DEPARTMENT OF THE ARMY
TECHNICAL MANUAL

DEPARTMENT OF THE AIR
FORCE TECHNICAL ORDER

TM 9-8024
(FORMERLY TM 9-819 A)
TO 36A12-1B-321

OPERATION AND ORGANIZATIONAL MAINTENANCE

2½ TON 6x6 CARGO TRUCKS M135 AND M211 DUMP TRUCK M215 GASOLINE TANK TRUCK M217 SHOP VAN TRUCK M220 TRUCK TRACTOR M221 AND WATER TANK TRUCK M222

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DEPARTMENTS OF THE ARMY AND THE AIR FORCE

TECHNICAL MANUAL No. TM 9-8024
TECHNICAL ORDER No. 36A12-1B-321

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
WASHINGTON 25, D. C., *3 October 1955*

OPERATION AND ORGANIZATIONAL MAINTENANCE: 2½-TON 6 X 6 CARGO TRUCKS M135 AND M211; DUMP TRUCK M215; GASOLINE TANK TRUCK M217; SHOP VAN TRUCK M220; TRUCK TRACTOR M221; AND WATER TANK TRUCK M222

***This manual supersedes TM 9-819A, 25 July 1951; TB 9-819A-1, 9 July 1952; TB 9-819A-2, 17 July 1952; TB 9-819A-3, 9 March 1953; TB 9-819A-4, 13 January 1953; TB 9-819A-5, 26 February 1953; TB 9-819A-6, 10 March 1953; TB 9-819A-7, 16 February 1953; TB 9-819A-8, 10 March 1953, including C 1, 28 April 1953; TB 9-819A-9, 8 April 1953; TB 9-819A-10, 22 May 1953; TB 9-819A-11, 6 May 1953; TB 9-819A-12, 11 June 1953; TB 9-819A-13, 30 October 1953; and those portions of TB ORD 247, 14 May 1951, TB ORD 463, 7 July 1952, TB ORD 492, 16 February 1953, TB ORD 530, 24 July 1953, and TB ORD 532, 15 July 1953 pertaining to the materiel covered herein.**

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

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

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

c. This manual differs from TM 9–819A as shown in (1), (2), and (3) below.

(1) Adds information on operational and organizational maintenance of 2½-ton 6 x 6 cargo truck M211, dump truck M215, gasoline tank truck M217, truck tractor M221, water tank truck M222, and shop van truck M220.

(2) Revises operational and organizational maintenance information on 2½-ton 6 x 6 cargo truck M135.

(3) Makes reference to applicable MWO's which are within the scope of organizational maintenance and using force.

2. Organizational Maintenance Allocation

In general, the prescribed organizational maintenance responsibilities will apply as reflected in the allocation of tools and spare parts in the appropriate columns of the current ORD 7 supply manual pertaining to these vehicles and in accordance with the extent of disassembly prescribed in this manual for the purpose of cleaning, lubricating, or replacing authorized spare parts. In all cases where the nature of repair, modification, or adjustment is beyond the scope or facilities of the using organization, the supporting ordnance maintenance unit should be informed in order that trained personnel with suitable tools and equipment may be provided or other proper instructions issued.

Note. The replacement of certain assemblies, that is, engine assembly, transmission assembly, transfer assembly, and front and rear axle assemblies, is normally an ordnance maintenance operation, but may be performed in an emergency

by the using organization, provided approval for performing these replacements is obtained from the supporting ordnance officer. A replacement assembly, any tools needed for the operation which are not carried by the using organization, any necessary special instructions regarding associated accessories, etc., may be obtained from the supporting ordnance maintenance unit.

3. Forms, Records, and Reports

a. General. Responsibility for the proper execution of forms, records, and reports rests upon the officers of all units maintaining this equipment. However, the value of accurate records must be fully appreciated by all persons responsible for their compilation, maintenance, and use. Records, reports, and authorized forms are normally utilized to indicate the type, quantity, and condition of materiel to be inspected, to be repaired, or to be used in repair. Properly executed forms convey authorization and serve as records for repair or replacement of materiel in the hands of troops and for delivery of materiel requiring further repair to ordnance shops in arsenals, depots, etc. The forms, records, and reports establish the work required, the progress of the work within the shops, and the status of the materiel upon completion of its repair.

b. Authorized Forms. The forms generally applicable to units operating and maintaining these vehicles are listed in the appendix. For a current and complete listing of all forms, refer to Pam 310–2. For instruction on use of these forms, refer to FM 9–10.

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

d. Report of Unsatisfactory Equipment or Materials. Any suggestions for improvement in design and maintenance of equipment and spare parts, safety and efficiency of operation, or pertaining to the application of prescribed petroleum fuels, lubricants, and/or preserving materials, or technical inaccuracies noted in Department of the Army publications, 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 Form 468, Unsatisfactory Equipment Report. Such suggestions are encouraged in order that other organizations may benefit.

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

Section II. DESCRIPTION AND DATA

4. Description

a. General. The trucks described in this manual are designated as 2½-ton 6 x 6 cargo truck M135 (figs. 1, 2, and 5), cargo truck M211 (figs. 3, 4, and 5), dump truck M215 (figs. 6 and 7), gasoline tank truck M217 (figs. 8 and 9), truck tractor M221 (figs. 10 and 11), water tank truck M222 (figs. 12 and 13), and shop van truck M220 (figs. 14 and 15). All vehicles are equipped with one driving front axle and two driving rear axles. The cargo truck M135 is equipped with single front and rear tires. The other models are equipped with single front tires and dual rear tires.

b. Power Plant. Power is supplied by a GMC-type 302, gasoline, six-cylinder in-line, valve-in-head engine, conventionally four-point mounted. Engine assembly and mounted accessories are accessible after hood is raised.

c. Transmission. A Hydra-Matic transmission, mounted directly to engine, has four automatic forward speeds and one reverse in each of two ranges, high and low. Speed changes are automatic in both ranges after driver manually places control lever in selected range positions.

d. Transfer. A single-speed transfer, mounted to rear of transmission, transmits power through conventional propeller shafts to front and rear driving axles. Transfer mechanism provides automatic engagement and disengagement of front driving axle, permitting front axle to run free, except when required for tractive effort. A manually operated lever permits transfer to be placed in neutral or driving position.

e. Power-Take-Off and Accessory Drive. The transfer is provided with an opening on the left side of the unit for mounting a power-take-off to operate winch equipment, or a power-take-off and accessory drive to operate dump body hoist, gasoline tank pump, water tank pump, and winch on vehicles so equipped.

f. Front Axle and Suspension.

(1) The front axle is full-floating, hypoid, single reduction-type, having a banjo-type housing. The differential carrier assembly and cover are interchangeable with rear axle differential carrier assemblies. The axle assembly incorporates constant velocity universal joints at steering knuckles which permit steering the vehicle in a conventional manner.

(2) Front axle suspension consisting of semielliptic springs, shackled at both ends, and mounted to axle housing with U-bolts. Front springs carry only lateral and vertical loads. Three torque rods, two lower and one upper, transmit driving

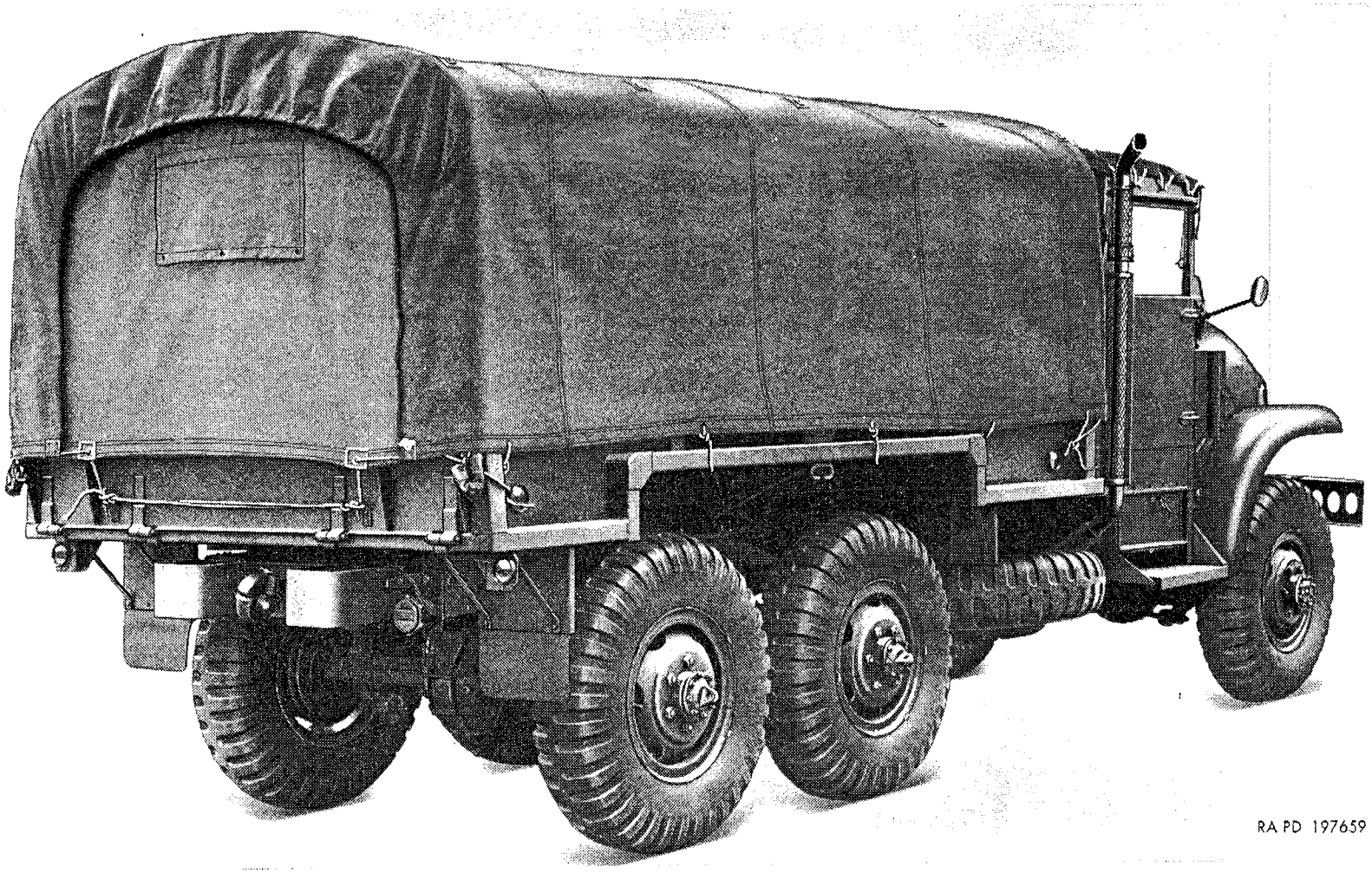

Figure 1. 2½-ton 6X6 cargo truck M135 (w/o winch)—three-quarter right rear view.

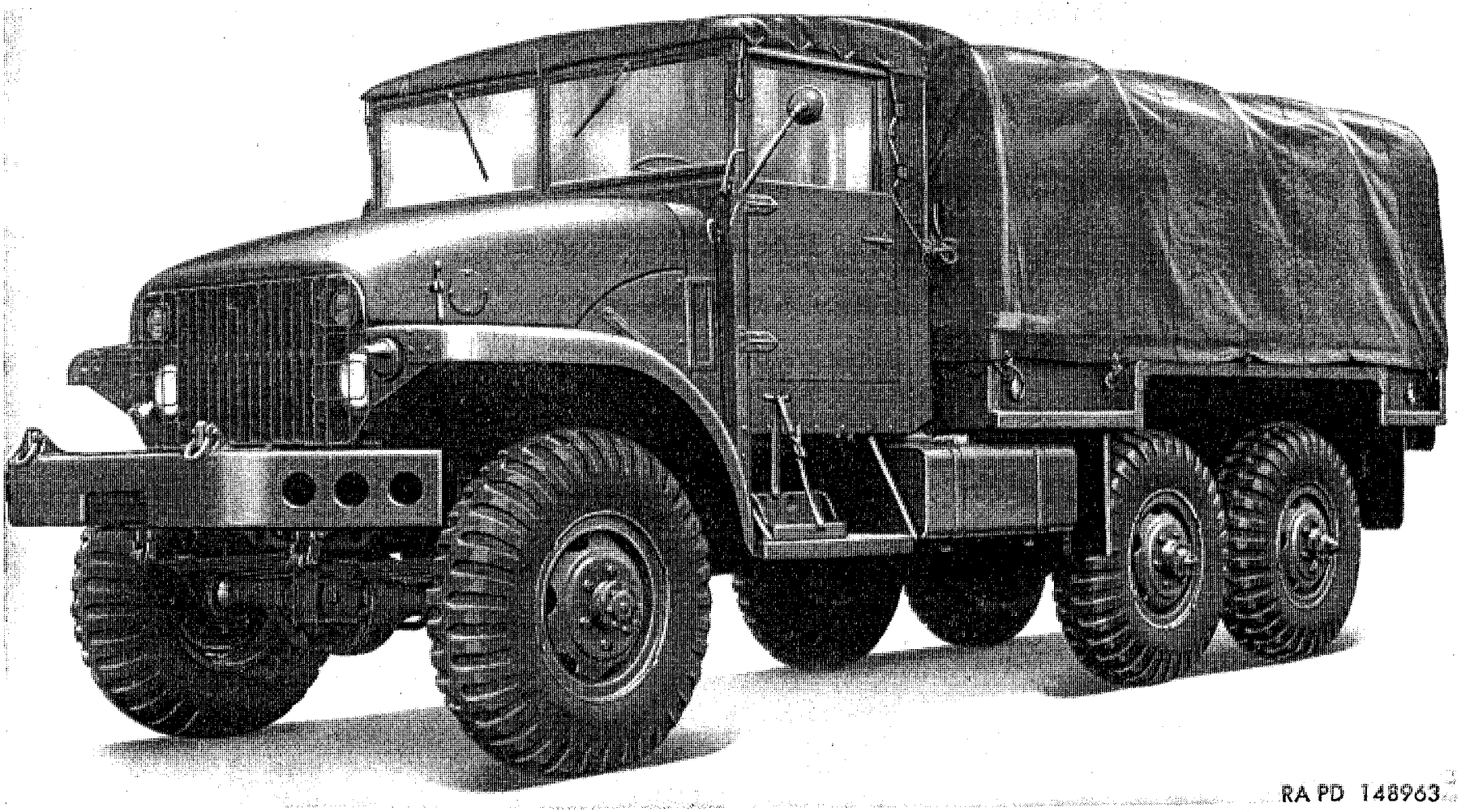

Figure 2. 2½-ton 6X6 cargo truck M135 (w/o winch)—three-quarter left front view.

Figure 3. 2½-ton 6X6 cargo truck M211 (w/o winch)—three-quarter right rear view.

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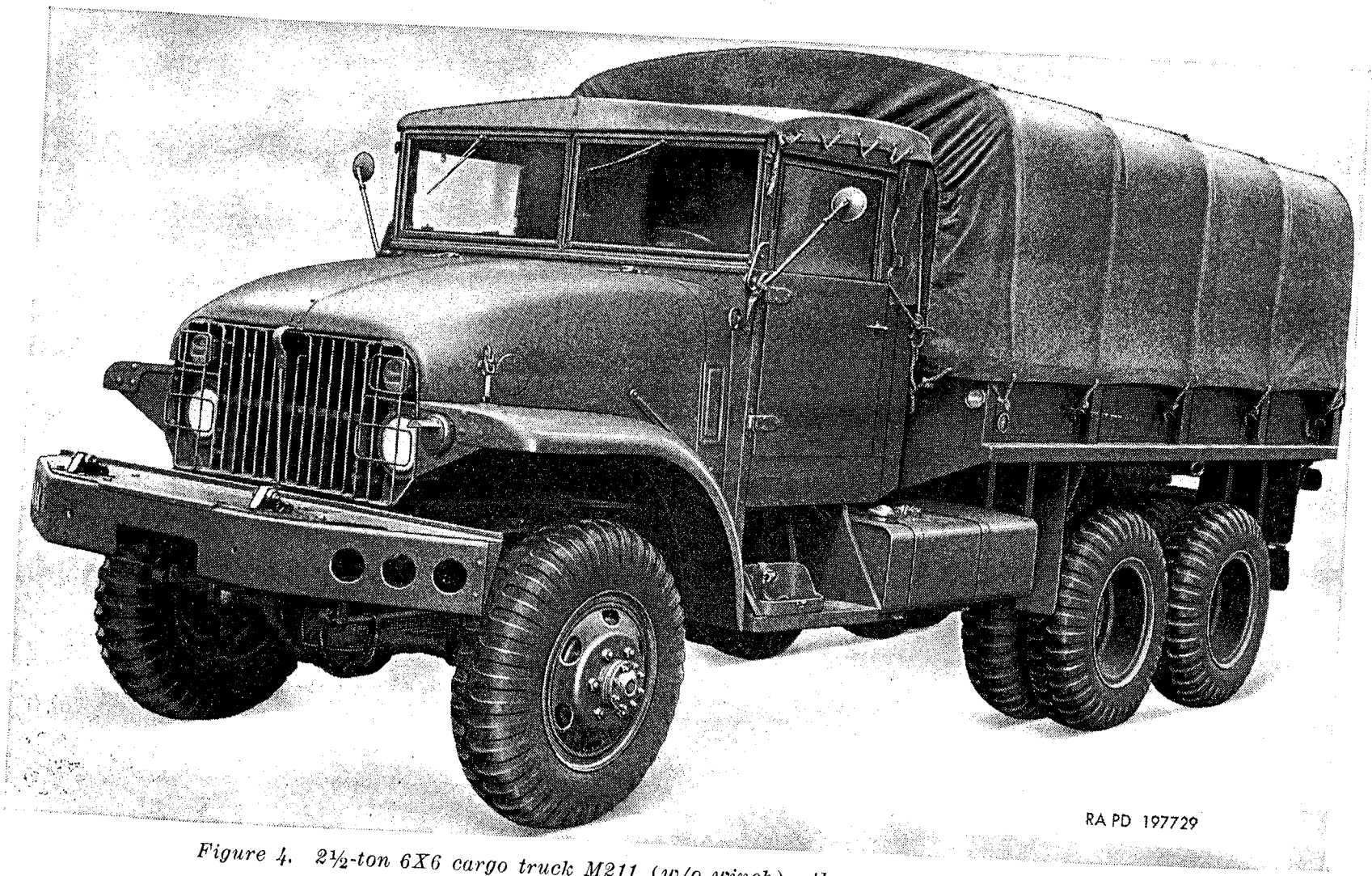

Figure 4. 2½-ton 6X6 cargo truck M211 (w/o winch)—three-quarter left front view.

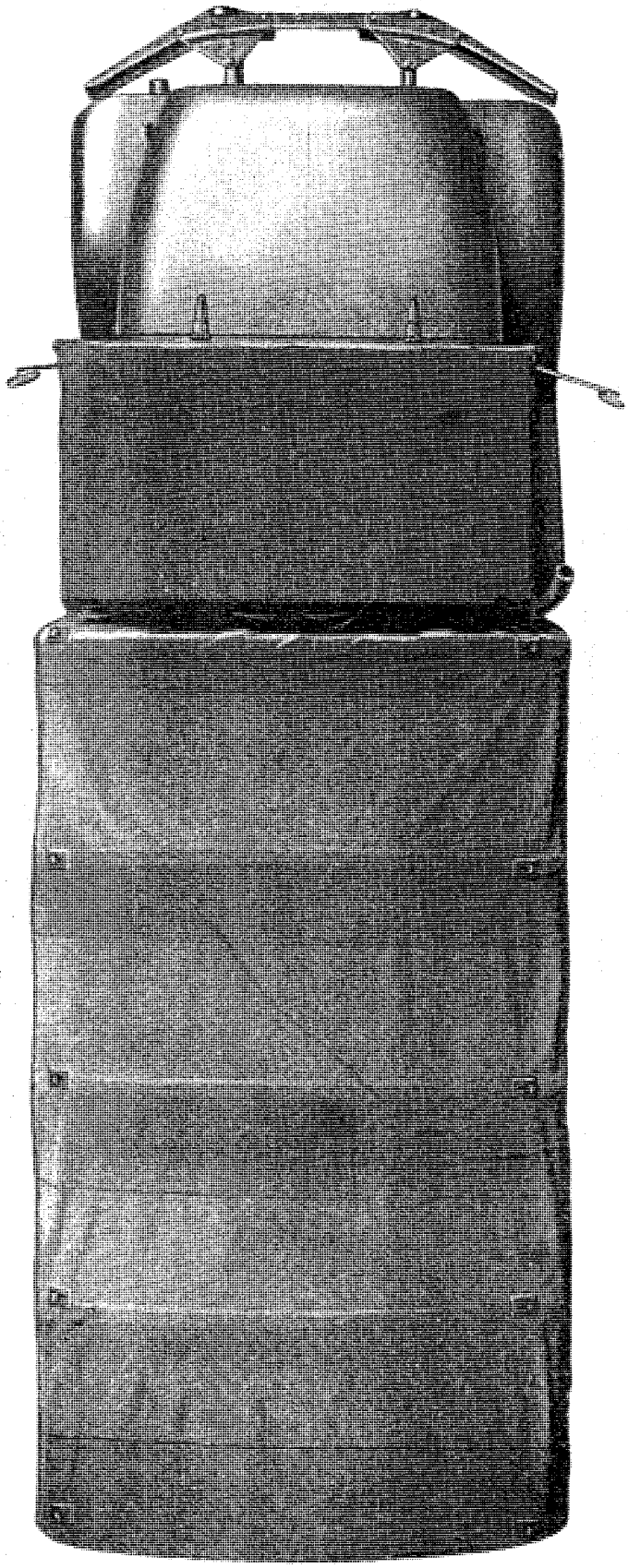

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Figure 5. 2½-ton 6X6 cargo truck M135 or M211 (w/o winch)—top view.

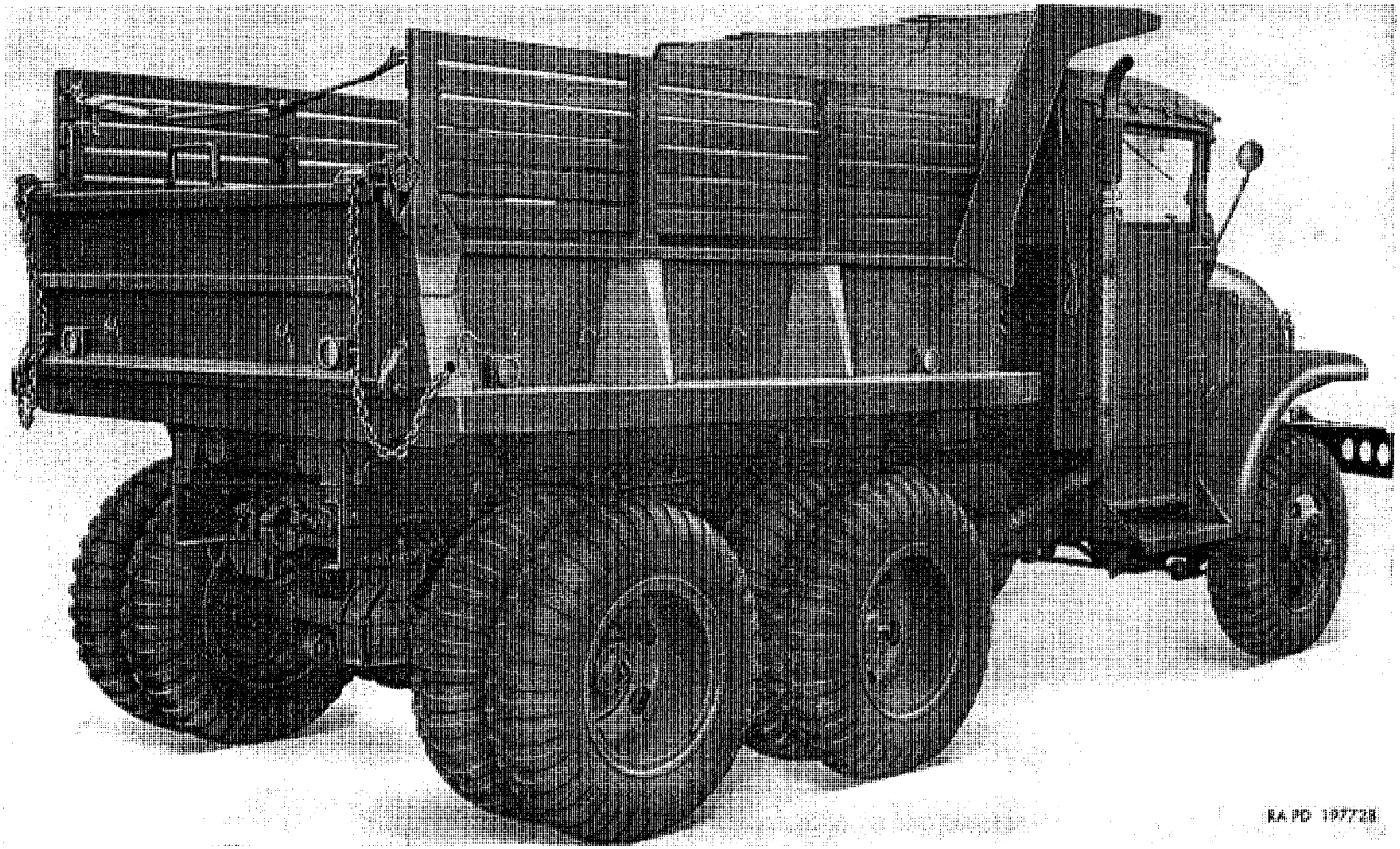


Figure 6. 2½-ton 6X6 dump truck M215 (w/o winch)—three-quarter right rear view.

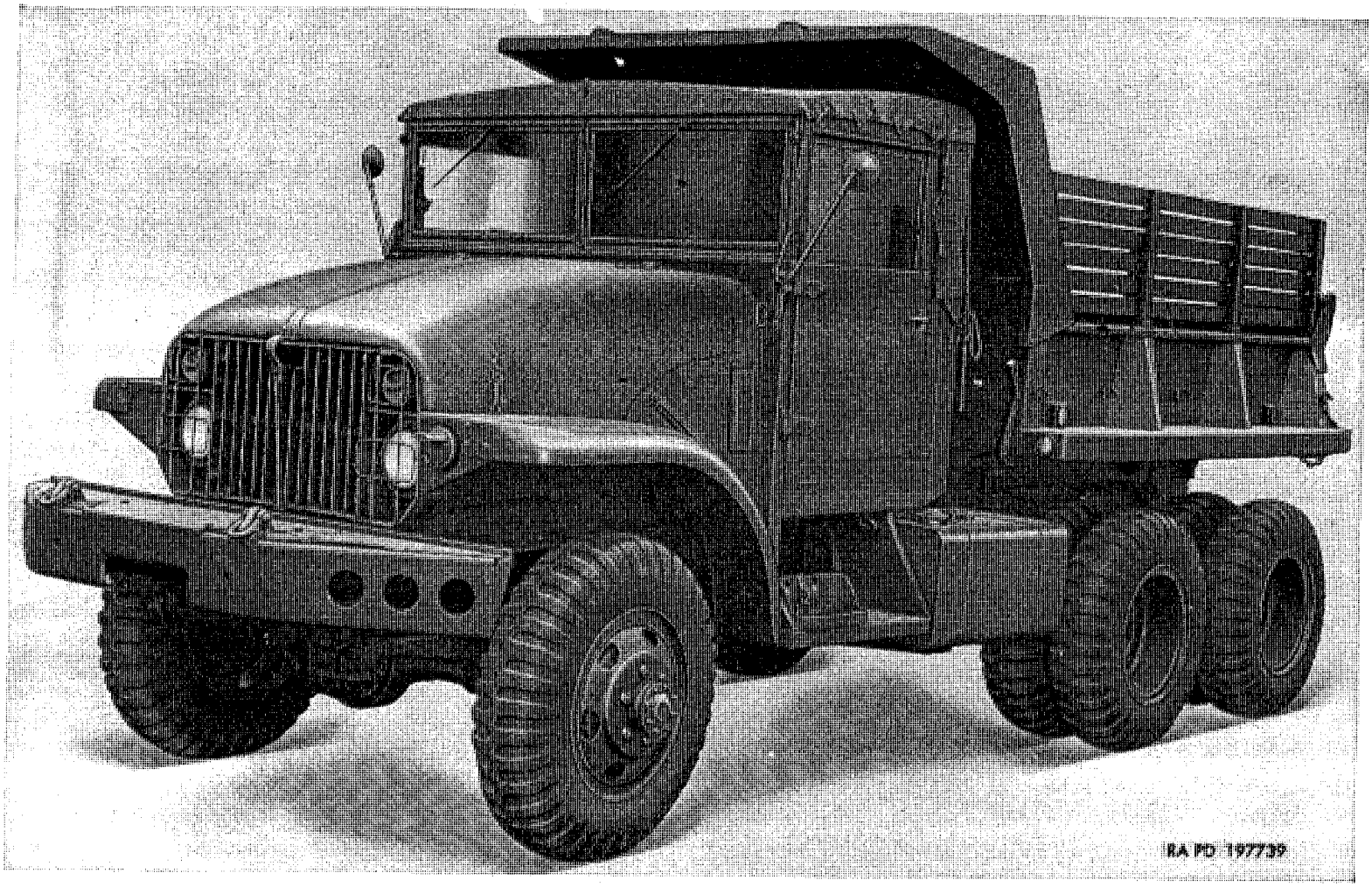


Figure 7. 2½-ton 6X6 dump truck M215 (w/o winch)—three-quarter left front view.

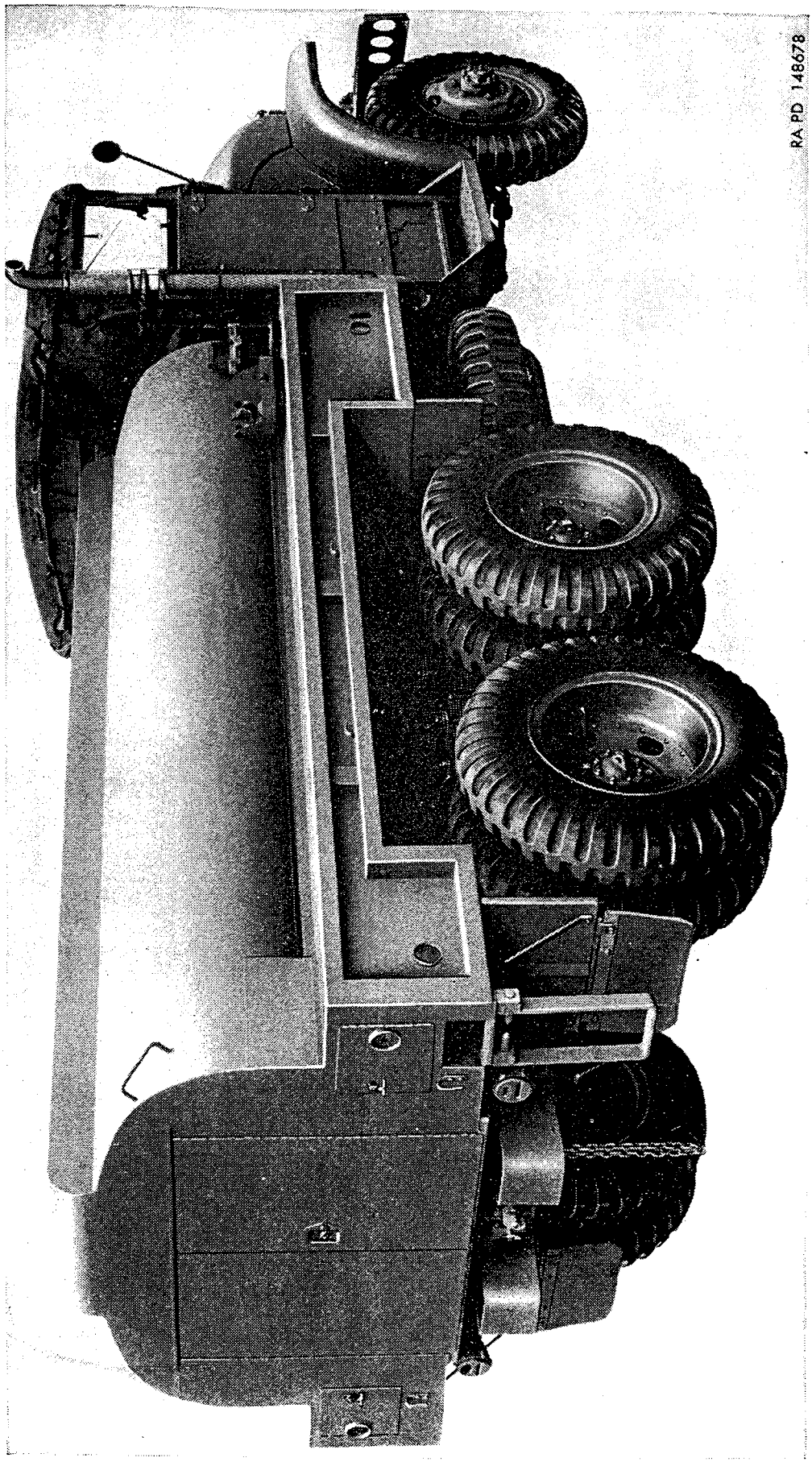


Figure 8. 2½-ton 6X6 gasoline tank truck M217—three-quarter right rear view.

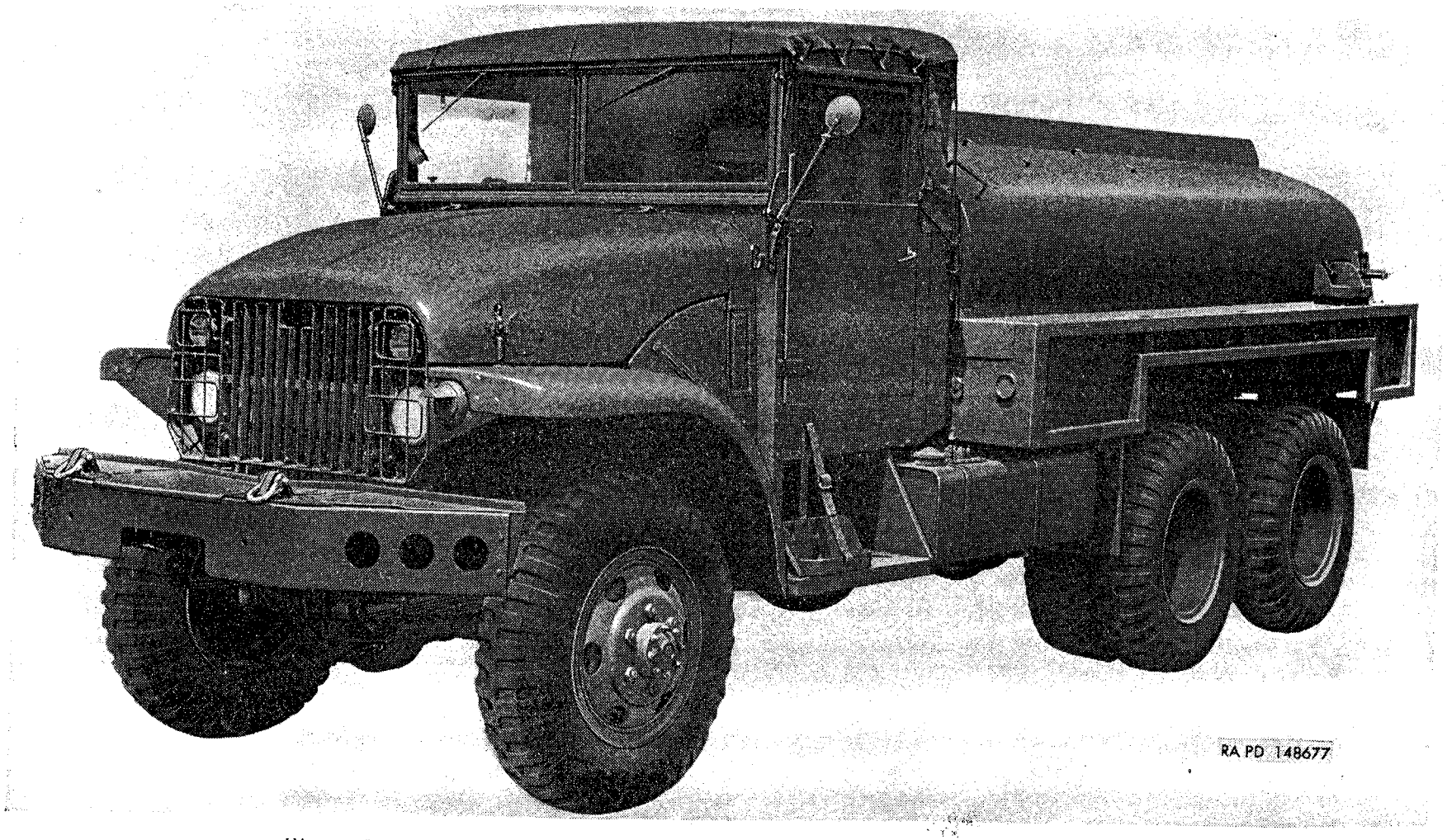


Figure 9. 2½-ton 6X6 gasoline tank truck M217—three-quarter left front view.

Figure 9. 2½-ton 6X6 gasoline tank truck M211—three-quarter left front view.

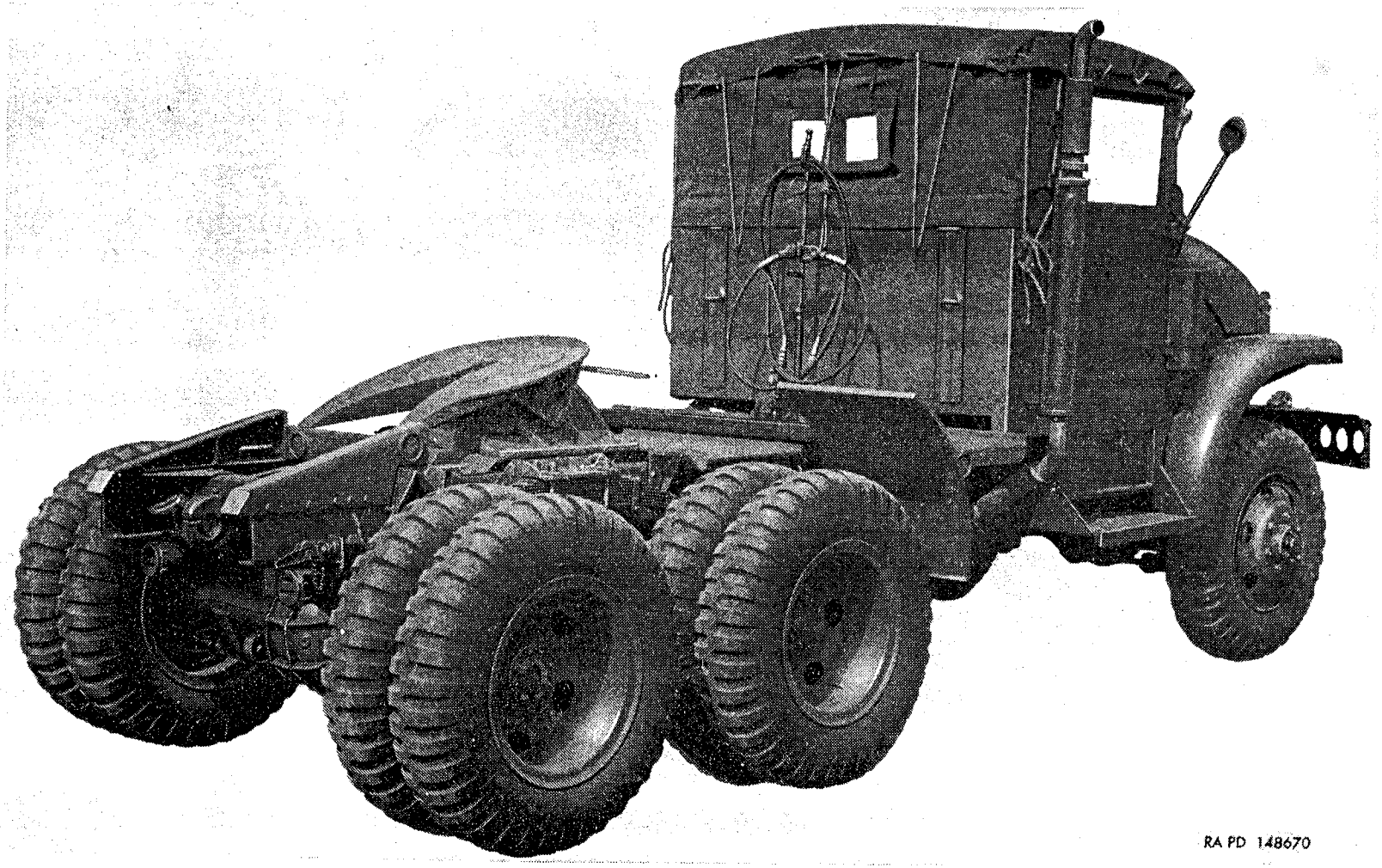


Figure 10. 2½-ton 6X6 truck tractor M221 (w/winch)—three-quarter right rear view.

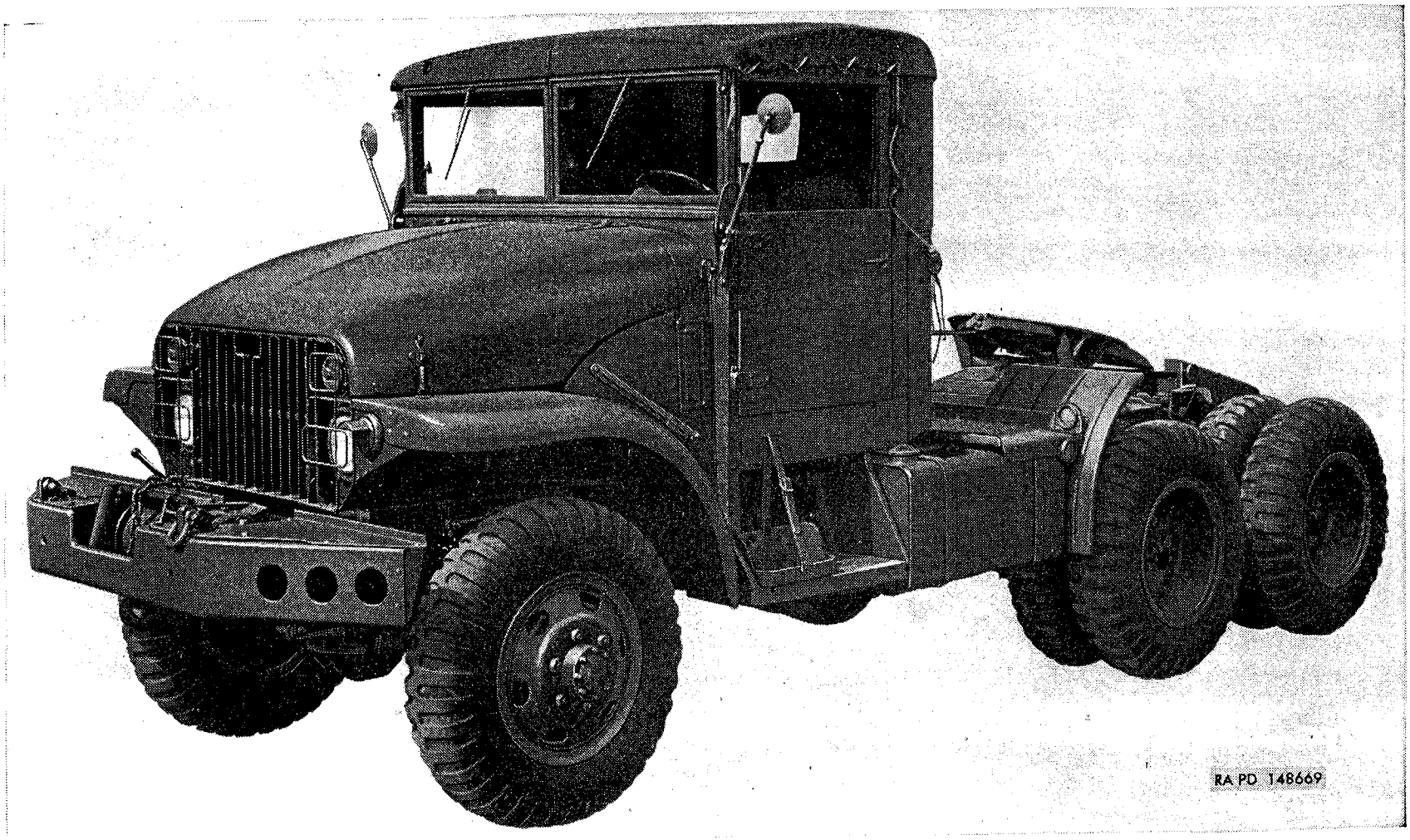


Figure 11. 2½-ton 6X6 truck tractor M221 (w/winch)—three-quarter left front view.

Figure 11. 2½-ton 6X6 truck tractor M221 (w/winch)—three-quarter left front view.

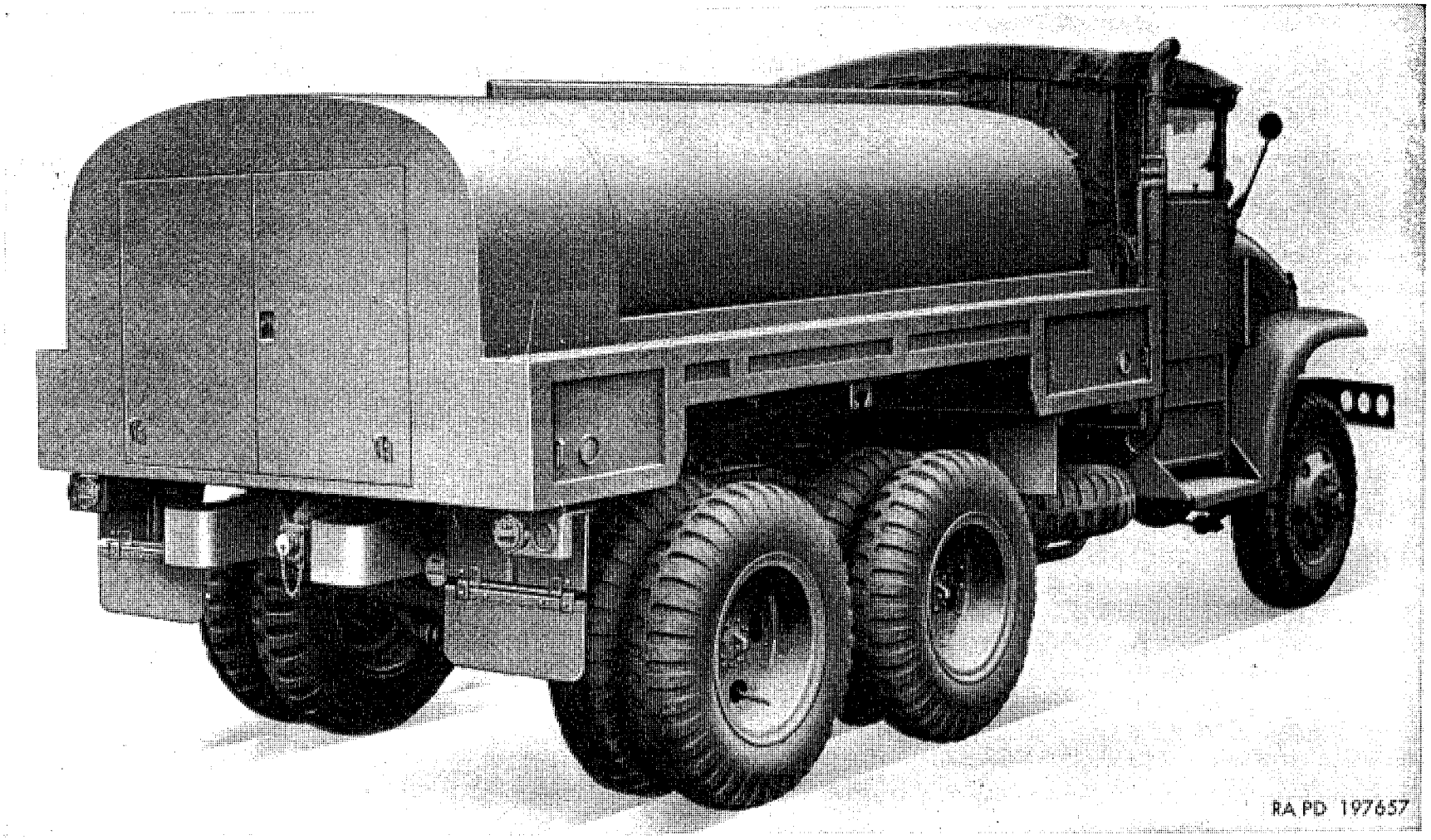


Figure 12. 2½-ton 6X6 water tank truck M222—three-quarter right rear view.

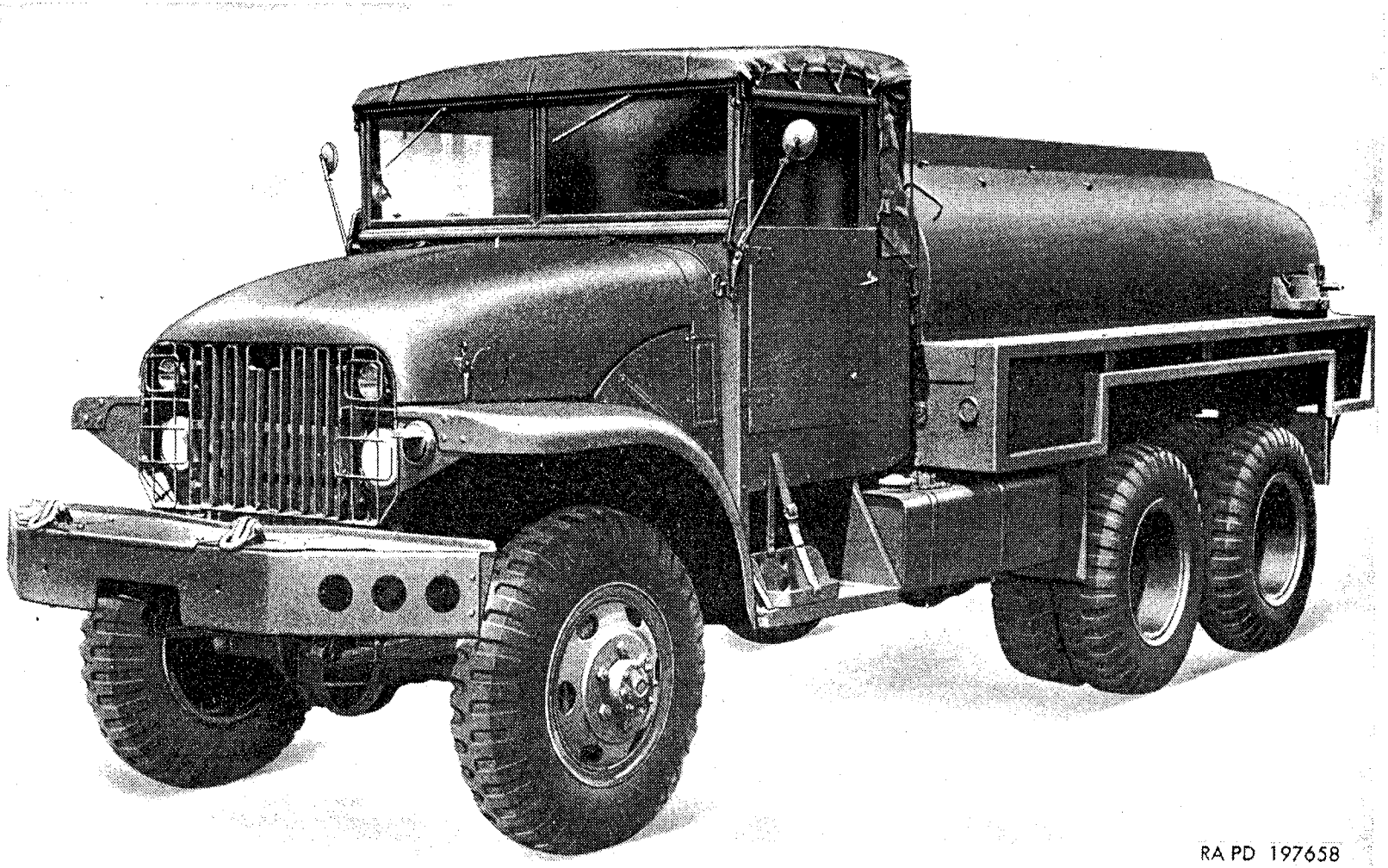


Figure 13. 2½-ton 6X6 water tank truck M222—three-quarter left front view.

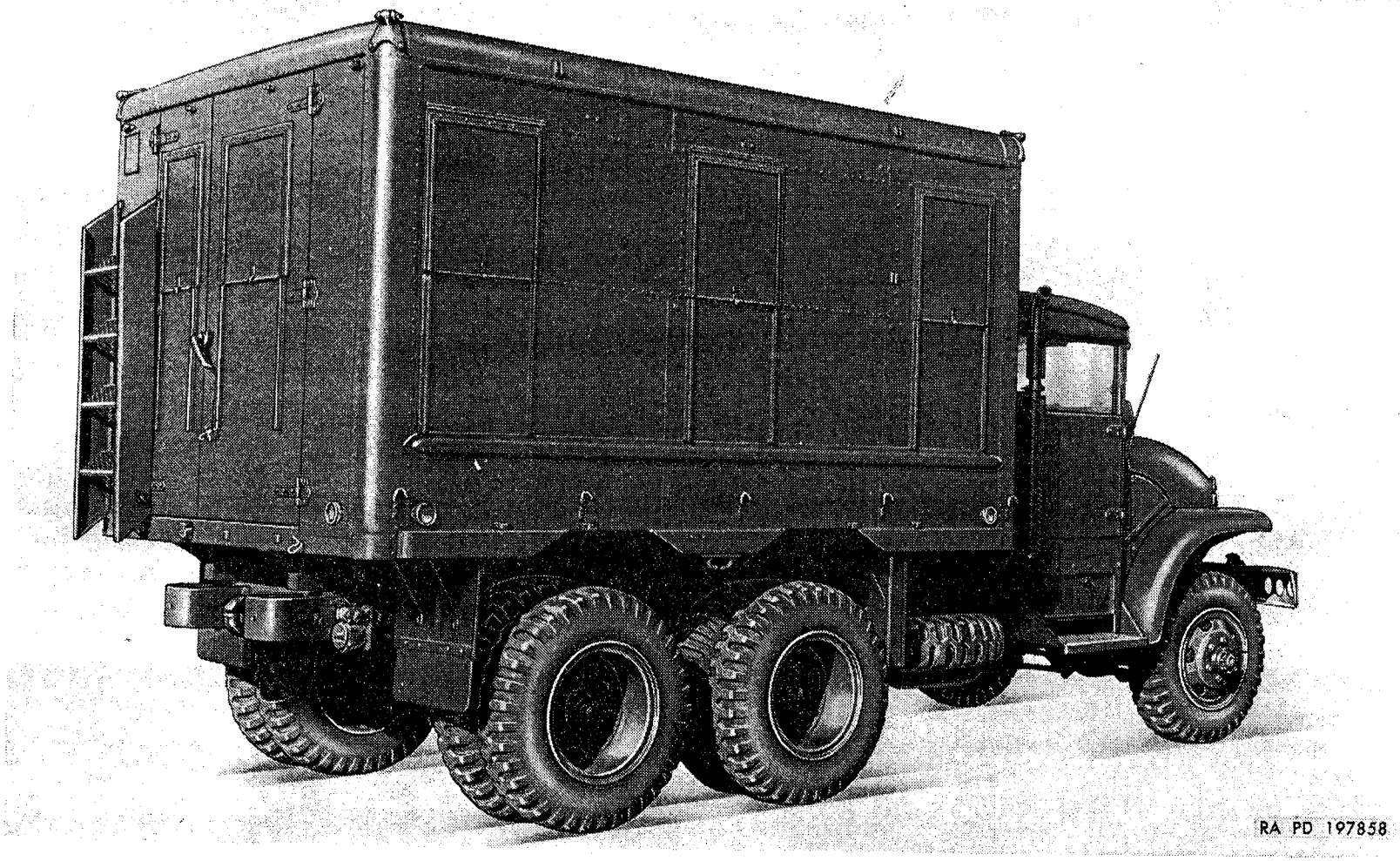


Figure 14. 2½-ton 6X6 shop van truck M220—three-quarter right rear view.

Figure 15. 2½-ton 6X6 shop van truck M220—three-quarter left front view.

and braking forces to frame and hold axle in position under vehicle. A double-acting lever-type shock absorber is mounted on frame at each side, and is connected to spring block with a link.

g. Rear Axles and Suspension.

(1) Both driving rear axles are full-floating, hypoid, single reduction-type with banjo-type housings. Both axles are driven from transfer by conventional propeller shafts. Differential carrier assemblies are interchangeable between the two rear axles and with the front differential carrier assembly.

(2) Rear spring suspension consists of an articulated main spring assembly and a fixed secondary spring assembly on each side. Both spring assemblies are inverted semielliptic-type with slipper ends, and are interchangeable. Each main spring is mounted with U-bolts on a spring seat which in turn operates on a cross-shaft on tapered roller bearings. Each secondary spring is mounted to a seat which is bolted to frame side member. Spring is held rigidly to seat with U-bolts. Ends of main and secondary springs contact brackets on each axle housing. Torque rods, three to each axle, transmit driving and braking forces to frame and hold axles in position under vehicle.

h. Service Brake System. Service brakes are air-actuated hydraulic-type, operating brakeshoes at all wheels. Air-actuated power cylinder transmits hydraulic pressure to dual wheel cylinders at each wheel. Air compressor, mounted to engine and belt-driven by crankshaft pulley, supplies compressed air for the system. Two air storage tanks are provided. The vehicle service brakes are actuated by a conventional brake pedal. Trailer service connections are provided on all vehicles, except gasoline tank truck M217 and water tank truck M222. The brake pedal actuates the trailer brakes on vehicles equipped with trailer connections; however, independent trailer brake control can be accomplished with hand control on the tractor truck M221.

i. Parking Brake.

(1) A contracting band-type parking brake assembly is mounted on output shaft at rear of transfer. A latch-type hand lever, to the right of driver, operates brake through rods and linkage to hold vehicle when parked, or for emergency stops.

(2) A temporary parking brake switch, mounted on instrument panel, controls circuit to a solenoid valve connected into master cylinder outlet hydraulic line. This parking brake is used in the event of hand operated brake failure.

Figure 15. 2½-ton 6X6 shop van truck M220—three-quarter left front view.

j. Cabs.

(1) *Soft-top cab.* All vehicles, except the shop van truck M220 are equipped with a three-man soft-top cab. The cab comprises a metal open top inclosure around driver's compartment with metal doors hinged to cab structure on each side. Each door is equipped with glass windows which can be raised and lowered with conventional regulator mechanism. The two windshield sections can be positioned for ventilation, or the entire window frame can be lowered to horizontal position over hood. Canvas top and back curtain, lashed into position to cab structure, can be positioned or removed to provide accessibility.

(2) *Hard-top cab.* The shop van truck M220 is equipped with a hard-top cab which utilizes the same lower structure and doors as used on the soft-top cab. A metal top and back replaces the canvas top and back curtain. The top and back assemblies bolt directly to the lower structure. Two sliding windows are furnished at back of cab, and fixed rear quarter-window on each side. The windshield can be tilted, but cannot be lowered to a horizontal position.

k. Bodies and Mounted Equipment. Refer to paragraph 5 for brief descriptions of bodies and mounted equipment which constitute major differences between models.

l. Provisions for Special Equipment. Some provisions have been made in the standard vehicle design to permit ready installation of winterization and deepwater fording equipment. Installation and use of such equipment are described in other directives.

5. Differences Between Models

a. Cargo Truck M135. This vehicle (figs. 1, 2, and 5) has the general characteristics described in paragraph 4, and is equipped with soft-top cab and steel cargo body. The cargo body, mounted to frame in back of cab, has wheel housings in floor of body. The body includes front and side cargo racks which are equipped with bow sockets into which removable bows may be installed. Top paulin and end curtains can be installed over bows and lashed to body structure. The vehicle is equipped with single front and rear tires, and may be furnished with or without front mounted winch which is operated from power-take-off. Vehicle weight differences with or without winch are designated on vehicle identification plates (fig. 16).

b. Cargo Truck M211. This vehicle (figs. 3, 4, and 5) has the general characteristics described in paragraph 4, and is equipped with soft-top cab and steel cargo body. The cargo body is basically the same as described in *a* above, except it has a flat floor (no wheel housings). The vehicle is equipped with single front tires and dual rear

tires, and may be furnished with or without front mounted winch. Vehicle weight differences with or without winch are designated on vehicle identification plates (fig. 17).

c. Dump Truck M215. This vehicle (figs. 6 and 7) has the general characteristics described in paragraph 4, and is equipped with soft-top cab and a 2½-yard steel dump body. The dump hoist mechanism is operated through drive shafts from power-take-off and accessory drive mounted on transfer. The vehicle is equipped with single front and dual rear tires, and is furnished with or without front mounted winch. Vehicle weight differences with or without winch are designated on vehicle identification plates (fig. 18).

d. Gasoline Tank Truck M217. This vehicle (figs. 8 and 9) has the general characteristics described in paragraph 4, and is equipped with soft-top cab and a 1,200-gallon, three-compartment gasoline tank body. The rear-mounted gasoline pump is operated through propeller shafts from power-take-off and accessory drive mounted on transfer. An engine auxiliary governor, interconnected with power-take-off linkage, limits the engine speed when pump is operating. The vehicle is equipped with single front and dual rear tires, and is furnished without winch equipment, trailer brake service lines, trailer light receptacle, or pintle.

e. Truck Tractor M221. This vehicle (figs. 10 and 11) has the general characteristics described in paragraph 4, and is equipped with soft-top cab. A universal-type fifth wheel is mounted at rear of chassis. Trailer brake service connections and electrical receptacle are furnished at rear of vehicle for trailer operation, and on a "hose-tenna" immediately back of cab for semitrailer brake and light operation. The vehicle is equipped with single front and dual rear tires, and is furnished with or without front mounted winch equipment. Vehicle weight differences with or without winch are designated on vehicle identification plates (fig. 20).

f. Water Tank Truck M222. This vehicle (figs. 12 and 13) has the general characteristic described in paragraph 4, and is equipped with a soft-top cab and a 1,000-gallon, two-compartment water tank body. The rear-mounted water pump is operated through propeller shafts from power-take-off and accessory drive mounted on transfer. An engine auxiliary governor, interconnected with power-take-off linkage, limits the engine speed when pump is operating. The vehicle is equipped with single front and dual rear tires, and is furnished without winch equipment, trailer brake service lines, trailer light receptacle, or pintle.

g. Shop Van Truck M220. This vehicle (figs. 14 and 15) has the general characteristics described in paragraph 4, and is equipped with hard-top cab and shop van-type body. The body is fully inclosed and equipped with access doors at rear. All windows at side, rear,

and front are equipped with exterior sliding blackout panels. Single front and dual rear tires are used. The vehicle is furnished without winch equipment.

6. Name, Caution, and Instruction Plates

a. General. Name, serial number, and data plates pertaining to major components as well as caution plates, driving instructions, unit shift diagrams, etc., are located on vehicle or mounted equipment as itemized in table I. Brief descriptions of such plates are described in *b* through *q* below.

Table I. Name, Caution, and Instruction Plates

Plate	Location	Illustration No.
All vehicles		
Vehicle identification	On instrument board	16 through 22.
Chassis serial number stamp	Stamped on frame right side member, front.	23.
Engine serial number	Right front of engine crankcase	24.
	Flywheel housing front and rear halves.	208.
Engine serial number stamp	Right side of cylinder block	25.
Responsible agency	Right side of instrument board	26.
Technical publication	Right side of instrument board	27.
Transmission and transfer instruction.	Instrument board instruction panel.	31.
Transfer control lever instruction	On transfer lever handle.	
Draining instruction	Right side of instrument board	139.
Choke control name	At choke control on instrument board.	R, 29.
Hand throttle control name	At hand throttle control on instrument board.	E, 29.
Ignition switch name	At ignition switch on instrument board.	A, 29.
Primer pump name (when used)	At primer pump knob on instrument board.	B, 29.
Wiper control name	At wiper control on instrument board.	T, 29.
Temporary parking brake instruction.	At switch on instrument board	33.
Transmission name	Right side of transmission case.	
Distributor name	On end of distributor body.	
Generator name	On generator field frame	152.
Starter name	On starter field frame	145.
Generator-regulator name	On regulator base.	
Carburetor name	On engine side of carburetor body.	
Air compressor name	Left side of compressor crankcase.	254.

Table I. Name, Caution, and Instruction Plates—Continued

Plate	Location	Illustration No.
With winch		
Winch instruction	Instrument board instruction panel.	42.
Power-take-off lever instruction	On lever handle (and winch instruction plate).	42.
Winch drum lock caution	Winch top tension channel	43.
Winch safety brake adjustment caution.	Winch automatic brake case cover.	339.
Winch name	Winch top tension channel	43.
Dump truck M215		
Dump body name	Lower right front corner of body	351.
Dump body operating instruction	Center of instrument board	44.
Power-take-off lever instruction (hoist).	On lever handle	45.
Gasoline tank truck M217		
Gasoline pump instruction	Center of instrument board	61.
Gasoline tank name	In rear equipment compartment.	
Power-take-off and accessory drive lever, instruction (pump).	On lever handle	61.
Gasoline pump name	Left side of pump body.	
Water tank truck M222		
Water pump instruction	Center of instrument board	52.
Water tank body name and instruction.	Inside rear equipment compartment.	53.
Water tank heating exhaust control valve instruction.	At control handle on instrument board.	
Water tank heater gate valve instruction.	On valve handwheel	60.
Water pump name	Left side of pump body.	
Cargo trucks M135 and M211		
Cargo body name	Right front lower corner of body	333.
Shop van truck M220		
Shop van body name	Left front lower corner of body.	
Exhaust blower switch instruction	On current converter	J, 68.
Exhaust blower voltage selector switch instruction.	On current converter	H, 68.
115 V blackout switch instruction	On 115 V blackout switchbox	A, 68.
Power switch instruction	On power switchbox	E, 68.
24 V light switch instruction	On rear wall at right side	71.
Exhaust blower operating instruction.	On current converter	G, 68.

b. Vehicle Identification Plate. Identification or truck nomenclature plate (figs. 16–22) is mounted on instrument board (fig. 29) to right of instrument board compartment door. The plate includes truck nomenclature, vehicle serial number, date of delivery, load capacities, dimensional data, and other pertinent vehicular information.

c. Chassis Serial Number Stamp (fig. 23). The manufacturer's chassis serial number is stamped on frame right side member just forward of the front axle. This serial number is also stamped on each vehicle identification plate (figs. 16–22).

d. Engine Serial Number.

(1) *Serial number plates.* Manufacturer's engine serial number is stamped on a plate which is mounted on boss on crankcase at right front of engine (fig. 24) directly behind the generator. Engine serial number plates (fig. 208) are also attached to flywheel housing front and rear halves.

(2) *Serial number stamp.* Engine serial number (fig. 25) is also stamped on boss at right side of cylinder block at rear of distributor.

e. Responsible Agency Plate. The responsible agency plate (fig. 26 and H, fig. 29) is mounted on right side of instrument board just above instrument board compartment door. This plate indicates the agency responsible for procurement and depot maintenance of chassis, body, and mounted equipment.

f. Technical Publication Plate. The plate (fig. 27 and M, fig. 29) is mounted on right side of instrument board directly under the instrument board compartment door. The plate indicates applicable parts lists, operators manual, and maintenance manuals.

g. Transmission and Transfer Instruction Plate. The plate (D, fig. 29 and fig. 31) is mounted on the instrument board instruction panel. The plate includes transmission and transfer shifting diagrams, maximum permissible road speeds, and brief transmission and transfer shifting instruction.

h. Transfer Control Lever Instruction Plate. The plate is attached to handle of transfer control lever and indicates engaged and neutral positions of transfer.

i. Draining Instruction Plate. The plate (L, fig. 29 and fig. 139) is mounted on right side of instrument board directly under instrument board compartment door. The plate provides brief instructions on draining the engine cooling system.

j. Instrument Board Control Nameplates.

(1) *Choke control* (R, fig. 29). The plate, marked CHOKE, is held in place by choke control knob on instrument board.

(2) *Hand throttle control* (E, fig. 29). The plate, marked THROTTLE, is held in place by hand throttle control knob on instrument board.

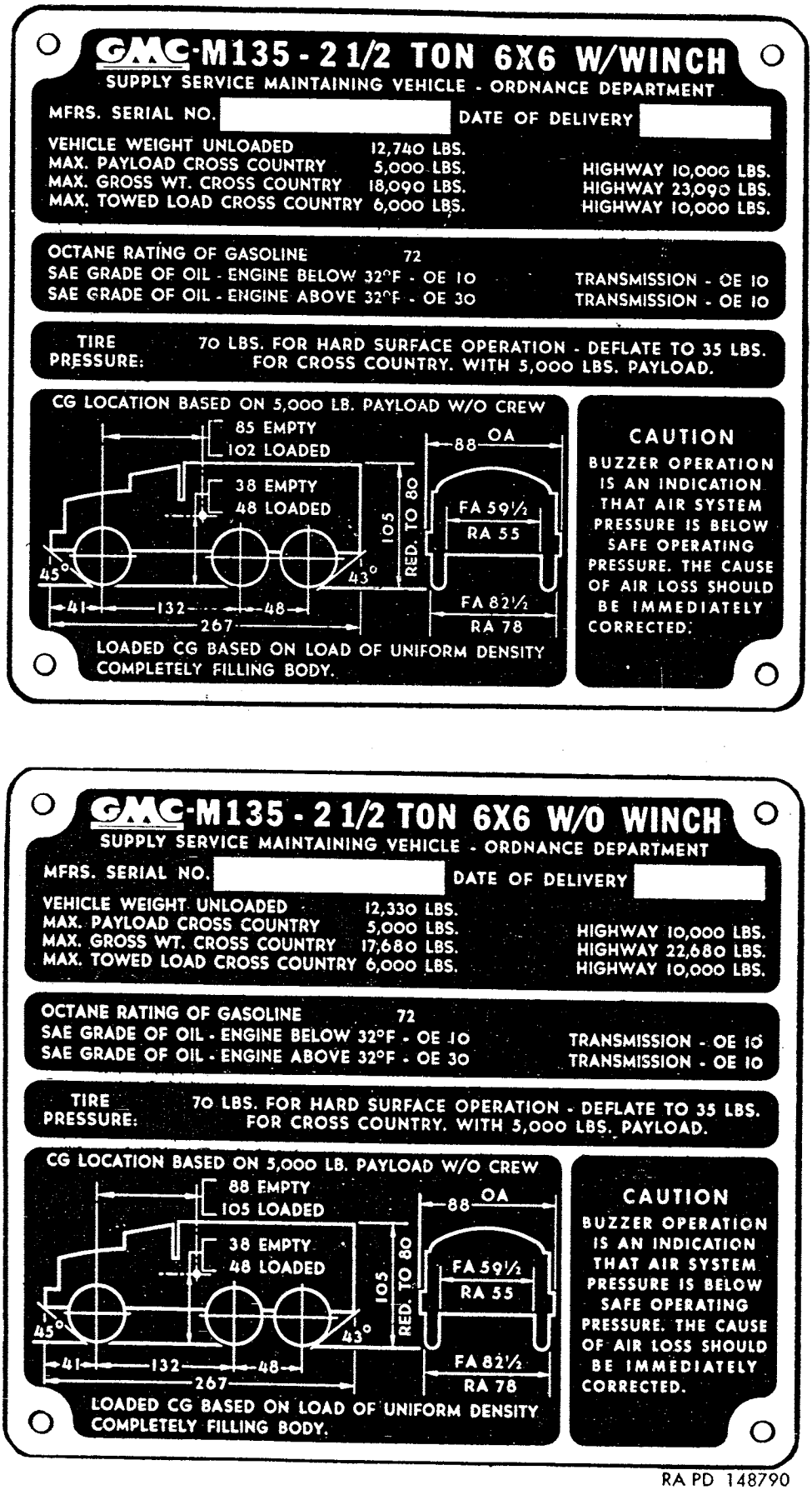


Figure 16. Vehicle identification plates, cargo truck M135, w/and w/o winch.

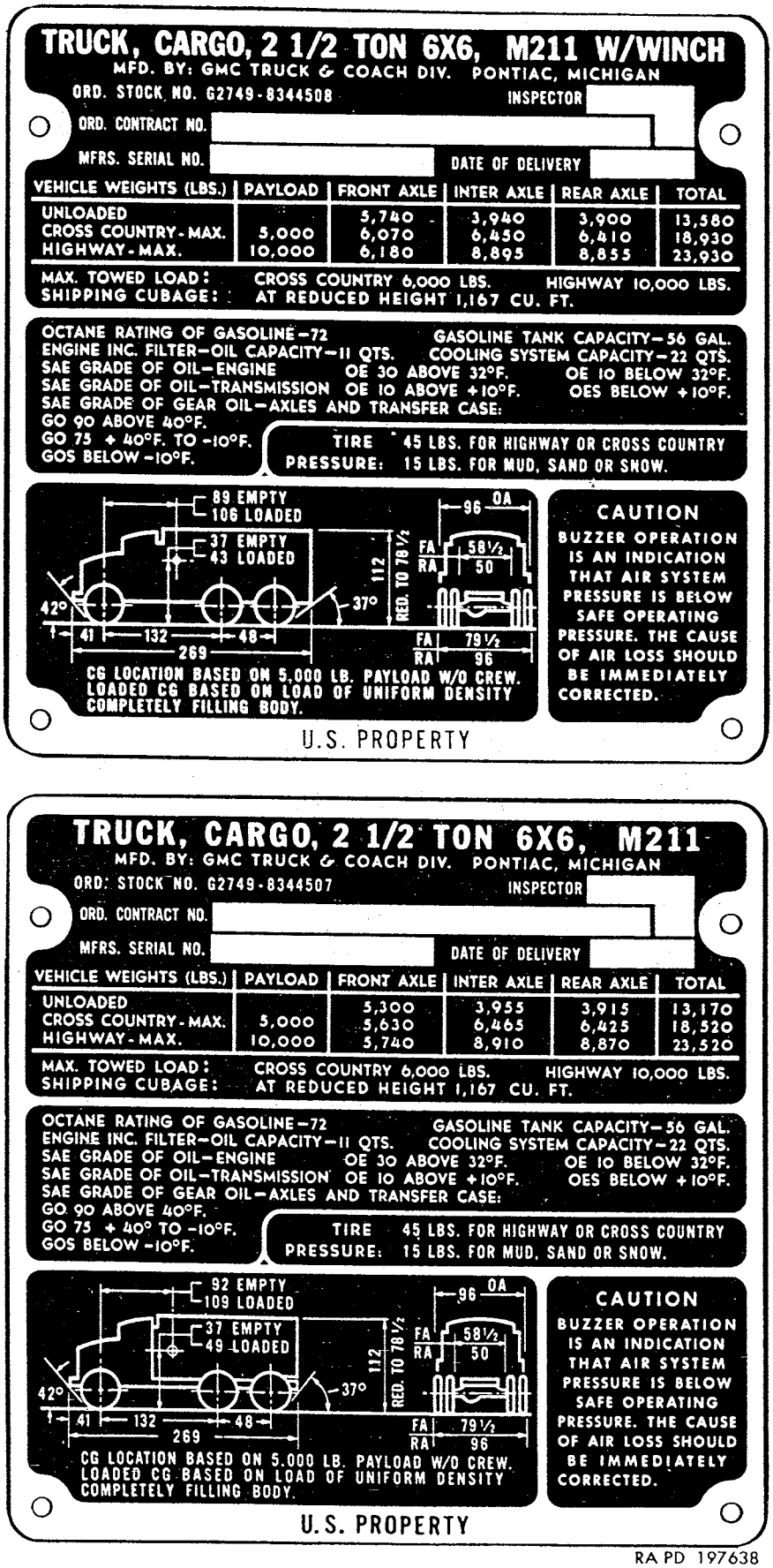


Figure 17. Vehicle identification plates, cargo truck M211, w/and w/o winch.

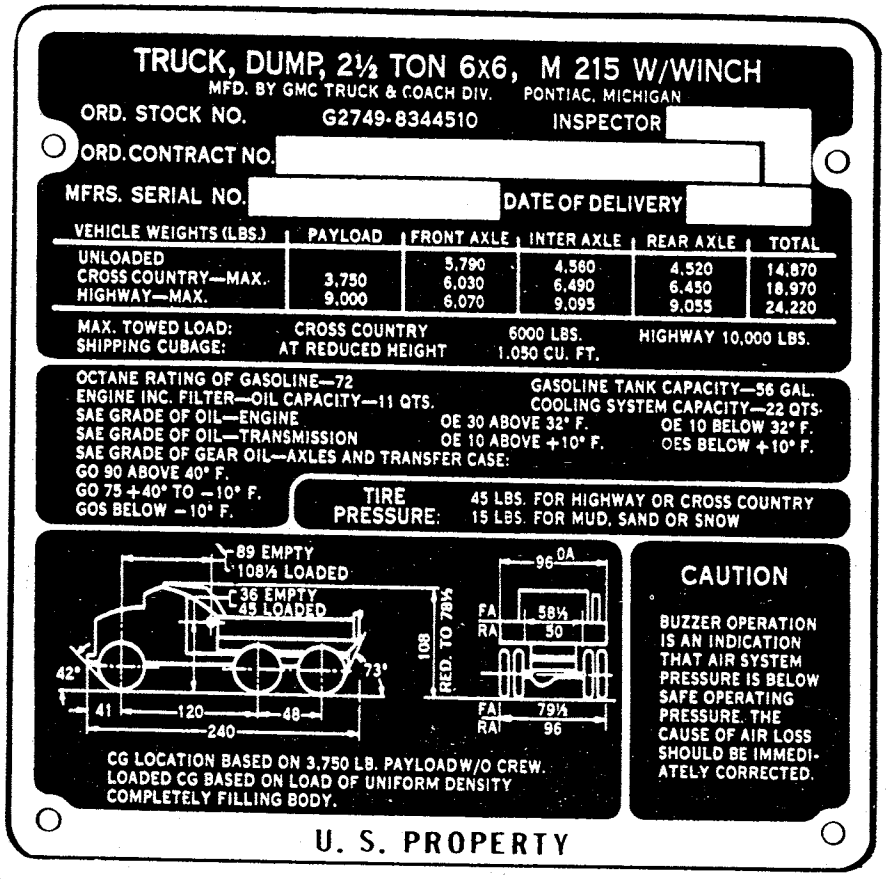


Figure 18. Vehicle identification plates, dump truck M215, w/and w/o winch.

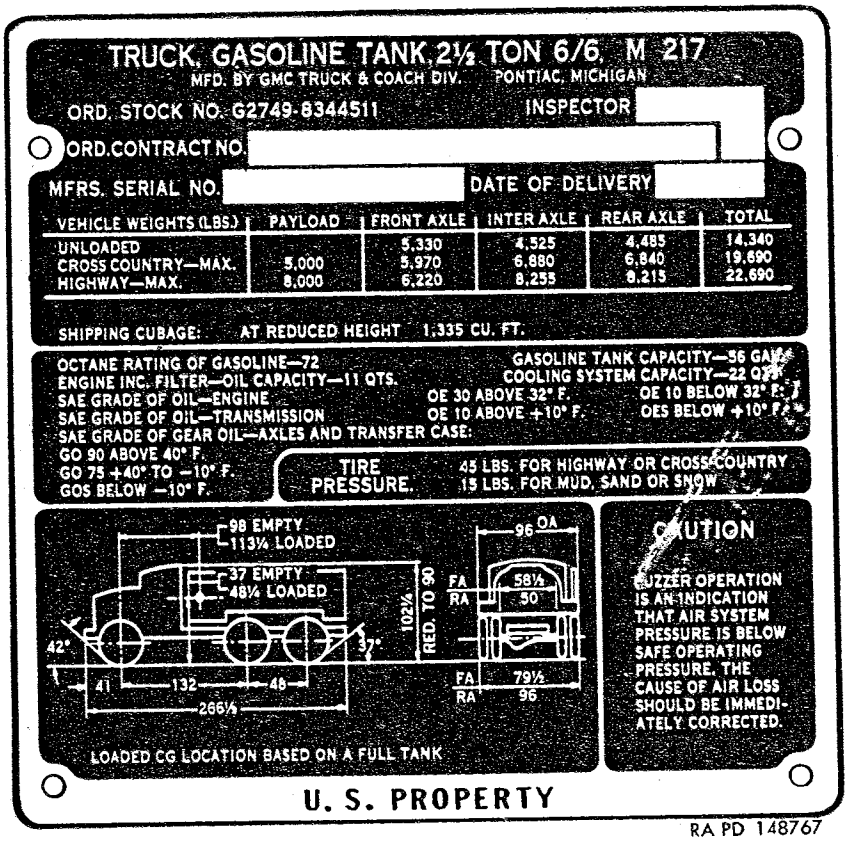


Figure 19. Vehicle identification plate, gasoline tank truck M217.

(3) *Ignition switch* (A, fig. 29). The plate, marked IGNITION, is held in place by ignition switch mounting nut on instrument board.

(4) *Primer pump* (B, fig. 29). The plate, marked PRIMER, is held in place by priming pump mounting nut on instrument board on early cargo truck M135 only.

(5) *Wiper control* (T, fig. 29). The plate, marked WIPER, is held in place on instrument board by windshield wiper control knob mounting nut.

(6) *Light switch* (Y, fig. 29). The plate, marked LIGHTS, is mounted directly above main light switch.

(7) *Temporary parking brake switch* (U, fig. 29). The plate, marked TEMPORARY PARKING BRAKE ONLY (fig. 33), is held in place on instrument board with temporary parking brake switch mounting nut. The plate also indicates ON and OFF positions of the switch.

k. Unit Nameplates.

(1) *Transmission.* The plate, mounted on right side of transmission case, includes manufacturer's name and serial number.

(2) *Distributor.* The plate, mounted on end of distributor body, includes manufacturer's model number and voltage data.

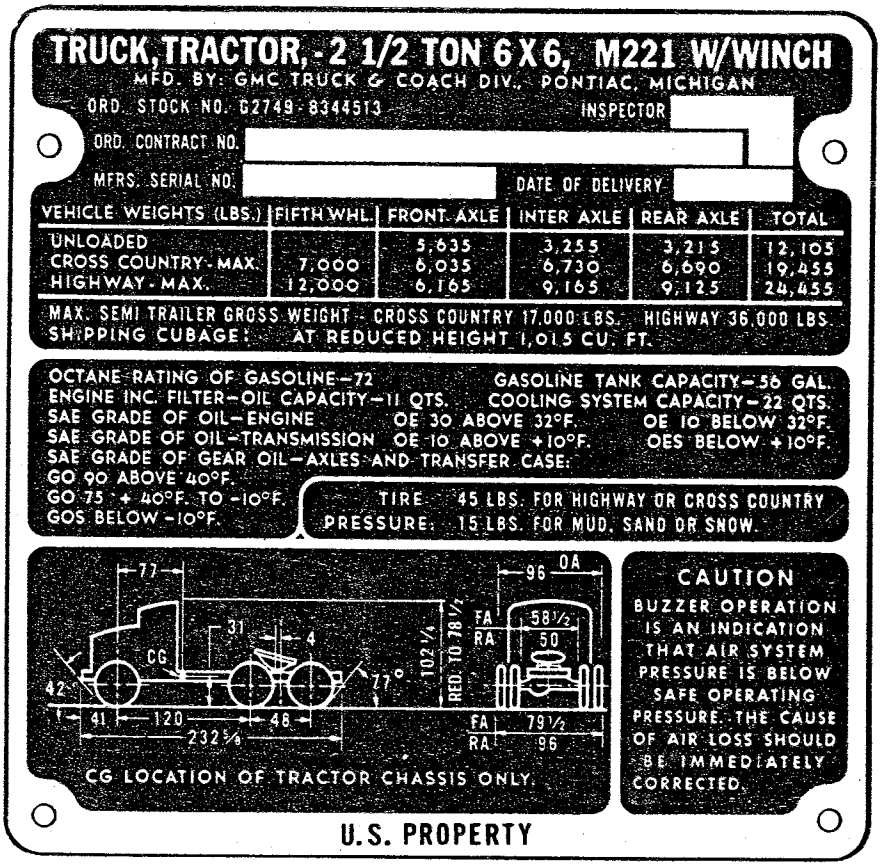


Figure 20. Vehicle identification plates, truck tractor M221, w/and w/o winch.

Figure 21. Vehicle identification plate, water tank truck M222.

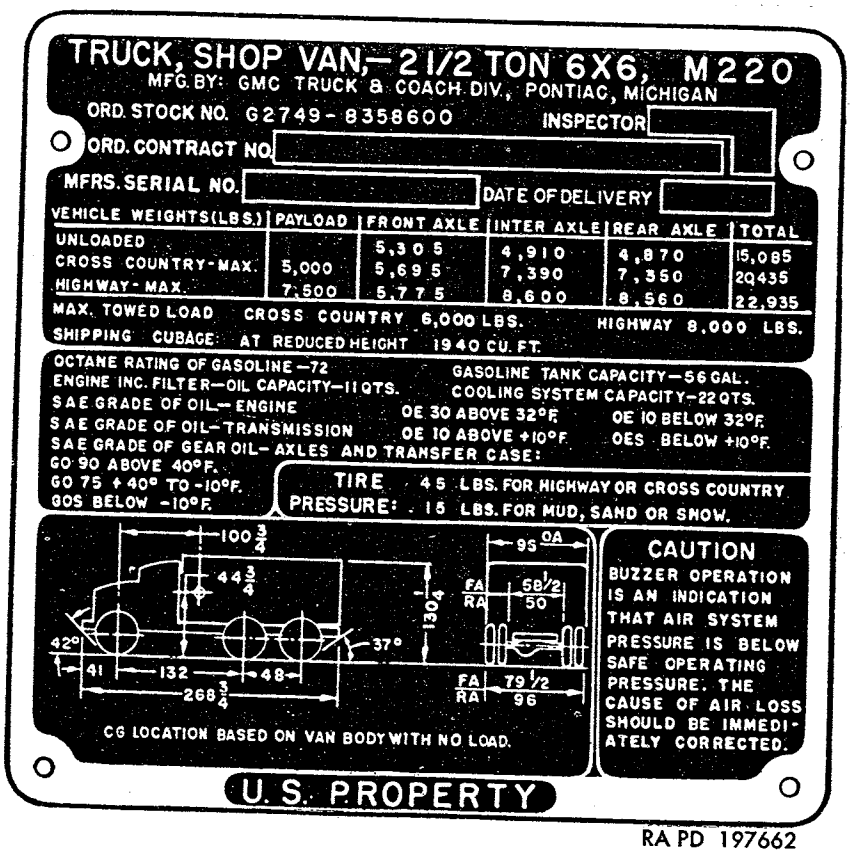


Figure 22. Vehicle identification plate, shop van truck M220.

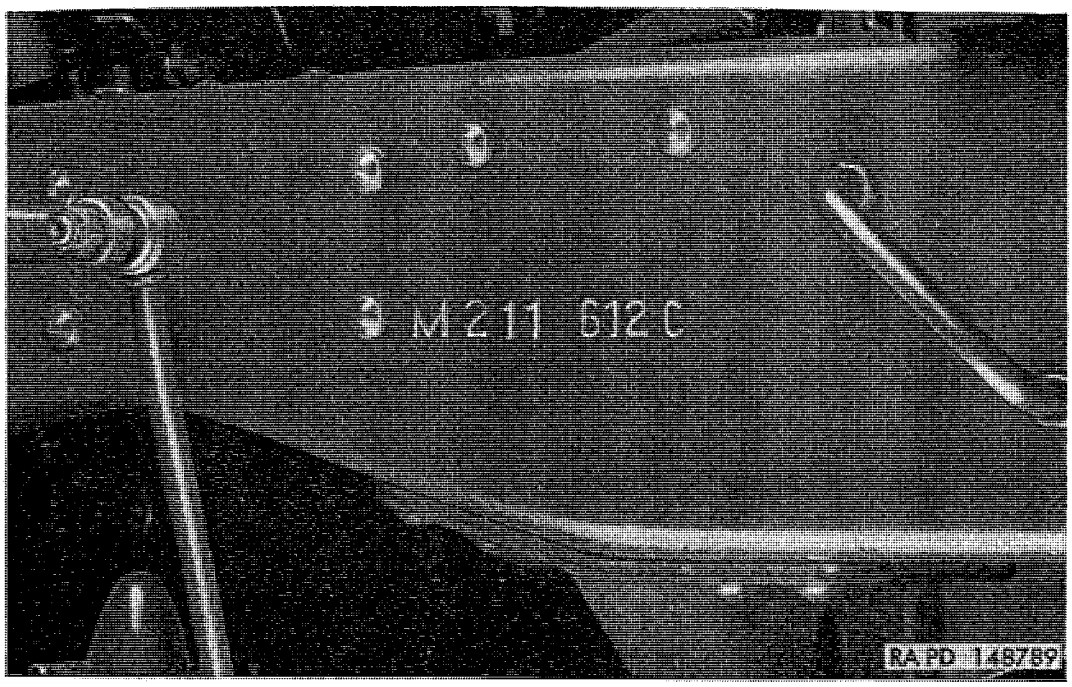


Figure 23. Chassis serial number stamp location.

(3) *Generator.* The plate, mounted on side of generator (fig. 152), includes ordnance number, manufacturer's model number, voltage, amperage, and serial number.

(4) *Starter.* The plate, located on left side of starter (fig. 145), includes voltage, direction of rotation, ordnance part number, manufacturer's model number, and serial number.

(5) *Generator-regulator.* The plate, located on base of regulator, includes model number, ordnance number, voltage, and amperage.

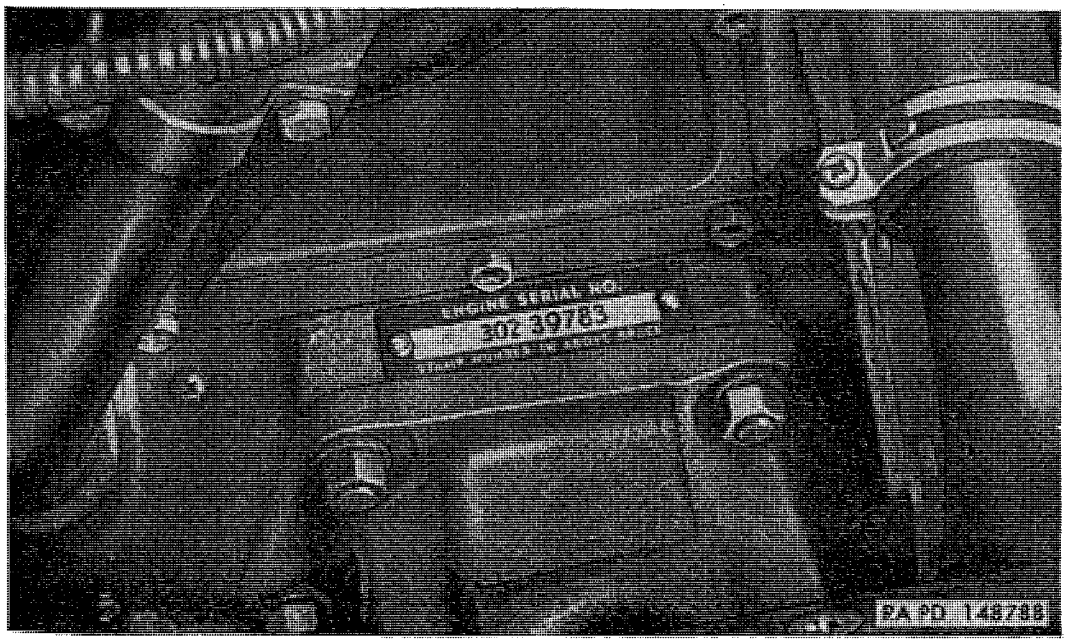


Figure 24. Serial number plate location on engine.

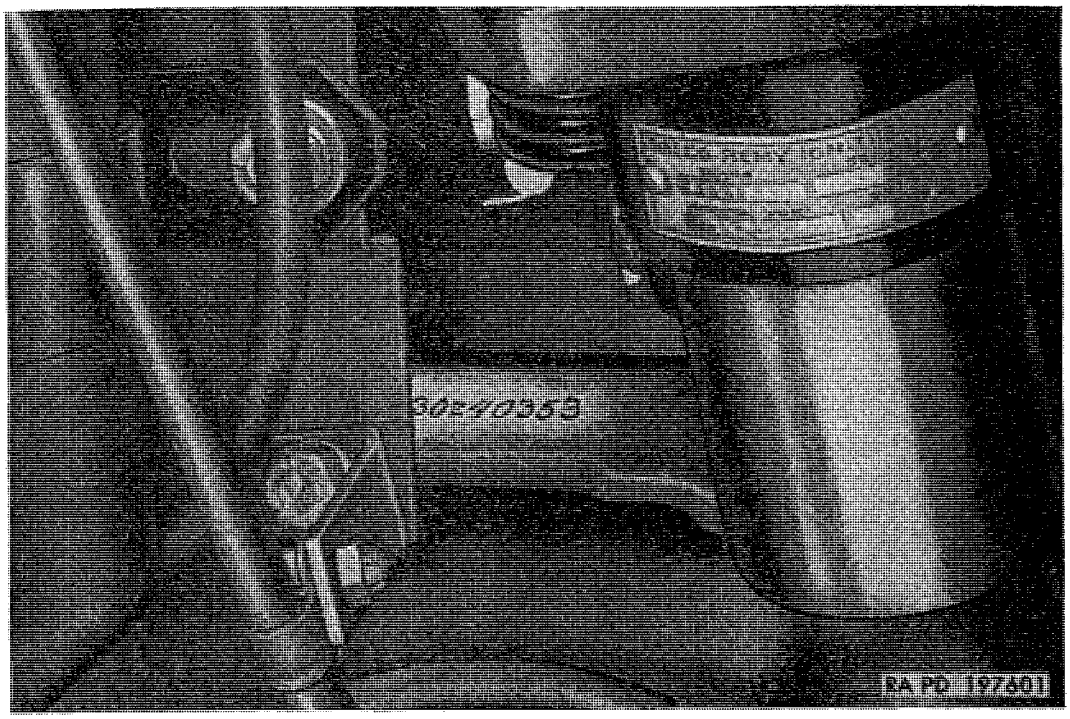


Figure 25. Engine serial number stamp location.

(6) *Carburetor.* The small plate, located on engine side of carburetor body, includes manufacturer's model and part numbers.

(7) *Air compressor* (fig. 254). The plate, located on left side of air compressor crankcase, includes manufacturer's model and serial numbers.

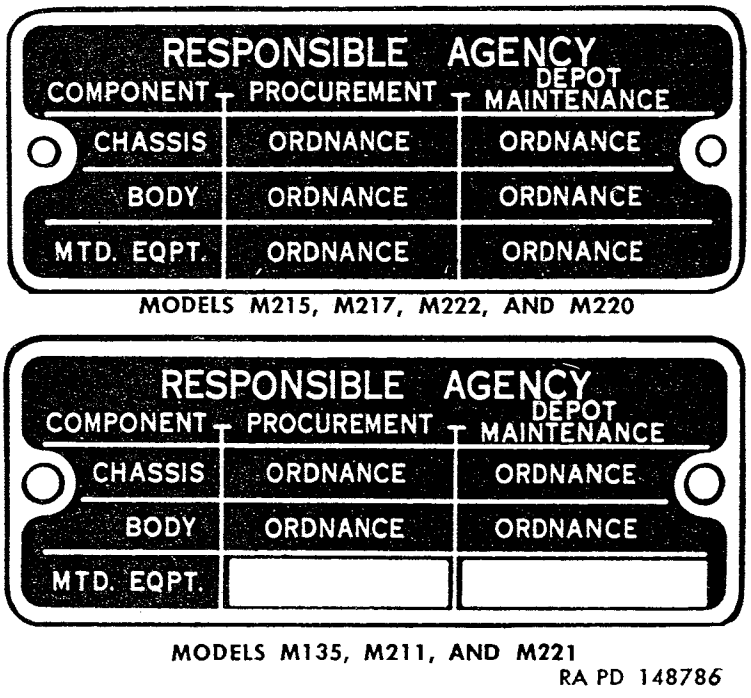


Figure 26. Responsible agency plates.

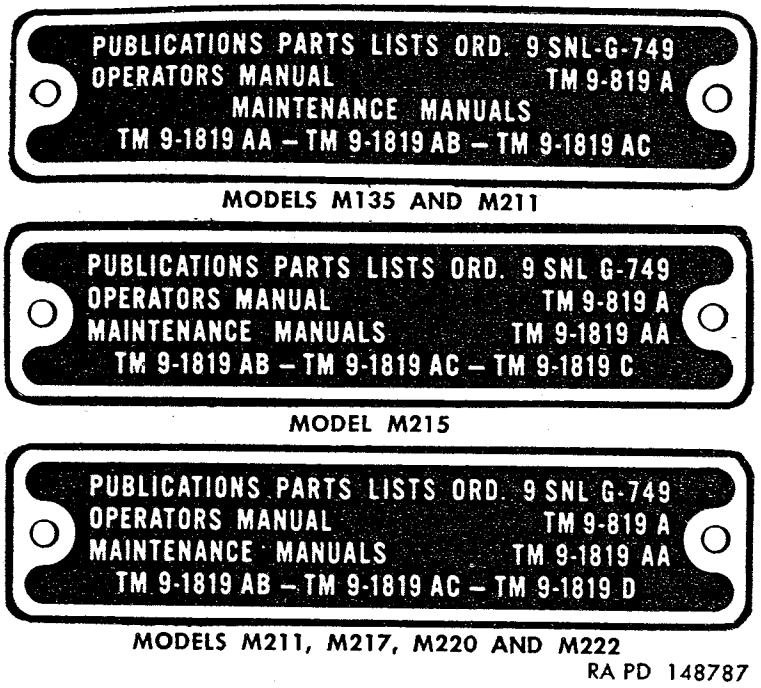


Figure 27. Technical publication plates.

l. Winch Instruction, Caution, and Nameplates.

(1) *Winch instruction plate.* The plate (fig. 42) is mounted on instrument board instruction panel directly to left of transmission and transfer instruction plate (D, fig. 29). This plate shows shifting diagrams of winch power-take-off lever and transfer lever, as well as brief winch operating instructions.

(2) *Power-take-off lever instruction plate.* The plate, attached to power-take-off lever handle (K, fig. 28), indicates position of lever for forward, neutral, and reverse operation of power-take-off for winch drive.

(3) *Winch drum lock caution plate.* The plate (fig. 43), mounted on winch top tension channel, includes a caution regarding use of winch drum lock.

(4) *Winch safety brake adjustment caution plate.* The plate, mounted on automatic brake case cover (fig. 339), includes caution regarding adjustment of winch safety brake.

(5) *Winch nameplate.* The plate (fig. 43), mounted on winch top tension channel, identifies winch assembly by manufacturer's model and serial number.

m. Dump Truck M215 Instruction Plates. In addition to plates described in *b* through *k* above, and *l* above when equipped with winch, following instruction and nameplates are used on dump truck M215.

(1) *Dump body operating instruction plate.* The plate (fig. 44) is mounted on instrument board over instrument cluster (G, fig. 29). The plate includes positioning diagram of the dump

body power-take-off lever and brief instructions for the operation of the dump body hoist.

(2) *Power-take-off lever instruction plate* (fig. 45). The plate is attached to the handle of dump body power-take-off lever located at floor to driver's right side (w/o winch) or left side (w/winch). The plate includes marked positioning diagram of the lever for the operation of dump hoist.

(3) *Dump body nameplate.* The plate, mounted on lower right front corner of body frame (fig. 351), includes manufacturer's name and number.

n. Gasoline Tank Truck M217 Instruction, Caution, and Nameplates. In addition to plates described in *b* through *k* above, the following instruction, caution, and nameplates are used on gasoline tank truck M217.

(1) *Gasoline pump instruction plate.* The plate (fig. 61) mounted on instrument board just above instrument cluster (G, fig. 29), includes brief instructions regarding the positioning of transfer, transmission, and power-take-off controls when operating gasoline pump.

(2) *Gasoline tank nameplate.* The plate, mounted on inside right rear bulkhead of rear equipment compartment, includes manufacturer's name and serial number.

(3) *Power-take-off and accessory drive lever instruction plate* (fig. 61). The plate, attached to power-take-off lever handle, has marked lever positioning diagram for the operation of tank gasoline pump.

(4) *Gasoline tank pump nameplate.* The plate, located on left side of pump body, includes manufacturer's name, model, and service number.

o. Water Tank Truck M222 Instruction, Caution, and Nameplates. In addition to plates described in *b* through *k* above, the following instruction, caution, and nameplates are used on water tank truck M222.

(1) *Water pump instruction plate.* The plate (fig. 52), mounted on instrument board just above instrument cluster (G, Fig. 29), includes brief instructions regarding the use of transmission, transfer, and power-take-off controls for the operation of the tank water pump. The plate also includes instructions for the use of tank exhaust heater and heater gate valve.

(2) *Water tank body name and instruction plate* (fig. 53). The plate, mounted inside the rear equipment compartment, includes manufacturer's name and serial number, schematic diagram of valves and suction and discharge lines, and brief instructions regarding the use of gate valves and connections.

(3) *Water tank heater exhaust control valve instruction plate.* The plate (fig. 52) is held in place on instrument board (fig.

29) by control mounting nut. The plate, marked TANK HEATER, gives instructions to PULL FOR HEAT for the operation of water tank exhaust heater.

(4) *Water tank heater gate valve instruction plate* (fig. 60). The plate, mounted on water tank heater gate valve handwheel, includes instructions regarding opening and closing the gate valve.

(5) *Power-take-off and accessory drive lever instrution plate* (fig. 52). The plate, attached to power-take-off lever handle, has marked positioning diagram for the operation of the tank water pump.

(6) *Water tank pump nameplate.* The plate, located on left side of pump body, includes manufacturer's name, model, and service number.

p. Shop Van Truck M220 Instruction and Nameplates. In addition to plates described in *b* through *k* above, the following name and instruction plates are used on shop van truck M220.

(1) *Body nameplate.* The plate, located on body at lower left front corner, includes manufacturer's name and ordnance number.

(2) *Exhaust blower operating instruction plate* (G, fig. 68). The plate, mounted on current converter in van body, indicates positions of exhaust blower operation switch as explained in paragraph 57*d*.

(3) *Exhaust blower voltage selector switch* (H, fig. 68). The plate mounted on current converter in van body, indicates position of current selector switch as explained in paragraph 57*d*.

(4) *Power switch instruction plate.* The plate, mounted on power switchbox in van body, indicates position of power switch handle (D, fig. 68) for selection of 115-volt ac or 24-volt dc system as explained in paragraph 57.

(5) *Blackout switch instruction plate* (*115 v*) (A, fig. 68). The plate, mounted on blackout switchbox in van body, indicates position of interior light switch when operating on 115-volt current as explained in paragraph 57*e*.

(6) *24-volt light switch instruction plate* (fig. 71). The plate, mounted on inside right rear wall of body, indicates positions of light switches when operating 24-volt interior lights as explained in paragraph 57*e*.

7. Tabulated Data

Vehicle weight data, dimensional data, operational data, performance data, and oil, fuel, and water capacities for all vehicles covered by this manual are included in table II. For additional tabulated data pertaining to individual components and systems, refer to the index.

Table II. Vehicle Tabulated Data

Vehicle model	Cargo M135	Cargo M211	Dump M215	Gas tank M217	Shop van M220	Tractor M221	Water tank M222
WEIGHT:							
Vehicle net weight: [1]							
W/winch	12,740 lb	13,580 lb	14,870 lb			12,105 lb.	
W/o winch	12,330 lb	13,170 lb	14,460 lb	14,340 lb	15,085 lb	11,695 lb	14,100 lb.
Maximum payload [2] (w/ or w/o winch):							
Highway operation	10,000 lb	10,000 lb	9,000 lb	8,000 lb	7,500 lb	12,000 lb [3]	8,500 lb.
Cross-country operation	5,000 lb	5,000 lb	3,750 lb	5,000 lb	5,000 lb	7,000 lb [3]	3,500 lb.
Maximum gross: [4]							
Highway operation:							
W/winch	23,090 lb	23,930 lb	24,220 lb			24,455 lb.	
W/o winch	22,680 lb	23,520 lb	23,810 lb	22,690 lb	22,935 lb	24,045 lb	22,950 lb.
Cross-country operation:							
W/winch	18,090 lb	18,930 lb	18,970 lb			19,455 lb.	
W/o winch	17,680 lb	18,520 lb	18,560 lb	19,690 lb	20,435 lb	19,045 lb	17,950 lb.
Maximum towed load (w/ or w/o winch):							
Highway operation	10,000 lb	10,000 lb	10,000 lb		8,000 lb	36,000 lb. [5]	
Cross-country operation	6,000 lb	6,000 lb	6,000 lb		6,000 lb	17,000 lb. [5]	
DIMENSIONS:							
Maximum overall length	269 in	269 in	240 in	266½ in	268¾ in	232⅝ in	266½ in.
Maximum overall width	88 in	96 in	96 in	96 in	96 in	96 in	96 in.
Maximum height:							
Overall	105 in	112 in	108 in	102¼ in	130¼ in	102¼ in	102¼ in.
Lowest reducible	80 in	78½ in	78½ in	90 in	130¼ in	78½ in	90 in.

Tire tread (track):							
Front	71 in.	69 in.	69 in.	69 in.	69 in.	69 in.	69 in.
Rear	66½ in.	73 in.	73 in.	73 in.	73 in.	73 in.	73 in.
Width at outside of tires:							
Front	82½ in.	79½ in.	79½ in.	79½ in.	79½ in.	79½ in.	79½ in.
Rear	78 in.	96 in.	96 in.	96 in.	96 in.	96 in.	96 in.
Width at inside of tires:							
Front	59½ in.	58½ in.	59½ in.	58½ in.	58½ in.	58½ in.	58½ in.
Rear	55 in.	50 in.	50 in.	50 in.	50 in.	50 in.	50 in.
Wheelbase (front axle to rear spring seat centerline).	156 in.	156 in.	144 in.	156 in.	156 in.	144 in.	156 in.
Front of vehicle to front axle centerline.	41 in.	41 in.	41 in.	41 in.	41 in.	41 in.	41 in.
Front axle to forward rear axle centerline.	132 in.	132 in.	120 in.	132 in.	132 in.	120 in.	132 in.
Forward rear axle to rear axle centerline.	48 in.	48 in.	48 in.	48 in.	48 in.	48 in.	48 in.
Rear rear axle centerline to rear of vehicle.	48 in.	48 in.	31 in.	45½ in.	47¾ in.	23⅝ in.	45½ in.
Shipping cubic (at lowest reducible height).	1,100 cu. ft.	1,167 cu. ft.	1,050 cu. ft.	1,335 cu. ft.	1,940 cu. ft.	1,015 cu. ft.	1,335 cu. ft.
Body:							
Length (inside)	147 in.	147 in.	108 in.		144 in.		
Width (inside):							
Between sides	80 in.	88 in.	70 in.		90 in.		
Between wheelhouses	48½ in.						

[1] Weight of fully equipped vehicle in operating condition with fuel, lubricants, and water, but without crew or payload.
[2] Weight of cargo or passengers, including crew, which may be safely imposed on vehicle.
[3] Weight at fifth wheel.
[4] Weight of vehicle fully equipped and serviced for operation, including crew, plus maximum allowable payload of cargo or passengers.
[5] Semitrailer maximum gross weight.

Table II. Vehicle Tabulated Data—Continued

Vehicle model	Cargo M135	Cargo M211	Dump M215	Gas tank M217	Shop van M220	Tractor M221	Water tank M222
DIMENSIONS—Continued							
Body:							
Height (inside):							
Floor to paulin bows	60 in.	60 in.	----------	----------	----------	----------	
Floor to top of seats	16 in.	16 in.	----------	----------	----------	----------	
Floor to top of side racks.	36½ in.	36½ in.	----------	----------	----------	----------	
Floor to top of body	14 in.	14 in.	15½ in.	----------	76 in.	----------	
OPERATIONS:							
Angle of approach	45 deg	42 deg	42 deg	42 deg	42 deg	42 deg	42 deg.
Angle of departure	43 deg	37 deg	73 deg	37 deg	37 deg	77 deg	37 deg.
Ground clearance at axle	12½ in.	12 in.	12 in.	12 in.	12 in.	12 in.	12 in.
Minimum turning radius (right or left).	34½ ft	34½ ft	32½ ft	34½ ft	34½ ft	32½ ft	34½ ft.
Maximum fording depth (without fording equipment).	30 in.	30 in.	30 in.	30 in.	30 in.	30 in.	30 in.
Tire size	11:00 x 20	9:00 x 20	9:00 x 20	9:00 x 20	9:00 x 20	9:00 x 20	9:00 x 20.
Tire pressure:							
Highway	70 lb	45 lb	45 lb	45 lb	45 lb	45 lb	45 lb.
Cross-country	35 lb	45 lb	45 lb	45 lb	45 lb	45 lb	45 lb.
Mud, sand, or snow	15 lb	15 lb	15 lb	15 lb	15 lb	15 lb	15 lb.
PERFORMANCE:							
Maximum permissible speed:							
High range (F–1 or F–2)	58 m. p. h.	55 m. p. h.	55 m. p. h.	55 m. p. h.	55 m. p. h.	55 m. p. h.	55 m. p. h.
Low range (F–1 or F–2)	15 m. p. h.	14 m. p. h.	14 m. p. h.	14 m. p. h.	14 m. p. h.	14 m. p. h.	14 m. p. h.

Reverse:							
High range	12 m. p. h.	12 m. p. h.	12 m. p. h.	12 m. p. h.	12 m. p. h.	12 m. p. h.	12 m. p. h.
Low range	3 m. p. h.	3 m. p. h.	3 m. p. h.	3 m. p. h.	3 m. p. h.	3 m. p. h.	3 m. p. h.
Maximum grade	60 percent	60 percent	60 percent	60 percent	60 percent	60 percent	60 percent.
Engine horsepower (SAE)	38.4 hp	38.4 hp	38.4 hp	38.4 hp	38.4 hp	38.4 hp	38.4 hp.
Winch capacity	10,000 lb	10,000 lb	10,000 lb			10,000 lb	
CAPACITIES:							
Fuel tank	56 gal	56 gal	56 gal	56 gal	56 gal	56 gal	56 gal.
Cooling system	22 qt	22 qt	22 qt	22 qt	22 qt	22 qt	22 qt.
Crankcase (refill)	11 qt	11 qt	11 qt	11 qt	11 qt	11 qt	11 qt.
Air cleaner	2 qt	2 qt	2 qt	2 qt	2 qt	2 qt	2 qt.
Transmission (aprx)	16 qt	16 qt	16 qt	16 qt	16 qt	16 qt	16 qt.
Transfer:							
W/power-take-off	7½ pt	7½ pt	7½ pt	7½ pt	7½ pt	7½ pt	7½ pt.
W/o power-take-off	6½ pt	6½ pt	6½ pt	6½ pt	6½ pt	6½ pt	6½ pt.
Differentials:							
Front axle	15½ pt	15½ pt	15½ pt	15½ pt	15½ pt	15½ pt	15½ pt.
Forward rear axle	13½ pt	13½ pt	13½ pt	13½ pt	13½ pt	13½ pt	13½ pt.
Rear rear axle	11½ pt	11½ pt	11½ pt	11½ pt	11½ pt	11½ pt	11½ pt.
Steering gear housing	1½ pt	1½ pt	1½ pt	1½ pt	1½ pt	1½ pt	1½ pt.
Winch:							
End frame	1 pt	1 pt	1 pt	1 pt	1 pt	1 pt	1 pt.
Gear case	1¼ pt	1¼ pt	1¼ pt	1¼ pt	1¼ pt	1¼ pt	1¼ pt.
Dump hydraulic hoist			5½ gal				
Gasoline tank body				1,200 gal			
Water tank body							1,000 gal.
Dump body			2½ cu yd				

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIEL

8. 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 is in condition to perform any mission to which it may be assigned when placed into 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. 65–68) to be sure every item is present, in good condition, clean, and properly mounted or stowed.

b. In addition, perform a "break-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 paragraph 10.

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

9. Preliminary Services

a. General Procedures. New or reconditioned vehicles may be driven to the using organization, they may be shipped in drivable condition, or they may be shipped crated. In any case, they require substantially the same treatment upon receipt and prior to being placed in use.

(1) Uncrate vehicles, if crated. Remove metal strapping, plywood, tape, seals, wrapping paper, and dehydrant bags. If any exterior surfaces are coated with rust-preventive compound, remove it with dry-cleaning solvent or volatile mineral spirits.

(2) Read Preparation Record for Storage or Shipment tag and follow all precautions checked thereon. This tag should be in driver's compartment attached to steering wheel.

(3) Refer to paragraph 76*b* for general procedures for all services and inspections.

b. Specific Procedures.

(1) Peform the "D" (6 months or 6,000 mile) preventive-maintenance service (table V) with variations in (*a*) through (*g*) below.

(*a*) Line out the other services on the worksheet (DA Form 461) and write in "New (or rebuilt) vehicle reception."

(*b*) Before starting engine, tighten cylinder head bolts with a torque-indicating wrench to the torque and in the sequence prescribed in paragraph 110*c*.

(*c*) Perform item 27 before starting road test. If a processing tag (*a*(2) above) on the engine or vehicle states that engine contains oil that is suitable for 500 miles of operation, and of the correct seasonal viscosity, check the level but do not change the oil. Lubricate all points, regardless of interval. Check the lubricant level in transfer, power-take-off, and front and rear axles. Check fluid level in transmission (par. 194*b*) and M215 dump hoist reservoir (par. 325*b*). If the lubricants are known to be of correct seasonal grade, do not change.

(*d*) When the engine has been thoroughly warmed up to operating temperature (par. 38*c*), recheck tightness of cylinder head bolts (par. 110*c*).

(*e*) Perform item 35. Inspect breaker points (par. 123*a*); dressing should not be necessary.

(*f*) Perform item 39. Look at wheel bearings. If lubrication appears to be adequate, do not clean and repack. Do not adjust brakes unless necessary.

(*g*) Peform item 9. The front band of the Hydra-Matic transmission requires adjustment (par. 201) prior to issue to the using organization.

10. Break-In Procedures

a. Service During First 500 Miles.

(1) After the preliminary services have been performed, the break-in period (500 miles) may be accomplished in normal service of the vehicle under the supervision of a competent driver. The driver will be cautioned against excessive speeds, rapid acceleration, or in any way loading the engine or power train to capacity during the break-in period. If the vehicle was driven to the using organization, consider the mileage so traveled as break-in mileage.

(2) Reference must be made to paragraphs 36 through 46 for operation of controls, instruments, and gages in the basic vehicles. Refer to paragraphs 47 through 58 for operation of auxiliary equipment such as winch, dump body, gasoline tank

and water tank equipment, tractor fifth wheel, and shop van body equipment.

(3) During break-in period, the driver's or operator's preventive-maintenance services (table IV) must be accomplished.

(4) At 200 miles and at 500 miles, the front band of the Hydra-Matic transmission must be checked and adjusted if required (par. 201).

b. Service After 500 Miles. After 500 miles of vehicle operation, perform the "C" (1,000 mile) preventive-maintenance services (table V), with the variations in (1) and (2) below.

(1) Line out the other services on the worksheet (DA Form 461) and write in "New (or rebuilt) vehicle 500-mile service."

(2) Change the engine oil (par. 108*a*).

c. Service After 1,000 Miles. When the vehicle has been driven 1,000 miles, it will be placed on regular preventive-maintenance schedule, and will be given the first regular "C" (1,000 mile) preventive-maintenance service (table V).

Note. At 1,500 miles and at 3,000 miles, the front band of the Hydra-Matic must be checked and adjusted if necessary (par. 201). The need for additional adjustment may vary, depending upon the service to which vehicle is subjected. In every case, where the shift does not conform to the automatic shift pattern (par. 199*b*), an immediate adjustment of the front band must be accomplished.

11. Correction of Deficiencies

a. Ordinary deficiencies disclosed during the preliminary inspection and servicing or during the break-in period will be corrected by the using organization or a higher maintenance echelon.

b. Serious deficiencies, which appear to involve unsatisfactory design or material, will be reported on DA Form 468. The commander of the using organization will submit the completed form (in accordance with SR 700–45–5) to the Chief of Ordnance, Washington 25, D. C., ATTN: ORDFM (or to chief of appropriate technical service for other than ordnance equipment).

Section II. CONTROLS AND INSTRUMENTS

12. General

a. This section describes, locates, and illustrates the various conventional controls and instruments provided for the driving of all vehicles.

b. Controls necessary for the operation of auxiliary equipment such as winch, dump body hoist, gasoline and water tank pumps, tractor fifth wheel attachments, and shop van body are described in paragraphs 47 through 58.

c. All pedals and hand lever controls, instruments, gages, and switches for normal operation of the vehicle are grouped in the driver's

compartment (fig. 28) and on instrument board (fig. 29) in driver's compartment. The major graduations, letters, figures, and pointer tips on gages grouped in instrument board cluster (fig. 30) are coated with luminous paint.

13. Service Brake Pedal

The brake pedal (P, fig. 28) is located on floor, accessible to driver's right foot, and is used to control service brakes at all wheels of vehicle, and trailer brakes on vehicles equipped with trailer brake service lines. Brakes are applied by depressing pedal. Degree of brake application is in direct proportion to the amount of physical effort applied to the pedal (par. 41*b*).

14. Accelerator Pedal

Treadle type accelerator pedal (N, fig. 28) is located on cab floor just to right of brake pedal. Engine is accelerated from idling speed to governed speed in varying degrees, depending upon pressure applied to pedal. When foot pressure is released, pedal will return throttle to engine idling position.

15. Parking Brake Lever

Manually operated parking brake lever (J, fig. 28) is located to right of driver between driver's and companion seat near floor. A band-type brake, mounted at rear of transfer, is actuated through linkage by pulling up on hand lever. Use of parking brake is explained in paragraph 42.

16. Temporary Parking Brake Switch

Temporary parking brake switch (U, fig. 29), located on instrument board under instrument board instruction panel, controls circuit to solenoid valve connected into master cylinder outlet line. Plate under switch lever is marked TEMPORARY PARKING BRAKE ONLY (fig. 33), for identification, and also indicates the ON and OFF positions.

Caution: This temporary parking brake is for emergency use only in the event of mechanical parking brake failure; therefore, should not be depended upon to hold the vehicle for extended periods. The brake should only be used as explained in paragraph 43. Switch should remain in OFF position except when used in emergency as a temporary parking brake.

17. Transmission Shift Control Lever

Transmission shift control lever (Q, fig. 29) is located on control tower (M, fig. 28), to the right and slightly ahead of driver. The shift control lever operates in adequately marked shift pattern slots

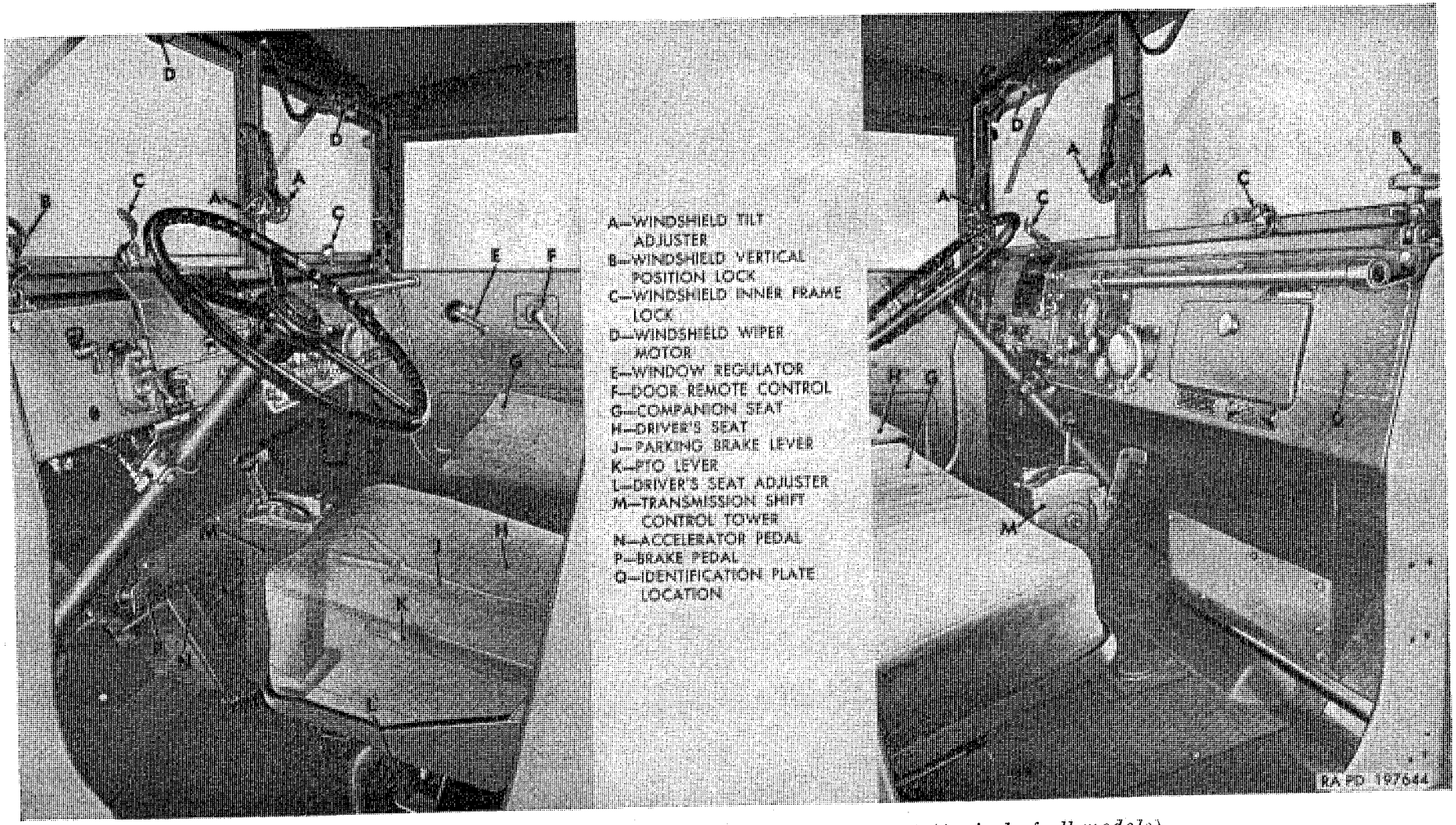


Figure 28. Left and right views into driver's compartment (typical of all models).

Figure 28. Left and right views into driver's compartment (typical of all models).

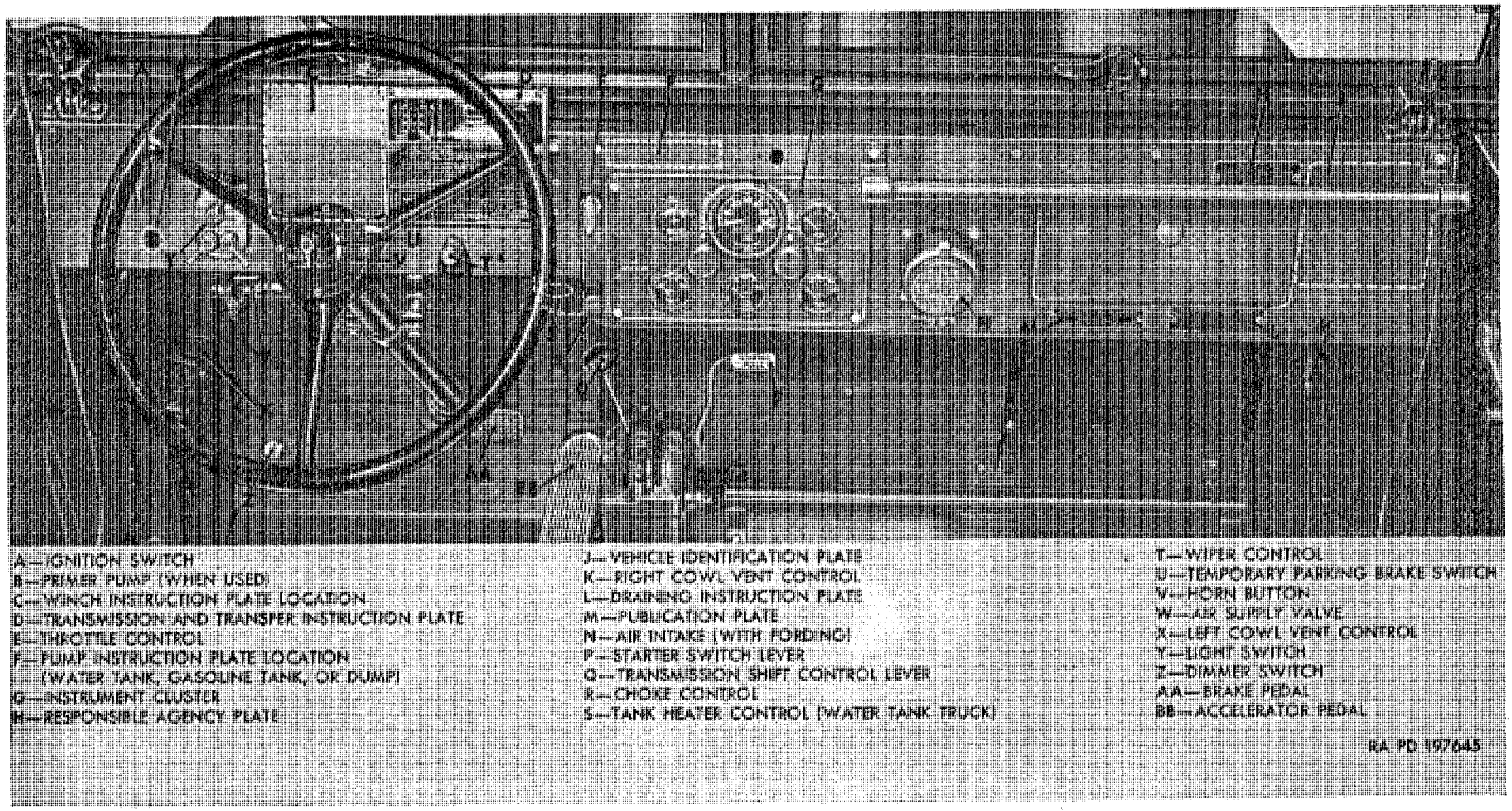


Figure 29. Instrument board in driver's compartment (typical of all models).

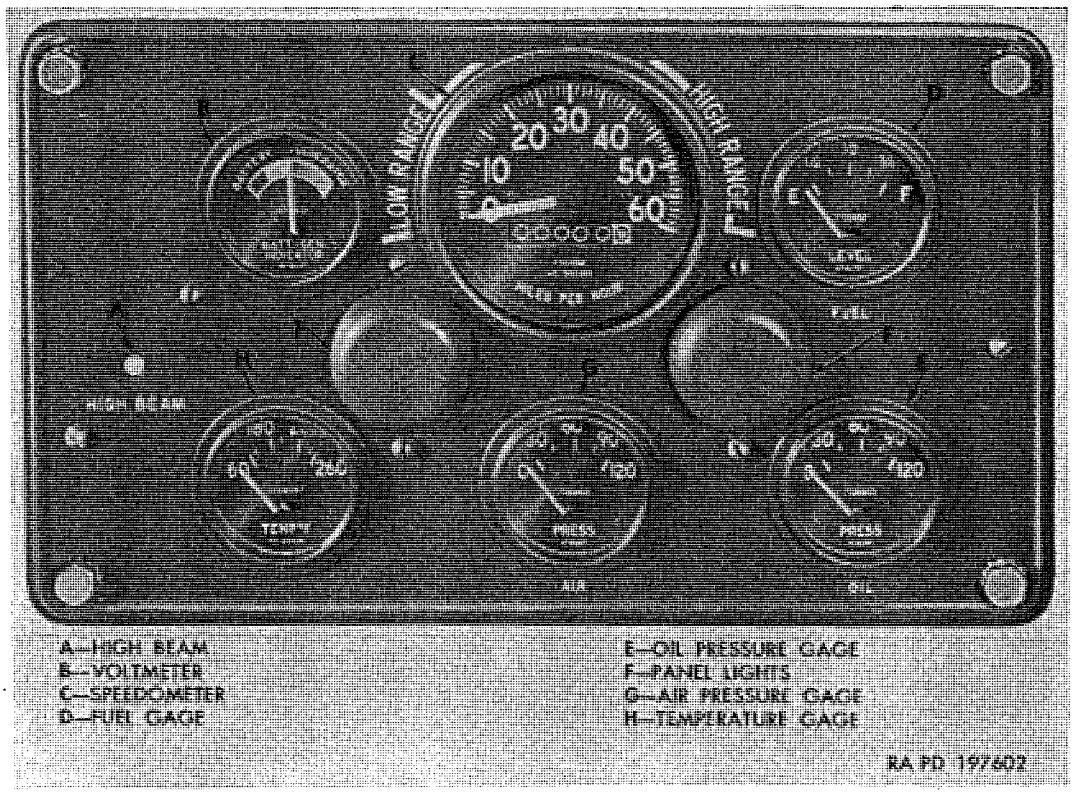


Figure 30. Instrument board cluster.

(fig. 32). Lever must be manually positioned in accordance with desired range and conditions as explained in paragraph 40.

18. Transfer Lever

Hand-operated lever is under and slightly to the right of driver's seat near floor. Lever is operated up and down in a slot and is used to position transfer into neutral and driving positions. Plate on lever indicates positioning of lever in accordance with transmission and transfer instruction plate (fig. 31). Lever must be in UP ENGAGED position before vehicle can be driven. Use of the lever is explained in paragraph 39*b*.

19. Power-Take-Off Levers

a. Winch Operation. Power-take-off lever for winch operation is located adjacent to transfer lever when vehicle is equipped with winch. Lever operation in conjunction with transfer and transmission for winch operation is explained in paragraphs 48 and 49.

b. Dump Body Hoist Operation. The lever is located at left of driver. Lever operation in conjunction with the transfer and transmission dump body hoist operation is explained in paragraphs 50 and 51.

c. Water Tank and Gasoline Tank Pump Operation. The lever is located near floor at left of driver. Lever operation in conjunction

with transfer and transmission water tank or gasoline tank pump operation is explained in paragraphs 53 and 55.

20. Ignition Switch

Lever-type ignition switch (A, fig. 29), indicated by nameplate marked IGNITION, is located on instrument board to driver's left. Lever must be turned to left to complete ignition circuit before engine can be started. When ignition circuit is completed, temperature gage, oil pressure gage, air pressure gage, and fuel level gage circuits are energized, permitting reading of the values on those gages. Low air switch and fuel tank fuel pump circuits are also energized when ignition switch is turned on.

21. Hand Throttle Control

(E, fig. 29)

The hand throttle control handle, indicated by nameplate marked THROTTLE, is located on instrument board at the left of the instrument cluster. Throttle handle can be pulled out in varying degrees to accelerate engine from idle to governed speed. Handle is automatically locked in accelerating positions, and can be unlocked and pushed back after handle is turned one-quarter turn to right or left. This control is generally used to set throttle to desired starting and warming-up speed, and to obtain sustained speeds when operating auxiliary units.

22. Choke Control

Choke control (R, fig. 29), indicated by nameplate marked CHOKE, is located on instrument board just to left of instrument cluster. Choke control button is connected with carburetor choke valve which is closed proportionally to degree button is pulled out. Control is used when starting and operating a cold engine. Control button must be held pulled out until engine is started and is operating correctly. After button is released, control is returned to off position by spring action.

23. Primer Pump

(B, fig. 29)

Primer pump knob, used on early cargo truck M135, is located on instrument board at left end. Pulling the knob out and pushing it in again, in a pumping action, pumps a stream of fuel directly into the intake manifold. The primer may be used to facilitate engine starting during cold weather (par. 37).

Note. Primer pump is deactivated on some vehicles according to MWO ORD G749–W2.

24. Windshield Wiper Control

Wiper control (T, fig. 29), indicated by nameplate marked WIPER, is located on instrument board at right of steering column, below the instruction plate panel. Turning the knob in varying degrees controls the action of the two air-operated windshield wipers. Each wiper is also equipped with a manually operated lever.

25. Light Switch

The light switch (Y, fig. 29), indicated by plate marked LIGHTS, is located on instrument board to the driver's left. This switch (fig. 38 or 39) is a three-lever-type with main, auxiliary, and mechanical switch levers. The levers are positioned to control all lights on the vehicle as explained in paragraph 45.

26. Dimmer Switch

Foot-operated dimmer switch (Z, fig. 29) is located on floor board, accessible to driver's left foot. The switch is used to control the upper and lower beams of the service driving headlights. Use of this switch permits driver to dim lights when passing other vehicles or to turn on bright lights when needed. Dimmer switch is only operative when light switch is positioned on SER DRIVE. High beam light, marked HIGH BEAM directly under light, is located on instrument board cluster (fig. 30). This light illuminates when upper beams of service headlights are used.

27. Horn Button

The horn button (V, fig. 29) is located in center of steering wheel, and must be depressed to sound air horn.

28. Starter Switch Lever

Starter switch lever (P, fig. 29), marked STARTER and PULL, is mounted on transmission control tower.

29. Voltmeter (Battery-Generator Indicator)

a. The battery-generator indicator (B, fig. 30), marked BATT-GEN INDICATOR on face of indicator, is located in instrument cluster. Three colored arcs are marked on face of indicator. The left arc is red, the arc to left of center is yellow, and the arc to right of center is green. Above the red and yellow arcs the word BATTERY is placed, while the green arc is marked GENERATOR.

b. The indicator has two purposes—to show condition of batteries when engine is not running, and to show charging activity of the generator when engine is running.

(1) The indicator is activated at all times regardless of position of ignition switch. If the indicator pointer is in the yellow arc when engine is not running, the batteries are at correct

voltage. If indicator shows in red arc, the batteries require recharging.

(2) When the engine is running, the indicator pointer will show in green arc if generator is properly charging. If during operation, the indicator shows well into yellow arc or into red arc, the batteries are not receiving sufficient charge.

30. Temperature Gage

Temperature gage (H, fig. 30), marked TEMP °F. on gage face, is located in instrument cluster. Face of gage is marked in graduations of 40° F. from 60° to 260° F. After ignition switch is turned on, gage is activated by a sending unit mounted in engine thermostat housing. Purpose of the gage is to indicate temperature of liquid in engine cooling system in degrees Fahrenheit. Operating temperatures between 160° and 220° F. are satisfactory for engine operation under normal operating conditions (par. 38*c*).

31. Oil Pressure Gage

Oil pressure gage (E, fig. 30), marked OIL on panel under gage and marked PRESS on gage face, is located in lower right portion of instrument cluster. Gage face is marked in graduations of 30 psi from 0 to 120 psi. After ignition switch is turned on, gage is activated during engine operation by a sending unit connected to engine oil system gallery. Purpose of gage is to indicate engine oil pressure when engine is running (par. 38*d*).

32. Air Pressure Gage

Air pressure gage (G, fig. 30), marked AIR on panel under gage and marked PRESS on gage face, is located on instrument cluster to the left of oil pressure gage. Gage face is marked in graduations of 30 psi from 0 to 120 psi. After ignition switch is turned on, gage is activated by a sending unit connected to air pressure line. Purpose of the gage is to indicate air pressure in air storage tanks. Full pressure in system is 100 psi. With engine running, air compressor governor cuts in at approximately 75 psi and compressor builds pressure up to full pressure (100 psi). Do not drive vehicle until pressure is up to 60 psi. If, during operation, air pressure buzzer sounds (when below 60 psi), vehicle should be stopped and cause of air leakage corrected.

33. Fuel Gage

Fuel gage (D, fig. 30) is located in upper right portion of instrument cluster. Face of gage is marked LEVEL, and marked FUEL on panel under gage. Dial graduations are marked E (empty), ¼, ½, ¾, and F (full). Purpose of gage is to indicate level of fuel in fuel tank. Ignition switch must be turned to show gage reading.

Caution: Do not permit ignition switch to remain on for any length of time if fuel gage indicates E (empty). Submerged-type fuel pump in tank is actuated when ignition switch is turned on. As the pump is lubricated by fuel, the pump will be damaged if tank is completely dry.

34. Speedometer

The speedometer (C, fig. 30) is located in center of instrument cluster. Speedometer indicates truck road speed in miles-per-hour, and also records total mileage. Face of speedometer is marked in graduations of 1 mph from 0 to 60 mph. Maximum permissible road speeds in high and low transmission ranges are indicated on transmission and transfer instruction plates (fig. 31). Low and high transmission speed ranges are indicated by brackets on instrument cluster panel around circumference of speedometer face.

35. Miscellaneous Controls

a. Driver's Seat Adjuster (L, fig. 28). Refer to paragraph 297.
b. Windshield Positioning (fig. 28). Refer to paragraph 294.
c. Air Supply Valve (W, fig. 29). Refer to paragraph 260*b*.

Section III. OPERATION UNDER USUAL CONDITIONS

36. General

a. This section contains instructions for the mechanical steps necessary to operate the 2½-ton 6 x 6 cargo trucks M135 and M211, dump truck M215, gasoline tank truck M217, truck tractor M221, water tank truck M222, and shop van truck M220 under conditions of moderate temperatures and humidity. For operation under unusual conditions, refer to paragraphs 59 through 64.

b. Before attempting to operate any one of the vehicles listed in *a* above, the driver should become familiar with important operation and driving items and procedures listed in (1) through (8) below.

(1) *Controls and instruments.* The driver must be familiar with the location and purpose of controls and instruments (figs. 28, 29, and 30) as described in paragraphs 12 through 35.

(2) *Operator's preventive maintenance services.* The before-operation procedures outlined in paragraph 78 and table IV must be accomplished prior to operation of vehicle to obtain efficient operation.

(3) *Auxiliary equipment operation.* Procedures for the operation of auxiliary material used with these trucks, such as winch, dump body hoist, gasoline and water tank pumps, tractor fifth wheel, and shop van body equipment are explained in paragraphs 47 through 58.

(4) *Cab roof paulin and curtain positioning.* Procedures covering the positioning of cab roof paulin and curtains for driver protection, ventilation, and visibility on vehicles equipped with soft-top cab, are explained in paragraph 293.

(5) *Windshield positioning.* Procedures covering the positioning of windshield are explained in paragraph 294.

(6) *Seat adjustment.* Procedures covering the adjustment of the driver's seat and positioning of the companion seat are explained in paragraphs 297 and 298.

(7) *Hood positioning.* Procedures covering the raising and lowering of the hood for access to engine and accessories are explained in paragraph 303*b*.

(8) *Cab side ventilators.* Instructions covering the use of cab side cowl ventilators are explained in paragraph 300.

37. Starting and Stopping Engine

a. Starting Engine.

(1) Before starting engine, the driver must accomplish the before-operation maintenance procedures outlined in paragraph 78 and table IV.

(2) Before starting engine, position controls as in (*a*) through (*g*) below.

(*a*) *Transfer lever.* Place in UP ENGAGED position (par. 39*b*).

(*b*) *Transmission shift control lever.* Place in N position on HIGH RANGE side (par. 40). Transmission shift control lever must be in N position before starter hand control lever can be engaged.

(*c*) *Power-take-off lever* (*winch drive*). Place in CENTER NEUTRAL position (par. 48 or 49).

(*d*) *Power-take-off and accessory drive lever* (*dump body*). Place lever down to POWER-OFF-DOWN position (par. 50 or 51).

(*e*) *Power-take-off and accessory drive lever* (*gasoline and water tank pump*). Place lever down into DOWN NEUTRAL position (par. 53 or 55).

(*f*) *Parking brake lever.* Pull up lever to fully apply brake (par. 42).

(*g*) *Temporary parking brake switch* (U, fig. 29). Switch lever must be in OFF position (par. 43).

(3) If engine is cold, hold out choke control knob, marked CHOKE. Pull out hand throttle control handle, marked THROTTLE, about one-half inch.

(4) If vehicle is equipped with primer pump (early M135), the primer may be used in severe cold atmospheric temperature

(par. 61*a*). Do not use primer unnecessarily. During normal weather temperature conditions, primer is not required to start engine.

Note. Primer pump may be deactivated on some vehicles according to MWO ORD G749–W2.

(5) Turn ignition switch lever to left to on position.

(6) Pull starter switch lever (P, fig. 29) (marked STARTER PULL) toward driver until starter operates. Starter lever cannot be operated until transmission shift control lever is in N (neutral) position. Release the lever the instant engine starts. Starter should not be engaged for more than 30 seconds at a time. After starter has been engaged without results, wait 10 to 15 seconds before engaging starter again. If after several attempts, the engine will not start, determine the cause and correct (par. 81*b*).

(7) After engine starts, adjust hand throttle control to an even idling speed during warmup period (par. 38*a*). Choke control must be held out until engine is operating correctly. Choke control knob will return to off position when released.

(8) Truck may be pushed or towed to start engine (par. 46*b*).

b. Stopping Engine. Engine should be permitted to idle for a few minutes before turning off ignition switch.

38. Engine Warmup

a. Warmup Period. Engine should operate through a short warmup period whenever conditions permit. This warmup period provides an opportunity for the driver to check gages and instruments for proper readings, and to check engine performance before truck is placed under way. During warmup period, engine should be run at normal idling speed.

Note. Engine must be run 3 to 5 minutes at idling speed before transmission oil level can be checked (par. 194*b*).

b. Air Pressure Buildup. When engine is started, low air pressure buzzer will sound if pressure is below 60 psi. Vehicle should not be moved until pressure is at least 60 psi on air pressure gage. Do not run engine over one-third throttle to build up air pressure during warmup.

c. Operating Temperature. Operating temperatures between 160° and 220° F. are satisfactory for engine operation. Whenever conditions permit, engine temperature should reach 160° F. on temperature gage before vehicle is moved. If temperature rises sharply above 220° F. during warmup or normal operation, stop engine and determine cause of overheating.

d. Oil Pressure. When the engine is first started cold, oil consistency may cause a sharp rise in oil pressure reading. As engine warms up,

pressure should recede slowly to normal of approximately 5 psi on oil pressure gage with engine idling. Pressure reading may fluctuate as engine speed increases or decreases. A sudden drop or an erratic fluctuation of pressures indicates faulty engine oiling system or inoperative gage circuit. Engine should then be stopped, and ordnance maintenance notified.

e. Battery-Generator Indicator. Refer to paragraph 29 for explanation of battery-generator indicator.

39. Use of Transfer

a. Transfer Controls. Transfer is placed into neutral or driving position with a manually operated lever located slightly to right and under driver's seat (H, fig. 28). A plate on handle of the transfer control lever is marked UP ENGAGED and DOWN NEUTRAL, indicating position lever must be placed in to engage and disengage transfer. Transfer shifting diagram is also shown on transmission and transfer instruction plate (fig. 31) and winch instruction plate (fig. 42). The control lever operates in a slot and will lock in either up or down position.

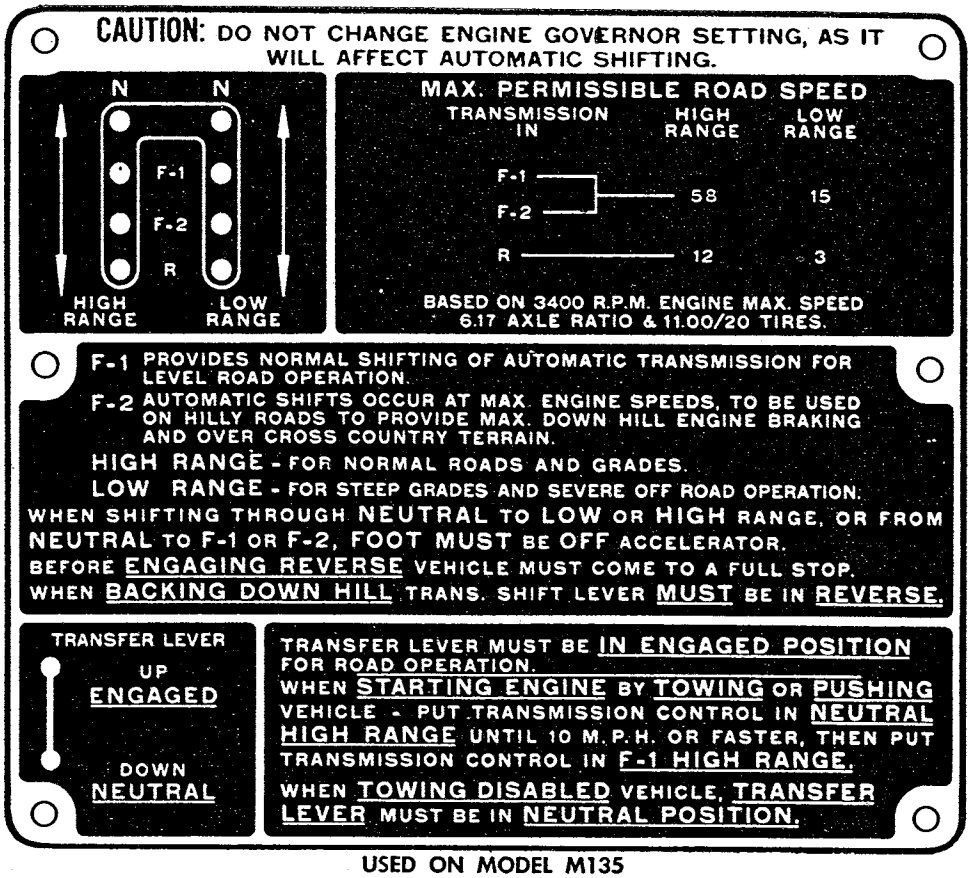
b. Use of Lever. Normally, transfer control lever should be placed in and remain in UP ENGAGED position at all times, including parking. However, for certain towing operations (par. 46), use of winch (pars. 48 and 49), use of dump body hoist (pars. 50 and 51), and use of gasoline or water tank pump (par. 53 or 55), the transfer control lever must be positioned as directed in paragraph indicated.

c. Front Axle Engagement. Transfer mechanism provides automatic engagement and disengagement of front driving axle in accordance with road and load conditions. Transfer front axle engagement mechanism is manually shifted for operation in forward or reverse driving through interconnection with transmission manual shift linkage.

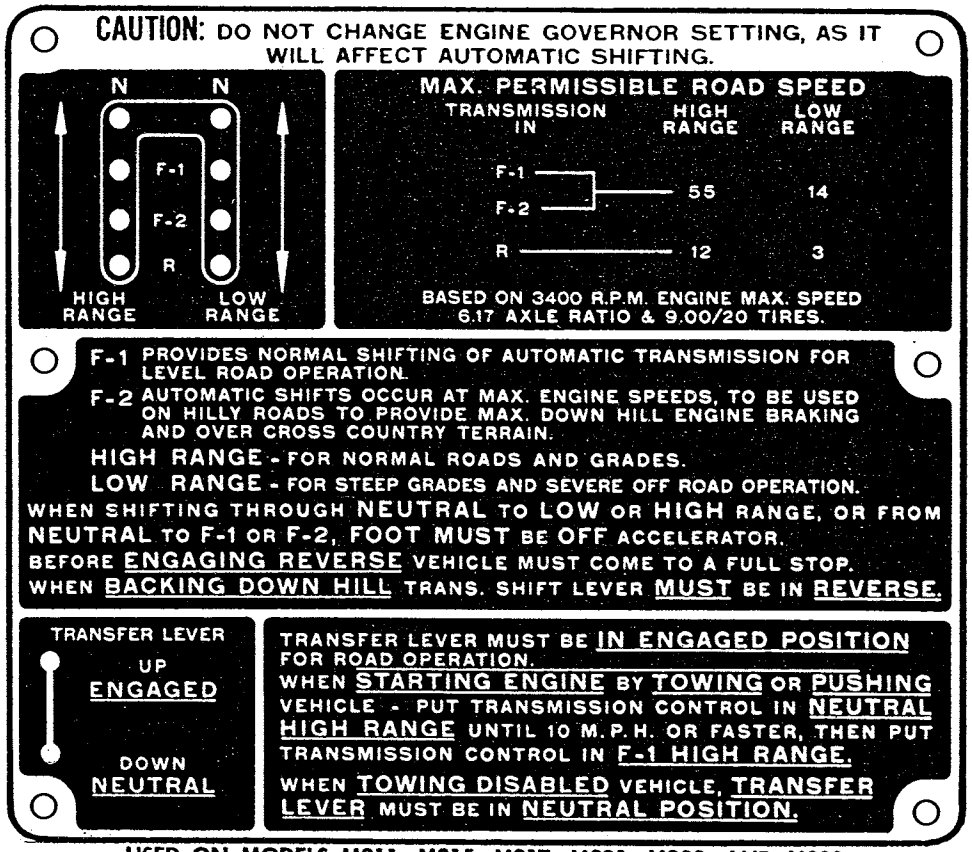
40. Use of Transmission

a. General. Transmission has automatic shifts and does not require a clutch pedal for operation. The transmission has four automatic forward speeds and one reverse in each of two ranges, high and low. The forward speeds in each range are selected automatically in accordance with performance demands required by load and road conditions. The driver manually selects control positions in each range depending upon terrain conditions. When lever position is properly selected, desired performance for any combination of conditions is provided.

b. Transmission Shift Control Lever Positions. The transmission shift control lever, mounted on tower to right of driver, operates in a marked shift pattern slot (fig. 32). Shift position diagram is also



USED ON MODEL M135



USED ON MODELS M211, M215, M217, M221, M222, AND M220

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Figure 31. Transmission and transfer instruction plate.

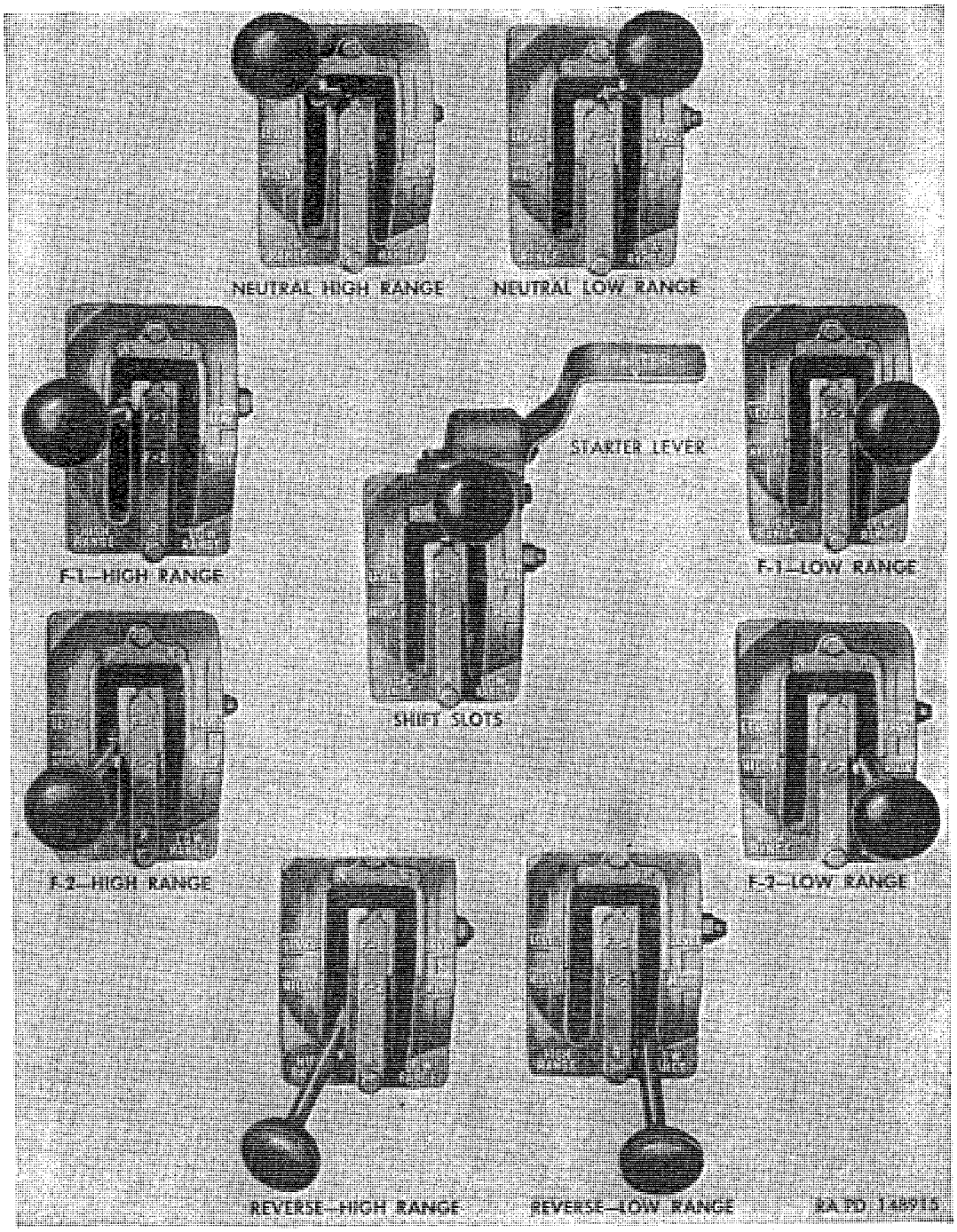

Figure 32. Transmission shift control lever positions.

shown on transmission and transfer instruction plate (fig. 31). The lower end of left slot is marked HIGH RANGE, and lower end of right slot is marked LOW RANGE. The upper ends of both slots are marked N. In the center, the forward speed positions are marked F–1 and F–2. Opposite the F–1 mark on both sides is the word LEVEL. Opposite the F–2 mark on both sides is the word HILLY. Reverse position is marked R.

(1) *Neutral.* Neutral position is marked N over LOW RANGE and HIGH RANGE slots. With control in either neutral position, the transmission is inoperative.

(2) *F–1 position.* Lever can be positioned in F–1 (forward speed) in either HIGH RANGE or LOW RANGE slot. This position is also marked LEVEL on side of each slot.

(3) *F–2 position.* Lever can be positioned in F–2 (forward speed) position in either HIGH RANGE or LOW RANGE slot. This position is also marked HILLY on side of each slot.

(4) *Reverse.* Lever can be positioned in R (reverse) position in either HIGH RANGE or LOW RANGE position.

c. Positioning Control Lever.

(1) If control lever cannot be moved out of neutral or any position with normal physical effort, notify ordnance maintenance personnel. Do not use force.

(2) Control lever knob must be pressed downward when moving lever out of any position, except N (neutral).

(3) When shifting through neutral to either HIGH RANGE or LOW RANGE slot, or from neutral to F–1 or F–2 position in either range, the foot must be off the accelerator pedal until lever is positioned.

d. Action in HIGH and LOW Ranges.

(1) *HIGH RANGE.* With transmission in HIGH RANGE in any of the shift positions (F–1, F–2, or R), operation is, in effect, in "direct." In other words, there is no additional reduction of the normal transmission ratios. In this range, the maximum miles-per-hour road speeds (fig. 31) can be attained in accordance with road and load conditions. This range is used for the greater part of driving where road and load conditions are normal.

(2) *LOW RANGE.* With transmission in LOW RANGE, there is additional reduction of the normal transmission ratios. In other words, the road speed is reduced to approximately one-quarter of that obtained in equivalent HIGH RANGE positions and pulling ability is increased accordingly. This range must be used for off-the-road operations and when road and load conditions cause the vehicle speed to reduce to 10 to 15 mph.

e. Action in F–1 Position.

(1) With transmission in F–1 position in either LOW or HIGH range, the automatic shift points of the four speeds vary according to throttle opening and road speeds. With light throttle, shifts occur at lower road speeds, and as throttle is opened, shifts occur at higher road speeds. This means that the transmission is, in effect, "throttle conscious" when in F–1 position. In other words, the driver, by the opera-

tion of accelerator pedal, controls the miles-per-hour point at which each shift occurs.

(2) With transmission in F–1 in HIGH RANGE, a forced downshift from 4th to 3d speed can be obtained for maximum acceleration ("passing or pickup" speed), and the additional power obtained in 3d speed. This is accomplished by depressing accelerator pedal to stop, overcoming a slight resistance to completely depress the pedal. Transmission will then automatically downshift from 4th to 3d speed providing road speed is less than 35 mph. Upshift from 3d to 4th speed will again occur when accelerator pedal is released, or automatically when road speed of approximately 38 mph is reached.

f. Action in F–2 Position.

(1) With control lever in F–2 position in either HIGH or LOW range, transmission will upshift from 1st to 2d speed when engine speed approaches maximum governed speed. Further upshifts will not occur within normal governed speed of engine. Transmission in F–2 position is, in effect, "road-speed conscious." This means that the upshift and downshift points occur at predetermined road speeds regardless of accelerator pedal action.

(2) While the normal use of F–2 position holds transmission in 2d speed, 3d speed can be attained by shifting into F–1 until 4th speed is reached at approximately 20 mph, and then shifting into F–2 position. Downshift will not take place until engine speed is reduced to about one-half governed speed. Consequently, transmission can be kept in a desired ratio over a wide range of engine speeds by proper use of accelerator pedal.

g. Proper Use of Shift Positions.

(1) A greater part of normal forward driving is accomplished in F–1 HIGH RANGE position. This position is used for normal, level road operation (*d* (1) and *e* above).

(2) The use of F–2 position permits proper ratios for climbing long hills, or when traveling over up-and-down (undulating) roads as explained in *f* above. This position also provides maximum engine braking power when going down long or steep hills.

Caution: Do not use F–1 position in either range when terrain and load conditions require the use of F–2. Such practice will cause excessive "hunting" between shifts with an overheated transmission as the result.

(3) HIGH RANGE should be used where road and load conditions are normal, and when speed of vehicle can be properly maintained within maximum shown on transmission and transfer instruction plate (fig. 31).

(4) LOW RANGE must be used for off-the-road operations, or whenever road or load conditions reduce vehicle speed to 10 to 15 mph.

Caution: Do not remain in LOW RANGE above 14 to 15 mph as this represents maximum speed in that range as indicated on transmission and transfer instruction plate (fig. 31). Maximum low range speed is also marked on speedometer (C, fig. 30). Faster speed must be obtained only in HIGH RANGE.

(5) Transmission can be shifted from F–1 or F–2 LOW RANGE or F–1 or F–2 HIGH RANGE at any road speed. A smoother shift can be made by stopping momentarily in N HIGH RANGE before shifting to F–1 or F–2.

(6) Transmission must not be shifted from F–1 or F–2 HIGH RANGE to F–1 or F–2 LOW RANGE when vehicle speed is over 10 mph.

(7) Transmission can be shifted from F–1 to F–2 and vice versa in any one range at any road speed.

h. Starting and Stopping Vehicle.

(1) With transfer lever in UP ENGAGED position, place transmission shift control lever in desired forward speed (F–1 or F–2) in range required. Shift control lever should remain in drive position except when parking, or when conditions necessitate change of position or range.

(2) With transmission in forward driving position, the vehicle will move forward as accelerator is pressed down. Transmission is automatically upshifted as engine and/or road speeds increase, and is downshifted as engine and/or road speeds decrease.

(3) To stop vehicle for normal traffic stop, release accelerator and apply service brakes as required to stop. It is not necessary to move transmission control lever out of driving position unless vehicle is to be stopped for some time.

Caution: If driver leaves his seat, parking brake must be applied, and transmission control lever moved to N position; otherwise just an accidental touching of the accelerator pedal will move vehicle.

(4) To again move vehicle after a traffic stop, release brake pedal and depress accelerator pedal.

i. Reversing.

(1) To engage R (reverse) in either HIGH RANGE or LOW RANGE, vehicle must be brought to a complete stop.

(2) While pressing down on lever knob, move lever to R in either LOW or HIGH range as desired. Control lever must be com-

pletely in reverse position. Press down on accelerator pedal to move truck. Apply brake pedal to stop truck.

(3) To move lever from R to any other position, vehicle must be at a complete stop.

j. Parking. When parking or when working on vehicle with engine running, always place transmission control lever into N (neutral) position, and apply parking brake. Transmission cannot be locked into gear to park on a steep incline. Parking brake must be used to hold truck under such conditions.

k. Coasting. Do not coast in N (neutral) position with engine not running. If attempting to start engine by coasting, follow instructions in paragraph 46*b*.

41. Use of Service Brakes

a. Air Pressure. Service brakes are air-actuated hydraulic-type; therefore, vehicle should not be moved until air pressure is at least 60 p. s. i. on air pressure gage (G, fig. 30). Vehicle should be stopped if air pressure falls below 60 p. s. i. (when buzzer sounds). Some degree of braking can be obtained without air pressure assistance; however, considerable physical effort must be applied to brake pedal. Vehicle should not be moved under these circumstances, except in case of emergency.

b. Application of Service Brakes. Degree of brake application is in direct proportion to the amount of physical effort applied to brake pedal. Gradually apply brakes as hard as speed and road conditions permit; then reduce pedal pressure gradually as speed is reduced, so that a very slight pressure is used at completion of stop. If brakes are applied lightly at beginning, and then pressure increased as speed decreases, the final high pressure will produce a severe stop.

42. Use of Parking Brake

Parking brake lever (J, fig. 28) is applied by pulling up on hand lever located at right of driver. To release brake, pull up on hand lever, and at the same time squeeze lever grip latch against lever. While holding latch against lever, lower lever to engage clip on floor. Parking brake must not be used to normally brake vehicle, but must only be used to hold vehicle while parking, except in case of an emergency stop.

43. Use of Temporary Parking Brake

a. Control. Temporary parking brake is controlled by switch on instrument board (fig. 29) identified with a plate marked TEMPORARY PARKING BRAKE ONLY (fig. 33). When the switch is turned to ON position and service brakes applied, an electric solenoid-operated valve in master cylinder outlet line acts to prevent the return

Figure 33. Temporary parking brake instruction plate.

of brake fluid to master cylinder, thus holding the vehicle hydraulic brakes applied. To release the brakes, turn switch to OFF position.

b. Application of Temporary Parking Brake.

Caution: The temporary parking brake is for emergency use only in the event of mechanical parking brake failure. This brake system must not be depended upon to hold the vehicle for extended periods. The mechanical parking brake must be adjusted or repaired at the earliest opportunity so that the necessity of using temporary parking brake will be minimized.

Apply service brake pedal, then turn temporary parking brake switch to ON position. Service brake pedal can then be released. Switch can be turned on before applying brake pedal; however, brakes are not affected until service brake pedal is applied. Always turn switch to OFF position before attempting to move truck.

44. Use of Trailer Brakes

a. Trailer Brake Control and Connections.

(1) *Rear of vehicle* (fig. 34). All vehicles, except gasoline tank truck M217 and water tank truck M222, are equipped with an air line coupling at rear end of vehicle on right and left sides. Coupling at right side of vehicle, marked EMERGENCY, delivers a constant supply of compressed air to trailer brake system. Coupling at left side of vehicle, marked SERVICE, delivers air pressure to trailer operating valve when vehicle service brakes are applied. A cutoff cock at

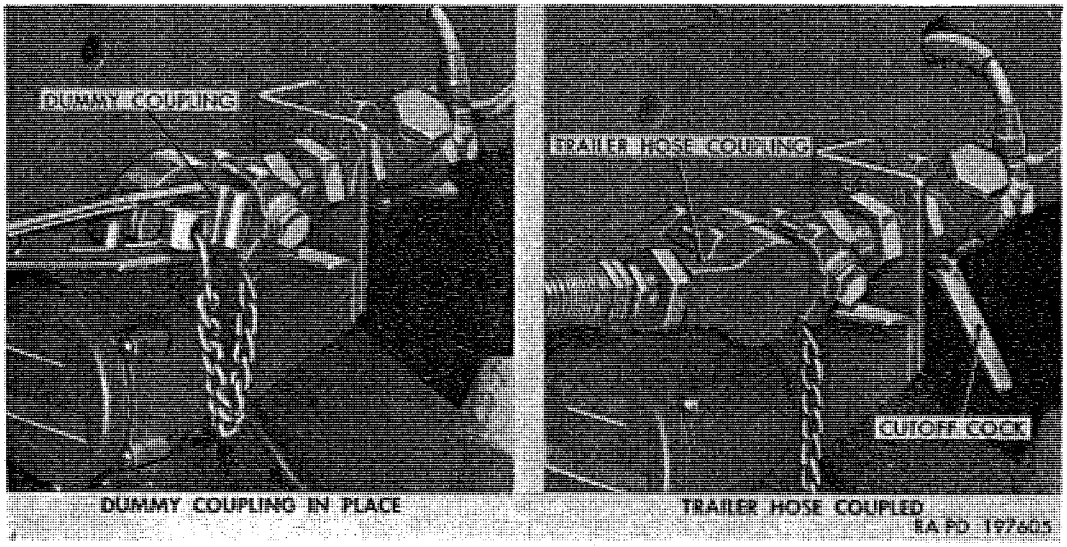

Figure 34. Trailer brake connection at rear of vehicle (EMERGENCY line shown).

each trailer coupling provides a means of shutting off the trailer brake lines when not connected to trailer. A dummy coupling, attached to frame bracket by a chain, is used at each coupling to seal coupling against the entrance of dirt when not in use.

(2) *Tractor semitrailer connections.* The truck tractor M211 is equipped with semitrailer air line couplings at rear of cab (fig. 35) in addition to those provided at rear of vehicle. These couplings are marked and function in same manner as described in (1) above. Two trailer hose and coupling assemblies are mounted on a hose-tenna as illustrated in figure 36. The hose-tenna is flexible, permitting movement of hose connections to prevent breakage of hoses when connected to semitrailer.

(3) *Trailer brake hand control* (fig. 37). The truck tractor M221 is equipped with a trailer brake hand control valve mounted on steering column directly under steering wheel. The hand control valve is used to apply trailer brakes independently of truck brakes. Varying degrees of trailer brake application ranging from fully released to fully applied position may be made with hand control.

b. Operation of Trailer Brakes.

(1) *Connecting trailer brake lines.* When connecting trailer brake couplings at rear of vehicle (fig. 34) or at semitrailer connections at cab of tractor (fig. 35), remove dummy coupling from EMERGENCY and SERVICE couplings on truck and trailer. Couple trailer EMERGENCY and SERVICE line coupling halves to truck EMERGENCY and SERVICE line coupling halves, making certain that the

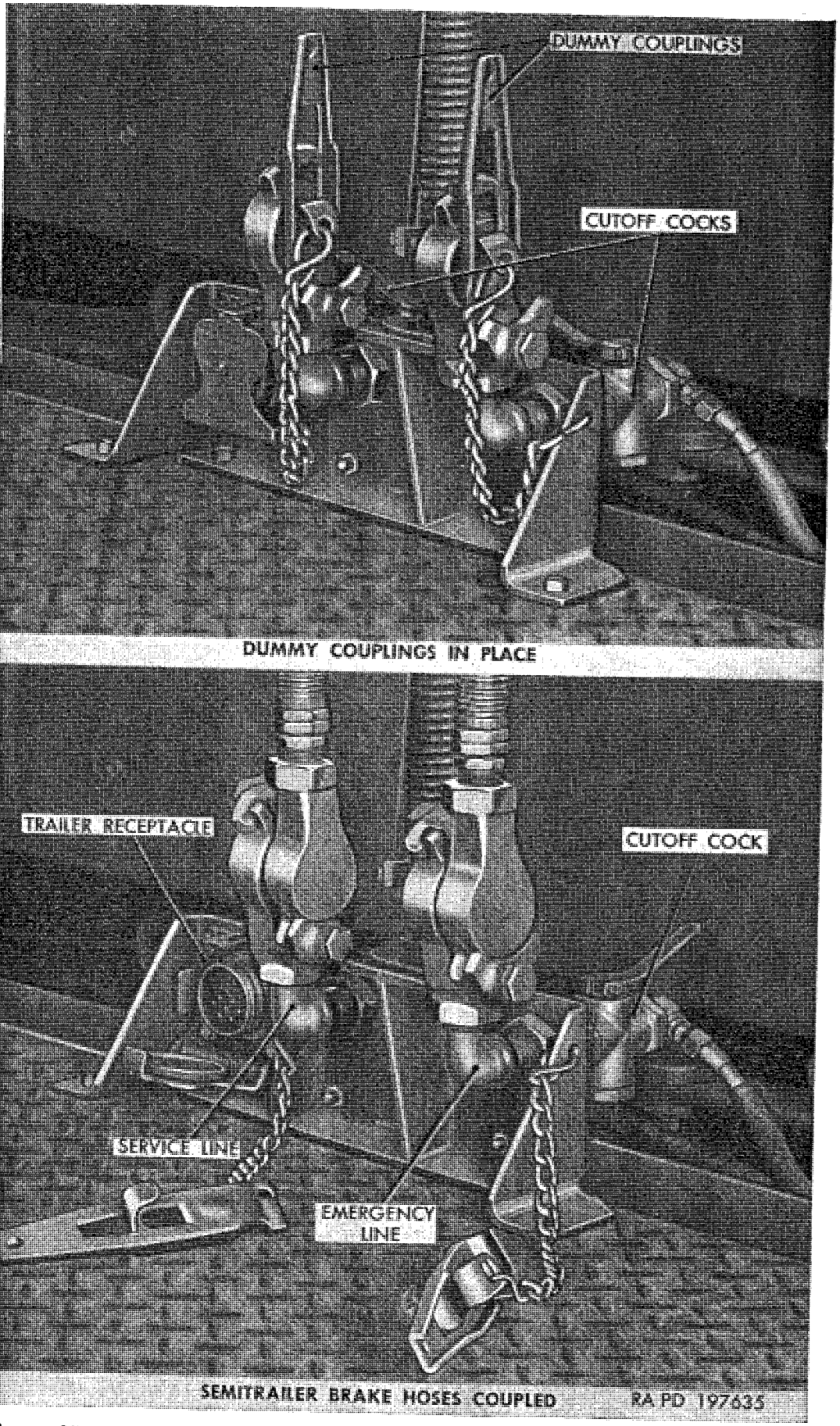

Figure 35. Semitrailer brake connections at rear of cab (truck tractor M221).

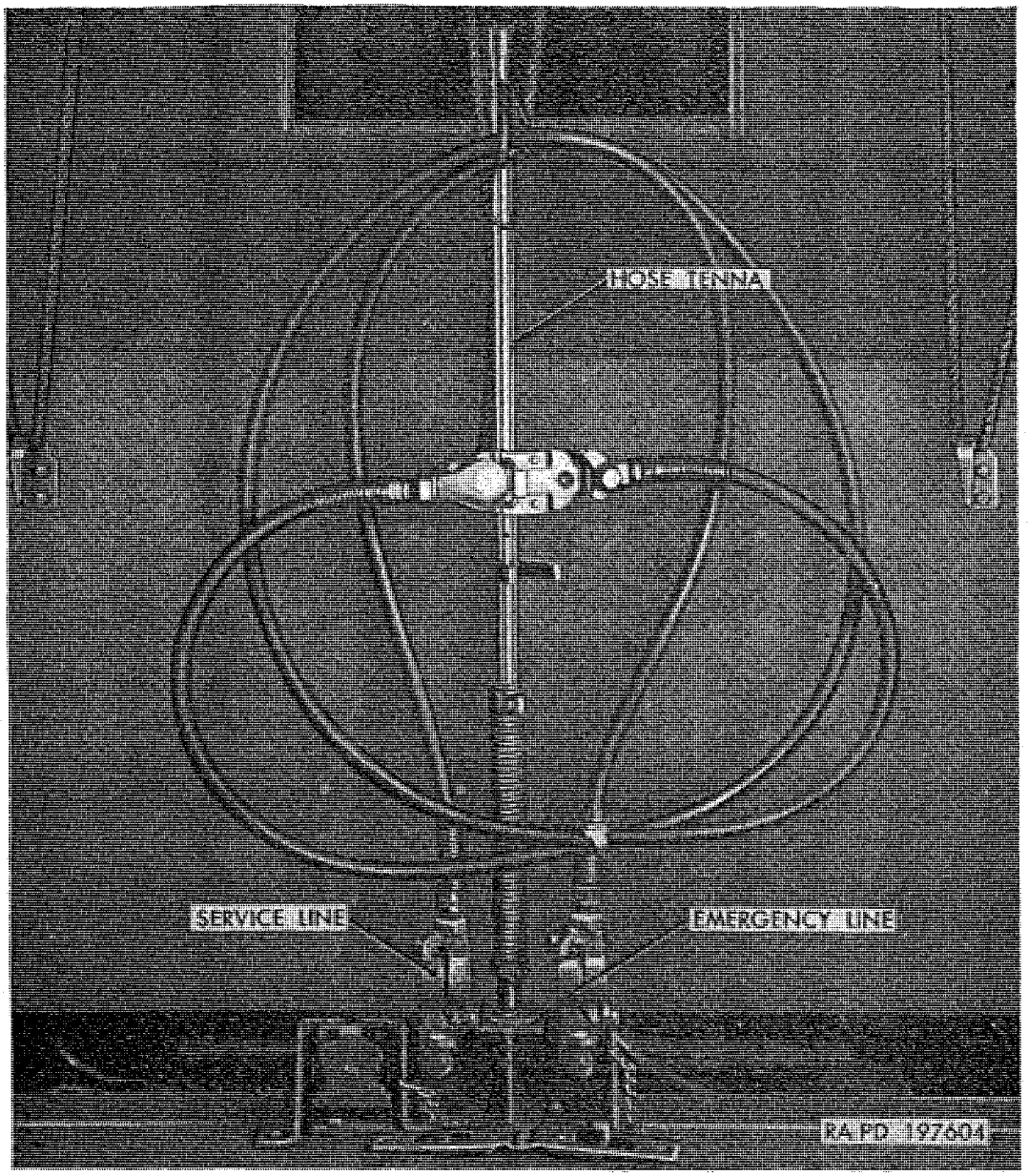

Figure 36. Semitrailer brake hose-tenna and connections (truck tractor M221).

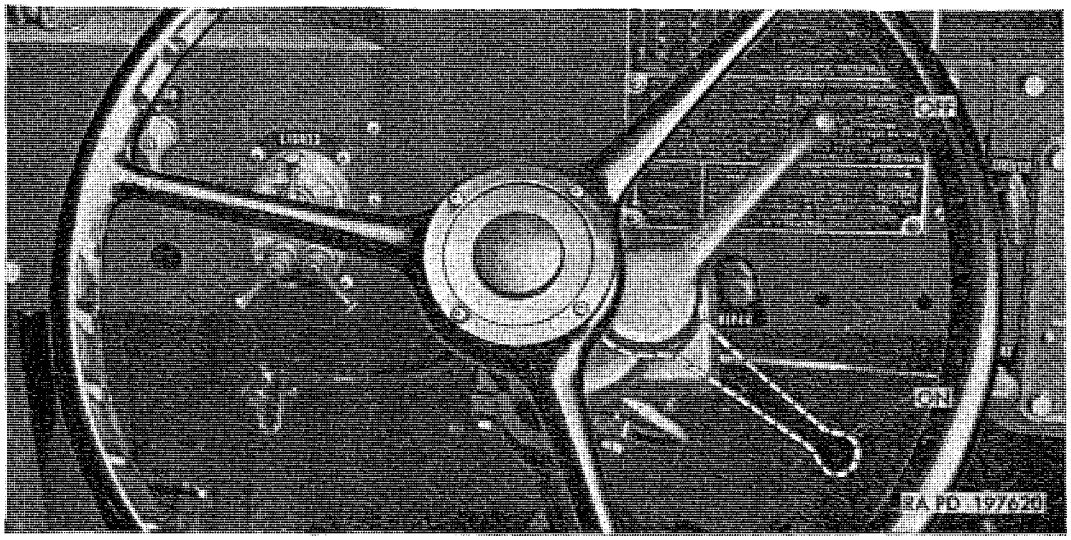

Figure 37. Trailer brake hand control (tractor truck M221).

coupling plungers lock the two halves together. Turn cutoff cock handle at each connection to ON position (straight out). When uncoupling trailer connections always turn cutoff cock handle to OFF position (parallel with cutoff cock) before uncoupling. Install dummy couplings.

(2) *Applying trailer brakes.* Trailer brakes are applied and released simultaneously with truck brakes by use of the truck service brake pedal. When trailer brake hand control valve is used (*a*(3) above), valve may be set to produce a slight drag on trailer when descending a grade, or trailer brakes alone may be applied by valve when stopping on slippery surface to avoid jackknifing. Application of truck brake pedal, however, will overrule partial hand control valve setting.

45. Use of Lights

a. Main Light Switch Levers. All lights are controlled by a three-lever main light switch (fig. 38 or 39) located on instrument board as shown in Y, figure 29. Light switch shown in figure 38 is used on early M135, while switch shown in figure 39 is used on late M135 and all other models. The late switch (fig. 39) is more adequately marked at mechanical and auxiliary switch positions. Both switches, however, operate the same.

(1) *Main switch lever.* The five-position main switch lever is located at upper part of switch with lever pointing up (fig. 38 or 39). This lever can be positioned to control all lights except instrument cluster lights and parking lights. The mechanical (or locking) switch lever must be raised up (toward UNLOCK, F, fig. 39) when positioning main switch lever to BO DRIVE, STOPLIGHT, or SER DRIVE positions.

(2) *Auxiliary switch lever.* The auxiliary switch lever is located to the left and below main switch lever (fig. 38 or 39). This lever may be positioned to control parking and instrument cluster lights when main switch lever is in positions as explained in *b* below.

(3) *Mechanical switch lever.* The mechanical (or locking) switch lever is located to the right and below the main switch lever (fig. 38 or 39). This lever must be held in a raised position (toward UNLOCK, F, fig. 39) before main switch lever can be positioned to BO DRIVE, STOPLIGHT, or SER DRIVE positions.

b. Operation of Main Light Switch (fig. 38 or 39).

(1) *OFF position.* When main switch lever is in OFF position, all lights are off.

(2) *BO MARKER position.* When main light switch is turned to left to BO MARKER position, circuits for front blackout marker light, blackout stoplight, and blackout taillights are energized. The auxiliary switch lever can be turned to positions shown in figures 38 and 39 for dim or bright instrument cluster lights.

(3) *BO DRIVE position.* The mechanical switch lever must be held raised to UNLOCK position while main switch lever is

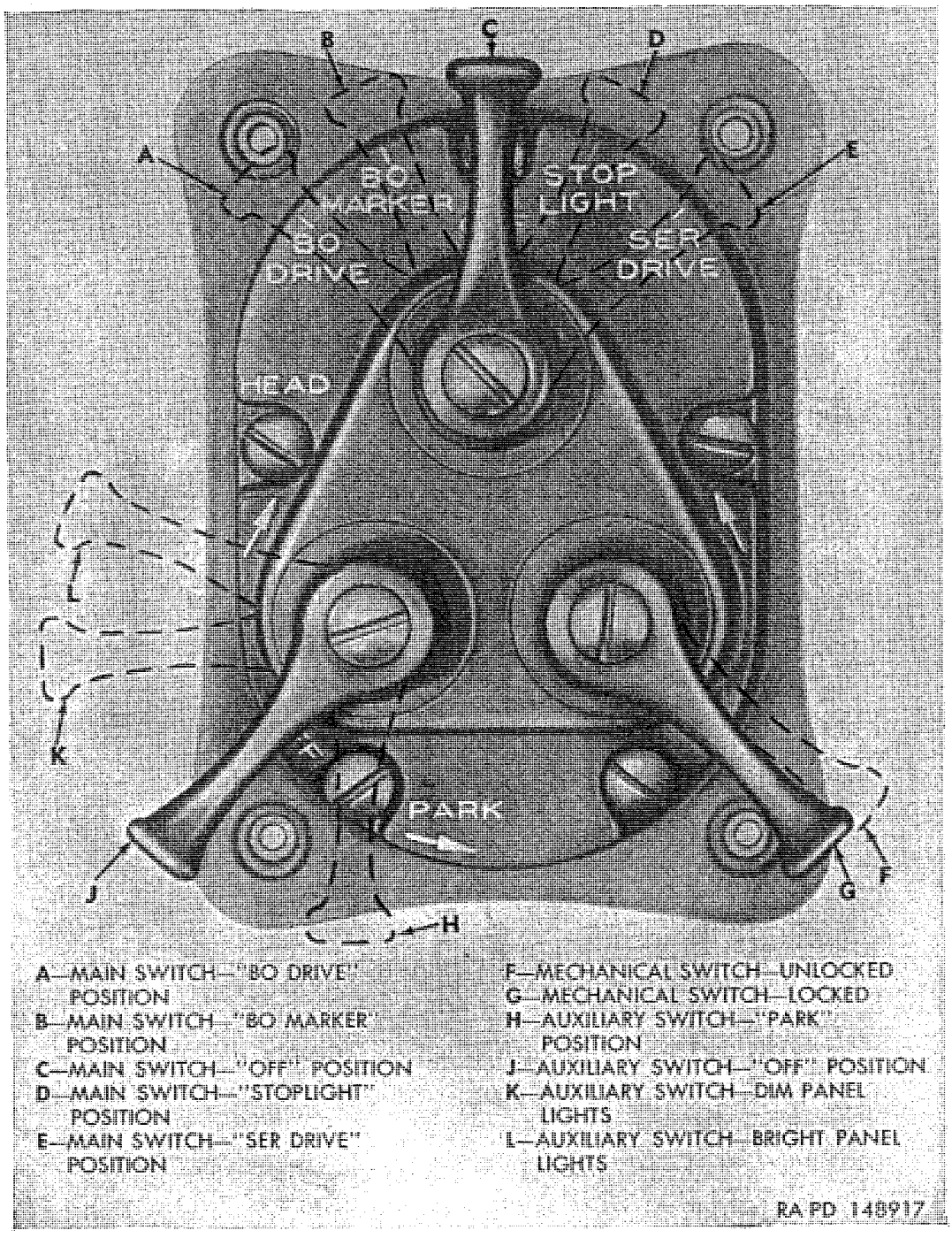

Figure 38. Main light switch (early M135).

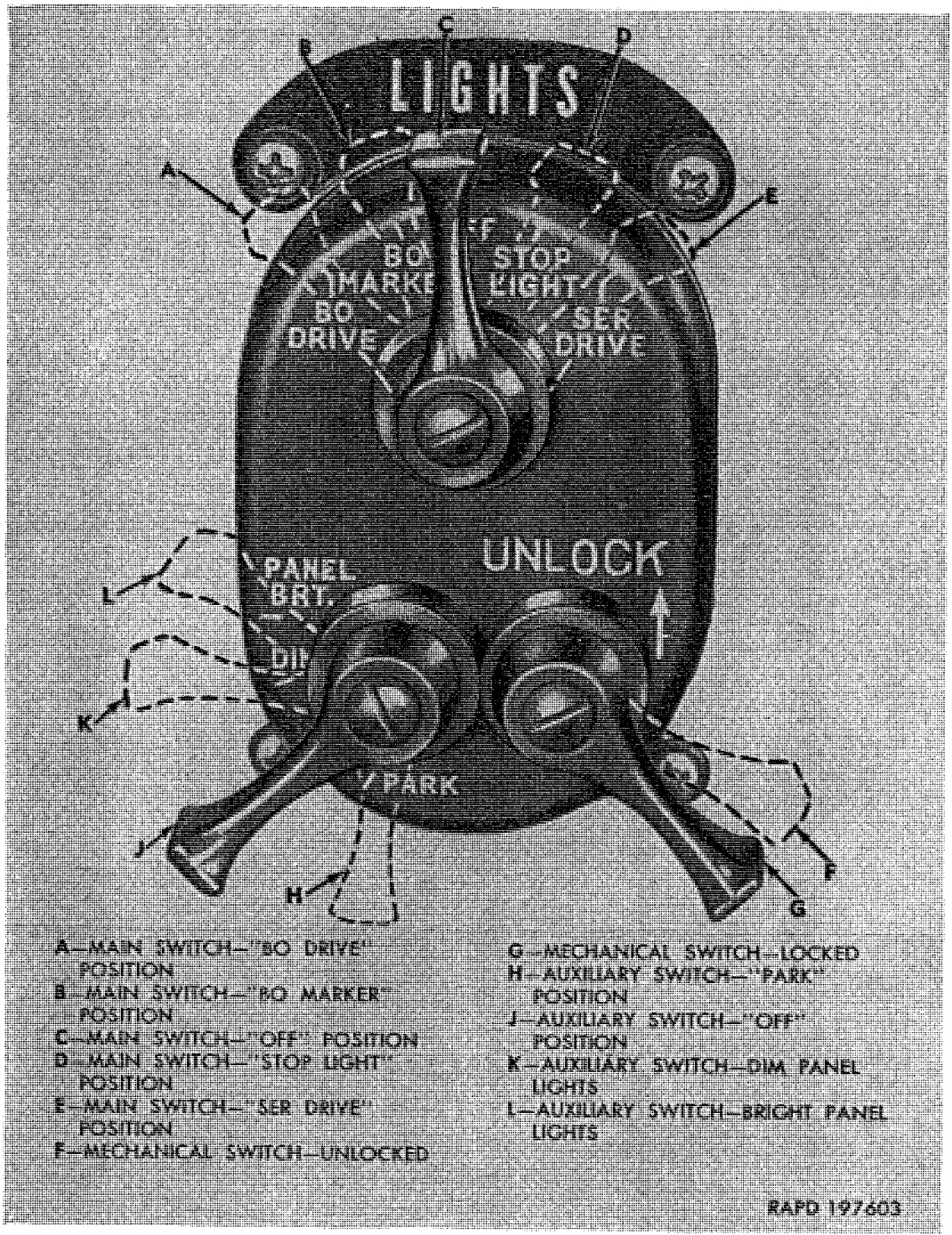

Figure 39. Main light switch (late M135 and all other models).

positioned to BO DRIVE. With main switch lever in this position, the circuits for blackout headlight, blackout stoplight, and blackout taillights are energized. The auxiliary switch lever can be turned up for dim or bright instrument cluster lights.

(4) *STOPLIGHT position.* The mechanical switch lever must he held raised to UNLOCK position while main switch lever is positioned to STOPLIGHT position. This position is used

for daylight driving. The left service stoplight will illuminate when brakes are applied.

(5) *SER DRIVE position.* The mechanical switch lever must be held raised to UNLOCK position while main switch lever is positioned to SER DRIVE. Main switch lever can be placed into SER DRIVE from STOPLIGHT position without raising the mechanical switch lever. When main switch lever is in SER DRIVE position, right and left service lights and left service taillight are energized. Left service stoplight will illuminate when vehicle service brakes are applied.

(6) *PARK position.* After main switch lever is placed into SER DRIVE position, auxiliary switch lever can be placed into PARK position to illuminate right and left front parking lights and left service taillight. With main switch lever remaining in SER DRIVE, the placing of auxiliary switch lever into OFF, or into DIM or BRT panel light positions, will again illuminate service headlights.

(7) *Instrument cluster lighting.* With main switch lever in any position except OFF, auxiliary switch lever can be turned to left from OFF to positions shown on figures 38 and 39. Auxiliary switch illustrated in figure 39 has marked positions under PANEL of BRT and DIM.

c. Use of Dimmer Switch. Foot-operated dimmer switch (Z, fig. 29), located on floor to driver's left, is used to control high and low service headlight beams. When the high beam is used, light marked HIGH BEAM on instrument board cluster (fig. 30), will illuminate.

d. Trailer Receptacle.

(1) The trailer receptacle (fig. 40) at rear of frame used on all models except M217 and M222, is interconnected with the main light switch. The main light switch controls blackout and service lights on trailer simultaneously with those on vehicle. Clip on receptacle cover holds trailer harness plug in place.

(2) On truck tractor M221, a semitrailer receptacle is mounted at rear of cab adjacent to the trailer brake lines (fig. 35). Main light switch controls semitrailer lights in same manner as explained in (1) above. In addition to connections for trailer lights, the trailer light receptacle at rear and at cab on the truck tractor M221 includes an auxiliary power circuit for operation of auxiliary units in trailer.

e. Shop Van Lights. Refer to paragraph 57*e* for operation of interior lights on shop van truck M220.

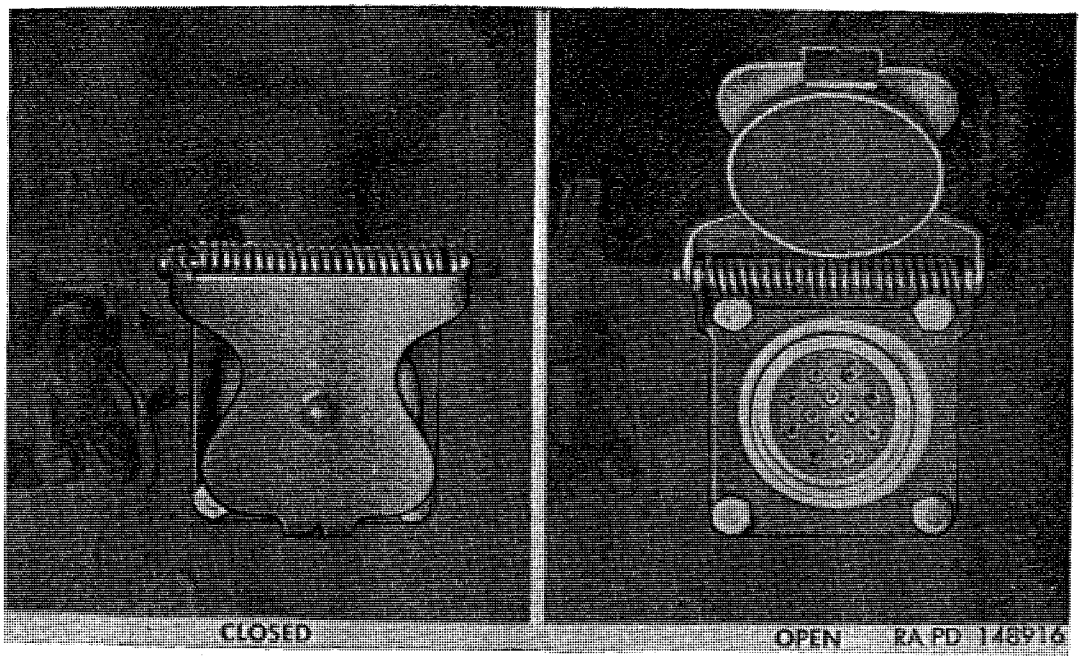

Figure 40. Trailer receptacle at rear of vehicle (all models, except M217 and M222).

46. Towing the Vehicle

Caution: Whenever necessary to tow vehicle for purpose of starting engine or if vehicle is disabled, vehicle controls must be placed in positions as explained in *b* and *c* below. A disabled vehicle must be prepared as indicated in *c* below. These instructions must be followed to avoid damage to transmission and transfer.

a. Use of Pintle (fig. 41). All vehicles except gasoline tank truck M217 and water tank truck M222, are equipped with a pintle mounted on rear frame cross member. To open pintle, pull cotter pin from pintle lock (upper half). Pull latch rearward, and, at the same time, pull up on the pintle lock. To close, push pintle lock down against pintle. Latch will automatically engage. Insert chained cotter pin into hole in pintle lock.

b. Towing to Start Engine. Engine can be started by pushing or towing vehicle; however, succeeding instructions must be carefully followed to avoid damage to transmission.

(1) Raise transfer lever to UP ENGAGED position.

(2) Place transmission shift control lever in N position in HIGH RANGE (fig. 32).

Caution: Do not place lever in LOW RANGE.

(3) Use choke control and hand throttle control as described for normal engine starting (par. 37*a*).

(4) Turn ignition switch to left to on position. When the vehicle speed reaches 20 mph, move transmission shift control lever into F–1 in HIGH RANGE position.

Caution: Do not place transmission shift control lever in F–2 or into any LOW RANGE position.

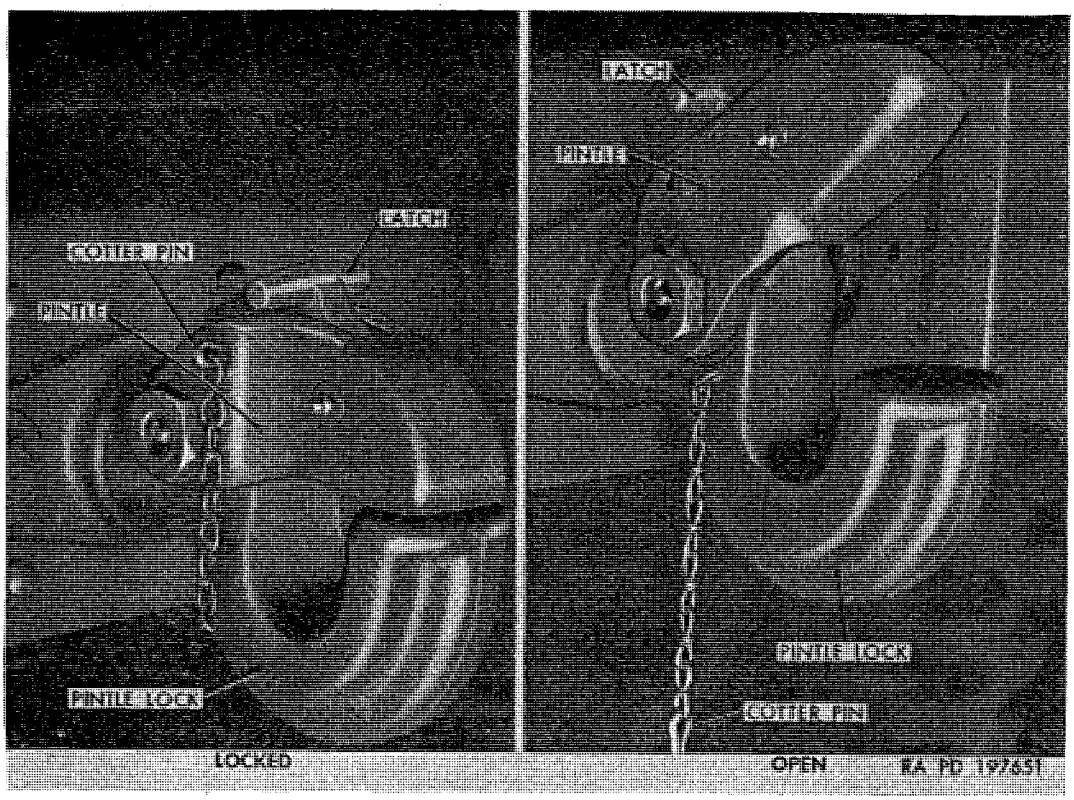

Figure 41. Pintle operating positions.

(5) If engine fails to start within a reasonably short distance, determine cause and correct (par. 81).

c. Towing a Disabled Vehicle. Conditions under which a disabled vehicle can be towed vary with the method of towing as in (1) through (4) below.

(1) *Towing forward with all wheels on ground.* Place transfer lever into DOWN NEUTRAL position and transmission shift control lever into N (neutral) position in the disabled vehicle. Do not pull disabled vehicle over 15 mph. If necessary to tow over 10 miles in distance, remove front axle drive hub flanges (par. 221*b*), and remove transfer-to-pillow-block propeller shaft assembly and transfer-to-forward-rear-axle propeller shaft assembly (par. 231*b*).

(2) *Towing rearward with all wheels on ground.* If necessary to tow vehicle in this manner for a short distance in order to position vehicle, place transfer lever and transmission shift control lever in positions described in (1) above.

(3) *Towing with rear wheels off the ground.* Place transfer lever and transmission shift control lever in positions described in (1) above. Also remove front axle drive hub flanges (par. 221*b*).

(4) *Towing with front wheels off the ground.* Place transfer lever and transmission shift control lever in positions de-

scribed in (1) above. If vehicle is to be towed over 10 miles, remove propeller shaft assemblies as described in (1) above. Also remove front axle drive hub flanges (par. 221*b*) to keep front wheels from spinning.

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

47. General

This section includes general operating information on winch, dump body hoist, gasoline and water tank pump and dispensing equipment, truck tractor fifth wheel, and shop van body mounted equipment. Operation of controls, instruments, and gages on the basic vehicles is covered in paragraphs 36 through 46.

48. Winch Controls

a. General. Front-mounted winch assembly is used on some vehicles of Models M135, M211, M215, and M221. The winch assembly is operated by a transfer-mounted power-take-off through a drive shaft.

b. Power-Take-Off Lever. Engagement of the transfer-mounted power-take-off, which drives winch through a drive shaft, is obtained by means of a lever located to right of driver adjacent to transfer lever. The lever operates up and down in a three-position slot. Lever positions are indicated on an instruction plate on lever handle as described in (1), (2), and (3) below.

(1) *DOWN FORWARD.* With lever in this position, wire rope cable can be wound in on drum.

(2) *CENTER NEUTRAL.* With lever in center position on NEUTRAL, winch is inoperative except when hand-unwinding at winch.

(3) *UP REVERSE.* With lever in this position, cable can be unwound under load.

c. Winch Instruction Plate (C, fig. 29). Plate (fig. 42) is mounted on instrument board instruction panel directly in front of driver. The plate includes shifting diagrams of winch power-take-off lever and transfer lever. Brief operating instructions are also shown.

d. Controls at Winch.

(1) *Clutch control lever.* Hand-operated clutch control lever (fig. 43), located at right side of winch, is used to engage or disengage winch drum from power-take-off drive shaft. On late vehicles, the lever handle is marked CLUTCH IN with an arrow pointing away from winch, and OUT with an arrow pointing toward winch. These markings indicate direction to move handle to place drum in engagement or out

of engagement. Pull lever away from drum (or in direction of arrow marked IN) to engage drum with power-take-off. Push lever toward winch (or in direction of arrow marked OUT) to disengage drum from power-take-off.

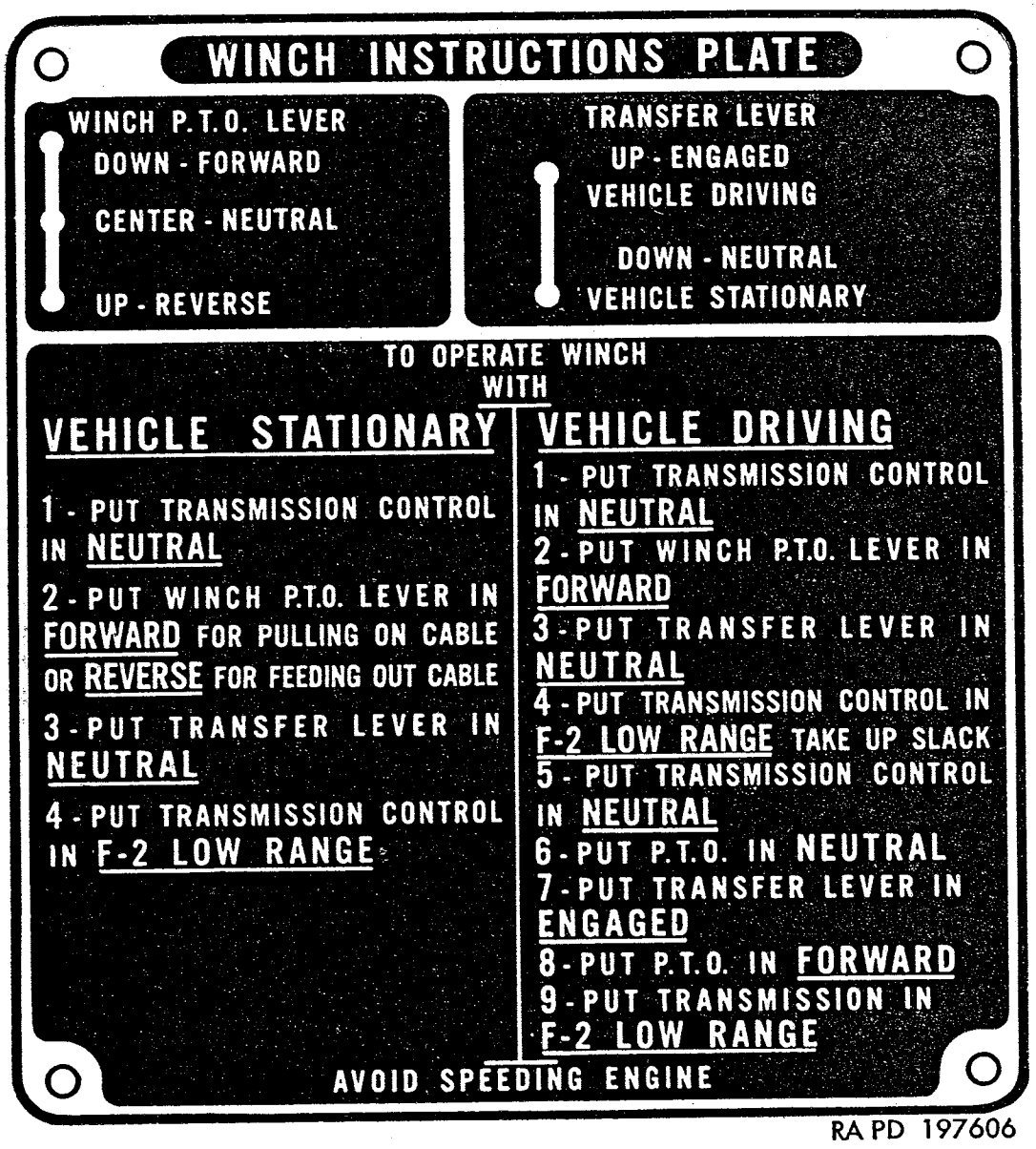

Figure 42. Winch instruction plate.

(2) *Drum lock poppet knob.* Knob (fig. 43) on right side of winch frame permits locking drum to prevent unwinding of cable when underway. To lock or engage drum, the knob should be completely in to permit the poppet to engage one of several holes in the flange of drum. To disengage drum to permit winch operation, pull out knob and turn one-quarter turn.

(3) *Automatic controls.* An automatic safety brake in winch mechanism will sustain the load while power-take-off lever

is being positioned. A drag brake, also in winch mechanism, will prevent drum from overrunning cable when cable is being pulled from drum.

49. Winch Operation

a. Use of Rigging.

(1) *Side angle winching.* The clearance in the front bumper is designed to prevent side angle winching. If a straight pull directly from the vehicle is not possible, a single tackle rigging, attached to a stake or tree, must be used to obtain such a pull.

Caution: Side angle winching transmits winch load to front axle spindles, therefore should not be attempted. The wire rope cable must be fed through opening in bumper (at top) and not under the bumper.

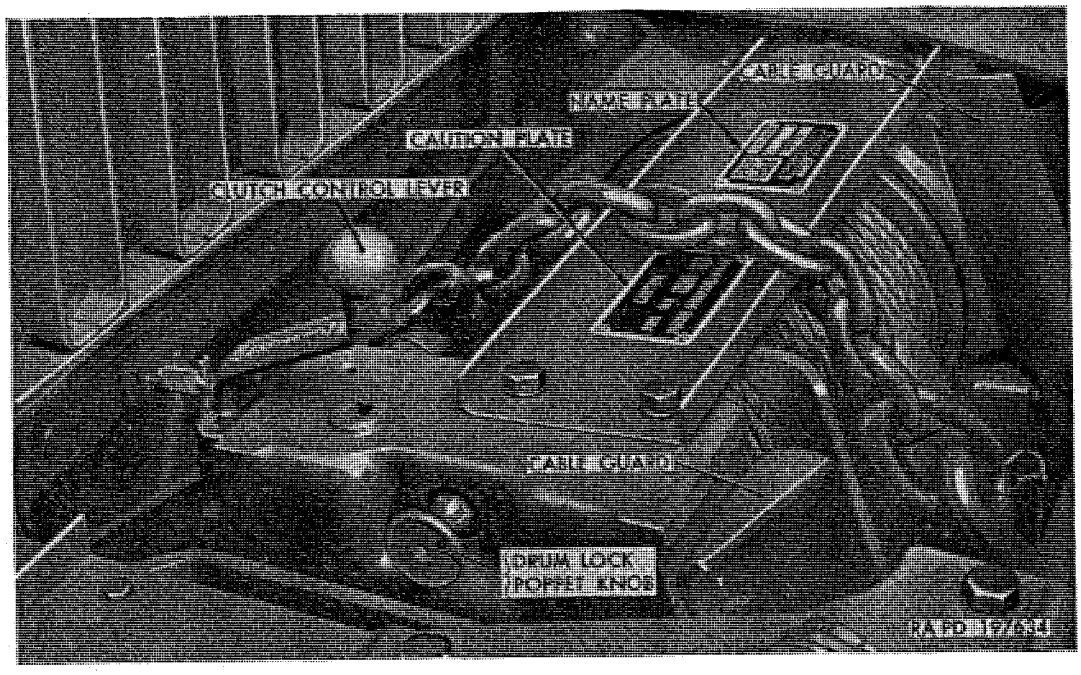

Figure 43. Controls at winch.

(2) *Horizontal angle winching.* The winch is mounted to limit angle winching up or down from horizontal to the points where the cable just clears nearest obstruction on the vehicle. If such angle winching is necessary beyond the points of cable interference, an A-frame and single tackle rigging must be used to reduce the angle. In that manner, shock loads to front axle spindles and suspension will be avoided.

b. Shearpin. A shearpin installed in drive shaft at winch will shear if load on winch is beyond rated capacity. Replacement of shearpin is described in paragraph 314.

c. Position of Controls With Winch Not in Use.

(1) Place power-take-off lever (in cab) into CENTRAL NEUTRAL position.

(2) Push clutch control lever at winch (fig. 43) toward winch (or in direction of arrow marked OUT on lever handle). Push lever against stop on some vehicles. Winch cannot be operated by power-take-off with lever in this position.

(3) Make sure that drum lock poppet knob at winch (fig. 43) is in locked position (par. 48*d*(2)) to engage a hole in flange of drum. Cable will not unwind in this position.

(4) Insert cable chain and hook through one front towing shackle; then place chain hook in opposite front towing shackle.

d. Winding in Cable or Pulling Load.

Note. The winch delivers maximum power with first layer of cable wound on drum. Under many conditions, cable cannot be payed out to that extent before pulling. However, pay out as much cable as possible before starting to pull.

(1) *With vehicle stationary.*

(*a*) Pull out drum lock poppet knob (fig. 43); then rotate knob one-quarter turn to unlocked position.

(*b*) Pull clutch control lever (fig. 43) as far as possible (in direction of arrow marked IN on lever handle) away from winch drum to engaged position.

(*c*) Lower transfer lever to DOWN NEUTRAL position. Apply parking brake firmly. Move transmission shift control lever to N position. Start engine.

(*d*) Lower power-take-off lever to DOWN FORWARD position. With engine idling (foot off accelerator pedal), move transmission shift control lever to F–2 in LOW RANGE position.

(*e*) Use handle throttle control to accelerate engine and to hold a sustained speed.

Note. Do not accelerate engine over one-third throttle (aprx. 1,200 rpm) when winding in cable.

(*f*) The automatic brake incorporated in winch mechanism will hold load if engine speed is reduced to idle or if power-take-off lever is moved to CENTER NEUTRAL position.

(2) *Winching out vehicle with driving wheel assistance.*

(*a*) At winch, pull out drum lock poppet knob (fig. 43); then rotate one-quarter turn to unlocked position. Pull clutch control lever as far as possible (in direction of arrow marked IN) away from winch drum to engaged position.

(*b*) Place transmission shift control lever in N position; then start engine.

(*c*) Place power-take-off lever in DOWN FORWARD.

(*d*) Place transfer lever in DOWN NEUTRAL position.

(*e*) With engine idling, move transmission shift control lever to F–2 in LOW RANGE. Slowly accelerate engine just enough to take up slack in cable. Reduce engine speed to idle and move transmission shift control lever to N position; then raise power-take-off lever to CENTER NEUTRAL position.

(*f*) Raise transfer lever to UP ENGAGED, place power-take-off lever to DOWN FORWARD; then move transmission shift control lever to F–2 in LOW RANGE. Accelerate engine with hand throttle control to pull in cable and drive wheels. Do not use over one-third throttle.

e. Unwinding Cable Under Load.

(1) Paying out or unwinding cable under load should be accomplished from cab after controls at winch are positioned. At the winch, pull out drum lock poppet knob; then rotate one-quarter turn to hold in unlocked position. Pull clutch control lever as far as possible (in direction of arrow marked IN) away from winch drum to engaged position.

(2) Place transmission shift control lever in N position; then start engine.

(3) Place transfer lever in DOWN NEUTRAL position. Place power-take-off lever in UP REVERSE position.

(4) With engine idling, place transmission shift control lever in F–2 in LOW RANGE position. Accelerate engine to pay out cable. Do not accelerate over one-third throttle.

Note. Cable can also be payed out with power-take-off lever in DOWN FORWARD position by placing transmission shift control lever in R (reverse), either in HIGH RANGE or LOW RANGE position.

f. Unwinding Cable at Winch. Push clutch control lever in toward winch drum to disengaged position. Pull out drum lock poppet knob; then rotate one-quarter turn to unlocked position. Place power-take-off lever in CENTER NEUTRAL position. Pull out necessary cable from drum. The drag brake will keep the drum from spinning.

Caution: Do not handle cable with bare hands; use gloves or other protection.

g. Winding Cable After Use. Cable can be rewound on drum by controlling winch from driver's compartment, or directly at winch. Cable must always be wound on drum under some cable tension. Winding on first layer of cable is particularly important. Coils of cable must be tight against each other to prevent coils on next layer wedging down between preceding coils. Wind cable slowly on drum, and use a bar to guide the cable evenly.

Caution: Do not handle cable with bare hands; use gloves or other protection.

Refer to paragraph 318 for replacement of winch cable.

Caution: Cable must be wound on drum to feed from top. Winding on drum to feed cable from the bottom will damage winch brakes.

(1) *Winding cable from driver's compartment.*

(*a*) At the winch (fig. 43), pull out drum lock poppet knob, and then rotate one-quarter turn to unlocked position. Pull clutch lever away from winch drum (in direction of arrow marked IN on lever handle) to engaged position. Attach cable hook to a suitable anchor to provide tension on cable while winding.

(*b*) Place transmission shift control lever in N position; then start engine.

(*c*) Lower transfer lever to DOWN NEUTRAL position; then lower power-take-off lever to DOWN FORWARD.

(*d*) With engine idling, move transmission shift control lever to F–2 in LOW RANGE position.

(*e*) While applying a light pressure on service brake pedal, accelerate engine (not over one-third throttle) to wind in cable to insure a tight, neat wind.

(2) *Winding cable at the winch.*

(*a*) Attach cable chain hook to some movable object, preferably another vehicle, to apply some tension to cable.

Note. If too much tension is applied to cable, clutch control lever cannot be disengaged while winch drum is turning.

(*b*) Push clutch control lever (fig. 43) as far as possible toward winch (or in direction of arrow on lever handle marked OUT). Pull out drum lock poppet knob and turn one-quarter turn to unlocked position.

(*c*) In driver's compartment, place transmission shift control lever into N position; lower transfer lever to DOWN NEUTRAL; start engine. Apply parking brake firmly; then lower power-take-off lever to DOWN FORWARD. Set hand throttle control to desired speed (not over one-third throttle).

(*d*) At winch, wind in cable by means of clutch control lever (fig. 43). Pull lever away from winch (or in direction of arrow on lever handle marked IN) to engage winch drum. Push lever toward winch (or in direction of arrow on lever handle marked OUT) to disengage winch drum.

(*e*) After cable is wound, set winch controls as explained in *c* above.

50. Dump Body Controls

a. General. The dump body and hydraulic hoist assembly on dump truck M215 (figs. 6 and 7), are mounted on a subframe which is at-

tached to truck chassis frame. Body is raised and lowered by cylinder hoist hydraulically operated by a hoist pump. The hoist pump is operated by transfer-mounted power-take-off through a drive shaft.

b. Power-take-off lever. The power-take-off lever, which is positioned to operate hoist pump, is located to right of driver near floor when winch is not used, or to left of driver when winch is used. The lever is also interconnected with hydraulic hoist control box to control the raising, lowering, and holding of the dump body. The lever has four operating positions as indicated on instruction plate, on lever handle (fig. 45), and on dump body instruction plate (fig. 44) mounted on instrument board.

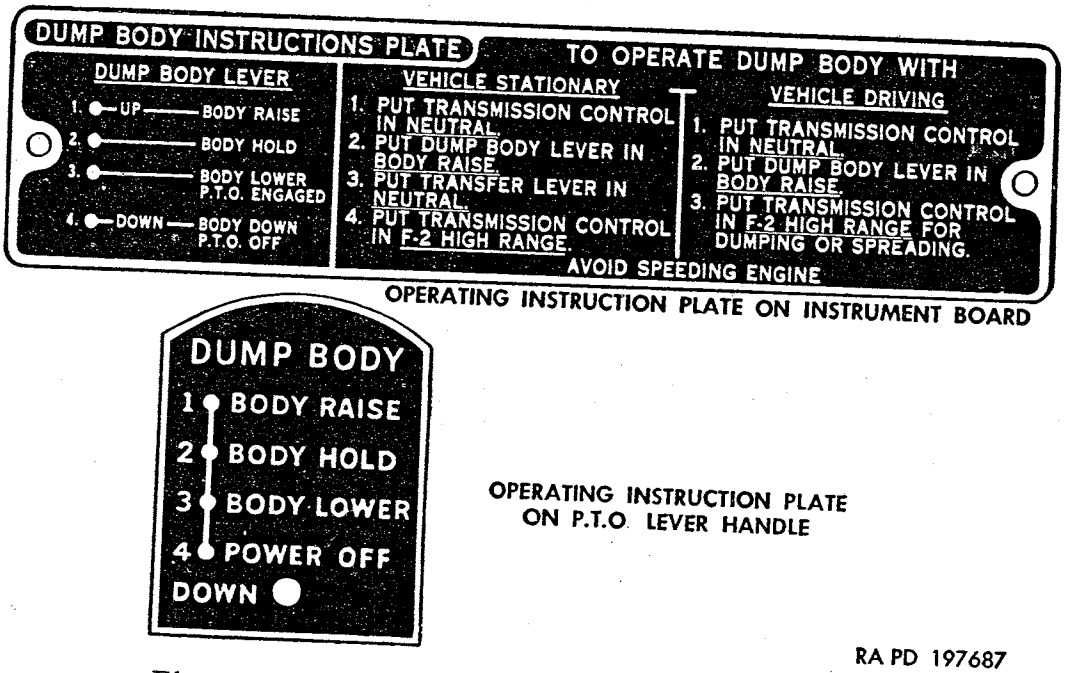

Figure 44. Dump body operating instruction plates.

c. End Gate Hand Lever. The end gate hand lever (fig. 46), located at left front corner of body, is manually positioned to operate lower latch at each lower side of end gate.

51. Dump Body Operation

a. End Gate Operation. Lower portion of end gate hinges in a latch (fig. 46), at each lower side. The lower latches are opened or closed by end gate hand lever. Upper part of end gate hinges in a latch at each side. The end gate upper pins are held in place in each upper latch with pins which are chained to each upper latch. Link chain on each side permit gate to be held in desired opened positions (figs. 48 and 49).

(1) *Closed position.* End gate hand lever (fig. 46) at left front corner of vehicle must be in upright or latched position to hold lower portion of end gate secure. Raise gate until upper

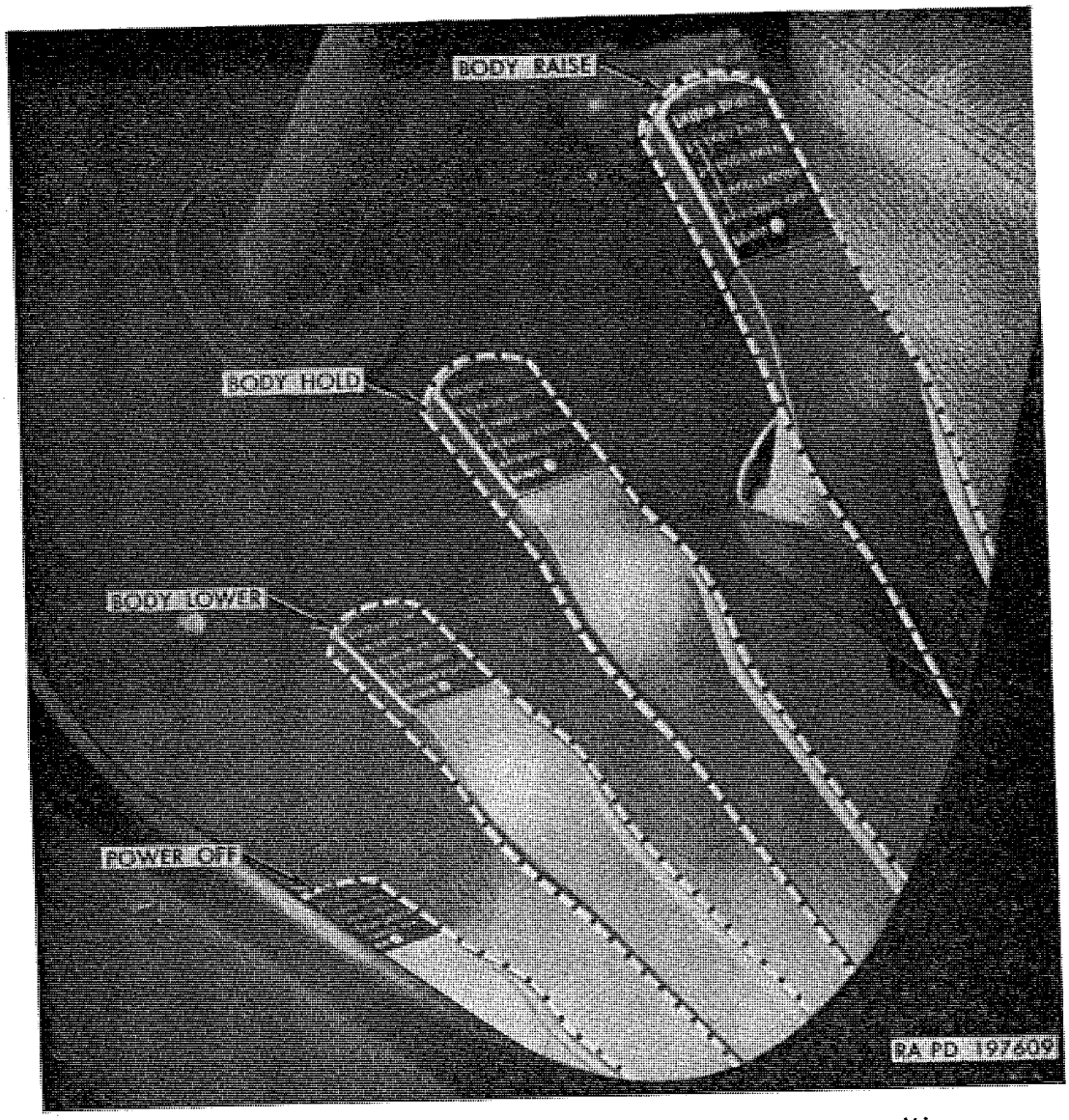

Figure 45. Dump body power-take-off lever operating positions.

pins engage upper latches. Insert chained pin through each upper latch to hold end gate secure. Pull chain down on each side through gate chain retainers. Pull end of each chain firmly through lower chain retaining holes (fig. 47).

(2) *Horizontal position* (fig. 48). Remove chained pin from upper latch on each side. Release chains on each side. Lower end gate to desired position. Hold in position with chain on each side. Each chain can be locked through hole in each upper latch.

(3) *Spreading or dumping position.* End gate (fig. 49) can be positioned to completely open to dump load, or partially open to spread. End gate hand lever must be pushed straight down to release lower latches (fig. 46). End gate then hinges on upper latches. Opening can be varied by chain on each side. Chains can be locked into hole on each side of body.

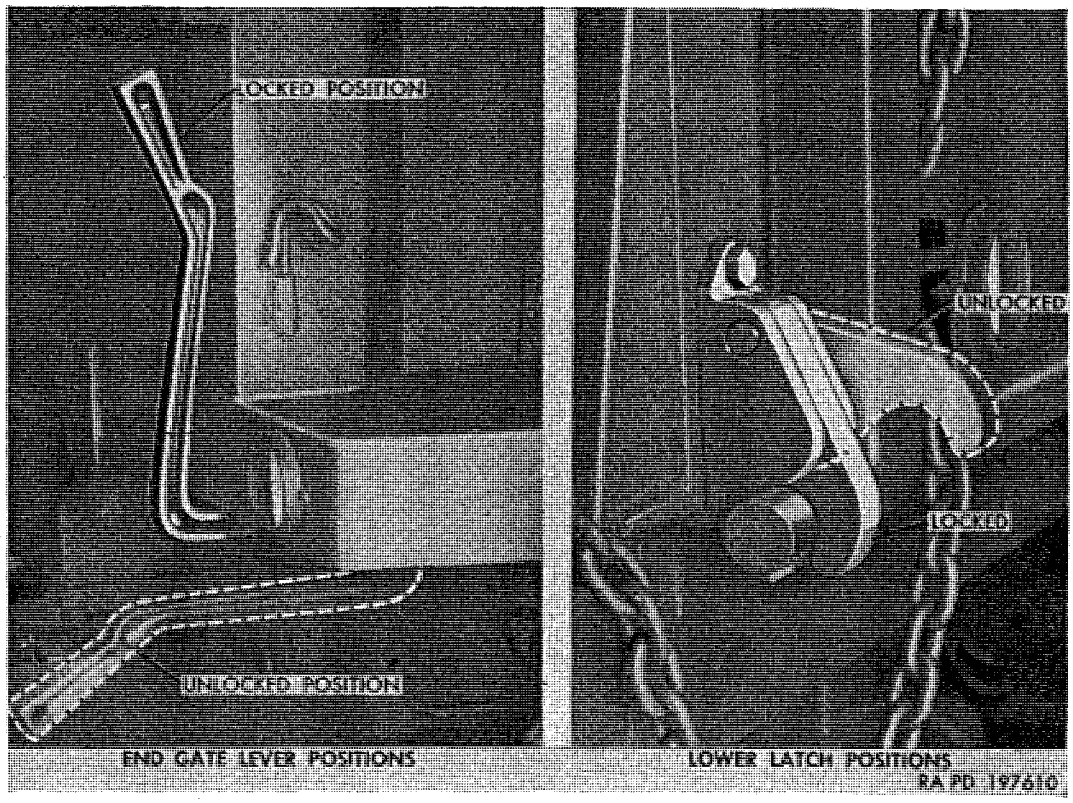

Figure 46. End gate hand lever and lower end gate latch positions.

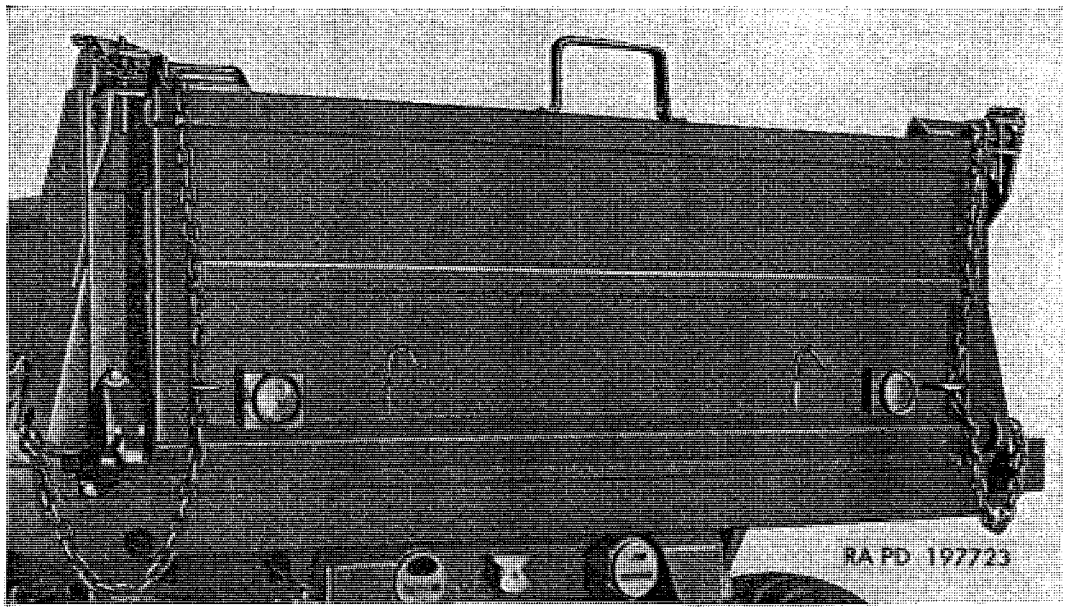

Figure 47. End gate in closed position.

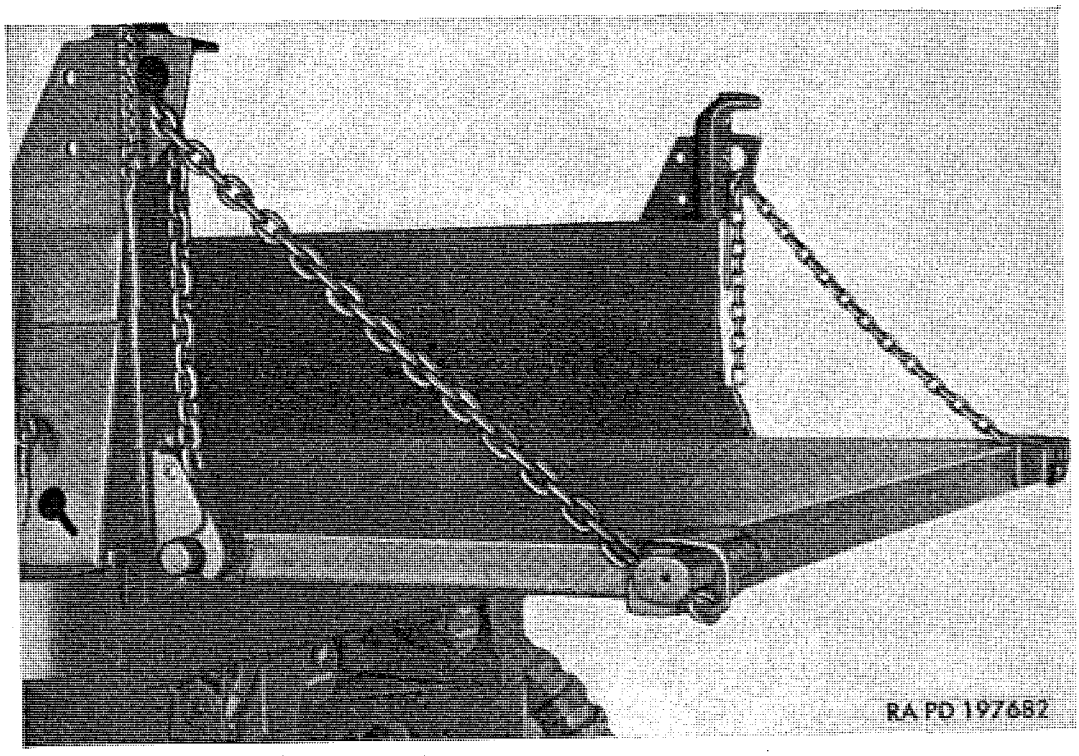

Figure 48. End gate in horizontal position.

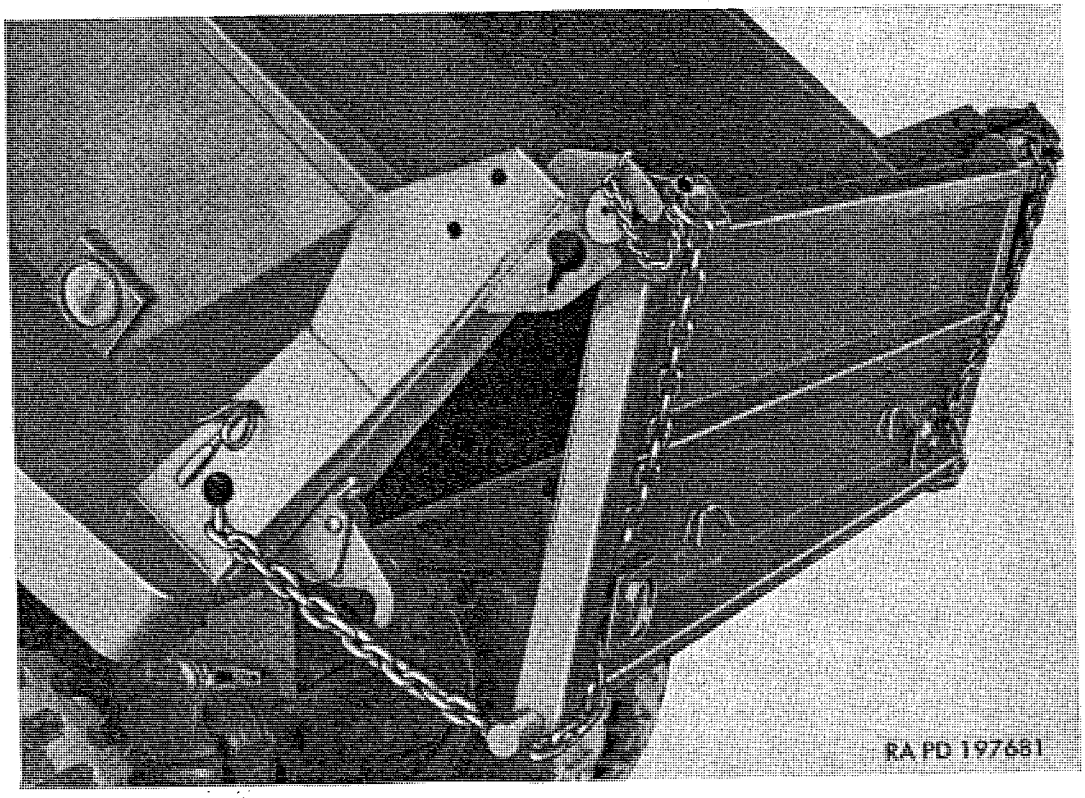

Figure 49. End gate in spreading or dumping position.

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b. Hoist Operation with Vehicle Stationary (fig. 45).

(1) *Raising.*

(*a*) Position end gate to desired spreading or dumping open position as described in *a*(3) above.

(*b*) Place transmission shift control lever into N position; then pull dump body power-take-off lever completely to BODY RAISE position.

(*c*) Place transfer lever into DOWN NEUTRAL position.

Note. In some instances, gears in the power-take-off will not readily mesh with transfer gears after power-take-off lever is positioned as in (*b*) above. If such is the case, again lower power-take-off lever to POWER OFF position, place transmission shift control lever into F–2 in HIGH RANGE position, and then slightly accelerate engine. Again place transmission lever into N position, and then raise power-take-off lever to BODY RAISE position.

(*d*) Place transmission shift control lever into F–2 in HIGH RANGE position. (Do not use F–1 in HIGH RANGE.)

(*e*) Accelerate engine to raise body. Do not use excessive speed. As engine is accelerated, body will continue to raise to the limitation of the hydraulic cylinder stroke.

(2) *Body hold.* Body can be held in partially raised position by lowering power-take-off lever to BODY HOLD position.

Note. Distinct lever stops at BODY HOLD and BODY LOWER positions cannot be readily noticed. The driver should watch action of the body to determine the exact BODY HOLD and BODY LOWER positions.

(3) *Lowering.* Body must be lowered by power from its fully raised position. Place power-take-off lever into BODY LOWER position; then accelerate engine to lower body. After body is over center on the way down, the body can then be lowered by gravity by placing power-take-off lever into POWER-OFF-DOWN position.

c. Hoist Operation with Vehicle Driving. Procedures for operating hoist with vehicle driving are the same as explained in *b* above. To drive the vehicle while hoist is operating, place transfer lever into UP ENGAGED position. Transmission shift control lever must be placed into F–2 in HIGH RANGE for forward driving or R in HIGH RANGE for reverse.

Caution: Do not use F–1 in HIGH RANGE when operating dump body while driving vehicle.

d. Use of Safety braces.

Caution: Whenever body must be in raised position for any maintenance or inspection of hoist mechanism, safety braces (fig. 50) must be positioned. Do not hold body in raised position by use of power-take-off lever in BODY HOLD position if working on hoist mechanism.

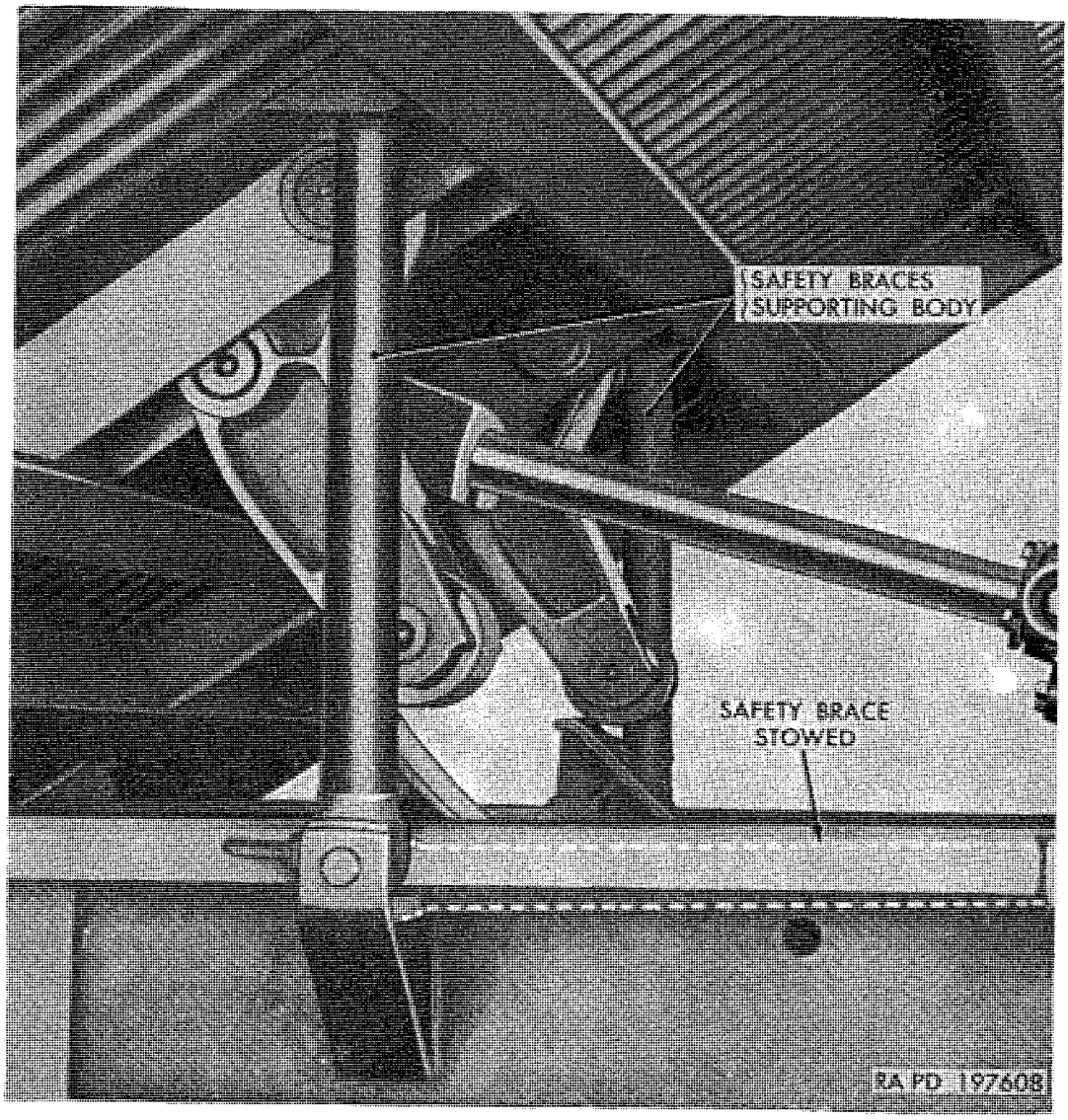


Figure 50. Dump body safety braces in position.

(1) Raise body high enough to place safety brace on each side under body sill as shown in figure 50.

(2) After braces are positioned, lower body until body rests on braces.

(3) To release braces (fig. 50), raise body (*b*(1) above), until right and left braces can be lowered to their respective clips on subframe. After braces are positioned in clips, lower body (*b*(3) above).

e. Use of Side Racks. Side racks with integral troop seats can be positioned in body as illustrated in figure 51.

f. Bows and Paulin. Bow pockets are provided in body sides for installation of top paulin and end curtains when vehicle is being used as a troop carrier, or for camouflage purposes.

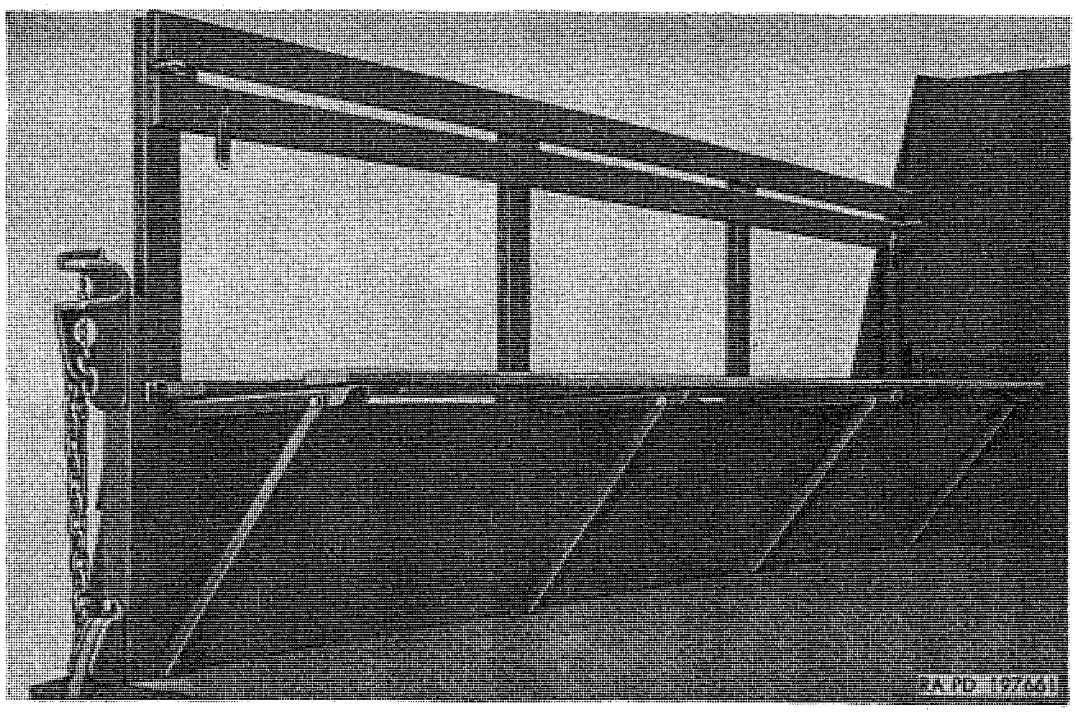


Figure 51. Side racks and troop seats installed.

52. Water Tank Controls and Equipment

a. General. Water tank body, mounted on water tank truck M222 (figs. 12 and 13), includes a 400-gallon compartment at rear of body and a 600-gallon compartment at front. Discharge and suction gate valves (G and K, fig. 55) connected to a pump are mounted in rear compartment. Tank compartments are filled through filler openings (fig. 58) in top of body.

b. Instruction Plates.

(1) *Water pump instruction plate.* The instruction plate (fig. 52) is mounted on instrument board (fig. 29). The plate includes brief instructions on the use of transmission shift control lever, transfer lever, and power-take-off lever for operation of tank pump. The plate also includes warning regarding use of tank exhaust heater.

(2) *Power-take-off lever instruction plate* (fig. 52). Plate is fastened to handle of power-take-off lever, and includes instructions regarding the positioning of lever to operate pump.

(3) *Tank exhaust heater instruction plate* (fig. 52). Plate is held in position by tank exhaust heater control which is mounted on instrument board (fig. 29).

(4) *Heater gate valve instruction plate* (fig. 60). Instruction plate is mounted to gate valve handwheel. The plate instructs on the use of heater gate valve. The valve is located at lower front part of tank body between tank and cab, and is accessible from right side of vehicle.

(5) *Water tank body name and instruction plate.* Plate (fig. 53, and D, fig. 55), on inside wall of rear compartment, includes manufacturer's name, serial number, ordnance stock number, and brief instructions regarding the use of suction and discharge equipment.

c. Water Tank Operating Equipment. In addition to lengths of suction hose (rubber) and discharge hose (cotton), operating equip-

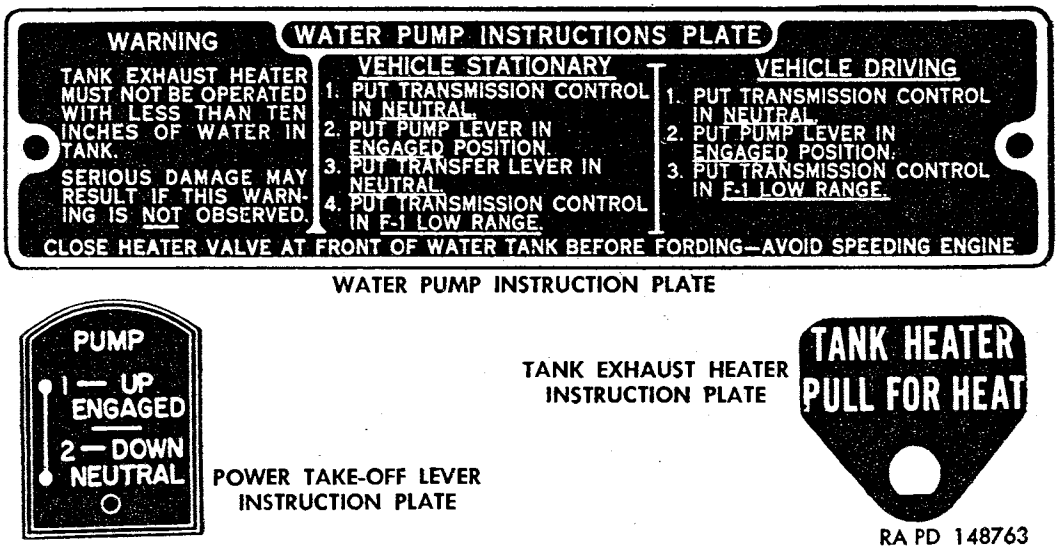


Figure 52. Water pump instruction plates.

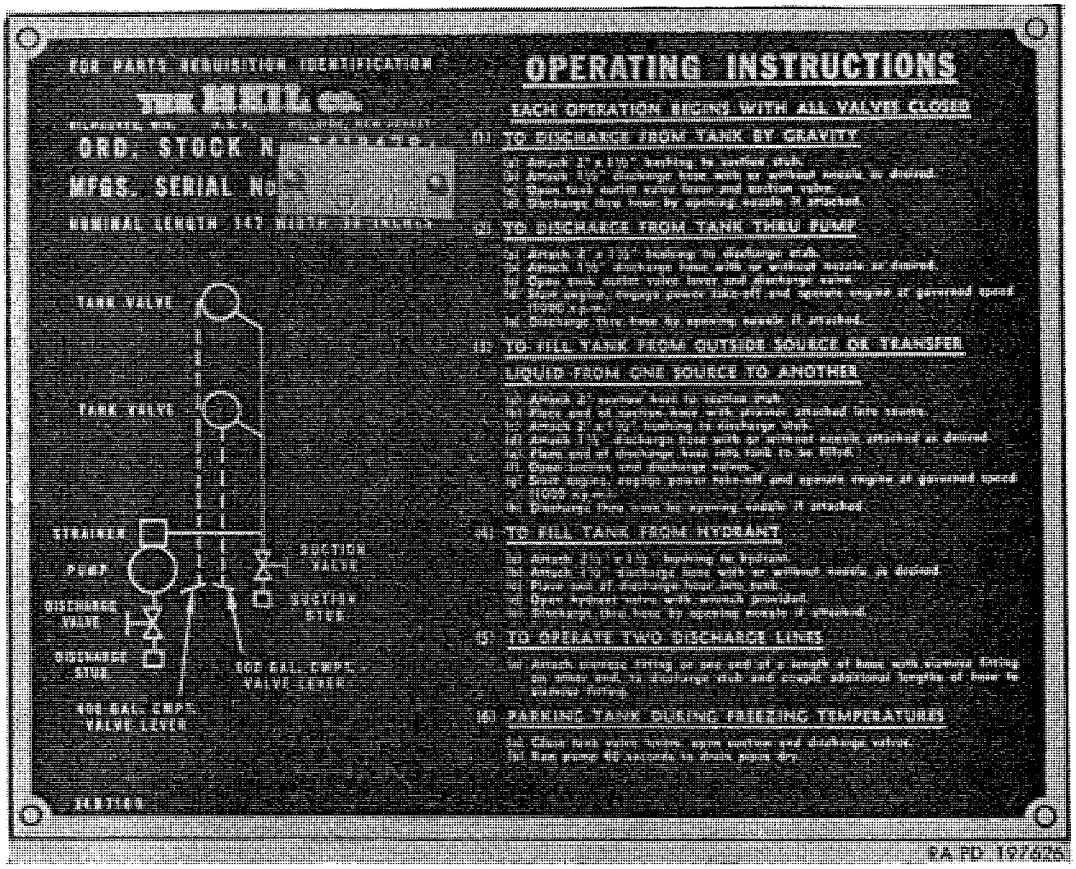


Figure 53. Water tank body name and instruction plate.

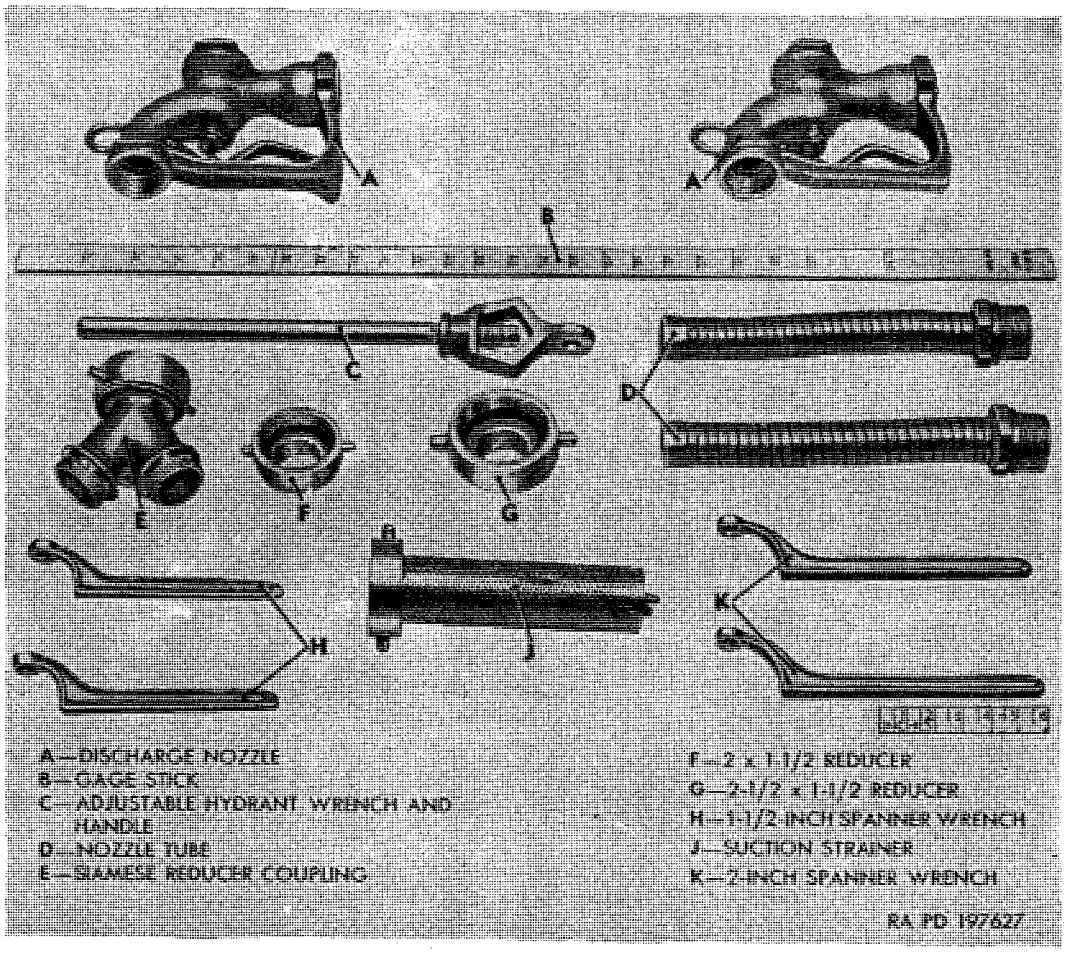


Figure 54. Water tank operating equipment.

ment as shown in figure 54 is stowed in rear compartment (fig. 55). Use of the equipment is explained in paragraph 53.

d. Discharge and Suction Controls. The water pump discharge gate valve, suction gate valve, and drain valve control operating levers are located in rear compartment (fig. 55).

53. Water Pump Operation

a. Pump Lever. Power-take-off pump lever is located to right of driver near floor. Instruction plate (fig. 52), mounted on lever handle, indicates two lever operating positions which are UP ENGAGED and DOWN NEUTRAL. After fitting hoses and positioning suction and discharge gate valves as explained in *d* below, pump is then operated as explained in *b* or *c* below.

b. Operation of Pump with Vehicle Stationary.

(1) Place transmission shift control lever into N position and start engine.

(2) Pull up power-take-off pump lever to UP ENGAGED position.

(3) Place transfer lever in DOWN NEUTRAL position.

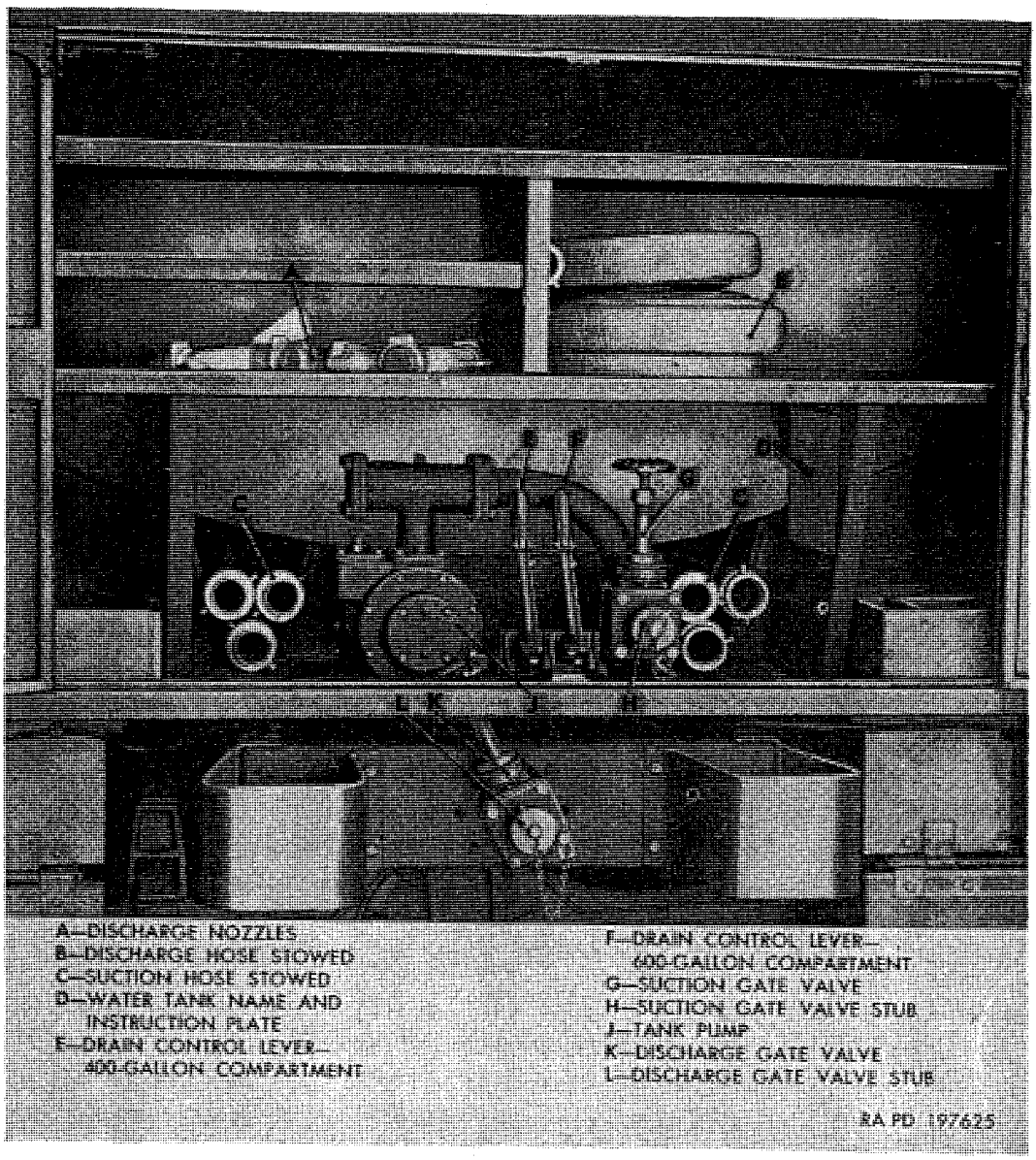


Figure 55. Water tank pump and equipment compartment.

(4) Place transmission shift control lever in F–1 in LOW RANGE position (fig. 32).

(5) Accelerate engine to operate pump. Do not attempt to overspeed engine, as auxiliary governor limits engine speed when pump lever is in engaged position.

(6) When pumping is completed, move transmission shift control lever into N position, and power-take-off lever into DOWN NEUTRAL position.

c. Operation of Pump with Vehicle Driving.

(1) Place transmission shift control lever into N position and start engine.

(2) Pull up power-take-off pump lever to UP ENGAGED position.

(3) Place transfer lever into UP ENGAGED position.

(4) Place transmission shift control lever into F–1 in LOW RANGE position (fig. 32). Accelerate engine to move truck and operate pump.

(5) After pumping is completed and truck is to be stopped, move transmission shift control lever to N position, transfer lever to DOWN NEUTRAL position, and power-take-off lever to DOWN NEUTRAL position.

d. Operation of Suction and Discharge Equipment. The gravity discharge gate valve and the pump suction gate valve (G and K, fig. 55) must be closed before all operations begin. Turn gate valve handwheels clockwise until closed. Both drain valve control operating levers must be pushed completely forward.

(1) *Discharging from tank by gravity.*

(*a*) Attach 2 x 1½ reducer (F, fig. 54) to suction gate valve stub (H, fig. 55).

(*b*) Attach 1½-inch discharge hose (cotton) to suction stub. Nozzle may be used if required.

(*c*) Open suction gate valve by turning handwheel counterclockwise.

(*d*) Pull desired drain valve lever straight back. The left lever (when facing compartment) drains 400-gallon compartment. The right lever drains the 600-gallon compartment. Discharge through hose by opening nozzle if attached. Both tank compartments can be drained in this manner.

(2) *Discharging from tank through pump.*

(*a*) Attach 2 x 1½ reducer (F, fig. 54) to discharge stub.

(*b*) Attach 1½-inch discharge hose (cotton) to discharge stub reducer.

(*c*) Pull drain valve operating lever straight back. Open discharge gate valve by turning handwheel counterclockwise.

(*d*) Operate pump as described in *b* or *c* above.

(*e*) Discharge through hose by opening nozzle if attached.

(3) *Filling tank from outside source.*

(*a*) Attach 2-inch suction hose (rubber) (fig. 56) to suction stub.

(*b*) If outside source of supply is a stream, lake, or river, attach suction strainer (J, fig. 54) to end of suction hose. Use the adjustable hydrant wrench and handle (fig. 57) as a support to prevent strainer from being imbedded at bottom of stream. If the outside source is a tank, the support need not be used.

(*c*) Attach 2 x 1½ reducer (F, fig. 54) to discharge stub. Attach desired lengths of 1½-inch discharge hose (cotton) (fig. 56) to discharge stub reducer. Nozzle may be attached to hose if required.

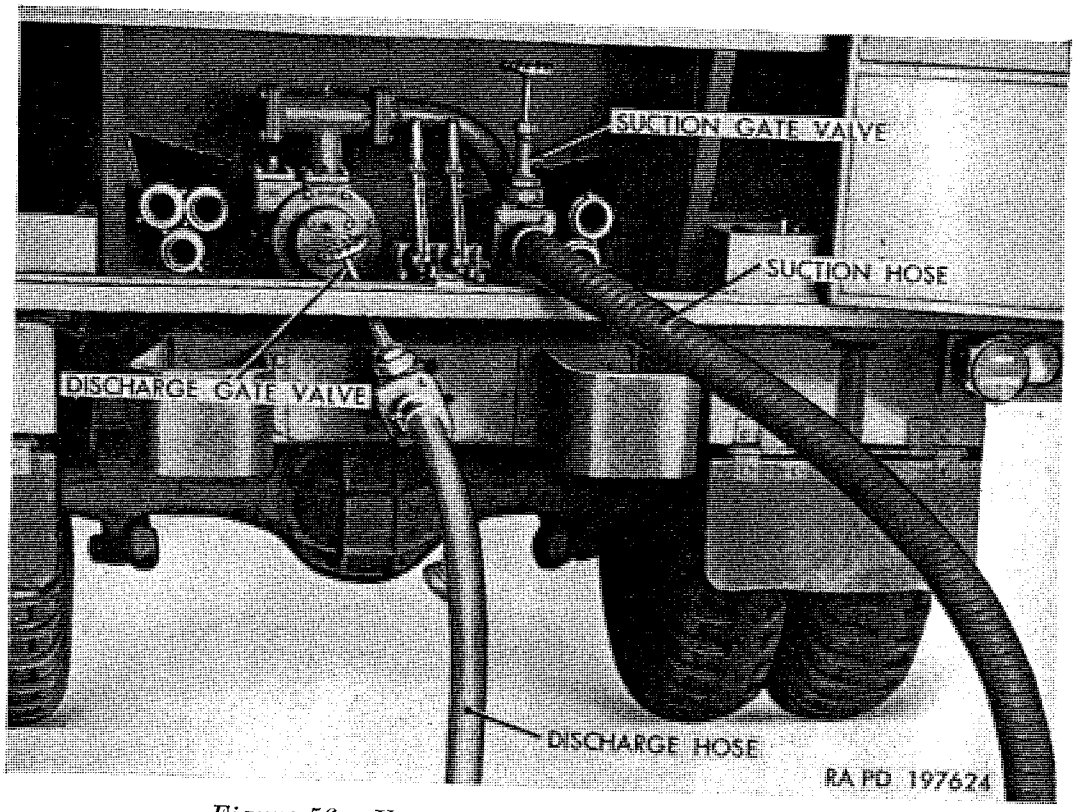


Figure 56. Use of discharge and suction hoses.

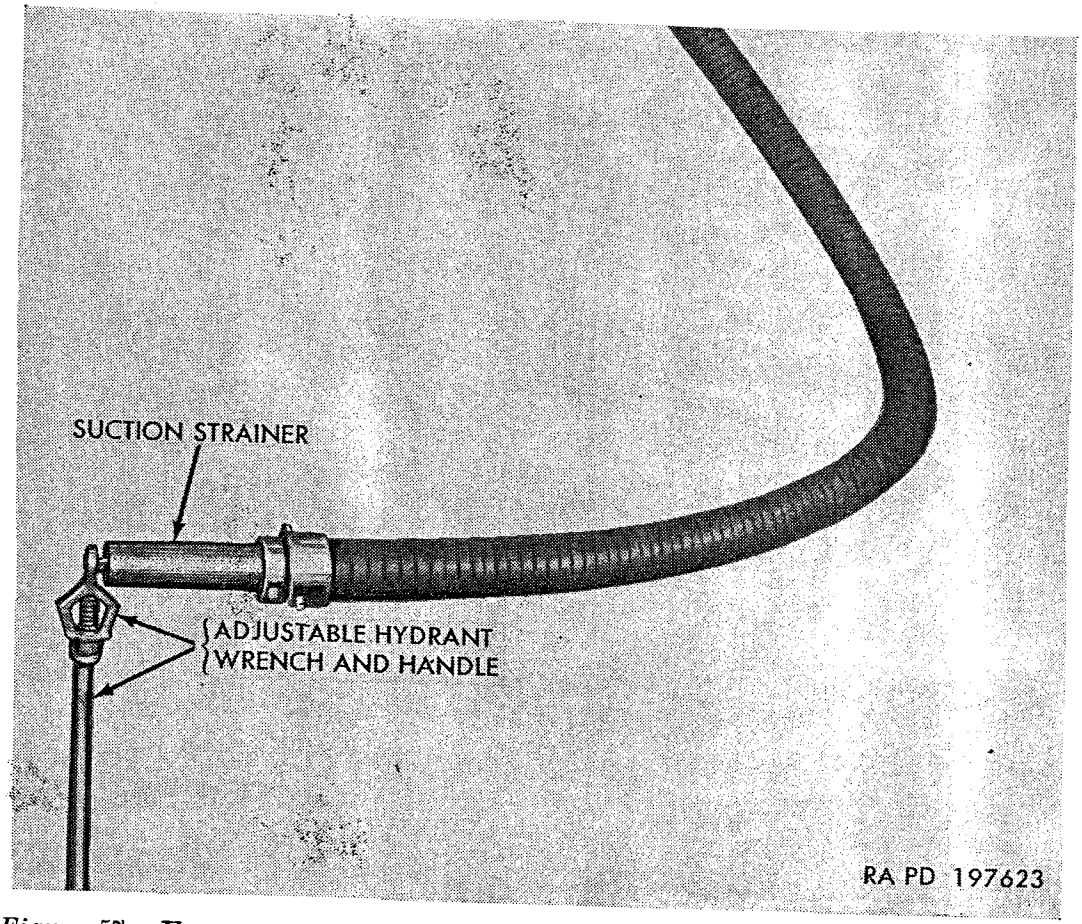


Figure 57. Use of suction strainer with adjustable hydrant wrench and handle.

(*d*) Open filler cover (fig. 58) of tank compartment to be filled. Place one end of discharge hose in filler opening.

(*e*) Open suction and discharge gate valves by turning handwheels counterclockwise.

(*f*) Start engine and operate pump as explained in *b* or *c* above. Discharge through hose by opening nozzle if attached.

(*g*) After compartment or compartments are filled, stop pump (*b* or *c* above) and close suction and discharge gate valves. Close and fasten filler covers (fig. 58).

(4) *Filling tank from hydrant.*

(*a*) Attach 2½ x 1½ reducer to hydrant (conventional fire hydrant).

(*b*) Attach 1½-inch discharge hose (cotton) to hydrant reducer. Nozzle may be attached if required.

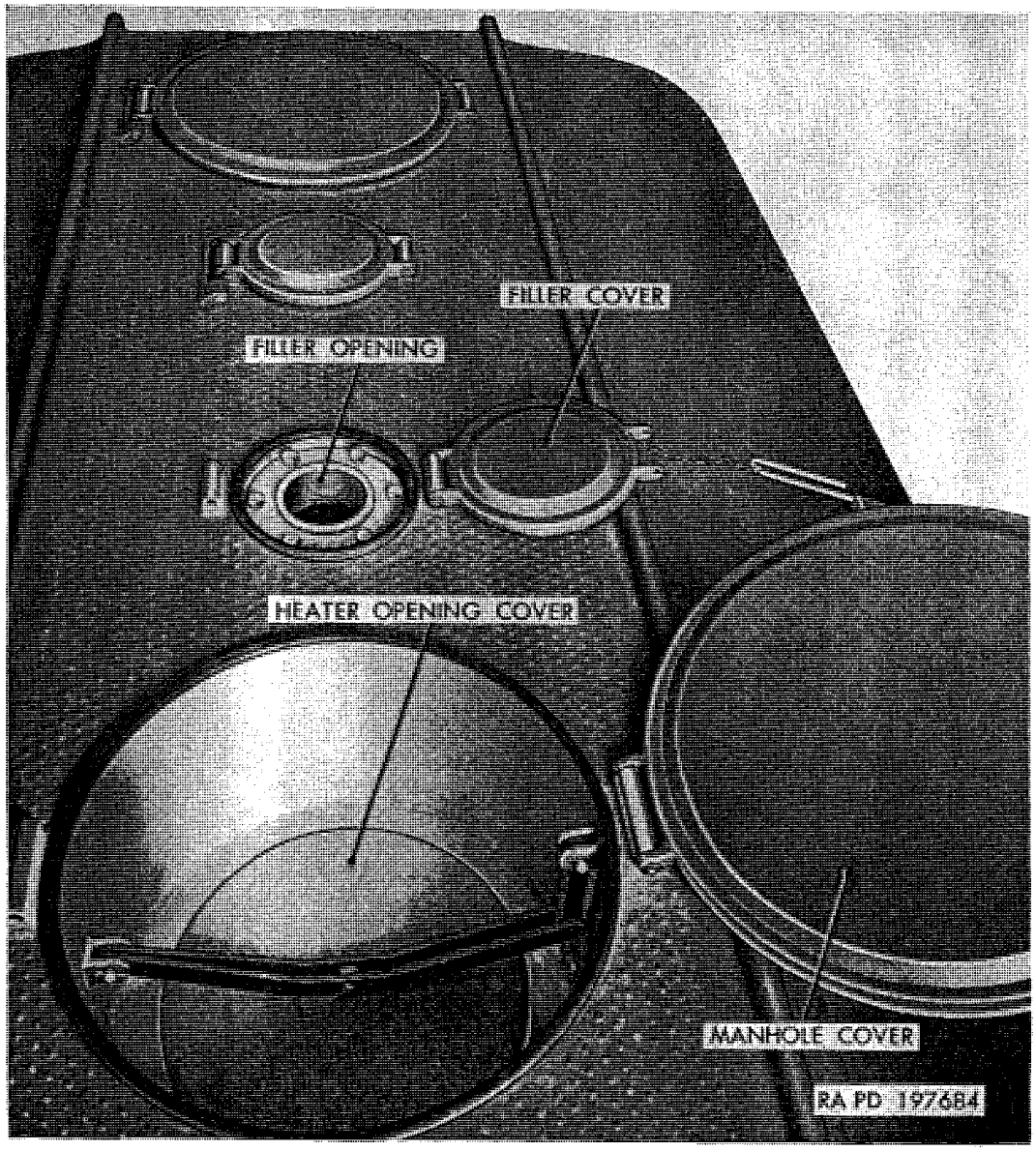


Figure 58. Water tank manhole and filler covers and openings.

(*c*) Place end of discharge hose into either tank opening (fig. 58).

(*d*) Using the adjustable hydrant wrench and handle (C, fig. 54), open hydrant valve. Discharge through hose by opening nozzle if attached.

(5) *Use of siamese reducer coupling.* Siamese reducer coupling (E, fig. 54) may be attached to discharge gate valve stub (L, fig. 55) to permit use of two discharge hose lengths as shown in figure 59.

Note. To minimize kinking of discharge hose at discharge gate valve stub during use, a length of suction hose (rubber) can be installed to discharge stub, and then desired number of discharge hose lengths can be attached to suction hose length. This is particularly effective if discharge hose is not used in a straight position.

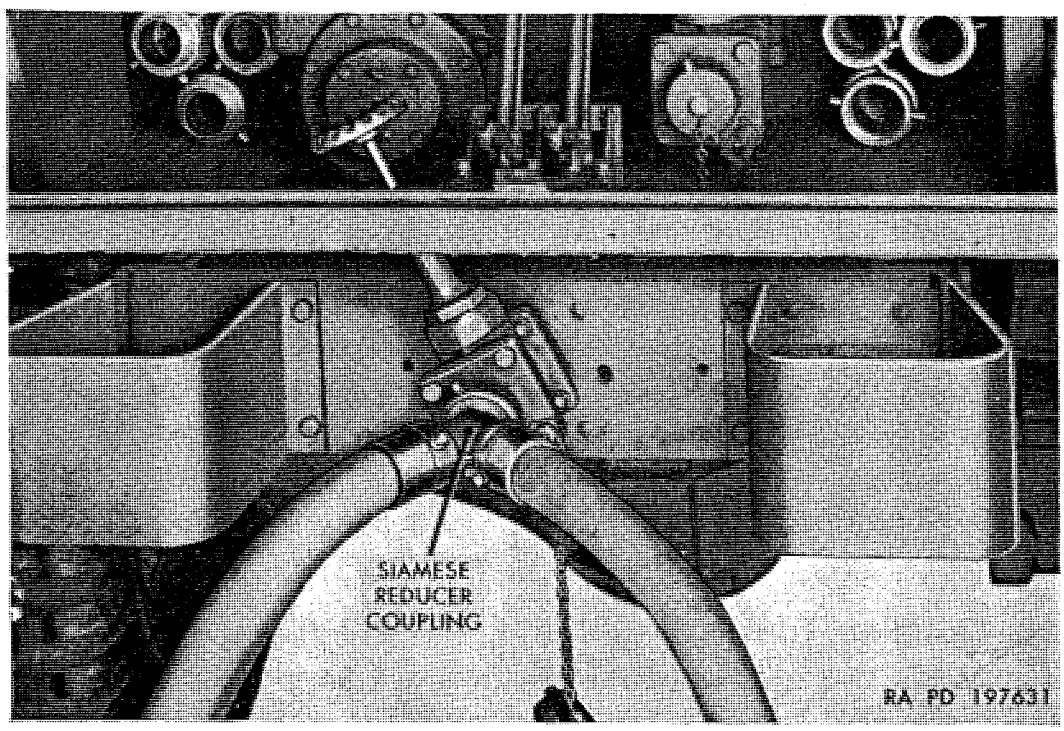


Figure 59. Use of siamese reducer coupling.

e. Use of Tank Heater.

(1) *Tank heater control.* The heater control handle on instrument board (fig. 29) must be pulled out to divert vehicle exhaust gases through tank body to assist in heating the water. Heater gate valve must be opened as explained in (2) below.

(2) *Heater gate valve* (fig. 60). The heater gate valve must remain open at all times except when fording in deep water as indicated on instruction plate attached to handwheel. Turn handwheel counterclockwise to open, and clockwise to close.

(3) *Submersion type heaters.* Submersion-type heaters can be used in each tank compartment after large manhole cover at

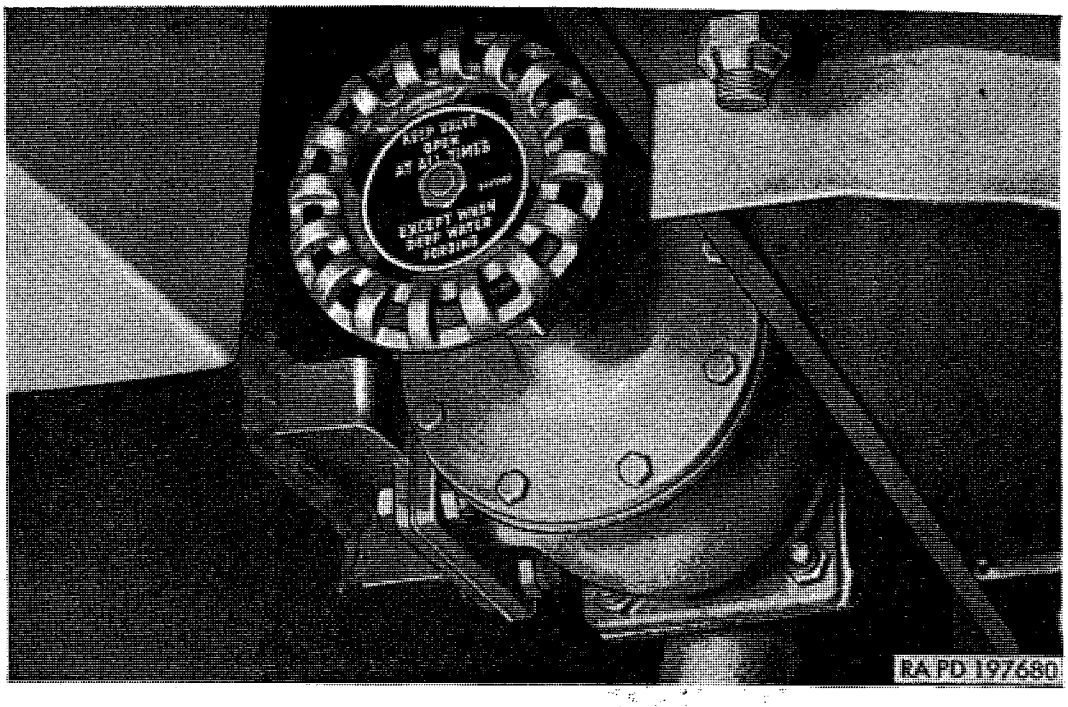


Figure 60. Heater gate valve.

each compartment is opened and heater opening cover removed as shown in figure 58.

f. Parking Truck. In freezing weather, if no provision has been made to keep water heated, drain compartments. Close both drain valve operating levers and open suction and discharge gate valves. Start engine and run pump about 60 seconds to drain pipes dry.

g. Bows and Paulin. Bow pockets are provided in running boards at sides of tank body for installation of bows and top paulin for camouflage purposes.

54. Gasoline Tank Controls and Equipment

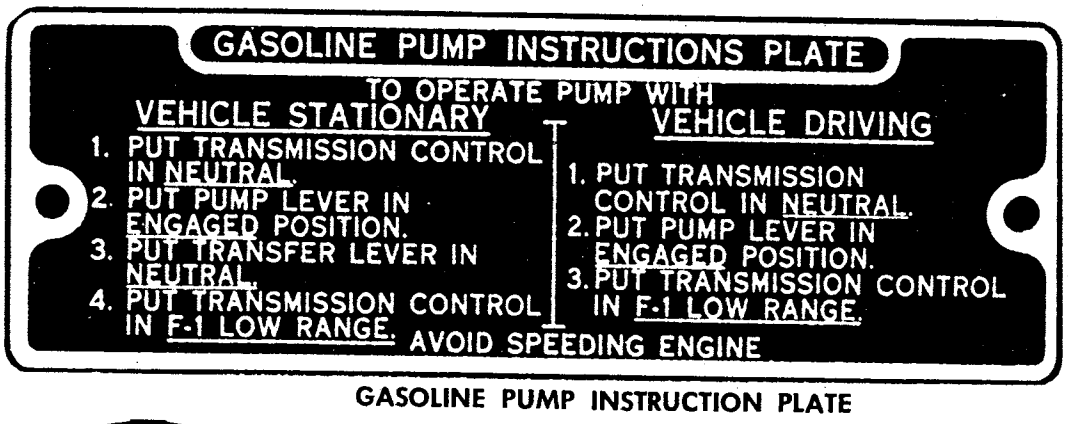
a. General. Gasoline tank body, mounted on gasoline tank truck M217 (figs. 8 and 9), has three compartments: 200-gallon front, 400-gallon center, and 600-gallon rear. Discharging of gasoline from the compartments is controlled by three drain valve control operating levers in rear compartment (fig. 63). Pump discharge gate valves, interconnected to tank pump, are also located in rear compartment. The tank pump is operated by transfer-mounted power-take-off through drive shafts when controls are properly positioned by driver.

b. Instruction Plates.

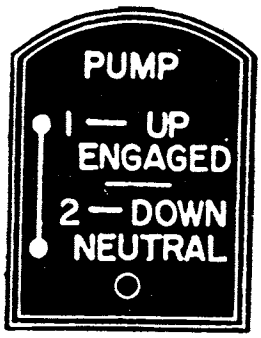
(1) *Gasoline pump instruction plate.* The instruction plate (fig. 61) is mounted on instrument board (fig. 29). The plate includes brief instructions on the use of transmission shift control lever, transfer lever, and power-take-off lever for operation of tank pump.

(2) *Power-take-off lever instruction plate.* Plate (fig. 61) is fastened to power-take-off lever and includes instruction regarding the positioning of lever to operate pump.

c. Gasoline Tank Operating Equipment. Dispensing hose, nozzles, and gage stick are stowed in rear compartment (fig. 62).



GASOLINE PUMP INSTRUCTION PLATE



POWER TAKE-OFF LEVER INSTRUCTION PLATE

RA PD 148765

Figure 61. Gasoline pump instruction plates.

55. Gasoline Pump Operation

Caution: When operating and driving the gasoline tank truck (fig. 62), the static chain at the rear must be in position at all times. During dispensing or loading gasoline, smoking near the truck (at least 50 feet) is forbidden. Use of open flame, electrically operated equipment, or tools which may cause static sparks must not be used on or near the truck. Dispensing equipment must be thoroughly drained and ventilated before stowage in rear compartment. All spillage in rear compartment and at manhole covers must be wiped thoroughly dry immediately after use. Personnel must not enter a compartment unless compartment is gas-free and precautions used as explained in paragraph 351.

a. Power-Take-Off Pump Lever. Power-take-off pump lever is located to right of driver near floor. Instruction plate (fig. 61), mounted on lever handle, indicates two lever operating positions that is: UP ENGAGED and DOWN NEUTRAL. After connecting dispensing hose and positioning gate valves as explained in *d* below, pump is then operated as explained in *b* or *c* below.

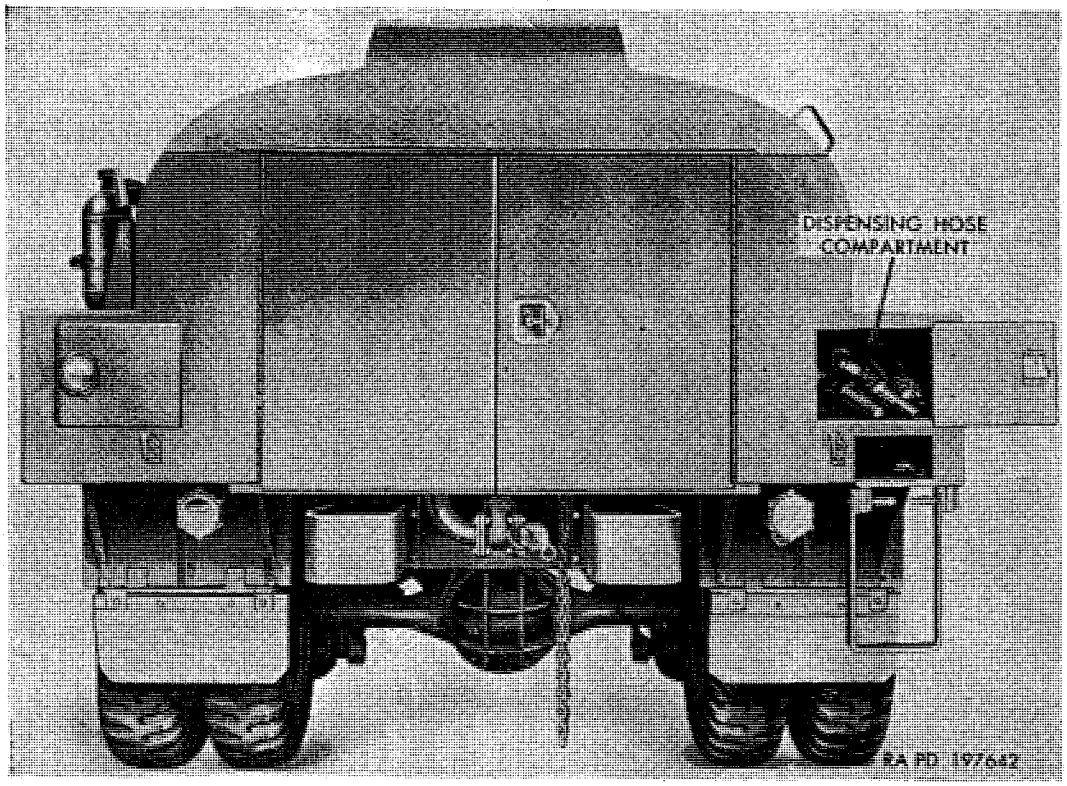


Figure 62. Gasoline tank body rear stowage compartments.

b. Operation of Pump With Vehicle Stationary.

(1) Place transmission shift control lever into N position and start engine.

(2) Pull up power-take-off pump lever to UP ENGAGED position.

(3) Place transfer lever into DOWN NEUTRAL position.

(4) Place transmission shift control lever to F–1 in LOW RANGE position (fig. 32).

(5) Accelerate engine to operate pump. Do not attempt to overspeed engine, as auxiliary governor limits engine speed when pump lever is in engaged position.

(6) When pumping is completed, move transmission shift control lever into N position, and power-take-off lever into DOWN NEUTRAL position.

c. Operation of Pump With Vehicle Driving.

(1) Place transmission shift control lever into N position and start engine.

(2) Pull up power-take-off pump lever to UP ENGAGED position.

(3) Place transfer lever into UP ENGAGED position.

(4) Place transmission shift control lever into F–1 in LOW RANGE position (fig. 32). Accelerate engine to move truck and operate pump.

(5) After pumping is completed and truck is to be stopped, move transmission shift control lever to N position, transfer lever to DOWN NEUTRAL position, and power-take-off lever to DOWN NEUTRAL position.

d. Use of Dispensing Equipment.

(1) *Gate valves and drain valve levers.*

(*a*) *Discharge gate valves.* The gravity discharge gate valve and pump discharge gate valve (F and K, fig. 63) are located in rear compartment. These gate valves are used in conjunction with pump to dispense gasoline from tank or to fill tank compartments.

(*b*) *Drain valve control levers.* Three drain valve control levers (A, B, and C, fig. 63) are mounted to left of pump in rear compartment. Each lever controls a drain valve in bottom of a tank compartment and is marked with an indi-

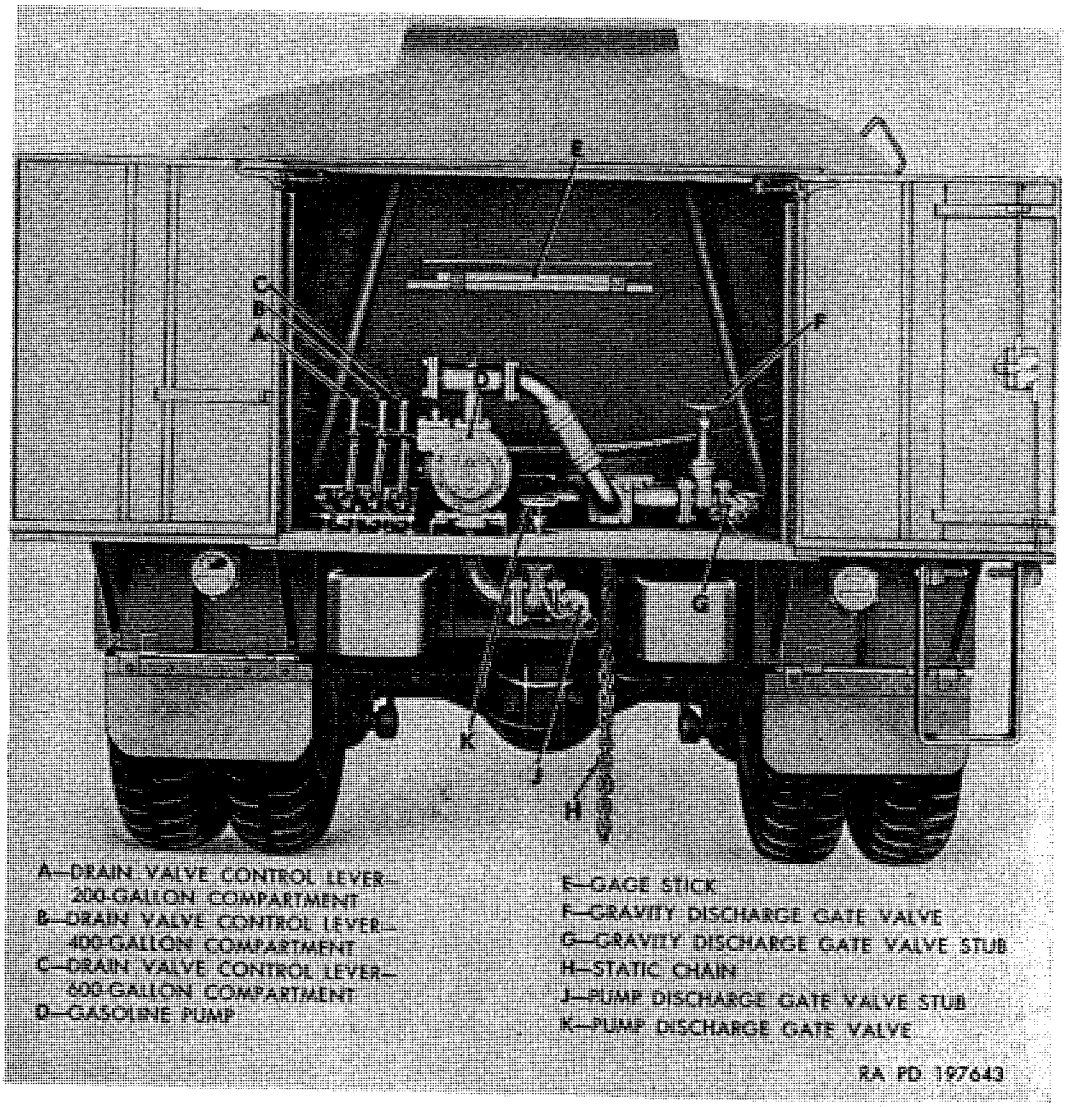


Figure 63. Gasoline tank body rear compartment.

cating plate at base of lever. The left lever drains the 200-gallon compartment, the center lever drains the 400-gallon compartment, and the right lever drains the 600-gallon compartment. Each lever must be pulled toward rear to open respective compartment drain valve. All levers must be off (in forward position) before left compartment door can be closed.

(2) *Dispensing hose and nozzle.*

(*a*) *Dispensing hose.* Two 10-foot 1½-inch, and four 10-foot 1-inch hose are furnished. These are equipped with male and female couplings and adapters. The 1½-inch dispensing hose must be used directly at the discharge gate valve stubs. The 1-inch hose are used with an adapter for use with dispensing nozzles.

(*b*) *Dispensing nozzles.* The dispensing nozzles are operated by pressing on nozzle trigger to discharge fluid, and releasing trigger to shut off fluid. Each nozzle is equipped with an audible device. When fluid in container being filled rises over end of nozzle, whistle is heard, indicating that container is full.

e. Discharging from Tank by Gravity.

(1) Close gravity and pump discharge gate valves (F and K, fig. 63) by turning handwheels clockwise. Close all drain valve control levers.

(2) Connect dispensing hose to gravity discharge gate valve stub (G, fig. 63). Open gravity discharge gate valve by turning handwheel counterclockwise.

(3) Pull desired drain valve control lever straight back. Discharge through hose nozzle.

f. Discharging from Tank through Pump.

(1) Close gravity and pump discharge gate valves (F and K, fig. 63) by turning handwheels counterclockwise. Close all drain valve control levers.

(2) Connect dispensing hose to pump discharge gate valve stub (J, fig. 63).

(3) Open pump discharge gate valve by turning handwheel counterclockwise.

(4) Pull desired drain valve control lever straight back.

(5) Operate pump as described in *b* or *c* above. Discharge through hose by opening nozzle.

Note. Tank compartments can be discharged by gravity and pump at the same time, applying procedures in *e* and (1) through (4) above.

g. Filling Tank from Outside Source.

(1) Close gravity and pump discharge gate valves (F and K, fig. 63) by turning handwheels clockwise. Close all drain valve control levers.

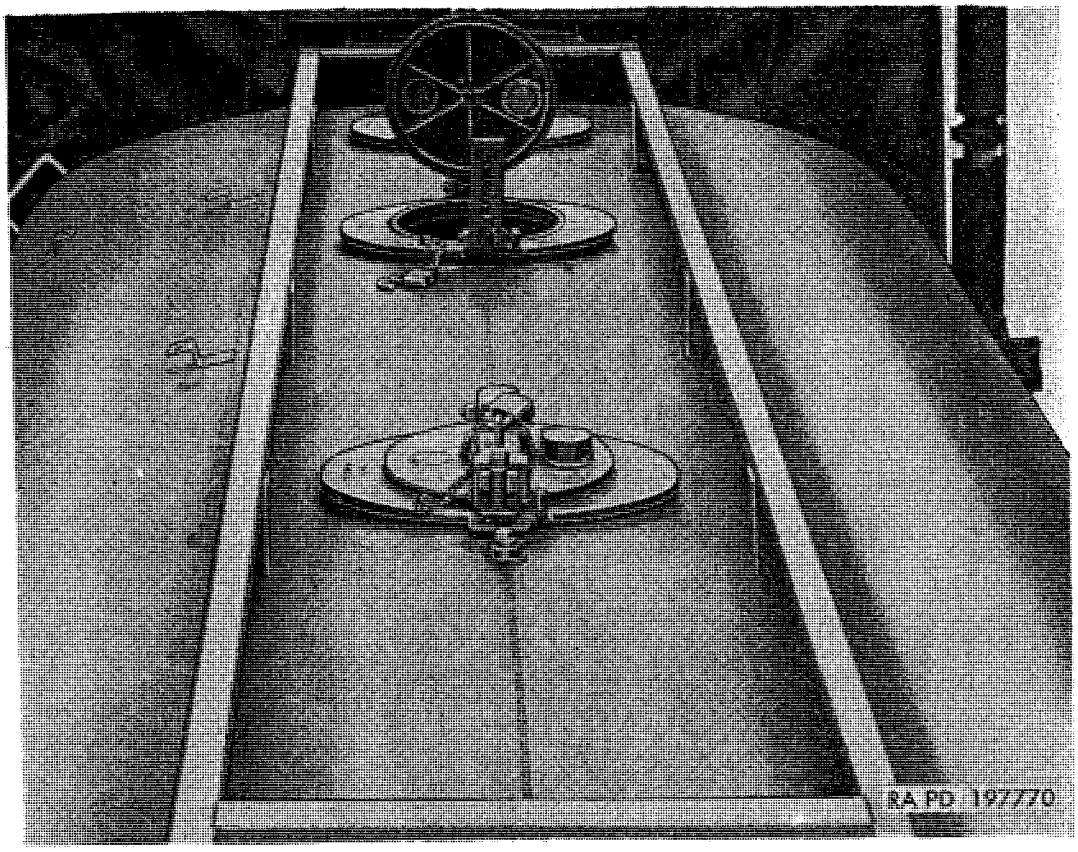


Figure 64. Gasoline tank compartment covers.

(2) Attach dispensing hose to gravity discharge gate valve stub.
(3) Attach dispensing hose to pump discharge gate valve stub.
(4) Place end of pump discharge hose into desired tank opening (fig. 64).
(5) Open the gravity and pump discharge gate valves.
(6) Operate pump in manner described in *b* above.
(7) Fluid level in tanks can be gaged with gage stick (E, fig. 63). This gage is calibrated on three faces, one for each compartment.

h. Use of Emergency Trip Release. Emergency trip release handle is located on left side of body at front, just outside the cab. Pull handle straight forward to close all three drain valve control levers in the rear compartment.

i. Use of Bows and Paulin. Bow pockets are provided in running boards for installation of bows and top paulin for camouflage purposes.

56. Tractor Fifth Wheel Operation

a. General. The truck tractor M221 (figs. 10 and 11) is equipped with manual release-type fifth wheel (fig. 65) mounted on frame at rear of chassis. The fifth wheel is a rocking-type to compensate for tractor and trailer movement.

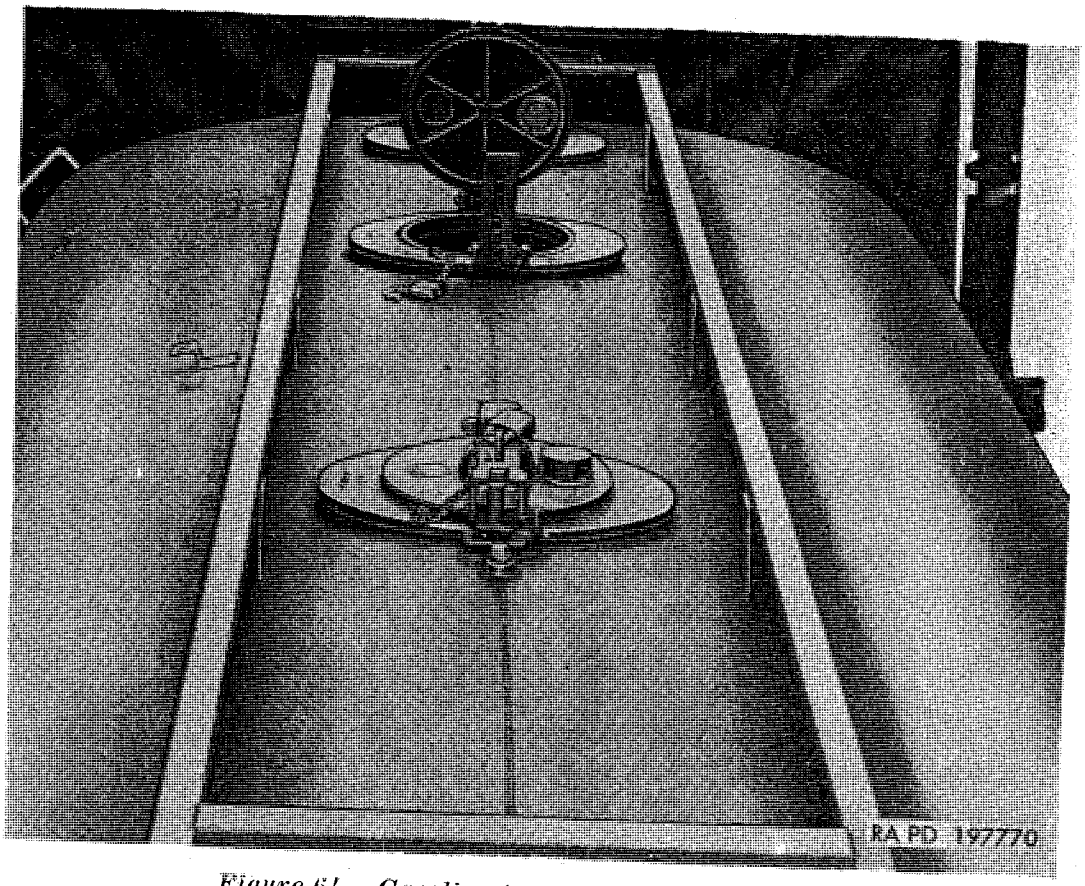


Figure 64. Gasoline tank compartment covers.

(2) Attach dispensing hose to gravity discharge gate valve stub.
(3) Attach dispensing hose to pump discharge gate valve stub.
(4) Place end of pump discharge hose into desired tank opening (fig. 64).
(5) Open the gravity and pump discharge gate valves.
(6) Operate pump in manner described in *b* above.
(7) Fluid level in tanks can be gaged with gage stick (E, fig. 63). This gage is calibrated on three faces, one for each compartment.

h. Use of Emergency Trip Release. Emergency trip release handle is located on left side of body at front, just outside the cab. Pull handle straight forward to close all three drain valve control levers in the rear compartment.

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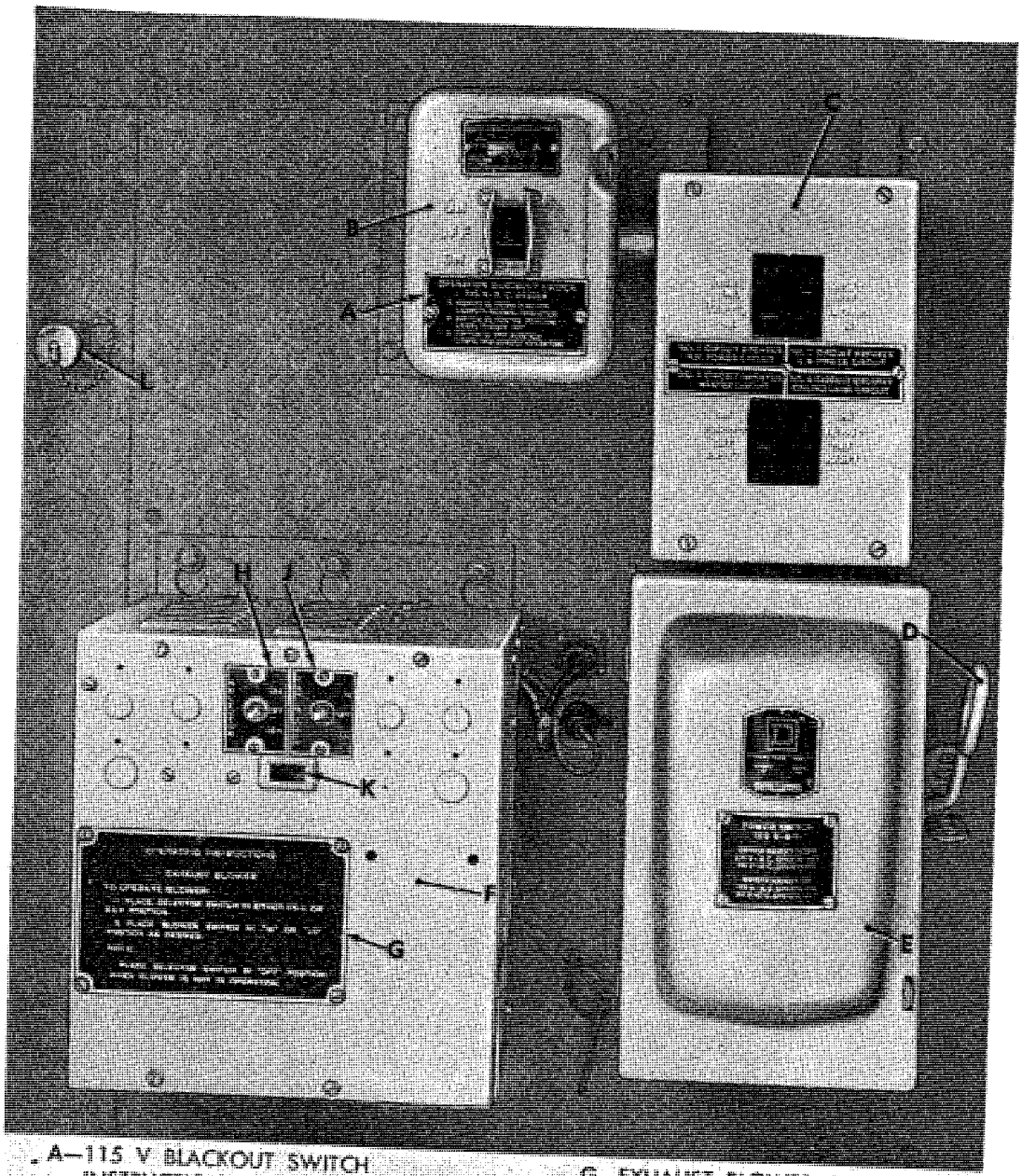


Figure 68. 115-volt light switch, multibreaker box, power switchbox, and current converter mounted.

b. Use of 24-Volt Dc Power. Interior lights and exhaust blower can be operated on vehicle 24-volt system after switches are placed in positions as described in *d* and *e* below.

c. Use of 115-Volt Ac Power.

(1) Outside source of 115-volt ac power must be plugged into the power entrance receptacle (fig. 69) located on upper

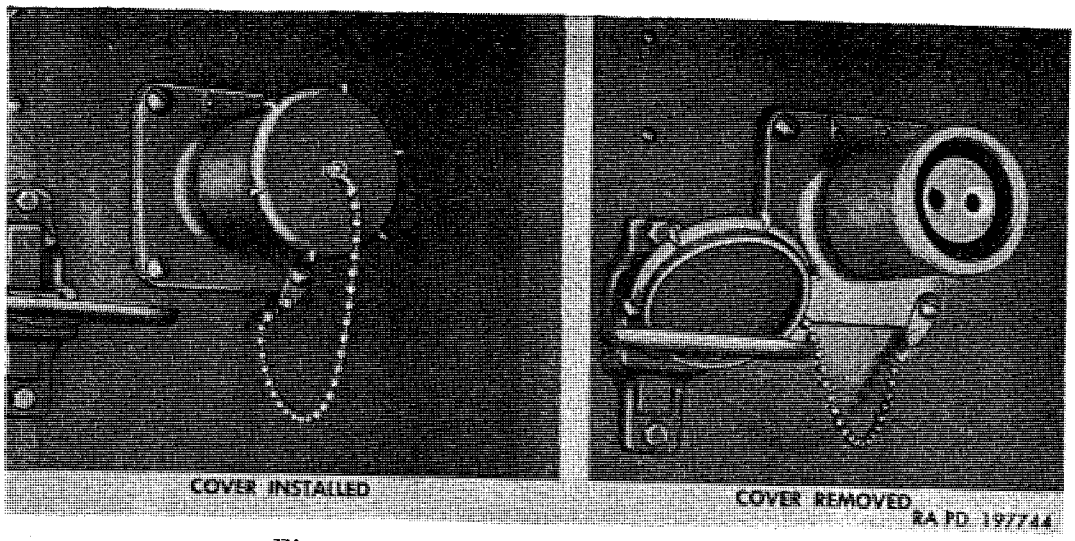


Figure 69. Power entrance receptacle.

right corner of body at the outside. Remove the chained cap from the receptacle. Power entrance plug is then accessible.

(2) Power switch handle (D, fig. 68) must be pushed up. Auxiliary equipment can then be operated on 115-volt ac current.

d. Operation of Exhaust Blower. Exhaust blower (fig. 70) is mounted on left rear interior wall of body near roof. Outlet vent must be manually positioned.

(1) Position outlet vent to degree of opening desired by pulling exhaust vent lever shown. Lever operates in notches in segment to provide various degrees of opening.

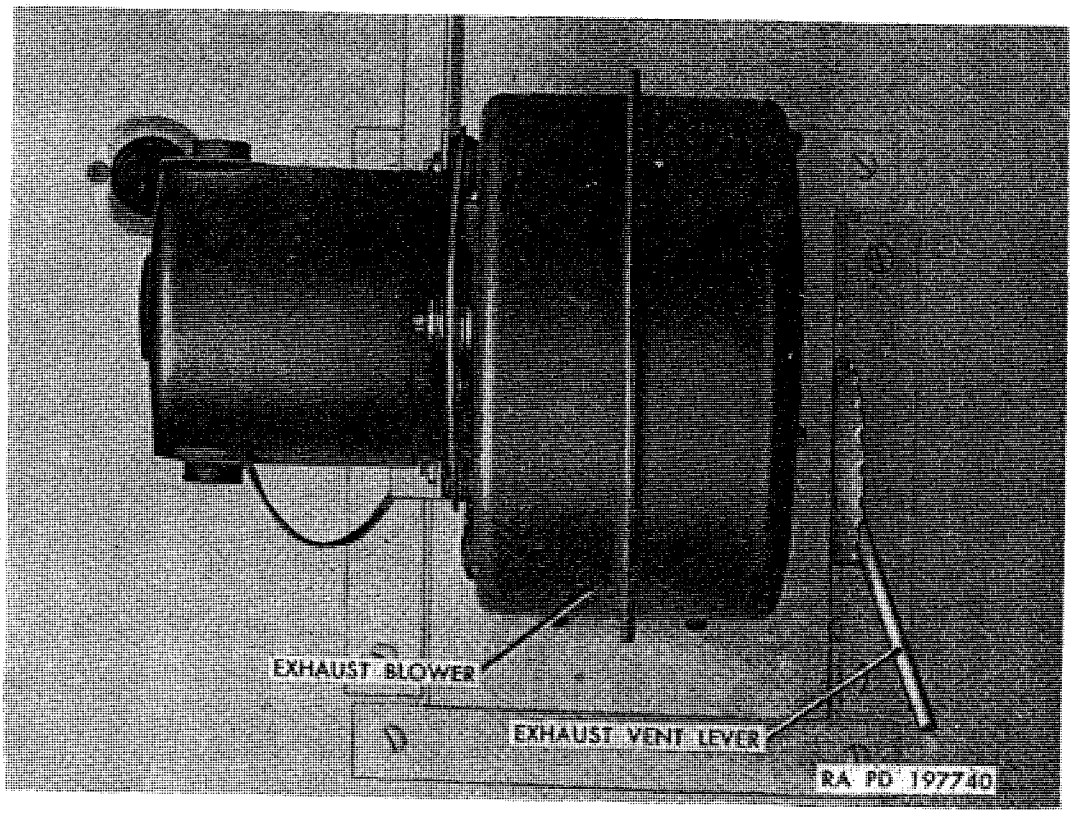


Figure 70. Exhaust blower installed.

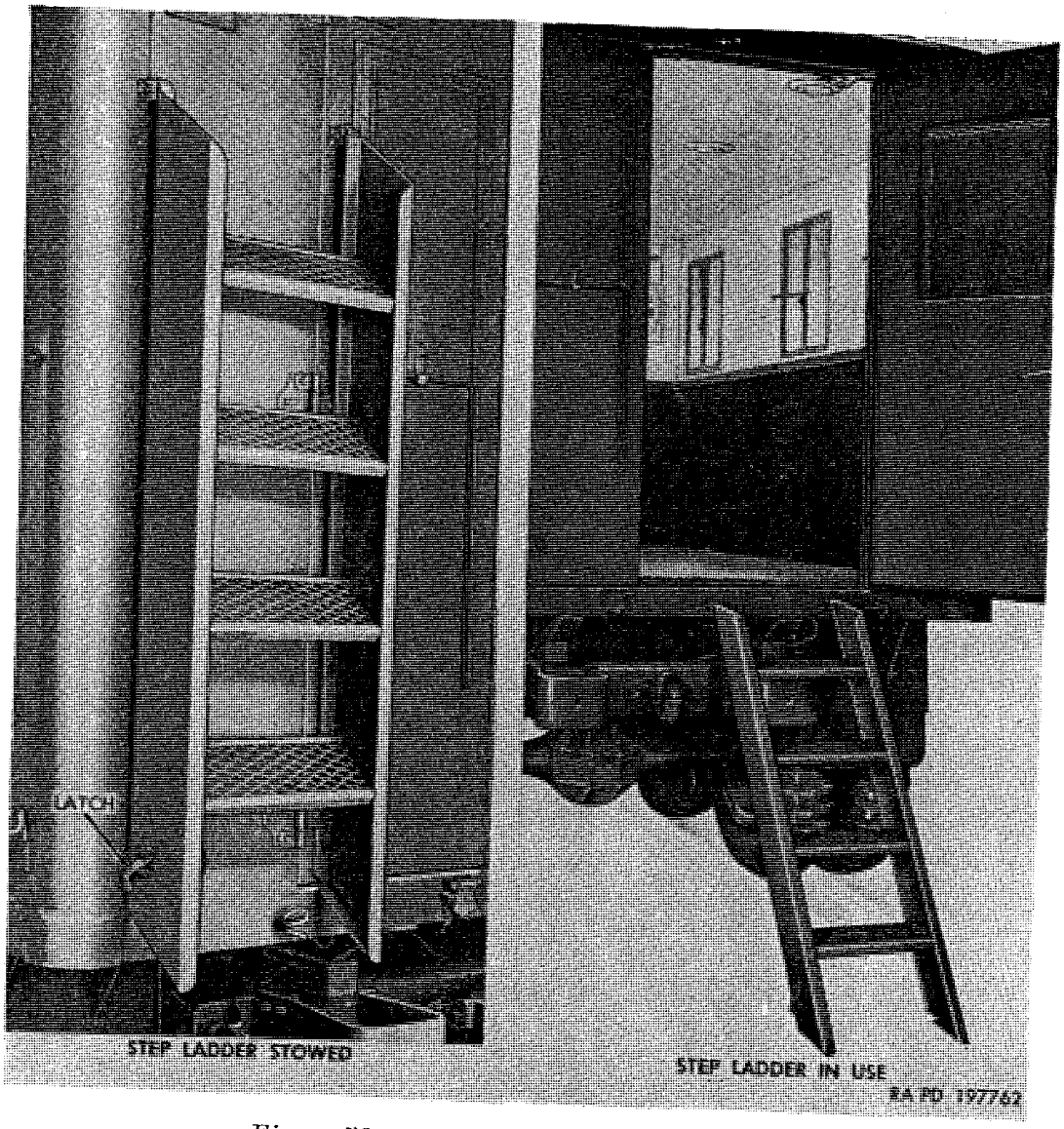


Figure 73. Stepladder stowed and in use.

g. Use of Windows.

(1) *Positioning blackout panels* (fig. 74). Blackout panels must be manually positioned over side, rear, and front windows from outside of vehicle. The side window panels and entrance door window panels must be pushed up to cover window or pulled down to uncover. Front window blackout panel slides sideways.

(2) *Positioning side windows* (fig. 75). Side window sash can be opened to varied degrees by unhooking control arm ring from control arm hook at top of screen. Pull down on slide bolt ring and push control arm until slide bolt engages a hole in control arm at desired opening. To close window, pull down on slide bolt ring to disengage control arm, and then pull control arm completely in. Position control arm to hook arm ring to arm hook at top of screen.

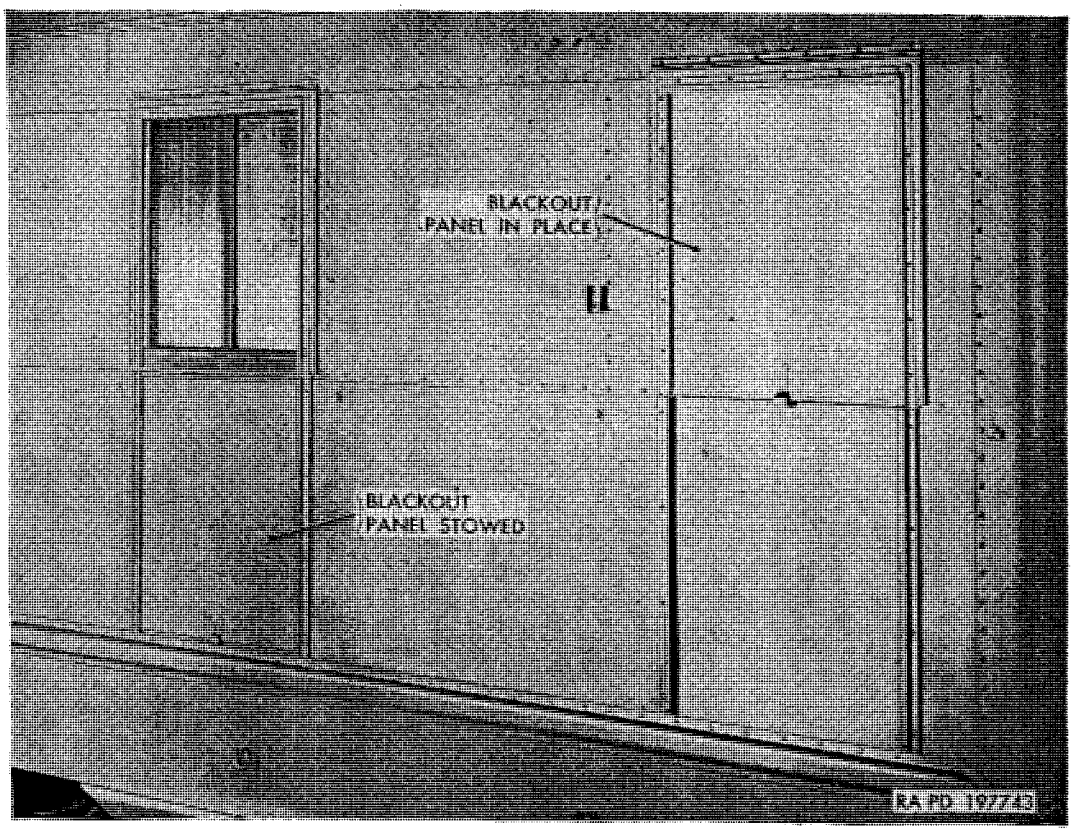


Figure 74. Side window blackout panels in use.

58. Fire Extinguisher Operation

a. Carbon-Tetrachloride-Type.

(1) *General.* On some vehicles, a carbon-tetrachloride fire extinguisher is mounted inside cab at right side below instrument board.

(2) *Operation.* Remove fire extinguisher from bracket. Turn handle to left to unlock; then pump handle in and out. Direct spray at source of flame. Extinguish one section of fire completely before attempting to extinguish another. Report use of extinguisher for refill.

Caution: Action of carbon-tetrachloride on flames produces a toxic gas. Avoid exposure to fumes. Do not use liquid for cleaning purpose. Avoid getting liquid on skin.

b. Carbon-Dioxide-Type.

(1) *General.* On gasoline tank truck M217, two carbon-dioxide fire extinguishers are mounted in brackets on body walkway, one at left rear and one at right front adjacent to spare water can brackets. These extinguishers are 5-pound capacity and must be weighed to determine extent of existing charge.

(2) *Operation.* Remove from bracket. Raise horn to direct extinguisher gas to base of flame. Pull trigger, breaking seal, to discharge. After discharge, cylinder should be weighed

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, Lubricants, and Antifreeze Compounds (Storage, Handling, and Use).

(1) The operation of equipment at arctic temperatures will depend to a great extent upon the condition of the fuels, lubricants, and antifreeze compounds used in the equipment. Immediate effects of careless storage and handling or improper use of these materials are not always apparent, but any deviation from proper procedures may cause trouble at the least expected time.

(2) In arctic operations, contamination with moisture is a 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 temperature. Other impurities will also contaminate fuels and lubricants so their usefulness is impaired.

(3) Refer to TM 9–2855 for detailed instruction on storage, handling, and use.

61. Extreme Cold Weather Operation

a. Starting Engine. These instructions are for starting the engine under extreme cold weather conditions on vehicles equipped with primer pump.

(1) Before attempting to start engine, various controls must be positioned as described in paragraph 37*a* (2). Turn ignition switch lever to on position.

(2) Leave choke control in full open position (knob pushed in) until engine starts.

(3) Pull primer pump knob out and push completely in three times, then depress accelerator treadle to floor and engage starter. Continue to pump primer pump while starter is cranking engine until engine starts.

(4) As soon as engine starts, pull out choke control knob to position necessary to keep engine running.

b. Driving Vehicle.

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

(2) The driver must be very cautious when placing the vehicle in motion after a shutdown. Thickened lubricants may cause failure of parts. Tires frozen to the ground or frozen to the shape of the flat spot while underinflated must be con-

sidered. One or more brakeshoes may be frozen fast and require preheating to avoid damage to the braking surfaces. After warming up the engine thoroughly, place transmission to F–2 in LOW RANGE and drive vehicle slowly about 100 yards, being careful not to stall the engine. This should heat transmission and tires to a point where normal operation can be expected.

(3) Constantly note instrument readings. If instrument reading consistently deviates from normal, stop the vehicle and investigate the cause. If temperature gage reading consistently exceeds 220° F., adjust flap on radiator winter front cover to admit more air.

c. At Halt or Parking.

(1) When halted for short shutdown periods, the vehicle should be parked in a sheltered spot out of the wind. If no shelter is available, park so that the vehicle does not face into the wind. For long shutdown periods, if high ground is not available, prepare a footing of planks or brush. Chock in place if necessary.

(2) When preparing a vehicle for shutdown periods, place control levers in the neutral position to prevent them from possible freezing in an engaged position. Freezing may occur when water is present due to condensation.

Note. On water tank truck M222, drain tank compartments as described in paragraph 53*f*.

(3) Clean all parts of the vehicle of snow, ice, and mud as soon as possible after operation. Refer to table IV for detailed after-operation procedures. If the winter front and side covers are not installed, be sure to protect all parts of the engine and engine accessories 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 heater is present, the battery should be removed and stored in a warm place.

(5) Refuel immediately in order to reduce condensation in the fuel tanks. Prior to refueling, open fuel tank drains and drain off any accumulated water.

(6) Correct tire inflation pressure is prescribed in paragraph 258*b*.

(7) When drain plugs have been removed or drain cocks opened to remove liquid from the cooling system of any equipment, the drains will be inspected to be sure none are obstructed.

(1) If water tank truck M222 is to be forded, make certain that heater gate valve (fig. 60) is closed (par. 53*e*).
(2) Do not exceed the known fording limits of the vehicle.
(3) The engine must be operated at maximum efficiency before attempting to ford.
(4) Shift transmission into F–2 in LOW RANGE. Enter the water at low engine speed. After submersion, increase engine speed. Should the engine stall while submerged, it may be started in the usual manner.
(5) All normal fording should be at speeds of from 3 to 4 mph to avoid forming a "bow wave." If the ford is deep enough for the spinning fan blades to catch water, loosen the fan belt before crossing, otherwise, they may throw water over the electrical units. The brakes will usually be "lost" but in some cases may "grab" after emergence. Applying the brakes a few times after dry land has been reached will help dry out the brake linings.
(6) If accidental complete submersion occurs, the vehicle will be salvaged, temporary preservation applied as outlined in paragraph 73, and then sent to the ordnance maintenance unit as soon as possible for necessary permanent maintenance.

c. Deepwater Fording. Refer to TM 9–2853 for general information, descriptions, and methods of use of deepwater fording kits, and for general procedures for the operation of vehicles so equipped.

d. After Fording Operations. Immediately after vehicle emerges from water, if tactical situation permits, accomplish maintenance operations listed in paragraph 372. Open all drain holes in cargo bodies. 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. Also, any *small* amount of water which has entered the crankcase either through leakage or due to condensation will usually be dissipated by the ventilation system.

Note. On water tank truck M222, open the heater gate valve (fig. 60) as described in paragraph 53*e*.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

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

65. General

Tools, equipment, and spare parts are issued to the using organization for maintaining the materiel. Tools and equipment should not be used for purposes other than prescribed and, when not in use, should be properly stored in the chest and/or roll provided for them.

66. Parts

Spare parts are supplied to the using organization for replacement of those parts most likely to become worn, broken, or otherwise unserviceable providing replacement of these parts is within the scope of organizational maintenance functions. Spare parts, tools, and equipment supplied for the vehicles listed in paragraph 4*a* are listed in Department of the Army Supply Manual ORD 7 SNL G–749, which is the authority for requisitioning replacements.

67. Common Tools and Equipment

Standard and commonly used tools and equipment having general application to this materiel are authorized for issue to 1st echelon by ORD 7 SNL G–749. Common tools and equipment for 2d echelon are listed in ORD 6 SNL J–7, sections 1, 2, and 3; ORD 6 SNL J–10, section 4; and are authorized for issue by TA and TOE.

68. Special Tools and Equipment

Certain tools and equipment (figs. 76 and 77) specially designed for operation and organizational maintenance, repair, and general use with the materiel, are listed in table III for information only. This list is not to be used for requisitioning replacements.

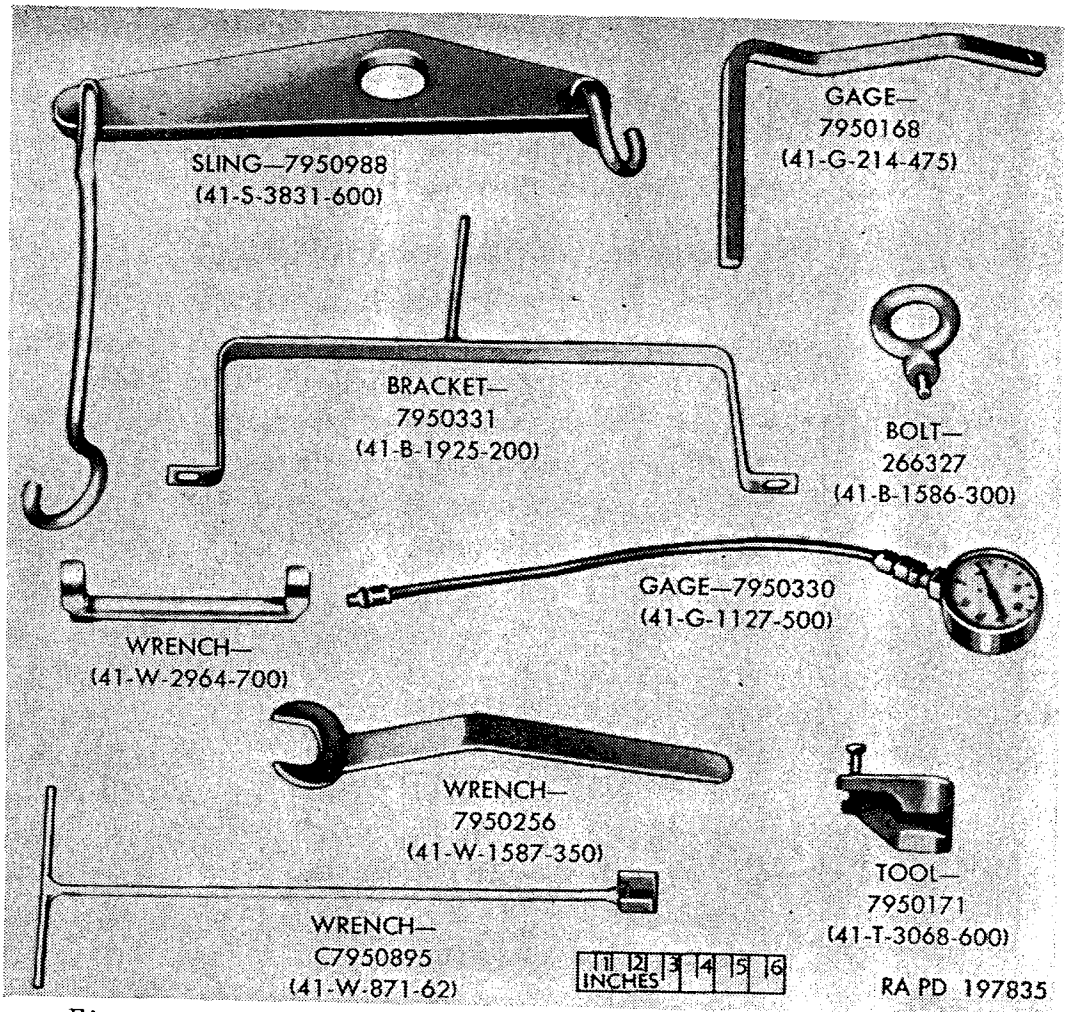
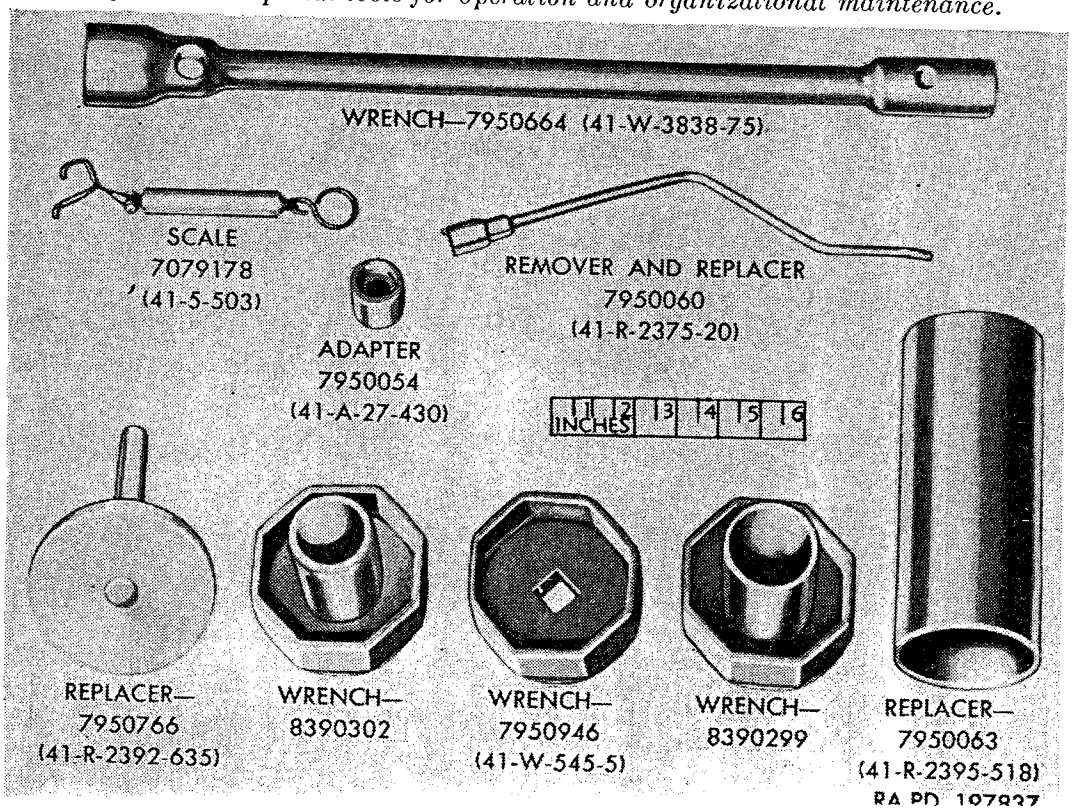


Figure 76. Special tools for operation and organizational maintenance.



Section II. LUBRICATION AND PAINTING

69. Lubrication Chart

Lubrication chart (figs. 78, 79, and 80) prescribes cleaning and lubricating procedures as to locations, intervals, and proper materials for this vehicle. That lubrication which is to be performed by ordnance maintenance personnel is listed on the chart in the notes. See Pam. 310–4 for current lubrication order.

70. General Lubrication Instructions

a. General. Any special lubricating instructions required for specific mechanism or parts are covered in the pertinent section.

b. Usual Conditions. Service intervals specified on the lubrication chart are for normal operation and where moderate temperature, humidity, and atmospheric conditions prevail.

c. Lubrication Equipment. Each vehicle is supplied with lubrication equipment adequate for its maintenance. Clean this equipment both before and after use. Operate the lubricating guns carefully and in such a manner as to insure a proper distribution of the lubricant.

d. Points of Application.

(1) Lubricating fittings, grease cups, oilers, and oilholes are shown in figures 81 through 90 and are referenced to the lubrication chart. Wipe these devices and the surrounding surfaces clean before and after lubricant is applied.

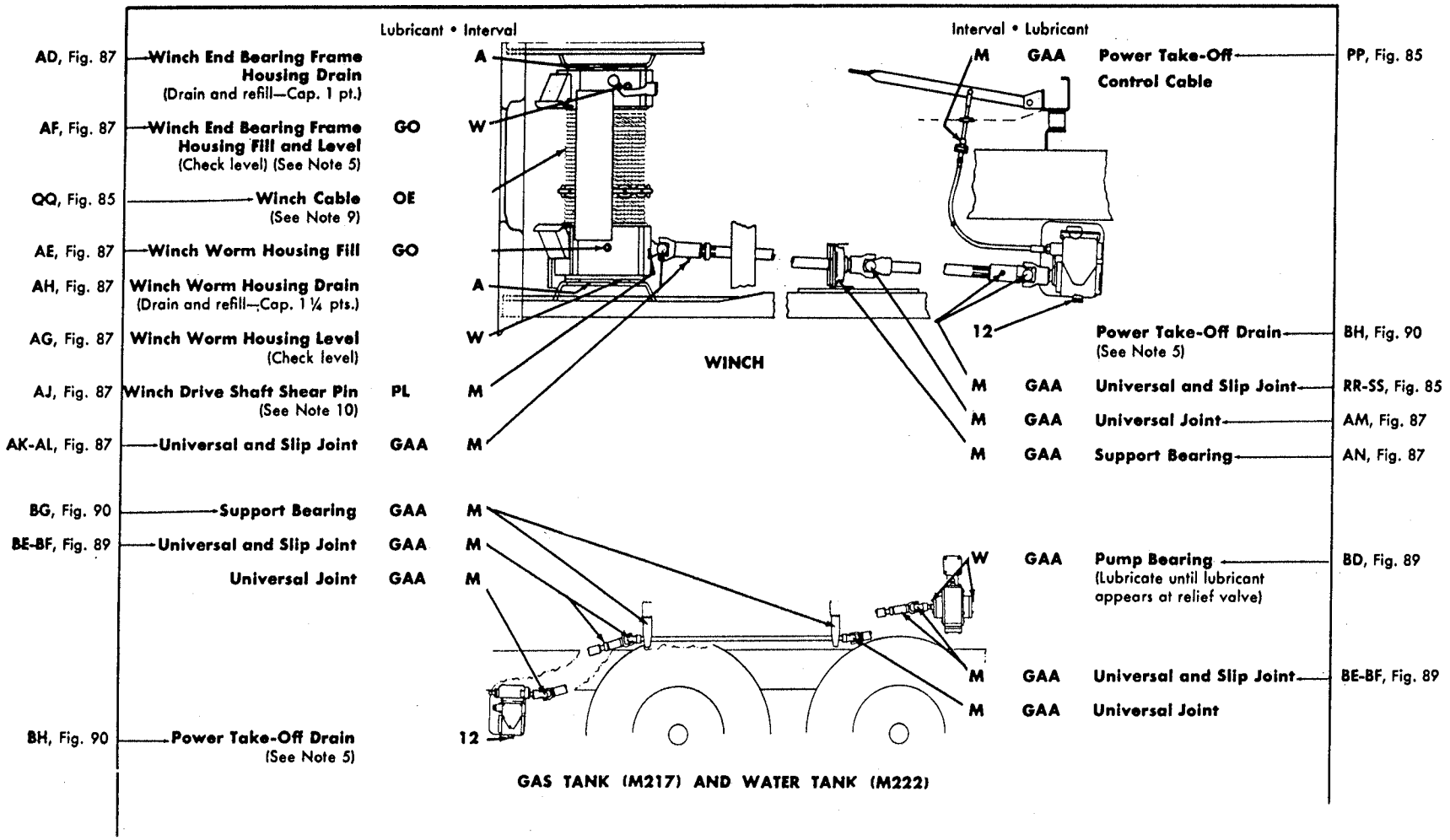
(2) A ¾-inch red circle should be painted around all lubricating fittings and oilholes.

(3) Clean and lubricate unsealed bearings as in (*a*), (*b*), and (*c*) below.

(*a*) Wash all of the old lubricant out of the bearings and from the inside of the hubs with volatile mineral spirits or dry-cleaning solvent and dry the parts thoroughly.

Caution: Bearings must not be dried or spun with compressed air. See TM 37–265 for care and maintenance of bearings.

(*b*) Pack the bearings by hand or with a mechanical packer, introducing the lubricant carefully between the rollers. Do not smear grease only on the outside of the bearings and expect it to work in. Great care must be exercised to insure that dirt, grit, lint, or other contaminants are not introduced into the bearings. If the bearings are not to be installed immediately after repacking, they should be wrapped in clean oilproof paper to protect them from contaminants.


Lubricant • Interval
Interval • Lubricant
AD, Fig. 87
Winch End Bearing Frame Housing Drain
(Drain and refill—Cap. 1 pt.)
A
AF, Fig. 87
Winch End Bearing Frame Housing Fill and Level
(Check level) (See Note 5)
GO
W
QQ, Fig. 85
Winch Cable
(See Note 9)
OE
AE, Fig. 87
Winch Worm Housing Fill
GO
AH, Fig. 87
Winch Worm Housing Drain
(Drain and refill—Cap. 1 ¼ pts.)
A
AG, Fig. 87
Winch Worm Housing Level
(Check level)
W
AJ, Fig. 87
Winch Drive Shaft Shear Pin
(See Note 10)
PL
M
AK-AL, Fig. 87
Universal and Slip Joint
GAA
M
WINCH
M
GAA
Power Take-Off Control Cable
PP, Fig. 85
12
Power Take-Off Drain
(See Note 5)
BH, Fig. 90
M
GAA
Universal and Slip Joint
RR-SS, Fig. 85
M
GAA
Universal Joint
AM, Fig. 87
M
GAA
Support Bearing
AN, Fig. 87
BG, Fig. 90
Support Bearing
GAA
M
BE-BF, Fig. 89
Universal and Slip Joint
GAA
M
Universal Joint
GAA
M
W
GAA
Pump Bearing
(Lubricate until lubricant appears at relief valve)
BD, Fig. 89
M
GAA
Universal and Slip Joint
BE-BF, Fig. 89
M
GAA
Universal Joint
BH, Fig. 90
Power Take-Off Drain
(See Note 5)
12
GAS TANK (M217) AND WATER TANK (M222)

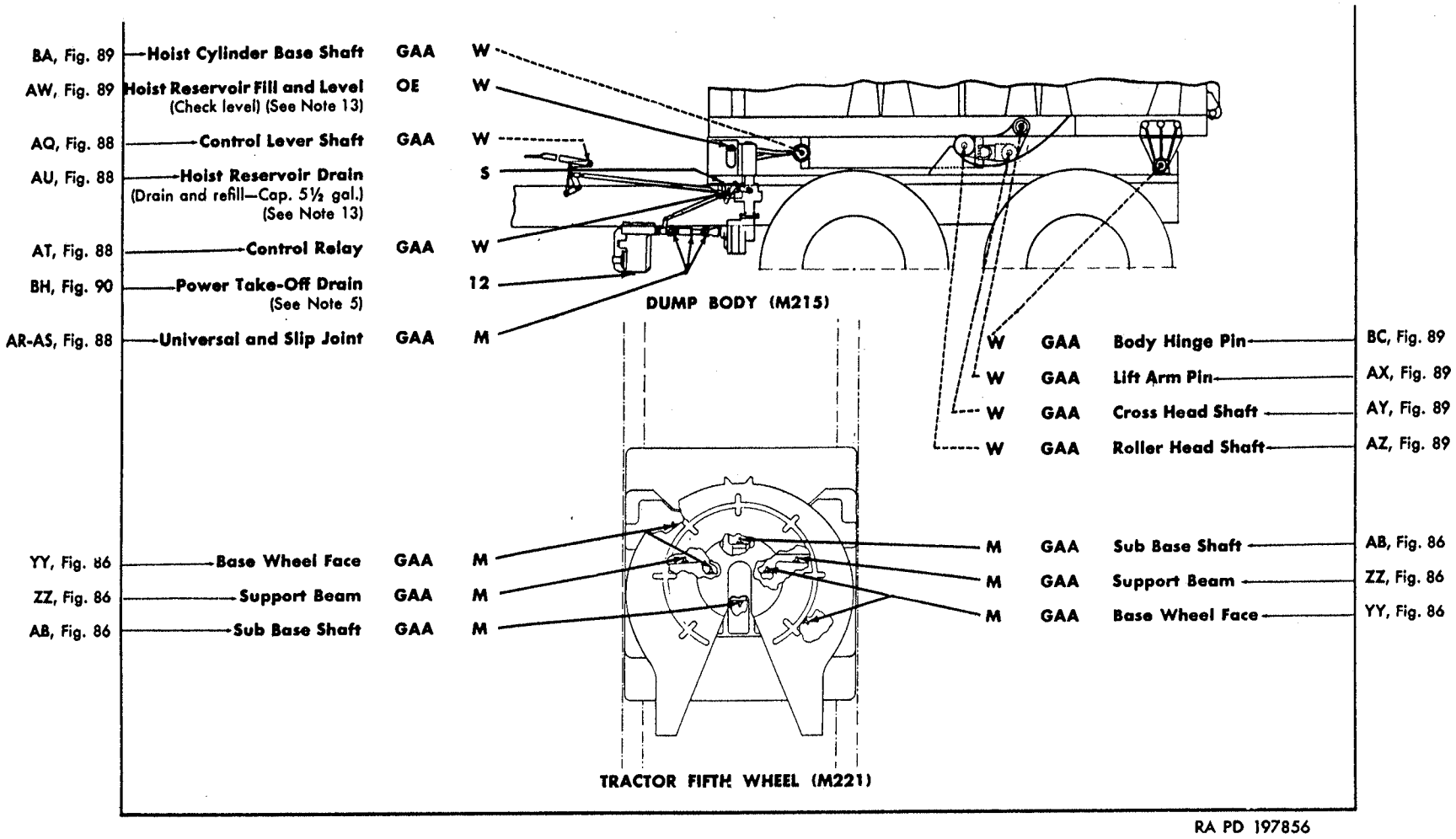


Figure 79. Sheet 2 of lubrication chart showing auxiliary equipment points.

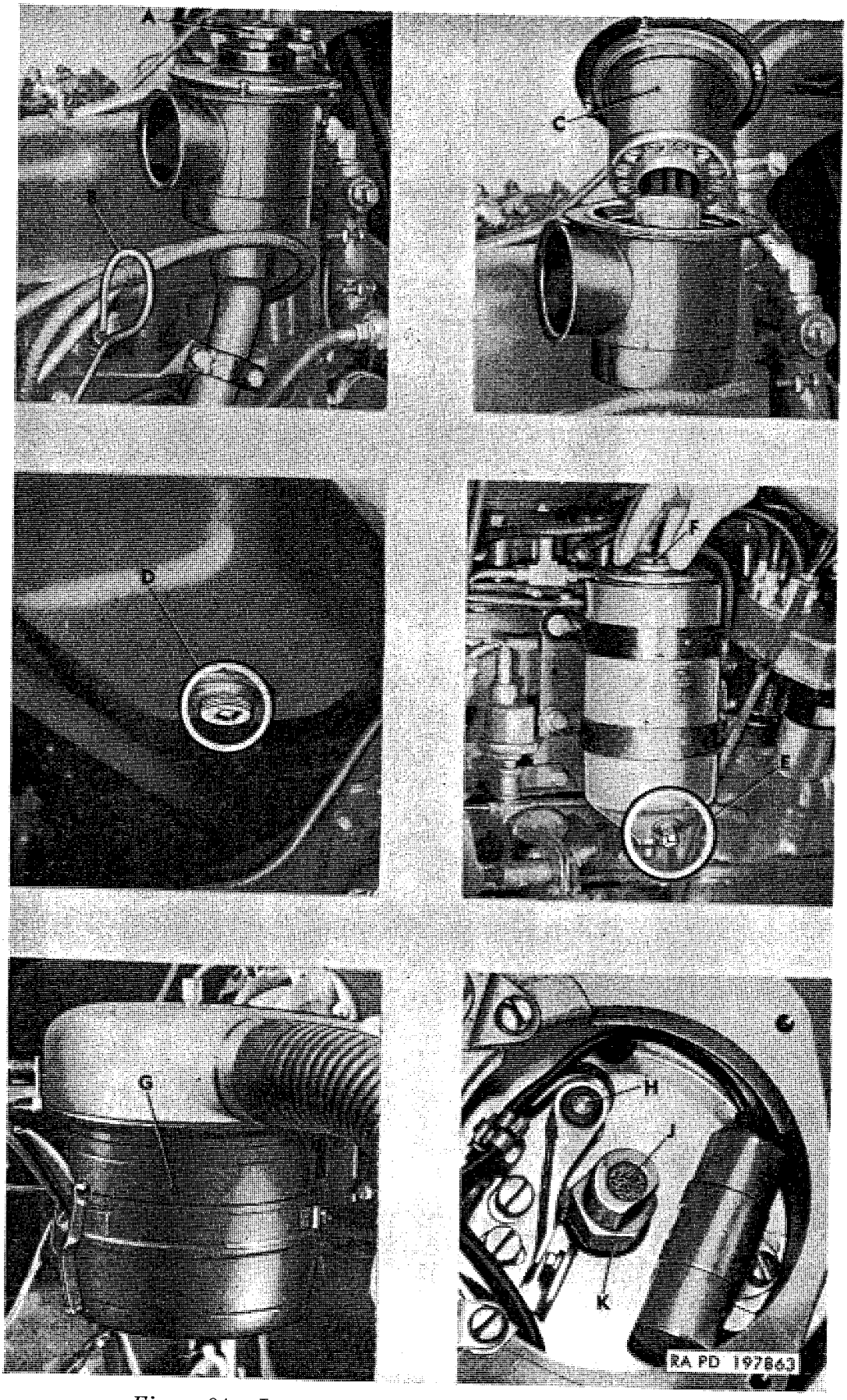


Figure 81. Localized lubrication points—A through K.

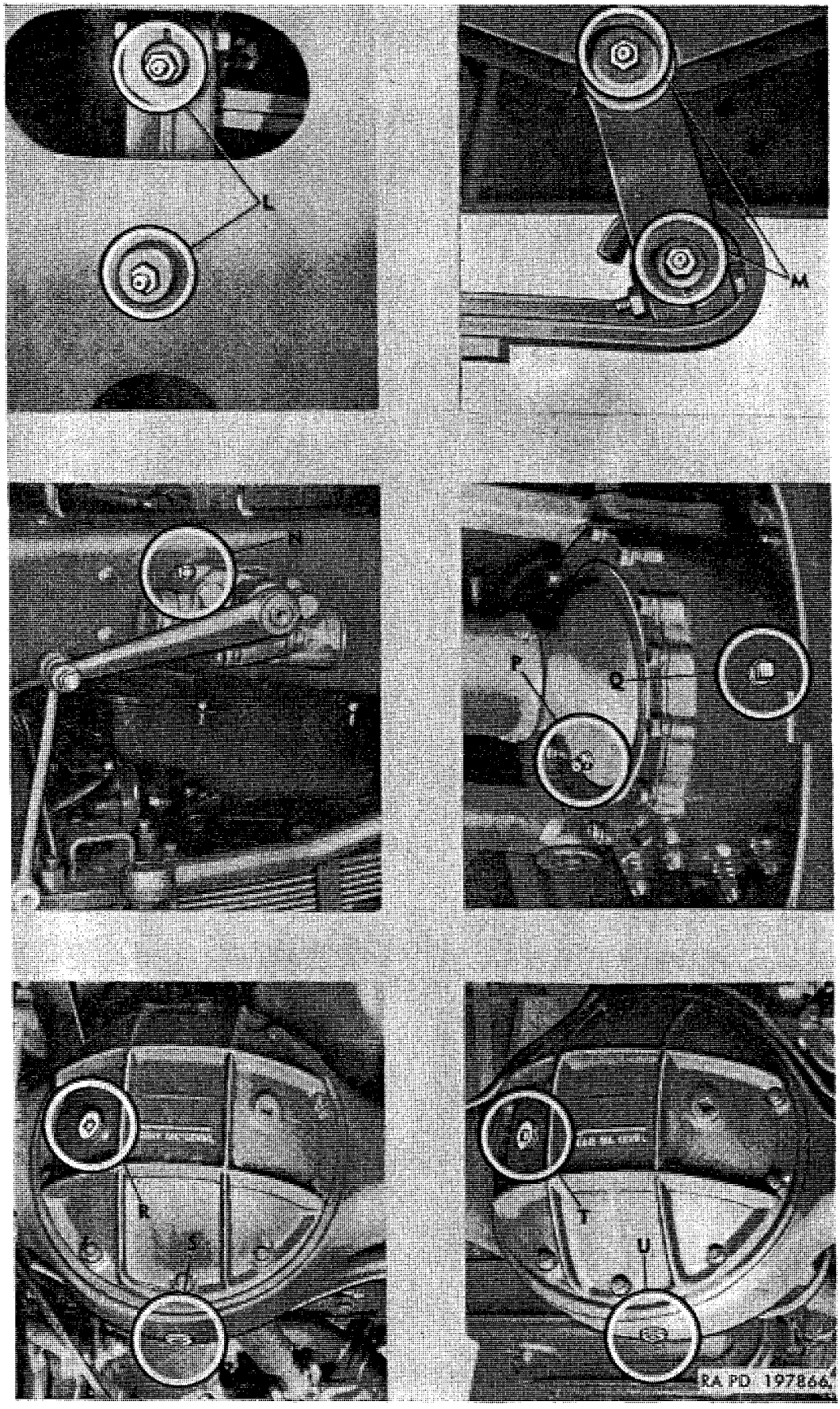


Figure 82. Localized lubrication points—L through U.

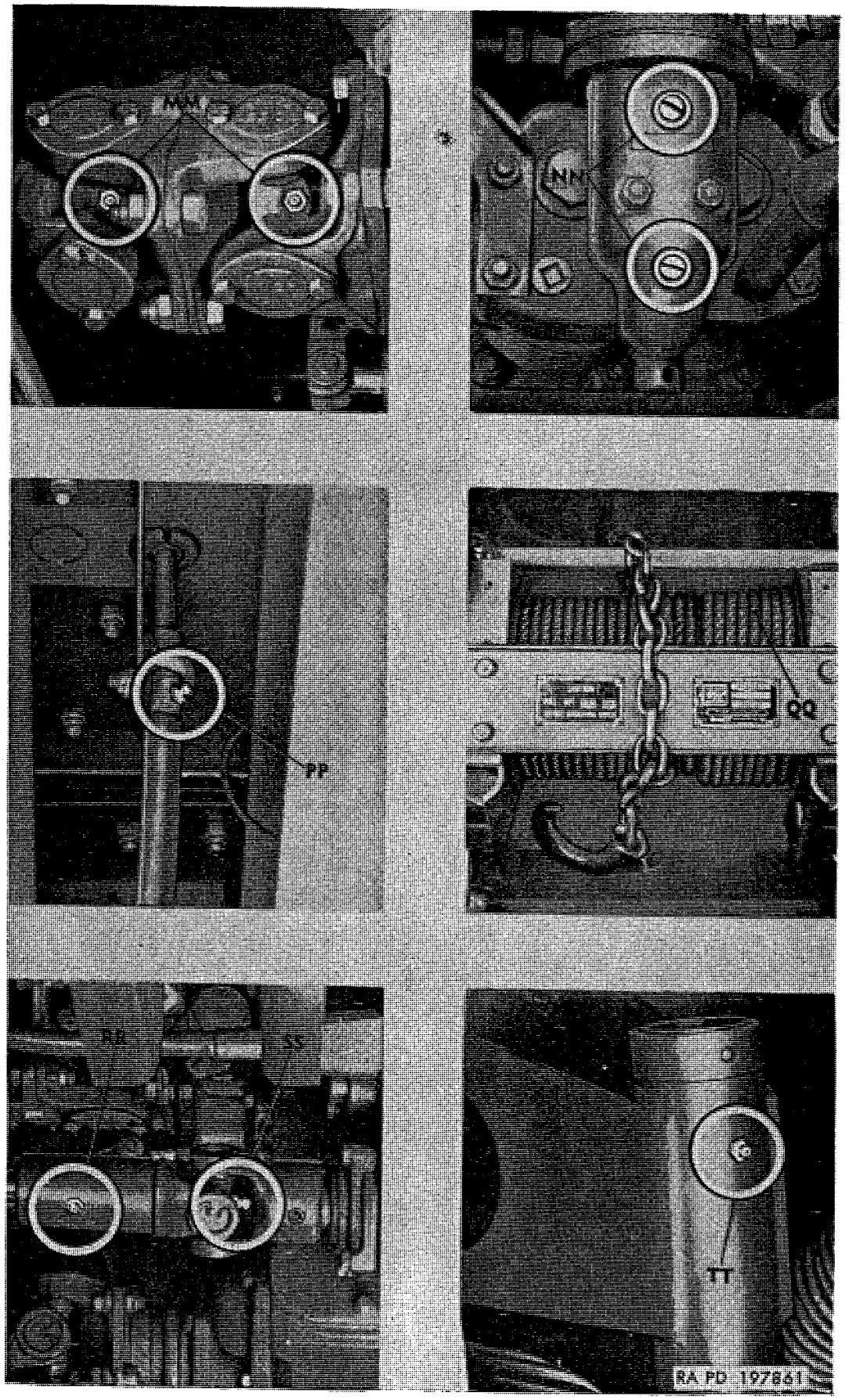


Figure 85. Localized lubrication points—MM through TT.

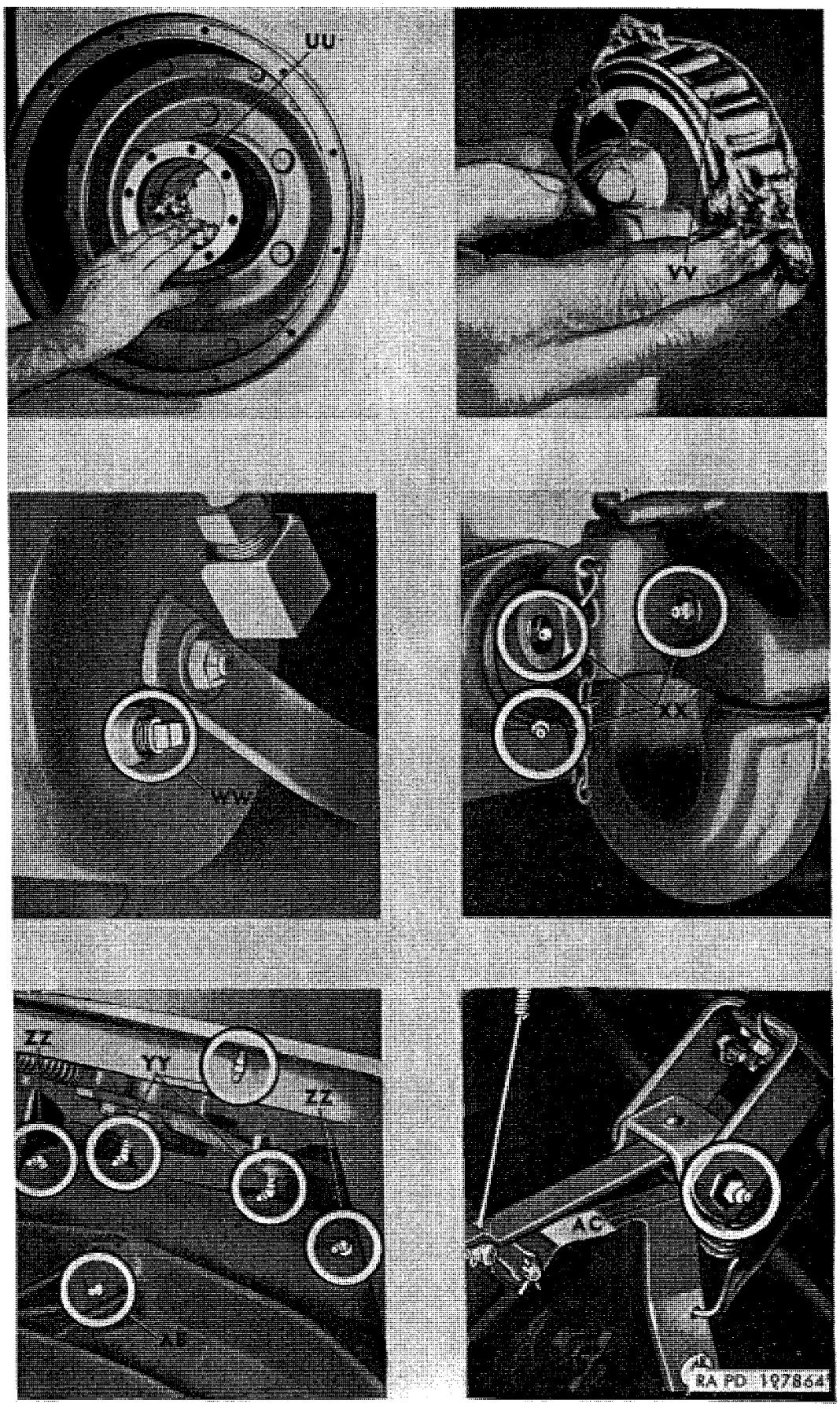


Figure 86. Localized lubrication points—UU through AC.

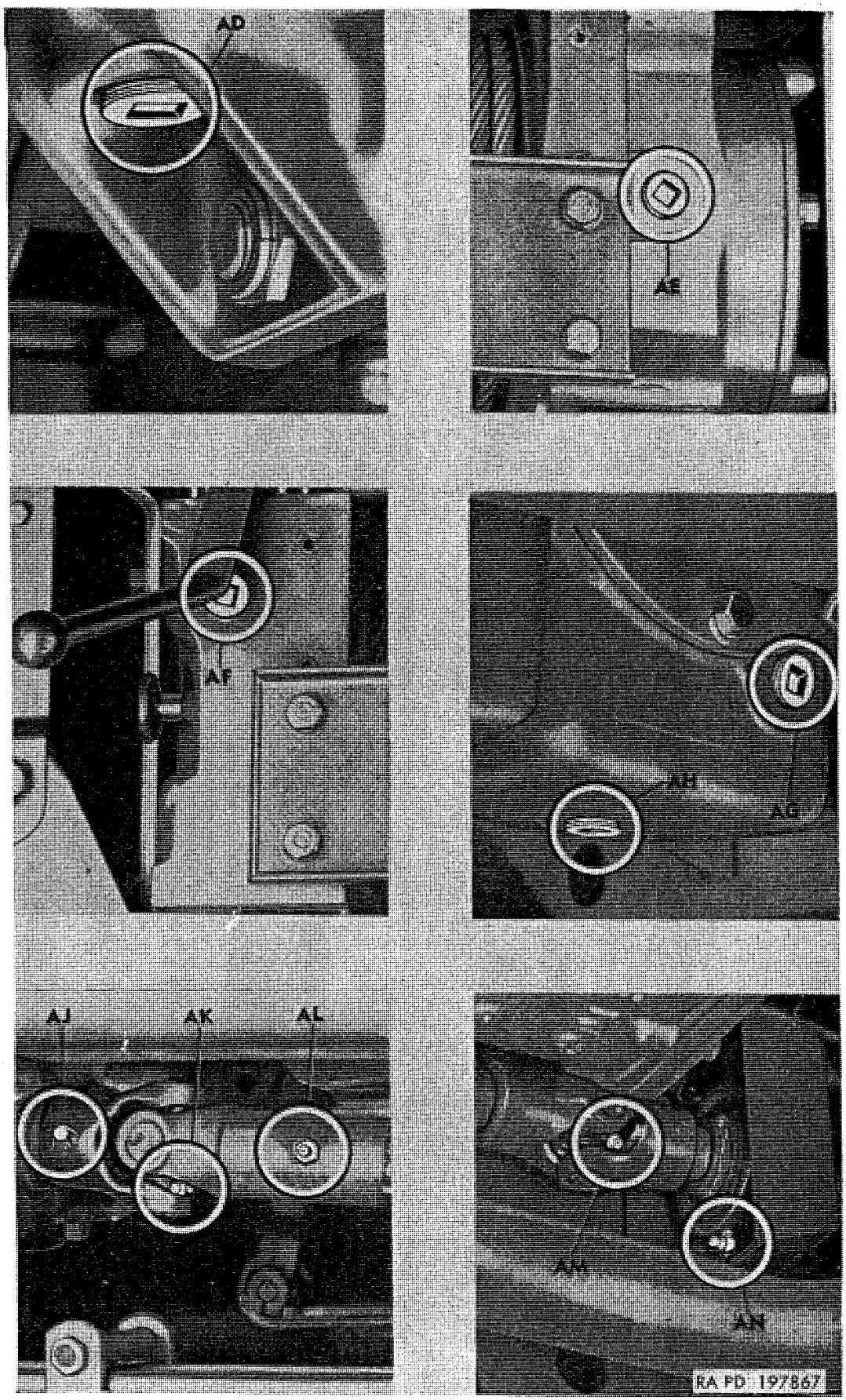


Figure 87. Localized lubrication points—AD through AN.

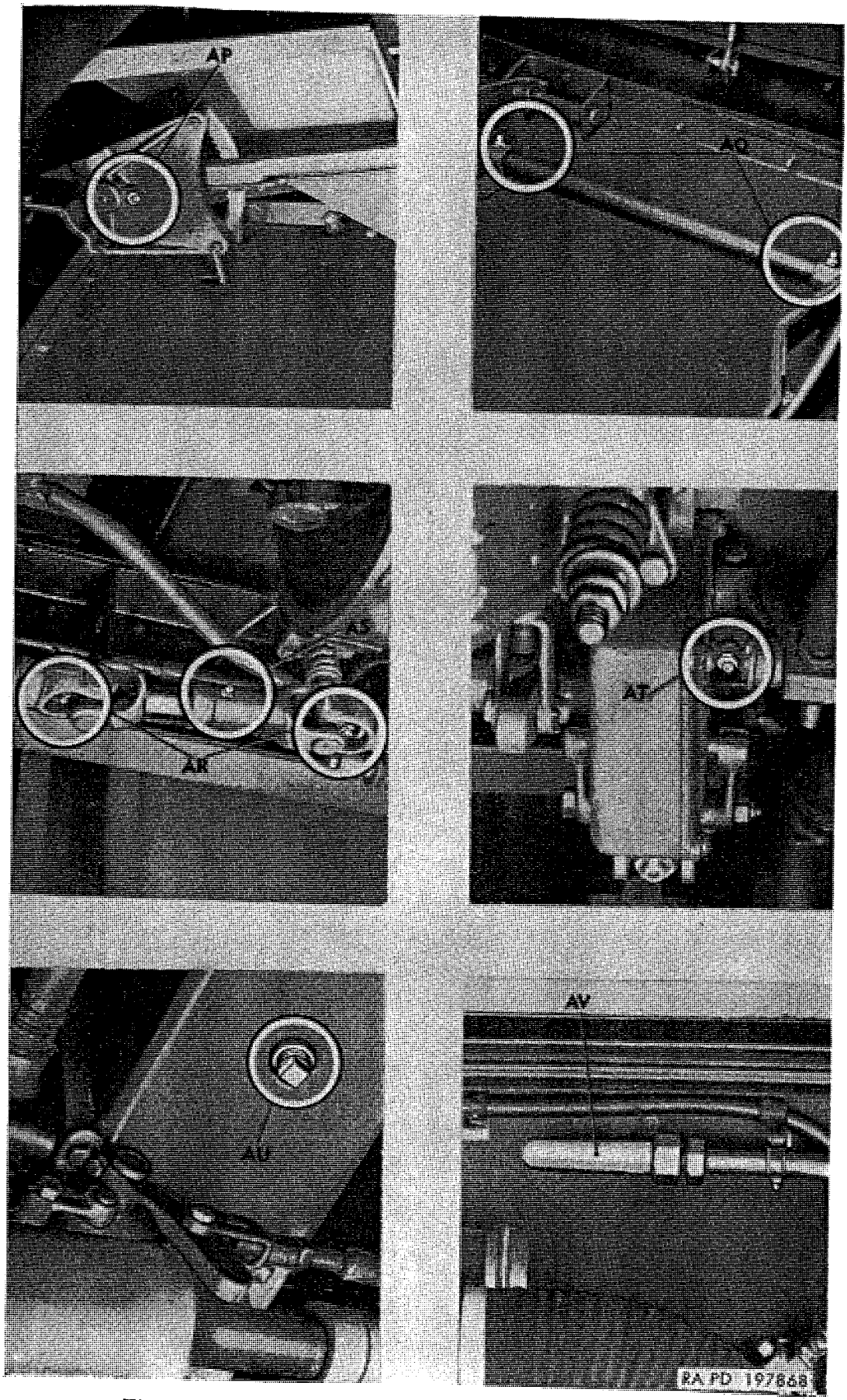


Figure 88. Localized lubrication points—AP through AV.

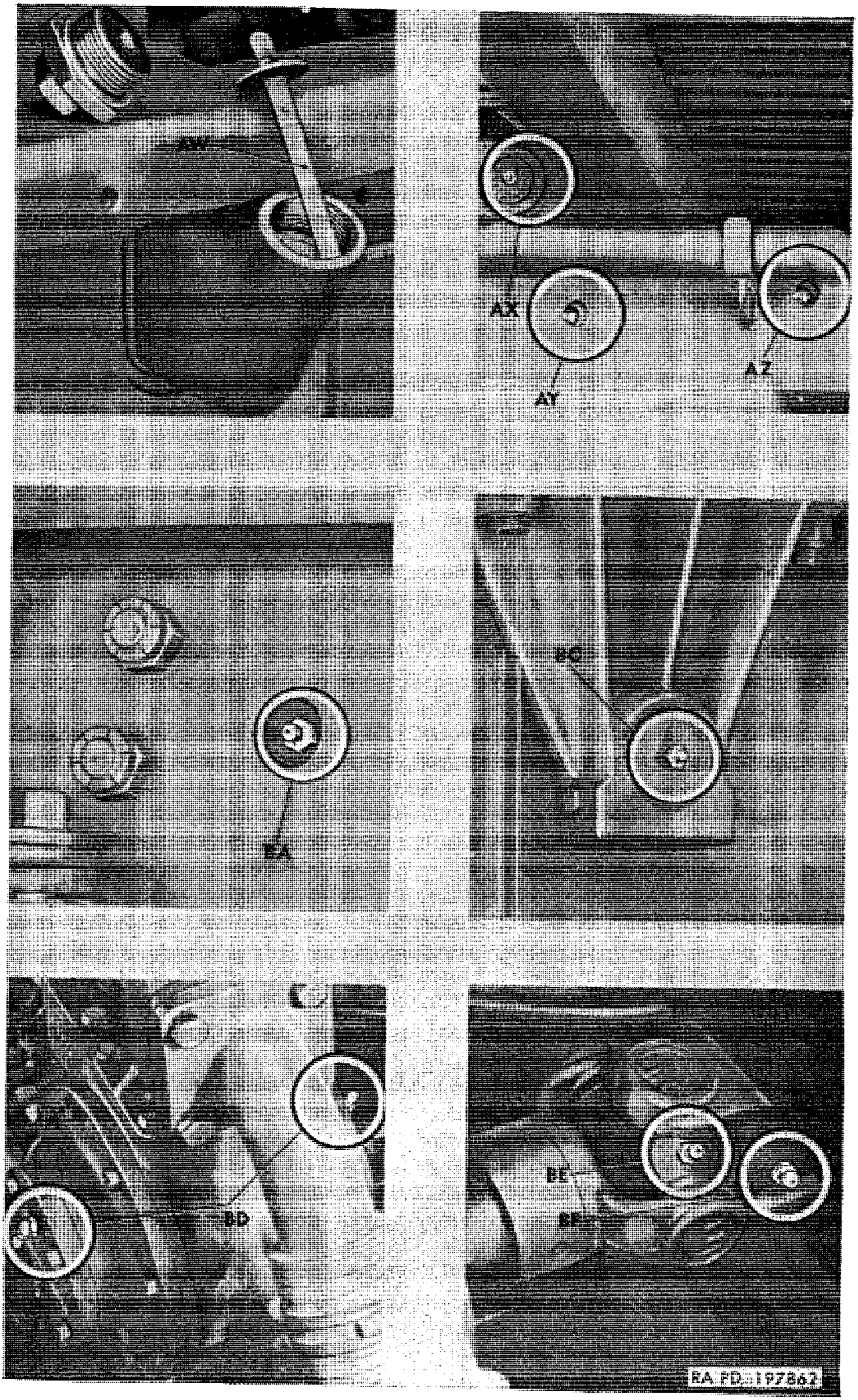


Figure 89. Localized lubrication points—AW through BF.

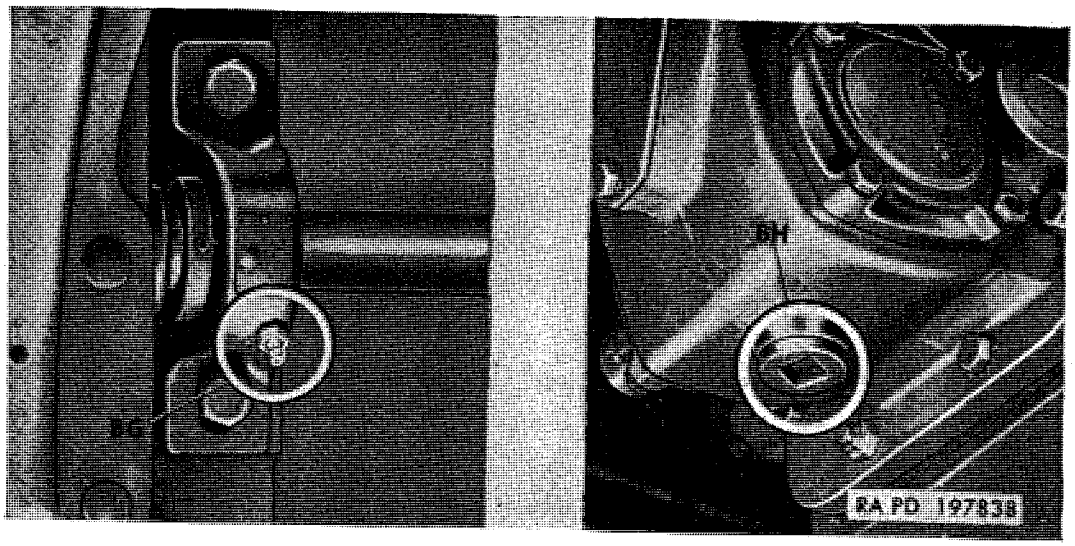


Figure 90. Localized lubrication points—BG and BH.

(*c*) After the wheel bearings are properly lubricated, cover inside of hub and outside of steering knuckle (front) or axle housing (rear) with a thin layer of lubricant (not over one-eighth of an inch) to prevent rusting.

Note. For normal operation, lubricate wheel bearings at 12,000 miles or at annual intervals, whichever comes first.

e. Reports and Records.

(1) Report unsatisfactory performance of prescribed petroleum fuels, lubricants, or preserving materials, using DA Form 468.

(2) Maintain a record of lubrication of the vehicle on DA Form 461, Preventive Maintenance Service and Inspection for Wheeled and Half-Track Vehicles.

f. Specific Lubrication Information. In addition to information given in lubrication chart notes (fig. 80), more detailed procedures on the cleaning and/or lubricating of some units are included in respective sections as in (1) through (15) below.

(1) *Engine crackcase.* Checking, draining, and filling (par. 108).

(2) *Engine oil filter* (E and F, fig. 81). Draining and element replacement (par. 109).

(3) *Crankcase breather* (C, fig. 81). Cleaning and refilling (par. 114*c*).

(4) *Chassis unit cleaner* (AV, fig. 88). Cleaning (par. 136*d*).

(5) *Carburetor air cleaners* (G, fig. 81). Cleaning and refilling (par. 134).

(6) *Transmission.* Checking, draining, and filling (par. 194).

(7) *Transfer.* Checking, draining, and filling (par. 207).

(8) *Front axle.* Checking, draining, and filling (par. 217).

(9) *Rear axles.* Checking, draining, and filling (par. 224).

(10) *Pillow block.* Checking and filling (par. 233*d*).

(11) *Wheel hub bearings.* Removal, cleaning, and installation (par. 266).
(12) *Shock absorbers.* Adding fluid (par. 277*b*).
(13) *Winch shearpin.* Replacement and lubrication (par. 314).
(14) *Winch.* Cable, worm housing, and end frame housing (par. 315).
(15) *Dump body fluid system.* Checking, draining, and filling (par. 325).

71. Lubrication Under Unusual Conditions

a. Unusual conditions. Reduce service intervals specified on the lubrication order, that is, 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, mud, or dust, immersion in water, or exposure to moisture. Any of these operations or conditions may cause contamination and quickly destroy the protective qualities of the lubricants. Intervals may be extended during inactive periods commensurate with adequate preservation.

Note. Operation in mud requires that spring shackle pins, propeller shaft universal joints, and slip joints be lubricated immediately before and after such operation, and every 4 hours during sustained operation under these conditions.

b. Changing Grade of Lubricants. 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 temperature 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.

c. Maintaining Proper Lubricant Levels. Lubricant levels must be observed closely and necessary steps taken to replenish in order to maintain proper levels at all times.

72. Lubrication for Continued Operation Below 0° F.

Refer to TM 9–2855 for instructions on necessary special preliminary lubrication of the vehicle, and to TB 9–2855–1 for instructions on installation of the winterization kit.

73. Lubrication After Fording Operations

a. After any fording operation, in water 12 inches or over, lubricate all chassis points to cleanse bearings of water or grit as well as any other points required in accordance with paragraph 372.

b. If the vehicle has been in deep water for a considerable length of time or was submerged beyond its fording capabilities, precau-

tions must be taken as soon as practicable to avoid damage to the engine and other vehicle components, as in (1), (2), and (3) below.

(1) Perform a complete lubrication service.

(2) 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. 109).

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

(3) Operation in bodies of salt water enhances the rapid growth 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.

74. Lubrication After Operation Under Dusty and 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.

75. Painting

Instructions for the preparation of the materiel 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. Materials for painting are listed in ORD 7 SNL G–749.

Section III. PREVENTIVE MAINTENANCE SERVICES

76. General

a. Responsibilities and Intervals. Preventive maintenance services are the responsibility of the using organization. These services consist generally of daily operators services (daily "A" services) performed by the operator or crew, and of biweekly services (biweekly "B" services) performed by the crew (under supervision of the squad, section, and platoon leaders); and of scheduled services to be performed by organizational maintenance personnel ("C" and "D" services). Intervals are based on normal operations. Reduce inter-

vals 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 conditon, correctly assembled or stowed, secure, not excessively worn, not leaking, and adequately lubricated.*

(1) The 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.

(2) The inspection of a unit to see that it is "correctly assembled or stowed" is usually an external visual inspection to see whether it is in its normal assembled position in the vehicle and if all its parts are present and in their correct relative positions.

(3) Inspection of a unit to determine if it is "secure" is usually an external visual examination or a check by hand-pull, wrench, screwdriver, or pry-bar for looseness. Such an inspection must include any brackets, lockwashers, locknuts, locking wires, cotter pins, connecting tubes, hoses, or wires 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. Excessive wear of mating parts or linkage connections is usually evidenced by too much play (lash or lost motion). It includes illegibility as applied to markings, data and caution plates, and printed matter.

77. Cleaning

a. General. Any special cleaning instructions required for specific mechanism or parts are contained in the pertinent section. General cleaning instructions are as in (1) through (5) below.

(1) Nameplates, caution plates, and instruction plates made of steel rust very rapidly. When they are found to be in a rusty condition, they should be thoroughly cleaned and heavily coated with an application of lacquer.

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

(3) A solution of one part grease-cleaning compound to four parts of 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.

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

(5) Before installing new parts, remove any preservative material, such as rust-preventive compound, protective grease, etc.; prepare parts as required (oil seals, etc.); and for those parts requiring lubrication, apply the lubricant prescribed in the lubrication chart (par. 69).

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. Use only in well ventilated places.

(2) These cleaners 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.

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

(4) The use of diesel fuel oil, gasoline, or benzine (benzol) for cleaning is prohibited.

78. Preventive Maintenance by Driver or Operator

a. Purpose. To insure efficient operation, it is necessary that the vehicle be systematically inspected at intervals every day it is operated and also biweekly, 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 driver or operators to correct must be reported at the earliest opportunity to the designated individual in authority.

b. Services. Driver or operator's preventive maintenance services are listed in table IV. Every organization must thoroughly school its personnel in performing the maintenance procedures for this vehicle as set forth in this manual.

Table IV. Drivers or Operators Preventive Maintenance Service

INTERVALS					PROCEDURE
Daily "A"				*Biweekly "B"*	
Before-operation	During-operation	At-the-halt	After operation		
					USUAL CONDITIONS
					Caution: Place all tags describing condition of vehicle in the driver's compartment in a conspicuous location so that they will not be overlooked.
X	----	X	X	X	*Fuel, oil, and water.* Check level of fuel in tank (par. 33). Add fuel if necessary (par. 132*b*) and note any indication of leaks. Check oil level and add oil if necessary (par. 108). Check transmission oil level and add oil if necessary (par. 194).
					Note. Transmission oil level cannot be checked until engine is operating as described in paragraph 194.
					Check coolant level and add water if necessary (par. 142*a*). If water is added in cold weather, test solution with a hydrometer to determine if there is sufficient antifreeze.
X	----	----	----	X	*Tires.* Gage tires for proper pressure (par. 258*b*). Spare must be properly secured in carrier (par. 262).
		X	X	X	Remove penetrating objects such as nails or glass. Remove stones from between duals. Note any apparent signs of low pressure, unusual wear, or missing valve caps.
X	----	X	X	X	*Leaks, general.* With engine running, and coolant at operating temperature, check under the vehicle and in the engine compartment for any indication of leaks.
X	----	----	----	----	*Vehicle equipment.* Visually inspect fire extinguishers (where used) and vehicle publications, including Standard Form 91 and DD Form 518.
				X	See that fire extinguishers (when used) are charged and sealed (par. 58).
X	----	----	X	X	Operate lights (par. 45), horn (if tactical situation permits), and windshield wipers. Visually inspect mirrors, reflectors, towing connections, paulins, and other mounted equipment.
X	X	----	----	----	*Instruments.* Observe for normal readings during warmup and during operation of the vehicle (par. 38).
					Caution: If it is necessary to add water to a radiator while the engine is overheated, run the engine at idling speed and slowly add the water.
	X	----	----	----	*General operation.* Be alert for any unusual noises or improper operation of any of the vehicle controls, including mounted equipment such as winch, water tank and gasoline tank pump, and dump body hoist.

Table IV. Drivers or Operators Preventive Maintenance Service

INTERVALS					PROCEDURE
Daily "A"				*Biweekly "B"*	
Before-operation	During-operation	At-the-halt	After operation		
					USUAL CONDITIONS—Continued
		X	X	X	*Operating faults.* Investigate and correct or report any faults noted during operation. Refer to paragraphs 80 through 106 for operating faults and remedies.
		X	X	X	*Springs and suspension.* Check springs for abnormal sag, broken or shifted leaves, loose or missing rebound clips, "U"-bolts, or shackles. Check shock absorbers for loose mounting, damage, or leaks. Check torque rods for distortion or looseness. Check rear spring seats for leaks.
			X	X	*Air tanks.* Drain air tanks (par. 249).
			X	X	*Lubricate.* Lubricate items specified on lubrication chart (par. 69).
			X	X	After deepwater fording, continuous fording of streams, or operation during wet weather over muddy terrain, check the gearcases for any evidence of emulsification of oil due to accumulation of moisture.
			X	X	*Clean.* Clean glass, vision devices, and inside of vehicle. Wipe off exterior of vehicle.
				X	Wash vehicle, clean engine and engine compartment.
				X	*Batteries.* Clean batteries and add necessary water (par. 159). Inspect terminals for corrosion, tightness, and coating of grease.
				X	*Assemblies and belts.* Check all assemblies such as carburetor, generator, regulator, starter, and water pump for loose connections and mountings. Check adjustment of fan belt (par. 145*b*). Check adjustment of air compressor belt (par. 247*a*).
				X	*Electrical wiring.* Check all accessible wiring, and ascertain that it is securely connected and supported, that insulation is not chafed or cracked, and that conduits and shielding are in good condition and secure. Report any unserviceable wiring.
				X	*Unit vents.* Axle housings, master cylinder, fuel tank, transfer, and transmission are vented through lines connected to gallery on right side of frame. Check vent connections for looseness at units and at vent gallery. Clean chassis unit breather at cowl (par. 136).

79. Preventive Maintenance by Organizational Maintenance Mechanics

a. Intervals. The indicated frequency of the prescribed preventive maintenance services is considered a minimum requirement for normal operation of 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 drivers or operators should accompany vehicle and assist the mechanics while periodic organizational preventive maintenance services are performed. Ordinarily, the driver should present the vehicle for a scheduled preventive maintenance service in a reasonably clean condition.

c. Special Services. These are indicated by the item numbers in the columns which show the intervals which the services are to be performed, and show that the parts or assemblies are to receive certain mandatory services. For an 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 in (1) through (5) below.

(1) *Adjust.* Make all necessary adjustments in accordance with instructions contained in the pertinent section of this manual, information contained in changes to the subject publication, or technical bulletins.

(2) *Clean.* Clean the unit as outlined in paragraph 77 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 not appear 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 elements.

(5) *Tighten.* All tightening operations should be performed with sufficient wrench torgue (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 lockwashers, locknuts, locking wire, or cotter pins to secure the tightened nut.

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 the 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. DA Form 461. The numbers of the preventive maintenance procedures that follow are identical with those outlined on DA Form 461. Certain items on the form that do not apply to this vehicle are not included in procedures in this manual. In general, the sequence on the form is followed, but in some instances their is deviation for conservation of the mechanic's time and effort:

f. Procedures. Table V 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 for designated intervals of every 1,000 miles ("C" service) and 6 months or 6,000 miles, whichever occurs first ("D" service). Very often it will be found that a particular procedure does not apply to both scheduled intervals. 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 operations indicated opposite the number.

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services

INTERVALS		PROCEDURE
"C" (Every 1,000 miles)	"D" (6 months or 6,000 miles, whichever occurs first)	
		INSPECTION AND ROAD TEST
		Note. When the tactical situation does not permit a full road test, perform those items which require little or no movement of vehicle. Test of mounted equipment such as water and gasoline tank pumping equipment, and dump truck hoist mechanism can be accomplished during actual use of such equipment.
3	3	*Before operation. Fuel, water, oil, antifreeze, tires, instruments, leaks, general visual inspection of vehicle and equipment.* Perform the *before-operation* services outlined in table IV.
		Engine—idle, acceleration, power, noise, and governed speed. In warming up the engine (par. 38), observe if it starts easily and if the action of choke and hand throttle are satisfactory. Note if idling speed is correct. Listen for any unusual noises at idle and higher speeds.
		Note. Perform item 6 during warmup period.
		When operating the vehicle, note if it has normal power and acceleration. Listen for any unusual noises when engine is under load. Speed up the vehicle on a level stretch to see if it will reach, but not exceed, the specified governed speed (fig. 31).

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services—Continued

INTERVALS		PROCEDURE
"C" (Every 1,000 miles)	"D" (6 months or 6,000 miles, whichever occurs first)	
		INSPECTION AND ROAD TEST—Continued
1	1	*Dash instruments, switches, and gages, oil pressure, voltmeter, temperature, ignition switches, and other controls.* *Oil pressure gage.* Observe oil pressure (par. 38*d*) under all conditions of engine speed. *Battery-generator indicator.* Observe the indicator before starting engine and during operation (par. 29). *Speedometer.* Watch the speedometer for proper operation, excessive fluctuation, and unusual noises that might indicate worn or damaged gears or cable. Note if accumulating mileage is recording satisfactorily. *Temperature gage.* Note the temperature gage and see if it indicates in the normal range (pars. 30 and 38*c*). The temperature should increase gradually during warmup period. Temperatures between 160° and 220° F. are satisfactory for normal operation. If temperature rises above 220° F. during warmup or during operation, stop engine and determine cause. Below normal temperature after a reasonable warmup may indicate a stuck thermostat (par. 147*c*). *Fuel gage.* Observe whether the fuel gage indicates the approximate level of fuel in the tank.
6	6	*Air pressure—buildup, governor, cutoff, and low-pressure indicator.* *Buildup.* During the warmup period, run engine about one-third throttle and observe if the air pressure builds up at a normal rate. *Governor cutoff.* Pressure should build up to 100 psi before governor cuts off to stop compressing action. Governor should cut in again when pressure drops to 75 to 80 psi. *Low-pressure indicator.* Reduce the pressure sufficiently to see if the low-pressure buzzer operates when pressure drops to 60–65 psi, and if buzzer will stop when pressure builds up over that amount. *Leaks.* Inspect for leaks in the airbrake system by stopping the engine when the air pressure is at a maximum and noticing if there is any appreciable drop on the air-pressure gage within 1 minute.
2	2	*Horns, mirrors, and windshield wipers.* Sound horn to see if signal is normal (if tactical situation permits). Test windshield wipers for satisfactory operations. Examine mirrors and reflectors.

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services—Continued

INTERVALS		PROCEDURE
"C" (Every 1,000 miles)	"D" (6 months or 6,000 miles, whichever occurs first)	
		INSPECTION AND ROAD TEST—Continued
4	4	*Steering—free-play, bind, wander, shimmy, side pull, column and wheel.* With the vehicle moving straight-ahead, see if the steering wheel has excessve free-play and if there is any tendency to wander, shimmy, or pull to the side. Turn the steering wheel through its entire range and note any bind. Examine steering column and steering wheel.
7	7	*Brakes—(foot, hand, and trailer)—braking effect, feel, side pull, noise, chatter, pedal travel, hand control.* *Brakes, service.* Make brake application at about 20 mph to determine if vehicle stops evenly and quickly. Note if pedal has a spongy feel indicating the necessity of bleeding brakes (par. 237). Note if pedal reserve travel is less than two inches indicating necessity of brakeshoe adjustment (par. 238). Make several stops noting side pull, noise, chatter, or any other unusual conditions (par. 96). *Trailer brake connections and controls.* Check operation of trailer brake control and connections (par. 44). *Parking brake.* Stop the vehicle on an incline; then apply the parking brake and observe if it holds the vehicle effectively, that the application lever has over one-third of its travel in reserve, and that the ratchet and pawl latch the applied brake securely. *Note.* Parking brake should be adjusted when hand lever requires more than three-quarters travel for full application (par. 254). *Temporary parking brake.* Apply temporary parking brake switch (par. 43) and note if it holds vehicle effectively.
8	8	*Generator, starter and switch—action, noise, speed.* When the engine is started, observe whether the general action of the starter is satisfactory, particularly whether it engages and operates without excessive noise and has adequate cranking speed. Remove the generator inspection plug and inspect commutator for dirty condition, roughness, high mica, or thrown solder. If any of these conditions are evident, generator must be replaced (par. 155).
9	9	*Transmission and transfer—lever action, vibration, noise.* *Operation test.* During road test, transmission should be tested as described in paragraph 199. This test includes oil pressure check, upshift and downshift check, and checking for unusual noises. Reference must also be made to trouble-shooting (par. 90) to determine symptoms and references to possible remedies as outlined in table VI.

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services—Continued

INTERVALS		PROCEDURE
"C" (Every 1,000 miles)	"D" (6 months or 6,000 miles, whichever occurs first)	
		INSPECTION AND ROAD TEST—Continued
9	--------	*Adjust front band.* If necessary, adjust transmission front band as described in paragraph 201.
9	9	*Transfer.* With transmission in N position, move transfer lever into UP ENGAGED and DOWN NEUTRAL positions. Drive vehicle with transfer lever in UP ENGAGED position; then attempt to drive vehicle with transfer in DOWN NEUTRAL position to make sure transfer is in neutral.
	9	*Jack up one wheel on each axle.* Run engine with transmission in both forward and reverse positions. Front wheel should revolve and in same direction as rear wheels. Failure of front wheel to turn would indicate defective transfer or maladjusted front axle drive shift linkage (par. 208).
10	10	*Unusual noises—attachments, cab, body and wheels, power train.* Be constantly on the alert for unusual or excessive noises that may indicate looseness, defects, or deficient lubrication in these units.
11	11	*Lamps—head, tail, body, running, directional, stop, and blackout.* During road test, operate main light switch (par. 45) and note if all lamps function at various positions of switch. Also test operation of stoplights. Note whether dimmer switch (par. 45*c*) properly controls headlight beams. Check to see that headlight beams are properly aimed (par. 161*a*). Note condition of all lamps to see that they are in good condition and secure. Check for dirty and broken lenses, or discolored or missing reflectors.
		AFTER ROAD TEST
25	25	*Temperatures—brakedrums, hubs, axles, transmission, transfer, differentials.* Immediately after the road test, feel these units cautiously. Cautiously hand feel all the brakedrums and hubs for abnormal temperature. An overheated wheel hub and brakedrum indicates an improperly adjusted, defective, or dry wheel bearing or a dragging brake. An abnormally cool condition indicates an inoperative brake. Cautiously feel each axle differential and carrier, transmission, and transfer for overheating.
		Note. It is normal for axles and transfer to run quite hot after vehicle has run a considerable distance. If these units are not abnormally hot, and are adequately lubricated, and do not indicate unusual noises, the units can be considered normal.
	25	Inspect axle propeller shafts. Tighten universal-joint flange cap screw nuts (par. 230). Check pillow block mounting stud nuts for looseness (par. 233).

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services—Continued

INTERVALS		PROCEDURE
"C" (Every 1,000 miles)	"D" (6 months or 6,000 miles, whichever occurs first)	
		AFTER ROAD TEST—Continued
26	26	*Leaks—engine oil, fuel, water, axles, housings, transmission, transfer and all other units carrying fluids, oil, or grease.* Make general observations in the engine compartment and underneath the vehicle for oil, water, fuel, and exhaust leaks. Examine axle housings, transmission, and transfer for oil leaks. Examine spark plugs, manifold, and cylinder head gaskets for leaking condition. ***Caution:*** Do not tighten cylinder head or manifold unless there is evidence of looseness or leakage. If the cylinder head requires tightening, use a torque-indicating wrench and tighten in sequence and to the torque indicated in paragraph 110*c*.
27	27	*Lubrication.* Lubricate vehicle in accordance with lubrication chart (par. 69). Coordinate with inspection and disassembly operations to avoid duplication.
27	27	During lubrication, observe whether all valve stems are in good condition, and that all valve caps are present. Replace stem if damaged (par. 260*d*). Examine all tires for cuts, bruises, breaks, and blisters. Remove imbedded glass, nails, or stones from tires. Look for irregular tread wear or any signs of flat spots, cupping, featheredges, and one-sided wear. Examine tires for proper matching (par. 260*c*).
	27	Rotate and match tires according to tread design and degree of wear (par. 260*c*).
	27	Tighten all rear axle shaft flange nuts to correct torque (par. 225*d*). Tighten front axle drive flange nuts to correct torque (par. 221*d* (5)). Examine stud nut dowels on axle flanges for damaged condition.
		MAINTENANCE OPERATIONS
28	28	*Batteries—specific gravity.* Make hydrometer test of electrolyte in each cell (par. 159*b*) and record specific gravity in space provided on DA Form 461. Batteries must be recharged if specific gravity is below 1.225 under normal temperature conditions. Refer to paragraphs 370 and 371 for battery care in extreme cold and hot temperatures.
29	29	*Batteries—voltage.*
		Note. Due to the sealed construction of submersible-type batteries used in these vehicles, high-rate discharge test to determine individual cell voltage cannot be made.

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services—Continued

INTERVALS		PROCEDURE
"C" (Every 1,000 miles)	"D" (6 months or 6,000 miles, whichever occurs first)	
		MAINTENANCE OPERATIONS—Continued
	29	After battery test, bring electrolyte to proper level in each cell (par. 159*d*). Clean entire battery and retainers. Repair or replace retainers if corroded or damaged. Clean battery cable terminals and battery posts. Tighten terminals and retainers. After tightening terminal clamp bolts, coat terminals with grease to retard corrosion. *Note.* If distilled or approved water is not available, clean water, preferably rainwater, may be used.
	34	*Valve mechanism—clearance, cover gaskets.* Gage valve clearance (par. 110) while engine is hot. Adjust if necessary. Rocker arms, shafts, and springs should appear in good condition. Check condition of cylinder head cover gasket. Replace if damaged.
	35	*Spark plugs.* Examine the spark plugs to see that their insulators are in good condition and clean and that there is no leakage around the insulators. When operating conditions require, the spark plugs may be removed for service (par. 124).
	35	Remove and inspect spark plugs (par. 124) for adjustment and condition. Clean and adjust if necessary. Replace damaged plugs. *Note.* While spark plugs are all out, take compression test as described in item 30.
	35	*Distributor.* Observe if distributor and ignition coil housing and external attachments are in good condition and secure. Examine other parts of the distributor as follows: *Cap, rotor, and points.* Remove cover from distributor. Inspect cover, both inside and out, rotor, and breaker plate assembly to see that they are in good condition. Dress distributor points and adjust (par. 123*a*). If distributor points are badly pitted, replace points and capacitor (par. 123*b* and *c*). Also replace rotor if contact is burned. *Shaft.* Test distributor shaft for looseness by hand. *Centrifugal advance.* Install rotor on shaft and note if camshaft can be rotated manually to the normal range of movement which is permitted by the centrifugal advance mechanism. Note if it returns to original position, when released, without binding.

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services—Continued

INTERVALS		PROCEDURE
"C" (Every 1,000 miles)	"D" (6 months or 6,000 miles, whichever occurs first)	
		MAINTENANCE OPERATIONS—Continued
	35	*Coil and wiring.* Examine the coil to see that it is in good condition and that all connections are tight. Install distributor cover, using new gasket if necessary. Check condition of all wiring and connections.
	35	*Ignition timing—initial.* With engine running, use timing light to check initial ignition timing (par. 122*b*). Adjust if necessary. Note if spark advances automatically as engine is accelerated.
	35	*Ignition manual advance.* Manual advance adjustment can be made (par. 122*c*) at time of final road test of vehicle.
	35	*Generating system test.* If the battery-generator indicator in instrument cluster indicates improper charging activity, make system tests as described in paragraph 154. The results of this test determine whether the generator or generator-regulator is at fault.
		Note. When a generator or generator-regulator is replaced, the generator must be polarized before engine is started as described in paragraph 155*d*.
	30	*Compression.* Test compression as described in paragraph 111*a*. Record in space provided on DA Form 461.
	31	*Breather caps and ventilators.* Remove, disassemble, and clean crankcase ventilator valve (par. 114*b*). Clean and refill crankcase breather as explained on lubrication chart (par. 69). Also refer to paragraph 114*c*. Refer to paragraph 136 and check all connections and lines in unit vent system. Clean chassis unit cleaner as described in paragraph 136*d*.
	32	*Radiator—core, shell, mountings, hose, cap, and gasket.* Inspect these items, noticing particularly if the outside of the radiator core is clogged with foreign matter or if fins are bent. Clean dirt and insects from exterior of core as described in paragraph 144*d*.
	32	Check condition of water hoses, lines, and fittings for evidence of cracks, cuts, or deterioration. Make sure that hose clamps are properly located and tightened sufficiently to prevent leaks.
	32	Check coolant level (par. 142). Examine coolant for evidence of contamination. If cleaning is necessary, drain and flush as described in paragraph 144. Refill system (par. 142) using rust-preventive, unless antifreeze containing rust-preventive is used. In cold weather, test coolant with a hydrometer to see if it contains sufficient antifreeze.

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services—Continued

INTERVALS		PROCEDURE
"C" (Every 1,000 miles)	"D" (6 months or 6,000 miles, whichever occurs first)	
		MAINTENANCE OPERATIONS—Continued
	32	If need is indicated, test cooling system (par. 143). Drain and flush if necessary. Tighten radiator mountings (par. 146).
	33	*Water pump, fan, drive belts, and pulley.* Inspect water pump to see if it is in good condition, not leaking, and securely installed. Inspect fan blades to see whether they are in good condition, and properly secured to hub. See that fan shroud is in good condition and securely mounted. Check tensions of water pump drive belt (par. 145) and air compressor drive belt (par. 247). Also check condition of belts. Replace and adjust if necessary.
	36	*Manifold and heat control.* Inspect intake and exhaust manifolds to see that they are in good condition, secure, and that the manifold gaskets are not leaking. If necessary, tighten manifold clamp nuts, exhaust pipe connections, and carburetor connecting flange nuts. Inspect manifold heat control to see that it is in good condition. Set manifold heat control valve for correct seasonal position (par. 135*b*).
37	37	*Carburetor—choke, throttle, linkage, and lines.* Inspect these items, noticing particularly if the shafts and linkage operate freely and are not excessively worn. Observe if the choke valve opens freely when the control is released and if the throttle valve opens fully when the accelerator is fully depressed. Examine fuel line connections for leaks.
	37	*Carburetor idling.* With electric tachometer and vacuum gage, check and adjust carburetor idling speed and mixture (par. 127*b*).
	37	*Vacuum test.* Perform vacuum test (par. 111*b*).
	37	*Fuel pump.* Clean fuel pump filter plates (par. 133*b*). Check fuel pump pressure (par. 133*c*).
	37	*Fuel tank.* Clean fuel tank filler neck screen (par. 132*b*). Drain water and sediment from fuel tank if there is evidence of contamination, using a container to hold the drainings (par. 132*c*). Inspect fuel and vent lines and connections. Tighten if necessary.
	37	*Governor.* Inspect governor seals and see that they are intact. Report improper governor action to proper authority.
	38	*Exhaust pipes and muffler.* Inspect; listen for excessive or unusual noises and look for exhaust leaks.
	38	*Tighten all mountings.*

Note. On the semiannual (or annual) services, the several brake, wheel bearing, and associated items which follow are group services which overlap. Perform these services in the best order for economy of mechanic's time and for orderly reassembly.

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services—Continued

INTERVALS		PROCEDURE
"C" (Every 1,000 miles)	"D" (6 months or 6,000 miles, whichever occurs first)	
		MAINTENANCE OPERATIONS—Continued
	39	*Wheel bearings.* Wheel bearings will be disassembled, cleaned, and repacked *every second* 6,000-mile inspection or *annually.* If the wheel bearings are due for repacking, inspection of brakeshoe mechanism as described below can be accomplished. Disassemble and repack wheel bearings as described in paragraph 266.
		Note. At the annual wheel bearing service, front axle shaft and universal joint can be cleaned and lubricated as described in paragraph 221.
		Brakeshoe mechanism.
		Note. Complete brakeshoe mechanism cannot be inspected or replaced unless brake drum and hub are removed. Brake drums only, however, can be removed (par. 240) for inspection of brake lining condition only. Coordinate the following inspection of brake shoe mechanism with the annual wheel bearing service described above.
	39	Observe whether linings are in good condition, tightly secured to the brakeshoes, in good wearing contact with the drums, free of lubricant or brake fluid, and not excessively worn. The thickness of the linings above the rivet heads at the most worn section should be sufficient until next scheduled inspection. If the linings are badly contaminated with lubricant, replace. If only slightly contaminated, clean thoroughly. See that brakeshoes are in good condition, and guided by the guide bolts and springs, and properly returned against their anchor blocks by the return springs.
	39	*Drum and backing plates.* Inspect drums for excessively worn or scored condition. Check drum mounting stud nuts for tightness (par. 240c). Inspect backing plates for condition. Check tightness of backing plate to axle flange or steering knuckle cap screws and nuts.
	39	*Wheel cylinders.* Inspect rubber boot at each end of wheel cylinder. If boots are deteriorated, or cylinders show sign of leaking, replace cylinders (par. 244). Examine wheel cylinder mounting cap screws and tighten if necessary.
	39	*Brake master cylinder.* Check brake master cylinder mounting and tighten if necessary. Examine push rod boot for leaks and deterioration. See that vent line is in good condition and securely connected.
	39	*Air-hydraulic power cylinder—air lines and cylinder.* See that these items are in good condition and securely mounted. Check for brake fluid leaks. Make sure air lines are securely connected and not leaking.

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services—Continued

INTERVALS		PROCEDURE
"C" (Every 1,000 miles)	"D" (6 months or 6,000 miles whichever occurs first)	
		MAINTENANCE OPERATIONS—Continued
	39	*Air compressor and tanks.* Adjust air compressor governor (par. 246*b*) if found necessary after road test (item 6). Check air compressor and tank mountings for tightness. Drain moisture from tanks.
	39	*Adjust.* Adjust service brakes (par. 238). Tighten rear axle flange stud nuts (par. 225*d*) and front axle drive flange stud nuts (par. 221*d*). Tighten all wheel nuts (par. 259*c*).
	40	*Cab and associated parts.*
		Cab mounting. Inspect cab mounting. Tighten only as described in paragraph 292*b*.
		Roof paulin and rear curtain. Inspect roof paulin and rear curtain. Check condition and lashings.
		Windshield. Check windshield condition. Test positioning adjustments (par. 294*b*).
		Windshield wipers. Check operation of windshield wipers. If necessary to change speed of blades, adjust as described in paragraph 295*b*.
		Seats. Check condition of driver's and companion seats; make certain that seats position correctly (pars. 297 and 298).
		Doors. Check condition of doors, door windows, and window regulators. If doors do not fit correctly, make adjustments (par. 299*b*).
		Cargo body and associated parts (M135 and M211).
		Mountings. Tighten body mountings if necessary (par. 308).
		Top bows and paulins. Inspect top bows and paulins for condition and lashings.
		Racks and seats. See that racks and seats are secure and not broken.
		Dump body (M215).
	40	*Body and subframe mounting.* Inspect mounting springs for proper compressed height and broken coils. Inspect hold-down brackets to be sure they are tight at vehicle frame and subframe (par. 326).
40	40	*Hoist operation.* Operate hoist mechanism though cycle of dumping operations (pars. 50 and 51). Refer to paragraph 104 for trouble symptoms and possible remedies. Refer to paragraphs 323 through 337 for dump hoist maintenance procedures within the scope of organizational maintenance.
		Water tank body and pump mechanism (M222).

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services—Continued

INTERVALS "C" (Every 1,000 miles)	INTERVALS "D" (6 months or 6,000 miles, whichever occurs first)	PROCEDURE
		MAINTENANCE OPERATIONS—Continued
	40	*Body mounting.* Inspect mounting springs for proper compressed height and broken coils (par. 339).
		Note. The frequency of inspection and maintenance of water tank body depends upon the condition of the water being pumped and the frequency of use. The following items must be inspected and maintenance operations applied as described in paragraph 338 through 349.
40	40	*Filler cover strainer.* Inspect filler cover strainer and clean if necessary. Replace filler pipe flange gasket and cover gasket if necessary (par. 341).
	40	*Drain valve screen* (fig. 369). Inspect and clean screen if necessary (par. 343*b*).
	40	*Pump strainer* (fig. 373). Clean pump strainer (par. 344*b*).
	40	*Manhole cover gaskets.* Inspect condition and replace if necessary (par. 340).
	40	*Gasoline tank body and pump mechanism (M 217).* Maintenance on gasoline tank body and pump mechanism is similar to those items shown above for water tank body, with the exception of filler cover strainer with which the gasoline tank body is not equipped. Refer to paragraph 106 for operation troubleshooting. Reference must be made to paragraph 350 through 359 for procedures within the scope of organizational maintenance.
	40	*Shop van body (M220).* Inspect body mounting for tightness. Inspect all doors, latches, windows, and screens for operation and mounting. Refer to paragraphs 360 through 368 for procedures within the scope of organizational maintenance.
	40	*Paint and markings.* Examine condition of paint and legibility of markings, identification, and caution plates.
	42	*Bumpers—front and rear, pintle.* Examine these items including two shackles. Test operation of pintle (par. 46*a*). Lockpin must be attached to chain.
	43	*Fifth wheel—bed plate and holddown bolts.* Inspect these items. See that they are secure and that mounting bolts are tight. Test operation of kingpin lock (par. 56).
		Winch—Power-take-off.
44	44	*Operation.* Test operation of winch (par. 49). Refer to paragraph 103 for operating trouble symptoms and remedial measures.
	44	*Drag brake and automatic brake.* Make drag brake and automatic brake test and adjust if necessary (par. 316).

Table V. Organizational Mechanic or Maintenance Crew "C" and "D" Preventive Maintenance Services—Continued

INTERVALS		PROCEDURE
"C" (Every 1,000 miles)	"D" (6 months or 6,000 miles whichever occurs fisst)	
		MAINTENANCE OPERATIONS—Continued
	44	*Shearpin.* Remove shearpin and clean and lubricate (par. 314).
	44	*Control linkage.* Check power-take-off control linkage for proper operation. Examine winch drive line and see that all parts are secure and in good condition.
	44	*Cable.* Unwind cable (par. 319*b*). Inspect for broken or frayed strands, flat or rusty spots, and kinks. Clean, oil, and rewind as described in paragraph 318.

Section IV. TROUBLESHOOTING

80. Scope

a. This section contains troubleshooting information and tests for locating and correcting some of the troubles which may develop in the vehicle. Troubleshooting is a systematic isolation of defective components by means of an analysis of vehicle trouble symptoms; 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 therefor are 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 in troubleshooting the vehicle. Question vehicle driver or operator 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.

81. Engine

a. Engine Will Not Turn.

(1) *Starter inoperative.* Refer to paragraph 86.

(2) *Incorrect oil viscosity.* Inspect oil. If improper grade, drain crankcase and refill with proper grade oil (par. 108).

(3) *Mechanical seizure of parts.* Notify ordnance maintenance personnel.

b. Engine Turns But Will Not Start.

(1) *Faulty ignition system.* Disconnect cable from one spark plug. Hold spring extending from cable end one-fourth of an inch from cylinder head while cranking engine with starter, with ignition switch turned on. If a spark does not jump the gap between the cable spring and the cylinder head, the ignition system is inoperative.

(2) *Faulty fuel system.* Remove fuel inlet line from carburetor and turn ignition switch on. If free flow of fuel is not evident, fuel is not reaching carburetor. Refer to paragraph 83*d*.

(3) *Inoperative carburetor choke.* Remove air inlet elbow from carburetor. Inspect choke controls for proper operation (par. 128*b*).

(4) *Improper valve adjustment.* Check valve clearance and adjust as required (par. 110).

(5) *Leak at intake manifold or carburetor gaskets.* Pour a small quantity of oil on edges of intake manifold and carburetor gaskets. Crank engine with starter. A sucking sound will be heard if gasket leaks. Replace manifold gasket (par. 112) or carburetor gasket (par. 127).

(6) *Faulty batteries.* Test battery specific gravity (par. 159*c*). Recharge or replace batteries as required.

(7) *Loose or corroded battery or ground cable connections.* Clean and tighten all connections in starting system circuit (fig. 144).

c. Engine Does Not Develop Full Power.

(1) *Faulty ignition.* Refer to paragraph 82.

(2) *Oil temperature too high.* Improper grade or insufficient oil may cause excessive temperatures. Drain and refill with correct grade to proper level (par. 108*d*).

(3) *Engine overheats.* Check cooling system (par. 85).

(4) *Improper valve adjustment.* Check valve clearance and adjust as required (par. 110).

(5) *Sticking valves.* Remove cylinder head cover and apply penetrating oil or kerosene to valve stems. If valves still are not free, replace cylinder head assembly (par. 113).

(6) *Improper grade of fuel.* Use fuel having octane rating of 70 to 72.

(7) *Preignition.* With engine temperature in normal operating range (160° to 220° F.), rapidly accelerate vehicle with transmission in high range. If preignition or spark knock is present, a pinging sound will be heard during at least a portion of the accelerating period. If the correct grade of

fuel is being used and the ignition system (par. 82) is functioning properly, the spark plugs may be of improper heat range or they may be defective. Replace spark plugs (par. 124). If spark plug replacement does not correct the condition, report to ordnance maintenance personnel.

(8) *Leak at intake manifold or carburetor gaskets.* Refer to *b*(5) above.

(9) *Faulty governor operation.* If governor prevents engine from attaining specified governed speed (par. 107*b*), replace carburetor (par. 127) and distributor (par. 123), or notify ordnance maintenance personnel.

(10) *Faulty compression.* Test compression (par. 111*a*). If compression between cylinders varies more than 20 psi, notify ordnance maintenance personnel.

(11) *Dragging brakes.* Adjust brakes (par. 238).

d. Engine Misfires at Idling Speeds.

(1) *Faulty ignition system.* Refer to paragraph 82.

(2) *Faulty compression.* Test compression (par. 111*a*). If compression between cylinders varies more than 20 psi, notify ordnance maintenance personnel.

(3) *Defective spark plugs.* Remove spark plugs and clean and adjust, or replace (par. 124).

(4) *Broken valve springs.* Remove cylinder-head cover and inspect valve springs. If springs are broken, replace cylinder head assembly (par. 113).

(5) Improper valve adjustment. Check and adjust valve clearance (par. 110).

(6) *Defective valves.* Check engine vacuum with vacuum gage (par. 111*b*). Erratic readings at constant engine speed are indicative of defective valves or valve operation. Replace cylinder head assembly (par. 113).

(7) *Leak at intake manifold gasket.* Refer to *b*(5) above.

(8) *Leaking cylinder head gasket.* Tighten cylinder head bolts to specified torque (par. 110*c*). If leak persists, replace cylinder head gasket (par. 113).

e. Engine Misfires at High Speed.

(1) *Incorrect spark plug gap.* Adjust spark plug gap (par. 124*b*).

(2) *Incorrect distributor point opening.* Adjust distributor points (par. 123*a*).

(3) *Incorrect valve adjustment.* Check and adjust valve clearance (par. 110).

(4) *Weak or broken valve springs.* Refer to *d*(4) above.

(5) *Leaking cylinder head gasket.* Refer to *d*(8) above.

(6) *Defective fuel pump.* Test pump (par. 133*c*). Replace pump if necessary.

f. Engine Overheats.

(1) *Faulty cooling system.* Refer to paragraph 85.

(2) *Late ignition timing.* Check ignition timing (par. 122*b*) and make necessary adjustment.

(3) *Lean fuel-air mixture.* Adjust carburetor (par. 127*b*). Inspect for leaks at intake manifold and carburetor gaskets as in *b*(5) above.

g. Excessive Oil Consumption.

(1) *Leaks.* Inspect engine, engine compartment, and ground under engine for oil leaks. Tighten any leaking connections, repair or replace broken lines, or notify ordnance maintenance personnel.

(2) *Engine overheats.* Refer to *f* above.

(3) *Faulty compression.* Refer to *d*(2) above.

(4) *Oil level too high.* Maintain oil at proper level (par. 108).

(5) *Incorrect oil viscosity.* Inspect oil. If improper grade, drain crankcase and refill with proper grade oil (par. 108).

(6) *Excessive vehicle speeds.* Avoid unnecessary and excessive speeds.

(7) *Excessive low range driving.* Operate vehicle in proper range for road and load conditions (par. 40).

82. Ignition System

a. Improper Ignition.

(1) *Defective distributor.* Remove distributor cover and rotor. Inspect cap (inside of cover) and rotor for cracks or carbonized short paths. Clean contacts in cap and clean rotor segment; replace cover or rotor if contacts or segments are burned excessively. Clean and adjust distributor points, or replace if burned (par. 123*a* or *b*). Inspect all cables inclosed by distributor cover for bare wires and loose connections. Replace units having defective cables or tighten connections as necessary.

(2) *Moisture on ignition units.* Disconnect cables from distributor cover and remove cover; wipe inside of towers, interior of cap, cables, coil, and spark plugs with a dry cloth or with a cloth saturated with carbon tetrachloride. Examine units for cause of moisture entry, such as a defective distributor cover gasket, and make the necessary corrections.

(3) *Inoperative ignition secondary circuit.* With rotor and distributor cover installed and cables connected to distributor cover, disconnect cables from all spark plugs. With the ignition switch turned on and starter cranking engine, hold spring

contact extending from end of one cable one-fourth of an inch from cylinder head. If spark jumps the gap from cable to cylinder head, secondary circuit is complete through the cable tested. Test all other cables in same manner. If spark is obtained at one or more, but not all cables, replace cables from which no spark was obtained. If no spark is obtained at any of the six cables, secondary circuit is inoperative. This may be due to defective secondary or primary circuit in ignition coil. Check primary circuit as in (4) (*a*) below. If primary circuit is satisfactory, replace ignition coil (par. 123*d* and *e*).

(4) *Inoperative ignition primary circuit.*

(*a*) Remove distributor cover and rotor. With ignition switch off, turn engine with starter until breaker points are closed. Turn ignition switch on, then open points with finger. If there is a spark as the points open, the primary circuit is complete and will function if the points open and close properly as engine is cranked.

(*b*) If no current is indicated when points are opened manually, the primary circuit is inoperative. Test primary circuit continuity with voltmeter as directed in *b* below.

b. Primary Circuit Continuity Tests. With distributor cover and rotor removed, turn engine with starter until points are open, or separate points and insert a piece of insulating material. Connect the negative (−) lead from a test voltmeter to any part of the chassis that will provide a good ground; then make the following circuit continuity tests to localize the trouble. Refer to ignition system circuit diagram (fig. 113).

(1) Disconnect cable No. 11 at ignition switch. Touch positive (+) lead from voltmeter to the harness cable terminal. If approximate battery voltage is registered on the voltmeter, the circuit is complete to the switch; connect cable to ignition switch and proceed with test (2) below. If low or no voltage is obtained, replace instrument-panel-to-regulator wiring harness.

(2) Disconnect cable No. 12 from ignition switch. Turn ignition switch on, then touch positive (+) lead from voltmeter to No. 12 cable terminal on ignition switch. If normal voltage is obtained, circuit is complete through switch; connect cable to switch and proceed with test (3) below. If low or no voltage is obtained, ignition switch is defective and must be replaced (par. 179).

(3) On early M135 having engine wiring harness connector at side of regulator, disconnect harness; make contact between voltmeter positive (+) lead and "A" terminal in receptacle

at engine connector. On late M135 and all other models, disconnect cables No. 12 at bayonet-type connector on dash at side of regulator; make contact between voltmeter positive (+) lead and terminal of No. 12 cable leading from instrument panel. If normal voltage is obtained, circuit is complete through harness; connect engine harness at connector (early M135) or connect No. 12 cables at bayonet-type connector and proceed with test (4) below. If low or no voltage is obtained, replace instrument-panel-to-regulator wiring harness.

(4) Disconnect primary cable connector at front side of distributor. Make contact between voltmeter positive (+) lead and terminal inside of cable connector. If normal voltage reading is obtained, circuit is complete through engine wiring harness; connect cable to distributor and proceed with test (5) below. If low or no voltage is obtained, replace engine wiring harness.

(5) Touch voltmeter positive (+) lead to terminal at top of primary circuit resistor in distributor housing. If normal voltage is obtained, circuit is complete through primary circuit capacitor; proceed with test (6) below. If low or no voltage is obtained, replace primary circuit coaxial capacitor (par. 189*c*).

(6) Touch voltmeter positive (+) lead to ignition coil positive (+) terminal. If normal voltage is obtained, circuit is complete through primary circuit resistor; proceed with test (7) below. If low or no voltage is obtained, disconnect ignition coil capacitor cable from ignition coil positive (+) terminal and repeat test. If normal voltage is obtained, replace ignition coil capacitor (par. 189*b*); if voltmeter still shows low or no voltage, replace primary circuit resistor (par. 189*d*).

(7) Touch voltmeter positive (+) lead to ignition coil negative (−) terminal. If normal voltage is obtained, primary circuit is complete through ignition coil. If low or no voltage is obtained, disconnect cable from ignition coil negative (−) terminal and repeat test. Normal voltage with cable disconnected indicates short circuit beyond this point; replace distributor breaker point capacitor (par. 123*c*) and repeat test. If voltmeter still shows low or no voltage, open primary circuit in ignition coil is indicated. Replace ignition coil (par. 123*d* and *e*).

83. Fuel and Air Intake System

a. Fuel Does Not Reach Carburetor.

(1) *Closed shutoff cock or line restricted.* Check for closed fuel line shutoff cock. On early models, shutoff cock is located at fuel pump outlet on tank; on late models, shutoff cock is located in engine compartment on frame left side member. Also check for restrictions such as a bent or dented fuel line.

(2) *Empty fuel tank.* Fill tank.

(3) *Inoperative fuel pump.* Disconnect fuel line from inlet side of carburetor. Turn ignition switch on. If fuel does not flow freely, test fuel pump (par. 133*c*). Also make sure fuel lines between fuel pump and carburetor are not restricted.

b. Fuel Does Not Reach Cylinders.

(1) *Throttle not opening.* Adjust throttle linkage (par. 128).

(2) *Clogged carburetor jets.* Replace carburetor (par. 127).

(3) *Low fuel pump pressure.* Test fuel pump (par. 133*c*) and replace if necessary.

(4) *Clogged fuel tank vent line.* Fuel tank is vented to the vehicle unit vent system. Make sure vent lines and vent line air cleaner (par. 136) are not restricted.

c. Excessive Fuel Consumption.

(1) *Fuel leaks.* Examine all components of the fuel system for leaks. Tighten connections or replace parts as required.

(2) *Worn carburetor components.* Replace carburetor (par. 127).

(3) *Improper carburetor adjustments.* Adjust carburetor (par. 127*b*).

(4) *Worn engine parts.* Refer to paragraph 111 for compression and vacuum tests.

d. Engine Stops When Idling.

(1) *Improper carburetor adjustment.* Adjust carburetor (par. 127*b*).

(2) *Sticking choke control.* Free up and lubricate choke shaft and controls.

(3) *Clogged carburetor idling circuit.* Replace carburetor (par. 127).

e. Engine Idles Too Fast.

(1) *Improper carburetor adjustments.* Adjust carburetor (par. 127*b*).

(2) *Improper carburetor control adjustments.* Adjust carburetor controls (par. 128).

f. Low Fuel Pressure.

(1) *Defective fuel pump.* Test fuel pump (par. 133*c*) and replace if necessary.

(2) *Clogged fuel lines.* Clean fuel lines between fuel pump and carburetor.

(3) *Clogged fuel pump filter plates.* Clean fuel pump filter plates (par. 133*b*).

g. Engine Falters On Deceleration. Clogged or worn carburetor parts will cause this condition. Replace carburetor (par. 127).

84. Exhaust System

a. Excessive Noise.

(1) *Rattles.* Tighten connecting clamps at exhaust pipe, muffler, and tailpipe. Tighten exhaust pipe and muffler supporting straps. Check mounting of tailpipe.

(2) *Exhaust Noises.* Excessively noisy operation is caused by leaking manifold gaskets or broken manifold, exhaust pipes, muffler, or tailpipes. Inspect and replace parts as required.

b. Odor of Exhaust Fumes in Cab. Leaky gaskets and seals, or broken exhaust manifold, exhaust pipe, muffler, or tailpipe will allow exhaust fumes to reach inside of cab. Inspect and replace parts as required. On water tank truck M222, when using exhaust heater system, make sure exhaust heater gate valve is fully open (par. 53*e*(2)).

Caution: Exhaust fumes in cab are dangerous. Replace defective parts as soon as possible.

85. Cooling System

a. Overheating.

(1) *Lack of water in system.* Check system for leaks and make necessary corrections. Replenish water, being sure to add antifreeze solution if required (par. 142).

(2) *Loose or broken fan belt.* Adjust or replace belt (par. 145).

(3) *Defective thermostat.* Remove and test thermostat and replace if necessary (par. 147).

(4) *Clogged cooling system.* Clean and flush system (par. 144).

(5) *Clogged radiator air passages.* Check for insects, leaves, etc., which may be lodged in radiator core air passages. Blow out from rear side, using moderate air pressure.

(6) *Defective water pump.* Replace water pump (par. 148).

b. Overcooling. If thermostat remains open, the system will operate at too low a temperature in cold weather. Remove and test thermostat and replace if necessary (par. 147).

86. Starting System

a. Starter Fails to Operate.

(1) *Discharged or defective batteries.* Service or replace batteries (par. 159).

(2) *Loose cable connections.* Tighten all connections in starting system circuit (fig. 144).

(3) *Starter switch contacts not closing.* This condition may be due to a bent starter switch bracket or to improperly adjusted starter linkage. Replace switch bracket, if bent, or adjust linkage (par. 152).

(4) *Defective starter switch.* Short across starter switch terminals. If starter operates, switch is defective. Replace switch (par. 151*d*).

(5) *Defective starter.* Replace starter (par. 151).

b. Starter Noisy.

(1) *Loose starter mounting.* Tighten starter mounting stud nuts to 48 to 64 pound-feet torque.

(2) *Defective starter drive clutch.* Replace starter (par. 151).

(3) *Worn commutator or bushings.* Replace starter (par. 151).

c. Slow Cranking Speed.

(1) *Discharged batteries.* Service batteries (par. 159).

(2) *Loose cable connections.* Clean and tighten all connections in starting system circuit (fig. 144).

(3) *Worn starter.* Replace starter (par. 151).

87. Generating System

a. High Charging Rate with Fully Charged Batteries. Refer to paragraph 154*c* to determine cause and for corrective measures.

b. Low Batteries and Low or No Charging Rate. Refer to paragraph 154*e* to determine cause and for corrective measures.

c. Noisy Generator.

(1) *Loose mounting.* Tighten generator mounting bolts.

(2) *Defective generator.* Replace generator (par. 155).

88. Batteries and Lighting System

a. General. Reference to wiring diagram (fig. 167 or 168) will show that a single circuit from ignition switch feed cable to light switch is common to all lights on the vehicle. At the light switch, this single circuit is divided into multiple circuits, each of which is common to one, two, or more lights. These circuits are then taken to various junction points where they are divided into individual circuits, each of which is taken to a single light. The return path of each circuit is through ground to battery. Dividing the circuit in this manner provides a convenient and logical method of locating the source of trouble. The use of a voltmeter or trouble light and adhering to the following principles will aid in locating trouble in the lighting system.

(1) Source of trouble common to all lights will be located in that part of the circuit common to all lights.

(2) Source of trouble common to two or more, but not all, lights will be located in that part of the circuit common only to the lights affected.

(3) Source of trouble at a single light will be confined to the individual circuit of the light affected.

b. One Light Fails. This condition is the result of an open circuit or grounded cable between the light ground and the feed cable connection. Open circuit or grounded cable may be caused by a burned out or broken lamp filament; poor ground at light or frame; corroded contacts or terminals; broken cable; frayed cable insulation; defective light switch (if the light which fails is the only light controlled by that circuit).

c. Two or More Lights Fail. The cause of this condition will be located between the light switch and the individual light junction. Cause may be a defective light switch; defective individual light switch (dimmer or stop-light switch); loose or corroded terminals; broken cable.

d. All Lights Fail. The cause of this condition may be at any one of several points in the electrical system.

(1) The cause may be discharged batteries, corroded or broken battery cable or ground cable. These conditions can be checked by cranking engine with starter; if cranking speed is normal, the trouble lies between the battery and the light switch.

(2) Other causes are loose or corroded terminals; defective light switch; defective circuit breaker; short circuit or ground at some point in system which causes circuit breaker to operate. The only remedy is to methodically check the entire system until the fault is located and corrected.

(3) A vehicle not in use for some time may possibly have all lamp contacts corroded to the point where lamps are inoperative. A remote possibility of failure is that all lamp filaments may have been broken by shock.

e. Insufficient Light. This condition may be caused by excessive resistance in circuit or by discharged batteries. Service batteries (par. 159), then look for loose or corroded terminals and contacts, and frayed insulation on cables.

f. Frequent Light Failure. Frequent burning out of lamp or filaments is the result of high voltage, caused by an improperly adjusted or defective generator-regulator. Replace generator-regulator (par. 156).

g. Discharged Batteries.

(1) Discharged batteries may be caused by loose or corroded terminals in any of the electrical circuits. Check for and correct such conditions. Shorted or dry battery cells will result in discharged batteries. Service or replace batteries as necessary (par. 159).

(2) Repeated failure of batteries to hold charge indicates improper generator or generator-regulator operation. Refer to paragraph 154.

h. Overheated Batteries. This condition is caused by a defective or improperly adjusted generator-regulator. Replace generator-regulator (par. 156).

89. Radio Interference

a. Locate Source of Noise. To locate the source of radio interference emanating from the vehicle, the use of a radio receiver in the vehicle or in an adjacent vehicle will be required. Noting the type of interference present in the receiver will help to determine the cause of the trouble. To determine if the noise is coming from the vehicle itself or from an outside source, drive the vehicle at least 100 feet from other vehicles. Turn engine off and turn radio on. Any noise heard will be from an outside source. Start engine. Any noise heard will come from the vehicle itself.

(1) *Engine.* Operate engine with vehicle not in motion and listen for noises in the receiver. If a crackling or clicking noise is present, accelerate the engine and turn ignition switch off with engine running at high speed. If noise stops immediately, the interference is being caused by the ignition circuit (*b* below). If an irregular clicking or chattering continues for a few seconds after the ignition is turned off, interference is being caused by the generating circuit (*c* below). If the interference is in the form of a whining or whirring noise which varies with engine speed, turn the ignition off. If the tone of the sound lowers in pitch but continues for a few seconds after ignition is turned off, interference is caused by the generator (*d* below).

(2) *Vehicle.* Operate the vehicle and note whether there is any interference present in the receiver. If clicking or scratching noise is present, stop the vehicle but leave the engine running. If noise stops when motion of vehicle stops, it may be attributed to loose cable connections or frayed cable insulation in vehicle wiring (*e* below).

b. Ignition Circuit. Make sure ignition circuit is functioning properly (par. 82). Improper spark plug gaps, improper distributor point adjustment, or worn parts will affect the suppression system. Clean and tighten all wiring connections. Tighten engine mountings. With engine running, disconnect cables from spark plugs, one at a time; if disconnecting any one of the cables reduces or eliminates the interference, the spark plug resistor or resistor in distributor cap is defective. Replace spark plug (par. 124) or distributor cover (par. 123).

c. Generating Circuit. Check generator-regulator mounting bolts and tighten if necessary. Check wiring harness connecting generator to generator-regulator for broken or damaged insulation. Replace generator (par. 155) or generator-regulator (par. 156) if necessary.

d. Generator. Check and tighten generator mounting bolts. If noise is still present, replace generator (par. 155).

e. Wiring. Inspect all wiring for worn, frayed, or otherwise damaged insulation. Replace if defective. Clean and tighten all connections.

90. Transmission and Controls

a. Diagnosis Guide. Various trouble symptoms are listed in table VI and each symptom is keyed to probable causes. Legend of malfunctioning units refer to subparagraphs in which detailed causes and suggested remedies are itemized. Determine trouble, then refer to probable causes which are listed in order of probability. Always check causes in sequence given. Units which cause various troubles, and possible remedies are listed in *b* through *z* below.

Table VI. Transmission Troubleshooting Diagnosis Guide

Symptom	Probable causes and remedies. Refer to subparagraphs as follows:
All shifts occur at too high vehicle speeds	*f, d, l,* and *m*
All shifts occur at too low vehicle speeds	*f, d, l,* and *m.*
Shifts vary—inconsistent	*b, f, d, i, l, m,* and *w.*
"Hunting" between two speeds	*g, e, l,* and *x*
Misses one or more shifts	*l* and *m.*
Improper throttle downshifts	*f, d, l,* and *m.*
Drives in 2d and 4th speeds only	*l* and *t.*
Drives forward but no reverse	*b, i, s, l, e,* and *g.*
Drives in reverse only	*k, g, e, o,* and *l.*
Starts in other than 1st speed (with excessive slipping)	*g, e, m, x,* and *w.*
Drives only in HIGH or LOW range (unable to change ranges)	*z, e,* and *h.*
Shift can be made from HIGH to LOW at improper vehicle speed.	*z.*
Does not readily respond when shifted from HIGH to LOW or vice versa.	*b, j, z, e,* and *h.*
Starts in first but goes into neutral at speed when 1 to 2 shift should occur.	*v, l,* and *u.*
No. 4 to 3 forced (past detent) downshift	*f, d, l,* and *t.*
Rough 4 to 3 downshift	*n, t,* and *l.*
Slips on 4 to 3 forced or open throttle downshift	*n, v, j,* and *l.*
No shifts—stays in 1st speed	*g, e, l, m, x,* and *p.*
No drive—control lever in any position	*b, i, g, e, h, z, j, l, r,* and *x.*

Table VI. Transmission Troubleshooting Diagnosis Guide—Continued

Symptom	Probable causes and remedies. Refer to subparagraphs as follows.
Shifts above 2d speed in F–2 under normal operating conditions.	*g, e, l,* and *j.*
Creeping	*c.*
Unable to move lever to reverse	*w* and *e.*
Transmission will not start engine by towing vehicle	*q* and *b.*
Slips on 2 to 3 upshift	*i, j, n, y, u, v, d, f,* and *l.*
Slips in 2d and 4th only	*i, t, y,* and *l.*
Slips in 3d and 4th only	*i, u, y, l,* and *v.*
Slips in 1st, 3d, and reverse	*j, n,* and *l.*
Slips in 1st and 2d	*k, n, j, o, l,* and *y.*
Slips when 1 to 2 shift occurs	*i, l, y,* and *v.*
Slips in all speeds	*b, i, r, g, e, z, l,* and *y.*
Slips in reverse only	*i* and *s.*
Noises	refer to par. 200.
Oil leaks	refer to par. 195.
Water leaks	refer to par. 196.

Note. The sequence for causes and remedies in table VI is as follows:

Subparagraph	Unit	Subparagraph	Unit
b	Oil level.	*n*	Front servo.
c	Engine idle.	*o*	Rear servo.
d	Throttle linkage.	*p*	Rear oil pump.
e	Manual linkage.	*q*	Reduction unit oil pump.
f	Throttle valve lever.	*r*	Fluid coupling.
g	Transmission shift lever.	*s*	Reverse unit parts.
h	Reduction unit control lever.	*t*	Front planetary unit.
i	Oil pressure (front pump and pressure regulator).	*u*	Rear planetary unit.
j	Front band.	*v*	Oil delivery sleeve.
k	Rear band.	*w*	Reverse blocker bracket.
l	Transmission control valve.	*x*	Manual detent control valve lever.
m	Governor.	*y*	Oil passages.
		z	Reduction unit and control valve.

b. Oil Level. Make oil level check (par. 194*b*). Bring oil to proper level.

(1) If oil level checked low, the conditions in (*a*) through (*f*) below could result.

(*a*) Shifts vary—inconsistent.

(*b*) Drives forward but no reverse.

(*c*) No drive with control lever in any position.

(*d*) Slips at all speeds.

(*e*) Transmission does not readily respond when shifted from LOW to HIGH or vice versa.

(*f*) Transmission will not start engine when towing vehicle.

(2) If oil level checked high, refer to caution regarding overfilling transmission (par. 194*c*) and make water leakage check (par. 196). This condition will cause heating and foaming of transmission oil, which in turn will cause erratic shifting and oil leakage.

c. Improper Engine Idle. Adjust engine idling speed (par. 127*b*(1)).

(1) Engine idling speed set too high will cause vehicle to creep, due to drive torus member rotating at excessive speed, thus exerting driving effort against driven torus member.

(2) Engine idling speed set too low will cause the engine to stall.

d. Improper Throttle Linkage Adjustment. Adjust throttle linkage and replace worn parts (par. 202).

(1) Throttle linkage adjusted too long will cause all shifts to occur at too high vehicle speeds.

(2) Throttle linkage adjusted too short could cause the following conditions in (*a*) through (*d*) below to exist.

(*a*) All shifts occur at too low vehicle speed.

(*b*) Improper throttle downshift.

(*c*) No 4 to 3 forced (past detent) downshift, caused by inadequate travel of throttle and T-valves in transmission control valve assembly.

(*d*) Slips on 2 to 3 upshift.

(3) Binding linkage will contribute to inconsistent shifts and varied engine idling speeds.

e. Improper Manual Linkage Adjustment. Adjust manual linkage and replace worn parts (par. 202). Improperly adjusted manual linkage will contribute to the conditions in (1) through (11) below.

(1) "Hunting" between two speeds.

(2) Drives forward—no reverse.

(3) Drives in reverse only.

(4) Starts in other than 1st speed (with excessive slippage).

(5) Drives only in HIGH or LOW range (unable to change from one range to the other).

(6) Will not readily respond when changing from one range to the other.

(7) No shifts—stays in 1st speed.

(8) No drive—control lever in any position.

(9) Shifts above 2d speed in F–2 range under normal operating conditions.

(10) Unable to move control lever into reverse.

(11) Slips in all speeds.

f. Transmission Throttle Valve Lever Loose on Control Valve Shaft or Incorrectly Positioned. Refer to paragraph 202*b* to correct condition. Transmission throttle valve lever (K, fig. 199) loose on shaft or

improperly positioned will contribute to the malfunctions in (1) through (5) below.

(1) All shifts occur at too high or too low vehicle speeds.
(2) Shifts vary—inconsistent.
(3) Improper throttle downshift.
(4) No 4 to 3 forced (past detent) downshift.
(5) Slips on 2 to 3 upshift.

g. Transmission Shift Lever (H, fig. 199) Loose on Shaft. Tighten shift lever clamp bolt. Transmission shift lever loose on control valve shaft will contribute to transmission troubles in (1) through (8) below.

(1) "Hunting" between two shifts.
(2) Drives in reverse only.
(3) Starts in other than 1st speed (with excessive slipping).
(4) No shifts—stays in 1st speed.
(5) No drive—control lever in any position.
(6) Shifts above 2d speed in F–2 position.
(7) Slips in all speeds.
(8) Drives forward—no reverse.

h. Reduction Unit Control Lever (DD, fig. 197) Loose on Control Shaft. Tighten lever clamp bolt. Control lever loose on shaft will contribute to the conditions in (1) and (2) below.

(1) No drive—control lever in any position.
(2) No ready response when shifting from HIGH to LOW range or vice versa.

i. Improper Oil Pressure. Make oil pressure test (par. 198). If oil pressure is not as specified, report to ordnance maintenance personnel. Low or fluctuating oil pressure will contribute to symptoms in (1) through (10) below.

(1) Shifts vary—inconsistent.
(2) Drives forward—no reverse.
(3) Does not readily respond when transmission is shifted from HIGH to LOW range or vice versa.
(4) No drive—control lever in any position.
(5) Slips on 2 to 3 upshift.
(6) Slips in 2d and 4th only.
(7) Slips in 3d and 4th only.
(8) Slips when 1 to 2 shift occurs.
(9) Slips in all speeds.
(10) Slips in reverse only.

j. Front Band Improperly Adjusted. Make front band adjustment (par. 201).

(1) No drive with control lever in any position may be caused by a broken front band; notify ordnance maintenance personnel.

(2) Improperly adjusted front band may cause the conditions in (*a*) through (*d*) below.

(*a*) Slips on 4 to 3 forced or open throttle downshift.

(*b*) Slips on 2 to 3 upshift.

(*c*) Slips in 1st, 3d, and reverse.

(*d*) Slips in 1st.

k. Rear Band. Rear band adjusts automatically, after initial adjustment at transmission assembly. If rear band is not functioning properly, notify ordnance maintenance personnel. The symptoms in (1) and (2) below may be caused by a malfunctioning rear band.

(1) Drives in reverse only.

(2) Slips in 1st and 2d.

l. Transmission Control Valve. After proper transmission throttle and manual control linkage adjustments have been made (par. 202*b*) and transmission still operates inefficiently, cause may be the transmission control valve. Notify ordnance maintenance personnel.

m. Governor. If governor is cause of transmission operating improperly, notify ordnance maintenance personnel. A governor that is operating inefficiently will contribute to transmission symptoms in (1) through (7) below.

(1) All shifts occur at too high or too low vehicle speed.

(2) No shifts—stays in 1st speed.

(3) Starts in other than 1st speed (with excessive slippage).

(4) Shifts vary—inconsistent.

(5) Misses one or more shifts.

(6) Shifts above 2d speed in F–2 range.

(7) Improper throttle downshift.

n. Front Servo. If front servo is causing transmission malfunction, notify ordnance maintenance personnel. A front servo assembly not operating properly will contribute to transmission symptoms in (1) through (5) below.

(1) Rough 4 to 3 downshift.

(2) Slips on 4 to 3 forced or open throttle downshift.

(3) Slips in 1st.

(4) Slips in 1st, 3d, and reverse.

(5) Slips on 2 to 3 upshift.

o. Rear Servo. Slipping 1st and 2d speed may be caused by broken or weak servo springs, restricted or interconnected oil passages in servo body, or excessive leakage from accumulator body around accumulator piston stem. Notify ordnance maintenance personnel.

p. Rear Oil Pump. No shifts, transmission stays in 1st speed may be caused by no drive from rear oil pump bronze drive gear to oil pump shaft. This is due to drive gear being stripped or loose on reverse planet carrier, or stripped steel driven gear. Both of these

conditions will result in no governor drive. Notify ordnance maintenance personnel.

q. Reduction Unit Oil Pump. If transmission fails to turn engine when vehicle is being pushed or towed to start, cause is probably lack of pressure from reduction unit oil pump or improperly operating pressure regulator in reduction unit control valve assembly. Notify ordnance maintenance personnel.

r. Fluid Coupling. Fluid coupling is composed of drive and driven torus members and torus covers. Damaged torus member vanes will contribute to slipping in all speeds and no drive with control lever in any position. Transmission must be removed to replace damaged fluid coupling parts. Refer to paragraphs 204 and 205 for transmission removal and installation.

s. Reverse Unit Parts. If reverse unit is not operating correctly, notify ordnance maintenance personnel. Malfunctioning reverse unit parts will contribute to the transmission symptoms in (1) and (2) below.

(1) Drives forward—no reverse.
(2) Slips in reverse only.

t. Front Planetary Unit. Notify ordnance maintenance personnel if front planetary unit is causing transmission malfunction. If front planetary unit is not operating properly, it could contribute to the symptoms in (1) through (4) below.

(1) Drives in 2d and 4th speed only.
(2) No 4 to 3 forced downshift.
(3) Rough 4 to 3 downshift.
(4) Slips in 2d and 4th only.

u. Rear Planetary Unit. If rear planetary unit is causing transmission malfunction, notify ordnance maintenance personnel. If rear planetary unit is not operating properly, it may contribute to the symptoms in (1) and (2) below.

(1) Slips on 2 to 3 upshift.
(2) Slips in 3d and 4th only.

v. Oil Delivery Sleeve. If oil delivery sleeve is cause of transmission troubles, notify ordnance maintenance personnel. If oil delivery sleeve is defective, it will contribute to the symptoms in (1) through (4) below.

(1) Slips on 2 to 3 upshift.
(2) Slips in 3d and 4th only.
(3) Slips when 1 to 2 shift occurs.
(4) Starts in 1st but goes into neutral at speed when 1 to 2 shift should occur.

w. Reverse Blocker Bracket. If reverse blocker bracket is causing transmission troubles, notify ordnance maintenance personnel. A

reverse blocker bracket that is not operating properly will contribute to the symptoms in (1), (2), and (3) below.

(1) Shifts vary—inconsistent.
(2) Starts in other than 1st speed.
(3) Unable to move transmission control lever into reverse.

x. Manual Detent Control Valve Lever. If manual detent control valve lever is causing transmission malfunctioning, notify ordnance maintenance personnel. Manual detent control valve lever is part of manual control valve and if defective will contribute to (1) through (4) below.

(1) "Hunting" between two speeds.
(2) No shifts—stays in 1st speed.
(3) No drive with control lever in any position.
(4) Starts in other than 1st speed.

y. Oil Passages. Oil passages in transmission case and reduction unit case are used as circuits to deliver oil under pressure from oil pumps to operating units. Interconnected, restricted, blocked, or leaking oil passages will result in various trouble symptoms. Inspection of oil passages in case can only be accomplished with transmission removed from vehicle and completely disassembled. Notify ordnance maintenance personnel.

z. Reduction Unit and Reduction Unit Control Valve. If any component part of reduction unit section of transmission is causing transmission malfunction, notify ordnance maintenance personnel. Faulty reduction unit parts will contribute to (1) through (5) below.

(1) Drives only in HIGH range.
(2) Drives only in LOW range.
(3) Shift can be made from HIGH to LOW range at improper engine speed.
(4) Will not readily respond when shifted from HIGH to LOW range or vice versa.
(5) Slips in all speeds.

91. Transfer and Controls

a. Hard Shifting.

(1) *Improper driving practices.* Refer to paragraph 39.
(2) *Control linkage binding.* Control linkage may bind or stick due to rust, corrosion, dirt, or need of lubrication. Inspect, clean, and lubricate linkage with oiler.

b. Slips Out of Gear.

(1) *Gears not fully engaged.* Control linkage improperly adjusted. Adjust linkage (pars. 208 and 209).
(2) *Weak or broken shift shaft poppet ball spring.* Replace transfer (par. 210).

reverse blocker bracket that is not operating properly will contribute to the symptoms in (1), (2), and (3) below.

(1) Shifts vary—inconsistent.
(2) Starts in other than 1st speed.
(3) Unable to move transmission control lever into reverse.

x. Manual Detent Control Valve Lever. If manual detent control valve lever is causing transmission malfunctioning, notify ordnance maintenance personnel. Manual detent control valve lever is part of manual control valve and if defective will contribute to (1) through (4) below.

(1) "Hunting" between two speeds.
(2) No shifts—stays in 1st speed.
(3) No drive with control lever in any position.
(4) Starts in other than 1st speed.

y. Oil Passages. Oil passages in transmission case and reduction unit case are used as circuits to deliver oil under pressure from oil pumps to operating units. Interconnected, restricted, blocked, or leaking oil passages will result in various trouble symptoms. Inspection of oil passages in case can only be accomplished with transmission removed from vehicle and completely disassembled. Notify ordnance maintenance personnel.

z. Reduction Unit and Reduction Unit Control Valve. If any component part of reduction unit section of transmission is causing transmission malfunction, notify ordnance maintenance personnel. Faulty reduction unit parts will contribute to (1) through (5) below.

(1) Drives only in HIGH range.
(2) Drives only in LOW range.
(3) Shift can be made from HIGH to LOW range at improper engine speed.
(4) Will not readily respond when shifted from HIGH to LOW range or vice versa.
(5) Slips in all speeds.

91. Transfer and Controls

a. Hard Shifting.

(1) *Improper driving practices.* Refer to paragraph 39.
(2) *Control linkage binding.* Control linkage may bind or stick due to rust, corrosion, dirt, or need of lubrication. Inspect, clean, and lubricate linkage with oiler.

b. Slips Out of Gear.

(1) *Gears not fully engaged.* Control linkage improperly adjusted. Adjust linkage (pars. 208 and 209).
(2) *Weak or broken shift shaft poppet ball spring.* Replace transfer (par. 210).

c. Loss of Lubricant.

(1) *Leaking gaskets.* Tighten bearing cap bolts. If leak persists, replace transfer (par. 210), or notify ordnance maintenance personnel.

(2) *Defective oil seals.* Replace transfer (par. 210) or notify ordnance maintenance personnel.

d. Noisy Operation.

(1) *Insufficient lubrication.* Lubricate transfer (par. 207).

(2) *Worn transfer components.* Replace transfer assembly (par. 210).

92. Power-Take-Off and Controls

a. Hard Shifting. Refer to paragraph 91*a*.

b. Noisy Operation. Noise in power-take-off, which will be reflected through transfer, is due to worn gears or bearings. Replace power-take-off (pars. 212 and 213).

93. Front Axle

a. General. Refer to paragraph 99 for diagnosis of steering difficulties which may be attributed to the steering gear. Refer to paragraph 94 for diagnosis of excessive axle noise and gear backlash.

b. Hard Steering.

(1) *Lack of lubrication.* Lubricate front axle steering knuckle as instructed in lubrication chart (par. 69).

(2) *Bind in steering knuckle.* Raise front wheels from ground and disconnect drag link at front axle (par. 269*b*). Turn wheels and tie rod from side to side. If binding is evident, remove tie rod (par. 219*a*). Test each steering knuckle separately, turning wheel from side to side. If bind persists, and lubrication does not free up, replace axle (par. 222).

(3) *Excessive caster.* Checking front axle caster requires special equipment. Notify ordnance maintenance personnel.

(4) *Tires underinflated, unequally inflated, or mismatched.* Inflate tires to correct pressure (par. 260*a*). Make sure tires are same make and size (par. 260*c*).

(5) *Improper toe-in.* Check front wheel toe-in and adjust if necessary (par. 220).

c. Shimmy.

(1) *Unevenly worn or unequally inflated tires.* Replace tires (par. 261) or inflate to correct pressure (par. 260*a*).

(2) *Loose or damaged hub bearings.* Adjust or replace bearings (par. 265 or 266).

(3) *Incorrect front wheel alinement.* Check and correct front wheel alinement where possible (par. 216); otherwise notify ordnance maintenance personnel.

(4) *Worn steering knuckle components.* Replace front axle (par. 222).

d. Wandering.

(1) *Tires unequally inflated.* Inflate to correct pressure (par. 260*a*).

(2) *Incorrect front wheel toe-in.* Check toe-in and correct if necessary (par. 220).

(3) *Front wheel bearings require adjustment.* Adjust bearings (par. 265).

94. Rear Axles

a. Continuous Axle Noise.

(1) *Tires improperly inflated or unevenly worn.* If axle noise is caused by tires, the noise will disappear when vehicle is driven over soft ground. Inflate tires equally (par. 260*a*).

(2) *Wheel bearings worn, out of adjustment, or in need of lubrication.* If noise persists, check wheel bearings for wear and adjustment. Replace wheel bearings (par. 266).

(3) *Lack of lubrication.* Add lubricant to axle (par. 224).

(4) *Worn or improperly adjusted differential gears and bearings.* If axle noise continues on soft ground, replace faulty axle (par. 226 or 227).

b. Axle Noise on Drive Only Or on Coast Only.

(1) *Pinion and ring gear out of adjustment or worn excessively.* Replace axle (par. 226 or 227).

(2) *Wheel bearings worn, out of adjustment, or in need of lubrication.* Check wheel bearings for wear and adjustment. Replace wheel bearings (par. 266).

c. Excessive Backlash in Axle Driving Parts.

(1) *Axle flange stud nuts loose or worn holes in flanges.* Tighten nuts to 55 to 65 pound-feet torque. If holes in flanges are worn, replace drive flanges (par. 221*b* (2) and *d* (5)).

(2) *Ring gear and pinion out of adjustment or worn excessively.* Replace faulty axle (par. 222, 226, or 227).

95. Axle Propeller Shafts

a. General. Any mechanical movement has vibration periods which do not result in noise until they tune in with some other part or unit. In this connection, loose or broken fenders, running boards, body or cab holddown bolts, etc., should be checked as possible sources of noise if noise cannot be traced to propeller shafts.

b. Excessive Noise or Vibration.

(1) *Universal joints require lubrication.* Lubricate propeller shaft universal joints (par. 69).

(2) *Loose pillow block mounting.* Tighten pillow block mounting stud nuts to 48 to 64 pound-feet torque.

(3) *Worn universal joint bearings or sprung propeller shaft.* Replace propeller shaft and universal joint assembly (pars. 229 and 230), or repair universal joint (par. 231 or 232).

(4) *Worn pillow block bearings.* Replace pillow block assembly (par. 233).

96. Service Brake System

a. Excessive Pedal Pressure and Poor Braking Action.

(1) *Brakes require adjustment.* Adjust brakes (par. 238).

(2) *Low air pressure.* Refer to *i* below.

(3) *Inoperative power cylinder.* Test brake system (par. 236).

(4) *Obstructed hydraulic lines.* Inspect hydraulic lines for sharp bends or kinks. Replace lines or hose if damaged (par. 245*a*).

(5) *Worn brake linings.* Replace shoe and lining (par. 239).

(6) *Scored brakedrums.* Replace drums (par. 240).

b. Pedal Goes to Floor.

(1) *Brakes require adjustment.* Adjust brakes (par. 238).

(2) *Broken or disconnected pedal linkage.* Replace or connect and adjust linkage (par. 241).

(3) *Excessively worn linings.* Replace shoe and lining (par. 239).

(4) *Air in hydraulic system.* Bleed brake system (par. 237).

c. Noisy Brakes.

(1) *Dirt in brakes.* Remove hub and drum (par. 266*a*) and clean out dirt.

(2) *Linings loose on shoes.* Replace shoe and lining (par. 239).

(3) *Broken return spring.* Replace brakeshoe return spring (par. 239).

(4) *Distorted brakedrum.* Replace distorted drum (par. 240).

(5) *Bent backing plate.* Notify ordnance maintenance personnel.

d. Springy, Spongy Pedal Action.

(1) *Brakes require adjustment.* Adjust brakes (par. 238).

(2) *Air in hydraulic system.* Bleed brake system (par. 237).

e. One Brake Drags.

(1) *Brake needs adjustment.* Adjust brakes (par. 238).

(2) *Binding or corroded brakeshoe.* Remove hub and drum (par. 266*a*), inspect brake mechanism, and make necessary correction.

(3) *Wheel bearings out of adjustment.* Adjust bearings (par. 265).

(4) *Broken return spring.* Replace broken brakeshoe return spring (par. 239).

(5) *Defective wheel cylinder.* Replace defective wheel cylinder (par. 244).

f. All Brakes Drag.

(1) *Brakes adjusted when drums were hot.* Adjust brakes with drums cold (par. 238).

(2) *Improperly adjusted pedal linkage.* Adjust pedal linkage (par. 241*b*).

(3) *Defective master cylinder.* Replace master cylinder (par. 242).

(4) *Defective power cylinder.* Test brake system (par. 236).

g. Grabbing Brakes.

(1) *Grease or brake fluid on lining.* Replace shoe and lining (par. 239).

(2) *Lining loose on shoes.* Replace shoe and lining (par. 239).

(3) *Loose spring-to-axle mounting.* Tighten spring U-bolts.

(4) *Worn or loose torque rod ends.* Replace torque rods (par. 276 or 282).

h. Locked Brakes. Any of the conditions listed under *f* above may be severe enough to prevent brake release.

i. Low Air Pressure in System.

(1) *Leakage in air system.* Refer to paragraph 245*b*.

(2) *Improperly adjusted compressor governor.* Adjust governor (par. 246*b*).

(3) *Loose compressor drive belt.* Adjust belt tension (par. 247*a*).

(4) *Worn compressor.* Replace compressor (par. 248).

j. Slow Air Pressure Buildup. Refer to *i* above.

k. Rapid Loss of Air Pressure When Engine is Stopped.

(1) *Leakage in air system.* Refer to paragraph 245*b*.

(2) *Leaking compressor discharge valves.* Replace compressor (par. 248).

l. Excessive Air Pressure.

(1) *Improperly adjusted compressor governor.* Adjust governor (par. 246*b*).

(2) *Sticking compressor governor plunger.* Lubricate governor (par. 69).

(3) *Leaking compressor governor diaphragm.* Replace compressor governor (par. 246*c*).

(4) *Restricted air line leading to governor.* Replace air line.

97. Parking Brake System

a. Parking Brake Does Not Hold Parked Vehicle.

(1) *Adjustment required.* Adjust (par. 254).

(2) *Brake lining worn.* Replace band and lining (par. 255).

(3) *Grease on lining.* Replace band and lining (par. 255).

b. Parking Brake Drags and Overheats.

(1) *Vehicle operated with brake partially applied.* Make sure hand lever is fully released.

(2) *Improperly adjusted.* Adjust (par. 254).
(3) *Brakedrum out-of-round.* Notify ordnance maintenance personnel.

98. Wheels, Tires, and Hubs

a. Excessive or Uneven Tire Wear.
(1) *Unequal pressure in tires.* Inflate all tires to same pressure (par. 260*a*).
(2) *Tires of unequal radii used on same axle.* Match tires (par. 260*c*).
(3) *Front wheels misalined.* Check alinement (par. 216).
(4) *Hub bearings need adjusting.* Adjust bearings (par. 265).
(5) *Wheel bent.* Replace wheel (par. 259).

b. Wheels Pounding.
(1) *Hub bearings need adjusting.* Adjust bearings (par. 265).
(2) *Hub bearings damaged.* Replace bearings (par. 266).
(3) *Wheel bent.* Replace wheel (par. 259).

99. Steering System

a. General. Many complaints of steering difficulty are falsely charged to the steering gear assembly. In order, therefore, to isolate the steering gear from the front axle, the drag link should be disconnected from the pitman arm at the gear housing. This will permit unobstructed diagnosis of the unit. Refer to paragraph 93 for diagnosis of steering difficulties which may be attributed to the front axle. In general, steering complaints rightfully traceable to the steering gear are as in *b*, *c*, and *d* below.

b. Hard Steering.
(1) *Lack of lubricant.* Lubricate steering gear; refer to lubrication chart (par. 69).
(2) *Worm bearings or pitman arm shaft adjusted too tight.* Adjust steering gear (par. 268).
(3) *Worn or damaged worm nut or balls.* Replace steering gear assembly (par. 272).
(4) *Misalined steering column, causing binding.* Loosen steering column mounting at instrument panel. If binding condition is relieved, hold steering column in position and tighten mounting (par. 272*d*).
(5) *Improperly tightened cab mountings, causing steering column bind.* Check steering column for binding at cowl bracket (par. 272*d*).

c. Wander or Weaving.
(1) *Loose steering gear mounting.* Tighten steering gear mounting bolts.
(2) *Excessive pitman arm shaft lash.* Adjust pitman arm shaft lash (par. 268*d*).

(3) *Worn steering parts.* Replace steering gear assembly (par. 272).

d. Oil Leaks.

(1) *Defective pitman arm shaft seal.* Replace steering gear assembly (par. 272).

(2) *Loose side cover or defective gasket.* Tighten side cover bolts or replace gasket.

100. Front Spring Suspension

a. Hard Riding.

(1) *Insufficient spring shackle lubrication.* Lubricate spring shackle pins and bolts; refer to lubrication chart (par. 69).

(2) *Frozen spring shackles.* Free-up shackles and lubricate.

(3) *Defective shock absorbers.* Check shock absorber action and replace if necessary (par. 277).

b. Excessive Flexibility.

(1) *Insufficient fluid in shock absorbers.* Refill shock absorbers (par. 277).

(2) *Defective shock absorbers.* Check shock absorber action and replace if necessary (par. 277).

(3) *Broken spring leaves.* Examine springs for broken leaves and, if found, replace spring assembly (par. 275).

c. Execessive Noise.

(1) *Worn shackle pins and bolts, or worn spring and shackle bushings.* Use pry bar to test wear of pins, bolts, or bushings. Replace pins, bolts, shackles, or spring assembly as necessary (par. 274 or 275).

(2) *Worn or broken shock absorber links.* Replace links (par. 277).

(3) *Defective shock absorbers.* Check shock absorber action and replace if necessary (par. 277).

(4) *Loose torque rod ends.* Tighten or replace torque rods (par. 276).

(5) *Loose spring* **U***-bolts.* Tighten spring **U**-bolts to 170 to 200 pound-feet torque.

d. Spring Leaf Failure.

(1) *Failure of spring leaf at spring eye.* Failures at this point are generally caused by frozen shackle pins or bolts. Free-up and lubricate shackle (par. 69), or replace (par. 274).

(2) *Failure of spring leaf at center section of spring.* Breakage of spring leaves at the center bolt section is generally caused by loose spring **U**-bolts. Replace spring and tighten **U**-bolts to recommended torque (par. 275).

(3) *Grabbing brakes.* Grabbing brakes cause extreme strains on springs. Refer to paragraph 96*g*.

(4) *Loose torque rod ends.* Tighten or replace torque rods (par. 276).

(5) *Loose spring* U-*bolts.* Tighten spring U-bolts to 170 to 200 pound-feet torque.

101. Rear Spring Suspension

a. Excessive Noise.

(1) *Loose spring* U-*bolts.* Tighten main and secondary spring U-bolt nuts to 375 to 400 pound-feet torque.

(2) *Loose torque rod ends.* Tighten torque rod end pin nuts or replace torque rods (par. 282).

(3) *Loose or worn spring seat bearings.* Adjust or replace bearings (par. 281).

b. Spring Leaf Failure.

(1) *Overloading and overspeeding.* Breakage of rear spring leaves is most commonly caused by overloading the vehicle or by driving at excessive speed over rough terrain. Refer to vehicle identification plate (figs. 16–22) for maximum load, and reduce vehicle speed over rough terrain when possible.

(2) *Loose spring* U-*bolts.* Tighten main and secondary spring U-bolt nuts to 375 to 400 pound-feet torque.

102. Cab and Associated Parts

a. Windshield Wipers.

(1) *Wiper blades operate too fast.* Control valve improperly adjusted. Adjust control valve (par. 295*b*).

(2) *Wiper blades operate too slow.*

(*a*) If this condition is evident at both wipers, it is probably due to an improperly adjusted control valve, dirty air supply air strainer, or restricted air supply line. Adjust control valve (par. 295*b*), service air strainer (par. 295*h*), or replace restricted air line.

(*b*) If the condition is evident at only one wiper, it is due to restricted or leaking air line from control valve to wiper motor, or to defective wiper motor. Replace wiper motor (par. 295*f* and *g*) or air line as necessary.

(3) *Wipers fail to operate.*

(*a*) If both wipers fail to operate, it is probably due to clogged air supply air strainer, defective control valve, or clogged or kinked air supply line. Service strainer (par. 295*h*); replace control valve (par. 295*c*); clean or replace air line as necessary.

(*b*) If only one wiper fails to operate, it is probably due to defective wiper motor, or clogged or kinked air line from

control valve to motor. Replace defective motor (par. 295*f* and *g*), or clean or replace air line as necessary.

b. Cowl Ventilator. If cowl ventilator lid fails to close tightly, linkage requires adjustment (par. 300*b*).

c. Doors. If doors rattle or fail to latch properly, adjust (par. 299*b*).

d. Cab Mounting. If steering gear binding (par. 99*b*(5)) indicates shifted cab mounting, adjust mountings (par. 292*b*).

103. Winch

a. Winch Fails to Operate When Shifted Into Gear.

(1) *Disengaged drum clutch.* Engage sliding jaw clutch (par. 48*d*).

(2) *Sheared shearpin.* Replace shearpin (par. 314).

b. Winch Fails to Hold Load. This condition is caused by automatic brake lining being in need of adjustment or worn excessively. Adjust automatic brake (par. 316*c*), or replace automatic brake band and lining assembly (par. 317).

c. Excessive Heat at Brake Cover.

(1) *Automatic brake adjusted too tight.* Adjust automatic brake (par. 316*c*).

(2) *Wrong type lining installed.* Replace automatic brake band and lining assembly (par. 317).

d. Winch Drum Overruns Cable When Cable Is Pulled Off By Hand. Winch drag brake requires adjustment. Adjust drag brake (par. 316*b*).

e. Noisy Operation.

(1) *Insufficient lubrication.* Lubricate winch (par. 69).

(2) *Worn winch components.* Replace winch assembly (par. 322).

104. Dump Body and Controls

a. End Gate Operates Improperly. Linkage improperly adjusted or broken. Adjust linkage (par. 327) or replace as necessary.

b. Body Fails to Raise.

(1) *Low fluid level due to leakage or broken lines.* Check for broken line, leakage at hoist cylinder piston rod packing, or other causes of fluid loss and make necessary corrections; then replenish fluid (par. 325).

(2) *Improperly adjusted control valve spool.* Adjust control valve spool (par. 324*d*).

(3) *Improperly adjusted or disconnected power-take-off and control box linkage.* Adjust linkage (par. 324*b* and *c*) or connect as necessary.

(4) *Defective control box.* Replace control box (par. 335).

(5) *Pump not being driven.* There is a possibility that the woodruff key was inadvertently left out of power-take-off accessory drive shaft or hoist pump shaft, permitting universal joint yoke to spin on shaft. Check for this condition and correct if necessary (par. 337*b*).

(6) *Defective pump.* Replace pump assembly (par. 331).

(7) *Defective crossover or control valve adapter.* Replace crossover adapter or control valve adapter (par. 332 or 333).

c. Body Fails to Hold in Raised Position.

(1) *Improperly positioned power-take-off lever.* Refer to paragraph 51 for operation of dump body controls.

(2) *Improperly adjusted control valve spool.* Adjust control valve spool (par. 324*d*).

(3) *Defective control valve.* Replace control valve (par. 334).

(4) *Internal fluid leakage in hydraulic cylinder.* Replace hydraulic cylinder assembly (par. 328).

d. Body Fails to Lower From Fully Raised Position.

(1) *Improperly positioned power-take-off lever.* Refer to paragraph 51 for operation of dump body controls.

(2) *Improperly adjusted control valve spool.* Adjust control valve spool (par. 324*d*).

(3) *Defective control box.* Replace control box (par. 335).

105. Water Tank Body and Controls

a. Tank Drain Valves Leak.

(1) *Cables adjusted too short, holding valve open.* Adjust cables to provide slight slack with valves closed (par. 343*f*(6)).

(2) *Camshaft packing worn.* Tighten camshaft packing nut or replace packing as necessary (par. 343*c*).

(3) *Drain valve plunger spring broken.* Replace drain valve plunger spring (par. 343*d*).

b. Gate Valves Leak.

(1) *Valve stem packing worn.* Tighten packing gland nut or replace valve stem packing as required (par. 342).

(2) *Gate valve worn or corroded.* Replace gate valve assembly (par. 342).

c. Excessive Noise or Vibration in Pump Propeller Shafts. Check for loose pillow block mountings, loose setscrews in universal joint yokes, or worn universal joint bearings. Tighten loose mountings and setscrews, and replace or repair propeller shafts as necessary (par. 345).

d. Pump Fails to Operate.

(1) *Valves and controls not properly positioned.* Refer to paragraph 53 for operating instructions.

(2) *Power-take-off accessory drive linkage improperly adjusted or disconnected.* Adjust linkage (par. 346) or connect as necessary.

(3) *Pump not being driven.* There is a possibility that the woodruff key was inadvertently left out of power-take-off accessory drive shaft or water pump shaft, permitting universal joint yoke to spin on shaft. Check for this condition and correct if necessary (par. 345*c*).

(4) *Pump does not prime.* Refer to *f* below.

e. Pump Noisy.

(1) *Pump being driven at too high a speed.* Power-take-off governor (Mechanovac) not limiting engine speed properly (par. 130). Notify ordnance maintenance personnel.

(2) *Vacuum too high.* Excessively high vacuums are created by closed valve in intake line, dirty intake strainer, too high suction lift, or other restrictions in intake line such as kinked intake hose. Make sure intake line is not restricted and that valves are open, and service intake strainer (par. 344*b*).

(3) *Relief valve chattering.* Relief valve chatter is caused by air leaks in pump intake system, such as in hose connections or in faulty flange gaskets. Make necessary corrections.

(4) *Pump damaged.* Replace pump assembly (par. 344).

f. Pump Does Not Prime.

(1) *Pump speed too low.* To lift water 16 feet, pump speed must be 1,000 rpm.

(2) *Air leaks in suction line.* Check all suction line connections and tighten if necessary.

(3) *Restricted suction line.* Check for kinked intake hose and service pump intake strainer (par. 344*b*).

(4) *Pump improperly assembled.* If pump has been repaired, pump liner may have been installed backward. Remove ¼-inch pipe plug from strainer body to see if vacuum is being produced there. If air or liquid blows out the pipe plug port, liner is installed backward. Replace pump assembly (par. 344).

(5) *Pump worn.* If pump produces some vacuum but not enough to efficiently pump water, pump is worn. Replace pump assembly (par. 344).

106. Gasoline Tank Body and Controls

a. Tank Drain Valves Leak.

(1) *Cables adjusted too short, holding valve open.* Adjust cables to provide slight slack with valves closed (par. 355*f*(5)).

(2) *Camshaft packing worn.* Tighten camshaft packing nut or replace packing as necessary (par. 355*b*).

(3) *Drain valve plunger spring broken.* Replace drain valve plunger spring (par. 355).

b. Gate Valves Leak.

(1) *Valve stem packing worn.* Tighten packing gland nut or replace valve stem packing as required (par. 342).

(2) *Gate valve worn or corroded.* Replace gate valve assembly (par. 354).

c. Excessive Noise or Vibration in Pump Propeller Shafts. Check for loose pillow block mountings, loose setscrews in universal joint yokes, or worn universal joint bearings. Tighten loose mountings and setscrews, and replace or repair propeller shafts as necessary (par. 358).

d. Pump Fails to Operate.

(1) *Valves and controls not properly positioned.* Refer to paragraph 55 for operating instructions.

(2) *Power-take-off accessory drive linkage improperly adjusted or disconnected.* Adjust linkage (par. 346) or connect as necessary.

(3) *Pump not being driven.* There is a possibility that the woodruff key was inadvertently left out of power-take-off accessory drive shaft or hoist pump shaft, permitting universal joint yoke to spin on shaft. Check for this condition and correct if necessary (par. 358).

(4) *Pump does not prime.* Refer to *f* below.

e. Pump Noisy.

(1) *Pump being driven at too high a speed.* Refer to paragraph 105*e*(1).

(2) *Vacuum too high.* Refer to paragraph 105*e*(2).

(3) *Relief valve chattering.* Refer to paragraph 105*e*(3).

(4) *Pump damaged.* Replace pump assembly (par. 344).

f. Pump Does Not Prime. Refer to paragraph 105*f*.

g. Drain Valve Control Levers Will Not Remain in Open Position. If drain valve control levers will not remain in open position, the fuse link has separated. Replace fuse link (par. 355*h*).

Section V. ENGINE DESCRIPTION AND MAINTENANCE IN VEHICLE

107. Description and Data

a. Description. The engine is a water-cooled, six-cylinder, valve-in-head-type with intake and exhaust manifolds installed on left side of cylinder head assembly.

(1) *Engine mountings.* Engine, complete with accessories, is mounted in conjunction with radiator and transmission assembly. This power plant, which can be removed as a unit,

is shown in figure 111. Four cushion-type mountings support engine and transmission assembly on frame, and radiator is supported on frame front cross member. Figure 108 shows construction and location of engine mountings.

(2) *Engine accessories.* Accessories installed on engine include starter, generator, oil filter, and distributor at right side; and air compressor, carburetor, and manifolds at left side. Water pump and fan are installed at front of cylinder block. Pulley on front end of engine crankshaft drives air compressor, generator, and water pump through V-type drive belts. Fan blades are installed on water pump pulley hub. For location of instructions regarding replacement and maintenance of accessories mounted on engine, refer to index.

(3) *Engine lubrication system.* Engine is pressure lubricated by a gear-type oil pump which is driven from the engine camshaft. Oil pump inlet is through a floating-type screen located in the oil pan cover on bottom of oil pan. The crankshaft is drilled for lubrication of main bearings and connecting rod bearings. Connecting rods are drilled to provide oil under pressure at piston pins. Engine valve mechanism is lubricated by oil which passes from fitting near left front corner of cylinder block through external oil line to front end of cylinder head. Restricted fitting in cylinder head controls volume of oil which passes through passage in cylinder head and rocker arm shaft bracket to lubricate valve rocker arms and related parts. Timing gears receive lubrication from nozzle in timing gear cover plate. Oilhole in nozzle directs oil against timing gear teeth. Engine is equipped with replaceable element type oil filter (fig. 92). Oil pressure in engine lubrication system is registered on gage in instrument panel cluster in driver's compartment. Oil level gage assembly (bayonet-type) (fig. 91) is provided at right side of engine near oil filter.

b. Data.

Make	GMC
Model	302
Type	valve-in-head
Number of cylinders	6
Cylinder bore	4 in.
Piston stroke	4 in.
Piston displacement	301.6 cu in.
Engine governed speed (full load)	3,350±50 rpm
Engine idling speed	375 rpm
Crankshaft rotation (viewed from front end)	clockwise
Firing order	1–5–3–6–2–4
Valve clearance (at operating temperature) :	
Intake valves	0.012 in.
Exhaust valves	0.020 in.
Wrench torque for cylinder head bolts	refer to figure 101