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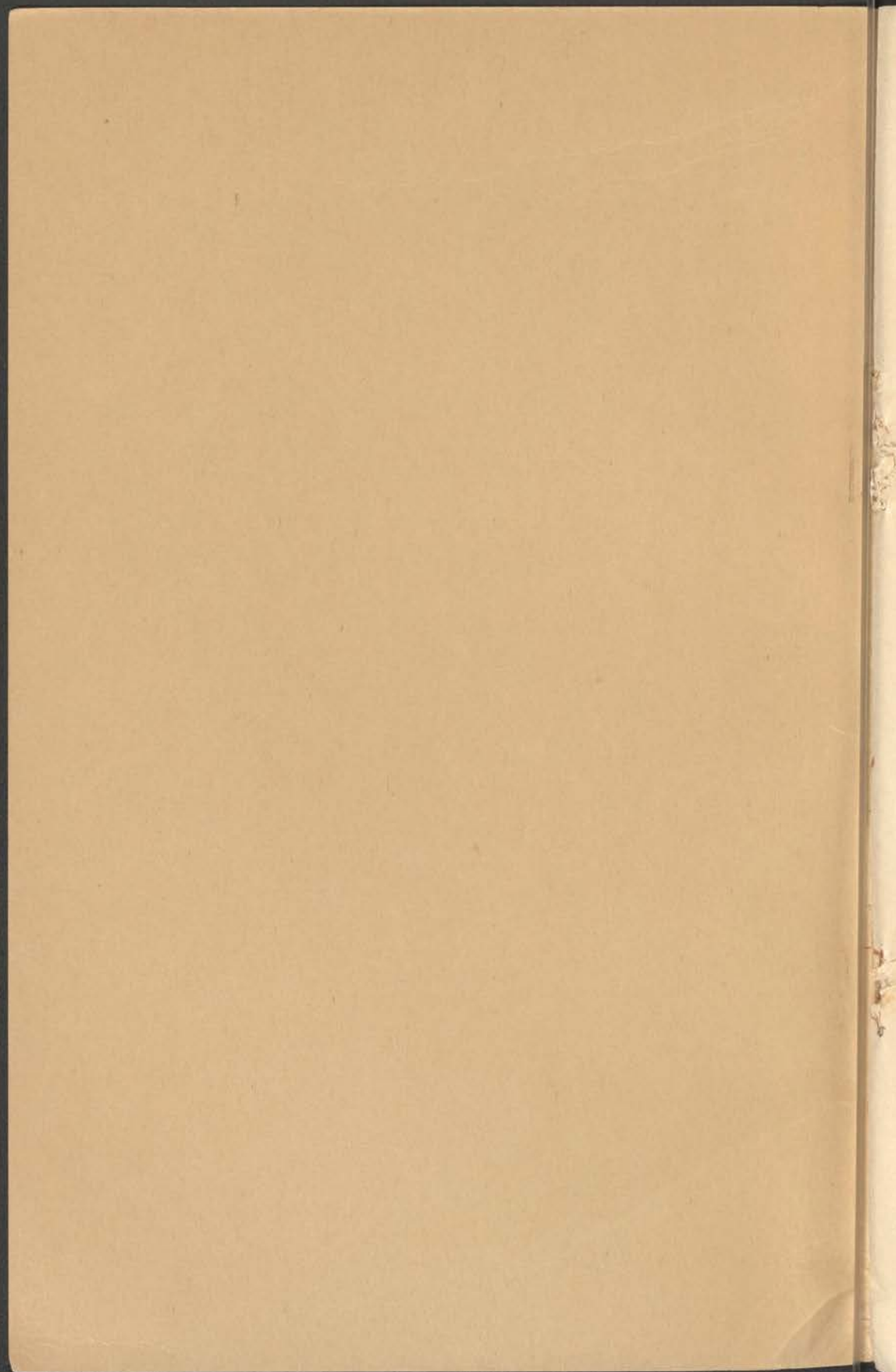
WAR DEPARTMENT TECHNICAL MANUAL

NON-CIRCULATING

1/4-TON 4x4 TRUCK (WILLYS-OVERLAND MODEL MB and FORD MODEL GPW)

WAR DEPARTMENT • 22 FEBRUARY 1944

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WAR DEPARTMENT TECHNICAL MANUAL

TM 9-803

**This manual supersedes TB 9-803-4, 5 January 1944. For supersession of Quartermaster Corps 10-series technical manuals, see paragraph 1*

¼-TON 4 x 4 TRUCK
(WILLYS-OVERLAND
MODEL MB and
FORD MODEL GPW)



WAR DEPARTMENT • 22 FEBRUARY 1944

WAR DEPARTMENT
Washington 25, D. C., 22 February 1944

TM 9-803, 1/4-ton 4 x 4 Truck (Willys-Overland Model MB and Ford Model GPW), is published for the information and guidance of all concerned.

[A. G. 300.7 (17 November 43)]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

DISTRIBUTION: C & H (1).

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

1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB and FORD MODEL GPW)

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PART ONE—OPERATING INSTRUCTIONS**Section I****INTRODUCTION**

Paragraph

Scope 1

1. SCOPE.

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

b. In addition to a description of the $\frac{1}{4}$ -ton 4 x 4 Truck (Willys-Overland model MB and Ford GPW), this manual contains technical information required for the identification, use, and care of the materiel. The manual is divided into two parts. Part One, sections I through VII, contains vehicle operating instructions. Part Two, sections VIII through XXXII, contains vehicle maintenance instructions to using arm personnel charged with the responsibility of doing maintenance work within their jurisdiction, including radio suppression and shipment and temporary storage information.

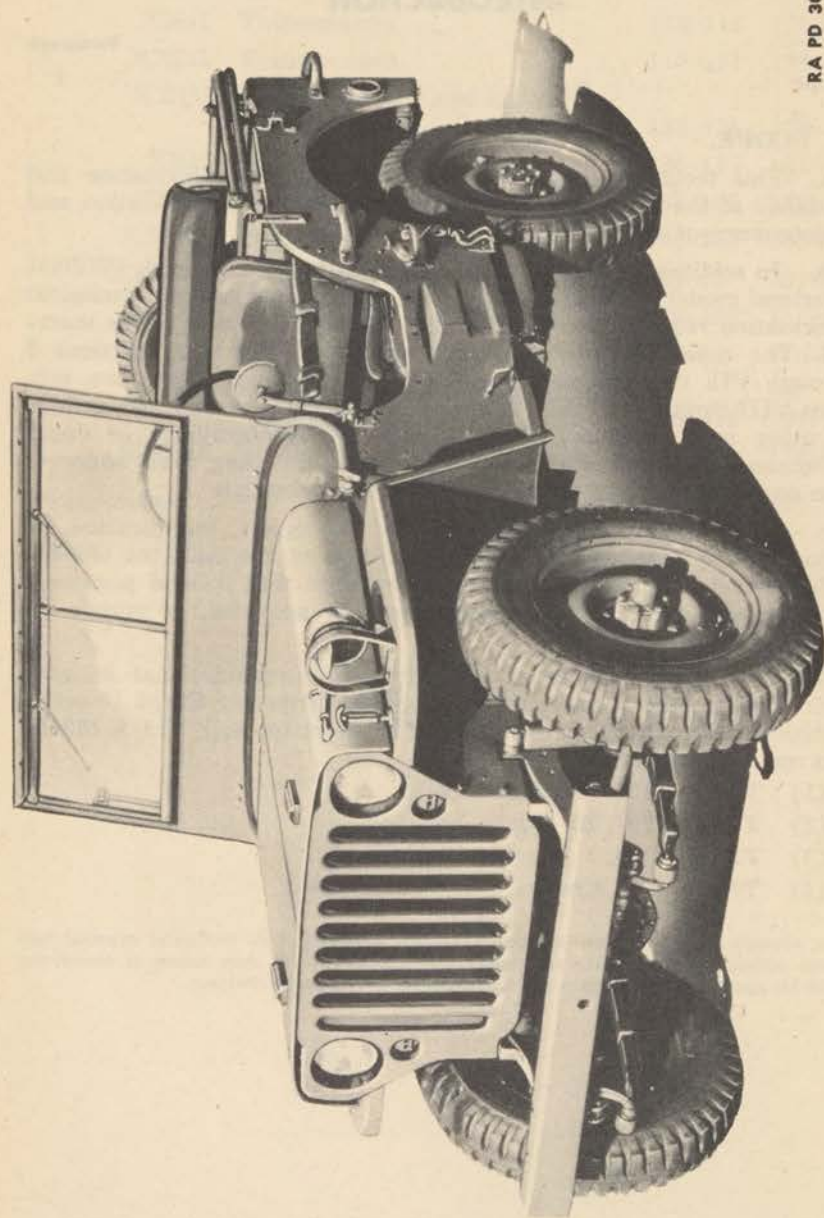
c. In all cases where the nature of the repair, modification, or adjustment is beyond the scope of facilities of the unit, the responsible ordnance service should be informed so that trained personnel with suitable tools and equipment may be provided, or proper instructions issued.

d. This manual includes operating and organizational maintenance instructions from the following Quartermaster Corps 10-series technical manuals. Together with TM 9-1803A and TM 9-1803B, this manual supersedes them:

- (1) TM 10-1103, 20 August 1941.
- (2) TM 10-1207, 20 August 1941.
- (3) TM 10-1349, 3 January 1942.
- (4) TM 10-1513, Change 1, 15 January 1943.

*To provide operating instructions with the materiel, this technical manual has been published in advance of complete technical review. Any errors or omissions will be corrected by changes or, if extensive, by an early revision.

**4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
and FORD MODEL GPW)**



RA PD 305251

Figure 1—1/4-Ton 4 x 4 Truck—Left Front

INTRODUCTION

RA PD 305250

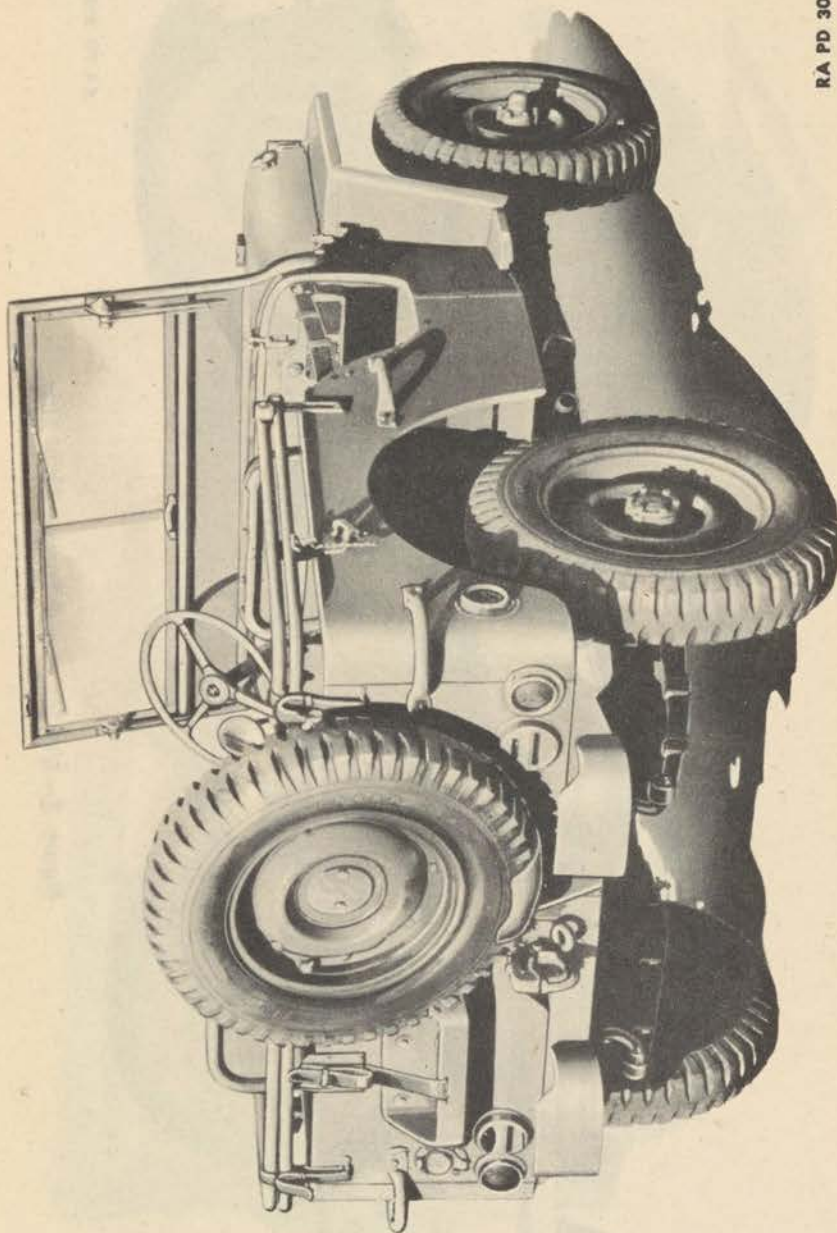
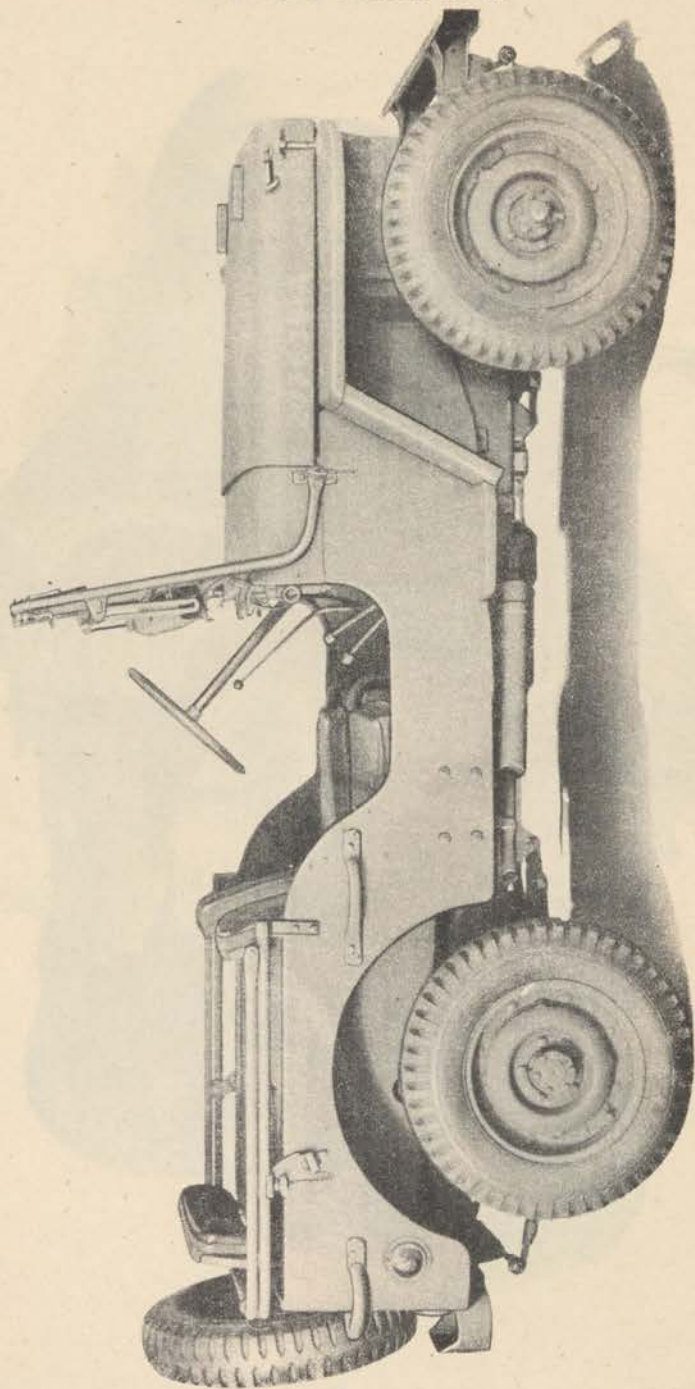


Figure 2—1 1/4-Ton 4 x 4 Truck—Right Rear

**1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
and FORD MODEL GPW)**



RA PD 305163

Figure 3—1/4-Ton 4 x 4 Truck—Right Side

INTRODUCTION

RA PD 305164

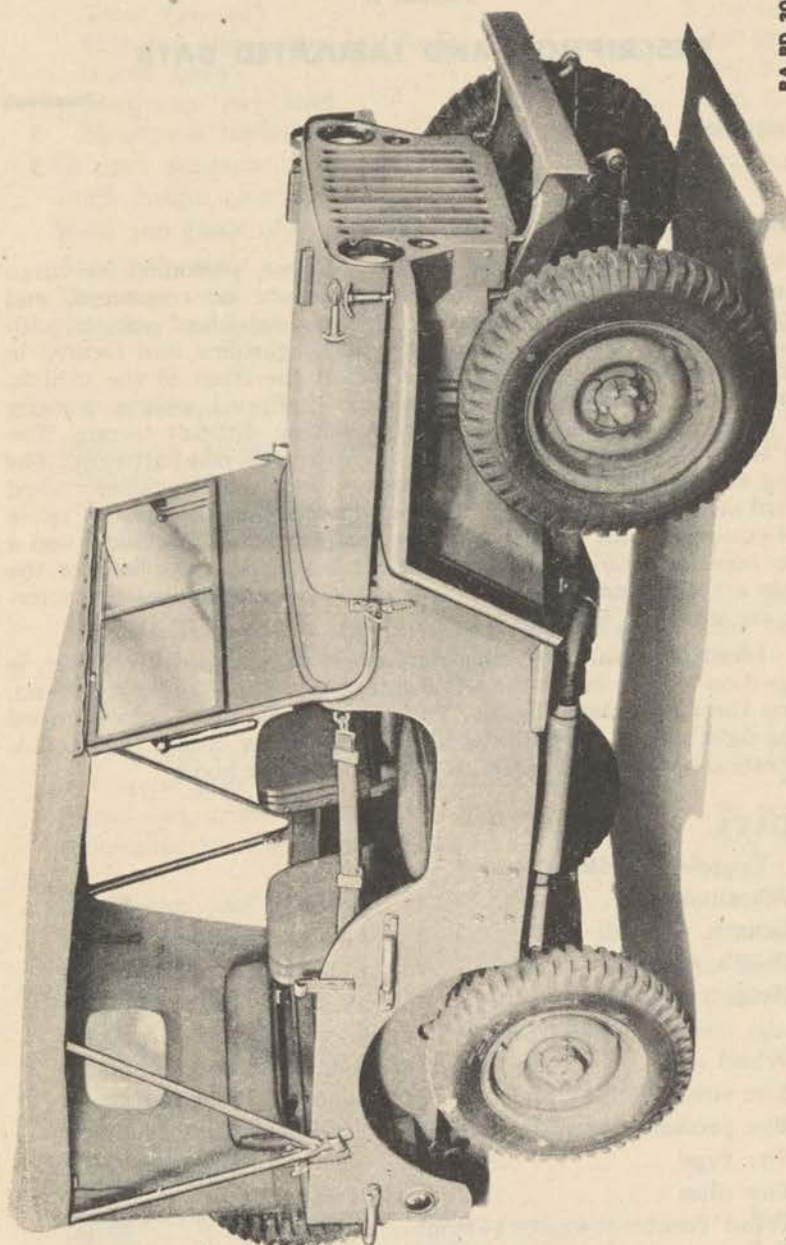


Figure 4—1/4-Ton 4 x 4 Truck—Right Front

DESCRIPTION AND TABULATED DATA

Weights:

Road, including gas and water	2,453 lb
Gross (loaded)	3,253 lb
Shipping (less water and fuel)	2,337 lb
Boxed gross	3,062 lb
Maximum pay load	800 lb
Maximum trailed load	1,000 lb
Ground clearance	8 $\frac{3}{4}$ in.
Pintle height (loaded)	21 in.
Kind and grade of fuel (octane rating)	Gasoline (68 min)
Approach angle	45 deg
Departure angle	35 deg
Shipping dimensions—cubic feet	331
—square feet	57

b. Performance.

Maximum allowable speeds (mph) with transfer case in "HIGH" range:

High gear (3rd)	65
Intermediate gear (2nd)	41
Low gear (1st)	24
Reverse gear	18

Maximum allowable speeds (mph) with transfer case in "LOW" range:

High gear (3rd)	33
Intermediate gear (2nd)	21
Low gear (1st)	12
Reverse gear	9

Maximum grade ability 60 pct |

Minimum turning radius—right	17 $\frac{1}{2}$ ft
—left	17 $\frac{1}{2}$ ft

Maximum fording depth 21 in. |

Towing facilities—front	none
—rear	pintle hook

Maximum draw-bar pull 1,930 lb |

Engine idle speed 600 rpm |

Miles per gallon—(high gear—high range)	
average conditions	20

Cruising range—(miles) average conditions 20 |

c. Capacities.

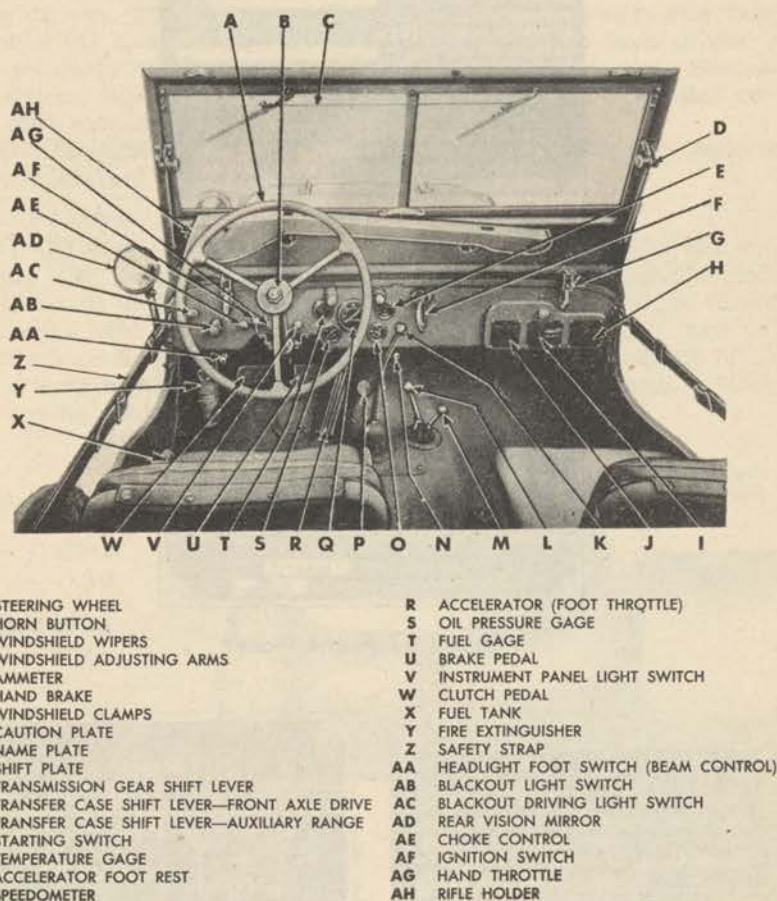
Engine crankcase capacity—dry	5 qt
—refill	4 qt
Transmission capacity	$\frac{3}{4}$ qt
Transfer case capacity	1 $\frac{1}{2}$ qt

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Section III

DRIVING CONTROLS AND OPERATION

	Paragraph
Instruments and controls.....	4
Use of instruments and controls in vehicular operation.....	5
Towing the vehicle.....	6



RA PD 334753

Figure 5—Instruments and Controls**4. INSTRUMENTS AND CONTROLS.****a. Instruments.**

(1) **AMMETER** (fig. 5). The ammeter on the instrument panel indicates the rate of current flow when the generator is charging the battery, and also indicates the amount of current being consumed when the engine is idle.

(2) **FUEL GAGE** (fig. 5). The fuel gage on the instrument panel

1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB and FORD MODEL GPW)

WILLYS	
NOMENCLATURE TRUCK 1/4 TON 4 x 4	
SUPPLY ARM OR SERVICE	ORDNANCE DEPT.
MAINTAINING VEHICLE	WILLYS MB.
MAKE AND MODEL	
SERIAL NUMBER:	
GROSS WEIGHT	LBS.
MAXIMUM PAYLOAD	800 LBS.
MAXIMUM TRAILOLOAD	1000 LBS.
DATE OF DELIVERY -	
RECOMMENDED BY MANUFACTURER	
OCTANE RATING OF GASOLINE 68 MIN.	
S.A.E. GRADE OF OIL BELOW 32° F USE 10W S.A.E.	
S.A.E. GRADE OF OIL ABOVE 32° F USE 30 S.A.E.	
PUBLICATIONS APPLYING TO THIS VEHICLE	
PARTS LIST	
TECHNICAL MANUAL T/M	

Ford	
NOMENCLATURE TRUCK 1/4 TON 4x4	
SUPPLY ARM OR SERVICE	ORDNANCE DEPARTMENT
MAINTAINING VEHICLE	FORD-GPW
MAKE AND MODEL	
SERIAL NUMBER	
GROSS WEIGHT	LBS.
MAXIMUM PAYLOAD	800 LBS.
MAXIMUM TRAILO LOAD	1000 LBS.
DATE OF DELIVERY	
RECOMMENDED BY MANUFACTURER	
OCTANE RATING OF GASOLINE 68 MIN.	
S.A.E. GRADE OF OIL ABOVE 32°F. --- 30 S.A.E.	
S.A.E. GRADE OF OIL BELOW 32°F. --- 10 S.A.E.	
PUBLICATIONS APPLYING TO THIS VEHICLE	
PARTS LIST T/M 10-	1348
MAINTENANCE MANUAL T/M 10-	1349

Figure 6—Name Plate

RA PD 330838

CAUTION		
MAXIMUM PERMISSIBLE ROAD SPEEDS IN THE FOLLOWING GEAR POSITIONS		
TRANSMISSION IN	TRANSFER CASE IN	
	HIGH RANGE	LOW RANGE
HIGH	60 M.P.H.	33 M.P.H.
INTERMEDIATE	41	21
LOW	24	12
REVERSE	18	9
TO DRAIN COOLING SYSTEM: OPEN RADIATOR DRAIN COCK LOCATED ON NOSE FITTING AT LOWER LEFT SIDE OF RADIATOR AND CYLINDER BLOCK DRAIN COCK ON RIGHT FORWARD SIDE OF ENGINE.		

RA PD 305162

Figure 7—Caution Plate

FRONT	
TRANSMISSION	TRANSFER CASE
FRONT AXLE DRIVE	AUX. RANGE
DISENGAGE FRONT AXLE DRIVE WHEN OPERATING ON DRY HARD SURFACED ROADS	

RA PD 305161

Figure 8—Shift Plate

DRIVING CONTROLS AND OPERATION

is an electrical unit which indicates the fuel level in the tank, and only registers while the ignition switch is turned on.

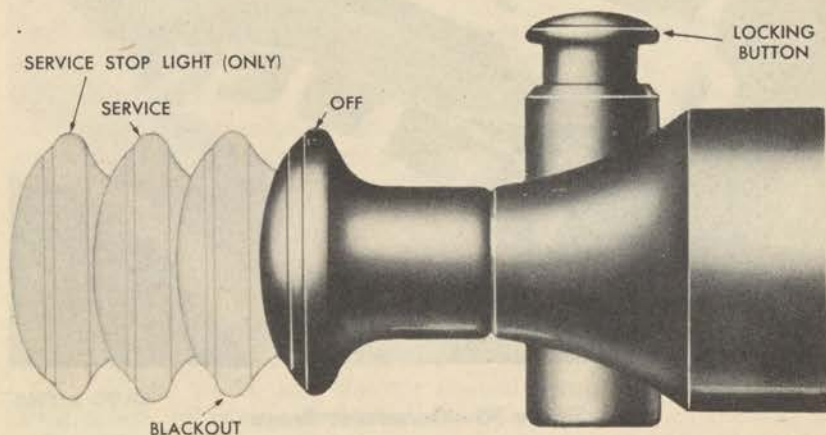
(3) **OIL PRESSURE GAGE** (fig. 5). The oil pressure gage located on the instrument panel indicates the oil pressure when the engine is running.

(4) **SPEEDOMETER** (fig. 5). The speedometer on the instrument panel indicates in miles per hour the speed at which the vehicle is being driven. The odometer (in upper part of speedometer face) registers the total number of miles the vehicle has been driven. A trip indicator (in lower part of speedometer face) gives distance covered on any trip. Set trip indicator by turning the knurled control shaft extending through back of the speedometer.

(5) **TEMPERATURE GAGE** (fig. 5). The temperature gage registers the temperature of the solution in the cooling system.

b. Controls.

(1) **BLACKOUT DRIVING LIGHT SWITCH** (fig. 5). The blackout driving light switch (B.O. DRIVE) on the instrument panel controls the blackout driving light located on the left front fender, to furnish additional light during blackout periods. To operate light, first pull the blackout *light* switch button to the first position, then pull blackout *driving* light switch knob. To switch off the light, push in blackout *driving* light switch knob.



RA PD 64586

Figure 9—Blackout Light Switch Operating Positions

(2) **BLACKOUT LIGHT SWITCH** (fig. 5). The knob on the instrument panel (LIGHTS) controls the entire lighting system, including the instrument panel lights, blackout driving light, and stop lights. A circuit-breaker type fuse, on the back of the switch, opens when a short circuit occurs, and closes when the thermostatic element cools. The light switch is a four-position push-pull type with a safety lock (fig. 9). When the control knob is pulled out to the first position, the blackout headlights and blackout stop and taillights are turned on.

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The switch control knob travel is automatically locked in this position by the lock-out button to prevent accidentally turning on of the service (bright) lights in a blackout area. To obtain service lights, push in on lock-out control button on the left side of the switch, and pull out control knob to second position. When switch is in this position service headlights, service stop and taillights are turned on, and the panel lights can be turned on by pulling out on the knob (PANEL LIGHTS). **CAUTION:** *When driving during the day, press in lock-out control button, and pull control knob out to the last or stop light position to cause only the regular stop light to function.*

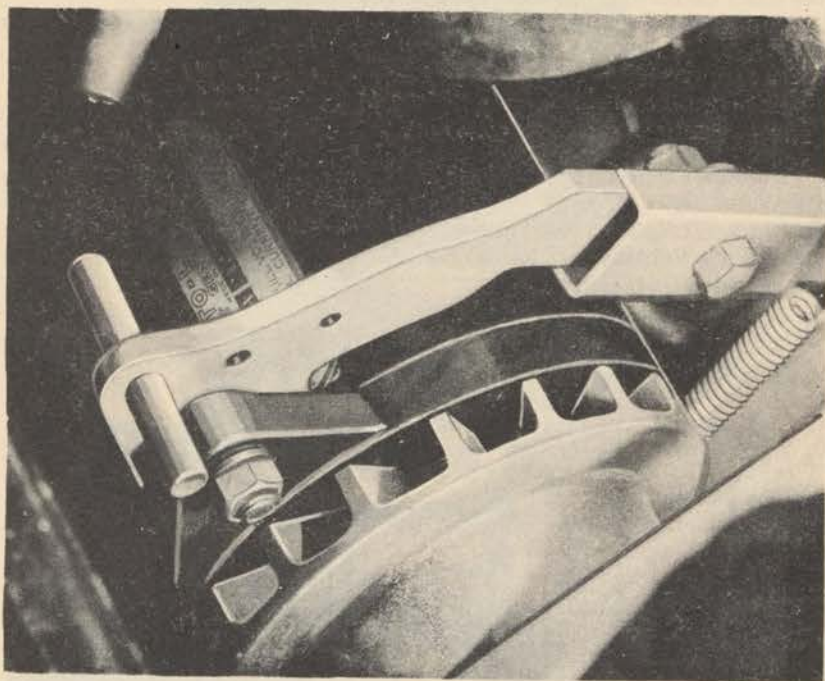


Figure 10—Generator Brace

RA PD 305165

(3) **PANEL LIGHT SWITCH** (fig. 5). The panel light switch knob (PANEL LIGHTS), located on the instrument panel, controls the lights to illuminate the panel instruments and controls. The blackout light switch (subpar. b (2) above) must be in service (bright light) position for this switch to control the panel lights.

(4) **FIRE EXTINGUISHER** (fig. 5). The fire extinguisher is mounted inside the left cowl panel. To remove, pull outward on the clamp release lever. To operate extinguisher, hold body in one hand and with the other, turn handle to left one-quarter turn, which releases plunger lock. Use pumping action to force liquid on base of fire. Read instructions on fire extinguisher plate.

DRIVING CONTROLS AND OPERATION

(5) **HAND BRAKE** (fig. 5). The hand brake is applied by pulling out on the handle at the center of the instrument panel. Pull the handle out in a vertical position when the vehicle is parked. The brake is released by turning the handle one-quarter turn.

(6) **WINDSHIELD ADJUSTING ARMS** (fig. 5). The windshield adjustment arms are mounted on each end of the windshield frame. To open windshield, loosen knobs and push forward on lower part, then set by tightening the knobs.

(7) **WINDSHIELD CLAMPS** (fig. 5). The windshield clamps are located on the lower part of the windshield. Pull up on both clamps and unhook them, after which the windshield can be lowered on top of the hood. Be sure to hook down the windshield, using the hold-down catches on both sides of the hood.

(8) **GENERATOR BRACE** (fig. 10). The generator brace can be pulled up to release tension on the fan belt and stop the fan from throwing water over the engine when crossing a stream. Pull generator out to running position as soon as possible thereafter, and it will lock in place. **CAUTION:** *Be sure fan belt is on pulleys.*

(9) **OTHER INSTRUMENTS AND CONTROLS.** Other instruments and controls are of the conventional type, and are shown in figure 5.

5. USE OF INSTRUMENTS AND CONTROLS IN VEHICULAR OPERATION.

a. **Before-operation Service.** Perform the services in paragraph 13 before attempting to start the engine.

b. **Starting Engine.** To start the engine proceed as follows:

- (1) Put transmission gearshift lever in neutral position (fig. 8).
- (2) Pull out hand throttle button about $\frac{3}{4}$ inch to 1 inch.
- (3) Pull out choke button all the way. **NOTE:** *Choking is not necessary when engine is warm.*
- (4) Turn ignition to "ON" position.
- (5) Depress clutch pedal to disengage clutch, and hold pedal down while engine is started.
- (6) Step on starting switch to crank again. Release switch as soon as engine starts.
- (7) Adjust choke and throttle control buttons to obtain proper idling speed. As engine warms up, push choke button all the way in.
- (8) Check oil pressure gage reading; at idle speed the indicator hand should show at least 10 on the gage.
- (9) Check ammeter for charge reading. Check fuel gage for indication of fuel supply.
- (10) After engine has operated a few minutes, check temperature gage reading. Normal operating temperature is between 160°F and 185°F.
- (11) In extremely cold weather refer to paragraph 7.

c. **Placing Vehicle in Motion.**

- (1) For daytime driving turn on service stop light (par. 4 b (2)).
- (2) Place transfer case right-hand shift lever in rear position to

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engage "HIGH" range, then place center shift lever in forward position to disengage front axle (fig. 8).

(3) Depress clutch pedal, and move transmission shift lever toward driver and backward to engage low (1st) gear (fig. 8).

(4) Release parking (hand) brake.

(5) Slightly depress accelerator to increase engine speed, and at the same time slowly release clutch pedal, increasing pressure on accelerator as clutch engages and vehicle starts to move. **NOTE:** *During the following operations perform procedures outlined in paragraph 14.*

(6) Increase speed to approximately 10 miles per hour, depress clutch pedal, and at the same time release pressure on accelerator. Move transmission shift lever out of low gear into neutral, and then into second gear. No double clutching is required. Release clutch pedal and accelerate engine.

(7) After vehicle has attained a speed of approximately 20 miles per hour, follow the same procedure as outlined above in order to shift into high (3rd) gear, moving the gearshift lever straight back.

d. Shifting to Lower Gears in Transmission. Shift to a lower gear before engine begins to labor, as follows: Depress clutch pedal quickly, shift to next lower gear, increase engine speed, release clutch pedal slowly, and accelerate. When shifting to a lower gear at any rate of vehicle speed, make sure that the engine speed is synchronized with vehicle speed before clutch is engaged.

e. Shifting Gears in Transfer Case (fig. 8). The transfer case is the means by which power is applied to the front and rear axles. In addition, the low gear provided by the transfer case further increases the number of speeds provided by the transmission. The selection of gear ratios depends upon the road and load conditions. Shift gears in the transfer case in accordance with the shift plate (fig. 8), and observe the instructions on the caution plate (fig. 7). The transmission gearshift does not in any way affect the selection or shifting of the transfer case gears. Vehicle may be driven by rear axle, or by both front and rear axles. The front axle cannot be driven independently.

(1) **FRONT AXLE ENGAGEMENT.** Front axle should be engaged only in off-the-road operation, slippery roads, steep grades, or during hard pulling. Disengage front axle when operating on average roads under normal conditions.

(a) **Engaging Front Axle with Transfer Case in "HIGH" Range.** With transfer case in "HIGH" range, move front axle drive shift lever to "IN" position. Depressing the clutch pedal will facilitate shifting.

(b) **Disengaging Front Axle with Transfer Case in "HIGH" Range.** Move front axle drive shift lever to "OUT" position. Depress the clutch pedal to facilitate shifting.

(c) **Disengaging Front Axle when Transfer Case is in "LOW."**
1. Depress clutch pedal, then shift transfer case lever into "HIGH."

2. Shift front axle drive lever into "OUT" position.

DRIVING CONTROLS AND OPERATION

3. Release clutch pedal and accelerate engine to desired speed.

(2) **ENGAGING TRANSFER CASE LOW RANGE.** Transfer case LOW range cannot be engaged until front axle drive is engaged.

(a) Engage front axle drive (subpar. e (1) above).

(b) Depress clutch pedal and move transfer case shift lever into "N" (neutral) position.

(c) Release clutch pedal and accelerate engine.

(d) Depress clutch pedal again and move transfer case shift lever forward into "LOW" position.

(e) Release clutch pedal, and accelerate engine to desired speed.

(3) **ENGAGING TRANSFER CASE—"LOW" to "HIGH."** This shift can be made regardless of vehicle speed.

(a) Depress clutch pedal and move transfer case shift lever into "HIGH" position.

(b) Release clutch pedal, and accelerate engine to desired speed.

f. Stopping the Vehicle. Remove foot from accelerator, and apply brakes by depressing brake pedal.

(1) When vehicle speed has been reduced to engine idle speed, depress clutch pedal and move transmission shift lever to "N" (neutral) position (fig. 8).

(2) When vehicle has come to a complete stop, apply parking (hand) brake, and release clutch and brake pedals.

g. Reversing the Vehicle. To shift into reverse speed, first bring the vehicle to a complete stop.

(1) Depress clutch pedal.

(2) Move transmission shift lever to the left and forward into "R" (reverse) position.

(3) Release clutch pedal slowly, and accelerate as load is picked up.

h. Stopping the Engine. To stop the engine turn the ignition switch to "OFF" position. *NOTE: Before a new or reconditioned vehicle is first put into service, make run-in tests as outlined in section 10.*

6. TOWING THE VEHICLE.

a. Attaching Tow Line. To tow vehicle attach the chain, rope or cable to the front bumper bar at the frame side rail gusset (fig. 11). Do not tow from the middle of the bumper. To attach tow line, loop chain, rope, or cable over top of bumper, bring tow line up across front of bumper, and back on opposite side of frame, then hook or tie.

b. Towing to Start Vehicle. Place transfer case (aux. RANGE) shift lever of towed vehicle to the rear ("HIGH"). Place front axle drive shift lever in "OUT" (forward) position. Depress clutch pedal and engage transmission in high (3rd) speed. Switch ignition "ON," pull out choke control knob (if engine is cold), pull out throttle knob about 1 inch, release parking (hand) brake, and tow vehicle. After

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vehicle is under way, release clutch pedal slowly. As engine starts, regulate choke and throttle controls and disengage clutch, being careful to avoid overrunning towing vehicle or tow line.

c. Towing Disabled Vehicle. When towing a disabled vehicle exercise care so that no additional damage will occur.

(1) ALL WHEELS ON GROUND.

(a) If transfer case is *not* damaged, shift transmission and transfer case into neutral position and follow steps (c) and (d) below.

(b) If transfer case is damaged, disconnect both propeller shafts at the front and rear axles by removing the universal joint U-bolts, being careful not to lose the bearing races and rollers. Securely fasten the shafts to the frame with wire or remove dust cap and pull apart at the universal joint splines. Place bolts, nuts, rollers, and races in the glove compartment.



Figure 11—Chain Tow

(c) If the front axle differential or propeller shaft is damaged, remove front axle shaft driving flanges. Place front axle drive shift lever in "OUT" (forward) position and drive vehicle under own power.

(d) If the rear axle differential is damaged, remove the rear axle shafts; remove rear propeller shaft at rear universal joint U-bolts and front universal joint snap rings in forward flange, then drive out bearing cups. Place front axle drive shift lever in "IN" (rear) position and this will allow front axle drive to propel vehicle under own power.

(e) If rear propeller shaft only is damaged, remove as described in step (d) above.

(2) TOWING VEHICLE WITH FRONT OR REAR WHEELS OFF GROUND. If vehicle is to be towed in this manner be sure that transfer case shift lever is placed in "N" (neutral) position and front axle drive shift lever is placed in "OUT" (disengaged) position.

Section IV

OPERATION UNDER UNUSUAL CONDITIONS

	Paragraph
Operation in cold weather	7
Operation in hot weather	8
Operation in sand	9
Operation in landing	10
Decontamination	11

7. OPERATION IN COLD WEATHER.

a. **Purpose.** Operation of automotive equipment at subzero temperatures presents problems that demand special precautions and extra careful servicing from both operation and maintenance personnel, if poor performance and total functional failure are to be avoided.

b. **Gasoline.** Winter grade of gasoline is designed to reduce cold weather starting difficulties; therefore, the winter grade motor fuel should be used in cold weather operation.

c. **Storage and Handling of Gasoline.** Due to condensation of moisture from the air, water will accumulate in tanks, drums, and containers. At low temperatures, this water will form ice crystals that will clog fuel lines and carburetor jets, unless the following precautions are taken:

(1) Strain the fuel through filter paper, or any other type of strainer that will prevent the passage of water. **CAUTION:** *Gasoline flowing over a surface generates static electricity that will result in a spark, unless means are provided to ground the electricity. Always provide a metallic contact between the container and the tank, to assure an effective ground.*

(2) Keep tank full, if possible. The more fuel there is in the tank, the smaller will be the volume of air from which moisture can be condensed.

(3) Add $\frac{1}{2}$ pint of denatured alcohol, Grade 3, to the fuel tank each time it is filled. This will reduce the hazard of ice formation in the fuel.

(4) Be sure that all containers are thoroughly clean and free from rust before storing fuel in them.

(5) If possible, after filling or moving a container, allow the fuel to settle before filling fuel tank from it.

(6) Keep all closures of containers tight to prevent snow, ice, dirt, and other foreign matter from entering.

(7) Wipe all snow or ice from dispensing equipment and from around fuel tank filler cap before removing cap to refuel vehicle.

d. **Lubrication.**

(1) TRANSMISSION AND DIFFERENTIAL.

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(a) Universal gear lubricant, SAE 80, where specified on figure 14, is suitable for use at temperatures as low as -20°F . If consistent temperature below 0°F is anticipated, drain the gear cases while warm, and refill with Grade 75 universal gear lubricant, which is suitable for operation at all temperatures below $+32^{\circ}\text{F}$. If Grade 75 universal gear lubricant is not available, SAE 80 universal gear lubricant diluted with the fuel used by the engine, in the proportion of one part fuel to six parts universal gear lubricant, may be used. Dilute make-up oil in the same proportion before it is added to gear cases.

(b) After engine has been warmed up, engage clutch, and maintain engine speed at fast idle for 5 minutes, or until gears can be engaged. Put transmission in low (first) gear, and drive vehicle for 100 yards, being careful not to stall engine. This will heat gear lubricants to the point where normal operation can be expected.

(2) CHASSIS POINTS. Lubricate chassis points with general purpose grease, No. 0.

(3) STEERING GEAR HOUSING. Drain housing, if possible, or use suction gun to remove as much lubricant as possible. Refill with universal gear lubricant, Grade 75, or, if not available, SAE 80 universal gear lubricant diluted with fuel used in the engine, in the proportion of one part fuel to six parts SAE 80 universal gear lubricant. Dilute make-up oil in the same proportion before it is added to the housing.

(4) OILCAN POINTS. For oilcan points where engine oil is prescribed for above 0°F , use light lubricating, preservative oil.

e. Protection of Cooling Systems.

(1) USE ANTIFREEZE COMPOUND. Protect the system with antifreeze compound (ethylene-glycol type) for operation below $+32^{\circ}\text{F}$. The following instructions apply to use of new antifreeze compound.

(2) CLEAN COOLING SYSTEM. Before adding antifreeze compound, clean the cooling system, and completely free it from rust. If the cooling system has been cleaned recently, it may be necessary only to drain, refill with clean water, and again drain. Otherwise the system should be cleaned with cleaning compound.

(3) REPAIR LEAKS. Inspect all hoses, and replace if deteriorated. Inspect all hose clamps, plugs, and pet cocks and tighten if necessary. Repair all radiator leaks before adding antifreeze compound. Correct all leakage of exhaust gas or air into the cooling system.

(4) ADD ANTIFREEZE COMPOUND. When the cooling system is clean and tight, fill the system with water to about one-third capacity. Then add antifreeze compound, using the proportion of antifreeze compound to the cooling system capacity indicated below. Protect the system to at least 10°F below the lowest temperature expected to be experienced during the winter season.

OPERATION UNDER UNUSUAL CONDITIONS

ANTIFREEZE COMPOUND CHART
(for 11-quart capacity cooling system)

Temperature	Antifreeze Compound (ethylene-glycol type)
+10°F	3 qt
0°F	3¾ qt
-10°F	4½ qt
-20°F	4¾ qt
-30°F	5½ qt
-40°F	6 qt

(5) **WARM THE ENGINE.** After adding antifreeze compound, fill with water to slightly below the filler neck; then start and warm the engine to normal operating temperature.

(6) **TEST STRENGTH OF SOLUTION.** Stop the engine and check the solution with a hydrometer, adding antifreeze compound if required.

(7) **INSPECT WEEKLY.** In service, inspect the coolant weekly for strength and color. If rusty, drain and clean cooling system thoroughly, and add new solution of the required strength.

(8) **CAUTIONS.**

(a) *Antifreeze compound is the only antifreeze material authorized for ordnance materiel.*

(b) *It is essential that antifreeze solutions be kept clean. Use only containers and water that are free from dirt, rust, and oil.*

(c) *Use an accurate hydrometer. To test a hydrometer, use one part antifreeze compound to two parts water. This solution will produce a hydrometer reading of 0°F.*

(d) *Do not spill antifreeze compound on painted surfaces.*

f. Electrical Systems.

(1) **GENERATOR AND CRANKING MOTOR.** Check the brushes, commutators, and bearings. See that the commutators are clean. The large surges of current which occur when starting a cold engine require good contact between brushes and commutators.

(2) **WIRING.** Check, clean, and tighten all connections, especially the battery terminals. Care should be taken that no short circuits are present.

(3) **COIL.** Check coil for proper functioning by noting quality of spark.

(4) **DISTRIBUTOR.** Clean thoroughly, and clean or replace points. Check the points frequently. In cold weather, slightly pitted points may prevent engine from starting.

(5) **SPARK PLUGS.** Clean and adjust or replace, if necessary. If it is difficult to make the engine fire, reduce the gap to 0.005 inch less than that recommended for normal operation (par. 67 b). This will make ignition more effective at reduced voltages likely to prevail.

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(6) **TIMING.** Check carefully. Care should be taken that the spark is not unduly advanced nor retarded.

(7) **BATTERY.**

(a) The efficiency of batteries decreases sharply with decreasing temperatures, and becomes practically nil at -40°F . Do not try to start the engine with the battery when it has been chilled to temperatures below -30°F until battery has been heated, unless a warm slave battery is available. See that the battery is always fully charged, with the hydrometer reading between 1.275 and 1.300. A fully charged battery will not freeze at temperatures likely to be encountered even in arctic climates, but a fully discharged battery will freeze and rupture at $+5^{\circ}\text{F}$.

(b) Do not add water to a battery when it has been exposed to subzero temperatures unless the battery is to be charged immediately. If water is added and the battery not put on charge, the layer of water will stay at the top and freeze before it has a chance to mix with the acid.

(8) **LIGHTS.** Inspect the lights carefully. Check for short circuits and presence of moisture around sockets.

(9) **ICE.** Before every start, see that the spark plugs, wiring, or other electrical equipment is free from ice.

g. Starting and Operating Engine.

(1) **INSPECT CRANKING MOTOR MECHANISM.** Be sure that no heavy grease or dirt has been left on the cranking motor throwout mechanism. Heavy grease or dirt is liable to keep the gears from being meshed, or cause them to remain in mesh after the engine starts running. The latter will ruin the cranking motor and necessitate repairs.

(2) **USE OF CHOKE.** A full choke is necessary to secure the rich air-fuel mixture required for cold weather starting. Check the butterfly valve to see that it closes all the way, and otherwise functions properly.

(3) **CARBURETOR AND FUEL PUMP.** The carburetor, which will give no appreciable trouble at normal temperatures, is liable not to operate satisfactorily at low temperatures. Be sure the fuel pump has no leaky valves or diaphragm, as this will prevent the fuel pump from delivering the amount of fuel required to start the engine at low temperatures, when turning speeds are reduced to 30 to 60 revolutions per minute.

(4) **AIR CLEANERS.** At temperatures below 0°F do not use oil in air cleaners. The oil will congeal and prevent the easy flow of air. Wash screens in dry-cleaning solvent, dry, and replace. Ice and frost formations on the air cleaner screens can cause an abnormally high intake vacuum in the carburetor air horn hose, resulting in collapse.

(5) **FUEL SYSTEM.** Remove and clean sediment bulb, strainers, etc., daily. Also drain fuel tank sump daily to remove water and dirt.

OPERATION UNDER UNUSUAL CONDITIONS

(6) **STARTING THE ENGINE.** Observe the following precautions in addition to the normal starting procedure (par. 5 a and b).

- (a) Clean ignition wires and outside of spark plugs of dirt and frost.
- (b) Free distributor point arm on post and clean points.
- (c) Be sure carburetor choke closes fully.
- (d) Operate fuel pump hand lever to fill carburetor bowl (fig. 12).
- (e) Free up engine with hand crank or use slave battery.
- (f) Stop engine if no oil pressure shows on gage.

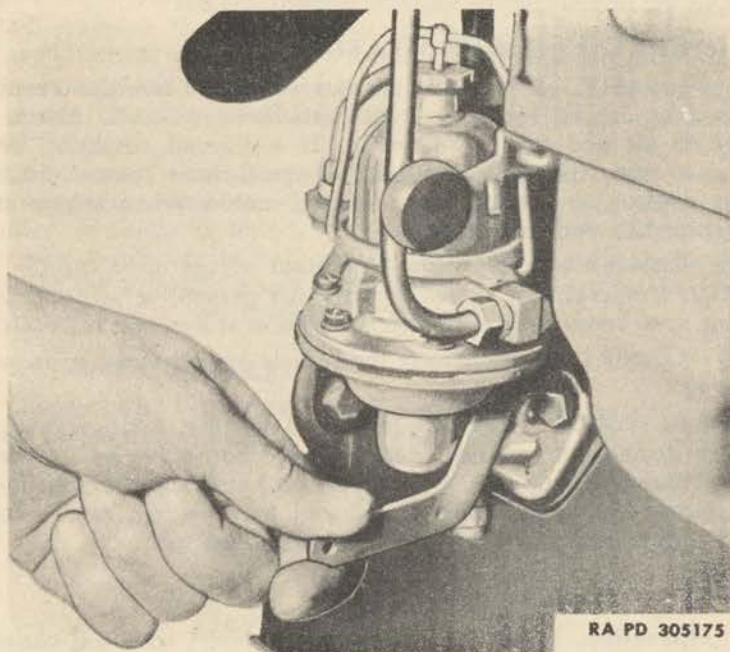


Figure 12—Fuel Pump, Hand Operation

(g) Engage clutch to warm up transmission oil before attempting to move vehicle.

(h) Check engine operation for proper condition (par. 13 b (22)).

h. Chassis.

(1) **BRAKE BANDS.** Brake bands, particularly on new vehicles, have a tendency to bind when they are very cold. Always have a blowtorch handy to warm up these parts, if they bind prior to moving, or attempting to move, the vehicle. Parking the vehicle with the brake released will eliminate most of the binding. Precaution must be taken, under these circumstances, to block the wheels or otherwise prevent movement of the vehicle.

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(2) **EFFECT OF LOW TEMPERATURES ON METALS.** Inspect the vehicle frequently. Shock resistance of metals, or resistance against breaking, is greatly reduced at extremely low temperatures. Operation of vehicles on hard, frozen ground causes strain and jolting which will result in screws breaking, or nuts jarring loose.

(3) **SPEEDOMETER CABLE.** Disconnect the oil-lubricated speedometer cable at the drive end when operating the vehicle at temperatures of -30°F and below. The cable will often fail to work properly at these temperatures, and sometimes will break, due to the excessive drag caused by the high viscosity of the oil with which it is lubricated.

8. OPERATION IN HOT WEATHER.

a. **Protection of Vehicle.** In extremely hot weather avoid the continuous use of low gear ratios whenever possible. Check and replenish oil and water frequently. If a flooded condition of the engine is experienced in starting, pull the throttle control out, push choke control in, and use the cranking motor. When engine starts, adjust throttle control.

(1) **COOLING SYSTEM.** Rust formation occurs more rapidly during high temperatures; therefore, add rust preventive solution to the cooling system, or clean and flush the system at frequent intervals.

(2) **LUBRICATION.** Lubricate the vehicle for hot weather operation (par. 8).

(3) **ELECTRICAL SYSTEM.** Check the battery solution level frequently during hot weather operation, and add water as required to keep it above the top of the plates. If hard starting is experienced in hot, damp weather or quick changes in temperature, dry the spark plugs, wires, and both inside and outside of distributor cap.

9. OPERATION IN SAND.

a. **Operation.** Reduce tire pressures in desert terrain if character of sand demands this precaution. When operating in sand deep enough to cause the use of a lower gear, do not exceed the speed specified on the caution plate for the particular gear ratio (fig. 7).

b. **Starting the Vehicle.** When starting the vehicle in sand, gravel, or soft terrain, engage the front wheel drive (par. 5 e (1)). Release clutch pedal slowly so the wheels will not spin and "dig in," necessitating a tow or "winch-out."

c. **Clutch.** Do not attempt to "jump" or "rock" the vehicle out with a quick engagement of the clutch, particularly if a tow or winch is available. Racing the engine usually causes the wheels to "dig in" farther.

d. **Air Cleaner.** In sandy territory clean the carburetor air cleaner more often. The frequency of cleaning depends upon the severity of the sandy condition.

OPERATION UNDER UNUSUAL CONDITIONS

e. **Radiator.** In desert operation check the radiator coolant supply frequently, and see that the air passages of the core do not become clogged.

f. For additional information on technique of operating the vehicle in sand, refer to FM 31-25.

10. OPERATION IN LANDING.

a. **Inspection.** As soon as possible after completing a landing or operation in water, inspect the vehicle for water in the various units.

(1) **ENGINE.** Drain the engine crankcase oil. If water or sludge is found, flush the engine, using a mixture of half engine oil SAE 10 and half kerosene. Before putting in new oil, clean the valve chamber, drain and clean the oil filter, and install a new filter element.

(2) **FUEL SYSTEM.** Inspect the carburetor bowl, fuel strainers, fuel pump, filter, fuel tank, and lines. Clean the air cleaner and change the oil.

(3) **POWER TRAIN.** Inspect the front and rear axle housings, wheel bearings, transmission, and transfer case lubricant for presence of sludge. If sludge is found, renew the lubricant after cleaning the units with a mixture of half engine oil SAE 10 and half kerosene. Lubricate the propeller shaft universal joints and spring shackles to force out any water which might damage parts.

11. DECONTAMINATION.

a. **Protection.** For protective measures against chemical attacks and decontamination refer to FM 17-59.

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Section V

FIRST ECHELON PREVENTIVE MAINTENANCE SERVICE

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Before-operation service	13
During-operation service	14
At-halt service	15
After-operation and weekly service	16

12. PURPOSE.

a. To ensure mechanical efficiency it is necessary that the vehicle be systematically inspected at intervals each day it is operated, also weekly, so that defects may be discovered and corrected before they result in serious damage or failure. Certain scheduled maintenance services will be performed at these designated intervals. The services set forth in this section are those performed by driver or crew before operation, during operation, at halt, and after operation and weekly.

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

c. The items listed on W.D. Form No. 48 that apply to this vehicle are expanded in this manual to provide specific procedures for accomplishment of the inspections and services. These services are arranged to facilitate inspection and conserve the time of the driver, and are not necessarily in the same numerical order as shown on W.D. Form No. 48. The item numbers, however, are identical with those shown on that form.

d. The general inspection of each item applies also to any supporting member or connection, and generally includes a check to see whether the item is in good condition, correctly assembled, secure, or excessively worn.

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

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

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

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

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

13. BEFORE-OPERATION SERVICE.

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

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

(1) **ITEM 1, TAMPERING AND DAMAGE.** Examine exterior of vehicle, engine, wheels, brakes, and steering control for damage by falling debris, shell fire, sabotage, or collision. If wet, dry the ignition parts to ensure easy starting.

(2) **ITEM 2, FIRE EXTINGUISHER.** Be sure fire extinguisher is full, nozzle is clean, and mountings secure.

(3) **ITEM 3, FUEL, OIL, AND WATER.** Check fuel tank, crankcase, and radiator for leaks or tampering. Add fuel, oil, or water as needed. Have value of antifreeze checked. If, during period when antifreeze is used, it becomes necessary to replenish a considerable amount of water, report unusual losses.

(4) **ITEM 4, ACCESSORIES AND DRIVES.** Inspect carburetor, generator, regulator, cranking motor, and water pump for loose connections and security of mountings. Inspect carburetor and water pump for leaks.

(5) **ITEM 6, LEAKS, GENERAL.** Look on ground under vehicle for indications of fuel, oil, water, brake fluid, or gear oil leaks. Trace leaks to source, and correct or report to higher authority.

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(6) **ITEM 7, ENGINE WARM-UP.** Start engine, observe cranking motor action, listen for unusual noise, and note cranking speed. Idle engine only fast enough to run smoothly. Proceed immediately with following services while engine is warming up.

(7) **ITEM 8, CHOKE.** As engine warms, push in choke as required for smooth operation, and to prevent oil dilution.

(8) **ITEM 9, INSTRUMENTS.**

(a) *Fuel Gage.* Fuel gage should indicate approximate amount of fuel in tank.

(b) *Oil Pressure Gage.* Normal oil pressure should not be below 10 with engine idling, and should range from 40 to 50 at running speeds (at normal operating temperature). If gage fails to register within 30 seconds, stop engine, and correct or report to higher authority.

(c) *Temperature Indicator.* Temperature should rise slowly during warm-up. Normal operating temperature range is 160°F to 185°F.

(d) *Ammeter.* Ammeter should show high charge for short period after starting and positive (plus) reading above 12 to 15 miles per hour with lights and accessories off. Zero reading is normal with lights and accessories on.

(9) **ITEM 10, HORN AND WINDSHIELD WIPERS.** Sound horn, tactical situation permitting, for proper operation and tone. Check both wipers for secure attachment and normal full contact operation through full stroke.

(10) **ITEM 11, GLASS AND REAR VIEW MIRROR.** Clean windshield and rear view mirror and inspect for cracked, discolored, or broken glass. Adjust mirror.

(11) **ITEM 12, LIGHTS AND REFLECTORS.** Try switches in each position and see if lights respond. Lights and warning reflectors must be securely mounted, clean, and in good condition. Test foot control of headlight beams.

(12) **ITEM 13, WHEEL AND FLANGE NUTS.** Observe whether or not all wheel and flange nuts are present and tight.

(13) **ITEM 14, TIRES.** If time permits, test tires with gage, including spare; normal pressure is 35 pounds with tires cold. Inspect tread and carcass for cuts and bruises. Remove imbedded objects from treads.

(14) **ITEM 15, SPRINGS AND SUSPENSION.** Inspect springs for sagged or broken leaves, shifted leaves, and loose or missing rebound clips.

(15) **ITEM 16, STEERING LINKAGE.** Examine steering gear case, connecting links, and Pitman arm for security and good condition. Test steering adjustment, and free motion of steering wheel.

(16) **ITEM 17, FENDERS AND BUMPERS.** Examine fenders and bumpers for secure mounting and serviceable condition.

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(17) **ITEM 18, TOWING CONNECTIONS.** Examine pintle hook for secure mounting and serviceable condition. Be sure pintle latches properly and locks securely.

(18) **ITEM 19, BODY AND LOAD.** Examine body and load (if any) for damage. Be sure there is a cap on front drain hole under fuel tank. See that rear drain hole cap is available in glove compartment. **CAUTION:** *Rear drain hole cap should be installed when about to pass through deep water.*

(19) **ITEM 20, DECONTAMINATOR.** Examine decontaminator for full charge and secure mountings.

(20) **ITEM 21, TOOLS AND EQUIPMENT.** See that tools and equipment are all present, properly stowed, and serviceable.

(21) **ITEM 23, DRIVER'S PERMIT AND FORM 26.** Driver must have his operator's permit on his person. See that vehicle manuals, Lubrication Guide, Form No. 26 (accident report) and W.D. AGO Form No. 478 (MWO and Major Unit Assembly Replacement Record) are present, legible, and properly stowed.

(22) **ITEM 22, ENGINE OPERATION.** Accelerate engine and observe for unusual noises indicating compression or exhaust leaks; worn, damaged, loose, and inadequately lubricated parts or misfiring.

(23) **ITEM 25, DURING-OPERATION SERVICE.** Begin the During-operation Service immediately after the vehicle is put in motion.

14. DURING-OPERATION SERVICE.

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

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

(1) **ITEM 27, FOOT AND HAND BRAKES.** Foot brakes must stop vehicle smoothly without side pull and within reasonable distance. There should be at least $\frac{1}{3}$ reserve brake pedal travel and $\frac{1}{2}$ -inch free travel. Hand brake must securely hold vehicle on reasonable incline with $\frac{1}{3}$ reserve ratchet travel. There must be $\frac{1}{2}$ -inch clearance (on cable) between relay crank and lower end of hand brake conduit.

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(2) **ITEM 28, CLUTCH.** Clutch must operate smoothly without chatter, grabbing, or slipping. Free clutch pedal travel of three-quarter inch is normal.

(3) **ITEM 29, TRANSMISSION.** Gearshift mechanism must operate smoothly, and not creep out of mesh.

(4) **ITEM 29, TRANSFER CASE.** Gearshift mechanism must operate smoothly and not creep out of mesh.

(5) **ITEM 31, ENGINE AND CONTROLS.** Observe whether or not engine responds to controls, and has maximum pulling power without unusual noises, stalling, misfiring, overheating or unusual exhaust smoke. If radio noise is reported during operation of the vehicle, the driver will cooperate with the radio operator in locating the interference. See paragraph 178.

(6) **ITEM 32, INSTRUMENTS.** During operation observe the readings of all instruments frequently to see if they are indicating properly.

(a) *Fuel Gage.* Fuel gage must register approximate amount of fuel in tank.

(b) *Oil Pressure Gage.* Oil pressure gage should register 10 with engine running idle, and 40 to 50 at operating speeds.

(c) *Temperature Indicator.* Temperature indicator should show a temperature of 160°F to 185°F after warm-up under normal conditions.

(d) *Speedometer.* Speedometer should show speed of vehicle without noise or fluctuation of indicator needle. Odometer should register accumulating trip and total mileage.

(e) *Ammeter.* Ammeter should show zero reading with lights on, zero or positive (plus) charge with lights off, and slightly higher positive (plus) charge for short time immediately after starting.

(7) **ITEM 33, STEERING GEAR.** Observe steering for excessive pulling of vehicle to either side, wandering, or shimmy.

(8) **ITEM 34, CHASSIS.** Listen for unusual noises from wheel or axles.

(9) **ITEM 35, BODY.** Observe body for sagging springs, loose or torn top or windshield cover, if in use.

15. AT-HALT SERVICE.

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

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

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- (1) **ITEM 38, FUEL, OIL AND WATER.** Check fuel supply, oil, and coolant; add, as required, for complete operation of vehicle to the next refueling point. If, during period when antifreeze is used, an abnormal amount of water is required to refill radiator, have coolant tested with hydrometer, and add antifreeze if required.
- (2) **ITEM 39, TEMPERATURES.** Feel each brake drum and wheel hub, transmission, transfer case, and front and rear axles for overheating. Examine gear cases for excessive oil leaks.
- (3) **ITEM 40, AXLE AND TRANSFER CASE VENTS.** Observe whether axle and transfer case vents are present, and see that they are not damaged or clogged.
- (4) **ITEM 41, PROPELLER SHAFT.** Inspect propeller shaft for looseness, damage, or oil leaks.
- (5) **ITEM 42, SPRINGS.** Look for broken spring leaves or loose clips and U-bolts.
- (6) **ITEM 43, STEERING LINKAGE.** Examine steering control mechanism and linkage for damage or looseness. Investigate any irregularities noted during operation.
- (7) **ITEM 44, WHEEL AND FLANGE NUTS.** Observe whether or not all wheel and axle flange nuts are present and tight.
- (8) **ITEM 45, TIRES.** Inspect tires, including spare, for flats or damage, and for cuts or foreign material imbedded in tread.
- (9) **ITEM 46, LEAKS, GENERAL.** Check around engine and on ground beneath the vehicle for excessive leaks. Trace to source, and correct cause or report to higher authority.
- (10) **ITEM 47, ACCESSORIES AND BELTS.** See that fan, water pump and generator are securely mounted, that fan belt is adjusted to 1-inch deflection, and is not badly frayed. If radio noise during operation of the engine was observed, examine all radio noise suppression capacitors, at coil, ignition and starting switches, generator, regulator, and radio terminal box; suppressors at spark plugs and distributor, and all bond straps for damage, and loose mountings or connections.
- (11) **ITEM 48, AIR CLEANER.** If dusty or sandy conditions have been encountered, examine oil sump for excessive dirt. Service if required. *CAUTION: Do not apply oil to element after cleaning.*
- (12) **ITEM 49, FENDERS AND BUMPERS.** Inspect fenders and bumpers for looseness or damage.
- (13) **ITEM 50, TOWING CONNECTIONS.** Inspect pintle hook and trailer light socket for serviceability.
- (14) **ITEM 51, BODY LOAD AND TARPAULIN.** Inspect vehicle and trailed vehicle loads for shifting; see that tarpaulins are properly secured and not damaged.
- (15) **ITEM 52, APPEARANCE AND GLASS.** Clean windshield, mirror, light lenses, and inspect vehicle for damage.

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and FORD MODEL GPW)****16. AFTER-OPERATION AND WEEKLY SERVICE.**

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

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

(1) **ITEM 54, FUEL, OIL, AND WATER.** Check coolant and oil levels, and add as needed. Fill fuel tank. Refill spare cans. During period when antifreeze is used, have hydrometer test made of coolant if loss from boiling or other cause has been considerable. Add antifreeze with water if required.

(2) **ITEM 55, ENGINE OPERATION.** Listen for miss, backfire, noise, or vibration that might indicate worn parts, loose mountings, faulty fuel mixture, or faulty ignition.

(3) **ITEM 56, INSTRUMENTS.** Inspect all instruments to see that they are securely connected, and not damaged.

(4) **ITEM 57, HORN AND WINDSHIELD WIPERS.** Test horn for sound, if tactical situation permits. See that horn is securely mounted and properly connected. Operate both windshield wipers. See that blades contact the glass effectively throughout full stroke.

(5) **ITEM 58, GLASS AND REAR VIEW MIRROR.** Clean glass of windshield and rear view mirror. Examine for secure mounting and damage.

(6) **ITEM 59, LIGHTS AND REFLECTORS.** Observe whether or not lights operate properly with the switch in "ON" positions, and go out when switch is off. See that stop light operates properly. Clean lenses and warning reflectors.

(7) **ITEM 60, FIRE EXTINGUISHER.** Be sure fire extinguisher is full, nozzle is clean, and that extinguisher is mounted securely.

(8) **ITEM 61, DECONTAMINATOR.** Examine decontaminator for good condition and secure mounting.

FIRST ECHELON PREVENTIVE MAINTENANCE SERVICE**(9) ITEM 62, *BATTERY.**

(a) See that battery is clean, securely mounted, and not leaking. Inspect electrolyte level, which should be $\frac{1}{2}$ inch above plates with caps in place and vents open. Clean cables as required.

(b) *Weekly.* Clean top of battery. Remove battery caps, and add water to $\frac{1}{2}$ inch above plates. (Use distilled water if available; if not use clean, drinkable water.) CAUTION: *Do not overfill.* Clean posts and terminals if corroded, and apply light coat of grease. Tighten terminals as needed. Tighten hold-down assembly. Clean battery carrier if corroded.

(10) ITEM 63, *ACCESSORIES AND BELTS.

(a) Test fan belt for deflection of 1 inch. Examine belt for good condition; it must not be frayed. Timing hole cover must be closed and tightened.

(b) *Weekly.* Tighten all accessories such as carburetor, generator, regulator, cranking motor, fan, water pump, and hose connections; examine fan belt for fraying, wear, cracking, or presence of oil.

(11) ITEM 64, *ELECTRICAL WIRING.

(a) See that all ignition wiring and accessible low voltage wiring is in good condition, clean, correctly and securely assembled and mounted.

(b) *Weekly.* Tighten all loose wiring connections or electrical unit mountings. Pay particular attention to radio noise suppression units such as: capacitors, bond straps, and spark plug and distributor suppressors.

(12) ITEM 65, *AIR CLEANER.

(a) Examine oil in air cleaner oil cup to see that it is at proper level, and not excessively dirty. Clean element and refill oil cup as required. CAUTION: *Do not apply oil to element after cleaning.*

(b) *Weekly.* Remove, clean, and dry air cleaner element and oil cup. Fill cup to indicated oil level (approximately $\frac{5}{8}$ qt). Do not apply oil to element after cleaning.

(13) ITEM 66, *FUEL FILTERS.

(a) Examine fuel filter for leaks.

(b) *Weekly.* Remove plug from bottom of dash-mounted fuel filter. Allow water and sediment to drain out. Be sure plug is replaced tightly, and does not leak.

(14) ITEM 67, ENGINE CONTROLS. Examine engine controls for wear or disconnected linkage.

(15) ITEM 68, *TIRES.

(a) Inspect tires for cuts or abnormal tread wear; remove foreign bodies from tread; inflate to 35 pounds when tires are cold.

(b) *Weekly.* Replace badly worn or otherwise unserviceable tires.

(16) ITEM 69, *SPRINGS.

(a) Examine springs for sag, broken or shifted leaves, loose or missing rebound clips, or shackles.

(b) *Weekly.* Aline springs, and tighten U-bolts and shackles as required.

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(17) ITEM 70, STEERING LINKAGE. Examine steering wheel column, gear case, Pitman arm, drag link, tie rod, and steering arm to see if they are bent, loose, or inadequately lubricated.

(18) ITEM 71, PROPELLER SHAFT. Inspect propeller shaft and universal joints for loose connections, lubrication leaks, or damage.

(19) ITEM 72, *AXLE AND TRANSFER VENTS.

(a) See that axle and transfer case vents are in good condition, clean, and secure.

(b) *Weekly.* Remove, clean, and replace vents.

(20) ITEM 73, LEAKS, GENERAL. Check under hood and beneath the vehicle for indications of fuel, oil, water, or brake fluid leaks.

(21) ITEM 74, GEAR OIL LEVELS. After units have cooled, inspect differential transmission and transfer unit lubricant levels. Lubricant should be level with bottom of filler hole. Observe gear cases for leaks.

(22) ITEM 76, FENDERS AND BUMPERS. Fenders and bumpers must be in good condition and secure.

(23) ITEM 77, *TOWING CONNECTIONS.

(a) Inspect pintle hook and towed-load connections for looseness or damage.

(b) *Weekly.* Tighten pintle hook mounting bolts, and lubricate pintle hook as required.

(24) ITEM 78, BODY AND TARPAULINS. Inspect body, top, and windshield cover for damage and proper stowage. Make sure rear drain below fuel tank is open, and that cap is in glove compartment.

(25) ITEM 82, *TIGHTEN.

(a) Tighten any loose wheel, axle drive flange, and spring U-bolt nuts.

(b) *Weekly.* Tighten all vehicle assembly or mounting nuts or screws that inspection indicates require tightening.

(26) ITEM 83, *LUBRICATE AS NEEDED.

(a) Lubricate spring shackles and steering linkage, if lubrication is needed.

(b) *Weekly.* Lubricate points indicated on current vehicle Lubrication Guide as requiring weekly attention, also points that experience and operating conditions indicate need lubrication. Observe latest lubrication directives.

(27) ITEM 84, *CLEAN ENGINE AND VEHICLE.

(a) Clean dirt and trash from inside of body. Keep sump under fuel tank cleaned of dirt and water. Remove excessive dirt or grease from exterior of the engine.

(b) *Weekly.* Wash vehicle if possible. If not possible, wipe off thoroughly; clean engine.

(28) ITEM 85, TOOLS AND EQUIPMENT. Check to see that all tools and equipment assigned to vehicle are present and secure.

Section VI

LUBRICATION

	Paragraph
Lubrication Guide	17
Detailed lubrication instructions	18

17. LUBRICATION GUIDE.

a. War Department Lubrication Guide No. 501 (figs. 13 and 14) prescribes lubrication maintenance for the $\frac{1}{4}$ -ton 4 x 4 truck.

b. A Lubrication Guide is placed on or is issued with each vehicle and is to be carried with it at all times. In the event the vehicle is received without a Guide, the using arm shall immediately requisition a replacement from the Commanding Officer, Fort Wayne Ordnance Depot, Detroit 32, Mich.

c. Lubrication instructions on the Guide are binding on all echelons of maintenance and there shall be no deviations from these instructions.

d. Service intervals specified on the Guide are for normal operation conditions. Reduce these intervals under extreme conditions such as excessively high or low temperatures, prolonged periods of high speed, continued operation in sand or dust, immersion in water, or exposure to moisture, any one of which may quickly destroy the protective qualities of the lubricant and require servicing in order to prevent malfunctioning or damage to the materiel.

e. Lubricants are prescribed in the "Key" in accordance with three temperature ranges; above $+32^{\circ}\text{F}$, $+32^{\circ}\text{F}$ to 0°F , and below 0°F . Determine the time to change grades of lubricants by maintaining a close check on operation of the vehicle during the approach to change-over periods. Be particularly observant when starting the engine. Sluggish starting is an indication of thickened lubricants and the signal to change to grades prescribed for the next lower temperature range. Ordinarily it will be necessary to change grades of lubricants *only when air temperatures are consistently in the next higher or lower range*, unless malfunctioning occurs sooner due to lubricants being too thin or too heavy.

18. DETAILED LUBRICATION INSTRUCTIONS.

a. **Lubrication Equipment.** Each piece of materiel is supplied with lubrication equipment adequate to maintain the materiel. Be sure to clean this equipment both before and after use. Operate lubricating guns carefully and in such manner as to insure a proper distribution of the lubricant.

b. Points of Application.

(1) Red circles surrounding lubrication fittings, grease cups, oilers and oil holes make them readily identifiable on the vehicle. Wipe clean such lubricators and the surrounding surface before lubricant is applied.

**1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
and FORD MODEL GPW)**

**No. 501
WAR DEPARTMENT LUBRICATION GUIDE
ORDNANCE DEPARTMENT**

TRUCK, 1/4 TON, 4x4 (FORD-WILLYS)

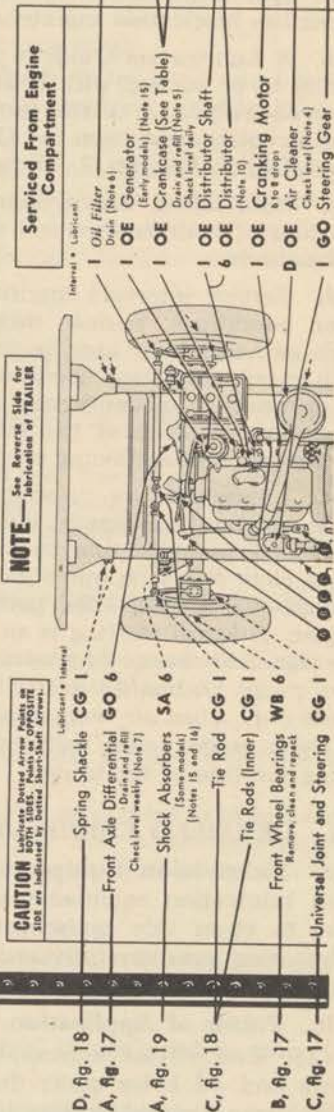
For detailed instructions, refer to TM.

TABLE OF CAPACITIES AND LUBRICANTS TO BE USED

UNIT	CAPACITY (Approx.)	LOWEST EXPECTED AIR TEMPERATURE	
		+32° F. and above	+32° F. to 0° F.
Crankcase (Including Oil Filter)	5 qt.	OE SAE 30	OE SAE 10
Transmission	3 1/4 qt.		
Transfer Case	1 1/2 qt.		
Differentials (each)	1 1/4 qt.	GO SAE 90	GO SAE 80
			GO Grade 75

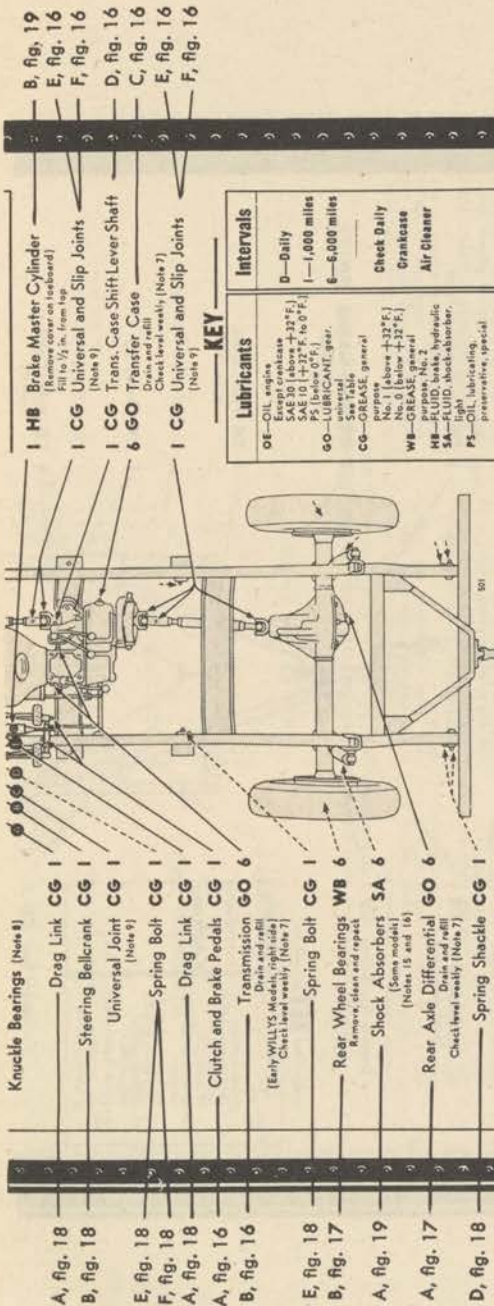
CAUTION Lubricate Dotted Arrow Points in 187th SUBC. Points on OPPOSITE SIDE are indicated by DOTTED ARROW POINTS.

NOTE—See Reverse Side for Lubrication of TRAILER



RA PD 305160

LUBRICATION



NOTES Additional Lubrication and Service Instructions on Individual Units and Parts NOTES

- FITTINGS**—Clean before applying lubricant. Lubricate until new lubricant is forced from the bearing, unless otherwise specified. **CAUTION:** Lubricate chassis points after washing truck and trailer.
- INTERVALS** indicated are for normal service. For extreme conditions of speed, heat, water, sand, mud, snow, rough roads, dust, etc., reduce interval by 1/2 or 1/3, or more if conditions warrant.
- CLEANING**—SOLVENT, dry-cleaning, or OIL, fuel, diesel, will be used to clean or wash all parts. Use of gasoline for this purpose is prohibited. All parts will be thoroughly dry before relubrication.
- AIR CLEANER**—Daily, check level and re-fill oil reservoir to bead level with used crankcase oil or OE. Every 1,000 miles, daily under extreme dust conditions, remove and wash all parts. From 0°F. to 40°F., use SA. Below -40°F., remove oil and operate dry.
- CRANKCASE**—Drain only when engine is (Notes continued on Reverse Side)

No. 501 [NOT TO BE REPRODUCED IN WHOLE OR IN PART WITH-
OUT PERMISSION OF THE DIRECTOR OF THE BUREAU OF MOTOR VEHICLES]

24 Jan 44
Supersedes all previous issues

Figure 13—Lubrication Guide—Truck, 1/4-Ton, 4 x 4 (Ford-Willys)

RA PD 3051608

**1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
and FORD MODEL GPW)**

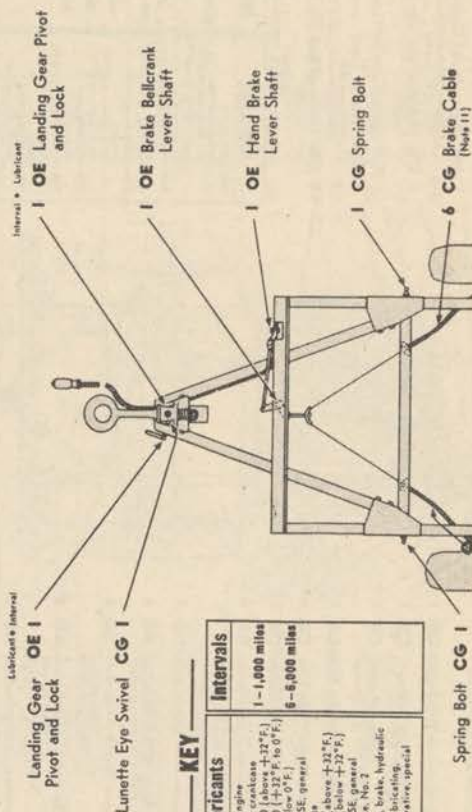
WAR DEPARTMENT LUBRICATION GUIDE
ORDNANCE DEPARTMENT

No. 501

TRUCK, 1/4 TON, 4x4 (FORD-WILLYS)

For detailed instructions, refer to TM.

NOTE—See Reverse Side for Lubrication of TRUCK



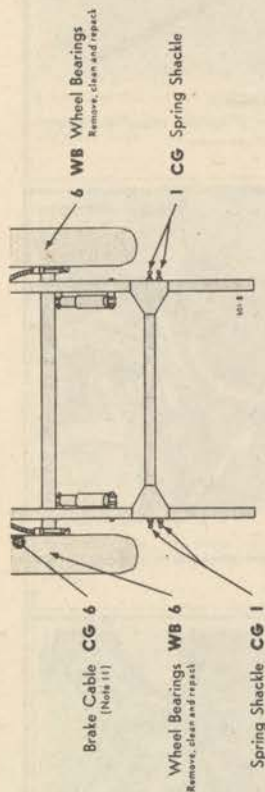
KEY

Lubricants	Intervals
OE—OIL, engine	
PS—SAE 30 (above +32°F.)	1—1,000 miles
SAE 10 (+32°F. to 0°F.)	
PS (below 0°F.)	8—6,000 miles
CG—OIL, chassis, general purpose	
No. 1 (above +32°F.)	
No. 0 (below +32°F.)	
WB—GREASE, general purpose	
HB—FLUID, brake, hydraulic	
PS—OIL, lubricating, preservative, special	

Spring Bolt CG 1

RA PD 330851

LUBRICATION



TRAILER, 1/4 TON, 2-WHEEL

NOTES Additional Lubrication and Service Instructions on Individual Units and Parts NOTES

- COLD WEATHER:** For Lubrication and Service below 0°F., refer to OHS 4-11.
14. OIL CAN POINTS—Every 1,000 miles, lubricate all carburetor, clutch, brake and throttle linkages, pinion hook, handbrake cable, trailer handbrake connections and linkage with OE.
 15. SERVICE—Clutch Release Bearing, Water Pump, Fan, Shock Absorber and Linkage on all FORD and early WILLYS models, Generator (late model).
 16. POINTS TO BE SERVICED AND/OR LUBRICATED BY ORDNANCE MAINTENANCE PERSONNEL—Shock Absorbers (late WILLYS), (Refer to TM.)
- Copy of this Guide will be carried on the material at all times. These lubrication instructions are binding on all echelons of maintenance.
- By Order of the Secretary of War:
G. C. Marshall, Chief of Staff.
- 24 Jan 44
Supersedes all previous issues.
- Notes continued from Reverse Side)**
hot. Refill to FULL mark on gage. Run engine a few minutes and recheck oil level.
CAUTION: Be sure pressure gage indicates oil is circulating.
6. OIL FILTER—Every 1,000 miles, drain sediment. Every 6,000 miles or more often if filter becomes clogged, drain filter, clean inside and renew element. Run engine a few minutes, check crankcase level, add OE FUL.
 7. GEAR CASES—Weekly check oil level with truck on level ground and, if necessary, add lubricant to plug level. Check only before operation while lubricant is cold. Drain and refill at intervals indicated on guide. Drain only after operation. On early WILLYS models, acid plate must be removed to reach drain plug.
 8. UNIVERSAL JOINT AND STEERING KNUCKLE BEARINGS—Every 1,000 miles, remove plug at rear and add CG to level of filler plug hole. Every 6,000 miles, remove, clean, dry, inspect and refill to plug level.
 9. UNIVERSAL JOINTS AND SLIP JOINTS—Apply CG to joints until it shows at joint cross and to slip joint until it shows at end of spline. Use hand gun only.
 10. DISTRIBUTOR—Every 6,000 miles, wipe distributor breaker arm lightly with CG and lubricate breaker arm pivot and wick under rotor with 1 to 2 drops of OE.
 11. TRAILER BRAKE CABLES—Every 6,000 miles, slide cable conduit forward, clean and coat with CG.
 12. SPEEDOMETER CABLE—Every 6,000 miles, remove core and coat lightly with CG No. 0.
 13. RUBBER BUSHINGS—Every 1,000 miles, apply HB to shock absorber linkage.
CAUTION: Do not use oil.

No. 501 [NOT TO BE SUPPLEMENTED IN whole or in part with] CHECK CHART
[For permission of the Chief of Ordnance]

Requisition replacement guides from the Commanding Officer, Fort Wayne Ordnance Depot, Detroit, Michigan.

Figure 14—Lubrication Guide—Trailer, 1/4-Ton, 2-wheel

RA PD 330851B

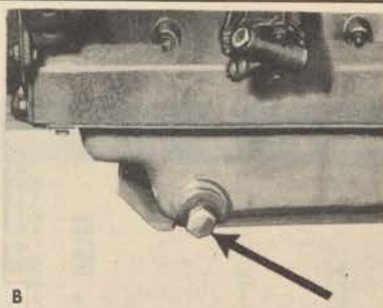
**1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
and FORD MODEL GPW)**



A

ENGINE CRANKCASE—OE

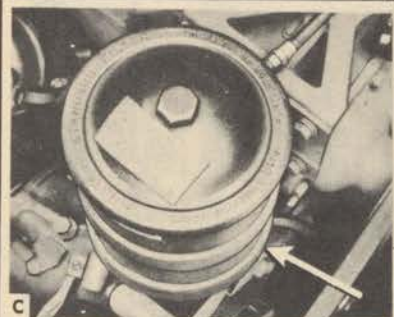
Oil level indicator in oil filler pipe. Check level at least daily. Keep oil up to FULL mark. Capacity five quarts; refill four quarts.



B

ENGINE CRANKCASE DRAINING—

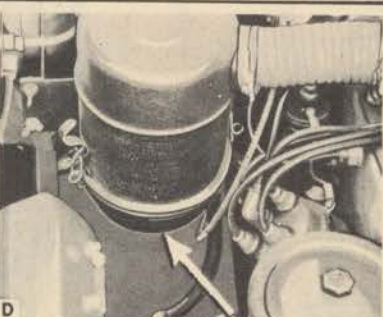
Remove drain plug to drain. At least once a year, remove the oil pan and clean floating oil intake screen.



C

OIL FILTER—OE

One filter—Remove drain plug to drain. To replace element, remove drain plug, filter cover then element. After completing installation run engine a few minutes and refill crankcase to FULL mark on oil level indicator.



D

AIR CLEANER—OE

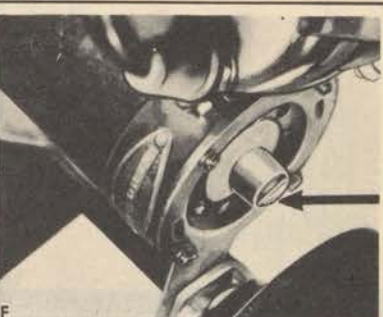
One air cleaner. Clean cleaner and refill reservoir to indicated level. Capacity 1/4 quart.



E

DISTRIBUTOR—OE

One distributor. Total places—four. Use oil can for oiler and lubricate sparingly wick and post; grease cam lightly.



F

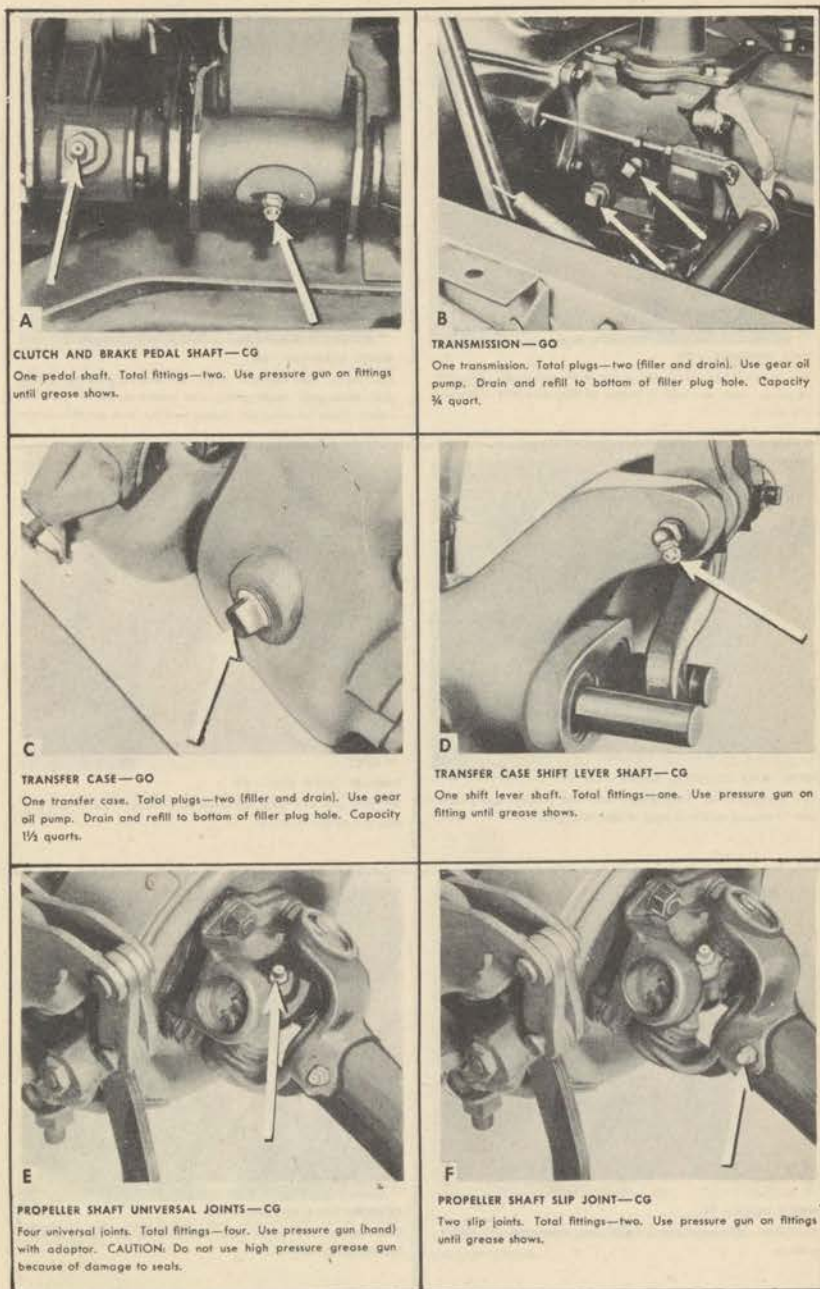
CRANKING MOTOR—OE

Total oilers—one. Use oil can, push aside oil hole cover. Oil and replace cover.

RA PD 305166

Figure 15—Engine Lubrication Points

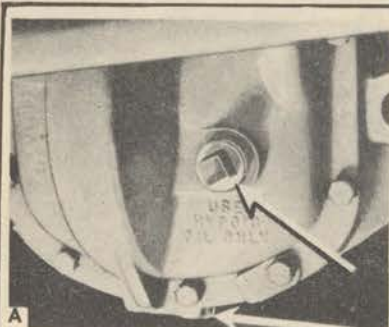
LUBRICATION



RA PD 305167

Figure 16—Pedal Shafts and Power Train Lubrication Points

**1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
and FORD MODEL GPW)**



A

AXLE HOUSINGS—GO

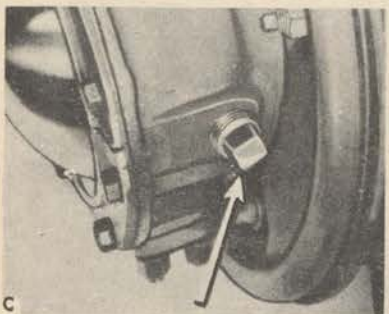
Two axle housings. Total plugs—four (filler and drain). Use gear oil pump. Drain and refill to bottom of filler plug hole. Capacity 1 1/4 quarts.



B

WHEEL BEARINGS—WB

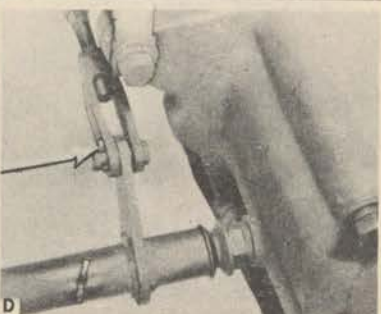
Four wheels. Total bearings—eight. Use bearing lubricator or hand pack thoroughly. Apply grease also around outside of cage and rollers. Clean out wheel hub, inspect bearing races, put three ounces of grease in each hub.



C

FRONT AXLE UNIVERSAL JOINTS—CG

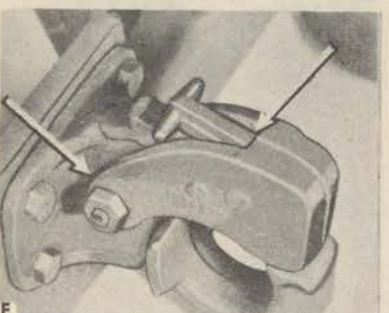
Two universal joints. Total plugs—two. Use pressure gun (hand) and fill housing slowly to level of filler plug hole.



D

LINKAGE CLEVIS PINS—OE

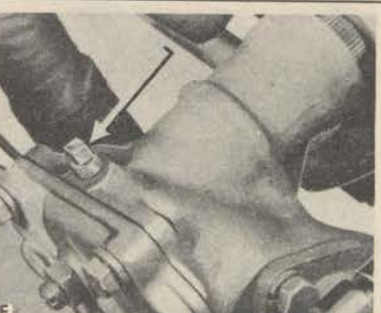
All clevis pins and hood and windshield catches. Use oil can and apply in proper quantity.



E

PINTLE HOOK—OE

One hook—With an oil can lubricate pins, connections and sliding surfaces.



F

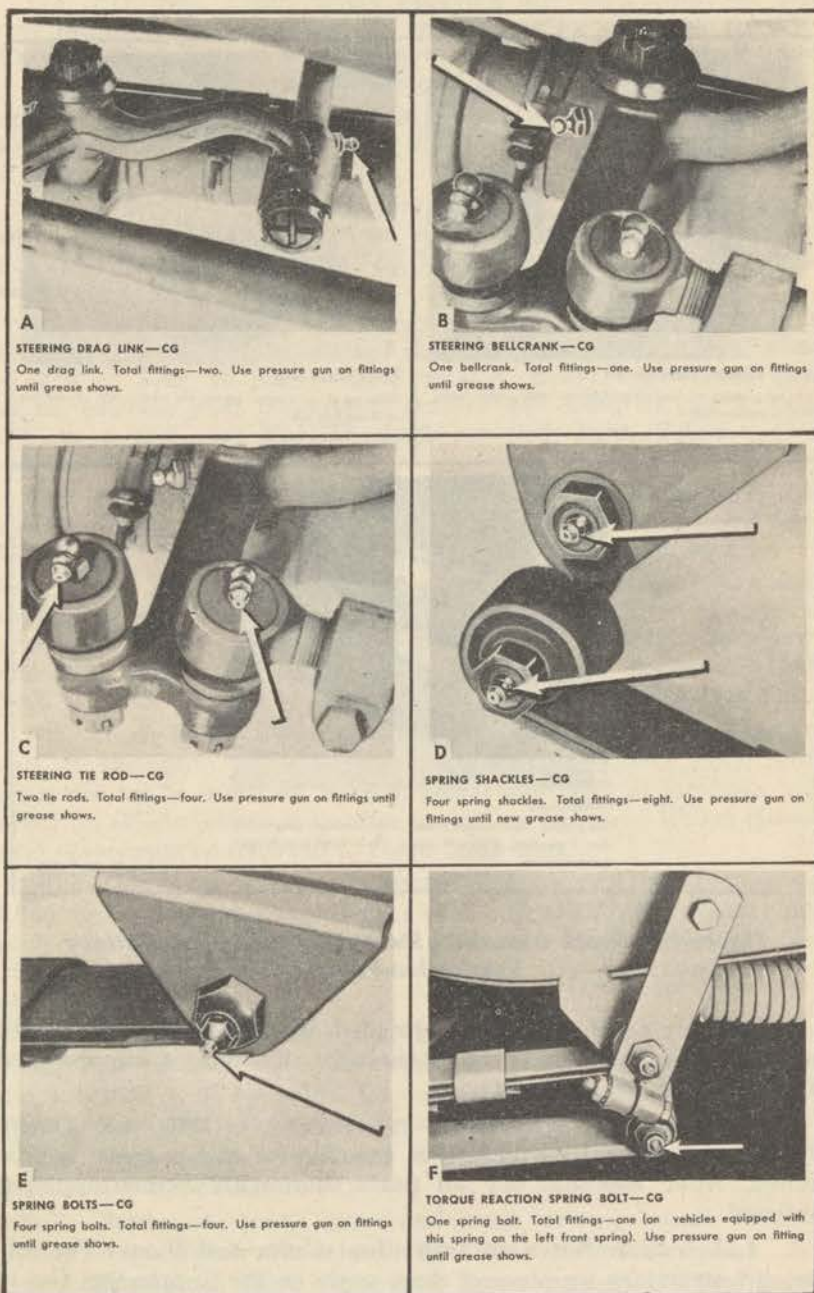
STEERING GEAR HOUSING—GO

One housing. Total plugs—one. Use pressure gun (hand) and fill housing slowly until full.

RA PD 305168

**Figure 17—Axle, Wheel, Pintle, and Steering Gear Housing
Lubrication Points**

LUBRICATION



RA PD 305169

Figure 18—Steering Gear and Spring Lubrication Points

**1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
and FORD MODEL GPW)**

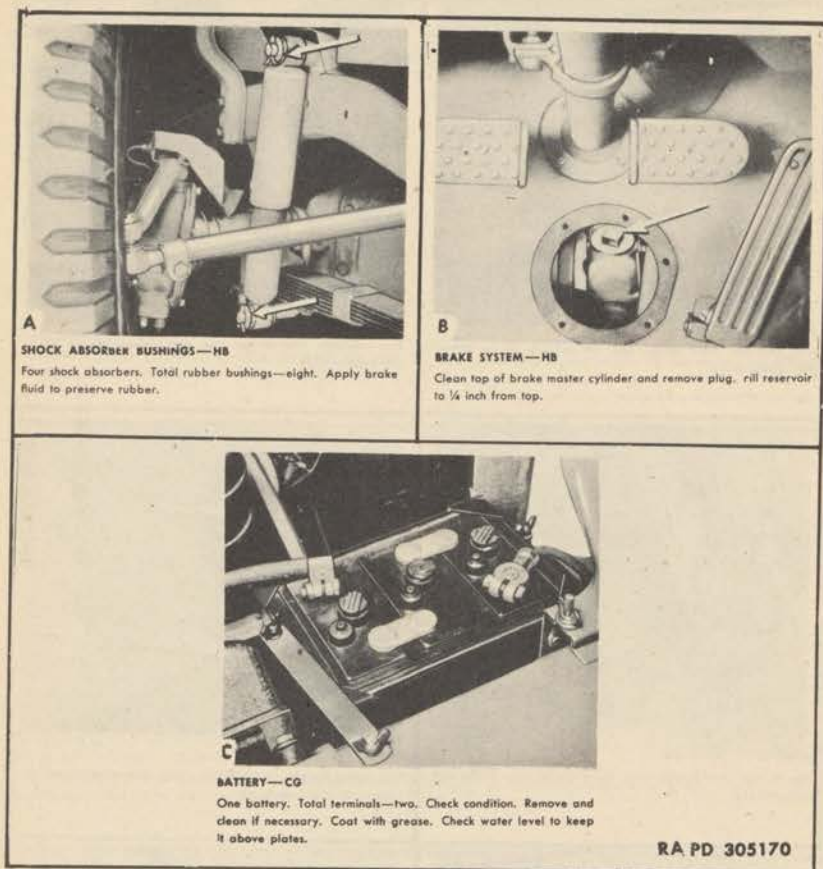


Figure 19—Shock Absorber, Master Cylinder, and Battery Lubrication Points

(2) Where relief valves are provided, apply new lubricant until the old lubricant is forced from the vent. Exceptions are specified in notes on the Lubrication Guide.

c. **Cleaning.** Use SOLVENT, dry-cleaning, or OIL, fuel, Diesel, to clean or wash all parts. Use of gasoline for this purpose is prohibited. After washing, dry all parts thoroughly before applying lubricant.

d. **Lubrication Notes on Individual Units and Parts.** The following instructions supplement those notes on the Lubrication Guide which pertain to lubrication and service of individual units and parts. All note references in the Guide itself are to the paragraph below having the corresponding number.

LUBRICATION

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

(2) **INTERVALS.** Intervals indicated are for normal service. For extreme conditions of speed, heat, water, sand, mud, snow, rough roads, dust, etc., reduce interval by one-third or one-half, or more if conditions warrant.

(3) **CLEANING.** **SOLVENT**, dry-cleaning, or **OIL**, fuel, Diesel, will be used to clean or wash all parts. Use of gasoline for this purpose is prohibited. All parts will be thoroughly dry before relubrication.

(4) **AIR CLEANER.** Daily, check level and refill oil reservoir to bead level with used crankcase oil or **OIL**, engine, SAE 30 above +32°F or SAE 10 from +32°F to 0°F. Every 1,000 miles, daily under extreme dust conditions, remove and wash all parts. From 0°F to -40°F, use **FLUID**, shock-absorber, light. Below -40°F, remove oil and operate dry.

(5) **CRANKCASE.** Drain only when engine is hot. Refill to "FULL" mark on gage. Run engine a few minutes and recheck oil level. **CAUTION:** *Be sure pressure gage indicates oil is circulating.*

(6) **OIL FILTER.** Every 1,000 miles, drain sediment. Every 6,000 miles or more often if filter becomes clogged, drain filter, clean inside and renew element. Run engine a few minutes, check crankcase level, add **OIL**, engine, to "FULL" mark on gage. (SAE 30 above +32°F; SAE 10 from +32°F to 0°F; below 0°F, refer to OFSB 6-11.)

(7) **GEAR CASES.** Weekly, check level with truck on level ground and, if necessary, add lubricant to plug level. Check only before operation while lubricant is cold. Drain and refill at intervals indicated on Guide. Drain only after operation. On early Willys models, skid plate must be removed to reach drain plug.

(8) **UNIVERSAL JOINT AND STEERING KNUCKLE BEARINGS.** Every 1,000 miles, remove plug at rear and add **GREASE**, general purpose, No. 1 above +32°F or No. 0 below +32°F, to level of filler plug hole. Every 6,000 miles, remove, clean, dry, inspect and refill to plug level.

(a) Remove brake tube and brake backing plate screws. This permits the removal of the axle spindle, the complete axle shaft, and the universal joint assembly. Care should be taken not to injure the outer oil seal assembly in the housing.

(b) Wash the axle shaft and universal joint thoroughly in **SOLVENT**, dry-cleaning, and dry.

(c) Clean and repack upper and lower steering spindle bearings within the universal housing and reassemble entire unit.

(9) **UNIVERSAL JOINTS AND SLIP JOINTS.** Apply **GREASE**, general purpose, No. 1, above +32°F, or No. 0 below +32°F, to joints until it shows at joint cross, and to slip joint until it shows at the end of spline. Use hand gun only.

**1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
and FORD MODEL GPW)**

(10) **DISTRIBUTOR.** Every 6,000 miles, wipe distributor breaker cam lightly with GREASE, general purpose, No. 1, above +32°F or No. 0, below +32°F, and lubricate breaker arm pivot and wick under rotor with 1 to 2 drops of OIL, engine, SAE 30 above +32°F; SAE 10 from +32°F to 0°F; OIL, lubricating, preservative, special, below 0°F.

(11) **TRAILER BRAKE CABLES.** Every 6,000 miles, slide cable conduit forward, clean and coat with GREASE, general purpose, No. 1 above +32°F and No. 0 below +32°F.

(12) **SPEEDOMETER CABLE.** Every 6,000 miles, remove core and coat lightly with GREASE, general purpose, No. 0.

(13) **RUBBER BUSHINGS.** Every 1,000 miles, apply FLUID, brake, hydraulic, to shock absorber linkage. **CAUTION:** *Do not use oil.*

(14) **OILCAN POINTS.** Every 1,000 miles, lubricate all carburetor, clutch, brake and throttle linkages, pintle hook and hand brake cable with OIL, engine, SAE 30, above +32°F; SAE 10, +32°F to 0°F; OIL, lubricating, preservative, special, below 0°F.

(15) **POINTS REQUIRING NO LUBRICATION SERVICE.** These are the clutch release bearing, water pump, fan, shock absorbers and linkage on all Ford and early Willys models, generator (late models), speedometer cable.

(16) **POINTS TO BE SERVICED AND/OR LUBRICATED BY ORDNANCE MAINTENANCE PERSONNEL ONLY.** These are the shock absorbers (late Willys). Every 6,000 miles, remove and disassemble the shock absorbers. Unscrew linkage eye and refill with FLUID, shock-absorber, light.

(17) **WHEEL BEARINGS.** Remove bearing cone assemblies from hub and wash spindle and inside of hub. Inspect bearing races and replace if necessary. Wet the spindle and inside of hub and hub cap with GREASE, general purpose, No. 2, to a maximum thickness of 1/16 inch only to retard rust. Wash bearing cones and grease seals. Inspect and replace if necessary. Lubricate bearings with GREASE, general purpose, No. 2, with a packer or by hand, kneading lubricant into all spaces in the bearing. Use extreme care to protect bearings from dirt and immediately reassemble and replace wheel. The lubricant in the bearings is sufficient to provide lubrication until the next service period. Do not fill hub or hub cap. Any excess might result in leakage into the brake drum.

e. Reports and Records. If lubrication instructions are closely followed, proper lubricants used, and satisfactory results are not obtained, make a report to the ordnance officer responsible for the maintenance of the materiel. A complete record of lubrication servicing may be kept in the Duty Roster (W.D., A.G.O Form No. 6).

f. Localized Views. The localized views of lubrication points (figs. 15, 16, 17, 18, and 19) supplement the instructions on the Guide and in the notes.

Section VII

TOOLS AND EQUIPMENT STOWAGE ON THE VEHICLE

	Paragraph
Vehicle tools	19
Vehicle equipment	20
Vehicle spare parts	21

19. VEHICLE TOOLS.

a. Unless the vehicle is equipped with extra tool equipment, the following are supplied (one of each unless otherwise specified):

Tool	Federal Stock No.	Where Carried
HAMMER, machinist's, ball peen, 16 oz	41-H-523	Tool bag
JACK, screw type, 1½-ton, w/handle	41-J-66	Tool compartment
PLIERS, combination, slip joint, 6-in.	41-P-1650	Tool bag
PULLER, wheel hub	41-P-2962-700	Tool compartment
WRENCH, drain plug	41-W-1962-50	Tool bag
WRENCH, engineer's open-end, ¾- x 7/16-in.	41-W-991	Tool bag
WRENCH, engineer's open-end, ½- x 19/32-in.	41-W-1003	Tool bag
WRENCH, engineer's open-end, 9/16- x 11/16-in.	41-W-1005-5	Tool bag
WRENCH, engineer's open-end, 5/8- x 25/32-in.	41-W-1008-10	Tool bag
WRENCH, engineer's open-end, ¾- x 7/8-in.	41-W-1012-5	Tool bag
WRENCH, hydraulic brake, bleeder screw	41-W-1596-125	Tool bag
WRENCH, adjustable, auto type, 11-in.	41-W-449	Tool bag
WRENCH, socket, screw fluted	41-W-2459-500	Tool bag
WRENCH, socket, spark plug, w/handle	41-W-3335-50	Tool bag
WRENCH, wheel bearing nut, 2⅛-in. hex	41-W-3825-200	Tool compartment
WRENCH, wheel stud nut, 49/64-in. hex	41-W-3837-55	Tool compartment

**1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
and FORD MODEL GPW)**

20. VEHICLE EQUIPMENT.

a. Unless vehicle is equipped with special equipment, the following are supplied (one of each unless otherwise specified):

Tool	Federal Stock No.	Where Carried
ADAPTER, lubr. gun		Tool bag
APPARATUS, decontaminating, 1 1/2 qt		Driver's compart- ment
AX, chopping, single-bit	41-A-1277	Body left side
BAG, tool	41-B-15	Tool compartment
CATALOG, ord. std. nom. list	SNL-G-503	Glove compart- ment
CHAINS, tire, 6.00 x 16	8-C-2358	Tool compartment (4)
CONTAINER, 5-gallon		Bracket on rear
COVER, headlight		Under right seat (2)
COVER, windshield		Under right seat
CRANK, starting		Under rear seat
EXTINGUISHER, fire	58-E-202	Inside cowl, left
GAGE, tire pressure	8-G-615	Tool compartment
GUN, lubr., hand-type	41-G-1330-60	Tool compartment
MANUAL, technical	TM 9-803	Glove compart- ment
NOZZLE, flexible tube		
OILER, straight spout, 1/2-pt.	13-O-1530	Front of dash
PUMP, tire, w/chuck	8-P-5000	Behind rear seat
RIFLE		On dash
SHOVEL, D-handle, rd. pt.	41-S-3170	Body, left side
TAPE, friction, roll	17-T-805	Parts bag
WIRE, iron, roll	22-W-650	Parts bag

21. VEHICLE SPARE PARTS.

a. Unless the vehicle is equipped with a special assortment of parts, the following are supplied (one of each unless otherwise specified):

Name of Spare Part	Federal Stock No.	Where Carried
BAG, spare parts	8-B-11	Glove compart- ment
BELT, fan	33-B-76	Parts bag
CAPS, tire valve (boxed)	8-C-650	Parts bag (5)
CORES, tire valve (boxed)	8-C-6750	Parts bag (5)

TOOLS AND EQUIPMENT STOWAGE ON THE VEHICLE

Name of Spare Part	Federal Stock No.	Where Carried
LAMP, elec. incand. 6-8V sing- tung-fil., 3 cp (MZ63).....	17-L-5215	Parts bag
LAMP-UNIT, blackout, stop, sealed, one opng., 6-8V, 3 cp	8-L-421	Parts bag
LAMP-UNIT, blackout, tail, sealed, 4 opngs., 6-8V, 3 cp	8-L-415	Parts bag
LAMP-UNIT, service tail and stop, sealed, 6-8V, 21-3 cp	8-L-419	Parts bag
PIN, cotter, split, s. type B boxed ass't.	42-P-5347	Parts bag
PLUG, spark, with gasket.....	17-P-5365	Parts bag

**1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
and FORD MODEL GPW)****PART TWO
VEHICLE MAINTENANCE INSTRUCTIONS****Section VIII****RECORD OF MODIFICATIONS**

MWO and major unit assembly replacement record 22

**22. MWO AND MAJOR UNIT ASSEMBLY REPLACEMENT
RECORD.**

a. **Description.** Every vehicle is supplied with a copy of A.G.O. Form No. 478 which provides a means of keeping a record of each MWO completed or major unit assembly replaced. This form includes spaces for the vehicle name and U.S.A. registration number, instructions for use, and information pertinent to the work accomplished. It is very important that the form be used as directed, and that it remain with the vehicle until the vehicle is removed from service.

b. **Instructions for Use.** Personnel performing modifications or major unit assembly replacements must record clearly on the form a description of the work completed, and must initial the form in the columns provided. When each modification is completed, record the date, hours and/or mileage, and MWO number. When major unit assemblies, such as engines, transmissions, transfer cases, are replaced, record the date, hours and/or mileage, and nomenclature of the unit assembly. Minor repairs and minor parts and accessory replacements need not be recorded.

c. **Early Modifications.** Upon receipt by a third or fourth echelon repair facility of a vehicle for modification or repair, maintenance personnel will record the MWO numbers of modifications applied prior to the date of A.G.O. Form No. 478.

Section IX

SECOND ECHELON PREVENTIVE MAINTENANCE

Paragraph

Second echelon preventive maintenance services..... 23

23. SECOND ECHELON PREVENTIVE MAINTENANCE SERVICES.

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

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

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

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

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

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

(b) When installing new lubricant retainer seals, a coating of the lubricant should be wiped over the sealing surface of the lip of the seal. When the new seal is a leather seal, it should be soaked in engine oil SAE 10 (warm if practicable) for at least 30 minutes, then, the leather lip should be worked carefully by hand before installing the seal. The lip must not be scratched or marred.

(c) The general inspection of each item applies also to any supporting member or connection, and usually includes a check to see

**1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
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whether or not the item is in good condition, correctly assembled, secure, or excessively worn. The mechanics must be thoroughly trained in the following explanations of these terms.

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

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

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

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

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

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

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

3. *Special lubrication.* This applies both to lubrication operations that do not appear on the vehicle Lubrication Guide and to items that do appear on such charts, but which should be performed in connection with the maintenance operations if parts have to be disassembled for inspection or service.

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

5. *Tighten.* All tightening operations should be performed with sufficient wrench-torque (force on the wrench handle) to tighten the unit according to good mechanical practice. Use torque-indicating wrench where specified. Do not overtighten, as this may strip

SECOND ECHELON PREVENTIVE MAINTENANCE

threads or cause distortion. Tightening will always be understood to include the correct installation of lock washers, lock nuts, and cotter pins provided to secure the tightening.

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

(f) The numbers of the preventive maintenance procedures that follow are identical with those outlined on W.D., A.G.O. Form No. 461, which is the Preventive Maintenance Service Work Sheet for Wheeled and Half-track Vehicles. Certain items on the work sheet that do not apply to this vehicle are not included in the procedures in this manual. In general, the numerical sequence of items on the work sheet is followed in the manual procedures, but in some instances there is deviation for conservation of the mechanic's time and effort.

(5) **SPECIFIC PROCEDURES.** The procedures for performing each item in the 1,000-mile (monthly) and 6,000-mile (6-month) maintenance procedures are described in the following chart. Each page of the chart has two columns at the left edge corresponding to the 6,000-mile and the 1,000-mile maintenance respectively. Very often it will be found that a particular procedure does not apply to both scheduled maintenances. In order to determine which procedure to follow, look down the column corresponding to the maintenance due, and wherever an item appears, perform the operations indicated opposite the number.

ROAD TEST

MAINTENANCE	
6000 Mile	1000 Mile
1	1
3	3

NOTE: When the tactical situation does not permit a full road test, perform those items which require little or no movement of the vehicle, namely, items 3, 4, 5, 6, 9, 10, and 14. Make a full road test of 5, but not more than 10 miles, over varied terrain if possible.

Before-operation Service. Perform Before-operation Service as outlined in paragraph 13.

Dash Instruments and Gages. Observe instruments frequently during road test.

AMMETER. Ammeter should show high charge for short time after starting, then zero or slight positive (plus) reading above speeds of 12 to 15 miles per hour with lights and accessories off. Zero reading is normal with lights and accessories on.

SPEEDOMETER. See that speedometer indicates vehicle speed, operates without excessive fluctuation or noise, and that odometer registers accumulating trip and total mileage correctly.

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MAINTENANCE			
6000 Mile	1000 Mile		
			TEMPERATURE INDICATOR. Temperature indicator should gradually increase to normal operating range of 160°F to 180°F.
			FUEL GAGE. Fuel gage must indicate the approximate amount of fuel in tank.
4	4		Horn, Mirror, and Windshield Wiper. Test horn for proper operation and tone, tactical situation permitting. Adjust mirror, and inspect for broken or discolored glass. Wiper should have sufficient arm tension to stay in "UP" position. Examine blade for good condition and full contact with glass throughout entire stroke.
5	5		Brakes. Test brakes for smooth, even stop, excessive pedal travel before application, "spongy" pedal, or loss of pedal pressure when brakes are held on. Brakes must not squeak or require excessive pedal pressure. Test pedal free travel, which should be 1/2 inch. Hand brake must hold vehicle on a reasonable grade, must have positive ratchet action and 1/3 reserve handle travel. There should be 1/2-inch reserve clearance between hand brake relay crank and lower end of hand brake cable conduit.
6	6		Clutch. Clutch must have free pedal travel of three-quarter inch. Test clutch for slip, grab, gear clash, or rattle. Listen for noises that would indicate dry or defective release bearing or pilot bushing.
7	7		Transmission and Transfer Case. Shift through entire range of transmission and transfer, noting whether the levers move easily and snap into each position. With shifting levers in each position, accelerate and decelerate engine, noting any unusual noises or tendency of levers to slip into neutral. Inspect for loose mountings.
8	8		Steering. Steering gear must not bind. There should be no excessive free play with wheels in straightahead position. Test for existence of front-end shimmy, wander, or side pull.
9	9		Engine. Engine must idle smoothly without stalling. Test acceleration and pulling power in each transmission speed. Listen for detonation and "ping," misses, popping, spitting, or other noises that might indicate need for engine repair.
10	10		Unusual Noises. Listen for noises that might indicate loose, damaged, or faulty parts.
13	13		Temperatures. Feel brake drums and wheel hubs for abnormally high temperatures. Overheated brake drum or wheel hub may indicate dragging brake or defective, dry, or improperly adjusted wheel bearing. Examine

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE	
6000 Mile	1000 Mile
14	14
16	16
17	17
22	22
22	22
18	18

differentials, transmission, and transfer case for too-high running temperature. NOTE: *Transfer case operates at a higher temperature than other cases.*

Leaks. Look on ground under vehicle for indications of coolant, fuel, oil, or hydraulic fluid leaks.

Gear Oil Level and Leaks. Examine lubricant levels of transmission, transfer case, and differentials. Inspect cases for leaks. Safe level when cold is even with filler plug. If an oil change is due, drain and refill, according to Lubrication Guide (par. 18). Capacities: transmission, $\frac{3}{4}$ quart; transfer case, $1\frac{1}{2}$ quarts; front differential, $1\frac{1}{4}$ quarts; rear differential, $1\frac{1}{4}$ quarts.

MAINTENANCE OPERATIONS

Unusual Noises. With engine running, proceed as follows: Accelerate and decelerate engine slightly, and listen for unusual engine noises. With transmission in third gear, front wheel drive engaged, and engine at fast idle, listen for unusual noises in operating units. Observe propeller shaft and universal joints, wheels, and axles for excessive vibration and run-out.

Battery. Inspect battery case for cracks and leaks. Inspect cables, terminals, bolts, posts, straps, and hold-downs for good condition and secure mounting. Clean top of battery. Test specific gravity and voltage, and record on W.D., A.G.O. Form No. 461. Specific gravity readings below 1.225 indicate battery should be recharged or replaced. Electrolyte level should be above top of plates, and may extend $\frac{1}{2}$ inch above plates.

SERVE. Perform high-rate discharge test according to instructions for "condition" test which accompany test instrument, and record voltage on W.D., A.G.O. Form No. 461. Cell variation should not be more than 30 percent. NOTE: *Specific gravity must be above 1.225 to make this test.*

CLEAN. Clean entire battery and carrier, and repaint carrier if corroded. Clean battery cable terminals, terminal bolts and nuts, and battery posts; grease lightly; inspect bolts for serviceability. Tighten terminals and hold-downs carefully to avoid damage to battery. Add clean water to $\frac{1}{2}$ inch above plates.

Cylinder Head and Gasket. Look for cracks, and indications of water or compression leaks. Tighten cylinder head (only if leaks are indicated and after performing item 21) with torque wrench; tighten head-screws to from 65 to 75 foot-pounds; head stud nuts

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MAINTENANCE		
6000 Mile	1000 Mile	
	19	to from 60 to 65 foot-pounds. Tighten in correct order (fig. 25). Be sure cylinder head to dash bond strap is in good condition and securely connected.
19		Valve Mechanism. Adjust valves only if noisy.
		ADJUST. Check clearance and adjust valves. Proper clearances are: intake valve, 0.014 inch when hot or cold; exhaust valve, 0.014 inch when hot or cold.
	20	Spark Plugs. Wipe off plugs without removing; inspect for insulator cracks and leakage through insulators and gaskets. Service if required.
20		SERVE. Clean and adjust plugs to gap of 0.030 inch, using round gage. Plugs with broken insulators, excessive carbon deposits, electrodes burned thin or otherwise unserviceable, must be replaced. Correct plug (AN-7). NOTE: <i>If sand blast cleaner is not available install new or reconditioned plugs.</i>
21	21	Compression. Test compression with all plugs removed, and with throttle and choke wide open. Standard pressure is approximately 110 pounds at cranking speed; minimum pressure is 70 pounds. Maximum variation between cylinders must not be more than 10 pounds. If variation is greater than 10 pounds, recheck weak cylinders, using oil test, and report to higher authority. Record all readings.
23	23	Crankcase. Observe vehicle for crankcase, valve cover, timing case, or flywheel housing oil leaks. Check oil level. Drain and refill crankcase if change is due. See Lubrication Guide (par. 18).
23		CAUTION: <i>Do not start engine until completion of item 24.</i>
24	24	Oil Filters and Lines. Inspect filters, lines, and connections for good condition or leaks.
24		SERVE: Remove filter cartridge, clean filter case and install new cartridge and gaskets. Refill crankcase (5 quarts with new filter cartridge). Again inspect for leaks with engine running and check oil level after engine is stopped.
25	25	Radiator. Observe radiator core, hose, cap and gaskets for good condition and inspect for leaks. CAUTION: <i>System operates under 3¼ to 4¼ pounds pressure (be careful in removing cap).</i> Examine air passages and guards for obstructions and clean out any dirt, insects, or trash. Test and record antifreeze value (as climate demands). Examine coolant for oil, rust, or foreign

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MAINTENANCE		
6000 Mile	1000 Mile	
25		material. Clean and flush radiator as needed. CAUTION: <i>Save and filter coolant if antifreeze is present.</i> Add inhibitor and antifreeze if needed.
		TIGHTEN. Tighten hose clamps. Inspect radiator cap and gasket for tight seal.
26	26	Water Pump and Fan. Loosen fan belt; test water pump shaft and bearing for play. Inspect pump for secure attachment, good condition, and for leaks. Inspect fan for alinement and secure mounting.
27	27	Generator, Cranking Motor, and Switch. Inspect these units to see if they are in good condition, clean and securely connected or mounted; particularly radio noise suppression capacitor on generator and starting switch terminal, and bond straps from generator and cranking motor.
27		SERVE. Inspect commutators and brushes for good condition and wear. Brushes should be free in holders, and have full contact with commutator. Clean commutators with 2/0 flint paper if needed. Blow out with compressed air. Replace generator or cranking motor when commutator is scored, rough, worn, or brushes are less than half their original length.
29	29	Drive Belt and Pulleys. Inspect fan belt for fraying, wear, and deterioration. Inspect pulleys for cracks and misalinement. Replace or adjust belt as needed. Adjust to deflection of 1 inch between pulleys.
31	31	Distributor. Clean and remove distributor cap. Examine cap and rotor arm for cracks, corrosion and burned conductors. Clean breaker plate assembly, if dirty. Inspect breaker points for burning, pitting, alinement, and adjustment. Replace and aline burned or badly pitted points. Feel to determine excessive distributor shaft play. Turn distributor shaft (with rotor), and release to test centrifugal advance for binding.
31		SPECIAL LUBRICATION. Sparingly lubricate cam surfaces, movable breaker arm pin, wick and camshaft according to Lubrication Guide (par. 18). Adjust breaker point gap to 0.020 inch.
32	32	Coil and Wiring. Examine coil, high tension, and exposed low voltage wiring for cleanliness, and secure connections and attachment. Clean and tighten as required. Pay particular attention to see that spark plug

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and FORD MODEL GPW)**

MAINTENANCE		
6000 Mile	1000 Mile	
33	33	and coil to distributor wire, radio noise suppressors, and coil terminal capacitor are in good condition, and securely mounted or connected.
		Manifolds and Heat Control. Tighten manifold stud nuts as required to from 31 to 35 foot-pounds. Inspect for gasket leaks. Heat control valve must be free and bimetal spring must be in good condition.
34	34	Air Cleaner. Examine air cleaner for good condition and secure mounting. Examine oil cup. If dirty, remove and clean filter element; do not apply oil to element after cleaning. Clean oil cup and refill ($\frac{5}{8}$ qt).
36	36	Carburetor. Make certain that the choke and throttle open and close fully. Lubricate linkage, and inspect for worn parts.
37	37	Fuel Filter, Screens, and Lines. Clean fuel pump screen, renew gaskets, inspect unit for leaks. Remove disk filter element from fuel filter mounted on dash; clean element and bowl. Reinstall with new gasket. Inspect for leaks after unit has been refilled.
38	38	Fuel Pump. Observe fuel pump for leaks, secure mounting, and pressure reading. Pressure should be $1\frac{1}{2}$ to $2\frac{1}{2}$ pounds with engine running at approximately 30 miles per hour vehicle road speed.
39	39	Cranking Motor. Start engine and observe cranking motor for positive action, normal speed, and unusual noise. Make sure oil pressure gage and ammeter readings are satisfactory.
40	40	Leaks. Look around engine and on ground under engine for oil, fuel, coolant, or hydraulic fluid leaks.
41	41	Ignition Timing. With neon light, check ignition timing. Observe if spark advances automatically. Adjust timing as required (par. 65). CAUTION: <i>Close timing hole cover and tighten screw.</i>
42	42	Engine Idle and Vacuum Test. Adjust engine to smooth idle, using vacuum gage; obtain highest possible steady vacuum reading.
	43	Regulator Unit. See that regulator and radio noise capacitors are in good condition, and that all connections and mounting are secure.
43		TEST. Connect low voltage circuit tester and test voltage regulator, current regulator, and cut-out for output control.
47	47	Tires and Rims. Inspect valve stems for correct position and missing caps. Inspect tires for cuts, bruises, blisters, irregular and excessive tread wear. Remove imbedded glass, nails, or stones. Directional and non-

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE	
6000 Mile	1000 Mile
48	48
49	49
49	
	52
52	
53	53
53	
54	

directional tires should not be installed on same vehicle. If equipped with directional tires, open end of chevron should meet ground first on front tires, and last on rear tires. Tires should match on all wheels within $\frac{3}{4}$ -inch over-all circumference, and as to type of tread. Take measurements with all tires equally inflated. Inspect tire carrier for looseness and damage. Tighten all lug nuts securely. Inflate tires to 35 pounds (cold).

Rear Brakes. Remove grease and dirt from brake drums and backing plates, and inspect for excessive wear or scoring and loose mounting bolts. Inspect brake hose for proper fit and for deterioration. Inspect wheel cylinders (exterior) for good condition, secure mounting, and for leaks. Tighten brake support and drum mounting bolts securely.

Rear Brake Shoes. Remove right rear wheel and inspect linings for wear, oil, and dirt, and possibility of rivets scoring drum before next 1,000-mile inspection. If lining on right rear wheel requires replacement, remove all wheels for lining inspection.

SERVE. Remove all wheels and drums. Observe linings for wear, oil, and dirt, and determine if shoes are secure and guided by anchor pins. Inspect return springs for good action. Lightly lubricate anchor pins. Adjust brake shoes to 0.005 inch at heel, and 0.008 inch at toe.

Rear Wheels. Inspect wheel for good condition and, without removal, test for evidence of looseness of wheel bearing adjustment, and dry or damaged bearings. Inspect around drive flanges, brake supports, and drums for lubricant or brake fluid leaks. Tighten drive flange and wheel nuts. **CAUTION:** *If it is known that vehicle has operated in deep water which may have entered wheel bearings, inspect right wheel bearing for contamination. Remove, clean, repack, and adjust as for 6,000-mile service. If contamination of lubricant has occurred, service other wheel bearings likewise.*

CLEAN. Disassemble wheel bearings and seals, clean, and inspect for damage.

SPECIAL LUBRICATION. Pack wheel bearings, install new seals, and adjust bearings.

Front Brakes. Examine brake hose for chafing, leakage, and deterioration. Inspect wheel cylinders (exterior) for good condition, secure mounting, and leaks.

DRUMS AND SUPPORTS. Clean drums and backing plates thoroughly, and tighten backing plate bolts. Inspect drums for damage, looseness, excessive wear, and scoring. Lightly lubricate anchor pins.

Front Brake Shoes. Inspect brake shoes, linings, and anchors for damage or looseness. Replace worn parts

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MAINTENANCE		
6000 Mile	1000 Mile	
55	55	and worn linings. Clean dust from linings. Adjust brake shoes to 0.005-inch clearance at heel, and 0.008-inch clearance at toe.
56	56	Steering Knuckles. Inspect steering knuckle housings and oil seals for serviceable condition. Check lubricant for contamination. Refill to bottom of filler hole.
57	57	Front Springs. Inspect front springs for good condition, correct alinement, and excessive deflection. Inspect springs for excessive wear of spring bushing and clips. Tighten U-bolts securely and uniformly. Examine U-shackles and pivot bolts for wear.
57	57	Steering. Observe steering gear, Pitman arm, drag link, tie rod, and steering connecting rods for good condition, correct assembly, and secure mounting.
57		TIGHTEN. Tighten and adjust assembly mounting nuts and screws, arms, tie rods, drag link, Pitman arm, and gear, and steering wheel nuts. Replace broken seals or worn parts.
58	58	Front Shock Absorbers. Inspect shock absorbers to see if they are in good condition and secure, if bodies are leaking fluid, and if rubber bushings have deteriorated. If rubber bushings are hard or cracked, apply a film of brake fluid. <i>NOTE: If fluid is leaking or bodies are defective, shock absorber must be replaced.</i>
60	60	Front Wheels. Inspect for good condition, security, end play, and lubricant leaks. Rotate wheels and observe for loose, broken, or dry bearings.
60		CLEAN AND LUBRICATE. Remove, clean, inspect, lubricate, and replace bearings. Adjust bearings and test for wheel shake before removing jack.
61	61	Front Axle. Examine front axle housing for good condition and lubricant leaks. Inspect pinion shaft for end play and grease leaks. Inspect axle for apparent alinement, and see that vent is open.
62	62	Front Propeller Shaft. Inspect propeller shaft for damage and incorrect assembly, excessive wear, and lubricant leaks. Inspect universal and slip joints for alinement, wear, and leakage.
62		TIGHTEN. Tighten flange yoke bolts.
63	63	Engine Mountings and Braces. See that engine mountings and bond straps are in good condition and secure, and that rubber mountings are not separated from metal backing. Tighten front mountings if loose. Adjust rear

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MAINTENANCE		
6000 Mile	1000 Mile	
64	64	mounting bolts to from 38 to 42 foot-pounds with torque wrench. Tighten radio noise suppression bond strap mountings securely.
		Parking (Hand) Brake. See that drum is not scored or oily; that lining is not oil-soaked nor worn thin. Inspect ratchet for positive holding action. Lubricate upper end of conduit tube at cable with engine oil.
64		ADJUST. Adjust clearance between drum and lining to from 0.005 inch to 0.010 inch. Reserve lever travel should be one-third the ratchet range. There must be $\frac{1}{2}$ -inch reserve clearance (on cable) between relay crank and lower end of hand brake conduit.
65	65	Clutch Pedal. Clutch pedal linkage must be secure and not worn; return spring must be operative; clutch should have free pedal travel of $\frac{3}{4}$ inch.
65		ADJUST. Adjust clutch pedal free travel to $\frac{3}{4}$ inch.
66	66	Brake Pedal. Test brake pedal operation; brake linkage must be secure and not worn excessively; return spring must be operative; brake should have $\frac{1}{8}$ reserve travel.
66		ADJUST. Adjust brake pedal free travel to $\frac{1}{2}$ inch.
67	67	Brake Master Cylinder. Inspect master cylinder for good condition and secure mounting; check master cylinder boot for good condition and correct installation; inspect stop light switch for terminal attachment and correct operation. Look for brake fluid leaks; clean out filler plug vent. Fill master cylinder reservoir to $\frac{1}{4}$ inch below plug.
71	71	Transmission. Inspect oil seals and gaskets for leakage. Test control for looseness, excessive wear, and improper operation. Inspect mounting and assembly bolts and cap screws for looseness.
71		TIGHTEN. Tighten mounting and assembly bolts and cap screws.
72	72	Transfer Case. Inspect oil seals and gaskets for leakage. Test controls for looseness, excessive wear, and improper operation. Inspect mounting and assembly bolts and cap screws for looseness. Clean vent.
72		TIGHTEN. Tighten mounting and assembly bolts, nuts, and cap screws.
73	73	Rear Propeller Shaft. Remove any trash that may be wrapped around shaft or universal joints. Inspect

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MAINTENANCE	
6000 Mile	1000 Mile
73	
75	75
77	77
78	78
80	80
81	81
82	82
82	
83	83
84	84
85	85
86	86

mounting of universal and slip joints for misalignment, wear, and grease leaks.

TIGHTEN. Tighten flange yoke cap screws.

Rear Axle. Inspect rear axle housing for leaks; feel for excessive play in pinion shaft; clean vent. Make sure differential carrier mounting cap screws are tight.

Rear Springs. Check springs for shifted leaves due to broken center bolt, loose spring clips, or U-bolts. If found loose, tighten U-bolts to from 50 to 55 foot-pounds. Tighten spring pivot bolt nut to from 29 to 30 foot-pounds.

Rear Shock Absorbers. Inspect in the same manner as for item 58.

Frame. Examine frame for loose side rails and cross members. Tighten loose bolts. If frame appears to be bent, or out of alignment, report condition to higher authority.

Wiring, Conduits and Grommets. Inspect all wiring for looseness and broken insulation; check conduits and grommets for proper position and good condition.

Fuel Tank and Lines. Inspect tank and lines for good condition, secure mounting, and leaks; check cap for defective gasket or clogged vent.

SERVE. Remove fuel tank drain plug briefly, and drain off accumulated water and sediment.

Brake Lines and Connections. Inspect brake lines for proper mounting, cracks, worn spots in lines, leaks, deteriorated or damaged hose and connections.

Exhaust Pipe and Muffler. Inspect exhaust pipe and muffler for secure mounting, rusted condition, damage or leaks. Inspect tail pipe for stoppage.

Vehicle Lubrication. Lubricate according to Lubrication Guide (par. 18) in this manual. Observe latest issued lubrication directives.

LOWER VEHICLE TO GROUND

Toe-in and Turning Stops. With front wheels on ground, straight-ahead position, use wheel alining gage, and check toe-in. Normal toe-in range is $\frac{3}{64}$ -inch to $\frac{3}{32}$ -inch. Turn front wheels fully in both right and left

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE	
6000 Mile	1000 Mile
91	91
91	
92	92
93	93
94	94
95	95
96	96
98	98
101	101

directions, and determine if turning stops hold tires clear of all parts of vehicle in these positions. Examine axle for loose turn stops.

Lights. Determine that switches for head, tail, instrument, and blackout lights operate properly. Operate stop light by depressing brake pedal. Test foot switch, noting whether beam is controlled for high and low positions. Inspect all lights; these must be clean, securely mounted, and in good condition; lenses must not be broken, cracked, or discolored; reflectors must not be discolored; blackout lights must be in good condition with shield in proper position.

ADJUST. Adjust and aim headlight beams.

Safety Reflectors. Safety reflectors must be present, clean, and secure. Replace if cracked or broken.

Front Bumper and Grille. Front bumper and grille must be present, in good condition, and securely mounted.

Hood, Hinges and Fasteners. Examine hood for alignment and secure mounting when fastened; see that fasteners are present, secure, undamaged, and not excessively worn or bent. Lubricate hinges and fasteners lightly. See that radio noise bond straps from hood to dash and grille are secure.

Front Fenders. Inspect front fenders for good condition and secure mounting.

Body Hardware. Inspect body of vehicle according to following standards: Hardware should operate properly and be adequately lubricated; top should be clean, having no holes or tears, and all grommets must be present and in good condition. Windshield should be free from cracks or discoloration; windshield frame and hold-down hooks at hood should be in good condition. Seats and upholstery should be clean and undamaged; safety straps should be present and in place; body handles should be present, secure, and undamaged; floor drain plugs (2) should be present, and in good condition.

Circuit Breaker, Terminal Blocks, or Boxes. Inspect points of thermal circuit breaker (30 amperes, located on main light switch) for pitting or corrosion. Be sure all radio noise suppression bond straps and capacitor on radio terminal box (if so equipped) are in good condition and secure.

Rear Bumpers and Pintle Hook, Latch and Lock Pin. Inspect rear bumpers and pintle hook to see if they are

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MAINTENANCE	
6000 Mile	1000 Mile
103	103
104	104
105	105
131	131
132	132
133	133
143	143
135	135

present, in good condition, and secure. Pintle hook safety latch should be free, and lock securely.

Paint and Markings. Inspect paint of entire vehicle for good condition and bright spots that might cause glare or reflection. Vehicle markings and identification must be legible. Inspect identification plates and their mountings (if furnished) for good condition, secure mounting, and legibility.

Radio Bonding (Suppressors, Filters, Condensers, and Shielding). See that all units not covered in the foregoing specific procedures are in good condition, and securely mounted and connected. Be sure all additional noise suppression bond straps and toothed lock washers listed in paragraph 177, are inspected for looseness or damage, and see that contact surfaces are clean. *NOTE: If objectionable radio noise from vehicle has been reported, make tests in accordance with paragraph 178. If cleaning and tightening of mountings and connections, and replacement of defective radio noise suppression units does not eliminate the trouble, the radio operator will report the condition to the designated individual in authority.*

Armament. Examine gun mounts and covers (if present) for good condition, cleanliness, and secure attachment. *NOTE: Guns, parts, and covers are to be referred to armorer or gun commanders for all inspections or service.*

TOOLS AND EQUIPMENT

Tools and Equipment. Standard vehicle tools, Pioneer tools, and equipment must be present, clean, serviceable, and securely mounted. Sharpen cutting tools and darken bright parts of exposed tools in combat areas. Check against stowage list (par. 19).

Fire Extinguisher. Inspect fire extinguisher for full charge and secure mounting. See that nozzle is clean.

Decontaminator. Inspect decontaminator for damage, secure mounting, and full charge. Make latter check by removing filler plug. Drain and refill with fresh solution every 90 days. See date of last filling on attached tag.

First Aid Kit. Examine contents of first aid kit for good condition, completeness, and satisfactory packing. Report any deficiency.

Publications and Form No. 26. See that the vehicle manuals and Lubrication Guide, Form No. 26 (Acci-

SECOND ECHELON PREVENTIVE MAINTENANCE

MAINTENANCE	
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dent Report) and W.D., A.G.O. Form No. 478 (MWO and Major Unit Assembly Replacement Record), are present, legible, and properly stowed.

Traction Devices. Inspect tire chains for broken or worn links, missing cross chains, or damaged fasteners.

Fuel Can and Bracket. Inspect fuel can and bracket for damage, leaks, loose mounting, and presence of cap on chain.

Fuel Can Nozzle and Bucket. See that fuel can nozzle and bucket are not damaged, are clean, and properly stowed.

Modifications (Completed). Inspect entire vehicle to be sure all Modification Work Orders have been completed, and enter any modifications or major unit replacements made at time of this service, on Form No. 478.

Final Road Test. Road test, rechecking items 2 to 16. Recheck transmission, transfer case, and differentials for lubricant level and for leaks. Confine this test to minimum distance necessary to satisfactory observations. *NOTE: Correct or report all defects found during final road test to higher authority.*

**1/4-TON 4 x 4 TRUCK (WILLYS-OVERLAND MODEL MB
and FORD MODEL GPW)**

Section X

NEW VEHICLE RUN-IN TEST

	Paragraph
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Correction of deficiencies	25
Run-in test procedures	26

24. PURPOSE.

a. When a new or reconditioned vehicle is first received at the using organization, it is necessary for second echelon personnel to determine whether or not the vehicle will operate satisfactorily when placed in service. For this purpose, inspect all accessories, subassemblies, assemblies, tools, and equipment to see that they are in place and correctly adjusted. In addition, they will perform a run-in test of at least 50 miles as directed in AR 850-15, paragraph 25, table III, according to procedures in paragraph 26 below.

25. CORRECTION OF DEFICIENCIES.

a. Deficiencies disclosed during the course of the run-in test will be treated as follows:

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

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

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

26. RUN-IN TEST PROCEDURES.

a. Preliminary Service.

(1) **FIRE EXTINGUISHER.** See that portable extinguisher is present and in good condition. Test it momentarily for proper operation, and mount it securely.

(2) **FUEL, OIL, AND WATER.** Fill fuel tank. Check crankcase oil and coolant supply; add oil and coolant as necessary to bring to correct levels. Allow room for expansion in fuel tank and radiator. During freezing weather, test value of antifreeze, and add as necessary to protect cooling system against freezing. **CAUTION:** *If there is a tag attached to filler cap or steering wheel concerning engine oil in crankcase, follow instructions on tag before driving the vehicle.*

(3) **FUEL FILTER.** Inspect main fuel filter for leaks, damage, and secure mountings and connections. Drain sediment bowl. Clean fuel pump filter screen and bowl. If any appreciable amount of dirt or water is present, remove main filter bowl and clean bowl and element

NEW VEHICLE RUN-IN TEST

in dry-cleaning solvent. Also, drain accumulated dirt and water from bottom of fuel tank. Drain only until fuel runs clean.

(4) **BATTERY.** Make hydrometer and voltage test of battery, and add clean water to bring electrolyte $\frac{3}{8}$ inch above plate.

(5) **AIR CLEANER.** Examine carburetor air cleaner to see if it is in good condition and secure. Remove element and wash thoroughly in dry-cleaning solvent. Fill oil cup to indicated level with fresh oil, and reinstall securely. Be sure oil cup and body gaskets are in good condition, and that air horn connection is tight.

(6) **ACCESSORIES AND BELT.** See that accessories such as carburetor, generator, regulator, cranking motor, distributor, water pump, fan, and oil filter, are securely mounted. Make sure that fan and generator drive belt is in good condition, and adjusted to have 1-inch finger-pressure deflection.

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

(8) **TIRES.** See that all tires, including spare, are properly inflated to 35 pounds, cool; that stems are in correct position; all valve caps present and finger-tight. Inspect for damage, and remove objects lodged in treads and carcasses.

(9) **WHEEL AND FLANGE NUTS.** See that all wheel mounting and axle flange nuts are present and secure.

(10) **FENDERS AND BUMPER.** Examine fenders and front bumper for looseness and damage.

(11) **TOWING CONNECTIONS.** Examine towing shackles and pintle hook for looseness and damage, and see that pintle latch operates properly and locks securely.

(12) **BODY.** See that all body mountings are secure. Inspect attachments, hardware, glass, seats, grab rails and safety straps, top and frame, curtains and hood, to see if they are in good condition, correctly assembled, and securely mounted or fastened. Examine body paint or camouflage pattern for rust, or shiny surfaces that might cause glare. See that vehicle markings are legible.

(13) **LUBRICATE.** Perform a complete lubrication service of the vehicle, covering all intervals, according to instructions on Lubrication Guide (par. 18), except gear cases, wheel bearings, and other units already lubricated or serviced in items (1) to (12). Check all gear case oil levels, and add as necessary to bring to proper levels. Change only if condition of oil indicates the necessity, or if gear oil is not of proper grade for existing atmospheric temperatures. **NOTE:** *Perform following items (14) through (17) during lubrication.*

(14) **SPRINGS AND SUSPENSIONS.** Inspect front and rear springs and shocks to see that they are in good condition, correctly assembled, secure, and that bushings and shackle pins are not excessively loose, or damaged.

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(15) **STEERING LINKAGE.** See that all steering arms, rods, and connections are in good condition and secure; and that gear case is securely mounted and not leaking excessively.

(16) **PROPELLER SHAFTS.** Inspect all shafts and universal joints to see if they are in good condition, correctly assembled, aligned, secure, and not leaking excessively.

(17) **AXLE AND TRANSFER VENTS.** See that axle housing and transfer case vents are present, in good condition, and not clogged.

(18) **CHOKE.** Examine choke to be sure it opens and closes fully in response to operation of choke button.

(19) **ENGINE WARM-UP.** Start engine and note if cranking motor action is satisfactory, and if engine has any tendency toward hard starting. Set hand throttle to run engine at fast idle during warm-up. During warm-up, reset choke button so that engine will run smoothly, and to prevent overchoking and oil dilution.

(20) **INSTRUMENTS.**

(a) *Oil Pressure Gage.* Immediately after engine starts, observe if oil pressure is satisfactory. (Normal operating pressure, hot, at running speeds is 40 to 50 pounds; at idle, 10 pounds). Stop engine if pressure is not indicated in 30 seconds.

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

(c) *Temperature Gage.* Engine temperature should rise gradually during warm-up period to normal operating range, 160°F to 185°F

(d) *Fuel Gage.* Fuel gage should register "FULL" if tank has been filled.

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

(22) **HORN AND WINDSHIELD WIPERS.** See that these items are in good condition and secure. If tactical situation permits, test horn for proper operation and tone. See if wiper arms will operate through their full range, and that blade contacts glass evenly and firmly.

(23) **GLASS AND REAR VIEW MIRROR.** Clean all body glass, curtain windows, and mirror, and inspect for looseness and damage. Adjust mirror for correct vision.

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

(25) **LEAKS, GENERAL.** Look under vehicle, and within engine compartment, for indications of fuel, oil, coolant, and brake fluid leaks. Trace to source any leaks found, and correct or report them to designated authority.

(26) **TOOLS AND EQUIPMENT.** Check tools and On Vehicle Stowage Lists, paragraphs 19 and 20, to be sure all items are present, and see that they are serviceable, and properly mounted or stowed.

NEW VEHICLE RUN-IN TEST

b. **Run-in Test.** Perform the following procedures, steps (1) to (11) inclusive, during the road test of the vehicle. On vehicles which have been driven 50 miles or more in the course of delivery from the supplying to the using organization, reduce the length of the road test to the least mileage necessary to make observations listed below. **CAUTION:** *Continuous operation of the vehicle at speeds approaching the maximum indicated on the caution plate should be avoided during the test.*

(1) **DASH INSTRUMENTS AND GAGES.** Do not move vehicle until engine temperature reaches 135°F. Maximum safe operating temperature is 200°F. Observe readings of ammeter, oil temperature, and fuel gages to be sure they are indicating the proper function of the units to which they apply. Also see that speedometer registers the vehicle speed, and that odometer registers accumulating mileage.

(2) **BRAKES: FOOT AND HAND.** Test service brakes to see if they stop vehicle effectively, without side pull, chatter, or squealing; and observe if pedal has at least 1/2-inch free travel before meeting push rod-to-piston resistance. Parking brake should hold vehicle on reasonable incline, leaving one-third lever ratchet travel in reverse. **CAUTION:** *Avoid long application of brakes until shoes become evenly seated to drums.*

(3) **CLUTCH.** Observe if clutch operates smoothly without grab, chatter, or squeal on engagement, or slippage (under load) when fully engaged. See that pedal has 3/4-inch free travel before meeting resistance. **CAUTION:** *Do not ride clutch pedal at any time, and do not engage and disengage new clutch severely or unnecessarily.*

(4) **TRANSMISSION AND TRANSFER.** Gearshift mechanism should operate easily and smoothly, and gears should operate without excessive noise, and not slip out of mesh. Test front axle declutching for proper operation.

(5) **STEERING.** Observe steering action for binding or looseness, and note any excessive pull to one side, wander, shimmy, or wheel tramp. See that column, bracket, and wheel are secure.

(6) **ENGINE.** Be on the alert for any abnormal engine operating characteristics or unusual noise, such as lack of pulling power or acceleration, backfiring, misfiring, stalling, overheating, or excessive exhaust smoke. Observe if engine responds properly to all controls.

(7) **UNUSUAL NOISE.** Be on the alert throughout road test for any unusual noise from body and attachments, running gear, suspension, or wheels, that might indicate looseness, damage, wear, inadequate lubrication, or underinflated tires.

(8) **HALT VEHICLE AT 10-MILE INTERVALS FOR SERVICES** (steps (9) and (10) below).

(9) **TEMPERATURES.** Cautiously hand-feel each brake drum and wheel hub for abnormal temperatures. Examine the transmission, transfer case, and differential housing for indications of overheating

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and excessive lubricant leaks at seals, gaskets, or vents. NOTE: *Transfer case temperatures are normally higher than other gear cases.*

(10) LEAKS. With engine running, and fuel, engine oil, and cooling systems under pressure, look within engine compartment and under vehicle for indications of leaks.

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

Section XI

ORGANIZATION TOOLS AND EQUIPMENT

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27. STANDARD TOOLS AND EQUIPMENT.

a. All standard tools and equipment available to second echelon are listed in SNL N-19, and their availability is determined by the table of equipment for any particular organization.

28. SPECIAL TOOLS.

a. The special tools available to second echelon for repair of this vehicle are listed in the Organizational Spare Parts and Equipment List of SNL G-503. The special tools required for the operations described in this manual are listed below:

Tool	Federal Stock No.
COMPRESSOR, shock absorber grommet.	41-C-2554-400
WRENCH, tappet, double-end, 11/32- x 17/32-in.	41-W-3575

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Section XII

TROUBLE SHOOTING

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29. GENERAL.

a. The following listed possible vehicle troubles and remedies will assist in determining the cause of unsatisfactory operation. A separate list is provided for each unit. If the remedy is not given, reference is made to a paragraph where more complete information will be found.

b. The information in this section applies to operation of the vehicle under normal conditions. If extreme conditions are encountered, it is assumed the vehicle has received the attention outlined in section IV.

30. ENGINE.

a. **Diagnosing Troubles.** Determine troubles in a general way first as follows:

(1) **CHECK MECHANICAL CONDITION.** Check for mechanical trouble such as broken or deficient parts in engine or cylinder compression.

TROUBLE SHOOTING

(2) **CHECK IGNITION SYSTEM.** Remove spark plug wire at a plug. Hold terminal end of wire about $\frac{1}{4}$ inch from a metal part of engine, and check for a good spark by having someone turn ignition switch on and operate cranking motor. If no spark is obtained, check ammeter operation to determine condition of ignition primary circuit. Ammeter must show slight deflection from zero to discharge side (with lights off) when cranking motor is operated and ignition switch is on. If ammeter drops to zero when starting switch is pressed, starting system is defective, or battery is discharged.

(3) **CHECK FUEL SYSTEM.** Operate priming lever on rear side of fuel pump; to determine if fuel is reaching carburetor. Resistance to operation indicates carburetor is empty or no fuel; no resistance indicates carburetor is full. A flooded carburetor and engine may prevail so the spark plugs are shorted.

b. Cranking Motor Will Not Crank Engine.

(1) **AMMETER DROPS TOWARD ZERO WHEN STARTING SWITCH IS PRESSED.**

Possible Cause	Possible Remedy
Battery discharged.	Replace or charge battery (par. 97).
Battery terminals or ground cables loose or corroded.	Remove and clean.
Cranking motor drive gear jammed in flywheel teeth.	Rock vehicle backwards or loosen cranking motor (par. 89).
Excessive engine friction due to seizure or improper oil.	Change oil to proper grade (par. 18); if seizure has occurred, report to higher authority.

(2) **AMMETER REMAINS UNCHANGED WHEN STARTING SWITCH IS PRESSED.**

Battery cable terminal corroded or broken.	Clean or replace.
Poor starting switch contacts.	Replace switch (par. 90).

(3) **CRANKING MOTOR RUNS BUT FAILS TO CRANK ENGINE WHEN SWITCH IS PRESSED.**

Cranking motor gear does not engage flywheel.	Remove cranking motor and clean gear (par. 89).
Cranking motor or drive gear faulty.	Replace cranking motor (par. 89).

c. Engine Will Not Start.

(1) **NO SPARK.**

(a) *Ammeter Shows No Discharge (Zero Reading) with Ignition Switch "ON."*

Ignition switch partly on.	Turn on fully.
Ignition switch faulty.	Replace switch (par. 68).

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Possible Cause	Possible Remedy
Ignition primary wires, or cranking motor cables broken, or connections loose.	Repair or replace and tighten
Ignition coil primary winding open.	Replace coil (par. 66).
Distributor points burned, pitted, or dirty.	Clean or replace and adjust (par. 64).
Distributor points not closing.	Clean and adjust; put one drop of oil on arm post (par. 63).
Loose or corroded ground or battery cable connections.	Clean or replace and tighten.
Open circuit in suppression filter.	Test for trouble by removing ignition switch and coil wires, and connect together; if filter is faulty, report to higher authority.

(b) Ammeter Reading Normal.

High tension wire from coil to distributor broken, grounded, or out of terminals.	Repair or replace (par. 69).
Short-circuited secondary circuit in coil.	Replace coil (par. 66).
Short-circuited condenser.	Replace condenser (par. 64).
Short-circuited or burned distributor cap or rotor.	Replace part (par. 64).
Spark plugs, distributor cap, or wires wet (shorted).	Dry and clean thoroughly.
Spark plug gaps wrong.	Reset gaps (par. 67).
Ignition timing incorrect.	Set timing (par. 65).
Ignition wires installed wrong in distributor cap.	Put in proper places (par. 69).

(c) Ammeter Indicates Abnormal Discharge.

Short-circuited wire between ammeter and ignition switch or coil.	Repair or replace wire.
Short-circuited primary winding in ignition coil.	Install new coil (par. 66).
Radio filter short-circuited.	Disconnect temporarily, and report to higher authority.
Short-circuited condenser or broken lead.	Repair lead or replace condenser (par. 64).

TROUBLE SHOOTING

Possible Cause	Possible Remedy
Distributor points not opening.	Clean or replace and adjust (par. 63).
Distributor does not operate cam to open points.	Report to higher authority.
(2) WEAK SPARK.	
Distributor points pitted or burned.	Clean or replace and adjust (par. 64).
Distributor condenser weak.	Replace (par. 64).
Ignition coil weak.	Replace (par. 66).
Primary wire connections loose.	Tighten.
High tension or spark plug wires or distributor cap wet.	Dry thoroughly.
High tension or spark plug wires or distributor cap damaged.	Replace (par. 69).
Distributor rotor burned or broken.	Replace (par. 64).
(3) GOOD SPARK.	
Fuel tank empty.	Refill tank (par. 75).
Dirt or water in carburetor or float stuck.	Report to higher authority.
Carburetor and engine flooded by excessive use of choke.	Pull out throttle; crank engine with motor; when engine starts, regulate throttle; leave choke control "IN."
Choke control not operating properly.	Adjust (par. 72).
Fuel does not reach carburetor.	Check for damaged or leaky lines; air leak into line between tank and fuel pump.
Dirt in fuel lines or tank.	Disconnect drain tank and blow out lines.
Fuel line pinched.	Repair or replace.
Fuel strainer clogged.	Dismantle and clean (par. 76).
Fuel pump does not pump.	Clean screen; replace pump if inoperative (par. 74).
Lack of compression.	Report to higher authority.
(4) BACKFIRING.	
Ignition out of time.	Retime (par. 65).
Spark plug wires in wrong places in distributor cap or at spark plugs.	Install in proper places (par. 69).

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Possible Cause

Possible Remedy

Distributor cap cracked or shorted.	Replace (par. 64).
Valve holding open—due to lack of compression.	Report to higher authority.

d. Engine Runs but Backfires and Spits.

Overheated engine.	Check (subpar. I below).
Improper ignition timing.	Reset (par. 65).
Spark plug wires in wrong place in distributor cap.	Install in proper places (par. 69).
Dirt or water in carburetor.	Clean and adjust (par. 72).
Carburetor improperly adjusted.	Check idle adjustment (par. 72).
Carburetor float level low.	Report to higher authority.
Valve sticking or not seating properly, burned, or pitted.	Report to higher authority.
Excessive carbon in cylinders.	Remove carbon (par. 54).
Valve springs weak.	Report to higher authority.
Heat control valve not operating.	Free-up and check thermostat spring position (par. 53).
Fuel pump pressure low.	Clean screen; replace pump, if faulty (par. 74).
Fuel strainer clogged.	Dismantle and clean (par. 76).
Partly clogged or pinched fuel line.	Clean or repair.
Intake manifold leak.	Check gaskets (par. 52).
Distributor cap cracked or shorted.	Replace (par. 64).

e. Engine Stalls on Idle.

Carburetor throttle valve closes too far, or idle mixture incorrect.	Adjust (par. 72).
Carburetor choke valve sticks closed.	Free-up and lubricate.
Dirt or water in idle passages of carburetor.	Replace carburetor (par. 72).
Air leak at intake manifold.	Tighten manifold stud nuts or replace gaskets (par. 52).
Heat control valve faulty.	Free-up and adjust (par. 53).
Spark plugs faulty, gaps incorrect.	Clean or replace, set gaps (par. 67).
Ignition timing too early.	Reset (par. 65).
Low compression.	Report to higher authority.

TROUBLE SHOOTING

Possible Cause	Possible Remedy
Water leak in cylinder head or gasket.	Replace gasket, or report cylinder head leak to higher authority.
Crankcase ventilator valve stuck open.	Clean (par. 59).
f. Engine Misfires on One or More Cylinders.	
Dirty spark plugs.	Clean and adjust or replace (par. 67).
Wrong type spark plugs.	Replace with correct type (par. 67).
Spark plug gap incorrect.	Reset gap (par. 67).
Cracked spark plug porcelain.	Replace spark plug (par. 67).
Spark plug or distributor suppressors faulty.	Replace (par. 67).
Spark plug wires grounded.	Replace.
Spark plug wires in wrong places in cap or at spark plugs.	Install correctly (par. 69).
Distributor cap or rotor burned or broken.	Replace (par. 64).
Valve tappet holding valve open.	Service (par. 56).
Compression poor—valve trouble.	Report to higher authority.
Leaky cylinder head gasket.	Replace gasket (par. 54).
Cracked cylinder block or broken valve tappet or tappet screw.	Report to higher authority.
g. Engine Does Not Idle Properly—(Erratic).	
Ignition timed too early.	Reset (par. 65).
Dirty spark plugs or gaps too close.	Clean and adjust (par. 67).
Ignition coil or condenser weak.	Replace (par. 66).
Distributor points sticking, dirty or improperly adjusted.	Adjust or replace (par. 64).
Distributor rotor or cap cracked or burned.	Replace (par. 64).
Weak or broken valve spring.	Report to higher authority.
Leaky cylinder head gasket.	Replace (par. 54).
Uneven cylinder compression.	Report to higher authority.
High tension or spark plug wires leaky—cracked insulation.	Replace.
Dirt or water in carburetor, or float level incorrect.	Report to higher authority.
Carburetor adjustment or choke not set right.	Adjust (par. 72).

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Possible Cause	Possible Remedy
Fuel pump pressure low.	Clean screen; replace pump (par. 74).
Crankcase ventilator valve leaks.	Clean (par. 59).
Leaky intake manifold.	Tighten manifold stud nuts or replace gaskets (par. 52).
h. Engine Misses On Acceleration.	
Dirty spark plugs or gaps too wide.	Clean and adjust (par. 67).
Wrong type spark plug.	Replace (par. 67).
Ignition coil or condenser weak.	Replace (par. 66).
Distributor breaker points sticking, dirty or improperly adjusted.	Adjust or replace (par. 64).
Distributor cap or rotor cracked or burned.	Replace (par. 64).
Distributor cap, spark plugs or wire wet or dirty.	Clean and dry thoroughly.
High tension or spark plug wires leaky—cracked insulation.	Replace (par. 69).
Carburetor choke not adjusted.	Adjust (par. 72).
Carburetor accelerating pump system faulty, dirt in metering jets or float level incorrect.	Report to higher authority.
Fuel pump faulty—lack of fuel.	Clean screen; replace faulty pump (par. 74).
Air cleaner dirty.	Clean and recoil (par. 73).
Heat control valve faulty.	Check and adjust (par. 53).
Valves sticking—weak or broken valve springs.	Report to higher authority.
Overheated engine.	Check (subpar. I below).
Fuel strainer clogged.	Dismantle and clean (par. 76).
i. Engine Misses at High Speeds.	
Distributor points sticking, adjusted too wide or burned.	Clean and adjust (par. 64).
Weak distributor arm spring.	Replace (par. 64).
Incorrect type of spark plugs.	Replace (par. 67).
Excessive play in distributor shaft bearing.	Replace distributor (par. 64).
Spark plugs faulty, dirty or incorrect gap.	Clean, adjust or replace (par. 67).
Weak ignition coil or condenser.	Replace (par. 66).

TROUBLE SHOOTING

Possible Cause	Possible Remedy
Valves sticking—weak or broken springs.	Report to higher authority.
Fuel supply lacking at carburetor.	Check fuel system (par. 71 a).
Heat control valve faulty.	Free-up and adjust (par. 53).
Air cleaner dirty.	Clean and recoil (par. 73).
Carburetor metering rod incorrectly set.	Report to higher authority.
j. Engine Pings (Spark Knock).	
Ignition timing early.	Reset (par. 65).
Distributor automatic spark advance stuck in advance position or spring broken.	Replace distributor (par. 64).
Overheated engine.	Check (subpar. l below).
Excessive carbon deposit in cylinders.	Remove cylinder head and clean (par. 54).
Heat control valve faulty.	Free-up and adjust (par. 53).
Wrong type spark plug.	Replace (par. 67).
Old or incorrect fuel.	Drain and use correct fuel (par. 3).
k. Engine Lacks Power.	
Ignition timing late.	Reset (par. 65).
Ignition system faulty.	Check (subpar. c above).
Old or incorrect fuel.	Use correct gasoline.
Leaky gaskets.	Replace.
Engine overheated.	Check (subpar. l below).
Excessive carbon formation.	Remove cylinder head and clean (par. 54).
Engine too cold.	Test thermostat (par. 85); in cold weather, cover radiator.
Insufficient oil or improper grade.	Use correct grade (par. 18).
Oil system failure.	Report to higher authority.
Air cleaner dirty.	Clean; change oil in reservoir (par. 73).
Spark plug gaps too wide.	Reset (par. 67).
Choke valve partially closed or throttle does not open fully.	Adjust (par. 72).
Manifold heat control inoperative.	Check valve operation; see that spring is in proper position (par. 53).

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Possible Cause	Possible Remedy
Exhaust pipe, muffler or tail pipe damaged or clogged.	Service or replace (par. 78).
Low compression—broken valve springs or sticking valves or improper tappet adjustment.	Report to higher authority.
Lack of fuel.	Clean filter (par. 76) check fuel pump (par. 74) check carburetor for water or dirt (par. 72).
l. Engine Overheats.	
Cooling system deficient.	Water low; air flow through radiator core restricted, clean from engine side; clogged core, clean or replace radiator (par. 81).
Radiator or water pump leaky.	Replace (par. 82).
Leaky cylinder head gasket.	Tighten or replace gasket (par. 54).
Damaged or deteriorated hose or fan belt.	Replace (par. 83).
Loose fan belt.	Adjust, or generator brace not hooked (par. 83).
Cylinder block, head or core hole plugs leaky.	Report to higher authority.
Ignition timing incorrect.	Reset (par. 65).
Damaged muffler; bent or clogged exhaust pipe.	Service or replace (par. 78).
Excessive carbon in cylinders.	Remove cylinder head and clean (par. 54).
Insufficient oil or improper grade.	Use correct grade (par. 18).
Air cleaner restricted.	Clean and renew oil (par. 73).
Inoperative thermostat or radiator cap.	Replace (par. 85).
Ignition system faulty.	Check (subpar. c above).
Water pump impeller broken.	Replace pump (par. 82).
Poor compression or valve timing wrong.	Report to higher authority.
Oil system failure (clogged screen).	Check (subpar. p below).
m. Low Fuel Mileage.	
High engine speeds (unnecessary and excessive driving in lower gear range).	Correct driving practice.

TROUBLE SHOOTING

Possible Cause	Possible Remedy
Air cleaner clogged.	Clean and renew oil (par. 73).
Carburetor float level too high. Metering rod, accelerating pump not properly adjusted.	Report to higher authority.
Fuel line leaks.	Tighten or replace.
Overheated engine.	Check (subpar. 1 above).
Carburetor parts worn or broken.	Replace carburetor (par. 72).
Fuel pump pressure too high or leaky diaphragm.	Replace fuel pump (par. 74).
Engine running cold.	Check thermostat (par. 85); cover radiator.
Heat control valve inoperative.	Free-up and put spring on bracket (par. 53).
Choke partially closed.	Adjust (par. 72).
Ignition timed wrong.	Reset (par. 65).
Spark advance stuck.	Replace distributor (par. 64).
Leaky fuel pump bowl gasket.	Replace gasket (par. 74).
Low compression.	Report to higher authority.
Carburetor controls sticking.	Free-up and lubricate.
Engine idles too fast.	Adjust carburetor throttle stop screw (par. 72).
Spark plugs dirty.	Clean or replace (par. 67).
Weak coil or condenser.	Replace (par. 64).
Clogged muffler or bent exhaust pipe.	Service or replace (par. 78).
Loose engine mountings permitting engine to shake and raise fuel level in carburetor.	Tighten; if damaged replace.
n. Low Oil Mileage.	
High engine speeds or unnecessary and excessive driving in low gear ranges.	Correct driving practice.
Oil leaks.	Replace leaky gaskets.
Improper grade or diluted oil.	Use new oil of proper grade (par. 18).
Overheating of engine causing excessive temperature and thinning of oil.	Check (subpar. 1 above).
Oil filter clogged.	Clean; replace element (par. 58).

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Possible Cause	Possible Remedy
Faulty pistons, or rings or rear bearing oil return clogged; excessive clearance of intake valves in guides; cylinder bores worn (scored, out-of-round, tapered); excessive bearing clearance; misaligned connecting rods.	Report to higher authority.
o. Poor Compression.	
Incorrect tappet adjustment.	Adjust (par. 56).
Leaky, sticking or burned valves; sticking tappets; valve springs weak or broken; valve stems and guides worn; piston ring grooves worn or rings worn, broken or stuck; cylinders scored or worn excessively.	Report to higher authority.
p. Low Oil Pressure.	
Insufficient oil supply.	Check oil level.
Improper grade of oil or diluted oil foaming at high speeds.	Change oil; check crankcase ventilator (par. 59); check for water in oil by inspecting dip stick.
High oil temperature causing oil to be thin.	Check (subpar. I above).
Oil too heavy (funneling in cold weather).	Dilute engine oil (par. 18).
Floating oil intake loose or gasket leaky.	Renew gasket, tighten (par. 57).
Oil screen clogged.	Remove oil pan and clean screen (par. 57).
Oil leak causing lack of oil.	Inspect and service.
Faulty oil pump or pressure regulator valve stuck or spring broken.	Report to higher authority.
Oil filter restriction hole too large.	Replace oil filter (par. 58).
Oil pressure too high.	Faulty oil pump regulator valve stuck closed or improperly adjusted, report to higher authority.
q. Faulty Valves.	
Incorrect tappet adjustment.	Adjust tappets (par. 56).
Other valve troubles.	Report to higher authority.

TROUBLE SHOOTING

r. Abnormal Engine Noises.

Possible Cause	Possible Remedy
Loose fan, fan pulley or belt, heat control valve, or noisy generator brush.	Tighten or service.
Leaky intake or exhaust manifold or gaskets, cylinder head gasket or spark plug.	Replace or tighten (pars. 52 and 54).
Overheated engine; clogged exhaust system.	Remove obstruction from muffler tail pipe. Check (subpar. 1 above).
Other abnormal engine noises.	Report to higher authority.

31. CLUTCH.

a. Clutch Slips.

Improper pedal adjustment.	Adjust pedal free travel (par. 109).
Release linkage binding.	Free-up and lubricate.
Clutch facings burned or worn, torn loose from plate, or oil-soaked.	Replace clutch driven plate (pars. 110 and 111).
Weak pressure spring.	Report to higher authority.
Sticking pressure plate.	Report to higher authority.

b. Clutch Grabs or Chatters.

Control linkage binding.	Free-up and lubricate.
Loose engine mountings.	Tighten.
Engine stay cable not adjusted.	Adjust; just taut.
Facings burned, worn, or loose on driven plate; driven plate crimped or cushion flattened out, worn, or binding on splined shaft.	Replace clutch driven plate (pars. 110 and 111).
Pressure plate or flywheel face scored or rough; pressure plate broken; improper clutch lever (finger) adjustment; excessive looseness in power train.	Report to higher authority.

c. Clutch Drags.

Too much pedal play.	Adjust pedal free play (par. 109).
Driven plate warped; facings torn or loose.	Replace clutch driven plate (pars. 110 and 111).
Pressure plate warped or binds in bracket; improper finger adjustment; excessive friction in flywheel bushing.	Report to higher authority.

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d. Clutch Rattles.

Possible Cause	Possible Remedy
Clutch pedal return spring is broken or disconnected.	Replace or connect.
Release fork loose on ball stud.	Adjust clutch pedal free travel to $\frac{3}{4}$ inch (par. 109).
Driven plate springs broken. Worn release bearing.	Replace (pars. 110 and 111).
Worn pressure plate or broken return springs at driving lugs; worn driven plate hub on splined shaft; worn release bearing; fingers improperly adjusted; pilot bushing worn in flywheel.	Report to higher authority.

32. FUEL SYSTEM.

a. Fuel Does Not Reach Carburetor.

No fuel in tank.	Fill tank.
Fuel filter clogged.	Service fuel filter (par. 76).
Fuel pump inoperative.	Replace.
Fuel line air leak between tank and fuel pump.	Locate and correct.
Fuel line clogged.	Disconnect and blow out lines.
Fuel tank cap not functioning.	Replace cap.

b. Fuel Reaches Carburetor but Does Not Enter Cylinders.

Choke does not close.	Free-up and lubricate; inspect for proper operation.
Fuel passages in carburetor clogged.	Replace carburetor (par. 72).
Carburetor float valve stuck closed.	Report to higher authority.

c. Low Fuel Mileage.

Engine at fault.	Check (par. 30 m above).
Lubricant in power train too heavy.	Use correct lubricant (par. 18).
Tires improperly inflated.	Inflate (par. 3).
Vehicle overloaded.	Reduce to 500 pounds if possible.

d. Low Fuel Pressure.

Air leak in fuel lines.	Tighten connections; repair if damaged; hand-tighten fuel pump dome nut.
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TROUBLE SHOOTING

Possible Cause	Possible Remedy
Fuel pump faulty; diaphragm broken; valves leaky; linkage worn.	Replace fuel pump (par. 74).
Fuel lines clogged.	Clean or replace lines.
e. Engine Idles Too Fast.	
Improper carburetor throttle adjustment.	Adjust throttle stop screw (par. 72).
Carburetor control sticking.	Free-up and lubricate.
Control return spring weak.	Replace.
f. Fuel Gage Does Not Register.	
Loose wire connection at instrument panel or tank units.	Tighten connection.
Instrument panel unit or tank unit inoperative.	Replace (pars. 75 and 77).

33. INTAKE AND EXHAUST SYSTEMS.

a. Intake System.

Leaky gaskets, sand hole or crack in manifold.	Replace (par. 52).
Leaky crankcase ventilator valve.	Replace (par. 59).

b. Exhaust System.

Leaky gaskets, sand hole or crack in manifold.	Replace (par. 52).
Exhaust pipe and connections loose or leaking.	Service and/or replace (par. 78).
Muffler leaks or rattles.	Replace (par. 78).
Exhaust system or muffler restricted; exhaust pipe kinked or tail pipe plugged.	Service or replace parts.
Heat control valve inoperative, causing miss on acceleration or slow warm-up.	Free-up; install spring in place on bracket (par. 53).

34. COOLING SYSTEM.

a. Overheating.

Abnormal conditions.	Check (par. 30 I).
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b. Loss of Cooling Solution.

Loose hose connection.	Tighten.
Damaged or deteriorated hose.	Replace.

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Possible Cause	Possible Remedy
Leaky radiator.	Replace (par. 81).
Radiator cap inoperative.	Replace.
c. Engine Running Too Cool.	
Thermostat stuck open.	Replace (par. 85).
Low air temperatures.	Cover radiator; refer to operation under unusual conditions (par. 7).
d. Noises.	
Frayed or loose fan belt.	Replace or adjust (par. 83).
Water pump faulty.	Replace (par. 82).
Fan blades striking.	Align blades.
35. IGNITION SYSTEM.	
a. Ignition System Troubles.	
No spark.	Refer to paragraph 30 c (1).
Weak spark.	Refer to paragraph 30 c (2).
Timing incorrect.	Retime ignition (par. 65); refer to paragraph 30 j for other causes.
Moisture on distributor wires, coil, or spark plugs.	Dry and clean thoroughly with cloth dampened with carbon tetrachloride.
Ignition switch "OFF."	Turn "ON" fully.
Ignition switch does not make contact.	Replace switch (par. 68).
Primary or secondary wiring loose, broken, or grounded.	Service.
Primary or secondary wiring wrong.	Check against wiring diagram (par. 62 and fig. 30); install secondary wires correctly in distributor cap and on spark plugs.
Ground strap connections (engine to frame) loose or dirty.	Clean and tighten.
Coil faulty.	Refer to subparagraph b below.
Distributor faulty.	Refer to subparagraph c below.
Spark plug or distributor suppressors faulty.	Replace (par. 67).
Filter unit open or grounded.	Replace filter (par. 69).

TROUBLE SHOOTING

b. Ignition Coil Troubles.

Possible Cause	Possible Remedy
Connections loose; dirty or broken external wire; wet.	Clean and tighten or repair; dry thoroughly.
Coil internal fault.	Replace coil (par. 66).

c. Distributor Troubles.

Distributor breaker points dirty or pitted; gap incorrect.	Clean or replace and adjust (par. 64).
Distributor breaker point arm spring weak.	Replace breaker point arm (par. 64).
Distributor breaker points stuck open.	Free-up and lubricate arm on post.
Distributor automatic advance faulty.	Lubricate and free up; if "frozen" replace distributor (par. 64).
Distributor cap or rotor shorted, cracked, or broken.	Replace.
Distributor rotor does not turn.	Report to higher authority.
Distributor cap cracked or shorted.	Replace cap (par. 64).
Condenser or lead wire faulty.	Replace condenser (par. 64).

d. Spark Plug Troubles.

Cracked, broken, leaky, or improper type.	Replace spark plug (par. 67).
Spark plug wires installed on wrong plugs, or in distributor cap.	Install in correct place (par. 69).
Spark plugs dirty; gaps incorrect.	Clean or replace; set gaps (par. 67).
Spark plug porcelain cracked or broken.	Replace plug.
Spark plugs wrong type.	Replace with correct type (par. 67).

36. STARTING AND GENERATING SYSTEMS.

a. Cranking Motor Troubles.

(1) CRANKING MOTOR CRANKS ENGINE SLOWLY.

Engine oil too heavy.	Change to proper seasonal grade (par. 18).
Battery low.	Replace or recharge (par. 97).
Battery cell shorted.	Replace battery (par. 97).

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Possible Cause	Possible Remedy
Battery connections corroded, broken, or loose; or engine ground strap to frame connections dirty or loose.	Clean and tighten or replace (par. 97).
Dirty commutator.	Clean (par. 89).
Poor brush contact.	Free-up brush or replace cranking motor (par. 89).
Cranking motor internal fault.	Replace cranking motor.
Starting switch faulty.	Replace switch (par. 90).

(2) CRANKING MOTOR DOES NOT CRANK ENGINE.

Engine oil too heavy.	Change to proper seasonal grade (par. 18).
Cranking motor, starting switch or cables faulty; loose connections.	Replace; tighten loose connections.

b. Generator Troubles.

(1) NO OUTPUT.

Generator faulty.	Replace generator (par. 93).
Filter unit or suppressors faulty.	Replace (par. 93).
Regulator faulty.	Replace (par. 94).

(2) LOW OR FLUCTUATING OUTPUT.

Loose fan belt.	Adjust (par. 83); generator brace not hooked (par. 4 b (8)).
Poor brush contact, weak brush springs; worn commutator; broken or loose connections.	Replace generator (par. 93).
Dirty commutator.	Clean (par. 93).
Regulator faulty.	Replace (par. 94).
Loose or dirty connections in charging circuit.	Clean and tighten.
Ground strap (engine to frame) broken.	Replace.
Filter unit faulty.	Replace (par. 93).

(3) EXCESSIVE OUTPUT.

Short circuit between field coil and armature leads.	Replace generator (par. 93).
Regulator faulty.	Replace regulator (par. 94).

(4) NOISY.

Loose pulley or generator mounting.	Tighten.
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TROUBLE SHOOTING

Possible Cause	Possible Remedy
Faulty bearings, improperly seated brushes, or armature rubbing on field poles.	Replace generator (par. 93).
c. Generator Regulator Troubles.	
Loose connections or mounting.	Clean and tighten.
Regulator internal defect.	Replace regulator (par. 94).
37. TRANSMISSION.	
a. Excessive Noise.	
Incorrect driving practice.	Correct practice (par. 5).
Insufficient lubricant.	Add lubricant (par. 18).
Incorrect lubricant.	Use correct lubricant (par. 18).
Gears or bearings broken or worn; shift fork bent; gears worn on splines.	Replace transmission (pars. 115 and 116).
Overheated transmission.	Check lubricant grade and supply (par. 18).
b. Hard Shifting.	
Clutch fails to release.	Adjust clutch pedal free travel (par. 109).
Clutch driven plate binds on splines, or pressure plate faulty.	Report to higher authority.
Gearshift binding in housing.	Lubricate and free-up.
Shift rods binding in case.	Report to higher authority.
Transmission loose on bell housing.	Tighten.
Clutch shaft pilot binding in bushing case or shift housing damaged.	Report to higher authority.
c. Slips Out of Gear.	
Weak or broken poppet spring.	Report to higher authority.
Interlock plunger not in place.	Install plunger (par. 116).
Transmission gears or bearings worn.	Replace transmission (pars. 115 and 116).
Shift fork bent, causing partial gear engagement.	Report to higher authority.
Transmission loose on bell housing.	Tighten.
Damaged bell housing.	Report to higher authority.
d. Loss of Lubricant.	
Worn or damaged seals or gaskets.	Report to higher authority.

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Possible Cause	Possible Remedy
Overfilled with lubricant.	Drain to proper level.
Loose bolts and screws.	Tighten.
38. TRANSFER CASE.	
a. Slips Out of Gear.	
Shift rod poppet spring weak or broken; gears not fully engaged; shift fork bent; end play in sliding gear shaft.	Report to higher authority.
Parts damaged or worn.	Replace transfer case (pars. 119 and 120).
b. Hard Shifting.	
Improper driving practice.	Use correct procedure (par. 5).
Lack of lubrication.	Replenish supply.
Shift lever seizing on shaft.	Lubricate and free-up.
Shift rod tight in case; poppet scored or stuck; shift fork bent, or parts worn or damaged.	Report to higher authority.
Low or uneven tire pressures; odd tires on (front and rear) wheels.	Service.
c. Oil Leaks.	
Leaks at gaskets or seals.	Report to higher authority.
Lubricant level too high.	Reduce to correct level.
Vent on top of unit clogged.	Clean.
d. Excessive Noise.	
Insufficient lubricant.	Replenish supply.
Incorrect lubricant.	Drain and refill with correct lubricant (par. 18).
Gears or bearings worn, improperly adjusted, or damaged.	Replace transfer case (pars. 119 and 120).
e. Overheats.	
Insufficient lubricant.	Replenish supply.
Vent on top of unit clogged.	Clean.
Bearings adjusted too tight.	Report to higher authority.
f. Backlash.	
Universal joint yoke loose on output shaft.	Report to higher authority.

TROUBLE SHOOTING

Possible Cause	Possible Remedy
Transfer case loose on transmission or snubbing rubber.	Tighten.
Parts worn or damaged.	Report to higher authority.
39. PROPELLER SHAFTS.	
a. Excessive Vibration or Noise.	
Foreign material around shaft.	Clean out.
Universal joints not in same plane.	Match arrows on joint and propeller shaft (par. 125).
Lack of lubricant.	Lubricate (par. 18).
Universal joint parts worn, or propeller shaft sprung.	Replace shaft.
b. Universal Joint Leaks.	
Overfilled.	Lubricate correctly (par. 18).
Oil seals leak.	Report to higher authority.
Lubricant fitting leaks.	Replace fitting.
40. FRONT AXLE.	
a. Steering trouble.	Refer to paragraph 45.
b. Noisy gears or backlash.	Report to higher authority.
c. Damaged axle.	Replace axle (pars. 136 and 137).
d. Abnormal tire wear.	Inflate tires (par. 13 b (13)) (do not use front wheel drive except where needed); correct toe-in; report to higher authority incorrect caster or camber.
e. Lubrication leaks.	Replace steering knuckle oil seals; for other remedies refer to paragraph 41 c.
41. REAR AXLE.	
a. Noisy gears or backlash.	Report to higher authority.
b. Damaged axle.	Replace axle (par. 145).
c. Lubrication leaks.	Drain excessive lubricant; clean housing vent; replace wheel bearing grease seals; remove excessive grease in wheel hubs; tighten or replace housing cover gasket.

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42. BRAKE SYSTEM.

a. All Brakes Drag.

Possible Cause	Possible Remedy
Improper pedal adjustment.	Adjust brake pedal free travel (par. 148).
Clogged master cylinder port.	Replace (par. 150).
Brake pedal return spring broken or weak.	Replace.
Brakes improperly adjusted.	Adjust (par. 148).
Rubber parts swollen from use of mineral oil in brake fluid.	Report to higher authority.

b. One Brake Drags.

Brake shoe adjustment faulty.	Adjust (par. 148).
Brake shoe anchor pin tight in shoes.	Free-up and lubricate lightly.
Brake shoe return spring broken or weak.	Replace.
Brake hose clogged or pinched.	Replace.
Loose or damaged wheel bearings.	Adjust or replace (pars. 128 and 141).
Wheel cylinder pistons or cups faulty.	Replace wheel cylinder (par. 150).

c. One Brake Grabs (Vehicle Pulls to One Side).

Tires underinflated.	Inflate tires (par. 13).
Tires worn unequally.	Replace.
Insufficient brake shoe clearance or brake anchor pin adjustment faulty.	Adjust (par. 148).
Axle spring clips or brake backing plate loose.	Tighten.
Brake shoes binding on anchor pin.	Free-up and lubricate lightly.
Weak or broken shoe return spring.	Replace spring.
Grease or brake fluid on linings.	Correct leakage; clean up and install new shoes and lining assemblies.
Dirt imbedded in linings or rivet holes.	Clean with wire brush.
Drums scored or rough.	Replace drums and brake shoe and lining assemblies.

TROUBLE SHOOTING

Possible Cause	Possible Remedy
Primary and secondary brake shoes reversed in one wheel.	Change shoes to proper place and adjust brakes (par. 148).
Odd kinds of brake lining on opposite wheels.	Replace shoe and lining assemblies in both wheels.
Loose or broken wheel bearings.	Adjust or replace (pars. 128 and 141).
Obstruction in brake line.	Clean or replace tube (par. 152).

d. Severe Brake Action on Light Pedal Pressure.

Brake shoes improperly adjusted.	Adjust (par. 148).
Grease or brake fluid on linings.	Correct leakage, clean up and replace shoe and lining assemblies.
Loose brake shoe anchor.	Adjust and tighten (par. 148).
Improper linings.	Replace shoe and lining assemblies (par. 148).

e. Brakes Locked.

Brake pedal lacks free travel.	Adjust pedal free travel (par. 148).
Bleed hole in master cylinder clogged.	Replace master cylinder (par. 150).
Dirt in brake fluid.	Flush system (par. 151).
Wheel cylinder stuck.	Replace cylinder (par. 150).
Brakes frozen to drums (cold weather).	Break loose by driving vehicle.

f. Brakes Noisy or Chatter.

Brake lining worn out.	Replace shoe and lining assemblies (par. 148).
Grease or brake fluid on linings.	Correct leakage, clean up and replace shoe and lining assemblies (par. 148).
Improper adjustment of anchor bolts.	Adjust (par. 148).
Dirt imbedded in linings and rivet holes.	Clean with wire brush.
Improper or loose linings.	Replace shoe and lining assemblies (par. 148).
Brake shoes, drums, or backing plate distorted.	Straighten or replace.
Loose spring clips or shackles.	Tighten.

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g. Excessive Pedal Travel.

Possible Cause	Possible Remedy
Normal lining wear.	Adjust brake eccentrics only (par. 148).
Lining worn out.	Replace shoe and lining assemblies (par. 148).
Brake not properly adjusted.	Adjust (par. 148).
Improper pedal adjustment.	Adjust (par. 148).
Brake line leaky or broken.	Locate and tighten or repair.
Low fluid level in master cylinder or air in brake system.	Fill master cylinder and bleed lines (par. 151).
Scored brake drums.	Replace (pars. 131 and 144).
Incorrect brake lining.	Replace with correct shoe and lining assemblies.
Pedal goes to floorboard (disconnected from master cylinder).	Connect or replace faulty part (par. 149).
Leaky piston cup in master or wheel cylinders.	Replace cylinder.

h. Excessive Pedal Pressure.

Grease or brake fluid on linings; worn or glazed lining.	Correct cause, clean up and replace shoe and lining assemblies (par. 148).
Warped shoes or improper brake linings.	Replace shoe and lining assemblies (par. 148).
Shoes improperly adjusted.	Adjust (par. 148).
Brake drums scored or distorted.	Replace damaged parts.
Improper brake fluid.	Clean system and fill with correct fluid.
Obstructed main brake line.	Locate and correct.

i. Spongy Brake Pedal Action.

Air or insufficient fluid in brake system.	Fill master cylinder and bleed lines (par. 149).
Brake anchor adjustment faulty.	Adjust (par. 148).

j. No Brakes—Pedal Will Pump Up.

Brake shoe clearance excessive.	Adjust brake eccentrics (par. 148).
Leaky master or wheel cylinder piston cup.	Replace cylinder.
Leaky brake line or hose.	Locate and tighten or replace.

TROUBLE SHOOTING

k. Pedal Goes to Floor Slowly When Brakes Are Applied.

Possible Cause	Possible Remedy
Leaky master cylinder piston cup.	Replace master cylinder (par. 149).
Leaky brake line or hose.	Tighten or replace part.

43. WHEELS, WHEEL BEARINGS, AND RELATED PARTS.

a. Wheel Troubles.

Wheel wobbles; bent.	Check mounting on hub; replace bent wheel.
Wheel loose on hub.	Tighten.
Wheel out of balance.	Remount tire correctly.
Wheel bearings run hot (pull vehicle to one side).	Adjust (pars. 128 and 141).
Wheels misaligned.	Refer to paragraph 135.
Excessive or uneven tire wear.	Refer to paragraph 45.
Diameter of front tires not the same in size or wear.	Replace or match up.

44. SPRINGS AND SHOCK ABSORBERS.

a. Broken Springs.

Improper handling of vehicle on rough terrain.	Use correct practice when possible (par. 5).
Overloaded vehicle.	Reduce load (par. 3).
Overlubricated springs.	Do not lubricate unless rusty.
Rebound clips off or out of place.	Service.
Shackles or pivot bolts too tight.	Free-up and lubricate.
Main leaf broken at end.	Replace spring (par. 156).
Axle clips loose (spring broken at center).	Keep clips tight.
Shock absorbers not adjusted correctly, lack fluid, or damaged.	Adjust or replace shock absorbers (par. 157).
Clutch or brakes grab.	Service.

b. Noisy Springs.

Worn shackles, pivot pins, or bushings.	Replace worn parts (par. 155).
Spring clips loose on axle or leaves.	Tighten.
Spring hangers loose on frame.	Report to higher authority.
Spring shackle bushing loose; inner spring eye opened up.	Replace spring (par. 156).

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Possible Cause	Possible Remedy
No fluid in shock absorbers, or bushings worn out.	Replace (par. 157).
c. Bottomed Springs.	
Overloaded vehicle.	Reduce load (par. 3).
Overlubricated springs.	Do not lubricate unless rusty.
Broken spring leaves.	Replace spring (par. 156).
Shock absorbers broken, lack fluid or proper adjustment.	Replace shock absorbers (par. 159).
d. Overflexible Springs.	
Overlubrication causes springs to bottom.	Do not lubricate springs.
Shock absorbers not adjusted right, lack fluid, or are broken.	Service, adjust, or replace shock absorbers (par. 157).
Rebound clips damaged or lost.	Replace.
Broken spring.	Replace spring (par. 156).
e. Stiff Springs.	
Rusted spring leaves.	Lubricate.
Shackle or pivot bolts too tight.	Free-up and lubricate.
Shock absorber adjustment not right.	Adjust (par. 157).
f. Noisy Shock Absorbers.	
Rubber bushings worn out.	Replace bushing (par. 157).
Mounting bracket loose.	Report to higher authority.
Shock absorber faulty.	Replace (par. 157).
g. Shock Absorber Control Too Stiff or Too Soft.	
Shock absorber adjustment wrong.	Adjust (par. 157).
Shock absorber damaged or lacks fluid.	Replace shock absorber (par. 157).

45. STEERING SYSTEM.

a. Steering Difficult.	
Lack of lubrication.	Lubricate (par. 18).
Tire pressures low.	Inflate (par. 13).
Tight steering system connections.	Lubricate and adjust (par. 159).
Tight steering gear; misaligned front wheels (caster or camber); or bent frame.	Report to higher authority.

TROUBLE SHOOTING

Possible Cause	Possible Remedy
Improper front wheel toe-in.	Adjust (par. 135).
Bent steering connecting parts.	Straighten or replace.
Misalined steering gear mounting.	Adjust mounting.
b. Wander or Weaving.	
Improper toe-in	Adjust (par. 135).
Improper camber or caster (axle twisted).	Report to higher authority.
Front springs settled or broken.	Replace spring (par. 156).
Axle shifted (spring center bolt broken).	Replace part.
Loose or lost spring clips.	Tighten or replace.
Loose or worn spring shackles or bolts.	Replace or tighten.
Tire pressures uneven.	Inflate (par. 13).
Steering system connections or king pin bearings not properly adjusted.	Lubricate and adjust (par. 159).
Loose wheel bearings.	Adjust (pars. 128 and 141).
Faulty shock absorbers.	Replace (par. 157).
Steering gear worn or out of adjustment.	Report to higher authority.
Steering gear mounting loose.	Tighten.
Steering Pitman arm loose.	Tighten.
c. Low Speed Shimmy or Wobble.	
Loose steering connections.	Adjust.
Spring clips or shackles loose.	Adjust or replace.
Front axle loose on spring (broken spring center bolt).	Replace bolt.
Insufficient toe-in.	Adjust (par. 135).
Improper caster or twisted axle.	Report to higher authority.
Steering gear worn, or adjustments too loose.	Report to higher authority.
Loose wheel or king pin bearings.	Adjust (par. 128).
d. High Speed Shimmy or Tight Wheel (Refer to remedies listed in subparagraph c above).	
Tire pressures low or uneven.	Inflate (par. 13).
Wheels and tires out of balance.	Check tire mounting; report other trouble to higher authority.

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Possible Cause	Possible Remedy
Wheel run-out; tire radial run-out or wheel camber incorrect.	Report to higher authority.
Front springs settled or broken.	Replace spring (par. 156).
Bent steering knuckle arm.	Report to higher authority.
Shock absorbers not effective.	Adjust or replace.
Steering gear loose in frame.	Tighten.
Front springs too flexible.	Do not lubricate.
Worn spring bolts, shackles, or bushings.	Replace (par. 155).
Axle housing or frame damaged.	Report to higher authority.
e. Wheel Tramp (High Speed).	
Wheels and tires out of balance.	Check tire mounting; report other trouble to higher authority.
Uneven tire wear.	Shift tires.
Shock absorbers ineffective.	Replace or adjust (par. 157).
f. Vehicle Pulls to One Side.	
Tires not inflated evenly.	Inflate (par. 13).
Unequal caster or camber (bent axle).	Report to higher authority.
Odd size, or new and old tires on opposite front wheels.	Switch tires.
Tight wheel bearing.	Adjust (pars. 128 and 141).
Bent steering arm or connection.	Straighten or replace.
Brake drag.	Adjust brakes (par. 148).
g. Road Shock.	
Tightness in steering connecting parts.	Adjust (par. 159).
Excessive spring flexibility.	Do not lubricate.
Loose wheel bearings.	Adjust.
Loose Pitman arm or mounting.	Tighten.
Looseness in steering gear.	Report to higher authority.
Shock absorbers out of adjustment or faulty.	Adjust or replace (par. 157).
h. Steering Dive.	
Steering gear loose on frame.	Tighten.
Broken front spring leaves.	Replace.
Worn spring shackles, bushings or bolts.	Replace.

TROUBLE SHOOTING

Possible Cause	Possible Remedy
Spring hangers loose on frame.	Report to higher authority.
Spring clips loose, broken, or lost.	Tighten or replace.
Spring center bolt broken and/or clips loose.	Replace.
Axle housing on frame damaged.	Report to higher authority.
i. Unequal Steering (Right and Left).	
Pitman arm not installed in proper position on steering gear.	Remove and install in correct position (par. 162).
Drag link bent.	Straighten or replace.
46. BODY AND FRAME.	
a. Body.	
Worn or damaged seat cushion.	Replace.
Badly damaged fender, radiator guard, hood, fuel can rack, seats, top, or windshield.	Replace; report minor damage to higher authority.
Windshield wiper faulty.	Service or replace.
b. Frame.	
Badly damaged bumpers and pintle hook.	Replace; report minor damage to higher authority.
Damaged frame.	Report to higher authority.
47. BATTERY AND LIGHTING SYSTEM.	
a. Battery.	
(1) BATTERY DISCHARGED.	
Battery solution level low.	Add distilled water to bring level above plates; check for cracked case.
Short in battery cell.	Replace battery (par. 97).
Generator not charging.	Check generator, fan belt and regulator (par. 92).
Loose or dirty connections; broken cables.	Clean and tighten connections; replace cables.
Excessive use of cranking motor.	Tune up engine; charge battery.
Idle battery, or excessive use of lights.	Replace or charge battery.
(2) BATTERY (OTHER TROUBLES.)	
Overheated battery.	Check for short circuit or excessive generator charge.

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Possible Cause	Possible Remedy
Case bulged or out of shape.	Check for overcharging and too tight hold-down screws.
b. Switch.	
Loose or dirty connections or broken wire.	Clean and tighten; replace broken wire.
Internal fault.	Replace switch.
c. Fuse (Circuit Breaker).	
Points dirty.	Clean.
Other troubles.	Replace fuse assembly (par. 104).
d. Wiring.	
Loose or dirty connections, broken wire or terminal.	Clean, tighten or replace.
e. Lights do Not Light.	
Switch not fully on.	Turn switch on fully.
Loose or dirty connection, or broken wire or terminal.	Clean and tighten; replace or repair wire or terminal.
Wiring circuit shorted or open.	Localize and repair.
Headlight, blackout driving light, tail or stop light burned out.	Replace lamp-unit (par. 96).
Blackout headlight burned out.	Replace lamp (par. 100).
f. Lights Dim.	
Loose or dirty connection or poor ground connection.	Clean and tighten.
Wire grounding.	Localize and replace (par. 98).
Poor switch contact.	Replace switch.
Headlight aim not right.	Adjust lights (par. 99).
g. Trailer Connection Trouble.	
No current supply.	Tighten loose wires; connect to correct terminals.
h. Horn Troubles.	
Loose or dirty connections.	Clean and tighten.
Sounds continuously (short circuit in wiring between horn and horn button).	Replace wire.
Improper tone.	Adjust points; tighten cover or bracket screws; clean and tighten loose or dirty wiring connections.

TROUBLE SHOOTING

Possible Cause	Possible Remedy
Internal defect.	Replace horn.
Battery low.	Charge or replace battery.
48. RADIO SUPPRESSION.	
a. Radio Interference.	
Faulty ignition.	Check distributor, spark plugs, and suppressors. Tighten braided bonding straps. Tighten radiator and fender supporting bolts. Check high-tension insulation. Tighten loose wiring connections, or replace corroded distributor cap towers. Replace defective switches or gages (par. 178).
Faulty generator.	Tighten generator to regulator bond. Check for faulty commutator, brushes, or holders. If defective, replace generator. Check for discharged battery causing high charging rate (par. 178).
Erratic noises.	Tighten or clean loose or dirty lock washer ground. Install lock washers in correct position (par. 178).
49. INSTRUMENTS.	
a. Faulty Instruments.	
Dirty or loose connections.	Clean and tighten.
Internal defects.	Replace instrument.
Broken speedometer cable.	Replace (par. 166).

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Section XIII

**ENGINE—DESCRIPTION, DATA, MAINTENANCE, AND
ADJUSTMENT IN VEHICLE**

	Paragraph
Description and tabulated data	50
Engine tune-up	51
Intake and exhaust manifolds	52
Manifold heat control valve	53
Cylinder head gasket	54
Valve cover gasket	55
Valve tappet adjustment	56
Oil pan gasket	57
Oil filter	58
Crankcase ventilator valve	59

50. DESCRIPTION AND TABULATED DATA.

a. **Description.** The engine (figs. 20 and 21) is of the conventional 4-cylinder, L-head, internal-combustion type. The engine with the clutch, transmission, and transfer case is built into a unit power plant which is mounted at four points in the chassis. For identification refer to paragraph 2 b.

b. **Tabulated Data.**

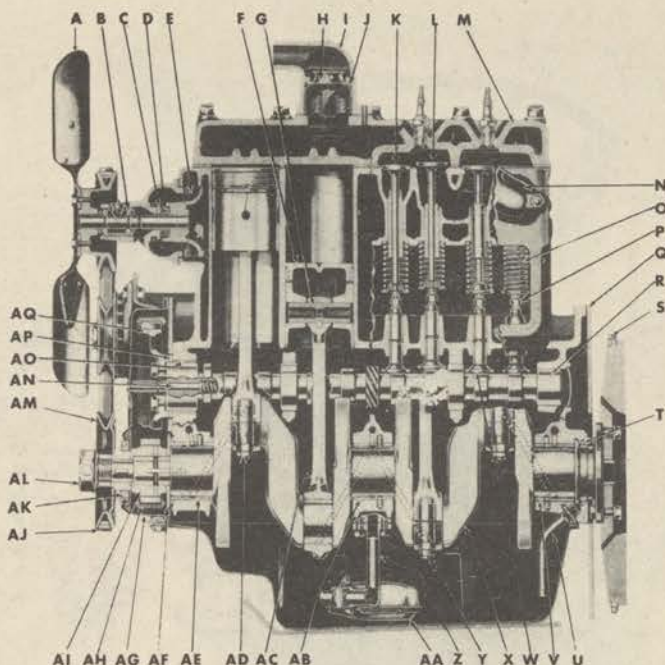
Type	L-head
Number of cylinders	4
Bore	3 $\frac{1}{8}$ in.
Stroke	4 $\frac{3}{8}$ in.
Piston displacement	134.2 cu in.
Compression ratio	6.48 to 1
Net horsepower	54 at 4,000 rpm
Compression	110 lb per sq in. at 185 rpm
SAE horsepower	15.63
Maximum torque	95 ft-lb
Firing order	1-3-4-2
Tappet clearance—intake and exhaust (hot or cold)	0.014 in.

51. ENGINE TUNE-UP.

a. **Procedure.**

- (1) Perform preventive maintenance and corrective operations listed in paragraph 16.
- (2) Remove spark plugs and clean. Adjust gaps (par. 67).

ENGINE—DESCRIPTION, DATA, MAINTENANCE, AND ADJUSTMENT IN VEHICLE

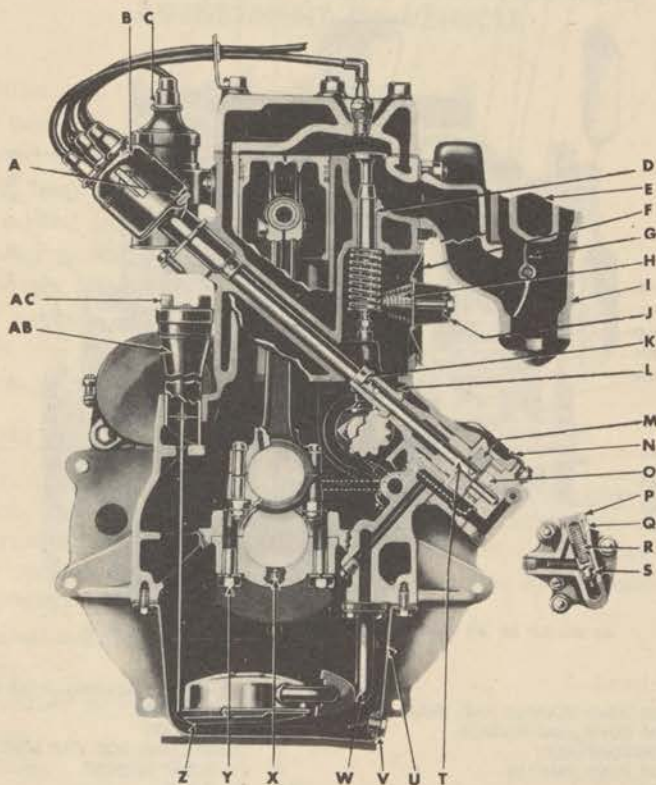


- | | |
|---|---|
| A FAN | V CRANKSHAFT BEARING—REAR LOWER |
| B WATER PUMP BEARING AND SHAFT | W VALVE TAPPET |
| C WATER PUMP SEAL WASHER | X CRANKSHAFT |
| D WATER PUMP SEAL | Y CONNECTING ROD CAP BOLT |
| E WATER PUMP IMPELLER | Z OIL FLOAT SUPPORT |
| F PISTON | AA OIL FLOAT |
| G PISTON PIN | AB CRANKSHAFT BEARING—CENTER LOWER |
| H THERMOSTAT | AC CONNECTING ROD |
| I WATER OUTLET ELBOW | AD CONNECTING ROD BOLT NUT LOCK |
| J THERMOSTAT RETAINER | AE CRANKSHAFT BEARING—FRONT LOWER |
| K EXHAUST VALVE | AF CRANKSHAFT THRUST WASHER |
| L INLET VALVE | AG TIMING CHAIN COVER |
| M CYLINDER HEAD | AH TIMING CHAIN |
| N EXHAUST MANIFOLD | AI CRANKSHAFT SPROCKET |
| O VALVE SPRING | AJ FAN BELT |
| P VALVE TAPPET ADJUSTING SCREW | AK CRANKSHAFT PACKING—FRONT END |
| Q ENGINE PLATE—REAR | AL STARTING CRANK NUT |
| R CAMSHAFT | AM FAN AND GENERATOR DRIVE PULLEY |
| S FLYWHEEL RING GEAR | AN CAMSHAFT THRUST PLUNGER |
| T CRANKSHAFT PACKING—REAR | AO CAMSHAFT BUSHING—FRONT |
| U CRANKSHAFT REAR BEARING DRAIN PIPE | AP CAMSHAFT THRUST WASHER |
| AQ CAMSHAFT SPROCKET | |

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Figure 20—Sectional View of Engine

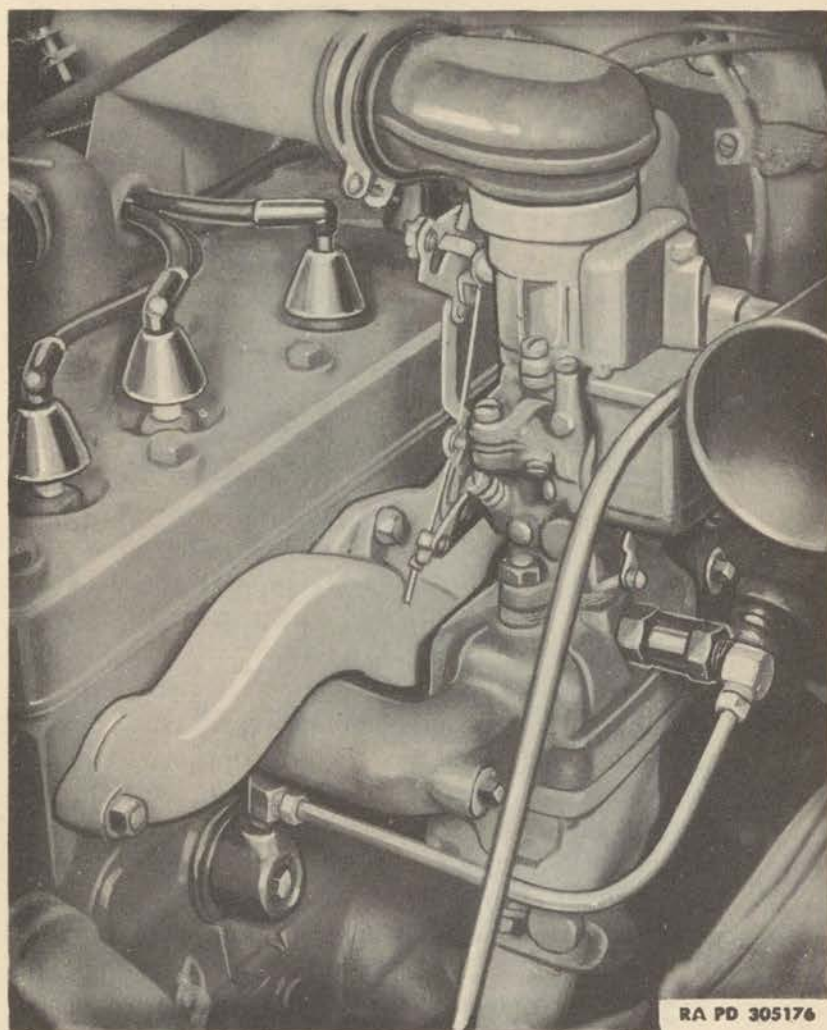
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- | | | | |
|---|-----------------------------------|----|---|
| A | DISTRIBUTOR OILER | O | OIL PUMP PINION |
| B | IGNITION DISTRIBUTOR | P | OIL RELIEF PLUNGER SPRING RETAINER |
| C | IGNITION COIL | Q | OIL RELIEF PLUNGER SPRING SHIMS |
| D | EXHAUST VALVE GUIDE | R | OIL RELIEF PLUNGER SPRING |
| E | INTAKE MANIFOLD | S | OIL RELIEF PLUNGER |
| F | VALVE SPRING COVER | T | OIL PUMP SHAFT AND ROTOR |
| G | HEAT CONTROL VALVE | U | OIL PAN |
| H | CRANKCASE VENTILATOR BAFFLE | V | OIL PAN DRAIN PLUG |
| I | EXHAUST MANIFOLD | W | OIL FLOAT SUPPORT |
| J | CRANKCASE VENTILATOR | X | CRANKSHAFT BEARING DOWEL |
| K | DISTRIBUTOR SHAFT FRICTION SPRING | Y | CRANKSHAFT BEARING CAP TO CRANKCASE SCREW |
| L | OIL PUMP DRIVEN GEAR | Z | OIL FLOAT |
| M | OIL PUMP ROTOR DISK | AB | OIL FILLER TUBE |
| N | OIL PUMP | AC | OIL FILLER CAP AND LEVEL INDICATOR |

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Figure 21—Sectional View of Engine

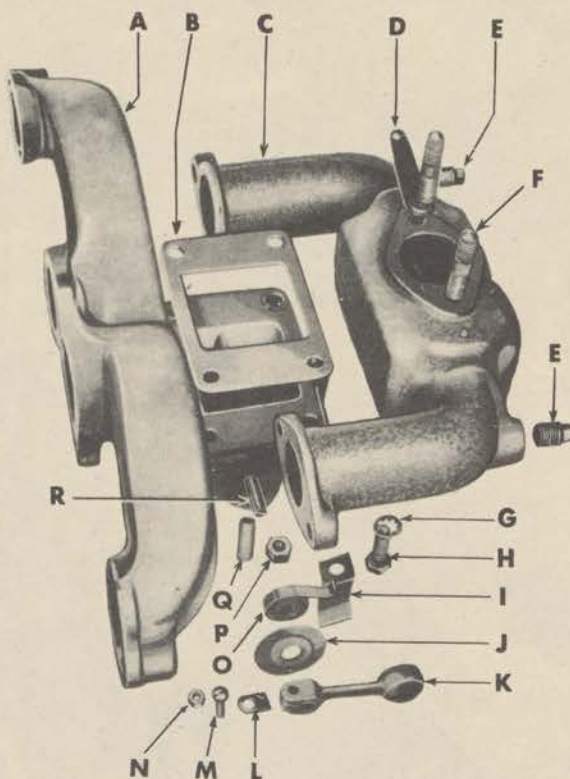
**ENGINE—DESCRIPTION, DATA, MAINTENANCE, AND
ADJUSTMENT IN VEHICLE****Figure 22—Manifolds**

(3) Test cylinder compression with gage. The gage must read more than 70 pounds, and the variation between cylinders remain less than 10 pounds. Normal compression is approximately 110 pounds per square inch at cranking speed. Report lack of compression to higher authority.

(4) Make sure that ground strap at engine left front support is in good condition and tight.

(5) Remove distributor cap and rotor. Check for cracks and leaks. Clean or replace breaker points and adjust (par. 64).

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- A EXHAUST MANIFOLD
- B INTAKE TO EXHAUST MANIFOLD GASKET
- C INTAKE MANIFOLD
- D ACCELERATOR SPRING CLIP
- E INTAKE MANIFOLD PLUG
- F INTAKE MANIFOLD TO CARBURETOR STUD
- G INTAKE TO EXHAUST MANIFOLD SCREW LOCKWASHER
- H INTAKE TO EXHAUST MANIFOLD SCREW
- I HEAT CONTROL VALVE BI-METAL SPRING STOP
- J HEAT CONTROL VALVE BI-METAL SPRING WASHER
- K HEAT CONTROL VALVE COUNTERWEIGHT LEVER
- L HEAT CONTROL VALVE LEVER KEY
- M HEAT CONTROL VALVE LEVER CLAMP SCREW
- N HEAT CONTROL VALVE LEVER CLAMP SCREW NUT
- O HEAT CONTROL VALVE BI-METAL SPRING
- P EXHAUST PIPE TO EXHAUST MANIFOLD STUD NUT
- Q EXHAUST PIPE TO EXHAUST MANIFOLD STUD
- R HEAT CONTROL VALVE SHAFT

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Figure 23—Manifolds, Disassembled

**ENGINE—DESCRIPTION, DATA, MAINTENANCE, AND
ADJUSTMENT IN VEHICLE**

- (6) Check ignition timing (par. 65).
- (7) Check valve tappet clearance (par. 56).
- (8) Install spark plugs, assemble distributor, start engine, and allow to run until normal temperature is reached; then set throttle valve stop screw so that engine will idle at 600 revolutions per minute (vehicle speed 8 mph).
- (9) Adjust idle adjustment screw until engine idles smoothly. If carburetor float level, accelerating pump, or metering rod require adjustment, report to higher authority.

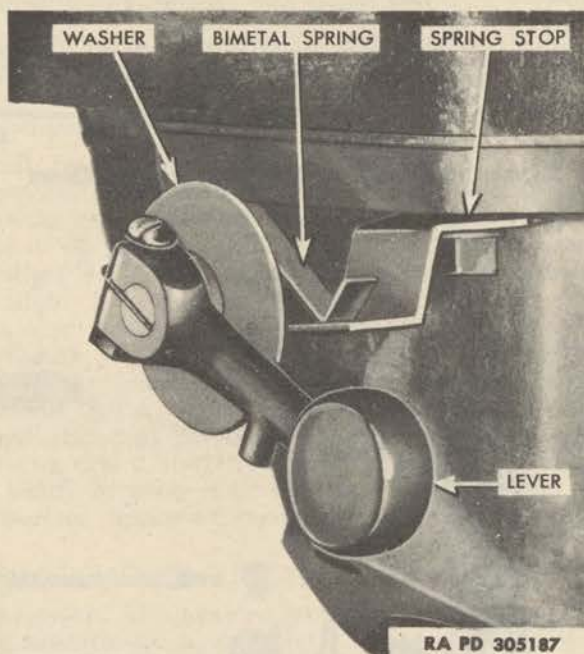


Figure 24—Heat Control Valve

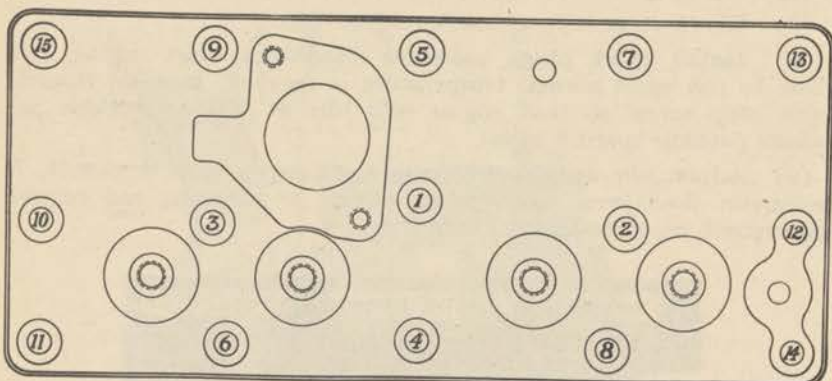
- (10) Tighten cylinder head screws and nuts, using torque wrench (par. 54).
- (11) Check operation of manifold heat control (par. 53).

52. INTAKE AND EXHAUST MANIFOLDS.

a. **Description.** The intake and exhaust manifolds (figs. 22 and 23) are attached to each other with four screws, making a unit in which a heat control valve is used to regulate the intake manifold temperature (par. 53).

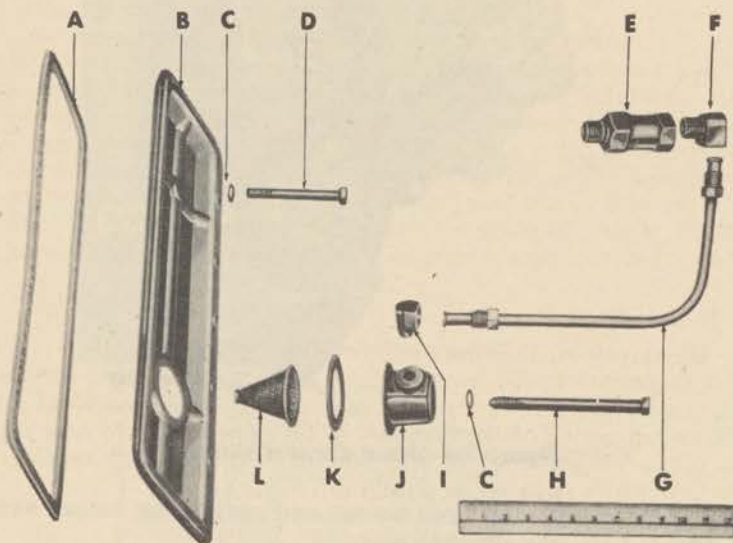
b. **Remove Intake and Exhaust Manifolds.** Remove carburetor air horn at top of carburetor, and disconnect hand throttle, choke,

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Figure 25—Cylinder Head Tightening Chart



- | | | | |
|---|----------------------------------|---|----------------------------------|
| A | VALVE SPRING COVER GASKET | G | CRANKCASE VENTILATOR TUBE |
| B | VALVE SPRING COVER | H | VALVE SPRING COVER SCREW—FRONT |
| C | VALVE SPRING COVER SCREW GASKET | I | CRANKCASE VENTILATOR BODY ELBOW |
| D | VALVE SPRING COVER SCREW—REAR | J | CRANKCASE VENTILATOR BODY |
| E | CRANKCASE VENTILATOR VALVE | K | CRANKCASE VENTILATOR BODY GASKET |
| F | CRANKCASE VENTILATOR VALVE ELBOW | L | CRANKCASE VENTILATOR BAFFLE |

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Figure 26—Valve Spring Cover, Disassembled

ENGINE—DESCRIPTION, DATA, MAINTENANCE, AND ADJUSTMENT IN VEHICLE

and accelerator at carburetor. Loosen fuel line at fuel pump, and disconnect at carburetor. Remove two nuts attaching carburetor to intake manifold, and remove carburetor with accelerator spring clip. Loosen the valve spring cover front screw to relieve any pull on crankcase ventilator tube, and then remove the tube. Disconnect exhaust pipe at the manifold. Remove all nuts and washers from manifold studs in cylinder block, remove manifolds as an assembly, and remove ventilator valve.

c. **Separate Intake Manifold from Exhaust Manifold.** Remove four screws holding intake and exhaust manifolds together, and remove intake to exhaust manifold gasket.

d. **Assemble Intake Manifold to Exhaust Manifold.** Attach intake manifold to exhaust manifold loosely, using a new gasket. Tighten screws only slightly until manifolds are installed on cylinder block. Install ventilator valve.

e. **Install Intake and Exhaust Manifolds.** Clean contact surfaces of manifolds and cylinder block. Place new gasket on studs in cylinder block, and install manifold. Install washers and nuts with convex side of washers against manifolds, and tighten evenly (torque wrench reading 31 to 35 ft-lb). Tighten the four screws attaching intake manifold to exhaust manifold. Attach exhaust pipe to manifold, using new gasket, and tighten in place with nut and screw. Install ventilator tube, and tighten valve spring cover front screw. Install carburetor, accelerator clip, and spring. Attach fuel line at carburetor, and tighten at fuel pump. Connect accelerator rod, hand throttle, and choke at carburetor. Push controls in on instrument panel (throttle closed and choke fully open). Install carburetor air horn and secure in place. Operate fuel pump priming lever to put fuel in carburetor, then start engine, and check for leaky gaskets.

53. MANIFOLD HEAT CONTROL VALVE.

a. **Description.** The heat control valve (figs. 23 and 24) is controlled thermostatically by a bimetal spring. This valve diverts exhaust gases around the central portion of the intake manifold during the warm-up period of the engine. *NOTE: The manifold heat control valve is an integral part of the exhaust manifold. For replacement follow procedure outlined in paragraph 52.*

54. CYLINDER HEAD GASKET.

a. **Removal.** Drain the cooling system by opening the drain cock under the radiator at the left front. If there is antifreeze in the cooling system, drain into a pan so it can be used again. Disconnect spark plug wires at the plugs, and remove distributor cap from distributor. Remove two nuts on cylinder studs holding air cleaner tube bracket, and remove bracket with wires and distributor cap. Remove radiator upper tube with hoses attached. Disconnect oil filter upper tube, remove two nuts holding filter to engine, and remove filter. Remove all cylinder head screws and nuts. Remove cylinder head and bond-

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ing strap, taking care not to damage oil filler tube, and discard gasket.

b. Installation. Clean cylinder head, tops of pistons, and cylinder block thoroughly. Place cylinder head gasket in position on cylinder block. *NOTE: The front and rear center studs are pilot studs to correctly position the gasket.* Install cylinder head. **CAUTION: Do not damage oil filler pipe.** Install rear bonding strap, oil filter, and air cleaner tube bracket. Install cylinder head bolts and nuts. Tighten cylinder screws and nuts evenly and in sequence (fig. 25), using a

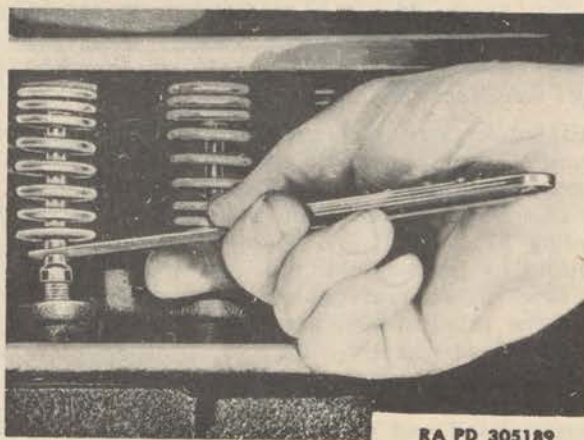


Figure 27—Valve Tappet Adjustment

torque-type wrench (screws, 65 to 70 ft-lb; nuts, 60 to 65 ft-lb). Connect oil filter tube, install distributor cap, and attach spark plug wires to correct plugs. Install radiator upper tube, tighten hose clamps, and close radiator drain cock. Fill the cooling system, giving due attention to antifreeze, if required (par. 7). Start engine, and check cooling system for leaks. See that cooling solution level has not gone down; replenish if necessary.

55. VALVE COVER GASKET.

a. Removal. Remove front valve spring cover bolt (fig. 26). Remove crankcase ventilator tube at ventilator valve, and remove tube and cap. Remove rear valve spring cover bolt, and slide valve spring cover forward, up, and out over the fuel pump. Discard gasket.

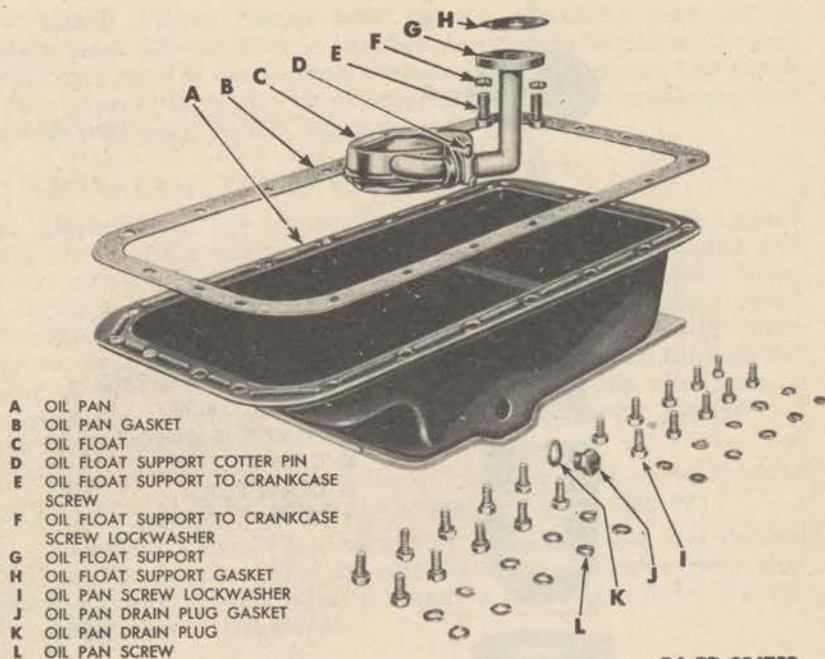
b. Installation. Clean cover and gasket seat on cylinder block. Cement cork gasket to cover. Position cover on cylinder block by sliding it to the rear over fuel pump. Install cover rear screw and copper gasket, but do not tighten. Install cover front screw and copper

ENGINE—DESCRIPTION, DATA, MAINTENANCE, AND ADJUSTMENT IN VEHICLE

gasket, with ventilator cap, baffle, and gasket. Connect ventilator tube to valve, and tighten both cover screws evenly. Start engine and check for oil leaks.

56. VALVE TAPPET ADJUSTMENT.

a. **Adjustment.** Remove the valve spring cover (par. 55). Adjust the self-locking tappet screws while they are cold (or warm) to 0.014 inch (fig. 27). Set tappet screws, starting with No. 1 cylinder on compression stroke at top center, then adjust valves in cylinder firing order (par. 62 b), turning the crankshaft one-half turn for each cylinder. **NOTE:** *The valve tappets will then be on the heel of the cam.* After adjusting, replace valve spring cover (par. 55).



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Figure 28—Floating Oil Intake and Oil Pan

57. OIL PAN GASKET.

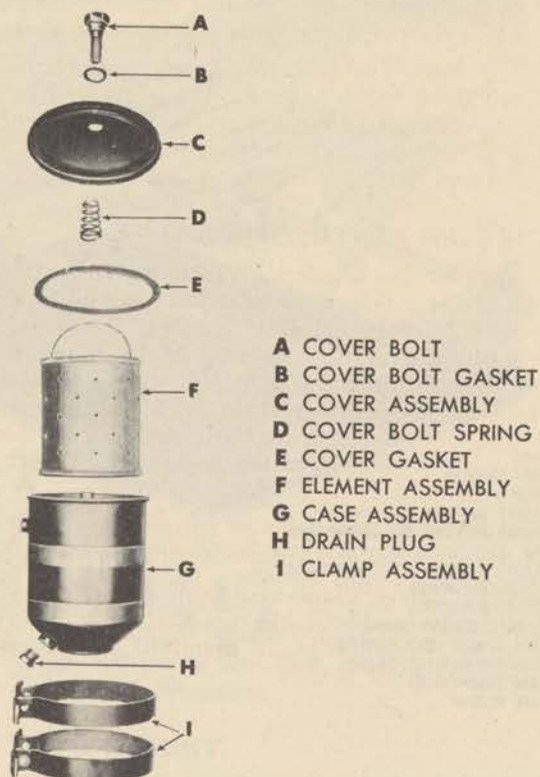
a. **Removal.** Drain oil by removing drain plug in lower left side of oil pan (fig. 28). Remove oil pan screws, exercising care not to lose spacers under fan belt guard. Remove oil pan, then remove gasket.

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b. Installation. First clean oil pan thoroughly. Check condition of floating oil intake screen and if dirty, clean in dry-cleaning solution. Clean face of oil pan and crankcase where gasket is installed, and cement gasket to oil pan. Put oil pan in position, and install screws. Be sure that spacers under belt guard are in position, and tighten all screws evenly. Torque wrench reading must be 10 to 14 foot-pounds.

58. OIL FILTER.

a. Description. The oil filter is the military standard type located on the right front side of the engine (fig. 36). Part of the oil circulated through the oiling system is sent through the filter. The filter-



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Figure 29—Oil Filter, Disassembled

ing element is a cylindrical replaceable unit which should be changed each 6,000 miles, more often if the oil gets dirty quickly. The inlet line at the top of the filter connects to the oil distribution line at the

ENGINE—DESCRIPTION, DATA, MAINTENANCE, AND ADJUSTMENT IN VEHICLE

plug in the left front side of the engine. The outlet or oil return line connects to the timing chain cover.

b. Remove Element. Unscrew cover bolt in top of unit and remove cover, exercising care not to damage gasket (fig. 29). Remove drain plug in lower side of filter to drain filter, then lift out element.

c. Installing Element. Clean filter thoroughly. Install drain plug, and put new element in filter. Inspect cover gasket, and replace if necessary. Install cover and tighten in place with cover bolt. Start engine, and check filter for oil leaks. Add enough oil to crankcase to bring level up to "FULL" mark on gage.

d. Remove Filter. Drain filter by removing drain plug in lower side. Disconnect upper and lower tubes at filter. Remove four bolts holding filter in bracket, and remove filter. Remove tube fittings, using care not to distort them; then install drain plug.

e. Install Filter. Install tube fittings, exercising care not to damage them. Mount filter in bracket, and tighten in place. Connect tubes, being careful not to cross threads. Start the engine and check for oil leaks after which check engine oil level in crankcase and replenish supply to "FULL" mark on gage.

59. CRANKCASE VENTILATOR VALVE.

a. Description. The crankcase ventilator valve (fig. 22) is located at the center of the intake manifold. This valve is spring-loaded, and is operated by the intake manifold vacuum. The valve is closed when the engine is idling (manifold vacuum high). When the engine speed is increased the manifold vacuum is lowered, and the valve opens to allow clean air to be drawn from the air cleaner tube through the engine oil filler pipe to ventilate the crankcase. If this valve fails to seat properly, an engine operating condition will occur similar to a leaky intake manifold.

b. Remove Valve. Loosen valve spring cover front screw. Remove ventilator tube at valve, and remove ventilator valve (fig. 22).

c. Installing Valve. Place ventilator valve in a vise and remove top. Clean the valve and seat. Be sure that spring operates freely, and reassemble valve. Install valve in manifold and attach tube. Tighten valve spring cover front screw.

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Section XIV

ENGINE—REMOVAL AND INSTALLATION

Removal	Paragraph 60
Installation	61

60. REMOVAL.

a. **Open Hood.** Unhook hood by pulling up catches at forward sides of hood. Raise hood and lay back against windshield. Hook or tie hood to windshield to avoid accidental closing.

b. **Drain Cooling System.** Open drain cocks at lower left-hand corner of radiator, and at right-front lower corner of cylinder block.

c. **Remove Battery.** Disconnect battery cables. Remove two wing nuts and washers from hold-down bolts. Remove battery hold-down frame, and lift out battery.

d. **Remove Radiator.** Remove upper and lower radiator hoses. Remove radiator stay rod nuts and remove rod. Remove two radiator stud nuts on bottom of radiator, and lift off radiator. Do not lose radiator pads.

e. **Remove Air Cleaner.** Disconnect air cleaner flexible hose at cleaner. Loosen wing nuts on side toward engine. Remove nuts on the opposite side, and remove cleaner. **CAUTION:** *Do not tip and spill oil from reservoir.*

f. **Remove Cranking Motor.** Disconnect cranking motor wires. Remove two bolts in engine rear plate, and one screw in side of crankcase. Remove motor.

g. **On Right Side of Vehicle.** Disconnect wires on generator. Disconnect ignition switch wire at ignition coil. Loosen fuel tank cap to relieve any pressure, and disconnect fuel line at flexible connection on right side of engine. Unscrew heat indicator unit from cylinder head. Remove two bolts holding engine front support insulator to frame, and disconnect bond strap.

h. **On Left Side of Vehicle.** Remove horn from bracket by removing two screws. Remove rear center cylinder head stud nut, and detach bond strap. Disconnect throttle and choke controls at carburetor. Remove fuel line (fuel pump to carburetor). Disconnect oil gage line at upper end of flexible tube on front of dash. Disconnect accelerator rod at lower end of bell crank on back of engine. Remove one bolt and one screw to separate exhaust pipe from manifold. Remove two engine front support bolts in frame, and disconnect engine ground strap from frame.

i. **Disconnect Bell Housing.** Remove bell housing upper bolts. Wrap a rope or cable around front and rear end of engine, attach chain hoist, and pick up weight of engine. Underneath vehicle, remove

ENGINE—REMOVAL AND INSTALLATION

the remaining bell housing bolts, and disconnect engine stay cable at the frame crossmember. Drive out two bell housing bolts at side of engine. Raise engine and guide out of frame.

61. INSTALLATION.

a. Installing Engine. Wrap rope or cable around front and rear end of engine, and attach chain hoist. Raise engine and lower into position. Insert transmission shaft in clutch driven plate hub, and work engine back into place. Install dowel bolts from engine side. Install bell housing bolts and tighten. Install engine front support insulator bolts in frame. Attach engine ground strap at left support and bond strap at right support. Install engine stay cable. Run rear adjusting nut up to the bracket, then with cable just taut, tighten lock nut on the front side of bracket.

b. On Right Side of Vehicle. Install cranking motor and attach wires. Attach ignition coil wire. Install heat indicator unit in cylinder head. Attach generator wires and ground strap. Connect flexible fuel line. Check air cleaner oil in reservoir, and install cleaner on dash with wing nuts. Tighten air flexible connection. Install battery, and secure in place with hold-down frame and wing nuts. Clean cable connections, grease, and attach to battery posts.

c. On Left Side of Vehicle. Install accelerator rod with cotter pin. Connect oil gage tube. Attach exhaust pipe to manifold with bolt and screw. Gasket must be in good condition. Install bond strap on cylinder head rear stud, and tighten nut to from 60 to 65 foot-pounds. Install carburetor choke and throttle wires. *NOTE: Controls on instrument panel must be all the way in, the throttle in the carburetor in the closed position, and the choke fully open.* Install fuel line between pump and carburetor. Attach horn to bracket.

d. Installing Radiator. See that radiator pads are in place, and install radiator on frame. Install upper and lower radiator hoses. Install radiator stay rod. Fill radiator, giving due attention to anti-freeze, if required.

e. Inspection. Tighten fuel tank cap. Check engine oil (par. 18 c). Start engine, check for leaks, tune-up, and finally check level of solution in radiator. Close hood and hook properly.

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Section XV

IGNITION SYSTEM

	Paragraph
Description and data	62
Maintenance	63
Distributor	64
Ignition timing	65
Coil	66
Spark plugs	67
Ignition switch	68
Ignition wiring	69

62. DESCRIPTION AND DATA.

a. Description. The ignition system (fig. 30) is a 6-volt system and consists of the spark plugs, high- and low-tension ignition wires,

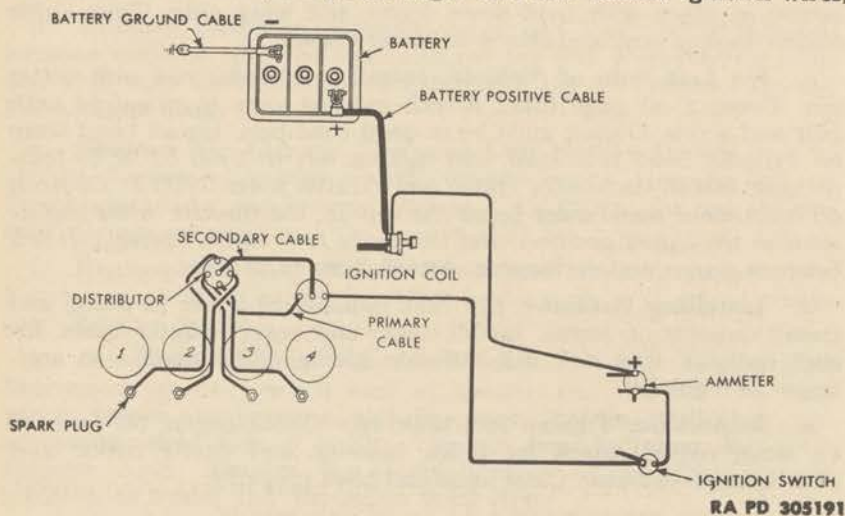


Figure 30—Ignition System Circuit

distributor, coil, and an ignition switch through which it is connected to the electrical system of the vehicle. There are two separate circuits in the ignition system (primary and secondary) which combine to develop the high-voltage current necessary to make a spark jump the plug gaps in the engine combustion chambers, and ignite the fuel mixture. In operation, with the ignition switch turned on, and the distributor points closed, current flows through the primary winding of the ignition coil and builds up a strong magnetic field. When the distributor points open, the magnetic field collapses and induces a high-voltage current in the secondary winding of the coil. This

IGNITION SYSTEM

happens each time the points open. This high-voltage current is delivered to the spark plugs at the correct time by the distributor rotor, cap, and secondary wires. To prevent burning of the distributor points by current arcing across the open points, a condenser is connected across the points (in parallel). This provides a place (capacity) for current to go until the points open enough to prevent arcing. Discharge of this condenser current back through the primary winding of the coil causes the magnetic field to collapse much faster in developing the high-voltage current for the spark plugs.

b. Data.**Distributor**

Make and model	Auto-Lite IAD-4008
Type advance	Centrifugal
Rotation	Counterclockwise
Firing order	1-3-4-2
Point gap	0.020 in.
Breaker arm spring tension.....	17 to 20 oz
Condenser capacity	0.18 to 0.26 mfd

Ignition coil

Make and model	Auto-Lite IG-4070L
Voltage	6-8
Draw (engine stopped)	5 amps at 6.4 volts
Draw (engine idling)	2.5 amps

Spark plugs

Make and model	Auto-Lite AN-7
Thread size	14-mm
Gap	0.030 in.

Ignition switch

Make and model	Douglas No. 6282
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Ignition wires

Primary (gage)	No. 14
Secondary (gage)	No. 16

c. Tests. The following procedure will assist in localizing trouble in the ignition system without the use of instruments:

(1) First check the brilliancy of the headlights and operate cranking motor, to judge the condition of the battery and connections as far as the ammeter.

(2) Remove an ignition wire at a spark plug and hold about three-eighths inch away from a bare metal part of the engine. A good spark should result when the cranking motor is operated with the ignition switch on. If spark is weak or absent, proceed as follows:

(3) Pull coil wire out of center of distributor cap; remove cap and crank engine until distributor points are fully closed. Turn on ignition switch, hold cap end of coil secondary wire about three-eighths inch away from cylinder block, and open breaker points with

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the fingers, or rock the distributor cam. If a good spark occurs, fault is located in distributor cap, rotor, or wires; inspect cap and rotor for cracks or carbon runners and ignition wires for short circuits. To test distributor cap place wire back in cap and operate cranking motor. Short circuit will be evidenced by a spark within or outside the cap. To check rotor, remove from distributor; put end of coil secondary wire in rotor, and hold top against cylinder block; operate distributor points (spark will show where "short" occurs). If no spark occurs in preceding test, proceed as follows:

(4) Open distributor points and notice if a slight spark is obtained. If spark occurs, current is reaching points. If no spark occurs, detach condenser, and repeat above operation. If spark is obtained, condenser is at fault, and must be replaced. If no spark is obtained, determine if coil primary wires are faulty, as follows:

(5) Remove switch wire at ignition coil, and strike wire terminal against cylinder block. If no spark is obtained, check wiring up to ammeter for loose connection or open circuit. If spark is obtained, current is reaching coil, and this indicates coil is faulty. Replace coil.

63. MAINTENANCE.

a. The distributor requires periodic lubrication at various points (par. 18). Keep coil and distributor wires pushed down in towers. Keep distributor cap and spark plug porcelains free from dirt and grease. All wire terminals must be clean and tight. Replace any wires that are frayed or have cracked insulation. Clean and adjust spark plugs and distributor points (par. 67).

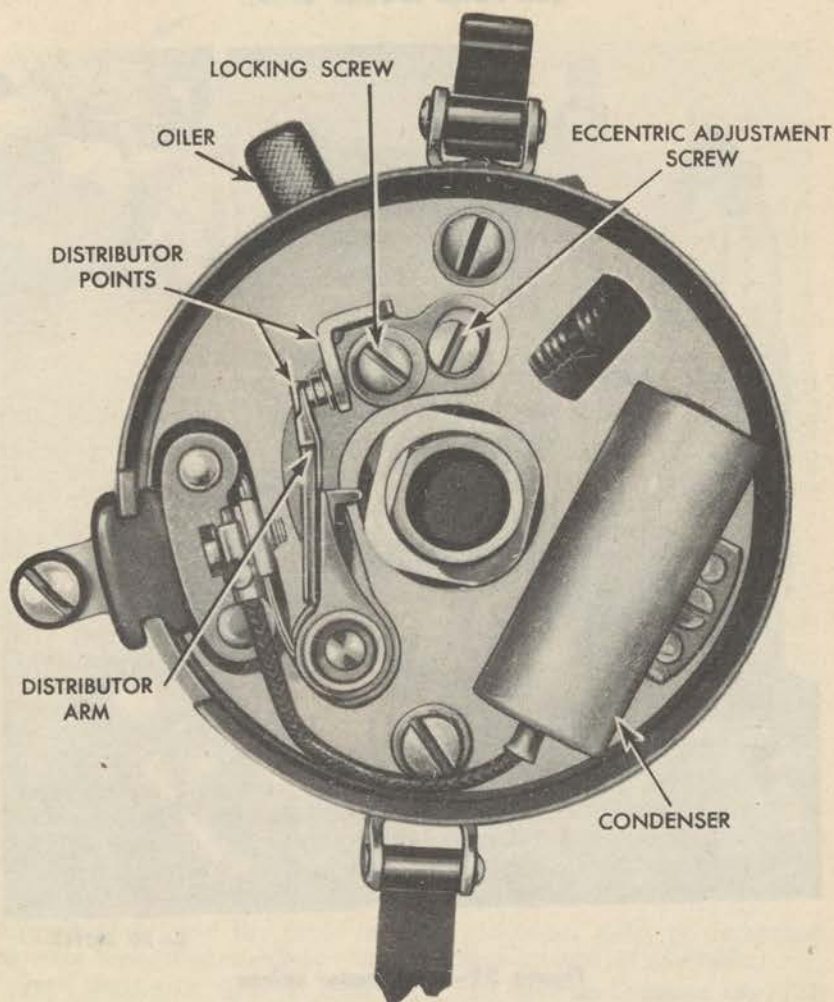
64. DISTRIBUTOR.

a. **Description.** The distributor (fig. 32) is mounted on the right side of the engine. A full automatic spark advance is mechanically governed by two counterweights which advance the spark as the engine speed increases. The distributor is driven by a shaft extending into the oil pump driven gear, which is driven by a gear on the camshaft. The lower end of the distributor shaft has an offset tongue which must be in correct relation to the oil pump shaft before the two can be assembled. A friction spring on the distributor shaft (fig. 21) engages in the oil pump gear to prevent backlash at this point, and uneven engine performance.

b. **Removal.** After raising hood, remove wires from distributor cap and primary wire from terminal on side of distributor. Remove screw holding advance arm to crankcase, and pull out distributor assembly.

c. **Installation.** Remove distributor cap. Insert distributor in crankcase, pushing it down into place, turn rotor until offset tongue on lower end of distributor shaft fits into oil pump shaft, then push farther down into position. Some resistance will be experienced, caused by friction of the spring on the lower end of the distributor shaft fitting into the oil pump gear (fig. 21). Install screw in advance arm loosely. Attach primary wire to distributor. Set timing (par. 65). Install distributor cap and wires (fig. 32).

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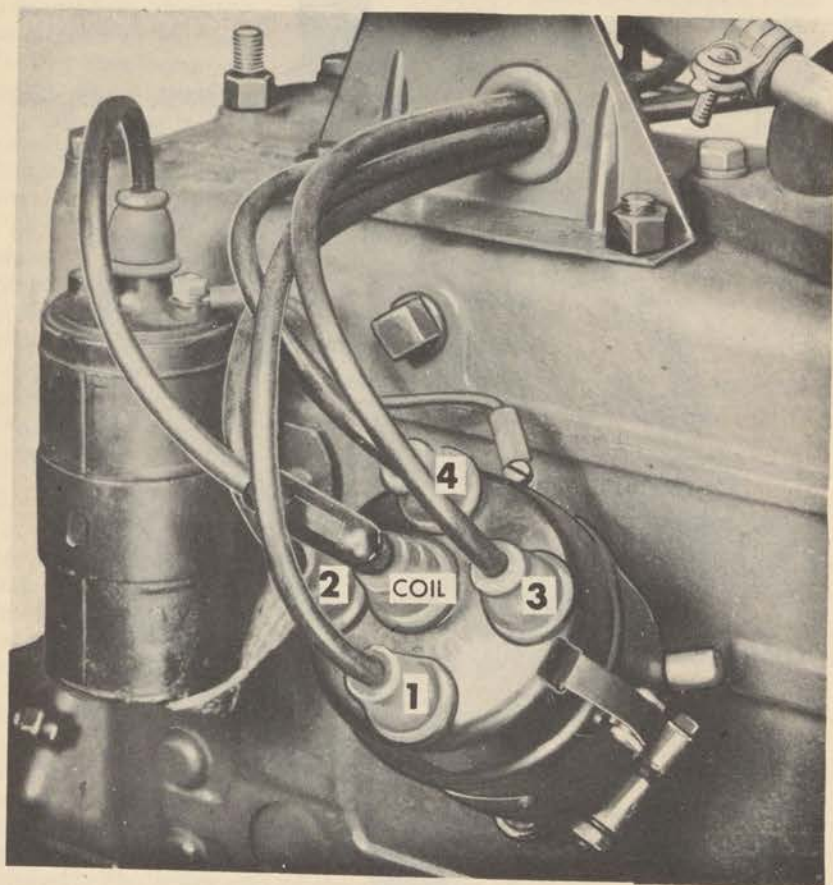
RA PD 305194

Figure 31—Distributor Points and Condenser

d. Distributor Points.

(1) **ADJUSTMENT.** Slip off the two clips holding the distributor cap in place and remove cap. Lift off rotor. Crank engine until point arm rubbing block is on top of a cam. Loosen lock screw (fig. 31), and turn eccentric screw until point gap is 0.020 inch measured with a thickness gage. Tighten lock screw and recheck gap. Install rotor and cap. Push wires well down into cap.

(2) **REMOVAL.** Slip off the two clips holding the distributor cap in place and lift off cap, then remove rotor (fig. 31). Using a small screwdriver, unscrew condenser lead which will release breaker arm

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Figure 32—Distributor Wires

spring, then lift off breaker arm. Remove screw in stationary breaker point, and lift out point.

(3) **INSTALLATION.** Place stationary breaker point in distributor, and install locking screw loosely. Lightly lubricate breaker arm pivot pin, and install breaker arm. Place spring in position with condenser lead, insert screw, and tighten securely in place. Aline points if necessary. To adjust points refer to step (1) above.

e. Distributor Condenser.

(1) **DESCRIPTION.** The condenser is attached by one screw to the support plate in the distributor, and connected by a short flexible wire across the distributor points. The condenser functions to absorb momentarily any current which has a tendency to arc across the points when they open. The condenser must be firmly attached to the