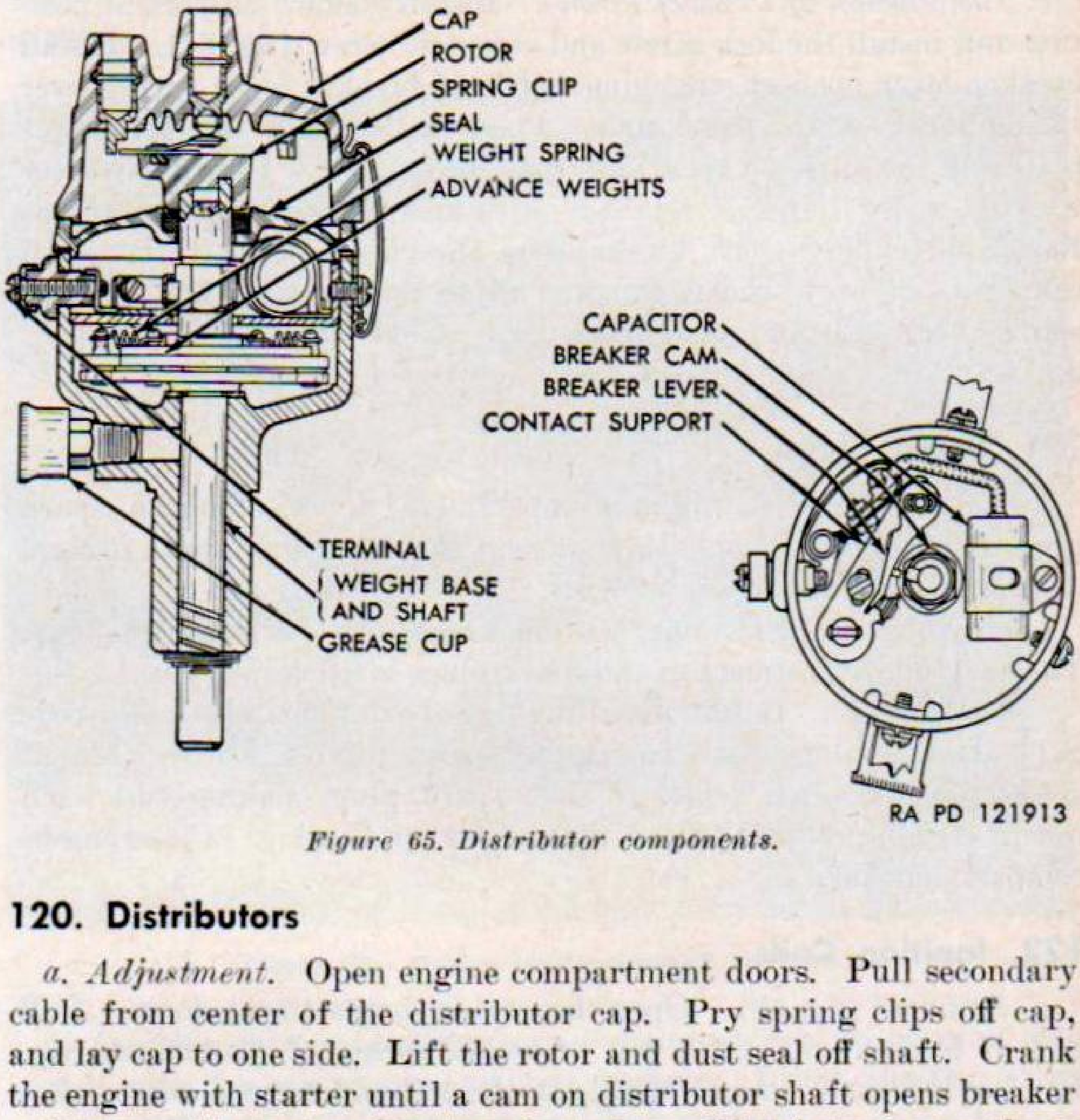


Figure 65. Distributor components.

120. Distributors

a. Adjustment. Open engine compartment doors. Pull secondary cable from center of the distributor cap. Pry spring clips off cap, and lay cap to one side. Lift the rotor and dust seal off shaft. Crank the engine with starter until a cam on distributor shaft opens breaker points to widest gap. Inspect the points. If points are rough or pitted, replace points (*b* and *c* below). Insert a feeler gage between the points to check gap opening. If more or less than 0.016 inch, loosen lock screw on stationary point (fig. 64). Turn eccentric screw (fig. 64) until a 0.016-inch feeler gage will slip between the points without spreading them, and a slight "drag" is felt on the gage. Tighten lock screw and recheck clearance. Correct if necessary. Install dust seal, rotor, and distributor cap. Close engine compartment doors.

b. Removal of Contact Points and Capacitor. Open engine compartment doors. Pull secondary wire from center of the distributor cap. Pry spring clips off cap, and lay cap to one side (fig. 64). Lift the rotor and dust seal off shaft. Remove lock and eccentric screws (fig. 64). Loosen breaker level spring screw and remove breaker lever retaining clip. Remove breaker level and contact support from distributor (fig. 65). Remove screw securing capacitor to distributor plate and disconnect capacitor wire from contact support screw (fig. 64).

c. Installation of Contact Points. Install contact support in position and install the lock screw and eccentric screw (fig. 64). Install breaker lever on post, engaging notch of breaker lever spring over spring screw at the same time. Position capacitor on distributor plate and install screw securing capacitor to plate. Install capacitor wire on screw. Install retainer clip and tighten spring screw. Rotate distributor shaft by cranking the engine with starter until cam opens points to widest gap, and adjust points (*a* above). Install rotor, dust seal, and distributor cap. Close engine compartment doors.

121. Spark Plugs

a. Removal. Open engine compartment doors. Remove spark plug terminal cable from spark plugs. Remove spark plugs, using a deep socket and extension wrench.

b. Adjustment. Use round wire feeler gage to check electrode gap. The electrode adjustment of the spark plugs is 0.025-inch gap.

c. Installation. Before installing new spark plugs, check electrode gap. Install plugs with new gaskets and tighten firmly. Install spark plug terminal cables to each spark plug, making sure each terminal cable is installed on the proper spark plug. Close engine compartment doors.

122. Ignition Coils

a. Removal (fig. 58). Open the engine compartment doors. Pull end of high tension cable out of center socket of distributor cap. Remove two nuts from terminals on the coil and remove wires. Remove the two coil mounting cap screws and remove coil. Slip rubber nipple up on cable at center of coil, and turn cable until removed from coil.

b. Installation. Install cable at center of coil and slide rubber nipple down on cable. Position ignition coil on bracket and install two mounting cap screws and lock washers. Position the two wires on terminals and install the two nuts and lock washers. Insert end of high tension cable at center of distributor cap. Close engine compartment doors.

c. Maintenance. The only services the coils will normally require is keeping the connections and mounting cap screws tight and the leads in good condition. Replace coil if found defective. A special testing instrument is required to check its electrical condition.

123. Ignition Switches and Wiring

a. Ignition Switch Removal. Open engine compartment door. Remove two nuts from the ignition switch terminals (fig. 66). Remove five cap screws from ignition switch (fig. 66) and remove switch from housing.

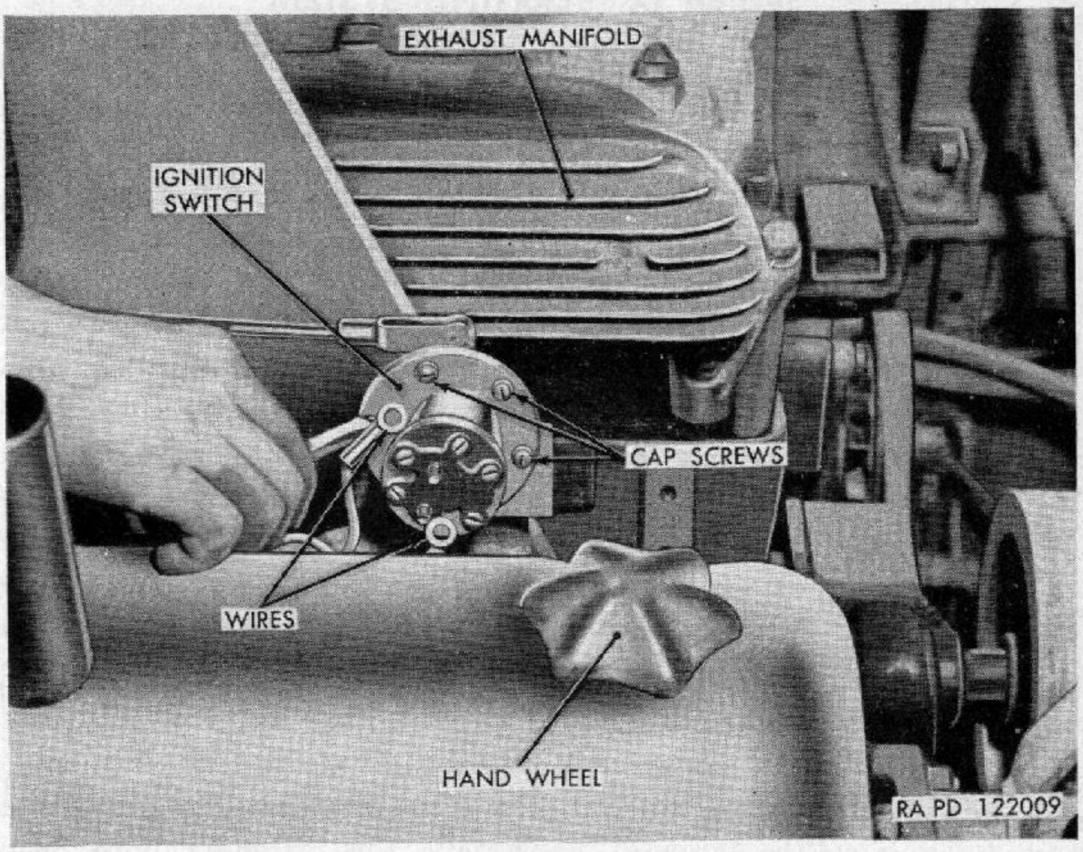


Figure 66. Engine ignition switch removal.

b. Ignition Switch Installation. Position switch on housing and install with five cap screws and lock washers. Install the two wires on terminals and install two nuts and lock washers.

c. Ignition Wiring Removal. Open engine compartment door. Remove engine connector plug (fig. 70) from junction box to disconnect engine wiring harness. Remove right engine connector plug from junction box located to the rear of the oil filters (fig. 46). The left engine wiring junction box is located above the engine starter (fig. 70). With the connector plug removed from junction box (depending which engine harness is to be removed) remove bracket holding plug cables together. Remove the six high tension cables from spark plugs. Remove two attaching clips from wiring harness and engine block. Remove cables from distributor cap, noting where each cable belongs in cap and related spark plug.

d. Ignition Wiring Installation. Position wiring harness on engine and install with two attaching clamps. Insert high tension cables on spark plugs and in distributor cap. Install bracket holding plug cables together. Install wiring harness plug at junction box. Start engines (par. 45) and check for proper operation. Close engine compartment doors.

Section IX. STARTING SYSTEM

124. Description and Data

a. Description.

(1) *Starting system.* The starting system for each engine consists of the batteries as a source of electrical energy, the starter, starter solenoid, starter switch, and wiring. The starters and starter solenoids are mounted on the right and left side of the engine near the flywheel housing (figs. 43 and 44). The positive cables from the batteries are connected to the starter solenoid of the right hand engine. A jumper cable leads from this solenoid to the solenoid of the left hand engine (fig. 44). Individual cables lead from each starter solenoid to the starter (figs. 43 and 44). Individual starter switches are located on the right instrument panel (fig. 6) and operate the starter solenoids.

(2) *Starter.* Each engine is provided with its own starter (fig. 67). These starters are the same except for their mountings, which are different due to the starter being on opposite sides of the engines. Each starter has a Bendix drive operated by starter solenoid and uses internal reduction gears. The Bendix drive provides automatic meshing of the driving pinion with gear on flywheel, when the starter switch is closed and the starter solenoid is energized. When the engine starts, the drive pinion is automatically disengaged.

(3) *Starter solenoid.* The two starter solenoids (figs. 43 and 44) are mounted on the flywheel housing and consist of a winding, plunger, contact terminal, and contact disk. When the winding is energized (connected to batteries) by the closing of the starter switch on the instrument panel, the resulting magnetic field pulls in the solenoid plunger, forcing the contact disk against the contact terminals, and connects the starter

to the batteries. Opening of the starter switch disconnects the solenoid from the batteries, so that the solenoid spring can separate the contact disk from the terminals, thus opening the circuit between the starter and batteries.

(4) *Starter switch.* The starter switch is a plunger type switch located in the instrument panel (fig. 6). When the button is pushed in, the circuit between solenoid terminals is closed and current flows to the winding in the solenoid. When the button is released, a spring returns the plunger to its inoperative position, opening the circuit between the solenoid and batteries.

b. Data.

Starter:	
Type	Solenoid operated
Make	Delco-Remy
Model	644
Number of brushes	6
Type of drive	Bendix
Revolutions per minute at no load	2,000 revolutions, and 75 amperes at 8.0 volts
Torque	45 ft-lbs at 3.5 volts and 500 amperes
Brush spring tension	36 to 40 oz

125. Starter

a. Removal. Remove seats from rear compartment and raise hinged floor plate. Remove nut and lift starter cable from terminal on the starter (fig. 67). Tape end of cable to prevent its touching metal parts of vehicle. Remove the three cap screws from the starter mounting flange and flywheel housing (fig. 67). Jar starter loose and lift it from flywheel housing.

b. Installation. Position starter on flywheel housing and install with three cap screws in mounting flange. Position starter cable on terminal and install lock washer and nut. Before reinstalling seats and closing hinged door plate in rear compartment, operate starter and check for proper operation.

c. Maintenance. Quarterly, remove the cover band located at the rear of each starter. Inspect the brushes and commutator for dirt and worn or defective operation. If the commutator is dirty, it may be cleaned with grade 2/0 flint paper.

Caution: Emery cloth must not be used as damage to commutator will result.

The brushes should have good contact with the commutator, and there should be sufficient brush length to last until the next inspection period. If the brushes wear rapidly, remove the starter and check for excessive

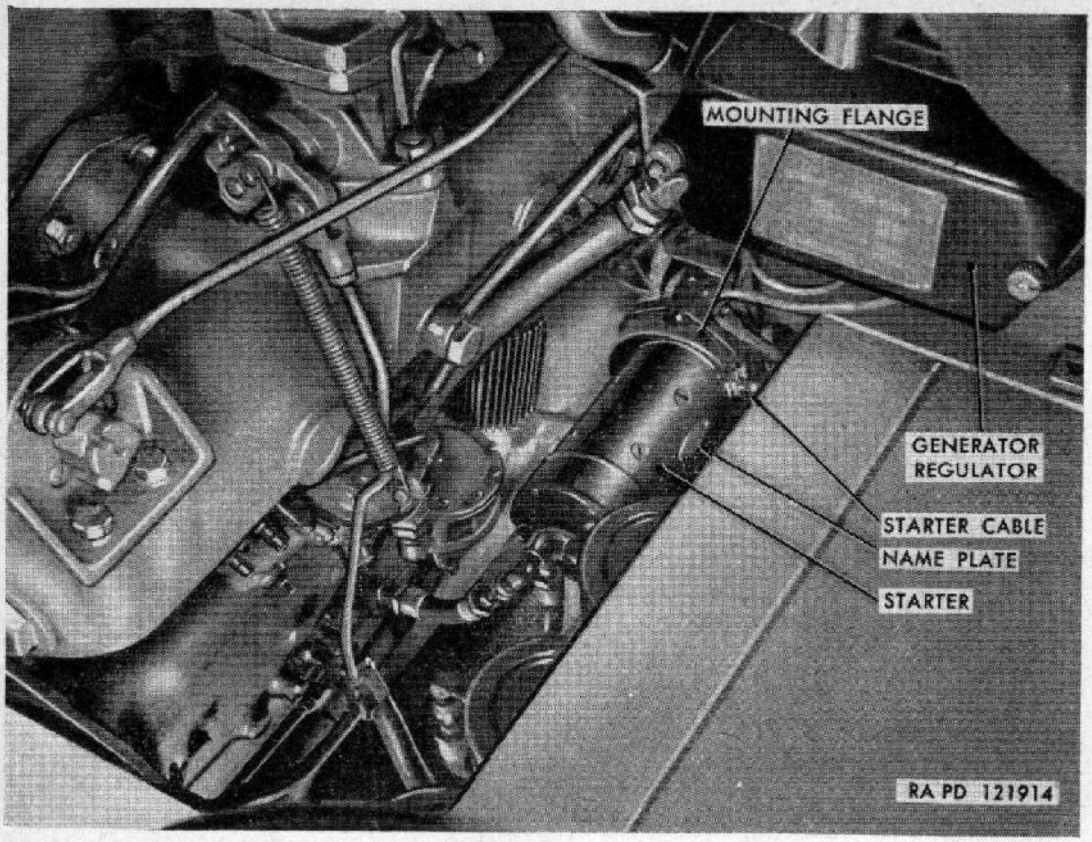


Figure 67. Starter installed.

spring tension, roughness, and high mica on the commutator. When the starter is operated, it should take hold promptly and turn the engine at good cranking speed.

Caution: Never operate the starter more than 30 seconds at a time without a pause of several minutes, since excessive operation will damage the starter.

126. Starter Solenoid

a. Removal (fig. 63). Remove seat back cushion from rear crew compartment. Remove two nuts and wires from coil winding terminals. Remove nut and cable from solenoid terminals. Tape end of each wire as it is removed. Remove two solenoid mounting cap screws and remove solenoid.

b. Installation. Position starter solenoid on flywheel housing and install with two cap screws and lock washers. Install the two wires, nuts, and lock washers on the coil winding terminals. Install the two cables on solenoid terminals with mounting nuts and lock washers. Install seat cushion.

127. Starter Switch

a. Removal. Refer to paragraph 157*a*.
b. Installation. Refer to paragraph 157*b*.

Section X. COOLING SYSTEM

128. Description

a. Cooling System. The cooling system of each engine consists of the water passages in the cylinder block and head, water outlet manifold, thermostat assembly, water pump, oil cooler assembly, radiator (center radiator of the three in each radiator assembly), and cooling fan, as well as the necessary water lines for circulation of the cooling liquid. The coolant is circulated by the water pump driven by the timing gears (fig. 81). It draws the coolant from the radiator and forces it through the oil cooler radiator to cool the engine oil as it is delivered to the engine. From there it passes into the cylinder block and cylinder head and out into the water outlet manifold (fig. 29). The thermostat (if the tractor is equipped with a thermostat) remains closed and coolant circulates through a bypass pipe and through the engine only until the engine reaches operating temperature. As the operating temperature is reached, the thermostat automatically opens to let the coolant pass into the water outlet manifold and to the radiator to be cooled. Part of the heated coolant also circulates through the fuel and air intake manifold to heat the fuel and air that is drawn into the cylinders. A bypass line in the system provides for circulation of coolant through the air compressor for cooling. The heated coolant is delivered to the radiator and the cooling fan draws air through the radiator, thus dissipating the heat and lowering the temperature of the coolant passing through the radiator from top to bottom. Each engine has an independent cooling system.

b. Radiators and Radiator Assemblies. Each of the two radiator assemblies consists of three radiators of the fin and tube type contained in a single radiator shell. The radiator toward the outside of the tractor is for cooling the torque converter oil. The center one is for cooling the engine coolant and will be referred to as the coolant radiator (fig. 75). The radiator closest to the fan is for cooling the oil from the transmission, differential, and power take-off cases (fig. 75). The radiator assemblies are supported in a frame extending across the engine. Expansion tanks are provided for expansion of the coolant in the coolant radiators and to prevent loss of coolant through expansion and overflow (fig. 68).

c. Thermostats. The thermostat assembly for each engine, consisting of two thermostats and a housing, is located at the front end of the water outlet manifold (fig. 68). It acts to keep the temperature of the cooling liquid and engine within operating range. When the engine is cold, the thermostats are closed and the water circulates only through the engine until the temperature of the coolant rises. Then the thermostats expand and open, due to the heat of the coolant, allowing the

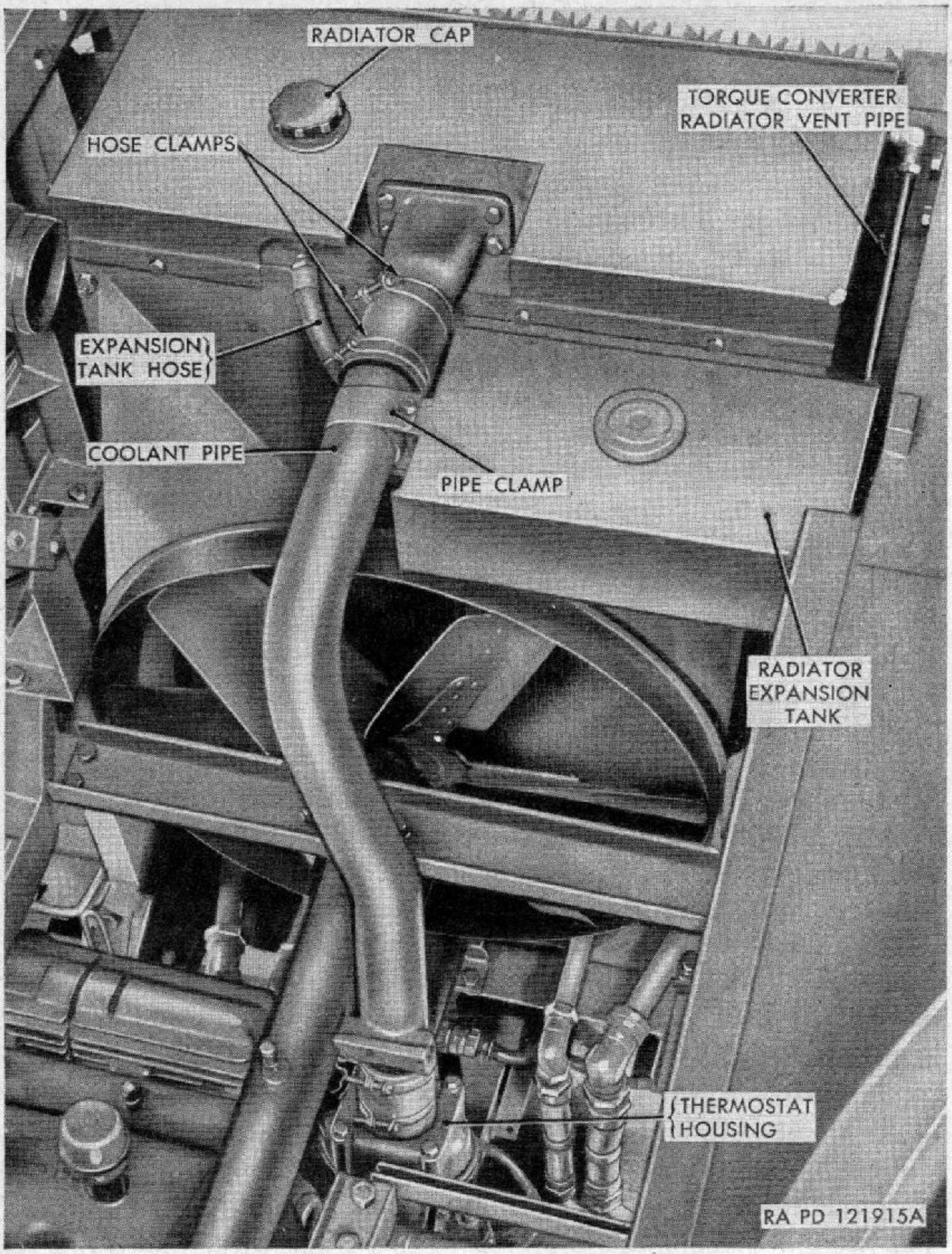


Figure 68. Radiator removal details—top view.

coolant to pass to the radiator to be cooled. A valve is provided on the thermostat housing which, when opened, allows water to drain from the pipes above thermostat when the system is being drained and allows air to escape from the engine cylinder head when filling the cooling system.

Note.—Some tractors are shipped with thermostats removed from the thermostat housing. A metal caution plate which states "THIS ENGINE NOT EQUIPPED WITH THERMOSTAT" will be found on the water tube above the thermostat housing on all tractors shipped without them (fig. 26).

If the tractor is transferred to a cold climate, the thermostat units must be procured and installed so that correct engine operating temperature may be mainained.

d. Cooling Fans and Fan Drives. Two six blade cooling fans are used to draw air through the radiators to cool the water, torque converter, and transmission oil as they are circulated through the radiators. Two fan drive shafts between the two engines are driven by **V**-belts from pulleys on the engine crankshaft (fig. 79). More **V**-belts connect the pulleys on the front end of the drive shafts with pulleys on the fan drives. Each fan drive assembly consists of a drive pulley and

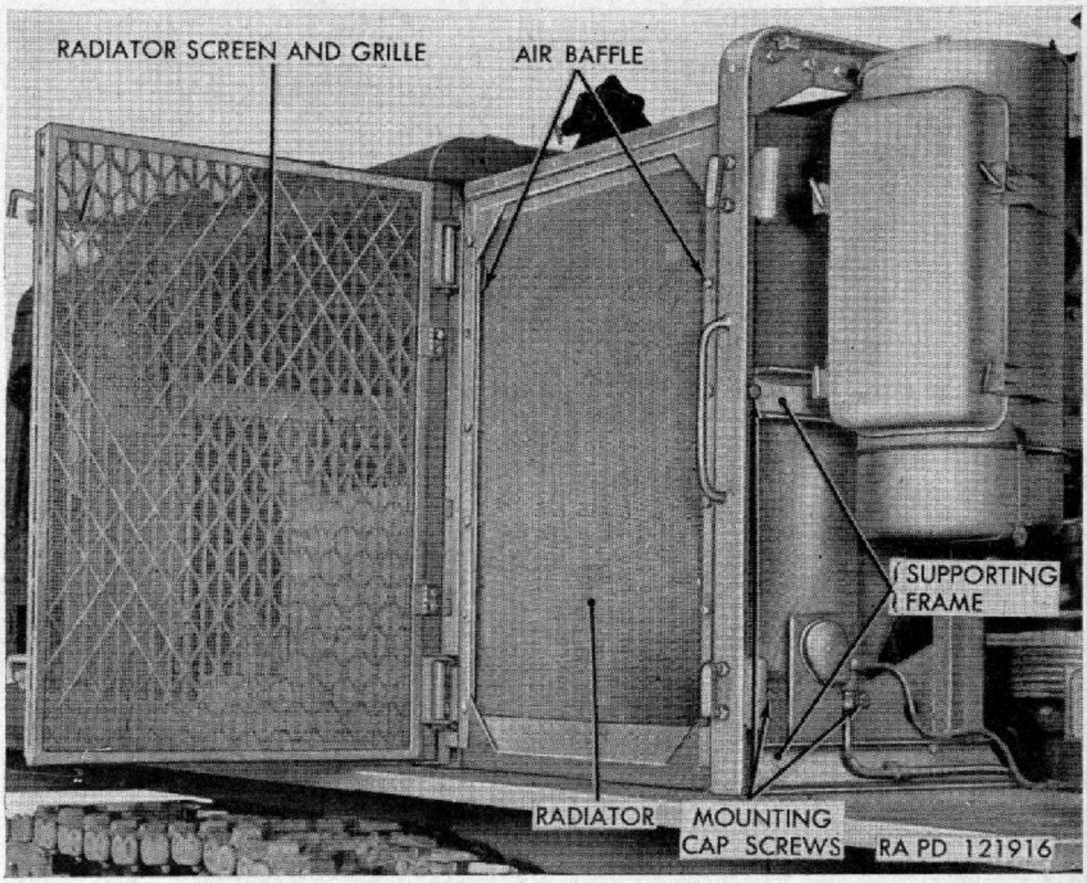


Figure 69. Radiator removal details—side view.

bevel gears enclosed in an **L**-shaped housing (fig. 80). Belt adjusters are provided for adjustment for proper tension on each set of belts (fig. 79).

e. Water Pumps. The water pump, located on the timing gear cover of each engine, is of the centrifugal type (fig. 81). The impeller is driven by the engine timing gears. The inlet elbow of the pump connects to the radiator. The coolant is discharged from the water pump into the oil cooler through the coolant outlet hose (fig. 81). A drain hose, connected to the bottom of the inlet elbow of each pump, connects to the water drain valve for that engine.

129. Radiators and Radiator Assembly

a. Removal.

(1) *Remove side hood.* Remove the four cap screws that attach front end of air intake to roof of the cab (fig. 3). Remove two cap screws that attach rear end of intake pipe to top of engine hood. Loosen air intake hose clamps at air cleaner (fig. 36), raise front end of intake pipe, and slip it out of hood. Remove the 11 cap screws that attach side hood to radiator supporting frame, cap frame, and engine hood frame (fig. 69), and remove side hood.

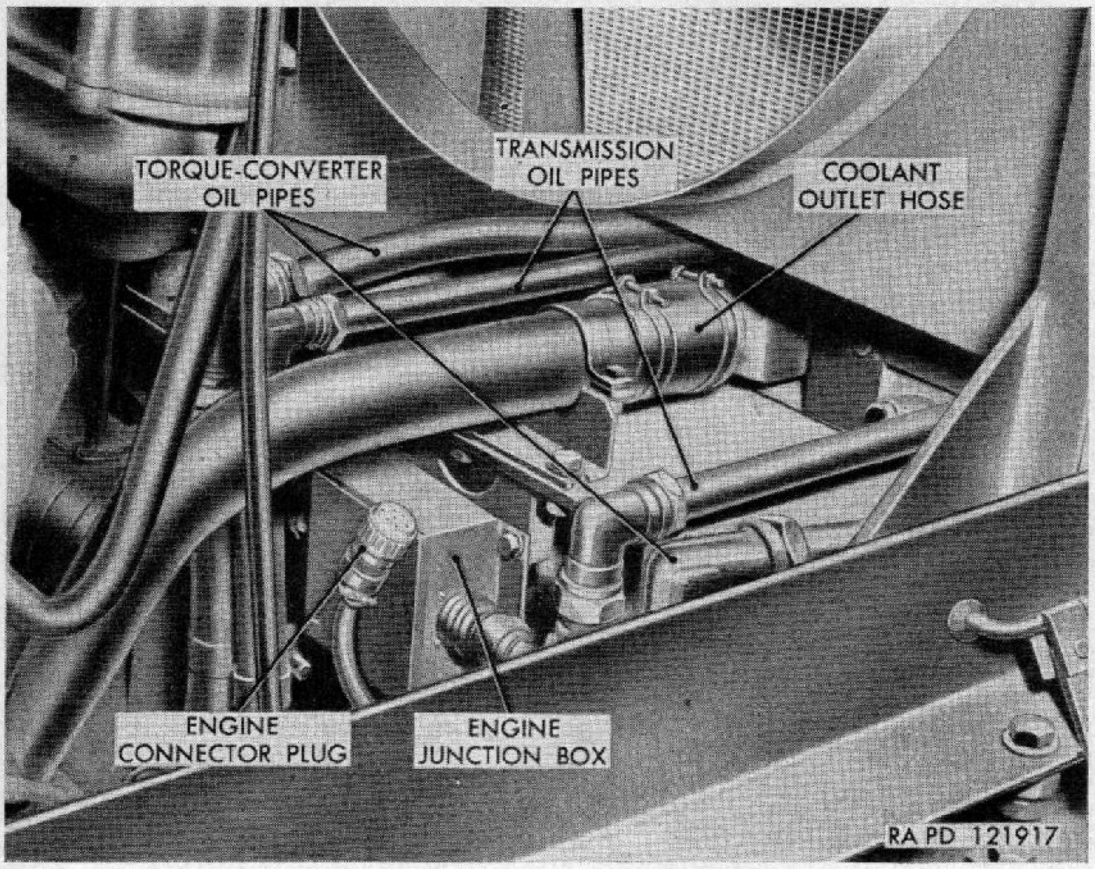


Figure 70. Radiator removal details—inside view.

(2) *Disconnect engine coolant, torque converter oil, and transmission oil lines.* Drain torque converter system (par. 181*a*). Drain engine cooling system (par. 131*a*) on the side from which radiator is to be removed. Drain the transmission system (par. 188*b*). Loosen outer clamp on hose connecting large coolant pipe to top of radiator (fig. 68). Disconnect upper end of small hose leading from radiator expansion tank to top of radiator (fig. 68). Disconnect upper end of torque converter radiator vent pipe from fitting at top of radiator between radiator and cab (fig. 68). Disconnect

transmission oil pipes, converter oil pipes, and coolant outlet hose at the elbow connection nearest cooling radiators (fig. 70).

(3) *Remove radiator assembly.* Open radiator grilles. Remove two cap screws from each of the two air baffles at side of radiator and remove these baffles (fig. 69). Remove the four cap screws at each side of radiator that attach radiator saddle to supporting frame (fig. 69). Slide radiator assembly out of suporting frame.

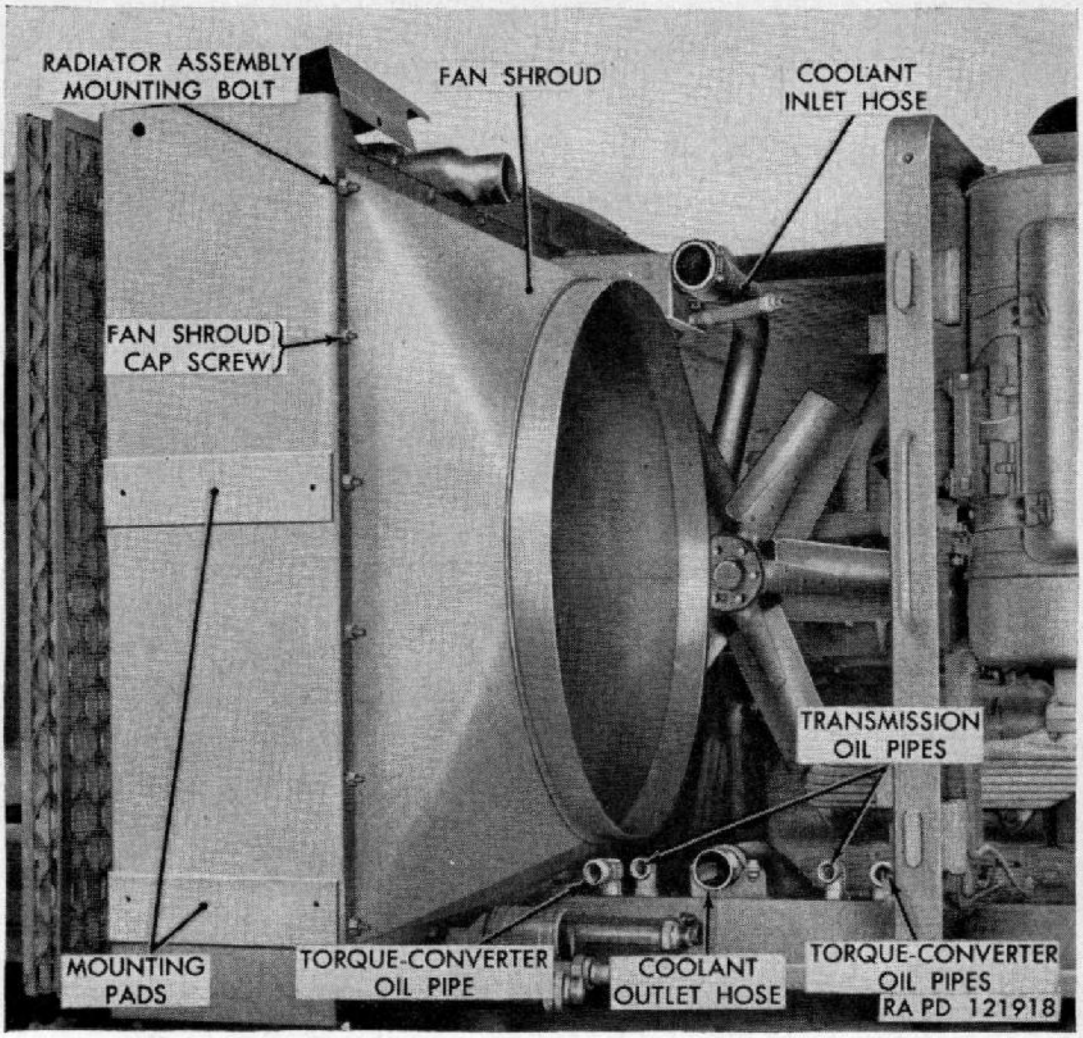


Figure 71. Radiator assembly removed.

b. Radiator Removal.

(1) *Remove cover plate, vent pipe, and fan shroud.* Remove all retaining cap screws from cover plate on top of radiator and remove cover plate. Remove plug and copper gasket from top of torque converter oil radiator (fig. 72). Remove copper gasket from below vent block. Unscrew vent pipe from block and remove pipe and block (fig. 73). Remove 14 cap screws and light nuts from fan shroud and radiator saddle

and remove shroud (fig. 71). After the fan shroud has been removed, drive the eight bolts out of radiators and shell from which the nuts were removed.

(2) *Remove transmission oil radiator from shell.* Remove fitting for expansion tank hose from top of coolant radiator (fig. 68). Remove four cap screws and remove hose connecting flange from coolant radiator (fig. 72). Remove the

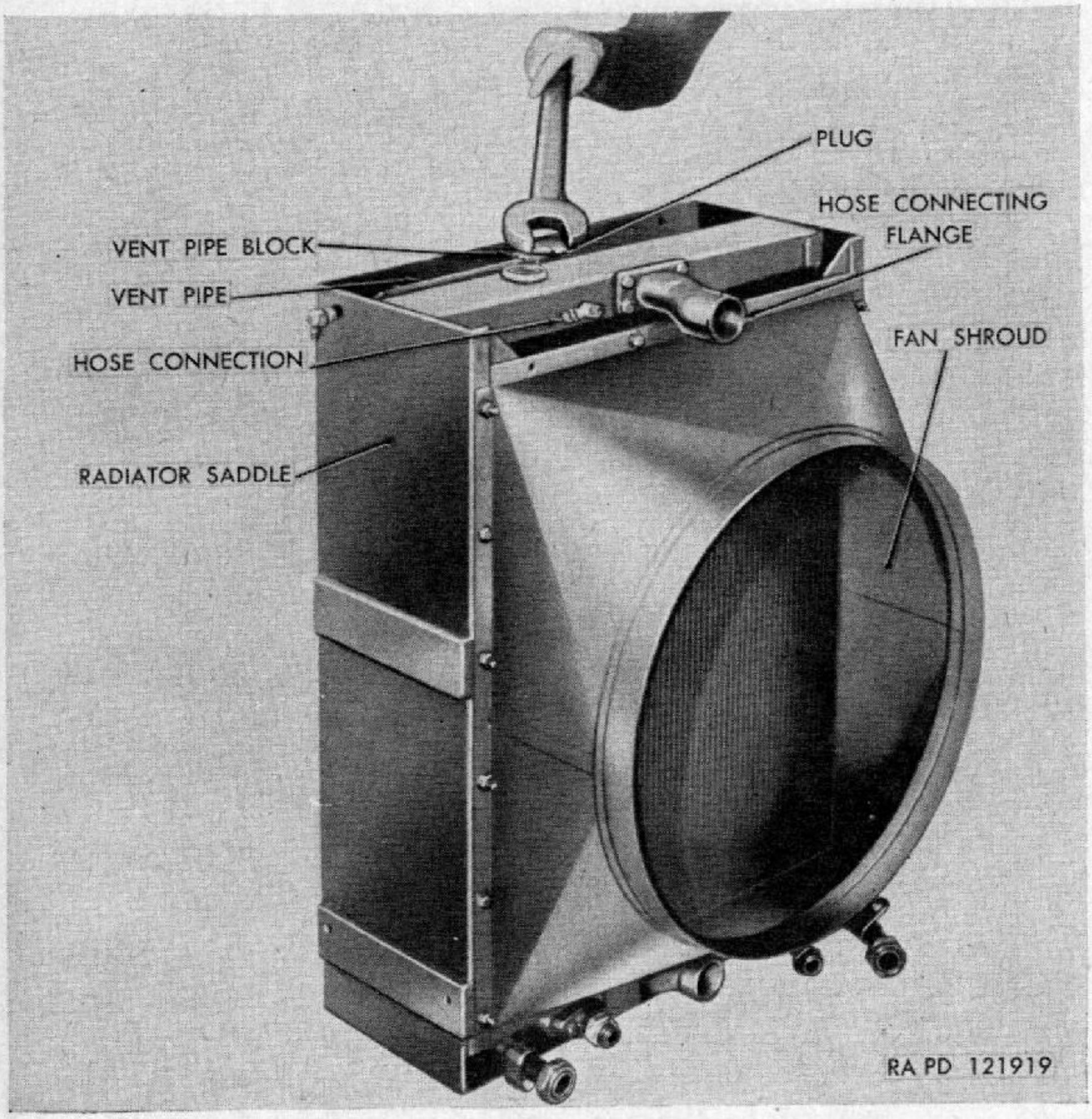


Figure 72. Removing plug from torque converter oil radiator.

two hose connecting flanges from lower end of transmission oil radiator by removing two cap screws from each flange (fig. 74). Lift transmission oil radiator up and out of the saddle (fig. 75).

(3) *Remove coolant and torque converter oil radiators.* Lift coolant radiator from saddle. Remove the four cap screws holding torque converter oil radiator in saddle and lift out torque converter oil radiator.

c. Repair. Leaks in the radiator, caused by vehicle vibration, punctures, or excessive internal pressures may be repaired by brazing with silver solder as follows:

(1) Clean the portion of the radiator to be repaired, with dry-cleaning solvent or volatile mineral spirits. After all oil and greasy matter has been removed, scrape the area as clean and bright as possible.

(2) Apply brazing flux.

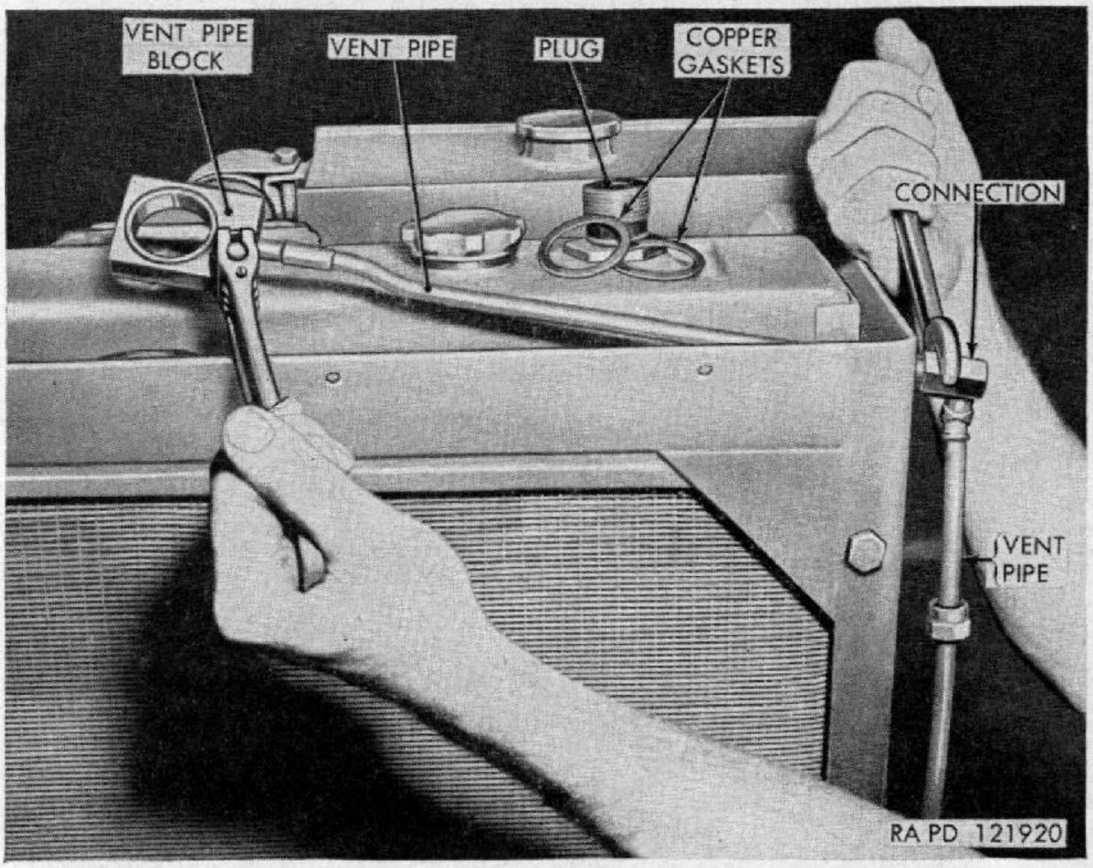


Figure 73. Removing vent pipe.

(3) Using class 4 silver solder and an oxy-acetylene welding torch with a No. 5 tip, heat the solder until it just starts to flow, and build up the metal slowly until the hole is closed.

Caution: Use only class 4 silver solder. Do not use brass brazing rod or lead-tin solder to repair torque converter or transmission oil cooler radiators. The intense heat required to melt the brass rod may cause further leaks in the radiator joints which were originally made with lower-melting point silver solder, while the use of lead-tin solder on any part of the radiator will prevent any subsequent use of silver solder on that part of radiator. Silver solder will not adhere to any part of radiator on which lead-tin solder has been used.

(4) If a tube in the radiator is split or seriously punctured and a satisfactory repair is difficult to make, puncture a small hole near the top and near the bottom of damaged tube and feed solder through the holes to seal the tube from the top and bottom header tanks.

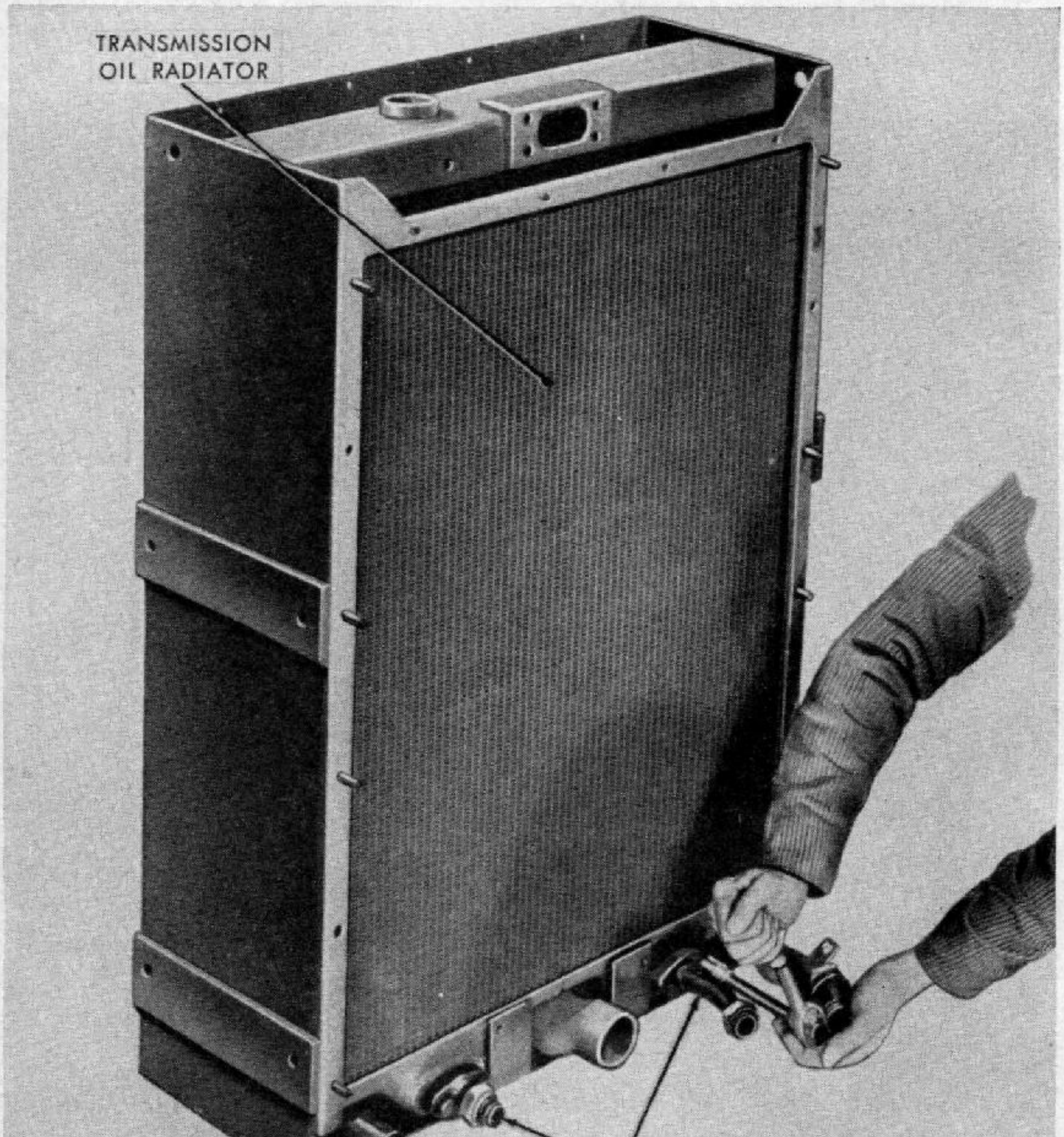


Figure 74. Removing hose connecting flanges from transmission oil radiator.

Caution: Avoid using too much heat to prevent silver solder from running into the header tanks.

Note.—If a center tube is split or punctured, it may be necessary to cut the outside tube, at top and bottom, in front of the punctured tube, to permit plugging of the damaged tube. Tubes may be cut with a sharp chisel.

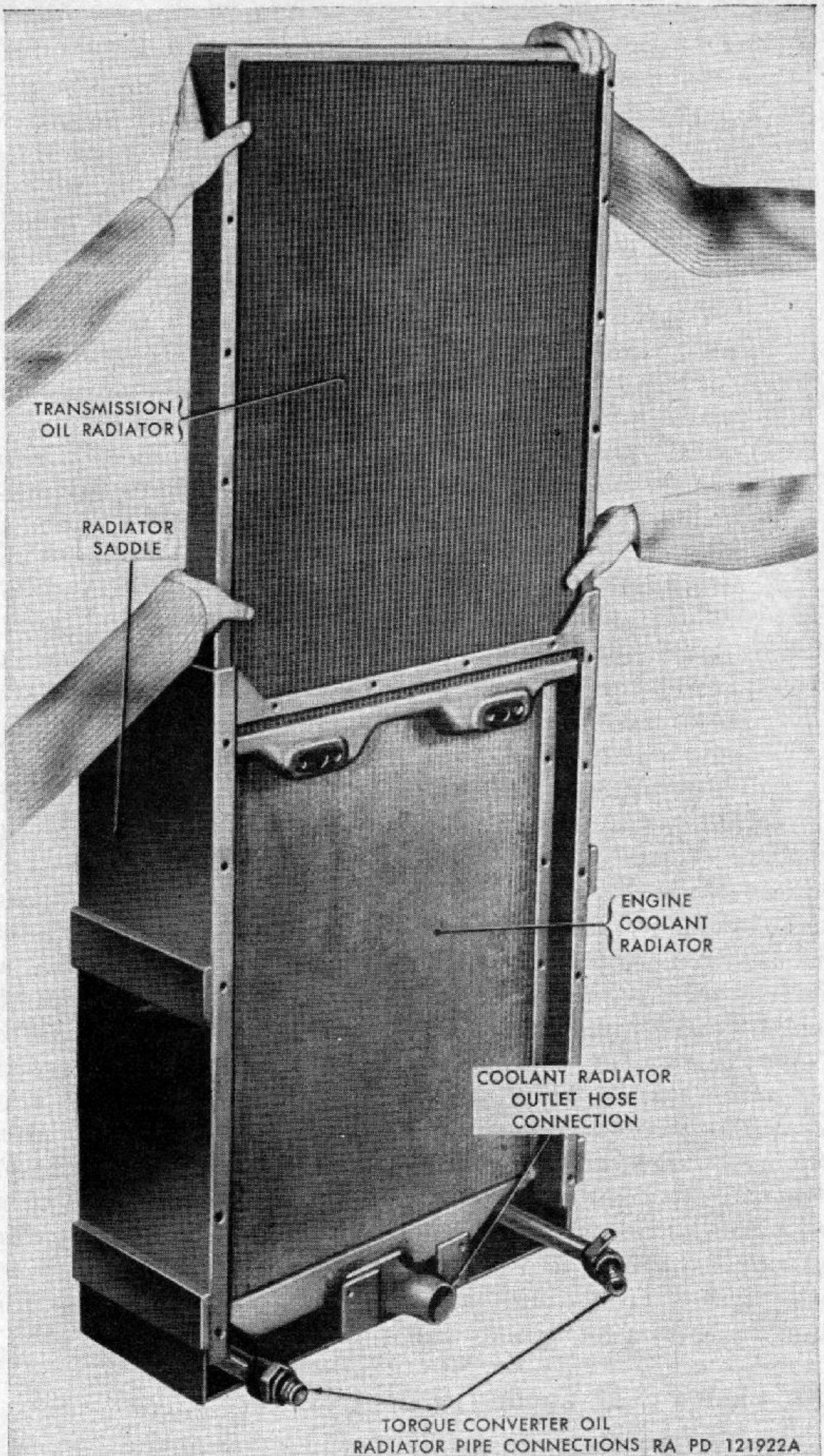


Figure 75. Lifting transmission oil radiator from saddle.

d. Radiator Installation.

(1) *Install radiators in saddle.* Set the torque converter oil radiator in saddle first, against outer side of saddle. Using new gaskets coated on both sides with cement, attach flanged pipe connections and pipes to inlet and outlet at lower end of radiator with two cap screws and lock washers (fig. 75). Set coolant radiator in saddle against converter oil radiator. Attach coolant outlet hose connection to bottom of radiator in same manner as for converter oil radiator (fig. 74). Next set the transmission oil radiator in saddle (fig. 75), and attach the connecting flanges with gaskets to bottom of radiator (fig. 74). Attach hose connecting flange to top of coolant radiator with four cap screws and gasket (fig. 72).

(2) *Install fan shroud and converter radiator vent line.* Place fan shroud against inner side of radiator saddle, and install four long bolts through each side of saddle and shroud and two cap screws at each side of shroud (fig. 71). Coat threads of fittings for expansion tank connecting hose with white or red lead and screw fitting into top of coolant radiator (fig. 68). Insert vent pipe through front side of shell and screw inner end of pipe into vent block; then, using copper gasket above block, insert large plug through block and screw it tightly into top of converter radiator (figs. 72 and 73). Install shell cover plate with cap screws and lock washers.

e. Radiator Assembly Installation. Slide radiator assembly into supporting frame and attach to frame with four cap screws and lock washers at each side of radiator (fig. 69). Install the two air baffles at sides of radiator with two cap screws and lock washers in each baffle (fig. 69). Connect the transmission oil pipes, coolant outlet pipe, and converter oil pipes with those in hull (fig. 70). Connect expansion tank hose and converter radiator vent pipe to fittings at top and front of side radiator (fig. 68). Connect coolant pipe to coolant radiator inlet connection (fig. 68). Install side hood over radiator with 11 cap screws, then insert rear end of air intake pipe through hood and into hose on the air cleaner (fig. 36). Install four cap screws with lock washers to attach air intake to roof of cab, and install hold-down clip over pipe with two cap screws and lock washers. Tighten hose clamp at air cleaner (fig. 36). Fill cooling system (par. 131*b*), torque converter system (par. 181*b*), and transmission system (par. 188*b*). Check for leaks at connections with engine running.

130. Cleaning of Cooling System

a. General. The engine cooling system should be cleaned at least twice a year, usually at the beginning of cold weather before antifreeze is put in the cooling system, and again after the antifreeze solution is removed. Cleaning at the prescribed intervals will reduce clogging and overheating of the engine to a minimum and this will largely eliminate the necessity for cleaning by a higher echelon. If the cooling systems are very dirty or clogged so that overheating occurs, notify ordnance maintenance personnel. Examine all parts of the system for leaks both before and after cleaning and flushing.

b. Flushing Radiator.

(1) *Clean water.* Drain cooling system (par. 131*a*). Remove thermostats from thermostat housing and reinstall housing (par 132). Fill cooling system (par. 131*b*), start engine (par. 45), then open drain valve (fig. 76) and, using a hose, keep the radiator filled as the water runs through the system and out the drain plug. When all the rust, dirt, and foreign matter has been flushed from system, stop the engine and install the thermostats (par. 132*b*). Close drain valve and refill the cooling system (par. 131*b*).

(2) *Solvent solution.* If a solvent is used to clean the cooling system, a different procedure is necessary. Drain cooling system (par. 131*a*), close drain valve, and fill system with solvent solution. Start the engine and run it for about an hour with a cover over radiator to hold engine temperature at 190° F. Then drain the solvent solution from cooling system (par 131 *a*), flush radiator thoroughly with clean water ((1) above), and fill cooling system (par. 131*b*). If rust or foreign material has gathered at the top of the tubes in radiator, reverse flushing of the radiator is necessary. Drain the cooling system (par. 131*a*) and remove radiator cap. (fig. 77). Disconnect lower coolant outlet hose of radiator (fig. 70). Remove two bolts and clamp attaching outlet pipe to hull. Insert a water hose inside this hose and stuff a cloth around it if an adapter is not available for connection. Let water run slowly into radiator through the lower inlet hose until water runs out the top of the radiator; then increase the water pressure. Run enough water through radiator to remove the rust and foreign material off the top of the tubes and out the radiator filler pipe. When reverse flushing is finished, remove water hose and cloth. Connect lower coolant outlet hose and fill the cooling system (par. 131*b*).

131. Draining and Filling of Cooling System

a. Drain System. The cooling system for each engine is so arranged that the coolant from the entire system can be drained by opening one drain valve. Figure 76 shows the levers for opening the drain valve. Water lines lead from the drain valves to the outside of the hull. To drain the cooling system for the left engine, first remove the front drain plug at side of hull (fig. 149), open the left engine compartment door, then turn the front drain valve lever (fig. 76) one-quarter turn (parallel with vehicle) to open valve. To drain the cooling system for the right engine, remove the rear drain plug and turn the second lever one-quarter turn to open valve.

Note.—These tractors when shipped are not equipped with thermotstats.

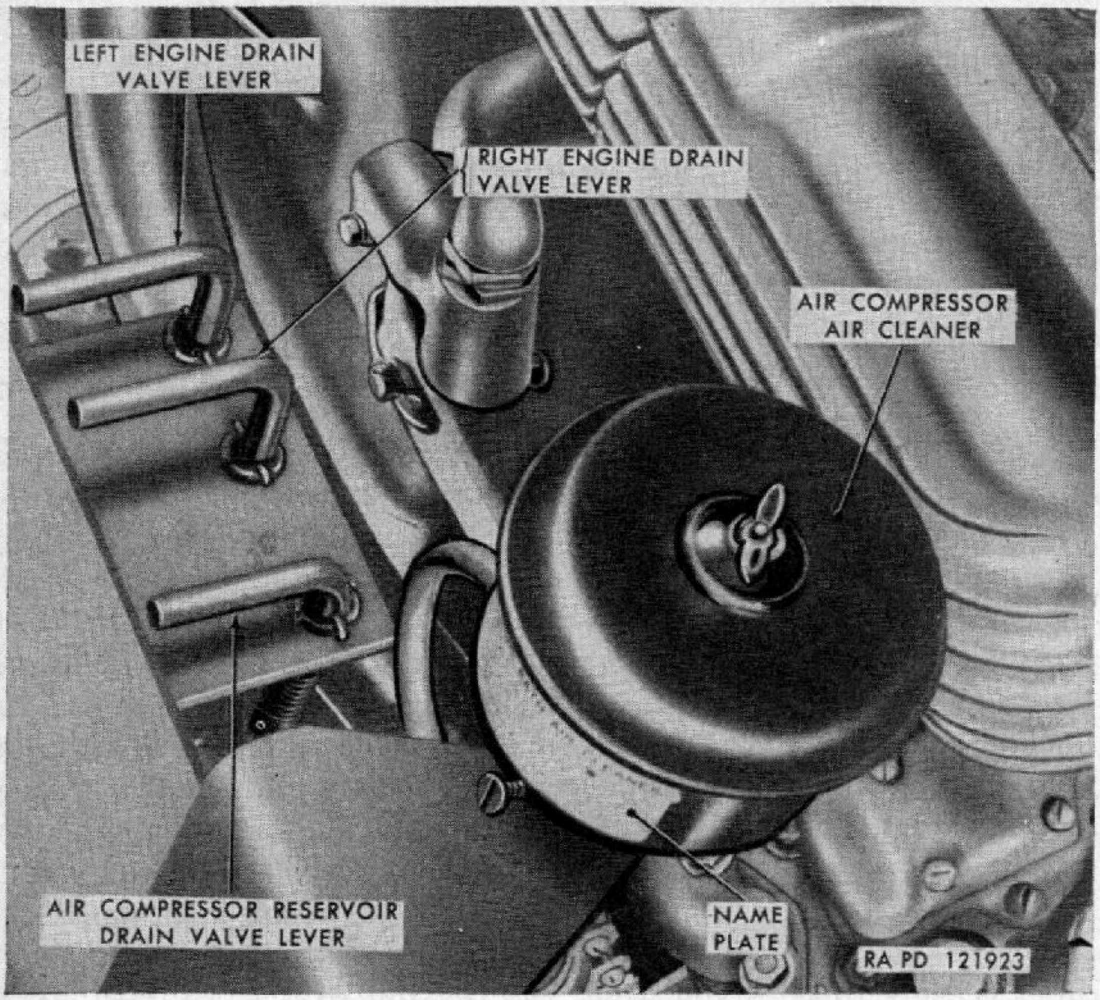


Figure 76. Cooling system drain levers.

If thermostats have been installed in thermostat housing (fig. 78) on coolant manifolds of engines at some time after the tractor has been put into operation, it will be necessary, when draining cooling system, to open the valves in the housings (fig. 43) by turning handwheels of valves counterclockwise to allow water that is trapped in the lines above the thermostat to drain out of the system.

b. Fill Systems. Close drain valves by turning the drain valve levers in the position shown in figure 76, and install plugs at the ends of drain lines at the side of hull (fig. 149). Open engine top grilles (fig. 3). Remove radiator caps from tops of radiators (fig. 77) and fill systems. Use water that is free from lime or alkalies. Use clean containers and take precautions against dirt, sand, or trash entering radiator while filling system. If engines have thermostats installed, it will be necessary to open the valves in the thermostat housing (fig. 43) by turning handwheel counterclockwise to allow air to escape from cylinder block while filling the system with water. Close these valves after systems are filled.

Note.—Do not fill expansion tanks, as these are provided to allow for expansion of coolant when the coolant temperature rises.

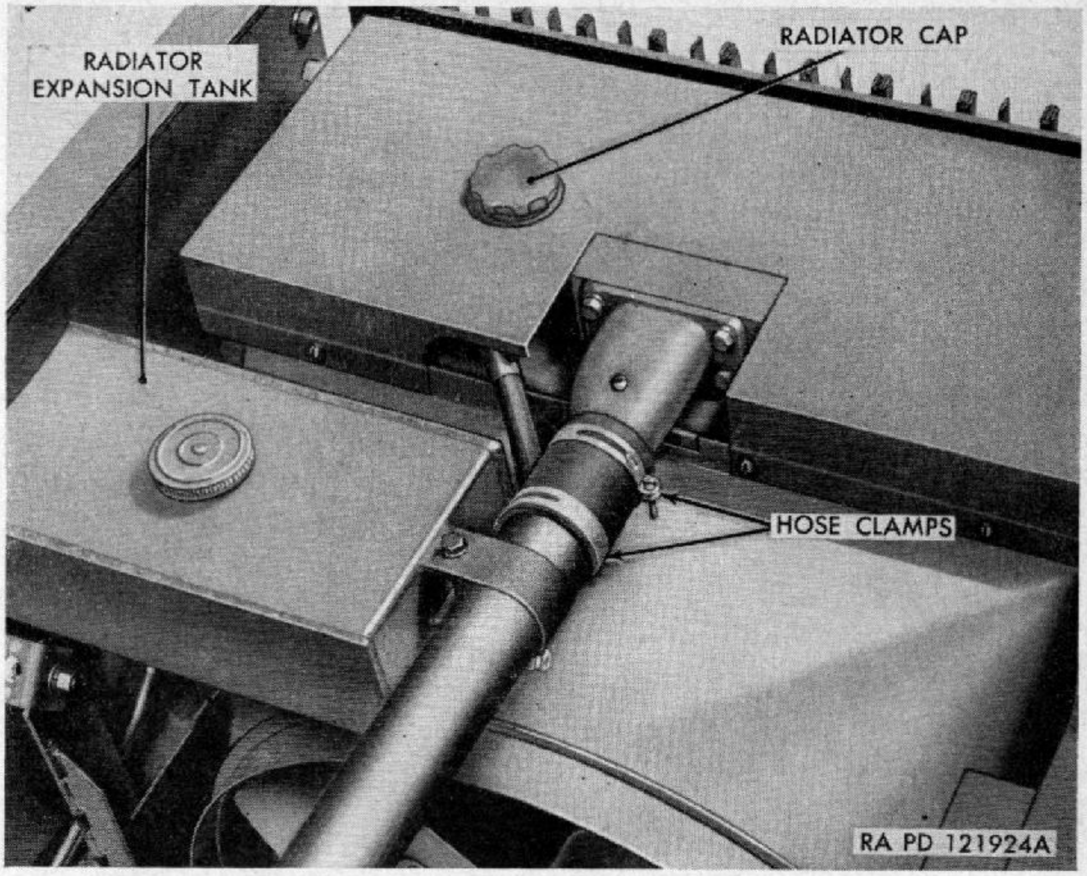


Figure 77. Cooling system radiator cap.

Use an antifreeze compound (ethylene glycol type) in the engine cooling system in cold weather. Test antifreeze solution daily to make sure it is of proper strength for prevailing temperature. Any leaks in system must be immediately corrected to prevent any loss of water and resultant overheating or damage of engine. Close engine top grilles (fig. 3).

132. Thermostats

a. Removal. Drain cooling system to a level below the thermostats (par. 131*a*). Remove seat backs in rear crew compartment. Loosen clamps on hoses that connect coolant inlet hose to thermostat housing and slide hose upward so it will be free of thermostat housing (fig. 78). Remove two cap screws to disconnect coolant bypass pipe from housing (fig. 78). Remove the four attaching cap screws from housing and lift out housing, thermostats, and gaskets (fig. 78).

b. Installation. Cement new gaskets to water manifold and thermostat housing where coolant bypass pipe is attached. Position thermostats in water manifold and install thermostat housing on mani-

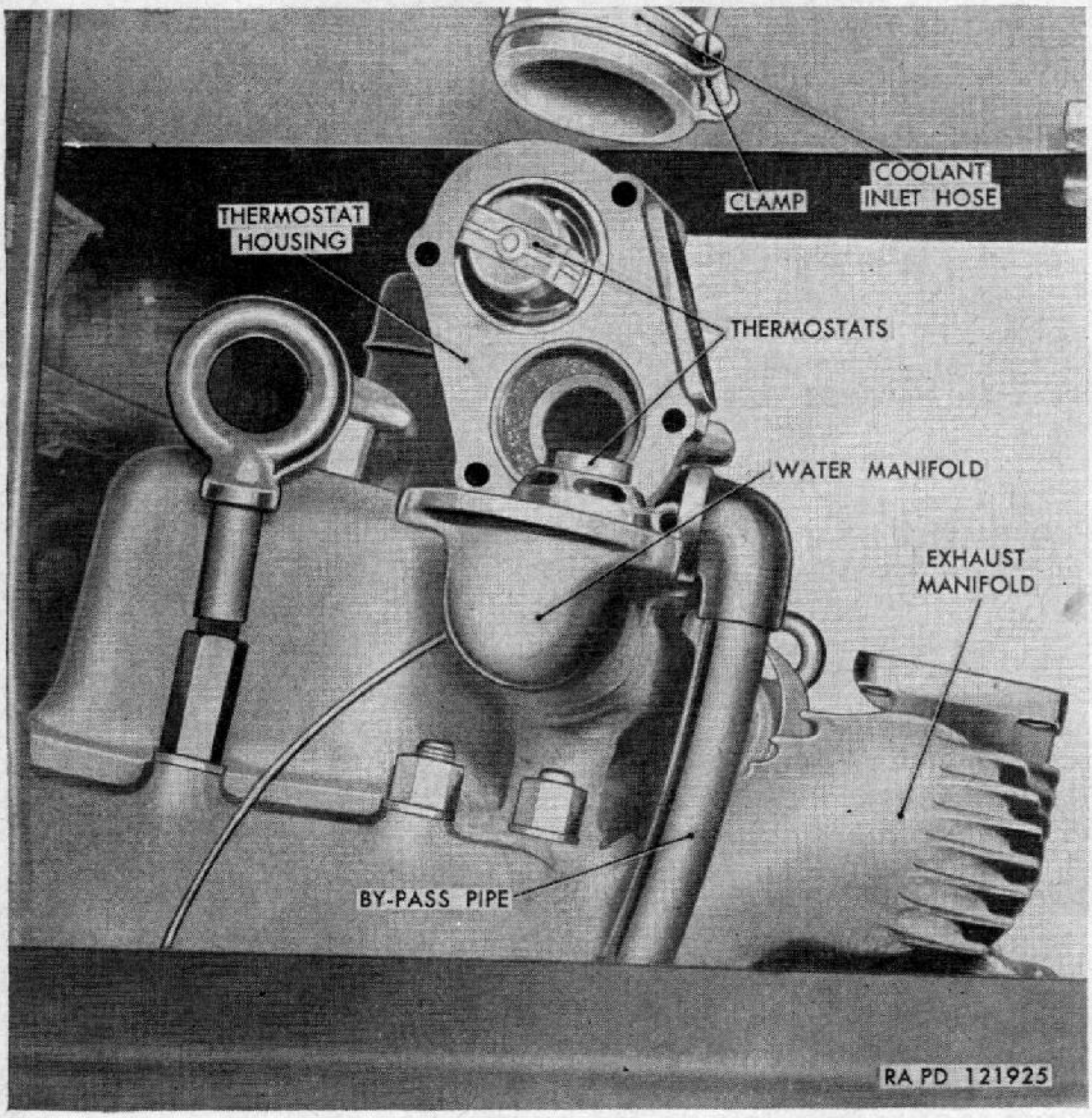


Figure 78. Engine thermostat removal.

fold with four cap screws and lock washers. Install the coolant bypass pipe to thermostat housing with two cap screws and lock washers. Slide inlet hose on thermostat housing and tighten hose clamps. Fill cooling system (par. 131*b*). Start engine and inspect for coolant leaks.

Note.—Do not attempt to repair thermostats.

Install seat backs in rear crew compartment.

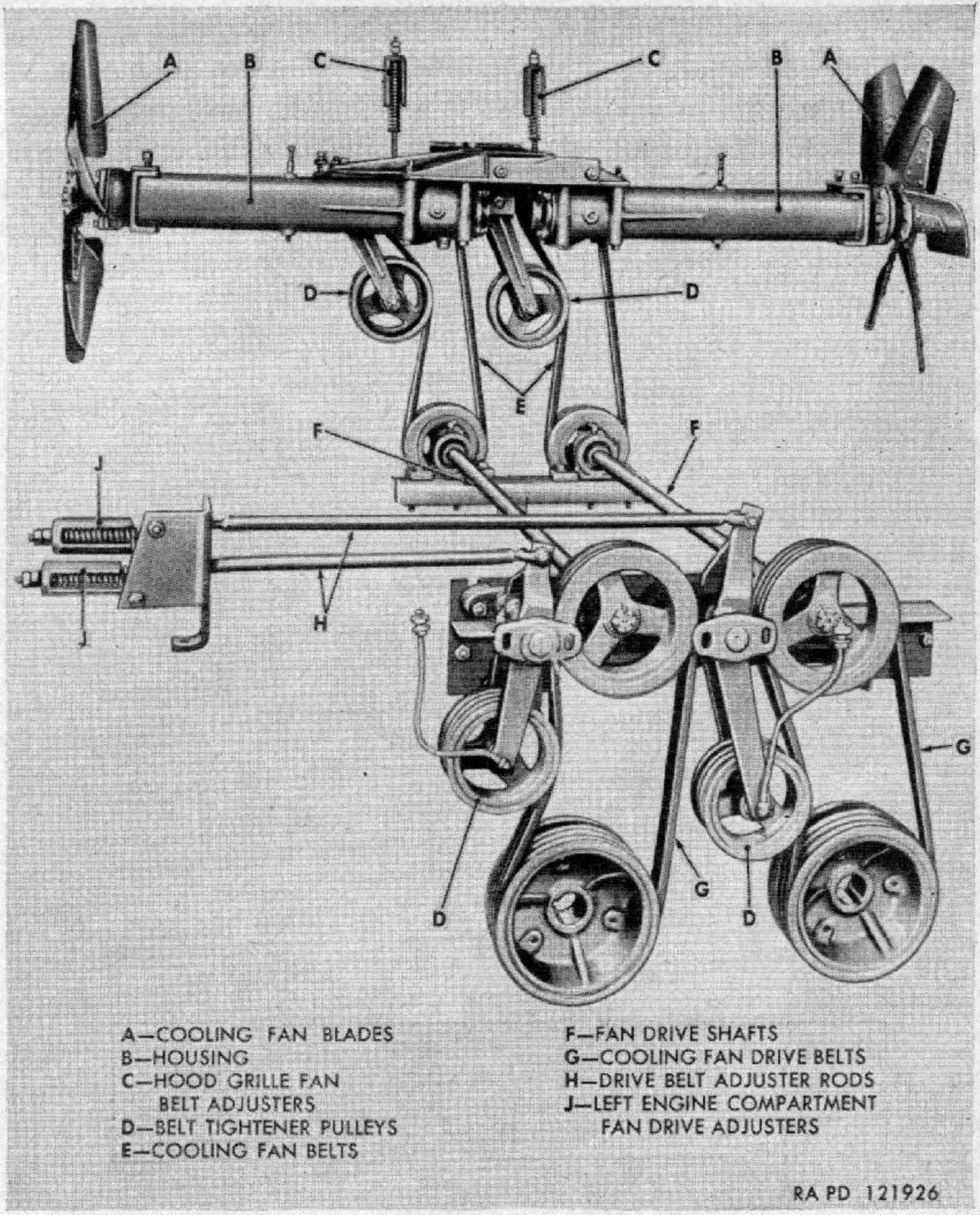


Figure 79. Cooling fan arrangement.

133. Cooling Fans and Fan Drives

a. Removal. Open engine top grilles (fig. 3). Using a screw driver, turn locking screws, holding air deflectors to supports, one-half turn counterclockwise and remove the two air deflectors from above the fan drive to be removed. Remove nut plain washer, and lock washer at end of housing holding cooling fan blade to shaft (fig. 80). Remove the cooling fan blade from inside of shroud. Relieve tension on the fan drive belts and remove belts from drive pulley (par. 99). Remove six bolts and lock washers attaching fan drive housing to its supports. The fan drive housing mounting holes are shown in figure 80. Lift out the fan drive assembly.

b. Installation. Place fan drive housing assembly in place and attach the assembly to supports with six bolts and lock washers. Position cooling fan blade on shaft and install plain washer, lock washer, and nut on shaft (fig. 80). Install fan drive belts on drive pulley and adjust drive belts (par. 99). Position air deflectors on supports and turn locking screw clockwise one-half turn to secure deflectors to supports. Close engine top grilles.

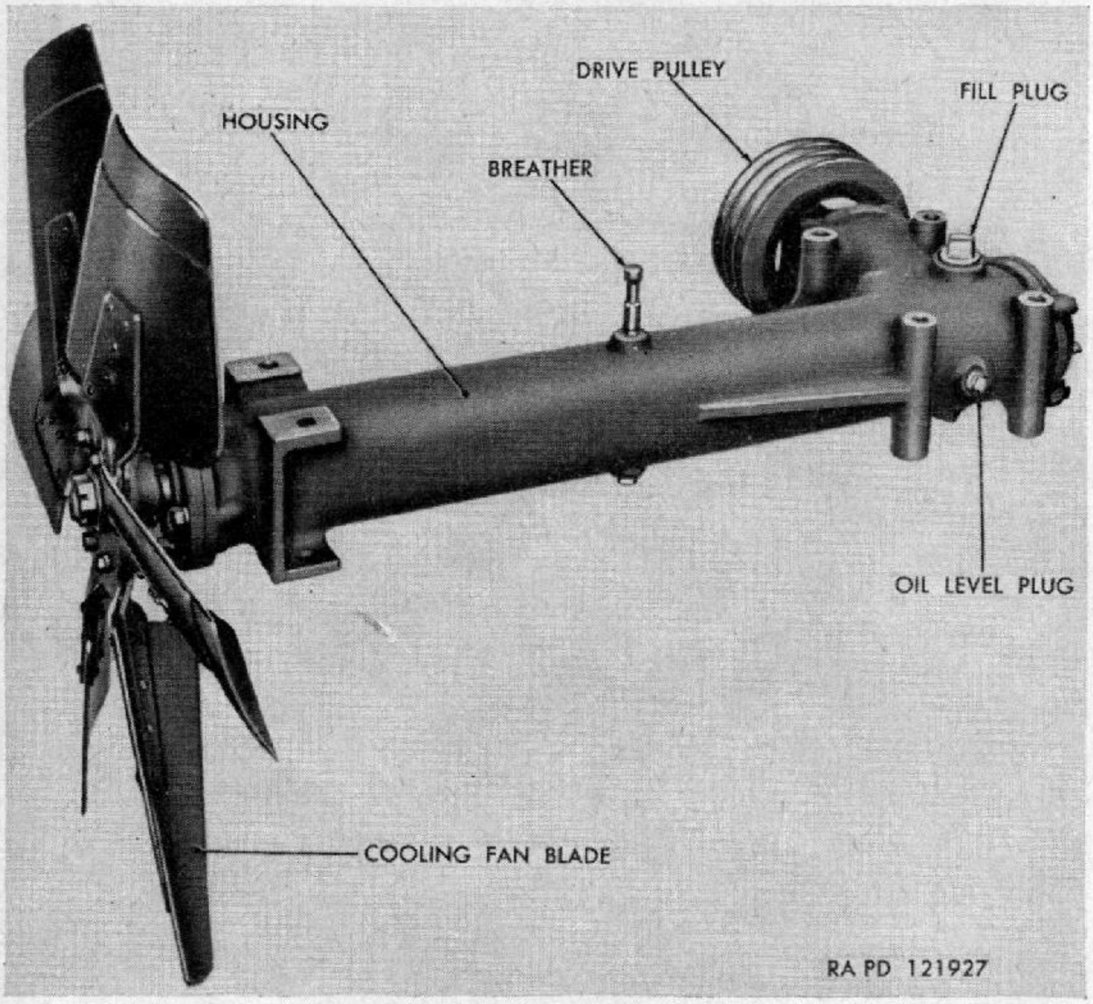


Figure 80. Fan and fan drive assembly.

134. Water Pumps

a. Removal.

(1) *Remove pump from left hand engine.* Open left engine compartment door. Drain cooling system (par. 131*a*). Remove air compressor (par 197). Remove engine oil cooler (par. 102*b*). Remove screw from clamp that connects coolant outlet hose to water pump (fig. 81) and remove outlet hose from water pump. Disconnect and remove water line connected to inlet elbow below water pump and air compressor. Remove engine maintenance plate under engine

(fig. 62). Reach up and remove the two cap screws that attach inlet elbow to pump. Remove five mounting cap screws and lock washers attaching pump to housing (fig. 81). Pull pump straight forward and out of the timing gear housing.

(2) *Remove pump from right hand engine.* Drain cooling system (par. 131*a*) and move ammunition box back (par. 214*c*). Remove four attacking cap screws from air baffle plate between engines (fig. 40) and remove plate. Remove water pump as explained in (1) above.

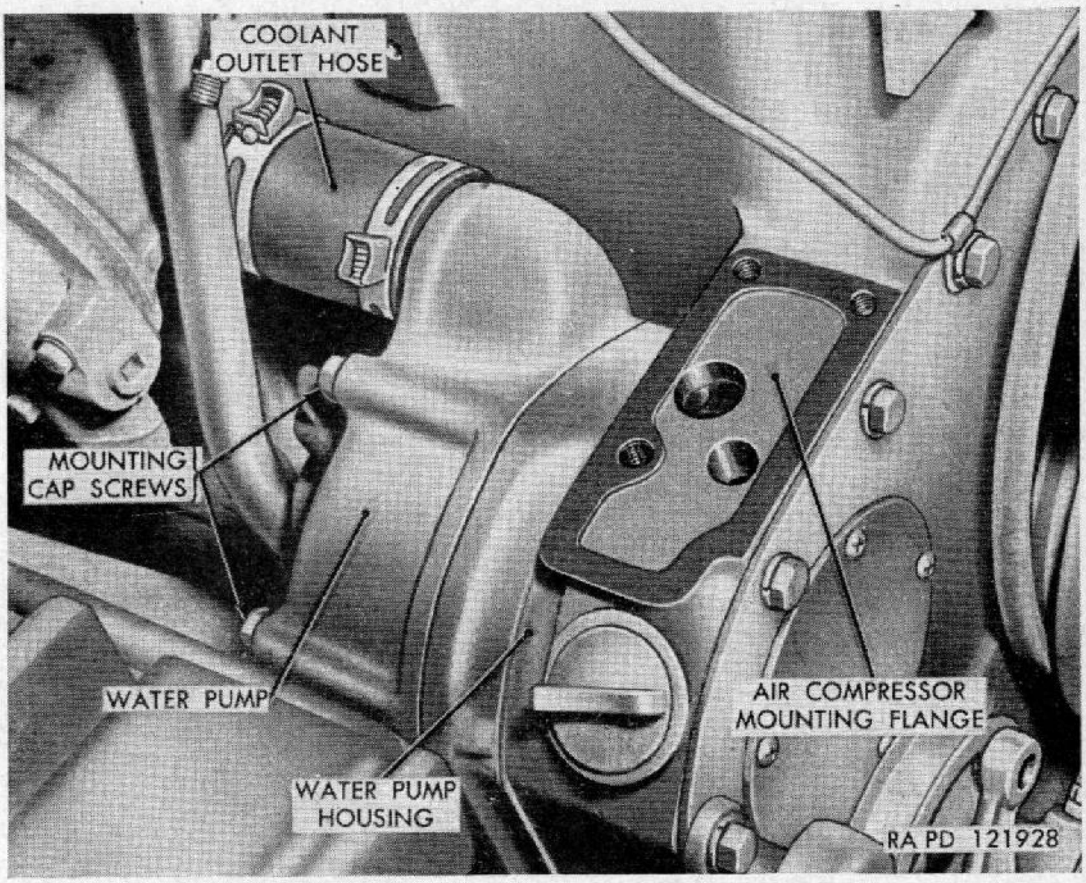


Figure 81. Engine water pump installed.

b. Installation.

(1) *Install pump on left hand engine.* Cement new gaskets to attaching flange of water pump and inlet elbow of pump. Insert pump drive gear into timing gear housing and install five attaching cap screws and lock washers (fig. 81). Reach up through hull bottom and connect inlet elbow to pump with two cap screws. Install engine oil cooler (par. 102*b*). Position coolant outlet hose on water pump and tighten clamp screw (fig. 81). Install air compressor (par. 197). Install and connect ends of water lines (fig. 120) to inlet elbow below water pump and air compressor. Fill cooling system

(par. 131*b*). Start engine (par. 45) and inspect for leaks. Install engine maintenance plate (fig. 62).

(2) *Install pump on right hand engine.* Install water pump as outlined in (1) above with the exception of installation of air compressor and air compressor water line. Install air deflector between engines with four cap screws and lock washers (fig. 40). Move ammunition box in position and secure to hull (par. 214*c*). Fill cooling system (par. 131*b*). Start engine (par. 45) and inspect for leaks. Install engine maintenance plate (fig. 62).

Section XI. BATTERIES AND GENERATING SYSTEM

135. Description and Data

a. Description.

(1) *System.* The battery and generating system consists of one generator, one generator regulator (fig. 58), two batteries (fig. 82), and the necessary wiring to connect the units. The purpose of the battery and generating system is to provide the necessary electrical current needed to operate the tractor and all electrical equipment included on the tractor. The generator is located to the rear of the right engine and supplies current for the batteries when the right engine is running (fig. 58).

(2) *Batteries.* Two 12-volt wet-cell storage batteries, connected in parallel, are located in a support in the right side of hull under the floor plate in the rear seat compartment (fig. 82). The two cables connected to the negative (−) terminals of the batteries are ground to the battery support. The two cables connected to the positive (+) terminals are connected to the starter solenoid of the right hand engine. A jumper cable from this solenoid to the starter solenoid of the left hand engine is provided (fig. 44).

(3) *Generator.* The generator is a 12-volt, 26-ampere, $5\frac{1}{16}$-inch frame size, ventilated unit, driven by a pulley, with the armature supported at both the drive end and commutator end by heavy-duty sealed ball bearings. It is mounted on a bracket at rear of right hand engine (fig. 58). The generator output is controlled by the current regulator unit of the generator regulator.

(4) *Generator regulator.* The generator regulator consists of three units, circuit breaker, voltage regulator, and current regulator. It is mounted on a bracket at the side of the right hand radiator (fig. 87).

(a) *Circuit breaker.* The circuit breaker closes the circuit between the generator and the batteries when the generator voltage has built up to a value sufficient to force a charge into the batteries. The circuit breaker opens the circuit when the generator slows or stops, preventing current from flowing from the batteries into the generator and thus having the generator driven as a motor.

(b) *Voltage regulator.* The voltage regulator prevents the line voltage from exceeding a predetermined value and thus protects the batteries and other electrical units in the system from high voltage. One characteristic of batteries is that as either the specific gravity or the charging rate increases, other conditions being the same, the battery terminal voltage increases. If the terminal voltage is held constant as the batteries come up to charge (specific gravity increases), the charging rate will be reduced. The voltage regulator preforms this job of holding the voltage constant and consequently protects the electrical system from high voltage and the batteries from overcharge.

(c) *Current regulator.* The current regulator limits the generator output to a safe value. It is, in effect, a current limiting device which operates when the generator output has increased to its safe maximum and prevents the generator from exceeding this value.

b. Data.

Generator:	
Name	Delco-Remy.
Model	1105906.
Cold output	25 amperes at 15 volts at 1,250 rpm of engine.
Hot output	Maximum output controlled by current regulator setting.
Brush spring tension	22 to 26 oz.
Generator regulator:	
Make	Delco-Remy.
Model	1864129.
Circuit breaker:	
Cut-out relay closing voltage	13. 5 volts.
Air gap	0.057 in.
Point opening	0.020 in.
Voltage regulator setting:	
Voltage regulator voltage setting	15.0 volts.
Point opening	0.015 in.
Current regulator setting:	
Current regulator current setting	25 amperes.
Point opening	0.015 in.

136. Batteries

a. Maintenance.

(1) *Specific gravity.* Specific gravity readings of each battery will be taken periodically. Use a hydrometer and test each cell separately. Hydrometer readings must be corrected to a temperature of +80° F. The normal correction for temperatures is 4 points (0.004) of gravity for each 10° F. change of temperature above or below +80° F. (Example: If specific gravity reading is 1.280 at 0° F., subtract 0.032. Correct reading will be 1.280 minus 0.032, which is 1.248.) A corrected specific gravity reading of 1.285 in each cell indicates a fully charged battery. A specific gravity reading of 1.225 or less in each cell indicates that the battery must be recharged or replaced.

Table IV. Battery Freezing Temperature Chart

Corrected specific gravity	Freezing temperature	Corrected specific gravity	Freezing temperature
1.285	−96° F.	1.185	−8° F.
1.255	−60° F.	1.150	+5° F.
1.220	−31° F.	1.100	+18° F.

(2) *Adding water.* If water is added in freezing temperatures, the batteries should be charged to mix water with electrolyte; otherwise, the water will remain on top and freeze. In cold weather, water should be added when the batteries are in a room warm enough so that the batteries can be sufficiently charged to thoroughly mix the water with electrolyte before the water can freeze. Distilled water or any approved water may be used. Do not overfill, as subsequent electrolyte expansion may cause flooding and damage. The proper filling height is approximately three-eights of an inch above top of separators. Many batteries are equipped with a lead washer in each vent well which is designed to prevent overfilling. Therefore, add water only until it begins to rise into the vent plug well. Draw off excess in order to obtain proper level when vent caps are in place.

(3) *Vent plugs.* Always keep vent plugs in place except when filling or taking gravity readings. Vent plugs must be in place while charging. Be sure holes in vent plugs are open.

(4) *Keep batteries clean and dry.* Remove batteries from tractor (*b* below) if wet or dirty. Wash batteries with baking soda solution or ammonia, then wash with clear water. Be sure vent plugs are tight before washing.

(5) *Terminals.* Keep terminals tight and clean. If corroded, disconnect and clean ((4) above). Apply a coat of light rust-preventive compound to terminal and battery posts after replacing terminal.

b. Removal. Remove nuts, lock washers, and flat washers from the two hold-down bolts of each battery (fig. 82), and lift hold-down assembly off bolts and battery. Loosen clamp bolts in cable terminals and lift cables from battery terminals. Lift battery out of support.

c. Installation. Set batteries in support with terminals toward rear of tractor. Clean battery and cable terminals. Place the two cable terminals of positive cable on the positive terminals of each battery (these terminals are on side of battery closest to side of hull). Tighten clamp bolts. Connect the terminals of negative ground cable to negative terminals of batteries and coat terminals with a thin film of rust-preventive compound (light). Make sure the rubber hold-down blocks on cross bars of hold-down assemblies are in good condition; then place hold-down assemblies on batteries and bolts and install flat washers, lock washers, and nuts on hold-down bolts (fig. 82). Tighten nuts firmly but do not overtighten.

137. Generator

a. Maintenance. Remove cover band located to the rear of generator and inspect the commutator and brushes. If the commutator is dirty, is may be cleaned with No. 2/0 flint paper.

Caution: Never use emery cloth to clean the commutator.

If the commutator is rough, out-of-round, or has high mica, the generator must be removed so the commutator can be turned down in a lathe and the mica undercut. If the brush length is not sufficient to last until the next inspection period, replace the brushes. The pulley nut must be tight, the belt tension adjusted for ¾-inch deflection (par. 99*c*), and the mounting bolts tight. The connections and wiring in the generator to battery circuit should be in good condition. No lubrication is required of the generator.

b. Removal. Open engine compartment door on right side of tractor. Remove cap screw from slotted belt adjusting bracket (fig. 83) and remove belt from generator drive pulley. Remove nuts from "A" and "F" generator terminals (figs. 44 and 84) and remove wires from terminals. Install washers and nuts on terminals to prevent loss of washers. Remove the two bolts from generator and its support bracket (fig. 83) and lift out generator.

c. Installation. Install generator on support bracket with two bolts (fig. 83), placing belt on drive pulley and adjusting for ¾-inch deflection before tightening bolts (par. 99*c*). Connect wire leading from center terminal on regulator to "F" terminal on generator.

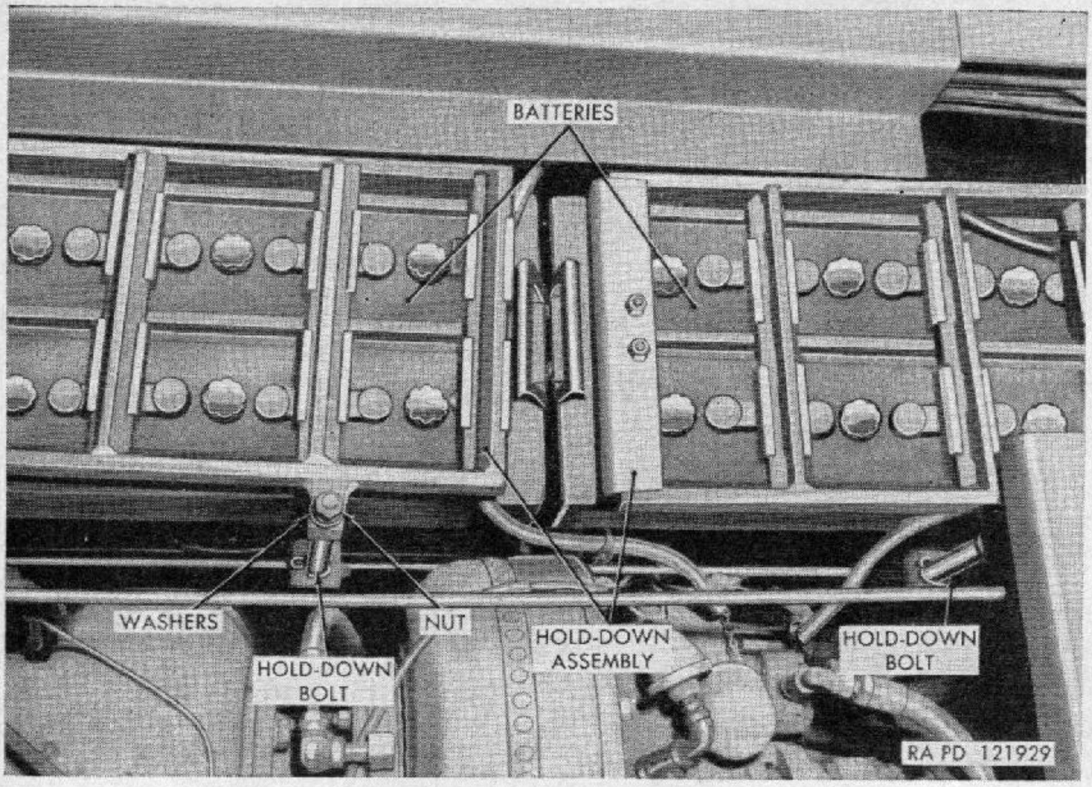


Figure 82. Batteries installed.

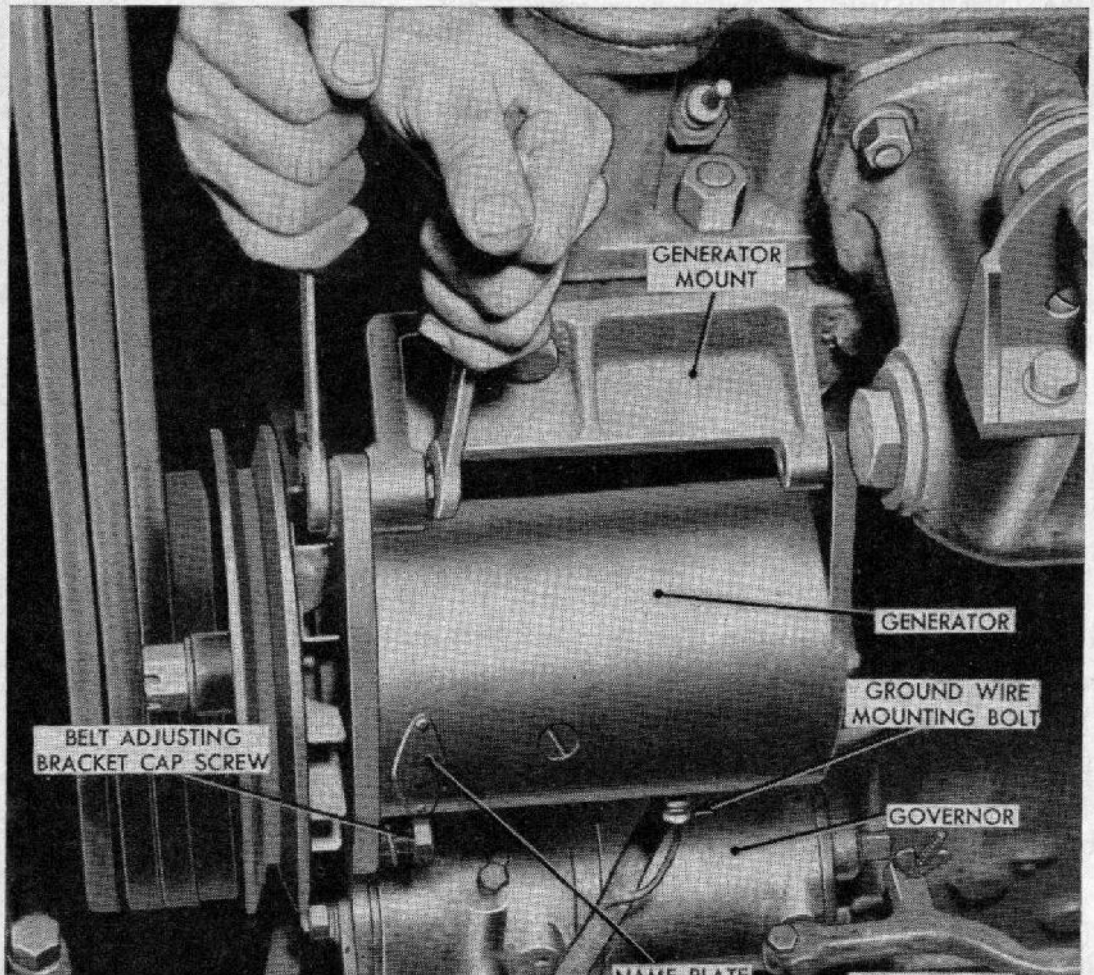


Figure 83. Generator removal.

The generator must now be polarized. Use a jumper lead to momentarily connect "BATTERY" terminal to "A" terminal. This allows a momentary surge of current to flow through the field windings which correctly polarizes the generator with respect to the battery. Then connect the wire from radio suppression capacitor on generator and wire leading from "ARMATURE" terminal on regulator to "A" terminal on generator.

Caution: Never operate the generator with the field circuit connected and the "A" terminal disconnected, since circuit would be open and allow high voltage to build up within the generator, which would damage the fields and armature.

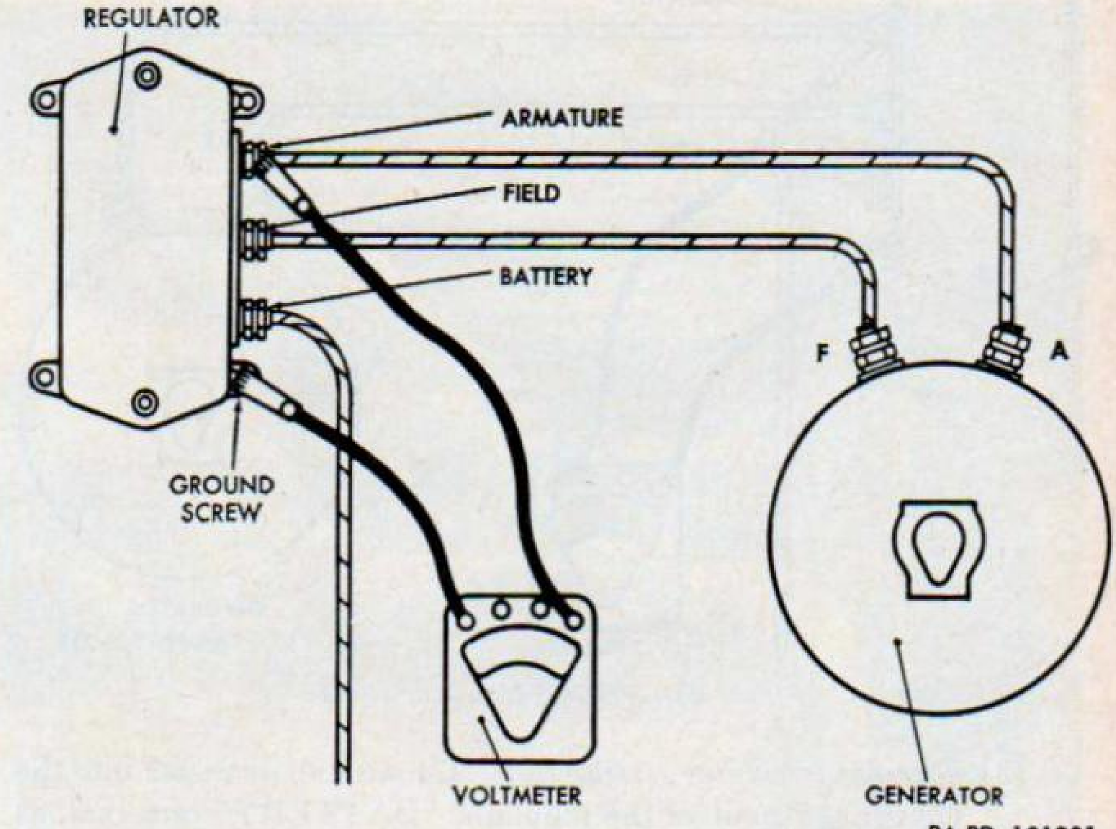


Figure 84. Circuit breaker check.

138. Generator Regulator

a. Maintenance. Check connections and mountings to be sure they are tight and that leads are in good condition. In addition, check the electrical settings of the units; replace regulator if settings are not in line with the specifications.

(1) *Circuit breaker closing voltage test.* Connect a voltmeter between the armature terminal of the regulator and regulator base (ground screw), as shown in figure 84. Slowly increase generator speed and note closing voltage of the cut-out relay.

(2) *Voltage regulator setting test.* Leave the voltmeter connected between the armature terminal and the ground screw

of the regulator as in the previous check, but disconnect the lead from the regulator "BATTERY" terminal so that the regulator generator system is an open circuit (fig. 85). Operate engines at 1,500 rpm and note voltage regulator setting. Regulator must be hot (at operating temperature). The check can be made at the end of a run, or the regulator should be operated at least 30 minutes to allow the regulator to attain operating temperature.

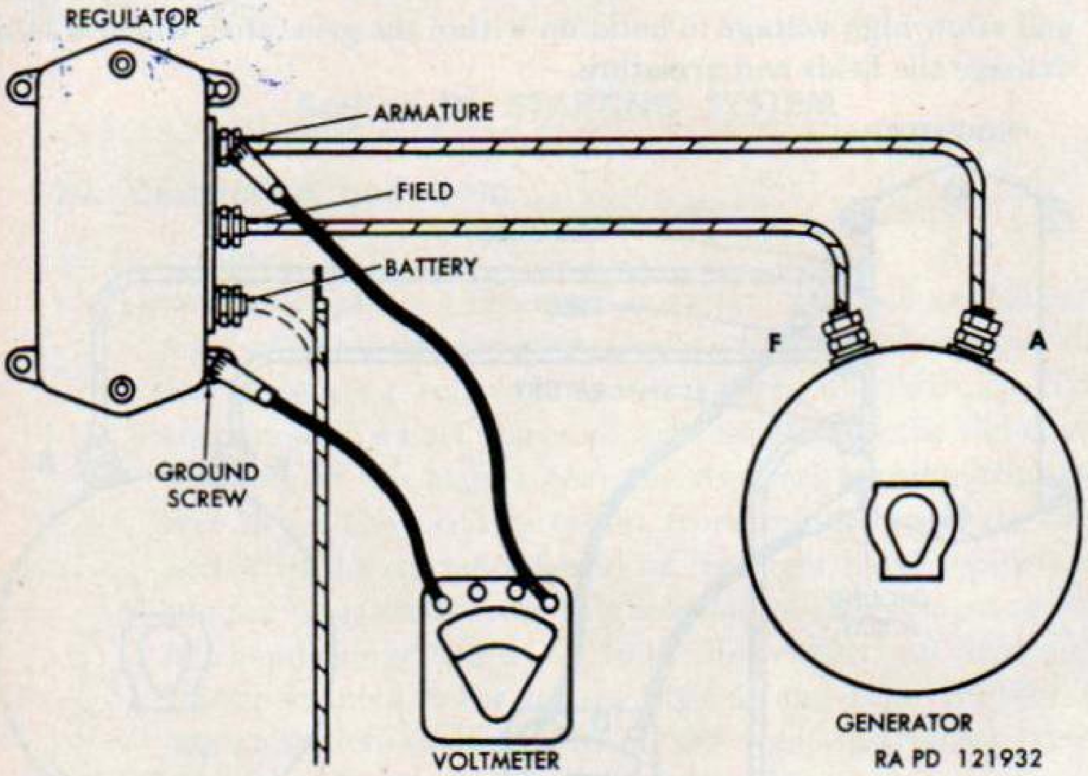


Figure 85. Voltage regulator check.

(3) *Current regulator setting test.* Connect an ammeter into the charging circuit at the regulator "BATTERY" terminal, as shown in figure 86. There are two methods of checking the current regulator setting without removing the regulator cover.

(*a*) *Battery discharge method.* By this method, the battery is partly discharged by starting the engine for 30 seconds with the ignition switch turned off so that the engine will not start.

Caution: Never use the starter for more than 30 seconds at a time without pausing several minutes to permit the starter to cool off.

Immediately after the starting cycle with the ignition switch off, start the engine, turn on lights and other accessories so that generator output will increase to its maximum, which should be 25 amperes, as determined by the current regulating setting, without causing the voltage regulator to operate. As current used in starting engines is replaced in the batteries, the batteries will come up to charge, and the voltage will increase so that the voltage regulator begins to operate and tapers off the output. The current regulator setting must be checked before this occurs.

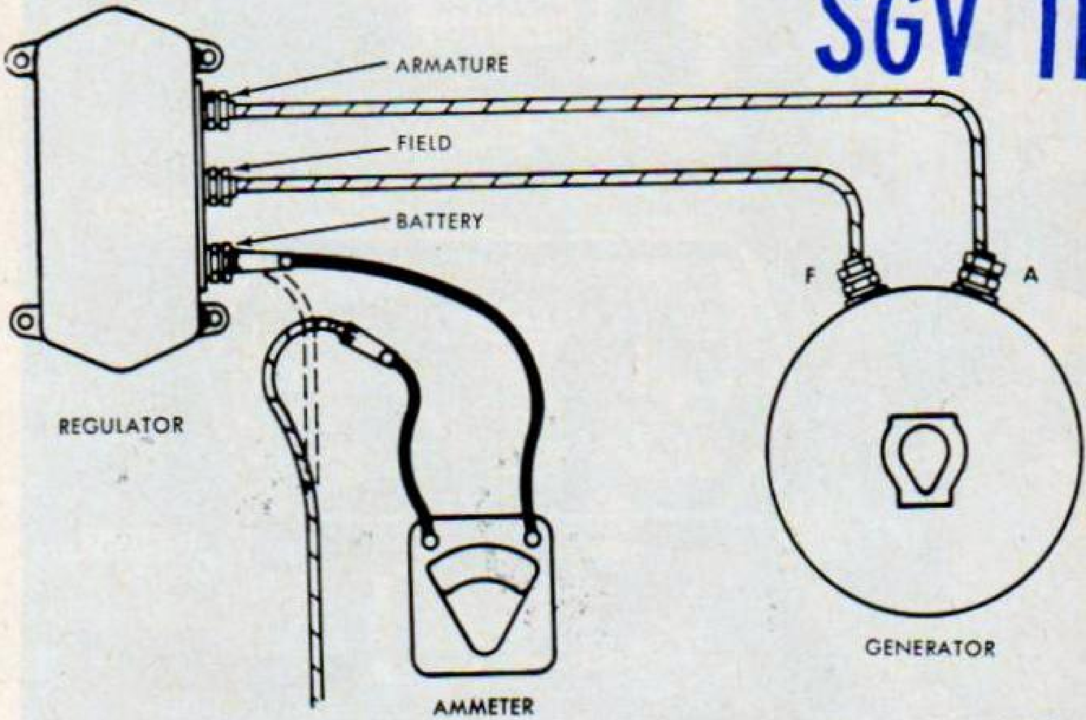


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Figure 86. Current regulator check.

(*b*) *Load method.* If a bank of lights or other load requiring approximately the same amount of current as the current regulator setting (25 amperes) is connected across the batteries during the time that current regulator test is made, the voltage will not increase sufficiently to cause the voltage regulator to operate.

b. Removal (fig. 87). Open engine compartment door on right side of tractor. Remove nuts from regulator terminals and lift wires from terminals. Install nuts and washers back on terminals to prevent their loss. Remove cap screw that connects regulator ground wire and clip on large wire to support bracket. Remove the four mounting cap screws attaching regulator to bracket (fig. 87) and remove assembly from vehicle.

c. Installation. Mount regulator on bracket with four cap screws and large washers (fig. 87) and connect wires as follows: connect wire from "A" terminals of generator to outer "ARMATURE" terminal of regulator (fig. 86); connect wire from center generator bypass capacitor and wire from "F" terminal of generator to center "FIELD" terminal on regulator (fig. 86); and connect wire from inner generator radio suppression capacitor and large wire from ammeter to inner "BATTERY" terminal on regulator (fig. 84). Connect regulator ground wire and clip on large wire to regulator support bracket, using toothed lock washer on cap screw.

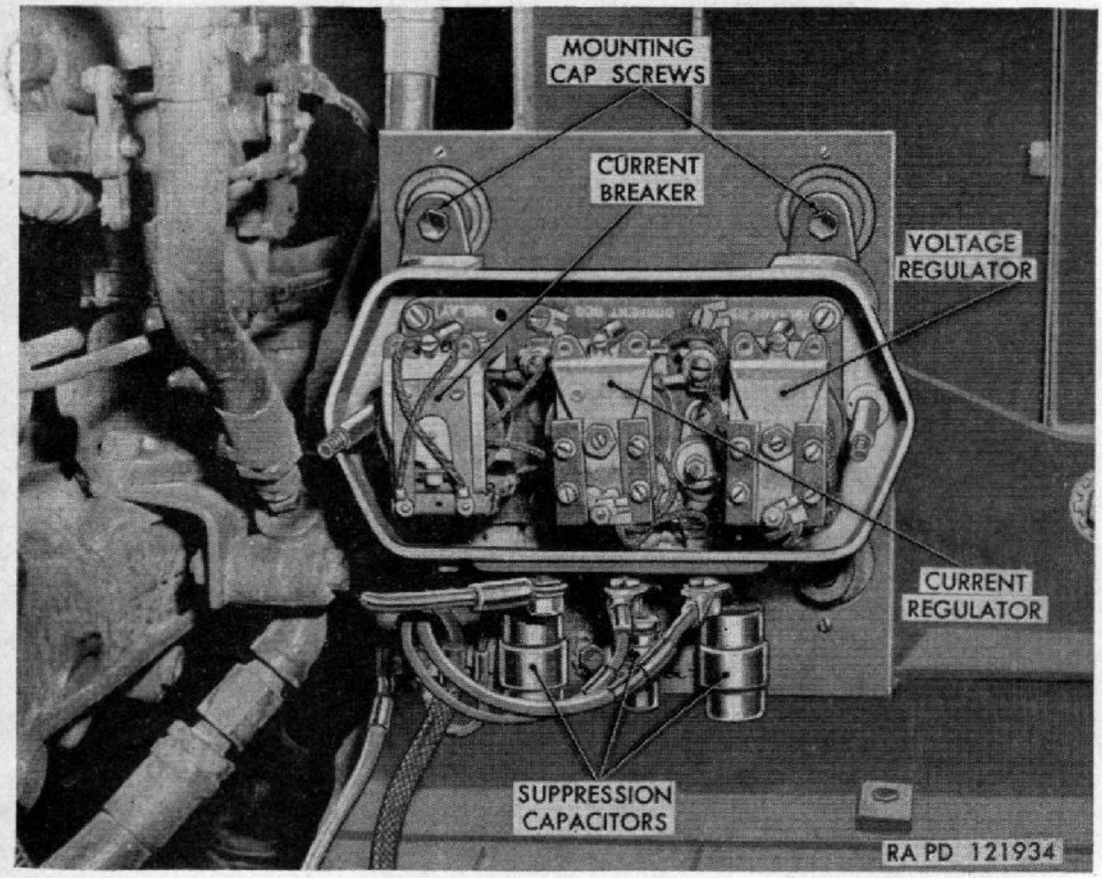


Figure 87. Generator regulator with cover removed.

Section XII. INSTRUMENT PANEL, SENDING UNITS, SWITCHES, AND GAGES

139. Description

a. Instrument Panel, Gages, and Switches. The instrument panel consists of two units which are referred to as the left and right instrument panel (fig. 7). It is mounted to the hull with brackets just ahead of the driver. Instruments and gages for the left engine and left torque converter are located on the left instrument panel. Instruments and gages for the transmission, right engines, and right torque converter are located on the right instrument panel. All switch controls are located on the right instrument panel except the blackout driving light switch which is located on the left instrument panel. Full description for the use of the various instruments and controls on the instrument panel is given in paragraph 10–43.

b. Sending Units and Warning Light.

(1) *Warning signal light sending unit.* There is one warning signal light. The low air pressure sending unit is directly connected by an air pressure line to the air compressor reservoir. The sending unit is located under the right instrument panel (fig. 128). Electrical wires are attached to warning light from the sending unit. The air pressure gage is directly connected to the air compressor reservoir by an air pressure line.

(2) *Temperature and oil pressure sending units.* All the temperature and oil pressure sending units operate in the same manner. The sending units are mounted in each system and are connected to the gages by electrical wires. Each sending unit has a quick disconnect acorn fitting to disconnect the wire from the top of each sending unit. The gages are grounded at the instrument panel to complete their electrical circuit.

(3) *Cables and connectors.* The electrical wires connecting the sending units and switches to the two instrument panels are terminated at the panel with four quick disconnect terminal plugs. All connections between the gages, switches, instruments, and panel lights, within the instrument panel, are installed on the terminals with nuts.

140. Instrument Panels

a. Removal. To remove either instrument panel, disconnect the engine tachometer and speedometer flexible shaft assemblies. Remove the engine shut-off and choke control bracket (fig. 6) from the panel. Disconnect the four fuel primer lines (on right panel only) and air pressure lines from its unit. Disconnect the low air pressure indicator wire from terminal of gage. Disconnect the three connector wiring plugs from sockets at right side of the instrument panel (fig. 89). Remove the six cap screws that attach the instrument panel to the hull brackets. Lift the instrument panel out carefully.

b. Installation. Position either instrument panel and install to the hull brackets with six cap screws and lock washers. Install the four primer fuel lines (on right panel only) and one air pressure line, speedometer, tachometer, and low air pressure indicator wire to each respective unit. Install the three connector wiring blocks and install the engine shut-off and choke control bracket to the instrument panel with two cap screws and lock washers. Start the engines and check all the instruments and gages for proper operation.

Note.—It is not necessary to remove the instrument panel to remove instruments, gages, switches, or panel lights; however, it is necessary to remove wiring connector plugs from sockets before removing gages, instruments, or switches to prevent sparking of electrical wires.

141. Air Pressure Gage

a. Removal. Open the drain valve at air reservoir to release the air from reservoir (fig. 76). To prevent sparking from contact of tools with electrical terminals, unscrew the retaining nut from the connector plug under the right instrument panel and pull plug from socket. Disconnect the air line from the gage (fig. 89) and remove the nuts from the mounting bolts of **U**-bracket. Remove the bracket and gage from the instrument panel.

b. Installation. Install the replacement pressure gage in the panel, place **U**-bracket over the gage, and install washers and nuts. Connect the air pressure line to gage then connect wiring plug to connector socket. Closs the drain valve at the air compressor reservoir (fig. 76).

c. Testing. Start the left engine and let the air pressure build up until 105 psi is reached. The air pressure gage should not register above the maximum limits. Make sure the replacement air pressure gage operates properly and check for leaks around the air pressure gage connection.

142. Low Air Pressure Light

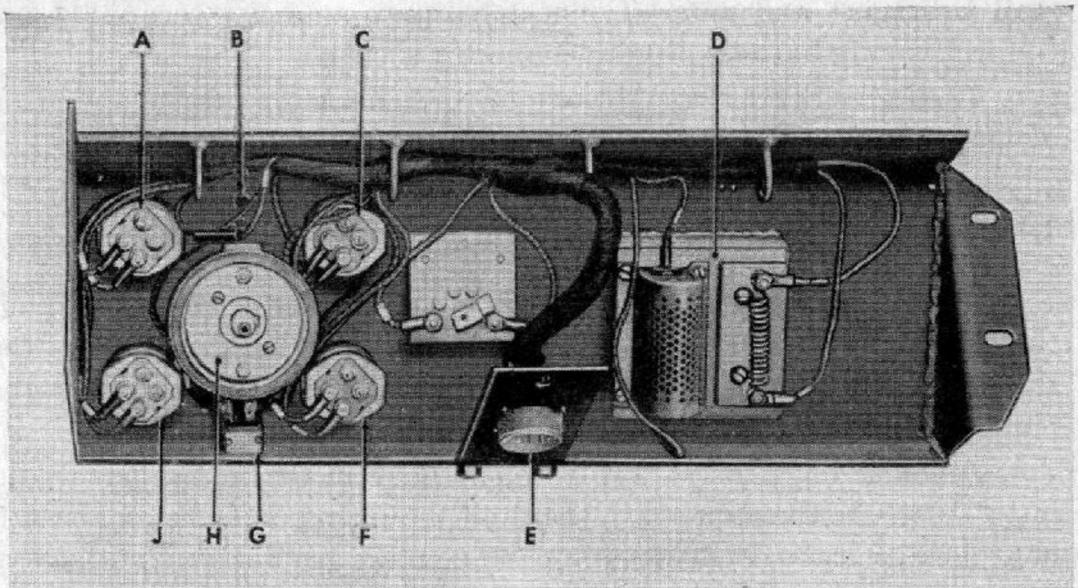
a. Removal. Reach behind the instrument panel and pull the lamp socket from the light. Turn the lamp one-eighth turn counterclockwise and pull it out from the socket (fig. 89).

b. Installation. Insert a new lamp in the socket and lock in place by turning it clockwise one-eighth turn. Insert the lamp socket into the light.

c. Testing. Start the left engine and allow air pressure to build up above 60 psi. Using the air brake pedal, press and release pedal so air can escape out the air valve; when pressure drops below 60 psi, the light should operate.

143. Ammeter

a. Removal. Disconnect large wiring harness plug from connector socket under right instrument paned (fig. 89). Remove nuts from ammeter terminals, tagging each wire so the wires can be installed on the same terminal of replacement unit. Remove nuts from ammeter mounting bolts and lift off **U**-bracket and pull ammeter from panel (fig. 89).



A—ENGINE OIL PRESSURE GAGE
B—PANEL LIGHT
C—TORQUE-CONVERTER OIL PRESSURE GAGE
D—ELECTRIC BRAKE LOAD CONTROL
E—WIRING HARNESS CONNECTOR SOCKET
F—TORQUE-CONVERTER OIL TEMPERATURE GAGE
G—BLACK-OUT DRIVING LIGHT SWITCH
H—ENGINE TACHOMETER
J—ENGINE COOLANT TEMPERATURE GAGE

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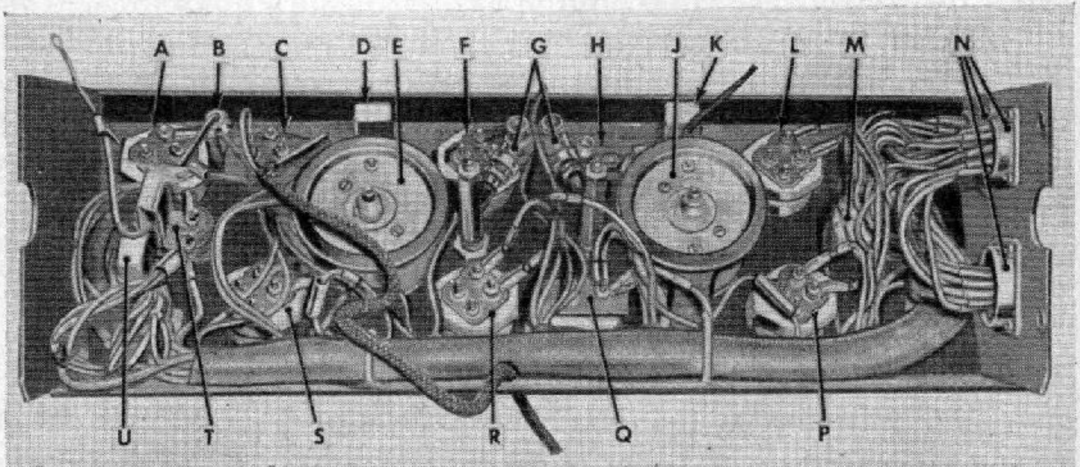
Figure 88. Left instrument panel removed.



A—FUEL LEVEL GAGE
B—LOW AIR PRESSURE LAMP
C—ENGINE COOLANT TEMPERATURE GAGE
D—PANEL LIGHT SWITCH
E—ENGINE TACHOMETER
F—TORQUE-CONVERTER OIL TEMPERATURE GAGE
G—FUEL PRIMER PUMPS
H—AIR PRESSURE GAGE
J—SPEEDOMETER
K—WINDSHIELD WIPER SWITCH
L—TRANSMISSION OIL PRESSURE GAGE
M—HOUR METER
N—WIRING HARNESS CONNECTOR SOCKETS
P—TRANSMISSION OIL TEMPERATURE GAGE
Q—AMMETER
R—TORQUE-CONVERTER OIL PRESSURE GAGE
S—ENGINE OIL PRESSURE GAGE
T—STARTER BUTTON SWITCHES
U—HEAD LIGHT SWITCH

RA PD 121936

Figure 89. Right instrument panel removed.

b. Installation. Install replacement ammeter in position and install U-bracket and nuts. Connect wires to ammeter terminals and connect wiring harness plug to connector socket.

c. Testing. Start the right engine and check for proper operation of ammeter according to paragraph 42.

144. Hour Meter

a. Removal. Remove cap screw at end of ground wire and pull out the other wire connected to hour meter connector plug. Remove the three mounting screws from the meter and remove the unit from the panel (fig. 89).

b. Installation. Install replacement hour meter in the panel and install meter to the panel with the three mounting cap screws. Install hour meter wire to connector plug and connect ground wire with a cap screw.

c. Testing. Turn on the right engine ignition switch and check the hour meter for operation. With the ignition switch on, the small meter hand should rotate.

145. Speedometer

a. Removal. Unscrew the retaining nut and remove flexible shaft assembly from the speedometer. Remove the two nuts from mounting bracket and remove the bracket and speedometer from the instrument panel (fig. 89).

b. Installation. Install speedometer and mounting bracket in the instrument panel, and install the two nuts. Install the speedometer flexible shaft assembly into the speedometer and tighten retaining nut.

c. Replacement of Speedometer Drive Shaft. Disconnect the front end of flexible shaft assembly from speedometer and the rear end from speedometer drive at transmission near the right torque converter. Pull end of core out of rear end of casing far enough to remove U-clip from core, and then remove the clip. Pull the core out of casing at the instrument panel. Coat the new core with light lubricant and feed core through front end of casing. Install U-clip on rear end of core. Connect ends of flexible shaft assembly to speedometer head and speedometer drive gear at the transmission. Replacement of the flexible shaft assembly will require removal of clips on the shaft assembly and floor plates. Install the new flexible shaft assembly as the old one is removed, replacing clips on the new assembly as they are removed from the old assembly.

d. Testing. Drive the tractor and observe if the speedometer operates properly.

146. Engine Tachometers

a. Removal. Unscrew the retaining nut and flexible shaft assembly from the tachometer head. Remove the two nuts from the mounting bracket and remove bracket and tachometer from instrument panel (fig. 88).

b. Installation. Install replacement tachometer with bracket and two nuts. Connect the flexible shaft assembly to the tachometer head and tighten retaining nut.

c. Replacement of Tachometer Drive Core. Disconnect the front end of flexible shaft assembly from tachometer and the rear end from the tachometer drive gear housing located below each engine distributor. Pull end of core out of rear end of casing far enough to remove **U**-clip from core, and then remove clip. Pull core out of casing at the instrument panel. Coat the new core with light lubricant and feed core through front end of casing. Install **U**-clip on rear end of core. Connect ends of flexible shaft assembly to tachometer head and tachometer drive gear housing at the distributor.

d. Testing. Start engines and check tachometers for proper operation. There should not be any excessive noise, fluctuation, or differences in rpm's between the two engines.

147. Engine Temperature Gages

a. Removal. The gages are held in the instrument panels by **U**-brackets through which bolts and terminals of the gages extend. Remove gages by removing nuts from mounting bolts and terminals; then remove **U**-bracket and gage (fig. 88).

b. Installation. Install replacement gage by placing unit in panel. Install the **U**-bracket and nuts and connect wire to the terminals.

Caution: Tighten mounting nuts firmly but not too tight. If these nuts are overtightened, the ends of the **U**-bracket will be spread and the spring ground contacts on the bracket will not contact the sides of the gage.

Turn the engine ignition switch on after installing gage. If the gage needle registers a maximum reading, the ground contacts are not contacting the sides of gage.

c. Testing. Start engines and operate until temperature gage reads the temperature of the engine coolant. The temperature reading should be between 160° and 180° F. If abnormal temperature is obtained, the cooling system may not be completely filled. Defective units of the cooling system may also be the cause (par. 83).

148. Oil Pressure Gages

a. Removal. Removal of the oil pressure gages (fig. 88) is the same as the removal of the engine temperature gage (par. 147*a*).

b. Installation. The same procedure can be followed to install the oil pressure gages as installing the engine temperature gage (par. 147*b*). The same caution must be used as installing the engine temperature gage.

c. Testing. Start the engines and the oil pressure gage should indicate at least 40 psi. If no reading or an abnormal reading is obtained, check the oil supply in the engine crankcase.

149. Fuel Gage

a. Removal. Remove the nuts from the fuel gage terminals, tagging each wire so the wires can be installed on the same terminals of the replacement unit. Remove the nuts from fuel gage mounting bolts and remove the **U**-bracket. Remove the fuel gage from the instrument panel (fig. 89).

b. Installation. Install replacement fuel gage with **U**-bracket and secure with nuts. Connect wires to the terminals, making sure each one is connected in the proper place.

c. Testing. Turn the engine ignition switch to "ON" position. Fuel gage should indicate the amount of fuel in the tank.

150. Torque Converter and Transmission Oil Pressure Gages

a. Removal. Removal of the torque converter and transmission oil pressure gages is the same as the removal of the engine temperature gage (par. 147*a*) (fig. 88).

b. Installation. The same procedure can be followed to install the torque converter and transmission oil pressure gages as installing the engine temperature gage (par. 147*b*). The same caution must be used when installing the gage **U**-bracket.

c. Testing. Start the engines and operate tractor. Check the operation of both gages for normal torque converter (par. 34) and transmission oil pressure (par. 32). If abnormal reading is obtained, the systems may require oil (par. 88*f* and 89*a*).

151. Torque Converter and Transmission Oil Temperature Gages

a. Removal. Removal of the torque converter and transmission oil temperature gages is the same as the engine temperature gage (par. 147*a*) (fig. 88).

b. Installation. The same procedure can be followed to install the torque converter and transmission oil temperature gage as used to install the engine temperature gage (par. 147*b*). The same caution must be observed when installing the gage **U**-bracket.

c. Testing. Start engines and operate tractor. Check the operation of both gages for normal torque converter and transmission oil temperatures. If abnormal reading is obtained (pars. 33 and 35), the systems may be low of oil or the cooling radiators may be inoperative.

152. Rear Floodlight Switch

a. Description. The switch is mounted at rear of the tractor and protected by a leather cover (fig. 5). Push in on the leather cover to turn the rear floodlight on and off. The switch is a spring loaded push button unit. The main light switch in cab must be on before rear floodlight will operate.

b. Removal. Remove two bolts from mounting plate and disconnect wire from plug at rear of switch. Remove switch assembly from the hull. Remove the five cap screws from front of switch. Remove cap screws holding switch in position inside of the case.

c. Installation. Install replacement switch in case and mount with cap screws. Install the five cap screws to front of switch. Install assembly in hull of tractor and bolt securely. Connect wire at rear of switch.

d. Testing. Turn main light switch on in cab. Push rear floodlight switch in and check for operation of light. If light fails to operate, check wiring and lamp.

153. Dimmer Switch

a. Removal. Remove two nuts that attach wires to rear of switch. Remove two mounting cap screws and remove switch from the mounting bracket.

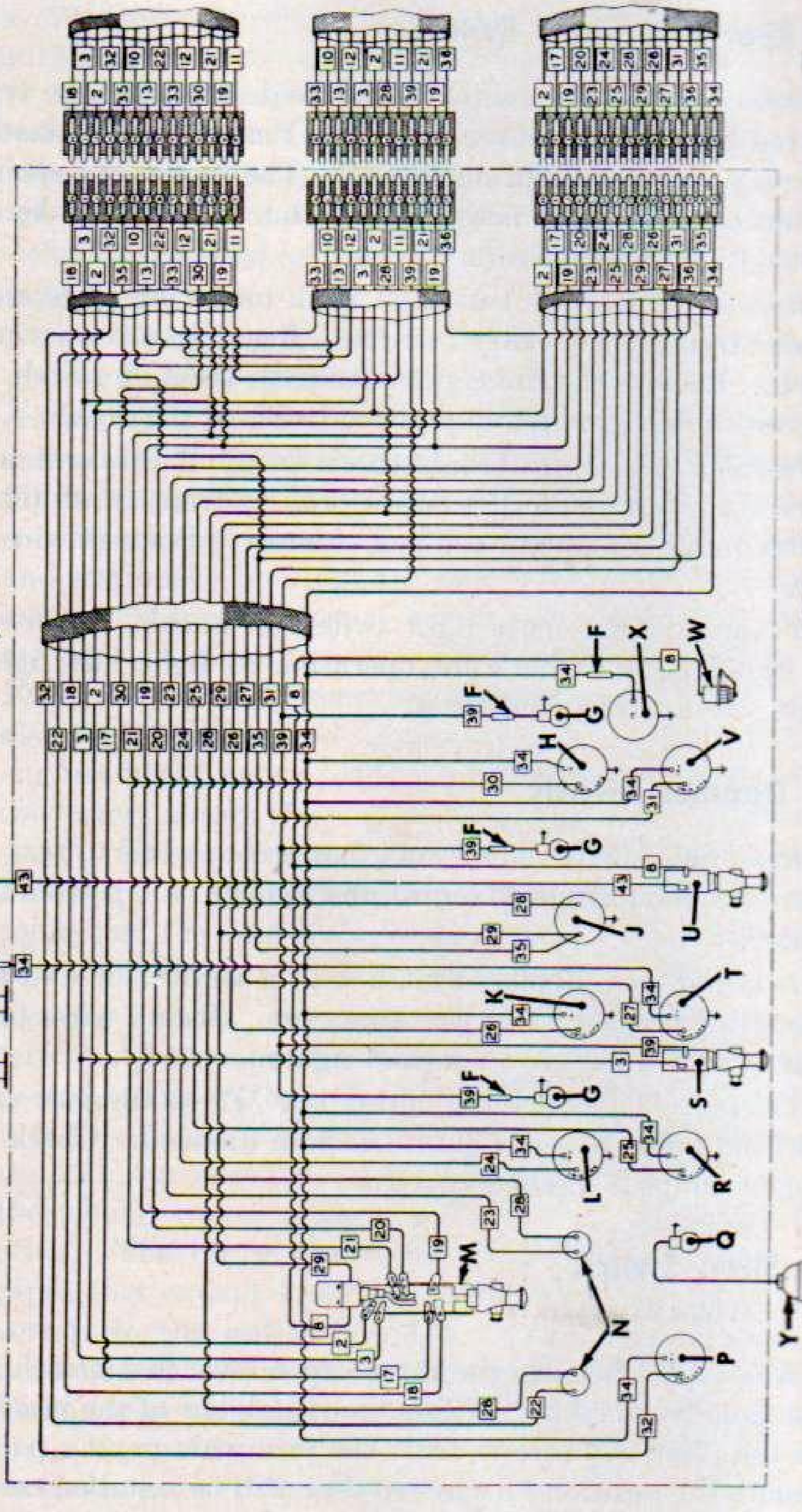
b. Installation. Replace switch with a serviceable unit and install on mounting bracket with two cap screws. Install wires to terminals at rear of switch with two nuts and tighten securely.

c. Testing. Turn driving lights on. Press dimmer switch and check head lights to see if beam has been dimmed. Check for faulty wiring or lamps if lights do not dim.

154. Siren Switch
(fig. 6)

a. Removal. Remove the three cap screws that attach the switch to the mounting bracket. Slide the switch out of the bracket and remove the three cap screws from the terminals paying particular attention to the position of wires so they will be installed correctly.

b. Installation. Install the three cap screws and wires to the switch terminals. Slide the switch into mounting bracket and securely mount with the three cap screws.



NOTE WIRING TAG NUMBERS ARE INDICATED THUS

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Figure 90. Wiring diagram for right instrument panel.

A—CAPACITORS
B—CONNECTORS
C—WINDSHIELD WIPERS
D—DEFROSTER SOCKETS
E—CONNECTOR
F—CONNECTOR
G—PANEL LIGHTS
H—TRANSMISSION OIL PRESSURE GAGE
J—AMMETER
K—TORQUE CONVERTER OIL PRESSURE GAGE
L—ENGINE OIL PRESSURE GAGE
M—HEADLIGHT SWITCH

N—STARTER BUTTON SWITCHES
P—FUEL LEVEL GAGE
Q—LOW AIR PRESSURE INDICATOR LAMP SWITCH
R—ENGINE COOLANT TEMPERATURE GAGE
S—PANEL LIGHT SWITCH
T—TORQUE CONVERTER TEMPERATURE GAGE
U—WINDSHIELD WIPER SWITCH
V—TRANSMISSION OIL TEMPERATURE GAGE
W—LIGHT SOCKET
X—HOUR METER
Y—LOW AIR PRESSURE INDICATOR LAMP

Figure 90.—Continued

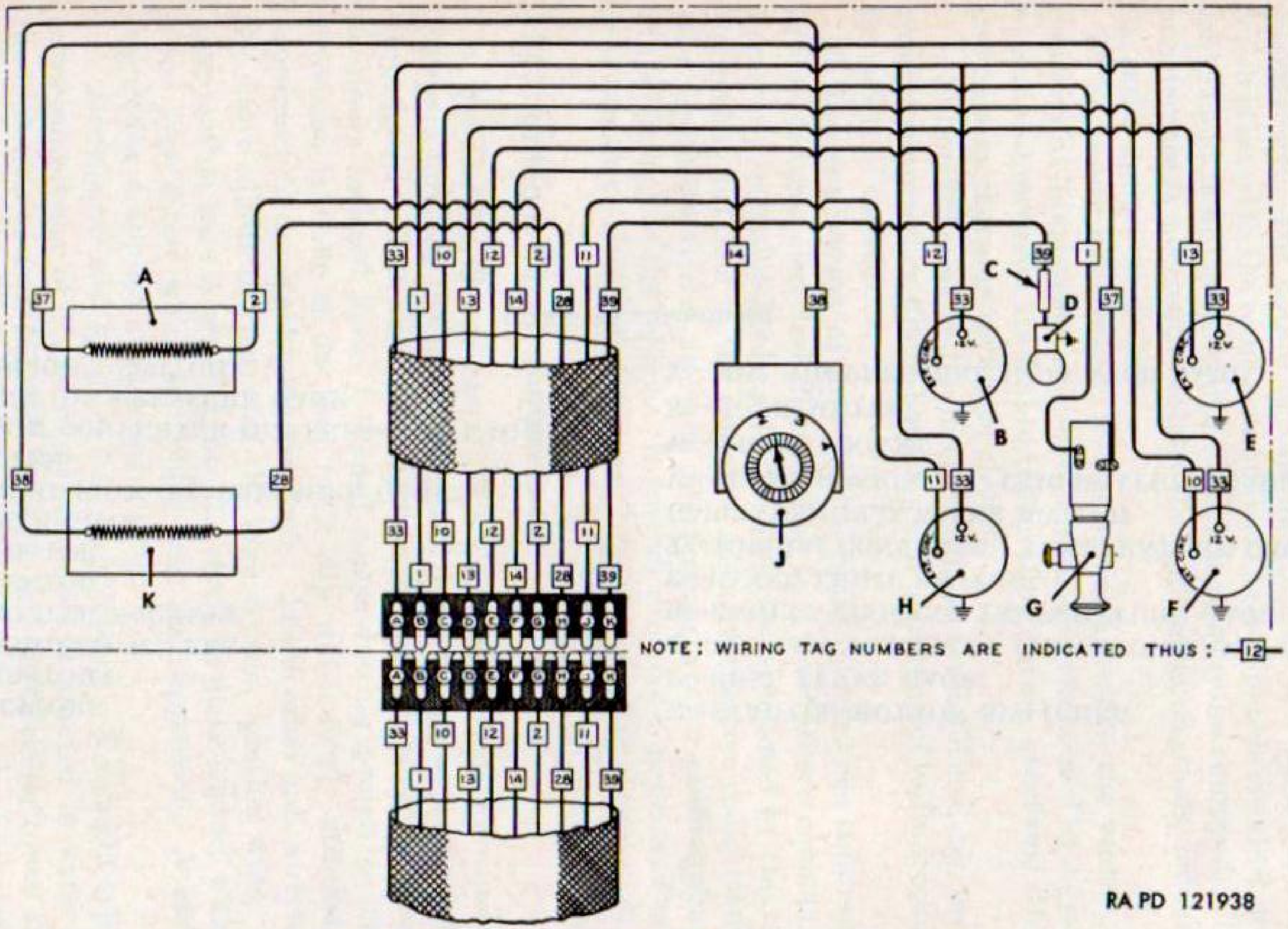


Figure 91. Wiring diagram for left instrument panel.

c. Testing. Operate siren switch and check for proper operation of the siren. If the siren does not operate, check terminal connections for proper installation. If installation of wires is correct, check for defective wiring or siren.

155. Main Light, Panel Light, Blackout Light, and Windshield Wiper Switches

a. Removal. When replacing a switch, remove one wire at a time from the defective switch and connect it to the corresponding terminal of the new switch. To remove switch, remove the small set screw and unscrew knob from switch shaft. Remove the locking cap screw from bottom of shaft guide plate and pull this plate off the shaft. Remove the mounting nut from the switch and push switch into panel. Remove and attach corresponding wires to the new switch and remove the old switch from the instrument panel.

b. Installation. Install replacement switch with wires assembled on the terminals. Install mounting nut on switch and place switch guide shaft plate in position and tighten the lock cap screws. Screw the knob onto the shaft and install the small screw in the knob.

c. Testing. Operate all the switches for proper operation. If any lights or windshield wipers fail to operate, check for defective wiring, faulty lights, or defective wiper motor.

156. Engine Shut-Off and Choke Control Knobs and Cables

a. Removal. The engine shut-off and choke control knobs are located on a bracket attached to the bottom of the right instrument panel (fig. 6). Remove two cap screws from bracket and remove bracket from bottom of instrument panel. Remove nut from end of control knob and remove knob from control cable.

A—BLACKOUT DRIVING LIGHT RESISTOR
B—TORQUE CONVERTER OIL PRESSURE GAGE
C—CONNECTOR
D—PANEL LIGHT
E—ENGINE OIL PRESSURE GAGE
F—ENGINE COOLANT TEMPERATURE GAGE
G—BLACKOUT DRIVING LIGHT SWITCH
H—TORQUE CONVERTER TEMPERATURE GAGE
J—ELECTRIC BRAKE LOAD CONTROL
K—ELECTRIC BRAKE RESISTOR COIL

Figure 91.—Continued.

b. Replacement of Control Cables. Remove cap screws from bracket at side of the right intake manifold (fig. 51). Remove pin at engine end of cable. At the engine end of cable, attach wire to the old cable so that when installing a new cable it can be pulled through the housing with the wire. Install pin at engine end of cable. Install bracket to intake manifold with a lock washer and cap screw.

c. Installation. Install control cable in end of control knob and tighten nut. Position knob control bracket at bottom of instrument panel and install with two cap screws and lock washers.

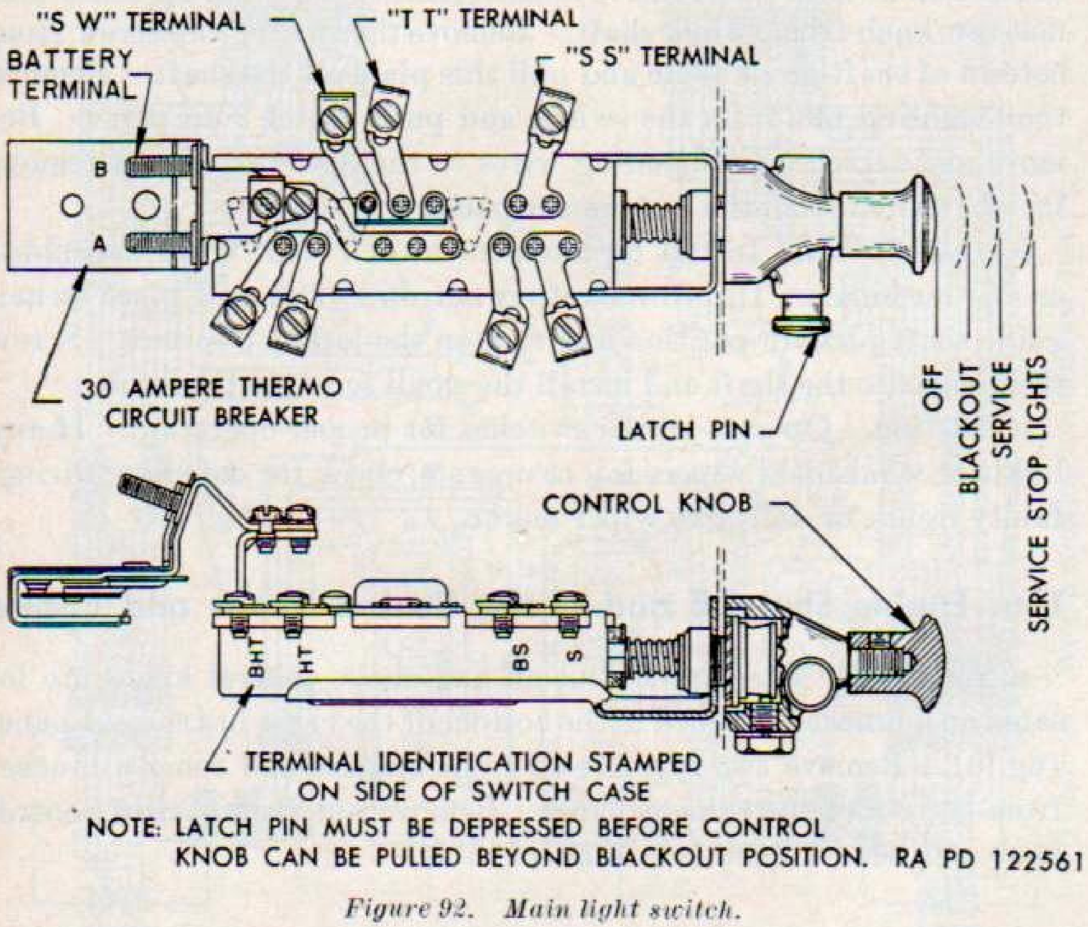


Figure 92. Main light switch.

157. Starter Switches

a. Removal. Remove mounting nut that holds starter push button in position on the instrument panel. Remove two nuts from starter switch terminals and push switch out of instrument panel (fig. 93).

b. Installation. Install the two wires on the terminals with nuts. Place replacement switch in position and install mounting nut on starter switch. Tighten mounting nut securely.

c. Testing. Operate starters and check for good operation. The switch springs should return the starter button immediately after release.

158. Low Air Pressure Sending Unit

a. Description. This sending unit is located to the right side of the hand-operated air brake application valve (fig. 128). It is directly connected to the air compressor or reservoir by an air pressure line. From the sending unit, there is one electrical wire attached to the low air pressure indicator. The sending unit is operated by air pressure and the pressure is transformed to electrical impulse by a diaphragm inside the unit.

b. Removal. Remove the air pressure line and two wire connections at each end of the unit. Remove the two mounting cap screws and remove the sending unit (fig. 128).

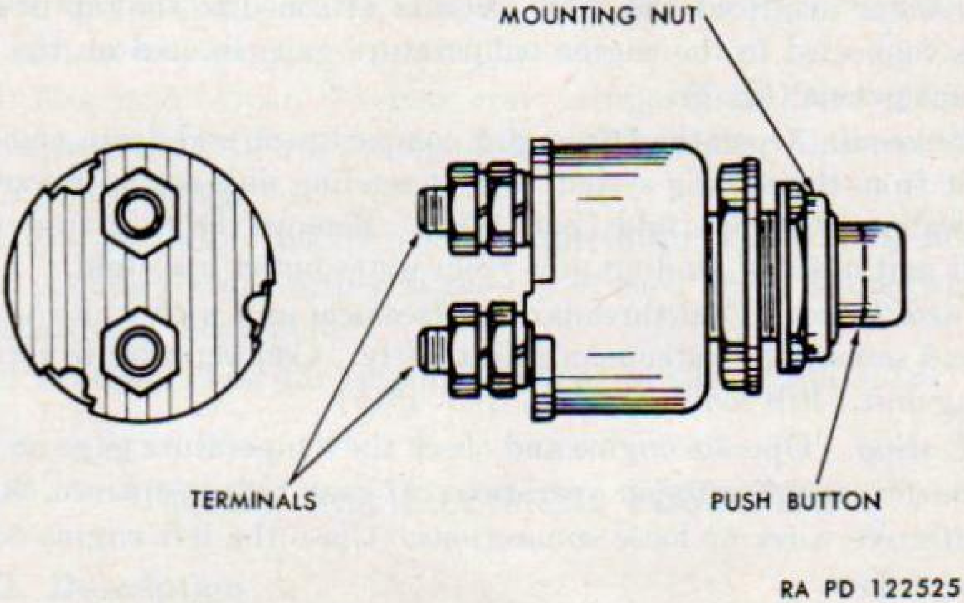


Figure 93. Starter switch.

c. Installation. Install sending unit with two cap screws to the bracket. Connect air pressure line to unit and install the two wires with attaching nuts and lock washers.

d. Testing. Start the left engine and operate until the red light goes off. At that time check the air pressure gage; it should indicate 60 p. s. i. in the air compressor tanks. If the low air indicator light should fail to operate, check for air leaks (par. 200) or inoperative air compressor (par. 197).

159. Fuel Gage Sending Unit

a. General. The fuel gage sending unit is located on top of the fuel tank (fig. 137). The float inside the gas tank operates an arm in the assembly and sends out an impulse through the wires to the fuel gage, thus giving the amount of fuel in the tank.

b. Removal. Remove ammunition box (par. 214*a*). Remove nut and wire from top of sending unit. Remove the five cap screws that secure the sending unit. Remove sending unit and gasket.

c. Installation. Position new gasket on flange of sending unit. Install sending unit with five cap screws and lock washers. Connect wire to top of sending unit. Install ammunition box (par. 214*b*).

d. Testing. Turn the right ignition switch to "ON" position and check for correct fuel reading. If gage fails to operate, check for defective wiring or loose connections.

160. Engine Coolant Temperature Sending Unit

a. General. The engine coolant temperature sending unit is located on the water manifold (fig. 37). A wire attached to the top of the unit is connected to the engine temperature gage located on the instrument panels (fig. 7).

b. Removal. Open the left engine compartment and drain enough coolant from the cooling system so that sending unit can be removed from water outlet manifold (par. 131*a*). Remove the wire from top of unit and unscrew sending unit from water outlet manifold.

c. Installation. Coat threads of replacement unit with white or red lead and screw into water manifold tightly. Connect wire to top of sending unit. Fill cooling system (par. 131*b*).

d. Testing. Operate engine and check the temperature gage on the instrument panel for proper operation. If gage fails to operate, check for defective wires or loose connections. Close the left engine compartment door.

161. Engine, Torque Converter, and Transmission Oil Pressure Sending Units

a. General. The engine oil pressure sending units are located on the right side of each engine and behind the clutch housing (fig. 45). The torque converter sending units are located near the right hand bottom of the converter housing. The transmission sending unit is located near the top of its housing (fig. 104). Each sending unit operates in the same manner and has one wire connected from the sending unit to its respective gage on the instrument panel.

b. Removal. Remove the rear seats and open rear crew compartment floor plate. Remove the acorn fitting at the top of the unit. Unscrew the sending unit from its position.

c. Installation. Install sending unit in position with a new gasket. Install acorn wire connection at the top of the sending unit. Close rear compartment floor plate and place rear seats in position.

d. Testing. Start the engines and operate the tractor. Check the oil pressure gages for proper operation. If any of the oil pressure gages fail to operate, stop the tractor and check oil level and fill as necessary. If the system is full, inspect for defective wiring or loose connections.

162. Torque Converter and Transmission Oil Temperature Sending Units

a. General. The torque converter oil temperature sending units are located on the torque converter housing (fig. 104). The transmission oil temperature sending units are located between the torque converter housing. These sending units have a wire running from the unit to each gage.

b. Removal. Open the rear crew compartment floor plate. Remove the acorn fitting at the top of the sending unit. Unscrew the unit from the housing.

c. Installation. Install sending unit in housing with a new gasket. Connect acorn fitting at the top of each unit. Close rear crew compartment floor plate.

d. Testing. Test the sending units as in paragraph 161*d*.

Section XIII. ELECTRICAL EQUIPMENT

163. Description

a. General. This section includes all the electrical equipment of the tractor with the exception of the ignition system, battery and generating system, instruments, starting system, and electric brake controls, which are covered in separate sections. The electrical system is 12-volt throughout, with the exception of the blackout driving light and electric brake control system. Resistors are employed in the wiring to reduce the voltage of the blackout driving lights and electric brake system to 6 volts.

b. Lights. Lights on the tractor consist of two head lights, one blackout driving light, and two blackout marker lights on the front of the tractor. Two combination blackout tail and stop lights and one flood light are at the rear of the tractor. Three panel lights are mounted on the instrument panels. The blackout driving light, tail, and stop lights are sealed-beam units. Snap terminal wire connectors are used throughout the wiring system for quick disconnection of wires if replacement of any of the light assemblies become necessary.

c. Windshield Wipers and Siren.

(1) *Windshield wipers.* The two windshield wipers are driven by separate electric motors controlled by a single switch located on the right instrument panel (fig. 6). The two wipers work individually when the switch is pulled out.

(2) *Siren.* The siren is electrically operated by a foot switch (fig. 6). It is used as a warning device only and is not to be used unless necessary.

164. Fuses

a. General. Only two fuses are used in the tractor, one in each wiring harness. These fuses will be found in single wires hanging out of each harness below the instrument panel. These fuses prevent damage to the instruments in the event of a short circuit. Burning of the fuses will cut off the ignition and the engine will stop.

b. Replacement of Fuse. Reach under the instrument panel and locate fuse. Turn wire connector plug at fuse a half-turn and remove the fuse. Check the cause for fuse burning out and, when the trouble is eliminated, install a new fuse.

165. Siren

a. Removal. Remove the three cap screws holding the siren to roof of cab. Disconnect the wire from connector before removing siren. The connector is located under the right instrument panel.

b. Installation. Place replacement siren in position and install the three bolts to cab roof.

Note.—Make sure the plate inside cab roof is also installed with the siren mounting cap screws. Connect siren wire at connector plug under the right instrument panel.

c. Testing. Press siren switch (fig. 6) and check for proper operation of siren. If siren fails to operate, inspect for faulty wiring or connections.

166. Windshield Wipers

a. Removal. Loosen screw nearest wiper motor shaft on wiper arm and pull wiper arm from the shaft. Remove shaft nut and pull arm drive from shaft. Remove nut from shaft housing and remove nuts from the two bolts holding wiper motor to cab. Pull motor from cab frame, disconnect wire at connector under the right instrument panel, and remove motor.

b. Installation. Place wiper motor in position and install with two bolts. Install nut on shaft housing. Install arm drive on shaft and install nut. Install the wiper arm on shaft and tighten screw after adjustment of wiper arm is made so the arm will swing equal distance both ways.

167. Driving and Rear Floodlight

a. Replacement of Lamps. Lamps may be replaced in the head lights and rear floodlight by removing one bolt from the light guard and swinging it to one side (fig. 94). Loosen cap screw at bottom of

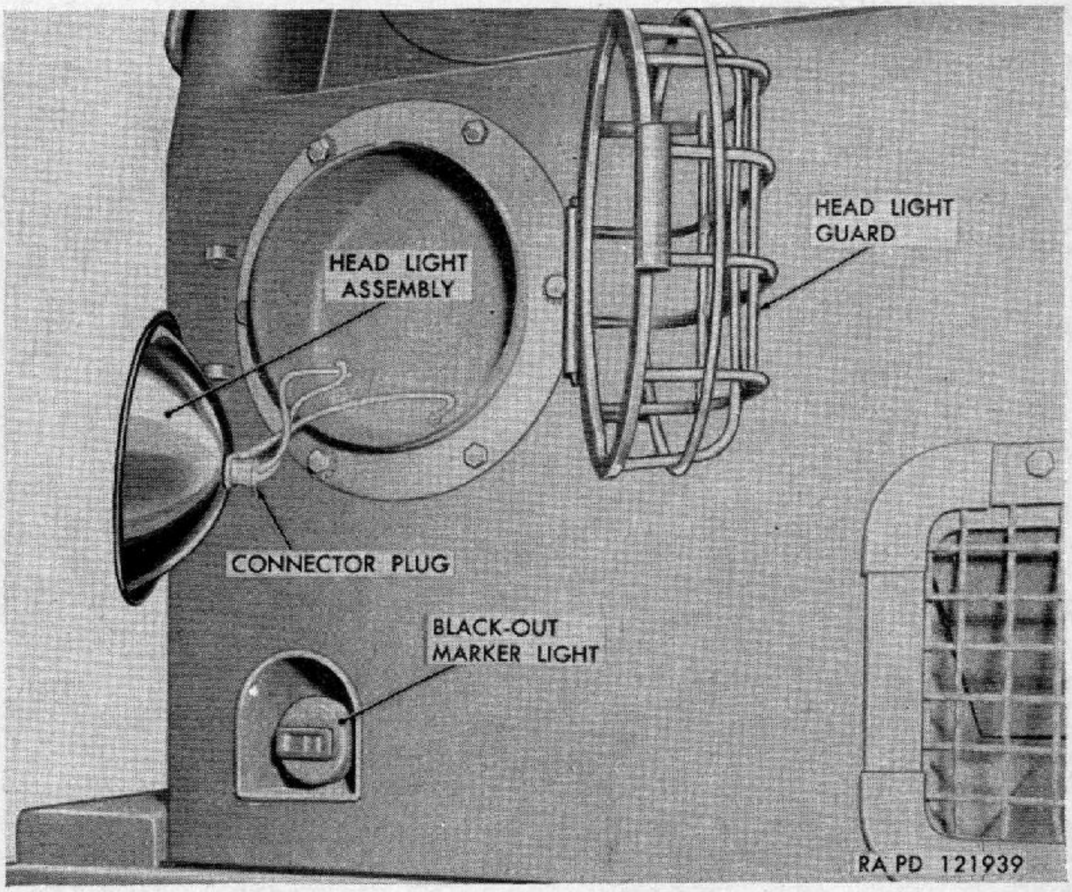


Figure 94. Head light assembly removal.

lens holder and remove holder and lens. Replace defective lamp, install lens, and holder. Install light guard bolt.

b. Replacement of Light Assembly. Remove one bolt from light guard and swing it to one side. Disconnect wires at connector plug behind assembly (fig. 94). Remove six cap screws from the light mounting flange and pull assembly out of hull. Replace assembly and install the six cap screws. Connect wires at plug and install bolt in light guard.

c. Testing Lights. Testing of the driving lights, blackout marker lights, rear floodlight, stop and tail light, and panel lights will be accomplished in the same manner. Pull out switch to operate desired light and check for operation of that light. If any of the lights fail to operate, check wiring, connections, and switches. Refer to the schematic diagrams for repair or replacement of wires (par. 172*a*). Replace faulty switches (par. 155).

168. Blackout Driving Lights

a. Replacement of Sealed-Beam Unit. If this light should burn out, the entire sealed-beam lamp unit must be replaced (fig. 95). To

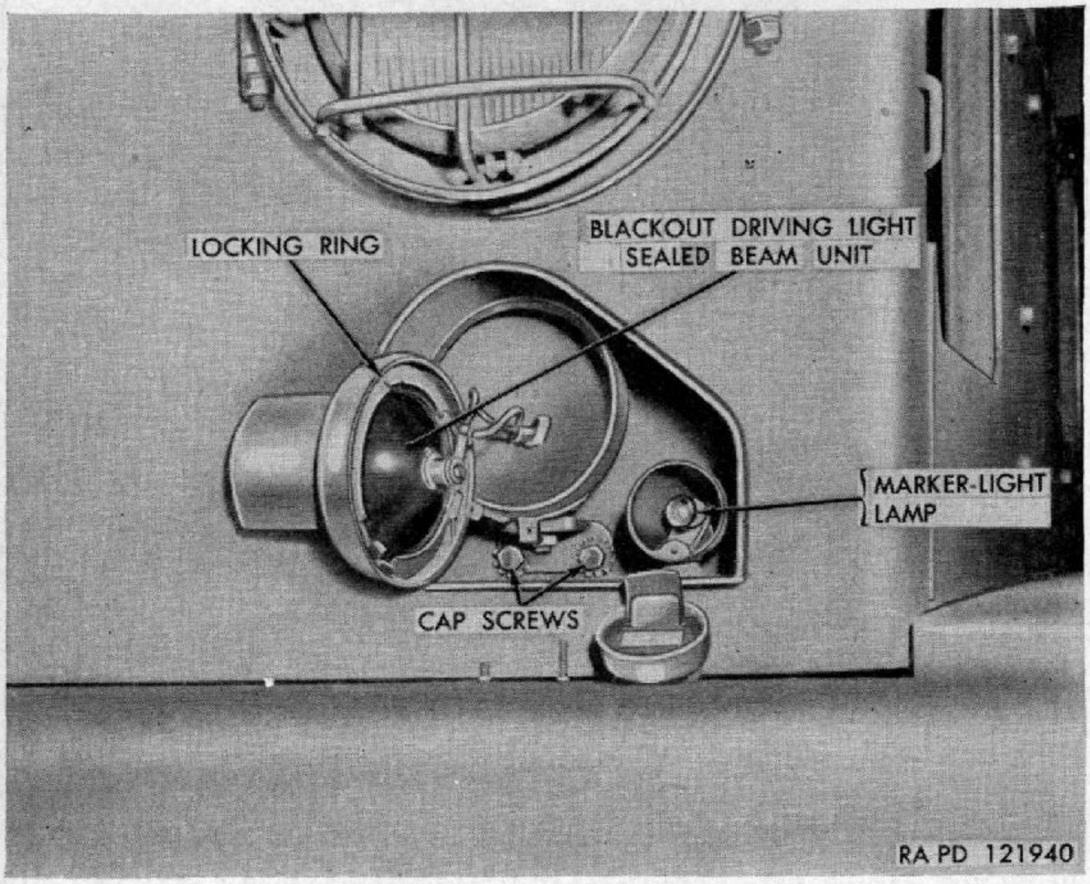


Figure 95. Blackout driving and marker light removal.

replace, remove screw from bottom of unit and remove locking ring from the sealed-beam unit (fig. 95). Remove sealed-beam unit and replace it with a serviceable unit. Place locking ring in position and install cap screw at bottom of unit.

b. Replacement of Light Assembly. Disconnect wires at connector plug from inside of cab and remove two cap screws from mounting bracket from the light assembly (fig. 95). Install mounting bracket on light assembly and install bracket to hull with two cap screws. Connect wires inside of cab at connector plug.

169. Blackout Marker Light

a. Replacement of Lamp. Remove screw from bottom of marker light and lift off cover (fig. 95). Replace defective lamp and install cover and screw.

b. Replacement of Blackout Marker Light Assembly. Disconnect wire near assembly inside the cab. Remove mounting nut from bottom of marker light. Lift out marker light and install replacement unit. Install mounting nut and connect wire inside of cab.

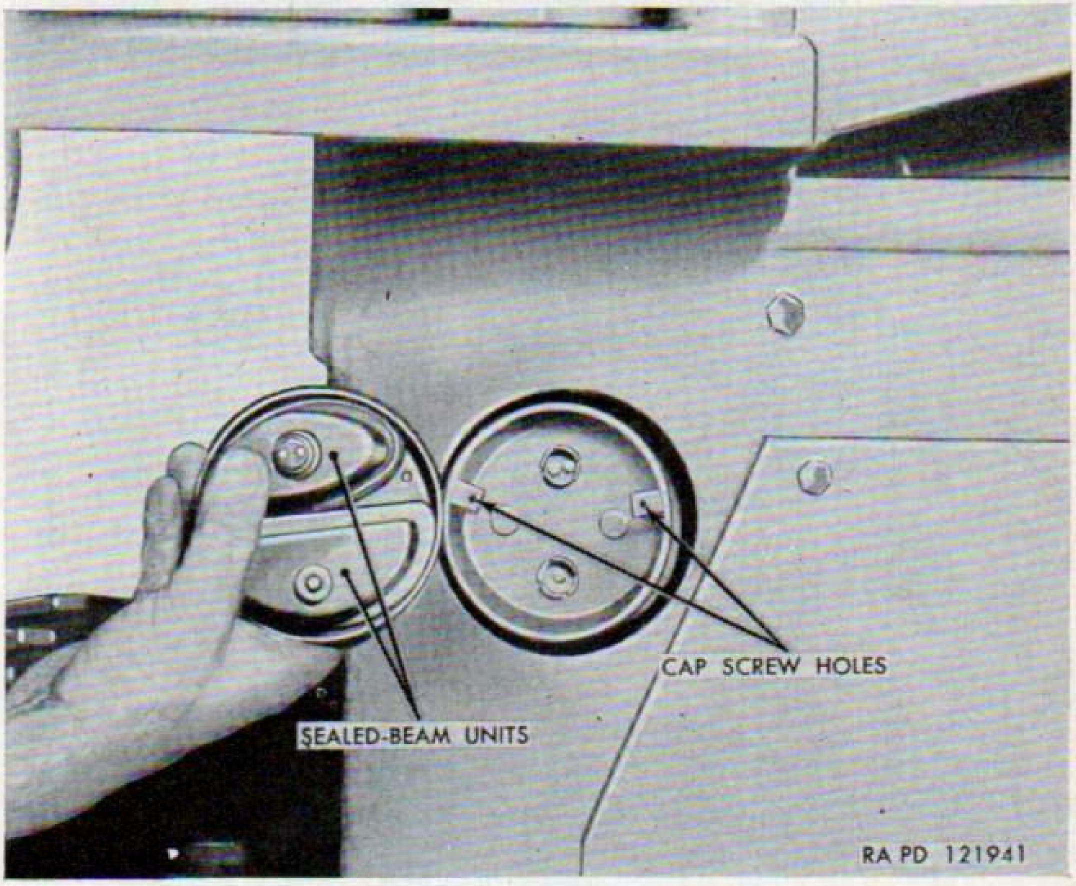


Figure 96. Stop and tail light assembly removal.

170. Stop and Tail Light and Blackout Stop and Tail Light

a. Replacement of Sealed-Beam Unit. To replace a sealed-beam unit, remove two cap screws and lift tail light cover (fig. 96). Remove defective sealed-beam unit and replace with a serviceable unit. Install light cover and the two cap screws.

b. Replacement of Tail and Stop Light Assembly. To remove complete unit, remove the two electric connecting light sockets and nuts from rear of light assembly. Remove unit from hull of tractor and replace it with a serviceable unit. Install the two nuts and tighten securely. Connect the two connector plugs.

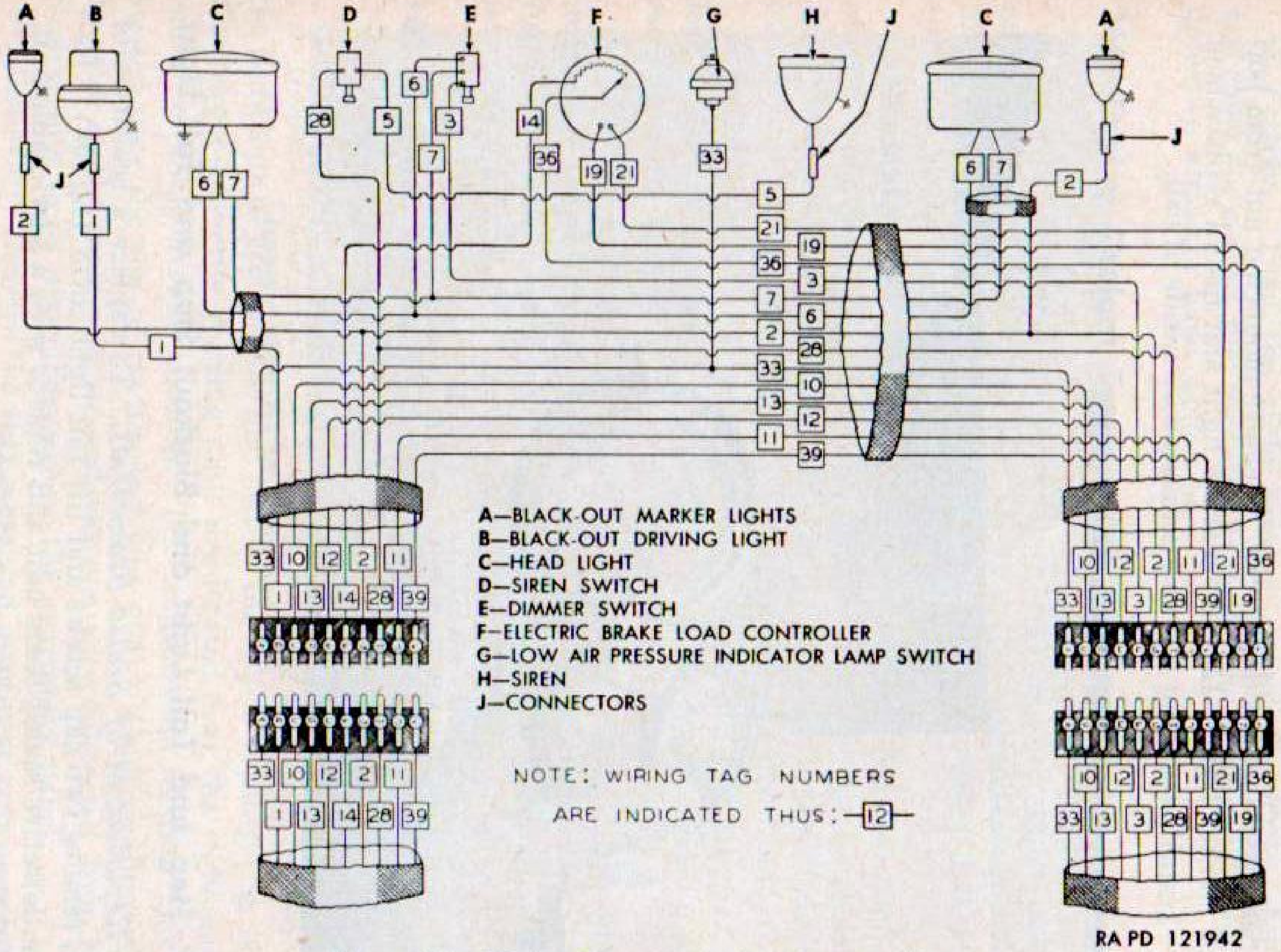


Figure 97. Wiring diagram for hull front section.

171. Panel Lights

a. Replacement of Lamps. Remove the two small screws from side of light and remove body of panel light. Remove lamp and replace it with a serviceable unit. Install panel light body and the two small screws.

b. Replacement of Panel Light. Disconnect wire at the rear of panel light. Remove the three cap screws inside dash and pull panel light out from the instrument panel. Replace unit with a serviceable panel light and install the three hold-down screws. Connect wire at rear of panel light.

172. Wiring System

a. Description. Figures 97 and 98 are schematic diagrams of the complete wiring system of the tractor. The various electrical units and accessories are shown in their relative location when installed in the tractor. All the wires in the tractor, with the exception of the spark plug wires, have tags wrapped around them at each end, with numbers on the tags corresponding to the numbers in the drawings to designate which wires are to be connected to the various units. Groups of wires are bound in looms. The wires in each harness are connected to coupling blocks for insertion into the electrical junction blocks or boxes, which are so constructed that the plugs can only be inserted one way. These junction boxes and blocks provide for quick disconnection when disassembling the vehicle.

b. Repair and Replacement of Wires.

(1) *Repair.* A broken wire may be spliced by stripping about an inch of insulation off both broken ends of the wire and twisting the ends tightly together. Then wrap several thicknesses of friction or rubber tape around spliced section for insulation. If insulation is worn off or frayed from rubbing on metal, wrap the frayed or bare wire with tape.

(2) *Replacement.* Replacement of wires is seldom necessary unless the wires are destroyed by fire or like causes. When replacing any or all of the wires, remove the numbered metal tags from the wires removed and install them on the corresponding new wires, unless the new wire already has a tag with the same number on it. Be sure to tighten terminal connections firmly when installing wires.

c. Engine Electrical Junction Box Replacement. Each engine has one electrical junction box. The left-hand engine junction box is located above the starter attached to the hull (fig. 70). The right-hand engine junction box is near the engine oil filters (fig. 27). To remove the junction box, remove the connecting plugs to the box and then remove the four attaching cap screws that hold the junction box to the hull. Replace defective junction box and install the four cap screws and connecting plugs.

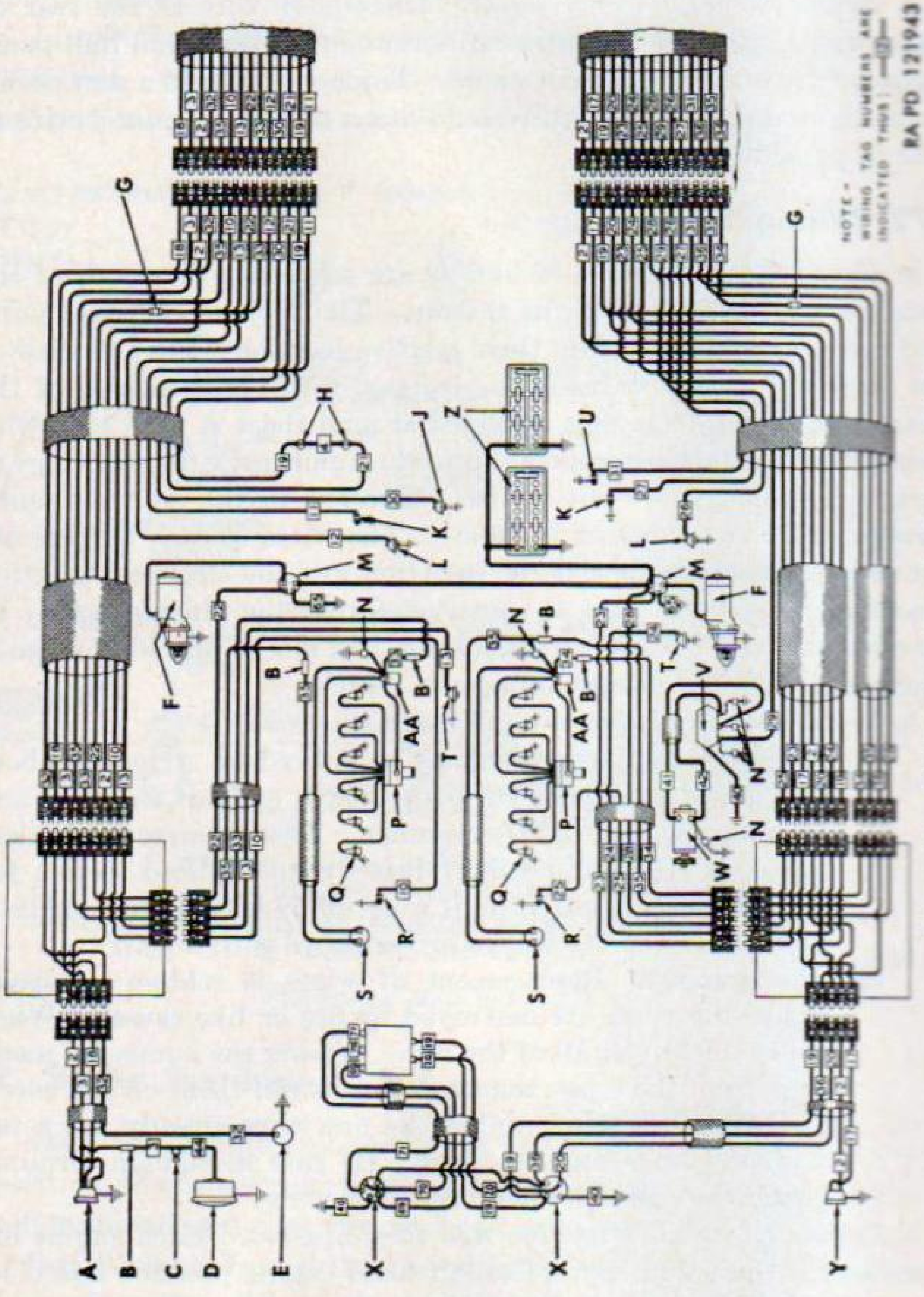


Figure 98. Wiring diagram for hull rear section.

A—SERVICE TAIL, BLACKOUT TAIL AND SERVICE STOP LIGHT
B—CONNECTOR
C—REAR FLOODLIGHT SWITCH
D—REAR FLOODLIGHT
E—FUEL LEVEL GAGE UNIT
F—STARTER
G—FUSES
H—STOP LIGHT SWITCHES
J—TRANSMISSION OIL PRESSURE GAGE UNIT
K—TORQUE CONVERTER OIL TEMPERATURE GAGE UNITS
L—TORQUE CONVERTER OIL PRESSURE GAGE UNITS
M—STARTER SOLENOID
N—CAPACITORS
P—DISTRIBUTORS
Q—SPARK PLUGS
R—COOLANT TEMPERATURE GAGE UNITS
S—IGNITION SWITCHES
T—ENGINE OIL PRESSURE GAGE UNITS
U—TRANSMISSION OIL TEMPERATURE GAGE UNIT.
V—GENERATOR REGULATOR
W—GENERATOR
X—TRAILER ELECTRIC BRAKE COUPLING SOCKETS
Y—BLACKOUT TAIL AND STOP LIGHT
Z—BATTERIES
AA—IGNITION COILS.

Figure 98.—Continued

Section XIV. RADIO INTERFERENCE SUPPRESSION

173. Description

a. Vehicular ignition and generating systems emit serious electrical interference. The nature of this interference is a pulse type noise which is heard in the radio communications equipment installed in the vehicle and in adjacent vehicles which may be radio equipped. This interference is sufficient to totally disrupt communications, rendering the radio equipment useless.

b. To insure interference free communications in the vehicle, the intensity of interference must be diminished or eliminated by a system of radio suppression applied to the ignition circuit, generator circuit, and battery charging regulator circuit.

c. Suppression of radio interference is accomplished by use of resistor suppressors, filters, bonding, and bypassing of radio frequency by means of capacitors.

d. The application of an effective radio interference suppression system reduces electrical disturbances to a level where communications may be maintained up to the limitations imposed by the radio equipment installed in the vehicle. Also, an effective radio interference supression system prevents interference to other radio equipment in the vicinity of the vehicle. It further provides a measure of safety from sensitive electrical detectors.

174. Ignition Circuit Suppression

a. Spark Plug Suppressors. The electrical disturbance caused by the spark jumping the gap in the spark plugs, is suppressed by resistor suppressors. These are carbon resistors, of approximately 10,000 ohms resistance inclosed in an L-shaped nonconducting protective sleeve. Provision is made at one end for a clip which firmly attaches the suppressor to the spark plug terminal. At the other end, a recess in the sleeve allows the entry of the high tension ignition wire. The high tension wire is screwed into the recess to make contact with the wood type screw which is molded into the suppressor. A resistor suppressor is applied at each spark plug.

b. Distributor and Ignition Coil Suppression. A straight type resistor suppressor of 10,000 ohms resistance is inserted in series with the high tension lead from the ignition coil to the center tower of the distributor cap. This suppressor has entries for the high tension wire at each end and is fastened by screwing the ends of the wire into the body of the suppressor. Contact is made by a wood type screw to the conductor in the center of the wire. This serves to eliminate the radio interference due to arcing at the rotor as it connects to each contact in the distributor. The interference in the primary circuit is bypassed to ground by a 0.1 mfd capacitor which is connected from the positive terminal of the coil to the mounting bracket. This prevents radiation of interference from the primary or low tension circuit.

175. Generator and Battery Charging Regulator Circuit and Windshield Wipers

a. The armature terminal of the charging generator is bypassed by means of a 0.5 mfd capacitor. The metal case of the capacitor serves as the negative terminal and is grounded to the frame of the charging generator.

b. The regulator armature terminal is bypassed by a 0.5 mfd capacitor mounted on the regulator mounting plate. The battery terminal of the regulator is bypassed on a 0.5 mfd capacitor which is also mounted on the regulator mounting plate.

c. The input leads to the windshield wipers are shielded. An 0.1 mfd capacitor is connected to the input terminal of the wiper at the wiper, and grounded to the frame of the wiper motor.

176. Bonding and Fastening

Tooth type lock washers are employed to assure good electrical contact from suppression components to the metal frame and mountings of the vehicle. The multiple teeth of these lock washers will cut through paint, grease, and dirt to engage the metal underneath. However, in places where the paint is very thick and hard, the area should be cleaned with a file or sandpaper. Contact will thus be insured. Tooth type lock washers are used to provide good contact in the mounting of all the suppression capacitors. These washers are installed between the windshield wiper and the windshield frame, on both sides of the mounting of the capacitor on the generator regulator, and under the mounting clips of the capacitors on the generator.

Section XV. MASTER CLUTCH, TORQUE CONVERTER, AND UNIVERSAL JOINTS

177. Description and Data

a. Description.

(1) *Master clutches.* A single clutch housing supports the front end of the engines and houses both clutch assemblies. The clutches are spring-loaded, dry disk assemblies. Each clutch consists of a driven disk and pressure plate and cover assembly (fig. 101). The driven disk, with friction lining on both sides, is riveted to a splined hub carried on the master

clutch shaft. The cover is bolted to the engine flywheel. The clutch is held engaged by springs between pressure plate and cover and disengaged by forcing the pressure plate away from the driven disk by depressing the clutch pedal. Pressing down on the clutch pedal forces the release bearing against the clutch release levers, compressing the clutch pressure springs, and relieves the pressure of the flywheel and pressure plate aginst the driven disk. The release shifter shafts of both clutches are connected by control rods to a single control shaft operated by the clutch pedal, so that both clutches are released and engaged simultaneously.

(2) *Torque-converters.*

(*a*) *Purpose and location.* Since an internal combustion engine is unable to produce torque effectively until it is operating at a certain minimum speed, it is necessary to convert the torque developed by the engines in order to apply it in starting a heavy load. The two hydraulic torque converters, each consisting of a pump or impeller, turbine, and stationary housing, are used to develop the required amount of torque to start heavy loads which the engines are capable of pulling after the tractor is in motion (fig. 108). Smooth and shockless starting and acceleration is also made possible, and slipping of clutches and stalling of engines under heavy loads is prevented, as the use of the converters allows the engines to maintain their operating speed. The converters are mounted at the rear of the transmission; the input shafts are connected to the universal joints and the output shafts are mounted to the transmission input shafts (fig. 104).

(*b*) *Cooling system.* As various load conditions are encountered by the tractor, the temperature of the oil can be expected to rise to the point where it becomes necessary for it to be cooled. Separate radiators have been provided in the radiator assemblies for cooling the converter oil and the cooling system of each converter is independent of the other. The oil is discharged from the converters into pipes that extend from the outside diameter of the converters to the radiators. After circulating through the radiators, the oil returns to the center of the converters. The oil velocity is greatest as the oil leaves the impeller, and is the least as the oil enters the impeller near the center of each converter. This difference in pressure is utilized to circulate the oil through the radiators.

(*c*) *Oil reservoirs.* Since the torque converters must be completely filled with oil for satisfactory operation, a reservoir for each converter is provided to take care of the volumetric increase of the oil as the temperature rises (fig. 108). Each reservoir is provided with an orifice connected to a vent pipe extending from the top of the oil radiator (fig. 68), which remains open to the reservoir at all times, and through which the expanded oil escapes from the main oil circuit. The orifice also serves as a means of relieving the converter and radiator of any gas or air which may become trapped within the converter or radiator. A reserve of approximately 2 gallons of oil is carried in each reservoir to provide against loss of oil due to vaporization or small leaks. The reservoirs are open to the atmosphere through separate vent pipes.

(*d*) *Auxiliary oil pumps* (fig. 107). An auxiliary oil pump is mounted on each converter. The auxiliary pump returns that oil to the converter which escapes from the radiator into the reservoir through the vent pipe. A relief valve is used in conjunction with the auxiliary pump and is set to maintain a pressure of approximately 40 to 50 psi. The capacity of this pump is approximately 3.5 gallons per minute. A filter (fig. 108) is located in the oil suction line of each auxiliary pump from each oil reservoir.

(*e*) *Oil filters.* Two oil filters with cotton elements are located just above the oil reservoirs (fig. 107). The oil drawn from the reservoirs by the auxiliary pumps passes through these filters before it is pumped into the converters. Two other smaller filters, one in each of the converter radiator vent lines (fig. 109), strain the oil escaping from the radiators and returning to the reservoirs. These two elements are replaced each time unit is removed.

(*f*) *Freewheel assemblies.* A freewheel assembly, consisting of an inner race, outer race, and cage assembly, is incorporated in each converter assembly. The freewheel outer race is assembled to the turbine and actually forms a part of the hydraulic chamber. The freewheel cage assembly is composed of alternately spaced rollers and sprags held within a cage. The freewheel inner race is mounted on the input shaft. The freewheel group assembly serves both as a pilot bearing and as a freewheel unit. When the engine is under load, pulling the tractor over rough terrain or along a highway, the freewheel group assembly functions as a bearing. If the tractor should encounter a down grade and begin to overrun the engine, the freewheel group assembly locks and the impeller and turbine turn together, driving back against the engine. Thus, better braking is obtained, because in addition to using the engine as a brake, the drag of the converter also augments the breaking action. The use of the freewheel group assembly again comes into the picture when trying to start the engine by towing or pushing the tractor. Normally, with a fluid drive, such a process is impracticable as it requires towing or pushing the tractor at too great a speed; however, starting the engine by towing or pushing is possible with the freewheel group assembly as the freewheel locks and the drive is taken back to the engine.

(3) *Universal joints.* Two universal joints connect the engines to the torque converters (fig. 104). The attaching flanges on the front of the universal joints are bolted to the coupling flanges of the converter impeller shafts; the rear of the universal joints slide on the splined clutch shafts. The universal joints are equipped with needle roller bearings.

b. Data.

Torque converter (two):	
Make	Twin-disk
Model	T-10010
Converter auxiliary pumps (two):	
Make	Eaton
Model	ER-1330
Converter oil filters (two):	
Make	Commercial
Model	AS 4¼/DDV

178. Clutch Pedal Adjustment

a. General. The master clutch pedal must have 1½- to 2-inches free travel at all times to ensure clearance between the release bearing and release levers in the cover assembly of each clutch and to ensure complete engagement and disengagement of the clutches. The adjustment for this free travel is made by shortening or lengthening the clutch pedal linkage rods (fig. 99) between the pedal and the shaft to which the clutch release shifter shafts are connected. Adjustable yoke ends are provided for this purpose.

b. Adjustment. Open crew rear compartment door and remove the yoke pin from the rear end of the linkage rod connected to clutch pedal (fig. 99). Loosen locking nut and turn yoke onto rod to decrease the free travel of the pedal, or back off of rod to increase the free travel (fig. 99). Connect rod and check distance of free travel. When adjustment is correct, tighten lock nut against yoke, and install cotter pin in yoke pin (fig. 99). After adjusting linkage rod for correct pedal free travel, hold pedal down to where a slight pressure is felt and disengagement of clutch begins; then have a second man check to see if either of the two links connected to the throw-out levers on the clutch release shifter shafts (fig. 100) are loose (can be rattled). If one is loose, remove yoke pin from adjustable yoke of the loose rod and adjust length of rod so the slack is removed. This will ensure both clutches disengaging and engaging at the same time. Be sure cotter pins are installed and jam nuts tight after rods are adjusted and connected.

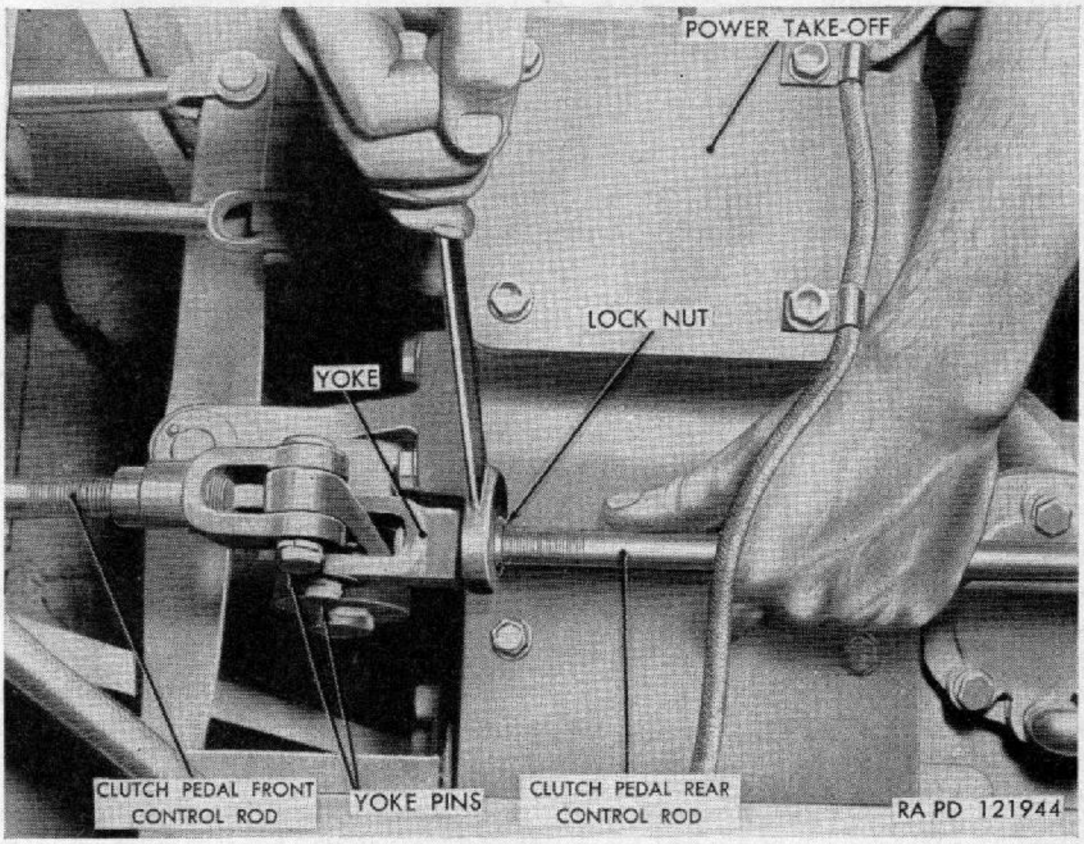


Figure 99. Adjusting clutch pedal linkage.

179. Replacement of Either Clutch

a. Coordination With Ordnance Maintenance Unit. Replacement of the clutch is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, provided authority for performing this replacement is obtained from the appropriate commander. Tools needed for the operation which are not carried in the using organization may be obtained from the supporting ordnance maintenance unit.

b. Remove Engines From Tractor. Refer to paragraph 104.

c. Remove Clutch Housing and Clutch From Engine (fig. 100). With engines removed from tractor and engines and clutch housing blocked up, remove the cap screws that attach clutch housing to flywheel housings, and move clutch housing from engines. Install six $\frac{3}{8}$ x $1\frac{1}{2}$-inch NC cap screws through holes in clutch cover and screw them into tapped holes until the heads of the cap screws are against the cover. These cap screws are to hold the clutch pressure springs compressed while the clutch assembly is removed. Then remove the 18 cap screws that attach clutch cover to flywheel, and remove pressure plate and cover assembly. The clutch driven disk will be removed at the same time. Be careful not to lose the three dowels in flywheel when the cover is removed (fig. 100). Inspect all the parts in pressure plate and cover assembly and in the clutch housing to determine if any of those parts are worn or damaged and in need of replacement (fig. 102). Wash grease from flywheel housing, cover assembly, and clutch housing.

d. Install Replacement Clutch Assembly. Insert the three small dowels with snap rings into holes in flywheel (if they were removed), seating the snap rings in recesses in flywheel. Set driven disk against flywheel with the long end of hub toward pressure plate assembly (fig. 102); then place cover plate in position on dowels. Start the 18 cap screws with lock washers that attach clutch cover to flywheel. Aline hub of driven disk with clutch shaft pilot bearing (fig. 100) and tighten cap screws. Remove the six cap screws installed in cover during removal (*c* above).

e. Check Clutch Release Lever Adjustment (fig. 100). Hold a straightedge across the clutch cover and measure from straightedge to face of thrust button on each lever. This distance from outer side of cover plate to thrust buttons should be 1⅜ inches to ensure proper operation of clutch. Adjust each release lever for this measurement by turning the adjusting nuts clockwise to decrease the distance or counterclockwise to increase the distance. The adjusting nuts are self-locked by friction.

f. Install Clutch Housing. Place the clutch housing in position against flywheel housings, inserting ends of clutch shafts through clutches and into pilot bearings in flywheels. Install cap screws with lock washers to attach housing to flywheel housings.

g. Install Engines in Tractor and Adjust Clutch Pedal. Refer to paragraph 105 for installation of engines. See paragraph 178 for adjustment of the clutch pedal.

180. Replacement of Clutch Release Bearings

a. Remove Engines From Tractor. Refer to paragraph 104.

b. Remove Clutch Housing and Release Bearing. Remove the cap screws that attach clutch housing to the flywheel housings and move clutch housing from engines (fig. 100). Remove the bolt from clip on release bearing lubricating tube inside the housing. Unhook ends of release sleeve retractor springs from the end of clutch shifter (fig. 101) and slide springs from the release sleeve. Slide the release sleeve and bearing off clutch shaft then disconnect lubricating tube from sleeve. Press release bearing off sleeve. Discard worn or damaged parts.

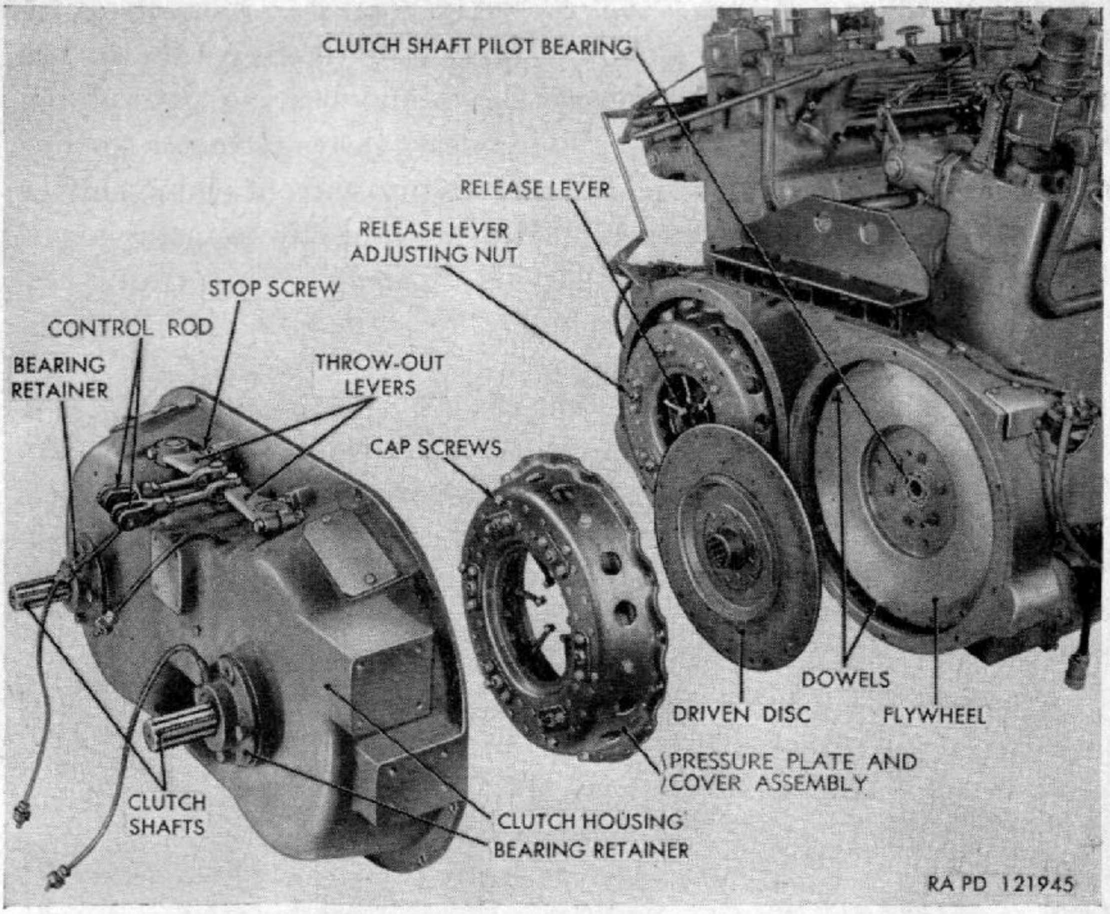


Figure 100. Clutches partially disassembled.

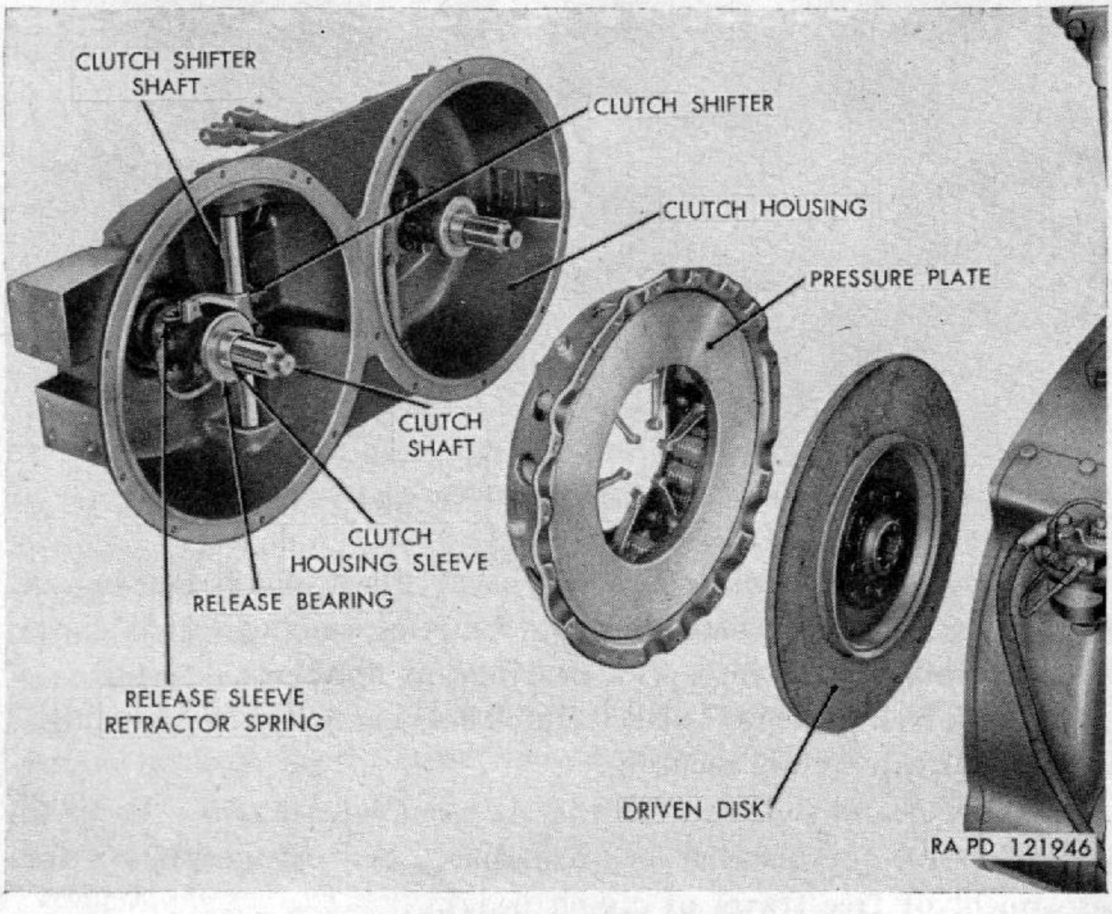


Figure 101. Release bearing and clutch components.

c. Install Release Bearings and Sleeve on Clutch Shaft. Press release bearing onto release sleeve. Connect lubricating tube to the release sleeve then slide the release sleeve and bearing onto clutch shaft and clutch housing sleeve. Slide release sleeve retractor springs into release sleeve and hook ends of springs into ends of clutch shifter (fig. 101). Install bolt to attach lubricating tube clip to inner side of clutch housing.

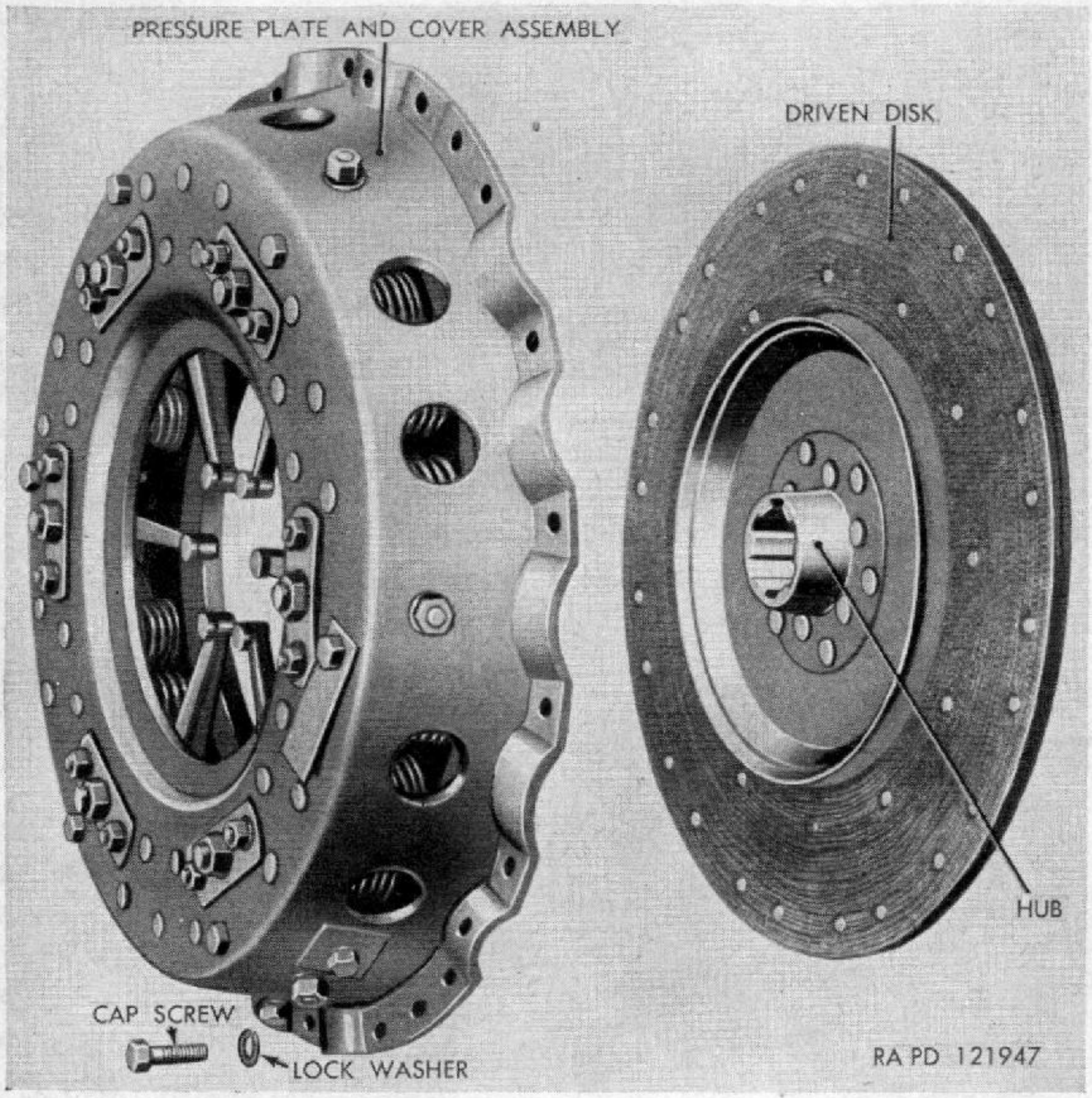


Figure 102. Master clutch assembly.

d. Attach Clutch Housing to Engines. Place clutch housing in position against the flywheel housing, inserting ends of clutch shafts through clutches and into pilot bearings in flywheels. Install cap screws with lock washers to attach clutch housing to flywheel housings. Tighten all cap screws securely.

e. Install Engines in Tractor and Adjust Clutch Pedal. Refer to paragraph 105 for installation of engines. See paragraph 178 for adjustment of free travel of clutch pedal.

181. Draining and Filling of Torque Converter Systems

a. Draining of Torque Converter Systems. Remove the rear maintenance and inspection plates from bottom of hull below each torque converter (fig. 62) to reach drain plugs in bottom of converter housings. Remove the drain plugs and open the drain valves at bottom of each oil reservoir. Remove the radiator vent line filter elements (par. 184*a*). (The elements should be replaced each time the oil in the converter is changed.) After draining system, replace drain plugs, close reservoir drain valves, and replace the vent line filters with the new elements installed (par. 184*a*). Remove the drain plugs and drain the oil from the torque converter pump drive housings at same interval that converters are drained and refilled. Renew the elements in the oil filters above the reservoirs (par. 184*a*).

b. Filling of Torque Converter Systems. After replacing vent line filter element (fig. 109), servicing the oil filters, and installing the drain plugs, fill the converter pump drive housing with oil (fig. 108). Fill the reservoirs with oil as specified on the lubrication order (par. 70), start engines and run them at half-throttle with the master clutches engaged. Add oil to the reservoirs as it is pumped into the systems until the oil levels in the reservoirs remain constant at the "FULL" marks on oil level gage rods (fig. 108) and the converter oil presssure gages show normal readings (par. 34) with no fluttering of the needles. Replace fill plugs, then check to make sure there are no leaks at filters, connections, or radiator.

182. Torque Converter Removal

a. Coordination With Ordnance Maintenance Unit. Replacement of the torque converter is normally an ordnance maintenance operation, but may be performed in an emergency by the using organization, provided authority for performing this replacement is obtained from the appropriate commander. Tools needed for the operation which are not carried in the using organization may be obtained from the supporting ordnance maintenance unit.

b. Remove Converter Oil Filter. Remove seats and open crew rear compartment door. Drain torque converter oil from system of the converter to be removed (par. 181*a*). Disconnect the oil inlet hose from left side of filter (fig. 106). Remove cap screw from clip supporting filter outlet hose from clutch shaft bearing retainer and disconnect lower end of outlet hose from converter auxiliary oil pump (fig. 107). Remove the two cap screws attaching converter oil filter head to filter mount, and remove filter assembly (fig. 106).

c. Remove Oil Reservoir. Remove filter inlet hose and elbows from front end of reservoir (fig. 107). Remove hose connected to

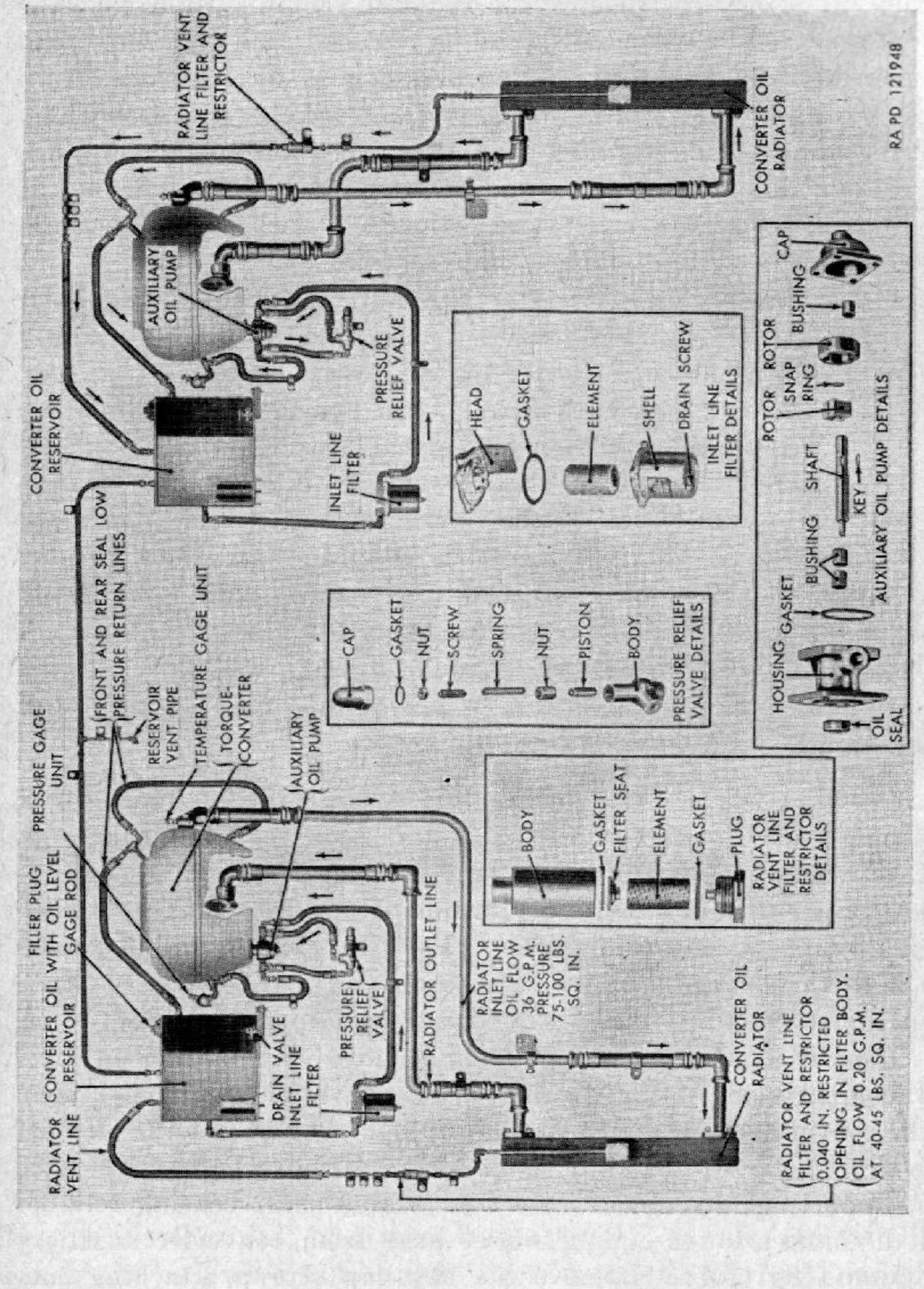


Figure 103. Torque converter oil circulatory system.

reservoir and lower end of converter radiator vent line. Disconnect lower section of reservoir vent line at both ends (fig. 42) and remove cap screw from clip on section of line. Remove bolt from hose clamp to hose support bracket on top of reservoir (fig. 107). Disconnect end of hose from lower front side of converter housing. Remove end of lubricating tube, leading from center winch drive center shaft bearing, from rear floor plate support. To remove left reservoir, remove clamp bolt from clutch control shaft lever and tap lever nearly off end of shaft. Remove the four cap screws that attach clutch shaft mounting bracket to side of clutch housing (fig. 42), slide bracket toward end of shaft until rear end of bracket can be turned down against winch drive shaft bearing. Remove the three cap screws that attach reservoir to bottom of hull and lift out reservoir. To remove the right hand reservoir, instead of moving clutch shaft mounting bracket and lever at left end of shaft, pull cotter pins and remove the yoke from the top of the yoke lever at right end of clutch shaft (fig. 42). Remove the clamp bolt in lever and remove lever. Remove the four cap screws that attach clutch shaft mounting bracket to clutch housing, and slide the bracket off end of shaft. Remove the three cap screws that attach reservoir to bottom of hull and lift out reservoir.

d. Remove Universal Joint Assembly. Cut and remove lock wires; then remove the four socket-head cap screws that connect the two journal bearings to coupling block. Remove block from between the two journals (figs. 41 and 112). Remove the eight bolts that connect the universal joint flange to coupling flange on converter impeller shaft and remove flange and journal, then slide yoke and journal off clutch shaft.

Caution: Hold bearings on journals when removing yoke and flange to prevent them from dropping off ends of journals.

e. Remove Converter. Disconnect ends of hoses from pressure relief valves (fig. 105). Disconnect converter front bearing lubricating oil hose (fig. 104) from fitting at top front side of converter housing. Disconnect front ends of oil inlet and discharge hoses from side of converter housing by removing two cap screws from each connecting flange (fig. 105). Pull ends of wires from converter oil temperature and pressure gage units (fig. 104). Remove nuts from the 12 rear mounting studs (fig. 104) that attach converter to adapter on rear of transmission case. Screw a ½-inch NC cap screw inserted through end links of a short chain into tapped hole in top of converter housing, attach lift hook chain hook into chain, and take up slack in hoist chain. Pry converter toward the rear with a bar until free of mounting studs and transmission input shaft; then raise converter out of vehicle.

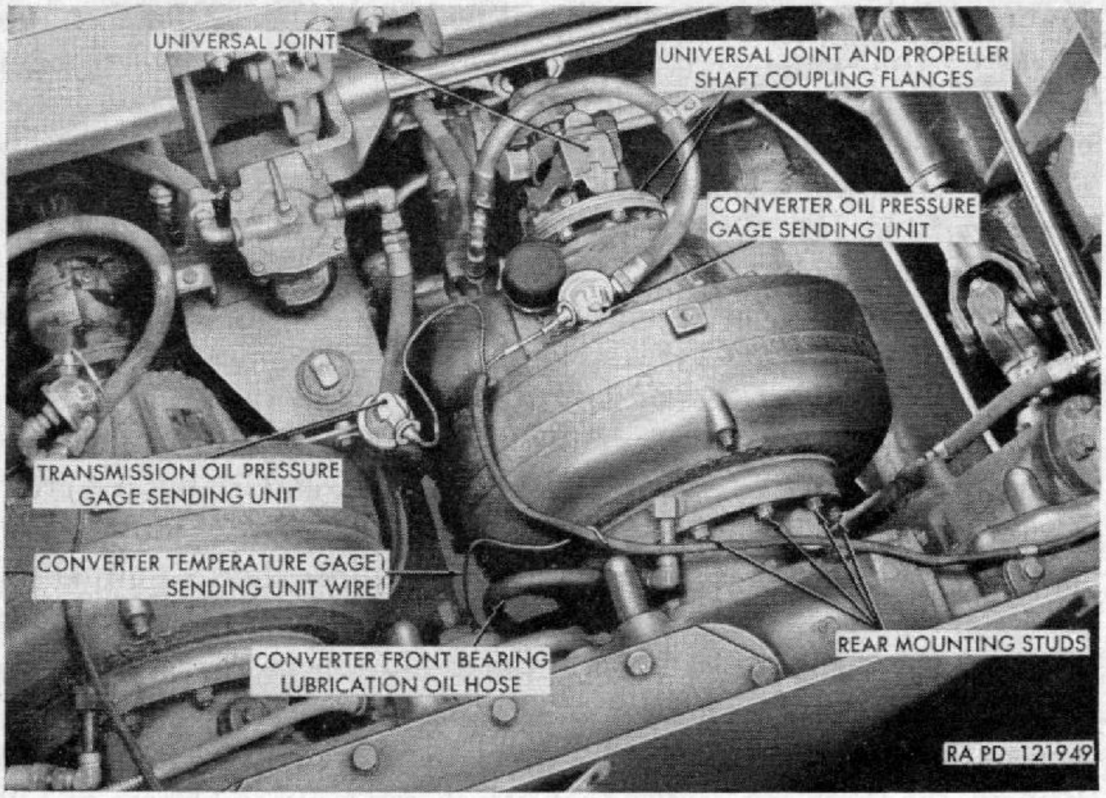


Figure 104. Torque converter removal details.

Figure 105. Removing torque converter.

183. Torque Converter Installation

a. Attach Torque Converter to Transmission. Cement new gasket to attaching surface of converter. Insert a ½-inch NC cap screw through end links of a short chain, and screw it into tapped hole in top of converter housing. Lift converter with chain and place it in position against converter-to-transmission adapter with transmission input shaft inserted into front of converter and studs entering holes in adapter. Install lock washers and nuts on the 12 rear mounting studs and tighten nuts (fig. 104). Remove lifter chain.

b. Connect Oil Hoses and Gage Wires. Using new gasket between converter and attaching flanges, connect oil inlet and oil discharge hoses (fig. 105) to lower side of converter housing with two cap screws and lock washers in each (fig. 105). Connect converter front bearing lubricating oil hose (fig. 104) to fitting at top front side of converter housing. Connect ends of converter oil hoses to pressure relief valve (fig. 105). Connect No. 30 wire to transmission oil pressure gage and No. 11 wire to the oil temperature gage unit (fig. 104).

c. Install Universal Joint Assembly. Slide yoke and journal on clutch shaft. Connect universal joint flange to coupling flange on converter impeller shaft with eight bolts and lock washers (fig. 104). Place coupling block between the two journals and install four socket-head cap screws through rear journal bearings and coupling block and into front journal bearings. Tighten screws and secure them with lock wires through the heads of each screw.

d. Install Torque Converter Oil Reservoir. Place reservoir in hull and attach to bottom of hull with three cap screws and lock washers. Turn clutch shaft mounting bracket (fig. 42) so that cap screws can be installed to front of clutch housing if installing left hand reservoir. Install clutch shaft mounting bracket to clutch housing (fig. 42) if installing right hand reservoir. Install the two clutch control rods to clutch shaft (fig. 42) with two yoke pins and cotter pins. Install lubricating hose to rear floor plate support, connect converter bearing lubricating oil hose (fig. 104) to bottom of reservoir and to top side of converter housing. Install bolt to attach hose clamp (fig. 107) of the auxiliary oil pump hose to top of reservoir. Install vent line hose to top of oil reservoir (fig. 107).

e. Install Torque Converter Oil Filter. Attach filter to the filter mount with two cap screws and lock washers (fig. 106). Install inlet oil hose between filter and reservoir (fig. 106). Connect end of filter outlet hose (fig. 106) to auxiliary oil pump. Install cap screw to attach clip on this hose to clutch shaft bearing retainer.

f. Fill Torque Converter System and Test for Proper Operation. Fill the system as outlined in paragraph 181*b*. Check for leaks at connections and observe if the torque converter oil pressure and temperature gages indicate proper operation (pars. 34 and 35). If operation is satisfactory and no leaks are evident, lower rear floor plate and install seats. Make the proper entry on DA AGO Form 478, MWO and Major Unit Assembly Replacement Record, and Organization Equipment File.

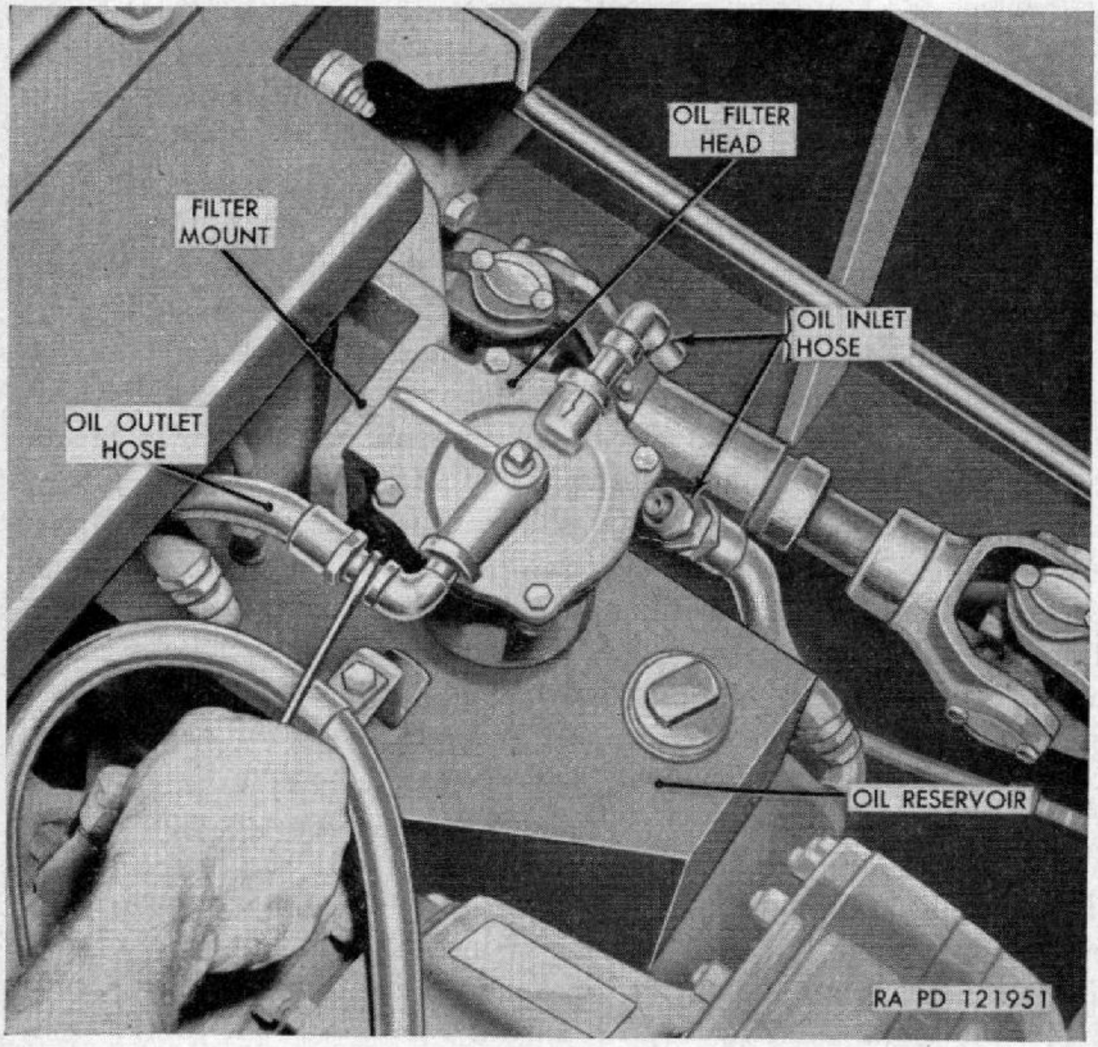


Figure 106. Torque converter oil filter assembly removal.

184. Torque Converter Oil Filters Pressure Relief Valve and Radiators

a. Oil Filters.

(1) *Reservoir oil filter maintenance.* To service the filters above reservoirs, remove the four cap screws that hold filter case to filter head (fig. 106), remove case, and lift out old element (fig. 107). Wash case with dry-cleaning solvent or volatile mineral spirits and install new element. Install case on filter head, using new attaching gasket between case and filter head. Tighten cap screws evenly to draw case tight. Start engines (par. 45) and check for converter oil leaks around filter case.

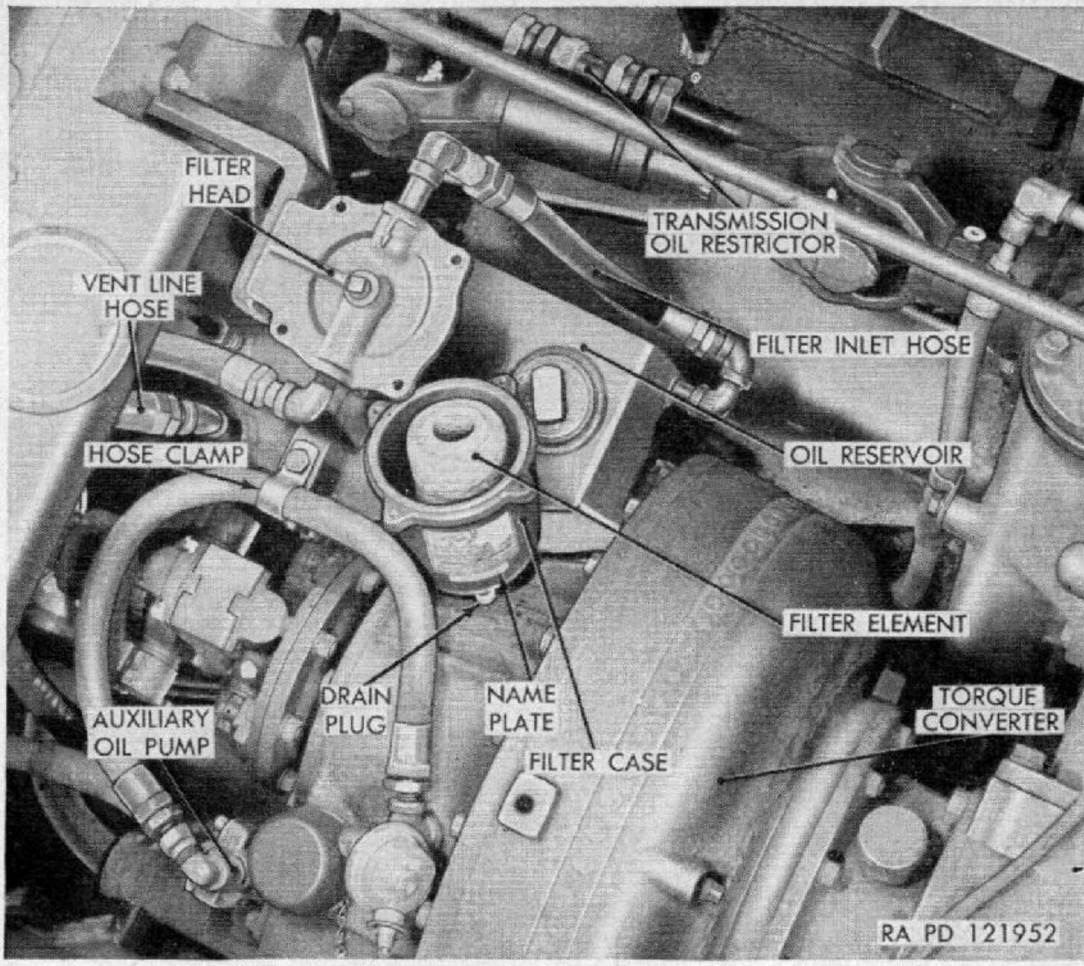
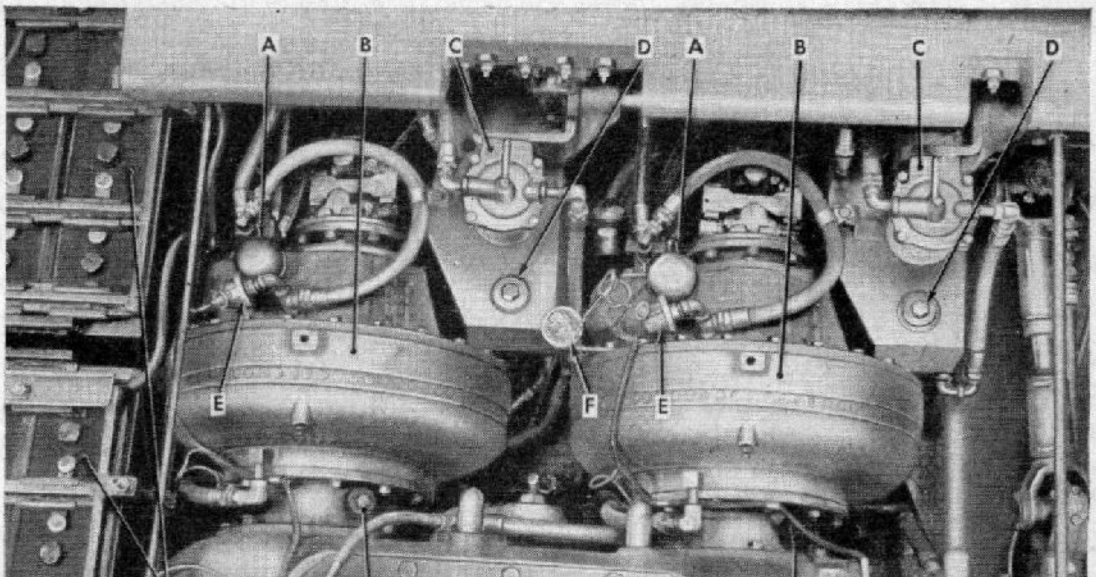


Figure 107. Torque converter oil filter removal.



A—CONVERTER PUMP DRIVE HOUSING BREATHER AND FILL CAPS
B—TORQUE-CONVERTERS
C—CONVERTER OIL FILTERS
D—OIL RESERVOIR FILL PLUGS AND LEVEL GAGE RODS
E—OIL PRESSURE GAGE SENDING UNITS
F—TRANSMISSION OIL PRESSURE GAGE SENDING UNIT
G—TRANSMISSION BREATHERS
H—BATTERIES

RA PD 121953

Figure 108. Torque converters, filters, and oil reservoirs.

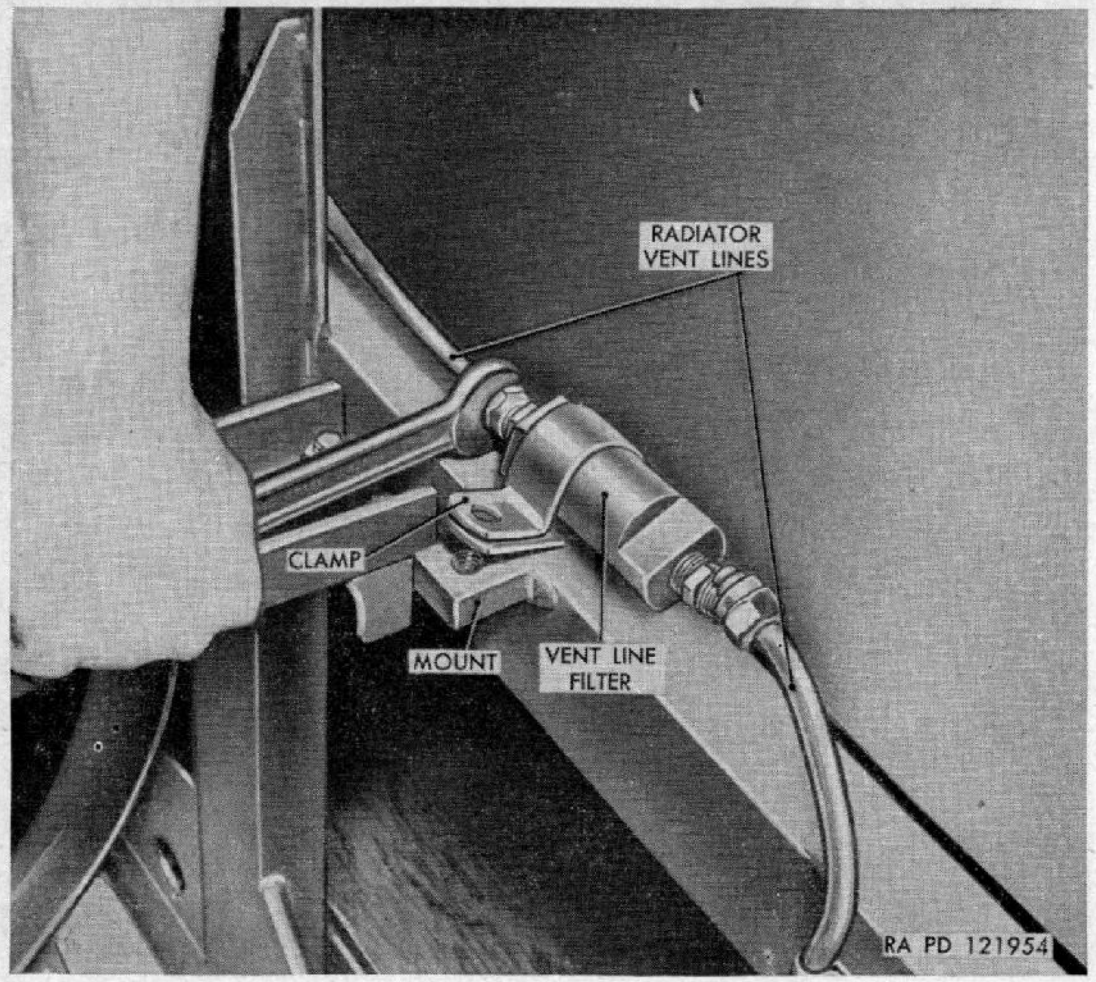


Figure 109. Removing torque converter radiator vent line filter.

(2) *Radiator vent line filter maintenance.* To service the radiator vent line filters, disconnect lines from ends of filters, remove bolt from clamp, and remove filter (fig. 109). Unscrew plug from inlet end of filter and remove plug, plug gasket, element, and filter seat and gasket (fig. 103). Wash case with dry-cleaning solvent or volatile mineral spirits and make sure the 0.040-inch orifice in outlet end of filter is unobstructed.

Note.—Clogged orifice will cause excessive torque converter oil pressure and possible damage to the torque converter oil cooler radiator.

Install gasket and filter seat, new element, plug gasket, and plug. Connect oil lines to filter; then install and tighten bolt to filter clamp.

b. Pressure Relief Valve Maintenance. Piston sticking in the torque converter pressure relief valve (fig. 105) will also ($a(2)$ above) result in excessive torque converter oil pressure and possible damage to the oil cooler radiators. If the pressure exceeds 50 pounds, check the relief valve for proper clearance between piston and cylinder wall as follows:

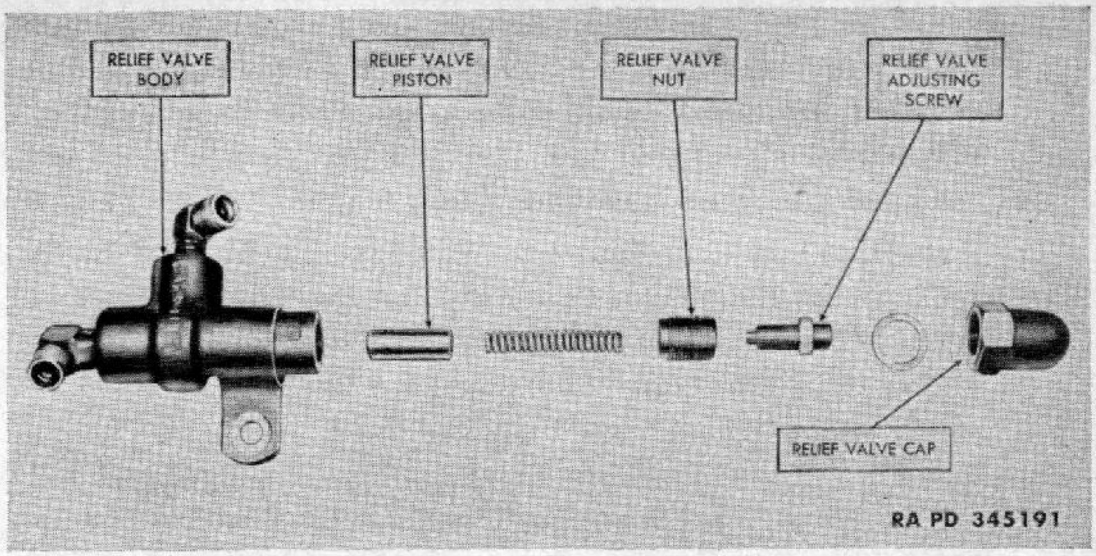


Figure 110. Torque converter pressure relief valve—disassembled.

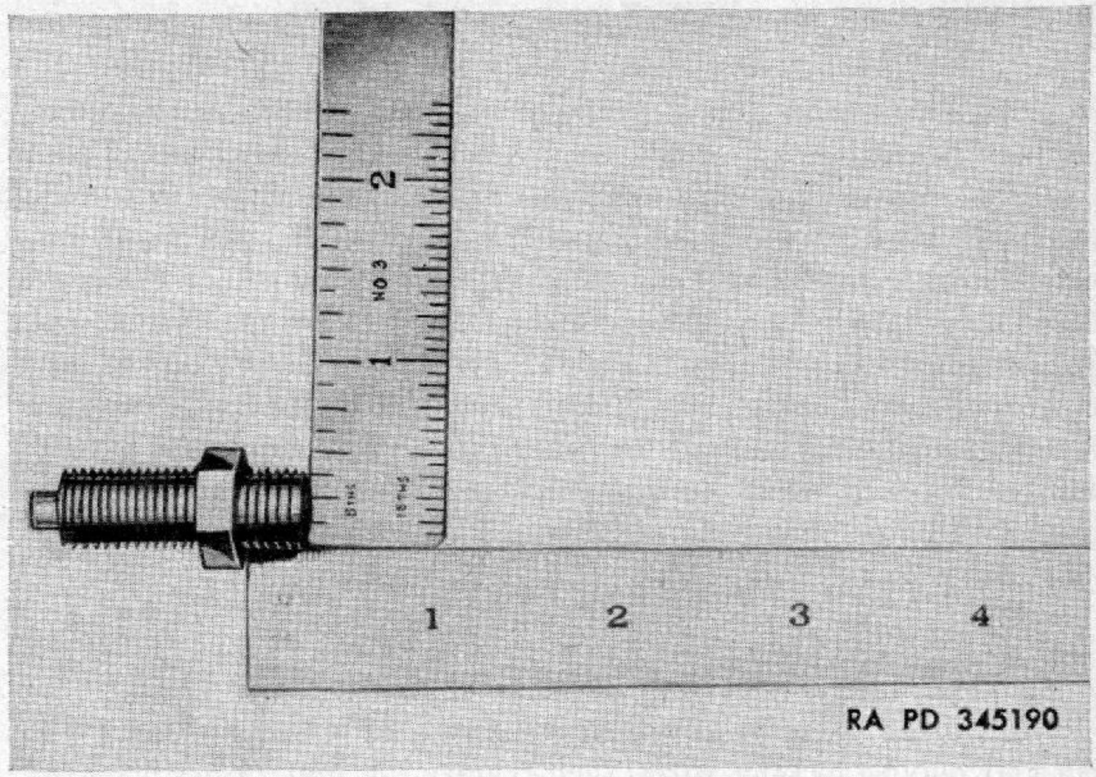


Figure 111. Measuring distance between lock nut and end of adjusting screw.

(1) Disconnect the oil pressure relief valve, remove bolt from clamp that secures the valve, and remove valve from vehicle.

(2) Disassemble valve by removing valve cap, adjusting screw, and valve nut (fig. 110).

Note.—To facilitate assembly of relief valve, with adjusting screw in approximate adjustment, measure the distance from the outer face of the lock nut on the adjusting screw to the end of the screw BEFORE removing adjusting screw from valve (fig. 111).

(3) Check clearance between the piston and cylinder wall by placing a 1/8-inch strip of 0.005-inch shim stock between the

piston and cylinder wall. If 0.005-inch clearance does not exist, reduce the diameter of the piston by means of crocus cloth or fine emery cloth, until a full 0.005-inch clearance is obtained.

(4) Assemble the relief valve and install.

Caution: When installing adjusting screw in relief valve, make sure the distance between outer face of lock nut and screw is the same as it was before disassembly (*b*(2) above), otherwise, pressure will have to be adjusted by means of adjusting screw.

(5) After complete assembly, start engine and check the oil pressure gage. If the reading is not between 40 and 50 pounds at 1,000 to 1,200 rpm, readjust the converter pressure relief valve by means of adjusting screw.

c. Torque Converter Oil Radiators.

(1) *Replacement of radiator.* Refer to paragraph 129.

(2) *Maintenance.* If clogging of the radiators occurs, the radiators may be cleaned by circulating live steam through them. Drain the torque converter system (par 181*a*). Disconnect the two torque converter oil pipes at elbow (fig. 70). Disconnect the torque converter radiator vent pipe at radiator (fig. 68). Plug end of vent pipe at radiator with a rag or wood plug. Insert a steam hose at end of disconnected pipe and pack several layers of cloth around the hose to prevent steam leaks. Slowly turn steam on and increase pressure as foreign materials run out the other pipe. When radiator is thoroughly cleaned, install torque converter oil pipes (fig. 70) and connect radiator vent pipe (fig. 68). Fill torque converter system (par 181*b*).

185. Universal Joints

a. Removal. Remove the rear seats and raise hinged floor plate. Cut and remove locking wires, then remove the four socket head cap screws that connect the journal bearings to coupling block (fig. 112). Remove coupling block from between the two journals (fig. 41). Remove the eight bolts that connect the universal joint flange to coupling flange on converter impeller shaft and remove flange and journal; then slide yoke and journal off clutch shaft.

Caution: Hold bearings on journals when removing yoke and flange to prevent their dropping off ends of journals.

b. Installation. Slide yoke and journal onto clutch shaft. Place universal joint flange against coupling flange of torque converter impeller shaft, and attach with eight bolts and lock washers (fig. 104). Place coupling block between the two journals and install four socket head cap screws through universal joint yoke journal bearings and coupling block, and into universal joint flange journal bearings. Tighten screws and secure with locking wires through heads of screws. Lubricate universal joint bearings as indicated on the lubrication order (par. 70).

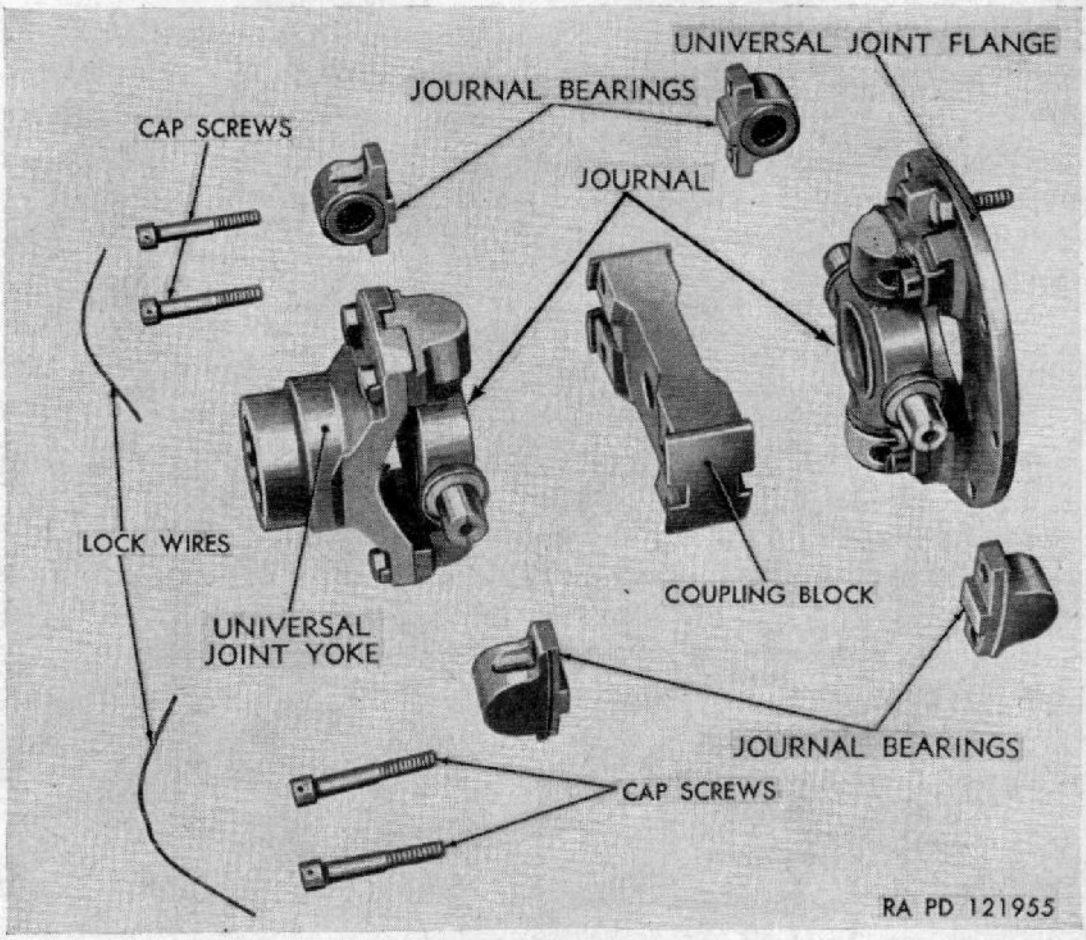


Figure 112. Universal joint disassembled.

Section XVI. TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVE

186. Description

a. Lubrication System (fig. 113). The final drives are lubricated by the oil carried in their respective housings. The transmission, differential, and power take-off assemblies are lubricated by a common oil supply distributed by a pump located inside the transmission case. The oil pump draws the oil from sumps in the bottom of the transmission and differential housings, circulates it through two oil cooling radiators where it is cooled; then the oil is delivered through a manifold pipe to oil lines leading to the transmission input shaft, pinion shaft, reverse idler shaft, and to the power take-off and differential. Restrictors in the return lines from the radiators maintain

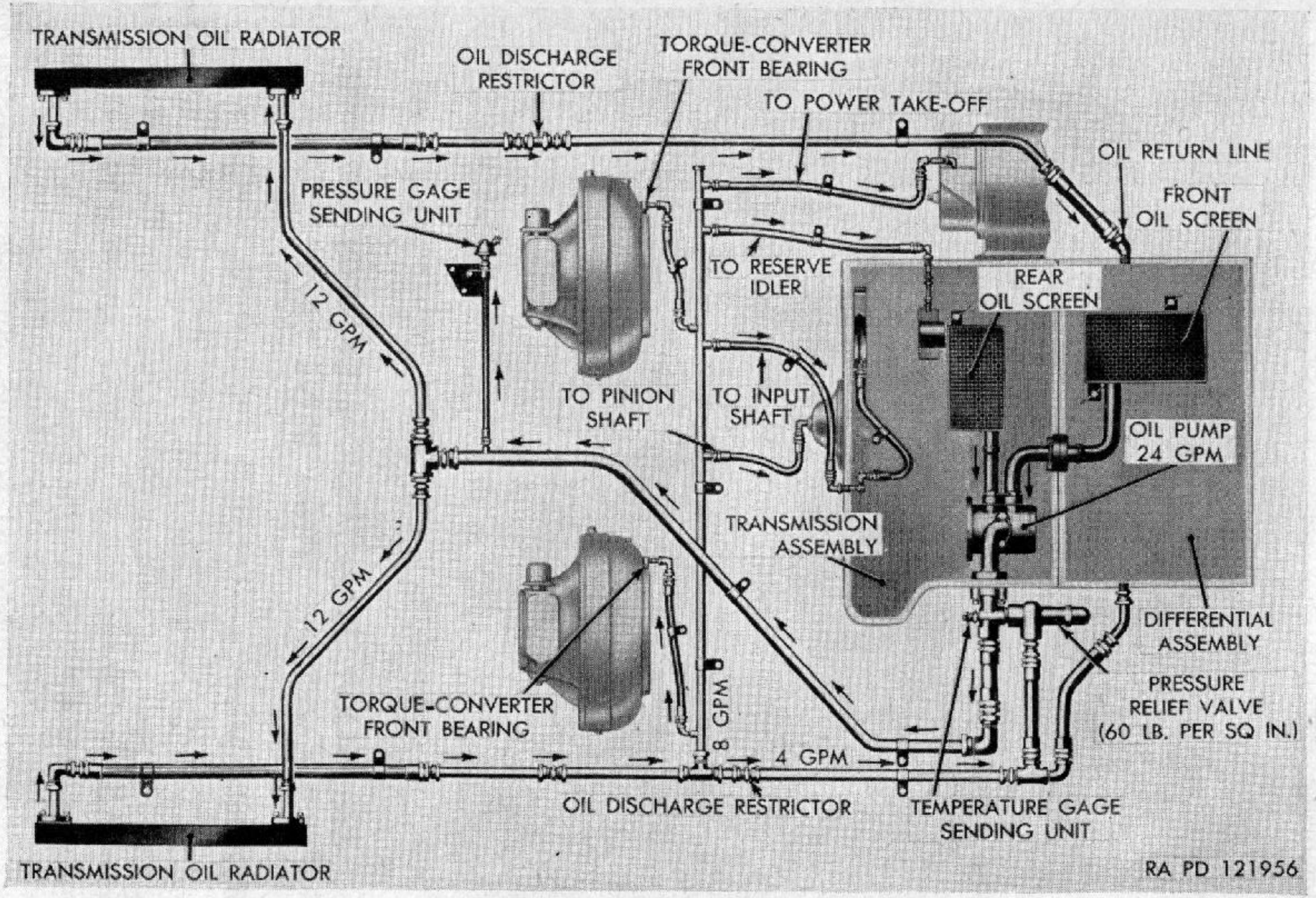


Figure 113. Transmission oil piping system.

pressure in the system. A pressure relief valve connected to the pump discharge pipe and set to open at a pressure of 60 psi is provided to open and allow the oil to pass directly back to the differential housing, in the event pressure above 60 psi is built up due to clogged oil lines or heavy oil.

b. Transmission. Power supplied by the engines is transmitted through the torque converters to the transmission, controlled differential, and final drives, to the drive sprockets. The transmission provides for two forward speed ranges, an engine brake gear position for descending hills, and one reverse speed range (fig. 9). The transmission and differential are enclosed in separate cases, the final drives are bolted to the differential case, and the power take-off is bolted to the transmission case. Steering brakes in the differential provide the means of steering the vehicle (par. 190).

c. Transmission Cooling Radiators. The transmission oil cooling radiators (inner radiator of the three in each radiator assembly) (fig. 75), are of the fin-and-tube type contained in a single radiator shell.

d. Final Drive and Sprocket Assembly. Each drive sprocket assembly consists of three sprockets bolted to a single hub attached to a flange on the final drive sprocket shaft (fig. 114). The sprockets can be reversed to permit further wear when teeth become worn on one side. The teeth of the sprockets engage the track connectors and track guides.

187. Replacement of Transmission Oil Radiators

a. Drain Transmission and Differential. Refer to paragraph 188*a*.

b. Remove Transmission Oil Radiators. Refer to paragraph 129*a* and *b*.

c. Install Transmission Oil Radiators. Refer to paragraph 129*c* and *d*.

d. Fill Transmission and Differential. Refer to paragraph 188*b*.

188. Transmission and Differential Maintenance

a. Draining. Remove the transmission drain plug access plate from bottom of vehicle (fig. 62). Remove the oil drain plug and drain oil into a clean container.

Note.—Drain oil only when warm.

Install drain plug and access plate.

b. Filling. Remove the seats from the front crew compartment. Remove the transmission filler plug and oil level gage. Fill to the "FULL" mark on the oil level gage according to instructions on the lubrication order (par. 70).

Caution: Do not overfill as high oil temperatures will result.

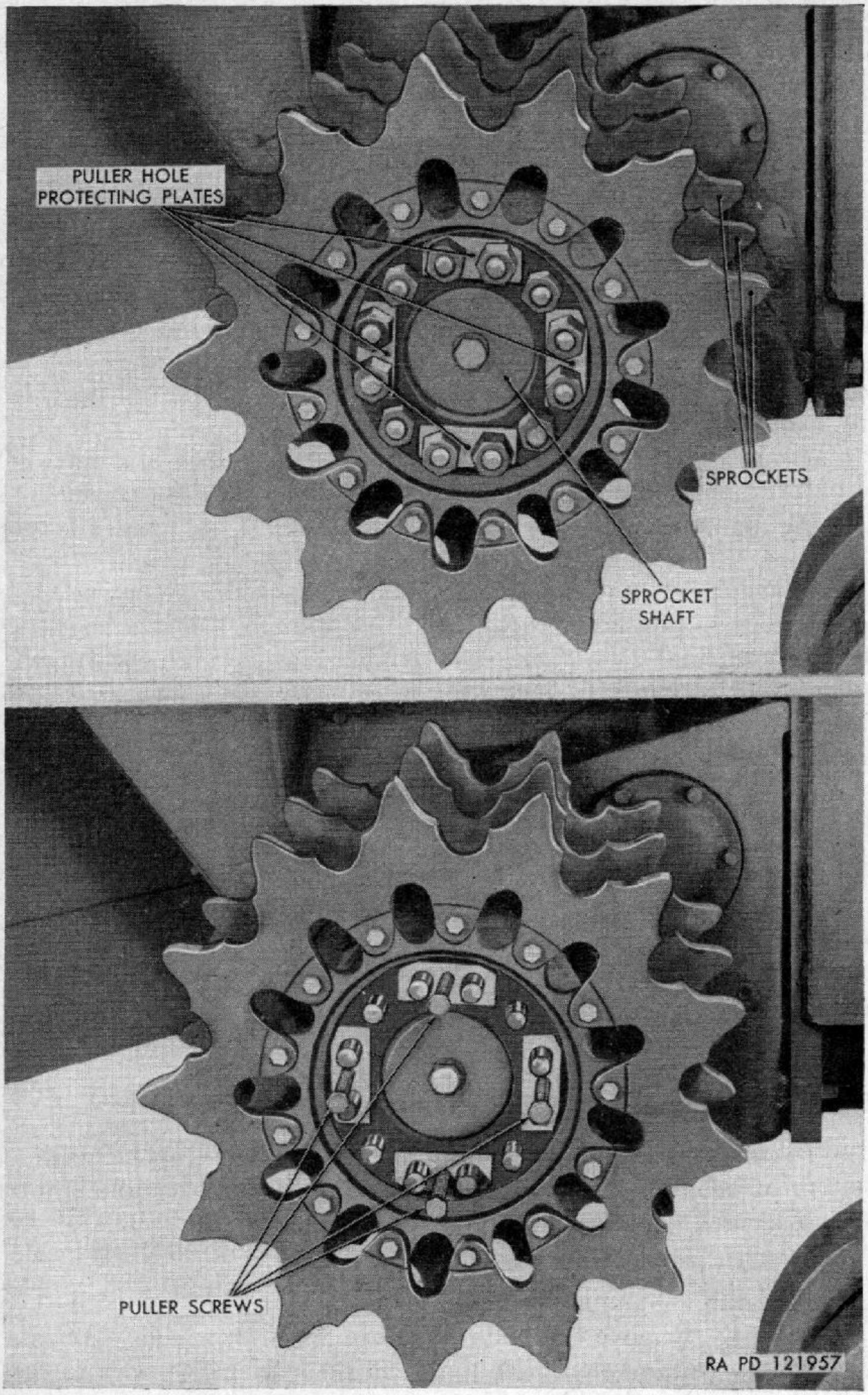


Figure 114. Drive sprocket removal.

189. Final Drive and Sprocket Assembly

a. Removal. Uncouple track (par. 204*c*) and back tractor until track drops off sprocket. Remove the 12 nuts from sprocket hub bolts. Remove the four puller hole protecting plates (fig. 114). Install ⅝ x 5-inch NC full thread cap screws in the four tapped holes in hub and turn them in evenly to force hub off sprocket shaft and bolts. Lift assembly off with hoist. Remove sprockets from the hub by removing the 13 bolts from each sprocket (fig. 114). The sprockets should be reversed or replaced when worn to a point where wedge bolts contact the sprockets.

b. Installation. Install sprockets on hub with 13 bolts in each. Then raise sprocket assembly with a hoist and slide assembly over the sprocket shaft and bolts. Install the four puller hole protecting plates on bolts. Install and tighten the 12 nuts on the sprocket bolts (fig. 114). Install track as explained in paragraph 204*d*.

c. Draining Final Drives. Remove final drive drain plug (fig. 62), and drain oil into a clean container.

Note.—Drain oil only when warm.

Install drain plug.

d. Filling Final Drives. Remove final drive filler plug and fill with oil according to instructions on the lubrication order (par. 70). The oil level should be maintained at a level even with the level plugs in outer sides of housings.

Section XVII. STEERING BRAKES

190. Description

The steering brakes consist of two lined brake shoe assemblies which encircle brake drums in the differential (fig. 118) and are operated by the two hand steering levers (fig. 6). Contracting the brake shoes of either brake around its drum sets the planetary gears in motion, causing the track on that side to slow down and the track on the other side to speed up to turn the vehicle. Locks are provided on top of the levers to engage the rachets to lock brakes in contracted position for parking the vehicle.

191. Brake Adjustment

a. General. A slight clearance must be maintained between the brake drums and brake bands. This clearance is obtained by adjusting the stabilizer bolts that contact the support yoke at rear of brake and the adjusting nut on yoke that supports the brake band at the front (fig. 116). With the proper clearance between bands and brake drums, the steering levers will have 8 inches free travel at the top before engagement of brakes begins. More or less than 8 inches free travel indicates the need of adjustment.

b. Adjustment Procedure.

(1) *Adjust free travel of levers.* Remove seats from front compartment. Remove five cap screws and one bolt, and lift curved plate on front of differential. Remove four cap screws from each brake hole cover from front side of differential case (fig. 115), and remove these covers. With levers forward against stop, measure the distance between dash and tops of steering levers. Then hold rule in same position and pull each lever back to point where pressure is felt and engagement of brake begins. Turn large adjusting nuts (reached through brake holes) clockwise to decrease free

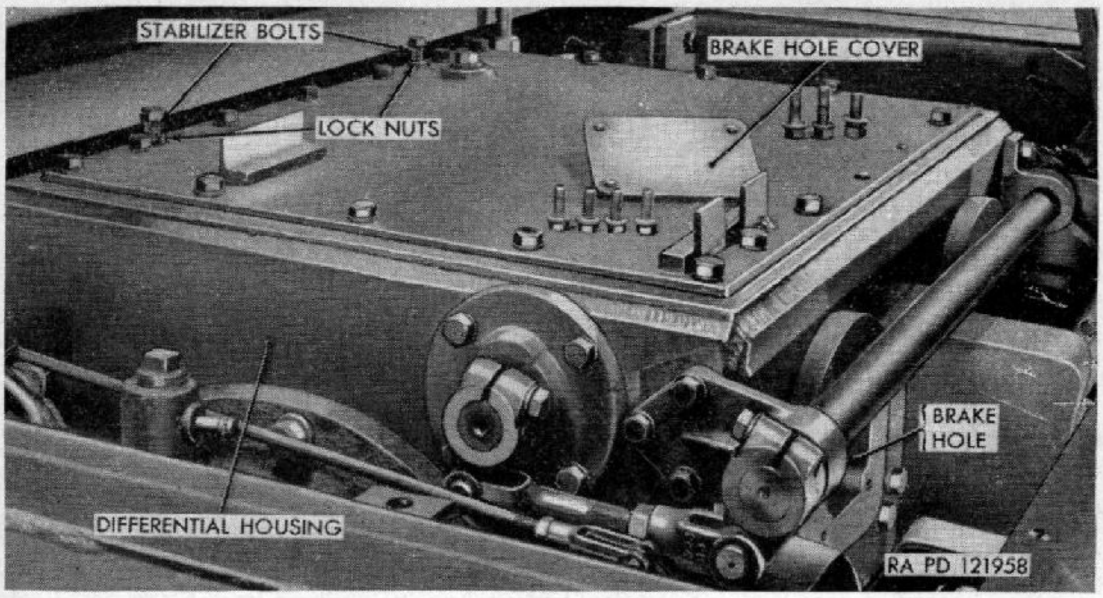


Figure 115. Brake hole cover removed to adjust brakes.

travel of levers, or counterclockwise to increase free travel until 8 inches free travel is obtained. These nuts lock every half turn on the early model tractors, every quarter turn on later model tractors.

(2) *Adjust stabilizer bolts.* Loosen lock nuts on stabilizer bolts, and turn bolts out until all pressure is relieved from the bottom of bolts. The lower part of the brakes will at that time contact the brake drums due to spring pressure. Then turn each bolt back in until it is felt to contact the support yoke in which it seats (fig. 116). Turn bolt in one-sixth turn more after it contacts yoke to provide the proper clearance between the brake band and drum, and tighten the lock nut. Recheck the free travel of levers; readjust if necessary. Install brake hole covers and curved plate.

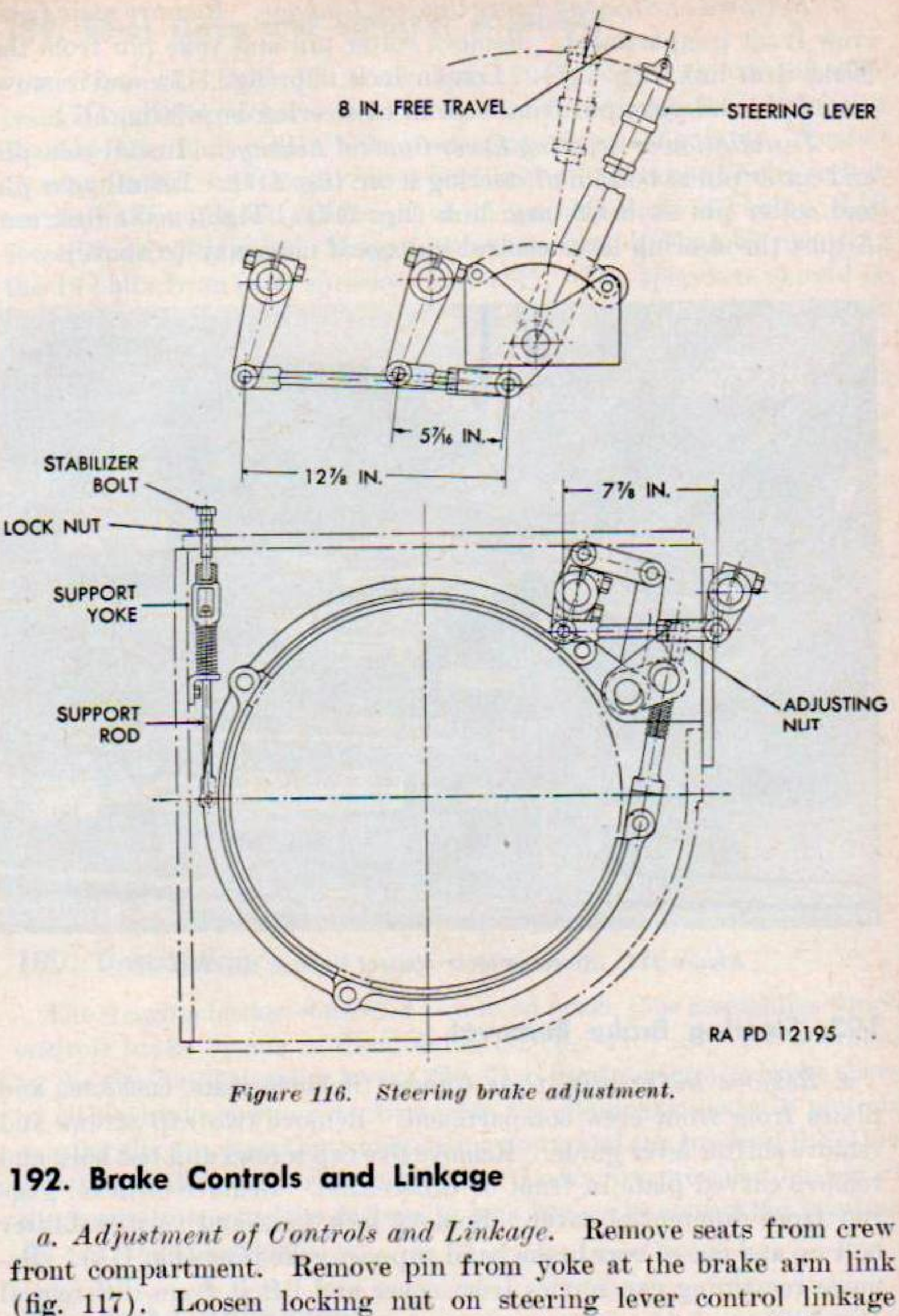


Figure 116. Steering brake adjustment.

192. Brake Controls and Linkage

a. Adjustment of Controls and Linkage. Remove seats from crew front compartment. Remove pin from yoke at the brake arm link (fig. 117). Loosen locking nut on steering lever control linkage (fig. 117). Turn control linkage in (clockwise) to shorten linkage or out (counterclockwise) to lengthen linkage. Connect steering linkage to brake arm link with yoke pin. Pull back on steering lever and, using a scale held against the instrument panel, free travel of steering levers should measure 8 inches before meeting resistance. Install cotter pin in yoke pin (fig. 117). Tighten lock nut (fig. 117). Install seats in crew front compartment.

b. Removal of Steering Lever Control Linkage. Remove seats from crew front compartment. Remove cotter pin and yoke pin from the brake arm link (fig. 117). Loosen lock nut (fig. 117) and remove cotter pin and yoke pin from bottom of steering lever (fig. 117).

c. Installation of Steering Lever Control Linkage. Install yoke pin and cotter pin at bottom of steering lever (fig. 117). Install yoke pin and cotter pin at brake arm link (fig. 117). Tighten the lock nut. Adjust the steering lever control linkage if necessary (*a* above).

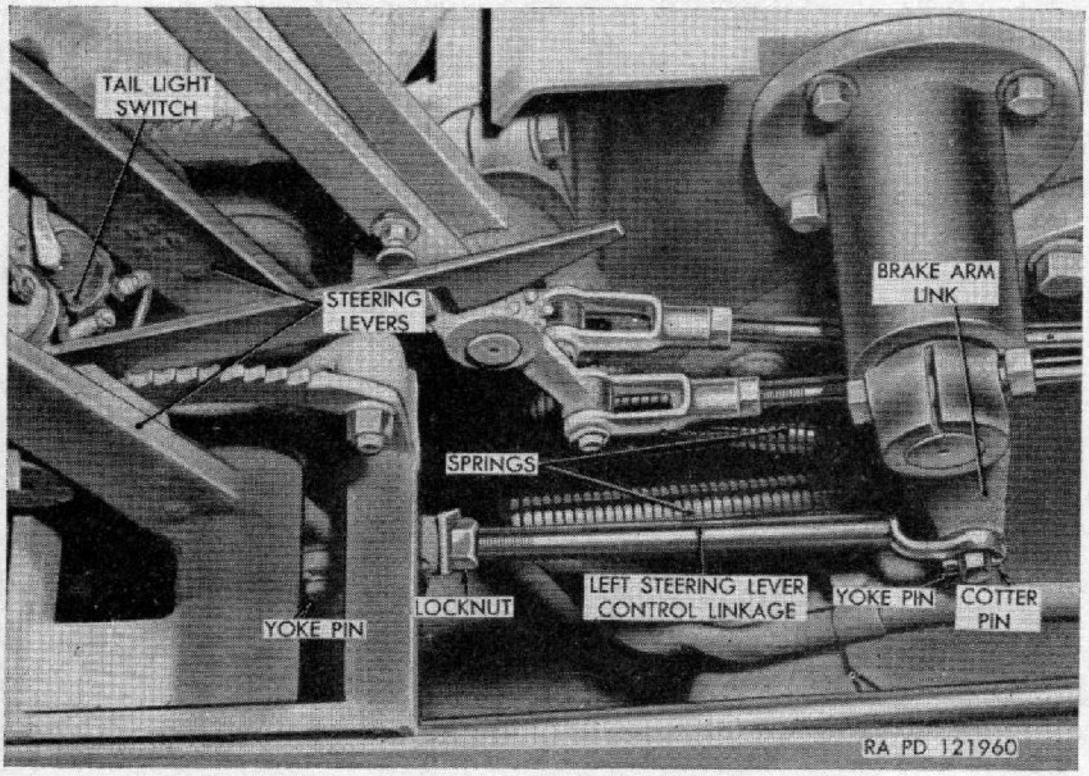


Figure 117. Steering lever control linkage adjustment.

193. Steering Brake Removal

a. Remove Differential Case Cover. Remove seats, cushions, and plates from front crew compartment. Remove two cap screws and remove shifter lever guide. Remove five cap screws and one bolt, and remove curved plate in front of differential. Remove oil level gage rod from differential cover. Remove lock nuts and turn stabilizer bolt up and out of rear brake band support yoke pins (fig. 115). Remove remaining cap screws from cover and lift it from differential (fig. 118).

b. Disconnect Brake Linkage and Remove Brakes. Remove brake hole covers from front side of differential case by removing four cap screws from each cover (fig. 115). Remove each brake separately. Loosen adjusting nut (fig. 116) on upper end of yoke bolt until all pressure is relieved on yokes and pins. Remove coupling pins (fig. 116) from front and rear ends of top brake shoe and remove upper shoe. Pull inside cotter pin from the coupling pin connecting front end of lower shoe to front yoke. Slide pin toward outer side of case until it releases the yoke; then rotate the two lower shoes around drum toward rear, tip rear support rod forward out of clip (fig. 119), and remove the two lower shoes. Remove rear support rod from brake shoe and lift brake shoes out of the differential case.

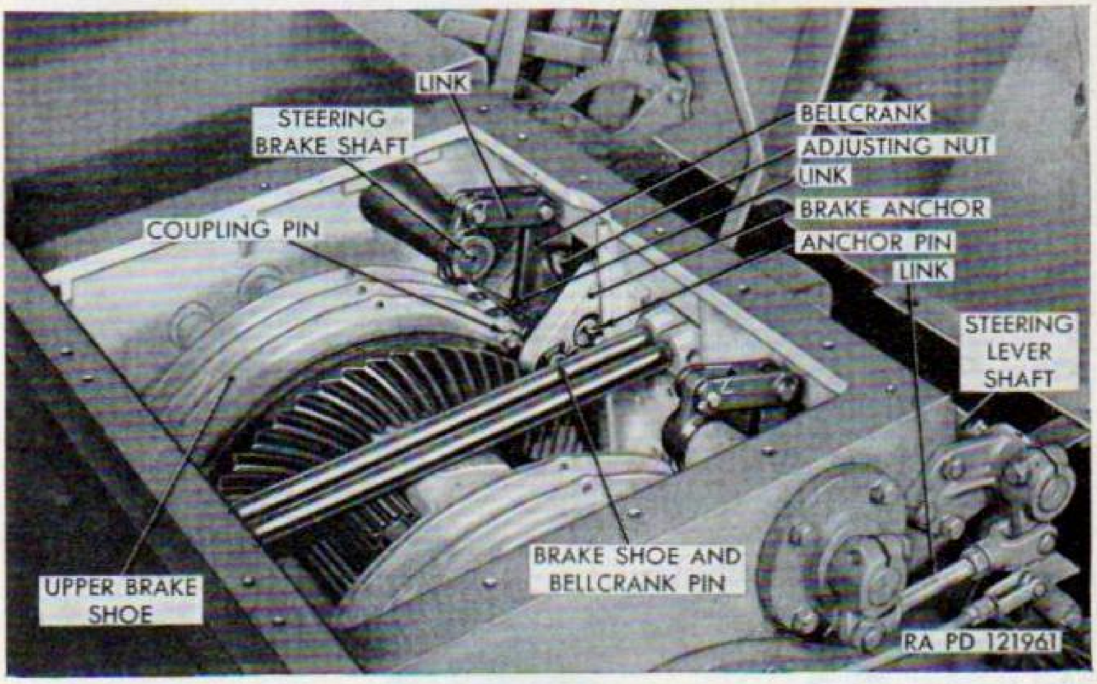


Figure 118. Differential cover removed.

194. Steering Brake Installation

a. Install and Connect Brakes. Couple two of the shoes together with a coupling pin and install cotter pins in ends of coupling pin (fig. 119). With narrow end of front shoe leading, start shoes around rear side of brake drums. Install rear support rod on second shoe with pin and cotter pin (fig. 119). Install cotter pin in one end of a coupling pin and bend ends of cotter pin. Start the coupling pin into outer-side of end of front shoe; then engage shoe with the front yoke, slip the coupling pin through the yoke and shoe, and install a cotter pin in the inner end of pin. Engage rear support rod in clip on back side of differential housing with spring above the clip. Install top shoe, connecting rear end of shoe to top of second shoe and front end to bellcrank connecting link with coupling pins (fig. 119). Secure pins with cotter pins in both ends.

b. Install Differential Cover. Position new gasket on differential, then lay the cover on differential case and install all the attaching cap screws (fig. 115) and lock washers, except those that also attach the curved plate and lever guide. Install lever guide with two cap screws and lock washers. Install brake hole covers with four cap screws and lock washers (fig. 115). Install curved plate in front of differential case with five cap screws and one bolt. Install stabilizer bolts in differential cover and into the brake band support yokes (fig. 115). Tighten lock nuts.

c. Adjust Brakes. Refer to paragraph 191.

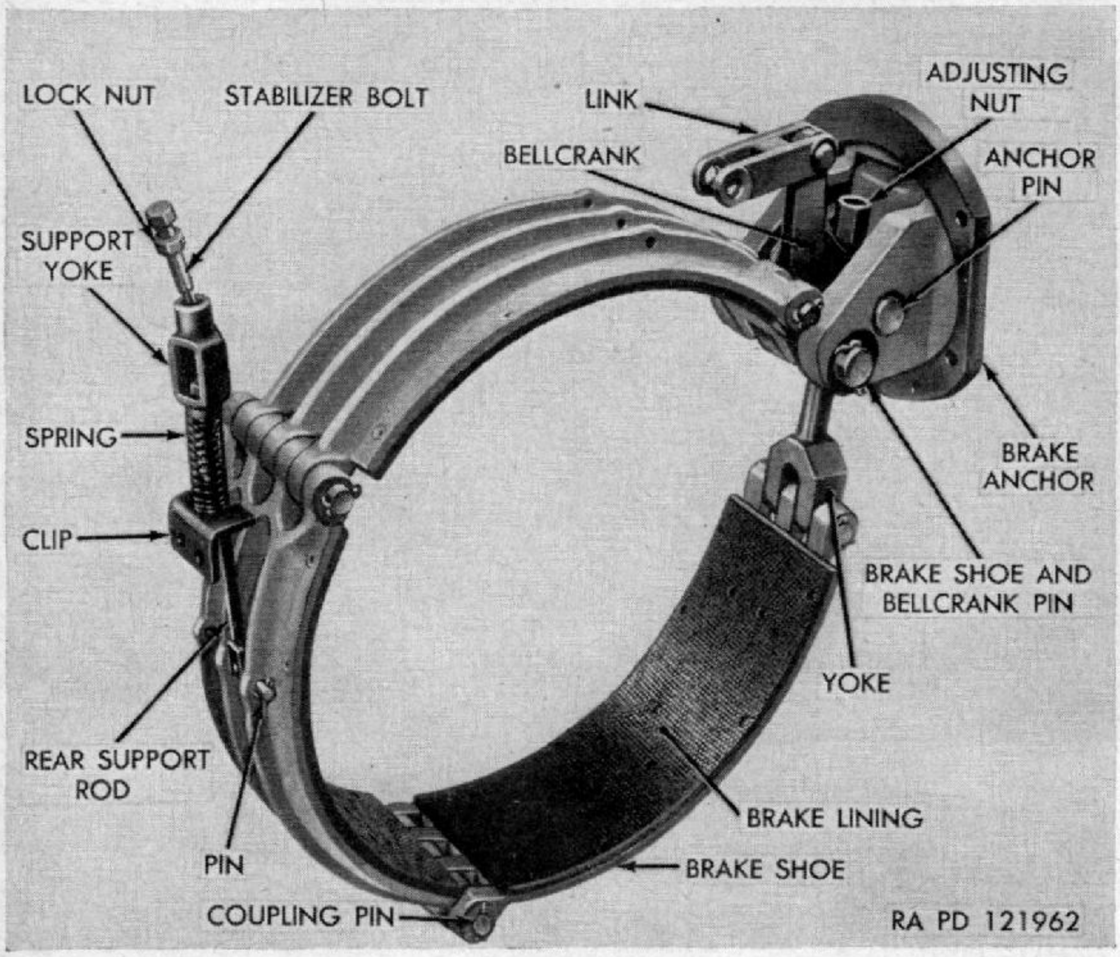


Figure 119. Steering brake assembly.

Section XVIII. TRAILER AIR BRAKE CONTROLS

195. Description

a. Air Compressor. The compressor is a two-cylinder, Bendix-Westinghouse Model No. 2–UE–71/4–VW. It is mounted on a mat on the timing gear housing of the cylinder block of left hand engine (fig. 43). The compressor is water cooled, lubricated by oil from the engine lubrication system, and is driven by a belt from a pulley on the engine crankshaft. When the pressure reaches 105 psi, the air pressure governor opens the unloader valve. This permits the air displaced by the upward movement of the piston to pass from one cylinder to the other without compression until pressure drops below 85 psi, at which time more air is delivered to the reservoir. The air compressor may be removed from the tractor if the primary purpose of the vehicle is to tow matériel equipped with electric brakes. The removal, however, should be accomplished only when the vehicles are operating continuously in sandy or extremely dusty terrain, which causes excessive wear of the compressor. Refer to paragraph 197*b* for instructions on capping lines, storage of compressor, and installation of compressor mounting bracket cover plate after removal of compressor.

b. Purpose. The purpose of the compressed air brake equipment on the tractor is to provide a means of operating the brakes on any vehicle that is equipped with air brakes and is being towed by the

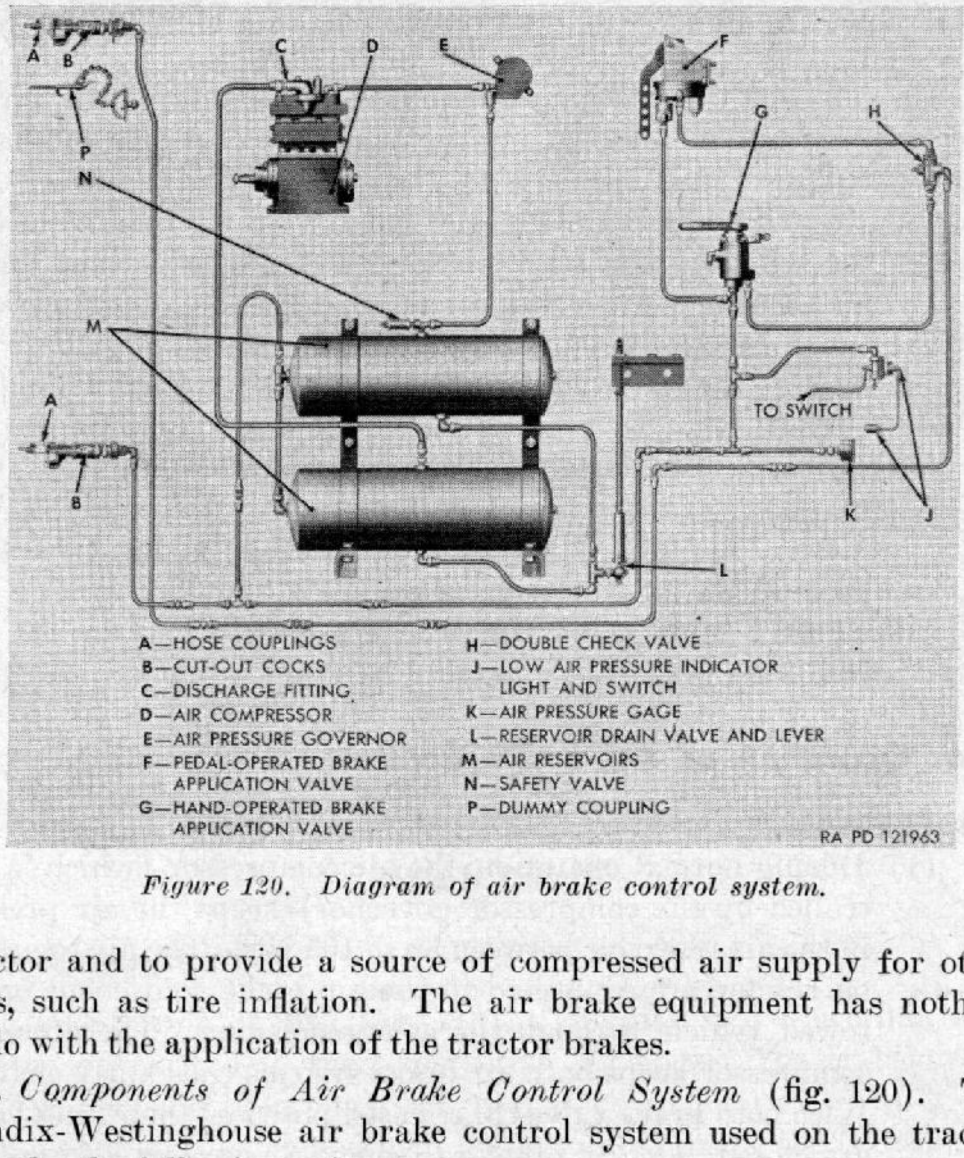


Figure 120. Diagram of air brake control system.

tractor and to provide a source of compressed air supply for other uses, such as tire inflation. The air brake equipment has nothing to do with the application of the tractor brakes.

c. Components of Air Brake Control System (fig. 120). The Bendix-Westinghouse air brake control system used on the tractor includes the following units:

(1) An air compressor with a displacement of 7¼ cfm at a rated speed of 1,250 rpm (1,475 engine rpm).

(2) Two 8 x 26-inch air storage reservoirs.

(3) A compressor governor which controls the air pressure in the air reservoir.

(4) A safety valve which protects the air system against excessive pressure.

(5) An air pressure gage to indicate the air pressure in the reservoir.

(6) Two brake application valves to control the air pressure delivered to the brakes of the trailing vehicle.

(7) A double check valve to permit the use of two brake valves. This valve prevents air pressure from escaping through the exhaust valve of one brake valve when the other brake valve is used to apply the brakes.

(8) Two hose couplings (fig. 5) mounted at the rear of the tractor for convenience in connecting the hose lines to the towed vehicle.

(9) Two cut-out cocks, also mounted at the rear of the tractor, which permits the connecting line to be shut off when not in use.

(10) Two dummy couplings, also mounted at the rear of the tractor, which permit sealing the hose couplings against the entrance of dirt when they are not being used.

(11) A drain cock, mounted in the bottom of the reservoir, which permits the condensation which normally collects there to be drained.

(12) Identification tags, mounted near the hose couplings at the rear of the tractor, to identify the service line and the emergency line. Similar tags are mounted on all vehicles to permit easy identification of connecting lines.

(13) Tubing and fittings which connect the various devices used in the air brake equipment.

196. Operation of Air Brake Controls

a. Operation of System (fig. 120).

(1) During normal operation, the air compressor (which is controlled by the compressor governor) keeps the air pressure in the air reservoir between 85 to 105 psi. The air reservoirs on tractor are connected to the air brake equipment on the towed vehicle through the emergency line. Therefore, the compressor keeps both air brake systems constantly charged. With both brake valves in released position, their inlet valves are closed, and air pressure from the reservoir is prevented from passing through them. As the driver depresses the brake pedal, the brake valve which is connected to the pedal is operated, its exhaust valve closes, and its inlet valve opens. Air then flows through this brake valve to the double check valve, and if necessary, moves the shuttle in the double check valve to a position which blocks off the line leading to the

other brake valve. This permits air pressure to flow through the double check valve and out of service line to the air brake system on the towed vehicle, applying the brake of the towed vehicle. If the hand-operated brake valve is used to apply the brakes, a similar action takes place.

(2) As soon as the air pressure in the service line corresponds to the position in which the driver has set the control mechanism of either brake valve, the inlet valve in the brake valve involved closes. This prevents any further build-up of pressure in the service line, and the brake valve is in its holding position. In other words, it is maintaining a pressure in the service line which corresponds to the amount the driver has moved the brake valve toward its fully applied position. When the driver partially releases the brake valve to apply the brakes, the exhaust valve of the brake valve opens and permits air pressure in the service line to be reduced. If he moves the brake valve to full release position, all air pressure in the service line is exhausted.

(3) Before the brakes will function normally, the brake system on both the tractor and the training vehicle must be charged to at least 70 psi. The air pressure gage on the instrument panel records this pressure, and the driver should always check to be sure this gage registers at least 70 psi before expecting maximum brake performance of the training vehicle.

b. Connecting Trailing Vehicle. When connecting any trailing vehicle to the tractor, be sure the service line and emergency line connections at the rear of the tractor are properly connected to the service and emergency line connections on the trailing vehicle. After this has been done, the cut-out cocks in the emergency and service lines at the rear of the tractor should be opened (handles parallel to lines). When opening or closing these cut-out cocks, the handles must always be turned with the hand and never struck with a hammer or other heavy instrument; otherwise they may be damaged and leakage may develop.

197. Air Compressor

a. Maintenance.

(1) *Air reservoirs.* The air reservoir drain valve must be opened daily and reservoirs drained to remove condensation which normally collects there. Turn handle clockwise (parallel with vehicle) one-quarter turn, drain condensation, and close drain valve after draining reservoirs (fig. 76).

(2) *Compressor air cleaner.* It is very important that only clean air enter the compressor. Entrance of dirt will result in oil passing, loss of compression efficiency, and rapid wear.

Service the cleaner at the same interval as the engine oil bath air cleaners (par. 70). Unscrew wing nut above cleaner cover, and lift filters and cap assembly from body (fig. 121). Wash oil and dirt from body and rinse filter in clean dry-cleaning solvent of volatile mineral spirits. Fill cleaner body to level indicated on body with clean oil as specified

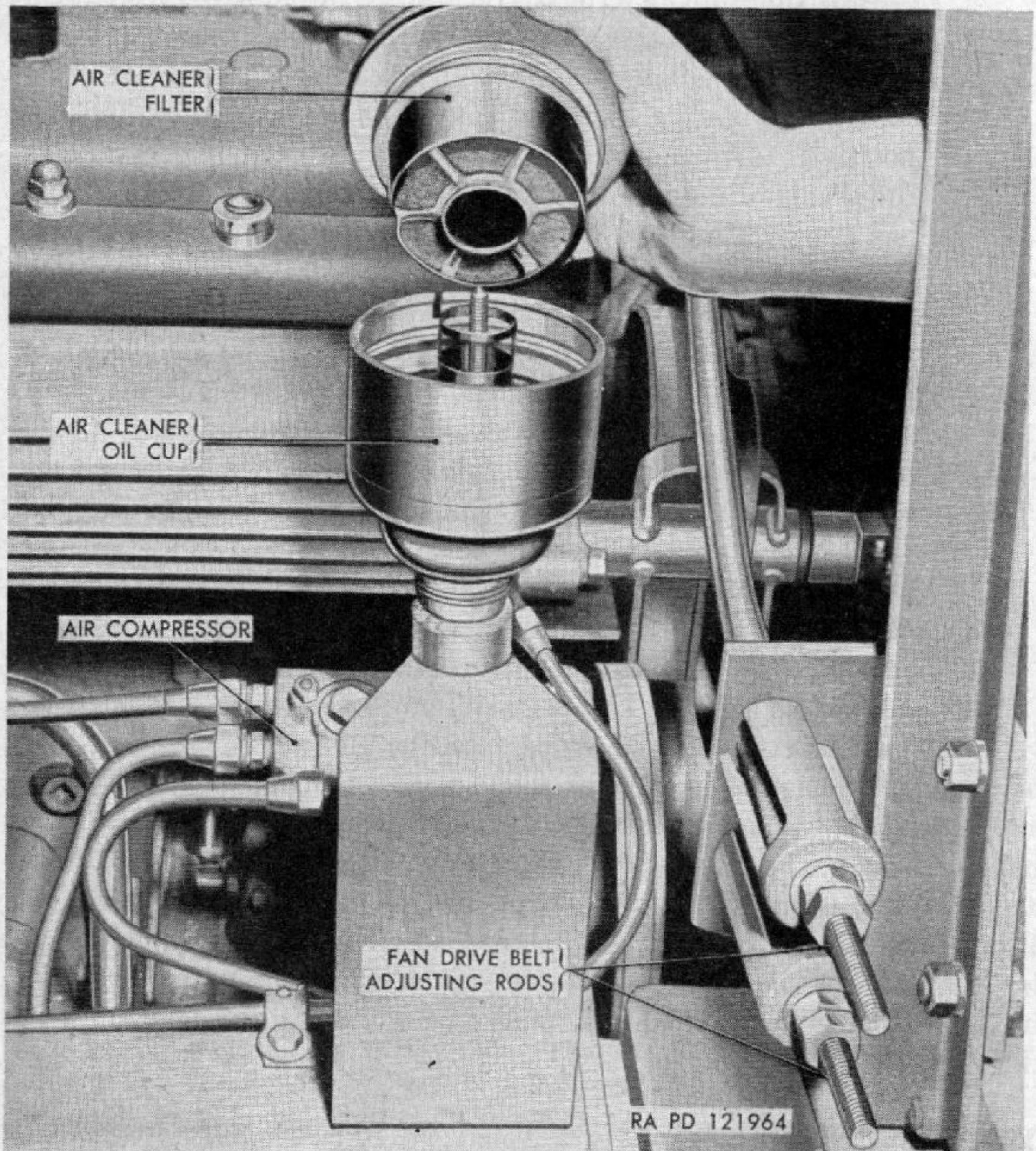


Figure 121. Compressor air cleaner.

on the lubrication order (par. 70); then install filter and cover (fig. 121). Tighten wing nut.

(3) *Unloader valve* (fig. 122). Check the clearance between rocker arms and ends of unloading valve stems in the compressor cylinder head after every 100 hours of operation. This clearance should be 0.010 to 0.025 inch. Use feeler gage to check this clearance and adjust, if necessary, as fol-

lows: Remove four cap screws and remove rocker arm cover. Loosen lock nuts on adjusting screws and turn screws to adjust clearance. Turning the screws counterclockwise increases the clearance; turning them clockwise decreases clearance. After correct clearance is obtained, tighten lock nut. Then check clearance again to determine if clearance changed when lock nut was tightened.

(4) *Compressor discharge pipe.* Remove compressor discharge pipe from air compressor (fig. 122). Remove discharge pipe supporting bracket and remove pipe. Clean pipe of carbon

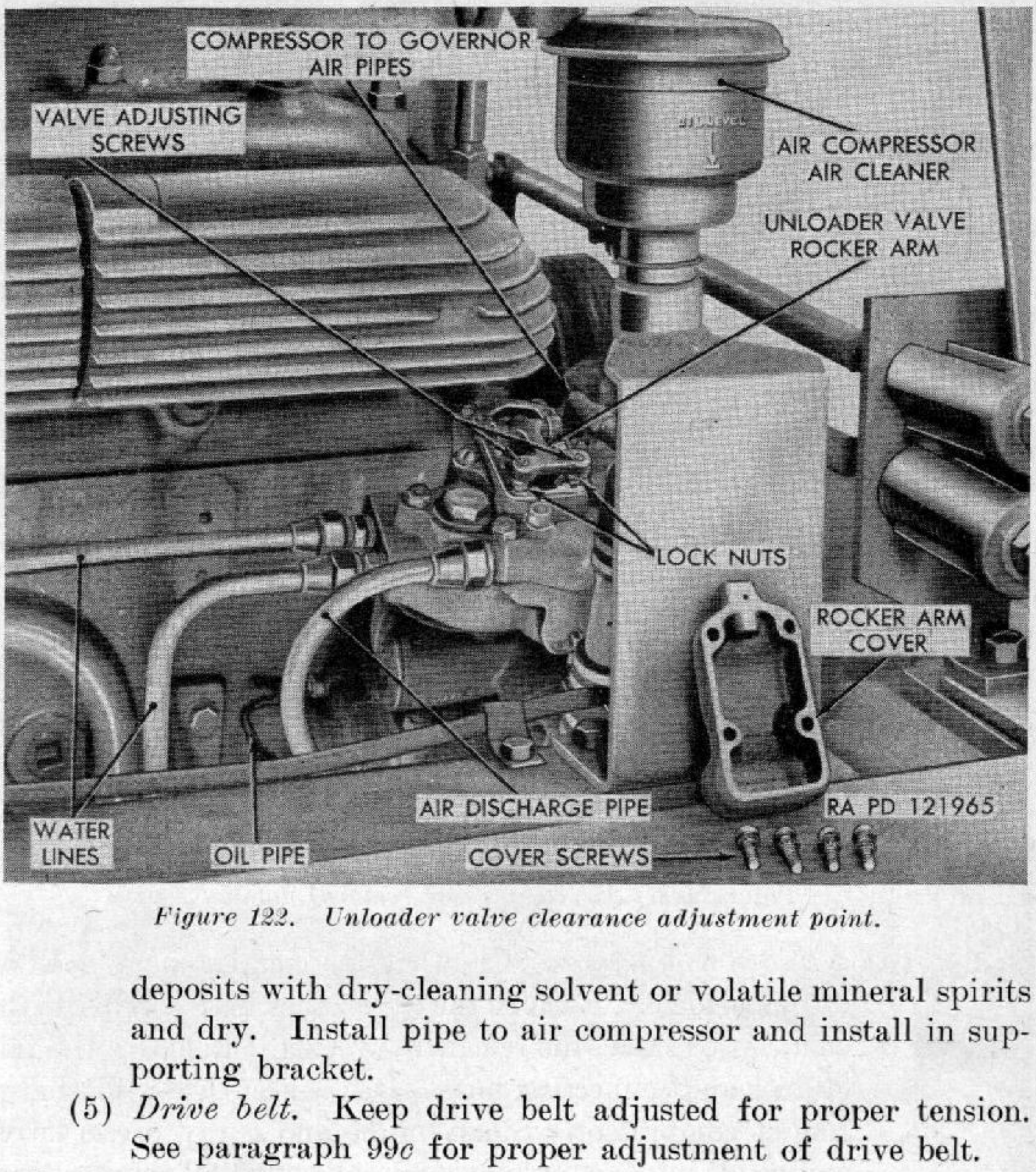


Figure 122. Unloader valve clearance adjustment point.

deposits with dry-cleaning solvent or volatile mineral spirits and dry. Install pipe to air compressor and install in supporting bracket.

(5) *Drive belt.* Keep drive belt adjusted for proper tension. See paragraph 99*c* for proper adjustment of drive belt.

b. Removal.

(1) *For service.* Open engine compartment door on left side of tractor. Drain cooling system of left hand engine (par. 131*a*). Relieve tension on compressor drive belt (par. 99). Disconnect the two water pipes and air pipes from fittings

on compressor head, and disconnect oil pipe from fitting on front end of compressor (fig. 122). Loosen hose clamps on compressor air cleaner connecting hose, and slip hose up on connecting pipe. Remove four cap screws that attach compressor to its mounting bracket, and lift compressor from tractor (fig. 123).

(2) *For storage.* If the primary purpose of the tractor is to tow matériel equipped with electric brakes and air compressor is to be removed to prevent excessive wear in dusty or sandy operations (par. 195*a*) proceed as follows:

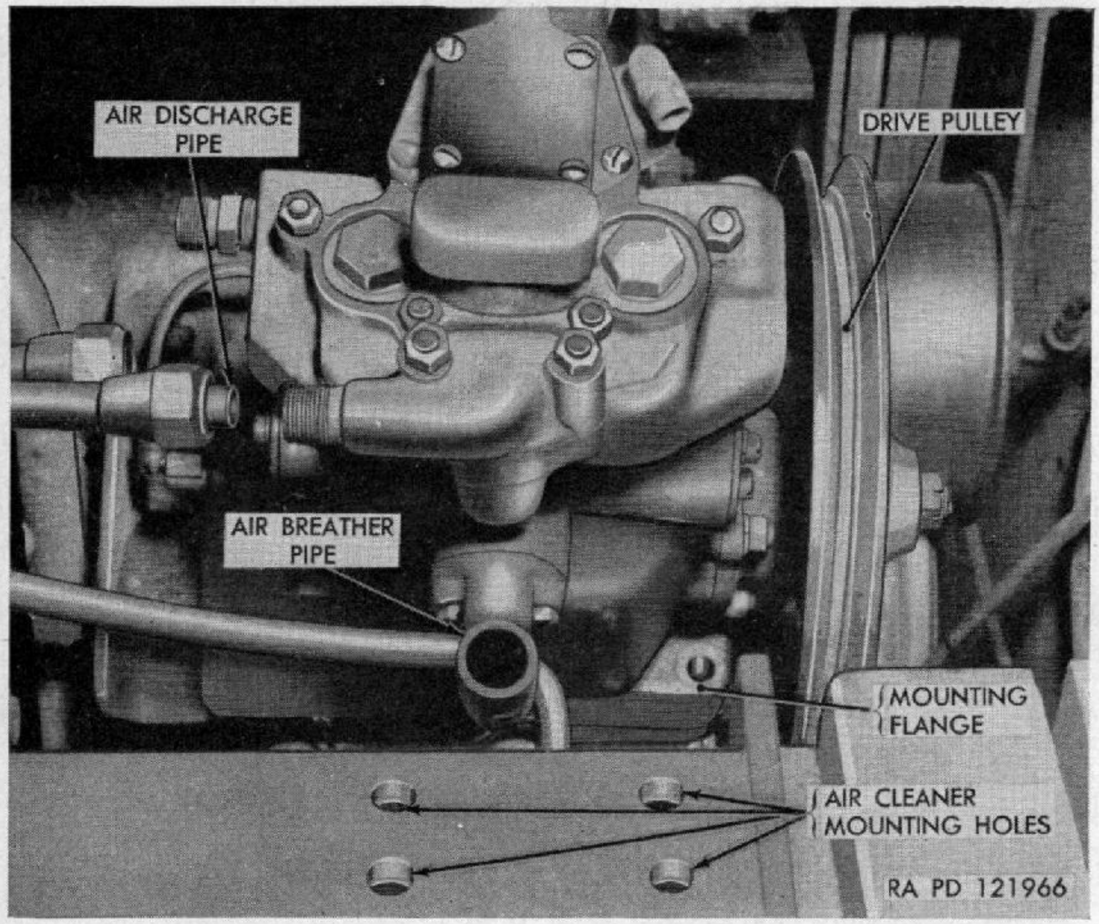


Figure 123. Air compressor removal details.

(*a*) *Remove compressor.* Open engine compartment door on left of vehicle. Remove the air cleaner hose clamps at the compressor and the cleaner bracket. Remove the air cleaner and connecting hose. Disconnect the air discharge line at compressor. Start engine and spray preservative engine oil into compressor air intake until oil coming from discharge line shows no evidence of emulsification. Drain the cooling system of left engine (par. 131*a*). Relieve tension of air compressor belt (par. 99) and remove the compressor belt. Remove oil lines, coolant lines, and remaining air line from compressor. Remove four bolts from the base of the compressor and remove the compressor from the mounting bracket on the engine.

(*b*) *Cap line ends.* Cap lines within engine compartment, using gasket cement to seal the caps, as follows:

1. Water lines. Cover the male pipe end of the compression tube connector with a 3/8-inch brass pipe cap (2 reqd).

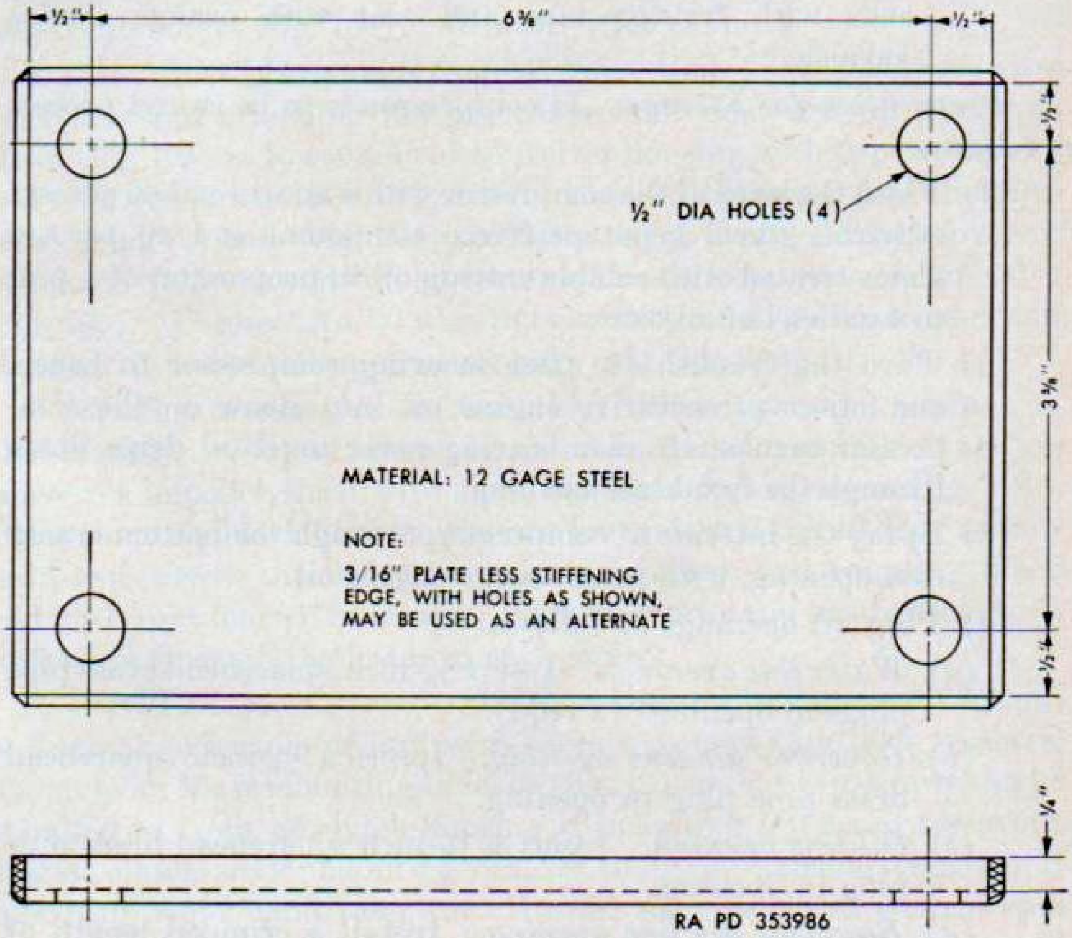


Figure 124. Compressor mounting bracket cover plate.

2. Governor air lines. Remove elbow from compressor and install it in the compression tube nut on end of line. Cover the male pipe end of elbow with a 1/4-inch brass pipe cap.

3. Oil line. Remove elbow from compressor and install in inverted flared tube fitting nut on end of line. Cover male pipe end of elbow with a 1/8-inch brass pipe cap.

4. Reservoir air line. Install a 1/2-inch ball sleeve compression tube connector, having a 3/8-inch male pipe end, in the compression tube nut on end of line and cover with a 3/8-inch brass pipe cap.

(*c*) *Install compressor mounting bracket cover plate.* Fabricate a cover plate as shown in figure 124. Install the cover plate with the air compressor mounting gasket, using liquid type gasket cement to seal the gasket. Bolt the cover plate to the air compressor mounting bracket with the four bolts previously removed.

(*d*) *Test for leaks.* Fill the cooling system (par. 131*b*). Start the engine and inspect all lines for leaks. If any leaks are located, shut off engine and tighten pipe caps or replace defective caps. If no leaks are detected, secure all tube ends with friction tape and coat with orange shellac varnish.

c. Preparation for Storage. If compressor is to be stored process as follows:

(1) Flush the head of the compressor with a mixture of 60 percent ethylene glycol type antifreeze compound and 40 percent water treated with soluble cutting oil in proportion of 1 pint to 4 gallons of mixture.

(2) Turn the crankshaft, after securing compressor to bench, and inject preservative engine oil into elbow on the compressor crankshaft rear bearing cover until oil drips down through the crankcase opening.

(3) Spray the interior of compressor, through the bottom crankcase opening, with preservative engine oil.

(4) Plug all openings as follows:

(*a*) *Water line openings.* Insert ⅜-inch squarehead brass pipe plugs in openings (2 reqd).

(*b*) *Governor air line opening.* Insert a ¼-inch squarehead brass pipe plug in opening.

(*c*) *Oil line opening.* Insert a ⅛-inch squarehead brass pipe plug in opening.

(*d*) *Reservoir air line opening.* Install a crimped length of copper tubing with a ball sleeve compression tube fitting nut and compression tube fitting ball sleeve on the elbow in the compressor. An alternate method is to cover elbow threads and openings with tape. Coat tape with orange shellac varnish.

(*e*) *Crankcase opening.* Cover with tape.

d. Installation. Set compressor in place on mounting pad on engine, place belt on drive pulley, and secure compressor with four cap screws and lock washers. Connect oil line to fitting on front end of compressor. Connect the two water lines and the two air lines to fittings on compressor head (fig. 122). Adjust compressor drive belt as explained in paragraph 99. Tighten lock nut. Fill cooling system (par. 131*b*); then start engine and inspect for leaks at fittings. Check unloader valve clearance; adjust if necessary (*a*(3) above).

e. Air Reservoir Replacement. Open engine compartment door on left side of tractor. Remove the drain valve support bracket. Disconnect air compressor lines and remove the four cap screws from air reservoir supporting bracket holding air reservoirs to hull side (fig. 46). Remove the drain line at bottom of tank and lift out the top air reservoir. Use the same procedure for removing the bottom reservoir. Install replacement air reservoir and connect drain line. Install drain valve levers support bracket to the hull of tractor. Start the left engine and check for air leaks at the connections.

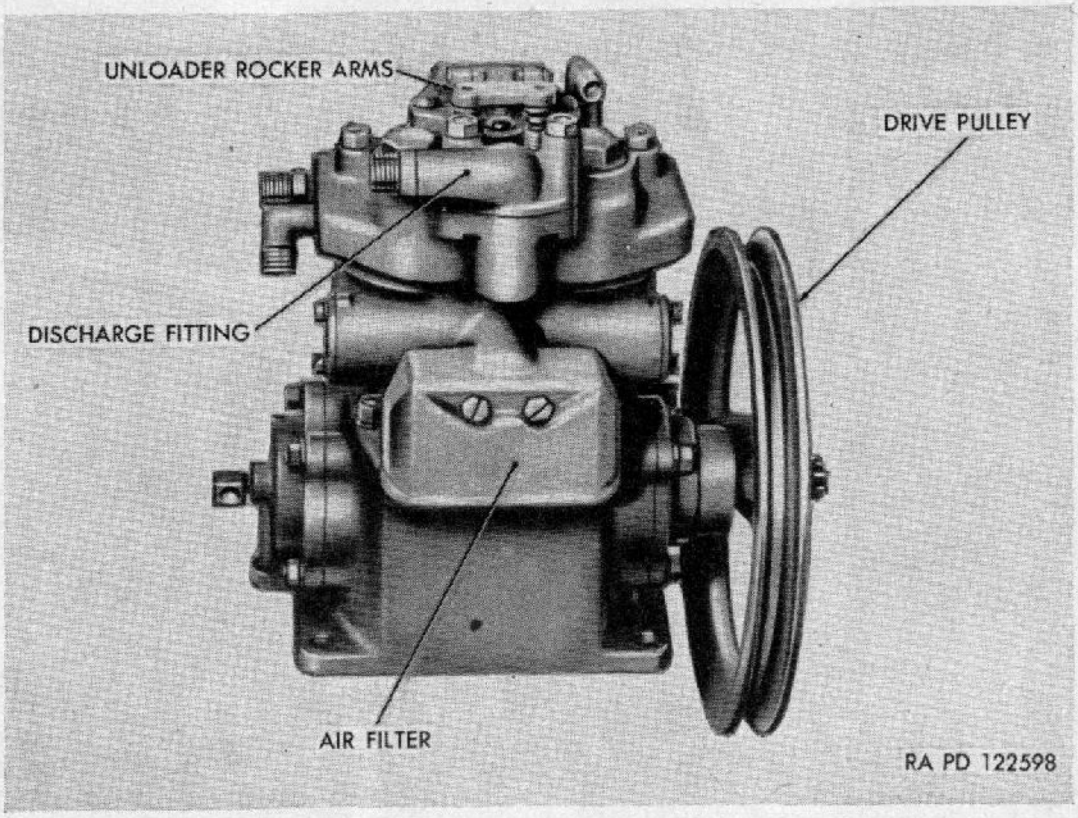


Figure 125. Air compressor removed.

198. Air Pressure Governor Adjustment

a. General. The governor should stop compression of air into the air reservoirs by the compressor when the pressure in reservoirs reaches 105 psi, and should start compression when the pressure drops to 85 psi. The governor should be adjusted if it does not maintain pressures within this range. It is advisable to check the air pressure gage on the instrument panel for accuracy by connecting an accurate gage in the air line before changing governor setting.

b. Adjustment Procedure. Operate engines and build up reservoir air pressure. Observe air pressure gage to see at what pressure the governor cuts out. Then slowly decrease pressure by opening reservoir drain cock or cut-out cock (fig. 120), and observe at what pressure the governor cuts in. To change governor setting, remove four screws from governor cover and remove cover (fig. 126). Loosen lock nut at top of adjusting screw (fig. 126). Turn adjusting screw clockwise to raise cut-in and cut-out pressure setting and turn adjusting screw counterclockwise to lower the pressure setting. After adjustment is made for proper operation of pressure, tighten lock nut and install cover with the four screws.

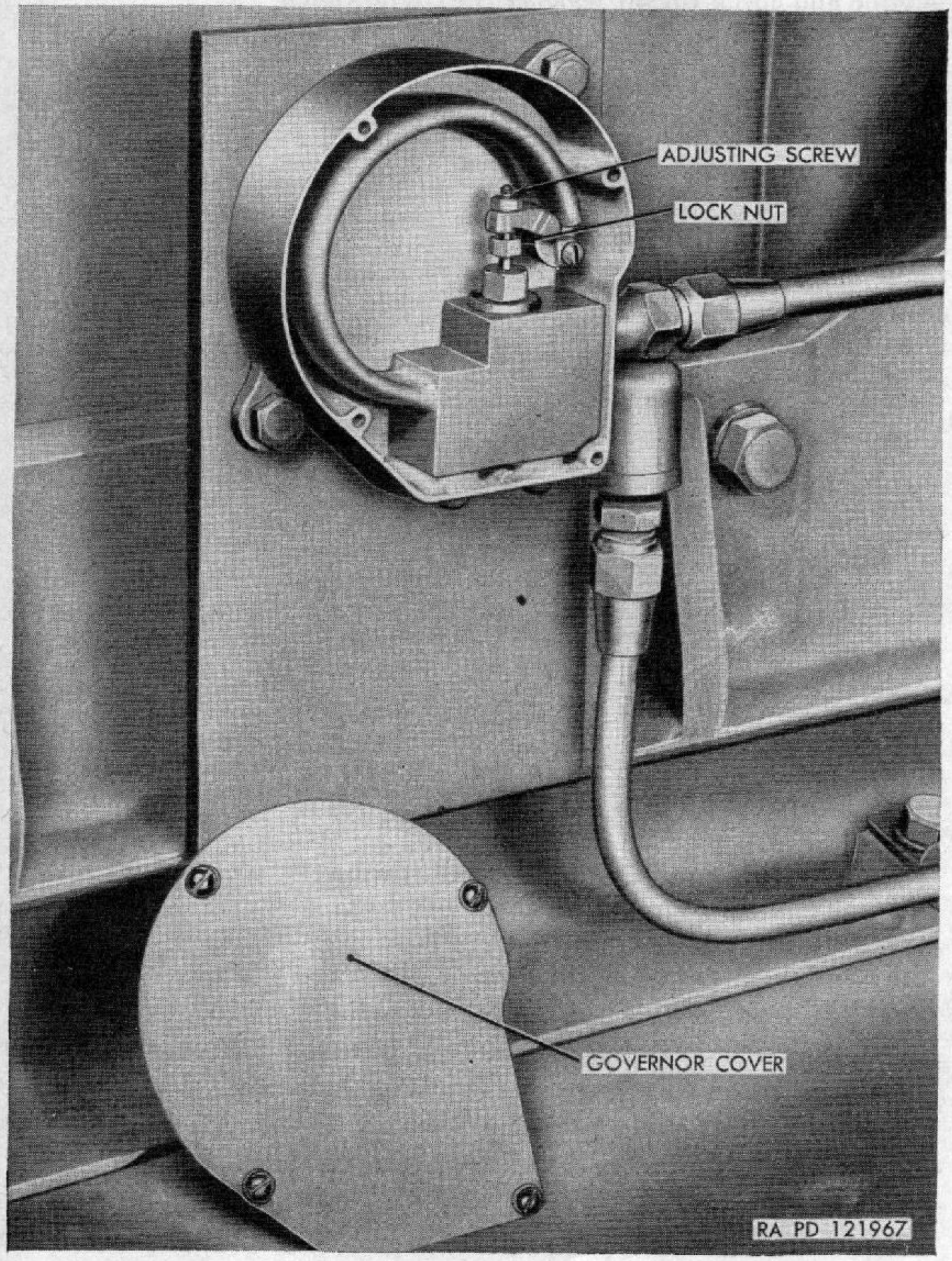


Figure 126. Air pressure governor.

199. Air Brake Application Valves

a. Location of Valves. The hand-operated brake application valve is mounted on the dash to the right of steering levers (fig. 128), and pedal-operated valve is mounted on a bracket ahead of steering levers (fig. 128).

b. Replacement of Hand-Controlled Air Brake Valve. Disconnect both in-let and out-let air lines from fittings on valve. Remove the two cap screws holding valve to dash, and remove valve assembly (fig. 128). Install replacement valve to dash with two cap screws and connect in-let and out-let air lines. Start the left engine and check for air leaks at connections after building up pressure in reservoirs.

c. Replacement of Pedal-Operated Air Brake Valve (fig. 128).

(1) *Remove valve.* Pull cotter pin and remove yoke pin connecting control link to operating lever on valve. Disconnect the two air lines from fittings at bottom of valve. Remove four cap screws holding valve to bracket on dash, and remove valve assembly.

(2) *Install valve assembly.* Secure valve assembly to bracket on dash with four cap screws and lock washers. Connect air lines to fittings on valve. Connect control link to valve operating lever with pin through rod yoke and lower end of lever. Install cotter pin in yoke pin. Operate engine to build up air pressure and inspect connections for leaks.

(3) *Linkage adjustment.* When trailer brake pedal is fully depressed, the air valve operating lever or electric brake controller lever should move its full travel and contact the stops. Adjust for full travel of air valve operating lever by removing pin of the control link from lever. Loosen lock nut and shorten or lengthen link by turning it in or out of yoke ends. When correct adjustment is made, connect link to valve lever and install cotter pin in link pin. Tighten lock nut on links. To adjust full travel of the electric brake controller, remove pin from operating lever, adjust link, and replace pin.

200. Air Brake System Tests

a. Purpose. Tests should be made at each inspection of the tractor to make sure excessive leakage has not developed which might impair the operation of the equipment and to make sure that all devices are functioning normally.

b. Air Pressure Tests.

(1) With the engine running, observe at what pressure, registered by the air pressure gage, the governor cuts out and compres-

sion is stopped. This pressure should be approximately 105 psi.

(2) Observe at what pressure the governor cuts in and compression is resumed while slowly reducing the air pressure in the reservoirs by applying and releasing one of the brake valves. This pressure should be approximately 85 psi.

c. Leakage Tests.

(1) With the brake system fully charged, the engines stopped, and both brake valves in released position, observe the drop in reservoir air pressure registered by the air pressure gage. The drop should not exceed 5 psi in 15 minutes.

(2) With the engines stopped and both brake valves in applied position, observe the drop in reservoir air pressure registered by the air pressure gage. The drop should not exceed 10 psi in 15 minutes.

(3) Check for leaks in lines or connections with soapy water and a clean paint brush.

d. Valve Delivery Pressure Test. Connect an accurate air test gage to the service line cut-out cock. When the trailer brake pedal is depressed to its fully applied position, the air test gage should register full reservoir pressure and the dash air pressure gage should register full reservoir pressure of 105 psi. When the hand-operated brake valve is moved to fully applied position, the air test gage should register at least 60 psi.

e. Operation Tests.

(1) With the tractor connected to an air-braked trailed vehicle, test the operation of the foot-operated brake valve by moving it to its applied position, and check to be sure the brakes on the towed vehicle apply and release properly.

(2) Check the operation of the hand-operated brake valve by moving it to its applied position, and check to be sure the brakes on the towed vehicle apply and release properly.

Section XIX. TRAILER ELECTRIC BRAKE CONTROLS

201. Description

a. General. The Warner electric trailer brake control system consists of a resistor, load control, brake controller, and coupling sockets for attaching cables from the trailed unit to the tractor. These controls are for operation of the brakes on a trailed unit only, and have nothing to do with the operation of brakes on the tractor.

b. Resistor. The resistor reduces the 12-volt electrical system to the required voltage necessary to operate electric brakes. This unit is a resistance coil mounted in the instrument panel. A wire leads from one of the ammeter terminals to one terminal of this unit. Another wire leads from the other terminal of the resistor to a terminal of the load control.

c. Load Control. The load control, mounted on the left instrument panel (fig. 6), allows the driver to regulate the power of the brake to meet varying road or load conditions. A light trailed unit requires less severe application of the brakes than a heavy load. Severity of application is lessened by turning knob of load control to left (counterclockwise) and increased by turning knob to right (clockwise).

d. Brake Controller. The brake controller is mounted on dash ahead of steering levers (fig. 128). Linkage from the trailer brake pedal is connected to a lever on the side of the controller. When the

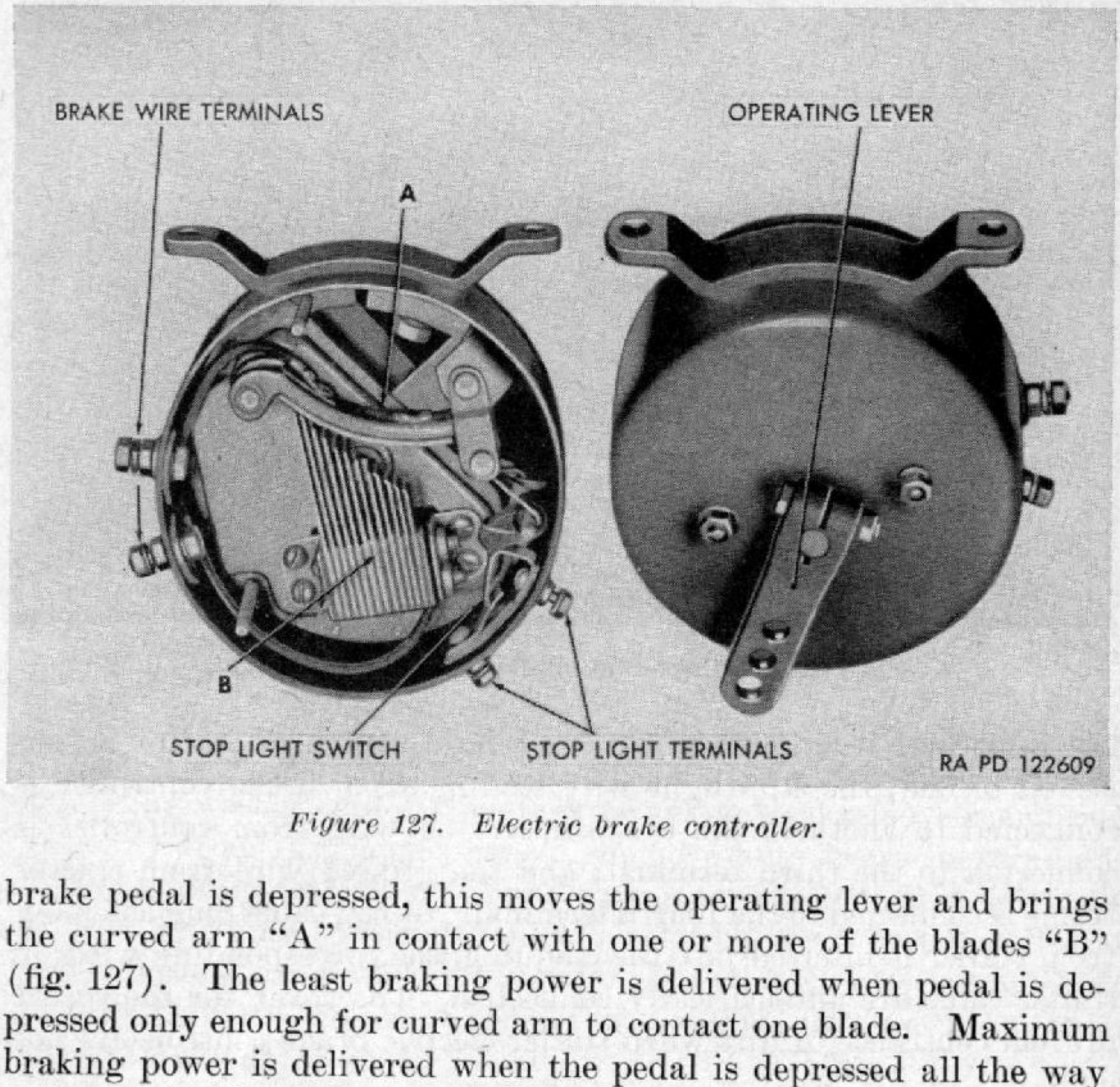


Figure 127. Electric brake controller.

brake pedal is depressed, this moves the operating lever and brings the curved arm "A" in contact with one or more of the blades "B" (fig. 127). The least braking power is delivered when pedal is depressed only enough for curved arm to contact one blade. Maximum braking power is delivered when the pedal is depressed all the way and the curved arm contacts all of the blades. The driver, therefore, can apply any degree of braking power desired. An integral stop light switch in controller operates the trailer stop light when trailer brakes are applied.

e. Coupling Sockets. Two coupling sockets are mounted at the rear of the tractor (fig. 129) and are designed for ready coupling of trailer brake cables. There are four terminals on each socket. The trailer

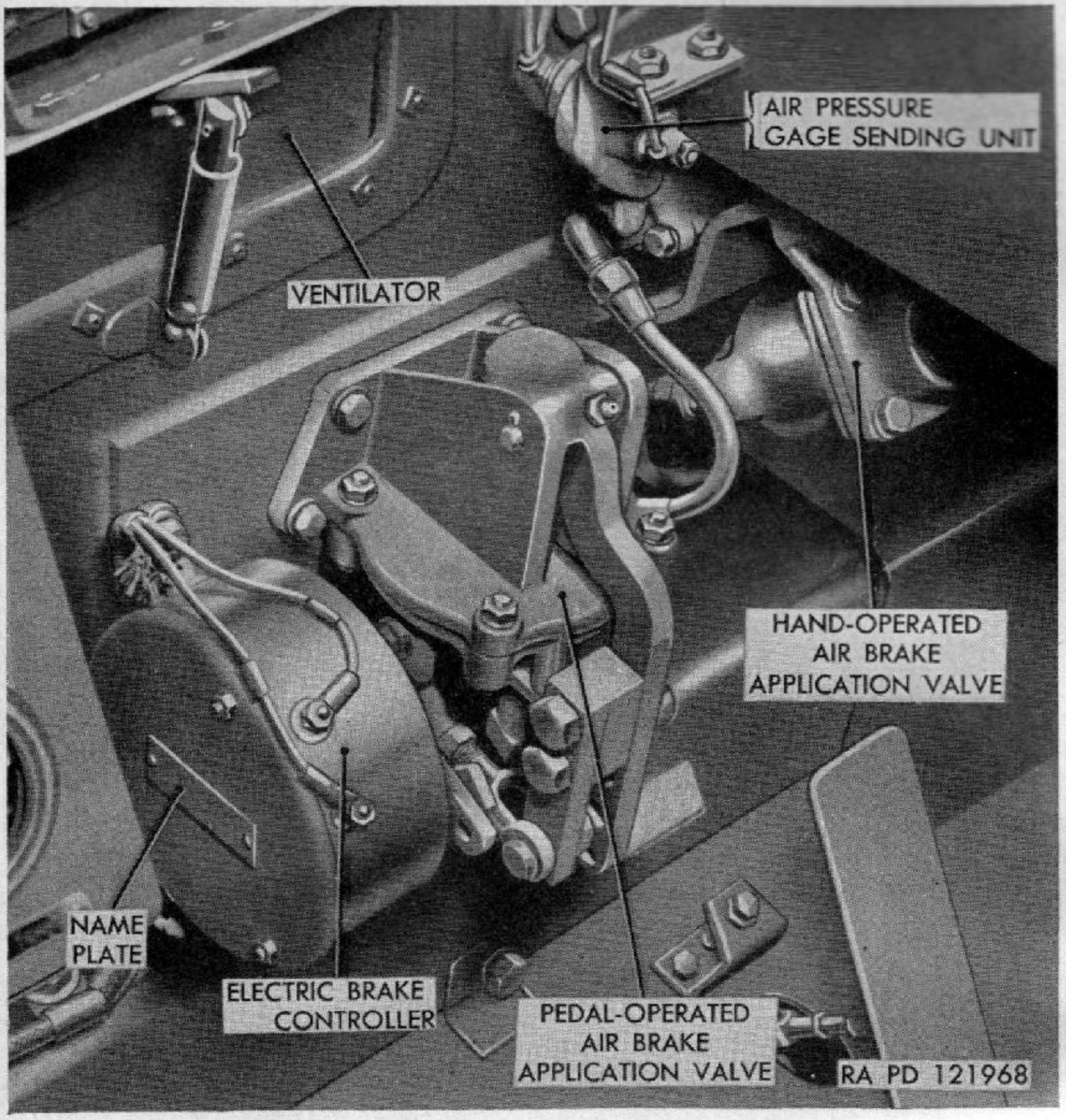


Figure 128. Electric and air brake control units.

tail light wire leading from the main light switch of tractor is connected to one; the stop light wire leading from brake controller is connected to another; the brake operating wire from controller is connected to the third terminal; and the ground wire from tractor frame is connected to the fourth terminal. When cable plug assembly from trailer is inserted into the coupling, the corresponding wires in trailer cable are automatically connected. The cover for the socket prevents entrance of dirt when trailer electric brake controls are not used.

202. Replacement of Control Units

a. Replacement of Resistor Unit (fig. 88). Disconnect main wiring harness from connector socket under the right instrument panel. Remove nut from ammeter terminal on load control unit and left end of wire leading to the resistor. Remove the two screws and lift resistor

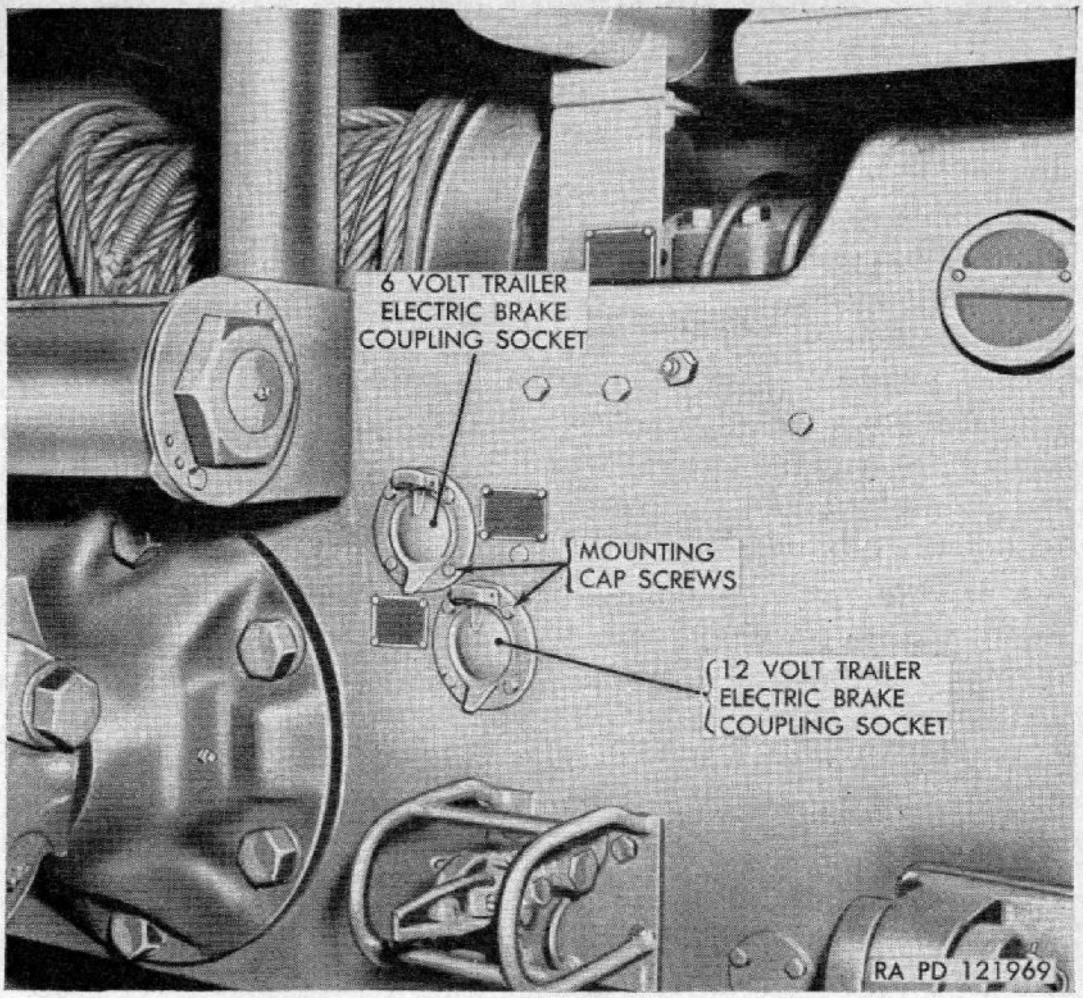


Figure 129. Electric trailer brake coupling sockets.

from panel. Install a new resistor unit on panel with the two screws. Install wire and nut on terminal and connect wiring harness to junction block.

b. Replacement of Load Control Unit (fig. 6). Loosen set screw in side of knob and pull knob off the shaft. Remove mounting nut, insulating washer, and dial plate from shaft; then remove remaining assembly from instrument panel. Remove nuts from the terminals of unit and remove wires. Connect wires to corresponding terminals of new unit, insert shaft through panel from rear, and install dial plate and insulating washer on shaft. Install mounting nut on shaft and tighten nut. Slip knob on shaft and tighten set screw in the knob against flat side of shaft.

c. Replacement of Brake Controller Assembly (fig. 128).

(1) *Remove controller.* Disconnect trailer stop light wires from the two smaller terminals of controller (fig. 128). Disconnect brake wires from the two larger terminals (fig. 128). Pull cotter pin and remove pin from operating lever on controller and link. Remove two cap screws holding controller to bracket on dash and remove unit.

(2) *Install Replacement Unit.* Install unit with two cap screws to bracket. Install pin and cotter pin at operating lever on controller and link. Connect brake wires at the two large terminals and connect trailer stop light wires to the smaller terminals.

d. Replacement of Coupling Sockets (fig. 129). Remove the two upper cap screws and remove cover assembly from socket. Remove the two lower cap screws and pull coupling socket assembly out of bracket. Remove nut and lock washer from center of socket and remove terminal cover. Remove two nuts from each terminal and lift off wires. Install wires on corresponding terminal of new unit as they are removed from old one. Install cover over terminals with nut and lock washer, install socket in bracket, and install socket cover with four bolts and lock washers.

e. Wiring System. Refer to schematic wiring diagrams (figs. 90, 91, 97, and 98) for wiring details of trailer electric brake system. At regular inspection periods, check terminal connections for tightness and defective wires.

Section XX. TRACKS AND SUSPENSION

203. Description and Data

a. Description.

(1) *General description* (fig. 130). The weight of the tractor is carried by 12 dual suspension wheels and 2 trailing idlers. The tractor is supported on these wheels by brackets bolted to the sides and bottom of the tractor hull. Each suspension assembly is equipped with volute springs to absorb road shocks when traveling over uneven terrain or rocks. The trailing idlers are adjustable to maintain correct track tension, and volute springs for the trailing idlers are mounted inside the hull (fig. 134). The suspension wheels and trailing idler wheels roll on the flat inner surfaces of the track blocks. The six track support rollers are mounted to the hull sides. The support rollers support the track as it returns to the drive sprocket. The two steel tracks are driven by two drive sprockets. The drive sprockets are bolted to the final drive hub.

(2) *Tracks.* Each track is made up of 83 steel track blocks. The steel-back, rubber-bushed, double-pin, center-track-guide blocks are 23 inches wide (fig. 130). The three 13-tooth drive sprockets (fig. 133) engage the track link connectors near the end and at the track guide. Each track block is connected by track link connectors and held in position by wedge

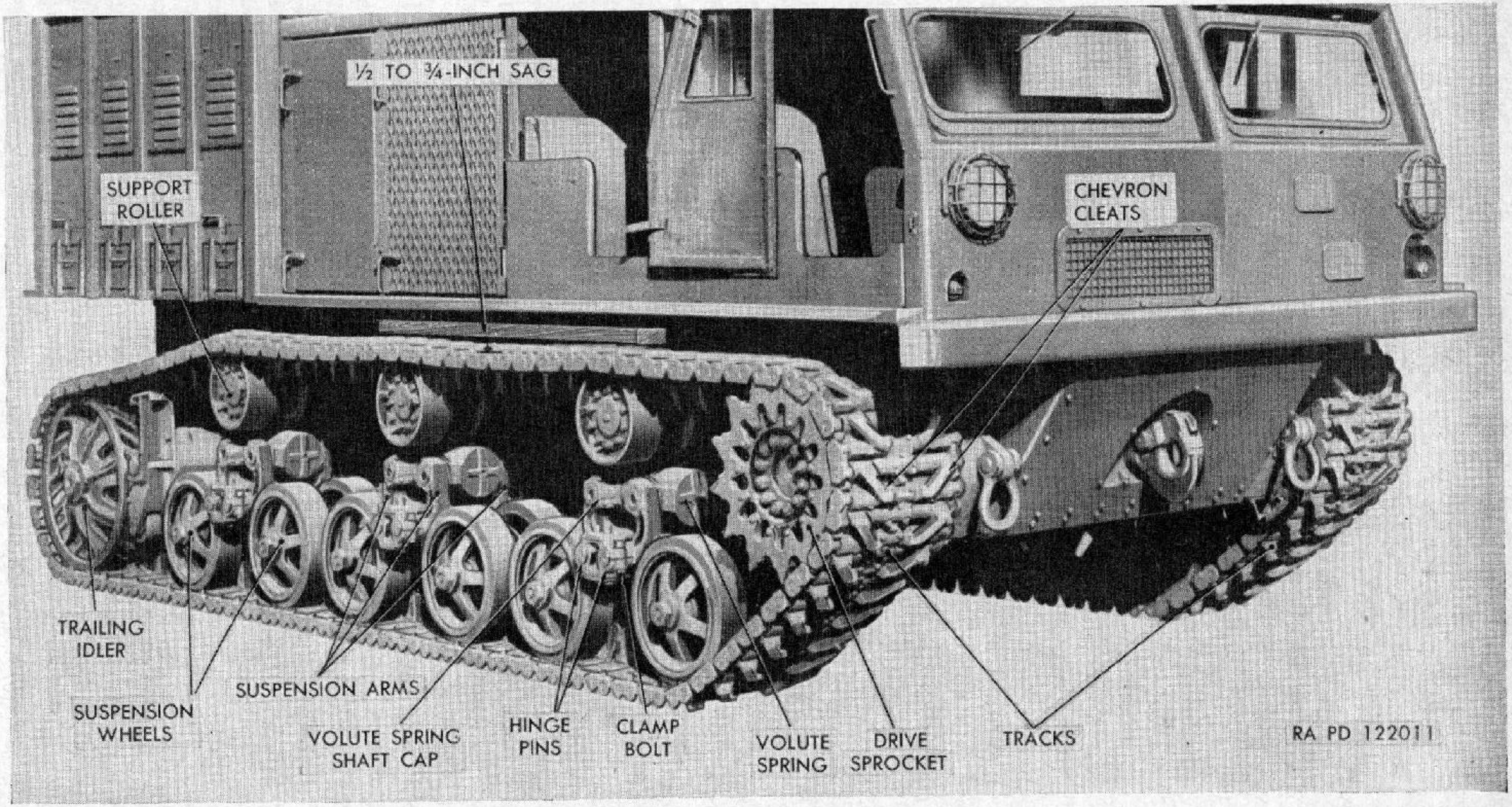


Figure 130. Tracks and suspension.

bolts (fig. 132). When the track link connectors are worn on one side, they may be reversed so the sprocket teeth will wear the other side of each connector and thus more wear from each connector may be obtained. The tracks are not reversible and require no lubrication. Flexing of the track is made possible by the rubber track pin bushings. Chevron cleats welded to the road surface of each track block provide added traction (fig. 130).

(3) *Trailing idlers.* The trailing idlers are double-wheeled assemblies with an eccentric hub for adjusting tension of tracks (fig. 130). Each idler arm oscillates on a hinged shaft to which the arm is keyed. The inner end of the hinged shaft is splined and extends through the side of the hull and through a spring arm which works against the two idler volute springs (fig. 137). The volute springs limit the upward travel of idler arm while the spring arm stop limits the downward travel.

(4) *Suspension wheels and arms.* Each suspension assembly on each side of the tractor consists of dual rubber-tired steel wheels (fig. 130) held in arms which oscillate on hinge pins held in a bracket bolted to the hull bottom and sides (fig. 130). These hinge pins are provided with rubber bushings to decrease wear of the suspension arms and hinge pins. Volute springs are located between and on top of the suspension arms to absorb road shocks and allow the wheels to rise or lower a limited distance when traveling over rough or rocky terrain (fig. 130). The suspension wheels rotate around their axle shafts on tapered roller bearings and are equipped with positive type oil seals to prevent leakage of oil or entrance of dirt.

(5) *Support rollers.* The three steel track support rollers on each side of the tractor are dual-wheeled rollers which support the track as it returns from the trailing idler to the drive sprocket. The support rollers are mounted to the upper side of the hull above each suspension wheel assembly (fig. 130). The support rollers turn on tapered roller bearings and are lubricated at regular intervals (par. 70). Positive type oil seals are used to prevent leakage of oil or entrance of dirt.

b. Data.

Tracks:

Length of track on ground	14 ft 8⅝ in
Width of track shoes	22 in
Number of shoes per track	84
Ground contact area	7,606 sq in
Ground pressure (psi)	(without load) 7.8916
Ground pressure (psi)	(loaded) 9.9916

Trailing idlers:	
Number of wheels	(each side) 1
Number of volute springs	(each side) 2
Type of wheels	(dual) steel
Bearings	Tapered rollers
Suspension wheels and arms:	
Number of wheels	(each side) 6
Number of arms	(each side) 12
Number of volute springs	(each side) 6
Type of wheel	(dual) Rubber-tired
Bearings	Tapered rollers
Support rollers:	
Number of rollers	(each side) 3
Type of rollers	(dual) steel
Bearings	Tapered rollers

204. Tracks

a. Maintenance. Keep wedge bolts drawn tightly (fig. 132). Inspect track guide (fig. 132) and track guide cap (fig. 133) for tightness and wear. Tighten loose cap screws or replace track guide if worn. Check adjustment of tracks periodically, as described in *b* below, and adjust as required. If track shoes appear to be wearing more on one end of the shoes than on the other, switch tracks to opposite sides of tractor. Thus more wear will be obtained from the tracks. Inspect track link connectors for wear or damage. Reverse or replace worn or damaged track link connectors. Replace track blocks if the chevron cleats are worn or damaged.

b. Adjustment. The tracks are correctly adjusted when there is ½- to ¾-inch sag between the support rollers when tractor is standing on level ground. Move tractor forward until the flange hole in wheel is in line with the socket in the eccentric hub (fig. 131). Insert bar 41–B–326–325 through trailing idler flange hole and into socket in the eccentric hub (fig. 131). Install bar 41–B–326–125 at rear of idler wheel, placing the hooked end of bar on the outside flange of wheel and between two track link connectors (fig. 131). This bar will prevent the track from sliding around the idler wheel when the tractor is moved. Loosen the two clamp bolts at rear end of trailing idler arm (fig. 139). To tighten track, move tractor forward slowly. This will cause the eccentric hub to turn downward in the idler arm, thus forcing the idler wheel to the rear to take up the slack in the track. To loosen track, move tractor rearward slowly. This will cause the eccentric hub to turn upward in the idler arm, thus forcing the idler wheel toward the front to release track tension. After the correct tension has been obtained, tighten the two clamp bolts and remove the adjusting bars. When the socket in the hub is directly forward from center, the idler wheel is moved back as far as possible, and when it is directly back from center of hub, it is moved ahead as far as possible. If, when adjusting

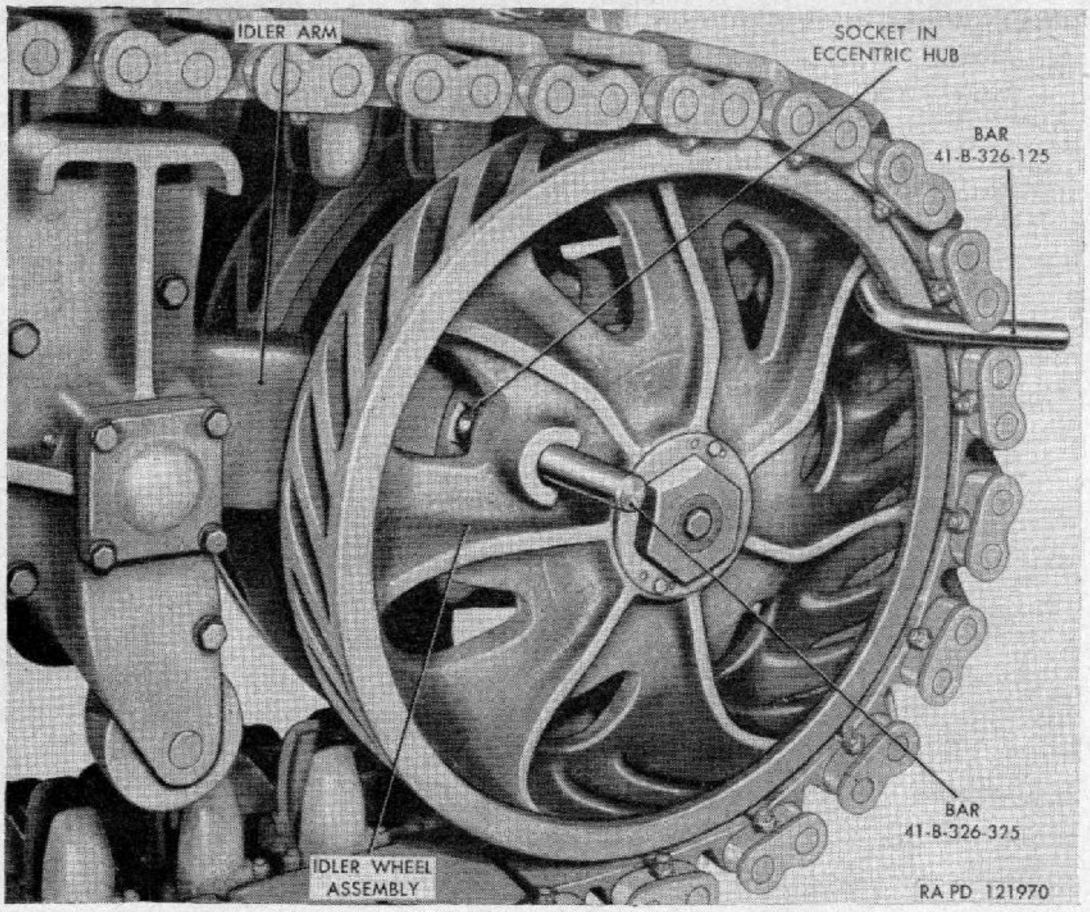


Figure 131. Track adjustment.

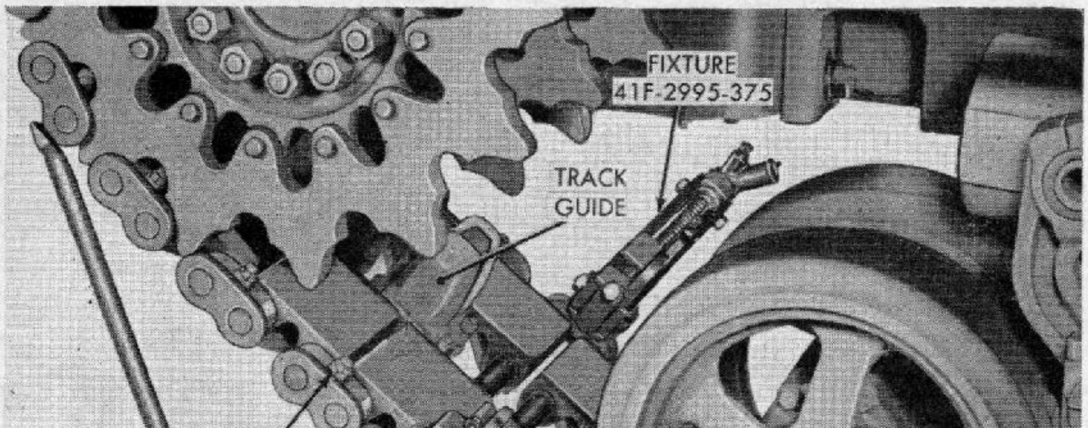


Figure 132. Removal of track link connectors.

the track, the eccentric has been turned until the socket is straight forward from center of hub and the track is still not tight enough, turn the hub on around until the socket is straight back from center of hub (to loosen the track) and remove one track block. Reconnect track and proceed as before, to adjust track for proper tension.

Note.—The correct operating position of the eccentric is with the socket always within the half circle above a line drawn through center of idler arm hinge shaft and center of hub.

c. Removal. Loosen track to secure maximum possible slack (*b* above). Remove five cap screws from track guide (fig. 132) midway

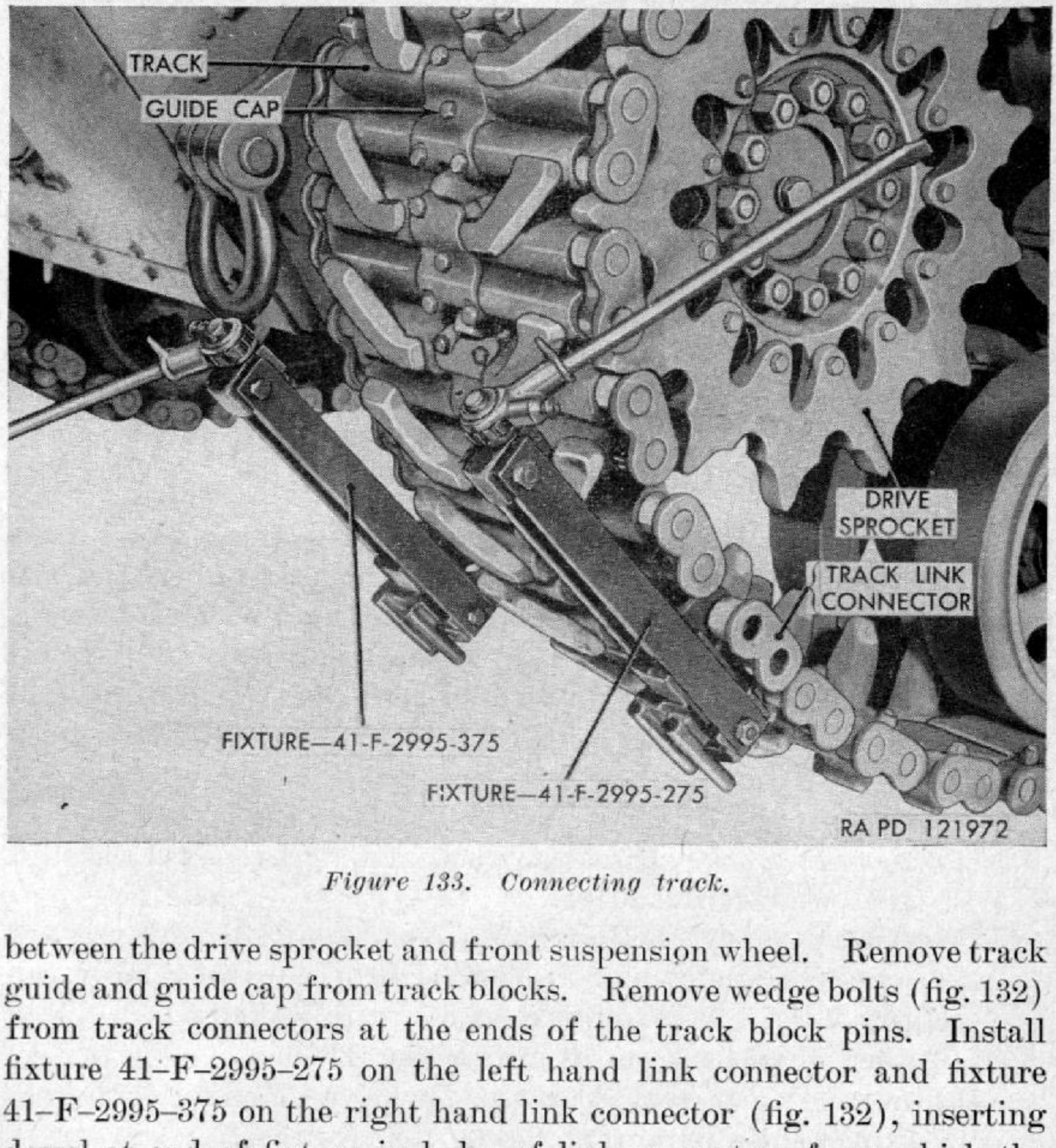


Figure 133. Connecting track.

between the drive sprocket and front suspension wheel. Remove track guide and guide cap from track blocks. Remove wedge bolts (fig. 132) from track connectors at the ends of the track block pins. Install fixture 41–F–2995–275 on the left hand link connector and fixture 41–F–2995–375 on the right hand link connector (fig. 132), inserting dowel at end of fixture in holes of link connectors from which the wedge bolts were removed. Pull connectors from ends of track block pins by turning fixture handle counterclockwise. After disconnecting track, drive tractor backward slowly until end of track falls off trailing idler to ground. If a new track is to be installed, lay new track behind one removed, and drive tractor backward onto new track.

d. Installation. Drive tractor backward until two track blocks are beyond the front suspension wheel. Place a 4- x 8-inch wood block on each side of tractor between two track guides and in front of the second suspension wheel. This procedure will keep the tractor from moving forward. Install a long heavy rope or cable around ends of track block pins at rear track block, and lay the rope or cable over the track support rollers. Attach the free end of rope or cable to the drive sprocket. Shift transmission in low gear and run engines slowly. The drive sprocket to which the rope or cable is attached, will rotate while the other drive sprocket with track installed will not rotate. As the drive sprocket rotates, the track will be pulled up around the trailing idler, support rollers, and drive sprockets. After track is engaged by the sprockets, remove rope or cable and operate tractor until ends of track are close enough to be connected. Install fixture 41–F–2995–275 and 41–F–2995–375 at ends of track block pins and turn fixture handles clockwise until link connectors can be installed onto ends of pins (fig. 133). After connectors are started on pins. remove fixtures and drive connectors onto pins. Install and tighten both wedge bolts (fig. 132). Install track guide (fig. 132) and guide cap (fig. 133) with five cap screws and lock washers. Adjust track tension (*b* above).

205. Trailing Idler Components

a. Maintenance. Keep idler wheels alined with tracks at all times to prevent excessive wear of track guides and insides of idlers and suspension wheels. Idler wheel arm clamp bolts (fig. 139) must be tight to maintain proper alinement. Inspect shaft plug (fig. 138) for oil leaks and tightness. Tighten or replace shaft plug gasket if oil leak is observed. Lubricate idler wheel and idler hinge shaft at regular intervals (par. 70).

b. Removal.

(1) *Remove track.* Discount track and remove until clear of idler wheel (par. 204*c*).

(2) *Remove idler wheel assembly from arm.* Remove the two clamp bolts and nuts from idler arm cap and remove cap (fig. 134). Mark top end of cap with center punch. Roll idler wheel back out of arm (fig. 134).

(3) *Remove idler arm assembly.* Remove ammunition box as explained in paragraph 214*a*. Remove the four cap screws from hinge shaft cap (fig. 134) and remove cap. Straighten lock washer and remove cap screw and lock washer from end of shaft (fig. 135). Remove thrust washer from dowels. Remove the four cap screws that attach bearing bracket to idler support bracket (fig. 135), and slide the bracket off hinge shaft (fig. 136). Remove snap ring from inner end

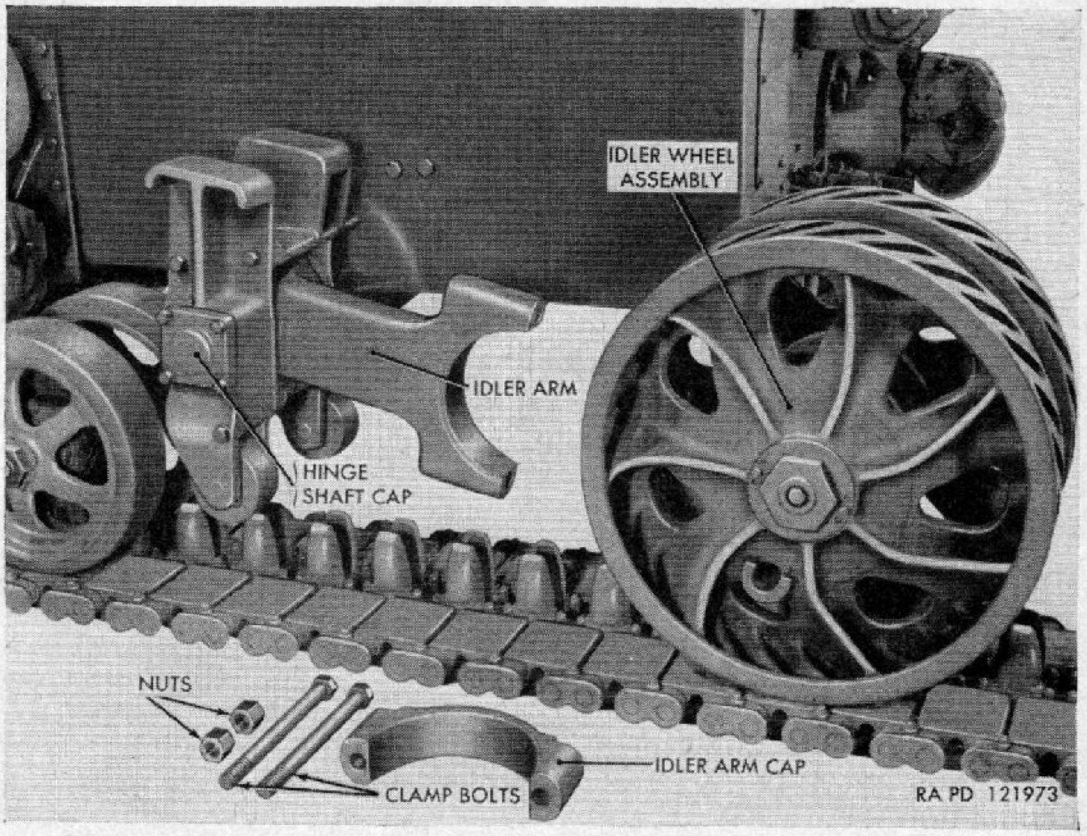


Figure 134. Trailing idler wheel removed.

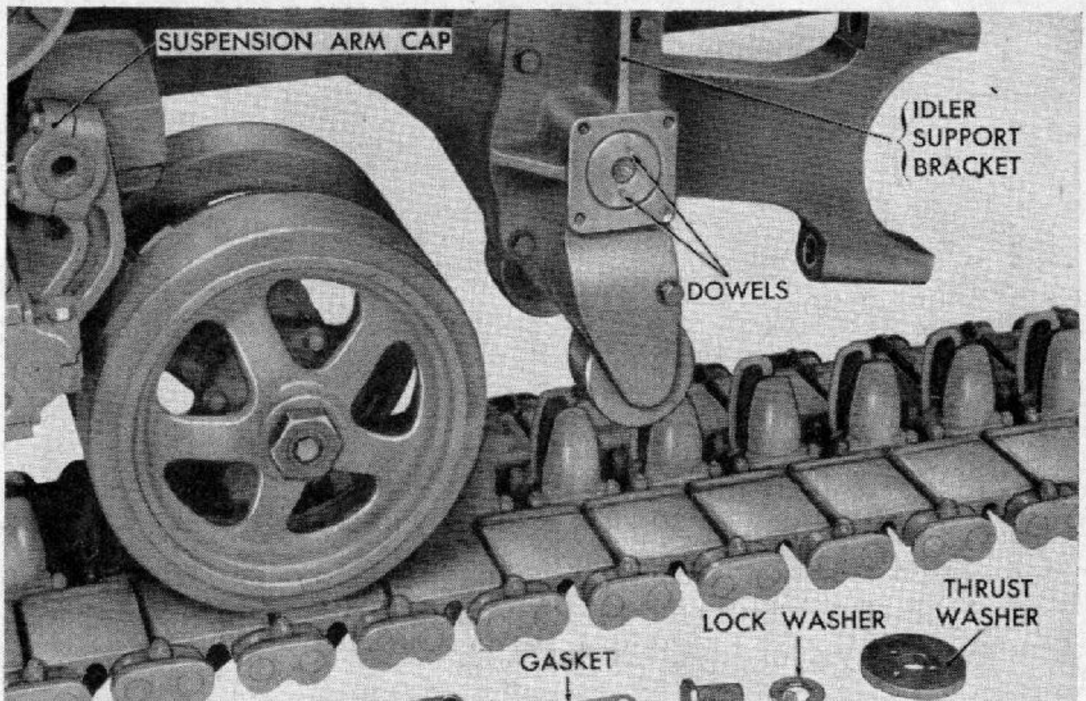


Figure 135. Hinge shaft bearing bracket removal.

of shaft (fig. 137). Screw puller 41–P–2957–100 into tapped hole in outer end of shaft (fig. 136). Operate sliding ram of puller and pull shaft out of spring arm and support bracket. The idler arm will be lifted away from tractor with the shaft. Remove hinge shaft bearings and oil seals if worn or if oil leaks are observed after shaft is removed from idler arm.

(4) *Remove trailing idler volute spring.* Remove the six attaching cap screws from the spring front seat (fig. 139), and lift volute spring assembly from tractor.

Note.—If replacement of the volute springs only is necessary, the idler wheel and hinge shaft need not be removed.

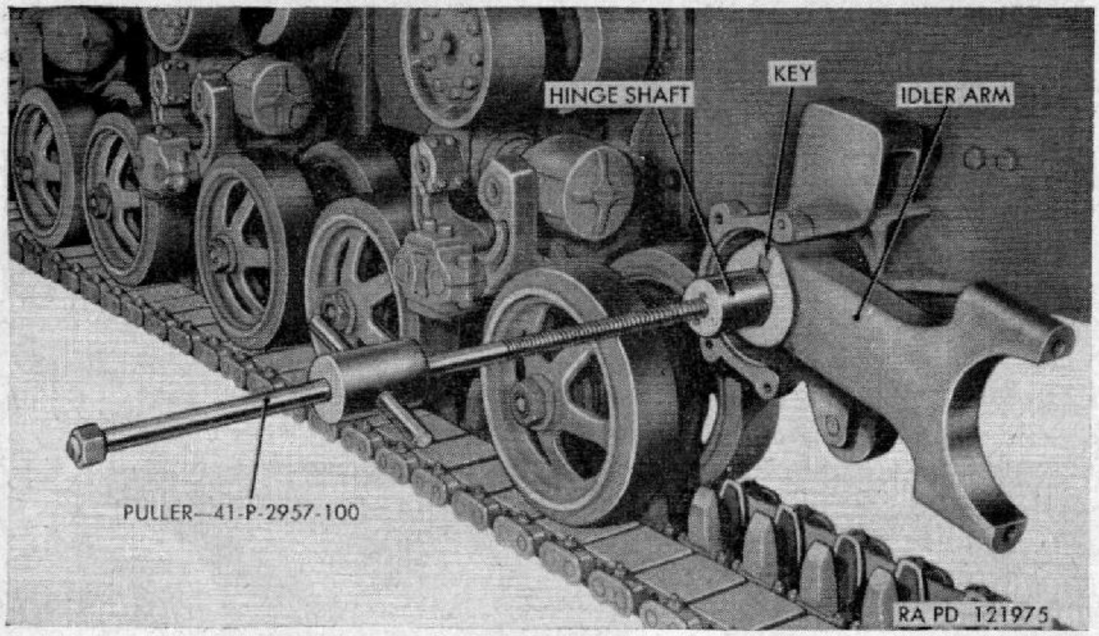


Figure 136. Removal of idler arm and hinge shaft.

Remove the ammunition box (par. 214), then proceed as follows: Raise trailing idler wheel with jack until spring arm inside hull is away from its stop (figs. 137 and 139). Remove the two attaching bolts from idler spring arm stop and remove stop (fig. 139). Lower idler wheel; then raise rear end of tractor until idler arm drops as far as possible. Turn bellcrank at top of spring arm up and over. Then remove the six cap screws that attach spring front seat to bracket in hull (fig. 137), and maneuver spring front seat assembly out of bracket.

c. Installation.

(1) *Install volute spring assembly.* Place volute springs over spring rear seat bolts (if the springs and seats were disassembled), insert ends of bolts through spring front seat and install the spring adjusting nuts until the distance between

end of bolt and side of nut away from end of bolt is 3⅜ inches and the side of nut toward end of bolt on upper spring is 3⅜ inches. Install and tighten the two lock nuts (fig. 137). Install springs and seat assembly on bracket in hull with six cap screws and lock washers.

Note.—If installing volute spring assembly only, the rear of tractor must be raised with jack until assembly is installed. Then the bell-crank at top of spring arm must be turned so that the idler spring arm stop can be installed with two bolts (fig. 137). Lower rear of tractor.

(2) *Install idler arm and spring arm* (figs. 134 and 139). Make sure the oil seals in support brackets and hinge shaft outer

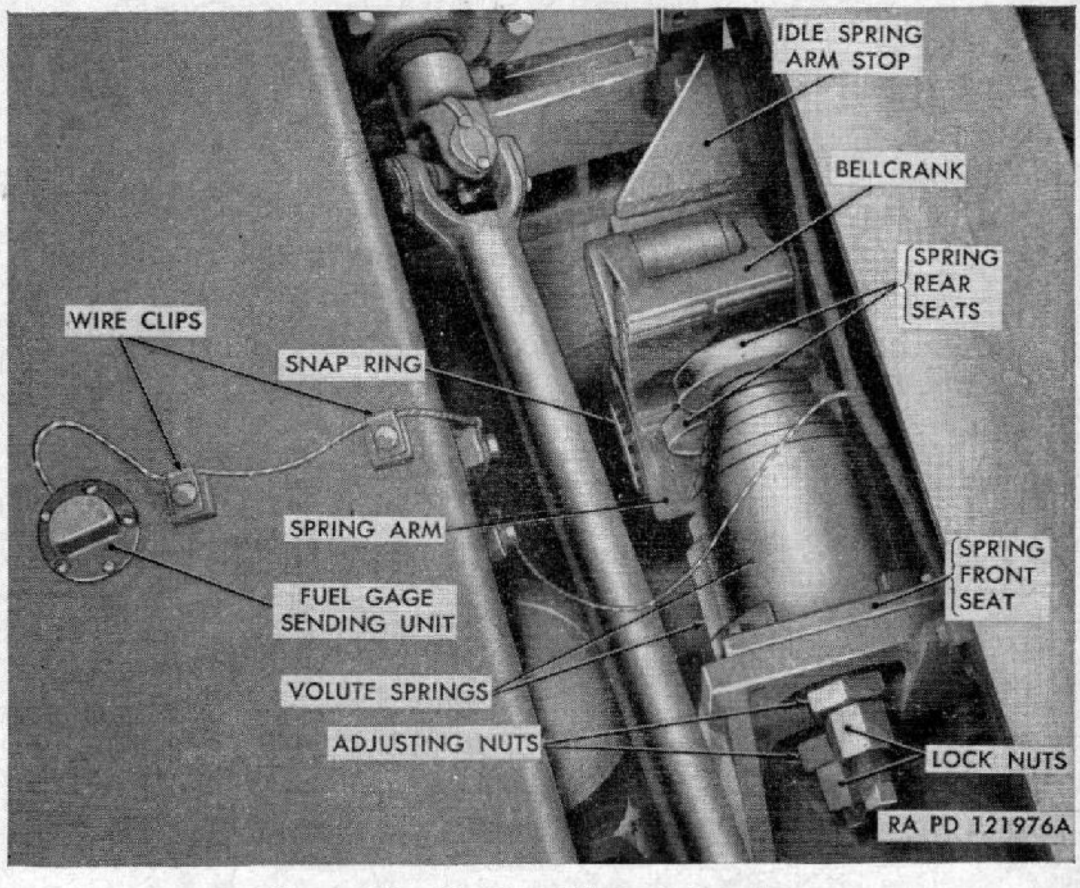


Figure 137. Trailing idler volute springs.

bearings are in good condition. If they are not, install new seals with lip of seal in bracket facing out and lip of seal in outer bearing facing inner side of bearing (fig. 138). Place spring arm in position in hull; then start splined end of idler hinge shaft through hull and into the spring arm, being careful not to damage lip of the oil seal. The spring arm must be held at right angle to the idler arm (fig. 137); use wood block or soft iron against end of hinge shaft while driving shaft into place. Install snap ring (fig. 137) in groove in end of shaft. Install bearing bracket on end of

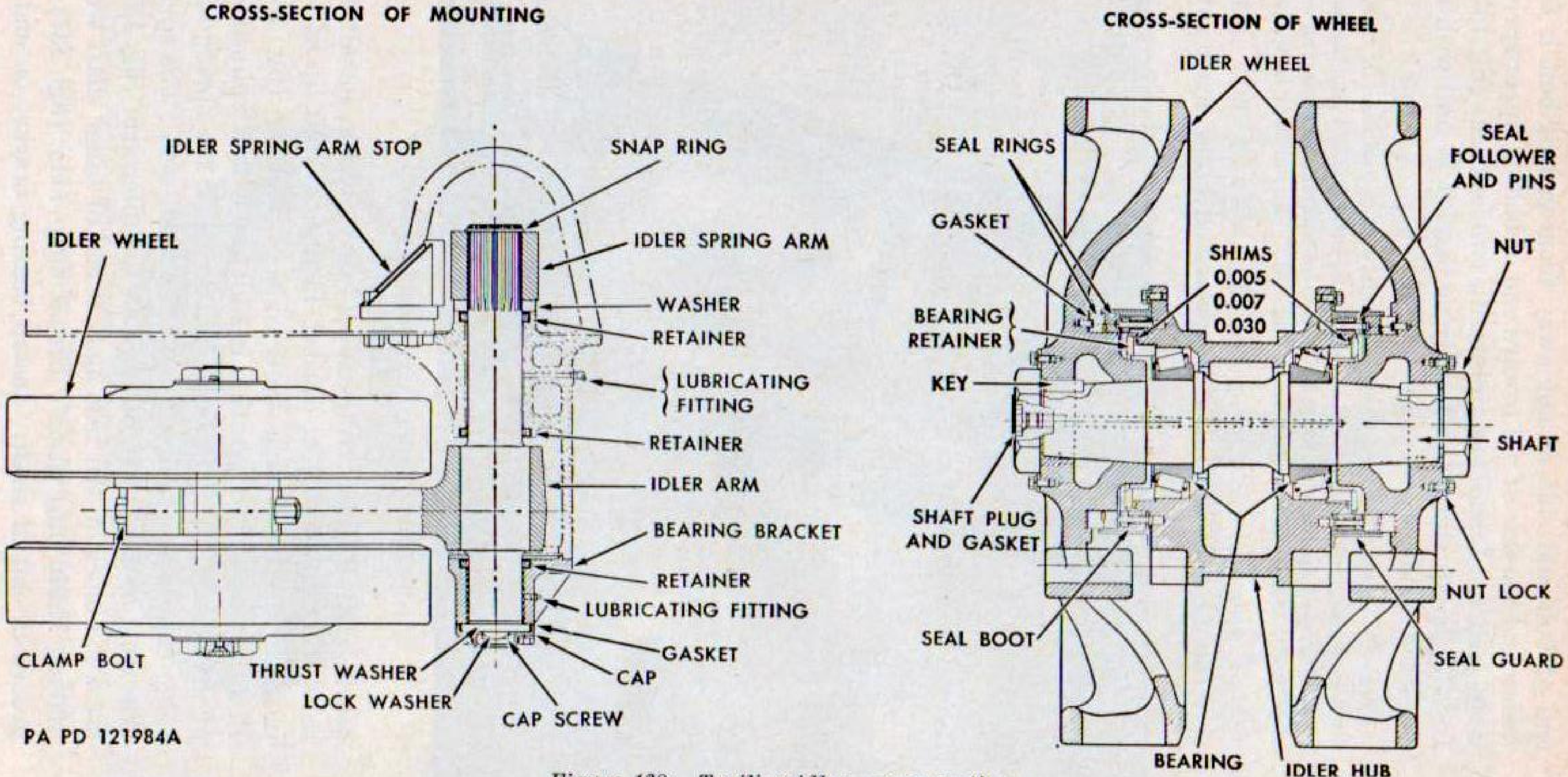


Figure 138. Trailing idler—cross section.

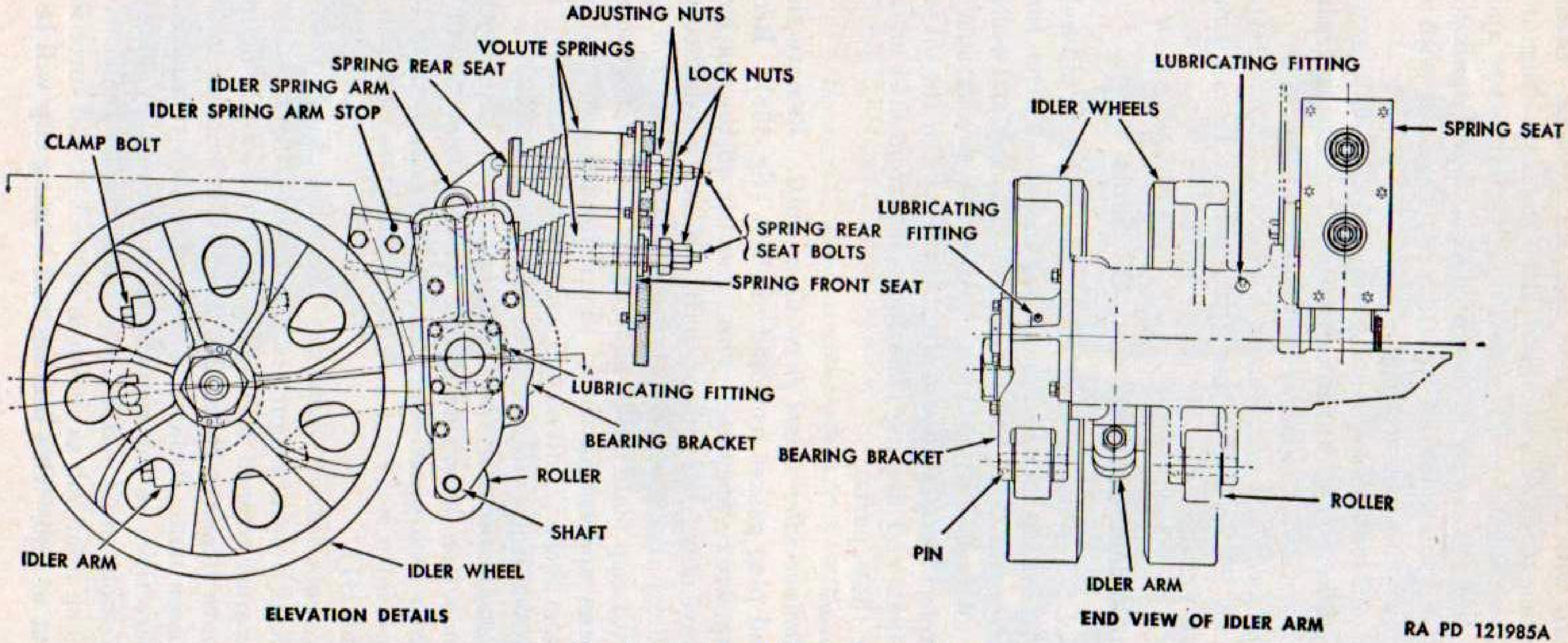


Figure 139. Trailing idler assembled.

shaft with four cap screws and lock washers. Install thrust washer on dowels in end of shaft (fig. 135); then install cap screw with flat lock washers. Tighten cap screw and prevent it from loosening by bending lock washer against one side of cap screw head. Install cap and gasket with four cap screws and lock washers (fig. 135).

(3) *Install idler wheel assembly* (fig. 134). Roll idler wheel into semicircle at end of idler arm and install cap (marked end up) with the two large clamp bolts and nuts.

(4) *Connect track and install ammunition box.* Install track (par. 204*d*) and adjust (par. 204*b*). Install ammunition box (par. 214*b*).

206. Idler Wheel Bearings and Oil Seals

a. General. The replacement of the bearings and oil seals should not be attempted without first removing the wheels from the tractor. Special tools required for disassembly and assembly and a clean working space must also be provided. Adequate precautions must be taken to protect the precision machined surfaces of the oil seal rings, bearing rollers, and bearing cups and cones from dust or dirt while assembling these parts.

b. Removal.

(1) *Remove idler wheel from idler shaft.* Remove shaft plug and plug gasket from end of shaft (fig. 138). Remove two cap screws from each wheel and lift off the nut locks. Remove nuts from ends of shaft. Mount suspension wheel and idler puller assembly 41–P–2905–67, as shown in figure 140, with step plate puller adapter 41–A–18–252 between forcing screw and end of shaft. Turn forcing screw to pull wheel from shaft. Pull second wheel in same manner. The outer oil seal rings will remain on wheels (fig. 147).

(2) *Remove oil seal rings and followers.* Remove outer seal rings from inner side of idler wheels. Remove six cap screws from each guard and remove seal guards from idler hub. Lift inner seal rings and spring followers from hub (figs. 138 and 147).

(3) *Remove bearing retainers.* Using unlocking tool 41–T–3380–25, as shown in figure 142, unlock bearing retainers. Using retainer wrench 41–W–3336–485, as shown in figure 143, remove retainers from idler hub. Use hammer on wrench to loosen nut. Remove shims under each retainer and tie or wire them to the retainer from which they were removed.

(4) *Remove shaft and bearing.* Install gear puller 41–P–2910–50 on idler hub as shown in figure 144, and force idler shaft out of hub. One bearing and bearing cup will be removed

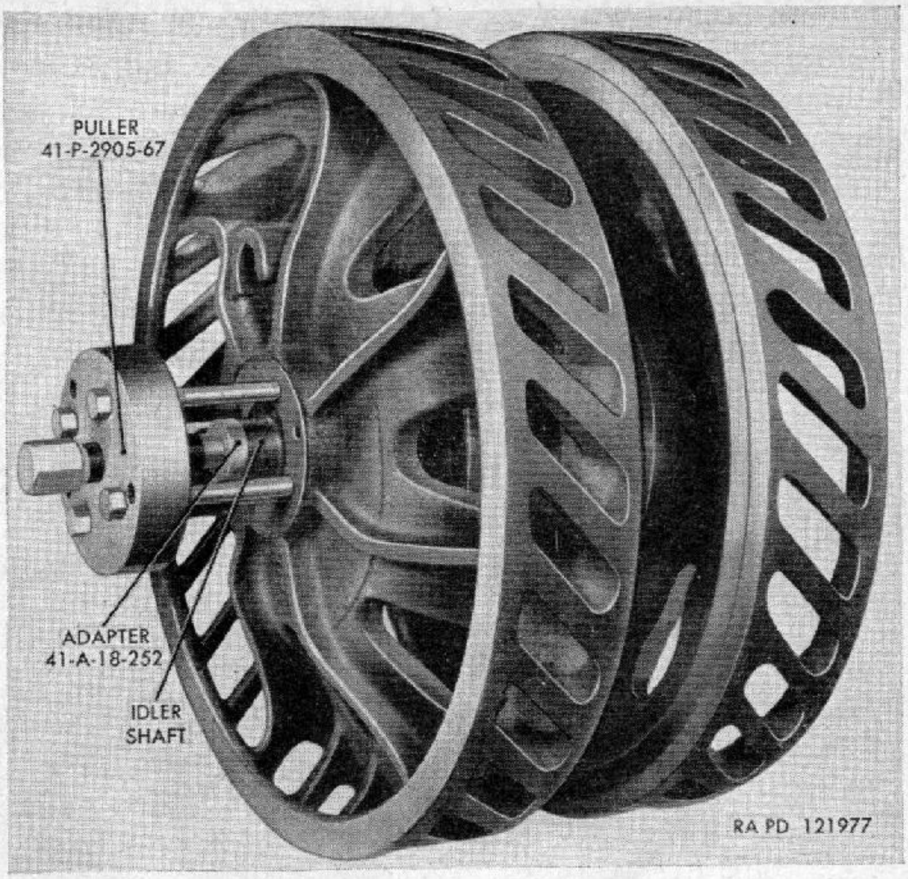


Figure 140. Removal of idler wheel from shaft.

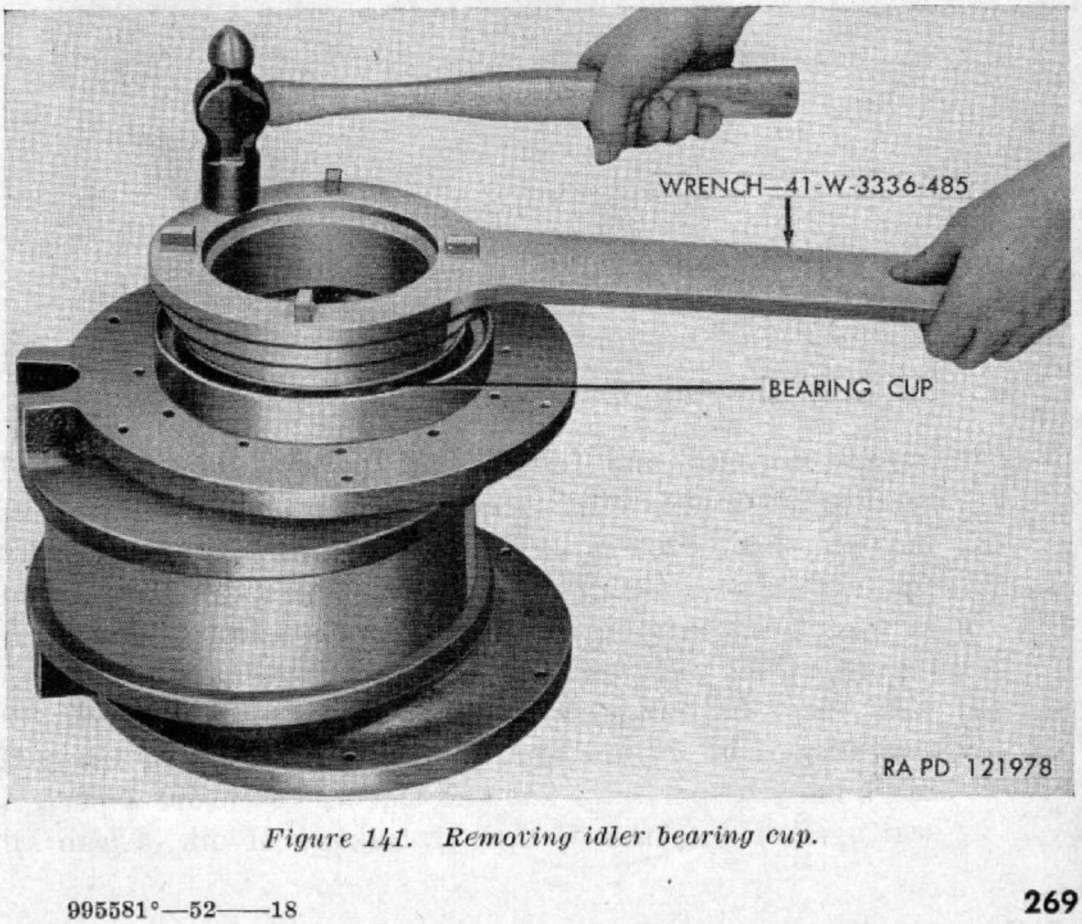


Figure 141. Removing idler bearing cup.

when shaft is removed. Install bearing cup puller attachment 41–A–345–65 with threaded adapter and puller 41–P–2904–235 with 18-inch legs, as shown in figure 145, and turn nut onto forcing screw to pull the second bearing and cup from the hub. Press or pull bearing that remained on the shaft from the shaft.

c. Inspection.

(1) *Shafts and bearings.* Clean and inspect bearing rollers and cups for chipping, roughness, wear, and discoloration. Bear-

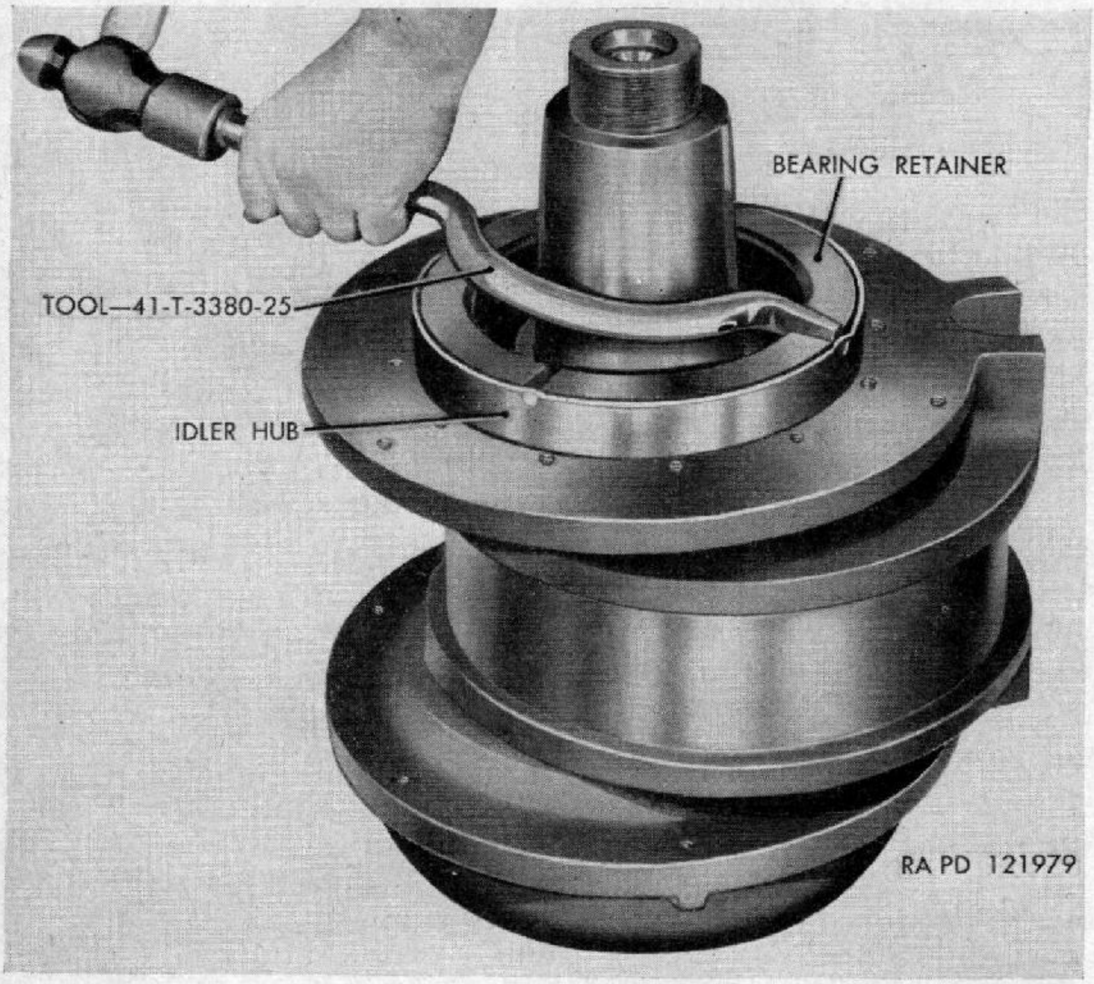


Figure 142. Unlocking bearing retainer.

ing cups, cones, and rollers must have a bright polished surface and be perfectly smooth. Blue or dark-colored parts indicate that bearings have been overheated and are unfit for further use. Clean oil passages in shaft with compressed air; replace shaft if it is damaged or worn. Replace or repair bearing retainers if the threads are burred or damaged.

(2) *Seal rings.* Clean and inspect seal rings for scoring or roughness (fig. 147). The contacting surfaces of the seal rings must be perfectly flat and smooth to ensure a perfect seal against entrance of dirt or leakage of oil. Clean all

cement and particles of gasket from seal rings. Replace damaged seal guards.

(3) *Seal boots and follower assemblies.* The seal boots may be used again when assembling if they are not softened by the use of corrosive oil, or damaged in any other way. Replace seal springs if pins are loose or broken or if assembly is twisted (fig. 146).

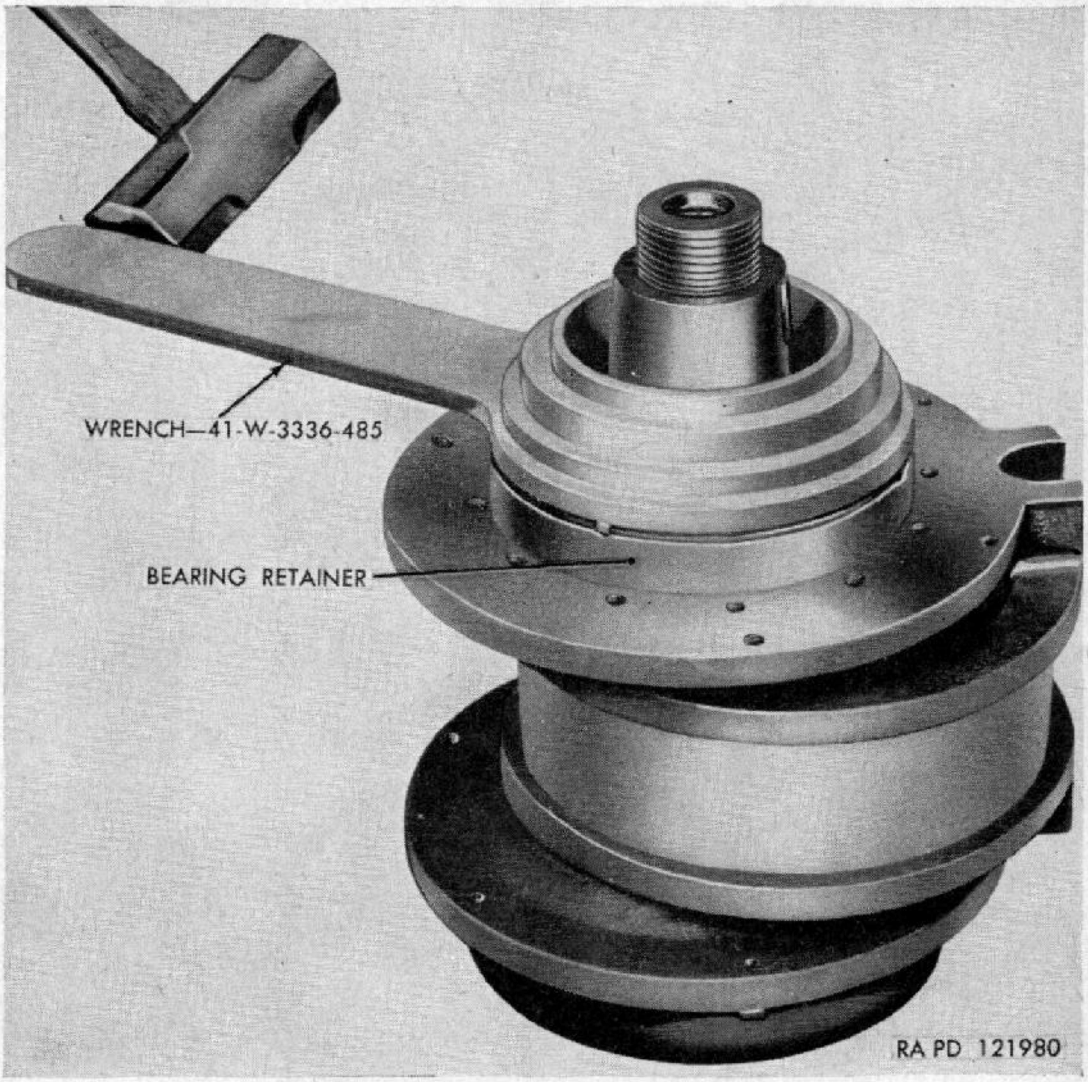


Figure 143. Removal of bearing retainer.

(4) *Idler wheels and arm.* Replace damaged wheels or other parts of the trailing idler assembly. Send parts that can be repaired to higher echelon. Replace dowels (fig. 135), if necessary, at hinge shaft bearing bracket. Broken dowel pins may be drilled and removed with a screw extractor. Replace damaged or broken shaft keys, and replace volute springs if broken or "set".

d. Installation.

(1) *Install shaft and bearings in hub.* Press one of the bearing cone and roller assemblies onto end of the shaft against

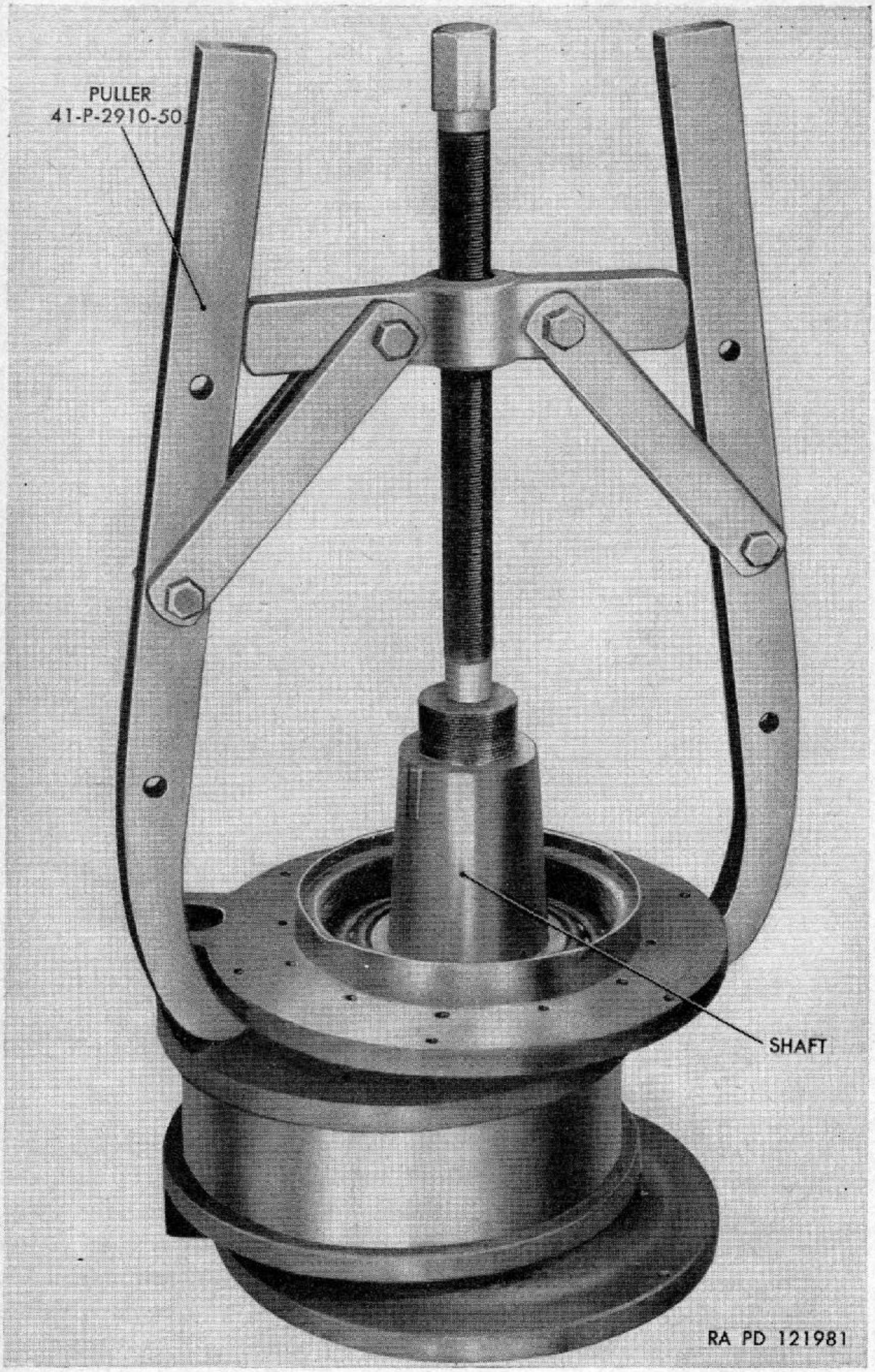


Figure 144. Forcing idler shaft and bearings from hub.

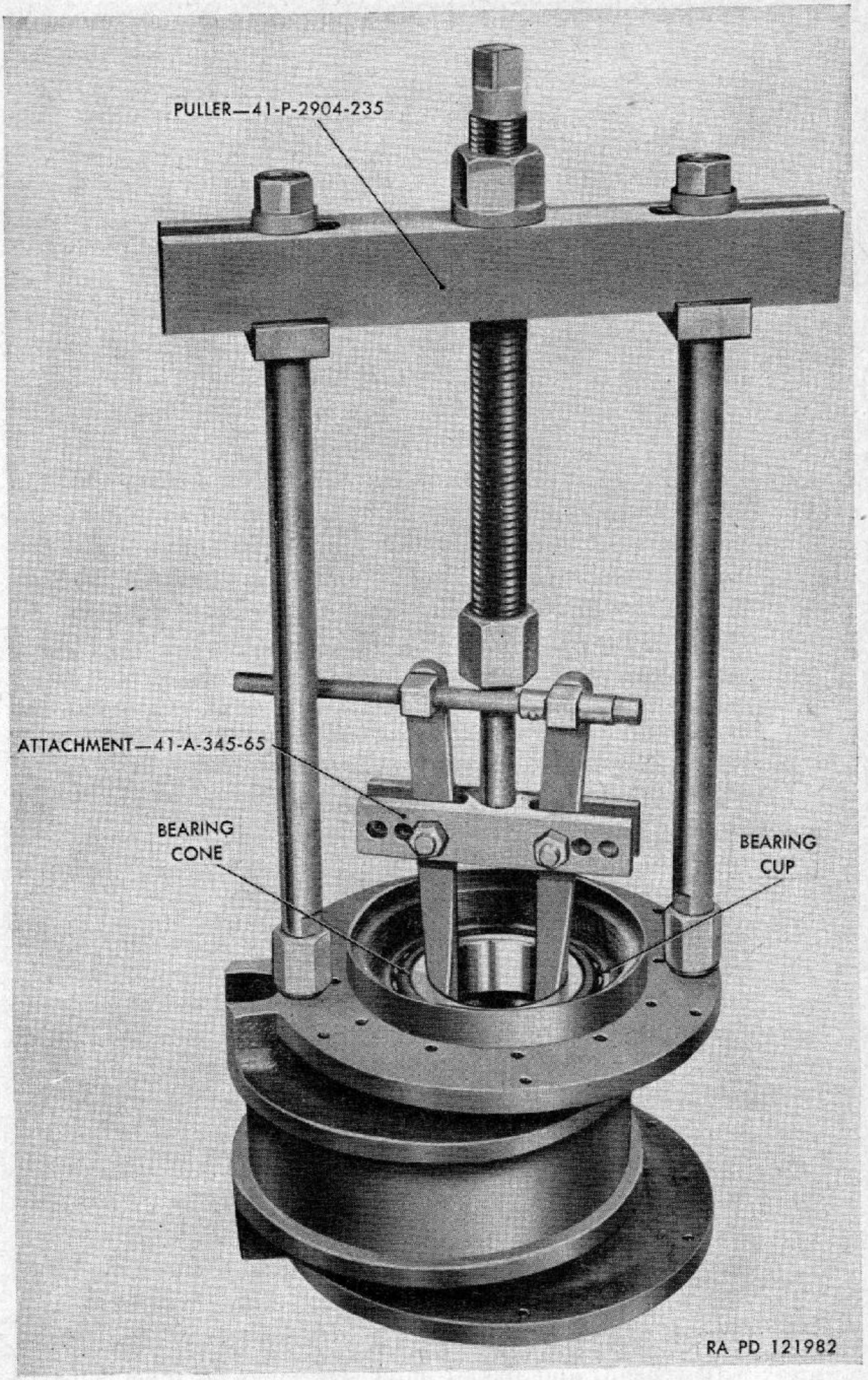


Figure 145. Removal of bearing cup.

shoulder large end first. Set the hub on blocks to hold it 6 or 8 inches off the floor. Lubricate bearings with light engine oil. Insert the end of the shaft without bearing down through the hub, then set bearing cup in center of hub and drive it onto hub (fig. 141) far enough to start a bearing retainer. The retainer wrench 41–W–3336–485 is used with lugs at top as shown in figure 141. A rim on the wrench fits inside the cup and prevents damage to threads in hub. Install bearing retainer with one 0.005-inch, one 0.007-inch and one 0.030-inch shim under rim of retainer. Force bearing cup into hub and tighten retainer with the retainer wrench. Then turn the hub over and install the second bearing cone and roller and bearing cup. Using the same amount of shims, install the second retainer. Tighten retainers by driving on handle of wrench with heavy hammer.

(2) *Adjust bearings and lock retainers.* Before locking the bearing retainers, the bearings must be adjusted so that all end play of shaft and bearings is eliminated and a slight preload is put on the bearings. This adjustment is made by adding or removing shims under the bearing retainers.

Note.—If it is necessary to add or remove more than 0.020 inch of shims to obtain the correct bearing adjustment, remove both retainers and adjust shims so there is a nearly equal amount at both ends of the shaft. Always tighten retainers as tightly as possible before testing adjustment.

The shaft should turn snugly when rolled by hand. Lock-bearing retainer after bearings are adjusted. The bearing retainers (fig. 142) are locked by bending flange of hub into retainer slots.

(3) *Install oil seal assemblies.* With follower assembly assembled as shown in figure 146, place seal boot over follower and cement inner sides of boot to outer surfaces of follower, using synthetic rubber cement; then with hub supported on blocks, place follower toward hub with projecting pins of follower engaging holes in hub (fig. 146). Lay one of the seal boots on follower with projecting pins in outer side of follower engaging holes in seal boot (fig. 146). Lay clean cloths on blocks to protect surfaces of seal ring, and turn hub over on blocks; then install follower assembly and seal ring on other side in same manner. Lay clean cloths on seal ring, place weight on ring, and allow cement to dry. Cement gasket to outer seal ring, coat outer surface of gasket with cement, and install outer seal rings on inner sides of idler wheels (fig. 147) with holes in rings engaging dowels in wheels.

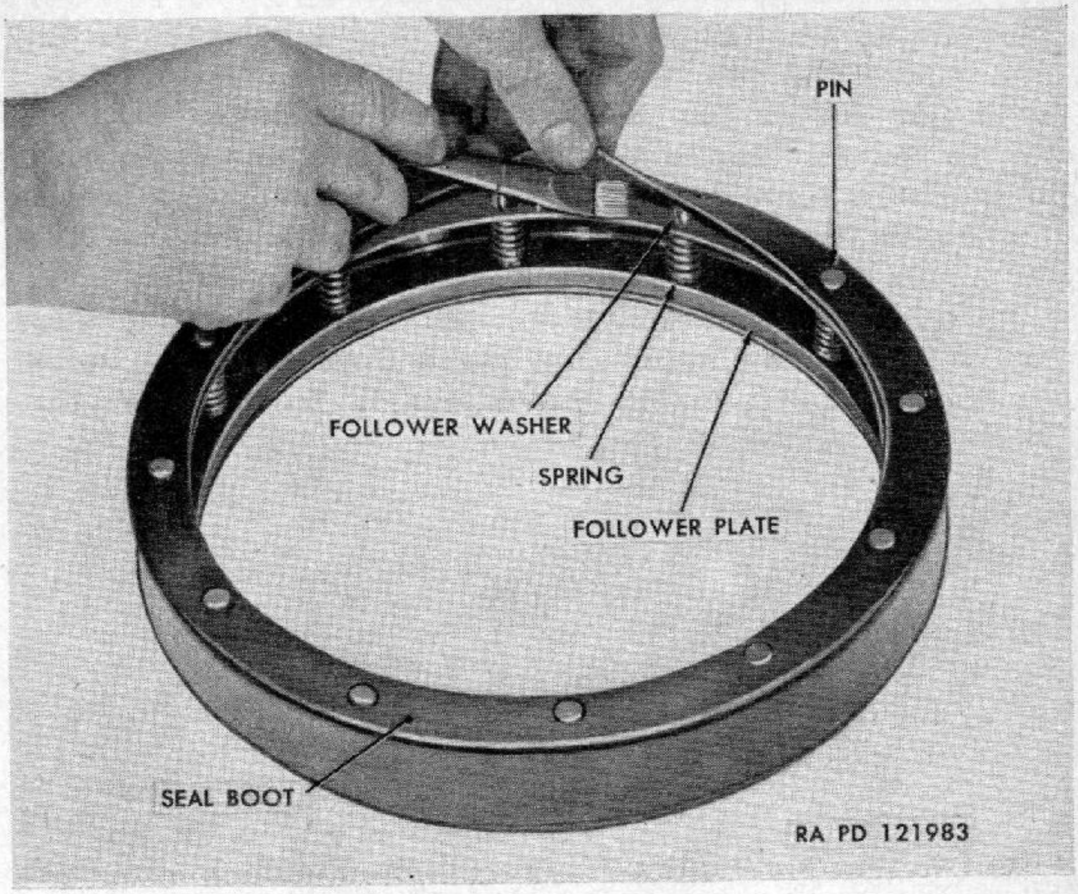


Figure 146. Cementing seal boot to follower assembly.

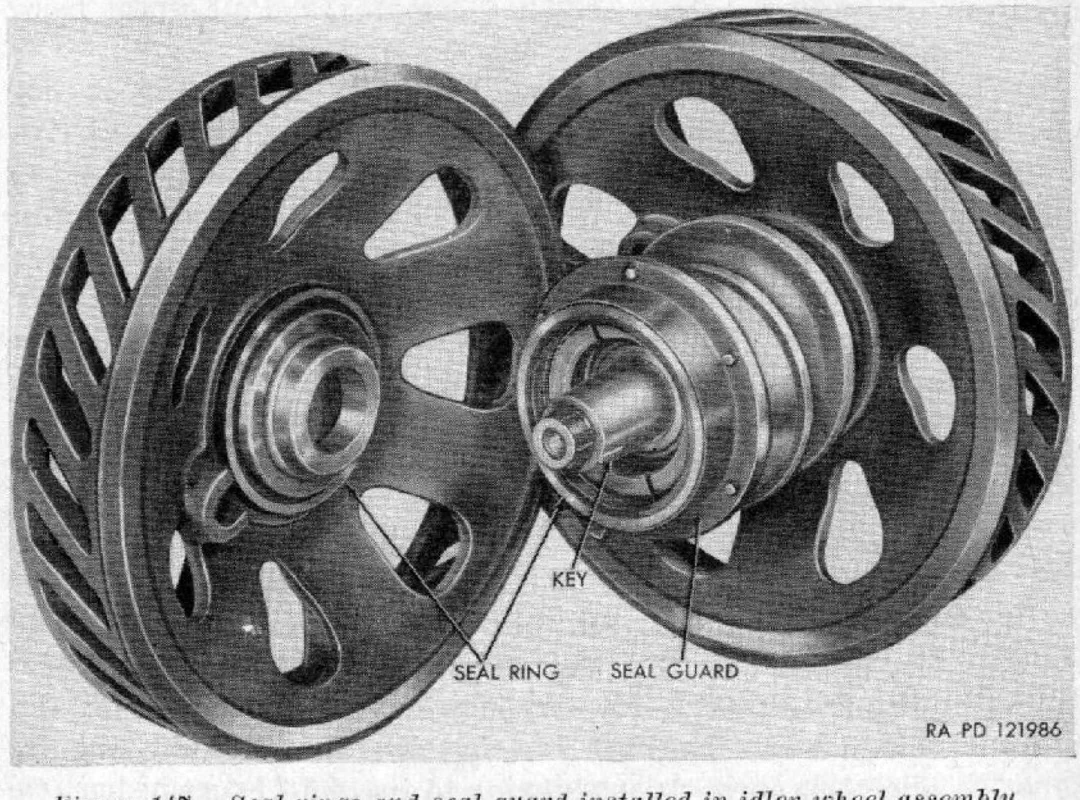


Figure 147. Seal rings and seal guard installed in idler wheel assembly.

(4) *Install seal guards and idler wheels.* Support hub on blocks. Install a seal guard on each side of idler hub with six cap screws with lock washers (fig. 147). With keys installed in slots in shaft (fig. 147), coat mating surfaces of seal rings with light oil and slide idler wheels onto ends of shaft, being careful not to dislodge the seal rings. Install nuts on ends of shaft and tighten (fig. 138). Then install nut locks over nuts with two cap screws and lock washers in each lock. Fill wheel with lubricant, as specified on the lubrication order (par. 70), and install shaft plug with plug gasket. Install idler wheel assembly (par. 205*c*(3)). Install track (par. 204 *d*) and adjust (par. 204*b*).

207. Suspension Wheels and Arms

a. Removal of Single Suspension Wheel. Place a short block on track ahead or behind the wheel on the same shaft as the one to be removed. Run tractor forward or back until the wheel is up on block as shown in figure 151. Straighten the lock washer that is bent over side of large shaft nut, and remove the nut from the shaft (fig. 148). If removing outer wheel, remove shaft plug and allow oil to drain from wheel. Using step plate puller adapter 41–A–18–252 against end of shaft, install suspension wheel and trailing idler wheel puller 41–P–2905–67, as shown in figure 148, placing the three puller block adapters 41–A–18–140 behind spokes of suspension wheel and inserting puller legs in adapter holes (fig. 148). Pull wheel from taper of shaft by turning in on forcing screw of puller.

b. Installation of Single Suspension Wheel. Install key in slot of the suspension shaft. Position suspension wheel on shaft. Drive wheel onto shaft with a block of wood placed on outer flange of wheel and tap with a heavy hammer. Install lock washer on shaft and against suspension wheel. Install and tighten shaft nut. Bend side of lock washer over one side of nut and over flat part of wheel hub. Lubricate wheel, as specified on the lubrication order (par. 70), and install shaft plug with a new plug gasket.

c. Removal of Suspension Wheel and Arm Assembly.

(1) *Remove track support roller.* Remove support roller above the suspension assembly to be removed (par. 209*a*).

(2) *Remove volute springs and seats.* Remove the four suspension arm caps (figs. 135 and 149) by removing four cap screws from each which attach the volute spring seat trunnions to the suspension arms (fig. 149). Insert volute spring compressor bolt 41–B–1598 through the seats and springs, and turn nut onto bolt until the spring is compressed enough to allow one spring seat trunnion to rise out of suspension arm (fig. 149). Remove spring and seat assembly.

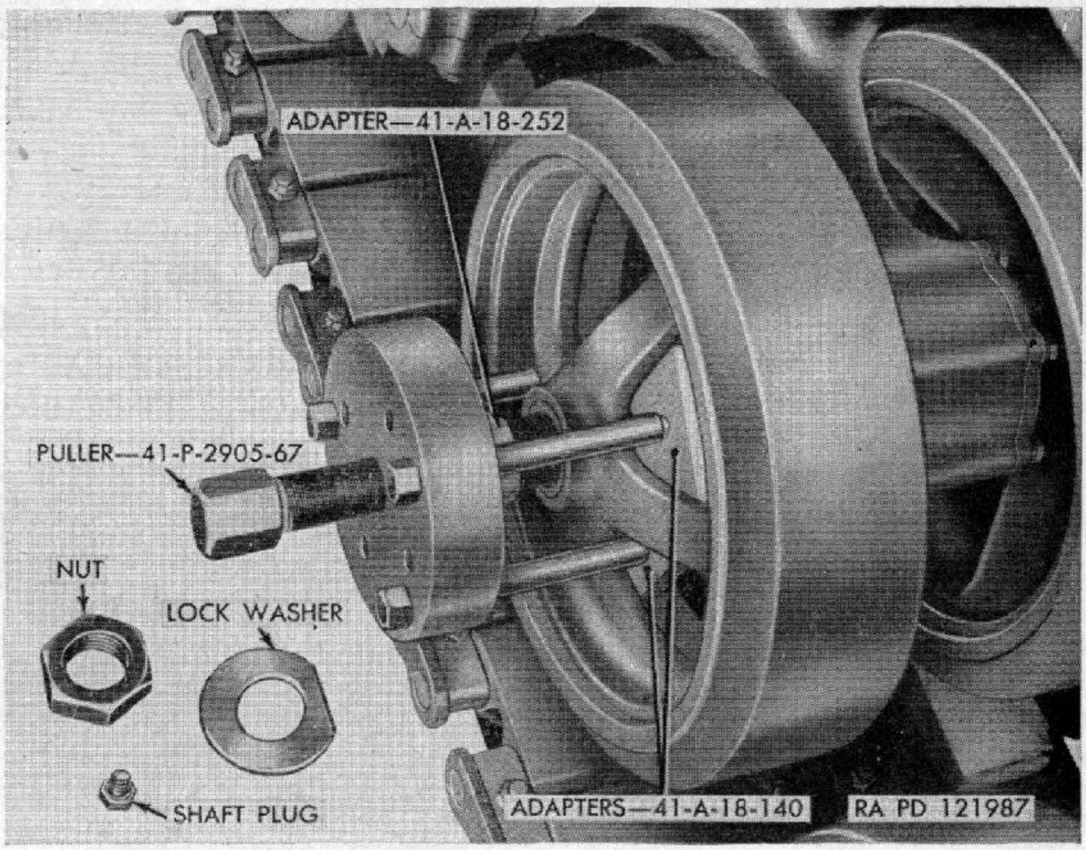


Figure 148. Removal of suspension wheel.

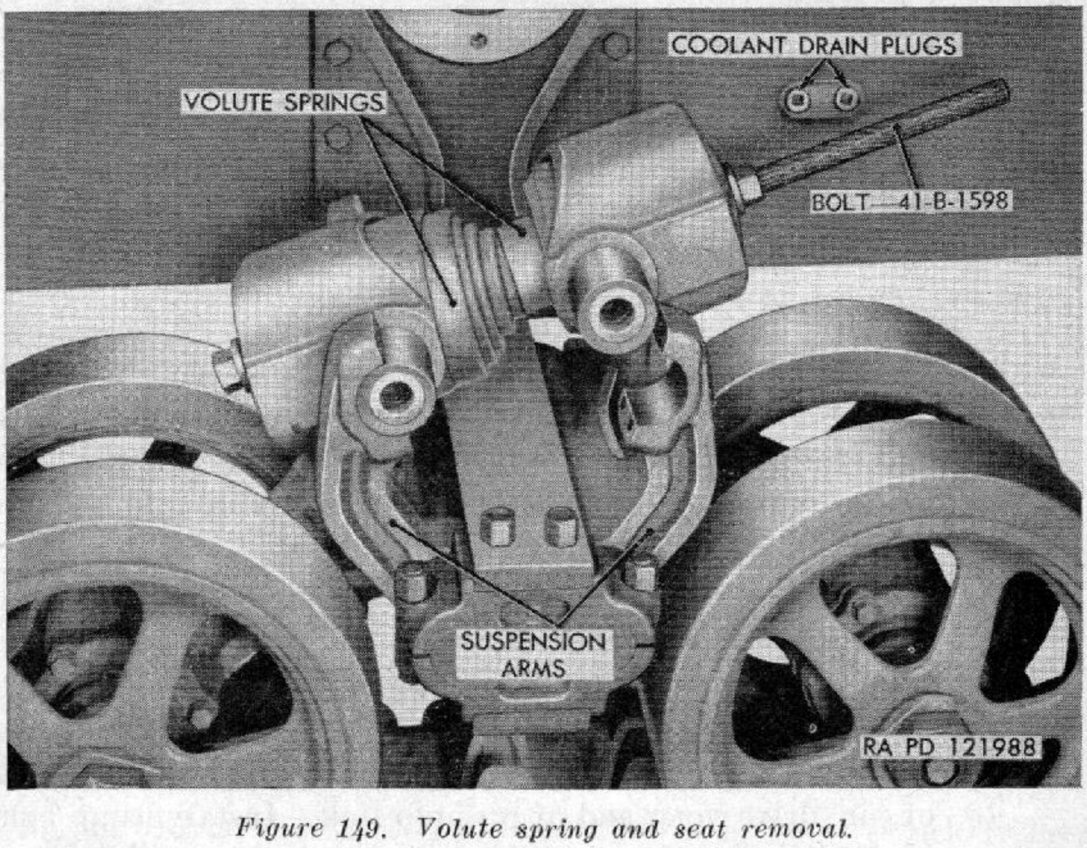


Figure 149. Volute spring and seat removal.

(3) *Remove hinge pin link from outer end of suspension arm hinge pins.* Remove the two clamp bolts and the two bolts that extend through the bracket and hinge pin link (fig. 150). Using two spacers against ends of the two shafts with a steel bar across them, place step plate puller adapter 41–A–18–252 against steel bar and mount puller 41–P–2910–50 shown in figure 150. Turn the forcing screw in against step plate adapter and bar to pull link from pins.

(4) *Remove wheel and arm assembly.* Remove the clamp bolts in link at inner end of hinge pins. Spread clamp slightly by driving steel bar (fig. 151) or chisel into notch. Raise wheels

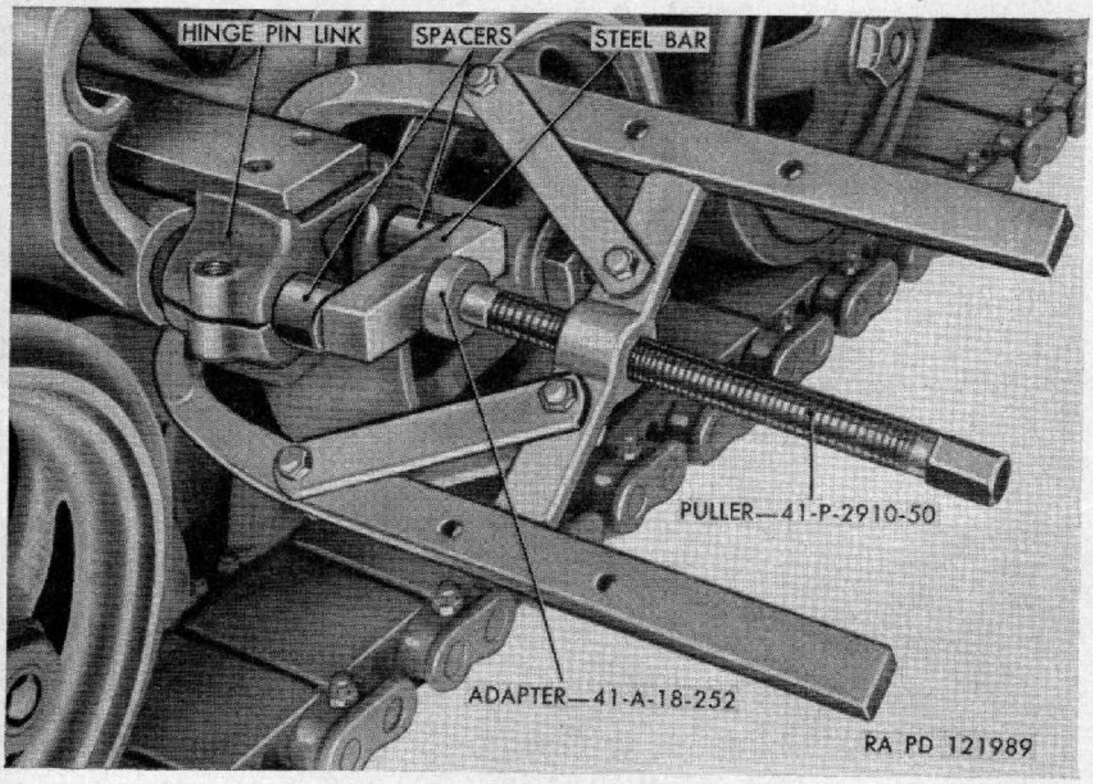


Figure 150. Removal of hinge pin.

and place a 6-inch block under one wheel so wheels will clear track guides; then drive suspension arm hinge pin out of link and arm (fig. 151) by driving against inner end of pin with soft bar and sledge. Repeat above operations to remove second wheel and arm assembly.

d. Installation of Suspension Wheel and Arm Assembly.

(1) *Install wheel and arm assembly.* Position a 6-inch block on track as shown in figure 151, lift assembly into position where inner end of hinge pin in arm will start into link bolted to bracket. Using block of wood or soft bar against outer end of pin, drive inner end of pin into link. Install clamp bolt in slit link, but do not tighten it until both assemblies and

volute springs are installed. Install second wheel and arm assembly in the same manner.

(2) *Install hinge pin link on outer end of suspension arm hinge pins.* Drive hinge pin link onto outer ends of hinge pins with a block of wood and hammer. Install two bolts in hinge pin link and two bolts in suspension bracket. Do not tighten clamp bolts until volute springs and seats are installed.

(3) *Install volute springs and seats.* If springs and seats are disassembled, assemble springs and seats on the volute spring compressor bolt 41–B–1598, and turn nut onto bolt until

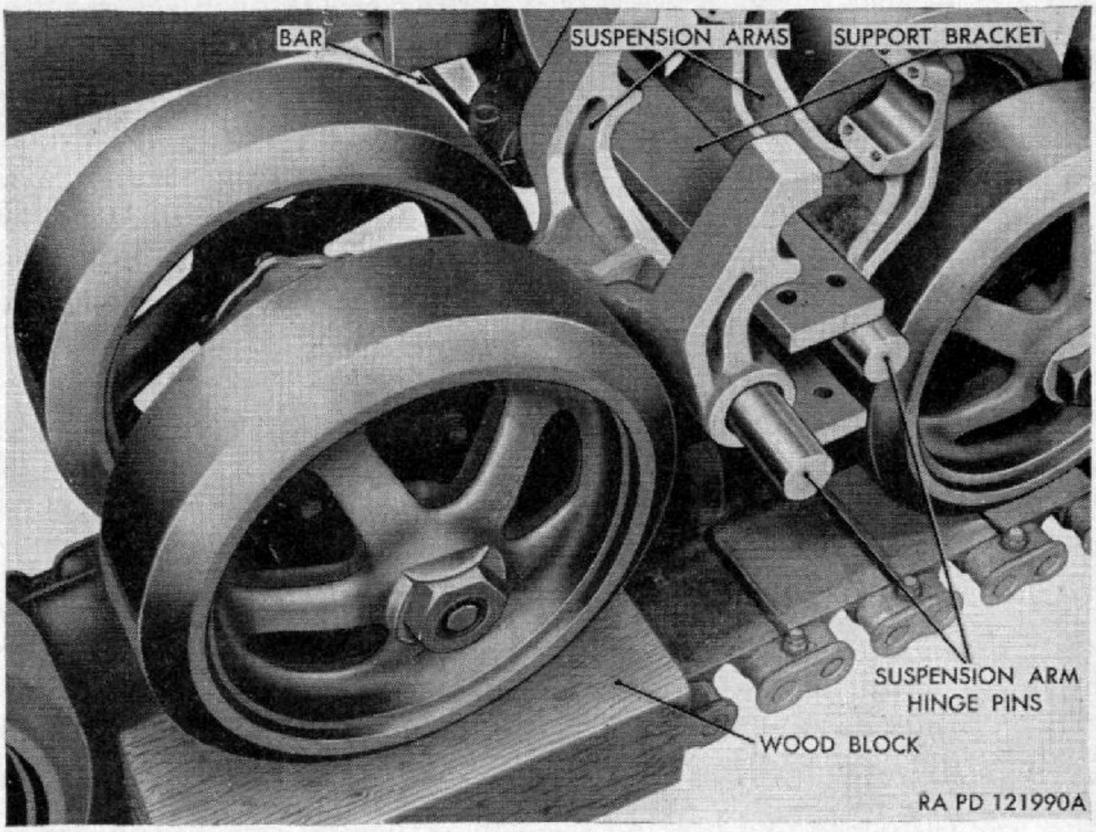


Figure 151. Removal of suspension wheel and arm assembly.

springs are compressed enough to lay spring and seats in suspension arms (longest spring toward front of tractor) as shown in figure 149.

Note.—Spacers are installed in the rear seat of the front and middle suspension assemblies. Use spacer 1½-inch thick for the front suspension wheel assembly, for middle suspension, use spacer 1-inch thick; for rear suspension, do not use spacers.

Unscrew nut on compressor bolt to relieve tension and remove bolt. Install suspension arm caps over ends of spring seat trunnions with four cap screws and lock washers in each cap (fig. 135). Remove compressor bolt. With weight of tractor on all suspensions, tighten clamp bolts at both ends of suspension arm hinge pins (fig. 130). If volute springs have retained their tension, the distance between centers of suspension wheel shafts of each assembly will be 30½ to 31 inches.

(4) *Install track support roller.* Refer to paragraph 209*b*.

208. Suspension Wheel Bearings and Oil Seals

a. Removal.

(1) *Remove wheel from shaft.* Refer to paragraph 207*a*.

(2) *Remove seal guards and bearing retainers.* Clamp jaws of bearing puller attachment 41–A–345–135 around seal guard in back of flange (fig. 152). Screw the 18-inch legs of push puller 41–P–2904–235 into tapped holes in the jaws, and assemble puller block on legs (fig. 152). Using step plate puller adapter 41–A–18–252 between the forcing screw and shaft, turn nut onto forcing screw to pull guard off shaft. Pull second wheel and seal guard in the same manner as above. The seal rings and seal boots and spring followers will be removed with the guards. Remove bearing retainers and shims under retainers by removing the six cap screws from retainer attached to the suspension arm assembly.

(3) *Remove shaft and bearings.* Screw shaft protector 41–P–2838–75 tightly onto one end of shaft (fig. 153). Drive shaft with protector end until the bearing cup on the opposite side is driven from the arm. Then screw the protector onto the other end of shaft and remove the second bearing cup in the same manner.

Caution: Have one man hold the shaft so the bearing rollers are held tightly and squarely in cup as another man drives on shaft.

Lift shaft and bearing from arm; then pull the bearing cone and roller assemblies from shaft in the same manner and with the same tools used to remove the seal guards (fig. 152).

b. Inspection. Since the parts and construction of the suspension wheels are similar to those in the trailing idler wheels, the same inspection of parts will be made. Refer to paragraph 206*c*.

c. Installation.

(1) *Install shaft and bearing in suspension arm.* Press or pull bearing cone and roller assemblies onto shaft against the shoulders, large end first. Install a bearing cup in one end of the hub. Place arm on its side on blocks with installed bearing cup down. Lubricate bearings with preservative lubricating oil and insert shaft and bearings into arm; then install the second bearing cup into arm over cone and roller assembly.

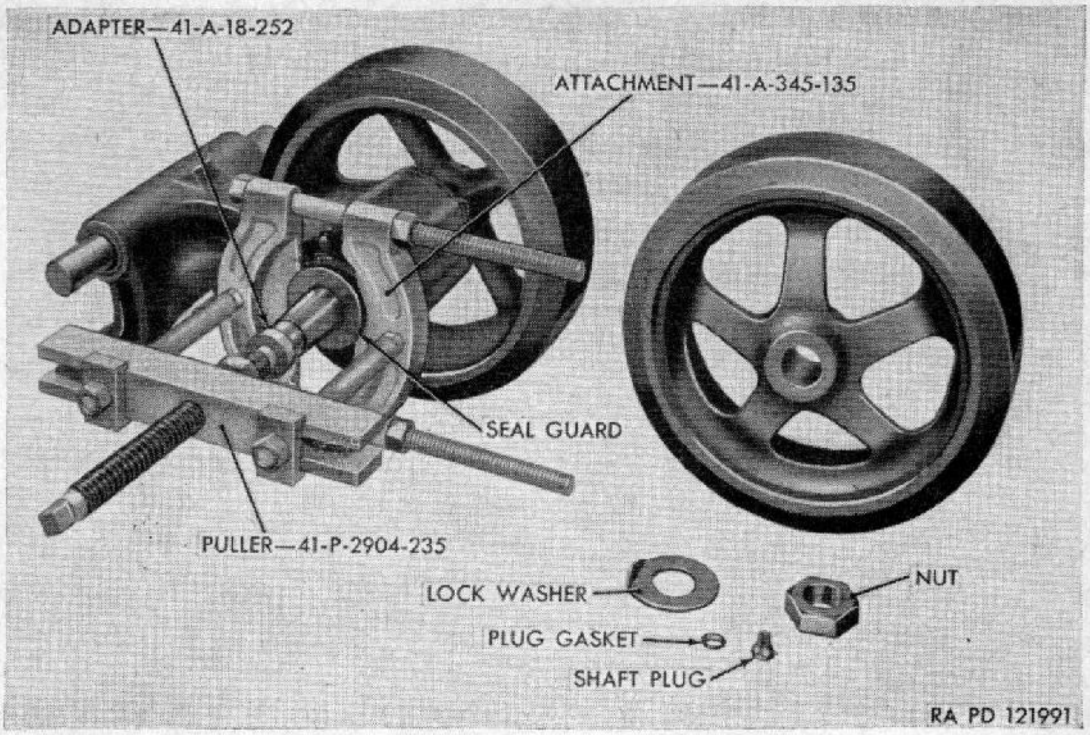


Figure 152. Removal of seal guard.

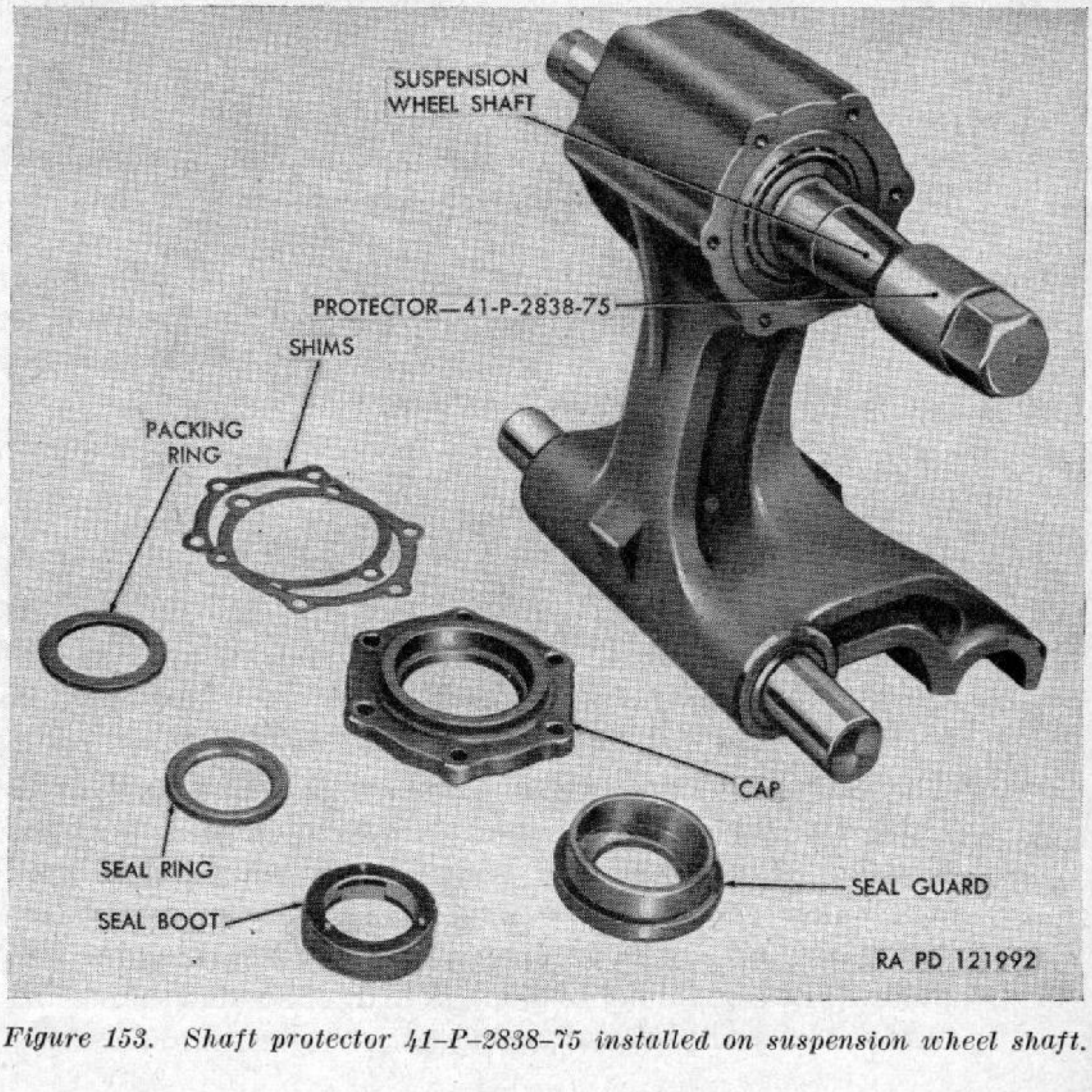


Figure 153. Shaft protector 41–P–2838–75 installed on suspension wheel shaft.

(2) *Assemble oil seal assemblies in seal guards and bearing retainers.* Make sure all particles of oil seal boots and cement have been cleaned from bearing retainers, seal rings, seal plates, and follower assembly (fig. 153). Install seal boot over the spring follower assembly in the same manner as for the trailing idler wheel (fig. 146). Cement inner sides of boot to sides of follower, then coat outer sides of boot with cement. Lay seal guard on a bench. Place spring and boot assembly in seal guard with projecting pins engaging holes

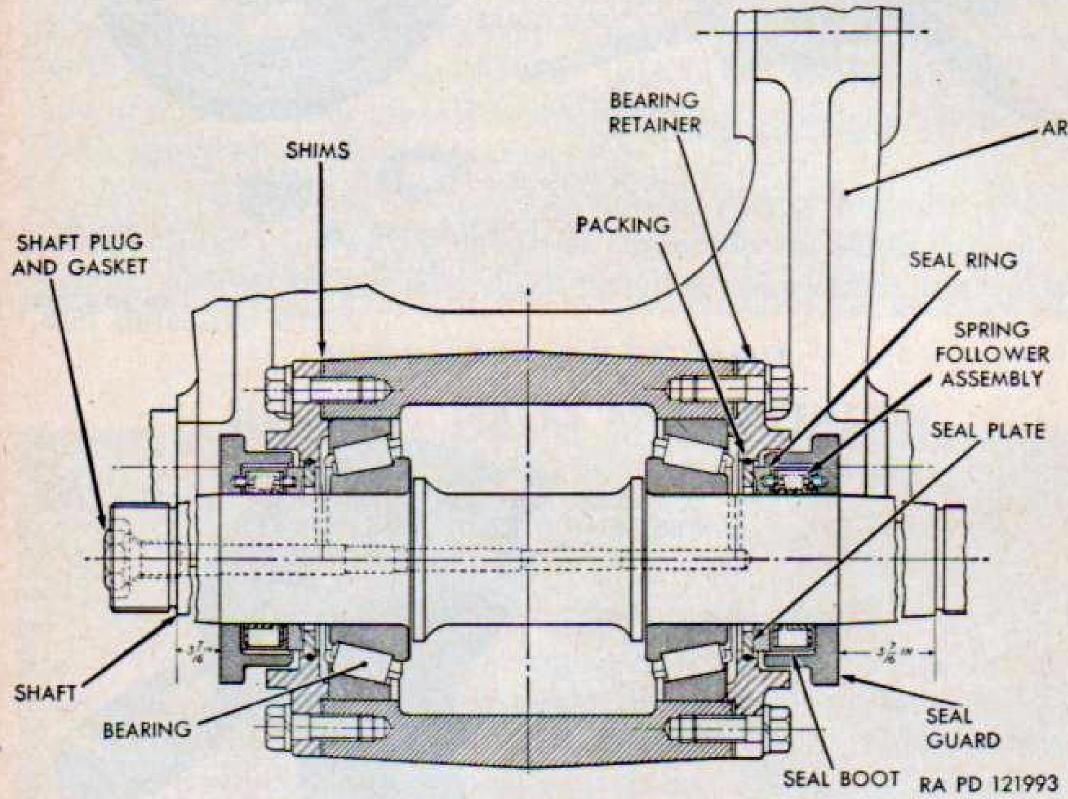


Figure 154. Suspension wheel shaft and bearing details.

in guard. Place seal ring (machined side up) on upper side of follower with holes in ring engaging pins of follower. Lay a clean cloth on the ring, place weight on top of ring, and allow cement to dry. Repeat these operations for second assembly. Install packing ring in groove in each seal plate.

Caution: Do not roll ring into groove, as this is likely to leave a twist or roll in the ring and cause a leak.

The ring must lie evenly in groove without being twisted. Using a wood block, press seal plates into retainers with the machined side facing out. It may be necessary to tap block with hammer to seat plates properly. Use clean preservative lubricating oil on the packing rings when installing the seal plates. Be careful not to damage, mar, or scratch the sealing surfaces of seal plates of seal rings.

(3) *Install bearing retainers and adjust bearings.* Using 0.007-inch and 0.031-inch shim under each retainer, install the bearing retainers with six cap screws with lock washers in each (fig. 154). After tightening cap screws, roll shaft by hand and test for end play. Remove or add shims under retainers until all end play is removed and a slight preload is felt on bearings when shaft is turned. If necessary to remove or add more than 0.020-inch thickness of shim, remove both retainers to keep the total thickness of shims on each side as nearly equal as possible. Always test bearing adjustment with the retainer cap screws tight.

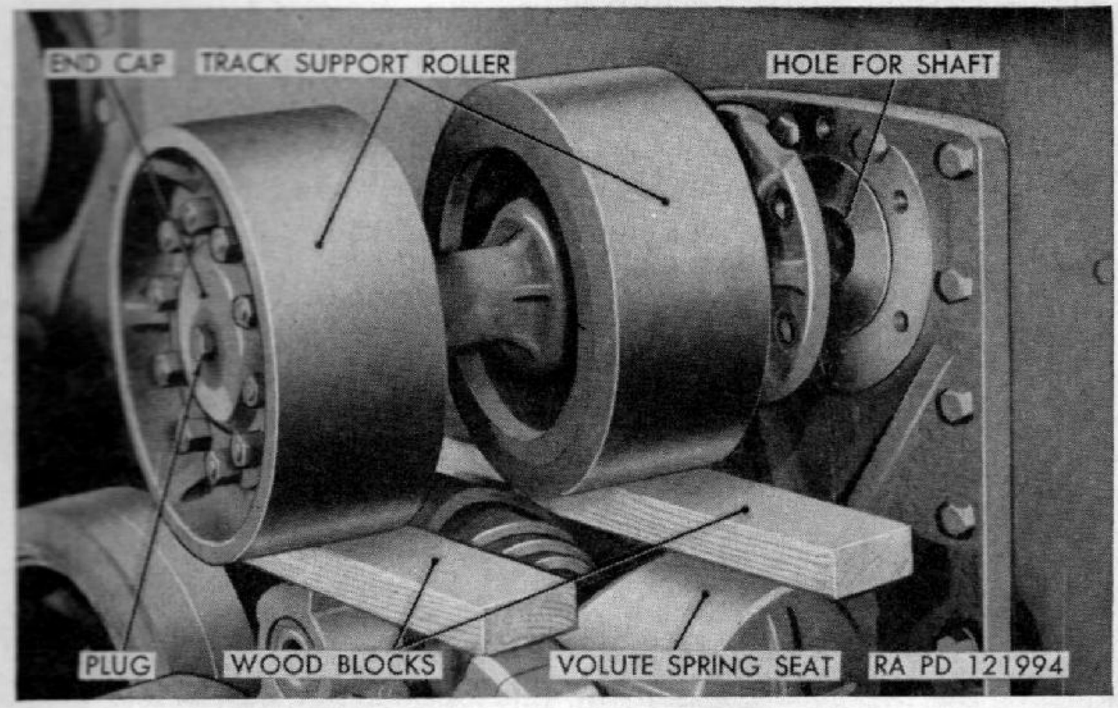


Figure 155. Track support roller removed.

(4) *Install seal guards.* Oil the mating surfaces of seal rings and plates with preservative lubricating oil, and press or pull seal guards onto shaft until outer surfaces of seal guards are $3\frac{7}{16}$ inches from shoulders at small end of taper on shaft.

(5) *Install suspension wheel.* Refer to paragraph 207*b*.

209. Support Rollers

a. Removal. Loosen track as much as possible (par. 204*b*). Position a jack on one of the suspension wheels close to the support roller to be removed. Raise track until the track guides clear the support roller. Position two 2- x 10-inch wood blocks across the suspension volute spring seats as shown in figure 155. Remove six cap screws attaching the support rollers to bracket on hull. Pry the roller outward until inner end of the shaft is free of the bracket (fig. 155) and remove roller from the tractor.

b. Installation. Insert inner end of shaft into hole in the bracket (fig. 155). Turn the attaching flange so the notches are over the two top screws in the hull bracket; then install the six attaching cap screws with lock washers and tighten them securely. Lower the track onto the support roller and remove the jack and wood blocks. Adjust track tension (par. 204*b*).

210. Support Roller Bearing and Oil Seals

a. Removal.

(1) *Remove support roller.* Refer to paragraph 209*a*.

(2) *Remove roller and hub assembly from shaft.* Remove the plug from end cap (fig. 155) and drain oil from the support roller. Remove 10 nuts from end cap bolts (fig. 155) and remove cap and gasket. Straighten the lock washer and remove cap screws, lock washer, thrust washer, and shims from end of the shaft (fig. 157). Remove nuts from the bolts that attach the seal guard and inner roller to the inner hub flange. Mount bearing puller attachment 41–A–345–135 and puller 41–P–2904–235, with 24-inch legs, as shown in figure 156, with step plate adapter 41–A–18–253 between the forcing screw and end of shaft. Turn forcing screw to force the rollers off the shaft. Use a long bar to hold roller from turning. The outer bearing will be pulled off the shaft; the inner bearing cone and roller assembly will remain on the shaft.

(3) *Remove inner bearing from shaft.* Using the same puller arrangement as in (2) above and substituting 18-inch legs for the 24-inch legs, pull the inner bearing from shaft. Slide seal plate and follower assembly, seal guard, and seal rings, off the bracket and shaft.

(4) *Remove bearing cups from hub.* Mount the bearing cup puller attachment 41–A–345–65 with threaded adapter and puller 41–P–2904–235 used in (3) above as shown in figure 145, and pull bearing cups from outer ends of hub. Roller may be pulled or pressed off hub.

b. Inspection. Since the construction and parts of the support roller are similar to those of the trailing idler, the same inspection can be made of the support roller (par. 206*c*).

c. Installation.

(1) *Assemble oil seal.* Install seal boot over spring follower assembly in same manner as for trailing idler (fig. 146). Place seal plate over projecting pins of follower and install cotter pins. Coat the opposite side of boot on follower with synthetic rubber cement and lay outer seal ring on pins of follower; then lay a clean cloth over surface of seal ring.

Lay a weight on seal ring and allow cement to dry for one-half hour. Press or pull inner bearing cone and roller onto roller shaft. Cement gasket to inner seal ring and coat other side of gasket with cement. Stand roller shaft on end, with bracket down, and set inner seal ring on dowels in bracket.

(2) *Install roller and hub assembly on shaft.* Install bearing cups into ends of hub, using a soft bar or wood block, and tap lightly with a hammer. Oil the mating surfaces of seal rings with preservative lubricating oil. Set seal guard in place around seal ring in bracket; then lay follower assembly

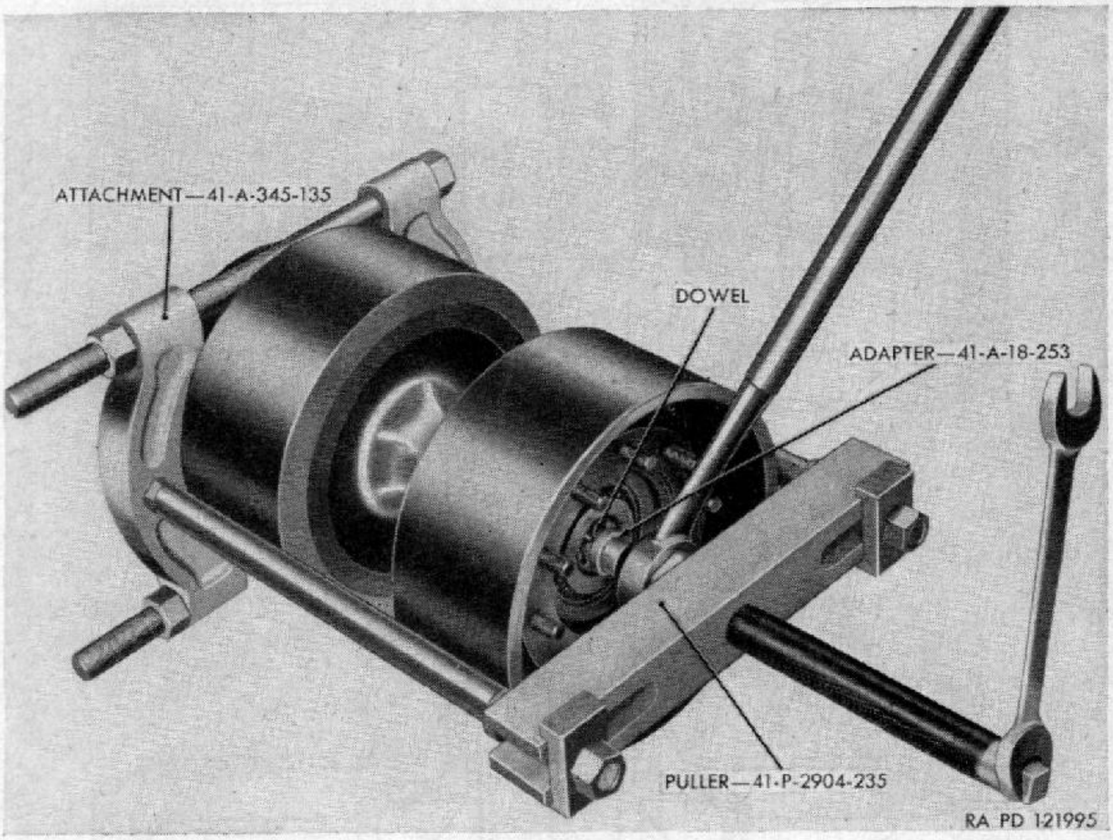


Figure 156. Removal of support roller bearings and shaft.

with outer seal ring and seal plate attached on top of inner seal ring. Using a soft bar against bearing cone, tap inner bearing cone and roller assembly onto shaft against bracket. Lubricate bearing with light engine oil; then lower roller and hub assembly into place on shaft, turning seal plate and seal guard so that bolts in roller enter the holes in these plates. Tap outer bearing end of shaft into outer bearing cup. Install one 0.005-inch, one 0.007-inch, and one 0.030-inch shim on dowels in end of shaft (fig. 157); then set thrust washer and lock washer on dowels and install large cap screw into end of shaft (fig. 157). Install and tighten nuts on the bolts that attach seal plate and guard to inner roller.

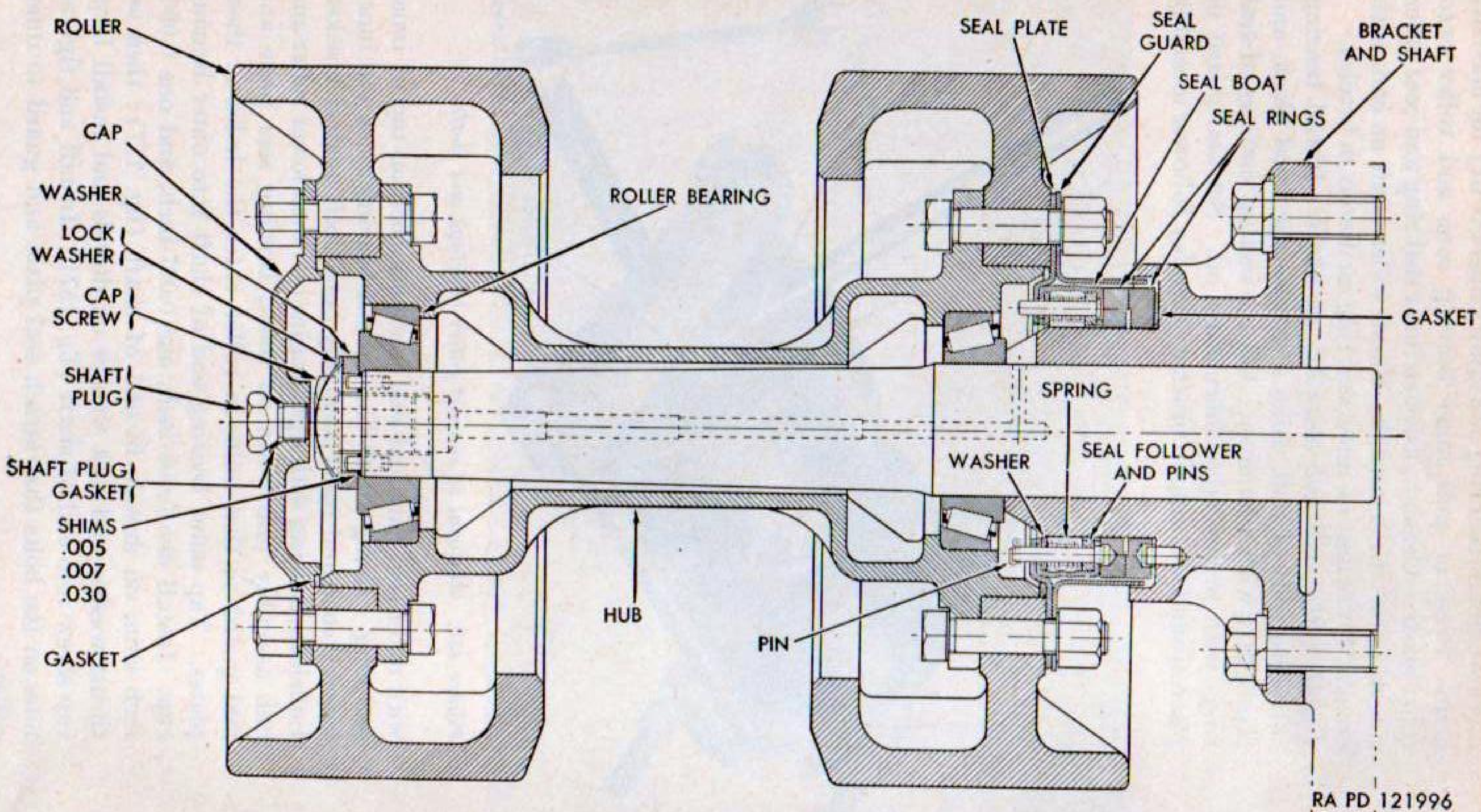


Figure 157. Track support roller assembly—cross section.

(3) *Adjust bearings.* With large cap screw in end of the shaft securely tightened, there should be no end play in shaft and bearings; a slight preload should be felt on bearings when roller is turned by hand. Adjust bearings by adding or removing shims at end of shaft under the thrust washer (fig. 157). After bearings are properly adjusted and cap screw tightened, bend lock washer over one side of the nut to secure it from loosening and install end cap and gasket (fig. 155).

(4) *Install support roller.* Refer to paragraph 209*b*. Fill wheel with lubricant specified in lubrication order (par. 70). Install shaft plug with a new gasket (fig. 157). Adjust track as explained in paragraph 204*b*.

Section XXI. HULL, PINTLES, AMMUNITION BOX, AND FIRE EXTINGUISHERS

211. Description

a. Hull. The hull is rectangular in shape with two sides, an end, and a bottom. Struts welded to the sides and bottom strengthen the hull and prevent twisting when subjected to severe strains. The front end of the hull is open to receive the transmission, differential, and final drive assembly which is bolted to the front ends of the side members. Service and inspection covers are provided on the bottom of the hull (fig. 62), which, when removed, allow access to units requiring periodic service or maintenance. With all covers in place and front guard of tractor installed, the hull is sufficiently watertight to allow fording of streams.

b. Cab. The cab is mounted to the hull of the tractor and is divided into two compartments. The front compartment seats the driver and four crew members. The rear compartment seats five crew members and has a machine gun mount on top of the cab roof.

c. Windshield. The tractor has two individual windshields with adjustable locking devices to open the windshield for circulation of air. Each windshield is provided with a windshield wiper (fig. 6) and controls to operate the wiper (fig. 6).

d. Pintles. A pintle with a swivel is mounted in each end of the tractor. These pintles are of standard military design. The front pintle is used primarily for placing the towed gun into position. With the gun hooked to the front pintle, the tractor driver can maneuver the gun into position more quickly and easily. The rear pintle is used for towing vehicles and is equipped with springs to absorb shocks from the towed vehicle. The front pintle is not equipped with shock springs.

e. Ammunition Box and Fire Extinguishers. A complete description of the ammunition box will be found in paragraph 58. A complete description of the fire extinguishers will be found in paragraph 56.

212. Hull

a. Windshields.

(1) *Removal.* Remove windshield wiper motor and arm assembly (par. 166*a*). Unlock windshield locking devices and open windshield 4 inches. Remove cotter pins and nuts from the adjusting rod attached to the windshield frame and remove the two pins. Remove the cotter pins and hinge pins from windshield frame outside the tractor and carefully remove the windshield.

(2) *Installation.* Place replacement windshield in position, lining up the hinge holes. Install hinge pin and cotter pin. Install adjusting rod and pin in position and secure with nut and cotter pin. Install windshield wiper assembly (par. 166*b*) and tighten all nuts securely. Lock windshield locking devices.

b. Seats. Damaged seat backs are replaced by removing seats and replacing with new ones. The seat backs are attached to the hull with hooks. To remove seat backs, lift up on seats and remove from tractor.

c. Maintenance. At regular inspection periods, examine the hull for cracks, broken welds, loose bolts, or drain plugs, and missing inspection covers. Replace any broken covers, or cover gaskets that are not in good condition. Remove appropriate drain plugs or covers, and clean interior of the hull at specified intervals. After fording operation, remove hull drain plugs to drain any water that may be in the tractor. Replace or tighten loose or missing bolts immediately.

213. Pintles

a. Replacement of Front Pintle. Remove the front plate from the tractor. Remove the two cap screws attaching pintle plate to hull bracket. Slide this plate forward and remove the six cap screws from pintle bracket and lift the pintle assembly out of the tractor. Install replacement pintle with six cap screws to hull pintle support. Install pintle to top of hull bracket plate with two cap screws. Thoroughly clean front cover and cement a new gasket before replacing cover with cap screws.

b. Replacement of Rear Pintle. Remove the six bolts holding the rear pintle to the tractor hull. Remove the complete pintle assembly from the tractor and install the replacement pintle in position with the six bolts. Tighten these bolts securely.

c. Maintenance. No maintenance is required of the pintles other than periodic lubrication (par. 70) and inspections at regular intervals to make sure all bolts are tight, pintle shafts and latches not worn, bent or broken, and for proper operation of the latching mechanism.

214. Ammunition Box

a. Removal. Remove the four bolts that attach the ammunition box to sides of hull. Unload all the cargo from the box. Discon-

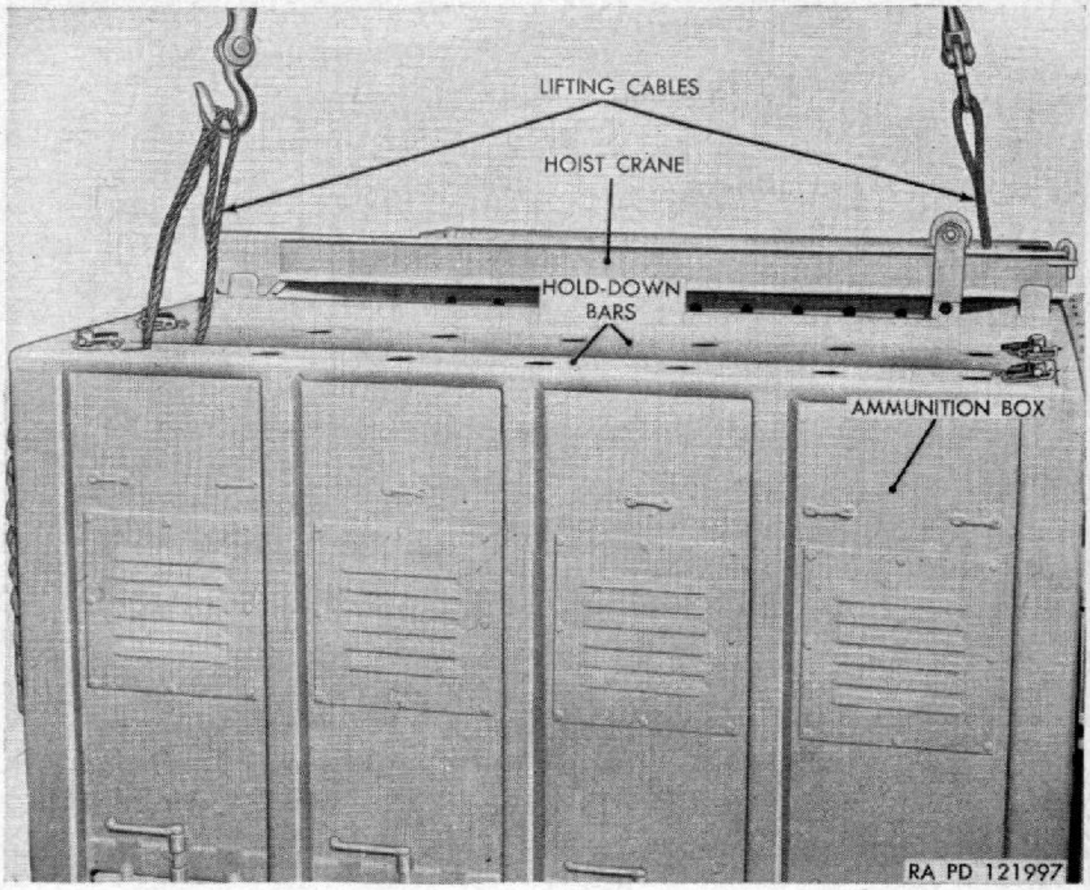


Figure 158. Ammunition box removal.

nect flood light switch wire at acorn fitting below flood light switch. Place lifting chain or cable through holes in hold-down bars, as shown in figure 158, and securing chain to hoist, lift ammunition box off tractor.

b. Installation. Lift box onto tractor with hoist and chains as shown in figure 155. Set box on hull so that the groove in bottom of box on the right-hand side contacts the rail on top of the right-hand side of hull. Install a bolt with lock washers in each corner of the box to attach the ammunition box to hull. Connect flood light switch wire at acorn fitting at rear of tractor.

c. Moving Ammunition Box Back. Figure 159 shows the box moved back to allow room ahead of box for better access to engines. To move box back, remove the four bolts (one at each corner of box) that attach the box to sides of hull. Place a wood block 3 feet long on each side of tractor in position shown, with one end of each block against chevron on track, the other against a cleat under box. Move the tractor back slowly until angles on the bottom of the box contact the stops on inside of hull. To move box ahead, reverse the blocks and drive the tractor forward. A rail on the right side of the hull engages a groove on the bottom of the ammunition box to keep box in alinement.

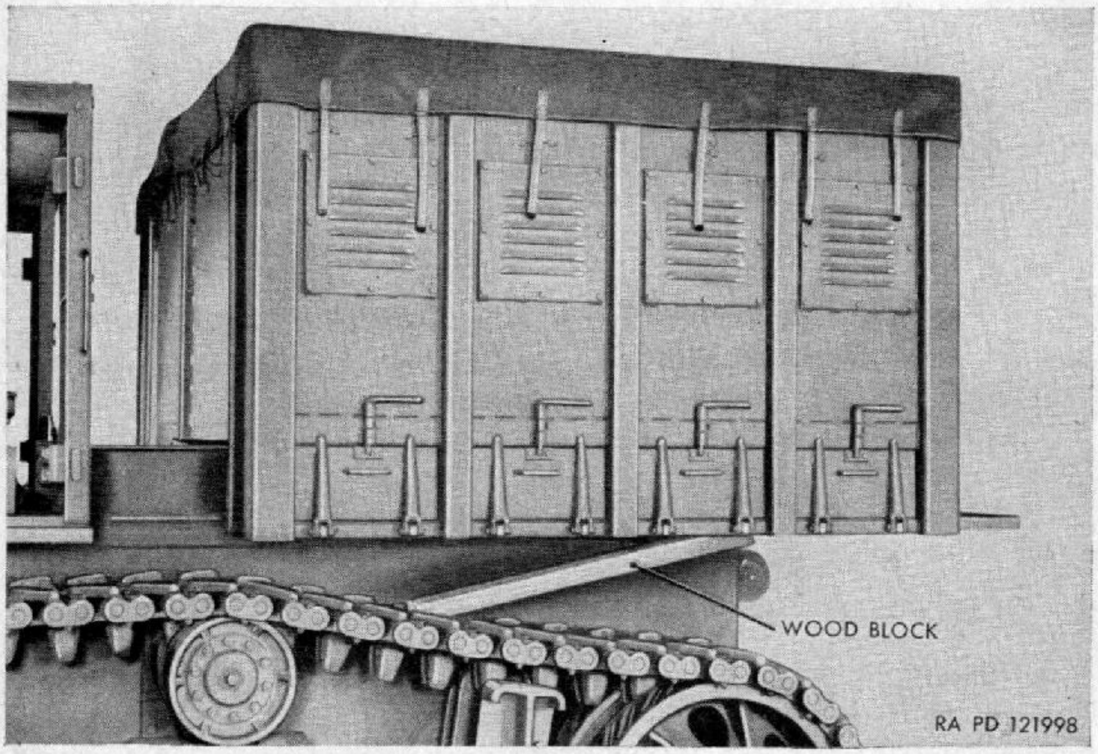


Figure 159. Ammunition box moved back.

215. Fire Extinguishers

a. Maintenance. Determine the contents of the fire extinguisher by weight every 4 months. Have cylinder recharged or replaced if weight is 6 ounces less than the weight stamped on the cylinder body. Check nozzle and trigger for proper operation. Check the seal, being sure it has not been broken.

b. Replacement of Fire Extinguisher Support Bracket. Remove the fire extinguisher from support bracket and then remove the six cap screws that attach bracket to back of the front seat (fig. 11). Install replacement bracket and install the six cap screws with toothed lock washers. Tighten cap screws securely and install fire extinguisher. Check the quick release mechanism of the bracket for proper operation to release the fire extinguisher.

Section XXII. WINCH AND POWER TAKE-OFF

216. Description and Data

a. Description.

(1) *Winch.* The standard heavy-duty military type winch is mounted in the end of tractor hull. Drive shafts with universal joints are connected to the winch worm shaft, in winch gear case, and to the power take-off which operates the winch (fig. 160). The winch drum shaft is driven by the worm and gear in gear case through a sliding jaw clutch operated by the control lever at right end of winch (fig. 10). This worm and gear reduction provides for maximum pull on cable. An automatic brake on the winch worm shaft (fig. 165) holds load suspended when engine master clutch is disengaged.

(2) *Power take-off.* The power take-off is mounted on the transmission case (fig. 169) and driven by a gear on the transmission shaft. It has two operating speeds and is of the reversible type which provides for turning winch drum in either direction to wind cable on drum or unwind cable from drum. A sliding gear in the power take-off permits shifting the power take-off to a winding, unwinding, or neutral position. It is operated by the shifter levers in the cab (fig. 6). The power take-off is lubricated by oil from the transmission.

b. Data.

Winch:	
Name	Gar Wood.
Model	6M823.
Length of cable	300 ft.
Diameter of cable	1 in.
Maximum line pull	55,000 lb.
Diameter of drum	8 in.
Power take-off:	
Maximum revolutions at rated engine speed	350 rpm at 2,100 rpm

217. Winch

a. Winch Brake Adjustment.

(1) If the winch worm automatic brake fails to hold the load when clutch pedal is depressed to disengage the engine, the brake requires adjustment. Remove the hull plate from rear of hull (fig. 161); then remove the cover from brake housing. Inspect linkage to make sure it is not binding; lubricate if necessary with a few drops of preservative lubricating oil. If no binding is evident, adjust as described in (2) below.

(2) With vehicle at the top of a steep grade, fasten end of winch cable to another tractor or truck at the bottom of grade, and

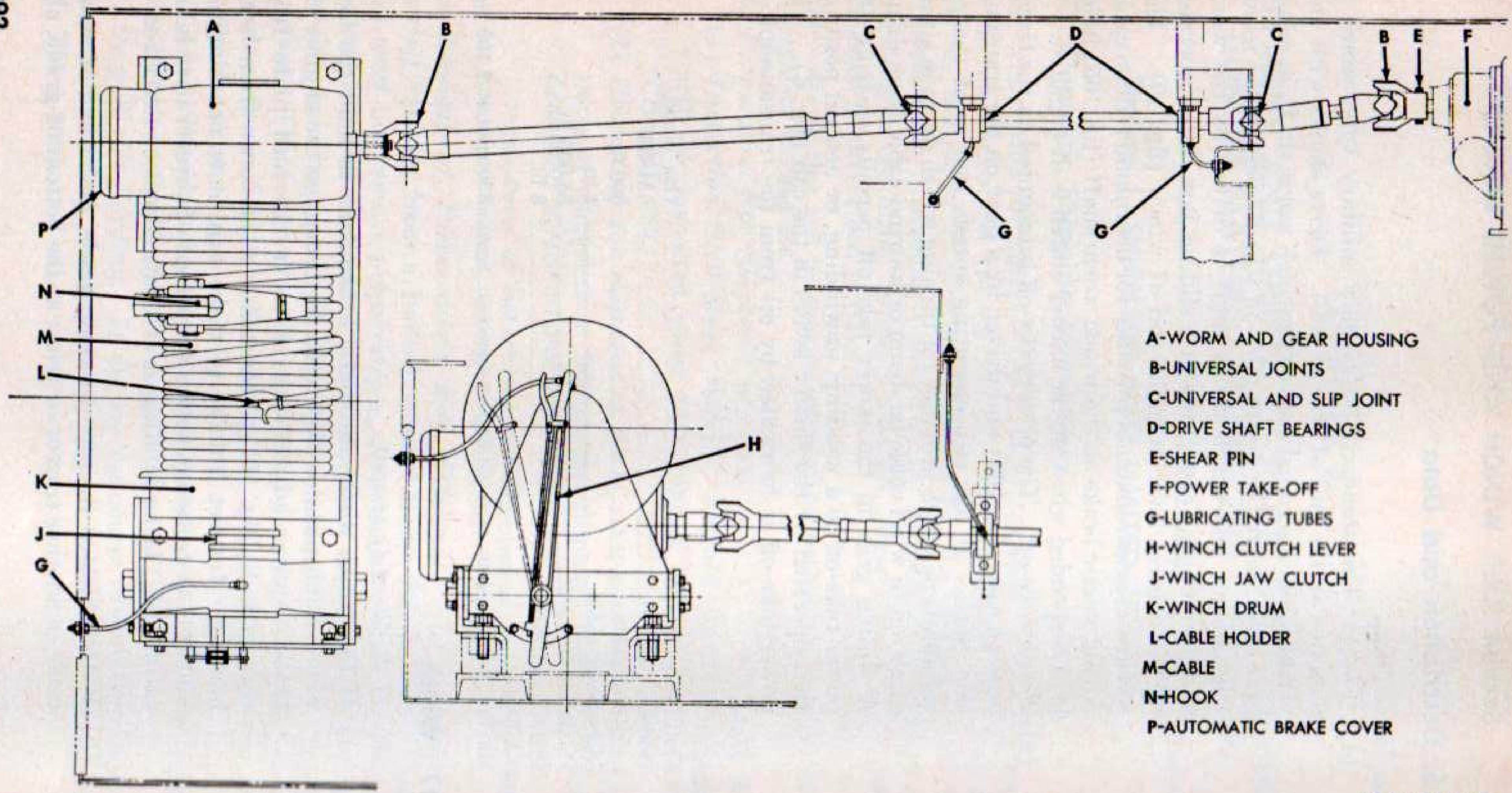


Figure 160. Winch and drive shaft assemblies.

start pulling it up the grade. After a short haul, depress clutch pedal. The winch will stop and the vehicle being pulled up the grade should not roll backward. If it does, loosen lock nut and tighten the brake band upper adjusting nut one-half turn (fig. 165). Push adjustment spacer, located above the lower adjusting nut, into brake rocker as far as it will go. Back off the lower nuts until the space between the nuts and spacer is one-eighth of an inch. Tighten lock nuts and test winch brake for holding as before. If brake does not hold, repeat the above adjustment by one-half turn on both upper and lower adjusting nuts.

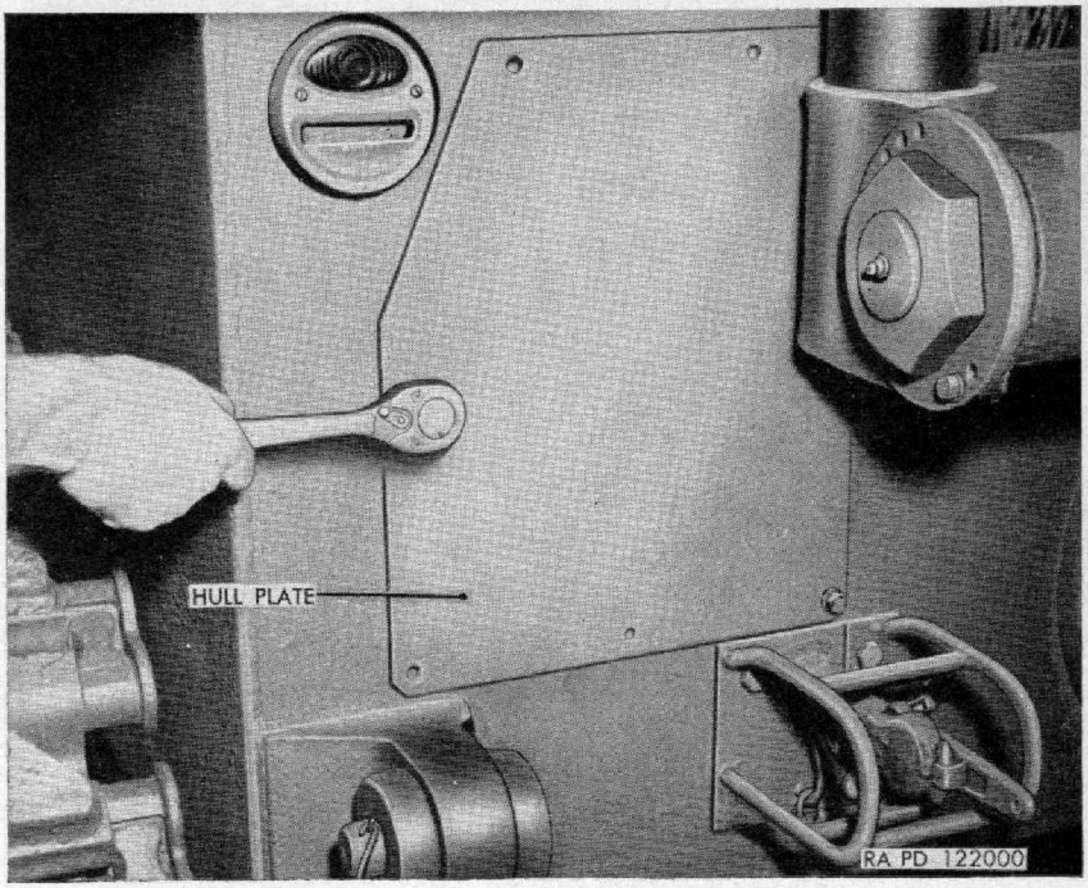


Figure 161. Winch hull plate removal.

Caution: If, after adjustment and testing for several minutes, hand cannot be held on brake housing cover because of heat, loosen adjusting nuts one-half turn and test. Even when correctly adjusted, brake may become warm but should not be too hot to allow the hand to be held on brake housing cover.

b. Removal of Winch Assembly.

(1) *Remove fuel filler pipe.* Remove ammunition box (par. 214*a*). If fuel tank is full, drain fuel from tank until fuel level is below filler pipe. Pull cotter pins from lower end of

heater valve lever (fig. 47). Loosen the two bolts connecting angle below rear end of pipe to support bracket. Remove the two bolts that attach support bracket to rear of hull, and remove nut outside of hull from lubricating tube. Remove the six cap screws connecting filler pipe to fuel tank, and lift filler pipe and valve lever assembly away from the fuel tank.

(2) *Remove winch assembly.* Remove the eight large cap screws that attach winch base to bottom of hull. Unscrew the packing nut from rear yoke sleeve on center drive shaft universal

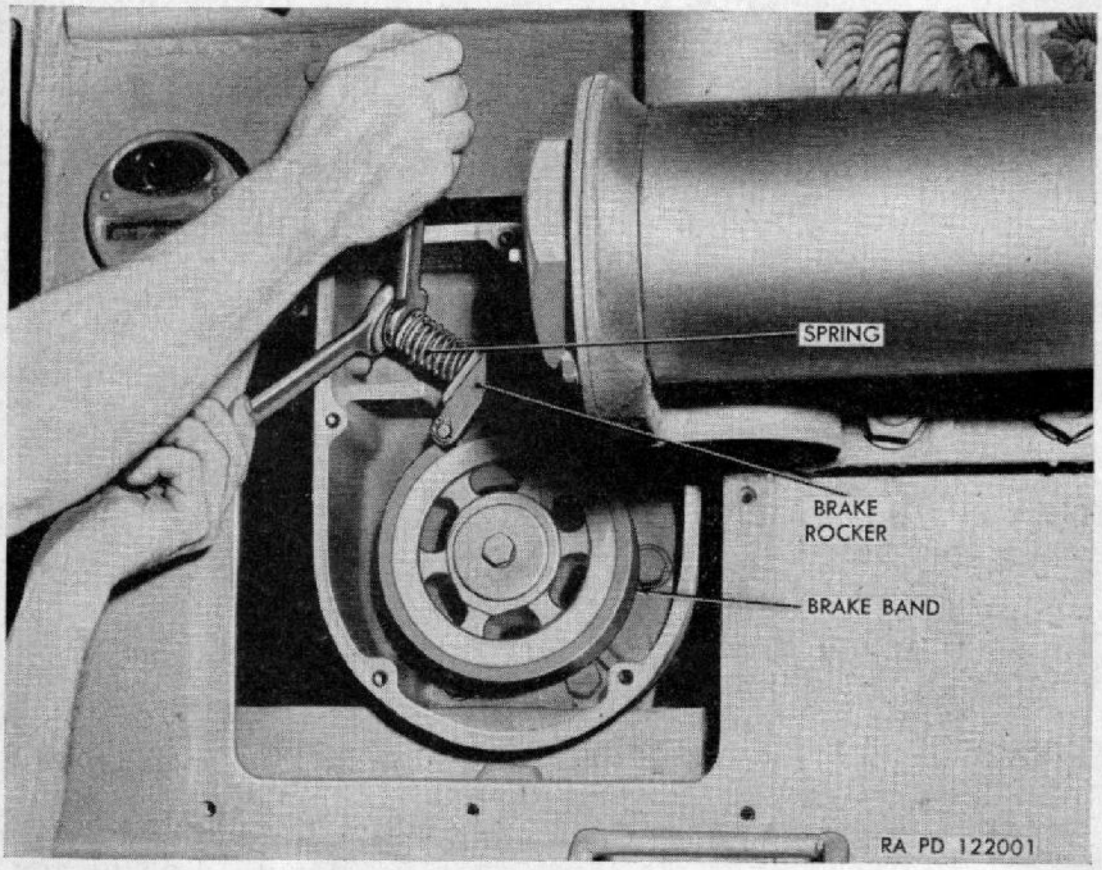


Figure 162. Winch brake adjustment.

(fig. 164). Place chains or rope sling on winch, and raise winch slowly with hoist until front end of rear drive shaft slips out of sleeve; then raise winch up and out of tractor. Remove cap screw and washer from front end of winch worm shaft after winch is removed (fig. 160) and slide universal off worm shaft.

c. Installation of Winch Assembly.

(1) *Install winch in tractor.* Slide the rear universal joint yoke into front end of winch worm shaft and install large flat washer, lock washer, and retaining cap screw in end of shaft (fig. 160). Lower winch into place; at same time, guide

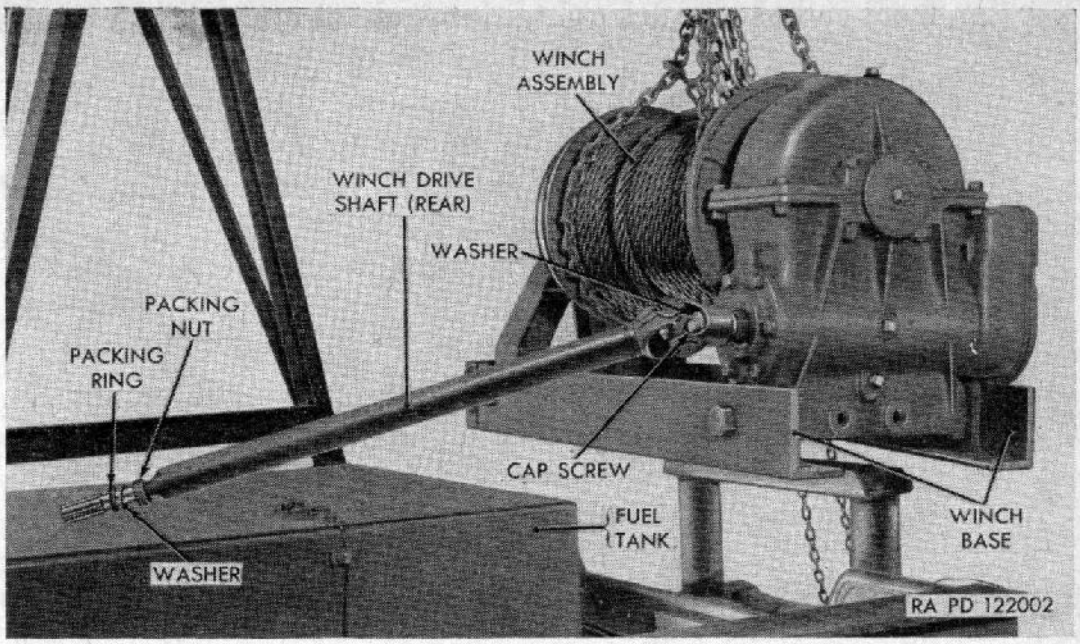


Figure 163. Winch assembly removed.

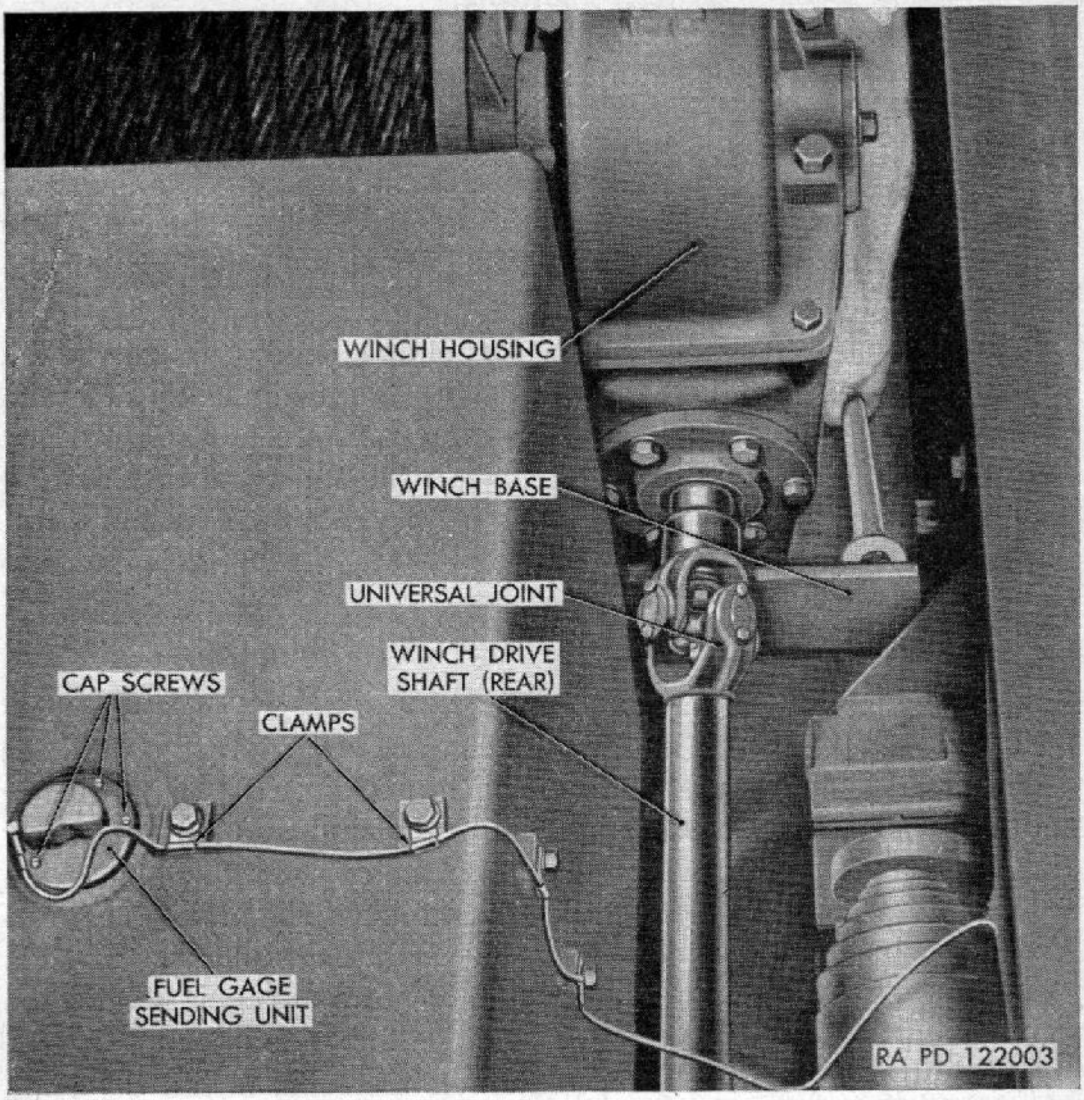


Figure 164. Installing winch.

front end of rear drive shaft into yoke sleeve. Attach winch base to bottom of hull with eight large cap screws and lock washers. Slip packing and thin washer into center universal yoke sleeve, and screw packing nut onto sleeve.

(2) *Install fuel filler pipe and heater valve lever.* Position new gasket between filler pipe flange and fuel tank. Place pipe in position (fig. 47); at same time insert prongs at lower end of heater valve lever in valve arm. Attach pipe to tank with six cap screws and lock washers, tightening cap screws firmly; then install attaching bolts in filler pipe support bracket. Tighten the two bolts connecting angle on bottom of pipe to support bracket first, then tighten support bracket bolts. Install cotter pins in ends of prongs in heater valve lever. Insert end of lubricating tube through hole in rear of hull, and install and tighten nut on end of tube. Install ammunition box (par. 214*b*).

218. Winch Brake Band Assembly

a. Removal. Remove hull plate (fig. 161) from rear of tractor and brake housing cover plate from winch. Remove both nuts, spring alining washer, and spring from threaded end of band (fig. 165). Pull cotter pins from pins in rocker and end of band, and remove pins and links. Remove the rocker and spacer from case. Remove lower adjusting and lock nut from band. Remove band assembly from the winch brake housing.

b. Installation. Install replacement brake band with the lower adjusting nut, lock nut, and spacer on the threaded end of the brake band. Install the rocker, links, and pins, and install cotter pins in pins in rocker and end of band. Then install the spring, spring alining washer and nuts on the threaded end of the brake band. Adjust winch brake according to paragraph 217*a*. Install winch brake housing cover plate and hull plate.

219. Winch Brake Drum

a. Removal. Remove hull plate (fig. 161) from rear of tractor and brake housing cover plate from winch. Remove the top adjusting nut and lock nut from threaded end of brake band, and remove spring and alining washer (fig. 165). This will loosen the brake band from around the drum. To remove the drum, remove the brake drum cap screw (fig. 165) and pull brake drum from the shaft. If the drum is tight, use a puller to remove the drum. The brake drum is held on the shaft by a key.

b. Installation. Install brake drum on shaft and install the drum cap screw. Install spring, spring alining washer, lock and adjusting

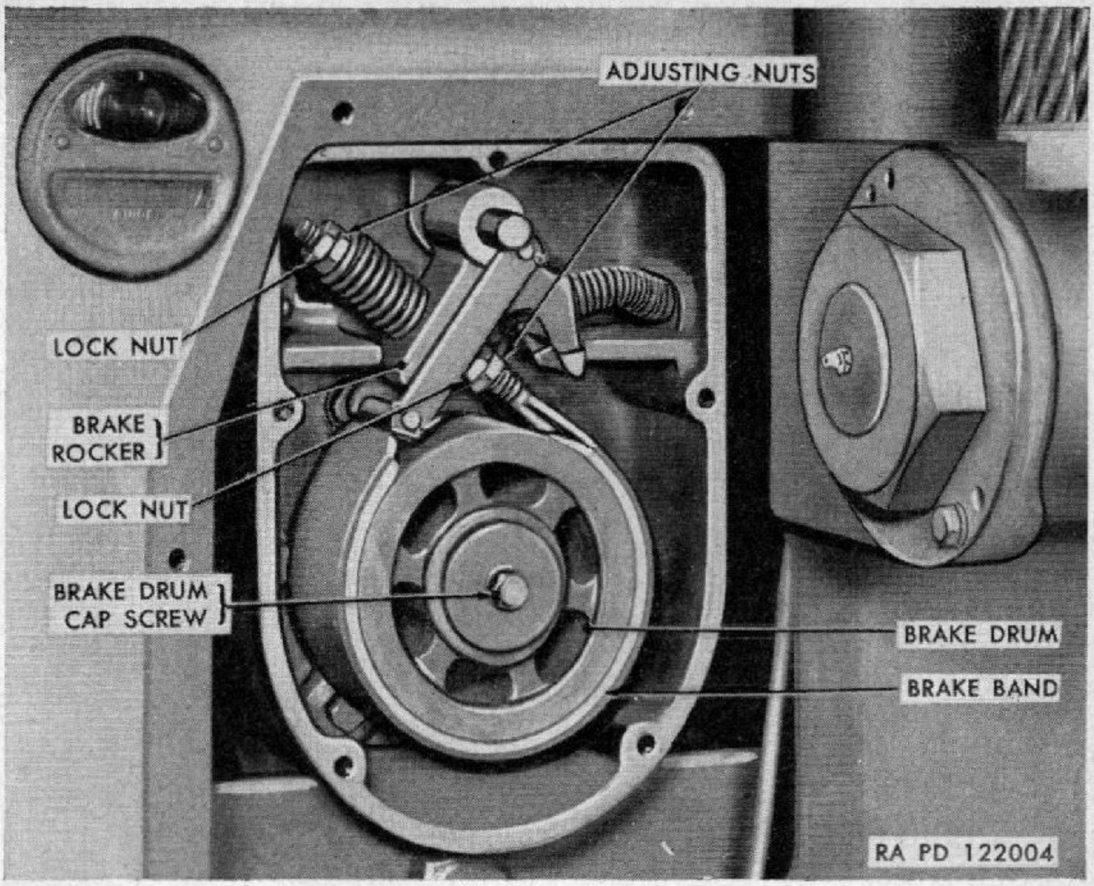


Figure 165. Winch brake installed.

nut on the threaded end of the band. Adjust winch brake according to paragraph 217*a*. Install winch brake housing cover plate and hull plate.

220. Winch Cable and Hook Assembly

a. Replacement of Winch Cable. To replace a cable; unwind the cable completely from the drum. Remove the two nuts from the clamp that attaches cable to the right side of drum flange. Install a replacement cable to drum flange with clamp and two nuts. When winding cable, be sure it is wound tightly and evenly. Lubricate cable according to instructions on lubrication order (par. 70).

b. Replacement of Cable Hook. Remove locking nut from cable end of hook. This will release the locking effect on the cable and the hook can be removed from the cable. Install replacement hook on end of cable and tighten hook locking nut securely. Use cable to test for proper operation and installation of hooks.

221. Winch Drive Shaft Bearings and Universal Joints

a. Removal. Slide the ammunition box back (par. 214*c*). Remove socket-head lock screw in drive shaft collar (fig. 166) so the shaft can

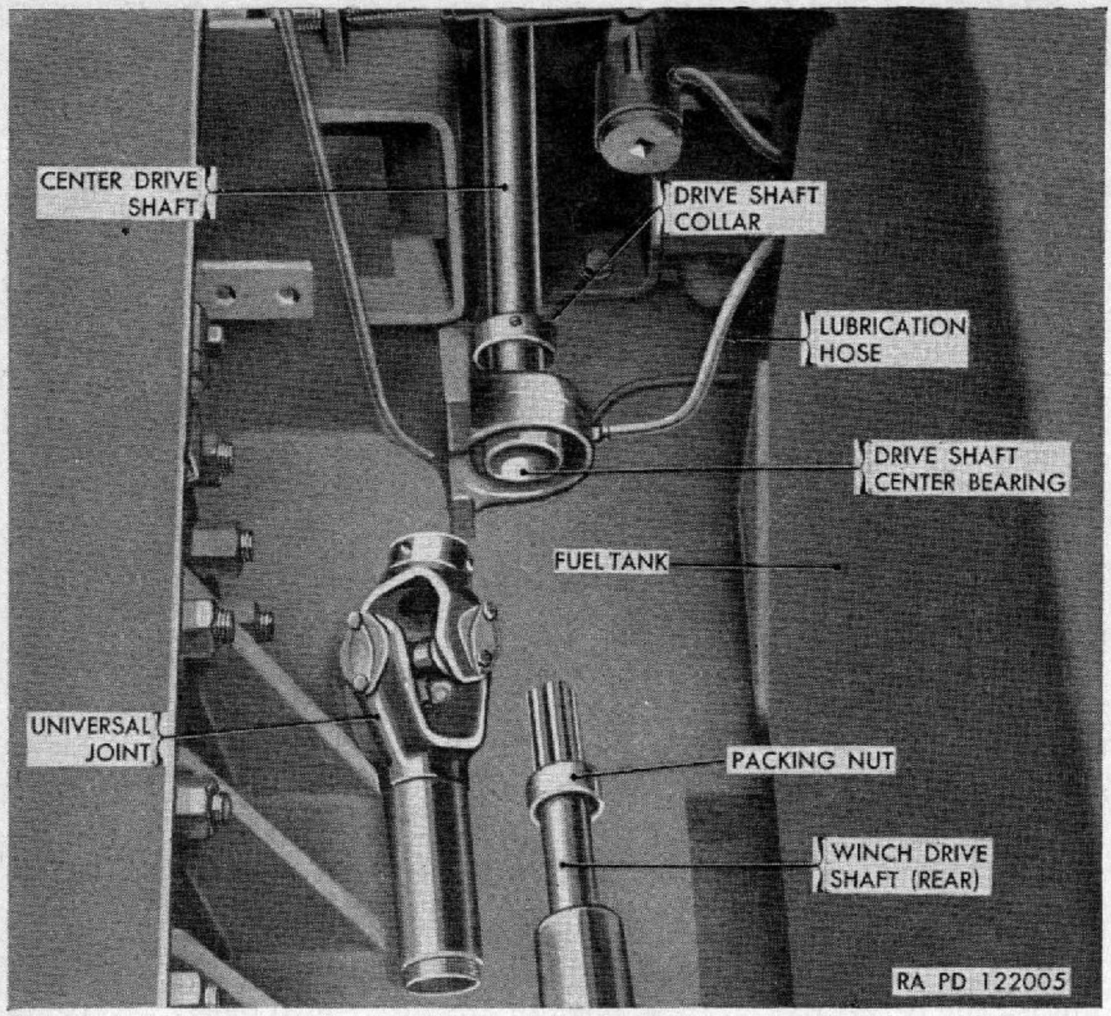


Figure 166. Winch drive shaft bearing removal.

slide endways. Remove the lubrication hose at fuel tank and at the bearing. Then remove the socket-head lock screw from the universal joint and unscrew the packing nut at spline. Slide the universal joint assembly toward rear of tractor while sliding drive shaft forward. This will release the universal joint assembly from the shaft; then remove the shaft Woodruff key. Remove the two cap screws that hold the bearing housing to the hull (fig. 167) and pull the bearing off the shaft. The same procedure is used to remove the front bearing with the exception of moving the ammunition box back.

b. Installation. Install replacement shaft bearing on shaft and install to hull with two cap screws (fig. 167). Insert Woodruff key in shaft and connect universal joint to shaft being sure it slides ahead far enough. Insert socket-head locking screw and tighten universal joint to shaft. Insert socket-head locking screw in shaft collar and slide it against the bearing and tighten screw. Install lubrication hose and lubricate bearing. Place ammunition box in position (par. 214*c*). Start engines and check for proper operation of winch center shaft and bearings.

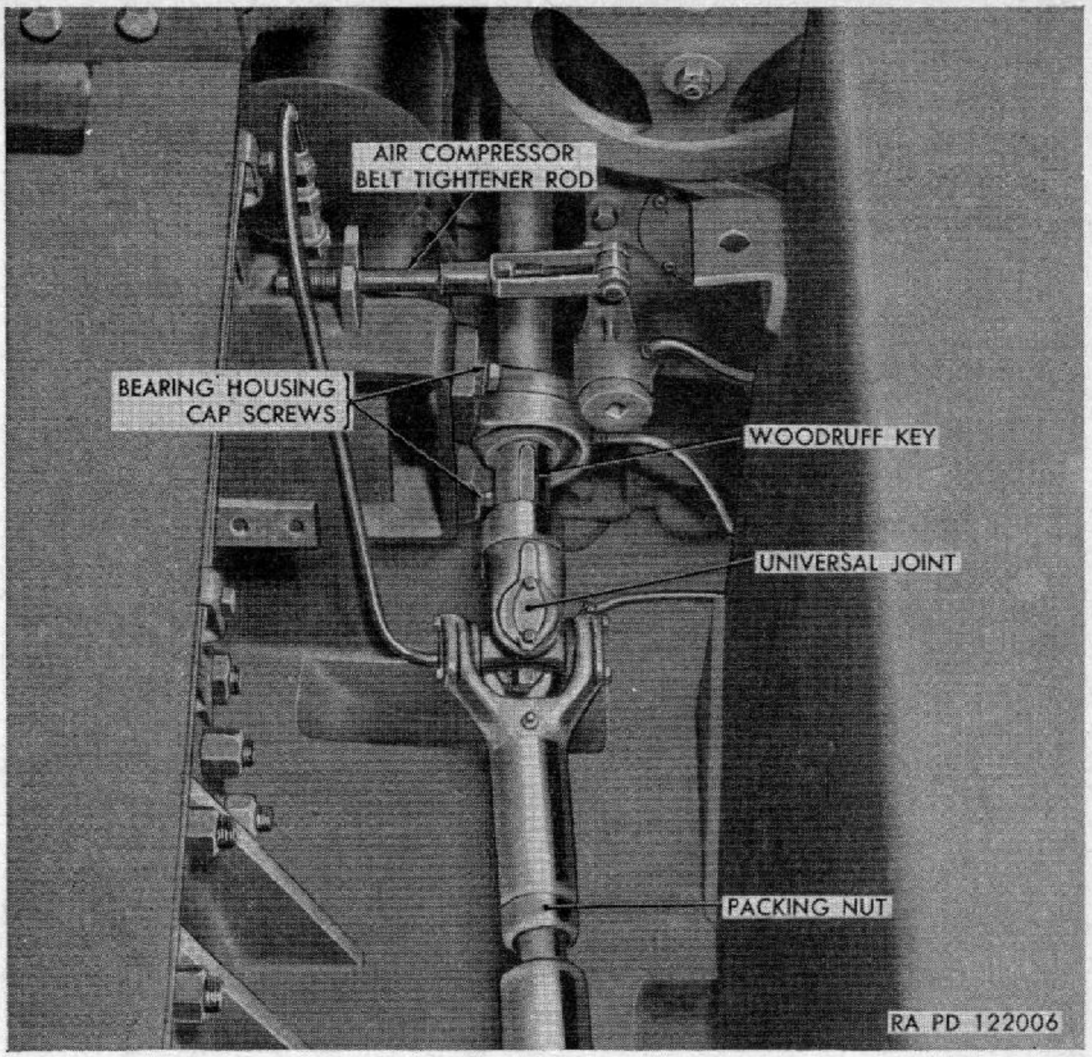


Figure 167. Winch universal joint removal.

222. Winch Drive Shaft Assembly

a. Removal. Slide the ammunition box back (par. 214*c*). The same procedure is used to remove the winch drive shaft as to remove the winch drive shaft bearing (par. 221*a*) with the exception of the bearing removal. The bearings are left on the shaft at both ends. Open door at rear compartment and remove the two bolts which attach bearing bracket to tractor hull. Slide universal joint off shaft and remove shaft out toward rear of tractor.

b. Installation. Install replacement drive shaft in position and attach both ends of bearing brackets to the hull. Place front universal joint in position on the shaft and tighten socket-head screw. Use same procedure as to install universal joint and collar assembly (par. 221*b*). Operate power take-off and check for proper operation.

223. Winch Shear Pin

a. Removal. Open rear crew compartment floor plate and remove cotter pin from shear pin (fig. 168). Using a hammer and a pin driver, remove pin from power take-off shaft. Inspect pin hole for wear or looseness.

b. Installation. Install shear pin and install cotter pin. Operate power take-off and winch and check for proper operation of shear pin. Check for looseness or worn shaft units. Close rear crew compartment floor plate.

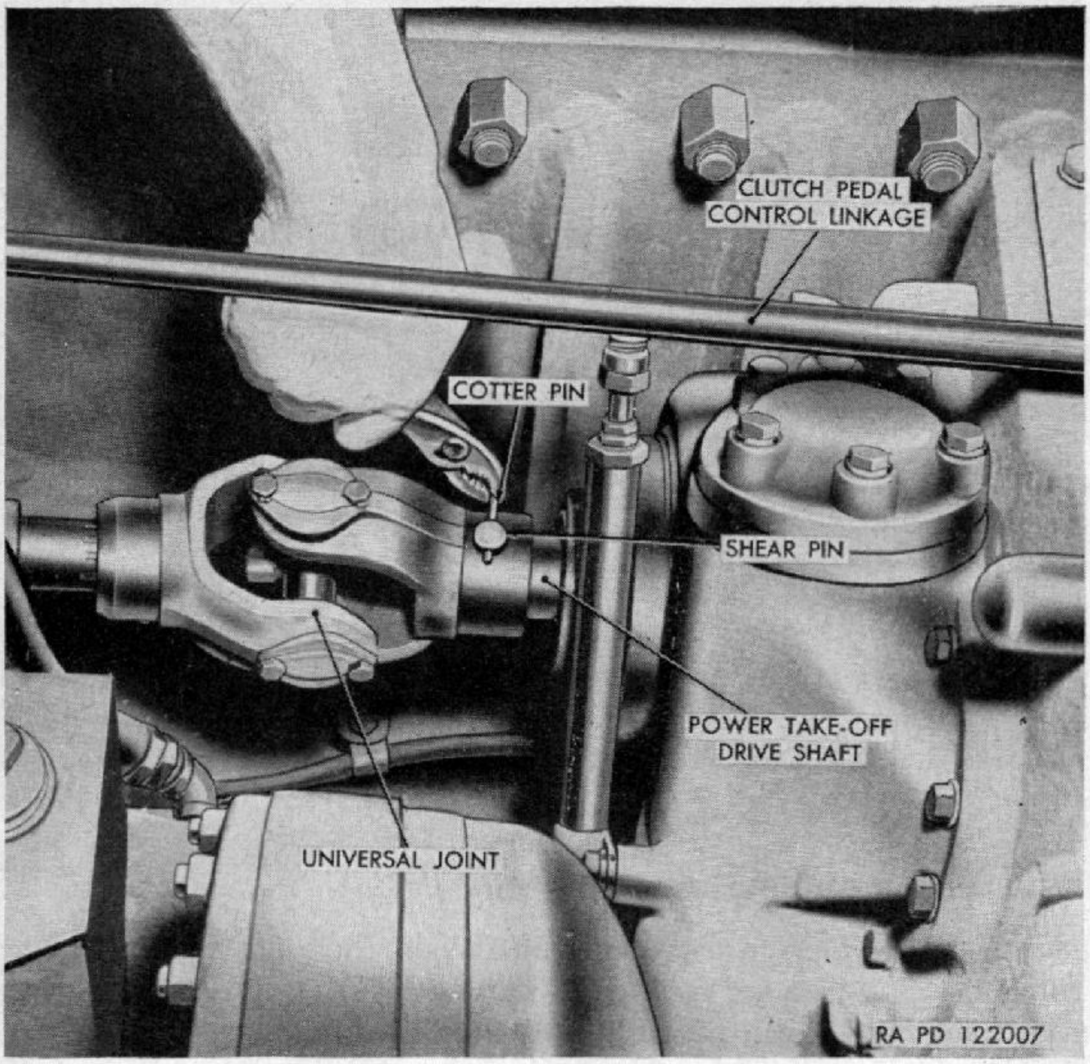


Figure 168. Winch shear pin replacement.

224. Power Take-Off

a. General. No maintenance of the power take-off is required other than lubrication or replacing worn or broken control rods, yoke pins, or levers that might cause improper shifting of gears or incomplete engagement of gears.

b. Adjustment of Control Linkage. The power take-off shifter rod and range shifter rod are adjusted at the control lever yoke end of linkage (fig. 169). Remove seat. Remove cotter pin from the yoke pin and loosen lock nut. Turn yoke on linkage until proper adjustment is acquired. To obtain proper adjustment, connect yoke with pin to control lever, start engine and operate winch drive shaft with the winch clutch disengaged. Continue adjustments until proper operation is obtained for complete shifting or engagement of gears. Install yoke with pin and cotter pin. Tighten lock nut on the control rod linkage and place seat in position.

c. Replacement of Levers and Control Linkages.

(1) *Replacement of levers.* Remove two large cap screws from floor plate to the left of control levers. Remove yoke pin

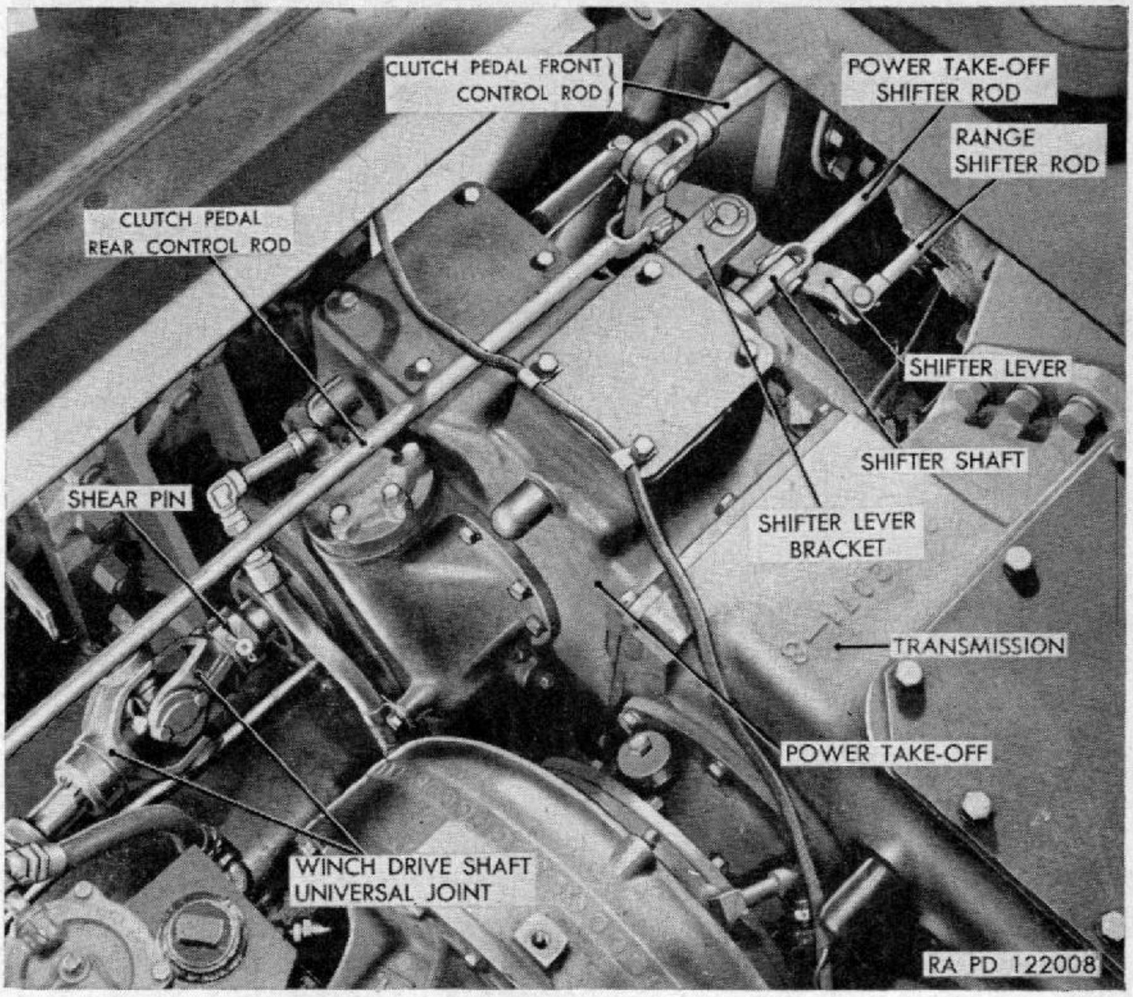


Figure 169. Power take-off installed.

from bottom of lever and remove the linkage. Loosen locking bolt on lever and pull the lever off stationary shaft. Install replacement lever on shaft and tighten locking bolt. Connect linkage and adjust properly (*b* above). Install floor plate with the two large cap screws.

(2) *Replacement of control linkages.* Remove yoke pin and yoke from control lever. At the power take-off, remove cotter and yoke pin from linkage (fig. 169). Install replacement linkage and connect both yoke pins and cotter pins. Operate winch for proper operation and adjust linkage if necessary.

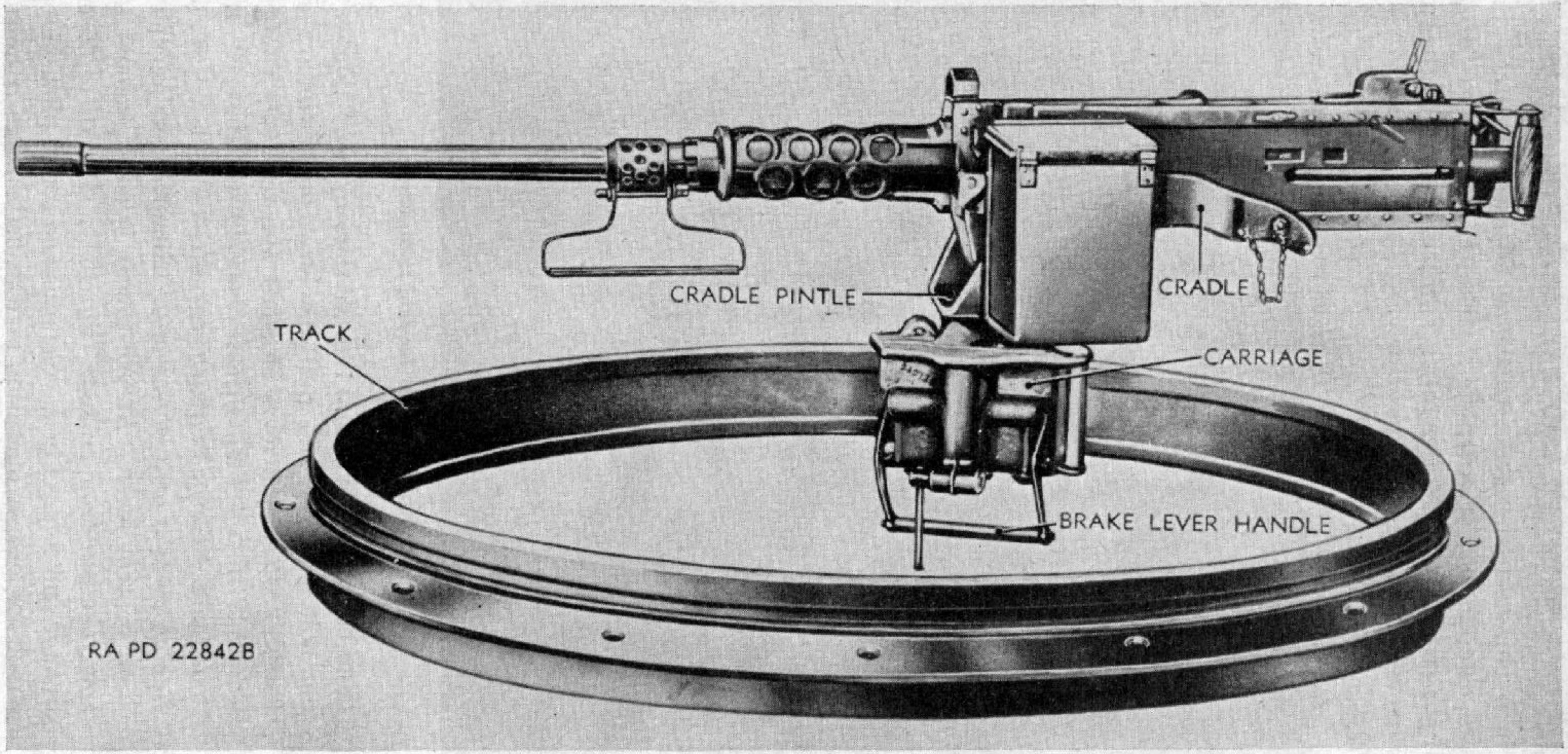


Figure 170. Ring mount, M49 C W/cal. .50 Browning, M2, heavy barrel, flexible machine gun.

Section XXIII. MACHINE GUN MOUNTS

225. Description

The 38-ton high-speed tractor M6 may be equipped with one of the following machine gun ring mounts: M49C, M49A1C, or M66. The mount is located on top of the cab over the rear seat compartment (fig. 3). These mounts consist essentially of a cradle with a carriage on a circular track (fig. 170). The carriage is guided on the track by means of rollers. When this vehicle is equipped with one of the aforementioned ring mounts, the cal. .50, Browning, M2, heavy barrel, flexible machine gun is used. The tripod mount M3, used when ground firing the cal. .50 machine gun, is stowed just forward of the ring mount (fig. 3). Complete detailed description, operating, and maintenance instructions for the machine gun and tripod mount are contained in FM 23–65. The ring mounts M49C, M49A1C, and M66 are essentially the same, therefore, the information in this section will apply to all.

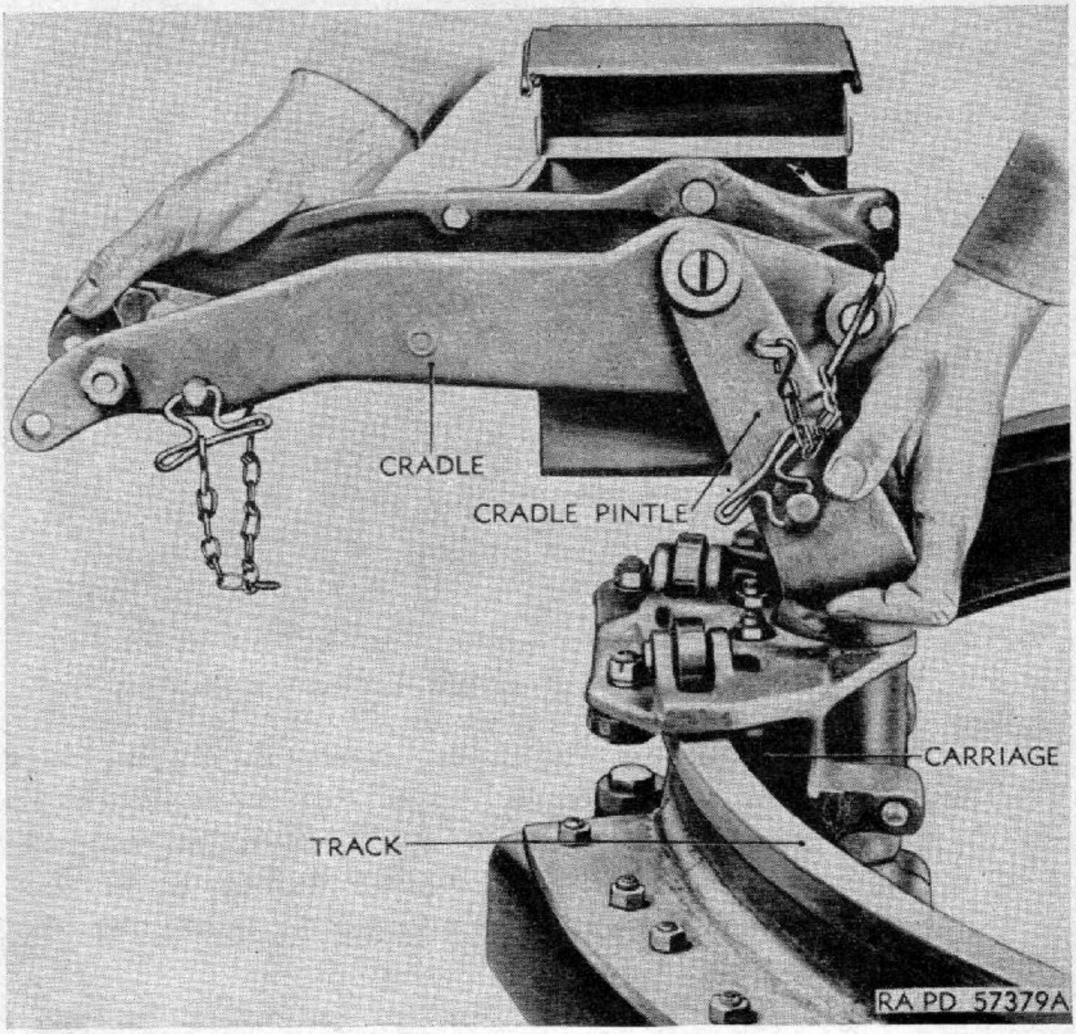


Figure 171. Installing the cradle and pintle on the carriage.

226. Mounting and Dismounting Machine Gun

a. Mounting Machine Gun.

(1) Place the cradle with the pintle on the carriage and rotate it until it snaps into position (fig. 171).

(2) Turn up the pintle clamping screw, but do not tighten. Raise the brake lever handle to lock carriage to the track (fig. 170). Adjust the cradle so that the locking holes of the cradle pintle and cradle aline. Insert the cradle locking pin and lock the cradle in a horizontal position (fig. 172).

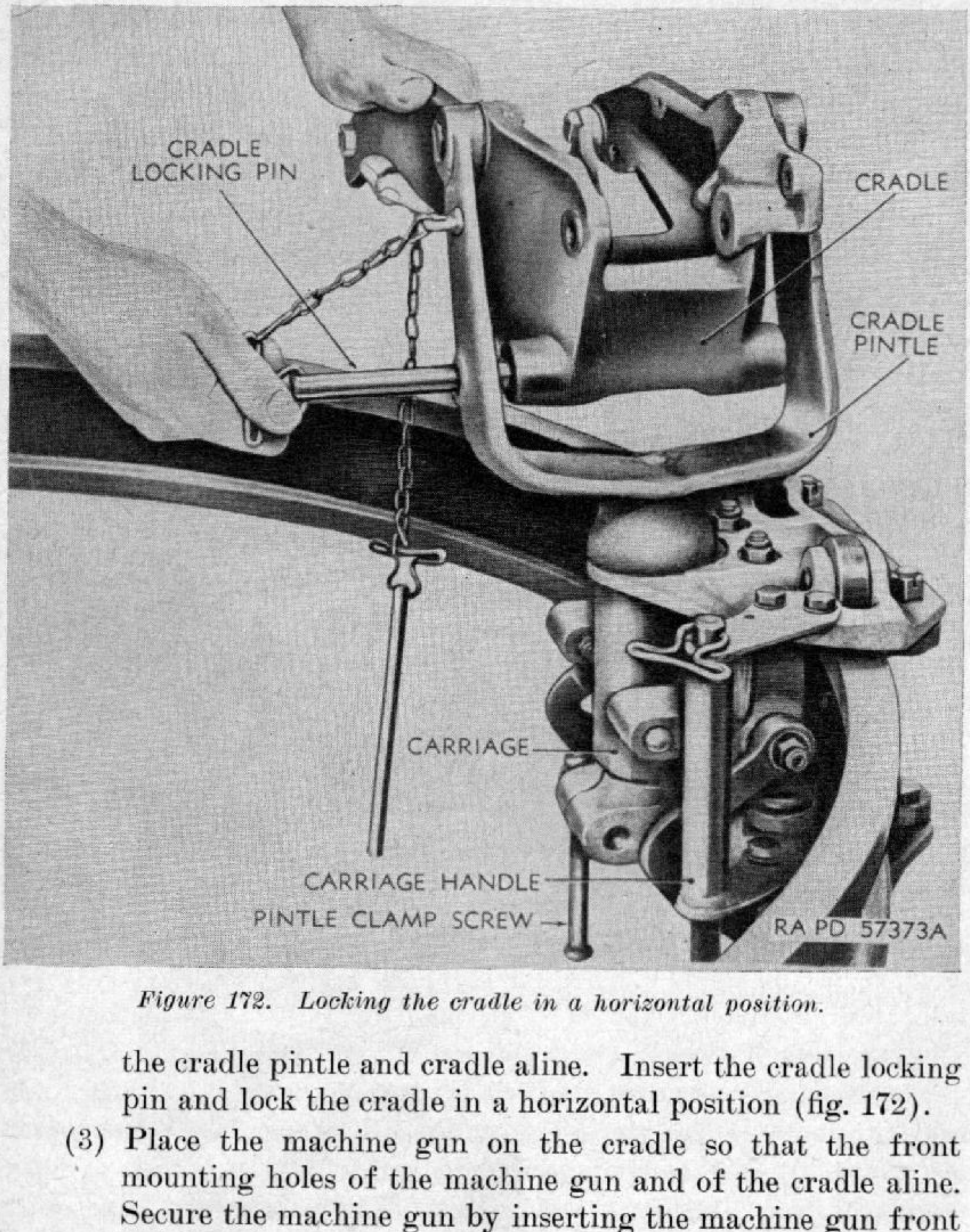


Figure 172. Locking the cradle in a horizontal position.

(3) Place the machine gun on the cradle so that the front mounting holes of the machine gun and of the cradle aline. Secure the machine gun by inserting the machine gun front locking pin (fig. 173).

(4) Swing the pivoted machine gun rear spacer forward, so that the rear mounting holes of the machine gun aline with the

holes in the spacer and with the rear mounting holes of the cradle. Insert the machine gun rear locking pin to secure the machine gun (fig. 174).

b. Dismounting Machine Gun.

(1) Check to make certain that gun is not loaded.

(2) Supporting the gun at the barrel support (do not hold by barrel), remove the machine gun front locking pin (fig. 173).

(3) Remove the machine gun rear locking pin and lift gun from cradle.

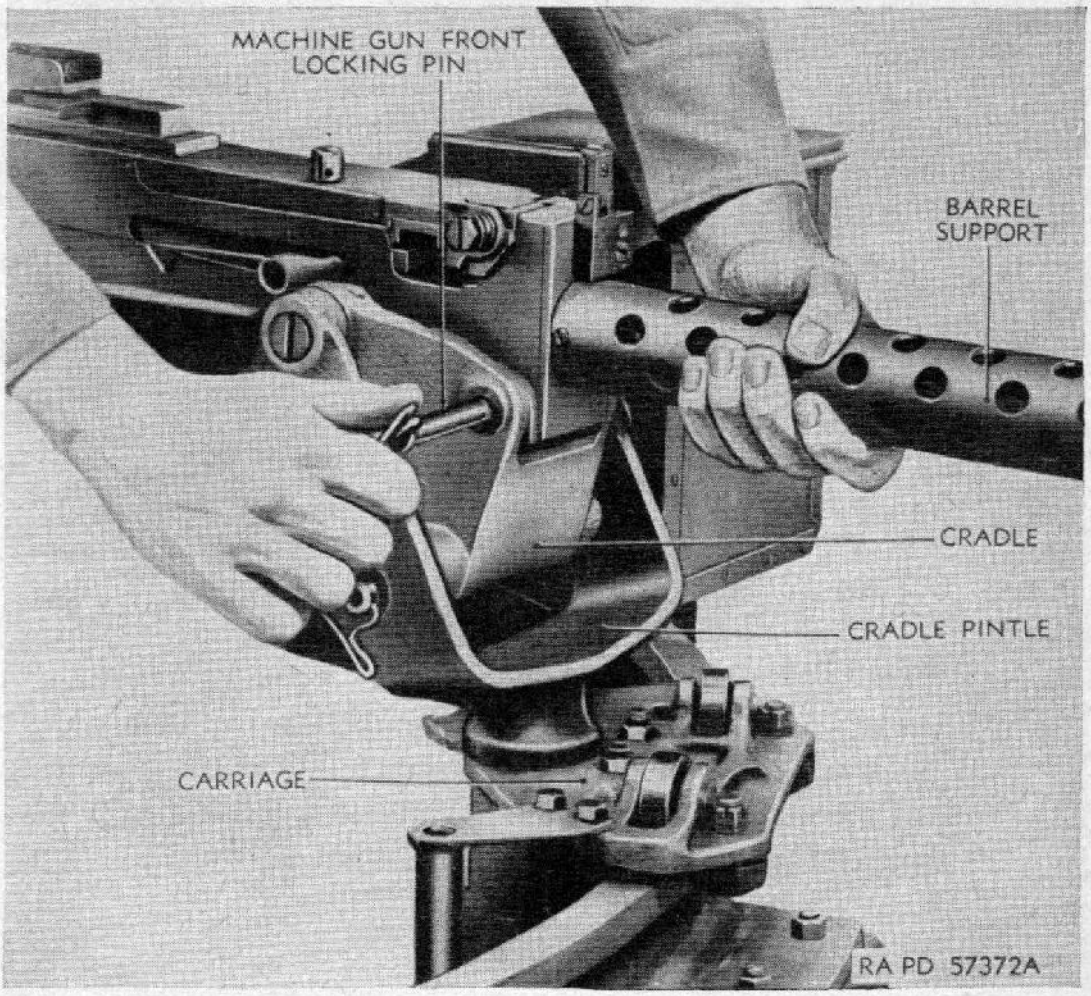


Figure 173. Securing front of machine gun to mount.

227. Maintenance

a. General. The maintenance services described in *b* below will be performed so as to insure maximum life and efficiency of the material. For a listing of the spare parts authorized the using arm personnel, refer to ORD 7 SNL G–184.

b. Procedures.

(1) Tighten all bolts, nuts, and screws to prevent their becoming loose in service. This should be done periodically when the vehicle is in use.

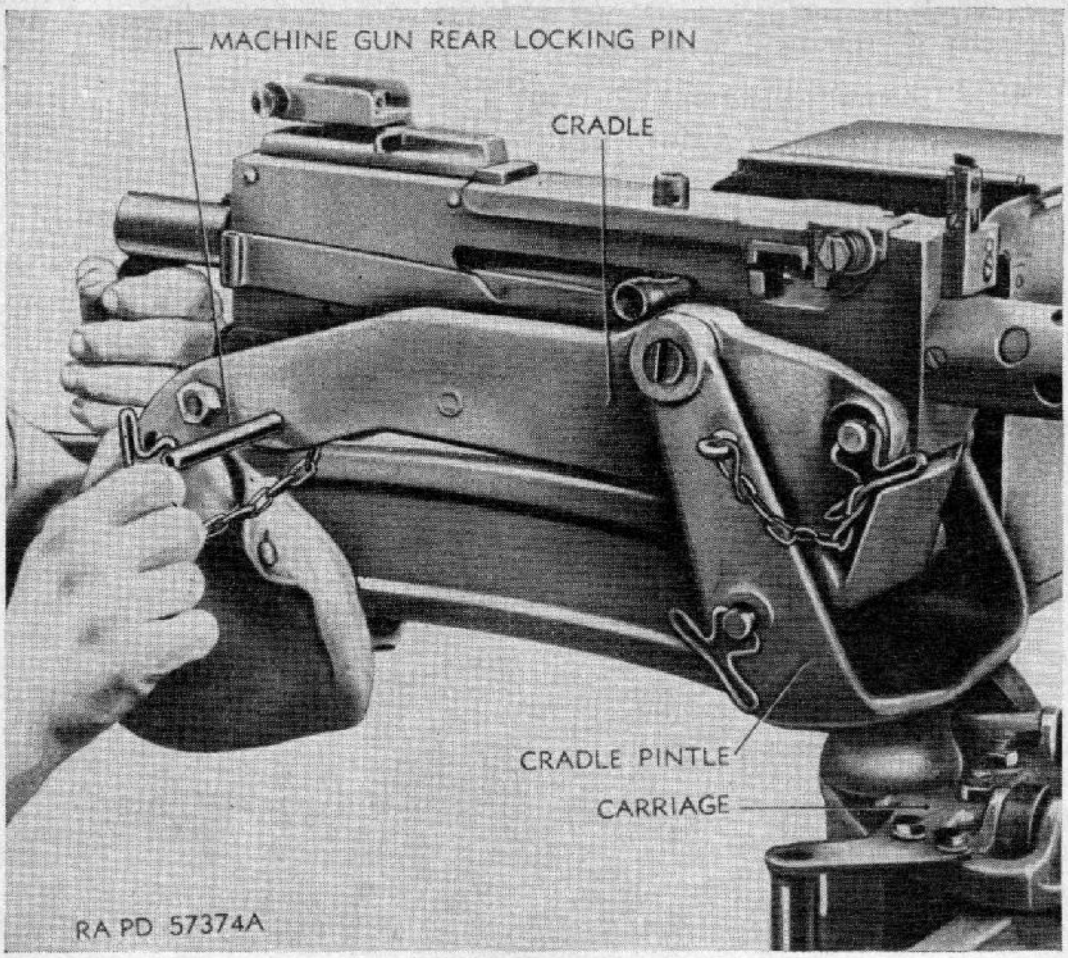


Figure 174. Securing rear of machine gun to mount.

(2) Remove all dirt and rust from the track and rollers.

(3) Clean all fittings and passages, making certain that all dirt and metal chips have been cleaned out. Clean the contacting surfaces on the pintle and in the pintle socket.

(4) Lubricate as specified on the lubrication order (par. 70).

228. Preparation for Traveling

If the machine gun is not going to be stowed while traveling, proceed as follows:

a. Support the barrel using the barrel locking clamp (fig. 3). This will prevent chattering and subsequent damage.

b. Raise the brake lever handle to lock the carriage to the track (fig. 170).

c. Install proper covers.

Section XXIV. MAINTENANCE UNDER UNUSUAL CONDITIONS

229. Extreme Cold Weather Maintenance Problems

a. The importance of maintenance must be impressed on all concerned, with special emphasis on organizational (preventive) maintenance. Maintenance of mechanical equipment in extreme cold is exceptionally difficult in the field. Even shop maintenance cannot be completed with normal speed, because the equipment must be allowed to thaw out and warm up before the mechanic can make satisfactory repairs. In the field, maintenance must be undertaken under the most difficult of conditions. Bare hands stick to cold metal. Fuel in contact with the hands results in supercooling due to evaporation, and the hands can be painfully frozen in the matter of minutes. Engine oils, except subzero grade, are unpourable at temperatures below −40° F. Ordinary greases become as solid as cold butter.

b. These difficulties increase the time required to perform maintenance. At temperatures below −40° F., maintenance requires up to five times the normal amount of time. The time required to warm up a vehicle so that it is operable at temperatures as low as −50° F. may approach 2 hours. Vehicles in poor mechanical condition probably will not start at all or only after many hours of laborious maintenance and heating. Complete winterization, diligent maintenance, and well-trained crews are the key to efficient arctic winter operations.

c. Refer to TM 9–2855 for general information on extreme cold weather maintenance procedures.

Caution: It is imperative that the approved maintenance procedures be followed. TM 9–2855 contains general information which is applicable to this vehicle as well as all other vehicles.

230. Extreme Hot Weather Maintenance

a. Cooling System. Thoroughly clean and flush the cooling system (par. 130) at frequent intervals and keep system filled to within a few inches of the overflow pipe with clean water. Formation of scale and rust in the cooling system occurs more often during operation in extremely high temperatures; therefore, corrosion inhibitor compound should always be added to the cooling liquid. Avoid the use of water that contains alkali or other substances which may cause scale and rust formations. Use soft water whenever possible.

b. Batteries.

(1) *Electrolyte level.* In torrid zones, check level of electrolyte in cells daily and replenish, if necessary, with pure distilled water. If this is not available, rain or drinking water may

be used. However, continuous use of water with high mineral content will eventually cause damage to the batteries and should be avoided.

(2) *Specific gravity.* Batteries operating in torrid climates should have a weaker electrolyte than for temperate climates. Instead of 1.280 specific gravity as issued, the electrolyte (sulphuric acid, sp-gr 1.280) should be diluted to 1.200 to 1.240 specific gravity (TM 9–2857). This is the correct reading for a fully charged battery. This procedure will prolong the life of the negative plates and separators. Battery should be recharged at about 1.160 specific gravity.

(3) *Self-discharge.* A battery will self-discharge at a greater rate at high temperatures if standing for long periods. This must be considered when operating in torrid zones. If necessary to park for several days, remove batteries and store in a cool place.

Note.—Do not store acid type storage batteries near stacks of tires, as the acid fumes have a harmful effect on rubber.

c. Hull and Cab.

(1) In hot, damp climates, corrosive action will occur on all parts of the vehicle and will be accelerated during the rainy season. Evidences will appear in the form of rust and paint blisters on metal surfaces and mildew, mold, or fungus growth on fabrics, leather, and glass.

(2) Protect exterior surfaces from corrosion by touch-up painting and keep a film of preservative lubricating oil (special) on unfinished exposed metal surfaces. Cables and terminals should be protected by ignition insulation compound.

(3) Make frequent inspections of idle, inactive vehicles. Remove corrosion from exterior metal surfaces with abrasive paper or cloth and apply a protective coating of paint, oil, or suitable rust preventive.

231. Maintenance After Fording

a. General. Although the vehicle unit housings are sealed to prevent the free flow of water into the housings, it must be realized that, due to the necessary design of these assemblies, some water may enter, especially during submersion. The following services should be accomplished on all vehicles which have been exposed to some depth of water or completely submerged, especially in salt water. Precautions should be taken as soon as practicable to halt deterioration and avoid damage before the vehicle is driven extensively in regular service.

b. Hull and Cab. Drain and clean out hull. Clean all exposed surfaces and touch up paint where necessary. Coat unpainted metal parts with preservative lubricating oil.

c. Engine, Transmission, Torque Converters, Differential, and Final Drives. Check the lubricant in the engines, transmission, torque converters, differential, and final drives. Should there be evidence that water has entered, drain, flush, and refill with the correct lubricant. Remove the clean engine and torque converter oil filters.

d. Suspension. Clean and lubricate all parts as specified on the lubrication order. Make sure that lubricant is generously forced into each lubrication fitting to force out any water present.

e. Batteries. Check the batteries for quantity and specific gravity of electrolyte to be sure no water entered through the vent caps. This is of special importance should the vehicle have been submerged in salt water.

f. Electrical Connections. Check all electrical connections for corrosion, particularly the bayonet-type connectors.

g. Fuel System. Drain fuel tanks of any accumulated water, clean fuel filter and lines as necessary. If water is found in the air cleaner, clean and refill with oil.

h. Condensation. Although most units are sealed, the sudden cooling of the warm interior air upon submersion may cause condensation of moisture within the cases or instruments. A period of exposure to warm air after fording should eliminate this condition. Cases which can be opened may be uncovered and dried.

i. Aluminum or Magnesium Parts. If vehicles remains in salt water for any appreciable length of time, aluminum or magnesium parts which were exposed to the water will probably be unfit for further use and must be replaced.

j. Deep-water Fording Kit. Refer to TM 9–2853 for deep-water fording kit information.

232. Maintenance After Operation on Unusual Terrain

a. Mud. Thorough cleaning and lubrication of all parts affected must be accomplished as soon as possible after operation in mud, particularly when a sea of liquid mud has been traversed. Clean all suspension components and lubricate as specified on the lubrication order (par. 70).

b. Sand or Dust. Clean engine and engine compartment. Touch up all painted surfaces damaged by sand blasting. Lubricate completely to force out lubricnts contaminated by sand or dust. Air cleaners, fuel, and oil filters must be cleaned at least daily. Engine grilles and other exposed vents should be covered with cloth when vehicles is not in use.

CHAPTER 4

SHIPMENT AND LIMITED STORAGE AND DESTRUCTION OF MATÉRIEL TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

233. Domestic Shipping Instructions

a. Preparation for Shipment in Zone of Interior. When shipping the 38-ton high-speed tractor M6 interstate or within the zone of interior, the officer in charge of preparing the shipment will be responsible for furnishing vehicles to the carriers for transport in a serviceable condition, properly cleaned, preserved, painted, and lubricated as prescribed in SB 9–4.

Note.—For loading and blocking instructions for vehicles on flatcars, refer to paragraphs 235 and 236.

b. Preparation For Shipment to Ports.

(1) *Inspection.* All used vehicles destined for oversea use will be inspected prior to shipment in accordance with TB ORD 385.

(2) *Processing for shipment to ports.* All vehicles destined to ports of embarkation for oversea shipment will be further processed in accordance with SB 9–4.

Note.—Ports of embarkation will supplement any necessary or previously omitted processing upon receipt of vehicles.

c. Removal of Preservatives For Shipment. Personnel withdrawing vehicles from a limited storage status for domestic shipment must not remove preservatives, other than to insure that they are complete and serviceable. If it has been determined that preservatives have been removed, they must be restored prior to domestic shipment. The removal of preservatives is the responsibility of depots, ports, or field installations (posts, camps, and stations) receiving the shipments.

d. Army Shipping Documents. Prepare all Army shipping documents accompanying freight in accordance with TM 38–705.

e. Deep Water Fording. If during the course of shipment, operations embrace deep water fording, prepare vehicles in accordance with TM 9–2853.

234. Limited Storage Instructions

a. General.

(1) Vehicles received for storage already processed for domestic shipment, as indicated on the vehicle processing record tag (DA AGO Form 9–3), must not be reprocessed unless the inspection performed on receipt of vehicles reveals corrosion, deterioration, etc.

(2) Completely process vehicles upon receipt directly from manufacturing facilities, or if the processing data recorded on the tag indicates that they have been rendered ineffective by operation or freight shipping damage.

(3) Vehicles to be prepared for limited storage must be given a limited technical inspection and be processed as prescribed in SB 9–63. The results and classification of vehicles will be entered on DA AGO Form 461–5.

b. Receiving Inspections.

(1) Report of vehicles received for storage in a damaged condition or improperly prepared for shipment will be reported on DD Form 6 in accordance with SR 745–45–5. Report of vehicles received in an unsatisfactory condition (chronic failure or malfunction of the vehicle or equipment) will be reported on DA Form 468 in accordance with SR 700–45–5.

(2) When vehicles are inactivated, they are to be stored in a limited storage status for periods not to exceed 90 days. Stand-by storage for periods in excess of 90 days will normally be handled by ordnance maintenance personnel only.

(3) Immediately upon receipt of vehicles for storage, they must be inspected and serviced as prescribed in paragraphs 6–9. Perform a systematic inspection and replace or repair all missing or broken parts. If repairs are beyond the scope of the unit and the vehicles will be inactivated for an appreciable length of time, store them in a limited storage status and attach tags specifying the repairs needed. The reports of these conditions will be submitted by the unit commander for action by an ordnance maintenance unit.

c. Inspections During Storage. Perform a visual inspection periodically to determine general condition. If corrosion is found on any part, remove the rust spots, clean, paint, and treat with the prescribed preservatives.

Note.—Touch-up painting will be in accordance with TM 9–2851.

d. Removal From Limited Storage.

(1) If the vehicles are not shipped or issued upon expiration of the limited storage period, they may either be processed for another limited storage period or be further treated for

stand-by storage (vehicles inactivated for periods in excess of 90 days up to 3 years) by ordnance maintenance personnel.

(2) If vehicles to be shipped will reach their destination within the scope of the limited storage period, they need not be reprocessed upon removal from storage unless inspection reveals it to be necessary according to anticipated in-transit weather conditions.

Note.—All vehicles being reissued through the depot supply system to troops within the continental limits of the United States must meet the requirements of TB ORD 385. This is NOT required for so-called reissues, exchanges or redistribution among troop units, where the depot supply system is not involved.

(3) Deprocess vehicles when it has been ascertained that they are to be placed into immediate service. Remove all rust preventive compounds and thoroughly lubricate as prescribed in paragraphs 70–73. Inspect and service vehicles as prescribed in paragraphs 6–9.

(4) Repair and/or replace all items tagged in accordance with *b*(3) above.

e. Storage Site. The preferred type of storage for vehicles is under cover in open sheds or warehouses whenever possible. Where it is found necessary to store vehicles outdoors, the storage site must be selected in accordance with AR 700–105 and protected against the elements as prescribed in TB ORD 379.

235. Loading the Tractor for Rail Shipment

a. Preparation.

(1) When vehicles are shipped by rail, every precaution must be taken to see that they are properly loaded and securely fastened and blocked to the floor of flatcar. All on vehicle matériel (OVM) will be thoroughly cleaned, preserved, packed (boxed or crated), and securely stowed in or on the vehicle or on flatcar for transit.

(2) Prepare all vehicles for rail shipment in accordance with paragraph 233*a*. In addition, take the following precautions:

(*a*) If vehicle is to be shipped within the continental United States, *except* directly to ports of embarkation, disconnect the battery cables from battery. Clean if necessary and wrap cable terminals and battery posts with nonhygroscopic adhesive tape. Secure terminals away from battery.

Note.—Not required for drive-away movement.

(*b*) If vehicle is to be shipped directly to ports of embarkation, *except* when vehicle is to be combat loaded, remove batteries, plug vents, clean with an alkali type cleaning compound or trisodium-phosphate diluted with water and rinse with *cool* water and remove vent plugs. Scrape or wire brush and clean cable terminals and battery box (holder) with a soda solution. Rinse with *cool* water. Coat cable terminals with No. 2 general purpose lubricating grease. Paint battery boxes with black acid-resisting paint. Battery will be boxed in accordance with TM 9–2857 and TM 9–2854 and secured in vehicle with OVM.

(*c*) Apply the parking brakes and place the transmission in neutral position after the vehicle has been finally spotted on the flatcar. The vehicle must be loaded on the flatcar in such a manner as to prevent the flatcar from carrying an unbalanced load.

b. Type of Cars. Instructions contained herein pertain to the loading of vehicles on flatcars (cars with wooden floors laid over sills and without sides and ends but equipped with stake pockets).

c. Method of Loading Vehicles on Flatcars.

(1) Vehicles will be loaded and unloaded with the use of hoisting equipment when available. When suitable hoisting equipment is not available for loading on or for subsequent unloading from a flatcar, an end ramp must be used in cases where the vehicle is not on a level with the flatcar deck. Vehicles on a warehouse platform or loading dock can be pivoted over spanning platforms aboard a flatcar adjacent to the platform, then again pivoted into lateral position on the flatcar.

(2) When vehicles must be loaded from ground level, a ramp may be improvised (*d* below) by borrowing railroad ties normally found stacked in railroad yards and by procuring necessary planking. An efficient end ramp is shown in place in figure 175. The bill of materials used to construct this ramp is shown in figure 176.

Note.—Railroad ties alone, stacked without deck planking and not securely anchored, provide a very unstable ramp and should not be attempted except under conditions of extreme emergency.

(3) Vehicles which can be loaded under their own power will be driven onto the improvised apron at base of ramp and then be carefully guided up the ramp to their positions on flatcar.

(4) To load vehicles which cannot be operated due to processing, tow onto the improvised apron at base of ramp and unhitch. Using a cable laid along the center line of the flatcar, attached to vehicle, the vehicle is pivoted to point toward the ramp.

Caution: Follow-up forward movement of the vehicle by chocking behind tracks on the ramp.

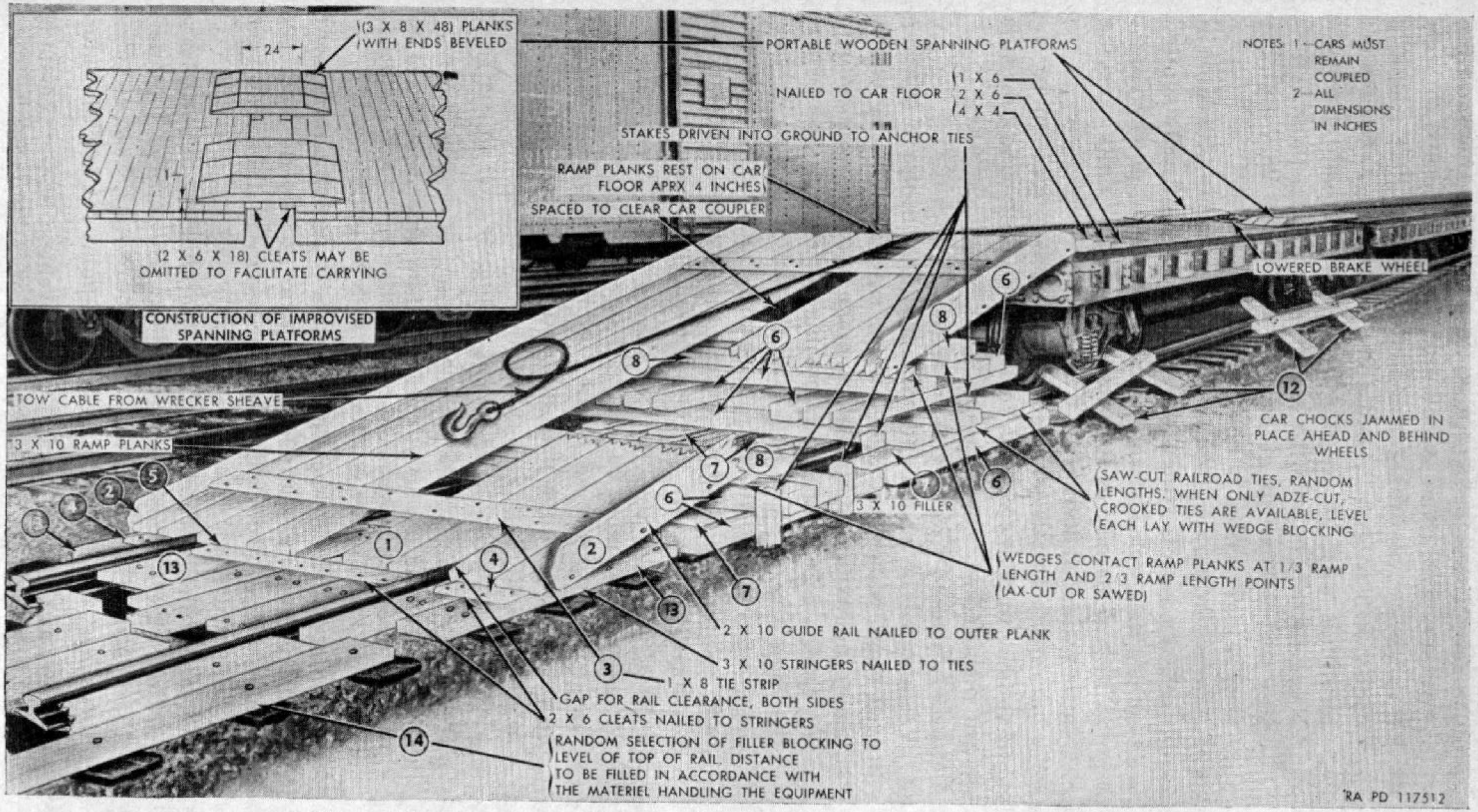


Figure 175. Construction of improvised loading ramp and spanning platforms.

BILL OF MATERIALS FOR RAMP AS ILLUSTRATED					
PART NO	QUANT REQ'D	PART NAME	LENGTH	WIDTH	THICKNESS
1	8	RAMP PLANKS	20 ft	10 in	3 in
2	2	GUIDE RAILS	20 ft	8 in	2 in
3	2	TIE STRIPS	8 ft	8 in	1 in
4	2	CLEATS	18 in	6 in	2 in
5	1	CLEAT	56 in	6 in	2 in
6	31	RAILROAD TIES	8 ft	8 in	8 in
7	AS REQD	FILLERS	AS REQD	10 in	3 in
8	AS REQD	WEDGES (CUT TO FIT)	8 ft	—	—
9	1	STEPDOWN PIECE	8 ft	4 in	4 in
10	1	STEPDOWN PIECE	8 ft	6 in	2 in
11	1	STEPDOWN PIECE	8 ft	6 in	1 in
12	4	CHOCK BLOCKS	AS REQD	4 in	4 in
13	AS REQD	STRINGERS	AS REQD	10 in	3 in
14	AS REQD	GROUND DUNNAGE	AS REQD		

NOTES:

1. RAMP SHOWN IS OF CAPACITY OF LARGEST END-LOADING FREIGHT CAR. FOR LESSER LOADS, REDUCE NUMBER OF RAMP PLANKS.
2. WIDTH DETERMINED BY TREAD OF MATERIEL BEING LOADED.
3. FOR LOADING TWO WHEELED ARTILLERY TRAILERS, OR SHORT WHEELBASE MATERIEL, RAMP PLANKS MAY BE SHORTER.

CAUTION: WHEN RAMP IS TOO SHORT, UNDERPINNING OF MATERIEL WILL STRIKE END OF RAMP (EX: 90 MM AA GUN).

4. OPENING AT CENTER MAY BE FILLED UP TO THE CAR COUPLER TO AVOID INJURY TO MANEUVERING PERSONNEL.
5. FOR LOADS OVER 40-TONS, APPROACH END OF FLATCAR MUST BE BLOCKED UP TO AVOID TIPPING OF FLATCAR.
6. THIS TYPE RAMP IS ADAPTABLE TO DROP-END GONDOLA AND AUTO END-DOOR BOX CAR LOADING.
7. WHEN LOADING AN AUTO END-DOOR BOX CAR, IT MAY BE NECESSARY TO LOAD A FLATCAR COUPLED TO THE BOX CAR, TO GAIN OVERHEAD LOADING CLEARANCE.
8. WHEN LOADING BY WRECKER CABLE, WITH PULL AT 90-DEGREES TO TRAIN, USING A SHEAVE, FLATCAR AT POINT OF PULL MUST BE LASHED TO ADJACENT RAILS, CARS, OR OTHER FIXED OBJECT.

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Figure 176. Bill of materials for improvised loading ramp.

(5) After the first vehicle is loaded on the flatcar, additional vehicles may be similarly hauled aboard by passing the towing cable beneath the loaded vehicle. When a train of flatcars is being loaded, steel or wooden spanning platforms or bridges are used to cover the gap between cars. Flatcar brake wheels must first be lowered to floor level to permit passage. A pair of improvised spanning platforms are shown in place in figure 175. These spanning platforms are moved along the train by hand as the vehicle advances.

(6) The above method train loading requires careful advance planning as to the order of loading, so that vehicles are arranged on each flatcar under prescribed methods and combinations.

(7) For powering the towing cable, a vehicle with a winch is spotted at *right angles* to the train. It is located at about the third or fourth flatcar to facilitate signaling and because of cable limits. A single-sheave snatch block located between cars on the train center line will provide the necessary *lateral* pull. A vehicle passing this point can be towed by a vehicle on the ground with personnel guiding its passage. A long tow cable from the towing vehicle will lessen the tendency of the towed vehicle to stray from the center line of the train.

Note.—The snatch block fastening chain must be lashed to an adjacent solidly fixed object or stake to offset the cross pull of the powered winch (fig. 177).

d. Loading Ramp.

(1) A ramp for end loading of vehicles on open top freight cars may be improvised when no permanent ramps or hoisting facilities are available. A ramp suitable for the loading of most ordnance items is shown in figure 175. For loading the tractor, the width of the ramp may be reduced to two double-planked runways, each cleated together. Length of planking must be determined with consideration to underhull clearance, in order to clear the hump at upper end of ramp.

Caution: Personnel guiding the vehicle up the ramp must exercise care when working close to the edges of the ramp planking.

(2) The flatcar bearing the ramp must be securely blocked against rolling, particularly when the car brakes are not applied as in train loading. Successive cars must remain coupled and be additionally chocked at several points along the train when ground towing of vehicles aboard the train is being effected.

(3) Whenever the flatcars are not on an isolated track or blocked siding, each end approach to the train must be posted with

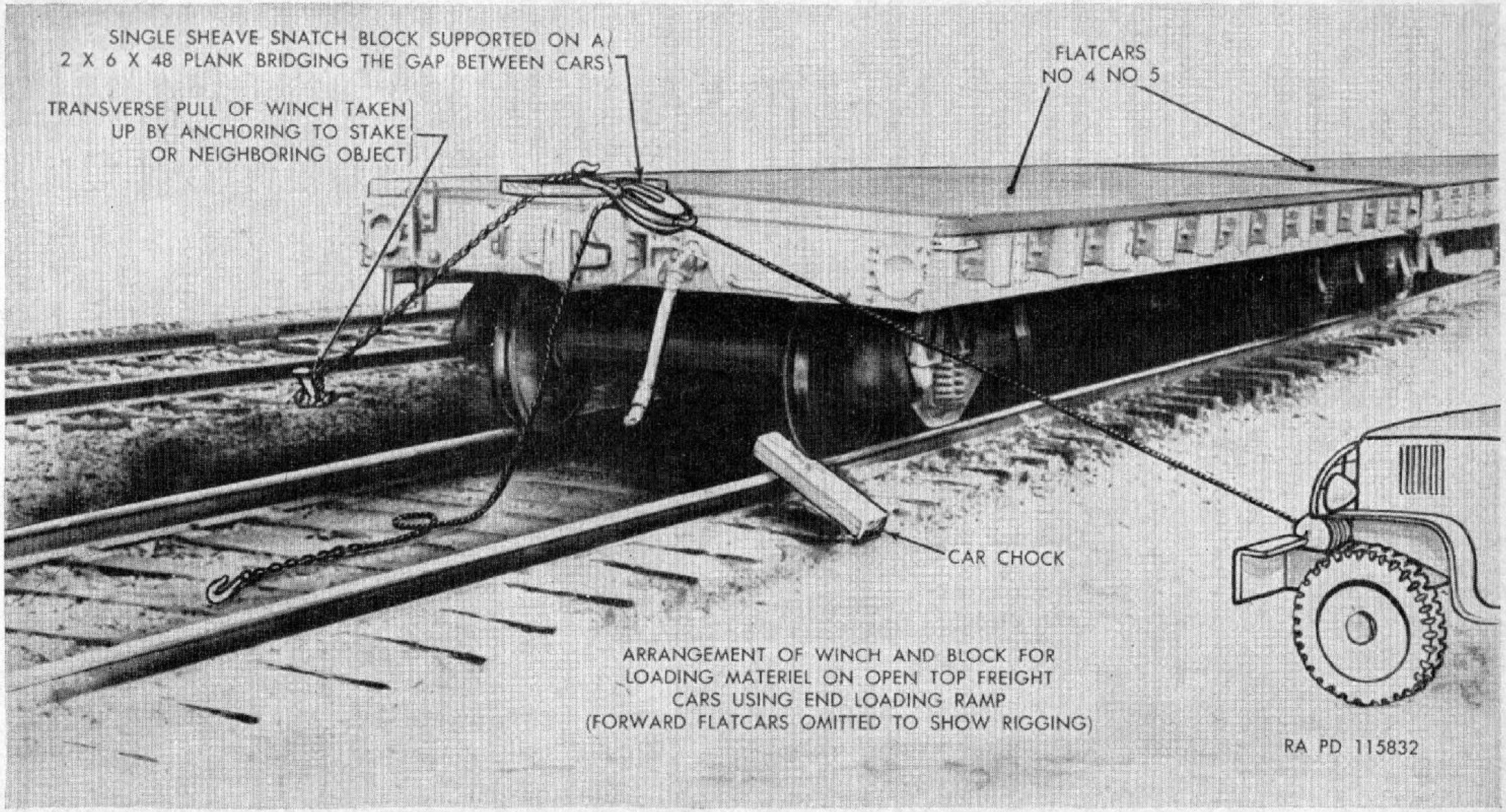

Figure 177. Method of powering the towing cable.

a blue flag or light to advise that men are at work and that the siding may not be entered beyond those points.

(4) Upon completion of the loading operation, the ramp planks and bridging devices should be loaded on the train for use in unloading operations. Random sizes of timbers used in building the approach apron up to rail level should be included. All materials should be securely fastened to the car floors, after vehicles are blocked in place, and entered upon the bill of lading (B/L). Railroad ties borrowed for the operation should not be forwarded to the unloading point unless specifically required and only with the consent of the owner.

e. Loading Rules. For general loading rules pertaining to rail shipment of ordnance vehicles, refer to TB 9–OSSC–G.

Warning: The height and width of vehicles when prepared for rail transportation must not exceed the limitations indicated by the loading table as prescribed in AR 700–105. Whenever possible, local transportation officers must be consulted about the limitations of the particular railroad lines to be used for the movement to avoid delays, danger, or damage to equipment.

236. Blocking the Tractor for Rail Shipment

a. General. All blocking instructions specified herein are minimum and are in accordance with the Association of American Railroads "Rules Governing the Loading of Commodities on Open Top Cars." Additional blocking may be added as required at the discretion of the officer in charge. Double-headed nails may be used if available, except in the lower pieces of two-piece cleats. All item reference letters given below refer to the details and locations as shown in figure 178.

Note.—Any loading methods or instructions developed by any source which appear in conflict with this publication or existing loading rules of the carriers, must be submitted to the Chief of Ordnance, Washington 25, D. C. for approval.

b. Brake Wheel Clearance "A." Load vehicles on cars with a minimum clearance of at least 4 inches below and 6 inches above, behind, and to each side of the brake wheel (fig. 178). Increase clearance as much as is consistent with proper location of load.

Note.—Cleats "F" and "G" must be located and nailed to car floor prior to loading the tractor on flatcars. This is accomplished by measuring the width between inside of tracks and applying chalk marks on car floor to establish the exact location of cleats.

c. Chock Blocks "B," Figure 179, Detail 1, (6 x 8 x 28 Inches, Eight Required.) Locate the 45° face of two chock blocks against the front of each track, and the 45° face of two chock blocks against the rear of

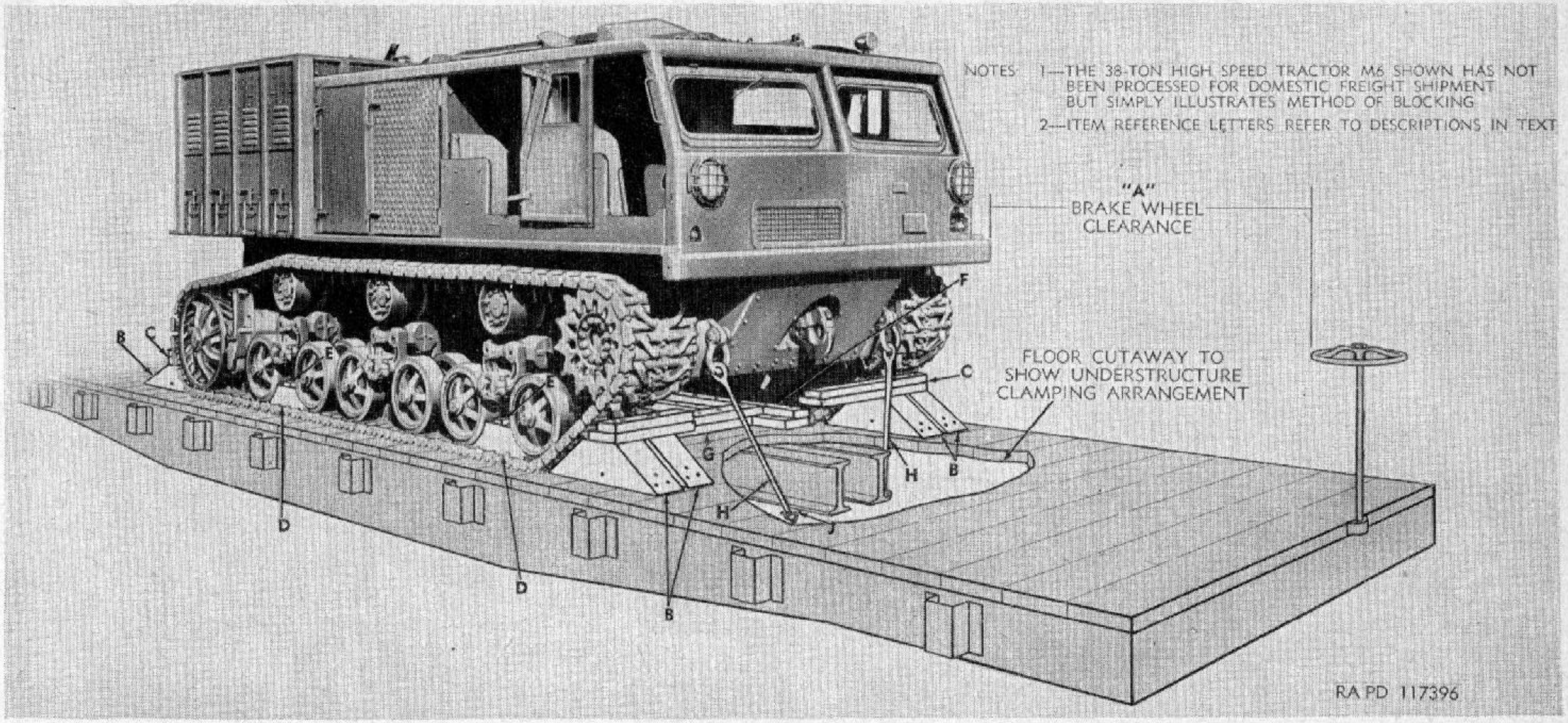

Figure 178. Method of blocking the 38-ton high-speed tractor M6 for rail shipment.

each track. Nail heel of chock blocks to car floor with three fortypenny nails and toenail sides of blocks to car floor with two fortypenny nails each.

d. Gross Cleats "C" (2 x 6 Inches and 2 x 4 Inches, Length to Suit, Two of Each Required). Locate the 2- x 6-inch cleats against tracks across the top of the front chock blocks and 2- x 6-inch cleats against tracks across the top of the rear chock blocks. Nail cleats to top of each chock block with two thirtypenny nails staggered. Locate the 2- x 4-inch cleats against track on top of lower cleats and nail to lower cleats and chock blocks with two fortypenny nails staggered in each chock block.

e. Suspension (Bogie) Blocks "D" (fig. 179, Detail 4, 6 x 8 Inches, Length to Suit; Eight Required). Locate a pair of chock blocks between first two sets of wheels and last two sets of wheels on each track. Place a 1- x 4- x 15-inch cleat "E" across top of suspension blocks and nail to top of each block with two eightpenny nails. Place a wedge beneath suspension blocks, if necessary, to force them up tightly against suspension wheels.

f. Floor Inner Cleats "F" (Lower Cleat 2 x 6 Inches and Length to Suit, Upper Cleat 2 x 4 Inches, Length to Suit, Two of Each Required). Locate the 2- x 6-inch cleats on car floor along the length of the inside of tracks. Nail to car floor with fortypenny nails staggered the length of the cleats. Place the 2- x 4-inch cleats on top of the 2- x 6-inch cleats flush on chalk marked position and nail to lower cleats and car floor with fortypenny nails staggered along their length.

g. Spreaders "G" (2 x 4 Inches, Length to Suit, Ten Required). Locate five spreaders evenly spaced beneath tractor crosswise of car floor with each end flush against lower cleats "F." Nail to car floor with thirtypenny nails staggered along their length. Locate the five remaining spreaders with their ends flush against the sides of upper cleats "F" on top of lower spreaders "G." Nail to lower spreaders and car floor with fortypenny nails staggered along their lengths.

h. Hull Blocking (fig. 178).

(1) *Eye Bolt "H" (1-inch diameter, length to suit, four required, fig. 178, Detail 2)*. Locate and drill holes through car floor where eye bolts "F" will pentrate to engage in clamping bar "J." Insert threaded end of eye bolts through holes and secure other ends to towing shackles.

(2) *Clamping Bar "J" (1- x 3-inch length to suit, two required)*. Locate clamping bars under center sill of freight car. Insert threaded ends of eye bolts through holes in ends of clamping bars. Secure with standard washers and 1-inch hex nuts and jam nuts.

i. Hull Blocking "K," Alternate Method (fig. 179, Detail 3, Six Strands No. 8 Gage Black Annealed Wire). Cut the six strands of

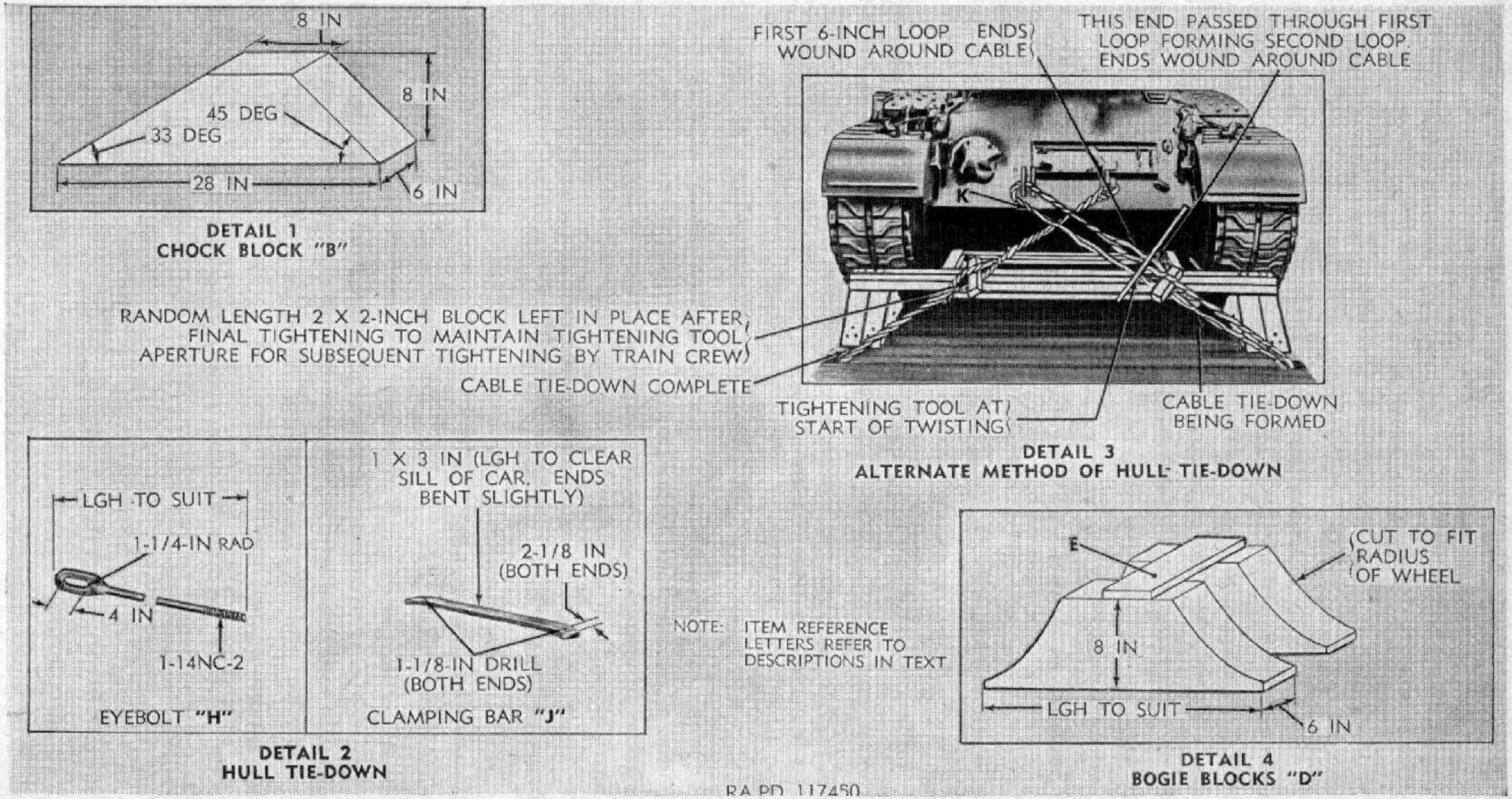

Figure 179. Method of blocking the 38-ton high-speed tractor M6 for rail shipment—blocking details.

wire to length required for securing hull to flatcar. Pass one end through towing lug on left front end of vehicle, bringing end to approximate center between towing lug and stake pocket. From a 6-inch loop in end, wind ends of each wire tightly around cable. Pass other end of wire through a stake pocket forward of vehicle on right side and insert end through loop pulling cable hand tight and form another loop. Insert a random length 2- x 2-inch block between cables. Insert a tightening tool in loop and twist-tie cables just taut enough to remove all slack, retaining random block in place between cables. Form strap for right front end of vehicle similarly, securing cable to stake pocket on left side of flatcar forward of vehicle. Repeat operation for securing rear end of vehicle to flatcar.

Section II. DESTRUCTION OF MATÉRIEL TO PREVENT ENEMY USE

237. GENERAL

a. Destruction of the high-speed tractor M6, when subject to capture or abandonment in the combat zone, will be undertaken by the using arm only when, in the judgment of the unit commander, such action is necessary in accordance with orders of, or policy established by, the Army commander.

b. The information which follows is for guidance only. Certain of the procedures outlined require the use of explosives and incendiary grenades which normally may not be authorized items for the vehicle. The issue of these and related materials, and the conditions under which destruction will be effected, are command decisions in each case, according to the tactical situation. Of the several means of destruction, those most generally applicable are:

Mechanical—Requires axe, pick mattock, sledge, crowbar, or similar implement.

Burning—Requires gasoline, oil, incendiary grenades, or other inflammables.

Demolition—Requires suitable explosives or ammunition.

Gunfire—Includes artillery, machine guns, rifles using rifle grenades, and launchers using antitank rockets. Under some circumstances hand grenades may be used.

In general, destruction of essential parts, followed by burning will usually be sufficient to render the matériel useless. However, selection of the particular method of destruction requires imagination and resourcefulness in the utilization of the facilities at hand under the existing conditions. Time is usually critical.

c. If destruction to prevent enemy use is resorted to, the matériel must be so badly damaged that it cannot be restored to a usable condition in the combat zone either by repair or cannibalization. Adequate destruction requires that all parts essential to the operation of the matériel, including essential spare parts, be destroyed or damaged beyond repair. However, when lack of time and personnel prevents destruction of all parts, priority is given to the destruction of those parts most difficult to replace. Equally important, the same essential parts must be destroyed on all like matériel so that the enemy cannot construct one complete unit from several damaged ones.

d. If destruction is directed, due consideration should be given to:

(1) Selection of a point of destruction that will cause greatest obstruction to enemy movement and also prevent hazard to friendly troops from fragments or ricocheting projectiles which may occur incidental to the destruction.

(2) Observance of appropriate safety precautions.

238. DESTRUCTION OF THE 38-TON HIGH-SPEED TRACTOR M6

a. Method No. 1—By Burning.

(1) Remove and empty portable fire extinguishers.

(2) On the fuel tank, open the sediment drain valve and cut the fuel supply lines.

(3) Using an axe, pick, sledge, or other heavy implement, smash all vital elements such as distributors, carburetors, generator, ignition coils, fuel pumps, hydraulic hoses, batteries, spark plugs, air cleaners, lights, wiring, instruments, and controls. If time permits and a sufficiently heavy implement is available, smash the engine cylinder blocks and heads, rocker arms, air compressor, torque converters, filters, transmission, differential, final drives, and winch and hoist mechanisms.

(4) Explosive ammunition should be removed from packing or other protective material. Place ammunition in and about the high speed tractor so that it will be fully exposed to the fire and in such locations that the greatest damage will result from its detonation. Remove any safety devices from ammunition.

(5) Pour gasoline and oil in and over the entire vehicle—ignite and take cover. Elapsed time: about 6 minutes.

Caution: Cover must be taken without delay since an early explosion of the explosive ammunition may be caused by the fire. Due consideration should also be given to the highly inflammable nature of gasoline and its vapor. Carelessness may result in painful burns.

b. Method No. 2—With Demolition Materials.

(1) Remove and empty portable fire extinguishers.

(2) On the fuel tank, open the sediment drain valve and cut the fuel supply lines.

(3) Prepare six 2-pound charges of EXPLOSIVE, TNT (two 1-lb blocks or equivalent per charge). Place the charge as follows:

(*a*) Set two charges on the engines—one charge as low on the *right* side of *each* engine as possible.

(*b*) Set the *third* charge between the torque converters.

(*c*) Set the *fourth* charge on the transmission.

(*d*) Set the *fifth* charge on the *left* track driving sprocket.

(*e*) Set the *sixth* charge on the *right* track driving sprocket. Connect the six charges for simultaneous detonation with detonating cord. Provide for dual priming to minimize the possibility of a misfire. For priming either a nonelectric blasting cap crimped to at least 5 feet of safety fuse (safety fuse burns at the rate of 1 ft in 30 to 45 sec—test before using) or an electric blasting cap and firing wire may be used. If a nonelectric blasting cap and safety fuse are used, the fuse should be sufficiently long and so positioned that it may be ignited from the outside of the vehicle since gasoline which is draining from the fuel tank may be exploded prematurely by the burning fuse. Safety fuse, which contains black powder, and blasting caps must be protected from moisture at all times. The safety fuse may be ignited by a fuse lighter or a match; the electric blasting cap requires a blasting machine or equivalent source of electricity.

Caution: Keep the blasting caps, detonating cord, and safety fuse separated from the charges until required for use.

Note.—For the successful execution of methods of destruction involving the use of demolition materials, all personnel concerned will be thoroughly familiar with the provisions of FM 5–25. Training and careful planning are essential.

c. Method No. 3—By Gunfire.

(1) Remove and empty portable fire extinguishers.

(2) On the fuel tank, open the sediment drain valve and cut the fuel supply lines.

(3) Destroy the vehicle by gunfire using artillery, machine guns, rifles using rifle grenades, or launchers using antitank rockets. Fire on the vehicle aiming at the ammunition box, engine, suspension, track driving sprockets, body, radiator, and

winch. Although one well placed direct hit may destroy the vehicle, several hits are usually required for complete destruction unless an intense fire is started in which case the vehicle may be considered destroyed. Elapsed time: about 6 minutes.

Caution: Firing at ranges of 500 yards or less should be from cover.

APPENDIX

REFERENCES

1. Publication Indexes

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

Index of Administrative Publications (Army Regulations, Special Regulations, Joint Army-Air Force Adjustment Regulations, General Orders, Bulletins, Circulars, Commercial Traffic Bulletins, Joint Procurement Circulars, Department of the Army Pamphlets, and ASF Manuals).	SR 310-20-5
Index of Army Motion Pictures and Film Strips	SR 110-1-1
Index of Army Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Graphic Training Aids, Joint Army-Navy Air Force Publications, and Combined Communications Board Publications).	SR 310-20-3
Index of Blank Forms and Army Personnel Classification Tests.	SR 310-20-6
Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Table of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, Tables of Equipment, and Tables of Basic Allowances.	SR 310-20-4
Introduction and Index (supply catalogs)	ORD 1
Military Training Aids	FM 21-8

2. Supply Catalogs

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

a. Ammunition.

Ammunition, Rifle, Carbine, and Automatic Gun	ORD 11 SNL T-1
Land Mines and Fuzes, Demolition Material, and Ammunition for Simulated Artillery and Grenade Fire.	ORD 11 SNL R-7

b. Armament.

Gun, Machine, Cal. .50, Browning, M2, Heavy Barrel, Fixed and Flexible, and Ground Mounts.	ORD (*) SNL A-39
Mount, Truck, M32, M36, M37, M37A1, M37A2, M37A3, and M50 Mount, Ring M49, M49A1, M49A1C, and M49C.	ORD (*) SNL A-55, Sec 19

c. Maintenance and repair.

Cleaners, Preservatives, Lubricants, Recoil Fluids, Special Oils, and Related Maintenance Materials.	ORD 3 SNL K-1
Items of Soldering, Metallizing, Brazing and Welding Materials: Gases and Related Items.	ORD 3 SNL K-2
Lubricating Equipment, Accessories, and Related Dispensers.	ORD (*) SNL K-3
Tool-sets (Common), Specialists' and Organizational.	ORD 6 SNL G-27, Sec 2

d. Vehicle.

Tractor, high-speed, 38 ton, M6	ORD (*) SNL G-184

3. Forms

The following forms are applicable to this matériel:

Standard Form 91, Operator's Report of Motor Vehicle Accident.
Standard Form 91A, Transcript of Operator's Report of Vehicle Accident.
Standard Form 93, Report of Investigating Officer.
Standard Form 94, Statement of Witness.
DA Form 30B, Report of Claims Officer.
DA AGO Form 9-3, Processing Record for Storage and Shipment (Tag).
DA AGO Form 9-69, Spot Check Inspection Report for all Full-Track and Tank-Like Wheeled Vehicles.
DA AGO Form 9-74, Motor Vehicle Operator's Permit.
DA AGO Form 9-75, Daily Dispatching Record of Motor Vehicle.
DA AGO Form 348, Driver's Qualification Record.
DA AGO Form 460, Preventive Maintenance Roster.
DA AGO Form 461-5, Limited Technical Inspection.
DA AGO Form 462, Preventive Maintenance Service and Inspection for Full-Track Vehicles.
DA AGO Form 468, Unsatisfactory Equipment Report.
DA AGO Form 478, MWO and Major Unit Assembly Replacement Records and Organizational Equipment File.
DA AGO Form 811, Work Request and Job Order.
DA AGO Form 811-1, Work Request and Hand Receipt.
DD Form 6, Report of Damaged or Improper Shipment.
DD Form 317, Preventive Maintenance Service Due (sticker).

4. Other Publications

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

*See ORD 1 for available catalogs.

a. Ammunition.

Distribution of Ammunition and Explosives for Training Purposes	SR 710-60-50
Ammunition, General	TM 9-1900
Ammunition, General	SB 9-AMM-1
Qualification in Arms and Ammunition Training Allowances	AR 775-10
Regulations for Firing Ammunition for Training, Target Practice, and Combat	SR 385-310-1

b. Armament.

Browning Machine Gun Cal. .50 HB, M2	FM 23-65
Machine Gun Mounts for Trucks	TM 9-224

c. Camouflage.

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

d. Decontamination.

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

e. Destruction to Prevent Enemy Use.

Explosives of Demolitions	FM 5-25

f. General.

Cooling Systems: Vehicles and Powered Ground Equipment.	TM 9-2858
Driver Selection, Training and Supervision, Half-Track and Full-Track Vehicles.	TM 21-301
Instruction Guide: Operation and Maintenance of Ordnance Matériel in Extreme Cold (0° to −65° F.).	TM 9-2855
Manual for the Full-Track Vehicle Driver	TM 21-306
Motor Vehicles	AR 700-105
Mountain Operations	FM 70-10
Operations in Snow and Extreme Cold	FM 70-15
Precautions in Handling Gasoline	AR 850-20
Preparation of Ordnance Matériel for Deep Water Fording.	TM 9-2853
Principles of Automotive Vehicles	TM 9-2700
Report of Accident Experience	SR 385-10-40
Spark Plugs	TB ORD 313
Storage Batteries Lead-Acid Type	TM 9-2857
Supplies and Equipment—General: Unsatisfactory Equipment Report.	SR 700-45-5

g. Maintenance and Repair.

Cleaning, Preserving, Sealing, and Related Materials Issued for Ordnance Matériel.	TM 9-850
Hand, Measuring, and Power Tools	TM 10-590
Instruction Guide: Welding Theory and Application	TM 9-2852
Lubrication Order	LO 9-788
Maintenance and Care of Hand Tools	TM 9-867

Maintenance of Supplies and Equipment: Maintenance Responsibilities and Shop Operation.	AR 750-5
Motor Vehicle Inspection and Preventive Maintenance Services.	TM 37-2810
Painting Instructions for Field Use	TM 9-2851
Tracklaying Vehicles: Tracks Currently Applicable	TB ORD 391

h. Shipment and Limited Storage.

Army Shipping Document	TM 38-705
Instruction Guide, Ordnance Packaging and Shipping (Posts, Camps, and Stations).	TM 9-2854
Inspection, Preservation, and Maintenance in Storage of Small Arms Matériel.	SB 9-65
Marking and Packing of Supplies and Equipment: Marking of Oversea Supply.	SR 746-30-5
Ordnance Storage and Shipment Chart—Group G	TB 9-OSSC-G
Preparation of Unboxed Ordnance Matériel for Shipment	SB 9-4
Protection of Ordnance General Supplies in Open Storage	TB ORD 379
Shipment of Supplies and Equipment: Report of Damaged or Improper Shipment.	SR 745-45-5
Standards for Oversea Shipment and Domestic Issue of Ordnance Matériel other than Ammunition and Army Aircraft.	TB ORD 385
Storage, Inspection, and Issue of Unboxed Serviceable Motor Vehicles; Preparation of Unserviceable Vehicles for Storage; and Deprocessing of Matériel Prior to Operation.	SB 9-63

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