TM 9-822

WAR DEPARTMENT TECHNI

2½-TON 4 x 2 DUMP TRUCK
(IHC K-7)

37-PASSENGER BUS
(IHC K-7 AND KS-7)

RESTRICTED DISSEMINATION OF RESTRICTED MATTER—
The information contained in restricted documents and the essential characteristics of restricted materiel may be given to any person known to be in the service of the United States, and to persons of undoubted loyalty and discretion who are cooperating in Government work, but will not be communicated to the public or to the press except by authorized military public relations agencies. (See also paragraph 23 b, AR 380-5, 15 March 1944.)

WAR DEPARTMENT • 7 NOVEMBER 1944

WAR DEPARTMENT TECHNICAL MANUAL

TM 9-822

This manual, together with TM 9-1822, supersedes TM 10-1115, 26 Jul 1941; TM 10-1141, 20 Aug 1941; TM 10-1173, 26 Jul 1941; TM 10-1345, 26 Jul 1941; TM 10-1511, 2 Mar 1942; TM 10-1561, 10 Jun 1942; and TM 10-1685, 14 May 1943. This manual supersedes the following publications insofar as they apply to this manual. These publications remain in force until such time as they are incorporated in other affected manuals or specifically rescinded: OFSTB 800-15, 14 Jul 1943; OFSTB 800-21, 30 Nov 1943; WDTB ORD 20, 24 Jan 1944; WDTB ORD 60, 13 Mar 1944; and WDTB ORD 126, 19 Jul 1944.

2½-TON 4 x 2 DUMP TRUCK

(IHC K-7)

37-PASSENGER BUS

(IHC K-7 AND KS-7)

WAR DEPARTMENT *7 NOVEMBER 1944*

RESTRICTED *DISSEMINATION OF RESTRICTED MATTER*— The information contained in restricted documents and the essenteal characteristics of restricted materiel may be given to any person known to be in the service of the United States, and to persons of undoubted loyalty and discretion who are cooperating in Government work, but will not be communicated to the public or to the press except by authorized military public relations agencies. (See also paragraph 23, AR 380-5, 15 March 1944.)

WAR DEPARTMENT

Washington 25, D. C., 7 November 1944

TM 9-822, 2½-ton 4 x 2 Dump Truck (IHC K-7) and 37-Passenger Bus (IHC K-7 and KS-7), is published for the information and guidance of all concerned.

[A. G. 300.7 (19 Jan 1944)]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

DISTRIBUTION: Armies (10); Corps (10); Sv C (10); Dept (10); D (2); Tech Sv (2); Arm & Sv Boards (2); P, C, and Stas (1); Gen & Sp Sv Schools (10); Ord Decentralized Sub-O (3); PE's "Mark for Ord O" (5); H & R Points (5); Ord Dist Off (5); Ord Reg Off (3); Ord Dist Br O (3); Ord Establishments (5).

Contents

PART ONE—GENERAL

PART TWO—OPERATING INSTRUCTIONS

PART THREE—MAINTENANCE INSTRUCTIONS

Contents—Cont'd

PART THREE—MAINTENANCE INSTRUCTIONS (Cont'd)

APPENDIX

RESTRICTED

This manual, together with TM 9-1822, supersedes TM 10-1115, 26 Jul 1941; TM 10-1141, 20 Aug 1941; TM 10-1173, 26 Jul 1941; TM 10-1345, 26 Jul 1941; TM 10-1511, 2 Mar 1942; TM 10-1561, 10 Jun 1942; and TM 10-1685, 14 May 1943. This manual supersedes the following publications insofar as they apply to this manual. These publications remain in force until such time as they are incorporated in other affected manuals or specifically rescinded: OFSTB 800-15, 14 Jul 1943; OFSTB 800-21 30 Nov 1943; WDTB ORD 20, 24 Jan 1944; WDTB ORD 60, 13 Mar 1944; and WDTB ORD 126, 19 Jul 1944.

PART ONE

GENERAL

Section I

Introduction

1. SCOPE.

a. These instructions* are published for the information and guidance of the personnel to whom this equipment is assigned. They contain information on the operation and maintenance of the International 2½-ton 4 x 2 Dump Truck and 2½-ton 4 x 2 Passenger Bus, as well as descriptions of the major units and their functions in relation to the other components of the vehicle.

b. This manual has the following arrangement:

(1) Part One, General, contains description and data. It lists the tools, spare parts, and equipment carried on the vehicle. It also lists organizational special tools for the vehicle.

(2) Part Two, Operating Instructions, contains instructions for the operation of the vehicle, with description and location of the controls and instruments.

(3) Part Three, Maintenance Instructions, contains information needed for the performance of the scheduled lubrication and preventive maintenance services, and instructions for maintenance operations which are the responsibility of the using organizations (first and second echelons).

(4) The Appendix contains instructions for shipment and limited storage, and a list of references including Standard Nomenclature Lists, Technical Manuals, and other publications applicable to the vehicles.

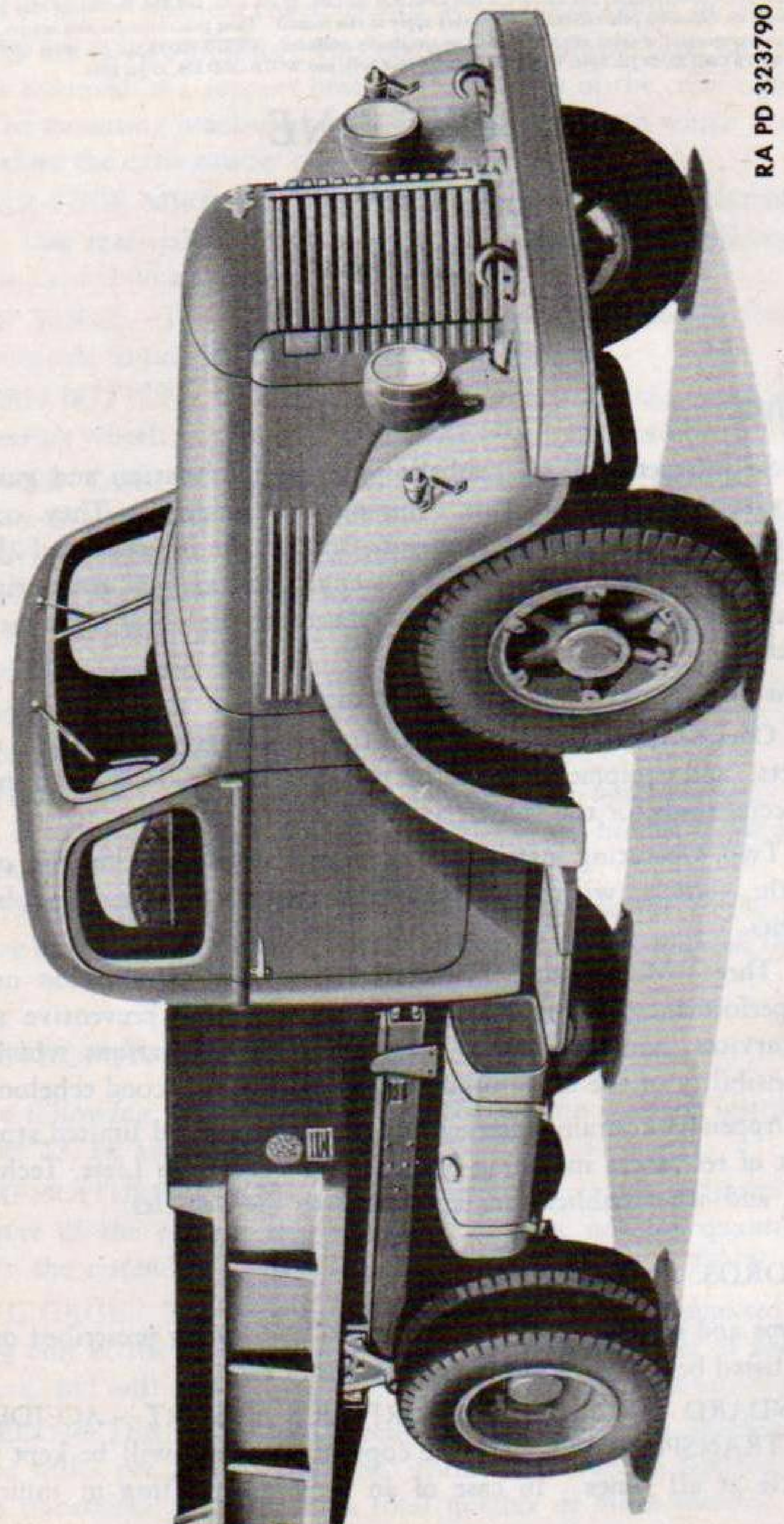
2. RECORDS.

a. Forms and records applicable for use in performing prescribed operations are listed below with brief explanations of each.

(1) STANDARD FORM NO. 26, DRIVER'S REPORT—ACCIDENT, MOTOR TRANSPORTATION. One copy of this form will be kept with the vehicle at all times. In case of an accident resulting in injury or

---

*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.



RA PD 323790

Figure 1 — 2½-Ton 4 x 2 Dump Truck (Galion Dump Body), Right Front View

property damage, it will be filled out by the driver on the spot, or as promptly as practical thereafter.

(2) WAR DEPARTMENT FORM NO. 48, DRIVER'S TRIP TICKET AND PREVENTIVE MAINTENANCE SERVICE RECORD. This form, properly executed, will be furnished to the driver when his vehicle is dispatched on nontactical missions. The driver and the official user of the vehicle will complete in detail appropriate parts of this form. These forms need not be issued for vehicles in convoy or on tactical missions. The reverse side of this form contains the driver's daily and weekly preventive maintenance service reminder schedule.

(3) W.D., A.G.O. FORM NO. 478, MWO AND MAJOR UNIT ASSEMBLY REPLACEMENT RECORD. This form, carried with the vehicle, will be used by all personnel completing a modification or major unit assembly (engine, transmission, axle, etc.) replacement to record clearly the description of work completed, date, vehicle hours and/or mileage, and MWO number or nomenclature of unit assembly. Personnel performing the operation will initial in the column provided. Minor repairs, parts, and accessory replacements will not be recorded.

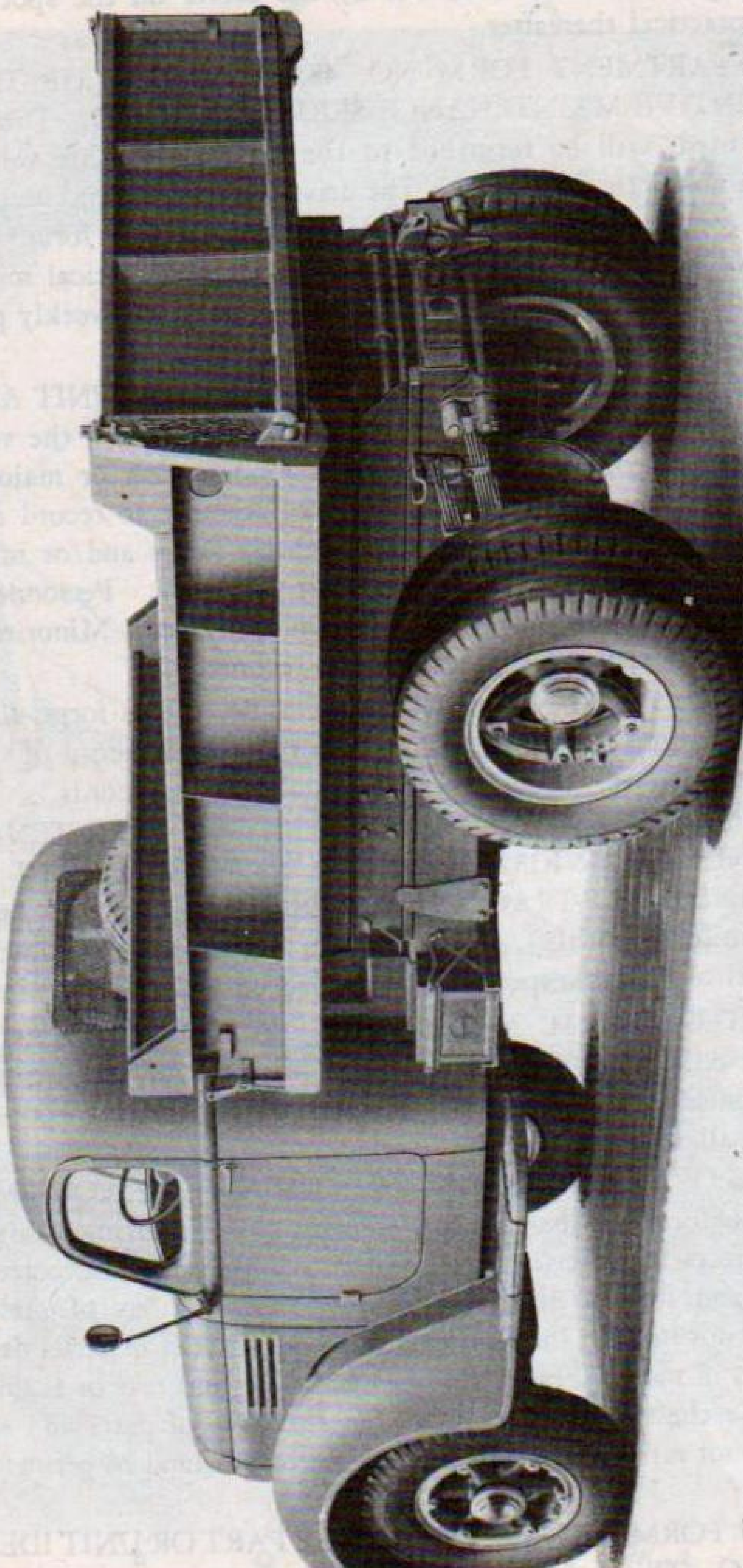
(4) W.D., A.G.O. FORM NO. 6, DUTY ROSTER. This form, slightly modified, will be used for scheduling and maintaining a record of vehicle maintenance operations. It may be used for lubrication records.

(5) W.D., A.G.O. FORM NO. 461, PREVENTIVE MAINTENANCE SERVICE AND TECHNICAL INSPECTION WORK SHEET FOR WHEELED AND HALF-TRACK VEHICLES. This form will be used for all 1,000-mile (monthly) and 6,000-mile (semiannual) maintenance services and all technical inspections performed on wheeled vehicles.

(6) W.D., A.G.O. FORM NO. 9-70, SPOT-CHECK INSPECTION REPORT FOR ALL MOTOR VEHICLES. This form may be used by all commanding officers or their staff representatives in making spot-check inspections on all vehicles.

(7) W.D., A.G.O. FORM NO. 468, UNSATISFACTORY EQUIPMENT REPORT. This form will be used for reporting manufacturing, design, or operational defects in materiel with a view to improving and correcting such defects, and for use in recommending modifications of materiel. This form will not be used for reporting failures, isolated materiel defects, or malfunctions of materiel resulting from fair wear and tear or accidental damage, nor for the replacement, repair, or the issue of parts and equipment. It does not replace currently authorized operational or performance records.

(8) W.D., O.O. FORM NO. 7370, EXCHANGE PART OR UNIT IDENTIFICATION TAG. This tag, properly executed, may be used when exchanging unserviceable items for like serviceable assemblies, parts, vehicles, and tools.



RA PD 323791

Figure 2 — 2½-Ton 4 x 2 Dump Truck (Galion Dump Body), Left Rear View

Section II

Vehicle Description and Data

3. VEHICLE DESCRIPTION.

a. General. Three vehicles are described in this manual.

(1) The 2½-ton 4 x 2 dump truck (IHC Model K-7) has a dump body with hoist. It has a wheelbase of 146 inches, and is a general service load carrier (figs. 1 to 4).

(2) The 2½-ton 4 x 2 bus (IHC Model K-7) has a bus body. It has a wheelbase of 230 inches, and is a passenger carrier. It is similar to the dump truck except for the differences (par. 4) in bodies and body controls and modifications due to the differences in length (figs. 5 and 6).

(3) The 2½-ton 4 x 2 bus (IHC Model KS-7) is identical with the Model K-7 bus except that it has a special two-speed-ratio rear axle (par. 13 *m*).

(4) Unless otherwise indicated in this manual, descriptions and maintenance instructions apply to all three vehicles.

b. Axles and Springs. The rear axle, of single-reduction type in the Model K-7 vehicles, and two-speed type in the Model KS-7 bus, is the drive axle. The front axle is of the I-beam type. Suspension of axles from the chassis frame is by semielliptic springs. The front springs are attached to the frame by shackles at the front end, and by brackets at the rear. The rear springs are attached to the frame by brackets at the front end, and by shackles at the rear. Auxiliary springs are mounted on the rear springs.

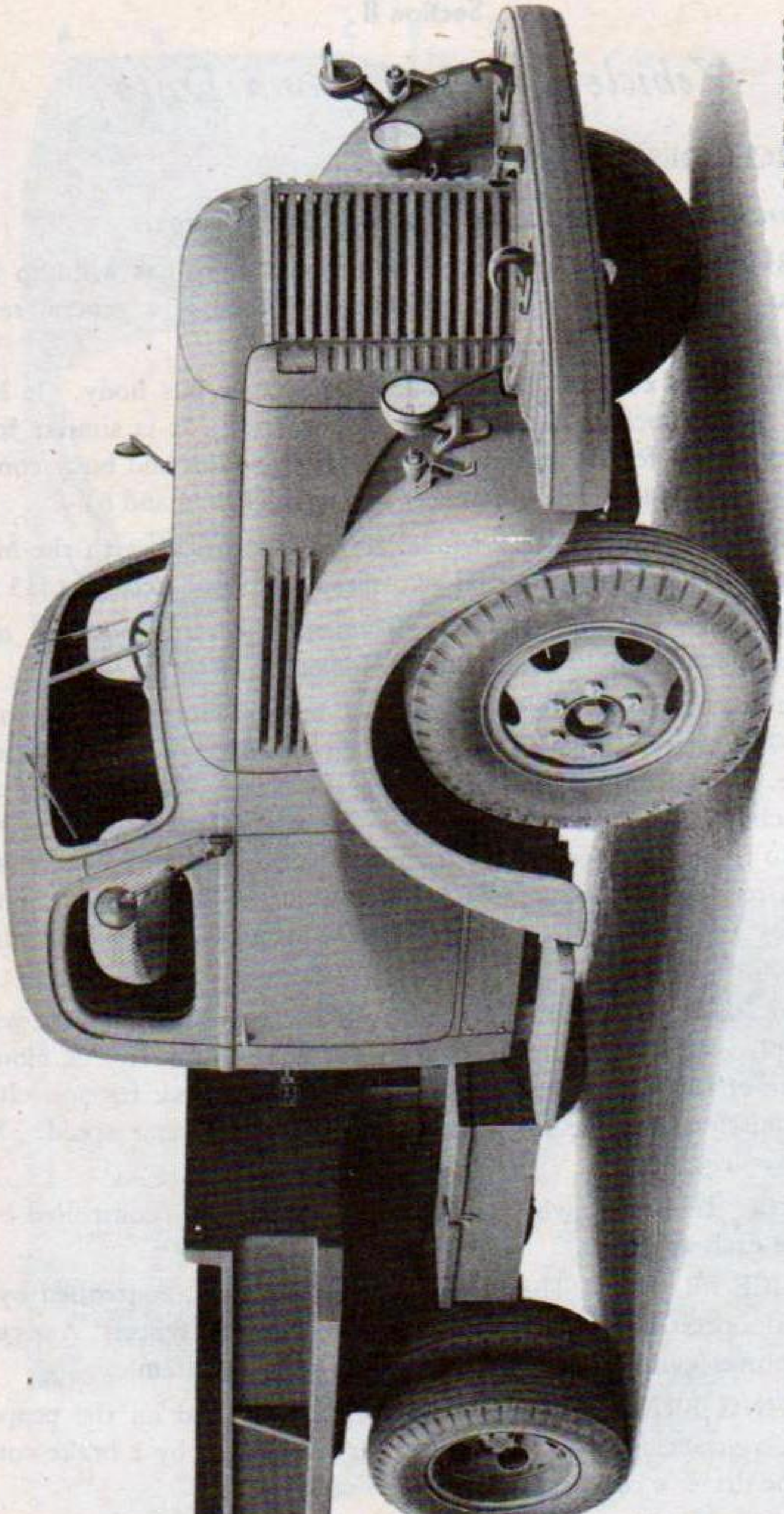
c. Power Plant. The engine is a six-cylinder, valve-in-head unit with a piston displacement of 269.10 cubic inches. The transmission is mounted at the rear of the engine and is driven by a single-disk friction clutch. The transmission has five forward speeds and one reverse speed. Fifth speed is overdrive.

d. Brakes. There are two separate and independently controlled brake systems on each vehicle.

(1) SERVICE BRAKES. The hydraulic service brakes, controlled by the brake pedal, operate two mechanical brake shoes at each wheel. A vacuum-operated power cylinder supplements the hydraulic system.

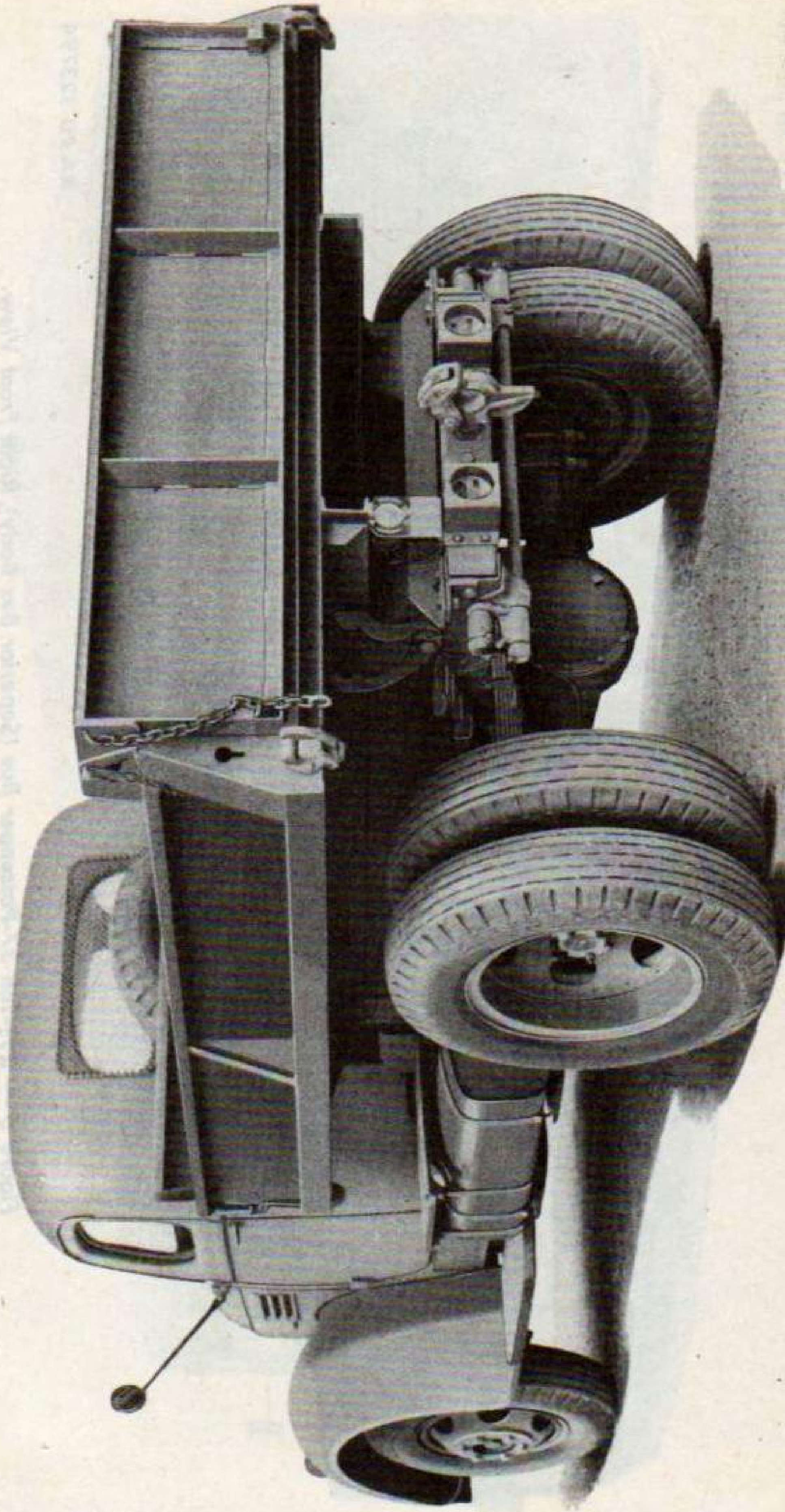
(2) PARKING BRAKE. The parking brake, mounted on the propeller shaft, is a contracting band-type brake. It is actuated by a brake control lever in the driver's compartment.

e. Cab (Dump Trucks). The two-man cab of the dump truck forms the driver's compartment. It is equipped with a windshield, full-length doors, and adjustable windows.



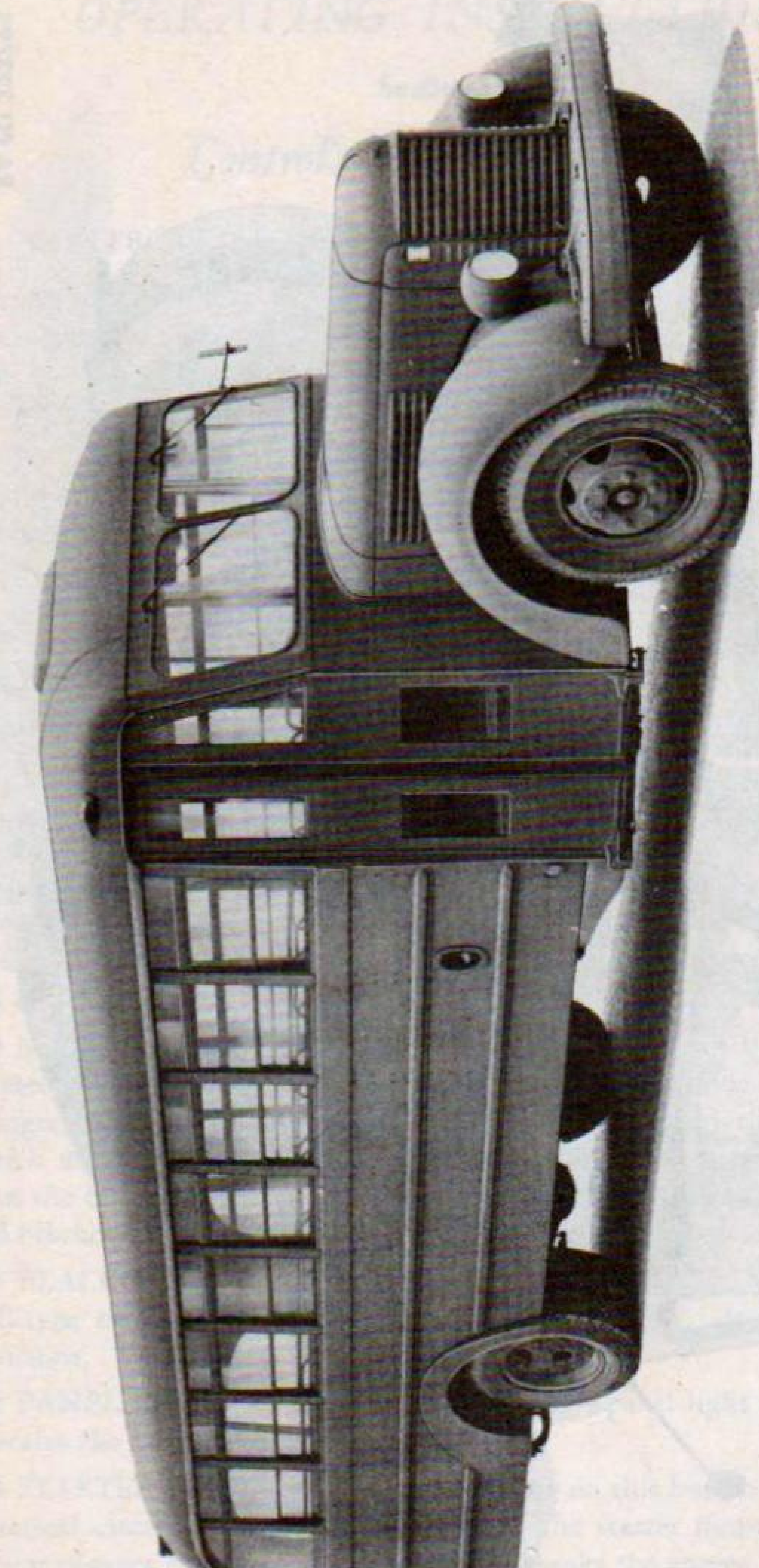
RA PD 323792

Figure 3 — 2½-Ton 4 x 2 Dump Truck (St. Paul Dump Body), Right Front View



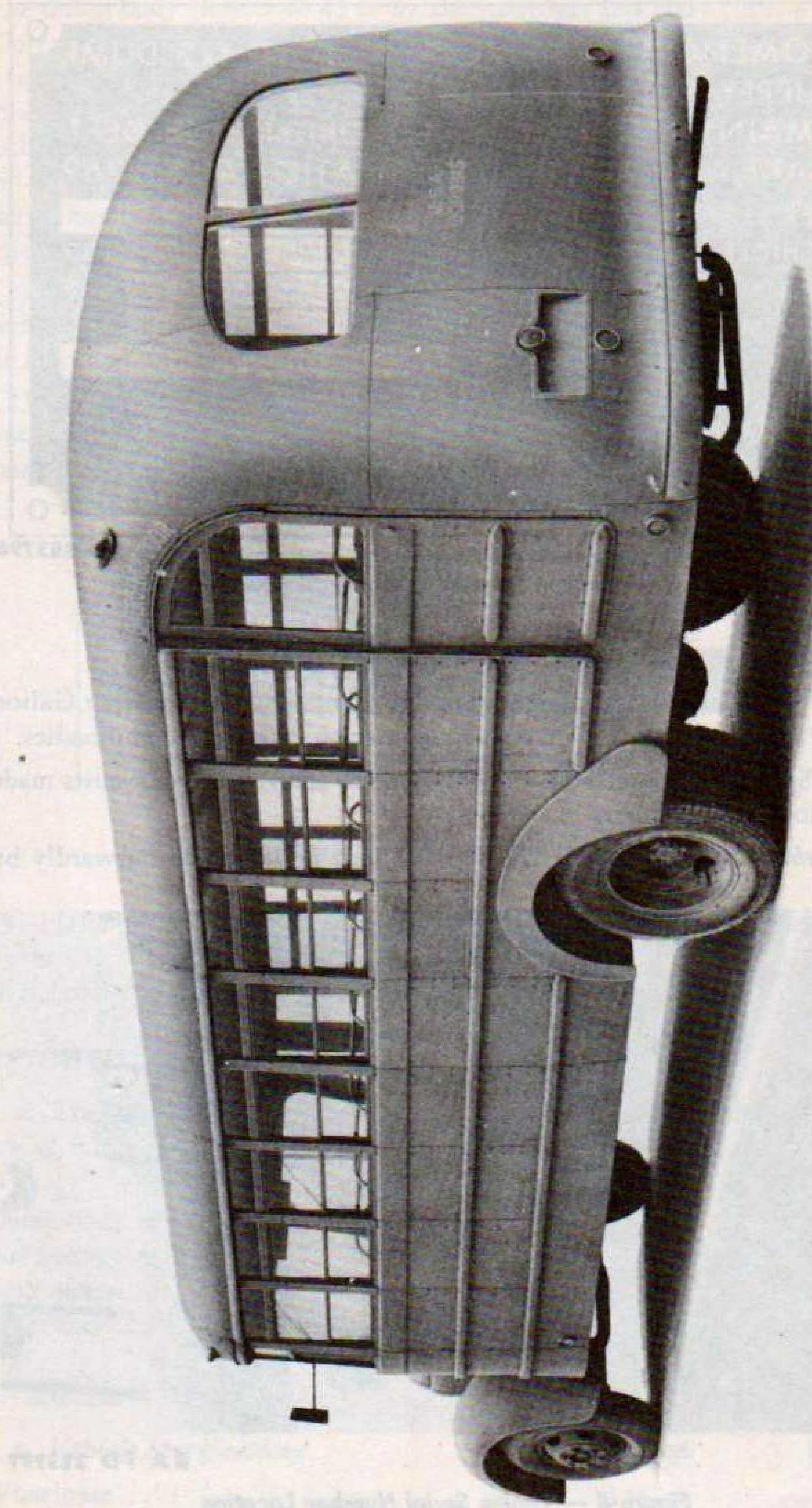
RA PD 323793

Figure 4 — 2½-Ton 4 x 2 Dump Truck (St. Paul Dump Body), Left Rear View



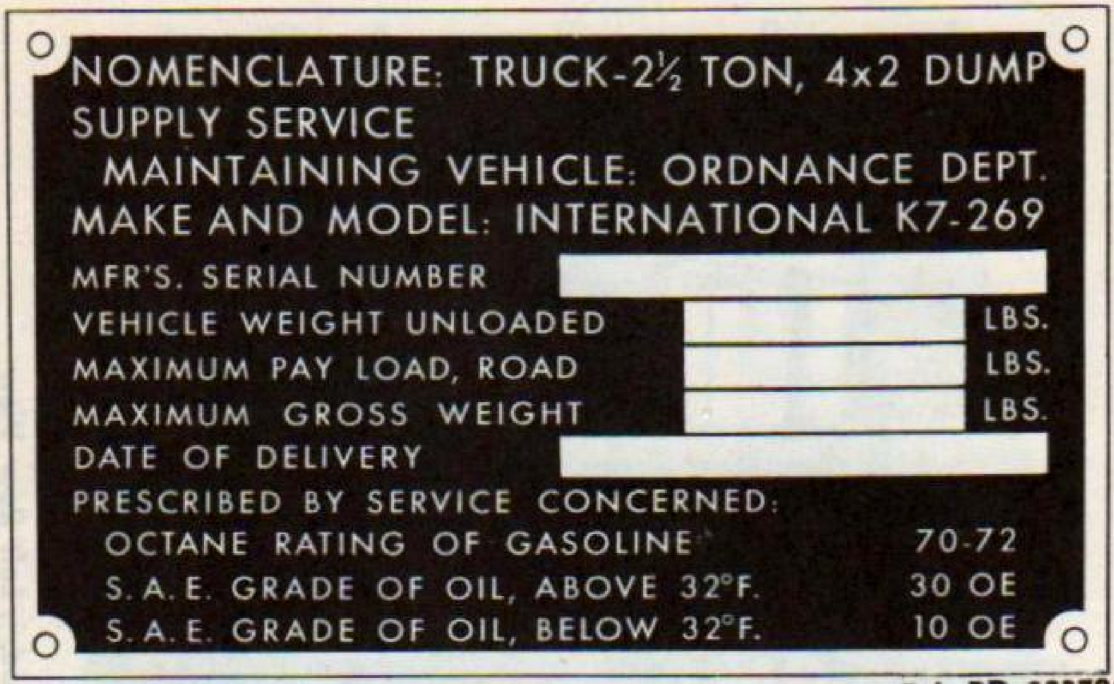
RA PD 323794

Figure 5 — 2½-Ton 37-Passenger Bus (Superior Bus Body), Right Front View



RA PD 323795

Figure 6 — 2½-Ton 37-Passenger Bus (Superior Bus Body), Left Rear View



RA PD 323796

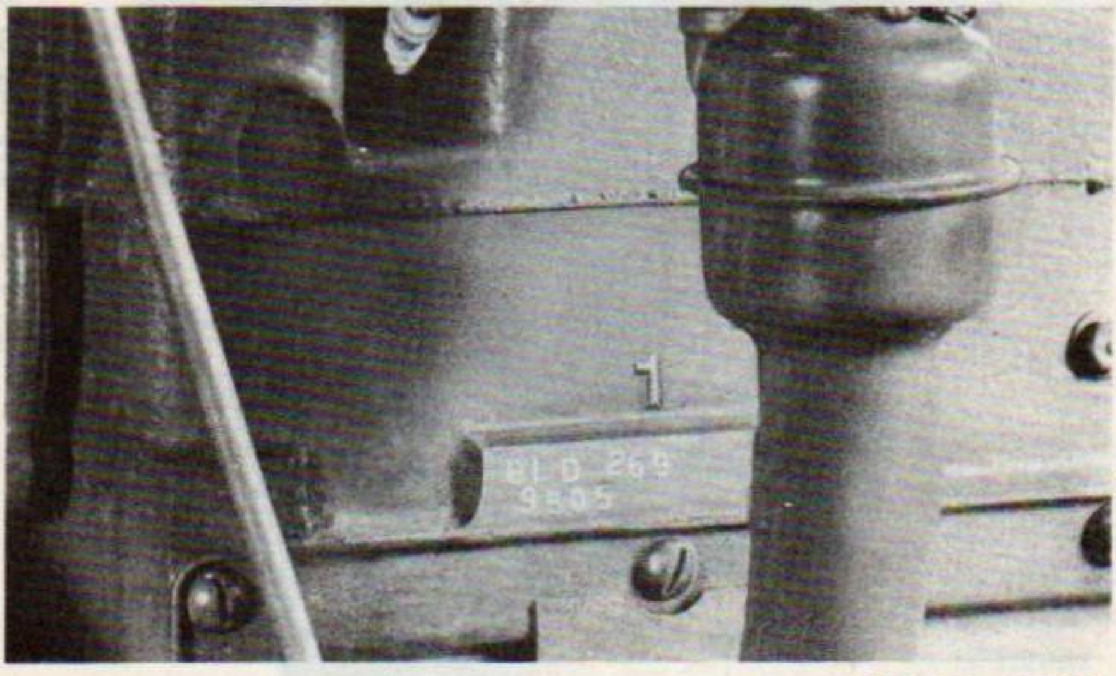
Figure 7 — Vehicle Nomenclature Plate (Dump Body)

f. Bodies.

(1) DUMP. The dump bodies used on the dump truck are of either Galion or St. Paul manufacture. They are combination cargo and dump bodies.

(2) BUS. The bus bodies on the bus vehicles are 37-passenger units made by various manufacturers.

g. Vehicle Identification. The vehicles may be identified outwardly by



RA PD 323797

Figure 8 — Engine Serial Number Location

the dump body (figs. 1 to 4) or by the passenger bus body (figs. 5 and 6). Correct identification of the various components of each vehicle is important for proper use of this manual. Identification can be made by checking plates, stamps, or tags which show model number, serial number, and other information applying to any unit. This identification is attached to, or stamped on, the various components. Vehicle serial number, engine serial number, and publications applying to the vehicle are determined by checking the following plates or stampings:

(1) VEHICLE NOMENCLATURE PLATE (fig. 7). This plate includes vehicle nomenclature, serial number, model, payload, and other data. It is located inside the driver's compartment on the cowl panel.

(2) ENGINE MODEL AND SERIAL NUMBER. This identification is stamped on a boss at the left front side of the engine just below the cylinder head (fig. 8).

RA PD 323798

Figure 9 — Publications Plate

(3) PUBLICATIONS PLATE (fig. 9). This plate gives the numbers of Technical Manuals and Parts List to use with the vehicle. It is located in the driver's compartment on the cowl panel.

4. DIFFERENCES BETWEEN MODELS.

a. The principal differences between the dump truck and bus models are as follows:

	Dump Truck	Bus (K-7)	Bus (KS-7)
Dump body and hoist	Yes	No	No
Bus body	No	Yes	Yes
Rear axle	Single-reduction	Single-reduction	Two-speed
Wheelbase	146 in.	230 in.	230 in.

5. DATA.

a. Vehicle Specifications.		Dump Truck	Bus
Wheelbase	in.	146	230

a. Vehicle Specifications—Continued

		Dump Truck	Bus
Length over-all	in.	227¾	374½
Width over-all	in.	90	96
Height over-all	in.	88³⁄₁₆	approx. 112
Wheel size	in.	20	20
Tire size	in.	8.25 x 20	8.25 x 20
Tire pressures (maximum):			
Front	lb	35	60
Rear	lb	45	65
Tread (center to center):			
Front	in.	65½	65⅜
Rear	in.	66⅛	66¼
Crew		Two	One
Weight of loaded vehicle (approximate):			
Front	lb	3,840	5,587
Rear	lb	9,010	13,325
Total	lb	12,850	18,912
Ground clearance (rear) (K-7)	in.	10¹⁄₁₆	9⅞
Ground clearance (rear) (KS-7)	in.		9⅜
Pintle height	in.	28	
Octane rating of fuel		70-72	70-72

b. Performance.

Approach angle	deg	31½	30
Departure angle	deg	37½	
Fording depth	in.	30⁵⁄₁₆	30 (app.)
Minimum turning radius (right or left)	ft	25¾	75
Turning radius in degrees (maximum)	deg	38	38
Towing facilities:			
Front		Hooks	
Rear		Pintle	
Maximum allowable engine speed	rpm	3,000	3,000

		Dump Truck	Bus K-7	KS-7 High	KS-7 Low
Maximum permissible road speeds:					
First (low)	mph	6	6	7	5
Second	mph	11	10	12	8
Third	mph	21	19	23	16
Fourth	mph	40	37	44	31
Fifth (high)	mph	49	45	53	38
Reverse	mph	6	6	7	5
Maximum grade ascending ability	pct	43.0	28.8	24.2	34.2

c. Capacities.

		Dump Truck	Bus
Transmission	pt	9½	9½
Rear axle (K-7)	pt	7	7
Rear axle (KS-7)	pt		16
Fuel tank	gal	32	32
Cooling system	qt	21	21
Crankcase:			
Refill and new filters	qt	10	10
Refill (pan only)	qt	7	7
Refill and drain filter sump	qt	8	8
Air cleaner	pt	2½	2½
Steering gear	pt	1½	1½

Section III

Tools, Parts, and Accessories

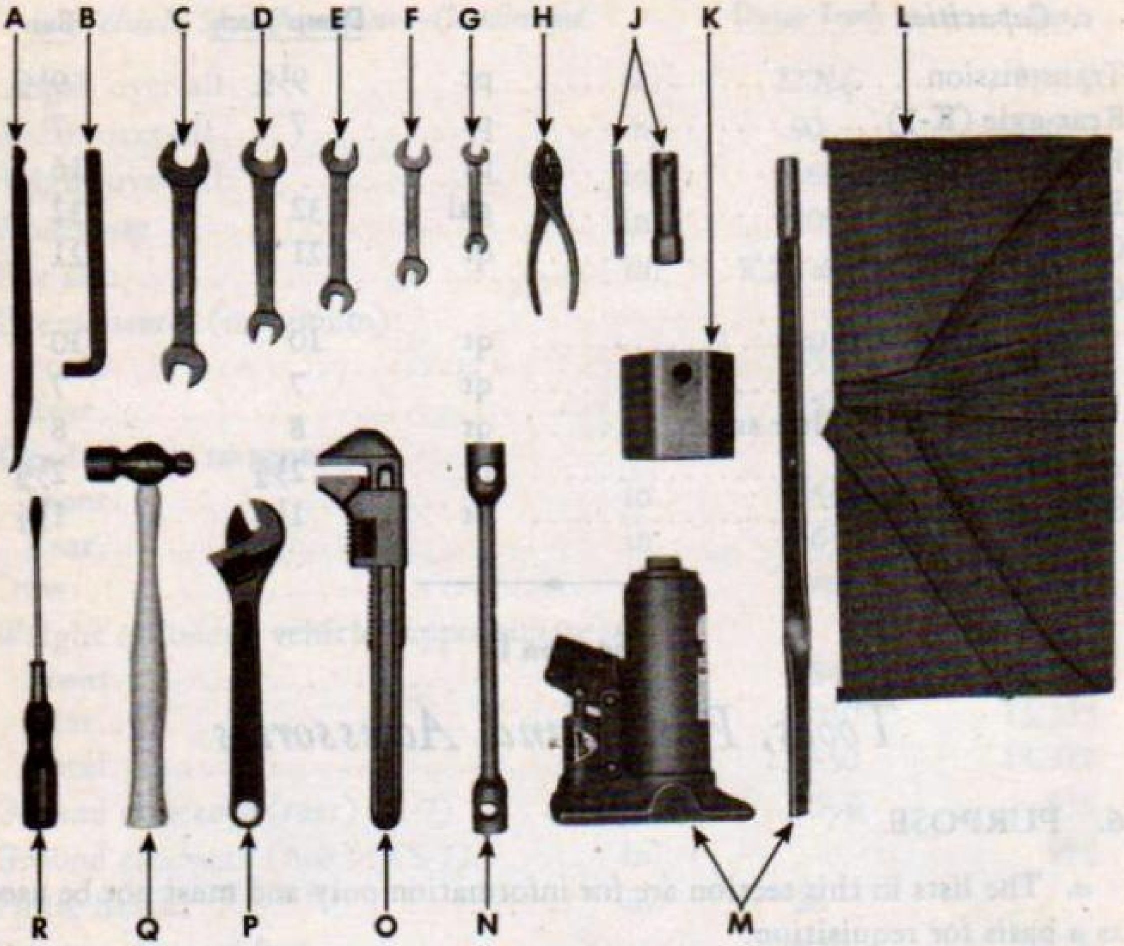
6. PURPOSE.

a. The lists in this section are for information only and must not be used as a basis for requisition.

7. ON-VEHICLE TOOLS (fig. 10).

a. Dump Truck Tools.

Quantity per Vehicle	Item Name and Stockage Number	Stowage Location
1	HAMMER, mach., ball peen 16 oz (41-H-523)	Tool box
1	HANDLE, wheel rim nut wrench (41-H-1542-25)	Tool box
1	JACK, hydr., 5-ton, W/HANDLE (41-J-73)	Tool box
1	PLIERS, combination, slip-joint, 6 in. (41-P-1650)	Tool box
1	SCREWDRIVER, common, heavy-duty, 6 in. (41-S-1636)	Tool box
1	WRENCH, drain plug (IHC-122815-H)	Tool box
1	WRENCH, engr's, dble-end, alloy steel, ⅜ x 7/16 (41-W-991)	Tool box
1	WRENCH, engr's, dble-end, alloy steel, ½ x 19/32 (41-W-1003)	Tool box
1	WRENCH, engr's, dble-end, alloy steel, 9/16 x 11/16 (41-W-1005-5)	Tool box
1	WRENCH, engr's, dble-end, alloy steel, ⅝ x 25/32 (41-W-1008-10)	Tool box
1	WRENCH, engr's, dble-end, alloy steel, ¾ x ⅞ (41-W-1012-5)	Tool box



A—TOOL, TIRE RIM
B—WRENCH, DRAIN PLUG
C—WRENCH, DOUBLE END, ¾ x ⅞
D—WRENCH, DOUBLE END, ⅝ x 25/32
E—WRENCH, DOUBLE END, 9/16 x 11/16
F—WRENCH, DOUBLE END, ½ x 19/32
G—WRENCH, DOUBLE END, ⅜ x 7/16
H—PLIERS
J—WRENCH, SOCKET, SPARK PLUG W/HANDLE
K—WRENCH, SOCKET, REAR WHEEL BEARING NUT
L—BAG, TOOL
M—JACK, HYDRAULIC W/ HANDLE
N—WRENCH, SOCKET, RIM NUT
O—WRENCH, SCREW, AUTO
P—WRENCH, ADJUSTABLE
Q—HAMMER, BALL PEEN
R—SCREWDRIVER RA PD 323799

Figure 10 — Vehicular Tools

Quantity per Vehicle	Item Name and Stockage Number	Stowage Location
1	WRENCH, screw, adj., auto., 15 in. (41-W-450)	Tool box
1	WRENCH, socket, rear wheel bearing nut (41-W-2825-115)	Tool box
1	WRENCH, socket, rim nut (IHC-19495-HA)	Tool box
1	WRENCH, socket, spark plug W/HANDLE (IHC-103688-H)	Tool box

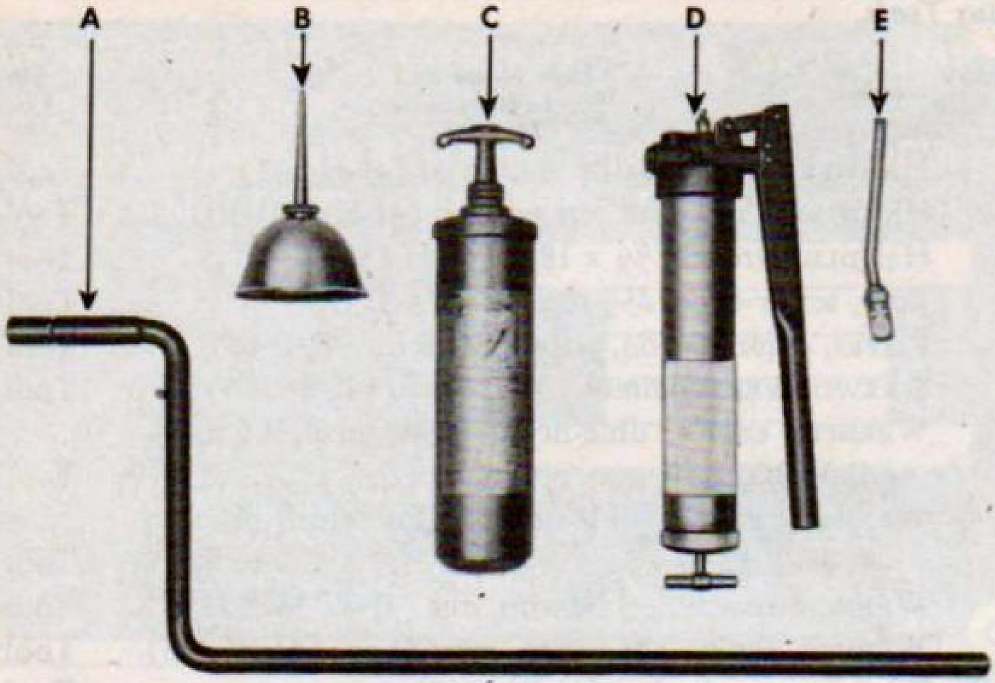
b. Bus Tools.

Quantity per Vehicle	Item Name and Stockage Number	Stowage Location
1	HAMMER, mach., ball peen, 16 oz (41-H-523).......	Tool box
1	HANDLE, wheel stud nut wrench (41-H-1541-10)....	Tool box
1	HANDLE, wrench, ⅝ x 18¾ (41-H-1549)...........	Tool box
1	JACK, screw-type, 4½-ton (41-J-74-575)............	Tool box
1	PLIERS, combination, slip-joint, 8 in. (41-P-1652)....	Tool box
1	SCREWDRIVER, common, 5-in. blade (41-S-1103).....	Tool box
1	WRENCH, engr's, dble-head, alloy steel, ⅝ x 9/16 (41-W-1005).................................	Tool box
1	WRENCH, engr's, dble-head, alloy steel, ¾ x ⅞ (41-W-1012-5)...............................	Tool box
1	WRENCH, rear wheel bearing nut (41-W-3825-115)...	Tool box
1	WRENCH, screw, adj., auto. type 11 in. (41-W-448)..	Tool box
1	WRENCH, spark plug (41-W-3305)..................	Tool box
1	WRENCH, wheel stud nut (41-W-3838-30)...........	Tool box

8. ON-VEHICLE EQUIPMENT (fig. 11).

a. Dump Truck Equipment.

Quantity per Vehicle	Item Name and Stockage Number	Stowage Location
1	ADAPTER, lubr. gun.............................	Tool box
1	BAG, tool (41-B-15)............................	Tool box
1	CATALOG, Ord, Standard Nomenclature List G-541 (in envelope) (SNL-G-541).................	Map compartment
2	CHAINS, tire, 8:20 x 20, Type ID (8-C-1600).....	Tool box
1	CRANK, starting (IHC-63959-HEX)............	Tool box
1	EXTINGUISHER, fire, 1 qt, CCL_4 (58-E-202)......	Driver's compartment
1	GAGE, tire pressure (8-G-615).................	Map compartment
1	GUN, lubr. pressure, hand type (41-G-1344-40)...	Tool box
1	MANUAL, Technical (in envelope) (TM 9-822)...	Map compartment
1	OILER, straight spout, spring bottom, ½ pt (13-O-1530)................................	Bracket in engine compartment
1	ORDER, Lubrication, War Dept, No. 533........	Driver's compartment
1	PUMP, tire inflation, and type 1 cylinder (8-P-5000)	Tool box



A—CRANK, STARTING
B—OILER
C—EXTINGUISHER, FIRE
D—GUN, LUBRICATION
E—ADAPTER, LUBRICATION GUN

RA PD 323800

Figure 11 — Vehicular Equipment (Dump Truck)

Quantity per Vehicle	Item Name and Stockage Number	Stowage Location
1	TAPE, friction, black, grade "A", ¾ in. wide, 8 oz roll (17-T-805)	Spare parts container
1	WIRE, annealed, 22-gage, ¼-lb, spool (22-W-1067)	Spare parts container

b. Bus Equipment.

1	CRANK, starting (IHC-98017-H).	

9. ON-VEHICLE SPARE PARTS.

a. Dump Truck Spare Parts.

Quantity per Vehicle	Item Name and Stockage Number	Stowage Location
1	CONTAINER, spare parts, metal (8-C-5498-50)	Below map compartment
1	BELT, fan (33-B-156)	Spare parts container
5	CAPS, tire valve (boxed) (8-C-650)	Spare parts container

Quantity per Vehicle	Item Name and Stockage Number	Stowage Location
5	CORES, tire valve (boxed) (8-C-6750)...........	Spare parts container
1	LAMP, incand, min. 6-8V. single-tung. fil., 3cp (MZ-63) (17-L-5215)........................	Spare parts container
1	LAMP-UNIT, blackout stop, sealed, 1-opening, 6-8V, 4cp (8-L-421)........................	Spare parts container
1	LAMP-UNIT, blackout tail, sealed, 4-opening, 6-8V, 3cp (8-L-415)........................	Spare parts container
1	LAMP-UNIT, service tail and stop, sealed, 6-8V (8-L-419).................................	Spare parts container
1	PINS, cotter, split, assorted (boxed) (42-P-5347).	Spare parts container
1	SPARK PLUG w/gasket (17-P-5355)............	Spare parts container

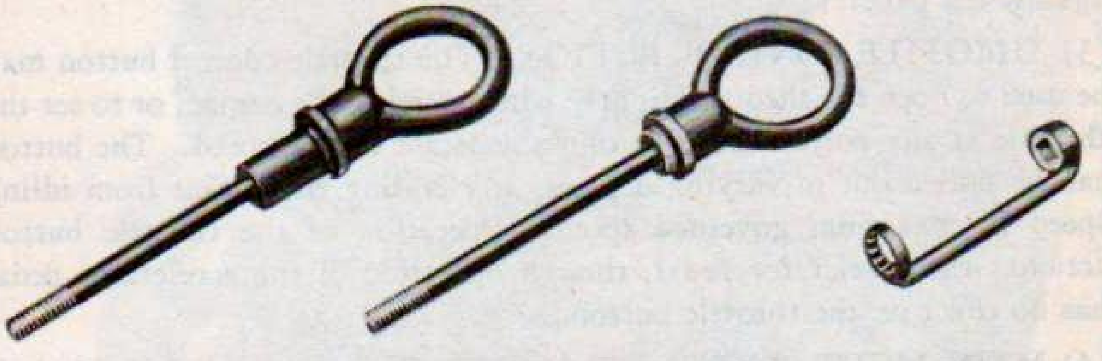


Figure 12 — Special Tools (Dump Truck)

10. SPECIAL TOOLS (fig. 12).

a. Dump Truck Special Tools.

Tool	Federal Stock Number	Manufacturer's Tool Number
BOLT, engine lifting (front)...........	41-B-1586-178	
BOLT, engine lifting (rear)............	41-B-1586-177	
OILER, engineer's, capacity 1 qt., spout 22 in, shock absorber refill..........	13-0-710	
WRENCH, socket, cylinder head bolt, close sweep, ¾-in. hex opening, ½ in. sq. dr.	41-W-2964-710	J-3764

PART TWO

OPERATING INSTRUCTIONS

Section IV

Controls and Instruments

11. CONTROLS (figs. 13 and 14).

a. Vehicle controls include all switches and various operating and miscellaneous controls located in the driver's compartment. Actual operation and use of each control is explained in the respective operation paragraphs.

(1) IGNITION SWITCH. The ignition switch is of the lever type. The handle must be turned clockwise to the "ON" position before the engine can be started.

(2) CHOKE CONTROL BUTTON. The choke control button is used to operate the carburetor choke valve when starting a cold engine. Pulling the choke button out away from panel closes the choke valve. The choke valve will be open when the choke button is again pushed all the way in against the panel.

(3) THROTTLE CONTROL BUTTON. The throttle control button may be used to open the throttle slightly when starting the engine, or to set the throttle at any position to maintain a constant engine speed. The button can be pulled out in varying degrees, accelerating the engine from idling speed to maximum governed speed. Operation of the throttle button actuates the accelerator pedal, though operation of the accelerator pedal has no effect on the throttle button.

(4) MAIN LIGHT SWITCH. The push-pull-type main light switch is located at the left of the instrument panel. It contains a safety lock plunger, designed to prevent accidental display of lights during maneuvers, which must be depressed before the switch lever can be moved to other than the blackout marker light position. The switch controls the service and blackout headlights, and the service and blackout tail and stop lights.

(5) BLACKOUT DRIVING LIGHT SWITCH (DUMP TRUCK). A push-pull-type switch operates the blackout driving light. It has only two positions, "ON" and "OFF."

(6) PANEL LIGHT SWITCH. The instrument panel light switch button operates the two panel illuminating lights.

(7) STARTER SWITCH BUTTON. Pressing on this button completes the electrical circuit between the battery and the starter pinion so that the pinion engages the flywheel ring gear and cranks the engine.

(8) DIMMER SWITCH. The foot-operated dimmer switch, accessible to

the driver's left foot, is used to control the upper and lower headlight beams. The switch is not operative unless the main light switch is in service position. Use of this dimmer switch permits the driver to dim the headlights when approaching or passing oncoming vehicles, and to turn on bright lights when again needed.

(9) CLUTCH PEDAL. The clutch pedal, operated by the driver's left foot, engages and disengages the clutch. Depressing the clutch pedal disengages the engine from the transmission so that transmission gears may be shifted.

(10) SERVICE BRAKE PEDAL. The service brake pedal, operated by the driver's right foot, controls the application and release of the hydraulic brakes at the wheels. The braking action at the wheels is in direct proportion to the pressure applied to the brake pedal. Release of the brake pedal pressure releases the brakes at the wheels.

(11) ACCELERATOR PEDAL. The accelerator pedal, operated by the driver's right foot, controls the carburetor throttle valve. When the pedal is completely released, the engine will operate at idling speed. Acceleration from idling speed to governed speed is controlled by the amount the pedal is pressed down.

(12) PARKING BRAKE CONTROL LEVER. The parking brake control lever, at the right of the driver, is operated by the right hand. It controls application of the mechanical brake band on the propeller shaft. The parking brake should not be used to brake the vehicle during normal road operation. The primary purpose of this brake is to hold the vehicle in parked position, or to assist in bringing it to an emergency stop. When the lever is pulled back, applying the propeller shaft brake, a spring-loaded latch will lock the lever in applied position.

(13) TRANSMISSION CONTROL LEVER. The transmission control lever, accessible to the driver's right hand, is used to select the various gear ratios or speeds provided in the transmission. The shifting pattern or diagram is shown on an instruction plate (fig. 15). Shifting instructions are detailed in paragraph 13 *d*.

(14) STEERING WHEEL. The front wheels are turned or steered by means of the steering wheel at the top of the steering gear assembly, which is connected to the front axle steering knuckles and tie rod by means of a drag link.

(15) WINDSHIELD WIPER CONTROL VALVES. Windshield wiper operating control valves are provided for the independent operation of each windshield wiper. The valve buttons must be turned to place the wipers in operation.

(16) WINDSHIELD ADJUSTING CRANK (DUMP TRUCK). The windshield of the dump truck can be opened or closed at the bottom through

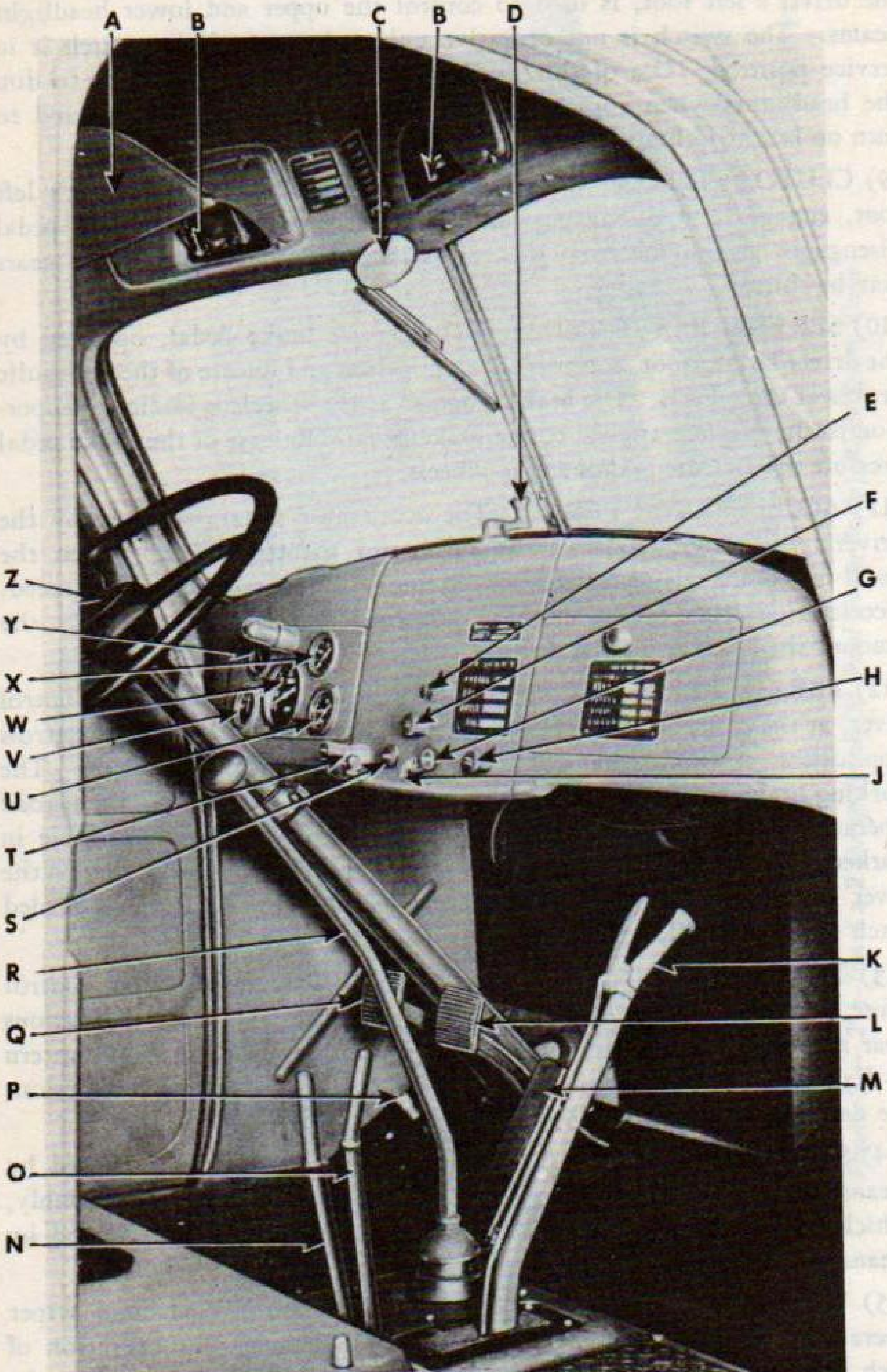


Figure 13 — Controls and Instruments (Dump Truck)

A—SUN VISOR

B—WINDSHIELD WIPER CONTROL VALVE

C—REAR VIEW MIRROR

D—WINDSHIELD ADJUSTING CRANK

E—STARTER SWITCH BUTTON

F—BLACKOUT DRIVING LIGHT SWITCH

G—THROTTLE CONTROL BUTTON

H—PANEL LIGHT SWITCH

J—IGNITION SWITCH

K—PARKING BRAKE LEVER

L—SERVICE BRAKE PEDAL

M—ACCELERATOR PEDAL

N—POWER TAKE-OFF CONTROL LEVER

O—HOIST OPERATING CONTROL LEVER

P—DIMMER SWITCH

Q—CLUTCH PEDAL

R—TRANSMISSION CONTROL LEVER

S—CHOKE CONTROL BUTTON

T—MAIN LIGHT SWITCH

U—TEMPERATURE GAGE

V—AMMETER

W—SPEEDOMETER

X—OIL PRESSURE GAGE

Y—FUEL GAGE

Z—HORN BUTTON RA PD 323802 B

Legend for Figure 13

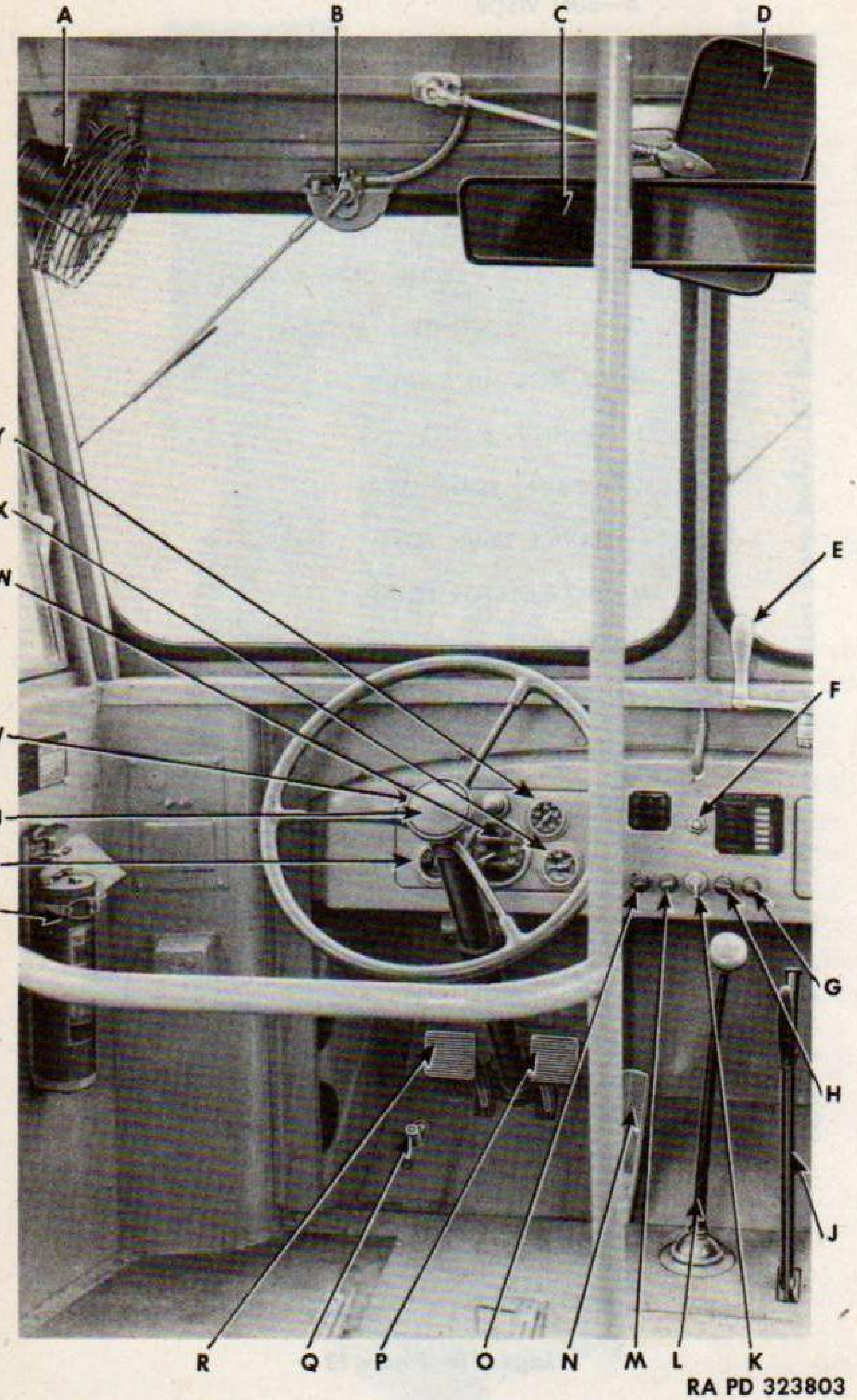


Figure 14 — Controls and Instruments (Bus)

A—DEFROSTER FAN

B—LEFT WINDSHIELD WIPER CONTROL VALVE

C—REAR VIEW MIRROR

D—SUN VISOR

E—DOOR CONTROL LEVER

F—STARTER SWITCH BUTTON

G—PANEL LIGHT SWITCH

H—THROTTLE CONTROL BUTTON

J—PARKING BRAKE LEVER

K—IGNITION SWITCH

L—TRANSMISSION CONTROL LEVER

M—CHOKE BUTTON

N—ACCELERATOR PEDAL

O—MAIN LIGHT SWITCH

P—SERVICE BRAKE PEDAL

Q—DIMMER SWITCH

R—CLUTCH PEDAL

S—FIRE EXTINGUISHER

T—AMMETER

U—HORN BUTTON

V—FUEL GAGE

W—SPEEDOMETER

X—TEMPERATURE GAGE

Y—OIL PRESSURE GAGE RA PD 323803B

Legend for Figure 14

operation of the windshield crank located at the upper center of the cowl.

(17) FIRE EXTINGUISHER. The carbon-tetrachloride-type fire extinguisher is mounted in a support bracket at the right of the crew compartment. The mounting bracket includes a spring-type clamp which must be opened before the extinguisher can be removed.

(18) REAR-VIEW MIRRORS. The rear-vision mirrors are adjustable for position. One rear-vision mirror is located in the driver's compartment, and one is located on either side of the vehicle.

(19) SUN VISOR. The sun visor is adjustable up or down, or can be swung from side to side to suit the driver's comfort.

(20) HORN BUTTON. The horn control button is located in the center of the steering wheel. Depressing the button causes the horn to operate.

(21) POWER TAKE-OFF CONTROL LEVER (DUMP TRUCK). The power take-off control lever controls the dump body hoist power take-off. The power take-off is disengaged in the forward position of the lever, and is engaged in the rearward position.

(22) HOIST OPERATING CONTROL LEVER (DUMP TRUCK). The hoist operating control lever controls the dump body hoist valve.

(23) DOOR CONTROL LEVER (BUS). The bus door control lever opens and closes the passenger entrance door.

(24) EMERGENCY DOOR HANDLE (BUS). The bus emergency door can only be opened with the door handle located in a holder at the left of the driver.

(25) DEFROSTER FAN (BUS). A defroster fan is located at the upper left corner of the bus windshield, and is controlled by a switch on the fan motor.

12. INSTRUMENTS.

a. The following instruments are grouped on the dash or instrument panel (figs. 13, 14, and 80).

(1) TEMPERATURE GAGE. The temperature gage indicates the temperature of the coolant in the cooling system, not the quantity of coolant in the system. The gage is graduated from 100°F to 220°F.

(2) FUEL GAGE. The electrically operated fuel gage is connected with a sending unit at the fuel tank. The gage indicates the level of gasoline in the tank, and will only register after the ignition switch is turned on.

(3) SPEEDOMETER. The speedometer indicates the road speed of the vehicle in miles per hour. The unit, operated through a flexible cable from the transmission, also records total number of miles traveled, also trip miles. The trip indicator can be cleared by turning the button located on the under side of the speedometer head.

(4) OIL PRESSURE GAGE. The oil pressure gage indicates the pressure of the engine lubricating oil, not the amount of oil in the crankcase. The pressure reading may vary according to operating conditions. However, if the oil pressure should fall to zero while the engine is operating, stop the engine immediately and determine the cause.

(5) AMMETER. The ammeter indicates the rate of charge or flow of electric current being supplied to the battery by the generator, or the rate of discharge from the battery. At low engine speeds the needle may show a negative or discharge reading. When the battery is fully charged, a very slight charge is indicated by the needle during normal vehicle operation.

Section V

Operation Under Ordinary Conditions

13. USE OF INSTRUMENTS AND CONTROLS IN VEHICLE OPERATION.

a. New Vehicle Run-in Test. Before a new or reconditioned vehicle is placed in service, be sure that the new vehicle run-in test prescribed in paragraphs 24, 25, and 26 has been performed.

b. Before-operation Service. Perform the services in items 1 to 6 in paragraph 28, before attempting to start the engine.

c. Starting the Engine.

(1) START THE ENGINE. Place transmission control lever in neutral position. Pull back parking brake control lever, and lock in applied position. If engine is cold, pull out hand throttle button about ½ inch, and hold choke button out about halfway. In extremely cold weather, choke button should be held out all the way. Push the clutch pedal down to disengage clutch, and hold in depressed position until engine has been started. NOTE: *If vehicle has been standing for some time in cold weather, it is recommended that engine be turned over several times with the starter before turning on ignition.* Turn ignition switch lever to "ON" position. Press starter button. Release starter button the instant the engine starts. Make necessary hand throttle and choke adjustments until even engine idling speed has been attained.

(2) WARM UP THE ENGINE. After the engine has been started, it should be permitted to operate through a short warm-up period whenever conditions permit. This warm-up period provides the driver with an opportunity to observe and check the performance of the engine before the vehicle is placed under way. After the engine is running smoothly,

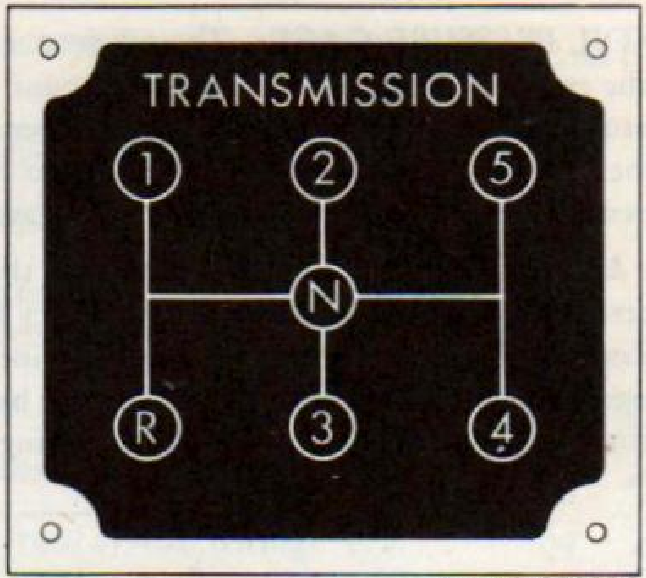


Figure 15 — Shifting Diagram

RA PD 323804

listen for any sharp knocks, clattering, or other unusual noises. Report any unusual noises immediately to the proper authority. No vehicle should be placed in service if the engine is not operating efficiently.

(a) *Minimum and Maximum Operating Temperatures*. It is essential that engine water temperature be maintained at or above 160°F, and that this temperature be reached as soon as possible. In cold weather this is best controlled by covering the lower portion of the radiator with corrugated paper carton or similar material. Temperature should rise steadily during warm-up period until the gage shows 160°F or higher. No prescribed time can be set for the temperature to reach normal operating stage, as atmospheric conditions, length of time engine has been idle, and other factors determine the length of the warm-up period. As a general rule, engine operation equivalent to driving five miles should bring the temperature up to 160°F. Run the engine during the warm-up period at a fast idle speed of 800 revolutions per minute. If the temperature rises sharply to above 190°F, the engine should immediately be stopped, and the cause of overheating must be determined and corrected.

(b) *Normal Operating Temperatures*. Between 160°F and 180°F are satisfactory temperatures for efficient engine operation. Temperatures above 180°F, or below 160°F after several miles of operation, indicate improper cooling system operation.

(c) *Oil Pressure*. When the engine first starts, the consistency of the oil may cause a sharp rise in the oil pressure gage reading. After the oil warms up, oil pressure should recede slowly to normal. The pressure readings may fluctuate as engine speed increases or decreases, but sudden drop, high reading, or erratic fluctuation of oil pressure indicates trouble. The engine should be stopped immediately, and the cause of the trouble must be localized and corrected.

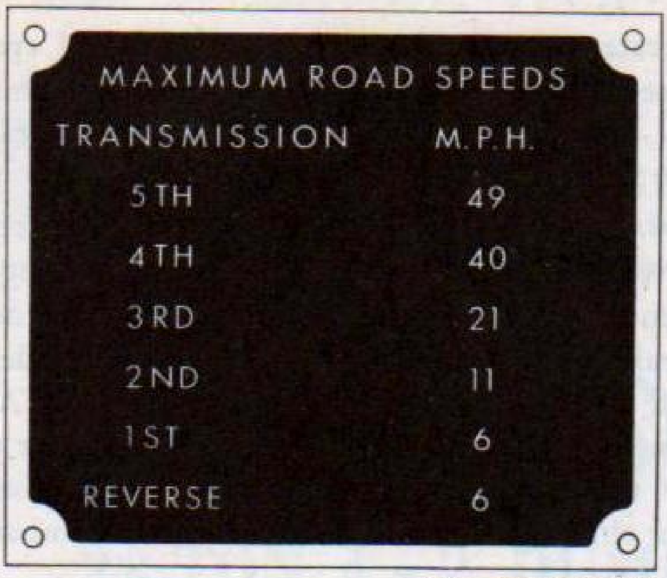


Figure 16 — Maximum Speed Plate (Dump Truck)

RA PD 323805

(d) *Ammeter.* This instrument indicates the charging activity of the generating system. The ammeter may or may not show charge by a plus (+) reading when the engine is first started. As a general rule, the ammeter will show charge after engine speed is increased, depending upon the amount starting has drained the battery, registering maximum charging rate when the battery is low. The ammeter should never show high discharge during the engine warm-up period.

d. Placing the Vehicle in Motion.

(1) START ON LEVEL GROUND. After the engine has been thoroughly warmed up and checked for satisfactory operation, be sure the choke and throttle buttons are pushed in against the dash. Release the parking brake control lever. Disengage the clutch fully. Move the transmission control lever to the first speed position (fig. 15). Release the clutch pedal gradually, and at the same time slowly depress the accelerator pedal to increase the speed of the engine. Do not race the engine.

(2) START ON A GRADE. If the vehicle is on a grade, one method of starting is as follows: With the parking brake in applied position, disengage the clutch fully. Move the transmission control lever to the first speed position (fig. 15). Gradually engage the clutch, release the parking brake as the engine picks up the load, and accelerate the engine by means of the foot accelerator.

(3) SHIFT TRANSMISSION FROM LOW TO HIGH SPEEDS. The transmission shift from first to fifth speeds can be accomplished in successive stages as follows: After first speed engagement is made, accelerate the engine until road speed is increased to approximately that indicated on the maximum permissible road speed plate (fig. 16) for transmission first speed. Then release the accelerator pedal, depress the clutch pedal, and move the transmission control lever into second speed position (fig. 15). Release

the clutch pedal and accelerate to approximately maximum road speed (fig. 16) for transmission second speed. Repeat operations for third, fourth, and fifth speeds, in successive stages. Fifth speed is generally used for normal operation on average roads.

e. Shifting Transmission from High to Low Speeds. The transmission should always be shifted down into the next lower gear before the engine starts to labor and before vehicle speed is appreciably decreased. The need for "downshifting" is generally apparent when climbing a steep grade or when power is needed to pull through rough terrain, muck, or sand. As a precautionary measure, the same speed ratio used to climb a grade, or the next lower, should be used to descend the same grade. Double-clutch procedure is recommended for shifting from a high to a lower transmission speed.

(1) The metal plate, located on the dash panel, showing the maximum permissible road speeds in the various gears (fig. 16) will be helpful in determining the maximum road speed at which a shift from a higher to a lower gear ratio can be made. The maximum road speeds are as follows:

Transmission Gear Range		Maximum Permissible Road Speed (MPH) Dump Truck	K-7 Bus	KS-7 Bus High	KS-7 Bus Low
5th Speed (high)	mph	49	45	53	38
4th Speed	mph	40	37	44	31
3rd Speed	mph	21	19	23	16
2nd Speed	mph	11	10	12	8
1st Speed (low)	mph	6	6	7	5
Reverse	mph	6	6	7	5

For example, in shifting from fifth speed to fourth speed on the dump truck, the maximum road speed at which this change should be made is approximately 35 to 40 miles per hour, since 40 is the maximum available road speed for fourth gear in the dump truck.

(2) Depress the clutch pedal and release the accelerator pedal at the same time. Shift the transmission control lever into neutral. Release the clutch pedal and accelerate the engine momentarily to synchronize the transmission gears. Depress the clutch pedal again, and move the transmission control lever into the next lower speed. Do not force the control lever, but rather "feel" it into position. Release the clutch pedal, and accelerate the engine to the desired speed, not exceeding the speed shown on the maximum permissible road speed plate (fig. 16) for the lower gear ratio.

(3) The transmission may be shifted successively into each successive lower speed in the same manner. As soon as the driver becomes accustomed to the sound of the engine at various engine speeds, and has become

practiced in "double-clutching," he will be able to shift from a higher to a lower gear very rapidly without clashing the gears.

f. Shifting Transmission into Reverse. The vehicle must first be at a full stop before the transmission control lever can be placed in reverse position (fig. 15). The shift from forward to reverse is made as follows: Depress the clutch pedal to disengage the clutch. Press down on the foot brake pedal to bring the vehicle to a full stop. Move the transmission control lever from neutral position toward the left, and then into the reverse position. Release the clutch pedal and accelerate the engine to the desired rate of speed. Do not, however, attempt to exceed the speed shown on the maximum permissible road speed plate (fig. 16).

g. Going Up Grades. When ascending steep grades, always shift into lower transmission speeds, using double-clutch procedure (subpar. *e* above), before the vehicle begins to labor. This can be accomplished most successfully when the vehicle still has sufficient momentum to permit changing gears without bringing vehicle to a stop. It is advantageous to shift at as nearly the top road speed of the next lower gear as possible. CAUTION: *When shifting to a lower gear at any rate of vehicle speed, make sure that the engine speed is synchronized with the vehicle speed before the clutch is engaged. If the clutch is engaged when the engine is operating at less than the relative vehicle speed, the drive line may be damaged.*

h. Going Down Grades. The importance of restraining the speed of the vehicle while descending grades cannot be overemphasized. Attention is again directed to the maximum permissible road speed plate (fig. 16). The plate clearly states the maximum speed at which the vehicle may be operated in various gear ratios of the transmission. In general, it is advisable to use the same transmission speed, or the next lower, going downhill as would be required to climb the same hill. The vehicle speed must not be allowed to exceed the maximum speed for that gear as shown on the caution plate (fig. 16). Keep the vehicle under control at all times. Reduce the speed of the vehicle by using the brakes as required to hold the speed below the maximum permissible road speed for the specific gear range. NOTE: *The possibility of overspeeding is greater when the truck is loaded, and therefore more caution is required.*

i. Operating the Vehicle Lights.

(1) SERVICE HEADLIGHTS. The driver must depend upon the service headlights for night time visibility. These headlights, when correctly aimed, adjusted (par. 92), and maintained in good order, will provide adequate lighting for all conditions. The high beam, as controlled by the foot dimmer switch, is generally used on unlighted roadways when there are no approaching vehicles. The low beam should be used when approaching or passing other vehicles. The low beam will not throw light far

enough ahead for clear road driving. However, when another vehicle is approaching, objects between the two vehicles show up in silhouette against the road. The visibility under this condition is sometimes greater than the clear road visibility with the high beam.

(2) BLACKOUT MARKER LIGHTS (DUMP TRUCKS). The blackout marker lights on dump trucks are designed for use when a display of illumination is not permissible. Only these lights can be operated without first depressing the locking plunger of the light switch. Blackout marker lights are divided into two parts. When seen from a distance of 60 feet or more, the two light beams appear as one light. At a distance of less than 60 feet, two light beams appear. Through this construction a driver is enabled to gage whether the vehicle behind him is at a safe distance in blackout driving, for if two light beams appear, the vehicle behind is too close for safe driving.

(3) BLACKOUT DRIVING LIGHT (DUMP TRUCKS). The blackout driving light (headlight) is used only when driving under blackout conditions.

(4) BLACKOUT TAILLIGHTS (DUMP TRUCKS). These are divided into four parts which appear as one light at a distance of 180 feet or more; as two lights at distances between 180 and 60 feet; and as four lights at distances of less than 60 feet. Through this construction the driver can gage the distance to the vehicle ahead, since if four points of light appear, the vehicles are too close; if only one point of light is visible, the distance is too great; and if two points of light appear, the distance between vehicles is proper for safe blackout driving.

j. Checking Vehicle Speed.

(1) Application or release of the service or foot brakes is accomplished in the conventional automotive manner. The driver applies pressure to the foot pedal in varying degrees to brake the vehicle as desired. A fine degree of brake application can be obtained, from a smooth, easy brake action to an abrupt stop. The driver should bear in mind that service brakes apply to all four wheels, so that only a normal amount of pedal pressure is required to actuate the brakes, provided the hydraulic system is functioning properly.

(2) Release the accelerator pedal. Depress the brake pedal slowly and evenly until the vehicle is checked to desired speed. Leaving the clutch engaged permits the engine to assist in checking vehicle speed.

k. Stopping the Vehicle.

(1) NORMAL VEHICLE STOP. Because operation of the brake pedal requires comparatively little physical effort, proper control of the brakes is easily accomplished. The best stop results when the first brake applica-

tion is as firm as the speed, condition of the road, and passenger comfort permit, followed by a tapering off of brake pressure as the speed decreases. If the brakes are applied lightly at first, and the braking pressure increased as the speed decreases, a very rough stop results. The brake pedal must not be fully depressed except in cases of emergency, as this causes full braking force, which is not necessary in ordinary service, to be delivered to the wheels. Disengage the clutch before coming to a full stop, to avoid stalling the engine.

(2) EMERGENCY STOP. Release the accelerator, step sharply and hard on the brake and clutch pedals, and at the same time pull up on the parking brake lever. NOTE: *This action should be used only in emergencies.*

(3) USE OF PARKING BRAKE. The primary purpose of the parking brake is to hold the stopped vehicle in stationary or parked position. During normal driving, do not touch the parking brake control lever until after the vehicle is at a full stop.

l. Stopping the Engine.

(1) PRELIMINARY. Before stopping the engine after a vehicle stop, observe the engine idling performance, and investigate any unusual noises noticed. Check the ammeter action to see that there is no excessive charge or discharge. Check the reading of the temperature gage to see that it is at least 160°F.

(2) PROCEDURE. With the clutch pedal pressed down, shift the transmission into neutral position. Apply the parking brake lever. Be sure the throttle and choke buttons are pushed all the way in. Allow the engine to idle for two or three minutes, then turn the ignition switch to "OFF" position.

m. Operation of Two-speed Rear Axle (Model KS-7 Bus). The Model KS-7 bus is equipped with a two-ratio or two-speed-range rear axle which is controlled through a vacuum shift mechanism. This feature makes available all five transmission speeds in two different rear axle ratio combinations. The advantage of this construction is that the same transmission gears that are used with low rear axle ratio to deliver maximum power in starting a loaded vehicle, or in pulling a vehicle up steep grades or through mud or sand, can also be used with high rear axle ratio to deliver maximum speed, without waste of power, in driving an empty vehicle, or a loaded vehicle over level roads.

(1) RECOMMENDED DRIVING PRACTICE. Always start a loaded vehicle in low rear axle ratio. Operating in congested city traffic or hauling heavy loads over rough roads, continue in low rear axle ratio, to avoid frequent shifting into the lower transmission speeds. Shift into high rear axle ratio on open stretches of level road. Shift back into low rear axle ratio when road or load conditions cause the engine to slow down,

and before it begins to labor. Use high rear axle ratio for starting and continuous operation of a vehicle only when it is empty or lightly loaded, or is operated on level, open roads.

(2) AVAILABLE GEAR RATIOS. A vehicle equipped with two-speed axle has twice as many final gear ratios available as there are transmission forward speeds. There are, therefore, 10 final gear ratios, in the following order:

Transmission Speed	Rear Axle Ratio
First (low)	Low
First (low)	High
Second	Low
Second	High
Third	Low
Third	High
Fourth	Low
Fourth	High
Fifth (high)	Low
Fifth (high)	High

While it would be possible to shift through all ranges from low low to high high, usual practice is to use the various transmission speeds with only one rear axle ratio (low for a loaded vehicle), shifting over to the other rear axle ratio (high) at proper shifting speed.

(3) SHIFTING SPEED. As used in this manual, "shifting speed" refers to the vehicle speed at which the rear axle ratio may be shifted to best advantage.

(a) *Low Ratio to High Ratio.* The proper shifting speed for this shift is reached when it may be made without loss of vehicle speed under existing road and load conditions. In high transmission gears, shifting speed is attained near the maximum permissible road speed of the transmission gear currently in use.

(b) *High Ratio to Low Ratio.* The proper shifting speed for this shift is reached when road or load conditions cause the engine to slow down. The shift must be made before the engine begins to labor. Allowing the engine to "lug" in high rear axle ratio submits the entire drive line, particularly the engine and clutch, to needless and harmful strain.

(4) REAR AXLE RATIO CONTROL BUTTON. A small push-pull button attached near the top of the transmission control lever controls the selection of the rear axle ratio. There are only two positions for this control button. When the button is pressed down into its lower position, the rear axle is in its low ratio (for power). When the button is pulled up into its upper position, the rear axle is in its high ratio (for speed).

(5) SHIFTING PROCEDURE. The various methods of shifting from one rear axle ratio to the other while the vehicle is in motion are as follows:

(a) *From Low to High Ratio (Except on Downgrade).* When shifting speed has been reached, with throttle open and without releasing pressure on the accelerator, pull up the control button. Now release accelerator pressure momentarily. After a short hesitation, again apply foot pressure to the accelerator, and the rear axle high ratio will pick up the load.

(b) *From Low to High Ratio on Downgrade.* Whereas the throttle is normally open in driving on level roads or uphill, on a downgrade the throttle is closed, the transmission is in one of its lower speed gears, and the engine is being used as a brake to hold back the vehicle. Under these conditions, first pull the control button up, then release and instantaneously re-engage the clutch.

(c) *From High to Low Ratio.* When shifting speed has been reached, without moving throttle or changing pressure on the accelerator, press the control button down, then release and instantaneously re-engage the clutch. The release and re-engagement of the clutch should be one continuous action, without any hesitation, and completed as fast as possible.

(d) *From High to Low Ratio (Alternate Method).* The above method of shifting from high to low ratio is satisfactory for all circumstances. The driver may, however, desire to make the shift without using the clutch. This may be done, when shifting speed has been reached, by pressing the control button down, then releasing and instantaneously re-applying pressure on the accelerator pedal. This operation must be carried through as rapidly as possible.

14. TOWING THE VEHICLE.

a. Towing to Start the Engine. The engine may be started by towing the vehicle with another vehicle. The tow chain or line should be of sufficient length to permit maneuverability of both vehicles. Pull the throttle button of the towed vehicle out about ½ inch, and hold the choke out part way if the engine is cold. Place the transmission in fourth speed (fifth if traction is difficult). Turn on the ignition switch. While being towed for the first 100 feet, press down on the clutch and hold in disengaged position. When the towed vehicle speed reaches approximately 10 miles per hour, slowly engage the clutch. Disengage the clutch immediately after the engine starts.

b. Towing a Disabled Vehicle. If the transmission on the vehicle to be towed is not damaged, shift transmission into neutral. While being towed, the revolving gears of the transmission will provide lubrication to the gears and bearings. If the transmission is damaged, it will be advisable to prevent the rotation of gears, bearings, and shafts which might otherwise suffer greater damage. Remove both rear axle drive shafts (par. 118), and cover the wheel hub openings to prevent the entrance of dirt or loss of lubricant. The same procedure should be followed if the front wheels are off the ground, to prevent rotation of the differential gears. A vehicle with rear wheels off the ground should be towed backwards only in an emergency, and it is advisable to disconnect and remove the rear propeller shaft (par. 110).

Section VI

Operation of Auxiliary Equipment

15. DUMP BODY AND HOIST.

a. Galion.

(1) DESCRIPTION. The Galion dump body with model GH-46 hoist is used on International K-7 chassis serial numbers 10001 to 12000. The body is of steel. The hoist is hydraulically operated, and is controlled from the driver's compartment by two control levers (fig. 17). The body tailgate is controlled by a locking lever at the left front corner of the body. When this lever is upright against the body, the tailgate is locked. When the body is in raised position, the tailgate opens at the bottom, provided the tailgate locking lever is pulled forward away from the body.

(2) OPERATION. The two control levers located in the driver's compartment (fig. 17) control the raising and lowering of the body. Lever "A" controls the hoist power take-off at the transmission. In the forward position of the lever, the power take-off is disengaged. In the rearward position of the lever, the power take-off is engaged and permits hoist operation. Lever "B" controls the dump body hoist valve. This lever has three positions. In the forward position of the lever the hoist valve is in "LOWER" position. In the mid-position of the lever, the hoist control valve is in "RAISE" position. In the rearward position of the lever, the hoist valve is in "HOLD" position. To operate the hoist and dump body, proceed as follows:

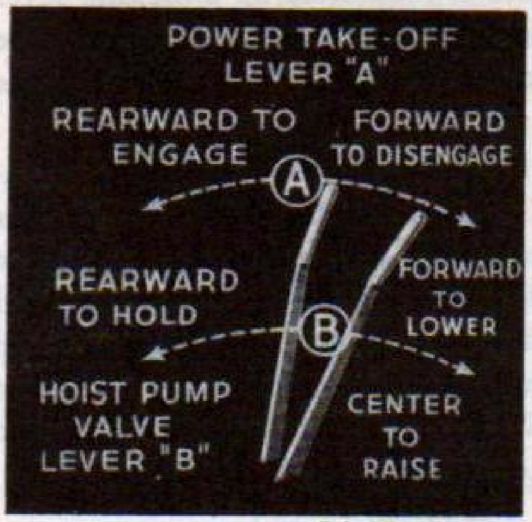
(a) Start engine.

(b) Disengage clutch.

(c) Shift power take-off control lever (A, fig. 17) rearward to engage the power take-off.

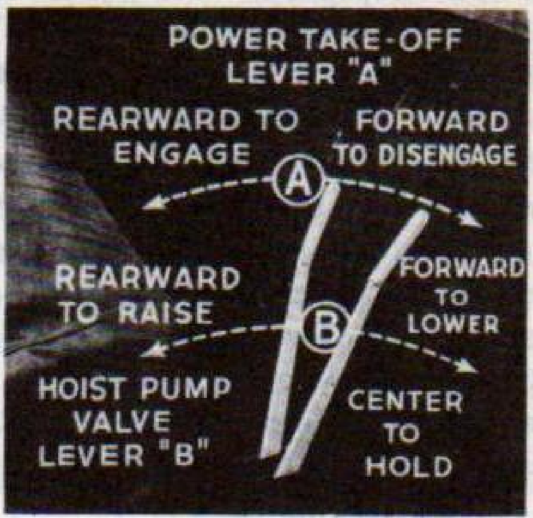
(d) Engage clutch.

(e) To raise the dump body, shift the hoist valve control lever (B, fig. 17) to the central "RAISE" position.



RA PD 323806

Figure 17 — Galion Dump Body Hoist Control Levers



RA PD 323807

Figure 18 — St. Paul Dump Body Hoist Control Levers

(f) To stop and hold the dump body, move the valve control lever to the rearward "HOLD" position.

(g) To lower the dump body, move the valve control lever to the "LOWER," or forward, position.

(h) When hoist operation is completed, shift the power take-off control lever (A, fig. 17) to neutral position by disengaging the clutch, moving the control lever to its forward position, and re-engaging clutch. Be sure to return the hoist valve control lever (B, fig. 17) to the rearward "HOLD" position.

(i) Do not operate hoist pump when vehicle is in motion, as this causes excessive heating and possible damage to the pump.

(3) SERVICING.

(a) *Preventive Maintenance.* At specified intervals, follow preventive maintenance instructions give in paragraph 31, Item 90. NOTE: *Block the body firmly in place before attempting to work on the hoist mechanism. Never work under any dump body without first placing a heavy timber proper underneath it to prevent it from accidentally dropping on the workman.*

(b) *Filling the Hoist Cylinder.* Refer to instructions in paragraphs 150 *b* (8).

b. St. Paul.

(1) DESCRIPTION. The St. Paul model BR dump body with model 36 hoist is used on International K-7 chassis serial numbers 15350 to 16704. The body is of steel. The hoist is hydraulically operated from a transmission-mounted power take-off. The dump body hoist is controlled by power take-off and hoist valve control levers (fig. 18) located in the

driver's compartment. The body tailgate is controlled by a locking lever at the left front of the dump body. When the lever is upright against the body, the tailgate is locked. When the lever is away from the body, the tailgate is unlocked at its bottom edge.

(2) OPERATION. The two control levers located in the driver's compartment (fig. 18) control the raising and lowering of the body. Lever "A" controls the transmission power take-off. In the forward position of this control lever, the power take-off is disengaged. In the rearward position of the lever, the power take-off is engaged and permits hoist pump operation. Lever "B" controls the dump body hoist valve. This lever has three positions, forward to "LOWER," centered to "HOLD," and rearward to "RAISE." To operate the dump body, proceed as follows:

(a) Start engine.

(b) Disengage clutch.

(c) Shift power take-off control lever (A, fig. 18) rearward to engage power take-off.

(d) Engage clutch.

(e) To raise the dump body, shift the hoist valve control lever (B, fig. 18) to the rearward "RAISE" position.

(f) To stop and hold the dump body, move the hoist valve control lever to the center "HOLD" position.

(g) To lower the dump body, move the hoist valve control lever to the forward "LOWER" position.

(h) When hoist operation is completed, shift the power take-off control lever to neutral position by disengaging the clutch, moving the lever all the way forward, and again engaging the clutch. Be sure to return the hoist valve control lever to the center "HOLD" position.

(i) Do not operate hoist pump when vehicle is in motion, as this causes excessive heating and possible damage to the pump.

(3) SERVICING.

(a) *Preventive Maintenance.* Refer to subparagraph *a* (3) above.

(b) *Filling the Hoist Cylinder.* Refer to paragraph 153 *b* (9).

16. FIRE EXTINGUISHER.

a. Description. A carbon-tetrachloride-type fire extinguisher is mounted in a bracket in the driver's compartment (fig. 14).

b. Inspection.

(1) Check the fire extinguisher at least monthly to see that it is full. Fasten the handle in locked position, and shake the cylinder. Extinguishers can lose their fluid both by evaporation and by operation for testing or use. When shaken, the extinguisher must feel and sound absolutely full.

(2) The fluid in an extinguisher may become dirty through corrosion from oxygen or dampness in the cylinder. Check for dirt at four-month intervals. Pump the fluid into a clean glass container. If the fluid is not dirty, it can be put back into the extinguisher. If the fluid is dirty, it must be discarded and the extinguisher filled with new fluid (Liquid, extinguisher, fire—1-qt container, Item Stock No. K2-01-00440).

(3) Never put water in a fire extinguisher of carbon-tetrachloride type. Moisture will mix with the carbon-tetrachloride and cause hydrochloric fumes that corrode the inside of the extinguisher. Further, if the water content is high, the effectiveness of the fluid as a fire-extinguishing agent is impaired.

c. Operation. The one-quart fire extinguisher of carbon-tetrachloride type is operated by a pump handle.

(1) Release the handle from the locked position by turning it one quarter turn toward right or left.

(2) Operate handle as a pump. The liquid will be discharged on both the up and the down strokes.

(3) Direct the stream of carbon-tetrachloride at the hottest part of the flame. This will produce a gas which smothers the flame. Direct the stream on one spot at a time, and extinguish that section of the fire completely before redirecting the stream. Coat the dying embers completely so they will not flare up again.

(4) Recharge the extinguisher at once, so that the unit will be ready for use at the next emergency.

d. Refilling or Recharging.

(1) Remove filler plug and gasket from top of unit.

(2) Using a funnel, if available, pour fire extinguisher liquid (Item Stock No. K2-01-00440) into extinguisher until full.

(3) Replace plug and gasket, and make sure plug is tight.

Section VII

Operation Under Unusual Conditions

17. COLD WEATHER OPERATION.

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 functional failures are to be avoided.

b. Gasoline. Winter grade gasoline is designed to reduce cold weather starting difficulties; therefore, winter grade 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 1 quart of denatured alcohol, grade 3, to the fuel tank at start of winter season, and ½ pint at each refueling. 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 openings 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.

(a) Universal gear lubricant, SAE 80, where specified on figure 19, or War Department Lubrication Order, is suitable for temperatures as low as -20°F. If consistent temperature below 0°F is anticipated, drain gear cases while warm, and refill with Grade 75 universal gear lubricant, which is suitable for operation at all temperatures below 0°F.

(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 the 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 Grade 75 universal gear lubricant.

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

(5) CRANKCASE OIL. Keep crankcase oil fluid by one of the following methods, listed in order of preference:

(a) Keep vehicle in a heated enclosure when not in use.

(b) After stopping engine, drain crankcase oil while still hot. Place warning tag in a conspicuous place in the driver's compartment to indicate that crankcase is empty. Store oil in a warm place if possible; otherwise, heat oil before reinstalling. NOTE: *Do not get oil too hot; heat only to the point where the bare hand can be inserted without burning.*

(c) Dilute crankcase oil. Crankcase oil may be diluted with gasoline or Diesel fuel according to their availability with preference being given to gasoline. Use one of the two following procedures to provide engine with properly diluted engine oil for cold starting.

1. Using Gasoline as a Diluent.

   a. Fill engine crankcase to the "FULL" mark with SAE 10 engine oil. Add 1½ quarts of gasoline for each 5 quarts of crankcase oil capacity.

   b. Run engine 5 to 10 minutes to mix lubricant and diluent thoroughly.

   c. Stop engine and note that level of the diluted oil is above the normal "FULL" mark on the oil gage. This level should be marked on the oil gage for future reference.

   d. The presence of a large percentage of light diluent will increase oil consumption and, for that reason, the oil level should be checked frequently. Use SAE 10 engine oil to maintain the oil level to the manufacturer's "FULL" mark on the gage during operation.

   e. If the vehicle is operated 4 hours or more at operating temperature, redilution will be necessary if it is anticipated that the vehicle will be left standing unprotected for 5 or more hours. This can be accomplished by adding SAE 10 engine oil to the manufacturer's "FULL" mark; then adding gasoline to the dilution mark on the gage described in step *c* above.

2. Using Diesel Fuel Oil as a Diluent.

   a. If Diesel fuel is used as a diluent, drain the crankcase while the engine is still warm and refill, using engine oil diluted with grade X Diesel fuel oil in the proportion of 1½ quarts of Diesel fuel to 5 quarts of engine oil.

The presence of a large percentage of diluent will increase oil consumption; therefore, check oil level frequently during operation and maintain to manufacturer's "FULL" mark on gage with engine oil diluted with Diesel fuel as described above. CAUTION: *When Diesel fuel is used as a diluent, the quantity of diluent necessary for starting is added when the crankcase is refilled and maintained by the addition of diluted make-up oil. Further additions of diluent prior to overnight shut-down are unnecessary.*

(d) Cover entire engine section, and cab of dump truck, with tarpaulin. Place fire pots under tarpaulin about 3 hours before engine is to be started. A Primus, Van Prag, or other type blowtorch, and ordinary kerosene lanterns may be used. CAUTION: *Be careful in applying flame directly to oil pan.*

e. Protection of Cooling System.

(1) USE ANTIFREEZE COMPOUND. Protect the system with antifreeze compound (ethylene-glycol type) for operation below +32°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 clean the system with cleaning compound (par. 75 *c*).

(3) REPAIR LEAKS. Inspect all hose, and replace if deteriorated. Inspect all hose clamps, plugs, and pet cocks, and tighten as necessary. Radiator leaks must be repaired before adding antifreeze compound. Correct all leakage of exhaust gas or air into the cooling system (par. 75 *c*).

(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.

ANTIFREEZE COMPOUND CHART
(for 21-quart capacity cooling system)

Temperature	Antifreeze Compound (ethylene-glycol type)
+10°F	5 qt
0°F	7 qt
—10°F	8 qt
—20°F	9 qt

—30°F	11 qt
—40°F	12 qt
—50°F	13 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) PRECAUTIONS.

(a) Ethylene-glycol-type 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. The correct hydrometer reading for this solution is 0°F.

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

f. Electrical System.

(1) GENERATOR AND STARTER. 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. Be sure that no short-circuits are present.

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

(4) DISTRIBUTOR. Clean distributor 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 spark plugs, or replace if necessary. If it is difficult to make the engine fire, reduce the gap to 0.005 inch less than the gap recommended for normal operation (par. 81). This will make ignition more effective at reduced voltages likely to prevail.

(6) TIMING. Check the timing carefully. Be sure that the spark is not unduly advanced or retarded (par. 49).

(7) BATTERY.

(a) The efficiency of batteries decreases sharply with the 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°F.

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

(8) LIGHTS. Inspect the lights carefully. Check for short-circuits, and for moisture around sockets.

(9) ICE. Before every start, see that the spark plugs, wiring, and all electrical equipment are free from ice.

g. Starting and Operating the Engine.

(1) INSPECT STARTER MECHANISM. Be sure that no heavy grease or dirt has been left on the starter throw-out 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 mixture required for cold weather starting. Check the butterfly valve to see that it closes all the way, and otherwise functions properly.

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

h. Chassis.

(1) BRAKE BANDS. Brake bands, particularly on a new vehicle, 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 the movement of the vehicle.

(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.

18. HOT WEATHER OPERATION.

a. General. Operation of these vehicles in high temperatures requires regular maintenance of cooling units, lubrication-filtering devices, and air cleaners. Avoid the continuous use of low gear ratios whenever possible. Frequently inspect and service the air cleaners, fuel filter, and oil filter during operation in dusty areas. Watch the temperature and oil gages constantly. Check and replenish oil and water frequently. CAUTION: *Inspect vehicle frequently for broken screws, bolts, or other metal parts, and for loosened nuts.*

b. Cooling System Maintenance.

(1) COOLING LIQUID. The formation of scale and rust in the cooling system occurs more often during operation at extremely high temperatures, so that rust preventives should always be added to the cooling liquids. Use only clean water. Avoid the use of water that contains alkali or other substances which may cause scale and rust formations.

(2) COOLING SYSTEM. Thoroughly clean and flush the cooling system at frequent intervals when operating in extremely high temperatures.

(3) FAN BELT AND WATER PUMP. Inspect fan belt at regular intervals, and adjust if necessary (par. 76). Water pump must be kept in good operating condition.

(4) THERMOSTAT. Check operation of thermostat (par. 79). Thermostat must open at calibrated temperature to prevent overheating of cooling liquid.

(5) HOSE CONNECTIONS. Check hose connections frequently for leaks.

c. Hot Dry Climates.

(1) Keep cooling system full of recommended coolant, and maintain proper level of correct grade of lubricating oil in lubricating system. Check engine temperature frequently. If temperature rises above 190°F, stop engine and inspect cooling system. Flush system if necessary. Look for sand in radiator fins, and blow out with compressed air, if available.

(2) Under desert conditions, check oil filter, carburetor, and air cleaner every few hours, and service as necessary.

(3) Under sandy conditions, use lubricants sparingly. Clean all sand from fittings before lubricating.

(4) Do not park vehicle in sun for long periods, because this shortens life of tires. If possible, place vehicle under cover to protect it from sand and dust. Cover inactive vehicles with tarpaulins if no suitable building is available.

d. Hot Damp Climates.

(1) Keep cooling system clean and filled with clean, fresh (not salt) water. Use soft water when possible. Note engine temperature as registered by

temperature gage frequently. Stop vehicle immediately if temperature of engine rises above 190°F.

(2) Protect exterior surfaces from atmosphere by renewing paint on all painted surfaces, and keeping a film of light engine oil on unfinished exterior metal surfaces.

(3) Flush metal surfaces which have been exposed to salt water with fresh water, and apply a film of light engine oil to unfinished metal parts.

(4) Make frequent inspections of stored vehicles. Remove corrosion from exterior surfaces with flint paper 2/0 (from machined surfaces with crocus cloth), and apply a protective coating of paint, oil, or rust-preventive compound.

e. Battery.

(1) WATER LEVEL. In torrid zones, check cell water level daily, and replenish as necessary with pure distilled water or, if this is not available, any water fit to drink. However, continuous use of water with high mineral content will eventually cause damage to battery and should be avoided.

(2) SPECIFIC GRAVITY. Batteries operating in torrid climates should have a weaker electrolyte than for temperate climates. Instead of 1.300 gravity, the electrolyte should be adjusted to around 1.210 to 1.230 for a fully charged battery. This will prolong the life of the negative plates and separators. Under this condition battery should be recharged at about 1.160. Where freezing conditions do not prevail, there is no danger with gravities from 1.230 to 1.075.

(3) SELF-DISCHARGE. A battery will self-discharge at a greater rate at high temperatures if standing for long periods. This must be taken into consideration when operating in torrid zones. If necessary to park for several days, remove and store battery in a cool place.

19. OPERATION IN MUD, SNOW, ICE, SAND, AND FLOOD.

a. Mud. Install tire chains on all rear wheels, and select low enough gear ratio to move vehicle steadily without putting undue driving strain on engine and axles.

b. Snow and Ice. Skidding is the general hazard encountered under these conditions. Install tire chains, and select the proper gear ratio to move the vehicle steadily, without imposing undue strain on engine and axles. When skidding occurs, turn the front wheels in the same direction that the rear end is skidding. Decelerate the engine, and apply brakes very gradually until vehicle is under control. Proceed with caution. Remove chains as soon as their use is no longer necessary.

c. Sand. The main objective when driving in sand is to avoid spinning the driving wheels. If possible, lay an improvised track of planks or brush in order to prevent the wheels from coming in contact with loose footing. Do not let the motor labor. Reverse and go forward several times, if necessary, until a solid road bed is reached.

d. Flood. Know the fording depth of the vehicle (approximately 30 in.), and do not exceed this limit. Reduce the vehicle speed to 4 miles per hour. Proceed with caution. Exercise care to avoid water damage to electrical and driving systems. Service lubricated parts which have been affected by mud and water at the earliest opportunity.

e. Precaution. Do not allow mud, snow, or ice to cake on wheels, steering knuckles, and steering arms, or to gather on the oil filter or air filter openings. Inspect and clean mud, snow, or ice from radiator core, fan, and fan belt. Keep all electrical connections free from mud, snow, ice, and moisture.

20. DECONTAMINATION.

a. Poisonous Gas. Removing and destroying dangerous chemical agents encountered when operating in affected areas is known as decontamination. For instructions, refer to FM 17-59.

PART THREE

MAINTENANCE INSTRUCTIONS

Section VIII

Lubrication

21. LUBRICATION ORDER.

a. War Department Lubrication Order No. 533 (figs. 19 and 20) prescribes first and second echelon lubrication maintenance. Refer to paragraph 22 for lubrication to be performed by Ordnance personnel.

b. A Lubrication Order is placed on or is issued with each item of materiel and is to be carried with it at all times. In the event the materiel is received without a WDLO, the using arm shall immediately requisition a replacement from the Adjutant General Depot. See lists in FM 21-60.

c. Lubrication instructions on the WDLO are binding on all echelons of maintenance and there shall be no deviations, except as indicated in subparagraph *d* below.

d. Service intervals specified on the Order are for normal operating conditions above 0°F when vehicle is in use. Reduce the intervals under extreme conditions such as excessively high or low temperatures, prolonged periods of high-speed operation, continued operation in sand or dust, immersion in water, or exposure to moisture, any one of which may quickly destroy the protective qualities of the lubricant. Intervals may be extended when vehicle is not in use.

e. Lubricants are prescribed in the "Key" in accordance with three temperature ranges, "above +32°F," "+32°F to 0°F," and "below 0°F." When to change grades of lubricants is determined by maintaining a close check on operation of the materiel during the approach to changeover periods, especially during initial action. Sluggish starting is an indication of lubricants thickening, and is 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.*

22. DETAILED LUBRICATION INSTRUCTIONS.

a. Lubrication Equipment.

(1) Each piece of materiel is supplied with lubrication equipment adequate to maintain the materiel. Clean this equipment both before and after use.

(2) Operate lubrication guns carefully and in such manner as to ensure a proper distribution of the lubricant.

b. Points of Application.

(1) Lubrication fittings, grease cups, oilers and oil holes are readily located by referring to the WDLO. These devices and the surrounding surfaces will be wiped clean before lubricant is applied.

(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 WDLO.

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

d. Lubrication Notes on Individual Units and Parts. The following instructions supplement those notes on the Lubrication Order which pertain to lubrication and service of individual units and parts. See figures 21 to 25 for localized lubrication views.

(1) AIR CLEANERS:

(a) *Oil Bath Type.* Daily, check level and refill engine air cleaner and valve cover breather (if so equipped) oil reservoirs to bead level with used crankcase oil, or engine oil SAE 30 above +32°F, or SAE 10 below +32°F. Every 1,000 miles, disassemble and wash all parts.

(b) *Mesh Type.* Every 1,000 miles, wash and reoil Hydrovac or vacuum cylinder air cleaners and crankcase breather in crankcase fill cap, with used crankcase oil or engine oil, SAE 30 above +32°F, or SAE 10 below +32°F.

(2) CLUTCH PILOT BEARING. When the clutch pilot bearing is made accessible either by engine removal or transmission removal, inspect, clean and repack with general purpose grease, No. 2.

(3) CRANKCASE. Daily, check level and refill to "FULL" mark with engine oil, SAE 30 above +32°F, or SAE 10 from +32°F to 0°F. Below 0°F refer to paragraph 17. Every 1,000 miles, remove drain plug from bottom of crankcase and completely drain crankcase. Drain only when engine is hot. After thoroughly draining, replace drain plug and refill crankcase to "FULL" mark on gage with correct lubricant to meet temperature requirements. Run engine a few minutes and recheck oil level. Be sure pressure gage indicates oil is circulating.

(4) DISTRIBUTOR. Every 1,000 miles, lubricate distributor shaft with general purpose grease No. 1 above +32°F, or No. 0 below +32°F, by turning grease cup one full turn. Refill as required. Every 6,000 miles, wipe the distributor breaker cam lightly with general purpose grease, No. 1 above +32°F, or No. 0 below +32°F. Also lubricate the breaker arm pivot and wick under rotor with one to two drops of engine oil, SAE 30 above +32°F, SAE 10 from +32°F to 0°F, or special preservative lubricating oil below 0°F.

No. 533

WAR DEPARTMENT LUBRICATION ORDER

WAR DEPARTMENT WASHINGTON 25, D. C., 25 AUGUST 1944

TRUCK, 2½ TON, 4x2 (2dt) (IHC K-7)

BUS, 37 PASS., 4x2 (IHC KS-7)

SNL G-841.

For detailed instructions, refer to TM 9-822.

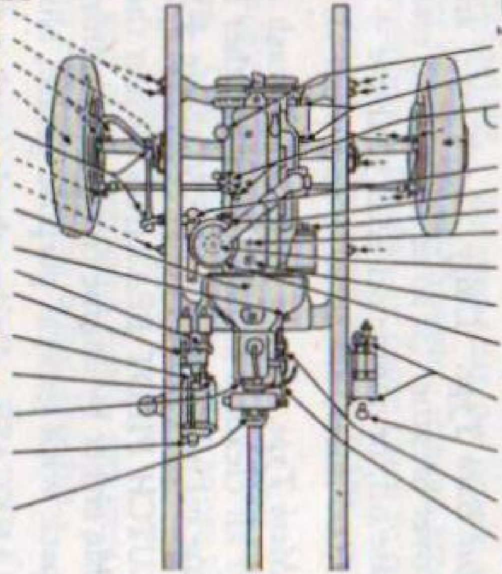
Clean fittings before lubricating. Lubricate after washing.

Clean parts with SOLVENT, dry cleaning or OIL, fuel, Diesel. Dry before lubricating.

Requisition replacement Lubrication Orders from the Commanding Officer, Fort Wayne Ordnance Depot, Detroit 32, Michigan.

NOTE—See Reverse Side for lubrication of DUMP BODIES

Service intervals are based on actual operation under normal conditions above 0°F. Reduce under extreme conditions. Extend when not in use.
Lubricate dotted arrow points on both sides.
Opposite points are shown by short arrows.

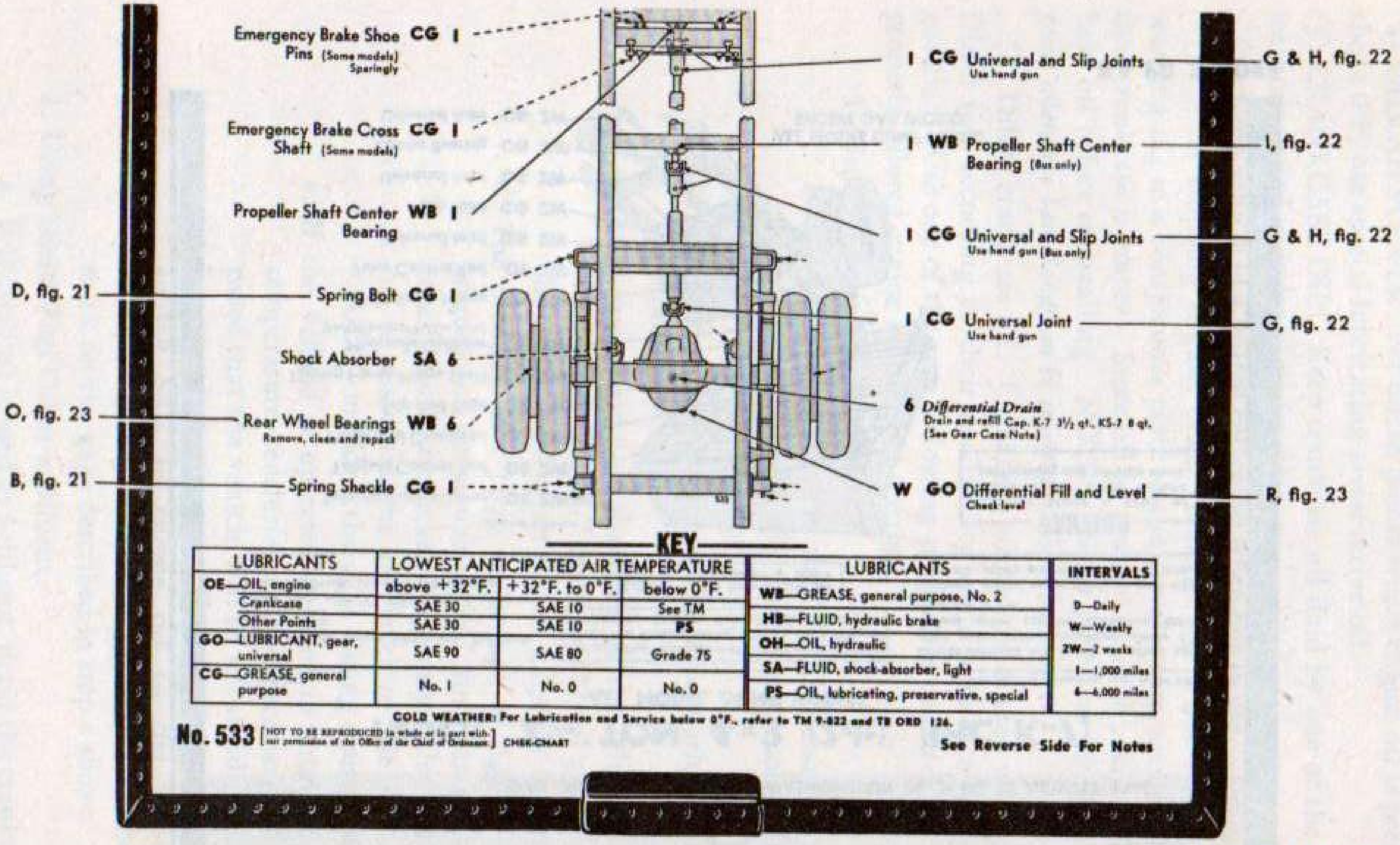


		Lubricant	Interval
A, fig. 21	Spring Shackle	CG	I
	Shock Absorber	SA	6
M, fig. 23	King Pin	CG	I
N, fig. 23	Front Wheel Bearings (Remove, clean and repack)	WB	6
F, fig. 21	Drag Link	CG	I
E, fig. 21	Tie Rod	CG	I
C, fig. 21	Spring Bolt	CG	I
	Clutch Pilot Bearing (See Note)	WB	
L, fig. 22	Clutch Release Shaft	CG	I
K, fig. 22	Brake Pedal	CG	I
J, fig. 22	Clutch and Brake Pedal Bracket	CG	I
	Brake Master Cylinder (Fill to ½ in. from top)	HB	I
	Brake Vacuum Cylinder (Some models) (Lubricate with 1 oz.)	SA	6
	Transmission Drain Drain and refill Cap. 4½ qt. (See Gear Case Note)		6
AA, fig. 25	Brake Vacuum Cylinder	OE	I
AA, fig. 25	Air Cleaner (Some models) (See Note)		
G, fig. 22	Universal Joint (Use hand gun)	CG	I

Serviced From Under Hood

Interval	Lubricant		
	OE	Crankcase Fill	W, fig. 24
I	OE	Generator 6 to 8 drops (Some models)	U, fig. 24
6		Distributor (See Note)	
I	CG	Distributor Shaft Turn cup down 1 full turn, refill as required	T, fig. 24
I	GO	Steering Gear	P, fig. 23
D		*Crankcase Level* Check level	
I	OE	Starter 6 to 8 drops	V, fig. 24
I	OE	Valve Cover Breather (Some models) (See Air Cleaner Note)	
I		*Oil Filter* (Some models) Drain sediment (See Note)	
I		*Crankcase Drain* Drain and refill Cap. 7 qt. (See Note)	
D	OE	Air Cleaner Check level (See Note)	X, fig. 24
6	SA	Hydrovac Cylinder (Some models) Lubricate through each plug with ½ oz.	Z, fig. 25
I	OE	Hydrovac Air Cleaner (Reached from under seat) (Some models) (See Note)	AB, fig. 25
W	GO	Transmission Fill and Level Check level	Q, fig. 23
6	CG	Speedometer Cable Remove core and coat lightly with No. 0	

RA PD 344097



LUBRICANTS	LOWEST ANTICIPATED AIR TEMPERATURE			LUBRICANTS	INTERVALS
	above +32°F.	+32°F. to 0°F.	below 0°F.		
OE—OIL, engine				WB—GREASE, general purpose, No. 2	D—Daily
Crankcase	SAE 30	SAE 10	See TM	HB—FLUID, hydraulic brake	W—Weekly
Other Points	SAE 30	SAE 10	PS	OH—OIL, hydraulic	2W—2 weeks
GO—LUBRICANT, gear, universal	SAE 90	SAE 80	Grade 75	SA—FLUID, shock-absorber, light	I—1,000 miles
CG—GREASE, general purpose	No. 1	No. 0	No. 0	PS—OIL, lubricating, preservative, special	6—6,000 miles

RA PD 344097B

Figure 19 — Lubrication Order — Chassis

No. 533

WAR DEPARTMENT LUBRICATION ORDER

WAR DEPARTMENT WASHINGTON 25, D. C., 25 AUGUST 1944

TRUCK, 2½ TON, 4x2 (2dt) (IHC K-7)

ALL MODEL DUMP BODIES

SNL G-541.

For detailed instructions, refer to TM 9-822.

Clean fittings before lubricating. Lubricate after washing.

Clean parts with SOLVENT, dry cleaning or OIL, fuel, Diesel. Dry before lubricating.

Requisition replacement Lubrication Orders from the Commanding Officer, Fort Wayne Ordnance Depot, Detroit 32, Michigan.

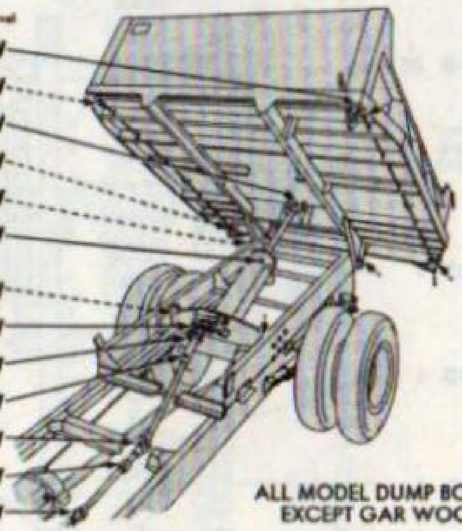
NOTE—See Reverse Side for lubrication of TRUCK

Service intervals are based on actual operation under normal conditions above 0°F. Reduce under extreme conditions. Extend when not in use.

Lubricate dotted arrow points on both sides. Opposite points are shown by short arrows.

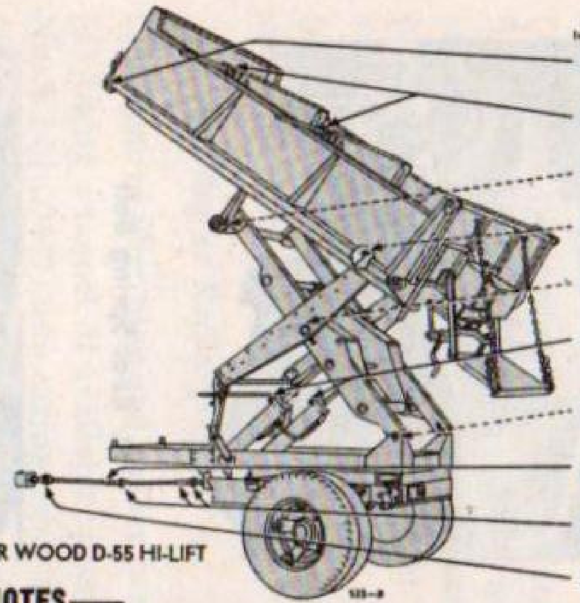
CAUTION Always place a prop or block under body before performing any service work.

	Lubricant	Interval
Tailgate Control Lever	OE	2W
Tailgate Control Rod	OE	2W
Piston Rod Crosshead	CG	2W
Trip Rod Yoke	OE	2W
Tipping Frame Hinge Shaft	CG	2W
Hydraulic Cylinder (Use OH below 0°F. [See Note])	OE	2W
Cylinder Hinge	CG	2W
Valve Control Rod	OE	2W
Universal Joint	CG	2W
Slip Joint	CG	2W
Universal Joint	CG	2W
Center Bearing	CG	2W
Universal Joint	CG	2W



ALL MODEL DUMP BODIES EXCEPT GAR WOOD

RA PD 344098



GAR WOOD D-55 HI-LIFT

—NOTES—

AIR CLEANERS AND BREATHERS—(Oil Bath Type) Fill to bead level. Every 1,000 miles, disassemble and wash all parts. (Mesh Type) Every 1,000 miles, wash and reoil Hydrovac or vacuum cylinder air cleaners and crankcase breather in crankcase fill cap. Used crankcase oil or OE will be used above 0°F. or OE SAE 10 below 0°F. in all air cleaners and breathers.

CLUTCH PILOT BEARING—When clutch is disassembled for any purpose, remove, clean and repack.

CRANKCASE—Drain only when engine is hot. After refilling run engine a few minutes and recheck oil level.

DISTRIBUTOR—Wipe breaker cam lightly with CG and lubricate breaker arm pivot and wick under rotor with 1 to 2 drops of OE.

GEAR CASES—Drain only after operation. Fill to plug level when hot, or to within ½ inch of plug level when cold. Clean vents weekly and after operation in mud or sand.

HYDRAULIC CYLINDERS—To fill hydraulic cylinder, raise body to maximum position. Prop up body to prevent accident, remove filler plug from cylinder and fill with correct grade of oil to overflowing. With engine idling, engage power take-off and shift valve control lever into "Raise" position and add oil. Leave out filler plug, remove prop and lower body to force out excess oil. Raise body and replace plug. Every 6 months, disconnect oil line from pump, drain and refill.

OIL FILTER—Every 6,000 miles, while crankcase is being drained, remove element, clean inside of case, install new element.

OIL CAN POINTS—Every 1,000 miles, lubricate Throttle and Choke Linkage, Clutch and Hand Brake Linkage, Pintle Hook (some models), Pins, Linkage and other rubbing parts with OE.

DO NOT LUBRICATE—Clutch Release Bearing, Springs, Generator (some models).

DISASSEMBLED PERIODICALLY BY ORDNANCE PERSONNEL—Water Pump. (Refer to TM 9-822.)

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 25 August 1944.

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

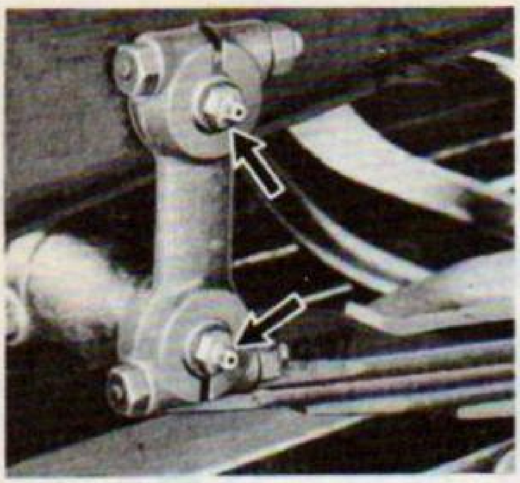
OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

See Reverse Side For Key

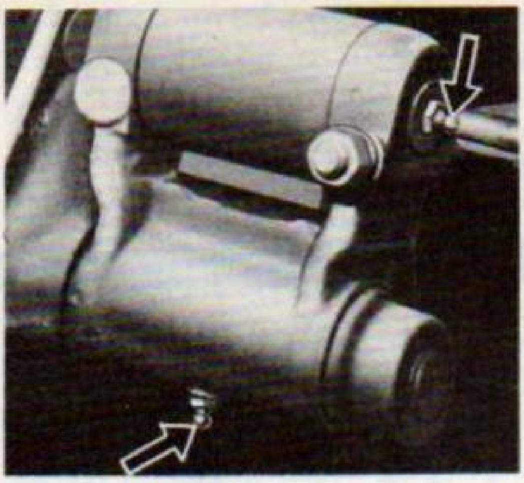
No. 533 [NOT TO BE REPRODUCED in whole or in part without permission of the Office of the Chief of Ordnance.] CHEK-CHART

RA PD 344098B

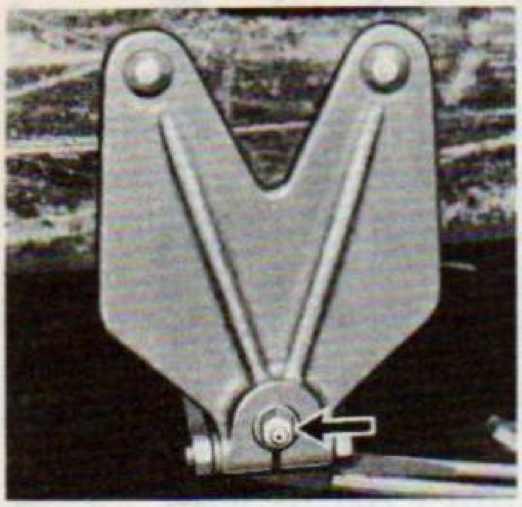
Figure 20 — Lubrication Order — Dump Bodies



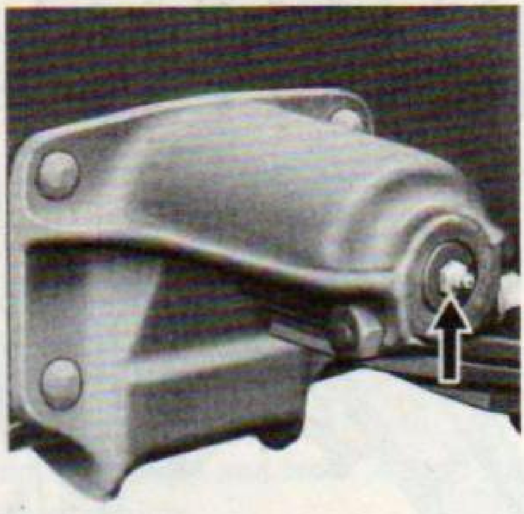
A. Front Spring Shackle



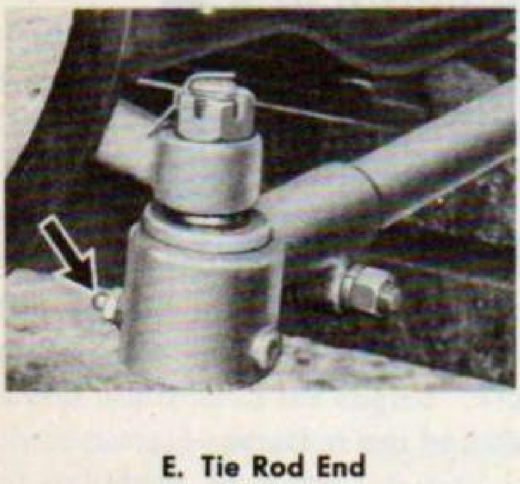
B. Rear Spring Shackle



C. Front Spring Bolt



D. Rear Spring Bolt

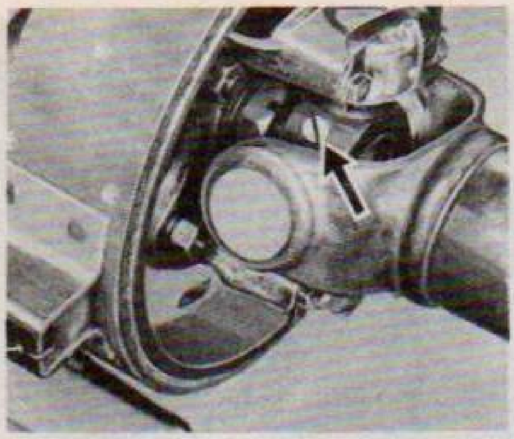


E. Tie Rod End

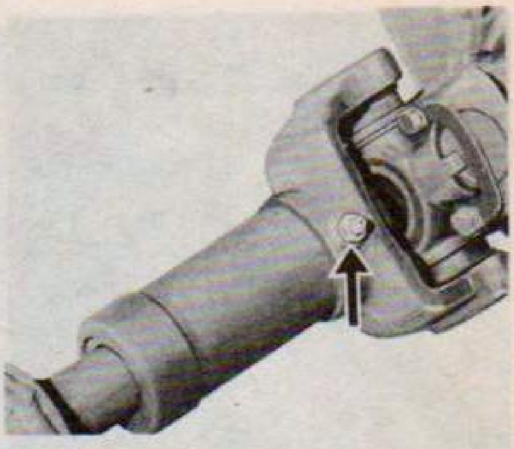
F. Drag Link

RA PD 323810

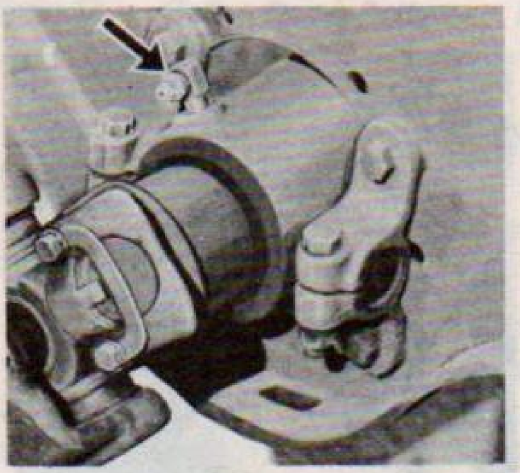
Figure 21 — Localized Lubrication Views



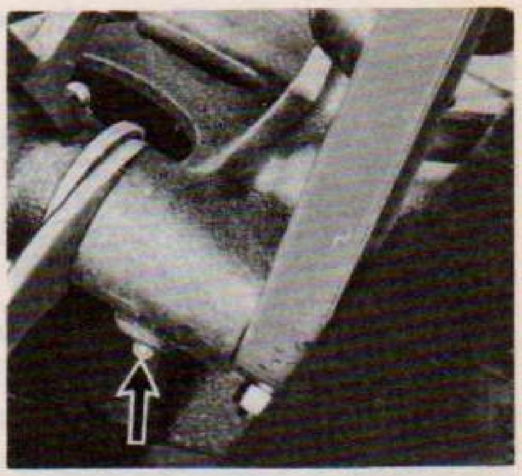
G. Universal Joint



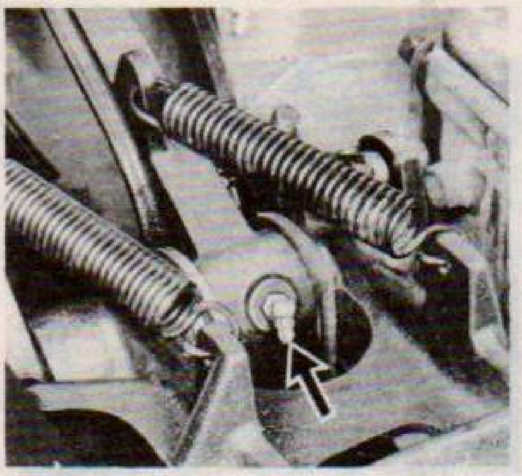
H. Universal Slip Joint



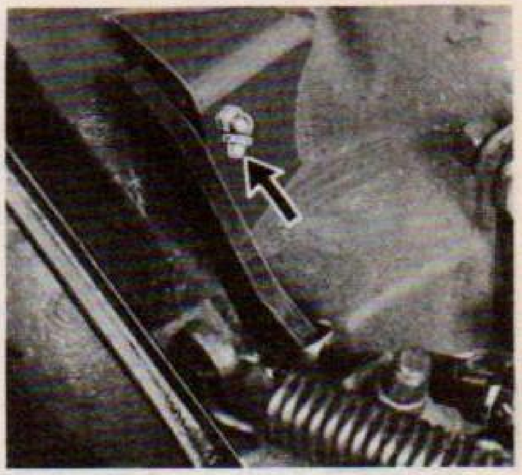
I. Propeller Shaft Center Bearing



J. Clutch and Brake Pedal Bracket



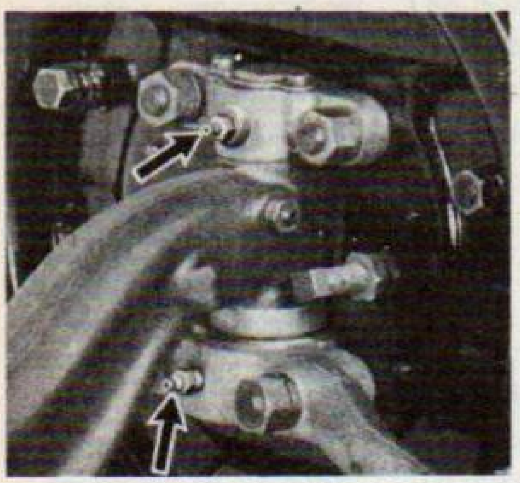
K. Brake Pedal



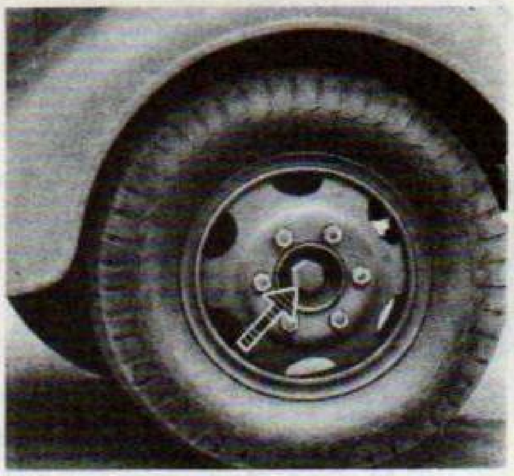
L. Clutch Release Shaft

RA PD 323811

Figure 22 — Localized Lubrication Views

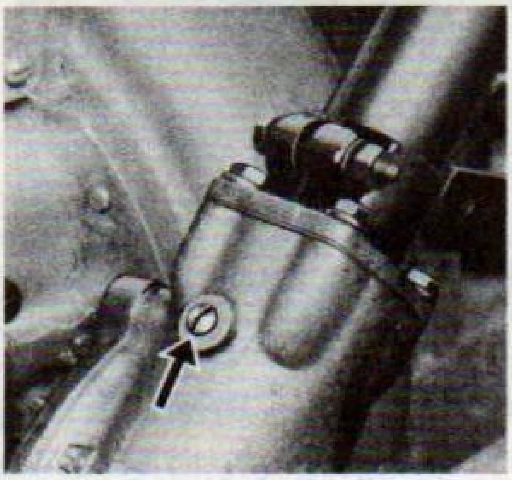


M. King Pin

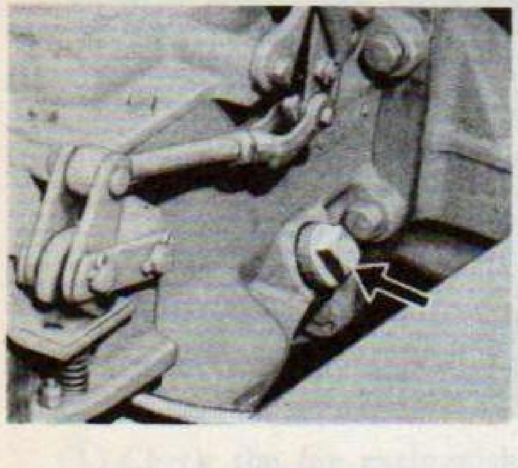


N. Front Wheel Bearings

O. Rear Wheel Bearings



P. Steering Gear Filler Plug

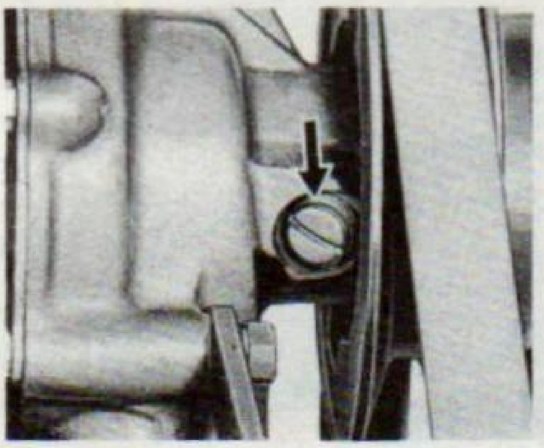


Q. Transmission Filler Plug

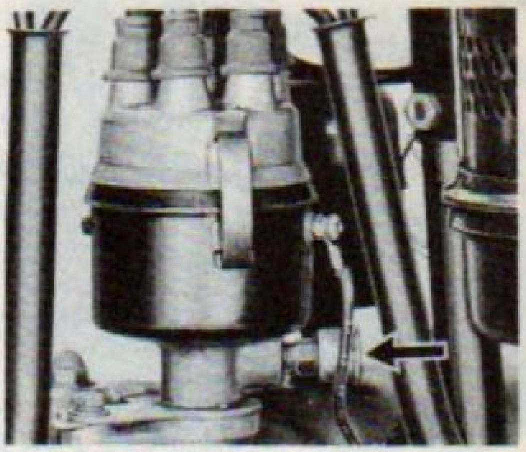
R. Differential Filler Plug

RA PD 323812

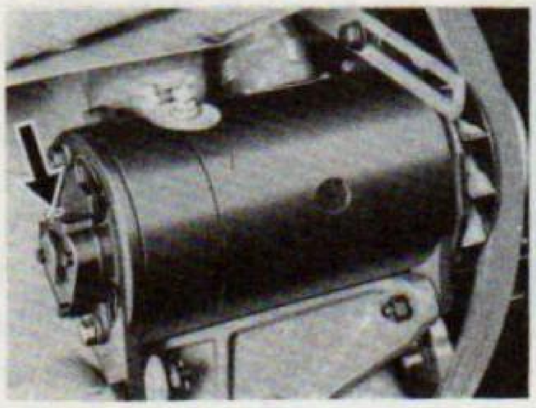
Figure 23 — Localized Lubrication Views



S. Water Pump Filler Plug

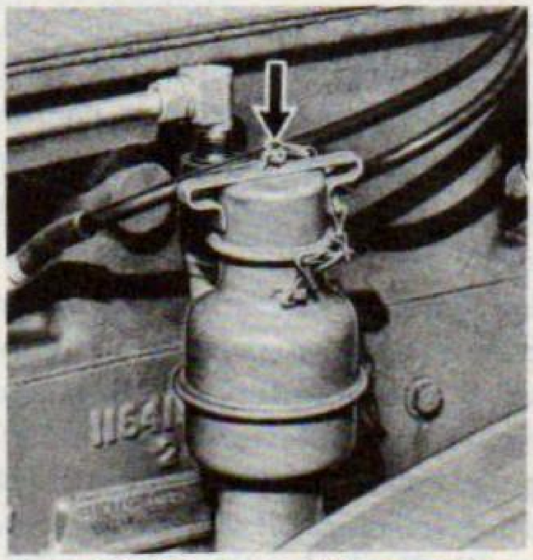


T. Distributor Grease Cup



U. Generator Oil Cup

V. Starter Oil Cup

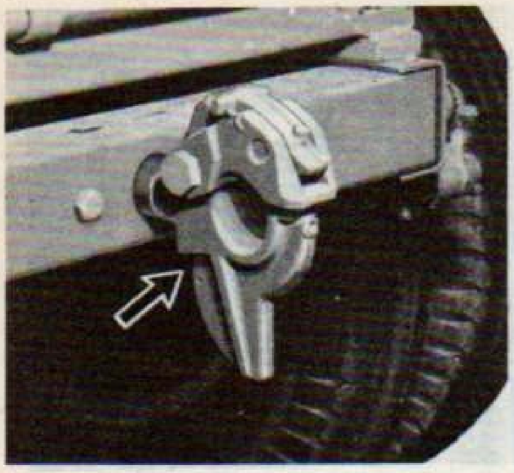


W. Crankcase Filler Cap

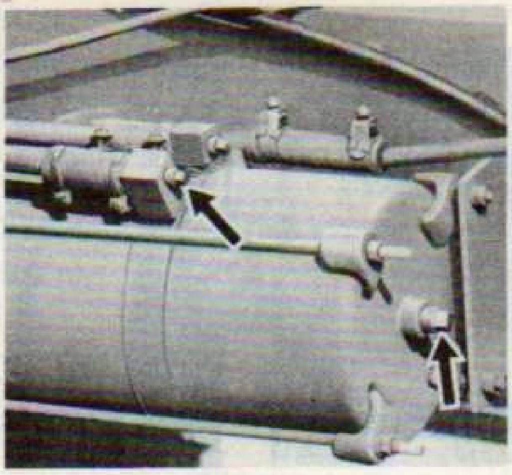
X. Air Cleaner Oil Cup

RA PD 323813

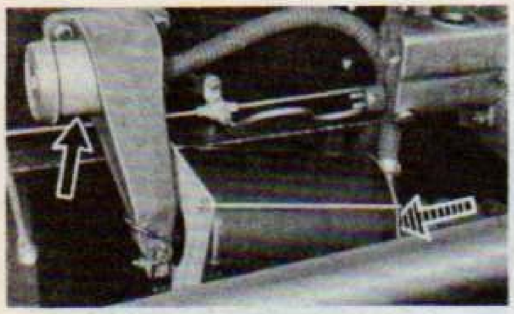
Figure 24 — Localized Lubrication Views



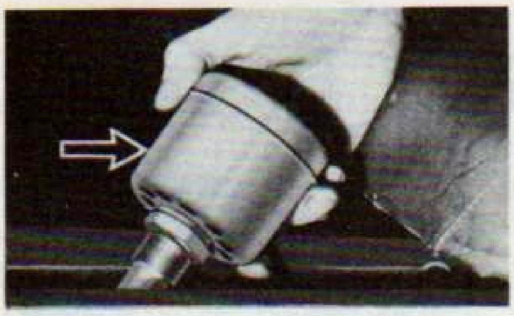
Y. Pintle Hook



Z. Hydrovac Cylinder Plug



AA. Brake Vacuum Cylinder and Air Cleaner



AB. Hydrovac Air Cleaner

RA PD 323814

Figure 25 — Localized Lubrication Views

(5) GEAR CASES. Weekly, check level with vehicle on level ground and, if necessary, add lubricant to within ½ inch of plug level when cold, or to plug level when hot. Clean vents weekly, and after operation in mud or sand. Every 6,000 miles, drain and refill. Drain only after operation when gear lubricant is warm. Refill with universal gear lubricant, SAE 90 above +32°F, SAE 80 from +32°F to 0°F, or Grade 75 below 0°F.

(6) HYDRAULIC CYLINDER. To fill hydraulic cylinder, raise body to maximum position. Prop up body to prevent accident, remove filler plug from cylinder and fill with correct grade of oil to overflowing. With engine idling, engage power take-off and shift valve control lever into "RAISE" position and add oil. Leave out filler plug, remove prop and lower body to force out excess oil. Raise body and replace plug. Every six months, disconnect oil line from pump, drain and refill. Use hydraulic oil below 0°F.

(7) OIL FILTERS. Every 1,000 miles, remove drain plug from oil filter to drain sediment. Every 6,000 miles, while crankcase is being drained, remove filter element, clean inside of case and install new element. After

renewing element, run engine a few minutes, recheck crankcase oil level and fill to "FULL" mark with the correct grade of engine oil.

(8) WHEEL BEARINGS. Remove bearing cone assemblies from hub. Wash bearings, cones, spindle and inside of hub and dry thoroughly. Do not use compressed air. Inspect bearing races and replace if damaged. Coat the spindle and inside of hub and hub cap with general purpose grease, No. 2 to a maximum thickness of $\frac{1}{16}$ inch only to retard rust. Lubricate bearings with general purpose grease (WB), No. 2 with a packer, or by hand, kneading lubricant into all spaces in the bearing. Use extreme care to protect the bearings from dirt and immediately reassemble and replace wheel. Do not fill hub or hub cap. The lubricant in the bearing is sufficient to provide lubrication until the next service period. Any excess might result in leakage into the drum. Adjust bearings in accordance with instructions in paragraph 131.

(9) OILCAN POINTS. Every 1,000 miles, lubricate throttle and choke linkage, clutch and hand brake linkage, pintle hook (some models) pins, linkage and other rubbing parts, with engine oil, SAE 30 above +32°F, SAE 10 from +32°F to 0°F, special preservative lubricating oil below 0°F.

(10) DO NOT LUBRICATE. *Do not lubricate* clutch release bearing, springs, or generator (some models).

e. Lubricated by Ordnance Personnel.

(1) WATER PUMP. When disassembled for inspection or repair, wash bearing assembly, dry, and knead general purpose grease, No. 2 thoroughly into bearing retainers.

f. Reports and Records.

(1) REPORTS. Report unsatisfactory performance of materiel to the Ordnance Officer responsible for maintenance in accordance with TM 38-250.

(2) RECORDS. A record of lubrication may be maintained in the Duty Roster (W.D., A.G.O. Form No. 6).

Section IX

New Vehicle Run-in Test

23. PURPOSE.

a. When a new or reconditioned vehicle is first received by 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, perform a run-in test of at least 50 miles, as directed in AR 850-15, paragraph 25, table III, according to procedure in paragraph 25 below.

24. 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.

25. PROCEDURE.

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, and add as necessary to bring to correct levels. Allow room for expansion in fuel tank and radiator. During freezing weather, test value of antifreeze solution, and add as necessary to protect cooling system against freezing (par. 17 *e* (4)). 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 FILTERS. Remove drain plug from primary filter (on vehicles so equipped), and drain off accumulated dirt and water. Remove carburetor filter bowl and strainer (on vehicles so equipped). Wash thoroughly in dry-cleaning solvent, and reinstall securely. Be sure gasket is serviceable. If any appreciable amount of dirt or water is evident in a filter, clean entire fuel system.

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

(5) AIR CLEANERS, BREATHER CAP, AND VENTILATOR. Examine carburetor and brake vacuum cylinder air cleaners, crankcase breather cap and ventilator tubes, and metering valve to see that they are in good condition and securely connected or mounted. Look for oil leaks. Inspect air cleaner elements for excessive dirt, and clean and service as required. See Lubrication Order, paragraph 22.

(6) ACCESSORIES AND BELTS. See that all accessible accessories, such as carburetor, generator, regulator, starter, distributor, water pump, fan, and fan drive belt, are in good condition and securely assembled or mounted. Be sure fan drive belt is adjusted to provide $\frac{1}{2}$- to $\frac{11}{16}$-inch finger-pressure deflection.

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

(8) TIRES. See that all tires, including spare, are properly inflated to proper pressure (dump truck, 35 pounds front, 45 pounds rear; bus 60 pounds front, 65 pounds rear), stems in correct position, and all valve caps present and finger-tight. Remove objects lodged in treads and carcasses, and between dual wheels, and inspect tires for damage.

(9) WHEEL AND FLANGE NUTS. Inspect all wheel mounting nuts and axle flange nuts or screws, and wheel rim lug nuts (on vehicles so equipped), to be sure they are present and secure.

(10) FENDERS, BUMPER, AND SPLASH GUARDS. Examine front fenders and running boards, front bumper, and rear splash guards (on vehicles so equipped) for looseness or damage.

(11) TOWING CONNECTIONS. Examine tow hooks and pintle hook (on vehicles so equipped) to see that they are in good condition and secure. Be sure pintle latch operates properly and locks securely.

(12) BODY AND TARPAULIN. Inspect cab and/or body for damage, for loose assembly or mounting nuts or screws, and for broken assembly welds. Be sure all body attachments, hardware, or brackets are in good condition and secure. Examine tarpaulin (where furnished) for damage, and see that it is properly installed and lashed or, if not in use, properly stowed.

(13) LUBRICATE. Perform a complete lubrication of the vehicle covering all intervals according to the instructions on the Lubrication Order, paragraph 22, omitting gear cases, wheel bearings, and other units covered in preceding procedures. Check all gear case oil levels, and add oil as necessary to bring to correct level. Change only if condition of oil indicates the necessity, or if gear oil is not of proper grade for existing atmospheric temperature. NOTE: *Perform operations (14) to (17) during lubrication.*

(14) SPRINGS AND SUSPENSION. Inspect front and rear springs and shock absorbers, and suspension bolts, arms, or brackets, for looseness and damage. Look particularly for shifted spring leaves, excessive spring sag, or leaking shock absorbers.

(15) STEERING LINKAGE. Inspect all rods, connections, arms, and steering gear case for looseness and damage.

(16) PROPELLER SHAFTS AND CENTER BEARING. Inspect all shafts, universal joints, and center bearing to see that they are in good condition, correctly assembled, alined, secure, and not leaking excessively at seals.

(17) AXLE VENT. Inspect axle vent to see that it is 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 control button.

(19) ENGINE WARM-UP. Start engine, noting starter action and any tendency toward hard starting. Set hand throttle to run engine at fast idle (800 rpm) during warm-up. Reset choke control button so that engine will run smoothly without over-choking and oil dilution.

(20) INSTRUMENTS.

(a) *Oil Pressure Gage*. Normal oil pressure at idle speed is 15 pounds, at operating speeds, 40 pounds. Stop engine and investigate if oil pressure is too high or too low for safe engine operation.

(b) *Ammeter*. Ammeter may show high charging rate for first few minutes after starting engine until generator has restored to battery the current used, then register slight charge or zero with lights and accessories turned off. High charging rate for extended period may indicate a dangerously low battery or faulty regulator.

(c) *Engine Temperature Gage*. Temperature should rise gradually during warm-up. Normal operating temperature is 160°F to 180°F. If temperature continues to rise above 190°F, stop engine and investigate.

(d) *Fuel Gage*. Fuel gage should register approximate amount of fuel in tank.

(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 operate through their full range, and if blades contact glass evenly and firmly.

(23) GLASS AND REAR-VIEW MIRRORS. Clean all cab and/or body glass and mirrors, and inspect for looseness and damage. Adjust rear-view mirrors 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 on ground under vehicle, and in engine compartment, for evidence of fuel, oil, water, and shock absorber or hydraulic fluid leaks, and around axles and transmission for evidence of grease leaks. Trace all leaks to their source, and correct them or report them to higher authority.

(26) TOOLS AND EQUIPMENT. Check tools and equipment against vehicle stowage lists (pars. 7 and 8) to be sure all items are present, and see that they are serviceable and properly mounted or stowed.

*b. **Run-in Test.*** Perform the following services 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. *Avoid continuous operation of the vehicle at speeds approaching the maximum indicated on the maximum speed plate (par. 13 **e** (1)).*

(1) INSTRUMENTS AND GAGES. Do not move vehicle until engine temperature reaches 140°F. Maximum safe operating temperature is 190°F. Observe readings of ammeter and oil, temperature, and fuel gages to be sure they are indicating the proper functioning of the units to which they apply. Also see that speedometer registers the vehicle speed, and that odometer registers total accumulating mileage.

(2) BRAKES. Test service brakes as soon as vehicle is put in motion, and before attaining any appreciable speed, to see if they stop the vehicle effectively. Note any side pull, grab, chatter, or squealing. Stop vehicle on a reasonable incline. The parking brake should hold the vehicle, and the locking mechanism should hold the control lever in applied position, with at least one-third of lever travel in reserve.

(3) CLUTCH. Observe if clutch operates smoothly, without grab, chatter, or squeal when engaging and without slippage when fully engaged and under load. See that pedal has 1¾- to 2-inch free travel before meeting resistance. CAUTION: *Do not ride clutch pedal at any time, and do not engage and disengage a new clutch severely or unnecessarily before the driven and driving disks have become properly worn in.*

(4) TRANSMISSION AND POWER TAKE-OFF. Gearshifting mechanism should operate easily and smoothly. Gears should operate without unusual noise, and must not slip out of mesh.

(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 unusual engine noise, and for

abnormal engine operating characteristics, 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 cab and/or body and attachments, running gear, suspension, or wheels that might indicate looseness, damage, wear, inadequate lubrication, or underinflated tires. NOTE: *Halt vehicle at 10-mile intervals, or less, for services (8) to (10).*

(8) BRAKE BOOSTER OPERATION.

(a) *Vacuum Power System.* Stop the engine, apply slight foot pressure to the service brake pedal, and again start the engine. As engine is started, and the vacuum is actuated, a slight depression of the pedal should be felt, indicating that the system is operative.

(b) *Hydrovac System.* As the brake pedal is applied and released, listen at the Hydrovac air cleaner for the sound of air movement. Lack of air movement indicates that the system is not operating properly.

(9) TEMPERATURES. Cautiously feel each brake drum and wheel hub for abnormally high temperatures. Examine transmission and differential housing for indications of overheating and excessive lubricant leaks at seals, gaskets, or vents.

(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. ***Vehicle Publications and Reports.***

(1) PUBLICATIONS. See that vehicle technical manuals, Lubrication Order, Standard Report Form No. 26 (Driver's Accident Report, Motor Transportation), and W.D., A.G.O. Form No. 478 (MWO and Major Unit Assembly Replacement Record) are in the vehicle, legible, and properly stowed. NOTE: *U.S.A. registration number and vehicle nomenclature must be filled in on Form No. 478 for new vehicles.*

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

Section X

First Echelon Preventive Maintenance

26. PURPOSE.

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

b. Driver's preventive maintenance services are listed on the back of "Driver's Trip Ticket and Preventive Maintenance Service Record," W.D. Form No. 48, covering vehicles of all types and models. Items peculiar to specific vehicles, but not listed on W.D. Form No. 48, are covered in manual procedure under the items with 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 or not they are listed specifically on W.D. Form No. 48.

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 or not the item is in good condition, correctly assembled, secure, or excessively worn.

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

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

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

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

27. BEFORE-OPERATION SERVICE.

a. This inspection schedule is designed primarily as a check to see that the vehicle has not been damaged, tampered with, or sabotaged since the previous After-operation Service was performed. Various combat conditions may have rendered the vehicle unsafe for operation, and it is the duty of the driver to determine whether or not the vehicle is in condition to carry out any mission to which it may be assigned. The 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. Inspect the vehicle generally for any injury that may have occurred after it was parked as a result of tampering, sabotage, falling debris, shell fire, or collision.

(2) ITEM 2, FIRE EXTINGUISHER. Examine the fire extinguisher to be sure it is in good condition, fully charged, and securely mounted. Remove filler plug to determine contents. Be sure nozzle is not clogged.

(3) ITEM 3, FUEL, OIL, AND WATER. Check the supply of fuel, engine oil, and coolant, and replenish as necessary. Investigate or report any unusual losses. Do not fill fuel tank or radiator to overflowing. Leave room for normal expansion. NOTE: *During weather when antifreeze is in use, if it becomes necessary to add any considerable amount of coolant, have value of antifreeze solution checked, and add sufficient solution to protect cooling system against freezing.*

(4) ITEM 4, ACCESSORIES AND DRIVES. Inspect carburetor, generator, regulator, starter, air cleaners, and fuel and oil filters for looseness or damage. Be sure fan drive belt is in good condition, and that adjustment provides approximately $\frac{1}{2}$- to $\frac{11}{16}$-inch deflection under normal finger-pressure. If wet, dry off ignition wiring and equipment to facilitate starting.

(5) ITEM 6, LEAKS—GENERAL. Look under vehicle, and within engine compartment, for indications of fuel, oil, coolant, or brake or hydraulic fluid leaks. Trace any leaks found to their source, and correct them or report to higher authority.

(6) ITEM 8, CHOKE. In conjunction with item (7) following, test operation of choke mechanism and control to be sure they function properly.

(7) ITEM 7, ENGINE WARM-UP. Start engine, taking all necessary starting precautions outlined in paragraph 13 *c* (1). Observe if starter action is satisfactory, and particularly if it has adequate cranking speed and engages and disengages properly without excessive noise. Set hand throttle so that engine will run at fast idle (800 rpm) during warm-up period, and reset choke control button as necessary for engine to run smoothly without overchoking and oil dilution. CAUTION: *If satisfactory oil pressure for safe operation of the engine is not indicated within 30 seconds, stop engine and investigate or report condition to higher authority.*

(8) ITEM 9, INSTRUMENTS.

(a) *Oil Pressure Gage.* Normal engine oil pressure at idle speed is 15 pounds, and at operating speed it is 40 pounds.

(b) *Ammeter.* Ammeter may show high charging rate for first few minutes after starting engine, until generator has restored to battery the current used, then register slight charge or zero with lights and accessories turned off. High charging rate for extended period may indicate a dangerously low battery or faulty regulator.

(c) *Engine Temperature Gage.* Reading should increase gradually during warm-up to normal operating range of 160°F to 180°F. Maximum safe operating temperature is 190°F. CAUTION: *Do not move vehicle until engine temperature has reached at least 140°F.*

(d) *Fuel Gage.* Gage should register the approximate amount of fuel in tank. Ordinarily, tank will have been filled and gage should register "FULL".

(9) ITEM 10, HORN AND WINDSHIELD WIPERS. If tactical situation permits, test horn for proper operation and tone. Test action of windshield wipers. Examine wiper motors, blades, and arms for looseness and damage, and see that blades contact glass evenly and firmly, and operate through their full stroke.

(10) ITEM 11, GLASS AND REAR-VIEW MIRRORS. Clean all vehicle glass and inspect it for looseness and damage. Adjust rear-view mirrors for correct vision.

(11) ITEM 12, LAMPS (LIGHTS) AND REFLECTORS. Clean off light and safety reflector lenses, and inspect units for looseness and damage. If tactical situation permits, open and close all light switches, and observe if lamps respond properly.

(12) ITEM 13, WHEEL AND FLANGE NUTS. Examine all wheel mounting and axle flange nuts or cap screws (lug nuts on spoke type wheels) to be sure they are all present and secure.

(13) ITEM 14, TIRES. Inspect all tires (including spare) for damage and underinflation. Remove all objects lodged in treads or between duals. Be sure valve stems are in correct position, and that all valve caps are present and finger-tight.

(14) ITEM 15, SPRINGS AND SUSPENSIONS. Inspect all springs, hangers, shackles, and shock absorbers for looseness or damage. Look particularly for broken or shifted spring leaves and excessive spring sag.

(15) ITEM 16, STEERING LINKAGE. Inspect all steering arms, rods, joints, and connections, and steering gear case for looseness or damage.

(16) ITEM 17, FENDERS AND BUMPER. Examine front fenders and running boards, front bumper, and rear splash guards (if used), for looseness or damage.

(17) ITEM 18, TOWING CONNECTIONS. Examine all tow hooks and rear pintle hook (when so equipped) for looseness and damage. Be sure pintle operates properly and locks securely.

(18) ITEM 19, BODY, LOAD, AND TARPAULIN. Inspect cab and/or body, mountings, attachments, and hardware to be sure they are in good condition, and that all assembly and mounting nuts or screws are secure. Look for broken assembly welds. Be sure doors and tailgate (on dump truck) operate and fit properly, and lock securely. Any loaded cargo must be properly distributed and secure. Examine tarpaulin (if used) for damage, and be sure it is correctly installed and lashed, or properly stowed.

(19) ITEM 20, DECONTAMINATOR. Examine cylinder for damage and full charge. Remove filler plug to determine contents. Be sure unit is securely mounted.

(20) ITEM 22, ENGINE OPERATION. After normal operating temperature (160°F to 180°F) has been reached, engine should idle smoothly with choke fully opened and throttle closed. Accelerate and decelerate a few times, and watch for any unsatisfactory operating characteristics, or unusual noise, vibration, or exhaust smoke.

(21) ITEM 21, TOOLS AND EQUIPMENT. Check to be sure all vehicle tools and items of equipment are present, serviceable, and properly and securely mounted or stowed (pars. 7 and 8).

(22) ITEM 23, DRIVER'S PERMIT AND VEHICLE PUBLICATIONS. The driver must have his operator's permit on his person. Vehicle and equipment manuals, Lubrication Order, Standard Form No. 26 (Driver's Accident Report) and Form No. 478 (MWO and Major Unit Assembly Replacement Record) must be present, legible, and properly stowed.

28. 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 for 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; fuel vapor from a leak in fuel system; exhaust gas; or other signs of trouble. Each time the brakes are used, gears shifted, or vehicle turned, consider this a test, and notice any unsatisfactory or unusual performance. Watch the instruments constantly. 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 procedure 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 PARKING BRAKES. When vehicle is first moved, but before it gains any appreciable speed, test brakes to be sure they stop vehicle effectively, and observe if there is any excessive pull to one side, chatter, grabbing, or squealing. Brake pedal should have about ¼- to ½-inch free travel before moving master cylinder piston. Stop vehicle on a reasonable incline, and test parking brake to see if it holds effectively, locks securely in applied position, and has at least one-third travel in reserve.

(2) ITEM 28, CLUTCH. Clutch pedal should have 1¾ to 2 inches of free travel before meeting resistance, and should engage without chatter, grabbing, or squealing. There should be no slippage when fully engaged under load.

(3) ITEM 29, TRANSMISSION. Shifting mechanism of transmission and power take-off (where used) should operate easily, and gears should operate without unusual noise and without slipping out of mesh.

(4) ITEM 31, ENGINE AND CONTROLS. Driver should be on the alert for deficiencies in engine performance, such as lack of power and acceleration, misfiring, backfiring, unusual noise, indications of overheating or excessive smoke. Observe whether or not engine accelerates satisfactorily and controls operate without excessive looseness or binding. If radio noise due to vehicle operation is reported, driver will cooperate with radio operator in locating the interference (sec. XXIII).

(5) ITEM 32, INSTRUMENTS. Observe all instruments frequently during operation of the vehicle to be sure they indicate or record the proper functioning of the units to which they apply. Speedometer should register vehicle speed in miles per hour, and odometer should record total accumu-

lated mileage. There should be no unusual noise in instrument or cable, or any pointer fluctuation.

(6) ITEM 33, STEERING GEAR. Be on the alert for any unusual steering characteristics, such as excessive looseness or binding, pull to one side, shimmy, wander, or wheel tramp. Be sure column bracket and steering wheel are secure.

(7) ITEM 34, RUNNING GEAR. Listen for any unusual noise from wheels, axles, springs, or suspension units that would indicate loose or damaged parts, inadequate lubrication, or underinflated tires.

(8) ITEM 35, BODY. During operation of the vehicle, be on the alert for indications of loosened body mountings, attachments, hardware, or shifting of load, or (when used) tarpaulin or curtain fastenings. During operation of the dump truck body hoist equipment, observe if controls function properly, and if all pertinent units respond properly. Be sure hoist will raise body to full "RAISE" position, and that it does not slip down due to a hoist deficiency. See that body lowers properly and rests in correct alinement with frame.

29. AT-HALT SERVICE.

a. The At-halt Service may be regarded as 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 procedure following each item, and correcting any deficiencies found. Deficiencies not corrected should be reported promptly to the designated individual in authority.

(1) ITEM 38, FUEL, OIL, AND WATER. Check to see that there is adequate fuel, oil, and water to operate vehicle to next scheduled stop. Replenish as supply and tactical situation permit. Loosen radiator cap cautiously, and do not fully remove until hissing has stopped.

(2) ITEM 39, TEMPERATURES—HUBS, DRUMS, TRANSMISSION, AND AXLE. Cautiously feel each wheel hub and brake drum for abnormal heat. Examine transmission and axle housing for overheating, and for excessive lubricant leakage.

(3) ITEM 40, AXLE VENT. Inspect vent to see that it is present, secure, and not clogged.

(4) ITEM 41, PROPELLER SHAFTS AND CENTER BEARING. Remove anything wound around propeller shafts or universal joints. Inspect shafts, joints, and center bearing for looseness or damage, and for excessive lubricant leakage at seals.

(5) ITEM 42, SPRINGS AND SUSPENSIONS. Examine all springs, hangers, shackles, and shock absorbers for looseness and damage.

(6) ITEM 43, STEERING LINKAGE. Examine steering arms, rods, joints, and connections for looseness and damage.

(7) ITEM 44, WHEEL AND FLANGE NUTS. Inspect wheel mounting, and axle flange nuts, cap screws, and lugs (on spoke-type wheels) to be sure they are present and secure.

(8) ITEM 45, TIRES. Examine all tires for underinflation and damage. Remove any objects lodged in treads or between duals.

(9) ITEM 46, LEAKS—GENERAL. Look under vehicle and in engine compartment for indications of fuel, oil, coolant, or shock absorber or hydraulic fluid leaks. Trace any leaks found to their source, and correct or report them.

(10) ITEM 47, ACCESSORIES AND BELTS. Inspect all accessible engine and other accessories for looseness or damage. Be sure fan drive belt is in good condition and properly adjusted to provide $\frac{1}{2}$- to $\frac{11}{16}$-inch finger-pressure deflection.

(11) ITEM 48, AIR CLEANERS. If operating under extreme conditions of dust or sand, examine carburetor, breather cap, and (if used) Hydrovac air cleaners to be sure they are in proper condition to deliver clean air. Clean and service as necessary according to Lubrication Order (par. 22).

(12) ITEM 49, FENDERS AND BUMPER. Inspect front fenders and running boards, front bumper, and (if so equipped) rear splash guards, for looseness and damage.

(13) ITEM 50, TOWING CONNECTIONS. Examine tow hooks and rear pintle hook (if so equipped) for looseness and damage. Be sure pintle operates properly and locks securely.

(14) ITEM 51, BODY, LOAD, AND TARPAULIN, Inspect cab and/or body, mountings, attachments, and hardware, to be sure they are in good condition, and that all assembly and mounting nuts or screws are secure. Look for broken assembly welds. Be sure doors and tailgate (on dump truck) operate and fit properly, and lock securely. Any loaded cargo must be properly distributed and secure. Examine tarpaulin (if used) for damage, and be sure it is correctly installed and lashed, or properly stowed.

(15) ITEM 52, GLASS. Clean all vehicle, light, and reflector glass, and inspect all units for looseness or damage.

30. AFTER-OPERATION AND WEEKLY SERVICES.

a. The 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 throughly, the vehicle should be ready to start again on a moment's notice. The Before-operation Service, with a few exceptions, is then necessary only to ascertain whether the vehicle is in the same condition in which it was left upon completion of the After-operation Service. The After-operation Service should never be entirely omitted even in extreme tactical situations, but may be reduced to the bare fundamental services outlined for the At-halt Service if necessary.

*b. **Procedures.*** When performing the After-operation Service, the driver must remember and give particular attention to 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 55, ENGINE OPERATION. Before stopping the engine, accelerate and decelerate a few times and note any excessive or unusual noise, vibration, or exhaust smoke. Investigate any unsatisfactory condition observed during operation.

(2) ITEM 56, INSTRUMENTS. Observe if all instruments continue to indicate the proper functioning of the units to which they apply.

(3) ITEM 57, HORN AND WINDSHIELD WIPERS. Investigate and correct or report any unsatisfactory operation of these items noted during operation. Stop engine.

(4) ITEM 54, FUEL, OIL, AND WATER. Fill the fuel tank. Check the engine oil level with the bayonet gage (dip stick) and, if necessary, fill crankcase to correct level. Check radiator coolant for proper level and contamination. Loosen radiator cap cautiously, do not fully remove until hissing has stopped, and add coolant as needed. In freezing weather, have coolant checked with hydrometer and add antifreeze compound with water as required. See that any fuel or water used from spare cans is replenished.

(5) ITEM 58, GLASS AND REAR-VIEW MIRRORS. Clean all vehicle glass and mirrors, and inspect for looseness and damage.

(6) ITEM 59, LAMPS (LIGHTS) AND REFLECTORS. Clean all light and safety reflector lenses, and inspect these units for looseness and damage. If during operation any unsatisfactory condition of the lights or switches was observed, investigate and correct, or report the condition.

(7) ITEM 60, FIRE EXTINGUISHER. Inspect unit for damage and full charge. Remove filler plug to check contents. If extinguisher has been used or damaged, report for refill or exchange. Be sure nozzle is not clogged. Mount unit securely.

(8) ITEM 61, DECONTAMINATOR. Follow instructions in preceding item 60.

(9) ITEM 62, *BATTERY.

(a) Inspect battery for damage, for loose hold-downs or connections, and for leaks. Be sure cell caps are present and finger-tight.

(b) *Weekly*. Clean battery and carrier. Examine terminals for corrosion. If necessary, clean connections, grease them lightly, and tighten them securely. If electrolyte is low, add clean water to bring level to $\frac{3}{8}$ inch above plates. CAUTION: *In freezing weather do not add water until just before vehicle is to be operated.*

(10) ITEM 63, ACCESSORIES AND BELTS. Inspect all accessible engine and other accessories for looseness or damage. Be sure fan drive belt is in good condition and properly adjusted to provide $\frac{1}{2}$- to $\frac{11}{16}$-inch finger-pressure deflection.

(11) ITEM 64, ELECTRICAL WIRING. Examine conduits and wiring for looseness or damage. Tighten all loose connections, and clean all accessible wiring. Be sure all radio noise suppression bond clips, straps, filters, condensers, and suppressors on all units are securely connected or mounted (par. 100). Tighten all conduit coupling ring nuts (where used).

(12) ITEM 65, AIR CLEANERS AND BREATHER CAP. Examine carburetor and brake vacuum power cylinder air cleaners, and crankcase breather cap for damage. Remove elements, and inspect them for excessive dirt. If necessary, clean and service these units according to instructions in Lubrication Order (par. 22).

(13) ITEM 66, *FUEL FILTER.

(a) Inspect fuel filter for looseness, damage, and leaks.

(b) *Weekly*. Remove filter sediment bowl and wash element and bowl in dry-cleaning solvent. Reinstall securely, using new gaskets as necessary. NOTE: *If any appreciable amount of dirt or water is found in filter, report for further cleaning of fuel system by higher echelon.*

(14) ITEM 67, ENGINE CONTROLS. Examine engine and accessory controls for loose, worn, or binding linkage.

(15) ITEM 68, *TIRES.

(a) Inflate all tires, including spare, to proper pressure measured when cool (dump truck 35 pounds front, 45 pounds rear, and bus 60 pounds front, 65 pounds rear). Inspect tires for damage. Remove any objects lodged in treads or between duals. Be sure valve caps are installed securely.

(b) *Weekly*. Report badly worn or otherwise unserviceable tires for repair or replacement. Mechanical defects that might contribute to such wear should be investigated and corrected or reported. Rotate unevenly worn but still serviceable tires to other wheel positions to even up wear.

(16) ITEM 69, SPRINGS AND SUSPENSIONS. Inspect all springs and shock absorbers for damage, and for loose assembly or mounting nuts. Look particularly for broken or shifted spring leaves, excessive spring sag, missing rebound clips, and loose U-bolts or shock absorber linkage.

(17) ITEM 70, STEERING LINKAGE. Examine all steering arms, rods, joints, connections, and steering gear case to be sure they are in good condition and securely assembled or mounted. Inspect gear case for excessive lubricant leakage. Be sure stops are in place.

(18) ITEM 71, PROPELLER SHAFTS AND CENTER BEARING. Inspect all propeller shafts and universal joints for damage. Be sure center bearing universal joints and yokes are secure. Remove any foreign material wound around shafts or joints. Examine seals for excessive lubricant leaks.

(19) ITEM 72, AXLE VENT. Inspect rear axle housing vent to see if it is in good condition, secure, and not clogged. Remove and clean vent passage, if necessary.

(20) ITEM 73, LEAKS—GENERAL. Look under vehicle and in engine compartment for indications of fuel, oil, coolant, and brake or hydraulic fluid leaks. Trace any leaks found to their source, and correct or report them.

(21) ITEM 74, *GEAR OIL LEVELS. Weekly, check level and condition of lubricant in transmission, rear axle, and steering gear cases, and report if low or contaminated. Proper oil level is from lower edge of filler hole when hot, to ½ inch below when cold.

(22) ITEM 76, FENDERS AND BUMPER. Inspect front fenders and running boards, front bumper, and rear splash guards (if used) for looseness and damage.

(23) ITEM 77, TOWING CONNECTIONS. Examine tow hooks and rear pintle hook (if used) for looseness and damage. Be sure pintle operates properly and locks securely.

(24) ITEM 78, BODY, LOAD, AND TARPAULIN. Inspect cab and/or body, mountings, attachments, and hardware to be sure they are in good condition and that all assembly and mounting nuts or screws are secure. Look for broken assembly welds. Be sure doors and tailgate (on dump truck) operate and fit properly, and lock securely. Any loaded cargo must be properly distributed and secure. Examine tarpaulin (if used) for damage, and be sure it is correctly installed and lashed, or properly stowed.

(25) ITEM 82, *TIGHTENING.

(a) Tighten all vehicle and attachment assembly or mounting nuts or screws where this inspection has indicated the necessity.

(b) *Weekly.* Tighten wheel mounting and axle flange nuts or screws, body mountings, engine mountings and accessories, spring U-bolts, clips and shackles, body attachments and any other units found loose during this service.

(26) ITEM 83, *LUBRICATE AS NEEDED.

(a) Lubricate any point of the vehicle where inspection has indicated that oilcan or hand greasing is necessary, and all points listed on the Lubrication Order (pars. 21 and 22) as requiring daily attention.

(b) *Weekly*. Lubricate all points listed on the Lubrication Order as requiring weekly attention, also any points where inspection or experience indicates the necessity for additional lubrication.

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

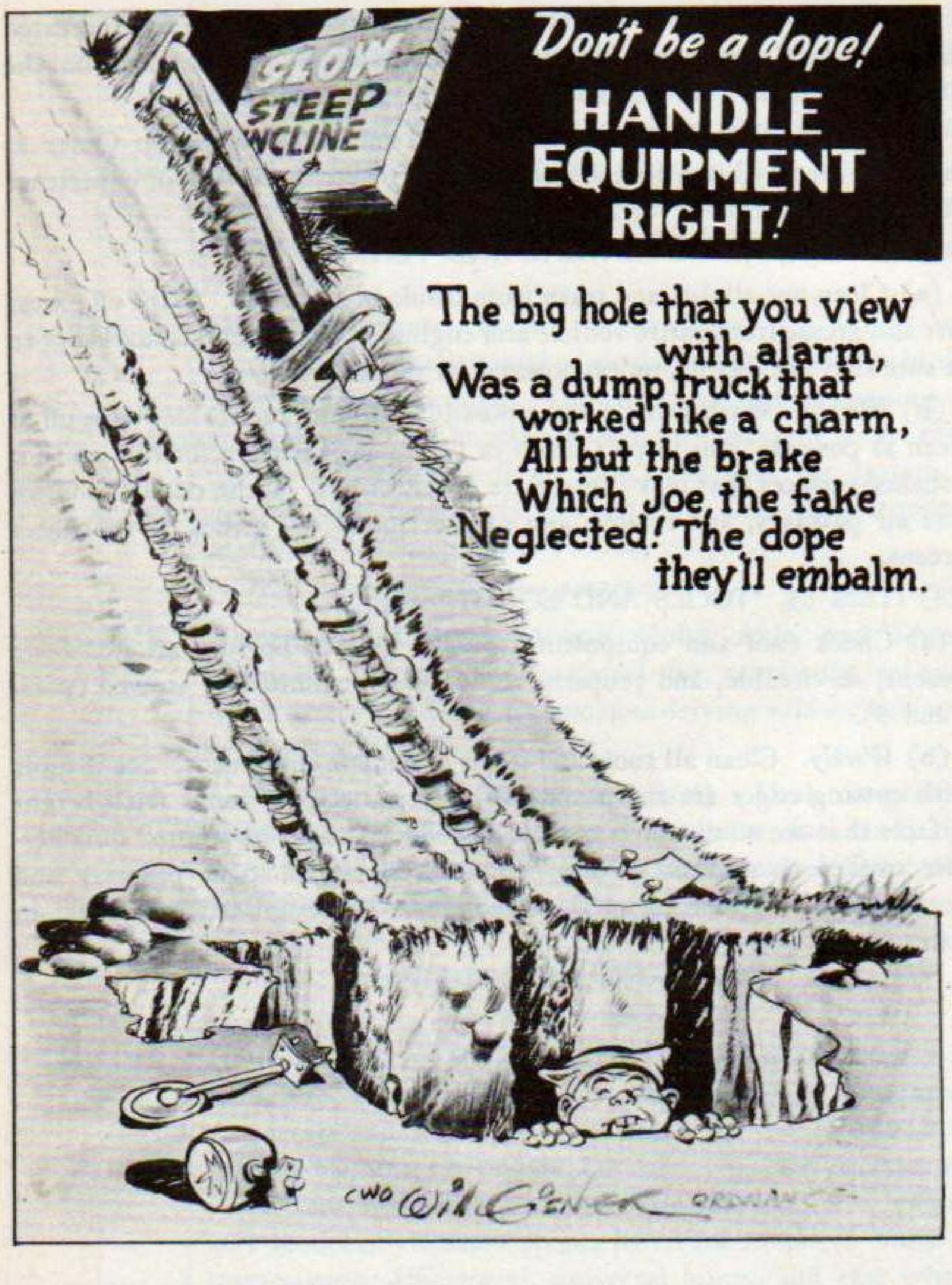
(a) Clean out all dirt and trash from inside body or cab. Wipe off excess dirt and grease from entire vehicle and engine. Inspect vehicle markings to be sure they are legible, unless covered for tactical reasons.

(b) *Weekly*. Wash vehicle when possible. If not practicable, wipe off as clean as possible, and inspect finish or camouflage pattern for rust and for polished surfaces that may cause glare or reflections. Clean out all radiator core air passages, and remove any obstructions from grilles or ventilator screens.

(28) ITEM 85, *TOOLS AND EQUIPMENT.

(a) Check tool and equipment stowage lists to be sure all items are present, serviceable, and properly and securely mounted or stowed (pars. 7 and 8).

(b) *Weekly*. Clean all tools and items of vehicle equipment. See if tools with cutting edges are sharp and properly protected. Items with bright surfaces that are mounted on outside of vehicle should be painted or otherwise treated to prevent glare. Mount or stow all items properly and securely. Report missing or damaged items to designated individual in authority.


SLOW
STEEP
INCLINE
Don't be a dope!
HANDLE
EQUIPMENT
RIGHT!
The big hole that you view
with alarm,
Was a dump truck that
worked like a charm,
All but the brake
Which Joe, the fake
Neglected! The dope
they'll embalm.
CWO Wil Glenek ORDNANCE

Section XI

Second Echelon Preventive Maintenance

31. SECOND ECHELON PREVENTIVE MAINTENANCE SERVICES.

a. Frequency. Regular scheduled maintenance inspections and services are a preventive maintenance function of the using arm, and are the responsibility of commanders of operating organizations. 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, dusty, sandy, or extremely wet terrain, or amphibian operations, it may be necessary to perform certain maintenance services more frequently.

b. 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.

c. Additional Instructions. If instructions other than those contained in the general procedures in subparagraph ***d*** or the specific procedures in subparagraph ***e***, which follow, are required for the correct performance of a preventive maintenance service or for correction of a deficiency, other sections of this manual pertaining to the item involved, or a designated individual in authority, should be consulted.

d. 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.*

(1) 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/or adjusted.

(2) When installing new lubricant retainer seals, a coating of the lubricant should be wiped over the sealing surface of the lip of the seal. When the

new seal is a leather seal, it should be soaked in SAE 10 engine oil (warm, if practicable) for at least 30 minutes, and the leather lip should then be worked carefully by hand before installing the seal. The lip must not be scratched or marred.

(3) The general inspection of each item applies also to any supporting member or connection, and usually includes a check to see whether the item is in good condition, correctly assembled, secure, or excessively worn. Mechanics must be thoroughly trained in the following explanations of these terms.

(a) 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, and not deteriorated.

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

(c) The inspection of a unit to determine if it is "secure" is usually an external visual examination, and a wrench, hand-feel, 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.

(d) "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.

(4) Special services are indicated by repeating the item numbers in the columns below, 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:

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

(b) *Clean.* Clean the 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 solvent, and dry them thoroughly. Take care to keep the parts clean until reassembled, and be certain to keep cleaning solvent away from rubber or other material that it would damage. Clean off the protective grease coating from new parts, since this material is usually not a good lubricant.

(c) *Special Lubrication.* This applies either to lubrication operations that do not appear on the vehicle Lubrication Order, or to items that do appear on the Order but which should be performed in connection with the maintenance operations only when parts have to be disassembled for inspection or service.

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

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

(5) 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 specified period if possible. All available time at halts and in bivouac areas must be utilized, if this is necessary to assure that maintenance operations are completed. When limited by the tactical situation, items with special services (step (4) above) in the columns, should be given first consideration.

e. Specific Procedure Item Numbers. The numbers of the preventive maintenance procedures that follow are identical with those outlined on W.D., A.G.O. Form No. 461 (Preventive Maintenance Service Work Sheet for Wheeled and Half-track Vehicles). Certain items on the work sheet that do not apply to these vehicles 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 mechanics' time and effort.

f. Specific Procedures. The procedures for performing each item in the 1,000-mile (monthly) and 6,000-mile (6-month) maintenance procedures, whichever shall occur first, are described in the following chart. Each page of the chart has two columns at its 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 number appears in that column, perform the operations indicated opposite the number.

Maintenance Six Months	Maintenance Monthly	ROAD TEST
		NOTE: *When the tactical situation does not permit a full road test, perform operations which require little or no movement of the vehicle. When a road test is possible, it should be for preferably 5 miles, and not over 10 miles.*
1	1	**Before-operation Service.** Perform the Before-operation Service as directed in paragraph 27.
3	3	**Instruments and Gages.** Before starting road test, observe if readings are satisfactory as follows:
		OIL PRESSURE GAGE. Oil pressure at idle speed should be 15 pounds, increasing to 40 pounds at normal operating speed.
		AMMETER. High charging rate may be indicated for a period of time, until generator restores to battery the current used in starting engine. High charging rate for extended period with all the electrical units turned off may indicate a low battery or a faulty regulator.
		TEMPERATURE GAGE. Reading should increase gradually during warm-up period until normal operating temperature of 160°F to 180°F is reached. CAUTION: *Stop engine and investigate if temperature rises above 190°F. Do not move vehicle until engine temperature reaches 140°F.*
		FUEL GAGE. The fuel gage should indicate the approximate amount of fuel in the tank.
		SPEEDOMETER AND ODOMETER. Speedometer needle should indicate vehicle speed, and odometer should record accumulating miles.
4	4	**Horn, Mirrors, and Windshield Wipers.** See that these items are in good condition and secure. If tactical situation permits, test horn for proper operation and tone. Adjust rear-view mirrors for correct vision. Test operation of windshield wipers, and see if blades contact glass evenly and firmly through their full stroke.
5	5	**Brakes (Service and Parking).** As soon as vehicle is put in motion and before gaining any appreciable speed, test service brakes to see if they stop vehicle effectively. There should be no pull to one side, chatter, grabbing, or squealing. Pedal should have about ¼ to ½ inch of free travel before meeting resistance, and should not feel hard or spongy. Stop vehicle on a reasonable incline, and test

Maintenance		
Six Months	Monthly	
		parking brake. It should hold the vehicle stationary, and control lever should lock securely in applied position and have at least one-third ratchet travel in reserve.
6	6	**Clutch.** While shifting gears, note any drag, chatter, or squealing of the clutch. Test for slipping while under load. Pedal free travel before meeting resistance should be $1\frac{3}{4}$ to 2 inches.
7	7	**Transmission and Power Take-off.** Control levers should operate freely, and gears must not slip out of mesh. Note any unusual noises that would indicate damaged gears or bearings, or inadequately lubricated parts.
8	8	**Steering.** Turn steering wheel full travel in both directions, road conditions permitting, and observe any looseness or binding. Note any tendency to wander, shimmy, or pull the vehicle to one side while driving in straight-ahead position. When the vehicle is stopped, inspect the steering wheel and column for good condition and secure mountings.
9	9	**Engine.** Make observations as follows:
		IDLE. The engine should idle smoothly (350 rpm) after reaching operating temperature (160°F to 180°F) with choke fully open and throttle closed.
		ACCELERATION AND POWER. Observe if engine accelerates satisfactorily, and if it has adequate pulling power in all gear ranges.
		NOISE. As engine is accelerated and decelerated, note any unusual noise or vibration that might indicate loose or damaged engine parts, mountings or accessories, or inadequate lubrication. A continued "ping" may indicate excessive carbon deposits or early timing. Note any excessive exhaust smoke.
		GOVERNED SPEED. With transmission in an intermediate gear, accelerate engine to top speed and observe if governor allows vehicle to attain, but not exceed, the maximum speed indicated on the caution plate. If necessary, adjust governor (fig. 47) according to instructions in paragraph 66.
10	10	**Unusual Noises.** During the road test, be on the alert for any unusual noises or vibration from body and attachments, or wheels and suspension units that might indicate loose, damaged, or improperly lubricated parts, or underinflated tires.
11	11	**Brake Vacuum Power Booster Operation.** As the service brakes are applied, observe if the B-K or Hydrovac booster

Maintenance Six Months	Maintenance Monthly	
		(as equipped) operates satisfactorily to assist in the efficient application of the brakes. Make minor test as follows:
		B-K Vacuum Power System. Stop engine. Apply brake several times to dispel all vacuum in system. Make a light brake application with the right foot, and hold in applied position. Start engine. If system is operating satisfactorily, the pedal will be pulled downward. Remove foot from pedal, and allow engine to idle a few seconds. Stop engine, and again apply brakes. Pedal should require no more physical effort for the same pedal travel than when engine is operating.
		Hydrovac System. Locate the air cleaner of this unit and listen closely for the sound of air movement while the brake pedal is being operated. The engine should be running so that this test may be repeated several times. If no air rush can be noticed, this is an indication that the system is inoperative. Also apply this test with the engine stopped, as a check for leaks in the vacuum system.
		NOTE: *For major test, see paragraph 121.*
13	13	**Temperature (Brake Drums, Hubs, Axle, and Transmission).** After completing road test, cautiously feel each brake drum, hub, transmission, and driving axle for evidence of overheating.
14	14	**Leaks (Engine Oil, Water, and Fuel).** Look on ground under vehicle, and around engine, radiator, fuel tank, and lines for evidence of fuel, oil, or water leaks. Trace any leaks found to their source, and correct or report them.
		MAINTENANCE OPERATIONS *Raise Vehicle — Block Safely*
17	17	**Unusual Noises (Engine, Belts, Accessories, Transmission, Propeller Shafts, Rear Axle, and Wheel Bearings).** Accelerate and decelerate the engine a few times, and listen for unusual noises in engine, fan drive belt, and accessories. Place transmission in an intermediate gear and, with engine at a moderate constant speed, listen for excessive noise in transmission, differential, universal joints, and rear wheel bearings. Investigate any noise in these units noticed during road test. Correct any deficiencies found, or report the condition for attention by higher echelon.
16	16	**Gear Oil Level and Leaks.** Check the level of the lubricant in the transmission, differential, and steering gear housings.

Maintenance: Six Months	Maintenance: Monthly	
		Examine oil for contamination and inspect units for leaks. Add oil to correct levels; or if a change of lubricant is due in any of these units, or condition of lubricant warrants, drain units and refill to correct levels. See Lubrication Order (pars. 21 and 22) for instructions.
22	22	**Battery.** Inspect battery case for cracks and leaks. Clean top of battery; inspect cables, terminals, bolts, posts, straps, and hold-downs for good condition. Test specific gravity, and record on W.D., A.G.O. Form No. 461. Specific gravity reading below 1.225 indicates battery should be recharged or replaced.
22		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, nuts, and battery posts. Inspect bolts for serviceability. Lightly grease posts before reassembling terminals. Tighten hold-down bolts carefully to avoid damage to the battery.
22	22	Add clean water to bring electrolyte ⅜ inch above plates.
18	18	**Cylinder Head and Gaskets.** Examine cylinder head to see that it is in good condition and secure, and look for oil, water, or compression leaks around bolts, or gaskets. Cylinder head should not be tightened unless there is definite evidence of looseness or leaks. If necessary to tighten cylinder head, tighten cylinder head bolts alternately, a little at a time, working from center of head outward, to a tension of 80 foot-pounds with torque-indicating wrench. NOTE: *After cylinder head is tightened, it is necessary to readjust valve stem to rocker arm clearance to from 0.018 to 0.020 inch with engine hot and running.*
	19	**Valve Mechanism.** Listen for noisy valves, indicating excessive valve stem to rocker arm clearance. Adjust clearance if need is indicated by excessive noise or faulty engine performance.
19		ADJUST. Adjust valve stem to rocker arm clearance to from 0.018 to 0.020 inch with engine hot and running (par. 53). Inspect valves, rocker arms, shafts, springs, and retainers to see that they are in good condition, correctly

Maintenance Six Months	Monthly	
		assembled, and secure. Make sure oil is being delivered to valve mechanism. Replace valve rocker arm cover gasket if unserviceable. Be sure bond strap is secure.
	20	**Spark Plugs.** Disconnect high-tension wires from spark plugs. Wipe the insulators clean. Inspect insulators for cracks or any indication of compression leaks. Connect wires.
20		SERVE. Clean dirt from around spark plug base. Remove spark plugs (par. 81), and clean thoroughly with abrasive-type cleaner, or install new or reconditioned plugs. Inspect insulators for cracks, and electrodes for excessive burning. Reset the gap, bending outer electrode only, to from 0.028 to 0.032 inch. After item 21 has been performed, install plugs, using new gaskets.
21		**Compression Tests.** Test compression of each cylinder (par. 49 ***a*** (1)), and record gage readings on W.D., A.G.O. Form No. 461. Normal compression at cranking speed is 110 to 120 pounds. Compression should not vary more than 10 pounds between cylinders.
23	23	**Crankcase.** Inspect oil pan, timing gear cover, and clutch housing for evidence of oil leaks. If an oil change is due, or if condition of oil indicates the necessity, remove oil pan drain plug, and drain the oil. Refill to proper level with specified oil. See Lubrication Order (pars. 21 and 22). CAUTION: *Do not start engine until item 24 has been performed.*
24	24	**Oil Filter and Lines.** Inspect filter unit and external engine oil lines to see if they are in good condition, securely connected and mounted, and not leaking. Remove filter body drain plug, and run off accumulated sediment.
24		SERVE. Remove oil filter cartridge (par. 57), clean and drain case, and install new cartridge, making sure to replace cover gasket when reassembling. Check filter for leaks after starting engine.
25	25	**Radiator (Shell, Core, Mountings, Hose, Cap and Gasket, and Antifreeze Solution).** Examine applicable items to see if they are in good condition, correctly assembled, securely mounted or supported, and free from coolant leaks. Clean out core air passages and grille guard, and straighten badly bent cooling fins. Be sure pressure cap valve is free, vent is open, and gasket is serviceable. During freezing weather, test value of antifreeze solution, and add as necessary to protect cooling system against freezing. Record

Maintenance Six Months	Maintenance Monthly	
		antifreeze value in space provided on Form No. 461. Examine coolant for contamination. If cleaning of cooling system is necessary, proceed only according to specific instructions for proper procedure with prescribed cleaning, neutralizing, and inhibiting materials. See paragraph 75. Be sure radio noise suppression bond straps from radiator shell to frame are clean and secure.
26	26	**Water Pump, Fan, and Shroud.** Examine water pump for evidence of leaks. See that fan blades are in good condition and mounting bolts tight. Note if there is noticeable end play in shaft. Inspect shroud to see that it is securely mounted, not bent, and that it does not contact the fan blades.
27	27	**Generator, Starter, and Switch.** Inspect these units to see if they are in good condition, securely connected and mounted, and clean. Momentarily test starter switches to see if they operate properly, that unit responds, and that they return to released position. See that radio noise suppression condenser and bond strap on generator are in good condition and securely connected or mounted.
27		Remove generator and starter inspection covers, and examine commutators and brushes to see if they are in good condition, clean, and not excessively worn. See if brushes are properly spring-loaded and connected. CLEAN. If commutators are dirty, clean with flint paper 2/0, and blow out accumulated dust with compressed air. Replace cover bands, and tighten all mounting bolts and electrical connections securely.
29	29	**Drive Belt and Pulleys.** Inspect fan and generator pulleys to see that they are in good condition and securely mounted. Examine drive belt for excessive wear or deterioration, and for adjustment. ADJUST. Adjust belt to allow $\frac{1}{2}$- to $\frac{11}{16}$-inch deflection (fig. 55) under normal finger-pressure halfway between the pulleys (par. 76 *b*).
31	31	**Distributor** (figs. 59, 60, and 61). Inspect distributor body and external attachments to see if they are in good condition, clean, and secure. Inspect other distributor parts as follows: CAP, ROTOR, AND POINTS. Remove and clean the cap. Look for cracks and carbon streaks in cap and rotor, and for corrosion of terminals and connections. See that points are well alined and adjusted to from 0.018 to 0.024 inch when

Maintenance		
Six Months	Monthly	
		wide open. If inside of distributor is dirty, remove assembly, clean in dry-cleaning solvent, dry thoroughly with compressed air, and lubricate according to Lubrication Order (par. 22). Replace breaker points that are pitted, burned, or worn to an unserviceable degree. Clean the points with 2/0 flint paper or a contact point dresser (never use emery), and blow out filings with compressed air. SHAFT. Feel the shaft and bushings for signs of excessive wear. CENTRIFUGAL ADVANCE. Install rotor on shaft, turn clockwise as far as it will go, and note if it will return to its original position when released without hang up or binding.
31		ADJUST. Set breaker point gaps to from 0.018 to 0.024 inch when wide open.
32	32	**Coil and Wiring.** Examine the ignition coil and wiring, including the radio noise resistor-suppressors on spark plugs and distributor, to see if they are in good condition, clean, and securely connected and supported. Be sure suppressors are not scorched or cracked. Inspect all low-voltage wiring in engine compartment in a like manner.
33	33	**Manifolds.** Inspect intake and exhaust manifolds for cracks, gasket leaks, or loose mounting nuts.
33		TIGHTEN. Tighten all manifold and mounting nuts securely.
34	34	**Air Cleaner** (fig. 53). Inspect carburetor air cleaner to see if it is in good condition, securely mounted and connected, and not leaking. Remove reservoir and element, wash in dry-cleaning solvent, dry, fill reservoir to proper level with clean engine oil (par. 22), and reassemble. Be sure gaskets are in place and all joints and air horn connections tight.
35	35	**Breather Cap and Ventilator.** Inspect crankcase breather cap, and ventilator tubing and valve to see if they are in good condition and secure. Remove and clean breather cap filter element in dry-cleaning solvent. Fill reservoir to correct level with clean oil (par. 58).
35		Remove ventilator metering valve (fig. 42), clean off all varnish or carbon deposits with dry-cleaning solvent, and reassemble securely (par. 58).
36	36	**Carburetor (Choke, Throttle, Linkage, and Governor).** Inspect all these items to see if they are in good condition, correctly assembled, and secure. Examine carburetor and line connections for leaks, and control linkage for excessive

Maintenance		
Six Months	Monthly	
		wear. Be sure choke and throttle open and close fully in response to operation of controls. The governor should be properly sealed.
37	37	**Fuel Filter.** Inspect primary filter (on vehicles so equipped) to see if it is in good condition, securely mounted and connected, and not leaking. Clean filter bowl and element in dry-cleaning solvent, and reassemble securely, using new gaskets if necessary. Recheck for leaks.
38	38	**Fuel Pump.** Inspect pump to see that it is in good condition, securely mounted, and not leaking.
38		Test. Attach pressure gage to fuel inlet line at carburetor (par. 67 ***b***) and start engine. Fuel pump pressure should be 3 to 4 pounds with engine running at idle speed.
39	39	**Starter.** Start engine, observe if action of starter is satisfactory, and note particularly if starting drive engages and disengages properly without unusual noise and has adequate cranking speed to start engine readily. As engine starts, observe if all instruments are operating properly.
40	40	**Engine Oil, Fuel, and Water Leaks.** With engine running and oil, fuel, and cooling systems under pressure, recheck each system thoroughly for leaks, and correct or report any leaks found.
41	41	**Ignition Timing.** Check ignition timing marks on crankshaft pulley and on pointer on gear case. They should line up as neon timing light flashes. Accelerate engine, and note if centrifugal advance is operating correctly.
41		Adjust. Adjust the ignition timing, following the instructions in paragraph 49.
42	42	**Engine Idle and Vacuum Tests.**
		Engine Idle. Make necessary carburetor adjustments according to paragraph 66 ***b***.
		Vacuum Test. Connect a vacuum gage, and test according to paragraph 49 ***a*** (2).
43	43	**Generator Regulator.** Inspect regulator unit and radio noise suppression filter and condensers to be sure they are in good condition, clean, and securely mounted and connected.
43		Connect a low-voltage circuit test instrument, and observe if voltage and current regulators and cut-out properly control generator output. Follow the instructions which accompany test instrument.
47	47	**Tires and Rims, Including Spares.** See if all valve stems

Maintenance		
Six Months	Monthly	
		are in good condition and in correct position. Replace leaky valve cores and missing caps. Examine tires for cuts, bruises, breaks, blisters, and irregular tread wear. Remove imbedded glass, nails, or stones from treads. Inflate tires to correct pressure (dump truck 35 pounds front, 45 pounds rear; bus 60 pounds front, 65 pounds rear). Determine, and correct or report, mechanical deficiencies causing abnormal tire wear. Remove tires worn thin at center of tread or otherwise unserviceable, and exchange for new or retreaded tires. Change the wheel position of tires with irregular wear, to equalize wear of all tires. When switching tire positions, spare tires must be mounted on one of the road wheels. Inspect rims for damage, and tighten all wheel lug nuts.
47		MATCHING TIRES. Match tires according to tread wear and over-all circumferences. With tires properly inflated, ¾-inch variation is permissible in over-all circumferences.
48		**Rear Brakes.** Remove rear wheels. NOTE: *On 6,000-mile maintenance, several wheel bearing and brake items up to 52 are group services and overlap. Perform in best order for economy of time and orderly reassembly.* Inspect and service as follows:
		DRUMS AND SUPPORTS. Clean dirt and grease from drums and supports (dust shields) keeping dry-cleaning solvent away from linings. Examine drums and supports to see if they are in good condition and securely mounted, and if drums are excessively worn or scored.
		WHEEL CYLINDERS. Inspect cylinders to see if they are in good condition, securely mounted and connected, and not leaking. See if rubber end covers are deteriorated.
	49	TIGHTEN. Tighten front brake support cap screws and all hub to drum screws securely.
		Rear Brake Shoes (Linings, Linkage, Guides, and Anchors). Inspect linings through inspection holes in brake drums to see if they are worn so that rivet heads may score drums within next 1,000 miles of operation. If vehicle has recently been operated in deep water, mud, loose sand, or dirt that may have entered brake drums, remove rear hub and drum for inspection of brake linings to determine whether they should be replaced and whether lubricant has been contaminated. If linings on one wheel brake must

Maintenance Six Months	Maintenance Monthly	
		be replaced, remove all wheels and service the brakes similarly.
49		With rear wheels removed, inspect linings to see if they are in good condition, secure to brake shoes, in good wearing contact with drums, free of dirt or lubricant, and not excessively worn. Also see that brake shoes are in good condition, properly secured and guided by anchor bolts and springs, and return to brake camshaft by retracting springs. Clean all dust from linings with a wire brush, clean cloth, or compressed air. Linings worn to rivet heads, or that will not be serviceable until the next inspection, should be replaced.
49	49	ADJUST. If linings are slightly worn, make minor brake shoe adjustment to compensate for wear (par. 127 *b* (2) (a)). Where new linings have been installed, adjust shoes by the major adjustment method (par. 127 *b* (2) (b)). Rear brake shoes should have a clearance of 0.008 inch at cam (heel) end of brake shoe, and 0.012 inch at the toe of the shoe (fig. 112).
	52	**Rear Wheel (Bearings, Seals, Drive Flanges, and Nuts).** Revolve the wheels to test for run-out, and listen for any indications of damaged wheel bearings. Gripping top and bottom of wheel, push in top while pulling out bottom to test wheel bearing adjustment. Tighten wheels, and adjust bearings (par. 131 *c*).
52		CLEANING. Disassemble the bearings and oil seals. Clean them thoroughly with dry-cleaning solvent, and inspect the cones, cups, and seals to see that they are in good condition and not excessively worn. Also see whether the machine surfaces on which the bearings operate are in good condition.
		SPECIAL LUBRICATION. When all of the related items have been performed to the point that the wheel bearings are to be installed, lubricate them according to the information and specifications in the Lubrication Order (pars. 21 and 22).
		ADJUST. Adjust the rear wheel bearings according to instructions in paragraph 131 *c*.
53	53	**Front Brakes.** Inspect front brake hose to see if it is in good condition, correctly assembled, and secure.
53		Remove front wheels, hubs, and drums, and inspect and service as follows:

Maintenance		
Six Months	Monthly	
		DRUMS AND SUPPORTS. Clean and inspect in same manner as in item 48.
		WHEEL CYLINDERS. Inspect in same manner as in item 48.
	54	**Front Brake Shoes.** Inspect in same manner as in item 49, 1,000-mile service. Adjust if necessary (par. 127 *a* (2)).
54		Inspect shoes, linings, anchors, and springs, in same manner as in item 49, 6,000-mile service.
		CLEAN. Clean in same manner as in item 49.
54	54	ADJUST. Adjust in same manner as in item 49, after following related items to 60 inclusive are completed. Front brake shoes require 0.010-inch clearance at the toe of the shoe, and 0.005-inch clearance at the heel of the shoe (fig. 108).
55	55	**Steering Knuckles.** Inspect the front axle steering knuckles to see if they are in good condition, and correctly and securely assembled. Test knuckle bearings for excessive wear with a pry bar.
56	56	**Front Springs (Clips, Leaves, U-bolts, Hangers, and Shackles).** Inspect these items to see if they are in good condition, correctly assembled, and secure. Look particularly for shifted spring leaves or excessive sag. Test eye and shackle bolts and bushings for excessive wear with a pry bar. Tighten U-bolts, rebound clips, and shackles if loose.
57	57	**Steering.** See if all parts of steering mechanism are in good condition, correctly and securely assembled and mounted, if steering gear case is leaking lubricant, and if lubricant is at proper level. Pay particular attention to Pitman arm to see if it is securely mounted and not bent out of its normal shape. Also observe if steering system is in good adjustment.
57		TIGHTEN. Tighten steering arm shaft nut securely. Loosen steering column bracket and tighten steering gear case assembly mounting bolts. Tighten steering column bracket.
58	58	**Front Shock Absorbers and Links.** See if shock absorber bodies are in good condition, secure to frame, and not leaking, and if links are secure and not damaged. If rubber bushings are hard or cracked, apply brake fluid to exposed surfaces.
58		SERVE. Fill shock absorber bodies with specified fluid (par. 137 *c*).
60	60	**Front Wheels.** Inspect front wheels, bearings, seals, drive

Maintenance Six Months	Maintenance Monthly	
		flanges, and nuts in same manner as in item 52 for similar rear wheel items.
60		CLEAN. Disassemble, clean, and inspect the front wheel bearings (par. 132) and oil seals in the same manner as described in item 52.
		LUBRICATION. Apply in same manner as described in item 52.
60		ADJUST. Adjust wheel bearings in same manner as described in item 52, and adjust brake shoes as described in item 49.
61	61	**Front Axle.** Inspect to see if axle is sprung or bent, or appears to have shifted. Measure distance from front spring eyebolt to center of axle spring pad on each side. This distance should be approximately the same on each side. Tighten all mounting bolts securely.
63	63	**Engine (Mounting and Ground Strap).** Inspect all mounting bolts to see that they are present and secure. Make sure radio bonding and ground strap connections are clean and tight. Tighten all loose mounting and side pan bolts.
64	64	**Parking Brake.** Examine sector, pawl, and linkage for excessive wear or loose mountings. Inspect linings for excessive wear or oil-soaked condition, and drum for scores.
64		ADJUST. Adjust clearance between linings and drum to 0.020 inch to compensate for wear (par. 129 *b*). Replace excessively worn or oil-soaked linings.
65	65	**Clutch Pedal.** Check clutch pedal free travel. It should be from 1¾ to 2 inches before meeting resistance. Inspect to see if pedal is securely mounted to shaft, and if clutch operating linkage is in good condition, securely connected, and not excessively worn at joints. Be sure return spring tension is satisfactory.
65		ADJUST. Adjust clutch pedal to provide 1¾ to 2 inches free travel (par. 62).
66	66	**Brake Pedal.** Brake pedal should have from ¼ to ½ inch of free travel before it starts to apply pressure to master cylinder piston. Inspect pedal, linkage, and return spring to see if they are in good condition and securely connected. Be sure spring tension is satisfactory.
67	67	**Brake Master Cylinder.** Cylinder should be in good condition and secure. Filler plug vent must be open, and boot

Maintenance		
Six Months	Monthly	
		properly installed. Inspect for fluid leaks. See that stop light switch is securely mounted and connected.
67	67	SERVE. Wipe dirt from around filler plug, remove plug, and fill master cylinder reservoir to correct level with specified fluid. Clean out filler plug vent hole. Install plug securely, using new gasket if needed.
68	68	**Brake Booster (B-K or Hydrovac).** One or the other of two types of booster is used on this vehicle. Inspect and service as follows:
		B-K VACUUM POWER SYSTEM. Inspect power cylinder, linkage, rubber dust guards, lines, and air cleaner to see if they are in good condition, correctly assembled, and securely connected or mounted. Make any necessary linkage adjustments (par. 122 *c*).
		HYDROVAC SYSTEM. Inspect the main cylinder, slave cylinder, relay valve, fluid and vacuum lines, and air cleaner to see if they are in good condition, correctly assembled, and securely connected or mounted. Inspect cylinders and lines for indications of leaks.
		AIR CLEANER. Wash the air cleaner element of the vacuum power system with dry-cleaning solvent, dry, and apply a film of clean light oil to element (par. 126 *c*). Reassemble securely.
		SPECIAL LUBRICATION. Lubricate the Hydrovac cylinder at two points according to instructions on Lubrication Order (par. 21).
71	71	**Transmission.** Note if transmission case is in good condition and securely mounted, and inspect for lubricant leaks at seals and gaskets. NOTE: *Slight seepage at seals is not considered as leakage.*
73	73	**Propeller Shafts (Joints, Alinement, Seals, Yokes).** Inspect these items to see that they are in good condition; that universal joints are properly alined; that there are no excessive leaks at universal joint or slip joint seals; and that universal joints and yokes are assembled and mounted securely.
73		TIGHTEN. Draw up all universal joint and yoke nuts securely.
74	74	**Center Bearing.** Inspect center bearing and carrier (fig. 88) to be sure they are in good condition, secure, and not excessively worn or leaking.
75	75	**Rear Axle.** Inspect axle for alinement, leaking grease seals, and clogged vent. Test pinion shaft for excessive end play.

Maintenance		
Six Months	Monthly	
		SERVE. Clean the axle vent, and tighten all mounting bolts and cap screws securely.
77	77	**Rear Springs.** Perform in same manner as item 56 for front springs.
78	78	**Rear Shock Absorbers and Links.** Perform in same manner as item 58.
79	79	**Cab and Body Mountings.** Inspect all mountings, insulators, and brackets to see if they are in good condition. Tighten all loose mounting bolt nuts securely.
80	80	**Frame.** Inspect frame, brackets, side rails, and cross-members to see if they are in good condition, secure, and correctly alined (par. 108 *b*). If the frame appears to be out of line, report to higher echelon.
81	81	**Wiring, Conduits, and Grommets.** Observe these items underneath the vehicle, to see if they are in good condition, properly supported, connected, and secure.
82	82	**Fuel Tank, Fittings, and Lines.** Inspect fuel tank to see if it is in good condition and securely mounted. Examine cap for defective gasket. See that filler neck is in good condition, and that cap fits securely.
82		Remove fuel tank drain plug, and drain off accumulated water and dirt in bottom of tank. Drain only until fuel runs clear. Use necessary precautions against fire.
83	83	**Brake Lines.** Examine all lines, fittings, and brake hose under vehicle to see if they are in good condition, securely connected so that they do not leak, and supported so that lines or hose will not chafe against other vehicle parts.
84	84	**Exhaust Pipe and Muffler.** Examine exhaust pipe to see that it is securely attached to exhaust manifold, that gasket or packing does not show evidence of leakage, and that the other end of pipe is clamped securely to muffler. Inspect muffler to see if it is in good condition and securely mounted. Check tail pipe to see if it is securely clamped to muffler, properly supported, and unobstructed at its outer end.
85	85	**Vehicle Lubrication.** Perform a complete lubrication service on the vehicle according to instructions in Lubrication Order (pars. 21 and 22), omitting only those items which have received attention in the foregoing procedures. Replace missing or damaged plugs or fittings.
		LOWER VEHICLE TO GROUND
86	86	**Toe-in and Turning Stops.** Use gage to determine if there

Maintenance Six Months	Maintenance Monthly	
		is toe-in of $\frac{1}{16}$ to $\frac{1}{8}$ inch. Turn steering wheel to limit in both directions and inspect the turning stops to see that they are present and securely locked, and that they prevent the tires from rubbing against the vehicle.
90	90	**Hoist (Mounting, Drive, Controls, Pump, Lines and Cylinder).** CAUTION: *Be sure to block body securely while making this inspection and lubrication.* On dump truck, raise body with the hoist, and note whether or not the above items are in good condition, correctly assembled and secure, and whether or not the pump, cylinder, or lines are leaking. See that groove pins are present and not worn. Remove blocking, stop the engine with the body up, and note any tendency of the body to drop, which would indicate a leak past the cylinder piston. When lowering the body, see that it lowers fully, and that the guides aline the body properly with the frame.
90	90	SERVE. Fill the hoist cylinder with the proper grade of oil according to Lubrication Order (pars. 21 and 22), taking care to leave the filler plug loose until body has been raised and lowered at least twice. Tighten filler plug securely. While the body is raised, lubricate fittings, pins, joints, and pump control mechanism according to Lubrication Order.
90		TIGHTEN. Tighten all hoist mounting and assembly bolts securely. Tighten the piston rod packing nut and any pump and control valve gland nuts, taking care not to over-tighten them, as this may score the shaft and cause leaks.
90		SERVE. Drain all oil from pump and refill (par. 22).
91	91	**Lamps (Lights).** Operate all switches and note if lamps respond. See if foot dimmer switch controls headlight beams properly, and if beams are aimed so as not to blind oncoming traffic. Examine all lights to see if they are in good condition and securely mounted, and if lenses are dirty or reflectors discolored.
91		ADJUST. Adjust headlight beams (par. 92 *c*).
92	92	**Safety Reflectors.** See if they are all present, in good condition, clean, and secure.
93	93	**Front Bumper, Tow Hooks, Brush Guards, and Grille.** See if these items are in good condition and secure, and that radiator grille is not obstructed.
94	94	**Hood (Hinges and Fasteners).** Inspect hood panels, hinges, and fastening devices to see if they are in good condi-

Six Months	Monthly	Maintenance
		tion. Be sure radio noise-suppression bond straps are clean and secure, and see that fasteners hold hood securely.
95	95	**Front Fenders and Running Boards.** Examine fenders and running boards to see that they are in good condition and securely mounted. Tighten all mounting bolts and nuts as necessary.
96	96	**Cab or Passenger Body.** Inspect doors, hardware, windshield and glass, top and frame, side curtains, seats, safety straps and grab rails, floorboards, ventilators, and map compartment to see if they are in good condition and secure; if the hardware and ventilators operate properly and are adequately lubricated; and if the doors engage their bumpers and strikers and latch properly in the closed position. See that the doors are properly alined with their openings. NOTE: *Glass need not be replaced as unserviceable when cracked or when laminated layers have separated, unless condition constitutes a safety hazard or obstructs vision of driver or crew.*
98	98	**Circuit Breakers** (figs. 67 and 68). Examine to see if they are in good condition, clean, dry, and securely mounted and connected.
99	99	**Rear Splash Guards.** Inspect splash guards (where used), to see if they are in good condition and securely mounted.
100	100	**Body (Panels, Doors, Tailgate and Chains, Floor, Windows, Hardware, Seats, Tarpaulin, and Stowage Compartments).** Inspect all applicable items to see if they are in good condition, correctly assembled, secure, and that hinges, fasteners, and regulators are not excessively worn or binding. Tarpaulins, when furnished, should be correctly installed and lashed, or properly stowed. Be sure stowage compartments are clean. Doors or tailgate should aline with openings, and lock securely in closed position.
101	101	**Pintle Hook.** Inspect the pintle hook for good condition and secure mounting. Pintle latch must operate freely, and lock pin must be attached to chain.
103	103	**Paint and Markings.** Inspect the paint of the entire vehicle for rust spots or chipping paint, and observe for any bright spots that would cause excessive glare and reflection. Make sure identification plates and markings, unless covered for tactical reasons, are legible.
104	104	**Radio Bonding (Suppressors, Filters, Condensers, and Shielding).** See that all units not covered in the foregoing specific procedures are in good condition and securely

Maintenance Six Months	Maintenance Monthly	
		mounted and connected. Be sure any additional noise-suppression bond straps, and all internal-external toothed washers listed in paragraph 100, are inspected for looseness or damage. See that contact surfaces are clean. NOTE: *If objectionable radio noise from vehicle has been reported, check electrical system in accordance with paragraph 99.* If cleaning and tightening of mountings and connections, and replacement of defective radio noise-suppression units do not eliminate the trouble, the radio operator will report the condition to the designated individual in authority.
		TOOLS AND EQUIPMENT
131	131	**Tools (Vehicle and Pioneer).** Check all the standard vehicle and pioneer tools to see that all items are present (pars. 7 and 8). Inspect all items to see that they are in good condition, clean, and properly stowed or securely mounted. Examine tools with cutting edges to see that they are sharp. Tools mounted on outside of vehicle that have bright or polished surfaces should be treated to prevent rust or glare.
132	132	**Fire Extinguisher.** See that it is in good condition, securely mounted, and fully charged. Remove filler plug to determine charge. See that nozzle is not clogged.
133	133	**Decontaminator.** Examine decontaminator to see that it is in good condition and securely mounted, and remove filler plug to determine whether or not it is fully charged. NOTE: *Contents must be renewed every 90 days, as solution deteriorates.*
134	134	**First Aid Kit.** See that the kit is in good condition, securely mounted or stowed, and that all items are present and properly packed.
135	135	**Publications and Form No. 26.** All vehicle and equipment manuals, Lubrication Order, Form No. 26 (Driver's Accident Report), W.D., A.G.O. Form No. 478 (MWO and Major Unit Assembly Replacement Record) must be in vehicle, legible, and properly stowed.
136	136	**Traction Devices (Chains).** Observe whether the required chains are present, in good condition, and properly stowed.
137	137	**Tow Chain or Rope.** See that the provided towing devices are in good condition, clean, and properly mounted or stowed.
139	139	**Fuel and Water Cans and Brackets.** Inspect any spare cans

Maintenance		
Six Months	Monthly	
		provided to see that they are in good condition; that filler caps fit properly and securely; that cans are not leaking; that they are securely mounted to brackets; and that brackets are in good condition and secure.
141	141	**Modifications (Modification Work Orders Completed).** Inspect vehicle to determine that all modification work orders have been properly completed. Enter any modifications or major unit replacements made during this service on Form No. 478.
142	142	**Final Road Test.** Make final road test, rechecking items 2 to 15 inclusive. Recheck transmission, power take-off (when used), and differential to see that lubrication is at correct level and that there are no leaks. Confine road test to the minimum distance necessary to make satisfactory observations. While testing vehicle, operate it in a normal manner. NOTE: *Correct or report deficiencies found during final road test to designated individual in authority.*

Section XII

Trouble Shooting

32. GENERAL.

a. Scope. The information contained in this section includes a compilation of symptoms of difficulties which might be encountered in the operation of the vehicle together with the possible causes, diagnosis, and remedies. Only those difficulties which can be detected by the using arms are included in this manual. Wherever practicable, the trouble shooting procedures are classified according to the sections of this manual. In some cases a symptom indicating trouble in one unit may be caused by difficulty in another unit, and cross references to the related units are made whenever this condition exists.

b. Diagnosis. Causes of trouble symptoms or faults in a vehicle may be numerous. Diagnosis of symptoms is an orderly process of eliminating causes of the symptom by checking the most probable or common cause first, and proceeding from that point.

33. ENGINE.

a. Engine Will Not Turn.

(1) STARTER INOPERATIVE. See paragraph 39 *a*.

(2) INCORRECT OIL VISCOSITY. Drain crankcase and refill with proper grade of oil (par. 22).

b. Engine Turns But Will Not Start.

(1) INOPERATIVE IGNITION SYSTEM. Remove a cable from a spark plug, hold cable terminal ¼ inch from cylinder head, and crank the engine. If the spark does not jump the gap, the ignition is inadequate. See paragraph 38.

(2) INOPERATIVE FUEL SYSTEM. Open fuel valves, remove outlet line at the fuel pump and, with the ignition turned off, turn the engine with the starter. If free flow of fuel is not evident, fuel is not reaching carburetor. See paragraph 35.

(3) CARBURETOR CHOKE INOPERATIVE. Disconnect air cleaner pipe at carburetor elbow. Pull choke button out away from the panel. Check to see that choke valve is completely closed. If not, readjust linkage to permit choke valve to close.

(4) VALVE STEM TO VALVE ROCKER ARM CLEARANCE IMPROPERLY ADJUSTED. Adjust valve stem to rocker arm clearance to 0.018 to 0.020 inches (par. 53).

(5) LEAK AT INTAKE MANIFOLD OR CARBURETOR GASKETS. Pour small quantity of oil from oilcan onto intake manifold and carburetor gasket edges. Turn engine with starter. A sucking sound will be heard if gasket leaks. Replace manifold gaskets (pars. 54 *c* and 55 *b*) or replace carburetor gaskets (par. 66 *c*).

(6) BATTERY WEAK OR DISCHARGED. Replace or charge battery.

(7) LOOSE OR CORRODED BATTERY TERMINALS. Clean and tighten battery terminals.

(8) POOR GROUND AT ENGINE GROUND STRAP. Remove engine ground strap at front of engine, clean connection of strap, and clean frame and engine contact surfaces. Reinstall ground strap, and tighten bolts securely.

c. Engine Does Not Develop Full Power.

(1) IMPROPER IGNITION. See paragraph 38.

(2) OIL TEMPERATURE TOO HIGH. Improper or insufficient engine oil. Change oil (par. 22).

(3) IMPROPER VALVE ADJUSTMENT. Check clearance, and adjust to 0.018 to 0.020 inch (par. 53).

(4) IMPROPER TYPE FUEL. Use fuel having octane rating of 70 to 72.

(5) PRE-IGNITION. Drive vehicle to bring engine temperature to normal of 160°F to 180°F, then rapidly accelerate in high gear. If a spark knock is present, a pinging sound will be heard during at least a portion of

the accelerating period. The intensity of the "ping" can be increased by covering the radiator and causing the engine to labor at high temperatures. If the proper octane fuel is being used, and the ignition system is functioning satisfactorily and properly adjusted, the spark plugs may be of improper heat range or defective. Replace plugs (par. 81). If spark plug replacement does not correct complaint, notify higher authority.

(6) AIR LEAKS AT CARBURETOR OR MANIFOLD GASKETS. With engine running at 800 revolutions per minute, apply a small amount of oil at carburetor gaskets and manifold flanges. If oil is sucked in, a leak is evident. Replace carburetor gaskets (par. 66 *c*) or manifold gaskets (pars. 54 *c* and 55 *b*).

(7) INCORRECT GOVERNOR SETTING. If governor cuts off below the governed engine speed of 3,000 revolutions per minute, report to higher authority, or replace carburetor and governor (par. 66 *c*).

d. Engine Misfires at Idling Speeds.

(1) FAULTY IGNITION SYSTEM. See paragraph 38.

(2) LOW ENGINE COMPRESSION. Test compression (par. 49 *a*), and if difference of 10 pounds pressure per square inch between cylinders is encountered, report to higher authority.

(3) DEFECTIVE SPARK PLUGS. Short out each spark plug by touching screwdriver with wood handle to spark plug terminal and to cylinder head. If spark plug is operating satisfactorily, a noticeable difference in operation of engine will result. If no difference is noted, replace spark plug (par. 81).

(4) WEAK OR BROKEN VALVE SPRINGS. Remove cylinder head cover and inspect valve springs. If broken springs are noted, replace cylinder head (pars. 50 and 52).

(5) IMPROPER VALVE STEM TO ROCKER ARM CLEARANCE. Adjust valve stem to rocker arm clearance to 0.018 to 0.020 inch (par. 53).

(6) DEFECTIVE VALVES. Use of a vacuum gage (41-G-500) will be helpful in diagnosing valve failures. Erratic action of gage is indicative of valve disorders. Apply penetrating oil or kerosene around valve stems, and note whether valves are freed up. If not, valves must be ground or replaced. Report to higher authority.

(7) INTAKE MANIFOLD LEAKS. Vacuum leaks at intake manifold or carburetor will cause a lean fuel-air mixture. Tighten manifold, or replace gaskets (pars. 54 *c* and 55 *b*).

(8) LEAKING CYLINDER HEAD GASKET. Tighten cylinder head cap screws evenly to 80 foot-pounds. If leak persists, replace cylinder head gasket (pars. 50 and 52).

e. Engine Misfires at High Speeds. Missing at high speeds is commonly caused by a weak secondary current in the ignition circuit. See paragraph 38 *g* for trouble shooting and diagnosis. Other possible causes are as follows:

(1) INCORRECT VALVE STEM TO ROCKER ARM CLEARANCE. Check and adjust clearance to 0.018 to 0.020 inches (par. 53).

(2) VALVE SPRINGS WEAK OR BROKEN. Remove cylinder head cover and inspect valve springs. If broken, replace cylinder head (pars. 50 and 52).

(3) LEAKING CYLINDER HEAD GASKET. Tighten cylinder head cap screws evenly to 80 foot-pounds. If leak persists, replace cylinder head gasket (pars. 50 and 52).

(4) DEFECTIVE FUEL PUMP. Worn fuel pump linkage will cause difficulty. Test fuel pump (par. 67 *b*). If defective, replace fuel pump (par. 67 *c*).

f. Engine Overheats. The most common cause of engine overheating is a faulty cooling system. Refer to trouble shooting and diagnosis of cooling system (par. 37). Other causes of engine overheating are as follows:

(1) LATE IGNITION TIMING. Check ignition timing (par. 49), and make necessary corrections.

(2) TOO LEAN FUEL-AIR MIXTURE. Check engine for vacuum leaks at intake manifold or carburetor, and correct as necessary.

g. Lack of Power. Lack of power is usually due to one of the following causes:

(1) ENGINE OVERHEATS. Follow procedure in subparagraph *f* above.

(2) POOR COMPRESSION. Test compression (par. 49), using a compression gage. Compression should not vary more than 10 pounds per square inch between cylinders.

(3) STICKING VALVES. Remove cylinder head cover, and apply penetrating oil or kerosene to valve stems. If treatment does not free-up valves, they must be removed and cleaned or replaced; therefore, replace cylinder head (pars. 50 and 52).

(4) LATE IGNITION TIMING. Check ignition timing (par. 49) and correct as necessary.

(5) BRAKES DRAGGING. Adjust brakes (par. 127).

h. Excessive Oil Consumption. Aside from obvious and readily discernible leakage of oil from the oil pan, gear cover, or oil filter base gaskets, the following are possible causes of excessive engine oil consumption:

(1) ENGINE OVERHEATS. See subparagraph *f* above.

(2) POOR COMPRESSION. Test compression (par. 49) and correct faults.

(3) OIL LEVEL TOO HIGH. Maintain oil level at "FULL" mark on oil level bayonet gage (dip stick).

(4) IMPROPER GRADE AND VISCOSITY OF OIL. Drain and refill crankcase with new oil of recommended grade and viscosity (par. 22).

(5) OVERSPEEDING ENGINE. Correct poor driving practices to avoid unnecessary and excessive engine speeds.

(6) EXCESSIVE LOW GEAR DRIVING. Correct poor driving practices.

(7) CLOGGED FUEL TANK CAP VENT. Open vent or replace cap.

(8) RESTRICTED FUEL FLOW. Check fuel lines for restriction (par. 69).

(9) WATER IN FUEL. Remove drain plug from base of carburetor and look for presence of water. If necessary, drain and refill fuel tank (par. 68).

34. CLUTCH.

a. Clutch Drags. Idle the engine at 350 to 400 revolutions per minute. Push clutch pedal to fully released position, and allow time for clutch to stop. Shift transmission into first or reverse gear. If the shift cannot be made without a severe clashing of the gears or if, after engagement of the gears, there is a jumping or creeping movement of the vehicle with the clutch fully released, the clutch is at fault. Check the following:

(1) EXCESSIVE PEDAL CLEARANCE. Adjust clutch linkage (par. 62).

(2) WARPED OR CRACKED DRIVING OR DRIVEN PLATES. Replace clutch (pars. 63 and 64).

(3) DEFECTIVE CLUTCH. Replace clutch (pars. 63 and 64).

b. Clutch Slips. Slippage of the clutch is generally caused by one or more of the following imperfections:

(1) IMPROPER ADJUSTMENT OF CLUTCH. Adjust clutch (par. 62).

(2) LACK OF PEDAL FREE TRAVEL. Adjust linkage (par. 62).

(3) DEFECTIVE CLUTCH. Replace clutch (pars. 63 and 64).

(4) WORN CLUTCH FACINGS. Replace clutch driven disk (pars. 63 and 64).

(5) GREASE ON CLUTCH FACINGS. Clean or replace clutch driven disk (pars. 63 and 64).

c. Clutch Chatters. In general, clutch chattering is most pronounced when starting vehicle in low or reverse gear under vehicle load, and results from the clutch disk failing to adhere to the flywheel surface.

(1) GREASE ON CLUTCH FACINGS. Replace or clean driven disk (pars. 63 and 64).

(2) EXCESSIVE LOOSENESS. Inspect transmission mounting, propeller shaft universal joints, and engine mountings for looseness, and correct.

35. FUEL SYSTEM.

a. Fuel Does Not Reach Carburetor.

(1) LACK OF FUEL. Check gage on instrument panel, and replenish fuel.

(2) FUEL VALVES NOT TURNED ON. Turn on fuel valves.

(3) CLOGGED GAS TANK VENT. Open vent in gas tank cap.

(4) INOPERATIVE FUEL PUMP OR CLOGGED LINES. Disconnect fuel line from inlet side of carburetor, and check flow from the tank. If fuel does not flow freely, clean lines back to fuel tank. If fuel flows freely through fuel lines but does not reach carburetor, the fuel pump is inoperative. Replace fuel pump (par. 67).

b. Fuel Does Not Reach Cylinders.

(1) THROTTLE NOT OPENING. Adjust throttle linkage (par. 66).

(2) CARBURETOR JETS CLOGGED. Replace carburetor (par. 66).

(3) LOW FUEL PUMP PRESSURE. Install fuel pump pressure gage (41-G-500) in the outlet side of the fuel pump. Pressure should read 3 to 4 pounds. If less than 3 pounds, replace fuel pump (par. 67).

c. Excessive Fuel Consumption. The most common cause of excessive fuel consumption is leaks in the system, and the logical remedy is to tighten the connections, replace defective gaskets, or replace leaking units.

(1) LEAKY FUEL LINES. Tighten connections.

(2) FUEL LEAK AT CARBURETOR. Tighten cover to body screws.

(3) FUEL LEAK AT FUEL PUMP. Tighten fuel pump cover, or replace fuel pump (par. 67).

(4) FUEL LEAKS IN FUEL TANK. Replace fuel tank (par. 68).

(5) WORN CARBURETOR PARTS. Replace carburetor (par. 66).

(6) IMPROPER CARBURETOR ADJUSTMENT. Adjust carburetor (par. 66).

d. Engine Idles Too Fast.

(1) IMPROPER THROTTLE LINKAGE ADJUSTMENT. Adjust idling speed stop screw and air-fuel idle screw (par. 66).

(2) CARBURETOR THROTTLE STICKING. Free-up and lubricate linkage.

(3) CONTROL LINKAGE RETURN SPRINGS BROKEN OR MISSING. Check linkage for weak, broken, or missing return springs. Replace as necessary.

e. Low Fuel Pressure.

(1) AIR LEAKS AT FUEL LINES, FUEL PUMP OR CARBURETOR. Isolate and correct leaks.

(2) FUEL PUMP DIAPHRAGM BROKEN. Test fuel pump (subpar. *b* (3) above), and replace if defective (par. 67).

(3) FUEL PUMP VALVES LEAKING. Test fuel pump (subpar. *b* (3) above), and replace if defective (par. 67).

(4) FUEL LINES PLUGGED. Disconnect fuel line at carburetor. With ignition switch turned off, crank engine and note fuel flow. If restricted flow is evident, repeat procedure at fuel pump, and finally at fuel tank to locate clogged fuel lines. Clean or replace lines.

f. Engine Falters on Accelerating. Dirt in carburetor will clog jets and cause trouble. Replace carburetor (par. 66).

36. EXHAUST SYSTEM.

a. General. The operator can generally detect any troubles in the exhaust system by unusually loud noises, or by the odor of exhaust fumes. Exhaust system deficiencies should be corrected with least possible delay.

b. Odor of Exhaust Fumes in Driver's Compartment. CAUTION: *Exhaust gases contain deadly poisonous carbon monoxide gas which is odorless, colorless, and tasteless.*

(1) MUFFLER BLOWN OUT OR LEAKING. Replace muffler (par. 73).

(2) MANIFOLD GASKET DEFECTIVE. Replace gasket (pars. 54 and 55).

c. Excessive Rattling.

(1) MUFFLER MOUNTINGS LOOSE. Tighten mountings.

(2) TAIL PIPE MOUNTINGS LOOSE. Tighten mountings.

37. COOLING SYSTEM.

a. General. The following causes and remedies pertain only to cooling system units. Since overheating or overcooling are the most common engine complaints, reference should be made to paragraph 33 for other causes of these troubles.

b. Overheating. Overheating is generally traceable to one of the following causes:

(1) LACK OF COOLANT IN SYSTEM. If system lacks coolant, replenish. Check for leaks at hose connections, water pump, and radiator.

(2) FAN BELT LOOSE. Loose fan belt causes loss of cooling efficiency from the fan. Adjust fan belt (par. 76).

(3) THERMOSTAT FAILURE. Rapid increase in engine temperature and overheating may be caused by failure of thermostat to open. Remove and test thermostat (par. 79), or replace.

(4) LOSS OF COOLANT. Check system for leaks. If hose leaks, tighten or replace. If water pump leaks, replace (par. 77). If radiator is leaking, replace (par. 78).

(5) COOLING SYSTEM CLOGGED. See paragraph 75 for cooling system tests and cooling system cleaning.

c. Overcooling.

(1) THERMOSTAT FAILURE. If the thermostat remains open, the system will operate at too low a temperature. Test thermostat (par. 79), and replace if defective.

38. IGNITION SYSTEM.

a. No Spark—Ammeter Shows Zero Reading.

(1) IGNITION SWITCH NOT FULLY ON. Turn on switch.

(2) DEFECTIVE IGNITION SWITCH. Replace switch (pars. 102 and 103).

(3) BROKEN PRIMARY WIRE FROM IGNITION SWITCH TO COIL OR FROM COIL TO DISTRIBUTOR. A zero reading on ammeter while ignition is turned on and engine is being cranked, indicates that no current is flowing in the ignition primary circuit. The following checks should be made on the units of the primary circuit:

(a) Disconnect wire at battery side of ammeter, and make flash test to determine if current is flowing to ammeter.

(b) Check continuity of circuit from ammeter to ignition switch, then through ignition switch with switch turned on.

(c) Check continuity of circuit through primary wire from ignition switch to coil, then from coil to distributor. If current flows through primary wire from switch to coil but not from coil to distributor, replace the ignition coil. If current flows through primary wire and coil to the distributor, the trouble is within the distributor.

(d) Remove distributor cap and check the condition of the breaker points and point opening.

(4) DISTRIBUTOR POINTS NOT CLOSING OR EXCESSIVELY BURNED OR PITTED. If points are not opening but are not burned or pitted, adjust opening. If points are excessively burned or pitted, replace breaker points (par. 82).

(5) DEFECTIVE COIL. Check coil (step (3) (c) above), and if defective, replace with new coil (par. 83).

(6) LOOSE CONNECTION FROM STARTER TO IGNITION SWITCH. Check connections, clean, and tighten.

b. No Spark—Ammeter Reading Normal. If ammeter shows a normal discharge (2 to 4 amperes) with ignition switch on, the primary circuit is functioning correctly and the trouble must be traced to the secondary circuit as follows:

(1) HIGH-TENSION WIRE FROM COIL TO DISTRIBUTOR BROKEN OR GROUNDED. Remove coil to distributor high-tension wire from distributor cap. Hold end of wire about $\frac{3}{8}$ inch from a ground (metal). While cranking engine with starter, or "rocking" the points, note spark. If a hot, snappy spark results, reconnect wire to distributor. If weak spark results, replace the condenser. If a weak spark persists, replace the coil. If no spark results, check high-tension wire from coil to distributor for continuity of circuit. Replace wire with one known to be good.

(2) DEFECTIVE DISTRIBUTOR CAP. With high-tension wire from coil to distributor inserted in socket in distributor cap, remove cap. Crank engine, and observe inside of cap for visible current leaks. If found defective, replace cap. Check condition of cap center electrode by holding one end of a high-tension wire on electrode, and other end about $\frac{3}{8}$ inch from a ground. Crank engine. Spark should jump to ground. If no spark is produced, replace cap.

(3) DEFECTIVE DISTRIBUTOR ROTOR. Remove coil to distributor high-tension wire from distributor cap. Remove cap. Hold end of the high-tension wire about $\frac{3}{8}$ inch away from rotor. Crank engine. If spark is noted, replace rotor.

(4) DEFECTIVE SPARK PLUG WIRES. Test each spark plug wire by disconnecting from spark plug and holding about $\frac{3}{8}$ inch from spark plug terminal while cranking engine. Note spark. Wires not producing a good spark should be replaced with wires known to be good, and the test repeated.

c. No Spark—Ammeter Indicates Abnormal Discharge. If ammeter shows an abnormal discharge (over 4 amperes) with ignition switch turned on, but zero with switch turned off, the trouble lies beyond the ignition switch and ahead of the primary exit at the coil. Check as follows:

(1) DEFECTIVE SWITCH. With ignition switch turned on, disconnect wire at dead side of switch. If ammeter returns to zero, the switch is correct. If ammeter does not return to zero, replace switch with one known to be good, and reconnect wire.

(2) COIL TERMINAL NOT GROUNDED. With switch turned on, wire at dead side disconnected, and ammeter at zero, disconnect wire at

primary entrance to coil. If ammeter returns to zero, check terminal of coil for grounded condition. If not grounded, replace coil.

(3) DEFECTIVE WIRE FROM SWITCH TO COIL. If ammeter still shows an abnormal discharge after disconnecting the primary wire at the coil, replace wire from switch to coil.

d. Weak Spark.

(1) DEFECTIVE DISTRIBUTOR POINTS. Remove distributor cap and check condition of points. Adjust opening, or replace points if badly burned or pitted.

(2) DEFECTIVE DISTRIBUTOR CAP. Refer to subparagraph *b* (2) above.

(3) DEFECTIVE CONDENSER. Replace condenser with one known to be good.

(4) LOOSE CONNECTIONS FROM STARTER THROUGH DISTRIBUTOR. Clean and tighten all connections.

(5) DEFECTIVE HIGH-TENSION WIRES: If wires are wet or swollen, replace with new wires.

(6) DEFECTIVE IGNITION COIL. Replace coil with one known to be good (par. 83).

e. Engine Overheats and Lacks Power. The main cause of engine overheating due to the ignition system is late ignition timing. Check and correct the timing (par. 49).

f. Engine Backfires.

(1) CROSSED SPARK PLUG CABLES. Check spark plug cables to assure their being attached in 1-5-3-6-2-4 order.

(2) CRACKED DISTRIBUTOR CAP. Refer to subparagraph *b* (2) above.

g. Engine Misfires at High Speed Under Load.

(1) INCORRECT SPARK PLUG GAP. Test and adjust spark plug gap to 0.028 to 0.032 inch (par. 81 *c*). Replace defective spark plugs (par. 81).

(2) DISTRIBUTOR POINT GAP INCORRECT. Check distributor point gap, and adjust to 0.018 to 0.024 inch (par. 82 *b*).

(3) DEFECTIVE COIL. Test for coil failure by replacing coil with one known to be good (par. 83).

(4) DEFECTIVE DISTRIBUTOR CONDENSER. Replace condenser with one known to be good (par. 82 *c*).

h. Pre-ignition.

(1) DEFECTIVE SPARK PLUGS. Install new spark plugs of correct type (par. 81).

i. Excessive "Ping" Under Load or at High Speed.

(1) INCORRECT DISTRIBUTOR TIMING. Correct the ignition timing (par. 49).

(2) INFERIOR FUEL. Change to fuel of octane rating 70 to 72.

39. STARTING AND CHARGING SYSTEM.

a. Starter Fails to Operate.

(1) DEFECTIVE BATTERY. Check battery level and specific gravity (par. 96), and clean and tighten battery terminals.

(2) LOOSE BATTERY GROUND CABLE. Clean and tighten battery ground terminal connection.

(3) DEFECTIVE MAGNETIC SWITCH. Connect a jumper lead from the battery terminal of the magnetic switch to the small terminal on the top of the magnetic switch. This bypasses the magnetic switch control circuit. If the starter now operates, replace the magnetic switch (par. 90).

(4) DEFECTIVE IGNITION SWITCH. If starter still does not operate, connect a heavy jumper lead between the two main terminals, connecting the lead to nuts, not studs, to avoid burning threads. This connects the starter to the battery. If starter is in normal condition it will operate, and the trouble will be known to be in the ignition switch. Replace ignition switch (pars. 102 *g* and 103 *g*).

(5) DEFECTIVE STARTER. If starter still does not operate after above tests, it must be replaced (par. 89).

b. Starter is Noisy.

(1) LOOSE STARTER MOUNTING. Tighten mounting cap screws.

(2) DEFECTIVE DRIVE ASSEMBLY. Replace starter (par. 89).

(3) WORN COMMUTATOR OR BUSHINGS. Replace starter (par. 89).

(4) LACK OF LUBRICATION. Lubricate starter (par. 21).

c. Starter Puts Excessive Strain on Battery.

(1) LOOSE TERMINALS. Clean and tighten terminals.

(2) STICKING BRUSHES, WORN COMMUTATOR, OR ARMATURE RUBBING FIELD COILS. Replace starter (par. 89).

d. Battery Not Being Charged.

(1) LOOSE OR DIRTY TERMINALS. Clean and tighten battery terminals (par. 96).

(2) EXCESSIVE RESISTANCE IN CABLES. Test cables for resistance (par. 88), or replace cables.

(3) GENERATOR REGULATOR NOT OPERATING. If there is low

or no charging rate with a low battery, check the circuit for defective wiring and loose connections. If these are in order, momentarily connect a jumper lead between the armature and field terminals of the regulator, and operate the generator at about 2,000 revolutions per minute. If the output increases substantially, the regulator may be considered at fault and must be replaced (par. 86). If the output remains low with the terminals bridged, then the generator may be considered at fault.

(4) GENERATOR NOT CHARGING. After having isolated trouble in generator, proceeds as follows:

(a) *No Generator Output*. If no generator output can be obtained from the generator, remove the cover band and check for sticking or worn-out brushes, gummed or burned commutator, or other causes of poor contact between the commutator and the brushes. If trouble is due to gummed or dirty commutator, operation may be temporarily restored by holding a strip of 2/0 flint paper against the commutator with a piece of wood while the generator is operated. This will clean the commutator.

(b) *Unsteady or Low Output*. Check for loose drive belt, and adjust (par. 76). Check for sticking brushes, out-of-round or rough commutator, or high mica on the commutator. If encountered, replace generator (par. 85).

40. TRANSMISSION.

a. Excessive Noise.

(1) INSUFFICIENT LUBRICANT. Add lubricant of proper viscosity (par. 22) to ½ inch below level of plug when cold.

(2) LUBRICANT OF INCORRECT VISCOSITY. Drain and refill with lubricant of correct viscosity (par. 22).

(3) GEARS OR BEARINGS BROKEN, WORN, OR LOOSE ON SHAFTS. If problem is not one of lubrication, and excessive noise is heard with vehicle standing still, engine running, and transmission in neutral, the transmission must be replaced (par. 107).

b. Hard Shifting.

(1) CLUTCH FAILS TO RELEASE. If clashing of gears is encountered when attempting to shift from neutral into low gear, the clutch is not fully releasing. Adjust clutch pedal free travel and adjust clutch (par. 62), or replace clutch (pars. 63 and 64).

(2) BINDING IN CONTROL COVER ASSEMBLY. Control cover assembly must be replaced.

c. Gears Slipping.

(1) WEAK OR BROKEN SHIFT POPPET SPRINGS. Control cover assembly must be replaced.

(2) EXCESSIVELY WORN GEARS. Replace transmission assembly (par. 107).

(3) BENT SHIFTING FORK. Control cover assembly must be replaced.

d. Lubricant Leakage.

(1) LOOSE DRAIN PLUGS. Tighten.

(2) DEFECTIVE GASKETS. Notify higher authority.

41. FRONT AXLE.

a. Hard Steering.

(1) FRONT AXLE SHIFTED. Check distance from front spring eye to some point on axle beam. Compare this measurement with like measurement on opposite side. If measurements do not agree, loosen spring U-bolts, relocate axle, and retighten spring U-bolts.

(2) LACK OF LUBRICATION. Lubricate front axle king pin, tie rod ends, and drag link ends (par. 22).

(3) BIND IN STEERING KNUCKLE. Raise front wheels from ground and disconnect drag link at front axle. Turn wheels and tie rod from side to side. If bind is found, disconnect one end of tie rod from steering knuckle. Test each wheel, turning from side to side. If bind persists and lubrication does not free-up, replace axle assembly (pars. 114 and 115).

(4) TIGHT STEERING GEAR. With drag link disconnected at front axle, revolve steering gear from one extreme to the other. If bind or rough spots are encountered, replace steering gear assembly (pars. 140 and 141).

(5) EXCESSIVE CASTER. Checking of front axle caster requires special equipment. Report to higher authority.

(6) TIRES UNDERINFLATED. Check air pressure, using an accurate gage, and inflate tires (dump truck, front 35 pounds, rear 45 pounds; bus, front 60 pounds, rear 65 pounds).

(7) IMPROPER TOE-IN. Check toe-in of front wheels and correct to from $\frac{1}{16}$ to $\frac{1}{8}$ inch (par. 113).

b. Shimmy.

(1) EXCESSIVE LOOSENESS IN FRONT AXLE. Raise front wheels from ground, move wheels from side to side and up and down, and note any looseness. If excessive, replace axle (pars. 114 and 115).

(2) FRONT AXLE SHIFTED. Refer to subparagraph *a* (1) above.

(3) EXCESSIVE AXLE CASTER. Refer to subparagraph *a* (5) above.

(4) INSUFFICIENT FRONT WHEEL TOE-IN. Check toe-in of front wheels, and correct to $\frac{1}{16}$ to $\frac{1}{8}$ inch (par. 113).

c. Wandering.

(1) AXLE SHIFTED. Refer to subparagraph *a* (1) above.

(2) TIRES UNEQUALLY INFLATED. Test tires with accurate pressure gage, and inflate (subpar. *a* (6) above).

(3) TIGHT STEERING GEAR. Localize trouble to steering gear by disconnecting drag link (subpar. *a* (3) above). Adjust (par. 139) or replace steering gear (pars. 140 and 141).

(4) FRONT WHEEL BEARINGS OUT OF ADJUSTMENT. Adjust front wheel bearings (par. 131).

42. REAR AXLE.

a. Continuous Axle Noise.

(1) TIRES IMPROPERLY INFLATED OR TREAD WORN UNEVENLY. If axle noise is caused by tires, the noise will disappear when the vehicle is driven over soft, unfinished road surface. Inflate tires equally and properly (par. 41 *a* (6) above).

(2) WHEEL BEARINGS WORN, OUT OF ADJUSTMENT, OR IN NEED OF LUBRICATION. If noise persists, check wheel bearings for wear and adjustment. Repack wheel bearings (par. 22).

(3) INSUFFICIENT LUBRICANT. Add lubricant (par. 22).

b. Axle Noise on Drive Only or on Coast Only.

(1) PINION AND RING GEAR OUT OF ADJUSTMENT OR WORN EXCESSIVELY. Replace rear axle assembly (pars. 118 and 119).

c. Excessive Backlash in Axle Driving Parts.

(1) AXLE FLANGE CAP SCREWS OR NUTS LOOSE, OR WORN HOLES IN AXLE SHAFT FLANGES. Tighten nuts. If holes in axle flanges are worn, replace axle shafts (pars. 118 and 119).

(2) RING GEAR AND PINION OUT OF ADJUSTMENT OR WORN EXCESSIVELY. Replace axle assembly (pars. 118 and 119).

43. BRAKES.

a. Pedal Goes to Floorboard.

(1) NORMAL WEAR OF LININGS. When linings become worn it is necessary to set shoes in closer to brake drums. Adjust brakes (par. 123).

(2) BRAKES IMPROPERLY ADJUSTED. Adjust brake shoes (par. 127).

(3) BRAKE FLUID LEAK. Inspect underneath chassis for signs of fluid leaks at master cylinder, wheel cylinders, and brake lines. Correct the leaks, and refill master cylinder.

(4) AIR IN SYSTEM. Air in the brake system will cause a springy or rubbery action of the pedal. Bleed the hydraulic system (par. 123 *e* (7)).

(5) PEDAL IMPROPERLY ADJUSTED. Brake pedal should have approximately ¼ to ½ inch free motion before pressure stroke starts. Additional free motion reduces the active travel of the master cylinder piston, which in turn limits the amount of working fluid to be expelled from the master cylinder. Adjust the brake pedal travel (par. 123 *e* (3)).

(6) NO FLUID IN SUPPLY TANK. Refill master cylinder supply tank, and bleed system of air (par. 123 *e* (7)).

b. All Brakes Drag.

(1) MINERAL OIL IN SYSTEM. The introduction of mineral oil into the hydraulic brake system will cause the cups to swell, and retard or prevent their action. Clean the system of deleterious oil, and refill with brake fluid. If this remedy is not effective, report to higher authority as the system will have to be reconditioned and all cylinder cups replaced.

(2) BRAKE PEDAL IMPROPERLY ADJUSTED. Brake pedal must have approximately ¼ to ½ inch of free travel before pressure stroke starts, otherwise the master cylinder relief port will be closed, pressure in the system will gradually build up, and all brakes will drag. Adjust brake pedal free travel from ¼ to ½ inch (par. 123 *e* (3)).

c. One Wheel Drags.

(1) WEAK BRAKE SHOE RETURN SPRING. A weak or broken shoe return spring will prevent brake shoes from being retracted. Replace spring (par. 127).

(2) BRAKE SHOES SEIZING ON ANCHOR PINS. Lubricate brake shoe bearing surface on anchor pins.

(3) BRAKE SHOES IMPROPERLY ADJUSTED. Adjust brake shoe to brake drum clearance (par. 127).

(4) LOOSE WHEEL BEARINGS. Adjust wheel bearings (par. 131).

d. Vehicle Pulls to One Side.

(1) GREASE-SOAKED LININGS. Replace brake shoes (par. 127).

(2) IMPROPERLY ADJUSTED BRAKE SHOES. Adjust brakes (par. 127).

(3) TIRES IMPROPERLY INFLATED. Correct the tire inflation (see par. 41 *a* (6)).

e. Springy, Spongy Pedal.

(1) BRAKE SHOES IMPROPERLY ADJUSTED. Adjust shoes (par. 127).

(2) AIR IN SYSTEM. Bleed hydraulic system (par. 123 *e* (7)).

f. Severe Braking Action from Light Pedal Pressure.

(1) IMPROPERLY ADJUSTED BRAKE SHOES. Adjust brake shoe to brake drum clearance (par. 127).

(2) LOOSE BRAKE BACKING PLATE. Report to higher authority.

(3) GREASE-SOAKED LINING. Replace brake shoes (par. 127).

g. Weak Braking Action from Severe Pedal Pressure.

(1) IMPROPER BRAKE SHOE ADJUSTMENT. Adjust brake shoes (par. 127).

(2) IMPROPER BRAKE LINING. Replace brake shoes (par. 127).

(3) OIL ON LININGS. Replace brake shoes (par. 127).

h. Insufficient Vacuum for Power Cylinder.

(1) LEAKS IN INTAKE MANIFOLD. Pour slight amount of oil on intake manifold gasket to check for leak. Tighten manifold or replace gasket (par. 54).

(2) INSUFFICIENT ENGINE VACUUM. Since vacuum power cylinders are dependent upon engine vacuum for operation, they can only be efficient in direct relation to the vacuum produced. Connect a vacuum gage to the engine intake manifold, and check engine vacuum. If vacuum gage does not read 18 to 21, engine needs repair.

i. Power Brake Application Slow.

(1) POWER CYLINDER NEEDS LUBRICANT. Lubricate power cylinder (par. 22).

(2) AIR CLEANER OBSTRUCTED. Remove, clean, and service power brake air cleaner (par. 126).

(3) INSUFFICIENT VACUUM. See *h* (2) above).

j. Power Brake Releases Too Slowly. .

(1) POWER CYLINDER NEEDS LUBRICANT. Lubricate power cylinder (par. 22).

(2) WEAK OR COLLAPSED VACUUM HOSE. Check vacuum hose for weakness or evidence of collapse, and replace defective hose.

(3) LEAK IN CHECK VALVE. Replace power system check valve (par. 124).

44. SPRINGS AND SHOCK ABSORBERS.

a. Insufficient Flexibility.

(1) INSUFFICIENT SPRING PIN LUBRICATION. Lubricate spring

pins and shackle pins (par. 22), making sure grease goes all the way around pins.

(2) FROZEN SPRING SHACKLES. Free-up, lubricate, and adjust spring shackles.

(3) SHOCK ABSORBERS INOPERATIVE. Disconnect shock absorber links, and test shock absorber action. If inoperative, replace unit (par. 137).

b. Excessive Flexibility.

(1) OVERLUBRICATION. Refer to paragraph 22. Clean excess grease from sides of springs.

(2) LACK OF FLUID IN SHOCK ABSORBERS. Refill shock absorbers (par. 137).

(3) SHOCK ABSORBERS INOPERATIVE. Disconnect shock absorber links, and test unit operation. If little or no resistance is felt, replace unit (par. 137).

(4) BROKEN SPRING LEAVES. Examine springs for broken leaves and, if found, replace spring (pars. 135 and 136).

c. Excessive Noise.

(1) WORN SPRING PINS OR SHACKLE BOLTS. Use pry bar to test for wear of pins or bolts. Replace as necessary.

(2) WORN OR BROKEN SHOCK ABSORBER LINKS. Inspect shock absorber links for wear, damage, or looseness. Replace links if defective (par. 137).

d. Spring Leaf Failures.

(1) SPRING LEAF FAILURES AT SPRING EYE. Failures at this point are generally caused by tight spring shackles or frozen spring pins. Free-up, lubricate, and adjust shackles, or replace spring (pars. 135 and 136).

(2) SPRING LEAF FAILURES AT CENTER SECTION OF SPRING. Breakage of spring leaves at the center bolt section are generally caused by loose spring U-bolts. Replace spring, and tighten U-bolts securely (pars. 135 and 136).

(3) GRABBING BRAKES. Grabbing brakes result in extreme twist or strain on springs. Adjust brakes (par. 127).

45. STEERING GEAR.

a. General. Many complaints of steering difficulty are falsely charged to the steering gear assembly. In order, therefore, to isolate the steering gear from the balance of the front axle and connections, the drag link should be disconnected from the steering arm at the gear housing assembly. This will permit unobstructed diagnosis of the unit. In general, steering complaints rightfully traceable to the steering gear are as follows:

b. Hard Steering.

(1) LACK OF LUBRICANT. Lubricate as instructed in paragraph 22.

(2) TIGHT STEERING GEAR. Revolve steering wheel from one extreme to the other. If tightness is felt, adjust steering gear (par. 139).

(3) DAMAGED BEARINGS, CAM, OR LEVER. If rough spots, bumps, or noise are encountered while revolving steering gear, internal damage is indicated. Replace steering gear assembly (pars. 140 and 141).

(4) STEERING COLUMN MISALINED. Loosen steering column clamp at top of steering gear housing, and loosen bracket at dash panel. Aline column, and retighten.

c. Wander or Weaving.

(1) TIGHT ADJUSTMENT IN STRAIGHT-AHEAD POSITION. If gear is tight in mid-position or straight ahead, adjust steering gear (par. 139).

d. Oil Leaks.

(1) DEFECTIVE OIL SEAL IN HOUSING. Replace steering gear (pars. 140 and 141).

(2) LOOSE COVER OR GASKET. Tighten cover, or replace gasket.

46. BATTERY AND LIGHTING SYSTEM.

a. Discharged Battery. If a battery repeatedly discharges, it may be caused either by generator or regulator malfunction (par. 139). Other possible causes of battery discharge are as follows:

(1) LOOSE OR DIRTY TERMINALS. Clean and tighten terminals.

(2) EXCESSIVE RESISTANCE IN CABLES. Check line voltage (par. 88).

(3) ELECTROLYTE LEVEL LOW. Replenish water to ⅜ inch above cell plates.

(4) BATTERY CELLS SHORTED. With ignition switch off, or high tension lead removed from ignition coil, operate starter and check each cell of battery with a low-reading voltmeter (par. 96). If voltage falls below 1.7 volts at 80°F, or if there is a difference between cell readings of more than $^1/_{10}$ volt, the battery should be replaced (par. 96).

b. Lights Do Not Light.

(1) BURNED-OUT LAMPS. Replace sealed-beam lamp unit (par. 92).

(2) BROKEN WIRE. Locate broken wire and repair or replace.

(3) DEFECTIVE LIGHT SWITCH. Replace switch (pars. 102 and 103).

c. Frequent Lamp Failures.

(1) GENERATOR REGULATOR OUT OF ADJUSTMENT. Replace regulator assembly (par. 86).

(2) POOR BATTERY GROUND CONNECTION. Clean and tighten ground connections.

d. Insufficient Light.

(1) POOR GROUND. Clean and tighten ground connections.

(2) LOOSE TERMINALS. Isolate and tighten terminals.

(3) DISCHARGED BATTERY. Recharge or replace battery (par. 96).

47. DUMP BODY HOISTS.

a. Noisy Hoist Pump.

(1) INSUFFICIENT OIL IN HOIST CYLINDER. Refill hoist cylinder (par. 150 *b* (8) or 153 *b* (9)).

(2) ENGINE SPEED EXCESSIVE. Run engine at reduced speed while operating hoist.

(3) OPERATING POWER TAKE-OFF AFTER HOIST HAS REACHED EXTREME RAISED POSITION. Disengage power take-off when body is fully raised.

b. Hoist Fails to Lift.

(1) INSUFFICIENT OIL IN HOIST CYLINDER. Refill hoist cylinder (par. 150 *b* (8) or 153 *b* (9)).

(2) DRIVE SHAFT KEYS SHEARED. Install new drive shaft keys.

(3) HOIST OVERLOADED. Decrease load.

(4) HOIST VALVE CONTROLS OUT OF ADJUSTMENT. Adjust controls.

c. Dump Body Settles.

(1) BALL CHECK NOT SEATING (GALION HOISTS). Remove ball check stud by removing the small square pipe plug from the top and removing the spring and the ball. Clean thoroughly, and replace the ball. Using a brass or other soft metal bar and hammer, give the ball about three hard taps to seat it. Replace spring and pipe plug.

(2) HOIST VALVE CONTROL LEVER NOT IN "HOLD" POSITION. Adjust hoist valve control lever and linkage for "HOLD" position.

(3) IMPROPER GRADE OF OIL IN HOIST CYLINDER. Refill hoist cylinder with proper grade of hoist cylinder oil (pars. 150 *b* (8) or 153 *b* (9)).

Section XIII

Engine Description and Maintenance In Vehicle

48. DESCRIPTION AND DATA (figs 26 and 27).

a. Description. The gasoline engine in these vehicles is a 4-cycle, 6-cylinder-in-line, overhead valve type. The engine serial number is stamped on a pad at the left front side of the engine crankcase just below the cylinder head (fig. 8). Cylinders are numbered from front to rear. Crankshaft rotation is clockwise as viewed from the front end. The starter, generator, and carburetor are located on the right side of the engine (fig. 26). The oil filler pipe, oil level bayonet gage (dip stick), ignition distributor, fuel pump, spark plugs, and oil filter are located on the left side of the engine

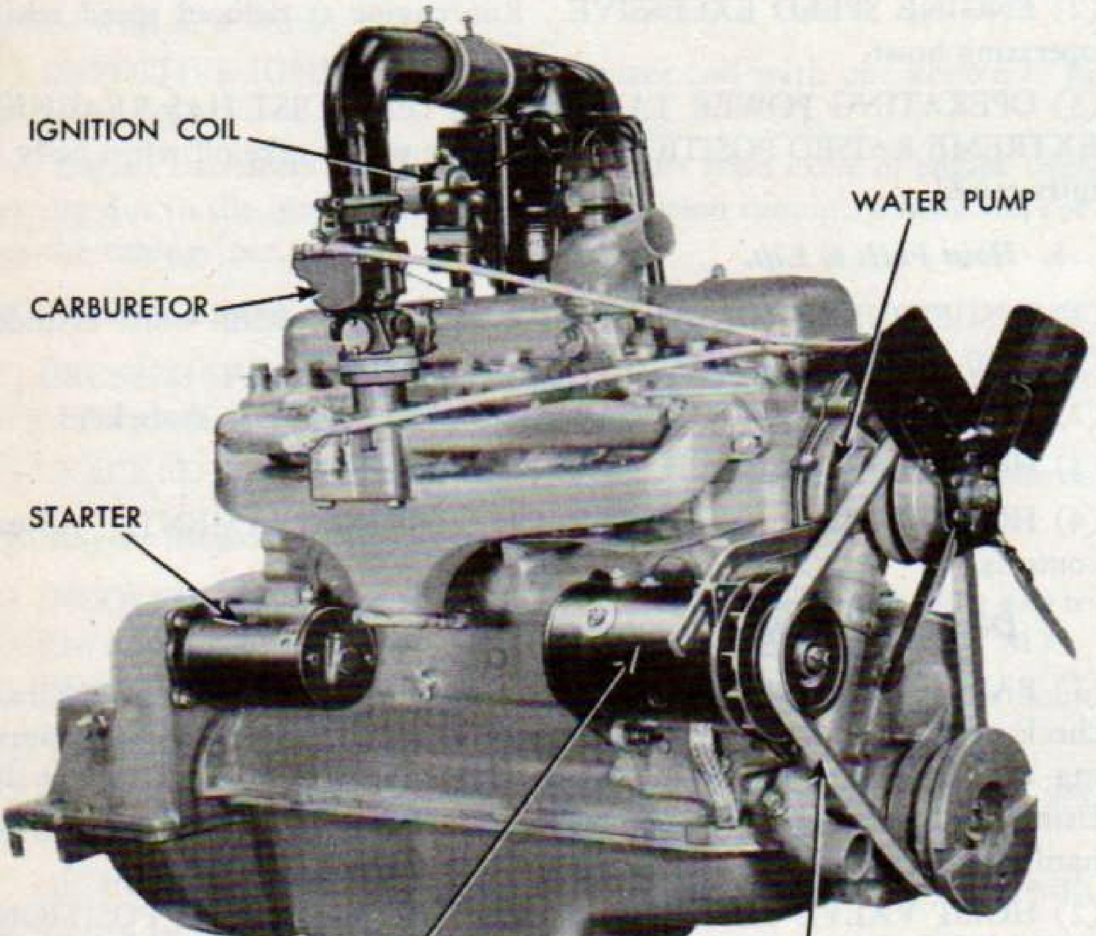


Figure 26 — Engine with Accessories, Right Side

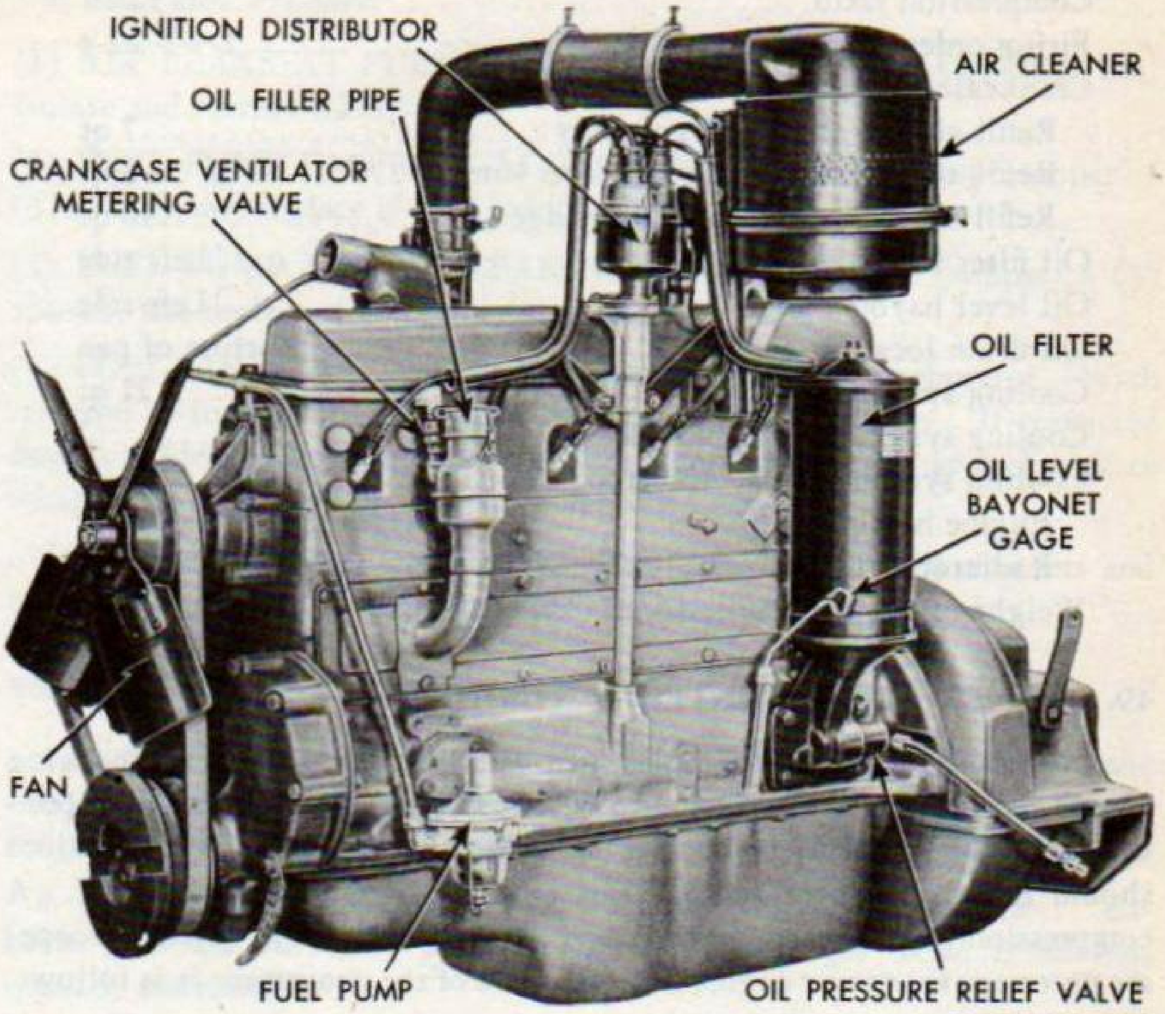


Figure 27 — Engine with Accessories, Left Side

(fig. 27). The air cleaner is also mounted in a bracket at the left side of the engine cylinder head. The ignition coil is mounted on the air cleaner bracket. This section of the manual covers the maintenance operations allocated to using arm maintenance personnel on the basic engine assembly, engine oiling system, and crankcase ventilation system.

b. Data.

Make	International
Model	BLD-269
Type	Overhead-valve
Number of cylinders	6
Bore	$3\frac{9}{16}$ in.
Stroke	$4\frac{1}{2}$ in.
Displacement	269.10 cu in.
Torque (maximum at 1,000 rpm)	222 ft-lb
Brake horsepower (maximum at 3,000 rpm)	100.5
Governed speed	3,000 rpm

Compression ratio	6.3 to 1
Firing order	1-5-3-6-2-4
Crankcase oil capacity:	
Refill after draining oil pan only	7 qt
Refill after draining pan and filter sump	8 qt
Refill after changing filter cartridge	10 qt
Oil filter location	Left side
Oil level bayonet gage location	Left side
Oil drain location	Bottom of pan
Cooling system capacity	21 qt
Cooling system drains—number	2
Cooling system drains—location:	
Engine block	Right side toward rear
Radiator	Lower right corner
Weight of engine w/accessories (approximate)	900 lb

49. TUNE-UP AND IGNITION TIMING.

a. General Tune-up. Engine tune-up is an orderly process of checking engine and accessory equipment to determine that they are within specifications. In addition, preventive maintenance and corrective operations should be accomplished so that new engine performance is restored. A compression gage, a vacuum gage, and a neon timing light (synchroscope) are necessary for proper engine tune-up. Use of the equipment is as follows:

(1) COMPRESSION TESTS.

(a) Shut off fuel supply, and run engine until carburetor and fuel pump are dry.

(b) Loosen spark plugs, blow loose dirt from around base of plugs, and remove plugs.

(c) With ignition key turned off, open throttle fully.

(d) Place compression tester tightly in spark plug hole. Turn engine over at cranking motor speed to allow three compression strokes on gage. Note reading. Follow same procedure for each cylinder.

(e) Compression readings between cylinders should not vary more than 10 pounds. Normal compression on pressure gage at cranking speed is 110 to 120 pounds per square inch.

(f) Recheck any low-reading cylinder after inserting about two tablespoons of SAE 50 engine oil on top of pistons. An increase in reading will indicate faulty pistons or piston rings. Failure to increase reading will indicate faulty valves. Two adjacent low-reading cylinders indicate a probable defective cylinder head gasket.

(2) VACUUM TESTS. Before using a vacuum gage, be certain that engine is thoroughly warmed up and normalized to engine operating

temperature of 160°F to 180°F. The vacuum gage should then be attached to the engine at the center of the intake manifold. Vacuum gage readings indicate the vacuum condition throughout the engine. Readings should be taken at approximately 350 revolutions per minute. Analysis of the gage readings is as follows:

(a) *Steady Needle—Normal Vacuum.* A normal engine pulls a vacuum of between 18 and 21 inches. The vacuum reading will drop to about 2 inches when the throttle is opened, and will rebound to about 25 inches when the throttle is closed.

(b) *Steady Needle—Slightly Low Vacuum.* If the engine pulls a vacuum of 15 to 16 inches with a steady needle, the piston rings, pistons, or oil are probably in poor condition. Slight needle motion indicates late ignition timing.

(c) *Steady Needle—Low Vacuum.* If the needle is between 8 and 12 inches, it is an indication of worn valve guides, worn piston rings, poor oil, or an intake manifold leak.

(d) *Steady Needle—Very Low Vacuum.* If the vacuum drops below 5 inches with a steady needle, it indicates an intake manifold leak.

(e) *Gradual Drop.* If a normal reading is obtained when the engine starts but the needle then gradually drops, check the exhaust system. Probably the muffler is clogged so that back pressure is being created.

(f) *Irregular Drop—Normal Vacuum.* If the engine pulls a normal vacuum of 18 to 21 inches but the needle drops at irregular intervals, check for gummy valve stems, rich mixture, lean mixture, or defective spark plugs.

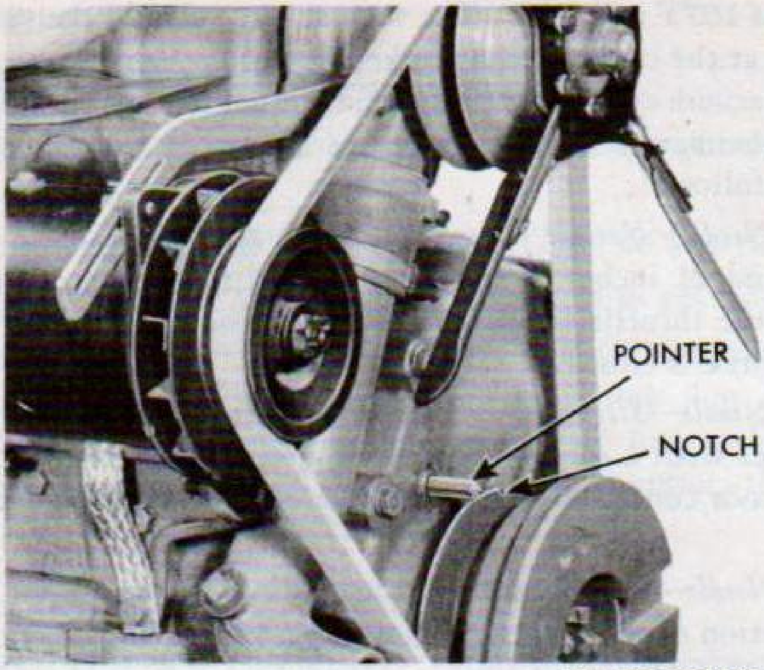
(g) *Regular Drop—Normal Vacuum.* A periodic regular drop with a normal vacuum indicates a faulty valve, or a cylinder head gasket leak.

(h) *Slow Movement—Low Vacuum.* A low vacuum with a slowly moving needle indicates late valve timing, poor carburetor adjustment, defective spark plugs, poor ignition, or gummy valve stems.

(i) *Wide Variation.* An oscillating needle over a wide range, with the variations increasing with increased engine speed, indicates weak or broken valve springs.

(3) NEON TIMING LIGHT (SYNCHROSCOPE). The neon timing light or synchroscope is an instrument designed to be connected into the high-tension circuit for the purpose of accurately synchronizing or timing the ignition and valves. Operating instructions for the use of neon timing lights vary. Follow the instructions of the instrument manufacturer.

b. Tune-up Procedure. Before performing the operations listed below, the engine crankcase should be drained and refilled with fresh engine oil (par. 22), the oil filter cartridge changed (par. 57), and the crankcase air cleaner serviced (par. 71). The following operations should then be performed in the order given:



RA PD 323817

Figure 28 — Pulley Timing Notch and Pointer

(1) SPARK PLUGS. Service and adjust (par. 81).

(2) BATTERY AND IGNITION CABLES. Clean and tighten.

(3) BATTERY. Test and service (par. 96).

(4) DISTRIBUTOR CAP. Clean and inspect (par. 82).

(5) DISTRIBUTOR ROTOR. Remove and clean (par. 82).

(6) DISTRIBUTOR POINTS. Inspect, clean, and adjust (par. 82).

(7) CONDENSER. Inspect and tighten connections (par. 82).

(8) IGNITION TIMING. Check and adjust (subpar. *c* below).

(9) CYLINDER HEAD. Tighten bolts with a torque wrench to a tension of 80 foot-pounds (par. 52 *a* (7)).

(10) VALVE ROCKER ARM TO VALVE STEM CLEARANCE. Check and adjust clearance to from 0.018 to 0.020 inch (par. 53).

(11) CARBURETOR. Check and adjust idling speed and mixture (par. 66).

(12) AIR CLEANER. Service (par. 71).

(13) FUEL PUMP. Check and service (par. 67).

(14) FUEL LINES. Check for leaks (par. 69).

*c. **Ignition Timing Procedure.***

(1) Loosen swivel clamp screw at distributor hold-down plate, and set pointer of plate to index with point on distributor mounting bracket. Tighten swivel clamp screw.

(2) Remove No. 1 spark plug wire from spark plug, pulling out with a

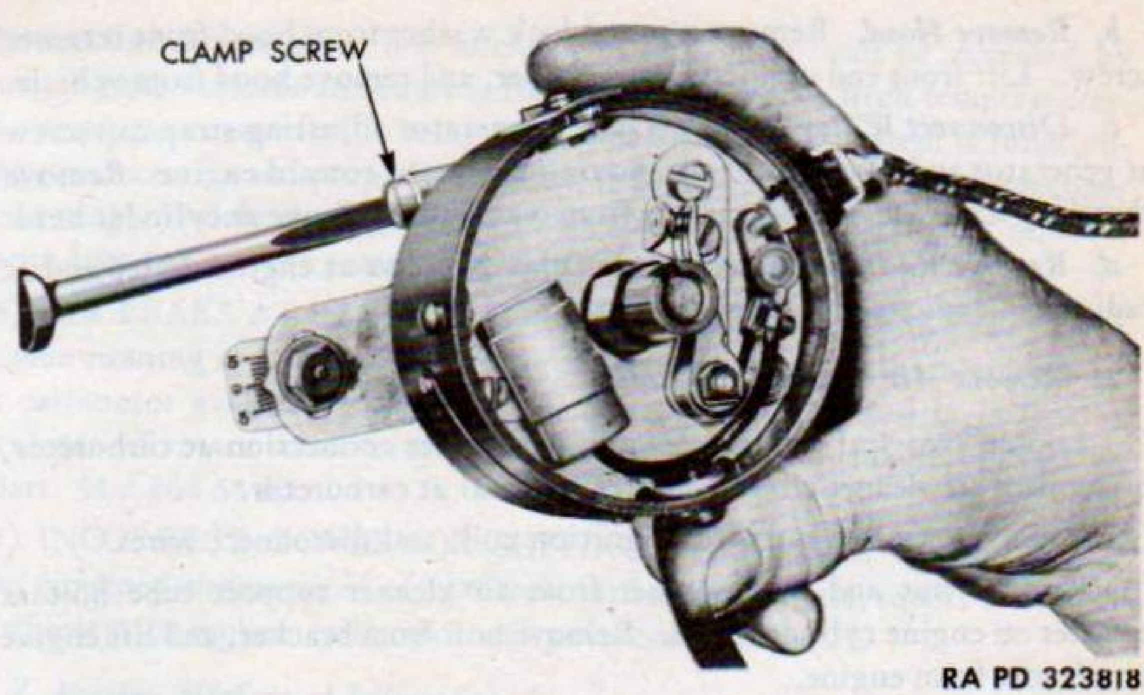


Figure 29 — Loosening Distributor Clamp Screw

slight twisting motion to prevent damage to the spring-type connections.

(3) Remove No. 1 spark plug and gasket from cylinder head, using a properly fitting socket wrench to avoid damage to spark plug.

(4) Turn engine over with hand crank until No. 1 cylinder is coming up on compression stroke. Hold thumb over spark plug hole until pressure is felt. Continue turning until notch in crankshaft drive pulley flange indexes with pointer on timing gear case cover (fig. 28). Replace spark plug and gasket.

(5) Note position of No. 1 spark plug wire terminal in distributor cap, and place mark on distributor housing.

(6) Remove distributor cap, and check position of rotor. Rotor arm should point to No. 1 spark plug wire terminal position on mark made on housing.

(7) Remove rotor and dust shield from distributor. Adjust breaker point gap clearance to from 0.018 to 0.024 inch (par. 82 *b*).

(8) With timing notch in crankshaft drive pulley flange and pointer indexing (fig. 28), and with rotor turned toward No. 1 cylinder, loosen distributor clamp screw (fig. 29), rotate distributor housing until contact points just separate, then tighten clamp screw.

(9) Install dust seal, rotor, and distributor cap, and install and connect spark plug.

50. CYLINDER HEAD GASKET REMOVAL.

*a. **Drain Radiator.*** Remove radiator filler cap. Open radiator drain cock at lower left of radiator core. If coolant contains antifreeze solution, save it.

b. Remove Hood. Remove nut and lock washer from hood front retainer screw. Lift front end of hood from retainer, and remove hood from vehicle.

c. Disconnect Water Pump. Loosen generator adjusting strap cap screw at generator and loosen fan belt, moving generator toward engine. Remove three cap screws and lock washers from water pump flange at cylinder head.

d. Remove Radiator Hose. Loosen clamp screws at engine outlet and at radiator. Remove radiator hose.

e. Remove Air Cleaner and Coil.

(1) Loosen two seal clamp screws in air cleaner connection at carburetor, disconnect air cleaner elbow, and remove seal at carburetor.

(2) Remove terminal nuts from ignition coil, and disconnect wires.

(3) Remove nut and lock washer from air cleaner support tube bolt at bracket on engine cylinder head. Remove bolt from bracket, and lift engine air cleaner from engine.

f. Disconnect Fuel Line, Vacuum Line, and Throttle Control.

(1) Loosen fuel line connection and disconnect fuel line at carburetor.

(2) Unhook snap-type connection of throttle control rod at carburetor.

(3) Loosen and disconnect crankcase ventilator vacuum line at intake manifold connection, and disconnect at metering valve on oil filler pipe. Remove one cylinder head bolt and vacuum line clip, and remove vacuum line from engine.

g. Remove Temperature Gage Sending Unit. Loosen and unscrew engine heat temperature gage sending unit from thermostat housing.

h. Remove Horn. Remove acorn nut and flat washer from cylinder head cover stud at horn bracket, and remove horn and bracket from cylinder head. Lay aside without disconnecting wires.

i. Disconnect Ignition Distributor at Head.

(1) Disconnect spark plug wires from spark plugs, using a twisting motion as spring-type terminals are pulled from spark plugs to avoid damage to the springs.

(2) Remove two cap screws and special washers from distributor bracket base. This will allow distributor and wires to lie outward from side of cylinder head. NOTE: *Do not remove distributor from engine without first noting position of distributor rotor. Otherwise, engine must be retimed.*

j. Disconnect Intake and Exhaust Manifolds. Remove eight cap screws and flat washers holding intake and exhaust manifolds to engine cylinder head. Manifolds and carburetor can be moved away from cylinder head. Remove manifold gasket, and remove three intake manifold port pilot rings.

k. Remove Cylinder Head Cover. Remove remaining two acorn nuts and flat washers from cylinder head cover studs, and lift cover and gasket from cylinder head.

l. Remove Engine Cylinder Head.

(1) Remove cylinder head cover spacer nuts from three cylinder head bolts.

(2) Remove nine cylinder head bolts and flat washers from valve rocker arm assembly. NOTE: *The cylinder head bolt at the left side of the front rocker arm shaft bracket is drilled as the oil supply source. It must be replaced in this same location.* Lift off valve rocker arm assembly.

(3) Lift 12 valve push rods from their sockets in cylinder head.

(4) Remove remaining 14 cylinder head bolts and flat washers (one already removed in subpar. *f* (3) above).

(5) Lift engine cylinder head from engine. Remove cylinder head gasket.

51. CARBON REMOVAL.

a. Remove cylinder head and gasket from engine (par. 50).

b. Scrape carbon from heads of pistons with scraper.

c. Using scraper or carbon brush, remove carbon from cylinder head combustion chambers.

d. Install cylinder head and new cylinder head gasket as outlined in paragraph 52.

52. CYLINDER HEAD GASKET INSTALLATION.

a. Install Cylinder Head.

(1) Make sure all gasket surfaces are absolutely clean and smooth. Coat new gasket lightly with cement joint and thread compound, type B. Place gasket on cylinder block, with marked side up as stamped.

(2) Lift cylinder head into position on engine, being careful not to slide gasket out of alinement with cylinder head bolt holes.

(3) Install 14 cylinder head bolts and flat washers in cylinder head, but do not tighten securely. Do not install bolt at right front of cylinder head at this time.

(4) Insert 12 valve push rods in their sockets, making sure that the lower ends enter the sockets in the valve tappets.

(5) Place valve rocker arm assembly in position on top of cylinder head having valve rocker arm adjusting screws entered in sockets of valve push rods. Install nine cylinder head bolts and flat washers, locating the three special cylinder head cover support bolts in the proper locations and placing the drilled oil supply cylinder head bolt in the left-hand hole in the front bracket. Do not tighten securely at this time.

(6) Loosen all valve rocker arm adjusting screw lock nuts, and screw adjusting screws up into rocker arms. This will avoid possible damage to the valve push rods.

(7) Tighten all cylinder head bolts evenly to 80 foot-pounds using tension wrench (41-W-3630). Tighten bolts alternately, each a little at a time, working from center of head outward.

b. Install Intake and Exhaust Manifolds.

(1) Place three intake manifold pilot rings in ports in cylinder head.

(2) Clean the gasket surface on cylinder head, and install new manifold gasket.

(3) Move intake and exhaust manifolds in against cylinder head, locating over pilot rings. Install eight cap screws and flat washers, and tighten evenly and securely.

c. Connect Ignition Distributor.

(1) Without removing distributor from its drive shaft and without moving rotor, move distributor bracket in against cylinder head, after installing gasket. Install two cap screws and special lock washers in the distributor bracket base and through spark plug wire shields.

(2) Connect spark plug wires to spark plugs, connecting in 1-5-3-6-2-4 rotation. Use a downward twisting motion in connecting the spring-type terminals to avoid damage to the springs.

d. Install Temperature Gage Sending Unit. Insert sending unit into opening in thermostat housing, and tighten connection.

e. Connect Vacuum Line, Throttle Control, and Fuel Line.

(1) Install one remaining cylinder head bolt and flat washer at right front of crankcase, and install ventilator vacuum line and clip. Connect ventilator vacuum line at intake manifold and at oil filler pipe.

(2) Connect throttle control rod to carburetor. Connection is of snap type.

(3) Connect and tighten fuel line at carburetor.

f. Install Air Cleaner and Coil.

(1) Lift air cleaner and coil assembly into position on engine, placing support tube in bracket on cylinder head. Install bolt through bracket and tube, and install nut and lock washer.

(2) Connect air cleaner elbow at carburetor, placing seal and clamp in place. Tighten clamp screws.

(3) Connect coil wires to coil terminals, and install terminal nuts.

g. Connect Radiator Hose. Place upper radiator hose in position,

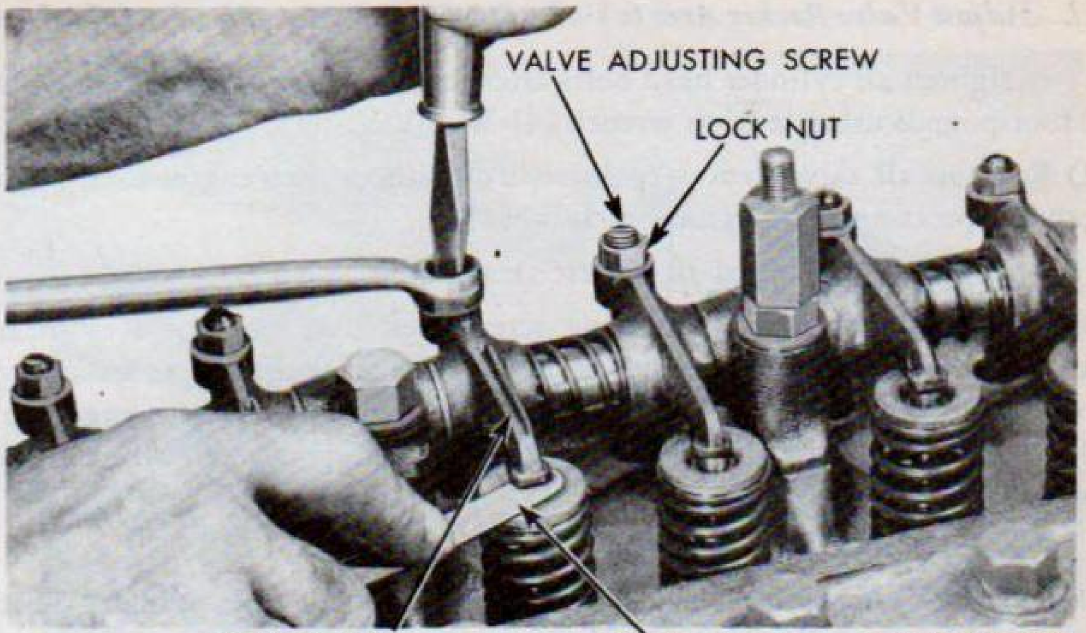


Figure 30 — Adjusting Valve Rocker Arm to Valve Stem Clearance

connecting to radiator and to engine outlet. Tighten hose clamp screws.

h. Connect Water Pump.

(1) Install new gasket at cylinder head water pump mounting surface. Place water pump against cylinder head, install three cap screws and lock washers in water pump flange, and tighten evenly and securely.

(2) With fan belt in position, move generator away from engine to tighten belt so as to permit from ½- to 11/16-inch depression of belt. Tighten generator adjusting strap cap screw.

i. ***Refill Radiator.*** Close radiator drain cock at lower right corner of radiator, and refill radiator with coolant. Install radiator cap.

j. Adjust Valve Rocker Arm to Valve Stem Clearance—Preliminary Adjustment.

(1) Place No. 1 piston on top dead center on the firing stroke.

(2) Adjust clearance between the rocker arms and stem ends of the intake and exhaust valves of No. 1 cylinder to from 0.018 to 0.020 inch by tightening the rocker arm adjusting screws until the clearance is obtained, then tightening the lock nuts (fig. 30).

(3) Revolve engine crankshaft 1/3 turn and adjust valve stem to rocker arm clearance at No. 5 cylinder as in (2) above. Continue process for cylinders 3-6-2-4 in the order named, turning crankshaft 1/3 turn for each.

k. ***Start Engine.*** Start engine and permit to operate until it has reached normal operating temperature of 160°F to 180°F.

l. Adjust Valve Rocker Arm to Valve Stem Clearance—Final Adjustment.

(1) Retighten all cylinder head bolts alternately and evenly to a tension of 80 foot-pounds using tension wrench (41-W-3630).

(2) Readjust all valve stem to rocker arm clearances with engine running at normal operating temperature, as follows:

(a) Adjust engine speed to lowest steady idle.

(b) Loosen rocker arm adjusting screw lock nuts on No. 1 cylinder valves and turn adjusting screws in or out of rocker arm as necessary to provide 0.018 to 0.020 inch clearance as measured with a feeler gage (fig. 30), then tighten lock nuts securely. NOTE: *Recheck clearance after tightening lock nuts.*

(c) Follow same procedure for remaining cylinders.

m. Install Cylinder Head Cover and Horn. Install new cylinder head cover gasket. Install cylinder head cover over gasket, and install horn and horn bracket over support stud. Install and tighten three acorn-shaped cylinder head cover nuts and flat washers.

n. Install Hood. Place hood in position on retainer, and install nut and lock washer on hood front retainer screw.

53. VALVE ROCKER ARM TO VALVE STEM CLEARANCE ADJUSTMENT.

a. Remove three acorn-shaped nuts and washers from cylinder head cover. Lift horn and bracket from cover. Lift off cylinder head cover and gasket.

b. With engine at operating temperature of 160°F to 180°F, and idling at lowest steady speed, adjust clearance between valve stems and rocker arms as follows:

(1) Loosen valve adjusting screw lock nut on first rocker arm, and adjust screw as necessary to provide clearance of from 0.018 to 0.020 inch measured with a feeler gage (fig. 30).

(2) Repeat operation at the adjusting screw for each valve.

(3) Tighten lock nuts securely, rechecking clearance at each valve before proceeding to the next valve.

c. Install new cylinder head cover gasket, and place cover over support studs. Place horn and bracket in position on support stud, and install three acorn-shaped nuts and washers.

54. REMOVAL OF INTAKE AND EXHAUST MANIFOLD ASSEMBLY AND GASKET.

a. Description. The exhaust and intake manifolds are bolted together

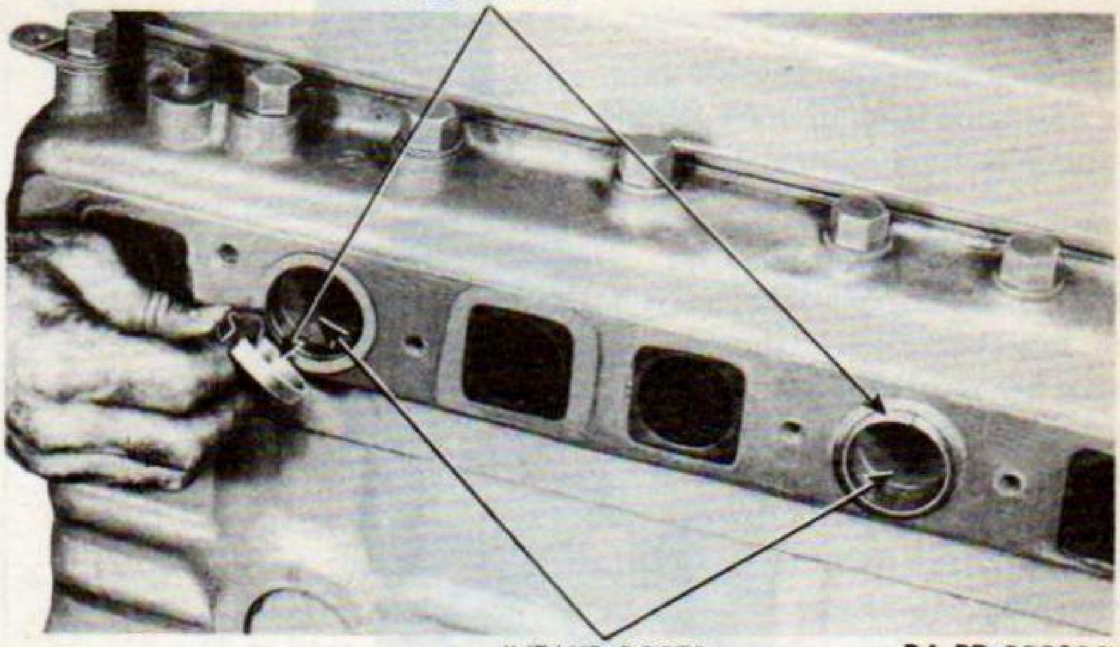


Figure 31 — Location of Intake Manifold Pilot Rings

at the center. They are held against the cylinder head by means of eight cap screws and flat washers. The intake manifold is of one-piece construction, and is piloted to the cylinder head by pilot rings in the intake ports (fig. 31). The exhaust manifold is also of one-piece construction. The carburetor is bolted to the intake manifold, while the exhaust pipe is attached to the exhaust manifold outlet flange. Gaskets are used between the manifolds and the cylinder head, and between the two manifolds.

b. Removal of Intake and Exhaust Manifolds.

(1) Disconnect fuel line at carburetor, and disconnect choke control wire. Disconnect throttle control rod at carburetor.

(2) Loosen carburetor to air cleaner elbow clamp screws, and disconnect elbow from carburetor.

(3) Remove two nuts from carburetor flange studs. Remove carburetor, two gaskets, and insulator from intake manifold (fig. 32).

(4) Remove nuts from three exhaust pipe flange bolts, remove bolts, and remove flange seal ring.

(5) Disconnect crankcase ventilator vacuum line at intake manifold.

(6) Remove eight manifold to cylinder head cap screws and washers.

(7) Lift intake and exhaust manifold assembly from cylinder head.

(8) Separate intake and exhaust manifolds by removing nuts from four retaining cap screws and lifting intake manifold from exhaust manifold (fig. 33). Remove gasket.

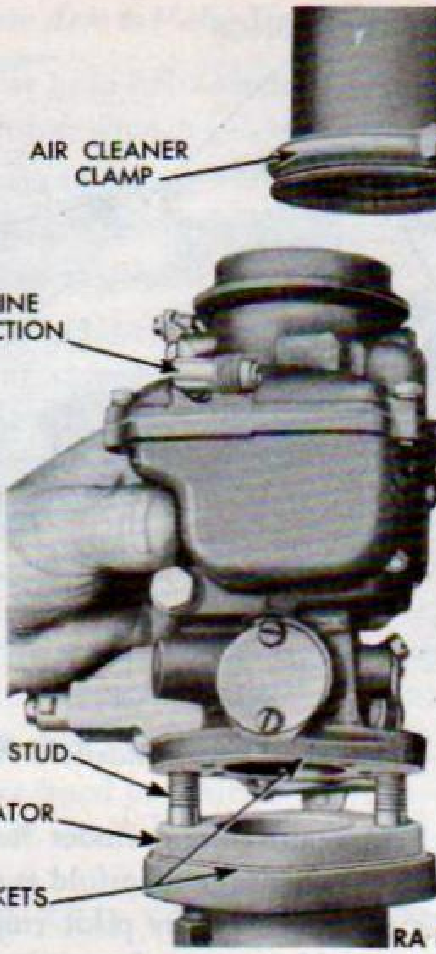


Figure 32 — Removing Carburetor

c. Removal of Gasket Only. The intake and exhaust manifold gasket may be removed with but little disassembly of parts as follows:

(1) Loosen clamp screws in carburetor to air cleaner elbow clamp, and disconnect elbow.

(2) Disconnect fuel line at carburetor, and disconnect throttle control rod.

(3) Disconnect crankcase ventilator vacuum line at intake manifold.

(4) Remove eight manifold to cylinder head stud nuts and washers.

(5) Move manifolds away from cylinder head.

(6) Remove old gasket, and clean gasket surfaces of both manifolds and of cylinder head.

55. INSTALLATION OF INTAKE AND EXHAUST MANIFOLD ASSEMBLY AND GASKET.

a. Installation of Intake and Exhaust Manifolds.

(1) Place new gasket between intake manifold and exhaust manifold center section (fig. 33). Install four retaining cap screws, and install but do not tighten four nuts.

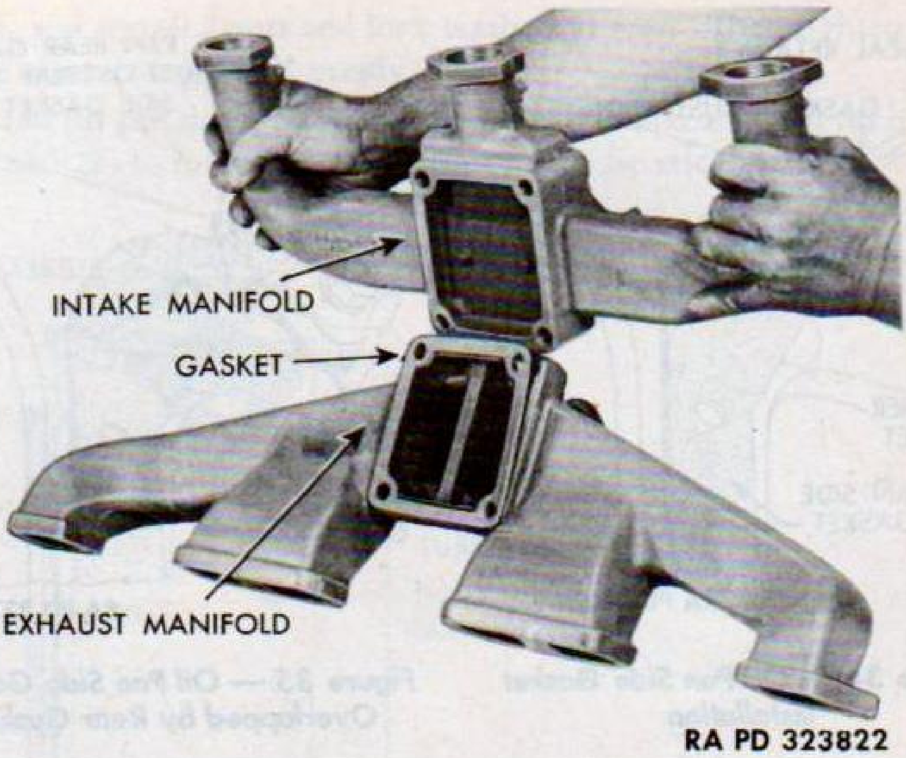


Figure 33 — Separating Intake and Exhaust Manifolds

(2) Place intake manifold pilot rings in intake ports of cylinder head (fig. 31). Place new manifold to cylinder head gasket in position over pilot rings.

(3) Place intake and exhaust manifold assembly in position and install eight cap screws and washers. Tighten evenly and securely.

(4) Tighten four exhaust manifold to intake manifold retaining cap screw nuts.

(5) Connect crankcase ventilator vacuum tube at intake manifold.

(6) Connect exhaust pipe flange at exhaust manifold, being sure that seal ring is in place. Install three flange bolts and nuts, and tighten securely.

(7) Install carburetor and insulator at intake manifold (fig. 32), and install two carburetor flange stud nuts.

(8) Connect air cleaner pipe elbow at carburetor, and tighten two clamp screws. Be sure seal gasket is in place.

(9) Connect throttle control rod, fuel line, and choke wire at carburetor.

b. Installation of Gasket Only.

(1) Install manifold to cylinder head gasket in place over intake manifold pilot rings.

(2) Place manifolds against cylinder head over gasket. Install eight cap screws and washers, and tighten evenly and securely.

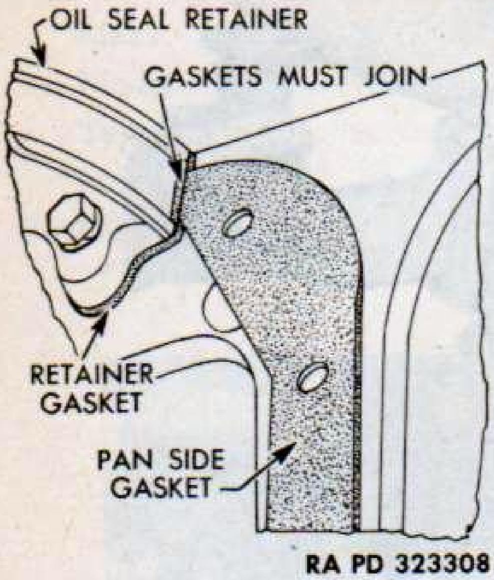


Figure 34 — Oil Pan Side Gasket Installation

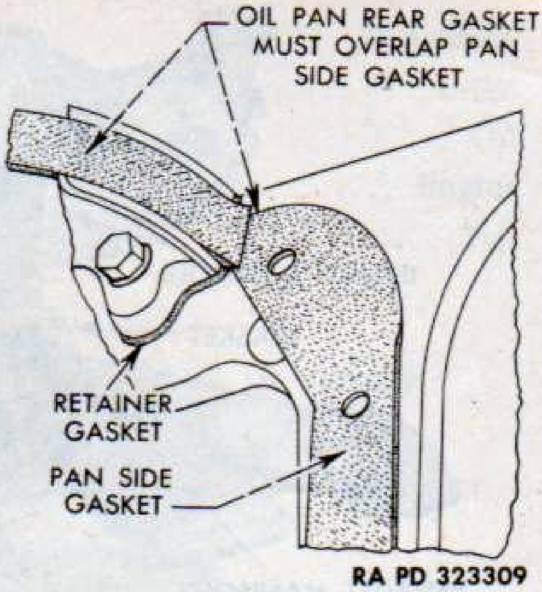


Figure 35 — Oil Pan Side Gasket Overlapped by Rear Gasket

(3) Connect crankcase ventilator tube at intake manifold.

(4) Connect air cleaner elbow at carburetor, and tighten clamp screw.

(5) Connect fuel line at carburetor, and connect throttle control rod.

56. OIL PAN.

a. Removal.

(1) Remove drain plug from base of oil pan, and drain oil into receptacle.

(2) Remove nuts and lock washers from 2 studs at rear end of oil pan, and remove 18 cap screws and lock washers from oil pan flange.

(3) Lower oil pan to floor, and remove oil pan gaskets from oil pan and from crankcase.

b. Cleaning. Wash oil pan externally and internally with dry-cleaning solvent. Wash drain plug, and clean off any accumulated metal particles.

c. Installation.

(1) Coat oil pan side gaskets with cement joint and thread compound, type B, and place in position on block. Be sure that side gasket joins but does not overlap the rear oil seal retainer gasket (fig. 34). Place oil pan front and rear gaskets in place over seal retainers. The rear gasket must overlap the pan side gaskets (fig. 35).

(2) Raise oil pan into position, lining up cap screw holes, and support with block or jack.

(3) Install 18 cap screws and lock washers, but do not tighten until all are

in place, and install 2 nuts and lock washers at rear. Then tighten all nuts and cap screws snugly and evenly.

(4) Install oil pan drain plug securely. Refill crankcase with oil of proper grade (par. 22) to full mark on bayonet gage (dip stick).

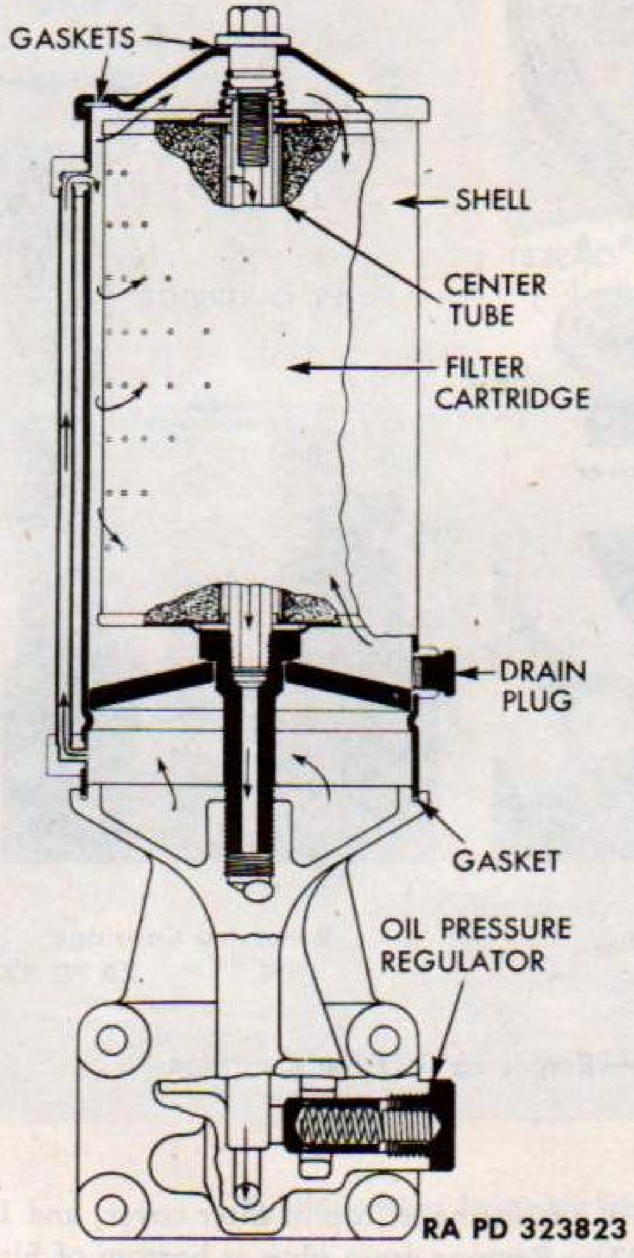


Figure 36 — Oil Filter Sectional View

57. OIL FILTER (fig. 36).

a. Description. The oil filter of replaceable-cartridge type is mounted on the left-hand side of the engine (fig. 27). All of the oil does not pass through the filter as a portion of it bypasses the filter at the oil pressure regulator control valve in the base of the filter. Oil passes through the filter to the external tube, upward to the top, and then into the filter. From here, it is forced through the cartridge out into the center tube, and down the center tube, through the filter base, and into the oil pan.

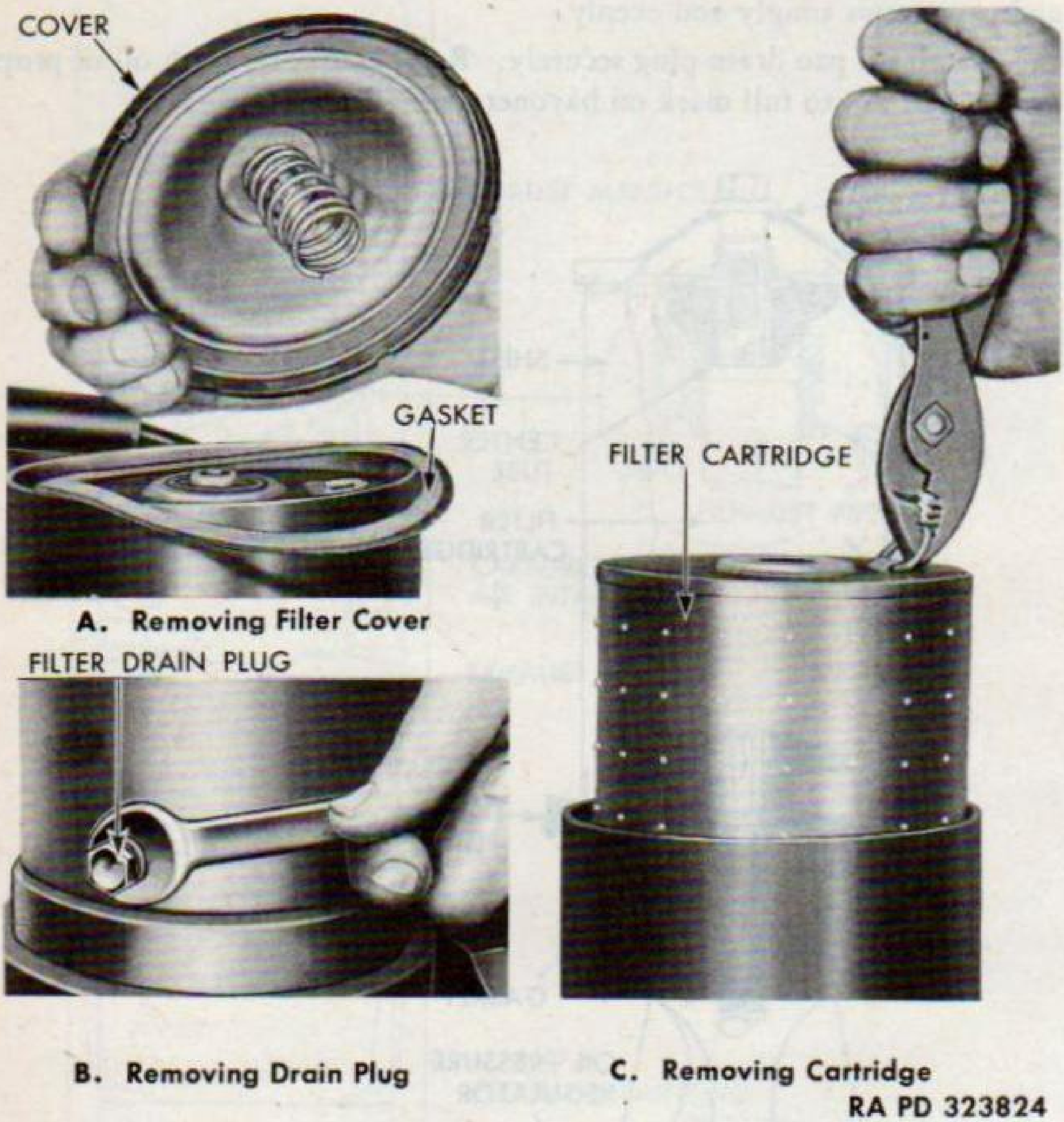


Figure 37 — Removing Oil Filter Cartridge

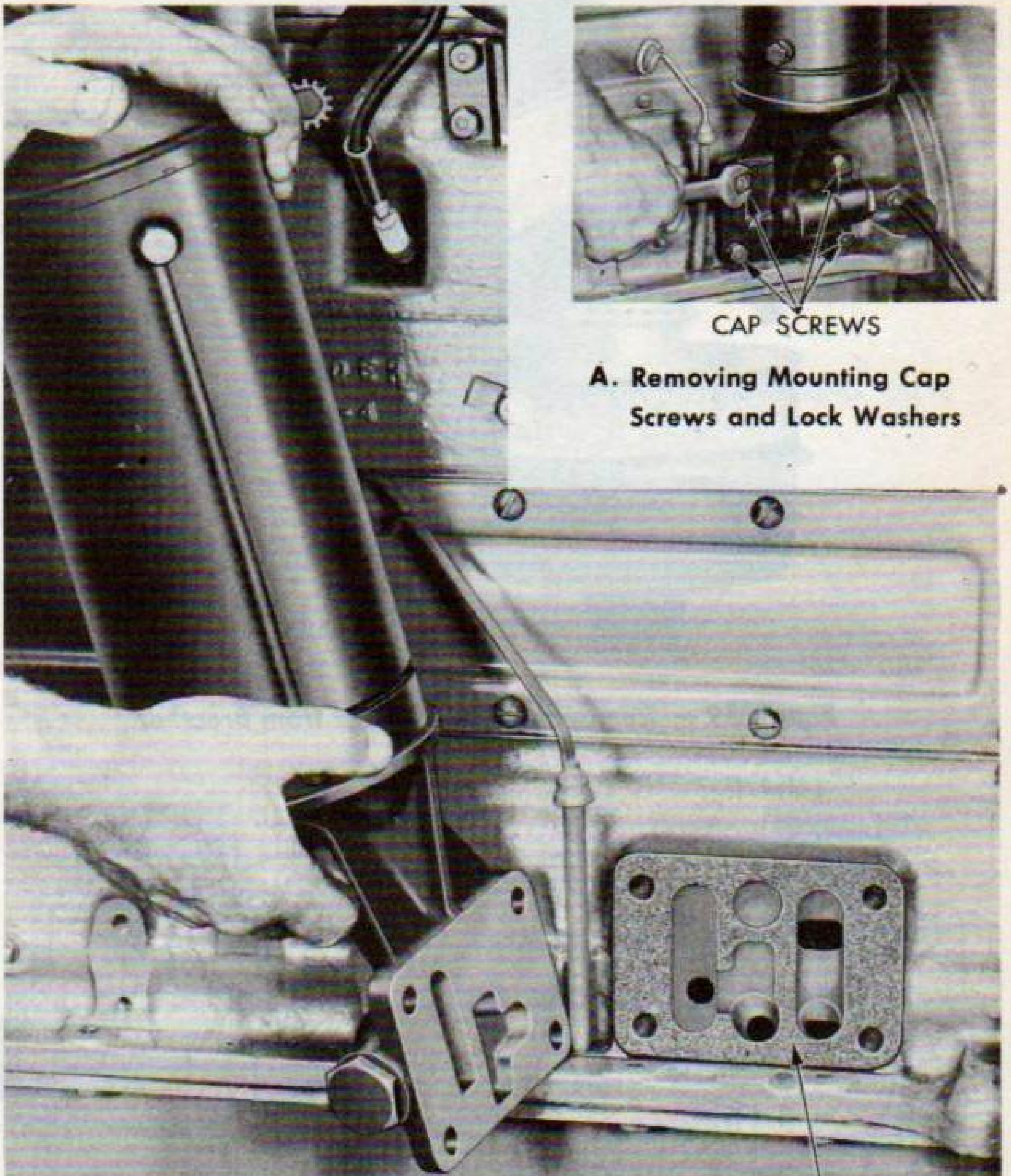
b. Removal.

(1) CARTRIDGE. Unscrew nut fitting at top of filter cover, and lift off cover and gasket (A, fig. 37). Remove drain plug at bottom of filter (B, fig. 37), and drain sump. Lift out filter cartridge (C, fig. 37).

(2) OIL FILTER ASSEMBLY. Remove four cap screws and lock washers from oil filter base (A, fig. 38). Remove oil filter and gasket (B, fig. 38).

c. Installation.

(1) CARTRIDGE (fig. 37). Insert new cartridge in oil filter case. Use new gasket at oil filter cover, and install cover. Tighten nut fitting at top of cover. Start engine and allow to run for at least 10 minutes to charge the new oil filter cartridge fully. Shut off engine, and add oil to crankcase to



A. Removing Mounting Cap Screws and Lock Washers

B. Lifting Filter Assembly from Engine **RA PD 323825**

Figure 38 — Removing Oil Filter Assembly

bring level to full mark on oil level bayonet gage (dip stick). Inspect filter for oil leaks.

(2) OIL FILTER ASSEMBLY (fig. 38). Install new gasket, and place filter in position on engine. Install four cap screws and lock washers, and tighten securely. Start engine and allow to run at least 10 minutes to charge filter cartridge fully. Shut off engine, and add oil to crankcase to bring level to full mark on bayonet gage (dip stick). Check filter for leaks.

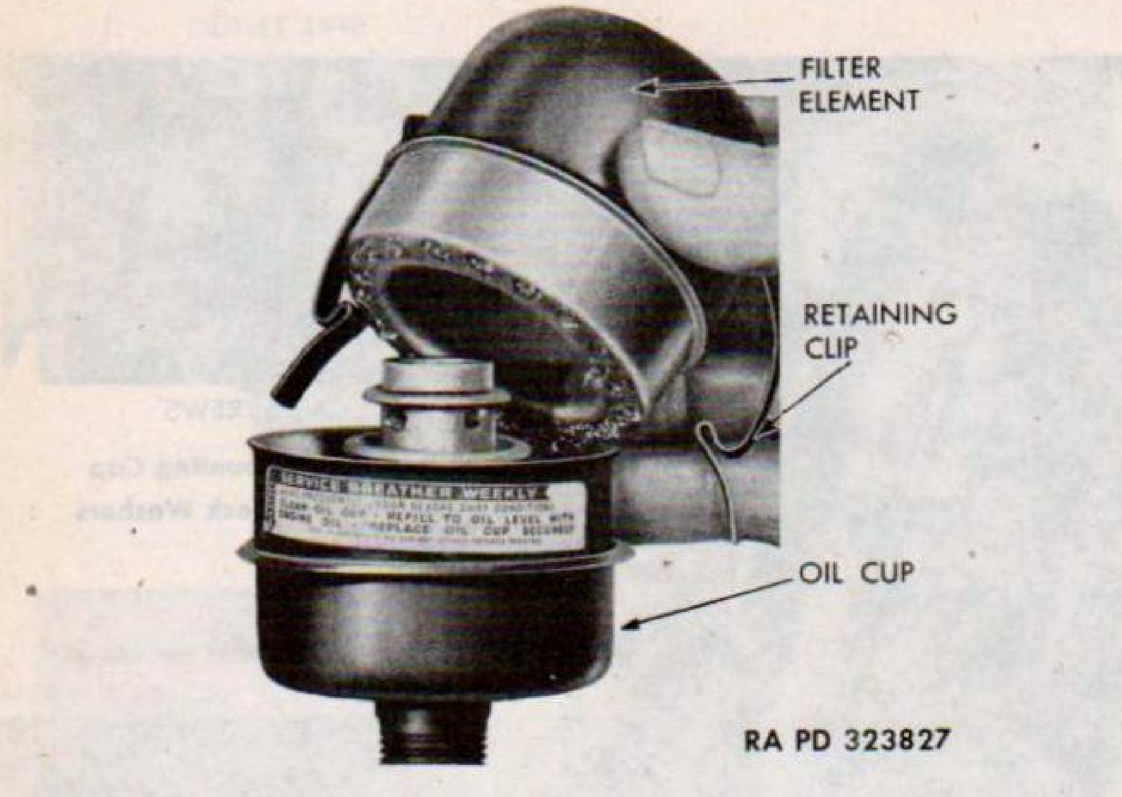


Figure 39 — Removing Filter Element from Breather

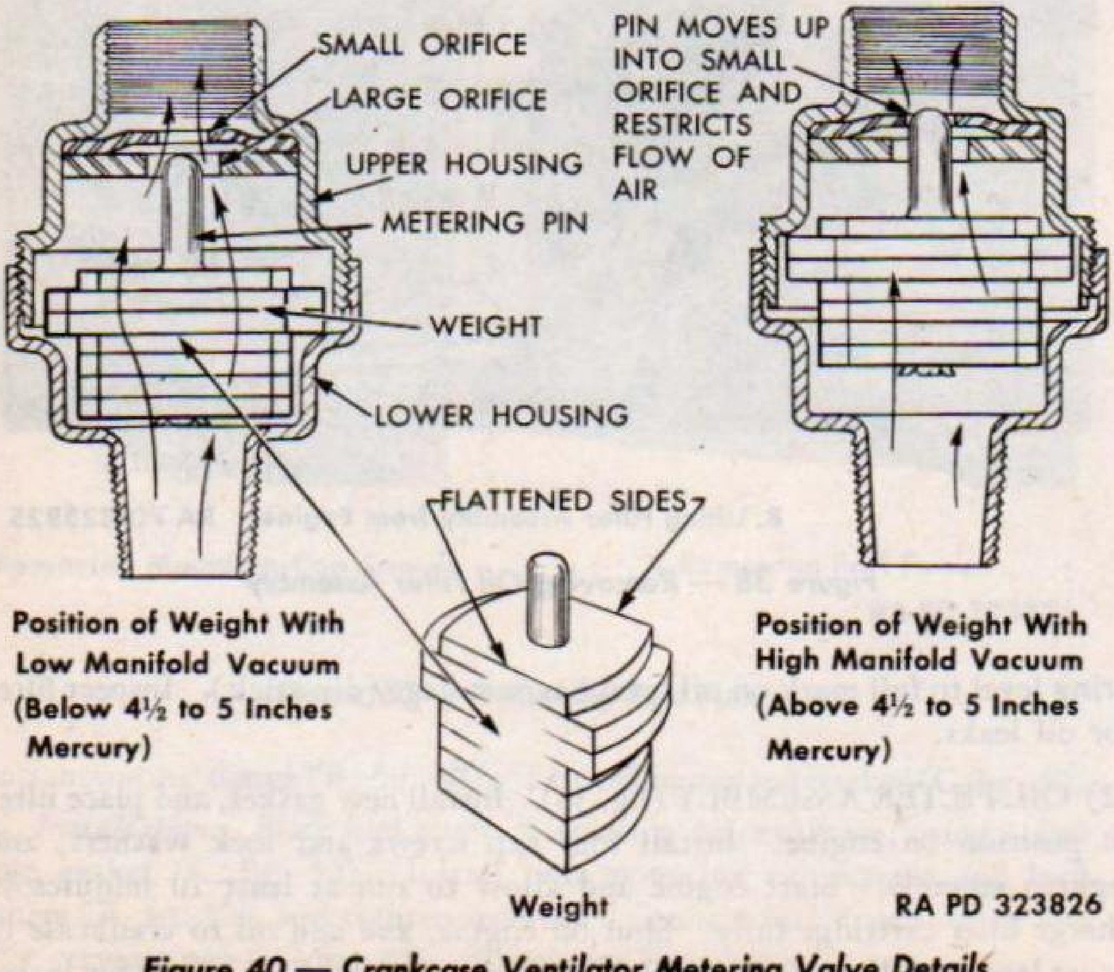


Figure 40 — Crankcase Ventilator Metering Valve Details

58. CRANKCASE VENTILATION.

a. Description. This vehicle has a crankcase ventilator metering valve (fig. 40) installed at the oil filler pipe (fig. 27), and the engine is also

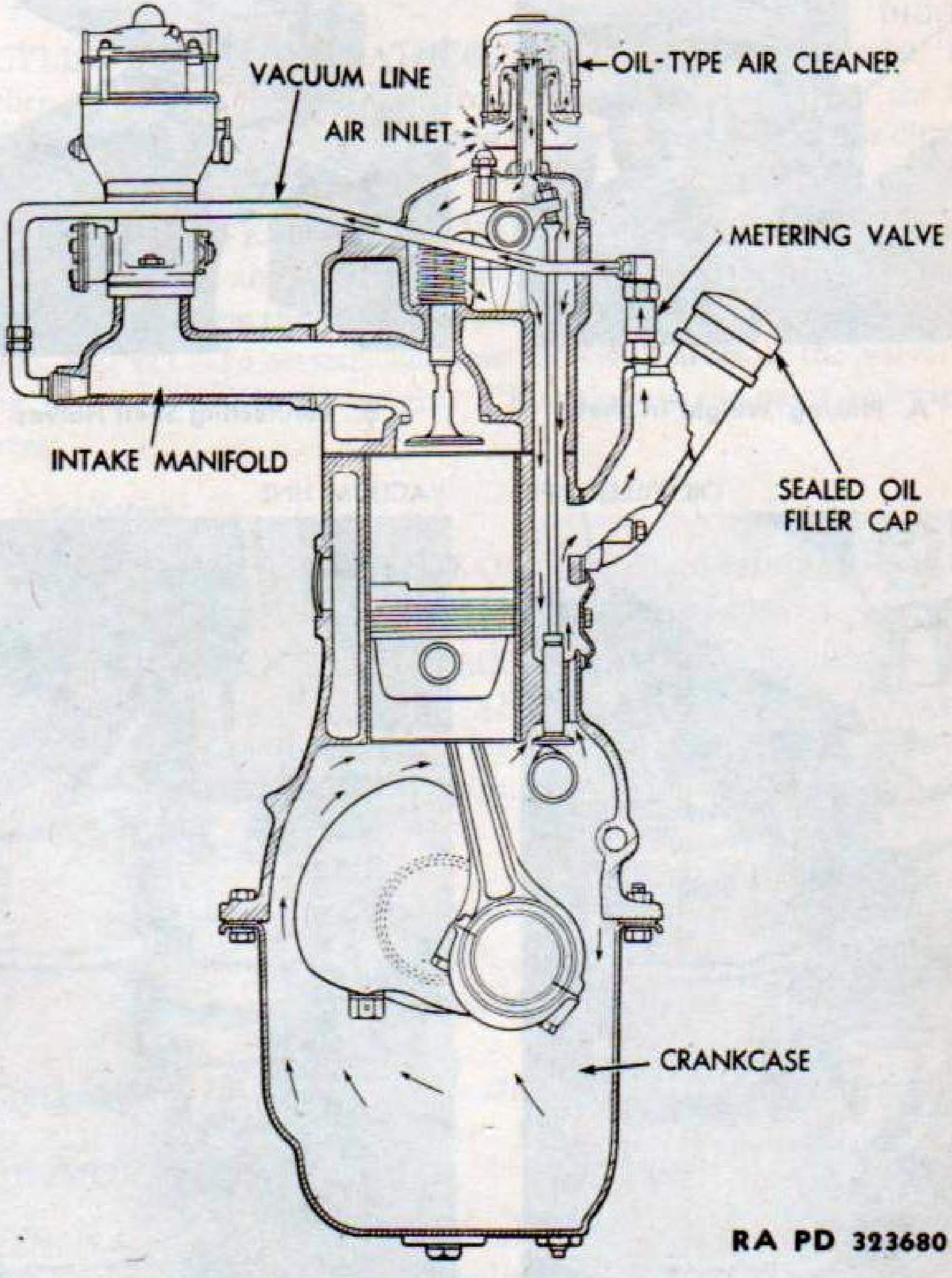


Figure 41 — Crankcase Ventilation System Diagram

equipped with a cylinder head breather (fig. 39). The purpose of the crankcase ventilator metering valve, which is connected to the intake manifold by a vacuum line, is to control the amount of fumes and vapors drawn from the crankcase by the intake manifold vacuum. The purpose of the cylinder head breather, which includes an oil-type air cleaner, is to

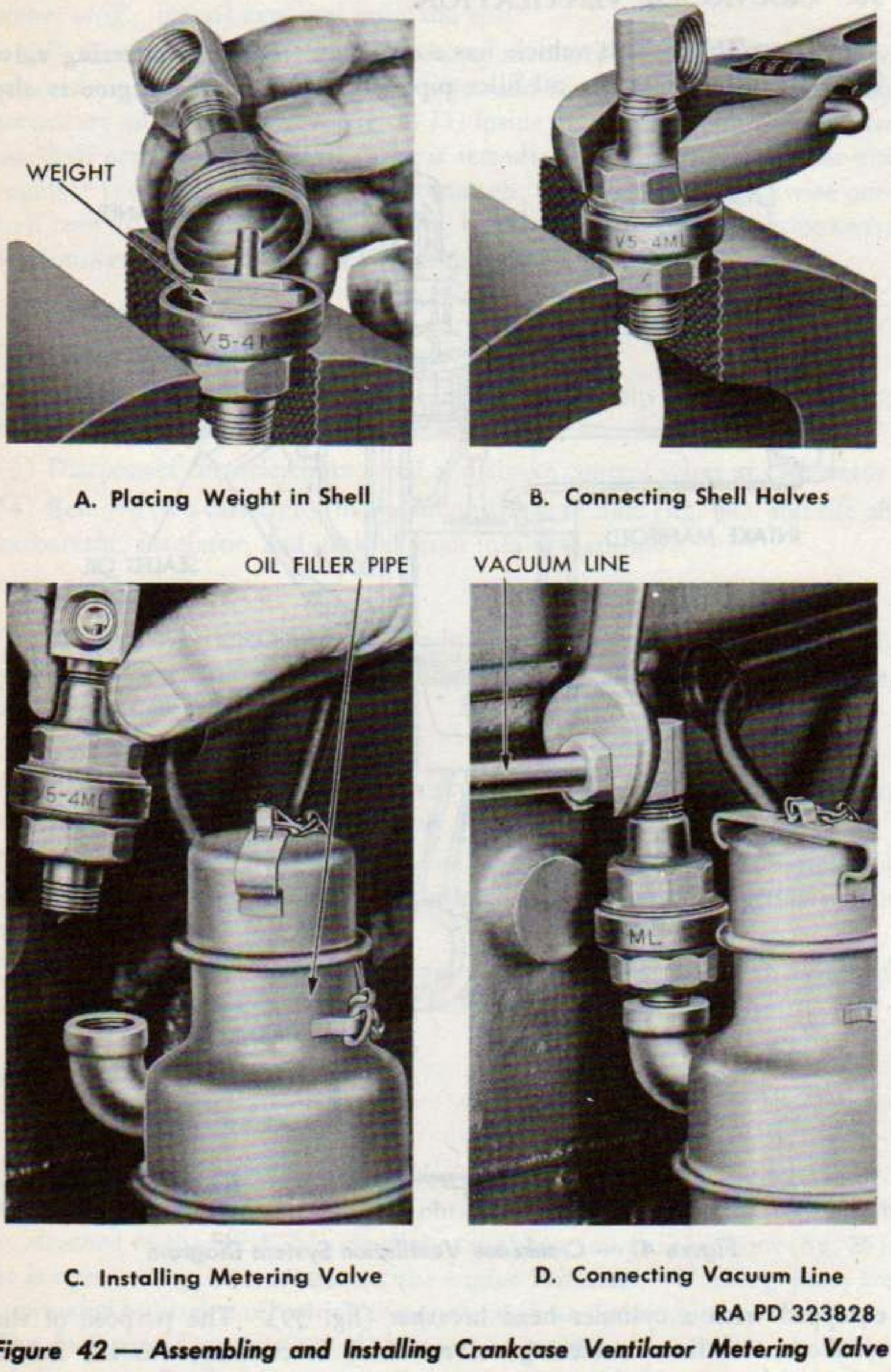


Figure 42 — Assembling and Installing Crankcase Ventilator Metering Valve

filter the air being drawn into the engine through the valve rocker arm compartment. The operation of the crankcase ventilating system consists of drawing cleaned air into the engine and withdrawing the fumes from the crankcase (fig. 41).

b. Removal.

(1) CYLINDER HEAD BREATHER. To service the cylinder head breather, disconnect the two clips from the oil cup, and lift off the filter element (fig. 39). The oil cup can then be lifted from the unit for cleaning and refilling.

(2) CRANKCASE VENTILATOR VALVE. To remove the ventilator metering valve, disconnect the vacuum line leading to the intake manifold (D, fig. 42). Unscrew the ventilator metering valve unit from the oil filler pipe (C, fig. 42). To service, unscrew the two halves of the valve unit (B, fig. 42), and remove the weight. Clean the parts in paint and varnish remover.

c. Installation.

(1) CYLINDER HEAD BREATHER (fig. 39). Place unit in position over tube on cylinder head cover, and fasten clips below oil cup.

(2) CRANKCASE VENTILATOR METERING VALVE. Place weight in lower half of valve shell (A, fig. 42). Screw halves of shell together (B, fig. 42). Install ventilator metering valve in position on oil filler pipe (C, fig. 42). Screw unit into filler pipe. Connect vacuum line leading to the intake manifold (D, fig. 42).

Section XIV

Engine Removal and Installation

59. REMOVAL.

a. Drain Cooling System. Remove radiator cap, open drain cock at lower right of radiator, and drain cooling system. Save coolant if it contains antifreeze solution.

b. Disconnect Battery Cables. Loosen nuts on battery cable clamp bolts, and disconnect battery cables from battery.

c. Remove Hood. See paragraph 78 *b* (2).

d. Remove Radiator and Shell. See paragraph 78 *b* (3).

e. Disconnect Fuel Line. Disconnect fuel line at fuel pump inlet fitting.

f. ***Disconnect Brake Vacuum Line.*** Loosen hose clamp screws at each end of vacuum line from intake manifold to brake vacuum check valve at dash. Remove vacuum line.

g. ***Disconnect Carburetor Controls.***

(1) Disconnect accelerator rod at carburetor throttle lever, unsnapping snap-type joint. Loosen throttle control wire clamp screw, and disconnect throttle control.

(2) Loosen two choke control wire clamp screws at carburetor air intake, and disconnect choke control.

h. ***Remove Exhaust Pipe.***

(1) Loosen nut on clamp bolt at front end of muffler.

(2) Remove nuts from three exhaust manifold flange to exhaust pipe flange bolts, and remove bolts.

(3) Remove exhaust pipe flange seal ring, pull exhaust pipe out of muffler, and remove from chassis.

i. ***Disconnect Wiring.***

(1) Disconnect ignition switch to ignition coil wire at coil, and disconnect wires from coil to distributor.

(2) Disconnect wiring at back of horn and at base of steering gear.

(3) Disconnect wires at generator terminals.

(4) Disconnect headlight wires at junction blocks at each front fender shield.

(5) Disconnect battery cable at starter.

(6) Disconnect wiring harness from retaining clips at engine.

j. ***Disconnect Oil Pressure Gage Line.*** Loosen coupling in oil pressure gage line, and disconnect line.

k. ***Disconnect Temperature Gage.*** Loosen connection at cylinder head, and disconnect temperature gage sending unit from cylinder head.

l. ***Disconnect Engine Front Support.***

(1) Cut locking wire and remove from front engine mounting bolts. Remove two bolts, washers, and springs.

(2) Remove nut from engine ground strap bolt at timing gear cover, and remove bolt.

m. ***Remove Floorboard and Toeboard.***

(1) Remove screws and lock washers from cab floorboard in driver's compartment, and remove floorboard.

(2) Remove screws and lock washers from toeboard, and remove toeboard.

n. Disconnect Transmission at Clutch Housing. Place jack or support beneath transmission. Remove three cap screws and lock washers from each side of the engine flywheel housing at clutch housing; remove cotter pin and yoke pin from clutch control lever.

o. Remove Engine Rear Mounting Bolts. Remove cotter pin and nut from each of two rear engine mounting bolts, and remove bolts.

p. Remove Engine Air Cleaner.

(1) Loosen air cleaner seal clamp screws at carburetor, disconnect elbow, and remove seal.

(2) Disconnect coil wire to switch at coil.

(3) Remove nut and lock washer from air cleaner bracket bolt, remove bolt, and lift engine air cleaner from engine.

q. Attach Engine Lifting Sling.

(1) Remove three acorn-shaped nuts from cylinder head cover, remove horn and horn bracket, and lift off cover.

(2) Remove one cylinder head bolt at front and one at rear of cylinder head, and screw lifting eye bolts into position in cylinder head.

(3) Attach engine lifting bolts (41-B-1586-177 and 41-B-1586-178). Make a sling of rope or chain and fasten it to the lifting bolts.

r. Remove Engine. Attach hoist to sling, and lift engine from chassis. Raise rear end of engine and pull forward, being careful not to bend shaft of transmission main drive gear. Move engine forward until clear of vehicle.

60. INSTALLATION.

a. Install Engine in Vehicle. Attach sling to engine lifting bolts in cylinder head. Raise engine with hoist, and guide into position in frame. Guide carefully while entering the shaft of the transmission main drive gear into clutch disk hub splines, being careful not to twist shaft. Place engine front support pad in position on frame front crossmember, install engine rear support insulators in place, and lower the engine onto the frame.

b. Remove Engine Lifting Sling. Disconnect hoist from rope or chain sling, and remove two engine lifting bolts from engine cylinder head. Install two cylinder head bolts and tighten to 80 foot-pounds, using tension wrench.

c. Install Rear Mounting Bolts. Install one rear mounting bolt at each side at rear of engine. Install nuts and lock washers on each bolt.

d. Connect Engine Front Support.

(1) Install one flat washer and one spring on each of two engine front mounting bolts. Install bolts in engine front mounting, and tighten to compress springs to a length of 3⅜ inches.

(2) Install locking wire in engine front mounting bolt heads, and fasten securely.

(3) Install cap screw, lock washer, and nut in engine ground strap.

e. Connect Transmission at Clutch Housing. Install six cap screws and lock washers in clutch housing flange at transmission.

f. Install Floorboard and Toeboard.

(1) Install toeboard with mounting screws and lock washers.

(2) Install floorboard with mounting screws and lock washers.

g. Install Engine Air Cleaner.

(1) Lift engine air cleaner into position on engine, and install bracket tube clamp bolt, nut, and lock washer.

(2) Connect air cleaner pipe at carburetor, placing seal and clamp in position, and tighten clamp screws.

h. Connect Oil Line. Connect oil pressure gage line and tighten coupling.

i. Connect Temperature Gage Sending Unit. Connect engine unit of temperature gage at cylinder head.

j. Connect Wiring.

(1) Connect wire at starter.

(2) Connect battery cable to starter terminal.

(3) Connect headlight wires at junction blocks at fender shields.

(4) Connect wires at terminals of generator.

(5) Connect wiring at back of horn and at coupling at base of steering gear.

(6) Connect ignition switch to ignition coil wire at ignition coil, and connect wires from coil to distributor.

(7) Fasten wiring harness into wiring clips at engine.

k. Install Exhaust Pipe.

(1) Place exhaust pipe in position in chassis, inserting rear end of pipe in front end of muffler.

(2) Install exhaust pipe flange seal ring in position on flange.

(3) Install three bolts and nuts at exhaust pipe flange, and tighten evenly and securely. Tighten muffler clamp bolt nut.

l. Connect Carburetor Controls.

(1) Connect snap-type coupling of accelerator rod at carburetor throttle lever.

(2) Connect carburetor throttle control wire, having throttle button in against dash. Tighten cable clamp screw.

(3) Connect choke control wire at carburetor air horn, having choke control button in against dash, and tighten two clamp screws.

m. Connect Brake Vacuum. Connect vacuum line from check valve to intake manifold at both ends, and tighten vacuum hose clamps.

n. Connect Fuel Line. Connect fuel line at fuel pump inlet, and tighten connection.

o. Install Radiator and Shell. See paragraph 78 *c*.

p. Install Hood. See paragraph 78 *c*.

q. Refill Cooling System. Close shut-off cock at lower right of radiator core. Be sure that drain cock at right rear of crankcase is closed. Fill cooling system.

r. Connect Battery Cables. Connect battery cables to battery, and tighten cable clamp bolt nuts.

s. Start and Warm Engine.

(1) Check to see that engine oil level is at "FULL" mark on dip stick. Start engine and allow to operate until thoroughly warmed to between 160°F and 180°F.

(2) Tighten all cylinder head bolts to 80 foot-pounds, using tension wrench (par. 52 *a* (7)).

(3) Adjust valve rocker arm to valve stem clearance to from 0.018 to 0.020 inch (par. 53).

(4) Check brake vacuum lines for leaks, and check fuel lines for leaks. Check for water or oil leaks.

t. Install Cylinder Head Cover. Install new gasket around valve rocker arm compartment and place cylinder head cover in position. Install horn bracket on cylinder head cover stud and install three acorn-shaped nuts and flat washers. Connect horn wires at horn.

Section XV

Clutch

61. DESCRIPTION AND DATA.

a. Description. The clutch in this vehicle is a single-plate, dry-disk unit secured to the flywheel by six cap screws. The clutch transmits power from the engine to the transmission. Depressing the clutch pedal causes the release bearing to move forward to contact the release levers. Pressure of the bearing against the release levers relieves the spring pressure on the clutch pressure plate or driving disk. In this position the

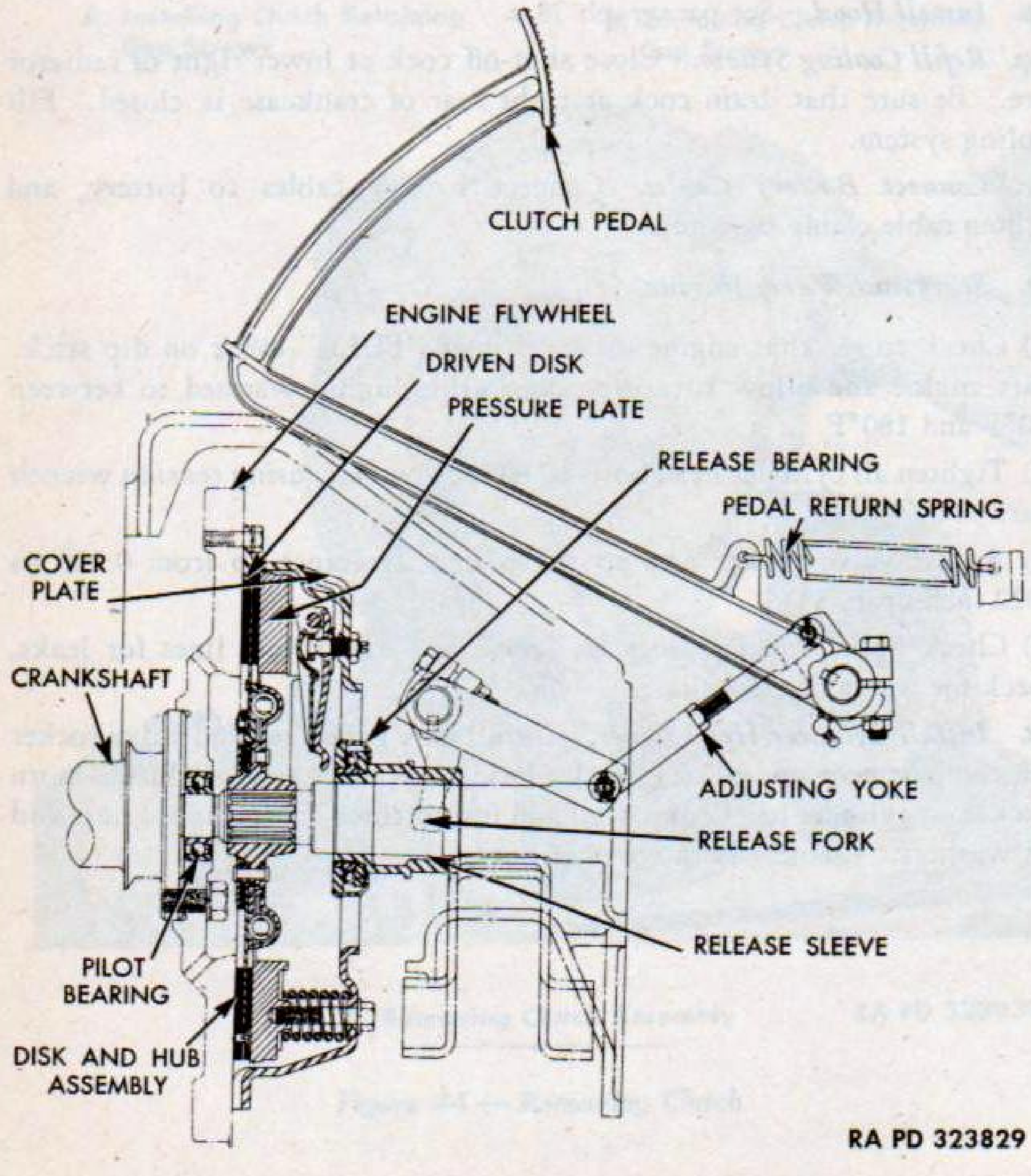


Figure 43 — Clutch Control and Adjustment Diagram

clutch is released. The clutch must be either fully engaged or fully released while driving. NOTE: *Do not "ride" the clutch pedal.* The clutch should be engaged slowly and not allowed to engage suddenly. A properly adjusted clutch will take hold gradually, will not slip, and will release instantly when the pedal is depressed.

b. Data.

Make	Rockford
Model	11-T.T.
Type	Single dry plate
Size	11 in.

62. ADJUSTMENT.

a. The clutch must be adjusted when the natural wear on the clutch facings has decreased the free travel of the clutch pedal before disengagement of the clutch starts to less than 1¾ inches. Clutch adjustment is as follows (fig. 43):

(1) DISCONNECT ADJUSTING YOKE. Loosen lock nut on adjusting yoke of release rod. Remove cotter pin from rod-end yoke pin at release fork shaft lever.

(2) ADJUST YOKE. Adjust yoke, either lengthening or shortening as necessary to provide from 1¾ to 2 inches of free pedal travel. Disconnecting clutch pedal return spring will facilitate feeling point of contact of release bearing with clutch release levers.

(3) CONNECT ADJUSTING YOKE. Connect adjusting yoke to release fork shaft lever, and install rod end yoke pin and cotter pin. Tighten lock nut at adjusting yoke.

63. REMOVAL.

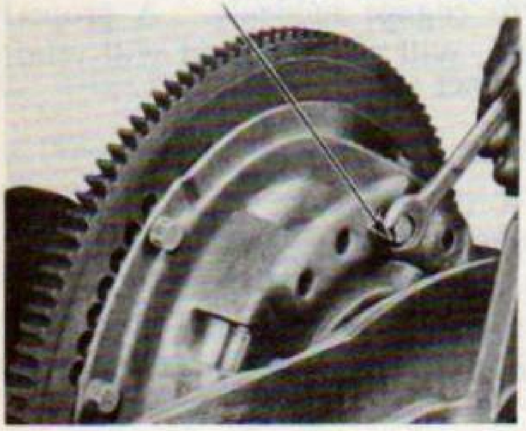
a. Remove Transmission. Transmission removal is described in paragraph 106.

b. Disconnect Clutch Pedal. Remove cotter pin from clutch adjusting yoke rod end pin, and remove pin from yoke and release fork shaft lever.

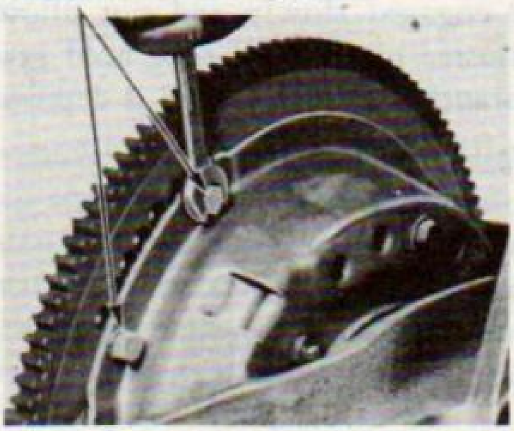
c. Remove Clutch Housing Lower Cover. Remove five cap screws and lock washers from clutch housing lower cover, and remove one cap screw, nut, and lock washer. Lift clutch housing lower cover and gasket from clutch housing.

d. Remove Clutch.

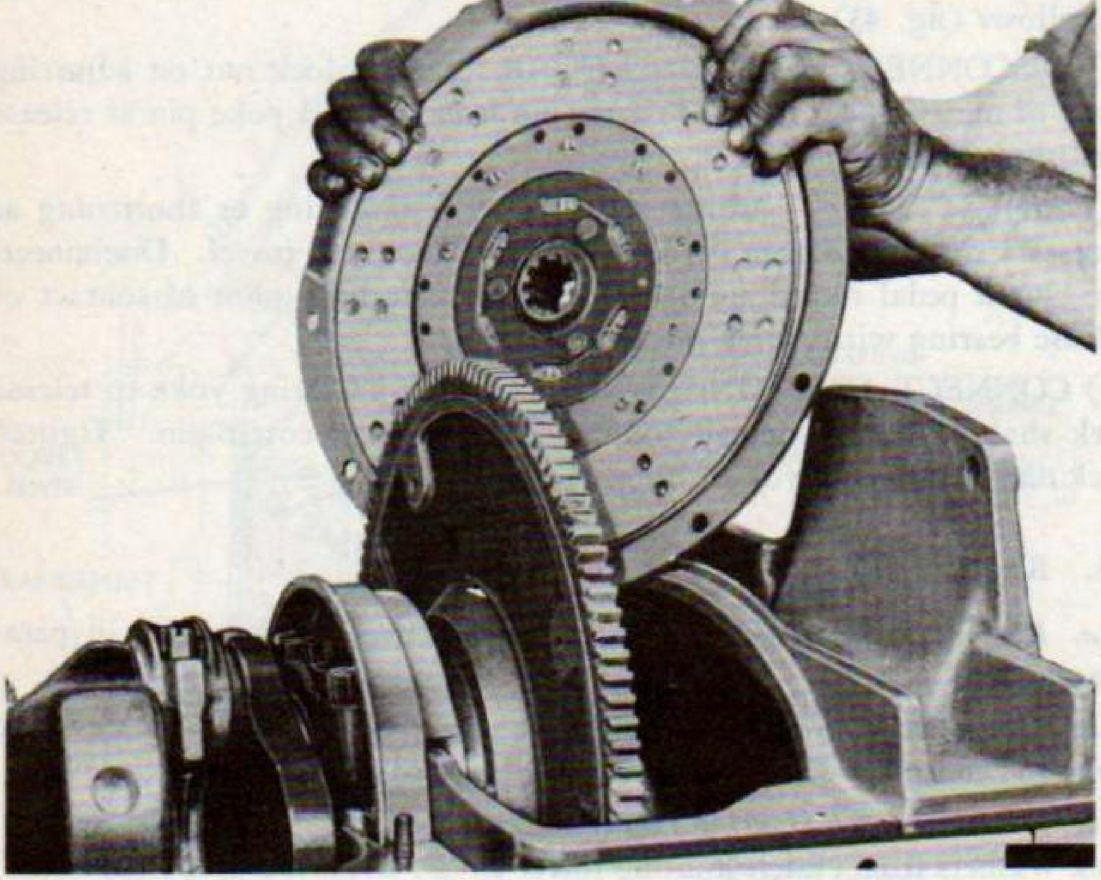
(1) Insert three clutch retaining cap screws (⅜-16 x 1¾ in.) and flat washers in three tapped holes to hold clutch compressed (A, fig. 44). Install only until flush.



A. Installing Clutch Retaining Cap Screws



B. Removing Clutch Mounting Cap Screws



C. Removing Clutch Assembly **RA PD 323830**

Figure 44 — Removing Clutch

(2) Remove six cap screws and lock washers from clutch pressure plate flange (B, fig. 44). Lift clutch and driven disk from flywheel (C, fig. 44).

64. INSTALLATION.

a. Install Clutch on Flywheel.

(1) Place clutch driven disk in position against engine flywheel (C, fig. 44), placing with long end of hub toward the rear. Place clutch in such position that arrow on clutch cover is as near as possible to the letter "L" on the flywheel.

(2) Insert six cap screws and lock washers loosely in clutch cover flange (B, fig. 44).

(3) Insert a clutch alining arbor, or a transmission main drive gear, through driven disk hub and into flywheel bearing. Hold in this position while tightening retaining cap screws.

(4) Remove three clutch retaining cap screws and flat washers (A, fig. 44). NOTE: *Removal of these cap screws is extremely important as the clutch will not operate properly, if at all, while these cap screws are installed.*

b. Install Clutch Housing Lower Cover. Lift clutch housing lower cover and gasket into position on bottom of clutch housing, install five cap screws and lock washers in housing flange, and install one cap screw, nut, and lock washer.

c. Install Transmission. Install transmission, as outlined in paragraph 107.

d. Connect Clutch Pedal. Connect clutch pedal adjusting yoke at clutch release fork shaft lever, and install yoke pin and cotter pin.

e. Adjust Clutch Pedal Travel. Check and adjust free travel of clutch pedal (par. 62).

Section XVI

Fuel System

65. DESCRIPTION.

a. Description. The air-fuel system of this vehicle consists of one frame-mounted fuel tank of 32-gallon capacity, fuel lines, fuel pump, carburetor, and suitable throttle and choke controls. The fuel system is illustrated diagrammatically in figure 45.

b. Operation. The fuel pump is actuated by the engine camshaft. Operation of the fuel pump forces gasoline from the fuel tank into the

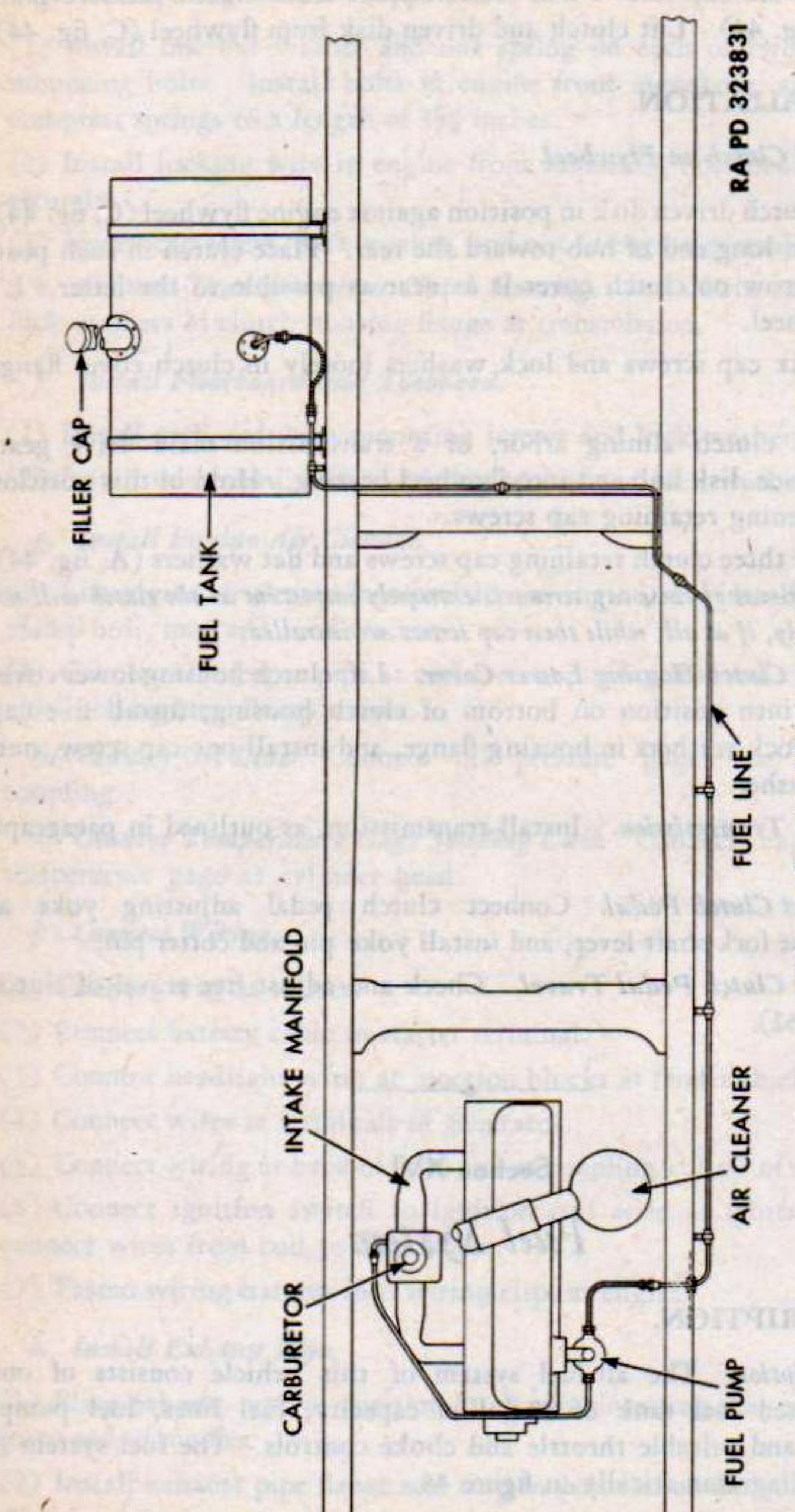


Figure 45 — Fuel System Diagram

carburetor. The fuel in the carburetor is mixed with cleaned air from the air cleaner and drawn into the engine cylinders by the suction stroke of the pistons.

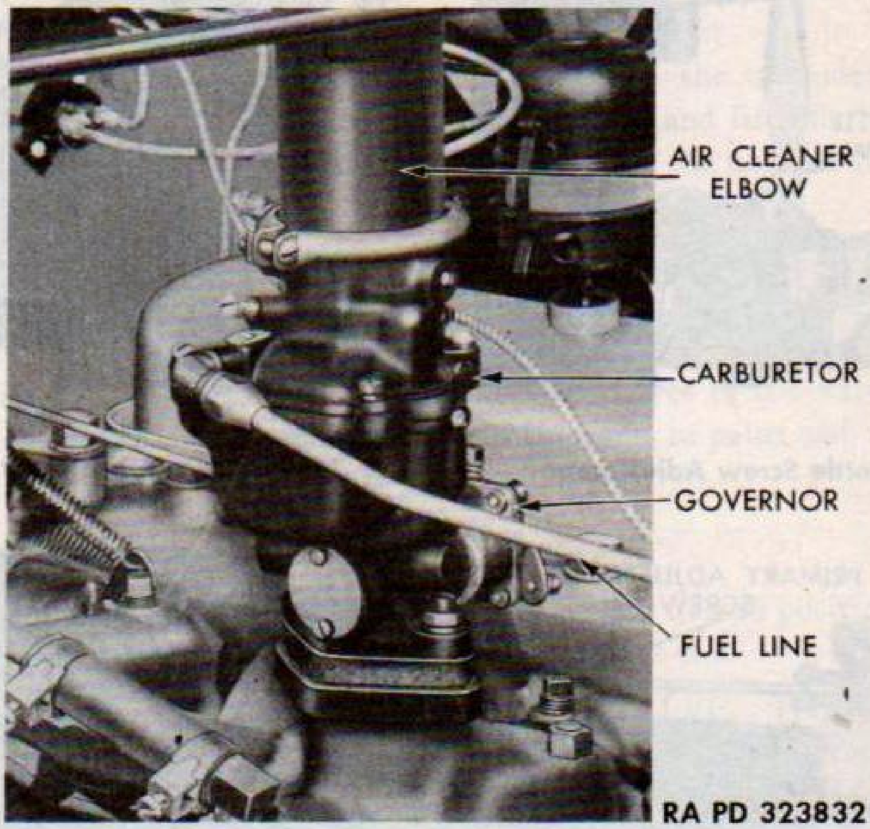


Figure 46 — Carburetor Installed

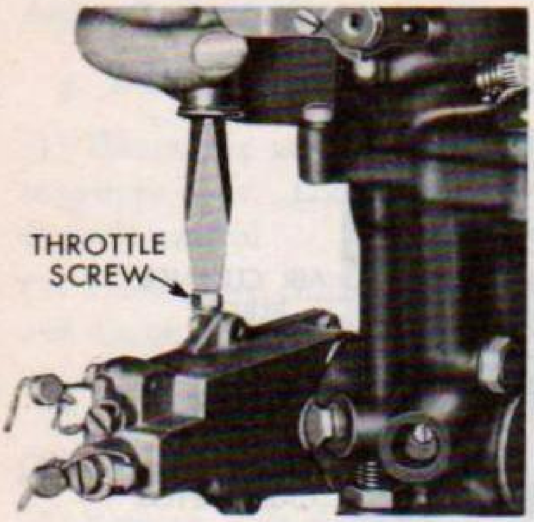
66. CARBURETOR.

a. Description and Data.

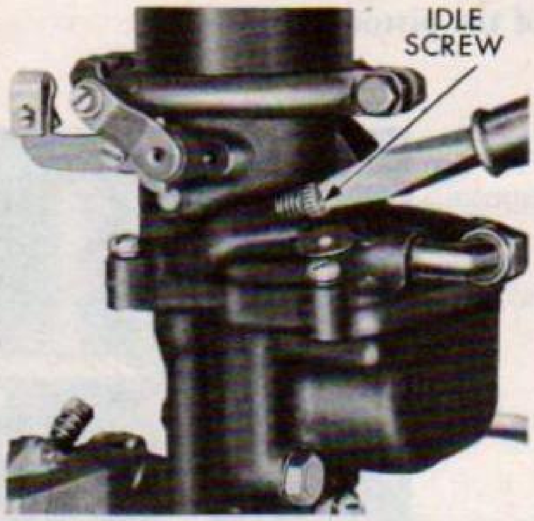
(1) DESCRIPTION. The Zenith 30-series carburetor (fig. 46) is a downdraft unit. It employs a secondary venturi to aid in complete vaporization of the fuel. It is a balanced carburetor in that all air for fuel chamber ventilation and idling must come through the air cleaner, and air cleaner restrictions have a minimum influence on fuel-air ratio. It is designed with a vacuum-controlled power jet and accelerating system. These auxiliary jet systems are to provide the extra fuel needed for certain operations.

(2) DATA.

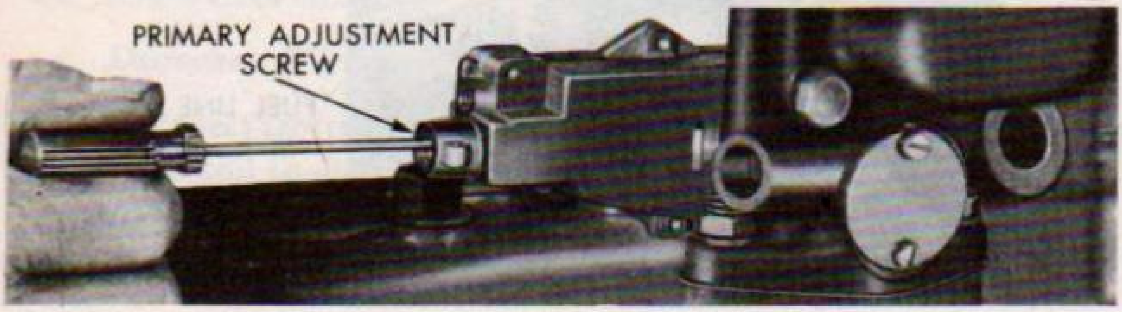
Make	Zenith
Series	30-BW-11-R
Outline number	9994
Type	Downdraft
Governor	Integral



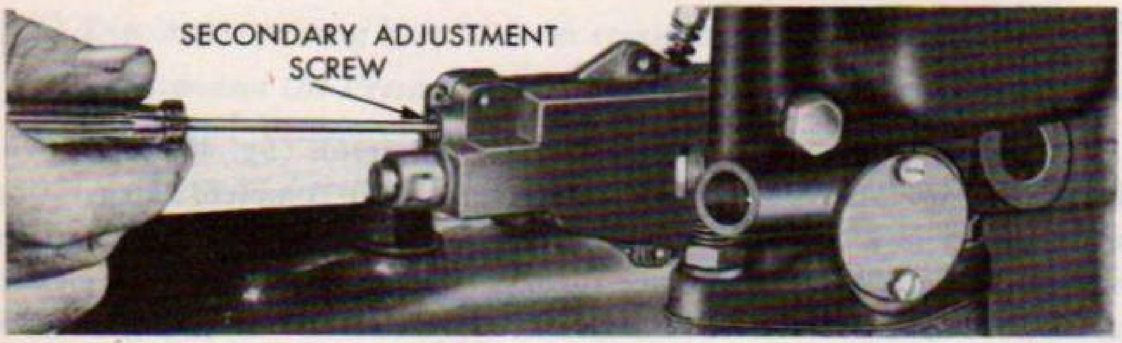
A. Throttle Screw Adjustment



B. Idle Mixture Adjustment



C. Governor Primary Adjustment



D. Governor Secondary Adjustment RA PD 323833

Figure 47 — Carburetor and Governor Adjustments

b. Adjustment. Only the idle speed jet and throttle adjusting screw are adjustable on this carburetor.

(1) THROTTLE SCREW. Adjust engine speed to from 350 to 400 revolutions per minute by turning throttle screw as necessary (fig. 47 A).

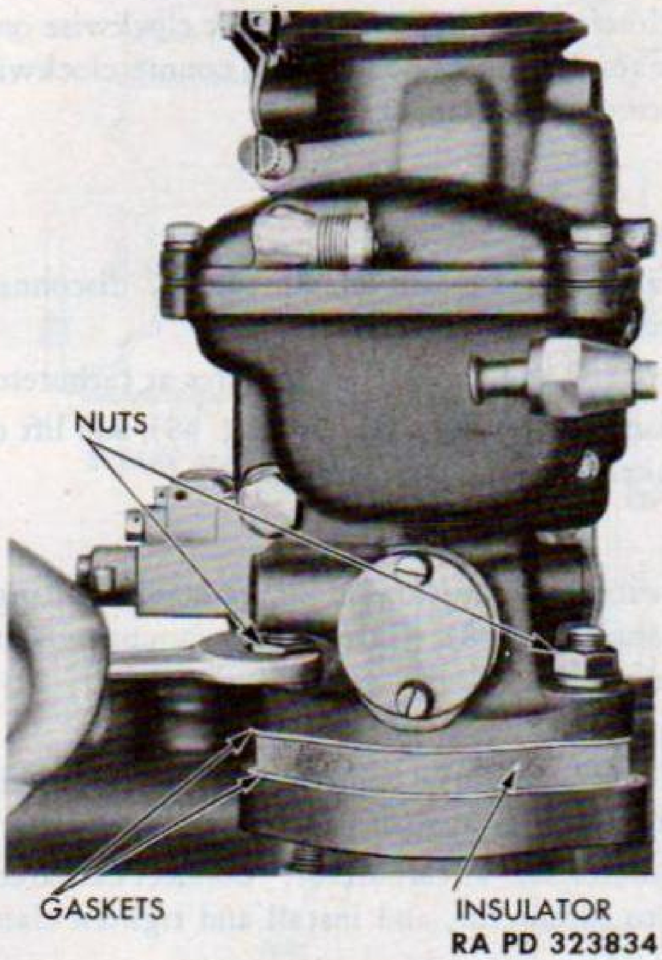


Figure 48 — Removing Carburetor Mounting Stud Nuts

(2) IDLE SPEED MIXTURE. After engine is warmed to normal operating temperature (160°F to 180°F), adjustment for idle mixture should be made with vacuum gage (41-G-500). Connect vacuum gage at intake manifold and, with engine operating at from 350 to 400 revolutions per minute, adjust idle screw (fig. 47 B) to obtain the highest possible steady vacuum reading on the gage. NOTE: *If impossible to idle carburetor by adjustment, check and service crankcase ventilator metering valve (par. 58 b (2)). If valve is clogged with carbon deposit, carburetor will be too rich in mixture.*

(3) GOVERNOR ADJUSTMENT. Following installation of a rebuilt carburetor, it may be necessary to make minor adjustments of the governor. There are two adjustment screws, the primary above, and the secondary below, and adjustments are made as follows:

(a) *Primary Adjustment.* Remove seal and seal wire. Remove screw plug. To increase speed, turn primary adjustment screw (fig. 47 C) clockwise. To decrease speed, turn adjustment screw counterclockwise. Replace screw plug. Install new seal wire and seal.

(b) *Secondary Adjustment.* If surge is encountered, it may be necessary to proceed as follows: Remove seal wire, and remove screw plug. Adjust secondary adjustment screw (fig. 47 D) inside by turning counterclockwise one-half turn at a time until surge is remedied. If the governor does not regulate the governed speed closely enough, turn the screw clockwise one-half turn at a time until surge results, then one-half turn counterclockwise to eliminate surge. Replace screw plug and seal wire.

c. Removal.

(1) Disconnect fuel line at carburetor.

(2) Loosen two carburetor air cleaner elbow clamp screws, disconnect elbow from carburetor, and remove seal.

(3) Disconnect throttle control rod and choke control wires at carburetor.

(4) Remove two carburetor flange mounting stud nuts (fig. 48), and lift off carburetor, insulator, and gaskets from intake manifold.

d. Installation.

(1) Place new gaskets and insulator in position on intake manifold flange, and install carburetor over studs (fig. 48). Install two mounting nuts, and tighten securely and evenly.

(2) Connect fuel line at carburetor.

(3) Connect throttle control rod and choke control wires at carburetor, making sure that control buttons are in against panel.

(4) Install air cleaner to carburetor seal at carburetor. Connect carburetor inlet elbow from air cleaner to carburetor, and install and tighten clamp screws.

(5) Start engine and warm to normal operating temperature, than adjust carburetor idle speed as outlined in subparagraph *b* above.

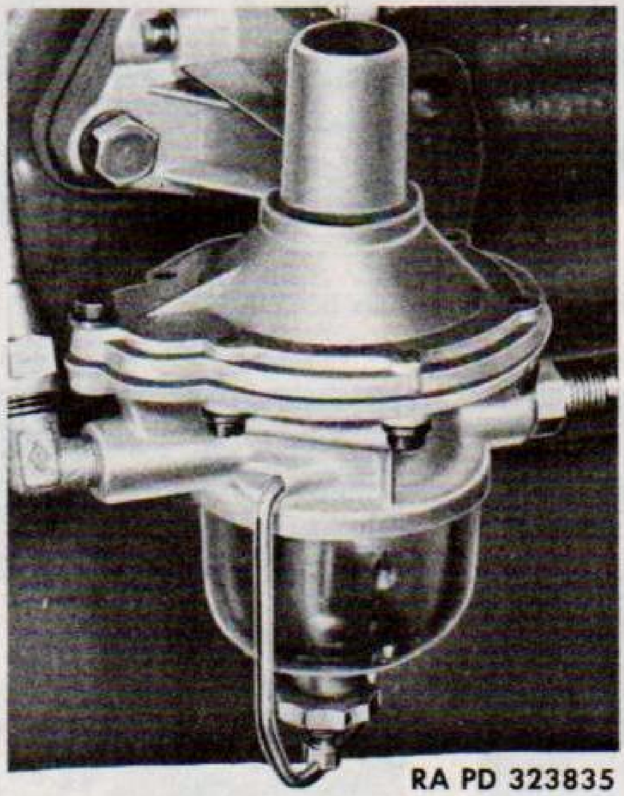
67. FUEL PUMP.

a. Description and Data.

(1) DESCRIPTION. The fuel is drawn from the fuel tank and pumped to the carburetor by a mechanical diaphragm-type fuel pump (fig. 49) which is attached to the left-hand side of the crankcase toward the front (fig. 26). It is operated by an eccentric on the engine camshaft. Working parts are lubricated by engine oil which comes through an opening in the crankcase. The fuel pump requires no adjustment or maintenance within the scope of this manual. Fuel line connection fittings should, however, be checked regularly for leaks. Body screws must be kept tight to prevent air and fuel leaks, and mounting nuts must be tight.

(2) DATA.

Make	AC
Type	AT
Static pressures:	
Minimum	3 lb
Maximum	4 lb



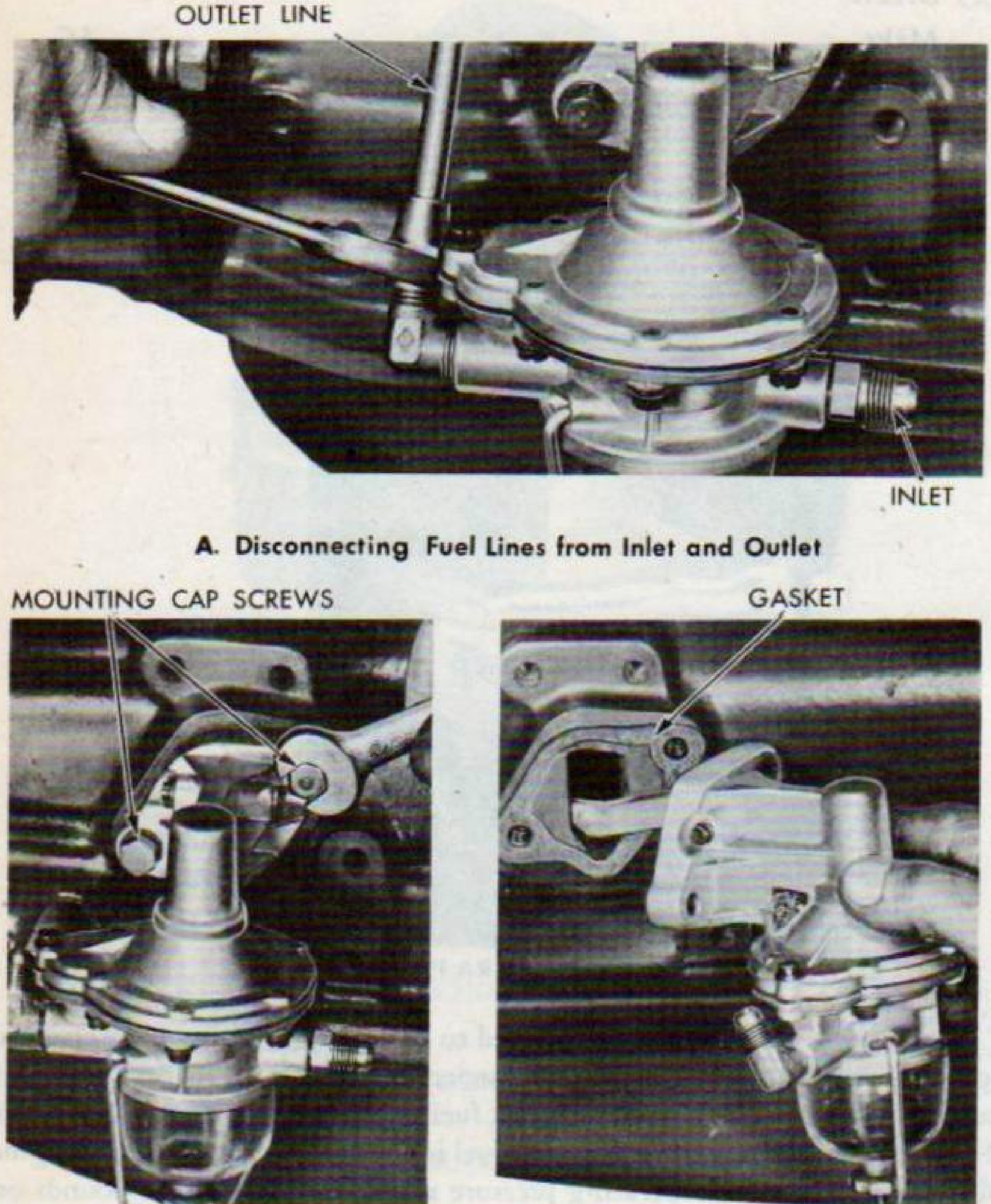
RA PD 323835

Figure 49 — Fuel Pump Installed

b. Testing. If fuel pump is believed to be defective, it should be checked prior to removal from engine. Disconnect fuel line from fuel pump outlet at the carburetor inlet, and connect a fuel pump pressure gage (41-G-500). Start engine. There will be sufficient fuel in the carburetor to operate engine during test. Normal operating pressure should be from 3 to 4 pounds on the gage. Higher, lower, or fluctuating pressure indicates fuel pump trouble. Stop engine, disconnect gage, and replace defective fuel pump as outlined below.

c. Servicing. The fuel pump incorporates a fuel filter screen just above the fuel bowl. To remove this screen for cleaning, or to remove the fuel filter bowl for cleaning, loosen the thumb screw nut at the base of the fuel filter bowl. Remove bowl and gasket from fuel pump, and lift screen from above bowl. Wash all parts in dry-cleaning solvent or clean gasoline, and reassemble, using new gasket. Tighten thumb screw nut.

d. Removal. Disconnect fuel lines at inlet and outlet sides of fuel pump (A, fig. 50). Remove two cap screws and lock washers from fuel



A. Disconnecting Fuel Lines from Inlet and Outlet

B. Removing Mounting Cap Screws **C. Removing Fuel Pump**

RA PD 323836

Figure 50 — Removing Fuel Pump

pump mounting flange (B, fig. 50). Lift off pump and gasket (C, fig. 50).

e. Installation. Place fuel pump in position on crankcase, using a new flange gasket (C, fig. 50). Install two mounting cap screws and lock washers (B, fig. 50), and tighten securely. Connect fuel lines to inlet and outlet connections (A, fig. 50). Check for fuel leaks.

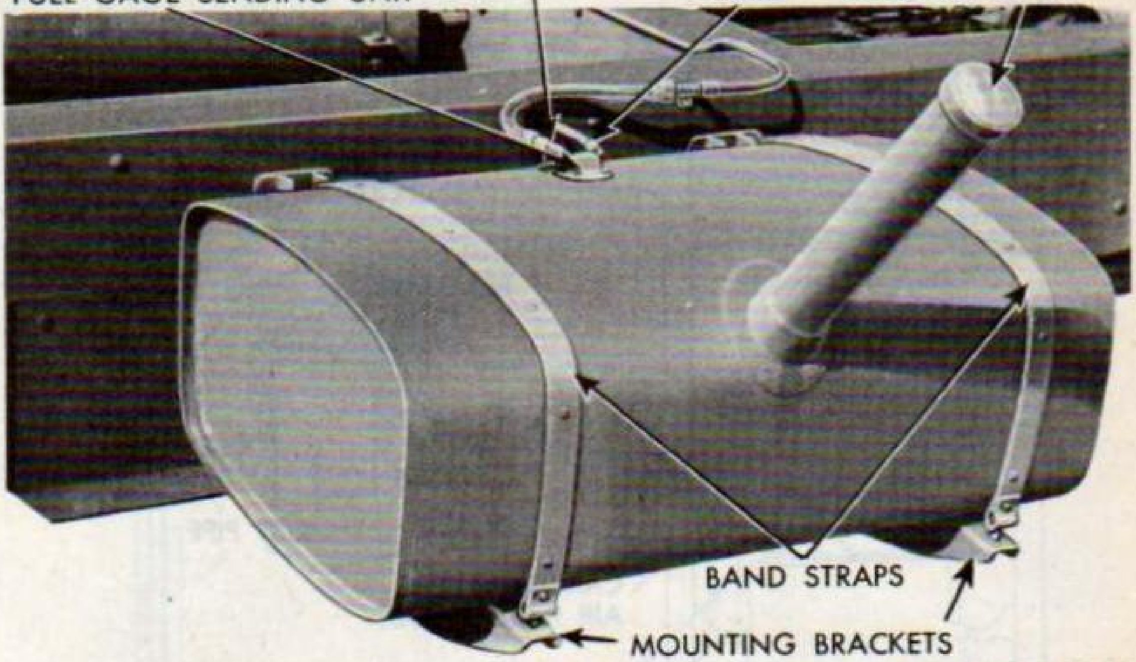


Figure 51 — Fuel Tank (Bus) Installed

68. FUEL TANK.

a. Description. One fuel tank of 32-gallon capacity is mounted on the right-hand frame side rail of the vehicle (fig. 51). The tank contains a fuel gage sending unit. The fuel tank cap is of pressure type; its pressure valve opens at 1½ to 2½ pounds, and its vacuum valve opens at ½ pound. The tank is grounded electrically as a precaution against static electricity sparks. A fuel gage receiving unit mounted on the instrument panel permits the checking of the fuel level in the tank.

b. Removal. Disconnect fuel line connection at fuel tank outlet (fig. 51). Disconnect fuel gage sending unit wire and ground wire at fuel gage tank unit. Remove nuts and lock washers from two fuel tank band straps, and disconnect bands from around tank. Lift fuel tank from mounting brackets.

c. Installation. Install fuel tank in position on mounting brackets, and connect band straps (fig. 51). Install and tighten nuts and lock washers on two band strap screws. Connect fuel line connection at fuel tank outlet. Connect fuel gage sending unit wire and ground wire at tank.

69. FUEL LINES.

a. Description.

(1) Flexible fuel lines are used at the fuel pump and the fuel tank to prevent damage from vehicle motion.

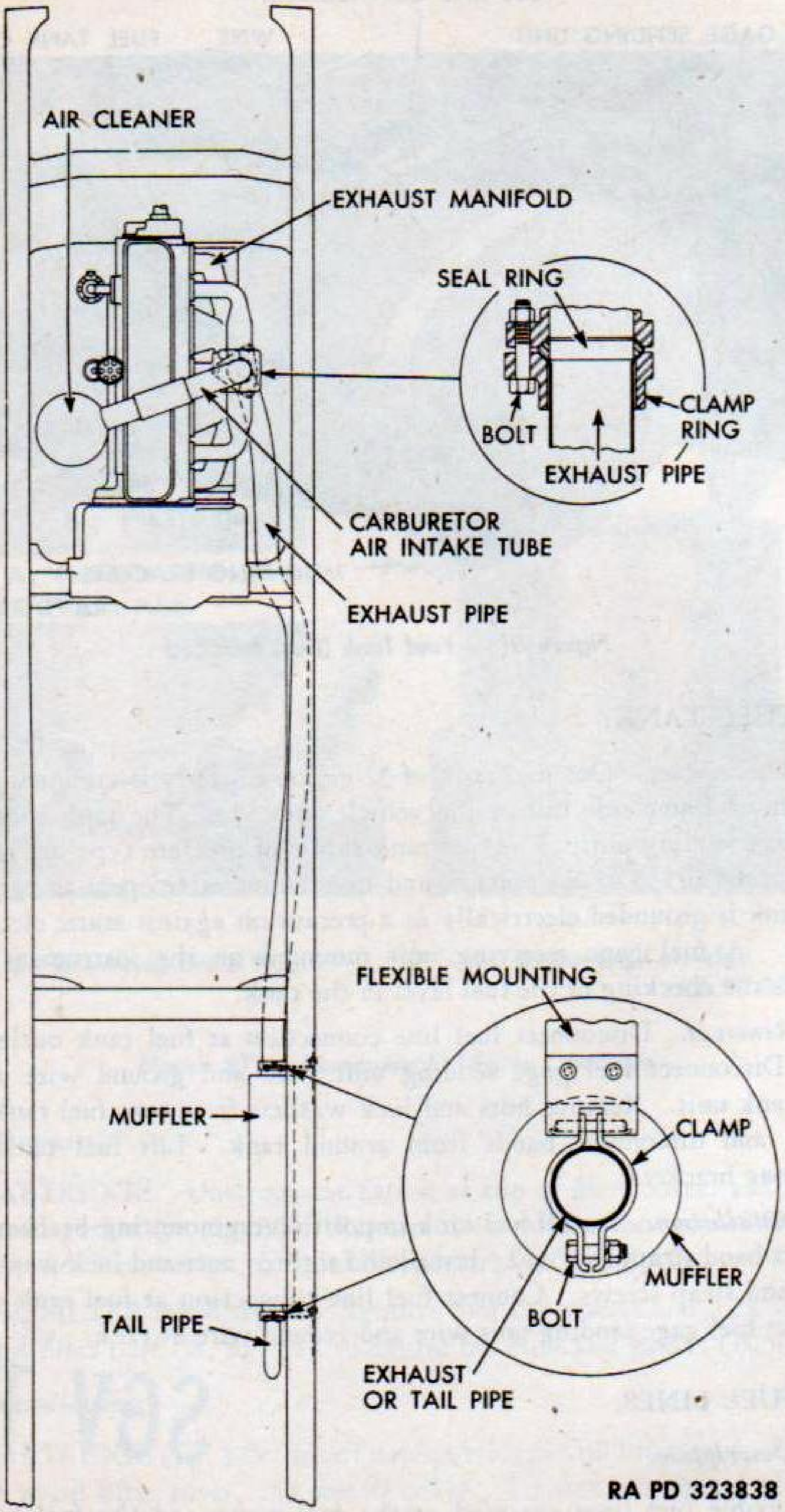


Figure 52 — Air Intake and Exhaust System Diagram

(2) Fuel lines of steel tubing are used between the fuel tank and the fuel pump flexible lines, and also between the fuel pump and the carburetor.

b. Repair. Any required repairs to fuel line connections must be carefully performed to avoid leaks. Flared connections must be made with special flaring tools which will perform a double-lap flare for steel tubing.

c. Replacement. Fuel lines are clipped to the frame and engine at various points. These clips must be secure to prevent fuel line vibration which might result in leaks. When connecting fuel line fittings, be careful not to start them cross-threaded. Start connections with fingers, and make final tightening with wrench.

Section XVII

Air Intake and Exhaust System

70. DESCRIPTION.

a. The air intake and exhaust system (fig. 52), consists of the air cleaner, the carburetor, the intake and exhaust manifolds, an exhaust pipe which attaches to the exhaust manifold, a frame-mounted muffler, and a tail pipe which carries the exhaust into the wheel airstream on the right-hand side of the vehicle. The function of the exhaust system is to carry the exhaust gases away from the engine and driver's compartment, and to muffle the combustion noises of the engine. All exhaust pipe, muffler, and tail pipe connections must be inspected regularly for leakage of exhaust gases and for looseness. After-operation inspection should be made for damage, and replacement made with new parts as necessary.

71. AIR CLEANER.

a. Description and Data.

(1) DESCRIPTION. The oil-bath-type carburetor air cleaner (fig. 53) is bracket-mounted on the engine, and is readily accessible by lifting the left-hand side of the hood. The construction is such that uncleaned air is drawn into the cleaner inlet openings and down through the center tube of the cleaner at high velocity. The direction of travel of the air is reversed above the oil level in the oil cup, and this reversal of flow causes the larger particles of dirt to fall into the oil. The partially cleaned air then travels upward through the oil-moistened filtering element where any remaining dirt and dust particles are removed. The cleaned and purified air then leaves the air cleaner and enters the carburetor.

(2) DATA.

Make	Donaldson
Model	E-784
Type	Oil
Mounting	Engine
Oil cup capacity	2 qt

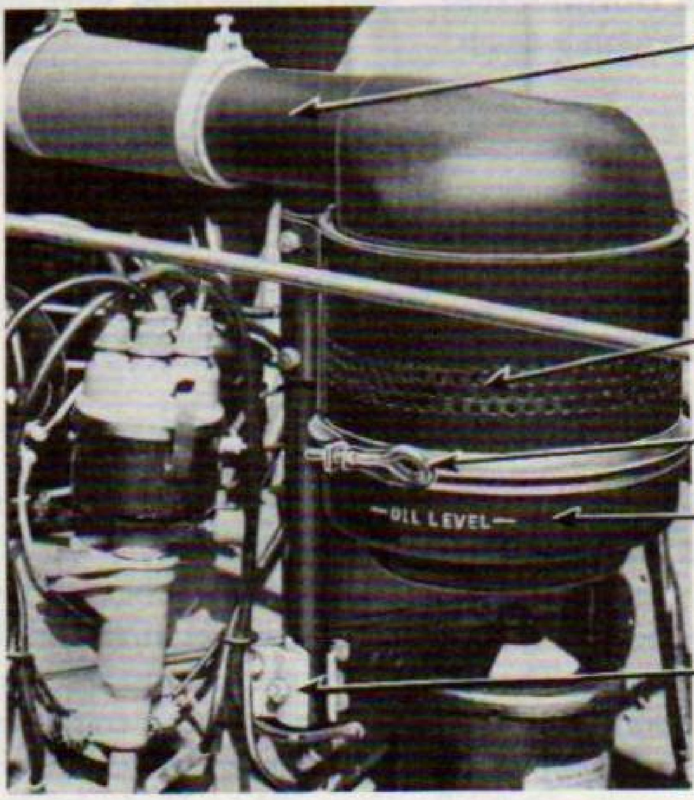


Figure 53 — Air Cleaner Installed

b. Removal.

(1) ASSEMBLY. To remove air cleaner assembly from vehicle, loosen outlet hose clamp screw, and disconnect hose at air cleaner. Remove nuts and lock washers from coil bracket to air cleaner mounting bracket screws, and remove coil and bracket assembly from air cleaner bracket. Remove nut and lock washer from air cleaner support tube bracket bolt, and remove bolt. Lift air cleaner assembly from engine.

(2) OIL CUP. Loosen clamp bolt from oil cup clamp, and lower oil cup.

c. Servicing. Empty oil from cup. Clean oil cup externally and internally with dry-cleaning solvent. Refill oil cup to level mark. When air cleaner body is removed, wash element by slushing in dry-cleaning solvent, and allow to drip dry.

d. Installation.

(1) ASSEMBLY. Place assembly in position on bracket, and install bolt, nut, and lock washer. Place coil and bracket in position, and install with screws, nuts, and lock washers. Connect air cleaner outlet hose at air cleaner, and tighten clamp screw.

(2) OIL CUP. Place oil cup in position, and tighten clamp bolt on oil cup.

72. EXHAUST PIPE.

a. Description. The exhaust pipe is a metal pipe extending from the exhaust manifold on the right side of the engine to the muffler. It is attached to the manifold by the exhaust pipe flange, three bolts, and three nuts. The connection is sealed by a seal ring located between the exhaust pipe flange and the exhaust manifold (fig. 52). The pipe attaches to the muffler where it is held in place by a clamp.

b. Removal. Loosen clamp bolt nut at front of muffler. Remove nuts from three bolts at exhaust pipe flange, and remove bolts. Slide exhaust pipe forward to disconnect from muffler, and lower from vehicle.

c. Installation. Place exhaust pipe in position, inserting end into muffler. Place exhaust flange seal ring in flange, insert three bolts from bottom of flange, and install three nuts on bolts. Tighten nuts evenly and securely, making sure that exhaust pipe has clearance at bottom of engine. Tighten exhaust pipe clamp bolt nut at muffler.

73. MUFFLER.

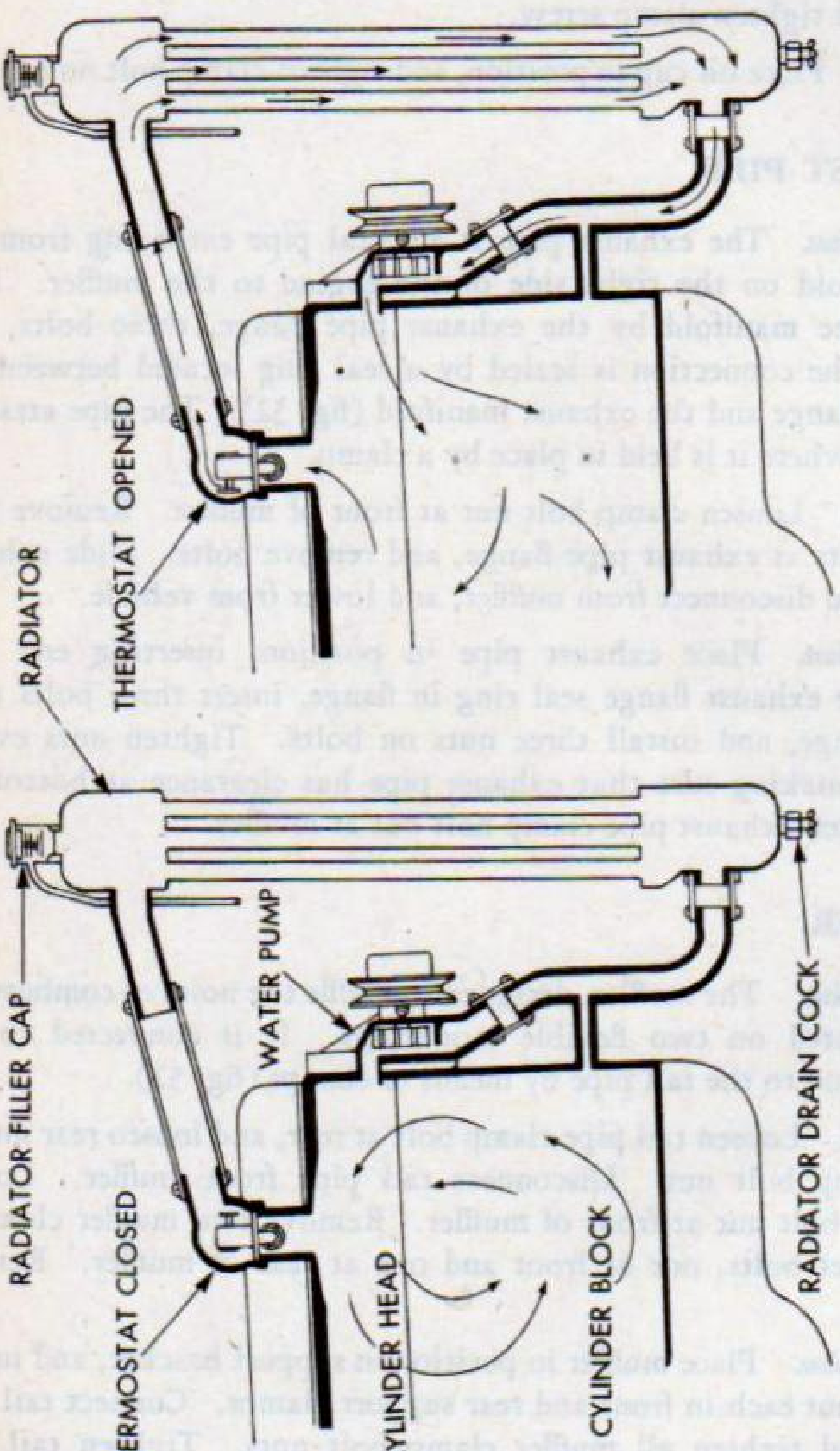
a. Description. The muffler, designed to muffle the noise of combustion, is frame-mounted on two flexible mountings. It is connected to the exhaust pipe and to the tail pipe by means of clamps (fig. 52).

b. Removal. Loosen tail pipe clamp bolt at rear, and loosen rear muffler tail pipe clamp bolt nut. Disconnect tail pipe from muffler. Loosen muffler clamp bolt nut at front of muffler. Remove two muffler clamp to support bracket bolts, one at front and one at rear of muffler. Remove muffler.

c. Installation. Place muffler in position in support bracket, and install one bolt and nut each in front and rear support clamps. Connect tail pipe to muffler, and tighten all muffler clamp bolt nuts. Tighten tail pipe clamp bolt nut at rear.

74. TAIL PIPE.

a. Description. The muffler tail pipe carries exhaust gases from the



A. Circulation at Temperature Below 145°F B. Circulation at Temperature Above 145°F

RA PD 323840

Figure 54 — Cooling System Diagram

muffler and discharges them into the wheel airstream. The pipe is attached to the rear end of the muffler by means of a clamp (fig. 52).

b. Removal. Remove tail pipe clamp bolt and nut at rear fender. Loosen tail pipe clamp bolt nut at rear of muffler. Force tail pipe from muffler, and remove from vehicle.

c. Installation. Install tail pipe in position, inserting front end into muffler. Install tail pipe clamp bolt and nut at rear fender, but do not tighten. Tighten tail pipe clamp bolt nut at rear of muffler, then tighten clamp bolt nut at fender.

Section XVIII

Cooling System

75. DESCRIPTION AND DATA.

a. Description. The cooling system consists of radiator, fan, water pump, and thermostat. The thermostat starts to open at approximately 145°F and is fully open at 180°F. When the engine is cool, the thermostat is closed, preventing water from entering the radiator (A, fig. 54). As the engine warms, the thermostat opens, permitting the coolant to circulate through the radiator (B, fig. 54). The cooling system is under pressure of from 3½ to 4½ pounds, which increases the cooling efficiency of the system, as the boiling point of water is raised about 3 degrees for each pound of pressure. The radiator filler cap is of pressure-type, having a pressure release valve which releases at from 3½ to 4½ pounds, and a vacuum vent valve which operates at from ¼ to ½ pound per square inch vacuum.

b. Data.

(1) RADIATOR.

Make .... Modine
Type .... Tubular
Model AD-4569

(2) WATER PUMP.

Make .... IHC
Type .... Mechanical seal

(3) FAN.

Size .... 17¾ in.
Number of blades 4
Angle of blades .... 42 deg

(4) FAN DRIVE BELT.

Number used	1
Type	V
Width	$\frac{11}{32}$ in.

(5) THERMOSTAT.

Make	Dole
Model	PT-5-6
Starts to open	145° to 150°
Fully open	180°

(6) SYSTEM CAPACITY .... 21 qt

c. Servicing.

(1) GENERAL MAINTENANCE. Cooling system maintenance involves the following procedures which must be accomplished:

(a) Keep sufficient cooling liquid in system. Basic coolant is fresh, clean water, to which must be added inhibitors (rust preventives) and, at temperatures below 32°F, antifreeze solutions (par. 11).

(b) Drain, flush, and refill system whenever inspection reveals any accumulations of rust or scale. Always clean system seasonally, as well as before and after using antifreeze solution (par. 11).

(c) If engine overheats from lack of water, do not add cold water immediately. Radiator should only be filled after boiling has ceased and engine has cooled, when water must be added slowly, preferably with engine running. Cold water should not be poured into system when engine is hot, as sudden change of temperature may damage cylinder head and block.

(d) Keep cylinder head bolts, water pump mounting bolts, hose clamps, and fitting connections tight. Examine all hose carefully, and replace if cracked, swollen, or deteriorated in any way.

(e) Test periodically for air suction and for exhaust gas leaking into the system.

(f) Inspect fan drive belt frequently and adjust or replace as necessary (par. 76).

(2) DRAINING. Remove radiator filler cap, and open radiator drain cock; also open drain cock at rear of right side of cylinder block. If cooling liquid is to be saved, catch in suitable container. Be sure both the radiator and cylinder block are empty. NOTE: *If system is not refilled immediately, attach a tag marked "No Water in Cooling System" to the steering wheel.*

(3) REFILLING PROCEDURE. Use clean, soft water. Avoid use of water that contains alkali or other substances that promote the accumulation of scale and rust. Close radiator drain cock and cylinder block drain cock tightly. Fill system through radiator filler neck until cooling

liquid can be seen through filler neck. Install radiator filler cap. Check water level again after engine is warmed up, and add coolant if needed to bring to proper level.

(4) AIR SUCTION AND EXHAUST GAS LEAKAGE TESTS. Air and exhaust gas that leak into the cooling system cause rapid corrosion and rust formation which will eventually clog the system and cause overheating and loss of cooling liquid. Air may be drawn into the system due to low liquid level in the radiator, leaky water pump, or loose fitting connections. Exhaust gas may be blown into the cooling system past the cylinder head gasket or through cracks in the cylinder head and block.

(a) *Air Suction Test.* Adjust level of cooling liquid in radiator, allowing room for expansion so as to avoid any overflow loss during test. Replace pressure cap with a plain cap, tightening it on radiator until airtight. Attach a length of rubber tubing to lower end of overflow tube, making connection airtight. Run engine with transmission in neutral gear at a safe high speed until temperature gage stops rising and remains stationary. Without changing engine speed, put end of rubber tubing in a bottle of water, avoiding kinks and sharp bends that might block flow of air. Watch for bubbles in the water. The continuous appearance of bubbles indicates that air is being sucked into the cooling system.

(b) *Exhaust Gas Leakage Test.* Start test with engine cold. Remove fan drive belt (par. 76) to prevent pump operation. Drain cooling system until cooling liquid level is at top of thermostat housing, but no lower. Level can be determined by loosening cylinder head outlet to thermostat housing to check level of liquid. If liquid leaks from this connection, continue to drain system until liquid no longer leaks. Remove thermostat (par. 79 ***b***). Make sure thermostat housing is full of liquid, adding liquid if necessary. With transmission in neutral gear, start engine and accelerate and decelerate several times, watching for bubbles in water in thermostat housing both while accelerating and after engine speed drops back to idle. The appearance of bubbles, or a sudden rise of cooling liquid, indicates exhaust gas leakage into cooling system. Make test quickly before boiling can start, as steam bubbles will give misleading results. If exhaust gas leakage is evident, replace cylinder head gasket and report to higher authority.

(5) PREVENTIVE SERVICE. It is recommended that the following procedure be performed at least twice a year. The cooling system should be cleaned before antifreeze compound (ethylene-glycol type) is put into the system, and again after it is removed. Cleaning at the prescribed intervals will reduce clogging and overheating to a minimum, and will largely eliminate the necessity for corrective cleaning by a higher echelon. If the cooling system is very dirty or clogged so that overheating occurs, Ordnance personnel should be notified. The entire cooling system should be examined for leaks both before and after the cleaning and flushing.

CAUTION: *The cleaning solution should never be mixed with antifreeze compound or other antifreeze solutions, or with inhibitors.*

(a) *Cleaning.*

1. Open the pet cocks which shut off the coolant from the heaters or other accessories to allow for complete circulation during the cleaning, flushing, and draining. Run the engine, with the radiator covered if necessary, until the temperature is within operating range (160°F to 180°F). Stop the engine, remove the radiator cap, and drain the system by opening the drain cocks in the radiator and crankcase. If necessary, use a wire to keep open any drain hole which tends to become clogged.
2. Allow the engine to cool. Close the drain cocks, pour water slowly into the radiator until the system is approximately half full, then run the engine at idling speed. Add cleaning compound (51-C-1568-500) in the proportion of one container of cleaner to every 4 gallons of cooling system capacity. Then complete filling the system with water. CAUTION: *Never mix the water and the cleaning compound before putting them into the system. Do not spill the solution on skin, clothing, or painted portions of the vehicle.*
3. Place a clean drain pan in position to collect the overflow, using the overflow to maintain the level in the radiator if necessary.
4. Replace the radiator cap, and run the engine at fast idling speed (approximately 800 rpm) until the coolant reaches a temperature above 180°F, but not over 200°F, covering the radiator if necessary. Do not drive the vehicle. Constantly check the level in the radiator
5. Stop the engine after it has run for 30 minutes at above 180°F. Remove the radiator cap, then the drain cocks, and drain the system completely.

(b) *Neutralizing.*

1. Allow the engine to cool. Close the drain cocks. Pour water slowly into the radiator until the system is approximately half full, then run the engine at idling speed. Add the neutralizer compound in the proportion of one container of neutralizer (51-C-1568-500) to every 4 gallons of cooling system capacity. Then fill the system with water.
2. With the radiator covered, let the engine idle for at least 5 minutes at the normal operating temperature. Then stop the engine.

3. Drain the system completely by removing the radiator cap and opening the drain cocks.

(c) *Flushing*.

1. Allow the engine to cool. Close the drain cocks. Pour water slowly into the radiator until the system is approximately half full, then run the engine at idling speed while filling the system completely.

2. Run the engine, keeping the radiator covered if necessary, until the coolant is heated to the normal operating temperature of at least 160°F.

3. Drain the system by removing the radiator cap and opening the drain cocks. Repeat the flushing operation until the drain water is clear.

4. Again allow the engine to cool. Clean all sediment from the radiator cap valves and the overflow pipe. Blow insects and dirt from radiator core air passages with compressed air, blowing from the rear. Use water to soften obstructions, if necessary.

(d) *Leaks*. After completing the flushing operation, make certain that the engine has been allowed to cool again. Close the drain cocks. Pour water slowly into the radiator until the system is approximately half full, then run the engine at idling speed while filling the system completely. Stop the engine when the cooling system is completely full. Examine the entire cooling system for leaks. This is important because the cleaning solution uncovers leaks which already existed but were plugged with rust or corrosion. Leaks that cannot be corrected by using arm personnel should be reported immediately to Ordnance maintenance personnel.

(e) *Coolant Service*.

1. When servicing the vehicle for summer, fill the system nearly full with clear water. Add corrosion inhibitor compound (51-C-1600) in the proportion of one container of inhibitor to each 4 gallons of cooling system capacity. Then complete filling the system with water.

2. When servicing for winter, fill the system about one-third full of clean water. Add sufficient antifreeze compound (ethylene-glycol type) for protection against the lowest anticipated temperature (par. 17 *e* (4)). Add water until the system is nearly full, then run the engine until the normal operating temperature is reached. Then add sufficient water to fill the system to proper level.

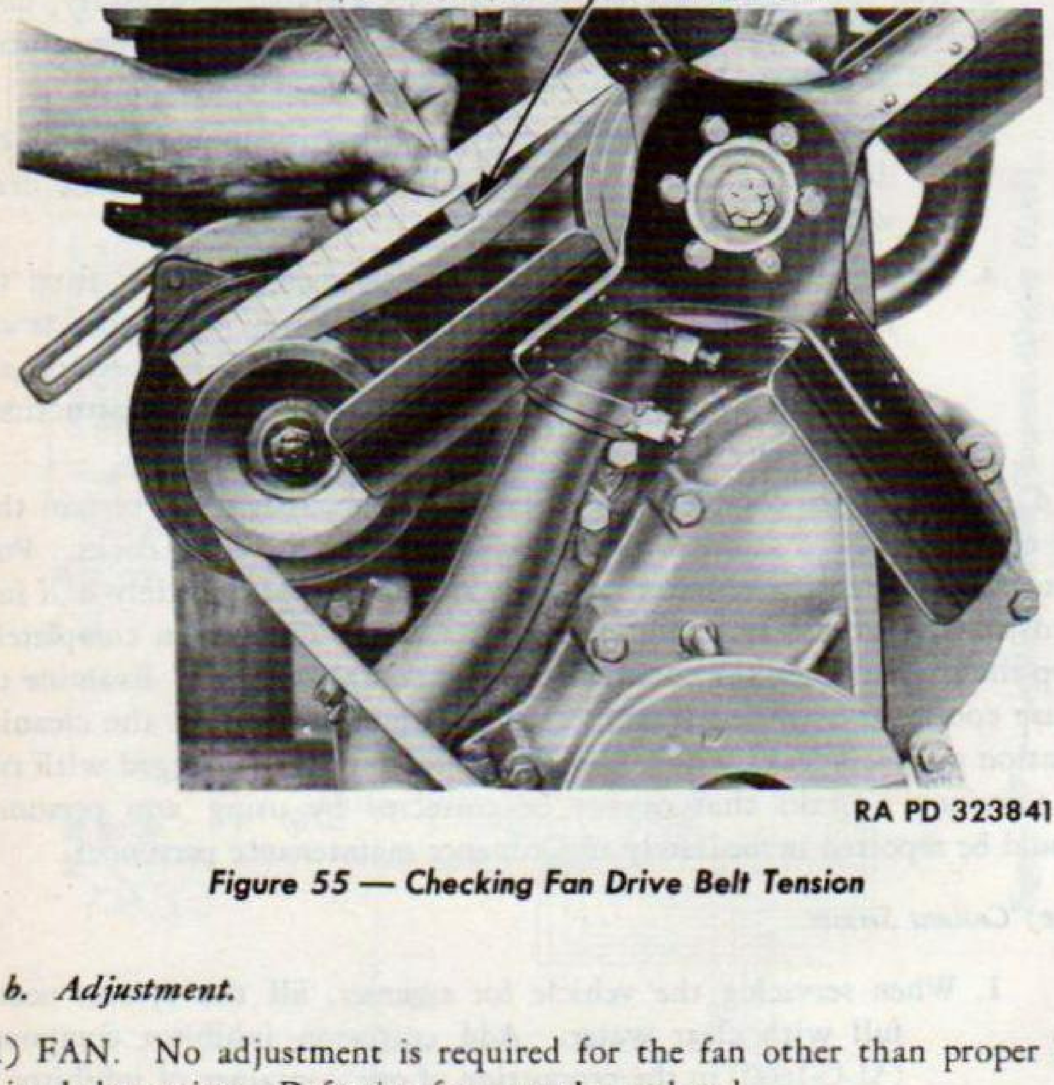
76. FAN AND FAN DRIVE BELT.

a. Description (fig. 26).

(1) FAN. The four-bladed fan assembly is attached to the fan and water pump pulley, which is driven by the fan drive belt.

(2) FAN DRIVE BELT. One endless V-belt is used to drive the fan, water pump, and generator.

1/2– TO 11/16 –INCH DEFLECTION



RA PD 323841

Figure 55 — Checking Fan Drive Belt Tension

b. Adjustment.

(1) FAN. No adjustment is required for the fan other than proper fan drive belt tension. Defective fan must be replaced.

(2) FAN DRIVE BELT.

(a) The tension of the fan drive belt is important, since too loose a tension will contribute to slipping, while excessive tension will cause premature belt failure.

(b) Adjustment of fan drive belt is accomplished by loosening the generator adjusting strap bolt nut, and moving the generator toward or away from the engine to provide approximately $\frac{1}{2}$- to $\frac{11}{16}$-inch deflection or sag of the drive belt from a straight line, measured at a point midway between the fan pulley and generator pulley (fig. 55). Tighten the generator adjusting strap bolt nut securely.

c. Removal.

(1) FAN. Remove six cap screws and lock washers attaching fan to the fan and water pump pulley, and remove fan.

(2) FAN DRIVE BELT. Loosen the generator adjusting strap bolt nut, and move generator toward engine. Lift fan belt from generator pulley, then from fan and water pump pulley, and finally from crankshaft fan drive pulley.

d. Installation.

(1) FAN. Place fan assembly in position on the fan pulley face, and install six cap screws and lock washers.

(2) FAN DRIVE BELT. Place fan drive belt over crankshaft fan drive pulley, then over fan and water pump pulley, and finally over generator pulley. Move generator away from engine to provide ½- to 11/16-inch sag or deflection (sub par. *b* (2) (b) above), and tighten generator adjusting strap bolt nut securely.

77. WATER PUMP.

a. Description. The water pump (fig. 26) is of packless design, and is mounted at the front of the engine. No adjustments are necessary. The only service required is lubrication at time of assembly. The water pump, driven by the fan drive belt, serves to draw coolant from the radiator and to circulate this coolant through the engine.

b. Removal.

(1) Remove radiator cap and open radiator drain cock. Drain cooling system, saving coolant if it contains antifreeze solution.

(2) Remove fan assembly by taking out six cap screws and lock washers from fan hub.

(3) Remove fan drive belt (par. 76 *c* (2)).

(4) Loosen hose clamp screws at lower hose connection at water pump, and disconnect hose.

(5) Remove four cap screws and lock washers holding water pump to engine cylinder head. Lift water pump from engine, and remove gasket.

c. Installation.

(1) Clean the gasket surface of the cylinder head. Coat new gasket with liquid joint and thread compound, and place in position on cylinder head.

(2) Place water pump in position, and install four cap screws and lock washers.

(3) Connect lower hose connection at water pump, and tighten hose clamp screws.

(4) Close radiator drain cock, refill cooling system, install radiator cap, and check for leaks.

78 RADIATOR.

a. Description. The radiator of this vehicle is of tubular design and has a pressure-type filler cap holding the system under a pressure of 3½ to 4½ pounds. The purpose of the pressure system is to increase cooling efficiency of the system (par. 75 ***a***). The radiator assembly is mounted at the front frame crossmember on two spring-type mountings and insulators, and is supported at the cowl by two truss rods.

b. Removal.

(1) DRAIN COOLING SYSTEM. Open drain cock at lower right of radiator, and remove radiator cap.

(2) REMOVE HOOD. Remove nut and lock washer from the hood hinge rod front retainer. Remove nut and lock washer from cap screw at each hood support brace arm at hood. Remove nuts and lock washers from bonding strap bolts at rear of hood. Lift hood from vehicle.

(3) REMOVE RADIATOR AND SHELL ASSEMBLY.

(a) Loosen two hose clamp screws at upper inlet radiator hose.

(b) Remove one nut and lock washer at radiator shell end of each of two radiator stay rods.

(c) Loosen two clamp screws at radiator lower outlet hose.

(d) Remove cotter pin, nut, washer, and spring from each of two radiator mounting bolts at bottom of radiator.

(e) Remove nuts and lock washers from bonding strap bolts at left side of radiator grille and frame.

(f) Lift radiator core and shell assembly from vehicle. Remove two mounting pads.

(4) REMOVE RADIATOR CORE FROM SHELL AND SUPPORT ASSEMBLY. Remove nuts, lock washers, and flat washers from screws holding the radiator core and core support brace to the radiator shell and core support assembly. Lift core from the shell and support assembly.

c. Installation.

(1) INSTALL RADIATOR CORE IN SHELL AND SUPPORT ASSEMBLY. Place radiator core in radiator support assembly and install flat

washers, lock washers, and nuts. Place radiator support brace in position on radiator support, and install lock washers and nuts on screws.

(2) INSTALL RADIATOR AND SHELL ASSEMBLY AND HOOD.

(a) Place new radiator mounting pads in position on radiator mounting screws. Lift radiator and shell assembly into position on chassis frame front crossmember.

(b) Install spring, flat washer, and nut on each radiator mounting screw. Tighten nut on each screw to compress springs sufficiently to permit installing new cotter pin in each nut. Install ground strap bolts, bonding strap lock washers, and nuts at left side of grille and frame.

(c) Connect lower and upper radiator hose, but do not tighten clamp screws at this time.

(d) Connect radiator stay rods at radiator, and install nuts and lock washers on radiator end of stay rods.

(e) Install hood in position, and install ground strap lock washer and nut on hood hinge rod front retainer. Check hood for fit around radiator shell and at cowl. If necessary, readjust by loosening adjusting nuts and lock nuts on rear end of rods to provide proper fit of hood. Tighten lock nuts.

(f) Tighten clamp screws in upper and lower hose clamps.

(g) Connect hood support brace arms at hood side panels, installing cap screw, nut, and lock washer at hood end of each arm. Install ground strap bolt, ground strap, lock washer, and nut at rear of hood.

(3) REFILL COOLING SYSTEM. Close radiator drain cock in lower right corner of radiator. Refill cooling system, and install radiator cap.

79 THERMOSTAT.

a. Description. The thermostat is located in the water outlet at the upper right front corner of the engine which serves as a thermostat housing (fig. 56).

b. Removal. Removal of the thermostat requires removal of the water outlet upper half.

(1) Drain cooling system below the level of the cylinder head, saving the coolant if it contains antifreeze solution.

(2) Loosen upper hose connection clamp screws, and loosen hose at water outlet.

(3) Remove three cap screws and lock washers attaching water outlet upper half to the lower half. Lift off upper half (fig. 56), and remove gasket. Remove thermostat.

c. Testing. To determine if thermostat is operative and fit for further service, test in water following removal. Warm the water gradually, and note the points of opening and closing of the thermostat, using a reliable thermometer. The thermostat should start to open at approximately 145°F and be fully open at approximately 180°F. If in doubt as to satisfactory performance of a thermostat, discard and install a new one.

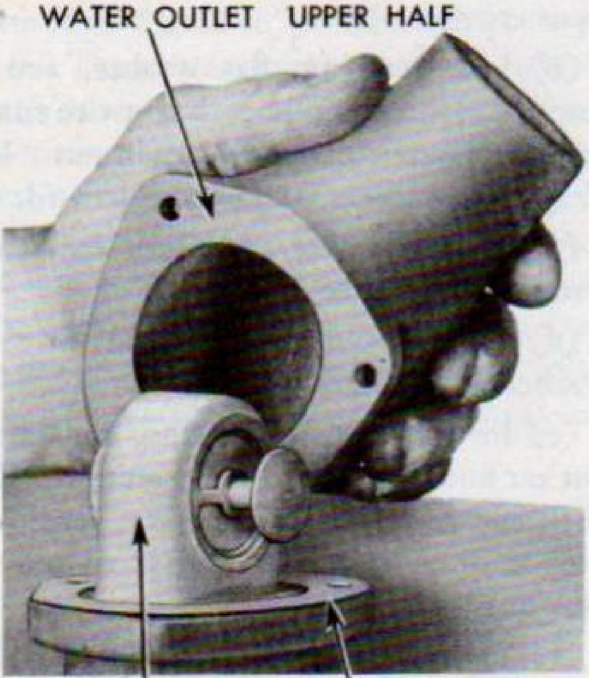


Figure 56 — Removing Thermostat

d. Installation. The proper mounted position of the engine outlet thermostat is with the small valve plate forward.

(1) Coat new gasket with joint and thread compound, type A, and place in position.

(2) Place water outlet upper half in position over lower half (fig. 56), install three cap screws and lock washers, and tighten securely.

(3) Connect hose, and tighten hose clamp screws.

(4) Refill cooling system, install radiator cap, and check for leaks.

Section XIX

Ignition System

80. DESCRIPTION AND DATA.

a. Description. The ignition system (figs. 57 and 58) includes an ignition switch (par. 101), the source of electrical energy, either the battery (par. 96) or generator (par. 85), an ignition coil, a distributor assembly,

ITEM	CABLE COLOR	TRACERS No.	TRACERS COLOR	GAGE
15	BLACK	2	ORANGE	14
19	BLACK	—	———	0
22	ORANGE	2	BLACK	14
23	RED	3	BLACK	12
30	ROPE STRANDED			0
31	RED	—	———	6

PART	DESCRIPTION
H	MAG. STARTING SWITCH
N	IGNITION SWITCH
R	BATTERY
S	MAIN LIGHT SWITCH
T	AMMETER
V	CIRCUIT BREAKER
EE	.5 MFD. CONDENSER
FF	.1 MFD. CONDENSER
HH	DISTRIBUTOR
JJ	IGNITION COIL
MM	SPARK PLUG CABLE CONDUITS

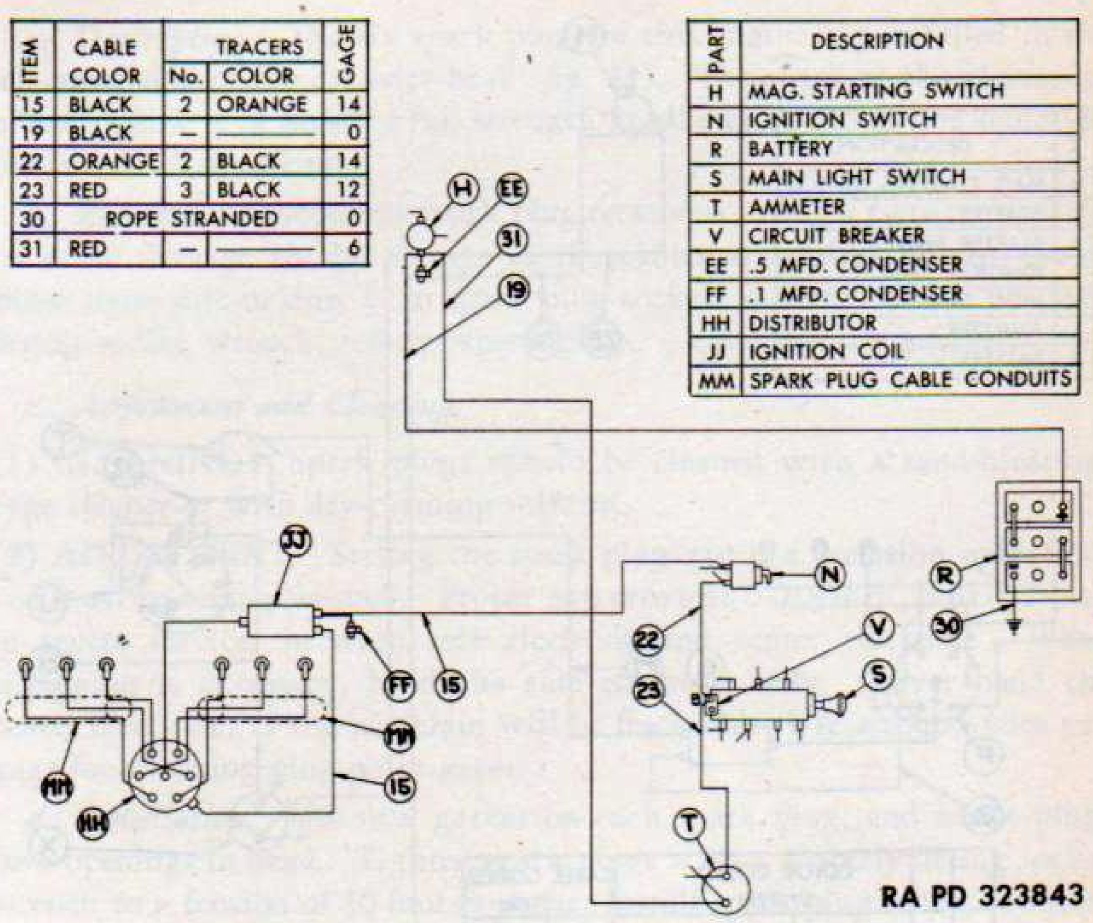


Figure 57 — Ignition Circuit Diagram (Dump Truck)

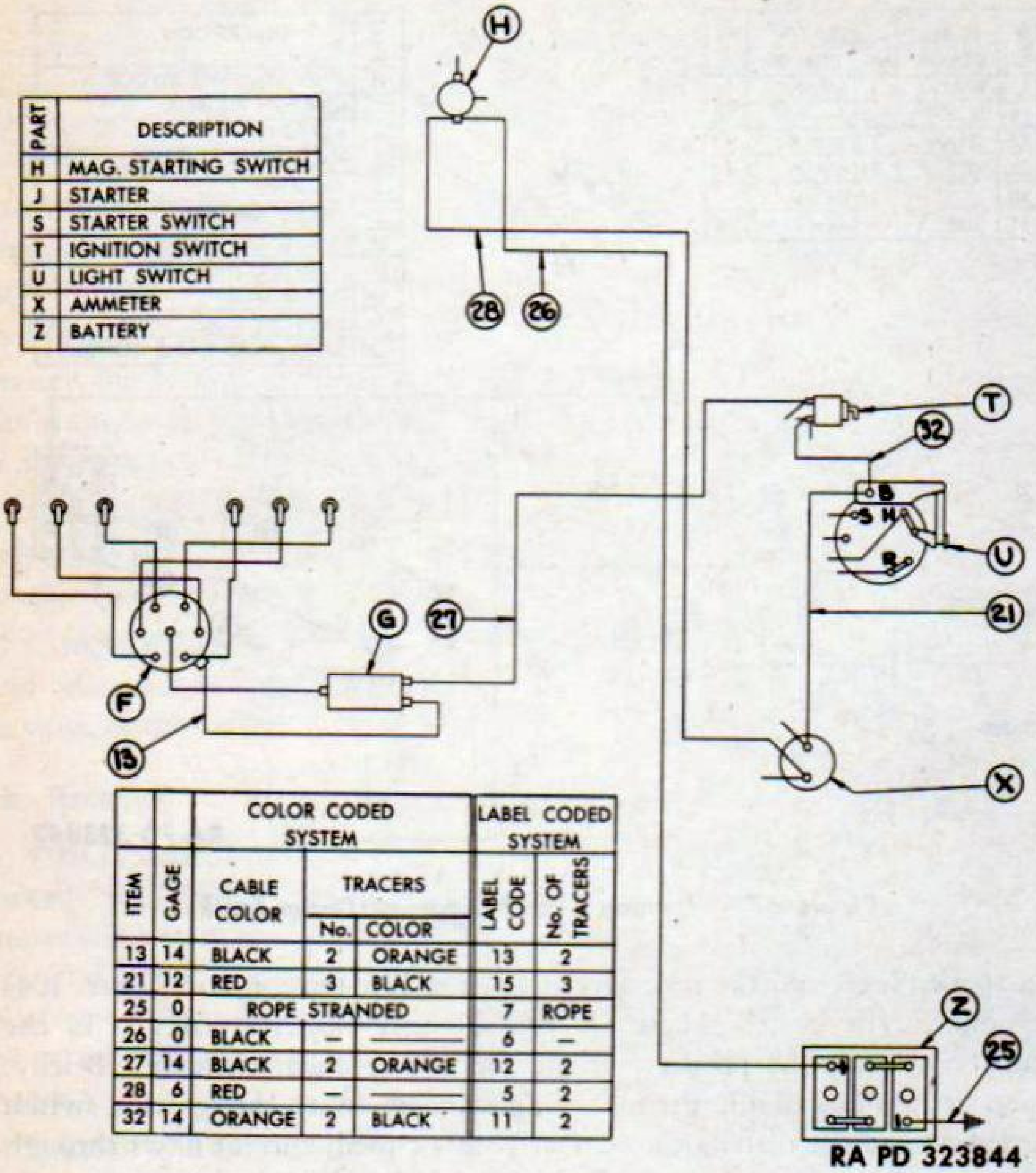
six spark plugs, and the necessary high- and low-tension wires (par. 104) to connect the units. There are two distinct electrical circuits in the ignition system, the primary circuit and the secondary circuit. Briefly, these circuits function in the following manner: With the ignition switch turned on and the distributor contact points closed, current flows through the primary winding of the ignition coil and builds up a strong magnetic field in the coil. This magnetic field collapses and induces a high voltage in the secondary winding of the coil every time the distributor contact points open. This induced high voltage is distributed to the spark plugs at correct firing intervals by the distributor cap and rotor, and the high-tension wires between the distributor cap and spark plugs.

b. ***Data.***

(1) DISTRIBUTOR.

Make .... Delco-Remy
Model .... 1110118 or 1110169
Breaker point gap .... 0.018 to 0.024 in.
Firing order 1-5-3-6-2-4
Cam angle .... 35 deg

PART	DESCRIPTION
H	MAG. STARTING SWITCH
J	STARTER
S	STARTER SWITCH
T	IGNITION SWITCH
U	LIGHT SWITCH
X	AMMETER
Z	BATTERY



ITEM	GAGE	COLOR CODED SYSTEM: CABLE COLOR	TRACERS: No.	TRACERS: COLOR	LABEL CODED SYSTEM: LABEL CODE	No. OF TRACERS
13	14	BLACK	2	ORANGE	13	2
21	12	RED	3	BLACK	15	3
25	0	ROPE STRANDED			7	ROPE
26	0	BLACK	—	———	6	—
27	14	BLACK	2	ORANGE	12	2
28	6	RED	—	———	5	2
32	14	ORANGE	2	BLACK	11	2

Figure 58 — Ignition Circuit Diagram (Bus)

Initial setting.............................Top dead center
Contact point spring pressure......................17 to 21 oz

(2) IGNITION COIL.

Make...Delco-Remy
Model.............................1115103 or 1115149

(3) SPARK PLUGS.

Make...Champion
Type...J-9-64
Size...14 mm
Point gap..........................0.028 to 0.032 in.

81. SPARK PLUGS.

a. Description. The six spark plugs in this engine are installed in the left-hand side of the cylinder head (fig. 27). The spark at the electrodes of each spark plug must be full strength at all engine speeds and under all conditions of operation.

b. Removal. Disconnect spark plug terminals, using a twisting motion to avoid damage to the springs as the cables are pulled off the plugs. Blow loose dirt or dust from spark plug sockets in head. With properly fitting socket wrench, remove spark plugs. Remove plug gaskets.

c. Adjustment and Cleaning.

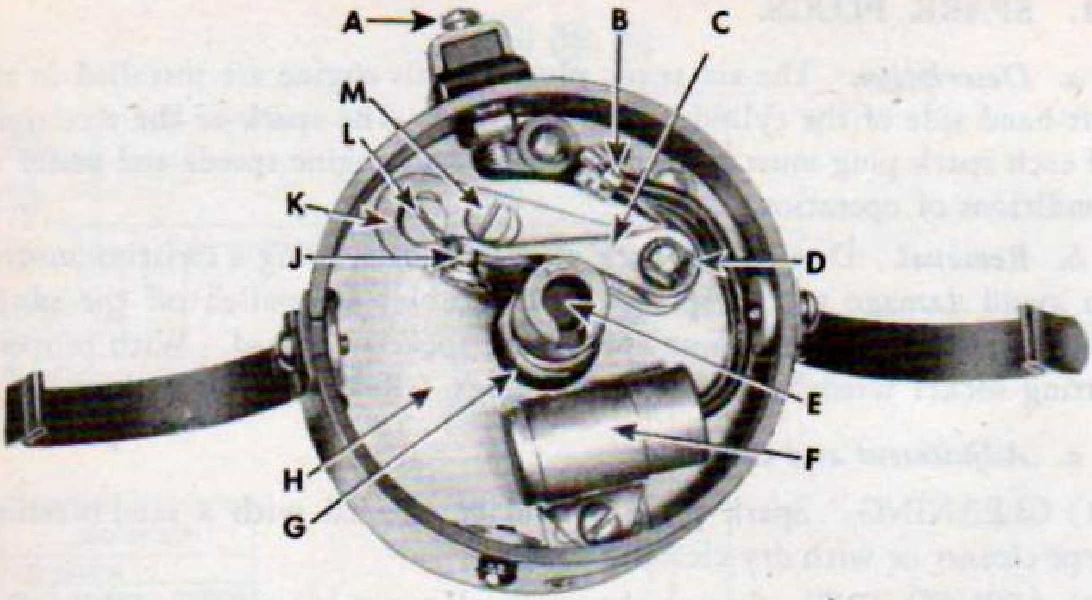
(1) CLEANING. Spark plugs should be cleaned with a sand-blasting-type cleaner or with dry-cleaning solvent.

(2) ADJUSTMENT. Setting the spark plug gap is a precision operation, and must be treated as such. Proper gap provides 0.028 inch, or 0.032 inch in severe service, between side electrode and center electrode. When regapping is necessary, bend the side electrode only. Never bend the center electrode, as the porcelain will be fractured. Use a round-wire gap gage for checking plug point gaps.

d. Installation. Use new gasket on each spark plug, and insert plugs into openings in head. Tighten spark plugs with a properly fitting socket wrench to a tension of 30 foot-pounds. Install spark plug wires, connecting the springs at the plugs with a downward twisting motion.

82. DISTRIBUTOR.

a. Description. The ignition distributor is located above the left side of the engine. Its function in the ignition system is to produce, time, and deliver the spark to the spark plugs by performing two operations. First, it opens and closes a pair of contact points which alternately connect and disconnect the primary winding of the ignition coil from the battery. When the primary winding is connected and thus energized, a magnetic field builds up in the coil. When the primary winding is disconnected, the magnetic field collapses, producing a high-voltage surge in the secondary winding of the coil. Second, the distributor distributes this high voltage surge, through the cap and rotor, to the correct spark plug wire. The ignition condenser, mounted on the breaker plate, aids in the quick collapse of the ignition coil magnetic field, thus aiding in the production of the high-voltage surge. The distributor consists of a distributor housing, mainshaft and weight base, and centrifugal advance mechanism. A rotor is mounted on top of the cam, and the assembly is covered by the distributor cap, held in place by spring clips. A bakelite plate containing dust seals is located inside the distributor below the rotor to keep out dust. The distributor has automatic controlled advance mechanism.



A—PRIMARY WIRE TERMINAL
B—CONDENSER PIG-TAIL TERMINAL
C—BREAKER LEVER
D—BREAKER LEVER RETAINING CLIP
E—OIL WICK
F—CONDENSER
G—CAM
H—BREAKER PLATE
J—BREAKER POINTS
K—BREAKER POINT SUPPORT
L—CLAMP SCREW
M—ECCENTRIC SCREW

RA PD 323396

Figure 59 — Distributor (with Cap, Rotor, and Seal Removed)

b. Adjustment of Breaker Points (fig. 59).

(1) Remove distributor cap from distributor by unhooking clips. Lift off rotor and seal.

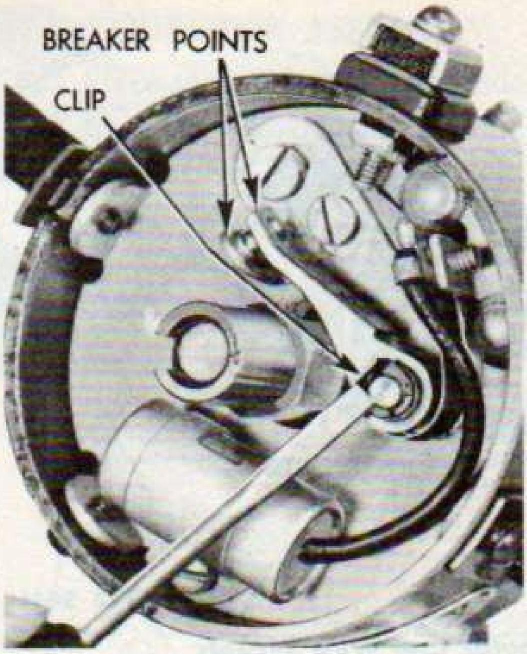
(2) Crank engine slowly with hand crank until breaker lever pad rests on the high point of distributor cam.

(3) Adjust opening of points by loosening clamp screw and turning eccentric screw, until a gap or opening of 0.018 to 0.024 inch is obtained (fig. 59). Use a feeler gage. Tighten clamp screw after adjustment is made.

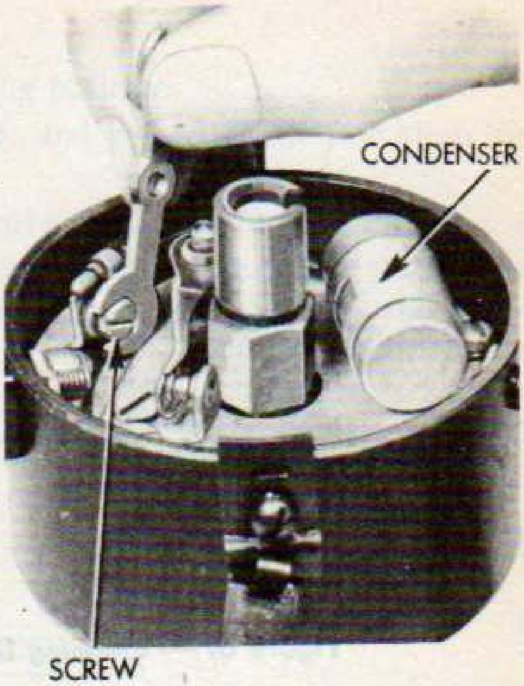
(4) Reinstall seal and rotor, and install distributor cap.

c. Removal.

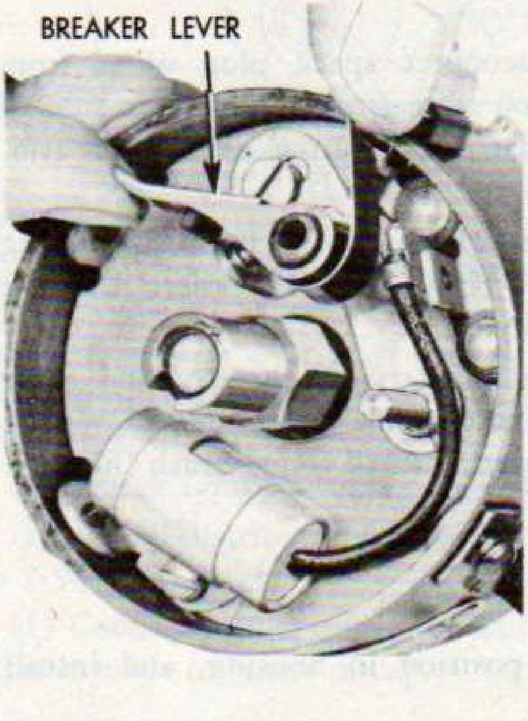
(1) BREAKER POINTS (fig. 60). Attain access to distributor breaker points (sub-par. *b* (1) and (2) above). Pry retaining clip from top of breaker lever pivot. Remove screw from terminal support. Lift breaker



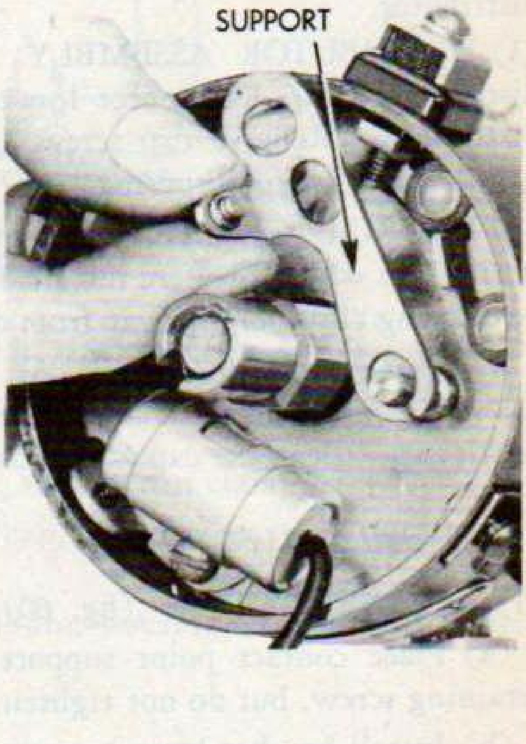
Removing Breaker Lever Retainer Clip



Removing Terminal Support Screw



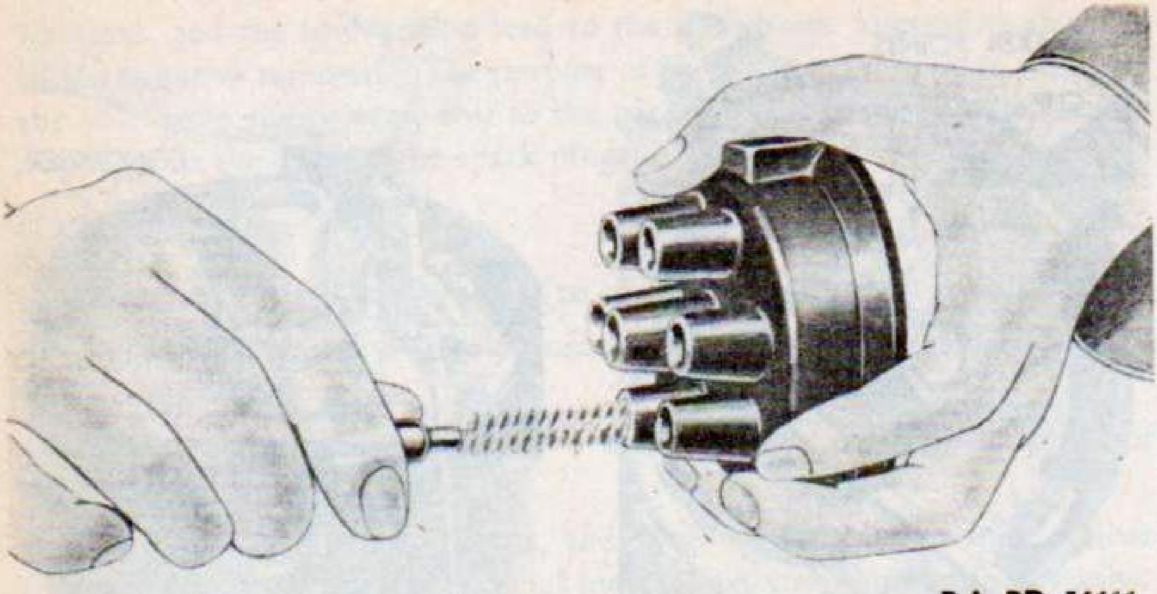
Lifting Out Breaker Lever



Removing Breaker Point Support

RA PD 323695

Figure 60 — Removing Breaker Points



RA PD 56111

Figure 61 — Cleaning Distributor Cap Wire Sockets

lever arm and spring from pivot. Remove breaker point support retaining screw, and lift out support.

(2) DISTRIBUTOR CONDENSER. Attain access to inside of distributor (subpar. *b* (1) and (2) above). Remove terminal screw from terminal support. Remove condenser retaining screw, and lift condenser from distributor.

(3) DISTRIBUTOR ASSEMBLY. Disconnect spark plug wires from distributor cap. Disconnect low-tension wire from terminal at side of distributor. Remove cap screw and flat washer from distributor arm. Lift distributor from housing.

(4) DISTRIBUTOR CAP. Disconnect spark plug wires from cap, noting position in which they are installed as to 1-5-3-6-2-4 firing order. Unhook two spring clips, and lift cap from distributor.

d. Inspection and Cleaning. At regular intervals, the cap and rotor should be inspected for cracks. Clean and examine the inside and outside of the cap. Clean the cap wire sockets with a small round brush (fig. 61).

e. Installation.

(1) BREAKER POINTS (fig. 60).

(a) Place contact point support in position in housing, and install retaining screw, but do not tighten.

(b) Install breaker lever over pivot, placing end of spring to inside of terminal support. Install screw in terminal support. Insert breaker arm retaining clip on top of pivot.

(c) Adjust breaker points. Refer to subparagraph *b* (3) and (4) above.

(d) Check ignition timing. Refer to paragraph 49 *c*.

(2) DISTRIBUTOR ASSEMBLY.

(a) Place engine in No. 1 cylinder firing position.

(b) Remove distributor cap and seal, and rotate distributor shaft to place rotor in No. 1 firing position.

(c) Insert distributor drive end into drive housing. Rotate distributor cam only as necessary to permit drive shaft tang to index with the slot in the driving shaft. NOTE: *When oil pump is in position, the locating tangs*

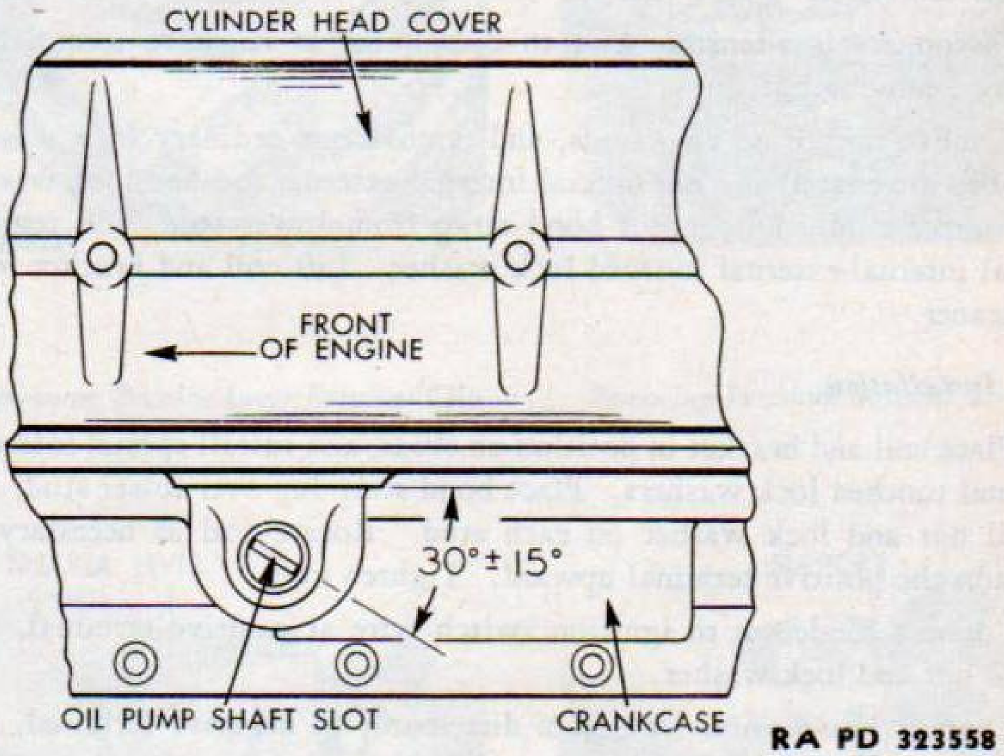


Figure 62 — Oil Pump Shaft Slot Location

for the distributor drive shaft must be in the position shown in figure 62 when engine is in firing position for No. 1 cylinder. This will assure proper installation of the distributor.

(d) Check ignition timing (par. 49 *c*), and tighten clamp screw.

(e) Install distributor seal, rotor, and cap, and connect spark plug wires in 1-5-3-6-2-4 order.

(f) Connect low-tension wire at distributor housing, and connect high-tension cable to center of cap.

83. IGNITION COIL.

a. Description. The ignition coil mounted at the air cleaner bracket (fig. 26) is an oil-filled unit encasing the primary and secondary coil windings. The high-tension lead to the distributor connects to the center terminal. The filter lead and switch lead are attached to the positive terminal, and the low-tension lead to the distributor housing is attached to the negative terminal. The purpose of the coil is to step up or multiply the voltage of the primary coil to the high value required for the electric discharge at the gaps of the spark plugs.

b. Removal.

(1) Disconnect high-tension wire (to center of distributor) at coil.

(2) Remove nut from positive terminal, and disconnect condenser to ignition switch wire.

(3) Disconnect low-tension wire to distributor at negative terminal of coil by removing nut.

(4) Remove nuts from two studs, and remove one ordinary lock washer from the lower stud and one special internal-external toothed lock washer from upper stud. Disconnect bond strap from lower stud, and remove special internal-external toothed lock washer. Lift coil and bracket from air cleaner.

c. Installation.

(1) Place coil and bracket in position on studs, and install special internal-external toothed lock washers. Place bond strap lug over lower stud, and install nut and lock washer on each stud. Rotate coil as necessary to position the positive terminal upward. Tighten nuts.

(2) Connect condenser to ignition switch wire at positive terminal, and install nut and lock washer.

(3) Connect low-tension wire from distributor to negative terminal, and install nut and lock washer.

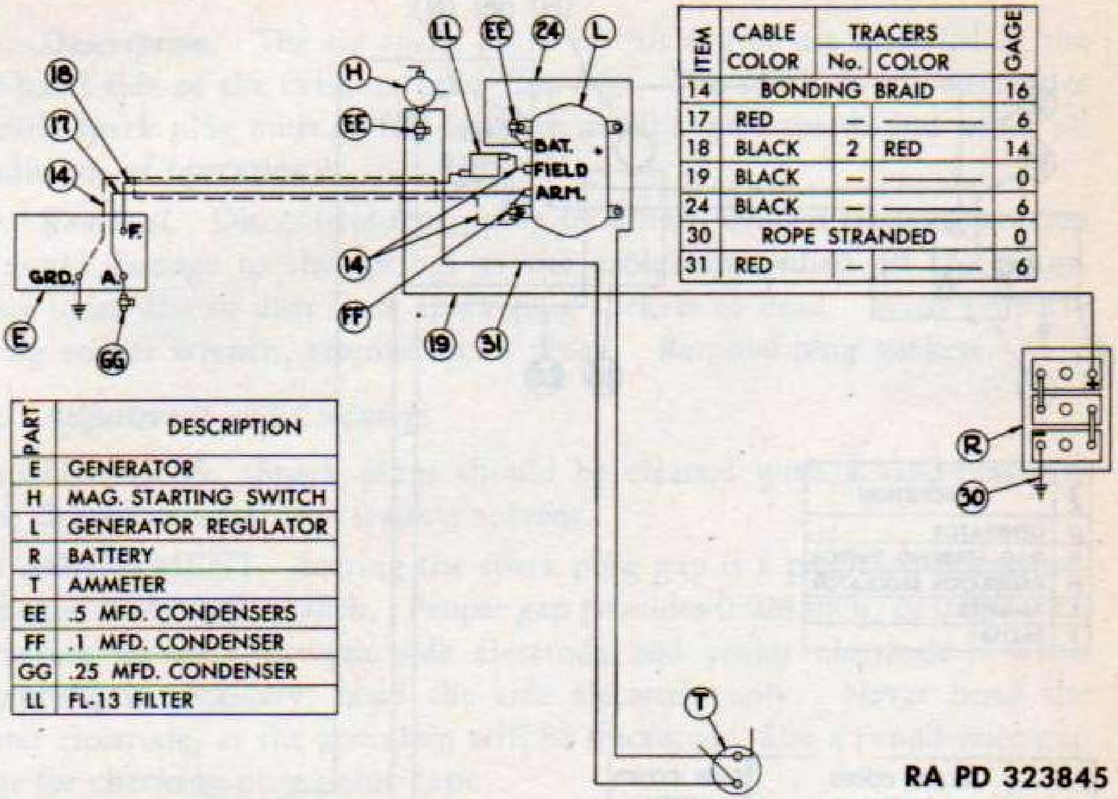
(4) Connect high-tension wire to terminal of coil.

Section XX

Charging System

84. DESCRIPTION AND DATA.

a. Description. The charging system (figs. 63 and 64) includes the engine-mounted generator, the bracket-mounted generator regulator, and connecting wires. The purpose of the system is to keep the battery charged and to furnish current for ignition, lighting, and electrical accessories. Only the generator and generator regulator are covered in this section. Refer to other electrical sections for information covering other electrical units.



ITEM	CABLE COLOR	TRACERS No.	TRACERS COLOR	GAGE
14	BONDING BRAID			16
17	RED	—	———	6
18	BLACK	2	RED	14
19	BLACK	—	———	0
24	BLACK	—	———	6
30	ROPE STRANDED			0
31	RED	—	———	6

PART	DESCRIPTION
E	GENERATOR
H	MAG. STARTING SWITCH
L	GENERATOR REGULATOR
R	BATTERY
T	AMMETER
EE	.5 MFD. CONDENSERS
FF	.1 MFD. CONDENSER
GG	.25 MFD. CONDENSER
LL	FL-13 FILTER

Figure 63 — Charging Circuit Diagram (Dump Truck)

b. Data.

(1) GENERATOR.

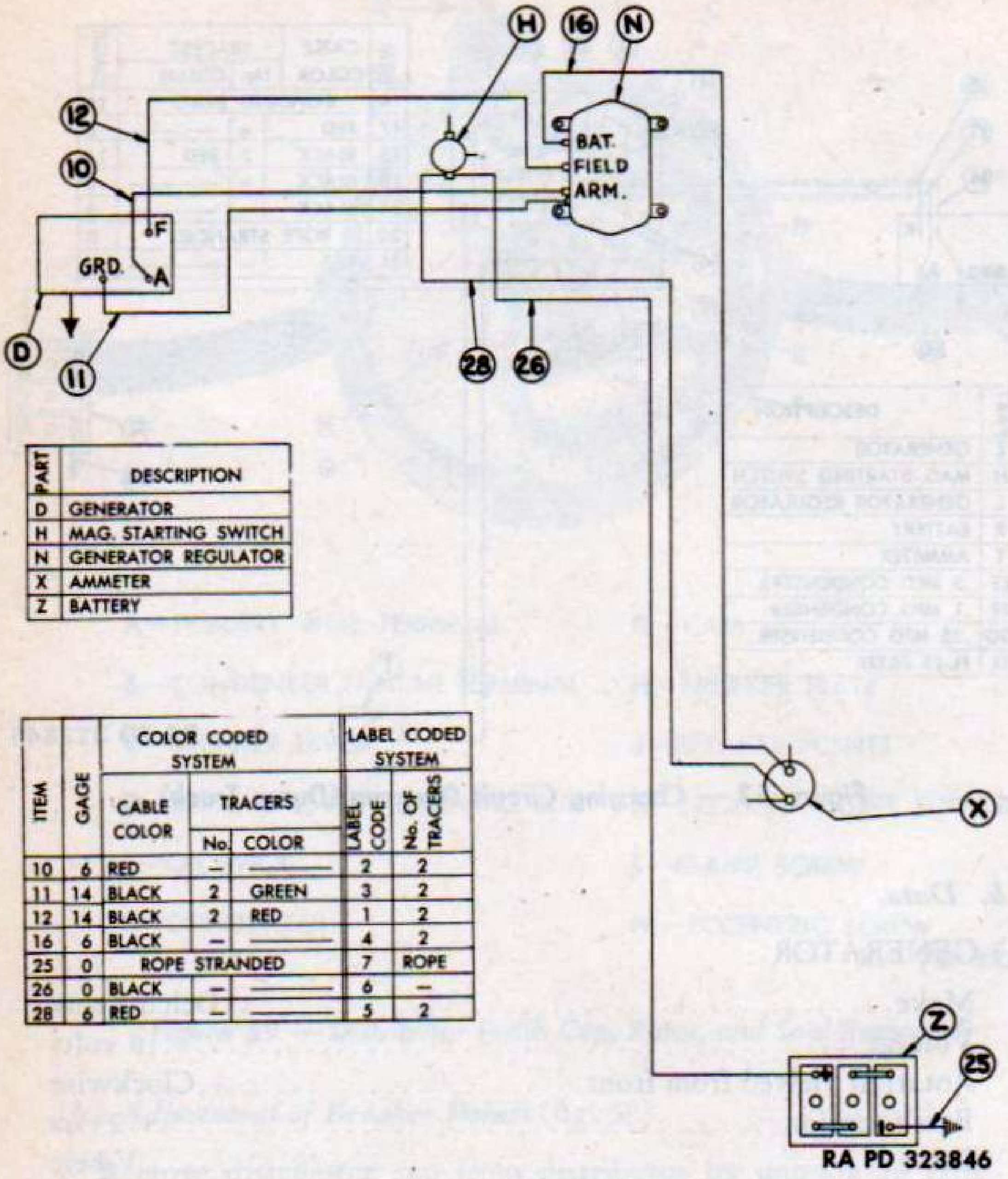
Make . . . . Delco-Remy
Voltage . . . . 6 volts
Rotation viewed from front . . . . Clockwise
Brush tension . . . . 25 oz
Drive . . . . V-belt

(2) GENERATOR REGULATOR.

Make . . . . Delco-Remy
Ground . . . . Negative
Voltage . . . . 6 volts

85. GENERATOR.

a. Description. The generator is a shunt-wound, two-brush unit mounted on a bracket at the right-hand front of the engine (fig. 26). It is driven by the fan drive belt from the crankshaft pulley in conjunction with the water pump and fan. The generator is cooled by air drawn in through openings in the rear of the generator by a fan mounted behind the generator drive pulley.



PART	DESCRIPTION
D	GENERATOR
H	MAG. STARTING SWITCH
N	GENERATOR REGULATOR
X	AMMETER
Z	BATTERY

ITEM	GAGE	COLOR CODED SYSTEM			LABEL CODED SYSTEM	
		CABLE COLOR	TRACERS		LABEL CODE	No. OF TRACERS
			No.	COLOR		
10	6	RED	—	————	2	2
11	14	BLACK	2	GREEN	3	2
12	14	BLACK	2	RED	1	2
16	6	BLACK	—	————	4	2
25	0	ROPE STRANDED			7	ROPE
26	0	BLACK	—	————	6	—
28	6	RED	—	————	5	2

Figure 64 — Charging Circuit Diagram (Bus)

b. Adjustments.

(1) TERMINALS. Tighten all wiring connections and, if necessary, remove and clean terminals. Check wiring for evidence of insulation cracks and other failures.

(2) BRUSHES. Remove cover band, and inspect brushes for worn condition. If brushes are excessively worn, replace the generator. Check pigtail lead connections to be sure they are tight. Install cover band.

(3) COMMUTATOR. Remove cover band, and inspect commutator. If dirty, clean with a strip of 2/0 flint paper. Do not use emery cloth. Blow out all dust with compressed air. Report to higher authority if commutator is excessively rough. Replace cover band.

(4) MOUNTING. Check and tighten mounting bracket to engine cap screws. Also tighten adjusting arm to generator cap screw.

(5) DRIVE BELT. Check generator and fan drive belt tension. A slight pressure on belt at a point midway between the generator pulley and fan drive pulley should result in $\frac{1}{2}$- to $\frac{11}{16}$-inch deflection or sag. Low belt tension will cause a reduced and unsteady generator output. Excessive tension will cause rapid wear of belt and of generator bearings. Adjust belt as necessary, or replace belt if frayed or worn (par. 76).

c. Removal.

(1) DISCONNECT WIRING. Remove nuts from field and armature terminals of generator and disconnect wires. Remove screw from bond strap lug at generator housing, and remove one regular and one special lock washer.

(2) REMOVE FAN DRIVE BELT. Remove nut from generator adjusting strap bolt, and remove bolt and lock washer. Move generator in toward engine, and lift fan drive belt from pulley groove.

(3) REMOVE GENERATOR. Remove two cotter pins, nuts, and lock washers from generator to mounting bracket bolts. Remove bolts, and lift generator from bracket.

d. Installation.

(1) INSTALL GENERATOR. Place generator in position on engine bracket, and install two bolts and special lock washers in bracket. Front bolt enters from front and rear bolt enters from rear. Install two nuts and lock washers on mounting bolts, and install cotter pins.

(2) INSTALL FAN DRIVE BELT. Place fan drive belt in groove of generator pulley, and install generator adjusting strap bolt, nut, and lock washer. Adjust fan drive belt tension (subpar. ***b*** (5) above).

(3) CONNECT WIRING. Connect wires to field and armature terminals of generator, and install terminal nuts. Connect bond strap at generator housing, and install screw, special lock washer and regular lock washer.

(4) POLARIZE GENERATOR. When generator or regulator wires have been disconnected or the battery changed, the generator must be polarized after the units are reconnected and before the engine is started. Reversed polarity will cause regulator points to vibrate excessively and burn. Make certain that generator is correctly polarized by momentarily causing a short-circuit across the field and armature terminals on the regulator with a screw-driver or jumper wire. NOTE: *This must be done before starting engine.* This allows a momentary surge of battery current to the generator, which automatically gives the generator the correct polarity with respect to the battery it is to charge.

86. GENERATOR REGULATOR.

a. Description. The generator regulator is a three-unit type containing a cut-out relay, a voltage regulator, and a current regulator. It is mounted on the right-hand side of the dash in the engine compartment, and is accessible by lifting the hood. Regulator units automatically open and close the circuit between the generator and battery as needs require, and control the maximum generator amperage and voltage output. The three units perform the following functions:

(1) CUT-OUT RELAY. The cut-out relay automatically closes the circuit between the generator and battery when the generator voltage rises above that of the battery, and automatically opens the circuit between the generator and battery when the generator voltage falls below that of the battery.

(2) VOLTAGE REGULATOR. The voltage regulator controls the generator voltage by not allowing it to rise above a value determined by the voltage regulator setting.

(3) CURRENT REGULATOR. The current regulator controls the maximum generator output (amperage) by not allowing the output to exceed the value of the current regulator setting.

b. Removal.

(1) DISCONNECT WIRES. Remove nuts and lock washers from terminals marked "BATTERY," "FIELD," and "ARMATURE" on regulator, and remove wires from terminal screws. Tape the end of the wire removed from the "BATTERY" terminal. Remove the screw and lock washer attaching the ground wire to the regulator base. After removing wires from terminal screws, reinstall nuts and lock washers, and reinstall ground screw and lock washer.

(2) REMOVE REGULATOR. Remove four nuts and lock washers from bolts attaching regulator to bracket, lift off one condenser at each end, lift generator regulator from bracket, and remove special lock washers.

c. Installation.

(1) INSTALL REGULATOR. Place generator regulator in position on bracket over mounting bolts and special lock washers. Place one condenser on bolt at each end of regulator, over special lock washer. Install four lock washers and nuts on mounting bolts.

(2) CONNECT WIRING. After removing nuts and lock washers from terminals, connect wiring to "ARMATURE," "FIELD" and "BATTERY" terminals as follows:

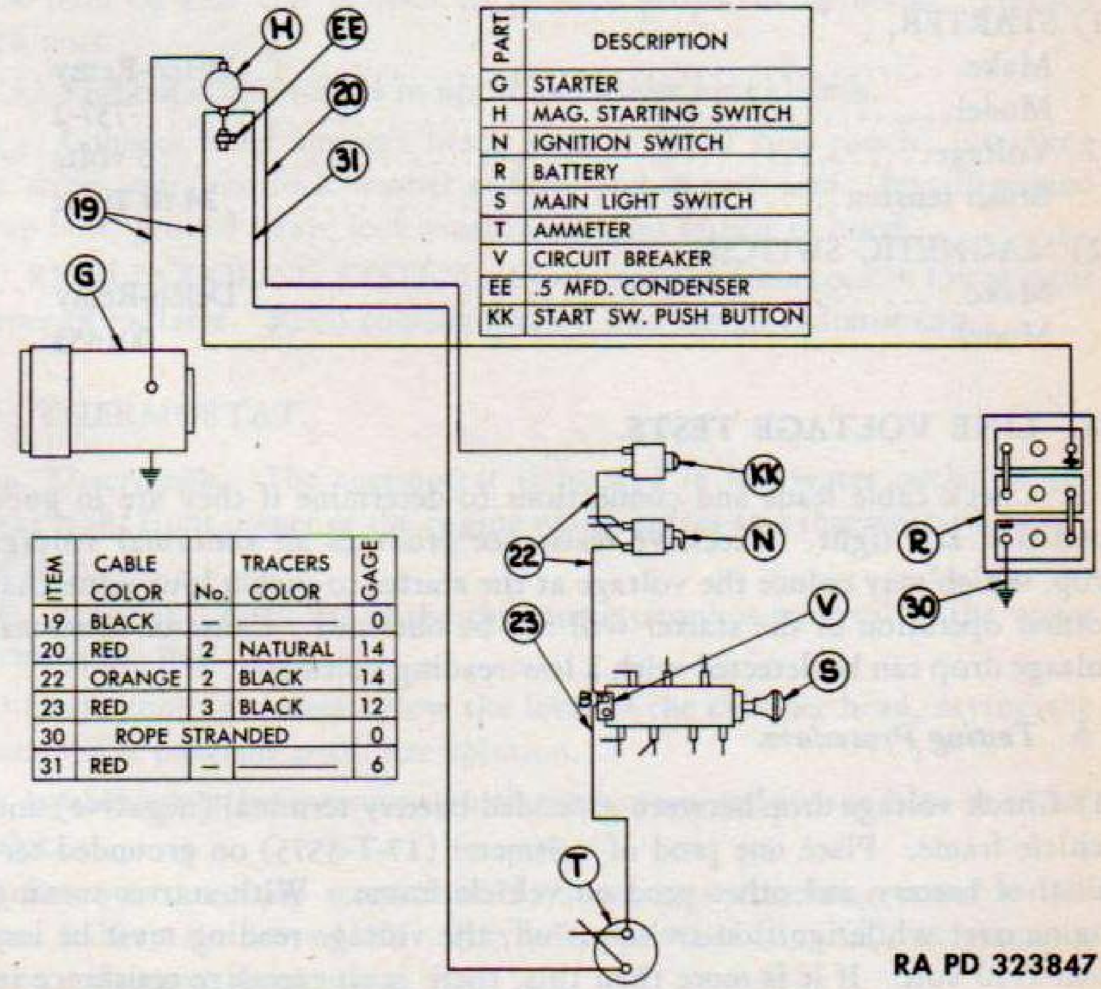
(a) *Armature Terminal.* Connect 0.1 microfarad condenser lead, and connect red cable.

(b) *Field Terminal.* Connect FL-13 filter lead, and connect black cable having red tracer threads.

(c) *Battery Terminal.* Connect 0.5 microfarad condenser lead, and connect black cable.

(d) *Install Nuts and Lock Washers.* Connect ground wire to regulator base with screw and lock washer.

(3) CORRECT POLARITY. When generator or regulator wires have been disconnected or the battery changed, the generator must be polarized after the units are reconnected, and before the engine is started. Reversed polarity will cause regulator points to vibrate excessively and burn. Make certain that generator is correctly polarized by momentarily causing a short-circuit across the "FIELD" and "ARMATURE" terminals of the regulator with a screwdriver or jumper wire. NOTE: *This must be done before starting the engine.* This allows a momentary surge of battery current to the generator which automatically gives the generator the correct polarity with respect to the battery it is to charge.



PART	DESCRIPTION
G	STARTER
H	MAG. STARTING SWITCH
N	IGNITION SWITCH
R	BATTERY
S	MAIN LIGHT SWITCH
T	AMMETER
V	CIRCUIT BREAKER
EE	.5 MFD. CONDENSER
KK	START SW. PUSH BUTTON

ITEM	CABLE COLOR	No.	TRACERS COLOR	GAGE
19	BLACK	—		0
20	RED	2	NATURAL	14
22	ORANGE	2	BLACK	14
23	RED	3	BLACK	12
30	ROPE STRANDED			0
31	RED	—	———	6

Figure 65 — Starting Circuit Diagram (Dump Truck)

Section XXI

Starting System

87. DESCRIPTION AND DATA.

a. Description. The starting system (figs. 65 and 66) consists of a battery (par. 96), magnetic switch, and starter. The starter cranks the engine when the circuit between the starter and the battery is completed at the starter switch button. The starting and continued running of the engine after cranking is dependent upon the proper functioning of carburetion and ignition, as well as upon other engine conditions. The starter merely cranks the engine electrically, thus eliminating hand cranking. When the driver presses the starter button, the circuit between the battery and the magnetic switch is closed, supplying the heavy current needed to rotate the starter armature. This rotation causes the starter mechanism to engage or mesh with teeth on the engine flywheel.

b. Data.

(1) STARTER.

Make .... Delco-Remy
Model 737-2
Voltage .... 6 volts
Brush tension .... 24 to 28 oz

(2) MAGNETIC SWITCH.

Make .... Delco-Remy
Model 001453

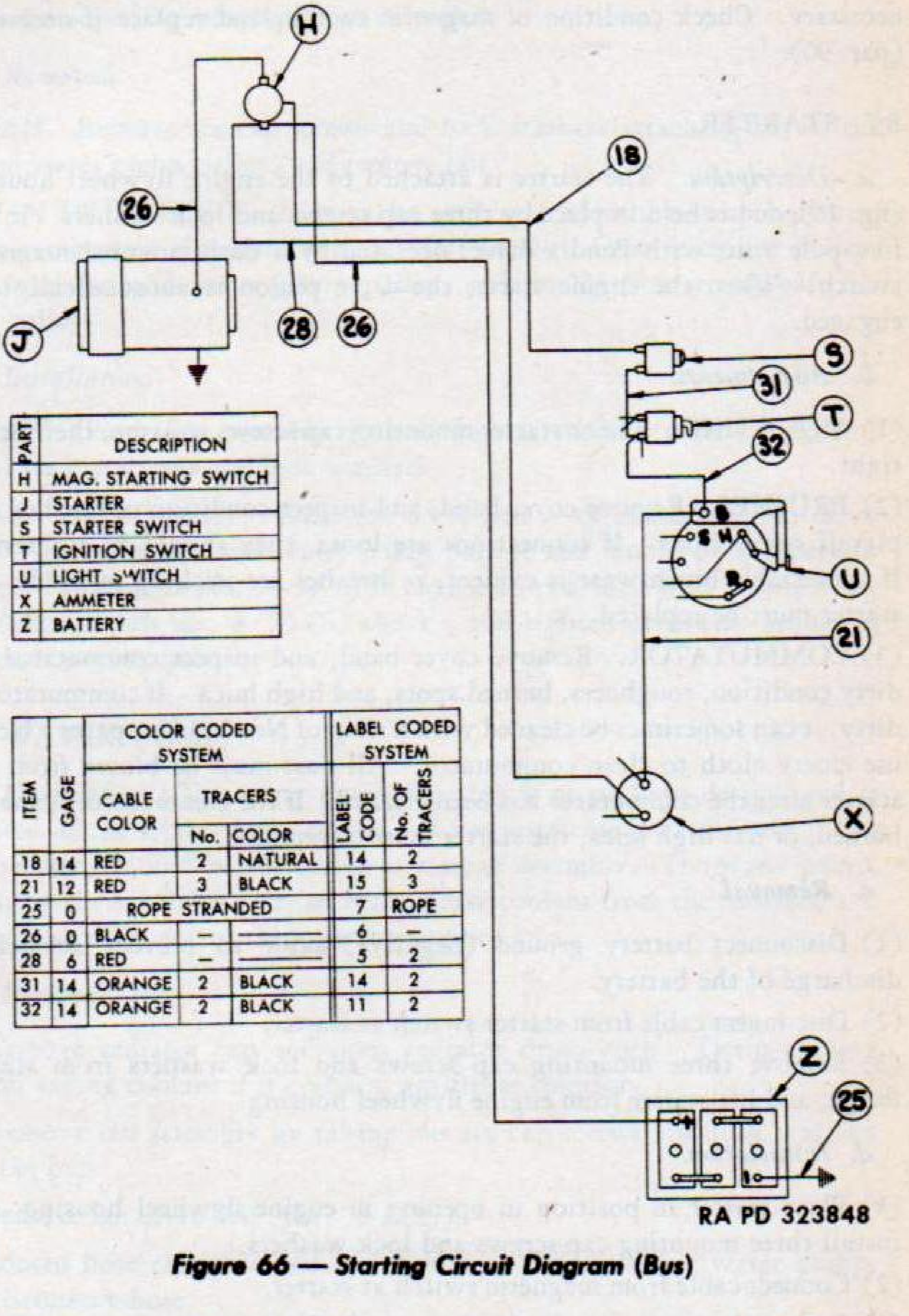
88. LINE VOLTAGE TESTS.

a. Check cable leads and connections to determine if they are in good condition and tight. Excessive resistance produces an abnormal voltage drop, which may reduce the voltage at the starter to such a low value that normal operation of the starter will not be obtained. Cause of abnormal voltage drop can be detected with a low-reading voltmeter.

b. Testing Procedure.

(1) Check voltage drop between grounded battery terminal (negative) and vehicle frame. Place one prod of voltmeter (17-T-5575) on grounded terminal of battery and other prod on vehicle frame. With starter turning engine over while ignition switch is off, the voltage reading must be less than 1/10 volt. If it is more than this, there is an excessive resistance in this circuit.

(2) Check voltage drop between ungrounded (positive) battery terminal



PART	DESCRIPTION
H	MAG. STARTING SWITCH
J	STARTER
S	STARTER SWITCH
T	IGNITION SWITCH
U	LIGHT SWITCH
X	AMMETER
Z	BATTERY

ITEM	GAGE	COLOR CODED SYSTEM			LABEL CODED SYSTEM	
		CABLE COLOR	TRACERS		LABEL CODE	No. OF TRACERS
			No.	COLOR		
18	14	RED	2	NATURAL	14	2
21	12	RED	3	BLACK	15	3
25	0	ROPE STRANDED			7	ROPE
26	0	BLACK	—	—	6	—
28	6	RED	—	—	5	2
31	14	ORANGE	2	BLACK	14	2
32	14	ORANGE	2	BLACK	11	2

Figure 66 — Starting Circuit Diagram (Bus)

and magnetic switch with voltmeter while starter is operated. If reading is more than 1/10 volt, there is excessive resistance in circuit.

(3) Check voltage drop between starter housing and vehicle frame with voltmeter. Reading must be less than 1/10 volt.

(4) If excessive resistance is found in any of the three circuits, disconnect cables, and clean the connections. If cables appear frayed, replace with new

cables of correct size. Check condition of ground strap, and replace if necessary. Check condition of magnetic switch, and replace if necessary (par. 90).

89 STARTER.

a. Description. The starter is attached to the engine flywheel housing (fig. 26), and is held in place by three cap screws and lock washers. It is a four-pole unit, with Bendix drive, operated by a dash-mounted magnetic switch. When the engine starts, the drive pinion is automatically disengaged.

b. Adjustments.

(1) MOUNTING. Check starter mounting cap screws to assure their being tight.

(2) BRUSHES. Remove cover band, and inspect condition of brushes and pigtail connections. If connections are loose, they should be tightened. If appreciable brush wear is evident, or brushes are sticking in holds, the starter must be replaced.

(3) COMMUTATOR. Remove cover band, and inspect commutator for dirty condition, roughness, burned spots, and high mica. If commutator is dirty, it can sometimes be cleaned with a strip of No. 2/0 flint paper. Never use emery cloth to clean commutator. All dust must be blown from the starter after the commutator has been cleaned. If the commutator is rough, burned, or has high mica, the starter must be replaced.

c. Removal.

(1) Disconnect battery ground (negative) cable to prevent accidental discharge of the battery.

(2) Disconnect cable from starter switch at starter.

(3) Remove three mounting cap screws and lock washers from starter flange, and lift starter from engine flywheel housing.

d. Installation.

(1) Place starter in position in opening in engine flywheel housing, and install three mounting cap screws and lock washers.

(2) Connect cable from magnetic switch at starter.

(3) Connect battery ground cable (negative) at battery.

90. MAGNETIC SWITCH.

a. Description. The magnetic switch, mounted on the engine compartment side of the dash, consists of a winding, solenoid plunger, contact terminals, and contact disk. When the winding is energized by connection to the battery by pressing the starter button, the resulting magnetic field pulls in the solenoid plunger, forcing the contact terminals against the contact disk, and connecting the starter to the battery. Release of the starter button disconnects the magnetic switch winding from the battery, so that the magnetic switch spring can separate the contact disk from the terminals, opening the circuit between the starter and the battery.

b. Removal.

(1) Disconnect battery ground cable at battery.

(2) Disconnect battery cable at magnetic switch, and disconnect condenser. Disconnect cable to starter at magnetic switch. Disconnect wire from magnetic switch to starter push button.

(3) Remove two cap screws, nuts, and special lock washers from magnetic switch bracket. Lift switch and bracket from dash.

c. Installation.

(1) Place magnetic switch and bracket in position on dash over special lock washers, and install and tighten nuts.

(2) Connect battery cable at magnetic switch, and connect condenser. Connect cable to starter at magnetic switch. Connect wire from magnetic switch to starter button at magnetic switch.

(3) Connect battery ground cable at battery.

Section XXII

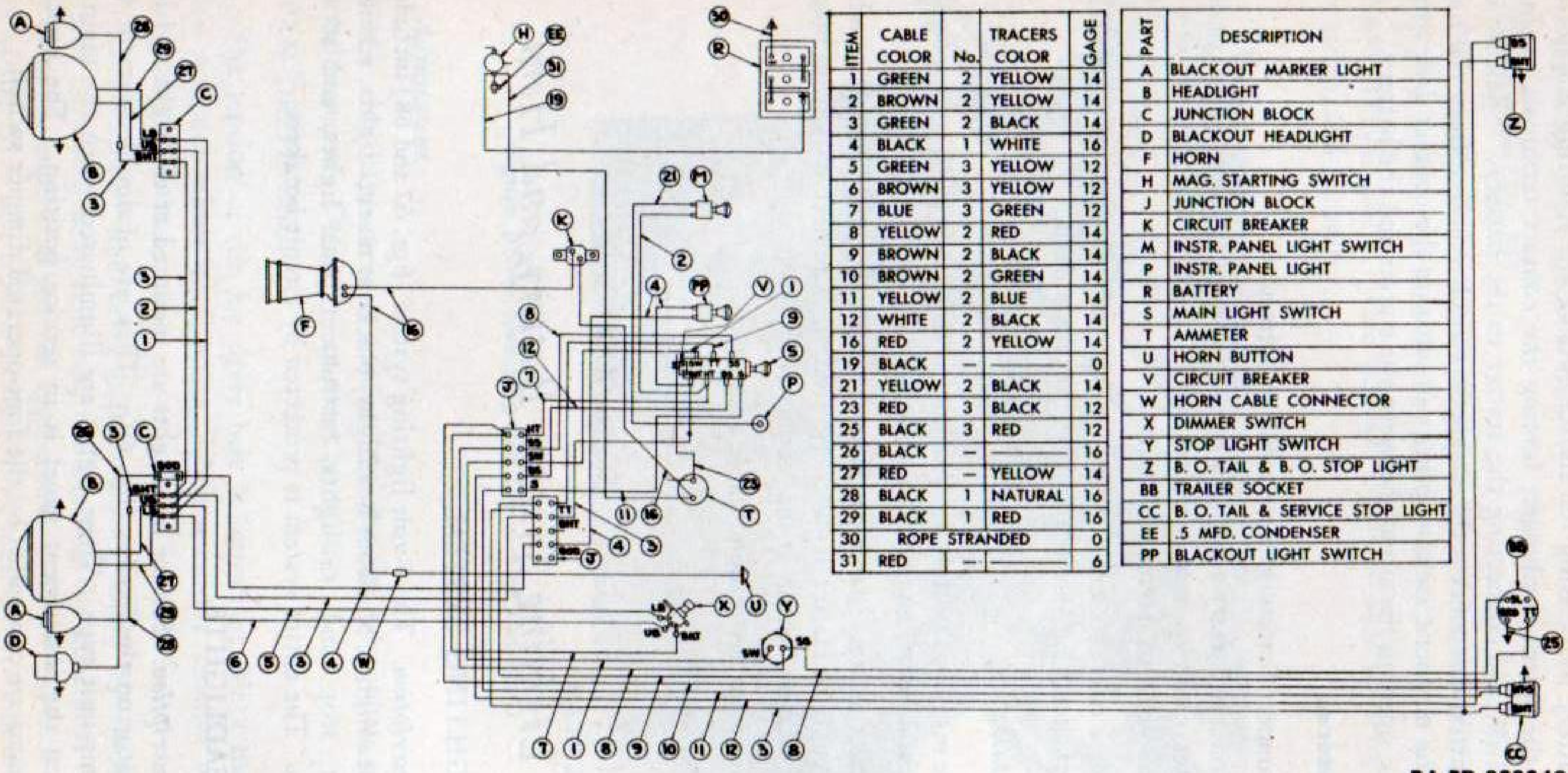
Lighting System, Battery, and Horn

91. LIGHTING SYSTEM.

a. Description. The 6-volt lighting system (figs. 67 and 68) includes the service headlights, blackout headlight, blackout marker lights, service and blackout stop and taillights, instrument panel lights, and actuating switches. The entire system is protected by circuit breakers.

92. HEADLIGHTS.

a. Description. Service headlights are mounted at the right and left of the radiator on the fenders (fig. 69). They are of double-filament sealed beam lamp-unit type. These lights are illuminated when the main light switch on the instrument panel is in service position. The upper and lower beams are controlled by the foot-operated dimmer switch.

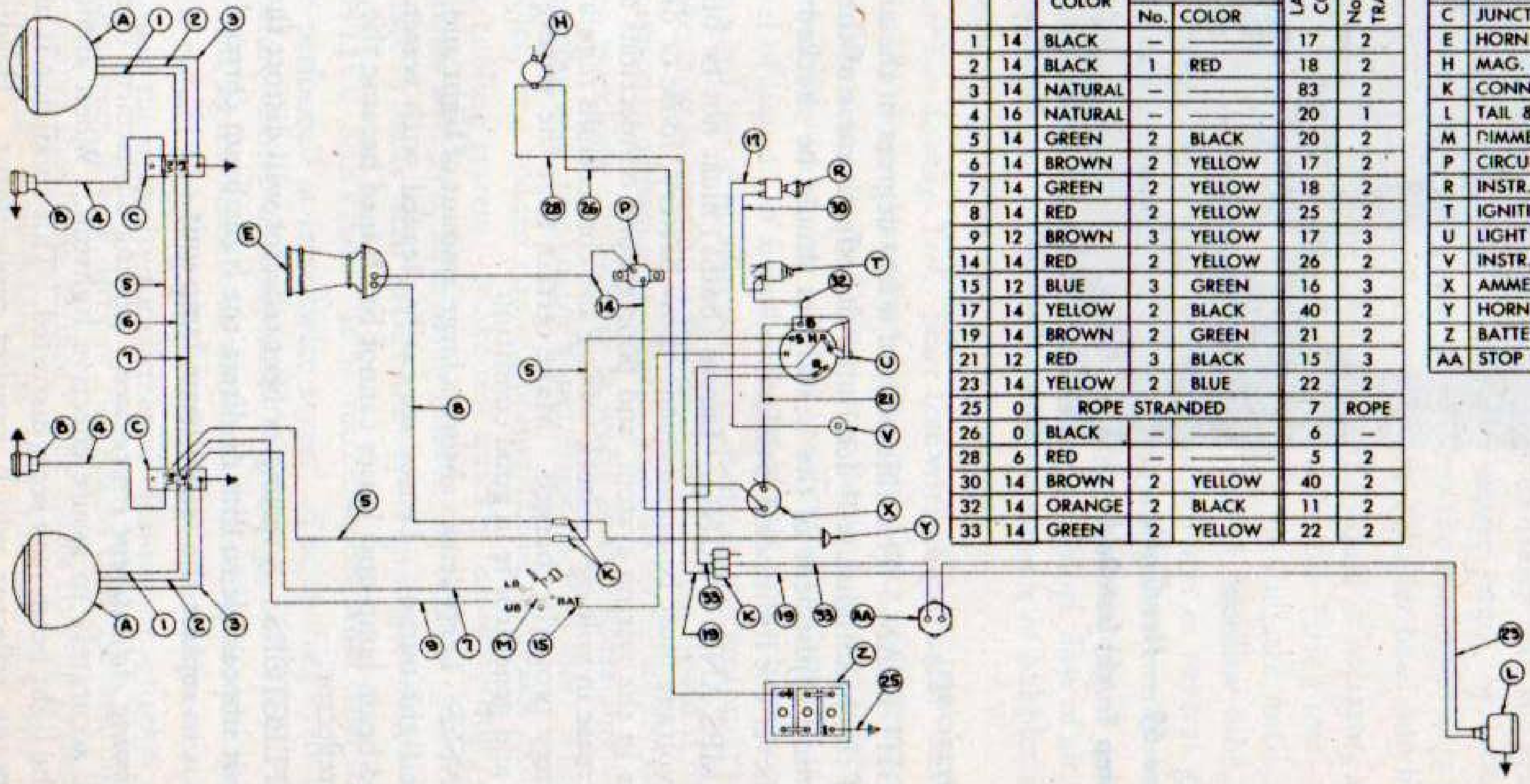


ITEM	CABLE COLOR	No.	TRACERS COLOR	GAGE
1	GREEN	2	YELLOW	14
2	BROWN	2	YELLOW	14
3	GREEN	2	BLACK	14
4	BLACK	1	WHITE	16
5	GREEN	3	YELLOW	12
6	BROWN	3	YELLOW	12
7	BLUE	3	GREEN	12
8	YELLOW	2	RED	14
9	BROWN	2	BLACK	14
10	BROWN	2	GREEN	14
11	YELLOW	2	BLUE	14
12	WHITE	2	BLACK	14
16	RED	2	YELLOW	14
19	BLACK	—	——	0
21	YELLOW	2	BLACK	14
23	RED	3	BLACK	12
25	BLACK	3	RED	12
26	BLACK	—	——	16
27	RED	—	YELLOW	14
28	BLACK	1	NATURAL	16
29	BLACK	1	RED	16
30	ROPE STRANDED			0
31	RED	—	——	6

PART	DESCRIPTION
A	BLACKOUT MARKER LIGHT
B	HEADLIGHT
C	JUNCTION BLOCK
D	BLACKOUT HEADLIGHT
F	HORN
H	MAG. STARTING SWITCH
J	JUNCTION BLOCK
K	CIRCUIT BREAKER
M	INSTR. PANEL LIGHT SWITCH
P	INSTR. PANEL LIGHT
R	BATTERY
S	MAIN LIGHT SWITCH
T	AMMETER
U	HORN BUTTON
V	CIRCUIT BREAKER
W	HORN CABLE CONNECTOR
X	DIMMER SWITCH
Y	STOP LIGHT SWITCH
Z	B. O. TAIL & B. O. STOP LIGHT
BB	TRAILER SOCKET
CC	B. O. TAIL & SERVICE STOP LIGHT
EE	.5 MFD. CONDENSER
PP	BLACKOUT LIGHT SWITCH

RA PD 323849

Figure 67 — Lighting Circuit Diagram (Dump Truck)



ITEM	GAGE	COLOR CODED SYSTEM: CABLE COLOR	TRACERS: No.	TRACERS: COLOR	LABEL CODED SYSTEM: LABEL CODE	No. OF TRACERS
1	14	BLACK	—	———	17	2
2	14	BLACK	1	RED	18	2
3	14	NATURAL	—	———	83	2
4	16	NATURAL	—	———	20	1
5	14	GREEN	2	BLACK	20	2
6	14	BROWN	2	YELLOW	17	2
7	14	GREEN	2	YELLOW	18	2
8	14	RED	2	YELLOW	25	2
9	12	BROWN	3	YELLOW	17	3
14	14	RED	2	YELLOW	26	2
15	12	BLUE	3	GREEN	16	3
17	14	YELLOW	2	BLACK	40	2
19	14	BROWN	2	GREEN	21	2
21	12	RED	3	BLACK	15	3
23	14	YELLOW	2	BLUE	22	2
25	0	ROPE STRANDED			7	ROPE
26	0	BLACK	—	———	6	—
28	6	RED	—	———	5	2
30	14	BROWN	2	YELLOW	40	2
32	14	ORANGE	2	BLACK	11	2
33	14	GREEN	2	YELLOW	22	2

PART	DESCRIPTION
A	HEADLIGHT
B	PARKING LIGHT
C	JUNCTION BLOCK
E	HORN
H	MAG. STARTING SWITCH
K	CONNECTOR
L	TAIL & STOP LIGHT
M	DIMMER SWITCH
P	CIRCUIT BREAKER
R	INSTR. PANEL LIGHT SWITCH
T	IGNITION SWITCH
U	LIGHT SWITCH
V	INSTR. PANEL LIGHT
X	AMMETER
Y	HORN BUTTON
Z	BATTERY
AA	STOP LIGHT SWITCH

RA PD 323850

Figure 68 — Lighting Circuit Diagram (Bus)

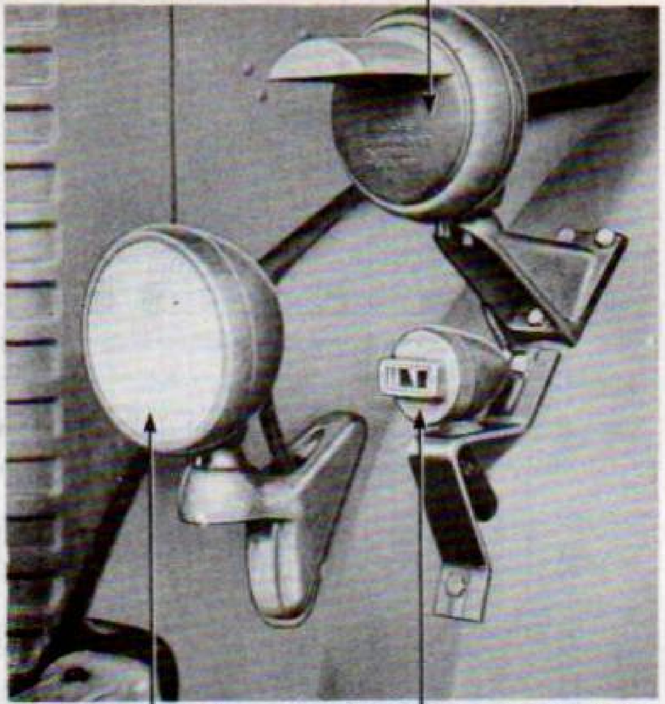


Figure 69 — Headlights (Dump Truck) Installed

b. Servicing.

(1) LIGHT BEAM. The difference of a few degrees in the aiming adjustment of the headlights will determine the effectiveness of the light beam. The aiming adjustment of the headlights should be checked periodically, or whenever the light beam is defective.

(2) LAMPS AND WIRING. Lamps (bulbs) must not be blackened, and proper voltage must be maintained. Low battery, loose or dirty electrical contacts in the wiring system, and poor ground connections all contribute to a decrease in voltage. Check wiring and connections regularly, and keep the battery properly charged. Make certain that the wiring between the battery and generator is in good condition.

(3) LENSES. Dirty lenses absorb a large amount of light and consequently decrease light output. Lenses are easily cleaned with water. The inside of sealed beam lamp-unit lenses cannot be cleaned because the lens is sealed to the reflector.

(4) REFLECTORS. A sprung or bent reflector will distort the light beam, making it impossible to dim or direct the light beam correctly. The only remedy is to replace the sealed beam lamp-unit.

c. Aiming Adjustment Procedure. Aiming adjustment operations must be done accurately to assure effective lighting. When aiming the headlights the light beam may seem distorted. This condition is usually caused by a sprung reflector which requires replacement. Headlights can be

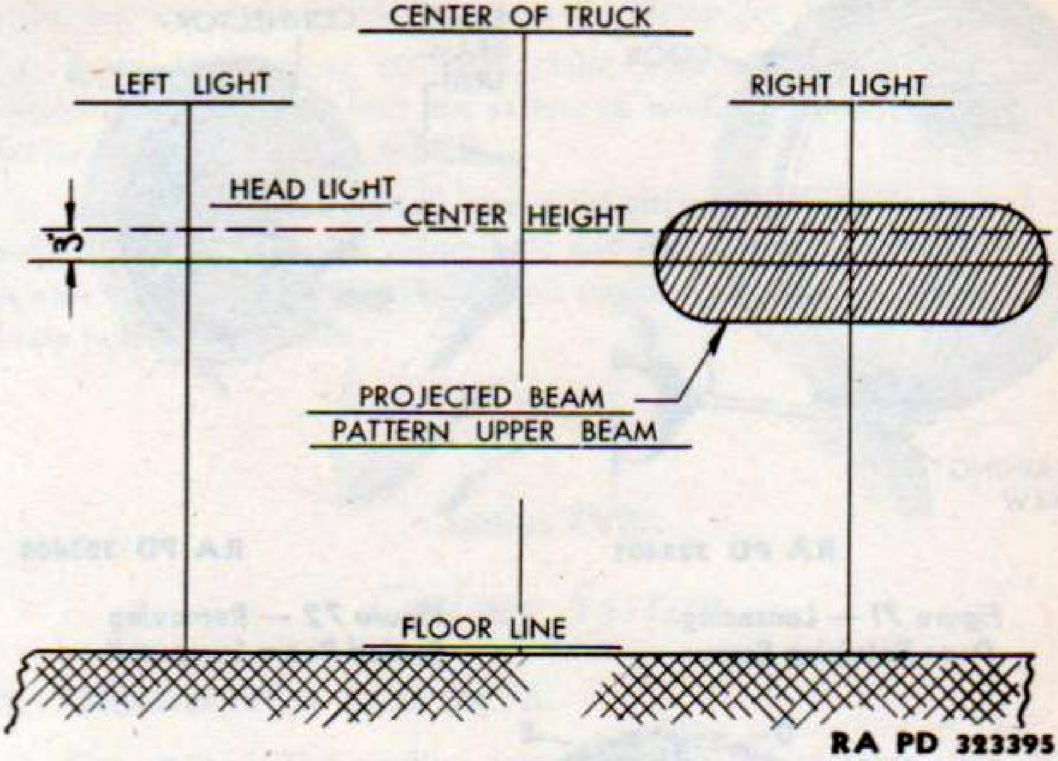


Figure 70 — Headlight Adjustment Pattern

adjusted quickly and accurately with a headlight tester. However, if this equipment is not available, a satisfactory adjustment can be made as follows:

(1) POSITION VEHICLE. Place vehicle on level floor so that headlights are 25 feet from a screen or chart. Mark a horizontal line on the chart at a level three inches below the height from the floor of the light centers. Vertical lines on the chart mark the distance between the center lines of the headlights, and must be equally spaced from the center line of the chart.

(2) ADJUSTMENT. Each light must be adjusted by loosening the mounting stud nut and shifting the light body so that the hot spot of the beam will be centered over the point of intersection of the vertical and horizontal lines. Covering one light while adjusting the other will facilitate adjustment. Figure 70 illustrates the beam pattern to be attained. Tighten headlight mounting nuts securely.

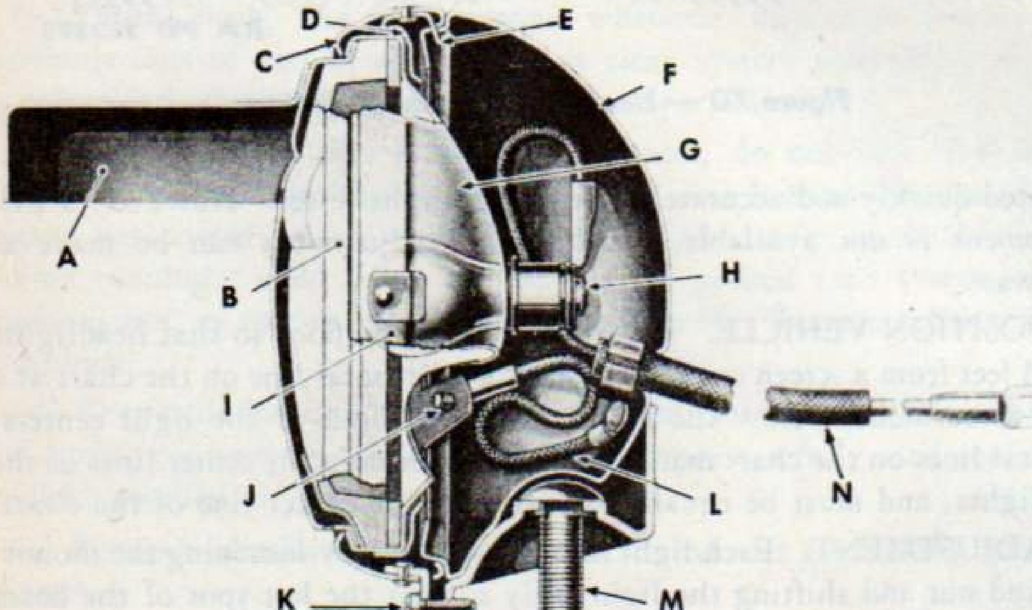
d. Removal.

(1) SEALED BEAM LAMP-UNIT. Loosen the door retaining screw of headlight body (fig. 71). Lift door from light. Lift sealed beam lamp-unit from light body, and disconnect three-way connector (figure 72).

(2) HEADLIGHT ASSEMBLY. Disconnect wiring at junction block. Remove nut and lock washer from headlight mounting stud. Lift assembly from bracket.

Figure 71 — Loosening Door Retaining Screw

Figure 72 — Removing Sealed Beam Lamp-unit



A BEAM VISOR
B LENS
C MOULDING RING
D RETAINING RING
E MOULDING RING TOP CLIP
F DRIVING LIGHT BODY
G REFLECTOR
H TERMINAL SCREW
I LAMP
J GROUND WIRE SCREW
K MOULDING RING RETAINING SCREW
L GROUND WIRE
M LAMP MOUNTING STUD
N WIRE HARNESS

RA PD 64649

Figure 73 — Blackout Driving Light, Sectional View

e. Installation.

(1) SEALED BEAM LAMP-UNIT. Connect sealed beam lamp-unit in position in body. Place door in position over unit, and tighten retaining screw.

(2) HEADLIGHT ASSEMBLY. Place headlight in position on mounting bracket, and install nut and lock washer. Connect wiring at junction block. Adjust headlight (subpar. *c* above)

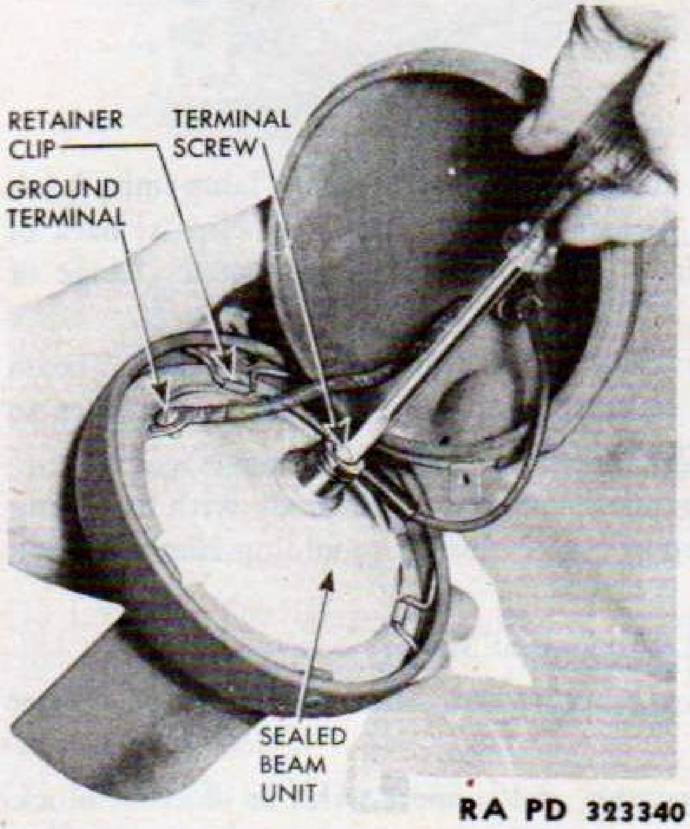


Figure 74 — Disconnecting Blackout Driving Light Sealed Beam Lamp-unit

93. BLACKOUT HEADLIGHT (DUMP TRUCK).

a. Description. The blackout headlight or driving light (fig. 73) is mounted on the fender to the left of the radiator (fig. 69). This light is controlled by the main light switch on the instrument panel. The blackout driving light furnishes a diffused light beam to permit limited illumination when driving under blackout conditions.

b. Removal.

(1) SEALED BEAM LAMP-UNIT. The sealed beam lamp-unit includes a lens, reflector, lamp or bulb element, and beam visor sealed together as a unit (fig. 73).

(a) Remove moulding screw at bottom of moulding.

(b) Pull moulding out at bottom, and raise sealed beam lamp-unit upward to free clip at top of light body.

(c) Disconnect wires from rear of sealed beam lamp-unit by loosening lamp terminal screw (fig. 74), and ground terminal screw at retaining ring.

(d) Use screwdriver to loosen three spring clips attaching retaining ring and sealed beam lamp-unit to moulding.

(2) BLACKOUT DRIVING LIGHT ASSEMBLY.

(a) *Disconnect Wiring.* Remove screws from driving light wiring at junction block, and feed harness through opening.

(b) *Remove Light.* Remove mounting stud nut and lock washer from stud at bracket, and lift unit from bracket.

c. ***Installation.***

(1) SEALED BEAM LAMP-UNIT.

(a) Place moulding around front side of sealed beam lamp-unit, with split in moulding at bottom. Locate retaining ring with clips at back of sealed beam lamp-unit, and force retaining ring springs under flange of moulding.

(b) Install light wire under terminal screw head at rear of sealed beam lamp-unit, and tighten screw securely (fig. 74). Attach ground wire to ground terminal at retaining ring in the same manner.

(c) Install sealed beam lamp-unit assembly in light body with moulding ring clip engaged in slot at top of body. Install moulding ring retaining screw at bottom of moulding.

(2) BLACKOUT DRIVING LIGHT ASSEMBLY.

(a) Place light in position on bracket, and install nut and lock washer thumb-tight on stud.

(b) Feed harness through opening, and connect wires at junction block screws.

(c) Use a projection screen (figure 70) for adjustment of the blackout driving light. The vehicle should be loaded and on a level surface at the time of adjustment.

1. Loosen light mounting stud nut at mounting bracket.
2. Shift the light as required so that the visual cut-off of the top of the beam on the vertical screen 10 feet in front of the light is at least 2 inches and not more than 3 inches below the bottom of the horizontal slot in the light shield.
3. Tighten mounting stud nut, being careful not to alter adjustment.

94. BLACKOUT MARKER LIGHTS (DUMP TRUCK).

a. Description. Blackout marker lights are mounted at the front of each front fender (fig. 69), and are illuminated only when the main light switch is in blackout driving position. The blackout marker lights incorporate a specially designed lens and color filter which diffuses the light beam.

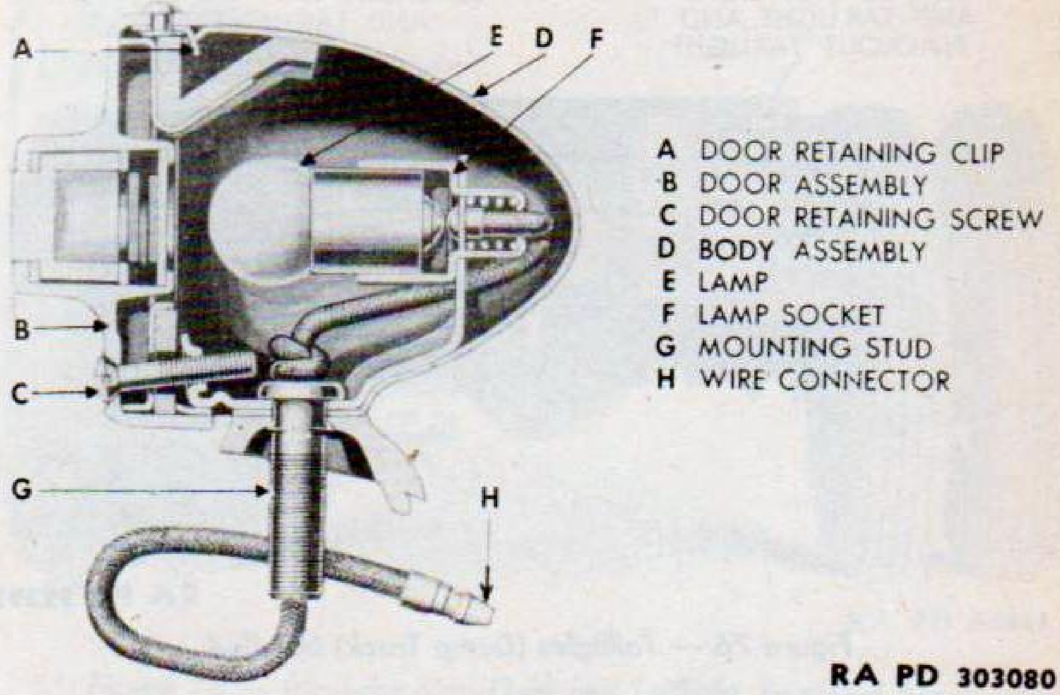


Figure 75 — Blackout Marker Light, Sectional View

b. Removal.

(1) LAMP. The lamp (bulb) of the marker light is replaceable in the conventional manner. Remove retaining screw from light door, and lift door from bottom and away from light body (fig. 75). Turn lamp and remove from socket.

(2) MARKER LIGHT ASSEMBLY. Disconnect wire at junction block, and feed wire through opening. Remove nut and lock washer from mounting stud at base of light, and lift light from bracket.

c. Installation.

(1) LAMP. Insert lamp into socket, and turn into position. Place light door in position, connecting clip at top of door into slot in body (fig. 75). Install door retaining screw.

(2) MARKER LIGHT ASSEMBLY. Place marker light assembly in position on mounting bracket (fig. 69), and install nut and lock washer on mounting stud, having marker light in a straight-ahead position before tightening nut. Feed wire through opening, and attach at terminal screw on junction block.

95. SERVICE AND BLACKOUT STOP LIGHTS AND TAILLIGHTS.

*a. **Dump Truck.*** Two combination stop light and taillight units are mounted at the rear of the dump truck (fig. 76). The left-hand light

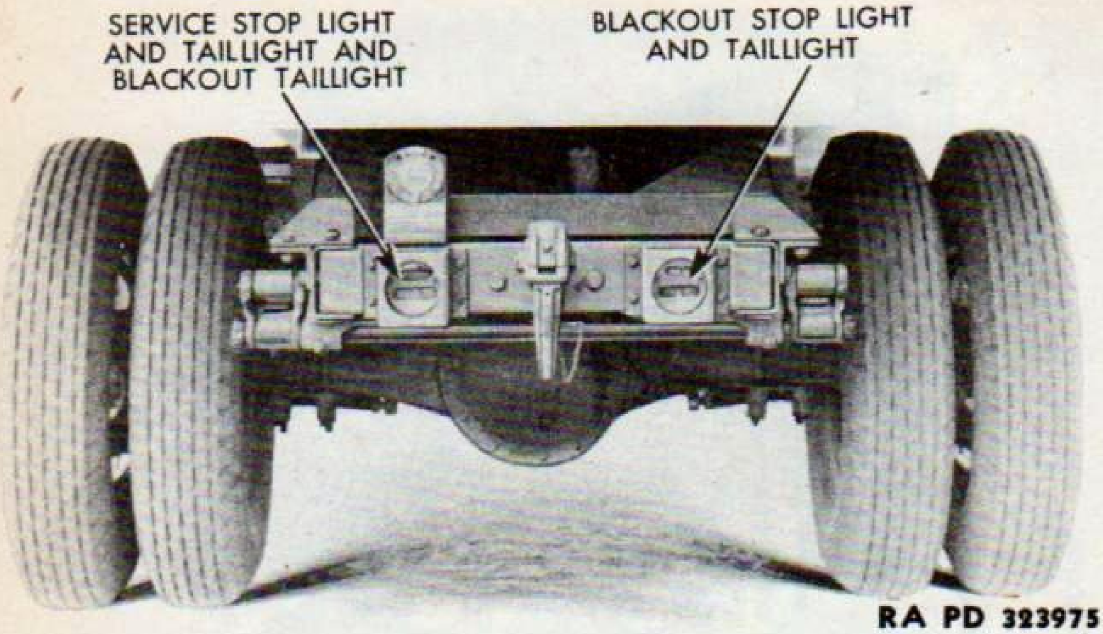


Figure 76 — Taillights (Dump Truck) Installed

incorporates a combination service stop light and taillight unit in the upper portion, and a blackout taillight unit in the lower portion (fig. 77). The right-hand light incorporates a blackout stop light in the upper portion and a blackout taillight in the lower portion (fig. 78). The lens of each blackout taillight unit is designed to produce two beams. These two beams are directed so that they merge into a single beam at a specified distance. Thus, when one vehicle is following another under blackout conditions, the driver of the rear vehicle can maintain a safe distance between vehicles by

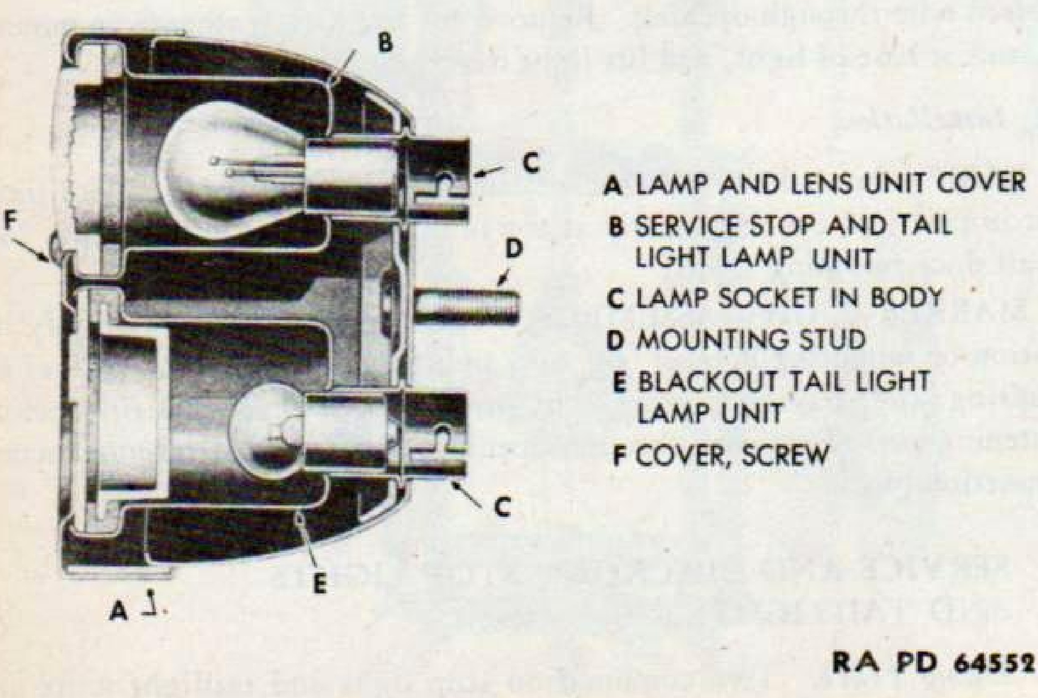


Figure 77 — Service Stop Light and Taillight, Sectional View

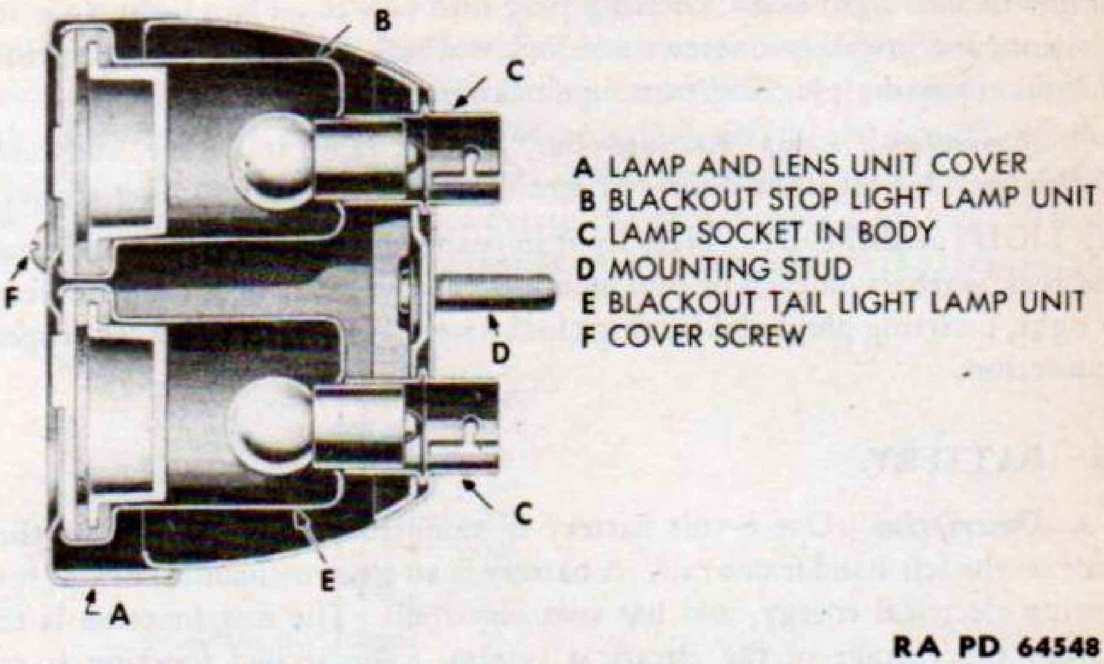


Figure 78 — Blackout Stop Light and Taillight, Sectional View

staying far enough behind so that the two beams appear as one. The beams of the blackout stop light and taillights are diffused so that they are not visible from above. The lights are composed of individual sealed beam lamp-units.

b. Passenger Bus. The combination stop light and taillight of the passenger bus is of conventional type, being of neither sealed beam nor blackout design. The lamp-unit (or lamp) is readily replaceable. It is housed in the light body and covered by a red lens.

c. Removal.

(1) INDIVIDUAL LAMP.

(a) *Sealed Beam Lamp-unit (Dump Truck)* Disconnect cable at rear of lamp-unit in conventional manner, turning counterclockwise and pulling plug from socket. Remove two screws from light door, and lift door from body. Pull defective lamp-unit from light body.

(b) *Conventional Lamp (Passenger Bus).* Remove two screws from light door, and remove light door and lens. Turn lamp counterclockwise to remove from socket.

(2) LIGHT ASSEMBLY. Disconnect cables at rear of light by turning plugs counterclockwise and pulling out. Remove nuts and lock washers from two mounting screws in rear of light body. Lift light from frame.

d. Installation.

(1) INDIVIDUAL LAMP.

(a) *Sealed Beam Lamp-unit (Dump Truck).* Insert new sealed beam lamp-unit into light body, entering plug into socket. Place light door in position, and install two screws and lock washers. Connect wiring at rear of light, inserting plug and turning clockwise.

(b) *Conventional Lamp (Passenger Bus).* Insert lamp in socket, and turn clockwise. Install light door and lens, and install two retaining screws.

(2) LIGHT ASSEMBLY. Place light in position on frame, and install nuts and lock washers on each of two mounting screws. Connect cables at rear of light, inserting plugs and turning clockwise. Test lights to assure proper connection.

96. BATTERY.

a. Description. One 6-volt battery is mounted in a carrier below the door on the left-hand frame rail. A battery is an electro-chemical device for storing electrical energy, and has two functions. The first function is to govern the voltage of the electrical system. The second function is to provide electrical energy to the starter and ignition circuit while the engine is being started. The battery also supplies energy, under limited conditions, to the lights and other electrical accessories. The battery has its negative terminal grounded.

b. Data.

Make	Auto-lite
Model	TS-4-19 or TS-4-23
Plates per cell	19 or 23
Voltage	6 volts
Ampere hours (20-hour rate)	152
Ampere hours (20-minute rate)	180

c. Servicing.

(1) WATER LEVEL. Remove three filler caps, and check level of water (electrolyte) in each cell. Water level should be approximately ⅜ inch above plates. Do not overfill. During cold weather, water should be added only immediately before operation. Use pure distilled water. If this is not available, use drinking water which is tasteless and odorless.

(2) BATTERY TERMINALS. Inspect condition of battery terminals. If found corroded, remove terminal and clean with a solution of ammonia and water. Coat cable terminal and battery post lightly with grease. Install terminal on post, and tighten clamp nut securely.

(3) TESTING AND CHARGING.

(a) *Specific Gravity in Cells.* With an accurate hydrometer, check each cell of battery for specific gravity of battery solution. A fully charged battery should test between 1.275 and 1.300. If the reading is below 1.225

under normal operating conditions, the battery should be replaced with a fully charged battery. To determine the actual specific gravity of the electrolyte, it is necessary to check the temperature of the solution with a thermometer. If the temperature is normal, 80°F, the specific gravity reading will be correct. However, if the temperature is above or below 80°F, it will be necessary to calculate the actual specific gravity. This is due to the fact that the liquid expands when warm, so that the same volume

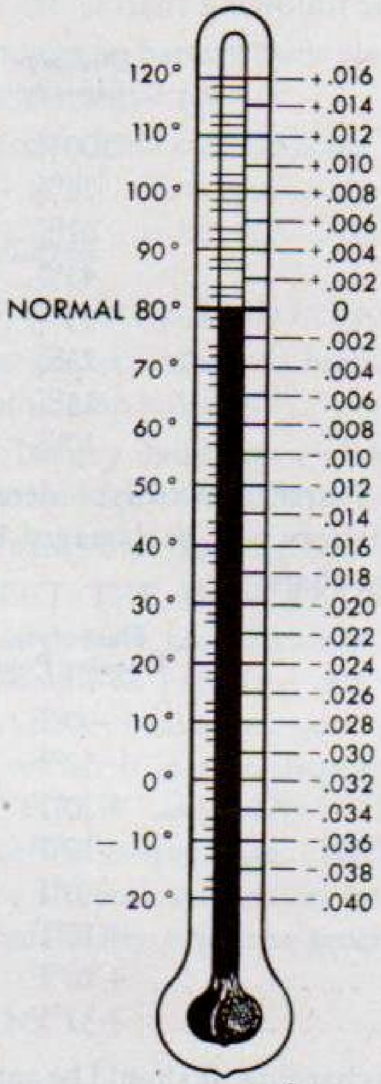


Figure 79 — Hydrometer Correction Chart

RA PD 43402

weighs less than it weighs at 80°F. The reverse is also true, so that when the temperature is below normal the liquid contracts and the same volume weighs more than it weighs at 80°F. The correction chart (fig. 79) gives the figures to be used to make these corrections. For example, when the specific gravity as shown by the hydrometer reading is 1.290 and the temperature of the electrolyte is 60°F, it will be necessary to subtract 8 points or 0.008 from the 1.290 reading, which gives 1.282 as the actual specific gravity. If the hydrometer reading shows 1.270 at a temperature of 110°F, it will be necessary to add 12 pounts or 0.012 to the reading, which gives 1.282 as the actual specific gravity.

(b) *Temperature Effects.*

1. In tropical or hot regions, the danger of overheating a battery is much greater than in cooler climates. The battery should be adjusted to have a specific gravity when fully charged of 1.225 maximum under such conditions.

2. For cold regions it must be remembered that a fully charged battery has only partial discharge capacity at lower temperatures, as shown in the following chart:

Temperature	Discharge Capacity
80°F	100%
40°F	76%
20°F	61%
0°F	43%
—10°F	35%
—20°F	25%
—30°F	15%
—40°F	10%

3. The specific gravity of the battery electrolyte determines the temperature at which a battery will be damaged by freezing, as shown in the following chart:

Electrolyte Specific Gravity	Electrolyte Freezing Point
1.280	—90°F
1.220	—30°F
1.210	—20°F
1.180	—10°F
1.160	— 0°F
1.140	+10°F
1.100	+20°F
1.000	+32°F

(c) *Charging.* When battery requires charging, it should be supplied with a charging rate of one ampere per positive plate per cell. Charging should continue for two hours after the specific gravity and terminal voltage show no further rise. The electrolyte temperature should not be permitted to rise above 110°F.

(4) CELL VOLTAGE TEST. With the ignition switch off, or the high-tension lead removed from the ignition coil, operate starter motor and quickly check each cell of battery with a low-reading voltmeter (17-T-5575). If voltage falls below 1.7 volts at 80°F, or if there is a difference between cell readings of more than 1/10 volt, the battery is defective and must be replaced.

(5) LINE VOLTAGE TESTS. Before it can be definitely determined that battery cables are satisfactory, tests should be made as directed in paragraph 88.

d. Removal. The battery is accessible below the left-hand door behind the cover plate.

(1) Remove screws from panel below left door, and remove panel.

(2) Loosen nuts and lock washers on battery hold-down clamp bolts, and loosen bracket.

(3) Loosen nuts on battery cable clamp bolts, and disconnect battery cables from battery terminal posts.

(4) Lift battery from carrier, being careful not to tip battery so as to spill electrolyte.

e. Installation.

(1) Lift battery into position in battery carrier.

(2) Connect battery cables to battery terminal posts, and tighten nuts on battery cable clamp bolts.

(3) Install battery hold-down clamp bolts in position on battery, and tighten nuts and lock washers on bolts.

(4) Install panel over opening below left door, and install screws.

(5) CORRECT THE GENERATOR POLARITY. When generator or regulator wires have been disconnected, or battery has been disconnected, generator should be polarized after units are reconnected and before the engine is started. Make sure generator is correctly polarized with respect to battery which it is to charge by momentarily causing a short-circuit across the "FIELD" and "ARMATURE" terminals on the regulator with a screwdriver or jumper wire. NOTE: *This must be done before starting the engine.* This allows a momentary surge of battery current to the generator which automatically gives the generator the correct polarity.

97. HORN.

a. Description. An electric horn is mounted on the engine cylinder head cover. It is a vibrating-type unit which operates on a magnetic principle to produce a warning signal.

b. Operation. When the circuit is completed at the horn button, current from the battery flows through the horn winding. The magnetic attraction of the armature toward the pole causes a tension and slight movement of the horn diaphragm. This movement opens the contact points which are connected in series with the field windings, thereby breaking the circuit. When the circuit is interrupted, the armature returns to its original position, relieving the tension on the diaphragm. This return movement allows the contact points to close, completing the circuit. The cycle is repeated many times per second, resulting in a rapid vibration of the horn diaphragm. The pitch of the signal depends on the rate of vibration.

c. Adjustments. If tone of horn is not satisfactory, after ascertaining that cause is not a low battery, poor connections, or broken or loose parts, the horn may be adjusted as follows:

(1) Remove screw from back of horn shell, and lift shell from horn.

(2) Adjust the current draw. Specified current draw is 7 to 9 amperes at 6 volts. Connect a voltmeter (17-T-5575) into the circuit at horn terminals and adjust current draw by varying the position of the adjusting nut. Loosen lock nut, and turn adjusting nut to left (counterclockwise) to increase current draw, or to right (clockwise) to decrease current draw. Too much current will cause horn to have a sputtering sound. The adjustment is very sensitive. Move adjusting nut 1/10 turn at a time, and lock in position each time before trying. NOTE: *If voltmeter is not available, adjust according to sound..*

(3) The correct air gap of from 0.027 to 0.033 inch between the armature and the core is important, and the gap must be uniform across the entire surface of the armature. Adjustments are made by means of the air gap adjusting nuts.

(4) Install back of horn shell, and install screw.

d. Removal. Disconnect wiring at horn terminal screw. Remove nut and washer from horn bracket at cylinder head cover, and lift off horn and bracket.

e. Installation. Place horn and bracket in position on cylinder head cover stud, and install nut and washer. Connect wiring at horn terminals.

Section XXIII

Radio Noise-Suppression

98. DESCRIPTION.

a. General. When the engine of any motor vehicle is running, the electrical system of that vehicle is a source of radio interference. It actually broadcasts radio waves or signals that not only interfere with any receiving apparatus that may be operating in the vehicle or in its vicinity, but also enable the enemy to determine the exact location of the vehicle through the use of detecting instruments. In view of the foregoing, this vehicle has been suppressed to eliminate radiated disturbances at their source. Radio noise-suppression is accomplished through the use of the following devices:

(1) FILTERS. A filter is an assembly consisting of a winding and one or more condensers connected internally in a metal case and mounted at the desired location in such a manner that the case is well grounded to the vehicle.

(2) RESISTOR SUPPRESSORS. A resistor suppressor is a high resistance unit or element, mounted securely in an insulated housing having electrical connections in both ends, and so constructed as to have electrical contacts at each end.

(3) BONDS. A bond is an electrical contact of extremely low resistance between two or more metal parts. Flexible braided metal bonding straps are used for this purpose.

(4) WASHER "PILE-UP." Special internal-external toothed lock washers are often used at points of bonding, where they are securely fastened by bolts and nuts. They may be used in varied quantities at each location. When occasion arises to remove for servicing a part having these special lock washers incorporated in the mounting of the part, the washers must always be reinstalled exactly as installed by the manufacturer.

(5) CAPACITORS (CONDENSERS). A capacitor (condenser) is an electrical element consisting of two conductors separated by a dielectric, the purpose of which is to control electrical surge.

b. Servicing or Testing.

(1) Location and manner of installation of all radio noise-suppression items is a function of the Signal Corps, so that no changes should be made except at their direction.

(2) If trouble is believed existent in one of the items, a new unit must be substituted for the old. No attempt should be made to repair defective suppression items.

99. ELECTRICAL SYSTEM CONDITION.

a. It is necessary that the electrical system be in proper operating condition to ensure successful radio noise-suppression. At such times as it is believed that the suppression system is not functioning properly a systematic and thorough check-up of the electrical system must be made to ensure that all parts are functioning properly. The following deficiencies in particular vitally affect the radio noise-suppression system:

(1) Dirty distributor cap.

(2) Incorrect spark plug gaps.

(3) Burned or pitted breaker contact points.

(4) Broken or oil-soaked wires.

(5) Loose electrical connections.

(6) Poor battery connections.

100. POINTS OF NOISE-SUPPRESSION.

a. Following are the details of construction and application of radio interference suppression components on this vehicle.

(1) FILTER UNIT APPLICATION. Generator field circuit is filtered with approved type FL-13 filter at regulator. Filter is connected in generator field lead between generator and regulator at regulator. Filter mounting bracket is fastened to dash panel by self-tapping screws threaded into dash panel, with internal-external toothed lock washers over, and under, filter mounting bracket feet.

(2) CAPACITOR APPLICATIONS.

(a) Ignition coil primary circuit is bypassed with an approved type 0.1 microfarad capacitor connected to coil primary terminal (switch side). Capacitor mounting bracket is fastened to coil support bracket by existing coil mounting bolt, with internal-external toothed lock washer between brackets.

(b) Generator armature circuit is bypassed with approved type 0.2 microfarad capacitor connected to armature terminal of generator. Capacitor mounting bracket is fastened to generator housing by existing ground screw, with internal-external toothed lock washer under bracket.

(c) Generator armature circuit is bypassed with approved type 0.1 microfarad capacitor connected to armature terminal of regulator. Capacitor mounting bracket is fastened to regulator mounting foot by existing regulator mounting bolt, with internal-external toothed lock washer under bracket. (Regulator frame is grounded to dash panel by internal-external toothed lock washers under feet.)

(d) Battery circuit is bypassed with approved type 0.5 microfarad capacitor connected to the battery terminal of regulator. Capacitor mounting bracket is fastened to regulator mounting foot by existing regulator mounting bolt, with internal-external toothed lock washer under bracket. (Regulator frame is grounded to dash panel by internal-external toothed lock washers under feet.)

(e) Battery circuit is bypassed with approved type 0.5 microfarad capacitor connected to battery terminal of starting switch. Capacitor mounting bracket is fastened to dash panel by same screw holding FL-13 filter to dash panel, with internal-external toothed lock washer over capacitor mounting bracket.

(3) SUPPRESSOR APPLICATIONS.

(a) One approved L-type suppressor is used at distributor end of distributor to ignition coil high-tension lead.

(b) One approved straight-type suppressor is used at spark plug end of each of six distributor to spark plug high-tension leads.

(4) BOND STRAP APPLICATIONS.

(a) Right and left hood top panels are bonded to right and left hood side panels across hinges at front and rear. Bonds are fastened by parkerized bolts and nuts, with internal-external toothed lock washers under bond lugs. Flat washers are used under heads of bolts and over bond lugs.

(b) Right hood top panel is bonded to left hood top panel across hinges at front and rear. Bonds are fastened to hood top panels by parkerized bolts and nuts, with internal-external toothed lock washers under, and over, bond lugs.

(c) Left hood top panel is bonded to radiator shell. Bond is fastened to left hood top panel by same bolt holding front bond described in step (b) above, with internal-external toothed lock washers under bond lug, and flat washers over bond lug. Bond is fastened to radiator shell by existing bolt and nut, with internal-external toothed lock washer under, and flat washer over, bond lug.

(d) Left hood top panel is bonded to cowl. Bond is fastened to left hood top panel by same bolt holding rear bond described in step (b) above, with internal-external toothed lock washer under, and flat washer over, bond lug. Bond is fastened to cowl by parkerized bolt and nut, with internal-external toothed lock washer under, and flat washer over, bond lug.

(e) Rear of cab right and left sides are bonded to right and left frame rails. Bonds are fastened to cab by parkerized bolts and nuts, with internal-external toothed lock washers under, and flat washers over, bond lugs. Bonds are fastened to frame side rails by parkerized bolts and nuts, with internal-external toothed lock washers under, and flat washers over, bond lugs.

(f) Radiator grille lower right and left sides are bonded to right and left frame rails. Bonds are fastened to radiator grille by parkerized bolts and nuts, with internal-external toothed lock washers under, and flat washers over, bond lugs. Bonds are fastened to frame rails by existing bolts and nuts, with internal-external toothed lock washers under, and flat washers over, bond lugs.

(g) Left lower cowl is bonded to front fender rear support bracket. Bond is fastened to cowl by self-tapping metal screw, with internal-external toothed lock washer over bond lug. Bond is fastened to fender support bracket by bolt and nut, with internal-external toothed lock washers over, and under, bond lug, and under head of bolt.

(h) Generator housing is bonded to motor block. Bond is fastened to generator housing by existing parkerized screw, with internal-external toothed lock washer under, and flat washer over, bond lug. Bond is fastened to motor block by existing parkerized bolt, with internal-external toothed lock washer under, and flat washer over, bond lug.

(i) Cylinder head is bonded to dash panel. Bond is fastened to cylinder head by existing cylinder head bolt, with internal-external toothed lock washer under, and flat washer over, bond lug. Bond is fastened to dash panel by parkerized bolt and nut, with internal-external toothed lock washer under, and flat washer over, bond lug.

(j) Ignition coil bracket and air cleaner support bracket are bonded to cylinder block. Bond is fastened by coil bracket mounting bolt and nut, with internal-external toothed lock washer under bond lug. Bond is fastened to cylinder block by existing bolt threaded into block, with internal-external toothed lock washer under bond lug.

(5) INTERNAL-EXTERNAL TOOTHED LOCK WASHER BONDING APPLICATIONS.

(a) Ignition coil support bracket is bonded to air cleaner support bracket with internal-external toothed lock washers on existing bolts and nuts between coil bracket and air cleaner support bracket.

(b) Right and left front fender splash aprons are bonded to right and left frame rails. Splash aprons are fastened to frame rails by bolts and nuts, with internal-external toothed lock washers between clips and splash apron and nuts of bolts.

(c) Left front fender rear support bracket is bonded to frame rail. Fender support is bracket-fastened to frame rail by bolts and nuts, with internal-external toothed lock washers under heads and nuts of bolts.

(d) Left front fender rear support bracket is bonded to fender splash apron and angle bracket. Fender support bracket is fastened to fender splash apron and angle bracket by bolt and nut, with internal-external toothed lock washers under head and nut of bolt.

(e) Spark plug wire manifolds are bonded to distributor housing bracket and to engine block. Ignition wire manifolds and distributor housing bracket are fastened by existing studs (welded to engine block) and nuts, with internal-external toothed lock washers used between bracket and manifolds and under nuts.

(6) CONTACT BOND APPLICATION. Right and left lower hood side panels are bonded to right and left front fenders. Phosphor bronze spring contact bonds are used to contact tinned areas at lower center of hood side panels. Spring bonds are fastened to support brackets by bolts and nuts, with internal-external toothed lock washers between bond and bracket. Support bracket is fastened to front fenders by bolts and nuts, with internal-external toothed lock washers under bolt heads, and between nuts and underside of fender.

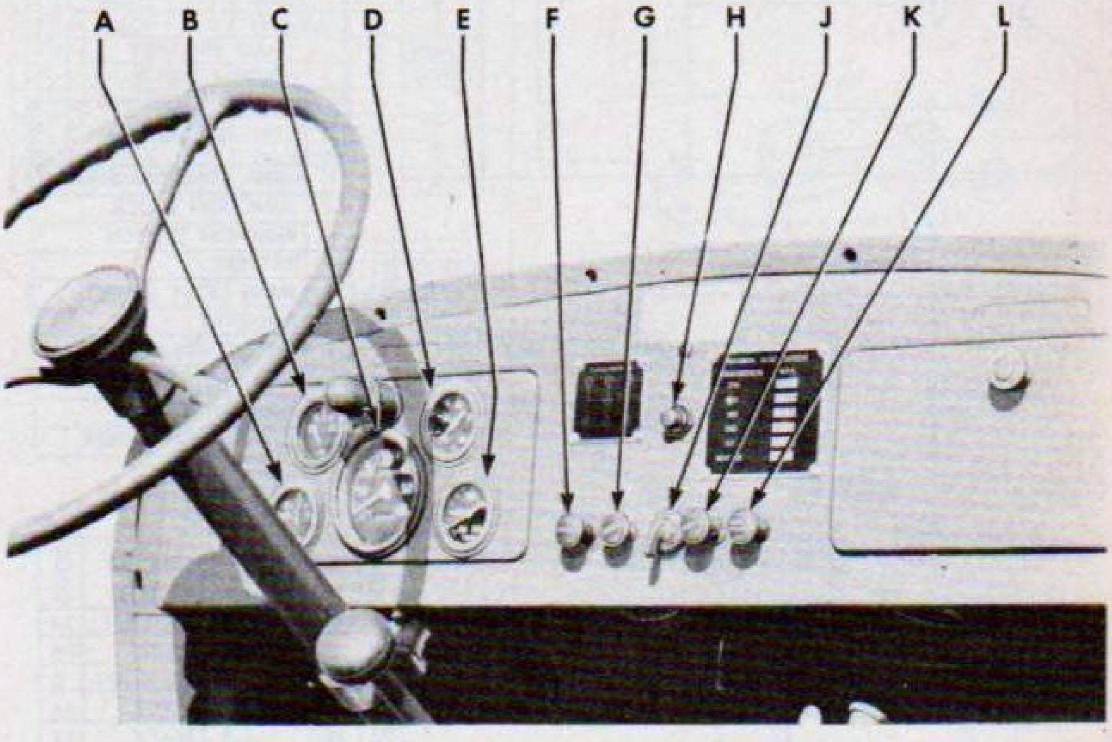
(7) CLIP BONDING APPLICATIONS.

(a) Generator-to-regulator armature and field lead shielding are bonded to dash panel. Shielding is grounded to dash panel with clip fastened by same screw holding FL-13 filter to dash, as described in step (1) above.

(b) Generator to regulator armature and field lead shielding are bonded to frame rail and to generator housing. Shielding is grounded to right frame rail at two places with clips fastened by same bolts and nuts as described in step (5) (b) above. Internal-external toothed lock washers are used under clips. Shielding is grounded to generator with lug fastened by existing ground screw, with internal-external toothed lock washer over clip.

(8) TINNED AREA BONDING APPLICATION. Tinned area, on the right and left lower hood side panels at center, makes contact with spring contact bonds described in step (6) above.

(9) TINNED COPPER BRAID APPLICATION. Generator to regulator field and armature leads are contained in tinned copper shielding braid, and are grounded by clips as described in step (7) above.



A—AMMETER
B—FUEL GAGE
C—SPEEDOMETER
D—OIL PRESSURE GAGE
E—TEMPERATURE GAGE
F—LIGHT SWITCH
G—CHOKE BUTTON
H—STARTER BUTTON
J—IGNITION SWITCH
K—THROTTLE BUTTON
L—PANEL LIGHT SWITCH

RA PD 323976

Figure 80 — Instrument Panel

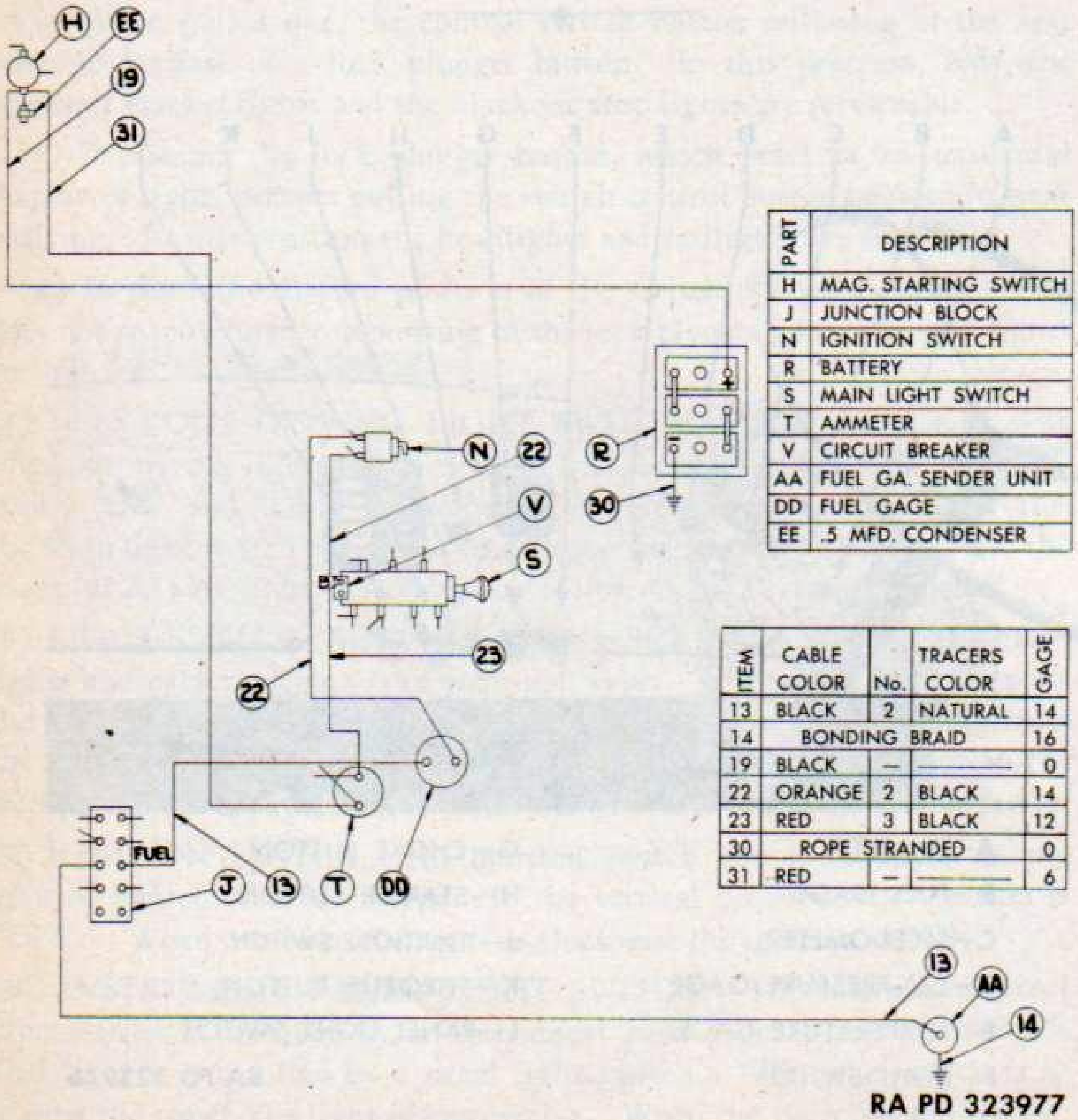
Section XXIV

Instruments and Gages

101. DESCRIPTION AND DATA.

a. Description. The various instruments and gages on this vehicle are mounted on an instrument panel (fig. 80). The instruments or gages are replaceable individually. Instrument circuit diagrams are shown in figures 81 and 82. The various items on the instrument panel are as follows:

(1) SPEEDOMETER. The speedometer is of dial type graduated 0 to 60 miles per hour. Total mileage up to 99,999 miles and trip mileage up to 999 miles are recorded on totalizers. The speedometer is driven by a

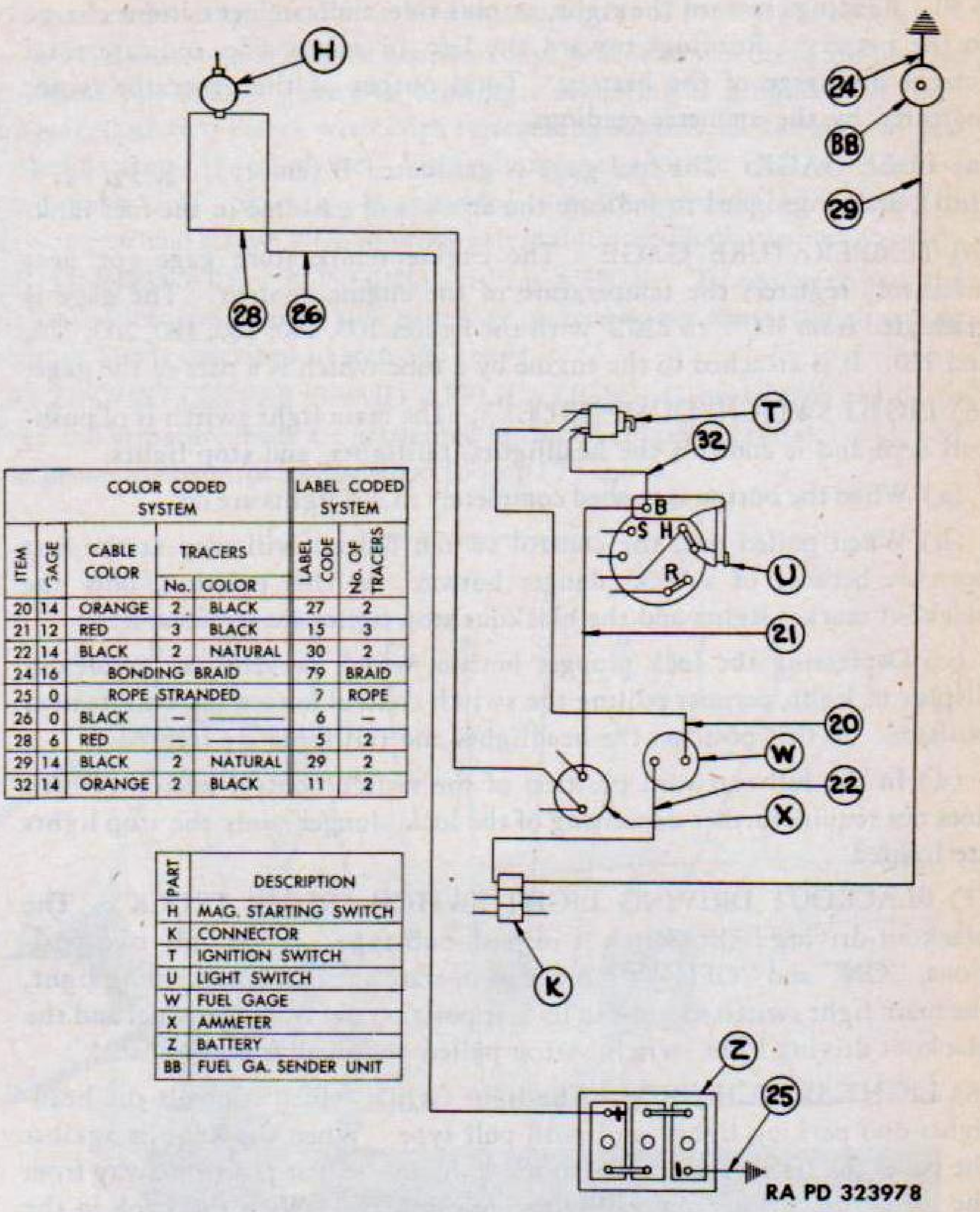


PART	DESCRIPTION
H	MAG. STARTING SWITCH
J	JUNCTION BLOCK
N	IGNITION SWITCH
R	BATTERY
S	MAIN LIGHT SWITCH
T	AMMETER
V	CIRCUIT BREAKER
AA	FUEL GA. SENDER UNIT
DD	FUEL GAGE
EE	.5 MFD. CONDENSER

ITEM	CABLE COLOR	No.	TRACERS COLOR	GAGE
13	BLACK	2	NATURAL	14
14	BONDING BRAID			16
19	BLACK	—	———	0
22	ORANGE	2	BLACK	14
23	RED	3	BLACK	12
30	ROPE STRANDED			0
31	RED	—	———	6

RA PD 323977

Figure 81 — Instrument Circuit Diagram (Dump Truck)



COLOR CODED SYSTEM					LABEL CODED SYSTEM	
ITEM	GAGE	CABLE COLOR	TRACERS No.	TRACERS COLOR	LABEL CODE	No. OF TRACERS
20	14	ORANGE	2	BLACK	27	2
21	12	RED	3	BLACK	15	3
22	14	BLACK	2	NATURAL	30	2
24	16	BONDING BRAID			79	BRAID
25	0	ROPE STRANDED			7	ROPE
26	0	BLACK	—	———	6	—
28	6	RED	—	———	5	2
29	14	BLACK	2	NATURAL	29	2
32	14	ORANGE	2	BLACK	11	2

PART	DESCRIPTION
H	MAG. STARTING SWITCH
K	CONNECTOR
T	IGNITION SWITCH
U	LIGHT SWITCH
W	FUEL GAGE
X	AMMETER
Z	BATTERY
BB	FUEL GA. SENDER UNIT

Figure 82 — Instrument Circuit Diagram (Bus)

flexible drive shaft. A trip mileage totalizer reset button is located in back and at the bottom of the instrument.

(2) OIL PRESSURE GAGE. The oil pressure gage is graduated from 0 to 80 pounds pressure. It is of pressure type and is connected to the engine by a tube and flexible line.

(3) AMMETER. The ammeter is located on the instrument panel just

above the light switch. The ammeter is graduated —50, —20, 0, +20, +50. Readings toward the right, or plus side, indicate net current charge to the battery. Readings toward the left, or minus side, indicate total current discharge of the battery. Total output of the generator is not indicated by the ammeter readings.

(4) FUEL GAGE. The fuel gage is graduated E (empty), ¼, ½, ¾, F (full), and is designed to indicate the amount of gasoline in the fuel tank.

(5) TEMPERATURE GAGE. The engine temperature gage (or heat indicator) registers the temperature of the engine coolant. The gage is graduated from 100°F to 220°F with the figures 100, 140, 160, 180, 200, 210, and 220. It is attached to the engine by a tube which is a part of the gage.

(6) LIGHT SWITCH (DUMP TRUCK). The main light switch is of push-pull type and it controls the headlights, taillights, and stop lights.

(a) When the button is pushed completely in, all lights are off.

(b) When pulled out, the control switch button will stop at the first position because of a lock plunger button. In this position, only the blackout marker lights and the blackout stop lights are serviceable.

(c) Depressing the lock plunger button, which prevents an accidental display of light, permits pulling the switch control button back to its next position. In this position the headlights and taillights are lighted.

(d) In the full rearward position of the switch control button (which does not require further depressing of the lock plunger) only the stop lights are lighted.

(7) BLACKOUT DRIVING LIGHT SWITCH (DUMP TRUCK). The blackout driving light switch is of push-pull type. It has only two positions, "ON" and "OFF." In order to operate the blackout driving light, the main light switch must be in its first position out from the panel and the blackout driving light switch button pulled out away from the panel.

(8) LIGHT SWITCH (BUS). The light switch which controls the headlights and parking lights is of push-pull type. When the knob is against the panel the lights are off. With the knob in the first position away from the panel the parking and taillights are operative. With the knob in the second position away from the panel the head and taillights are operative.

(9) IGNITION SWITCH. No ignition switch key is required, as the ignition switch is of lever type. In the vertical position, the ignition is "OFF." When turned to the right or clockwise the ignition is "ON."

(10) INSTRUMENT PANEL LIGHT SWITCH. The instrument panel illumination is provided by an instrument panel light which is shielded. This light is controlled by a panel light switch. When the switch is in against the panel, the light is inoperative. When the switch is pulled out, the light is on.

b. Data.

(1) SPEEDOMETER.

Make . . . . Stewart-Warner
Model 590-AB

(2) TEMPERATURE GAGE.

Make . . . . Stewart-Warner
Model 442080

(3) OIL PRESSURE GAGE.

Make . . . . Stewart-Warner
Model 444063

(4) FUEL GAGE.

Make . . . . Stewart-Warner
Model 441023

(5) AMMETER.

Make . . . . Stewart-Warner
Model 440047

102. REMOVAL.

a. Speedometer.

(1) Disconnect speedometer drive shaft at rear of speedometer.

(2) Remove two mounting bracket screw nuts, and remove bracket.

(3) Remove speedometer from front of panel.

b. Oil Pressure Gage.

(1) Disconnect oil pressure line from rear of instrument.

(2) Remove two nuts from mounting screws, and remove mounting bracket.

(3) Remove oil pressure gage from front of panel.

c. Ammeter.

(1) Disconnect wiring from ammeter, removing two terminal screw nuts.

(2) Remove mounting bracket.

(3) Remove ammeter from front of panel.

d. Fuel Gage.

(1) Disconnect ignition switch to fuel gage wire, and disconnect fuel tank to gage wire at gage terminals by removing terminal nuts.

(2) Remove nuts from two mounting screws, and lift off bracket.

(3) Remove fuel gage from front of panel.

e. Temperature Gage.

(1) Disconnect temperature gage tube from engine, and pull through felt grommet at cowl.

(2) Remove two nuts from gage mounting screws, and remove bracket.

(3) Remove gage and tube from front of panel.

f. Instrument Panel Light Switch.

(1) Disconnect wires at panel light switch terminals.

(2) Remove screws from switch knob, and remove knob.

(3) Remove lock nut and lock washer from front of panel.

(4) Remove panel light switch from rear of panel.

g. Ignition Switch.

(1) Disconnect wires from ignition switch terminals.

(2) Remove spanner nut from ignition switch.

(3) Remove ignition switch from rear of panel.

h. Light Switches (Dump Truck).

(1) Tag and disconnect wiring at switch terminals.

(2) Loosen screw from switch control button.

(3) Loosen cap screw from lock out control housing, and remove housing.

(4) Remove lock nut and lock washer from switch at front of panel.

(5) Remove switch from rear of panel.

i. Light Switch (Bus.)

(1) Disconnect wires from switch terminals.

(2) Remove mounting nut and lock washer from mounting sleeve at rear of panel.

(3) Remove rod, knob, and sleeve assembly from front of panel, and remove switch from rear of panel.

103. INSTALLATION.

a. Speedometer.

(1) Insert speedometer through panel from front.

(2) Install mounting bracket and two mounting screw nuts.

(3) Connect speedometer drive shaft to rear of speedometer.

b. Oil Pressure Gage.

(1) Insert oil pressure gage in panel from front.

(2) Install mounting bracket, and install two nuts on mounting screws.

(3) Connect oil pressure line at rear of oil pressure gage.

(4) Start engine, and check for oil leaks.

c. Ammeter.

(1) Insert ammeter in panel from front.

(2) Install bracket, and install two nuts on mounting screws.

(3) Connect wiring at ammeter, and install terminal nuts.

d. Fuel Gage.

(1) Insert fuel gage in panel from front.

(2) Install mounting bracket, and install two nuts on mounting screws.

(3) Connect wires leading to ignition switch and to fuel tank to terminals.

e. Temperature Gage.

(1) Insert temperature gage in panel from front.

(2) Install mounting bracket, and install two nuts on mounting screws.

(3) Connect temperature gage tube engine unit at cylinder head.

f. Panel Light Switch.

(1) Insert panel light switch in panel from rear.

(2) Install lock nut and lock washer on switch at front of panel.

(3) Install switch knob, and install knob set screw.

(4) Connect wires at switch terminals.

g. Ignition Switch.

(1) Insert ignition switch in panel from rear.

(2) Install spanner nut on switch at front of panel.

(3) Connect wires to terminals of switch.

h. Light Switches (Dump Truck).

(1) Insert light switch in panel from rear.

(2) Install lock nut and lock washer on switch at front of panel.

(3) Install lock out control housing on switch, and tighten cap screw.

(4) Install switch button, and tighten screw.

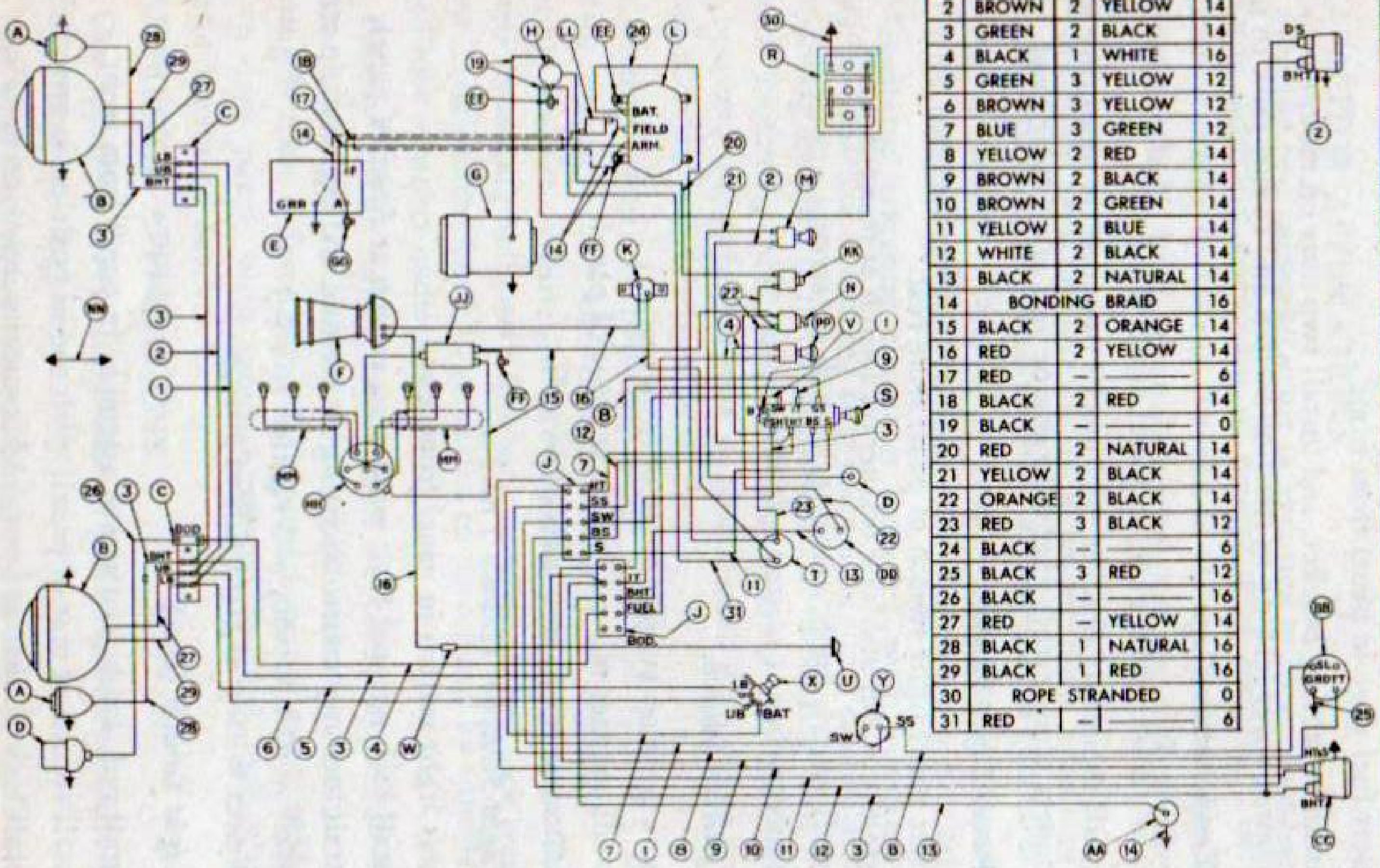
(5) Connect wiring at terminals of switch.

i. Light Switch (Bus).

(1) Install rod, knob, and sleeve assembly in panel from front.

(2) Install switch at rear of panel, with rod in position in switch.

(3) Install lock washer and nut, and connect wires to terminals.



ITEM	CABLE COLOR	TRACERS No.	TRACERS COLOR	GAGE
1	GREEN	2	YELLOW	14
2	BROWN	2	YELLOW	14
3	GREEN	2	BLACK	14
4	BLACK	1	WHITE	16
5	GREEN	3	YELLOW	12
6	BROWN	3	YELLOW	12
7	BLUE	3	GREEN	12
8	YELLOW	2	RED	14
9	BROWN	2	BLACK	14
10	BROWN	2	GREEN	14
11	YELLOW	2	BLUE	14
12	WHITE	2	BLACK	14
13	BLACK	2	NATURAL	14
14	BONDING BRAID			16
15	BLACK	2	ORANGE	14
16	RED	2	YELLOW	14
17	RED	—	—	6
18	BLACK	2	RED	14
19	BLACK	—	—	0
20	RED	2	NATURAL	14
21	YELLOW	2	BLACK	14
22	ORANGE	2	BLACK	14
23	RED	3	BLACK	12
24	BLACK	—	—	6
25	BLACK	3	RED	12
26	BLACK	—	—	16
27	RED	—	YELLOW	14
28	BLACK	1	NATURAL	16
29	BLACK	1	RED	16
30	ROPE STRANDED			0
31	RED	—	—	6

PART	DESCRIPTION
A	BLACKOUT MARKER LIGHT
B	HEADLIGHT
C	JUNCTION BLOCK
D	BLACKOUT HEADLIGHT
E	GENERATOR
F	HORN
G	STARTER
H	MAG. STARTING SWITCH
J	JUNCTION BLOCK
K	CIRCUIT BREAKER
L	GENERATOR REGULATOR
M	INSTR. PANEL LIGHT SWITCH
N	IGNITION SWITCH
P	INSTR. PANEL LIGHT
R	BATTERY
S	MAIN LIGHT SWITCH
T	AMMETER
U	HORN BUTTON
V	CIRCUIT BREAKER
W	HORN CABLE CONNECTOR
X	DIMMER SWITCH
Y	STOP LIGHT SWITCH
Z	B. O. TAIL & B. O. STOP LIGHT
AA	FUEL GA. SENDER UNIT
BB	TRAILER SOCKET
CC	B. O. TAIL & SERVICE STOP LIGHT
DD	FUEL GAGE
EE	.5 MFD. CONDENSERS
FF	.1 MFD. CONDENSERS
GG	.25 MFD. CONDENSER
HH	DISTRIBUTOR
JJ	IGNITION COIL
KK	START. SW. PUSH BUTTON
LL	FL-13 FILTER
MM	SPARKPLUG CABLE CONDUITS
NN	ENGINE GROUND STRAP
PP	BLACKOUT LIGHT SWITCH

RA PD 323979

Figure 83 — Complete Vehicle Circuit Diagram (Dump Truck)

Section XXV

Electrical System Wiring

104. WIRING AND CIRCUIT DIAGRAMS.

a. Wiring. The electrical wiring consists of several wiring harnesses which connect at various junction blocks on the vehicle. On vehicles using a code numbering system, each end of each wire has a band of transparent tape on which a code number will be found. This system is know as "code labeling." The purpose of "code labeling" is to facilitate and assure proper connection of wires, and is a more positive means of identification than "color coding." On older vehicles "color coding" was employed, in which colors of tracers differed for differentiation of wires. The complete circuit diagram for the vehicle is illustrated in figures 83 and 84. Reference to the illustration will reveal that each item is numbered. Reference to the table gives the code number and also the number of tracers, where used. In other wiring diagrams, cable gage is also given to facilitate emergency service repairs where proper tracer or code-numbered wire might not be readily available. For example, assume that on the passenger bus the wire leading to the taillight is defective. Reference to the circuit diagram (fig. 84) shows this wire to be item 23. Refer to the table, and item 23 is given as circuit or code label 22, and describes the wire as having 2 tracers. Further reference, if necessary, can be made to the lighting circuit diagram, figure 68, on which it will be noted that item 23 is of 14-gage cable. It is better to refer to the individual circuit diagrams rather than to a complete vehicle diagram. Item identifications coincide on the respective complete vehicle diagrams (figs. 83 and 84), and on the individual circuit diagrams (figs. 57 and 58, 63 to 68, and 81 and 82).

b. Individual Circuit Diagrams. Individual circuit diagrams facilitate trouble shooting and emergency repairs. These individual circuits are as follows:

(1) IGNITION CIRCUIT. For ignition circuit details, see figures 57 and 58.

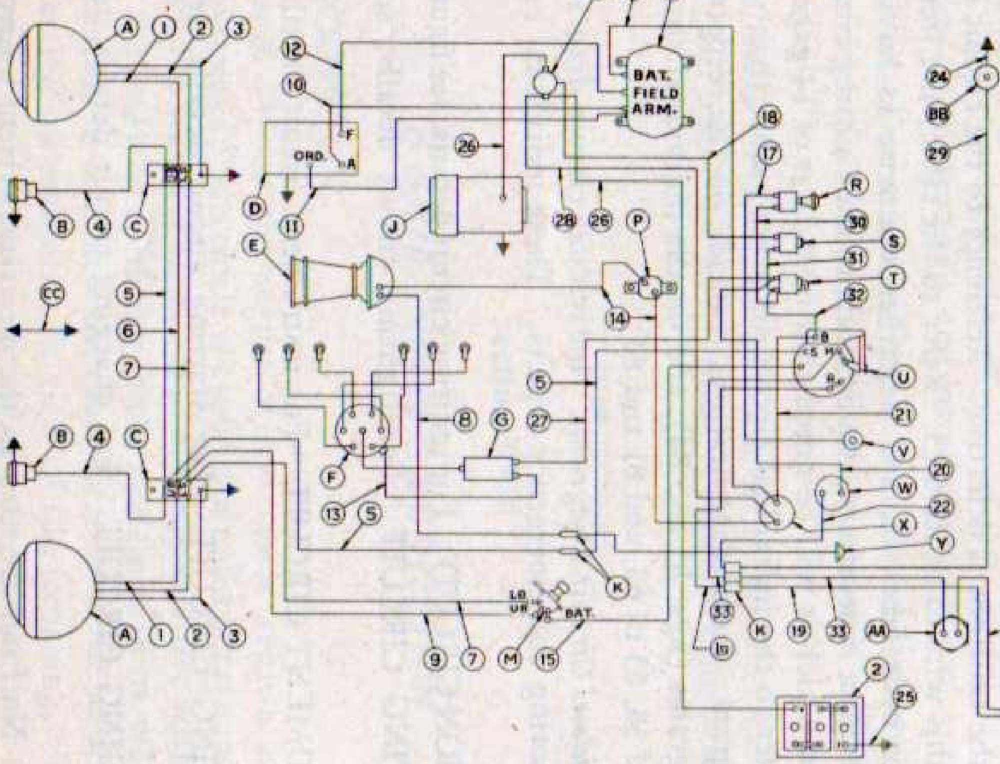
(2) LIGHTING CIRCUIT. For lighting circuit details, see figures 67 and 68.

(3) INSTRUMENT CIRCUIT. For instrument circuit details, see figures 81 and 82.

(4) STARTING CIRCUIT. For starting circuit details, see figures 65 and 66.

(5) CHARGING CIRCUIT. For charging circuit details, see figures 63 and 64.

c. Fuses. No fuses are used in the electrical system. Circuit breakers (subpar. *d* below) are used for protection against circuit overload.



PART	DESCRIPTION
A	HEADLIGHT
B	PARKING LIGHT
C	JUNCTION BLOCK
D	GENERATOR
E	HORN
F	DISTRIBUTOR
G	IGNITION COIL
H	MAG. STARTING SWITCH
J	STARTER
K	CONNECTOR
L	TAIL & STOP LIGHT
M	DIMMER SWITCH
N	GENERATOR REGULATOR
P	CIRCUIT BREAKER
R	INSTR. PANEL LIGHT SWITCH
S	STARTER SWITCH
T	IGNITION SWITCH
U	LIGHT SWITCH
V	INSTR. PANEL LIGHT
W	FUEL GAGE
X	AMMETER
Y	HORN BUTTON
Z	BATTERY
AA	STOP LIGHT SWITCH
BB	FUEL GA. SENDER UNIT
CC	ENGINE GROUND STRAP

		COLOR CODED SYSTEM			LABEL CODED SYSTEM	
ITEM	GAGE	CABLE COLOR	TRACERS No.	TRACERS COLOR	LABEL CODE	No. OF TRACERS
1	14	BLACK	—	———	17	2
2	14	BLACK	1	RED	18	2
3	14	NATURAL	—	———	83	2
4	16	NATURAL	—	———	20	1
5	14	GREEN	2	BLACK	20	2
6	14	BROWN	2	YELLOW	17	2
[illegible]	14	GREEN	2	YELLOW	18	2
8	14	RED	2	YELLOW	25	2
9	12	BROWN	3	YELLOW	17	3
10	6	RED	—	———	2	2
11	14	BLACK	2	GREEN	3	2
12	14	BLACK	2	RED	1	2
13	14	BLACK	2	ORANGE	13	2
14	14	RED	2	YELLOW	26	2
15	12	BLUE	3	GREEN	16	3
16	6	BLACK	—	———	4	2
17	14	YELLOW	2	BLACK	40	2
18	14	RED	2	NATURAL	14	2
19	14	BROWN	2	GREEN	21	2
20	14	ORANGE	2	BLACK	27	2
21	12	RED	3	BLACK	15	3
22	14	BLACK	2	NATURAL	30	2
23	14	YELLOW	2	BLUE	22	2
24	16	BONDING BRAID			79	BRAID
25	0	ROPE STRANDED			7	ROPE
26	0	BLACK	—	———	6	—
27	14	BLACK	2	ORANGE	12	2
28	6	RED	—	———	5	2
29	14	BLACK	2	NATURAL	29	2
30	14	BROWN	2	YELLOW	40	2
31	14	ORANGE	2	BLACK	14	2
32	14	ORANGE	2	BLACK	11	2
33	14	GREEN	2	YELLOW	22	2

RA PD 323980

Figure 84 — Complete Vehicle Circuit Diagram (Bus)

d. Circuit Breakers. Automatic circuit breakers are used to protect the electrical system from overload. They are of automatic-reset type. They are so constructed that, in the closed position, a conductive snap-acting disk, having two silver contacts electrically attached to it, bridges the terminal contacts, thereby maintaining the circuit. At predetermined overloads, the resistance heat, caused by current passing through the disk, snaps the disk into reverse position, opening the contacts and thereby breaking the circuit. A short time after opening, the disk automatically closes and reestablishes the circuit. If overload conditions still exist the breaker again automatically opens. If overload conditions are corrected, breaker remains closed. These circuit breakers are permanent protective devices. They repeatedly interrupt short-circuits or overloads, remaining available for continued service. Their inherent thermal time-lag characteristics avoid nuisance openings by harmless transient shorts or overloads. Circuit breakers are located as follows:

(1) HORN CIRCUIT. Located on dash panel on engine compartment side. Capacity is 20 amperes.

(2) LIGHTING CIRCUIT. One 30-ampere circuit breaker is located on the lighting switch.

e. Wiring Replacement or Repair.

(1) REPLACEMENT. The wiring of this vehicle is comprised of several wiring harness assemblies. Each harness is held at various points by retaining clips, which prevent vibration of the harness and avoid resultant wear and damage. When replacing a wiring harness assembly, be sure to fasten the harness securely in clips, to prevent motion and chafing.

(2) REPAIRS. If emergency repairs must be made with a new wire between two points, the following procedure is recommended.

(a) Disconnect old or defective wire at each end.

(b) Select desired length of wire of specified gage (see wiring circuit diagrams).

(c) Run new wire along harness, and attach in numerous places with friction tape.

(d) Solder new terminals to new wire; or if old terminals are to be used, connect new wire to terminal ends of old wire, and solder and tape point of union of wires.

Section XXVI

Transmission

105. DESCRIPTION AND DATA.

a. Description.

(1) The transmission (fig. 85) has five forward speeds and one reverse speed. Fifth speed (high) is overdrive.

(2) The transmission is operated by a control lever located in the driver's compartment.

(3) The transmission is bolted to the clutch housing which, in turn, is bolted to the engine flywheel housing. It is connected to the rear axle by the front and rear propeller shafts.

b. Data.

Model (IHC)	F-51
Design	Fuller
Model (Fuller)	5-A-330
Number of forward speeds	5
Fifth speed	Overdrive
Number reverse speeds	1
Reduction gear ratios:	
First (low)	6.525 to 1
Second	3.722 to 1
Third	1.925 to 1
Fourth	1.00 to 1
Fifth (high)	0.823 to 1
Reverse	6.380 to 1

106. REMOVAL.

a. Transmission Assembly. The transmission assembly can be removed from the vehicle without disturbance of the clutch, as follows:

(1) REMOVE FLOORBOARD AND TOEBOARD. Remove seven screws and lock washers from floorboard, and lift floorboard from driver's compartment. Remove six screws and lock washers from toeboard, and remove toeboard.

(2) DISCONNECT BATTERY CABLE CLIPS. Remove screws from cable clips at transmission cover. Lay cable aside, and reinstall screws.

(3) DISCONNECT PROPELLER SHAFT.

(a) Remove two screws, nuts, and lock washers from each side of center bearing dust shield. Remove upper and lower half of dust shield.

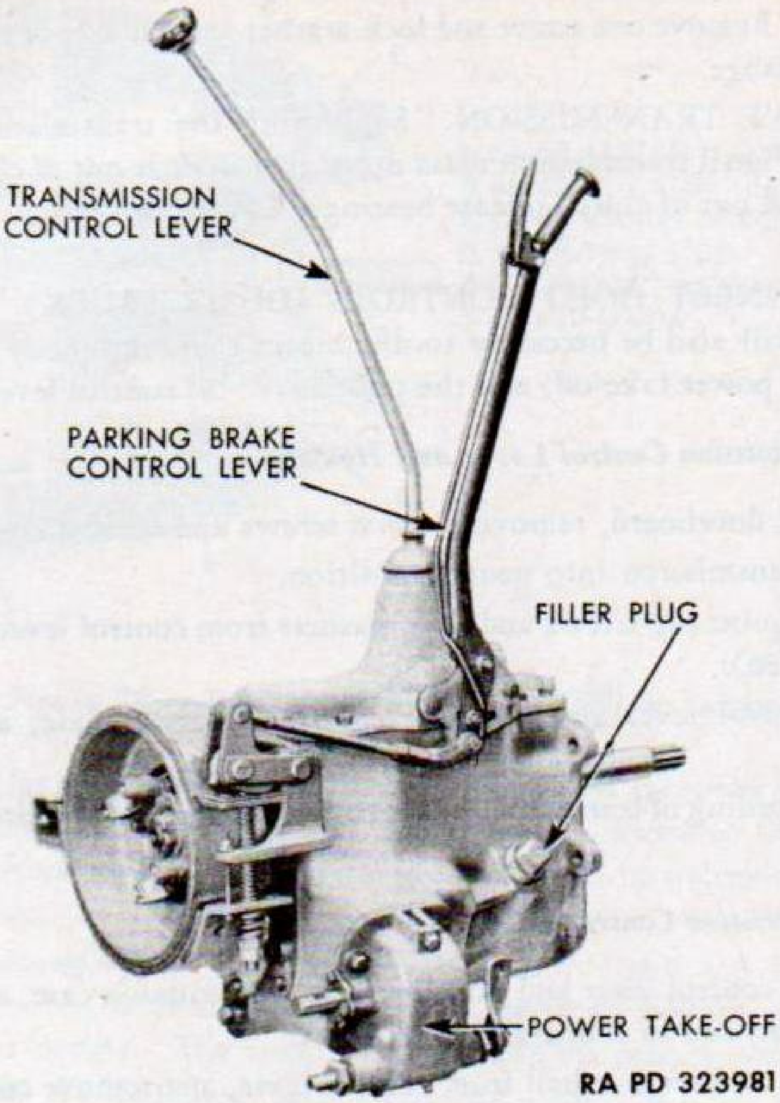


Figure 85 — Transmission

(b) Disconnect rear propeller shaft at front universal joint by bending down tabs on lock plates and removing four bolts from propeller shaft universal joint trunnion bearing flanges.

(c) Remove four bolts, nuts, and lock washers from propeller shaft center bearing housing support brackets.

(d) Disconnect front propeller shaft universal joint at transmission end, by bending tabs on lock plates and removing four bolts from trunnion yoke bearing flanges.

(e) Slide front propeller shaft toward rear through frame crossmember sufficiently to clear transmission.

(4) DISCONNECT SPEEDOMETER. Loosen speedometer drive coupling nut at rear of transmission, and disconnect speedometer drive shaft from transmission.

(5) DISCONNECT TRANSMISSION AT CLUTCH HOUSING. Remove

nuts and lock washers from two bolts at each side of transmission at mounting flange. Remove one screw and lock washer at each side of transmission mounting flange.

(6) REMOVE TRANSMISSION. Supporting the transmission, slide it toward rear until transmission main drive gear shaft is out of clutch driven disk hub and out of clutch release bearing. Lower the transmission to the floor.

(7) DISCONNECT HOIST CONTROLS (DUMP TRUCK). On dump trucks, it will also be necessary to disconnect the dump body hoist drive shaft at the power take-off, and the power take-off control levers.

*b. **Transmission Control Lever and Housing.***

(1) Remove floorboard, removing seven screws and lock washers.

(2) Shift transmission into neutral position.

(3) Remove nine cap screws and lock washers from control lever housing at flange (fig. 86).

(4) Lift control lever and housing from transmission case, and remove gasket.

(5) Cover opening of transmission case to prevent entrance of dirt or foreign materials.

*c. **Transmission Control Lever*** (fig. 86).

(1) Remove control lever and housing from transmission case, and remove gasket, as outlined in subparagraph ***b*** above.

(2) Unscrew and remove ball from control lever, and remove control lever boot.

(3) Remove spring from control lever housing by twisting the spring end from retaining lug in housing, using a large pair of pliers. Lift spring from housing, and remove spring retainer.

(4) Lower control lever down through bottom of control lever housing.

107. INSTALLATION.

*a. **Transmission Assembly.***

(1) INSTALL TRANSMISSION. Raise transmission and move assembly forward, guiding the transmission main drive shaft into clutch release bearing and into splines of the clutch driven disk. Continue to move forward until the end of the shaft enters the clutch pilot bearing in the flywheel.

(2) CONNECT TRANSMISSION AT CLUTCH HOUSING. Install two bolts, nuts, and lock washers at each side of transmission. Install one screw and lock washer at each side of transmission.

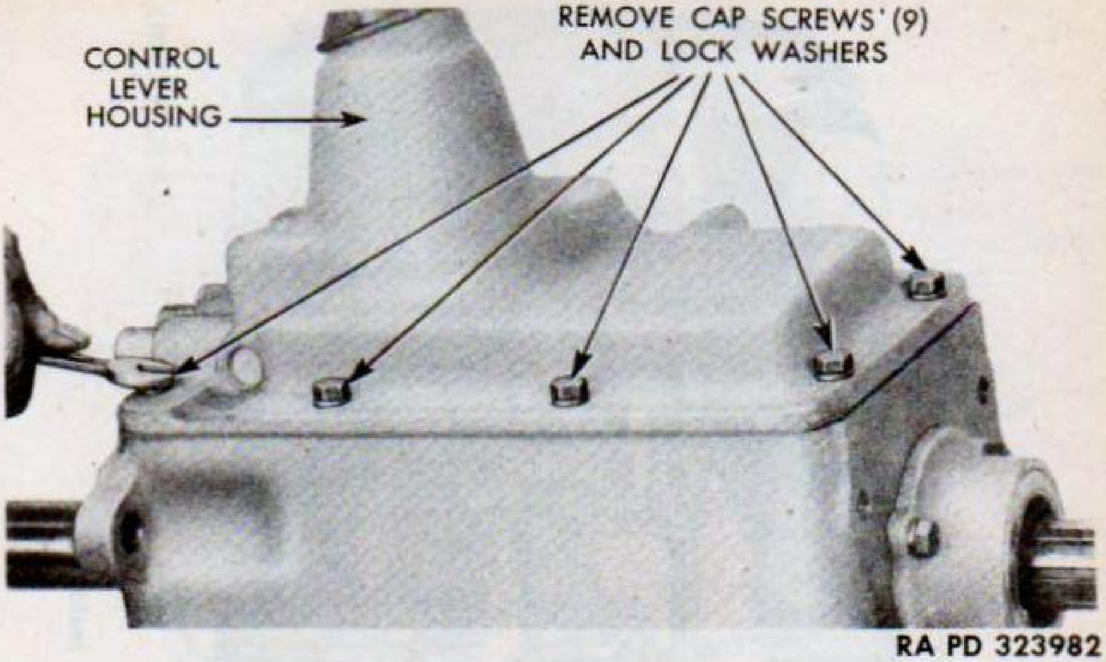


Figure 86 — Removing Transmission Control Lever

(3) CONNECT SPEEDOMETER. Connect speedometer drive cable at rear of transmission, and tighten cable housing coupling nut.

(4) CONNECT PROPELLER SHAFTS.

(a) Slide front propeller shaft, center bearing assembly, and brake drum forward to transmission. Connect front universal joint at transmission, installing four bolts and two lock plates at trunnion bearing flanges. Bend tabs on lock plates.

(b) Install four bolts, nuts, and lock washers in propeller shaft center bearing housing support brackets. NOTE: *Parking brake may require readjustment. See paragraph 129.*

(c) Connect rear propeller shaft front universal joint, installing four bolts and two lock plates in universal joint trunnion bearing flanges. Bend tabs on lock plates.

(d) Install upper and lower dust shields, and install two screws, nuts, and lock washers at each side.

(5) CONNECT BATTERY CABLE CLIPS. Connect battery cable clips to transmission cover. Remove cover screws and lock washers, install battery cable clips, and reinstall screws and lock washers.

(6) CONNECT HOIST CONTROLS (DUMP TRUCK). On dump truck, connect dump body hoist drive shaft at power take-off, and connect the power take-off control levers.

(7) INSTALL FLOORBOARD AND TOEBOARD. Install toeboard in position, and install six screws. Install floorboard, and install seven screws.

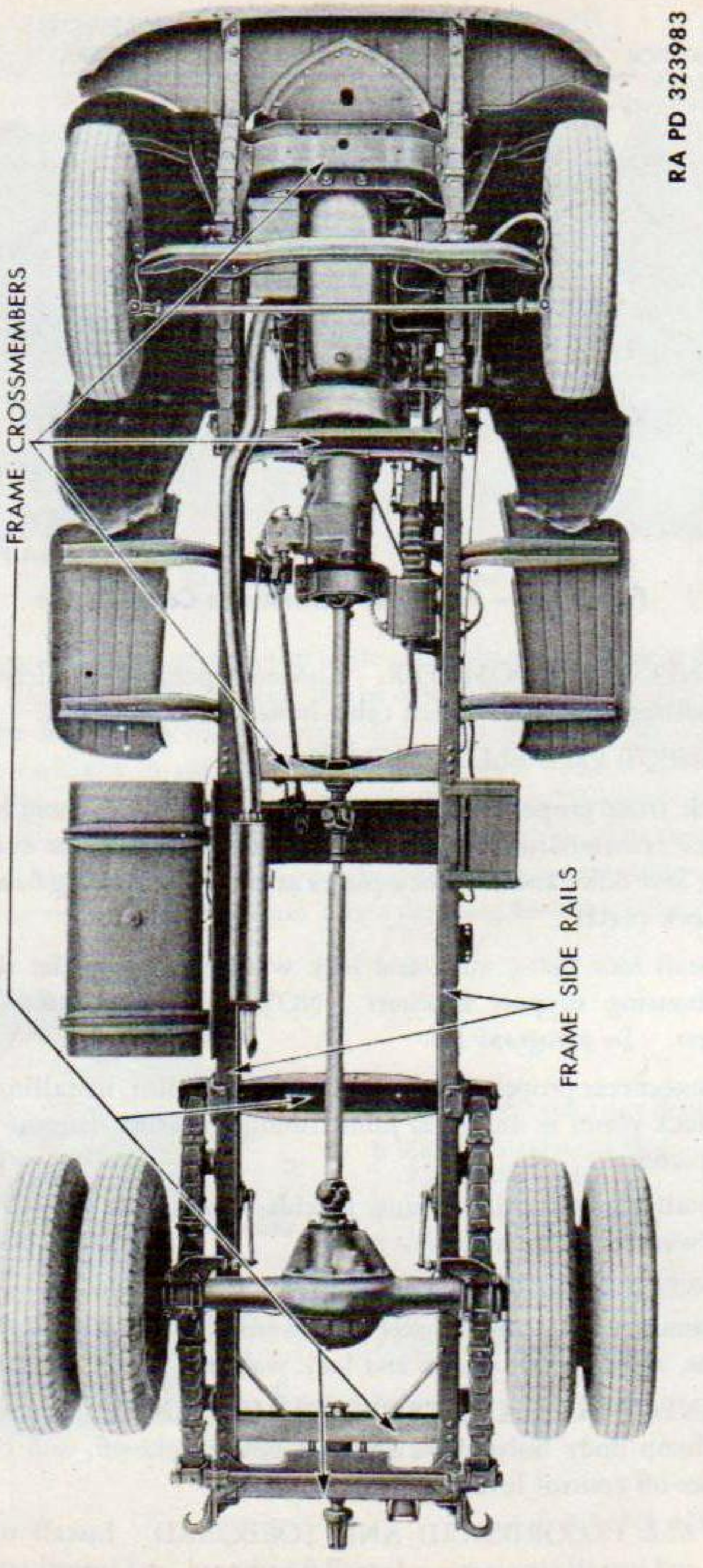


Figure 87 — Chassis Frame (Dump Truck) Installed

b. Transmission Control Lever and Housing.

(1) Remove protective cover from opening of transmission case and install new gasket in position.

(2) Place control lever and housing in position on transmission case over gasket and install nine cap screws and lock washers in control lever housing flange.

(3) Install floorboard, and install seven screws and lock washers.

c. Transmission Control Lever.

(1) Insert transmission control lever up through bottom of the transmission control cover, and locate pivot ball at control lever pivot pin.

(2) Install control lever spring retainer, and install control lever spring, placing small end into cover. Use a large pair of pliers to twist the end of the control lever spring into position at retaining lug in cover.

(3) Install control lever boot, and install and tighten control lever ball.

(4) Install control lever and housing, as outlined in subparagraph ***b*** above.

Section XXVII

Frame, Bumper, and Tow Hooks

108. FRAME, BUMPER, AND TOW HOOKS.

a. Frame. The frames of the dump truck and of the bus are quite similar in construction, being composed of two frame side rails held together by front, rear, and intermediate frame crossmembers. The bus frame is considerably longer than that of the dump truck, and the dump truck carries a pintle tow hook. The frame illustrated in figure 87 is that of the dump truck.

b. Frame Alinement. Correct frame alinement is of major importance to vehicle operation. The chassis units will not function properly in a swayed, bent, or broken frame. Improper frame alinement, usually the result of an accident, places excessive strains on the various parts of the vehicle, and affects wheel alinement. Diagonal frame measurements will quickly determine which, if any, section of the frame is bent, and where force should be applied to restore correct alinement. The diagonal measuring should be performed with accuracy and care. Measurements can be taken without removing the body from the chassis through use of a plumb bob and chalk line, as follows:

(1) Place vehicle on a level floor with tires properly inflated.

(2) Suspend a plumb bob from various corresponding points on both sides

of the frame. The plumb bob should be suspended slightly above the floor when it comes to rest. Mark the floor directly underneath it.

(3) Move the vehicle so that the diagonal distances between the chalk marks can be measured.

(4) Measure the various diagonals. Corresponding diagonals should agree within 1/8 inch. CAUTION: *Make sure that any two diagonals compared represent exactly corresponding points on each side of the frame.*

c. ***Pintle Tow Hook*** **(*Dump Truck*).** A pintle tow hook is mounted at the rear of the dump truck frame.

(1) REMOVAL. Remove cotter pin from large pintle hook nut. Remove nut and flat washer. Withdraw pintle hook from bracket and spring.

(2) INSTALLATION. Insert pintle hook through bracket and spring. Install large flat washer and nut. Tighten nut to compress spring and permit installation of new cotter pin.

(3) LATCH PIN. If latch pin is worn, replace it with a hex head steel bolt, two tapered washers, castellated nut, and cotter pin. Discard latch pin lock screw, and plug latch pin lock screw hole with a wooden plug.

d. ***Towing Hooks*** **(*Dump Truck*).** Two towing hooks are mounted at the front of the dump truck. They are bolted through the frame side rails, and spacers are used between the frame flanges.

(1) REMOVAL. Remove nut and lock washer from each of two towing hook mounting bolts. Remove bolts from towing hook, and remove hook.

(2) INSTALLATION. Place towing hook in correct position at front of frame. Right and left hooks have different angles. Install towing hook bolts, being sure that bolts pass through frame spacers. Install lock washers and nuts.

e. ***Bumper.*** The bumper is bracket-mounted to the frame at the front of the vehicle and is covered by a bumper shield.

(1) REMOVAL.

(a) Remove nut and lock washer from cap screw at rear of bumper shield at each side of radiator, and remove cap screws.

(b) Remove nuts and lock washers from two cap screws at upper front of bumper at each side rail end. Remove cap screws.

(c) Remove nuts and lock washers from three cap screws attaching lower front of bumper to bracket at end of each frame side rail. Remove cap screws.

(d) Lift front bumper and bumper shield from vehicle.

(e) Remove nuts and lock washer from two cap screws at each end of bumper shield, and remove cap screws. Remove nuts and lock washers from two starting crank support cap screws, and remove cap screws and starting crank support. Lift bumper shield from bumper.

(2) INSTALLATION. Install bumper shield on bumper, then install bumper and shield as an assembly, as follows:

(a) Place bumper shield in position on bumper, lining up cap screw holes.

(b) Install two cap screws at each end of shield, and install starting crank support and two cap screws at center of bumper. Install and tighten nuts and lock washers on all cap screws.

(c) Lift bumper and bumper shield into position on frame, lining up cap screw holes.

(d) Install two cap screws in upper front of bumper at end of each frame side rail. Install three cap screws at lower front of bumper to bracket at end of each frame rail. Install nuts and lock washers, but do not tighten.

(e) Install and tighten two cap screws, nuts, and lock washers at rear of bumper shield, one at each side of radiator.

(f) Tighten all bumper mounting cap screws and nuts.

Section XXVIII

Propeller Shafts and Center Bearings

109. DESCRIPTION AND DATA.

a. Description.

(1) Two propeller shafts are used on the dump truck and three on the bus. They transmit power from the transmission to the rear axle. Universal joints are used at the transmission end at the parking brake drum, at the center bearing, and at the rear axle. A propeller shaft slip yoke is incorporated in the rear propeller shaft at the front end. The propeller shafts are of tubular construction with splined slip yoke end, and the universal joints have steel roller bearings.

(2) The front propeller shaft section is supported at the frame center cross-member in a propeller shaft center support bearing (fig. 88) which is self-alining. This support bearing permits the use of shorter propeller shaft sections. The center bearing consists of two opposed tapered roller bearing assemblies in a single bearing cup, effective seals, dust shields, a dust slinger, and a housing. The assembly is supported at the frame cross-member by two trunnion yokes mounted in fabric insulators.

(3) The passenger bus has a third propeller shaft section, and this center section is supported at each end by a center bearing as described in step (2) above.

110. REMOVAL.

a. Rear Propeller Shaft.

(1) DISCONNECT SHAFT AT REAR AXLE. Bend lock plates, and remove four cap screws from universal joint trunnion bearing flanges at rear axle companion flange. Lower the rear end of the propeller shaft. Fasten the universal joint trunnion bearings in place on the universal joint cross with wire or string to prevent loss of trunnion bearings or entrance of dirt.

(2) DISCONNECT SHAFT AT CENTER BEARING. Bend lock plates, remove four cap screws from universal joint flanges at front of rear shaft, and lower the shaft and slip yoke. Wire the trunnion yoke bearings in position on the universal joint cross to prevent their loss or entrance of dirt.

b. Front or Center Propeller Shafts.

(1) DISCONNECT UNIVERSAL JOINT AT REAR OF PROPELLER SHAFT. NOTE: *If universal joint at rear of propeller shaft has already been disconnected, omit this operation.* Bend lock plates, and remove four cap screws from propeller shaft universal joint trunnion bearing flanges at rear of propeller shaft being removed. Lower end of propeller shaft. Wire or tie trunnion bearings to universal cross to prevent their loss or entrance of dirt.

(2) REMOVE COMPANION FLANGE AT CENTER BEARING. Remove cotter pin from companion flange nut, and remove nut from propeller shaft at center bearing. Remove flat washer. Pull companion flange toward rear, and remove from propeller shaft.

(3) REMOVE PROPELLER SHAFT CENTER BEARING ASSEMBLY.

(a) Remove two screws, nuts, and washers from dust shield, and remove upper and lower halves of dust shield.

(b) Remove nuts and lock washers from two center bearing housing trunnion bracket bolts at each side of center bearing assembly.

(c) Slide center bearing assembly from propeller shaft. Wrap with cloth or paper to prevent dirt from entering assembly.

(4) DISCONNECT SHAFT AT FRONT. Bend lock plates, and remove four cap screws from the front universal joint trunnion bearing flanges. Fasten universal joint trunnion bearings in place on universal cross with wire or string to prevent loss of trunnion bearings or entrance of dirt. Remove propeller shaft from vehicle.

c. Center Bearing Assembly.

(1) Remove four cap screws from two universal joint trunnion bearing flanges at companion flange at center bearing, and lower end of propeller

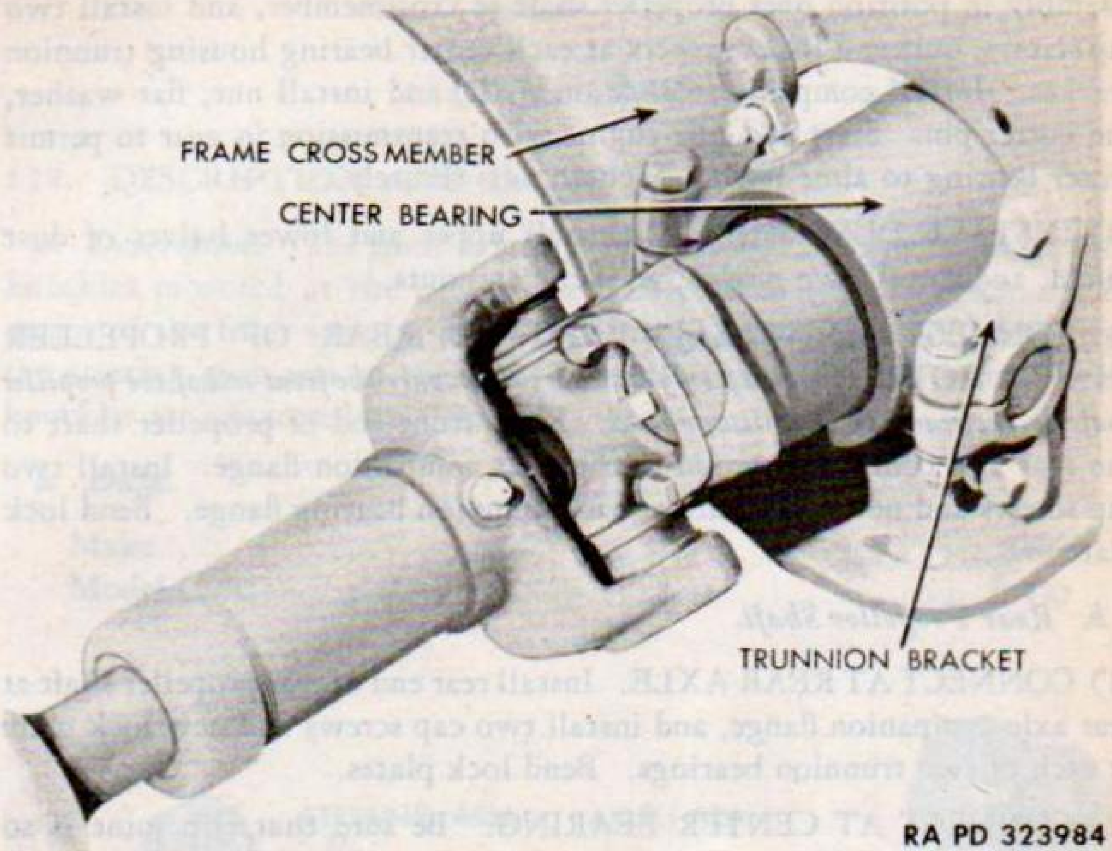


Figure 88 — Propeller Shaft Center Bearing Installed

shaft. Wire or tie trunnion bearings to universal cross to prevent loss or entrance of dirt.

(2) Remove cotter pin, nut, and flat washer from rear of front propeller shaft, and remove companion flange from propeller shaft.

(3) Remove two screws, nuts, and washers from dust shield, and remove upper and lower halves of dust shield.

(4) Remove nuts and lock washers from two cap screws at each center bearing assembly bracket.

(5) Slide center bearing assembly from propeller shaft. Wrap the assembly in cloth or paper to prevent entrance of dirt.

111. INSTALLATION.

a. Front or Center Propeller Shaft.

(1) POSITION SHAFT. Install propeller shaft in position, inserting rear end through frame crossmember.

(2) CONNECT FRONT UNIVERSAL JOINT. Install new lock plates, and install two cap screws at each of two trunnion bearing flanges. Bend lock plates.

(3) INSTALL CENTER BEARING. Place propeller shaft center bearing

assembly in position over propeller shaft at crossmember, and install two cap screws, nuts and lock washers at each center bearing housing trunnion bracket. Install companion flange on shaft, and install nut, flat washer, and cotter pin. Start and idle engine with transmission in gear to permit center bearing to aline itself. Tighten nuts securely.

(4) INSTALL DUST SHIELD. Install upper and lower halves of dust shield, and install two screws, washers, and nuts.

(5) CONNECT UNIVERSAL JOINT AT REAR OF PROPELLER SHAFT. NOTE: *This step only necessary when only the front end of the propeller shaft to the rear has been disconnected.* Raise front end of propeller shaft to the rear and connect trunnion bearings at companion flange. Install two cap screws and new lock plate at each trunnion bearing flange. Bend lock plates.

b. Rear Propeller Shaft.

(1) CONNECT AT REAR AXLE. Install rear end of rear propeller shaft at rear axle companion flange, and install two cap screws and new lock plate at each of two trunnion bearings. Bend lock plates.

(2) CONNECT AT CENTER BEARING. Be sure that slip joint is so installed on rear shaft that arrows on slip yoke and rear shaft are in alinement. Connect front universal joint at companion flange at center bearing, installing two cap screws and new lock plate at each trunnion bearing flange, and bending lock plates.

c. Center Bearing Assembly.

(1) Slide center bearing assembly onto rear end of propeller shaft.

(2) Install two cap screw, nuts, and lock washers in each center bearing bracket at frame crossmember, but do not tighten securely.

(3) Install propeller shaft rear companion flange onto shaft, making sure that the spacer is installed between the companion flange and bearing. Install companion flange flat washer, nut, and cotter pin.

(4) Start engine, and allow transmission to operate in first gear at low speed to permit center bearing to aline itself properly. Tighten four center bearing bracket retaining nuts securely on cap screws.

(5) Connect front end of propeller shaft at rear to companion flange, and install new lock plate and two cap screws in each universal joint trunnion bearing flange. Bend lock plates against sides of cap screw heads.

(6) Install upper and lower halves of center bearing dust shield, and install two screws, washers, and nuts.

Section XXIX

Front Axle

112. DESCRIPTION AND DATA.

a. Description. The front axle (fig. 89) is of I-beam type, with steering knuckles mounted at the ends. The axle is attached to the chassis by means of the front springs, and to the steering gear by a drag link from the steering gear arm to the front axle steering arm. The two steering knuckles are connected by a tie rod.

b. Data.

Make	IHC
Model (IHC)	F-470

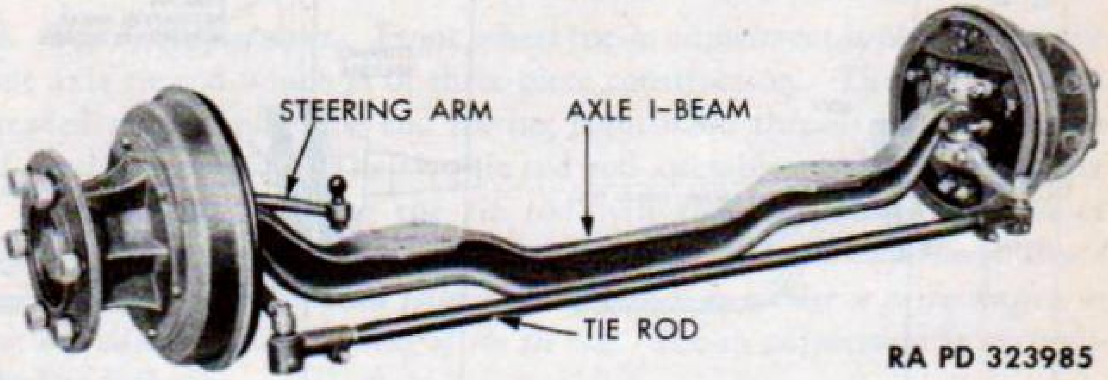


Figure 89 — Front Axle

113. ADJUSTMENTS.

a. Steering Angles. Correction of front wheel toe-in is the only adjustment which comes within the scope of this manual. The steering angles and their purpose in the axle are, however, described below and illustrated in figure 90. NOTE: *The values of the angles shown in figure 90 are for illustration only and do not necessarily apply to these vehicles.*

(1) TOE-IN. The toe-in adjustment is a setting of the front wheels so that they are closer together at the front than at the rear. The purpose of toe-in is to offset the tendency of the wheels to roll outward due to the camber angle. The specified toe-in of the front wheels is $\frac{1}{16}$ to $\frac{1}{8}$ inch. Incorrect toe-in of the front wheels will result in rapid tire wear.

(2) CAMBER. Front wheel camber is the inclination of the front wheels from a vertical plane. Positive camber is an outward tilt or inclination of the wheels at the top. The specified positive camber of these front

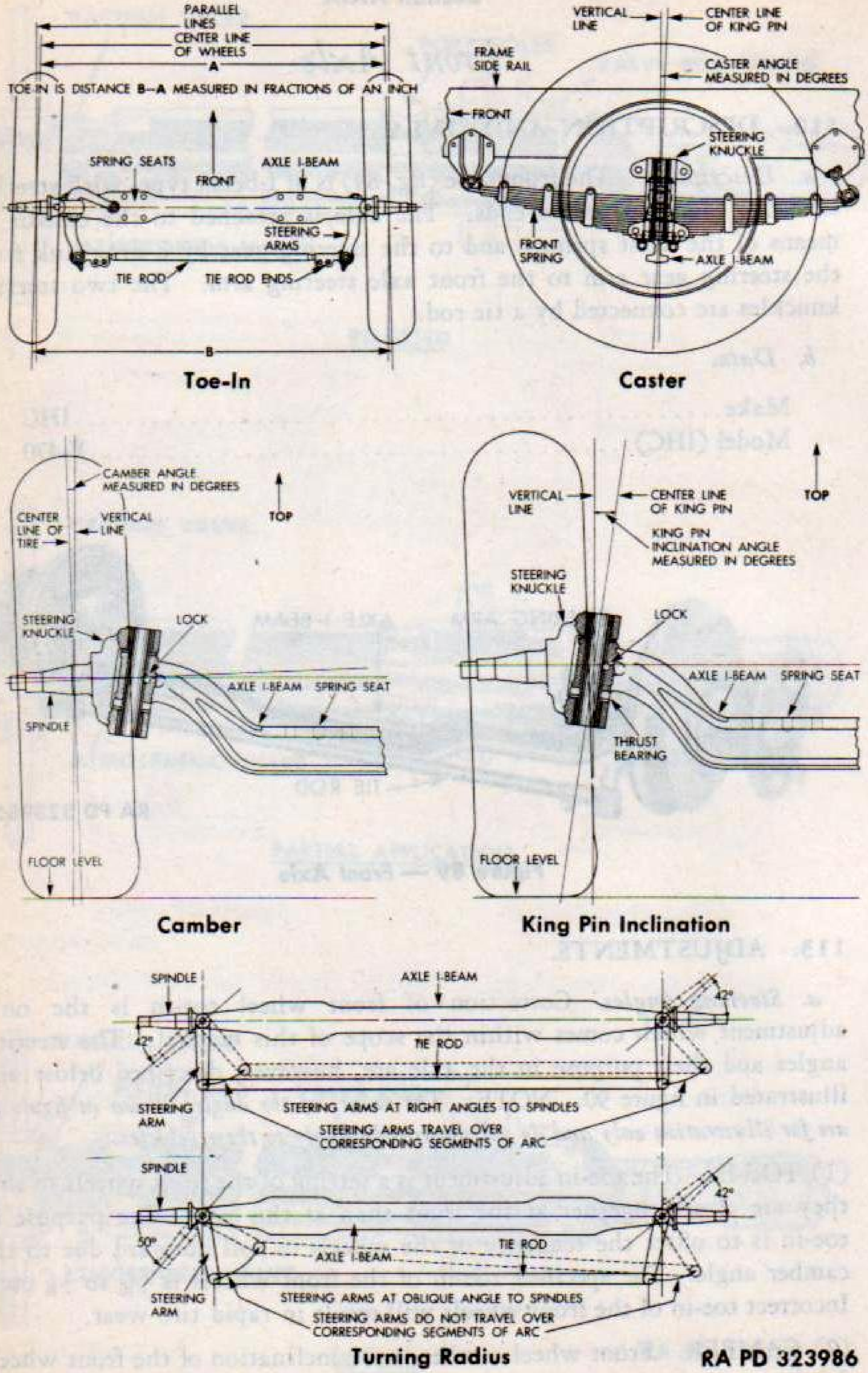


Figure 90 — Front Axle Steering Angles

wheels is one degree. The purpose of camber is to place the road contact point of the tire as nearly as possible under the point of load, to reduce the strain on the spindle, and reduce binding action on the knuckle pin.

(3) CASTER. Axle caster is the amount of tilt of the axle knuckle pin or king pin toward the front or rear of the vehicle at the top. Positive caster is had when the top of the knuckle pin tilts toward the rear. The purpose of axle caster is to provide stability of steering. The specified positive axle caster of this vehicle is from two to three degrees.

(4) KNUCKLE PIN INCLINATION. The angle which the steering knuckle pin makes with the vertical plane is known as knuckle pin or king pin inclination. The purpose of this inclination is to stabilize steering characteristics. The knuckle pin inclination of this axle is four degrees.

(5) TURNING RADIUS. The turning radius angle is the angle at which the steering arms are attached to the steering knuckle in relation to the spindle. The purpose of the turning radius angle, or toe-out on turns, is to cause the inside wheel to turn shorter than the outside wheel.

b. Toe-in Adjustment. Front wheel toe-in adjustment is obtained at the front axle tie rod which is of three-piece construction. The rod proper is threaded at the ends, one end having right-hand threads, and the other end left-hand threads. The two tie rod end assemblies are locked in place by clamp bolts. Turning the tie rod will therefore either shorten or lengthen the distance between the ends. NOTE: *Toe-in adjustment should always be checked and corrected following any change in camber or caster angles, or after any adjustment or servicing of the tie rod.* Toe-in adjustment is accomplished as follows:

(1) Inflate tires to proper and equal pressures (Dump truck—front, 35 pounds; rear, 45 pounds; Bus—front, 60 pounds; rear 65 pounds).

(2) Raise front wheels from floor so that wheels may be rotated freely.

(3) Spin wheels, and chalk the center of the tire tread of each front tire.

(4) Scribe a line on the chalked portion of the tread. This line will be continuous around the circumference of the tire if made by holding a sharp-pointed instrument in front of the tire while revolving the wheel.

(5) Lower the wheels to the floor, in a straight-ahead position. Roll vehicle forward about one foot.

(6) Measure the distance between the scribed lines at the front and rear of the tires, measuring at as near hub height as possible. NOTE: *Do not measure between tire sidewalls or between tire rims.* The difference between the two measurements denotes the amount of toe-in or toe-out present. The measurement at the front of the tires should be $\frac{1}{16}$ to $\frac{1}{8}$ inch less than that at the rear.

(7) Loosen the tie rod end clamp bolt nuts at each end of the tie rod.

(8) Turn tie rod a small amount to alter toe-in.

(9) Raise front wheels to remove vehicle weight momentarily, then lower and roll vehicle forward one foot. Recheck measurements.

(10) When adjustment of the tie rod results in a toe-in of $\frac{1}{16}$ to $\frac{1}{8}$ inch (closer at front than at rear), tighten tie rod end clamp bolts securely.

c. Front Wheel Bearing Adjustment. For instructions covering front wheel bearing adjustment, see paragraph 131.

114. REMOVAL.

a. Front Axle Assembly.

(1) Loosen front wheel stud nuts about $\frac{1}{2}$ turn at each wheel.

(2) Disconnect front wheel brake lines at each side.

(3) Remove cotter pin from axle end of drag link, and unscrew drag link plug. Remove dust shield and felt seal from drag link. Lift drag link end from steering arm at axle.

(4) Remove nuts and lock washers from front spring U-bolts at each front spring.

(5) Raise front end of vehicle, either with hoist or with jacks under frame at rear of front springs, sufficiently to permit rolling front axle assembly from beneath the vehicle.

(6) Roll front axle toward front and out from under vehicle. Place axle and wheel assembly on support stands, clamping to prevent rolling.

(7) Remove wheel stud nuts from each wheel, and remove tire and disk assemblies from hubs.

b. Tie Rod Assembly.

(1) Remove cotter pin and nut from tie rod end ball stud at each end of tie rod.

(2) Use puller to remove tie rod end ball stud from steering arm at each end.

(3) Lower tie rod from axle.

c. Steering Knuckle.

(1) REMOVE WHEEL AND BEARINGS. See paragraph 132.

(2) REMOVE BRAKE BACKING PLATE AND BRAKE SHOES.

(a) Remove screws and lock washers from grease guard, and remove grease guard.

(b) Remove four nuts and lock washers from steering knuckle bolts holding backing plate and steering arms to steering knuckle.

(c) Remove the four bolts, and remove backing plate with brake shoes as an assembly.

(3) REMOVE STEERING KNUCKLE.

(a) Remove two screws from top and bottom king pin caps. Remove caps and gaskets.

(b) Remove nut and lock washer from king pin draw key in end of axle beam, and drive the key from the axle.

(c) Drive king pin out of steering knuckle.

(d) Lift steering knuckle, upper spacer, and lower bearing from axle.

115. INSTALLATION.

a. Front Axle Assembly.

(1) With front axle placed on support stands, install front tire and rim assemblies. Remove axle and wheel assembly from stand.

(2) Roll axle and wheel assembly under vehicle, and place in position below the front springs.

(3) Lower the vehicle onto the axle, making sure that front spring center bolt heads enter their sockets in the axle.

(4) Install U-bolts in position, and install nuts and lock washers on U-bolts at each spring. Before finally tightening the nuts, measure from the front spring front pin lubricator to the axle spring seat on each side. The measurements must be identical. Shift the axle forward or backward as necessary to correct the alinement. Tighten U-bolt nuts securely.

(5) Connect steering drag link at front axle steering arm, and install drag link end plug. Draw plug up snugly, then back off to first hole and install cotter pin. Place dust seal and dust shield around end of drag link, and lock in place.

(6) Connect brake line at each side. Bleed brake system (par. 123 *e*).

(7) Tighten front wheel stud nuts securely.

(8) Check front wheel toe-in, and correct if necessary (par. 113 *b*).

b. Front Axle Tie Rod.

(1) Loosen tie rod end clamp bolt nuts at each end of tie rod. This will permit ends to aline themselves.

(2) Place tie rod in position, with lubricator fittings toward front of chassis. Insert tie rod end ball studs in steering arms, install nuts securely, and install cotter pins.

(3) Adjust front wheel toe-in (par. 113 *b*).

c. Steering Knuckle.

(1) INSTALL STEERING KNUCKLE.

(a) Install steering knuckle on axle beam, placing spacer between top of axle beam and steering knuckle. Place thrust bearing between axle beam lower surface and steering knuckle.

(b) Install king pin in steering knuckle and axle beam, having draw key slot in alinement with bolt hole in axle beam.

(c) Install king pin draw key in axle beam and king pin, and install and tighten nut and lock washer.

(d) Install king pin cover caps and gaskets at top and at bottom of steering knuckle, and install two screws in each plate.

(2) INSTALL BRAKE BACKING PLATE AND BRAKE SHOES.

(a) Place brake backing plate and brake shoe assembly in position on steering knuckle, install four bolts on each side, and install steering arms on lower bolts, install and tighten nuts and lock washers.

(b) Install grease guard, lock washers, and screws.

(3) INSTALL WHEEL AND BEARINGS. See paragraph 133.

(4) BLEED BRAKE SYSTEM. See paragraph 123 *e*. Check for leaks at all connections.

(5) ADJUST FRONT WHEEL TOE-IN. See paragraph 113 *b*.

(6) ADJUST BRAKES. See paragraph 127.

Section XXX

Rear Axle

116. DESCRIPTION AND DATA.

a. Description.

(1) MODEL K-7. This rear axle is of full-floating type (fig. 91). The full-floating design permits easier servicing, as axle drive shafts may be removed or installed without disturbing the wheels. The axle drive shafts carry none of the vehicle weight and are concerned only with transmitting the driving force to the wheels. The rear axle assembly is attached to the vehicle by the rear springs and rear spring U-bolts. It is connected to the transmission and power plant by propeller shafts.

(2) MODEL KS-7. The two-speed rear axle of the model KS-7 vehicle is also of full-floating type. It incorporates a spiral bevel drive, having four planetary gears which mesh with an internal gear on the bevel drive gear. The primary reduction is accomplished through the bevel drive gear and a straddle-mounted bevel drive pinion. The secondary reduction is accomplished through the planetary gears, which in turn mesh with a

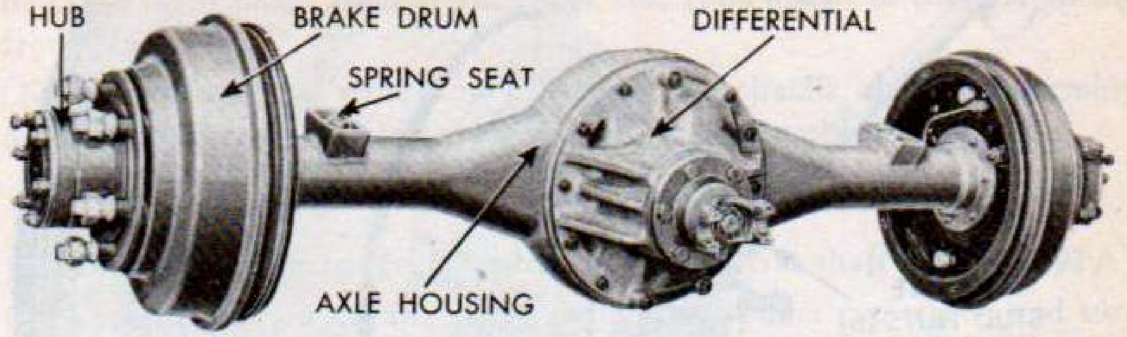


Figure 91 — Rear Axle (Model K-7)

sliding clutch serving to lock or unlock the planetary gears. The two-speed axle is operated by a vacuum-controlled cylinder at the rear axle through actuation of the push button control at the transmission control lever.

b. Data.

	KS-7	K-7
Make	Eaton	IHC
Model (IHC)	R-2460	R-1560
Type	Full-floating 2-speed	Full-floating, single-reduction
Gear ratio	High–6.14 to 1.00 Low –8.52 to 1.00	7.16 to 1.00

117. ADJUSTMENTS.

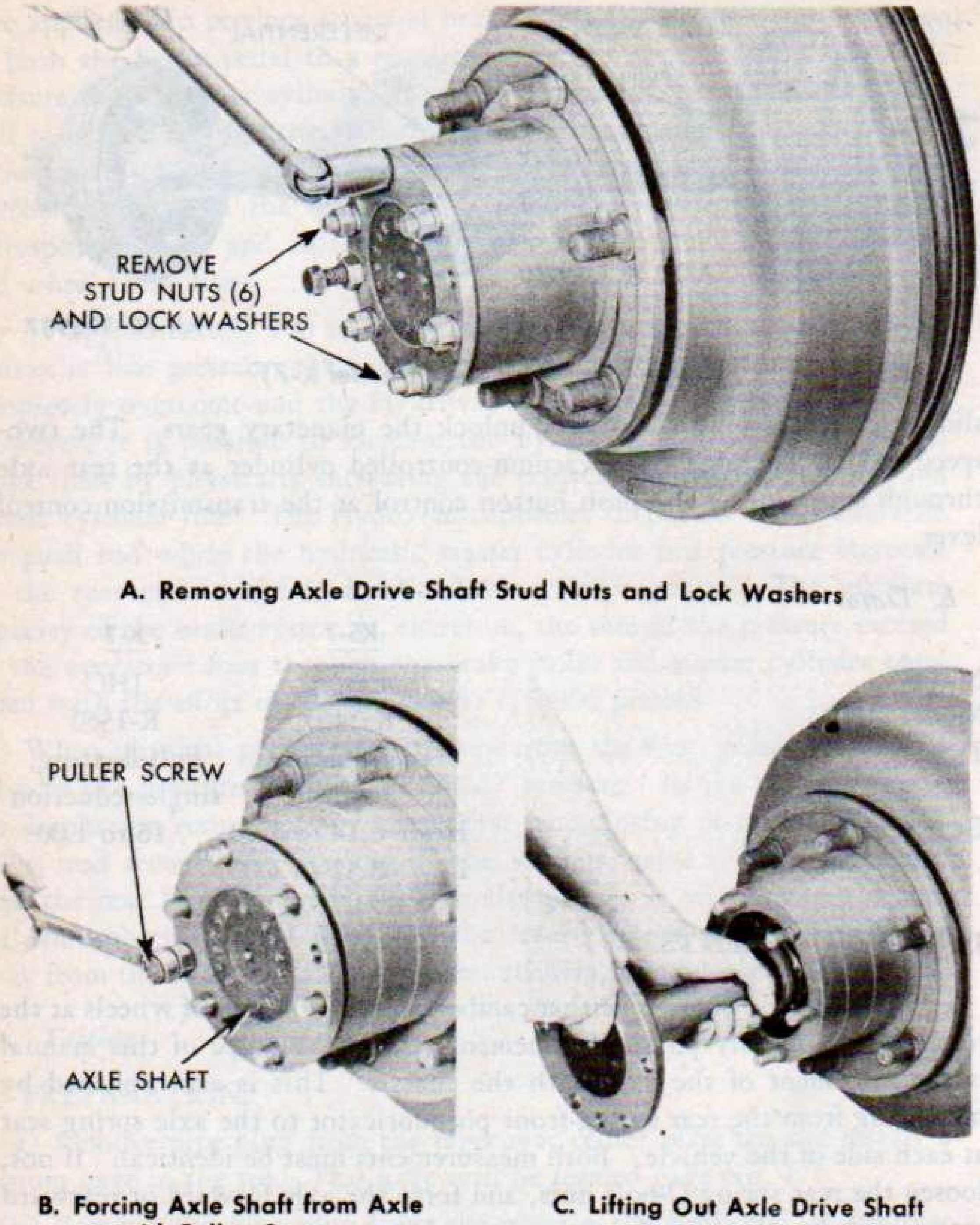
a. Alinement. There is neither camber, caster, or toe-in of wheels at the rear axle. The only phase of alinement within the scope of this manual is the alinement of the axle with the chassis. This is accomplished by measuring from the rear spring front pin lubricator to the axle spring seat at each side of the vehicle. Both measurements must be identical. If not, loosen the rear spring U-bolt nuts, and force the axle forward or rearward into alinement, then retighten the spring U-bolt nuts.

118. REMOVAL.

a. Rear Axle Assembly. The only replacements allowable within the scope of this manual concern the axle drive shafts, wheels or wheel bearings (par. 132), brake shoes (par. 127), or brake drums (par. 128). Any other services or replacements require complete axle assembly replacement. Removal procedure is as follows:

(1) Loosen wheel stud nuts at each rear wheel.

(2) Bend lock plates, and remove four cap screws from rear propeller shaft



A. Removing Axle Drive Shaft Stud Nuts and Lock Washers

B. Forcing Axle Shaft from Axle with Puller Screw

C. Lifting Out Axle Drive Shaft

RA PD 323988

Figure 92 — Removing Rear Axle Drive Shaft

universal joint flanges at rear axle. Lower the propeller shaft end to floor.

(3) Disconnect brake line at rear axle.

(4) Support front end of differential case on floor jack. Loosen and remove nuts and lock washers from rear spring U-bolts.

(5) On Model KS-7, disconnect shift control vacuum line at vacuum power cylinder.

(6) Raise vehicle frame and springs from the rear axle, either with a chain

hoist, or with jacks beneath the frame side rails ahead of the rear spring front pins.

(7) Roll rear axle and wheels out from under the chassis, and place assembly on support stands while removing tire and disk assemblies from hubs.

b. Axle Drive Shaft.

(1) Remove six nuts and lock washers from axle drive shaft studs (fig. 92 A).

(2) Loosen lock nut on axle drive shaft flange puller cap screw, and turn the screw in to force axle drive shaft from position (fig. 92 B).

(3) Lift axle drive shaft from axle tube (fig. 92 C).

119. INSTALLATION.

a. Rear Axle Assembly.

(1) With rear axle assembly on support stands, install tire and disk assemblies onto hubs.

(2) Roll axle assembly under vehicle, and place in position beneath the rear springs.

(3) Lower vehicle onto rear axle, making sure that rear spring center bolts rest properly in their recesses.

(4) Install U-bolts in place in rear axle, and install nuts and lock washers on U-bolts. NOTE: *Before tightening U-bolt nuts, check axle alinement by measuring from the front rear spring pin lubricators to the axle spring seats, and shift the axle as necessary to aline. The measurements must be identical.* Tighten U-bolt nuts securely.

(5) Raise propeller shaft end, connect at rear universal joint, install four cap screws, and bend lock plates on universal joint flanges.

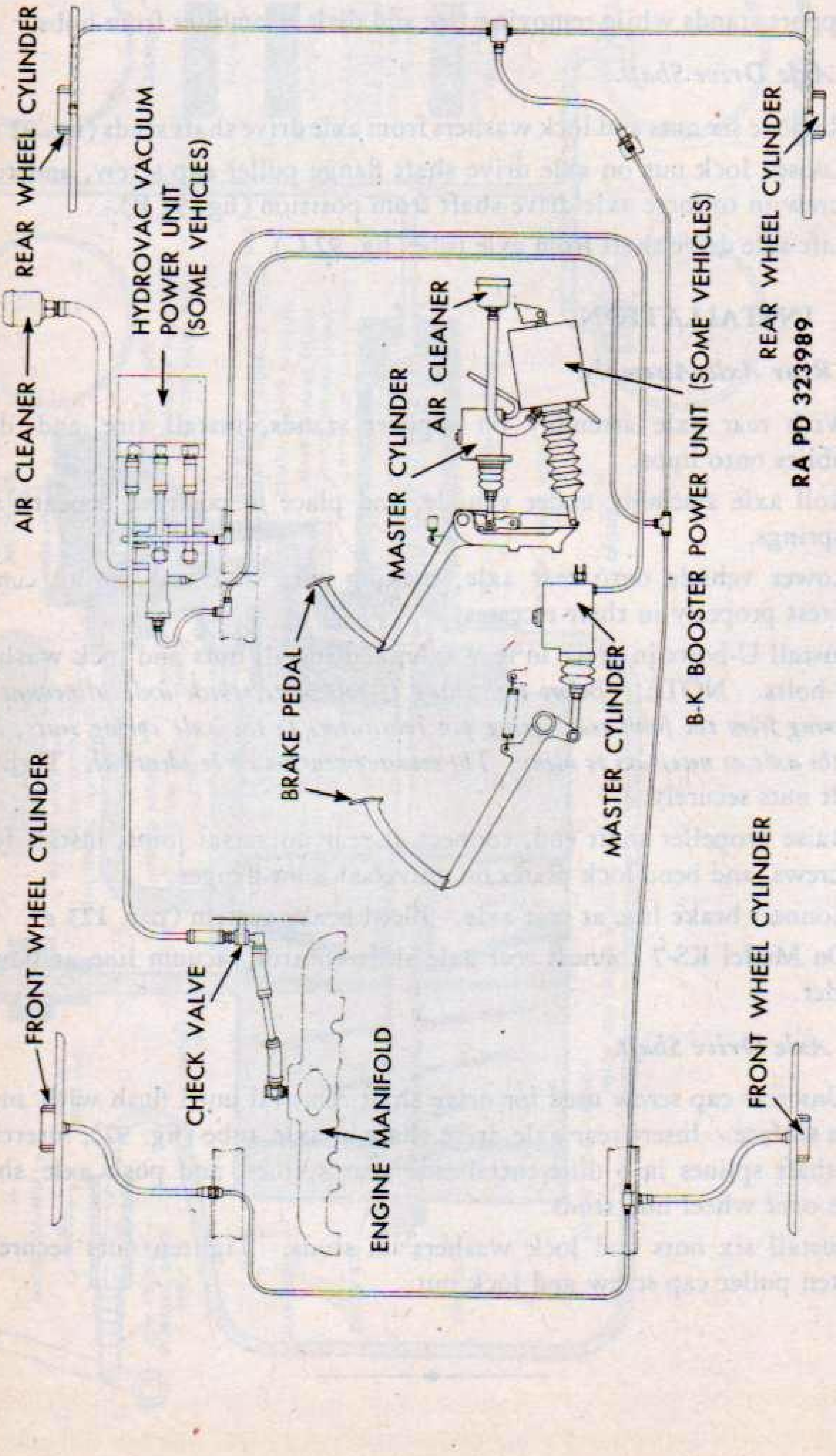
(6) Connect brake line at rear axle. Bleed brake system (par. 123 *e*).

(7) On Model KS-7 connect rear axle shift control vacuum line at power cylinder.

b. Axle Drive Shaft.

(1) Unscrew cap screw used for drive shaft removal until flush with inner flange surface. Insert rear axle drive shaft in axle tube (fig. 92), inserting axle shaft splines into differential side gear splines, and push axle shaft flange over wheel hub studs.

(2) Install six nuts and lock washers on studs. Tighten nuts securely. Tighten puller cap screw and lock nut.



RA PD 323989

Figure 93 — Brake System (Dump Truck), Schematic View

Section XXXI

Brake System

120. DESCRIPTION AND DATA.

a. Description (figs. 93 and 94).

(1) The brakes are hydraulic, and are vacuum-actuated either by a B-K power cylinder (booster) or by a Bendix Hydrovac vacuum power unit. The hydraulic system consists of a compensating-type hydraulic master cylinder in which the hydraulic pressure originates; individual hydraulic wheel cylinders in which the hydraulic pressure is applied to cause the brake shoes to be expanded against the brake drums; brake lines which consist of connecting steel tubes and flexible hose; two brake shoes and a brake drum at each wheel; and an actuating brake pedal. The vacuum power system actuating these hydraulic brakes is either the B-K booster or the Bendix Hydrovac. These two units are described individually in later paragraphs.

(2) The front wheel brakes are Wagner-Lockheed type, while those of the rear wheels are Wagner Hi-Tork type.

(3) The parking brake is a lever-actuated band-type brake mounted on the propeller shaft. The parking brake hand lever is located in the driver's compartment.

b. Operation.

(1) Depressing the brake pedal causes movement of a piston in the master cylinder which displaces the fluid from the master cylinder through its outlet orifice into the tubing (and, on Hydrovac-equipped vehicles, into the Hydrovac slave cylinder), and out through the brake lines into the wheel cylinders at each wheel. The brake fluid enters each of the wheel cylinders and, being noncompressible, causes the wheel cylinder pistons to move outward and force the brake shoes to expand against the wheel brake drums. As pressure on the pedal is increased, greater hydraulic pressure is built up within the wheel cylinders, and consequently greater force is exerted against the brake shoes. When the pressure on the pedal is released, the brake shoe retracting springs return the brake shoes to their normal released position. The return movement of the brake shoes in turn causes movement of the wheel cylinder pistons toward their released position, thus forcing the fluid back through the tubing (and, if Hydrovac-equipped, through the Hydrovac slave cylinder) to the master cylinder.

(2) The purpose of either the B-K power cylinder (booster) or the Hydrovac is to assist and supplement the hydraulic brake system application.

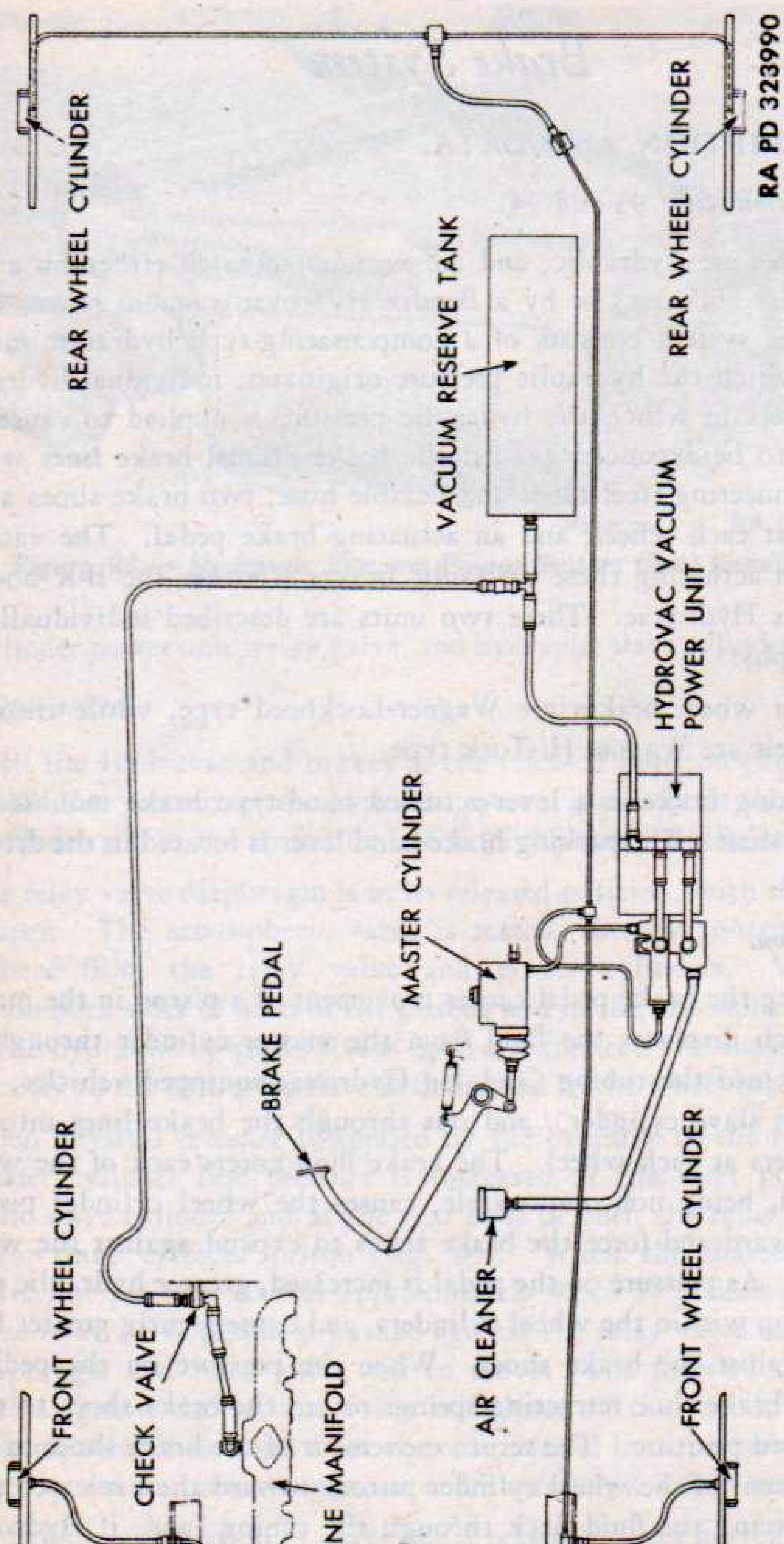
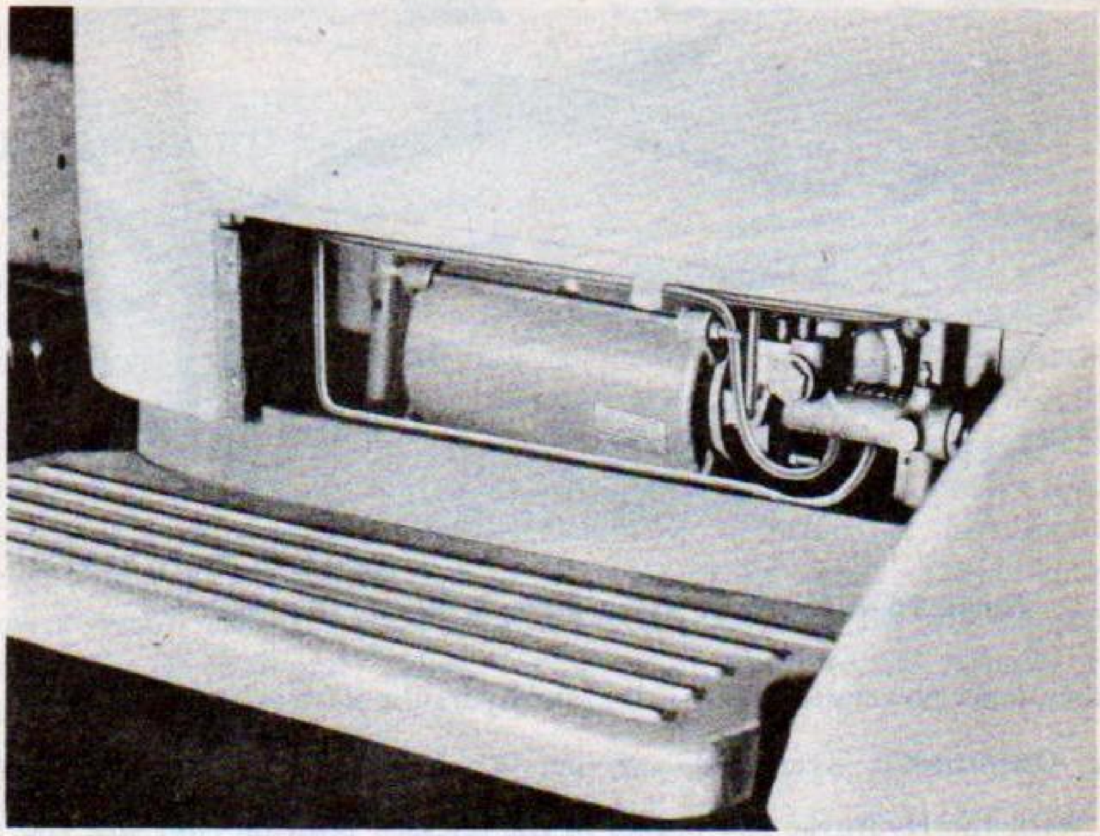


Figure 94 — Brake System (Bus), Schematic View



RA PD 323991

Figure 95 — Hydrovac Vacuum Power System (Dump Truck) Installed

c. Data.

	Bus	Dump Truck
Type	Hydraulic	Hydraulic
Power cylinder	Hydrovac or B-K	Hydrovac or B-K
Size of brake shoes:		
Front	14 x 2 x ¼ in.	14 x 2 x ¼ in.
Rear	15 x 4½ x ⅜ in.	15 x 4 x ⅜ in.

121. HYDROVAC VACUUM POWER CYLINDER.

a. Description.

(1) The Hydrovac vacuum power cylinder is located at the right frame side rail on the dump truck, and is accessible below the right-hand door behind a removable panel (fig. 95). On the bus chassis, the hydrovac is located on the left-hand frame side rail (fig. 96).

(2) The Hydrovac vacuum cylinder provides the operator with more braking pressure than could be applied by foot pressure alone. The unit is a combined hydraulic-vacuum power system using the engine vacuum and atmospheric pressure for its operation. It is self-contained, having no external rods or levers exposed to dirt or moisture, and consists of a

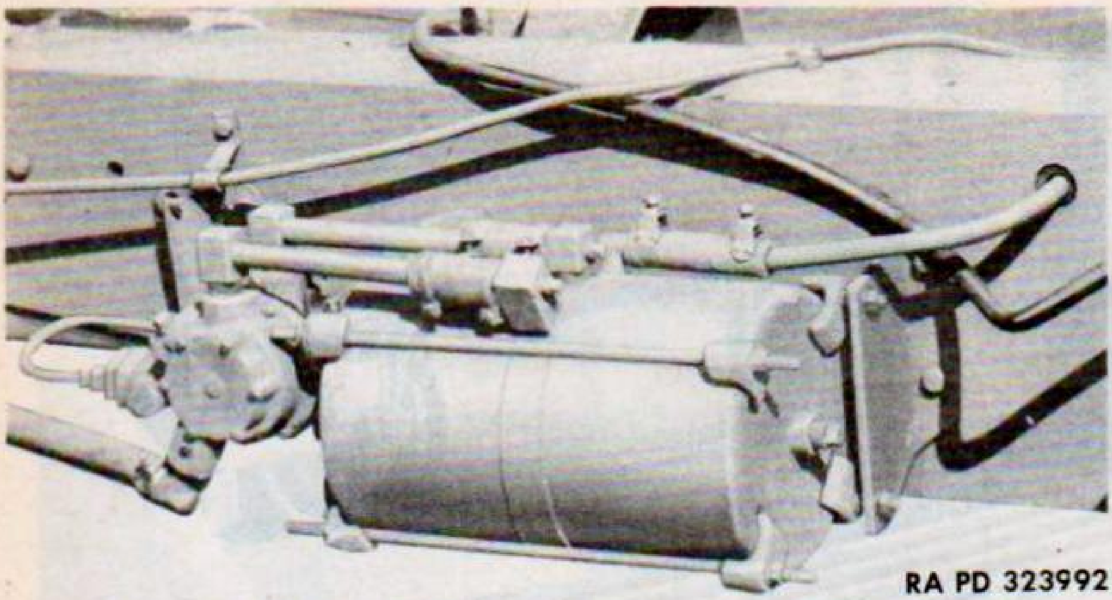


Figure 96 — Hydrovac Vacuum Power System (Bus) Installed

dual-cylinder power unit, relay valve, and hydraulic slave cylinder (fig. 97).

b. Operation.

(1) With the Hydrovac and brakes in the released position (fig. 98), the "residual" line pressure of the hydraulic system is present in the hydraulic slave cylinder and in the hydraulic line from the master cylinder.

(2) The relay valve diaphragm is in its released position, with the vacuum valve open. The atmospheric valve is seated, thereby shutting off the atmosphere from the relay valve and power cylinders. Vacuum is present on both sides of both of the pistons and in the atmospheric control line. The hydraulic by-pass valve is open and connects the master cylinder line directly to the hydraulic slave cylinder and to the wheel brake lines.

(3) When physical pressure is applied by the operator to the foot pedal, the master cylinder line pressure is increased at the inlet port to the hydraulic slave cylinder and at the rear ends of both the relay valve and hydraulic slave cylinder piston (fig. 99). When the master cylinder hydraulic line pressure reaches approximately 40 to 70 pounds per square inch, the relay valve piston is pushed against the relay valve rod, causing the diaphragm and relay valve rod to move. The forward diaphragm plate seats against the vacuum valve and closes off the vacuum from the atmospheric control line and from the rear faces of both pistons. In this, the "lap" position, both the vacuum and atmospheric valves are seated.

(4) Additional application of brake pedal pressure causes movement of the relay valve piston, and the atmospheric valve is unseated, with the vacuum valve remaining closed. Both the atmospheric and vacuum valves are integral with one shaft and move simultaneously. The vacuum valve

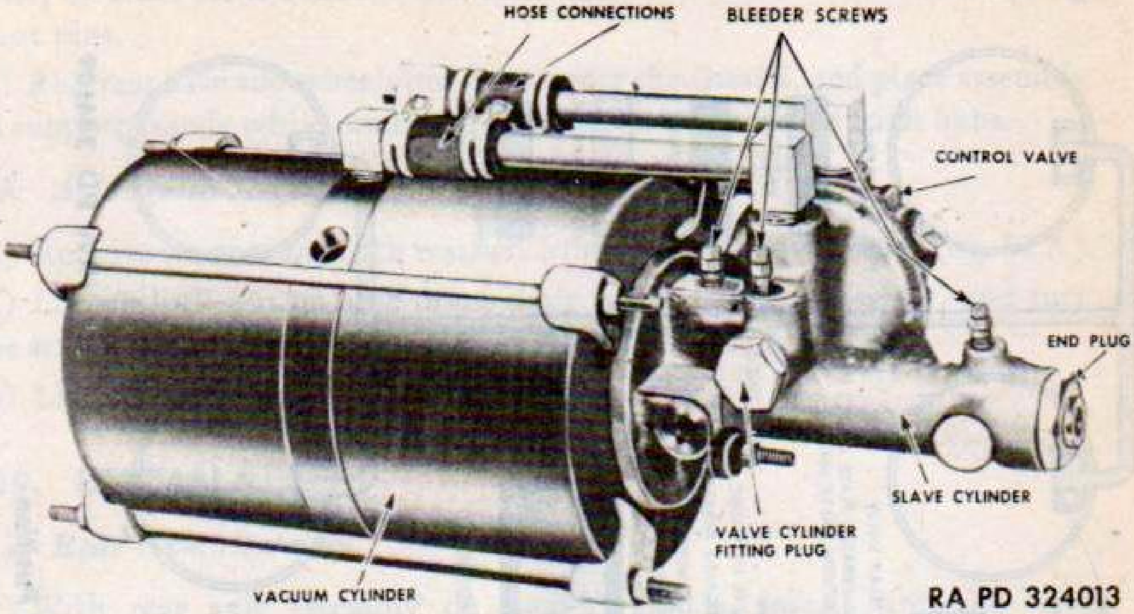


Figure 97 — Hydrovac Vacuum Power Cylinder

remains seated because the diaphragm is flexible, allowing the diaphragm plates to be pushed forward to keep the vacuum valve seated.

(5) The opening of the atmospheric valve allows air, at atmospheric pressure, to enter the atmospheric control line which directs it to the rear face of the front piston. The hollow piston rod conducts the atmosphere to the rear face of the rear piston. The vacuum remains on the front faces of both pistons and on the rear side of the diaphragm.

(6) The difference in pressure between the atmosphere on the rear faces of the pistons and the vacuum on the front faces causes the pistons to move forward, pushing the vacuum cylinder piston push rod against the hydraulic slave cylinder piston and closing the by-pass valve. The pressure now acting on the hydraulic piston is the combination of the pressure of the push rod and the hydraulic pressure from the master cylinder. Thus, should the Hydrovac fail to operate, the foot pedal pressure would still act to operate the brakes. The hydraulic slave cylinder piston is moved forward, and the fluid column in the cylinder is displaced, causing the wheel brakes to operate.

(7) The admission of air to the forward side of the diaphragm while there is a vacuum at the rear side causes lack of balance in pressure and creates pressure against the diaphragm which tends to close the atmospheric valve. This pressure is termed the "reactionary force" and it is transmitted through the relay valve piston to the hydraulic line from the master cylinder, and finally, to the brake pedal. It gives the operator the "feel" of the brakes and more accurate control of the brake application, since the force increases in direct proportion to the amount of brake pres-

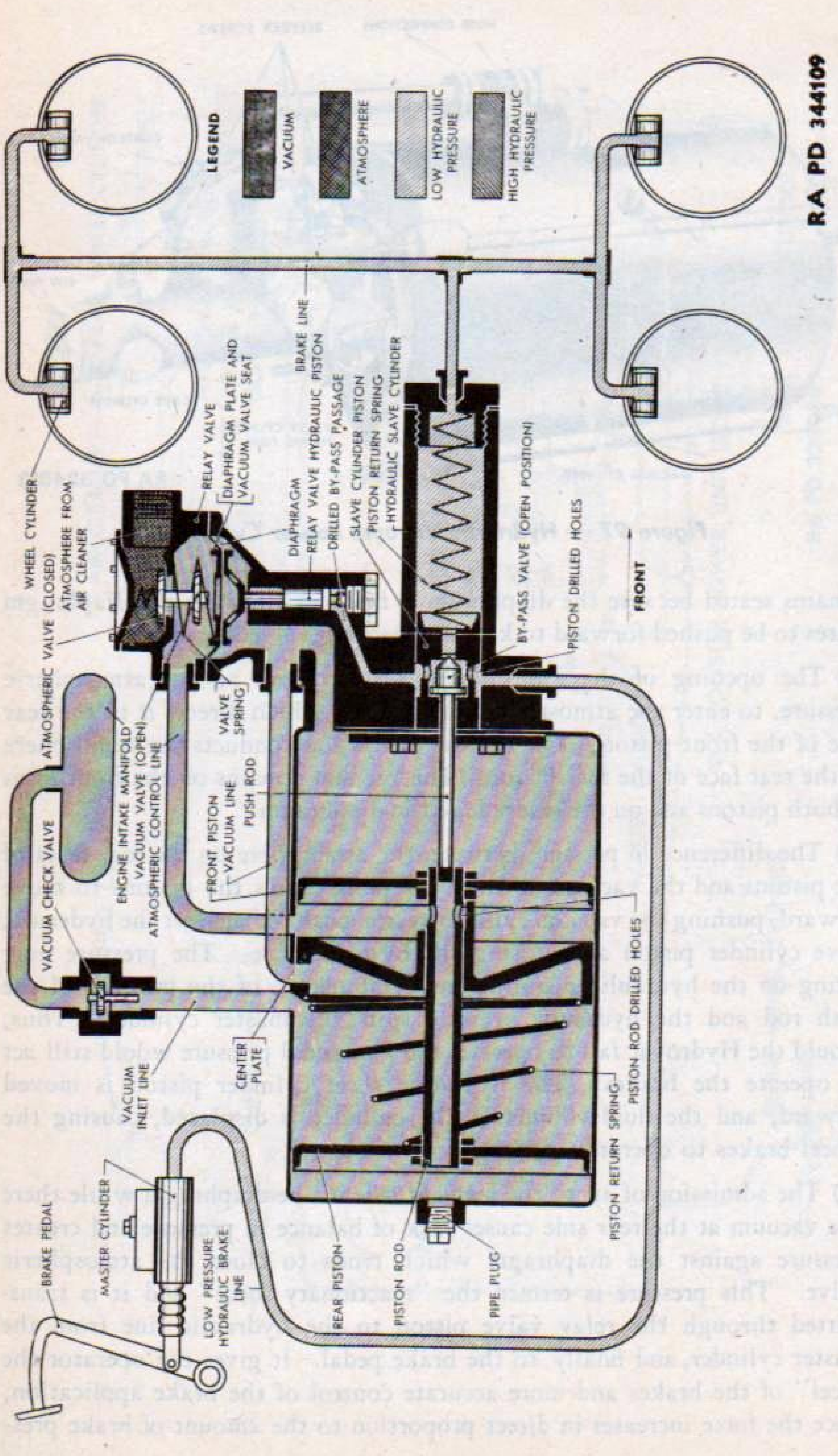


Figure 98 — Hydrovac Operation — Released Position

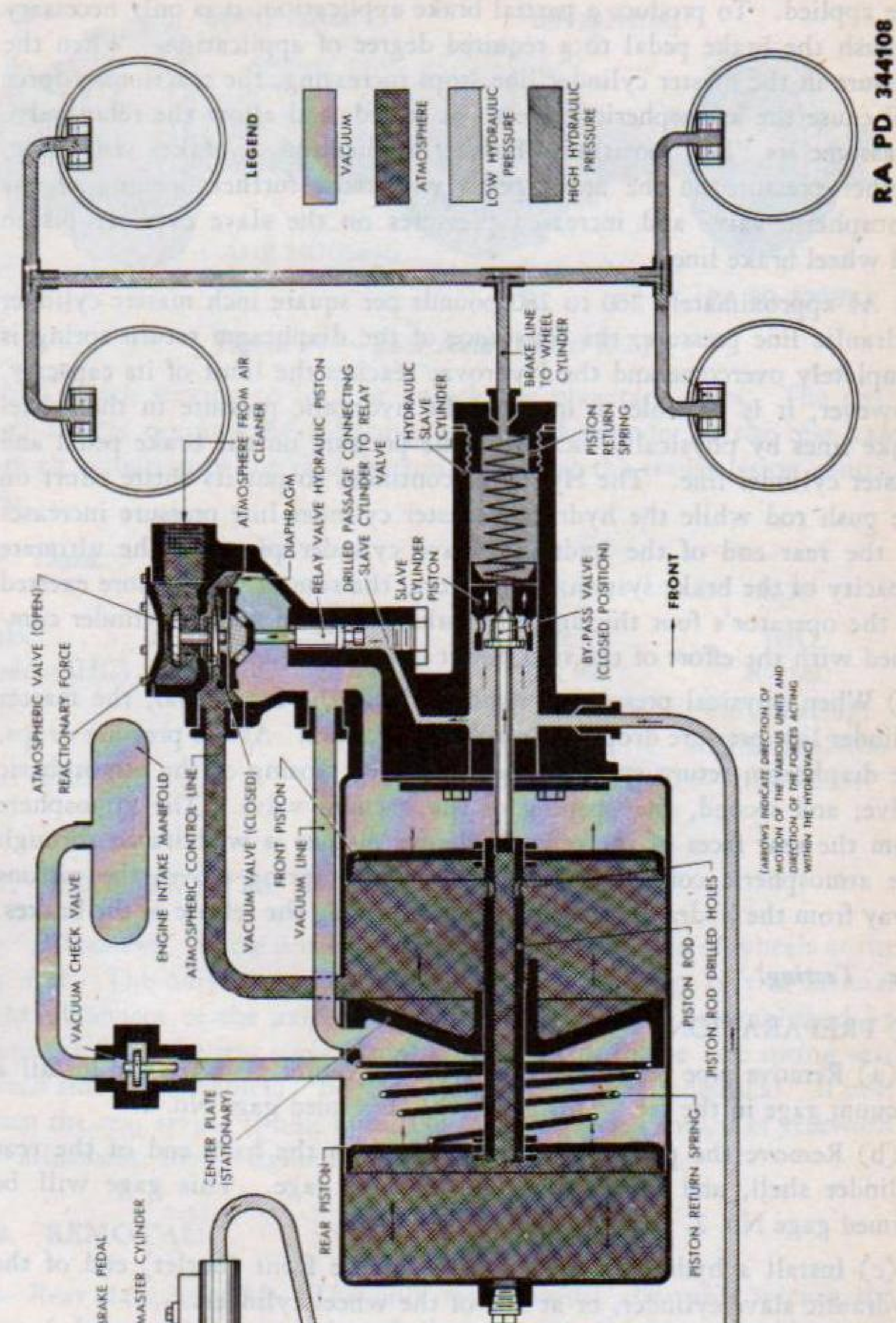


Figure 99 — Hydrovac Operation — Applied Position

sure applied. To produce a partial brake application, it is only necessary to push the brake pedal to a required degree of application. When the pressure in the master cylinder line stops increasing, the reactionary force will cause the atmospheric valve to be sealed, and allow the relay valve to assume its "lap" position. Further application of brakes will cease. Further pressure on the brake pedal will cause further opening of the atmospheric valve and increased pressures on the slave cylinder piston and wheel brake lines.

(8) At approximately 260 to 280 pounds per square inch master cylinder hydraulic line pressure, the resistance of the diaphragm return spring is completely overcome and the Hydrovac reaches the limit of its capacity. However, it is possible to increase the hydraulic pressure in the wheel brake lines by physically increasing the pressure on the brake pedal and master cylinder line. The Hydrovac continues to put its entire effort on the push rod while the hydraulic master cylinder line pressure increases on the rear end of the hydraulic slave cylinder piston. The ultimate capacity of the brake system is, therefore, the sum of the pressure exerted by the operator's foot through the brake pedal and master cylinder combined with the effort of the two power cylinder pistons.

(9) When physical pressure is removed from the foot pedal, the master cylinder line pressure drops to "residual" pressure. As the pressure drops, the diaphragm return spring causes, first, the closing of the atmospheric valve, and second, the opening of the vacuum valve. The atmosphere from the rear faces of the power cylinder pistons is withdrawn through the atmospheric control line, and the return spring moves the pistons away from the hydraulic slave cylinder, allowing the release of the brakes.

c. Testing.

(1) PREPARATION.

(a) Remove pipe plug from the Hydrovac center plate tee and install a vacuum gage in the tee. This gage will be termed gage No. 1.

(b) Remove the pipe plug from the boss in the back end of the rear cylinder shell, and install a second vacuum gage. This gage will be termed gage No. 2.

(c) Install a hydraulic pressure gage in the front (outlet) end of the hydraulic slave cylinder, or at one of the wheel cylinders.

(2) VACUUM TEST (BRAKES RELEASED).

(a) Start the engine, and leave the brake pedal in the released position. Note the reading on both vacuum gages. They should register engine manifold vacuum and should be exactly alike. If the reading is below manifold vacuum, a leak exists in the Hydrovac or in the lines from the manifold check valve.

(b) Stop the engine, and remove gage No. 1 from the Hydrovac center plate tee. Remove the vacuum line from the rear side of the center plate tee, and connect gage No. 1 to the vacuum line. Start the engine, and note the reading on gage No. 1. If the gage does not register manifold vacuum, the leak is in the manifold check valve lines, and they should be repaired or replaced.

(c) After repairing or replacing the manifold check valve lines, reinstall gage No. 1 in the Hydrovac center plate tee, connect the vacuum line to the rear side of the center plate tee, and repeat test (a) above.

(d) If the gages still register less than manifold vacuum, the leak exists in the Hydrovac. A leak in the Hydrovac can be caused by leaky gaskets, loose connections, or improper seating of the atmospheric relay valve. Any of these conditions would allow atmosphere to enter and break the vacuum sufficiently to cause the gage reading to be below manifold vacuum.

(3) VACUUM TEST (BRAKES APPLIED).

(a) If, with the engine running and the brake pedal released, the gages both register manifold vacuum, depress the brake pedal and hold in the applied position. Note the reading of gages No. 1 and No. 2. Gage No. 1 should continue to register manifold vacuum, while gage No. 2 should drop to zero or, if a combination vacuum and pressure gage is used, to atmospheric pressure.

(b) If gage No. 1 does not continue to register manifold vacuum, it may be attributed to one or more of the following causes: Improper seating of the relay valve vacuum valve, loose or torn piston packing, torn diaphragm, or distorted cylinder shells. Remove Hydrovac and send to higher echelon for repairs.

(4) HYDRAULIC PRESSURE TEST. If proper readings of manifold vacuum and atmospheric pressure are registered on gages No. 1 and No. 2 with the brake pedal depressed, the following test should be performed to check the hydraulic slave cylinder for leaks.

(a) Stop the engine, and depress the brake pedal several times to deplete the vacuum in the Hydrovac. Then depress the brake pedal, and note the reading on the hydraulic pressure gage at the hydraulic slave cylinder or at the wheel cylinder.

(b) Start the engine and depress the brake pedal, again noting the pressure gage reading. If the reading is not double the pressure reading with the engine stopped, a leak in the hydraulic system is indicated. Hold the pedal in the applied position for a few minutes, and note the pressure reading at various intervals. The hydraulic pressure should not drop quickly, and should not drop below the reading attained at the moment of brake application.

(c) A low reading or a drop of hydraulic pressure indicates a leak in the hydraulic slave cylinder, or in the brake lines or wheel cylinders.

(d) Inspect each brake line and wheel cylinder separately, and repair or replace damaged parts. Repeat tests (a) and (b) above. If the hydraulic pressure is still low or drops too rapidly, the leak is in the slave cylinder. If such exists, replace the Hydrovac.

d. Bleeding the Hydrovac. Trapped air must be bled from the hydraulic system at any time the hydraulic lines have been disconnected or when the oil supply has been allowed to become low in the master cylinder. The Hydrovac, on vehicles so equipped, must be bled first, and then the wheel cylinders. Bleeding of the Hydrovac is performed as follows:

(1) Engine must be shut off.

(2) Bleed Hydrovac at the three bleeder screws (fig. 97) in 2-1-3 order.

(a) Remove the center bleeder screw and lock washer, and insert bleeder tube in bleeder valve.

(b) Insert end of bleeder tube in a container holding a small amount of brake fluid, with end of tube below the surface of the fluid.

(c) Loosen bleeder valve nut. Depress brake pedal slowly by hand, then allow brake pedal to release slowly. Continue this process until no more air is expelled from bleeder tube.

(d) When no more air is expelled from system, tighten bleeder valve nut, remove bleeder tube, and install cap screw and lock washer in bleeder valve.

(e) Repeat steps (a) to (d) at bleeder valve nearest the power cylinder, and at bleeder valve nearest outer end of hydraulic slave cylinder, in order named. NOTE: *Make sure that hydraulic master cylinder is kept filled with brake fluid during bleeding operation. Fluid withdrawn during the bleeding operation must not be re-used.*

(3) After Hydrovac has been bled, bleed wheel cylinders in any convenient order (par. 123 *e* (7)).

e. Removal. Removal of the Hydrovac from the vehicle is accomplished as follows:

(1) Loosen clamp screw, and disconnect Hydrovac to check valve vacuum line at Hydrovac.

(2) Loosen screw in air cleaner hose at Hydrovac end, and disconnect hose.

(3) Loosen nut on slave cylinder to wheel cylinder brake line at end of slave cylinder, and disconnect line.

(4) Loosen nut on master cylinder to Hydrovac line at Hydrovac, and disconnect line.

(5) Remove two nuts and lock washers from front end of two long Hydrovac clamp screws at front mounting bracket.

(6) Remove two nuts and lock washers from rear end of long screws at rear bracket.

(7) Loosen nuts and lock washers on two rear mounting bracket bolts.

(8) Lower Hydrovac from mounting brackets and from frame of vehicle.

f. Installation.

(1) Raise Hydrovac into position in brackets on vehicle frame side rail, feeding long clamp screws into front and rear mounting brackets.

(2) Tighten two nuts and lock washers of rear mounting bracket bolts. Install and tighten four nuts and lock washers on front and rear ends of two long Hydrovac clamp screws.

(3) Connect Hydrovac to master cylinder brake line at Hydrovac, and tighten nut.

(4) Connect Hydrovac to wheel cylinder brake line at slave cylinder, and tighten nut.

(5) Connect air cleaner hose at Hydrovac, and tighten clamp screw.

(6) Connect Hydrovac to check valve vacuum line at Hydrovac, and tighten two clamp screws.

(7) Bleed Hydrovac as outlined in subparagraph *d* above, and bleed hydraulic system (par. 123 *e* (7)).

122. B-K VACUUM POWER BRAKE CYLINDER.

a. Description. The B-K vacuum power brake cylinder (booster) is of vacuum-suspended type, having the engine as its source of vacuum. The unit has an internal control valve, located in the hollow piston rod and actuated by external pedal linkage. The unit is of "reactionary" type because the foot pedal linkage feeds an opposing force against the foot pedal.

b. Operation.

(1) As this unit is of the vacuum-suspended type, a vacuum is created on both sides of the vacuum piston. The front shell is connected directly to the vacuum source; and a direct opening at the center of the piston allows vacuum to be present on the opposite side of the piston, thus suspending the piston in vacuum. A conical return spring holds the piston in its released position, and a valve return spring holds the vacuum valve in open position (fig. 101). Air is admitted into the hollow piston rod through port holes in the piston rod, and through the rubber guard and air cleaner.

(2) When the foot pedal is depressed, the operating linkage moves the valve rod toward the cylinder (fig. 101). This movement, first, seats the

vacuum valve, sealing off communication between both sides of the vacuum piston, and, second, the atmospheric valve leaves its seat, allowing air from the air cleaner and hollow piston rod to enter the rear compartment of the power cylinder, moving the piston toward the vacuum side. As the power cylinder piston rod is connected to the brake linkage, this motion applies the brakes.

(3) In the holding or partially applied position, the piston will position itself at the point reached when both vacuum and atmospheric valves are on their respective seats.

*c. **Adjustments.*** The power cylinder is a self-contained unit requiring no internal adjustments. The only external adjustments are the positioning of the piston rod yoke in relation to the power lever, and the positioning of the valve rod yoke in relation to the piston rod yoke pin. Adjustment procedure, with references to figure 100, is as follows:

(1) Be sure that support spring at the end of the vacuum cylinder mounting is in position.

(2) Loosen nut "A" from its lock washer. Hold brake pedal up in fully released position, then depress to allow clearance of from ¼ to ⅜ inch between pedal and floorboard, and hold in this position.

(3) Pull power lever "B" forward to assure vacuum cylinder piston being in fully released position. Tighten nut "A" while holding pedal linkage in this position.

(4) Depress brake pedal just barely enough to open the vacuum cylinder valve. This may be determined by observing when all the valve yoke to clevis pin clearance is at the cylinder side of the clevis pin (fig. 100, Applied Position).

(5) Loosen the lock nut on stop screw "C" and turn the screw with the fingers until it contacts the hydraulic master cylinder lever "D." Tighten the lock nut, exercising caution not to alter the stop screw adjustment.

(6) Holding the brake pedal in the position described in step (4) above, adjust the hydraulic master cylinder yoke by lengthening or shortening the master cylinder push rod to remove clearance between the push rod and the piston.

(7) When the brake pedal is released, the clevis pin will return to the cylinder end of the valve lever slot (fig. 100, Released Position). This will give the correct master cylinder push rod to piston clearance.

(8) Remove the master cylinder filler plug and note that there is a surge of fluid up into the reservoir upon a slight application of brake pedal. This will assure that the compensating port is clear in the master cylinder.

(9) Test vacuum cylinder action by making a brake application with the engine operating. The vacuum cylinder response and release should be immediate. If the response upon application is sluggish, the vacuum

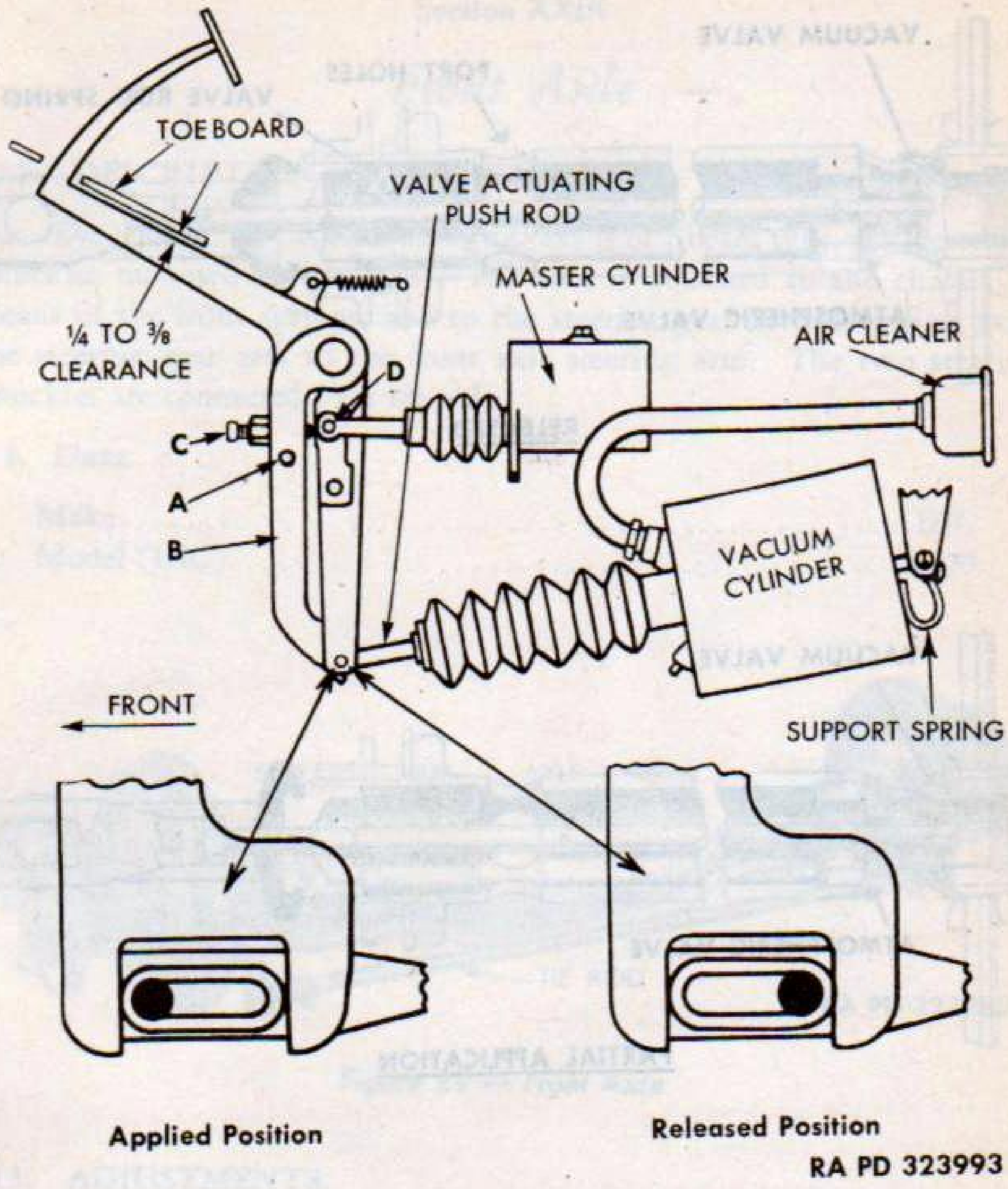


Figure 100 — Vacuum Power Cylinder Control Adjustment Diagram

cylinder valve actuating push rod is too short. If the response upon release is sluggish, the valve actuating push rod is too long. Correction must be made by adjusting the valve actuating push rod length one-half turn at a time, as required, until proper vacuum cylinder response is attained.

d. Testing. The power cylinder can be tested on the vehicle as follows: (1) Remove pipe plug in the power cylinder end plate, and connect a vacuum gage.

(2) Start engine, and note reading on vacuum gage. It should read the same as engine vacuum, and must be from 16 to 20 inches. Stop engine, and note how long vacuum is retained. It should release vacuum very

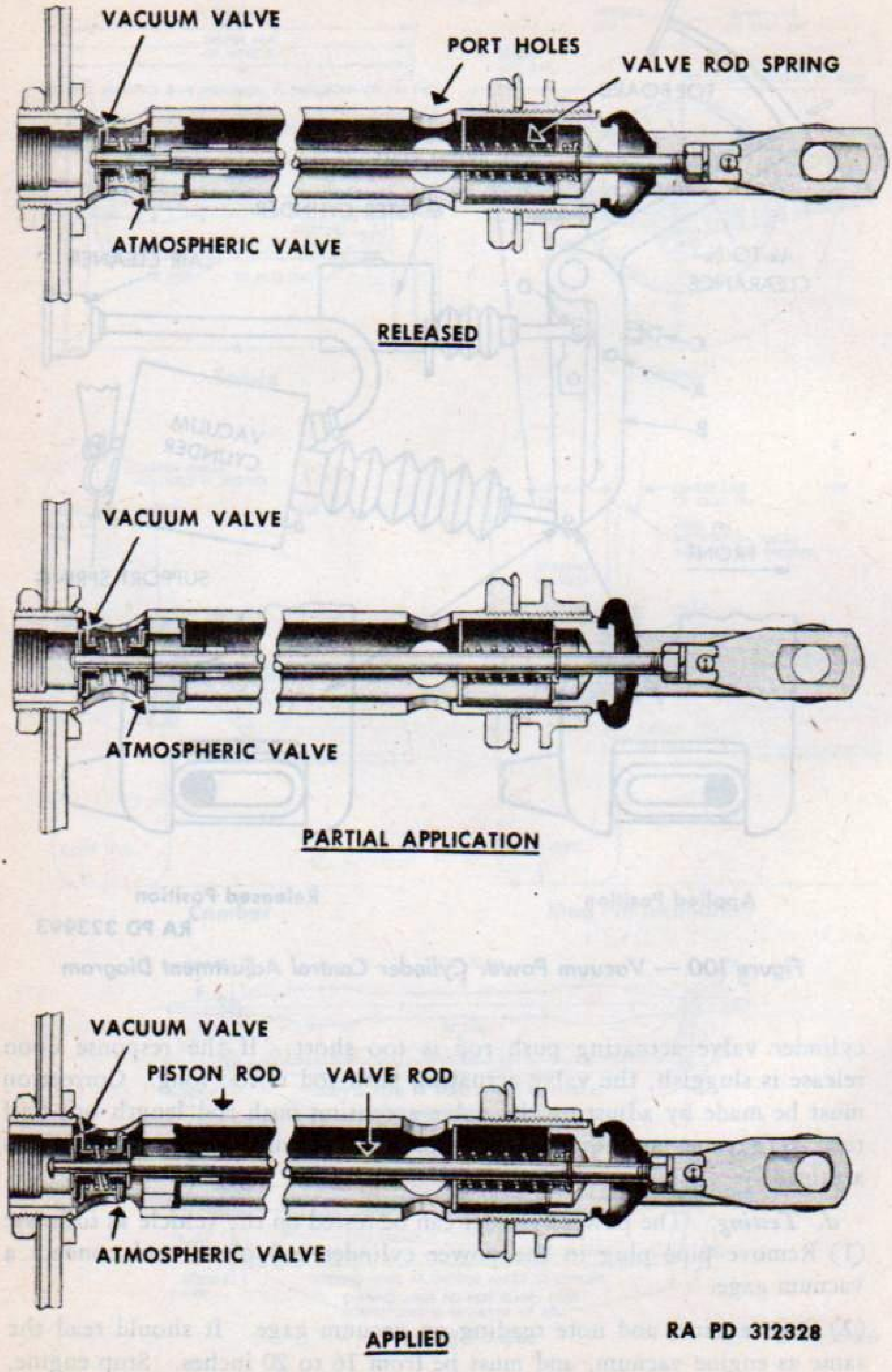


Figure 101 — Vacuum Power Cylinder Valve Rod, Sectional Views

slowly. If gage shows rapid drop (more than 10 inches in 10 seconds) a leak is indicated. This leakage may be in the power cylinder, vacuum lines, or fittings.

(3) Test the check valve by connecting the vacuum gage to bottom connection of check valve. Start engine, note gage reading, then stop engine. If gage shows a drop of more than 10 inches in one minute, the valve should be replaced.

(4) Before testing vacuum line, inspect all hose and tubes to see that they are in good condition, and check all connections to see that they are tight. Connect vacuum gage in power cylinder end of vacuum line. Start engine, and note gage reading. Stop engine, and note drop in reading of vacuum gage. The drop should not exceed that at the check valve as tested in step (3) above.

(5) If tests (3) and (4) show no excessive drop in vacuum (more than 10 inches in one minute), then connect vacuum gage back in power cylinder end plate and repeat test (2). If gage still shows drop greater than 10 inches in 10 seconds, the leak is in the power cylinder, and it must be replaced.

e. Removal.

(1) Loosen clamp screw in vacuum line hose at power cylinder, and disconnect hose.

(2) Loosen clamp screw in air cleaner hose at vacuum cylinder, and disconnect hose.

(3) Remove cotter pin from yoke pin at front of power cylinder push rod, and remove clevis pin.

(4) Remove cotter pin from yoke pin at rear of power cylinder, and remove yoke pin and hook spring.

(5) Lower vacuum power cylinder from vehicle.

f. Installation.

(1) Raise vacuum power cylinder into position on the vehicle, and support it there.

(2) Place hook spring in position at rear of power cylinder, and install yoke pin and cotter pin.

(3) Connect power cylinder valve rod yoke to lever, install yoke pin, and install new cotter pin in yoke pin.

(4) Connect vacuum line hose to power cylinder, and tighten clamp screw.

(5) Connect air cleaner hose to vacuum power cylinder, and tighten hose clamp screw.

(6) Check power cylinder adjustment as outlined in subparagraph *c* above, and readjust linkage as necessary.

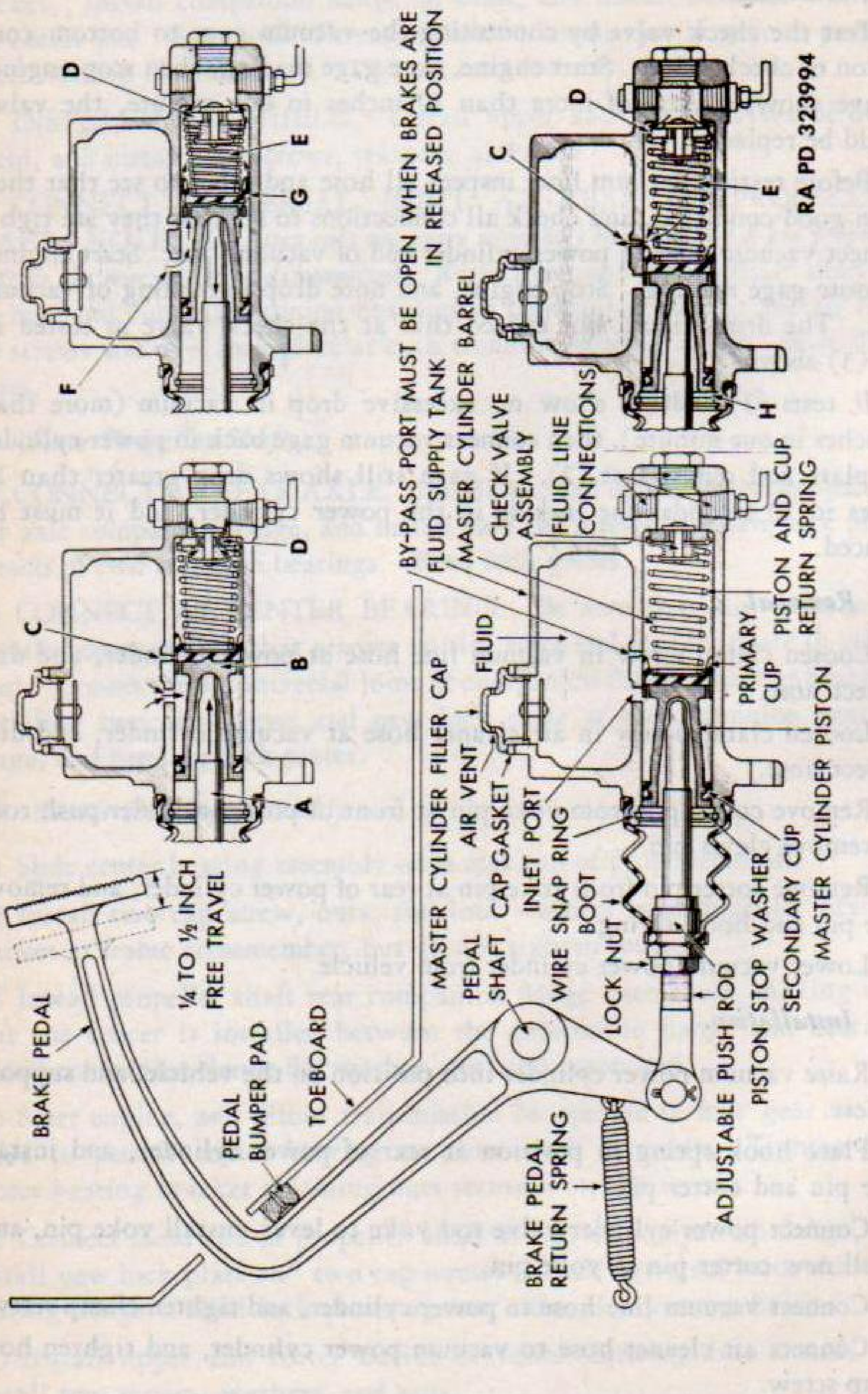


Figure 102 — Master Cylinder, Sectional Views

123. MASTER CYLINDER.

a. Description.

(1) The master cylinder is located on a bracket just behind the brake pedal shaft. It consists of barrel and tank casting, double check valve, piston cup return spring, piston cup, piston, piston stop, boot, and a connecting link (fig. 102).

(2) The master cylinder is of the compensating type. Its primary compensating function is to maintain a constant volume of fluid in the system at all times, regardless of expansion from heat or contraction from cold. The secondary function of the compensating system is the replacement of additional fluid into the system to balance any loss due to gravity seepage.

b. Operation. References below are to figure 102.

(1) Depressing the brake pedal moves the adjustable push rod "A" against the piston "B," causing the master cylinder piston assembly to move toward the outlet end of the cylinder.

(2) A slight movement of the piston and cup closes the by-pass port "C," and the pressure stroke starts.

(3) As the piston travels toward the outlet end of the cylinder, fluid is forced out through the inner port of the check valve "D" into the lines and wheel cylinders.

(4) When the brake pedal is released, the fast return of the piston and cup by pressure of the piston return spring "E," and the relatively slower return of the fluid from the wheel cylinders and lines, causes a vacuum in the master cylinder. This momentary vacuum pulls additional fluid from the supply tank through the intake port hole "F," past the lip of the primary cup "G," thus supercharging the pressure system.

(5) During the pressure stroke, the fluid is forced from the cylinder through the inner port of the check valve "D." When the fluid returns to the master cylinder, it must raise the entire check valve assembly from its seat.

(6) When the master cylinder piston and cup have returned to their stop "H," the surplus fluid can escape into the supply tank through the by-pass port "C."

(7) When the pressure on the returning fluid drops to approximately 7 pounds, the piston return spring "E" closes the check valve "D." The wheel cylinders and lines are thus held under approximately 7-pound pressure. This residual line pressure effects a seal which prevents seepage of fluid from the system and prevents air from entering the system at the wheel cylinders.

c. Adjustment.

(1) PURPOSE. The compensating features of the master cylinder cannot

function without proper brake pedal adjustment which permits fluid return from the brake lines. Brakes will drag after several applications if the master cylinder by-pass port is blocked. It is imperative that the master cylinder piston be against its stop, and that pedal link rod be adjusted for clearance where it seats in the master cylinder piston. There must be at least ¼-inch free play or travel of the brake pedal before the pressure stroke starts, but too much free travel reduces the effective travel of the master cylinder piston, which in turn reduces brake effectiveness.

(2) PROCEDURE.

(a) Loosen lock nut on master cylinder adjustable push rod at push rod yoke.

(b) Remove cotter pin from master cylinder push rod yoke pin, and remove yoke pin from yoke.

(c) With pedal back against toeboard, and with master cylinder push rod pulled outward from the master cylinder to bring the master cylinder piston against its stop, adjust master cylinder adjustable push rod length by lengthening or shortening it to permit installation of yoke pin.

(d) Install new cotter pin in yoke pin, and tighten lock nut.

(e) Remove the master cylinder filler plug and note that there is a surge of fluid up into the reservoir upon a slight application of the brake pedal. This will assure that the compensating port is clear in the master cylinder.

d. Removal. Removal of the hydraulic master cylinder is accomplished as follows:

(1) Disconnect stop light switch wires at stop light switch at master cylinder.

(2) Loosen lock nut at master cylinder on brake line to Hydrovac (on vehicle so equipped), or to wheel cylinders (on B-K power-cylinder-equipped vehicle), and disconnect brake line.

(3) Remove cotter pin from master cylinder push rod yoke, and remove yoke pin from yoke.

(4) Remove nuts and lock washers from three cap screws in master cylinder flange at mounting bracket.

(5) Lower master cylinder from mounting bracket.

e. Installation.

(1) Place master cylinder in position on mounting bracket, and install three cap screws, nuts, and lock washers.

(2) Connect master cylinder to Hydrovac line, or to wheel cylinder line, at master cylinder, and tighten lock nut.

(3) With master cylinder push rod pulled outward from the master cylinder so as to position the master cylinder piston against its stop, and

with brake pedal just below the toeboard, check to see if it is possible to install yoke pin in master cylinder push rod yoke. If not, adjust length of push rod by lengthening or shortening push rod.

(4) Install push rod yoke pin, and install new cotter pin.

(5) Connect stop light switch wires at stop light switch at master cylinder.

(6) Remove master cylinder filler plug, and note that there is a surge of brake fluid up into the master cylinder upon a slight application of the brake pedal. This will assure that the compensating port is clear in the master cylinder.

(7) Bleed hydraulic brake system, bleeding Hydrovac first (on vehicles so equipped) as described in paragraph 121 ***d***, and then bleeding system at wheel cylinders as follows:

(a) Remove cap screw from bleeder connection, and screw brake bleeder hose into connection. Place lower end of bleeder hose below fluid level of a small amount of brake fluid in a container.

(b) Be sure that brake master cylinder is full of fluid, and that it is kept full during the bleeding operation.

(c) Loosen bleeder valve screw one full turn. Depress the brake pedal very slowly, then allow it to return slowly to its released position. Repeat this operation several times, forcing fluid through the lines to expel all air. Air is fully expelled when no bubbles appear at the lower end of the bleeder hose.

(d) When bubbles cease and the stream is a clean, solid mass, close the bleeder valve screw, and remove bleeder hose. Install cap screw in bleeder screw.

(e) Repeat bleeding operation at remaining wheel cylinders. NOTE: *Fluid withdrawn during the bleeding operation must not be re-used.*

124. VACUUM CHECK VALVE.

a. Description. A check valve is installed in the engine vacuum line from the engine intake manifold (figs. 93 and 94). It is mounted on the engine compartment side of the dash. Its purpose is to trap vacuum in the system at its highest point. This trapped vacuum allows for one or two additional brake applications after the source of vacuum has ceased. Another purpose of the vacuum check valve is to protect the vacuum power cylinder in case of an engine backfire, which might otherwise damage the cylinder.

b. Removal.

(1) Loosen clamp screws in vacuum hose clamps at upper and lower ends of vacuum check valve, and disconnect hose from check valve.

(2) Remove nut and lock washer from clamp cap screw at check valve, and remove check valve from dash bracket.

c. Installation.

(1) Install check valve in bracket on dash, being sure to install right side up. Install and tighten nut and lock washer on clamp cap screw.

(2) Connect upper and lower vacuum hose at check valve, and tighten clamp screws.

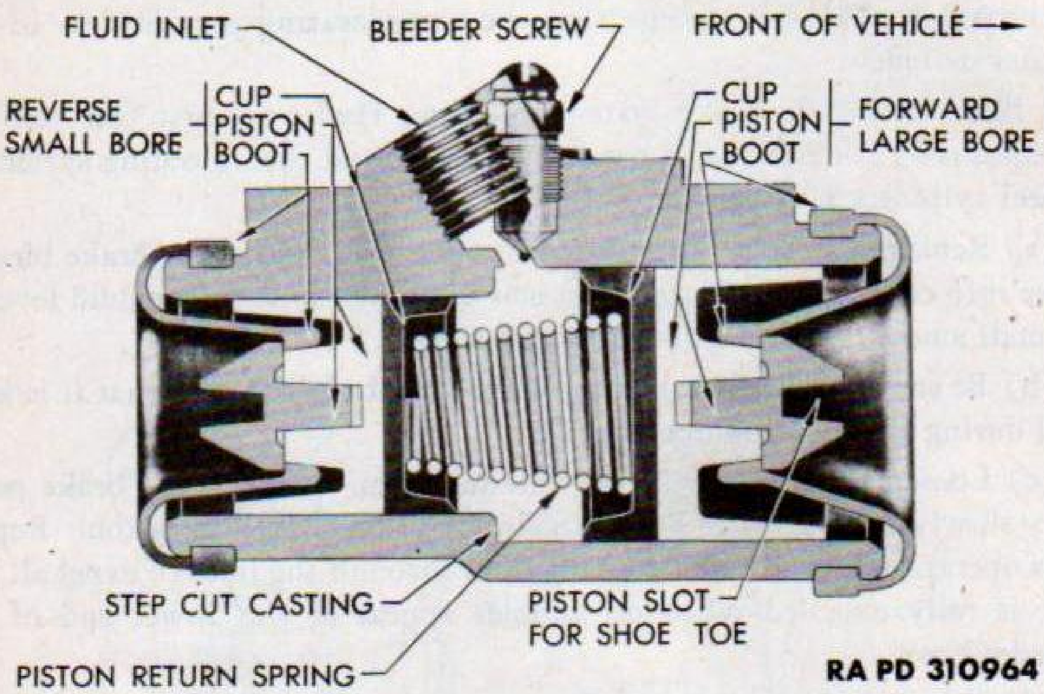


Figure 103 — Front Wheel Cylinder, Sectional View

125. WHEEL CYLINDERS.

a. Front Wheel Cylinder.

(1) DESCRIPTION. The front wheel brake cylinders are of step-bore type, having a larger cylinder bore at one end than at the other (fig. 103). The purpose of the step-cut casting is to vary hydraulic pressure.

(2) CONSTRUCTION AND OPERATION. The wheel cylinder consists of two rubber cups, two pistons, a piston return spring, and two rubber boots. The wheel cylinder is connected to the hydraulic system by metal tube and flexible hose. Brake fluid enters the wheel cylinder through the fluid inlet opening between the two pistons and forces the pistons outward. Since the brake shoes are connected to the wheel cylinder pistons, through connecting links, they in turn are expanded into contact with the brake drum. The rubber cups, assembled against the flat face of each piston and held in position by the wheel cylinder return spring, seal the system against loss of pressure. A bleeder screw is located above the inlet opening and is used to expel air from the system during the bleeding operation.

(3) REMOVAL.

(a) Remove brake shoes as outlined in paragraph 127 *a* (3).

(b) Loosen brake hose connection at wheel cylinder, and disconnect hose.

(c) Remove three mounting cap screws and lock washers from wheel cylinder, and remove wheel cylinder from brake backing plate.

(4) INSTALLATION.

(a) Place wheel cylinder in position on brake backing plate, and install three mounting cap screws and lock washers.

(b) Connect brake hose to wheel master cylinder, and tighten connection.

(c) Install and adjust brake shoes as outlined in paragraph 127 *a* (4).

(d) Bleed brake system as outlined in paragraph 123 *e* (7).

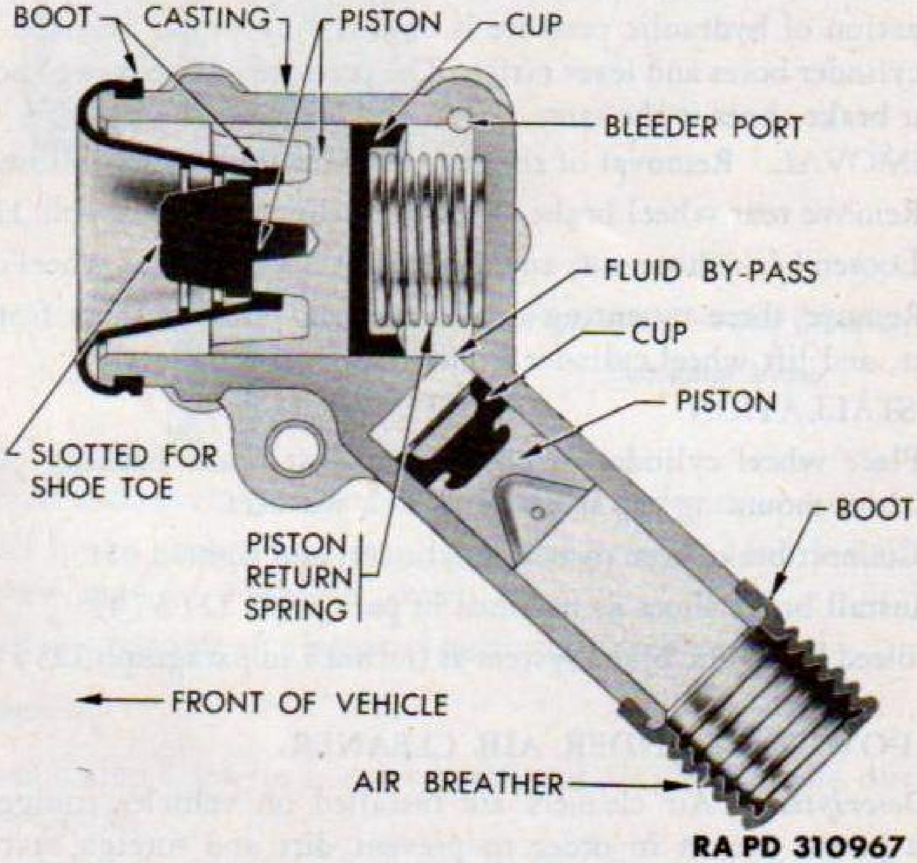


Figure 104 — Rear Wheel Cylinder, Sectional View

b. Rear Wheel Cylinder.

(1) DESCRIPTION. The wheel cylinder used at the rear wheels is of L-type. The pistons are at an angle to each other (fig. 104) and are not of the same diameter. The larger piston, actuating the front brake shoe, is of slotted-insert type, and is directly in contact with the brake shoe. The smaller piston, actuating the rear brake shoe, is of socket type, and is connected to the brake shoe through mechanical linkage. The large

diameter portion of the cylinder includes in addition to the piston, a rubber cup, a return spring, and a rubber boot over the end of the casting. The small or angular end of the cylinder has, in addition to the piston, a rubber cup which is of collar-button type which snaps into a recess in the face of the piston. This eliminates the necessity of a return spring. An accordion-type rubber boot is used over the end of the casting.

(2) CONSTRUCTION AND OPERATION. The L-type wheel cylinder is connected to the hydraulic system by flexible hose. Fluid enters the wheel cylinder through the inlet opening between the pistons, and forces the pistons outward. The large piston, connected directly to the front brake shoe, forces this shoe into contact with the brake drum. The cup seals the cylinder against loss of pressure, the return spring holding the cup in place against the flat face of the piston. The small piston, acting through a mechanical lever, forces the rear shoe into contact with the brake drum. Equalization of hydraulic pressure is obtained by proper relation between wheel cylinder bores and lever ratio. The pressure on the toes of both front and rear brake shoes is the same.

(3) REMOVAL. Removal of the rear wheel cylinder is as follows:

(a) Remove rear wheel brake shoes as outlined in paragraph 127 ***b*** (3).

(b) Loosen brake hose nut, and disconnect brake hose at wheel cylinder.

(c) Remove three mounting cap screws and lock washers from wheel cylinder, and lift wheel cylinder from brake backing plate.

(4) INSTALLATION.

(a) Place wheel cylinder in position against brake backing plate, and install three mounting cap screws and lock washers.

(b) Connect brake hose to wheel cylinder, and tighten nut.

(c) Install brake shoes as outlined in paragraph 127 ***b*** (4).

(d) Bleed hydraulic brake system as outlined in paragraph 123 ***e*** (7).

126. POWER CYLINDER AIR CLEANER.

a. Description. Air cleaners are installed on vehicles equipped with vaccum power brakes in order to prevent dirt and foreign matter from entering the brake system. The cleaning element is a combination of hair and screens through which the air is drawn (fig. 105). On the dump truck, the air cleaner is located beneath the driver's compartment seat cushion on the right-hand side. On the bus chassis, the air cleaner is mounted to a bracket beneath the cowl just ahead of the driver.

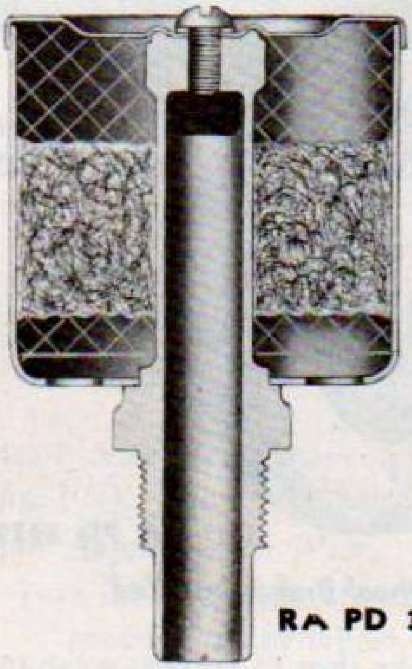
b. Operation. The lower port of the air cleaner is connected to the power brake system by a length of flexible hose. Air enters the unit at the bottom of the cleaner, passes through a wire screen, a mass of curled hair, and another screen up into a center tube, and finally down into the flexible hose and on into the vacuum power cylinder.

c. Cleaning and Servicing.

(1) The air cleaner can best be serviced after removing from the vehicle as outlined in step *d* below.

(2) Remove screw and lock washer from air cleaner cover, and lift off cover. Lift out top screen, hair mass, and lower screen.

(3) Wash parts thoroughly in dry-cleaning solvent, and allow them to drain dry.



RA PD 312352

Figure 105 — Air Cleaner, Sectional View

(4) Dip hair mass in light engine oil, and allow to drain.

(5) Install lower screen, hair mass, and upper screen, and install cover. Install screw and lock washer in cover.

(6) Install and connect air cleaner as outlined in step *e* below.

d. Removal.

(1) Loosen clamp screw in hose at bottom of air cleaner, and disconnect hose from cleaner.

(2) Remove large nut and lock washer from bottom of air cleaner center tube.

(3) Lift air cleaner from its mounting bracket or base.

e. Installation.

(1) Place air cleaner in position on mounting bracket.

(2) Install and tighten large nut and lock washer on bottom of air cleaner center tube.

(3) Connect air hose to lower end of air cleaner, and tighten hose clamp screw.

127. BRAKE SHOES.

a. Front Brakes.

(1) DESCRIPTION (fig. 106). The front wheel brakes are of the Lockheed type. The brake shoe group consists of a forward brake shoe and a reverse brake shoe, both with brake linings installed, mounted on two anchor pins at their lower ends, and with their upper ends inserted into the wheel cylinder. A guide is used for each brake shoe to prevent wear and chattering. The brake shoes are held in their contracted position, or released by a brake shoe return spring, attached between the shoes, which causes the brake shoes to leave the brake drum upon brake release. The anchor pins are eccentric, and they are used in making major brake adjustments only. There are two adjusting cams, one for each brake shoe, which are used for minor, or service, adjustments. The brake shoes and wheel cylinder are mounted on a brake backing plate. As the brake pedal is depressed, hydraulic fluid is forced into the wheel cylinders against the wheel cylinder pistons which move outward forcing the brake shoes to expand against the wheel brake drum to create the friction necessary to arrest the motion of the wheel. As pedal pressure is released, the brake shoe return spring pulls the brake shoes away from the brake drum, and the brake fluid is forced to return to the master cylinder. In the Lockheed-type brake, when the brake drum is in forward rotation, the forward brake shoe does most of the stopping, and the reverse shoe is a trailing shoe with less stopping ability.

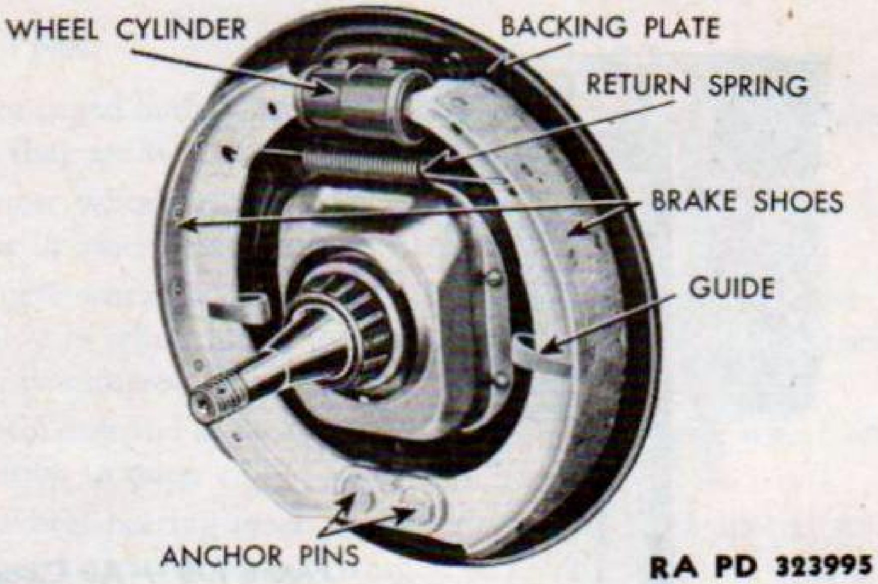
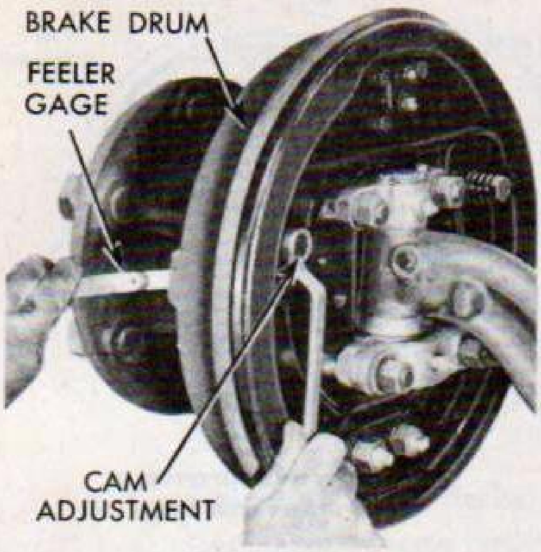
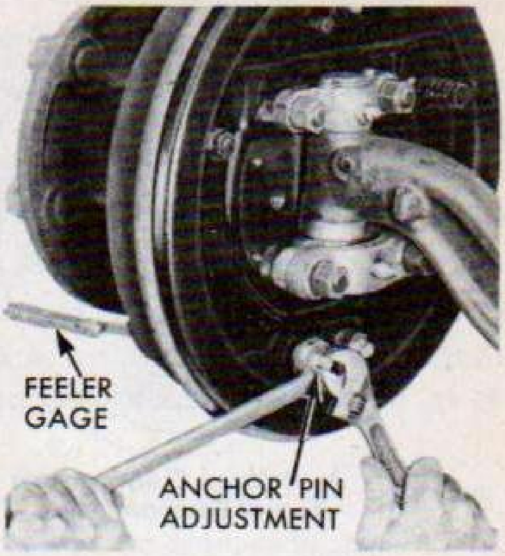


Figure 106 — Front Wheel Brakes Installed

(2) ADJUSTMENTS. Only a minor, or service adjustment need be made to compensate for wear of brake shoe linings (A, fig. 107), and the anchor pin adjustment must not be altered for this service adjustment. When brake shoes are replaced, however, a major brake shoe adjustment involving the



A. Making Cam Adjustment



B. Making Anchor Pin Adjustment

RA PD 323996

Figure 107 — Adjusting Front Wheel Brakes

anchor pins is mandatory to assure proper shoe to drum contour and clearance (B, fig. 107). The adjustments are as follows:

(a) *Minor Adjustment for Wear.*

1. Turn forward brake shoe cam adjustment in direction of forward rotation of the wheel until a definite brake drag is felt, then back off adjustment until wheel is free (A, fig. 108).
2. Turn reverse brake shoe cam adjustment in the direction of the reverse rotation of the wheel until a definite brake drag is felt, then back off adjustment until wheel is free (D, fig. 108).

(b) *Major Adjustment.* This adjustment is required only when brake shoe anchor pins have been disturbed, or when brake shoes have been replaced.

1. Reduce Clearance at Toe of Forward Shoe (A, fig. 108). Turn front brake shoe cam adjustment in the direction of the forward rotation of the wheel until a definite brake drag is felt, then back off adjustment until wheel is free.
2. Centralize Forward Brake Shoe in Brake Drum (B, fig. 108). Loosen lock nut on eccentric anchor pin and turn anchor pin in the direction of forward rotation of the wheel until a definite brake drag is felt. Note position of punch mark on end of anchor pin. Turn anchor pin in opposite direction until a definite brake drag is again felt. Again note position of punch mark on end of anchor pin. Turn anchor pin to a position with the punch mark on anchor pin just between the two extremes.

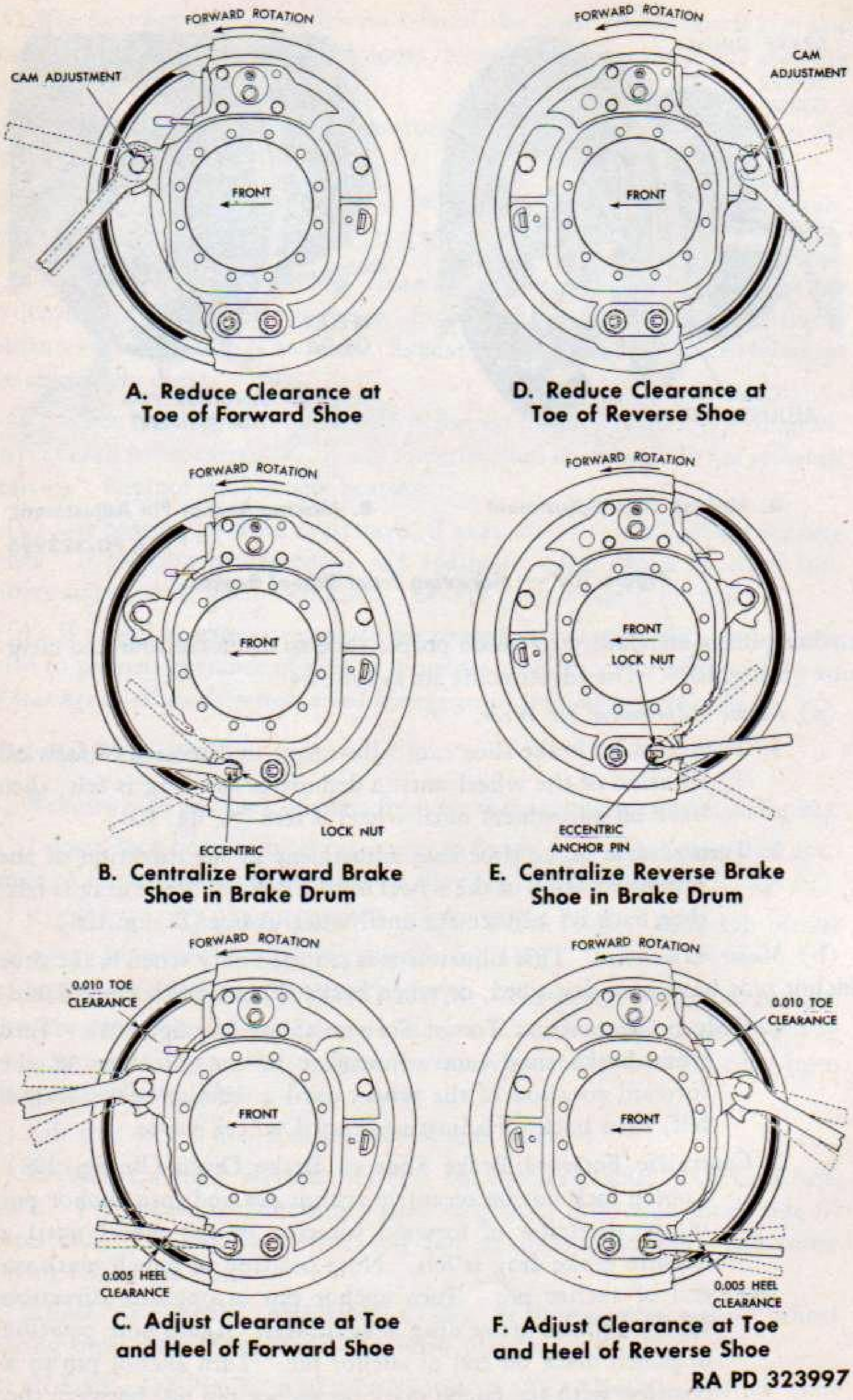


Figure 108 — Front Wheel Brake Adjustment Diagram

3. Adjust Clearance at Toe and Heel of Forward Shoe (C, fig. 108). Check clearance at both toe (upper) and heel (lower) end of forward brake shoe, and adjust cam adjustment and anchor alternately until the toe clearance is 0.010 inch and the heel clearance is 0.005 inch. Tighten anchor pin lock nut securely, recheck brake shoe to brake drum clearances, and adjust again if necessary.
4. Reduce Clearance at Toe of Reverse Shoe (D, fig. 108). Adjust reverse brake shoe clearance at toe as in step 1 above, turning cam adjustment in the direction of reverse rotation of the wheel.
5. Centralize Reverse Brake Shoe in Brake Drum (E, fig. 108). Centralize reverse brake shoe in brake drum as in step 2 above, turning anchor pin in direction of reverse rotation of wheel.
6. Adjust Clearance at Toe and Heel of Reverse Shoe (F, fig. 108). Check clearance at both toe (upper) and heel (lower) ends of reverse brake shoe as in step 3 above, to provide a brake shoe to brake drum clearance of 0.010 inch at toe, and 0.005 inch at heel of shoe.

(3) REMOVAL. Removal of front brake shoes is accomplished as follows:

(a) Remove front wheel and brake drum as outlined in paragraph 132 ***a***.

(b) Loosen and remove anchor pin nut and lock washer from each of two anchor pins (A, fig. 109).

(c) Tap anchor pins to drive them out of brake shoes, and remove anchor pins and anchor pin plate (B, fig. 109).

(d) Remove brake shoes, moving lower ends outward to free shoes from shoe guides, then inward toward each other while moving upper ends out of wheel cylinder (C, fig. 109). Remove brake shoes from brake backing plate, and remove brake shoe return spring.

(4) INSTALLATION (fig. 109).

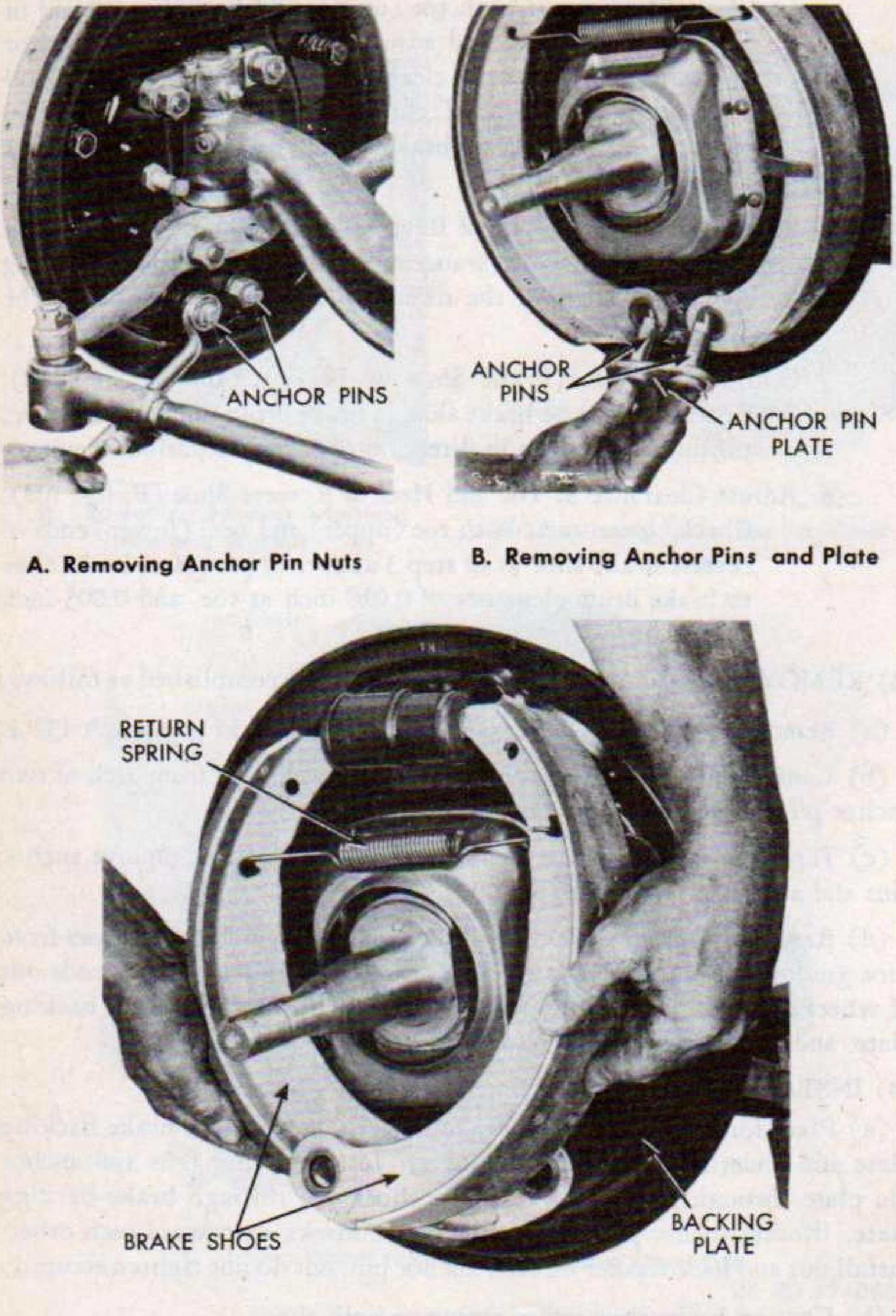
(a) Place forward and reverse brake shoes in position on brake backing plate and underneath brake shoe guides. Install anchor pins and anchor pin plate through lower ends of brake shoes and through brake backing plate. Rotate anchor pins so that the punch marks are toward each other. Install nut and lock washer on each anchor pin, but do not tighten securely.

(b) Connect brake shoe return spring to both shoes.

(c) Install front wheel as outlined in paragraph 133 ***a***.

(d) Adjust brake shoes as outlined in subparagraph ***a*** (2) (b) above.

(e) Bleed brake system as outlined in paragraph 123 ***e*** (7).



A. Removing Anchor Pin Nuts **B. Removing Anchor Pins and Plate**

C. Removing Brake Shoes from Backing Plate **RA PD 323998**

Figure 109 — Removing Front Wheel Brake Shoes

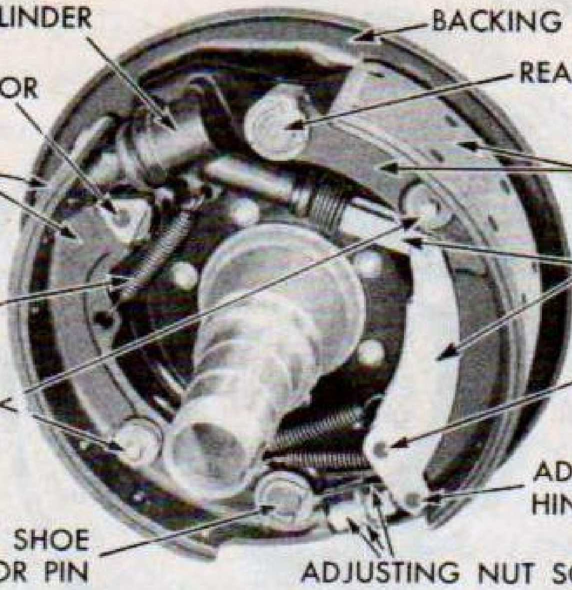


Figure 110 — Rear Wheel Brakes Installed

b. Rear Brakes.

(1) DESCRIPTION (figs. 110 and 111).

(a) The rear wheel brakes are of Hi-Tork type. The Hi-Tork brake assembly is designed to take advantage of brake drum energization on both front and rear brake shoes, when the vehicle is being braked while traveling in the forward direction. When the vehicle is moving backward, the rear brake shoe only is energized. The L-type wheel cylinder is used with this brake design. The top or toe-end of the front brake shoe is inserted directly into the slotted metal insert in the wheel cylinder piston. The rear shoe is connected to the wheel cylinder piston by a push rod and lever. The heel of the rear shoe is located at the top of the brake assembly, adjacent to the wheel cylinder. The toe of the rear shoe is located at the bottom end of the brake assembly. These locations are reversed on the front brake shoe. Eccentric anchor pins are used. The rear brake shoe is anchored in a fixed position at the heel of the shoe by an anchor pin located near the wheel cylinder. In operation, brake drum energization is applied to both front and rear shoes while the vehicle is making a stop in the forward direction. When vehicle is braked in the backward direction, only the rear shoe receives drum energization. In this type of brake, hydraulic pressure is applied to the toe of the front brake shoe, and brake drum energization is applied to both shoes. Each shoe pivots on an eccentric anchor pin, so that the shoe radius may remain concentric with the brake drum radius, and full lining contact may be maintained.

(b) The anchor pins are eccentric. The rear shoe is anchored in a fixed position at the heel of the shoe by an anchor pin located near the wheel

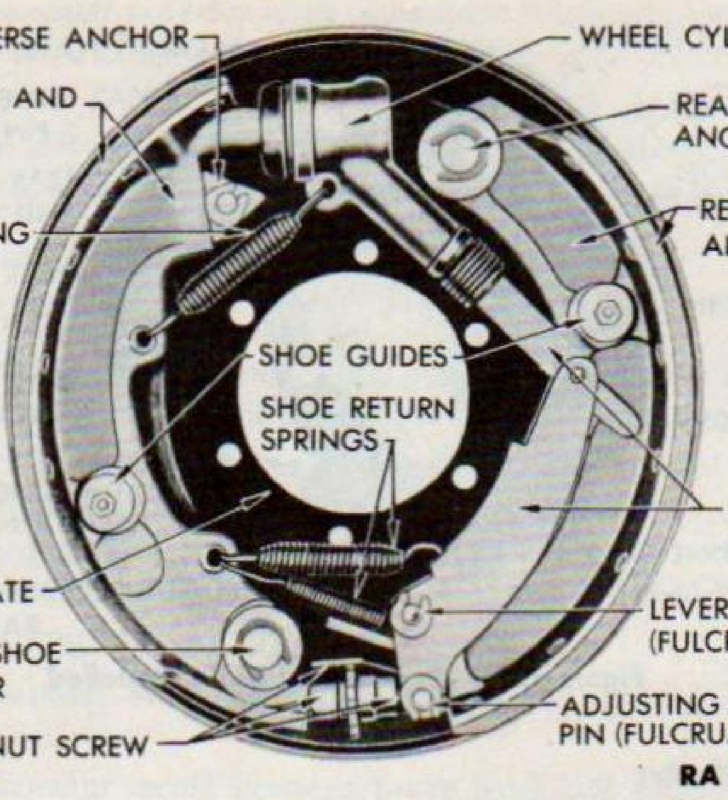


Figure 111 — Hi-Tork Brake Assembly Details

cylinder. The front shoe heel anchor, on the side opposite to the wheel cylinder, is not located in a fixed position. When the vehicle is moving in reverse direction, the shoe pivot point changes. The triangular cam, or reverse anchor, at the top of the shoe now becomes the pivot point, and the lower tip of the shoe now becomes the toe. The front shoe is actuated by the small wheel cylinder piston when the vehicle is in reverse motion.

(c) A star wheel, or adjusting nut, located opposite the wheel cylinder, floats between the heel of the front shoe and the toe of the rear shoe.

(d) When the vehicle is moving forward, pressure on the brake pedal causes the wheel cylinder pistons to push the toe of the front shoe into contact with the brake drum, and, through the linkage, to push the toe of the rear shoe against the brake drum. The front shoe seats on the anchor located opposite the wheel cylinder, and both shoes receive energization from the rotation of the drum.

(e) When the vehicle is moving backward, the small wheel cylinder piston, through its linkage, forces the rear shoe against the brake drum, where it serves as a helper shoe, and also forces the heel of the front shoe away from its anchor and into contact with the drum. The shoe then anchors on the cam located at the toe end, and the front shoe receives energization from the brake drum.

(2) ADJUSTMENT. Only a minor, or service, adjustment need be made to compensate for wear of brake shoe linings, and the anchor pin adjustment

must not be altered for this service adjustments. When brake shoes are replaced, however, a major adjustment is mandatory to assure proper shoe to brake drum contours and clearance. Adjustments are as follows:

(a) *Minor Adjustment for Wear.*

1. Reduce Clearance at Toe of Front Shoe (A, fig. 112). Insert 0.012-inch feeler gage through upper front slot in brake backing plate into space between brake shoe lining and brake drum. Loosen lock nut on cam adjustment, and turn cam in direction of forward rotation of wheel until definite drag is felt on feeler gage. Remove feeler gage, and tighten lock nut. Recheck clearance.

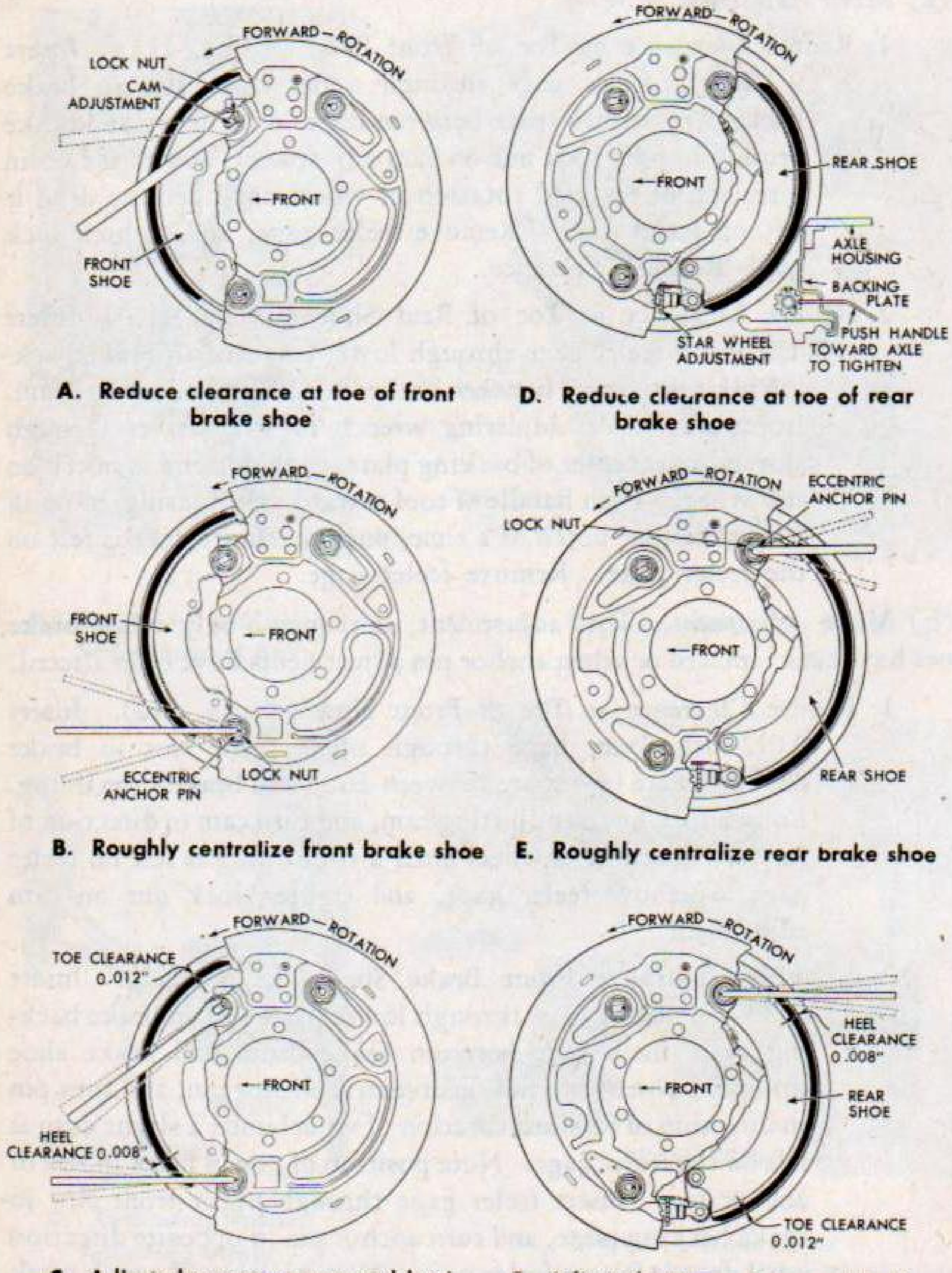
2. Reduce Clearance at Toe of Rear Shoe (D, fig. 112). Insert 0.012-inch feeler gage through lower rear slot in brake backing plate into space between brake shoe lining and brake drum. Insert star wheel adjusting wrench or screwdriver through slot in lower center of backing plate, engaging end in notch on star wheel. Push handle of tool toward axle housing, moving star wheel one notch at a time, until a definite drag is felt on the feeler gage. Remove feeler gage.

(b) *Major Adjustment*. This adjustment, is required only when brake shoes have been replaced or when anchor pin adjustments have been altered.

1. Reduce Clearance at Toe of Front Shoe (A, fig. 112). Insert 0.012-inch feeler gage through upper front slot in brake backing plate into space between drum and brake shoe lining. Loosen lock nut on adjusting cam, and turn cam in direction of forward rotation of wheel until a slight drag is felt on feeler gage. Remove feeler gage, and tighten lock nut on cam adjustment.

2. Roughly Centralize Front Brake Shoe (B, fig. 112). Insert 0.008-inch feeler gage through lower front slot in brake backing plate into space between brake drum and brake shoe lining. Loosen lock nut on eccentric anchor pin, and turn pin in direction of forward rotation of wheel until a slight drag is felt on the feeler gage. Note position of punch mark in end of anchor pin. Insert feeler gage through upper front slot in brake backing plate, and turn anchor pin in opposite direction until drag is felt on feeler gage. Note position of punch mark on end of anchor pin. Turn anchor pin so that punch mark is halfway between the two extremes.

3. Adjust Clearance at Heel and Toe of Front Shoe (C, fig. 112). Check clearance at both toe (upper) and heel (lower) ends of front brake shoe, and adjust cam and anchor alternately until



A. Reduce clearance at toe of front brake shoe

D. Reduce clearance at toe of rear brake shoe

B. Roughly centralize front brake shoe

E. Roughly centralize rear brake shoe

C. Adjust clearance at toe and heel of front shoe

F. Adjust clearance at toe and heel of rear shoe

RA PD 324000

Figure 112 — Rear Wheel Brake Adjustment Diagram

the toe clearance (upper end of shoe) is 0.012 inch and the heel clearance (lower end of shoe) is 0.008 inch. Tighten lock nuts securely, and recheck clearances. Readjust if necessary.

4. Reduce Clearance at Toe of Rear Brake Shoe (D, fig. 112). Insert feeler gage through lower rear slot in brake backing plate into space between the brake drum and brake shoe lining. Insert a star wheel adjusting tool or screwdriver through slot in brake backing plate, engaging end of notch on star wheel. Push handle of tool toward axle housing, moving star wheel one notch at a time, until a slight drag is felt on feeler gage.

5. Roughly Centralize Rear Brake Shoe (E, fig. 112). Insert feeler gage through lower rear slot in brake backing plate into space between the brake drum and brake shoe lining. Loosen the lock nut on the eccentric anchor pin, and turn anchor pin in direction of reverse rotation of the wheel until a slight drag is felt on the feeler gage. Note the position of the punch mark on the end of the anchor pin. Insert feeler gage through upper rear slot in brake backing plate, and turn the anchor pin in the opposite direction until a slight drag is felt on the feeler gage. Note position of punch mark on end of anchor pin. Turn anchor pin so that the punch mark is halfway between the two extremes.

6. Adjust Clearance at Toe and Heel of Rear Shoe (F, fig. 112). Check clearance at both the toe (lower end) and heel (upper end) of rear brake shoe, and adjust star wheel and anchor pin alternately until toe clearance (lower end of shoe) is 0.012 inch, and heel clearance (upper end of shoe) is 0.008 inch. Tighten anchor pin lock nut, and recheck clearances. Readjust if necessary.

(3) REMOVAL.

(a) Remove rear wheel as outlined in paragraph 132 *c*.

(b) Remove shoe return springs from brake shoes, using spring removing tool.

(c) Remove lock nuts from two brake shoe guide bolts (A, fig. 113). Remove two plain washers from guide bolts, and remove guide bolts.

(d) Spread one "C" washer at top brake anchor pin, pry it loose, and remove from anchor pin (B, fig. 113).

(e) Remove front brake shoe, sliding lower end of shoe out from under anchor pin washer (C, fig. 113).

(f) Remove rear brake shoe, pressing lever connected to push rod firmly against the web of the brake shoe, and rotating brake shoe outward until the push rod is out of the small diameter of the wheel cylinder. Pull brake

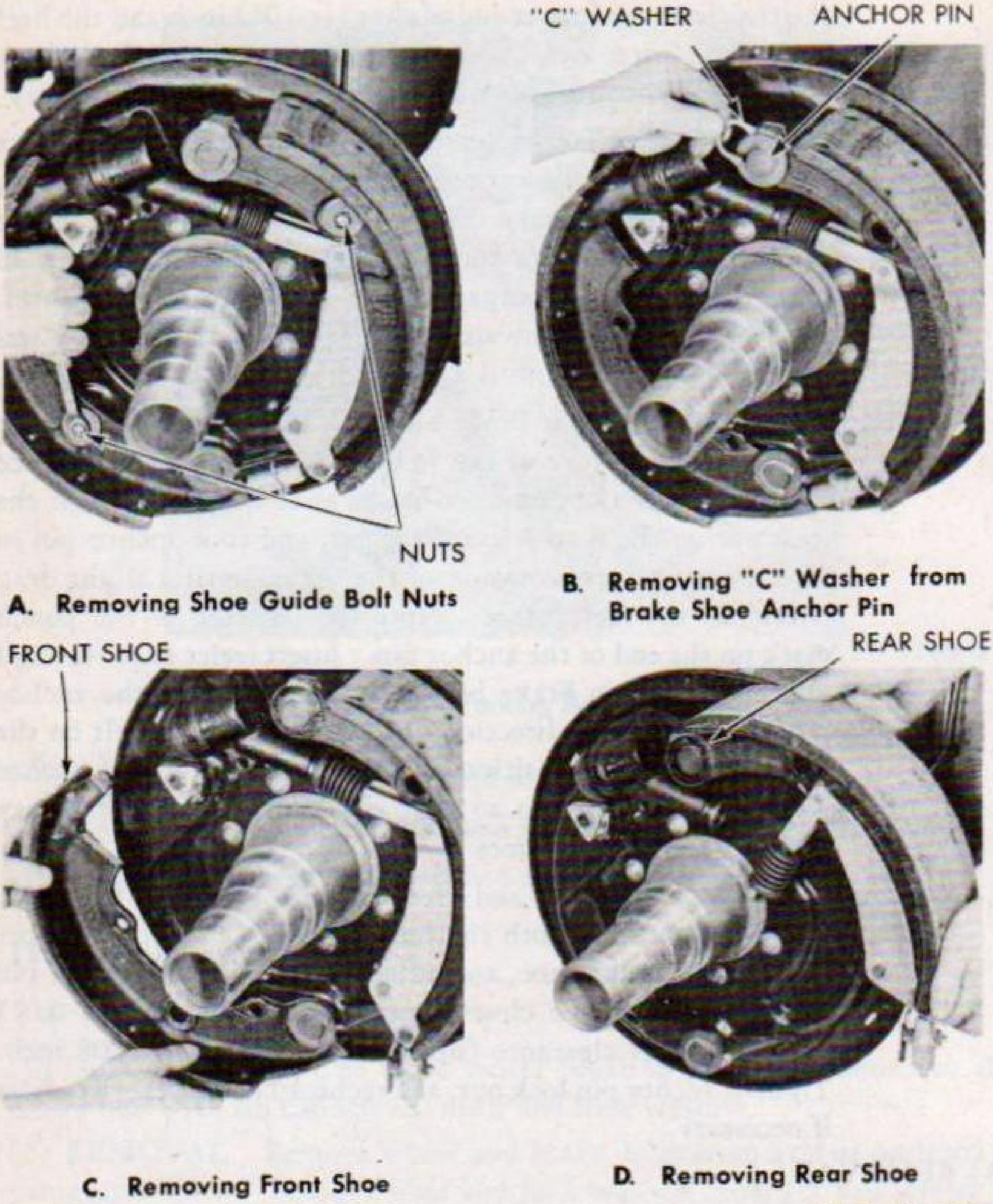


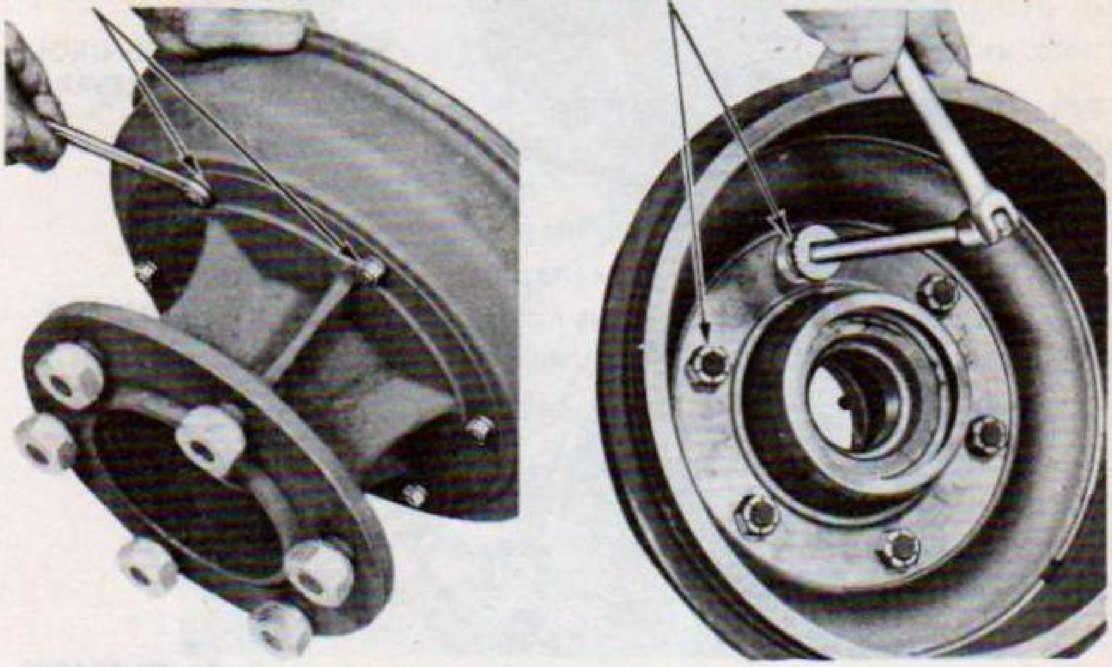
Figure 113 — Removing Rear Wheel Brake Shoes

shoe forward over the anchor pin (D, fig. 113). CAUTION: *Care must be exercised in removing the lever-actuating push rod from the wheel cylinder to prevent scoring the wheel cylinder wall.*

(g) Remove "C" washer from lower anchor pin, and remove anchor pins. Remove adjusting star wheel nut, screw, and spring assembly. Remove push rod and lever assembly.

(4) INSTALLATION.

(a) Lubricate bearing surfaces of anchor pins with a thin coating of wheel



A. Removing Front Wheel Brake Drum

B. Removing Rear Wheel Brake Drum

RA PD 324002

Figure 114 — Removing Front and Rear Brake Drums

bearing grease, and install anchor pins. Install new "C" washer on lower pin.

(b) Assemble adjusting nut (star wheel), screw, and spring assembly to lever and push rod. Install lever and push rod assembly on rear brake shoe.

(c) Press lever and push rod against web of rear brake shoe. Place brake shoe over upper anchor pin, and push shoe outward away from center of brake until push rod will enter small diameter of wheel cylinder. CAUTION: *Care must be exercised in replacing the push rod into the wheel cylinder, or the wheel cylinder bore will be scratched, causing the wheel cylinder to leak.*

(d) Slide lower end of front brake shoe underneath lower anchor pin flat washer, and raise shoe into position, entering upper end into wheel cylinder.

(e) Place flat washers, after coating with film of wheel bearing grease, over brake shoe guide bolts, and install lock nuts. Place a forked 0.010-inch feeler gage between the flat washer and the brake shoe, and tighten lock nuts until drag is felt on feeler gage. Install and tighten jam nut on each brake shoe guide bolt.

(f) Install flat washer on upper anchor pin, spread and install new "C" washer in anchor pin groove, and compress washer.

(g) Install brake shoe return springs on brake shoes.

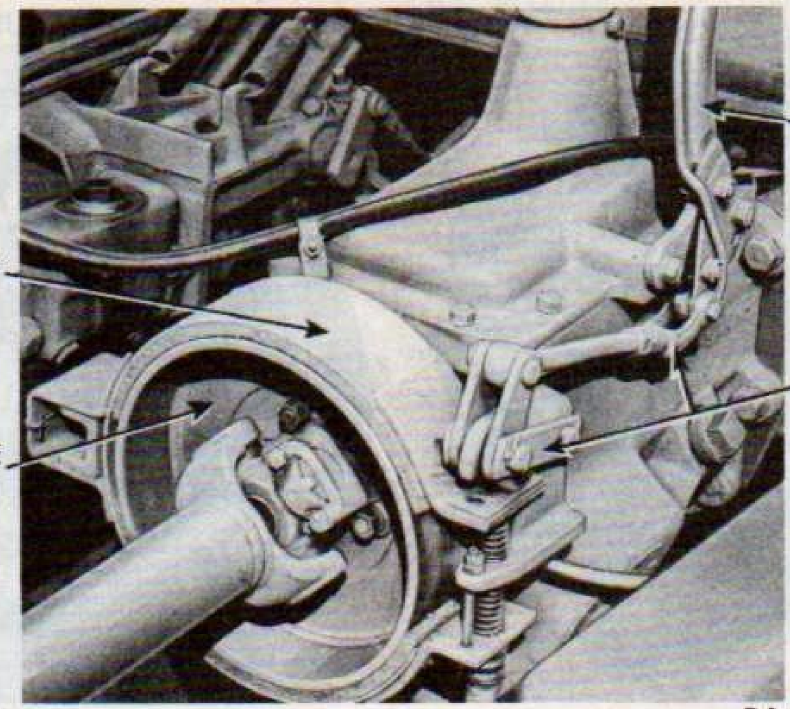


Figure 115 — Parking Brake Installed

(h) Install rear wheel as outlined in paragraph 133.

(i) Adjust brake shoes as described in subparagraph *b* (2) (b) above.

(j) Bleed brake system as outlined in paragraph 127 *e* (7).

128. BRAKE DRUMS.

a. Front Wheel Brake Drum.

(1) DESCRIPTION. The front wheel brake drums are attached to the wheel hub with six cap screws, nuts, and lock washers.

(2) REMOVAL. Remove wheel and brake drum from axle as outlined in paragraph 132 *a*. Remove nuts and lock washers from six cap screws in wheel hub flange (A, fig. 114). Lift brake drum from wheel hub.

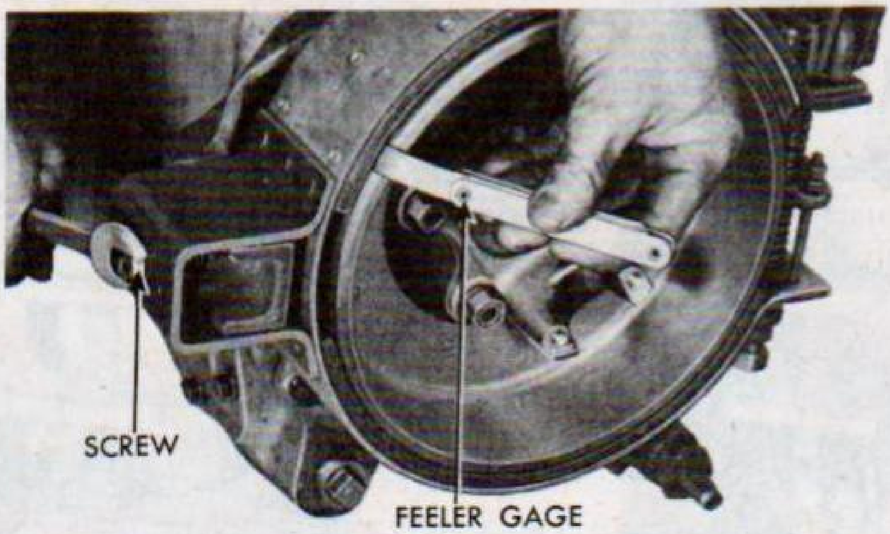
(3) INSTALLATION. Place brake drum in position on wheel hub, and aline cap screw holes. Install six cap screws in brake drum and wheel hub flange, and install nuts and lock washers. Tighten securely. Install wheel hub and brake drum assembly on axle (par. 133 *a*).

b. Rear Wheel Brake Drum.

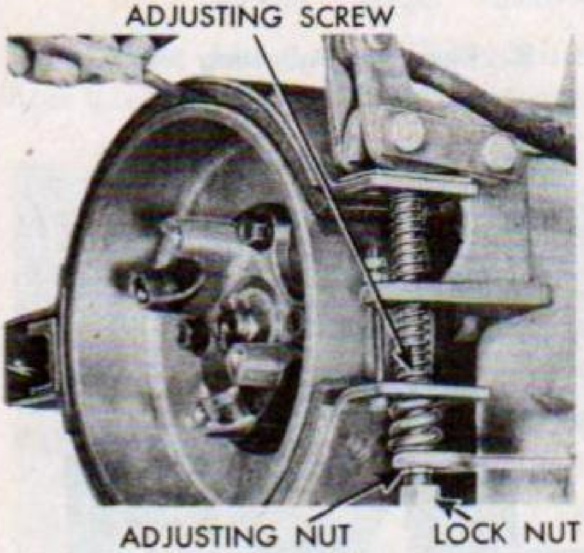
(1) DESCRIPTION. The rear wheel brake drum is attached to the rear wheel hub by six self-locking nuts on inner ends of wheel studs.

(2) REMOVAL. Remove wheel and brake drum assembly from axle (par. 132 *c*). Remove six self-locking nuts from six wheel studs (B, fig. 114), and lift brake drum from wheel hub.

(3) INSTALLATION. Install brake drum on wheel hub over wheel studs. Install and tighten six self-locking nuts on wheel studs. Install wheel hub and brake drum assembly on axle as outlined in paragraph 133 *b*.



A. Adjusting at Brake Anchor End



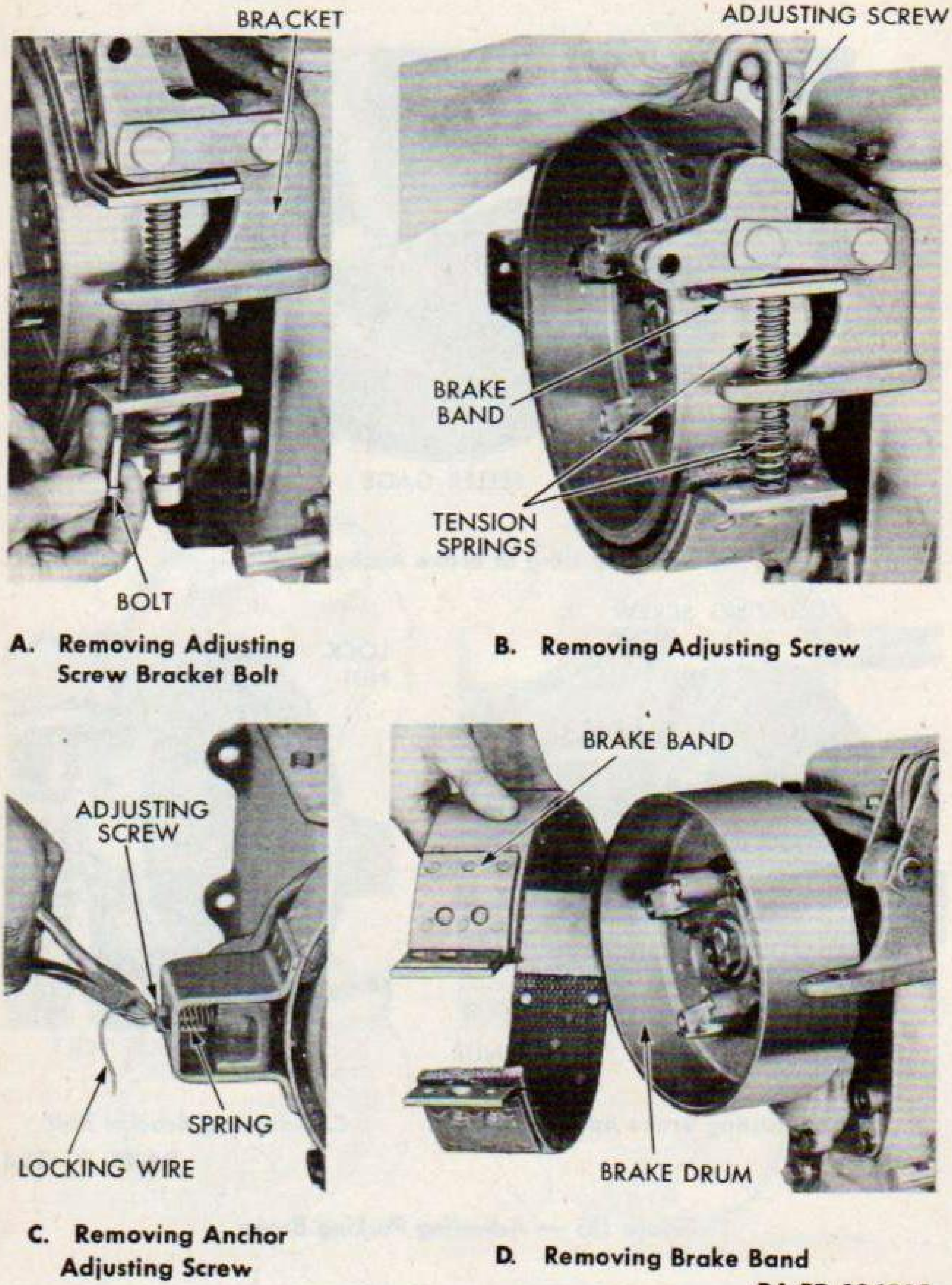
B. Adjusting Brake Band Clearance **C. Adjusting Bracket Bolt**

RA PD 324004

Figure 116 — Adjusting Parking Brake

129. PARKING BRAKE.

a. Description (fig. 115). The drum-type parking brake is transmission-mounted, and is operated from a control lever in the driver's compartment. It consists of a brake drum mounted on the propeller shaft companion flange, a band-type brake band, and a control lever with suitable linkage.



A. Removing Adjusting Screw Bracket Bolt

B. Removing Adjusting Screw

C. Removing Anchor Adjusting Screw

D. Removing Brake Band

RA PD 324005

Figure 117 — Removing Parking Brake Band

b. Adjustment.

(1) Place control lever in fully released position.

(2) Insert a 0.020-inch feeler gage between the brake band lining and the brake drum at the anchor side, and tighten adjusting screw (A, fig. 116) to point where drag is felt on feeler gage.

(3) Loosen lock nut on adjusting screw (B, fig. 116) at bracket end, and insert 0.020-inch feeler gage between the brake drum and upper portion of the brake band lining. Tighten adjusting nut on adjusting screw (B, 116) until a drag is felt on the feeler gage. This adjustment should also result in a 0.020-inch clearance between the brake drum and lower half of the brake band lining.

(4) Loosen upper lock nut on adjusting bracket bolt (C, fig. 116). Tighten adjusting bracket bolt as much as possible without altering the 0.020-inch clearance obtained in previous steps.

(5) Tighten all lock nuts securely.

c. Removal.

(1) CONTROL LEVER.

(a) Place control lever in fully released position. Remove cotter pin from control rod yoke bolt nut, and remove nut and bolt.

(b) Remove two mounting cap screws and lock washers from control lever quadrant, and lift control lever assembly from side of transmission case.

(2) BRAKE BAND.

(a) Remove cotter pin from parking brake control rod yoke pin at brake cam lever at parking brake, remove yoke pin from cam lever, and disconnect parking brake lever control rod.

(b) Remove lock nut from brake band adjusting screw bracket bolt, remove adjusting nut, and remove bolt (A, fig. 117).

(c) Remove lock nut, adjusting nut, and flat washer, and lower spring from brake band adjusting screw. Lift adjusting screw out of brake band, tension springs, and bracket (B, fig. 117).

(d) Remove locking wire from brake anchor adjusting screw (C, fig. 117), and remove adjusting screw and tension spring.

(e) Lift brake band from brake drum and brake anchor (D, fig. 117).

(3) BRAKE DRUM. The parking brake drum can be removed without removal of brake band as follows:

(a) Disconnect front propeller shaft universal joint at transmission companion flange by bending two lock plates at universal joint cap screws and removing four cap screws from two trunnion bearings. Lower front end of propeller shaft out of way.

(b) Remove cotter pin from large companion flange nut, and remove nut. Pull brake drum and companion flange assembly from transmission mainshaft splines.

(c) Remove nuts and lock washers from four cap screws holding companion flange to brake drum, and remove companion flange from drum.

d. Installation.

(1) CONTROL LEVER.

(a) Place parking brake control lever assembly in position against transmission, and install two mounting cap screws and lock washers.

(b) Connect control rod to control lever, having control lever in full forward position and brake band released. Adjust control rod length to permit inserting control rod yoke bolt through control lever and control rod. Install bolt, install and tighten nut, and install new cotter pin.

(2) PARKING BRAKE BAND.

(a) Place parking brake band over anchor and over brake drum (D, fig. 117).

(b) Insert tension spring between brake band and anchor, and install brake anchor adjusting screw, but do not tighten at this time.

(c) Place adjusting screw tension springs at top and bottom of brake bracket, and install brake band adjusting screw (B, fig. 117). Install lower spring and flat washer on lower end of adjusting screw, and loosely install adjusting nut and lock nut on screw.

(d) Install adjusting screw bracket bolt through lower half of brake band and into bracket (A, fig. 117), and loosely install adjusting nut and lock nut.

(e) Connect parking brake control rod to cam lever, and install yoke pin and cotter pin.

(f) Adjust parking brake as outlined in subparagraph ***b*** above.

(g) Tighten all lock nuts, and install locking wire in anchor adjusting screw (C, fig. 117).

(3) BRAKE DRUM.

(a) Place brake drum and companion flange together, and aline cap screw holes. Install four cap screws in holes, install four nuts and lock washers, and tighten securely.

(b) Place brake drum and companion flange assembly over splines of transmission mainshaft. Install large flat washer and large nut, tighten securely, and install new cotter pin.

(c) Raise front propeller shaft front end into position, and install two new universal joint trunnion bearing lock plates and four retaining cap screws. Tighten cap screws, and bend lock plates to retain cap screws.

(d) Adjust parking brake, if necessary (subpar. ***b*** above).

Section XXXII

Wheels and Bearings

130. DESCRIPTION.

a. Disk-type wheels are used. The disks are attached to the wheel hubs by wheel hub stud nuts. The front wheels carry single tires, while the rear wheels mount dual tires.

b. Data.

(1) WHEELS.

Make	Budd
Size	20 in.

(2) TIRES.

Tread type	Non-directional
Size	8.25 x 20

Tire pressures:

	Bus	Dump Truck
Front	60 lb	35 lb
Rear	65 lb	45 lb

(3) WHEEL BEARINGS.

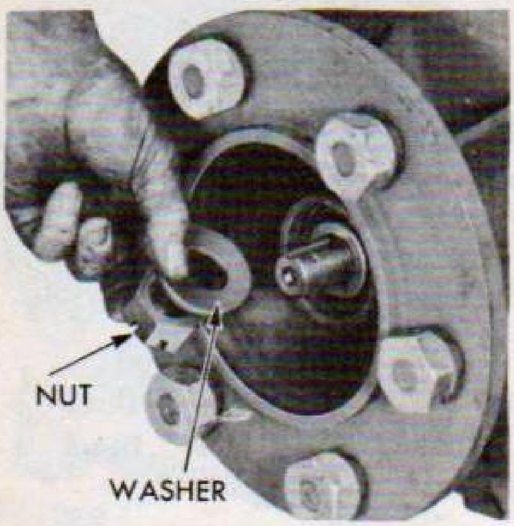
Front wheel:

Make	Timken
Models:	
Inner cup	3525
Inner cone	3578
Outer cup	2620
Outer cone	2687

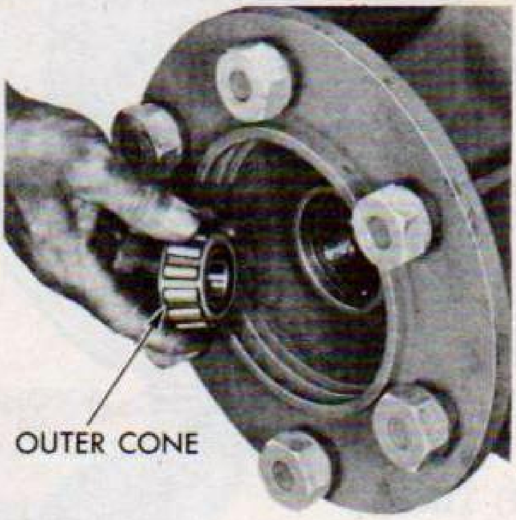
Rear wheel:

Make	International
Models:	
Inner and outer cup	ST-856
Inner and outer cone	ST-731

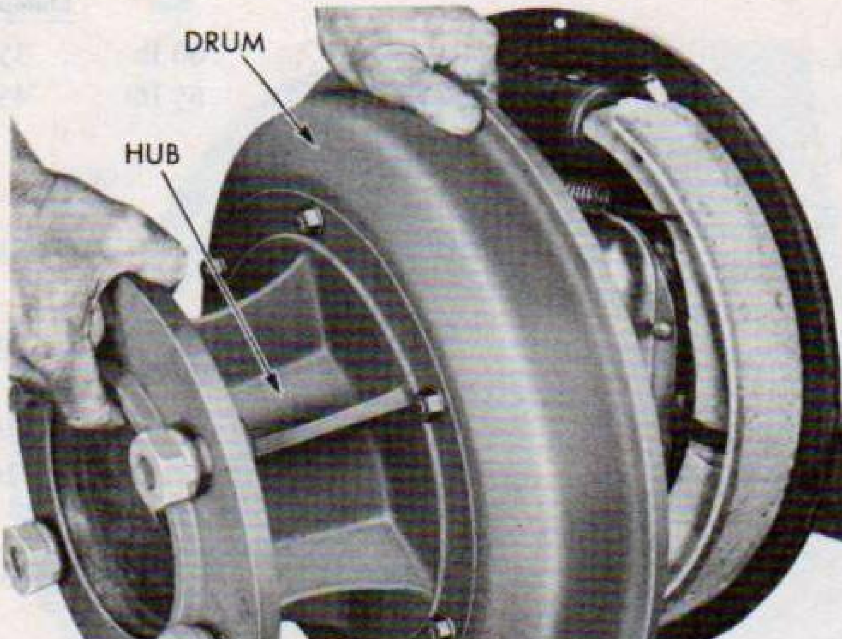
c. Tires and Tubes. Tires should be repaired in accordance with conventional methods. Punctures and tears causing exposure of the cord or fabric must be vulcanized (TM 31-200). Tires must be inflated correctly, and not operated underinflated. Balanced correct tire pressures facilitate steering, improve riding comfort, and contribute to safe driving and maximum tire mileage. Before pumping air into a tube, depress the valve momentarily to blow out any dirt. Keep valve caps in place to prevent entrance of dirt and foreign matter.



A. Removing Bearing Adjusting Nut and Washer



B. Removing Outer Bearing Cone



C. Lifting Wheel Hub and Brake Drum from Axle

RA PD 324006

Figure 118 — Disassembling Front Wheel

131. ADJUSTMENTS.

a. Wheel Stud Nuts. Check and tighten wheel stud nuts daily for the first 500 to 1,000 miles of service. Use special wrench provided for this purpose in the vehicle, but do not use extension on the handle or apply pressure other than direct hand effort. Successively tighten opposite nuts to prevent cocking wheel on studs. Never use oil on wheel stud nuts. Wheel studs and nuts are marked "R" and "L" to indicate side of vehicle on which they must be installed in the wheel hubs. Those marked "R" are right-hand threaded and must be used on the right side of the chassis. Those marked "L" are left-hand threaded and must be installed on the left side of the vehicle.

b. Front Wheel Bearings. Raise wheel from floor, and block. Remove hub cap, using special wrench. Remove cotter pin from bearing adjusting nut. Using adjustable wrench, adjust wheel bearings. Revolve wheel by hand while tightening bearing adjusting nut until a definite drag is felt. Back off adjustment about one-sixth turn or to first cotter pin hole. Install new cotter pin. Install hub cap at hub. Lower wheel to floor.

c. Rear Wheel Bearings. Raise wheel from floor, and block. Remove six stud nuts and lock washers from rear axle flange studs (A, fig. 92). Loosen lock nut on puller screw in axle shaft flange, and turn screw into flange to force axle drive shaft from studs (B, fig. 92). Remove axle drive shaft from housing (C, fig. 92). Bend tab on nut lock (A, fig. 119) and, using special wrench, remove outer bearing adjusting nut from axle, and remove nut lock. Use special wrench to adjust wheel bearings. Rotate wheel by hand while tightening inner adjusting nut until a definite drag is felt. Back off adjustment about one-sixth turn. Place nut lock in position over inner adjusting nut. Install outer adjusting nut, and tighten securely. Bend lock tab of nut lock against outer adjusting nut. Install axle drive shaft in position in axle housing, indexing the drive shaft splines with the differential side gear splines. Revolve wheel to permit holes in shaft flange to index with drive studs. Install six nuts and lock washers on studs, after backing out the puller screw from the flange. Tighten nuts securely. Screw puller cap screw into flange, and tighten lock nut. Lower wheel to floor.

132. REMOVAL.

a. Front Wheel and Bearings.

(1) Remove hub cap from front wheel hub. Remove cotter pin from front wheel bearing adjusting nut, and remove nut and flat washer (A, fig. 118).

(2) Remove outer wheel bearing cone from steering knuckle (B, fig. 118).

(3) Lift front wheel hub and brake drum from steering knuckle (C, fig. 118).

(4) Use two opposed screwdrivers behind the inner wheel bearing grease seal to force seal retainer and inner wheel bearing cone from steering knuckle.

(5) Drive inner and outer wheel bearing cups from front wheel hub, or use puller equipment.

(6) Following removal of hub and bearings, clean all grease from hub.

(7) CLEAN, INSPECT, AND LUBRICATE BEARINGS.

(a) Place bearings in fresh dry-cleaning solvent, and allow sufficient time to dissolve larger particles of grease. Slosh bearings up and down in solvent while revolving bearings on races. Repeat process of cleaning until bearings are absolutely clean.

(b) When bearings are clean and dry, inspect for pits, cracks, or rust spots. Inspect each roller carefully. If any imperfections are found, do not reinstall bearing. Replace with a new bearing.

(c) Use bearing packing equipment, if available, to repack wheel bearing cones. If packing equipment is not available, pack grease by hand into rollers and retainer until well filled. Do not pack wheel hub cavity.

(d) If wheel bearings are not to be immediately reinstalled, wrap carefully to prevent entrance of dirt or moisture. NOTE: *Do not use engine oil on bearings as oil would prevent wheel bearing grease from adhering to rollers.*

b. Rear Wheel.

(1) Remove nuts and lock washers from six rear axle flange studs (A, fig.92).

(2) Loosen lock nut on puller cap screw in flange, and screw cap screw into flange to force shaft from housing (B, fig. 92). Remove shaft (C, fig. 92).

(3) RELEASE BEARING OUTER ADJUSTING NUT. Bend tab of nut lock away from side of adjusting nut (A, fig. 119).

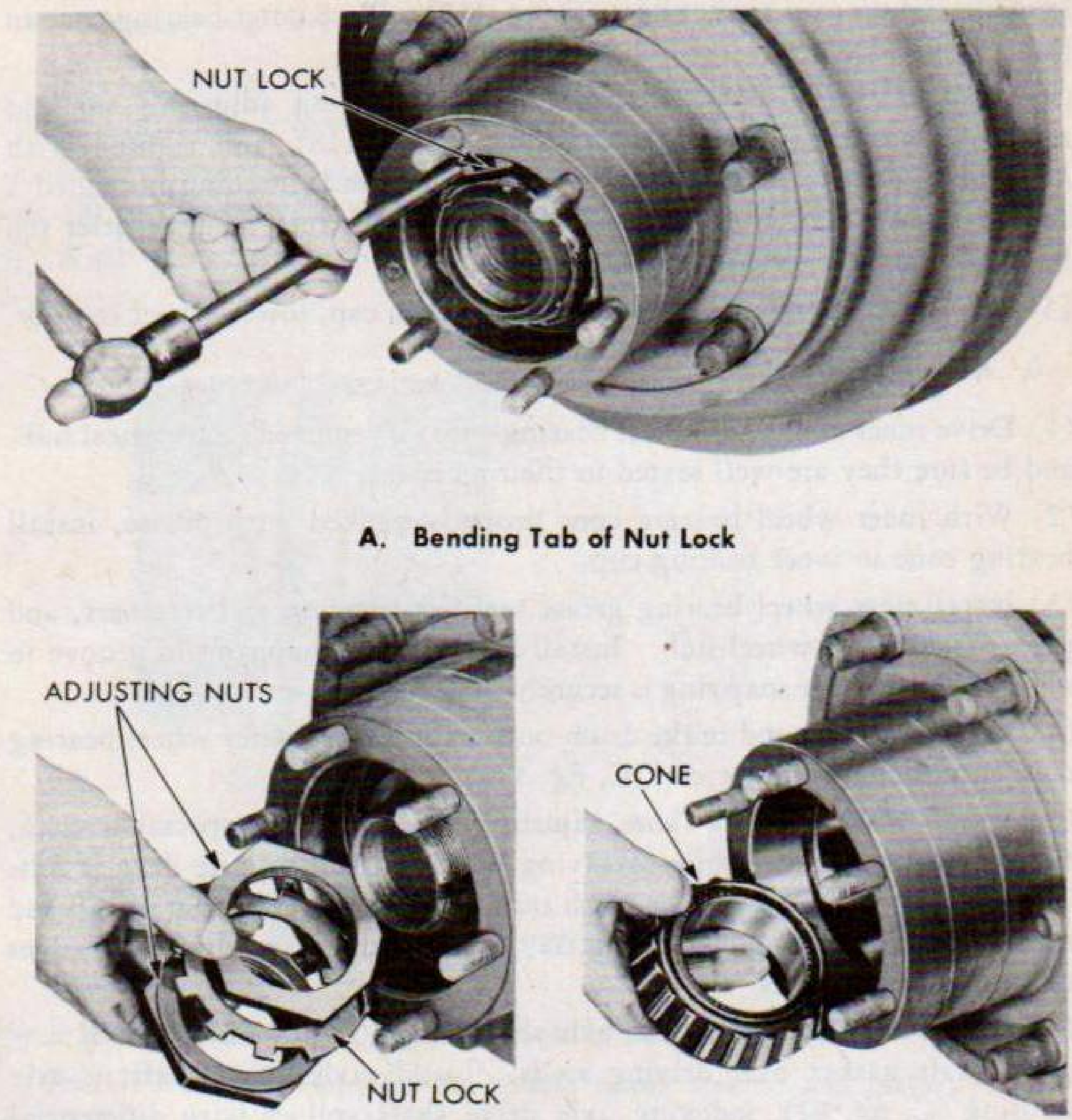
(4) REMOVE WHEEL BEARING NUTS. Use special wrench to remove wheel bearing outer adjusting nut, and remove nut lock and inner adjusting nut from axle (B, fig. 119). Remove rear wheel outer bearing cone from wheel hub (C, fig. 119).

(5) Lift rear wheel hub and drum from rear axle.

(6) REMOVE REAR WHEEL INNER BEARING CONE AND GREASE SEAL. Pry grease seal retaining snap ring from groove in inner side of wheel hub. Lift out grease seal felt and retainers from hub. Lift inner bearing cone from hub.

(7) REMOVE WHEEL BEARING CUPS. If necessary to replace wheel bearing cups, remove cups from hub with a puller.

(8) CLEAN, INSPECT, AND LUBRICATE BEARINGS. Follow procedure outlined in subparagraph ***a*** (7) above.



A. Bending Tab of Nut Lock

B. Removing Adjusting Nuts **C. Removing Outer Bearing Cone**

RA PD 324007

Figure 119 — Disassembling Rear Wheel

133. INSTALLATION.

a. Front Wheel.

(1) INSTALL GREASE SEAL. Install new grease seal in seal retainer, and place retainer on steering knuckle.

(2) INSTALL INNER BEARING CONE. Place inner bearing cone in position on steering knuckle.

(3) INSTALL WHEEL HUB AND DRUM. With bearing cups well seated in recesses in wheel hub, and brake drum attached to hub with retaining cap screws, lock washers, and nuts, place wheel hub in position on steering

knuckle and up over brake shoes (C, fig. 118). Place outer bearing cone in hub (B, fig. 118).

(4) ADJUST WHEEL BEARINGS. Install bearing adjusting nut and retaining washer on steering knuckle (A, fig. 118), and tighten with adjustable wrench. Rotate wheel by hand while tightening nut until a definite drag is felt, then back off about one-sixth turn to first cotter pin hole, and install new cotter pin.

(5) INSTALL HUB CAP. After installing hub cap, lower wheel to floor.

b. Rear Wheel.

(1) Drive inner and outer wheel bearing cups (if removed) into wheel hub, and be sure they are well seated in their recesses.

(2) With inner wheel bearing cone properly packed with grease, install bearing cone in inner bearing cup.

(3) Install new wheel bearing grease seal felt between seal retainers, and place assembly in wheel hub. Install seal retainer snap ring in groove in wheel hub. Be sure snap ring is securely seated in groove.

(4) Lift wheel hub and brake drum onto axle. Place outer wheel bearing cone in position in outer cup (C, fig. 119).

(5) Install wheel bearing inner adjusting nut and, using special wrench, tighten adjusting nut while revolving wheel until a definite drag is felt. Then, back off adjustment one-sixth turn. Install nut lock, and install and tighten outer adjusting nut (A, fig. 119). Bend edge of nut lock over edges of both adjusting nuts.

(6) Back out puller screw from axle shaft flange (B, fig. 92). Install new drive shaft gasket over driving studs. Install axle drive shaft in axle housing (C, fig. 92), indexing axle drive shaft splines with differential side gear splines. Rotate hub as necessary to permit axle drive shaft flange holes to engage with the driving studs, and push axle drive shaft into axle. Install six nuts and lock washers on studs (A, fig. 92), and tighten securely. Tighten axle shaft puller screw into axle shaft flange, and tighten lock nut.

(7) Lower wheel to floor.

Section XXXIII

Springs and Shock Absorbers

134. SPRING SUSPENSION.

a. The semi-elliptic type front springs are shackled at the front and pivoted in brackets at the rear (fig. 120). The springs are attached to the front axle I-beam with U-bolts.

b. Auxiliary or overload springs are mounted on the semi-elliptic type rear springs. The rear springs are shackled at the rear and are pivoted at the front ends in brackets (fig. 121). The springs are attached on top of the axle housing by means of U-bolts.

c. Spring shackle bolts, bracket bolts, clips, U-bolts, and spring center bolts must be kept tight at all times to avoid spring leaf failures. Spring leaf failures near the center bolt are indicative of loose U-bolts. With the vehicle under load, spring U-bolt nuts should be retightened at the end of each 50 miles of operation until the U-bolt nuts show no further signs of looseness. Use a wrench having at least 18-inch leverage.

135. FRONT SPRINGS.

*a. **Description.*** The front springs are mounted on top of the front axle, and support the weight of the front of the vehicle (fig. 120). They are attached to the front axle by U-bolts. The spring leaves are held in alinement by clips, and are held together at the center by a center bolt. The top or main leaf of each front spring has an eye at each end into which bushings are pressed. The second leaf is wrapped around the eye at the rear bracket only. Tension plates are mounted at each end of the front springs, and are secured in place by clips attached to each end of the fifth leaf.

*b. **Removal.*** Breakage of a spring leaf or leaves requires that repairs be made immediately. Spring repair requires removal of the spring for sending to higher echelon.

(1) REMOVE U-BOLTS. Remove two nuts and lock washers from each of two front spring U-bolts. Lift U-bolts from spring, and remove one spacer plate from each side of spring. NOTE: *The shock absorber connecting link is attached to a connecting link bracket below the axle which can be laid aside without the necessity of disconnecting the link.*

(2) RAISE VEHICLE. Raise front end of vehicle high enough to remove weight of vehicle from spring, but still allow weight of spring to rest on axle. Place jacks or blocks beneath the vehicle frame at each side for safety.

(3) REMOVE SPRING FRONT SHACKLE PIN. Remove nuts and lock washers from two spring pin shackle bolts at each side at lower pin. Drive spring pin from spring eye and shackle, driving pin from inner side.

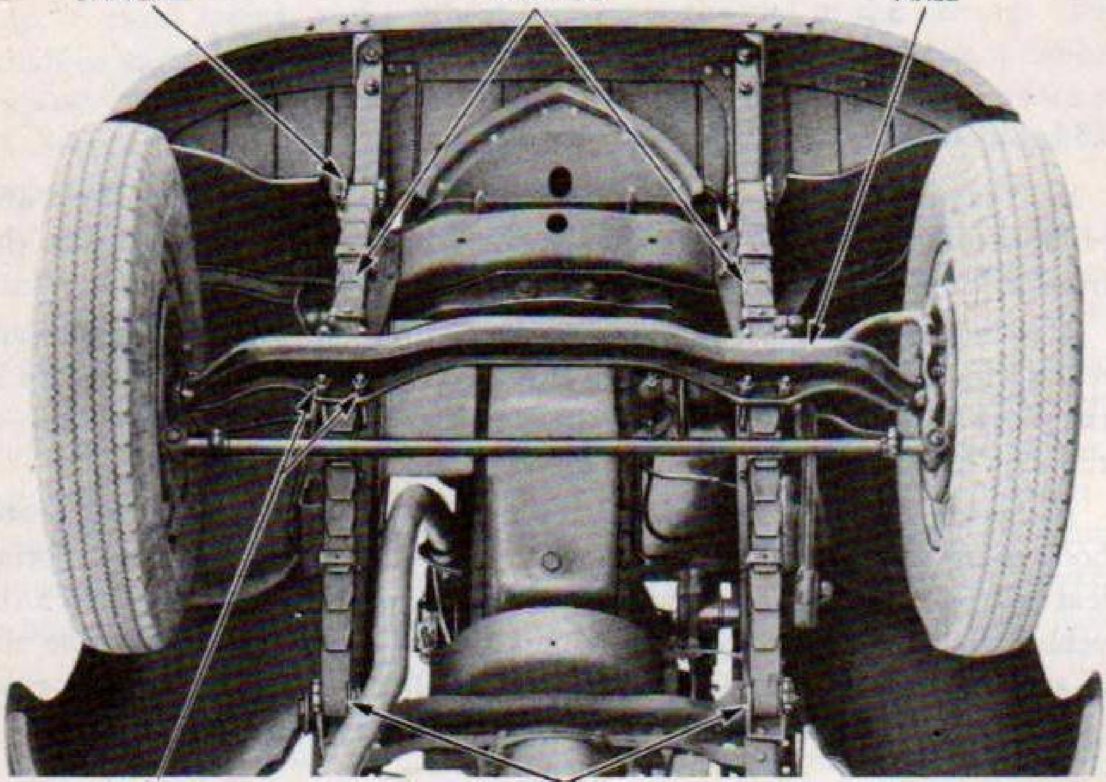


Figure 120 — Front Springs Installed

(4) REMOVE SPRING REAR BRACKET PIN. Remove nut and lock washer from front spring rear bracket clamp bolt, and remove bolt from bracket. Drive pin from spring eye and bracket, driving pin toward inside.

(5) REMOVE SPRING. Raise vehicle enough to allow lifting spring down from axle.

*c. **Installation.***

(1) INSTALL SPRING. Lift front spring into position on front axle, being sure that spring center bolt head rests in socket in axle.

(2) INSTALL SPRING SHACKLE PIN. Raise front end of spring to position in front spring shackle. Drive spring pin into shackle and spring eye, having slot in pin on bottom to assure alinement with clamp bolt. Line up slot and bolt hole with punch, install one clamp bolt at each side, and install nuts and lock washers.

(3) INSTALL SPRING BRACKET PIN. Raise rear end of spring to position in bracket. Drive spring pin into spring eye and bracket, having slot in pin in alinement with clamp bolt hole. Install clamp bolt, nut, and lock washer, and tighten securely.

(4) INSTALL U-BOLTS. Lower vehicle weight onto spring. Place spring bumper on spring, and install U-bolts. Install two nuts and lock washers on each U-bolt. Tighten securely.

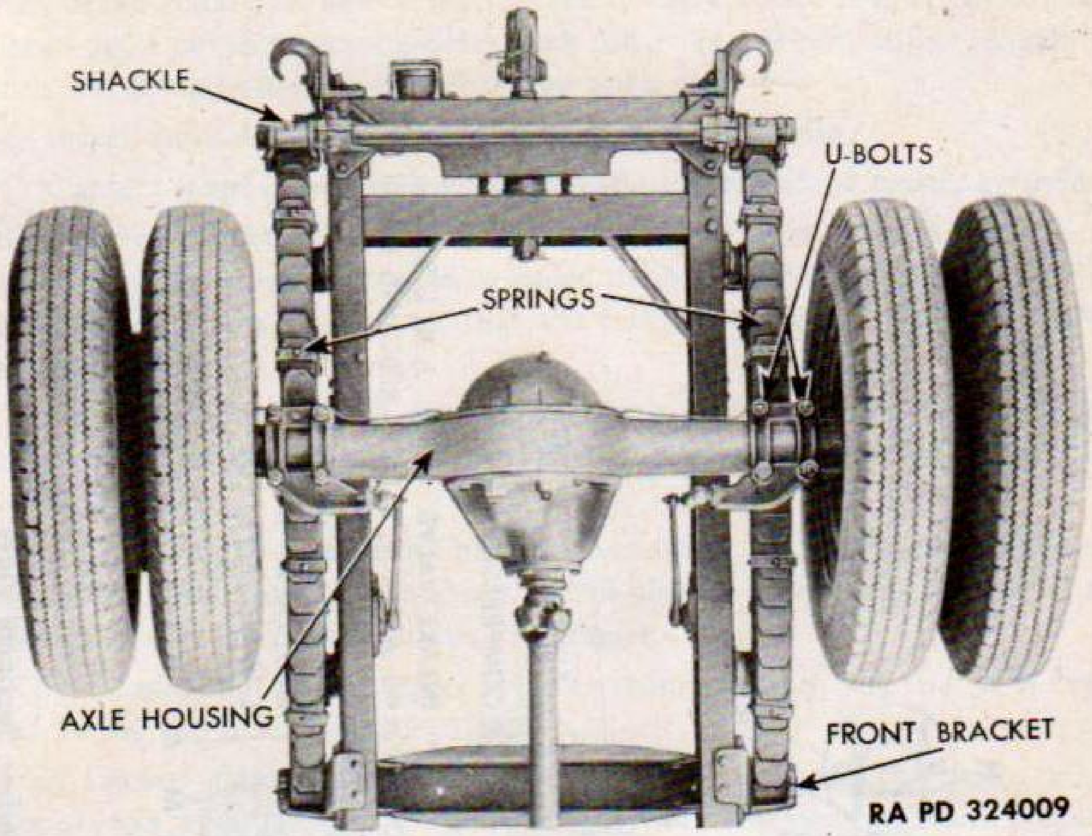


Figure 121 — Rear Springs Installed

136. REAR SPRINGS.

a. Description. The top or main leaf of each rear spring has an eye formed at each end into which a bushing is pressed. The auxiliary spring is mounted on a shroud or seat on top of the main spring. The entire assembly is attached to the rear axle housing by U-bolts. The front of each rear spring is attached to the vehicle by a bracket and the rear by a shackle (fig. 121). The spring leaves are held in position by clips and center bolts.

b. Removal. To replace broken spring leaves it is necessary to remove the spring, but to remove an auxiliary spring it is not necessary to remove the main spring. Removal of main spring is accomplished as follows:

(1) REMOVE AUXILIARY SPRING. Remove two nuts and lock washers from each of two U-bolts. Remove U-bolt seat plate and U-bolts. Lift off auxiliary spring. Lift off spring shroud from main spring.

(2) RAISE VEHICLE. Raise rear of vehicle frame high enough to remove vehicle weight from spring, but still allow spring to rest on rear axle housing.

(3) REMOVE FRONT SPRING PIN. Remove nut and lock washer from spring pin clamp bolt, and drive out clamp bolt. Remove lubricator fitting from end of spring pin, attach puller, and remove spring pin.

(4) REMOVE REAR SHACKLE PIN. Remove nut and lock washer from

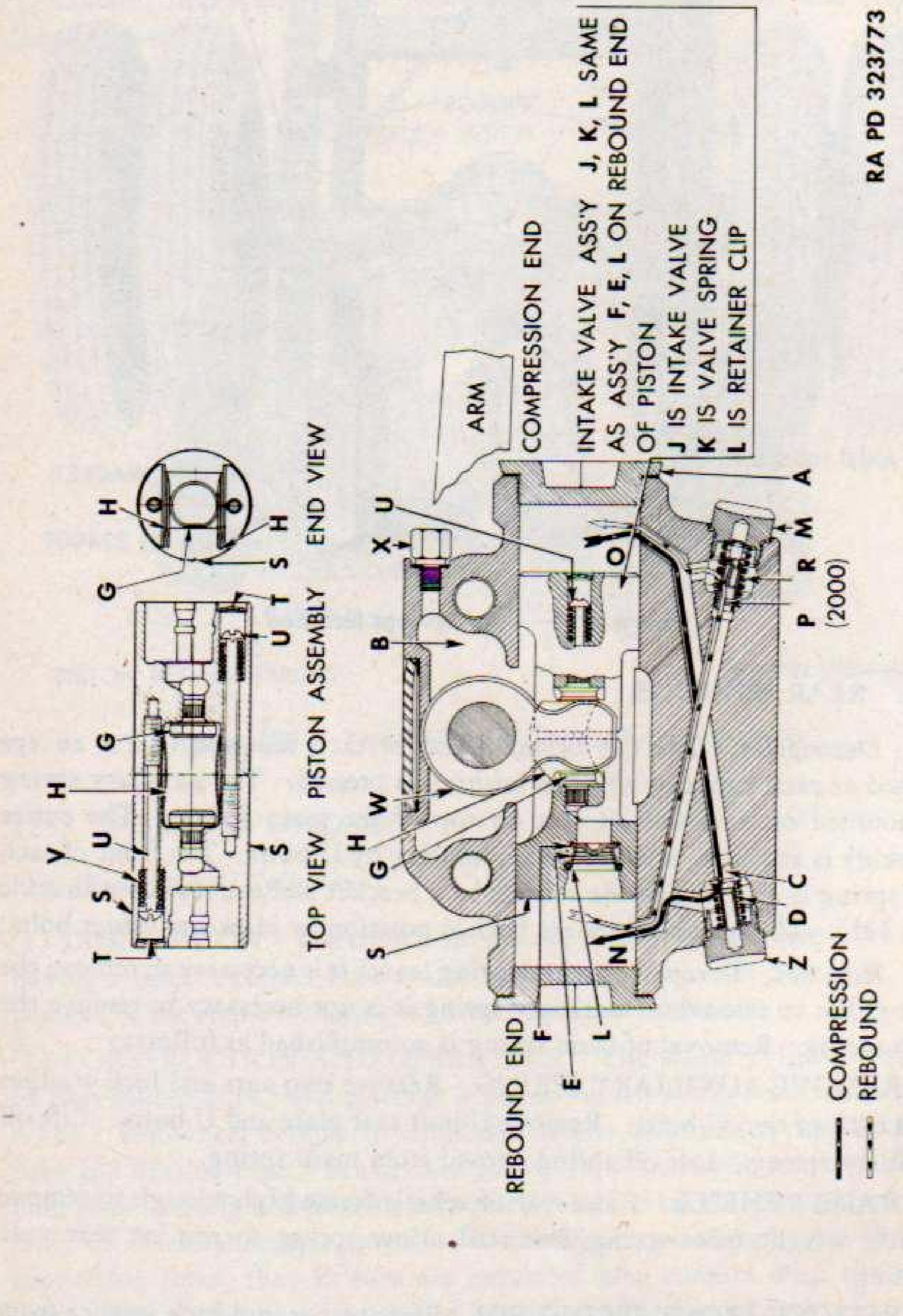


Figure 122 — Front Shock Absorber, Sectional View

shackle pin clamp bolt, and drive out clamp bolt. Remove lubricator fitting from spring pin, attach puller, and remove pin.

(5) REMOVE SPRING. Raise vehicle sufficiently to allow lifting spring assembly from axle, and lift off spring.

c. Installation.

(1) INSTALL SPRING. Lift rear spring into place on rear axle housing, being certain that the spring center bolt rests in the socket in the spring seat.

(2) INSTALL FRONT SPRING PIN. Lower vehicle frame into position over spring eyes. Drive front spring pin into bracket and spring eye, having slot in pin in alinement with clamp bolt hole. Use punch to line up pin and bolt hole. Install clamp bolt, nut, and lock washer.

(3) INSTALL REAR SHACKLE PIN. Drive shackle pin into shackle, having slot in pin in alinement with clamp bolt hole. Use punch to line up pin and bolt hole. Install clamp bolt, lock washer, and nut.

(4) INSTALL AUXILIARY SPRING AND U-BOLTS. Place spring shroud over main spring. Place auxiliary spring on top of shroud, and install U-bolt plate on top of auxiliary spring. Install U-bolts in position, install two nuts and lock washers on each U-bolt, and tighten securely.

(5) LUBRICATE. Install lubricators in spring pins, and lubricate (par. 22).

137. SHOCK ABSORBERS.

a. Description. Shock absorbers at both front and rear springs control the rebound action of the springs. The shock absorber mechanisms are bolted to the frame, and the connecting links are attached to connecting link brackets at the front and rear of the vehicle. The shock absorbers are double-acting, controlling both the speed of rebound and the compression of the springs. The operation of the shock absorber is as follows:

(1) The flow of fluid in the shock absorber is shown in figure 122. As the arm moves upward (compression stroke), the piston moves toward the arm end of the shock absorber, displacing the fluid in the compression end of the shock absorber. In slight or slow axle movements, the fluid flows only through the orifice of the compression valve "C" (figure 122) into the rebound end of the shock absorber cylinder "N." In rapid movements, the pressure lifts the valve from its seat by compressing spring "D," thus letting a greater volume of fluid into the rebound end. At the same time, the intake valve "F" opens, allowing fluid to flow from the reservoir "B" into the rebound end of the cylinder "N." This is to compensate for any loss of fluid between piston and cylinder walls from the compression end "O" into the reservoir.

(2) During the rebound stroke, or as the arm moves downward, the direction of flow is reversed. The piston moves away from the arm end of

the shock absorber, displacing the fluid in the rebound end of the shock absorber. In slow action, the fluid flows only through the orifice of the rebound valve "P" into the compression end of the shock absorber cylinder "O." During rapid action, the rebound valve "P" is lifted from its seat, and the fluid passes in greater volume into the compression end. At the same time, intake valve "J" opens, allowing fluid to pass from the reservoir "B" into the compression end of the cylinder "O," thus compensating for any loss of fluid between piston and cylinder walls.

b. Data.

Make	Delco-Remy
Model (front)	2000
Model (rear)	2008

*c. **Refilling.*** To prevent particles of dirt from entering the shock absorber when refilling, clean all dirt from unit and from frame surrounding unit. Remove filler plug "X" (fig. 122), and inspect fluid which should be at level of plug. Refill if necessary.

(1) Disconnect shock absorber link from bracket at axle end.

(2) Pump shock absorber arm up and down several times to dispel air trapped in the unit. Add fluid, and repeat pumping. When the working chamber is properly filled, there will be uniform resistance and no "rubbery" feeling or lost motion. Refill chamber to level of filler plug, and install filler plug.

(3) Connect shock absorber link to connecting link bracket.

*d. **Removal.*** Remove self-locking nut from lower end of shock absorber link. Using soft hammer, drive tapered ball stud from connecting link bracket. Remove two nuts and lock washers from shock absorber mounting bolts at frame, remove bolts, and lift unit from frame.

*e. **Installation.*** Place shock absorber in position on frame, and install two bolts, nuts, and lock washers. Drive ball stud into connecting link bracket. Install self-locking nut.

Section XXXIV

Steering Gear and Drag Link

138. DESCRIPTION AND DATA.

a. Description.

(1) The steering gear is mounted at the left-hand frame side rail. The steering gear is of cam and twin-lever design (fig. 123). This design embodies a variable-ratio worm which engages an internal lever on the side of the worm. This provides long internal leverage in combination with variable ratio, which provides desirable mechanical steering characteristics. Higher gear reduction in the normal or straight-ahead driving position results in road shock reduction, easier steering, and more freedom from wandering, while lower gear reduction at the turning range provides quicker and easier steering on the turns.

(2) The drag link serves to connect the steering gear arm (Pitman) with the front axle steering arm. It consists of a tube whose ends contain thrust plugs and springs which serve to form ball-and-socket joints at the steering arms.

b. Data.

Steering Gear:

Make	Ross
Model	TA-21
Type	Cam and twin-lever
Ratio	22-18-22

139. ADJUSTMENTS.

a. Steering Gear. There are two adjustments, the adjustment of the ball thrust bearings on the cam, and the adjustment of the tapered studs in the cam groove for backlash. The cam in this steering gear is mounted between two ball bearings which are adjustable by means of shims between the housing and upper cover plate. Backlash of the studs of the lever shaft in the cam groove is adjusted by means of a screw and lock nut on the side cover. The cam grooves are ground slightly higher in the mid-position range to provide close adjustment where the usual straight-ahead driving action takes place. The adjustments must be made in the order named. When making adjustments, free the steering gear of all load, preferably by disconnecting the steering gear drag link from the steering gear arm, and loosening the instrument panel dash bracket clamp on the steering column.

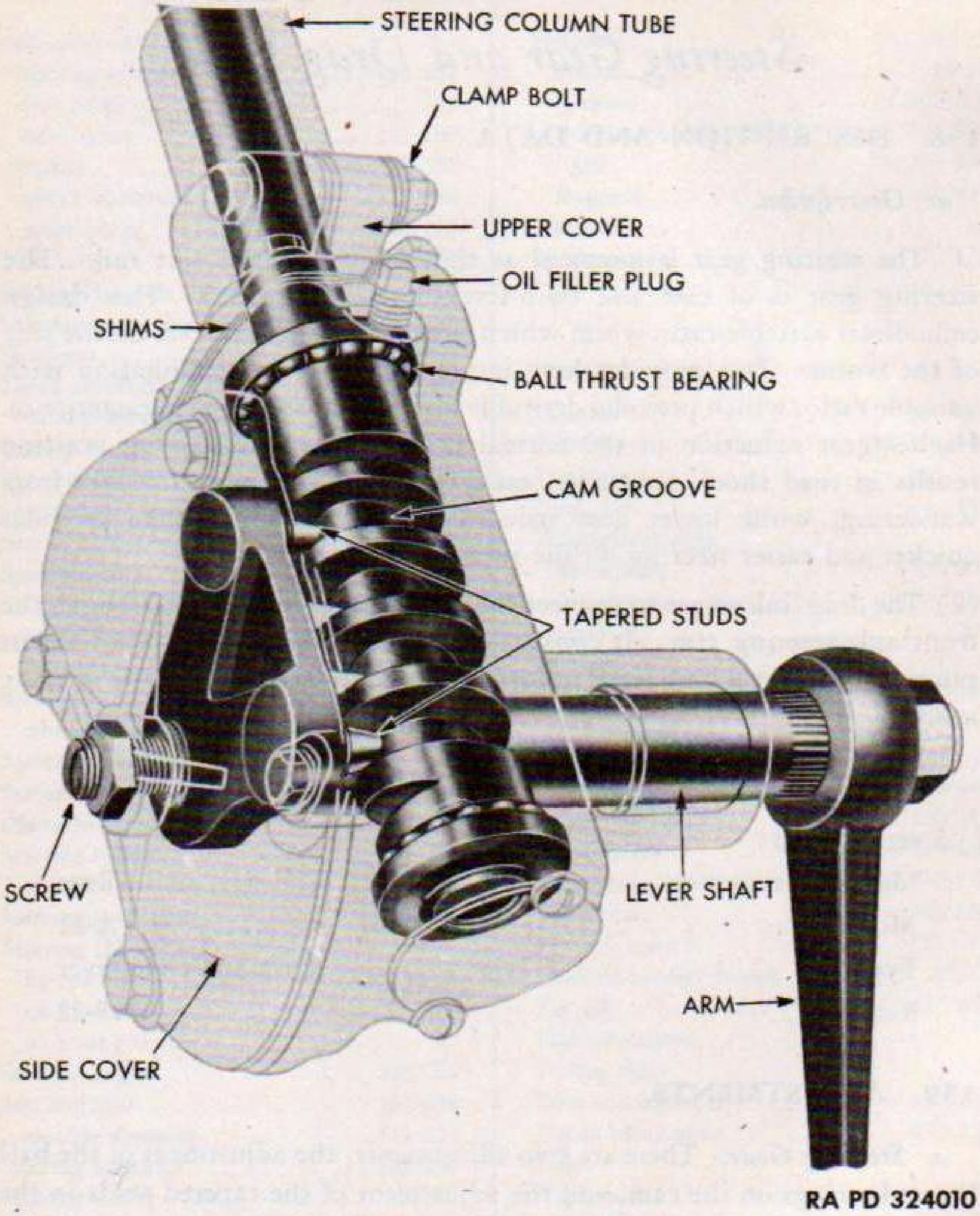


Figure 123 — Steering Gear, Sectional View

(1) ADJUSTMENT OF BALL THRUST BEARINGS ON CAM.

(a) Loosen the housing side cover adjusting screw lock nut, accessible through a hole in the frame side rail, working from inside. Loosen the adjusting screw.

(b) Unscrew the four cap screws from the upper cover of the steering gear. Remove from the upper cover the clamp bolt clamping the steering column tube. This will permit raising the cover for the removal of shims as necessary.

(c) Remove a thin shim. NOTE: *Shims are 0.002, 0.003, and 0.010 inch thick.* Clip shim for removal.

(d) Reassemble cover, and tighten four cap screws. NOTE: *The cover should always be drawn down tight against the shims to provide a tight assembly. Be careful, however, in the event that too much shim thickness has been removed, not to draw so tight as to break the ball races.*

(e) Adjust in the above manner through the addition or removal of shims until there is a barely perceptible drag but the steering wheel turns freely with the thumb and forefinger lightly gripping the wheel rim.

(f) When adjustment of ball thrust bearings is completed, install steering column upper cover clamp bolt, nut, and lock washer.

(2) ADJUSTMENT FOR MINIMUM BACKLASH OF TAPERED STUDS IN CAM GROOVE. Backlash of the studs in the cam groove appears as end play of the lever shaft, and as backlash at the steering wheel and at the ball on the steering gear arm. Proper adjustment requires that a very slight drag be felt through the mid-position when turning the steering wheel slowly from one extreme position to the other.

(a) Count the number of revolutions of the steering wheel while turning from one extreme to the other. One-half this number denotes the mid-position (or straight-ahead position) of the gear. Always make adjustment in this mid-position. Do not adjust in positions off mid-position, as backlash at these positions is normal and not objectionable.

(b) Tighten side cover adjusting screw until the adjustment is correct, a very slight drag being felt through the mid-position when turning the steering wheel slowly from one extreme to the other. Tighten lock nut to hold this adjustment, and recheck.

(c) Tighten steering column clamp bolt at instrument panel.

(d) Place front wheels in straight-ahead position. With steering gear in mid-position, raise end of drag link, and note whether ball of steering arm will connect at the drag link without excess movement to one side or the other. If not, remove nut and lock washer from steering gear lever shaft, remove the steering arm with a puller, and reset arm on the lever shaft splines. Install and tighten lock washer and lock nut.

(e) Connect steering arm and drag link, and install drag link plug. Tighten plug until snug, then back off just enough to permit inserting cotter pin. Install dust seal and seal shield on drag link.

b. Drag Link Adjustment. Remove cotter pin at each end of drag link. Tighten each drag link end plug until snug, then back off adjustment about one-sixth turn or enough to permit inserting new cotter pins. It should be possible to move drag link on steering arm balls, using full hand-pressure.

140. REMOVAL.

a. Steering Wheel.

(1) Disconnect horn wire at base of steering gear.

(2) Remove horn button by depressing button, rotating one-sixth turn to free from retaining lugs, and releasing pressure. Lift off horn cable contact cup, horn button spring, and horn cable contact cap.

(3) Remove three screws from horn button base plate, and remove plate and horn wire from steering wheel hub.

(4) Remove steering wheel nut and lock washer from steering shaft.

(5) Using puller, remove steering wheel from steering shaft.

b. Steering Arm (Pitman).

(1) DISCONNECT DRAG LINK.

(a) Bend tabs on drag link dust shield at steering gear Pitman arm, and remove dust shield and dust shield felt.

(b) Remove cotter pin from drag link adjusting plug. Loosen and remove adjusting plug from drag link, and disconnect drag link from steering arm.

(2) REMOVE STEERING ARM.

(a) Remove nut and lock washer from end of steering lever shaft.

(b) Using puller, remove steering arm from lever shaft. NOTE: *Do not use hammer on steering lever shaft.*

141. INSTALLATION.

a. Steering Wheel.

(1) Rotate steering gear to straight-ahead or mid-position.

(2) Place steering wheel on steering shaft, having one spoke of wheel at top. Install washer, and install and tighten nut.

(3) Place horn button base plate in position, and feed horn wire down through tube. Install three screws in base plate.

(4) Install horn button, contact cap, horn button spring, horn cable contact cup, and horn button, press down and rotate horn button one-sixth turn with palm of hand, and release.

(5) Connect horn wire at base of steering gear.

b. Steering (Pitman) Arm.

(1) PLACE STEERING GEAR IN STRAIGHT-AHEAD POSITION. Rotate steering gear from one extreme to the other, counting the number of complete revolutions. Place steering gear at one-half this total which will place the steering gear in straight-ahead or mid-position.

(2) INSTALL STEERING ARM. Steering arm is marked, and end of steering gear lever shaft is also marked for position. Place steering gear arm on steering gear lever shaft splines. Install lock washer, and install and tighten nut securely.

(3) CONNECT DRAG LINK. With wheels in straight-ahead position and with steering gear in mid-position, the drag link should be in position for connection to the steering arm ball with but very little movement of either wheels or steering gear. If this is not the case, remove the steering arm from the steering gear lever shaft and relocate on the splines. NOTE: *When the steering gear is in mid-position, the wheels must be in the straight-ahead position.* Connect drag link to steering arm, and install adjusting plug in drag link.

(4) ADJUST DRAG LINK ADJUSTING PLUG. Turn adjusting plug into drag link until snug, then back off adjustment to the first cotter pin hole. Install new cotter pin.

(5) INSTALL DRAG LINK DUST SHIELD. Wrap drag link dust shield felt and dust shield into position, and bend tabs of dust shield.

Section XXXV

Fenders, Running Boards, Cab, and Windshield

142. FENDERS.

a. Description. Front fenders are high-crowned and bracket-mounted, and are attached at the rear end to the running boards.

b. Removal.

(1) Remove nuts and lock washers from two running board to fender mounting cap screws. Remove cap screws and spacers.

(2) Remove two nuts, lock washers, and cap screws from fender front mounting bracket.

(3) Remove two nuts, lock washers, and cap screws from fender rear bracket.

(4) Disconnect headlight wiring at junction block at fender shield.

(5) Lift fender from chassis.

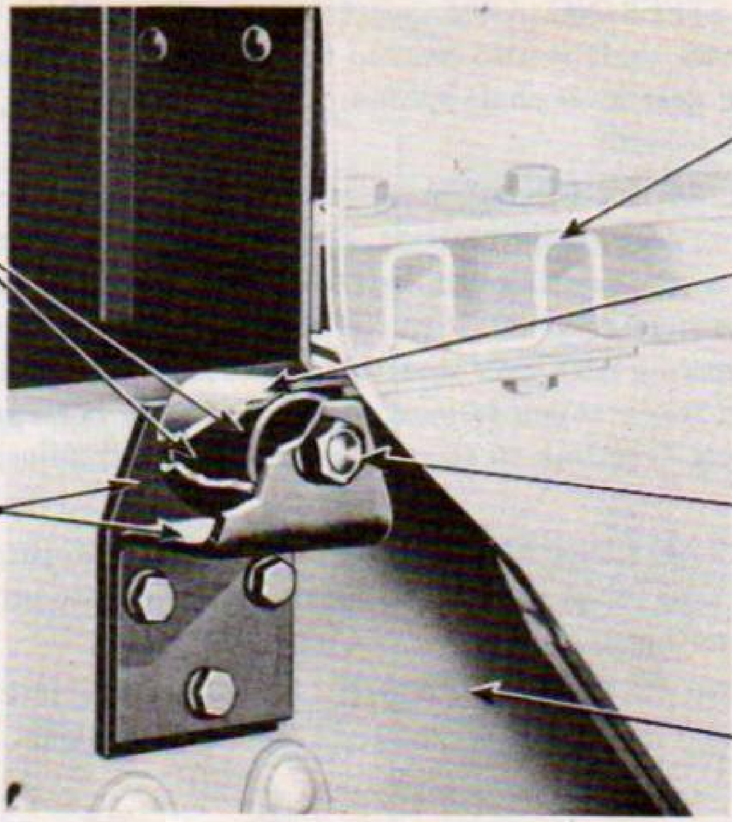


Figure 124 — Cab Front Mounting (Dump Truck)

c. Installation.

(1) Install fender in position on vehicle, and install two cap screws in front bracket and two cap screws in rear bracket. Install nuts and lock washers on cap screws, but do not tighten.

(2) Install fender to running board spacers between fender and running board, and install cap screws, nuts, and lock washers.

(3) Tighten all cap screws and nuts securely.

(4) Connect headlight wires at junction block at fender shield.

143. RUNNING BOARDS (DUMP TRUCKS).

a. Description. The two steel running boards are mounted on brackets attached to the frame side rails. The running boards are attached at the front to the fenders.

b. Removal.

(1) Remove nuts and lock washers from two cap screws attaching front of running board to fender, remove cap screws, and remove two spacers.

(2) Remove nuts and lock washers from two cap screws attaching running board to front bracket, repeat at rear bracket, and remove cap screws.

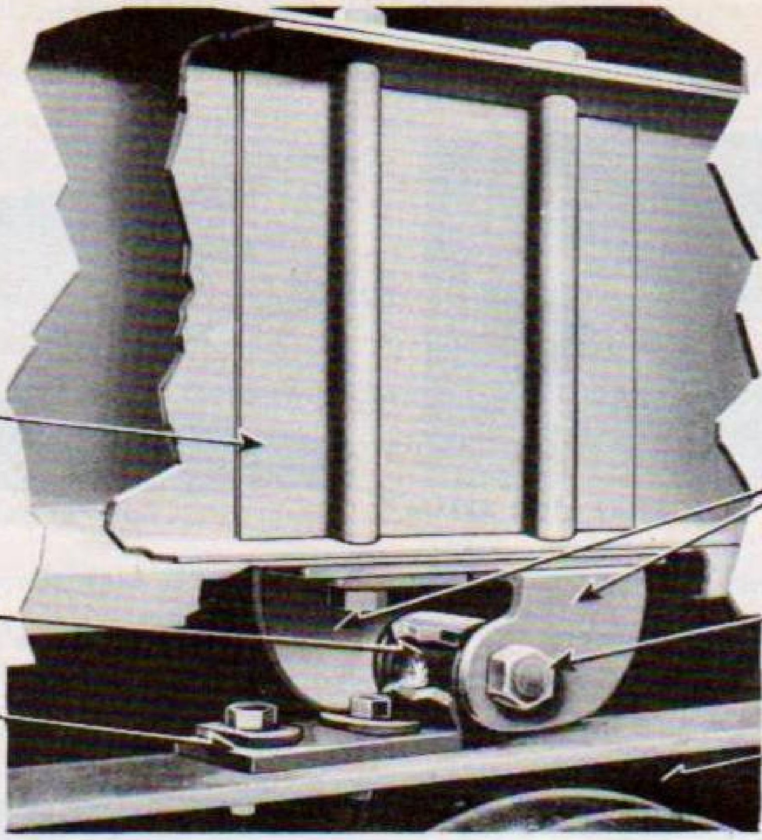


Figure 125 — Cab Rear Mounting (Dump Truck)

(3) Lift running board from brackets.

c. Installation.

(1) Place running board on running board brackets.

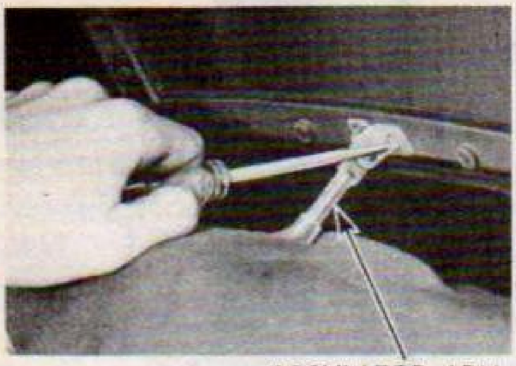
(2) Install two cap screws in both front and rear brackets through running board, and loosely install nuts and lock washers.

(3) Place two spacers between rear of fender and front of running board in line with cap screw holes, and install two cap screws. Loosely install nuts and lock washers on cap screws.

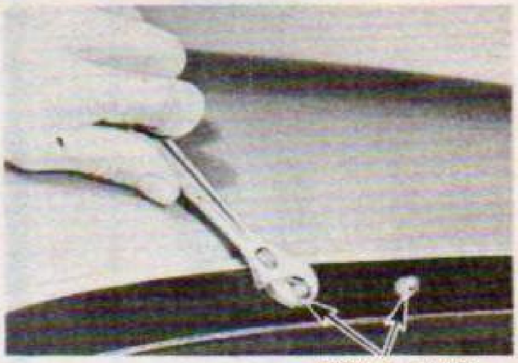
(4) Tighten all nuts securely.

144. CAB (DUMP TRUCK).

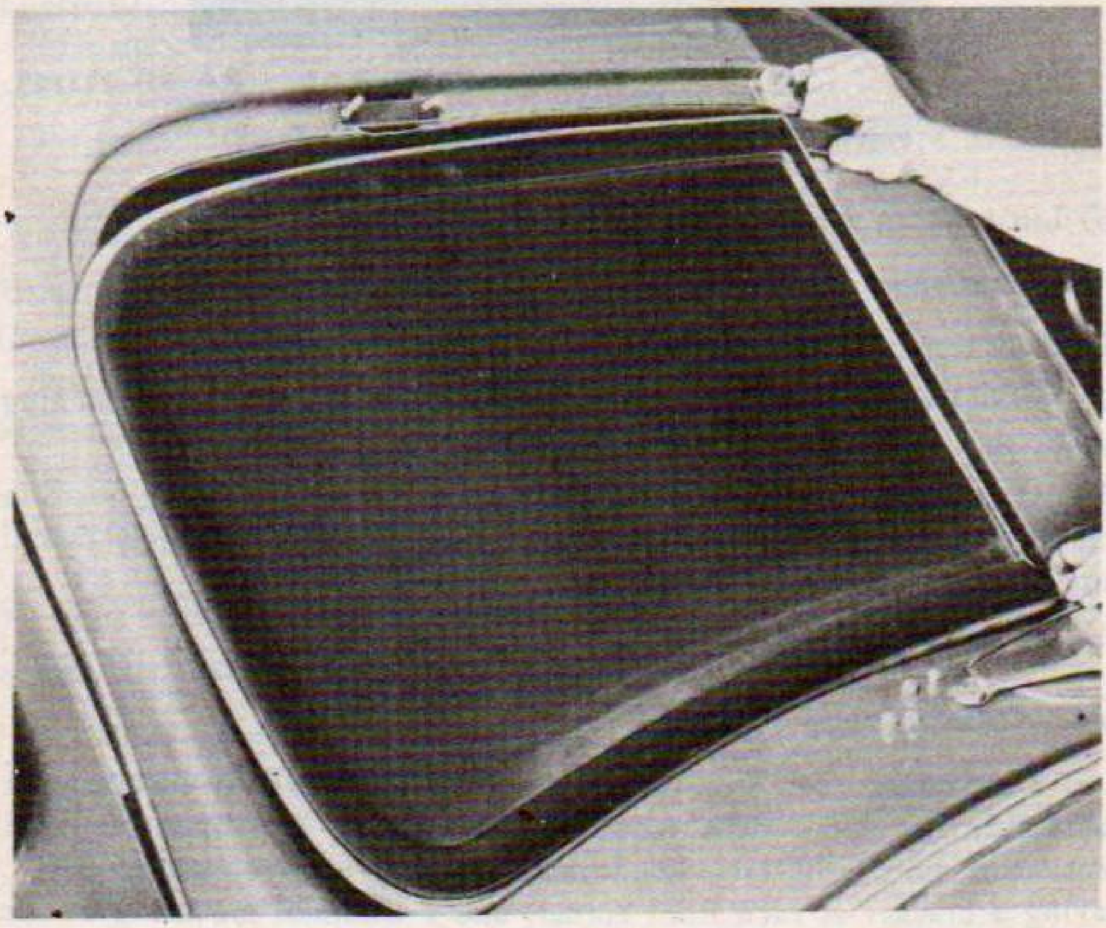
a. Description. The steel cab on the dump truck is fully enclosed. It has full-length doors with adjustable door glass, an adjustable cowl ventilator, and an adjustable windshield. The cab is three-point mounted, having a bracket at each front corner, and a trunnion mounting at the rear. Figure 124 illustrates a front mounting, and figure 125 illustrates the rear trunnion mounting. Each of the mountings contains insulators. The cab front mountings prevent cab side movement, and the rear mounting prevents chassis twist from being transferred to the cab.



Removing Regulator To Windshield Screws



Removing Dome Nuts From Hinge Screws At Top



RA PD 323730

Figure 126 — Windshield Removal

145. WINDSHIELD (DUMP TRUCK).

a. Description. The windshield of the dump truck is adjustable, opening from the bottom on hinges at the top. A windshield control handle is located at the top center of the cowl.

b. Removal (fig. 126).

(1) Open windshield, and remove two screws from each of two windshield regulator arms.

(2) Remove dome nuts from two upper windshield hinge screws.

(3) Lift windshield assembly from vehicle.

c. Installation.

(1) Place windshield in position on windshield opening, inserting upper hinge screws into windshield holes (fig. 126).

(2) Install dome nuts on each of two hinge screws at each upper hinge.

(3) Install two screws in each windshield regulator arm.

(4) Close windshield, and check alinement. If necessary, windshield can be shifted in opening as outlined in steps (5) and (6) below.

(5) Remove four screws from each windshield header plate at inside of cab, and remove plates.

(6) Loosen windshield hinge screws, and aline windshield. Tighten screws in hinges. Install windshield header plates, and install screws.

146. WINDSHIELD WIPERS (DUMP TRUCK).

a. Description. There are two vacuum-operated windshield wipers on the dump truck. The windshield wipers are individually controlled by valves at the wipers (fig. 13).

b. Removal. Windshield wipers are individually removable as follows:

(1) Disconnect windshield wiper blade from wiper arm.

(2) Remove retaining nut from windshield wiper arm at outside of windshield wiper.

(3) Remove screws from windshield header plate inside cab, and remove header plate.

(4) Disconnect windshield wiper vacuum hose from windshield wiper motor.

(5) Remove nuts and lock washers from windshield wiper bracket, and lift wiper motor from opening.

c. Installation.

(1) Install windshield wiper motor in position in windshield header

opening, inserting shaft through opening of cab above windshield. Install cap screws, nuts, and lock washers in wiper motor mounting bracket.

(2) Connect windshield wiper vacuum hose to wiper motor.

(3) Install windshield header plate in position over opening, and install header plate screws.

(4) Install windshield wiper arm on wiper shaft, and install retaining nut.

(5) Install windshield wiper blade on wiper blade arm.

Section XXXVI

Bodies

147. DUMP BODY.

a. Description. The Galion or St. Paul all-steel dump body used on the dump truck is mounted on channel iron crossmembers and longitudinal members. The sides of the body are supported by vertical braces and front box corner posts. The body has tailgate hinges at both top and bottom which are controlled by a lever at the left front corner.

b. Operation. The dump body is raised and lowered by a hydraulic hoist, described in paragraphs 149 and 152, whose operation is described in paragraph 15.

c. Tailgate Removal. To remove the tailgate from the dump body, unlock the lower tailgate latch by pulling the control lever at the front of the body, unhook chains at upper hinges by removing the two upper hinge pins from the hinges, and lift off the tailgate.

d. Tailgate Installation. Lift tailgate into position, install upper hinge pin in each upper hinge, and connect chains to hinge pins. Lock lower latches by raising control lever at front of body to upright position.

e. Tailgate Controls.

(1) DESCRIPTION. The tailgate control lever is attached to a cross shaft at the front of the body. To this cross shaft are attached two tailgate control rods at the ends of which are control rod hooks which clamp over the tailgate lower pivots.

(2) ADJUSTMENT. The control rods must be adjusted for length so that, with the control lever in its upright position, the control rod hooks will clamp the pivots securely. This is accomplished by removing the

two lock nuts and flat washers from the control rod end at the control lever cross shaft, and screwing the control rod in or out to change its length according to requirements. Reinstall cap screw in control rod, and install two lock nuts and flat washers.

148. BUS BODY.

a. Description. The passenger bus bodies on the bus vehicles are built by different manufacturers, but are all of generally the same design. Each has a capacity of 37 seated passengers. The entrance door at the right front of the body is controlled by the driver through a control lever inside the driver's compartment (fig. 14). The rear emergency door is provided only as an emergency exit, and is opened from the outside by use of a special door handle which is kept in a holder at the left of the driver.

Section XXXVII

Dump Truck Body Hoists

149. DUMP BODY HOIST (GALION).

a. Description.

(1) The Galion dump body hoist used on some of these vehicles is a model GH-46 hydraulic hoist. It is of single-point lift in that the hoist piston rod pushes directly against the bottom of the body at a point near the back of the center of the load. A heavy cast alloy steel pivot bracket takes the thrust against a heavy cross angle. The hoist cylinder pivots on a heavy alloy shaft which is supported on two full length thrust bars. The cylinder pivots flexibly on the pivot cross shaft so that neither breakage nor distortion can occur when the unit is used either on uneven grades, or under strained or twisted chassis conditions. The hoist cylinder and its subframe assembly are shown in figure 127.

(2) The hoist cylinder contains a piston and a piston rod. The piston is actuated through a hoist pump located at the front end of the cylinder. The hoist pump is operated by a transmission mounted power take-off which is connected to the hoist pump by a drive shaft. A control rod connects to the hoist pump valve lever, and the front end of this control rod attaches to the control lever in the driver's compartment. Operation is described in paragraph 15.

150. HOIST CYLINDER AND PUMP (GALION).

a. Removal.

(1) Raise and block body securely. Prop body with heavy timbers.

(2) Remove cotter pin from pump control rod at pump lever, and disconnect control rod.

(3) Remove set screw from pump drive shaft at pump, and disconnect drive shaft from pump.

(4) Remove large cotter pin from hoist cross head pin, drive the pin from piston cross head, and lower the rear end of the hoist.

(5) Remove large cotter pin from hoist cylinder pivot shaft, remove nut and lock washer from pivot shaft stay bolt, and remove the bolt. Drive pivot shaft out of hoist cylinder base and from shaft spacers.

(6) Lift hoist cylinder and pump from vehicle.

(7) Remove hoist pump manifold stud with ball check, remove plain hoist pump manifold stud, and lift hoist pump assembly and gasket from hoist cylinder.

b. Installation.

(1) Place new gasket in position at hoist cylinder base, and place hoist pump assembly on hoist cylinder base.

(2) Install manifold stud with ball check, and install manifold plain stud, using new gaskets.

(3) Raise hoist cylinder and pump assembly into position in hoist subframe.

(4) Drive hoist cylinder pivot shaft into hoist cylinder base and into the long and short pivot shaft spacers. Install new cotter pin in end of pivot shaft, and install pivot shaft stay bolt, nut, and lock washer.

(5) Raise rear end of hoist, drive cross head pin into piston cross head, and install new cotter pin in cross head pin.

(6) Connect hoist pump drive shaft to hoist pump, and install set screw.

(7) Connect hoist pump control rod to hoist pump manifold valve lever, and install new cotter pin.

(8) Refill hoist cylinder as follows:

(a) Remove two screws from oil filler and relief plate on hoist cylinder, and remove plate and gasket.

(b) Fill cylinder full of oil (par. 22). Replace filler plate and gasket, and install two screws loosely.

(c) Run engine at idling speed while raising and lowering body five or six times. Tighten filler plate screws. CAUTION: *Do not speed engine while raising or lowering the body as this causes air pockets to form in the oil*

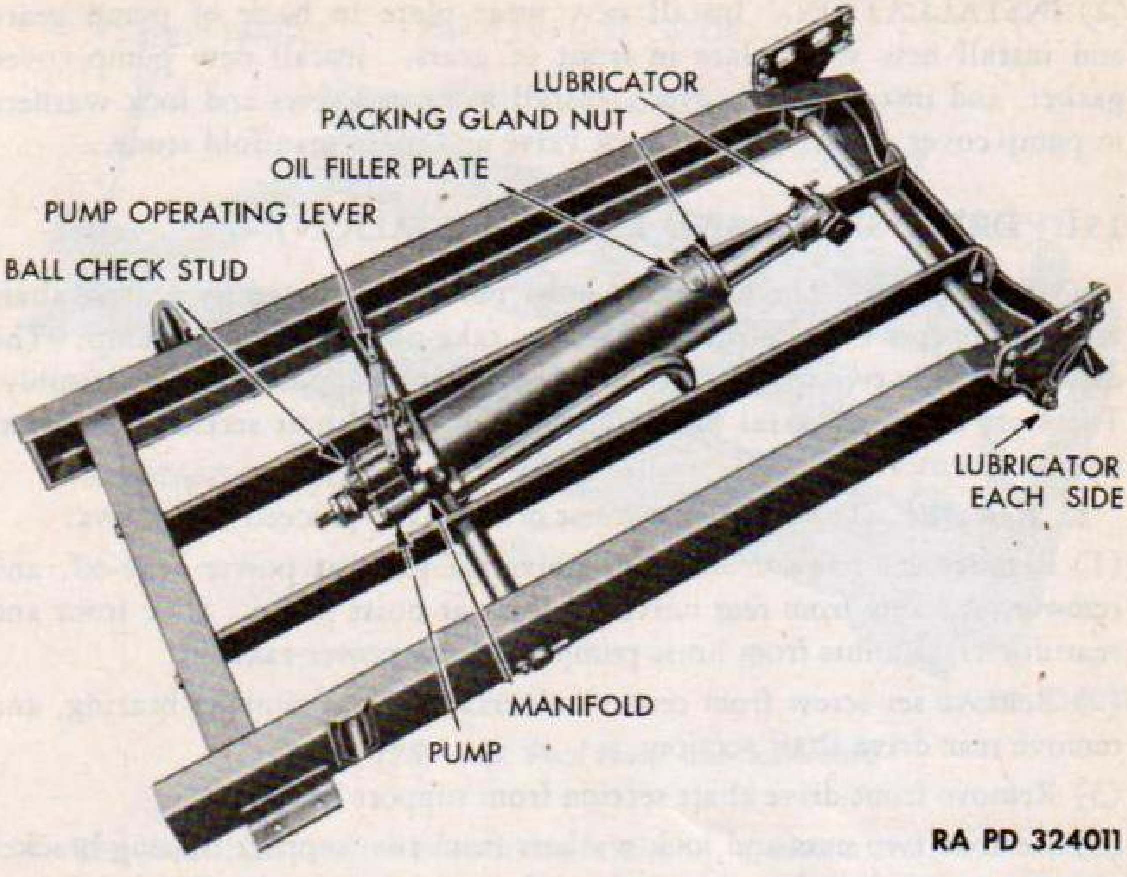


Figure 127 — Galion Hoist and Subframe

It is also important that oil be strained before using when taken from containers not properly sealed.

c. Cylinder Packing Nuts and Connections.

(1) Should the cylinder head leak where it screws into the hoist cylinder, turn it out of the cylinder three or four threads and clean off both the face of the head and cylinder. Apply shellac to both faces, and draw up tight, using a blunt-pointed bar and a hammer.

(2) Keep the piston packing nut at the top of the hoist cylinder snug, but not too tight.

(3) If at any time the manifold studs are removed, be sure the ball check stud is placed back in the right-hand side of the pump looking toward the front of the truck from the rear. Manifold studs must be kept tight, and the packing nut on the pump drive shaft must be drawn up snug.

d. Pump Wear Plates.

(1) REMOVAL. Remove two manifold studs and five cap screws from the pump cover. Remove pump cover and gasket from the pump. Remove one bronze wear plate from in front of the pump gears and one from in back of the gears.

(2) INSTALLATION. Install new wear plate in back of pump gears and install new wear plate in front of gears. Install new pump cover gasket, and install pump cover. Install five cap screws and lock washers in pump cover. Install both check valve and plain manifold studs.

151. DRIVE SHAFT AND LINKAGE (GALION).

a. Description. The hydraulic hoist pump is actuated by a drive shaft which connects the transmission power take-off to the hoist pump. The drive shaft is in two sections and is supported in a support bearing assembly. There are three universal joints on the two drive shaft sections, at front, rear, and center.

b. Removal. To remove the hoist drive shaft, proceed as follows:

(1) Remove set screw from front universal joint at power take-off, and remove set screw from rear universal joint at hoist pump. Slide front and rear universal joints from hoist pump and from power take-off.

(2) Remove set screw from center universal joint at support bearing, and remove rear drive shaft section.

(3) Remove front drive shaft section from support bearing.

(4) Remove two nuts and lock washers from two support bearing bracket cap screws, remove the cap screws, and remove support bearing bracket.

c. Installation.

(1) Install support bearing and bracket in position, and install two cap screws, nuts, and lock washers.

(2) Install front section of drive shaft in position in bearing, connect universal joint to power take-off, and install set screw in universal joint.

(3) Connect rear section of drive shaft to front section, and install and tighten set screw.

(4) Connect rear universal joint to pump shaft, and install and tighten set screw.

152. DUMP BODY HOIST (ST. PAUL).

a. Description.

(1) The St. Paul hydraulic hoist, Model 36, is used on some of these vehicles. It consists of a hydraulic pump, a manifold, hydraulic cylinder, and suitable connecting linkage. The hoist is mounted in a subframe assembly (fig. 128).

(2) The hoist pump is attached to a manifold. The manifold, in turn, is attached to a trunnion angle. A control valve is mounted on top of this trunnion angle directly above the manifold. The control valve is then attached to the hoist cylinder at its base.

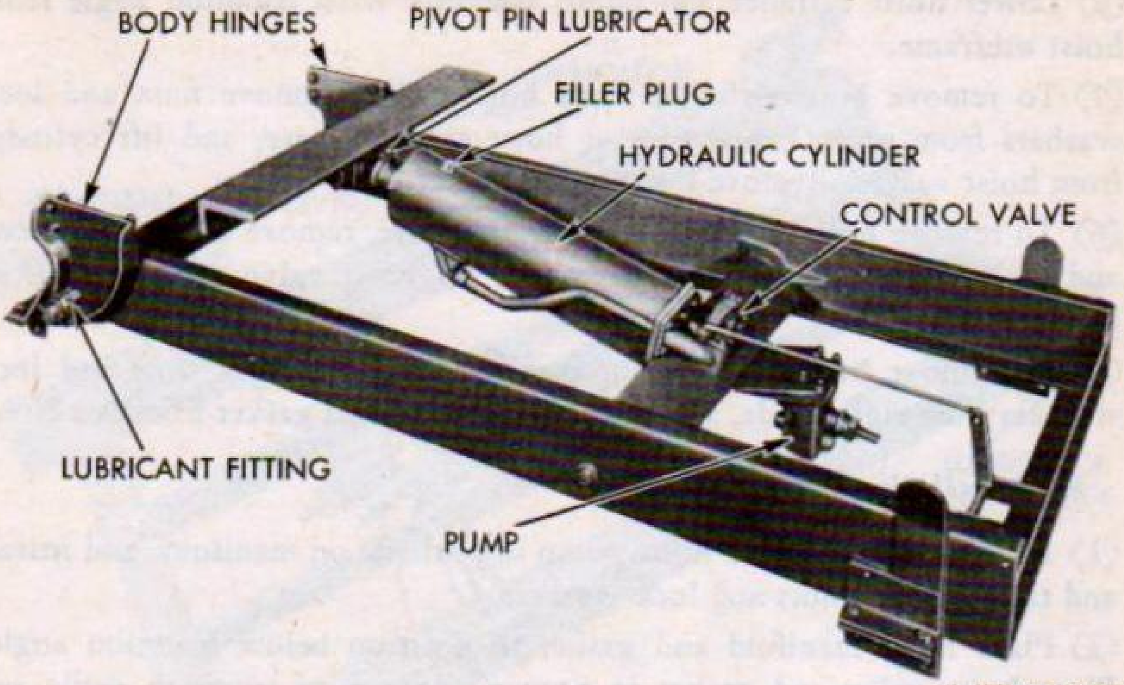


Figure 128 — St. Paul Hoist and Subframe

(3) The steel hoist cylinder contains a piston, a piston rod, and a piston return spring. At the top or outer end of the piston rod there is a piston rod end into which fits the cylinder piston rod end pin. The piston rod end pin fits into the cylinder body angle.

(4) The hoist is controlled by a control lever located in the driver's compartment. Control rods attach to the control lever and to the hoist valve. Operation is described in paragraph 15. The hoist pump is actuated by a transmission-mounted power take-off which is connected to the hoist pump by a drive shaft having three universal joints.

153. HOIST CYLINDER AND PUMP (ST. PAUL).

a. Removal.

(1) Raise and block dump body securely. Prop body with heavy timbers to prevent falling.

(2) Disconnect hoist drive shaft by removing set screw from universal joint at pump end of shaft, and slide universal joint from the pump shaft.

(3) Remove cotter pin from control rod at pump valve, and disconnect control rod from valve lever at valve.

(4) Remove two cotter pins from piston rod end pin, and drive pin from piston rod and piston rod end. Support rear end of hoist.

(5) Remove nut and flat washer from each end of hoist subframe tie rod, and drive tie rod from cylinder trunnion angle.

(6) Lower hoist cylinder and pump assembly with trunnion angle from hoist subframe.

(7) To remove hoist cylinder from hoist valve, remove nuts and lock washers from seven cap screws at hoist cylinder base, and lift cylinder from hoist valve. Remove hoist valve gasket.

(8) To remove hoist valve from trunnion angle, remove eight cap screws and lock washers from hoist valve, and lift hoist valve and gasket from trunnion angle.

(9) To remove hoist pump from manifold, remove eight nuts and lock washers from eight studs, and lower hoist pump and gasket from manifold.

b. Installation.

(1) Place new gasket and hoist pump in position on manifold, and install and tighten eight nuts and lock washers.

(2) Place hoist manifold and gasket in position below trunnion angle. Place hoist valve and gasket in position on top of trunnion angle and install eight cap screws and lock washers.

(3) Place new hoist valve gasket and hoist valve in position against hoist cylinder base, install seven cap screws, nuts, and lock washers, and tighten securely.

(4) Lift hoist cylinder, pump, and trunnion angle assembly into position in hoist subframe, and support it.

(5) Drive subframe tie rod into hoist trunnion angle through subframe, and install nuts and flat washers at each end of tie rod.

(6) Raise rear end of hoist piston rod and drive piston rod end pin into position in rod end. Install new cotter pin in each end of pin.

(7) Connect hoist drive shaft universal joint at hoist pump, and install set screw in universal joint.

(8) Connect control rod at valve lever, and install new cotter pin in control rod.

(9) Refill hoist cylinder as follows:

(a) Remove filler plug located at upper end of hoist cylinder.

(b) Fill cylinder with oil (par. 22) to overflowing.

(c) With engine idling, engage power take-off, and shift valve control lever into "RAISE" position, adding oil steadily and keeping cylinder full to prevent air from being drawn into the hydraulic system.

(d) Shift valve control lever to "LOWER" position, and permit body to return slowly to horizontal position. NOTE: *Filler plug must be left out to allow excess oil to overflow.*

(e) Repeat operations above if oil fails to overflow in step (d).

(f) Raise body, and install filler plug.

154. DRIVE SHAFT AND LINKAGE (ST. PAUL).

a. Description. The drive shaft of the St. Paul hoist consists of front and rear shaft sections, three universal joints, and a support bearing assembly.

b. Removal. To remove the drive shaft from the vehicle, proceed as follows:

(1) Remove set screw from universal joint at hoist pump, and slide universal joint from pump shaft.

(2) Remove nut and lock washer from support bearing support screw, and lower bearing assembly from bracket.

(3) Remove set screw from universal joint at power take-off, and slide universal joint from power take-off shaft.

c. Installation.

(1) Connect front universal joint to power take-off shaft, and install set screw in universal joint.

(2) Connect support bearing screw at support bracket, and install nut and lock washer on screw.

(3) Connect rear universal joint at hoist pump shaft, and install set screw in universal joint.

d. Control Rods. The control rods are attached at either end by cotter pins, and the two control rods pass through relay linkage.

APPENDIX

Section XXXVIII

Shipment and Limited Storage

155. GENERAL INSTRUCTIONS.

a. Preparation for domestic shipment of the vehicle is the same as preparation for limited storage. Preparation for shipment by rail includes instructions for loading and unloading the vehicle, blocking necessary to secure the vehicle on freight cars, number of vehicles per freight car, clearance, weight, and other information necessary to prepare the vehicle properly for rail shipment. For more detailed information, and for preparation for indefinite storage, refer to AR 850-18.

156. PREPARATION FOR LIMITED STORAGE OR DOMESTIC SHIPMENT.

a. Vehicles to be prepared for limited storage or domestic shipment are those ready for immediate service, but not used for less than thirty days. If vehicles are to be indefinitely stored after shipment by rail, they will be prepared for such storage at their destination.

b. If the vehicles are to be placed in limited storage, temporarily stored or bivouacked, take the following precautions:

(1) LUBRICATION. Lubricate the vehicle completely (par. 21).

(2) COOLING SYSTEM. If freezing temperature may normally be expected during the limited storage or shipment period, test the coolant with hydrometer, and add the proper quantity of antifreeze to afford protection from freezing at the lowest temperature anticipated during the storage or shipping period. Completely inspect the cooling system for leaks.

(3) BATTERY. Check battery and terminals for corrosion and, if necessary, clean and thoroughly service battery (par. 96).

(4) TIRES. Clean, inspect, and properly inflate all tires. Replace with serviceable tires any tires requiring retreading or repairing. Do not store vehicles on floors, cinders, or other surfaces which are soaked with oil or grease. Wash off immediately any oil, grease, gasoline, or kerosene which comes in contact with the tires under any circumstances.

(5) ROAD TEST. The preparation for limited storage will include a road test of at least 5 miles, after the battery, cooling system, lubrication, and tire service, to check on general condition of the vehicle. Correct any defects noted in the vehicle operation, before the vehicle is stored, or place a note on a tag attached to the steering wheel, stating the repairs needed or describing the condition present. A written report of these items will then be made to the officer in charge.

(6) FUEL IN TANKS. It is not necessary to remove the fuel from the tanks for shipment within the United States, nor to label the tanks under Interstate Commerce Commission regulations. Leave fuel in the tanks except when storing in locations where fire ordinances or other local regulations require removal of all gasoline before storage.

(7) EXTERIOR OF VEHICLES. Remove rust appearing on any part of the vehicle with flint paper. Repaint painted surfaces whenever necessary to protect wood or metal. Coat exposed polished metal surfaces susceptible to rust, such as cables or chains, with medium grade preservative lubricating oil. Close firmly all cab doors, windows, and windshields. Vehicles equipped with open-type cabs with collapsible tops will have the tops raised, all curtains in place, and the windshield closed. Make sure tarpaulins and window curtains are in place and firmly secured. Leave rubber mats, such as floor mats, where provided, in an unrolled position on the floor, and not rolled or curled up. Equipment such as pioneer and truck tools, tire chains, and fire extinguishers will remain in place in the vehicle.

(8) INSPECTION. Make a systematic inspection just before shipment or limited storage to ensure that all the above steps have been covered, and that the vehicle is ready for operation on call. Make a list of all missing or damaged items and attach it to the steering wheel. Refer to Before-operation Service (par. 27).

(9) ENGINE. To prepare the engine for storage, remove the air cleaner from the carburetor. Start the engine, set the throttle to run the engine at a fast idle, and pour 1 pint of medium grade preservative lubricating oil, Ordnance Department Specification AXS-674 of the latest issue in effect, into the carburetor throat, being careful not to choke the engine. Turn off the ignition switch as quickly as possible after the oil has been poured into the carburetor. With the engine switch off, open the throttle wide, and turn the engine five complete revolutions by means of the starter. If the engine cannot be turned by the starter with the switch off, turn it by hand, or disconnect the high-tension lead and ground it before turning the engine by means of the starter. Then reinstall the air cleaner.

(10) BRAKES. Release the brakes and check the wheels.

c. Inspections in Limited Storage. Vehicles in limited storage will be inspected weekly for condition of tires and battery. If water is added when freezing weather is anticipated, recharge the battery with a portable charger, or remove the battery for charging. Do not attempt to charge the battery by running the engine.

157. LOADING AND BLOCKING FOR RAIL SHIPMENT.

a. Preparation. In addition to the preparation described in paragraph

156, when Ordnance vehicles are prepared for domestic shipment, the following preparations and precautions will be taken.

(1) EXTERIOR. Cover the body of the vehicle with a canvas cover supplied as an accessory.

(2) TIRES. Inflate pneumatic tires to from 5 to 10 pounds above normal pressure.

(3) BATTERY. Disconnect the battery to prevent its discharge by vandalism or accident. This may be accomplished by disconnecting the positive lead, taping the end of the lead, and tying it back away from the battery.

(4) BRAKES. The brakes must be applied and the transmission placed in low gear after the vehicle has been placed in position with a brake wheel clearance of at least 6 inches. Vehicles will be located on the car in such a manner as to prevent the car from carrying an unbalanced load.

(5) All cars containing Ordnance vehicles must be placarded "DO NOT HUMP."

(6) Ordnance vehicles may be shipped on flat cars, end door box cars, side door box cars, or drop end gondola cars, whichever type car is the most convenient.

b. Facilities for Loading. Whenever possible, load and unload vehicles from open cars under their own power, using permanent end ramps and spanning platforms. Movement from one flat car to another along the length of the train is made possible by cross-over plates or spanning platforms. If no permanent end ramp is available, an improvised ramp can be made from railroad ties. Vehicles may be loaded in gondola cars without drop ends by using a crane. In case of shipment in side door cars, use a dolly-type jack to warp the vehicles into position within the car.

c. Securing Vehicles. In securing or blocking a vehicle, three motions, lengthwise, sidewise, and bouncing, must be prevented. There are two approved methods of blocking the vehicles on freight cars, as described below. When blocking dual wheels, all blocking will be located against the outside wheel of the dual.

(1) METHOD 1 (fig. 129). Locate eight blocks "B," one to the front and one to rear of each wheel. Nail the heel of each block to the car floor with five 40-penny nails to each block. That portion of the block under the tread will be toenailed to the car floor with two 40-penny nails to each block. Locate two blocks "D" against the outside face of each wheel. Nail the lower block to the car floor with three 40-penny nails, and the top block to the lower block with three 40-penny nails. Pass four strands, two wrappings, of No. 8 gage black annealed wire "C" through clevis on bumper at the front of the vehicle, and then through a stake pocket on the railroad car. Perform the same operation at the rear of the vehicle,

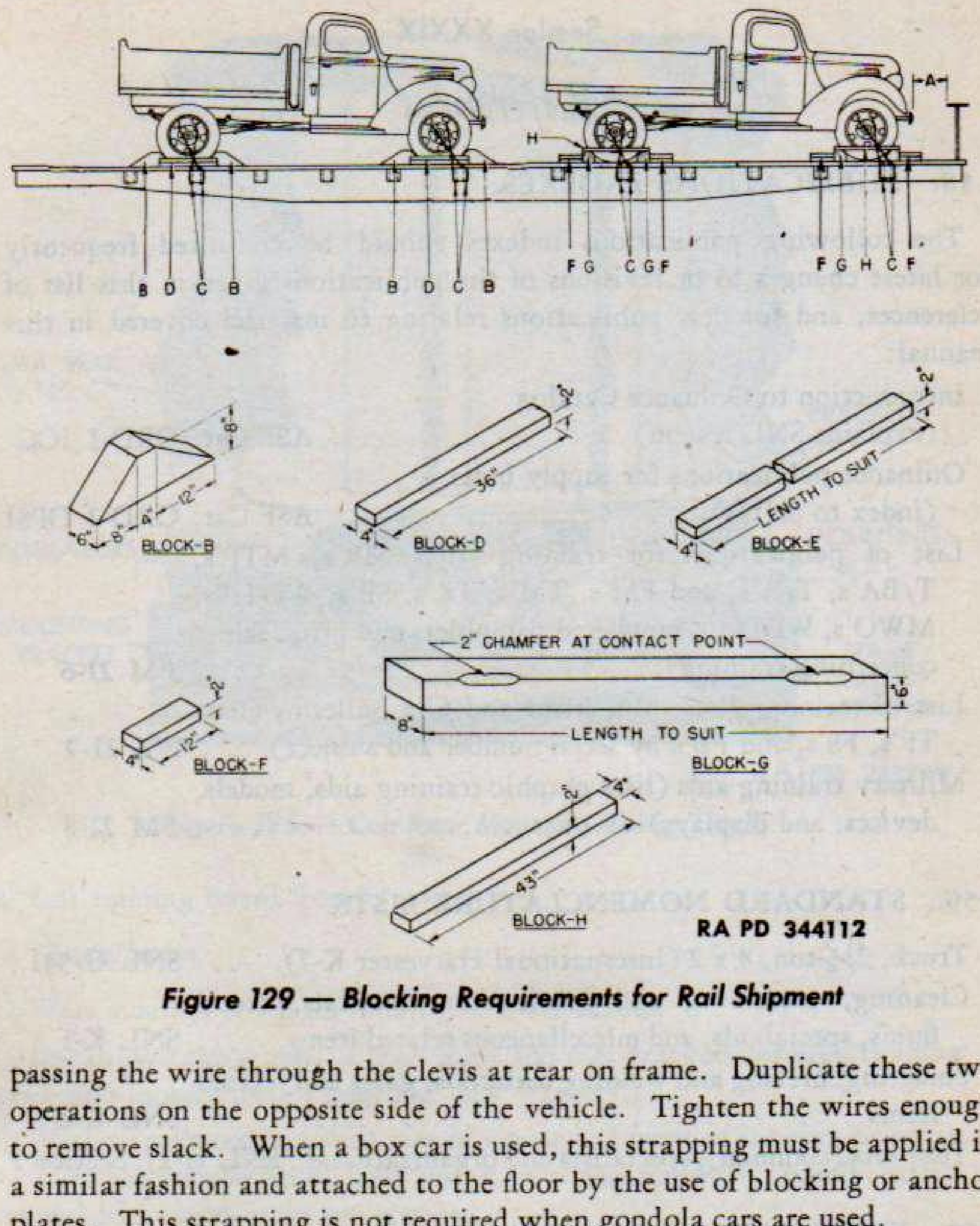


Figure 129 — Blocking Requirements for Rail Shipment

passing the wire through the clevis at rear on frame. Duplicate these two operations on the opposite side of the vehicle. Tighten the wires enough to remove slack. When a box car is used, this strapping must be applied in a similar fashion and attached to the floor by the use of blocking or anchor plates. This strapping is not required when gondola cars are used.

(2) METHOD 2 (fig. 129). Place four blocks "G," one to the front and one to the rear of each set of wheels. These blocks are to be at least 8 inches wider than the over-all width of the vehicle at the car floor. Using sixteen blocks "F" as cleats, locate two against blocks "G" to the front of each wheel, and two against blocks "G" to the rear of each wheel. Nail the lower cleat to the floor with three 40-penny nails, and the top cleat to the cleat below with three 40-penny nails. Locate four cleats "H" on the outside of each wheel to the top of each block "G" with two 40-penny nails. Pass four strands, two wrappings, of No. 8 gage black annealed wire "C" through clevis on front bumper and also clevis at rear of frame, as described in Method 1 above.

Section XXXIX

References

158. PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes to or revisions of the publications given in this list of references, and for new publications relating to materiel covered in this manual:

Introduction to Ordnance Catalog (explains SNL system)	ASF Cat. ORD-1 IOC
Ordnance publications for supply index (index to SNL's)	ASF Cat. ORD-2 OPSI
List of publications for training (lists MR's, MTP's, T/BA's, T/A's, and FM's, TM's, TR's, SB's, WDTB's, MWO's, WDLO's, numbered pamphlets and firing tables concerning training)	FM 21-6
List of training films, film strips and film bulletins (lists TF's, FS's, and FB's by serial number and subject)	FM 21-7
Military training aids (lists graphic training aids, models, devices, and displays)	FM 21-8

159. STANDARD NOMENCLATURE LISTS.

Truck, 2½-ton, 4 x 2 (International Harvester K-7)	SNL G-541
Cleaning, preserving and lubrication materials, recoil fluids, special oils, and miscellaneous related items	SNL K-1
Soldering, brazing and welding materials, gases and related items	SNL K-2
Tool-sets (common), specialists and organizational	SNL G-27, Section 2

160. EXPLANATORY PUBLICATIONS.

a. Fundamental Principles.

Automotive power transmission units	TM 10-585
Automotive electricity	TM 10-580
Automotive brakes	TM 10-565
Basic maintenance manual	TM 38-250
Chassis, body, and trailer units	TM 10-560
Driver's manual	TM 10-460
Driver's selection and training	TM 21-300
Electrical fundamentals	TM 1-455
Military motor vehicles	AR 850-15

Motor vehicle inspections and preventive maintenance service . . . . . TM 9-2810
Precautions in handling gasoline . . . . . AR 850-20
Sheet metal work, body, fender, and radiator repairs . . . TM 10-450
Standard military motor vehicles . . . . . TM 9-2800
The internal combustion engine . . . . . TM 10-570

b. Maintenance and Repair.

Cleaning, preserving, lubricating and welding materials and similar items issued by the Ordnance Department. TM 9-850
Maintenance and care of pneumatic tires and rubber treads . . . . . TM 31-200
Ordnance Maintenance: 2½-ton 4 x 2 dump truck (IHC K-7) and 37-passenger bus (IHC K-7 and KS-7) . . . . . TM 9-1822
Ordnance Maintenance: Electrical equipment (Delco Remy) . . . . . TM 9-1825A
Ordnance Maintenance: Power brake systems (Bendix-Westinghouse) . . . . . TM 9-1827A
Ordnance Maintenance: Carburetors (Zenith) . . . . . TM 9-1826C
Ordnance Maintenance: Fuel pumps . . . . . TM 9-1828A
Ordnance Maintenance: Speedometers, tachometers and recorders . . . . . TM 9-1829A

c. Protection of Materiel.

Camouflage . . . . . FM 5-20
Chemical decontamination company . . . . . FM 3-70
Chemical decontamination, materials and equipment . . . . TM 3-220
Decontamination of armored force vehicles . . . . . FM 17-59
Defense against chemical attack . . . . . FM 21-40
Explosives and demolitions . . . . . FM 5-25

d. Storage and Shipment.

Ordnance storage and shipment chart, group G—Major items . . . . . OSSC-G
Preparation of unboxed Ordnance materiel for shipment SB 9-4
Registration of motor vehicles . . . . . AR 850-10
Rules governing the loading of mechanized and motorized army equipment, also major caliber guns for the United States Army and Navy, on open top equipment published by Operations and Maintenance Department of Association of American Railroads.
Storage of motor vehicle equipment . . . . . AR 850-18
The Ordnance company, depot . . . . . FM 9-25

Index

C—Cont'd

D

E

L — Cont'd

M

N

O

P

R

S

S — Cont'd

T

T — Cont'd

V

W

IHC-6JAN45-20M