CHAPTER 2

SERVICE AND MAINTENANCE INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIEL

8. General

a. Upon receipt of a new, used or reconditioned vehicle, it is the responsibility of the receiving organization to determine whether the vehicle has been properly prepared for service by the supplying unit, and is in condition to perform satisfactorily its assigned mission. 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 (TM 9-2320-209-10) to be sure every item is present, in good condition, clean, and properly mounted or stowed. Follow the general procedures for all services and inspections given in TM 9-2320-209-10.

b. Whenever practicable, the operator will assist in the performance of these services.

c. Refer to TM 9-2320-209-10 for operating instructions, break-in operating precautions, and break-in speeds.

9. Equipment Logbook (Binder)

The Equipment Logbook should be with the vehicle when it is serviced, repaired, modified, or transferred. Instructions for preparation and application of equipment logbooks, as well as special reporting requirements of performed maintenance on the equipment are contained in TM 38-750.

10. Preliminary Services, Performed by Organizational Maintenance or Supplying Organization

a. General Procedures.

(1) If any exterior surfaces are coated with rust-preventive compound, remove it with dry-cleaning solvent or mineral spirits paint thinner.

(2) Read "Processing and Deprocessing Record of Shipment, Storage, and Issue of Vehicles and Spare Engines" Tag DD Form 1397 (formerly DA Form 9-3) and follow all precautions checked thereon. This tag should be attached to the steering wheel, shifting levers or ignition switch.

(3) Gasoline engines not processed or reprocessed within the time limitation established in the block titled "Reprocessing Cycle-Days" on the face of DD Form 1397 will be serviced prior to use as outlined in TB ORD-392 as follows:

(*a*) Remove spark plugs from each cylinder.

(*b*) Atomize-spray 2 ounces of Lubricating Oil, General Purpose, 9150-281-2007 (PL-Special) (NATO Symbol 0-190), into each cylinder through the spark plug opening.

Note. Use oil gun, pneumatic, curved rigid neck, 32 ounces capacity, 4920-222-2927. This is in the No. 1 common tool kit. More permanent equipment may be fabricated as shown in TB 9-299/1.

(*c*) After an interval of 15 minutes, rotate engine with starter for 30 seconds.

(4) Install spark plugs. When an engine is received for use without a DD Form 1397 attached, refer to TB 9-300-2/1 for method of establishing time limits of reprocessing cycles.

Note. If the vehicle has been driven to the using organization, most or all of the foregoing procedures should have been performed.

b. Specific Procedures.

(1) Warm engine by running at 1200 rpm for 20 minutes. Tighten cylinder head

bolts as described in paragraph 42*b*(8) for gasoline engine.

Figure 29. Rescinded.

(2) Perform the "S" (6-month or 6000 mile) preventive-maintenance (PM) service using Equipment Inspection and Maintenance Worksheet, DA Form 2404, as a worksheet.

(3) Lubricate all points of vehicle in accordance with lubrication order regardless of interval. Check processing Tag (DD Form 1397) for gearcase and engine oil. If tag indicates oil is suitable for an additional 500 miles of operation and is of the proper viscosity for local operation, check the level but do not change the engine or gearcase oils.

(4) Schedule second "S" (PM) services on Preventive-Maintenance Schedule and Record, DD Form 314, and arrange for oil change at 500 miles.

(5) Fuel and water tank trucks M49, M49C, M49A1C; M50 and M50A1 which have been in storage or in transit must be checked for tightening of all valve packings, flange bolts, and pump connections to prevent possible leakage caused by shrinkage of gaskets and packings.

11. Report of Deficiencies

Deficiencies disclosed during preliminary inspection which appear to involve unsatisfactory design or material, will be reported on DA Form 2407 (Maintenance Request) and prepared in accordance with TM 38-750, and sent to Commanding General, HQ, U.S. Army Tank-Automotive Command, ATTN: AMSTA-M, Warren, Michigan 48090.

Section II. PARTS, TOOLS AND EQUIPMENT

12. General

Tools, equipment, and repair parts are issued to organizational maintenance personnel for maintaining the trucks. 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.

13. Repair Parts

Repair parts are issued to organizational maintenance personnel for replacement of those parts most likely to become worn, broken, or otherwise unserviceable, provided replacement of these parts is within their scope. Repair parts supplied for the 2½ ton, 6 x 6, trucks, are listed in TM 9-2320-209-20P, which is the authority for requisitioning replacements.

14. Common Tools and Equipment

Standard and commonly used tools and equipment having general application to these trucks are authorized for issue by tables of allowances and tables of organization and equipment.

15. Special Tools and Equipment

Certain tools and equipment (fig. 30) especially designed for organizational maintenance, repair, and general use with the trucks are listed in table 1 for information only. This list is not to be used for requisitioning replacements. Special tools for organizational maintenance are listed in TM 9-2320-209-20P, which is the authority for requisitioning replacements.

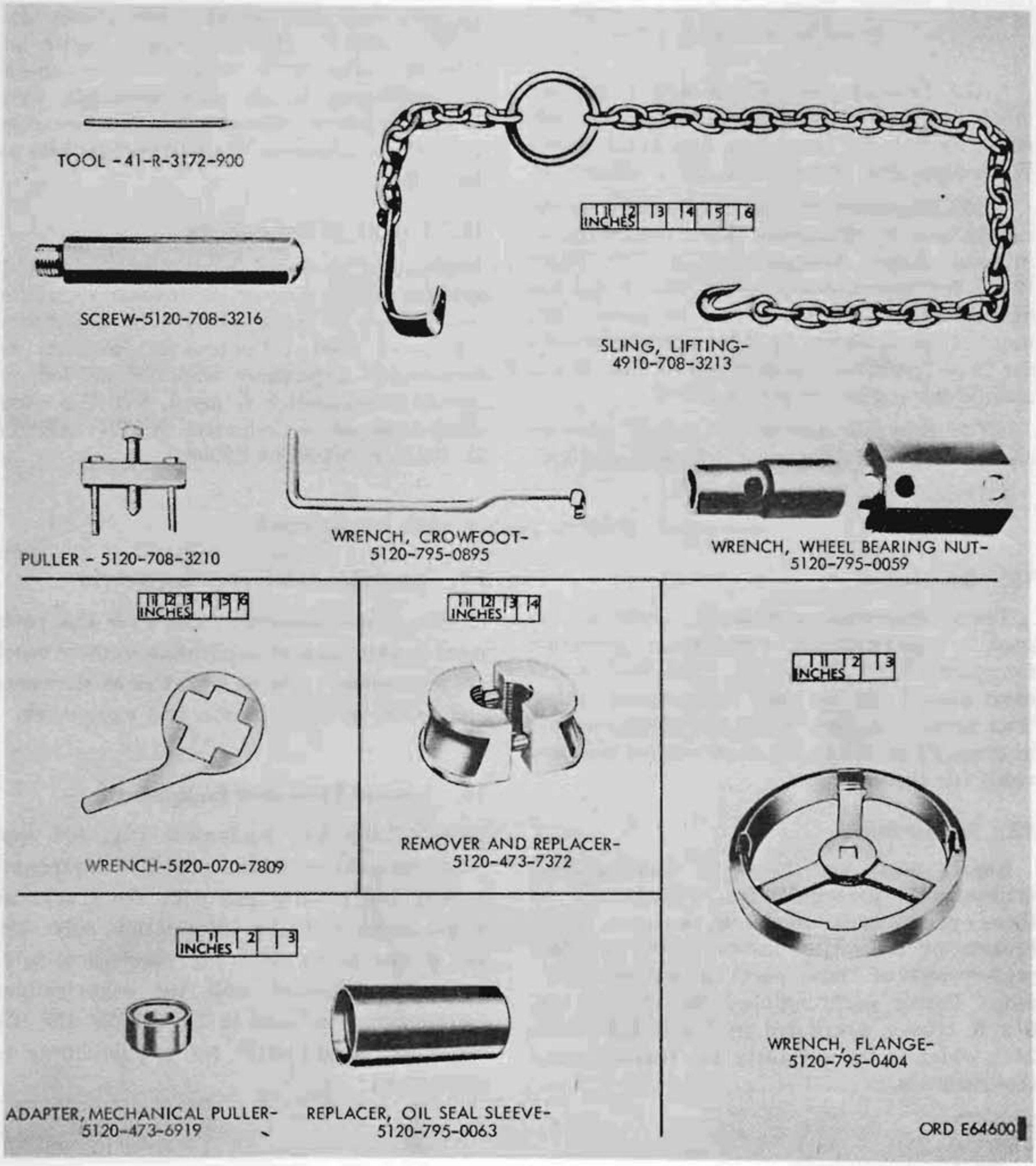


Figure 30. Special tools and equipment.

Table 1. Special Tools and Equipment for Organizational Maintenance

Item	Ordnance No.	Federal stock No.	Reference		Use
			Fig.	Par.	
PULLER (water pump pulley and fan hub).	7083210	5120-708-3210	139	91	Used for removing fan and water pump pulley.
REMOVER AND REPLACER (wheel bearing cup or rear seat bearing cup).	7082863	5120-473-7372	230	206	Used w/screw 5120-708-3216 for removing and replacing wheel bearing cup.
REPLACER, OIL SEAL SLEEVE (front or rear wheel hub inner oil seal).	7950063	5120-795-0063			Used for replacing wheel hub inner oil seal.
SCREW, REMOVER AND REPLACER.	7083216	5120-708-3216	230	206	Used w/remover and replacer 5120-473-7372 and 5120-708-3246.
SLING, LIFTING (cylinder head and manifold assembly).	7083213	4910-708-3213	85	42	Used for removing and installing cylinder head (gasoline engine only).
TOOL, ADJUSTING (governor).	41-R-3172-900	No FSN available	274	249	Used for adjusting auxiliary governor (gasoline engine only).
WRENCH, CROWFOOT (ignition harness nut).	7950895	5120-795-0895	145	99	Used for removing and installing spark plug cables.
WRENCH, (air compressor pulley).	10935288	5120-070-7809	241	218	Used for adjusting air compressor pulley (multifuel).
WRENCH, WHEEL BEARING NUT (wheel bearing nut).	7950059	5120-795-0059	228	185	Used for removing and replacing wheel bearing nut.
WRENCH, FLANGE.	7950404	5120-795-0404	241	218	Used to adjust air compressor pulley drive belt (air-cooled gasoline).
GAGE, Air Pressure.	7451305	6685-387-9654			Used to check pressure in air brake system.

Section III. LUBRICATION AND PAINTING

16. Lubrication Order (LO)

The Lubrication Order (LO 9-2320-209-12) prescribes cleaning and lubricating procedures as to locations, intervals, and proper materials for these trucks. Lubrication to be performed will be in accordance with the maintenance allocation chart (app. II) and the lubrication order. Whenever necessary, the operator, crew or user will assist the organizational maintenance personnel in lubrication of the trucks.

17. General Lubrication Instructions

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

b. Service Intervals. Service intervals specified on the lubrication order are for normal operation and where moderate temperature, humidity, and atmospheric conditions prevail. Refer to TM 9-207 for instructions on necessary special lubrication of the vehicle for operation in extreme cold weather.

c. Reports and Records.

(1) Report unsatisfactory performance of prescribed petroleum fuels, lubricants, or preserving materials on DA Form 2407 and prepare in accordance with TM 38-750.

(2) Maintain a record of lubrication of the vehicle in the vehicle log book on DA Form 2408-2 (Equipment Lubrication Record).

18. Painting, Spot Painting and Marking (Stencilling)

a. General. Instructions for the preparation of the material for painting, method of painting, and material to be used are contained in TM 9-213. Instructions for camouflage painting are contained in FM 5-20B.

b. Spot Painting. Spot painting and marking (stencilling) of tactical vehicles will be performed under the control of organizational maintenance personnel, except in cases where the driver is also a mechanic or mechanic's helper.

c. Painting of Vehicle. Painting of a complete vehicle will be performed by direct support maintenance units.

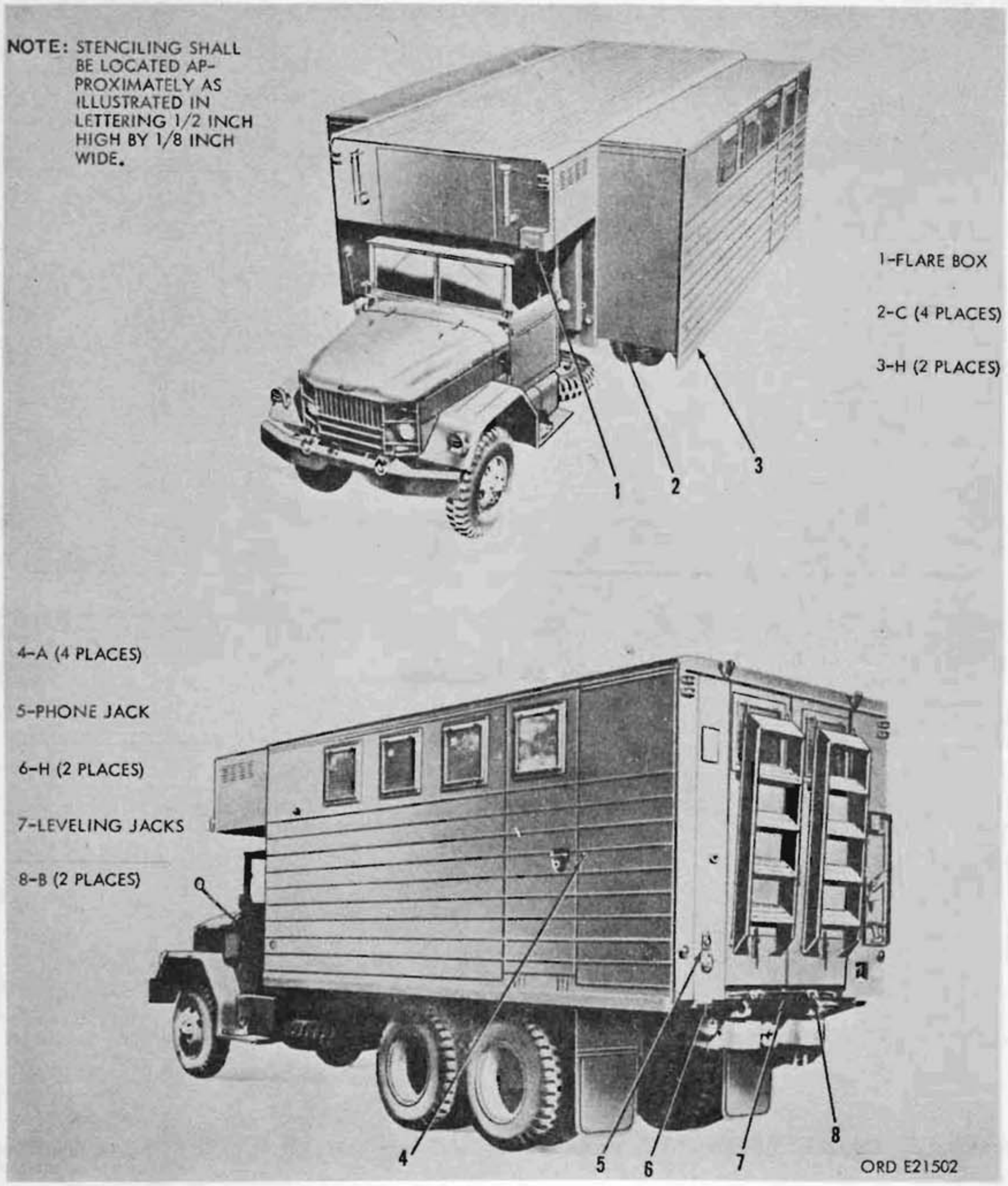
d. Stencilling Vehicle Markings. Stencilled markings must be renewed periodically because of weathering or repainting. To stencil markings use white (gloss) on olive drab (gloss) background. The legend "U.S. Army" and vehicular registration numbers shall be of a size to fit the vehicle (1, 2, 3, or 4 inches). The maximum safe refueling rate (TM 9-2320-209-10) must be stencilled on each vehicle, at a location near the fuel tank filler cap. Vehicles equipped with more than one fuel tank will be marked for each tank.

Refer to TB 746-93-1 and to figure 34 for instructions on marking military vehicles.

Figure 31. Rescinded.

Figure 32. Rescinded.

Figure 33. Rescinded.



Key	Item	Key	Item
1	Flare box	5	Phone jack
2	C (4 places)	6	H (2 places)
3	H (2 places)	7	Leveling jacks
4	A (4 places)	8	B (2 places)

Figure 34. Vehicle stencil markings, M292 van body

Section IV. PREVENTIVE-MAINTENANCE SERVICES

19. General

The purpose of preventive-maintenance services is to detect first signs of electrical and mechanical failures of assemblies in the vehicle, and to ensure that appropriate corrective action is taken before expensive and time-consuming repairs or replacements are required. The system of preventive-maintenance services is based on frequent inspections and services accomplished by operators, company, battalion, or regimental maintenance personnel under active supervision by all commanders and leaders.

20. Responsibility

Operators and crew chiefs are charged with personal responsibility for assigned vehicles. Squad, section, and platoon leaders are charged with supervisory responsibility for vehicles pertaining to their commands. Unit and organization commanders are required to ensure that vehicles issued or assigned to their commands are properly maintained in a serviceable condition, and that they are properly cared for and used.

21. Intervals

The mileage that a vehicle travels is the principal criterion for the frequency of preventive-maintenance service. Operation under adverse conditions, such as extreme temperature, dust, or mud, may require preventive-maintenance services to be performed more frequently. Reduce intervals between preventive-maintenance services when environmental conditions indicate the need. Do not extend intervals between preventive-maintenance services, except when authorized to do so.

22. Outline

The system of preventive-maintenance services for tactically used wheeled vehicles is outlined in Table 2. Daily services, as outlined, are designated as operators' services. Semi-annual "S" services are designated as organizational maintenance services.

23. General Procedures for Services and Inspections

a. The following general procedures apply to organizational maintenance preventive-maintenance services and to all inspections, and are just as important as the specific procedures.

b. Inspections to see if items are in good condition, correctly assembled or stored, secure, not excessively worn, not leaking, and adequately lubricated apply to most items in the preventive-maintenance and inspection procedures. Any or all of these checks that are pertinent to any item (including supporting, attaching, or connecting members) will be performed automatically, as general procedures, in addition to any specific procedures given.

(1) Inspection for good condition is usually visual inspection to determine if the unit is safe or serviceable. Good condition is explained furhter as meaning: Not bent or twisted, not chafed or burned, not broken or cracked, not bare or frayed, not dented or collapsed, not torn or cut, not deteriorated.

(2) Inspection of a unit to see if it is correctly assembled or stored is usually a visual inspection to see if the unit is in its normal position in the vehicle and if all its parts are present and in their correct relative positions.

Table 2. Outline of Preventive-maintenance Service

Service	Interval	Accomplished by
Semiannual "S" service.	Every 6 calendar months or 6000 miles, whichever occurs first.	Regimental or battalion or separate company/battery maintenance personnel.

(3) Excessively worn is understood to mean worn beyond serviceable limits or likely to fail, if 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.

c. Where the instruction "tighten" appears in the procedures, it means tighten with a wrench, even if the item appears to be secure.

d. Such expressions as "adjust if necessary" or "replace if necessary" are not used in the specific procedures. It is understood that whenever inspection reveals the need of adjustments, repairs, or replacements, the necessary action will be taken.

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

(1) Use drycleaning solvent or mineral spirits paint thinner to clean or wash grease or oil from all parts of the vehicle.

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

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

(4) When authorized to install new parts, remove any preservative materials, 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 order.

f. General precautions in cleaning are as follows:

(1) Drycleaning solvent or mineral spirits paint thinner is flammable and should not be used near an open flame. Fire extinguishers should be provided when this material is used. Use only in well-ventilated places. The battery ground cable should be disconnected and taped.

(2) This cleaner evaporates quickly and has a drying effect on the skin. If used without gloves, it 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 drycleaning solvent or mineral spirits paint thinner, engine fuels, or lubricants on rubber parts; they will deteriorate the rubber.

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

g. Nameplates, caution plates, and instruction plates made of steel rust rapidly. When plates are found in a rusty condition, they should be thoroughly cleaned and heavily coated with an application of clear lacquer. (Refer to TM 9-213.)

24. General Procedures

a. Automatically Applied. All of the general procedures given in paragraph 26 will be followed. Organizational mechanics must be so thoroughly trained in these procedures that they will apply them automatically at all times in the performance of their duties.

b. Operator's Participation. The driver or crew usually accompanies the vehicle and assists the organizational mechanics in the performance of second-echelon services.

c. Unwasher Vehicle. The driver or crew should present the vehicle for a scheduled preventive-maintenance service in a reasonably clean condition; that is, it should be dry and not caked with mud to such an extent as to seriously hamper inspection and services. However, washing of the vehicle should be avoided immediately prior to an inspection, since certain types of defects as loose parts and oil leaks may not be evident immediately after washing.

d. Services. Organizational maintenance services are defined by and restricted to general procedures unless approval has been given by the supporting Ordnance organization.

(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 23*c* to remove old lubricant, dirt, and other foreign material.

(3) *Special lubricant.* This applies either to lubrication operations that do not appear on the vehicle lubrication order or to items that do appear but which should be performed in connection with the maintenance operations if parts have to be disassembled for inspection or service.

(4) *Service.* This usually consists of performing special operations, such as replenishing battery water, draining and refilling units with oil, and changing and cleaning the oil filter, air cleaner or cartridges.

(5) *Tighten.* All tightening operations should be performed with sufficient wrench torque (force on the wrench handle) to tighten the unit according to good mechanical practice. Use a torque-indicating wrench where specified. Do not overtighten as this may strip threads or cause distortion. Tightening will always be understood to include the correct installation of lockwashers, locknuts, locking wire, or cotter pins to secure the tightened nut.

(6) *Modification work order application.* At least every 6 months, a checkup will be made to see that all modification work orders have been applied. A list of current modification work orders is published in DA Pam 310-7. If a modification has not been applied, promptly notify the local Ordnance officer. No alteration or modification which will affect the moving parts, will be made by organizational personnel, except as authorized by official publications.

e. Special Condition. When conditions make it dfficult 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 should be given first consideration.

f. DA Form 2404 (Equipment Inspection and Maintenance Worksheet.) Perform the "S" preventive-maintenance service in the sequence given in table 3, using DA Form 2404 as a worksheet.

25. Semiannual "S" Preventive-Maintenance Services

a. Purpose. The "S" preventive-maintenance services ensure the correct adjustment, securing, and assembly of all components of the materiel. Necessary replacements, cleaning, lubrication and protection of parts and/or assemblies will be accomplished as required, to give reasonable assurance of trouble-free operation until the next "S" preventive-maintenance service is performed.

b. Intervals. The semiannual "S" preventive maintenance services are performed by the organizational mechanics every 6 months or at every 6000 miles of vehicle operation, whichever occurs first. Under unusual conditions temporary deviation from the prescribed service or interval may be authorized at the discretion of the commander. The commander will consult with the direct support Ordnance officer prior to a decision to deviate from these services.

26. Specific Procedures for Organizational Maintenance

Specific procedures for performing each item in the semiannual "S" preventive-maintenance services on the material are given in Table 3 in accordance with procedures outlined. Results of inspection and checking during preventive-maintenance services is authorization to take corrective action by performing the service or repair at organizational maintenance level. If repairs by a higher maintenance level are required, a DA Form 2407 (Maintenance Request) will be prepared and forwarded with the equipment to the supporting maintenance activity.

Table 3. Preventive-Maintenance Checks and Services

Organizational maintenance		Semiannual schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		PRIOR TO ROAD TEST	
	Perform all "before operation" checks listed in TM 9-2320-209-10, "Preventive Maintenance Checks and Services."	*Note.* When the tactical situation does not permit a full road test, perform those items which require little or no movement of vehicle.	
		ROAD TEST	
1	Starter and switch	Notice if starter pedal requires only normal pressure to engage starter, and engine starts immediately without unusual noises.	102
2	Instruments and operational check.	Immediately after starting, notice oil pressure will have a sharp rise. Correct reading on gage is 30 to 40 psi at normal-temperature and idling speed. Check generator indicator before generator regulator has reduced charging rate. Observe all instruments for normal readings. Test windshield wipers. If tactical situation permits, sound horn.	126
3	Air pressure	During warmup period, run engine at fast idle (about 1000 rpm) and observe if air pressure builds up to 100 psi in 10 minutes (or less) and if the governor cuts off the compressor when air pressure is between 100 and 105 psi. Operate service brake to reduce air pressure and observe if governor cuts in compressor when air pressure is 85 psi. Reduce pressure to 65 psi to see if low air pressure warning buzzer is operating. Stop engine with air pressure at maximum, and notice if any drop on airpressure gage within 1 minute. Restart engine.	216
4	Hand throttle and choke	Notice if actions of choke and hand throttle are satisfactory.	65

Table 3. Preventive-Maintenance Checks and Services—Continued

Organizational maintenance		Semiannual schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		ROAD TEST—Continued	
5	Clutch	Check pedal travel. Free travel must be from 1½ to 2 inches. Listen for defective clutch release bearing, drag, noise, chatter or slippage.	150
6	Transmission and transfer	Shift transmission and transfer into all speeds. Observe any unusual stiffness of shifting levers, tendency to slip out of gear, unusual noise, or excessive vibration. Excessive vibration of shifting levers may indicate loose mountings.	155 and 159
7	Brakes (service, hand and trailer).	Check braking effect, feel, side pull, noise, chatter, pedal travel, hand control and effort necessary to apply. Make service stops noting other unusual conditions. Notice if air-hydraulic cylinder is assisting satisfactorily. Observe if ratchet and pawl of handbrake holds and if lever requires more than three-quarters travel for full application. Release handbrake and check to see that brake band is free and completely released. Stop vehicle on an incline and apply handbrake to see if it holds vehicle or if application of handbrake at speed of 10 mph stops vehicle within reasonable distance.	176, 186 and 247
8	Steering assembly	With vehicle moving straight ahead, steering wheel free play should not exceed 1 inch. Notice if there is any tendency to wander, shimmy, or pull to side. Turn steering wheel through its entire range and note any bind.	196

Table 3. Preventive-Maintenance Checks and Services—Continued

Organizational maintenance		Semiannual schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		ROAD TEST—Continued	
9	Power train, wheels, body and cab.	While operating the vehicle notice if it has normal power and acceleration in each speed. Listen for any unusual noise when engine is under load. Speed up vehicle on level stretch to see if it will reach, but not exceed governed speed indicated on data plate. At all times during road test, be alert for unusual or excessive noise that may indicate looseness, defects or deficient lubrication in these components.	155, 159, 171, 174, 203
		AFTER ROAD TEST	
10	Hubs, drums, axles, power train.	Immediately after road test, feel these units cautiously. An overheated wheel hub and brakedrum indicate an improperly adjusted, defective, or dry wheel bearing or a dragging brake. An abnormally cool condition indicates an inoperative brake. An overheated gear case indicates internal maladjustment, damage, or lack of lubrication. Cautiously feel each axle differential and carrier, transmission, and transfer for overheating. *Note.* It is normal for transfer to run hot after vehicle has run for a considerable distance. If transfer is too hot for hand to be placed upon it, it is not necessarily a sign of malfunctioning. If it is adequately lubricated and did not howl during road test, the unit can be considered normal. Inspect axle propeller shafts. Tighten universal joint assembly and flange units.	162, 169, 176, 205
10.1	CV boots	Examine front axle steering knuckle boots for tears and leaks	169d

Table 3. Preventive-Maintenance Checks and Services—Continued

Organizational maintenance		Semiannual schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		AFTER ROAD TEST—Continued	
11	Leaks	Check engine oil, fuel and water systems, transmission, transfer and all other components carrying fluids, oil, or grease. Make general observations in the engine compartment and underneath the vehicle for oil, water, fuel and exhaust leaks. Examine spark plugs, manifold, and cylinder head gaskets for leaking condition.	41, 43, 98
		CAUTION: Do not tighten manifold unless there is evidence of looseness or leakage.	
		Gasoline engine vehicles only:	
		Tighten cylinder head using torque wrench. Tighten in proper sequences. When new cylinder head gasket is installed, tighten cylinder head upon installation and also after completion of final road test while engine is at normal operating temperature.	10, 42
		Check and adjust valve clearance, if necessary.	39
12	Battery specific gravity	Make hydrometer test of electrolyte in each cell. Inspect cables, terminals, bolts, posts, holddown frame, slave receptacle and radio receptacle.	111
13	Battery voltage	Check batteries for damaged case, terminals, or cell cover plates. Check for holddown-to-cable short circuit. If any of these conditions are noted, replace batteries. Test battery voltage using low voltage circuit tester.	111
	Note. The following checks (14 through 20) are to be performed on the gasoline engine only.		
14	Spark plugs	Remove and inspect. Clean spark plugs and adjust gap to 0.030 inch. Replace if necessary.	98

Table 3. Preventive-Maintenance Checks and Services—Continued

Organizational maintenance		Semiannual schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		AFTER ROAD TEST—Continued	
15	Compression test	With engine at normal operating temperature, throttle, and choke full open, test compression of each cylinder.	41
16	Engine valve mechanism	Gage valve clearance and look for broken valve springs, if need for adjustment is indicated by poor engine performance, low compression or noise. If clearance is found insufficient, adjust, and recheck compression. Replace rocker-arm cover gasket.	39
17	Ignition components	Remove and inspect distributor cap, rotor and breaker points. Test distributor shaft for looseness. Inspect and test ignition coil and distributor breakage plate capacitor with low and high tension tester. Using neon timing light, observe if ignition timing is correct and if spark advances automatically as engine is accelerated. Test generator-regulator with low voltage circuit tester. Dress or replace breaker points.	94 through 97, 100, 109 Table 5, fig. 45
18	Carburetor, choke, throttle, linkage.	Inspect these items, noticing particularly if shafts and linkage operate freely and are not excessively worn. Observe if the choke valve opens fully when control is released and if throttle valve opens fully when accelerator is fully depressed.	65
19	Carburetor adjustment	Perform a vacuum test by running engine at normal idling speed (450 rpm). Vacuum gage should read between 18 and 21 inches of mercury and the pointer should be steady. A needle reading fluctuating between 10 and 15 inches of mercury may indicate defective cylinder head gasket or valve. An extremely low reading indicates leak in carburetor spacer or gaskets. Accelerate and decelerate the engine quickly. If gage indicator fails to drop approximately 2 inches as throttle is opened, and fails to recoil to at least 24 inches as throttle is closed, this may be an indication of diluted oil, poor piston ring sealing, or abnormal restriction in the carburetor, air cleaner or exhaust system. *Note.* The above readings apply to sea level. There will be approximately a 1-inch drop for each increase of 1000 feet of altitude. Adjust carburetor idle mixture and test fuel pump pressure.	63

Table 3. Preventive-Maintenance Checks and Services—Continued

Organizational maintenance		Semiannual schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		AFTER ROAD TEST—Continued	
20	Manifold and heat control valve.	Inspect these items. Look particularly for signs of leakage at manifold gasket. Check seasonal adjustment of heat control valve.	46
	Note. The following checks (21 through 28) are to be performed on the multifuel engine only.		
21	Air intake system	Check air cleaner and air intake tubes and hose for secureness. Inspect hose for damage. Check air cleaner element for contamination and clean if necessary.	70
22	Manifold preheater	Check connections, tubing and wiring for secureness.	72, 73
23	Oil filters	Inspect oil filters for leaks and secureness. Replace element in accordance with intervals specified in LO 9-2320-209-12.	55
24	Fuel filter	Inspect secondary and final fuel filters for leaks. Replace elements in accordance with intervals specified in LO 9-2320-209-12.	77
25	Fuel lines and fittings	Inspect high pressure fuel lines at fuel injection pump and fuel injection nozzles for looseness, leaks, damaged lines and fittings. Inspect low pressure lines from fuel filters to fuel injector.	74-75

Table 3. Preventive-Maintenance Checks and Services—Continued

Organizational maintenance		Semiannual schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		AFTER ROAD TEST—Continued	
26	Throttle linkage	Inspect, noticing particularly if shafts and linkage operate freely and are not excessively worn. Observe if the throttle valve opens fully when accelerator pedal is fully depressed.	71
27	Fuel-air mixture	Observe color of exhaust gas. At engine speeds above 1400 rpm, smoke should be clear to light gray. If color is darker, notify direct support maintenance unit. *Note.* Black smoke is normal while engine is accelerating to 1400 rpm.	
28	Exhaust pipe and mufflers	Inspect; listen for excessive or unusual noises and look for exhaust leaks. Tighten mountings.	79, 80, 82
29	Crankcase, breather caps and ventilators.	Inspect crankcase breather, air cleaner, ventilation valves and lines. Clean and service these items in accordance with the lubrication order.	62
30	Radiator and cap	Inspect core, shell, hose, cap and gasket, and overflow tank, noticing particularly if the radiator core is clogged with foreign material or if fins are bent. Test operation of filler cap. Observe coolant level and examine for contamination. Test coolant with a hydrometer to see if it contains sufficient antifreeze during cold weather. If need is indicated, drain radiator and block, clean, flush, refill, and add inhibitor unless antifreeze, which contains inhibitor, is used. Tighten radiator mountings and hose connections.	84

Table 3. Preventive-Maintenance Checks and Service-Continued

Organizational Maintenance		Semiannual Schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		AFTER ROAD TEST – Continued	
32	Water pump fan, pulleys, and belts.	Inspect pulleys and fan for alinement, and belts for tension. Check water pump for leaks.	88, 89, 91
33	Air compressor and governor.	Inspect condition of air compressor, belts for tension, pulley alinement, and secure. Inspect compressed air cleaner and governor, air strainer. Clean and service these items in accordance with the lubrication order.	218, 219, 220
34	Engine speed governor.	If road test indicates the vehicle speed was incorrect, adjust engine speed governor.	64
35	Fuel tank and filter.	Clean fuel tank filter neck screen. Drain water and sediment from fuel tank. If there is evidence of contamination, drain into a container. Inspect fuel and vent lines and connections.	67, 68
36	Brakeshoes, linkage, anchor pins, cylinders, and brakehoses.	a. Test brake linkage for freedom of action. Drain water from reservoirs. Examine air-hydraulic cylinder. Adjust brakes.	176, 178, 179, 180, 183, 184
		b. Check flexible brakehoses for seepage at any point; pinching of hose; evidence of wear due to rubbing with vehicle structure; and hose stress due to improper installation. Replace or reposition hose as required.	
37.	Tires.	Rotate and match tires according to tread design and degree of wear. Refer to TM 9-1870-1 for acceptable limits in matching tires. All wheel nuts, rims and side rings should be in serviceable condition and secure. Check that wheel turning stops are secure. Turn front wheels fully in both directions and check whether turns are limited by stops and the tires clear all parts of vehicle.	201, 204
38.	Springs and shock absorbers.	Inspect springs, suspension, shock absorbers, and torque rods for damage and security.	188

Table 3. Preventive-Maintenance Checks and Services - Continued

Organizational Maintenance		Semiannual Schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		AFTER ROAD TEST - Continued	
39	Body and frame.	Inspect body and frame for security of mounting bolts. **Caution:** Do not tighten front winch brake spring adjusting screw on winch automatic brake during tightening of body and frame bolts.	
40	Lubrication.	Lubricate vehicle in accordance with the lubrication order.	LO 9-2320-209-12
41	Cab and body.	Inspect doors, glass, top and frame, hardware, curtain and fasteners, seats, upholstery, trim, safety straps and paint for general condition and security. Test operation of doors, windows, windshield, ventilators, hood hinges and catches.	229 through 234
42	Bumpers, pintle and shackles.	Inspect bumpers, pintle and lifting shackles. Test operation of pintle assembly and note if it locks securely and lockpin is attached with chain.	225, 226
43	Power takeoff and winch.	Inspect transmission power takeoff, front winch drum line, drive shaft and shear pin. Test operation of front winch. Adjust winch drag and worm automatic brakes if necessary.	163 207 through 213
44	Transfer power takeoff.	(Models M49, M49C, M49CA1, M50, M50A1, M60, M108, V-17A/MTQ, V-18A/MTQ) Inspect transfer power-takeoff control lever linkage.	158
		ITEMS SPECIAL TO CARGO TRUCKS M34, M35, M35A1, M36, M36C	
45	Cargo body.	Inspect panels and tailgate for damage and corrosion. Check for warping and looseness. Check body paulin for tears, holes and fit.	236, 237, 238

Table 3. Preventive-Maintenance Checks and Services—Continued

Organizational maintenance		Semiannual schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		ITEMS SPECIAL TO CARGO TRUCKS M34, M35, M35A1, M36, M36C—Continued	
46	Bedplate and mounting bolts	Inspect bedplate and mounting bolts for security and damage. Tighten all assembly and mounting bolts.	
		ITEMS SPECIAL TO DUMP TRUCK M47, M59, AND M342	
47	Hydraulic hoist	Inspect hydraulic hoist pump, control box, control valve, oil lines, and linkage for security and damage. Test operation of dump body for holding raised position, lowering fully, and alinement with truck body.	239, 240, 241
48	Dump body	Inspect dump body. Tighten mounting and assembly bolts and capscrews. Adjust or tighten linkage, if necessary.	239
		ITEMS SPECIAL TO TRACTOR TRUCK M48 AND M275	
49	Trailer air brake hoses, coupler jaws, electrical cable and connectors.	Inspect trailer air-brake hose, electrical cable, and connectors for security, chafing, damage and wear. Check operation of air-brake hand control valve and coupler jaw.	244 through 247
50	Fifth wheel	Inspect this item. Look particularly for face wear or damage, proper swivel action. Observe to see if face of disk is level with width of truck. Tighten mounting bolts and screws securely.	243
		ITEMS SPECIAL TO TANK TRUCKS M49, M49C, M49CA1, M50, AND M50A1	
51	Pumps	Inspect delivery pump, valves, lines, hose, controls, strainers, nozzles, vents and safety wiring for security, leaks and damage. Check valves and controls for proper operation.	251 through 254 266 through 271

Table 3. Preventive-Maintenance Checks and Services—Continued

Organizational maintenance		Semiannual schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		ITEMS SPECIAL TO TANK TRUCKS M49, M49C, M49CA1, M50, AND M50A1—Continued	
52	Tank body	Inspect tank body for leaks, scraped paint, and properly fitted manhole and filler covers. Check all vents, chains, locks, and safety wiring for condition and operation.	251, 255, 274
53	Engine speed	Check engine speed as controlled by engine auxiliary governor, and adjust if necessary.	249
54	Clean	Clean pump, valve, filler and suction line strainers. Flush and dry all water hoses.	252 through 258 266 through 273
55	Dispensing unit	Tighten nozzles, dispensers, valves, pump, and line mounting and assembly bolts and capscrews. *Note.* Tighten packing nuts cautiously. Overtightening will cause restricted action, excessive wear and possible leaks. Adjust control cables, if necessary.	252 through 258 266 through 273
55.1	Filter	Change filter, element and fuses annually.	405–407
		ITEMS SPECIAL TO CRANE TRUCKS M60 AND M108	
56	Hydraulic crane	Inspect boom and shipper, hydraulic cylinder, swing motors, cable hoist drum and motor, control valves, lines, hose, pump, valves and lights for security of mounting. Check for wear, adjustment, chafing, binds and other damage. Operate control valve hand levers, noting if crane action is smooth. Crane should not creep when levers are in NEUTRAL position with a normal load on the hoist cable. Operate brake-lock switch and check for holding and releasing of solenoid brake lock.	278 through 286

Table 3. Preventive-Maintenance Checks and Services - Continued

Organizational Maintenance		Semiannual Schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		ITEMS SPECIAL TO CRANE TRUCKS M60 AND M108 - Continued	
57	Engine speed.	Check engine speed as governed by engine auxiliary governor at 1700 rpm, and adjust if necessary.	249
58	General condition.	Tighten all connections, fittings, and mounting and assembly bolts. Do not overtighten packing retainer.	282
		ITEMS SPECIAL TO SHOP VAN TRUCKS M109, M109A1, M109A2, 109C, 109D, 185, 185A1, 185A2 AND XM567	
59	Van body, body accessories and hardware.	Inspect van body for leaks. Tighten mounting and assembly bolts and connections. Visually inspect body panels and reflectors. Examine condition of paint and legibility of markings and data plates. Inspect boarding ladder, mountings, and hardware. Inspect and test operation of doors, hinges, locks, latches, padlock, and door holders; inspect seals for weathertightness. Lubricate main and auxiliary door hinges, locks, latches, and door holders. Lubricate boarding ladder stowage fastener.	16, 17, 18
60	Harness (24v).	Check exterior wiring harness (24v) to be sure it is connected. Also check condition of wiring and connections.	120
61	Lights.	Operate lights (if tactical situation permits).	293, 294, 295 365
62	Blower.	Check operation of ventilator blower at the multibreaker. Check blower for security of mounting and tightness of electrical connections.	229, 331

Table 3. Preventive-Maintenance Checks and Services - Continued

Organizational Maintenance		Semiannual Schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		ITEMS SPECIAL TO SHOP VAN TRUCKS M109, M109A1, M109A2, M109C, M109D, M185, M185A1, M185A2 AND XM567 - Continued	
63	Heater.	Check space heater for security of mounting and check fuel and electrical connections for tightness. Inspect heater fuel pump and exterior fuel line connections for leaks.	363
64	Fire extinguisher.	Visually check to see that the fire extinguisher is charged, sealed, and securely mounted to the bracket.	
65	Clean.	Clean inside of vehicle. Wash vehicle, if possible; otherwise, wipe off thoroughly.	
		ITEMS SPECIAL TO TELEPHONE CONSTRUCTION AND MAINTENANCE TRUCK V-17A/MTQ	
66	Telephone construction and maintenance body components.	Inspect pole derrick, collapsible cable reel, pole-pulling jack, body, and other equipment, for damage. Tighten mounting and assembly bolts.	302, 303, 304
67	Rear winch.	Inspect rear winch cable, control lever linkage, worm and auxiliary shaft drive chains, rear winch drive shaft, and pillow block. Test operation of winch. Adjust drive chain. Clean and oil drum line in accordance with lubrication order.	305 through 308
		ITEMS SPECIAL TO EARTH BORING MACHINE AND POLE SETTER TRUCK V-18A/MTQ	
68	Earth boring and pole setter components.	Inspect equipment holders, power-dividers, collapsible reel, earth augers, pole pulling jack, control lever linkage, and earth boring machine for wear, security and damage. Operate power-divider and check for shifting and holding	317 through 321

Table 3. Preventive-Maintenance Checks and Services - Continued

Organizational Maintenance		Semiannual Schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		ITEMS SPECIAL TO EARTH BORING MACHINE AND POLE SETTER TRUCK V-18A/MTQ - Continued	
68	Earth boring and pole setter components - continued.	action. Operate the earth boring machine and check vertical power leveler and horizontal leveling worm assembly for positioning of auger rack. Check feed and drive actions of boring machine. Pay special heed to slippage in clutch and brake case. Make sure all auger rack action stops upon release of operating handles. Adjust leveling worms and control levers if necessary. Tighten mounting and assembly bolts.	
69	Rear winch.	Inspect rear winch cable, control lever linkage, worm drive chain and chain idler pulley. Test operation of winch. Adjust drive chain tension if necessary. Clean and oil drum line or cable in accordance with lubrication order.	310 through 316
		ITEMS SPECIAL TO EXPANSIBLE VAN TRUCKS M292 AND M292A1	
70	Van body.	Inspect van body and equipment as directed in sequence 59 through 65.	
71	Expansible mechanism (van in use).	Inspect the rails and sliding portions of the sides for evidence of misalinement, corrosion, cracks, or damage which would prevent proper operation of the expansible feature.	339
72	Expansible mechanism (van empty).	Operate the various sections enough to determine if the expansible feature is operational. Lubricate in accordance with LO 9-2320-209-12. Tighten all mounting and assembly screws and bolts.	TM 9-2320-209-10

Table 3. Preventive-Maintenance Checks and Services - Continued

Organizational Maintenance		Semiannual Schedule	
Sequence No.	Item to be inspected	Procedure	Paragraph references
		ITEMS SPECIAL TO EXPANSIBLE VAN TRUCKS M292 AND M292A1 - Continued	
73	Air conditioner.	Inspect air conditioners for security of mounting, condition of filters, motors, heat exchangers, piping and wiring. Clean out any debris or excessive dirt accumulation. Check control panel for good condition. Perform an operational check upon completion of inspection.	346
		ITEMS SPECIAL TO MISSILE FIRING COMPUTER VAN TRUCK XM472	
74	Van body.	Inspect van body as directed in sequences No. 59 through 65.	367
		ITEMS APPLICABLE TO ALL TRUCKS	
75	Clean.	Wash vehicle, clean cab, glass, engine and engine compartment as required.	
		FINAL ROAD TEST	
76	Test.	Observe additional items which require repair, replacement, or adjustment.	

Section V. TROUBLESHOOTING THE VEHICLE

27. Scope

a. This section contains troubleshooting information and tests for locating and correcting some of the troubles which may develop in the vehicle. Each symptom of trouble or malfunction given for an individual unit or system is followed by a list of probable causes of the trouble and corrective actions necessary to remedy the malfunction.

b. This technical manual cannot cover all possible troubles and deficiencies that may occur under the many conditions of operation. If a specific malfunction, cause, and corrective action, therefore, are not covered herein, proceed to isolate the system in which the trouble occurs and then locate the defective component. Use all the senses to observe and locate troubles. Do not neglect the use of any test instruments such as ohmmeter, 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 the vehicle operator to obtain the maximum number of observed symptoms. The greater the number of symptoms of trouble that can be evaluated, the easier will be the isolation of the primary cause or defect. Since the operator of the vehicle, in most instances, can describe malfunctions only in terms of unsatisfactory vehicle performance, trained personnel should be capable of analyzing the operational symptoms to determine the primary cause of the malfunction.

c. Good operational trouble analysis depends on logical followthrough from effect or major malfunction to the primary cause before corrective measures (remedies) may be applied. This section has been arranged to assist organizational maintenance personnel in systematic followthrough to isolate the primary causes of malfunction. The test and remedies provided herein are governed by the scope of the organizational level of maintenance.

28. Procedures

Table 4 lists possible malfunctions that may be experienced during the operation of this vehicle or its components. Each malfunction is followed by a list of probable causes that may be considered in determining the action necessary to correct the malfunction. Probable causes are listed in their order of probability and should be considered in that manner during troubleshooting.

29. General

Table 4 supplements the troubleshooting section in TM 9-2320-209-10. It provides a continuation of instructions, where a remedy in the operator's manual refers to organizational maintenance personnel for corrective action.

Table 4. Troubleshooting

Malfunction	Probable causes	Corrective action
	GASOLINE ENGINE	
1. Engine fails to crank when starter switch is held on.	a. Inoperative starting system.	a. Troubleshoot starting system (item 46 below) for inoperative starter.
	b. Mechanical seizure of parts.	b. If starting system (a above) is in satisfactory operating condition, trouble may be caused by mechanical seizure of parts. Notify direct support maintenance unit.
2. Engine cranks but will not start.	a. Ineffective starting system.	a. If starter action is sluggish, troubleshoot starting system for noisy or sluggish starter (items 47 and 48).
	b. Defective ignition system.	b. Refer to item 22, Ignition System.
	c. Faulty fuel system.	c. Remove one spark plug (par. 90) from cylinder head. Crank engine with starter. If fuel is not detected in cylinder, disconnect pump-to-carburetor line at carburetor (par. 63). Crank engine with starter. If fuel flows freely from line, troubleshoot fuel system for lack of fuel to engine cylinder (item 14). If no fuel flows from line, troubleshoot fuel system for lack of fuel to carburetor (item 15). If fuel flow is small or low in pressure, troubleshoot fuel system for insufficient fuel and low fuel pressure (items 16 and 18).
	d. Improper intake and exhaust valve adjustment.	d. Check intake and exhaust valve clearance (par. 39) and adjust, if necessary.
3. Engine starts but stalls immediately after starting.	a. Ineffective ignition system.	a. Troubleshoot ignition system for weak spark (item 22).
	b. Faulty fuel system.	b. Troubleshoot fuel system for improper fuel-air mixture and low fuel pressure (items 17 and 18).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	GASOLINE ENGINE - Continued	
3. Engine starts but stalls immediately after starting - Continued	c. Leaking cylinder head gasket.	c. Pour a small quantity of oil onto edges of cylinder head gasket. Start engine. A blowing out or sucking in of oil will occur if gasket leaks. Tighten cylinder head bolts (par. 42) in proper sequence and to proper torque. If leak persists, replace cylinder head gasket(s).
	d. Intake and exhaust valves not functioning properly.	d. Remove valve rocker arm cover (par. 39) and check for broken or weak valve springs. Check for sticky valves. Apply penetrating oil to sticky valves. Check valve clearance (par. 39) and adjust if necessary. Check engine vacuum (item 19, table 3). If adjustments do not remedy valve malfunctioning, notify direct support maintenance unit.
	e. Low or uneven engine cylinder compression.	e. Test engine cylinder compression (par. 41). Compression must be 120 to 130 psi and must not vary more than 10 psi between cylinders. If compression is low or variation is greater than 10 psi, notify direct support maintenance unit.
4. Engine stalls when vehicle is standing, slowing down, or stopping.	a. Faulty fuel system.	a. Troubleshoot fuel system (item 17) for improper fuel-air mixture.
	b. Ineffective ignition system.	b. Refer to item 22.
	c. Intake and exhaust valves not functioning properly.	c. Refer to item 3d.
	d. Low or uneven engine cylinder compression.	d. Refer to item 3e.
5. Engine misfires or knocks at idling.	a. Defective ignition system.	a. Troubleshoot ignition system (item 22) for intermittent spark failure.
	b. Faulty fuel system.	b. Troubleshoot fuel system (item 17) for improper fuel-air mixture.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	GASOLINE ENGINE - Continued	
5. Engine misfires or knocks at idling - Continued	c. Hydraulic resonance.	c. Refer to paragraph 29.
	d. Intake and exhaust valves not functioning properly.	d. Refer to item 3d.
	e. Low or uneven engine cylinder compression.	e. Refer to item 3e.
	f. Leaking cylinder head gasket.	f. Refer to item 3c.
6. Engine backfires.	a. Defective ignition system.	a. Troubleshoot ignition system for improper timing (item 22).
	b. Faulty fuel system.	b. Troubleshoot fuel system for improper fuel-air mixture (item 17).
	c. Open intake valve.	c. Check for open intake valve due to stickiness, defective valve spring, or improper valve clearance according to procedure in item 3d.
7. Engine runs erratically at low speeds.		Troubleshoot according to procedure in item 4.
8. Engine misfires at high speeds.	a. Ineffective ignition system.	a. Troubleshoot ignition system (item 22).
	b. Faulty fuel system.	b. Troubleshoot fuel system for insufficient fuel flow and low fuel pressure (items 16 and 18).
	c. Leaking cylinder head gasket.	c. Refer to item 3c.
	d. Intake and exhaust valves not functioning properly.	d. Refer to item 3d.
9. Engine does not develop full power.	a. Overheated engine.	a. Check for broken or loose fan belt. Troubleshoot Cooling System (item 44). Check for diluted engine oil.
	b. Faulty ignition system.	b. Troubleshoot ignition system (item 22).
	c. Intake and exhaust valves not functioning properly.	c. Refer to item 3d.
	d. Faulty fuel system.	d. Troubleshoot fuel system for insufficient fuel flow and improper fuel-air mixture (items 16 and 17) or grade of fuel.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	GASOLINE ENGINE - Continued	
9. Engine does not develop full power - Continued	e. Incorrect governor setting.	e. Check engine speed governor for correct governed speed. Use a tachometer attached to distributor (par. 93) to check engine speed. Adjust governor (par. 64) if necessary.
	f. Low or uneven engine cylinder compression.	f. Refer to item 3e.
	g. Faulty breather and ventilation system.	g. Troubleshoot breather and ventilation system (item 112) for high engine crankcase pressure.
	h. Wear of engine parts.	h. Excessive piston or bearing wear can cause loss of power. If wear is suspected, as evidenced by noisy engine, notify direct support maintenance unit.
10. Engine overheats.	a. Ineffective cooling system.	a. Refer to item 44.
	b. Faulty ignition system.	b. Check ignition timing (par. 100) for late firing and adjust timing if necessary.
	c. Faulty fuel system.	c. Troubleshoot fuel system (item 14) for improper fuel-air mixture.
	d. Faulty breather and ventilation system.	d. Troubleshoot breather and ventilation system (item 112) for high engine crankcase pressure.
	e. Oil contamination.	e. Check for engine-oil dilution that would cause thinning of oil or prevent proper engine lubrication. Clean air cleaner (par. 62) and compressor air strainer (par. 221).
11. Excessive engine oil consumption.	a. Leaks.	a. Inspect engine, oil filter, engine compartment, flywheel housing, and ground under engine for signs of oil leaks. Check for signs of cylinder block oil seal failure. Tighten leaking connections. Repair or replace defective oil-filter inlet and outlet lines (par. 44). If trouble is not remedied or oil-seal

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Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	GASOLINE ENGINE - Continued	
11. Excessive engine oil consumption - Continued	a. Leaks - Continued	a. Continued failure is indicated, notify direct support maintenance unit.
	b. Engine overheats.	b. Refer to item 10.
	c. Low or uneven engine cylinder compression.	c. Refer to item 3e.
	d. Improper operation.	d. Refer to TM9-2320-209-10.
	e. Wear of engine parts.	e. Wear of engine internal parts can cause increased consumption of oil. If wear is suspected as evidenced by exhaust fume odor or dark color, notify direct support maintenance unit.
12. Engine consumes excessive fuel.	a. Improper operation of vehicle.	a. Improper operation of vehicle can cause éxcessive fuel consumption. See TM 9-2320-209-10.
	b. Faulty fuel system.	b. Troubleshoot fuel system (item 19) for excessive fuel consumption.
	c. Brakes dragging or other friction.	c. Check for dragging brakes, and adjust brakes (pars. 176 and 178). Trouble-shoot transmission (items 65-68), transfer (items 73-80), clutch (items 61 -64), front axle (items 83-85), propeller shafts (items 81 and 82), rear axles (items 85-88), and wheels, tires, and hubs (items 101 and 102) for wear, damage, noise, overheating, shimmy shake, and other signs of excessive drag on engine. Lubricate the component or replace if defective.
13. Engine operation erratic at different altitudes or temperatures.	Fuel-air mixture not adjusted for environment.	Adjust carburetor for proper fuel-air mixture (par. 63).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	FUEL SYSTEM (GASOLINE ENGINE)	
14. Lack of fuel in engine cylinders.	a. Throttle not opening.	a. Check throttle control (par. 65) and adjust if necessary.
	b. Choke inoperative.	b. Loosen hose clamps and remove carburetor intake hose from carburetor. Check choke valve plate action by moving choke control knob in and out. Plate must be fully open when knob is pushed in to instrument panel, and closed when knob is pulled out. Adjust choke (par. 65) if necessary.
	c. Leaking carburetor or manifold heat control valve.	c. Pour a small quantity of oil on edges of gaskets. Crank engine with starter. A sucking sound will be heard if gasket leaks. Replace carburetor gasket (par. 63) or manifold heat control valve housing gasket, if necessary.
	d. Maladjustment or defective carburetor.	d. Check carburetor adjustments (par. 63) and adjust, if necessary. Replace carburetor if defective (par. 63).
15. Lack of fuel in carburetor.	a. Empty fuel tank.	a. Check level of fuel in tank. A defective fuel gage or sending unit may cause reading on gage indicating presence of fuel in tank when tank is empty. If tank is empty, fill tank (TM 9-2320-209-10). Troubleshoot gage and sending unit (item 57).
	b. Defective tank-to-carburetor fuel-line shutoff valve.	b. Check valve to make sure valve (fig. 119) is open. Vehicle vibration may have caused valve to close because of loose valve stem nut. Tighten loose nut or replace valve (par. 68), if necessary.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	FUEL SYSTEM (GASOLINE ENGINE) - Continued	
15. Lack of fuel in carburetor - Continued	c. Defective fuel line.	c. Check fuel-tank line, fuel-pump flexible line, and carburetor line for cracks, sharp bends, or breaks. Replace line if damaged (par. 68). Disconnect lines and blow clean with compressed air to relieve obstructions (par. 68). Tighten lines to prevent fuel leakage or air suction into line.
	d. Restricted or obstructed fuel-tank filter.	d. Disconnect fuel-tank line at tank. Remove fuel-tank filler pipe cap (par. 67). Blow compressed air through line fitting on tank and note if air enters fuel tank. **Note.** A dirty fuel filter in the fuel tank can sometime be cleaned temporarily by blowing air through filter. If restricted filter is cleare by use of compressed air, drain fuel tank (par. 66) to remove any water or dirt settled in bottom of tank. If air does not enter fuel tank, notify direct support maintenance unit.
	e. Defective fuel pump.	e. Check pump for air or fuel leaks. Correct leakage or replace pump (par. 66) if leakage continues. Test pump for pressure and capacity. Replace defective pump.
	f. Faulty breather and ventilation system.	f. Troubleshoot breather and ventilation system (item 117) for obstructed fuel-tank ventilation and restricted fuel-pump action.
16. Insufficient fuel flow.	a. Throttle not opening sufficiently.	a. Check throttle control (par. 65) and adjust, if necessary.
	b. Maladjusted or defective carburetor.	b. Refer to item 14d.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	FUEL SYSTEM (GASOLINE ENGINE) - Continued	
16. Insufficient fuel flow - Continued	c. Defective fuel line.	c. Refer to item 15c.
	d. Defective fuel pump.	d. Refer to item 15e.
	e. Defective fuel-line shutoff valve.	e. Refer to item 15b.
	f. Restricted fuel-tank filter.	f. Refer to item 15d.
	g. Restricted fuel-tank and fuel-pump ventilation.	g. Refer to item 15f.
17. Improper fuel-air mixture.	a. Leaking carburetor or manifold heat control valve housing gaskets.	a. Refer to item 14c.
	b. Improper choke adjustment.	b. Adjust choke (par. 65) if necessary.
	c. Air leaks into fuel lines.	c. Check fuel lines for loose connections. Tighten loose connections. Check for cracks and breaks. Repair or replace defective lines (par. 68).
	d. Defective fuel pump.	d. Check fuel pump for air suction into fuel system. Replace pump (par. 62), if defective.
	e. Maladjusted or defective carburetor.	e. Refer to item 14d.
	f. Restricted air cleaner.	f. Check and service air cleaner (par. 62).
18. Low fuel pressure.	a. Air leaks into fuel lines.	a. Refer to item 17c.
	b. Defective fuel pump.	b. Test fuel pump (par. 66) for pressure. Check pump for air leaks. Replace pump (par. 66), if defective.
	c. Restricted fuel lines.	c. Refer to item 15c.
	d. Restricted fuel tank and fuel pump ventilation.	d. Refer to item 15f.
19. Excessive fuel consumption.	a. Fuel leaks.	a. Check all fuel system components for fuel leaks. Tighten, repair, or replace leaking fuel tank (par. 67), fuel line (par. 68), fuel pump (par. 66), or carburetor (par. 63).
	b. Maladjusted or defective carburetor.	b. Refer to item 14d.
	c. Defective fuel pump.	c. Test fuel pump (par. 66) for high pressure.
	d. Excessive fuel tank pressure.	d. Refer to item 15f.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	EXHAUST SYSTEM (GASOLINE ENGINE)	
	Warning: Replace defective parts as soon as possible. Exhaust fumes are extremely dangerous and can cause loss of life.	
20. Excessive exhaust noise.		Inspect for leaking manifold gasket and for defective exhaust manifold, exhaust pipe, muffler, or tailpipe. Replace manifold (par. 43), exhaust pipe (par. 79), muffler (par. 80), or tailpipe (par. 79), if necessary.
21. Odor of exhaust fumes in driver's compartment.		Troubleshoot exhaust system according to procedure in item 20.
	IGNITION SYSTEM (GASOLINE ENGINE)	
22. No spark or defective sparking.	a. Discharged or low-charged batteries. b. Defective ignition system.	a. Refer to item 52. b. Refer to electrical troubleshooting figs. 46, 47, 48. Repair or replace ignition system components as necessary (pars. 93 through 99).
23. Overheated distributor.	a. Underlubricated distributor shaft. b. Obstructed distributor venting.	a. Lubricate distributor according to lubrication order. b. Troubleshoot breather and ventilation system (par. 45) for obstructed distributor venting.
	MULTIFUEL ENGINE	
24. Engine fails to crank when starter switch is held on.	a. Inoperative starting system. b. Mechanical seizure of parts.	a. Troubleshoot starting system (item 46) for inoperative starter. b. If starting system (a above) is in satisfactory condition, trouble may be caused by mechanical seizure of parts. Notify direct support maintenance unit.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	MULTIFUEL ENGINE - Continued	
25. Engine cranks but will not start.	a. Ineffective starting system.	a. If starter action is sluggish, troubleshoot starting system for noisy or sluggish starter (items 47 and 48).
	b. Faulty fuel system.	b. Refer to items 36 and 37.
	c. Air cleaner or intake system clogged or defective.	c. Refer to item 38.
	d. Defective intake manifold heater plug or switch (in cold-weather conditions).	d. Refer to item 43. **Warning:** Heater develops enough heat to burn hands.
26. Engine starts but misfires or does not run smoothly.	a. Fuel injector pump or injector nozzles defective or not properly adjusted.	a. Notify direct support maintenance unit.
	b. Defective turbosupercharger.	b. Notify direct support maintenance unit.
	c. Leaking cylinder head gasket (s).	c. Refer to item 3c.
	d. Defective valve action.	d. Adjust valve clearance (par. 53) or, if valves must be replaced, notify direct maintenance unit.
	e. Precombustion chambers inadequately heated.	e. Refer to item 43.
27. Engine does not develop full power.	a. Defective fuel system.	a. Refer to items 36 and 37.
	b. Defective air intake system.	b. Refer to item 38.
	c. Defective exhaust system.	c. Refer to items 41 and 42.
	d. Leaking cylinder head gasket (s).	d. Refer to item 3c.
	e. Defective cooling system.	e. Refer to items 44 and 45.
	f. Defective valve action.	f. Refer to item 26d. If adjustment does not produce desired results, notify direct support maintenance unit.
	g. Engine overloaded.	g. Shift transmission and/or transfer to a lower gear range.
	h. Too much friction. Bearings may be too tight or lubrication may be inadequate.	h. Look for engine overheating. Check for proper lubrication. If trouble cannot be eliminated, notify direct support maintenance unit.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	MULTIFUEL ENGINE - Continued	
28. Engine overheats as indicated by coolant temperature gage.	a. Defective cooling system. b. Defective engine oil coolant system. c. Dragging brakes. d. Late combustion. e. Defective temperature gage or sending unit.	a. Refer to items 44 and 45. b. Repair or replace oil filter, oil lines or fittings as required, or notify direct support maintenance unit. c. Refer to item 90. d. Notify direct support maintenance unit. e. Refer to item 57.
29. Low engine oil pressure as indicated by oil pressure gage.	Defective engine lubricating system.	Notify direct support maintenance unit.
30. No engine oil pressure as indicated by oil pressure gage.	a. Defective engine lubricating system. b. Defective oil pressure gage or sending unit.	a. Notify direct support maintenance unit. b. Refer to item 57.
31. Engine oil consumption excessive.	a. External oil leaks. b. Crankcase ventilation system restricted. c. Worn internal engine components. d. Turbosupercharger lubrication system leaks.	a. Refer to item 11. b. Refer to item 112. c. Notify direct support maintenance unit. d. Notify direct support maintenance unit.
32. Smoky exhaust black smoke.	a. Engine overloaded. b. Poor combustion.	a. Refer to item 27g. b. Check grade of fuel used. Check for clogged air-intake filter. If trouble is not eliminated, notify direct support maintenance unit.
33. Smoky exhaust blue smoke.	Excessive lubrication.	Blue smoke in exhaust often indicates excessive lubrication. Check oil pressure. If trouble is not eliminated, notify direct support maintenance unit.
34. Engine knocks.	a. Fuel timing wrong. b. Inlet or exhaust valve sticking. c. Improper fuel; dirt or water in fuel.	a. Notify direct support maintenance unit. b. Notify direct support maintenance unit. c. Drain and replace fuel.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	MULTIFUEL ENGINE - Continued	
35. Unusual mechanical noises.	a. Loose crankpin bearing.	a. Notify direct support maintenance unit.
	b. Loose wristpin bearing.	b. Notify direct support maintenance unit.
	c. Excessive valve clearance.	c. Adjust valve clearance (par. 53).
	d. Other causes.	d. Notify direct support maintenance unit.
	FUEL AND AIR SYSTEM - MULTIFUEL ENGINE	
36. Lack of fuel in engine.	a. Throttle not opening.	a. Check throttle control and adjust, if necessary. Refer to paragraph 71.
	b. Fuel injector pump not operating.	b. Notify direct support maintenance unit.
	c. Fuel shutoff valve fails to open.	c. Adjust valve control linkage or notify direct support maintenance unit.
37. Lack of fuel in fuel injector.	a. Empty fuel tank.	a. Replenish fuel.
	b. Defective fuel shutoff valve.	b. Refer to item 36c above.
	c. Defective fuel line.	c. Check fuel lines and clean or replace damaged lines as required.
	d. Obstructed fuel filters.	d. Remove and clean or replace fuel filter element as required. Refer to paragraph 77.
	e. Defective in-tank fuel pump.	e. Check in-tank fuel pump for air suction into fuel system, or low output pressure. Replace if defective. Refer to paragraph 76.
	f. Faulty breather and ventilation system.	f. Troubleshoot breather and ventilation system and correct deficiencies.
38. Improper fuel air mixture.	a. Leaking manifold heater housing gaskets.	a. Replace gaskets. Refer to paragraph 72.
	b. Restricted air cleaner.	b. Check and service air cleaner. Refer to paragraph 70.
	c. Defective turbosupercharger.	c. Notify direct support maintenance unit.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	FUEL AND AIR SYSTEM - MULTIFUEL ENGINE - Continued	
39. Low fuel pressure at injector pump intake.	a. Air leaks into fuel lines.	a. Check fuel lines for loose connections, cracks or breaks. Repair or replace defective lines as required.
	b. Defective in-tank fuel pump.	b. Refer to item 37e.
	c. Restricted fuel lines.	c. Refer to item 37c.
	d. Restricted fuel tank ventilation.	d. Refer to item 37f.
	e. Clogged fuel filters.	e. Refer to paragraph 77.
40. Excessive fuel consumption.	a. Fuel leaks.	a. Check fuel system for leaks; repair or replace lines and fittings as required.
	b. Excessive fuel pump pressure.	b. Refer to item 37e. Replace defective fuel pump (par. 76).
	c. Excessive fuel tank pressure.	c. Defective fuel bypass valve. Notify direct support maintenance unit.
	Warning: Exhaust gases are dangerous and can cause loss of life. Replace defective parts as soon as possible.	
41. Excessive exhaust noise.	a. Leaking manifold gasket.	a. Notify direct support maintenance unit.
	b. Defective exhaust manifold.	b. Notify direct support maintenance unit.
	c. Leaking exhaust pipe.	c. Repair or replace exhaust pipe. Refer to paragraph 82.
42. Odor of exhaust fumes in driver's compartment.	a. Leaking manifold gasket.	a. Refer to item 41a.
	b. Defective exhaust manifold.	b. Refer to item 41b.
	c. Leaking exhaust pipe.	c. Refer to item 41c.
	d. Obstructed exhaust pipe or tailpipe.	d. Replace pipe if obstruction is caused by damaged pipe. Otherwise clear obstruction from pipe.
43. Manifold heater does not operate when switch is turned on. **Warning:** Heater develops enough heat to burn hands.	a. Defective manifold heater switch.	a. Refer to electrical troubleshooting, fig. 57.
	b. Shorted or improperly connected wiring to heater.	b. Clean and tighten wiring connections. Repair or replace wiring as required.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	FUEL AND AIR SYSTEM - MULTIFUEL ENGINE - Continued	
43. Manifold heater does not operate when switch is turned on - Continued	c. Clogged or damaged fuel supply and return lines.	c. Clean or replace fuel lines. Refer to paragraph 72.
	d. Obstructed heater supply filter.	d. Clean or replace filter as required. Refer to paragraph 72.
	e. Manifold heater fuel supply pump defective.	e. Replace defective pump. Refer to paragraph 72.
	f. Defective fuel supply or return valves.	f. Replace defective valves as required. Refer to paragraph 72.
	g. Defective heater spark plug.	g. Replace spark plug. Refer to paragraph 72.
	h. Defective ignition unit.	h. Replace ignition unit. Refer to paragraph 72.
	i. Clogged or defective nozzle.	i. Clean or replace nozzle as required. Refer to paragraph 72.
	COOLING SYSTEM	
44. Overheating.	a. Lack of coolant.	a. Check coolant level in radiator. Fill radiator, if necessary, with proper coolant (par. 84.
	b. Loose or broken drive belts.	b. Check fan and water-pump drive belts (par. 88). Check for correct tension and tighten, if necessary.
	c. Defective thermostat.	c. Remove thermostat (par. 86) and inspect for corrosion or sticking valve. Replace thermostat, if defective.
	d. Coolant leaks.	d. Inspect cooling system for leaks. Tighten loose assembly bolts or hose clamps, or replace leaking radiator (par. 85), hose (par. 85), or water pump (par. 85).
	e. Clogged system.	e. Clean radiator and flush cooling system (par. 84). Test system for air suction or any exhaust gas leakage (item 14c). Add rust preventive to system after cleaning.
	f. Defective water pump.	f. Replace water pump (par. 91).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	COOLING SYSTEM - Continued	
45. Overcooling.	Defective thermostat.	Remove thermostat (par. 86) and check to see if thermostat valve is stuck in open position. Replace thermostat (par. 86), if defective.
	STARTING SYSTEM	
46. Inoperative starter.	a. No electrical current reaching starter.	a. Service and test batteries and cables to be sure these are in satisfactory working condition and that full power is available. Refer to electrical troubleshooting, table 5, fig. 42.
	b. Defective starter.	b. Test starter by operating it without use of starter pedal. Starter must rotate freely without engaging flywheel. If starter does not rotate, or if teeth contact flywheel, replace starter (par. 102).
	c. Defective starter, drive gear or spring.	c. Depress starter pedal. If starter rotates without drive engagement, starter drive gear or spring may be damaged. Replace starter (par. 102).
47. Noisy starter.	Loose mounting.	Tighten loose starter mounting nuts. If noise is still present, replace starter (par. 102).
48. Sluggish starter.	Excessive friction due to defective bearings or bent shaft.	Operate starter switch without use of starter pedal or shifter lever. If starter does not start rotating immediately and rotate freely, replace starter (par. 102).
	CHARGING SYSTEM	
49. Low or no-charge indication on ammeter or battery-generator indicator when batteries have low charge.	a. Defective ammeter or battery-generator indicator.	a. Replace gage if defective (par. 136). Refer to electrical troubleshooting, fig. 55, test 6.
	b. Loose fan and water pump drive belt.	b. Check drive belt (par. 88) and tighten, if necessary.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	CHARGING SYSTEM - Continued	
49. Low or no-charge indication on ammeter or battery-generator indicator when batteries have low charge.	c. Batteries, battery cables, and wiring system.	c. Inspect cables and wiring system for shorts, fraying, breaks, corrosion, loose or high resistance connections, or other damage and test battery wiring system. Refer to electrical troubleshooting, fig. 41.
	d. Defective generator and/or regulator.	d. Test generator and regulator. Refer to electrical troubleshooting, figs. 43, 44, 45. Replace regulator, if defective or improperly set.
50. High-charge indication on ammeter or battery-generator indicator when batteries are fully charged.	a. Defective ammeter or battery-generator indicator.	a. Refer to item 49a.
	b. Poor electrical connections at generator or generator-regulator.	b. Refer to item 49c.
	c. Defective generator and/or regulator.	c. Refer to item 49d.
51. Noisy generator.	Loose generator mountings.	Inspect generator mountings and generator mounting brackets. Tighten, if necessary. If noise is still present, replace generator (par. 108).
52. Discharged or low charged batteries.	a. Excessive use of batteries at low engine speeds.	a. Replace or recharge battery.
	b. Defective batteries.	b. Replace batteries. Refer to paragraph 111.
	c. Defective cables or wiring.	c. Check battery cables and vehicle wiring for shorts. Replace cable or wiring, if defective (par. 111).
	d. Defective generator and/or regulator.	d. Refer to item 49d.
53. Excessively charged batteries.	Defective generator-regulator.	Refer to item 49d.
	LIGHTING SYSTEM	
54. Lights dim.	a. Defective batteries or battery cables.	a. Refer to item 52.
	b. Defective charging system.	b. Troubleshoot charging system (items 49 thru 51).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	LIGHTING SYSTEM - Continued	
54. Lights dim - Continued	c. Overloaded circuit.	c. Troubleshoot chassis wiring and components for short circuits or high resistance circuits. Refer to electrical troubleshooting, figs. 49 through 52.
	d. Defective lamp contact.	d. Inspect lamp contacts for corrosion and clean, if corroded.
	e. Poor grounding.	e. Inspect grounding of light to body or chassis. Clean and tighten as necessary.
	f. Defective circuit wiring and switches.	f. Refer to electrical troubleshooting, figs. 49 through 52.
	g. Dirty lenses.	g. Clean lenses.
	h. End of normal lamp life.	h. Replace lamps.
55. Light failure.	a. Defective lamp.	a. Inspect lamp and, if burned out, replace service headlight lamp unit (par. 114), blackout headlight lamp unit (par. 115), marker light lamp (par. 107), service and blackout tail- and stoplight lamp (par. 117), cab and crane floodlight lamp unit (par. 279), or instrument cluster light lamp (par. 127).
	b. Defective batteries or battery cables.	b. Refer to item 52.
	c. Poor grounding.	c. Refer to item 54e.
	d. Defective light switch.	d. Replace light switch (par. 130).
	e. Defective chassis wiring harness.	e. Troubleshoot chassis wiring harness. Refer to electrical troubleshooting, figs. 49 through 52.
56. Frequent lamp failure.		Test generator-regulator for proper output. Refer to electrical troubleshooting, figs. 43, 44, and 45.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	INSTRUMENT PANEL GAGES, SENDING UNITS, AND SWITCHES	
57. Electrical components of instrument panel inoperative.	Defective components or wiring.	Refer to electrical troubleshooting, figs. 53, 54, and 55 for troubleshooting instrument cluster gages, switches, circuit breakers, sending units and electrical wiring.
58. Air pressure gage does not register or gives incorrect reading.	a. Defective air pressure gage.	a. Measure vehicle air pressure with accurate air gage. Replace air pressure gage if defective (par. 126).
	b. Restricted airline (s) or air intake screen.	b. Clean or replace line (s) or screen as required.
	c. Defective air compressor, governor, or safety valve.	c. Replace air compressor, air governor, or safety valve as required (pars. 217 and 220).
	d. Loose or broken air compressor drive belt.	d. Tighten or replace air compressor drive belt as required (pars. 218 or 219).
	e. Air reservoir drain valve open.	e. Close drain valve par. 217).
	f. Leaking airline (s).	f. Repair or replace airline (s) as required (par. 215).
59. Low air pressure warning buzzer does not operate or operates improperly.	Defective or improperly connected wiring circuit or component.	Refer to electrical troubleshooting, fig. 56, and repair if possible. If not, notify direct support maintenance unit.
	CHASSIS WIRING HARNESS, CABLES AND CONNECTORS	
Each electrical system of vehicle is interconnected to the other electrical systems through use of common power sources -- generator and batteries. A symptom of trouble in one system may be caused by failure in another system as well as failure in the system itself. If failure is not located in the system showing the symptom, systematically troubleshoot the entire electrical system (figs. 71 and 72) until the fault is located.		
60. Circuit tracing procedure.		Refer to electrical troubleshooting section.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	CLUTCH Note. When troubleshooting the clutch, gear clash caused by spinning of clutch is frequently confused with clutch dragging. A clutch disk which releases perfectly will naturally spin under its own weight and momentum immediately after being released, if transmission gears are in neutral position. When shifting from neutral to first speed, or to reverse, wait a few seconds for clutch to stop to avoid gear clash.	
61. Clutch drags.	a. Excessive pedal clearance.	a. Idle engine, depress clutch pedal to fully released position, and allow time for clutch to stop. Shift transmission into first or reverse gear. If the shift cannot be made without severe clashing of gears; or, if after engagement of gears, there is jumping or creeping movement of truck with clutch fully released, clutch is dragging. Adjust linkage (par. 150).
	b. Worn clutch, throwout shaft, bearing or yoke	b. Remove transmission (par. 154) and inspect clutch release bearing and throwout shaft yoke for wear or damage. Replace bearing or yoke (par. 152), if damaged.
62. Clutch slips.	a. Insufficient pedal free travel.	a. Adjust clutch linkage (par. 150).
	b. Worn driven disk facings.	b. Notify direct support maintenance unit.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	CLUTCH - Continued	
63. Clutch chatters.	a. Oil or grease on clutch disk facings.	a. Clean clutch disk facings and check for defective oil seals caused by overlubricating or clogged ventilating valve in transmission or crankcase. If seals are defective, notify direct support maintenance unit.
	b. Improper connections.	b. Inspect transmission mounting, propeller shafts, universal joints, and engine mounting for loose connections. Tighten as required.
64. Clutch does not disengage.	a. Defective clutch assembly.	a. Notify direct support maintenance unit.
	b. Improper adjustment of clutch control linkage.	b. Adjust clutch linkage (par. 150).
	TRANSMISSION	
65. Transmission noisy.	a. Insufficient lubricant.	a. Add lubricant of proper viscosity to proper level. (Refer to lubrication order LO 9-2320-209-12.)
	b. Lubricant of incorrect viscosity.	b. Drain and refill with lubricant of correct viscosity (LO 9-2320-209-12).
	c. Transmission power takeoff.	c. Noise in transmission power takeoff may be transmitted to transmission. Refer to item 69.
66. Gears clash when shifting.	Improper clutch adjustment.	If clashing of gears is encountered when attempting to shift from neutral into low gear, clutch is not releasing fully. Troubleshoot clutch (items 61-63).
67. Jumping out of gear.	a. Bent transmission gearshift lever.	a. Straighten gearshift lever until lever clears instrument panel by 1 inch.
	b. Power train windup.	b. Jack up front wheel to relieve possible front axle propeller shaft windup from transfer sprag tension. Check adjustment of transfer linkage (par. 158).
	c. Defective transmission.	c. Replace transmission (par. 154).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	TRANSMISSION - Continued	
68. Lubricant leakage.	a. Obstructed transmission venting.	a. Check breather and ventilation system for high transmission pressure (item 114).
	b. Loose drain plugs.	b. Tighten loose drain plugs.
	c. Defective gaskets.	c. Tighten housing bolts. If leakage is not relieved, notify direct support maintenance unit.
	TRANSMISSION POWER TAKEOFF	
69. Excessive noise.	Noise from transmission may be transmitted to power takeoff.	Check for loose power takeoff mounting screws and tighten, if necessary. Continued noise indicates worn gears or bearings in transmission. Replace defective transmission (par. 154).
70. Hard shifting.	Damage to sliding gear or sliding gear fork will cause hard shifting.	Notify direct support maintenance unit.
71. Slips out of gear.	Gear slippage may be caused by excessively worn gears.	Notify direct support maintenance unit.
72. Lubricant leakage.	Loose gaskets or covers.	Tighten loose mounting screws or replace defective mounting gasket (par. 163). If leakage is around shaft, notify direct support maintenance unit.
	TRANSFER	
73. Hard shifting.	Insufficient lubrication.	Clean and lubricate transfer linkage (par. 158).
74. Slips out of gear.	a. Gears do not fully engage.	a. Adjust transfer linkage (par. 158).
	b. Defective transfer.	b. Replace transfer (par. 159).
75. Lubricant leakage.	a. Loose drain plugs.	a. Tighten loose drain plugs.
	b. Damaged gaskets or oil seals.	b. Tighten case bolts. If leakage persists, notify direct support maintenance unit.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	TRANSFER - Continued	
75. Lubricant leakage - Continued	c. Obstructed transfer venting.	c. Troubleshoot breather (item 115), for high transfer pressure.
76. Excessive noise.	Noise from the transfer power takeoff may be transmitted through the transfer.	Notify direct support maintenance unit.
	TRANSFER POWER TAKEOFF	
77. Hard to shift.	Damage to sliding clutch jaw will cause hard shifting.	Notify direct support maintenance unit.
78. Gear slipping.	Damage or wear of sliding clutch jaw or gears may cause gear slippage.	Notify direct support maintenance unit.
79. Excessive noise.	Noise from transfer power takeoff may reflect through transfer.	Check for loose mounting screws and tighten. Check oil pump to see that it is operating properly. Continued noise indicates worn gears or bearings. Notify direct support maintenance unit.
80. Lubricant leakage.		Tighten mounting screws or replace defective gasket (par. 160). If leakage is around shaft, notify direct support maintenance unit.
	PROPELLER AND DRIVE SHAFTS	
	Warning: Before removing front propeller shaft, jack up the front wheel to relieve the sprag unit windup tension on the front propeller shaft.	
81. Excessive noise or vibration	a. Lack of lubrication.	a. Lubricate all universal joints (par. 166).
	b. Worn universal joint parts or sprung shaft.	b. Repair universal joint (par. 166), or replace propeller or drive shaft (par. 165).
82. Lubricant leakage.	Loose or damaged gaskets or oil seals.	If caused by damaged oil seals, replace propeller or drive shaft (par. 165).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	FRONT AXLE	
83. Hard steering.	a. Lack of lubrication.	a. Lubricate front axle steering knuckle, tie-rod ends, and drag link ends (par. 197).
	b. Loose wheel bearings.	b. Check for loose wheels. Adjust front wheel bearings (par. 206).
	c. Bind in steering knuckle.	c. Raise front wheels from ground and disconnect drag link at front axle. Turn wheels and tie rod from side to side. If bind is found, disconnect one end of tie rod from steering knuckle. Test each wheel, turning from side to side. If bind persists and lubrication does not free steering knuckle, replace axle (par. 171).
	d. Tight steering gear.	d. With drag link disconnected at front axle, revolve steering wheel from one extreme to the other. If bind or rough spots are encountered, notify direct support maintenance unit.
	e. Front axle shifted.	e. Check distance from front spring eye to some point on axle. Compare this measurement with like measurement on opposite side of vehicle. If measurements do not agree, loosen spring U-bolts, relocate axle, and tighten spring U-bolts (par. 171).
	f. Tires underinflated.	f. Check air pressure, using an accurate gage, and inflate tires to correct pressure (par. 204).
	g. Improper toe-in.	g. Check toe-in of front wheels (par. 168). Loose wheel bearings, damaged wheels, bent steering knuckle, bent axle housing, or bent tie rod will affect toe-in. Adjust wheel bearings (par. 206) or replace damaged wheel (par. 203), and again check toe-in (par. 168) before replacing tie rod.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	FRONT AXLE - Continued	
83. Hard steering - Continued	h. Excessive caster or camber.	h. Notify supporting field maintenance unit.
84. Shimmy.	a. Excessive looseness in front axle steering knuckles.	a. Raise front wheels from ground, move wheels from side to side and up and down, and note any looseness in steering knuckle. If knuckles are loose, replace axle (par. 171).
	b. Loose front wheel bearings.	b. Refer to item 83b.
	c. Front axle shifted.	c. Refer to item 83e.
	d. Improper caster.	d. Refer to item 83h.
	e. Insufficient front wheel toe-in.	e. Refer to item 83g.
85. Wandering.	a. Loose wheel bearings.	a. Refer to item 83b.
	b. Axle shifted.	b. Refer to item 83e.
	c. Tires unequally inflated or tread worn unevenly.	c. Test tires with accurate pressure gage, and inflate to correct pressure, or replace worn tires in pairs (par. 204).
	REAR AXLES	
86. Continuous axle noise.	a. Tires improperly or unevenly inflated or tread worn unevenly.	a. If noise is caused by tires, the noise will disappear when the truck is driven over soft, unfinished road surface. Inflate tires equally (par. 204), or replace worn tires in pairs.
	b. Wheel bearings worn, out of adjustment, or in need of lubrication.	b. If noise persists (a above), check wheel bearings for wear and adjustment (par. 206). Repack or replace wheel bearings (par. 206).
	c. Insufficient lubricant of differential.	c. Add lubricant according to lubrication order LO 9-2320-209-12.
87. Axle noise on drive only or on coast only.	a. Wheel bearings worn, out of adjustment, or in need of lubrication.	a. If noise persists, check wheel bearings for wear and adjustment (par. 206). Repack wheel bearings (par. 206).
	b. Pinion and ring gear out of adjustment or worn excessively.	b. Replace rear axle (par. 174), or notify direct support maintenance unit.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	REAR AXLES - Continued	
87. Axle noise on drive only or on coast only - Continued	c. Insufficient lubricant.	c. Add lubricant according to lubrication order LO 9-2320-209-12.
88. Excessive backlash in axle driving parts.	a. Axle flange screws or nuts loose.	a. Tighten nuts.
	b. Ring gear and pinion out of adjustment or worn excessively.	b. Replace axle (par. 174), or notify direct support maintenance unit.
	SERVICE BRAKES	
89. Pedal goes nearly to floorboard.	a. Normal wear of linings.	a. When linings become worn, it is necessary to set shoes closer to brakedrums. Adjust brakes (par. 176).
	b. Brakes improperly adjusted.	b. Adjust brakes (par. 176).
	c. Brake fluid leak.	c. Inspect underneath chassis for signs of fluid leaks at master cylinder, wheel cylinders, and brake lines. Correct leaks and fill master cylinder (par. 179).
	d. Air in system.	d. Air in brake system will cause spongy or rubbery action of pedal. Bleed hydraulic system (par. 177).
	e. Pedal improperly adjusted.	e. Brake pedal should have 1/4- to 1/2-inch free travel before pressure stroke starts. Additional free motion reduces active travel of master cylinder piston, which in turn, limits amount of working fluid to be expelled from master cylinder. Adjust brake pedal travel (par. 178).
	f. No fluid in hydraulic master cylinder reservoir.	f. Fill master cylinder reservoir (par. 179) and bleed hydraulic system (par. 177).
90. All brakes drag.	a. Mineral oil in system.	a. Introduction of mineral oil into hydraulic brake system will cause cylinder cups to swell and retard or prevent their action. Clean brake system of improper oil and fill with hydraulic brake fluid (par. 179). If this

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	SERVICE BRAKES - Continued	
90. All brakes drag - Continued	a. Mineral oil in system - Continued	a. Continued remedy is not effective, refer to direct support maintenance unit, as system will have to be reconditioned and all cylinder cups replaced.
	b. Brake pedal improperly adjusted.	b. Brake pedal must have approximately 1/4- to 1/2-inch free travel before pressure stroke starts, otherwise, the master-cylinder relief port will be closed, pressure in the system will gradually build up, and all brakes will drag. Adjust brake-pedal free travel (par. 178).
	c. Faulty breather and ventilation system.	c. Troubleshoot breather and ventilation system for obstructed air-hydraulic and master-cylinder venting.
91. One wheel drags.	a. Brakeshoes improperly adjusted.	a. Adjust brake clearance between shoe and brakedrum (par. 183).
	b. Brakeshoes seizing on anchor pins.	b. Lubricate brakeshoe bearing surface on anchor pins (par. 183).
	c. Weak brakeshoes return spring.	c. A weak or broken shoe return spring will prevent brakeshoes from being retracted. Replace spring (par. 183).
	d. Loose wheel bearings.	d. Adjust wheel bearings (par. 206).
92. Truck pulls to one side when brakes are applied.	a. Grease-soaked linings.	a. Replace brakeshoes (par. 183).
	b. Improperly adjusted brakeshoes.	b. Adjust brakes (par. 176).
	c. Tires improperly inflated.	c. Correct the tire inflation (par. 204).
93. Springy, spongy pedal.	a. Brakeshoes improperly adjusted.	a. Adjust brakes (par. 176).
	b. Air in system.	b. Bleed hydraulic system (par. 177).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	SERVICE BRAKES - Continued	
94. Severe braking action from light pedal pressure (brakes "grab").	a. Improperly adjusted brakeshoes.	a. Adjust clearance between brakeshoe and brakedrum (par. 183).
	b. Loose brake backing plate.	b. Notify direct support maintenance unit.
	c. Grease-soaked lining.	c. Replace brakeshoes (par. 183).
95. Weak braking action from heavy pedal pressure.	a. Improper brakeshoes adjustment.	a. Adjust brakes (par. 176).
	b. Improper brake lining.	b. Replace brakeshoes (par. 183).
	c. Oil or water on lining.	c. Replace brakeshoes, if oil (par. 183). If water, allow linings to dry.
	d. Faulty breather and ventilation system.	d. Refer to item 90c.
96. Insufficient air pressure for air-hydraulic brake cylinder.	a. Reservoir draincocks open.	a. Close draincocks.
	b. Compressed air leakage.	b. Check all airlines and fittings for leaks. Correct leaks (par. 215).
	c. Slipping compressor drive belt.	c. Adjust belt (par. 218 or 219).
	d. Governor out of adjustment.	d. Replace governor (par. 220).
	e. Defective compressor.	e. Replace compressor (par. 218 or 219).
97. Brake application too slow.	a. Low air pressure.	a. Refer to item 96.
	b. Excessive leakage with brakes applied.	b. Proceed as in item 96b.
	c. Restricted airline.	c. Remove and clean.
98. Brake releases too slowly.	a. Hydraulic brake system not functioning properly.	a. Refer to item 90.
	b. Leak in check valve.	b. Replace air-hydraulic cylinder (par. 180).
	c. Faulty breather and ventilation system	c. Refer to item 90c.
	HANDBRAKE	
99. Brake does not hold.	a. Improperly adjusted handbrake.	a. Adjust handbrake lever linkage (par. 186).
	b. Broken handbrake cable.	b. Replace cable (par. 186).
	c. Worn handbrake shoe lining.	c. Replace worn handbrake shoe (par. 185).
	d. Grease on handbrake shoe lining.	d. Replace handbrake shoe (par. 185).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	HANDBRAKE - Continued	
100. Brake drags or overheats.	a. Brake partially applied. b. Improperly adjusted handbrake. c. Brakedrum out of round.	a. Release handbrake fully. b. Adjust handbrake (par. 186). c. Notify direct support maintenance unit.
	WHEELS, TIRES, AND HUBS	
101. Wheel wobbles.	a. Loose on hub. b. Bent wheel. c. Wheel bearings out of adjustment or damaged. d. Wheel out of balance.	a. Tighten wheel nuts (par. 203). b. Replace wheel (par. 204). c. Adjust wheel bearings (par. 206) or replace bearings, if necessary. d. Remount tire correctly (par. 204).
102. Excessive or uneven tire wear.	a. Unequal pressure in tires. b. Improper front-wheel alinement. c. Bent wheel. d. Damaged wheel bearings.	a. Inflate tires equally (par. 204) using an accurate gage. b. Check front-wheel alinement (fig. 199) and correct (par. 168). c. Replace wheel (par. 204). d. Replace wheel bearings (par. 206).
	STEERING GEAR	
103. Hard steering.	a. Lack of lubricant. b. Tight steering gear. c. Damaged bearings, cam, or lever. d. Steering column misalined.	a. Lubricate in accordance with lubrication order LO 9-2320-209-12. b. Revolve steering wheel from one extreme to the other. If tightness is felt, adjust steering gear (par. 196). c. If rough spots, bumps, or noise is encountered while revolving steering gear, internal damage is indicated. Refer to direct support maintenance unit. d. Aline steering column (par. 198).
104. Wander or weaving.	a. Tight adjustment in "straight-ahead." b. Steering drag link ends loose.	a. If gear is tight in mid-position or straight-ahead, adjust steering gear (par. 196). b. Inspect drag link ends for proper adjustment. Adjust drag link (par. 201).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	STEERING GEAR - Continued	
104. Wander or weaving - Continued	c. Steering gear parts are worn or incorrectly adjusted.	c. Refer to direct support maintenance unit.
105. Oil leaks.	a. Defective oil seal in housing.	a. Refer to direct support maintenance unit.
	b. Loose cover or gasket.	b. Tighten cover, or refer to direct support maintenance unit.
	SPRINGS AND SHOCK ABSORBERS	
106. Insufficient flexibility.	a. Insufficient spring pin or shackle lubrication.	a. Lubricate spring pins and shackle pins (par. 192), making sure grease goes all the way around pins.
	b. Frozen spring shackles.	b. Free shackles and lubricate (par. 192).
	c. Shock absorbers inoperative.	c. Disconnect shock absorber links and test shock absorber action. If inoperative, replace unit (par. 193).
107. Excessive flexibility.	a. Overlubrication.	a. Refer to lubrication order LO 9-2320-209-12. Clean excess grease from sides of springs.
	b. Lack of fluid in shock absorbers.	b. Replace shock absorbers (par. 193).
	c. Shock absorbers inoperative.	c. Disconnect shock absorber links, and test operation. If little or no resistance is felt, replace unit (par. 193).
	d. Broken spring leaves.	d. Examine springs for broken leaves and, if found, replace springs (pars. 189 and 190).
108. Excessive noise.	a. Worn spring pins, shackle bolts, or bearings.	a. Use pry bar to test for wear of pins, bolts, or bearings. Replace parts as necessary (par. 191 or 192).
	b. Worn or broken shock absorber links.	b. Inspect shock absorber links for wear, damage, or looseness. Replace shock absorber (par. 193), if defective.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	SPRINGS AND SHOCK ABSORBERS - Continued	
109. Spring leaf failure.	a. Spring leaf failures at spring eye.	a. Failures at this point are generally caused by tight spring shackles or frozen spring pins. Free shackles and lubricate (LO 9-2320-209-12) shackles and pins, or replace spring (pars. 189 and 190).
	b. Spring leaf failures at center section of spring.	b. Breakage of spring leaves at the center bolt section are generally caused by loose spring U-bolts. Replace spring, and tighten U-bolts securely (pars. 189 and 190).
	c. Grabbing brakes.	c. Grabbing brakes result in extreme twist or strain on springs. Adjust brakes (par. 176).
	FRONT WINCH	
110. Front winch fails to operate.	a. Drum clutch not engaged.	a. Operate front winch clutch control lever as described in paragraph 208.
	b. Shear pin failure.	b. If front winch drive shaft revolves and winch worm shaft is stationary, check for cause of shear pin failure and replace shear pin (par. 210). **Caution:** Always use aluminum-alloy shear pin to prevent failure or damage in truck power train.
	c. Drum lock poppet not released.	c. Pull out drum lock poppet knob (TM 9-2320-209-10).
111. Winch fails to operate properly.	a. Fails to sustain load.	a. Adjust worm automatic brake (par. 209), or replace brake (par. 211), if necessary.
	b. Excessive heat at brake case.	b. Adjust worm automatic brake (par. 209).
	c. Drum spins too fast when unwinding wire line by hand.	c. Adjust drum drag brake (par. 208).
	d. Noisy operation.	d. Lubricate according to lubrication order LO 9-2320-209-12.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	BREATHER AND VENTILATION SYSTEM	
112. High engine crank-case pressure.	a. Obstructed crankcase breather and crankcase ventilation shutoff valve (gasoline engine).	a. Check shutoff valve (if present) and open valve if closed. Adjust shutoff valve control wire length, if necessary. Clean valve and breather (par. 45).
	b. Obstructed valve push rod cover ventilating valve (gasoline engine).	b. Check valve action. Valve must close completely when engine is idling and open as engine speed increases. Clean valve, if valve is clogged, or replace valve (par. 45), if defective.
	c. Obstructed push rod cover ventilating valve breather line, and crankcase ventilation shutoff valve (gasoline engine).	c. Check shutoff valve (if present), and open valve if closed. Adjust shutoff valve control wire length, if necessary. Clean valve (par. 45). Check breather line for causes of obstruction. Clean dirty lines or replace damaged line (par. 62).
113. Restricted fuel pump action (gasoline engine).	Inoperative breather valve, closed crankcase ventilation shutoff valve, or obstructed line.	Check for obstructed fuel pump breather valve. Clean valve (par. 66) if necessary. If vehicle is equipped with crankcase ventilation shutoff valve and fuel pump breather line, check shutoff valve and open if closed. Clean a restricted shutoff valve (par. 45). Check breather line for causes of obstruction. Clean dirty line or replace a damaged line (par. 62).
114. High transmission pressure.	Inoperative vent valve.	Clean transmission ventilation valve (par. 154), if present. If vehicle is equipped with transmission breather line, check line for causes of obstruction. Clean dirty line or replace damaged line.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	BREATHER AND VENTILATION SYSTEM - Continued	
115. High transfer pressure.	Inoperative vent valve or obstructed line.	Clean transfer ventilating valve (par. 161), if present. If vehicle is equipped with transfer breather line, check line for causes of obstruction. Clean dirty line or replace damaged line.
116. High axle pressure.	Inoperative vent valve or obstructed line.	Clean axle ventilating valve (par. 170), if present. If vehicle is equipped with axle breather line, check line for causes of obstruction. Clean dirty line or replace damaged line.
117. Improper fuel-tank ventilation.	Obstructed ventilation line or inoperative filler cap valve.	Clean fuel-tank ventilating valve (par. 67) and breather lines (par. 68). Replace line (par. 68), if damaged. If valve is defective, replace filler cap.
118. Improper distributor venting (gasoline engine).	Inoperative shutoff valve or obstructed line.	Check crankcase ventilation shutoff valve and breather line (112c above). Check distributor inlet and outlet breather lines for causes of obstruction. Clean dirty line or replace damaged line.
119. Improper airbrake hand control valve venting (M48 and M275).	Obstructed ventilation line.	Check breather line for causes of obstruction. Clean dirty line or replace damaged line.
	COMPRESSED AIR SYSTEM	
120. Air pressure does not build up.	a. Leaking lines or fittings.	a. Check compressed air system for leaky tubes or fittings (par. 215). Tighten or replace, as necessary.
	b. Improperly adjusted air compressor drive belt.	b. Check air compressor drive belt for looseness. Adjust loose drive belt (par. 218 or 219).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	COMPRESSED AIR SYSTEM - Continued	
120. Air pressure does not build up - Continued	c. Dirty compressor air strainer.	c. Clean air strainer (par. 221).
	d. Dirty governor air strainer.	d. Clean governor air strainer (par. 220).
	e. Air compressor unloader valve improperly adjusted.	e. Replace air compressor (par. 218 or 219).
	f. Defective air compressor cylinder head gasket.	f. Check for leaking gasket by soapsuds method (par. 215). If gasket is defective, replace air compressor (par. 218 or 219).
	g. Defective air governor.	g. Replace air governor (par. 220).
	h. Air compressor defective in any other way.	h. Replace air compressor (par. 218 or 219).
121. Air compressor does not shut off.	a. Lack of sufficient air pressure.	a. Refer to item 120.
	b. Defective air governor.	b. Replace governor (par. 220).
	M47, M59 and M342 AUXILIARY EQUIPMENT	
122. Dump body does not rise.	a. Defective hydraulic hoist control linkage.	a. Check control linkage for damage or disconnected parts or replace defective parts (par. 240).
	b. Lack of oil in subframe reservoir.	b. Fill subframe reservoir according to instruction lubrication order LO 9-2320-209-12.
	c. Broken crosshead roller arm.	c. Notify direct support maintenance unit.
	d. Defective crosshead roller arm rollers.	d. Notify direct support maintenance unit.
	e. Cylinder oil leakage.	e. Tighten loose capscrews. If leakage persists, notify direct support maintenance unit.
	f. Defective hydraulic hoist cylinder.	f. Notify direct support maintenance unit.
	g. Leaking or defective lines and fittings.	g. Tighten loose fittings, or disconnect and replace defective lines and fittings (par. 241).
	h. Defective transmission power takeoff.	h. Troubleshoot transmission power takeoff according to procedure in items 69-72.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M47, M59 and M342 AUXILIARY EQUIPMENT - Continued	
122. Dump body does not rise - Continued	i. Pump will not produce sufficient pressure.	i. Check for oil leakage from pump. Tighten loose capscrews, or notify direct support maintenance unit.
	k. Defective control valve.	k. Notify direct support maintenance unit.
123. Dump body does not lower.	a. Safety braces in raised position.	a. Lower safety braces (TM 9-2320-209-10).
	b. Defective hydraulic hoist control linkage.	b. Refer to item 122.
	c. Defective control valve.	c. Notify direct support maintenance unit.
124. Dump body does not hold in raised position.	a. Defective hydraulic hoist control linkage.	a. Refer to item 122.
	b. Defective control valve.	b. Notify direct support maintenance unit.
	c. Leaking oil.	c. Tighten loose fittings and capscrews. If leakage continues, replace fitting or line (par. 241) or notify direct support maintenance unit.
	M48 and M275 AUXILIARY COMPONENTS	
125. Coupler jaws do not open.	Defective fifth wheel.	Replace fifth wheel (par. 243).
126. Coupler jaws fail to stay open.	Defective fifth wheel.	Replace fifth wheel (par. 243).
127. Coupler jaws fail to close.	Defective fifth wheel.	Replace fifth wheel (par. 243).
128. Airbrake hand control valve fails to furnish air to trailer brake airhose.	a. Hose coupling cutout cocks closed.	a. Open hose coupling cutout cocks (par. 245).
	b. Defective lines or hose.	b. Clean line or hose, or replace blocked or defective lines or hose (par. 246).
	c. Defective airbrake hand control valve.	c. Replace hand control valve (par. 247).
	d. Air not furnished to hand control valve.	d. Troubleshoot compressed air system (item 120).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M48 and M275 AUXILIARY COMPONENTS - Continued	
129. Trailer brakes drag or lock.	a. Airbrake hand control valve fails to shut off air supply.	a. Replace defective hand control valve (par. 247).
	b. Faulty breather and ventilation system.	b. Troubleshoot breather and ventilation system (item 142) for obstructed air-brake hand control valve venting.
	M49 and M49C AUXILIARY EQUIPMENT	
130. Discharge valve will not remain open.	a. Broken discharge valve control fuse link.	a. Check for a melted or broken fuse link. Replace an open link (par. 266).
	b. Tripped discharge valve control remote control.	b. Check the remote control for damage. Replace a damaged control (par. 266). Make sure remote control is in released position and place discharge valve control in the opened position.
131. Discharge valve will not open.	a. Corroded discharge valve cable.	a. Check discharge valve cable for break or damage. Replace a broken or damaged cable (par. 266).
	b. Corroded discharge valve.	b. Replace a corroded discharge valve (par. 266).
132. Delivery pump fails to run.	a. Defective transfer power takeoff.	a. Troubleshoot transfer power takeoff and linkage (par. 158).
	b. Defective drive shaft.	b. Check delivery pump front, intermediate, and rear drive shafts. Replace a defective or broken drive shaft (par. 272).
133. Delivery pipe fails to discharge.	a. Closed valve.	a. Open necessary delivery line gate and discharge valves (TM 9-2320-209-10).
	b. Defective discharge valve control.	b. Check discharge valve control and cable for defective parts. Replace damaged or broken control or cable (par. 266).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M49 and M49C AUXILIARY EQUIPMENT - Continued	
133. Delivery pipe fails to discharge - Continued	c. Dirty discharge valve screen.	c. **Caution:** Safety precautions (TM 9-2320-209-10) must be observed when transferring gasoline. Empty tank section, using delivery pump as a suction pump (TM 9-2320-209-10). Clean dirty discharge valve screen (par. 266).
	d. Dirty delivery pump strainer.	d. Clean dirty delivery pump strainer (par. 273).
	e. Defective delivery pump.	e. Check to see if load can be discharged by gravity (par. 271). If this is possible, trouble may be caused by defective delivery pump. Replace defective pump (par. 273).
	f. Clogged water segregator filter (M49C or M49CA1).	f. Check condition of filter by attempting to discharge fuel. Turn differential pressure gage valve (par. 260(9)) to the right, read gage, and then turn valve to the left and read gage. A difference of more than 15 psi indicates a clogged filter. Replace filter (par. 261).
	g. Clogged meter screen or inoperative meter mechanism (M49C or M49CA1).	g. Check meter screen (par. 265) for excessive dirt or foreign material. Clean meter screen. If fuel is delivered to meter screen compartment, but meter does not indicate, replace entire meter (par. 265). **Caution:** Do not disassemble meter.
134. Delivery pipe discharges too slowly.	a. Engine speed too slow.	a. Pull out hand throttle control to its extreme. If engine speed is below 1000 rpm, adjust or replace engine auxiliary governor (par. 249).
	b. Defective discharge valve control.	b. Refer to item 133b.
	c. Dirty discharge valve screen.	c. Refer to item 133c.

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Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M49 and M49C AUXILIARY EQUIPMENT - Continued	
134. Delivery pipe discharges too slowly - Continued	d. Dirty delivery pump strainer.	d. Refer to item 133d.
	e. Clogged water segregator filter.	e. Refer to item 133f.
	f. Clogged meter screen or sluggish meter mechanism.	f. Refer to item 133g.
	g. Defective delivery pump.	g. Replace delivery pump (par. 273).
	h. Leaking delivery pump.	h. Tighten loose capscrews at gasket points or replace delivery pump (par. 272).
	i. Pinched or flattened hoses.	i. Repair or replace hoses (par. 269).
135. Unusual noise in delivery pump.	a. Too high engine speed.	a. Check to see if transmission shifter lever is in fifth gear. If lever is in fifth gear, check engine speed. If engine speed is over 1100 rpm, adjust engine auxiliary governor (par. 249).
	b. Restricted suction passages.	b. Check delivery line passages for dirt or any other restricting substance. Remove substance (par. 270).
	c. Defective delivery pump.	c. Chattering or grinding noises in pump indicate defective pump. Replace defective pump (par. 273).
136. Engine speed varies during pumping.	Defective governor.	Replace defective engine auxiliary governor (par. 249).
	M50 AUXILIARY EQUIPMENT	
137. Discharge valve will not open.	Refer to item 131.	Refer to item 131.
138. Delivery pump fails to run.	Refer to 132.	Refer to item 132.
139. Delivery pump fails to discharge.	Refer to item 133a through e.	Refer to item 133 a through e.
140. Delivery pump discharges too slowly.	Refer to item 134a through d, g and h.	Refer to item 134 a through d, g and h.
141. Unusual noise in delivery pump.	Refer to item 135.	Refer to item 135.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M50 AUXILIARY EQUIPMENT - Continued	
142. Engine speed varies during pumping.	Refer to item 136.	

M60 AND M108 AUXILIARY EQUIPMENT

143. Before troubleshooting crane, check preparation for operation of trucks M60 and M108 (TM 9-2320-209-10). Make sure transfer power takeoff is engaged, transmission is in fifth gear, and throttle control is all the way out and locked in this position. Check hydraulic oil reservoir level (par. 284). Check reservoir shutoff cock at outlet on underside of reservoir to be sure cock is in open position. Inspect for hydraulic oil leaks in lines, connections, and other hydraulic system components. Look for bulging, kinked, twisted, bent, cracked, broken, or otherwise damaged or obstructed lines. Replace damaged or obstructed lines (par. 282). Check hydraulic pump drive shaft to make sure shaft is connected securely and not damaged. Tighten loose shaft or replace damaged shaft (par. 283). Listen to engine sound and note if engine is running about 1700 rpm. If in doubt, connect tachometer to distributor (par. 93) and check engine speed. Adjust engine auxiliary governor (par. 249), if necessary. Work control valve bank hand levers slowly back and forth to free valve spools. Check relief valve adjustment (par. 285) and adjust, if necessary. If trouble is not determined by these checks, troubleshoot hydraulic system according to procedure in items 144 through 158.

Note. Be sure to troubleshoot for any particular symptom in the sequence given in the corresponding subparagraph.

144. Pressure checks. To measure pressure at required check points, disconnect designated line as directed in items 145 through 158 and connect pressure gage of at least 1300 psi range, using piping adapters when necessary.

Caution: Provide a suitable container to catch the residue hydraulic oil when the lines are removed. Do not return this residue oil to the vehicle hydraulic reservoir; use authorized procedure for disposal of waste oil.

With vehicle prepared for crane operation (TM 9-2320-209-10), start engine, and check pressure while operating necessary control valve hand levers as directed in procedure in items 145 through 158. System pressure must not be less than 1200 psi at any check point.

Note. After removal of gage and fittings, reconnect the line and operate the component a few times, if possible, to purge the air from the hydraulic system.

145. Crane fails to operate in any direction.	a. Defective control valve bank.	a. Disconnect valve bank inlet line at control valve bank end cover. Check line pressure (item 144). If pressure is at least 1200 psi, control valve bank may be defective. Notify direct support maintenance unit.
	b. Obstructed swivel valve.	b. Disconnect oil supply line at swivel valve (par. 282). Check line pressure (item 144). If pressure is at least 1200 psi, swivel valve

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M60 AND M108 AUXILIARY EQUIPMENT - Continued	
145. Crane fails to operate in any direction - Continued	b. Obstructed swivel valve - Continued	b. Continued may be obstructed. Notify direct support maintenance unit, if obstructed.
	c. Defective relief valve.	c. Remove relief valve (par. 285), and install one known to be in operating condition. If crane will now operate, trouble was in the relief valve. If crane will not operate, trouble is in pump. Replace pump (par.
	d. Defective hydraulic pump.	d. Refer to c above. Replace pump (par. 283), if defective.
146. Crane boom fails to swing.	a. Defective drive pinion or idler gear.	a. Position swing control valve hand lever to operate swing motor, and check motor action. If swing motor operates through complete cycle, driving gears are probably damaged. Notify direct support maintenance unit.
	b. Defective swing motor.	b. Disconnect swing motor left cylinder elbow line at left cylinder on swing motor (par. 282). Connect pressure gage (item 144) to line, move swing motor control valve hand lever to LEFT position, and check line pressure. If pressure is at least 1200 psi, connect line to motor left cylinder. Disconnect swing motor right cylinder swivel elbow line at swing motor right cylinder. Connect pressure gage to line, move hand lever to LEFT position and check line pressure. If pressure is at least 1200 psi, connect line to right cylinder. Disconnect swing motor left cylinder swivel elbow line at left cylinder. Connect gage to line, move

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M60 AND M108 AUXILIARY EQUIPMENT - Continued	
146. Crane boom fails to swing - Continued	b. Defective swing motor - Continued	b. Continued hand lever to RIGHT position and check line pressure. If pressure is at least 1200 psi, connect line to left cylinder. Disconnect swing motor right cylinder elbow line at right cylinder. Connect gage to line, move hand lever to RIGHT position and check line pressure. If pressure was at least 1200 psi, in all four lines to swing motor, swing motor may be defective. Notify direct support maintenance unit.
	c. Obstructed junction block.	c. Disconnect junction block line marked "3" at junction block. Connect pressure gage (item 144) to line, move swing motor control valve hand lever to LEFT position, and check line pressure. If pressure is at least 1200 psi, connect line to junction block. Disconnect junction block line marked "2" at junction block. Connect pressure gage to line, move hand lever to RIGHT position, and check pressure. If pressure was at least 1200 psi in both lines, junction block may be obstructed. Disconnect all lines (par. 282) from block. Clean block of obstructing dirt or other substance with a piece of wire and compressed air, or notify direct support maintenance unit.
	d. Obstructed swivel valve.	d. Disconnect control valve to swivel valve upper line at swivel valve (par. 282). Connect pressure gage (item 144) to line, move swing motor control valve and lever to RIGHT position, and check line pressure. If

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M60 AND M108 AUXILIARY EQUIPMENT - Continued	
146. Crane boom fails to swing - Continued	d. Obstructed swivel valve - Continued	d. Continued pressure is at least 1200 psi, connect line to valve. Disconnect control valve to swivel valve lower line at valve. Connect pressure gage to line, move lever to LEFT position, and check pressure. If pressure was at least 1200 psi in both lines, swivel valve may be obstructed. Notify direct support maintenance unit.
	e. Defective swing motor control valve.	e. If either pressure measured in d above was less than 1200 psi, swing motor control valve may be defective. Notify direct support maintenance unit.
147. Crane swings sluggishly.		Troubleshoot crane according to procedure in item 146, paying particular attention to subnormal pressures indicating restricted components.
148. Crane swings erratically.	a. Air in hydraulic system.	a. Operate crane (TM 9-2320-209-10) sufficiently to clean air from hydraulic system.
	b. Defective drive pinion or idler gear.	b. Notify direct support maintenance unit.
	c. Defective swing motor.	c. Trouble may be caused by sticking swing motor valve spool. Operate swing motor and check if swing motor left and right cylinder cams ride constantly on cam rollers. If cams do not ride rollers, operate swing motors for 1 hour to try and free valve spools. If spools do not free, notify direct support maintenance unit. If cams ride rollers properly, troubleshoot swing motor to procedure in item 146. If pressures are correct, notify direct support maintenance unit.
	d. Obstructed junction block.	d. Refer to item 146.
	e. Obstructed swivel valve.	e. Refer to item 146.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M60 AND M108 AUXILIARY EQUIPMENT - Continued	
149. Boom fails to extend or retract.	a. Defective boom crowd cylinder.	a. Disconnect crowd cylinder nipple flexible line at boom crowd cylinder (par. 282). Connect pressure gage (item 144) to line, move boom crowd cylinder control valve hand lever to RETRACT position, and check line pressure. If pressure is at least 1200 psi, connect line to cylinder. Disconnect crowd cylinder flexible line at cylinder. Connect gage to line, move hand lever to EXTEND position, and check pressure. If pressure was at least 1200 psi in both lines, crowd cylinder may be defective. Notify direct support maintenance unit, if defective.
	b. Defective boom crowd cylinder control valve.	b. If either pressure measured in a above was less than 1200 psi, boom crowd cylinder control valve may be defective. Refer to direct support maintenance unit.
150. Boom extends or retracts sluggishly.		Troubleshoot crane according to procedure in item 149, paying particular attention to subnormal pressures indicating restricted components.
151. Boom extends or retracts erratically.	a. Air in hydraulic system.	a. Operate crane (TM 9-2320-209-10) sufficiently to clear air from hydraulic system.
	b. Defective boom crowd cylinder.	b. Refer to item 149a.
	c. Defective boom crowd cylinder control valve.	c. Refer to item 149b.
152. Cable hoist drum fails to rotate.	a. Damaged cable hoist drum drive gear.	a. Operate cable hoist and listen for gear noises at hoist. If noises are heard, stop operation and notify direct support maintenance unit.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M60 AND M108 AUXILIARY EQUIPMENT - Continued	
152. Cable hoist drum fails to rotate - Continued	b. Defective cable hoist motor.	b. Disconnect hoist motor flexible line at cable hoist motor. Connect pressure gage (item 144) to line, move cable hoist motor control valve hand lever to DOWN position, and check line pressure. If pressure is at least 1200 psi, connect line to motor. Disconnect hoist motor check valve flexible line at cable hoist motor check valve (par. 286). Connect gage to line, move hand lever to UP position, and check pressure. If pressure is at least 1200 psi, troubleshoot cable hoist motor check valve c below. If check valve is functioning, trouble may be caused by defective cable hoist motor. Notify direct support maintenance unit.
	c. Obstructed cable hoist motor check valve.	c. Remove cable hoist motor check valve (par. 286) from fitting on cable hoist motor. Inspect valve to see if valve seat is free in valve body. If valve seat binds or is stuck in position, use a new check valve (par. 286). Install check valve on end of hoist motor check valve flexible line with rounded end of valve toward line. Connect pressure gage (item 144) to squared end of valve, move cable hoist motor control valve hand lever to UP position, and check pressure which must be at least 1200 psi. Install check valve on motor and connect line.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M60 AND M108 AUXILIARY EQUIPMENT - Continued	
152. Cable hoist drum fails to rotate - Continued	d. Defective cable hoist motor control valve.	d. If pressures measured in b and c above were less than 1200 psi, cable hoist motor control valve may be defective. Notify direct support maintenance unit.
153. Cable hoist drum revolves too slowly.		Troubleshoot crane according to procedure in item 152, paying particular attention to subnormal pressures indicating restricted components.
154. Cable hoist drum revolves erratically.	a. Air in hydraulic system.	a. Operate crane (TM 9-2320-209-10) sufficiently to clear air from hydraulic system.
	b. Defective cable hoist motor.	b. Refer to item 152.
	c. Obstructed cable hoist motor	c. Refer to item 152.
	d. Defective cable hoist motor control valve.	d. Refer to item 152.
155. Boom fails to raise or lower.	a. Defective boom lift cylinder.	a. Disconnect lift cylinder flexible line at boom lift cylinder (par.282). Connect pressure gage (item 144) to line, move boom lift cylinder control valve hand lever to DOWN position, and check line pressure. If pressure is at least 1200 psi, connect line to cylinder. Disconnect lift cylinder check valve (par. 286). Connect pressure gage to line, move hand lever to UP position, and check pressure. If pressure is at least 1200 psi, troubleshoot boom lift cylinder check valve (b below). If check valve is functioning, trouble may be caused by defective boom lift cylinder. Notify direct support maintenance unit.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M60 AND M108 AUXILIARY EQUIPMENT - Continued	
155. Boom fails to raise or lower - Continued	b. Obstructed boom lift cylinder check valve.	b. Remove boom lift cylinder check valve (par. 286). Inspect valve to see if valve seat is free in valve body. If valve seat binds or is stuck in position, use a new check valve (par. 286). Install check valve on end of lift cylinder check valve flexible line with rounded end of valve toward line. Connect pressure gage (item 144) to squared end of valve, move boom lift cylinder control valve hand lever to UP position, and check pressure which must be at least 1200 psi. Install check valve on cylinder and connect line.
	c. Defective boom lift cylinder control valve.	c. If pressures measured in a and b above were less than 1200 psi, boom lift cylinder control valve may be defective. Notify direct support maintenance unit.
156. Boom raises or lowers sluggishly.		Troubleshoot crane according to procedure in item 155 above, paying particular attention to subnormal pressures indicating restricted components.
157. Boom raises or lowers erratically.	a. Air in hydraulic system.	a. Operate crane (TM 9-2320-209-10) sufficiently to clear air from hydraulic system.
	b. Defective boom lift cylinder.	b. Refer to item 155a.
	c. Obstructed boom lift cylinder check valve.	c. Refer to item 155b.
	d. Defective boom lift cylinder control valve.	d. Refer to item 155c.
158. Control valve hand lever sticks or does not return to NEUTRAL position.	All causes	Notify direct support maintenance unit.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M109 AND M185 AUXILIARY EQUIPMENT	
159. **Caution:** Disconnect all power to shop van body before cleaning contact surfaces, tightening a connection, or replacing a defective component. Before making any voltage checks, clean all corroded or burned switch, relay and cable contact surfaces with crocus cloth. Do not use emery cloth or other metallic abrasive materials. Blow off abrasive dust and wipe contact surfaces with 1, 1, 1-Trichlorethane, FSN 6810-664-0387. Do not use carbon tetrachloride; refer to TB 9-268 for proper method of cleaning electrical components. Tighten electrical connections securely. If minor cleaning will not correct the poor contact action, replace the complete switch or relay. Do not attempt to adjust switches, relays or circuit breakers. Refer to Electrical Troubleshooting, Section VI, 60 through 66 for complete troubleshooting procedures		
	V-17A/MTQ AUXILIARY EQUIPMENT	
160. Pillow block leaks lubricant.	Loose assembly screws.	Inspect pillow block for loose assembly screws. Tighten loose screws. Lubricate pillow block (par. 305). If leakage continues, replace pillow block.
161. Noisy pillow block.	Loose mounting bolts or companion flange bolts.	Inspect pillow block for loose mounting or connections with rear winch drive shaft and winch drive chain. Tighten loose drive shaft companion flange bolts. Tighten loose pillow block. Check pillow block sprocket alinement with winch worm sprocket (par. 307) and aline sprockets, if necessary. Check drive chain tension (par. 306) and adjust, if necessary. Replace pillow block if defective.
162. Winch drum shaft does not rotate.	a. Defective transfer power takeoff.	a. If transfer power takeoff is not rotating rear winch drive shaft, notify direct support maintenance unit.
	b. Damaged rear winch drive shaft.	b. Inspect drive shaft for damage. Repair or replace drive shaft (par. 305).
	c. Broken winch drive chain or chain is loose and does not engage sprocket.	c. Replace broken chain (par. 305). Aline pillow block and winch worm sprockets (par. 305). Check drive

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	V-17A/MTQ AUXILIARY EQUIPMENT - Continued	
162. Winch drum shaft does not rotate - Continued	c. Broken winch drive chain or chain is loose and does not engage sprocket - Continued	c. Continued chain tension (par. 305) and adjust.
	d. Defective winch worm sprocket. Damaged drum shaft drive gear.	d. Replace worn or damaged sprocket (par. 305). Listen for unusual gear noises at worm housing cover. Damaged drum shaft drive gear may prevent drum shaft from rotating. Replace rear winch (par. 305), if drive gear is defective.
163. Rear winch drum does not rotate with drum shaft.	a. Defective rear winch control lever linkage.	a. Check action of toothed flange on drum clutch and brake plate to see if flange engages toothed end of winch drum when winch control lever is moved to the IN position. If plate flange does not engage drum, check action of detent on hub of clutch and brake plate. Sleeve must move along plate hub a distance of five thirty-seconds of an inch when control lever is moved OUT to IN position. If sleeve does not move correct distance, inspect control lever linkage for bent, worn, or damaged parts. Repair or replace worn or damaged linkage (par. 306). Check linkage adjustment (par. 306) and adjust, if necessary.
	b. Worn detent sleeve.	b. If detent sleeve moves correct distance, but trouble persists, detent sleeve may need rotating. Notify direct support maintenance unit.
	c. Weak or broken clutch and brake plate spring.	c. If rotation of detent sleeve does not remedy trouble, clutch and brake plate spring may be weak or broken. If spring is

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	V-17A/MTQ AUXILIARY EQUIPMENT - Continued	
163. Rear winch drum does not rotate with drum shaft - Continued	c. Weak or broken clutch and brake plate spring - Continued	c. Continued defective, replace rear winch (par. 305).
	d. Damaged clutch and brake plate.	d. If flange of clutch and brake plate engages winch drum, clutch and brake plate may be damaged. Replace rear winch (par. 305).
164. Rear winch drum clutch does not disengage.	a. Defective rear winch control lever linkage.	a. Inspect control lever linkage for wear or damage. Repair or replace worn or damaged linkage (par. 306). Check linkage adjustment and adjust, if necessary.
	b. Worn detent sleeve.	b. Move winch control lever from IN to OUT position and check movement of detent sleeve on hub of clutch and brake plate. Sleeve must press against plate flange and force flange out of engagement with winch drum. If sleeve does not bear against plate flange, detent sleeve may need rotating. Notify direct support maintenance unit.
	c. Defective clutch and brake plate.	c. If detent sleeve presses against clutch and brake plate, and if plate does not disengage from drum, plate may be damaged. Replace rear winch (par. 305).
165. Rear winch brake does not hold.	a. Defective rear winch control lever linkage.	a. Refer to item 164a above.
	b. Worn brake lining.	b. Replace rear winch (par. 305).
166. Winch drum brake drags during free spooling of winch drum cable.	a. Defective rear winch control lever linkage.	a. Refer to item 164a above.
	b. Weak or broken clutch and brake plate spring.	b. Replace rear winch (par. 305) if spring is defective.
167. Winch drum slips backward or "overruns."	Incorrect worm automatic brake adjustment.	Notify direct support maintenance unit.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	V-17A/MTQ AUXILIARY EQUIPMENT - Continued	
168. Winch worm housing leaks lubricant.	Loose bearing capscrews.	Tighten loose bearing capscrews. If leakage continues, replace rear winch (par. 305).
	V-18A/MTQ AUXILIARY EQUIPMENT	
169. Noisy power-divider.	a. Insufficient lubricant.	a. Inspect power-divider for lubricant leakage. Tighten loose capscrews and pipe plugs. Check lubricant according to lubrication order (LO 9-2320-209-12) and lubricate, if necessary. If leakage continues, replace power-divider (par. 318).
	b. Defective gears, shafts or bearings.	b. If noise continues after lubrication, and power-divider is securely mounted, noise may be caused by worn or damaged gears, shafts, or bearings. Replace power-divider (par. 318), if defective.
170. Hard shifting.	a. Defective power-divider control lever linkage.	a. Inspect control lever linkage for damage. Repair or replace damaged linkage (par. 314). Check linkage adjustment (par. 314) and adjust, if necessary.
	b. Worn or damaged shifter rod or sliding gear.	b. Hard shifting may be caused by defective shifter rod or sliding gear in power-divider. Replace power-divider (par. 318), if defective.
171. Power-divider fails to remain engaged.	a. Worn or damaged shifter shaft or shifter fork detent.	a. Failure of power-divider to remain in engagement may be caused by defective shifter shaft or shifter fork detent in power-divider. Replace power-divider (par. 318), if defective.
	b. Defective power-divider control lever linkage.	b. Refer to item 204a.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	V-18A/MTQ AUXILIARY EQUIPMENT - Continued	
172. Power-divider fails to operate in all positions.	Worn or damaged shifter rod, input sliding gear, or input shaft.	When power-divider fails to operate in all positions, replace power-divider (par. 318).
173. Power-divider fails to operate in any one position.	Worn or damaged shafts or gears.	Replace power-divider (par. 318).
174. Power-divider leaks lubricant.	Loose capscrews or pipe plugs.	Tighten loose capscrews or pipe plugs. If leakage continues, case may be cracked. Replace power-divider, if defective (par. 318).
175. Power does not reach winch drum shaft.	a. Defective transfer power takeoff.	a. If transfer power takeoff does not rotate power-divider drive shaft, notify direct support maintenance unit.
	b. Damaged power-divider drive shaft.	b. Inspect drive shaft for damage. Repair or replace drive shaft (par. 316).
	c. Defective power-divider.	c. If power-divider fails to provide power to winch drive chain when placed in REAR WINCH "FOR." or REAR WINCH "REV." position, troubleshoot power-divider.
	d. Broken or damaged winch drive chain.	d. Inspect for breaks, or other damage. Replace damaged chain (par. 313). Aline power-divider and winch worm sprockets (par. 315) if chain binds. Check drive chain tension (par. 313) and adjust, if necessary.
176. Winch drum shaft does not rotate.	a. Power does not reach winch.	a. Refer to item 175 above.
	b. Defective winch worm sprocket.	b. Inspect winch worm sprocket for looseness, wear, or damage. Tighten loose sprocket. Replace worn or damaged sprocket (par. 315).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	V-18A/MTQ AUXILIARY EQUIPMENT - Continued	
176. Winch drum shaft does not rotate - Continued	c. Damaged drum shaft drive gear.	c. Listen for unusual gear noises at worm housing cover. Damaged drum shaft drive gear may prevent drum shaft from rotating. Replace rear winch (par. 310), if drive gear is defective.
177. Winch drum does not rotate with drum shaft.	a. Defective rear winch control lever linkage.	a. Check action of toothed flange on drum clutch and brake plate to see if flange engages toothed end of winch drum when winch control lever is moved to the ENGAGED position. If plate flange does not engage drum, check action of detent sleeve on hub of clutch and brake plate. Sleeve must move along plate hub a distance of five thirty-seconds of an inch when control lever is moved to NEUTRAL to ENGAGED position. If sleeve does not move correct distance, inspect control lever linkage for bent, worn, or damaged parts. Repair or replace worn, or damaged linkage (par. 311). Check linkage adjustment (par. 311) and adjust, if necessary.
	b. Worn detent sleeve.	b. If detent sleeve moves correct distance, but trouble persists, detent sleeve may be in need of rotating. Notify direct support maintenance unit.
	c. Weak or broken clutch and brake plate spring.	c. If rotation of detent sleeve does not remedy trouble, clutch and brake plate spring may be weak or broken. If spring is defective, replace rear winch (par. 310).

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	V-18A/MTQ AUXILIARY EQUIPMENT - Continued	
177. Winch drum does not rotate with drum shaft - Continued	d. Damaged clutch and brake plate.	d. If flange of clutch and brake plate engages winch drum, clutch and brake plate may be damaged. Replace rear winch (par. 310).
178. Winch drum clutch does not disengage.	a. Defective rear winch control lever linkage.	a. Inspect control lever linkage for wear or damage. Repair or replace worn or damaged linkage (par. 311). Check linkage adjustment (par. 311) and adjust, if necessary.
	b. Defective detent sleeve.	b. Move rear winch control lever from ENGAGED to NEUTRAL position and check movement of detent sleeve on hub of clutch and brake plate. Sleeve must press against flange of plate and force flange out of engagement with winch drum. If sleeve does not bear against plate, detent sleeve may need rotating. Notify direct support maintenance unit.
	c. Defective clutch and brake plate.	c. If detent sleeve presses against clutch and brake plate, and if plate does not disengage from drum, plate may be damaged. Replace rear winch (par. 310).
179. Winch drum brake does not hold.	a. Defective rear winch control lever linkage.	a. Refer to item 178a above.
	b. Worn brake lining.	b. Replace rear winch (par. 310).
180. Winch drum brake drags during free spooling of winch drum cable.	a. Defective rear winch control lever linkage.	a. Refer to item 178a above.
	b. Weak or broken clutch and brake plate spring.	b. Replace rear winch (par. 310), if spring is defective.
181. Winch drum slips backward or "overruns."	Worn or loose worm automatic brake.	If winch fails to hold against sustained load, or winch drum cable overruns during lowering of load, refer to direct support maintenance unit.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	V-18A/MTQ AUXILIARY EQUIPMENT - Continued	
182. Winch worm housing leaks lubricant.	Loose bearing capscrews.	Tighten loose bearing capscrews. If leakage continues, replace rear winch (par. 310).
183. Earth boring machine leaks lubricant.	Loose cover or assembly screws.	Inspect earth boring machine for loose screws. Tighten loose screws. Lubricate boring machine (LO 9-2320-209-12). If leakage continues, notify direct support maintenance unit.
184. Noisy earth boring machine.	Loose mountings or assemblies.	Inspect earth boring machine for loose mountings or assemblies. Tighten loose screws. If boring machine continues to make excessive or undue noise, notify direct support maintenance unit.
185. Earth boring machine functions without operator.	Worn or damaged clutch, brakes, or internal parts.	**Warning:** If earth boring machine functions without pressure on either of control lever operating handles, remove power to boring machine by shifting transfer power takeoff or power-divider into NEUTRAL position. Personnel injury and extreme damage may be caused by an uncontrolled machine. Notify direct support maintenance unit.
186. Earth boring machine inoperative.	a. Defective transfer power takeoff.	a. If transfer power takeoff does not rotate power-divider drive shaft, notify direct support maintenance unit.
	b. Damaged power-divider drive shaft.	b. Inspect drive shaft for damage. Repair or replace damaged drive shaft (par. 316).
	c. Defective power-divider.	c. If power-divider fails to rotate earth boring machine drive shaft when placed in EARTH AUGER position, troubleshoot power-divider.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	V-18A/MTQ AUXILIARY EQUIPMENT - Continued	
186. Earth boring machine inoperative - Continued	d. Damaged earth boring machine drive shaft.	d. Inspect drive shaft for damage. Repair or replace damaged drive shaft (par. 316).
	e. Defective earth boring machine.	e. If power is present at input shaft on underside of boring machine, boring machine is defective. Notify direct support maintenance unit.
	f. Earth auger fails to rotate.	f. If auger fails to rotate, boring machine is defective. Notify direct support maintenance unit.
	g. Earth auger fails to feed or raise.	g. If auger fails to feed or raise and auger rack lock is disengaged, boring machine is defective. Notify direct support maintenance unit.
	h. Vertical power leveler inoperative.	h. If power leveler fails to operate inspect vertical power leveler chain for damage and correct tension (par. 313). Replace damaged chain or adjust tension (par. 313). If chain is not at fault, notify direct support maintenance unit.
	M292 VAN BODY	
Major maintenance and overhaul of the M292 Expansible Van Body and its expansion mechanism is the responsibility of a higher maintenance unit. Items 187 through 200 pertain to minor troubles and expedient remedies for a temporary situation. If the troubles cannot be corrected with the corrective action shown, contact a direct support maintenance unit.		
187. Difficulty in expanding and retracting side panels.	Foreign matter in rollers or sprockets.	Remove roller and sprocket covers. Remove foreign matter.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	M292 VAN BODY - Continued	
188. Side panel cannot be locked in retracted position.	a. Front edge of side panel not fully retracted.	a. Place heavy wood block against rub rail at front of panel. Strike block with heavy hammer.
	b. Top of side panel too far out to engage edge of roof.	b. Place heavy wood block against flat surface of seal retainer opposite locking bar at top of side panel. Strike block with heavy hammer.
189. Van body not waterproof or lighttight.	a. Lower part of side panel not tight against van body.	a. Place heavy wood block against rub rail at end of side panel where leak is apparent. Strike block with heavy hammer.
	b. Toggle clamp not drawing top of side panel sufficiently tight.	b. Loosen jamnut on toggle clamp eyebolt. Screw eyebolt inward to shorten. Tighten jamnut.
	c. Sagging end panel door.	c. Add shims of rubber seal material to seal on outer edge of hinged roof until seal meets top of end panel door.
	d. Lip of block seal at inner rear corner of hinged roof forced out of position.	d. Move side panel out to disengage corner block seal. Push seal lip up into correct position so end panel door properly engages seal when side panel is retracted.
	e. Loss or wear of seal at top of two rear doors.	e. Recover area with rubber-seal shim stock material.
190. Right rear and side door locks will not operate.	a. One or more lock bolts jammed.	a. Locate jammed lock by removing vertical bars and testing each lock. Replace lock or locks (par. 329).
	b. Lock bolt fails to engage striker plate.	b. Place shim under lock until bolt properly engages striker plate.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	ILLUMINATION, SERVICE AND BLACKOUT CIRCUITS	
191. Ceiling lights and service receptacles do not deenergize when doors are opened under blackout conditions.	Defective blackout circuit switches.	Refer to electrical troubleshooting, fig. 66.
192. Ceiling lights and service receptacles fail to energize when doors are closed under blackout conditions.	a. Plunger not making contact with contact plate.	a. Screw toggle clamp eyebolt inward to shorten clamp. If malfunction persists, aline hinged section-operated plungers with surface of contact plate.
	b. Loose connection to plunger or contact plate.	b. Remove plungers (par. 357) and contact plates. Repair connections at terminals.
193. Ceiling fluorescent tube fails to light.	Fluorescent tube terminals not making proper contact.	Press end terminals of ceiling fixture together to improve contact with fluorescent tubes. Refer to electrical troubleshooting, fig. 63.
194. Emergency light, blackout light, and ceiling lights fail to light.	a. Burned out lamp.	a. Replace lamp (par.
	b. Defective switch or wiring.	b. Refer to electrical troubleshooting, fig. 62.
	VEHICLE CLEARANCE AND BLACKOUT LIGHTS	
195. Clearance and blackout lights fail to light.	a. Burned-out lamps.	a. Replace lamps (par. 347).
	b. Damaged tee connectors.	b. Check tee connectors. Replace if necessary (par. 348).
	c. Defective wiring harness.	c. Refer to electrical troubleshooting, fig. 60 and 61.
	HEATING SYSTEM	
196. Fuel pump does not operate.	a. Fuse in converter burned out.	a. Replace fuse.
	b. Loose connection at converter or pump.	b. Check and tighten connections.
	c. Defective pump or connections.	c. Refer to electrical troubleshooting section, fig. 61.

Table 4. Troubleshooting - Continued

Malfunction	Probable causes	Corrective action
	HEATING SYSTEM - Continued	
197. Heater will not ignite.	a. Burned-out fuel pump. b. Shutoff valve closed on gas tank. c. Restriction in fuel line. d. Defective heater.	a. Replace fuel pump (par. 340). b. Open shutoff valve. c. Check and clear all fuel lines. d. Notify direct support maintenance unit.
198. Heater stops operating.	a. Burned-out fuel pump. b. Restriction in fuel lines. c. Restriction in check valve. d. Clogged fuel filter screen. e. Defective heater.	a. Replace fuel pump (par. 340). b. Check and clear all fuel lines. c. Check and clear check valve. d. Clean or replace filter screen (par. 341). e. Notify direct support maintenance unit.
	AIR CONDITIONING SYSTEM	
199. Air conditioner fails to maintain proper temperature.	Dirty or clogged air filters.	Remove and clean filters.
200. Air conditioner compressor fails to start.	a. Bonnet front door is closed. b. No electric power. c. Defective air conditioner.	a. Open bonnet front door. b. Refer to electrical trouble-shooting, fig. 67. c. Notify direct support maintenance unit.

Section VI. TROUBLESHOOTING THE ELECTRICAL SYSTEM

30. General

This section contains detailed troubleshooting information for locating and correcting malfunctions in the electrical system. Each subsystem is treated separately by 1) providing a simplified schematic diagram where required, 2) pointing out the physical locations of the components, 3) pinpointing the disconnect points and 4) giving in detail a step-by-step procedure to diagnose the trouble using low voltage circuit tester TV-100, figure 35, and adapter set, figure 36.

31. Scope

Table 5 lists complete troubleshooting procedures for the following subsystems:

1. Battery System
2. Starting System
3. Generating System
4. Ignition System
5. Lighting System
6. Instruments and Gages
7. Horn and Low Air Warning Buzzer
8. Fuel Pump and Manifold Heater
9. Trailer Connecting Cable and Receptacle
10. Floodlight System (Wrecker Trucks)
11. Van Bodies, 24-volt Systems
12. Van Bodies, 115-volt Systems
13. Blackout Relay Systems
14. Expansible Van 3-phase System
15. Hot Water Heater Blower System
16. Winterization Kit Fuel Pump

32. Low Voltage Circuit Tester

a. Description.

(1) Low voltage circuit tester. Figure 35 illustrates one of the types of Low Voltage Circuit Testers (LVCT) in general use. The LVCT consists of a voltmeter, an ammeter, a fixed resistance, load bank, and field rheostat unit. They are mounted in a metal case, which also provides stowage space for the meter leads and accessories (fig. 37) used for making all the necessary tests. Other test sets consist of these elements (voltmeter, ammeter, etc.) as separate units; the tests described can be performed equally well using meters and load banks separately.

(2) Adapter sets. At present, there are several adapter sets in use. They are interchangeable, differing only in design. Adapter sets are used for making external connections in the waterproof electrical system on military vehicles. Figure 36 illustrates a typical adapter set.

b. Tester Functions and Use.

Note. The key numbers noted in parentheses are in figure 35, except where otherwise noted.

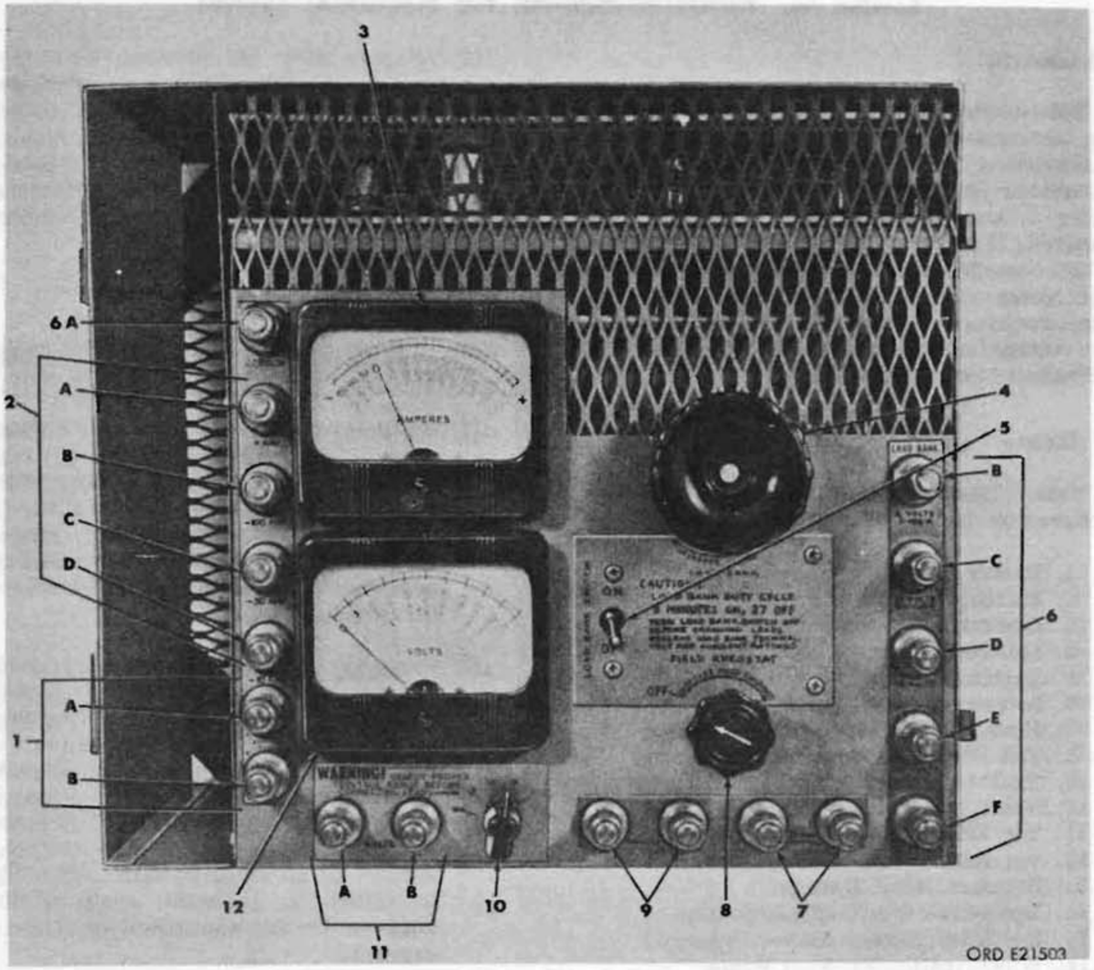
(1) Voltmeter. The two voltmeter binding posts (11), marked positive (+) and negative (-) are used for making voltage tests of batteries, generators or wiring circuits. Four meter ranges (1, 10, 20 and 50 volts) are available, selected by the voltmeter range selector switch (10).

(2) Ammeter. Four ammeter binding posts (2) are provided for making current readings up to 100 amperes. One terminal (A) is a common positive (+) terminal; the others (B, C, D) provide a selection of three negative ranges of 10, 50, or 100 amperes. Two binding posts (1) are provided for the connection of an external shunt assembly to extend the ammeter range to 500 amperes for the measurement of heavy currents.

(3) Fixed 1/4-ohm resistance unit. Two binding posts (7) provide a fixed 1/4-ohm resistance for use in charging circuit tests. Although the ammeter is used for these tests, the 1/4-ohm resistor has no internal connection to the ammeter.

(4) Field rheostat unit. Two binding posts (9) provide a changeable resistance for use in generator and charging circuit tests. There is no internal connection between the field rheostat unit and any other component of the tester.

(5) Load bank. Six binding posts (6) provide the proper load resistances to set up generator charging rate tests for various battery and generator voltages.



Key	Item	Key	Item
1	External shunt binding posts		B - 6 volts, 5-100 A
	A - Negative		C - 12 volts, 50-100 A
	B - Positive		D - 12 volts, 5-50 A - 24 volts, 80-100 A
2	Ammeter binding posts		E - 24 volts, 10-80 A
	A - Positive		F - 24 volts, 5-10 A
	B - 100 amp negative	7	1/4-ohm resistor binding posts
	C - 50 amp negative	8	Field rheostat control
	D - 10 amp negative	9	Field rheostat binding posts
3	Ammeter	10	Voltmeter range selector switch
4	Load bank control	11	Voltmeter binding posts
5	Load bank switch		A - Positive
6	Load bank binding posts		B - Negative
	A - Common	12	Voltmeter

Figure 35. Low voltage circuit tester TV-100 - FSN 6625-092-9136

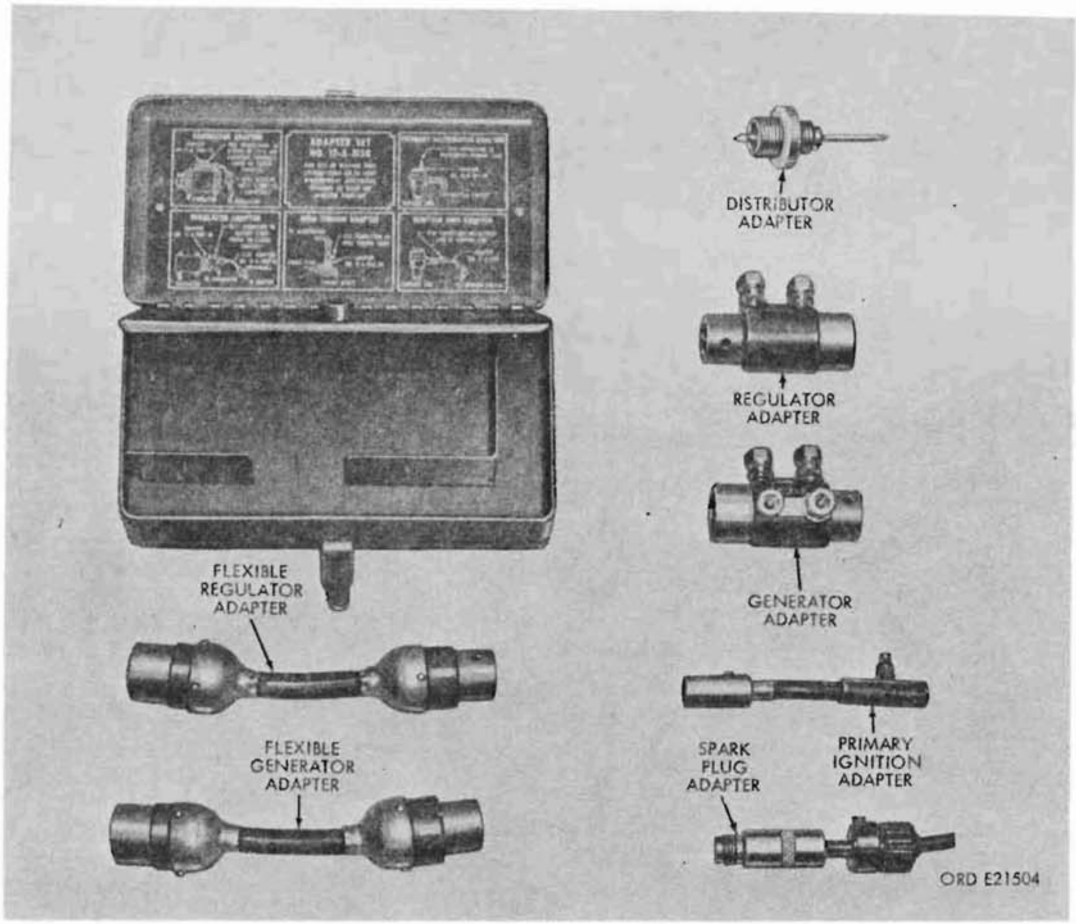


Figure 36. Engine electrical adapter set

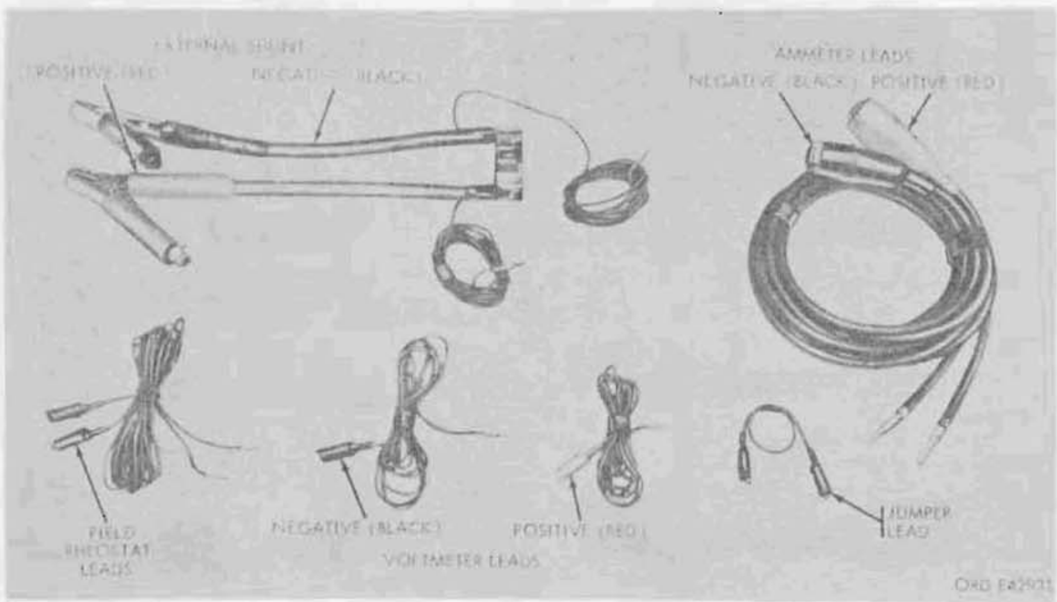


Figure 37. Test leads for use with TV-100 tester

The common binding post (6A) is connected internally to the ammeter positive (+) binding post (2A) eliminating the need for a jumper lead when making load tests. The load resistance may be changed by the load bank control knob (4) or removed from the circuit by the load bank switch (5).

33. General Instructions for Use of Test Set

Caution: Before proceeding with vehicle troubleshooting procedures, paragraph 34 must be read and understood by all personnel using the test set. Incorrect connections to the test set could result in costly damage to test equipment or vehicle components.

a. Be sure of the test to be made and the procedure to be used. Follow the step-by-step procedure given in Table 5 for each individual test.

b. Always select a meter range higher than the expected reading. Set the tester for this range before connecting it into the circuit.

c. Be sure to read the correct row of meter scale figures which correspond to the selected range. The range selector switch or the binding post marking always shows the right-hand figure of the row to be used. For example, if the range selector is set for 50 volts, read the row of meter scale figures that ends with 50 on the right-hand end.

d. When testing with an ammeter or ammeter shunt, always connect it in series with circuit to be tested. For maximum safety, the power should be turned off when connecting or disconnecting the ammeter or ammeter shunt.

e. When testing with a voltmeter, always connect it in parallel with (across) the termi-

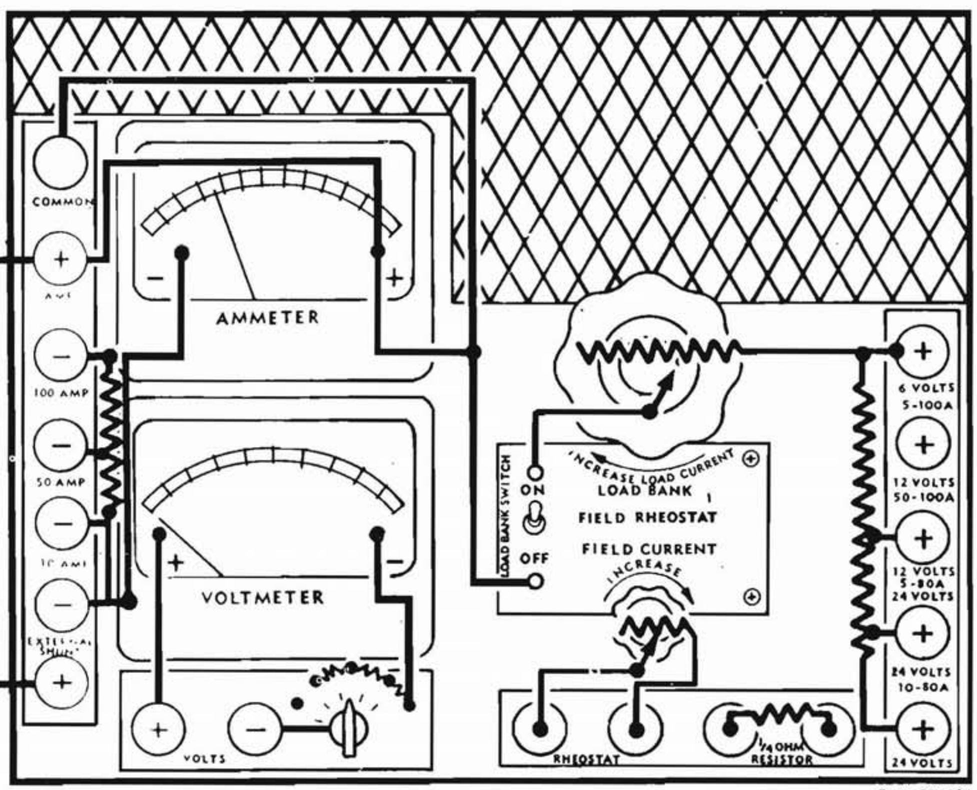


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Figure 38. Schematic layout of low voltage circuit tester TV-100

nals of the component to be tested. Where the terminals are easily accessible, the power need not be turned off to make voltage tests. Where there is a possibility of touching an adjacent terminal or the vehicle frame when attaching the positive test lead clip, the power should be off and the test lead clipped securely to the terminal to be tested before restoring power.

f. Always handle the test set carefully. Although the test set is ruggedly built, the meter movements are delicate mechanisms and can be damaged easily by rough handling. Be sure to stow all test leads and adapters in their proper compartments after the tests have been completed.

34. Specific Instructions for Use of the Test Set

a. D.C. Voltage Tests.

(1) Determine exactly what is to be tested, where the test leads will be connected, and what voltage to expect.

(2) Voltage must be measured at the exact circuit point specified in Table 5. Resistance of poor wiring, connections, and switch contacts can cause errors if voltages are measured at points elsewhere in the circuit.

(3) Connect the voltmeter test leads (fig. 37) to the voltmeter binding posts (11, fig. 35). Connect the black lead to the negative (-) post (B), and the red lead to the positive (+) post (A).

(4) Set the voltage range selector switch to a range higher than the expected voltage. Determine exactly which row of figures you will read.

Caution: (4) must be done before (5). A voltage range setting lower than the circuit voltage will damage the meter when (6) is performed.

(5) Connect the negative (black) lead first to the circuit to be tested. This will usually be the chassis frame, or a similar ground point (fig. 39, A).

(6) Touch the positive (red) lead to the other circuit connection. If the meter needle moves to the left, reverse the test leads at the circuit—not at the tester binding posts.

(7) Read the voltage carefully, facing the meter squarely. Viewing the meter from an angle will result in inaccurate readings.

b. D.C. Current Tests.

(1) Determine exactly what is to be tested, where the test leads will be connected, and what amperage to expect.

(2) Amperage may be measured at any convenient point in a single circuit, since the current is always the same throughout the circuit.

(3) Connect the ammeter red test lead (fig. 37) to the positive (+) binding post (2A, fig. 35). Tighten the binding post securely.

(4) Select a negative binding post (2 B, C or D, fig. 35) marked with an amperage range higher than the expected amperage. Connect the ammeter black test lead (fig. 37) to this selected binding post and tighten the binding post securely. Determine exactly which row of figures on the ammeter you will read.

Caution: (4) must be done before (5). An amperage range lower than the circuit current will damage the meter when (6) is performed.

(5) Be sure that no power is being applied to the circuit to be tested. Separate the circuit at a convenient junction point to form two connection points. Connect the red wire to the connection point which is electrically closer to the battery positive (+) terminal. Connect the black wire to the other connection point (fig. 39, B).

(6) Apply power to the circuit momentarily, observing the ammeter. The needle should move to the right. If the needle moves to the left, interchange the red and black wires at the circuit test points—not at the tester binding posts.

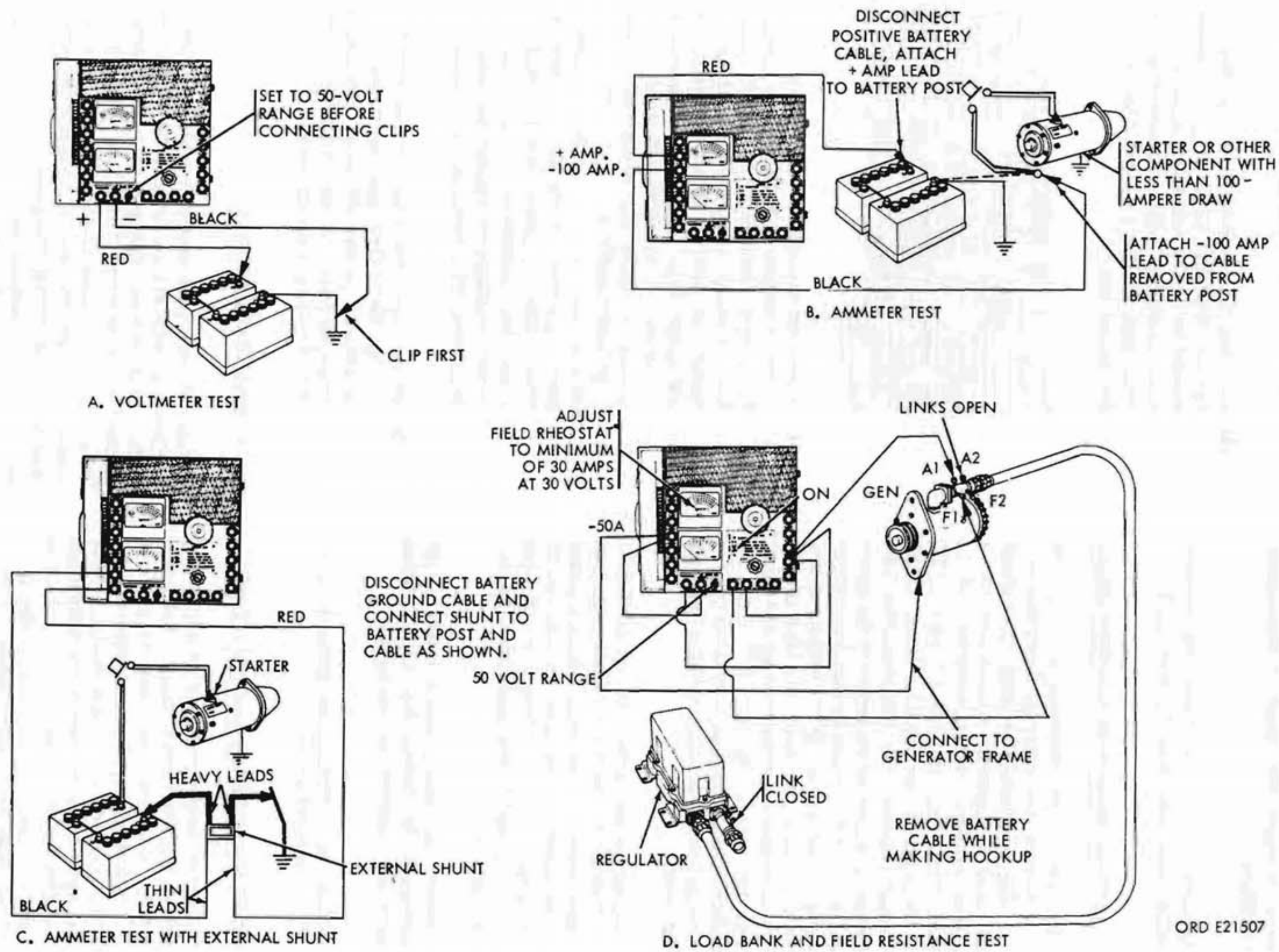

Figure 39. Typical arrangement for use of circuit tester

(7) Read the ammeter carefully, facing the meter squarely. Viewing the meter from an angle will result in inaccurate readings.

(8) Remove the power from the circuit before disconnecting the test leads.

c. D.C. Current Tests with Ammeter Shunt.

(1) When amperage exceeding 100 amperes is expected, the external shunt assembly (fig. 37) should be used. The shunt assembly consists essentially of a power resistor which absorbs 98% of the circuit amperes and allows only 2% to be sent to the meter. Thus, if the circuit current was 200 amperes, 196 amperes would be absorbed by the shunt and 4 amperes would be indicated on the meter. The 500-ampere figures on the meter scale are used for this shunt. A 200-ampere current through the shunt will indicate a reading of 200 on the meter scale, although a current of only 4 amperes is actually flowing through the meter.

(2) Disconnect the power to the circuit to be tested. Connect the small diameter shunt leads to the shunt binding posts of the tester (1, fig. 35); the red lead to the positive (+) binding post (B) and the black lead to the negative (-) binding post (A).

(3) Connect the heavy shunt leads to the circuit to be tested (fig. 39, C). Make sure all connections are tight.

(4) Follow all instructions given in b(5), (6), (7) and (8) above.

d. Load Bank and Field Resistance Tests.

(1) Three or more sections of the tester are used for these tests: the voltmeter, ammeter, and one or more of the resistances. Use extreme caution when connecting the test leads; severe damage can be caused to the tester and the components being tested if the test setup is incorrect. Follow the individual test setup illustration in Table 5 for the specific test being made. Figure 39 D shows an example of a test of this type.

(2) Observe precautions in a and b above, for use of the voltmeter and ammeter.

(3) Both the LOAD BANK (4, fig. 35) and FIELD RHEOSTAT (8, fig. 35) knobs should be in the extreme counterclockwise position before connecting the load bank or field rheostat to the circuit being tested.

Note. The nameplates on the LOAD BANK and FIELD RHEOSTAT controls indicate clockwise rotation is required for an increase in current. However, to accomplish this effect, the actual resistance presented to the circuit is decreased with clockwise rotation of these controls. Refer to figure 38.

(4) Whenever resistances carry heavy currents, considerable heat is developed. To prevent heat damage to the resistors and other tester components, power should be applied to the resistors for not more than 3 minutes continuously. At least 27 minutes off time is required to allow the resistors to cool down sufficiently for another three (3)-minute period of operation. Before applying power to the circuit, have all connections in place and be ready to make the necessary adjustments and meter readings as rapidly as possible, consistent with accuracy and safety.

(5) Do not turn the LOAD BANK SWITCH (5, fig. 35) to OFF position while power is applied to the circuits. The switch contacts will arc and burn when subjected to heavy dc currents.

35. Overall Battery Check

Vehicle batteries should be tested prior to performing any electrical checks in the vehicle. This vehicle has two 12-volt batteries connected in series, furnishing 24 volts to the electrical system (fig. 40, A) which uses a negative (-) ground and a positive (+) power feed to the electrical components. Turn on the accessory (or ignition) switch and observe the battery indicator (fig. 40, B). Start the engine, accelerate to 1200 rpm, and again observe the battery indicator (fig. 40, C). If the indicator shows further tests are required, refer to the Electrical Troubleshooting Chart, Table 5, fig [illegible]1.

36. Hazard Warning

a. Because of the higher power capabilities, 24-volt systems are more dangerous than 6- or 12-volt systems. Certain precautions must be observed before beginning any tests on the 24-volt system. Do not permit a "hot" wire to touch metal parts of the vehicle at any time. "Flash" testing by striking a hot wire against a ground will cause an arc that will completely destroy the connector on the lead. Accidental contact of metal tools between battery or starter cables and the frame of the vehicle causes a direct short circuit resulting in arcing and instant heating of the tool to red heat. This can cause painful burns on the hands and serious damage to tools, vehicle components and batteries. Moreover, the overloaded battery may explode, spraying hot acid and sharp fragments over the surrounding area.

b. When removing electrical equipment, harnesses, battery cables or starter cables, disconnect the battery ground cable first. Protect the ground cable from accidental contact with the battery terminal until the work has been completed, then connect the battery ground cable last.

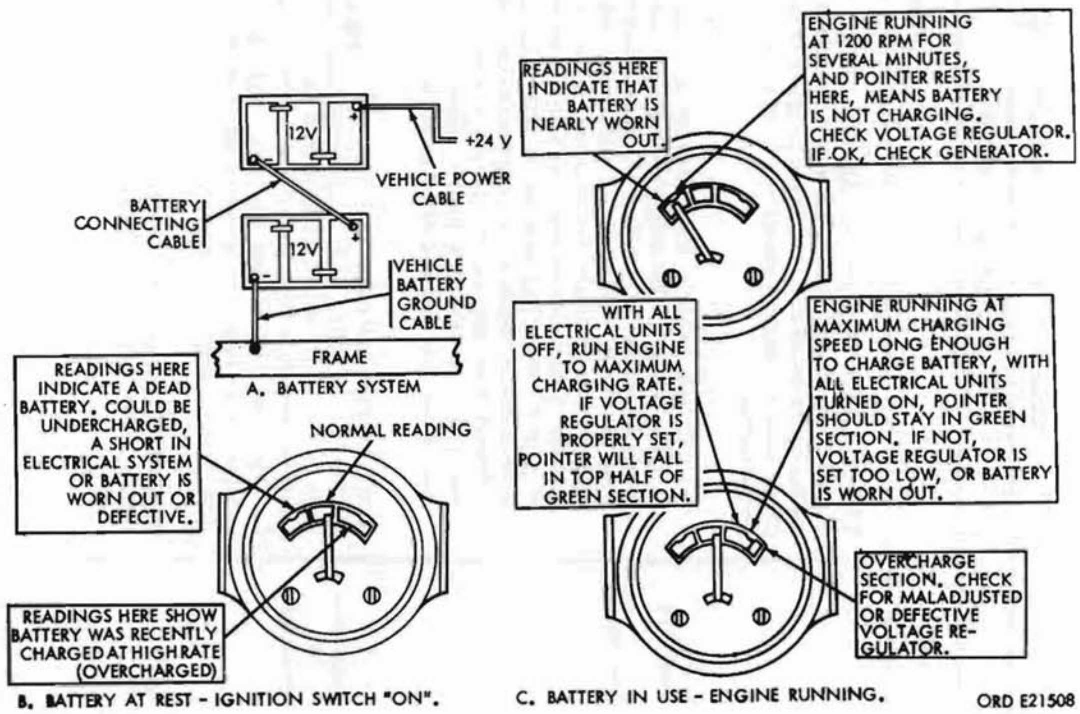

Figure 40. Interpretation of battery indicator dial

Table 5. Electrical Troubleshooting

Malfunction	Circuit	Test
		BATTERY SYSTEM
No starter action		TEST 1. Check each cell for specific gravity of battery electrolyte with hydrometer. Batteries must test 1.225, temperature corrected, and each cell must test within 25 gravity points of the others. If variation is more than 25 points, charge batteries fully, and re-check specific gravity on all cells. If 25-point variation still exists, one or both batteries are defective.
Slow cranking under normal weather conditions	7, 82 (Gasoline) 6, 7 (Multifuel)	Test 2 Test batteries under load to determine their ability to crank engine under starting conditions, and to determine maximum voltage drop with a 100-ampere load for 15 seconds. Turn load bank switch "OFF" with load bank control completely counterclockwise. Set voltmeter range selector switch to 50 volts. Connect circuit tester to batteries as shown in figure 41, test 2 Turn load bank switch "ON" and rotate load bank knob clockwise, watching ammeter scale until 100 amperes is indicated. Voltmeter should read not less than 18 volts during test, and 24 to 26 volts before and after test. If less, perform tests 3 and 4 to test individual batteries.
	68, 82 (Gasoline) 6, 68 (Multifuel)	TEST 3. Test individual batteries to determine maximum voltage drop with a 90-ampere load for 15 seconds, or if each has a maximum variation of ±2 volts of the other. Turn load bank switch "off" with load bank control completely counterclockwise. Set voltmeter range selector switch to 20 volts. Connect circuit tester to batteries as shown in figure 41, test 3. Turn load bank switch "on" and rotate load bank knob clockwise, watching ammeter scale until 90 amperes is indicated. Voltmeter should indicate 9 volts or more. If less than 9 volts, battery is defective.
	7, 68	TEST 4. Same as test 3, on the other battery. Voltage should not fall below 9 volts, or be more than 2 volts higher or lower than the other battery.

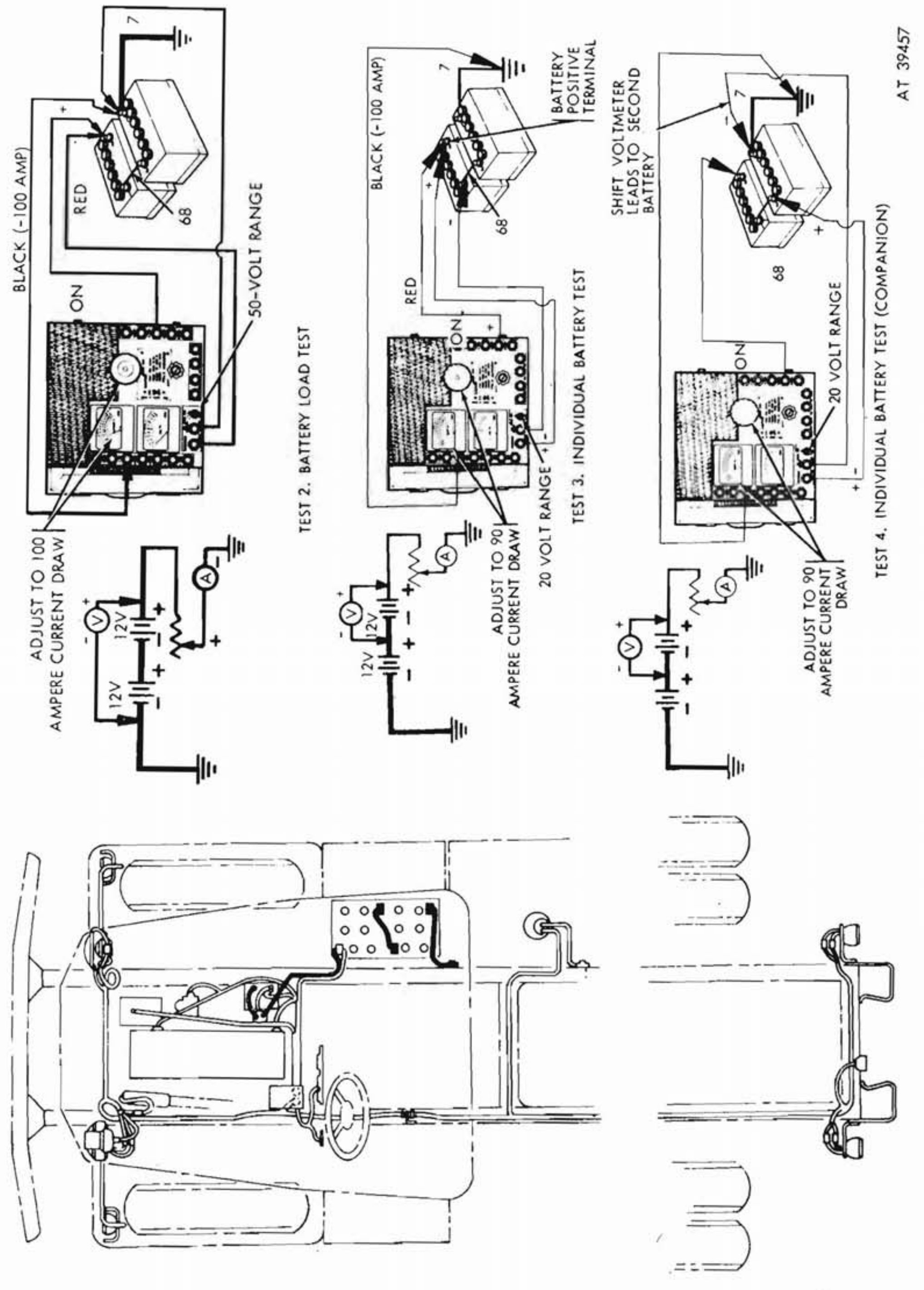

Figure 41. Battery tests.

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Table 5. Electrical Troubleshooting - Continued

STARTER SYSTEM

Malfunction	Circuit	Test
Engine fails to crank, or cranks slowly	82, frame (Gasoline) 14, frame (Multifuel)	TEST 1. Connect low voltage circuit tester (50-volt range) between starter terminal and starter frame as shown in figure 42, test 1. Depress starter switch. If reading is 18.5 volts or more, starting switch, cables and batteries are not the cause of slow cranking. Check for tight engine or defective starter. If reading is less than 18.5, continue tests 2, 3, and 4.
	7, frame	TEST 2. Connect low voltage circuit tester (50-volt range) between battery ground terminal and starter frame as shown in figure 42, test 2. Depress starter switch. If voltmeter shows no or low reading, switch the voltmeter range selector to a lower range until a reading is obtained or the 1-volt range is reached. If reading is more than .2 volt, check for corroded or loose battery ground cable, loose starter, or missing or loose engine ground strap.
	82 (Gasoline) 6, 14 (Multifuel)	TEST 3. Connect low voltage circuit tester (50-volt range) between starter terminal and positive battery post as shown in figure 42, test 3. (Contact the actual battery post and not the cable clamp.) Depress starter switch. If voltmeter shows no or low reading, switch the voltmeter range selector to a lower range until a reading is obtained or the 1-volt range is reached. If reading is more than .3 volt, check for loose connections, corroded cables or a defective starter switch.
	68	TEST 4. Connect low voltage circuit tester (50-volt range) across battery-to-battery cable. Contact the actual battery posts, and not the cable clamp, with positive and negative test leads as shown in figure 42, test 4. Depress starter switch. If voltmeter shows no or low reading, switch the voltmeter range selector to a lower range until a reading is obtained or the 1-volt range is reached. If reading is zero, cable is serviceable. If reading is .1 or more, check for loose connections or corroded cable.

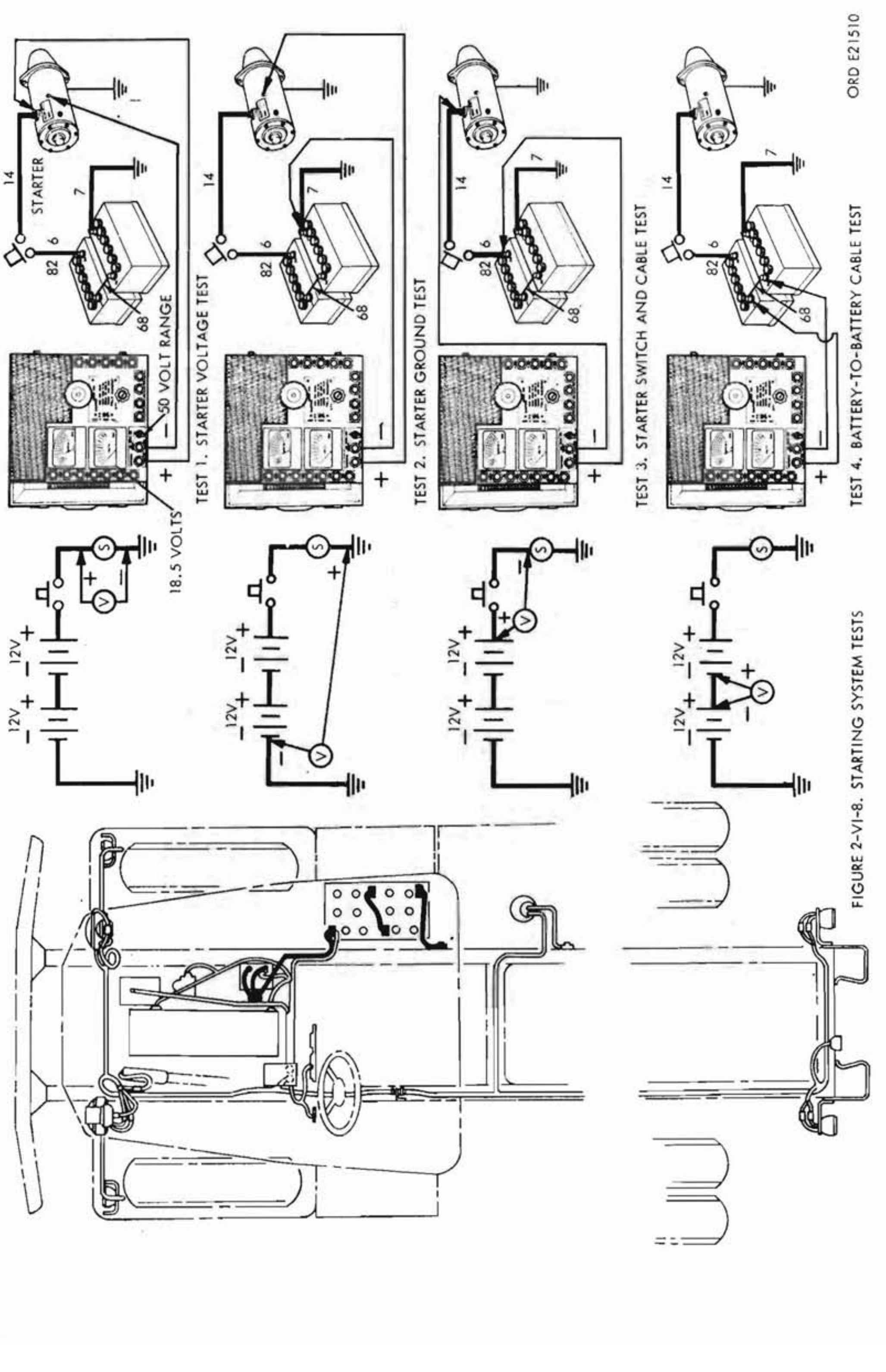


Figure 42. Starting system tests

Table 5. Electrical Troubleshooting - Continued

GENERATING SYSTEM		
Malfunction	**Circuit**	**Test**
		Caution: When performing the following tests, make sure none of the exposed parts or links of the adapters touch the engine or frame of the vehicle.
		Note. Start and operate engine until temperature is normal.
		Caution: Disconnect battery ground cable before connecting adapter to regulator. Reconnect battery ground cable after adapters are installed.
No charging action	1,2	TEST 1. Install adapters (fig. 45) at generator, and at regulator. Connect battery ground cable. Polarize generator by connecting one end of a jumper to terminal 1 of the regulator adapter and briefly touching other end of jumper to field terminal F1 on generator adapter. Perform generator output test. Connect voltmeter, ammeter, adapter, field rheostat and load bank as shown in figure 43, test 1. Start the engine and operate at high idle (1000-1200 rpm). Rotate field rheostat clockwise until voltmeter indicates 30 volts. Switch load switch "on" and rotate load bank control clockwise until ammeter indicates 30 amperes. Both knobs must be adjusted, because as amperage increases, voltage falls off. Adjust load bank and field rheostat until a reading of at least 30 amperes at 30 volts is obtained. If reading is 30 amperes, generator is serviceable. If reading is less than 30 amperes, check for loose generator drive belt. If drive belt is slipping, tighten or replace and repeat test. If drive belt is not slipping, generator is faulty.
Incorrect charging rate (Low charge or high charge)	1,2,4	TEST 2. Perform generator regulator circuit breaker test. Connect voltmeter, ammeter, adapter and field rheostat as shown in figure 43, test 2. Make sure load switch is "off" and field rheostat knob is in maximum counterclockwise position. Start engine (fast idle, 1000-1200 rpm) and slowly rotate field rheostat clockwise until ammeter moves off zero; voltmeter must indicate not less than 24 volts. Rotate field rheostat counterclockwise until ammeter returns to zero and continues below zero. Continue this reduction of generator output until reverse current relay opens and ammeter returns to zero, indicating generator is disconnected from battery circuit. **Caution:** If ammeter does not return to zero before it reaches left end of scale, replace unserviceable generator regulator. Repeat test with newly installed regulator. Ammeter must return to zero when generator is not charging.

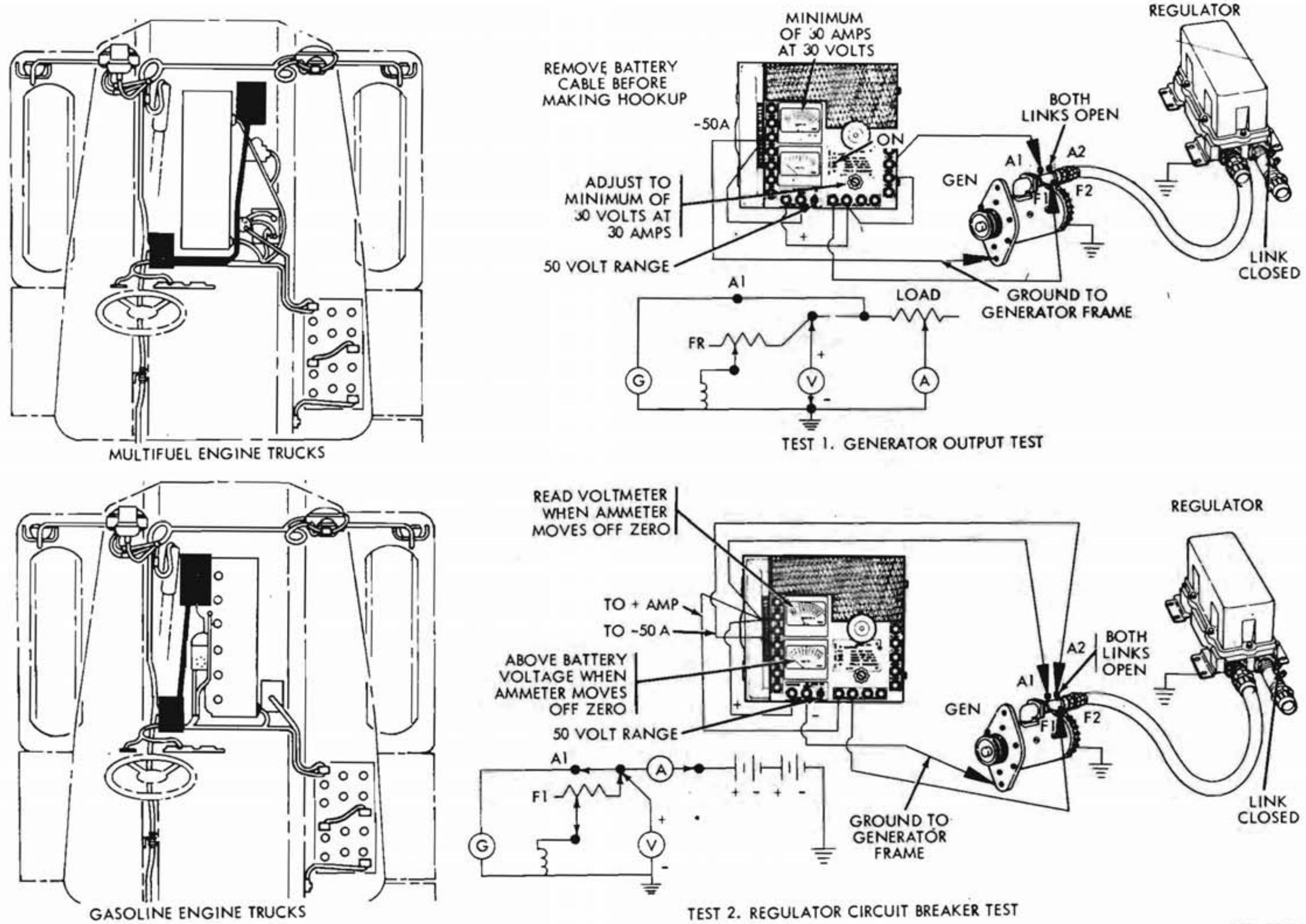


FIGURE 2-VI-9-1. GENERATING SYSTEM TESTS (1 OF 3)

Figure 43. Generating system tests (1 of 3)

Table 5. Electrical Troubleshooting - Continued

GENERATING SYSTEM - Continued

Malfunction	Circuit	Test
Incorrect charging rate (Low charge or high charge)	2, 4, 7, 6, 8	TEST 3. Perform charging circuit insulated cable resistance test. Connect voltmeter (50-volt range), ammeter (50-ampere range), adapters and field rheostat as shown in figure 44, test 3. Set field rheostat to "off" position. Start engine and set at fast idle (100-1200 rpm). Slowly rotate field rheostat clockwise until ammeter indicates 20 amperes of charging current. Voltmeter should read zero on 50-volt range. Switch the voltmeter range selector to a lower range until a reading is obtained or the 1-volt range is reached. The voltage should read .7 volt or less. If voltage reading is excessive, perform the main wiring harness test (test 4, fig. 44). If main wiring harness tests check out correctly, the regulator or regulator-to-generator cable is faulty.
	4, 7, 10, 68	TEST 4. Perform main wiring harness test. Connect voltmeter (50-volt range), ammeter (50-ampere range), adapter and field rheostat as shown in figure 44 , test 4. Set field rheostat to "off" position. Start engine and set at fast idle (1000-1200 rpm). Rotate field rheostat clockwise until ammeter indicates 20 amperes of charging current. Voltmeter should read zero on 50-volt range. Switch the voltmeter range selector to a lower range until a reading is obtained or the 1-volt range is reached. The voltage should read .4 volt. If voltage is over .4 volt, the fault is in the battery cable or wiring harness. Perform starter switch and cable test (fig. 42 , test 3). If starter switch and cable check out correctly, main wiring harness is faulty.
	7, and generator grounding circuit	TEST 5. Perform charging circuit ground resistance test. Connect voltmeter (50-volt range) directly between generator frame and battery ground terminal. The negative voltmeter lead connects to the battery ground terminal. Connect the ammeter (50-ampere range), adapters and field rheostat as shown in figure 44, test 5. Start engine and operate at high idle (1000-1200 rpm). Rotate field rheostat clockwise until ammeter registers 20 amperes of charging current. Voltmeter should read zero on 50-volt range. Switch the voltmeter range selector switch to a lower range until a reading is obtained or the 1-volt range is reached. The voltage should read .2 volt or less. If voltage is over .2 volt check generator regulator ground connections, battery ground connections, and generator mounting bolts and flanges for clean and tight connections.

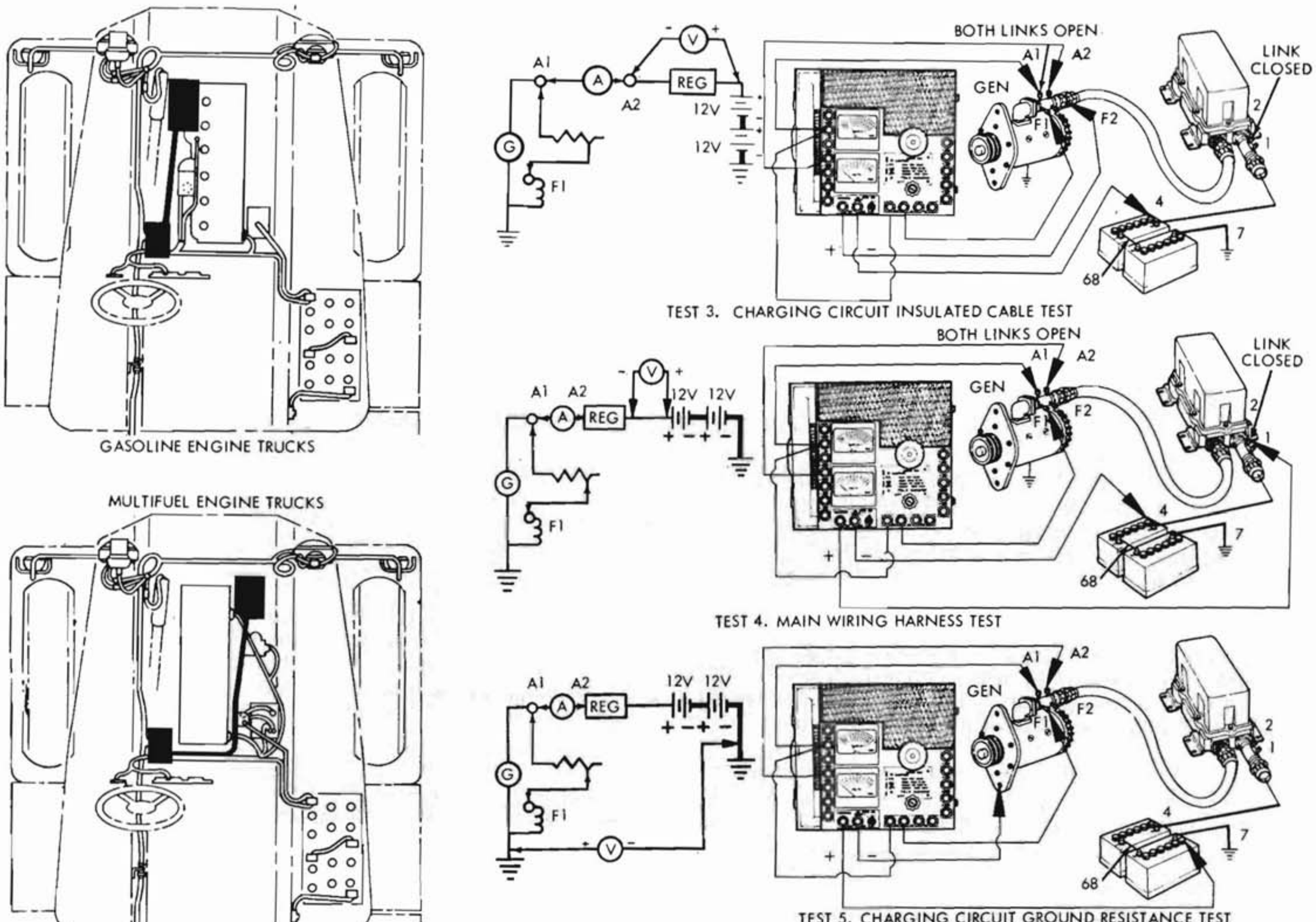


FIGURE 2-VI-9-2. GENERATING SYSTEM TESTS (2 of 3) ORD E21512

Figure 44. Generating system tests (2 of 3)

Table 5. Electrical Troubleshooting - Continued

GENERATING SYSTEM - Continued

Malfunction	Circuit	Test
		Note. Voltage regulator and current limiter tests are usually made consecutively; therefore, the circuit tester connections are the same. During the voltage regulator test the load bank switch is off and only open voltage is tested; the load bank and ammeter are not in the circuit.
Low charging rate	4, 7	TEST 6. Perform voltage regulator test. Connect voltmeter (50-volt range), ammeter (50 ampere range), load bank and adapters as shown in figure 45, test 6. Switch load bank switch to "off" and remove link from regulator adapter. Start engine and set at fast idle (1000-1200 rpm). The voltmeter should register the voltage regulator setting of 27.5 to 29 volts. If voltage is not in this range, the generator regulator is faulty.
High charging rate	4, 7	TEST 7. Perform current limiter test. Connect voltmeter, ammeter, load bank and adapters as shown in figure 45, test 7. (Same as test 6) Leave engine operating at fast idle. Set load bank control all the way counterclockwise, and switch load bank switch "on." Rotate load bank knob clockwise until voltmeter reads below 24 volts and read ammeter. The ammeter should read 24-27 amperes steady. If current is not in this range, the generator regulator is faulty. **Caution:** Do not allow voltmeter to go below 22 volts while making this test.

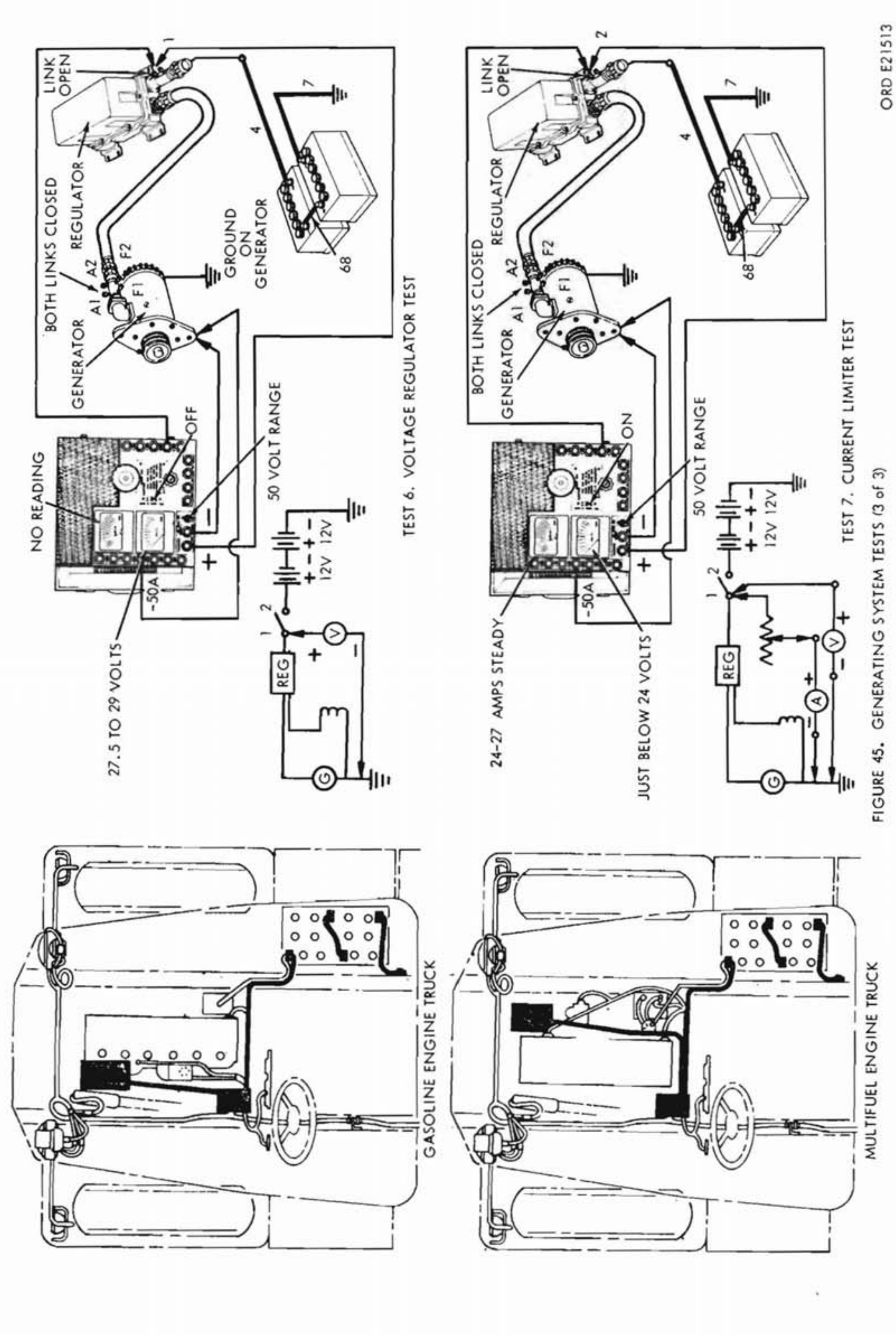


Figure 45. Generating system tests (3 of 3)

Table 5. Electrical Troubleshooting - Continued

IGNITION SYSTEM (GASOLINE)		
Malfunction	Circuit	Test
Engine won't fire	12	TEST 1. Remove each spark plug cable from spark plug. Crank engine with starter (ignition switch on) while holding the spark plug cable end one-fourth inch from cylinder head as shown in figure 46, test 1. If spark jumps the gap between the cable and head, spark plug is defective, dirty, or has incorrect electrode gap adjustment. If, after cleaning, adjusting, or replacing spark plugs, engine still does not fire, check fuel system (par. 58) and distributor timing (par. 92). If spark does not jump gap, proceed with test 2.
	11, 12	TEST 2. Perform primary circuit resistance test. Connect adapters, jumper wire and voltmeter as shown in figure 46, test 2. Select 50-volt range. Turn on ignition switch. If the voltmeter shows low or no reading, switch the voltmeter range selector to a lower range until a reading is obtained or the 1-volt range is reached. If voltmeter reads less than .2 volt, ignition switch and primary circuit connection are normal. A reading of more than .2 volt indicates a faulty ignition switch or primary circuit. Turn switch to "OFF" and to "ON" several times. If meter indicates a different voltage each time switch is turned on, check for loose or corroded connections.

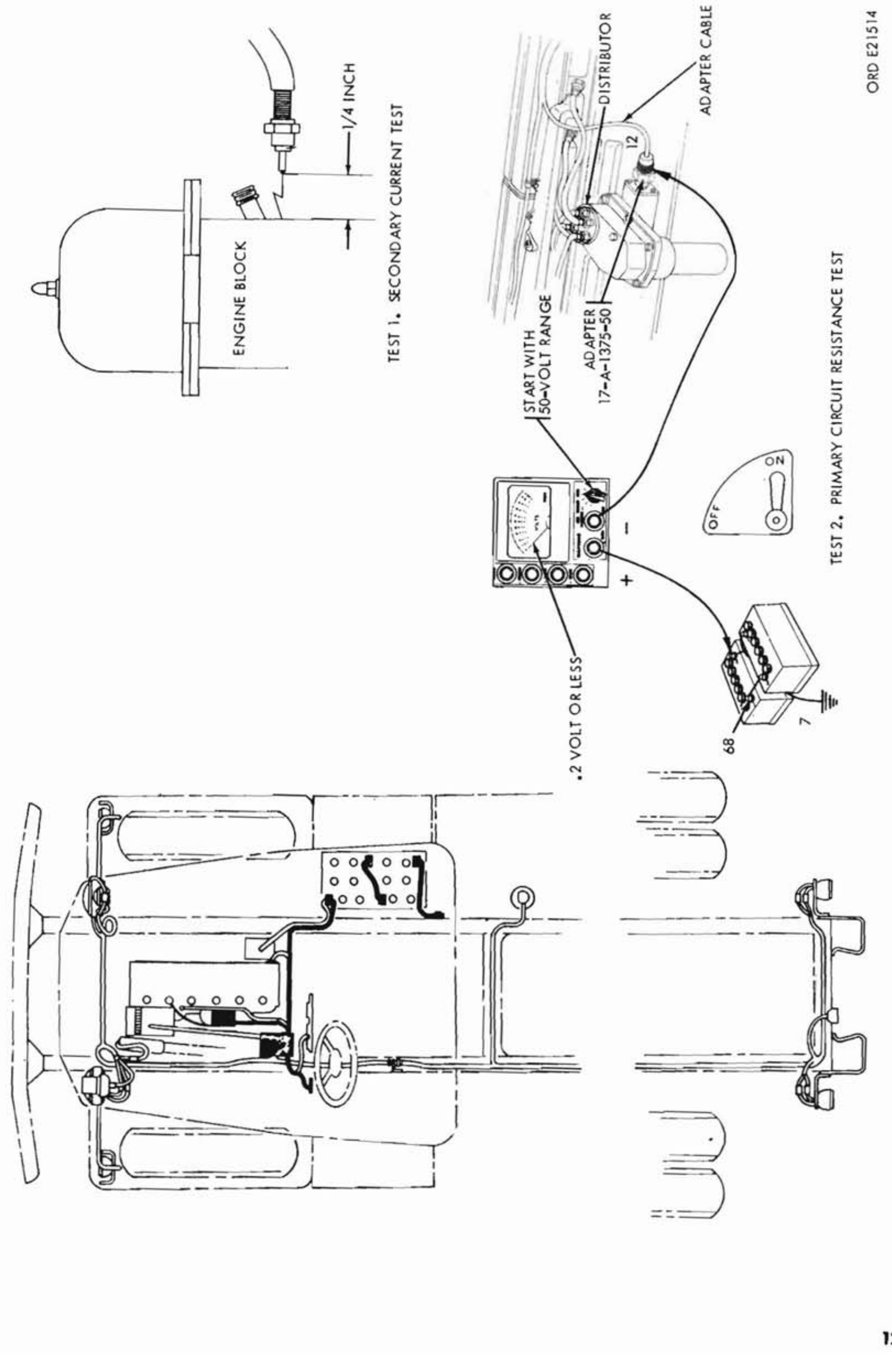


Figure 46. Ignition system tests (1 of 3)

Table 5. Electrical Troubleshooting - Continued

IGNITION SYSTEM - Continued		
Malfunction	Circuit	Test
Engine starts hard or stalls easily	12	TEST 3. Perform breaker point resistance test. Connect voltmeter and adapter as shown in figure 47, test 3. Select 50-volt range on voltmeter. Turn ignition switch to "ON" position. Actuate starter switch for short intervals until voltmeter reads zero, or very low value. Breaker points are now closed. Switch the voltmeter range selector to a lower range until a reading is obtained or the 1-volt range is reached. A reading of less than .2 volt indicates that breaker points, internal primary connections and distributor ground are normal. A reading of more than .2 volt indicates a poor distributor ground to engine or burned and pitted breaker points.
Engine misfires at high speed and under load, or is hard to start	12	TEST 4. Perform breaker point dwell test. Connect dwell meter and adapter as shown in figure 47, test 4. If truck is not equipped with a tachometer, connect an external tachometer as shown in figure 47, test 4. Set dwell meter selector switch to 6-cylinder position. Start and operate engine at 600 rpm. Observe dwell meter. A reading of 39-44 degrees indicates normal breaker point gap setting. A reading of more than 44 degrees (small gap) may be a cause of hard starting. A reading of less than 39 degrees (gap too large), may cause engine to misfire at high speeds of under load. **Note.** Ignition timing must be checked whenever breaker point gap is adjusted.
Engine runs unevenly	12	TEST 5. Perform dwell variation test. First, perform breaker point test shown in figure 47, test 4. Slowly increase engine speed from 600 rpm to 1500 rpm and observe the highest and lowest dwell indication on dwell meter. A variation of less than 3 degrees indicates distributor shaft and bushing are within specification. If a variation of more than 3 degrees is noted, distributor is faulty.

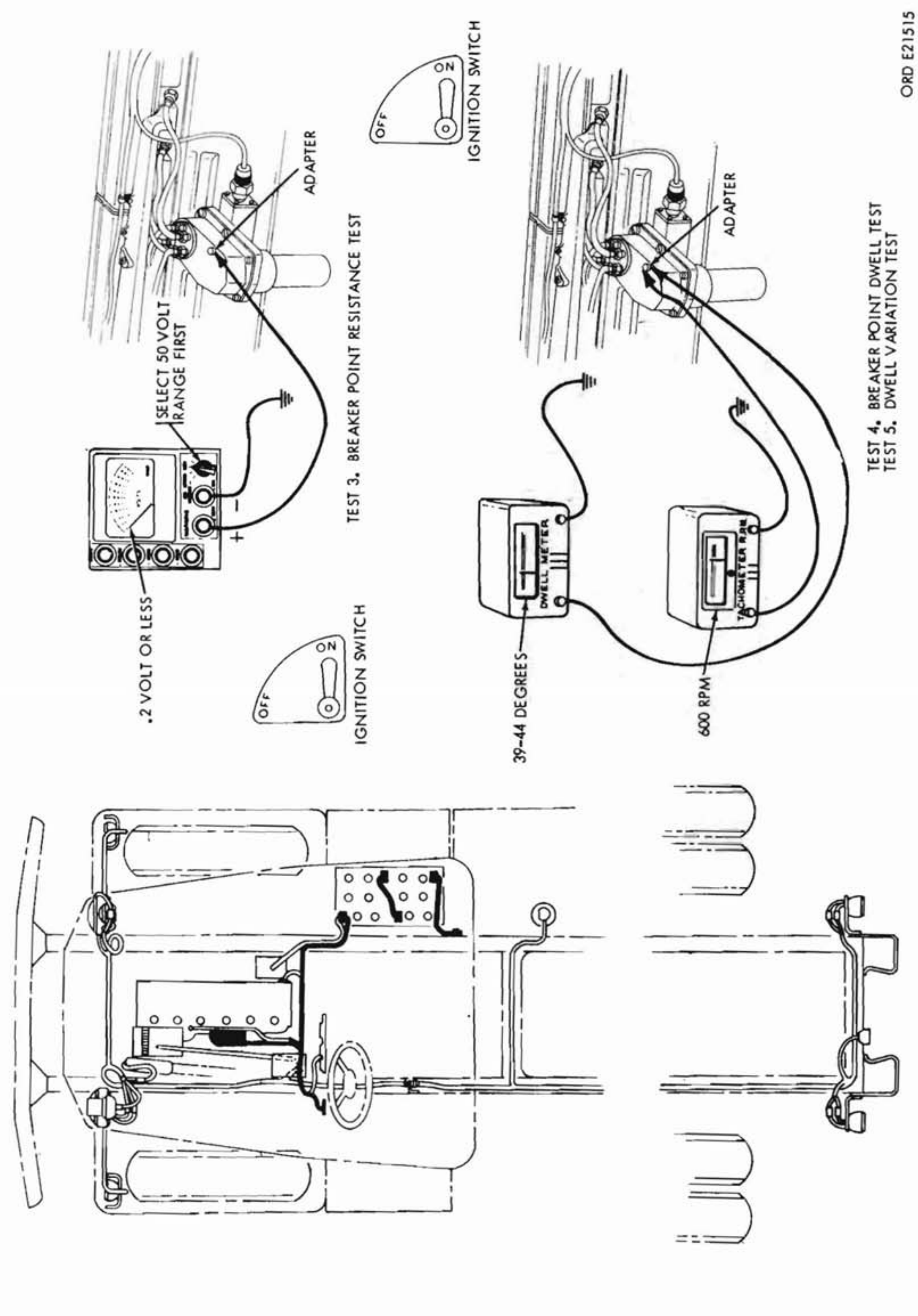


Figure 47. Ignition system tests (2 of 3)

Table 5. Electrical Troubleshooting - Continued

IGNITION SYSTEM - Continued		
Malfunction	Circuit	Test
Engine has spark knock on hard pull, overheating, hard starting, lack of power	4, 7, 10 11, 12, 68	TEST 6. Perform ignition timing test. Clean crankshaft timing notch and pointer (fig. 141). Connect tachometer (if truck does not have tachometer installed) and adapter as shown in figure 47, test 4. Connect adapter and timing light as shown in figure 48, tests 6 and 7. Start engine and set idle speed at or below 500 rpm. Timing notch alined with pointer indicates ignition timing is in correct adjustment. Timing notch above pointer or below pointer indicates incorrect adjustment.
Engine runs unevenly, misfires at high speed, spark knock on hardpull	4, 7, 10, 11, 12, 68	TEST 7. Perform ignition timing advance test. Start and operate engine at 500 rpm. Use timing light to observe timing notch and slowly increase engine speed to 1500 rpm. Hold engine speed at 1500 rpm and observe timing notch. If timing notch moves from pointer, distributor governor mechanism is operating normally. If timing notch does not move or jumps from pointer, distributor is faulty. If timing notch moves back and forth when engine speed is held constant, replace distributor and repeat test. If timing mark still moves back and forth, engine timing gears may be worn. Notify direct support maintenance unit.

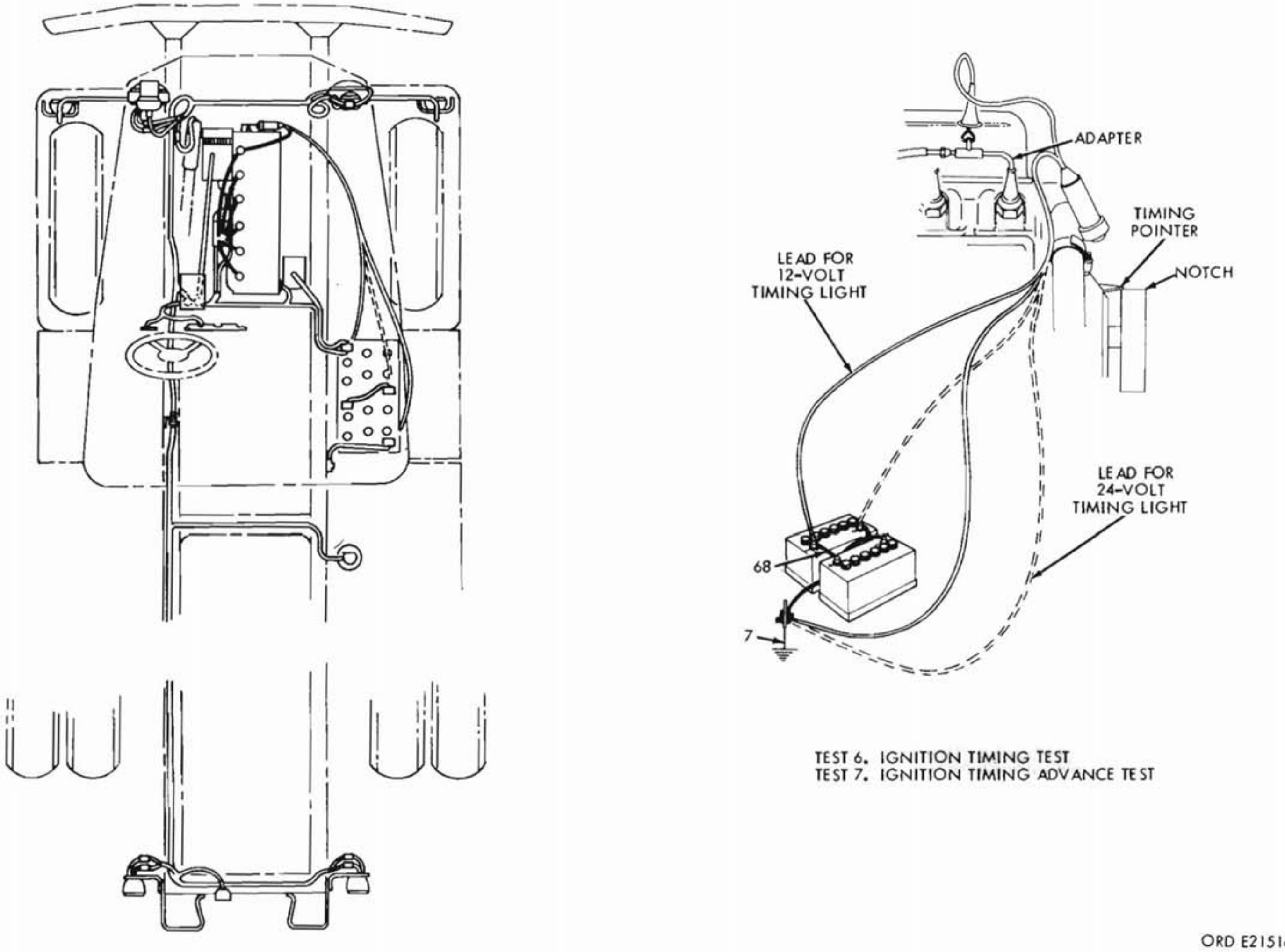


Figure 48. Ignition system tests (3 of 3)

Table 5. Electrical Troubleshooting - Continued

LIGHTING SYSTEM		
Malfunction	Circuit	Test
		Note. Before attempting to troubleshoot the lighting system, refer to the TM 9-2320-209-10 to become familiar with the lighting arrangement for each switch position and the nomenclature for each light.
Headlight (one side) inoperative	17, 18, 91	TEST 1. Perform service headlamp connector voltage test. Disconnect connector and connect voltmeter as shown in figure 49, test 1. Turn lighting switch to "SER DRIVE" position. If no voltage is indicated, operate dimmer switch. If 24 to 28 volts is indicated, replace sealed lamp unit. If replacement lamp unit does not light, pin connector of headlamp body may be faulty. If no reading is indicated, in either position of the dimmer switch, and the other boom of the headlight operates, the wiring harness from headlamp to dimmer switch is unserviceable.
Headlights (both sides) inoperative	16, 17, 18	TEST 2. Perform service headlamp voltage test (both sides). Check for voltage at connectors of both lamps as in test 1. If voltage is not present, disconnect No. 17 and No. 18 wires at dimmer switch. Connect voltmeter as shown in figure 49, test 2. Check for voltage at exposed terminal No. 17 of the dimmer switch. If voltage is not present, actuate switch. Repeat this step for exposed terminal No. 18 of the dimmer switch. If 24-volt reading is indicated at No. 17 and No. 18 switch terminals, but not at headlamp connectors, wiring harness from headlamps to dimmer switch is unserviceable. If voltage readings are not present at No. 17 and No. 18 dimmer switch terminals, remove No. 16 wire and connect the positive lead of the voltmeter to the No. 16 wire (not the dimmer switch terminal), to see if supply voltage is present. If voltage is indicated, replace dimmer switch; if no voltage is indicated, perform lighting switch connector voltage test (test 8) to determine if lighting harness from dimmer switch to lighting switch is unserviceable.

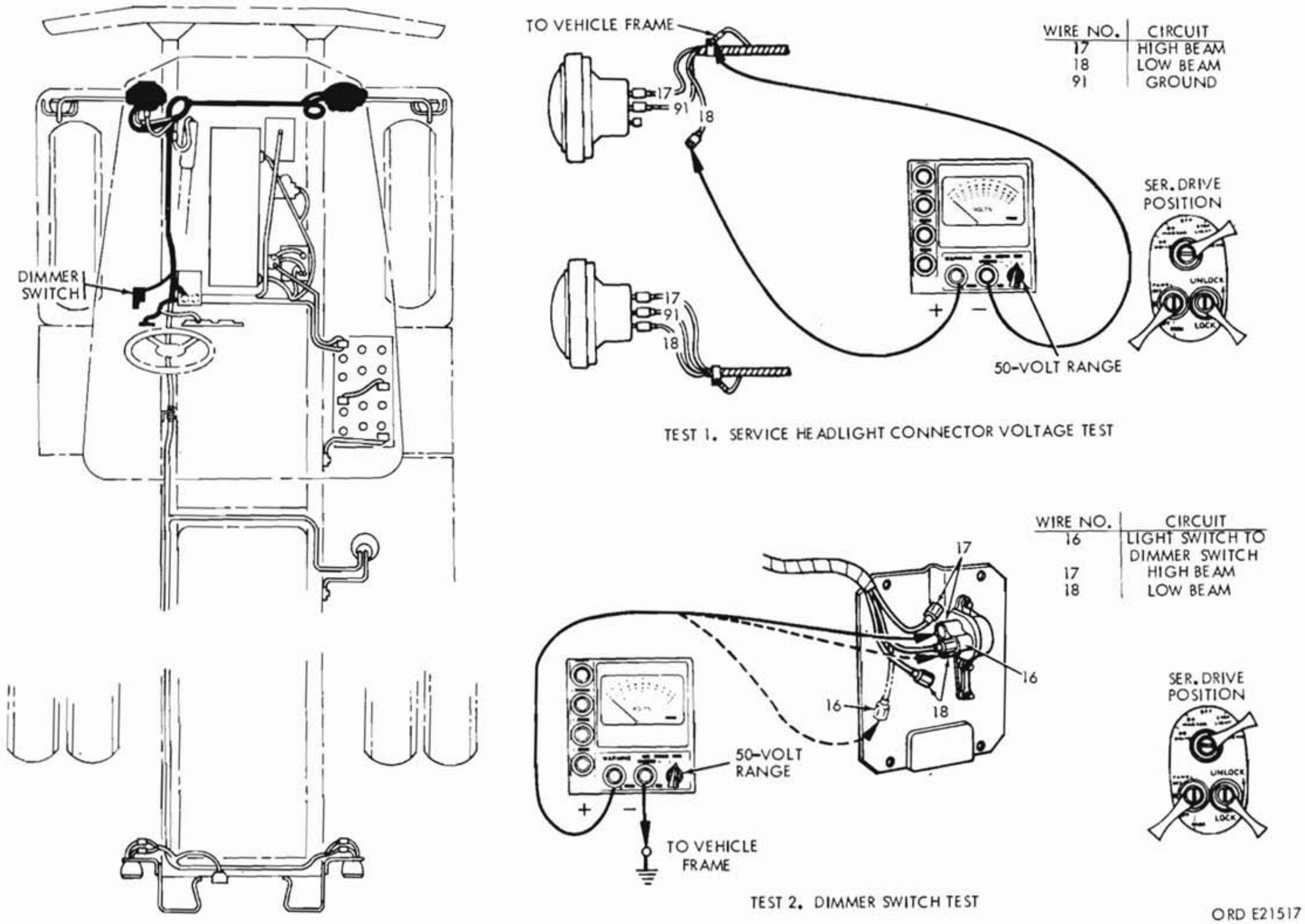


Figure 49. Lighting system tests (1 of 4)

Table 5. Electrical Troubleshooting - Continued

LIGHTING SYSTEM - Continued

Malfunction	Circuit	Test
Blackout and marker lights inoperative	19, 20 91, 491	TEST 3. Perform front blackout lamp connector voltage test. Connect voltmeter as shown in figure 50, test 3. Turn lighting switch to "BO DRIVE" position. If 24 to 28 volts is indicated, replace bulb; if new bulb does not light, check for corroded, dirty or defective socket and wire assembly. If no reading is indicated, perform lighting switch connector voltage test figure 52, test 8, to determine if wiring harness is unserviceable.
Rear lights inoperative	21, 22 23, 24	TEST 4. Perform rear lamp connector voltage test. Connect voltmeter as shown in figure 52, test 4. Turn lighting switch to position corresponding to position of faulty rear lamp; if stoplamp, depress brake pedal. If 24 to 28 volts is indicated, replace bulb; if new bulb does not light, check for corroded, dirty or defective socket and wire assembly. If no voltage reading is indicated, perform lighting switch connector voltage test figure 52, test 8, to determine if wiring harness is unserviceable.

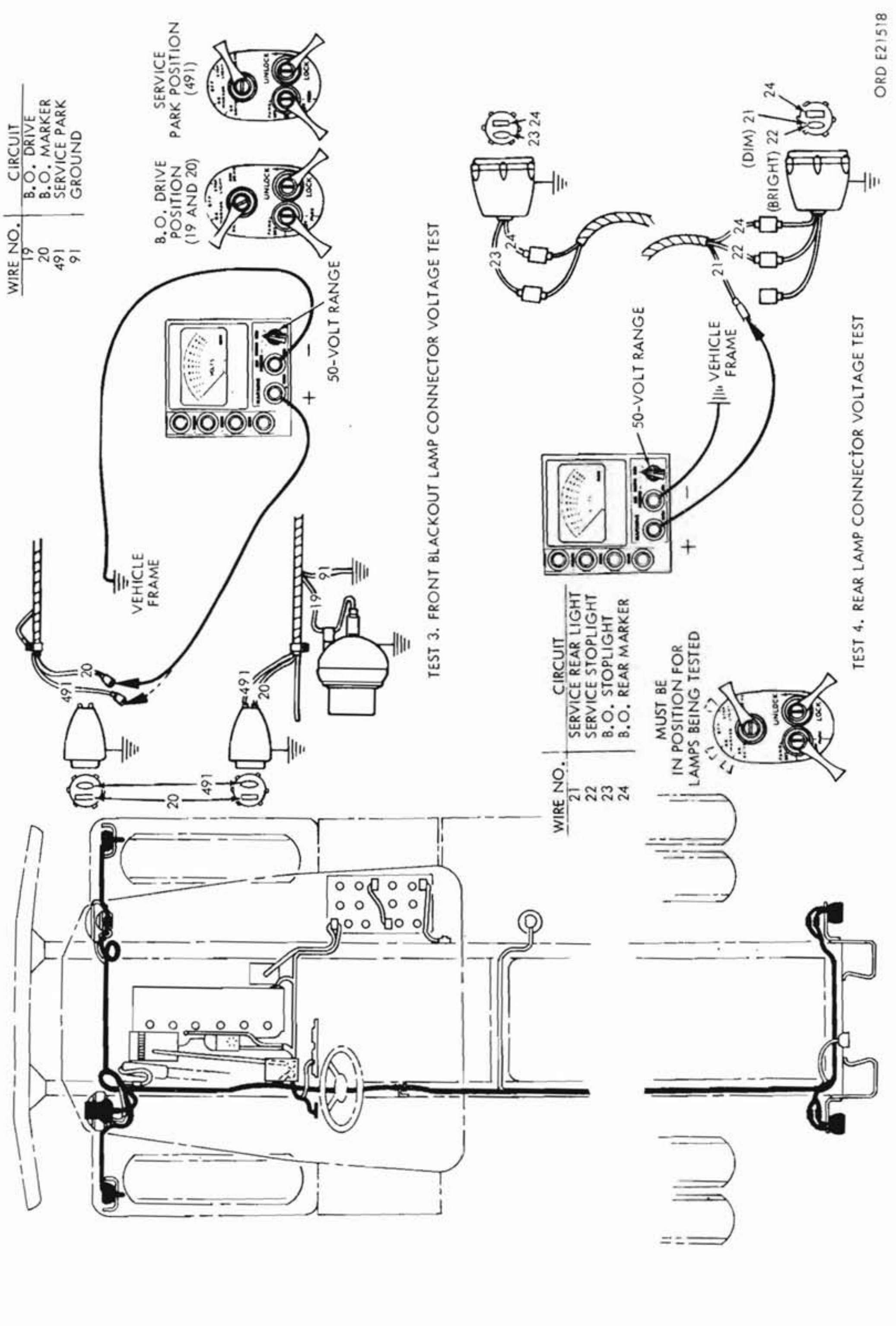
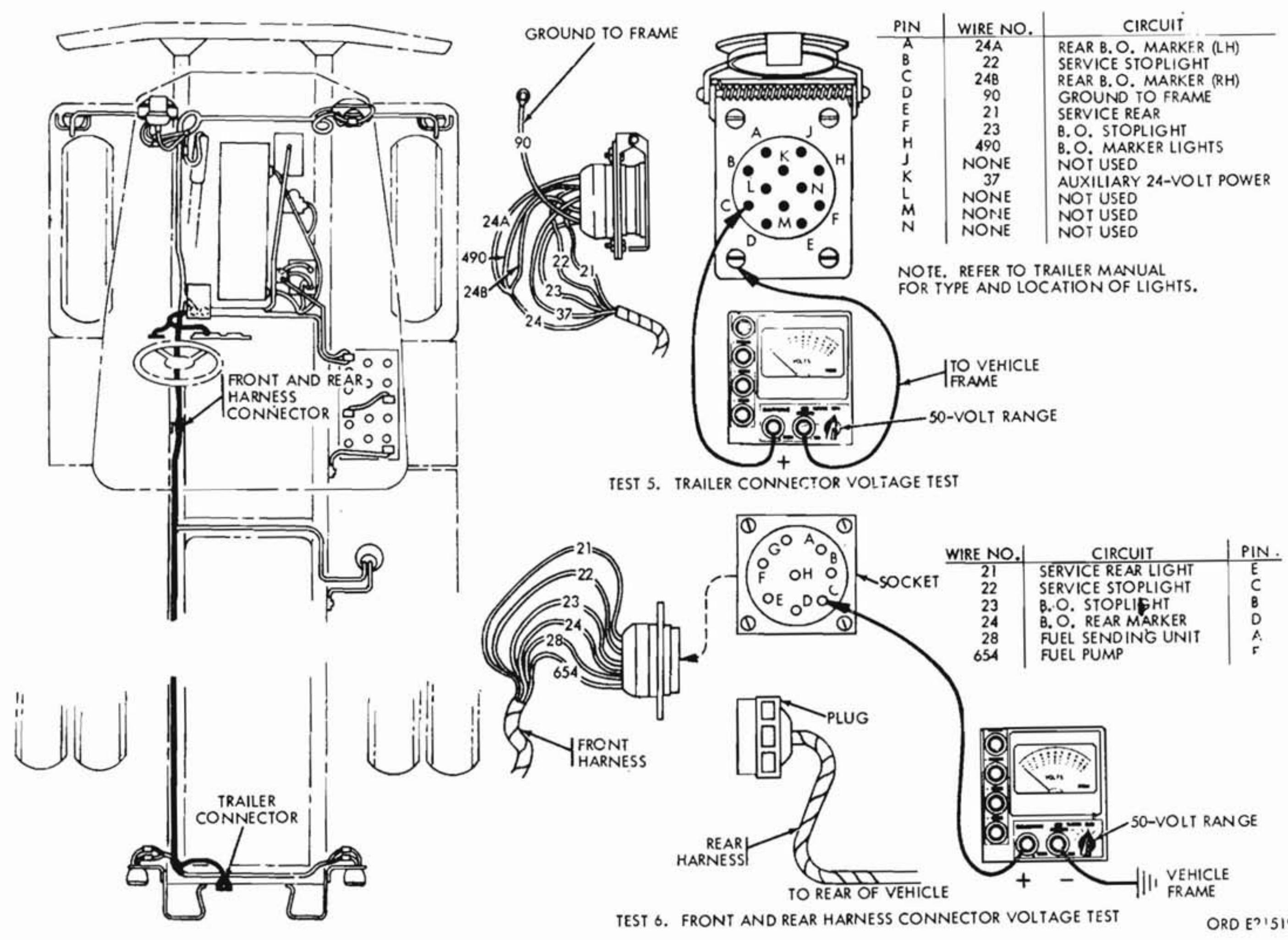


Figure 50. Lighting system tests (2 of 4)

Table 5. Electrical Troubleshooting - Continued

LIGHTING SYSTEM - Continued

Malfunction	Circuit	Test
One or more trailer lights out (Trailer receptacle in-operative)	21, 22, 23, 24A, 24B, 90, 490	TEST 5. Perform trailer connector voltage test. Turn lighting switch to position which should light inoperative trailer lamp. Connect voltmeter as shown in figure 51, test 5, to appropriate connector socket of inoperative circuit. If 24 to 28 volts is indicated at correct connector socket, check the No. 90 wire ground connection. If No. 90 wire is tightly grounded, trailer electrical system is faulty. If no reading is indicated at correct connector socket, perform chassis harness connector voltage test (test 6 below).
Rear lamps inoperative (test to determine if cause of failure is lighting switch or wiring harness)	21, 22, 23, 24, 28, 77	TEST 6. Perform chassis harness connector voltage test. Remove rear chassis harness connector (located on left side of frame under cab between tool box and spare tire rack). Connect voltmeter as shown in figure 51, test 6, to appropriate connector socket for in-operative circuit. Turn light switch to position which should light faulty lamp; if stoplight is the inoperative circuit, depress brake pedal. If 24 to 28 volts is indicated check rear harness from rear chassis connector to inoperative lamp for broken or chafed wires. If no reading is indicated for blackout marker or service lamp connector terminals, perform lighting switch voltage test (test 8). If no reading for stoplight circuit terminals (brake pedal depressed and lighting switch in correct position), perform stoplight switch test (test 7).



PIN	WIRE NO.	CIRCUIT
A	24A	REAR B.O. MARKER (LH)
B	22	SERVICE STOPLIGHT
C	24B	REAR B.O. MARKER (RH)
D	90	GROUND TO FRAME
E	21	SERVICE REAR
F	23	B.O. STOPLIGHT
H	490	B.O. MARKER LIGHTS
J	NONE	NOT USED
K	37	AUXILIARY 24-VOLT POWER
L	NONE	NOT USED
M	NONE	NOT USED
N	NONE	NOT USED

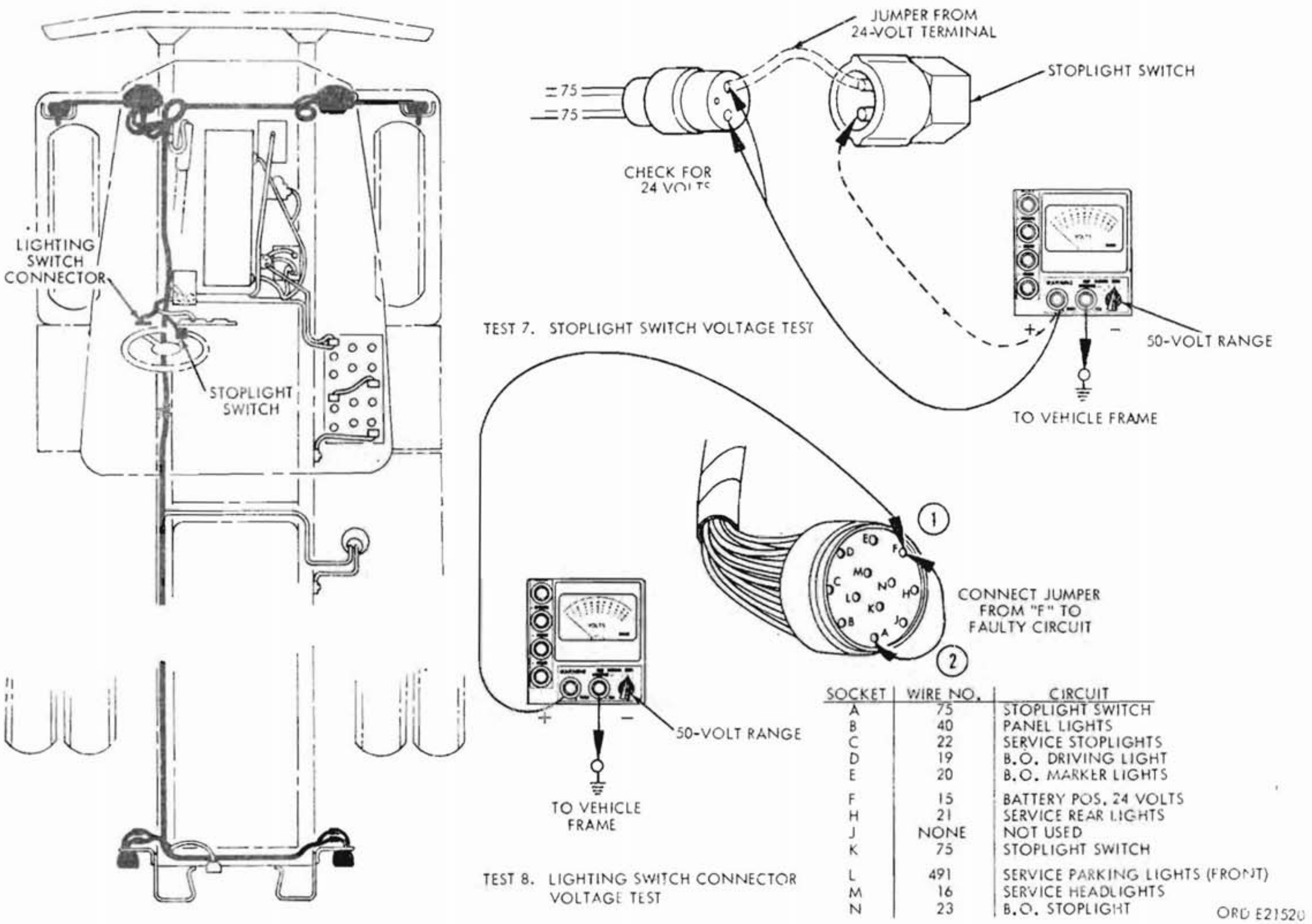
WIRE NO.	CIRCUIT	PIN.
21	SERVICE REAR LIGHT	E
22	SERVICE STOPLIGHT	C
23	B.O. STOPLIGHT	B
24	B.O. REAR MARKER	D
28	FUEL SENDING UNIT	A
654	FUEL PUMP	F

Figure 51. Lighting system tests (3 of 4).

Table 5. Electrical Troubleshooting—Continued.

LIGHTING SYSTEM—Continued

Malfunction	Circuit	Test
Stoplight inoperative (stoplight switch test).	75	TEST 7. Perform stoplight switch voltage test. Move lighting switch to "STOPLIGHT" position. Disconnect connector from the stoplight switch located on the air-hydraulic cylinder mounted on the left-hand frame channel near the brake pedal linkage. Connect voltmeter as show in figure 52, test 7. Check for voltage at one of the two No. 75 wires. If voltage is indicated, jumper that wire to one terminal of the stoplight switch. With brake pedal depressed, use positive voltmeter lead to check for voltage at exposed stoplight switch terminal. If 24 to 28 volts is indicated, stoplight switch is serviceable. If no reading is indicated, stoplight switch is faulty. If no reading is indicated at either of the two No. 75 wires, perform lighting switch connector voltage test (test 8) to determine if wiring harness is broken or if lighting switch is unserviceable.
Lamps will not light (some lamps will not light).	10, 11, 15, 16, 19, 20, 21, 22, 23, 40, 75, 491	TEST 8. Perform lighting switch connector voltage test. Remove lighting switch from dash panel and disconnect harness connector. Connect voltmeter between vehicle frame and socket (F) of lighting switch harness as shown in figure 52, test 8. If 24 to 28 volts is not indicated, check wiring harness circuits No. 15, 10 (gasoline) or 15, 11, 10 (multifuel) between lighting switch and generator regulator for broken wires or loose connections. If 24 to 28 volts is indicated on socket (F) of the connector, connect a jumper wire from (F) socket to socket of faulty circuit. If lamps light with jumper connected, replace light switch.

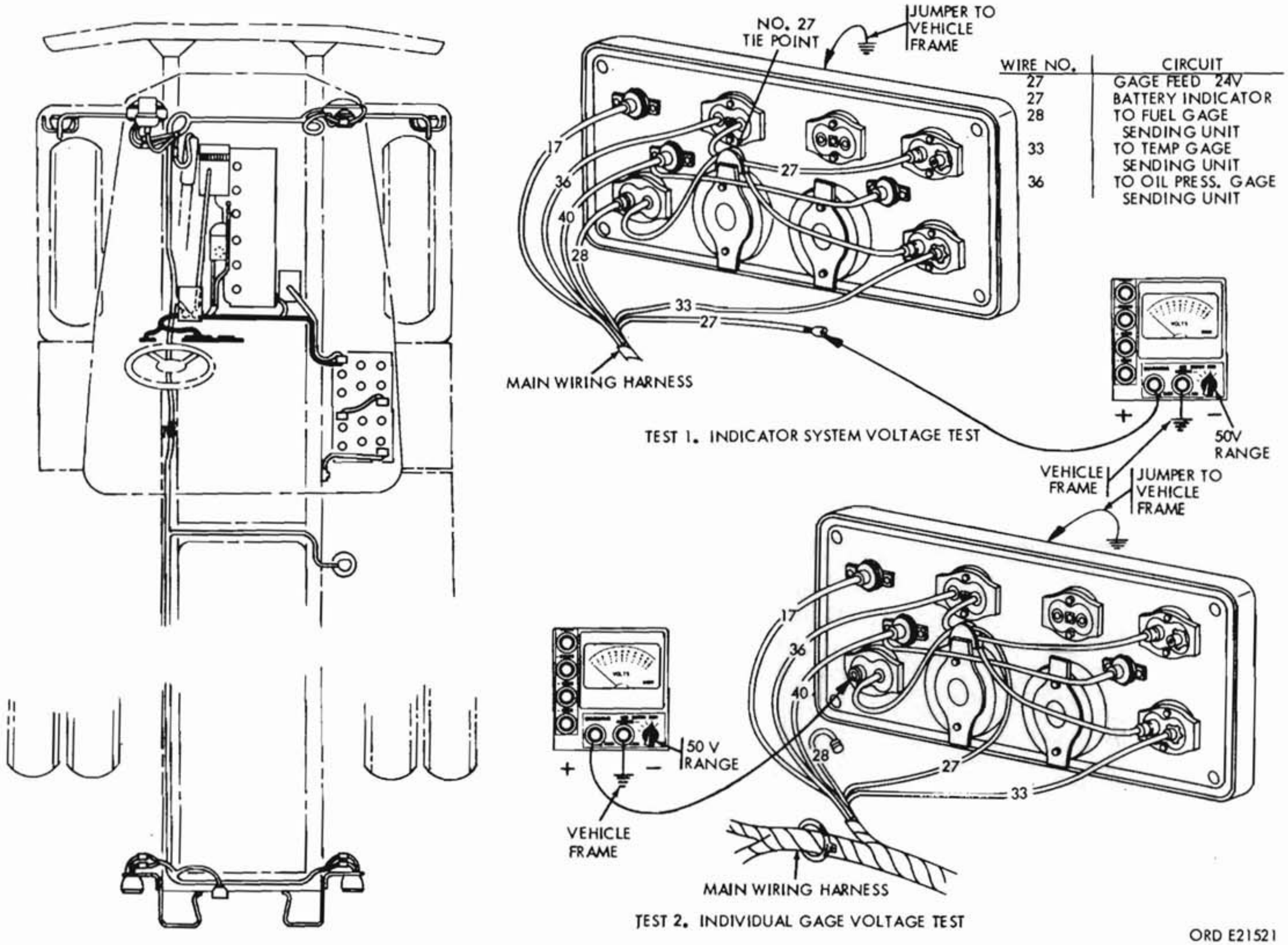


SOCKET	WIRE NO.	CIRCUIT
A	75	STOPLIGHT SWITCH
B	40	PANEL LIGHTS
C	22	SERVICE STOPLIGHTS
D	19	B.O. DRIVING LIGHT
E	20	B.O. MARKER LIGHTS
F	15	BATTERY POS. 24 VOLTS
H	21	SERVICE REAR LIGHTS
J	NONE	NOT USED
K	75	STOPLIGHT SWITCH
L	491	SERVICE PARKING LIGHTS (FRONT)
M	16	SERVICE HEADLIGHTS
N	23	B.O. STOPLIGHT

Figure 52. Lighting system tests (4 of 4)

Table 5. Electrical Troubleshooting - Continued

INSTRUMENTS AND GAGES		
Malfunction	Circuit	Test
		Note. When instrument panel is removed from dash panel, connect a jumper wire from instrument panel to vehicle frame to provide a return circuit for the indicator lights and the gage actuators.
All gages inoperative	27, 28, 33, 36	TEST 1. Perform indicator system voltage test. Remove instrument panel. Disconnect No. 27 wire at instrument tie point terminal strip. Connect voltmeter as shown in figure 53, test 1. Turn ignition (or accessory) switch to "ON" position. If 24 to 28 volts is not indicated check No. 27 wire at the ignition (or accessory) switch for loose connection. If satisfactory, remove No. 27 wire from ignition (or accessory) switch. Connect meter to exposed pin of ignition (or accessory) switch. If voltage is indicated, check wiring harness between switch and instrument panel for loose connection or open circuit. If voltage is not indicated at exposed pin, remove No. 11 wire from ignition (or accessory) switch and check No. 11 wire for voltage. If voltage is present, the switch is faulty. If voltage is not present, check main wiring harness for open circuit or loose connection.
One gage inoperative	27, 28, 33, 36	TEST 2. Perform individual gage voltage test. Remove wire and connector from inoperative gage. Connect voltmeter negative lead to vehicle frame. Connect voltmeter positive lead to terminal of gage, as shown in figure 53, test 2. Turn ignition (or accessory switch) to "ON" position and observe reading. If reading is 3 to 4 volts for fuel level gage and oil pressure gage circuit or 24 volts for temperature gage, perform sending unit resistance test. If no reading is indicated, check wire from gage to tie point for breaks or loose connections. If satisfactory, gage is faulty.
		Note. Test 2 is useful for troubleshooting a completely inoperative gage. For a complete test procedure, including accuracy tests, refer to TB 9-2300-228-20 and TB ORD 434.

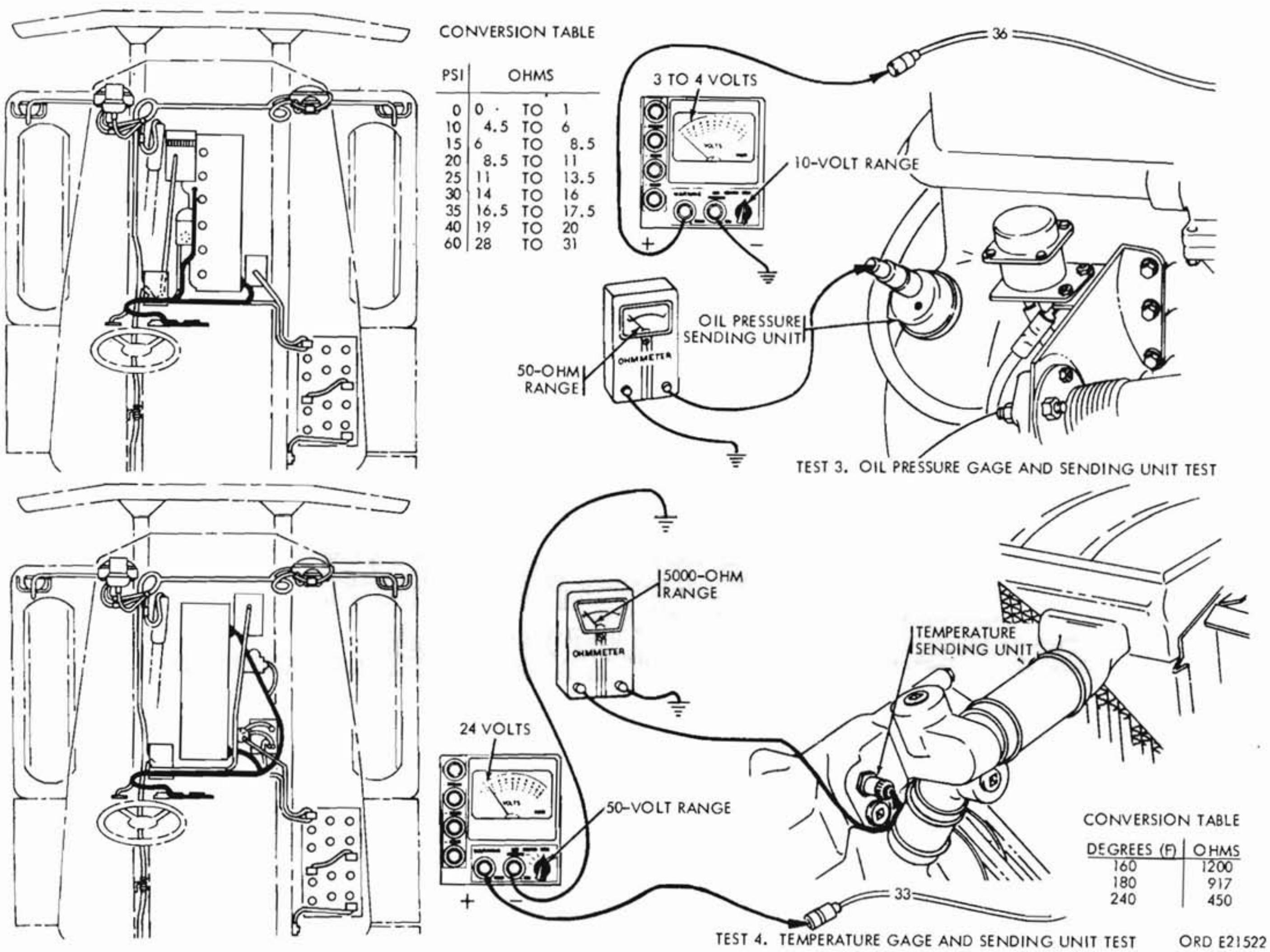


WIRE NO.	CIRCUIT
27	GAGE FEED 24V
27	BATTERY INDICATOR
28	TO FUEL GAGE SENDING UNIT
33	TO TEMP GAGE SENDING UNIT
36	TO OIL PRESS. GAGE SENDING UNIT

Figure 53. Instruments and gages (1 of 3)

Table 5. Electrical Troubleshooting - Continued

INSTRUMENTS AND GAGES - Continued		
Malfunction	Circuit	Test
Oil pressure gage inoperative (sending unit test)	36	TEST 3. Perform oil-pressure sending-unit resistance test. Disconnect No. 36 wire from oil pressure sending unit. Connect an ohmmeter having a suitable range to the sending unit and the vehicle frame, as shown in figure 54, test 3. Start and operate engine at high idle speed. Ohmmeter reading should be less than 1 ohm before engine is started, and rise to about 6 to 10 ohms for normal oil pressures. Refer to conversion table in figure 54, test 3, for a conversion of resistance values to pressures. If sending unit has more than 1 ohm resistance with engine off, or considerably different resistances than shown in the table, sending unit is faulty. If resistance agrees with table, shut off engine and connect voltmeter to wire No. 36 as shown in figure 54, test 3. Turn on ignition (or accessory) switch. Voltage should read 3 to 4 volts. If less, or no voltage, check main wiring harness for open circuit or loose connection. If more, perform test 2 to check for faulty gage.
Temperature gage inoperative (sending unit test)	33	TEST 4. Perform temperature sending unit resistance test. Remove radiator filler cap and insert a test thermometer into coolant. Start and operate engine until thermometer temperature is stable. Disconnect No. 33 wire from temperature sending unit. Connect an ohmmeter as shown in figure 54, test 4. Refer the ohmmeter reading to the conversion table in test 4, and compare the temperature to the test thermometer reading. Stop the engine and observe the ohmmeter reading as the radiator cools. The ohms should increase as the engine cools off, to a maximum of approximately 3000 ohms, depending on adjacent air temperature. If hot resistance differs considerably, sending unit is faulty. If resistance agrees with table, connect voltmeter to No. 33 wire as shown in figure 54, test 4. Turn on ignition (or accessory) switch. Voltage should read 24 to 28 volts. If much less, or no voltage, check main wiring harness for open circuit or loose connections.



CONVERSION TABLE

PSI	OHMS
0	0 TO 1
10	4.5 TO 6
15	6 TO 8.5
20	8.5 TO 11
25	11 TO 13.5
30	14 TO 16
35	16.5 TO 17.5
40	19 TO 20
60	28 TO 31

CONVERSION TABLE

DEGREES (F)	OHMS
160	1200
180	917
240	450

Figure 54. Instruments and gages tests (2 of 3)

Table 5. Electrical Troubleshooting - Continued

INSTRUMENTS AND GAGES - Continued		
Malfunction	Circuit	Test
		Caution: Be very careful when making electrical tests near the fuel tank. When components are removed, cover the tank opening with tape and make electrical tests as far from this area as possible. Do not permit smoking, sparks, or open flame within 50 feet of the area.
Fuel level gage inoperative (sending unit test)	28	TEST 5. Disconnect No. 28 wire from sending unit. Remove sending unit from fuel tank. Connect ohmmeter as shown in figure 55, test 5. Move sending unit float from bottom to to stops. A uniform increase from 0 to 40 ohms resistance indicates sending unit is serviceable. Connect voltmeter to No. 28 wire as shown in figure 55, test 5. Turn on ignition (or accessory) switch. Voltage should read 3 to 4 volts. If less or no voltage, check main wiring harness for open circuit or loose connections. If voltage is considerably more than 4 volts, perform test 2 to check for faulty gage. When testing float resistance, an uneven increase in resistance or erratic ohmmeter pointer movement indicates the fuel sending unit is faulty.
Battery-generator indicator inoperative	27	TEST 6. Perform battery-generator indicator voltage test. Check batteries for normal voltage. Remove instrument panel and connect it to the vehicle frame with a jumper wire. Disconnect No. 27 wire from indicator and connect voltmeter as shown in figure 55, test 6. Turn on ignition (or accessory) switch. If 24 to 28 volts is indicated, check other terminal and metal case of indicator for proper grounding to instrument panel. If grounding is satisfactory, battery-generator indicator is faulty. If No. 27 wire shows less than battery voltage, check wiring harness from indicator to battery for loose or corroded connections or broken wires.

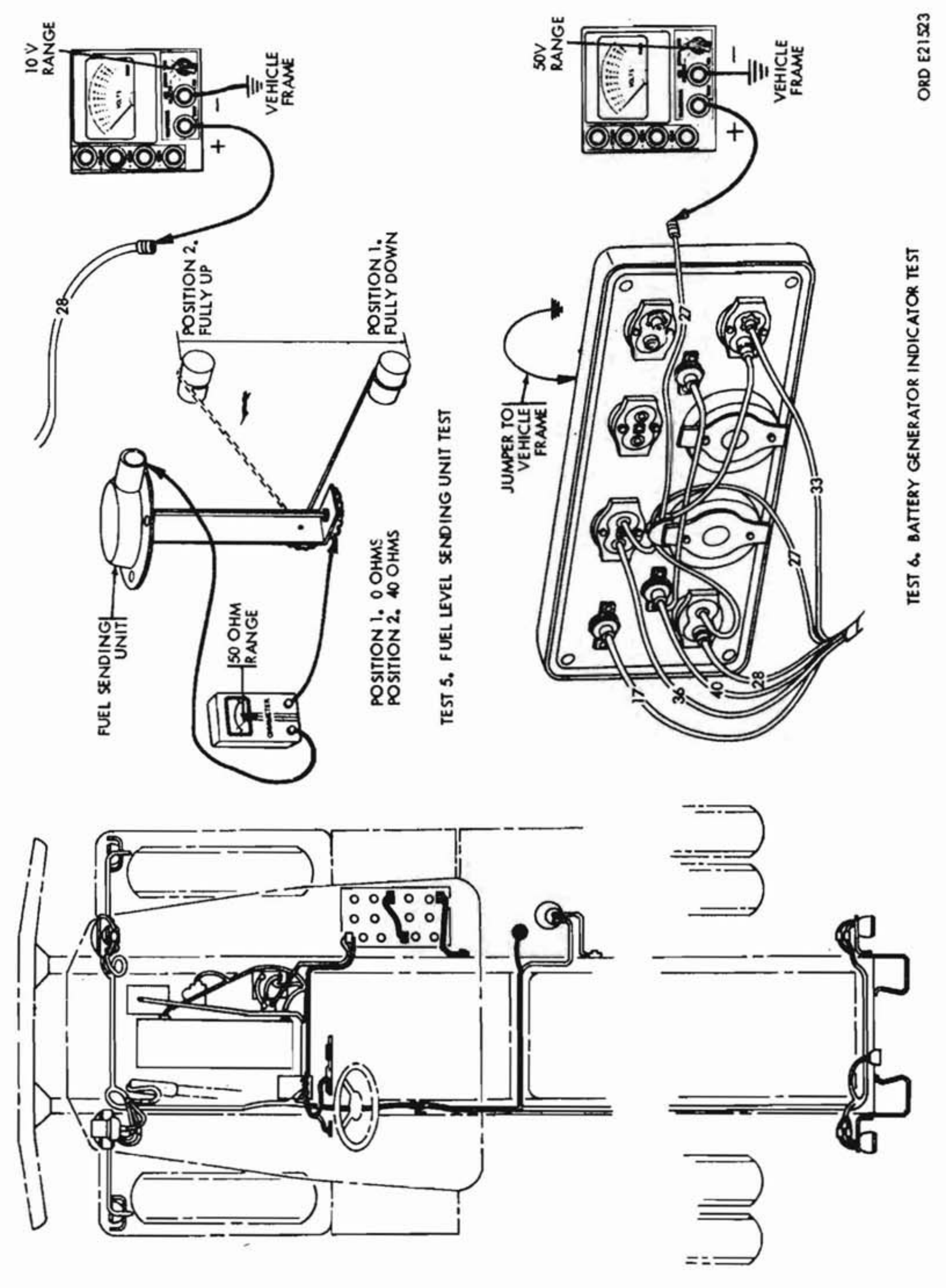


Figure 55. Instruments and gages tests (3 of 3)

Table 5. Electrical Troubleshooting - Continued

HORN AND LOW AIR WARNING BUZZER		
Malfunction	Circuit	Test
Horn inoperative	25	TEST 1. Perform horn circuit voltage test. Disconnect two No. 25 wires from horn. Connect voltmeter as shown in figure 56, test 1. Test both No. 25 wires for voltage. One wire should read zero volts, and the other should read 24 to 28 volts. If a reading is indicated on one No. 25 wire at horn, connect this wire to horn and jumper other horn terminal to vehicle frame. If horn does not operate, it is faulty. If horn operates, remove jumper and connect both wires to horn. Disconnect No. 25 wire at horn button wire leading from steering gear housing. Ground No. 25 wire that goes to wiring harness; if horn operates, check horn switch assembly in steering wheel. If neither No. 25 wire at the horn reads 24 volts, test the No. 25 terminal at the circuit breaker mounted on the engine side of the firewall. If 24 volts is present, check No. 25 wire to horn for open circuit. If no reading is indicated, check other terminal of circuit breaker. If 24 volts is indicated, circuit breaker is faulty. If no reading is indicated, check main wiring harness for broken wire or loose connection.
Low air warning buzzer inoperative	85	TEST 2. Perform low air warning buzzer voltage test. Disconnect No. 85 wire from warning buzzer. Connect voltmeter as shown in figure 56, test 2. Reduce air pressure below 65 psi and turn on ignition (or accessory) switch. If 24 to 28 volts is indicated on No. 85 wire, check for proper grounding of buzzer frame. If grounding is satisfactory, buzzer is faulty. If No. 85 wire has low or no voltage, remove top wire from air switch and connect voltmeter to top terminal of air switch. If 24 volts is indicated, check switch-to-buzzer wire for breaks or loose connections. If no or low voltage is indicated, remove No. 85 wire from bottom terminal of air switch and connect voltmeter to end of wire. If 24 volts is indicated, air switch is maladjusted or faulty. If no or low voltage is indicated, check No. 85 wire to ignition (or accessory) switch for broken wire or loose connection.

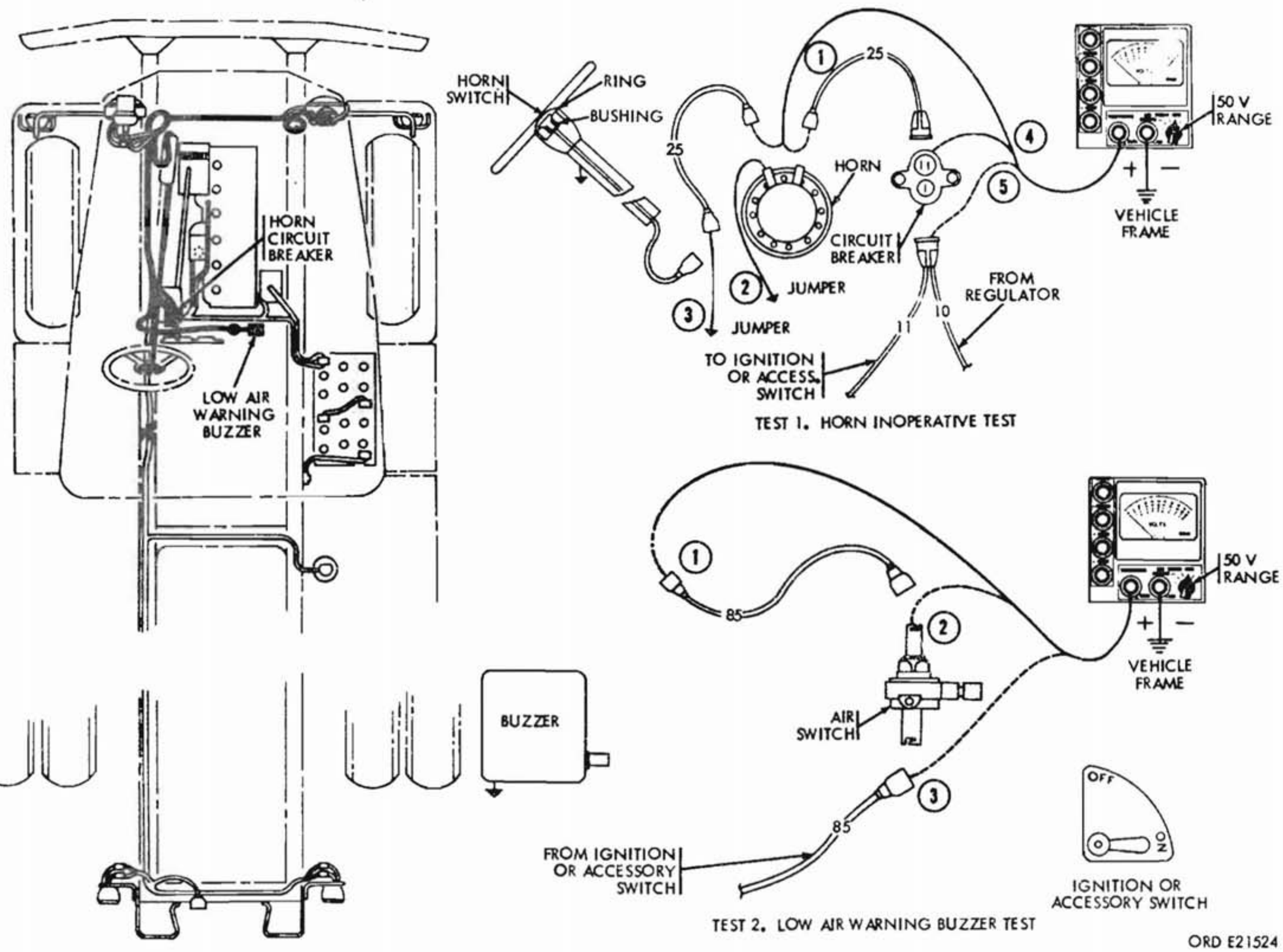


Figure 56. Horn and air warning buzzer tests

Table 5. Electrical Troubleshooting - Continued

FUEL PUMP AND MANIFOLD HEATER (MULTIFUEL)		
Malfunction	Circuit	Test
Fuel pump inoperative	77	TEST 1. Perform fuel pump voltage test. Disconnect wire No. 654 at fuel pump. Connect voltmeter as shown in figure 57, test 1. Turn on accessory switch. If 24 to 28 volts is indicated on the end of No. 654 wire, check for broken or loose ground connection of No. 79 wire to vehicle frame. If ground connection is satisfactory fuel pump is faulty. If no or low voltage is indicated on No. 654 wire remove No. 654 wire at accessory switch. Test switch terminal for voltage. If 24 to 28 volts is indicated, inspect main wiring harness for broken wire or loose connection. Inspect front-to-rear harness connector on frame under cab for loose or corroded connection. If 24 volts is not indicated at accessory switch terminal, refer to test 2 under Ignition System for additional tests.
Engine manifold heater inoperative	55	TEST 2. Perform manifold heater voltage test. Disconnect wire No. 55 at manifold heater igniter coil. Connect voltmeter as shown in figure 57, test 2. Turn on accessory switch and manifold heater switch on dash panel. If 24 volts is indicated on No. 55 wire, refer to direct support maintenance unit for further manifold heater trouble shooting procedure. If low or no voltage is indicated on No. 55 wire, remove both No. 55 wires from manifold heater switch, and test both wires for voltage. One wire will indicate 24 volts. Reinstall this wire on the manifold heater switch. Turn on manifold heater switch. If 24 volts is not indicated on the other terminal of the switch, manifold heater switch is faulty. If 24 volts is indicated on switch terminal, check No. 55 ignitor-to-switch wire for broken wire or loose connection. If neither No. 55 wire at manifold heater switch indicates 24 volts, check No. 55 wire to accessory switch for broken wire or loose connections.

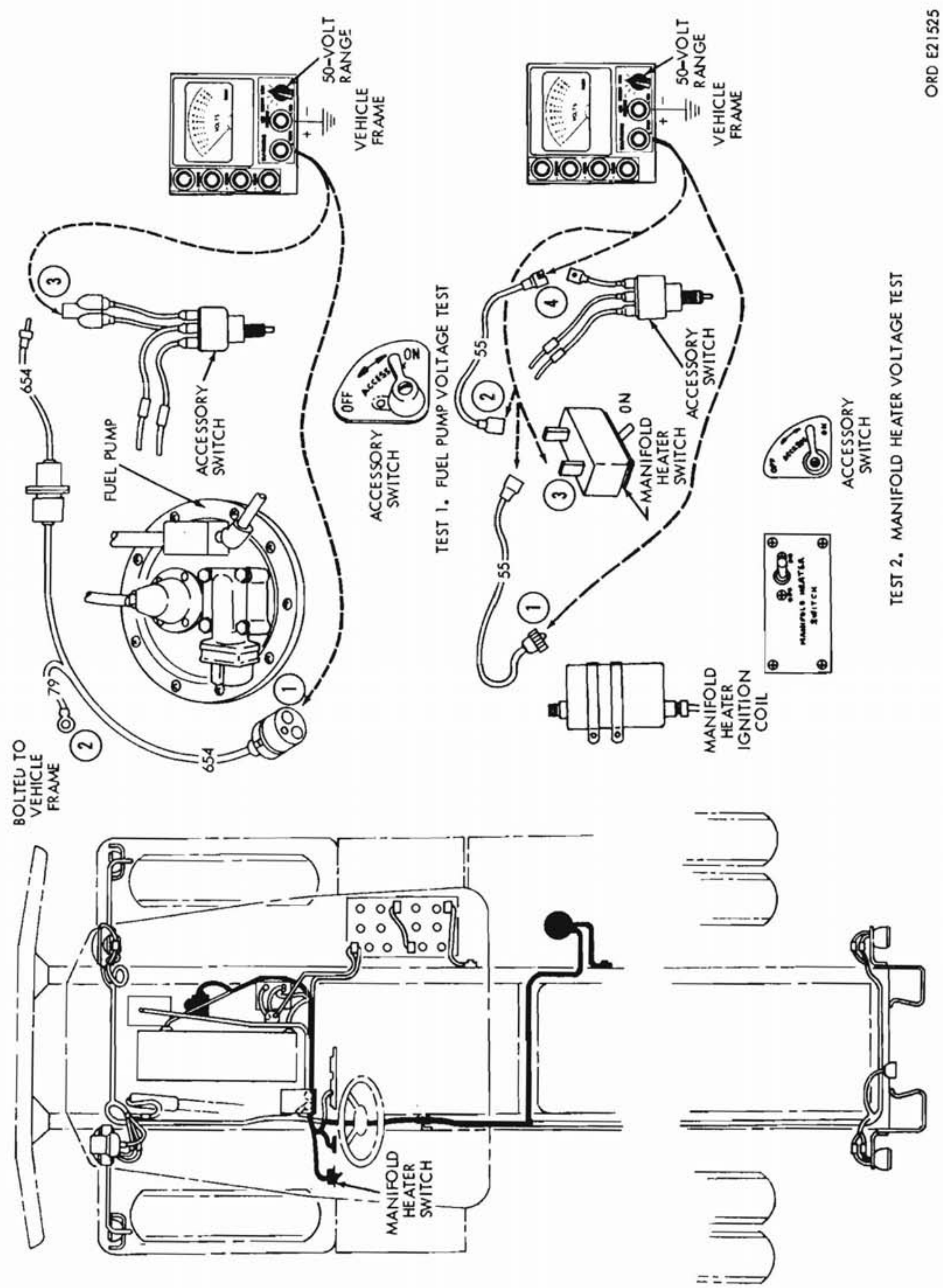
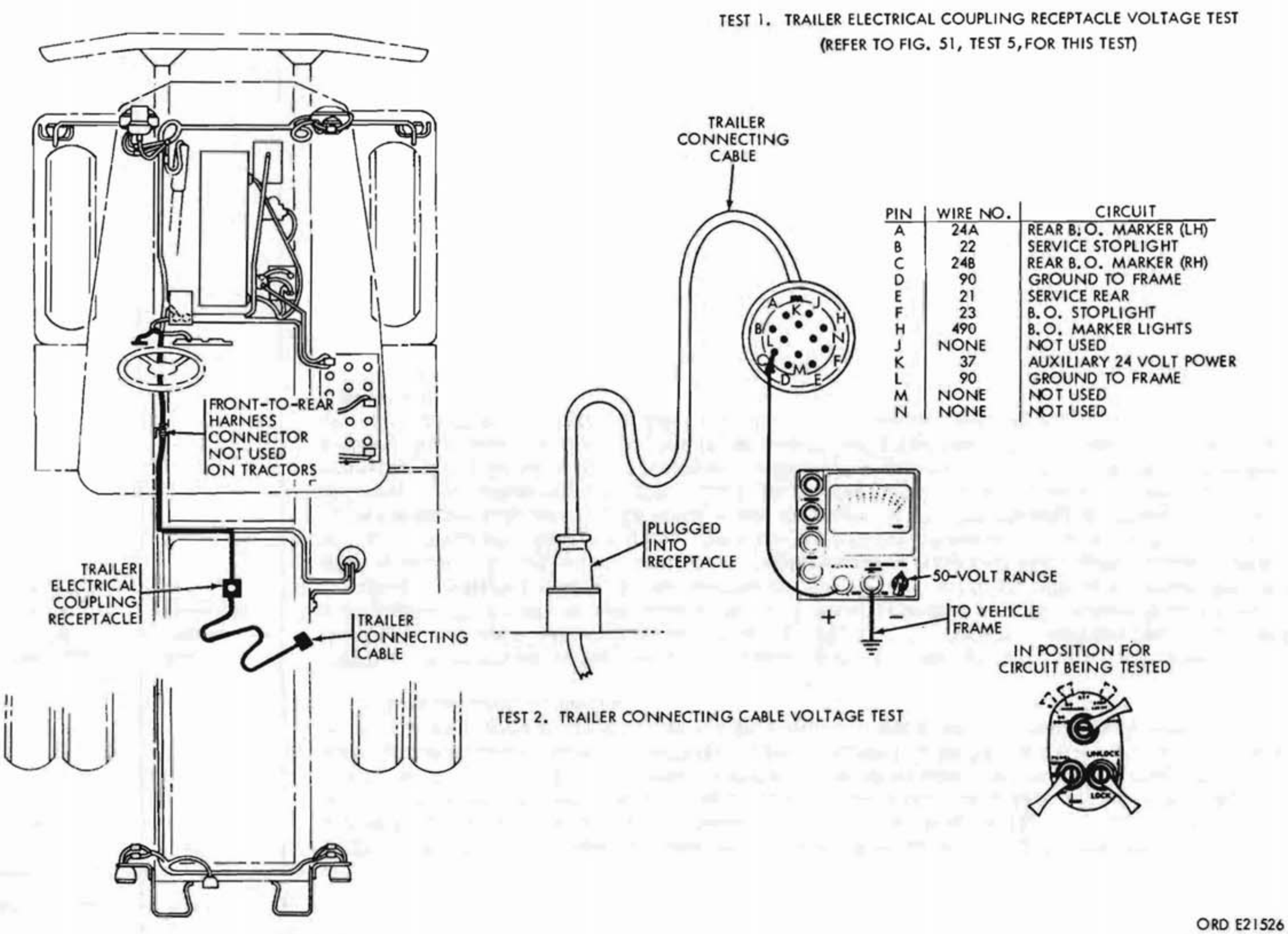


Figure 57. Fuel pump and manifold heater tests

481-454 O - 85 - 6

Table 5. Electrical Troubleshooting - Continued

TRAILER CONNECTING CABLE AND RECEPTACLE (Tractor Truck, M48, M275 and M275A1)		
Malfunction	**Circuit**	**Test**
One or more trailer lights inoperative	21, 22, 23, 24, 37, 90, and 490	TEST 1. Perform trailer electrical coupling receptacle voltage test. Refer to Lighting System, test 5, for this test. TEST 2. Perform trailer connecting cable voltage test. Plug cable into trailer coupling receptacle of truck. Connect voltmeter as shown in fig. 58, test 2, to appropriate pin socket corresponding to inoperative light on trailer. Turn truck lighting switch to position which should light the inoperative trailer light. If 24 to 28 volts is indicated at correct pin socket, trailer electrical system is faulty. If no reading is indicated at pin socket, trailer connector cable is faulty.



PIN	WIRE NO.	CIRCUIT
A	24A	REAR B.O. MARKER (LH)
B	22	SERVICE STOPLIGHT
C	24B	REAR B.O. MARKER (RH)
D	90	GROUND TO FRAME
E	21	SERVICE REAR
F	23	B.O. STOPLIGHT
H	490	B.O. MARKER LIGHTS
J	NONE	NOT USED
K	37	AUXILIARY 24 VOLT POWER
L	90	GROUND TO FRAME
M	NONE	NOT USED
N	NONE	NOT USED

Figure 58. Trailer connecting receptacle and cable tests

Table 5. Electrical Troubleshooting - Continued

FLOODLIGHT SYSTEM (Wrecker Truck, M60 and M108)		
Malfunction	Circuit	Test
All flood-lights inopera-tive	518	TEST 1. Perform floodlight harness voltage test. Disconnect No. 518 wire from crane wiring harness, at base of crane. Connect voltmeter as shown in fig. 59 ; test 1. Turn on master floodlight switch on truck dash panel. Check the test points shown in fig. 59, test 1, in the order indicated. When a test point is found which indicates 24 volts, the previous item tested (harness, switch, circuit breaker) is faulty. If 24 volts is not indicated on No. 10 wire when removed from the floodlight circuit breaker, check truck wiring harness for broken or loose connections.
One floodlight inoperative, but others operate nor-mally	518, Crane Harness	TEST 2. Perform individual floodlight voltage test. Disconnect No. 518 wire at rear of floodlight. Connect voltmeter as shown in fig. 59, test 2. Turn on floodlight switch on truck dash panel. If 24 volts is indicated on No. 518 wire, reinstall it on the floodlight and jumper the other floodlight terminal to the vehicle frame. If light operates, check for faulty No. 496 wire to frame. If light does not operate, replace sealed lamp unit and repeat jumper check, above. If lamp still does not light, check the switch and connector as shown in fig. 59 , test 2, in the order indicated. If 24 volts is not indicated on No. 518 floodlight connector, if on one of the two outboard floodlights, check the wiring harness for broken wires or loose connections. If 24 volts is not indicated on No. 518 connector of the crane-mounted floodlights, remove the connection from the top of the swivel valve and check for voltage as shown in fig. 59, test 2. If swivel valve is defective, coordinate repairs with direct support main-tenance unit.

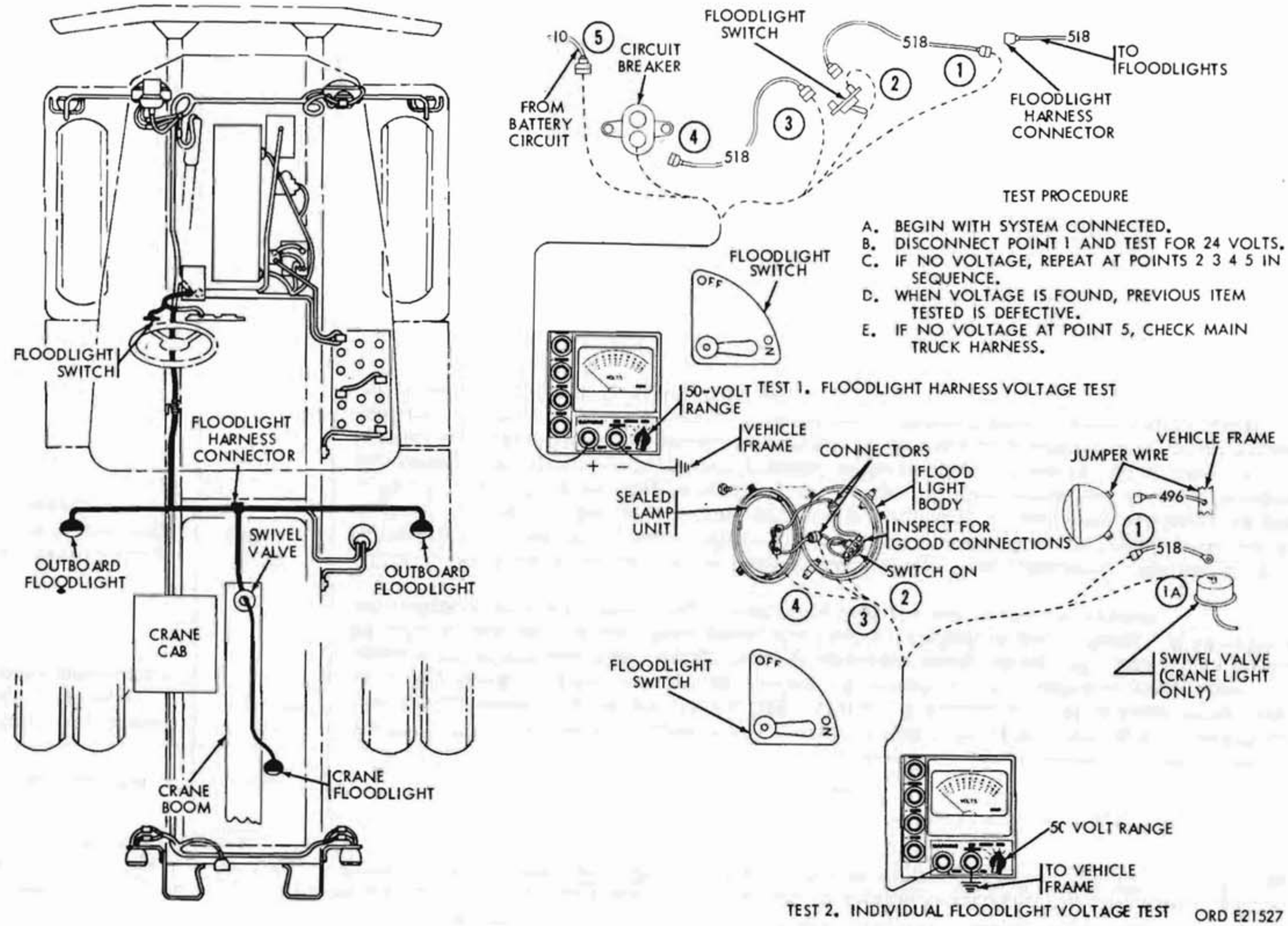


Figure 59. Floodlight system voltage tests

Table 5. Electrical Troubleshooting - Continued

VAN BODIES, 24-VOLT SYSTEMS

Note. The electrical systems on all van bodies in this manual are similar. A general troubleshooting procedure, which may be used for any van body, is given for each subsystem. Refer to the electrical wiring diagrams (figs. 73 to 76) for the specific circuit numbers.

Malfunction	Circuit	Test
Blackout marker and clearance lights inoperative	21, 24, 489, 490	TEST 1. Perform blackout marker and clearance light test. Put truck lighting switch in position corresponding to inoperative light system. If individual light is inoperative, replace lamp and check for loose or corroded socket. If complete set of lights is inoperative, connect voltmeter and make voltage tests in sequence shown in fig. 60, test 1. As soon as 24 volts is indicated at any check point, the item previously tested is faulty. If 24 volts is not indicated at truck connection, check truck harness and electrical system.
All 24-volt equipment in van body inoperative	37, 38, 400	TEST 2. Perform incoming circuit breaker and harness test. Disconnect the No. 37 wire of the truck harness from the auxiliary power circuit breaker (usually located near the lower right-hand corner of the outside front wall of the van body). Connect the voltmeter as shown in fig. 60, test 2. If 24 volts is indicated on the No. 37 wire, reconnect it to the breaker and remove the wire from the other terminal of the breaker. If the terminal does not indicate 24 volts, the circuit breaker is faulty. If 24 volts is indicated, the circuit breaker and truck harness are satisfactory. Contact direct support maintenance unit to assist in checking out the van body wiring harness.

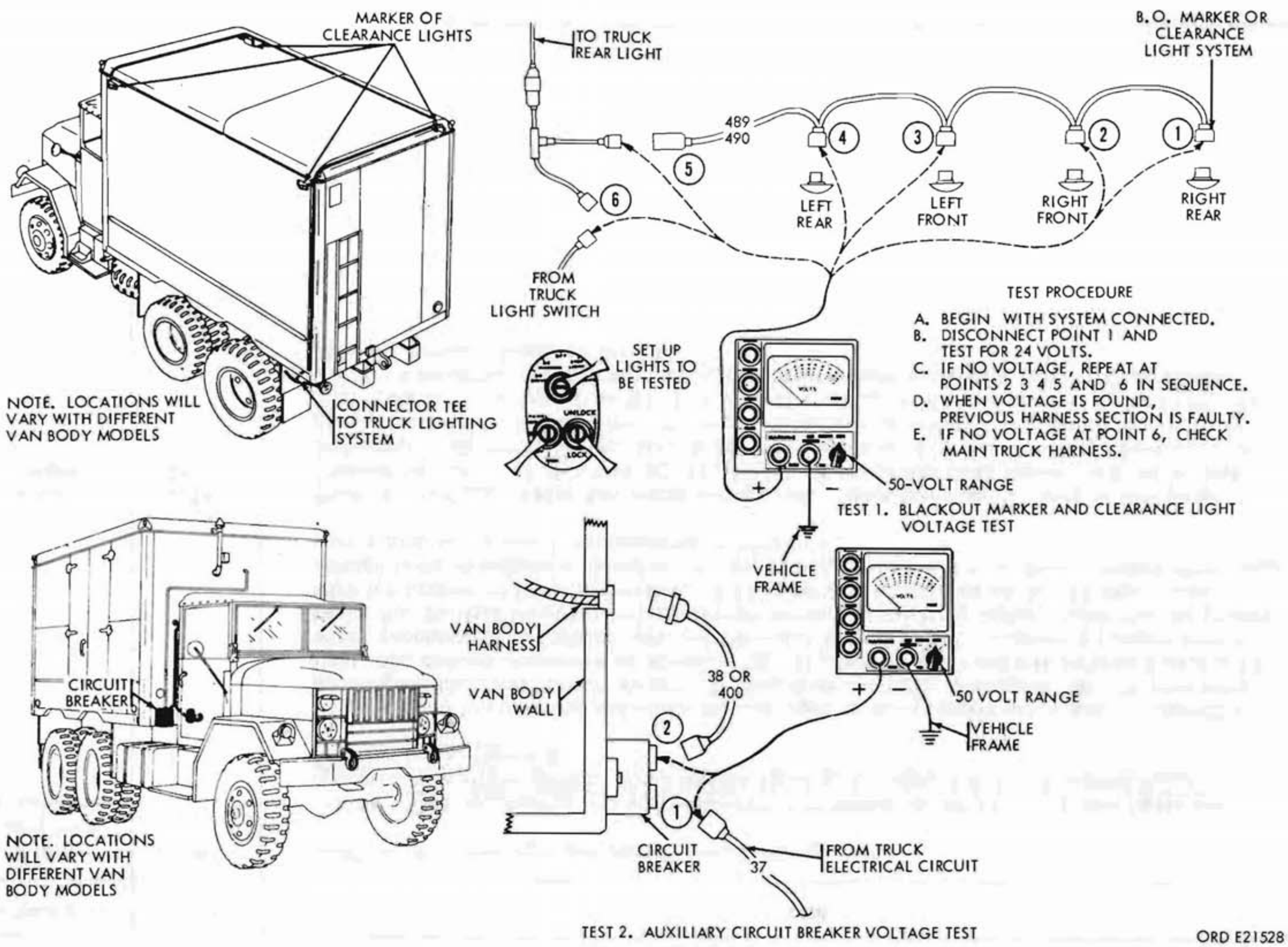


Figure 60. Van body 24-volt system tests (1 of 2)

Table 5. Electrical Troubleshooting - Continued

VAN BODIES, 24-VOLT SYSTEMS

Malfunction	Circuit	Test
24-volt dome or emergency light inoperative	38, 90	TEST 3. Perform light and switch circuit voltage test. **Note.** This test covers any light-and-switch combination where one or two lights are operated by a single switch. For blackout lighting systems, refer to Blackout Relay Lighting tests, figure 66. Remove lamp from socket and check for corroded or dirty socket and contacts. Install a known good lamp and turn on switch. If lamp does not light, disconnect No. 38 wire from light, and connect voltmeter as shown in fig. 61, test 3. If 24 volts is indicated on No. 38 wire, reconnect it to light and remove the other wire (No. 90). Connect a jumper wire between No. 90 light terminal and the vehicle frame. If the lamp lights, check No. 90 ground wire for broken or loose connection. If 24 volts is not indicated on No. 38 wire, make voltage tests in sequence shown in fig. 61, test 3. If harness is at fault, contact direct support maintenance unit if replacement is required.
Heater fuel pump inoperative	25, 35, 654	TEST 4. Perform heater fuel pump voltage test. Disconnect No. 25 wire at fuel pump. Connect voltmeter as shown in fig. 61, test 4. Turn on van body heater controls so that fuel pump would normally operate. If 24 volts is indicated on No. 25 wire, check for poor ground connection to fuel pump. If ground connection is satisfactory, fuel pump is faulty. If 24 volts is not indicated on No. 25 wire make voltage tests in sequence shown in fig. 61, test 4. If no voltage is indicated at the converter output terminals, refer to Van Bodies, 115-volt systems tests, figure 65.

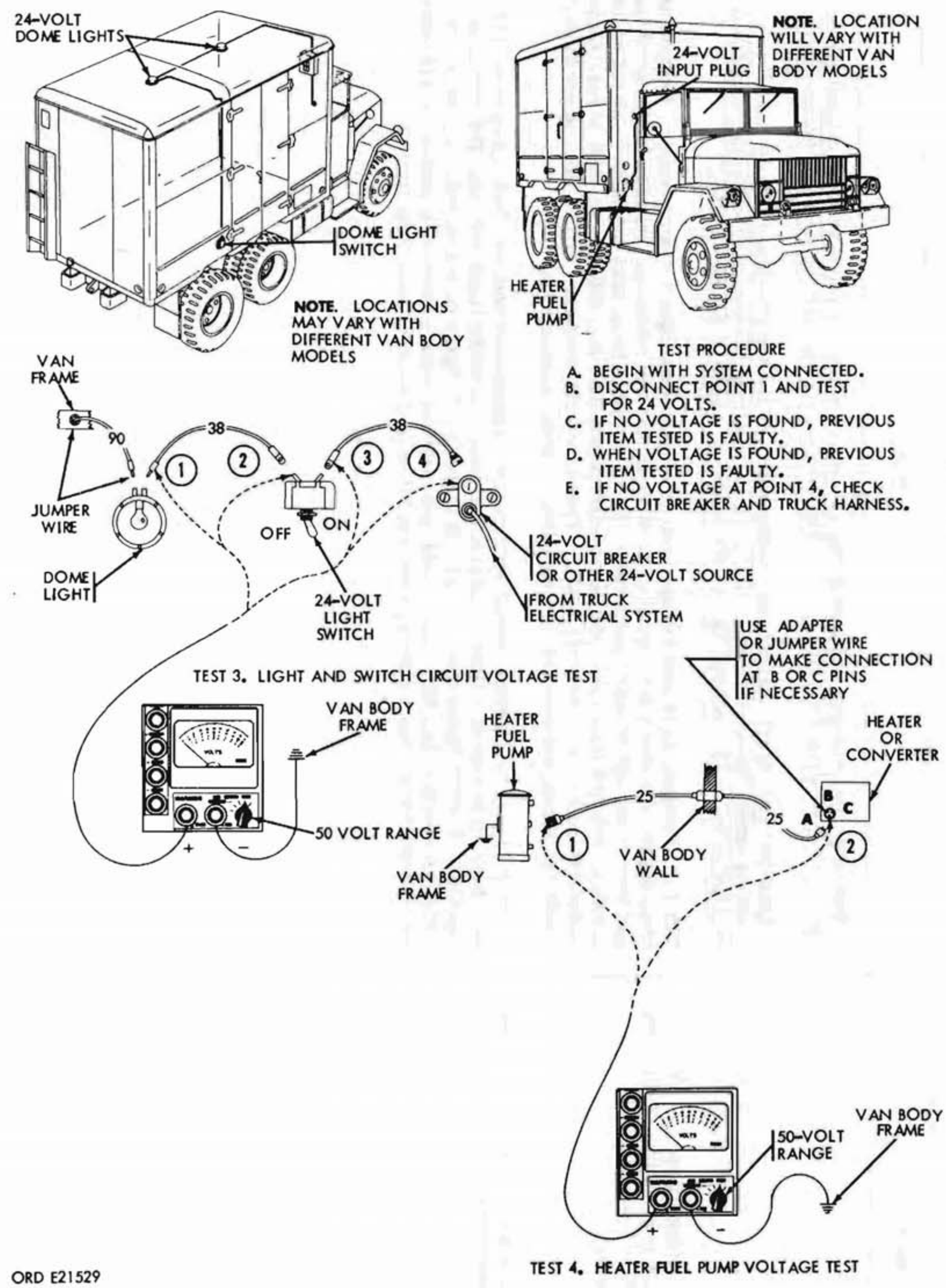


Figure 61. Van body 24-volt system tests (2 of 2)

Table 5. Electrical Troubleshooting - Continued

VAN BODIES, 115-VOLT SYSTEMS		
Malfunction	Circuit	Test
		Warning: The voltages present in the 115-volt system can cause severe or fatal electrical shock. Tests on the 115-volt system should be performed only by properly trained personnel.
		Caution: The direct current (dc) voltmeter used for the previous tests on the 24-volt systems cannot be used for these tests. An alternating current (ac) voltmeter capable of measuring up to 125 volts at 60 and 400 cycles is required for these tests.
Individual dome light inoperative; others operate normally	652, 700, 705	TEST 1. Perform light unit voltage test. Turn off dome light circuit breaker. Remove lamp from socket and check for corroded or dirty socket and contacts. Install a known good lamp and turn on circuit breaker and switch. If replacement lamp does not light, turn off circuit breaker, remove light from ceiling and disconnect both No. 700 and No. 705 wires. Connect voltmeter as shown in fig. 62, test 1. Turn on circuit breaker. If 115 volts is not indicated, check van wiring harness for broken wires or loose connections.
All dome lights inoperative	700, 705	TEST 2. Perform lighting circuit voltage test. Disconnect both No. 705 wires from 115-volt dome-light switch. Turn on circuit breaker. Carefully touch both No. 705 switch wires together. If dome lights operate, switch is faulty. If lights do not operate, connect voltmeter as shown in fig. 62, test 2, and make voltage tests in sequence shown. If 115 volts is not indicated at circuit breaker, perform 115-volt circuit breaker test (test 6).

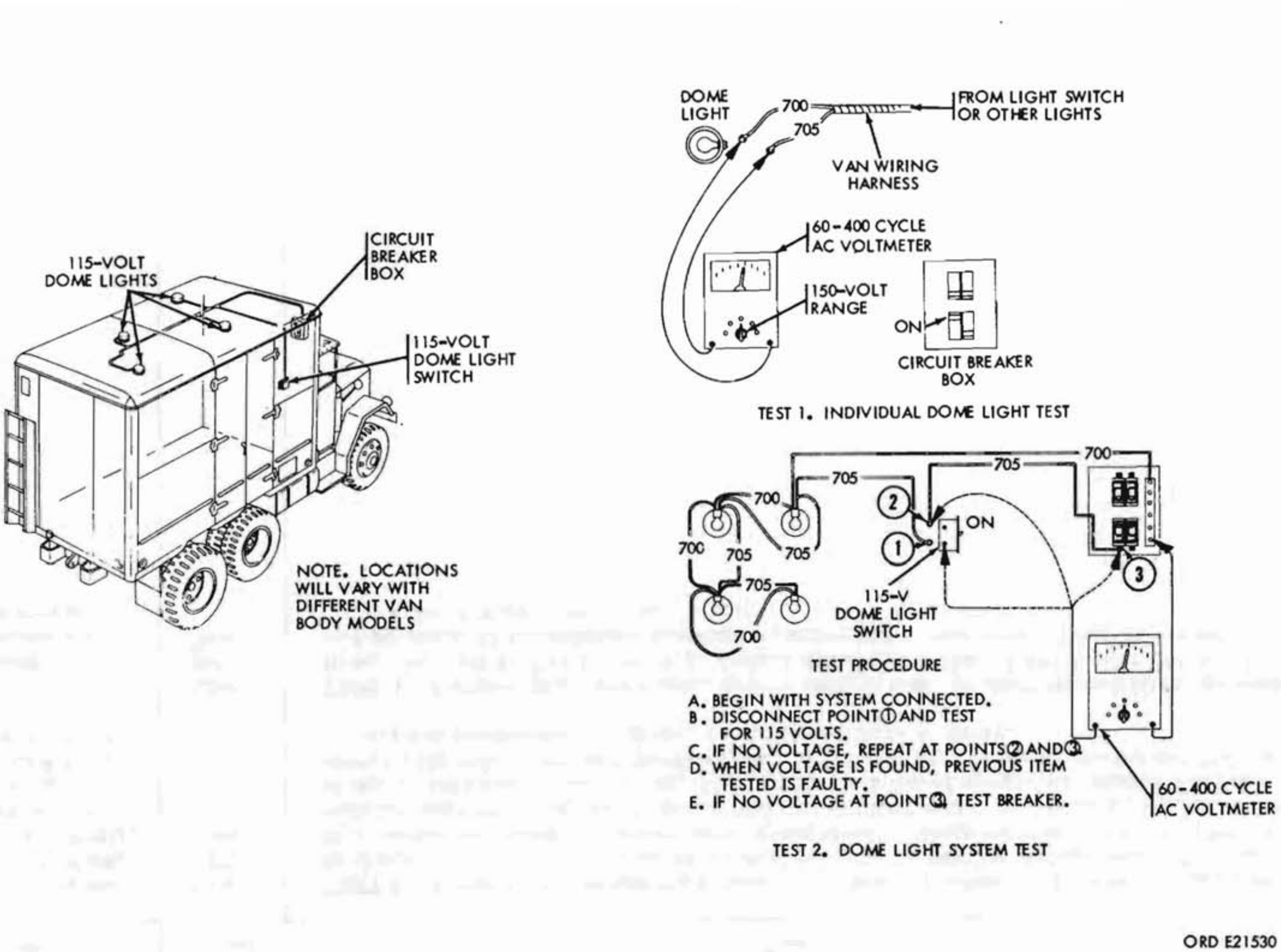
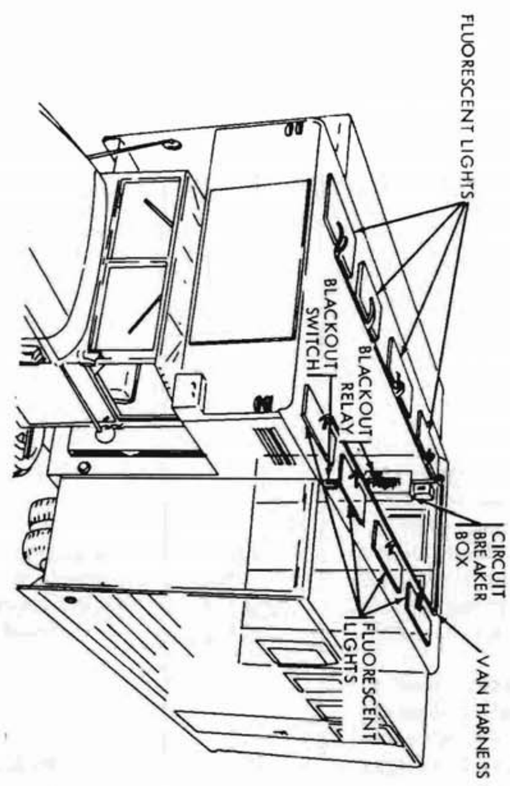


Figure 62. Van body 115-volt systems tests (1 of 4)

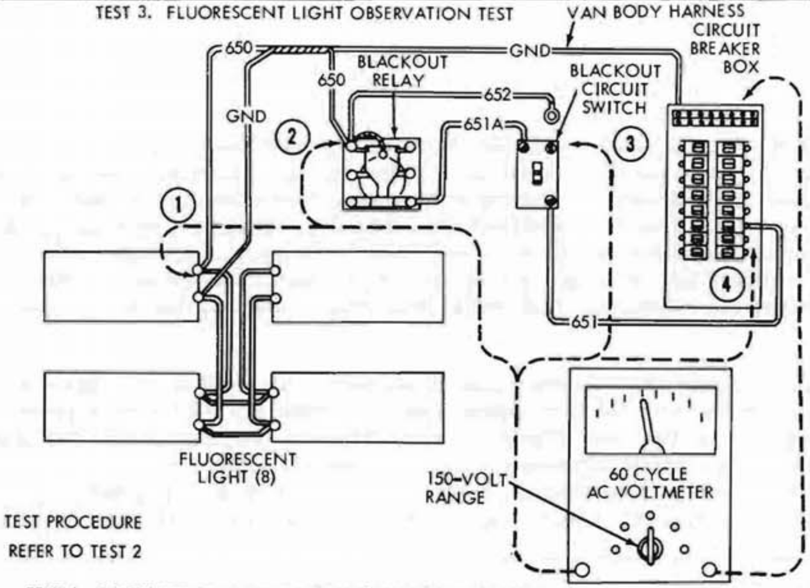
Table 5. Electrical Troubleshooting - Continued

VAN BODIES, 115-VOLT SYSTEMS		
Malfunction	**Circuit**	**Test**
Fluorescent lamps start slowly, blink, flicker, glow dimly, or otherwise not satisfactory, but incandescent lamp operates normally	GND, 650, 706c	TEST 3. Perform fluorescent lamp observation test. Troubles in fluorescent lights can be diagnosed more easily by careful visual observation than by voltage tests. Turn on light switch and observe whether lamp starts slowly, blinks but does not start, glows at ends but does not blink, starts but is dim or has black spots, or has large blackened areas at one or both ends. Refer to fig. 63, test 3, for a list of symptoms, causes and remedies for the listed observed malfunctions. If voltage, temperature, starter and lamp are normal and malfunction continues, entire light fixture is faulty.
Neither fluorescent nor incandescent portions operate	GND, 650, 706c	TEST 4. Perform fluorescent lamp system voltage test. Connect the voltmeter as shown in fig. 63, test 4. Use the same procedure described in tests 1 and 2, Van Bodies 115-volt Systems, to troubleshoot harness, switches and connections. If harness is defective, contact direct support maintenance unit.



OBSERVED SYMPTOM	PROBABLE CAUSE	REMEDY
DELAYED OR SLOW START	LOW CIRCUIT VOLTAGE OR INCORRECT FREQUENCY	ADJUST VOLTAGE TO 115 VOLTS, 60 CYCLES
	LOW SURROUNDING TEMPERATURE	RAISE ABOVE 65°F.
	END OF LAMP LIFE	REPLACE LAMP
BLINKS, BUT WON'T START	LOOSE SOCKET CONTACTS	REPAIR SOCKET
	LOW CIRCUIT VOLTAGE	ADJUST TO 115 VOLTS
	LOW TEMPERATURE	RAISE TO 65°F
	END OF LAMP LIFE	REPLACE LAMP
GLOWS DIMLY, BUT DOES NOT BLINK OR START	DEFECTIVE STARTER	REPLACE STARTER
	DEFECTIVE BALLAST	REPLACE COMPLETE LIGHT
STARTS, BUT IS DIM AND HAS DARK AREAS	TEMPERATURE BELOW 50°F	RAISE ABOVE 65°F.
	TEMPORARY LAMP DEFECT	ALLOW WARM-UP TIME
BOTH ENDS BLACKENED AND LAMP FLICKERS	END OF LAMP LIFE	REPLACE LAMP

TEST 3. FLUORESCENT LIGHT OBSERVATION TEST



TEST PROCEDURE
REFER TO TEST 2

TEST 4. FLUORESCENT LIGHT SYSTEM VOLTAGE TEST (M292 VAN)

ORD E21531

Figure 63. Van body 115-volt systems tests (2 of 4)

Table 5. Electrical Troubleshooting - Continued

VAN BODIES, 115-VOLT SYSTEMS		
Malfunction	Circuit	Test
No power available from power outlet receptacles	700, 702	TEST 5. Perform power outlet receptacle voltage test. With circuit breaker in "off" position, disconnect wires No. 700 and 702 from power outlet. Connect voltmeter as shown in fig. 64, test 5. Turn on circuit breaker and make voltage tests in the sequence shown. If no or low voltage is indicated at the circuit breaker, perform circuit breaker test, test 6. On the M292 van body the power outlet receptacles are equipped with a switch and are connected into the blackout relay circuit. Fig. 64, test 5 also shows the proper sequence for testing this type of power outlet.
No power available when circuit breakers are turned on	700, 702, 703, 704, 705, others	TEST 6. Perform 115-volt circuit breaker voltage test. Open circuit breaker box to expose circuit breakers. Connect voltmeter as shown in fig. 64, test 6. With circuit breaker in "on" position check for 115-volt indication on exposed terminal. If no or low voltage, test incoming power terminals. If 115 volts is indicated, disconnect external power source. Remove individual circuit breaker and inspect for loose, corroded or dirty rear terminal. If terminal is satisfactory, circuit breaker is faulty. If 115 volts is not indicated at incoming power terminals, check van harness, incoming power receptacle and cable, and the power source itself.

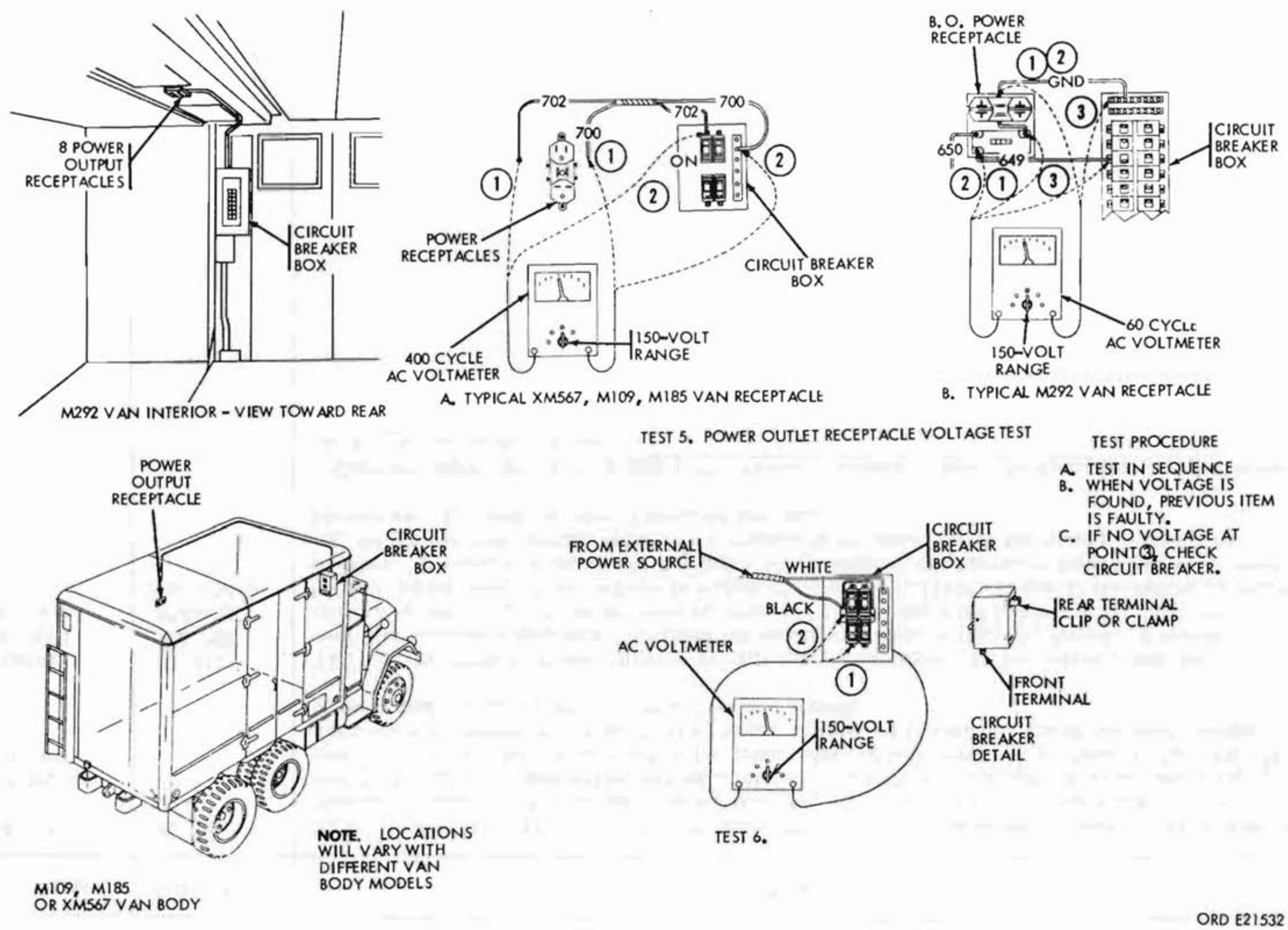


Figure 64. Van body 115-volt systems tests (3 of 4)

Table 5. Electrical Troubleshooting - Continued

VAN BODIES, 115-VOLT SYSTEMS

Malfunction	Circuit	Test
No 24-volt power available from converter unit	25, 700, 704	TEST 7. Perform 115-volt to 24-volt converter test. Turn on heater as instructed on heater instruction plate. If fuel pump does not operate, perform fuel pump voltage test, fig. 61, test 4. If fuel pump and wiring are satisfactory, connect both voltmeters as shown in fig. 65, test 7. First test for 24-volt indication from output of converter. If no results, test for 115 volts input to converter. If no or low voltage at input of converter, check van body wiring harness and circuit breaker or other voltage source.
Ventilator blower will not operate	90, 411, 700, 703, 654A, B, C, and others	TEST 8. Perform ventilator blower voltage test. Disconnect the two wires from the ventilator blower receptacle. Connect voltmeter as shown in fig. 65, test 8. If correct voltage is indicated, check receptacle, plug and connecting wire to blower for loose or broken connections. If no voltage is indicated, test for correct voltage at the switch or circuit breaker. If voltage is indicated, contact a direct support maintenance unit to assist in checking out the van body wiring harness. If voltage is not indicated at the circuit breaker or blower switch, perform circuit breaker test (test 6). **Caution:** Some vans are equipped with 24-volt blowers. Check the data plate to determine the correct voltmeter to use.

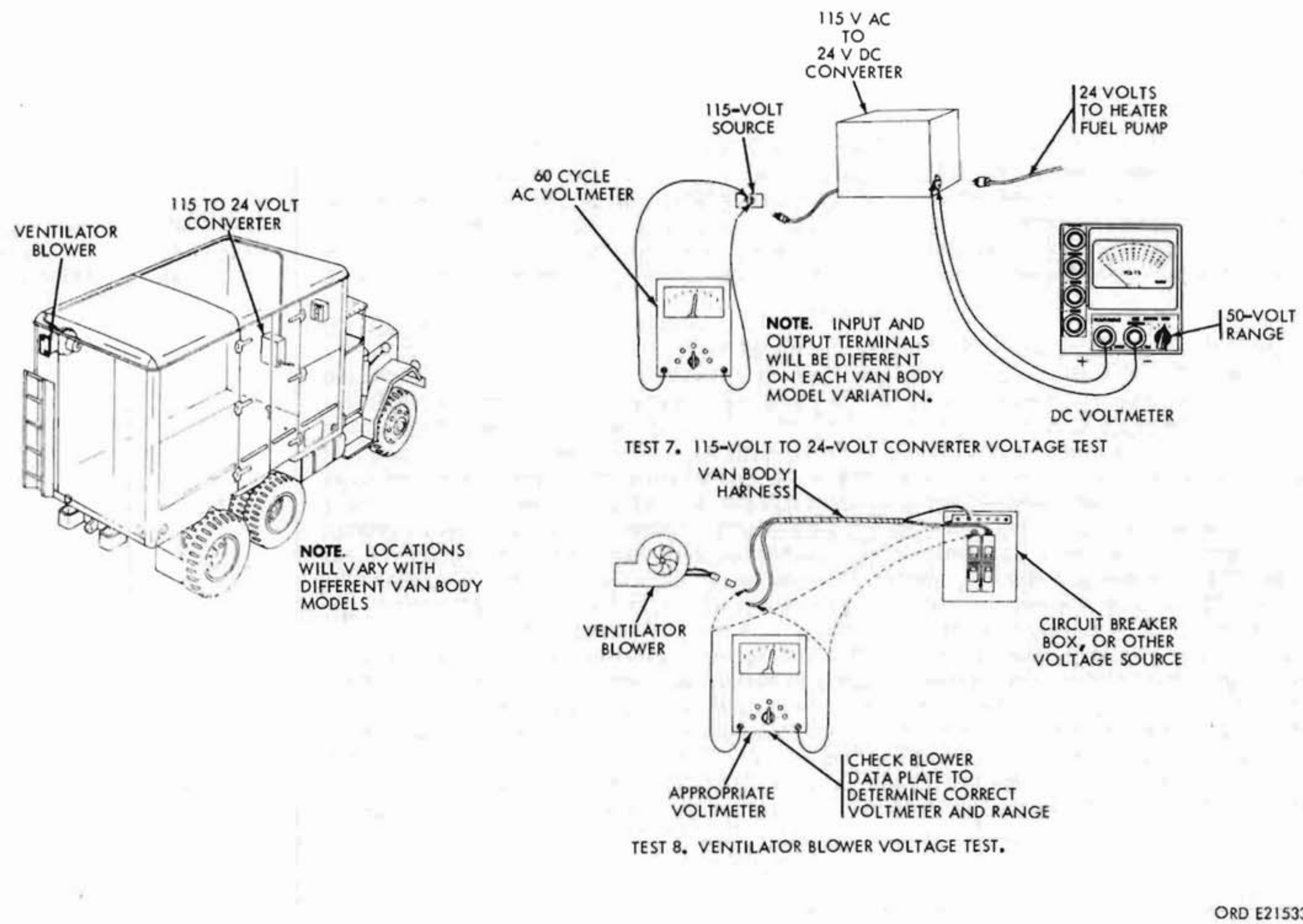
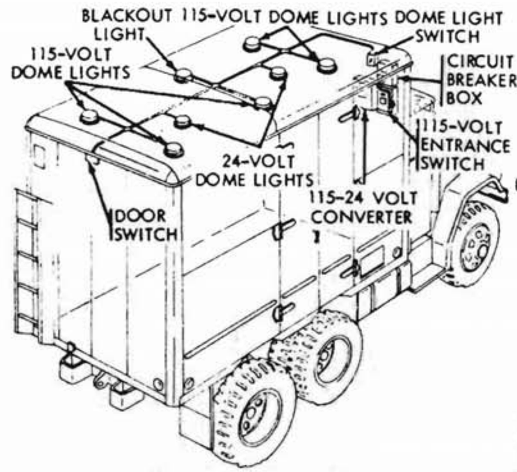


Figure 65. Van body 115-volt systems tests (4 of 4)

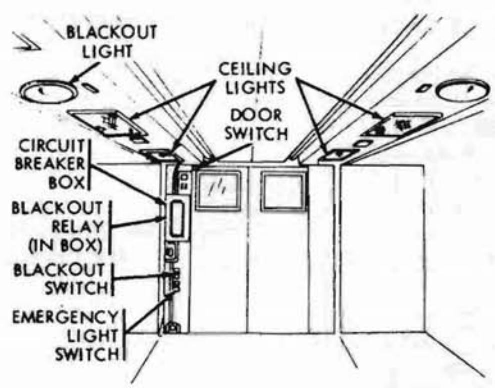
Table 5. Electrical Troubleshooting - Continued

BLACKOUT RELAY SYSTEMS

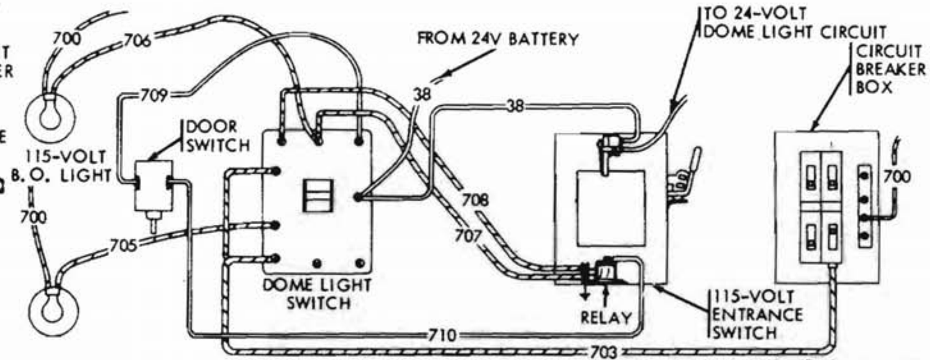
Malfunction	Circuit	Test
Blackout relay system in vans M109 or M185 not operating properly	38, 90, 700, 705, 706, 709, 710	TEST 1. Perform M109 and M185 blackout relay voltage tests. Study the blackout system circuits (fig. 66 , test 1 and fig. 73). With the dome light switch cover open, operate the dome light switch to "down" position. If the dome lights do not light, check for 115 volts between circuit No. 700 and terminals 7 and 4 of the dome light switch. If no voltage is on terminal 7, check circuit No. 703 and the circuit breaker unit. If 115 volts is on terminal 7 but not terminal 4, the dome light switch is faulty. Operate the switch to the "up" or blackout position. With all van doors closed, the dome lights and blackout light should be on. If not, check for 115 volts on terminals 5 and 2. If no voltage is on terminal 5, check the jumper wire between terminals 5 and 7. If 115 volts is on terminal 5 but not terminal 2, the dome light switch is faulty. Open each of the van body doors. The dome lights should go off and the blackout light remain on. If the dome lights do not turn off, listen for a "click" of the blackout relay. If none is heard, check for 24 volts dc on terminal 6 of the dome light switch. If no voltage, check circuit No. 38 and 400 through to the 24-volt circuit breaker. If 24 volts is on terminal 6 but not terminal 3, the dome light switch is faulty. If 24 volts is on terminal 3, check the coil terminal of the blackout relay in the entrance switch box. If no voltage, check the blackout door switch and circuits No. 709 and 710. If 24 volts is on the relay coil terminal, the blackout relay is faulty. If the relay "clicks" when a van body door is opened but the dome lights stay on, check for 115 volts on terminal 1 of the dome light switch. If 115 volts is on terminal 1, check the blackout relay terminals or contacts, and circuits No. 707 and 708 for a short circuit.
Blackout relay system in expansible van M292	647, 650, 651, 652, GND	TEST 2. Perform M292 blackout relay voltage tests. Put blackout switch in "blackout" position. Use 115-volt 60 cycle voltmeter and make tests as shown in fig. 66 , test 2. Compare symptoms with table in fig. 66, test 2 to isolate trouble. With circuit breaker No. 12 on, the "click" of the blackout relay should be heard whenever door or roof panels are opened. If not, check relay, door switch, or van harness. In obstinate cases, contact a direct support maintenance unit for assistance.



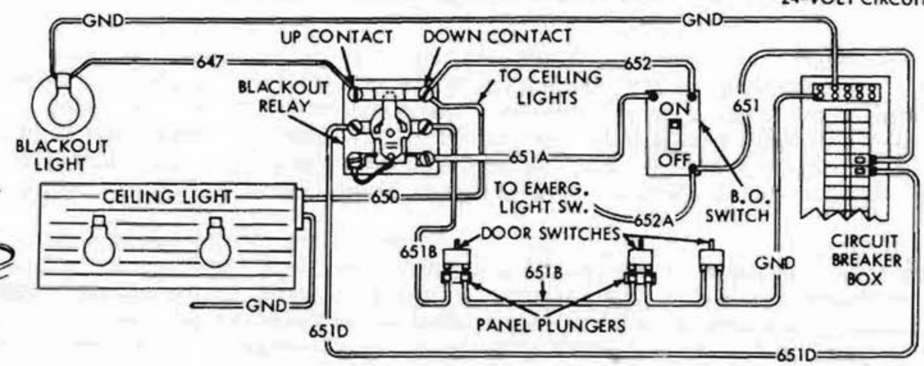
M109 AND M185 VAN BODY



M292 VAN INTERIOR - VIEW TOWARD REAR



TEST 1. M109 VAN BLACKOUT RELAY VOLTAGE TEST



TEST NO.	B.O. SWITCH	DOOR POSITION	RELAY POSITION	B.O. LIGHT	CEILING LIGHT	115 V SHOULD BE BETWEEN	MEASURED AT	FAULTY PART IF NO VOLTAGE
A	ON	OPEN	UP	OUT	OUT	651 AND GND	CIRCUIT BREAKER	CIRCUIT BREAKER
B	ON	OPEN	UP	OUT	OUT	651A AND GND	RELAY	B.O. SWITCH
C	ON	OPEN	UP	OUT	OUT	647 AND GND	RELAY	RELAY CONTACT
D	ON	CLOSED	UP	LIT	OUT	651B AND 651D	RELAY	DOOR SWITCH
E	ON	CLOSED	DOWN	LIT	LIT	—	—	RELAY CONTACTS SHORTED
F	ON	OPEN	DOWN	OUT	LIT	—	—	DOOR SWITCH
G	ON	CLOSED	DOWN	OUT	OUT	650 AND GND	RELAY	RELAY CONTACT
H	ON	CLOSED	DOWN	OUT	OUT	650 AND GND	CEILING LIGHT	VAN HARNESS
I	OFF	ANY	ANY	OUT	OUT	651 AND GND	CIRCUIT BREAKER	CIRCUIT BREAKER
J	OFF	ANY	ANY	OUT	OUT	652 AND GND	B.O. SWITCH	B.O. SWITCH

TEST 2. M292 VAN BLACKOUT RELAY VOLTAGE TESTS

ORD E21534

Figure 66. Blackout relay tests

Table 5. Electrical Troubleshooting - Continued

EXPANSIBLE VAN 120/208 VOLT 3-PHASE SYSTEM		
Malfunction	Circuit	Test
		Note. The 120/208 volt, 4-wire, three-phase electrical system used on the M292 expansible van body will normally indicate 115 to 120 volts between the green (or ground) wire and each one of the black, red or white wires. However, the voltage between any two of the black, red or white wires will be only 205 to 210 volts instead of double the individual leg voltage as in single phase circuits.
Air conditioner unit inoperative	646A, 646C, 646E, GND	TEST 1. Perform air conditioner input voltage test. Remove cover from air conditioner circuit breaker box. Connect voltmeter and make voltage tests as shown in fig. 67, test 1. Observe that the wires are connected to proper terminals from incoming power receptacles all the way through to air conditioner unit. Interchanging any two wires (red, black or white) will reverse the phase and cause any three-phase motor in the air conditioner to run backwards! This condition cannot be detected with a voltmeter. Fig. 67 , test 1, shows the correct connections. If connections and voltages are normal and air conditioner will not function, notify a direct support maintenance unit.
Some circuits receive power others inoperative	646, 646B, 646D	TEST 2. Perform 115-volt circuit breaker voltage test. Open cover on 115-volt circuit breaker box. Refer to fig. 67 , test 2, and note that the circuit breakers are divided into three groups of four breakers, with each group receiving power from a separate leg of the three-phase supply source. If a complete group of breakers is inoperative, make voltage measurements and inspect the wiring for that particular leg. If a single breaker is inoperative, refer to Van Bodies 115-volt systems, figure 64, test 6, for procedure.

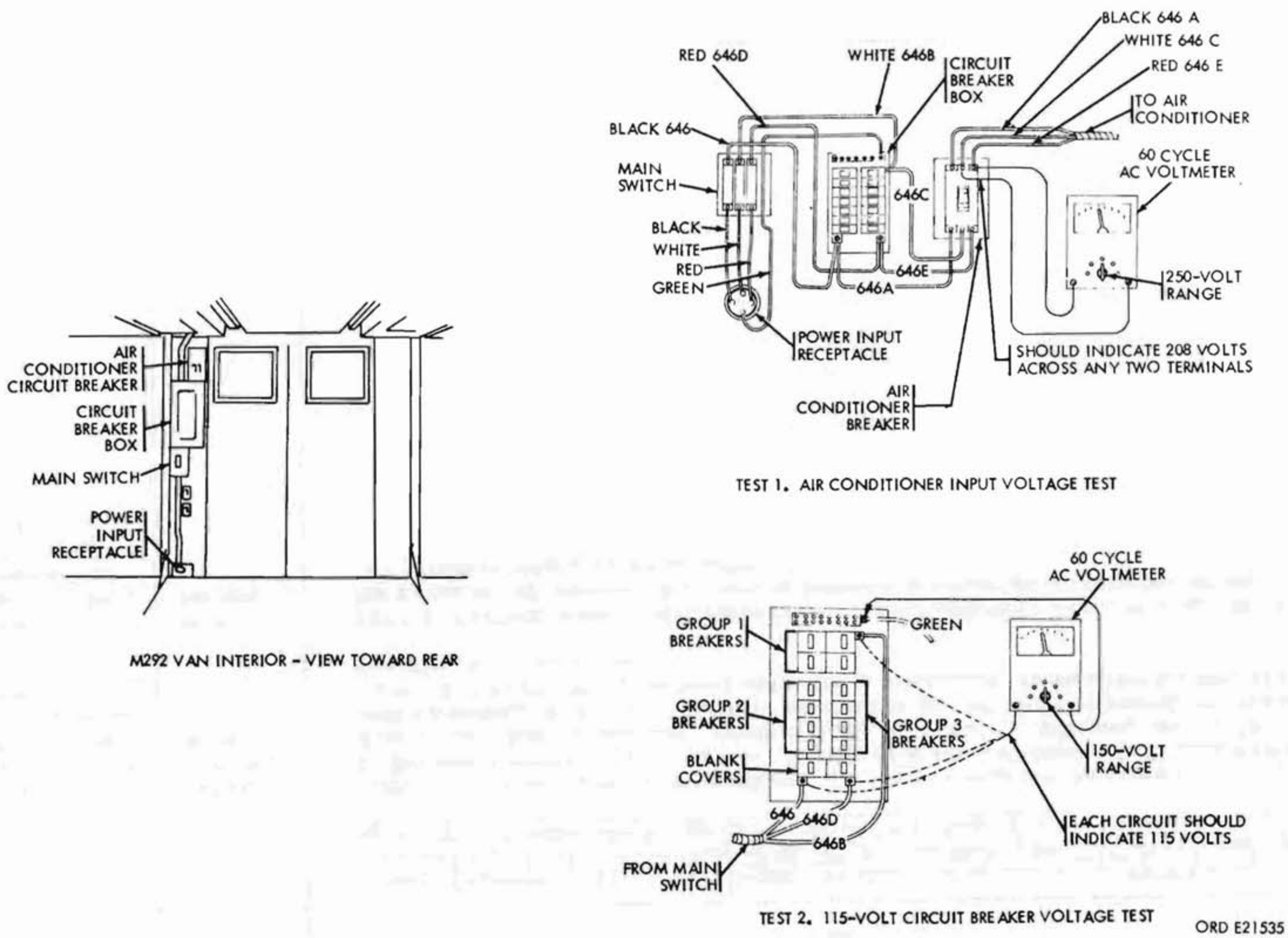


Figure 67. M292 expansible van three-phase system tests

Table 5. Electrical Troubleshooting - Continued

HOT WATER HEATER (-25°F) BLOWER		
Malfunction	**Circuit**	**Test**
		Note. Organizational units are allocated the electrical system of the -25°F hot water personnel heater, and the fuel pump of the -65°F winterization kits. All other winterization kit electrical troubleshooting should be referred to a direct support maintenance unit.
Hot water heater blower operates on "HI" position only	Switch, resistor, harness	TEST 1. Perform heater resistor voltage test. Connect voltmeter as shown in fig. 68, test 1. Put heater switch on "LO" position. 24 volts should be indicated on "LO" switch terminal. If no or low voltage is indicated, switch is faulty. If 24 volts is indicated, test the "HI" switch terminal. If 12 to 24 volts is not indicated on the "HI" switch terminal, the resistor is faulty. If 12 to 18 volts is indicated and motor is inoperative, check motor for tight bearings, poor ground, or loose wires.
Hot water heater blower operates on "LO" position only	Switch, harness	TEST 2. Perform heater switch voltage test. Connect voltmeter as shown in fig. 68, test 2. Put switch in "HI" position. If 24 volts is indicated on center switch terminal but not on "HI" switch terminal, switch is faulty.

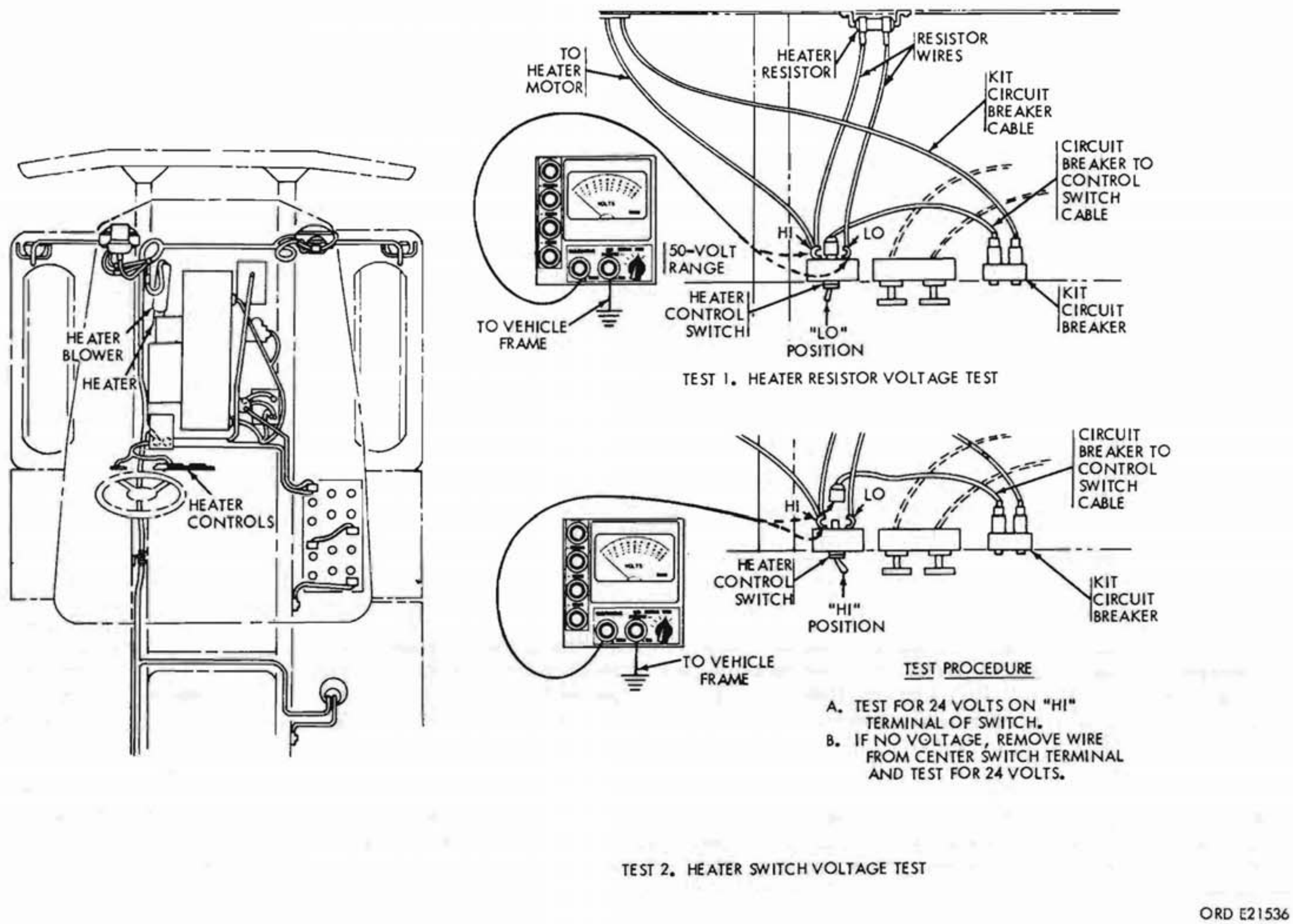


Figure 68. Hot water heater tests (1 of 2)

Table 5. Electrical Troubleshooting - Continued

HOT WATER HEATER (-25°F) BLOWER - Continued		
Malfunction	Circuit	
Hot water heater blower does not operate on either switch position	Circuit breaker, switch, connectors, harness	TEST 3. Perform blower motor circuit voltage test. Connect voltmeter as shown in fig. 69, test 3, and make voltage checks as shown. If 24 volts is indicated on motor lead at "HI" switch terminal, check motor for loose connections, poor ground, or for tight or frozen bearings.
Hot water heater blower does not turn off when switch is in "off" position	Switch, harness	TEST 4. Perform heater switch voltage test. Connect voltmeter as shown in fig. 69, test 4. Put switch in "OFF" position. If 24 volts is indicated on either, or both, side switch terminals, check for frayed wires at switch terminals, corrosion or rust between terminals, or other similar conditions. If none of these conditions exist, switch is faulty.

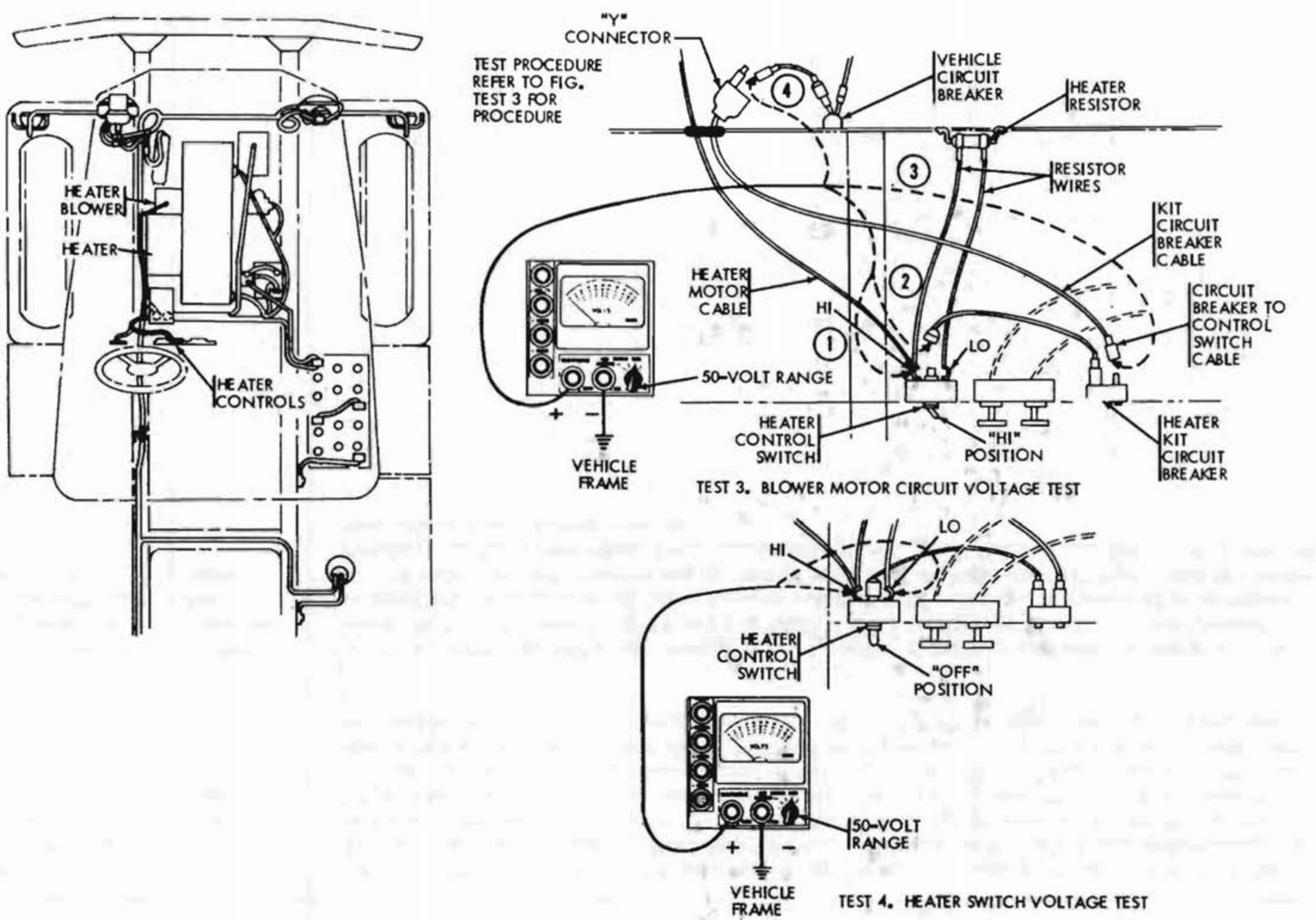


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Figure 69. Hot water heater tests (2 of 2)

Table 5. Electrical Troubleshooting - Continued

WINTERIZATION KIT FUEL PUMP		
Malfunction	**Circuit**	**Test**
Heater fuel pump inoperative on only one control box	Control box to fuel pump	TEST 1. Perform control box harness voltage test. Fuel pump is common to both the Power Plant Heater and the Personnel Heater. Turn on each control box individually. If fuel pump operates with one of the two control boxes, the trouble is not the fuel pump. Physically check connections at the fuel pump and the cable connector at the inoperative control box for loose or broken wires. If wire is satisfactory, connect the voltmeter as shown in fig. 70, test 1, and make voltage checks as shown. If 24 volts is not indicated at inoperative control box connector, terminal "A," notify a direct support maintenance unit.
Heater fuel pump inoperative on both control boxes	Control boxes to fuel pump	TEST 2. Perform fuel pump voltage test. Connect voltmeter and make voltage tests as shown in fig. 70, test 2. If 24 volts is indicated at fuel pump, check for poor ground connection. If satisfactory, fuel pump is faulty. If 24 volts is not indicated at terminal "A" of either or both control boxes, but is indicated on wire No. 400 from vehicle circuit breaker, notify a supporting field maintenance unit. If 24 volts is not indicated at wire No. 400, check truck wiring system.

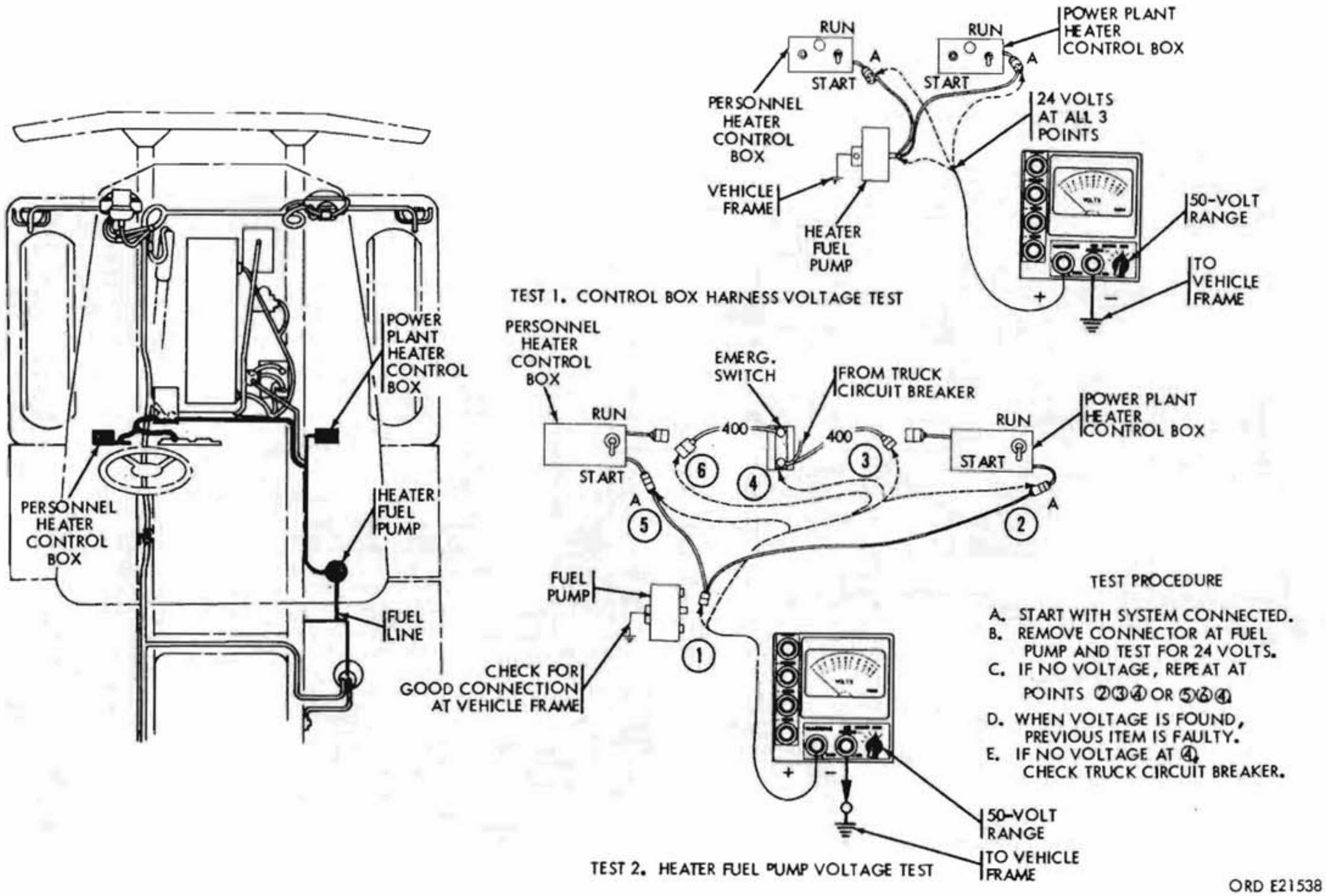

Figure 70. Winterization kit fuel pump tests

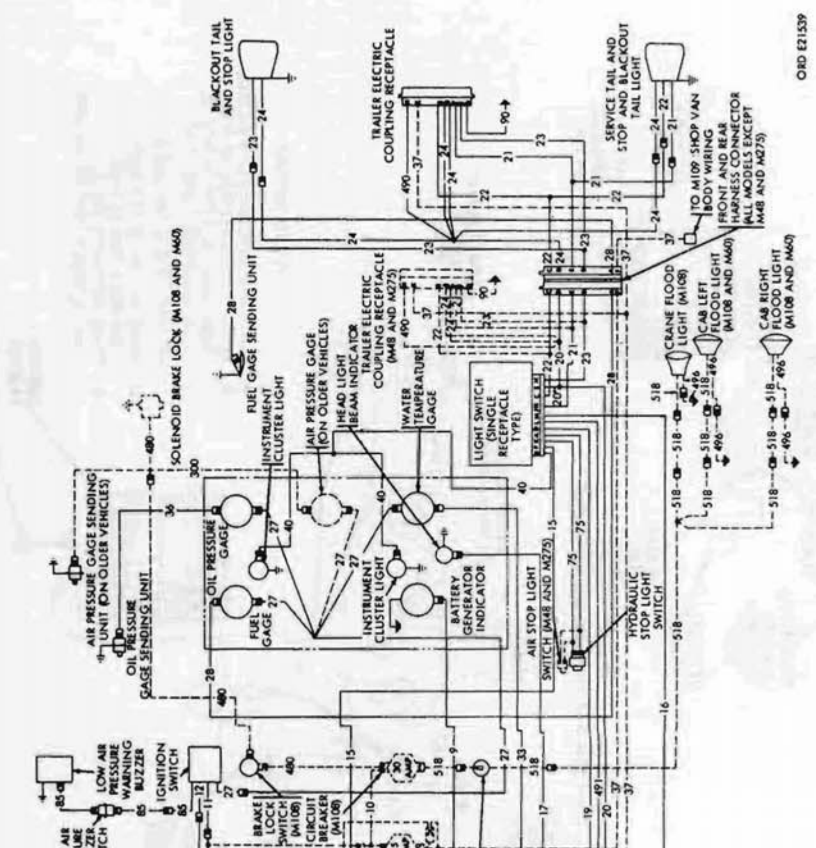

Figure 71. Wiring diagram, chassis with gasoline engine

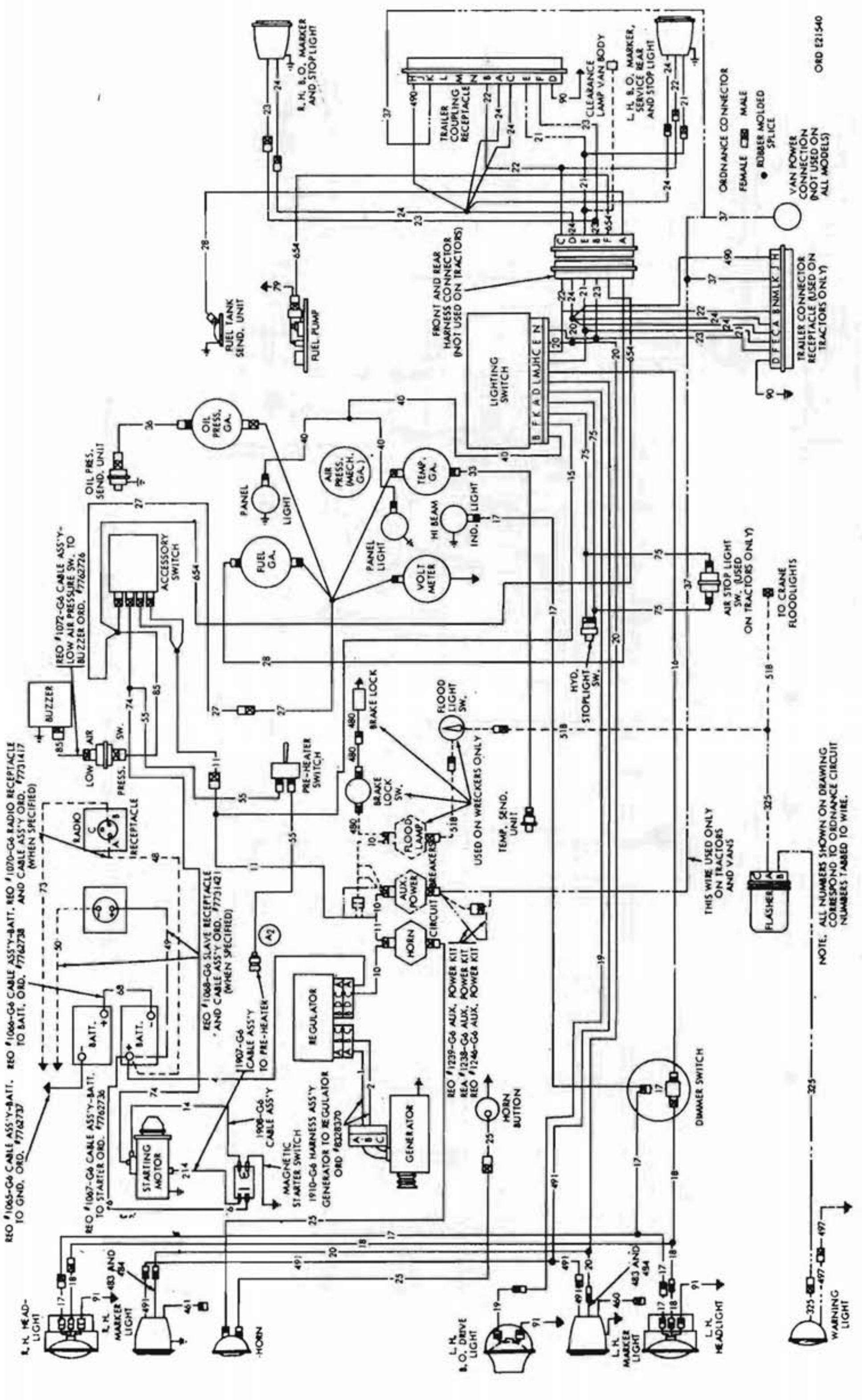

Figure 72. Wiring diagram, chassis with multifuel engine

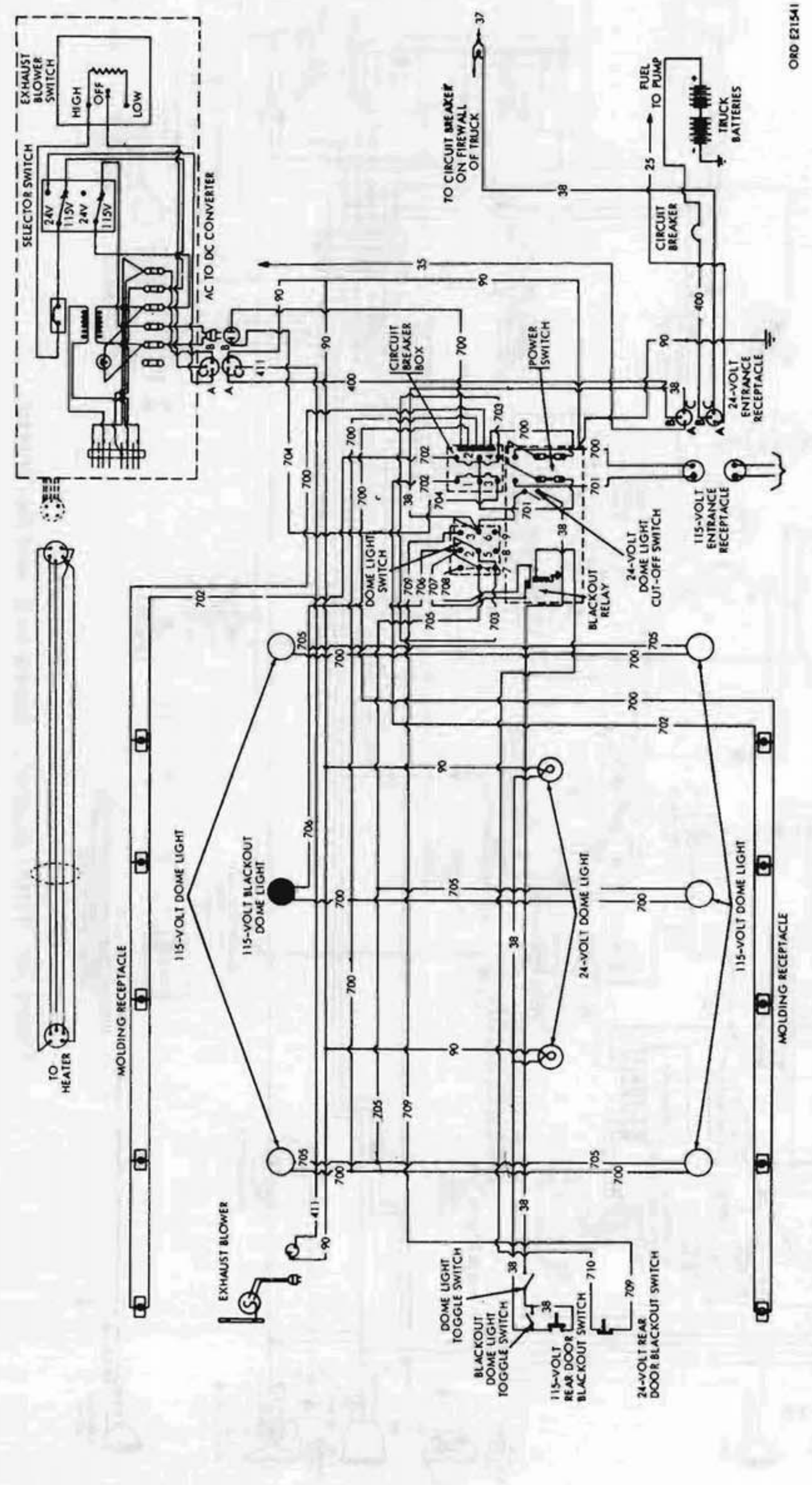

Figure 73. Wiring diagram, M109 and M185 van bodies

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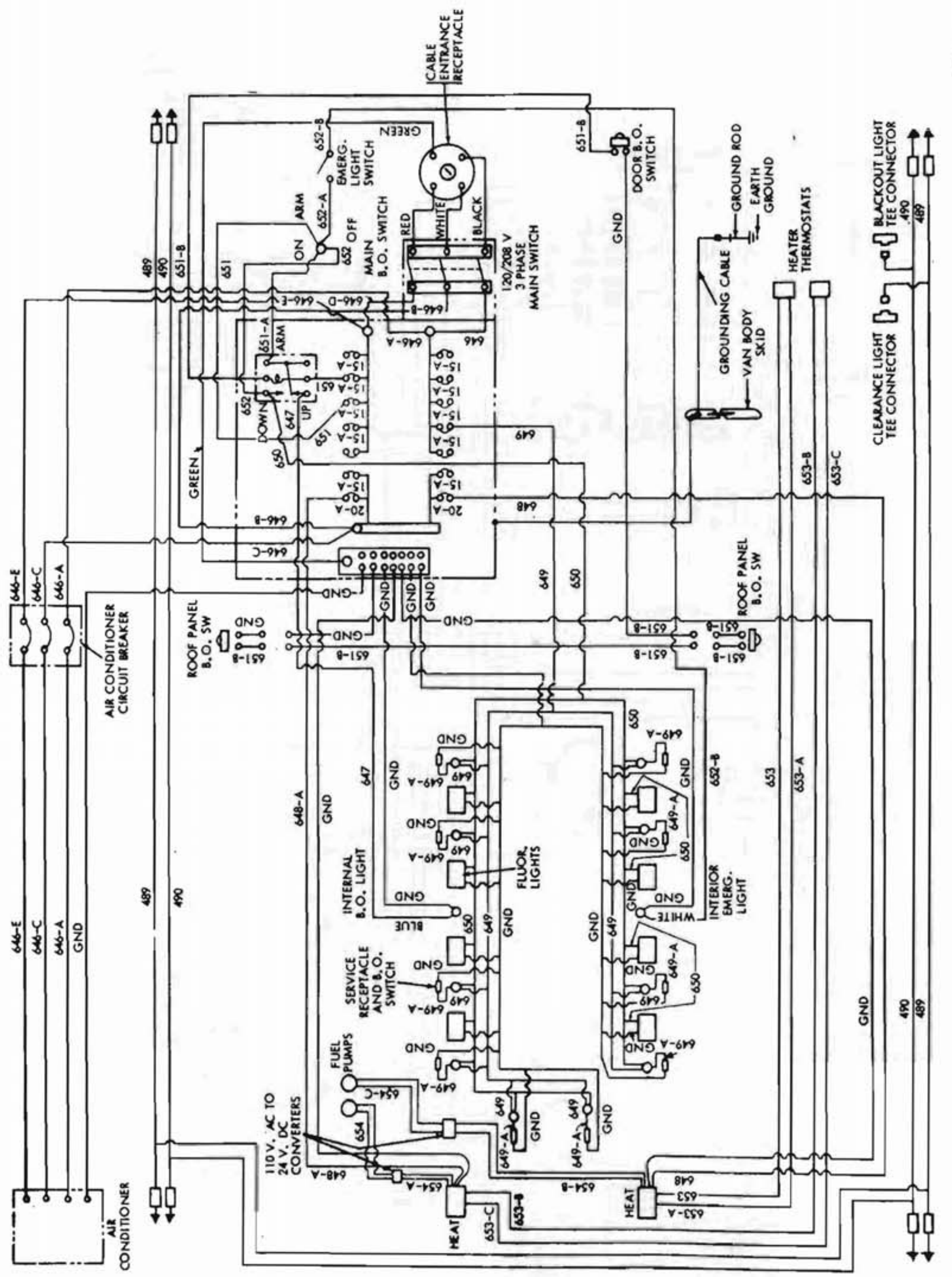

Figure 74. Wiring diagram, M292 and M292A1 expansible van body

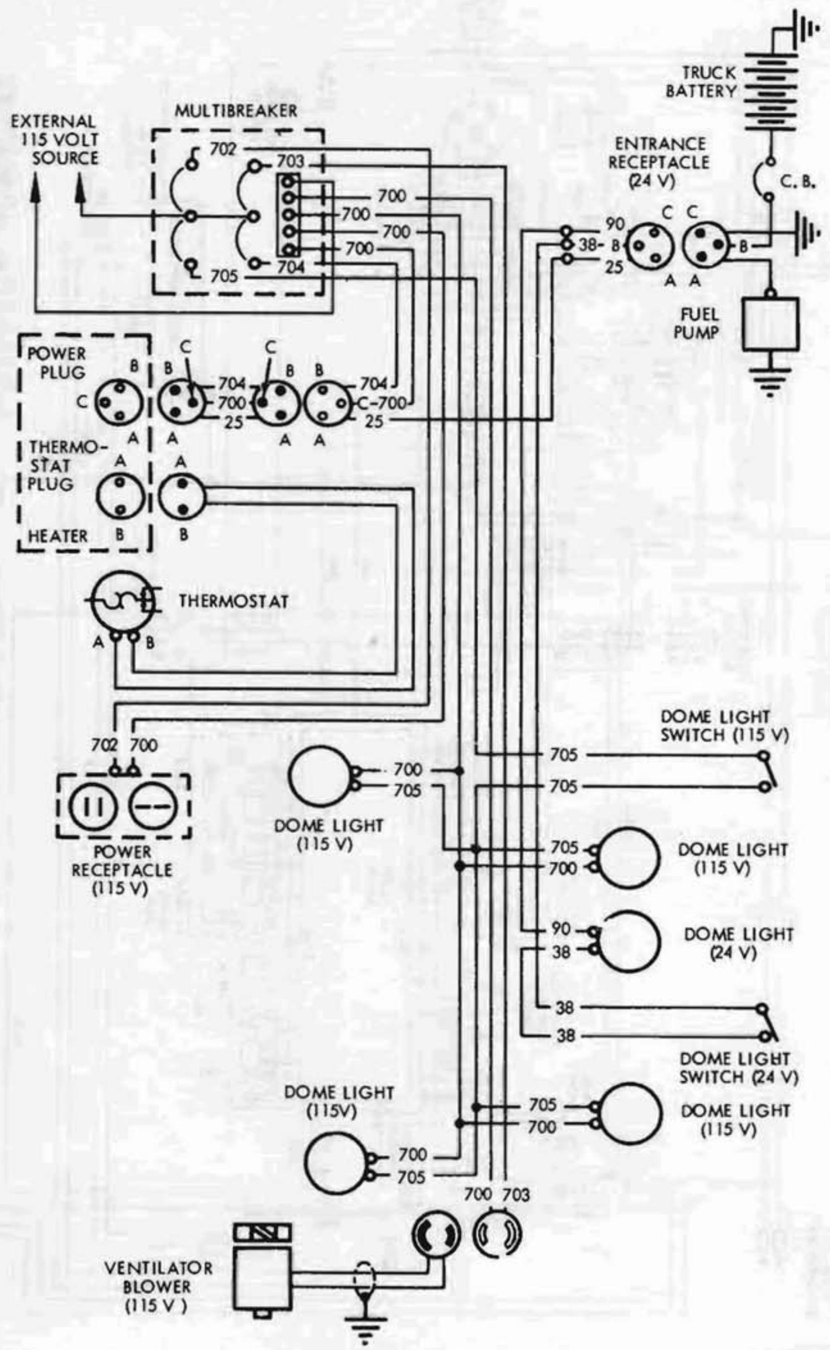

Figure 75. Wiring diagram, XM567 electronic van body

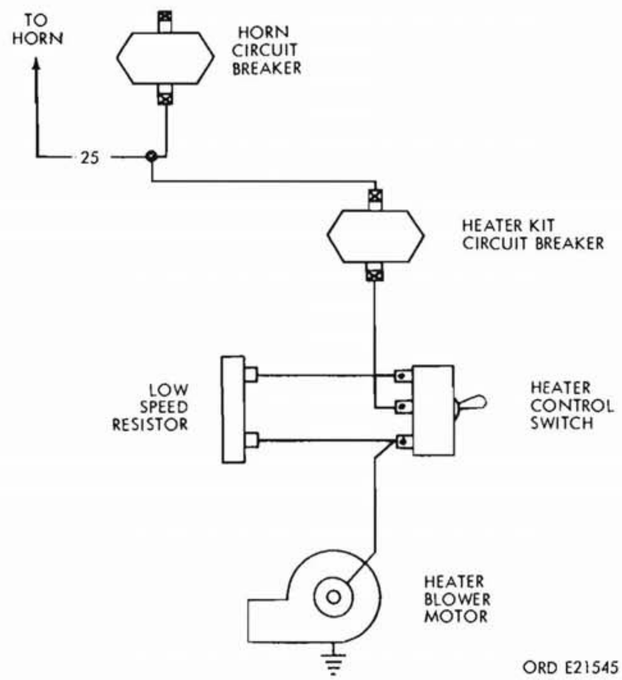

Figure 77. Wiring diagram, hot water personnel heater (-25^{o} F)

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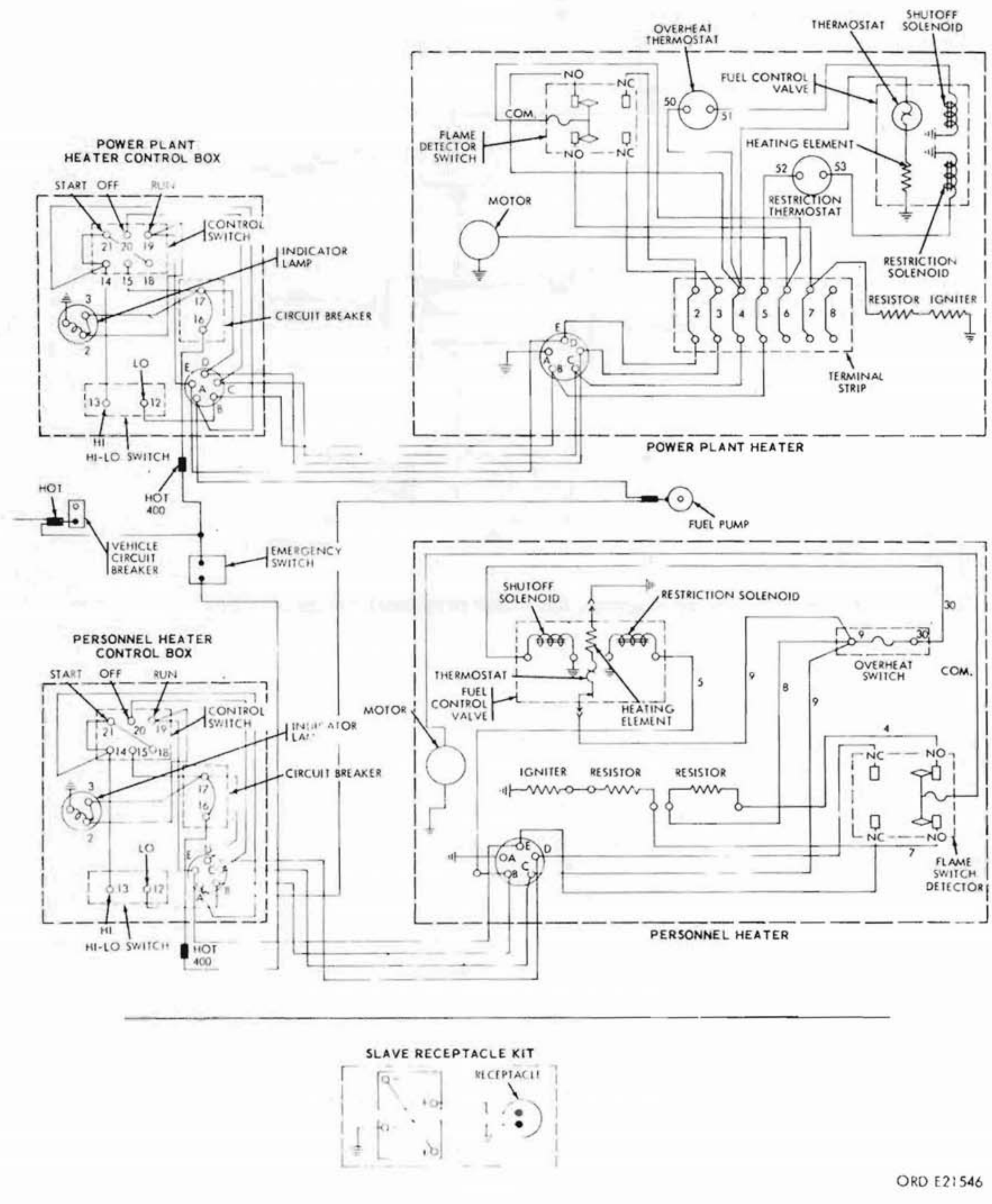

Figure 78. Wiring diagram, winterization kit (-65^{o} F)

Section VII. ENGINE DESCRIPTION AND MAINTENANCE IN VEHICLE (GASOLINE)

37. Description and Data

a. Description. The engine (figs. 79 and 80) is a gasoline, 6-cylinder, in-line, 4-stroke cycle, valve-in-head, wet-sleeve type. The cylinders have replaceable cylinder sleeves with pistons mounted in the cylinder block.

(1) Intake and exhaust manifold. The exhaust manifold (fig. 80) is at the right side of the cylinder head. The intake manifold, an integral part of the cylinder head, is provided with a mounting pad for the exhaust manifold heat control valve housing (fig. 80). This housing, mounted over the opening in the exhaust manifold, provides a direct passage from the carburetor (fig. 80) to the intake manifold passage in the cylinder head. The lower portion of the heat control valve housing is open to exhaust gases. A manually adjusted heat control valve (par. 46) in the valve housing gives optional control over the exhaust heat used in heating the fuel-air mixture.

(2) Engine mountings. The front of the engine is bolted at each side with cushion-type mountings (fig. 94) to the front mounting support, which is bolted to the frame crossmember. The flywheel housing at the rear of the engine is bolted to cushion-type mountings (fig. 92) attached to the frame left and right side rails.

(3) Engine lubrication. Positive pressure lubrication of all moving internal engine parts is provided by a gear-type oil pump mounted inside the crankcase and driven off the camshaft. Normal pressure with the engine running at idling speed is 15 psi. Normal

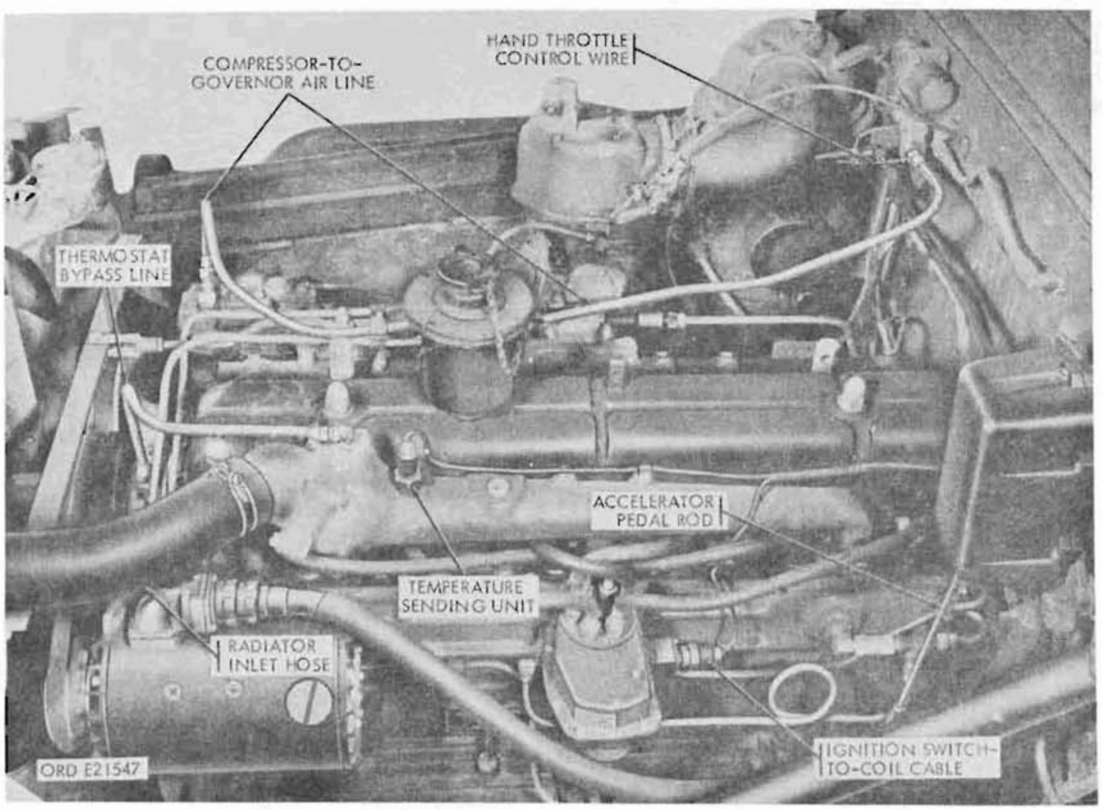

Figure 79. Left side of installed engine - gasoline

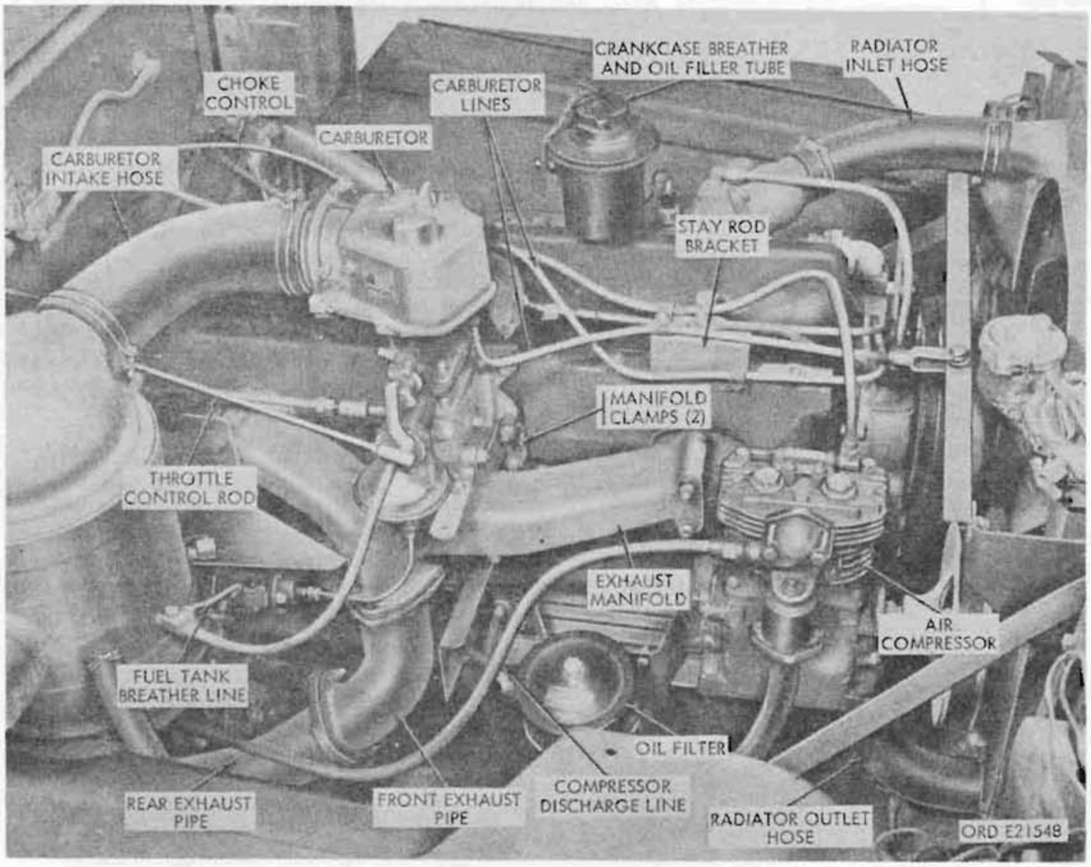

Figure 80. Right side of installed engine - gasoline

oil pressure with the engine running at 1500 to 1800 rpm is approximately 50 psi. A removable plate is provided in the side of the engine, behind the oil filter, for the installation of an accessory oil cooler, if required.

(4) Engine oil filter. A replaceable-element-type oil filter (fig. 80) is located on a mounting bracket bolted to the right side of the engine. When the engine is in operation, a portion of the oil is continuously circulated under pressure through the flexible inlet line, the filter and the flexible outlet line back into the oil pan.

(5) Crankcase ventilation. The combination breather and oil filler (fig. 80), mounted on top of the valve rocker arm cover, is essentially an oil-bath air cleaner. The assembly consists of a body, a replaceable element assembly, and a waterproof cap. Oil for the engine is poured in through the center of the breather. The crankcase and cylinder valve area is vented to the atmosphere through the breather area surrounding the filler.

(6) Engine nomenclature. The fan end of the engine will be referred to as the "front." The flywheel end will be referred to as the "rear." The terms "left" and "right," as used with reference to the engine, are as viewed from the rear or flywheel end and looking toward the front or fan end. Cylinders are numbered from the front. Viewing the engine from the front, the crankshaft rotates in a clockwise direction.

b. Tabulated Data.

Manufacturer	Reo Division of White Motor Co.
Model	OA331
Valve type	valve-in-head
Valve lash adjustment (hot)	0.015 in.
Number of cylinders	6 (in-line)
Bore	4-1/8 in.
Stroke	4-1/8 in.
Displacement	331 cu in.
Compression ratio	6.73:1
Firing order	1-5-3-6-2-4
Governed speed	2800 rpm
Idle speed	450 rpm
Maximum brake hp	146
Weight (with accessories)	872 lb

38. Operations Performed with Engine in Truck

All organizational maintenance operations listed below can be performed with the engine installed in the truck. Refer to specific paragraphs as noted for detailed instructions.

Compression test. Perform (par. 41).

Crankcase breather. Service or replace (par. 45).

Cylinder head and/or gasket. Replace (par. 41).

Exhaust manifold. Replace (par. 43).

Exhaust manifold heat control valve. Adjust (par. 46).

Fuel line shutoff valve, lines, and line connectors. Repair or replace (par. 68).

Oil filter. Service or replace (par. 44).

Valves. Adjust clearance (par. 39).

39. Valve Clearance Adjustment

Note. Certain components of the breather and ventilation system (par. 45) are not present on all vehicles.

a. Preliminary. Start the engine and run it until normal operating temperature (160°-180°F.) is reached.

Note. Engine is not necessarily normalized at the same time the temperature gage indicates normal operating temperature. Run the engine 1/2 to 2 hours (depending on beginning engine temperature) to normalize. Keep the engine running at idling speed while adjustments are made.

b. Remove Valve Rocker Arm Cover (Fig. 81). Stop the engine. Disconnect the valve control wire from the crankcase ventilation shutoff valve at the crankcase breather (if present). Loosen the screw securing the control wire in the control wire clip on the rocker arm cover and pull the control wire from the clip. Remove two high crown blind nuts, plain washers, and gaskets holding the valve rocker arm cover on the cylinder head, and remove the cover and cover gasket. Discard the gaskets.

Warning: In making the following adjustments, use extreme caution when working near moving components or hot manifolds. Cover bare arms, but do not wear loose clothing which might become entangled with moving parts. Have an assistant in the cab who can stop the engine in an emergency.

c. Check and Adjust Valve Clearance. Start the engine. With the engine at normal operating temperature (a above) and idling, insert a 0.015-inch feeler gage between the rocker arm and the valve stem. Using a wrench and a screwdriver, loosen the valve adjusting screw locknut, and tighten or loosen the valve adjusting the screw until 0.014 to 0.016-inch

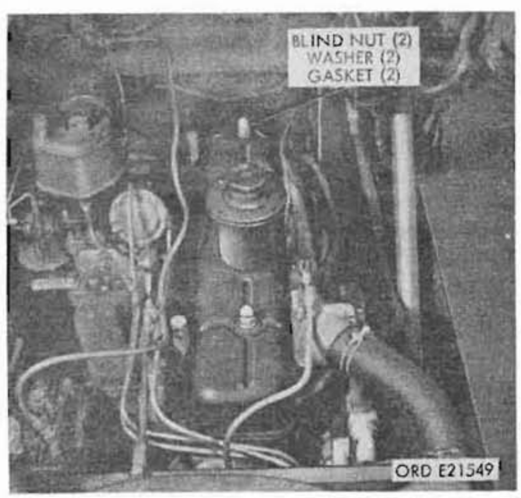

Figure 81. Valve rocker arm cover

clearance is obtained (fig. 82). Hold the screw in adjusted position, tighten the locknut, and again check the clearance. Use the same procedure to adjust all valves to 0.014 to 0.016-inch clearance.

d. Install Valve Rocker Arm Cover. Stop the engine. Install the valve rocker arm cover (fig. 81) with a new cover gasket, and secure with two annular gaskets, plain washers, and high crown blind nuts. Tighten the nuts securely. Check for leakage at the gasket. Slide the shutoff valve control wire through the wire clip on the cover and connect the wire to the crankcase ventilation shutoff valve on the crankcase breather. Tighten the screw on the clip to secure the wire.

40. Valve Adjusting Screw (Fig. 83)

a. Removal.

(1) Remove the valve rocker arm adjusting screw locknut.

(2) Turn the valve rocker arm adjusting screw clockwise to remove it from the rocker arm assembly.

b. Installation.

(1) Install the new rocker arm adjusting screw by reversing the procedure in a above.

(2) Do not tighten the rocker arm adjusting screw locknut before adjusting the valve clearance (par. 39).

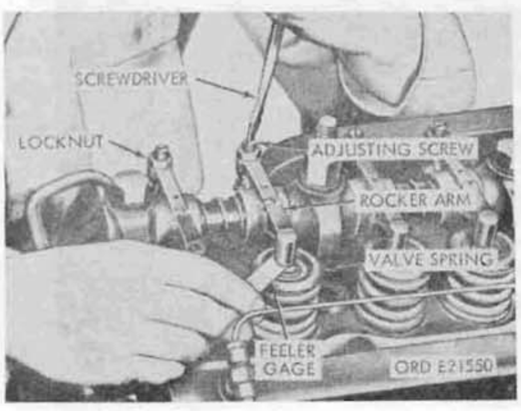

Figure 82. Valve clearance adjustment

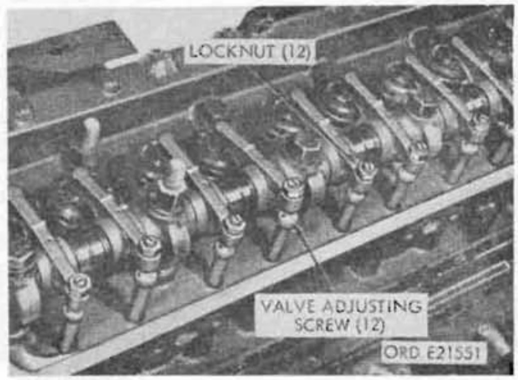

Figure 83. Valve adjusting screws

41. Cylinder Head Assembly and Gasket and Compression Test

Note. Refer to TB ORD 1033 when performing compression test on a gasoline engine at altitudes other than sea level.

a. Check the battery (par. 111) to be sure that it is fully charged.

b. Run the engine until normal temperature is reached (par. 39). Stop the engine.

c. Remove all the spark plugs from the engine (par. 98).

d. Open the throttle and choke. Insert a compression gage firmly in No. 1 spark plug hole. Have an assistant depress the starter pedal to crank the engine. Note the maximum compression indicated by the gage.

Caution: Do not crank the engine more than necessary to obtain a maximum reading.

e. Record the reading in the space provided in DA Form 2404.

f. Normal compression is from 120 to 130 psi. Minimum allowable compression is 90 psi, and maximum allowable variation between the lowest and highest reading cylinder is 10 psi.

g. If pressure in any cylinder is considerably below normal, pour one teaspoonful of engine oil through the spark plug hole on top of the piston to prevent loss of compression temporarily, and repeat (d above).

Note. Low compression brought up to normal by this oil-sealing method indicates piston, piston ring, or cylinder sleeve wear or damage. Low compression not brought up to normal by this method indicates valve or cylinder head gasket leakage.

h. Repeat d and e above for each of the other cylinders, and repeat g above, if necessary.

i. Install the spark plugs, using new gaskets (par. 98).

j. Release the throttle control.

42. Cylinder Head and Gasket

a. Removal.

(1) Drain the cooling system (TM 9-2320-209-10). Loosen both clamps on the radiator inlet hose (fig. 79) and remove the hose.

(2) Disconnect the thermostat bypass line (fig. 79) at the water manifold and pull it clear.

(3) Disconnect the temperature gage cable (fig. 79) from the temperature sending unit on the water manifold.

(4) Disconnect the ignition-switch-to-ignition-coil cable (fig. 79) at the distributor. Remove the harness clip from the water manifold and place the harness over the top of the generator regulator.

(5) Disconnect the spark plug cables (par. 99) at the spark plugs, and remove the spark plugs (par. 98).

(6) Disconnect the compressor-to-governor airline (fig. 79) at the air governor.

(7) Remove the valve rocker arm cover (par. 39).

(8) Remove two hex-head screws securing the stay rod bracket (fig. 79) and the pump-to-carburetor line to the cylinder head. Remove two safety nuts securing the valve-to-carburetor line, compressor-to-governor airline, and radiator stay rod to the bracket, and remove the lines and stay rod from the bracket. Remove the bracket from the cylinder head, and move the stay rod aside to clear the cylinder head.

(9) Disconnect the compressor-to-governor airline (fig. 79) at the air compressor and remove the tube.

(10) Disconnect the pump-to-carburetor line (fig. 80), valve-to-carburetor line, and valve-to-governor line from the carburetor, and pull the lines clear. Disconnect the shutoff valve control wire from the crankcase ventilation shutoff valve at the exhaust manifold heat control valve housing.

(11) Disconnect the throttle control and choke control linkage at the carburetor (par. 60).

(12) Disconnect the carburetor intake hose (fig. 80) by loosening the hose clamp at the carburetor. Pull the hose clear.

(13) Disconnect the priming tee line (if present) from the tee nozzle at the rear of the cylinder head.

(14) Disconnect the front exhaust pipe from the exhaust manifold (par. 43).

(15) Remove 14 cylinder head holddown bolts and washers (fig. 84) securing the cylinder head to the cylinder block.

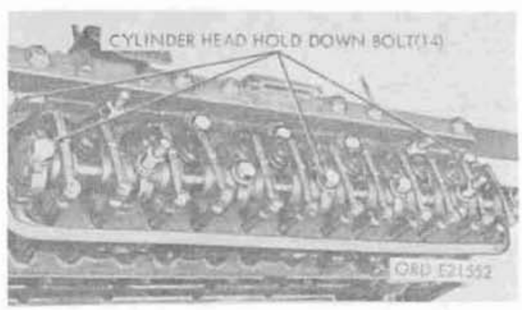

Figure 84. Cylinder head with valve rocker arm cover removed

(16) Lift off the valve rocker arm assemblies from the cylinder head.

(17) Install the cylinder head and manifold assembly lifting sling No. 4910-708-3213 (fig. 85). Slide the sling clamp forward on the water manifold as far as it will go. Hook the sling chain around the exhaust manifold and the carburetor mounting spacer tightly to avoid damage to the carburetor, governor assembly and primer lines when lifting the cylinder head. Lift the cylinder head straight up from the cylinder block. Check to see that all lines and cables are clear as the cylinder head is lifted. Remove the cylinder head, and discard the cylinder head gasket and exhaust pipe gasket.

b. Installation.

(1) Clean the gasket surface of the cylinder head and cylinder block thoroughly.

(2) Install a new cylinder head gasket on the cylinder block, making sure the side of the gasket marked "THIS SIDE DOWN" is placed next to the block. This is necessary in order to aline the water passage holes in the gasket with the passages in the block end head.

(3) Place a new exhaust pipe gasket over the end of the front exhaust pipe and push it down to the collar.

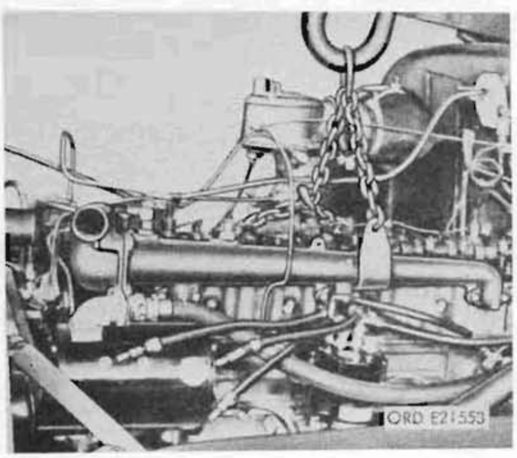

Figure 85. Removing cylinder head

(4) Check to be sure that all lines, cables, and parts are installed on the cylinder head that were connected to it and removed with it from the engine. If any components of the cylinder head were removed and installed, check to make sure that all installations were accomplished correctly.

(5) Install lifting sling No. 4910-708-3213 (a (17) above). Raise the cylinder head high enough to be clear, then carefully lower the cylinder head into place, being sure the push rods enter the proper holes in the cylinder head. Remove the sling.

(6) Place the valve rocker arm assemblies on the cylinder head. Space the rocker arms on shafts so as to center them over the valve stems and push rods.

(7) Install two (threaded each end) bolts and washers in the second hole from each end on the left-hand side (positions 7 and 9, fig. 86) through the rocker arm shaft supports. Do not tighten. Install two (threaded each end) bolts and washers in the second hole from ends on the right-hand side (positions 8 and 10) in the cylinder head, and five bolts and washers in the remaining cylinder head holes (positions 14, 6, 2, 3, and 12). Do not tighten. Install five bolts and washers in the remaining rocker arm shaft support holes (positions 13, 5, 1, 3, and 11). Do not tighten.

(8) Cylinder head bolts must be tightened gradually, evenly, and in a definite sequence to prevent distortion of the cylinder head. Using a torque wrench, start at bolt number 1 (fig. 86) and gradually tighten all the bolts in numerical order until a torque of 100 to 105 lb.-ft. is reached.

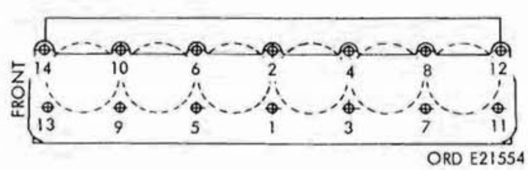

Figure 86. Cylinder head bolt tightening sequence

(9) Connect the priming tee line (if present) to the priming tee nozzle at the rear of cylinder head.

(10) Connect the carburetor intake hose (fig. 80) at the carburetor and tighten the hose clamp.

(11) Connect the throttle control and choke control at the carburetor (par. 65).

(12) Connect the valve-to-carburetor line (fig. 80) to the elbow on the side of the carburetor throttle body, valve-to-governor line to the elbow on the side of the carburetor governor, and pump-to-carburetor line to the fitting on the underside of the carburetor throttle body flange. Connect the shutoff valve control wire to the crankcase ventilation shutoff valve on the exhaust manifold control valve housing.

(13) Install and connect the compressor-to-governor airline (fig. 80) at the air compressor and air governor (fig. 79).

(14) Install the stay rod bracket (fig. 80) on the cylinder head and pump-to-carburetor line on the bracket with two split lockwasher hex-head screws. Secure the valve-to-carburetor line and valve-to-governor line to the bracket with a safety nut. Connect the radiator stay rod to the forward hole in the bracket with a safety nut.

(15) Connect the front exhaust pipe to the exhaust manifold (par. 43).

(16) Connect the spark plug cables (par. 99) to the spark plugs.

(17) Connect the ignition-switch-to-ignition-coil cable (fig. 79) at the distributor. Install a harness clip to the water manifold.

(18) Connect the temperature gage cable (fig. 79) to the temperature gage sending unit on the water manifold.

(19) Connect the thermostat bypass line (fig. 79) at the water manifold.

(20) Install the radiator inlet hose (fig. 79) on the radiator and the water manifold, and tighten the hose clamps securely.

(21) Fill the cooling system (TM 9-2320-209-10). Adjust the intake valve clearance to 0.016 inch and the exhaust valve clearance to 0.018 inch with the engine cold according to the procedure in paragraph 39 for the engine at normal temperature.

Note. These settings will approximate normal settings as the valves expand with a rise in engine temperature.

Start the engine and run it until normal operating temperature is reached. (See NOTE in paragraph 39.)

(22) After the engine is warmed up, check the tightness of the cylinder head bolts (100 to 105 lb.-ft.), following the sequence shown in figure 86.

(23) Adjust the valve clearance for 0.014 to 0.016 inch (par. 39).

(24) Install the valve rocker arm cover (par. 39).

43. Exhaust Manifold

a. Service. Broken manifold studs, and loose or stripped exhaust manifold and exhaust pipe flange nuts on early production vehicles must be replaced. Remove and discard the rear exhaust pipe front bracket located at the rear shackle of the right front spring, to remove stress on the exhaust manifold.

Note. Do not remove the rubber-mounted exhaust pipe bracket from late production vehicles.

Replace any broken, stretched, or stripped manifold studs. Replace all exhaust manifold and exhaust pipe brass flange nuts with seize-proof coated-thread safety nuts.

b. Removal.

Note. Certain components of the breather and ventilation system (par. 45) are not present on all vehicles.

(1) On trucks M49, M49C, M50, M60 and M108, remove the carburetor-with-governor (par. 63), and then remove the auxiliary slave unit with the throttle body (fig. 80) from the exhaust manifold heat control valve housing.

On all other models, remove the carburetor-with-governor (par. 63), and then remove the carburetor mounting spacer (fig. 114) from the exhaust manifold heat control valve housing (fig. 87).

(2) Disconnect the shutoff valve control wire and the push rod cover ventilating valve breather line, where present, from the crankcase ventilation shutoff valve at the rear of the exhaust manifold heat control valve housing.

(3) Disconnect the fuel tank breather line (fig. 80) from the fitting on the front of the air cleaner and disconnect the compressor discharge line from the air compressor. Pull the lines to side to clear the manifold. Do not bend the lines sharply.

(4) Loosen three nuts and screws at the flanges between the front and rear exhaust pipes (fig. 80) and turn the rear exhaust pipe flange so as to separate the pipes. Discard the gasket.

(5) Remove two screws, nuts, and manifold clamps (fig. 80) holding the exhaust manifold heat control valve housing (fig. 87) to the cylinder head.

(6) Observe that the shutoff valve control wire clip support, where present, is held on the manifold by two manifold nuts. Remove the support after removing the nuts. Remove six nuts and two washers holding the exhaust manifold to the cylinder head and pull the manifold with the attached exhaust manifold heat control valve housing and the front exhaust pipe from the cylinder head (fig. 87). Discard the gaskets.

(7) Remove four nuts from the studs holding the manifold heat control valve housing to the exhaust manifold, and lift the control valve from the manifold (fig. 87).

(8) Remove three nuts and screws securing the front exhaust pipe (fig. 80) to the manifold and remove the pipe. Discard the gasket.

c. Inspection (Fig. 88). Inspect the exhaust manifold for cracks and remove any carbon deposits. Check the alinement of the mounting flanges on a surface plate, or with straightedge. Replace the manifold if misalinement of the flanges exceeds 1/32 inch.

d. Installation (Fig. 87).

(1) Install a new exhaust pipe gasket and attach the front exhaust pipe to the exhaust manifold (fig. 80) with three new split lockwasher hex-head screws and safety nuts.

(2) Clean the mounting pads on the cylinder head and place new manifold-to-cylinder-head gaskets on studs.

(3) Install the manifold on the studs and secure the front end with two new steel safety nuts and plain washers. Install the valve control wire clip support, where present, on the studs at the rear end of the manifold, and secure it with two steel safety nuts.

(4) Connect the fuel tank breather line (fig. 80) to the fitting on the side of the air cleaner, and the compressor

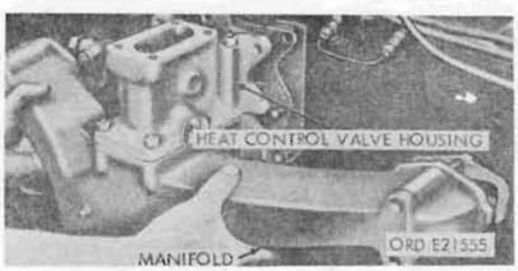

Figure 87. Removing or installing the exhaust manifold

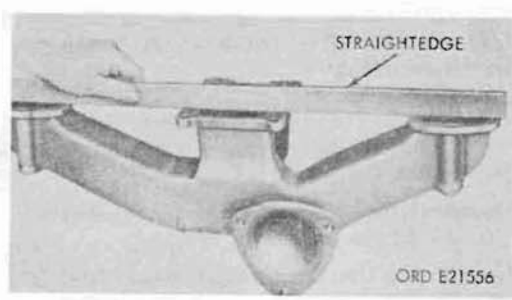

Figure 88. Checking the exhaust manifold flanges

discharge line to the fitting at the top rear of the air compressor.

(5) Place a new manifold-to-heat-control-valve gasket on the exhaust manifold, and install the exhaust manifold heat control valve housing (fig. 87) on top of the manifold. Secure the valve housing to the manifold with four new safety nuts.

(6) Secure the flanges of the exhaust manifold and heat control valve housing to the cylinder head with two manifold clamps (fig. 80) and new steel safety nuts.

(7) Install two new hex-head external teeth lockwasher screws in the upper holes in the flanges of the heat control valve housing and tighten them securely.

(8) Install an exhaust pipe gasket between the flanges on the front and rear exhaust pipes (fig. 80). Bring the flanges together so that the flange screws engage in the flange slots. Engage the screws, and tighten the nuts.

(9) On trucks M49, M49C, M50, M60 and M108, install the engine auxiliary governor slave unit with the throttle body (fig. 80) on the exhaust manifold heat control valve housing, and then install the carburetor-with-governor (par. 63) on the slave unit throttle body. On all other models, install the carburetor mounting spacer (fig. 114) on the exhaust manifold heat control valve housing, using new mounting gaskets, and then install the carburetor-with-governor (par. 63) on the spacer.

(10) Clamp the crankcase ventilation shutoff valve control in the clip on the valve control wire clip support, where present, and attach the control wire to the shutoff valve on the heat control valve housing.

(11) Connect the push rod cover ventilating valve breather line, where present, to the shutoff valve.

(12) Start the engine, and run it until normal operating temperature (160°-180° F.) is reached and check the tightness of all gasket joints.

Caution: Exhaust manifolds and related parts become extremely hot during operation. Use care to avoid contact with hot components when tightening the gasket joints.

44. Oil Filter and Oil Lines

a. Oil Filter Element (Fig. 89).

(1) Remove the drain plug at bottom of the filter and drain the filter of oil. Remove the screw from center of the cover, lift off the cover, and remove the cover spring from the center of the filter element. Discard the cover gasket. Lift the element from the filter body and discard.

(2) Clean the inside of the filter cover and the body with dry-cleaning solvent or mineral spirits paint thinner and install a new filter element.

(3) Install the drain plug. Fill the filter with 2 quarts of seasonal engine oil. Place the spring in the top of the filter element and install the cover with a new cover gasket. Secure the cover with the cover screw.

(4) Start the engine and run it until normal operating temperature (160° to 180°F.)

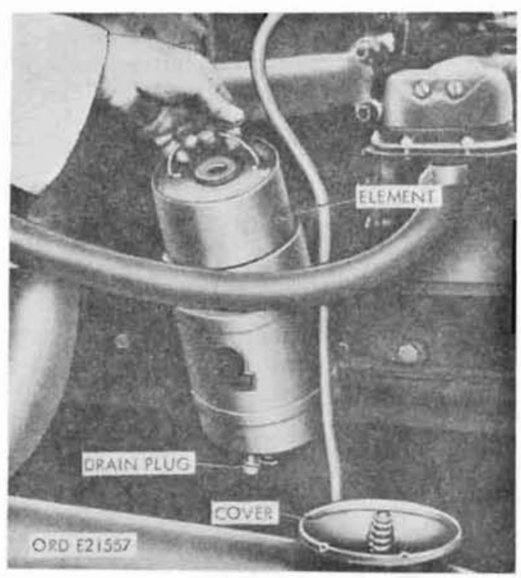

Figure 89. Removing oil filter element

is reached. Examine the filter thoroughly for oil leaks, and tighten where necessary.

b. Oil Filter Housing.

(1) Removal.

(a) Remove the drain plug at the bottom of the filter, drain the oil, and install the plug.

(b) Disconnect the oil filter inlet and outlet flexible lines from the filter fittings (fig. 90).

(c) Loosen the nuts on the two screws that tighten the mounting straps around the filter. Loosen the two screws that secure the straps on one side of the mounting bracket. Remove the filter from the straps. Remove the two elbows from the filter housing.

(2) Installation.

(a) Install a 1/4-inch flared tube elbow in each filter housing port.

(b) Position the filter in the mounting straps. Tighten the two strap tightening screws and then tighten the two strap mounting screws.

(c) Connect the oil filter inlet and outlet lines to the elbows on the filter housing, being sure to connect the line from the cylinder block port, marked "TOP," to the elbow on the side of the filter.

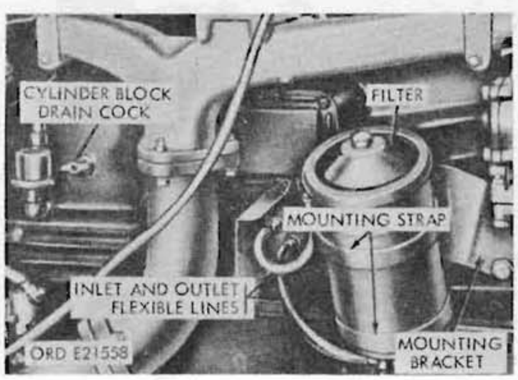

Figure 90. Oil filter disconnect points

(d) Fill the filter with oil (a (3) above).

(e) Start the engine and check for oil leaks (a (4) above).

c. Oil Filter Inlet and Outlet Lines.

(1) Removal.

(a) Remove the drain plug at the bottom of the filter, drain the oil, and install the plug.

(b) Remove the oil filter inlet and outlet lines from the elbows on the oil filter (fig. 90).

(c) Remove the lines from the ports in the cylinder block.

(2) Installation.

(a) Install the lines in the ports in the side of the cylinder block.

(b) Connect the line from top cylinder block port to the elbow on the side of the filter housing and the line from the lower cylinder block port to the elbow on underside of filter housing.

(c) Fill filter with oil (a (3) above).

(d) Start the engine and check for oil leaks (a (4) above).

45. Crankcase Breather and Shutoff Valve

a. General. The crankcase breather and element (fig. 91) should be removed, cleaned, and reinstalled at each oil engine change.

b. Removal.

(1) Remove the breather cap. Unscrew four screws holding the breather element in the housing and lift the element from the breather housing (fig. 91).

(2) Disconnect the valve control wire from the crankcase ventilation shutoff valve, if present, at the rear of the breather housing.

(3) The breather housing is secured to the rocker arm cover by a central holding screw. Back off this screw

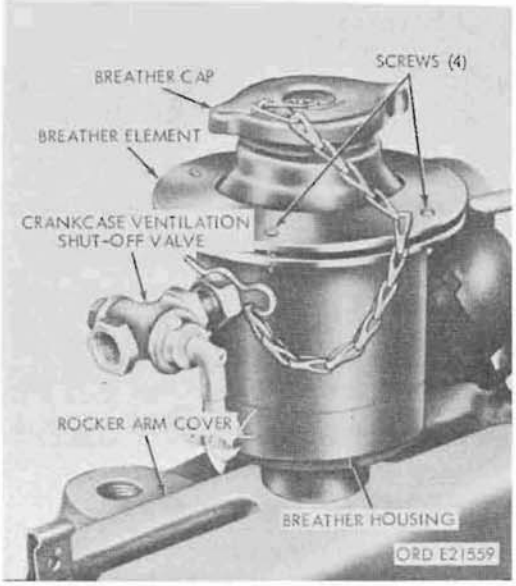

Figure 91. Crankcase breather

(counterclockwise) and remove the breather housing. Remove the shutoff valve.

c. Cleaning.

(1) Remove the filter element and pour out the old oil from the oil cup.

(2) Wash all parts in dry-cleaning solvent or mineral spirits paint thinner.

(3) Submerge the filter mesh in the dry-cleaning solvent and move the filter up and down in the solvent to clean the mesh thoroughly. If the mesh is badly clogged, replace it with a new filter element.

(4) Remove the filter from the dry-cleaning fluid and let it drip dry.

d. Installation.

(1) Install the shutoff valve in the breather housing. Place the breather housing in position on the rocker arm cover, with the shutoff valve (or pipe nipple if there is no valve) pointing directly to the rear.

(2) Insert the central holding screw through the breather housing into the rocker arm cover and tighten it securely.

(3) Connect the valve control wire to the shutoff valve, where present, at the rear of breather housing.

(4) Fill the breather oil cup with engine oil to the level indicated.

(5) Dip the filter element in engine oil, install the element in breather housing, and secure with four screws provided on the element. Install the cap on the breather.

46. Exhaust Manifold Heat Control Valve Adjustment

The heat control valve in the exhaust manifold heat control housing (fig. 87) has two positions, on and off. When the valve sector is moved downward, the valve is closed, and upward, the valve is open. Loosen the locknut and move the valve sector to obtain the required setting of the valve. Tighten the locknut after adjustment.

Note. The sector should be in down or OFF position for usual operating conditions. Opening the valve is necessary only in extreme cold weather.

47. Engine Mountings

a. Removal.

(1) Remove the self-locking nut and bolt on each side of the engine securing the engine and the engine rear mounts to the frame (fig. 92).

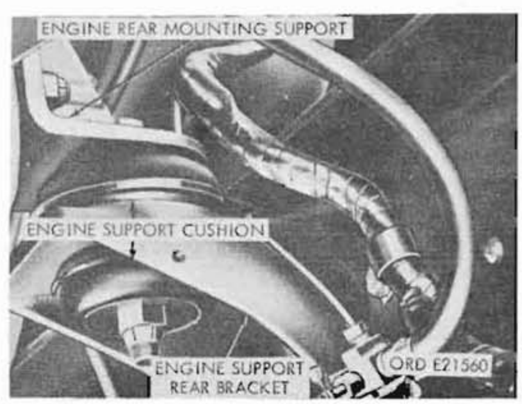

Figure 92. Engine rear mounts

(2) Place a jack under the transmission and raise the power plant enough to facilitate removal of the rear mounts (fig. 93).

(3) Remove the engine rear mounts and install new mounts.

(4) Remove the nut and bolt on each side of the engine securing the engine and the engine front mounts to the frame (fig. 94).

(5) Place a jack under the front of the oil pan and raise the power plant enough to facilitate the removal of the front mounts (fig. 95).

(6) Remove and discard the engine front mounts.

b. Installation. Install the new mounts in reverse order of removal.

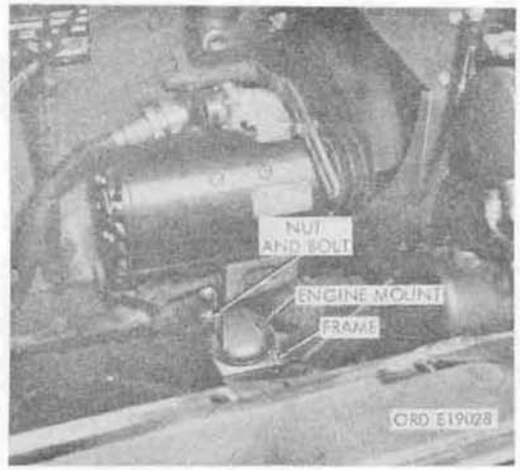

Figure 94. Engine front mounts

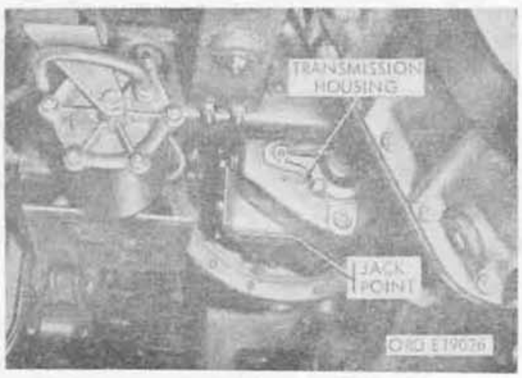

Figure 93. Rear jack point

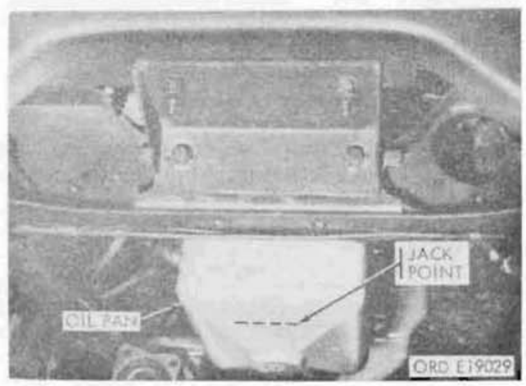

Figure 95. Front jack point

Section VIII. POWER PLANT REMOVAL AND INSTALLATION (GASOLINE)

48. Coordination With Direct Support Maintenance Unit

Refer to paragraph 2 for information on coordination with the direct support maintenance unit.

49. Removal

a. General. The radiator, engine, engine accessories, transmission and clutch are considered as the power plant unit for removal and installation purposes only. Removal of the power plant is best accomplished by two men, but one mechanic may perform all the disconnect operations.

b. Preliminary Instructions. Place the vehicle under suitable power plant lifting equipment. Arrange to have tools, lifting sling, stand, and supports available for use when needed. Block wheels to prevent the vehicle from moving. The disconnect points at the left and the right sides of the engine (figs. 96 and 97) in engine compartment are readily accessible when the hood top panel is raised to its extreme height, and both hood side panels are lowered. Release holddown catches at the side panels and hood. Raise the hood until it is supported by the windshield frame, and lock in raised position by engaging the left hood-top-panel-to-windshield catch, and cowl mounted hood top panel hook. Release the hood side panels and lower until they rest on the fenders. Open the air reservoir draincocks (fig. 239) and leave them open.

c. Disconnect Points at Left Side of Engine (Fig. 96).

(1) Disconnect fuel pump flexible line. Turn fuel line shutoff valve (figs. 96 and 119) to closed position. Disconnect the line at the shutoff valve.

(2) Disconnect engine ground strap. Unscrew the hex-head screw securing the ground strap to the push rod cover, remove the strap, and tighten the screw.

(3) Disconnect ignition-switch-to-ignition-coil cable. Disconnect the cable from the clip on the water manifold.

(4) Disconnect temperature gage cable. Disconnect the cable from the temperature gage sending unit and place the cable over the top of the generator regulator.

(5) Disconnect generator-to-regulator wiring harness. Disconnect the harness at the generator and lay over the steering column.

d. Disconnect Points at Front of Engine.

(1) Remove brush guard. Remove two nuts and screws at bottom of brush guard

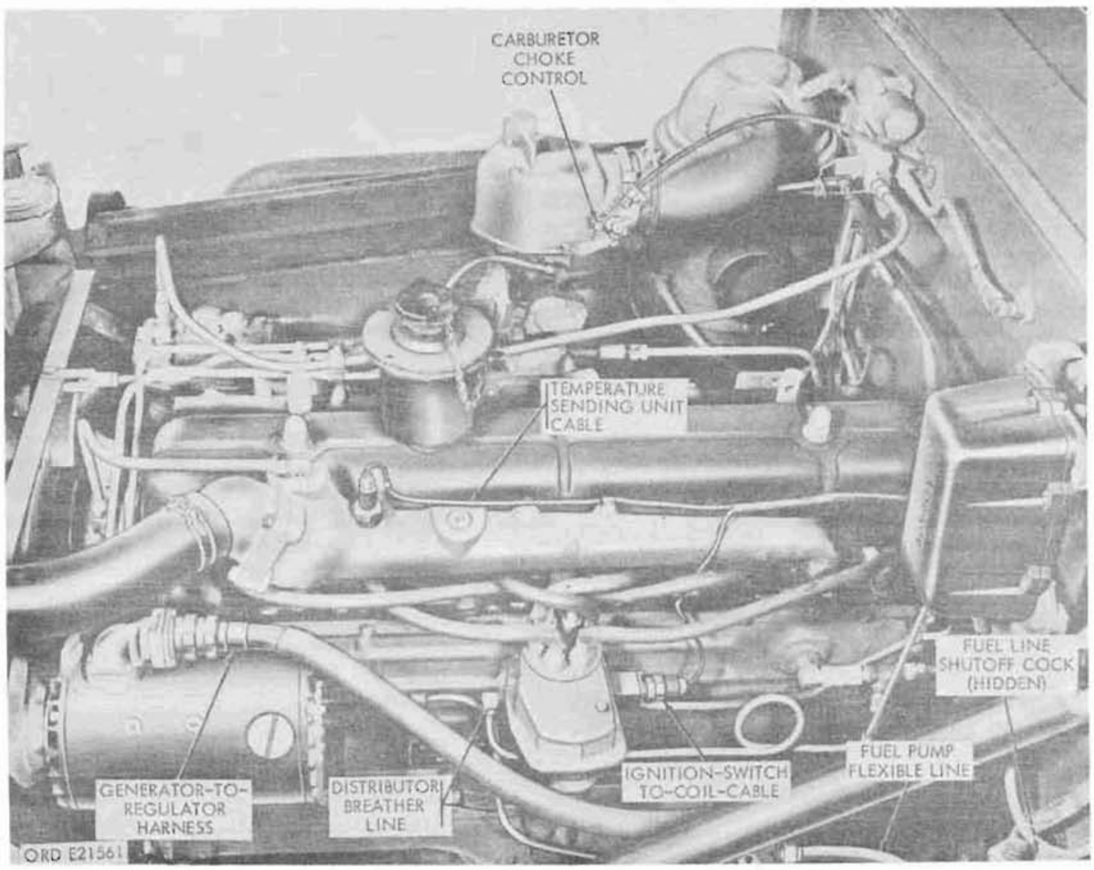

Figure 96. Disconnect points at left side of gasoline engine

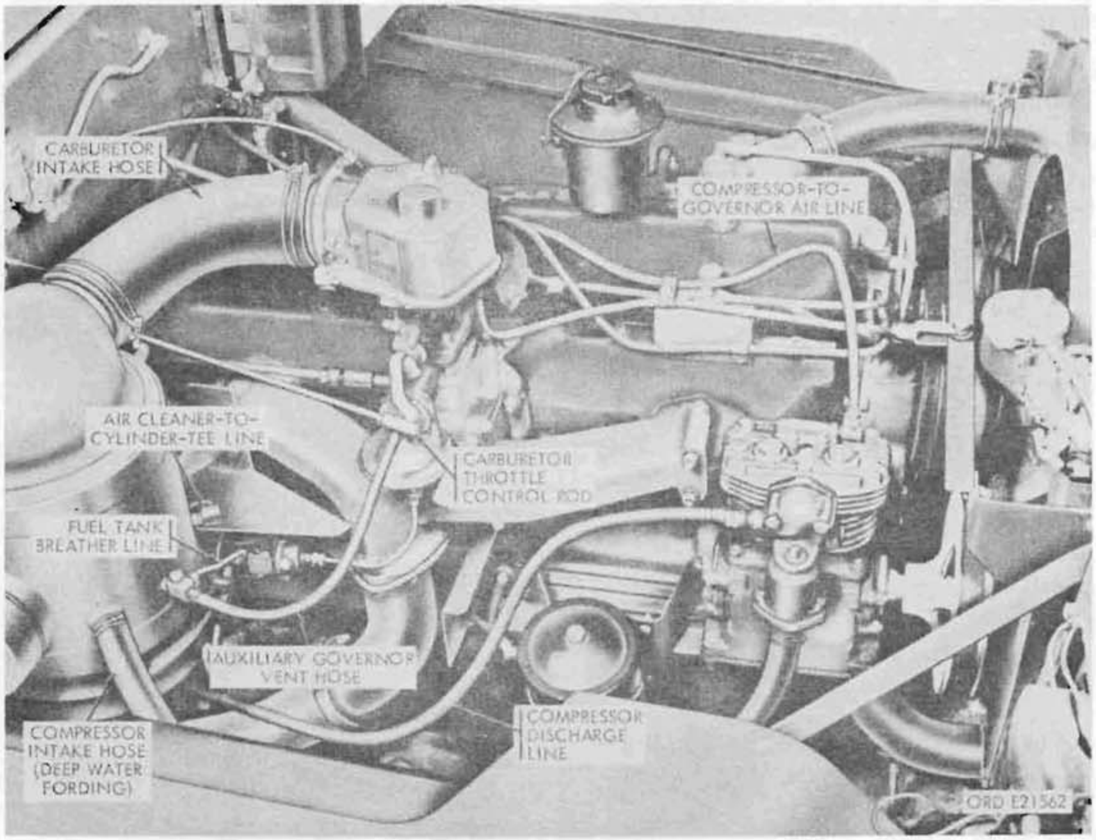

Figure 97. Disconnect points at right side of gasoline engine

(fig. 134) from brush-guard right and left brackets, and one on each side. Loosen two nuts and screws securing brush guard to brush-guard braces, one on each guard vertical inner bar, and remove brush guard.

(2) Remove radiator upper shield.

Note. Radiator upper shield has been removed on some model trucks.

Loosen two bolts holding radiator upper shield to headlight support bracket, one on each side, and remove radiator upper shield by pulling toward front.

e. Disconnect Points at Right Side of Engine (Fig. 97).

(1) Disconnect points for all models.

Note. Certain components of the breather and ventilation system (par. 45) and hand primer pump are not present on all vehicles.

(a) Disconnect compressor discharge line. Open the two draincocks on the air reservoirs to release air pressure. Disconnect the line at the air compressor.

(b) Disconnect compressor intake hose. Loosen the hose clamp and disconnect the hose at the compressor air strainer.

(c) Disconnect carburetor intake hose. Disconnect the hose at the carburetor.

(d) Disconnect oil pressure gage cable. Disconnect the cable from the oil pressure sending unit on the side of the cylinder block near the rear of the engine (fig. 178).

(e) Disconnect battery ground cable. Disconnect the battery ground cable (fig. 153) at the battery.

(f) Disconnect starter cable.

Caution: Be sure that the battery ground cable ((e) above) is disconnected before disconnecting the starter cable.

Disconnect the cable at the starter switch.

(g) Disconnect the carburetor throttle control rod (fig. 97). Remove the locknut and disconnect the control rod at the throttle lever. Screw the nut back on the bolt to prevent loss.

(h) Disconnect carburetor choke control. Disconnect the choke control (fig. 96) at the choke lever (fig. 113) and choke lever bracket.

(i) Disconnect compressor-to-governor airline. Disconnect the line (fig. 97) at the air compressor. Remove the tube from the clip on stay rod bracket, and pull the tube clear of the engine.

(j) Disconnect the fuel tank breather line. Disconnect the line at the air cleaner (fig. 112).

(k) Disconnect cleaner-to-cylinder-tee to breather line. Disconnect the line at the air cleaner (fig. 112).

(l) Disconnect distributor inlet breather line. Disconnect the line at the air cleaner (fig. 112).

(m) Disconnect fuel pump breather line, where present. Disconnect the line at the air cleaner (fig. 112).

(n) Disconnect the crankcase ventilation shutoff valve control, where present. Disconnect the control wires from the crankcase ventilation shutoff valve at air cleaner, exhaust the manifold heat control valve housing and crankcase breather. Remove the control wire sheath from line clips.

(o) Disconnect priming tee line, where present. Disconnect line at priming tee nozzle at the rear of the engine.

(2) Trucks M49, M49C, M50, M60, and M108 additional disconnect points (fig. 97).

(a) Disconnect auxiliary governor slave unit vent hose. Disconnect hose at the air cleaner (fig. 111).

(b) Disconnect auxiliary governor flexible shaft from the auxiliary governor slave unit (fig. 111).

(3) Trucks M48 and M275 additional disconnect point. Disconnect the hand control valve breather line at air cleaner.

f. Disconnect Points Inside of Cab.

(1) Raise the transmission gearshift lever boot (fig. 99) and remove the screw, washer, and nut holding the lever to the transmission. Remove lever and rubber boot.

(2) Remove front and intermediate tunnel (fig. 99). Remove 13 screws holding intermediate tunnel to the front tunnel, the rear tunnel, and the cab floor, and remove the tunnel. Remove seven screws securing the front tunnel to the firewall and cab floor, and remove the tunnel.

(3) Disconnect the clutch control rod (fig. 98). Disconnect the clutch control rod from the clutch throwout shaft lever at the clutch housing by pulling the quick-disconnect pin part way out of the rod end yoke.

(4) Disconnect the transfer reverse shift lever rod from the transfer reverse shift lever at the transmission by pulling a quick-disconnect pin part way out of the rod end yoke.

(5) Disconnect the transmission-to-transfer propeller shaft (fig. 98).

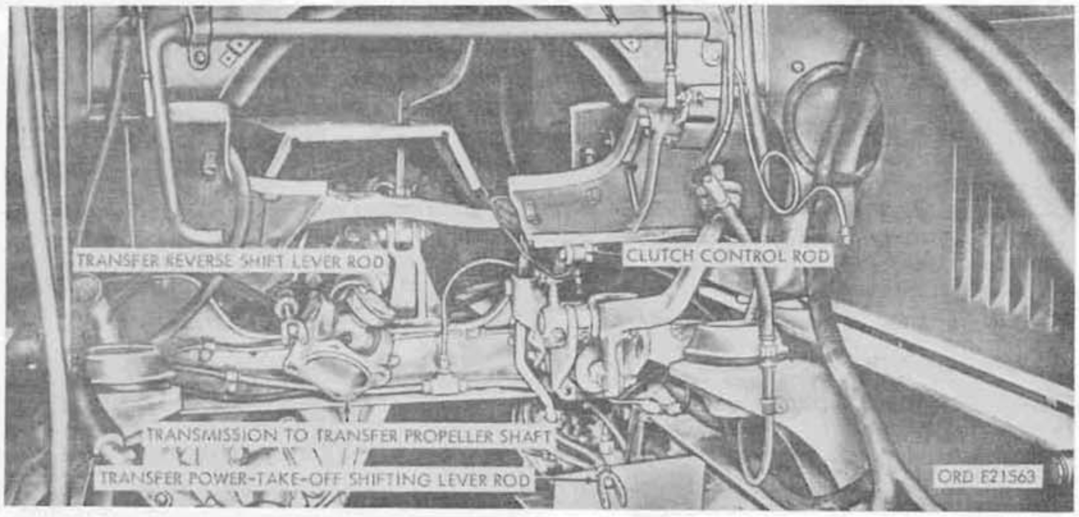

Figure 98. Disconnect points under vehicle

Warning: Before disconnecting propeller shaft, always raise one front wheel off the ground to relieve torsional strains on propeller shaft. Failure to observe this warning may result in personnel injury when disconnecting the shaft.

Disconnect the propeller shaft from the transmission by removing four bolts and nuts from the companion flanges at the transmission end of the shaft.

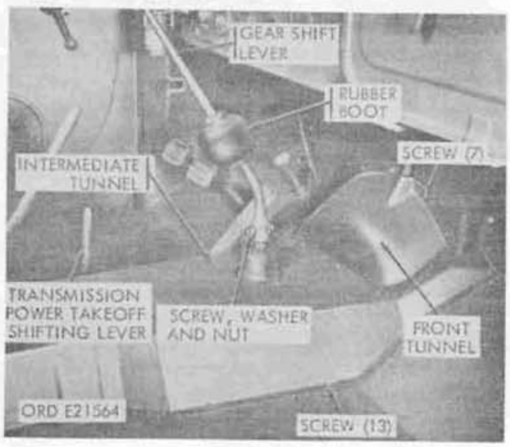

Figure 99. Tunnel and gearshift lever

g. Disconnect Points Under Truck.

(1) Disconnect points for all models.

(a) Disconnect exhaust pipe (fig. 97). Loosen three nuts and screws at flanges between the front and the rear exhaust pipes. Turn the rear exhaust pipe flange and separate the pipes. Discard gasket.

(b) Disconnect engine at rear mounting supports (fig. 92). Remove the two nuts and screws securing the engine rear mounting supports to the engine rear support brackets, and remove the engine, support cushions, one set on each side. Loosen the screw holding the engine ground strap to mounting support, and slide open the end of the strap from support.

(c) Disconnect engine at front mounting support (fig. 94). Remove the horizontal hex-head screws and safety nuts that hold the engine support to the frame front crossmember.

(2) Vehicles equipped with front winch.

(a) Disconnect the front winch drive shaft (par. 213). Loosen the socket-head setscrew in the stop collar at the slip joint. Loosen the setscrew in the drive shaft end yoke on the drive shaft at the transmission power takeoff four or five turns, and push yoke off power-takeoff shaft. Wire or tie key in power-takeoff shaft to prevent loss.

(b) Disconnect transmission power take-off-shifting lever rod (fig. 98). Disconnect the lever rod at the transmission power takeoff by pulling the quick disconnect pin part way out of the rod end yoke.

(3) Trucks M47 and M59 additional disconnect points.

(a) Disconnect hydraulic hoist pump drive shaft (fig. 195). Loosen setscrew in drive shaft end yoke on the drive shaft at transmission power takeoff four or five turns, and push yoke off the power-takeoff shaft. Wire or tie the key in the shaft to prevent loss.

(b) Disconnect control box-to-power takeoff rod (fig. 267). Loosen safety nut securing the power-takeoff rod to the rod arm on the accessory drive, shifter shaft on the power take-off, and remove the arm.

h. Remove Power Plant (Fig. 100).

(1) Install engine and transmission lifting sling. Attach engine and transmission lifting sling 4910-795-0121 to suitable hoist. Center the hoist over the power plant and attach the lifting sling to the lifting eyes.

(2) Hoist power plant from truck. Check to be sure all the disconnects have been accomplished and the lines, tubes, hose, cables, etc., are away from power plant. Carefully lift power plant, using a series of short lifts, until radiator and engine support will clear front of vehicle. Raise the power plant slowly, while pressing down on the transmission from the cab, and at same time pulling the power plant toward the front. Check to see that all accessories and lines are clear as the power plant is being moved upward and forward. Place the power plant on a suitable stand, and remove sling.

50. Installation

a. General. All cables, connections, parts, and accessories which were removed must be installed on the engine before the installation of the engine into the truck. Prior to the power plant installation, check to be sure that all the lines, cables, and parts are installed on the power plant that were connected to it when it was removed from the truck. If any components of the power plant were replaced, check all the connections and related parts after the assembly of the power plant to be sure that the installations were accomplished correctly.

b. Installation of Power Plant. Install the power plant in the reverse order of removal.

c. Record of Replacement. Make a record of the replacement on DA Form 2408-1.

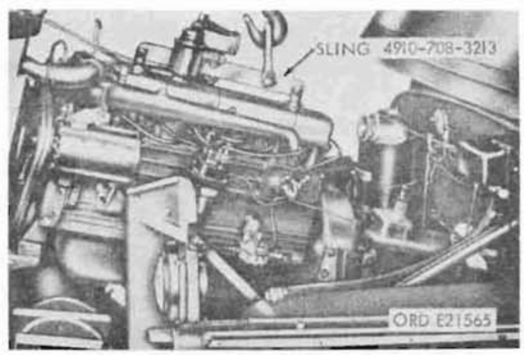

Figure 100. Removal of power plant from truck

Section IX. ENGINE DESCRIPTION AND MAINTENANCE IN VEHICLE (MULTIFUEL)

51. Description

a. Engine (Figs. 101 and 102). The engine is a six-cylinder, in-line, liquid-cooled, compression ignition engine with 140 brake horsepower at 2600 rpm. The engine employs a multifuel combustion system which permits the use of various grades of fuel. The exhaust-driven turbosupercharger lubricated by external oil lines from the engine oil system is

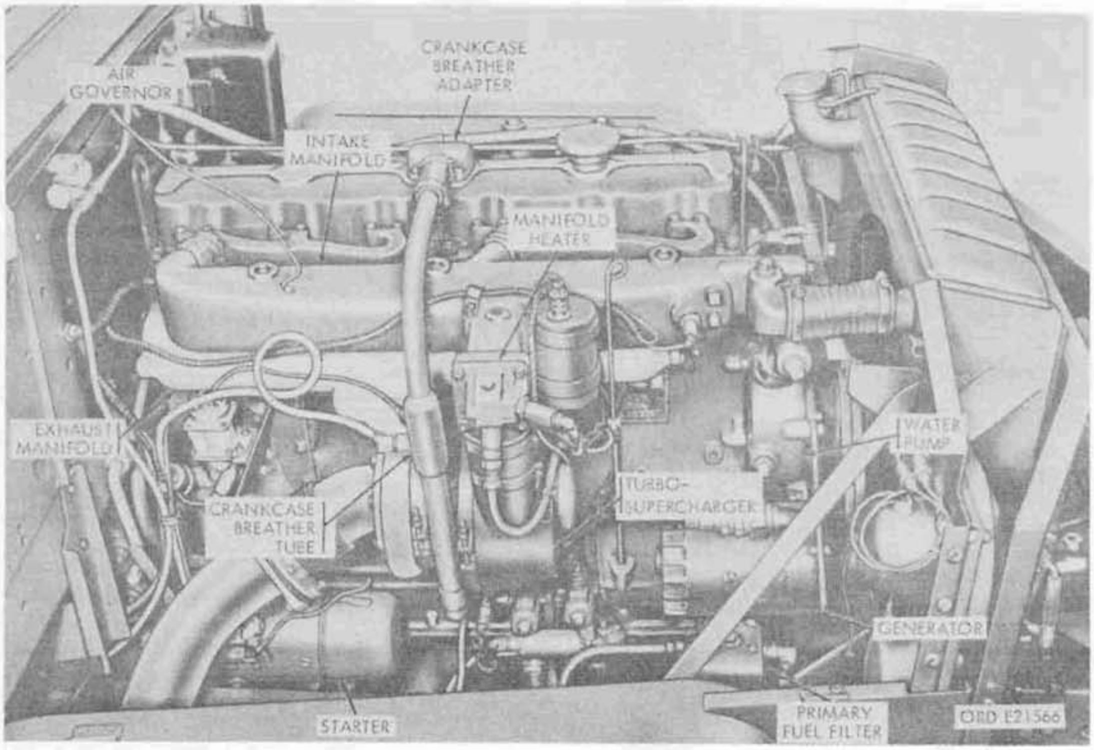

Figure 101. Right side of installed engine - multifuel

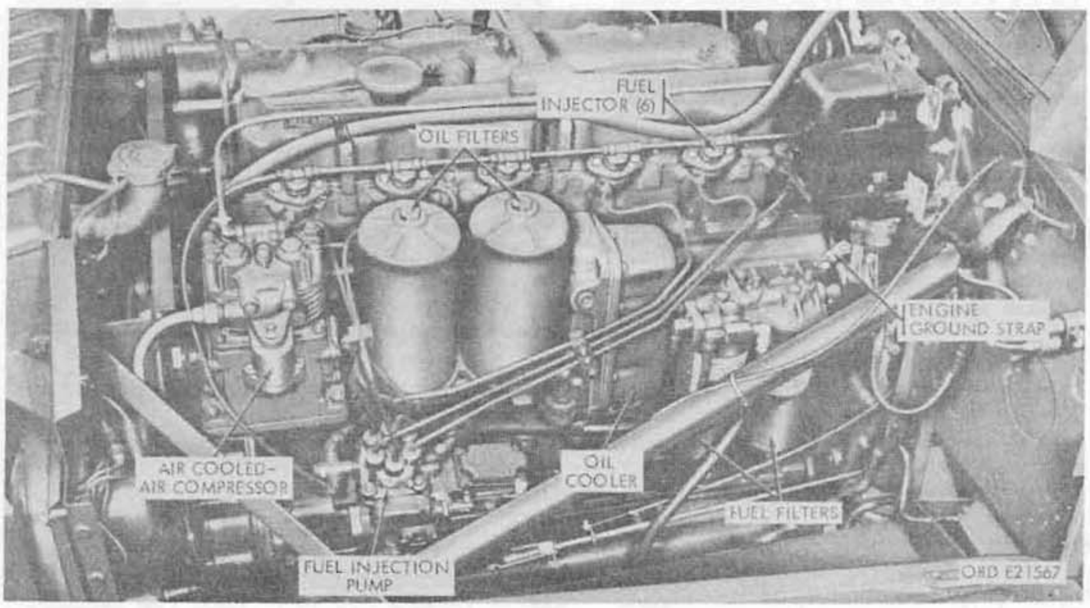

Figure 102. Left side of installed engine - multifuel

mounted on the right side of the engine and provides supercharged air to the cylinders for high performance.

b. Engine Manifold Heater. The engine is equipped with a flame-type manifold heater for heating the induction air during cold-weather starting and warm-up operation.

c. Intake Manifold. The one-piece cast aluminum intake manifold is equipped with a water jacket. Coolant is circulated through the jacket, and heat thus transferred to the induction air improves the cold weather combustion characteristics of the engine. The thermostat housing is secured to the front flange of the manifold. The intake manifold also accommodates the water temperature sending unit.

d. Exhaust Manifold. The exhaust manifold consists of three high-temperature cast iron sections. The two end sections are joined to the center section by slip joints. To prevent exhaust leaks at these joints, metal seal rings are used at each end where the two end sections join the center section.

e. Lubrication System. The model LDS–427–2 Hypercycle multifuel engine incorporates full-pressure continuous delivery of oil to all the engine moving parts regardless of the angle at which the vehicle may be inclined.

f. Oil Filters. The engine employs two replaceable element-type oil filters which ensure dirt-free engine oil for the engine bearings and other moving parts. Both oil filters are identical and are interchangeable. The dual unit oil filters are mounted on the oil cooler and oil filter housing assembly. The engine lubricating oil under pressure is forced through the filters prior to the oil entering the oil cooler and engine lubricating system. The oil filter bypass valve is located beneath the front oil filter and is used to bypass engine oil directly to the oil cooler in the event the oil filters become clogged. The bypass valve opens at a differential pressure of 15 psi.

g. Engine Nomenclature. The fan end of the engine will be referred to as the "front." The flywheel end will be referred to as "rear." The terms "left" and "right," as used with reference to the engine, are as viewed from the rear or the flywheel end and looking toward the front or fan end. The cylinders are numbered from the front. Viewing engine from the front, the crankshaft rotates in a clockwise direction.

h. Tabulated Data.

Type	Compression ignition, multifuel, liquid cooled
Model	LDS 427–2, LD 465–1
Valves	Valve-in-head
No. cylinders	6 (in line)
Firing order	1–5–3–6–2–4
Bore and stroke (in.):	
LDS 427–2	4.31x4.87
LD 465–1	4.56x4.87
Displacement (cu. in.):	
LDS–427–1	427
LD 465–1	478
Maximum brake hp	140@2600 rpm
Compression ratio	22:1
Oil filters	2
Idle speed	650–700 rpm
Governed, full-load	2600–2650 rpm
Governed, no-load	2850 max. rpm

52. Operation Performed with Engine in Vehicle

Rescinded.

53. Adjusting Intake and Exhaust Valves

Rescinded.

Figure 103. Rescinded.

Figure 104. Rescinded.

54. Valve Adjusting Screw

Rescinded.

55. Engine Oil Filter Elements

a. *Removal.*

(1) Open drain plug and drain oil from the oil filters (fig. 105).

Note. If a recessed-type drain plug is installed in the oil filter, replace it with the latest-type drain plug FSN 4730-044-4583, ORD No. 444583..

(2) Remove filter retaining screw securing the filter housing to the filter base. Remove and discard retaining screw gasket.

Note. On engine installed in the latest M44A2 series trucks, the filter housing and element are removed with retaining screw. Remove cotter pin, then disassemble filter element, spring, cup and housing from retaining screw (fig. 105.1).

(3) Remove the filter housing.

(4) Remove and replace the filter element.

(5) Remove and replace the housing filter seal.

(6) Retain cup and spring for reuse.

b. *Installation.* Install the filter components in reverse order of removal, using new filter seal, retaining screw gasket, and cotter pin (if present) provided in oil **filter kit. Torque retaining screw to 60 foot pounds.**

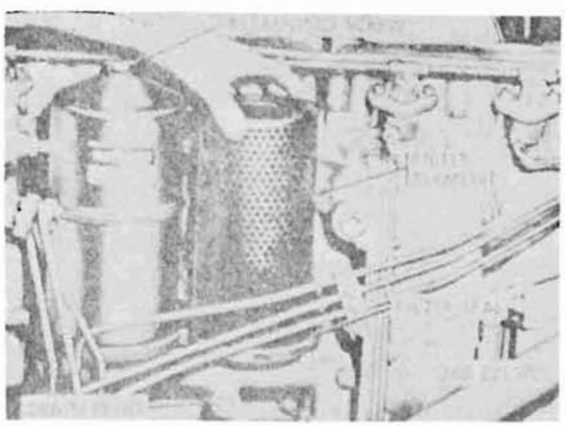

Figure 105. Engine oil filter element replacement

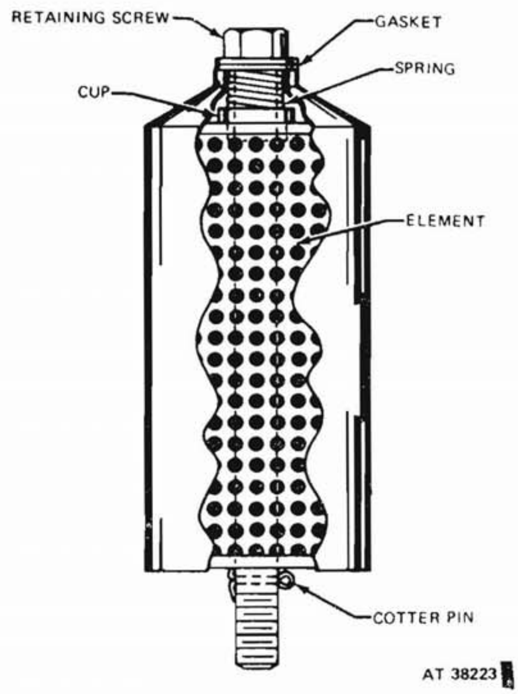

Figure 105.1. Engine oil filter (LD465-1 and LD465-1C multifuel engines)

56. Engine Oil Lines and Connections

a. *Removal.* Disconnect fittings from each end of oil lines and remove oil lines (fig. 106).

b. *Installation.* Install oil lines in reverse order **of removal.**

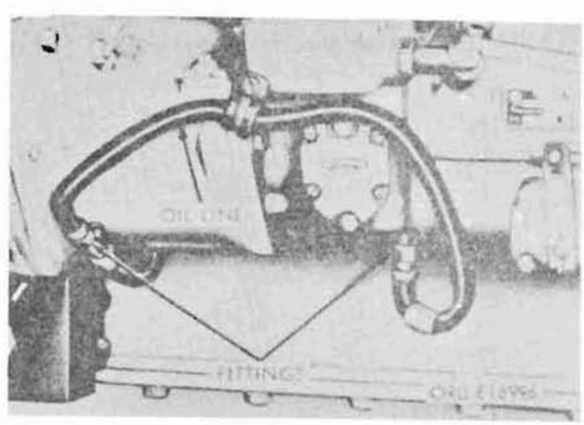

Figure 106. Engine oil lines and connections

57. Engine Mounting Cushions

a. Removal. Refer to paragraph 47 for removal of engine mounting cushions.

b. Installation. Refer to paragraph 47 for installation of engine mounting cushions.

Section X. POWER PLANT REMOVAL AND INSTALLATION (MULTIFUEL)

58. Coordination With Direct Support Maintenance Unit

Refer to paragraph 2 for information on coordination with the direct support maintenance unit.

59. Removal

a. General and Preliminary Instructions. Refer to paragraph 49*a* and *b* for general and preliminary instructions.

b. Disconnect Points at Left Side of Engine (fig. 107).

(1) Remove locknuts and bolts and disconnect rear engine mounts.

(2) Disconnect accelerator linkage (fig. 109). Remove nut and lockwasher, disconnect rack control link from fuel rack lever.

Note. On early production engines, also remove bellcrank retaining spring. Remove screws and lockwashers securing bellcrank mounting bracket to engine, and remove bracket (fig. 108).

(3) Disconnect fuel return line from fuel filter.

(4) Disconnect fuel shutoff control. Remove cotter pin, castellated nut, washer and screw. Disconnect fuel shutoff valve.

(5) Disconnect fuel inlet line from fuel injector pump.

(6) Disconnect air compressor outlet line from air compressor.

(7) Disconnect tachometer flexible shaft. Refer to paragraph 134*b* for the removal of the tachometer flexible shaft.

(8) Disconnect the engine ground strap. Loosen the hex-head screw and slide the strap from under the head. Retighten the screw.

(9) Disconnect the generator-to-regulator cable. Disconnect the generator-to-regulator cable at the generator. Tie or tape the end of the cable to a portion of the engine to prevent damage to the cable when the engine is lifted out of the frame.

c. Disconnect Points at Front of Engine. Refer to paragraph 49*d* for disconnecting procedure at front of engine.

d. Disconnect Points at Right Side of Engine (fig. 110).

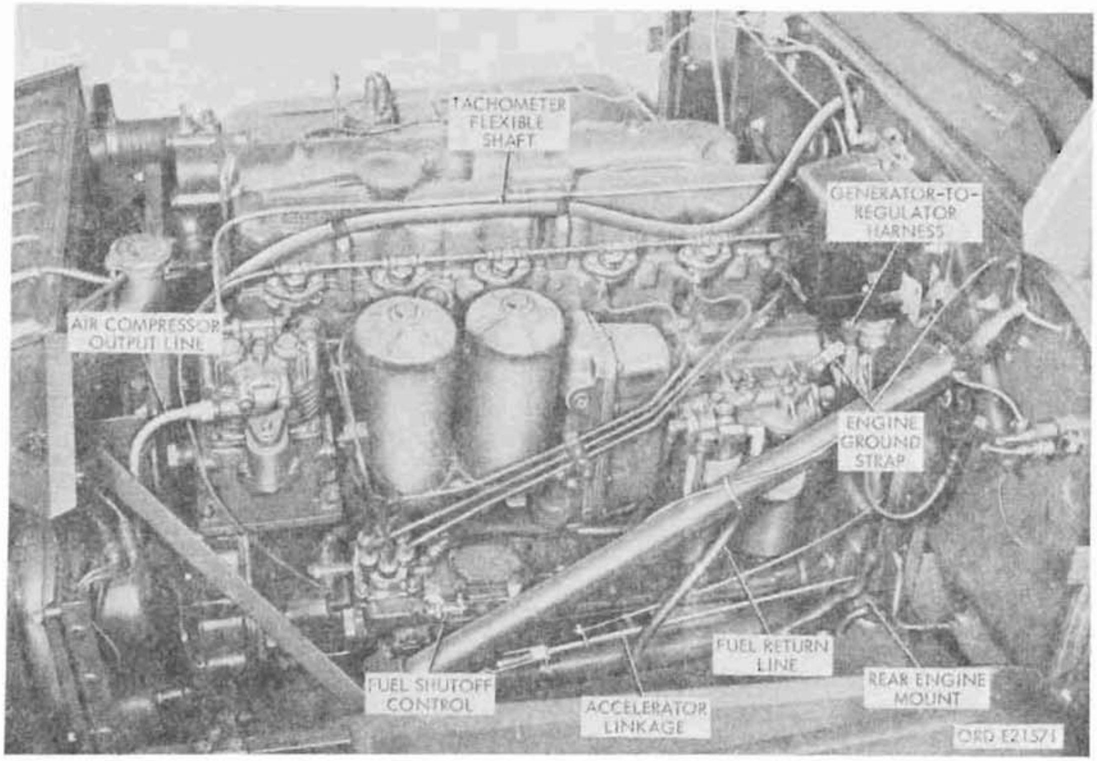

Figure 107. Disconnect points at left side of multifuel engine

(1) Remove air cleaner element and bracket (par. 67).

(2) Remove turbosupercharger inlet tube. Loosen clamp and remove turbosupercharger inlet tube.

(3) Disconnect exhaust pipe. Remove self-locking nuts on bolts securing exhaust pipe flange to exhaust pipe bracket. Separate flange from bracket and discard gasket.

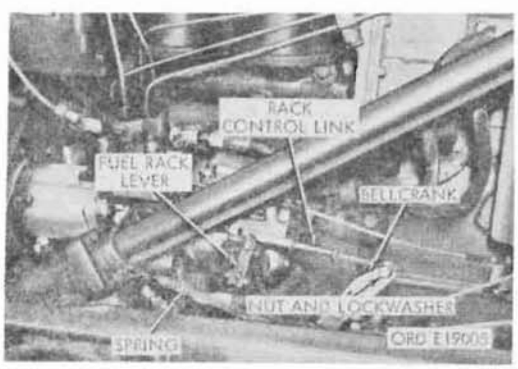

Figure 108. Accelerator linkage - early models

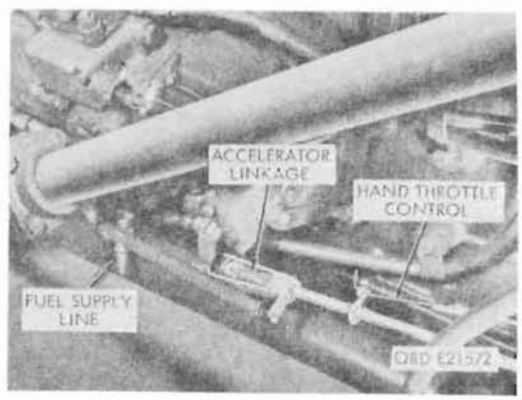

Figure 109. Accelerator linkage - later models

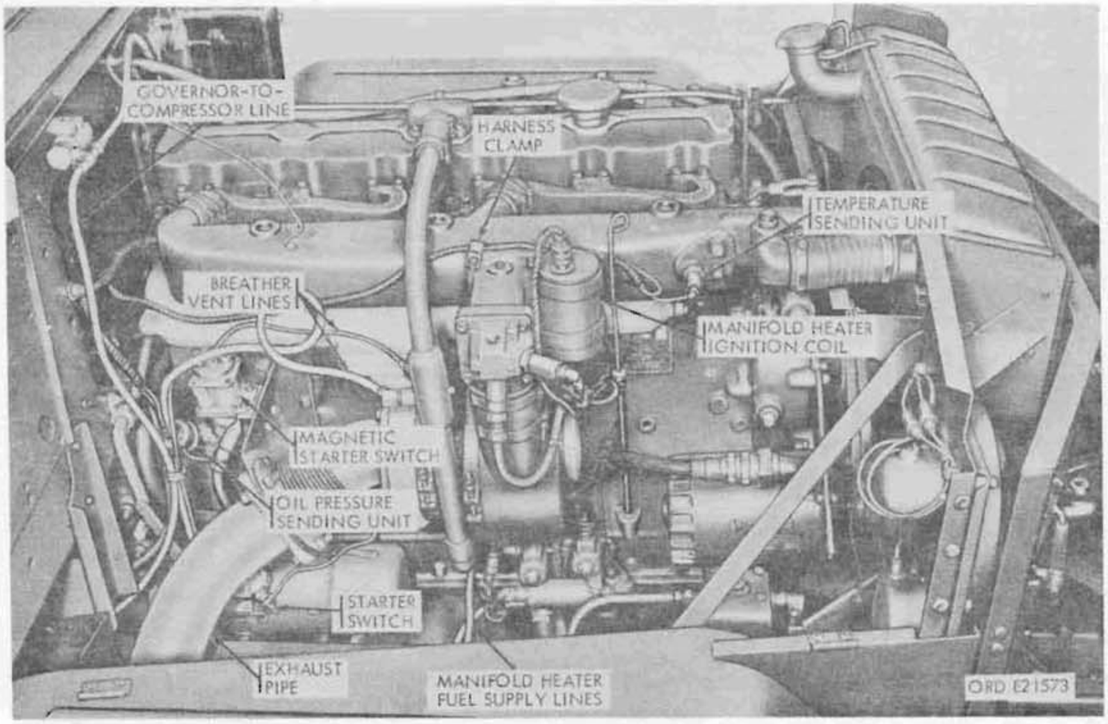

Figure 110. Disconnect points at right side of multifuel engine

(4) Disconnect breather vent lines. Disconnect fuel tank vent line and master cylinder vent line from crankcase breather tube.

(5) Disconnect air governor-to-air compressor line at air governor.

(6) Disconnect battery ground cable. Disconnect battery ground cable (fig. 153) at battery.

Caution: Be sure that battery ground cable is disconnected before disconnecting any other electrical leads.

(7) Disconnect starter electrical leads. Disconnect two electrical leads from starter switch. Disconnect engine ground strap from starter mounting stud.

(8) Disconnect two electrical leads from magnetic starter switch.

(9) Disconnect electrical lead at oil pressure sending unit.

(10) Disconnect electrical leads at temperature sending unit and at manifold heater ignition coil.

(11) Remove harness clamp. Remove nut and lockwasher securing harness clamp on water temperature sending unit harness to intake manifold elbow. Remove harness clamp from stud and reinstall nut and lockwasher.

(12) Disconnect manifold heater fuel supply and return lines.

e. Disconnect Points Inside of Cab. Refer to paragraph 49 f for disconnecting procedures inside of cab.

f. Disconnect Points Under Truck. Refer to paragraph 49 g for disconnecting procedures under the truck.

g. Remove Power Plant. Refer to paragraph 49 h for lifting of the power plant from the truck, except that lifting sling 4910-798-7584 should be used with the multifuel engine.

60. Installation

Refer to paragraph 50 for installation of the power plant into the truck.

Section XI. FUEL AND AIR INTAKE SYSTEM (GASOLINE)

61. Description and Data

a. Description.

(1) General. The fuel and air intake system is composed of the air cleaner, carburetor, carburetor controls and linkage, engine speed governor and governor valve, exhaust manifold heat-control valve and housing, fuel pump, fuel tank, fuel line, and hand primer pump, when present. M49, M49C, M50, M60 and M108 trucks are equipped with an engine auxiliary governor (fig. 111) consisting of the governor-drive unit and the governor slave unit. The drive unit is driven by a flexible shaft from an angle-drive adapter on the transfer power takeoff. The slave unit is secured to the throttle body that replaces the carburetor-mounting spacer.

(2) Air cleaner. The oil-bath-type air cleaner (fig. 112) is mounted on the right side of the firewall in the engine compartment. All the air for combustion passes through the air cleaner before entering the carburetor. Air, entering the cleaner through the side opening, passes into the oil chamber where most of the suspended dirt is deposited in the oil cup at the bottom. The air then passes through oil-saturated mesh and through the carburetor-intake hose to the carburetor. The breather system lines (par. 62) are connected to the air cleaner.

(3) Carburetor. The double venturi, downdraft carburetor with governor (fig. 113) is mounted on the exhaust manifold heat-control valve housing. This carburetor, with its governor control, is designed to maintain proper fuel mixture under all operating conditions.

(4) Carburetor controls and linkage. The carburetor controls consist of a choke control, throttle control, accelerator pedal, and linkage.

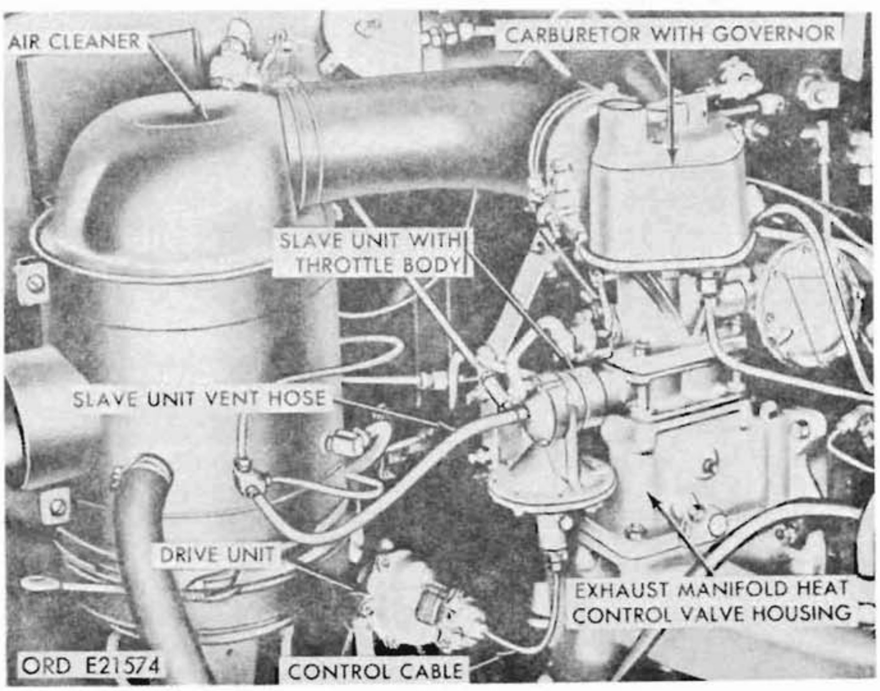

Figure 111. Engine auxiliary governor - installed

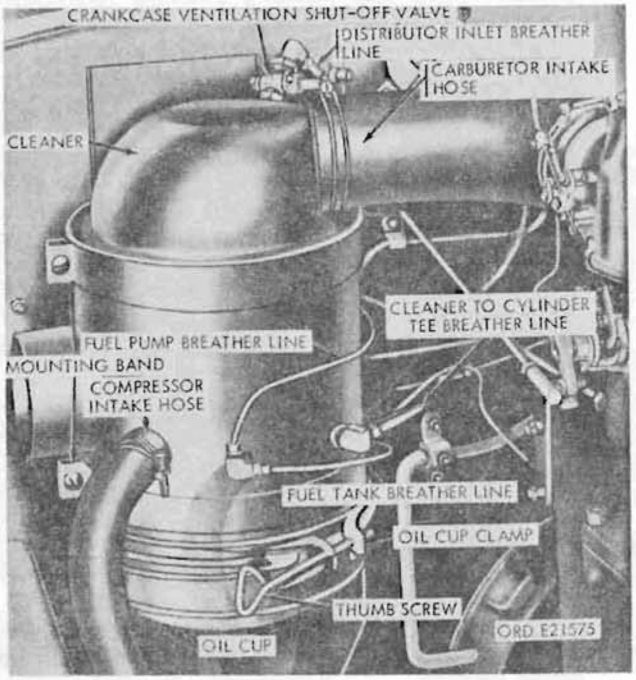

Figure 112. Air cleaner

(5) Engine-speed governor. The engine-speed governor is a mechanism to limit the engine speed to a maximum specified limit. It consists of two units: a diaphragm-operated carburetor governor (fig. 114), mounted on the left side of the carburetor; and the carburetor-governor valve, mounted on the front of the timing-gear cover (fig. 115). The valve, connected to the carburetor-throttle body by the valve-to-carburetor line, and to the governor by the valve-to-governor line, is driven by a camshaft gear and regulates the atmospheric air from the carburetor through the valve to the governor. Air is balanced in the governor against the manifold and carburetor suction to operate the carburetor throttle valve. Governed speed is set by adjusting the tension on the governor valve weight spring. The engine governor is sealed to prevent unauthorized adjustment.

(6) Exhaust manifold heat-control valve. The exhaust manifold heat-control valve housing (fig. 87) is mounted on the exhaust manifold. The upper portion of the valve housing provides direct passage for the fuel mixture from the carburetor to the intake manifold; the lower portion is open to exhaust gases in the exhaust manifold. An adjustable heat control valve in the housing permits setting of the valve (par. 46) for preheating the fuel-air mixture.

(7) Fuel pump. The diaphragm-type fuel pump (fig. 117), mounted on the left side of the cylinder block, is mechanically operated from the camshaft. The pump is equipped with a hand-operated priming lever which may be used to pump the fuel into the carburetor whenever the carburetor bowl is empty.

(8) Fuel tank. All model trucks except the M47, M59, M342 and M275 have the fuel tank (fig. 118) mounted below the right front corner of the body. The tank is supported by two brackets and secured by two mounting straps. The fuel tank on the M47, M59, M342 and M275

trucks is mounted on the left side of the truck below the cab. It is supported by three brackets and secured by three mounting straps. All tanks are vented to the air cleaner.

(9) Fuel lines. The fuel lines extend from the fuel tank to the fuel pump. The fuel-tank line is copper tubing from the tank to the fuel-line shutoff valve (fig. 119); and flexible line, covered with protective loom, from the valve to the pump. The shutoff valve is used to stop the fuel flow during maintenance of the fuel pump.

(10) Hand primer pump. The primer pump, when present, is a cylinder-and-piston type. It is mounted on the instrument panel and is manually operated. The pump draws fuel through the line from the fuel-line shutoff valve (fig. 119) and injects fuel into the priming nozzles at each cylinder.

(11) Engine auxiliary governor (fig. 111). The auxiliary governor, composed of slave and drive units, controls the engine speed during operating of the truck-mounted equipment on M49, M49C, M50, M60 and M108 trucks. The auxiliary governor operates from an angle-drive adapter on the transfer power takeoff through the flexible shaft to the drive unit. The shaft rotation causes the flyweights in the drive unit to move against the spring tension, causing the control cable to actuate the control valve in the slave unit. The control valve uses the engine manifold vacuum to position the throttle valve plates in the slave-unit throttle body, regulating fuel mixture flow from the carburetor to the engine intake manifold. Governed speed is set by adjusting the drive-unit spring tension (par. 249). The auxiliary governor is sealed to prevent unauthorized adjustment.

b. Data.

Air cleaner:
Make .... Donaldson
Model ON-E929

Carburetor with governor:
Make .... Holley
Model 885FFG

Numbers:
For vehicles without engine auxiliary governor R60Z-1A

For vehicles with engine auxiliary governor.......... R74Z-A

Engine speed governor valve:
Make .... Holley
Model HOL-79R207A

Carburetor controls:
Make .... Delco-Remy

Engine auxiliary governor angle driver adapter:
Make .... Stewart-Warner
Model 649-AL

Engine auxiliary governor drive unit:
Make .... Zenith
Model B-726-1

Engine auxiliary governor slave unit with throttle body:
Make .... Zenith
Model A-212-194

Engine auxiliary governor flexible shaft:
Make .... Stewart-Warner
Model 446128

Fuel pump:
Make .... AC
Model AC-1539542

Fuel tank:
Make......... Michiana Products Corp.
Models:
Right hand MPC-D9633
Left hand MPC-9530

Hand primer pump:
Make.................. Dole Valve
Model DV-PR4786

62. Air Cleaner (Fig. 112)

a. Servicing. To renew oil bath, support the oil cup and loosen the thumbscrew on the cup clamp to release the cup. Lower the cup to clear the air cleaner, lift out, and empty. Clean the cup with dry-cleaning solvent or mineral spirits paint thinner and refill with engine oil to the level indicated. Install the cup and tighten the clamp.

b. Removal.

(1) Support the oil cup and loosen the thumbscrew on the cup clamp until the cup can be removed from the cleaner. Remove the cup.

(2) Loosen the hose clamps and detach the carburetor-intake hose, and compressor-intake hose from the cleaner. Disconnect the breather lines (fig. 112) from the cleaner.

(3) Remove the screws from the mounting bands, spread bands, and remove air cleaner.

c. Installation.

(1) Place the air cleaner body in position within the mounting bands and position it so that the air intake port on the side faces outward at right angles to the truck side. Install the band-clamping screws and tighten.

(2) Install the carburetor-intake hose on the air cleaner top outlet, and tighten the hose clamp.

(3) Remove the fittings from the old air cleaner and install in the same relative position on the new cleaner. Connect the breather lines (fig. 112). Connect the compressor-intake hose, and tighten the hose clamp.

(4) Make sure the oil cup gasket is in good condition and properly positioned. Fill the air-cleaner cup with engine oil to the level indicated. Position it under air cleaner, and raise to contact with the air cleaner body. Support the cup and tighten the clamp.

63. Carburetor With Governor

a. Removal (Fig. 113).

(1) Loosen the hose clamp holding the carburetor-intake hose to the carburetor, and remove the hose from the carburetor.

(2) Disconnect the throttle control rod from the carburetor-throttle lever, and the choke control (par. 65) from the carburetor.

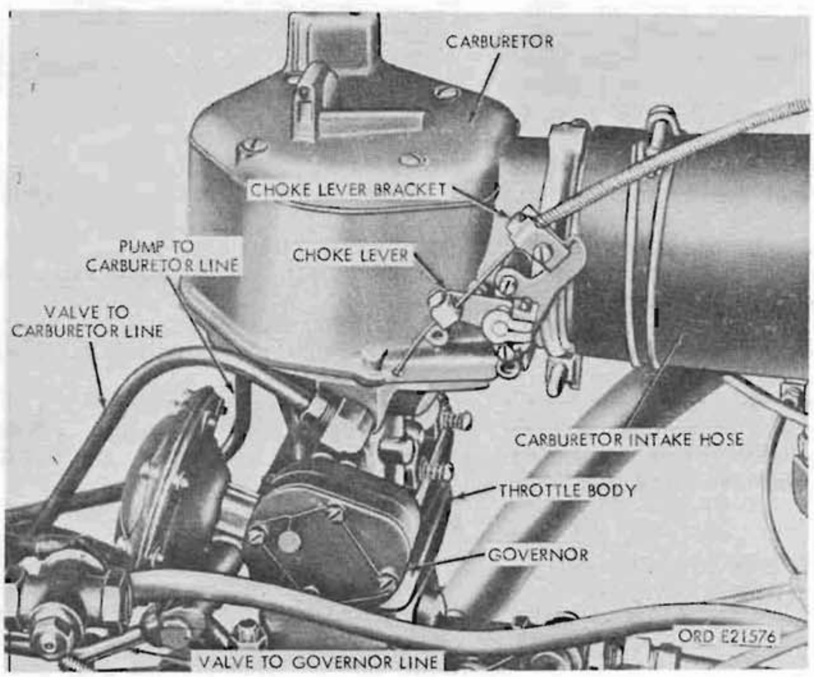

Figure 113. Carburetor with governor disconnect points

buretor choke valve plate is wide open with the control knob on the instrument panel pushed in. To adjust, loosen the clamping screw in the choke lever (fig. 116). With the choke control knob pushed in, tighten the clamp screw on the control wire when the carburetor choke plate is fully open.

(2) Removal. Loosen the clamp screws in the choke lever and the choke lever bracket (fig. 113), and pull the control free. Remove the nut on the reverse side of the instrument panel, holding the control to the panel, and pull the choke control out through the panel.

(3) Installation. Insert the choke control through the instrument panel, and install the nut and lockwasher holding the control to the panel. Position the control so that the lettering on the control knob is horizontal, and tighten the nut. Pass the control through the dash panel and secure to the choke lever bracket and the choke lever (fig. 113). Check the choke control adjustment ((1) above).

(4) Repair. Straighten or replace any broken or damaged parts, as necessary.

b. Throttle Control.

(1) Adjustment. The throttle control is in proper adjustment if the throttle return spring returns the throttle lever to idling position when the throttle control knob on the instrument panel is pushed in. To adjust control, loosen the connector holding hand-throttle control wire (fig. 79) to the throttle-control rod. See that the throttle lever (fig. 116) is in the idle position, and tighten the locking connector against the clip attached to the carburetor link.

(2) Removal. Remove the locking connector holding the control to the carburetor control link. Loosen the safety-nut clamping control in the special bolt, and pull the control from the dash panel. Remove the nut and lockwasher holding the throttle knob to the instrument panel, and pull the control out.

(3) Installation. Insert the control through the instrument panel, and install the lockwasher and nut holding the control to the panel. Position the knob with the lettering vertical, and tighten the control. Insert the free end of the control in the special bolt in the dash panel, and tighten the safety nut. Adjust the locking connector ((1) above).

(4) Repair. Weld, straighten, or replace broken or damaged parts as required.

c. Accelerator Pedal and Linkage.

(1) Adjustment. The accelerator linkage is in proper adjustment if the throttle return spring returns the throttle lever (fig. 116) to the idling position when no foot pressure is on the accelerator pedal. To adjust the linkage, adjust the length of the throttle control rod (fig. 80) or the accelerator pedal-lever rod by loosening the rod end joint jamnuts. Shorten or lengthen the rods until the throttle lever is in idling position. Tighten the jamnuts securely.

(2) Repair. Repair of the accelerator pedal linkage consists of straightening, welding, or replacing the broken or damaged parts as necessary. It is not necessary to remove the complete linkage to repair or replace the part.

(3) Removal.

(a) Remove the cotter pin from the pin holding the pedal to the pedal-bracket on the cab floor, remove the pedal rod from the pedal, and remove the pedal.

(b) Remove the cotter pin holding the pedal rod in the accelerator-pedal lever and remove the rod.

(c) Remove the safety nut holding the accelerator-pedal lever rod (fig. 79) to the pedal lever, and remove the rod from the lever. Remove the cotter pin holding the lever to the lever bracket, and remove the lever and plain washers.

(d) Disconnect the throttle return spring from the cross-shaft bracket. Remove the safety nut holding the pedal-lever

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rod to the cross-shaft left lever, and remove the rod.

(e) Loosen the connector holding hand-throttle control wire to the throttle-control rod, and remove the wire.

(f) Remove the safety nuts holding the throttle-control rod (fig. 80) to the throttle lever and the cross-shaft right bracket, and remove the rod.

(g) Remove the safety nuts and screws holding the cross-shaft brackets to the firewall and remove the shaft lever and brackets.

(4) Installation.

(a) Install the cross-shaft levers and the brackets on the firewall with two hex-head screws and safety nuts.

(b) Install the throttle-control rod (fig. 80) on the throttle lever and cross-shaft right lever with one-fourth-inch safety nut for each end of rod. Connect and adjust the throttle control rod (b (1) above).

(c) Connect the pedal-lever rod to the cross-shaft left bracket with one-fourth-inch safety nut. Connect the return spring to the cross-shaft bracket.

(d) Install the accelerator-pedal lever in the lever bracket with two plain washers and cotter pin. Connect the accelerator-pedal rod (fig. 79) to the lever with 1/4-inch safety nut.

(e) Connect the pedal rod to the pedal lever with a cotter pin.

(f) Position the accelerator pedal on the pedal rod, and install the pedal in the pedal bracket with the pedal pin and cotter pin.

66. Fuel Pump

a. Removal (Fig. 117). Turn off the fuel-line shutoff valve (par. 74). Disconnect the fuel-pump flexible line, fuel-pump breather line, when present, and the pump-to-carburetor line at the fuel pump. Remove the pump and discard the gasket.

b. Installation (Fig. 117). Position the pump on the mounting boss on the engine, using a new gasket. Secure the pump with two 85,000-psi yield strength capscrews and lockwashers. Connect the flexible line, fuel-pump breather line, and pump-to-carburetor line at the fuel pump. Turn on the fuel-line shutoff valve.

67. Fuel Tank

Warning: Do not permit smoking, sparks or open flame within 50 feet of vehicle during any operation involving open fuel tanks, fuel line removal, or fuel draining.

Note. Refer to TM 9-2320-209-10 for instructions on removal of fuel tank filler cap.

a. Removal (Fig. 118). Drain the fuel tank. (Refer to TM 9-2320-209-10.) Loosen the nuts at the bottom ends of the holding straps. Remove the screws and nuts at top ends of the holding straps, and slide the tank out on the fuel tank supports to clear the disconnect points from the body. Disconnect the fuel-gage cable, fuel tank line, and fuel-tank breather line from the top of the tank. Remove the tank. (Refer to TB ORD 524 for cleaning and preserving of fuel tank(s).)

b. Installation (Fig. 118). Position the fuel tank on the supports. Connect the fuel-gage cable, fuel tank line, and fuel-tank breather line to connections at the top of the fuel tank. Place the holding straps in position and secure

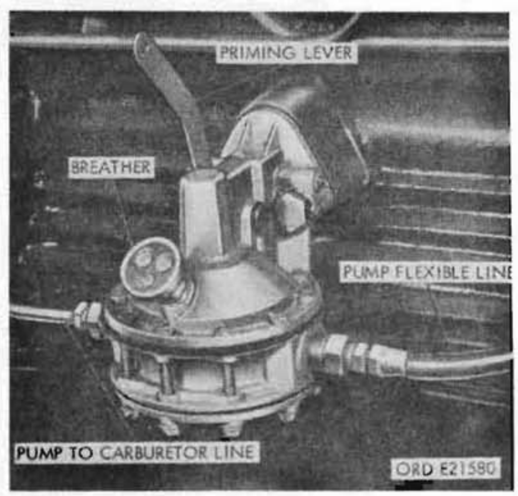

Figure 117. Fuel pump installed

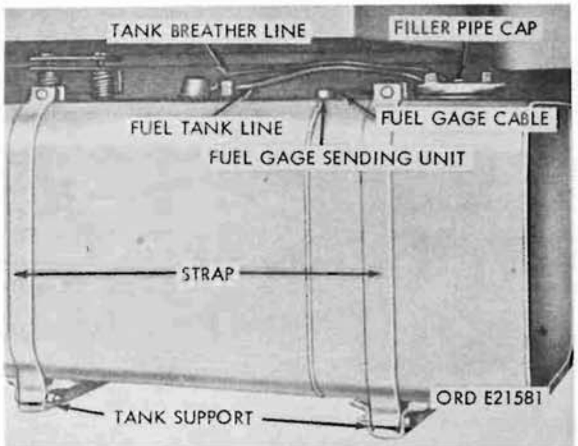

Figure 118. Fuel tank disconnect points.

with 85,000-psi yield strength hex-head screws and ⅜-inch safety nuts at top, one in each strap. Tighten the safety nuts at the bottom end of the holding straps.

68. Fuel Tank Lines and Fittings

a. Replacement.

(1) When replacing any lines, fittings, or shutoff valve, coat all threaded elbow, tee, or valve connections with liquid type gasket cement before installation. Tighten all connections. Secure all lines with clips provided.

(2) To replace the shutoff valve, first drain the fuel tank (TM 9-2320-209-10). Disconnect the fuel tank line(fig. 118), fuel pump flexible line, and primer pump line, where present, from the valve. Remove the nut and screw securing the valve to the bracket, and remove the valve (fig. 119). Install the new valve on the bracket with hex-head screw and safety nut. Connect the fuel tank line, fuel pump flexible line, and primer pump line to the valve. Fill the fuel tank (TM 9-2320-209-10).

b. Repair. Repair damaged ends by cutting off damaged portion and reflaring, if length of line permits. Otherwise, replace complete line. Do not attempt to repair flattened or punctured lines.

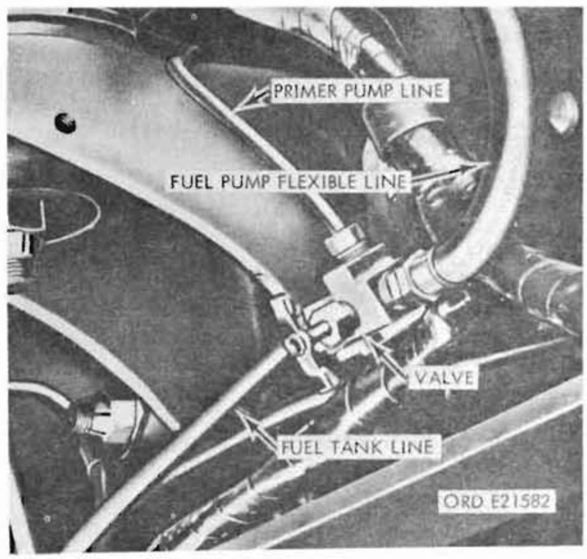

Figure 119. Fuel line shutoff valve.

Section XII. FUEL AND AIR INTAKE SYSTEM (MULTIFUEL)

69. Description and Data

a. Description. This section contains the description of the engine fuel and air intake systems, also the procedures for removal and, where applicable, the procedures for servicing the engine fuel-intake heater, fuel and oil filters, fuel and oil (external) lines and fittings, fuel shutoff valve and control cable. The engine fuel system has an electrically driven fuel pump in the fuel tank, which pumps fuel to the primary fuel filter located on the right frame rail of the vehicle. The fuel supply pump of the injection pump assembly pumps fuel from the primary fuel filter through the secondary and final fuel filters to the distributor-type injector pump which supplies fuel to the cylinders at high pressure. The air intake system includes an intake manifold heater which heats the inducted air during cold-weather starting and warmup operations of the engine. The fuel for the manifold heater is taken directly from the vehicle fuel tank. The system is energized by operating a momentary on-off toggle switch on the vehicle instrument panel. An electrical rotary pump delivers the fuel from the heater fuel filter through the nozzle supply solenoid valve to the nozzle in the heater body and fuel is sprayed into the intake manifold. At the same time, the heater ignition coil and spark plug are energized and a flame is started in the manifold. The quantity of fuel sprayed into the manifold is controlled by the return flow nozzle which ensures an optimum fuel-air mixture in the manifold.

b. Data.

Fuel System:	
Type of system	American Bosch PSB fuel injection system
Model	PSB6A85GH-52SOB
Fuel:	
Type of fuel	specification
Compression-ignition	MIL-F-4512A
Diesel	VVF-800 (DF-A arctic) (DF-1 winter) (DG-2 regular)
Gasoline (military grade)	MIL-G-3056A
JP-4	MIL-J-5624D

70. Air Cleaner

a. Removal.

(1) Remove rain sheild hood. Refer to TM 9-2320-209-10.

(2) Loosen the screw on the clamp securing the air intake flexible tube to the air cleaner (fig. 120).

(3) Remove the four nuts, washers, and screws securing the air cleaner to the firewall.

b. Service. Wash with detergent in cool to lukewarm water. Do not use gasoline or other solvents. Soak element five to ten minutes, then "slosh" in solution. Rinse with clean water, shake water from element, and let dry. After washing carefully inspect for evidence of holes, tears, or seal damage. If element is serviceable, return to stock.

c. Repair. Repair the air cleaner by replacing damaged or unserviceable components.

d. Installation. Install the air cleaner and components, using the reverse procedure of removal.

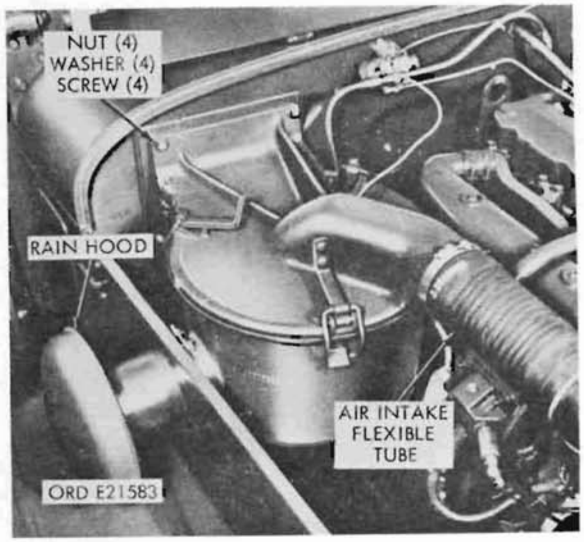

Figure 120. Air cleaner.

71. Accelerator Controls and Linkage

a. Removal.

(1) Disconnect the throttle control wire from the fuel supply unit (fig. 121).

Note. Newer vehicles do not have a bellcrank. Omit (2) and (3) below.

(2) Remove the screw securing the rack control link to fuel rack lever and disconnect bellcrank-retaining spring.

(3) Remove the nut and screw securing the bellcrank to linkage mount.

(4) Remove cotter pin from accelerator pedal lever and remove pedal from pedal lever.

(5) Remove nuts and screws securing the linkage mount to the floorboard and remove the accelerator linkage.

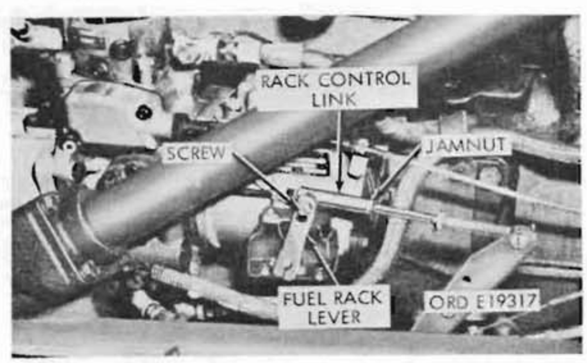

Figure 121. Accelerator linkage adjustment.

b. Installation. Install items in reverse order of removal.

c. Accelerator Linkage Adjustment. Disconnect the rack control link from the fuel rack lever (fig. 121), hold the accelerator pedal down on the stop. With the fuel rack lever completely forward, adjust the rack control linkage to hold the fuel rack in the forward or full open position.

d. Fuel Shutoff Valve Adjustment. Push engine stop knob (fig. 168) completely forward on the instrument panel. Loosen the locking screw on the fuel shutoff control wire (fig. 123) and adjust the wire so that the fuel shutoff valve is fully open (full "IN" position). Tighten the locking screw.

72. Engine Manifold Heater Replacement

a. Removal.

(1) Disconnect ignition lead from spark plug and remove spark plug and gasket. Discard gasket (fig. 122).

(2) Disconnect fuel supply and fuel return lines from heater nozzle and remove heater nozzle.

(3) Disconnect power supply lead and ignition lead from ignition unit.

(4) Remove nuts and lockwashers securing ignition unit to ignition unit bracket and remove ignition unit.

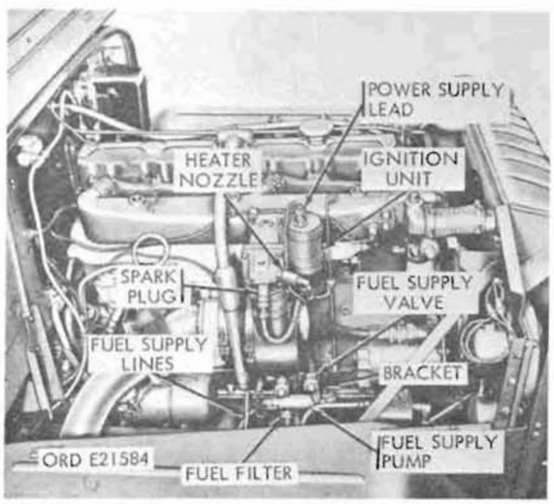

Figure 122. Engine manifold heater replacement.

(5) Disconnect fuel supply lines and electrical lead from fuel supply pump.

(6) Remove nuts, lockwashers, and bolts securing supply pump to bracket and remove supply pump.

(7) Disconnect heater fuel filter inlet and outlet lines. Remove screws and lockwashers securing filter to bracket and remove ground wire and fuel filter.

(8) Disconnect electrical lead and fuel supply valve inlet and outlet lines from the heater fuel supply valve.

(9) Remove three capscrews and lockwashers securing the manifold heater fuel pump filter bracket to the crankcase. Remove the bracket with the solenoid valves attached.

(10) Remove two machine screws and lockwashers securing each fuel solenoid valve to the manifold heater fuel filter bracket.

(11) Remove fuel solenoids.

b. Installation. Install engine manifold heater in reverse order of removal.

73. Manifold Heater Fuel Lines

a. Removal. Disconnect the fuel line fittings at both ends of the line. Tag each line, if necessary, to aid in correct replacement.

b. Installation. Coat the threaded portion of each fitting with liquid-type gasket cement before assembly. Install fuel lines in the reverse order of removal. Do not overtighten fittings.

74. Engine Fuel Lines and Connections (Low Pressure)

a. Removal. Disconnect the low pressure fuel line fittings at both ends and remove the fuel lines (fig. 123).

b. Installation. Install the low pressure fuel lines and fittings in reverse order of removal. Coat all threaded connections with liquid-type gasket cement before assembly.

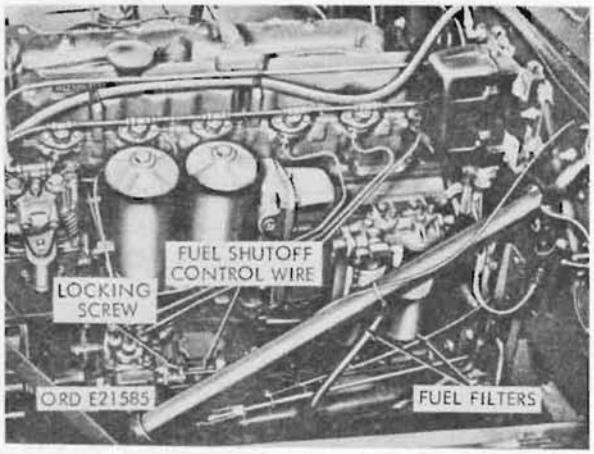

Figure 123. Engine low pressure fuel lines and fittings.

75. Engine Fuel Lines and Connections (High Pressure)

Warning: **The penetrating power of atomized fuel under pressure is sufficient to puncture the skin and may cause blood poisoning. Use caution when working on or near high pressure fuel lines.**

a. Removal.

(1) Slip the six dust caps from the fuel injection tube nuts at the fuel injection pump distributor head (fig. 124).

(2) Disconnect cylinders Nos. 1, 2 and 3 fuel injection tube assemblies from the fuel injection pump distributor head.

(3) Remove two self-locking nuts, flat washers, and capscrews securing the outer clamps to the inner clamps and remove the clamps.

(4) Disconnect the cylinders Nos. 4, 5, and 6 fuel injection tube assemblies from the fuel injection pump assembly.

(5) Plug the fuel injection tube openings in the injection pump distributor head to prevent entry of dirt.

(6) Disconnect fuel injection tubes from fuel injector nozzle holders and remove tubes.

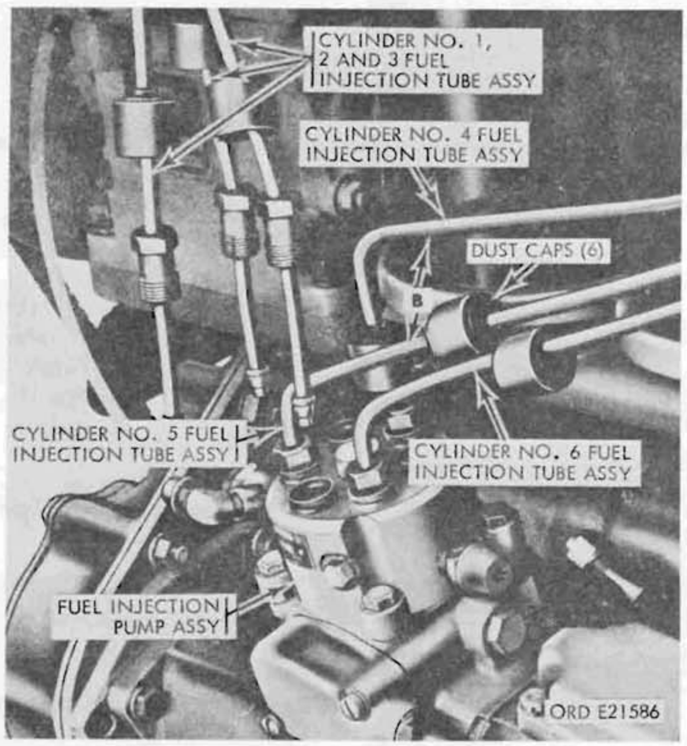

Figure 124. Disconnecting or connecting fuel lines from injection pump assembly and fuel filter assembly.

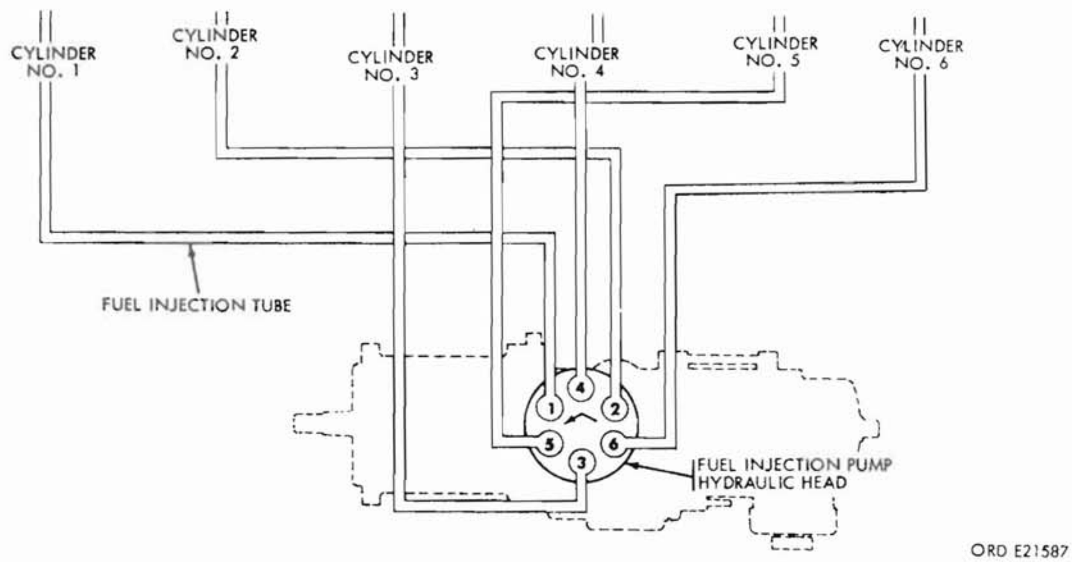

Figure 125. Fuel injection tube and injection pump ports identification.

b. *Installation.*

Note. The fuel injection pump assembly fuel discharge sequence is counterclockwise around the distributor head in the following order: cylinders Nos. 1, 5, 3, 6, 2, and 4. Refer to figure 125 for correct location.

(1) Connect the fuel injection tube to the fuel injector nozzle holder in cylinder No. 1. Remove the dust cover from the No. 1 port opening in the pump distributor head and connect the tube (fig. 124).

(2) Repeat the procedure in (1) above, for the fuel injection tubes in cylinders and ports Nos. 2 and 3 (fig. 124).

(3) Install two fuel injection tube clamps and secure in position with capscrews, flatwashers, and self- locking nuts. Slide the dust caps over the tube nuts and injection pump ports.

(4) Repeat the procedure in (1) above, for the fuel injection tubes in cylinders and ports Nos. 4, 5 and 6.

(5) Install two capscrews, plain washers, and self-locking nuts to secure the fuel injection tube inner and outer clamps together.

(6) Move the fuel injection tube dust caps down over the tube nuts and fuel injection pump ports.

75.1. Fuel Tank Assembly Replacement.

Warning: Do not permit smoking, sparks, or open flame within 50 feet of vehicle during operation involving open fuel tanks, fuel line removal, or draining fuel from tank.

a. *Removal.*

(1) Drain fuel tank in accordance with TM 9-2320-209-10.

(2) Disconnect all fuel lines and electrical cable connectors from fuel tank and pump (fig. 126).

(3) Loosen nut at bottom end of each tank strap (fig. 118). Remove screw and nut at top end of each strap and lower straps. Remove tank.

Note. To facilitate the removal of fuel tank on M275A1 and A2 trucks, the left side of cab must be raised as described in (4) below.

(4) Loosen the two cab rear mounting screws as far as possible without removing nuts. Loosen left front cab mounting screw. Loosen steering

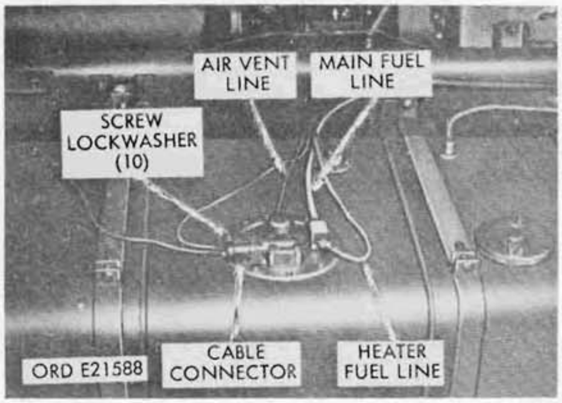

Figure 126. Fuel tank fuel pump installed.

column clamp inside of cab. Using pry bar, raise left side of cab sufficiently to facilitate the withdrawal of tank from under cab. Place blocks between cab back panel and frame rail, and cab front sill and frame rail to support cab in raised position.

b. Installation. Install fuel tank assembly in reverse order of removal. Tighten tanks straps securely and replenish fuel in tank. After installing tank on M275A1 and A2 trucks, tighten left front cab mounting screw securely. Tighten two cab rear mounting screws until springs have compressed length of 1-25/32 inches. Tighten steering column clamp.

76. Fuel Tank Fuel Pump Assembly Replacement (Fig. 126).

Note. Before replacing the fuel pump assembly on the M109A3, M275A1 and A2 trucks, the fuel tank must be removed. Refer to paragraph 75.1 for fuel tank removal and installation instructions.

a. Removal.

(1) Disconnect cable connector, main fuel supply and air vent lines, and heater fuel line, if present, from pump.

(2) Remove ten (10) mounting screws and lockwashers. Lift fuel pump assembly from the fuel tank and discard pump mounting gasket.

b. Installation.

Warning: Great care must be taken during the reinstallation of the pump into the fuel tank to assure the shielded metal electrical covering is not scraped against the sharp edges of the tank opening causing a fraying or damaged condition which might later result in an electrical wire failure.

Note. Before installing a new pump assembly, check pump depth (fig. 126.1) for particular truck application. The pump depth for the M275A1 and A2 trucks is 14-3/16 inches, and 15-3/16 inches for all other M44A1 and A2 series trucks. If required, adjust pump depth (1) below.

(1) Remove the screw, lockwasher, and nut attaching pump to each adjusting bracket (fig. 126.1), and adjust pump to proper depth for particular truck application. Reinstall pump mounting screws, lockwashers, and nuts after adjustment is complete.

(2) When installing pump assembly (10947358-3), remove the existing vent line elbow from this pump and replace with vent elbow from pump being replaced.

(3) Install fuel pump assembly in reverse order of removal, after installing new pump mounting gasket.

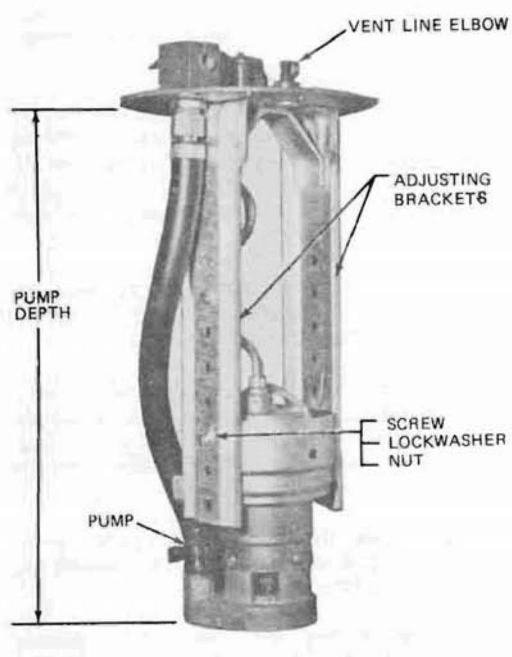

Figure 126.1. Fuel tank fuel pump depth adjustment.

76.1. Fuel Tank Fuel Pump Fuse Replacement (Fig. 126.2).

a. Description. A 2-ampere-automotive-type fuse is used to protect the fuel pump from short circuits. The fuse and fuse holder are encased in the fuel pump terminal cover mounted to the fuel pump mounting plate.

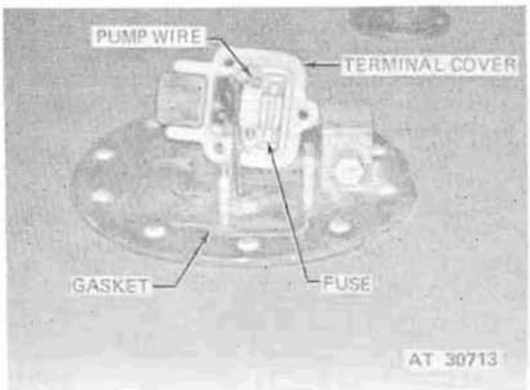

Figure 126.2. Fuel tank fuel pump fuse.

b. Removal.

(1) Disconnect electrical connector from fuel pump.

(2) Straighten seal retainer tab and remove seal. Discard seal.

(3) Remove three nuts and lockwashers securing terminal cover to pump mounting plate.

(4) Lift terminal cover from mounting studs. Disconnect pump wire from fuse block and remove and discard cover gasket.

(5) Remove fuse from fuse holder.

c. Installation. Install fuse and terminal cover in reverse order of removal, being certain to install a new cover gasket and seal. After installing new cover gasket, attach pump wire to fuse block.

77. Engine Fuel Filters

a. Inspection.

(1) Open drain valves on all fuel filter (fig. 127) and drain fuel into an approved container.

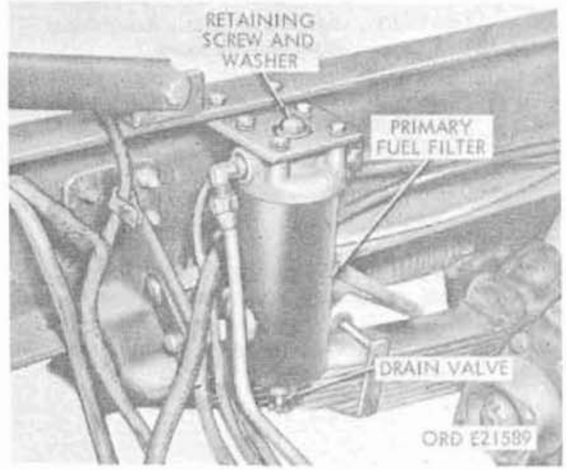

Figure 127. Primary fuel filter

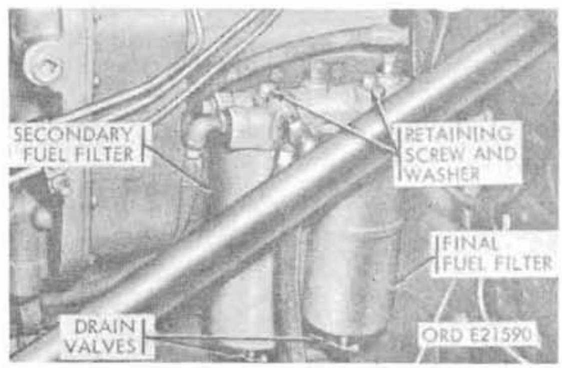

Figure 128. Engine fuel filter element replacement.

Note. The primary fuel filter is mounted to the frame located under engine generator.

(2) Do not drain filters completely. Drain sufficient quantities to remove water and impurities only. If large quantities of water or impurities are found in the fuel filters, remove the filter elements and replace with a new filter element and gasket.

b. Filter Element Replacement.

Note. Primary, secondary and final fuel filter element replacement procedures are similar. Use the following procedure.

(1) Open drain valves on primary, secondary, and final filters, and drain fuel into an approved container.

(2) Remove the filter retaining screws and washers and remove the filter housings. Discard gaskets.

(3) Remove and discard the fuel filter elements and gaskets from the housings.

(4) Clean all three housings in dry cleaning fluid or mineral spirits paint thinner. Keep items covered until ready for installation to prevent contamination from dust and dirt.

(5) Install new fuel filter elements and gaskets, in reverse order.

(6) Close drain cocks and purge trapped air from low pressure system as follows: Turn accessory switch "on". Open two bleeder valves on top of secondary and final filter head. Allow in-tank fuel pump to fill the three filter housings. Open and close bleeder valves until air bubbles disappear. Close valves and tighten. Start engine and check for leaks. With engine running, recheck for air bubbles at bleeder valves.

Section XIII. EXHAUST SYSTEM (GASOLINE)

78. Description

The exhaust system consists of four sections; the front exhaust pipe, rear exhaust pipe, muffler, and tailpipe. The front exhaust pipe is joined to the exhaust manifold by a flange joint, fitted with a gasket, and secured with three bolts and nuts. The front exhaust pipe is secured to the frame side member by means of the rear exhaust pipe bracket on all models except M47, M59, M60, M108, and M342. The rear exhaust pipe is joined to the front exhaust pipe by the exhaust pipe flange and the exhaust pipe gasket. One U-bolt-type muffler-to-exhaust pipe clamp secures the rear pipe to the muffler. The muffler is secured to the muffler support by the muffler-to-support clamp. The tailpipe is secured to the muffler by one U-bolt-type muffler-to-tailpipe clamp and is secured to the frame side member by means of a tailpipe bracket. Mufflers on fuel and tractor trucks are of flame- or spark-arresting-type and have drain plugs (fig. 294) in place of drain holes. The M50 truck is equipped with exhaust bypass and bypass fording valves (figs. 129 and 130) for controlling the exhaust heating of the water tank.

79. Exhaust Pipes

a. Removal. Remove three nuts and screws at flanges between the front exhaust pipe and the exhaust manifold (fig. 131), and separate the pipe from the manifold. Discard the gasket. Loosen three nuts and screws holding the rear exhaust pipe flange to the front exhaust pipe flange. Turn the rear flange to free the front pipe and discard the gasket. Loosen the U-bolt on the muffler-to-exhaust pipe clamp (fig. 294) securing the rear pipe to the muffler. Remove the screw and nut holding the rear pipe in the rear exhaust pipe bracket, and remove the rear pipe. Remove the flange from the rear pipe only if necessary.

b. Installation (Fig. 131). Install the flange (if removed) on the rear pipe. Position the rear pipe in the pipe bracket and front end of the muffler. Install the hex-head capscrew and safety nut in the bracket, but do not tighten. Position the U-Bolt clamp securing the pipe to the muffler, but do not tighten the nuts. Connect the front pipe to the exhaust manifold, using a new exhaust pipe gasket and the three hex-head split lockwasher screws and safety nuts, but do not tighten the nuts. Install a new gasket between flanges of the front and rear pipes, bring the flanges together, and turn the rear flange to engage the three screws in the front flange. Tighten the nuts securing the front pipe to the exhaust manifold, front pipe to rear pipe, rear pipe to muffler, and rear pipe to the rear exhaust pipe bracket in the order named.

80. Muffler

a. Removal. Remove tailpipe (par. 79). Loosen U-bolt clamp securing the muffler to rear exhaust pipe. Remove two nuts and screws from the muffler-to-support clamp holding the muffler, and pull the muffler from the exhaust pipe. Remove muffler from clamp.

Note. When removing old muffler 7521752 it is necessary to install a new muffler 8345253 and replace the front and rear air

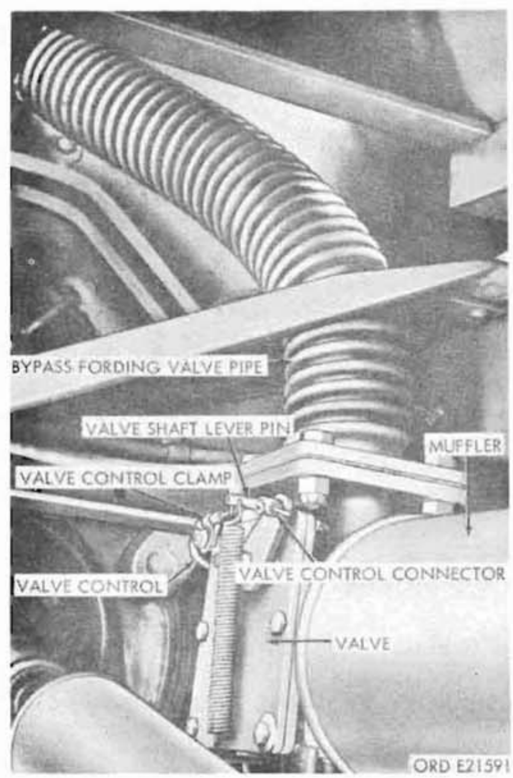

Figure 129. M50 bypass valve

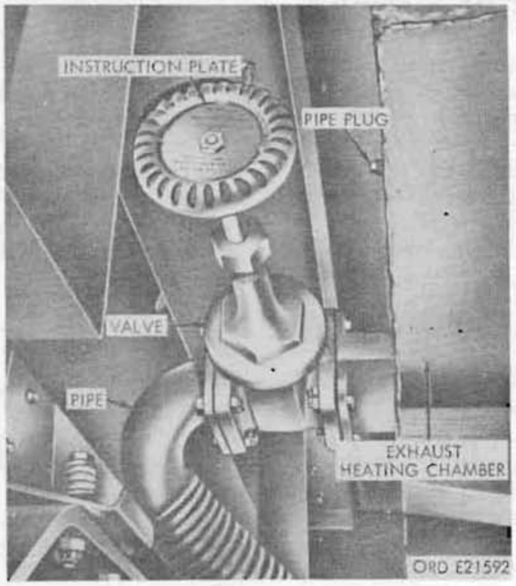

Figure 130. M50 exhaust bypass fording valve

reservoir supports with support 8332528 and spacer 8345250. These added parts are to provide added clearance between the muffler and drive shaft.

b. Installation. Install muffler (fig. 294) in the muffler-to-support clamp with muffler end opening over the rear exhaust pipe. Secure muffler in the clamp with two hex-head screws and safety nuts. Secure the rear exhaust pipe to the muffler by tightening the U-bolt clamp. Install tailpipe (par. 79).

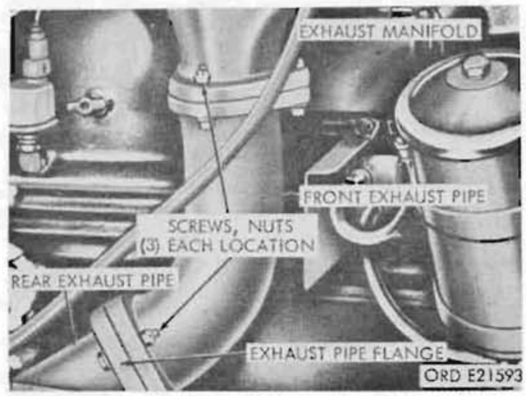

Figure 131. Exhaust pipe disconnect points

Section XIV. EXHAUST SYSTEM (MULTIFUEL)

81. Description

The engine exhaust gases drive the engine air turbosupercharger which is lubricated by the engine oil system. External oil lines are provided to supply and drain the necessary lubricating oil. The exhaust gases from the turbosupercharger are channeled through an exhaust pipe that extends along the right frame channel of the vehicle to the rear of the front tandem axle wheel where it is expelled to the atmosphere.

82. Exhaust Pipe

a. Removal. Remove air cleaner (par. 70).

(1) Remove three safety nuts, lockwashers and screws securing the exhaust pipe to the bracket on the engine. Discard the gasket between the exhaust pipe and the exhaust flange and bellows (fig. 132).

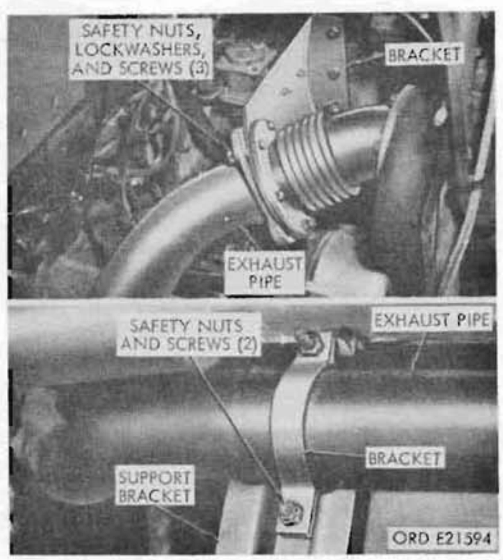

Figure 132. Exhaust pipe removal

(2) Remove safety nuts, screws and bracket securing exhaust pipe to exhaust on battery box support bracket.

(3) Remove safety nuts, screw and bracket securing exhaust pipe to bracket on the frame and remove exhaust pipe.

b. Installation. Install the exhaust pipe in reverse order of removal.

Section XV. COOLING SYSTEM

83. Description and Data

a. Description.

(1) General. The sealed-type cooling system consists of the radiator, fan, drive belts, thermostat, water pump, temperature gage, pressure-type filler cap, thermostat bypass line, hose lines, and fittings connecting the radiator to the engine and water pump. Water is drawn from the bottom of the radiator by action of the water pump; it is circulated through the engine, and returned to the radiator through upper connections. Air is drawn through the radiator core by the fan and by motion of the truck, and cools the water to maintain correct engine operating temperature.

(2) Radiator. The radiator (fig. 133) consists of a fin-and-tube core, upper and lower tanks, draincock, coolant level cock, pressure-type filler cap, and overflow tube. The radiator is mounted in a vertical position at the front of the engine, and may be replaced while the engine is in the truck. Later production vehicles are not equipped with the radiator upper shield.

(3) Fan and drive belts. The five-blade fan is mounted on the fan-and-water-pump pulley hub, and is driven by two V-belts from the crankshaft pulley. The same belts also drive the water pump and generator. On older vehicles, the fan has been modified or changed to a later type to eliminate possible interference between the fan blades and radiator core.

(4) Water pump. the centrifugal-type water pump (fig. 137) is mounted at the front of the engine, and forces coolant

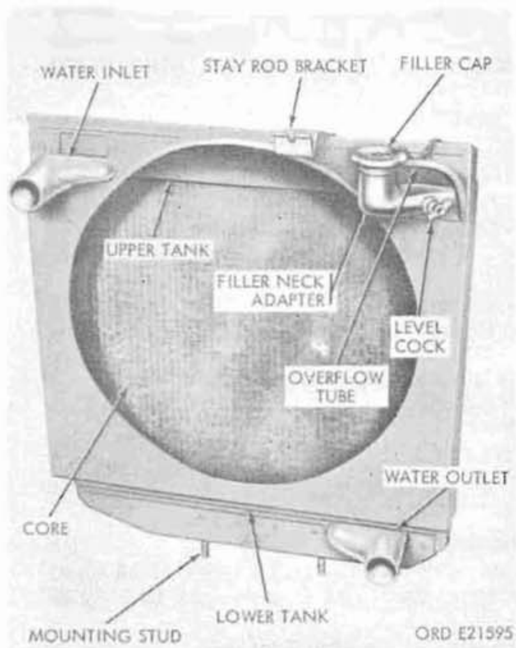

Figure 133. Radiator - rear view

through the water passages in the engine, radiator, and connections.

(5) Thermostat. The bellows-type thermostat (fig. 136) is mounted in the end of the water manifold, contains a restriction valve, sensitive to temperature, which opens gradually as the engine temperature increases. The valve in the thermostat starts to open at approximately 160° F.; the valve remains closed, eliminating the flow of coolant through the radiator. The bypass line around the thermostat permits a small circulation of coolant through the engine water passages until normal oper-

ating temperature is reached and the thermostat opens to permit full circulation of coolant.

b. Data.

Cooling system capacity:
- Gasoline . . . . 22 qt
- Multifuel . . . . 34 qt

Thermostat:
- Starts to open . . . . 160^{o} F
- Fully opened . . . . 185^{o} F
- Make . . . . Harrison Radiator
- Model HR-3125363

Water pump:
- Make . . . . Reo Motors, Inc.
- Model RC-1016A7

Radiator:
- Make . . . . Modine Mfg Co.
- Model:
  - Gasoline MO-AD-ADS109
  - Multifuel SPR9260-8

Fan and water pump drive belt (set of two matched belts):
- Make . . . . Reo Motors, Inc.
- Model RC-1030A7
- Type . . . . notched V

Radiator filler cap:
- Opening pressure . . . . 6-1/2 to 8 psi
- Opening vacuum . . . . 0 to 1/4 psi

84. Servicing of Cooling System

a. General. Responsibility of maintaining coolant level and installation of season anti-freeze solutions is assigned to the operator of the vehicle. When the condition of the cooling system indicates that flushing or cleaning is necessary, or leakage is indicated, responsibility is assigned to the organizational maintenance for these operations.

b. Flushing and Cleaning. Refer to TM 9-2320-209-10 for the draining and filling procedure and the location of the draincocks. Refer to TB ORD 1028 for the correct procedure to flush and clean the cooling system.

c. Sealing Minor Leaks. Leaks should be investigated and components tightened, repaired or replaced as required.

85. Radiator and Hoses

a. Removal.

(1) Tilt brush guard. Loosen two safety nuts on screws securing the brush guard braces (fig. 134), one at each guard inner vertical bar, and remove the braces from the guard. Tilt the guard forward.

Note. On trucks with front winch, complete removal of brush guard may be necessary. Refer to paragraph 49 d.

(2) Remove radiator. Drain the cooling system. Loosen the clamps on the radiator inlet and outlet hose at the radiator (fig. 80) and pull both hoses free. Loosen the nut on the radiator stay rod at radiator end of the rod, and remove the rod from the radiator, one on each side. Remove two nuts, washers, and springs from the engine front mounting support (fig. 135). Lift off the radiator and remove the mounting shims.

b. Installation.

(1) Install radiator. Position the two mounting shims on the engine front mounting support. Place the radiator on the support with mounting studs (fig. 135) through the holes in the shims and support. Install the mounting spring, plain washer, and safety nut on each stud. Tighten the nuts evenly and securely, but do not tighten enough to completely compress the springs. Connect the two bond straps at the bottom of the radiator, one on each side with the external-teeth lock-

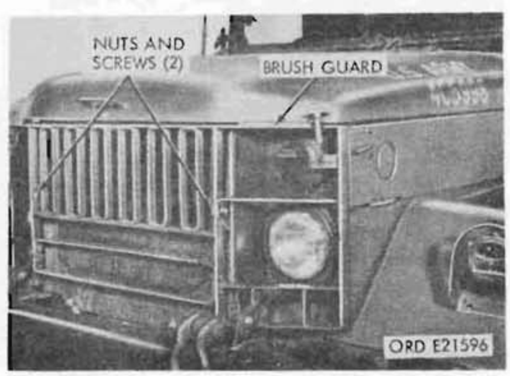

Figure 134. Brush guard - installed

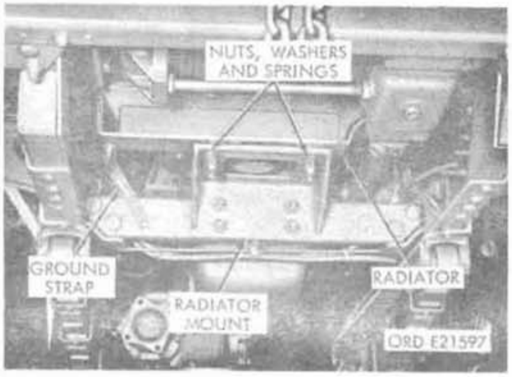

Figure 135. Radiator mounting studs

washer hex-head screw and the safety nut for each strap. Connect the radiator stay rod to the bracket on top of the radiator, positioning the washer on the rod forward of the bracket and the stay rod clip behind and under the bracket and tighten the safety nut to secure the rod in place. Connect the inlet and outlet hose at the radiator, and tighten the hose clamps securely. Fill the cooling system.

(2) Position brush guard. Place the brush guard (fig. 135) in vertical position and engage the guard braces over the screws, one on each guard vertical inner bar, and tighten the nuts on the screws. On trucks with front winch, install the brush guard (if removed in a above) in the reverse order of removal.

86. Thermostat (Fig. 136)

a. Removal. Remove the radiator cap and open the radiator draincock at bottom of radiator and drain enough coolant to lower level below the thermostat. Loosen both clamps on the radiator inlet hose and remove the hose. Remove the four screws and lockwashers holding the thermostat housing to the water manifold. Remove the housing and discard the gasket. Pull the thermostat out of the end of the water manifold.

b. Installation. Place the thermostat in position in the end of the water manifold. Position the thermostat housing with the new gasket on the water manifold, and install four external-teeth lockwasher screws. Install the radiator inlet hose and tighten the clamps. Fill the radiator. Install the radiator cap.

87. Water Manifold (Fig. 137)

a. Removal. Remove six screws and lockwashers holding water manifold to the engine. Discard the three gaskets.

b. Installation. Install the three gaskets and secure water manifold to the engine with six lockwashers and screws.

88. Fan Belts

a. Drive Belts (Fig. 138).

(1) Adjustment. Loosen the two safety nuts securing the generator to the mounting bracket. Loosen the screw holding the generator to the adjusting arm and move the generator toward or away from the engine, as necessary, to obtain the correct belt tension. A light thumb pressure on the belts at

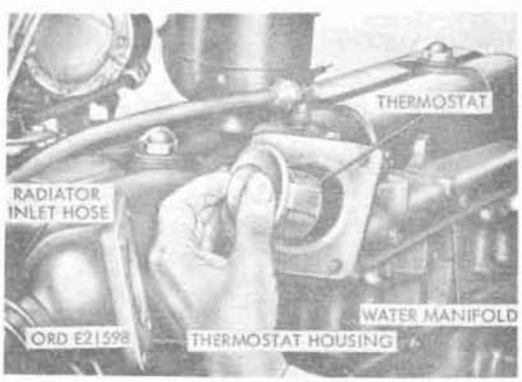

Figure 136. Removing thermostat

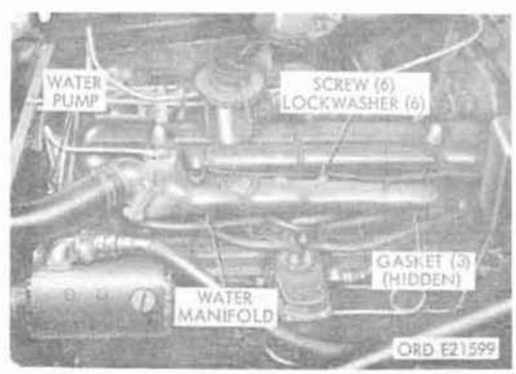

Figure 137. Water manifold disconnect points

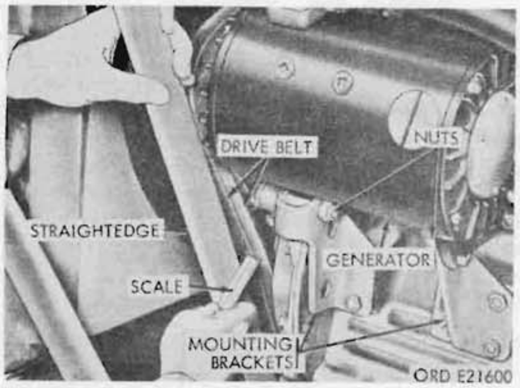

Figure 138. Generator, fan and water pump drive belt adjustment

a point midway between the generator and crankshaft pulleys should cause a one-half-inch deflection. Tighten the screw holding the generator to the adjusting arm and tighten the two safety nuts securing the generator to the mounting bracket.

(2) Removal. Loosen the two safety nuts securing the generator to the mounting bracket. Loosen the screw holding the generator to the adjusting arm, and move the generator toward the engine as far as it will go. Remove the compressor drive belt (par. 218). Remove the fan and water pump drive belts from the generator, water pump and crankshaft pulleys and lift the belts over the fan.

b. Installation. Work the fan and water pump drive belts over the fan, and crankshaft, water pump, and generator pulleys. Install the compressor drive belt. Adjust the belts and tighten the generator ((1) above).

89. Fan

a. Removal. Remove the six screws and washers holding the fan to the water pump drive pulley hub, remove the fan, and the fan-to-pulley adapter.

b. Installation. Position the fan-to-pulley adapter on the fan and water pump drive pulley hub. Place the fan on the adapter with the straightedge of blades toward the engine, and install six hex-head screws and lockwashers to secure the fan.

90. Water Lines and Fittings

a. General. The hose connections are provided at the radiator inlet and outlet. The thermostat bypass line extends from the water pump to the water manifold. There are two compressor water lines (on engines equipped with water-cooled compressors), one from the water pump to the air compressor and the other from the air compressor to the cylinder block.

b. Repair and Replacement. Repair of the cooling system hose and fittings consists of replacement of damaged or defective parts. The cooling system must be drained before the hose or water lines are replaced. When replacing the hose, make sure the clamps are tightened securely. Drain the air compressor cylinder head (if water-cooled) before replacing the air compressor water lines. When replacing the lines or fittings, coat all threaded connections with liquid-type gasket cement before installation. Be certain all connections are tight.

91. Water Pump

a. Removal. Remove the fan, fan-to-pulley adapter, and the drive belts (par. 88). Disconnect the thermostat bypass line and air compressor water inlet line, where present, from the top of the water pump housing, and pull clear. Remove the nut and washer securing the fan and water pump pulley on the water pump shaft, and remove the pulley with the water pump pulley and fan hub puller 5120-708-3210 (fig. 139). Remove the key from the shaft and pull off the two bearing retainers. Disconnect the radiator outlet hose at the

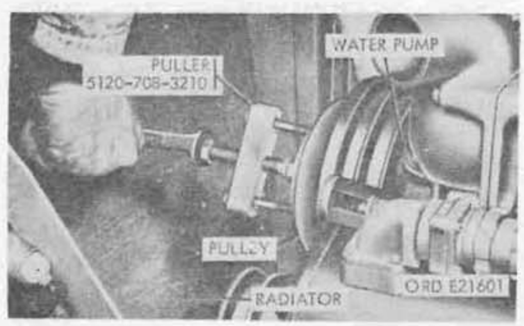

Figure 139. Removing fan and water pump with puller

water pump. Remove the five screws and lockwashers securing the water pump to the cylinder block. Remove the pump and generator adjusting arm. Discard the gasket. Remove the inlet and bypass line fittings from the pump.

b. Installation. Install the 1/2-inch and 3/8-inch tube connectors in the tapped ports in the pump housing. Place the water pump in position on the cylinder block with a new gasket. Be sure the pump is in the correct position to aline with the radiator outlet hose. Secure the pump to the cylinder block (fig. 137) with two hex-head screws and external-teeth lockwashers in the bossed holes near the pump inlet port, and three hex-head screws and external-teeth lockwashers in the low holes. Use one screw to hold the generator adjusting arm to the pump housing. Install two bearing retainers, concave sides facing each other, on the pump shaft. Install the woodruff key in the pump shaft and slide the pulley onto shaft over key. Secure the pulley on the shaft with the washer and safety nut. Connect the radiator outlet hose to the pump. Connect the thermostat bypass line to the tube connector, and the air compressor water inlet line to the 1/2-inch tube connector on top of the water pump housing. Install the fan-to-pulley adapter, fan, and drive belts (par 88).

Section XVI. IGNITION SYSTEM (GASOLINE)

92. Description and Data

a. Description.

(1) General. The ignition system (fig. 140) produces and delivers high voltage surges to spark plugs at timed intervals. The system consists of the ignition coil, the distributor, spark plugs, and connecting cables.

(2) Distributor with coil. The distributor with a built-in ignition coil is a device to convert low voltage to high voltage by interrupting the current flow through the self-contained ignition coil at timed intervals and so delivering the resulting high voltage surges to the spark plugs in correct firing sequence. Provision also is made to automatically advance or retard the timing relation to piston position, as necessary, for efficient operation of engine. Later production distributors have an access screw in the distributor cover. Removal of this screw permits the installation of a primary circuit adapter in the screw hole. A tachometer clamp is attached to the adapter. A new-type distributor cover must be temporarily

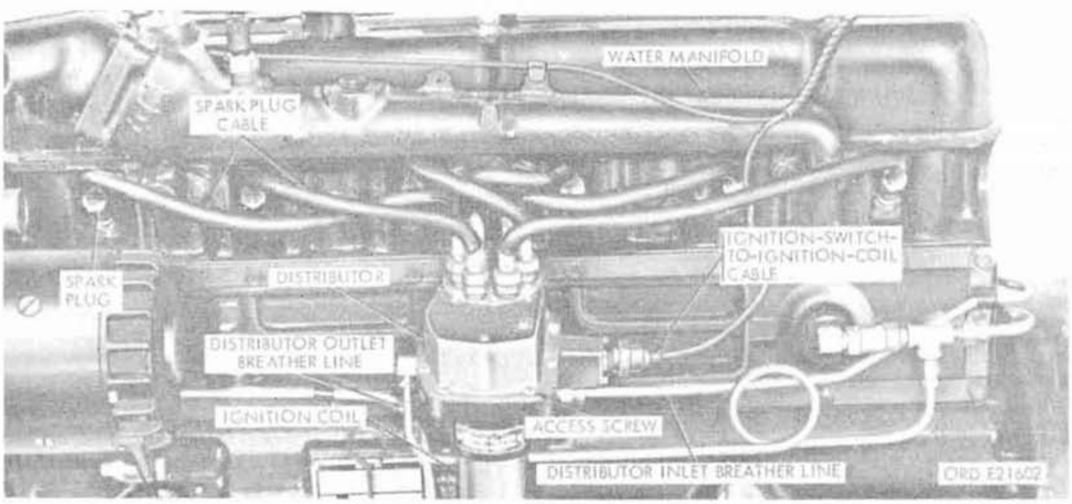

Figure 140. Ignition system

installed on older distributors, during use of the tachometer.

(3) Spark plugs. A spark plug consists of a central electrode insulated from a metal shell threaded to fit into an opening in the combustion chamber. The center electrode extends into combustion chamber where it is separated by a small gap from the ground electrode integral with the shell. High voltage surges jump the gap between the center and the ground electrodes and produce ignition sparks for firing of gas mixture in the cylinder.

b. Data.

Distributor with coil:
- Make . . . . Delco-Remy
- Model 1111556
- Rotation as viewed from top . . . clockwise
- Breaker point pressure . . . . 17-21 oz
- Breaker point opening . . . . 0.022 in.
- Input voltage 24
- Ignition timing at 400 rpm or below (before top dead center) . . . 4 deg
- Ignition coil draw . . . . 2-3 amp
- Breaker plate capacitor . . . 0.18-0.23 mfd

Spark plug:
- Gap . . . . 0.030 in.

93. Distributor with Coil

a. Removal. Disconnect ignition-switch-to-ignition-coil cable (fig. 140) and spark-plug cables (par. 99) from the distributor. Disconnect the distributor inlet and outlet breather lines (fig. 140) from fittings in sides of the distributor. Remove the screws and lockwashers from the mounting clamps holding the distributor to the cylinder block, remove the clamps, and lift out the distributor with coil.

b. Installation. With the ignition switch in the OFF position, turn the engine over by small increments with starter until the 4-degree timing mark stops in line with the timing pointer (fig. 141). Remove the distributor cover and the rotor. Install the distributor in position in the side of the cylinder block while turning the distributor cam to engage the distributor drive coupling with the coupling on the oil pump shaft in the block. Install the two distributor mounting clamps with two external-teeth lockwasher hex-head screws, but do not tighten the screws. Place a straightedge across flat on the side of the cam and

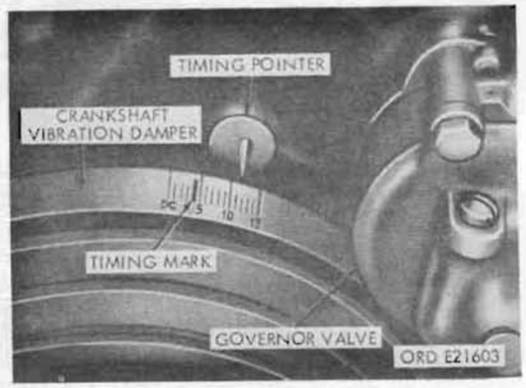

Figure 141. Timing pointer and marks

rotate the distributor housing (fig. 140) until the edge of the straightedge is between the indicating mark scribed on the rim of the housing. Tighten the screws on the distributor mounting clamps to secure the distributor in position. Check to see that the breaker points are just at the opening point. Connect the ignition-switch-to-ignition coil cable and the spark-plug cables (par. 99) to the distributor.

Note. Precise timing of the distributor is necessary after this operation. Refer to paragraph 100 for the correct procedure.

94. Distributor Cover, Cap and Rotor

a. Removal. Disconnect spark-plug cables (par. 99) from distributor. Remove the eight screws securing the cover to the distributor, and remove the cover. Discard the cover gasket. Remove the five screws securing the cap in the distributor cover and remove the cap. Lift rotor off cam.

b. Installation. Install the distributor cover, cap and rotor in reverse order of removal.

95. Breaker Points

a. Cleaning. Remove the distributor cover and rotor. Clean breaker points on the breaker lever (fig. 142) and the stationary contact bracket, using a contact-point dresser. If points are badly pitted or burned, replace points (b below).

b. Removal. Remove distributor cover and rotor. Remove the bracket screw securing the stationary contact bracket (fig. 142) to the

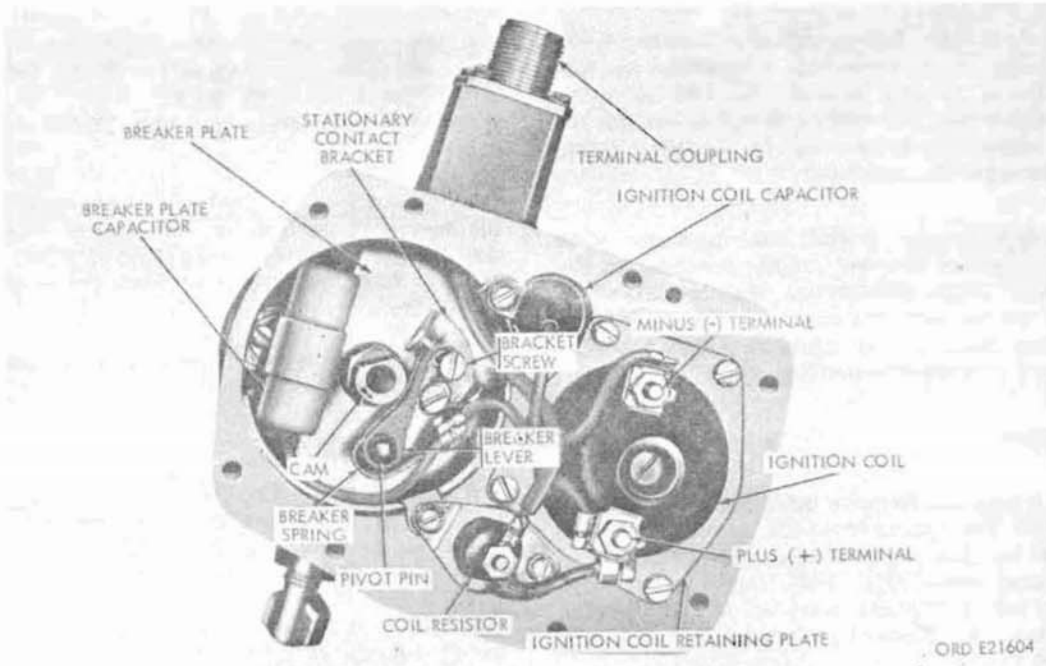

Figure 142. Distributor - interior components

breaker plate, and lift the contact bracket and breaker lever, with cables attached, up off the pivot pin. Remove the screw spring clamp and nut holding cables and the breaker lever spring to the contact bracket, and remove the bracket and lever from the cables.

c. Installation. Connect the breaker plate capacitor and ignition coil cables to the contact bracket with hex-head screw, spring clamp, and hex-nut, being sure to press the breaker spring underneath the clamp so that the notch in the spring makes good contact with the screw. Tighten the nut. Put two drops of preservative lubricating oil (PL) on pivot pin. Install the stationary contact bracket and breaker lever over the pivot pin with the center hole in the bracket over the adjusting screw in breaker plate. Install the stationary contact bracket screw.

d. Adjustment.

(1) Adjust breaker lever spring tension. Turn the engine in small stages by closing the starter switch momentarily, with the ignition switch in OFF position, until the distributor breaker cam comes to rest with the breaker lever on the flat side of the cam (points closed). Using the tension gage, check the pull on lever required to open points. The pull must be between 17 and 21 ounces at the instant the points begin to open. If necessary, adjust the tension by bending the spring slightly or replace the breaker lever assembly (c above).

(2) Adjust breaker point gap. With the ignition switch in the OFF position, turn the engine in small stages by closing the starting switch momentarily until the engine stops with a high point of the cam holding the breaker lever at the maximum gap. Check the gap with a 0.022-inch feeler gage. To adjust the gap, loosen the bracket screw near the end of the stationary contact bracket and turn the adjusting screw to obtain the correct opening of 0.022 of an inch. Tighten the bracket screw. Install the rotor and the cover.

96. Capacitor (Condenser)

a. Removal. Disconnect the breaker plate capacitor wire from the connection on the stationary contact bracket (fig. 142). Remove the screw and lockwasher securing the capacitor mounting bracket to the breaker plate, and remove the capacitor.

b. Installation. Install the capacitor with the mounting bracket in the position on the breaker plate and secure with the fillister-head screw and lockwasher. Connect the capacitor wire to the connection on the stationary contact bracket (fig. 142).

97. Coil

a. Removal. Remove distributor cover. Disconnect two cables from the ignition coil. Remove the four screws from the ignition coil retaining plate (fig. 142). Remove the plate from the distributor housing, and lift out the ignition coil. Discard gasket.

b. Installation. Place the new ignition coil gasket in the recess in the distributor housing, and install the ignition coil in the housing (fig. 143). Note that the coil must be placed with the plus (+) terminal near the coil resistor (fig. 142). Install the clamp plate and secure with four screws. Connect the coil resistor cable and the coil capacitor cable to the plus (+) terminal on the coil. Connect the cable from the stationary contact bracket to the minus (-) terminal. Install the distributor cover.

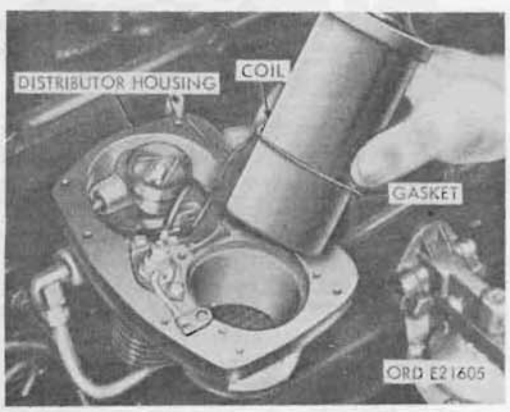

Figure 143. Replacing ignition coil

98. Spark Plugs

a. Removal. Remove the spark-plug cable (par. 99) from the spark plug. Use the spark-plug wrench or deep socket wrench to remove the spark plug (fig. 144). Discard gasket.

b. Cleaning and Testing. Clean and test the spark plugs with a spark-plug cleaner and tester. Replace plugs that fail the test or have badly burned electrodes or porcelain insulators.

c. Gap Adjustment. Using a round feeler gage, check for proper gap between electrodes. Adjust the gap to 0.030 of an inch by bending the side electrode only.

d. Installation. Place a new gasket on the spark plug and start plug into the cylinder head. Tighten the plug until it bottoms against the gasket, using a deep socket or spark-plug wrench (fig 144). Then tighten the plug one-quarter to one-half turn to partially compress the gasket. Do not tighten enough to crush gasket.

Note. Always test spark-plug cable (par. 99 a) after installing new plug. Install spark plug cable (par. 99 c) on spark plug.

99. Spark-plug Cables

a. Test.

(1) Remove the spark-plug cable from the distributor (b below). Insert the secondary circuit (spark plug) adapter in re-

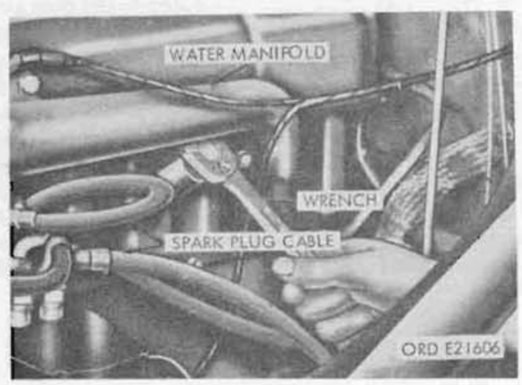

Figure 144 Removing or installing a spark plug

ceptacle. Start the engine. Use a low- and high-tension tester such as 17-T-5536-100, and check the distributor output.

(2) Remove the adapter from the distributor and connect the spark-plug cable to distributor. Remove the other end of the cable from the spark plug (b below) and insert an adapter in the end of the cable. Check the output with the tester. Replace the defective cable. If the cable is shorted or grounded, replace the spark plug used with the cable (par. 98).

b. Removal. Unscrew the conduit nuts on both ends of the spark-plug cable, using wrench 5120-795-0895 (fig. 145), and remove the cable from the spark plug and distributor cover.

c. Installation. Position the cable between the distributor and the spark plug, and start the nuts with the fingers to avoid damaging the threads. Tighten the nuts with wrench 5120-795-0895 (fig. 145).

Note. Be sure to connect proper cable to each plug to ensure the correct firing order (1-5-3-6-2-4).

100. Ignition Timing

a. General. Adjustment of the distributor timing is required so that the distributor will deliver a spark in the compression chamber of each cylinder when each piston position is 4 degrees before top dead center on the compression stroke. Timing is checked by means of a small timing pointer, set in the timing gear cover in conjunction with degree marks on the outer rim of the crankshaft vibration damper (fig. 141). Due to the waterproof design of the ignition system, a timing light adapter, or substitute, is required for connecting either the 2- or 3-wire timing light. After initial setting of distributor by the timing light, the vehicle should be road-tested, and a small distributor adjustment made to compensate for excessive ignition ping or knock.

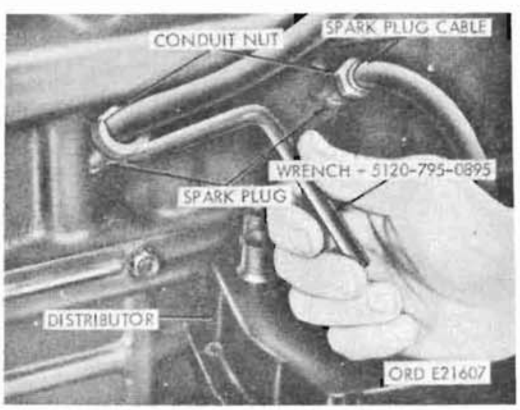

Figure 145. Removing spark plug cable with wrench 5120-795-0895

b. Timing Procedure.

Note. Refer to Electrical Troubleshooting, Section VI, figure 38, for a visualized timing procedure.

(1) Connecting two-wire timing light. Disconnect the spark-plug cable (par. 99) from No. 1 spark plug, and connect the timing light adapter (fig. 48) between the spark plug and the spark-plug cable. Connect one terminal of the timing light to the adapter terminal and the other timing light terminal to a good ground.

(2) Connecting 3-wire timing light. Disconnect the spark-plug cable (par. 99) from No. 1 spark plug, and connect the timing light adapter (fig. 48) between the spark plug and the spark-plug cable. Connect the red cable from the light to the battery positive terminal and the black cable to the battery negative terminal.

(3) Checking timing. With the engine running at 400 rpm or below, direct the beam of the timing light down at the timing pointer (fig. 141). The relation of the timing marks with the timing pointer can be seen by flashes of the timing light. Timing is correct when the pointer coincides with the 4-degree mark when the light flashes.

(4) Correcting timing. To correct the timing, loosen the mounting clamps holding the distributor to the crankcase and rotate the distributor slightly. Clockwise rotation will retard the spark, counterclockwise rotation will advance it. Adjust the distributor until the pointer registers with the 4-degree

mark. When the timing is adjusted properly, tighten the distributor mounting clamps to secure the distributor in the correct position. Remove the adapter, and install the spark-plug cable (par. 99) on the spark plug.

c. Antiknock Spark Adjustment. After the engine is at normal operating temperature, road-test the vehicle, using the grade of fuel used in regular vehicle service. Engine should not ping or knock excessively under load and full throttle. A slight amount of knock is not objectionable. If the knock is excessive, loosen the distributor mounting clamps and turn the distributor housing clockwise slightly until the knock is at a minimum. Tighten the mounting clamps.

Section XVII. STARTING SYSTEM

101. Description and Data

a. Description. The starting system consists of a 24-volt waterproof starter (fig. 146), starter switch, and starter pedal. Pressure on the starter shifter lever first causes the starter drive to engage the engine flywheel, and then closes the starter switch to energize the starter. On the multifuel, the starter switch energizes a heavy-duty magnetic starter switch, which energizes the starter. The starter drive pinion automatically disengages when the engine starts. The starter is a four-pole, four-brush unit with three field coils connected in series and one in shunt, and is mounted on the flywheel housing on the right side of the engine. The switch is mounted on the starter frame. The pedal, secured to the cab floor, contacts the starter shifter lever.

b. Tabulated Data.

Starter (gasoline):
- Make . . . . Delco-Remy
- Model 1108575
- Drive pinion rotation . . . . clockwise, viewing drive end
- Voltage 24

Starter switch:
- Make . . . . Delco-Remy
- Model 1996466

Starter (multifuel):
- Make . . . . Autolite
- Model MBD-4043UT
- Drive pinion rotation . . . . clockwise, viewing drive end
- Voltage 24

102. Starter

a. Inspection and Cleaning (Fig. 146). Remove the commutator end cover by releasing the two cover clips from the pins in the starter housing and sliding the cover off. Inspect the commutator for dirty condition, roughness, high spots, and high mica. If the commutator is dirty, clean with grade 2/0 flint paper only

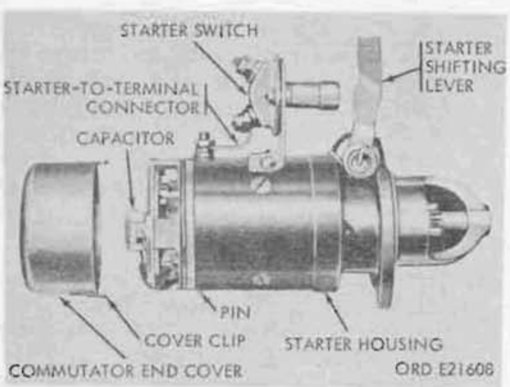

Figure 146. Starter with commutator end cover removed

Figure 147. Starter removal

and blow out dust with compressed air. If the commutator is rough, out-of-round, or has high mica, the starter must be replaced.

b. Test. Refer to Electrical Troubleshooting, Section VI, figure 42, for a complete test on the starter.

c. Removal.

Caution: Be sure the battery ground cable (fig. 153) is disconnected before disconnecting the starter cable.

Disconnect the battery ground cable at the batteries (fig. 153). Disconnect the battery-to-starter cable at the starter switch. Remove three safety nuts holding the starter (fig. 147) to the flywheel housing. Pull the starter straight out from the housing to remove. Discard the gasket.

d. Installation. Place the starter in position on the mounting studs (fig. 147), using a new gasket. Be sure the starter switch is pointing up. Secure with three safety nuts. Connect the starter cable to the starter switch terminal. Connect the battery ground cable at the batteries (fig. 153).

103. Starter Pedal

a. Removal. Remove four nuts and screws holding the starter pedal to the floor, and remove the pedal.

b. Repair. Weld, straighten, or replace the broken or damaged parts as necessary.

c. Installation. Install the pedal on the floor with four hex-head screws and safety nuts.

104. Starter Switch

a. Removal. Remove the ground cable from the batteries (fig. 153). Disconnect the battery-to-starter cable at the starter switch. Remove the starter-to-terminal connector (fig. 146) from the starter switch. Remove the two screws, washers, and nuts holding the switch to the mounting bracket, and remove the switch.

b. Installation. Position the switch on the mounting bracket and secure with two hex-head screws, lockwashers, and nuts. Attach the starter-to-terminal connector (fig. 146) to the starter switch, and tighten the nut. Wrap the connector and terminals with 1/2-inch-wide cotton tape, and paint with synthetic insulating paint (Glyptal). Connect the battery-to-starter cable to the switch terminal. Connect the battery ground cable to the batteries (fig. 153).

105. Starter Switch Adjustment (Multifuel)

a. Disconnect the battery cables (par. 111 e).

b. Adjust the starter control as shown in (1) through (7) below.

(1) Loosen the locknut and turn the adjusting screw completely in (fig. 148).

(2) Compress the switch return spring to close the switch (fig. 149).

(3) While holding the return spring compressed, pull the lever forward until the drive pinion engages the flywheel ring gear and rests against the pinion stop. At this point the lever is in a near vertical position (fig. 149). Further movement of the lever causes the positork drive spring to compress. Do not compress positork drive spring.

Note. When operating properly, the lever moves freely from its initial position to a near vertical position. If the shifting mechanism binds or sticks,

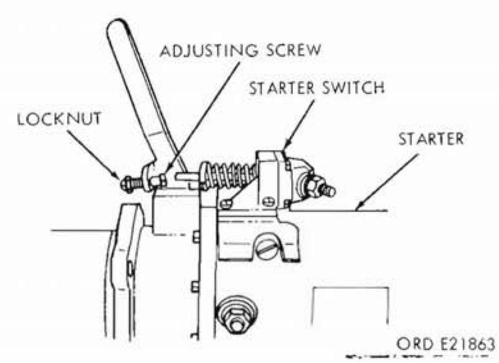

Figure 148. Starter switch assembly - multifuel

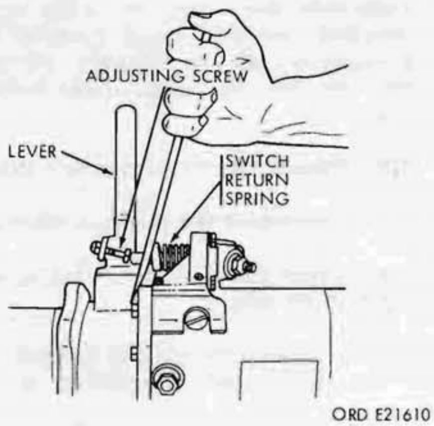

Figure 149. Starter control adjustment - multifuel

remove the starter (par. 102) and send to direct support maintenance unit for cleaning and lubrication.

(4) Turn the adjusting screw out until the screw head rests against the switch plunger rod.

(5) Release the lever and the switch return spring.

(6) Turn the adjusting screw one-half turn out (away from the lever).

(7) Tighten the locknut.

c. Connect the battery cables (par. 111 e).

106. Magnetic Starter Switch (Multifuel)

a. Removal.

(1) Disconnect the electrical leads from the magnetic starter switch (fig. 150).

Note. Tag the leads and posts before disconnecting.

(2) Remove the self-locking nuts and bolts securing the magnetic starter switch to switch bracket and remove the switch.

b. Installation. Install the magnetic starter switch in the reverse order of removal.

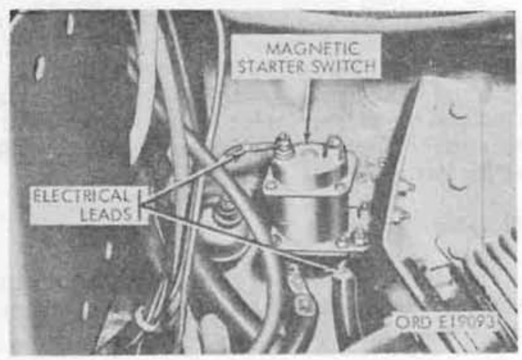

Figure 150. Magnetic starter switch - multifuel

Section XVIII. CHARGING SYSTEM

107. Description and Data

a. Description.

(1) General. The charging system consists of a generator and a generator regulator. The purpose of these units is to keep the batteries fully charged and to supplement the battery current for the ignition and lighting systems when the speed of the engine permits.

(2) Generator (fig. 151). The watertight generator is either a two- or four-brush, four-pole, shunt-type unit. The generator is mounted on the left side of the engine and is driven by drive belts from the crankshaft.

(3) Generator regulator (fig. 152). The watertight generator regulator contains three units; a voltage regulator, a current regulator, and a cutout relay. The regulator is mounted in the rear of the engine compartment on the front side of the firewall near the steering column. Two models of regulators have been used. The later model regulators are installed vertically, the older models are installed horizontally.

b. Data.

Generator:
- Make (gasoline) . . . . Delco-Remy
- Models:
  - Four-brush 1117486
  - Two-brush 1117495
- Make (multifuel) . . . . Autolite
- Model GHA-4802UT
- Both units:
  - Armature rotation . . . . clockwise, viewing drive end
  - Voltage (rated) 24
  - Output:
    - Cold . . . . 25 amp at 28.5 v at 1700 rpm
    - Hot (at operating temperature). . . maximum controlled by generator regulator
  - Field current draw. . . . . . 1.0 - 1.1 amp at 28.5 v

Generator regulator:
- Make. . . . . Delco-Remy
- Model . . . . 1118546 or 1118606
- Type. . . . . vibrating
- Voltage (rated) 24
- Ground polarity . . . . .negative

Voltage regulator:
- Operating range (hot) . . . . 27-29 v

Current regulator:
- Operating range (hot) . . . . 22-26 amp

Cutout relay:
- Closing range (hot) . . . . 24.5 - 26.5 v

108. Generator

a. Inspection (Fig. 151). Remove the generator inspection plug and inspect the commutator.

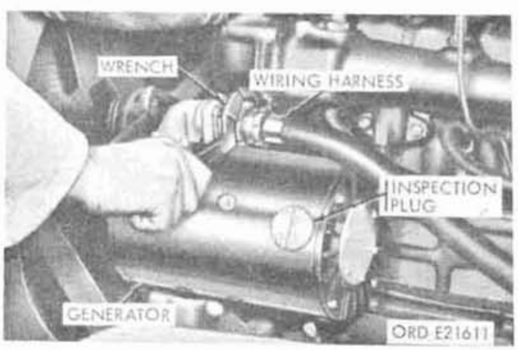

Figure 151. Disconnecting generator-to-regulator wiring harness from generator

If the commutator is rough, out-of-round, burned, or has high mica, the generator must be replaced.

Caution: When replacing the inspection plug, make sure the gasket is seated properly to prevent moisture leakage into the generator.

b. Test. Refer to Electrical Troubleshooting, Section VI, for a complete test of the generator and regulator.

c. Removal. Loosen nut on generator-to-regulator wiring harness at generator (fig. 151), and pull the cable from the generator. Remove two nuts from the screws holding the generator to the mounting brackets (fig. 113). Remove the screw and lockwasher holding the generator to the adjusting arm and push the generator toward the engine as far as it will go. Remove the drive belts from the generator pulley. Remove the two screws holding the generator to the mounting brackets and remove the generator.

d. Installation. Position generator in place on the mounting brackets (fig. 138), and install the screw and safety nut attaching the generator to the mounting front bracket, but do not tighten the nut. Install the screw and safety nut attaching the generator to the mounting rear bracket, but do not tighten the nut. Place the drive belts over the generator pulley. Secure the generator to the adjusting arm with a plain washer and a lockwasher screw. Adjust the drive belts (par. 88), and tighten the nuts on the mounting screws. Polarize the generator (e below).

e. Polarization. When a new or rebuilt generator or regulator has been installed, or the generator-to-regulator wiring harness has been disconnected for any reason, the generator must be polarized after the unit is installed and before the engine is started. Disconnect the generator-to-regulator wiring harness at the generator (fig. 151). Disconnect the chassis wiring harness (fig. 152) at the regulator. Leave the generator-to-regulator wiring harness connected to the regulator. Use a jumper wire, and momentarily connect the field terminal "B" at the generator, to the battery-to-generator-regulator "A" cable terminal in the chassis wiring harness connector. Remove the jumper wire. Connect the chassis wiring harness to the regulator, and the generator-to-regulator wiring harness to the generator and tighten the connections.

109. Generator Regulator

a. Test. Refer to Electrical Troubleshooting, Section VI, figures 43, 44 and 45, for a complete test of the generator regulator.

b. Removal. Disconnect the generator-to-regulator wiring harness at the regulator (fig. 152). Disconnect the chassis wiring harness at the regulator. Remove four screws attaching the regulator to the mounting bracket, and remove the regulator.

c. Installation. Position the regulator on the mounting bracket with the harness connector receptacles downward. Secure with four external-teeth lockwasher screws. Connect the generator-to-regulator wiring harness to the regulator (fig. 152), and tighten the connector. Connect the chassis wiring harness to the regulator. Polarize the generator (par. 108 e).

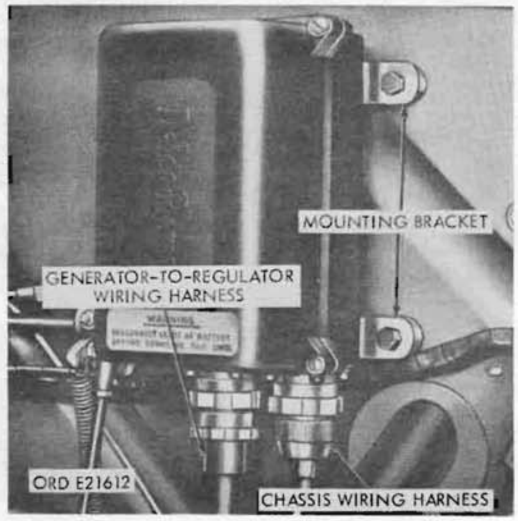

Figure 152. Generator regulator

Section XIX. BATTERIES AND BATTERY CABLES

110. Description and Data

a. Description.

(1) Batteries and cables (fig. 153). Two 12-volt, lead-acid-type batteries, connected in series, supply 24 volts for the truck electrical system. The batteries are located in a comparment on the right side of the truck, between the running board and the cab door. These batteries are a submersible type with special vent plugs which prevent entrance of water into the cells when the battery is submerged or being externally flushed with water during cleaning. Terminals are waterproofed by packing with heavy asbestos grease at the time of preparation for fording operations (TM 9-2320-209-10). Waterproof cables and harness assemblies are used for all battery connections.

(2) Slave battery receptacle (fig. 154). On winterized vehicles, a slave battery receptacle is installed at the right rear corner of the cab body. This receptacle is wired in parallel with batteries. It is used to charge batteries. It is used to charge batteries from an external source or to connect a source of additional electrical booster power from an external source to operate the truck electrical components.

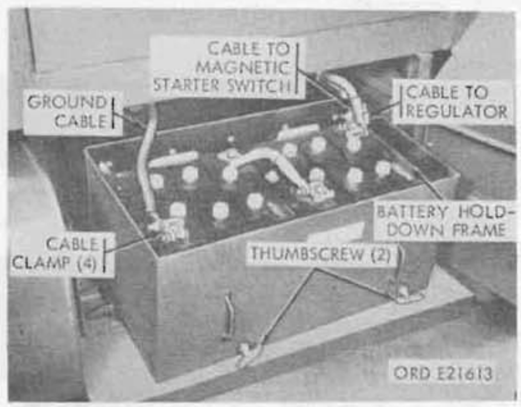

Figure 153. Batteries and battery cables

(3) Radio receptacle (fig. 154). On some vehicles, a radio receptacle is located on the cab rear panel behind the assistant driver's seat, and provides a power connection for the radio equipment.

b. Data.

Make	Delco-Remy
Model	6TN23
Voltage	12
Plates per cell	23
Capacity	20 hr rate, 100 amp hr
Number of batteries used	2
Specific gravity at full charge at 80° F	1.275 to 1.290

111. Maintenance

a. Servicing.

(1) Battery specific gravity. Refer to Electrical Troubleshooting, Section VI, figure 41, for information on specific gravity.

(2) Electrolyte.

(a) Water in electrolyte solution will evaporate at high temperatures or with excessive charging rates. Inspect the electrolyte level and add, distilled or clean water, when necessary, to bring the electrolyte level to three-fourths of an inch above the plate separators in each cell.

(b) Dry-stored batteries should be filled before use with prepared electrolyte to a level of three-fourths of an inch above the separators. Flush off any spilled fluid with clean water.

Caution: Electrolyte will burn wood, clothing, and skin. Spills should be washed immediately with flowing water, and a paste solution of bicarbonate of soda and water applied to the affected area.

(3) Cleaning. The top of the battery must be kept clean. Tighten the vent plugs and clean the battery with a nonmetallic brush dipped in an alkaline solution, such as ammonia, or a solution of bicarbonate of soda and water. After the foaming stops, flush the top of the battery with clean water. If the terminals and cable clamps are corroded, disconnect the cables and clean in the same manner as described above for the top of the battery.

(4) Battery holddown frame. Later production vehicles have a rubber-dipped holddown frame to prevent a possible short circuit or current leakage between the battery cable terminals and the frame. Older vehicles should have the frame top members cut in an arc under the cable terminals to allow more clearance between the cables and the frame.

b. Inspection. Open the battery compartment door. Batteries can be pulled out from the battery compartments onto the running board for inspection. The battery box is held in place by a clamp at each end. To inspect batteries, loosen the thumbscrews to disengage these clamps, push the clamps down to the clear box, and pull the battery box out. After inspection, push the battery box back into the compartment, lift the clamps up into position against the box and tighten the thumbscrews to secure the clamps. Close the battery compartment door.

c. Excessive Cable Length. Due to a procurement error, some replacement battery-to-starter cables were supplied in 82-inch lengths. The correct length for these cables is 62 inches. If an 82-inch cable is found installed on a truck it should be replaced immediately with the correct length cable.

d. Test. Refer to Electrical Troubleshooting, Section VI, figure 41, for complete testing procedure.

e. Removal. Open the battery compartment door. Loosen the two thumbscrews and push the clamps down to clear the battery box. Pull the battery box out on the running board (fig. 153).

Caution: Disconnect the battery ground cable first. Disconnect all cables from the batteries. Loosen the battery retaining clamp bolts and remove the battery holddown frame (fig. 153). Lift the batteries from the box.

f. Installation. Position the batteries in the box, paying particular attention to placement of batteries (fig. 153). Place holddown frame over the batteries and secure with retaining clamp bolts.

Caution: Connect the battery ground cable last.

Connect the interconnecting cable between the positive terminal of rear battery and the negative terminal of the front battery. Connect the positive cables to positive terminal of front battery. Connect ground cable to the negative terminal of the rear battery. Push the battery box into the box compartment. Lift the clamps to engage the thumbscrews, and tighten the thumbscrews (fig. 153) securely. Close the compartment door.

112. Slave Battery Receptacle

a. General.

Caution: When using the receptacle, be sure that the external source is in the same polarity as the truck batteries, positive (+)-to-positive (+), and that the cable being used for the connection is assembled correctly. Failure to do so will cause burning out of generator and generator regulator, and severe damage to the connecting cable.

Remove the slave receptacle dust cover to install cable in receptacle. After use, install the dust cover to protect the contacts and prevent entrance of moisture.

b. Removal. Disconnect cables at batteries (fig. 153). Remove four screws and nuts securing the receptacle flange to the cab panel, and remove receptacle and cables.

c. Installation. Install the receptacle and its cables. Secure with four hex-head screws and safety nuts, and tighten firmly. Connect the cables at the batteries (fig. 153), observing correct polarity. Cable No. 50 connects to the negative (-) terminal and No. 49 to the positive (+) terminal of the batteries.

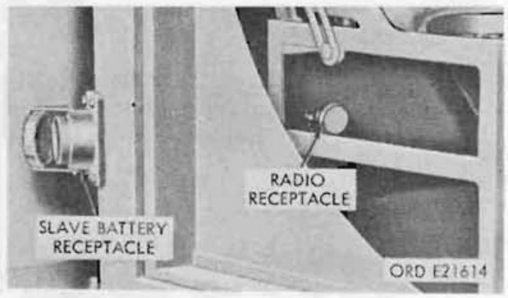

Figure 154. Slave battery and radio receptacles

Section XX. LIGHTING SYSTEM

113. Description and Data

a. Description.

(1) General. Power for the lighting system is obtained from the batteries (par. 110) or the charging system (par. 108), depending on the battery charge and the generator charging rate.

(2) Service and blackout headlights (fig. 155).

(a) Service and blackout headlights are mounted in panels at each side of the radiator. On the trucks equipped with a front winch, service headlights are at the top of the panel and blackout headlights below. On the trucks without a front winch, the mounting panels are reversed and the blackout headlights are at the top with the service headlights in the lower portion of the panels. Service headlights use waterproof, double-filament, sealed-beam, type lamp units. The upper and lower light beams are selected by a foot-operated dimmer switch (par. 130).

Caution: If lamp units are equipped with plastic lenses, use care to prevent harmful solvents from coming into contact with them. Use only soap and water for cleaning plastic lenses.

(b) The blackout headlight, mounted below the headlight in the panel on the left side of the radiator, has a waterproof, sealed-beam-type lamp unit. The blackout headlight is controlled by the light switch (par. 129) and furnishes a diffused low-intensity light.

(3) Marker lights (fig. 155). Waterproof marker lights are mounted on the right and left front fenders and are controlled by the light switch (par. 129). Three lamps in the light housing are used for blackout marker, service parking, and signal lights.

(4) Tail- and stoplights (fig. 156). Tail- and stoplights include two waterproof units mounted at the rear of the vehicle. The right-hand light incorporates

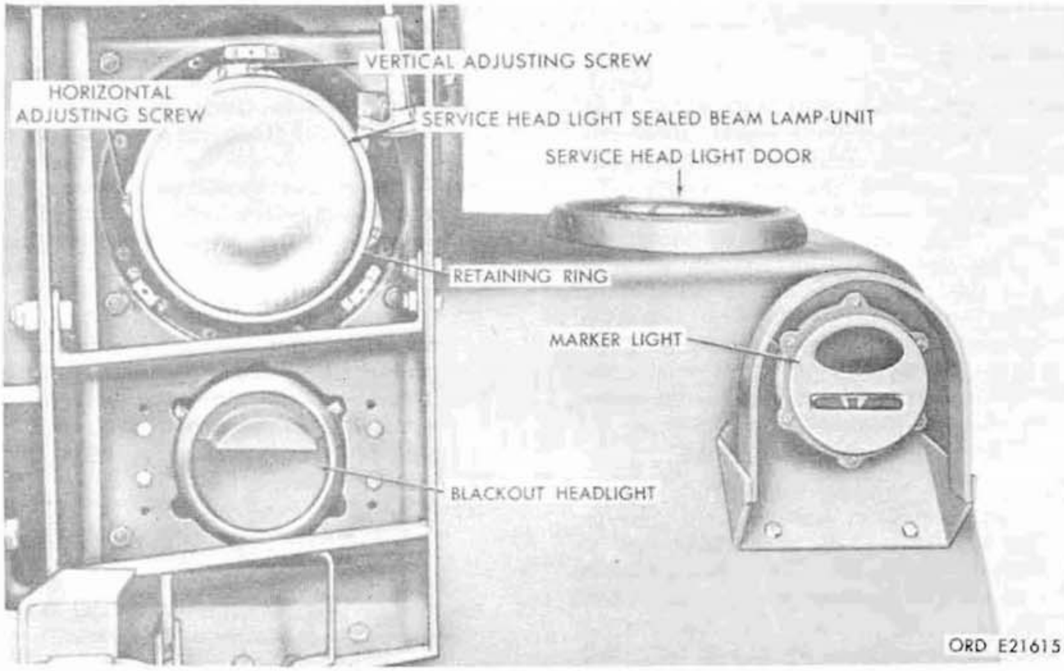

Figure 155. Service headlight, blackout headlight, and marker light - service headlight door removed

a blackout stop lamp in the upper portion and a blackout tail lamp in the lower portion. The left-hand light incorporates a combination service stop- and tail-lamp in the upper portion, and a blackout tail lamp in the lower portion.

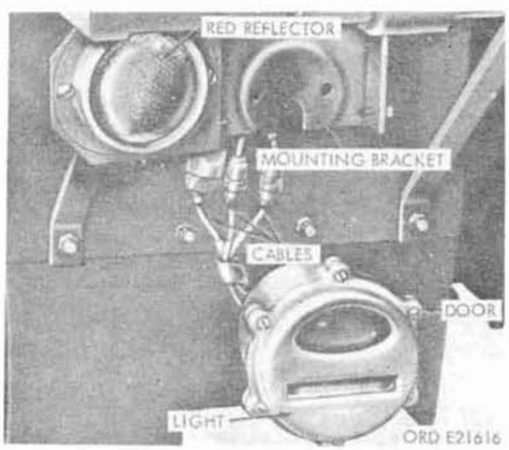

Figure 156. Left-hand tail- and stoplight partially removed (typical)

b. Data.

Blackout tail- and stoplight:
Make . . . . Guide Lamp Co.
Model 927644

Blackout headlight:
Make . . . . Guide Lamp Co.
Model 925875

Service headlight:
Make . . . . Guide Lamp Co.
Model 925876

Marker light:
Make . . . . Guide Lamp Co.
Model 928551

Service tail- and stop- and blackout taillight:
Make . . . . Guide Lamp Co.
Model 927643

114. Service Headlights

a. Adjustment.

(1) To reduce service headlight glare and prevent temporary blinding of the operator of the oncoming vehicle, headlights must be adjusted properly. The headlight beam direction is changed by two lamp-unit adjusting screws, one at the top and one on the side. Remove the three door screws and remove the headlight door. Turn the top adjusting screw to change the direction of the beam vertically, and turn the side adjusting screw to change the direction horizontally. Adjust the lights as detailed in (2) through (9) below.

(2) Place the unloaded vehicle on a smooth level surface so that the headlights are 25 feet away from a vertical wall or other vertical surface. The centerline of vehicle must be at right angles to the vertical surface. Use the service headlight adjustment diagram (fig. 157) for aid in laying out the adjustment lines.

(3) Measure the height of the headlight center from the floor, and mark a horizontal line (X-X) at this height on the vertical surface.

(4) Mark a line (A-A) one-twelfth of the distance between line (X-X) and the floor below line (X-X).

(5) Draw vertical lines (B-B) and (C-C) directly in front of each headlight.

(6) Turn on the headlights at the light switch and select the high beam with the dimmer switch. Remove the headlight rims.

(7) Cover one headlight while adjusting the other. Aim the headlight so that the center of the hot (brightest) spot registers with the intersecting lines (A-A) and (B-B), or (A-A) and (C-C) respectively.

(8) After each light is aimed separately, check both lights simultaneously for conformity to line (A-A).

(9) Install the headlight doors and secure each with three grooved screws.

b. Sealed-beam Lamp Unit.

(1) Removal. Remove the three screws attaching the headlight door, and remove the door. Remove the three screws attaching the retaining ring

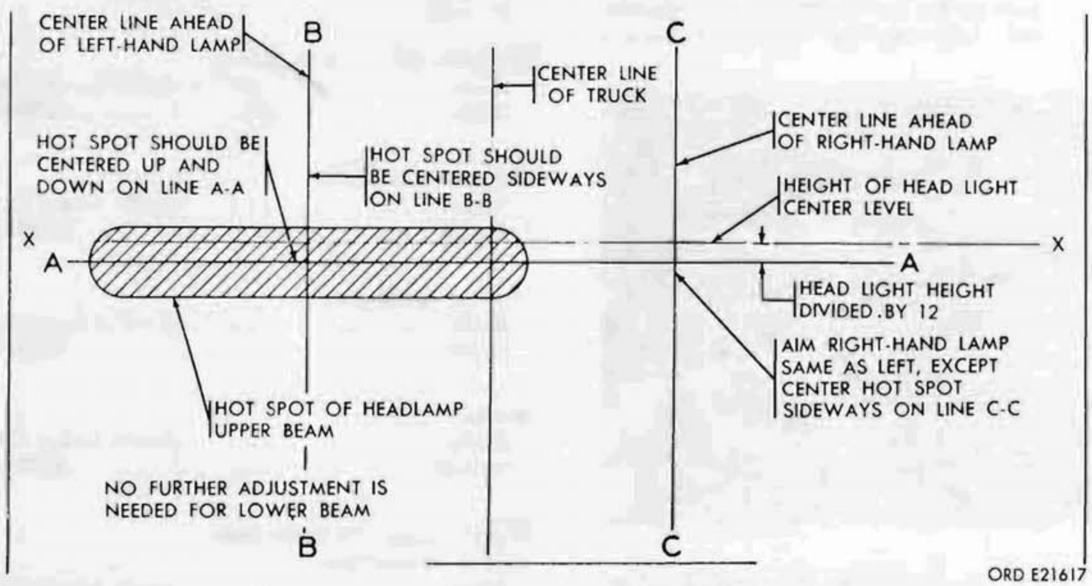

Figure 157. Service headlight adjustment diagram

to the headlight body, and remove the ~ing ring. Pull the lamp unit the headlight body and disconnect the cables (17, 18, and 91, fig. 71 or 72).

(2) Installation. Connect cables (17, 18, and 91, fig. 71 or 72) to the connectors in the headlight body. Position the new lamp unit in the body and install the retaining ring. Secure with the three screws. Adjust the light (a above). Install the door and fasten with three groove screws.

c. Headlight.

(1) Removal. Disconnect cables (17, 18, and 91, fig. 71 or 72) at the light. Remove eight nuts, lockwashers, and screws holding the service headlight to the mounting bracket, and remove the light.

(2) Installation. Install the light in its mounting bracket and secure with eight cross-recess panhead screws, lockwashers, and hex-nuts. Connect cables (17, 18, and 91, fig. 71 or 72) to the light.

115. Blackout Headlight (Fig. 155)

a. Sealed-beam Lamp Unit.

(1) Removal. To remove the sealed-beam lamp unit, remove the three door-retaining screws and remove the door. Pull the lamp unit forward, remove the connectors from the clips, and disconnect the cables (19 and 91, fig. 71 or 72) at the connectors.

(2) Installation. To install the lamp unit, connect the cables (19 and 91, fig. 71 or 72) to the lamp-unit connectors and position the connectors in the clips. Position the lamp unit in the body. Install the door and secure it with three fillister-head screws.

b. Headlight (Fig. 155).

(1) Removal. Disconnect the cables (19 and 91, fig. 71 or 72) from light. Remove the nut and lockwasher securing the light in mounting bracket, and remove the light and the bearing washer.

(2) Installation. Position the bearing washer on the bracket, and install the light over washer. Secure the light to the bracket with a lockwasher and hex-nut. Connect the cables (19 and 91, fig. 71 or 72) at the light.

116. Marker Lights (Fig. 155)

a. Lamp.

(1) Removal. Remove six screws from the door, and remove the door and gasket. Push the lamp in and turn counterclockwise to remove it from the socket.

(2) Installation. Push lamp into the socket and turn it clockwise to lock. Turn the light switch on and test the lamp. Install the door seal gasket and door, and secure the door with six roundhead screws. Tighten securely.

b. Light.

(1) Removal. Disconnect the cables (20 and 491, fig. 71 or 72) at the light. Remove two screws securing the light on the marker light support and remove the light.

(2) Installation. Install the light on the support and secure with two lockwasher hex-head screws. Connect the cables (20 and 491, fig. 71 or 72) at the light.

117. Service and Blackout-, Tail- and Stoplights

a. Lamp.

(1) Removal. Remove six roundhead screws from the door. Remove the door and the door seal gasket. Push the lamp in and turn it counterclockwise to remove the lamp from socket (fig. 156).

(2) Installation. Insert the lamp in the socket and turn it clockwise to lock. Test the lamp by turning on the light switch. Install the door seal gasket and door. Install six grooved roundhead screws, and tighten securely.

b. Light.

Note. Right-hand tail- and stoplight is connected to cables (23 and 24, fig. 71 or 72); left-hand light is connected to cables (21, 22, and 24).

(1) Removal. Disconnect the cable connectors at the light. Remove the two screws securing the light to the mounting bracket, and remove the light.

(2) Installation. Install the light on the bracket with the two lockwasher hex-head screws. Connect the cable connectors to the light, observing proper connection numbers (see note above).

Section XXI. WIRING, CIRCUITS, AND HARNESSES

118. Description

a. The chassis wiring harnesses are made up of the cables, connectors, plugs, receptacles, and terminals needed to carry power to the truck electrical components. Harnesses are secured to the vehicle by clips and terminate in the connector plugs, connector receptacles, or the cable terminals. All connectors are protected by rubber sealing gaskets or grommets to ensure waterproof connections. A trailer electric coupling receptacle is provided on all trucks. The M48 and M275 series tractors have two trailer coupling receptacles; one for the pintle-towed trailer and one for the semitrailer connection.

b. The wiring harnesses differ somewhat in early and later production trucks. Latest harnesses on all trucks, except the M48 and M275 series trucks, are in two sections. The cab and front of the vehicle are serviced by front wiring harness section. The rear of the vehicle is serviced by the chassis rear wiring harness section. A floodlight harness is provided on M60 and M108 trucks for floodlights and electric brake lock. Van bodies have special wiring circuits (Section VI, figs. 71 through 76). Individual harnesses, such as generator-to-regulator wiring harness, battery cables, and cables for individual components are provided, where necessary, for connection to chassis wiring harness or between electrical components.

119. Circuit Identification

The different circuits can be identified from wiring diagrams (figs. 71 through 76). All harness terminals and the separate cables on the trucks are plainly marked with circuit numbers.

120. Repair

a. Remove cracked or peeled cable assembly (fig. 158).

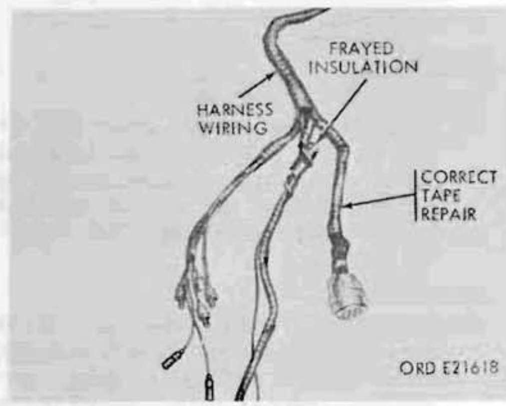

Figure 158. Repair of frayed or damaged harness

b. Remove all loose outer covering and clean conduit and remaining covering with rubber solvent 51-S-1728 and wipe dry.

c. Wrap cable assembly with insulating tape (FSN 5970-644-2635 for 1/2-inch width, or FSN 5970-644-2637 for 1-inch width) from one end to the other, making certain to have a lap joint one-half the width of the tape. Tie the loose end of tape at the connector.

d. Install cable assembly in its normal position on the truck.

e. Resolder any wires which have broken or pulled off a connector terminal (fig. 159).

f. Clean the corrosion from the pin terminal and pin socket connector fittings with sandpaper or crocus cloth.

g. Connect loose connectors and inspect rubber grommets. Replace the grommet if required.

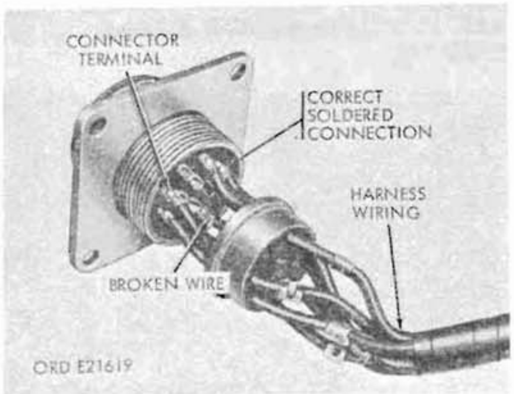

Figure 159. Repair of connector wires

121. Generator-to-Regulator Harness

a. Removal. Disconnect the generator-to-regulator harness at both ends (fig. 160) and remove from vehicle.

b. Repair. Repair the generator-to-regulator harness in accordance with paragraph 120 above.

c. Installation. Connect one end of the generator-to-regulator harness to the generator and the other end to the regulator (fig. 160).

122. Engine Ground Strap

a. Removal. Unscrew the hex-head screw securing ground strap to push rod cover, remove the strap, and tighten the screw.

Note. Prior to installing the engine ground strap, make certain that the strap and screws are cleaned for good electrical contact.

b. Installation. Loosen the hex-head screw at the end of push rod cover and slip the open end of the engine ground strap under the screw head. Tighten the screw securely to hold the strap.

123. Trailer Electric Coupling Receptacle

a. Removal. Remove four nuts and screws securing the receptacle cover and connector polarizing bracket to receptacle mounting bracket, and remove cover and polarizing bracket. Push coupling receptacle free of mounting bracket, and remove receptacle (fig. 161).

b. Installation. Position receptacle behind the mounting bracket. Install receptacle, polarizing bracket, and cover to the mounting bracket with four hex-head screws and safety nuts.

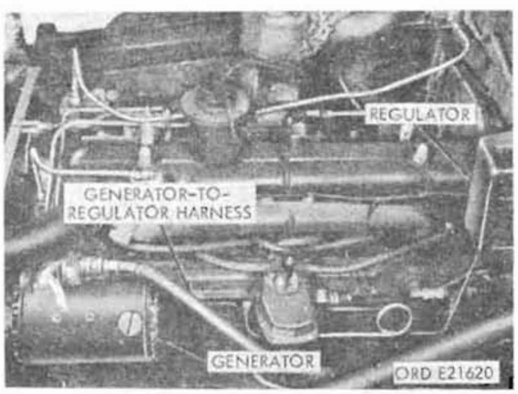

Figure 160. Removal of generator-to-regulator harness

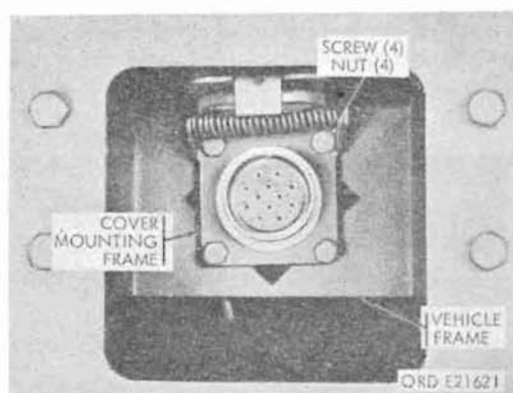

Figure 161. Trailer electrical coupling receptacle - typical

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Section XXII. INSTRUMENT CLUSTER, INSTRUMENTS, SWITCHES, CIRCUIT BREAKERS, HORN, SENDING UNITS, INDICATOR LIGHTS, SPEEDOMETER AND TACHOMETER

124. Description

a. Instrument Cluster. The instrument cluster (fig. 162 or 163), held on the instrument panel by four quick-disconnect mounting studs, holds the battery-generator indicator, fuel gage, water temperature gage, oil pressure gage, air pressure gage, speedometer, tachometer, two instrument cluster lights, and the headlight beam indicator light. The instruments are bolted or screwed to the instrument cluster. Electrical connections are through cable connectors. A flexible shaft, from an angle-drive joint on the transfer, connects to the speedometer. A flexible shaft from an angle-drive joint on the distributor drive shaft (if tachometer is used on the gasoline engine) or the front of the timing gearcase (multifuel engine) connects to the tachometer. The instrument cluster lights are controlled by a switch. The headlight beam indicator is controlled by a dimmer switch. Two models of temperature gages are in use on these trucks. Each type must be used in conjunction with its matching temperature gage sending unit.

b. Horn. Vehicles equipped with an electric horn have the horn mounted on the right headlight panel. Vehicles equipped with an air horn (fig. 175), have the horn mounted on the inner section of the right fender. The horn has an electric solenoid to control the horn operation. Either type horn is actuated from horn button on the steering wheel.

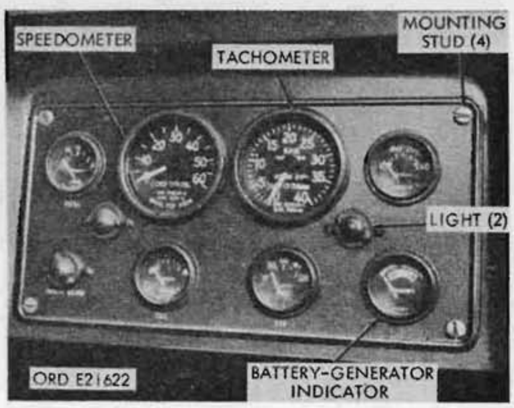

Figure 162. Instrument cluster, front view - multifuel

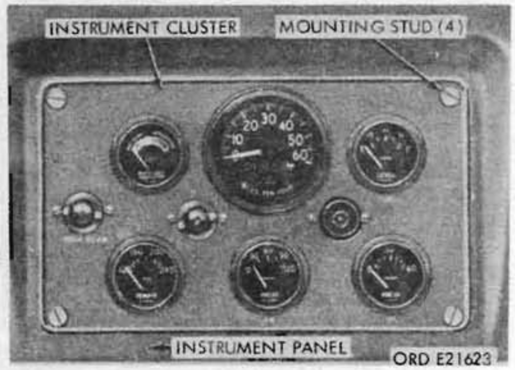

Figure 163. Instrument cluster, front view - gasoline

c. Circuit Breakers (Fig. 169). The circuit breakers are mounted on the engine side of the dash panel near the generator regulator. The vehicles have a 15-ampere circuit breaker to protect the horn circuit and a breaker built into the light switch to protect the light circuits. The M48, M275, some of the M109 and M185 series trucks, and the trucks equipped with auxiliary power outlet (as supplied in a kit form), have an additional 15-ampere circuit breaker on the firewall for special purposes. The M108 and M60 trucks have a 30-ampere circuit breaker on the dash panel for the floodlight system. The shop van body has a circuit breaker (fig. 167) on the exterior front body panel.

d. Sending Units.

(1) Fuel gage sending unit (fig. 176). This unit is mounted on the top of the fuel tank, and contains a resistance coil, formed in an arc, and swept by a radial contact. The contact is operated by a float mounted within the tank. Varying resistance, due to movement of the contact, actuates the fuel gage on the instrument panel.

(2) Temperature gage sending unit (fig. 177). This unit is mounted in a threaded opening on the engine water manifold near the outlet to the radiator. It is electrically connected to the water temperature gage in the instrument

cluster, and operates on variable resistance caused by thermal variation. The sending unit must be matched to the gage.

(3) Oil pressure gage sending unit (fig. 178). This unit is mounted in a threaded opening which extends to the engine oil passage in the lower right side of the cylinder block. The unit contains a resistance element, resistance of which varies with the engine oil pressure, which in turn varies the indicator on the oil pressure gage in the instrument cluster.

e. Switches

(1) Light switch (fig. 166). This switch is screwed to the instrument panel and provides a selective control of lighting circuits. There are two types of switches, one- and two-socket, which are not interchangeable (par. 130). Later switches, have a built-in circuit breaker for protection of lighting circuits.

(2) Dimmer switch (fig. 166). The dimmer switch is foot-operated and is located to the left and above the clutch pedal. It is effective only when the auxiliary switch of the light switch is in SER DRIVE position. The switch controls high and low headlight beam and beam indicator.

(3) Ignition switch (fig. 166). This switch, secured to instrument panel by a hex-nut, controls power to ignition circuit on the gasoline engine and to the instrument cluster gages, but not to the ammeter or battery-generator indicator. On the multifuel engine, the ignition switch is replaced by an accessory switch which controls the power to the instrument cluster gages and the engine starting circuits.

(4) Hydraulic stoplight switch (fig. 179). This switch is mounted in the slave cylinder of the air-hydraulic cylinder. It is closed by the initial fluid pressure from the master cylinder and remains closed until all pressure is relieved. Two types of switches are supplied for replacement. They are not completely interchangeable; however, the procedure for adapting either type to the existing wiring harness is given in paragraph 138.

(5) Air stoplight switch (fig. 180). The air stoplight switch, used on the M48, M275, and M257A1 trucks, is mounted behind the cab near the base of the airbrake hose support. The switch is secured by a pipe nipple to a double check-valve in the air line for the trailer airbrakes. The switch operates on air pressure from the check-valve when air is supplied to the brake hose by the airbrake hand control valve.

(6) Low air pressure buzzer switch and warning buzzer. The switch and buzzer are used to indicate unsafe pressure in the compressed air system. The switch, mounted under the cowl on the rear side of the dash panel, is actuated by air pressure in the air manifold. The switch contacts are held open by air pressures over 65 psi. Lower pressures close the contacts and cause electric current to flow to the warning buzzer, under the dash panel, causing the buzzer to sound.

125. Instrument Cluster (Fig. 162 or 163)

a. Removal. Release four quick-disconnect-type cluster mounting studs, and pull the cluster away from the panel. Disconnect the air-pressure gage airhose from the air pressure gage. Disconnect cables from the gages and lights, and disconnect the flexible shaft from the speedometer and tachometer.

b. Installation.

Caution: Be sure a replacement cluster has water temperature gage that is matched to the temperature gage sending unit (par. 126 d); otherwise, the sending unit must be replaced.

Connect the flexible shafts to the speedometer and tachometer. Connect the electrical cables to lights and gages.

Note. Be sure to follow correct circuit numbering (fig. 55).

Connect the air pressure gage airhose to the air pressure gage. Raise the cluster and place in position on the instrument panel and secure with four mounting studs.

126. Instruments

a. Standardization of Replacement Instruments. Refer to TB ORD 479 for a list of standard replacement instruments which may be used to replace defective or damaged instruments.

b. Instruments that Do Not Return to Zero. On most models, the instruments automatically return to zero when the ignition or accessory switch is turned off. On some models, the instruments remain at the readings indicated when the ignition or accessory switch is turned off. These instruments are not defective. Refer to TB ORD 434 for a complete explanation.

c. Removal.

(1) The ammeter or battery-generator indicator, fuel gage, oil pressure gage, and water temperature gage are all replaced in the same manner. The air-type air pressure gage has an airhose connection instead of the electrical cable. Disconnect the airhose at the gage when the instrument cluster is removed.

(2) Remove the instrument cluster (par. 125). Disconnect the hose or the electrical cable connectors from the gage to be replaced. Remove the two nuts and lockwashers at the back of the gage securing the gage to the clamp (fig. 164). Remove the gage and clamp from the instrument cluster panel.

d. Installation.

Note. Be sure the water temperature gage is correctly matched to the temperature gage sending unit.

Place the gage in the instrument cluster panel from the front. Install the clamp on the gage mounting studs and secure the assembly with lockwashers and nuts provided with the gage. Make hose or electrical cable connections (fig. 164 or 165). Install the instrument cluster (par. 125).

127. Instrument Cluster Lights and Headlight Beam Indicator (Fig. 162 or 163)

Note. The headlight beam indicator and the instrument cluster lights are similar. The following procedures apply to both units.

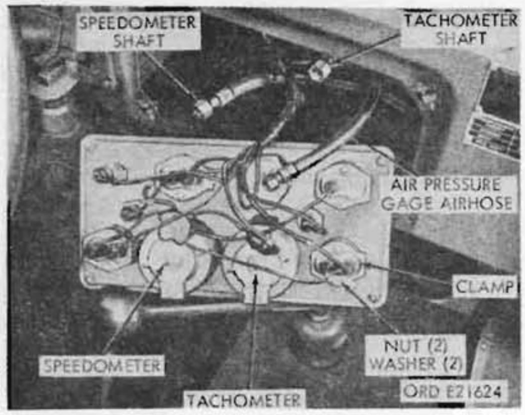

Figure 164. Instrument cluster, rear view - multifuel

a. Lamp Replacement.

(1) Removal. Press the light cover, turn counterclockwise, and remove the cover and gasket from the light body. Press in on the lamp, turn the lamp counterclockwise, and remove from socket.

(2) Installation. Install the replacement lamp in the socket and turn clockwise to lock. Install the gasket and cover on the body and turn the cover clockwise to lock it on the body.

b. Lampholder Replacement.

(1) Removal. Remove the instrument cluster (par. 125). Disconnect the cable (fig. 164 or 165) from the back of the lampholder. Remove two screws and

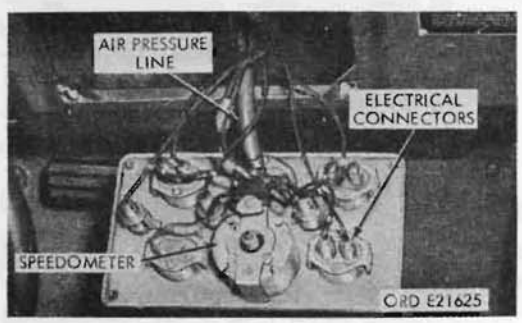

Figure 165. Instrument cluster, rear view - gasoline

lockwashers from the front of the instrument cluster panel, and remove the lampholder from the panel.

(2) Installation. Insert the lampholder from the back of the instrument cluster panel, and fasten to the panel with two roundhead screws and lockwashers inserted from the front. Install the proper cable (fig. 164 or 165) on the back of the lampholder, and install the instrument cluster (par. 125).

128. Ignition Switch (Gasoline Engine)

a. Removal. Disconnect the battery ground cable (fig. 153) before the removal of the ignition switch (fig. 166). Remove the screw from the center of the switch handle and remove the handle. Remove the hex-nut and lockwasher holding the switch to the instrument panel and remove the switch from the back of the panel. Disconnect the cables from the switch.

b. Installation. Connect the cables (11, 12, 27, and 85) (fig. 71) to the switch. Place the ignition switch in position on the instrument panel and secure to the panel with a lockwasher and hex-nut. Install the switch handle and secure with screw. Connect the battery ground cable (fig. 153) to the battery.

129. Accessory Switch (Multifuel Engine)

The accessory switch is identical to the ignition switch in gasoline model trucks. Refer to paragraph 128 for removal procedures.

130. Light Switch

a. General. Either single or double receptacle light switches are in use on these vehicles. Replacement switch should be the same as the original; otherwise the chassis wiring harness (par. 118) may have to be exchanged for one fitting the new-type switch. Refer to the direct support maintenance personnel, if the equivalent switch is not obtainable.

b. Removal. Remove the receptacle connector(s) from the receptacle(s) on the back of the light switch (fig. 52). Remove the four screws holding the switch to the instrument panel, and remove the switch.

c. Installation. Place the light switch (fig. 166) in the dash panel from the front, and secure with the four internal-teeth lockwasher and cross-recess-binding head screws. Connect the connector(s) to the switch receptacle(s).

d. Testing. Test the light switch by setting the switch levers in all positions and checking the lights. Refer to Table 6 for combinations of settings and conditions of the lights.

131. Headlight Dimmer Switch

a. Removal. Remove the two screws securing the dimmer switch (fig. 167) and switch protector to the toeboard, and remove the switch and protector. Disconnect the cables from the switch.

b. Installation. Connect the cables (16, 17, and 18) (fig. 71) to the switch. Install the dimmer switch (fig. 167) to the underside of the toeboard with two external-teeth lockwasher and cross-recess panhead screws, but do not tighten the screws. Position protector over the switch and slide the slotted side of the protector between the switch mounting bracket and the toeboard. Tighten the screws to secure the protector and switch on the toeboard.

c. Testing. With the auxiliary switch of the light switch (par. 130) in SER DRIVE position, operate the dimmer switch button and check the headlight high and low beams.

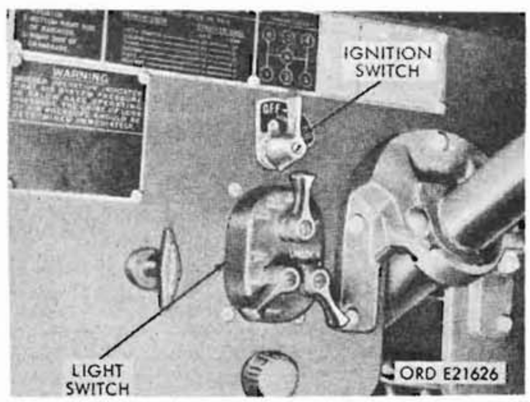

Figure 166. Switch group - gasoline

Table 6. Test Chart for Light Switch

Position of switch levers	Condition of lights
1. MAIN-OFF and AUXILIARY-OFF	All lights out.
2. MAIN-BO MARKER and AUXILIARY-OFF	Blackout marker, blackout stop, and blackout taillight circuits energized.
AUXILIARY DIM	Adds dim instrument cluster lights.
AUXILIARY-PANEL BRT	Adds bright instrument panel lights.
AUXILIARY-PARK	Adds dim instrument cluster lights.
3. MAIN-BO DRIVE (UNLOCK MECHANICAL LOCK) and AUXILIARY-OFF	Blackout head, blackout stop, blackout tail, and blackout marker light circuits energized.
AUXILIARY-OFF	Adds dim instrument cluster lights.
AUXILIARY-DIM	Adds dim instrument cluster lights.
AUXILIARY-PANEL BRT	Adds dim instrument cluster lights.
AUXILIARY-PARK	Adds dim instrument cluster lights.
4. MAIN-STOPLIGHT (UNLOCK MECHANICAL LOCK) and AUXILIARY-OFF	Service stoplight circuit energized.
AUXILIARY-DIM	Adds dim instrument cluster lights.
AUXILIARY-PANEL BRT	Adds bright instrument cluster lights.
AUXILIARY-PARK	Adds dim instrument cluster lights.
5. MAIN-SER DRIVE (UNLOCK MECHANICAL LOCK) and AUXILIARY-OFF	Service head, service tail, and service stoplight circuits energized.
AUXILIARY-DIM	Adds dim instrument cluster lights.
AUXILIARY-PANEL BRT	Adds bright instrument cluster lights.
AUXILIARY-PARK	Adds service parking lights and dim instrument cluster lights. Remove service headlights.

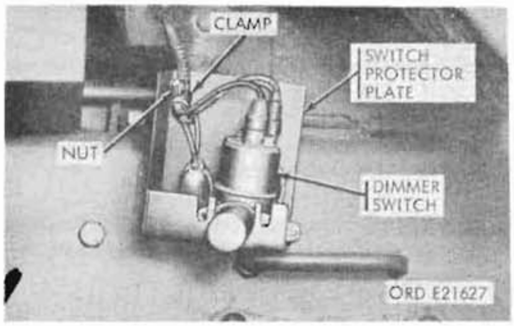

Figure 167. Dimmer switch - partially removed

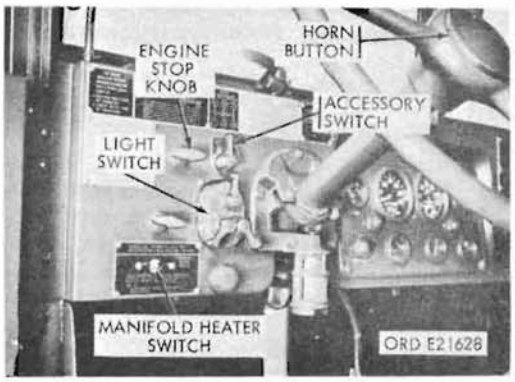

Figure 168. Switch group - multifuel

132. Circuit Breakers (Fig. 169)

a. Removal. Disconnect the connectors (fig. 169) from the circuit breaker. Remove two screws, and remove the breaker.

b. Installation. Install the circuit breaker with two cross-recess panhead tapping screws, and install the connectors (fig. 169).

c. Testing. Operate the switch in the circuit containing the circuit breaker to be tested; then operate a unit protected by the circuit breaker. If the unit operates, the circuit breaker is in good condition.

133. Speedometer Assembly

a. Speedometer.

(1) Removal. Remove the instrument cluster (par. 125) from the dash panel. Disconnect the flexible shaft from the speedometer (fig. 164 or 165). Remove two mounting nuts and lockwashers from the mounting clamp, and remove the speedometer from the front side of the instrument cluster panel.

(2) Installation. Place the speedometer in position and install the mounting clamp, lockwashers, and nuts. Connect the flexible shaft to the speedometer. Install the instrument cluster (par. 125).

(3) Mileage. Enter in the vehicle equipment log the odometer mileage indication from both the speedometer being replaced and the speedometer being installed, to preserve the continuity of the total vehicle mileage. See TB ORD 1030 for data plate changes.

b. Speedometer Flexible Shaft.

(1) Removal. Disconnect the flexible shaft from the angle-drive adapter on the transfer (fig. 170) and from the speedometer. Disconnect the clips and remove the flexible shaft from the vehicle.

(2) Installation.

(a) Note that the ends of the flexible shaft are different. The end attached to the angle-drive adapter has a small projecting shaft with a key. Place the flexible shaft in the truck

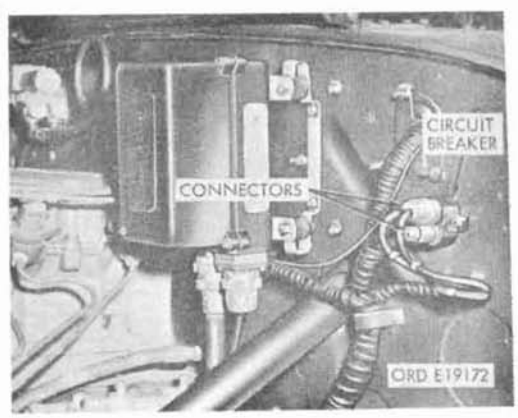

Figure 169. Circuit breaker

frame in the original location. Aline the key in the end of the flexible shaft with the keyway in drive adapter and insert the shaft. Tighten the connecting nut on the drive joint.

(b) Pass the speedometer end of the flexible shaft through the firewall. Insert the square end of the shaft into the speedometer, and tighten the connecting nut. Fasten the clips to secure the flexible shaft to the chassis.

c. Speedometer Angle-drive Adapter (Fig. 170).

(1) Removal. Disconnect the flexible shaft from the angle-drive adapter. Unscrew the adapter from the transfer.

(2) Installation. Screw the adapter into the adapter hole in the transfer.

Note. Make sure the lip of the rubber seal faces inward - toward the transfer case - to prevent lubricant leakage.

Connect the flexible shaft to the adapter.

d. Speedometer Flexible Shaft Core.

(1) Removal. Disconnect both ends of flexible shaft. Remove damaged core by pulling on the transfer end with a pair of pliers. If core is broken, also pull the speedometer end of the core out of the flexible shaft housing by using the same procedure.

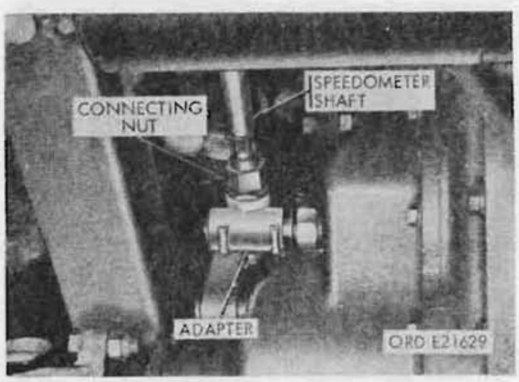

Figure 170. Speedometer flexible shaft angle drive adapter

(2) Installation.

(a) Insert the replacement core into the transfer end of the flexible shaft housing and carefully push it through until it fits snugly into the end of the attachment bushing.

(b) Reconnect the ends of the flexible shaft to the transfer and speedometer.

134. Tachometer Assembly (Fig. 171)

a. Tachometer.

(1) Removal. Removal procedure for the tachometer is the same as for the speedometer. Refer to paragraph 133a.

(2) Installation. Installation procedure for the tachometer is the same as for the speedometer. Refer to paragraph 133a.

(3) Hours of operation. Enter in the vehicle equipment log the hours indication from both the tachometer being replaced and the tachometer being installed, to preserve the continuity of the total vehicle hours of operation.

b. Tachometer Flexible Shaft.

(1) Removal. Disconnect the flexible shaft ends from the angle-drive adapter

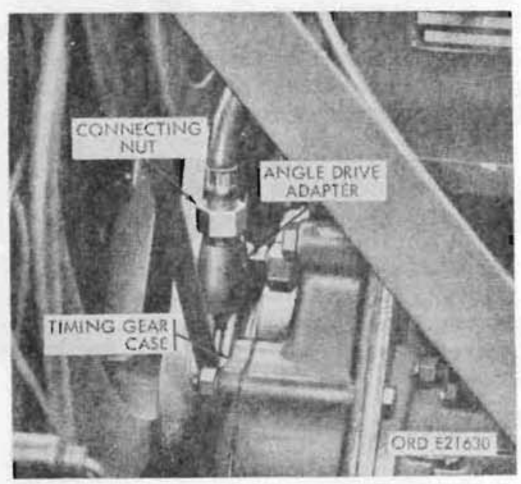

Figure 171. Tachometer flexible shaft angle drive adapter

on the timing gearcase (fig. 171). Disconnect the clips on the engine and remove the flexible shaft from the vehicle.

(2) Installation.

(a) Notice that the ends of the flexible shaft are different. The end attached to the angle-drive adapter has a small projecting shaft with a key. Push the other end of the shaft through the rubber bushing in the firewall. Place shaft along the top of the engine in the original location. Aline the key in the flexible shaft with the keyway in the drive adapter and insert the shaft. Tighten the connecting nut on the drive joint.

(b) Insert the square end of the flexible shaft into the tachometer, and tighten the connecting nut. Fasten the clips to secure the flexible shaft to the engine.

c. Tachometer Angle-drive Adapter.

(1) Removal. Disconnect the flexible shaft from the angle-drive adapter (fig. 171). Unscrew the adapter from the timing gearcase.

(2) Installation. Screw the adapter into the adapter hole in the timing gearcase, facing it in the direction most convenient for connection to the flexible shaft. Connect the flexible shaft to the adapter (b(2)(a) above).

d. Tachometer Flexible Shaft Core.

(1) Removal. Disconnect both ends of flexible shaft. Remove damaged core by pulling on the engine end with a pair of pliers. If the core is broken, also pull the tachometer end of the core out of the flexible shaft housing, using the same procedure.

(2) Installation.

(a) Insert the replacement core into the the engine end of the flexible shaft housing and carefully push it through until it fits snugly into the end of the attachment bushing.

(b) Reconnect the ends of the flexible shaft to the engine and the tachometer.

135. Horn and Horn Button

a. Horn Button.

(1) Removal. Horn button is mounted in the center of the steering wheel. To remove, lift the rubber cap, press down on the button, and turn counterclockwise one-quarter turn to disengage from the steering wheel (fig. 172).

(2) Cleaning. Clean contacts thoroughly. Wipe out the button recess in the steering wheel.

(3) Installation. Place the horn button in recess in the steering wheel, press down and turn clockwise until engaged. Install the rubber cap over the button.

b. Electric Horn (Fig. 173).

(1) Removal. Disconnect the cables (fig. 56) at the horn. Remove two screws and lockwashers holding the horn mounting bracket to the panel, and remove the horn and bracket. Remove the four nuts, the four lockwashers, and the two screws securing the horn to the bracket, and remove the horn.

(2) Adjustment (fig. 174).

(a) Remove screws and star washers securing back cover of horn assembly.

(b) Remove back cover from horn assembly.

(c) Install horn assembly on horn mounting bracket with back cover off.

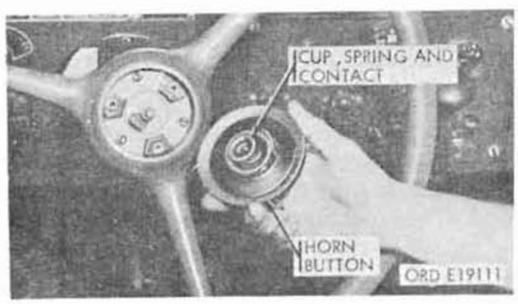

Figure 172. Horn button removed

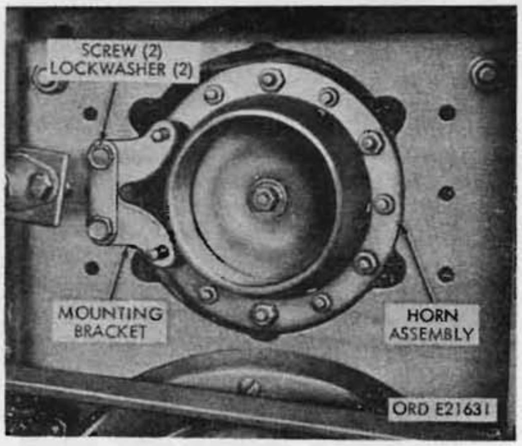

Figure 173. Electric horn

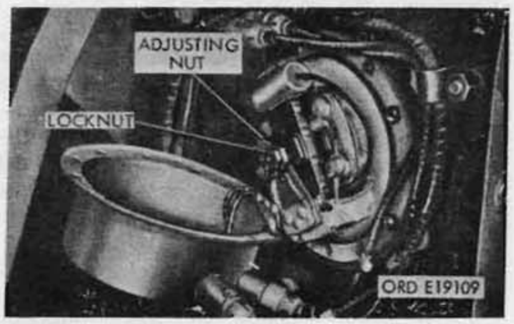

Figure 174. Electric horn adjustment

(d) Loosen outer locknut and turn adjusting nut for horn adjustment. Tighten locknut.

(e) Remove horn from bracket, install back cover, and install horn ((3) below).

(3) Installation. Install the horn on the bracket with two roundhead screws, four lockwashers, and four hex-nuts. Position the horn against the back of the headlight panel, and install two hex-head screws and the lockwashers through the panel into the mounting bracket. Connect the cables (fig. 56) to the horn.

c. Air Horn (Fig. 175).

(1) Removal. Drain air reservoirs (par. 222). Disconnect two cables (fig. 56) at the horn solenoid. Disconnect the air horn and air supply line from the horn solenoid. Remove the two screws holding the horn to the mounting bracket, and remove the horn.

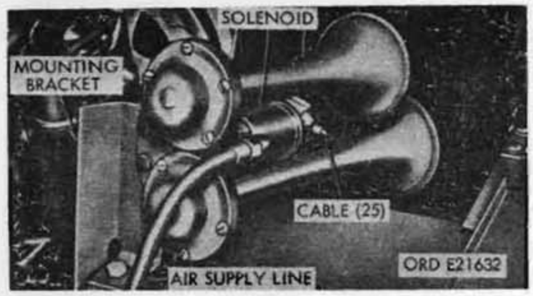

Figure 175. Air horns

(2) Air horn solenoid replacement. Unscrew the solenoid from the horn. Install the new solenoid in the horn.

(3) Installation. Install the horn on the bracket and secure with two hex-head screws and safety nuts. Connect the air supply line to the horn solenoid. Connect the two cables (fig. 56) to the solenoid.

136. Sending Units

a. Removal.

(1) Water temperature and oil pressure gage sending units. These units have pipe thread connections. Disconnect the proper cable (fig. 177 or 178), and remove unit.

(2) Fuel gage sending unit.

Warning: Do not permit smoking, sparks or open flame within 50 feet of vehicle during any operation involving open fuel tanks, fuel line removal, or fuel draining.

This unit is flange-mounted on the fuel tank. Loosen nuts on the bottom ends of straps holding the fuel tank. Remove screws and nuts at the top ends of straps, and slide the tank out on fuel tank supports (fig. 176) to clear body. Disconnect the cable from the

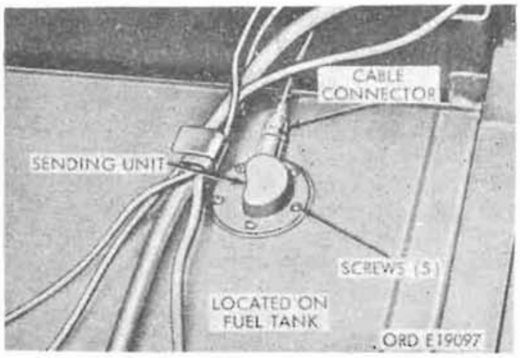

Figure 176. Fuel level gage sending unit

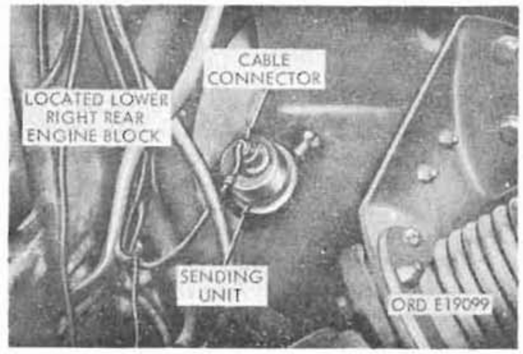

Figure 178. Oil pressure gage sending unit

sending unit. Remove five screws and copper washers securing the unit in the tank, and lift unit from the tank. Discard gasket.

b. Installation.

(1) Water temperature and oil pressure, gage sending units. These units have pipe thread connections. Coat the threads with an approved heat-resistant sealer, screw the unit into its mounting hole and connect the proper cable (fig. 177 or 178).

(2) Fuel gage sending unit.

Note. Observe warning in a (2) above.

This unit is flange-mounted on the fuel tank. Place a new sending unit gasket on the mounting pad on the tank, insert the unit operating mechanism in the tank and secure the unit to pad with five roundhead screws and copper washers. Connect the cable to the unit. Reposition tank on supports, and secure the holding straps with a hexhead screw and safety nut for each strap. Tighten the bottom nuts on straps.

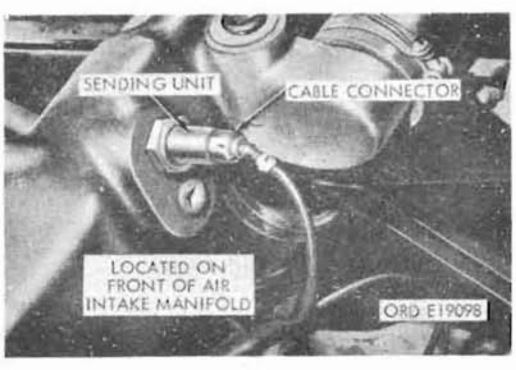

Figure 177. Temperature gage sending unit

137. Air Stoplight Switch (M48, M275 and M275A1) (Fig. 179)

a. Removal. Disconnect two cables from switch. Remove the switch from the pipe nipple on check-valve.

b. Installation. Install the switch on pipe nipple on check-valve. Connect two cables to the switch.

c. Testing. With light switch set to the stoplight position, operate the airbrake hand control and check to see that the stoplights light.

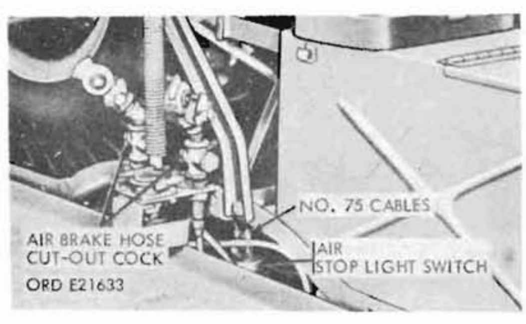

Figure 179. Air stoplight switch - M48 and M275 tractor trucks

138. Hydraulic Stoplight Switch

a. General.

(1) Two types of stoplight switches are in use on the 2-1/2 ton, 6 x 6, trucks. The older type (A, fig. 181) consists of a switch body with two electrical wires permanently attached, terminated in individual connectors. The newer type (C, fig. 181) does not have the permanently attached wires and connectors. Instead, it consists of a switch body with an attached connector shell encircling two male contacts.

(2) The correct replacement switch should be used whenever possible. However, if necessary, the switches may be interchanged, using the procedure in e and f below.

b. Removal. Disconnect the electrical connections from the switch (fig. 180) and unscrew switch from air-hydraulic cylinder.

c. Installation.

(1) Install switch in the air-hydraulic cylinder and screw in tight. Connect electrical connections to the switch (fig. 180).

(2) Bleed the service brake system (par. 177).

d. Testing. With light switch set to stoplight position, depress brake pedal and check to see that stoplights light.

e. Replacing Old-type Stoplight Switch with New-type Stoplight Switch.

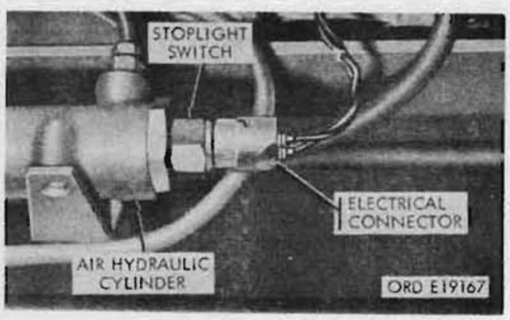

Figure 180. Hydraulic stoplight switch

(1) The required parts are contained in Waterproof Electrical Repair Kit H020-5701060.

(2) Replacement of the old-type switch (A, fig. 181) with a new-type switch (C, fig. 181) presents a condition where the chassis harness will not reach the switch; also, the connecting terminals will not match. The additional length of cable needed to reach the chassis harness is provided by utilizing a portion of the old-type switch ((3) below).

(3) Sever the electric cables from the old-type switch as close as possible to the switch body and strip these cable ends (B, fig. 181) to permit the installation of two male terminals, the waterproof cable-connector grommet, the grommet adapting bushing, and the female "Y" connector waterproof shell (D, fig. 181).

(4) Utilizing this modified portion of the old-type switch and two electrical connector terminal sleeves, connect the new-type switch to the chassis harness.

f. Replacing a New-type Stoplight Switch with an Old-type Stoplight Switch.

(1) Replacement of the new-type switch (C, fig. 181) with an old-type switch (A, fig. 182) presents a condition where, although the switch and chassis harness are in position to be joined, the connecting terminals will not match.

(2) Cut the male waterproof cable-connector shell and the female waterproof cable-connector shell off the old-type switch (A, fig. 182).

(3) Replace with the male waterproof connector shell, utilizing the terminals, grommets, and bushings of the old-type switch (B, fig. 182).

(4) Connect the chassis harness to the old-type stoplight switch.

Note. By making the above change to the old-type stoplight switch cables instead of to the chassis harness, it will not be necessary to change any

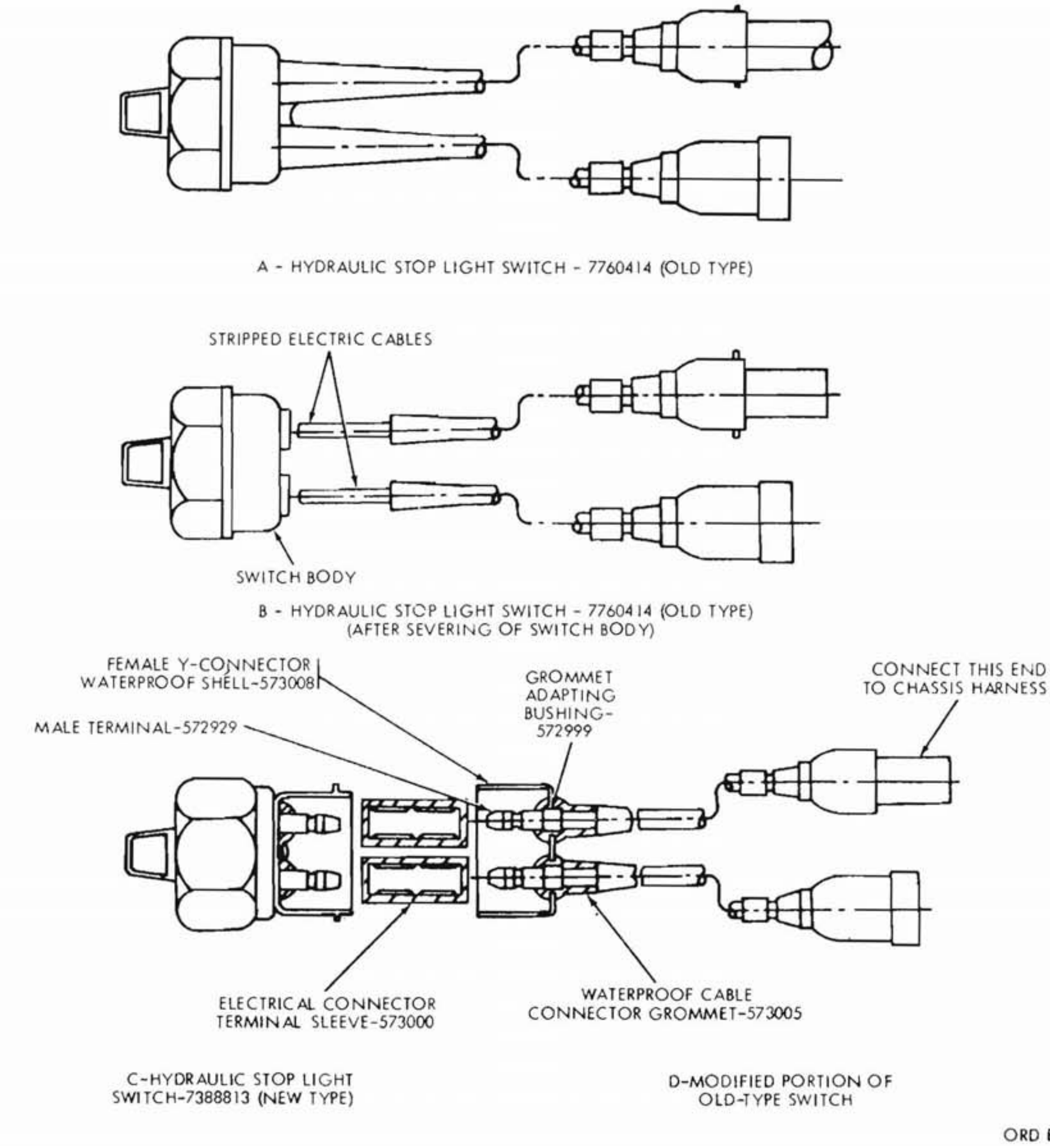

Figure 181. Cables from old-type stoplight switch adapted for use with new-type switch

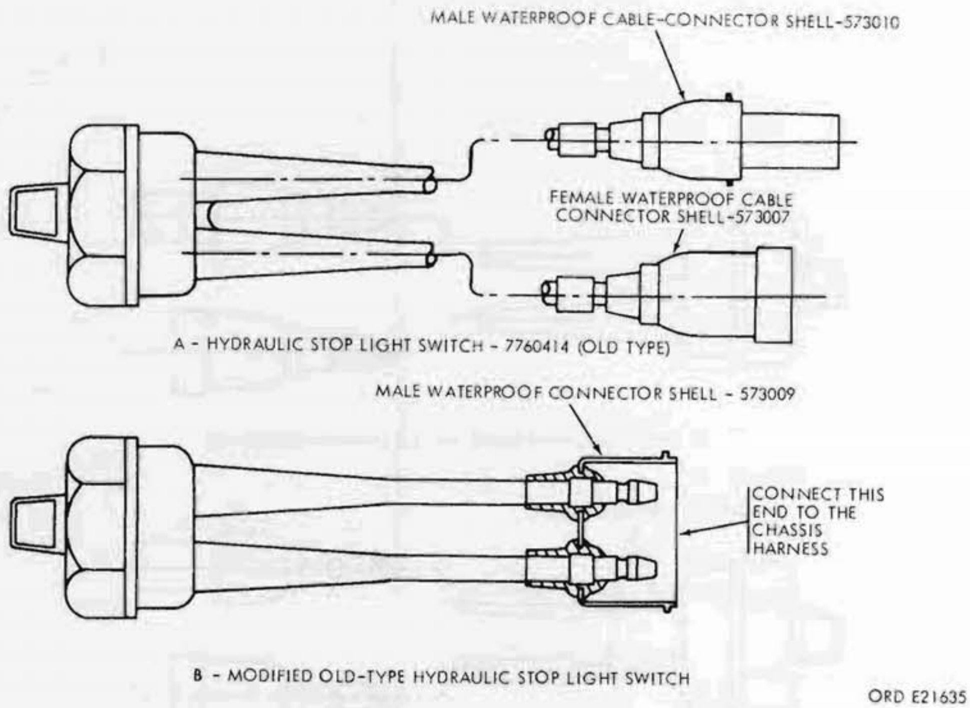

Figure 182. Old-type stoplight switch adapted for use with new-type harness

of the harness connections when it becomes necessary to replace with a new-type switch.

139. Low Air Pressure Warning Buzzer (Fig. 183)

a. Removal. Disconnect cable from buzzer, remove three screws and safety nuts securing the buzzer to the dash panel, and remove the buzzer.

b. Installation. Place the buzzer on the dash panel and secure with three hex-head screws and safety nuts. Connect the cable to the buzzer.

c. Test. Drain the air reservoir (par. 222) until the pressure is below 65 psi. Buzzer must operate with the air pressure below 65 psi.

140. Low Air Pressure Buzzer Switch (Fig. 183)

a. Removal. Disconnect two cables from switch. Drain air reservoirs (par. 222) by opening draincocks. Disconnect pressure switch airline from switch, remove two screws securing switch to the dash panel, and remove switch.

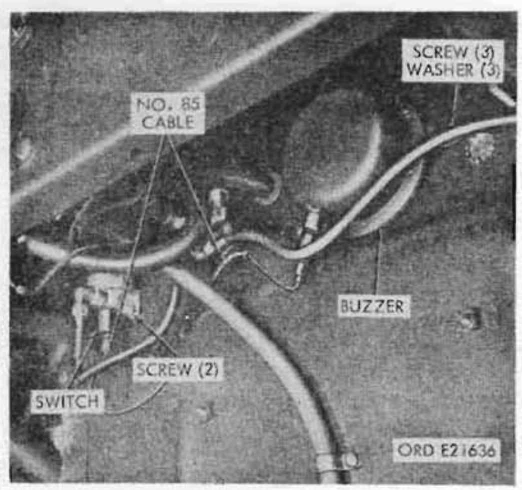

Figure 183. Low air pressure warning buzzer and switch

b. Installation. Install the switch on the dash panel with two external-teeth lockwasher screws. Connect the switch airline to the switch. Connect the two cables to the switch. Start the engine and build up the air pressure in reservoirs.

c. Test. Refer to Table 5, figure 56, test 2.

141. Manifold Preheater Switch (Fig. 168)

a. Removal (Fig. 184).

(1) Remove screws securing manifold preheater switch to the dash panel, and remove switch.

(2) Disconnect cable connectors from manifold preheater switch.

b. Installation (Fig. 184).

(1) Hold switch in position and connect two cable connectors to switch terminals.

(2) Install switch on dash panel with two external-teeth lockwasher screws.

c. Test. Refer to TM 9-2320-209-10.

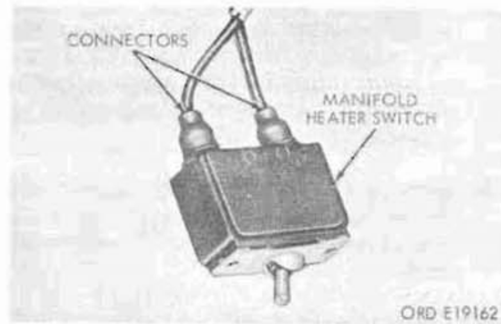

Figure 184. Manifold preheater switch - removed

Section XXIII. RADIO INTERFERENCE SUPPRESSION

142. Purpose

a. Radio interference suppression is the elimination or minimizing of electrical disturbances which interfere with radio reception or disclose the location of the vehicle to sensitive electrical detectors. It is important, therefore, that all vehicles, with or without radios, be suppressed properly to avoid detection and to prevent interference with radio reception of neighboring vehicles.

b. Suppression in these vehicles is accomplished by the use of resistor suppressors and capacitors. In addition, metal parts in the vicinity of the engine are formed into a shield by use of braided bond straps and toothed washers, confining electrical disturbances so they cannot disturb receiving equipment. Wiring that may carry interfering surges to a point where interference will affect radio reception is shielded.

143. Coordination with Direct Support Maintenance Unit

Refer to paragraph 2 for information on coordination with direct support maintenance unit.

144. Description

a. Ignition System (Gasoline Engine).

(1) Spark plugs. Each plug is integrally shielded and contains a built-in resistor for interference suppression.

(2) Spark plug cables. Each cable is shielded by copper-braid conduit covered by rubber. Conduit nuts ground the flexible shielding.

(3) Distributor. The distributor has a resistor,. capacitor or feed-through capacitor in the input circuit to the ignition coil. A capacitor is located in the terminal coupling and coupling housing on the distributor (fig. 142). A terminal on the coupling end of capacitor acts as a coupling terminal for cable connection. A resistor-capacitor assembly connects on other end to the coil resistor in the distributor. The coil resistor connects to the ignition coil and coil capacitor. These two capacitors and one resistor act as an input filter to the ignition system for radio suppression. Distributor rotor has a built-in resistor and each

cable terminal on distributor cap has a built-in resistor for distributor output filtering.

b. Charging System.

(1) Generator. Generator has static collector brushes and generator capacitor for suppression purposes. Capacitor, in cable connector receptacle elbow on generator housing, is connected to generator output cable.

(2) Generator regulator. Regulator has choke coil in field circuit input and two capacitors in regulator output circuit.

(3) Generator-to-regulator wiring harness. Harness is shielded by braided conduit and terminates in connectors, grounding the shielding.

c. Starting System. Starter has capacitor inside of commutator end cover. Capacitor is located in field circuit to prevent feedback to electrical system.

d. Ground and Bond Straps. Two radiator ground straps are located at bottom of radiator (fig. 135). Engine ground straps are located at rear of engine (fig. 79) and on flywheel housing. The two ground straps at bottom of radiator, one on each side, are between radiator and engine front mounting support. The ground strap at rear of engine is between left side of engine and firewall. The ground strap connects flywheel housing to chassis at engine rear mounting support.

145. Ignition System (Gasoline Engine)

a. Spark Plugs. Suppression resistor is an integral part of spark plug. Replace spark plug (par. 98), if resistor is defective.

b. Spark Plug Cables. Cable shielding is integral with cable. Replace cable (par. 99), if shielding is defective.

c. Distributor (Fig. 142).

(1) Resistor-capacitor.

(a) Removal. Remove ignition-switch-to-ignition-coil cable from distributor. Remove distributor cover (par. 94). Remove four screws securing distributor terminal coupling on distributor housing, and remove coupling and gasket. Disconnect coil capacitor cable from coil resistor, and pull out resistor-capacitor.

(b) Installation. Insert resistor-capacitor into distributor housing with capacitor cable extending into distributor interior and secure cable to coil resistor. Install gasket and coupling on housing and secure with four lockwasher fillister-head screws. Install distributor cover (par. 94).

(2) Coil resistor.

(a) Removal. Remove distributor cover (par. 94). Remove cables connecting coil resistor to ignition coil and resistor-capacitor. Remove two screws, washers, and resistor mounting bracket holding resistor in distributor housing, and remove resistor.

(b) Installation. Install resistor in housing and secure with mounting bracket and two roundhead screws and lockwashers. Connect coil capacitor cable to terminal on top end of resistor. Connect resistor cable to positive (+) terminal on ignition coil. Install distributor cover (par. 94).

(3) Coil capacitor.

(a) Removal. Remove distributor cover (par. 94). Remove coil capacitor cable from ignition coil positive (+) terminal. Loosen screw holding capacitor clamp over capacitor, and turn clamp to clear capacitor. Remove capacitor.

(b) Installation. Install capacitor in distributor housing. Turn clamp over capacitor, and tighten clamp screw. Connect capacitor cable to ignition coil positive (+) terminal. Install distributor cover (par. 94).

(4) Rotor resistor. Resistor is integral with rotor. Remove distributor cover (par. 94). Replace rotor (par. 95), if resistor is defective. Install distributor cover (par. 94).

(5) Cap terminal resistors. Resistors are integral with cap. Replace distributor

cap and cover (par. 94), if resistors are defective.

146. Charging System

a. Generator. The generator capacitor is enclosed in the waterproof generator housing. Replace generator (par. 108) if capacitor is defective.

b. Generator Regulator. Regulator capacitors are enclosed in sealed regulator. Replace generator regulator (par. 109) if capacitors are defective.

147. Starting System

a. Starter Capacitor Removal. Remove commutator end cover (fig. 146) from starter. Loosen screw holding capacitor cable to brush holder, and remove cable. Loosen commutator end head screw securing capacitor mounting bracket to end head, and remove bracket and capacitor.

b. Starter Capacitor Installation. Install capacitor by securing mounting bracket under commutator end head screw. Connect capacitor cable to brush holder screw. Install commutator end cover (fig. 146) on starter.

148. Ground Straps

a. Radiator Ground Straps.

(1) Removal. Remove nut and screw securing each strap to radiator (fig. 135). Loosen nut and screw securing open end terminal of strap to engine front mounting support and remove strap.

(2) Installation. Connect each strap to engine front mounting support (fig. 135), and tighten nut and screw securely. Connect strap to radiator with an external-teeth lockwasher hex-head screw and safety nut for each strap.

b. Engine Ground Strap.

(1) Removal. Loosen screw securing open end terminal of engine ground strap (fig. 79) to push rod cover and remove strap from cover. Remove nut and screw securing strap to firewall and remove strap.

(2) Installation Connect engine ground strap (fig. 79) to firewall with external-teeth lockwasher hex-head screw and safety nut. Slide open end terminal under screw on push rod cover and tighten screw securely.

c. Flywheel Ground Strap.

(1) Removal. Loosen screw on flywheel housing securing strap, and remove strap from housing. Remove screw and washer securing strap to engine rear support bracket, and remove strap.

(2) Installation. Connect strap to engine rear support bracket with external-teeth lockwasher, hex-head screw and plain washer. Slide open end terminal of strap under flywheel housing screw, and tighten screw securely.

Section XXIV. CLUTCH

149. Description

The clutch consists of two separate groupings of parts. The clutch disk and pressure plate mechanism is in the flywheel housing (fig. 185). The clutch release bearing and throwout shaft mechanism is in the clutch housing (fig. 186) and is attached to and considered part of the transmission (par. 153). The driven disk, when clamped between the flywheel and the pressure plate, transmits engine power from the flywheel to the transmission. The clutch is always in engaged position, unless purposely disengaged by the driver. Foot pressure on the clutch pedal causes the release bearing to actuate the pressure plate to free the clutch disk from engagement.

150. Controls and Linkages

a. Adjustment. Adjust the engine clutch controls and linkage as shown in figure 187. Loosen the locknut on the clutch control rod assembly and remove the pin connecting the

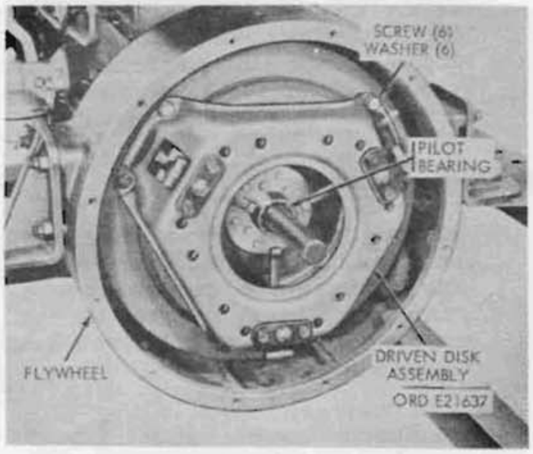

Figure 185. Clutch disk and pressure plate mechanism

adjustable yoke to the clutch throwout shaft lever. Turn the yoke until the desired setting is obtained. Free pedal travel must be between one and one-half to two inches. Connect the yoke to the clutch throwout shaft lever and tighten locknut. See par. d. for approximate configuration of linkage.

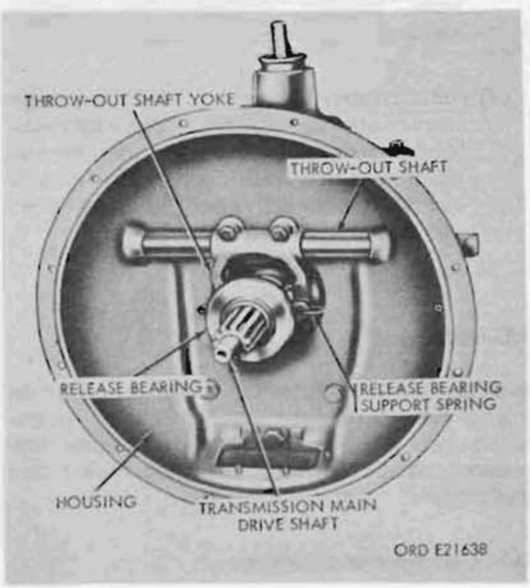

Figure 186. Clutch release bearing and throwout shaft yoke

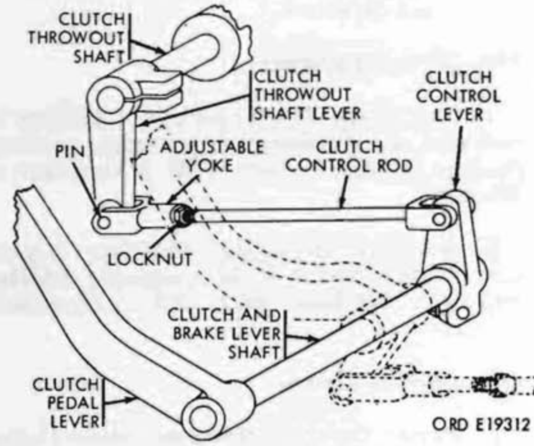

Figure 187. Clutch controls and linkage adjustment

b. Removal (Fig. 187).

(1) Loosen the screw securing the clutch pedal lever to the clutch and brake lever shaft and remove the clutch pedal lever.

(2) Loosen the nut on the clamp securing the clutch throwout shaft lever to the clutch throwout shaft and remove the lever.

(3) Loosen the nut on the screw securing the clutch control lever to clutch and brake lever shaft and remove the control lever and lever shaft.

c. Repair. Weld, straighten, or replace broken or damaged parts as necessary.

d. Installation. Install items in reverse order of removal. Using the following as an approximate configuration of the linkage.

(1) Rotate clutch throwout shaft clockwise until face of throw out bearing contacts ends of release levers in clutch assembly.

(2) Install throw out lever on throw out shaft with the lever center line one (1) spline to the rear of the vertical center line of throw out shaft (fig. 187.1) and onto shaft until 3/8" full splines shows after "flated" area (fig. 187.1). From center line of hole in throw out lever for control rod attaching pin to flywheel housing flange on transmission should be approximately 3-1/4" (fig. 187.1).

(3) Measurement between center line of the hole for attaching control rod, should be approximately 14-1/8" (fig. 187.1).

(4) Attach control rod to throw out release lever with pin head toward transmission control rod to clutch control lever with locknut toward transmission. Pins must fit freely.

(5) This should give 1-1/2" to 2" free pedal travel. If adjustment is required, lengthening the rod decreases amount of free pedal; shortening the rod increases amount of free pedal.

151. Pressure Plate.

Note. Prior to removal of the clutch asssembly, it is necessary to remove the transmission in accordance with paragraph 154.

a. Coordination with Direct Support Maintenance Unit. Refer to paragraph 2 for information in coordination with the direct support maintenance unit.

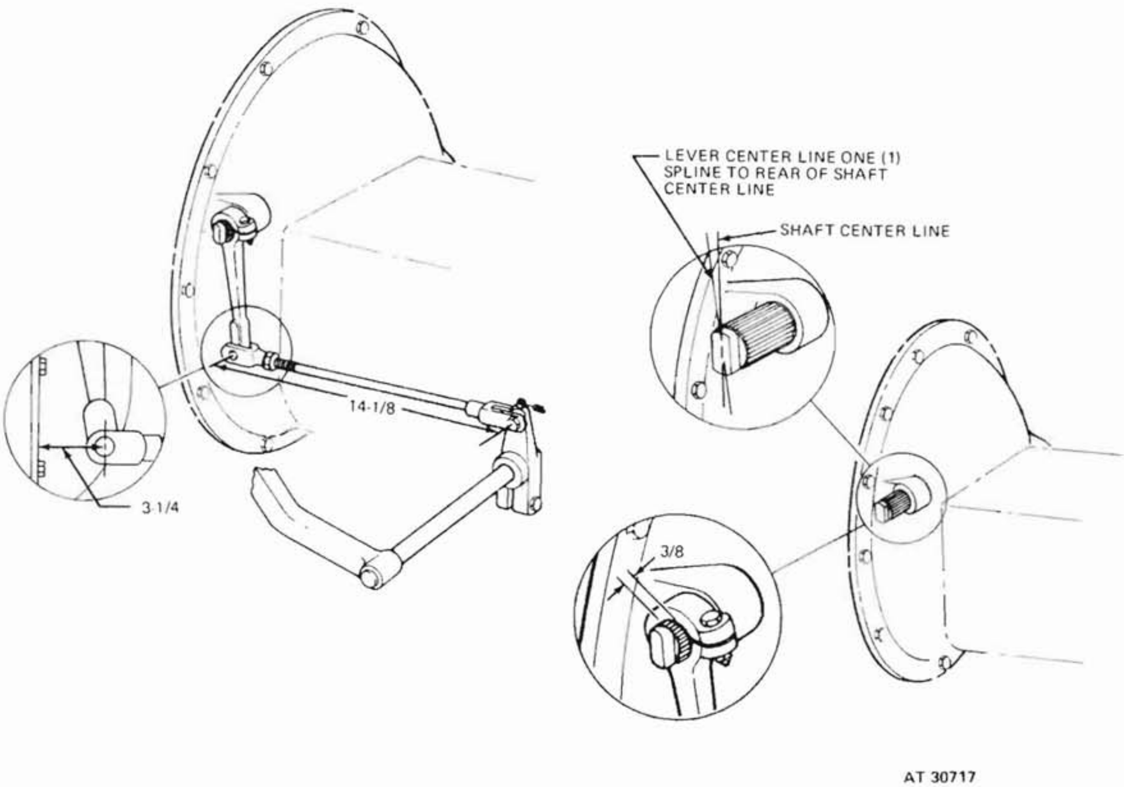

Figure 187.1 Location of linkage adjustment points.

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b. Removal (Fig. 185).

(1) Remove the six screws and washers securing the clutch assembly to the flywheel.

(2) Remove the driven disk from the shaft and flywheel assembly.

c. Installation (Fig. 185).

(1) Position the alining arbor in the clutch pilot bearing.

(2) Position the driven disk with the short extension of the hub toward the flywheel.

(3) Install the pressure plate assembly to the flywheel with six washers and screws.

152 Clutch Release Bearing and Throwout Shaft Yoke

a. Coordination with Direct Support Maintenance Unit. Refer to paragraph 2 for information on coordination with the direct support maintenance unit.

b. Removal.

(1) Remove transmission. Refer to paragraph 154.

(2) Remove clutch release bearing. Remove the clutch release bearing support springs (fig. 186) from the clutch release bearing support, and slide the bearing and support from the sleeve of the transmission main drive shaft bearing cap. Remove the release bearing and two support buttons from the bearing support.

(3) Remove clutch throwout shaft yoke. Remove the two screws, lockwashers, and keys holding the clutch throwout shaft yoke to the clutch throwout shaft. Pull the shaft from the clutch housing, and remove the yoke.

c. Installation.

(1) Install clutch throwout shaft yoke. Slide the clutch throwout shaft through the shaft opening in the clutch housing with the squared end of the shaft to the right when facing the clutch housing end of the transmission. Install the throwout shaft yoke on the end of the shaft in the housing, being sure the curved surfaces that will contact the release bearing support face away from the transmission. Slide the shaft through the other shaft opening in the housing, and install two yoke keys through the yoke slot into the keyways in the shaft. Secure the yoke keys in place and the yoke on the shaft with two hex-head screws and lockwashers.

(2) Install clutch release bearing. Install the release bearing on the bearing support. Insert two support buttons in the holes in the bearing support. Slide the bearing and the support on the sleeve of the main drive shaft bearing cap. Install two release bearing support springs (fig. 186) in the throwout shaft yoke and the bearing support.

Section XXV. TRANSMISSION

153. Description and Data

a. Description. The transmission (fig. 188) is a manually shifted, selective gear type with five speeds forward and one reverse. It is mounted on and supported by the flywheel housing and includes part of the clutch (par. 149). Gear shifting is by transmission gearshift lever.

b. Data.

Make	Spicer Mfg. Co.
Model	3052
Type	synchromesh
Gear ratios:	
Reverse	7.36-to-1.00
First	7.55-to-1.00
Second	4.18-to-1.00
Third	2.45-to-1.00

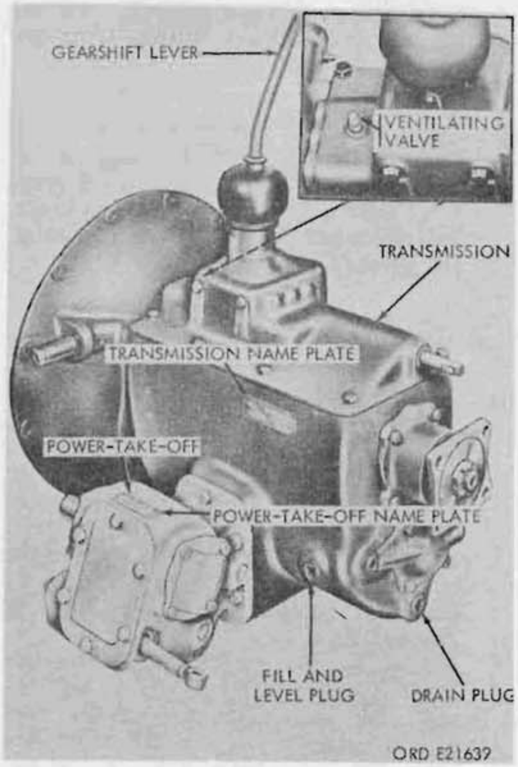

Figure 188. Transmission with power takeoff

Fourth	1.45-to-1.00
Fifth	1.00-to-1.00

154. Transmission

a. Coordination with Direct Support Maintenance Unit. Refer to paragraph 2 for information on coordination with the direct support maintenance unit.

b. General. Replacement of the transmission is facilitated when the engine and transmission are removed together as a unit (par. 49). However, the transmission can be removed separately (c below) without the engine removal.

c. Removal.

(1) Disconnect points inside of the cab.

(a) Remove the transmission gearshift lever. Refer to paragraph 49f (1).

(b) Remove the front and intermediate tunnels. Refer to paragraph 49f (2).

(c) Disconnect the clutch control rod. Refer to paragraph 49f (3).

(d) Disconnect the transfer reverse shift-lever rod. Refer to paragraph 49f (4).

(e) Disconnect the transmission-to-transfer propeller shaft. Refer to paragraph 49f (5).

(2) Disconnect points under the truck.

(a) Vehicles equipped with a front winch.

1. Disconnect the front winch drive shaft. Refer to paragraph 49g(2) (a).

2. Disconnect the transmission power-takeoff shifting lever rod. Refer to paragraph 49g(2)(b).

(b) Trucks M47, M59, and M342.

1. Disconnect the hydraulic hoist pump drive shaft. Refer to paragraph 49g(3)(a).

2. Disconnect the transmission power-takeoff rod. Refer to paragraph 49 g(3)(b).

(c) All models.

1. Disconnect the flywheel ground strap. Loosen the screw holding the strap to the flywheel housing, and slip the strap out from under the screw.

2. Drain transmission. Remove the drain plug and remove the fill and level plug (fig. 188) from the transmission, and allow the oil to drain completely. Install the plug securely.

3. Remove transmission (fig. 189).

a) Loosen the top two nuts only.

b) Remove ten nuts and lockwashers.

c) Install a chain, and install and attach the hoist.

d) Operate the hoist to absorb the weight of the transmission.

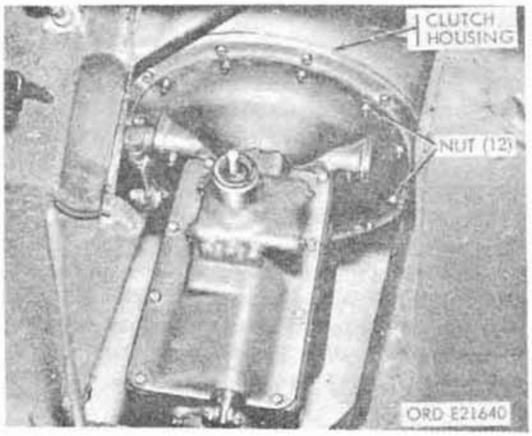

Figure 189. Transmission - removal

e) Remove the two nuts and lockwashers loosened in (a) above.

f) Slide the transmission back until the input shaft clears the clutch plate and housing.

(g) Using the hoist (fig. 190), lower the transmission on to a low wheel dolly and remove it from under the vehicle.

4. Remove transmission ventilating valve (fig. 188).

(3) Remove the transmission power take-off (if equipped).

Note. P.T.O. driven gear to transmission drive gear should be .008 to .012 in. backlash. Each gasket changes backlash .006 in.

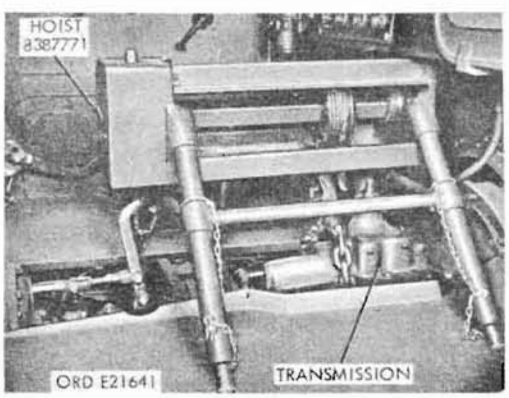

Figure 190. Lowering transmission vsing hoist 8387771

d. Installation.

(1) Install the transmission power take-off (if equipped).

(a) Install P.T.O. using one gasket.

(b) Check for binding of gears. If bind exists add second gasket.

(2) Connect points under the truck.

(a) All models.

1. Install the transmission ventilating valve (fig. 188).

2. Install the transmission. Refer to paragraph 154.

Note. Raise transmission so that input shaft will slide striaght into clutch. Line up and match splines of input shaft and clutch as nearly as possible. If splines do not mate properly, place trnasmission in 4th (or 5th) gear and turn output shaft slightly to match splines. Torque (12) mounting nuts to 23-26 ft. -lbs.

3. Connect the flywheel ground strap. Loosen the screw on the flywheel housing, slide the open-end terminal of the strap under the screw, and tighten the screw securely.

(b) Trucks M47, M59 and M342.

1. Connect the transmission power take-off rod. Refer to paragraph 49g (3) (b).

2. Connect the hydraulic hoist pump drive shaft. Refer to paragraph 49g (3) (a).

(c) Vehicles equipped with front winch.

1. Connect the transmission power take-off shifting lever rod. Refer to paragraph 49g (2) (b).

2. Connect the front winch drive shaft. Refer to paragraph 49g (2) (a).

(3) Connect points inside of the cab.

(a) Connect transmission-to-transfer propeller shaft. Refer to paragraph 49f (5).

(b) Connect the transfer reverse shifting lever rod. Refer to paragraph 49f (4).

(c) Connect the clutch control rod. Refer to paragraph 49f (3).

(d) Install the front and intermediate tunnels. Refer to paragraph 49f (2).

(e) Install the transmission gearshift lever. Refer to paragraph 49f (1). If gearshift lever contacts the instrument panel, remove the lever from the transmission. Remove the lever knob, and bend lever until it clears the panel by at least 1 inch. Install the knob, and install the lever on the transmission.

(4) Lubricate transmission. Lubricate the transmission according to the lubrication instructions in LO 9-2320-209-12.

(5) Record of replacement. Make a record of the replacement on DA Form 2408-1.

155. Preliminary Tests

a. Before vehicles are serviced for issue, a preliminary test should be made to determine that the mainshaft front-bearing rollers are functioning correctly. In order to detect and correct incipient failures and prevent serious damage to the transmission components, the following tests will be made:

Note. Tests will be performed with the transmission warm.

b. With the engine running and the transmission in neutral position, permit the clutch to engage slowly. If a decided growl is heard, mainshaft front-bearing rollers may be faulty.

c. With the transmission shifted to first speed forward and the transfer shifted to neutral position, permit the clutch to engage slowly. If a decided growl is heard, the transmission mainshaft front-bearing rollers may be faulty.

d. Move the transmission gearshift lever to fifth speed forward position and the transfer gearshift to neutral position, then permit the clutch to engage slowly. No growl should be heard as the transmission main drive shaft, main (input) shaft, and mainshaft front-bearing rollers are turning at the same speed.

e. If the above tests disclose that the rollers are defective or if it is found that the main drive shaft or main (input) shaft is defective, the transmission should be repaired. Notify a direct support maintenance unit.

f. Operate power take-off if whining noise occurs, gear clearance is too tight. Add a mounting gasket. If installation clatters, clearance is too large. Remove a mounting gasket. However, one gasket is always required to control oil leakage.

156. Special Instructions

The letter "R" will be stamped on the transmission case on the rear countershaft boss after the main drive and main (input) shafts are replaced. This change will be noted on DA Form 2408-5, Equipment Modification Record.

Section XXVI. TRANSFER

157. Description and Data

a. Description. The transfer (fig. 192) is a two-speed, double-sprag unit driven by the transmission and distributing power to the front and rear axles through propeller shafts. It is located immediately back of the transmission and is supported on two sides. Control is by the transfer shift lever (fig. 191) in the cab of the vehicle. The transfer gearing is designed to drive the front axle at a slightly lower speed than the rear axles. An overrunning double sprag clutch in the transfer drive to the front axle automatically eliminates delivery of power to the front axle during normal operation, forward or reverse, and front wheels run free. When rear wheels slip about 8 percent, overrunning clutch engages and drives the front axle.

b. Data.

Make	Wisconsin Axle
Model	T-136-10

157.1 Description and Data – Transfer with Air Actuated Positive Lock-Up.

a. Description. This transfer transmission is a two speed unit with an air actuated positive lock-up mechanism. This system enables the driver to engage the front driving axle at his option. A front wheel drive selector lever is mounted below the instrument cluster with an air control valve located behind the lever and indicator plate for controlling air pressure to the cylinder mounted on the transfer case. When the selector lever is placed in the IN position, the air cylinder moves a shifting fork inside the transfer case to lock-up two output shaft clutch halves. When this action takes place, the front output shaft of the transfer is driving the front axle at the same rate of speed as the rear axles.

b. Data.

Ord. No. 11609224
Model . . . . T-136-36 (FCM 78500)
Type . . . . .Two-speed synchromesh

158. Controls and Linkage.

a. Coordination with Direct Support Maintenance Unit. Refer to paragraph 2 for information on coordination with a direct support maintenance unit.

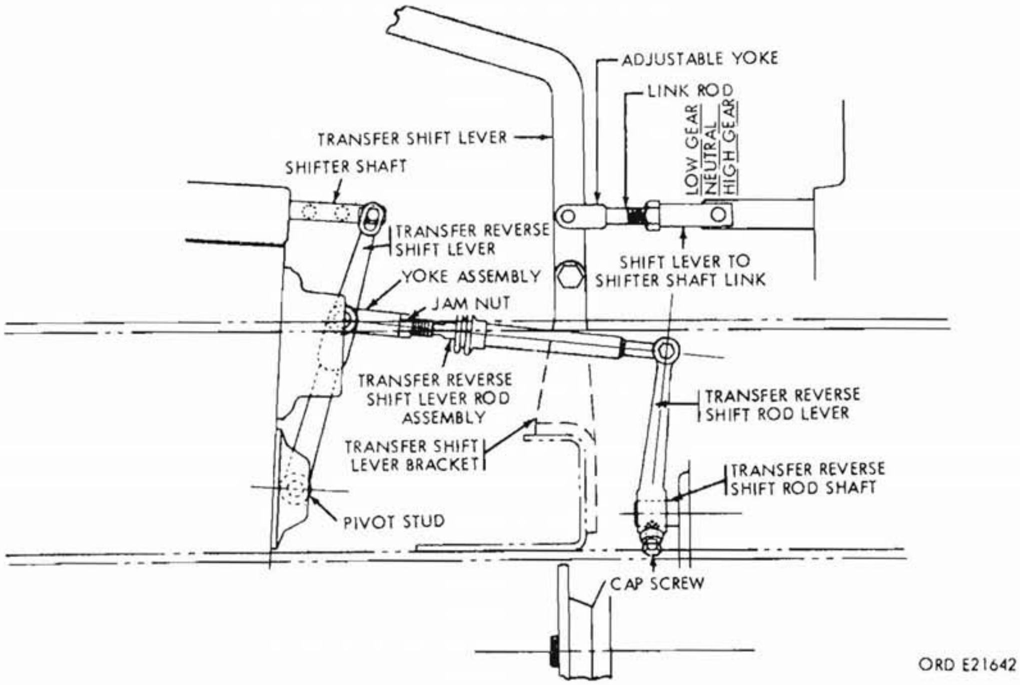

Figure 191. Transfer linkage for double sprag transfer

b. Removal (Fig. 191).

(1) Remove shift lever linkage. Remove two safety nuts and screws holding shift-link assembly on shift lever and on the transfer shifter shaft, and remove link assembly. Remove safety nut and screw holding shift lever on shift-lever bracket, and remove lever.

(2) Remove reverse shift linkage.

(a) Remove reverse shift rod lever. Jack up one front wheel. Loosen the safety nut and screw securing the reverse shift rod lever on the transfer reverse shift rod shaft. Remove the screw holding lever on the shaft, and pull lever from shaft.

(b) Remove reverse shift lever. Remove safety nut from the stud at lower end of the reverse shift lever. Remove safety nut, screw and washer holding lever to transmission shifter shaft, and remove lever and linkage as a unit.

c. Installation (Fig. 191).

(1) Install shift lever linkage.

(a) Install shift lever. Install the shift lever on the lever bracket with hex-head screw and safety nut. Install the shift-link assembly on the shift lever, with a hex-head screw and safety nut. Place the shift lever in the low range position. Place the transfer in the low range position by pulling the transfer shifter shaft outward to engage the low speed gears. Check if shift link can be connected to the shifter shaft without shift lever movement. If so, install the link to the shaft with hex-head screw and safety nut. If not, adjust linkage ((b) below).

(b) Adjust linkage. Adjust link until links fit to shifter shaft without control lever or shaft motion. Attach link ((a) above). Move the shift lever to the NEUTRAL and HIGH RANGE position and note by the lever motion if transfer-shifter shaft is engaged in each position by the shaft detent within the transfer case. Readjust link, if necessary.

(2) Install reverse shift linkage.

(a) Install reverse shift lever. Jack up one front wheel. Position the reverse shaft linkage at the rear of the transmission and connect the reverse shift linkage to the pivot stud on the lower end of the transmission with a safety nut. Connect the upper end of the lever to the transmission-shifter shaft with a hex-head screw, and plain washer, and 3/8-inch safety nut.

(b) Install reverse shift rod lever. Install the shift-rod lever on the transfer reverse shift shaft with the offset end of the lever towards the transfer. Install hex-head screw in the lower end of lever and make sure screw enters the hole in the shaft. Tighten the screw and safety nut on the lever. Check the reverse-shift linkage and adjust as necessary ((3) below).

Caution: Replacement of the transmission, transfer, or reverse-shift linkage will require complete adjustment of the reverse-shift linkage to assure proper double-sprag action of the transfer-overrunning clutch.

(3) Check reverse shift linkage.

Note. The vehicle and transfer mechanism must be warmed up to operating temperature before any adjustments or checks are made on the transfer linkage.

(a) Raise one front wheel clear of ground. Shift transmission into reverse. Turn front wheel backwards. Then try to turn it forward. The wheel should be locked against forward rotation but free to turn backwards.

(b) Place transmission in low gear. Turn front wheel forward. Try turning wheels backwards. The wheels should be locked against backward rotation but free to turn forward.

(c) If these conditions do not exist, adjust reverse shift linkage ((d) below).

(d) Adjust linkage. With one front wheel of vehicle jacked up, shift transmission into first gear. Turn jacked-up wheel one-half turn forward. Shift transmission into neutral. During this shift, observe if transfer reverse shift-rod lever moves. If lever moves, the transfer reverse shift-lever rod assembly must be shortened by loosening the jamnut and turning the rod into the yoke. If the lever does not move, proper adjustment may exist, but more likely the transfer reverse shift lever-rod-assembly must be lengthened by loosening jamnut and turning the rod out of the yoke. Repeat the above test procedure until the lever does not move but is just on the verge of moving when transmission reaches neutral gear after a shift from first gear. Recheck adjustment with transmission in neutral by trying to pry reverse shift-rod lever away from transfer case with a screwdriver. If lever cannot be moved, forward speed adjustment is complete. If the lever moves, shorten the reverse lever-rod assembly as described above. Shift the transmission into reverse and turn the jacked-up wheel one-half turn backwards, making sure transmission stays in reverse. Try to pry shift-rod lever toward transfer. If the lever can be moved one-sixteenth of an inch or less, the reverse speed adjustment is complete. If lever moves more than one-sixteenth of an inch, lengthen the shift lever rod assembly, and recheck the forward and reverse speed adjustments. After final recheck, perform adjustment check ((c) above).

Note. When the shift is made from reverse to neutral, the front wheel must be turned one-half turn forward. When the shift is made from neutral to reverse, the front wheel must be turned one-half turn backward.

159. Transfer

a. Coordination with Direct Support Maintenance Unit. Refer to paragraph 2 for information on coordination with direct support maintenance unit.

b. Removal.

(1) Vehicles equipped with transfer power-takeoff.

(a) Disconnect transfer power-takeoff shift-control lever link. Refer to paragraph 158 for disconnecting of shift control lever link from power-takeoff shifter shaft lever.

(b) Disconnect drive shaft. Refer to paragraph 257 for drive shaft disconnecting procedure for the M50 and M50A1 delivery pump drive shaft; paragraph 272 for the M49, M49C and M49A1C delivery pump drive shaft; or paragraph 280 for the M60 and M108 hydraulic pump drive shaft.

(c) Disconnect auxiliary governor flexible shaft (M49, M49C, M49A1C M50, M50A1, M60 and M108). Disconnect flexible shaft from angle-drive adapter (fig. 275) on power takeoff, and remove adapter. Remove adapter driven gear from power takeoff.

(2) All models.

(a) Disconnect propeller shafts. Disconnect front axle, transmission-to-transfer, and forward rear axle propeller shafts (par. 165) from transfer. Be sure to observe the precautionary warning in paragraph 165 before disconnecting shafts.

(b) Disconnect handbrake cable. Remove nut and disconnect handbrake cable from handbrake shoe lever (fig. 192). Remove U-bolt, and remove cable from bracket on transfer.

(c) Disconnect transfer linkage. Remove transfer-shift lever and transfer-shift rod-lever from transfer (par. 158).

(d) Disconnect speedometer flexible shaft. Disconnect speedometer flexible shaft (fig. 192) from angle drive adapter on transfer, and remove adapter.

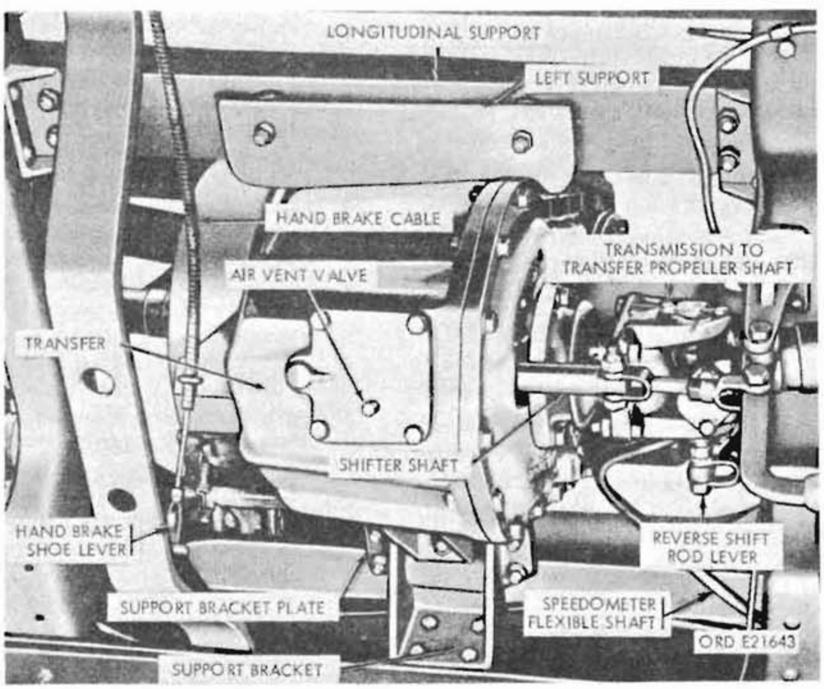

Figure 192. Transfer assembly

(e) Remove transfer. Drain transfer. Support transfer on suitable lift. Remove four safety nuts and screws holding transfer support bracket plate to the transfer support bracket on the right side of the transfer. Remove four safety nuts and screws holding the transfer longitudinal support to longitudinal support brackets at left of transfer. Lower transfer from position, and remove from vehicle. Remove two bolts holding right support to the transfer case, and remove support and support bracket plate as a unit. Remove four bolts holding the left support to the transfer case, and remove the left support and longitudinal support as a unit. Remove the transfer power take-off, if so equipped, from the transfer. If transfer is being replaced, remove PTO driving clutch half by breaking lock wire and loosening set screw. Remove the transfer ventilating valve (para 161) from the transfer.

c. *Installation.*

(1) *All models.*

(a) Install transfer. Before installing the transfer power take-off, if so equipped, on transfer, place the PTO driving clutch half on the rear end of transfer input shaft. Tighten set screw and secure with lock wire. Install the ventilating valve on transfer (para 161). Install the left support (fig. 192) with an attached longitudinal support, to the transfer case with four self-locking hex-head bolts. Install the right support, with attached support-bracket plate, to the transfer case with two self-locking hex-head bolts. Raise the transfer into position and secure the support-bracket plate to the support bracket with four hex-head screws and safety nuts. Secure longitudinal support to the support brackets with four hex-head screws and safety nuts.

(b) Connect speedometer flexible shaft. Install the angle drive adapter on the transfer, and connect the speedometer flexible-shaft (fig. 192) to the adapter.

(c) Connect transfer linkage. Install the transfer shift lever and reverse shift rod-lever on the transfer (para 158).

(d) Connect handbrake cable. Connect the handbrake cable (fig. 192) to handbrake lever with the nut, and to transfer-case bracket with cable-to-bracket U-bolt.

(e) Connect propeller shafts. Connect the front axle, transmission-to-transfer, and forward-rear axle propeller shafts (para 165) to the transfer.

(2) *Vehicles equipped with transfer power takeoff.*

(a) Connect auxiliary governor flexible shaft (M49, M49C, M49CA1, M50, M50A1, M60 and M108). Place the angle drive-adapter driven gear in the power takeoff, and install the angle drive-adapter (fig. 175) on the power takeoff over the gear. Connect the flexible shaft to the adapter.

(b) Connect drive shaft. Refer to paragraph 257 for installation procedures for the M50 and M50A1 delivery pump drive shaft; paragraph 272 for the M49, M49C, and M49CA1 delivery pump drive shaft; or paragraph 280 for the M60 and M108 hydraulic pump drive shaft.

(c) Connect transfer power-takeoff shift control lever link. Refer to paragraph 158c(2) for connecting of the shift control lever link to power-takeoff shifter shaft lever.

(3) *Lubricate—transfer.* Lubricate the transfer according to lubrication order LO 9-2320-209-12

(4) *Check transfer linkage adjustment (para 158c).* Engage and disengage the shift lever and adjust, if necessary. Check the reverse shift linkage adjustment and adjust, if necessary.

(5) *Record of replacement.* Make record of replacement on DA Form 2408-5.

160. Transfer Output Cover Seal Replacement

a. Removal.

(1) Remove gearshift lever and boot, figure 99.

(2) Remove screws and remove intermediate and rear tunnel from cab.

(3) Remove screws and lockwashers and remove transfer output cover and seal.

b. Installation.

(1) Install new seal.

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(2) Install output cover and secure with screws and lockwashers.

(3) Install intermediate and rear tunnel and secure with screws.

161. Transfer Air Vent Valve (Fig. 192)

a. Removal. Remove air vent valve from transfer output cover by turning it counterclockwise.

b. Installation. Install air vent valve in transfer output cover by turning it clockwise.

Section XXVII. TRANSMISSION POWER TAKEOFF

162. Description and Data

a. Description.

(1) Single-ended. The single-ended-transmission power takeoff (fig. 188) is a two-speed-and-reverse unit mounted on the left side of the transmission. Its purpose is to supply power to the front winch. The transmission power-takeoff shifting lever extends through the cab floor to the left of the transmission.

(2) Double-ended. The double-ended-transmission power takeoff (fig. 193) with accessory drive is mounted on left side of the transmission. The forward output shaft is a two-speed-and-reverse drive to the front winch with a shifting-lever control, the same as in (1) above. The rear accessory drive shaft drives the hydraulic hoist pump for dump mechanism on the dump trucks M47, M59 and M342 and is controlled by the driver's hydraulic hoist control lever.

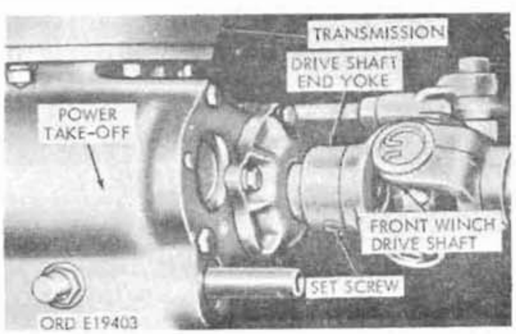


Figure 193. Transmission power takeoff with accessory drive

b. Data.

Transmission power takeoff (single-ended):
Make . . . . Spicer Mfg Co.
Model WN7

Transmission power takeoff with accessory drive (double-ended):
Make . . . . Spicer Mfg Co.
Model WND7

163. Transmission Power-takeoff Shift Linkage (Fig. 194)

a. Removal. Disconnect the shift linkage from the transmission power takeoff by removing the cotter pin and the clevis pin holding the shifting-lever rod yoke on the power-takeoff shifter shaft. Remove the two screws holding the shifting-lever support to the master cylinder, and remove the shift linkage from the vehicle.

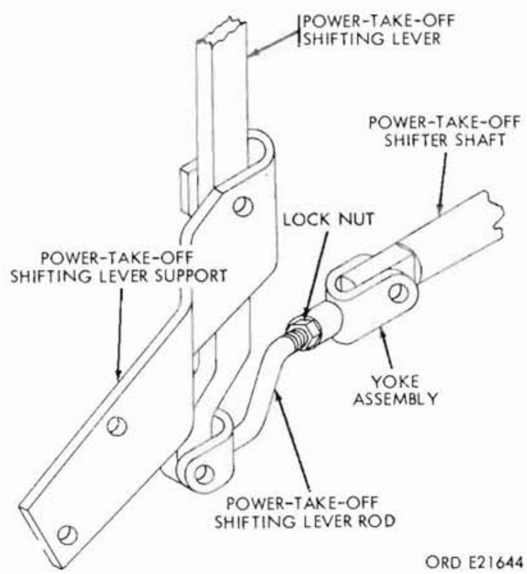


Figure 194. Transmission power-takeoff shift linkage

481-454 O - 85 - 10

b. Installation. Install the shifting-lever support on the master cylinder with two split lockwasher and hex-head screws. Connect the shifting-lever rod yoke to the power-takeoff shifter shaft with clevis pin and a cotter pin. Check the linkage adjustment (d below).

c. Check and Adjust Linkage. Move the shifting lever through the shifting range (TM 9-2320-209-10). The power-takeoff shifter-shaft should be held in each indicated shift position by the shifter-shaft ball in the power-takeoff case. If necessary, adjust the shifting-lever rod yoke (fig. 194) to change the shifting lever position in respect to the shifter-shaft position.

d. Hydraulic Hoist Control Linkage. Refer to paragraph 240 for information on replacement of the hydraulic hoist-control linkage.

Section XXVIII. PROPELLER SHAFTS AND UNIVERSAL JOINTS

164. Description

a. General. Different combinations of propeller shafts with universal joints are used on the various trucks. Because of the great similarity between the many propeller shafts, the replacement procedure is similar for these and similar shafts. Dissimilar units are covered separately, the similar units being covered by groups or types. The universal joint replacement is covered in like manner.

b. Propeller Shafts. The forward-rear-axle-to-rear-rear-axle, the transfer-to-forward-rear axle, the M46 intermediate-shaft-to-forward-rear-axle, the transfer-to-front axle, and the transmission-to-transfer propeller shafts (fig. 195) are equipped with two universal joints and one slip joint, each having two flanged yokes for connecting to the driving and the driven components. The M46 intermediate propeller shaft (fig. 195) has a universal joint and a flanged yoke at one end, a slip joint between the ends, and a supporting bearing and companion flange at the other end.

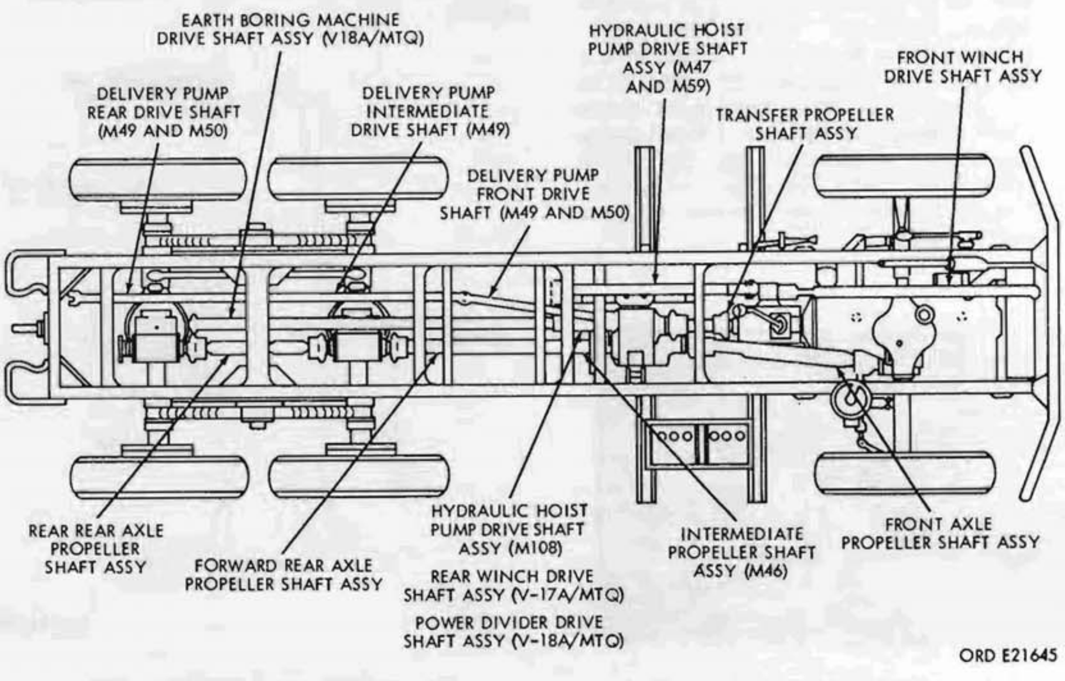


Figure 195. Propeller and drive shaft location

c. Universal Joints. There are two basic types of universal joints used on the trucks, the snapring type (fig. 196), and the bearing cap-type (fig. 197). The forward-rear-axle-to-rear-rear axle and transfer-to-front-axle-propeller shafts are of the snapring type. The transmission-to-transfer, the transfer-to-forward-rear-axle, and (on the M46 truck) intermediate-to-forward-rear-axle propeller shafts are of the bearing-cap type. The M46 truck intermediate propeller shaft has a single universal joint of the bearing-cap type.

165. Propeller Shafts

a. General.

***Warning:* Always jack up one wheel of the axle driven by propeller shaft to be removed, to prevent the possible injury to personnel due to the windup of the shaft.**

Before removing any propeller shaft, make sure that the arrow marks stamped on the shaft and sleeve yoke at the slip joint are visible; if not, mark both members so they can be reassembled in the same relative position. Protect the universal joints against damage or loss of parts during and after removal, and before and during installation. During installation, make sure arrows or marks made before removal are in the same relative position. Install all propeller shaft with the slip joint nearest to the source of power.

b. Double Flanged Yoke-type.

(1) *Removal.* Disconnect the flanged yokes securing the shaft to the companion flanges, and remove the shaft.

(2) *Installation.* Install the shaft and connect the flanged yokes to the companion flanges.

166. Universal Joints

a. General. Universal joints should be repaired whenever excessive wear is indicated by looseness in bearings between the journal and yoke. Repair kits are available for maintenance of universal joints.

b. Snapring Type (fig. 196).

(1) *Disassembly.* Remove snapring from each end of journal. Remove lubricating fitting. Tap exposed face of one journal bearing until opposite bearing comes out of yoke. Tap exposed end of journal until second bearing is driven from yoke. Remove journal by moving it to one side as far as possible and tilting to clear side of yoke. Repeat procedure to remove journal from other yoke. Remove four journal gaskets and gasket retainers from journal. Remove relief valve, if installed. Discard gasket.

(2) *Cleaning.* Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Make sure all parts are thoroughly cleaned of grease, dirt and grit. Check to make sure lubrication and relief openings are clean and open. When necessary, soak parts in solvent and brush with stiff brush to remove caked grease. Dry parts thoroughly with compressed air. Cover until ready for installation.

(3) *Inspection and repair.* Inspect yokes for cracks, wear, or bent condition. Clean slight nicks or burs with fine stone. Inspect journal bearing surfaces for nicks, burs, and scratches. Remove light marks with fine stone. Replace journal, if marks cannot be removed. If journal is replaced, replace bearings also. Inspect bearing for wear. Worn condition is usually indicated if needles drop out of bearing, or if journal bearing surfaces show marks of needles. Replace all bearings and journal, if wear is evident.

(4) *Assembly.*

Note. When assembling the snapring-type universal joint always use new gasket retainers, journal gaskets, and snaprings.

Install lubricating fitting and valve in journal. Install four new gasket retainers and journal gaskets on journal. With lubricating fitting facing toward the shaft yoke, install journal in yoke by inserting one journal trunnion into yoke and tilting journal until opposite trunnion enters yoke. Slide journal into position in yoke. Repeat procedure to install journal in other yoke. Work automotive and artillery grease (GAA) into journal bearings until bearing needles are well lubricated. Insert bearings in yoke over journal trunnions and tap into place with a rawhide mallet. With bearings in position, install new snaprings in yoke, making sure that rings seat properly in yoke grooves. If joint appears to bind, tap snapring ends of bearings lightly to relieve pressure of bearings on ends of journal.

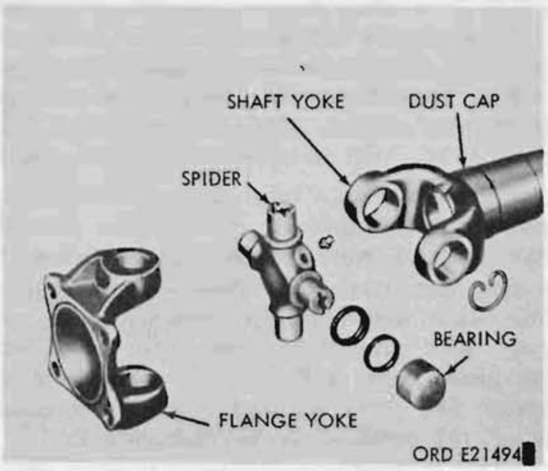


Figure 196. Snapring-type universal joint.

c. *Bearing Cap-type.*

(1) *Disassembly.* Bend down locking strap lugs and remove two bolts, locking strap, and bearing cap from each end of journal. Remove lubricating fitting. Tap exposed face of one bearing or the journal until opposite bearing comes out. After removing all four bearings, remove journal from yoke by moving it to one side as far as possible and tilting to clear side of yoke. Repeat procedure to remove journal from other yoke. Remove four journal gaskets and gasket retainers from journal. Remove lubricating valve. Discard gasket.

(2) *Cleaning.* Refer to *b*(2) above for cleaning procedure.

(3) *Inspection and repair.* Refer to *b*(3) above for inspection and repair.

(4) *Assembly.*

Note. When assembling the bearing cap-type universal joint, use new gasket retainers, journal gaskets and locking straps.

Install lubricating fitting and valve in journal. Install four new journal gasket retainers and gaskets on journal. With lubricating fitting facing shaft yoke, install journal in yoke by inserting one journal trunnion into yoke and tilting journal until opposite trunnion enters yoke. Slide journal into position in yoke. Repeat procedure to install journal in other yoke. Work automotive and artillery grease (GAA) into journal bearings until bearing needles are well lubricated. Insert bearings in yoke over journal trunnions and tap into place with a rawhide mallet Install bearing cap and new locking strap over each bearing, being sure key on bearing cap fits into keyway in bearing end. Secure cap and strap with two hexhead bolts. Turn up lugs of strap against side of bolt heads. If joint appears to bind, tap bearing caps lightly to relieve pressure of bearings on ends of journal.

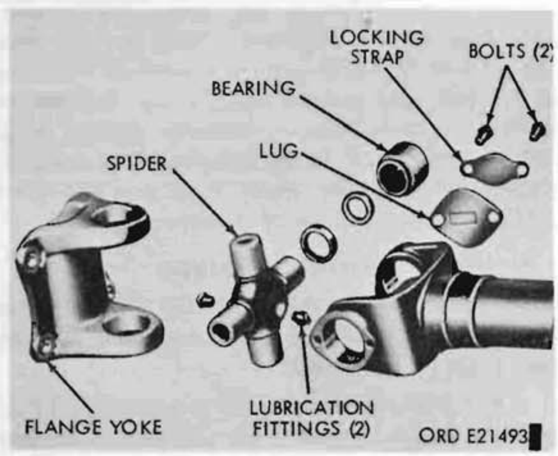


Figure 197. Bearing cap-type universal joint.

d. Universal Joint Repair Parts: For Propeller Shafts, Federal Supply Code for Manufacturers 76260. (fig. 197-1)

(1) *General.* Due to parts shortage during manufacturing, trucks are in service with Propeller Shafts produced by an alternate Vendor (FSCM 76260). These can be identified by a grooved bearing assembly with a snap ring retainer on the inside of the yoke. Parts Kit, Universal Joint (1146167) (FSCM 76260) should be requisitioned to replace worn or damaged universal joints in these propeller shafts.

(2) *Disassembly.* Remove snap rings that secure bearings in yoke.

NOTE

Removal of the grease fitting from the journal will provide more clearance between journal and yoke and prevent damage to grease fitting.

Place yoke over opening in jaws of fise or hollow object large enough to receive the bearing. Use a drift punch and hammer and drive bearing inward through yoke until the journal hits the inside of the yoke on the opposite side. It may be necessary to tap yoke until bearing is released. Repeat procedures on opposite bearing by placing punch on exposed end of the journal. Apply same procedure to other bearings until all bearing assemblies have been removed. Remove journal from yoke. Discard old bearings, journals, and snap rings.

(3) *Cleaning.* Refer to paragraph *b*(2), above.

(4) *Inspection and repair.* Refer to paragraph *b*(3), above.

(5) *Assembly.* Use new journal, bearings, and snap rings.

NOTE

Removal of grease fitting from journal will provide more clearance between yoke and journal and prevent damage to grease fitting.

Place seal next to dust shield on journal. Install journal in yoke. Place bearing assembly in bearing hole in yoke and tap with hammer to hold in place. Repeat on opposite side of yoke. Place assembly in soft jawed vice and press bearings into yoke until snap ring grooves in bearing assembly is in position to receive snap rings. It will be necessary to use a spacer smaller in diameter than the bearing to press the bearing in far enough to allow installation of the snap ring. Install snap rings with drift punch and hammer. Install grease fitting, if removed, and lubricate entire assembly with MIL-L-10924 (GAA) grease.

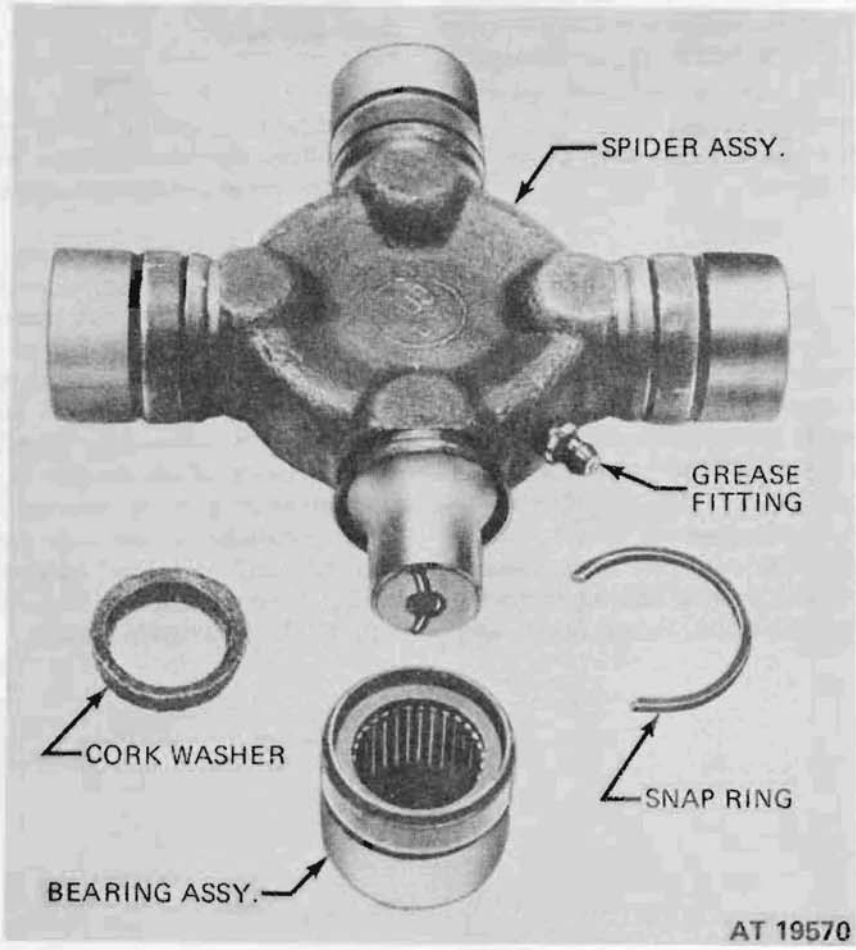


Figure 197.1. Internal snapring universal joint.

Section XXIX. FRONT AXLE

167. Description

The front axle (fig. 198) is a bevel-drive, top-mounted, double-reduction, single-speed type. It consists essentially of a housing, differential and pinion, axle shaft with universal joint, and steering knuckle. Power is transmitted from the differential to the wheels through the axle shaft. Universal joints permit continuous delivery of power to wheels when truck is turned to the right or left. An overrunning clutch, located in the transfer, automatically eliminates delivery of power to the front axle during normal operation.

168. Front Wheel Alinement

a. General. Front wheel alinement has a major effect on steering from the standpoint of control, ease of steering, and safety. Front wheel misalinement is a major cause of premature and uneven tire wear. Factors involved in front wheel alinement are caster, camber, turning angle, and toe-in.

(1) Caster (fig. 199). Front axle caster (C to D) is inclination of centerline through upper and lower steering knuckle sleeves toward rear of truck. Caster angle is established by design and can be changed only by shifting of the front axle on springs or by distortion of chassis, frame or springs. There is no adjustment for caster.

(2) Camber (fig. 199). Front wheel camber (B minus A) is outward inclination of tops of wheels, that is, wheels are farther apart at the top than at the bottom. There is no adjustment for camber; however, loose wheel bearings, worn knuckle sleeve bearings, bent steering knuckle, or bent axle housing will affect camber.

(3) Turning angle. Front wheel turning angle is maximum angle through which wheels may be turned from STRAIGHT-AHEAD position. This angle is limited by turning stops that are welded after adjustment. Failure of steering knuckle boots may be caused by incorrect turning angle. Correct angle is from 28° to 29°, 28° being optimum angle. If angle exceeds 29°, refer to direct support maintenance unit.

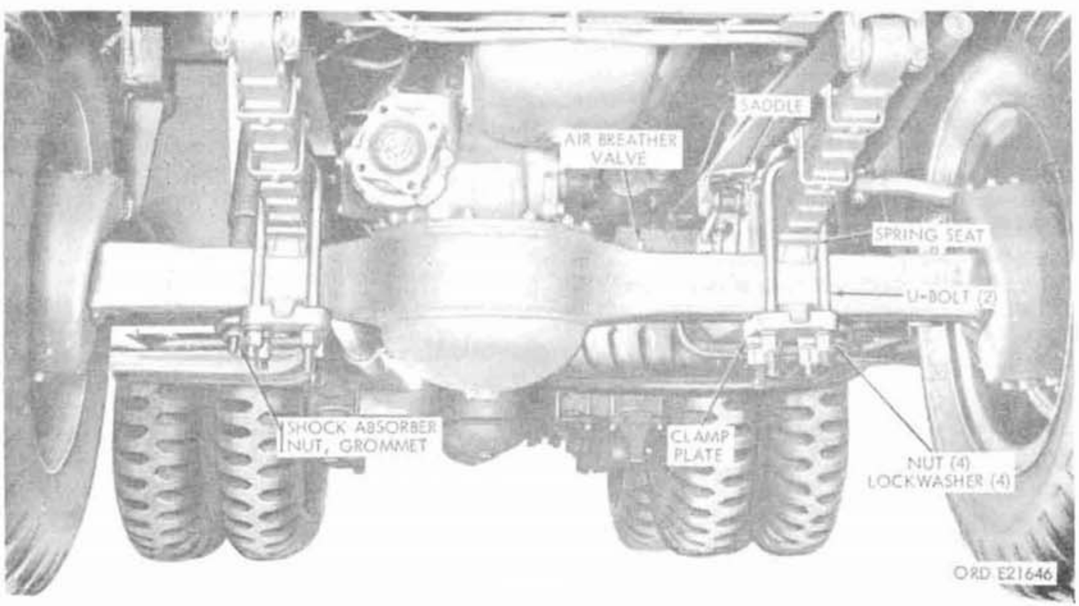


Figure 198. Front axle installed

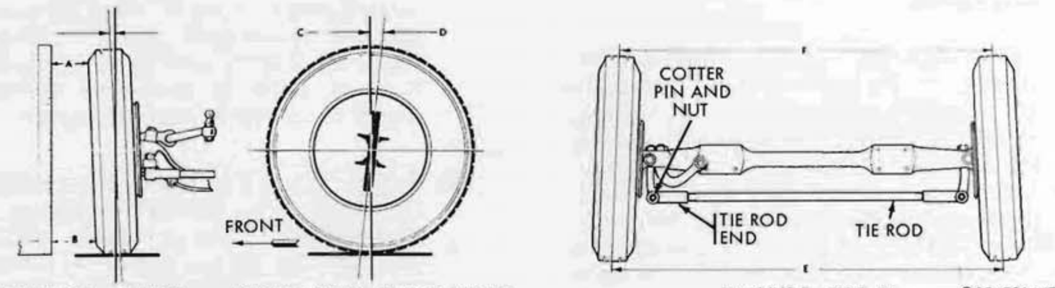


Figure 199. Front wheel alinement

(4) Toe-in (fig. 199). Front wheel toe-in (E minus F) is the amount by which wheels are closer together at the front than at the rear, with wheels in a STRAIGHT-AHEAD position. Camber causes both wheels to have tendency to turn outward from truck. Toe-in counteracts this tendency and causes wheels to roll straight ahead with no scuffing action.

b. Toe-in Check. Inflate tires to correct pressure, and place truck on smooth, level surface with wheels in straightahead position. Place toe-in gage between tires ahead of axle with ends of gage bearing against the tire side walls. Both pendant chains must be at equal distance from the ground so that the gage is the same distance from the ground at the axle. Set gage so point registers zero. Move truck forward until gage is brought into a corresponding position in back of the axle. Pointer will indicate amount of toe-in or toe-out. Correct toe-in is one-sixteenth to three-sixteenths of an inch.

Note. On trucks equipped with 11.00 x 20 single tires, correct toe-in is one-sixteenth to one-eighth of an inch.

c. Tie Rod Adjustment. Remove tack welds (if present) from tie rod ends, using care not to damage threads. Loosen the two nuts at the end of clamps on each end of tie rod (fig. 199). Shorten or lengthen tie rod by turning the tie rod with the pipe wrench. After adjusting, again check the toe-in. When adjustment is correct, tighten the end clamp bolts, but do not reweld.

d. Tie Rod Replacement.

(1) Removal. Place truck on level surface and apply handbrake. Raise front axle enough to take weight of truck off front wheels. Remove cotter pin and nut from the tie rod end (fig. 199), one at each end of the tie rod.

Note. Use care to prevent damage to threads on studs.

Force studs from steering knuckles and remove tie rod.

(2) Installation. Making sure the stud dust covers are in place, push the tie-rod end studs through holes in steering knuckles and secure each stud with slotted nut and cotter pin. Adjust the tie rod (c above).

e. Tie-rod End Replacement.

(1) Remove cotter pin and nut holding stud of rod end in arm on steering knuckle, and force stud from knuckle. Break tack welds (if present) holding tie-rod end from tie-rod.

(2) Install tie-rod end in tie rod. Connect end to steering knuckle with slotted nut and cotter pin. Check toe-in (b above) and adjust tie-rod (c above), being sure to tighten end clamps. Do not reweld tie-rod ends to tie-rod.

169. Front Axle Shaft with Universal Joint

a. Removal.

(1) Remove axle shaft drive flange. Remove wheel (par. 203). Remove eight bolts and washers holding drive flange to hub, and remove flange. Remove and discard gasket.

(2) Remove hub and drum. Remove the hub (para. 204) and drum.

(3) Remove steering spindle. Remove 12 nuts and lockwashers from studs in the steering knuckle outer flange, and remove brake drum oil slinger. Remove brake flange plate and support to eliminate disconnecting brake line. Slide steering spindle from the end of axle shaft.

(4) Remove axle shaft with universal joint. Withdraw axle shaft with universal from steering knuckle and axle housing.

b. Cleaning and Inspection

(1) Cleaning. Thoroughly clean the axle shaft, universal joint, inside of steering knuckle and housing outer end.

(2) Inspection.

(a) Ball and socket type. Inspect balls and races for grooved, scratched, or pitted condition. To determine if excessive play or backlash exists in the universal joint, place assembly in vise in a vertical position with the outer shaft up, and with vise jaws gripping inner shaft just below the universal joint. Use soft metal or wood protectors in jaws of vise. Firmly push down on the outer shaft so that it rests on intermediate ball, and at the same time attempt to twist the joint in both directions. If any play or backlash is evident, report to direct support maintenance unit. Inspect axle housing for excessive wear or damage. Examine axle shaft splines for nicks, cracks, or other damage. Check shafts for twisted or bent condition. If either the inner or outer shaft is damaged or excessively worn, install a complete new axle shaft with universal joint.

(b) Center cross type with snap rings.

Note. Trucks having front axle containing center cross universal joint assembly No. 8738035. To inspect the "U" joint refer to 2 (a) above.

To remove the "U" joint see paragraph 166. Proceed according to paragraph 166, however the left U-joint assembly No. 8738035 FSN 2520-075-1763 and the right U-joint assembly No. 8738035-1 FSN 2520-075-1762 has no grease fittings, nor separate gaskets and gasket retainers, as they are part of the bearing cup. If ,'U" joint is damaged, replace it with "U" joint kit no. 5703480 FSN 2520-941-6166. Lightly lubricate the bearings within the bearing cups with GAA grease.

(3) Special lubrication. Spread new lubrication well into the universal joint until it fills all the space between the balls and the universal joint yokes. Also, spread lubricant on surfaces which contact spacers and bushing-type bearing spindle. See Lubrication Order, LO 9-2320-209-12.

c. Installation.

(1) Install the axle shaft with the universal joint. Using care not to damage the oil seal in the housing outer end, insert the axle shaft with the universal joint into the axle housing, guiding splined end of the inner shaft into the splined differential side gear.

Note. Trucks having front axle containing center cross "U" joint assembly No. 8738035.

Place washers on drive shaft according to figure 199.1. Place assembly retainer and oil seal (No. 8738032) in the housing, and then slide the inner shaft into it. Install remainder of assembly as directed in paragraph 169c.

(2) Install steering spindle. Position steering spindle on steering knuckle studs. Milled slot in threaded end of spindle must be at top. Place brake flange plate and brakedrum oil slinger on steering knuckle studs, and install 12 hex nuts and lockwashers.

(3) Install hub and drum. Install the hub and the drum and adjust wheel bearings (para. 206).

(4) Install the axle shaft drive flange. Using the new drive flange gasket coated with grease, install the drive flange over the splined outer end of axle shaft and position against hub. Install eight hex-head bolts and lockwashers, and tighten to 85 to 95 pound-feet torque. Install wheel.

(5) Lubricate. Lubricate steering knuckle and universal joint (b) (3) (above).

d. Steering Knuckle Boot (fig. 200).

(1) Removal. Remove four screws securing the steering knuckle boot guard and remove guard. Cut boot from axle. Loosen outer and inner clamps, and detach remainder of boot.

(2) Installation.

(a) Replacement boot kits may or may not be cut along mold line and have a zipper vulcanized to the inside of boot. If axle assembly is sufficiently tore down to allow boot to be slipped on, the mold line should not be cut. If not, cut should be made with a sharp instrument along mold line. Kit is composed of one boot and a tube of sealer cement.

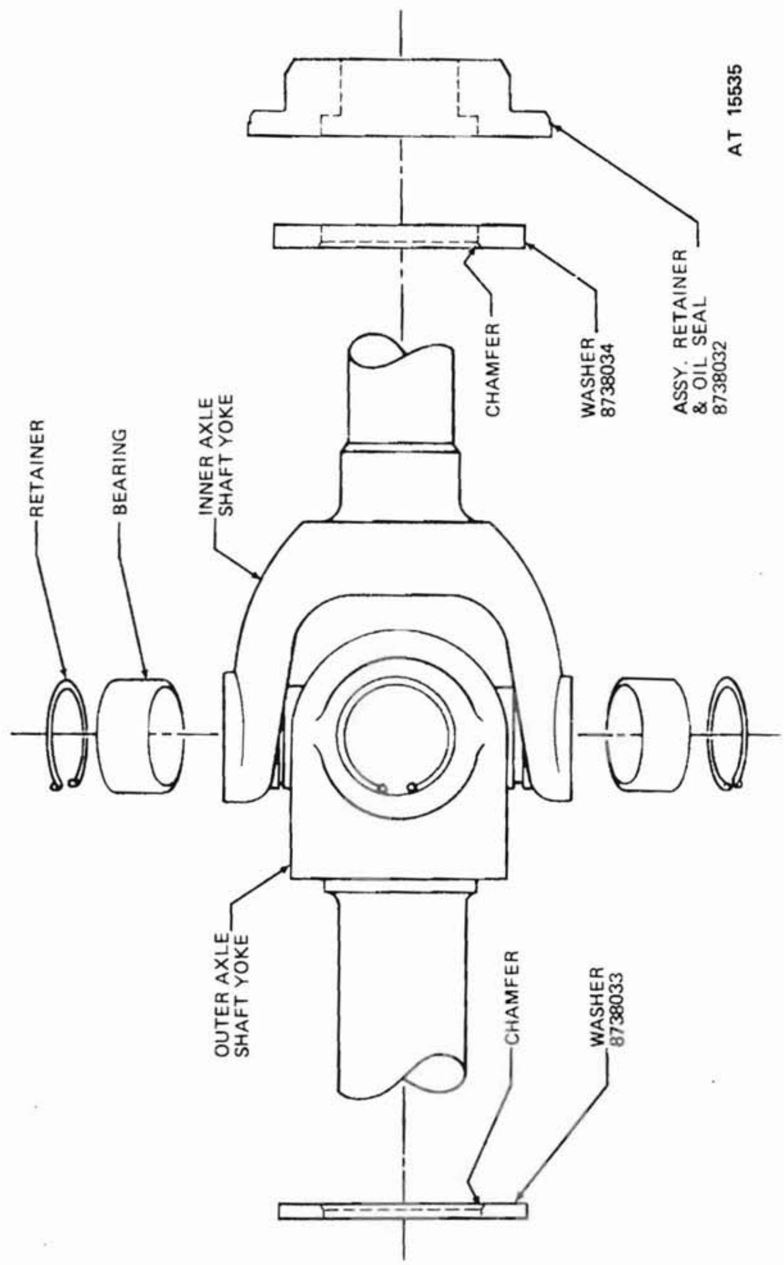


Figure 199.1. Axle shaft with washers.

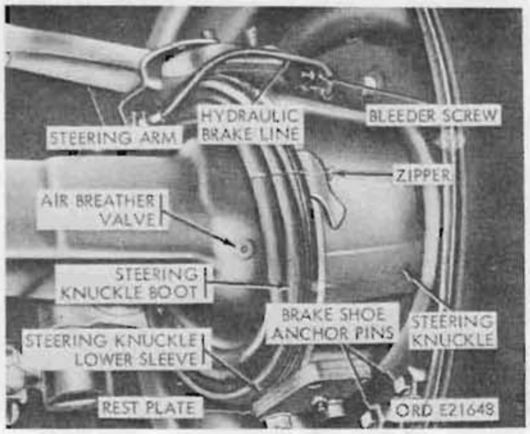


Figure 200. Steering knuckle boot

(b) Put boot inside out over axle housing with zipper side of boot away from axle, and close zipper. Seal with cement furnished with kit.

(c) With word TOP on boot alined with center of steering knuckle upper sleeve, work clamp groove in small diameter of boot over clamp groove in axle housing. Install inner clamp and tighten, making sure boot is in axle groove and well sealed.

(d) Pull boot right side out over inner clamp and work large diameter of boot over groove in steering knuckle. Be sure boot does not twist. Install outer clamp and tighten. Make sure boot is clamped in the knuckle groove.

(e) Lock the zipper with fine wire near the edge of boot and cut off excess zipper. Apply cement to zipper and inside of cut in boot.

(f) Position boot guard and secure with four capscrews and lockwashers.

170. Air Breather Valves (Fig. 200)

a. General. Air breather valves are provided on the rear axle, front axle and transfer. The removal and installation procedure is the same for all components.

b. Removal. Remove breather valve by turning counterclockwise.

c. Installation. Install breather valve by turning and tightening in a clockwise direction.

171. Front Axle Assembly

a. Coordination with Direct Support Maintenance Unit. Refer to paragraph 2 for information on coordination with the direct support maintenance unit.

b. Removal.

(1) Position truck. Place truck on level surface and apply the handbrake to prevent truck from rolling. Place a dolly jack under the differential housing and raise the front end of the truck high enough to permit withdrawing axle. Place blocks under frame side rails at the rear of the front spring hanger brackets. Lower the jack until the entire front end weight rests on the blocks. Leave the jack raised high enough to support the axle.

(2) Remove wheels. Remove the wheel stud nuts, and remove the wheel and the tire from each side (par. 203).

(3) Disconnect propeller shaft. Disconnect the propeller shaft at the front end. Tie the propeller shaft up to prevent the universal joint from becoming damaged or filled with dirt.

(4) Disconnect drag link. Disconnect the drag link (par. 201) at the steering arm.

(5) Disconnect brake lines. Remove the brake line brackets from the boot guards and from axle housing. Disconnect the hydraulic brake lines (fig. 200) from the wheel cylinders at the rear of the brake flange plate.

(6) Remove axle. Remove the nut, grommet retainer, and the grommet from the lower end of the shock absorbers. Remove the nuts and lockwashers from U-bolts, and remove both the clamp plates (fig. 199), U-bolts, and saddles. Lower the jack until the axle clears. Remove the spring seats from the axle. Pull the axle from under the truck, making sure the hydraulic brake lines are not damaged. Remove the second grommet and retainer from the shock absorbers. Remove the axle air breather valve from the axle.

c. Installation.

(1) Position axle. Clean the breather valve and install on the axle. Place the axle on a dolly jack and move into position under truck. Place the spring seats on the axle. Raise the axle in position against the springs, being certain the spring center bolt heads enter alinement holes in the axle spring seats. Place saddles on the springs, and install U-bolts (fig. 199). Install the clamp plates, and install lockwashers and hex-nuts on the U-bolts. Tighten to 170 to 180 pound-feet torque. Install one retainer and mounting grommet in place on each stud at the lower end of the shock absorbers. Collapse the absorbers and insert the studs in the clamp plates. Install the second grommet and retainer on each stud end and secure with two hex-nuts.

(2) Connect brake lines. Connect the hydraulic brake lines at the wheel cylinders. Install 85,000-psi yield strength hex-head screws and lockwashers connecting brake-line brackets to boot guards and axle housing.

(3) Connect propeller shaft. Connect propeller shaft at front end.

(4) Connect drag link. Refer to paragraph 201 for instructions on installing and adjusting the drag link at the axle steering arm.

(5) Install wheels. Install wheels and tires on hubs, install the wheel stud nuts, and tighten to 400 to 450 pound-feet torque.

(6) Remove blocks and dolly jack. Raise front of truck with dolly jack, and remove the blocks from under the frame side rails. Lower the jack and withdraw from under the truck. Check all the nuts on spring mounting bolts for tightness with full weight of truck resting on springs.

(7) Bleed brakes. Bleed the front wheel brakes (par. 177).

(8) Lubricate. Check lubrication of complete axle and propeller shaft universal joints, as instructed in LO 9-2320-209-12.

(9) Record of replacement. Make a record of the replacement on DA Form 2408-5.

Section XXX. REAR AXLES

172. Description

Both rear axles are bevel-drive, top-mounted, double-reduction, single-speed type. The differential and carrier are mounted as an assembly in the housing. Forward-rear and rear-rear axles are mounted in tandem with torque rods on each side of the interconnecting axles. Power is transmitted from the transfer by the propeller shaft to forward-rear-axle differential and from forward-rear axle to rear-rear axle differential by another propeller shaft. Driving force is transmitted from the axles to the chassis frame by six torque rods, four attached to lower brackets and two attached to upper brackets. Three torque rods (fig. 201) are attached to each axle and take all driving and braking load. Trucks M60 and M108 have larger spring guide brackets to accommodate heavier rear springs. Axle shafts are full floating type with flanges forged at outer ends. Axle shafts transmit driving power from differential to wheels. Flanges are attached to hubs by capscrews and inner ends of shafts are splined to differential side gears.

173. Rear Axle Shaft (Fig. 202)

a. Removal. Place a dolly under the axle containing the axle shaft to be removed and raise it sufficiently to take the weight off the wheel. Remove eight screws and lockwashers attaching drive flange to hub (fig. 203). Withdraw shaft from hub by pulling on flange. Remove and discard gasket.

b. Installation. Raise axle slightly to take vehicle weight off the wheel (a above). Make sure axle shaft is clean. Slide new gasket over the end of the axle shaft and hold it in place on drive flange. Insert splined end of shaft through hub and guide splines into differential side gear. Aline holes in flange and hub, and install eight hex-head screws and lockwashers. Tighten screws gradually and evenly to 70 to 80 pound-feet torque.

174. Rear Axle (Fig. 201)

a. Coordination with Direct Support Maintenance Unit. Refer to paragraph 2 for information on coordination with a direct support maintenance unit.

b. Removal.

(1) Position truck. Place truck on a level surface and block front wheels securely.

(2) Raise rear of truck.

Caution: Do not use tie-down and safety chain shackles on the extreme rear of the frame for lifting the vehicle. The use of these will cause excessive strain on the frame side members.

Raise the rear of the truck with a hoist and a suitable sling under the frame. Use spreader bars to protect the truck body, and soft wood blocks where the sling wraps around corners of the body. Support the frame of the truck with safety jacks placed forward of the rear axle assembly under the right- and left-hand frame members. An alternative method is to raise both sides of the rear axle assembly with lifting jacks or a dolly, insert safety jacks (above) and remove the dolly or lifting jacks from the rear axle, thus removing the weight of the vehicle from the springs.

(3) Remove wheels. Place a dolly under the axle to be removed and raise it sufficiently to take the weight off the axle. Remove the wheel-stud nuts, and remove the wheels and tires from eac side.

(4) Disconnect brake lines. Remove the brake line brackets from axle housing and disconnect brake lines from the wheel cylinders at the brake flange plates.

(5) Disconnect propeller shaft. Disconnect propeller shaft or shafts, as necessary, to free axle (par. 165).

(6) Disconnect torque rods. Remove torque rods (fig. 201) from upper and lower brackets on axle.

(7) Remove axle. With axle resting on the dolly, move it to the front or rear as

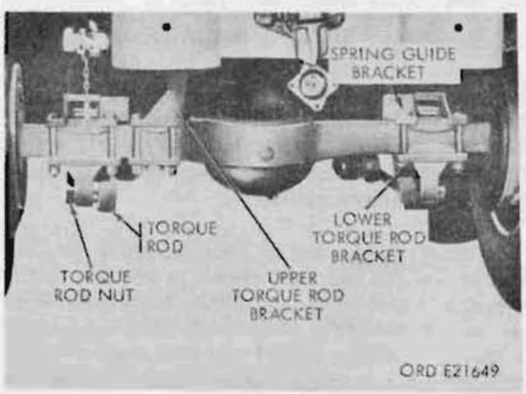


Figure 201. Rear axle installed

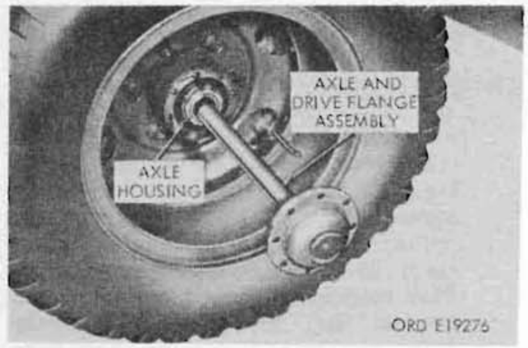


Figure 202. Rear axle shaft - partially removed

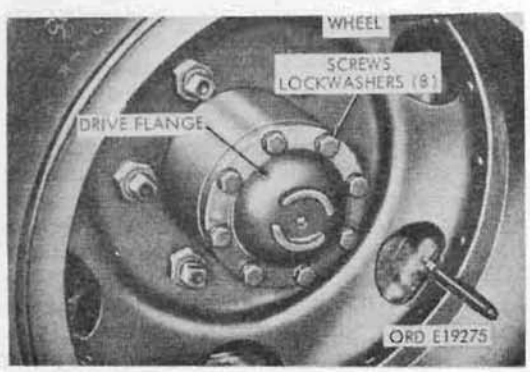


Figure 203. Rear axle shaft - installed

necessary, until spring ends are free of guide brackets on axle housing and withdraw axle from under truck.

(8) *Remove air breather valve.* Remove air breather valve from axle (par. 170).

c. *Installation.*

(1) *Position axle.* Clean and install air breather valve on axle. Place axle on dolly and move axle into position under truck, guiding the spring ends into guide brackets on axle housing.

(2) *Connect torque rods.* Aline torque rod ends with holes in brackets. Install the torque rods (fig 201) on the brackets on the axle.

(3) *Connect propeller shaft.* Connect propeller shaft or shafts, as necessary (para 165).

(4) *Connect brake lines.* Connect brake lines to wheel cylinders at brake flange plates. Install hex-head screws and lockwashers connecting brake line brackets to axle housing.

(5) *Bleed brakes.* Bleed the rear wheel brakes (para 177).

(6) *Install wheels.* Install the wheels and the tires on hubs, install the wheelstud nuts, and tighten to 400 to 450 pound-feet torque. Remove the safety jacks and lower the vehicle to the ground.

(7) *Lubricate.* Lubricate the axle and the propeller shaft universal joints, as directed in LO 9-2320-209-12.

(8) *Record of replacement.* Make a record of the replacement on DA Form 2408-5, Equipment Modification Record.

Section XXXI. BRAKE SYSTEM

175. Description

a. *Service Brake System.* The service brake system is an air-operated hydraulic system comprising the master cylinder, air-hydraulic cylinder, individual hydraulic wheel cylinders, and necessary lines for hydraulic fluid and linkage to operate system.

b. *Master Cylinder* (fig. 208). The master cylinder contains hydraulic fluid, acted upon by a piston operated by action of the service brake pedal. Pressure on the brake pedal is transmitted to the air-hydraulic cylinder which automatically increases fluid pressure to the wheel cylinders in direct ratio to the foot pressure applied to the brake pedal.

c. *Air-hydraulic Cylinder* (fig. 208). The air-hydraulic cylinder embodies an air cylinder and a hydraulic cylinder in tandem, fitted with a common piston rod. The air piston is of greater area than the hydraulic piston. This difference in areas gives a resultant hydraulic pressure much greater than the air pressure admitted to the air cylinder. The automatic valves, actuated by fluid pressure from the master cylinder, control the air admitted to the air cylinder. Thus, fluid pressure in brake lines is always in direct ratio to foot pressure on brake pedal. Air lines from air-hydraulic cylinder connect to the trailer airbrake hose coupling at rear of truck.

d. *Handbrake* (fig. 213). The handbrake consists of a brakedrum mounted on rear output shaft of transfer, and inner and outer brakeshoes operated by a single shoe lever. A cable, attached to brakeshoe lever, runs through protective casing to the handbrake lever at left of driver's seat.

176. Service Brake Adjustment

a. *Adjustment Tests.*

(1) Adjustments of the service brake system to compensate for normal wear are confined to adjustments at brakeshoes. Adjustment of master cylinder push rod is necessary only to obtain proper brake pedal free travel (para 179).

Note. Adjust service brakes when brake pedal pad travel is within 2-inches of cab floor with pedal in applied position. Master cylinder must be full to within 1/2-inch of the top and air pressure above 65 psi.

(2) Service brake adjustment to compensate for lining wear is made by turning the adjusting cam only (fig. 206), and is termed "minor adjustment." Following rebuild, or when new linings are installed, each brakeshoe must be adjusted to center the brakeshoe arc in relation to drum. This involves turning both the anchor pins and the cams and is termed "major adjustment."

(3) Always check the wheel bearing adjustment (para 206) before adjusting the brakes. Satisfactory brake adjustment cannot be obtained unless the wheel bearings are in proper adjustment.

Note. It is not necessary to disturb properly adjusted wheel bearings to adjust service brakes.

Brake lining clearance (fig. 204) can be checked without removing brakedrum (*c*(2) below), but the wheels must be removed. Do not adjust the brakes when drums are hot.

b. Minor Adjustment (fig. 206). Adjust the brakes by turning the front shoe adjusting cam, to bring lining into contact with the drum, until the brake drags slightly when the wheel is turned by hand. Back off the adjusting cam just enough to allow the wheel to rotate freely. Repeat this procedure at the rear shoe adjusting cam, turning the cam counterclockwise. Make both adjustments at each wheel as uniform as possible. Repeat the opertion on all other wheels.

c. Major Adjustment.

(1) Remove wheel (para 203).

(2) Remove inspection cover from outside of brakedrum. Rotate the drum until opening is 1½ inches from bottom end of the forward brakeshoe. Insert 0.010-inch feeler gage between the drum and bottom end of the shoe (fig. 204). Loosen the locknut on the anchor pin. Hold the locknut with one wrench and turn the anchor pin clockwise (fig. 205) with the second wrench until 0.010-inch clearance is obtained. Tighten the locknut.

(3) Rotate the drum until the opening is 1½ inches from the top end of the forward brakeshoe (fig. 204). Insert 0.020-inch feeler gage and turn the adjusting cam (fig. 206) until 0.020-inch clearance is obtained. Check the lower clearance again ((2) above).

(4) Repeat procedures (2) and (3) for rear brake shoes.

(5) Repeat (2), (3) above on the other wheels.

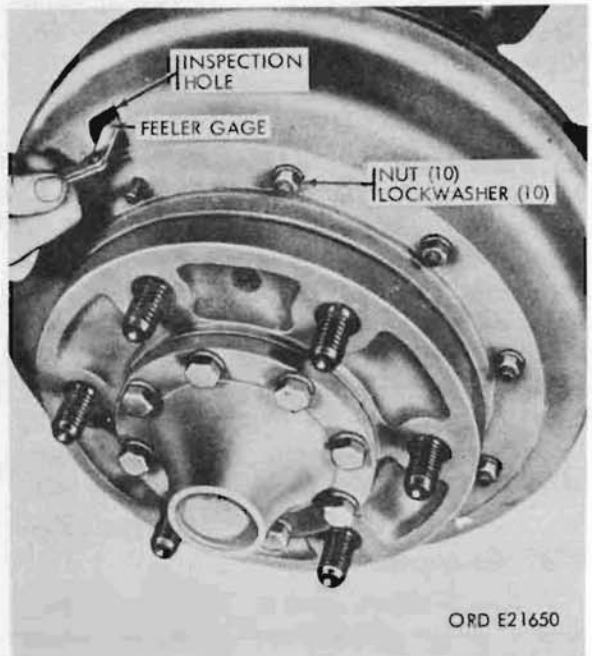


Figure 204. Checking brake line clearance.

(6) Adjust the brake lining clearance at the cams by minor adjustment (*b* above). Install the inspection cover on the brakedrum and install the wheel.

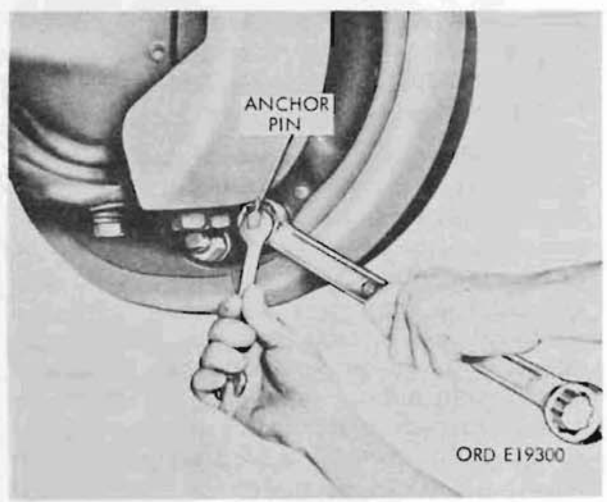


Figure 205. Anchor pin adjustment.

177. Service Brake System Bleeding

a. The hydraulic lines must be bled to expel the air which may have entered lines if any of the hydraulic line connections have been broken or disconnected, or if the level of the hydraulic fluid has been allowed to get too low.

b. The system can be bled manually or with a pressure tank. When the manual system is used, two persons are needed; one to pump the brake pedal and to maintain a constant supply of fluid in the master cylinder reservoir and the other to accomplish bleeding operations at the air-hydraulic cylinder and wheel cylinders.

(1) If a pressure tank is used, connect the tank hose with proper size adapter to the master cylinder filler cap opening in top of cylinder reservoir. The pressure tank should contain between 10 to 20 psi air pressure and sufficient fluid to maintain constant fluid level in the master cylinder.

(2) The air-hydraulic cylinder must be bled before bleeding the wheel cylinders. Clean the bleeder screw at the air-hydraulic cylinder (fig. 207) and wheel cylinders (fig. 208). Attach the bleeder hose to the air-hydraulic cylinder bleeder screw, and place the other end in a glass jar or bottle so that the end is submerged in the hydraulic brake fluid. While pumping the brake pedal or with use of the pressure tank, open the bleeder screw three-quarters of a turn counterclockwise. Close the bleeder screw firmly as soon as the fluid flows out of the tube in a solid stream without air bubbles. Remove the bleeder hose.

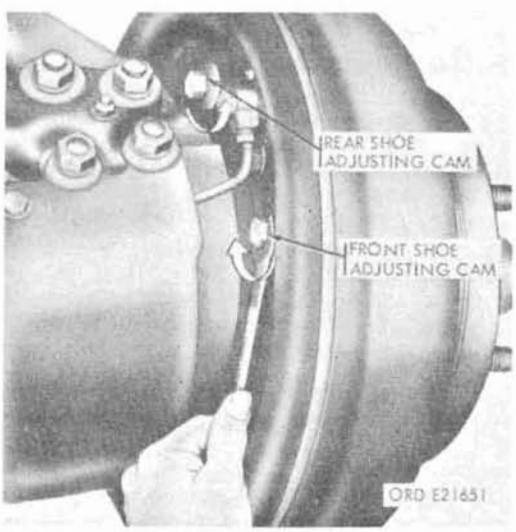


Figure 206. Adjusting brake lining clearance

(3) Repeat the bleeding operation on each wheel cylinder, replenishing brake fluid in master cylinder, if manual system is used, before each wheel is bled.

178. Service Brake Pedal and Linkage

a. General (Fig. 209). The brake pedal, mounted on the clutch and brake lever shaft with the clutch pedal, is linked to the master cylinder by an adjustable push rod. The push rod is adjusted at the rod end yoke to give correct brake pedal free travel (par. 179).

b. Removal.

(1) Remove clutch linkage. Disconnect the clutch and brake pedal return springs. Remove the safety nut and screw holding the clutch control rod on the clutch control lever, and remove the rod. Loosen the safety nut on the screw securing the clutch pedal lever on the lever shaft, and remove the lever and key.

(2) Remove brake pedal and pedal lever. Remove the screw holding the pedal on the lever, and remove the pedal and pedal bumper. Disconnect the pedal lever from the master cylinder push rod. Pull the lever shaft from the clutch and brake pedal support, and remove the brake pedal lever.

c. Installation.

(1) Install brake pedal and pedal lever. Install the brake pedal lever in the pedal support, and install the lever shaft with the attached clutch control lever through the shaft and support. Install the brake pedal and bumper on the brake pedal lever with split lockwasher screw. Connect the pedal lever to the master cylinder push rod.

(2) Install clutch linkage. Install the clutch pedal lever on the lever shaft over the

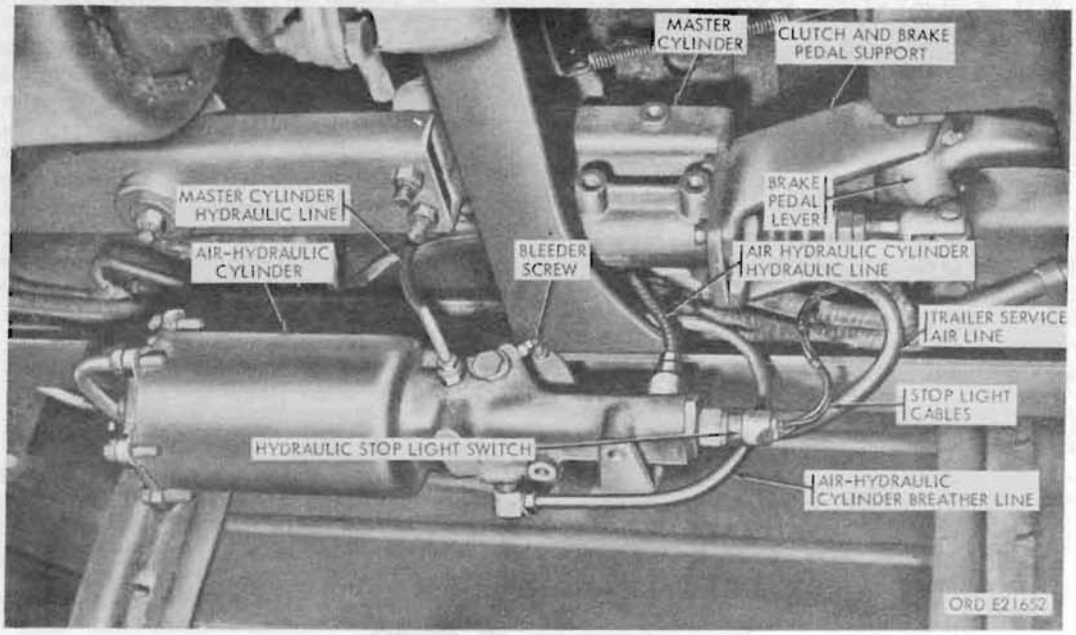


Figure 207. Air hydraulic cylinder

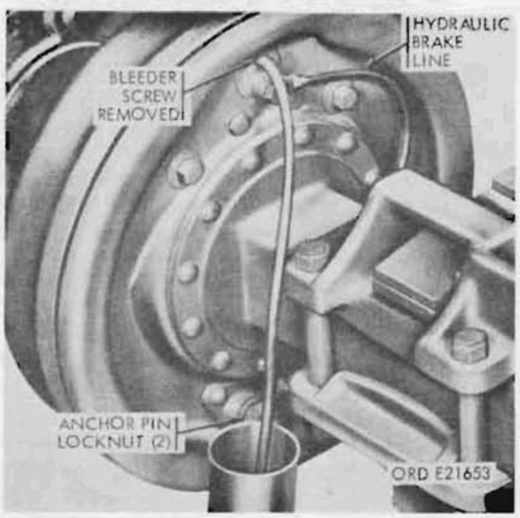


Figure 208. Bleeding service brake cylinder

woodruff key, and tighten the safety nut on the lever screw to secure the lever on shaft. Install the clutch control rod on the clutch control lever with hex-head screw and safety nut. Connect the pedal return springs.

179. Master Cylinder

a. Adjustment. Check the brake pedal free travel. Free travel should be not less than one-fourth and not more than one-half inch. Adjust the free travel to these limits by adjusting the master cylinder push rod (fig. 209). Remove the cotter pin and clevis pin attaching the push rod yoke to the brake pedal lever. Hold the push rod from turning, loosen jamnut, and turn yoke to obtain desired setting. Tighten jamnut and connect the yoke to pedal lever.

b. Removal. Disconnect the master cylinder line (fig. 207) at the top, and the master cylinder line at the rear of the master cylinder. Remove two screws holding the power-takeoff shift lever bracket to the side of the cylinder. Remove the clevis pin connecting the master cylinder push-rod yoke to the brake pedal lever (fig. 209). Remove four capscrews holding the master cylinder to the clutch and brake pedal support, and remove the master cylinder.

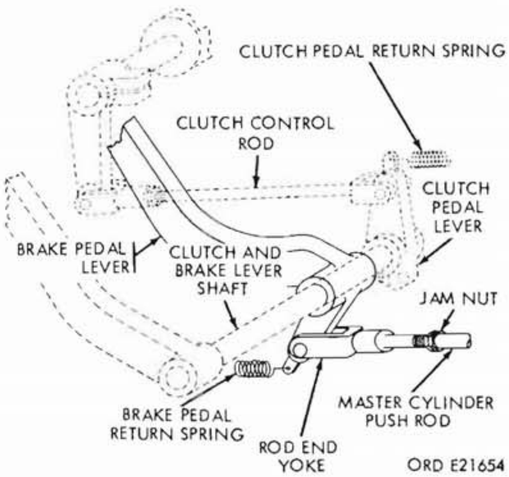


Figure 209. Service brake pedal linkage

c. Installation.

(1) Place the master cylinder (fig. 207) in position, and install four split lock-washer screws holding the cylinder to the clutch and brake pedal support. Install two screws holding the transmission power-takeoff shift lever bracket to the side of the master cylinder. Install the clevis pin with a cotter pin through the brake pedal lever and the push-rod yoke. Adjust the brake pedal free travel (a above).

(2) Connect the master cylinder hydraulic line (fig. 207) at the rear of the master cylinder.

(3) Remove the filler cap and fill the master cylinder reservoir to within one-half inch of the top. Bleed the brake system (par. 177). Install the double baffle-type filler cap, using a new gasket when necessary, and attach the breather line.

180. Air-hydraulic Cylinder

a. Adjustment. No adjustments are provided for the air-hydraulic cylinder.

b. Removal.

(1) Open the compressed air reservoir draincocks (par. 222). Remove the metal shield from the lower side of the cylinder. Figure 207 shows the cylinder as installed with the shield removed.

(2) Disconnect the master cylinder hydraulic line, air-hydraulic cylinder hydraulic line, air-hydraulic cylinder breather line, air-hydraulic cylinder air line, and trailer service air line from the cylinder.

(3) Disconnect the stoplight cables from the hydraulic stoplight switch.

(4) Support the cylinder, remove the bolt at the rear from the shell cover, and remove the cylinder.

c. Installation.

(1) Support the cylinder on the front bracket and install the bolt through the support bracket into the center of the shell cover.

(2) Connect the stoplight cables to the switch.

(3) Connect the master cylinder hydraulic line, air-hydraulic cylinder hydraulic line, air-hydraulic cylinder breather line, air-hydraulic cylinder air line, and trailer service air line to the cylinder.

(4) Place the cylinder shield in position, and install a self-locking hex-head bolt through the shield and support bracket into the cylinder. Secure the shield with rear bolt. Close the air reservoir draincocks.

d. Air Pressure Tests.

(1) Relieve brake system of all air pressure.

(2) Remove lubrication pipe plug from rear end of air-hydraulic cylinder and connect an air pressure test gage at this point. Build up air pressure in system to normal operating pressure (100 psi) as registered on air pressure gage in instrument cluster; then shut off engine.

(3) Coat all air line connections with a solution of soap and water to check for leakage. Leakage can sometimes be corrected by tightening the connection. If this fails to correct leakage, air line or fittings must be replaced.

(4) Disconnect air exhaust line from air-hydraulic cylinder exhaust port. Connect a flexible hose or a bent tube to exhaust port; hose or tube must be long enough to hand down over side of air-hydraulic cylinder. Hold a jar of water up under exhaust tube so that end of tube is immersed in water. Watch for bubbles to appear in water. The appearance of bubbles indicates a leaking control valve poppet air inlet seal, requiring replacement of the air-hydraulic cylinder.

(5) Apply brakes and hold pressure on pedal, observing action of air pressure test gage at rear of air-hydraulic cylinder. Air-hydraulic cylinder should hold maximum pressure registered on test gage without noticeable loss until the brake pedal is released. Loss of air pressure indicates a leaking control valve poppet exhaust seal, or leakage past the air-hydraulic cylinder air piston. Replace air-hydraulic cylinder.

(6) Depress and momentarily hold brake pedal to several positions between fully released and fully applied positions. Pressure registered on test air pressure gage should increase gradually according to brake pedal depression. Failure to graduate the pressure evenly indicates a sticking control valve hydraulic piston, which necessitates replacing air-hydraulic cylinder.

(7) Make a full brake application; then observe action of air pressure test gage when brakes are released. If gage does not return to zero or is slow in returning, a sticking control valve hydraulic piston is indicated. Replace air-hydraulic cylinder.

181. Wheel Cylinders

a. Removal.

(1) *Remove service brakedrum.*

NOTE

It is not always necessary to remove brake hub to remove service brakedrum.

If brake hub removal is required, remove the hub (para 205). If the hub is not removed, remove the brakedrum (para 182).

(2) Disconnect hydraulic line. Disconnect the hydraulic brake line (fig. 208) from the wheel cylinder at the rear of flange plate.

(3) Remove wheel cylinder. Install the hydraulic brake cylinder clamp (fig. 210) over the ends of the wheel cylinder, and remove the return spring with brake return spring pliers. Remove two screws and lockwashers holding the wheel cylinder to the flange plate, and remove the dust cover and wheel cylinder.

b. Installation.

(1) Install wheel cylinder. Place the brake cylinder clamp (fig. 210) over the ends of the wheel cylinder. Position the cover and wheel cylinder on the flange plate, and install two lockwashers and hex-head screws. Tighten the screws securely. Position the brakeshoes at the ends of the wheel cylinder. Install the return spring with return spring pliers (fig. 210). Remove the brake cylinder clamp from the cylinder.

(2) Connect hydraulic line. Connect the hydraulic brake line (fig. 208) to the wheel cylinder.

(3) Install service brakedrum. If the brake hub was removed, install the brake hub (par. 205). If not, install the brakedrum (par. 182).

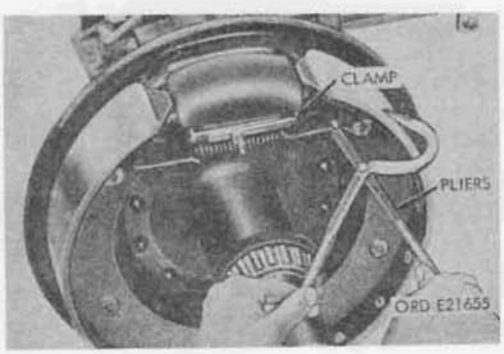


Figure 210. Removing service brake return spring

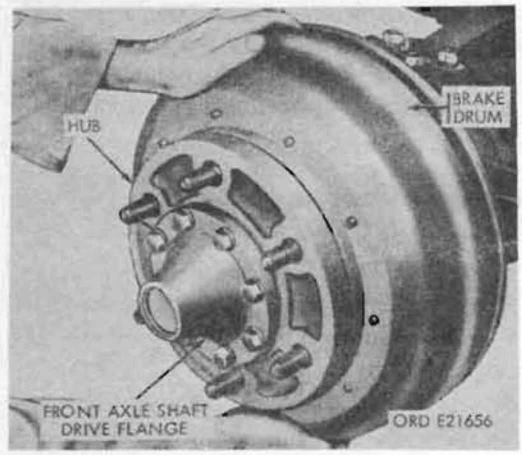


Figure 211. Removing service brakedrum

(4) Bleed brakes. Bleed the brake system (par. 177).

(5) Adjust brakes. Make minor brake adjustment (par. 175b).

182. Brakedrums

a. Removal. Remove the wheel (par. 203) and tire. Remove 10 nuts and lockwashers holding the drum to the hub assembly (fig. 204). Pry the drum loose and pull the drum (fig. 211) off the studs.

b. Installation. Place the drum over studs on the brakedrum adapter. Install 10 lockwashers and nuts and tighten nuts evenly and securely. Install the wheel (par. 203).

183. Service Brakeshoes

a. General. Some trucks, by replacement or by later production, have screw-type service brakeshoe guide pins (fig. 212), instead of riveted ones. Inspection of the pins will reveal type. Pins having hex-head are of later or modified screw-type. Earlier pins had C-washers or spring pins to hold the brakeshoe on pins.

b. Removal.

(1) Remove service brakedrum.

Note. It is not always necessary to remove brake hub to remove service brakedrum.

If the hub removal is required, remove the brake hub (par. 205). If the hub is not removed, remove the brakedrum (par. 182).

(2) *Remove brakeshoe return spring.* Install the brake cylinder clamp (fig. 210) over the ends of the wheel brake cylinder to prevent the cylinder pistons from leaving the cylinder body during removal. Remove the return spring from the guide pins with return spring pliers.

(3) *Remove brakeshoe anchor pin C-washer.* Remove the anchor pin C-washer (fig. 212) from anchor pins. Remove the shoe anchor pin washer from the pins.

(4) *Remove shoes.*

(a) *Remove shoes retained by guide pin C-washers or spring pins holding the shoes on four guide pins.* Remove the plain washers from the guide pins. Remove the shoe by pulling the shoes free of the wheel cylinder piston rods, and then straight out from the flange plate to clear the guide and anchor pins. Remove the plain washers, anti-rattle springs, felt washers, and felt washer retainers from the pins.

(b) *Remove shoes retained by hex-head type guide pins.* Remove the hex-nuts and lockwashers holding four long guide pins (fig. 212) to the flange plate. Pull the shoes free of the cylinder piston rods and then straight out from the flange plate, being careful not to lose the shoe antirattle springs on the long guide pins and lower guide pin washers. Remove the washers and short guide pins from shoes. Remove the upper guide pin C-washer holding long guide pins in shoes, and remove the pins from shoes. Remove the felt washers and felt washer retainers from the anchor pins.

c. Installation.

(1) *Install shoes.*

(a) *Install shoes retained by hex-head type guide pins.* Install the long guide pins (fig. 212) through the upper holes in the brakeshoes and secure each pin in the shoes with the upper guide pin C-washer. Install the antirattle spring on each long pin. Install the short guide pin in the lower pin holes in the shoes, and install the lower guide pin washer on each short pin. Install the felt washer and felt washer retainer on each anchor pin. Install the brakeshoes on the anchor pins, engage the shoes in the cylinder pistons, and insert the guide pins in the pin holes in flange plate. Secure each guide pin to plate with a lockwasher and hex-nut.

(b) *Install shoes retained by guide pin C-washers or spring pins (fig. 212).* Install the felt washer and felt washer retainer on each anchor pin. Install the antirattle spring and guide pin thick washer on each long guide pin, and thick washer on each short guide pin. Install the brakeshoes on anchor pins, engage the shoes in cylinder piston rods, and slide the shoes inward to install the guide pins in the pin holes in shoes. Install the guide pin thin washer over each pin and secure the washer and brakeshoe on pin with the guide pin C-washer or spring pin.

(2) *Install brakeshoe anchor pin C-washer.* Install the anchor pin washer and C-washer on anchor pin. Turn the anchor pins in directions indicated in figure 212 until the marks on pins are toward each other. Check the freedom of shoes on the guide and anchor pins. Remove the cylinder clamp from cylinder.

(3) *Install brakeshoe return spring.* Using return spring pliers (fig. 210), install the shoe return spring on the upper guide pins. Remove the clamp from the wheel cylinder.

(4) *Install service brakedrum.* If the brake hub was removed, install the brake hub (par. 205). If not, install the brakedrum (par. 182).

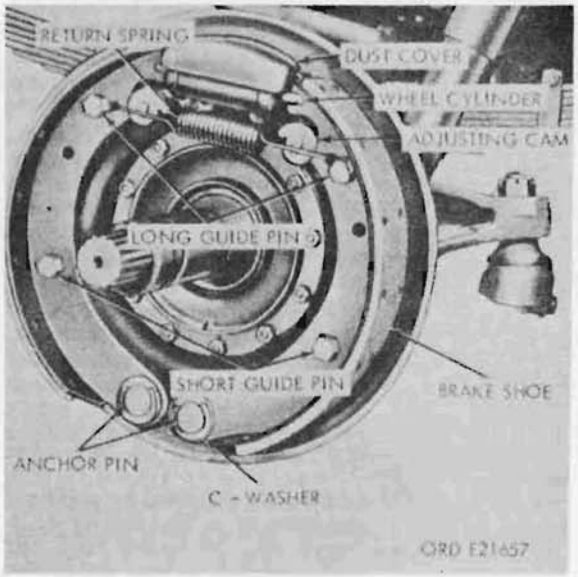


Figure 212. Service brake interior.

184. Hydraulic Lines, Hose, and Fittings (Fig. 213)

a. General. All hydraulic lines are composed of metal tubing and inverted flared tubetype fittings. Lines are securely anchored to the truck frame and axles to prevent vibration. Flexible hoses, supported by suitable brackets, are used for connection between chassis and axle lines, and between the front axle lines and the front wheel brake cylinders.

b. Removal. Disconnect the lines and hose at flared fittings, and remove the lines and hose. Remove the brackets.

c. Preparation of Lines. When replacing the hydraulic line tubes from the stock tubing, do not use guess work. Make correct calculations as to length, number of bends, and their locations. The ends must be square; use a tubing cutter. Ream the ends to remove all burrs and blow out the tubes with compressed air. Make all bends with a bending fixture. Make preliminary check for length before flaring ends. Do not install lines which are too short or too long; cut and bend to fit. Make flares carefully and blow out lines with compressed air before installation.

d. Installation. Install brackets. Connect the lines and hose at flared fittings, being sure to tighten connections securely. Check for leaks and bleed hydraulic brake system (par. 177).

185. Handbrake Shoes (Fig. 214)

Note. The replacement handbrake shoe assembly must match the type of transfer installed. Refer to TM 9-2320-209-20P.

a. Removal. Disconnect and remove the shoe return spring, and disconnect the handbrake cable from shoe lever. Remove the jamnut from the shoe anchor pin at the lower end of the shoe lever and unscrew the anchor pin from the rear bearing cover on the transfer case. Do not lose the spacers from between the outer brake shoe and bracket. Slide the shoes from brakedrum. To remove the brakeshoes, remove shoe lever pins and slide the shoes from the pins.

b. Installation. Place the inner and outer brakeshoes on the shoe lever pins and secure with shoe lever pin washers. Slip the shoes on the brakedrum and secure to the transfer case with the shoe anchor pin and a hex jamnut. Use spacer washers as required to locate brake lining on drum 1/16-inch to flush with brake drum rim. Connect the handbrake cable to the shoe lever, and install the shoe return spring. Adjust the linkage (par. 186).

186. Handbrake Lever Linkage (Fig. 215)

a. Adjustment. The handbrake linkage must be adjusted when the handbrake lever reserve travel is less than one-half of ratchet range. To adjust, block the wheel to keep the truck from moving. Release the handbrake lever. Loosen the locknut and the jamnut on the cable at the brakeshoe lever and/or handbrake lever. Take up slack in the cable by turning the locknut. Tighten the jamnut firmly. Remove the blocks from wheel.

b. Removal. Remove the nut from each end of the cable. Remove U-bolts from the cable brackets, and pull the cable from the handbrake lever and the brakeshoe lever. Remove four safety nuts and screws holding the lever mounting and cable brackets to the cab floor, and remove the brackets and lever.

c. Installation. Install the handbrake lever mounting and cable brackets on the cab floor with four hex-head screws and safety nuts. Install the cable on the cable brackets with U-bolts. Secure end of cable to the handbrake lever with a safety nut. Secure the other end of the cable to the brakeshoe lever with a hex-nut. Adjust the brake (a above).

186.1 Handbrake Lever Linkage (Orscheln).

a. Handbrake Adjustments (Fig. 215.1 and 215.2).

(1) On currently manufactured models equipped with the Orscheln handbrake lever, the inner and outer drum linings must be adjusted when the adjustment ability has been used up by usage of the cable adjusting knob on the handbrake lever. Block the front wheels to keep the truck from moving. Position the handbrake lever for full release and minimum stroke. This condition can be recognized when the pin that holds the handbrake lever assembly and cable yoke is at the bottom of the slotted floorboard brackets (see encircled detail, fig. 215.2).

(2) Using a feeler gauge, check the clearance between the outer and inner shoe linings and drum. A minimum free running clearance of .015 is to be obtained between the entire surface of the outer and inner shoe linings and drum before brake is applied. Perform adjustments in the following sequence:

(a) Turn the adjusting screw adjacent to the brake shoe return spring, for outer shoe clearance (see step 1, fig. 215.1).

(b) Prior to performing the inner lining adjustment, loosen the nut at end of eccentric shoe adjusting pin on the lower portion of the brake shoe. Turn the end-of-cable nut at brake drum lever assembly (see step 2, fig. 215.1) while at the same time, turning the eccentric shoe adjusting pin (see step 3, fig. 215.1) to equalize clearance at both ends of the inner lining. When this is accomplished, tighten the locking nut at end of eccentric shoe adjusting pin to 27-35 ft. lbs. to secure adjusting pin.

(3) Remove the wheel blocks. Optimum brake lever efficiency can now be obtained by adjusting the knob on the handbrake lever.

b. Removal of Handbrake Cable and Lever (Fig. 215.2).

(1) *Remove handbrake cable.* To release cable at brake drum lever assembly remove nut. Release cable from clamp at rear of transfer case by removing bolt and lockwasher. Remove two brackets securing cable to left hand frame side rail and pull the cable out through hole in frame side rail. Remove clamp attaching forward end of cable and spacer to clamp bracket assembly mounted on underside of cab floor. Remove cotter pin, washer and pin, connecting the cable yoke to the handbrake lever assembly. Pull cable down through the floorboard and bracket hole to remove the cable from vehicle.

Note. If cable assembly is being replaced, remove and retain two clamps, four screws, four nuts, and wear plate.

(2) *Remove handbrake lever.* Remove three self-locking nuts, and one screw and nut holding the righthand and lefthand floorboard brackets to the cab floor and clamp bracket underneath the floorboard. Remove remaining self-locking nut at lefthand rear corner of the cab floor to drop the clamp bracket from underneath the floorboard (see encircled detail, fig. 215.2). The handbrake lever assembly can now be lifted from the floorboard with both brackets attached. Disassemble brackets from handbrake lever assembly on bench.

Remove one nut, washer, spacer, and screw holding the rear of the handbrake lever assembly to the right hand and left hand floorboard brackets. Remove the forward outer nut. The forward portion of brake lever base may now be spread so that

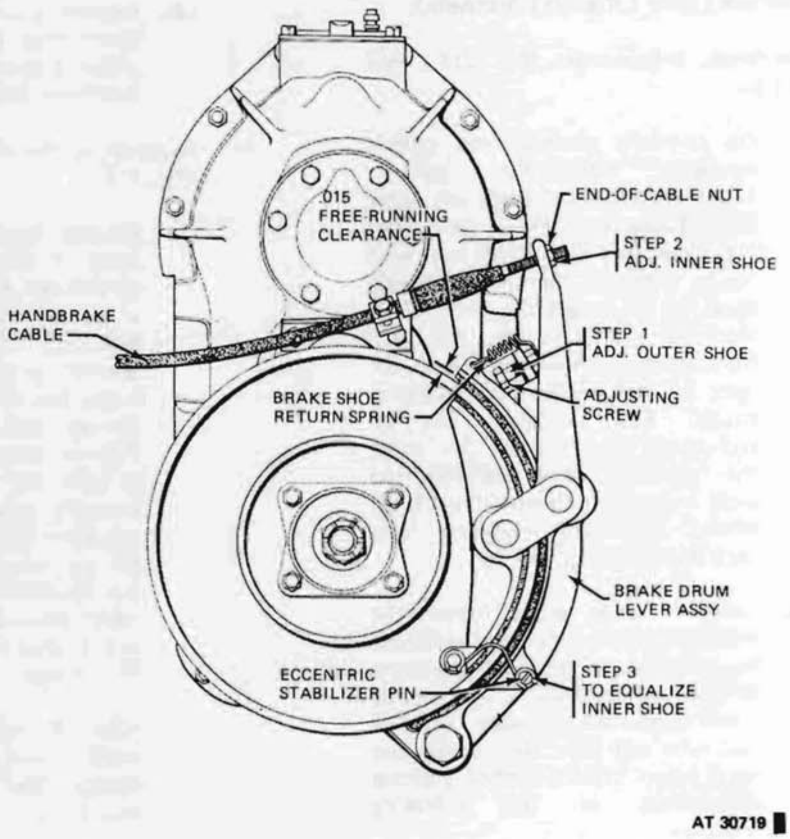


Figure 215.1. Handbrake cable and shoe adjustment.

outer screw may be removed to release the lefthand bracket. Remove the other nut and screw to release righthand bracket from the handbrake assembly.

c. *Installation of Handbrake Cable and Lever (Fig. 215.2).*

(1) *Install handbrake lever.* Prior to installing the handbrake lever, assemble the lefthand and righthand floorboard brackets on bench. Spread the forward portion of the brake lever base and position screws from inside so that threads face outward (see encircled detail, fig. 215.2). Position both brackets and secure forward portion of handbrake lever with two self-locking nuts. Line up spacer and washer at rear portion of handbrake lever; assemble screw and secure with self-locking nut. Line up handbrake assembly with attached brackets to mounting holes in floorboard. Position clamp bracket underneath floorboard. Assemble screw and nut to rear position of lefthand bracket. Assemble self-locking nuts to remaining three clamp bracket screws facing upward. Also assemble remaining self-locking nut to lefthand rear corner of clamp bracket and floorboard. Tighten all nuts.

(2) *Install handbrake cable.* Insert the cable yoke up through the hole in clamp bracket mounted under cab

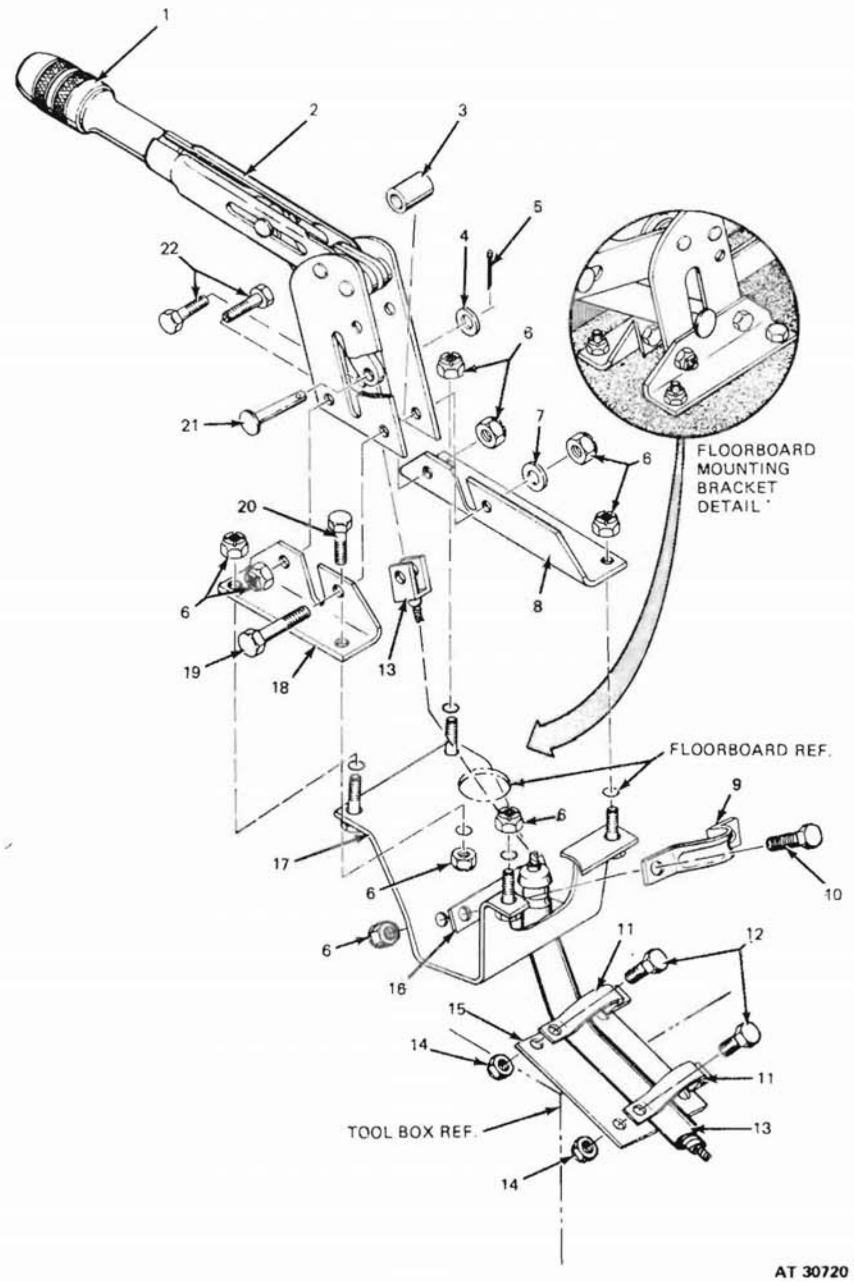
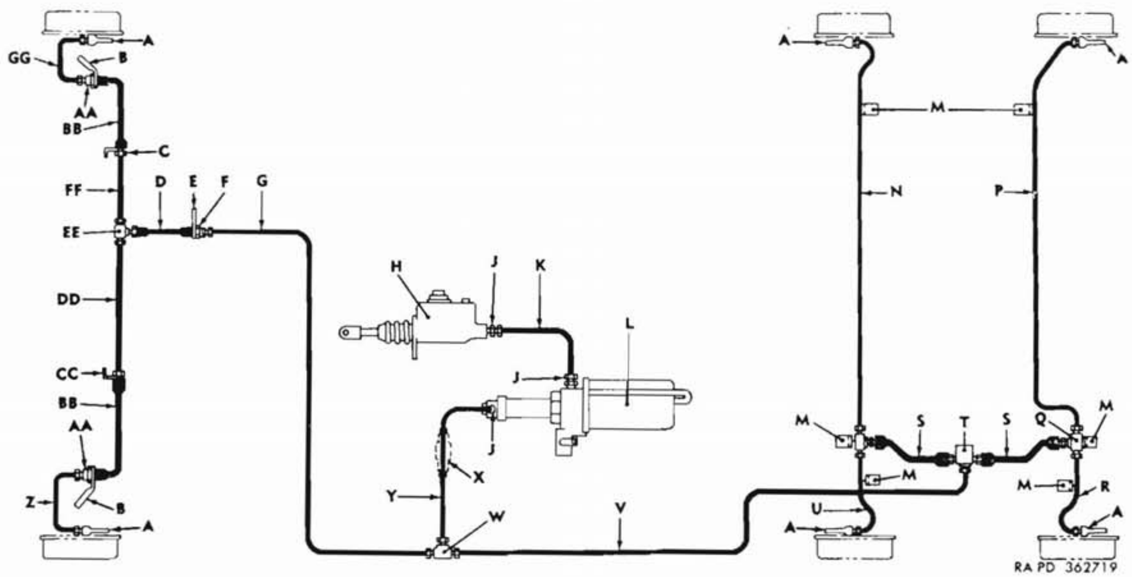


Figure 215.2. Handbrake installation.

Item	Key	Item	Key
1	Cable adjusting knob	13	Handbrake cable assy
2	Handbrake lever assy	14	4-Nuts, 1/4-in, self-locking
3	Spacer	15	Wear plate
4	Flatwasher	16	Connecting link
5	Cotter pin	17	Bracket assy, brake cable clamp
6	10-Nuts, 3/8-in, self-locking	18	Bracket, LH floorboard
7	Flatwasher	19	Screw, 3/8 x 2-in, hex cap
8	Bracket, RH floorboard	20	Screw, 3/8 x 7/8-in, hex cap
9	Clamp	21	Pin
10	2-Screws, 3/8 x 1-1/4-in, hex cap	22	2-Screws, 3/8 x 3/4-in, hex cap
11	2-Clamps		
12	4-Screws, 1/4 x 3/4-in, hex cap		

Figure 215.2--Continued.

floor and hole in cab floor; secure the yoke to the lever with pin, flatwasher and cotter pin. Secure the cable to bracket under floorboard with spacer, clamp, two screws, and two self-locking nuts. If a new or different handbrake cable is being used, assemble wear plate to the cable so as to be located approximately 3-inches from bottom of bracket mounted under floorboard so as to contact corner of toolbox or gas tank. Secure wear plate to cable with two clamps, four screws, and four self-locking nuts. Place opposite end of cable through hole in left hand frame side rail. Install two clamps into the frame rail as to hold the cable in place. Secure cable to clamps with two screws and two self-locking nuts. Take care when routing the brake cable to prevent any sharp bends or kinks. Install cable to clamp on bracket at rear of transfer case with bolt and lockwasher. Attach end of cable to the brake drum lever assembly. Secure with nut. Perform handbrake adjustments in accordance with *a* above.



RA PD362719

Key	Item	Key	Item
A	Wheel cylinder fitting	R	Rear-rear axle left wheel cylinder line
B	Brake hose outer bracket	S	Rear axle brake supply hose
C	Brake hose inner right bracket	T	Supply hose tee
D	Front axle brake supply hose	U	Forward rear axle left wheel cylinder line
E	Supply hose bracket	V	Rear axle brake line
F	11/16-in. hex-nut	W	Hydraulic lines tee
G	Front axle brake line	X	Solenoid brake lock (M108 only)
H	Master cylinder	Y	Air-hydraulic cylinder line
J	5/16-in. connector	Z	Front axle left wheel cylinder line
K	Master cylinder line	AA	5/8-in. hex-nut
L	Air-hydraulic cylinder	BB	Front axle brake hose
M	Brake line bracket	CC	Brake hose inner left bracket
N	Forward rear axle right wheel cylinder line	DD	Left front brake line
		EE	Brake line tee
P	Rear-rear axle right wheel cylinder line	FF	Right front brake line
Q	Brake hose tee	GG	Front axle right wheel cylinder line

Figure 213. Brake hydraulic system and piping diagram.

187. Handbrake Drum

a. Removal.

(1) *Remove the propeller shaft (par. 165).*

(2) Remove the cotter pin from the rear output shaft (fig. 216). Apply the handbrake and remove the rear output shaft companion flange nut and flat washer. Release handbrake. Disconnect and remove the brake shoe assy. (par. 185) (Fig. 214).

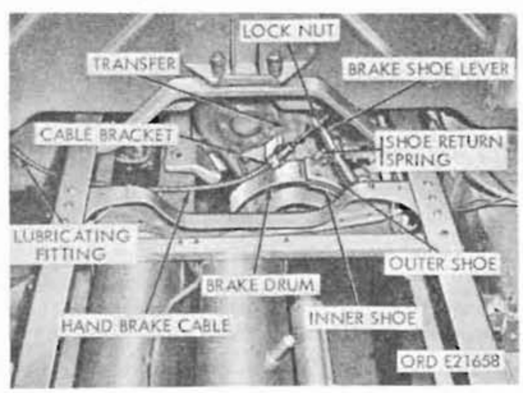


Figure 214. Handbrake drum and shoes.

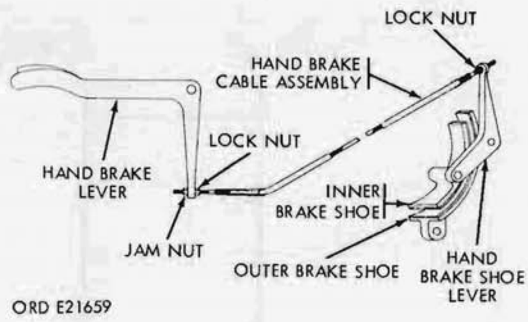


Figure 215. Handbrake lever and linkage diagram

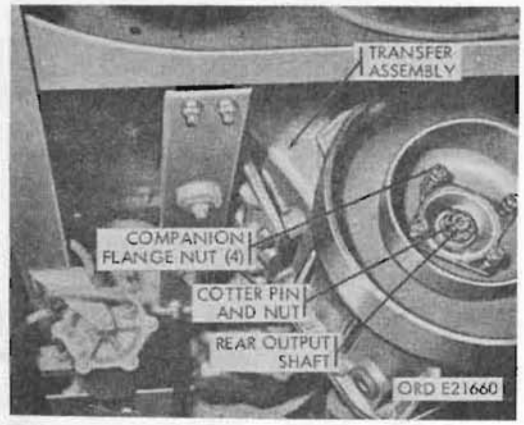


Figure 216. Removal of handbrake drum

Pull the companion-flange, brakedrum, and dust deflector from the rear output shaft. Remove the two capscrews and lockwashers securing the shoe-stop bracket to the transfer case and remove the bracket.

b. Installation. Install parts in reverse order of disassembly.

Section XXXII. SPRINGS AND SHOCK ABSORBERS

188. Description

a. Front Springs (Fig. 217). The front springs are semielliptic type, assembled with a bolt through the center of the leaves, and the leaves alined with four rebound clips. The springs are mounted on the spring seat resting on the axle, and each is secured by two U-bolts, seated on the U-bolt saddle, and passing through the clamp plate under the axle. The front spring is pivoted in a spring hanger at the front end and shackled to the spring hanger at the rear end. Trucks mounted on M46 series chassis, and trucks M47, M59, M60 and M108 have heavy-duty front springs.

b. Rear Springs (Fig. 218). The rear springs are inverted semielliptic type with slipper-type ends. The springs are mounted on the rear spring seats which are mounted on the spring seat cross-shaft. Each is secured to the spring seat by two U-bolts seated on the U-bolt saddle. Spring leaves are held together by a center bolt, and the leaves are alined with four rebound clips. The ends of the spring rest on axle housing and are free to slide in the guide brackets. Trucks mounted on M46 series chassis and trucks M47, M59, and M342 have heavy-duty rear springs and rear spring lock-out beams instead of the regular U-bolt saddles, to limit spring motion under heavy load.

c. Rear Spring Seats (Fig. 218). The spring seat mounted on the underside of the spring is equipped with tapered roller bearings which support the seat cross-shaft.

d. Torque Rods (Fig. 218). Driving and braking forces are transmitted to the chassis by a system of torque rods arranged to maintain the vertical position of the rear-axle drives, regardless of uneven road surface. Upper and lower rods are installed on the left side of the truck, and lower rods only on the right side.

e. Shock Absorbers (Fig. 217). The shock absorbers are hydraulic, double-acting, cylindrical-type and are installed at the front of the truck.

189. Front Springs (Fig. 217)

a. General. Some trucks were originally equipped with the front spring 7521855, which is no longer authorized as a replacement part.

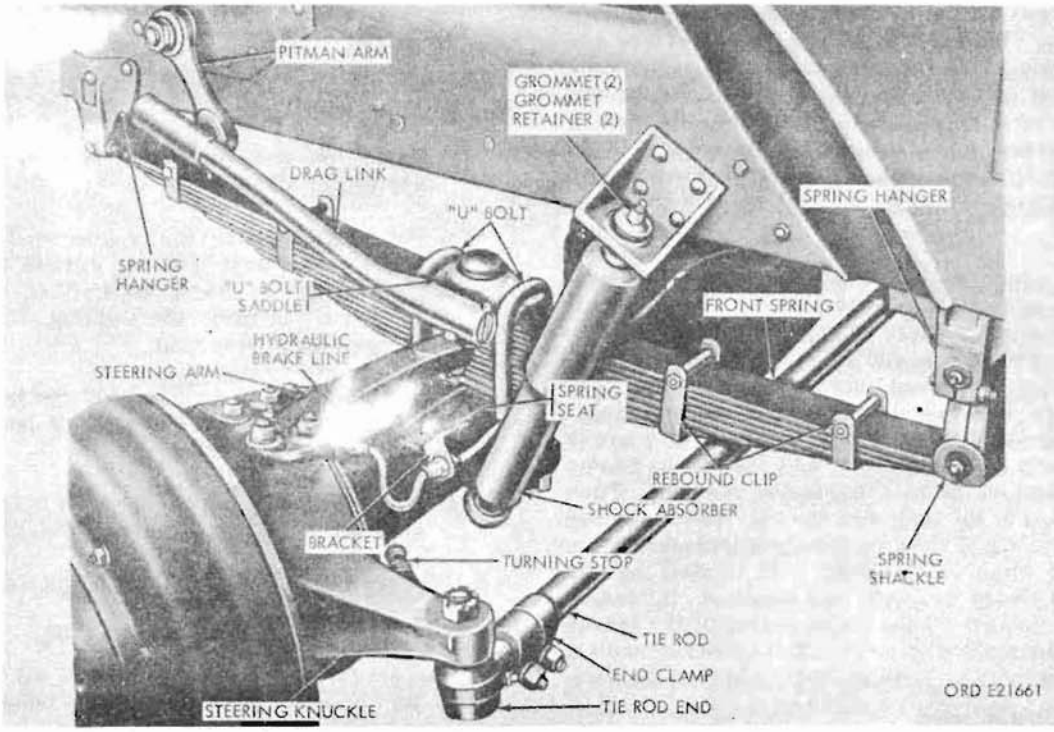


Figure 217. Front spring and steering gear components

When the failure of a front spring 7521855 occurs, the springs will be replaced with a front spring 7368628, in pairs only. Replace the seat 7521821 and the bumper 7521830 with the seat 7368627 and the bumper 7368626 when installing the new springs.

Note. Installation of the new springs will increase the clearance between the axle and frame.

b. Removal.

(1) Raise frame to free spring of load.

(2) Remove nuts and screws holding the spring-mounting pins in the spring hangers and the shackle at the front and the rear of the spring, and remove pins.

(3) Disconnect the shock absorber (par. 193) from the clamp plate, and remove the nuts holding the U-bolts to the clamp plate.

(4) Remove the clamp plate, U-bolts, and U-bolt saddle.

(5) Lift the spring off the seat, and remove.

(6) Remove the nuts and the screws holding the mounting pin and the spring shackle, and remove pin and the shackle from the spring.

c. Disassembly.

Warning: Springs are under tension. Use care in disassembling to prevent personal injury.

Remove the nuts, the spacers, and the bolts securing the rebound clips on the springs, and remove the clips. Remove the nut and the bolt securing the spring leaves together and separate the leaves.

d. Cleaning. Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Wire brush or buff all the rust and corrosion from the leaves.

e. Inspection and Repair. Inspect the leaves for cracks and breaks. Replace defective leaves. Inspect the bushing-type bearings and mounting pins for wear or damage. Check the mating of pins and bearings and replace the worn or damaged parts. Press out old bearing and press in new bearing. Ream new bearing to 0.991 to 0.994 inch. If bearings are loose in the spring eye or the shackle, replace the bearings.

f. Assembly. Assemble the leaves in order, starting with the longest leaf. Place a small amount of powdered graphite between all the leaves when assembling. Line up the holes for the center bolt and insert the bolt with the head on the shortest leaf for the front springs. Press the leaves tightly together in a press or with a heavy clamp and install the center bolt-nut on the bolt, tightening securely. Peen the end of the bolt over the nut. Install the two long rebound clips on the sixth leaf and the two short clips on the ninth leaf. Install the clip bolts, bolts spacers, and bolt-nuts, tightening nuts enough so the clips maintain the leaves in alinement without restricting free movement of the leaves. Peen the bolt ends over the nuts.

g. Installation.

(1) Install the shackle on rear end of the spring with a mounting pin, hex-head screws and safety nuts.

(2) Set the spring in position on the spring seat.

(3) Place the U-bolt saddle on the spring and place the U-bolts in position.

(4) Place the clamp plate under the axle and over the U-bolts. Be sure that the anchor lug for the shock absorber is at the rear of the axle. Install lockwashers and hex-nuts on the U-bolts, and tighten securely.

(5) Connect the shock absorber (par. 193) to the clamp plate.

(6) Connect the spring and the shackle to the spring hangers with mounting pins and secure with hex-head screws and safety nuts.

(7) Lower the frame to put full vehicle weight on the springs. Check to make sure the spring clips are secure and, if necessary, tighten the clips.

190. Rear Springs (Fig. 218)

a. Removal.

Caution: Refer to paragraph 174b(2) for correct lifting procedure.

(1) Raise the chassis frame to free the springs of all the load.

(2) Put blocks under the spring seat to prevent the seat and the torque rod from dropping when the U-bolts are removed. Loosen the clamp bolts through the spring seat.

(3) Remove the nuts and the washers from the U-bolts, and remove the U-bolts, and the U-bolt saddle.

(4) Slip the spring out of the guide brackets on either axle and remove the spring.

b. Disassembly. Refer to paragraph 189c.

c. Cleaning. Refer to paragraph 189d.

d. Inspection and Repair. Inspect all the leaves for breaks and cracks. Replace any defective leaves.

e. Assembly. Assemble the leaves in order, starting with the longest leaf. Place a small amount of powdered graphite between all the leaves. Line up the holes in the leaves and insert the center bolt with the head on the longest leaf of the rear springs. Press the leaves tightly together in a press or with a heavy clamp, and install the center bolt-nut on the bolt. Tighten securely, and peen the end of the bolt over the nut. Position two long rebound clips on the fourth leaf and the two short clips on the seventh leaf. Install the clip bolts, bolt spacers, and the bolt-nuts, tightening the nuts enough so that the clips will maintain alinement of the leaf without restricting the free movement of the leaves. Peen the bolt ends over the nuts.

f. Installation.

(1) Slip one end of the spring through the spring guide bracket on either axle, insert the other end in its guide bracket, and adjust to an even extension over the axles.

(2) Place the U-bolt saddle in position on the spring and place U-bolts in position.

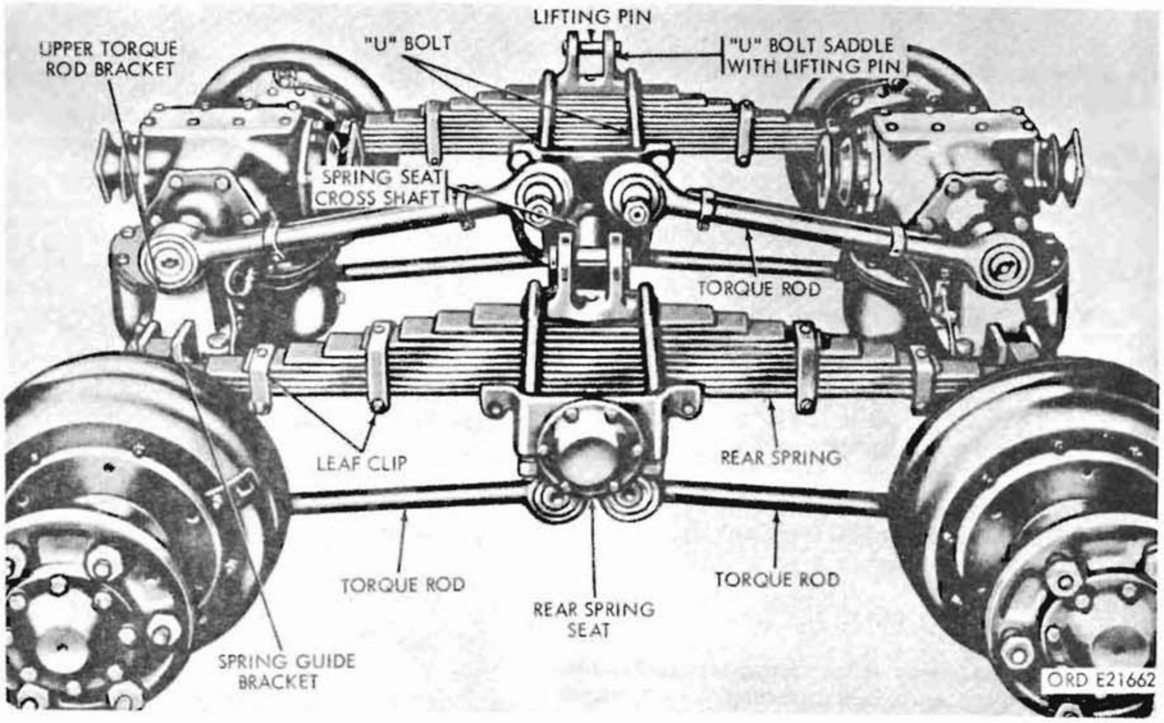


Figure 218. Rear springs and torque rods

(3) Raise the spring seat, enter the U-bolts in the seat, and raise the seat to the spring.

(4) Install lockwashers and hex-nuts on U-bolts, and tighten securely. Torque "U" bolt nuts 190-230 ft. lbs.

(5) Lower the truck frame to put full vehicle weight on the springs.

191. Rear Spring Seats (Fig. 218)

a. Bearing Adjustment.

Caution: Do not lift truck with rear tie-down rings. Refer to paragraph 174b (2).

(1) Remove rear wheels. Rear spring seat bearing adjustment requires the removal of all the rear wheels. Using jack, raise the rear axles until the rear wheels are clear of the ground. Substitute blocking for jacks. Remove the rear wheels (par. 203).

(2) Remove bearing cap. Remove six screws from the spring seat bearing cap, and remove cap and gasket.

(3) Support spring seat cross-shaft. Set jacks under cross-shaft and take up enough weight to hold jacks in position.

(4) Remove U-bolts. Remove nuts, washers, and U-bolts from the spring seat. Place blocking under cross-shaft.

(5) Raise spring. Place the jacks under the spring, one each side of the spring seat, and raise the spring clear of the seat to permit some rotation of the spring seat around cross-shaft.

(6) Remove locknut. Straighten bent-over portion of the nut lock (locknut only). Lip on adjusting nut may be straightened after locknut is removed.) Remove locknut and nut lock.

(7) Tighten adjusting nut. With adjusting nut and washer in place, tighten the adjusting nut with wrench 5120-795-0059 (fig. 219) to 60 to 75 pound-feet torque.

(8) Install locknut. Install nut, lock and locknut, and tighten locknut to 100 to 150 pound-feet torque. Lock bearing adjusting and locknuts by bending the

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edge of the nut lock, one portion on the flat of locknut and one directly opposite on the flat of adjusting nut.

b. Removal.

(1) Remove spring from the spring seat by proceeding as detailed in a (1) through (5) above.

(2) Removal of the spring seat from cross shaft requires the same procedure as for the wheel hub removal. Follow procedure as described in paragraph 205*a* (1).

NOTE

If spring seat does not have a lubrication plug in bottom center of housing, drill and tap plug hole in accordance with procedure in paragraph 191.2

c. Installation.

(1) Installation of the spring seat on the cross shaft is the same as installation of the wheel hub on the axle. Follow procedure as described in paragraph 205*a* (2).

(2) Place U-bolts over the spring and seat them in saddle grooves. Lower the spring with jacks to normal position and enter U-bolts in the spring seat.

(3) Install lockwashers and hex-nuts on the U-bolts, and tighten securely. Remove all jack and blocking. Check to make sure the spring clips are secure and if necessary, tighten the clips.

Figure 219. Tightening rear spring adjustment.

191.1 Improved Rear Spring Seats

(fig. 219.1)

NOTE

Improved rear spring seats are equipped with solid adapter bushings installed in the spring seat. Replacement of these bushings or replacement of bearings with solid type bushings will be in accordance with the following:

a. Remove Spring Seats. Follow instructions in paragraph 191*b*.

(1) *Remove spring seat and adapter bushings.* Remove spring seat outer adapter bushing, (J) making certain not to lose key (H) between outer adater bushing and cross shaft. Pull spring seat (L) from cross shaft and remove inner adapter bushing (N) from cross shaft.

(2) *Remove spring seat cups* (fig. 219.2). When replacing bearings with adapter bushings it will be necessary to replace spring seat cups ((K) and (M) fig. 219.1). Use remover and replacer FSN 5120-473-7372 and screw, FSN 5120-708-3216. To remove cups, insert remover and replacer on cup, with lips of tool positioned on both sides of cup. Thread screw into both sections of remover and replacer, and drive cup from spring seat. Reverse procedure for installation.

b. Cleaning, Inspection and Lubrication.

(1) *Cleaning.* Remove excess lubricant and clean adapter bushings, bushing cups, and inside of spring seat. Dry thoroughly after cleaning.

(2) *Inspection.* Inspect the adapter bushing and cups for pitting and wear. Replace adapter bushings and cups, if required. Also inspect cross-shaft seat for wear and signs of lubricant leakage. Replace if required.

(3) *Lubrication.* After internal parts have been installed hand pack cavity with approximately 1 lb. of GAA grease.

c. Cross-Shaft Oil Seal Replacement.

(1) *Outer seal.* Place a driver against back side of washer (S) and drive seal (P), retainer (Q), felt seal (R) and washer off cross-shaft. Install in reverse order with rubber seal facing outward using replacer FSN 5120-974-2232. Replace other parts with new parts, if inspection indicates the necessity.

(2) *Inner seal.* Remove outer seal as explained in (1) above. Slide seal retainer (Q) and felt seal (R) from cross-shaft. Install new felt seal against washer, and insert flanged portion of seal retainer between cross-shaft and inside diameter of felt seal.

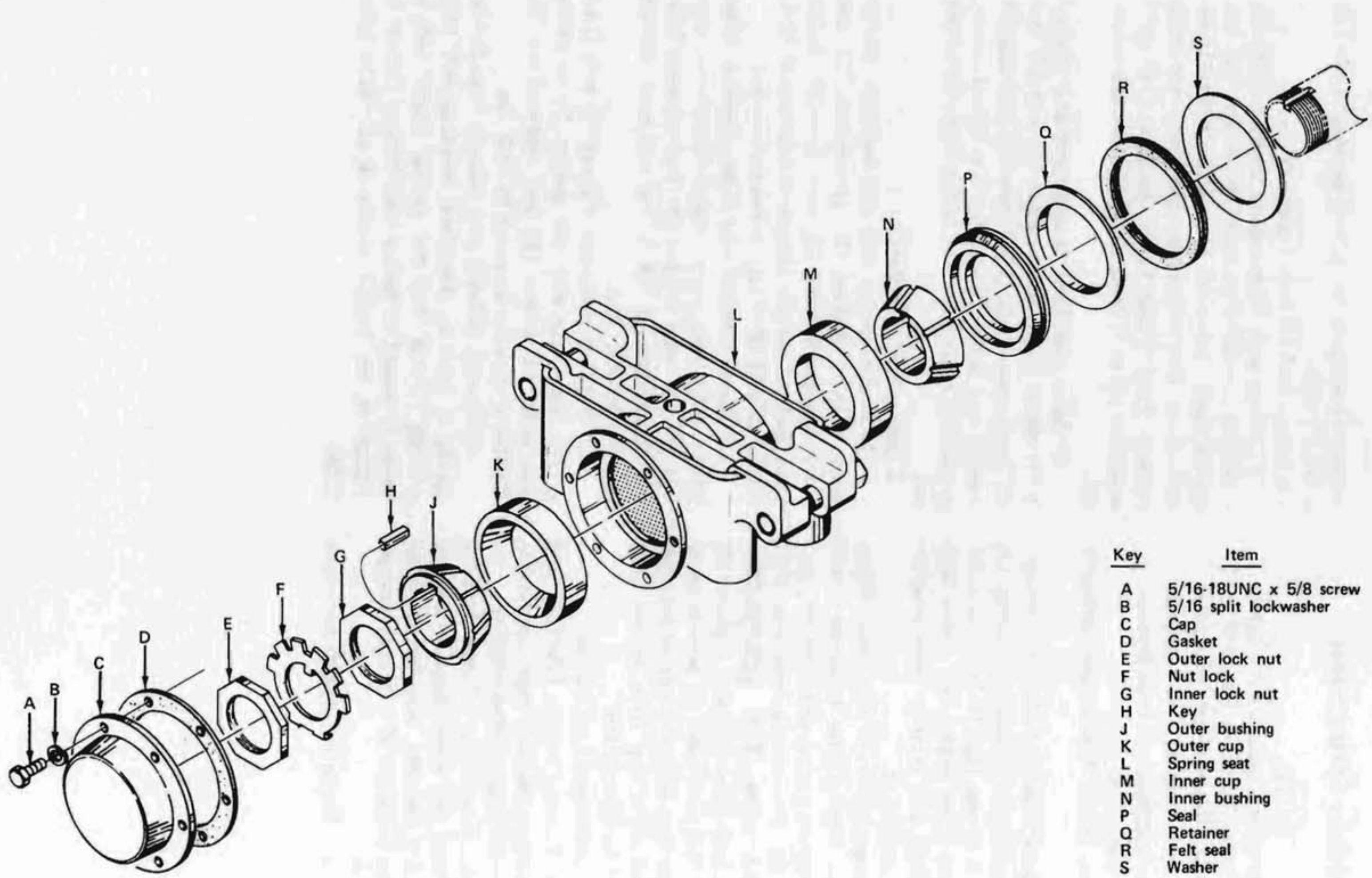
d. Spring Seat Installation.

(1) *Install spring seat and bushings.* Install inner adapter bushing (N), spring seat (L), and outer adapter bushing (J), with key (H). Install inner locknut (G) and tighten to a torque of 70 ft. lbs., then back off ¼ turn or two flats on nut.

(2) *Install nutlock and outer locknut.* After torque tightening inner locknut install new nutlock (F) and outer locknut (E). Tighten outer locknut to a torque of 150 ft. lbs. and bend nutlock tabs over each locknut.

(3) *Install bushing cap.* Fill cap (C) with GAA grease. Install cap with new gasket (D), on spring seat with six screws (A) and lockwashers (B). Tighten screws to a torque of 16-20 ft. lbs.

(4) *Install U-bolts and wheels.* Install rear spring U-bolts as described in paragraph 190*f*, making certain that the spring center bolt is properly seated in spring seat. Torque tighten to 180-230 ft. lbs. Install wheels on axle hubs (para 203*b*).



Key	Item
A	5/16-18UNC x 5/8 screw
B	5/16 split lockwasher
C	Cap
D	Gasket
E	Outer lock nut
F	Nut lock
G	Inner lock nut
H	Key
J	Outer bushing
K	Outer cup
L	Spring seat
M	Inner cup
N	Inner bushing
P	Seal
Q	Retainer
R	Felt seal
S	Washer

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Figure 219.1 Spring seat assembly.

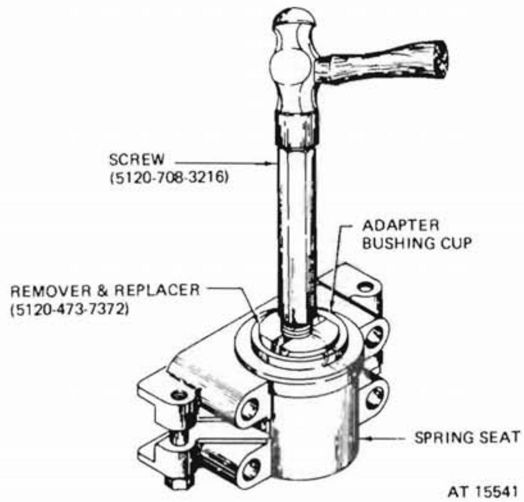

Figure 219.2 Spring seat cup replacement.

191.2 Drilling and Tapping Rear Spring Seat.

Note. Current production trucks are being manufactured with rear spring seat assemblies that do not have lubrication points located in the bottom of the spring seat. Vehicles without a lubrication point will be modified to provide one in accordance with the following procedure.

a. Accomplishing the Modification.

Rear spring seats will be drilled and tapped when trucks are undergoing either annual or 6,000 mile-maintenance or at a time when vehicles are in maintenance for the purpose of having work performed on the rear spring seat. Vehicles will not be diverted from normal operations for the exclusive purpose of having this modification accomplished.

b. Installing Lubrication Plug.

Note. Use "R" size (.3390 inch) drill to accomplish the following.

(1) Drill hole through spring seat at location shown in figure 219.3.

(2) Tap 1/8-27 NPSF thread.

(3) Install plug.

c. Lubrication Intervals.

(1) *Interval.* Every 1,000 miles.

(2) *Procedure.* Remove plug and insert lubrication fitting. Lubricate spring seat with GAA. Remove lubrication fitting and re-install plug.

d. Continuing Maintenance.

Every 6,000 miles or annually, perform required maintenance on the rear spring seat bearings or bushings as prescribed in LO 9-2320-209-12.

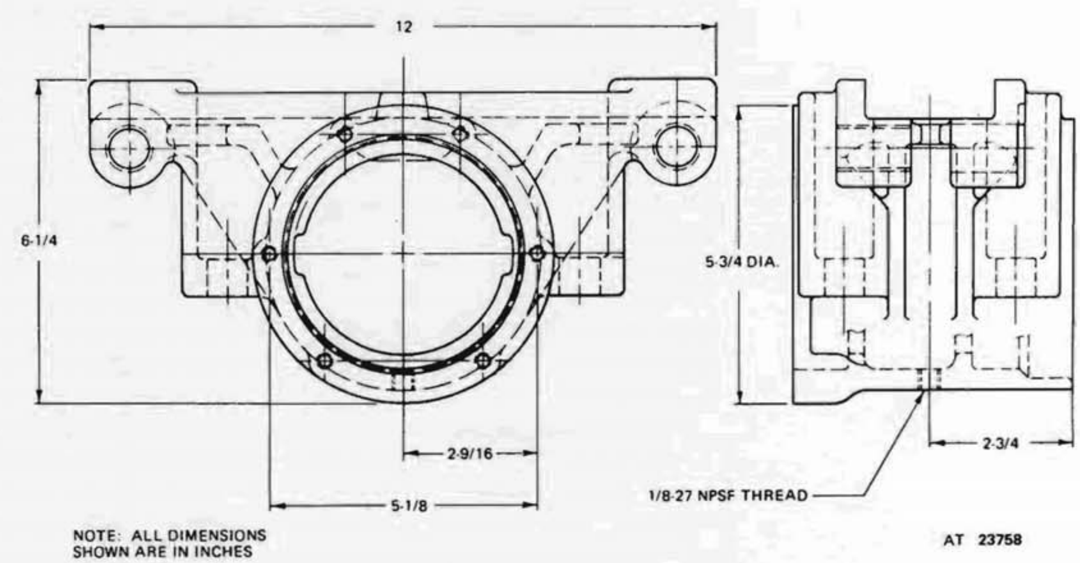

Figure 219.3 Drilling and tapping rear spring seat.

192. Shackles and Bolts

Refer to paragraph 189*b* for removal of shackles and bolts and to paragraph 189*g* for installation.

193. Shock Absorbers

(fig. 217)

a. Removal. Remove the nut, grommet, and grommet retainers from each end of the shock absorber. Press the upper section down to clear bracket, and remove the shock absorber. Remove grommet and grommet retainer from studs at end of absorber.

b. Installation. Place grommet retainers and grommets over the mounting studs in the ends of absorber. With the smaller end of the shock absorber down, insert stud in the clamp plate, and install the grommet, grommet retainer, and two nuts. Collapse assembly until the upper stud can be inserted in the bracket, and install the grommet, the grommet retainer, and two nuts. Tighten all nuts.

194. Torque Rods

(fig. 218)

a. Removal.

(1) Disconnect torque rod from side frame.

(a) Nut holding the torque rod ball end to the rear suspension support bracket and the plate is accessible from the outside of the frame through holes in the frame sidemember. Remove the nut and lockwasher with a deep socket wrench.

(b) Drive ball end out of the frame bracket with a drift and heavy hammer.

(2) Disconnect the torque rod from the torque rod or cross-shaft brackets. Remove the nut and lockwasher from the torque rod ball end with a deep socket wrench. Insert the pry bar between the rod ball end and bracket. Apply pressure, sharply strike the bracket over the ball end, and remove the torque rod.

(3) Remove rod ball end. Press ball end out of rod.

b. Installation.

(1) Install rod ball end. Press the ball in rod.

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(2) Connect torque rod to torque rod or cross-shaft brackets. Insert the rod ball end into the bracket, drive into place, and secure with lockwasher and the end ball nut. Tighten the nut to 350 to 400 pound-feet torque.

(3) Connect torque rod to side frame. Insert the ball end into the suspension bracket and plate, and drive into place with heavy hammer. Install lockwasher and end ball nut through the hole in the frame bracket, and tighten with socket wrench. Tighten nuts to 350 to 400 pound-feet torque.

Section XXXIII. STEERING SYSTEM

195. Description

a. General. The steering mechanism consists of the steering gear, the steering wheel, the pitman arm, and the drag link.

b. Steering Gear (Fig. 220). The steering gear is helical cam and lever-type. The pitman arm shaft, extending from the steering gear housing assembly, is mounted at the right angles to the steering gearshaft. The studs, mounted on the pitman arm shaft lever, engage the machined helix of the cam on the end of the steering gearshaft in the gear housing. The gear housing is bolted to the side frame of the truck. The steering gearshaft is enclosed in the jacket which is joined to the gear housing by a flanged cover. The jacket and housing are watertight.

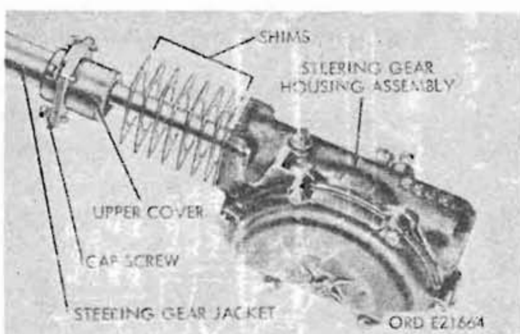

Figure 220. Steering gear end play adjustment.

c. Steering Wheel (Fig. 223). A three-spoke wheel is mounted on the end of the steering gearshaft and secured by a hex-nut. The horn button is mounted in the center of the wheel. Replacement of the horn button is covered in paragraph 135.

d. Pitman Arm (Fig. 222). The pitman arm is steel forging, broached to fit the splined end of the pitman arm shaft. It is held on the shaft by a hex-nut.

e. Drag Link (Fig. 224). The drag link consists of the tubular member connecting the pitman arm to the steering arm on the front axle. The spring-loaded ball seats in each end of the link, are adjustable and engage the stud balls on the pitman arm and on the steering arm in the axle.

196. Steering Gear Adjustment

a. End Play Adjustment (Fig. 220).

(1) Disconnect the drag link from the pitman arm (par. 201). Loosen the steering jacket bracket clamp (fig. 223) on the instrument panel. Loosen the locknut on the backlash adjusting screw (fig. 221) and loosen the screw.

(2) Grip the steering wheel lightly with thumb and forefinger and turn the wheel. The steering wheel should turn freely with just a perceptible drag. If no resistance is evident, the housing upper cover shims must be removed.

(3) To remove the shims, disconnect the horn cable near the lower end of the steering gear. Remove four screws holding the steering gear housing upper cover to the gear housing.

Caution: Be careful not to pull the jacket far enough to break the horn wire.

With jacket bracket clamp (fig. 223) on the instrument panel loosened, pull the upper cover and steering gear jacket away from the gear housing to expose the adjusting shims. The shims are of 0.002-inch, 0.003-inch, and 0.010-inch thickness. Clip and remove a thin shim, assemble the jacket and housing, and test wheel (2) above). Repeat the process until the proper adjustment is obtained.

(4) Tighten the jacket bracket clamp on the instrument panel (fig. 223).

(5) Adjust the backlash (b below).

(6) Connect the drag link (par. 201).

b. Backlash Adjustment (Fig. 221).

(1) Disconnect the drag link (par. 201) from the pitman arm.

(2) Turn the steering wheel clockwise as far as possible, then rotate the wheel counterclockwise as far as possible and count the number of turns. Turn the wheel one-half total number of turns. The steering gear is now in midposition.

(3) Loosen the locknut and turn the adjusting screw until a slight drag is felt at this midposition when turning the steering wheel slowly from one extreme position to another.

Caution. Adjustment of the screw is critical. Tightening the screw too much will cause the steering gear to bind.

(4) Tighten the locknut. Recheck the drag ((3) above).

(5) Connect the drag link (par. 201).

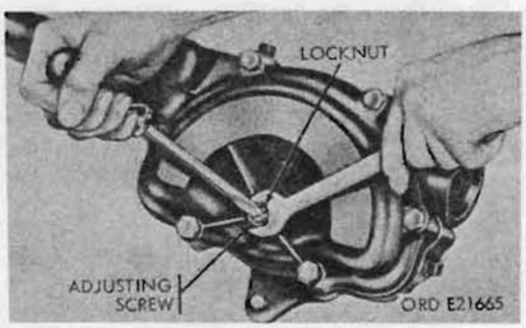

Figure 221. Steering gear backlash adjustment.

197. Steering Gear Replacement.

a. Coordination with Direct Support Maintenance Unit. Refer to paragraph 2. for information on coordination with direct support maintenance unit.

Note. It is not necessary to completely remove the engine from the vehicle prior to replacing the steering gear.

b. Preparation for Removal.

(1) Place the vehicle under suitable lifting equipment to raise the engine. Disconnect battery cables. Remove engine fan from water pump. Drain cooling system and remove the radiator. Remove plastic or brass band that secures the engine stop cable to the steering column under the hood. Remove air compressor output line. Disconnect electric horn wire from bottom of steering gear at front frame crossmember. Loosen bolt on front frame crossmember to release ground strap.

(2) Attach lifting equipment to front engine sling eye and relieve the weight of the engine so that the front engine mounting bolts (2) and insulators (4) may be removed. Remove the left rear mounting bolt and insulators (2). Loosen, but do not remove, right rear engine mounting bolt. Remove nuts and bolts that secure the radiator to the front frame crossmember.

(3) With lifting equipment attached to front engine sling eye, raise front of enigne approximately 4 inches or until rear engine sling eye almost touches the fire wall. (Use caution not to allow sling eye to touch fire wall). Move the engine to the right approximately 3-4 inches or until there is enough clearance to remove the steering gear.

c. Removal.

(1) Remove the pitman arm (para. 199). Remove the steering wheel (para. 200).

(2) Remove the split lockwasher and screw to loosen clamp on the steering gear column bracket at the instrument panel (fig. 233) and remove rubber grommet from the bracket and column. Remove four self-tapping screws that hold dust seal to dash panel and remove seal. Remove four bolts and two reinforcing straps that hold steering gear to the frame rail. Slide the steering gear and column assembly down

and under the front frame crossmember.

d. Installation.

(1) Slide the new steering gear into position with the steering gear column extending through hole in dash panel. Insert the pitman arm shaft through hole in frame rail. Secure steering gear to frame rail with four self-locking, hex-head bolts, but do not tighten the bolts. Install the column dust seal and rubber clamp grommet on the column and position grommet in the column bracket on the dash panel. Secure the dust seal to the dash panel with four cross-recess, pan-head, self-tapping screws. Tighten steering gear housing bolts to a torque of 60-65 foot-pounds to secure housing in position on frame rail.

(2) Install steering wheel (para. 200). Install pitman arm (para. 199).

(3) Complete reassembly in reverse order of removal.

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198. Steering Column Alinement

Check the steering column alinement by loosening the steering column jacket bracket clamp at the instrument panel. If the steering column moves to a new position, tighten the clamp in that position.

Note. After alinement, if stiffness still exists while turning the steering wheel, the steering gear jacket may be bent. Refer to direct support maintenance unit.

199. Pitman Arm

a. Removal (Fig. 222).

(1) Disconnect the drag link (par. 201) from the pitman arm.

(2) Remove the nut and the washer holding the pitman arm in position. Pull the pitman arm from the shaft with puller.

b. Installation.

(1) With the front wheels straight ahead, set the steering wheel in midposition according to the procedure in paragraph 195.

(2) Place the pitman arm on the splined shaft with the arm straight downward.

(3) Push or tap the pitman arm into position on the shaft until the nut can be engaged on the threads. Install 1-inch lockwasher and hex jamnut, and tighten.

(4) Connect the drag link (par. 201) to the pitman arm.

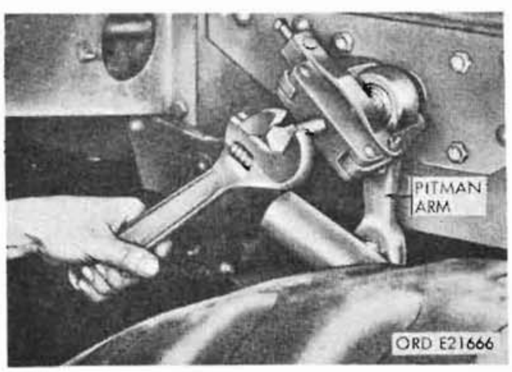

Figure 222. Removing pitman arm

200. Steering Wheel

a. Removal.

(1) Remove the horn button (par. 135) and the horn cable from the steering wheel and the column.

(2) Remove the steering wheel nut, holding the wheel on the steering gearshaft.

(3) Place the steering wheel puller adapter 5120-473-6919 (fig. 223) on the end of the steering gearshaft. Install the steering wheel puller with hooks engaging puller ring, and pull the wheel from shaft.

b. Installation.

(1) With the front wheels pointing straight ahead, place the steering wheel in the desired position on the steering gearshaft and tap into position until the steering wheel nut can be engaged with threads. Tighten nut.

(2) Install the horn button (par. 135) and the cable.

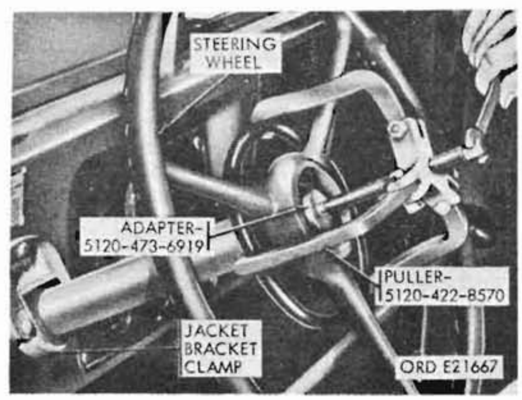

Figure 223. Removing steering wheel with puller

201. Drag Link (Fig. 224)

a. Adjustment. Be sure the ball seats are thoroughly lubricated before making adjustment. Remove the cotter pin, and screw the adjusting plug in tight, then back the screw out one-half turn or less, until the new cotter pin can be installed. Repeat adjustment at the other end.

b. Removal. Remove the cotter pin from each end of the drag link, and back out adjusting plugs as far as possible without removing them. Turn the steering wheel in both directions to loosen the stud balls in the seats. Remove adjusting plug from pitman arm end of the drag link, and pull link from the pitman arm, being careful not to lose any drag link components from within the link end. Tip the link end down and remove the safety plug, ball seat spring, and the two ball seats. Repeat procedure to remove the link from the steering arm.

c. Cleaning. Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Dry thoroughly with compressed air.

d. Inspection and Repair. Examine ball seats for excessive wear, cracks or chipping. Check the springs for weakness or failure. Replace worn or damaged parts.

e. Installation.

Caution: Make certain the safety plug and the ball seat spring are near the center of the drag link at the steering arm end; and that the ball seat spring and the safety plug are near the forward end of the drag link at the pitman arm end. These locations of springs must be maintained to assure two-way cushioning of the drag link.

(1) Noting that the ball opening is closer to the end of the drag link at the steering arm end than at the pitman arm end (fig. 224), install the safety plug in the steering arm end opening of the link with the small diameter of the plug facing the opening. Install the ball seat spring and one ball seat in the same end of the link. Install the drag link on the steering arm ball by pressing the link over the ball so that the ball enters the ball opening and mates with the cupped surface of the ball seat. Install the second ball seat in the end of the link and screw the adjusting plug into the link end to secure the ball in the link.

(2) Turn steering wheel to extreme left, and turn front wheels to the left against the turning stop. Hold the drag link to the pitman arm. The pitman arm ball should be one-half inch ahead of drag link ball seat position. Turn the steering wheel and front wheels to the right, to their limits. The pitman arm ball should be one-half inch behind the drag link ball seat.

(3) If either distance is less than one-half inch, check for the following conditions and correct the trouble:

(a) Pitman arm bent or out of position on the shaft.

(b) Bent drag link.

(c) Front axle out of position.

(d) Steering knuckle turning stops out of position or missing.

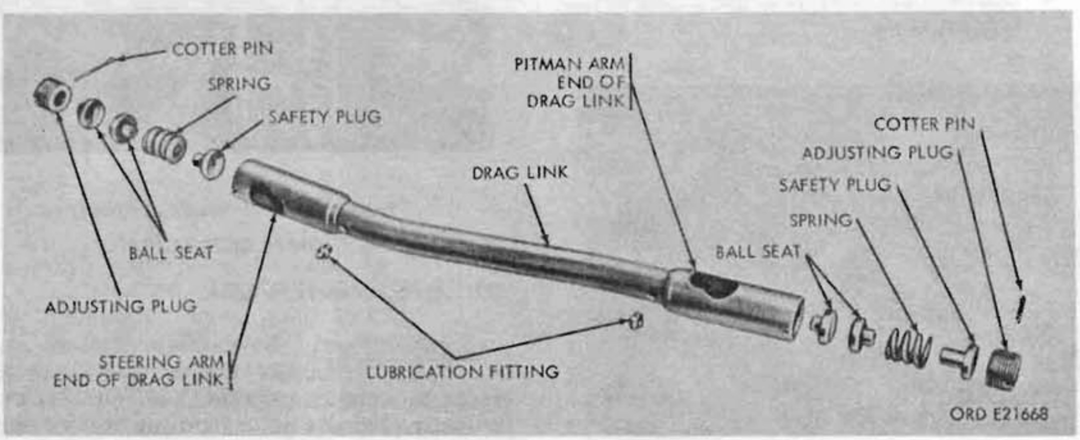

Figure 224. Drag link

(4) Install one ball seat in the pitman arm end of the link with the cupped surface facing forward (fig. 224). Install the drag link over the pitman arm ball. Install the second ball seat in the link with the cupped surface mating to the ball. Install the ball seat spring, safety plug, and adjusting the plug in the drag link.

(5) Adjust the drag link (*a* above).

201.1 Steering Gear Check Level Plug

a. General. The current series of military 6 x 6, 2½ ton vehicles being manufactured have three plugs on the steering gear housing and cover. Included is a steering gear fill, a steering gear drain, and a steering gear check level plug.

b. Conversion Procedure. Older models now in service may be converted to conform with current production models by accomplishing the following procedure.

(1) Drain oil from steering gear housing.

(2) On models equipped with front winch, drop the winch drive shaft. Take necessary steps to shift engine, so that the side cover of the steering gear housing is accessible for removal. Refer to paragraph 59, section X of this manual for engine removal procedures.

(3) Remove six hex-head cap screws securing side cover to the steering gear housing. Remove and discard gasket. The adjusting screw and lock nut located on center of side cover, should not be touched.

(4) Place side cover in bench vise in upright position. On the top surface of cover, measure back 1.484 inches from the center of the forward upper cap screw opening and mark. Measure ½-inch outward from the mounting edge of the side cover so that this measurement location will bisect the previous mark made on top of cover (fig. 224.1).

(5) At this point drill and tap one 1/8-27 NPT hole. Clean off any metal particles left on cover.

(6) Obtain a new gasket. Position side cover and gasket. Secure side cover to steering gear housing with six lockwashers and six hex-head cap screws.

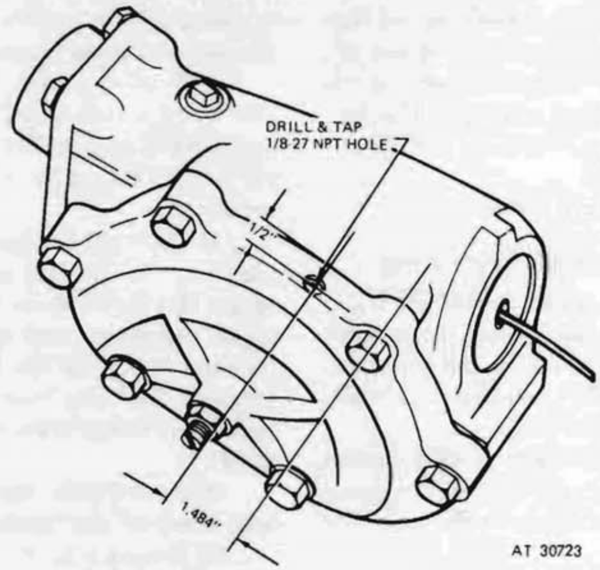

Figure 224.1. Check oil level plug—steering gear cover.

(7) Refill the steering gear housing with lubricant up to new check hole (LO 9-2320-209-12).

(8) Install new 1/8-inch square head pipe plug (Ord. No. 103877, FSN 4730-187-4300).

(9) Replace front winch drive shaft and secure engine in its original position. Refer to paragraph 60, section X of this manual for engine installation procedures.

(10) Turn the steering wheel clockwise as far as possible, then rotate the wheel counterclockwise. If the steering gear is binding or is loose, perform the backlash adjustment as prescribed in paragraph 196.

Section XXXIV. WHEELS, TIRES, AND HUBS

202. Description

a. Wheels.

(1) Offseat disk-type wheels are secured to hubs on six studs. Wheels are completely interchangeable as to the location.

(2) Trucks with single wheels use 11 x 20 tires, the trucks with dual wheels use 9 x 20 tires. Single wheeled trucks can be used with the dual wheels and trucks with dual wheels can be used with the single wheels, provided the clearance between the tires and the body is sufficient under full allowable payload to provide for the spring action during truck movement.

b. Tires and Rims.

(1) Early production trucks had tires secured with hinged-type beadlock. Tires were secured with tire retaining ring bolted to the wheel disk.

(2) Later production trucks are equipped with rims on which the tires are secured by a retaining ring which is sprung into place and interlocks with the rim. Six bead clips, installed on each side between the tire and the rim, are used to prevent displacement of the tire when partially deflated, or when traversing sand, snow, or mud.

(3) Latest production trucks are not equipped with the bead clips.

c. Hubs and Bearings. All hubs are mounted on opposed tapered roller bearings. Each hub is secured on its axle with two adjusting nuts, and adjusting nutlock. All hubs have an inner oil seal and the rear hubs also have an outer oil seal.

203. Wheels

NOTE

Use the wheel stud nut wrench to remove and install the wheel nuts. Refer to TM 9-2320-209-10.

a. Removal.

NOTE

On the left side of the vehicle, the wheel nuts have left-hand threads. On the right side, the wheel nuts have right-hand threads.

(1) *Single wheels.*

CAUTION

Do not loosen the nuts on the bolted-type side rings. Loosen the nuts on wheel studs, jack up the truck, remove nuts, and remove the wheel.

(2) *Dual wheels.* Loosen the nuts on the wheel studs, jack up the truck, remove the outside wheel, Remove the special nuts holding the inner wheel to the hub, and remove the inner wheel.

b. Installation.

(1) *Single wheels.* Install the wheel on the hub and secure with six right- or left-hand hex capnuts, depending on the side of the vehicle on which the wheel is installed. Tighten the opposite nuts alternately. Remove the jack, and tighten nuts to 400 to 450 pound-feet torque.

(2) *Dual wheels* (fig. 225).

NOTE

Install dual wheels with ventilating holes in each pair alined to permit the flow of air to cool the wheels. Place the valves on duals diametrically opposed (180° apart) for easier checking and inflation, and for quick location even in the darkness.

Install the inner wheel on the hub and secure with internal and extenal, right-or left-hand capnuts, depending on the side of the vehicle on which the wheel is being installed. Tighten opposite nuts alternately. Be sure all the nuts are tight before installing the outer wheel. Position the outer wheel on the capnuts and secure the wheel with six right- or left-hand hex-capnuts. Tighten the opposite nuts alternately. Lower the wheel to ground and tighten the nuts to 400 to 450 pound-feet torque.

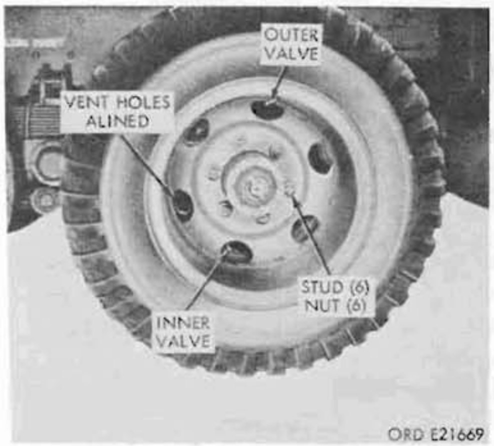

Figure 225. Dual wheel showing correct relationship of valves and ventilating holes

204. Tires, Tubes, and Rims

a. Tire Inflation. Refer to TM 9-2320-209-10 for correct tire inflation pressures. Pressure in all tires must be equal.

Note. When checking tire pressure, do not reduce pressure if tires are hot.

b. Removal.

(1) Wheel. Remove the wheel (par. 203), and deflate the tire completely by removing valve core.

Warning: Do not attempt to remove the tire until the tire has been completely deflated. Stand clear of the retaining ring to avoid personal injury if the ring should fly off.

(2) Tires with hinged-type beadlock. Remove the tire retaining ring stud nuts, and remove ring. Use tire irons (fig. 226) to dislodge bead of tire from rim. Remove tire, tube, and beadlock from rim. Install the valve core and inflate the tube enough to spread the tire beads. Pry up from beadlock at a point about eight inches from hinges. Collapse the beadlock and turn 90 degrees to remove from casing. Deflate the tube and remove.

(3) Tires with bead clips. Insert pry bar in slot of side ring near split, pry end of ring out over edge of rim, and remove ring from wheel with tire irons. Remove tire, 12 bead clips, flap, and tube.

(4) Tires without bead clips. Refer to (3) above. Omit reference to 12 bead clips.

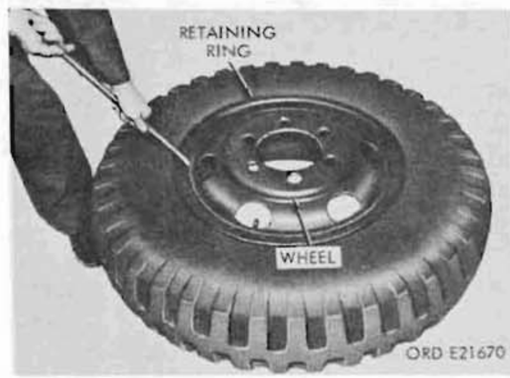

Figure 226. Removing beadlock ring

c. Tube Repair. Repair by patching or replace a punctured tube. Remove a defective tube valve and install a new valve.

d. Installation.

(1) Tires with hinged-type beadlock. Install the tube in the casing and inflate it enough to hold it in place. With the beadlock collapsed, insert the valve stem through the hole in the beadlock. Install the beadlock inside of the casing and press it part way through the tire. Inflate the tube enough to spread the tire beads. Turn the beadlock and work into position between the tire beads. Deflate the tube completely.

Hold one end of the beadlock with the foot, and pull the other end up with both hands until the hinges snap into place. Center the beadlock so the edges are below the beads of tires at all points. Install the tire and beadlock assembly on the wheel rim with the valve stem pointing outward. Be sure the lug on the beadlock engages the valve stem slot in the wheel rim. Install tire retaining ring and sixteen hex-nuts. Tighten the nuts alternately.

Warning: These ring stud nuts must be tightened before inflating tire. Keep personnel away from the tire area while inflating the tire.

Inflate the tire and install the wheel (par. 203). Tighten wheel capnuts, and remove the jack.

(2) Tires with bead clips. Install the tube in the tire so that the valve stem is in line with the balancing mark on tire. Install the tire flap and inflate the tube sufficiently to prevent it from falling out, or from being pinched during mounting. Place the tire on the wheel and insert the valve stem with the stem pointing toward the outer side of the mounted wheel. Install six bead clips under the tire bead on each side of tire. Be sure that the inner ends of the clips engage the inner sides of tire bead. Arrange the clips in approximately even spaces. Place one end of the side ring over the edge of the rim and force the entire ring over the rim and under the outer ends of clips. Use the tire irons or soft hammer to seat the ring. Be sure that the ring is seated in the rim groove.

Warning: Keep personnel away from tire area while inflating tire.

Inflate the tire in accordance with a above, and install wheel (par. 203).

(3) Tires without bead clips. Refer to (2) above. Omit reference to the bead clips.

205. Hubs

a. Removal.

(1) Remove the hub and the drum assembly (fig. 227). Remove the wheel (par. 203). Remove the front axle shaft drive flange (par. 169) or the rear axle shaft (par. 173). Straighten the bent-over portions of the adjusting nut lock. Remove the outer wheel bearing adjusting nut with the wheel bearing nut wrench 5120-795-0059 (fig. 228). Remove the adjusting nut lock, then remove the inner wheel bearing adjusting nut (fig. 227) with the same wrench. Remove the outer bearing oil seal (rear axles only), the outer bearing cone, and the drum assembly (fig. 229).

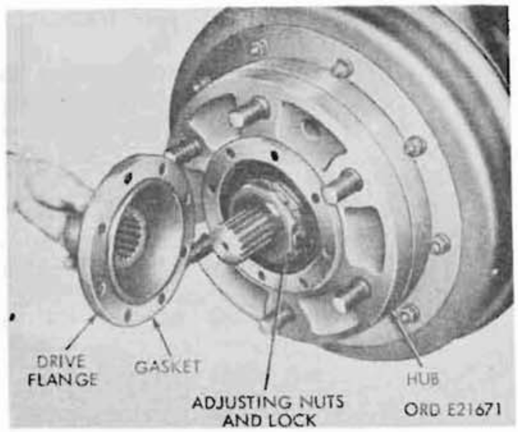

Figure 227. Wheel hub

(2) Remove the hub.

Note. For replacement of the wheel bearings, it is not necessary to remove the hub from the brakedrum adapter.

(a) For the single wheel hub removal, drive the wheel studs (fig. 229) out of the hub and drum adapter on the brakedrum, and remove the hub from adapter.

(b) For the dual wheel hub removal, remove the eight bolts and lockwashers securing the hub to the drum adapter on the brakedrum, and remove the hub from the adapter. Remove the wheel studs from the hub.

b. Installation.

(1) Install hub.

(a) For the single wheel hub installation, position the hub on the drum adapter attached to the brakedrum. Install six wheel studs through the adapter and the hub, being sure the studs are driven evenly and securely into the hub.

(b) For the dual wheel hub installation, install six wheel studs securely and evenly in the hub. Install the hub on the drum adapter attached to the brakedrum with eight hex-head bolts and lockwashers.

(2) Install the hub and the drum assembly. Clean and lubricate the hub and bearings according to procedure in paragraph c below. Install the hub and the drum assembly (fig. 229) over inner bearing cone. Install the outer bearing cone, the outer bearing oil seal (rear axles only), and the inner wheel bearing adjusting nut. Install the wheel (par. 203). Adjust the bearing and install the adjusting nut lock and the outer wheel bearing adjusting nut as described in paragraph a(2) below. Install the front axle shaft drive flange (par. 269) or the rear axle shaft (par. 173).

206. Bearings

a. Adjustment.

(1) Check adjustment. Jack up the wheel to be checked until the tire clears the ground. Grasp the tire at the top and pull back and forth, or use a bar under the tire. If bearings are correctly adjusted, the movement of the brakedrum in relation to the top edge of the brake flange plate will be just perceptible, with the wheel turning freely. If movement is excessive, adjustment is required as explained in (2) below.

(2) Adjust wheel bearing. With the wheel jacked up, remove the front axle shaft drive flange (par. 169) or the rear axle shaft (par. 173). Straighten the bent over portions of adjusting nut lock. Remove the jam nut (outer) with the wheel bearing nut wrench 5120-974-2243 (fig. 228). Remove the nut lockwasher. While turning the wheel, tighten the inner adjusting nut to 50 lb/ft torque while hub is being rotated. Rotate hub in both directions to correctly position the bearings. Back off adjusting nut 1/4 turn so that wheel turns freely. Assemble nut lockwasher and jam nut. Tighten jam nut to 100 to 150 lbs/ft torque. Then check the adjustment ((1) above). Bend nut lockwasher over both nuts.

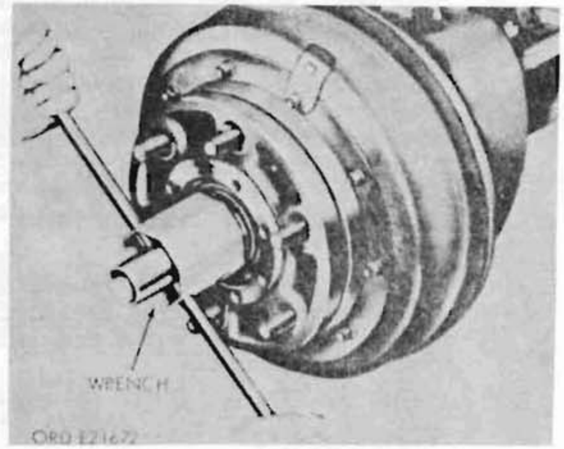

Figure 228. Wheel bearing adjustment using wrench 5120-974-2243

Caution: Do not use a chisel, hammer, or drift to lock the adjusting nut. The use of pliers will prevent damaging outer oil seal.

Install the front axle shaft drive flange (par. 169) or the rear axle shaft (par. 173).

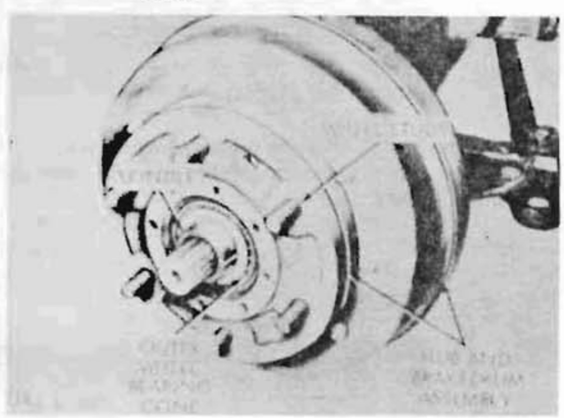

Figure 229. Hub, bearings and cone

b. Removal.

(1) Remove bearing cones (fig. 229). Remove the hub and the drum assembly (par. 205a). Remove the inner bearing cone.

(2) Remove the bearing cups (fig. 230).

Note. Do not remove the bearing cups unless replacement is necessary.

Install the remover and replacer 5120-473-7372 and screw 5120-708-3216 in the bearing cup inside of the hub. Remover and replacer are first pushed together and placed in the position in the bearing cup. Spread the two parts and insert the screw. Drive out the bearing cup with the hammer. Turn the hub and the drum assembly over and remove the other bearing cup from the opposite side of the hub in same manner.

c. Clean and Lubricate.

Caution: Bearings must not be dried or spun with compressed air. (Refer to TM 9-214 for inspection, care and maintenance of bearings.)

Immerse the bearing cones in dry-cleaning solvent or mineral spirits paint thinner. Clean with a brush to remove the old lubricant. Inspect for defects and wear. Using lubricants specified in LO 9-2320-209-12 completely fill the spaces around the rollers and above and beneath the cone. Thoroughly wash the hub with dry-cleaning solvent or mineral spirits paint thinner to remove the old lubricant. Inspect the condition of the bearing cups and replace if worn, distorted or scored.

d. Installation.

(1) Install bearing cups (fig. 230). Position the bearing cup in hub, and install the remover and replacer 5120-473-7372 and 5120-708-3216 in the bearing cup. Drive the bearing cup into place. Turn the hub and the drum assembly over, and install the other bearing cup in the hub in the same manner.

(2) Install bearing cones. Install the inner bearing cone on the shaft. Coat the inner bearing cone cage and fill the space between the cone and the oil seal with the bearing lubricant. Install the hub and the drum assembly (b(2) above).

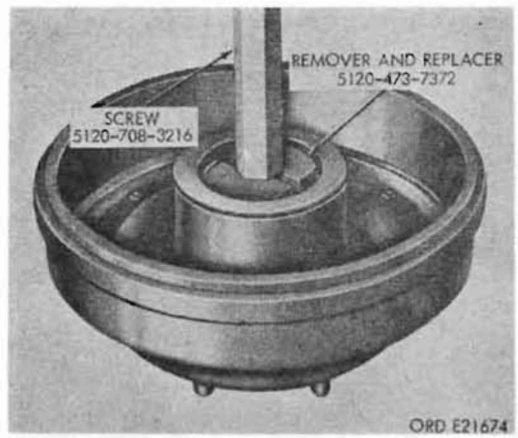

Figure 230. Inner bearing cup installation using remover and replacer 5120-473-7372 and screw 5120-708-3216

Section XXXV. FRONT WINCH

207. Description and Data

a. Descripton.

(1) A horizontal drum-type front winch (fig. 231) is mounted at the front of some trucks between the radiator and front bumper. The winch is secured to the support brackets attached to the chassis frame side rail extensions. A clutch control lever locking plate is supplied on the later vehicles for locking the clutch control lever. The power for operating the winch is supplied by the truck engine through the front winch drive shaft connected to the transmission power takeoff. The drive shaft is connected to the winch drive worm by an aluminum alloy shear pin (fig. 232). This shear pin is installed to protect

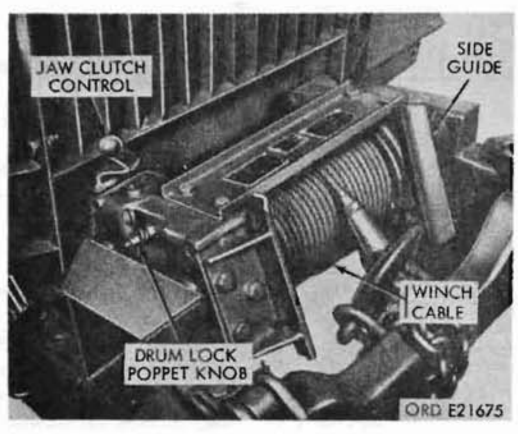

Figure 231. Front winch

the chassis frame, the transmission, winch, and the winch line from overloads.

(2) A safety brake adjustment caution plate is installed on the winch brake case cover.

b. Tabulated Data.

Make	Gar Wood
Model	CA 514
Type	horizontal drum
Drive	drive shaft
Capacity	10,000 lb
Winch line, wire rope	200 ft. long, 1/2 in.

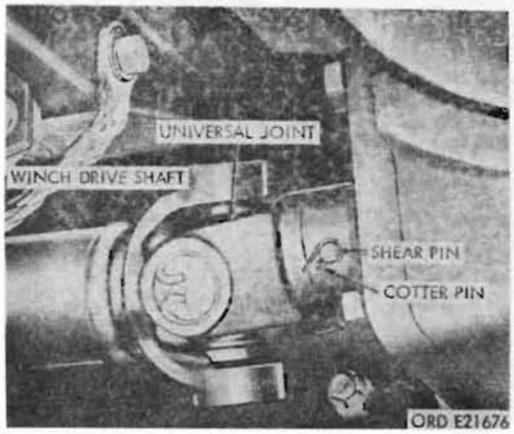

Figure 232. Front winch drive shaft and shear pin

208. Adjustment

a. Drag Brake (Fig. 233).

(1) Test. Normally the drag brake will not require adjustment, but adjustment can be checked by pulling the line off the winch drum with the winch clutch disengaged. If the drum continues to turn when the pulling is stopped, adjust in accordance with (2) below.

(2) Adjustment. The drag brake is tightened to prevent the drum from spinning when pulling off the line by hand. With the winch clutch disengaged, pull the line from the drum by hand, turning the drag brake adjusting screw clockwise (fig. 233), until the drum just stops rotating when pulling stops. Test adjustment in accordance with (1) above.

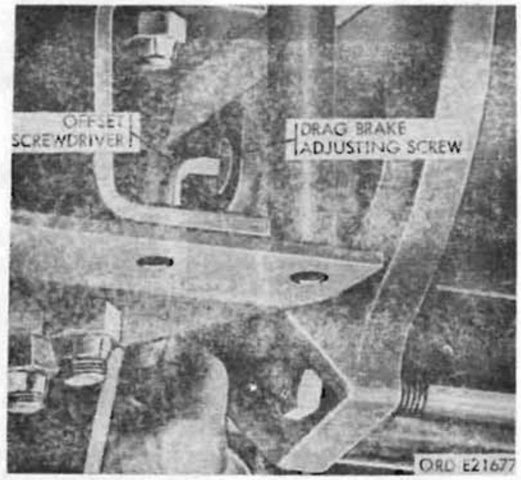

Figure 233. Adjusting front winch drag brake

b. Automatic Brake (Fig. 234).

(1) Test. With truck parked at the top of a steep grade, start pulling another vehicle up the incline, using the front winch only. When the vehicle is part way up the incline, shift the transmission power takeoff into NEUTRAL position. If the vehicle being pulled rolls backward, adjust the automatic brake in accordance with (2) below.

(2) Adjustment. Increase the tension on the brake spring by turning the brake spring adjusting screw on underside of brake case (fig. 234).

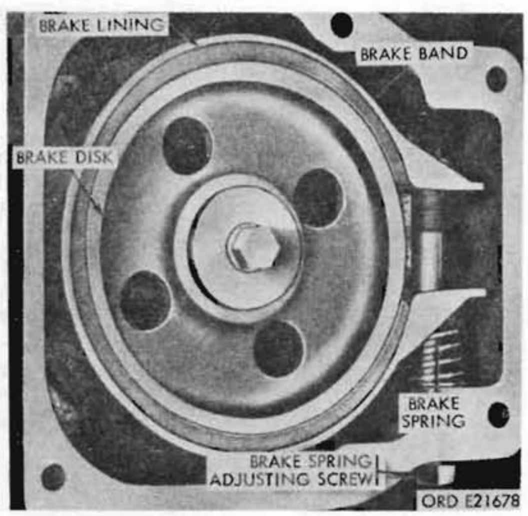

Figure 234. Front winch automatic brake

209. Automatic Brake (Fig. 234)

a. Removal. Remove six screws attaching the cover to the brake case, and remove the cover and gasket. Discard the gasket. Loosen the brake spring adjusting screw on the underside of the brake case. Remove the screw, washer, gasket, and spring. Pull the brake band from the brake disk.

b. Installation. Position the brake band on the brake disk with the opening in band away from the winch drum. Place a washer and gasket on the adjusting screw and start screw into the brake case. Install the spring between the case and the band and push the screw through the lower end of the band. Using a pry bar, force upper end of band down so the nut will engage the threads on adjusting screw. Position the cover on the case with the new gasket, and install the external-teeth lockwasher and hex-head screws. Tighten securely. Adjust automatic brake in accordance with paragraph 208b.

210. Front Winch Drive Shaft Shear Pin and Stop Collar

a. General. The front universal joint of the front winch drive shaft is connected to the winch drive worm shaft by an aluminum alloy shear pin (fig. 232). The stop collar is positioned on the drive shaft 3/4 inch ahead of the rear universal joint to prevent the drive shaft from dropping off the winch drive worm shaft if the shear pin breaks.

b. Shear Pin Replacement. When the shear pin fails, slide the universal joint along the winch drive worm shaft to expose the shear pin hole. Remove the broken parts of the shear pin. With the universal joint in position, lubricate and insert a new aluminum alloy shear pin. Install two cotter pins (fig. 232). Check the stop collar adjustment (c below).

Caution: Never substitute rivets, bolts, or nonaluminum pins for the authorized aluminum alloy shear pin. Pins harder than the aluminum pin will damage the driving mechanism or winch cable. Pins softer than the aluminum pin will reduce the maximum working load of the winch.

c. Stop Collar Adjustment. Loosen the setscrew in the collar. Move the collar toward the rear universal joint until 3/4 inch exists between the collar and the universal joint yoke. Tighten the collar setscrew securely.

Note. This adjustment is important to prevent the universal joint end yoke from backing off the winch drive worm shaft in event of a shear pin failure.

211. Front Winch

a. Removal.

(1) Remove the front winch cable from winch drum by disengaging the jaw clutch from the winch drum. Pull out the drum lock poppet knob (fig. 231). Turn knob to the out position and pull winch cable from drum. Loosen the setscrew and disengage cable from the clamp and drum.

Caution: Gloves must be worn when handling the winch cable due to broken strands which could result in injuries to the hands.

(2) Attach a hoist to the winch to support its weight.

(3) Disconnect winch drive shaft (par. 213).

(4) Remove the cotter pin from the shear pin and remove shear pin (fig. 232). Loosen the setscrew in the stop collar. Slide the universal joint free of the winch drive worm shaft.

(5) Remove six screws, lockwashers, plain washers, and mounting bolt spacers from each end of the winch (fig. 235). Raise the winch to clear the bumper and pull forward from the truck.

b. Installation.

(1) Attach a hoist to the winch, and raise the winch to clear the bumper. Lower into place and aline the mounting holes in the winch with those in the support brackets (fig. 235). Secure the winch to the support brackets with six mounting bolt spacers, plain washers, lockwashers, and screws for each bracket. Tighten all mounting screws securely. Remove hoist. Adjust winch drag and automatic brakes (par. 208).

(2) Install shear pin, insert cotter pin and adjust stop collar (par. 210).

(3) Install winch line (a(1) above) on winch drum.

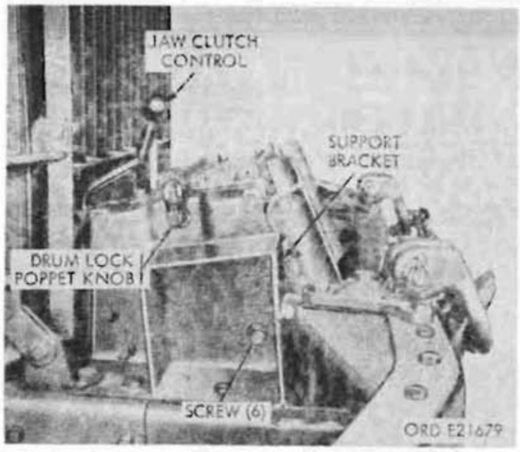

Figure 235. Front winch disconnect points

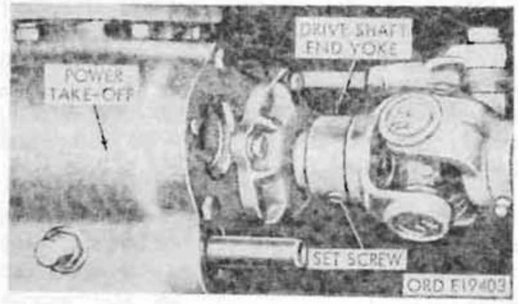

Figure 236. Front winch drive shaft

212. Front Winch Universal Joint

a. Removal. Refer to paragraph 166 for removal.

b. Installation. Refer to paragraph 166 for installation.

213. Front Winch Drive Shaft (Fig. 236)

a. Removal. Loosen setscrews securing drive shaft end yokes on output and input shafts, and remove drive shaft.

b. Installation. Insert end yokes over keys in output and input shafts. Tighten end yoke setscrews.

Section XXXVI. COMPRESSED AIR SYSTEM

214. Description and Data

a. Description.

(1) Air compressor (water-cooled). The air compressor (fig. 237) is a two-cylinder, single-acting type mounted on the right side of the gasoline engine, and is belt driven. The compressor cylinder head is water-cooled, the coolant being circulated through it from the engine cooling system. An unloading valve mechanism in the cylinder head automatically unloads the compression stroke when the air pressure reaches predetermined maximum of 100 to 105 psi as controlled by the air governor. An air strainer (fig. 244) mounted on the side of the compressor cylinders filters the incoming air.

(2) Air compressor (air-cooled). The two-cylinder, single-acting type, air-cooled air compressor is mounted to a mounting plate attached to the left side of the multifuel engine and belt-driven from the accessory drive pulley. An unloading valve mechanism in the cylinder head automatically unloads compression stroke when the air pressure reaches predetermined maximum of 100 to 105 psi as controlled by the air governor (3) below. An air strainer mounted on the side of the compressor cylinders filters the incoming air (fig. 244).

(3) Air governor. The waterproof governor is mounted on the outer dash panel and is connected in the airline between the compressor and the air reservoirs. When the pressure in the reservoirs reaches the maximum of 100 to 105 psi, a valve in the governor bypasses the air under pressure to a diaphragm in the compressor cylinder head which opens the compressor unloader valves and stops the compression.

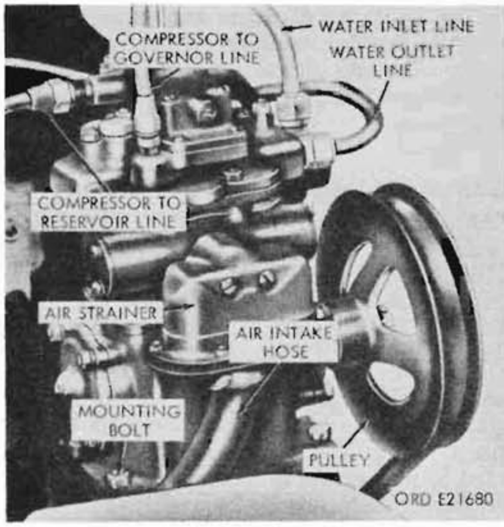

Figure 237. Air compressor - water cooled

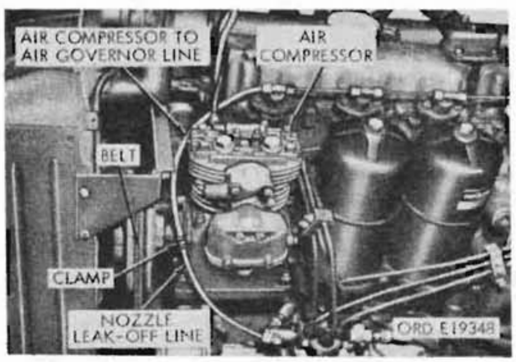

Figure 238. Air compressor - air cooled

(4) Air reservoirs. The air reservoirs (figs. 239 and 240) are two steel cylindrical drums. Their function is to maintain an adequate supply of compressed air during the times the truck is in operation. The trucks M47, M342, M59, and M275 have reservoirs (fig. 240) mounted on the right side of the vehicle behind the cab and outside of the frame. The M60 and M108 trucks have one reservoir under the vehicle within the frame and the other outside of the frame under the oil reservoir. All the other models have the reservoirs suspended from the frame underneath the vehicle to the rear of the transfer. Reservoirs are mounted side by side (fig. 239) or separated, depending on the presence of auxiliary equipment. All the reservoirs are secured by large "U" bolts.

(5) Air-leakage tests. For leakage tests of the components of the compressed air system refer to TM 9-1827A. Leakage at connections of the airlines is tested by the soapsuds method. Coat the connection with soapsuds. Leakage in excess of a 3-inch soap bubble in 1 minute, when the system is charged to 100 psi, is not permissible. Tighten or replace the connection, if defective.

Caution: Fittings for metal tubing can be ruined by excessive tightening. Pull the nuts up just tight enough to stop the leakage.

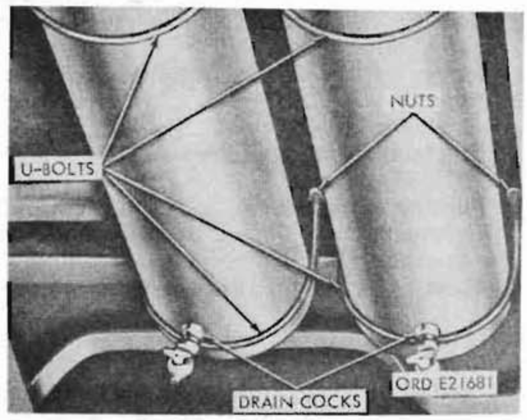

Figure 239. Air reservoirs - typical

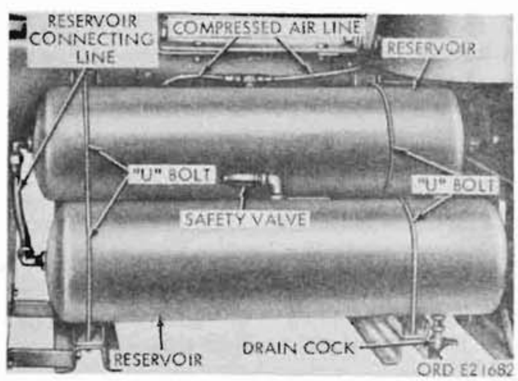

Figure 240. Air reservoirs - trucks M47, M59, M275 and M342

(6) Trailer brake connections and couplings. The brake hose couplings cutout cocks (fig. 246) for the compressed air service to the trailer are installed on the vehicle, at the rear. Airlines to the couplings are closed by the cutout cocks, and the hose couplings are sealed by dummy couplings when the trailer is not attached. Trucks M48, M275 and M275A1 (par. 245) have an additional set of couplings on the brake air hose support. On these trucks, air in the air service lines is controlled by the airbrake hand control valve (par. 247).

b. Tabulated Data.

Air compressor:
- Water-cooled:
  - Make . . . . Bendix-Westinghouse
  - Type 2-UE-7-1/4-VW
  - Cooling . . . . engine coolant
- Air-cooled:
  - Make . . . . Midland Ross Co.
  - Type 5400B
- Both types:
  - Displacement per minute . . . . 7-1/4 cu ft @ 1250 rpm
  - Number of cylinders 2
  - Lubrication . . . . engine-lubricated
- Air governor:
  - Make . . . . Bendix-Westinghouse

215. Air System Lines and Fittings

a. Removal. Open draincocks (fig. 239) and drain air reservoirs. All lines and fittings are removed in similar manner. Disconnect lines by unscrewing fitting nuts. Unscrew and remove sleeve fittings.

Caution: Be sure to tag all lines before removal to facilitate correct installation. The tag should precisely locate the correct connections of the line to the exact components.

Note. Do not bend lines unnecessarily. Do not make sharp bends.

Remove clips, if the line is so supported, and remove the line. (Do not misplace the clips: these must be installed in their original positions.) Unscrew and remove fittings.

b. Repair. Repair of tubes and fittings consists of replacement of defective or damaged parts.

c. Installation. All lines and fittings are installed in similar manner. Replacement lines of correct length and with necessary bends are available for requisition, or may be made from stock tubing.

Caution: In installation of the flareless compression lines previously removed the line fitting nuts must be pulled up fingertight, then given one-eighth turn only with a wrench. This is extremely important. Further tightening will distort sleeve and line. For installation of new lines or lines with new sleeves, never tighten the nut over two turns after the sleeve has been shouldered in body of fitting. Install fittings on system components. Connect lines to fittings, being sure lines are correctly connected to proper components and are not damaged during installation. Secure lines with clips where provided, as originally installed.

216. Warning Signal Buzzer

Refer to paragraph 139 for removal and installation of the warning signal buzzer.

217. Air System Safety Valves

a. General. All safety and air supply valves, hose couplings and draincocks are removed in a similar manner.

b. Removal. Open draincocks (fig. 239) and drain the air reservoirs. Unscrew the valve, couplings, or draincocks, and remove.

c. Installation. Install valves, couplings, or draincock, being sure to tighten sufficiently to prevent air leakage. Close the draincocks after installation.

218. Air Compressor Drive Belt and Pulley

a. Removal.

(1) Remove radiator (par. 85).

(2) Loosen the setscrew on the inside of the pulley hub (fig. 237) and unscrew flange of hub. Remove the drive belt from the pulleys.

(3) Remove the cotter pin and locknut securing the pulley on the shaft. Remove the pulley, being careful not to lose the key in the shaft.

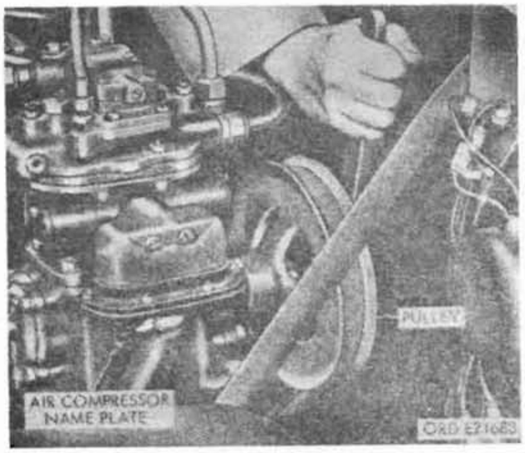

Figure 241. Adjusting air compressor drive belt

b. Installation.

(1) Install pulley on shaft over key and secure with locknut and cotter pin.

(2) Install drive belt on compressor drive pulley on the engine. Place belt over compressor pulley, and install pulley flange on compressor pulley.

(3) Adjust drive belt tension (c below).

c. Drive Belt Adjustment.

(1) Check that the belt does not have more than 1/2-inch deflection midway between the drive and driven pulleys.

(2) Loosen the setscrew on the inside of pulley hub. Using the correct air compressor adjusting tool (refer to Table 1), turn the flange in or out on the threaded hub until the desired belt tension is obtained (fig. 241). Turning flange in tightens the belt, turning flange out loosens the belt.

(3) Turn flange slightly until hub setscrew alines with a groove cut in the flange, and tighten the setscrew.

(4) Install radiator (par. 85).

219. Air Compressor

a. Air-cooled (Fig. 238).

(1) Removal.

(a) Open draincocks (fig. 239) and release air pressure. Disconnect air outlet line from air compressor. Remove air compressor drive belt (par. 218).

(b) Disconnect air compressor-to-air governor line from air compressor and remove clamp securing nozzle leak-off line to air compressor.

(c) Remove four (4) nuts and lockwashers securing the air compressor to mounting bracket and remove compressor.

(d) Remove two screws and lockwashers securing mounting bracket to engine and remove bracket. Discard gasket.

(2) Installation. Install items removed in reverse order of removal, using new gaskets where required.

b. Water-cooled (Fig. 237).

(1) Removal.

(a) Open draincocks (fig. 239) and drain air reservoirs.

(b) Disconnect compressor-to-reservoir line, compressor-to-governor line, and water inlet and outlet lines from compressor, and remove line fittings.

(c) Loosen hose clamp and detach air intake hose from air strainer.

(d) Remove drive belt (par. 218).

(e) Remove four mounting bolts and safety nuts securing compressor to mounting bracket, and lift compressor off bracket.

(f) Remove two screws and lockwashers securing mounting bracket to engine and remove bracket. Discard gaskets.

(2) Installation. Install items removed in reverse order of removal, using new gaskets where required.

219.1 Replacing Water Cooled Compressor with Air Cooled Compressor

NOTE

Replacement air cooled compressor is procured under Military Standard (96906) MS51322-1 and is supplied less the driver pulley, inlet and discharge fitting. These items are transferred from the old to the new compressor at time of installation. However, when this compressor is installed on early production vehicles to replace water cooled compressor, a new air filter manifold assembly is required.

a. Coordination with Ordnance Maintenance Unit. Refer to paragraph 2 for information on coordination with an Ordnance Maintenance Unit.

b. Procedure. Procedure for replacing water cooled compressors with air cooled compressor is as follows:

NOTE

Cylinder head may be rotated 180° for installation.

(1) Drain engine coolant from radiator and engine.

(2) Disconnect and remove compressor to pump water tubes.

(3) Disconnect air discharge and governor lines at air compressor.

(4) Remove compressor drive pulley.

(5) Remove air compressor.

(6) Remove water tube fittings from pump and install 2 pipe plugs.

(7) Remove air discharge fitting from water cooled compressor and install on new compressor, using 2 screws, 2 washers and new gasket supplied with compressor.

(8) Attach manifold assembly to new compressor using 2 screws, 2 washers and new gasket supplied with compressor.

(9) Install elbow in governor part of compressor.

(10) Install compressor on engine using new gasket furnished with compressor.

(11) Install drive pulley (removed from old compressor) on compressor.

(12) Attach main airline to discharge fitting. (Line must be pulled outward approximately 5½ inches and bent to be in line with fitting.)

(13) Attach governor line to elbow on compressor. (Line must be bent to be in line with fitting.)

220. Air Governor

a. Air Governor Type O-1 (Fig. 242).

(1) Removal. Open draincocks (fig. 239) and drain air reservoir. Disconnect the compressor-to-governor line, governor-to-manifold line, and reservoir-to-governor line from the governor. Remove two nuts and screws securing the governor to the dash panel, and remove the governor. Remove the line fittings from the governor.

(2) Installation. Install 3/8 x 1/4 tee in the governor strainer body capnut, and 3/8 x 1/8 large connector in governor body. Secure the governor to the dash panel with two hex-head screws and safety nuts. Connect compressor-to-governor line to the connector, and the governor-to-manifold line and reservoir-to-the governor line to the tee on the governor. Close the reservoir draincocks.

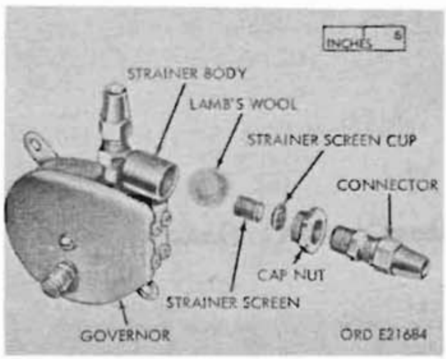

Figure 242. O-1 air governor - showing air strainer disassembled

b. Air Governor Type D (Fig. 243).

(1) Removal. Open draincocks (fig. 239) and drain air reservoirs. Disconnect the compressor-to-governor line, governor-to-manifold line, and reservoir-to-governor line from the governor to the dash panel, and remove the governor. Remove the tube fittings from the governor.

(2) Installation. Install an elbow in the outlet port of the governor, and a tee in the inlet port of the governor. Install the governor on the dash panel with two external-teeth lockwasher hex-head bolts. Connect the compressor-to-governor line to the elbow, and the governor-to-manifold line and reservoir-to-governor line to the tee on the governor. Close the reservoir draincocks.

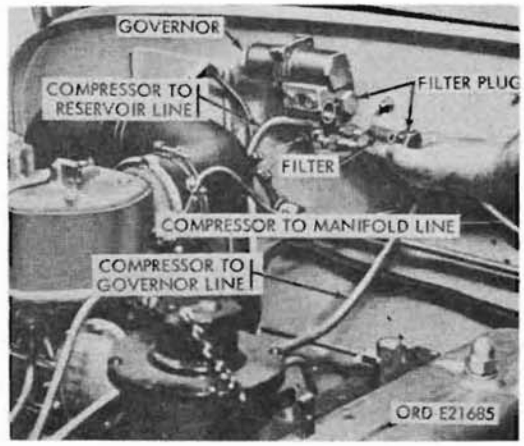

Figure 243. Type D air governor - installed

c. Replacement of Type O Air Governors with Type D.

(1) Replacement. When a type O air governor becomes unserviceable, it should be replaced with a type D air governor. The following procedure should be used to avoid the necessity of installing new airlines or cutting the old ones.

(2) Removal. Remove the type O air governor according to instructions in a(1) above.

(3) Installation.

(a) To connect the lines to the governor, it will be necessary to obtain an air service ball sleeve compression tube tee 504327 and a 90-degree air service ball sleeve compression tube elbow 504255.

Note. The tee used with the type O governor does not fit the type D governor.

(b) Install the elbow in the outlet port and the tee in the inlet port of the governor.

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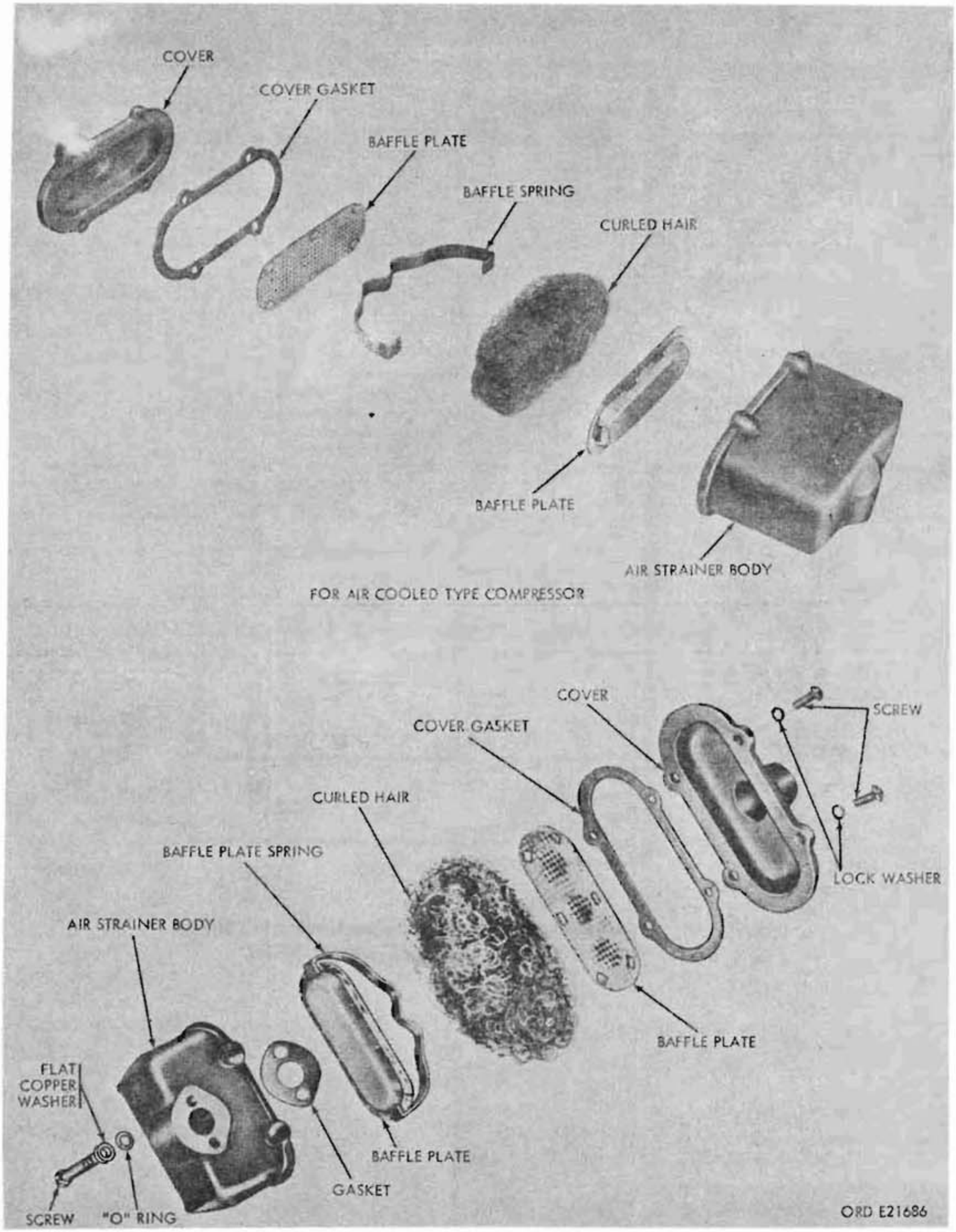


Figure 244. Compressor air strainer - exploded view

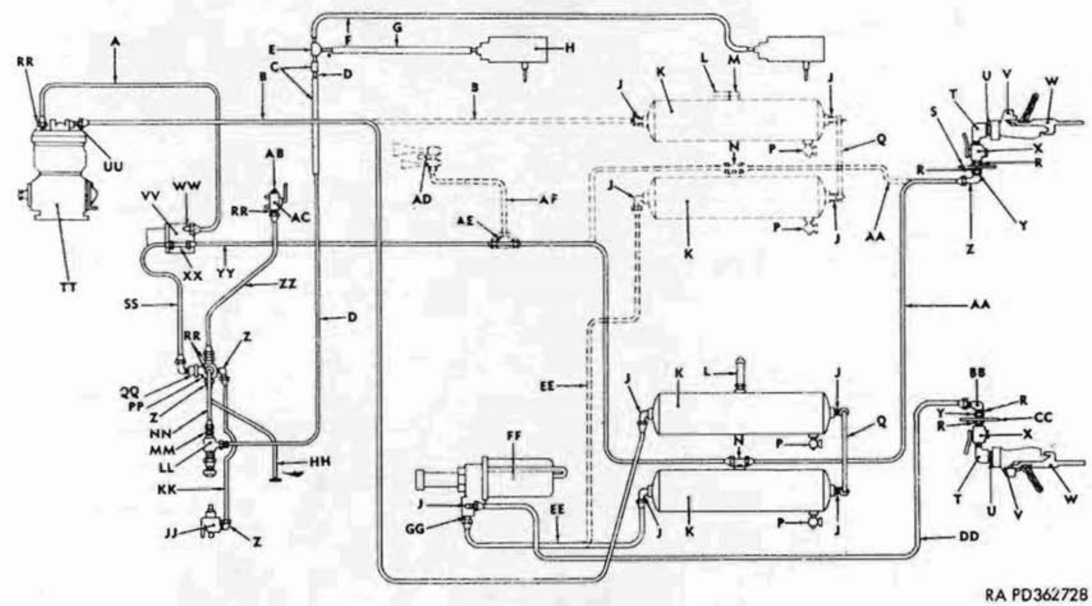


Figure 245. Compressed air system connections and fittings (except tractor trucks M48, M275, and M275A1)

Key	Item	Key	Item
A	Compressor-to-governor line	DD	Trailer service line
B	Compressor discharge line	EE	Air-hydraulic cylinder line
C	Wiper motor supply hose	FF	Air-hydraulic cylinder
D	Wiper motor supply line	GG	1/2-in. connector
E	1/4-in. tee	HH	Left supply valve line (older vehicles) or pressure gage hose (latest vehicles)
F	Right wiper motor hose		
G	Left wiper motor hose	JJ	Low pressure buzzer switch
H	Windshield wiper motor	KK	Pressure switch line
J	1/2-in. elbow	LL	Wiper motor pressure regulator valve
K	Reservoir	MM	3/8 x 1/8 connector
L	Safety valve	NN	Wiper motor regulator valve line
M	3/8-in. elbow	PP	Pressure gage sending unit (older vehicles)
N	3/8 x 3/8 elbow (M49 and M50) or 3/8 x 3/8 tee (all other models)	QQ	Manifold
		RR	3/8 x 1/4 connector
P	Draincock	SS	Governor-to-manifold line
Q	Reservoir connecting line	TT	Compressor
R	Cutout cock stud	UU	Discharge elbow
S	Brake hose coupling emergency tag	VV	Governor
T	1/2-in. pipe elbow	WW	3/8 x 1/8 large connector (type O-1 governor) or 3/8 x 1/8 elbow (type-D governor)
U	1/2 x 1-1/2 nipple		
V	Brake hose coupling	XX	3/8 x 1/4 tee
W	Brake hose coupling dummy coupling	YY	Reservoir-to-governor line
X	Brake hose coupling cutout cock	ZZ	Right supply valve line
Y	1-in. jamnut	AB	1/4-in. plug
Z	3/8 x 1/4 elbow	AC	Supply valve
AA	Trailer emergency line	AD	Air horn (some vehicles)
BB	1/2 x 1/2 elbow	AE	3/8-in. tee or 3/8-in. pipe elbow
CC	Brake hose coupling service tag	AF	Air horn supply line

Figure 245. Compressed air system connections and fittings - legend

481-454 O - 85 - 12

(c) Position the governor with the filter plugs toward the right of the vehicle as shown in figure 243. Connect the compression-to-governor line to the elbow and the governor-to-manifold line and governor-to-reservoir line to the governor. Do not tighten the nuts.

(d) Place the governor against the firewall as indicated in figure 243. Bend the governor-to-reservoir line to clear the hand throttle control wire and bend the compressor-to-governor line to clear the engine. Mark on the firewall the location of the two new governor bolt holes.

(e) Remove governor and drill two 9/16-inch-diameter holes in the firewall at the locations marked.

(f) Install the governor on the firewall, using two bolts 455172 and nuts 7397595.

(g) Connect the lines according to (c) above, and tighten.

(h) Close reservoir draincocks.

221. Compressor Air Strainer

a. Removal.

(1) Open draincocks (fig. 239) and drain air reservoirs. Loosen clamp and detach air intake hose from strainer. Remove two screws and washers holding strainer to compressor, and remove strainer.

(2) Remove screws holding cover (fig. 244) to strainer body, and remove cover and gasket. Discard gasket.

(3) Lift out baffle plate, curled hair, spring, and baffle plate.

b. Cleaning. Wash curled hair thoroughly in dry-cleaning solvent or mineral spirits paint-thinner. Dry with compressed air.

c. Installation.

(1) Saturate curled hair with engine oil and squeeze out excess oil.

(2) Place one baffle plate in body with screen side toward open end. Set spring on baffle plate and place curled hair on spring. Install baffle plate with screen side next to hair. Install cover with new gasket and secure with four fillister-head screws and lockwashers.

(3) Install air strainer, with new gasket, on compressor and secure with two hex-head screws, plain copper washers, and O-ring (if provided).

(4) Connect air intake hose to strainer, and tighten hose clamp. Close reservoir draincocks.

222. Air Reservoirs

a. Removal. Open draincocks to relieve the air pressure. Disconnect reservoir-to-governor line, compressor-to-reservoir line, reservoir connecting line, trailer emergency line (except on trucks M49 and M50 series), air-hydraulic cylinder line, and front trailer service line (M48, M275 and M275A1 only) from reservoirs. Remove safety nuts and U-bolts holding reservoirs in place, and remove reservoirs. Remove safety valve, draincocks, and fittings from reservoirs.

b. Installation.

(1) On trucks M47, M48, M59, M342, M108, M275, and M275A1, install 3/8-inch elbow and safety valve on top of one reservoir. On all other trucks, install safety valve directly on top of reservoir. On trucks M49, and M50 series, install 3/8 x 3/8 elbow on top of second reservoir. On all other trucks, install 3/8 x 3/8 tee on top of second reservoir. Install draincock in bottom of each reservoir. Install 1/2-inch elbow in end of each reservoir nearest draincock. On all trucks (except M48, M275, and M275A1), install 1/2-inch elbow in other end of each reservoir. On trucks M48, M275, and M275A1, install 1/2 x 3/8 elbow in end of reservoir having safety valve, and 3/8 x 1/2 tee in end of other reservoir.

(2) Being sure to install the reservoir that has the safety valve in the right-hand position, install reservoirs on the vehicle and secure each reservoir with two reservoir U-bolts and four 1/4-inch safety nuts.

Note. Refer to figure 245 for guidance on the connection of the lines.

Connect the reservoir connecting tube to the elbows on the rear of the reservoirs. On trucks M49 and M50 series, connect reservoir-to-governor line to the elbow on top of the left-hand reservoir. On the other vehicles, connect reservoir-to-governor line and trailer emergency line to the tee on top of the left-hand reservoir. Connect the compressor-to-reservoir line to the elbow on end of the right-hand reservoir. On trucks M48, M275 and M275A1 connect the air-hydraulic-cylinder line and front trailer service to the tee on the end of the left-hand reservoir. On other vehicles, connect the air-hydraulic cylinder line to the end of the left-hand reservoir. Close the draincocks.

223. Trailer Airbrake Coupling(s) (Fig. 246)

a. Removal.

(1) Open the air reservoir draincocks and release the air pressure (fig. 239).

(2) Remove the dummy coupling from the trailer brake hose coupling.

(3) Unscrew the brake hose coupling from the nipple.

b. Installation. Install items removed using the reverse order of removal.

224. Trailer Brake Connections and Fittings (Tractor Trucks)

Refer to paragraph 245 for replacement of trailer brake connections and fittings on tractor trucks.

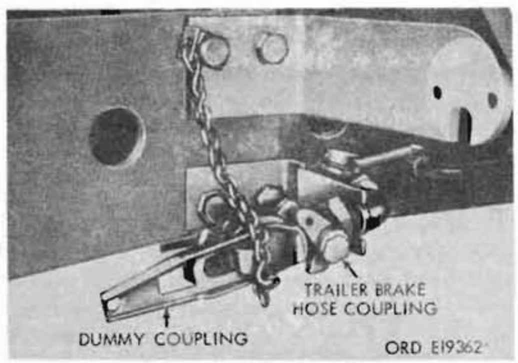


Figure 246. Trailer airbrake coupling

Section XXXVII. PINTLE, LIFTING SHACKLES, AND SPARE WHEEL CARRIER

225. Pintle Hook Assembly

a. Hook Removal. Remove the cotter pin from the castellated nut. Remove the castellated nut and washer from the front side of the rear crossmember (fig. 247). Remove the pintle from the bracket.

b. Repair. Weld, straighten or replace any broken or damaged parts as required.

c. Pintle Bracket Removal. Remove the two screws and safety nuts securing the bracket to the rear crossmember and remove the bracket (fig. 248).

d. Pintle Bracket Installation. Position the bracket on the rear frame crossmember and secure in place with two screws and safety nuts.

e. Pintle Hook Installation. Insert the threaded end of the hook in the mounting hole of the pintle bracket. Secure to the bracket with a plain washer and castellated nut, and insert a cotter pin to lock the castellated nut in position.

226. Front Lifting Shackles

a. General. The lifting shackles (fig. 249) are located on the top of the front bumper and are secured to the bumper by brackets, screws and safety nuts.

b. Removal. Remove four screws and safety nuts securing each lifting shackle and bracket to the bumper. Remove the brackets and shackles.

c. Installation. Position brackets and shackles on the front bumper and secure in position with the screws and safety nuts removed in b above.

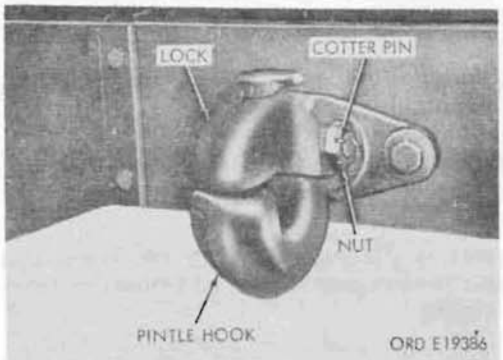


Figure 247. Pintle hook - front view

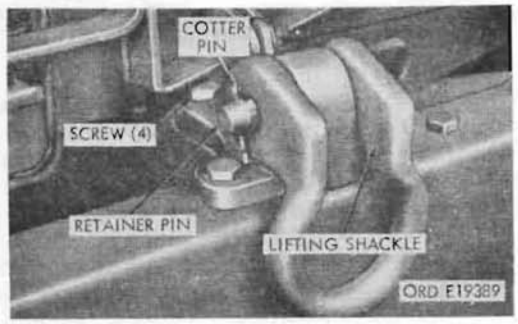


Figure 249. Lifting shackle

227. Spare Wheel Carrier

a. General. All model trucks except the M47, M59 and M342 dump trucks, the M60 and M108 wrecker trucks, and the M48 tractor truck have the underbody-type wheel carrier which is mounted on the left side of the frame (fig. 250). The wheel with the tire is suspended in a horizontal position below the carrier. The carrier frame is equipped with a hand windlass, and a 1/4-inch wire rope with a pickup plate for support. The ratchet on the windlass shaft engages the locking pawl for safety in raising or lowering the spare wheel.

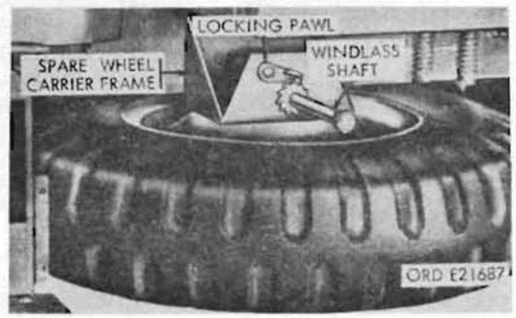


Figure 250. Spare wheel carrier mounted under left front of body

b. Trucks M47, M59, M342, and M48. The M47, M59, M342 and M48 trucks have the spare wheel carrier mounted at the rear of the cab,

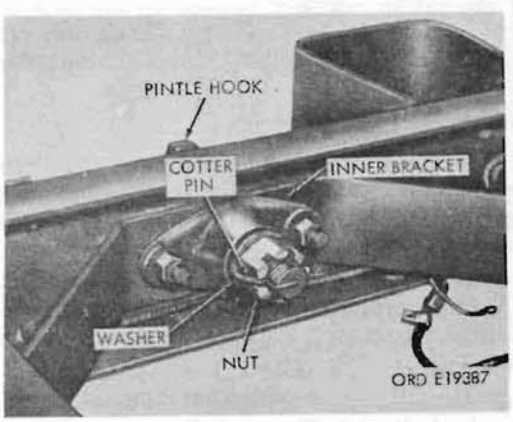


Figure 248. Pintle hook - rear view

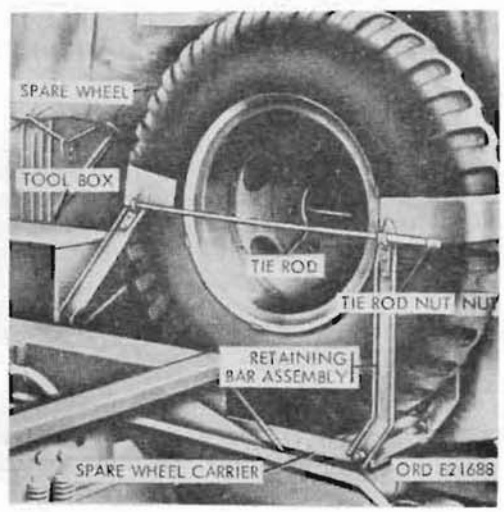


Figure 251. Spare wheel carrier mounted to rear of cab - M47, M59 and M342

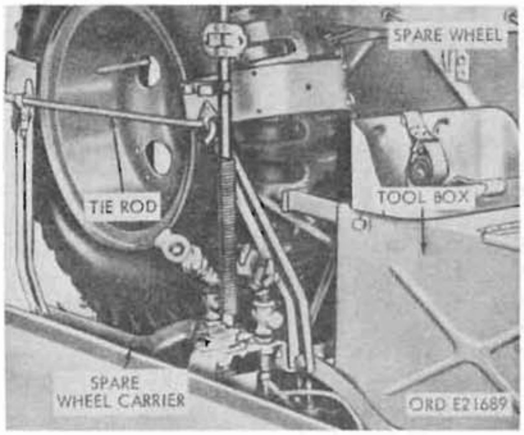


Figure 252. Spare wheel carrier mounted to rear of cab - M48 truck

figures 251 and 252. An inner support and outer support with a top conforming to the tire contour hold the tire with the wheel in position.

c. M60 and M108 Trucks. The M60 and M108 trucks have the spare wheel carrier mounted on the right side on the crane shipper support (fig. 253). The tire with wheel is held by three mounting posts with stud nuts.

d. Repair. Weld, straighten or replace any bent, broken, or damaged parts.

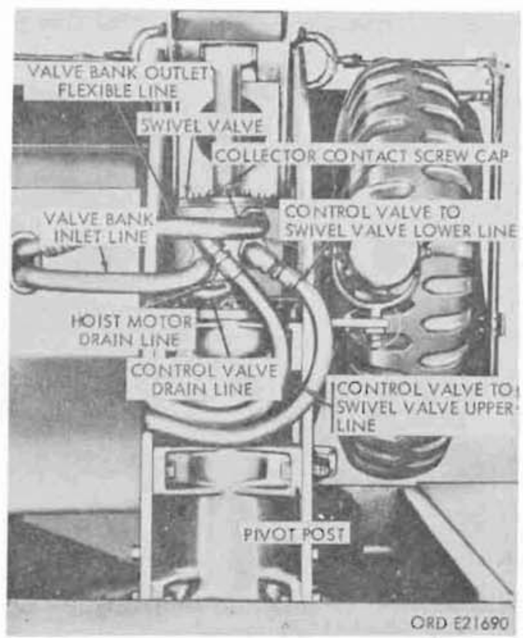


Figure 253. Spare wheel mounted on wrecker pivot post - M60 and M108

Section XXXVIII. CAB AND ASSOCIATED PARTS

228. Description

a. The cab is a metal, open-top structure inclosing the driver's compartment. Side and front weather protection is provided by a windshield and by doors with lowering glass windows. Top protection is provided by either a canvas cab top paulin with rear curtain, or by a metal hardtop closure roof and back. The truck vans are equipped with hardtop closure, other trucks usually are equipped with top paulin and curtain.

b. Two windshield wipers, operated by compressed air, are mounted at the top of the windshield window frame. A cowl ventilator is installed on each side of the cab, forward of the door.

c. Brackets are provided on the cab for mounting a machinegun.

229. Cab Top Paulin and Supports

a. General. The cab paulin (fig. 255) secured to the top of the windshield frame, is supported by removable pillar posts and the top bows, and lashed in place on the rear of the cab.

b. Removal. Release the lashing rope from the side handles and from the hooks at rear of the cab. Release the paulin from the fastener studs in the side-roof rails and slip the paulin from the channels in the pillar posts. Throw the paulin over the windshield and pull the paulin edge from the channel in the windshield. Disengage the side-roof rails from the windshield, and fold in and down to the pillar posts. Lift out posts and bow assemblies. Remove the crossbars (fig. 254) from bows.

c. Stowage. Strap crossbars together with the attached straps and stow them with the post and bow assemblies behind the seats. Fold the top paulin and stow back of the seats.

Note. Do not fold or stow paulin when it is wet.

d. Installation. Install the crossbars (fig. 254) in bows; the bar with the straps attached

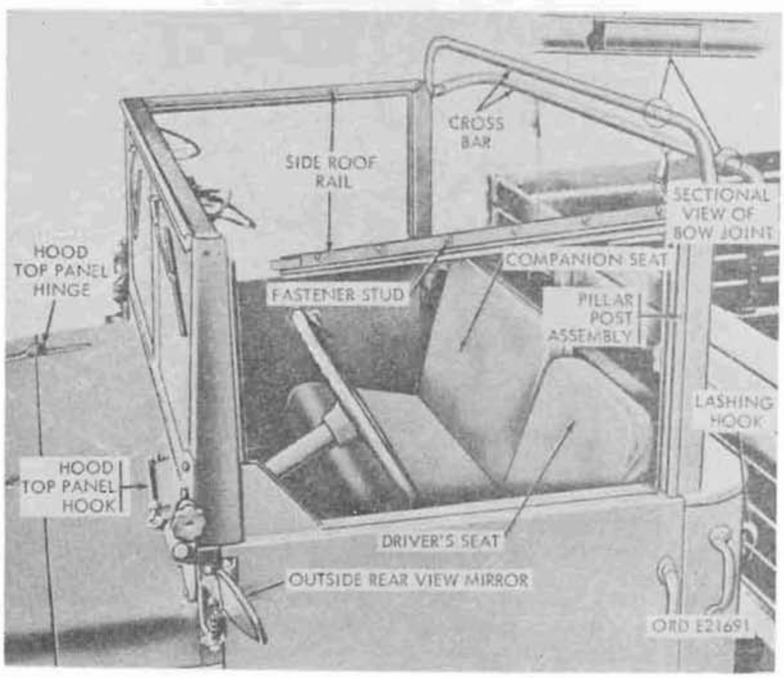


Figure 254. Cab top frame

Figure 255. Installing cab top paulin

is installed in the rear position. Install the pillar posts, in the sockets. Raise the side-roof rails and engage them in slots at the top corners of the windshield. Spread the paulin (fig. 255) on the hood and slide the front edge into the channel at the top of the windshield frame. Throw the paulin back over the supports and slide the sides into the channels in the pillar posts. Fasten the paulin at the upper corners of the windshield and secure the fastener studs in the side rails. Engage the lashing rope on the hooks at the back of the cab and tie the ends in handles at sides of the cab.

230. Hardtop Cab Closure (Fig. 256)

a. General. The hardtop cab closure, consisting of the hardtop closure roof and back is fastened to the top of the windshield frame and to the back of the cab. Rubber seals are used to weatherproof closure to the cab.

b. Removal. Remove the two tapping screws and lockwashers securing the closure front corners to the windshield side posts. Remove the two safety nuts, and clamping washers, and bolts securing the top to the windshield top frame. Remove the 14 safety nuts, the 28 washers, and 14 screws securing the top to the rear of the cab, and remove the top and top-to-back the seal. Remove 14 safety nuts, washers, and screws securing the closure back to the cab, and remove the back and back-to-cab seal.

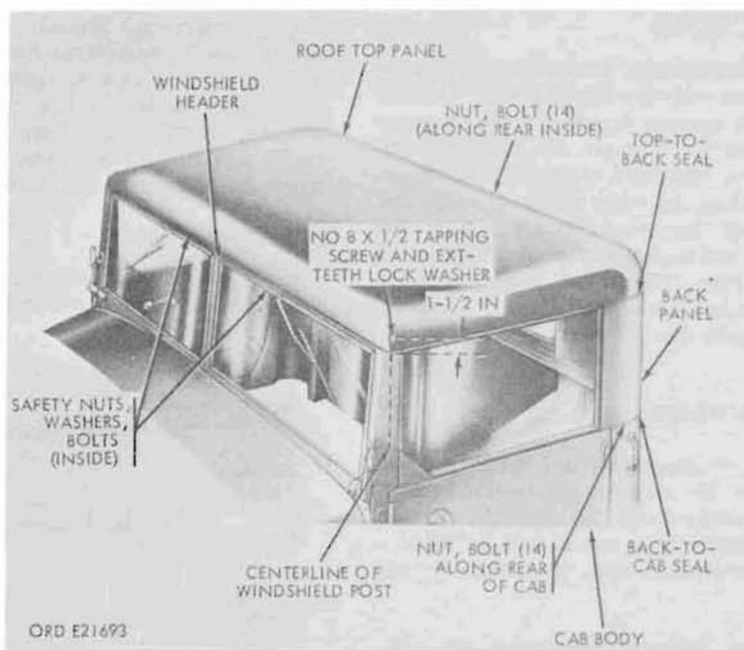


Figure 256. Hardtop cab closure - installed

c. Installation.

Note. Do not tighten any screws until all screws are in place.

Place the back-to-cab seal on the top of the rear edge of the cab with holes in the seal lined up with the holes in the cab. Set closure back on the seal and fasten to the cab with 14 cross-recess roundhead screws, plain washers, and safety nuts. Secure ends of the seal to the back with two seal-retaining clips, using two cross-recess flathead tapping screws to secure clips. Place top-to-back seal on closure back with holes in seal lined up to holes in back. Set the closure top on the seal with the front edge in place on the windshield frame. Fasten the top to the windshield frame with the two hex-head bolts, clamping washers, and the safety nuts. Fasten the top to the back with the 14 cross-recess roundhead screws, the 28 plain washers, and the 14 safety nuts, adjusting the windshield, if necessary, to aline the holes in the closure top and back.

Note. On hardtop installation on the vehicles formerly equipped with the canvas top paulin, two 0.140-inch holes, one in each windshield side post, must be drilled for No. 8 tapping screws after the top is positioned. Refer to figure 256 for location.

Secure the closure front corners to the windshield side posts with two No. 8 x 1/2" cross-recess-panhead tapping screws and external-teeth lockwashers. Tighten all screws and bolts. Close the cab door windows and adjust the door seal along the edge of the closure and door by tapping the seal retainers with the hammer in or out to cause the seal to form a good weather seal. Trim all seals, if necessary, to eliminate seals rolling with the door, and to make tight the weather-sealing of the doors.

231. Rear View Mirror

a. Removal. Remove the nut, washers, and screw securing the mirror adjustable arm in the bracket, and remove the arm and mirror (fig. 257). Remove the nut and washer securing the mirror on the arm, and remove the mirror.

b. Installation. Place an external-tooth lockwasher on the mirror ball joint stud, and install the mirror on the arm with a safety nut. Install arm with mirror on the arm mounting bracket with two fiber washers (one on each side of the arm flange), a hex-head screw, two external-teeth lockwashers, and a hex nut.

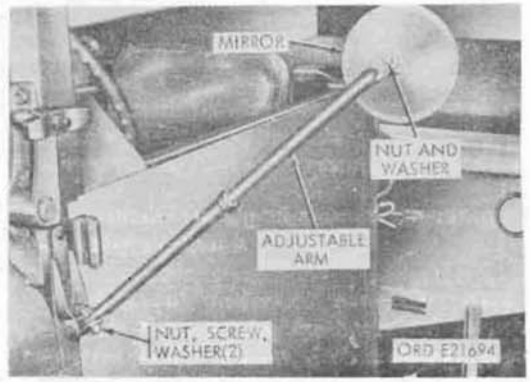


Figure 257. Rear view mirror

232. Windshield Wipers

a. Removal. Remove the nut holding the wiper arm to the wiper motor shaft, and remove the arm and blade. Remove the two screws holding the wiper motor to the windshield frame (fig. 258) disconnect the wiper motor hose, and remove the wiper motor.

b. Installation. Install wiper motor with motor shaft projecting through the hole in the windshield frame, and secure with two internal-teeth lockwasher cross-recess binding-head screws. Install wiper arm and the blade on the shaft and secure the arm on the shaft with a blind nut. Connect the wiper motor hose.

233. Windshield

a. General. Windshield (fig. 259) is made with two independent sections assembled in

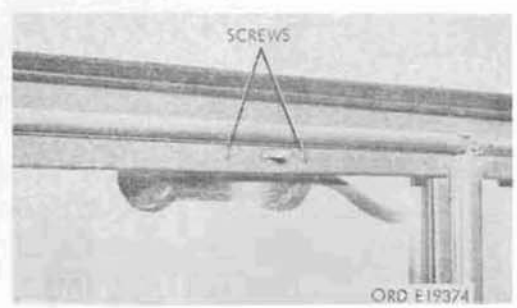


Figure 258. Windshield wiper motor - removal

a metal frame. Sections are hinged at the top and can be swung out at the bottom as desired. Friction locks hold the sections in adjusted position. A locking handle at the bottom of each section locks it closed. The outer frame is pivoted at the bottom and can be folded forward and locked on the hood.

b. Removal (Fig. 259).

(1) Remove windshield wiper motors (par. 232).

(2) Extend windshield and tighten wingnut.

(3) Remove the screws holding the windshield to the adjustable support brackets.

(4) Remove the screws holding the windshield hinge section to the windshield frame.

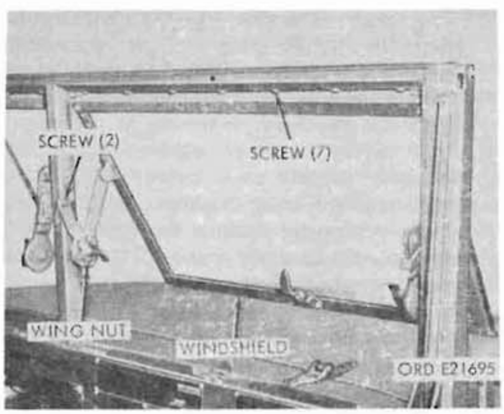


Figure 259. Windshield

c. Installation. Install items in reverse order of removal. Do not overtighten screws at points where glass may be damaged.

234. Cab Seats

a. General.

(1) Driver's seat (fig. 254). The driver's seat is mounted on a fully inclosed base which is anchored to the cab floor. Seat and back cushions are supported in the frame which is mounted on the base. The seat is adjustable forward and backward, and is held in position by the spring latch adjuster which engages a slot in the left side of the base. Seat is pivoted and can be raised to give access to the storage compartment in the base.

(2) Companion seat. The companion seat (fig. 254) is supported on the welded frame, right side of which is anchored to the cab floor. The left end of the frame is attached to the upper portion of the driver's seat base. The seat cushion can be tilted up against the back cushion, or the back can be laid forward on the seat to serve as the gunner's platform when using the cab-mounted machinegun.

b. Driver's Seat Replacement.

(1) Removal. Lift up the driver's seat cushion, and remove the four safety nuts and the eight washers holding the driver's seat frame to the seat frame base (fig. 260). Release the seat adjuster locking handle, and remove the seat.

(2) Installation. Position the driver's seat on the base and engage the adjuster locking handle. Lift up the seat cushion and fasten the seat frame to the base with the two plain washers and safety nut on each of the four studs.

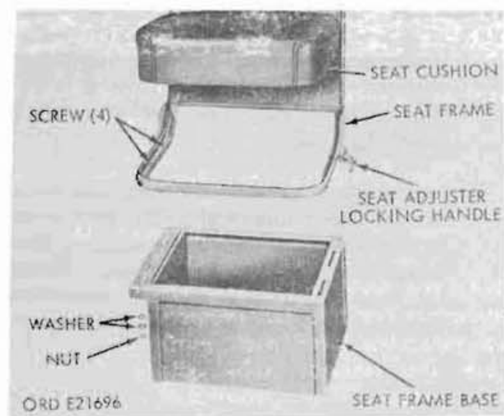


Figure 260. Driver's seat - removal

Note. Do not tighten nuts to interfere with sliding movement of seat on base.

c. Driver's Seat and Backrest Cushion Replacement.

(1) Removal. Slide the backrest cushion up and off the frame. Remove the two nuts and bolts holding the seat cushion hinges to the seat frame hinges (fig. 261), and remove the cushion.

(2) Installation. Position the seat cushion on the seat frame and fasten the hinges with the two bolts and safety nuts. Slide the backrest cushion over the back frame so that frame enters the upper portion of the cushion cover.

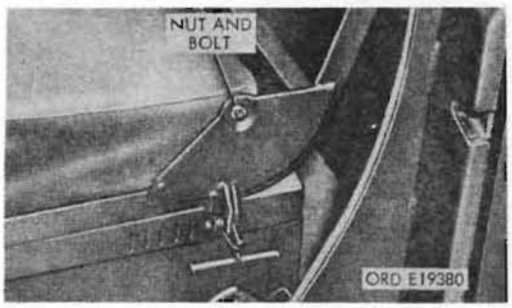


Figure 261. Driver's seat cushion disconnect points

d. Companion Seat Replacement.

(1) Removal. Lift up the companion seat cushion, remove the two screws securing the companion seat frame legs to the floor, remove the four safety nuts and screws securing the seat frame to the driver's seat base, and remove the seat (fig. 262).

(2) Installation. Place the companion seat on the floor and secure the seat frame to the driver's seat base with four hex-head screws, and safety nuts. Secure the seat frame legs to the floor with two hex-head split lockwasher screws.

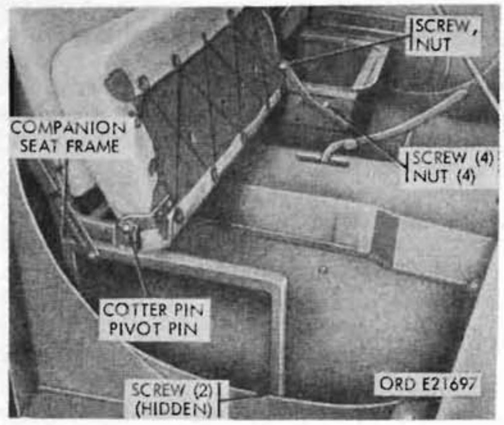


Figure 262. Companion seat removal

e. Companion Seat and Backrest Cushion Replacement.

(1) Removal. Remove the two cotter pins and the pivot pins or the two safety nuts and screws holding the seat cushion hinges to the seat frame (fig. 262). Lift up the seat cushion, and remove the safety nut and screw holding the cushion to the seat cushion link, and remove the seat cushion. Pull up and pull out on the bottom rear edge of the backrest cushion, and pull the cushion from the backrest frame.

(2) Installation. Seat the top rear edge of the backrest cushion under hooks on the top edge of the backrest frame. While pulling up on the cushion, press the cushion back to seat the lower edge in the frame. Place the seat cushion on the seat frame, and install the two pivot and cotter pins or two hex-head screws and safety nuts through the seat and frame hinge to secure the seat. Lift up the seat and secure the cushion to the seat cushion link with a hex-head screw and safety nut.

Section XXXIX. CARGO BODIES AND AUXILIARY EQUIPMENT (M34, M35, M35A1, M36 and M36C)

235. Description

a. General. Refer to paragraph 5d, e and f for a general description of the cargo trucks.

b. Cargo Racks. The cargo trucks are equipped with sockets in the sides and front of the body to permit installation of the cargo racks. The lower portion of each side rack is hinged at the bottom so it can be lowered for use as a troop seat.

c. Bows and Paulin. Tubes in the side racks provide sockets to accommodate bows for support of the paulin and end curtains. The end curtains have flaps which can be opened for ventilation. The paulin sides can be rolled up and strapped for side ventilation.

236. Paulin and End Curtains

a. Removal.

Note. Do not fold or stow wet paulin or end paulin curtains.

Untie all paulin lashing and draw ropes from lashing hooks. Make the first fold of paulin on each side lengthwise until lower edge of paulin is even with top buckles. Make second fold lengthwise on both sides until both folds meet. Bring one folded side over other fold. At each end make an equal fold toward center. Make another equal end fold until folded paulin is supported only by center bow. Remove paulin from body. Untie end curtain front and rear lashing ropes from lashing hooks. Unwind lashing ropes from curtain and end bows and remove curtains, figure 263.

b. Installation. Place end curtain in position on end of body. Make certain center of lashing rope is in center eyelet of curtain. Wind lashing rope alternately around bow and through eyelets in the curtain. Tie ends of lashing rope to the lashing hooks. Install second end curtain in the same manner. Place folded paulin across the center bow. Locate end marked "front" and position paulin so this end will be at front of body. Unfold paulin and pull tight over bows with front and rear ropes. Tie down paulin lashing ropes to lashing hooks on body to secure paulin. Tie down paulin draw ropes to lashing hooks on ends of body.

c. Raising Sides of Paulin for Ventilation. Untie all paulin lashing and draw ropes. Fold paulin under, three folds on each side. Fasten paulin in place, using straps on bows and buckles on paulin. Tie front and rear draw ropes to lashing hooks at each end of the body.

237. Bows, Repair

When possible, bend bow corners (fig. 264) to correct angle, using an undamaged corner as a pattern. Replace broken or splintered bow tops or stakes by removing two bolts holding each stake and four bolts holding bow top in bow corners. Replace damaged portion

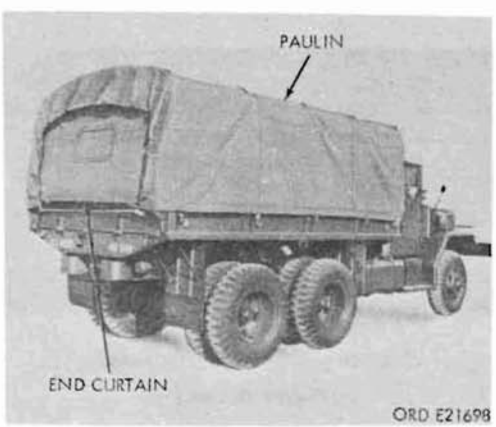


Figure 263. Cargo truck paulin with end curtains

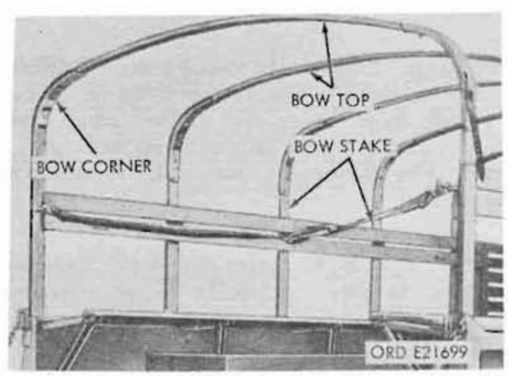


Figure 264. Cargo body bow assembly

and secure stakes and bow top with eight truss-head bolts.

238. Paulin Cover and End Curtains, Repair

Use approved materials and methods to reinforce torn or ripped seams by sewing or riveting. Patch holes where feasible; otherwise, replace a complete section. Use approved waterproofing materials for coating thin or abraded areas. Remove mildew where present. Refer to TM 10-269 for repair of canvas and webbing.

Section XL. DUMP BODY AND AUXILIARY EQUIPMENT (M47, M59 and M342)

239. Description and Data

a. Description. The M47, M59, and M342 dump body and hydraulic hoist mechanism are mounted on a subframe attached to the truck chassis. The double acting hydraulic hoist

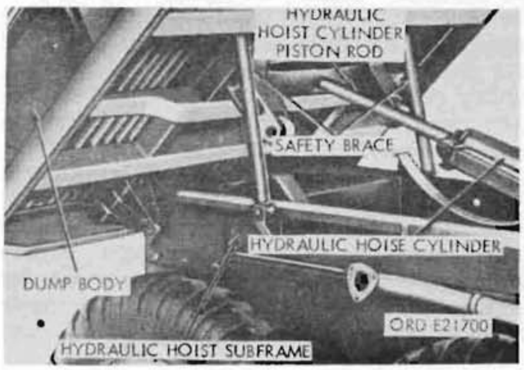


Figure 265. Safety braces in safety position

cylinder (figs. 265 and 266) is mounted in the forward part of the subframe. Safety braces, attached to the sides of the subframe, are provided to secure the body in the raised position.

Warning: The safety braces (fig. 265) must always be used if maintenance or adjustment is being done under the fully raised body. When working under partially raised body, be sure to use blocks or a hoist as precautionary measure.

Note. The M342 hydraulic hoist assembly consists of two hydraulic hoist cylinders mounted side-by-side. Each cylinder pivots on a shaft attached to the subframe. The upper end of each hoist cylinder piston rod is clamped to a crosshead, which is pivoted to a lifting arm assembly pinned to the underside of the dump body (fig. 266).

High pressure pump lines (fig. 268) connect the cylinder ports to the hydraulic hoist control valve which is attached to the side of the subframe reservoir and supports the pump adapter. The pump spacer is attached to the underside of the adapter, and the hydraulic hoist pump is secured to the bottom flange of the spacer. The hydraulic hoist pump drive shaft transmits power to the pump from the accessory output shaft of the transmission power takeoff. The hydraulic hoist control box, mounted adjacent to the pump spacer, controls the operation of the accessory output of the transmission power takeoff (fig. 268) and also the action of the control valve in regulating the flow of oil to and from the hoist cylinder. The pump adapter directs the flow of oil from the pump to the control valve. The oil reservoir is in the front crossmember of the subframe. It has a drain plug in the bottom and a filler neck on the left side. The filler neck has a filler plug and holds a bayonet-type gage for checking the reservoir oil level. The cylindrical filter screen in the filler neck can be lifted out with the fingers after gage is removed. The dump body must be raised slightly to afford access to the filler neck.

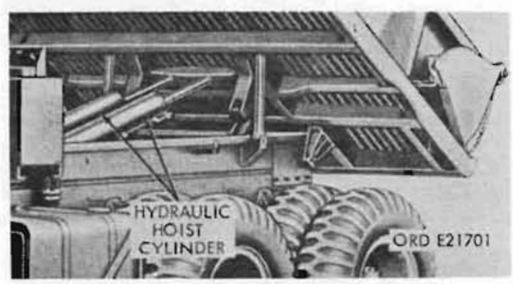


Figure 266. M342 hydraulic cylinder assembly

b. Data.

Hydraulic hoist cylinder:
Make. . . . . Perfection Steel Body Co.
Model PSB-A4020

Hydraulic hoist pump:
- Make . . . . Perfection Steel Body Co.
- Model PSB-A4057
- Capacity . . . . 15 gpm at 1000 rpm
- Pressure . . . . 1000 psi

Hydraulic hoist pump drive shaft:
- Make. . . . . Spicer Mfg Co.
- Model SP-10372-1SF

Hydraulic hoist control box:
- Make . . . . Perfection Steel Body Co.
- Model PSB-A3853

Hydraulic hoist control valve:
- Make . . . . Perfection Steel Body Co.
- Model PSB-A3017

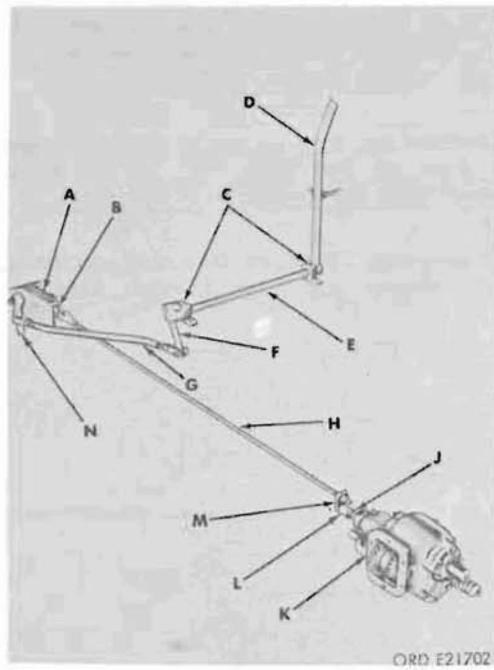
Hydraulic hoist system capacity . . . . . 7 gal

240. Hydraulic Hoist Control Linkage

Note. The key letters noted in parentheses are in figure 267, except where otherwise indicated.

a. Removal. Remove cotter pin and clevis pin holding control-box-to-power-takeoff rod (H) on control box power-takeoff shaft lever (B), and remove rod from lever. Remove screw (M) holding power-takeoff rod arm (L) on accessory drive shifter shaft (J) of transmission power takeoff (K), and remove arm and rod as a unit. Remove cotter pins and clevis pins holding control-box-to-shift-control-lever rod (G) on control box control rod lever (N) and on shift control lever (F), and remove rod. Remove four safety nuts and screws holding control lever shaft bearing brackets (C) to floor of the cab, and remove brackets, driver's control lever (D), control lever shaft (E), and shift control lever (F) from cab as a unit.

b. Installation. Position driver's control lever (D), control lever shaft (E), shift control lever (F), and control lever shaft bearing brackets (C) as a unit on floor of cab behind driver's seat with shift control lever (F) extending through hole in floor. Secure brackets to floor with two 85,000-psi yield strength hex-head screws and safety nuts for each bracket. Install control-box-to-shift-control-lever rod (G) on shift control lever (F) with a clevis pin and cotter pin. With driver's control lever (D) locked in OFF position and control box control rod lever (N) pulled forward to its limit of travel, check length of the control-box-to-shift-control-lever rod (G). Adjust rod length, if required, in order that rod can be connected without moving levers. Connect rod to lever using a clevis pin and cotter pin. Connect control-box-to-power-takeoff rod (H) and power-takeoff rod arm (L) as a unit to transmission power takeoff (K) by securing rod arm (L) to accessory drive shifter shaft (J) of power takeoff with a hex-head screw (M). Pull out accessory drive shifter shaft (J) to its full limit of travel and place driver's control lever (D) in OFF position. Adjust length of control-box-to-power-takeoff rod (H), as required, without moving levers. Connect rod to control box power-takeoff shaft lever (B) with a clevis pin and cotter pin.



Key	Item
A	Hydraulic hoist control box
B	Control box power-takeoff shaft lever
C	Control lever shaft bearing brackets
D	Driver's control lever
E	Control lever shaft
F	Shift control lever
G	Control box to shift control lever rod
H	Control box to power-takeoff rod
J	Accessory drive shifter shaft
K	Transmission power takeoff
L	Power takeoff rod arm
M	Screw
N	Control box control rod lever

Figure 267. Hydraulic hoist control linkage

241. Flexible Lines and Fittings (Fig. 268)

a. Draining. Raise body and place safety braces in position. Be sure to observe safety warning (par. 239a).

Caution: To ensure relief of hydraulic pressure before removing filler plug, start engine and operate hoist pump with driver's control lever in POWER TAKEOFF ENGAGED - BODY DOWN position (refer to TM 9-2320-209-10) for at least 1 minute. Remove filler plug and oil level gage from filler neck at left end of subframe reservoir end. Remove drain plug from bottom of reservoir. Drain oil into container with capacity of at least 5 gallons.

Caution: Be sure to use a clean container and keep oil free from dirt. Do not re-use drained oil if contamination is suspected.

b. Removal. Unscrew threaded end fittings from cylinder and control valve assembly. Protect openings to prevent dirt or other foreign matter from entering.

c. Installation. Replace with lines of correct length. Make sure threaded ends are sound and are not bent or nicked. Clean openings carefully and screw threaded ends of the tubes into the cylinder and control valve assemblies, using figure 268 as a guide.

Caution: When re-installing lines previously removed, fitting nuts must be pulled up finger-tight, then given one-eighth turn only with a wrench. Further tightening will distort ball sleeve tube. When installing new lines and/or fittings, never tighten nut over two turns after sleeve has shouldered in body of fitting.

Do not bend, kink or damage lines during installation. Do not leave lines twisted after installation. Fill oil reservoir (refer to LO 9-2320-209-12). Check for leaks by operating dump body mechanism (TM 9-2320-209-10). Tighten fittings where necessary. If leakage continues, notify direct support maintenance unit.

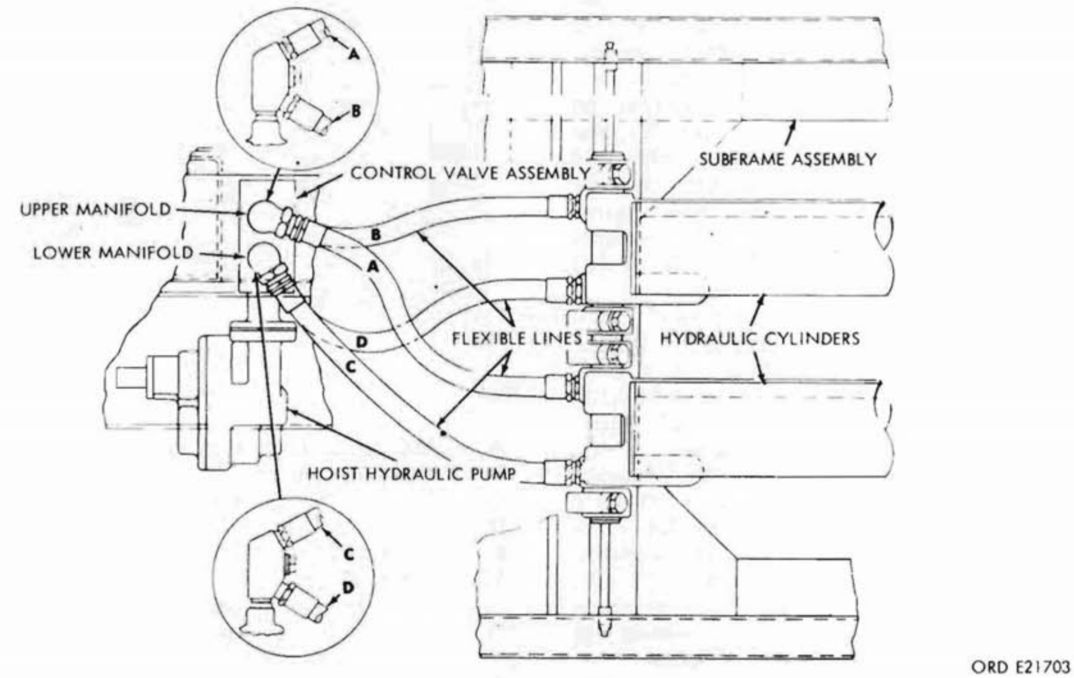


Figure 268. Hydraulic lines and fittings - M342

Section XLI. TRACTOR TRUCK AND AUXILIARY COMPONENTS (M48, M275 and M275A1)

242. Description and Data

a. Description. M48, M275 and M275A1 differ only in length of chassis and the absence of a toolbox and spare wheel carrier on the M275 and M275A1. Each truck is equipped with a fifth wheel (fig. 269) mounted on a chassis frame. Deck plates are provided as an access platform in front of the fifth wheel. Skid plates are provided for convenience of attaching or removing the semitrailer and are riveted to the frame sidemembers behind the fifth wheel. An airbrake hose support (fig. 270) is mounted on a bracket behind the cab on the M275 and M275A1 and to the rear of the spare wheel carrier and toolbox on the M48. The airbrake hand-control valve is mounted on the steering column on both vehicles. Connections for the electricity and the air for operation of semitrailer lights and brakes are mounted on the hose support mounting frame. An air stoplight switch (fig. 271) is mounted below the air hose support. The fuel tank on the M275 and M275A1 truck differs in size and shape from the rest of the trucks, and is mounted under the left-hand side of the cab.

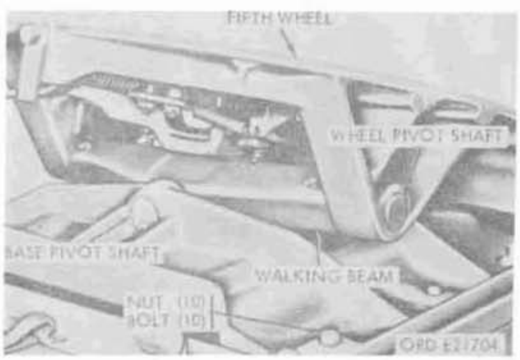


Figure 269. Fifth wheel assembly

b. Data.

Fifth wheel:
- Make . . . . Dayton Steel Foundry Co.
- Model 2-FWU-33-QB

Airbrake hand-control valve:
- Make . . . . Bendix-Westinghouse
- Model 225108

Air stoplight switch:
- Make . . . . Bendix-Westinghouse
- Model 224106

243. Fifth Wheel (Fig. 269)

a. Removal. Remove ten safety nuts, plain washers, and bolts securing fifth wheel base to truck frame sidemembers, and remove fifth wheel with a suitable hoist. Remove mounting spacers.

b. Installation. Place one fifth wheel mounting spacer on each frame sidemember, alining holes in spacers to rivet heads in frame. With a suitable hoist, lower fifth wheel in place on spacers. Secure wheel base to frame with ten hex-head bolts, plain washers, and safety nuts.

244. Trailer Connector Electrical Cable (Fig. 270)

a. Removal. Press in locking latch on cable connector until latch opens. Pull connector from receptacle.

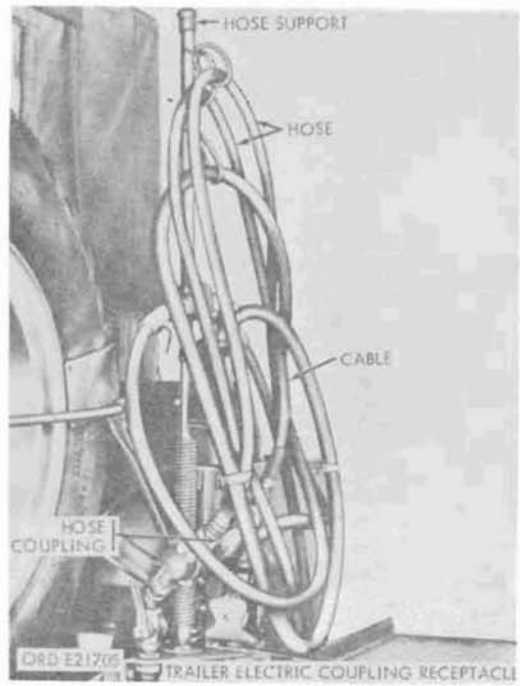


Figure 270. Air brake hose and trailer connector electrical cable stowed on airbrake hose support

b. Installation. Lift up receptacle cover, and push cable connector into receptacle after alining connector pins with receptacle pin sockets. Press connector down until latch on connector engages catch on receptacle.

245. Airbrake Cutoff Cocks and Couplings (Fig. 271)

a. Removal. Open draincocks (par. 222) and drain air reservoirs. Unscrew valve, coupling, or cock, and remove.

b. Installation. Install valve, coupling or cock, being sure to tighten sufficiently to prevent air leakage. Close draincocks.

246. Airbrake Hose (Fig. 270)

a. Removal. Grasp airbrake hose coupling firmly, and pull up on hose coupling until tab in coupling clears flange on mating coupling. Tip hose coupling sideways and remove.

b. Installation. With hose coupling in vertical position, press coupling against mating coupling alining air passages in both parts. Push down on hose coupling until tab enters and locks in flange on mating part.

247. Airbrake Hand-control Valve (Fig. 272)

a. Removal. Open draincocks (par. 222) and drain air reservoirs. Disconnect brake hand-control valve supply, outlet, and breather lines from hand-control valve. Remove two screws and lockwashers securing valve mounting bracket to steering column, and remove valve. Remove fittings from valve.

b. Installation. Install flared tube connector in exhaust port, and compression tube connector in supply and delivery ports. Install valve (fig. 272) on steering column and fasten with two bolts and lockwashers, but do not tighten. Connect brake hand-control valve breather line to flared tube connector in the exhaust port. Connect brake hand-control valve supply line to compression tube connector in supply port. Connect brake hand-control valve line to connector in delivery port. Tighten valve mounting bolts securely. Close reservoir draincocks (par. 222).

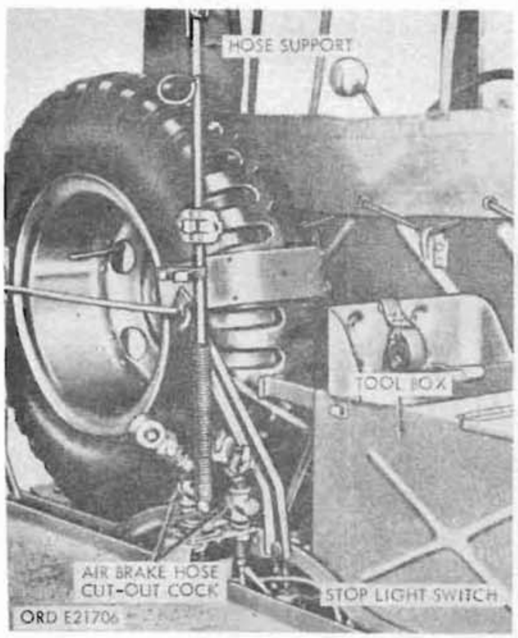


Figure 271. Brake system connections

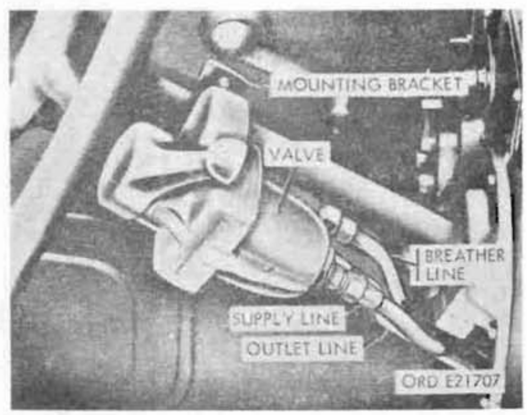


Figure 272. Airbrake hand control valve

Section XLII. WATER TANK BODY AND AUXILIARY EQUIPMENT (M50 and M50A1)

248. Description and Data

a. Description. The M50 and M50A1 trucks are equipped with an aluminum tank of double-shell construction with insulation between the shells. The tank is divided into two compartments; one 400-gallon compartment, and one 600-gallon compartment. Each compartment has a manhole and a filler opening with covers. The filler openings have strainers to prevent solids from entering the tank compartments. Each tank compartment discharges water through a discharge valve into the tank drainpipe located underneath the tank. Valves are operated from the discharge valve control (fig. 273) located in the equipment compartment built into the rear of the tank body. An exhaust heater chamber on the underside of the body protects the discharge valves and drainpipe during freezing temperatures. Exhaust gases are brought from the exhaust bypass valve, located just ahead of the muffler, through the exhaust bypass fording valve into the front end of the chamber. Water leaving either tank compartment enters the drainpipe and passes to a T-connection on the delivery pump suction pipe in the equipment compartment where it can be dispensed through the gravity delivery-line gate valve or fed through the suction line into the delivery pump. The pump discharges water under pressure through the pump delivery-line gate valve located under the equipment compartment. Power to operate the pump is obtained from the transfer power takeoff through the delivery pump front and rear drive shafts located under the tank body.

b. Data.

Delivery pump:
- Make . . . . Blackmer Pump Co.
- Model TRLO-W60
- Type . . . . . . rotary, positive displacement
- Rotation . . . . clockwise
- Rating . . . . 80 gpm at 700 rpm

Delivery pump front drive shaft:
- Make . . . . Spicer Mfg Co.
- Model . . . . 10444 SF
- Type . . . . tubular
- Construction . . . . snapring

Delivery pump rear drive shaft:
- Make . . . . The Heil Co.
- Model 8A6579
- Type . . . . tubular
- Length . . . . 63-9/16 in.

Delivery pump rear drive shaft flange block with bearing:
- Make . . . . Link-Belt Co.
- Model F-219

Delivery-line gate valve:
- Make . . . . . . Ohio Pattern & Foundry Co.
- Model 215-3

Discharge valve:
- Make. . . . . Wheaton Brass Works
- Model 505

Discharge valve control:
- Make. . . . . Wheaton Brass Works
- Model . . . . 514, 2 compartment

Exhaust bypass valve:
- Make. . . . . Reo Motors, Inc.
- Model 661-L2

Exhaust bypass fording valve:
- Make. . . . . . . Ohio Pattern & Foundry Co.
- Model 215-2

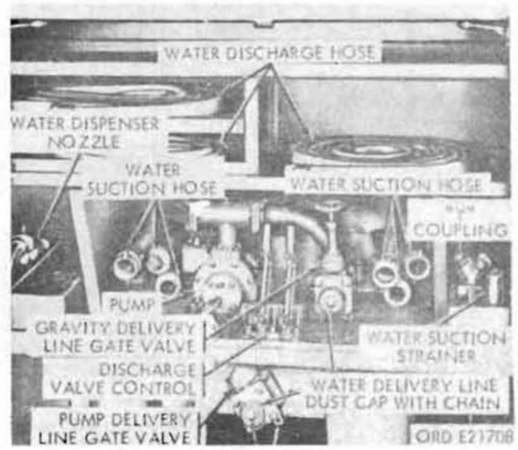


Figure 273. M50 and M50A1 delivery pump and discharge valve controls

249. Engine Auxiliary Governor

a. Auxiliary Governor Drive Unit.

(1) Coordination with direct support maintenance unit. Refer to paragraph 2 for information on coordination with direct support maintenance unit.

(2) Adjust and seal. Disconnect pump drive shaft from transfer power takeoff. Place transmission in fourth gear, transfer in neutral, and transfer power

takeoff in engaged position. Connect a tachometer to distributor (if truck is not equipped with tachometer) to determine engine speed. Start engine. When engine is at normal operating temperature, pull throttle control out to its maximum limit and turn it to lock it in OUT position. Remove locking wire from screws holding adjusting port cover plate on drive unit housing, and remove screws, cover plate, and cover plate gasket. Using governor-adjusting tool 41-R-3172-900 (fig. 274), hold main spring tension adjusting nut in position against rotation. Slowly turn main spring rate-adjusting nut with a suitable screwdriver in a downward direction to decrease engine speed or in an upward direction to increase engine speed. Adjust governor until tachom-

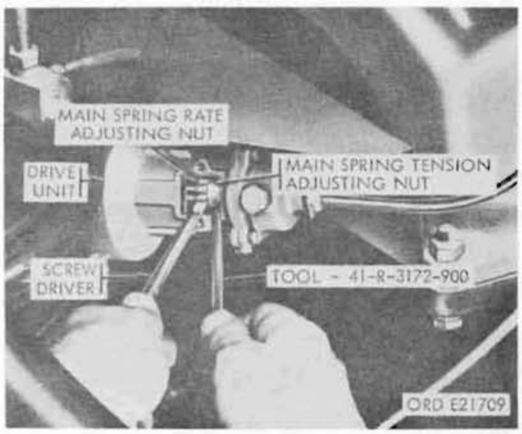


Figure 274. Adjusting auxiliary governor drive unit

eter shows an engine speed of 1450 to 1595 rpm. Install cover plate, gasket, screws and locking wire removed prior to adjustment.

b. Auxiliary Governor Flexible Shaft (Fig. 275).

(1) Removal. Unscrew auxiliary governor flexible shaft from auxiliary governor angle drive adapter on transfer power takeoff and from auxiliary governor drive unit below air cleaner in engine compartment. Remove shaft assembly from vehicle.

(2) Flexible shaft core replacement. Remove flexible shaft core from shaft casing. Install new core in casing.

(3) Installation. Install shaft in vehicle with square end of core at transfer power takeoff. Connect shaft to drive adapter and to governor drive unit.

c. Governor Valve Adapter (Fig. 275).

(1) Removal. Disconnect governor flexible shaft and disconnect flexible shaft from angle drive adapter on power takeoff. Remove adapter and adapter drive gear.

(2) Installation. Insert angle drive adapter and gear into opening on the power takeoff, and tighten securely. Connect governor flexible shaft to angle drive adapter.

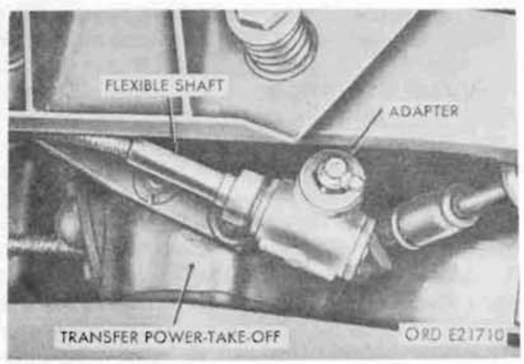


Figure 275. Auxiliary governor angle drive adapter

250. Exhaust Bypass Valve and Bypass Fording Valve

a. Exhaust Bypass Valve (Fig. 276).

(1) Removal. Loosen screw securing valve control connector on valve control wire, and remove connector. Remove safety nut securing valve control clamp on valve body, and remove clamp and valve control from valve. Remove tailpipe. Loosen safety nuts and screws on muffler-to-support clamp holding muffler in place. Loosen two safety nuts holding U-bolt of muffler-to-valve clamp. Pull muffler back away from valve. Loosen safety nuts holding

U-bolt on valve-to-exhaust pipe clamp, and separate valve from rear exhaust pipe. Remove four safety nuts and screws holding valve to bypass fording valve pipe, and remove valve from pipe. Discard gaskets.

(2) Installation. Using a new gasket, install valve on fording valve pipe with four hex-head screws and safety nuts. Install valve on rear exhaust pipe together with valve-to-exhaust-pipe clamp, being sure exhaust pipe extends no more than 1 inch into valve body. Tighten safety nuts on pipe clamp U-bolt to secure pipe in position. Move muffler forward and connect muffler to valve. Tighten safety nuts on clamp U-bolt and on muffler-to-support clamp and secure muffler in position. Install tailpipe. Connect valve control to valve body with valve control clamp, securing clamp to capscrew in upper front corner of valve body with a safety nut. Push valve control wire through hole in valve shaft lever pin. Install valve control connector on end of wire and secure on wire by tightening round-head screw on connector.

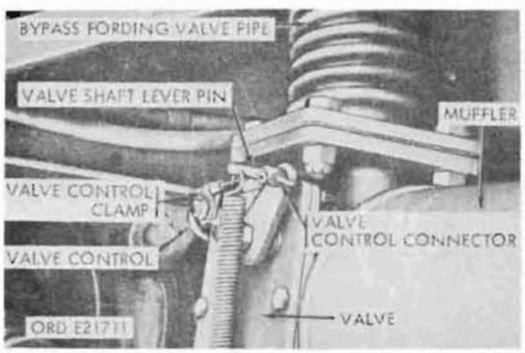


Figure 276. M50 exhaust bypass valve

b. Exhaust Bypass Fording Valve (Fig. 277).

(1) Removal. Remove eight safety nuts and screws holding fording valve to mounting flange on exhaust heating chamber and to flange on bypass fording valve pipe, and remove fording valve. Discard gaskets.

(2) Installation. Position new exhaust bypass fording valve gaskets on valve, and install valve to heating chamber flange with four hex-head screws and safety nuts. Install fording valve pipe to valve with four hex-head screws and safety nuts.

c. Exhaust Bypass Fording Valve Pipe (Fig. 277).

(1) Removal. Remove four safety nuts and screws holding fording valve pipe to exhaust bypass fording valve, and remove pipe and gasket from valve. Discard gasket.

(2) Installation. Position new gasket on pipe and install pipe on bypass fording valve with four hex-head screws and safety nuts.

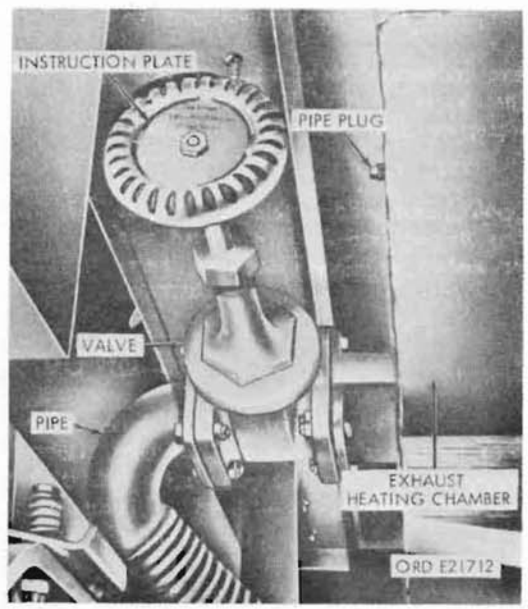


Figure 277. M50 exhaust bypass fording valve

251. Body Components

a. Discharge Valve.

(1) Removal. Remove safety nuts and six screws holding the cover of exhaust heating chamber (fig. 277) on underside of body, and remove cover. Loosen nut (fig. 278) securing valve cable bolt on discharge valve control cable yoke,

and remove cable from valve. Remove 12 safety nuts, six lockwashers, and six screws holding discharge-valve to tank compartment and to tank drain pipe, and remove valve and gaskets. Discard gaskets.

(2) Installation. Position new discharge-valve-to-tank and discharge-valve-to-tank-drain-pipe gaskets on valve. Install discharge valve on tank compartment with six safety nuts and on tank drain pipe with six hex-head screws, lockwashers, and safety nuts. Install end of the cable in valve cable bolt on valve yoke and tighten hex-nut on bolt to secure cable. Install exhaust heating chamber cover (fig. 277) on underside of body with six hex-head screws and safety nuts.

b. Discharge Valve Control (Fig. 273).

(1) Removal. Loosen nuts securing discharge valve cables in valve cable bolts, and remove cables from valve control operating levers. Remove six safety nuts and lockwashers securing valve control to body, and remove control.

(2) Installation. Install control on body with six hex-head screws and safety nuts. Install valve cables in valve cable bolts on control operating levers, and tighten hex-nuts on bolts to secure cable. Cables must be of correct length to allow valves to close completely just before levers reach forward end of their travel.

c. Discharge Valve Packing.

Note. The key letters noted in parentheses are in figure 279, except where otherwise indicated.

(1) Removal. Remove cotter pin (E) holding discharge valve operating lever (F) on valve stem (M) and remove the lever. Remove packing nut (D) from valve body (A) and remove and discard packing (C) from valve body.

(2) Installation. Install new packing (C) around valve stem (M) and seat firmly in valve body (A). Position packing nut (D) over stem (M) and screw into valve body to secure packing tightly around

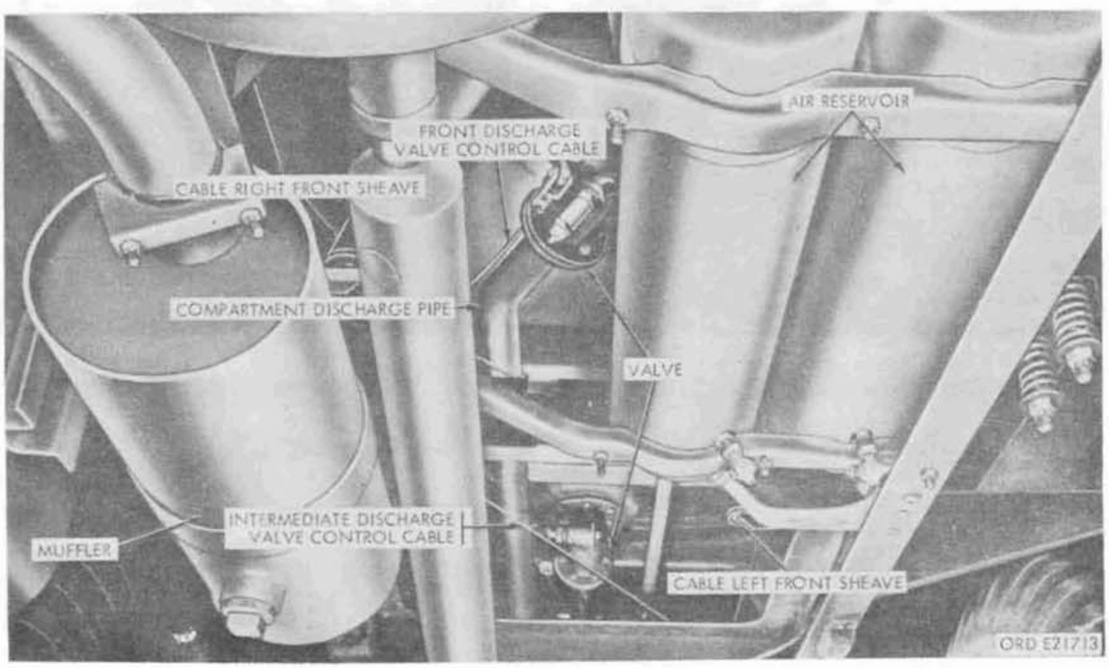


Figure 278. Discharge valve - removal and installation

stem. Install operating lever (F) on valve stem and secure with cotter pin (E).

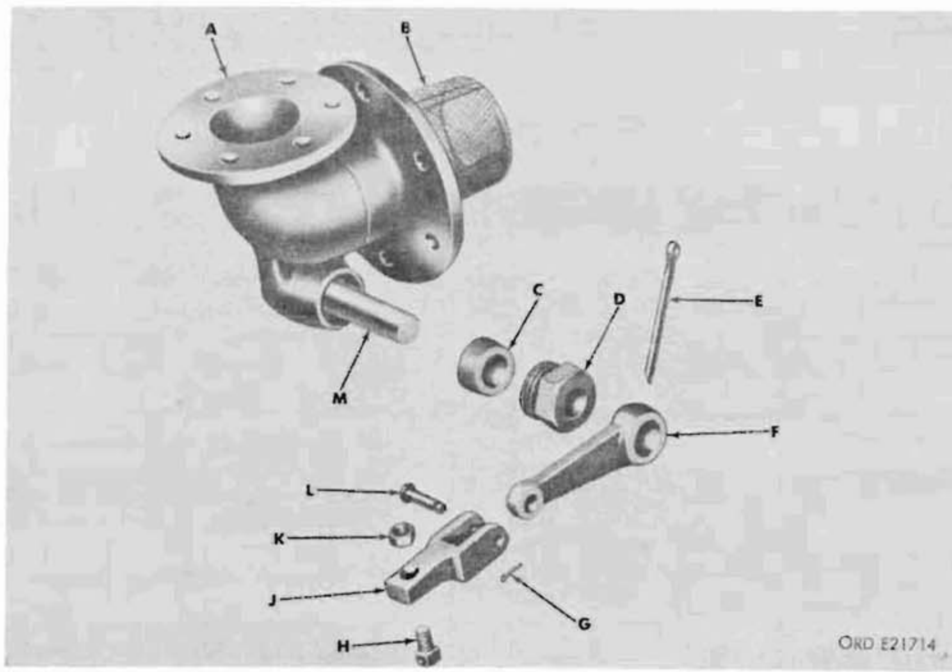
d. Discharge Valve Wire Cables.

Note. The key letters noted in parentheses are in figure 279, except where otherwise indicated.

(1) Removal. Loosen nut securing valve cable bolt on discharge valve control operating lever (fig. 277) and remove wire cable from discharge valve control. Loosen nut (K) securing the valve cable bolt (H) on discharge valve control cable yoke (U) and remove wire cable from discharge valve. Remove wire cable from truck frame and body.

(2) Installation. Install wire cable in truck body extending from discharge valve control in equipment compartment (fig. 273) down through the truck frame to discharge valve (fig. 278) on bottom of rear compartment. Install end of wire cable in cable bolt (H) on valve control cable yoke (J) and secure to yoke by tightening hex-nut (K) on bolt. Install other end of cable in cable bolt on valve control operating lever and secure to lever by tightening hex-nut on bolt. The cable must be of such length that discharge valve closes just before operating lever reaches forward end of its travel. Figure 280 shows routing of discharge valve cables.

e. Gate Valve Stem Packing.



Key	Item	Key	Item
A	Body	G	Cotter pin
B	Screen	H	Cable bolt
C	Packing	J	Control cable yoke
D	Packing nut	K	Nut
E	Cotter pin	L	Clevis pin
F	Operating lever	M	Stem

Figure 279. Discharge valve - partially exploded view

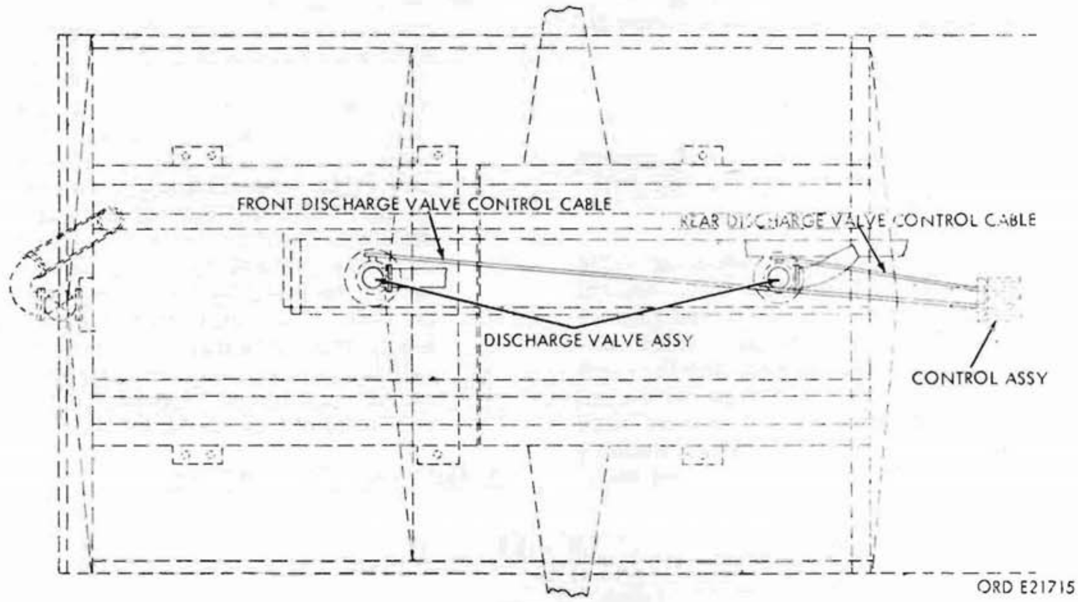


Figure 280. Discharge valve cable location

Note. The key letters noted in parentheses are in figure 298, except where otherwise indicated.

(1) Removal. Remove handwheel nut (A) securing handwheel (B) on valve stem (F), and remove handwheel. Remove stem packing nut (C) and packing gland (D) from stem (F) and bonnet (G). Remove and discard packing (E) from bonnet.

(2) Installation. Install new packing (E) in bonnet (G), seating packing deep in bonnet. Install packing gland (D) in bonnet and tighten packing nut (C). Install handwheel (B) and secure with the handwheel nut (A).

252. Water Discharge Hose

a. Removal. Using spanner wrench provided with vehicle, unscrew hose from reducer on coupling.

b. Installation. Install hose on reducer coupling, using spanner wrench provided with the vehicle. Tighten the hose securely.

253. Water Dispenser Nozzles

a. Removal. Using spanner wrench, unscrew and remove nozzle from hose.

b. Installation. Install nozzle on hose and tighten securely with the spanner wrench.

254. Water Suction Hose and Strainer

a. Removal. Unscrew hose from reducer on coupling, using spanner wrench provided with vehicle. Unscrew strainer from hose, using the spanner wrench.

b. Installation. Install hose on reducer on coupling, using spanner wrench provided with vehicle. Install strainer on hose, using the spanner wrench.

255. Manhole and Filler Covers

a. Coordination with Direct Support Maintenance Unit. Refer to paragraph 2 for information on coordination with direct support maintenance unit.

b. Manhole Cover.

(1) Removal. Remove padlock from outer cover. Remove snaprings and plain washers securing hinge pin in cover, and remove pin. Remove outer cover from body. Remove cotter pin and clevis pin securing cover inner brackets to body, and remove brackets and inner cover from body.

(2) Installation. Position inner cover on body with inner cover brackets alined to bracket mount and secure brackets to body, with clevis pin and cotter pin. Position outer cover on body and install hinge pin through cover and cover mounting brackets. Secure hinge pin in position with a plain washer and snap-ring on each end of pin.

c. Manhole Cover Gasket.

(1) Removal. Remove gasket from cover.

(2) Cleaning. Clean cover of all particles of old gasket.

(3) Installation. Position new gasket in cover and seat gasket, making sure gasket seats evenly.

d. Filler Cover Gasket.

(1) Removal. Remove filler cover gasket from cover.

(2) Cleaning. Clean cover of all particles of old gasket.

(3) Installation. Position a new gasket in cover, making sure gasket seats evenly.

e. Filler Strainer.

(1) Removal. Open filler cover and remove six screws and lockwashers holding filler strainer flange coupling on tank body, and remove coupling, gasket, and attached strainer.

(2) Cleaning. Clean strainer with soap and water. Blow compressed air through strainer mesh, making sure mesh is clear of all particles of dirt, mold, and other foreign substances. Rinse thoroughly in clean water to remove all traces of soap from strainer. Dry strainer with clean compressed air.

(3) Installation. Install filler strainer flange coupling. Install coupling on tank body with six hex-head screws and lockwashers.

256. Pump Drive-Shaft Universal Joint

For removal and installation of the pump drive-shaft universal joint, refer to paragraph 166.

257. Delivery Pump Drive Shaft

a. Removal. Loosen setscrew and disconnect mating shaft. Loosen setscrews in each flange block retaining collar. Remove delivery pump (par. 258). Loosen setscrew in drive-shaft coupling sprocket on end of shaft and pull sprocket from shaft. Push shaft forward to clear rear flange block (fig. 281). Remove four screws and safety nuts securing rear flange block to body, and remove block. Push drive shaft to rear, placing end of shaft in hole in equipment compartment front partition. Remove screws and nuts securing front flange block to body, and remove flange block and shaft. Remove block from shaft.

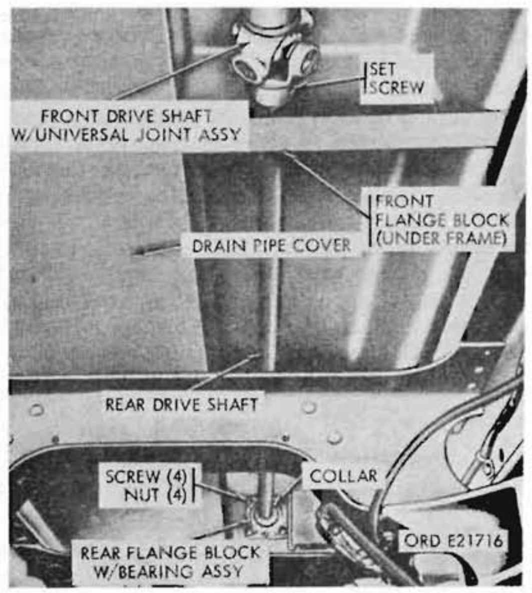


Figure 281. Delivery pump drive shaft

b. Installation. Install flange blocks on body with four 85,000-psi yield strength hex-head screws and safety nuts. Install drive-shaft sprocket over key in end of drive shaft, and install drive shaft through flange blocks (fig. 281) by inserting shaft through shaft hole in equipment compartment front partition. Connect mating shaft to drive shaft, and tighten setscrew. Install delivery pump (par. 258).

Tighten setscrews in flange block retaining collars to secure collars to the shaft.

258. Delivery Pump

a. Removal. Remove connecting link from coupling sprocket chain (fig. 282), and remove chain from coupling sprockets. Remove four screws and lockwashers holding delivery pump strainer body flange to strainer body, and free flange from body. Remove four screws holding delivery pump outlet flange to underside of pump, and free flange from pump. Remove four safety nuts and screws holding pump to mounting bracket, and remove pump. Unscrew and remove strainer body flange from delivery pump suction line. Unscrew and remove outlet flange from delivery pump discharge pipe. Loosen setscrew securing coupling sprocket on delivery pump rotor shaft, and remove sprocket and key.

b. Installation. Install strainer body flange (fig. 282) on pump suction line. Install outlet flange on pump discharge line. Position strainer body flange and outlet flange gaskets on pump and install woodruff key in pump rotor shaft. Install coupling sprocket on rotor shaft over key. Position pump on mounting bracket and secure pump to strainer body flange with four hex-head screws and external-teeth lockwashers. Secure pump to mounting bracket with four 85,000-psi yield strength hex-head screws and safety nuts. Secure outlet flange to underside of pump with four hex-head screws. Push coupling sprocket forward against mating sprocket and tighten setscrew in sprocket hub. Install coupling chain on the sprockets, and install connecting link.

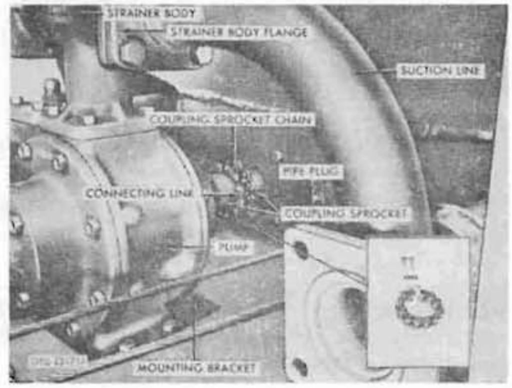


Figure 282. M50 and M50A1 delivery pump

259. Power-takeoff Controls and Linkage

For removal and installation of the power-takeoff controls and linkage, refer to paragraph 163.

Section XLIII. FUEL TANK BODY AND AUXILIARY EQUIPMENT (M49, M49C and M49CA1)

260. Description and Data

a. Description.

(1) General. The fuel servicing trucks have several variations, using the same basic body and chassis, but varying somewhat in types and location of auxiliary equipment.

(2) Basic fuel tank body. Each truck has a basic 1200-gallon tank body divided into 200-, 400- and 600-gallon compartments. Each compartment has a manhole equipped with manhole and filler covers. The filler covers contain a 2-inch fusible plug as a safety measure in case of fire. Each tank compartment discharges gasoline through its own discharge valve (fig. 294) in the bottom of the compartment into the discharge pipe manifold. The discharge valves are operated from the discharge valve control (fig. 283) in the equipment compartment. An emergency remote control shutoff cable is connected to the discharge valve control assembly and terminates in a pull knob at the left front of the body. When the knob is pulled, a spring-loaded latch releases all three discharge valve control levers, closing al

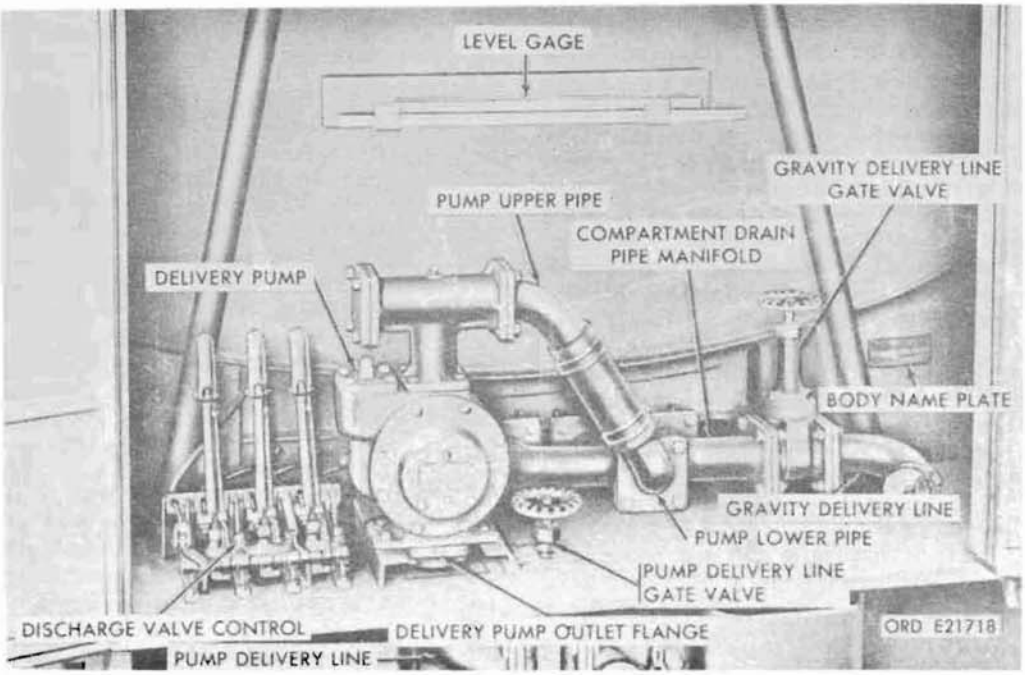


Figure 283. M49 fuel tank body rear compartment components

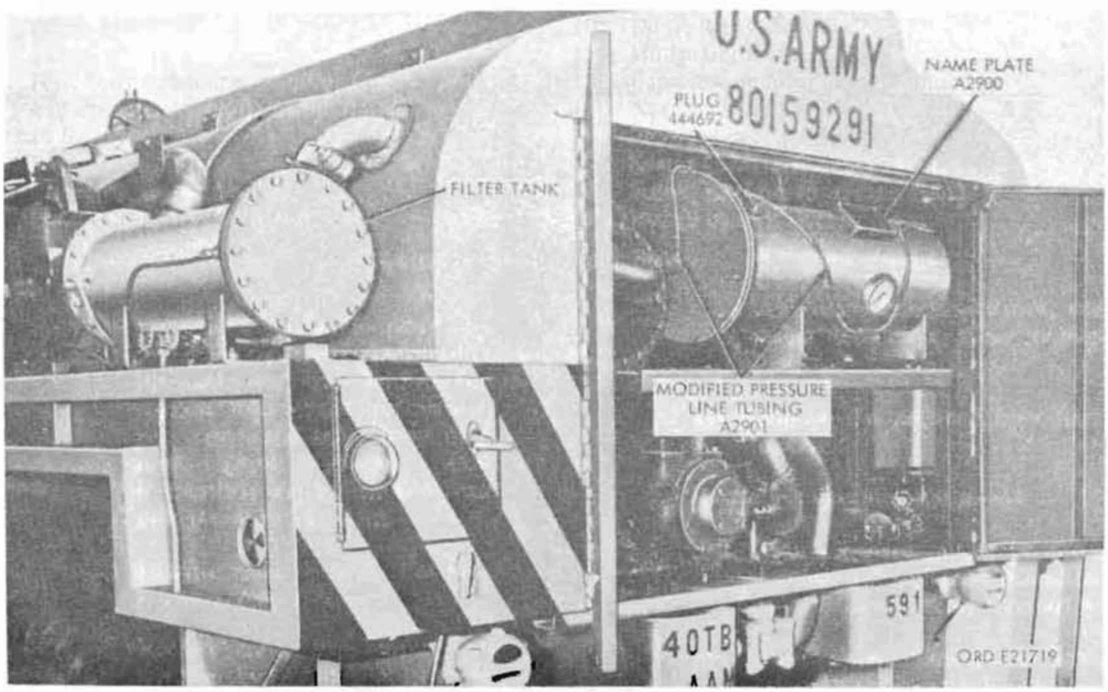


Figure 284. M49C with filter assembly on catwalk (up to serial No. 140699)

three discharge valves. A fusible link is also connected to the spring-loaded latch. In the event of a fire, the fusible link will separate, causing the latch to release all three discharge valve control levers, and close the discharge valves. In later production trucks, fusible links are installed at each discharge valve to close the valve if the link is separated by fire. Three discharge pipes drain into a drainpipe manifold in the equipment compartment from which gasoline can be dispensed through the gravity delivery-line gate valve (fig. 283) or fed to the pump. The pump discharges gasoline under pressure through the pump-delivery-line gate valve. Power to operate the pump is obtained from the transfer power takeoff through the delivery pump front, intermediate, and rear drive shafts located under the tank body. Refer to TM 9-2320-209-10 for a complete description of the functions of the valves and fittings.

(3) M49 truck (fig. 283). The M49 model fuel tank truck dispenses fuel into the fuel delivery hose either by gravity or through a pump (11, below), without the use of a filter other than the fine mesh screens in the discharge nozzle, pumps and valves.

(4) M49C truck (fig. 284). The M49C fuel tank trucks manufactured by Reo Motors with serial numbers below 140700 and those manufactured by Studebaker (Curtis Wright) with serial numbers below 49265 have a water segregator unit in the rear compartment and an additional filter mounted on the left catwalk. The segregator and filter separate water and other impurities from aviation gasoline. The segregator and filter may be bypassed, when required, by use of the gravity discharge system. An accurate meter (fig. 292) is provided in the discharge pipe system between the segregator and discharge hose to measure the amount of fuel delivered through the pump discharge system. The meter is not connected to the gravity discharge system.

(5) M49C and M49CA1 (fig. 285). The M49C trucks with serial numbers above 140699 (Reo) and 49265 (Studebaker), and the M49CA1, have a combined filter and water segregator unit in-

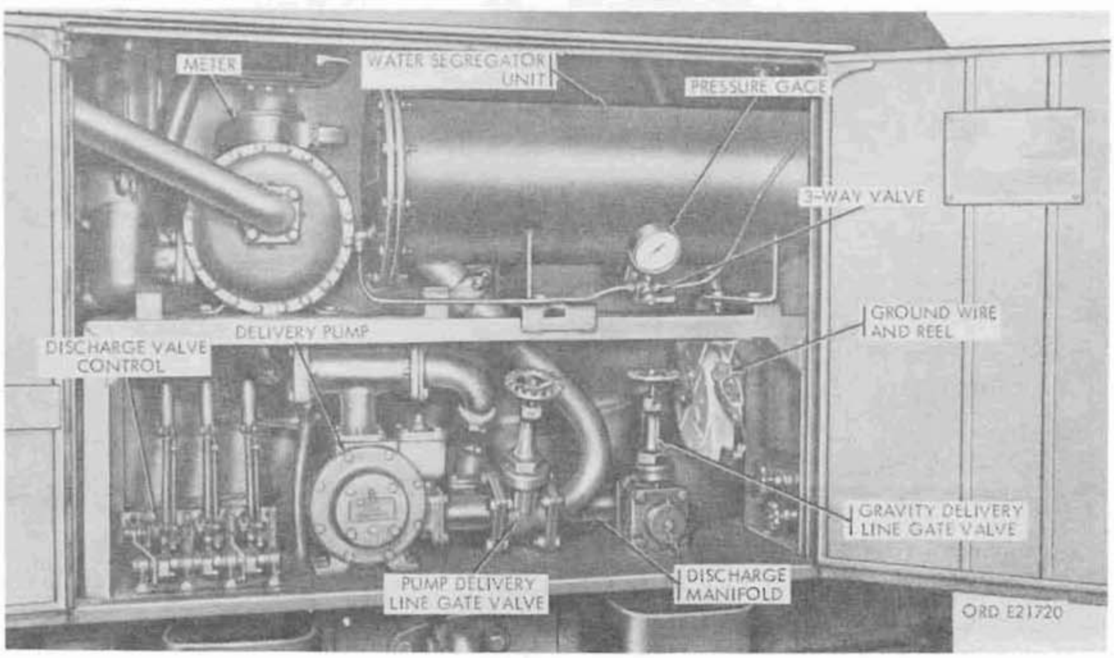


Figure 285. M49C fuel tank body rear compartment components

stalled in the segregator unit housing inside the rear compartment of the body.

(6) Segregator kits. Some of the M49 trucks have been modified by the addition of a water segregator kit (FSN 2540-693-0685). When modified, these trucks are similar to the model M49C trucks (a(5) above).

(7) Water segregator unit. The water segregator unit (fig. 285) removes foreign matter and moisture from the fuel before it passes through the meter and the discharge hose assembly. The fuel enters through the inlet fuel pipe (fig. 286) through the sediment filter into the water separator chamber. The water, being heavier than fuel, drops to the bottom of the vertical water separator chamber and collects on the bottom. An automatic dump valve, designed to float in water but sink in gasoline, opens periodically to drain the accumulated water from the water separator chamber.

(8) Sediment filter cartridge (fig. 287). The sediment filter is a replaceable cartridge inside the water segregator unit. As it fills up with impurities removed from the fuel, it tends to restrict the free flow of the fuel. A three-way manual valve and pressure gage (a(9) below) is provided to enable the operator to determine when replacement is needed.

(9) Differential pressure gage. A pressure gage (fig. 285) is connected to the input and output ends of the water segregator unit through a three-way manually operated air valve. The gage is graduated in 100 divisions, representing a total pressure of 100 pounds-per-square-inch (psi). Turning the handle of the valve to the left (fig. 285) will cause the gage to indicate the flow pressure on the input side of the water segregator unit, and turning the valve handle to the right will cause the gage to indicate the flow pressure on the output side of the segregator. A difference of 15 psi or more indicates the filter is clogged and should be replaced. Turning the valve handle downward shuts off the gage and is the normal operating position.

(10) Meter and meter screen (figs. 291 and 292). An accurate meter is installed between the water segregator unit and the discharge hose assembly. The meter measures the number of gallons of fuel being pumped through the hose and nozzle assembly. An integral strainer and filter unit is mounted on the side of the meter to protect the mechanism from small particles of dirt which might still remain in the fuel. This strainer should be inspected and cleaned at intervals based on the amount and condition of the fuel being pumped.

(11) Delivery pump (fig. 301). The rotary-type delivery pump assembly consists of a pump unit and a strainer assembly mounted on top of the pump body. An adjustable bypass valve, integral with the pump body, prevents the buildup of excessive and damaging pressures in the pump. The pumps on the M49 trucks have a bottom discharge outlet (fig. 293) and the pumps on the 49C and 49CA1 trucks have a side discharge outlet (fig. 285). Otherwise the pumps are the same.

b. Data.

Delivery pump:
- Make . . . . Blackmer Pump Co.
- Model TRL-60
- Type . . . . . rotary, positive displacement
- Rotation . . . . clockwise
- Rating . . . . 80 gpm at 700 rpm

Delivery pump front drive shaft:
- Make . . . . Spicer Mfg Co.
- Model 200002
- Type . . . . snapring
- Construction . . . . tubular

Delivery pump intermediate drive shaft:
- Make . . . . Butler Mfg Co.
- Model 2-33-202
- Construction . . . . rod

Delivery pump intermediate drive shaft pillow block with bearing:
- Make . . . . Stephens-Adamson Mfg Co.
- Model NP-18

Delivery pump rear drive shaft:
- Make . . . . Spicer Mfg Co.
- Model 200003
- Type . . . . snapring
- Construction . . . . tubular

Delivery-line gate valve:
- Make. . .Ohio Pattern Works & Foundry Co.
- Model 215-3

Discharge valve:
- Make . . . . Wheaton Brass Works
- Model 505

Discharge valve control:
Make. . . . . Wheaton Brass Works
Model . . . . 154, 3 compartment
Gasoline dispenser nozzle: ,
Make . . . . Wheaton Brass Works
Model 250
Segregator-filter:
Make . . . . Fram Mfg. Co.
Model T-80 R/M-398
Flow rate . . . . 50 GPM
Replacement cartridge type CC-E2
Gallon-indicating meter:
Make. . . . . Ralph M. Brodie
Model B-41C-5AL
Capacity . . . . 60 GPM
Ground cable and reel:
Make. . . . . Benjamin Reel Products
Model 700-40-GOR

Warning: Do not permit smoking, sparks, or open flame within 50 feet of vehicle during any operation involving draining or transfer of fuel, or opening or removing fuel tanks, lines, or other fuel-carrying components.

261. Water Segregator Filter Element

a. Removal.

(1) Open the drain valves at the bottom of the water separator chamber (fig. 286) and drain the liquid into an authorized container for combustible liquids.

(2) Disconnect gage-to-input tube at both ends and remove tube.

(3) Loosen two nuts and bolts on left-hand mounting bracket of water segregator unit.

(4) Remove two nuts, bolts and lockwashers from right-hand mounting bracket of water segregator unit.

(5) Remove clamp-type pipe couplings from inlet and outlet fuel pipes of water segregator unit.

(6) Remove drain valves and tubes from lower section of water separator chamber.

(7) Slide water segregator unit outward on slotted bracket sufficiently to allow room for (8) below.

(8) Remove 12 nuts, lockwashers and capscrews and remove plate. Discard gasket.

(9) Remove three huglock nuts and flat washers (View A, fig. 287).

(10) Remove filter assembly from water segregator unit (View B, fig. 287).

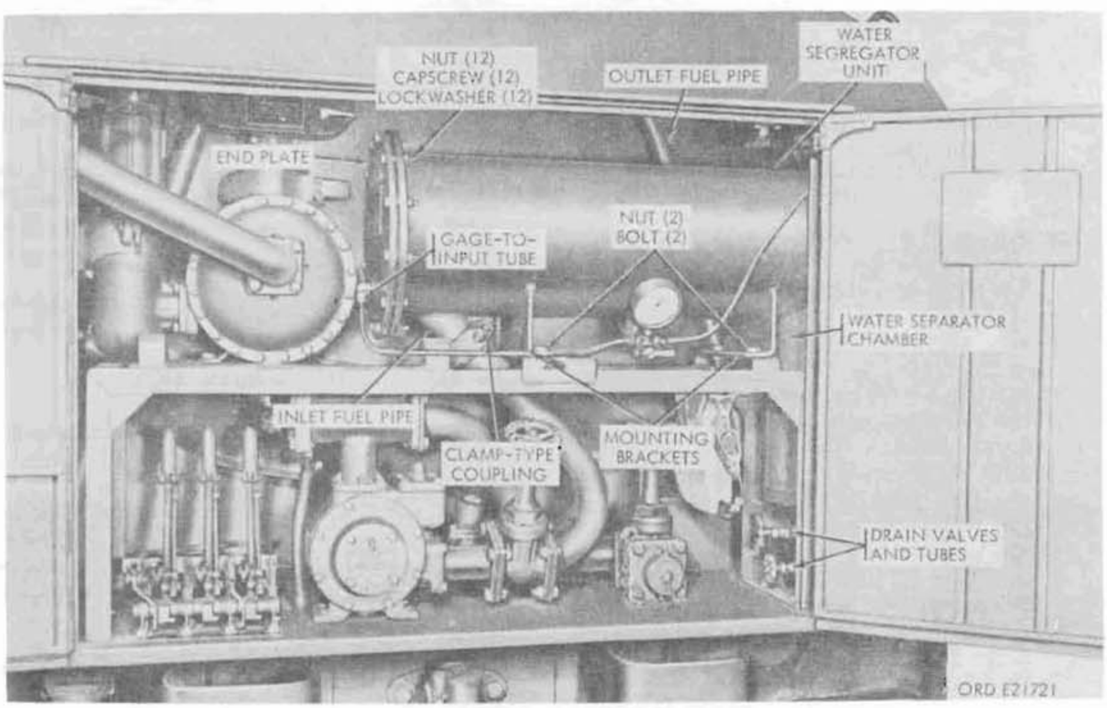
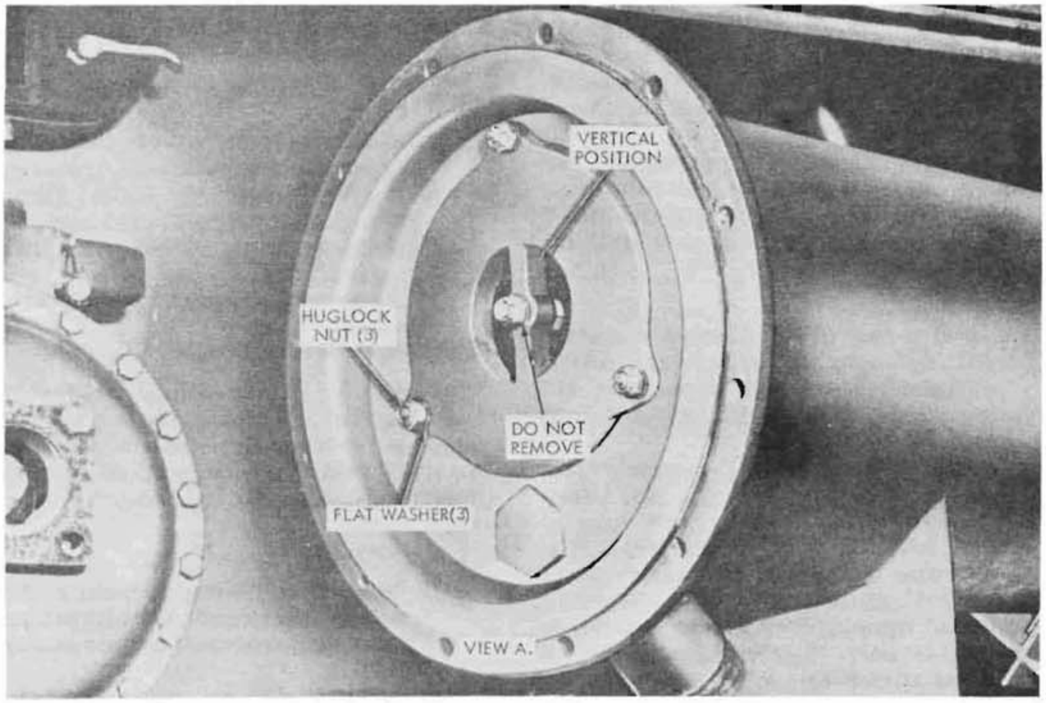


Figure 286. Water segregator tank disconnect points



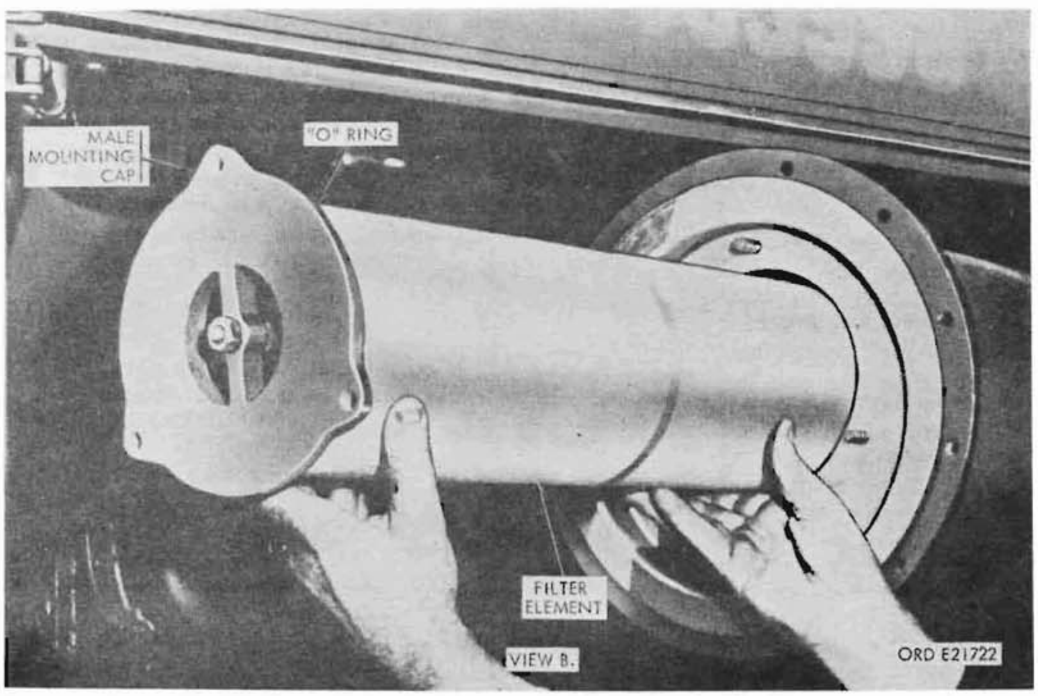


Figure 287. Removing filter element from water segregator

(11) Remove huglock nut, washer and gasket from center rod (fig. 287, View A). Remove filter element end plates. Remove filter element and dispose of element, using an authorized container. Discard "O" ring.

b. Cleaning. Clean all components and interior of water segregator unit with dry-cleaning solvent or mineral spirits paint thinner. Protect from dust or dirt until installation is completed.

c. Installation.

(1) Install a new filter element on center rod and male mounting cap. Install end plate, gasket and washer and nut (fig. 288). Tighten huglock nut to 5 pound-feet torque.

(2) Install filter element assembly into water segregator unit (fig. 287, View B), using a new packing "O" ring in the groove on male-mounting cap. The mounting plate crossbar must be in vertical position (fig. 287, View A). Install three flat washers and three huglock nuts. Tighten huglock nuts to 25 pound-feet torque.

(3) Install end plate on end of water segregator unit (fig. 286), using a new gasket. Install the 12 capscrews, lockwashers, and nuts and tighten to 25 pound-feet torque.

(4) Reposition water segregator unit, replace two bolts, lockwashers, nuts and tank-mounting bracket, and tighten all four mounting bolts to 25 pound-feet torque.

(5) Connect tubing between water segregator unit end plate and pressure gage.

(6) Connect inlet and outlet couplings, using attaching bolts and nuts.

(7) Replace drain valve tubes in drain valves.

(8) Close water separator chamber drain valve.

262. Water Segregator Unit (Fig. 286)

a. General. All normal maintenance operations may be performed on the water segregator unit while it is still in the compartment. However, if the unit is damaged or deteriorated, use the following procedure for replacement.

b. Removal.

(1) Open drain valves at bottom of water separator chamber and drain liquid into an authorized container for combustible liquids.

(2) Remove two nuts, bolts and lockwashers from left-hand mounting bracket of water segregator unit.

(3) Remove two nuts, bolts and lockwashers from right-hand mounting bracket of water segregator unit.

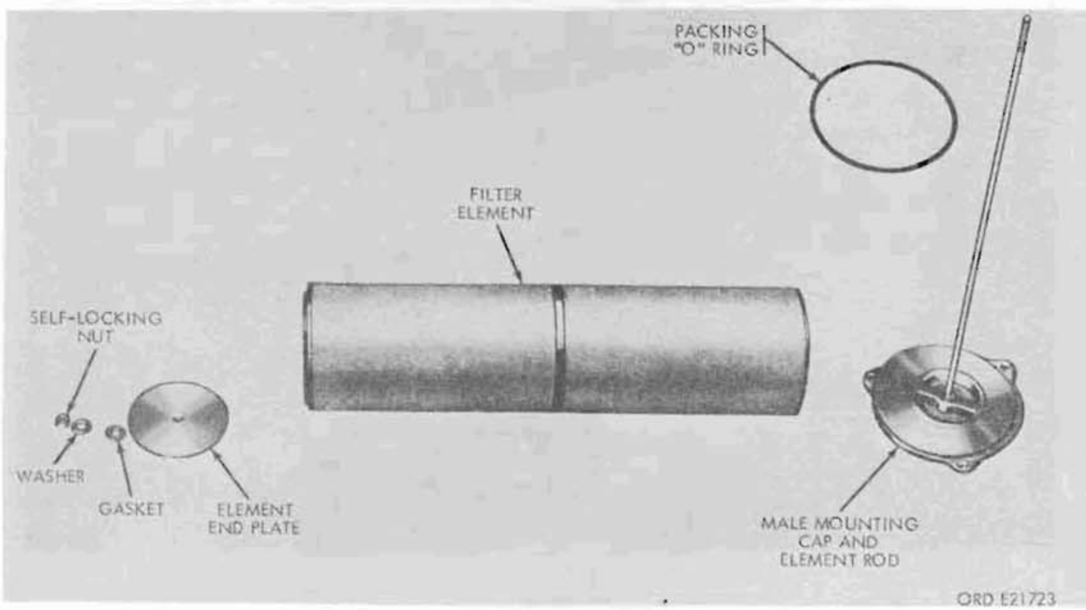


Figure 288. Filter element parts

(4) Remove clamp-type pipe couplings from inlet and outlet fuel pipes of water segregator unit.

(5) Remove drain valves and tubes from lower section of water separator chamber.

(6) Slide left-hand end of water segregator out of compartment, and lift right-hand end up and out, removing complete segregator unit.

c. Installation. Install water segregator unit in reverse order of removal.

263. Outboard Filter Elements

Note. This procedure is required for M49C trucks with a filter unit installed outside on the left catwalk.

a. Removal (Fig. 289).

(1) Open both filter drain valves and drain filter assembly.

Note. Drain gasoline or fuel into an authorized container for combustible liquids.

(2) Remove 16 nuts, lockwashers and bolts securing rear end plate (fig. 289, View B) of filter assembly and remove end plate.

(3) Compress spring retainer and remove lockpin (fig. 289, View A). Remove spring retainer, first element, element spacer, and second element on each of the four banks. Discard the eight filter elements.

Note. Place discarded filter elements in an authorized fireproof container.

Remove all sediment from filter assembly housing, and wash thoroughly with dry-cleaning solvent or mineral spirits paint thinner. Keep interior clean while replacing filter elements.

b. Installation.

(1) Install two new filter elements on each of the four element banks. Place filter element retainer, spring, and spring retainer on each element post (fig. 289, View A). Compress spring retainer and install lockpin.

(2) Install filter end plate, using a new gasket. Secure end plate (fig. 289, View B) with 16 bolts, lockwashers, and nuts and tighten nuts to 25 pound-feet torque.

(3) Close filter drain valves.

264. Automatic Dump Valve

a. General. The automatic dump valve is designed to empty only water from the bottom of the water segregator unit. If large amounts of fuel is drained with the water, or fuel alone is drained, the automatic dump valve should be removed and serviced.

b. Removal.

(1) Open drain and drain water segregator unit (fig. 286) into an authorized container for combustible liquid.

(2) Remove drain valves and tubes from lower section of water separator chamber.

(3) Remove eight capscrews (fig. 290) securing dump valve to water separator chamber housing.

(4) Lower dump valve assembly from housing as far as possible. Remove and discard gasket.

c. Inspection and Repair.

(1) If tank body is being put into service from storage, or if a new water segregator unit has been installed, check to see if float-shipping blocks have been left in place.

(2) Check for obstructions, loose parts, or sediment that might prevent free movement of float.

(3) Check for damage or wear of float and moving parts.

(4) Replace any badly worn or damaged parts.

(5) Clean and flush accessible areas of water separator chamber and all dump valve components with dry-cleaning solvent or mineral spirits paint thinner.

d. Installation.

(1) Install automatic dump valve assembly in water separator chamber housing and secure with eight capscrews. Use a new gasket, coated with liquid gasket cement or sealer.

(2) Install drain valves and pipe nipples on lower section of water separator chamber.

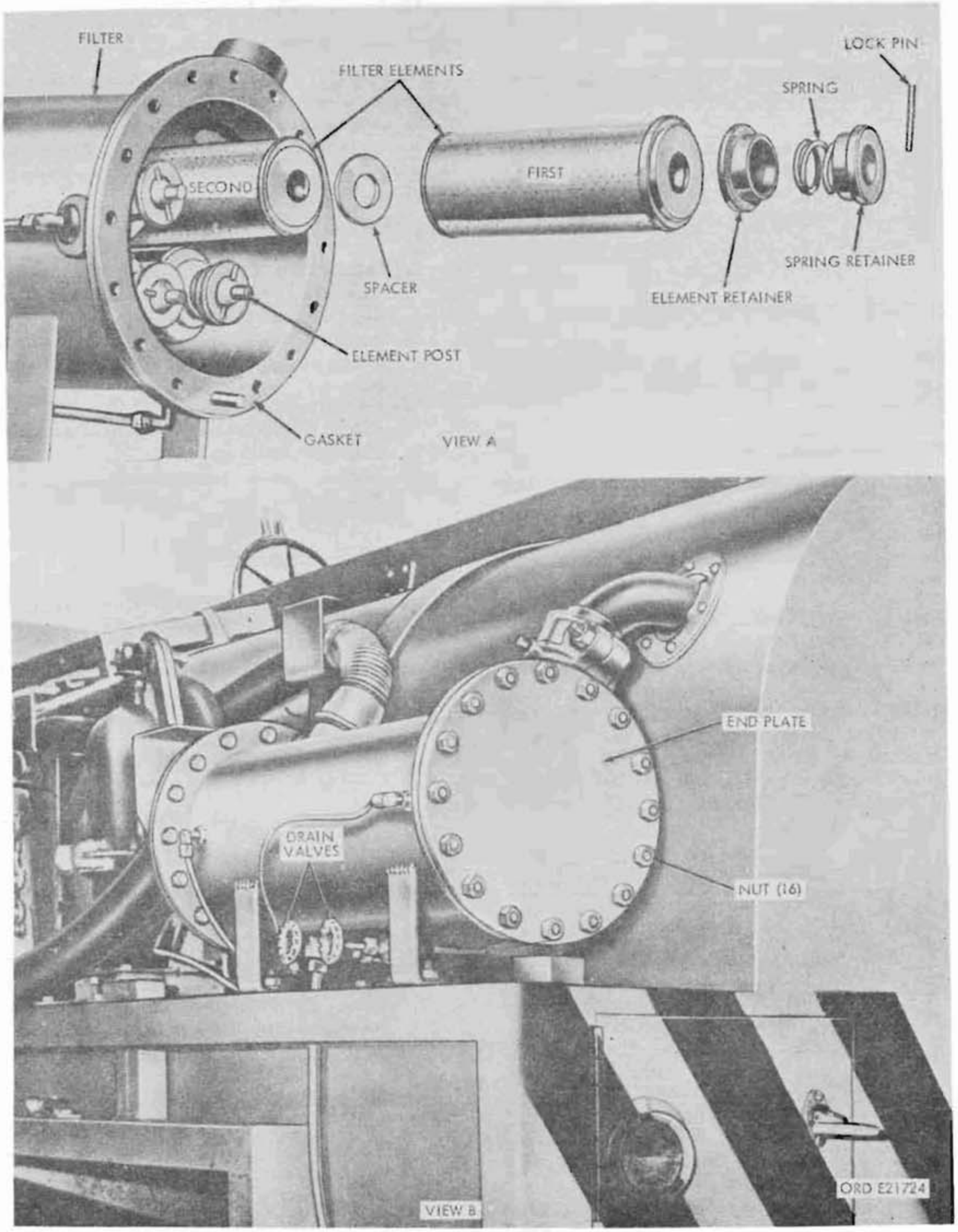


Figure 289. Outboard filter elements

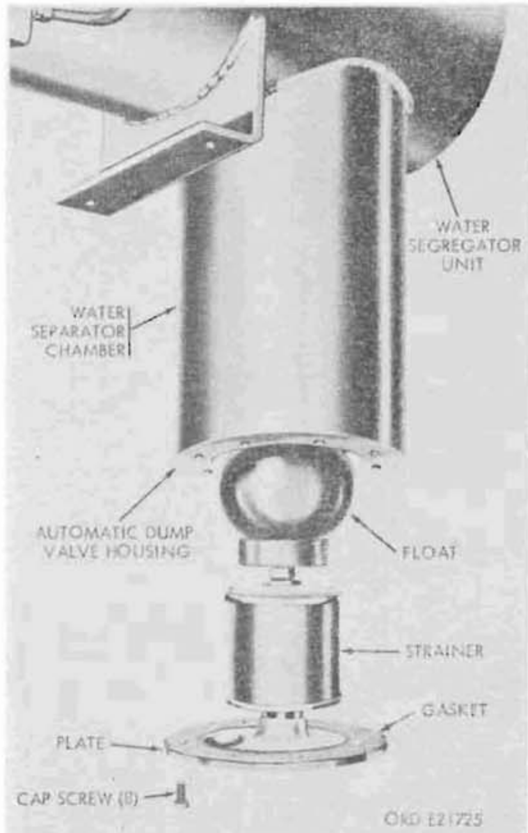


Figure 290. Servicing automatic dump valve

(3) Close drain valves.

Note. After disassembly and assembly of components, operate entire system and check for leaks. Repair leaks as required.

Caution: When cleaning interior of gasoline tank, do not flush out cleaning compounds or water through water segregator unit. Drain cleaning compounds and water through gravity delivery system of fuel tank.

265. Gallon-indicating Meter

a. General. The gallon-indicating meter is a precision measuring device which must be handled carefully. Organization maintenance procedures are limited to cleaning the meter screen, and replacement of the complete meter assembly if defective.

Caution: Do not attempt to disassemble any portion of the meter unit. Expensive damage can be caused to the delicate mechanisms inside the unit.

b. Meter Screen Cleaning (Fig. 291).

(1) Drain meter into an authorized container for combustible liquid. Earlier vehicles have a drain plug; later vehicles are equipped with a drain valve and hose.

(2) Remove air eliminator tube from top of meter strainer and push it aside carefully (fig. 292).

(3) Disconnect two bolt-type clamps securing air expansion chamber to meter screen housing. Remove air expansion chamber (fig. 291).

(4) Remove screen assembly from screen housing.

(5) Wash screen in mineral spirits paint thinner or dry-cleaning solvent. Using only a fiber bristle brush, remove all sediment and deposits from screen. Thoroughly clean screen housing.

(6) Install screen and other components in reverse order of removal.

(7) Test complete system for leaks. Tighten or repair where necessary.

c. Meter Unit Replacement.

(1) Removal (fig. 292).

(a) Drain meter into an authorized container for combustible liquid (b(1) above).

(b) Remove four bolts and lockwashers securing segregator-to-meter pipe to meter screen inlet. Remove and discard gasket.

(c) Remove air eliminator tube from top of meter strainer and push it aside carefully.

(d) Remove four bolts and lockwashers securing meter-to-hose pipe to meter. Cover opening with tape to keep out foreign matter. Remove and discard gasket.

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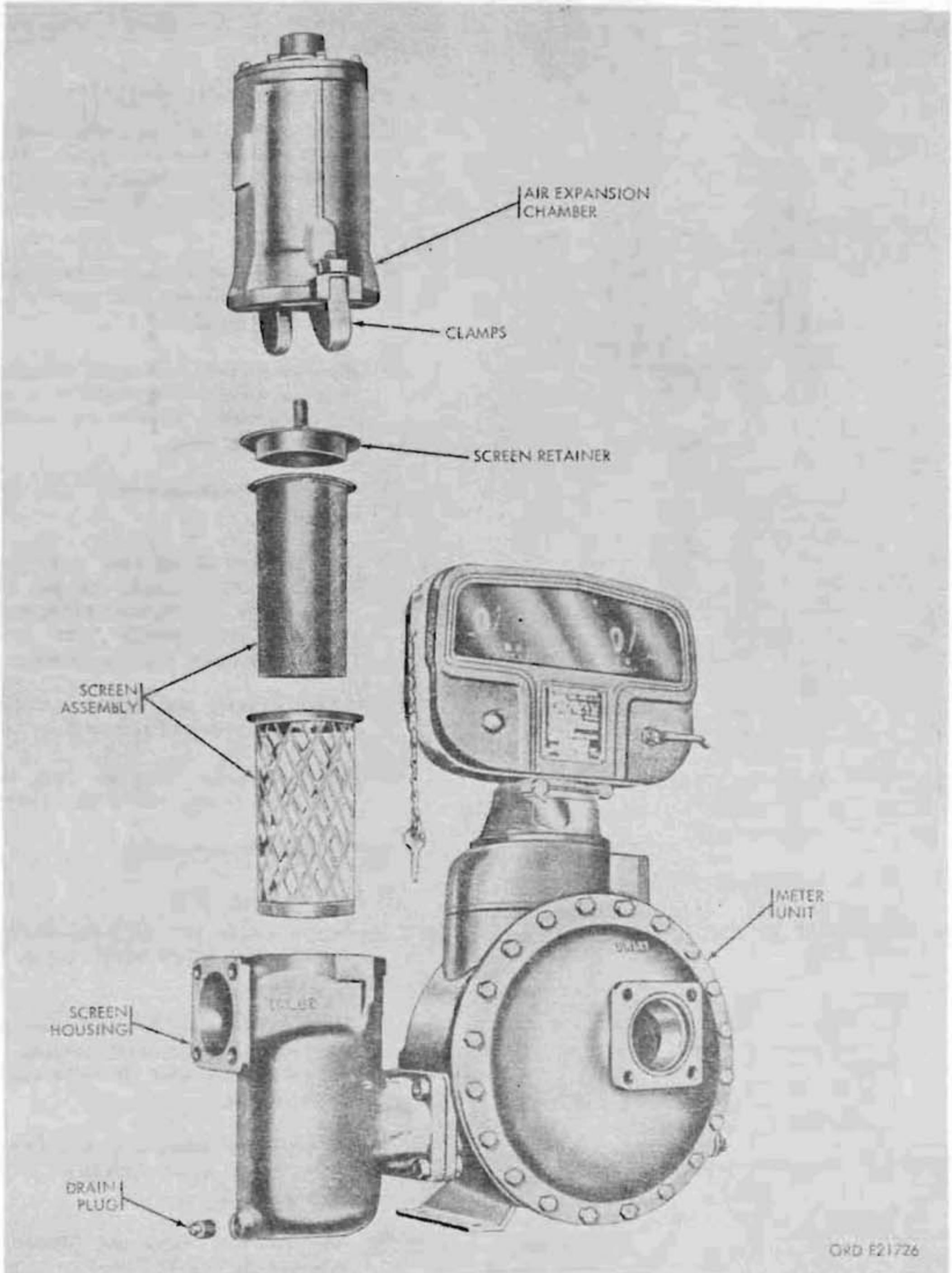


Figure 291. Servicing meter screen

(e) Remove four bolts, nuts and lockwashers securing meter to mounting frame (fig. 286).

(f) Carefully maneuver meter up and out of compartment.

(2) Installation. Install meter in reverse order of removal. Use new gaskets when installing pipes to meter openings. Coat gaskets with liquid gasket cement or sealer before installation.

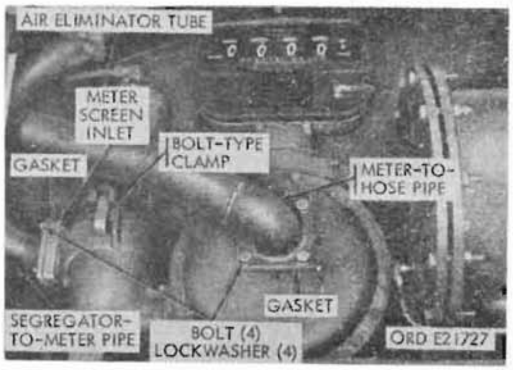


Figure 292. Meter disconnect points

266. Discharge Valves and Control Assembly

a. Discharge Valve Operating Lever Assembly.

(1) Removal. Remove discharge valve wire cables from each discharge valve operating lever (fig. 293). Loosen hex-nut securing emergency remote control cable yoke and remove remote control cable from yoke. Remove eight safety nuts and screws holding discharge valve control to equipment compartment floor, and remove control.

(2) Installation. Install valve control in equipment compartment with two hex-head screws and safety nuts for each of four discharge valve-control bearing brackets. Install end of remote control wire cable in remote-control cable bolt on remote-control cable yoke, and secure cable in yoke by tightening hex-nut on bolt. Secure ends of discharge valve wire cables to cable clamps on control-valve operating levers.

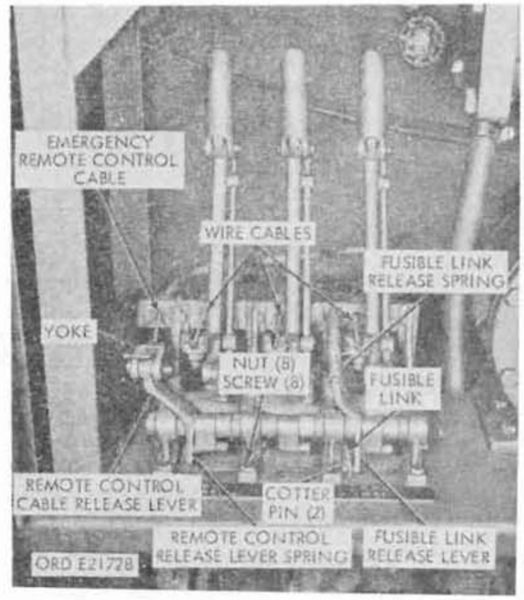


Figure 293. Discharge valve control assembly

b. Discharge Valve Control Fusible Link (Fig. 293).

(1) Removal. Disengage remote-control cable release lever spring from underside of remote-control cable-release lever (fig. 293). Disengage fusible-link release spring from fusible link release lever. Remove cotter pins securing fusible link to bearing bracket and fusible link release lever, and remove link.

(2) Installation. Position one end of fusible link on bearing bracket and secure with cotter pin. Position other end of link on fusible link release lever and secure with cotter pin. Connect end of fusible link release iever. Connect end of the remote-control cable release lever spring to cable release lever.

c. Discharge Valve Fusible Links.

Note. The key letters noted in parentheses are in figure 297.

(1) Removal. Remove cotter pin (G) and clevis pin (L) from clevis on fusible link (K) and remove link from discharge

valve operating lever (F). Unscrew the clip-and-thimble assembly (H) and remove fusible link (K) from wire cable (J).

(2) Installation. Install discharge valve fusible link in reverse order of removal.

d. Discharge Valves.

(1) Removal. Disconnect discharge valve wire cable (e below) from discharge valves. Remove six safety nuts and screws holding valve to compartment discharge pipe (fig. 294). Remove six safety nuts and screws holding valve to tank compartment and remove valve from compartment. Remove and discard discharge-valve-to-pipe and discharge-valve-to-tank gaskets from valve.

(2) Installation. Position a new discharge-valve-to-tank gasket on valve and install valve on tank compartment with six hex-head screws and safety nuts. Position a new discharge-valve-to-pipe gasket on valve and connect discharge pipe to valve with six hex-head screws and safety nuts. Connect discharge valve wire cable (e below) to valves (fig. 294).

e. Discharge Valve Wire Cables.

(1) Removal. Loosen nut securing valve cable bolt on discharge valve control operating levers (fig. 293) and remove wire cable from discharge valve controls. Loosen nut securing the valve cable bolt on discharge valve operating lever yoke and remove wire cable from discharge valves (fig. 294). Remove wire cables from truck frame and body.

(2) Installation. Install wire cables in truck body extending from discharge valve controls in equipment compartment down through truck frame to discharge valves on bottom of rear compartment.

Note. On M49 trucks, intermediate discharge valve wire cable must first pass around discharge valve cable left rear sheave on left-hand side of truck frame, then around right rear sheave on right side before connecting to discharge valve. The front discharge valve wire cable must first pass around left front sheave, then around right front sheave before connecting it to its discharge valve (fig. 295). The M49C and M49CA1 trucks use tubes for the wire cables, and cables pass directly from the rear compartment, through the tubes, to the discharge valve.

On the M49 trucks, install end of wire cable in cable bolt on valve operating lever yoke and secure to yoke by tightening hex-nut on bolt. On M49C and M49CA1 trucks, install end of wire cable on end of discharge valve fusible link (b above). Install other end of cable in cable bolt on valve control operating lever and secure to lever by tightening hex-nut on bolt. Cable must be of such length that discharge valve closes just before operating lever reaches forward end of its travel.

f. Discharge Valve Packing.

Note. The key letters noted in parentheses are in figure 297, except where otherwise indicated.

(1) Removal. Remove cotter pin (E) holding discharge wire cable operating lever (F) on valve stem and remove lever. Remove discharge valve packing plug (D) from valve stem (M) and remove packing (C) from valve body (A).

(2) Installation. Install new packing (C) around valve stem (M) and seat it firmly in valve body (A). Position packing plug (D) over stem (M) and screw it into valve body (A) to secure packing tightly around the stem. Install operating lever (F) on valve stem and secure with cotter pin (E).

g. Discharge Valve Screen.

(1) Removal. The tank compartment must be empty prior to removal of valve. Remove discharge valve (d above). Pull the screen (B, fig. 297) up and off valve body.

(2) Cleaning. Clean with mineral spirits paint thinner or dry-cleaning solvent. Blow compressed air through screen mesh, making sure mesh is clear of all particles of dirt or other foreign substances.

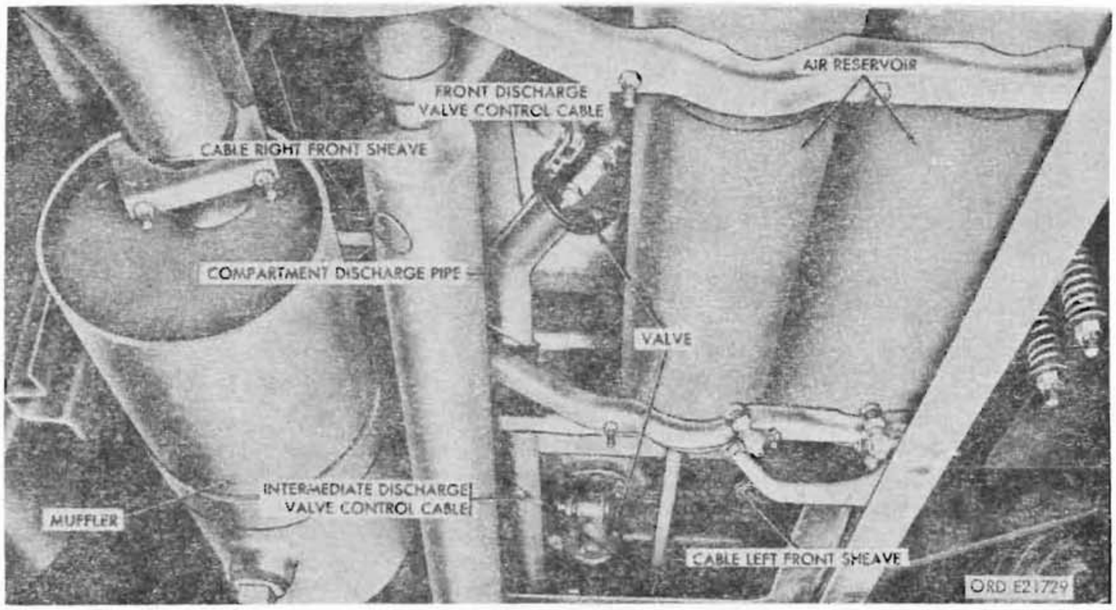


Figure 294. Discharge valve and cables

(3) Installation. Install screen over valve body. Install discharge valve (d above).

267. Delivery-Line Gate Valves (Fig. 298)

a. Delivery-Line Gate Valve Stem Packing.

Note. The key letters noted in parentheses are in figure 298, except where otherwise indicated.

(1) Removal. Remove handwheel nut (A) securing handwheel (B) on valve stem (F), and remove handwheel. Remove stem packing nut (C) and stem packing gland (D) from valve bonnet (G). Remove stem packing (E) from bonnet.

(2) Installation. Install stem packing (E) in valve bonnet (G), seating packing deep into bonnet. Install stem packing

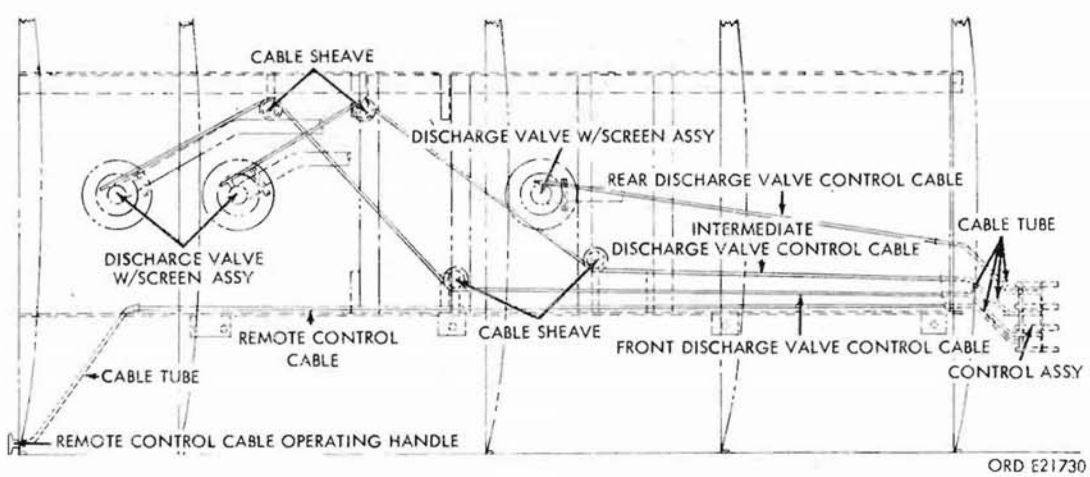


Figure 295. Discharge valve cable threading diagram

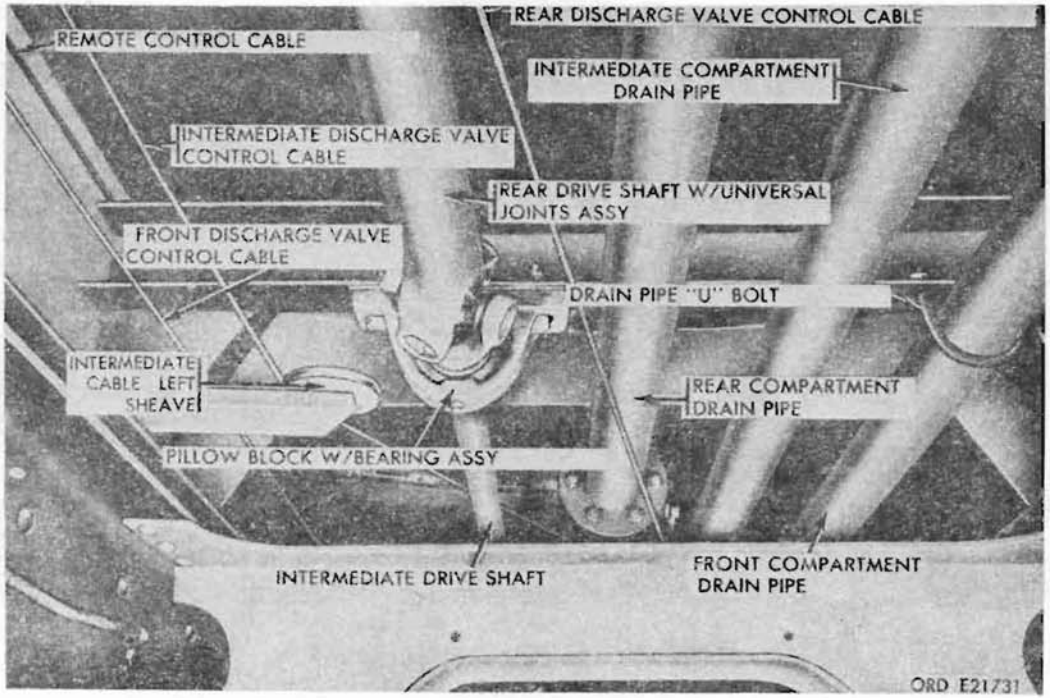


Figure 296. Fuel tank body discharge valve control cables, compartment drainpipes, pump drive shafts, and pillow block with bearing assembly

gland (D) in bonnet and secure with packing nut (C). Install and secure handwheel (B) on valve stem (F) with handwheel nut (A).

b. Gravity Delivery-Line Gate Valve.

(1) Removal. Remove eight safety nuts and screws holding gate valve to flanges on discharge manifold (fig. 299) and gravity delivery line, and remove valve. Discard flange gaskets.

(2) Installation. Position new flange gaskets on flanges on manifold and gravity delivery line, and install delivery-line gate valve between flanges. Secure valve to flanges with eight hex-head screws and safety nuts.

c. Pump Delivery-Line Gate Valve (Fig. 299).

(1) Removal. Remove eight safety nuts and screws holding gate valve to pump delivery line and pump delivery elbow flanges. Discard flange gaskets.

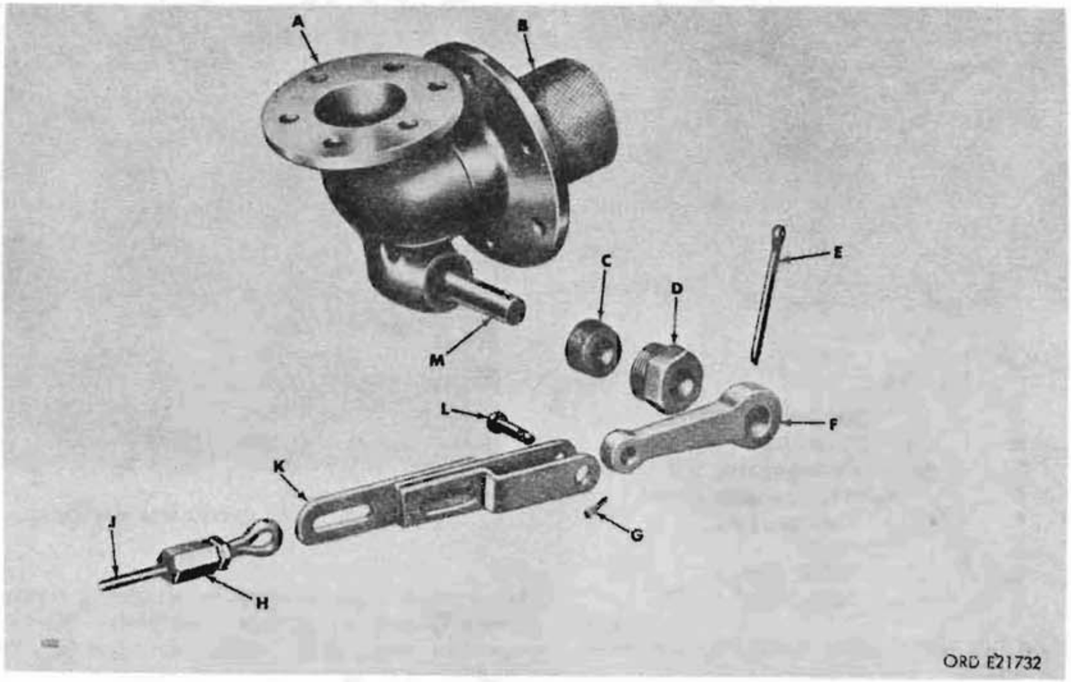
(2) Installation. Position new flange gaskets on delivery line and pump delivery elbow flanges. Install delivery-line gate valves between flanges and secure to flanges with eight hex-head screws and safety nuts.

268. Discharge Manifold (Fig. 299)

a. Removal. Remove gravity delivery-line gate valve (par. 269b) from manifold. Remove four safety nuts and screws holding manifold to each of three compartment drainpipe flanges and to pump lower pipe and remove manifold and five gaskets. Discard gaskets.

b. Cleaning. Clean the interior of the manifold of surface deposits and minor rust or corrosion with mineral spirits paint thinner and a stiff brush. If corrosion or rust deposits are more than minor, replace the manifold.

c. Installation. Install manifold on pump lower pipe and three compartment drainpipes, using new gaskets. Secure each pipe with four hex-head screws and safety nuts. Install gravity delivery-line gate valve (par. 267b) to manifold.



Key	Item	Key	Item
A	Body	G	Cotter pin
B	Screen	H	Clip-and-thimble assembly
C	Stem packing	J	Wire cable
D	Stem packing plug	K	Fusible link
E	Cotter pin	L	Clevis pin
F	Operating lever	M	Stem

Figure 297. Discharge valve - partially exploded view

269. Gasoline Dispenser Hose and Nozzles

a. Gasoline Dispenser Hose Gasket.

(1) Removal. Unscrew dispenser 1-1/2-inch hose from "Y" coupling. Remove hose gasket from inside of female coupling on end of hose.

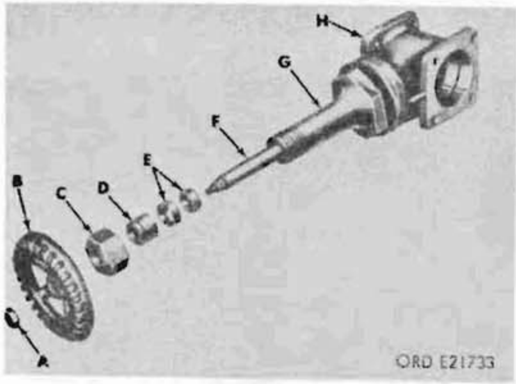
(2) Installation. Install and seat hose gasket in coupling on end of hose. Install hose on "Y" coupling and tighten securely.

b. Gasoline Dispenser One-inch Hose.

(1) Removal. Remove dispenser nozzle from end of hose. Remove hose from "Y" coupling.

(2) Installation. Install hose on "Y" coupling. Install nozzle on hose.

c. Gravity Discharge Hose. Inspect the gravity discharge hose for cuts, holes, brittleness or other defects. Inspect metal ends for damaged threads or other damage which will



Key	Item
A	Handwheel nut
B	Handwheel
C	Stem packing nut
D	Stem packing gland
E	Stem packing
F	Stem
G	Valve bonnet
H	Valve body

Figure 298. Gate valve - partially exploded view

prevent proper use. If defects are found, replace the complete hose; do not attempt repairs.

d. Gasoline Dispenser Nozzle Tube Cap.

(1) Removal. Remove tube cap from dispenser nozzle. Open end link of tube cap chain and remove cap from chain.

(2) Installation. Install tube cap on end link of tube cap chain and close link to secure cap on chain. Install cap over end of dispenser nozzle.

e. Gasoline Dispenser Nozzle.

(1) Removal. Unscrew dispenser nozzle from gasoline dispenser hose, and remove nozzle.

(2) Installation. Install nozzle on male hose coupling on end of one-inch dispenser hose, and tighten securely.

270. Pump Intake Pipes and Flexible Tube

a. Removal. Remove four safety nuts and screws holding pump lower pipe to compartment discharge manifold (fig. 299). Remove

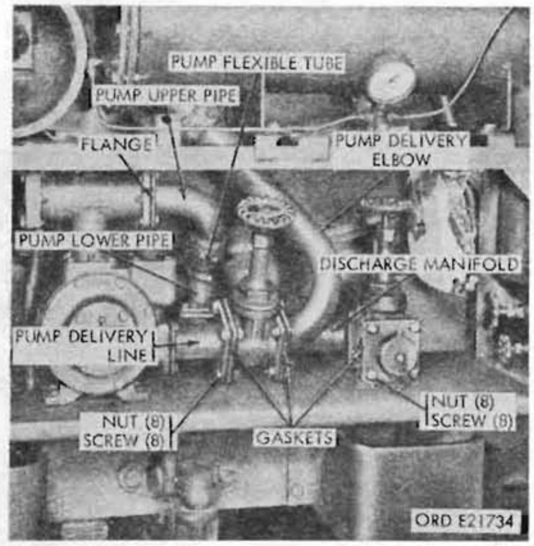


Figure 299. Gate valves and discharge manifold

four screws and lockwashers holding strainer body flange on strainer body (fig. 301) and remove pump upper and lower pipes (fig. 299) and pump flexible tube from strainer body and manifold. Remove two clamps holding flexible tube on upper and lower pipes, and remove flange from upper pipe. Discard gaskets.

b. Installation. Install flange on upper pipe. Install flexible tube on upper and lower pipes with two 2-3/4-inch hose clamps, but do not tighten clamp screws. Use new gaskets. Install strainer body flange on strainer body with four hex-head screws and lockwashers screws and lockwashers. Install lower pipe on manifold with four hex-head screws and safety nuts. Tighten screws on flexible tube clamps.

271. Delivery Pump Drive Shafts

a. Removal.

(1) Loosen hex-socket set bolt in safety collar on front drive shaft assembly (fig. 300). Slide collar forward as far as possible and tighten set bolt. Loosen set bolt securing drive shaft assembly on intermediate shaft. Pull rear end of shaft assembly from intermediate shaft and remove shaft assembly.

(2) Loosen set bolt securing rear drive-shaft assembly on intermediate drive shaft (fig. 300). Pull rear drive-shaft assembly backward from intermediate

drive shaft and then forward out of sleeve yoke, with plug assembly. Remove yoke assembly from pump compartment.

(3) Remove two hexagon self-locking nuts and hex-head bolts attaching each pillow block, with bearing, assembly (figs. 296 and 300) to body crossmembers and remove intermediate drive shaft and two pillow block assemblies as a unit. Remove two pillow block mounting spacers from pillow block assemblies.

b. Installation.

(1) Position intermediate drive shaft (fig. 300), two pillow block with bearing assemblies (figs. 296 and 300), and two pillow block mounting spacers to body crossmembers. Secure each pillow block assembly with two hex-head bolts and hexagon self-locking nuts.

(2) Remove sleeve yoke with plug assembly from rear drive-shaft assembly (fig. 300). Insert splined (rear) end of rear drive-shaft assembly in hole in pump compartment bulkhead. Aline keyway in front end of drive-shaft assembly with key in intermediate shaft and slide rear drive-shaft assembly onto intermediate drive shaft. Secure shafts together by tightening set bolt in rear drive-shaft assembly. Working in pump compartment, install sleeve yoke assembly on splined end of rear drive-shaft assembly.

(3) Aline keyway in rear end of front drive-shaft assembly with key in intermediate shaft and slide front drive-shaft assembly onto intermediate drive shaft (fig. 300). Secure shafts together by tightening set bolt in front of drive-shaft assembly. Swing front end of front drive-shaft assembly against body and secure in position with wire.

(4) Lubricate pump drive-shaft assemblies and pillow block assemblies in accordance with lubrication order LO 9-2320-209-12.

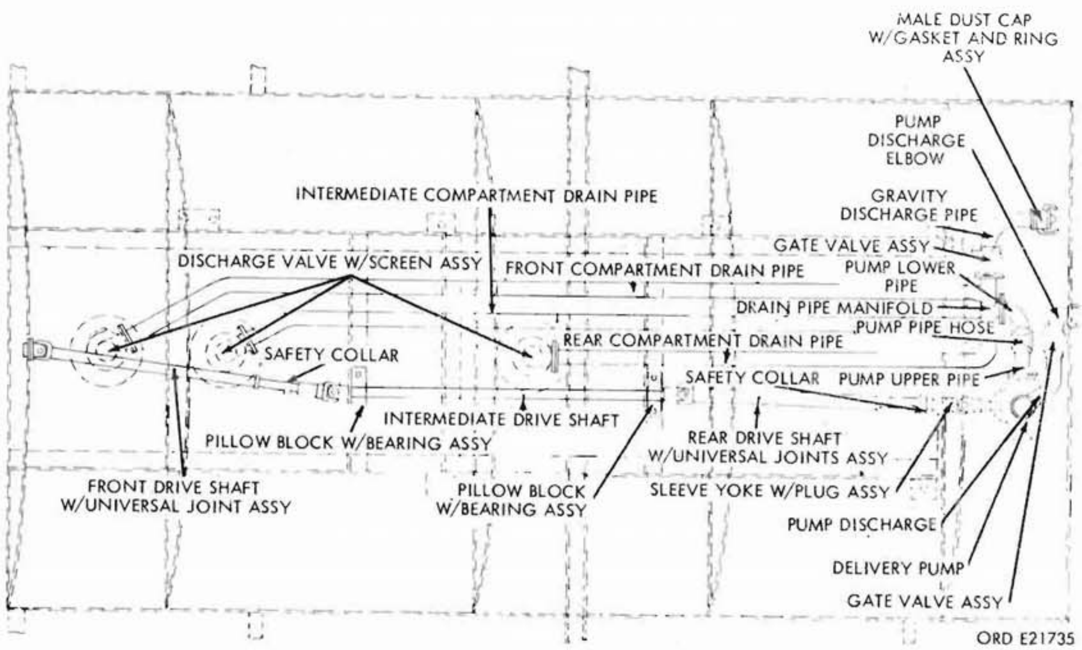


Figure 300. Fuel tank body drainpipes, pump drive shafts and pillow block assemblies

272. Delivery Pump

a. Delivery Pump Strainer Body Cover Gasket.

(1) Removal. Remove four screws and lockwashers securing strainer body cover to strainer body (fig. 301) and remove cover and gasket. Remove gasket from cover. Clean gasket particles from cover and strainer body. Discard gasket.

(2) Installation. Position new gasket on strainer body and place body cover over gasket on body. Secure cover to body with four hex-head screws and external-teeth lockwashers.

b. Delivery Pump Strainer.

(1) Removal. Remove strainer body cover (a above). Pull strainer from strainer body.

(2) Cleaning. Clean strainer thoroughly with dry-cleaning solvent or mineral spirits paint thinner. Make sure strainer mesh is free of particles. Dry with compressed air.

(3) Installation. Position strainer in strainer body and install strainer body cover (a above).

c. Delivery Pump.

(1) Removal. Disconnect delivery pump rear drive shaft from pump rotor shaft on delivery pump by loosening setscrew in drive-shaft yoke and removing yoke from rotor shaft. Remove four screws and lockwashers holding delivery pump strainer body flange to strainer body and free flange from body. Remove four screws holding delivery line to outlet flange on underside of pump (on M49) or on right-hand side of pump (on M49C and M49CA1), and free flange from pump. Remove four safety nuts and screws holding delivery pump to mounting angles, and remove pump. Remove woodruff key, strainer body flange gasket, and outlet flange gasket from the pump. Discard flange gaskets.

(2) Installation. Install new delivery pump outlet flange gasket on pump delivery line. Install strainer body flange and new outlet flange gaskets and woodruff key on pump. Position pump on the mounting angles, making sure the woodruff key in pump rotor shaft enters keyway in drive-shaft yoke on pump rear drive shaft. Tighten the setscrew in drive-shaft yoke to secure drive shaft to rotor shaft. Secure pump to mounting angles with four hex-head screws and safety nuts. Secure outlet flange to pump with four hex-head screws. Secure strainer body flange to strainer body with four hex-head screws and external-teeth washers.

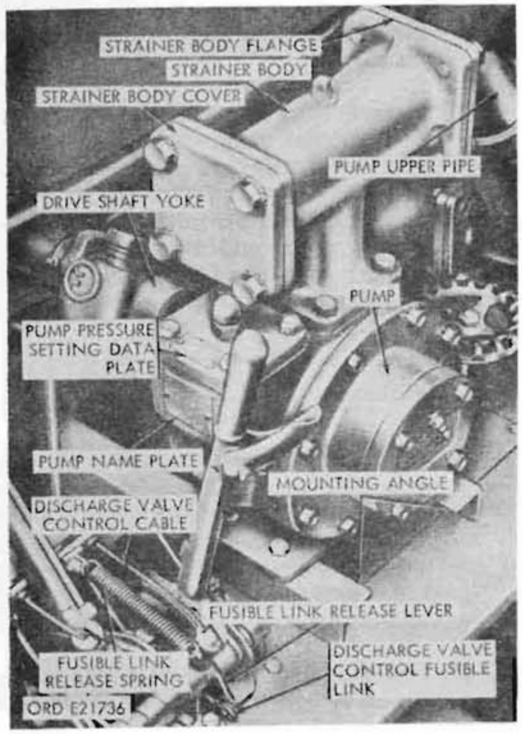


Figure 301. Delivery pump

273. Manhole and Filler Covers

a. Removal (Manhole Covers on Early Production M49 Trucks). Open filler cover. Reach in through filler opening and loosen six wingnuts holding manhole cover holddown clamps in position on body. Turn clamps to side, and remove manhole and filler covers as a unit (fig. 302).

b. Cleaning. Clean the mating surfaces of the manhole cover and tank opening, removing all old gasket material.

c. Installation. Position manhole and filler covers as a unit over manhole in gasoline tank body. Use a new gasket, making sure it is in correct position to make an air- and gasoline-tight seal. Position each manhole cover holddown clamp so that clamp hook will engage flange on tank. Tighten clamp wingnuts evenly until cover is tight on tank body.

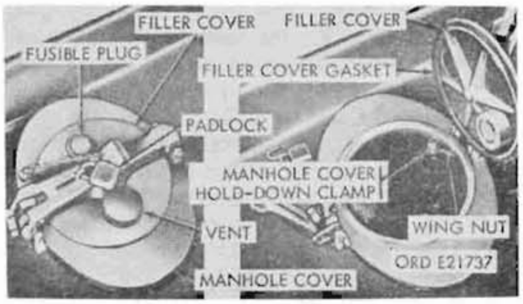


Figure 302. M49 manholde and filler covers - early-production models

d. Removal (Manhole Covers on Later Production M49, M49C and M49CA1 Trucks).

(1) Remove nut and bolt on compression ring securing manhole cover to tank body (fig. 303).

(2) Remove compression ring and lift manhole cover from body. Discard gasket.

e. Installation.

(1) Clean mating surfaces of manhole cover and tank opening. Remove all old gasket material.

(2) Position a new gasket on tank opening. Lower cover on tank opening, making certain all surfaces are alined properly.

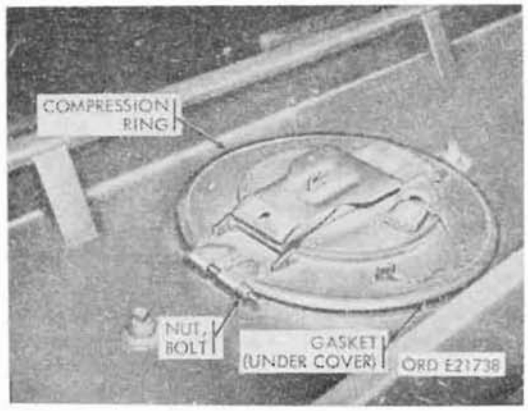


Figure 303. M49, M49C and M49CA1 manhole and filler covers - later-production models

(3) Position compression ring to clamp both cover and tank edges, and tighten nut and bolt.

f. Filler Cover Gasket Replacement.

(1) Removal. Remove filler cover gasket from filler cover. Clean cover of all particles of old gasket.

(2) Installation. Position a new gasket on cover, making sure gasket seats evenly under cover lip. Tighten cover to seat gasket.

274. Power-takeoff Controls and Linkage

For removal and installation of the power-takeoff controls and linkage, refer to paragraph 163.

Section XLIV. CRANE BODY AND AUXILIARY EQUIPMENT (M60 and M108)

75. Description, Operation and Data

a. Description.

(1) M60 and M108. The crane trucks are equipped with a hydraulic crane mounted on the body platform, and powered from the truck engine through the transfer power takeoff. The crane consists of a hydraulic pump, relief, swivel, and check valves; toolbox with oil reservoir control valve assembly; boom crowd and lift hydrauiic cylinders; cable-hoist drum and cable, cable-hoist drive worm and drive-gear set, and cable hoist-hydraulic motor; hydraulic-swing motor; three floodlights and floodlight control switch; solenoid brake lock and brake-lock switch; and hydraulic oil lines, hose, and fittings necessary to

conduct flow of hydraulic oil through the hydraulic system. The M60, in addition, is equipped with a rear winch and a power-divider assembly which drives the winch and/or the hydraulic pump.

(2) Oil reservoir with toolbox. The oil reservoir with toolbox (fig. 312) consists of heavy gage sheet metal formed and welded together. The center part of the assembly is a 50-gallon oil storage reservoir, and each end contains a covered toolbox.

(3) Shutoff cock. The shutoff cock is attached to the underside of the oil reservoir, between the oil reservoir outlet port and the hydraulic motor inlet port.

(4) Hydraulic pump. The hydraulic pump (fig. 304) on the M108 is connected to the transfer power-takeoff drive shaft. On the M60 the hydraulic pump is connected to one of the output shafts of the power-divider. The hydraulic pump is a balanced vane type having a constant rate of delivery per revolution. The slotted rotor is driven by a splined shaft and, a vane in each slot slides radially as the rotor revolves. Centrifugal force and fluid pressure cause the vanes to follow the inside cam contour of the hardened and ground spacer which is so shaped that two opposing pump chambers are formed between the body and pressure plate. Inlet flow is received through a port connection in the body, passes around the rotor by vane action through ports in the pressure plate, and out the port connection of the cover. The hydraulic pump is driven at a constant rate of 1700 rpm controlled by the engine auxiliary governor.

(5) Relief valve. The relief valve (fig. 304) is located on the underside of the oil reservoir, attached to the outlet port of the hydraulic pump. The relief valve is set at 1200 psi for the protection of the hydraulic working parts and at any time the pressure in the system reaches or exceeds 1200 psi, the relief valve reroutes the oil and returns it to the oil reservoir.

(6) Swivel valve. The swivel valve (fig. 305) is mounted on the top of the pivot post and provides a means of transmitting the hydraulic oil to the crane-operating units. This valve permits free rotation of the wrecker crane assembly. The swivel valve consists of an inner hub and oil seal body which are held together by a swivel valve guide and sealed at the top by a plate and gasket.

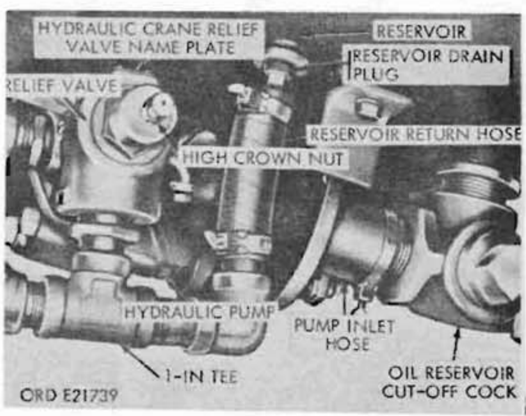


Figure 304. Relief valve, hydraulic pump and oil reservoir shutoff cock

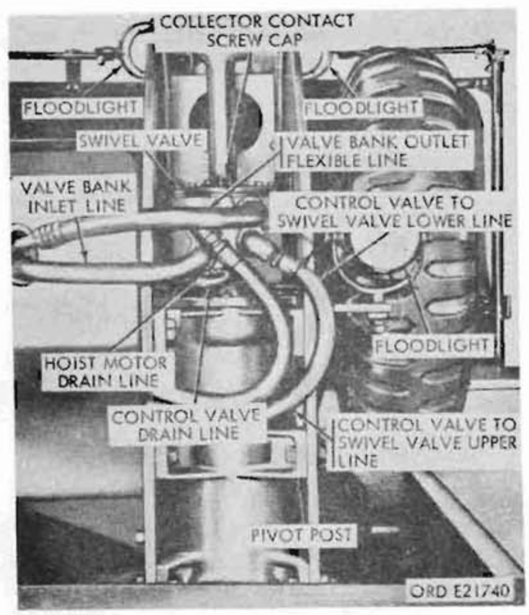


Figure 305. Swivel valve, hoses, and floodlights

(7) Control valve assembly. The control valve assembly is located in the crane operator's compartment. This assembly consists of four separate control valves bolted together to form a single unit. Each valve controls one of the four functions of the wrecker crane, which are lifting or lowering the boom, winding or unwinding the hoist drum, extending or retracting the boom, and swinging the boom to the left or right. Each valve is spring-loaded and will return to neutral position when the operator releases the control lever.

(8) Shipper and boom assembly. The shipper and boom assembly (fig. 325) consists of a shipper, boom, and boom crowd cylinder. The shipper is mounted to the shipper support and is elevated or lowered by the boom lift cylinder. The boom is located within the shipper and can be extended or retracted as operation requires. The boom crowd cylinder is approximately 8 feet in length and is used to extend or retract the boom.

(9) Boom lift cylinder. The boom lift cylinder assembly (fig. 315) used to lower and raise the shipper and boom assembly, is of heavy steel construction. Ports for hydraulic lines are located, one at the base of the cylinder, and one at the cylinder head for operation of the boom lift cylinder.

(10) Swing motor. The swing motor (fig. 315) is a piston and cylinder type. Each swing motor cylinder consists of a body, piston, and a control valve spool. The valve chamber is integral with the cylinder body. Each swing motor cylinder body is mounted to the base plate by a cylinder-mounting pivot pin. The piston rods are interlocked and are installed on the drive pinion crank when the swing motor is mounted on the base plate.

(11) Hydraulic motor. The hydraulic motor (fig. 314) is mounted directly to the gearcase of the hoist drum and may be operated in either direction without damage.

(12) Hoist drum and worm and drive gearset. The hoist drum and worm and drive gearset (fig. 314) is mounted on the rear of the shipper assembly and is powered by the hydraulic motor. The hydraulic motor rotates the worm and drive gearset, which, in turn, rotates the hoist drum to lower or raise the hoist-drum cable.

(13) Pivot post and base plate assembly. The pivot post and base plate assembly (fig. 315) are two separate units assembled together to support and provide axis for rotation of the wrecker crane. The pivot post rotates on two tapered roller bearings and is powered by the swing motor.

(14) Check valve assemblies. One check valve is located in the return line of the boom lift cylinder (fig. 315) and the other in the return line of the hydraulic motor (fig. 315). The valves restrict the flow of oil in the return line and thereby control dropping speed of the load.

(15) Hydraulic lines. Both flexible and rigid line assemblies are used for connecting the components of the hydraulic system. The rigid line assemblies are made of steel tubing. Most of the flexible line assemblies are high pressure restriction type that restrict the flow of hydraulic oil in one direction only to prevent excessive dropping speed of heavy loads on the end of the boom hoist line assembly.

(16) Rear-mounted winch (M60 only). The rear winch (fig. 326) is mounted on the wrecker body at the rear of the crane. The rear winch is equipped with a cable level wind, cable tensioner and automatic brake. The automatic brake, which is attached to the rear end of the drive (worm gear) shaft, sustains the winch load whenever the delivery of power to the drive shaft is interrupted, as by shifting the winch shift lever to neutral. When winding cable, tension of the cable, controlled by the cable tensioner, causes the guide roller of the level wind to travel from side to side on the track. This causes the cable to be wound on the drum in tight, even coils and layers, preventing loose layers or crossed coils.

(17) Wrecker power train (M60).

(a) Power takeoff. The power takeoff for the M60 wrecker truck is mounted directly to the rear of the transfer input shaft and supplies power to the power-divider. It is constant drive type and incorporates its own lubricating system.

(b) Power-divider and drive sprocket assembly (M60). The power-divider (fig. 319) is connected by a drive shaft to the transfer power takeoff. The hydraulic pump is bolted directly to the power-divider frame and is coupled to one output shaft of the power-divider. The other output shaft (fig. 323) is connected to a rear drive shaft, which extends from the power-divider to the bearing assembly bolted to the rear of the wrecker body. A drive sprocket secured to the rear end of the bearing assembly shaft is connected by a drive chain to the driven sprocket secured to the front end of the winch drive shaft. The driven sprocket is secured to the drive shaft by a shear pin which prevents damage to the winch resulting from overloading.

(c) Pillow block. The pillow block is secured to the base plate and consists of a sealed bearing and housing. It provides a support for the rear-mounted winch drive shaft.

(18) Operator's cab. The sheet steel operator's cab, bolted to the right side of the shipper support, contains seat and backrest cushion assemblies for the crane operator. The control valve assembly is installed on a shelf in front of the operator.

(19) Floodlight assemblies. Two cab floodlight assemblies (fig. 305) mounted on cab floodlight mountings, and one crane floodlight assembly, mounted on a bracket on the shipper support are provided for night operation. All three floodlight assemblies are identical. Lamp units are sealed-beam type controlled by switches on each light. All lights are connected to a master switch on the instrument panel of the truck cab.

(20) Solenoid brake lock. A solenoid brake lock, in the hydraulic brake line near the air-hydraulic cylinder, is controlled by the brake-lock switch (fig. 306) on the instrument panel.

(21) Wrecker body and outriggers. A large safety tread platform surrounding the revolving structure is identified as the wrecker body. Grips and steps are located at each end of the body. Tool and stowage boxes are built into the rear of the wrecker body on each side. There are four outriggers, one at each corner of the wrecker body. They are the screw-jack type and provide sufficient leverage to effectively counterbalance the loads. The outrigger assembly frame construction takes all the down load, thus eliminating twisting strains on the truck chassis.

b. Operation.

Note. The key letters noted in parentheses are in figure 311.

(1) General. The hydraulic system consists of various rigid and flexible line assemblies, valves, cocks, hoses, junction block, and drain lines through which the hydraulic oil passes during crane operation. During normal operating conditions with truck engine running, transfer power takeoff engaged, and hydraulic pump assembly rotating the system flow is as follows:

(2) Pressurizing the hydraulic system. The hydraulic pump draws the hydraulic oil from the oil reservoir through the shutoff cock to the hydraulic pump, which maintains 1200-psi pressure in the hydraulic system, regulated by the relief valve. (If the pressure exceeds 1200 psi, the relief valve will reduce the excessive pressure by returning a portion of the oil to the reservoir.) Oil is forced from the hydraulic pump outlet port through line (A) into the bottom of the swivel valve and out port No. 4 of the swivel valve through line (B) to the control valve assembly inlet port.

(3) Control valve assembly in neutral position. With the control valve assembly in neutral position, the hydraulic oil flows through the control valve assem-

bly, and through line (C) into port No. 1 of the swivel valve, out the bottom of the swivel valve and through line (D) to the reservoir. Excess oil drains through line (E) into the drain port of the swivel valve, out the bottom of the swivel valve, and returns to the reservoir through line (F).

(4) Raising or lowering the boom.

(a) Raising the boom. To raise the boom, the operator moves the lever to the UP position. Hydraulic oil flows from the control valve assembly through line (G), through the check valve (unrestricted) to the base of the boom lift cylinder, extending the piston. The hydraulic oil returns from the head of the boom lift cylinder through line (H) to the control valve assembly.

(b) Lowering the boom. To lower the boom, the operator moves the lever to the DOWN position. Hydraulic oil now flows from the control valve assembly through line (H) to the head of the boom lift cylinder, retracting the piston. The hydraulic oil returns from the base of the boom lift cylinder through the check valve, which restricts the oil flow to prevent the boom from lowering too rapidly and causing damage. From the check valve, hydraulic oil returns to the control valve assembly through line (G).

(5) Extending or retracting the boom.

(a) Extending the boom. To extend the boom, the operator moves the lever to EXTEND position. Hydraulic oil flows from the control valve assembly through line (I) to the boom crowd cylinder, extending the cylinder. The hydraulic oil returns from the boom crowd cylinder through line (J) to the control valve assembly.

(b) Retracting the boom. To retract the boom, the operator moves the lever to RETRACT position. The hydraulic oil now flows in the reverse direction, flowing from the control valve assembly through line (J) to the boom crowd cylinder, retracting the cylinder and returning through line (I) to the control valve assembly.

(6) Swinging the boom.

(a) Swinging the boom to the right. To swing the boom to the right, the operator moves the lever to RIGHT position. Hydraulic oil flows from the control valve through line (K) to port No. 2 of the swivel valve, out the bottom of the swivel valve through line (L) to port No. 1 of the junction block. From the junction block the oil is distributed through lines (M) and (N) to the two cylinders of the swing motor, rotating the motor. Hydraulic oil returns from the two cylinders of the swing motor through lines (O) and (P) to the junction block, out through port No. 2 of the junction block, through line (Q) to the bottom of the swivel valve and out port No. 3 of the swivel valve, through line (R) to the control valve assembly.

(b) Swinging the boom to the left. To swing the boom to the left, the operator moves the lever to LEFT position. Hydraulic oil now flows in the reverse direction, flowing from the control valve assembly through line (R), port No. 3 of the swivel valve, line (Q), port No. 2 of the junction block and lines (O) and (P) to the swing motor cylinders, rotating the motor. The hydraulic oil returns from the swing motor cylinders through lines (M) and (N), port No. 1 of the junction block, line (L), port No. 2 of the swivel valve, and line (L) to the control valve assembly.

(7) Hoisting and lowering the boom line.

(a) Lowering the boom line. To lower the boom line, the operator moves the lever to the DOWN position. Hydraulic oil flows from the control valve assembly through line (S) to the hydraulic motor, rotating the motor. Hydraulic oil returns from the hydraulic motor through the check valve, which restricts the oil flow to prevent the line from lowering too rapidly and causing damage. From the check valve, the hydraulic oil flows through line (T) to the control valve assembly. Excess oil accumulating inside the hydraulic motor is drained through line (U) into the tee fitting in the drain port of the swivel valve and out the bottom of the swivel valve through line (F) to the oil reservoir.

(b) Hoisting the boom line. To hoist the boom line, the operator moves the lever to the UP position. Hydraulic oil flows from the control valve assembly through line (T) and through the check valve (oil flow is not restricted in this direction) to the hydraulic motor, rotating the motor. Hydraulic oil returns from the hydraulic motor through line (S) to the control valve assembly. Excess oil accumulation is drained through line (U), the drain port of the swivel valve, and through line (F) to the oil reservoir.

c. Data.

Swivel valve:
Make . . . . Austin-Western Co.
Model AWR-HCU242
Toolbox with oil reservoir:
Make . . . . Austin-Western Co.
Model AWR-HCF1374H
Relief valve:
Make . . . . Austin-Western Co.
Model AWR-HCF1535
Check valve:
Make . . . . Austin-Western Co.
Model AWR-HCU241
Hydraulic pump:
Make . . . . Vickers, Inc.
Model MJ-3C4529A
Hydraulic swing motor:
Make . . . . Austin-Western Co.
Model AWR-HCU224F
Boom lift hydraulic cylinder:
Make . . . . Austin-Western Co.
Model AWR-HCU349
Boom crowd hydraulic cylinder:
Make . . . . Austin-Western Co.
Model AWR-HCU350
Control valve bank:
Make . . . . Austin-Western Co.
Model AWR-HCU310C
Cable hoist hydraulic motor:
Make . . . . Vickers, Inc.
Model VKR-M2540-150-6FC-11
Floodlight:
Make . . . . Guide lamp
Model 926014
Rear winch (M60 only):
Make . . . . Tulsa Div. of Vickers, Inc.
Model 120-HA 62125
Power-divider (M60 only):
Make . . . . Tulsa Div. of Vickers, Inc.
Model HA-62126

276. Auxiliary Governor

Refer to paragraph 222 for adjustment of governor speed, and replacement of flexible shaft and core.

277. Floodlight Control Switch

a. Removal. Disconnect two cables from floodlight control switch (fig. 306). Remove screw holding switch handle on switch, and remove handle. Remove nut and lockwasher holding switch instruction plate and switch to instrument panel, and remove switch and plate.

b. Installation. Install switch on instrument panel with positioning lug protruding through lug hole in panel. Position switch instruction plate on outside of panel over switch, and secure switch and plate to panel with a lockwasher and hex-nut provided with switch. Connect two cables to floodlight control switch (fig. 306).

278. Brake-lock Switch

a. Removal. Disconnect two cables from brake-lock switch (fig. 306). Remove two screws holding electric brake-lock instruction plate and brake-lock switch to instrument panel, and remove plate and switch.

b. Installation. Install brake-lock switch with switch button protruding through hole in instrument panel and with mounting screw holes alined with screw holes in panel. Position instruction plate on front of panel and secure plate and switch to panel with two cross-recess panhead screws. Connect two cables to brake-lock switch (fig. 306).

279. Cab and Crane Floodlights

a. Floodlight Lamp Unit.

(1) Removal. Loosen three screws holding door on floodlight body and separate door and lamp unit from body. Pull door and lamp unit out from body until rear of lamp unit is accessible. Loosen two screws holding cables to lamp unit contact terminals, and remove lamp unit and door from floodlight body (figs. 307 and 308).

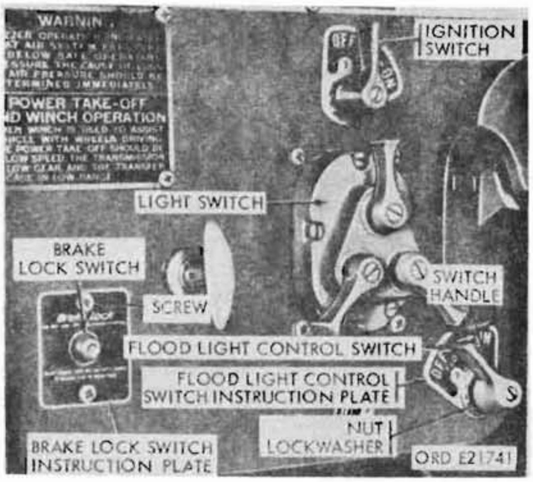


Figure 306. Floodlight and brake-lock switches

Note. Be sure not to lose the four lamp-unit retaining springs when removing the lamp unit from the flood-light door.

Remove four retaining springs holding lamp unit in door, and remove lamp unit.

(2) Installation. Position lamp unit in floodlight door, and install four retaining springs on four locating lugs on edge of lamp unit. Press down on ends in rim of door. Connect cables to lamp-unit contacts and secure door to body with three screws attached to door.

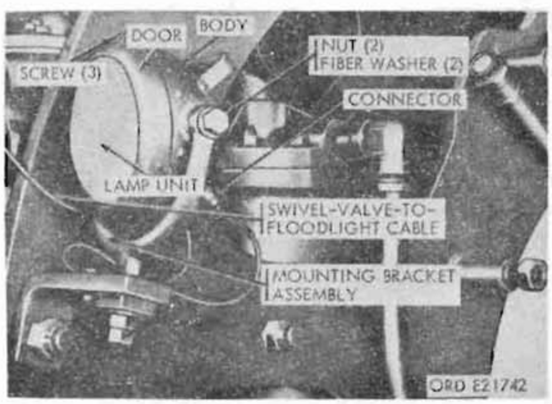


Figure 307. Crane floodlight - installed

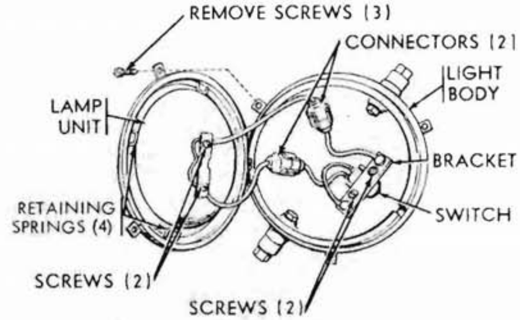


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Figure 308. Crane floodlight - disassembled showing lamp and toggle switch

b. Floodlight Toggle Switch (Fig. 308).

(1) Removal. Remove floodlight lamp unit (a(1) above). Separate cable female and male connector shells at light switch. Remove two screws holding switch contact bracket on body, and remove bracket and switch.

(2) Installation. Install floodlight switch in position under floodlight switch housing and position switch contact bracket over switch. Secure bracket and switch to floodlight body with two roundhead screws. Connect cable connector shells at switch. Install lamp unit (a(2) above).

c. Floodlight (Fig. 307).

(1) Removal. Disconnect cables (fig. 307) at floodlight. Remove two nuts and fiber washers holding light in floodlight mounting bracket and remove light.

(2) Installation. Install light on mounting bracket with two fiber washers and nuts. Tighten nuts until washer friction prevents light from being turned freely, yet permits turning of floodlight by hand. Connect cables (fig. 307) at light.

d. Floodlight Harness. Refer to paragraph 120 for repair procedure for wiring harnesses.

280. Universal Joint, Drive Shaft and Power-takeoff Control

a. Universal Joint.

(1) General. Universal joints should be repaired whenever excessive wear is indicated by looseness in bearings between journal and yoke. Repair kits are available for maintenance of universal joints.

(2) Removal (fig. 309). Bend down lugs on locking plates, and remove two screws and locking plate from each side of end and sleeve yokes. Remove journal with bearings from end and sleeve yokes. Remove gasket inner and outer retainers and journal gasket from bearings. Discard gasket.

(3) Cleaning. Clean all parts thoroughly with dry-cleaning solvent or mineral spirits paint thinner. Blow dry with compressed air. Inspect parts for nicks, burs, or excessive wear. Replace with new parts where necessary.

(4) Installation. Install gasket inner and outer retainers and new journal gaskets on journal. Work automotive and artillery grease (GAA) into bearings until bearing needles are well lubricated. Install journal bearings on the journal. Install journal with bearings on yokes, using two hex-head screws and locking plate for each bearing. Bend up lugs of locking plates against sides of the screw heads. If joint appears to bind, tap bearings lightly to relieve pressure of bearings on the ends of the journal.

b. Drive Shaft (Fig. 310).

Note. The hydraulic pump drive shaft must be partially disassembled at front universal joint during removal.

(1) Removal. Loosen setscrews securing drive-shaft end yokes on output and input shafts, and remove drive shaft.

(2) Installation. Install drive shaft by inserting end yokes over keys in output and input shafts. Tighten end yoke set screws.

c. Power-takeoff Control Linkages. Refer to paragraph 158 for removal and installation of power-takeoff control and linkages.

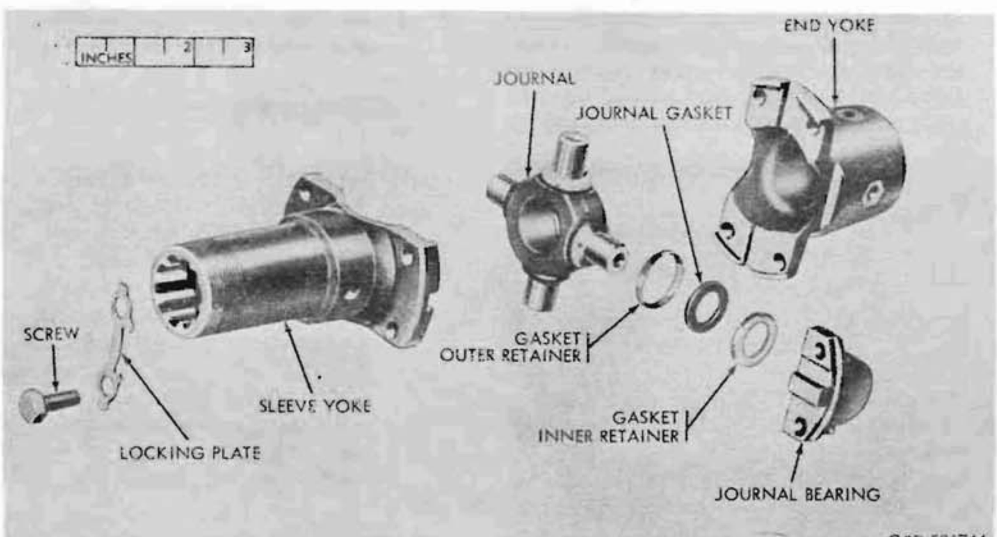


Figure 309. Lock plate-type universal joint - exploded view

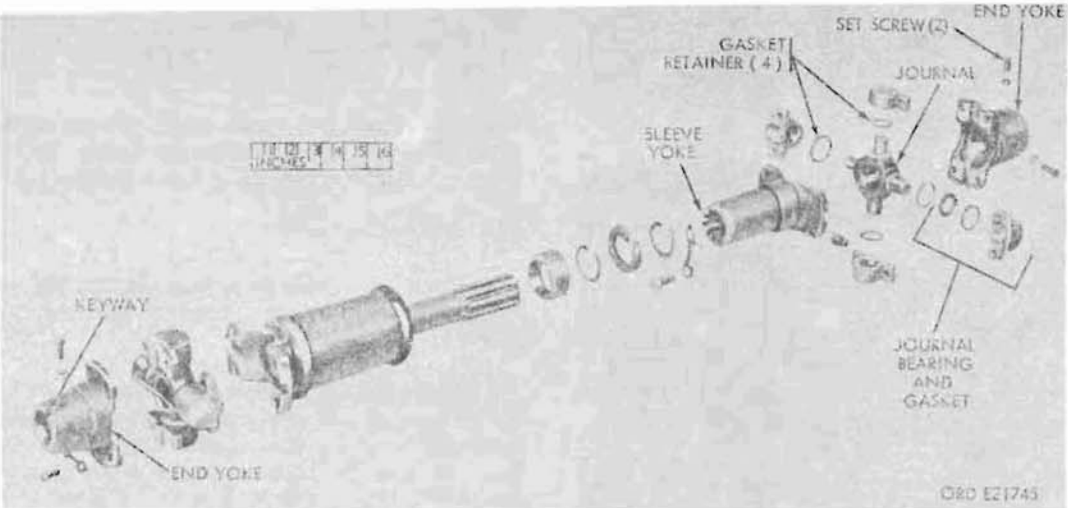


Figure 310. Hydraulic pump drive shaft, M108 - exploded view

281. Hoist Cable

Caution: Always wear leather gloves when handling cable to prevent damage to hands by frayed or broken strands.

a. Removal. Operate crane to run hoist cable off cable hoist drum until last turn is off drum. Remove cable wedge holding end of cable in drum, and remove cable from crane.

b. Installation. Install end of cable around boom sheave and beneath upper roller. Insert end of cable in cable anchor hole, and secure in hole by driving cable wedge into place. Operate crane to take up cable, being sure cable spools evenly on hoist drum.

282. Hydraulic Oil Lines, Hose, and Fittings

a. General. The hydraulic system uses rigid lines, rubber hose, and flexible lines to carry hydraulic oil to the major components of the hydraulic crane. Pipe adapters, bushings, couplings, nipples, and tees are used to make connections between the components and lines. Brackets, clamps, clips, grommets, molding, spacers, straps, and supports are used to mount, support, and protect the lines. Lines must be free from twists, kinks, and dents that might cause interference with free flow of oil. Cut or frayed lines must be replaced to prevent bursting under pressure.

b. Removal.

Caution: Before removal, all lines must have an identification tag tied to the line to facilitate correct installation. The tag should precisely locate correct connections. This is essential since certain lines are not high pressure lines and cannot withstand the high fluid pressure created by hydraulic pump.

Close the shutoff cock on the oil reservoir (par. 284a) and drain oil from lines into a suitable container.

Note. Do not return the drained oil to the hydraulic system. Replenish lost oil with clean new oil.

All lines, hose, and fittings are removed similarly. First disconnect the line at the swivel connection, then at the other end. Remove lines, hose supporting clips, brackets, clamps, and other supporting or protecting devices. Do not misplace or lose these devices, since all must be installed in their original positions. Remove adapters, bushings, couplings, nipples, and tees.

c. Installation.

Note. Use the hydraulic flow diagram, figure 311, as a guide for correct routing of lines and fittings.

Replacement of lines, hose, and fittings is done similarly. Replacement lines of correct length and necessary bends, with connection fittings, are available for requisition. Install hydraulic line ball sleeve compression tube fitting nuts properly.

Caution: In installing flareless compression fitting-type lines previously removed, tube fitting nuts must be pulled up fingertight, then given only one-eighth turn more with wrench. This is extremely important. Further tightening will distort ball sleeve and tube. For installation of lines with new sleeves or tubes, never tighten nut over two turns after sleeve has shouldered in body of fitting. Install adapters, bushings, couplings, nipples, and tees. Install hose and secure with hose clamps. Install correct lines, making solid connections before connecting swivel connections. Do not bend, kink, or damage lines during installation. Do not leave lines twisted after installation. Secure lines with clamps, clips, and other devices as in original installation. Secure lines properly against chafing, cutting, or vibration as originally installed.

Fill oil reservoir (par. 284). Open shutoff cock. Operate all functions of crane several times to purge air from hydraulic system.

283. Hydraulic Pump

a. General. Refer to paragraph 282 for removal and installation procedure for lines and fittings.

b. Removal. Turn oil reservoir shutoff cock (fig. 304) to OFF position. Remove hydraulic pump drive shaft (par. 280b) and relief valve (par. 285) from pump. Loosen hose clamps. Disconnect and remove pump inlet hose from fittings connecting shutoff cock and pump. Remove six screws holding pump inlet hose from

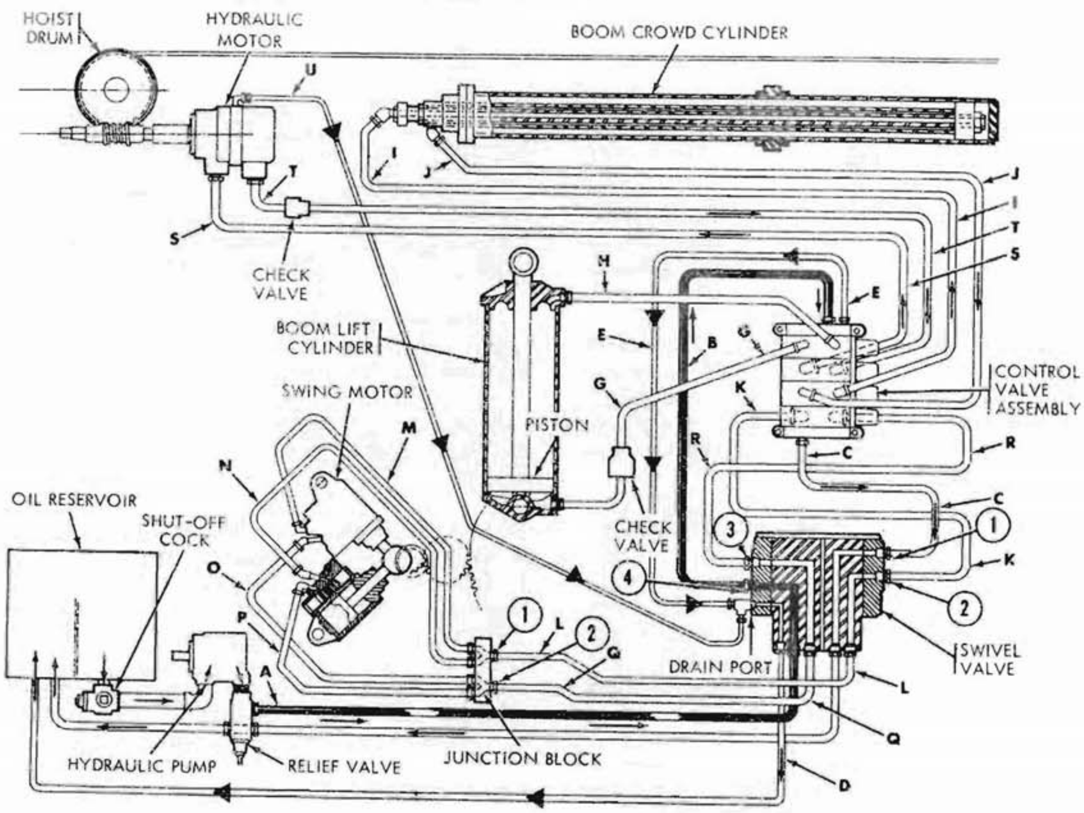


Figure 311. Crane hydraulic system piping diagram

fittings connecting shutoff cock and pump. Remove six screws holding pump to pump-mounting bracket on reservoir, and remove pump. Remove pipe fittings from pump.

c. Installation. Install nipple and street elbow in pump ports and nipple in elbow, and install pump on pump-mounting bracket with six hex-head screws. Install and connect pump inlet hose to nipples on pipe elbow and shutoff cock. Tighten hose clamps. Install relief valve (par. 285) on pump. Connect pump drive shaft to pump (par. 280b). Turn on shutoff cock. Check reservoir oil level (par. 284) and add new oil as required.

284. Hydraulic Reservoir (Fig. 312)

a. Maintenance. Remove drain plug (fig. 304) from drain hole on underside of reservoir, and drain oil from reservoir.

Caution: Be sure to use clean containers and keep oil free of dirt. Do not return drained oil to hydraulic system if contamination is suspected.

Remove reservoir breather cap from oil reservoir cover. Remove six screws holding reservoir cover on reservoir, and remove cover with screen and gasket. Clean drain plug, breather cap, and screen with dry-cleaning solvent or mineral spirits paint thinner, and dry with compressed air. Flush reservoir thoroughly with clean hydraulic oil. Position cover gasket on opening in reservoir and install screen with cover on reservoir with six hex-head screws. Install drain plug in drain hole. Fill reservoir according to lubrication order LO 9-2320-209-12 and install breather cap on reservoir cover. Operate all functions of crane several times to fill lines and components and purge air from hydraulic system. Recheck reservoir level and add oil, as necessary, to bring level up to top of mark on oil level gage.

b. Removal.

Note. The oil reservoir is a welded part of the toolbox and is removed and installed with the toolbox.

Drain the reservoir (a above) and remove hydraulic pump-drive shaft (par. 280b), relief valve (par. 285), and hydraulic pump (par. 283). Disconnect swivel valve drain line (F, fig. 311) from fitting on bottom of the reservoir, and remove the fitting from reservoir. Remove the shutoff cock (fig. 304) with two attached nipples from reservoir. Remove four safety nuts, lockwashers, and screws (fig. 313) holding toolbox with oil reservoir to chassis and, with suitable hoist, remove toolbox with oil reservoir.

c. Installation. Install toolbox with oil reservoir on chassis with four hex-head screws, lockwashers, and safety nuts. Install nipple,

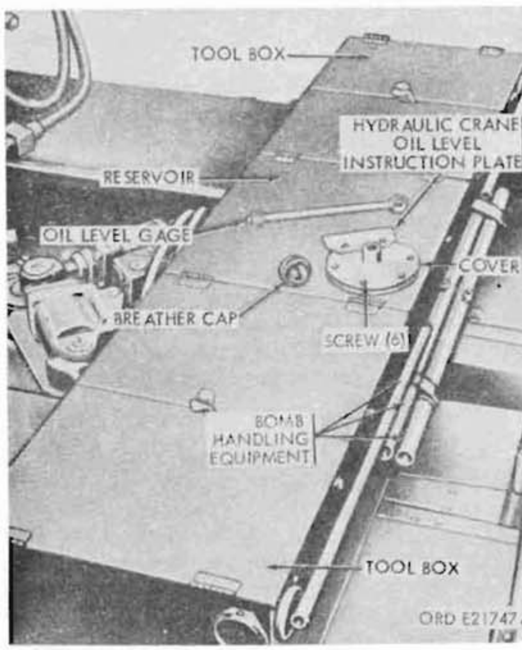


Figure 312. Hydraulic oil reservoir and equipment box

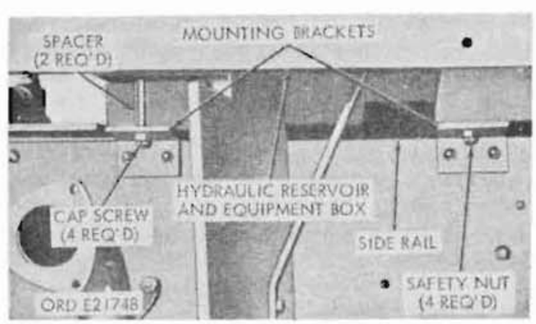


Figure 313. Hydraulic oil reservoir mounting bolts

oil reservoir cutoff cock (fig. 304), and nipple on reservoir. Install pipe fitting on reservoir, and connect swivel valve drain line (F, fig. 211) to fitting. Install hydraulic pump (par. 283), relief valve (par. 285), and hydraulic pump drive shaft (par. 280b) on reservoir. Fill reservoir in accordance with LO 9-2320-209-12, and a above.

285. Relief Valve

a. General. Refer to paragraph 282 for information on removal and installation of lines, hose, and fittings.

b. Removal. Either drain reservoir or securely clamp reservoir return lines at connections near relief valve. Tie identification tags on both lines. Remove relief valve from pipe nipple on pump (fig. 304). Remove pipe fittings from valve.

c. Installation. Install relief valve on pipe nipple extending from pump. Connect reservoir inlet hose. Connect oil return line to pipe adapter on tee. Connect oil supply line to pipe adapter on valve. Check oil reservoir level (par. 284a).

d. Adjustment. Remove pipe plug (fig. 314) in elbow at cable hoist motor, and install pressure gage capable of reading 1500 psi. Start hydraulic pump. Lower cable hoist line hook sufficiently to prevent fouling of line. Retract boom completely. Hold boom crowd control-valve hand lever in RETRACT position to open relief valve under excess pressure and, at the same time, hold cable-hoist motor control-valve hand lever in UP position. Read relief valve opening pressure on pressure gage. If necessary to adjust relief valve, remove cap nut on end of relief valve, remove capnut on end of relief valve (fig. 304). Loosen jamnut on relief valve adjusting screw and turn screw to the right, when facing screw head, to raise relief valve opening pressure, or to the left to lower pressure. Adjust valve until gage reads 1200 psi. Tighten jamnut on adjusting screw without disturbing screw position. Install capnut. Stop hydraulic pump. Remove pressure gage, and install pipe plug in elbow.

286. Check-valves

a. General. Refer to paragraph 282 for information on removal and installation of lines and fittings.

b. Cable-hoist Motor Check-valve (Fig. 314).

(1) Removal. Disconnect hoist motor check-valve flexible line from rigid line at swivel connection, and remove flexible line from check-valve. Remove check-valve from cable-hoist motor.

(2) Installation. Install hoist motor check-valve on nipple on cable-hoist motor with square end of valve nearest nipple. Connect one end of hoist motor check-valve flexible line to check-valve and other end to swivel connection on rigid line.

c. Boom Lift Cylinder Check-valve (Fig. 315).

(1) Removal. Disconnect lift cylinder check-valve flexible line from rigid line at swivel connection, and remove lift cylinder check-valve flexible line from check-valve. Remove check-valve from boom lift cylinder.

(2) Installation. Install lift cylinder check-valve on pipe elbow at lower port on boom lift cylinder, with square end of valve nearest elbow. Connect one end

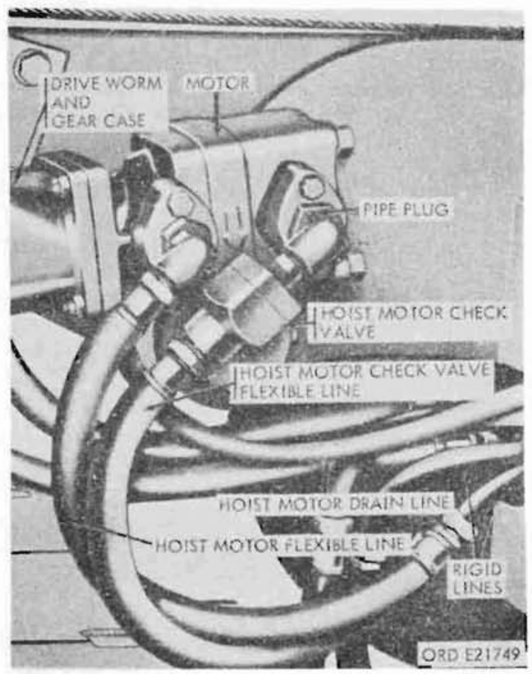


Figure 314. Cable hoist hydraulic motor and check valve

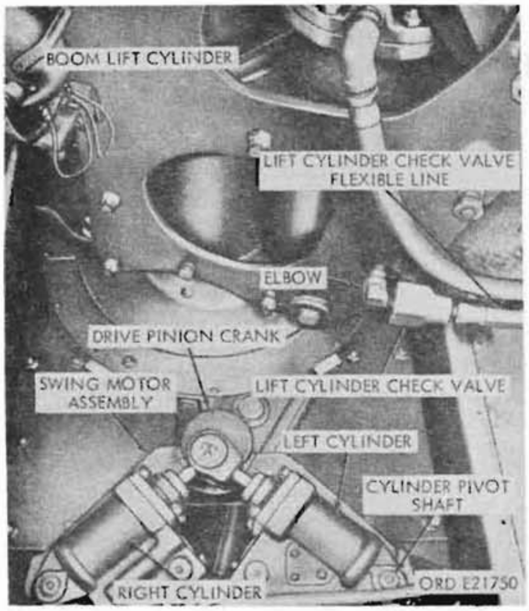


Figure 315. Boom lift hydraulic cylinder, check valve, and swing motor

of lift cylinder check-valve flexible line to lift cylinder check-valve and other end to swivel connection on rigid line.

287. Operator's Seat Cushion and Seat Backrest Cushion

a. Removal. Remove seat cushion from operator's seat. Remove two nuts and lockwashers holding backrest cushion on back of operator's seat, and remove backrest cushion.

b. Installation. Install backrest cushion on back of operator's seat and secure in place with two hex-nuts and lockwashers. Install seat cushion on operator's seat.

288. Power-divider (M60 only)

a. Removal.

(1) Loosen hose clamp securing reservoir inlet hose (fig. 316) to inlet pipe at rear of reservoir, and remove hose from pipe. Turn elbow 45° to allow clearance for removal between relay lever assemblies.

(2) Remove cotter pin and yoke pin securing rear-winch-front-control-rod yoke (fig. 316) to rear-winch right relay lever, and remove yoke from lever.

(3) Disconnect swivel-valve-to-relief-valve line (fig. 317) from relief valve outlet, and disconnect swivel-valve-to-reservoir-inlet-tee line from pipe tee at relief valve.

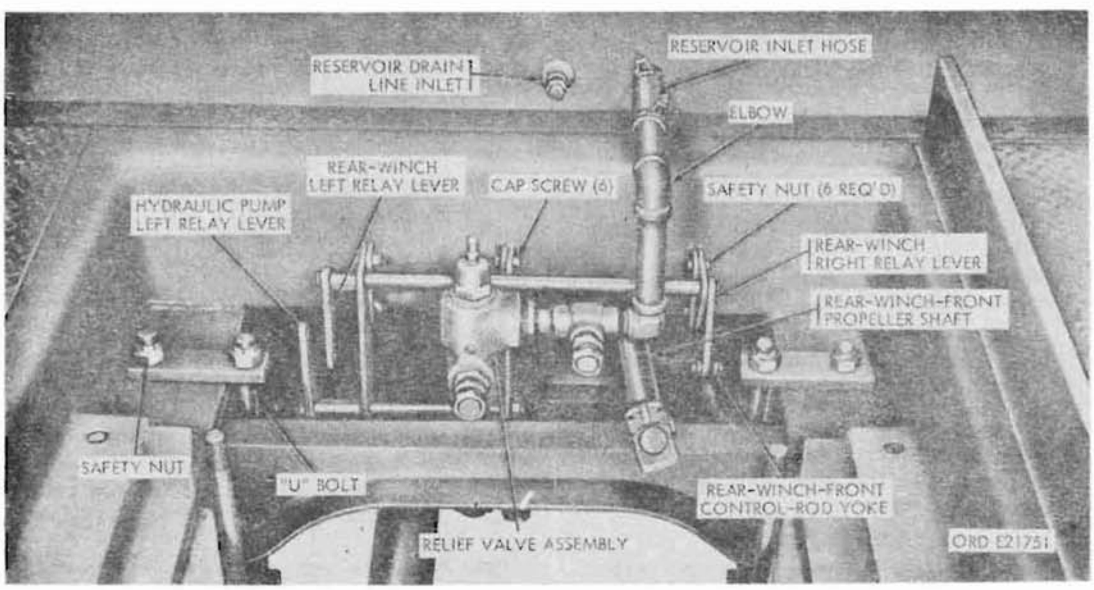


Figure 316. Rear view of forward end of wrecker body M60

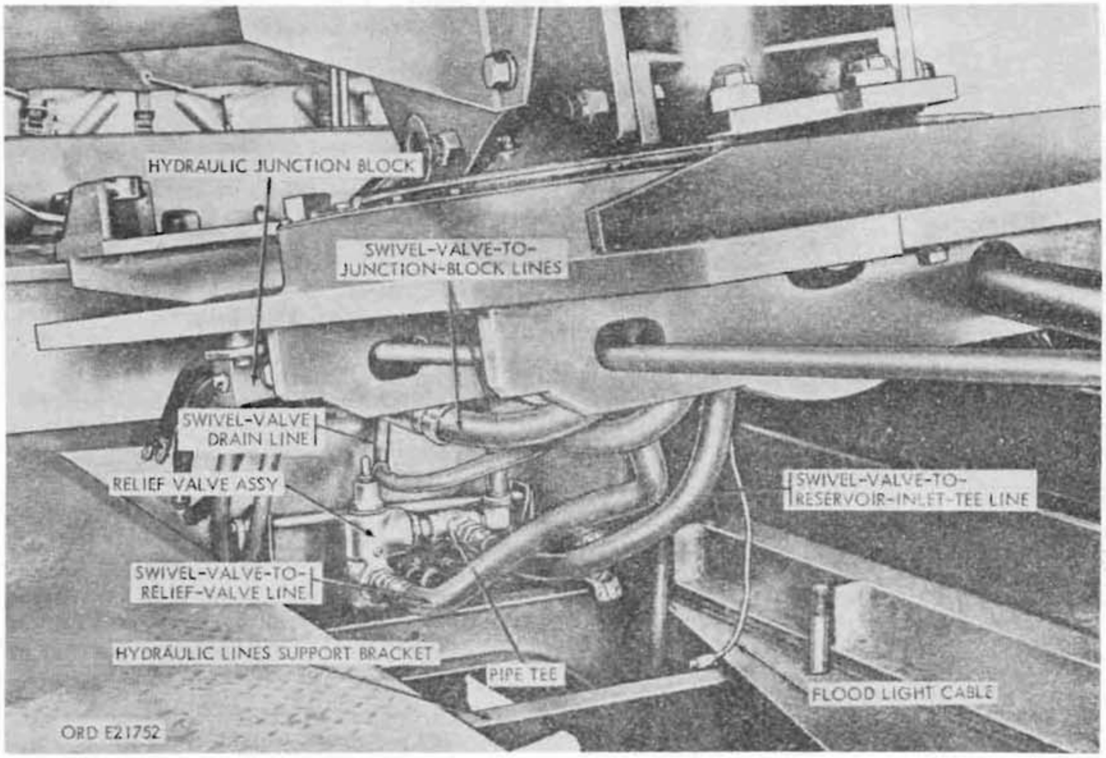


Figure 317. Swivel valve hose connections

(4) Remove clamp securing swivel valve drain line (fig. 317) to top of relief valve and remove line from valve.

(5) Close shutoff cock (fig. 304) at underside of hydraulic reservoir.

(6) Loosen two hose clamps securing pump inlet hose (fig. 304) to reservoir outlet.

(7) Remove cotter pin and yoke pin (fig. 318) securing hydraulic-pump-front-control-rod yoke to hydraulic-pump right relay lever, and remove yoke from lever.

(8) Disconnect the power-takeoff propeller shaft yoke (CC, fig. 320) at front of power-divider.

(9) Disconnect rear-winch front propeller shaft (fig. 316) from winch output shaft yoke (fig. 319) at rear of power-divider.

(10) Remove yoke pin and cotter pin (fig. 318) securing power-divider-rear-control rod yoke to input shifter-shaft arm, and remove yoke from arm.

Note. The key letters noted in parentheses are in figure 320, except where otherwise indicated.

(11) Unscrew nut securing carburetor-to-governor-valve line (AA) to governor-valve (W) inlet port elbow (Z), and remove line from elbow.

(12) Unscrew nut securing governor-valve-to-control-valve line (BB) to control-valve inlet port elbow (Z) and remove line from elbow.

(13) Unscrew nut securing control-valve-to-governor line (A) to control-valve outlet port elbow (Z) and remove line from elbow.

(14) Support power-divider, pump, and relief valve assembly, and remove four cotter pins and castellated nuts (fig. 318) securing power-divider mounting bracket to studs on bottom of reservoir. Remove power-divider, pump, and relief valve assembly from under vehicle.

(15) Remove hydraulic pump from pump adapter at rear of power-divider (fig. 319).

(16) Remove governor-valve from front of power-divider (fig. 321).

(17) Remove governor-valve control valve (fig. 321) from front of power-divider.

(18) Remove four cotter pins (fig. 321) and castellated nuts from studs securing mounting bracket to power-divider, and remove bracket from studs.

(19) Remove cotter pin, clevis pin, and washer securing hydraulic-pump-front-control-rod slotted clevis (fig. 321) to hydraulic-pump-output-shifter-shaft arm, and remove clevis, with control-valve control rod attached, from arm.

(20) Remove cotter pin and yoke pin securing rear-winch-front-control-rod yoke (fig. 321) to rear-winch output shifter-shaft arm and remove yoke from arm.

b. Installation.

(1) Position rear-winch-front-control-rod adjustable yoke (fig. 321) on rear-winch-output shifter-shaft arm and secure with yoke pin and cotter pin.

(2) Position hydraulic-pump-front-control-rod slotted clevis (fig. 321), with governor-valve control-valve control rod attached, on left side of hydraulic-pump-output-shifter-shaft arm, and secure with clevis pin and cotter pin.

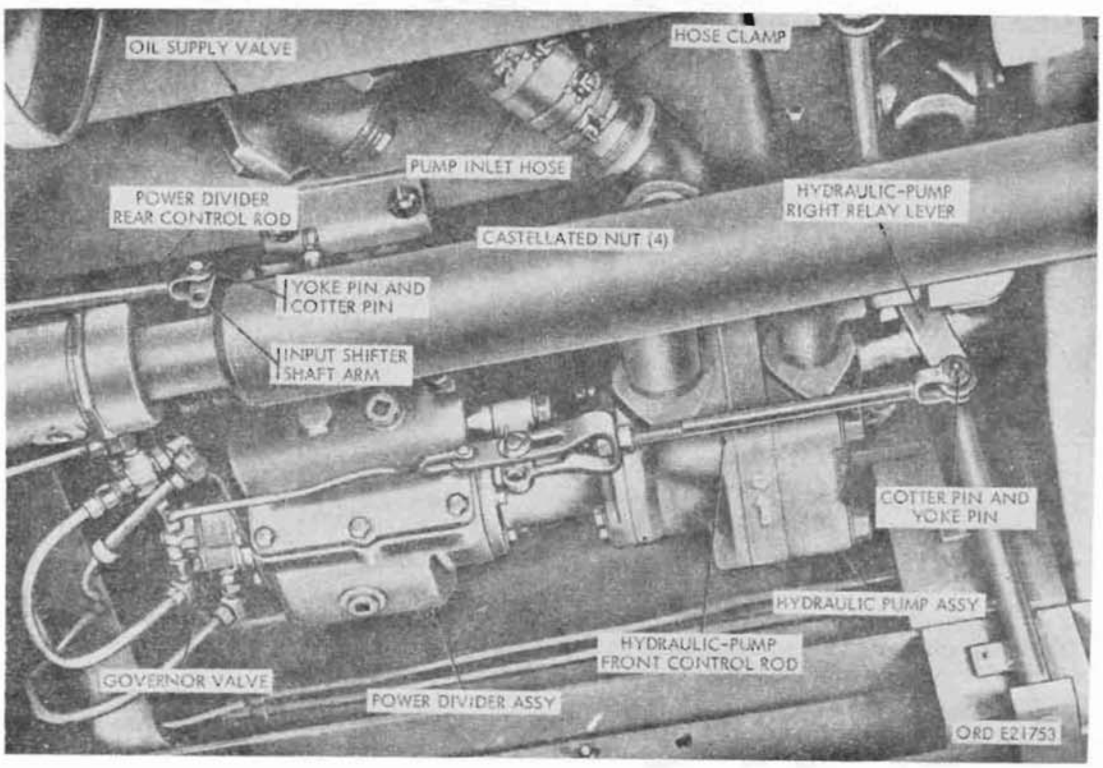


Figure 318. Bottom view of right side of power-divider - M60

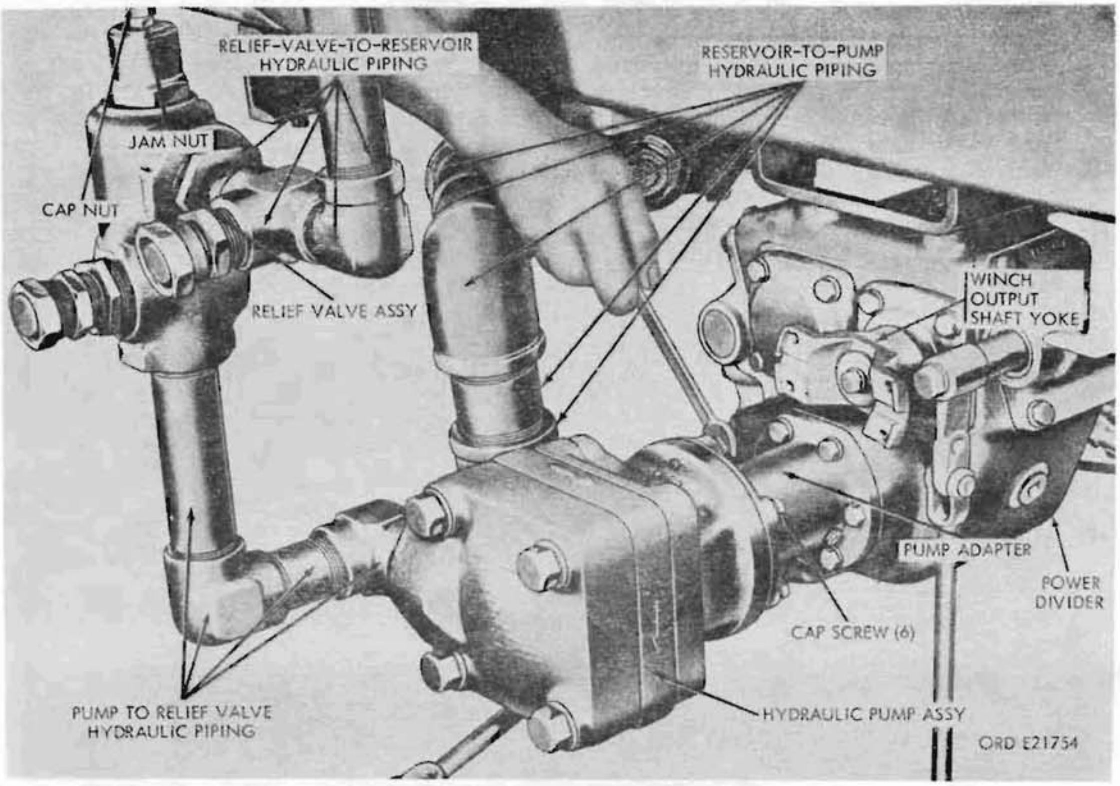


Figure 319. Hydraulic pump and relief valve assembly - M60

(3) Position mounting bracket (fig. 321) on studs on top of power-divider, and secure with four castellated nuts and cotter pins.

(4) Install governor-valve control valve on front of power-divider (fig. 321).

(5) Install governor-valve on front of power-divider (fig. 321).

(6) Position governor-valve-to-control-valve line (fig. 321) between governor-valve outlet port elbow and control-valve inlet port adapter, and tighten connector nuts.

(7) Install hydraulic pump on pump adapter at rear of power-divider (fig. 319).

(8) Position power-divider, pump, and relief valve assembly under vehicle, and secure power-divider mounting bracket to studs on underside of hydraulic reservoir with four castellated nuts (fig. 318) and cotter pins.

Note. The key letters noted in parentheses are in figure 320, except where otherwise indicated.

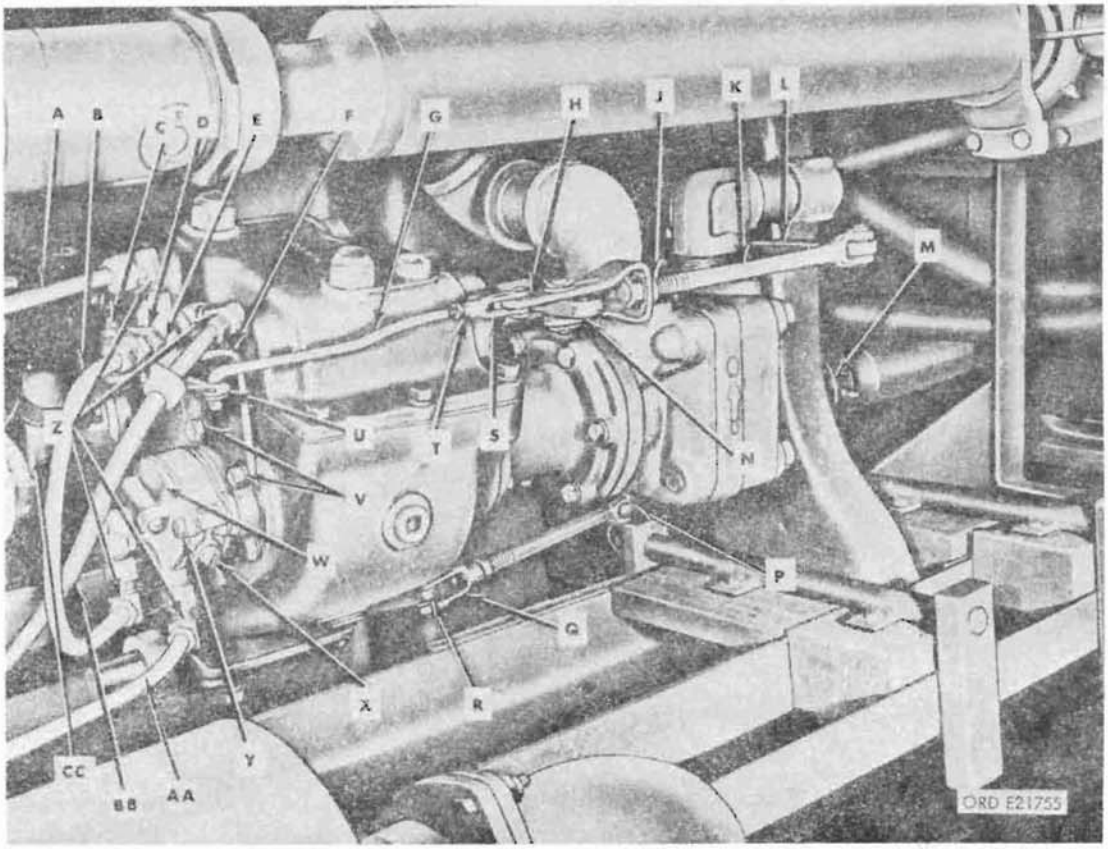
(9) Position control-valve-to-governor line (A) at control-valve outlet port elbow (Z) and tighten connector nut.

(10) Position governor-valve-to-control-valve line (BB) at control-valve inlet port elbow (Z), and tighten connector nut.

(11) Position carburetor-to-governor valve line (AA) at governor-valve inlet port elbow (Z), and tighten connector nut.

(12) Position power-divider-rear-control-rod yoke on input shifter-shaft arm (fig. 318), and secure with yoke pin and cotter pin.

(13) Connect rear-winch front propeller shaft (fig. 316) to winch-output shaft yoke (fig. 319) at rear of power-divider.



Key	Item	Key	Item
A	Control-valve-to-governor line	Q	Rear-winch-front-control-rod adjustable yoke
B	Governor-valve-to-control-valve line	R	Winch-output shifter-shaft arm
C	Safety nut	S	Yoke
D	Adapter	T	Nut
E	Governor-valve control valve	U	Control valve lever
F	Control-valve mounting bracket	V	Capscrews
G	Control-valve control rod	W	Governor valve
H	Slotted clevis	X	Adjusting hole plug
J	Nut	Y	Nut
K	Hydraulic-pump front control rod	Z	Elbows
L	Hydraulic-pump right relay lever	AA	Carburetor-to-governor-valve line
M	Pillow block	BB	Governor-valve-to-control-valve line
N	Hydraulic-pump-output-shifter-shaft arm	CC	Power takeoff propeller shaft
P	Rear-winch right relay lever		

Figure 320. Bottom view of underside of power-divider - M60

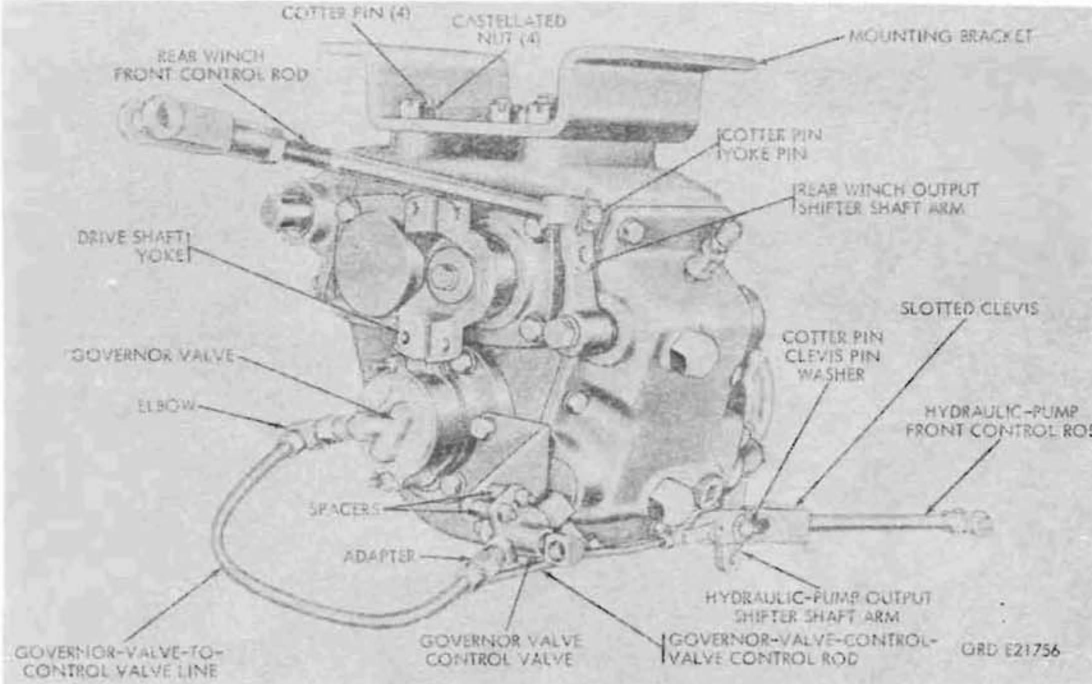


Figure 321. Power-divider removed from truck M60 - left front view

(14) Connect power-takeoff propeller shaft to drive-shaft yoke (CC) at front of power-divider.

(15) Position hydraulic-pump-front-control rod yoke on hydraulic pump right relay lever (fig. 318), and secure with yoke pin and cotter pin.

(16) Install pump inlet hose (fig. 304) on reservoir outlet, and tighten two hose clamps.

(17) Position swivel - valve -drain line (fig. 317) at top of relief valve and secure with clamp.

(18) Connect swivel-valve-to-reservoir-inlet-tee line to pipe tee at relief valve.

(19) Position rear-winch-front-control-rod yoke (fig. 316) on rear-winch right relay lever, and secure with yoke pin cotter pin.

(20) Turn elbow (fig. 316) to aline reservoir inlet hose with inlet sleeve on front of reservoir, install hose on sleeve, and tighten hose clamp securely.

(21) Open shutoff cock (fig. 304) at underside of hydraulic reservoir.

(22) Operate all functions of crane mechanism to purge air from hydraulic system.

(23) Add new oil to hydraulic reservoir, if necessary (par. 284).

289. Rear-mounted Winch (M60 only)

a. <u>Removal.</u>

(1) Remove cotter pin (fig. 322) and yoke pin securing air-chamber push-rod

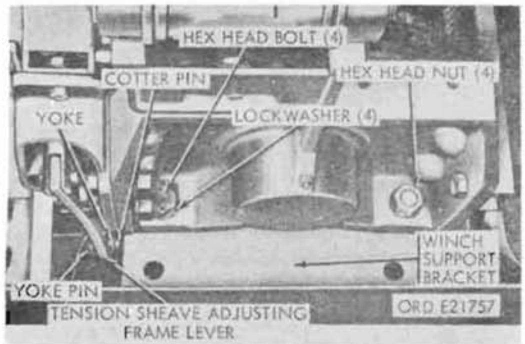


Figure 322. Top view of right end of rear winch - M60

yoke to lower end of tension-sheave-adjusting frame lever, and remove yoke from lever.

(2) Remove two capscrews and safety nuts securing floor plate (fig. 324) to support bracket bolted to rear of winch.

(3) Operate winch in small increments until master chain link is visible, remove link pin, and remove drive chain (fig. 324).

(4) Remove four hex-head bolts (fig. 322), nuts, and lockwashers securing winch to left and right support brackets.

(5) Remove chain and hook assembly from winch cable.

(6) Using wrecker crane (fig. 325) or other overhead hoisting equipment, remove rear winch from vehicle.

b. Installation.

(1) Lift rear winch into position on rear of wrecker body, and aline winch-mount-

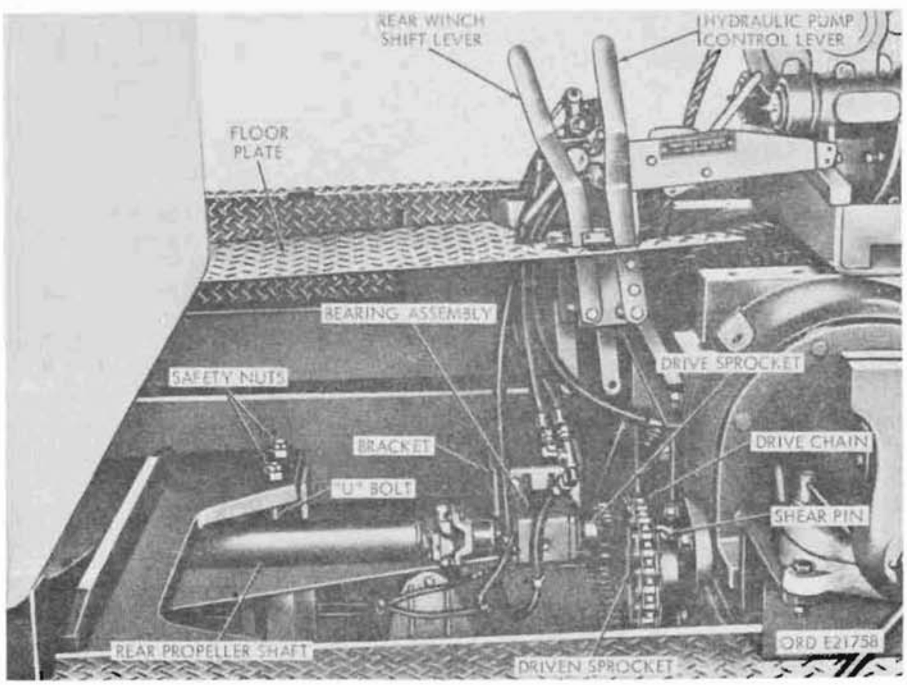


Figure 323. Left rear of wrecker body with floor plate raised

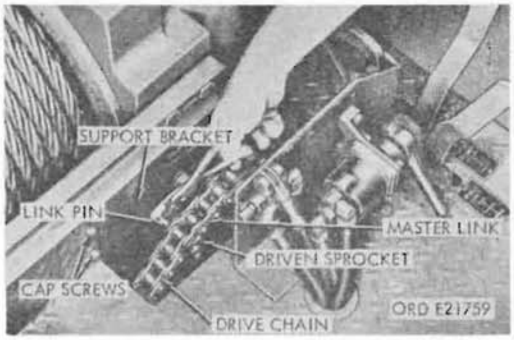


Figure 324. Removal of rear winch drive chain

ing holes in left and right support brackets.

(2) Secure winch to support brackets with four hex-head bolts (fig. 322), lock-washers, and nuts.

(3) Pass cable between tension sheaves of cable tensioner (fig. 325) and between upper and lower guide rollers and install chain and hook assembly on cable.

(4) Place drive chain around sprockets, pull ends of chain together, and install link pin (fig. 324).

(5) Install two capscrews in holes in floor plate (fig. 324) and support bracket bolts to rear winch. Install safety nuts on screws and tighten.

(6) Position air-chamber push-rod yoke on lower end of tension-sheave-adjusting-frame lever (fig. 322), and secure with yoke pin and cotter pin.

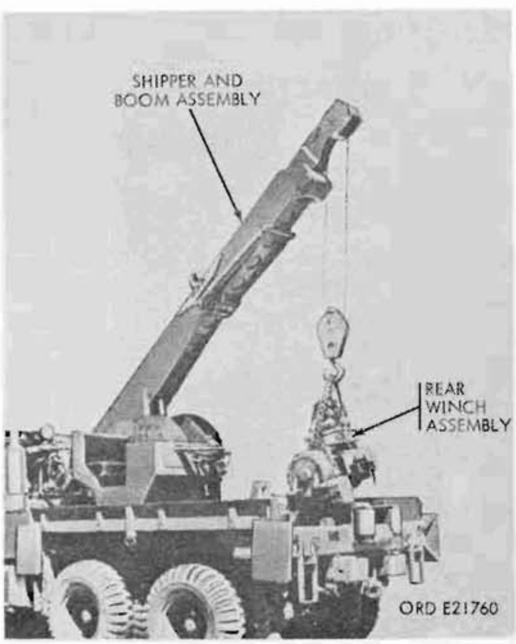


Figure 325. Removing rear winch assembly using wrecker crane M60

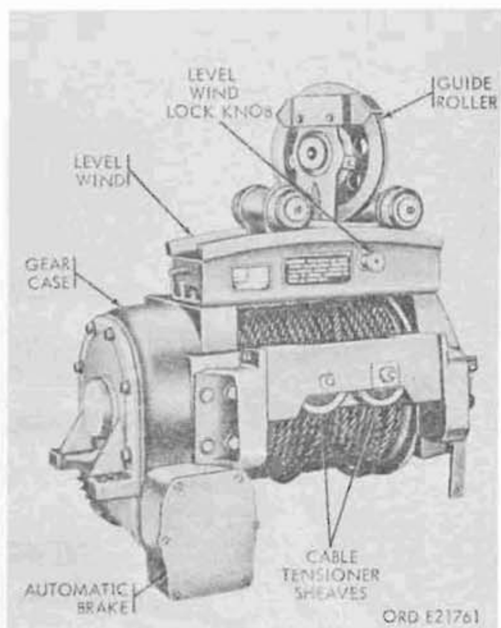


Figure 326. Left rear view of rear winch removed from wrecker truck M60

Section XLV. SHOP VAN BODY AND AUXILIARY EQUIPMENT (M109, M109A1, M109A2, M109C, M109D, M185, M185A1, M185A2)

290. Description and Data

Note. This section pertains specifically to the basic M109 Shop Van Body. Other M109 models and the M185 models are similar to this basic M109 model, but have minor differences. The organization maintenance procedures given herein for the basic M109 model are also applicable to the models mentioned in the title of this section.

a. Description. The van bodies are equipped with two 24-volt dc power circuits and one 115-volt ac power circuit (par. 291). An exhaust blower (fig. 328) is located on the body inside the rear panel to the left side of the rear doors. An ac-to-dc converter (fig. 329) is mounted directly on the body inside the front panel. The converter changes the 115-volt ac power to 24-volt dc power for the exhaust blower. Switches in the converter control the source voltage to the converter and adjust the output voltage to allow variation of the blower speed. A built-in circuit breaker in the converter protects the blower motor circuit. The power switch and circuit breaker box are mounted on brackets secured to the body inside the front panel. The power switch box contains a 115-volt switch section for control of 115-volt power in the van body, dome-light cutoff switch section for 24-volt power control to 24-volt dome lights, and blackout dome-light relay for control of the 115-volt blackout dome lights. The relay is actuated by the 115-volt rear door blackout switch. The relay contacts are normally closed. The circuit breaker box contains four circuit breakers used only for 115-volt circuits. The dome-light switch is mounted on a bracket above the converter. A conduit nipple connects the switch box to the circuit breaker box. A manually operated switch (fig. 329) selects the operating conditions for 115-volt

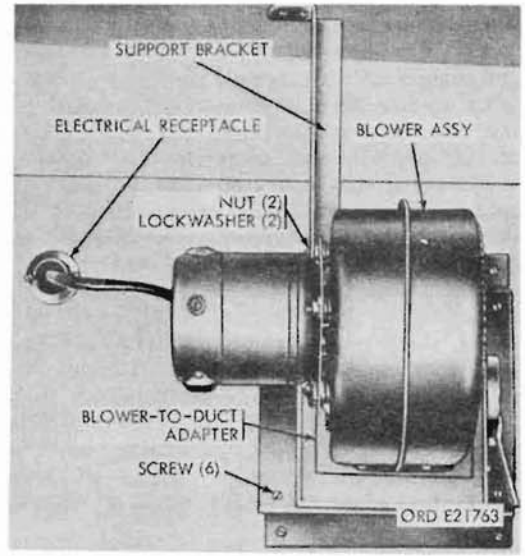


Figure 328. Exhaust blower

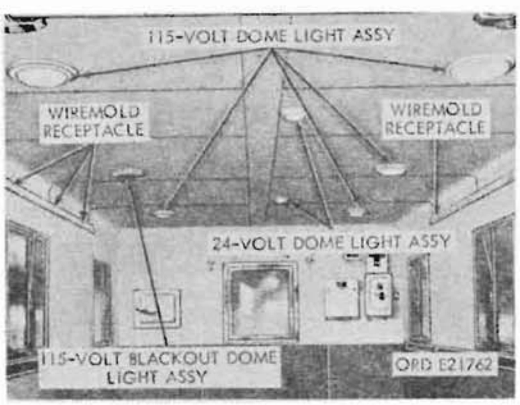


Figure 327. Dome lights and receptacles

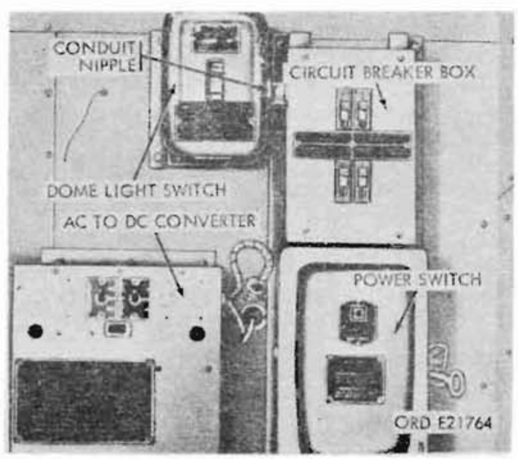


Figure 329. AC-to-DC converter, dome-light switch, power switch, and circuit breaker box

dome-light system. A dome-light toggle switch (fig. 330) and a blackout dome-light toggle switch are mounted on the body inside the rear panel on the right of and above the rear doors. The dome-light toggle switch operates the 24-volt dome lights, and blackout dome-light toggle switch inserts the door blackout switch in the 24-volt dome-light circuit. The rear door blackout switches (fig. 331), 24-volt and 115-volt, located above the rear doors on the inside of the body, operate on opening of the right rear door. A 24-volt rear door blackout switch removes power to the 24-volt dome lights on opening of the right rear door. A 115-volt door blackout switch actuates the blackout relay to extinguish the 115-volt dome lamps, leaving only the 115-volt blackout dome light on. There are five 115-volt dome lights, one blue-lens 115-volt blackout dome light, and two 24-volt dome lights. Five receptacles are mounted in each of the two plug-molding strips located on the body side panels just above the side windows. The two entrance receptacles (fig. 332), 24-volt and 115-volt, are located under the folding steps on the right outside front of the body. The side windows are provided with screens and can be opened as required.

b. Data.

Exhaust blower:
- Make . . . . Stewart-Warner
- Model SW-G488051
- Voltage . . . . 24 dc

Ac-to-dc converter:
- Make . . . . Stewart-Warner
- Model SW-G488050

Power switch:
- Make . . . . Superior Coach
- Model A-100218

Circuit breaker box:
- Make . . . . Trumbull Electric
- Model TE-TQLA7020

Dome-light switch:
- Make . . . . Trumbull Electric
- Model TE-M8360

291. Electrical System

a. The wiring circuits (fig. 73) for the M109 shop van body cover three electrical systems (b, c, and d below). Power for the shop

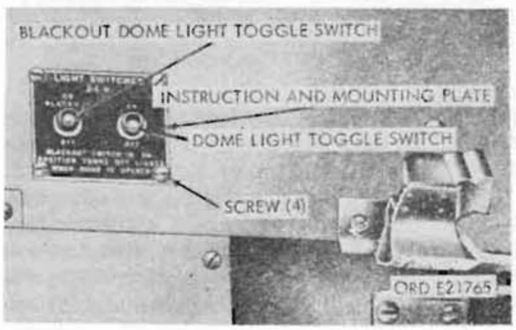


Figure 330. Dome light and blackout dome-light toggle switches

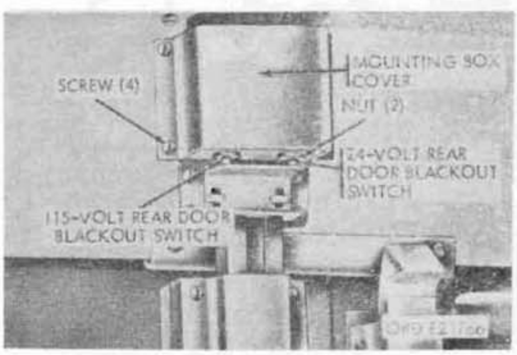


Figure 331. 24-volt and 115-volt rear door blackout switches

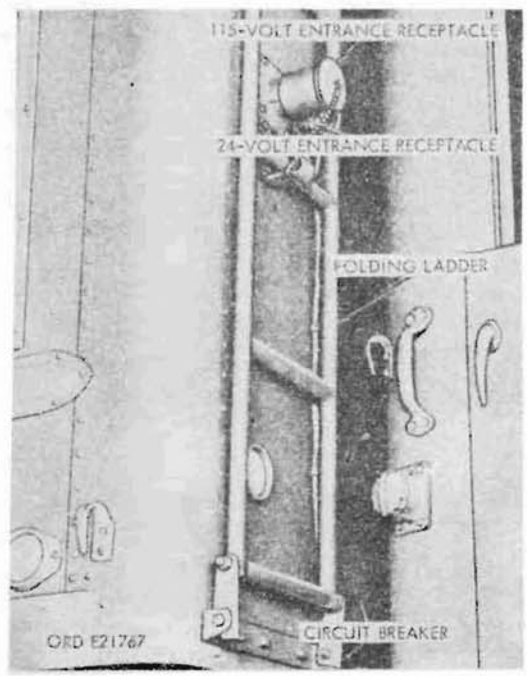


Figure 332. 24-volt and 115-volt entrance receptacle

van is obtained from two primary sources; the truck system and, when available, a 115-volt outside source.

b. The exhaust blower system is supplied either with 24-volt dc power from truck batteries through a circuit breaker mounted on the front panel of the van body or from a 115-volt to 24-volt dc converter mounted on the interior front wall of the van body. The converter receives 115-volt power from the 115-volt circuit breaker panel via a selector switch. The 115-volts ac is stepped down to approximately 24 volts by a transformer, and converted to 24 volts dc by a dry-disk rectifier.

c. The 24-volt dome-light system is supplied with power from the truck batteries through a circuit breaker on the firewall of the truck cab to a 24-volt entrance receptacle on the shop van body. A blackout switch on the rear door removes power from the 24-volt dome light when the door is opened during blackout conditions. This feature can be selected by a switch adjacent to the 24-volt dome-light switch (fig. 330). A cutoff switch is mounted in the 115-volt power switch box to cut out the 24-volt dome-light circuit when 115-volt power switch is switched to "ON" position to connect 115-volt ac power to the interior 115-volt van body circuits.

d. The 115-volt dome-light system is supplied with 115-volt ac power from an outside source through the 115-volt entrance receptacle and power switch, to circuit breaker box. The 115-volt dome-light switch is arranged so that the 115-volt dome lights may be turned on directly ("up" position) or ("down" position) may be connected through a blackout relay to turn on the blue blackout light and turn off the 115-volt dome lights when the rear doors are opened. The relay coil operates on 24 volts dc; the blackout light operates on 115 volts ac. Refer to Chapter 2, Section VI, figure 66, test 1, for a complete explanation.

Caution: Before replacing any electrical component, disconnect power sources at entrance receptacles. Contact with 24-volts or 115-volts can cause severe burns and shock, and damage to tools and equipment.

292. Power Switch

a. Power Switch Fuse Replacement. Disconnect external power cables from van body. Remove fuses from the fuse clips. Press two 250-volts, 60-amp cartridge fuses into fuse clips, and reconnect external power cables.

b. Power Switch (Fig. 333).

(1) Removal. Disconnect external power cables from two entrance receptacles. Disconnect electrical cables from power switch section, dome-light cutoff switch section, and blackout dome-light relay in switch box. Unscrew and remove bushing and locknut on end of nipple extending into switch box. Remove four screws and lockwashers holding the box to circuit breaker box (fig. 329) and power switch mounting left and right brackets, and remove switch box from brackets.

(2) Installation. Install switch box on mounting brackets with four lockwashers and hex-head screws after inserting electrical leads and end of 1-inch nipple into box. Secure the nipple to box with 1-inch conduit locknut and end bushing. Refer to figure 333 for a guide to wire locations. Connect cable (90) from body ground connection and converter dc receptacle to ground terminal on the power switch box. Connect cable (700) from 115-volt entrance receptacle to the terminal on the power switch blade right-hand contact. Connect cable (701) from 115-volt entrance receptacle to left-hand contact. Connect cable (700) from circuit breaker box (fig. 329) to terminal on fuse right-hand clip. Connect cable (701) from circuit breaker box to fuse left-hand clip. Connect cable (38) from dome-light switch to terminal on switch blade base of dome-light cutoff switch section. Connect cable (38) from 24-volt dome light to terminal on blade contact of cutoff switch. Connect cable (710) to top terminal on blackout relay coil. Connect cable (708) to terminal on one relay contact and cable (707) to other relay contact terminal. Connect two external power cables to entrance receptacles.

293. Dome-light Switch (Fig. 334)

a. Removal. Disconnect external power cables from two entrance receptacles. Disconnect electrical cables from terminals in

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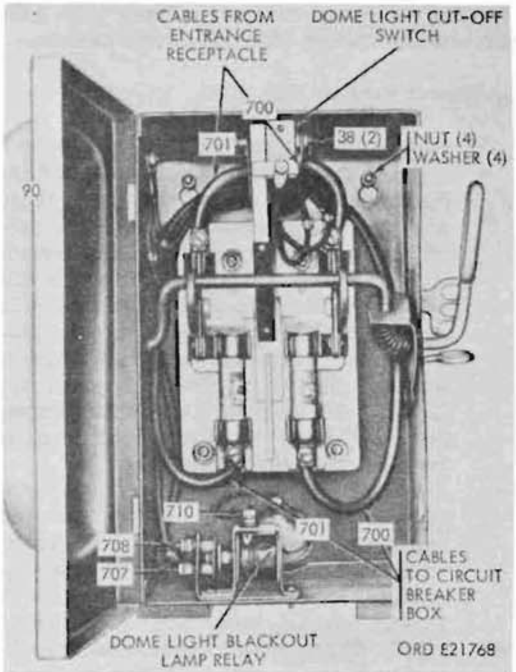


Figure 333. Power switch assembly

switch box. Unscrew and remove bushing and conduit locknut from end of nipple extending into box (fig. 329). Remove four screws and lockwashers holding box on mounting bracket (fig. 334) and remove box.

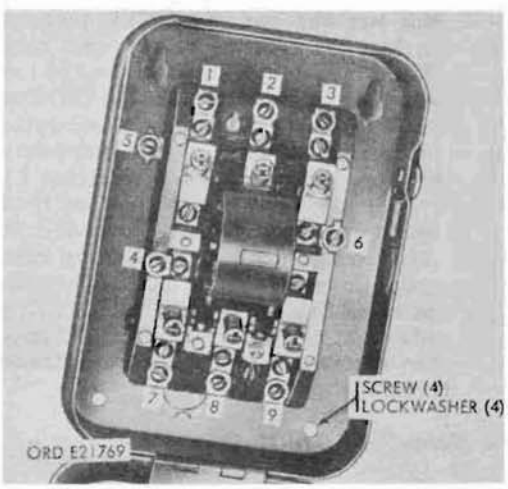


Figure 334. Dome-light switch

b. Installation. Install box on mounting bracket with four hex-head screws after inserting electrical leads and end of nipple into box. Secure nipple to box with a 3/4-inch conduit locknut and end bushing. Refer to figure 66, test 1, for a guide to wire locations. Connect the two cables (38) to terminal No. 6 in box. Connect cable (709) to terminal No. 3, cables (706 and 707) to terminal No. 2, cable (708) to terminal No. 1, cable (705) to terminal No. 4, and cable (703) to terminals Nos. 7 and 5. Terminals Nos. 8 and 9 have no wires connected to them. Connect external power cables to two entrance receptacles.

294. Dome-light and Blackout Dome-light Toggle Switches (Fig. 330)

a. Removal. Disconnect external power cables from two entrance receptacles. Remove four screws holding dome-light and blackout dome-light toggle switch and mounting instruction plate on body rear panel, and remove plate. Disconnect cables from each switch, noting location for future reconnection. Remove nut holding each switch to plate, and remove switches.

b. Installation. Install switches on mounting plate with hex-nut provided with each switch. Connect cables to terminals on switches. Install plate on body rear panel with four roundhead tapping screws. Connect external power cables to two entrance receptacles.

295. 24-Volt and 115-Volt Rear Door Blackout Switches (Fig. 331)

a. Removal. Disconnect external power cables from two entrance receptacles. Remove four screws holding door blackout switch mounting box cover in plate on blackout door switch mounting box, and remove cover. Unscrew nut holding each switch on mounting box, and pull switches away from box. Disconnect electrical cables from each switch, and remove switches.

b. Installation. Connect cables (38, fig. 73) to terminals on 24-volt door blackout switch, and cables (709 and 719, fig. 73) to terminals on 115-volt door blackout switch. Install each switch in mounting box with hex-nut provided with switch. Install mounting box cover over box with four roundhead tapping screws. Connect external power cables to two entrance receptacles.

296. Lamps

a. 24-Volt Dome Lamp Replacement.

(1) Removal. Loosen screw securing light door and lower the hinged door. Press in and turn lamp counterclockwise to release bayonet-type lamp base from the socket, and remove lamp.

(2) Installation. Install 24-volt lamp in socket. Raise hinged door and secure door to light body with roundhead machine screw.

b. 115-Volt Dome Lamp Replacement.

(1) Removal. Loosen machine screw securing light door and lower the hinged door. Unscrew and remove lamp.

(2) Installation. Install 75-watt, 115-volt dome lamp in socket. Raise hinged door and secure to light body with panhead machine screw.

297. Lights

a. 24-Volt Dome Light (Fig. 327).

(1) Removal. Disconnect external power cables from two entrance receptacles. Remove dome lamp (par. 296). Remove four screws securing light fixture to roof panel. Pull light away from panel. Disconnect one electrical cable from socket and other cable from screw in side of light fixture, and remove light.

(2) Installation. Connect cable (90, fig. 61) to tapping screw in side of light fixture, and cable (38, fig. 61) to lamp socket. Install light in roof panel with four flat-head screws. Install dome lamp (par. 296). Connect external power cables to two entrance receptacles.

b. 115-Volt Dome Light and Blackout Dome-Light (Fig. 327).

(1) Removal. Disconnect external power cables from two entrance receptacles. Remove dome lamp (par. 296). Remove four screws securing light fixture to roof panel. Pull light away from panel, disconnect electrical cables from socket, and remove light.

(2) Installation. Connect cables (700 and 706, fig. 72) to light socket in dome light, or cables (700 and 705, fig. 62) to light socket in blackout dome light. Install light in roof panel with four fillister-head screws. Install dome lamp (par. 296). Connect external power cables to two entrance receptacles.

298. Door Seal Assembly

a. Removal. Open doors and pull seal assembly from channel in door opening.

b. Installation.

(1) Be sure that door channel is free from cement, dirt, or other foreign material.

(2) Cement seal assembly into door channels with adhesive FSN 8040-221-3811.

299. Exhaust Blower (Fig. 328)

a. Removal. Unplug blower motor cable connector from receptacle in body rear panel. Remove two nuts and lockwashers holding exhaust blower support bracket to exhaust blower motor mounting plate. Remove six lockwashers and screws holding exhaust blower wheel housing to exhaust blower duct, and remove blower. Screw two nuts and lockwashers back on motor mounting plate studs.

b. Repair. Straighten bent fins in wheel assembly. Bump out dents and straighten bent wheel housing and cutoff damper. Replace all parts damaged beyond repair. Replace damaged plug or terminal on cable assemblies. Replace motor assembly if satisfactory repairs cannot be made.

c. Installation. Remove the nuts and lockwashers from rear two motor mounting studs, and install exhaust blower on exhaust blower support bracket by sliding motor mounting studs through holes in bracket. Secure blower to bracket with two hex-nuts and lockwashers removed from studs. Secure exhaust blower wheel housing to blower duct with roundhead screws. Plug blower motor cable connector into its receptacle on body rear panel.

300. Reflectors

a. Removal. Remove two screws securing reflectors to van body side and remove reflectors.

b. Installation. Position reflector in place and secure to van body with two screws.

301. Data Plates

a. Removal. Remove four screws attaching data plate to panel and remove plate.

b. Installation. Position data plate in place and attach to panel with four roundhead screws.

Section XLVI. TELEPHONE CONSTRUCTION AND MAINTENANCE BODY AND AUXILIARY EQUIPMENT (V-17A/MTQ)

302. Description and Data

a. Description. The V-17A/MTQ truck carries a revolving platform (fig. 335) on top of the body. The platform is constructed of a steel plate welded to a support ring. The ring has rollers and bearings, revolving on the base frame with a brake ring, which is bolted to the body. The pole derrick (fig. 336) is carried in the left side of the body and held in place by two derrick leg holddown clamps. The pole-pulling jack is mounted in a holder in the body on the left side of the body platform. A universal sheave-block socket is secured to the rear edge of the body platform. Wheel chocks with a chain are located in the holders, one between each pair of rear wheels. The roller sheave spindle bars are mounted on brackets in three locations on the truck body, one within the body above the rear winch and two at the rear of the body. A collapsible cable reel is held in stowed position on a holder fastened on the right, within the body. The support legs are secured to the truck by welded mounting brackets and are held in stowed position by chains. The V-17A/MTQ rear winch (fig. 337) is enclosed within the front end of the body and is secured to the truck frame by mounting angles. Both the auxiliary shaft of the winch (mounted to the

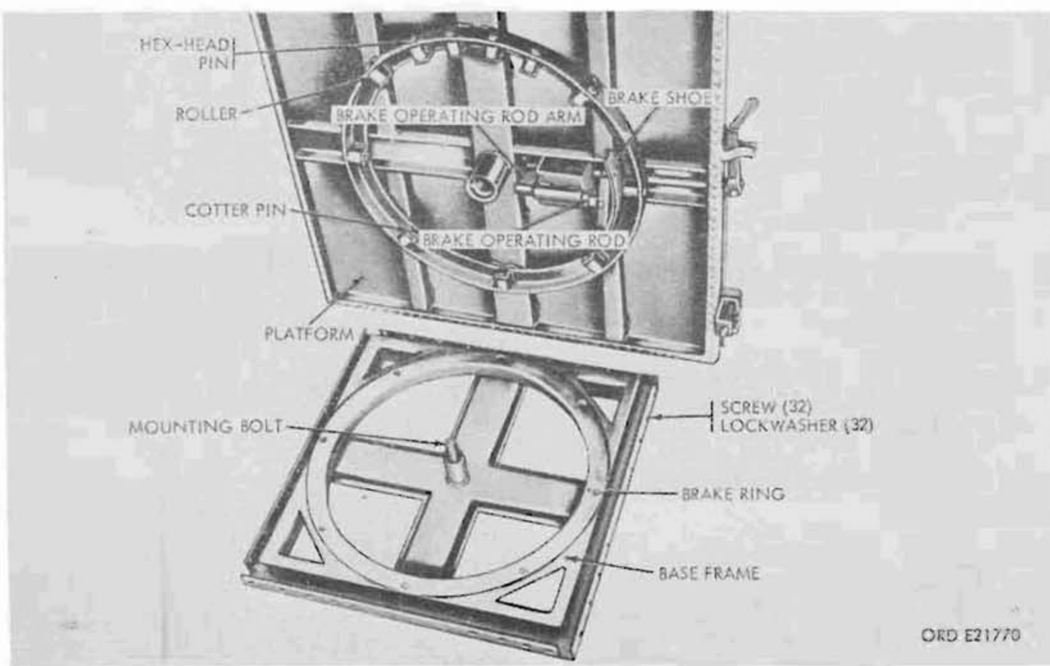


Figure 335. Revolving platform, rollers, and brakeshoe

underside of the winch) and the winch drum shaft extend through protected openings on the right side of the body. The winch-drum clutch and brake are operated by action of a control lever in the cab. Power to the winch is through a drive chain from the V-17A/MTQ pillow block support mounted on the underside of the winch mounting frame. The pillow block receives power from the transfer power take-off through the rear winch drive shaft.

b. Data.

V-17A/MTQ rear winch:
- Make . . . . Highway Trailer Co.
- Model L18-RLC-92
- Characteristics:
  - Drum drive . . . . tooth clutch
  - Drum brake . . . . friction disk
  - Drum type . . . . single, free
  - Worm brake . . . . automatic friction
  - Winch rope . . . . 700 feet by 7/16-in. dia. (6 strands, 19 wires per strand)

V-17A/MTQ pillow block:
- Make . . . . Highway Trailer Co.
- Model . . . . F

Rear winch drive shaft:
- Make . . . . Spicer Mfg Co.
- Model SP-8847-SF

Revolving platform:
- Make . . . . J. H. Holan Corp.

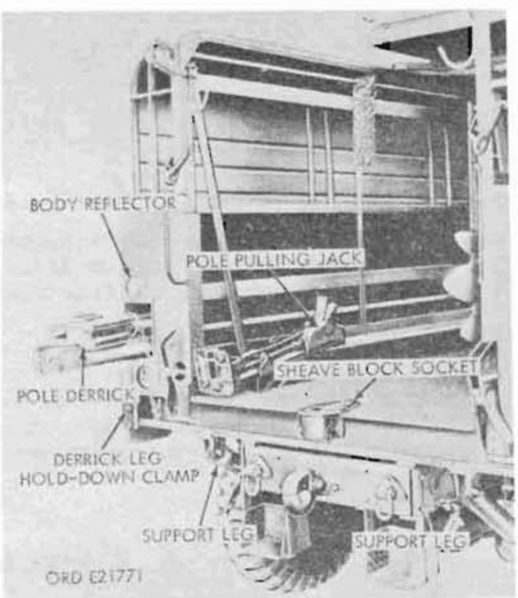


Figure 336. V-17A/MTQ body mounted auxiliary equipment

- Model JHH-1800-66

Pole derrick:
- Make . . . . J. H. Holan Corp.
- Model . . . . JHH-MA 40H

Pole-pulling jack:
- Make . . . . Templeton, Kenly & Co.
- Model TK-329
- Capacity . . . . 15 ton
- Lift . . . . 22 in.

Universal sheave block with socket:
- Make . . . . Gar Wood Industries
- Model . . . . GW 9Y 651B

Collapsible cable reel:
- Make . . . . Highway Trailer Co.
- Model . . . . CR

V-17A/MTQ support legs:
- Make . . . . Gar Wood Industries
- Model GW-304917
- Length:
  - Extended . . . . 41 in.
  - Collapsed . . . . 25-1/2 in.

303. Revolving Platform, Rollers and Brakeshoe (Fig. 325)

a. Revolving Platform Removal. Remove screws holding mounting bolt access cover to platform, and remove the cover. Remove cotter pin, slotted nut, plain washer, and fiber washer from mounting bolt. With chain hoist, remove platform from base frame and brake ring. Remove 32 screws, lockwashers, and nuts holding base frame on base frame support, and remove base frame and brake ring as a unit.

b. Platform Rollers.

(1) Removal. Remove cotter pin and hex-head pin from roller bushing-type bearing. Remove bearings and rollers from revolving platform assembly.

(2) Installation. Install roller bushing-type bearings in rollers and install rollers in ring of revolving platform assembly with hex-head pin and insert cotter pin.

c. Brakeshoe.

(1) Removal. Remove cotter pin and clevis pin holding brakeshoe on brake-operating rod, and remove shoe.

(2) Installation. Install brakeshoe on brake-operating rod with clevis pin and cotter pin.

d. Revolving Platform Installation. Position brake ring and base frame on frame support and secure to support with thirty-two hex-head screws, lockwashers, and hex-nuts. Using a chain hoist, install platform on base frame. Secure platform to frame by installing a thick fiber washer; thick lockwasher; slotted nut; and cotter pin on mounting bolt. Install access cover on platform with two roundhead screws.

304. Collapsible Cable Reel

a. Removal and Installation. Refer to TM 9-2320-209-10 for removal and installation of collapsible cable reel.

b. Repair. Weld, straighten or replace bent, broken or damaged parts.

305. Rear Winch

a. Rear Winch Cover (Fig. 337)

(1) Removal. Remove 10 screws holding winch lower shaft cover and cover plate to body, and remove cover and plate. Remove 14 nuts, lockwashers and screws holding winch upper cover side support to inside of body. Remove four nuts, lockwashers, and screws holding winch upper cover front support to body. Remove winch front and upper covers and upper cover supports from body.

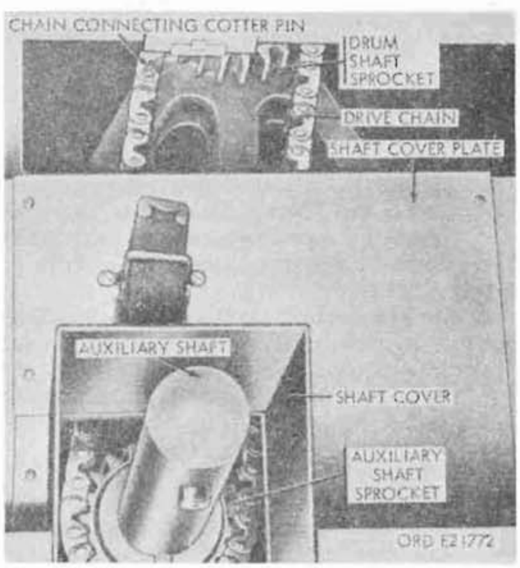


Figure 337. V-17A/MTQ rear winch lower shaft cover and plate, and auxiliary drive chain

(2) Installation. Install winch front and upper covers, and upper cover supports in place over winch, and secure upper cover front support to body with four hex-head screws, lockwashers, and hex-nuts. Secure upper cover side support to body with 14 roundhead screws, lockwashers, and hex-nuts. Install winch lower shaft cover and plate over right end of auxiliary shaft with 10 roundhead tapping screws.

b. Rear Winch Cable.

Caution: Use leather gloves when handling the winch cable. Frayed cable can cause painful injury.

(1) Removal. Unspool winch cable from winch drum. Remove screw and wire rope clamp securing cable to drum, and remove cable.

(2) Installation. Install end of winch cable on drum with a wire rope clamp and fillister-head screw. Secure clamp tightly. With cable running over top of drum, place a suitable load on end of cable. Operate winch to take up cable, being sure to wind cable tight.

Note. Make sure first layer of cable goes on drum in order and that each additional layer starts back across drum properly. If necessary, use a block of wood to hammer or push the cable into place, assuring proper wrapping of first layer.

c. Rear Winch Drive Chain.

(1) Removal. Move chain until chain-connecting long and short pins are accessible. Remove tension of pillow block (fig. 338) on winch drive chain by loosening hex-head bolt on side of pillow block. Remove cotter pin from end of long pin, and remove long and short pins from chain. Remove chain from pillow block and worm sprockets.

(2) Installation.

Note. Check alinement of faces of pillow block and worm sprockets before installing winch drive chain. Improperly alined sprockets will cause uneven wear on sprocket teeth and chain.

Install chain on pillow block and worm sprockets with free ends of chain in an accessible place. Connect ends of chain with long and short pins, and cotter pin. Using hex-head bolt and jamnut on the side of the pillow block (fig. 338), adjust the chain tension to less than taut to minimize the whipping action of the chain during winch operation.

d. Rear Winch Worm Sprocket (Fig. 338).

(1) Removal. Remove winch drive chain (c above). Remove wire from worm sprocket screw and spacer on end of left-hand worm shaft, and remove screw and spacer from shaft. Pull sprocket from worm shaft with a suitable puller. Tape key in shaft keyway to prevent its loss.

(2) Installation. Install sprocket on worm shaft over key and secure with sprocket spacer and screw. Tie spacer and screw with 0.041-inch diameter wire. Install winch drive chain (c above).

e. Rear Winch Auxiliary Shaft Drive Chain.

(1) Removal. Remove winch cover (a above). Turn winch drum shaft until chain-connecting long and short pins (fig. 337) are accessible. Remove cotter pin from end of long pin, and remove long and short pins from chain. Remove chain from drum shaft and auxiliary shaft sprockets.

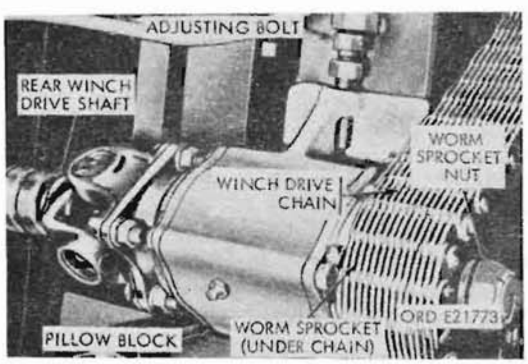


Figure 338. Pillow block and winch drive chain

(2) Installation.

Note. Check alinement of drum shaft and auxiliary shaft sprockets before connecting chain. Improperly alined sprockets will cause uneven wear on sprockets and chain.

Install auxiliary shaft drive chain around drum shaft and auxiliary shaft sprockets, and secure ends of the chain together with long and short pins (fig. 337). Install cotter pin through end of long pin to hold pin in position. Install winch cover (a above).

f. Rear Winch Auxiliary Shaft Sprockets (Fig. 339).

(1) Removal. Remove winch cover (a above). Remove auxiliary shaft drive chain (e above). Remove auxiliary shaft (g below). Loosen setscrew securing auxiliary shaft sprocket on shaft, and remove sprocket. Tape key in shaft keyway to prevent loss of key.

(2) Installation. Install sprocket on auxiliary shaft over key, and tighten setscrew to secure sprocket in place. Install auxiliary shaft drive chain (e above). Install winch cover (a above).

g. Rear Winch.

(1) Removal. Remove winch cable (b above). Remove winch cover (a above). Remove auxiliary shaft drive chain (e above). Remove taper pins securing thrust collars in place on auxiliary shaft

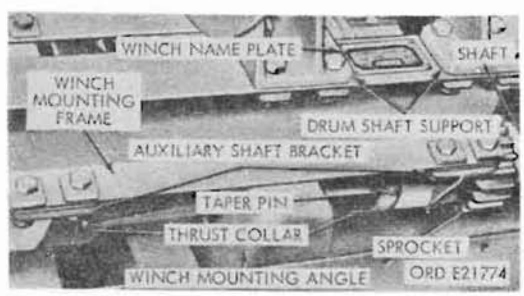


Figure 339. Rear winch auxiliary shaft and sprocket

(fig. 339). Remove auxiliary shaft from auxiliary shaft brackets, and remove thrust collars from shaft. Remove cotter pin and clevis pin, and disconnect control lever rod at cross-shaft left arm (fig. 340). Remove winch drive chain (c above). Remove pillow block (fig. 338). Remove four nuts, lockwashers, and bolts holding winch-mounting frame to winch mounting-angles (fig. 339). Using a chain hoist, remove winch from body. Remove part of control lever linkage (par. 306) remaining on winch.

(2) Installation. Install part of control lever linkage (par. 306) attached directly on winch. Using a chain hoist, install winch with winch-mounting frame resting on mounting angles. Secure winch frame to mounting angles with four hex-head bolts, lockwashers, and hex-nuts. Install pillow block (fig. 338). Install winch drive chain (e above). Connect control lever rod to cross-shaft left arm with clevis pin and cotter pin. Install auxiliary shaft through right-hand auxiliary shaft bracket. Install two thrust collars on left end of shaft and slide shaft through other bracket. Aline taper pin holes in collars to holes in shaft, and install taper pins. Install auxiliary shaft drive chain (e above). Install winch cover (a above). Install winch cable (b above).

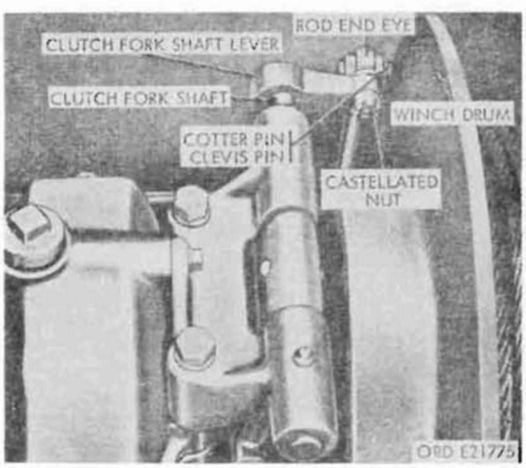


Figure 340. Rear winch control linkage - at winch

h. Rear Winch Drum Shaft Sprocket.

(1) Removal. Remove auxiliary shaft drive chain (e above). Drive out straight pin at end of drum shaft. Loosen setscrew in drum shaft sprocket, and remove sprocket. Tape key in shaft keyway to prevent loss.

(2) Installation. Install drum shaft sprocket on shaft over key. Tighten sprocket setscrew to secure sprocket in place. Install straight pin in end of shaft. Install auxiliary shaft drive chain (e above).

i. Rear Winch Testing. Prepare vehicle for rear winch operation (TM 9-2320-209-10). Operate winch to remove drum cable by hand and apply drum brake to control free spooling of winch drum. Operate winch to take up drum cable and check drum clutch engagement. Disengage drum clutch and check for complete disengagement of clutch and brake plate from drum. Install a suitable load on drum cable and operate winch to raise load.

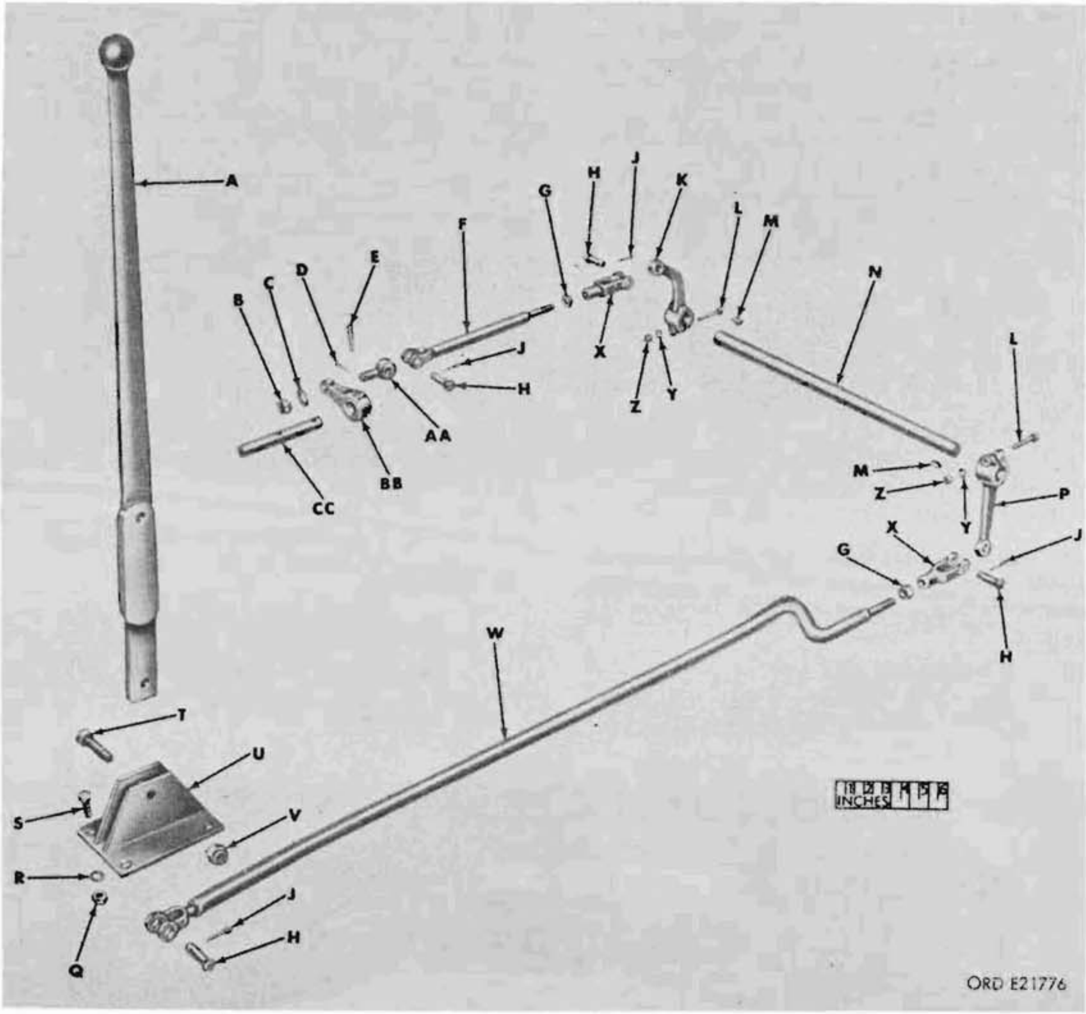
Caution: Do not disengage drum clutch when load is on cable. Remove power to winch and check for creeping of suspended load. Load must not creep. Apply power to winch and lower load. If winch does not function in any of these conditions, refer to direct support maintenance unit.

306. Winch Controls and Linkages

Note. The key letters noted in parentheses refer to figure 341, except where otherwise indicated.

a. Removal. Remove the cotter pin (J) and clevis pin (H) holding end yoke of control lever rod (W) to control lever (A) and remove rod from lever. Remove safety nut (V) and screw (T) holding control lever (A) in mounting bracket (U), and remove lever. Remove four nuts (Q), lockwashers (R), and screws (S) holding control lever mounting bracket to floor of cab, and remove bracket. Remove cotter pin (J) clevis pin (H) holding end yoke (X) of control lever rod (W) to cross-shaft left arm (P) near winch-mounting frame, and remove rod from truck.

Note. If the rear winch is to be removed, removal of the winch (par. 305) at this time will facilitate the removal of the remainder of the control linkage.



Key	Item	Key	Item
A	Control lever	Q	Nut (4)
B	Castellated nut	R	Lockwasher (4)
C	Flat washer	S	Screw (4)
D	Cotter pin	T	Screw
E	Taper pin	U	Mounting bracket
F	Clutch control rod	V	Safety nut
G	Jam nut	W	Control lever rod
H	Clevis pin	X	End yoke
J	Cotter pin	Y	Lockwasher
K	Cross-shaft right arm	Z	Nut
L	Screw	AA	Rod-end eye
M	Woodruff key	BB	Clutch fork shaft lever
N	Cross-shaft	CC	Clutch fork shaft
P	Cross-shaft left arm		

Figure 341. Rear winch controls and linkages - exploded view

Remove cotter pin (D), castellated nut (B) and flat washer (C) holding rod-end eye (AA) on clutch-fork shaft lever (BB), and remove eye. Remove taper pin (E) holding shaft lever (BB) to clutch fork shaft (CC), and remove lever. Loosen nuts (Z) on arms (K and P) of cross-shaft (N) extending through winch-mounting frame (fig. 339) and remove arms from shaft. Remove woodruff keys (M) from cross-shaft, and remove shaft from mounting frame.

b. Installation. Install cross-shaft (N) in winch-mounting frame. Install two woodruff keys (M) in shaft. Install shaft left (P) and right (K) arms on shaft over keys. Tighten nuts (Z) on arms. Install clutch fork shaft lever (BB) on clutch fork shaft (CC) with taper pin (E). Install rod-end eye (AA) in clutch fork-shaft lever (BB) with a flat washer (C), castellated nut (B) and cotter pin (D).

Note. If the rear winch has been removed from the vehicle, install the winch (par. 305) before proceeding with further linkage installation.

Install control lever rod (W) to cross-shaft left arm (P) with clevis pin (H) and cotter pin (J). Install control-lever mounting bracket (U) on floor of cab with four hex-head screws (S), lockwashers (R), and hex-nuts (Q). Install control lever (A) in bracket with hex-head screw (T) and safety nut (V). Connect end of control-lever rod to control lever with clevis pin (H) and cotter pin (J).

c. Adjustment. Move control lever through its operating positions (refer to TM 9-2320-209-10) to make sure that linkage engages and disengages winch clutch and brake. Adjust linkage with adjustable rod-end yokes, if necessary, for proper engagement and disengagement.

307. Winch Universal Joint

Refer to paragraph 166 for removal and installation of the snapring-type universal joint.

308. Power Takeoff Controls and Linkage

a. Removal.

(1) Disconnect shift control lever link. Remove two safety nuts holding link to power-takeoff shifter shaft lever (fig. 342) and to shift control lever, and remove link.

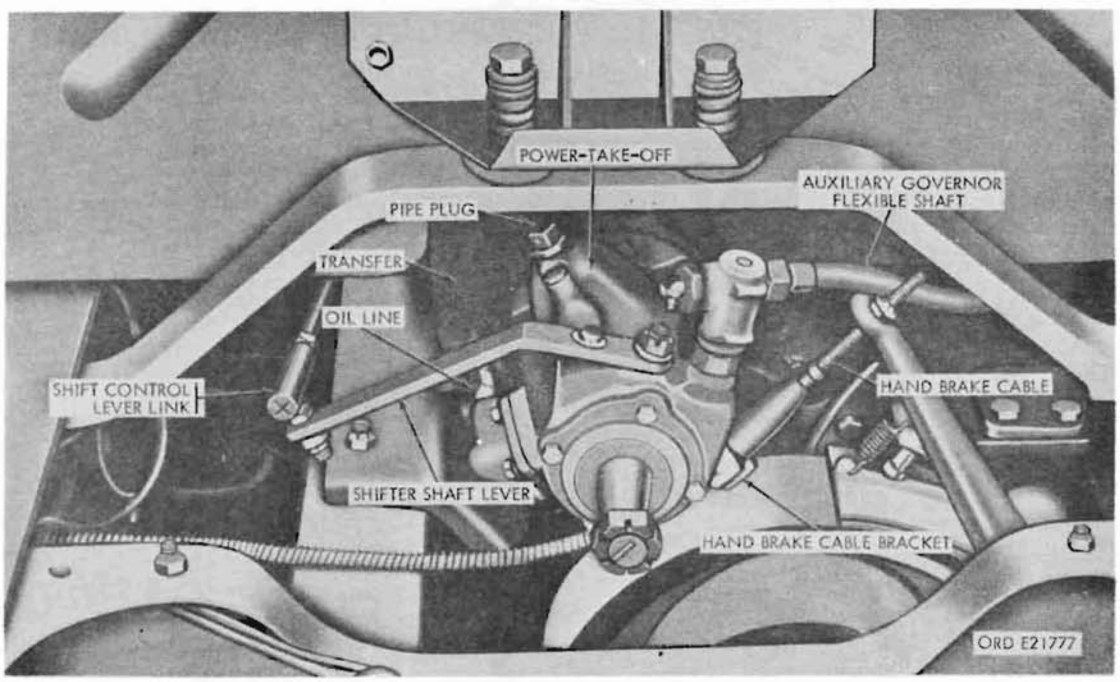


Figure 342. Transfer power takeoff - installed

(2) Remove shifting lever. Remove four safety nuts holding control-lever shaft bearing brackets to floor of cab, and remove brackets, shifting lever with integral shaft, and shift control lever from cab as a unit.

b. Repair. Weld, straighten or replace any bent, broken or damaged parts as required.

c. Installation.

(1) Install shifting lever. Position shifting lever with integral shaft, shift control lever, and shaft bearing brackets on the floor of cab with control lever extending through hole in floor of cab. Secure bearing brackets to cab floor with two 85,000-psi yield strength hex-head screws and safety nuts for each bracket.

(2) Install shift control lever link. Install shift control lever link to shift control lever with safety nut. Lock shifting lever in the disengaged position. Place power takeoff in the disengaged position by moving power-takeoff shifter-shaft lever in a rearward direction to disengage the power takeoff. Detent in power takeoff will hold shifter shaft in position. Check to see whether the shift control lever link can be connected to shifter-shaft lever (fig. 342) without shaft lever movement. If so, connect link to shaft lever with safety nut. If not, adjust linkage (d below).

d. Adjust Linkage. Adjust shift control lever link length until link mates with shaft lever without shaft motion, then attach link with safety nut. Unlock shifting lever and move to the engaged position. Check to be sure power takeoff is fully engaged and that detent holds shifter shaft in position. Adjust control lever link length, if necessary, to relieve any partial disengagement.

Section XLVII. EARTH BORING MACHINE AND POLE SETTER BODY AND AUXILIARY EQUIPMENT (V-18A/MTQ)

309. Description and Data

a. Description. The V-18A/MTQ truck has an earth boring machine (fig. 345) mounted in an opening in the rear of the body platform. The clutch and brake case of the boring machine extends through an opening in the body platform where the boring-machine drive shaft attaches to the boring machine. The drive shaft is attached at the front end to the power-divider, mounted underneath the body. The power-divider drive shaft connects the transfer power takeoff to the power-divider. The four earth augers are mounted in holders, two at each side of the rear winch (fig. 343). A collapsible cable reel is mounted on a holder secured at the left side of the body and to the left wheel housing. Support legs (fig. 344) are attached to the ends of the chassis frame sidemembers by mounting brackets, and are held up in the stowed position by chains. Wheel chocks with chain are held in holders, located at the rear of the truck wheel housings. The controls are mounted on the boring machine (fig. 345). The control lever operating handles are mounted on the feed and drive clutch shaft tube. The vertical power leveler shifter shaft lever (fig. 345) is attached to the vertical power leveler chain guard, located on the intermediate case of the boring machine.

b. Data.

Earth boring machine:	
Make	Highway Trailer Co.
Model	HD
Rack length	13 ft
Earth boring machine drive shaft:	
Make	Spicer Mfg. Co.
Model	SP-8075-200-SF
Power-divider:	
Make	Highway Trailer Co.
Model	P
Power-divider drive shaft:	
Make	Spicer Mfg. Co.
Model	SP-10413-SF
Earth augers:	
Make	Highway Trailer Co.
Sizes	9, 12, 16, and 20-in. dia
Model:	
9 in.	HG-EA2990
12 in.	HG-246B14
16 in.	HG-158A36
20 in.	HG-240B21
V-18A/MTQ support leg:	
Make	Highway Trailer Co.
Model	HG-EA3726D

Length:
- Collapsed . . . . .18-3/16 in.
- Extended . . . . .40-3/16 in.

Wheel chock with chain:
- Make. . . . . Highway Trailer Co.
- Model HG-EA3834C

Strap sheave:
- Make . . . . Highway Trailer Co.
- Model HG-EA4336C

V-18A/MTQ rear winch:
- Make . . . . Highway Trailer Co.
- Model L18-RRC-88
- Characteristics:
  - Drum drive . . . . tooth clutch
  - Drum brake . . . . friction disk
  - Drum-type . . . . single, free
  - Worm brake . . . . automatic friction
  - Winch line . . . . . . 700 ft by 7/16 in. dia (6 strands, 19 wires per strand)

310. Rear-mounted Winch

a. Removal. Remove the winch cable (refer to par. 305b). Remove six nuts, 12 lockwashers, four wedge-type spacers, and six screws holding winch cover on winch-mounting frame, and remove winch cover. Remove seven screws holding winch cross-shaft cover to winch mounting frame and truck body, and remove shaft cover. Remove nut, lockwasher, two capscrews, and two tapping screws holding winch drive-chain guard to winch-mounting frame and body, and remove guard. Remove two safety nuts, adjusting wedge, and two screws holding chain idler pulley (fig. 346) to its mounting frame, and remove pulley. Remove winch drive chain. Remove power-divider (par. 318). Remove cotter pin and clevis pin and disconnect cross-shaft left arm from yoke assembly (fig. 347). Remove four nuts, lockwashers, and bolts holding winch-mounting frame to winch-mounting brackets on chassis frame. Using a suitable hoist, remove rear winch from truck. Remove part of control lever linkage (par. 311) remaining on winch.

b. Installation. Install part of control lever linkage (par. 311) attached directly to the winch. Install rear winch on truck, using suitable hoist. Secure winch-mounting frame to mounting brackets on truck frame with four hex-head bolts, lockwashers, and hex-nuts. Connect cross-shaft left arm to yoke assembly with a clevis pin and cotter pin. Install power-divider (par. 318). Install winch-drive

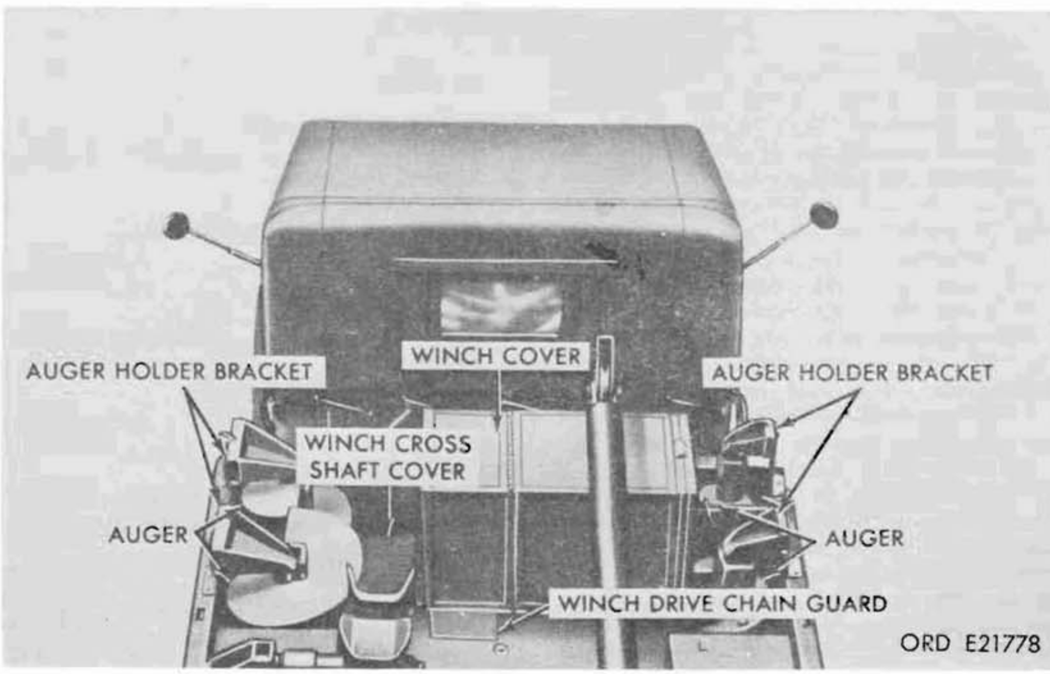


Figure 343. Earth augers and rear winch

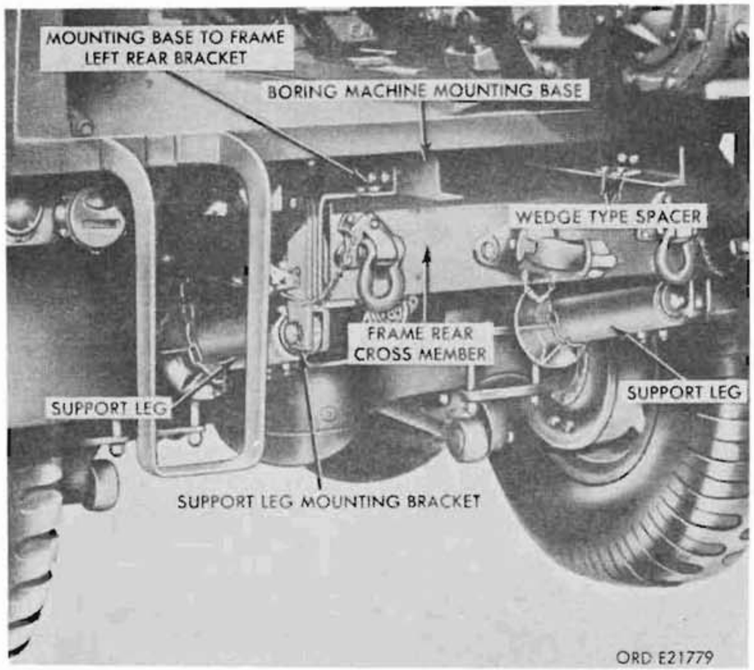


Figure 344. Support legs and earth boring machine

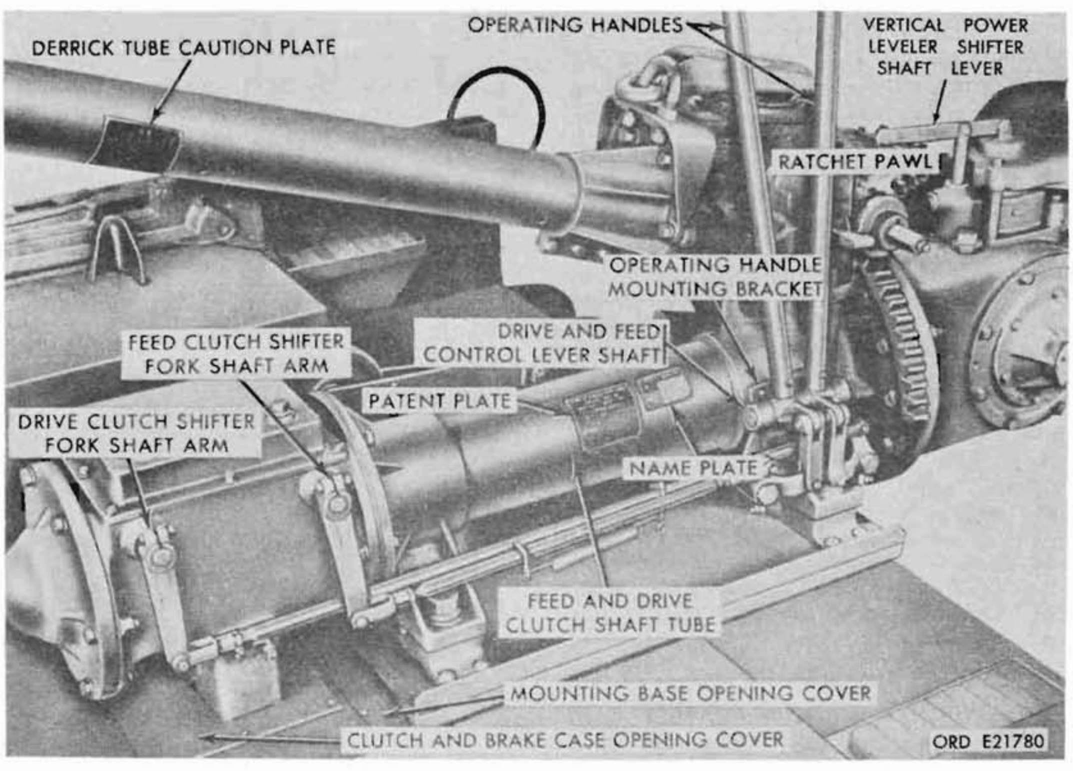


Figure 345. Earth boring machine and control lever operating handle assembly

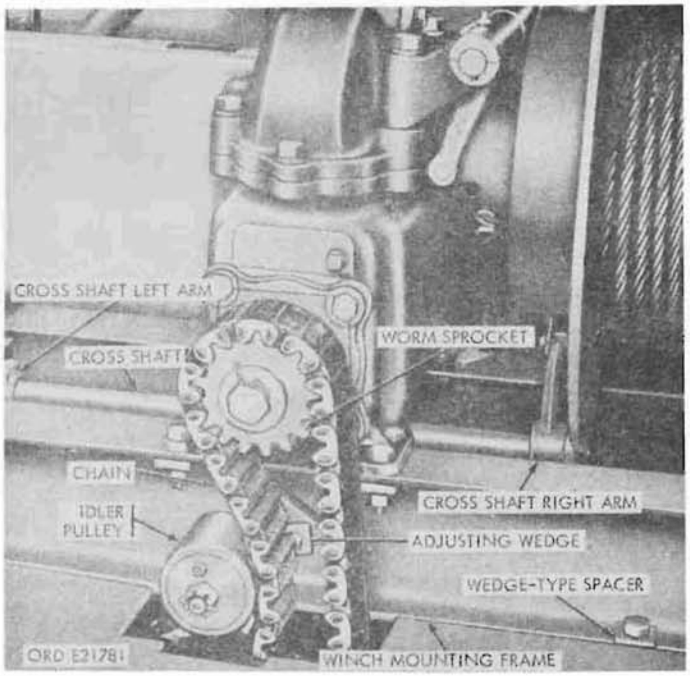


Figure 346. Rear winch drive chain and chain idler pulley

chain. Install chain idler pulley (fig. 346) on mounting frame with hex-head screw and safety nut. Press pulley against chain to determine proper hole in frame for adjusting purposes, and install adjusting wedge with hex-head screw, and safety nut through pulley bracket and frame. Take up chain slack to less than taut, and tighten capscrews to secure pulley in place. Install winch-drive chain guard (fig. 343) on winch-mounting frame with hex-head screws, lockwashers, and hex-nuts. Secure lower edge of guard to body platform with two panhead tapping screws. Install winch cross-shaft cover on body platform over left end of winch-mounting frame with five panhead tapping screws. Secure top of cover to mounting frame with two binding-head tapping screws. Install winch cover over winch, and secure to winch-mounting frame with two hex-head screws, four lockwashers, and two hex-nuts on right-hand side, and four hex-head screws, eight lockwashers, four wedge-type spacers, and four hex-nuts on left side. Install winch cable (par. 305b).

311. Rear Winch Controls and Linkages

a. Removal. Remove spare wheel (par. 227). Remove cotter pin and clevis pin holding rod end yoke on control-lever rod to rear winch control lever (fig. 347), and remove rod from lever. Remove four nuts, lockwashers, plain washers, and screws holding control-lever mounting bracket to floor of cab, and remove bracket and lever from vehicle. Remove cotter pin and clevis pin holding end yoke on control-lever rod (fig. 348) to pivot bar, and remove rod. Remove cotter pin and clevis pin holding yoke assembly (fig. 347) from arm. Remove

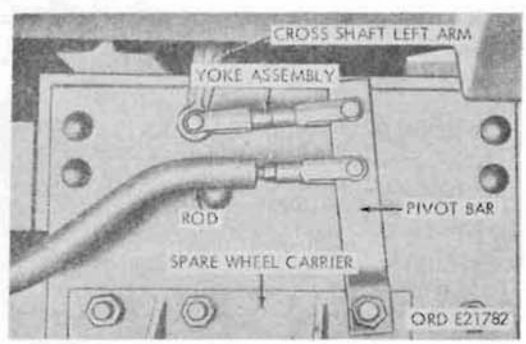


Figure 347. Rear winch control lever rod

jamnut, hex-nut, and plain washer holding pivot bar to spare-wheel carrier, and remove pivot bar and yoke assembly. Install plain washer, hex-nut, and jamnut back on attaching bolt to secure spare wheel carrier.

Note. If rear winch is to be removed, remove in accordance with paragraph 310. This will facilitate removal of the remainder of control lever linkage.

Remove cotter pin, castle nut, and plain washer holding rod end eye (fig. 345) in clutch fork shaft lever, and remove eye. Remove taper pin holding shaft lever to clutch-fork shaft, and remove lever. Loosen nut on cross-shaft left arm and drive cross-shaft to left until arm is free of woodruff key on shaft. Remove key from shaft. Loosen nut on cross-shaft right arm, and drive cross-shaft to right until arm is free of woodruff key on shaft. Remove key from shaft. Remove shaft from winch-mounting frame, and arms from shaft.

b. Repair. Weld, straighten or replace any bent, broken or damaged parts as required.

c. Installation. Install cross-shaft left- and right-arms on cross shaft (fig. 347), and install cross-shaft in winch-mounting frame. Install two woodruff keys in cross-shaft. Position shaft arms over keys, and tighten hex-nut on arms to secure arms in place. Install clutch-fork shaft lever (fig. 347) on clutch fork shaft on rear winch after alining taper pin holes in shaft and lever. Drive taper pin through holes to secure lever on shaft. Install rod end eye in end of clutch-fork shaft lever with a plain washer, castellated nut, and cotter pin.

Note. If rear winch has been removed from the vehicle, install winch (par. 310) before proceeding further with linkage installation.

Install control lever and control-lever mounting bracket on floor of cab with four hex-head screws, plain washers, lockwashers, and hex-nuts. Connect rod end yoke, on straight end of control-lever rod, to control lever with clevis pin and cotter pin. Remove jamnut, hex-nut, and plain washer from spare wheel-carrier mounting bolt, and install pivot bar (fig. 347) on bolt, with a plain washer, hex-nut, and jamnut, being sure to allow for movement of bar on bolt. Secure rod end of yoke assembly on pivot bar to cross-shaft left arm with a clevis pin and cotter pin. Secure rod end of yoke on end of control-lever rod to pivot bar with a clevis pin and cotter pin. Install spare wheel (par. 227).

312. Winch Cable

Refer to paragraph 305b for removal and installation procedures for rear winch cable.

313. Rear Winch Drive Chain and Idler Pulley

a. Removal. Remove winch cover and chain guard (par. 310a). Turn winch drive chain (fig. 346) until chain-connecting long and short pins are accessible. Remove chain idler pulley. Remove cotter pin from end of long pin, and remove long and short pins from chain. Place power-divider control lever in NEUTRAL position to disengage power-divider. Remove drive chain from winch worm sprocket, and pull chain free of power-divider sprocket.

Note. Power-divider may be operated at a very slow speed, if necessary, to run chain off sprocket.

b. Installation. Install drive chain around power-divider sprocket and winch worm sprocket.

Note. Power-divider may be operated at a very slow speed to run chain onto sprockets.

Connect ends of chain (fig. 346) by inserting the short pin and long pin through chain links, and installing a cotter pin through long pin to secure pins in place. Install chain idler pulley, winch covers, and chain guard.

c. Adjustment. Loosen adjusting wedge safety nut (fig. 346). Take up slack in drive chain until nearly taut and tighten capscrews and safety nuts. If chain is too loose or too tight, move pulley bracket to another hole in frame.

314. Power-divider Control-lever Linkage

a. Removal. Place control lever in NEUTRAL position. Remove cotter pin and clevis pin holding end yoke on control-lever rod (fig. 348) to power-divider shifter rod, and remove lever rod from shifter rod. Remove 13 screws securing intermediate tunnel, and remove tunnel from cab floor. Remove cotter pin and clevis pin holding other end of control-lever rod to control lever, and remove rod from lever. Remove two nuts, lockwashers, and screws securing control-lever mounting bracket; remove bracket and lever.

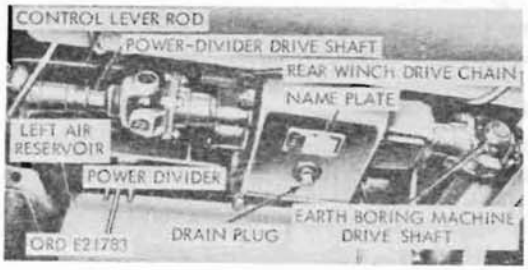


Figure 348. Power-divider installed - bottom view

b. Installation. Install mounting bracket and control lever with two hex-head screws, lockwashers, and hex-nuts. Install control-lever rod to control lever by attaching rod end yoke on straight end of lever rod to control lever with a clevis pin and cotter pin. Push power-divider shifter rod completely in to last detent position. With control lever in extreme rearward position, install other end of control-lever rod (fig. 348) to shifter rod on power-divider with a clevis pin and cotter pin. Shift control lever to make sure linkage moves shifter rod in power-divider through all four positions. Adjust linkage with adjustable rod end yokes, if necessary. Install intermediate tunnel with hex-head external-teeth lockwasher screws.

315. Rear Winch Drive Sprocket (Fig. 346)

a. Removal. Remove winch drive chain (par. 313a). Remove wire from worm sprocket screw and spacer on end of sprocket worm shaft, and remove screw and spacer. Pull sprocket from shaft, using suitable puller. Tape key in shaft keyway to prevent loss of key.

b. Installation. Install sprocket over key in end of worm shaft and secure with sprocket spacer and screw. Secure spacer and screw with .041-in. diameter wire. Install winch-drive chain (par. 313b).

316. Rear Winch Universal Joint

a. Removal. For removal of the universal joint, refer to paragraph 166.

b. Installation. For installation of the universal joint, refer to paragraph 166.

317. Power-takeoff Controls and Linkages

a. Repair. For repair of the controls and linkages, refer to paragraph 306.

b. Removal. For removal of the controls and linkages, refer to paragraph 306.

c. Installation. For installation of the controls and linkages, refer to paragraph 306.

318. Power-divider

a. Coordination with Direct Support Maintenance Unit. Refer to paragraph 2 for information on coordination with direct support maintenance unit.

b. Removal.

(1) Remove rear winch drive chain. Refer to paragraph 313a.

(2) Disconnect drive shafts. Disconnect flanged yokes securing shaft to companion flanges, and remove shaft.

(3) Disconnect power-divider control-lever rod (fig. 348). Remove cotter pin and clevis pin securing control-lever rod end yoke on power-divider shifter rod, and remove lever rod from shifter rod.

(4) Remove power-divider. Remove drain plug from bottom of the power-divider and oil-level plug from left side, and drain lubricant from case into an approved container, and discard.

Note. Removal of left-hand oil-level plug is necessary to permit removal of power-divider without the necessity of removing left air reservoir.

Supporting weight of power-divider, remove two screws, two bolts, and four lockwashers securing power-divider to mounting brackets. Lower power-divider from brackets, and remove from vehicle. Install drain and oil-level plugs to prevent loss and to keep dirt out.

c. Installation.

(1) Install power-divider. Remove the left-hand oil-level plug, if installed. Raise the power-divider into position under mounting brackets with sprocket end of power-divider forward and to the left. Install forward end of power-divider to mounting bracket with two hex-head

screws and lockwashers. Install rear end of power-divider to mounting bracket with two hex-head bolts and lockwashers. Lubricate with new lubricant according to lubrication order LO 9-2320-209-12 and install oil-level plug.

(2) Connect power-divider control-lever rod (fig. 348). Connect control-lever rod to power-divider shifter rod with a clevis pin and cotter pin.

(3) Connect drive shafts. Install shaft and connect flanged yokes to companion flanges.

(4) Install rear winch drive chain. Refer to paragraph 313b.

(5) Record of replacement. Make record of replacement on DA Form 2408-6.

319. Earth Boring Machine Components

a. Universal Joints and Drive Shaft. The earth boring machine drive shaft is made with two universal joints and one slip joint (fig. 349), having a flanged yoke at each end for connecting to driving and driven components. Replacement of this shaft is covered in paragraph 165b. Replacement and repair of the universal joints is covered in paragraph 166b.

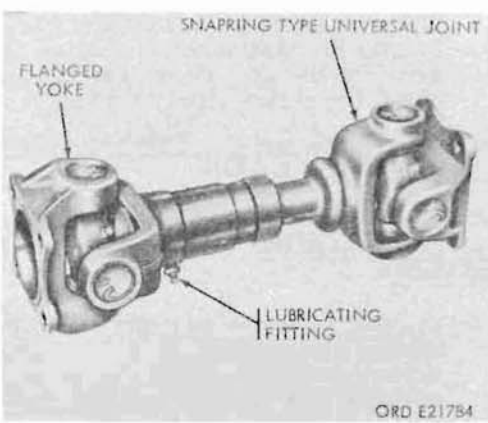


Figure 349. Earth borer drive shaft and universal joints

b. Vertical Power Leveler Chain.

(1) Removal. Remove cotter pin and clevis pin holding shifter-shaft lever (fig. 351) on shifter shaft, and remove lever. Remove two nuts and lockwashers holding chain guard on guard mounting posts, and remove guard and shifter-shaft lever. Loosen nut on idler sprocket (fig. 350) and place some slack in chain. Remove two cotter pins holding detachable pin-link plate on two adjacent pins, and remove link plate and pin link. Remove chain from power leveler.

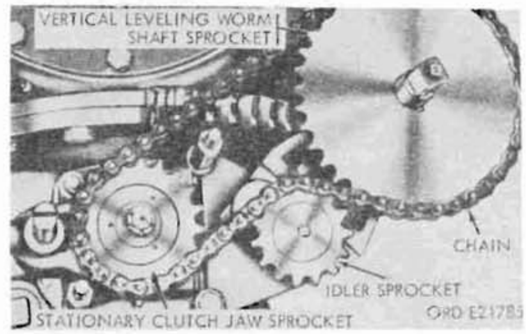


Figure 350. Vertical power-leveler chain - threading arrangement

(2) Installation. Install chain (fig. 350) around outside of stationary clutch jaw sprocket and vertical leveling shaft sprocket. Install one end of chain around inside edge of idler sprocket so that sprocket bears on outside of chain. Secure chain ends together by inserting pin link (fig. 352) through end holes, installing detachable pin-link plate on pins, and installing cotter pins. Take up chain slack with idler sprocket to less than taut, and tighten hex-nut on sprocket to maintain adjustment. Install chain guard (fig. 351) on mounting posts with two hex-nuts and lockwashers. Install shifter-shaft lever in shifter shaft with clevis pin and cotter pin.

c. Controls and Linkages.

(1) Removal. Loosen nuts and screws holding feed and drive clutch shifter-fork shaft arms on shifter-fork shafts, and remove arms (fig. 345). Remove cotter pin securing drive and feed con-

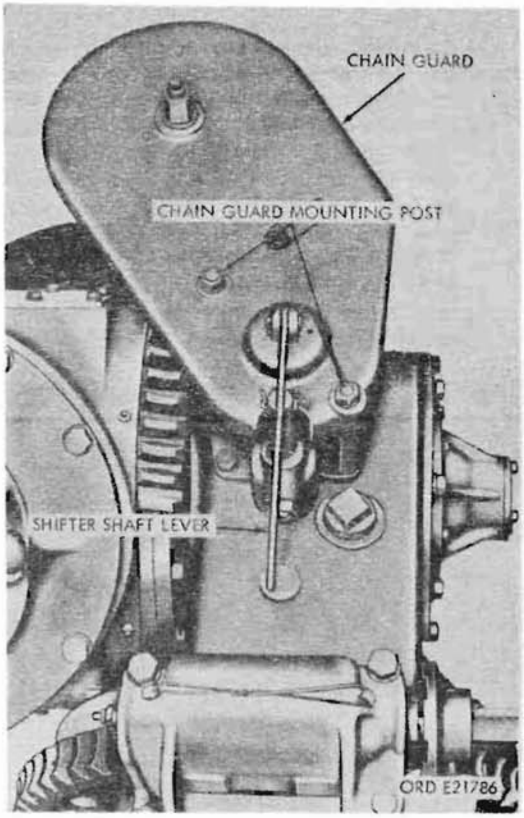


Figure 351. Vertical power-leveler shifter shaft and chain guard

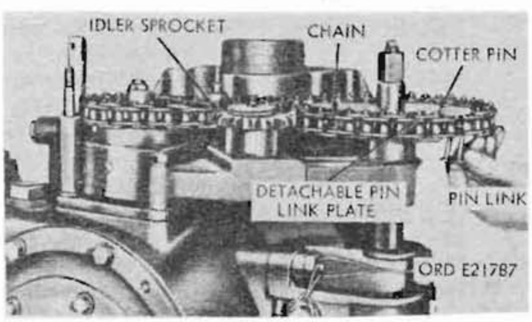


Figure 352. Removing vertical power-leveler chain

trol-lever shaft in operating handle mounting bracket, and remove shaft. Lower feed and drive control-lever operating handles away from feed and drive clutch shaft tube, and remove four screws and lockwashers securing mounting bracket to tube. Remove operating handle assembly from the boring machine.

(2) Repair. Weld, straighten or replace bent, damaged or broken parts as required.

(3) Installation. Install control lever operating handle assembly on clutch shaft tube by securing the mounting bracket to tube. Secure bracket with two hex-head screws and lockwashers in upper two holes in bracket and tube, and two hex-head screws and lockwashers in lower two holes. Lift operating handles to vertical position and insert control-lever shaft through mounting bracket and control levers. Secure shaft in position with a cotter pin. While holding operating handles vertical, install shifter-fork shaft arms on splined ends of shafts, and secure arms by tightening nuts and screws on arms.

320. Earth Augers

a. Earth Auger.

(1) Removal. Remove pin holding auger holder bracket (fig. 343) to auger holder channel. Remove holder bracket and tube from holder channel and earth auger frame. Lift auger up until point is free of retainer and remove auger from truck.

(2) Installation. Install auger on truck with auger point in retainer. Install holder tube over auger frame and auger holder bracket (fig. 343) in holder channel. Insert pin through holder bracket and channel to secure auger in place.

b. Auger Blade, Thrust Plate, Point, and Pin Replacement (Fig. 353).

Note. Replacement procedure is similar for all augers, except that 9-inch auger has no thrust plate.

(1) Removal. Remove two nuts and bolts holding auger blade to auger frame, and remove blade. Remove nuts, lockwashers and screws holding auger thrust plate to frame, and remove plate. Remove nut, lockwasher, and bolt holding auger point in frame; remove point. Remove cotter pin holding clevis pin in frame; remove pin.

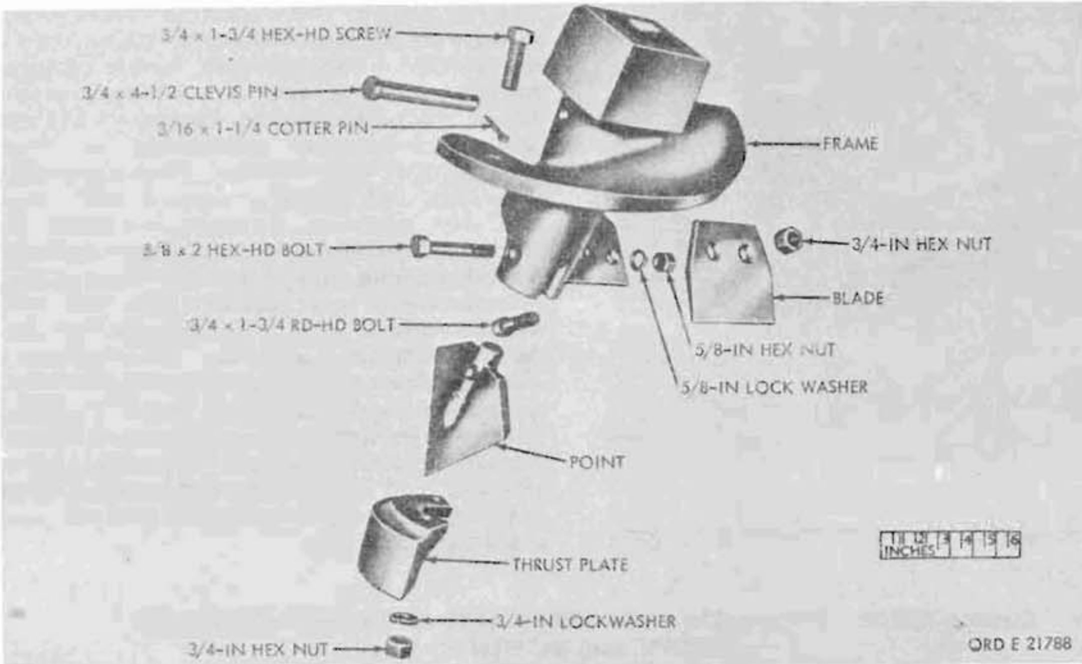


Figure 353. Auger - exploded view

(2) Installation. Install clevis pin in auger frame with a cotter pin. Install auger point in frame with hex-head bolt, lock-washer, and hex-nut. Install auger thrust plate on frame with hex-head screws, washers, and hex-nuts. Install auger blade in frame with two roundhead bolts and hex-nuts.

321. Earth Boring Machine Assembly

a. Coordination with Direct Support Maintenance Unit. Refer to paragraph 2 for information on coordination with direct support maintenance unit.

b. Removal. Remove six screws holding clutch and brake case opening cover (fig. 343) to body platform, and remove cover. Remove six screws holding mounting base opening cover to body platform, and remove cover. Disconnect boring machine drive shaft (par. 319a) from boring machine (fig. 349). Remove four screws, eight lockwashers, four wedge-type spacers, and four nuts holding boring-machine mounting base (fig. 354) to frame rear crossmember. Remove two screws, four lock-

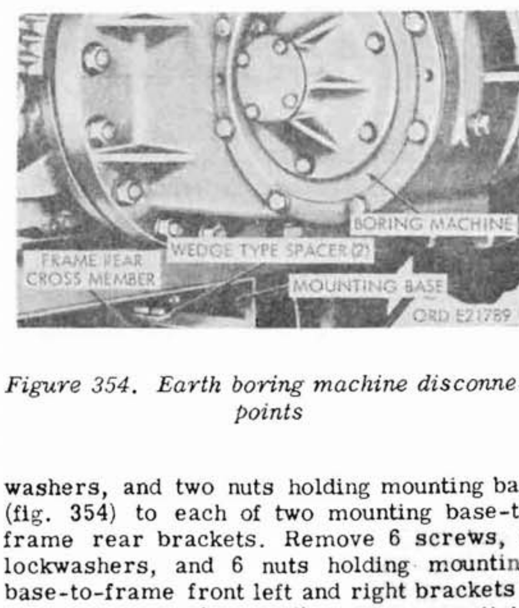


Figure 354. Earth boring machine disconnect points

washers, and two nuts holding mounting base (fig. 354) to each of two mounting base-to-frame rear brackets. Remove 6 screws, 12 lockwashers, and 6 nuts holding mounting-base-to-frame front left and right brackets to mounting base (fig. 355). Using a suitable hoist, remove boring machine from body platform, being careful to balance weight of machine on hoist chains or lines.

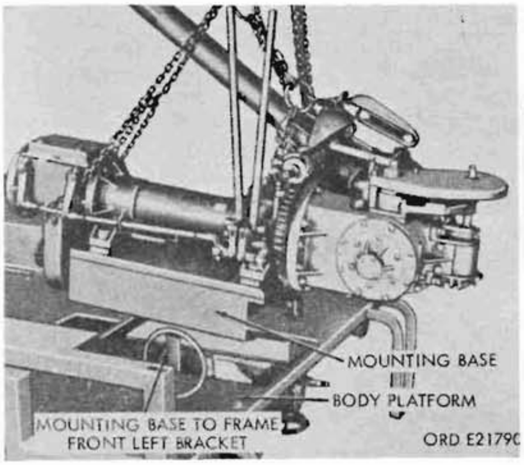


Figure 355. Removing earth boring machine

c. Installation. Use a hoist and lower earth boring machine (fig. 355) into position in opening in rear of body platform. Secure boring-machine mounting base to mounting-base-to-frame front left and right brackets with three hex-head screws, six lockwashers, and three hex-nuts for each bracket. Secure mounting base (fig. 354) to frame rear crossmember with four hex-head screws, four wedge-type spacers, eight lockwashers, and four hex-nuts. Secure mounting base to each of two mounting-base-to-frame rear brackets (fig. 355) with two hex-head screws, four lockwashers, and two hex-nuts for each bracket. Connect boring-machine drive shaft (par. 319a) to input shaft companion flange (fig. 349). Install mounting base opening cover (fig. 343) on body around front of mounting base with six panhead tapping screws. Install clutch and brake case opening cover on platform around case with six pan-head tapping screws.

Section XLVIII. EXPANSIBLE VAN BODY AND AUXILIARY EQUIPMENT (M292 and M292A1)

322. Description

a. Expansible Van Body. Refer to paragraph 50 for the description of the expansible van body.

b. Expanding Mechanisms. Refer to paragraph 50 for the description of the expanding mechanism.

c. Electrical Systems.

(1) General. The van electrical system includes three basic electrical circuits for the operation of its auxiliary equipment and vehicle lights. All circuits incorporate appropriately designed overload protection and control facilities described under specific headings later in this paragraph. The circuits include:

(a) The 24-volt dc system, powered by the vehicle batteries. This system is used only for the operation of the van body clearance and blackout lights mounted on the four top outside corners of the van body. Connection to the vehicle electrical system is made by means of tee connectors inserted into the vehicle rear light circuit at the lower left-hand corner of the van body (fig. 356).

(b) The 120-208-volt, 3-phase, 60-cycle system, powered from an external source. This system is used directly to furnish power to the 208-volt air conditioner unit, and is split into three single phases to furnish power to the 120-volt circuit breaker box. Connection to the van body is by means of a 4-wire cable and connector plugged into the power cable entrance receptacle at the rear of the van body (fig. 356).

(c) The 120-volt, single phase, 60-cycle system, derived from the 208-volt, 3-phase, 60-cycle system. The 208-volt, 3-phase, power circuit is separated into three groups of four circuits each in the 120-volt circuit breaker box. Each group of circuit breakers is used to supply power to various items of auxiliary equipment mounted permanently in the van body, as well as additional equipment installed for tactical purposes.

(2) Power entrance receptacle. The power entrance receptacle (fig. 356) is located on the lower right corner of the van rear panel. A spring-loaded, hinged cap locks the cable in the receptacle and prevents the entrance of foreign matter when the cable is removed.

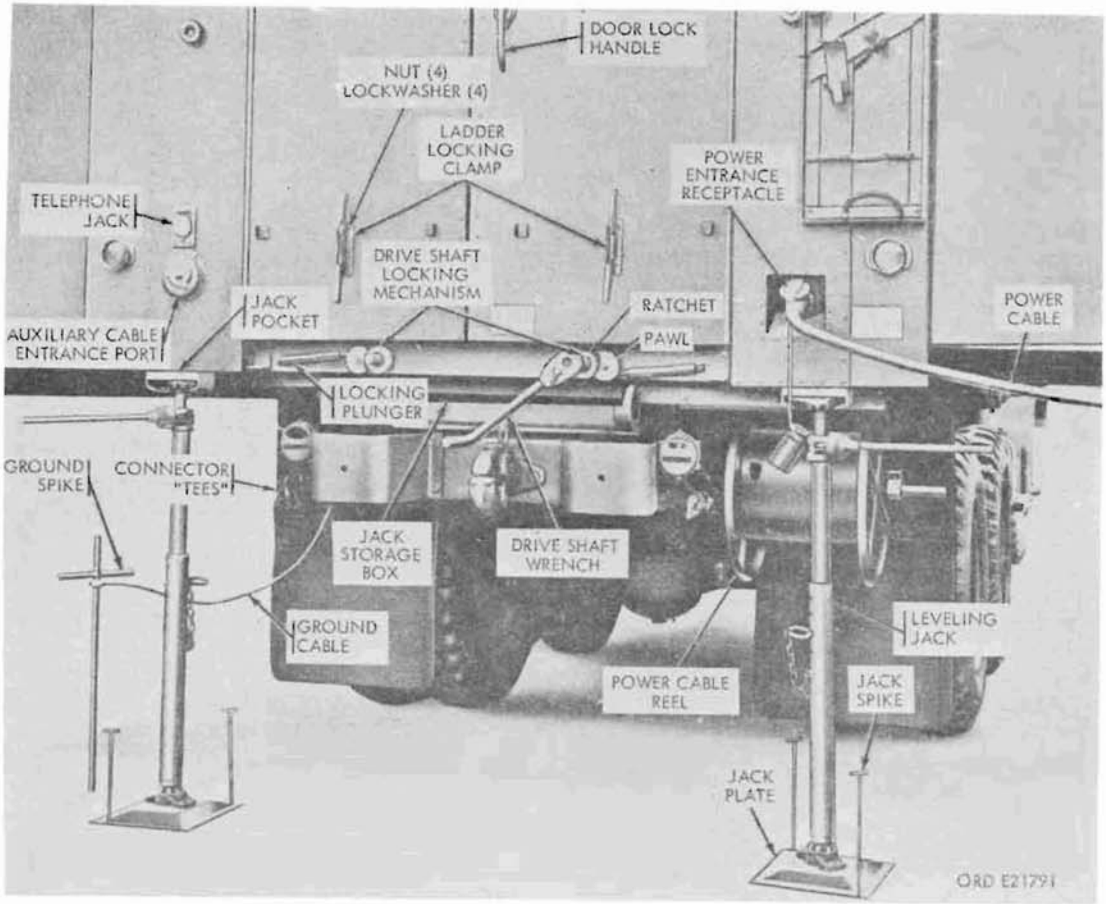


Figure 356. Van in operating position - rear view

(3) 100-foot power cable and reel. The 100-foot power cable consists of a 4-wire rubber-insulated cable equipped at one end with a female receptacle to accommodate the 4-prong entrance receptacle, and at the opposite end with a male receptacle designed to fit the female receptacle of the outside power source. The cable is stowed on the power cable reel mounted on the right rear corner of the chassis frame (fig. 356) when the van is in the traveling position. A canvas boot is provided to protect the cable while in the stowed position.

(4) 36-inch auxiliary power cable. The 36-inch auxiliary power cable (fig. 357) is similar in construction to that of the 100-foot power cable except that only one end is fitted with a receptacle to accommodate the van power entrance receptacle. The opposite end is separated into four individual wires which are used to make connections to an outside power source whose output connector differs from the one on the far end of the 100-foot power cable (3, above). When in use, the auxiliary power cable is plugged into the far end of the 100-foot power cable and the four wires on the auxiliary cable are used to make appropriate connections to the outside power source. The auxiliary power cable is stowed on the left equipment anchor rail attached to the ceiling of the van body.

(5) Main power switch. The main power switch (fig. 358) is provided to cut off

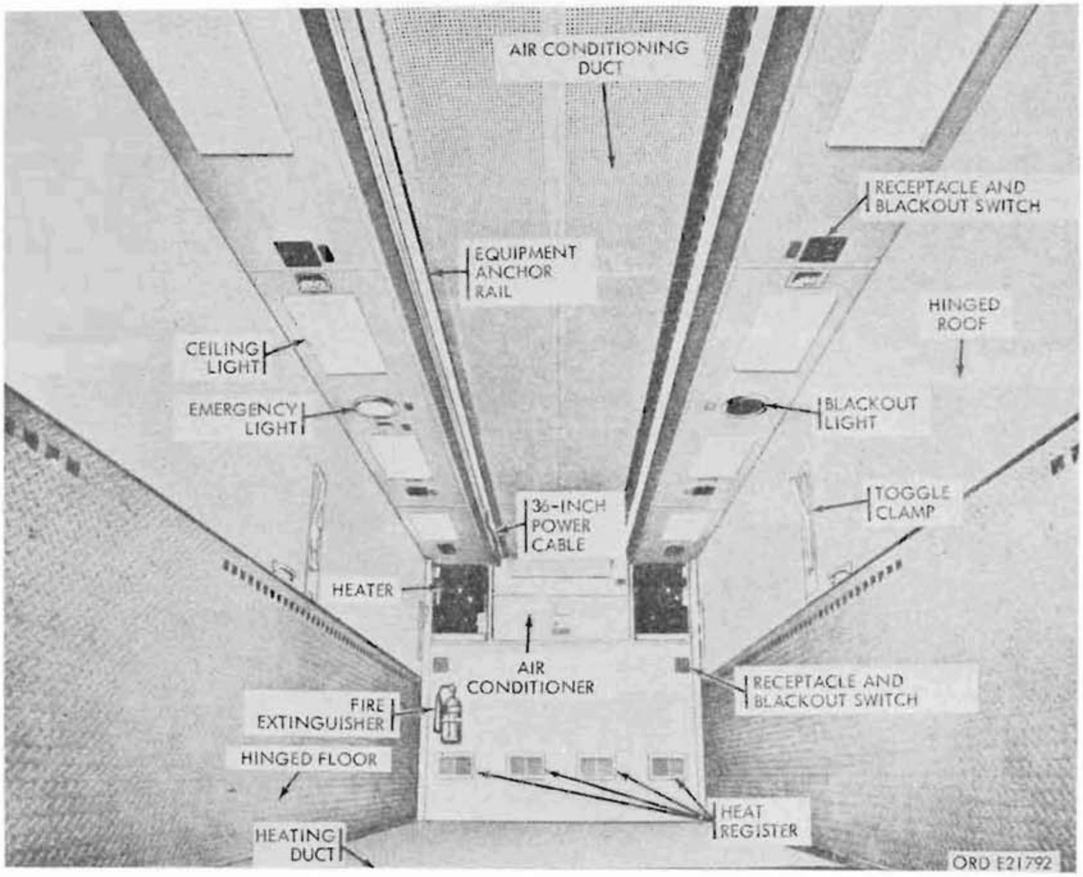


Figure 357. Van body in retracted position - front interior view

all external power to the van body electrical system. It contains no fuses or circuit breakers, and is used when electrical repairs are made to the van wiring system, or as an emergency switch.

(6) 120-volt circuit breaker box. The 120-volt circuit breaker box (fig. 358) provides a distribution and control station for all equipment requiring 120-volt ac power. It contains 12 push-type circuit breaker switches, electrically connected in three groups of four each. Each group is connected to one leg of the 3-phase power system, thus providing three individual 120-volt branch circuits (fig. 67). Six of the circuit breaker switches are used in the van body electrical system. The remaining six are available for use with tactical materiel installed in the van body, as required. The circuit breakers function as primary control switches for all 120-volt equipment, and also provide protection for overloaded circuits. The circuit breaker box is covered by a large door which provides access to the interior wiring compartment for maintenance. A smaller door, equipped with lock and key, permits access to the circuit breaker switches. A circuit identification directory plate is attached to the inner side of the smaller door.

(7) Blackout relay. The blackout relay is located inside the circuit breaker box (fig. 358). It is a single-pole, double-throw, magnetic type rated at 60 amperes at 120 volts. The relay automatically interrupts the van lighting and

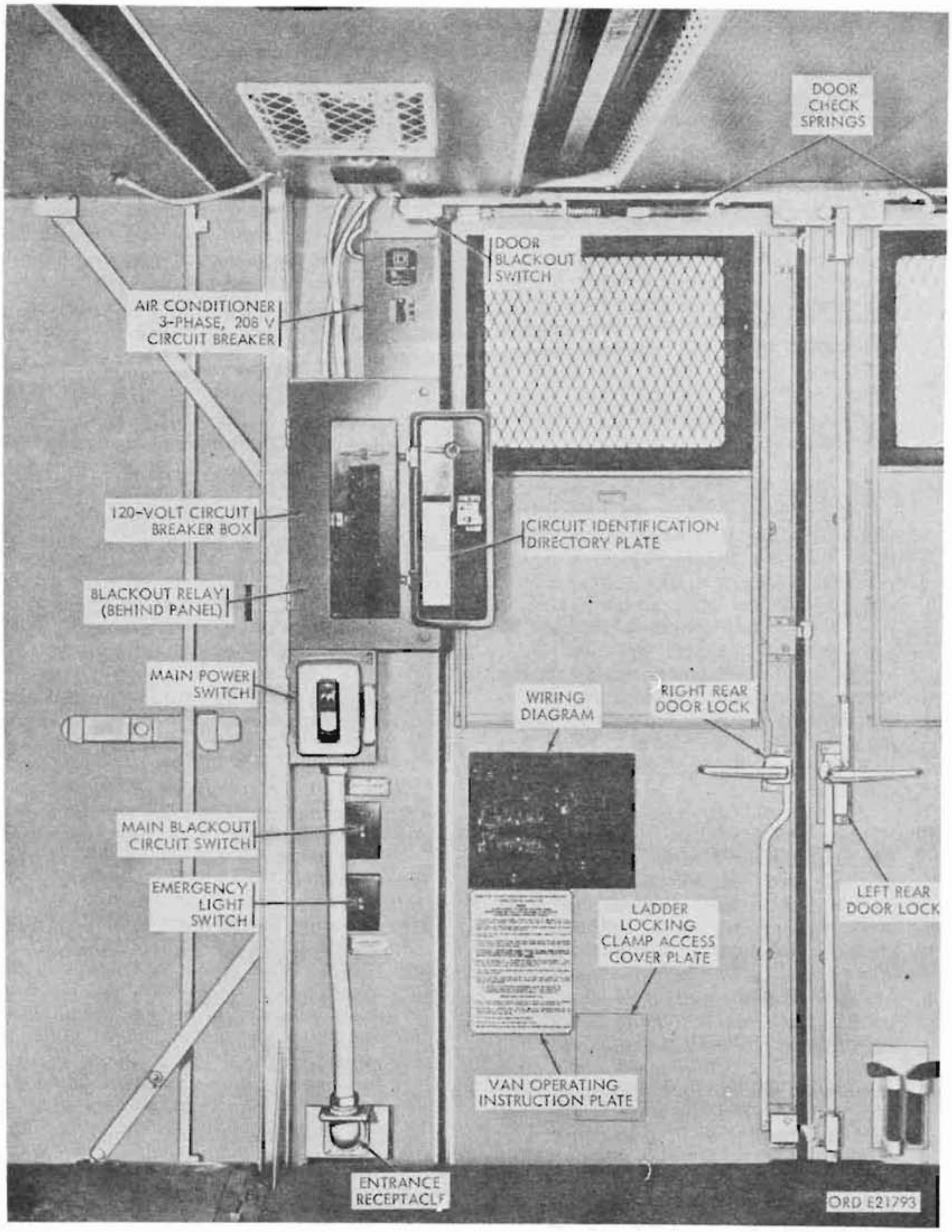


Figure 358. Van electrical controls

receptacle circuits whenever the doors are opened, provided the main blackout circuit switch is in the ON position. However, the individual receptacle blackout switches can override the relay when the operating equipment must be in continuous operation or is not a blackout hazard.

(8) Main blackout circuit switch. The main blackout circuit switch (fig. 358) controls the blackout circuit. In the ON position the switch includes the blackout relay in the lighting and receptacle circuits so that these circuits are interrupted by the door-operated switches. In the OFF position the switch bypasses the blackout relay, eliminating the function of the door-operated switches.

(9) Door-operated blackout switches. Three 6-ampere, 120-volt, pushbutton type door-operated blackout switches (figs. 358 and 361) are located in the van wall near the top of the hinged sides of the two side doors and right rear door. Each switch is actuated by an adjustable plunger operated by a striker plate attached to the top of the door. Thus, when the door is opened the plunger actuates the switch, which in turn trips the blackout relay and interrupts the lighting and receptacle circuits.

(10) Hinged roof-operated plungers and plates. Blackout circuit contact plungers (fig. 369) are located in the edges of the hinged roof sections so as to aline with striker plates in the mating edges of the hinged floor sections and side panels. The plungers and mating plates maintain continuity of the blackout circuits when the van is in both the expanded and retracted positions.

(11) Receptacle and blackout switches. Ten combined receptacles and blackout switches located in the van ceiling and front wall (figs. 357 and 359) provide power outlets for operation of 120-volt equipment housed in the van. The integral blackout switches are used to bypass the blackout feature when the equipment must remain in continuous operation, or does not involve a blackout hazard. Cord holder hooks (fig. 359) are placed adjacent to ceiling receptacles to prevent accidental disconnection of power cords.

(12) Emergency light. The emergency light (figs. 357 and 359) is located approximately in the center of the van ceiling at the left of the air conditioning duct. It consists of a fixture containing a standard 60-watt lamp covered by a white frosted lens. The light is controlled by a separate emergency light switch and operates independently of the main blackout circuit switch and door-operated switches.

(13) Blackout light. The blackout light (fig. 357) is located approximately in the center of the van ceiling at the right of the air conditioning duct. It is similar to the emergency light, except that it is equipped with a 25-watt blue lamp and blue lens. The light operates in conjunction with the blackout relay and blackout door-operated switches, and is automatically turned on when the doors are opened, and off when they are closed, when the main blackout switch is in the ON position.

(14) Ceiling fixtures and lights. Eight rectangular ceiling light fixtures (figs. 357 and 359) are located in the van ceiling on either side of the air conditioning duct. Each contains three 20-watt fluorescent tubes, two 60-watt lamps, and light switches. The tubes and lamps are protected by a hinged wire-mesh guard.

(15) 120-volt ac to 24-volt dc fuel pump converters. Two 120-volt ac to 24-volt dc fuel pump converters (fig. 367) are located on the van right and left front corner post gussets. They convert 120-volt ac power supplied by the heater circuits to 24-volt dc power required for the operation of the heater fuel pumps. Each converter is protected from overloads by a 1/2-amp, 250-volt, glass-type cartridge fuse.

(16) 3-phase air conditioner circuit breaker. The 3-phase air conditioner circuit breaker (fig. 358) is a 3-pole, 20-amp, 250-volt magnetic thermal-type used to protect the air conditioner circuit and to shut off power to the air

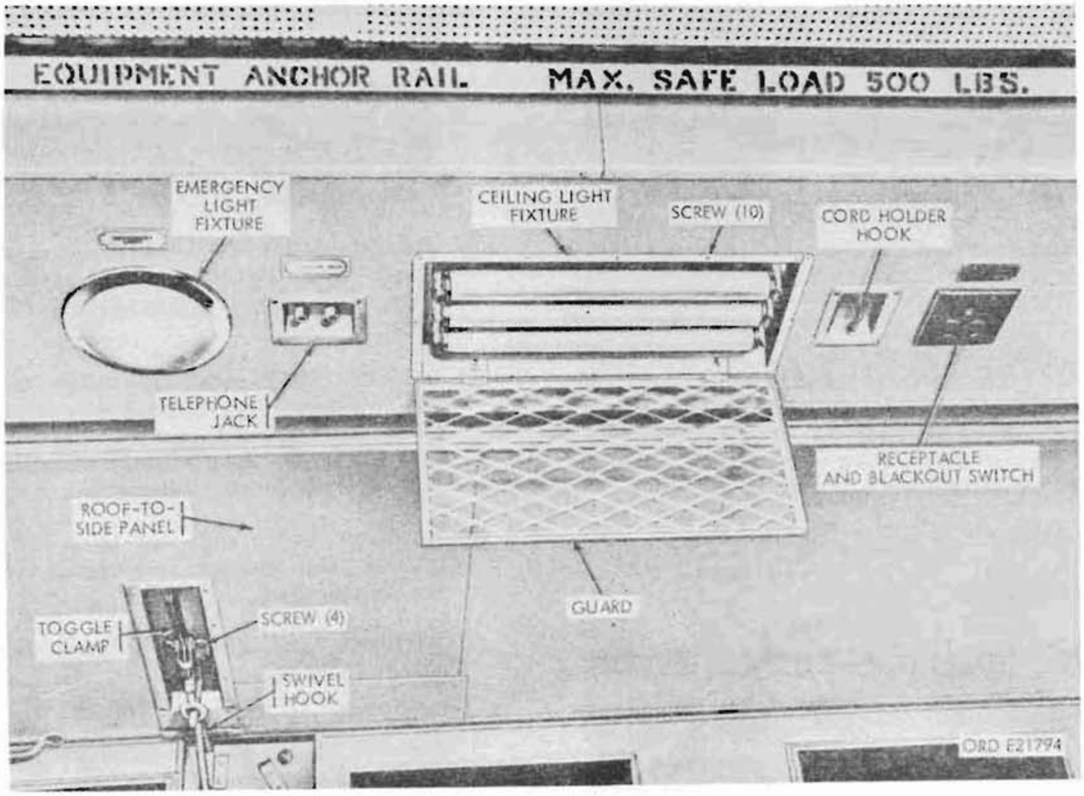


Figure 359. Ceiling fixtures and lights

conditioner system during maintenance. It may also be utilized as an emergency switch for the air conditioner when necessary.

(17) 24-volt vehicle clearance and blackout lights. The 24-volt clearance and blackout lights (fig. 364) are located on the upper front face of the bonnet and on the upper corners of the van rear panel. The clearance lights are placed above the blackout lights, and are identical except that the front lights are equipped with amber lenses and the rear lights with red lenses. The clearance and blackout lights are controlled from the vehicle light switch in conjunction with the vehicle lighting system.

(18) Ground spike. The van electrical system ground spike (fig. 356) consists of a pointed steel spike to which the ground cable is attached. The other end of the cable is fitted with a terminal for attachment to the ground spike connector at the rear of the van body. Handles are provided on the ground spike so it may easily be pushed into the earth. The spike is stowed in the jack storage box (fig. 356) at the rear end of the van when not in use.

d. Heating System. The van heating system incorporates two gasoline-burning, 60,000 Btu-noncontaminating, hot air heaters operating on 120-volt ac, 60-cycle, single phase power. The heaters are located in the van bonnet on either side of the air conditioner (fig. 357). Control facilities permit circulation of both heated and unheated fresh air drawn from outside the van, mixed with heated and unheated air drawn from inside the van. The proportion of outside and inside air may be varied. Hot air ducts in the van front wall conduct heated air from the heaters into the van interior through four heat registers (fig. 357) in the van front panel, when the registers are open. When the registers are closed, the heated air is conducted through corrugated ducts beneath the aluminum floor tread plate, which functions as a radiator. This function extends to the hinged floor sections so that the heat-radiating surface of the floor is available when the van is in both expanded and retracted positions.

e. Air Conditioning System. The van air conditioning system, located in the van bonnet (fig. 365) incorporates a 24,000 Btu, package-type, air-cooled, air conditioned unit operating on 208-volt ac, 3-phase power. Control facilities permit circulation of both cooled and uncooled air drawn from outside the van, and cooled and uncooled air drawn from inside the van. The proportion of outside and inside air may be varied. A perforated air conditioning duct (fig. 357), located on the van ceiling, conducts cooled or uncooled air to the van interior.

323. Data

a. Heaters.

Note. Data given below is for each heater.

Manufacturer	Hunter
Model no.	UH-68
Power requirements	single phase, 120-volts, ac, 60 cycle
Output	60,000 Btu-hr
Lowest starting temperature	-65°F
Power consumption:	
Starting	400 w
Running	800 w
Air output	425 cfm

b. Air Conditioner.

Manufacturer	York
Model no.	U-81
Power requirements	three phase, 208 to 220 volts, ac, 60 cycle
Output	24,000 Btu/hr
Air output	900 cfm
Air input	1600 cfm
Temperature range:	
Minimum	68°F
Maximum	92°F

324. Side Panel Counterbalance Cables (Fig. 350)

a. Removal.

(1) Place van side panel in fully expanded position (TM 9-2320-209-10).

(2) Secure end panel doors in open position.

(3) Support hinged roof with swivel hooks (fig. 349). Place a 1-inch wood block between end swivel hook and hinged roof to release tension on counterbalance cable.

(4) Remove cotter pin, clevis pin, and clevis which attach cable to vertical drop arm, and remove clevis from arm.

(5) Remove cotter pins and roller pins which attach upper and lower rollers to corner post and remove upper and lower rollers. Removal of lower roller will release lower folding arm.

(6) Unscrew lower cable end from turnbuckle, then unscrew turnbuckle from turnbuckle eye.

(7) Withdraw cable upward through guides, and remove cable.

b. Installation.

(1) Remove turnbuckle and turnbuckle eye from replacement cable.

(2) Thread turnbuckle end of cable downward through guides.

(3) Screw turnbuckle onto turnbuckle eye remaining in floor bracket, and screw turnbuckle end of cable into turnbuckle.

(4) Aline holes in end of folding arm with holes in corner post. Place roller in channel of folding arm with cable behind roller. Insert roller pin through arm and roller. Secure roller pin with a cotter pin.

(5) Position upper roller in roller mounting plate on corner post with cable in roller groove. Insert roller pin through roller and corner post and secure pin with a cotter pin.

(6) Pull cable clevis down over end of vertical drop arm and aline holes in clevis and arm. Insert pin through holes and secure pin with a cotter pin.

(7) Tighten turnbuckle until cable is taut.

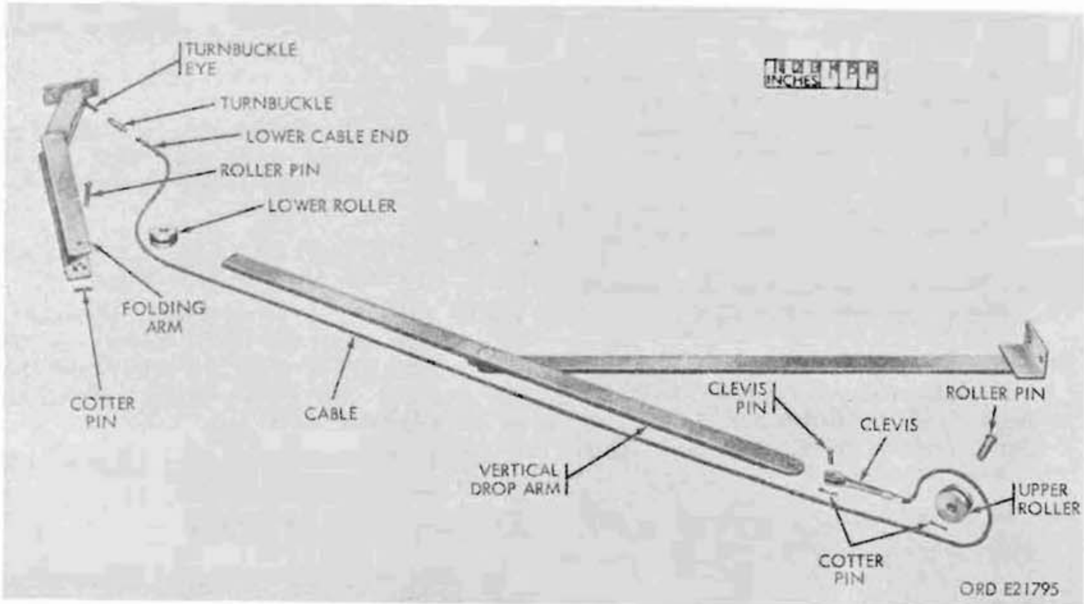


Figure 360. Side panel counterbalance cables - disassembled view

325. Ladder Locking Clamp (Fig. 356)

a. Removal. Working inside van (fig. 358) remove six screws attaching cover plate to rear door and remove cover plate. Working outside van, remove four nuts and lockwashers attaching locking clamp to rear door, and remove locking clamp.

b. Installation. Position locking clamp on outside of rear door and insert four roundhead screws through holes in clamp yoke and door. Attach clamp to door with four lockwashers and four hexagon nuts. Install cover plate with four panhead screws.

326. Roof-to-Side Panel Toggle Clamps (Fig. 359)

Note. The roof-to-side panel toggle clamps can be replaced only when van is in the retracted position.

a. Removal. Release clamp. Remove four screws which attach yoke base to niche in hinged roof section and remove clamp.

b. Installation. Position yoke base in niche with eyebolt toward anchor post and attach base to niche with four self-tapping screws. Engage hook eye with anchor post and close clamp.

327. Side Panel Rear Locks (Figs. 361 and 362)

a. Removal (Fig. 362).

(1) Remove eight screws attaching lock cover plate to panel and remove cover plate. Remove insulating material.

(2) Remove two screws attaching lock bolt retainer to edge of door frame.

(3) Remove cotter pins from clevis pins, remove clevis pins, and separate clevises from lock.

(4) Remove self-locking nut and washer securing lock handle shank in lock.

(5) Remove four nuts and lockwashers which attach lock to van body and remove lock.

b. Installation.

(1) Slide lock bolt retainer onto lock bolt with plate toward end of bolt.

(2) Position lock on lock handle shank and four corner studs.

(3) Slide lock bolt retainer into position against inside of door frame and attach with two panhead tapping screws inserted from outer edge of door frame.

(4) Attach lock to van body with four lockwashers and four self-locking nuts.

(5) Secure lock handle shank to lock with a washer and self-locking nut.

(6) Aline holes in clevises with holes in lock arms and insert clevis pins. Secure clevis pins with cotter pins. Replace insulating material previously removed.

(7) Attach lock cover plate to panel with eight panhead screws.

328. Side Panel Front Locks and Hinged Roof Locks

a. Removal.

(1) Remove eight screws attaching lock cover plate to panel and remove cover plate. Remove insulating material from lock recess.

(2) Remove cotter pins from clevis pins, remove clevis pins, and separate clevis from the lock.

(3) Remove self-locking nut securing lock handle shank in lock.

(4) Remove four nuts and lockwashers attaching lock to van body and remove lock.

b. Installation.

(1) Position lock on lock handle shank and four corner studs and attach it to van body with four lockwashers and four self-locking nuts.

(2) Secure lock handle shank to lock with a washer and self-locking nut.

(3) Aline holes in clevises with holes in lock arms and insert clevis pins. Secure clevis pins with cotter pins. Replace insulating material previously removed.

(4) Attach lock cover plate to panel with eight panhead screws.

329. Door Locks and Latches

a. Right Rear and Side Door Locks (Figs. 358 and 363).

(1) Removal.

(a) Remove cotter pin holding vertical bar to lockpin.

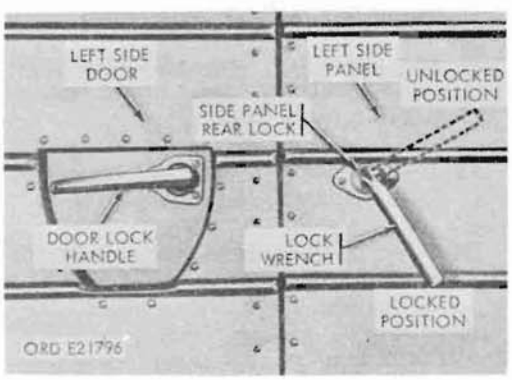


Figure 361. Side panel locks

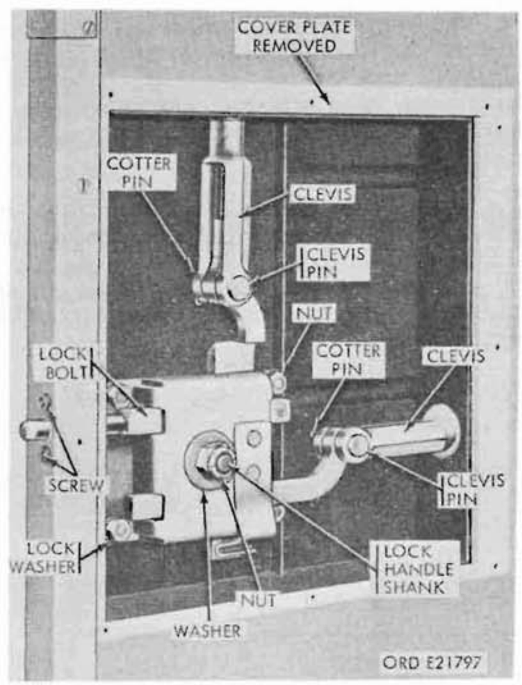


Figure 362. Side panel lock mechanism

(b) Remove four attaching screws which attach lock to door and remove lock.

(2) Installation.

(a) Aline holes in lock and door. Attach lock with four panhead tapping screws.

(b) Place hole in vertical bar over lock-pin. Secure with a cotter pin.

b. Left Rear Door Lock (Fig. 358).

(1) Removal.

(a) Drive out pin which attaches lock handle to lock mechanism and remove lock handle.

(b) Remove cotter pins which attach vertical bars to lock mechanism.

(c) Remove four screws which attach lock mechanism to door and remove mechanism.

(2) Installation.

(a) Aline holes in lock mechanism and door and attach mechanism with four panhead tapping screws.

(b) Secure vertical bars to lock mechanism with cotter pins.

(c) Insert shank of lock handle into hole in lock mechanism with pin holes alined.

(d) Secure handle in lock mechanism with a dowel pin.

330. Door Striker Plates (Fig. 363)

a. Removal. Remove three screws holding striker plate to door or body and remove striker plate.

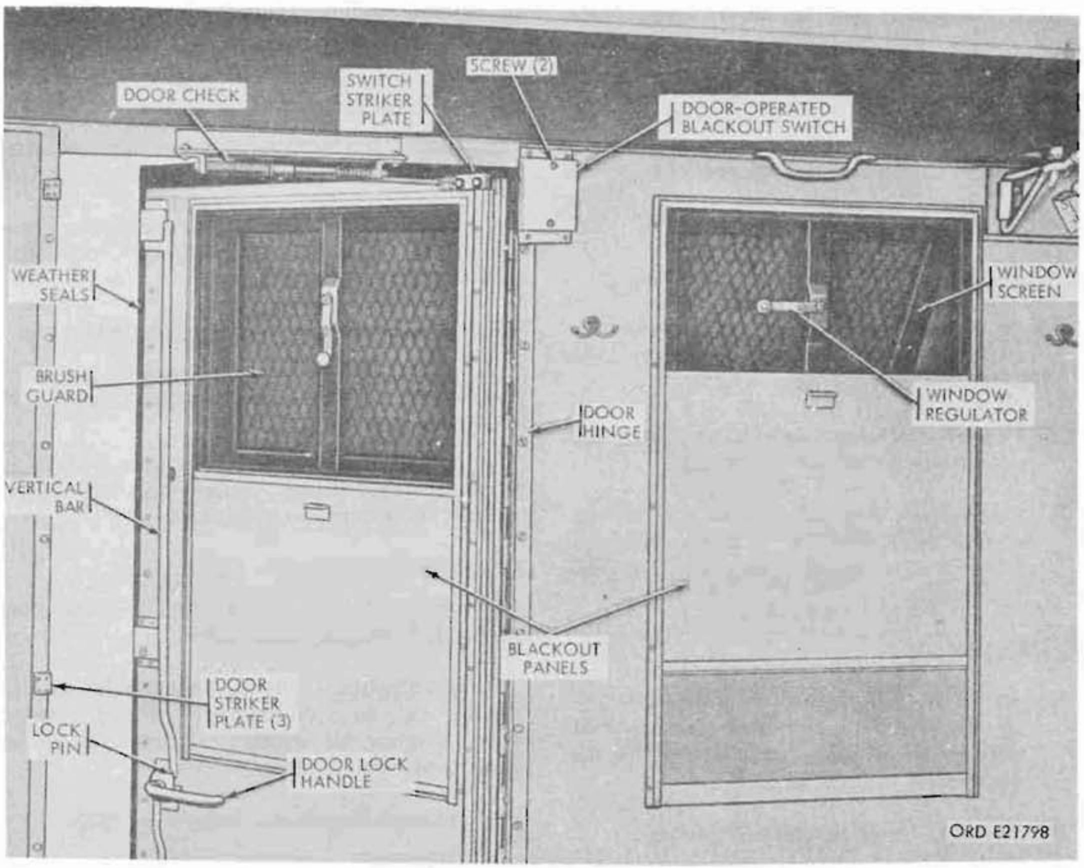


Figure 363. Door locks and windows

b. Installation. Install seal around window glass and position glass with seal in window frame. Position seal retainer and secure it with 18 roundhead tapping screws.

338. Window Blackout Panel (Fig. 363)

a. Removal. Remove 18 screws around blackout panel guide frame and remove blackout panel.

b. Installation. Aline holes in blackout panel side frame and van body side panel. Attach guide frame with 18 panhead tapping screws.

339. Van Operating and Locking Devices

a. Drive Shaft Locking Ratchets (Fig. 356).

(1) Removal.

(a) Drive out taper pin which attaches ratchet to drive shaft.

(b) Tap ratchet free from shaft and remove ratchet.

(2) Installation.

(a) Position ratchet on drive shaft with teeth facing toward pawl and with taper pin holes alined.

(b) Secure ratchet to drive shaft with a taper pin.

b. Drive Shaft Locking Pawls (Fig. 356).

(1) Removal.

(a) Remove special shoulder screw which attaches locking pawl to underframe rear crossmember.

(b) Disengage locking plunger from pawl and remove pawl.

(2) Installation.

(a) Engage slot in pawl with locking plunger. Aline screw holes.

(b) Secure pawl to crossmember with special shoulder screw.

c. Drive-shaft Locking Plungers (Fig. 356).

(1) Removal.

(a) Remove self-locking nut which attaches locking plunger housing to stud on rear crossmember.

(b) Disengage plunger from slot in pawl and remove plunger housing from stud.

(2) Installation.

(a) Engage plunger in slot in pawl, then depress plunger until it is possible to attach plunger housing to stud on rear crossmember.

(b) Secure housing to stud with a self-locking nut.

Warning: Do not permit smoking, sparks or open flame within 50 feet of vehicle during any operation involving removal or draining of fuel-carrying components.

340. Heater Fuel Pumps

a. Plunger Spring and Filter Element Servicing.

(1) Remove bottom cap from fuel pump (fig. 364).

(2) Wash filter element, spacer, spring and cover (fig. 406) in mineral spirits paint thinner. Inspect filter element for cracks or other damage; replace if necessary. Test action of spring. Replace weak, bent or broken spring.

(3) Install parts (fig. 406) in reverse order of removal, using a new gasket in pump cap.

b. Removal (Fig. 364).

(1) Close heater shutoff valve.

(2) Remove screw attaching 24-volt cable (fig. 367) to terminal on converter and remove cable.

(3) Disconnect fuel lines from fuel pump inlet and outlet.

(4) Remove two screws holding fuel pump integral bracket to corner post and remove fuel pump.

c. Installation.

(1) Secure fuel pump with its integral bracket to corner post with two hexhead screws.

b. Installation.

(1) Connect line from fuel tank to end of check valve opposite ball and spring.

(2) Connect line from fuel pump to end of valve containing ball and spring.

(3) Tighten nuts on both ends of valve.

346. Bonnet Handles and Control Rods

a. Bonnet Front Door Control Handles (Fig. 365).

(1) Removal.

(a) Working inside van, open bonnet front door with bonnet front door control handles.

(b) Working outside van, remove hooked end of control rod from control rod clip on door (fig. 366).

(c) Working inside van, remove cotter pin from rearward end of rod and separate rod from handle.

(d) (Right-hand control rod only). Remove cotter pin from forward end of louver control rod and separate louver control rod from bracket on door control rod.

(e) Pull rod rearward through rubber bellows seal. Exercise caution to prevent tearing seal.

(2) Installation.

(a) Working inside van, push hooked end of control rod through rubber bellows seal.

(b) Insert rearward end of rod into hole in handle and secure it with a cotter pin.

(c) (Right-hand control rod only.) Insert forward end of louver control rod in bracket on door control rod and secure it with a cotter pin.

(d) Working outside van, insert hooked end of door control rod into control rod clip on door.

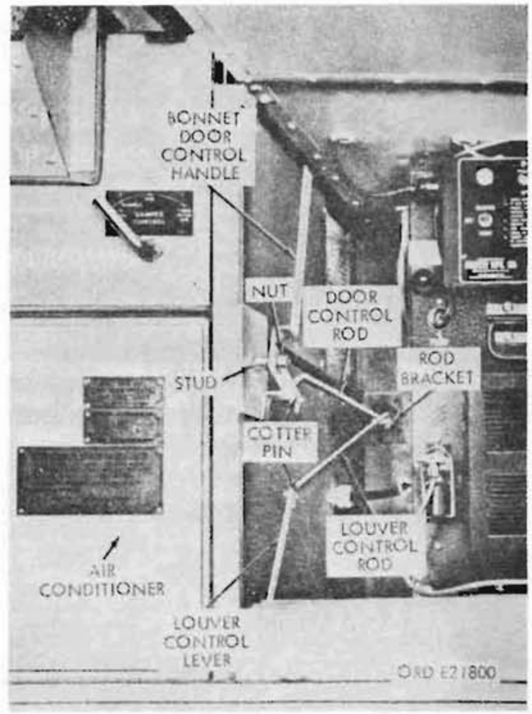


Figure 365. Bonnet door right-hand controls and linkages

Note. When necessary to replace both rods at the same time, unhook rods from rod clips and prop front door open with door support rod attached to inner side of the door.

b. Bonnet Drainage Louver Control Rod (Fig. 365).

(1) Removal. Remove cotter pins which attach ends of louver control rod to bracket on door control rod and to drainage louver control lever and remove rod.

(2) Installation. Insert ends of louver control rod into bracket on door control rod and into drainage louver control lever and secure rod ends with two cotter pins.

347. Van Body Clearance and Blackout Lamps

a. Removal (Fig. 366).

(1) Remove two screws attaching lens housing to base and remove housing.

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(2) Remove screw attaching 24-volt cable to terminal on converter and disconnect cable.

Note. The converter is installed upside down in order to provide clearance for the 24-volt cable terminals.

(3) Remove six screws attaching cover to converter chassis and remove cover.

(4) Remove three screws attaching converter chassis to corner post gusset and remove converter.

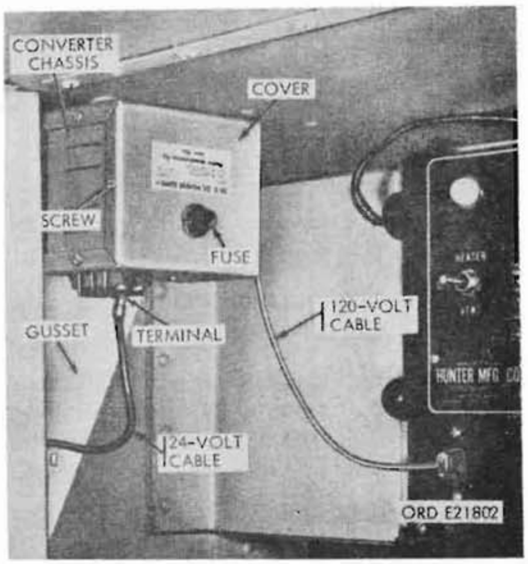


Figure 367. Fuel pump converter

c. Installation.

(1) Aline screw holes in converter chassis and gusset and attach chassis to gusset with three self-tapping screws.

(2) Attach cover to chassis with six pan-head screws.

(3) Plug 120-volt cable into heater receptacle.

(4) Connect 24-volt cable to terminal on converter with one roundhead machine screw.

350. 24-Volt Harness

Refer to paragraph 120 for repair procedure for 24-volt harness.

351. Outside Power Connector Cable (Fig. 356)

a. Removal.

(1) Remove cable reel canvas boot.

(2) Remove cotter pin from reel outer bearing support.

(3) Unbuckle strap holding end of cable to reel.

(4) Unreel cable and detach it from reel barrel.

b. Installation.

(1) Place end of cable into hole in reel barrel, reel cable onto barrel, and secure free end with strap.

(2) Lock reel by inserting cotter pin through hole in outer bearing support and reel shaft.

(3) Cover reel with the canvas boot.

352. Power Cable Reel (Fig. 356)

a. Removal. Remove cotter pin from outer reel bearing housing. Support reel. Remove nuts, lockwashers, and bolts attaching bearing housings to angle bars. Lower reel to ground.

b. Installation. Position reel on angle bars with bearing housing bolt holes alined with holes in angle bars. Attach bearing housings to angle bars with four hex-head bolts, lockwashers, and hex-nut.

353. Inside Telephone Jack Posts (Fig. 359)

a. Removal.

Note. Inside jack posts are located on the van ceiling panel at the left of the air conditioning duct and on the van left rear panel immediately below the fire extinguisher.

(1) Remove four screws attaching jack post box to ceiling (or rear panel) and separate box from panel.

(b) Install a 60-watt white frosted lamp in emergency light fixture or a 25-watt blue lamp in blackout light fixture.

(c) Close and secure ring door.

b. Light Fixtures (Fig. 369)

(1) Removal.

(a) See that main power switch is in OFF position. Loosen ring door locking screw and open ring door.

(b) Remove four screws in reflector flange attaching fixture to ceiling and separate fixture from the ceiling.

(c) Disconnect electrical wires from socket terminals. Note location of connections for installation.

(2) Installation.

(a) In emergency light, connect wires 652-B and GND (fig. 369) to socket terminals from which they were removed. In blackout light, connect wires 647 and GND (fig. 369) to socket terminals from which they were removed.

(b) Attach fixture to ceiling with four panhead tapping screws.

(c) Close ring door and tighten ring door locking screw.

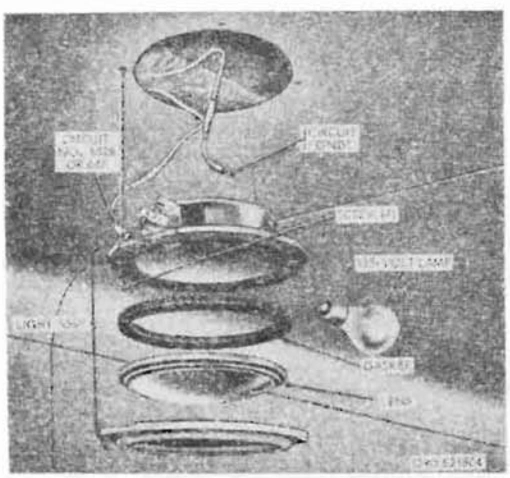


Figure 369. Emergency and blackout light fixture replacement

356. Fluorescent Ceiling Light Fixture

a. General. Correct diagnosis of fluorescent light troubles should be made to avoid unnecessary component replacement. Refer to Electrical Troubleshooting, Section VI (fig. 63), for procedures in troubleshooting fluorescent lights.

b. Replacement of Fluorescent Tubes (Fig. 370).

(1) Loosen two screws and open hinged mesh guard (fig. 359).

(2) Spread retaining terminals and remove tube (fig. 370).

(3) Install replacement 15-watt fluorescent tube by snapping it into retaining terminals.

(4) Press terminals together.

(5) Close mesh guard (fig. 359) and secure it with two panhead tapping screws.

c. Replacement of Starters.

(1) Loosen two screws and open hinged mesh guard (fig. 359).

(2) Remove fluorescent tube (b above).

(3) Turn starter one-quarter turn counterclockwise and remove starter from fixture (fig. 370).

(4) Position new starter in fixture and turn starter one-quarter turn clockwise.

(5) Install fluorescent tube (b above).

(6) Close mesh guard (fig. 359) and secure it with two panhead tapping screws.

(2) Installation.

(a) Connect electrical wires 651, 651A, and 652 (fig. 66) to switch terminals from which they were removed.

(b) Attach switch to switch box with two panhead tapping screws.

(c) Attach cover plate to switch with two ovalhead machine screws.

b. Door-operated Blackout Switches (Figs. 358 and 363).

(1) Removal.

(a) See that main power switch is in OFF position.

(b) Remove two screws attaching cover plate to switch box and remove cover plate.

(c) Disconnect electrical wires from switch terminals. Note location of connections for installation.

(d) Remove two screws attaching switch to switch box and remove switch from box.

(2) Installation.

(a) Thread electrical wires through holes in switch box to bring wires adjacent to terminals.

(b) Install switch in switch box with two flathead machine screws. Connect wires 651-B and GND (fig. 66) to switch terminals from which they were removed.

(c) Attach cover plate to switch box with two flathead machine screws.

c. Hinged Roof-operated Blackout Circuit Plungers (Fig. 371).

(1) Removal.

(a) Place van side panel in fully expanded position and support hinged roof with swivel hooks (TM 9-2320-209-10).

(b) See that main power switch is in OFF position.

(c) Remove four screws attaching plunger plate to edge of hinged roof and remove plunger plate.

(d) Disconnect two electrical wires from plunger terminals. Note location of connections for installation.

(2) Installation.

(a) Connect electrical wires 651-B and GND (fig. 66) to the plunger terminals from which they were removed with two roundhead screws.

(b) Attach the plunger plate to the hinged roof edge with four roundhead screws.

(c) Retract van side panel to full retracted position (TM 9-2320-209-10).

d. 120-Volt Receptacle and Blackout Switch (Fig. 372).

(1) Removal.

(a) See that main power switch is in OFF position.

(b) Remove three screws attaching cover plate to switch and remove cover plate.

(c) Remove two screws attaching switch to switch box and separate switch from switch box.

(d) Disconnect three electrical wires from switch terminals. Note location of connections for installation.

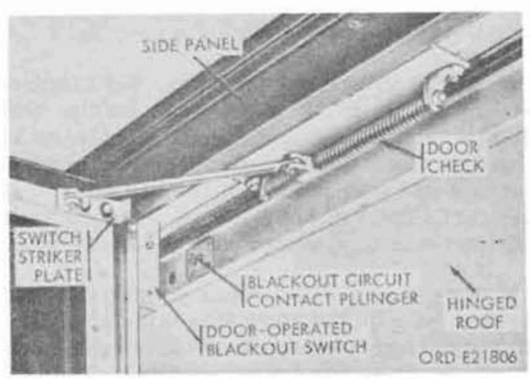


Figure 371. Hinged roof-operated blackout switch

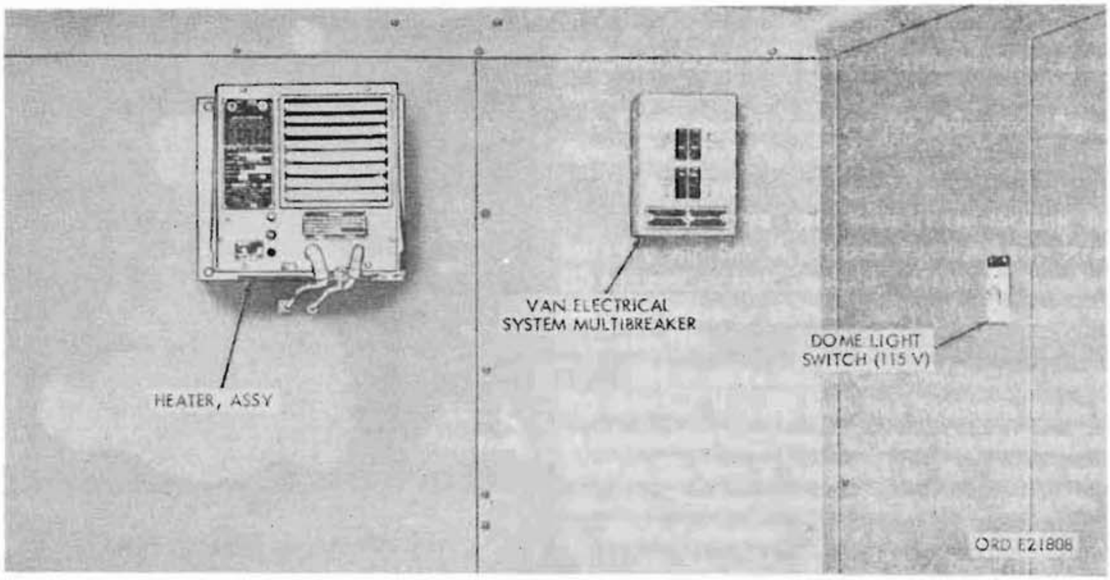


Figure 373. Van body heater, multibreaker and dome-light switch

at upper center (fig. 373). Heater exhaust is carried out of the van by a pipe passing through the front wall (fig. 374). This pipe connects with an exhaust pipe fastened to the front of the van body roof by a clamp and a bracket. Air for heater combustion is supplied by an air intake tube assembly passing through the van body front wall. The outer end of the tube is protected by a cover, attached to the van body outer wall (fig. 374).

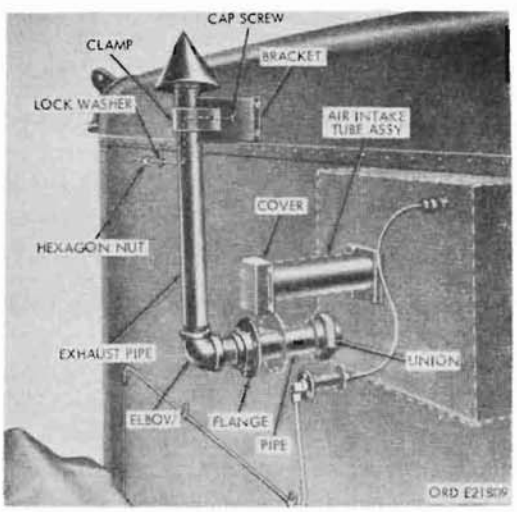


Figure 374. Heater exhaust and air intake

e. Ventilator Blower. Ventilation of the van body is provided by a ventilator blower and a built-in blower duct in the upper left rear of the van body (fig. 375). The duct assembly includes a door which closes the duct opening when the blower is not operating. This door is located on the outside of van body, at the upper left corner.

f. Electrical System.

(1) General. The van electrical system includes three basic electrical circuits for operation of van body auxiliary

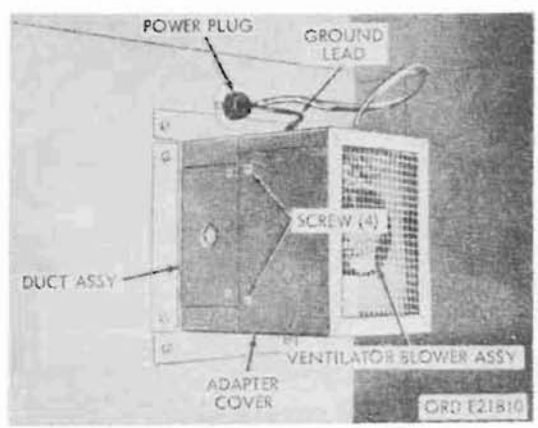
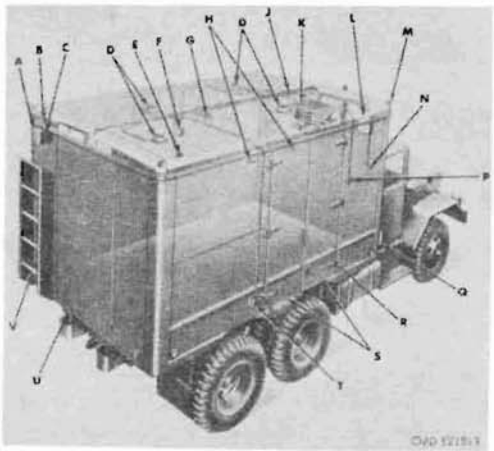


Figure 375. Body ventilator - blower assembly



Key	Item
A	Blower duct door
B	Ventilator blower receptacle
C	Ventilator blower
D	Dome light (115V)
E	Power receptacles
F	Thermostat
G	Dome light (24V)
H	Rear door holder
J	Main body wiring harness
K	Heater, assy
L	Multibreaker
M	Lifting eyes
N	Power receptacle (24V)
P	Dome-light switch (115V)
Q	Heater fuel pump
R	Front door retainer
S	Side doors
T	Dome-light switch (24V)
U	Trailer electrical connector
V	Ladder

Figure 378. Dome lights - 24 volt and 115 volt

of the left wall, supply 115-volt ac, 400-cycle power for additional equipment, as required.

(10) Heater fuel pump. The heater fuel pump (fig. 376), is located on the exterior of the van at the lower right front corner of the body, supplies gasoline from the vehicle fuel tank to the heater (fig. 379). The fuel pump operates from a 24-volt dc power supply located inside the heater.

(11) Heater thermostat. A manually adjustable heater thermostat (fig. 380), located in the interior of the van near the center left wall, controls the van body interior temperature.

360. Door Seals

a. Power Cable Entrance Door (Fig. 381).

(1) Removal. Open door and pull seals from channel in door opening.

(2) Installation. Be sure channel is free from cement, dirt, or other foreign matter. Cement weatherseals into channel with adhesive FSN 8040-221-3811.

b. Side Doors (Fig. 381).

(1) Removal. Open both side doors fully, and secure with retainers. Pull seals from channel around door opening.

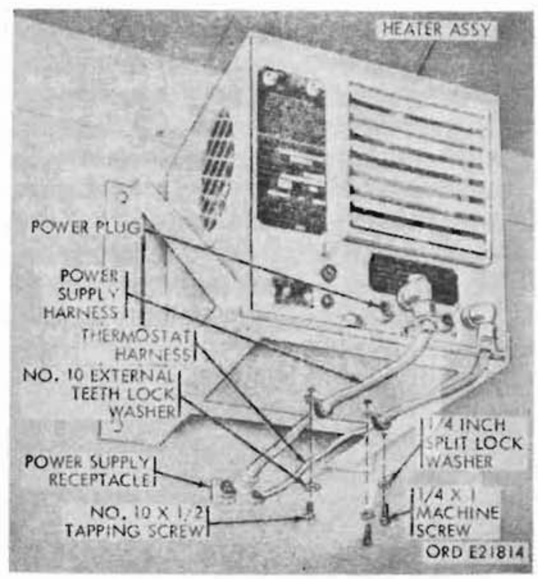


Figure 379. Heater power supply harness and connectors

(3) Position ventilator blower assembly in adapter opening; secure with three existing screws and clips. Be careful not to pinch harness or wires under harness clamps.

(4) Install blower capacitor on adapter with two machine bolts, lockwashers, and hex-nuts.

(5) Using four existing screws, attach adapter cover.

(6) Insert blower harness plug in electrical receptacle on van body rear wall. Turn plug one-eighth turn clockwise, and release.

(7) Secure blower assembly ground wire lead (a(2) above) to van body with existing screw. Make sure the ground wire lead is securely connected to blower assembly.

363. Heater

a. Removal.

(1) Turn heater switch (located on heater) to OFF position (fig. 379).

(2) Turn off heater power supply at No. 4 circuit breaker (fig. 387).

(3) Remove two screws, lockwashers, and retaining clips from power supply and thermostat harnesses on bottom of heater (fig. 379) and disconnect harness at both ends.

(4) Disconnect adapter-to-heater fuel line upper fitting at heater (fig. 385).

(5) Remove interior exhaust pipe from heater by disconnecting union (fig. 374).

(6) Remove four machine bolts, washers, and lockwashers attaching heater to heater support bracket (see fig. 379), and slide heater off support bracket.

(7) Remove air intake tube assembly from heater by sliding assembly upward (fig. 382).

b. Installation.

(1) Install air intake tube assembly on heater by engaging assembly flange behind retainer clips on rear of heater unit, and sliding assembly downward (fig. 382).

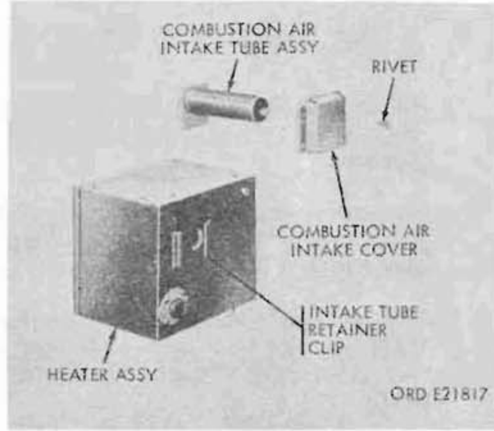


Figure 382. Heater air intake

(2) Slide heater unit onto support bracket, and connect heater to exhaust pipe coupling.

(3) Secure heater to support bracket with four existing bolts, washers, and lockwashers.

(4) Install exterior exhaust pipe and elbow on exhaust pipe, and secure clamp over exterior pipe and bracket.

(5) Connect adapter-to-heater fuel line upper fitting at heater (fig. 385).

(6) Insert heater power supply plug into 115-volt ac power receptacle on van body front wall and tighten connector lockring (fig. 379). Connect heater power supply and thermostat harnesses to heater front panel connectors.

(7) Install two existing screws, lockwashers, and retaining clips securing power supply and thermostat harnesses to bottom of heater (fig. 379).

364. Heater Fuel Pump, Fuel Lines and Fittings

Warning: Do not permit smoking, sparks, or open flame within 50 feet of vehicle during any operation involving removal or draining of fuel-carrying components.

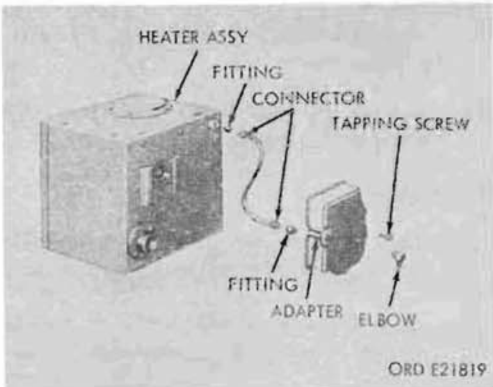


Figure 384. Adapter to heater fuel line

b. Cleaning and Inspection.

(1) Fuel pump filter. Refer to paragraph 340a for cleaning procedures for fuel pump filter element.

(2) Lines and fittings. Examine lines for holes, cracks, or flat areas which would obstruct fuel flow. Blow clean compressed air through lines to remove dirt or obstructions. Examine fittings for poor threads or defective sealing surfaces. Replace all defective components.

c. Installation.

(1) Fuel line adapter (fig. 385).

(a) Install elbow and fitting on adapter, turning each component clockwise.

(b) Install adapter, inserting it through van body front wall from exterior side, and secure it to wall with three slotted, panhead, tapping screws.

(c) Install fuel pump-to-adapter line on adapter elbow.

(d) Install adapter-to-heater line on adapter ((2) below).

(2) Adapter-to-heater fuel line assembly (fig. 385). Install adapter-to-heater line by connecting upper and lower fittings to the adapter and heater.

(3) Fuel pump. Install lines and fittings on fuel pump, securing fuel pump and electrical connector to van body front wall with three slotted, panhead, machine screws, split lockwashers, and plain hex-nuts (fig. 384). Install fuel pump cover and connect fuel pump power input plug to input socket (fig. 383).

(4) Fuel pump-to-adapter line and fittings.

(a) Install fuel pump-to-adapter line assembly by connecting fittings to adapter elbow and to fuel pump upper elbow (fig. 383). Position line under five existing retaining clips, and tighten clips.

(b) Install fuel pump cover and secure it to van body front wall with five existing screws.

(5) Fuel tank-to-fuel pump line and fittings.

(a) Install fuel tank-to-fuel pump line, connecting fittings to fuel pump lower elbow and to tee (fig. 383).

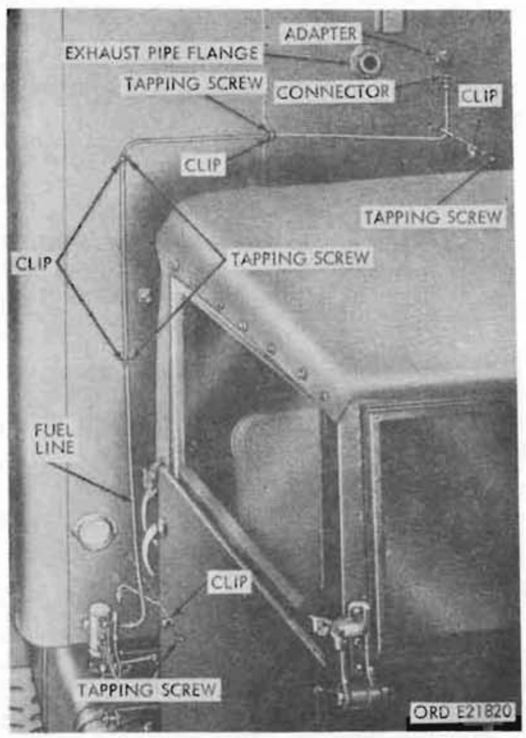


Figure 385. Fuel pump to adapter fuel line

(b) Remove leads from truck electrical system. Tag ends of wires for future installation.

(c) Remove connectors from 24-volt dc circuit breaker and fuel pump.

(d) Release harness from six attaching clamps, and remove.

(2) Repair. Refer to paragraph 120 for repair procedures for wiring harnesses.

(3) Installation.

(a) Insert input plug into socket in van body front wall.

(b) Thread harness through six attaching clamps and tighten clamps.

(c) Attach harness connectors to circuit breaker.

(d) Attach the harness to truck electrical system at same location as tagged in (1)(b) above.

e. Dome-light Lamp (24v).

(1) Removal (fig. 388).

(a) Remove lock screw from light door, and allow door to swing down. Replace lock screw in light, to avoid loss.

(b) Push lamp into socket, turn lamp counterclockwise one-quarter turn, and remove.

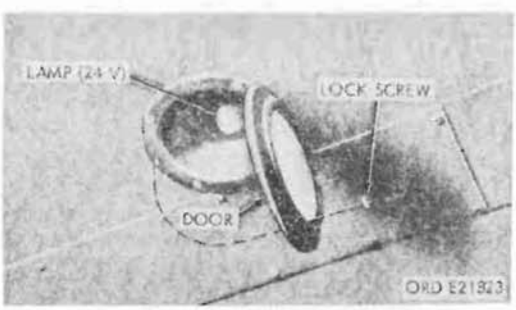


Figure 388. Dome light removal - 24-volt

(2) Installation.

(a) Insert lamp into socket, push in, turn clockwise one-quarter turn, and release.

(b) Close light door; install and tighten lock screw.

f. Dome-light Lamps (115v).

(1) Removal (fig. 389).

(a) Loosen lock screw in light door, until door swings down.

(b) Unscrew lamp counterclockwise.

(2) Installation.

(a) Screw lamp clockwise securely into socket.

(b) Close light door, and secure by tightening lock screw.

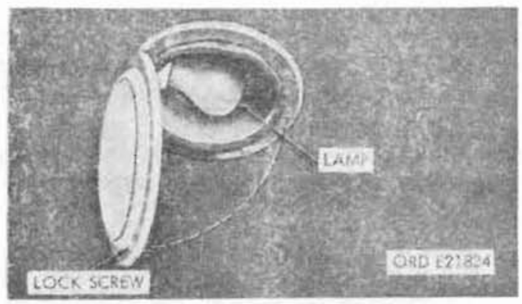


Figure 389. Dome light removal - 115 volt

g. Dome-light Fixture (24v or 115v).

(1) Removal (fig. 390).

(a) Open light door (e(1)(a) above).

(b) Remove four screws attaching light assembly to ceiling.

(c) Remove two wires from socket terminals.

(2) Installation.

(a) Attach two wires to socket terminals.

(b) Secure light to ceiling with four flat countersunk, slotted head, tapping screws.

(c) Install receptacle cover plate, securing plate with flat, countersunk, slotted head, machine screw.

j. Dome-light Switch (24v).

(1) Removal.

(a) Remove two screws from dome-light switch identification and mounting plate, and pull plate away from wall (fig. 393).

(b) Remove two screws and two wires from switch. Replace two screws in switch to avoid loss.

(c) Remove nut and washer from switch, and release switch from plate.

(2) Installation.

(a) Insert switch into identification and mounting plate. ON position of switch must be alined with ON position of plate.

(b) Install and tighten nut and washer.

(c) Replace two wires on switch (fig. 393), and retape (refer to TB-ORD 650).

(d) Attach switch plate to van body wall with two slotted, internal-teeth lockwasher, tapping screws.

k. Dome-light switch (115v).

(1) Removal (fig. 373).

(a) Remove two screws from switch cover plate, and remove plate.

(b) Remove two screws securing switch to van body wall.

(c) Pull switch from recess, disconnect wires from switch, and replace screws to avoid loss.

(2) Installation.

(a) Connect wires to switch with ON position of switch upwards.

(b) Secure switch to van body wall with two existing screws.

(c) Replace switch cover plate, and secure with two flat, countersunk, slotted head, machine screws.

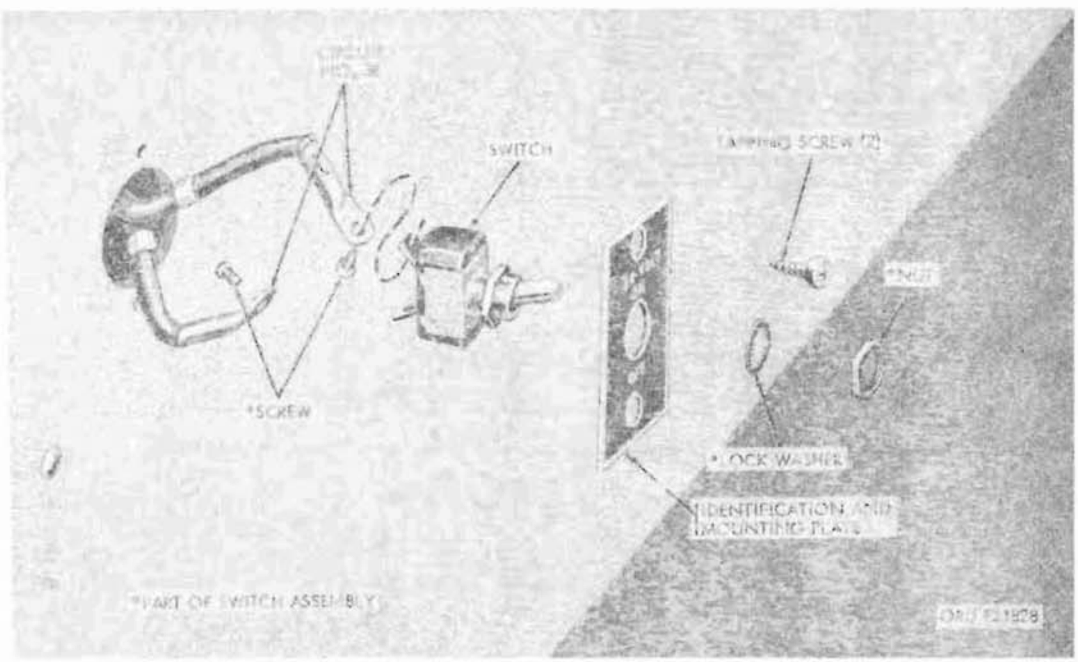


Figure 393. Dome-light switch - 24-volt