

TM 9-2320-211-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DIRECT SUPPORT, GENERAL SUPPORT
AND DEPOT MAINTENANCE

FOR:

TRUCK, CHASSIS: 5-TON, 6 X 6

M39, M39A2, M40, M40A1, M40A2, M40A1C, M40A2C, M61, M61A1, M61A2, M63, M63A1, M63A2, M63C, M63A1C, M63A2C, M63A1D, M63A2D, M139A1, M139A2, M139C, M139A2C, M139D, M139A2D, M139F, M139A1F, M139A2F; TRUCK, CARGO: M41, M41A2, M54, M54A1, M54A2, M54A1C, M54A2C, M55, M55A1, M55A2; TRUCK, DUMP: M51, M51A1, M51A2; TRUCK, TRACTOR: M52, M52A1, M52A2; TRUCK, TRACTOR, WRECKER: M246, M246A1, M246A2; TRUCK, VAN, EXPANSIBLE: M291A1, M291A2, M291A1C, M291A2C, M291A1D, M291A2D; TRUCK, WRECKER, MEDIUM: M62, M543, M543A1, M543A2; TRUCK, BRIDGING: M139, M328A1, M328A2; TRUCK, LOGGING, M748A1, M748A2.

This copy is a reprint which includes current pages from Changes 1 through 5.

HEADQUARTERS, DEPARTMENT OF THE ARMY

SEPTEMBER 1964

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 20 May 1978

Change

No. 5

**Direct Support General Support
and Depot Maintenance Manual:
TRUCK, CHASSIS: 5-TON, 6x6**

**M39, M39A2, M40, M40A1, M40A2, M40A1C, M40A2C, M61, M61A1, M61A2,
M63, M63A1, M63A2, M63C, M63A1C, M63A2C, M63A1D, M63A2D, M139A1,
M139A2, M139C, M139A2C, M139D, M139A2D, M139F, M139A1F, M139A2F;
TRUCK, CARGO: M41 , M41A2, M54, M54A1, M54A2, M54A1C, M54A2C, M55,
M55A1, M55A2; TRUCK, DUMP: M51, M51A1, M51A2; TRUCK, TRACTOR: M52,
M52A1, M52A2; TRUCK, TRACTOR, WRECKER: M246, M246A1, M246A2; TRUCK,
VAN, EXPANSIBLE: M291A1, M291A2, M291A1C, M291A2C, M291A1D, M291A2D;
TRUCK, WRECKER, MEDIUM: M62, M543, M543A1, M543A2; TRUCK,
BRIDGING: M139, M328A1 , M328A2; TRUCK, LOGGING, M748A1, M748A2.**

TM 9-2320-211-35, 15 September 1964, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the outer margin of the page. When an entire chapter or section is revised or change, the bar will be adjacent to the title only. New or revised illustrations are indicated by a vertical bar adjacent to the identification number.

REMOVE PAGES

v and 1
1A and 2
65 and 66
None
None
253 and 254
279 through 282

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v and 1
1A and 2
65 and 66
66.1 through 66.27/(66.28 blank)
140.1 through 140.16
253 and 254
279 through 282

2. File this change sheet in the front of the publication for reference purposes.

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The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-38, direct and general support requirements for 5-ton truck chassis, cargo, dump, tractor, wrecker tractor, van expansible, and bridge transport stake.

Technical Manual }
No. 9-2320-211-35 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D. C., 15 September 1964

Direct Support, General Support and Depot Maintenance For:

TRUCK, CHASSIS: 5-TON, 6x6, M39, M39A2, M40, M40A1, M40A2, M40A1C, M40A2C, M61, M61A1, M61A2, M63, M63A1, M63A2, M63C, M63A1C, M63A2C, M63A1D, M63A2D, M139A1, M139A2, M139C, M139A2C, M139D, M139A2D, M139F, M139A1F, M139A2F; TRUCK, CARGO: M41, M41A2, M54, M54A1, M54A2, M54A1C, M54A2C, M55, M55A1, M55A2; TRUCK, DUMP M51, M51A1, M51A2; TRUCK, TRACTOR: M52, M52A1, M52A2; TRUCK, TRACTOR, WRECKER: M246, M246A1, M246A2; TRUCK, VAN, EXPANSIBLE: M291A1, M291A2, M291A1C, M291A2C, M291A1D, M291A2D; TRUCK, WRECKER, MEDIUM: M62, M543, M543A1, M543A2; TRUCK, BRIDGING: M139, M328A1, M328A2; TRUCK, LOGGING, M748A1, M748A2.

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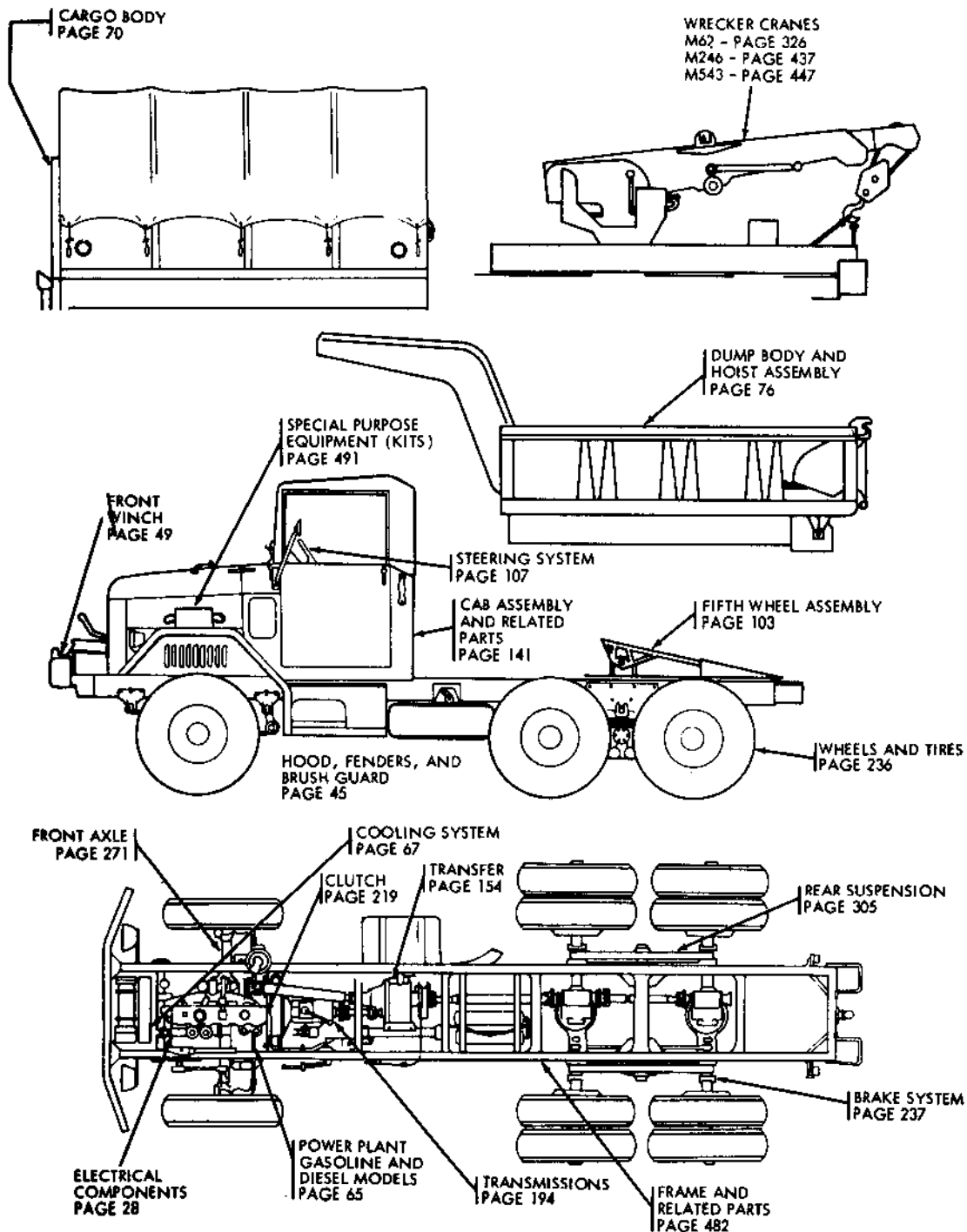
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VISUAL GUIDE TO CONTENTS

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This technical manual contains instructions for field and depot maintenance of the following items:

- (1) Truck Chassis - 5-Ton, 6x6, Models M39, M40, M40C, M61, M61A2, M63, M63C, M139, M139C, M139D, and M139F.
- (2) Cargo Truck - 5-Ton, 6x6, M41, M54, M54A1, M54A2, M55.
- (3) Dump Truck - 5-Ton, 6x6, Model M51, M51A2.
- (4) Tractor Truck - 5-Ton, 6x6, Models M52, M52A1, and M52A2.
- (5) Tractor-Wrecker Truck - 5-Ton, 6x6, Model M246.
- (6) Medium Wrecker Truck - 5-Ton, 6x6, Models M62, M543, and M543A2.

b. This manual contains descriptions of, and procedures for, removal, disassembly, inspection, repair, and assembly of the body, cab, and chassis components as well as the transmission, transfer, power takeoff, axles, winch, hoist and miscellaneous peculiar hardware of the aforementioned vehicles. Illustrated step-by-step figures are included. Disassembly procedures are illustrated with a white arrow in the upper left corner and assembly with a black inverted arrow in the lower right corner. The arrows are numbered to indicate removal and installation sequence. Steps applicable only to installation or only to removal will have only the arrow application to the operation being performed.

c. The appendix contains a list of current references, including supply manuals, forms, technical manuals, and all other available publication applicable to the vehicles listed in paragraph a and all peculiar components.

d. You can improve this publication by calling attention to errors and by recommending improvements using DA Form 2028

(Recommending Changes to Publications), or by letter mailed to Commander, U.S. Army Tank Automotive Material Readiness Command, ATTN: DRSTA-MTP, Warren, Michigan 48090. A reply will be furnished direct to you.

e. TM 9-2320-211-10 contains operating instructions and all maintenance operations allocated to using organizations, performing maintenance work within their scope, for the vehicles.

f. LO 9-2320-211-12 contains lubrication instructions for the vehicles.

g. TM 9-2320-211-20 contains instructions for all maintenance operations allocated to Organizational Maintenance Personnel for the vehicles.

h. TM 9-2320-211-20P contains listings of repair parts and special tools for organizational maintenance of the vehicles.

i. TM 9-2320-211-35P contains listings of repair parts and special tools for field and depot maintenance of the cab, body, and chassis components including steering gear, transmission, transfer, power takeoff, front and rear axles, electrical components (except engine mounted), and winch assembly for vehicles listed in paragraph a.

j. TM 9-2815-207-35 contains service information on the Mack Model ENDT 673 Diesel engine, Rockford Model 15 TM clutch, and Bendix Westinghouse Model TU-FLO 500 air compressor.

k. TM 9-2815-207-35P Field and Depot Maintenance repair parts and special tool list for engine, assembly w/accessories (Diesel) (2815-9807092) and clutch (Rockford Model 15 TM) w/all accessories.

l. TM 9-2805-203-35 Field and Depot Maintenance manual for engine, assembly w/accessories (Continental Model R-6602) and clutch (Rockford Model 15 TM).

m. TM 9-2805-203-35P Field and Depot Maintenance repair parts and special tool list for engine, assembly w/accessories (Continental Model R-6602) and clutch (Rockford Model 15 TM).

n. TM 9-2815-210-35 Direct Support, General Support and Depot Maintenance for engine, diesel (multifuel): turbocharged, fuel injected, water cooled, 6-cylinder, assembly 2815-076-5998 (Military Model LDS 465-1).

o. TM 9-2815-210-34P Direct Support, General Support and Depot Maintenance repair parts and special tool list for engine, diesel (multifuel): turbocharged, fuel injected, water cooled, 6-cylinder, assembly 2815-076-5998 (Military Model LDS 465-1).

p. TM 9-2920-247-34 Field Maintenance manual for: generator assembly (2920-737-4750) (Auto-Lite Model GHA-4802 UT).

q. TM 9-2920-209-34P Field Maintenance repair parts for: generator assembly (2920-737-4750) (Auto-Lite Model GHA-4802 UT).

r. TM 9-2920-210-34 Field Maintenance manual for: generator regulator assembly (2920-335-4678) (Auto-Lite Model VBC 4003 UT).

s. TM 9-2920-214-35 Field and Depot Maintenance manual for: generator (2920-735-5736) (Delco-Remy Model No. 1117495).

t. TM 9-2920-214-35P Field and Depot Maintenance repair parts for: generator (2920-735-5736) (Delco-Remy Model No. 1117495).

u. TM 9-1825B Field and Depot Maintenance manual for: electrical equipment (Auto-Lite).

v. TM 9-1826D Field and Depot Maintenance manual for: carburetors and governors (Honey).

w. TM 9-1828A Field and Depot Maintenance manual for: fuel pump.

x. TM 9-8615 Field and Depot Maintenance manual for: steering gears (Ross Gear and Tool co.)

y. TM 9-8627 Field and Depot Maintenance manual for: electrical equipment (Delco-Remy).

z. TM 9-2920-242-35 Direct Support, General Support and Depot Maintenance, and Parts List for: starter (Delco-Remy).

aa. TM 9-2920-243-34 Direct Support, General Support and Depot Maintenance, and Parts List for: starter (Leece-Neville).

ab. TM 9-2910-226-34 Direct Support, General Support and Depot Maintenance, and Parts List for: fuel injector pump.

2. Field and Depot Maintenance Allocation

The publication of instructions for complete disassembly and repair is not to be construed as authority for the performance by field maintenance units of those functions which are restricted to depot shops and arsenals. In general, the prescribed maintenance responsibilities will be reflected in the allocation of maintenance parts listed in the appropriate columns of TM 9-2320-211-34P, Repair Parts and Special Tools List. Instructions for depot maintenance are to be used by maintenance

companies in the field only when the tactical situation makes the repair functions imperative. Supply of the parts listed in the depot guide column of TM 9-2320-211-35P will be made to field maintenance only when the emergency nature of the maintenance to be performed has been certified by a responsible officer of the requisitioning organization and upon express authorization by the chief of the service concerned. Those operations which can be performed as "emergency field maintenance" are specifically covered as such in this technical manual. (See Appendix II of TM 9-2920-211-20, Organizational Maintenance Manual for the Maintenance Allocation Chart, authorizing maintenance operations to various echelons of the using and servicing organization.)

3. Forms, Records, and Reports

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

b. Authorized Forms. The forms generally applicable to units maintaining this equipment are listed in the appendix. No forms other than those approved for the Department of the Army will be used. Pending availability of forms listed, old forms may be used. For current and complete listings of all forms, refer to DA circular 700-15. Additional forms applicable to the using personnel are listed in the operation technical manual. For instructions on use of these forms, refer to TM 38-750.

c. Field Report of Accidents Involving Injury to Personnel or Damage to Materiel. The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in SR 385-10-40. These reports are required whenever accidents involving injury to personnel or damage to materiel occur.

d. Report of Unsatisfactory Equipment, Materials, or Publications. Any suggestions for improvement in design and maintenance of equipment and spare parts, safety, and efficiency of operation, or pertaining to the application of prescribed petroleum fuels, lubricants, and/or preserving materials, will be reported through technical channels as directed in TM 38-750. Such suggestions are encouraged in order that other organizations may benefit.

Note. Do not report all failures that occur. Report only REPEATED or RECURRENT failures or malfunctions which indicate unsatisfactory design or material. However, reports will always be made in the event that exceptionally costly equipment is involved. See also TM 38-750 and the printed instructions on DA Form 2407.

Section II. DESCRIPTION AND DATA

4. Description

a. Truck Nomenclature. In this manual, the use of the terms "left," "right," "front," and "rear" is with respect to the driver sitting in the seat. **"Left" indicates to the left of the driver; "right" indicates to the right of the driver. "Front" indicates the radiator end of the vehicle; "rear" indicates the end opposite the radiator.** This terminology when applicable to the wrecker crane portion of models M246,

M62, and M543, will be used in respect to the crane operator sitting in the crane operator's compartment with the crane hook centered over the rear of the vehicle.

b. Models Covered. This manual covers the 5-ton, 6 x 6, chassis trucks M39, M40, M40C, M61, M63, M139, M139C, M139D, and M139F; cargo trucks M41, M54, M54A1, M54A2, M55, and M55A2; dump truck M5, and M51 A2; tractor trucks M52, M52A1; tractor-wrecker truck M246; and medium wrecker trucks M62, M543 and M543A2 (fig. 1 through 19). These vehicles are six-wheel trucks equipped with one driving front axle, a driving forward rear axle and a driving rear-rear axle.

dium wrecker trucks M62, M543 and M543A2 (figs. 1 through 19). These vehicles are six-wheel trucks equipped with one driving front axle, a driving forward rear axle and a driving rear-rear axle.

c. Axles. The front axle steering knuckles incorporate universal joints for driving the front wheels. Tandem rear axles are used on the aforesaid vehicles; both axles being drive axles. The drive is through a conventional double reduction differential which functions in exactly the same manner as that used for the front axle. The carriers are of through-shaft construction; this means that the pinion shaft passes through the carrier so that power is delivered to the rear-rear axle after passing through the through-shaft of the forward rear axle. The axles are full floating.

d. Springs and Torque Rods. The front springs are semielliptic type mounted with the arch down. The springs are assembled with a bolt through the center of the leaves, and alined with rebound clips. The front springs are pivoted in a hanger at the front end and shackled to a hanger at the rear end. The rear springs are semielliptic type mounted with the arch up and have slipper-type ends. Spring leaves are held together with a center bolt and spring clips. The ends of the springs rest on the axle housing and are free to slide in brackets. Spring seats mounted on the underside of the springs are equipped with tapered roller bearings that support the spring seat connecting tube. Driving and braking forces are transmitted to the chassis by a system of torque rods arranged for parallel motion.

e. Power Plant. Power for models M52A1 and M54A1 is supplied by a six-cylinder, four-cycle, valve-in-head, water-cooled, turbosupercharged diesel engine. Gasoline models are powered with a six-cylinder, four-cycle, water-cooled, valve-in-head gasoline engine. Power for multifuel models M51A2, M52A2, M54A2, M55A2, M61A2 and M543A2 is supplied by a six-cylinder, in-line liquid cooled compression ignition engine, designed to operate a variety of fuels. The transmission, mounted at the rear of the engine, has five speeds forward and one reverse. The clutch is of a single, dry-disk type and is attached to the engine flywheel.

f. Transfer. The transfer is a two-speed unit driven by the transmission, and distributes power to the front and rear axles through propeller shafts. Driver's control is by a shift lever located in the cab, for high and low ranges. Transfer gearing is designed to drive

the front axle only when the rpm of the rear axles exceeds that of the front axle; an example of this would be during the spinning or slipping of the rear wheels. An overrunning clutch on the drive to the front axle automatically eliminates delivery of power to the front axle, when the speed of the rear axle is the same as that of the front axle, as during normal operation. When the transmission is shifted into reverse gear, an air valve, mounted on the transmission, automatically shifts the overrunning clutch into the reverse position. Power is then delivered to the front and rear axles during reverse motion in the same manner as described for forward motion.

5. Differences Between Models

a. General. The 5-ton, 6 x 6, trucks covered in this manual are of various wheelbases and body styles. A brief description of the various chassis and body types is shown in b through t below.

b. Chassis Truck M40. The 5-ton, 6 x 6 chassis M40 has a 179-inch wheelbase. The overall length, winch equipped, is 309-3/4 inches; without winch 294-1/4 inches. Chassis height at rear of unloaded vehicle is 43-7/8 inches; loaded 42-1/4 inches. The frame is 34 inches wide. The front track of the vehicle is 73-5/8 inches; rear track is 72 inches. The vehicle is equipped with dual wheels on the front rear axle and the rear-rear axle. The tires are 11:00 x 20. This vehicle is used with the M54 series cargo bodies.

d. Chassis Trucks M40C. The 5-ton, 6 x 6 chassis truck M40C has a 179-inch wheelbase. The overall length, winch equipped, is 300-3/4 inches; without winch 294-1/4 inches. Chassis height at rear of unloaded vehicle is 45 inches; loaded 43-1/8 inches. The frame is 34 inches wide. The frame and springs are of a heavier construction than the M40. This structural variation is the only technical difference from the M40. The front track of the vehicle is 73-5/8 inches; the rear track of the vehicle is 72 inches. The vehicle is equipped with dual wheels on both the front rear axle and the rear-rear axle. The tires are 11:00x20. This vehicle is used with the M62 wrecker body and the M543 wrecker body.

d. Chassis Truck M61. The 5-ton, 6 x 6 chassis truck M61 has a 167-inch wheelbase. The overall length of the winch-equipped vehicle is 269-1/2 inches, including the 60-

inch optional overhang. The overall length of the vehicle without winch is 254 inches, including the optional 60-inch overhang. The frame is 34 inches wide. The front track of the vehicle is 73-5/8 inches; the rear track is 72 inches. The unloaded vehicle is 43-7/8 inches high at the rear, and 42 inches high loaded. The overall width of the vehicle is 97-1/4 inches. The tires are 11:00 x 20. This chassis is used with the M51 dump body and the M52 tractor truck; a multifuel equipped chassis (M61A2) is used on M51A2 dump and M52A2 tractor.

e. Chassis Truck M63. The 5-ton, 6 x 6 chassis truck M63 has a 215-inch wheelbase. The overall length of the winch-equipped vehicle is 385-13/16 inches. The overall length of the vehicle, without winch, is 370-5/16 inches. The unloaded height of the chassis is 43-7/8 inches at the rear of the vehicle. The overall width of the vehicle is 97-1/4 inches; the width of the frame is 34 inches. The front track of the vehicle is 73-5/8 inches; the rear track of the vehicle is 72 inches. The tires are 11:00 x 20. The vehicle is equipped with dual wheels on the front rear end the rear-rear axle. This chassis is used with the M55 cargo body.

f. Chassis Truck M63C. The 5-ton, 6 x 6 chassis truck M63C has a 215-inch wheelbase. The overall length of the winch-equipped

vehicle is 324-3/4 inches. The overall length of the vehicle, without winch, is 309-1/4 inches. The width of the frame is 34 inches. The height of the unloaded chassis is 45 inches at the rear of the vehicle. The front track of the vehicle is 74 inches. The vehicle is equipped with dual wheels on the front rear axle and the rear-rear axle. The tires are 12:00 x 20. This chassis is used with the M246 medium wrecker body.

g. Chassis Truck M139. The 5-ton, 6 x 6 chassis truck M139 has a 215-inch wheelbase. The vehicle is equipped with dual wheels on the front rear axle and the rear-rear axle. The tires are 14:00 x 20. This chassis is used with and was specifically designed for the transporting of bridge-building equipment.

h. Chassis Truck M139C. The 5-ton, 6 x 6 chassis truck M139C has a 215-inch wheelbase. The overall length of the winch-equipped vehicle is 368-1/2 inches. The overall length of the vehicle, without winch, is 353 inches. The front track of the vehicle is 76-3/4 inches. The tires are 14:00 x 20. The vehicle is equipped with dual wheels on the front rear axle and the rear-rear axle. The axle ratio of the vehicle is 10.26 to 1 which gives vehicle increased tractive capability. This chassis is used with and was specifically designed to accept a rocket launcher body.

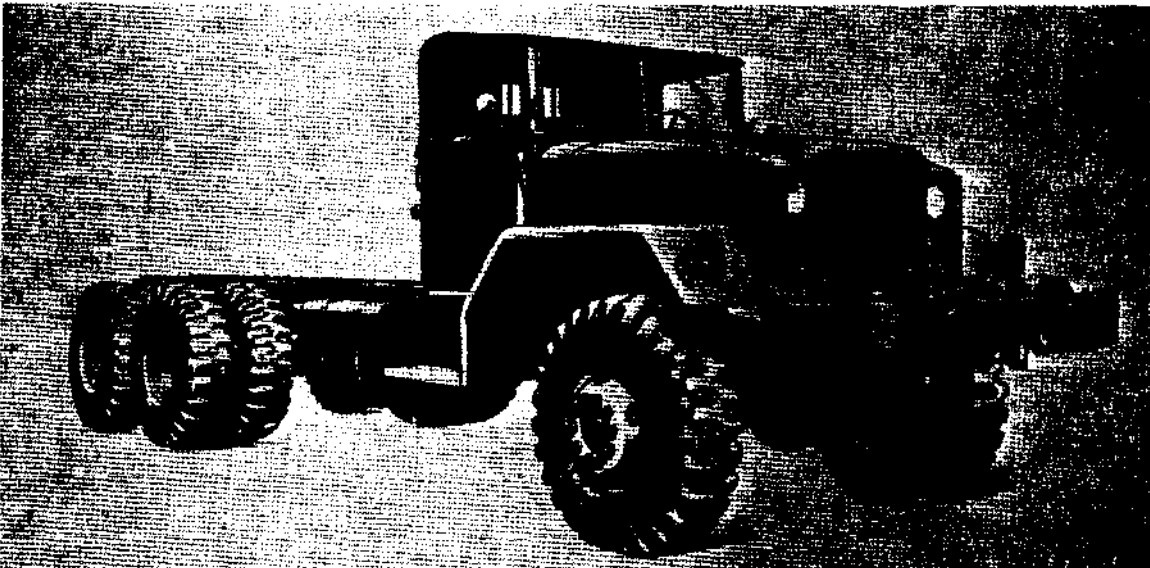


Figure 1. Truck, chassis, M39, M40, M61, M63, M139, - right front view

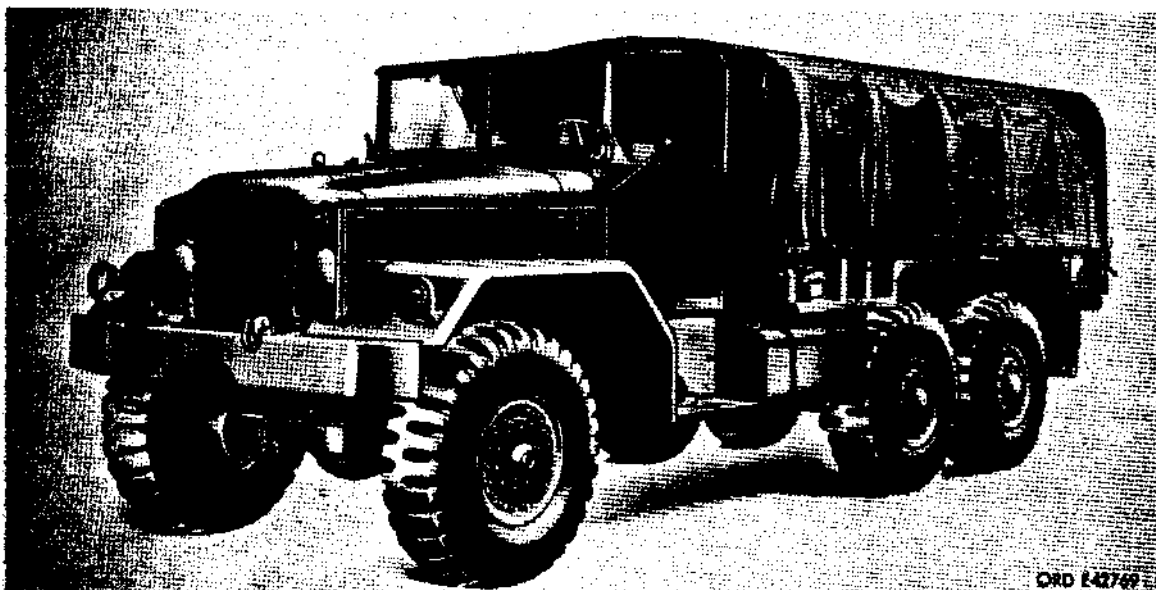


Figure 2. Truck, cargo, M41 - left front view

i. Chassis Truck M139D. The 5-ton, 6 x 6 chassis truck M139D has an overall length of 368-1/2 inches with winch, the overall length without winch, is 353 inches. The front track of the vehicle is 76-3/4 inches. The vehicle is equipped with dual wheels on the front rear axle and on the rear-rear axle. The tires are 14:00 x 20. The technical difference between the 139D and the 139C is mainly structural. This vehicle was specifically designed to accept a modified rocket launcher body.

j. Chassis Truck M139F. The 5-ton, 6 x 6 chassis truck M139F has an overall length winch-equipped vehicle of 368-1/2 inches; without winch is 353 inches. The front track of the vehicle is 76-3/4 inches. The vehicle is equipped with dual wheels on the front rear axle and on the rear-rear axle. The tires are 14:00 x 20. This vehicle was specifically designed to accept a modified rocket launcher body.

k. Cargo Truck M41. The 5-ton, 6 x 6 cargo truck M41 has a 179-inch wheelbase. The vehicle has single rear wheels. The tires are 14:00 x 20. The cargo body, mounted on an M39 chassis, is 14 feet long and mounted on the rear of the chassis. The function of this vehicle is to transport cargo or troops.

l. Cargo Truck M54. The 5-ton, 6 x 6 cargo truck M54 has a 179-inch wheelbase. The vehicle is equipped with dual wheels on the front rear axle and the rear-rear axle. The tires are 11:00 x 20. The cargo body is mounted on an M40 chassis. The cargo body is 14 feet long and is mounted on the rear of the chassis. The function of this vehicle is to transport cargo or troops.

m. Cargo Truck M4A1, M54A2. The 5-ton, 6 x 6 cargo truck M54A1, M54A2 has a 179-inch wheelbase. The vehicle is equipped with dual wheels on the front rear axle and the rear-rear axle. The tires are 11:00 x 20. The cargo body is mounted on the rear of the chassis. The function of this vehicle is to transport cargo or troops.

n. Cargo Truck M55, M55A2. The 5-ton, 6 x 6 cargo truck M55, M55A2 has a 215-inch wheelbase. The vehicle is equipped with dual wheels on the front rear axle and on the rear-rear axle. The tires are 11:00 x 20. The cargo body is mounted on the rear of a M63 chassis. The function of this vehicle is to transport cargo or troops.

o. Dump Truck M51, M51A2. The 5-ton, 6 x 6 dump truck M51, M51A2 has a 167-inch wheelbase. The

vehicle is equipped with dual rear wheels on the front rear axle and on the rear-rear axle. The tires are 11:00 x 20. The 5-cubic yard dump body and twin cylinder hoist assembly are mounted on the rear of an M61 chassis. The function of this vehicle is to transport dirt, gravel, or waste material.

p. Tractor Truck M52, M52A2. The 5-ton, 6 x 6 tractor truck M52, M52A2 has a 167-inch wheelbase. The vehicle is equipped with dual wheels on the front rear axle and on the rear-rear axle. The tires are 11:00 x 20. A fifth wheel assembly, approach plates, and deck plates suitable for hauling trailers are mounted on the rear of an M61 (modified) chassis. The primary function of this vehicle is to haul trailers.

q. Tractor Truck M52A1, M52A2. The 5-ton, 6 x 6 tractor truck M52A1, M52A2 has a 167-inch wheelbase. The vehicle is equipped with dual wheels on the front rear axle and the rear-rear axle. The tires are 11:00 x 20. A fifth wheel assembly, approach plates, and deck plates suitable for hauling trailers are mounted on the rear of an M61 (modified for Diesel) chassis. The function of this vehicle is to haul trailers.

r. Tractor-Wrecker Truck M246. The 5-ton, 6 x 6, tractor-wrecker truck M246 has

a 215-inch wheelbase. The vehicle is equipped with dual wheels on the front rear axle and the rear-rear axle. The tires are 12:00 x 20. A hydraulic crane and a fifth wheel assembly are mounted on the rear of an M61 chassis. The function of this vehicle is to tow away disabled wheeled vehicles.

s. Medium Wrecker Truck M62. The 5-ton, 6 x 6, medium wrecker truck M62 has a 215-inch wheelbase. The vehicle is equipped with dual wheels on the front rear axle and on the rear-rear axle. The tires are 11:00 x 20. A hydraulic crane and winch assembly are mounted on the rear of an M40C chassis. The function of this vehicle is to tow away disabled wheeled vehicles.

t. Medium Wrecker Truck M543, M543A2. The 5-ton, 6 x 6, medium wrecker truck M543, M543A2 has a 215-inch wheelbase. The vehicle is equipped with dual wheels on the front rear axle and on the rear-rear axle. The tires are 11:00 x 20. A hydraulic crane and winch assembly are mounted on the rear of an M40C chassis. The M543 differentiates from the M62 in structural and design areas on the hydraulic crane. The function of this vehicle is to tow away disabled vehicles.

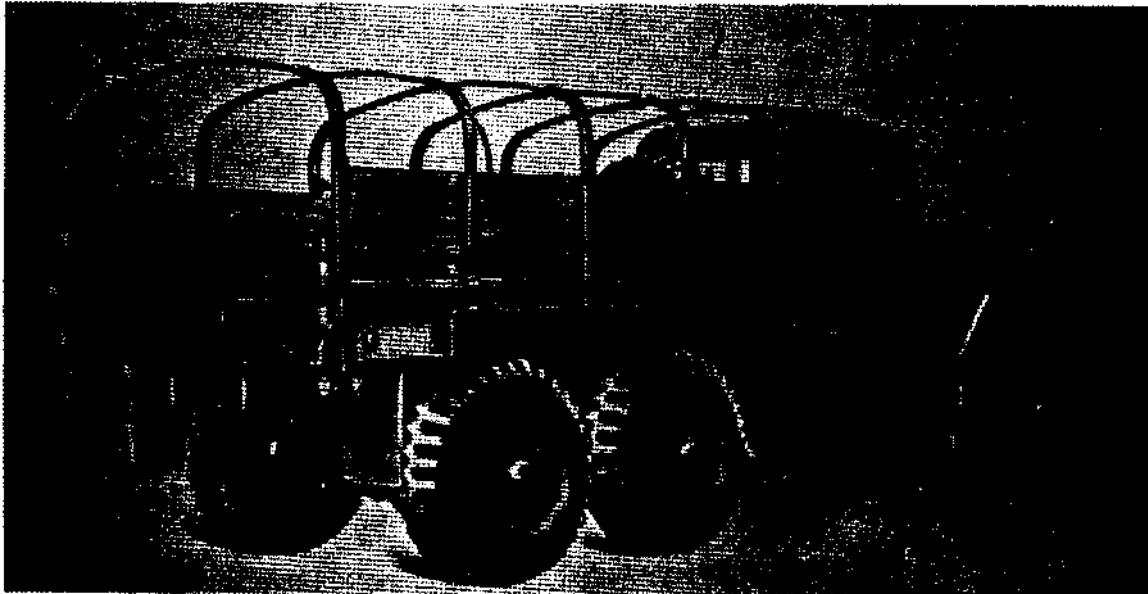


Figure 3. Truck, cargo, M41 - right rear view

6. Data

General data for the vehicles listed is found in TM 9-2320-211-10, Operator's Manual and

TM 9-2320-211-20, Organizational Maintenance Manual. Additional data for the individual components is found in the pertinent chapter or section of this manual.

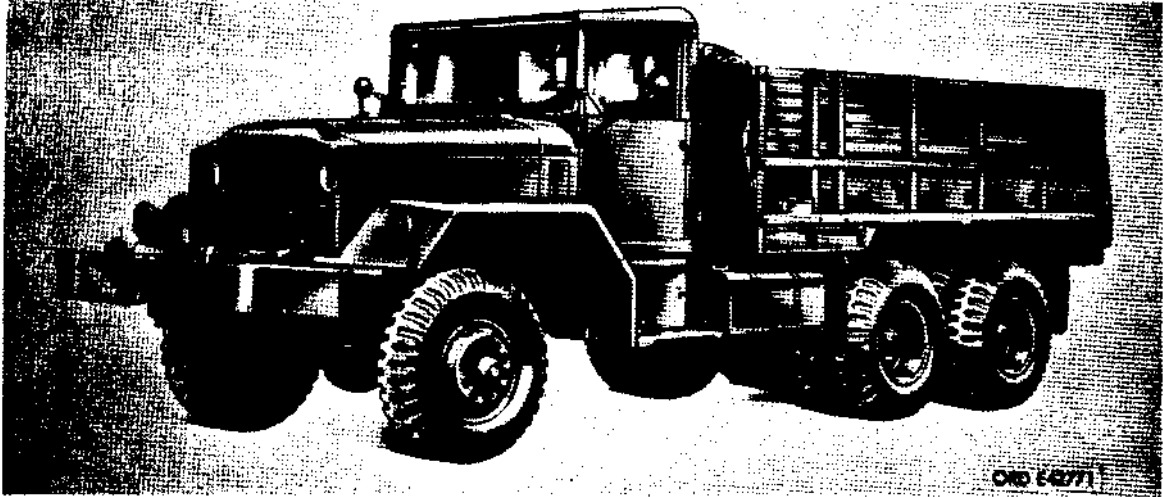


Figure 4. Truck, cargo, flat bed M54 - left front view

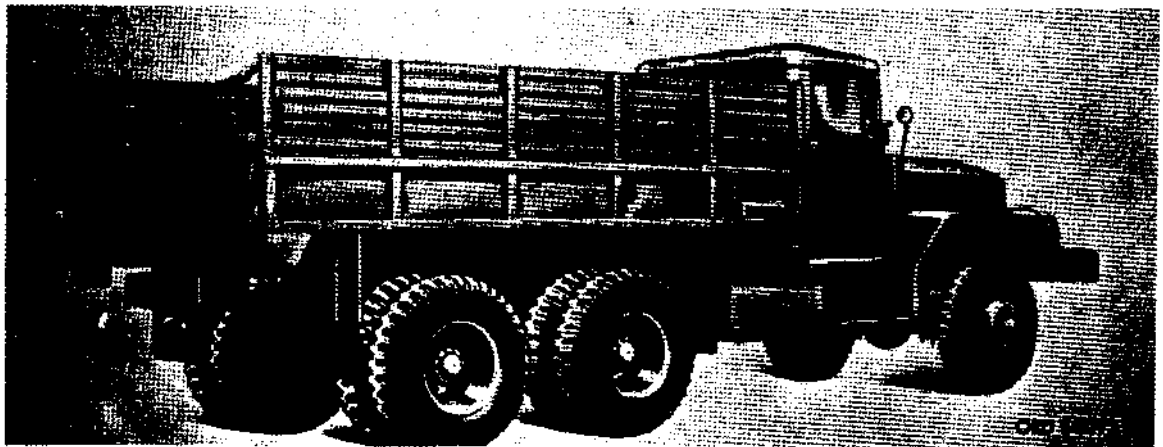


Figure 5. Truck, cargo, flat bed M54 - right rear view

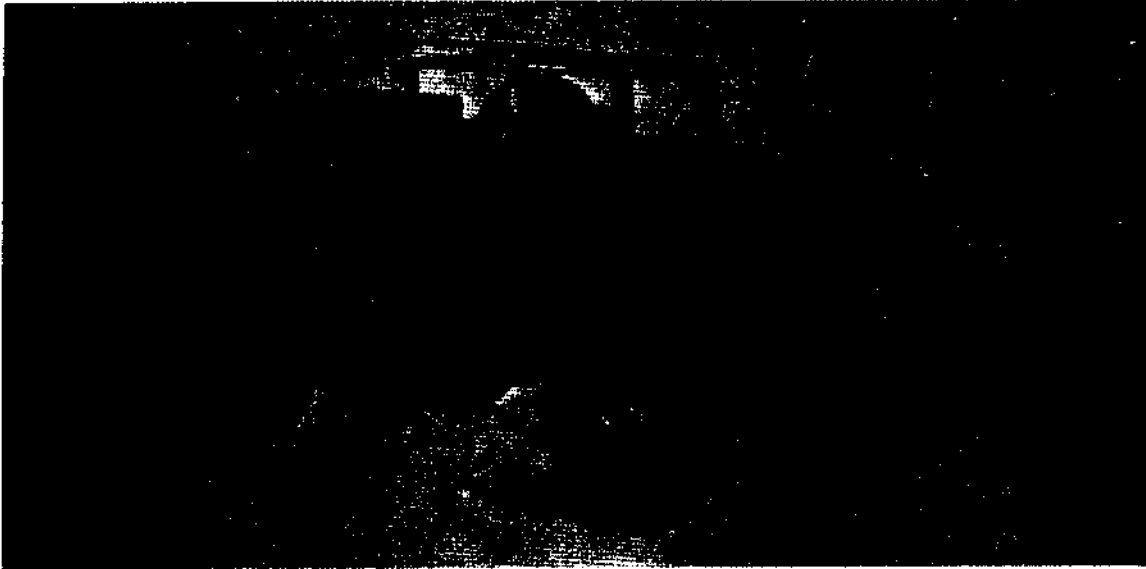


Figure 6. Truck, cargo, M54A1, M54A2 - right front view

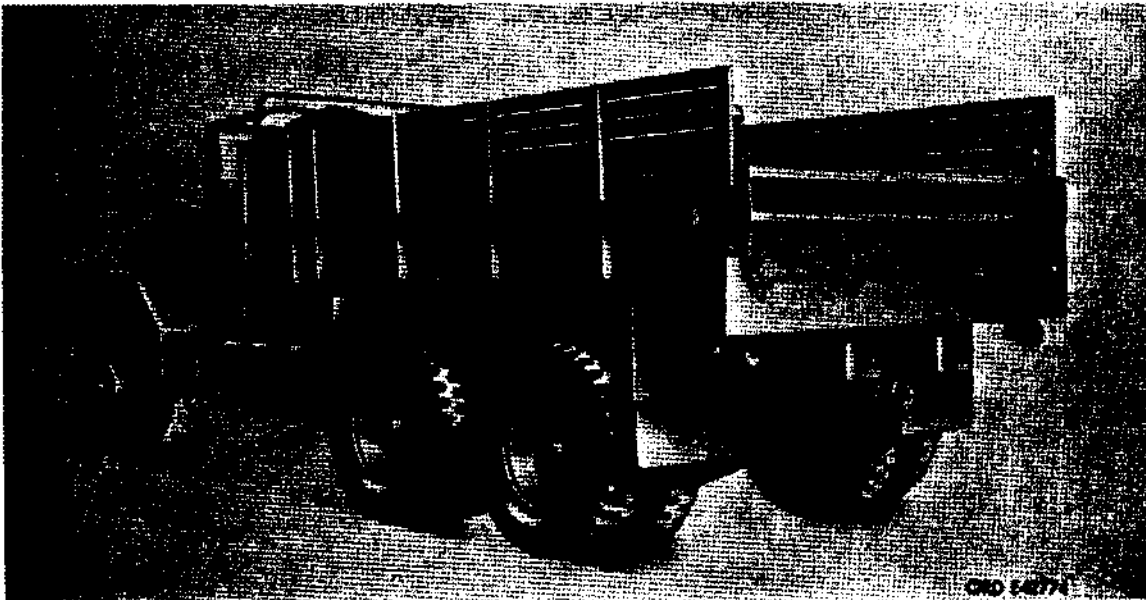


Figure 7. Truck, cargo, flat bed, M54A1, M54A2 - left rear view

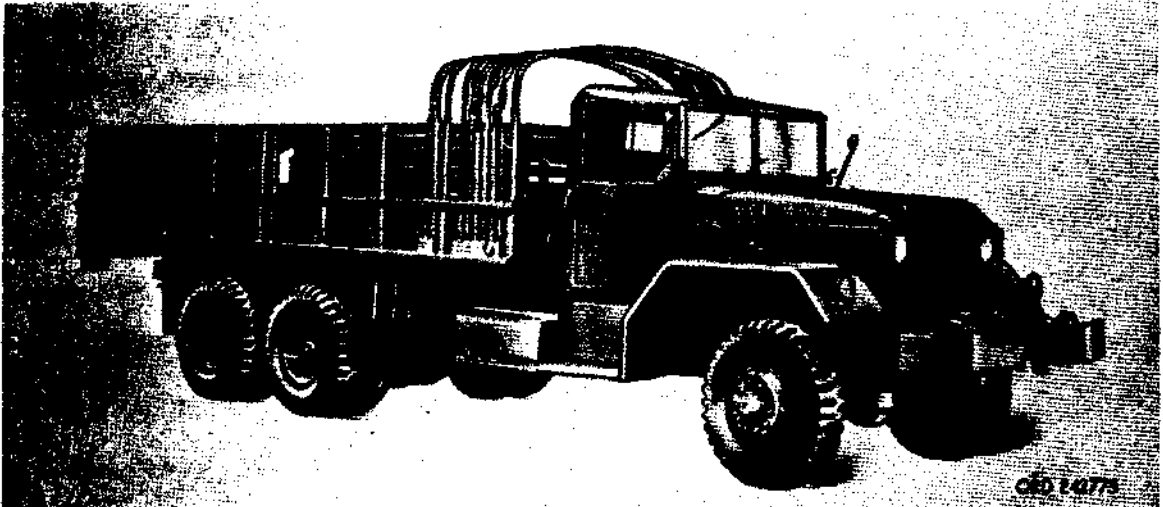


Figure 8. Truck, cargo, M55 - tight front view

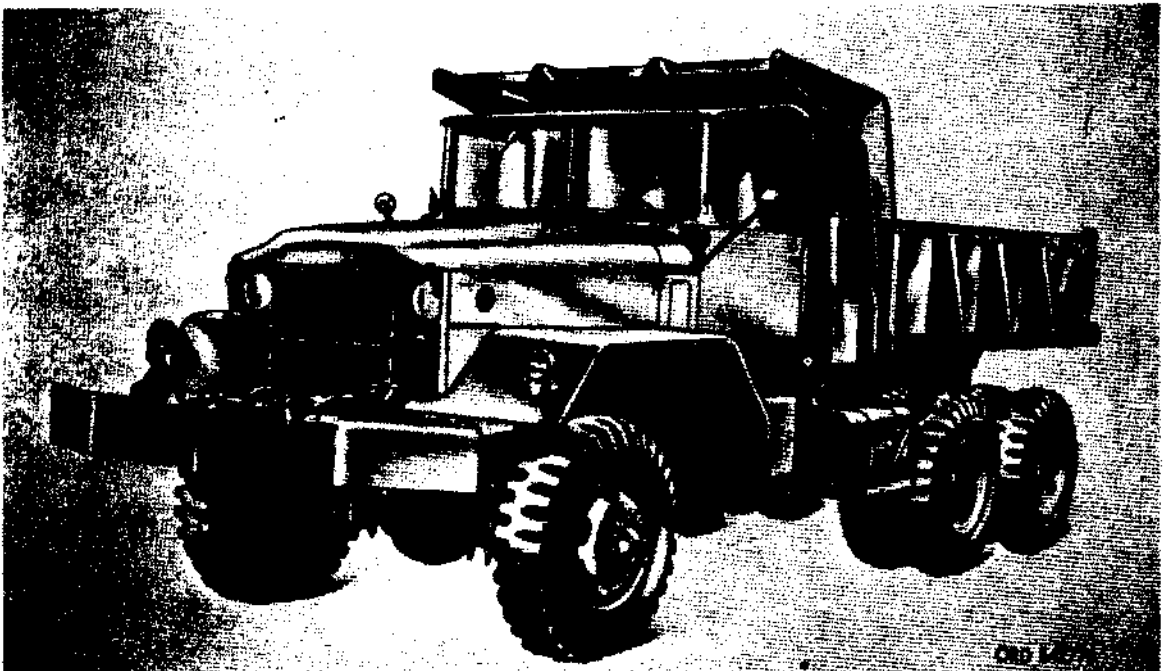


Figure 9. Truck, dump, M51 - left front view

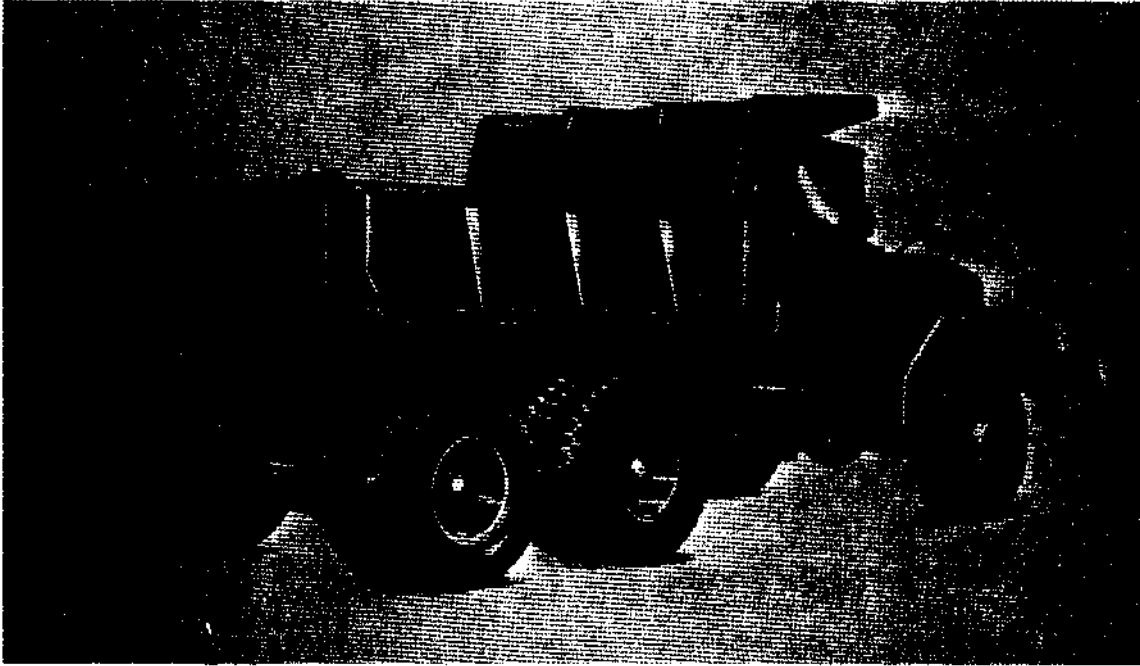


Figure 10. Truck, dump, M51 - right rear view

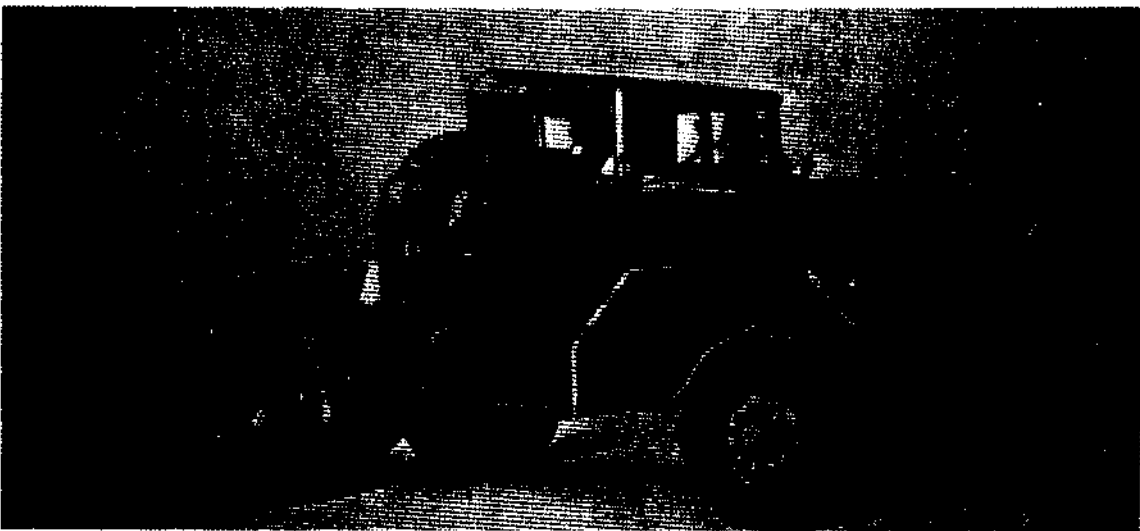


Figure 11. Truck, tractor, M52 - right front view

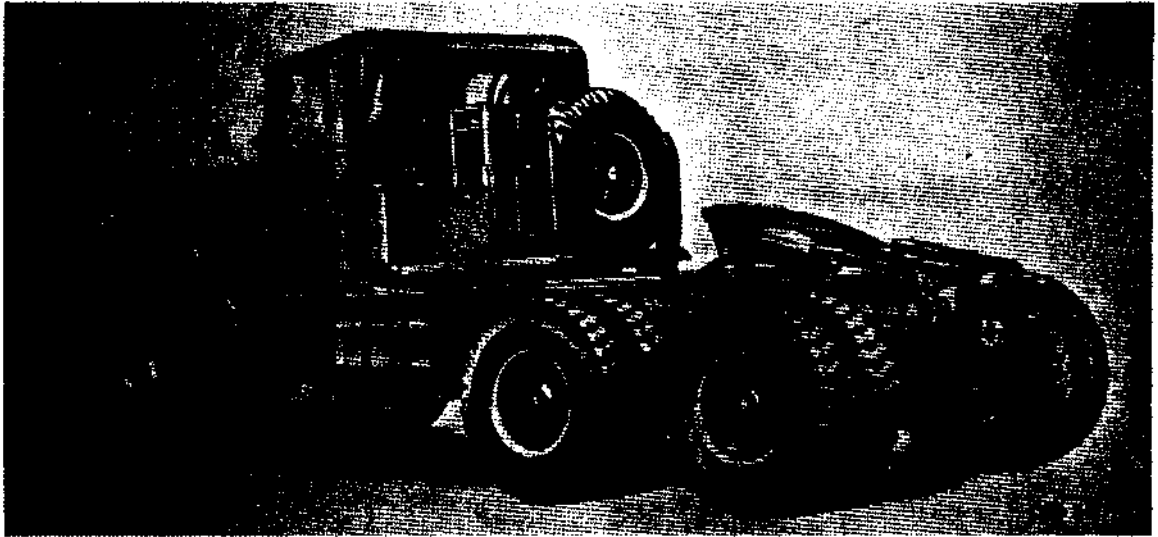


Figure 12. Truck, tractor, M52 - left rear view

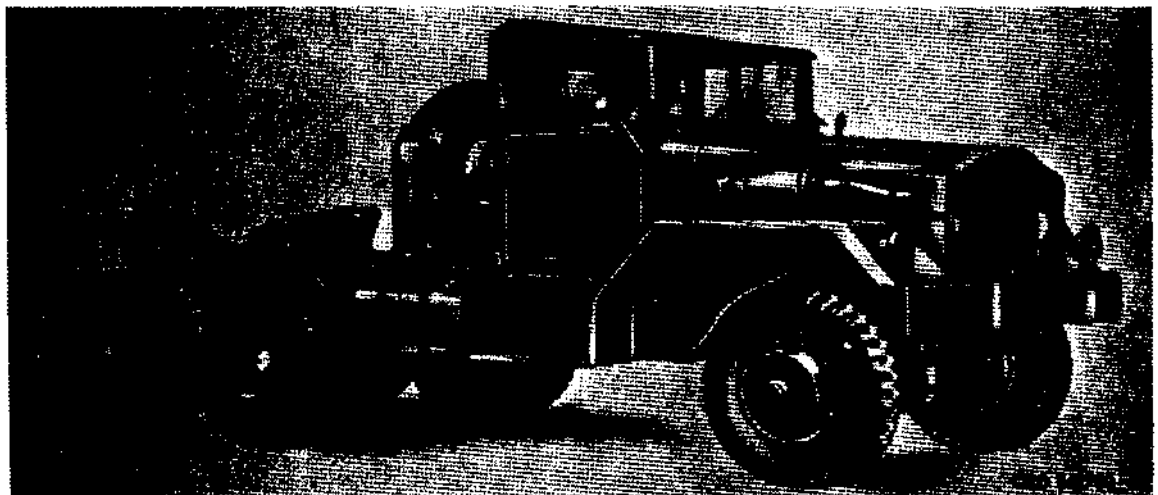


Figure 13. Truck, tractor, M52A1, M52A2 - right front view



Figure 14. Truck, tractor, wrecker, M246 - left front view

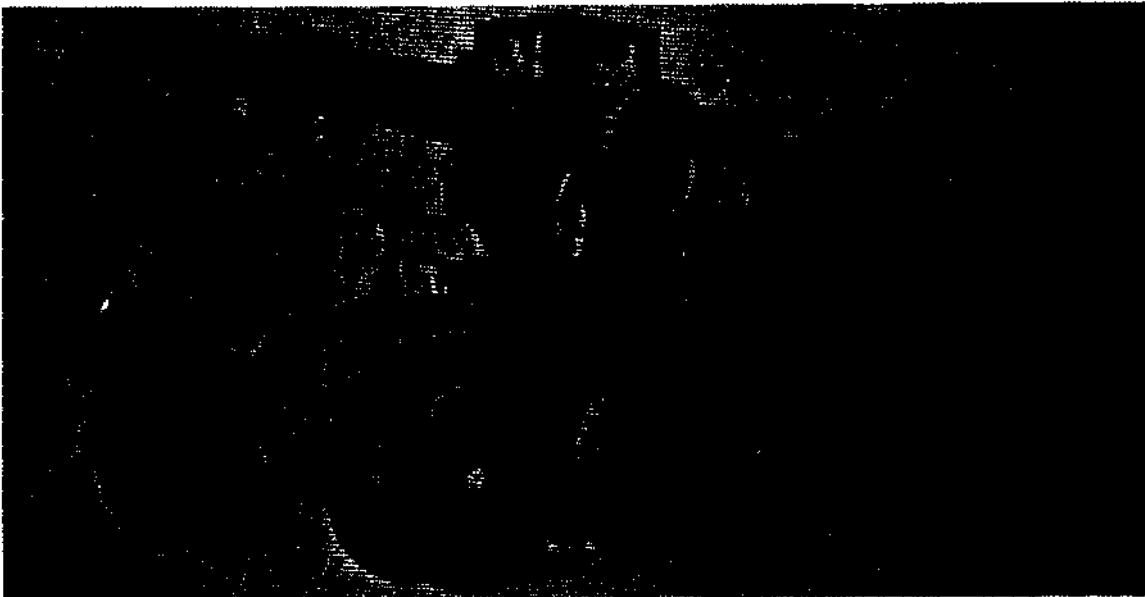


Figure 15. Truck, tractor, wrecker, M246 - right rear view

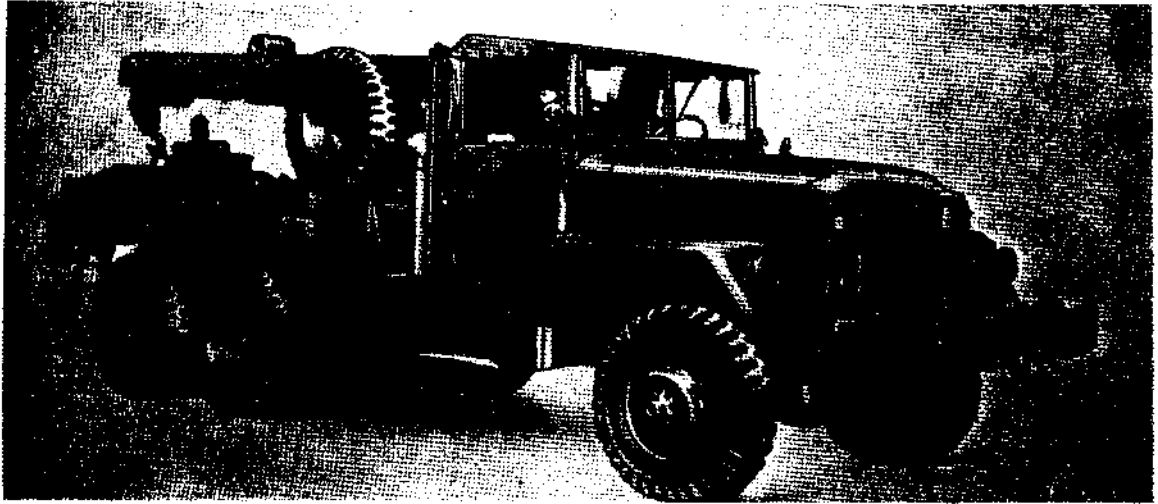


Figure 16. Truck, tractor, wrecker, M62 - right front view

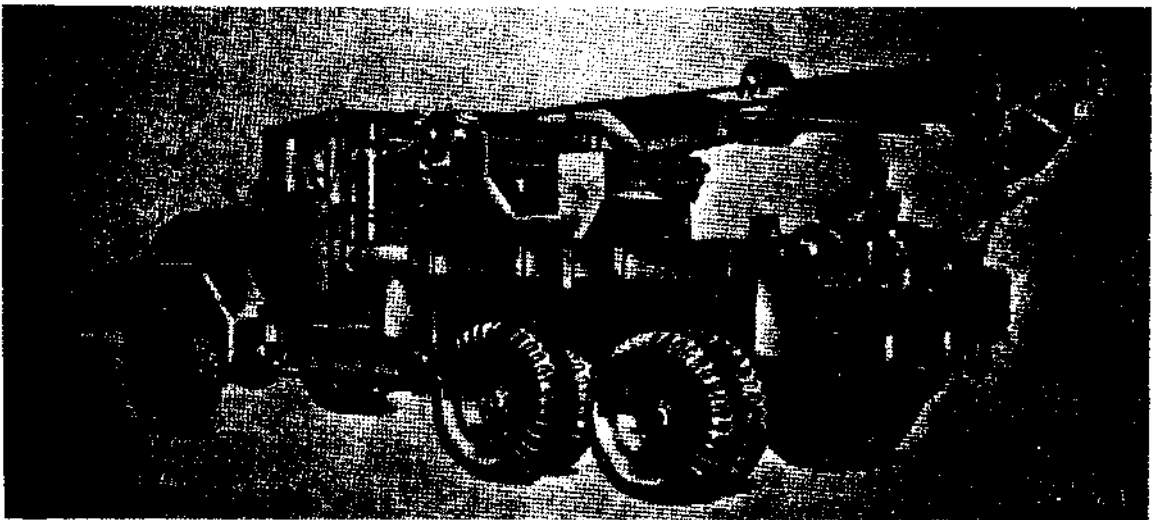


Figure 17. Truck, tractor, wrecker, M62 - left rear view

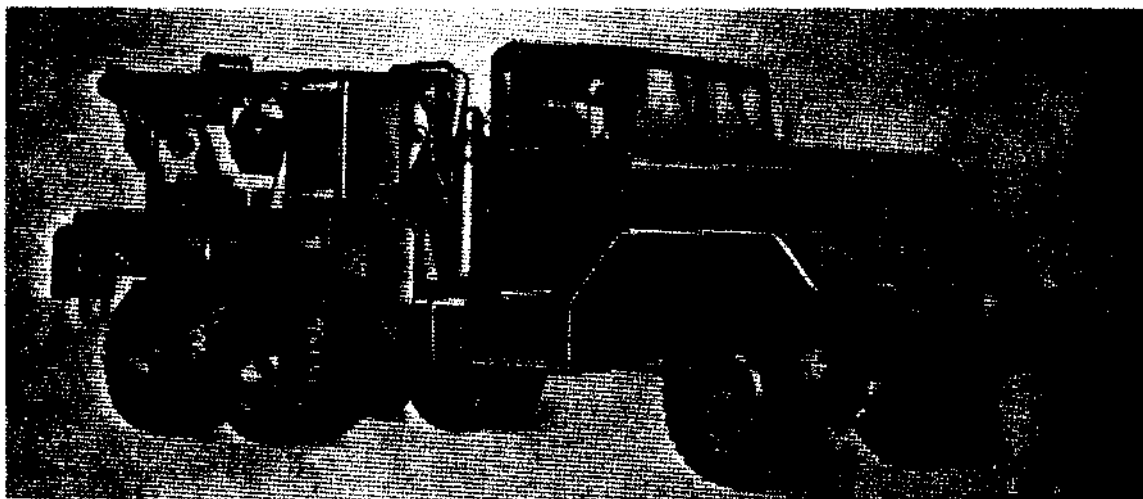


Figure 18. Truck, tractor, wrecker, M543 - right front view

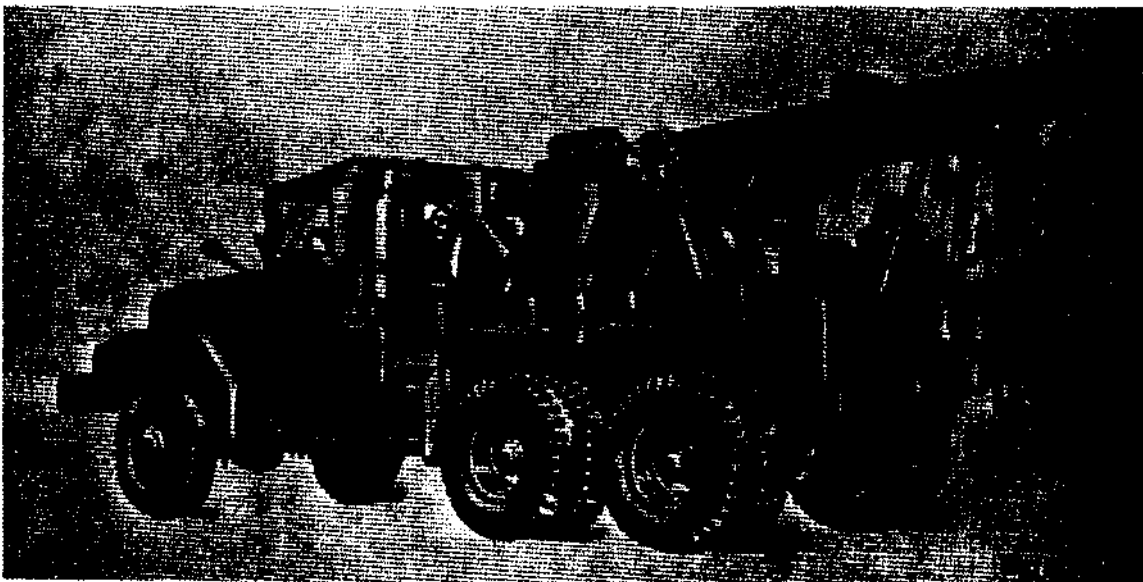


Figure 19. Truck, tractor, wrecker, M543 - left rear view

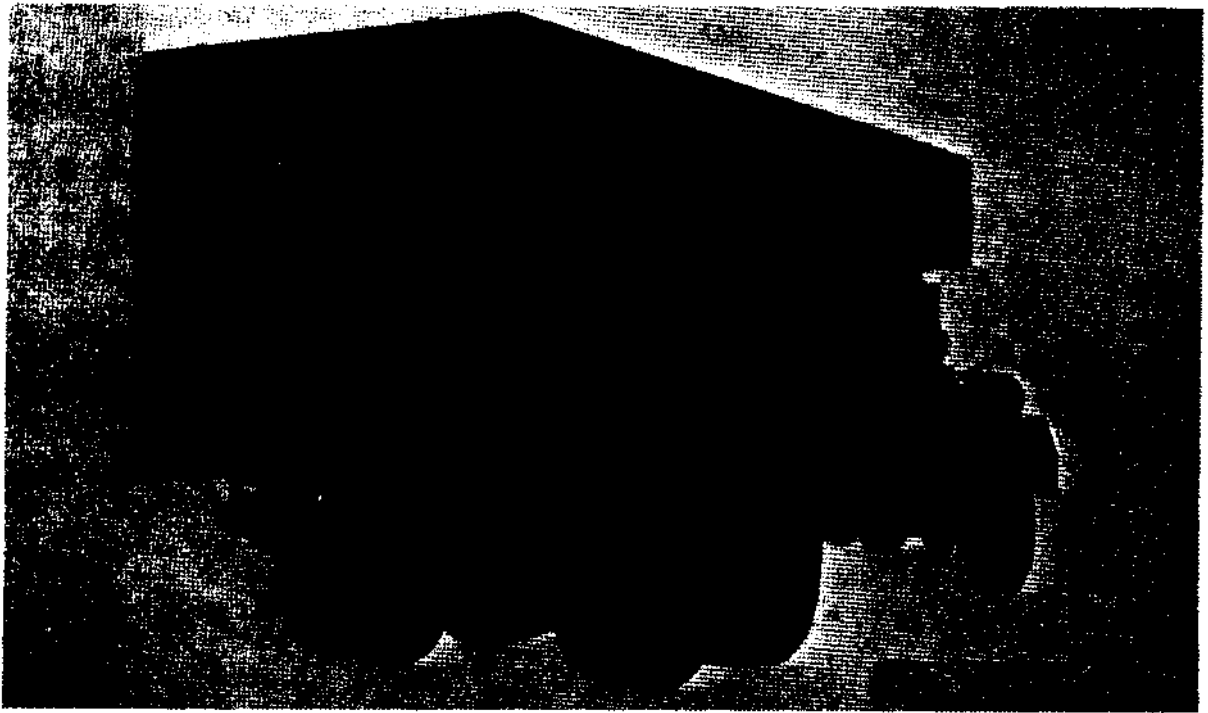


Figure 19.1 (Added) Truck, van: expansible, M291A2.

CHAPTER 2

PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR FIELD AND DEPOT MAINTENANCE

7. General

Tools and equipment and maintenance parts, over and above those available to the using organization, are supplied to ordnance field maintenance units and depot shops for maintaining and accomplishing repair on the materiel.

8. Parts

Maintenance parts for vehicles covered in this manual are listed in the Repair Parts manuals. (See paragraph 1.) These manuals are authorized for requisitioning replacements.

9. Common Tools and Equipment

Standard and commonly used tools and equipment having general application to this ma-

teriel are listed in ORD 6 SNL J-8, Sections 7, 12, 13 and 18; ORD 6 SNL J-9, Sections 1, 2, 3, 8 and 10; ORD 6 SNL J-10, Sections 4, 7, 8, 11, 12 and 15; and are authorized for issue by T/A and T/O and E.

10. Special Tools and Equipment

All special tools and equipment for 3d, 4th, and 5th echelons are listed for requisition in the pertinent 35P manual. Table I contains only those special tools and equipment necessary to perform the operations described in this technical manual; it is included for information only and is not to be used as a basis for requisitions.

Table I. Special Tools and Equipment for Field and Depot Maintenance

Item	Identifying number	Reference		Use
		Figure	Page	
RUNNING GEAR				
ADAPTER, differential	5120-795-0112	20	311 313	Used w/Puller 5120-356-4544 for carrier bearing removal.
ADAPTER, steering	5120-707-9783	20	21	Used w/Puller 5120-473-6396 for removal of steering relay pin.
ADAPTER, steering wheel	5120-303-1195	20	110	Used w/Puller 5120-432-8510 for steering wheel removal.
BURNISHER, differential	5120-795-0088	371	315	Used to burnish spider pinion bushing.
BURNISHER, front axle	5120-795-0133	20	20	Used to burnish spindle bushing.

Table I. Special Tools and Equipment for Field and Depot Maintenance - Continued

Item	Identifying number	Reference		Use
		Figure	Page	
RUNNING GEAR - Continued				
BURNISHER, steering knuckle	5120-795-0134	20	20	Used to burnish steering knuckle sleeve.
BURNISHER, steering gear	5120-795-0139	166	129	Used to burnish steering gear housing bushing.
GAGE, indicator	4910-795-0104	366 389	294 317	Used to set the differential pinion.
GAGE, pressure dial indicator	246-35P 6685-387-9654 (7541305)	20	21	Used to check air brake pressure.
KIT	4910-627-7043	20	23	Used to check hydraulic pressure in power steering.
PULLER, screw type (2 required per operation)	5120-836-6689	20	20	Used in differential helical pinion cage.
REAMER, front axle	5110-795-0124	20	21	Used w/BAR 41-B-155 to rear front axle spindle bushing.
REAMER, steering gear	5110-795-0248	165	129	Used to ream steering gear housing bushing.
REMOVER, front axle	5120-378-4301	20	21	Used to remove front axle inner spindle bushing.
REMOVER AND REPLACER, torque rod	5120-048-7370			Used to remove and/or replace the torque rod ball assembly.
REMOVER AND REPLACER, differential	5120-795-0159	228	291 312	Used to remove and/or replace forward bearing cage bearing cup.

Table I. Special Tools and Equipment for Field and Depot Maintenance - Continued

Item	Identifying number	Reference		Use
		Figure	Page	
RUNNING GEAR - Continued				
REMOVER AND REPLACER, differential	5120-795-0089	20	315	Used to remove and/or replace forward bearing cage bearing cup.
REMOVER AND REPLACER, steering gear	5120-795-0137	163 164	129	Used to remove and/or replace steering gear housing bushing.
REMOVER AND REPLACER, differential	5120-795-0079	20	312 317	Used to remove and/or replace differential rear bearing cage bearing cup.
REMOVER AND REPLACER, differential	5120-795-0130	20	20	Used to replace steering knuckle bushing.
REPLACER, tachometer drive	5120-795-0108	20	22	Used to remove or replace tachometer drive oil seal and bearing.
REPLACER, front axle	5120-795-0129	167	20	Used to remove and/or replace front axle oil seal.
REPLACER, rear axle	5120-795-0136	20	22	Used to remove and/or replace rear axle oil seal wiper.
REPLACER, differential	5120-795-0082	20	318	Used to remove and/or replace pinion cage bearing cup.
REPLACER, oil seal	5120-610-6719	20	21	Used to remove and/or replace cylinder push rod oil seal.

Table I. Special Tools and Equipment for Field and Depot Maintenance - Continued

Item	Identifying number	Reference		Use
		Figure	Page	
RUNNING GEAR - Continued				
REPLACER, snap ring	5120-610-6720		24	Used to remove and/or replace hydraulic cylinder check valve snap ring.
REPLACER, rear axle	5120-795-0155		321	Used to replace rear axle oil seal.
SCALE, differential	6670-347-5922	20	316	Used to check the preload of differential pinion bearing.
WRENCH	5120-378-3139	331	268	Used to tighten the wheel bearing nut.
TRANSMISSION AND TRANSFER				
ADAPTER, transfer case	5120-795-0090	227	179	Used w/PULLER 5120-356-4544 for front drive rear bearing cone removal.
BRACKET, angle	4910-610-0919	20	165	Adapting left side of transfer to stand 4910-447-4196. (7010363).
BRACKET, angle	4910-610-0920	20	165	Adapting right side of transfer to stand 4910-449-4196 (7010363).
FIXTURE, transfer case	4910-694-4974	197	161	Used w/LIFT 4910-422-8565 (8708279) to remove or replace transfer case.
HOISTING UNIT	4910-448-0254 (8387771)	244	200	Used to remove and replace transmission.

Table I. Special Tools and Equipment for Field and Depot Maintenance-Continued

Item	Identifying number	Reference		Use
		Figure	Page	
TRANSMISSION AND TRANSFER-Continued				
PULLER KIT	5120-338-6721	20	166	To pull the timing gears and/or companion flange.
REPLACER	5120-795-0147	263	207	Transmission and/or transfer case flanges.
REPLACER, transfer case	5120-795-0152	233	133	To remove or replace front drive gear oil seal.
315				
WRECKER BODY-M543, M543A1, M543A2				
HANDLE, bushing replacer (7010321)	5120-601-2234	19.2	466	Used with hoist cylinder head guide bushing replacer 5120-792-1612.
REPLACER, bushing 3005319 (24076)	5120-792-1612	19.2	466	Used to remove and replace cylinder head guide bushings when used with bushing replacer handle 5120-601-2234.
TOOL, oil seal Y56205(45681)	5120-150-5950	19.2	475	Used to remove and install oil seals in the control valve bank seal retainer.
WRENCH, spanner (8747917)	5120-532-3836	19.2	464	Used to remove and install hoise cylinder head packing nut.

11. Improvised Tools

The improvised tools listed in table II and the dimensioned detail drawings furnished herein apply only to field and depot shops in order to enable these maintenance organizations to fabricate the tools locally, if desired. These tools are of chief value to maintenance organizations en-

gaged in repairing a large number of identical components; however, they are not essential for repair and are not available for issue. The following data are furnished for information only. Refer to figures 21 through 24 for fabrication and assembly drawings.

Table II. Improvised Tools for Field and Depot Maintenance

Item	Reference		Use
	Fig.	Par.	
Adjusting fixture	234	166	Adjusting transfer intermediate shaft bearings.
	236	166	Adjusting transfer rear output shaft bearings.

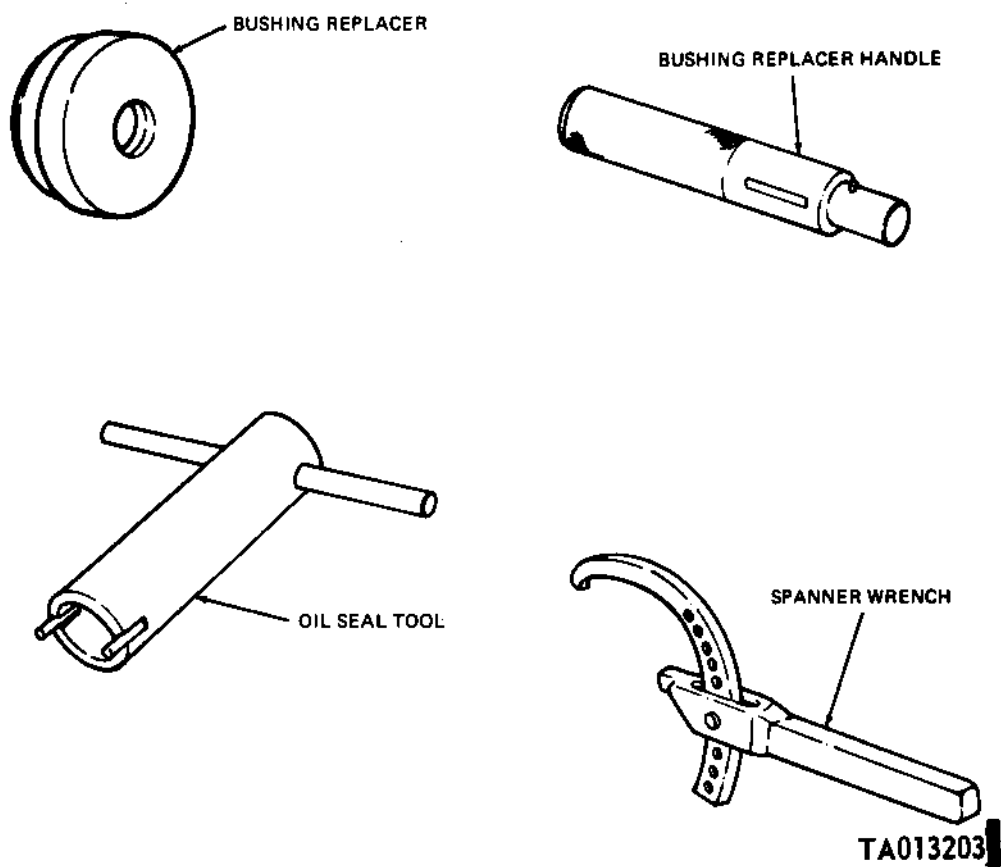


Figure 19.2. Special tools and equipment.

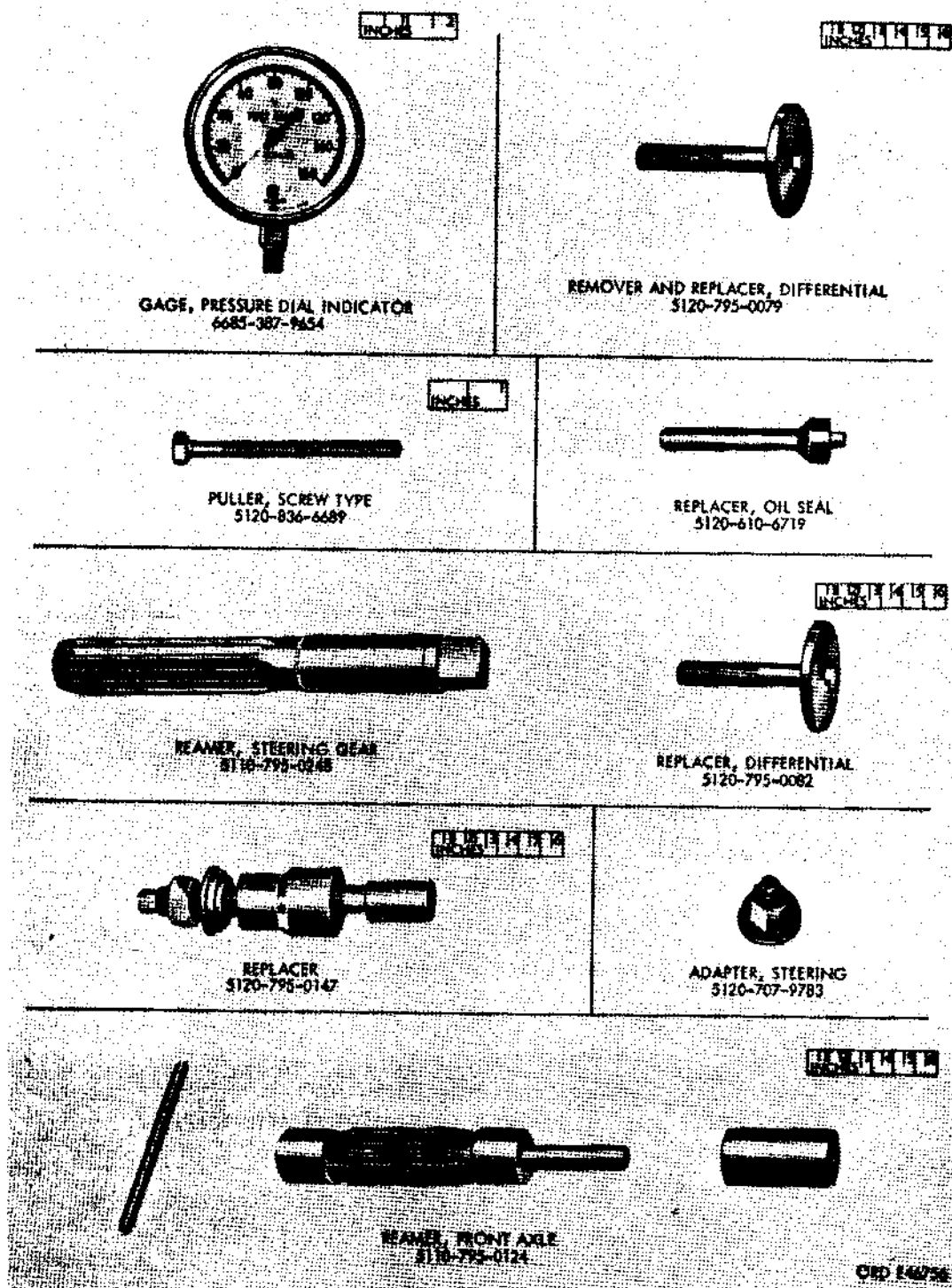


Figure 20. Special tools and equipment for field and depot maintenance (2 of 5)

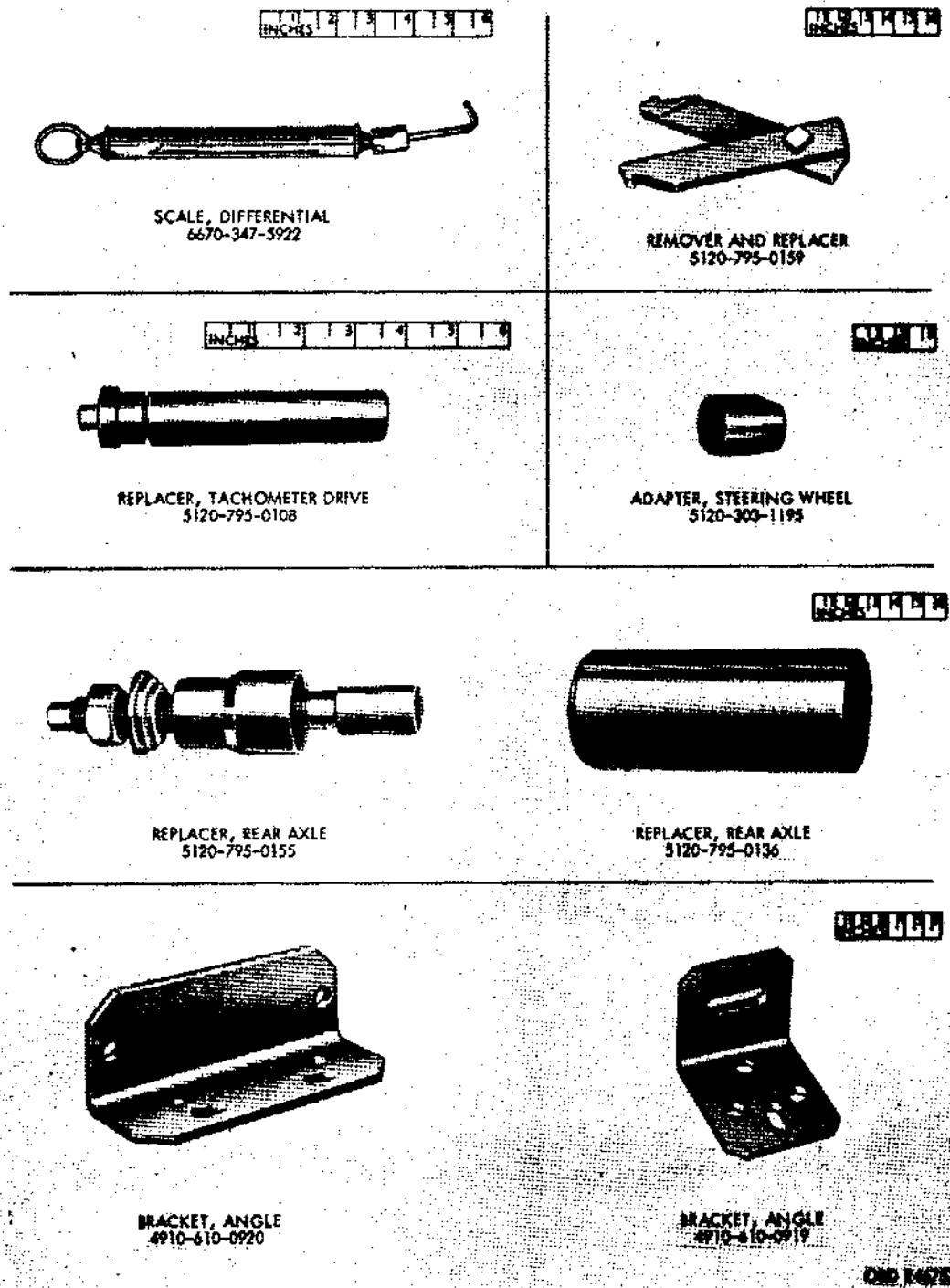


Figure 20. Special tools and equipment for field and depot maintenance (3 of 5)

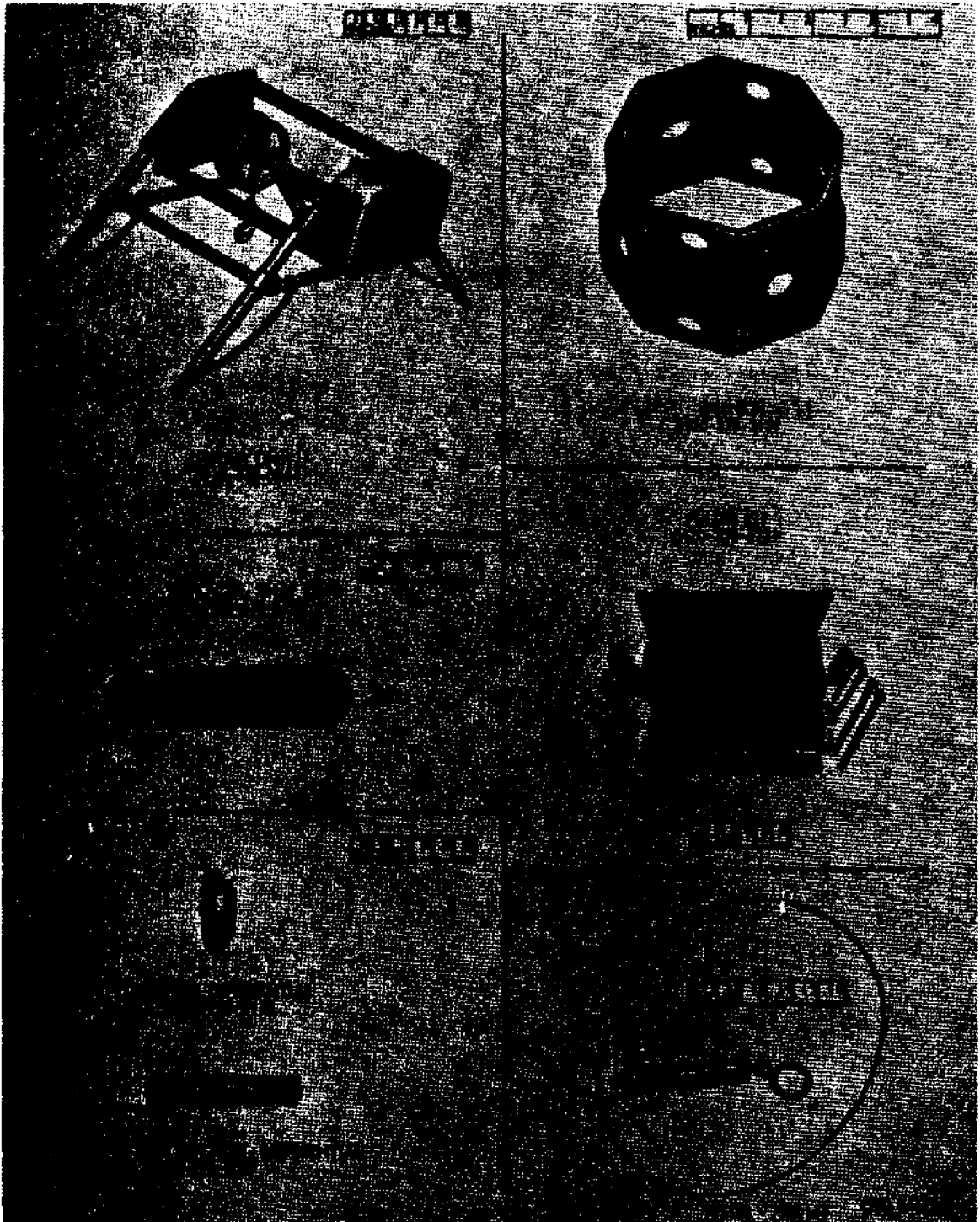


Figure 20. Special tools and equipment for field and depot maintenance (4 of 5)

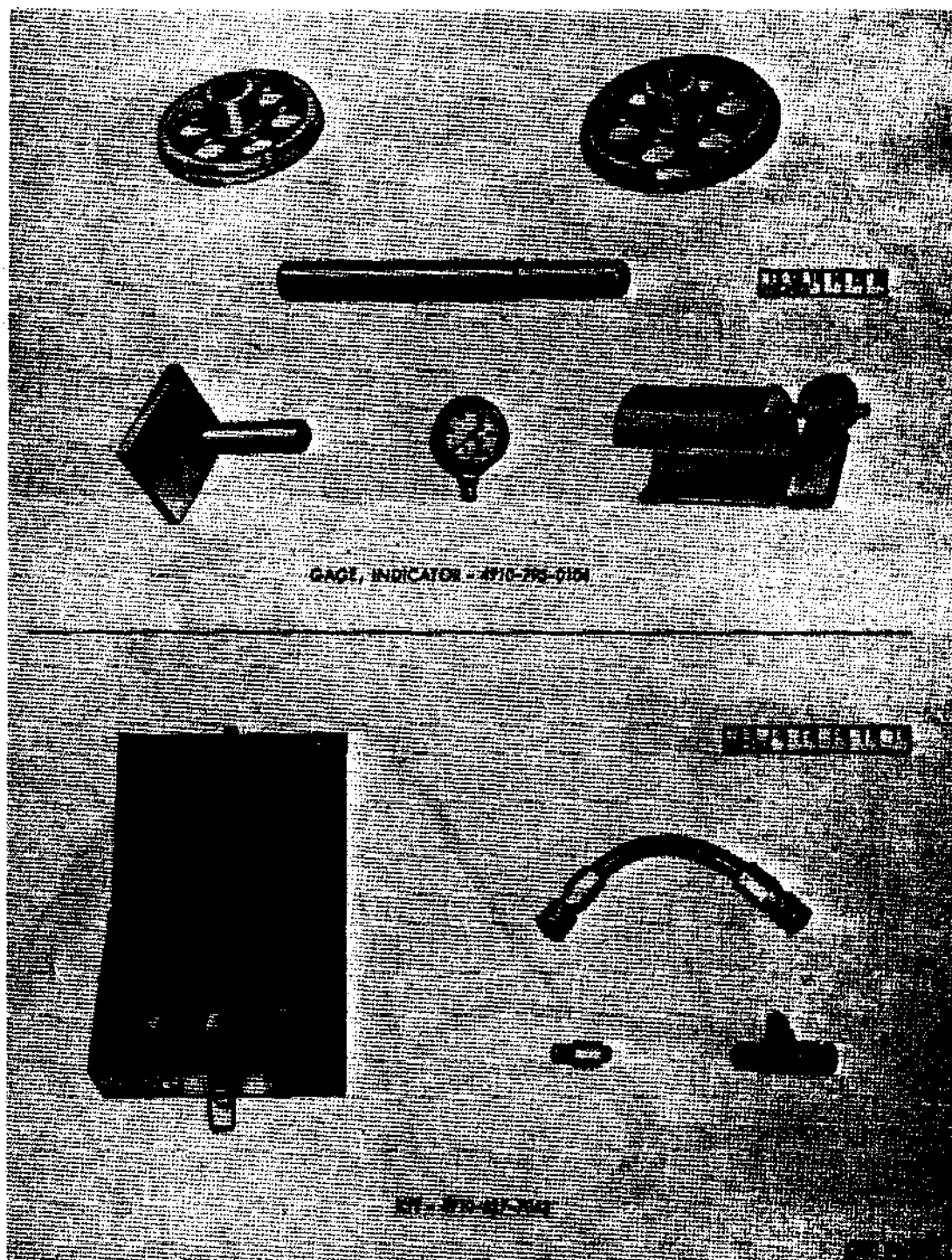


Figure 20. Special tools and equipment for field and depot maintenance (5 of 5)

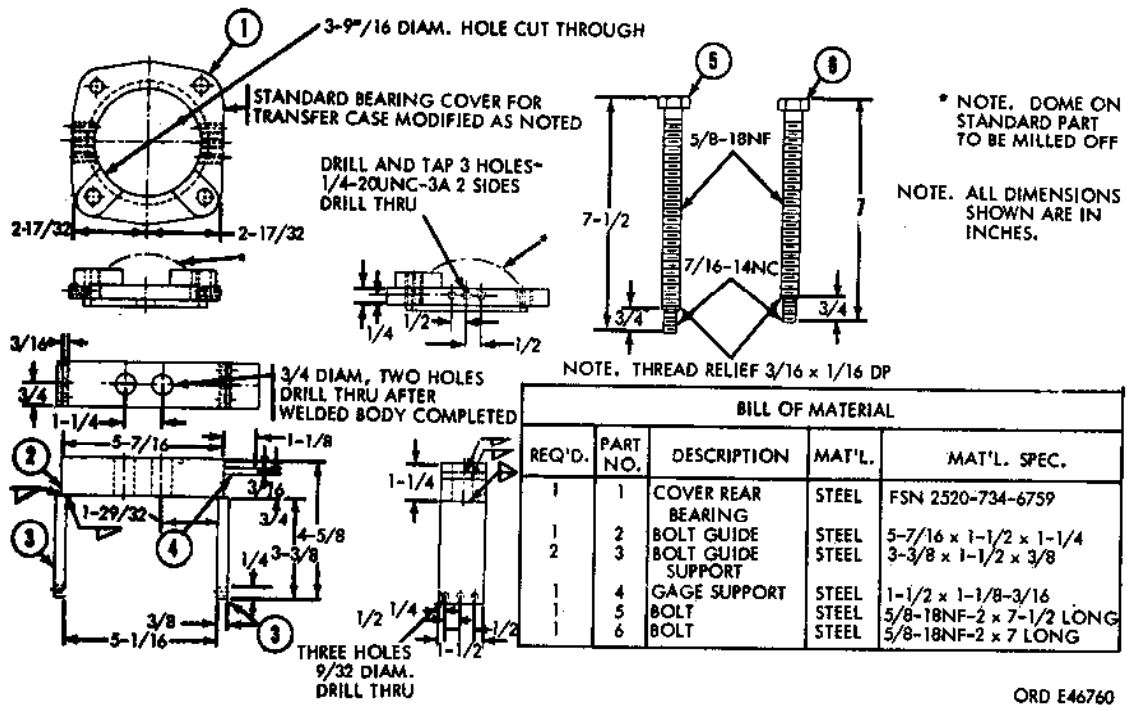


Figure 21. Fabricating adjusting fixture for intermediate shaft bearings

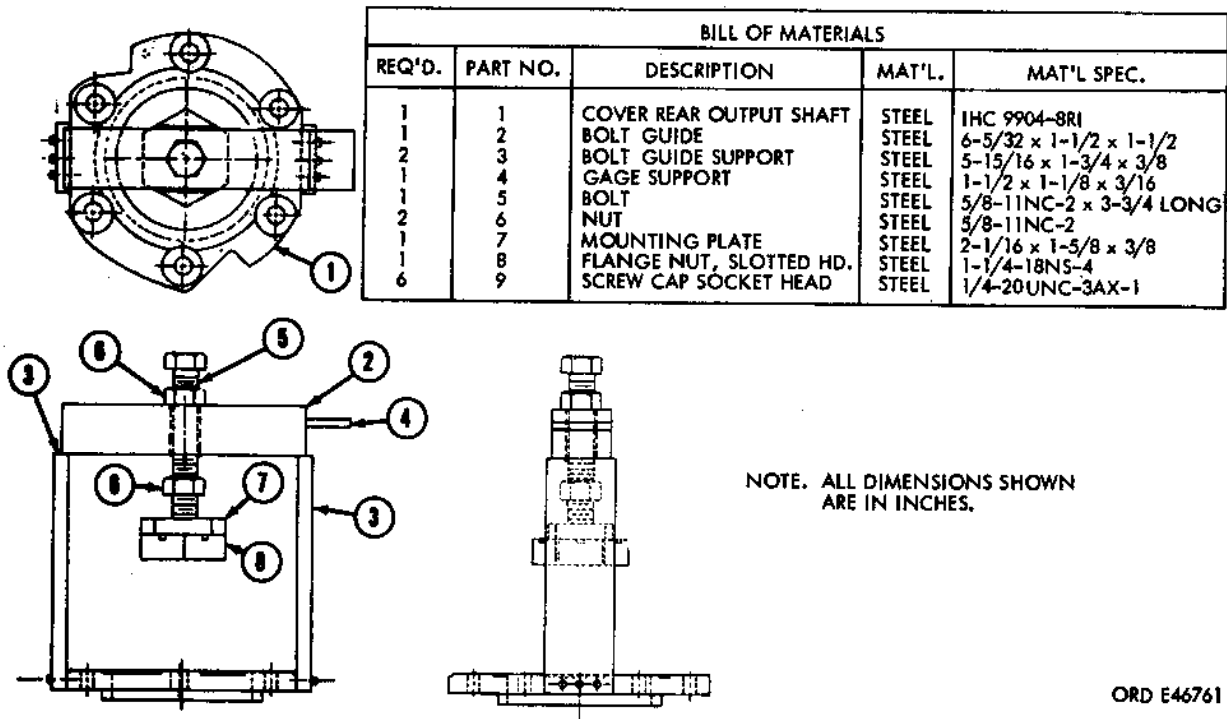


Figure 22. Assembling adjusting fixture for intermediate shaft bearings

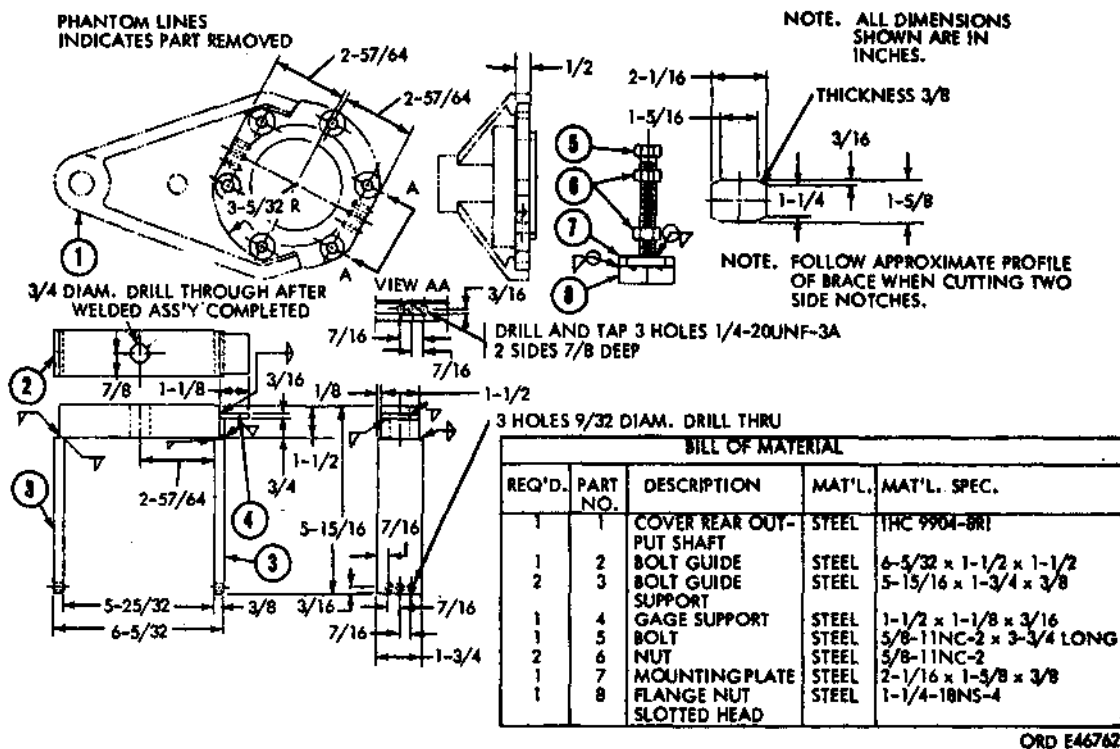
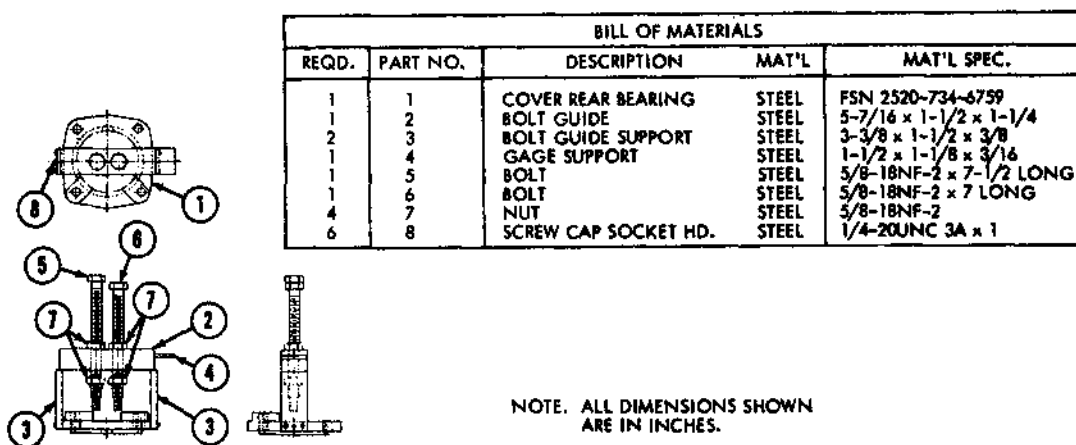


Figure 23. Fabricating adjusting fixture for rear output shaft bearings



ORD E46763

Figure 24. Assembling adjusting fixture for rear output shaft bearings

CHAPTER 3

TROUBLESHOOTING

12. Purpose

Note. Information in this chapter is for use of Ordnance Maintenance Personnel in conjunction with the troubleshooting section in the chapter pertinent to the item.

Operation of a deadlined vehicle without a preliminary examination can cause further damage to a disabled component and possible injury to personnel. By careful inspection and troubleshooting such damage and injury can be avoided, and in addition, the causes of faulty operation of a vehicle or component can often be determined without extensive disassembly.

13. General Instructions and Procedures

a. The inspections made while the component is mounted in the vehicle are, for the most part, visual and are to be performed before attempting to operate the vehicle. The object of these inspections is to determine the condition of the component, and if found defec-

tive, to take precautions to prevent any further damage to it.

b. The troubleshooting performed while the component is mounted in the vehicle is that which is beyond the normal scope of the using organization. Check the troubleshooting section of TM 9-2320-211-20, then proceed as outlined in the section of the pertinent chapter of this manual. It is assumed that organizational maintenance has checked the assembly or attaching hardware for tightness before reporting gasket or seal damage when lubricant leaks are evident.

c. Inspection after component is removed from the vehicle is performed to verify the diagnosis made while the component was mounted in the vehicle, to uncover further defects, or to determine malfunctions if the component above is received by the ordnance establishment. This inspection is particularly important in the last case, because it is often the only means of determining the malfunction without completely disassembling the component.

CHAPTER 4

ELECTRICAL COMPONENTS

Section I. DESCRIPTION AND DATA

14. General

Coverage of electrical components in this manual is confined to the repair of the generator regulator, batteries, horn, and replacement of chassis wiring harness. Information for replacement and repair of the engine mounted electrical components is found in TM 9-1825B and TM 9-8627. Information for replacement of instrument lights switches and associated electrical components is found in TM 9-2320-211-20. Refer to TM 9-8627 for troubleshooting procedures and information.

15. Generator Regulator

The generator regulator, model 1118656, is a watertight, fungus and corrosion resistant unit. It is a heavy duty, 24-volt, 25-ampere regulator designed for use with a generator having an internally grounded field circuit. The unit is used in a system having a negative ground. Connections to the regulator are made by mating receptacles on the vehicle wiring harness. The regulator consists of three units: a cutout relay, current regulator, and a voltage regulator. Shunt connections for the vehicle ammeter are provided in the 4-outlet receptacle. One condenser for radio suppression is mounted in the base of the regulator. This condenser, a "feed-thru type," is connected in the circuit between the terminal of the output receptacle and the lower contacts of the cutout relay. The cutout relay is designed to close the circuit from the generator to the battery when generator voltage is sufficient to charge the battery and to open the circuit when the generator slows or stops. The current regulator is a current-limiting device which protects the generator by preventing it from exceeding its maximum safe output. The voltage regulator is a limiting device which prevents the generator voltage from exceeding a predetermined maximum. With voltage limited, the generator delivers varying outputs as required for changing battery conditions and electrical loads.

16. Batteries

Two 12-volt, lead-acid-type batteries are located in a compartment directly under the right

cab door; they are connected in series to supply the 24-volt electrical current required to start and operate the engine and lights when current requirements exceed generator output. These batteries are of the submersible type with special vent plugs which prevent entrance of water into cells when the batteries are submerged. The terminals are waterproofed with heavy asbestos grease after the batteries are installed. Waterproofed cables and harness assemblies are used to connect the batteries to the starter, generator regulator, slave battery receptacle, and radio receptacle.

17. Horn

The waterproof horn is an electrically controlled air-operated unit. Depressing the horn button completes the circuit to the solenoid mounted between the horn projectors. The solenoid opens an air valve which permits compressed air to pass through the horn body. The compressed air causes a pair of diaphragms inside the dual horn body to vibrate rapidly, thereby "sounding" the horn.

18. Chassis Wiring Harness

There are two main harnesses: the front wiring harness extends from the connection with the rear harness on the left side of the frame forward to the instrument panel, lights and horn; the rear extends from the connections with the front harness to the stop and taillights. All cables are covered with rubber insulation, and some cables in the engine compartment are also shielded with tinned copper braid over loom to prevent electrical interference when using radio equipment. Cable ends are always soldered using resin flux solder (never acid flux), to their connecting plug, socket, or terminal. Two types of cable connectors are used on these vehicles: one is a plug and receptacle type, with the receptacle encased by a metal sleeve and the plug secured to the receptacle by a retaining nut screwed onto the sleeve so as to form a watertight housing for the connector; and the other is a bayonet-type connector, with two interlocking bells enclosing an insulated connector and two rubber bushings which form a watertight joint.

19. Data

a. Generator Regulator.

Manufacturer Delco-Remy
Auto-Lite
Model No:
Delco Rely 1118656
1118606
Auto-Lite VBC-4008-UT
Voltage rating 24v
Voltage regulator unit:
Air gap satisfactory 0.084 in.
Operating range 27.5-29.5v*
If outside range adjust to 28.5v*
Current Regulator:
Air gap 0.115 in.
Satisfactory operating 23-27 amp*
If outside range adjust to..... 25 amp*
Cutout Relay:
Air gap 0.048 in.

Point opening 0.025 in.
Satisfactory closing range 25-27v*
If outside range, adjust to 26v*

***Note.** These values apply only when the regulator is being tested at operating temperature, on the vehicle, and in accordance with the procedure described in TM 9-8627.

b. Batteries.

Make Delco-Remy
Model No 6TN23
Voltage 12
Plates per cell 23
Number of batteries 2

c. Horn.

Make Hadley
Model No. 765
Rated volts 24

Section II. REMOVAL AND INSTALLATION

20. Generator Regulator

Refer to TM 9-2320-211-20.

21. Batteries

Refer to TM 9-2320-211-20.

22. Horn

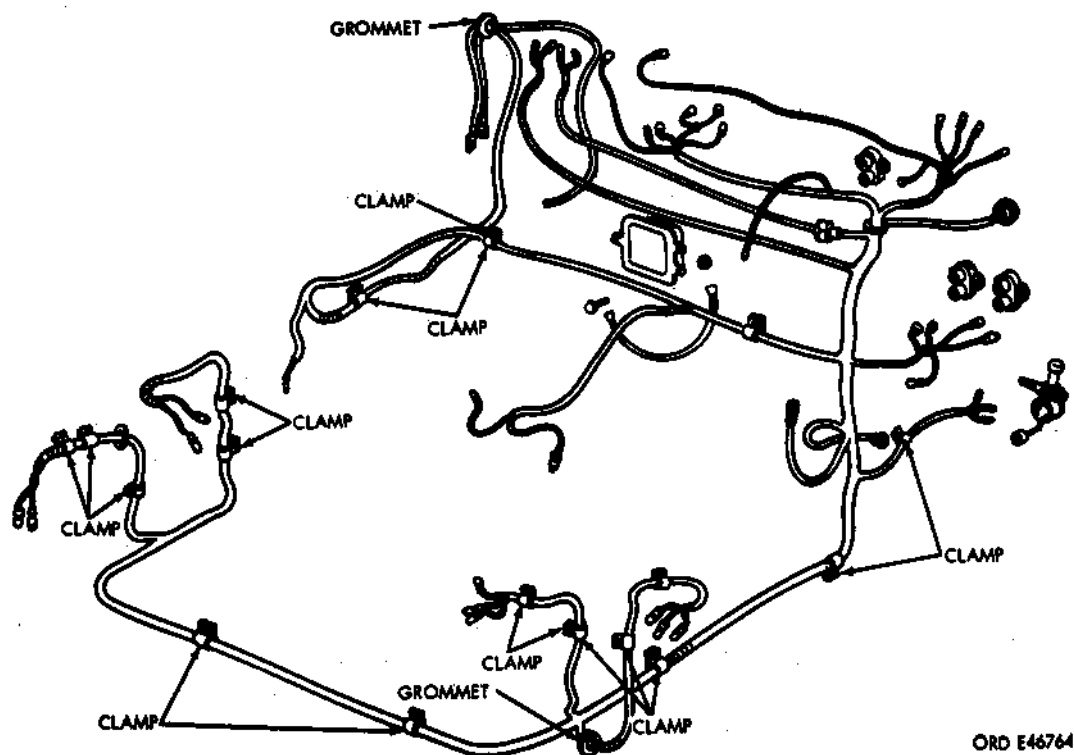
Refer to TM 9-2920-211-20.

23. Chassis Wiring Harness

a. General. Figures 25 and 26 show the general routing of the harness, identifying dip locations and disconnect points for harness replacement operations.

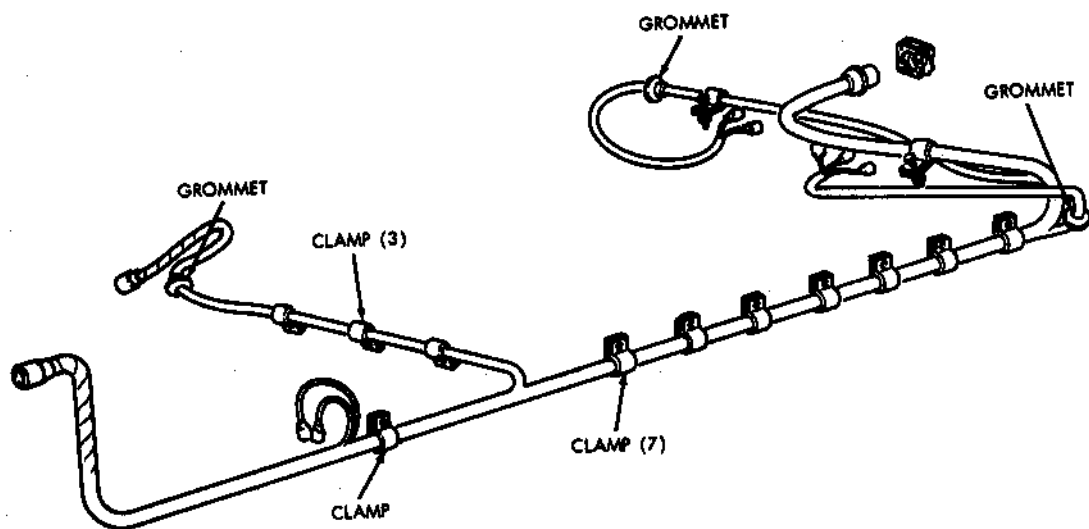
b. Removal (Front Wiring Harness). Remove the front wiring harness as shown in figure 27.

Note. Late production diesel (A1) and multifuel (A2) models are being built with turn signals installed. For these harnesses, refer to Changes No. 1 to TM 9-2320-211-20.



ORD E46764

Figure 25. Schematic drawing of front electrical harness



ORD E46765

Figure 26. Schematic drawing of rear electrical harness

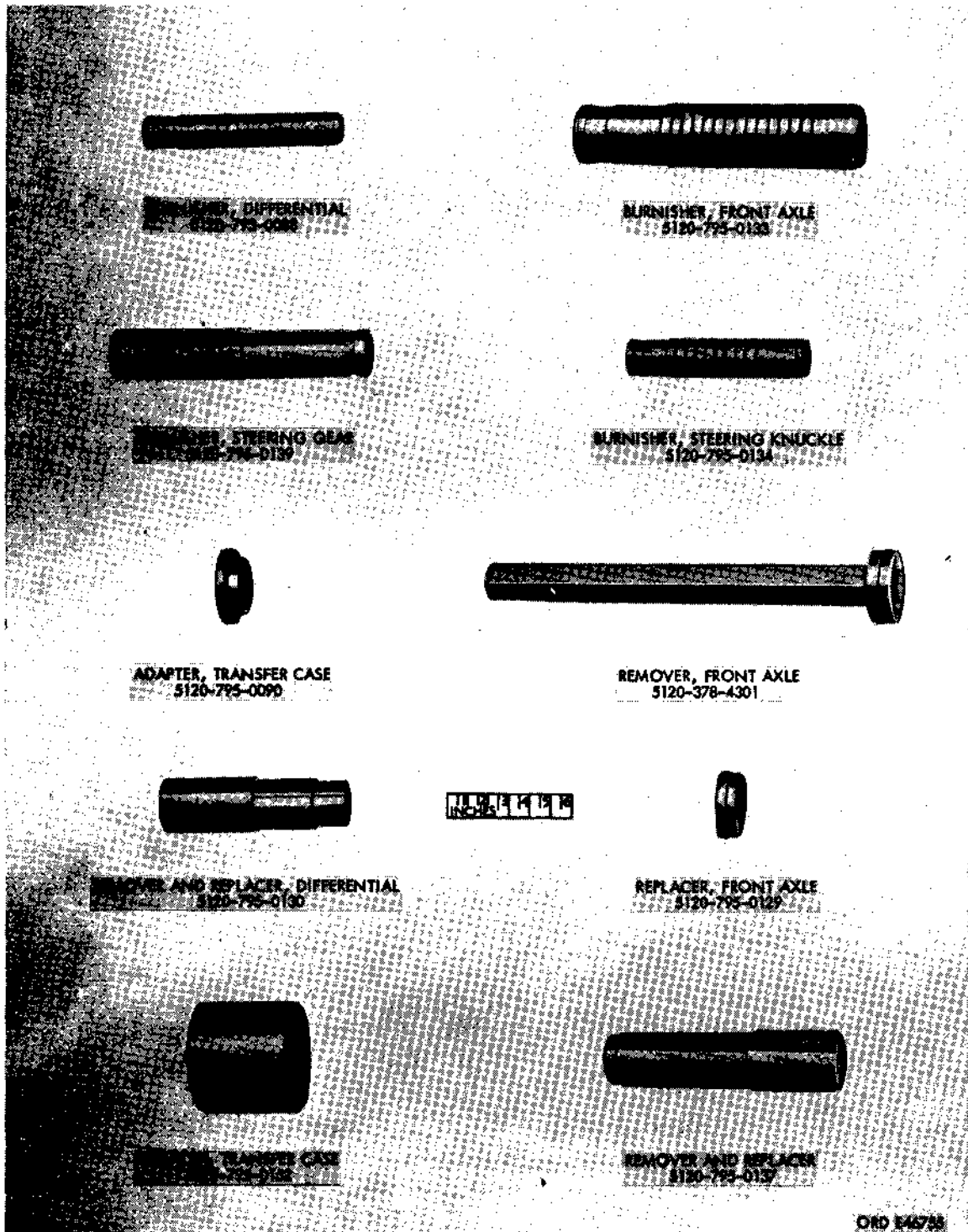
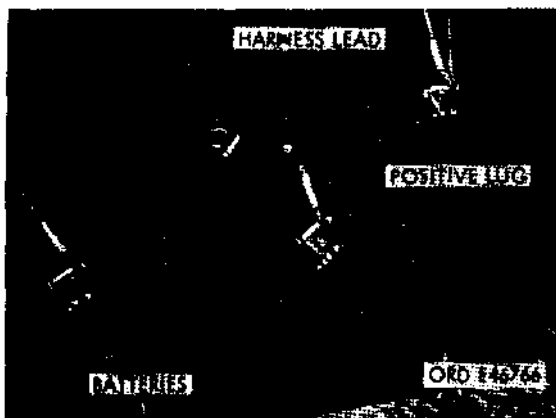


Figure 20. Special tools and equipment for field and depot maintenance (1 of 5).

FIGURE 27
FRONT WIRING HARNESS REPLACEMENT
Steps 1 through 24



Step 1. Remove nut and lockwasher at battery positive lug and remove front harness lead.



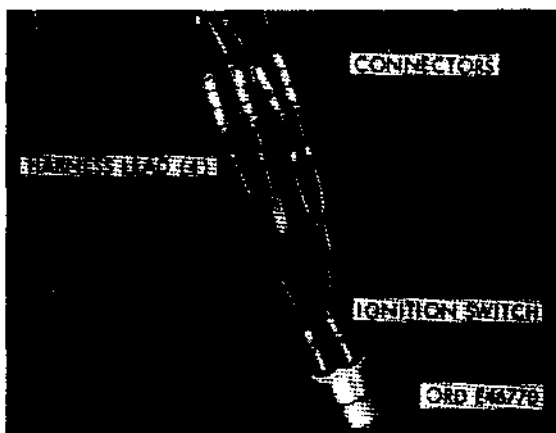
Step 2. Disconnect front harness leads at instrument cluster.



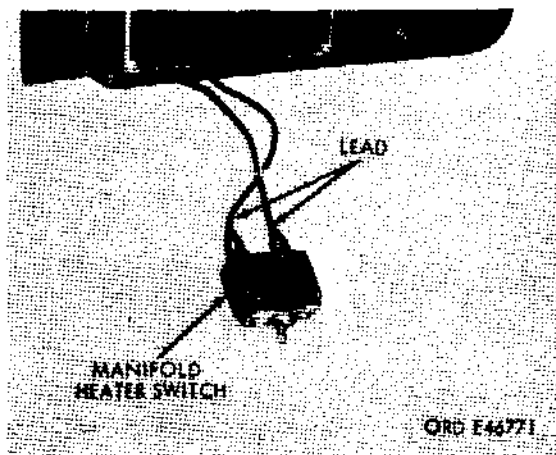
Step 3. Disconnect front harness leads at starter switch (Diesel models only).



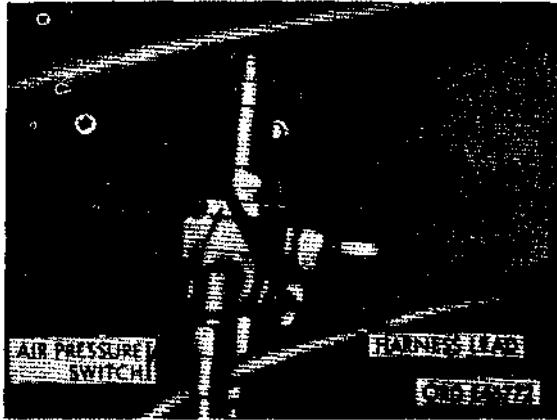
Step 4. Disconnect multiple connector at light switch.



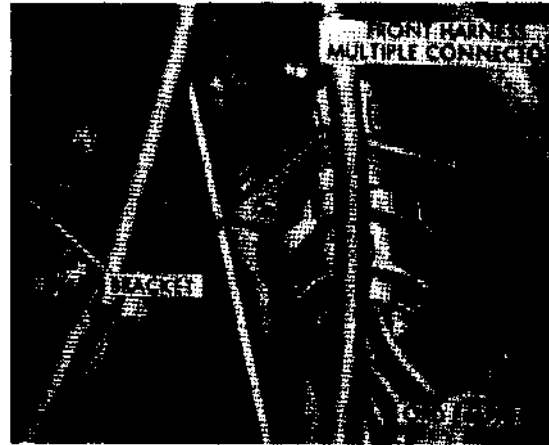
Step 5. Disconnect front harness lead from ignition switch at connectors.



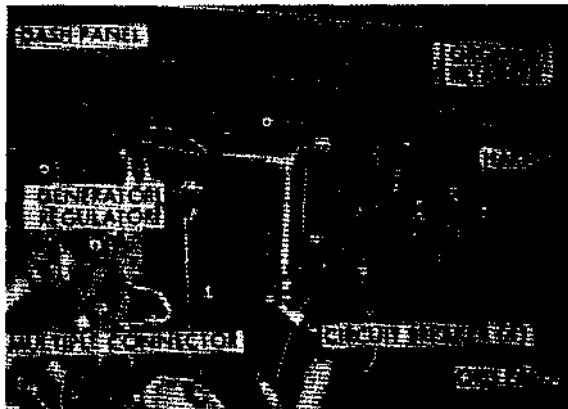
Step 6. Disconnect front harness leads at manifold heater switch (Diesel models only).



Step 7. Disconnect front harness lead at low pressure switch.



Step 12. Disconnect front harness from rear harness at bracket on dash panel.



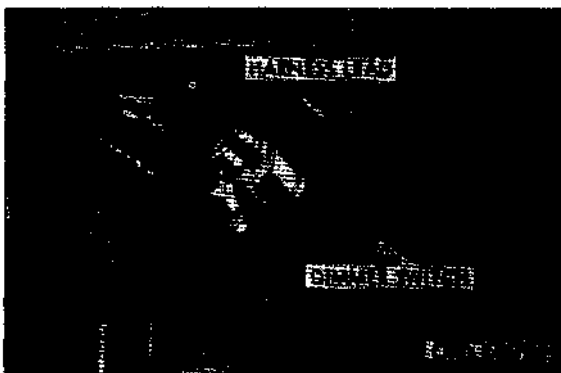
Step 8. Open grommet retainer for clearance and pull harness through dash panel opening.

Step 9. Disconnect front harness leads at circuit breakers.

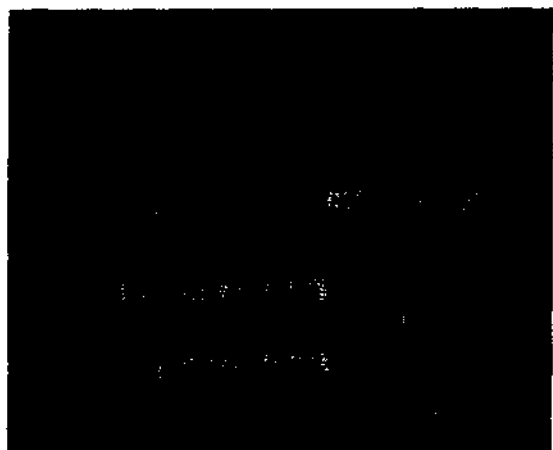
Step 10. Disconnect multiple connector at generator regulator.



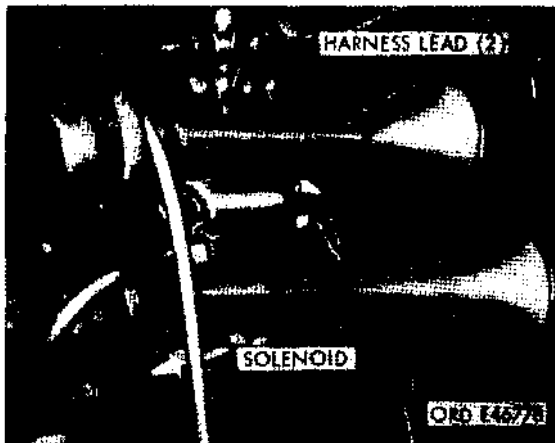
Step 13. Disconnect front harness lead at temperature sending unit.



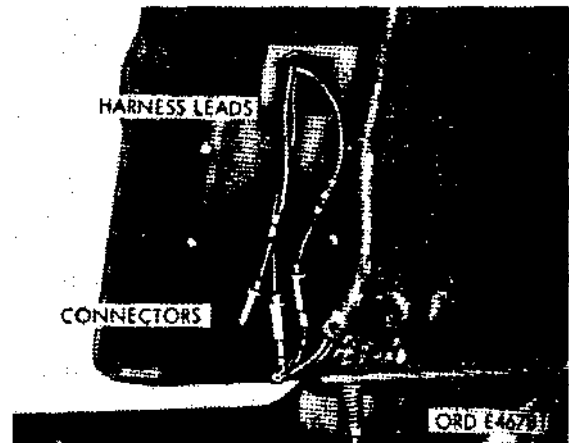
Step 11. Disconnect front harness leads at dimmer switch.



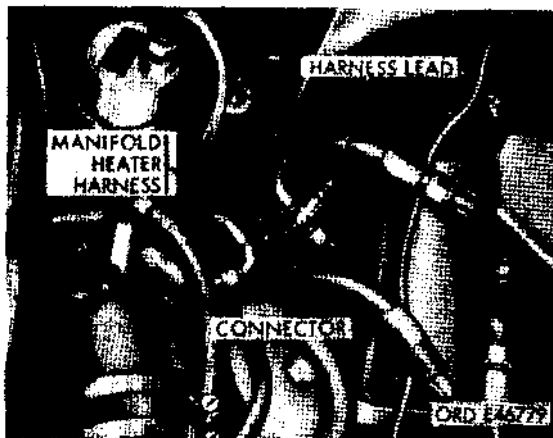
Step 14. Disconnect front harness lead at horn terminal on steering column



Step 15. Disconnect front harness leads at horn solenoid, on dash panel (Diesel models only).



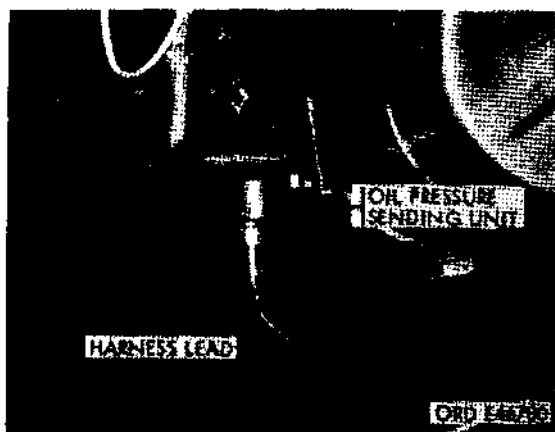
Step 18. Disconnect front harness leads from left and right B.O. marker light at connectors.



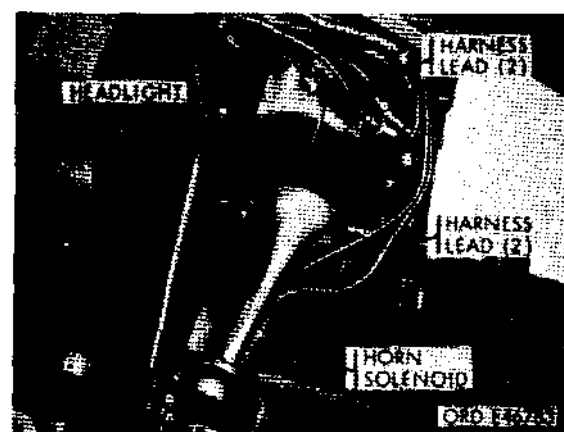
Step 16. Disconnect front harness leads from manifold heater harness at connector (Diesel models only).



Step 19. Disconnect front harness leads from headlight pigtailed and B.O. driving light pigtailed at connectors.

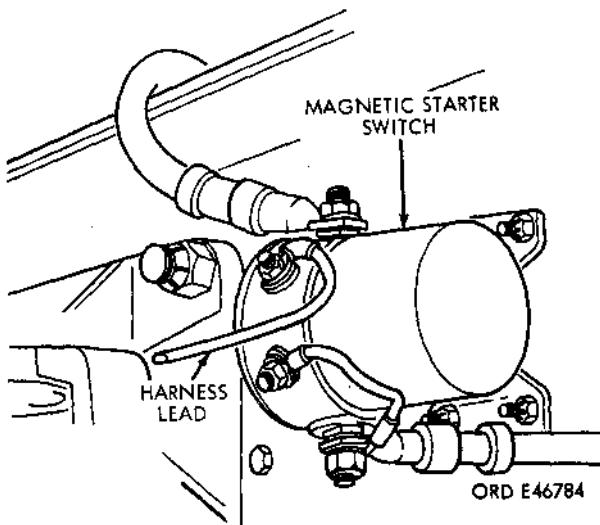


Step 17. Disconnect front harness lead from oil pressure sending unit.

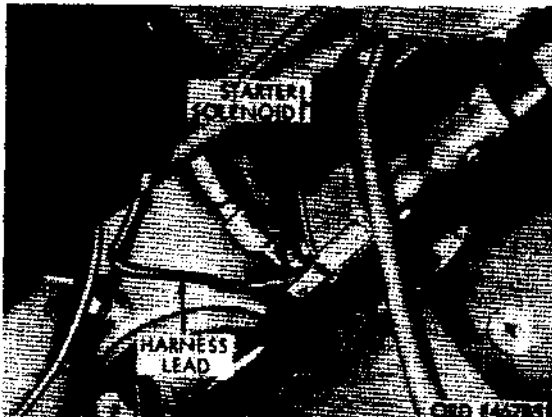


Step 20. Disconnect front harness leads from right headlight pigtailed at connectors.

Step 21. Disconnect from harness leads at horn solenoid (gasoline models only).



Step 22. Remove nut and lockwasher and remove front harness lead from magnetic starter switch (Diesel models only).



Step 23. Remove screw and remove front harness lead from starter solenoid (Diesel models only).

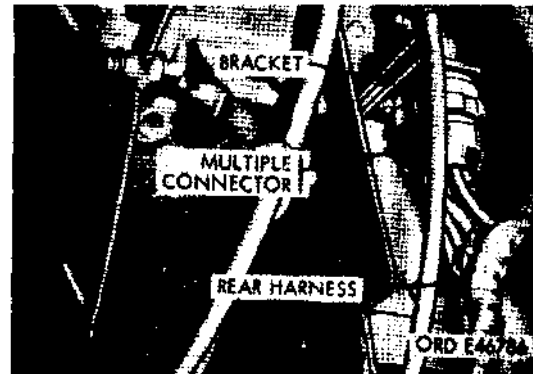
Step 24. Follow course of front wiring harness and remove clamps securing harness to frame, fender extensions, and cab, Refer to figure 25 for schematic location of clamps and grommets.

Figure 27. Front wiring harness replacement.

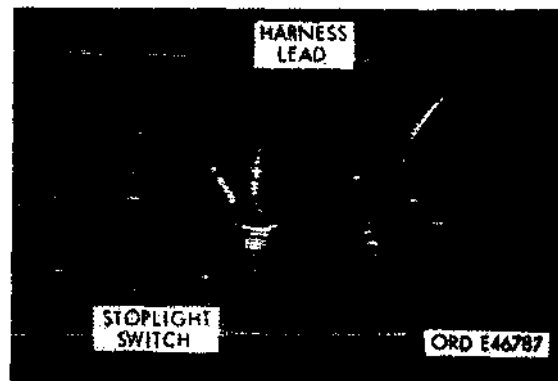
c. Installation (Front Wiring Harness). Install front wiring harness in reverse order of removal proceeding from step 24 through step 1.

d. Removal (Rear Wiring Harness). Remove rear wiring harness as shown in figure 28.

FIGURE 28
REAR WIRING HARNESS REPLACEMENT
Steps 1 through 8



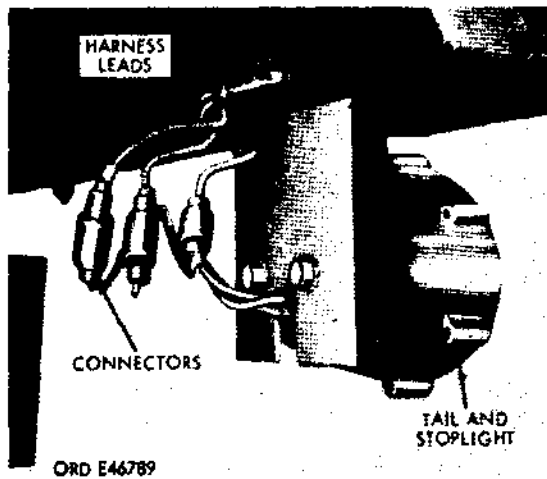
Step 1. Disconnect multiple connector from bracket at dash panel.



Step 2. Disconnect rear harness leads at stoplight switch.



Step 3. Disconnect rear harness leads at fuel tank sending unit.



step 4. Disconnect rear harness leads from left tail and stoplight pigtails at connectors.

Note. Rear harness leads may be disconnected from connectors without removing guard.

Step 5. Disconnect rear harness lead from right tail and stoplight pigtails at connectors.



Step 6. Remove screws securing trailer electrical receptacle to pintle bracket.

step 7. Follow course of harness and remove clamps securing harness to frame. Refer to figure 26 for schematic locations of clamps.

Step 8. Pull rear harness out through trailer electrical receptacle hole in pintle bracket.

Figure 28. Rear wiring harness replacement

~. Installation (Rear Wiring Harness). Install rear wiring harness in reverse order of removal, proceeding from step 8 through step 1.

Section III. REPAIR

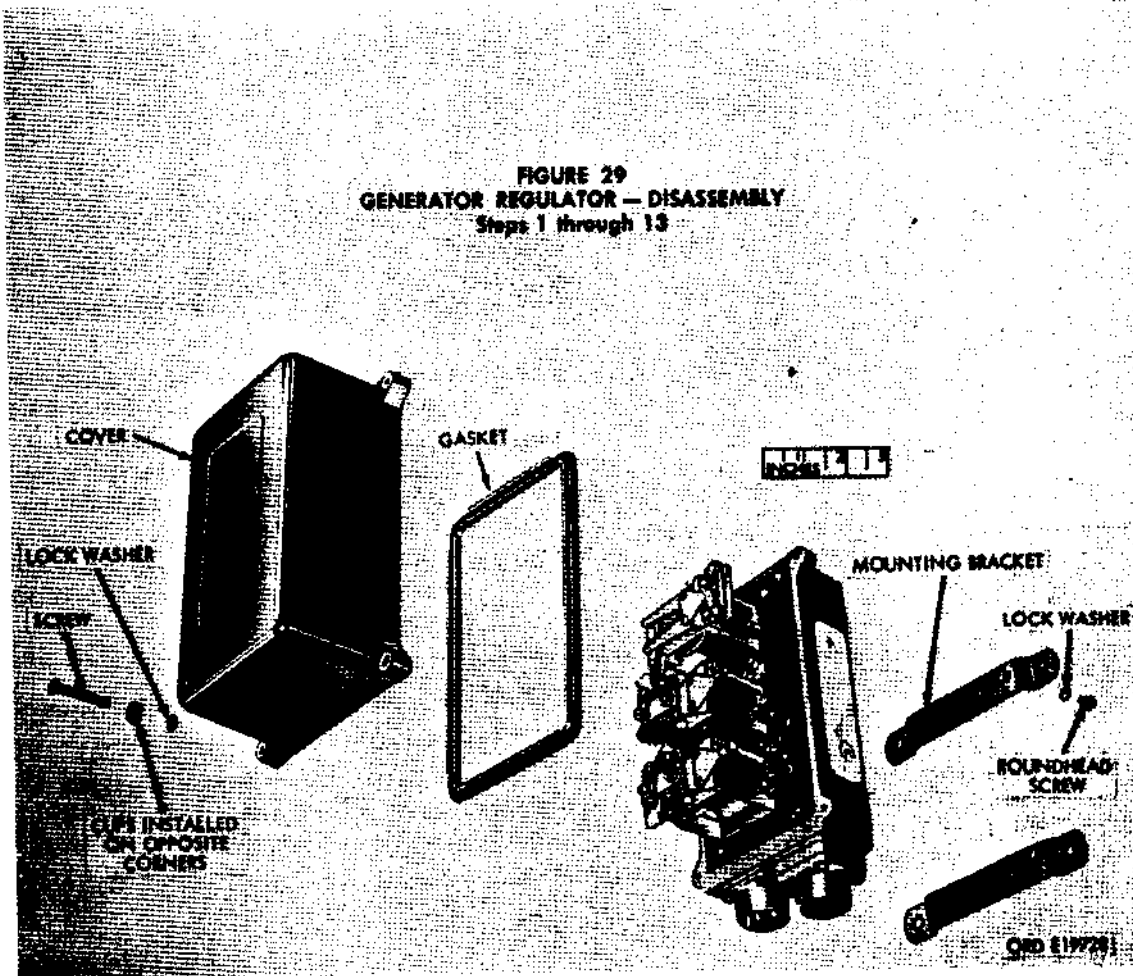
24. Generator Regulator

~. Auto-Lite VBC-4003-UT Regulator. Refer to TM 9-2920-210-34.

b. Delco-Remy 1118606 Regulator. Refer to TM 9-8627.

q Delco-Remy 1118656 Regulator.

(1) Disassembly. Disassemble the generator regulator as shown in figure 29.

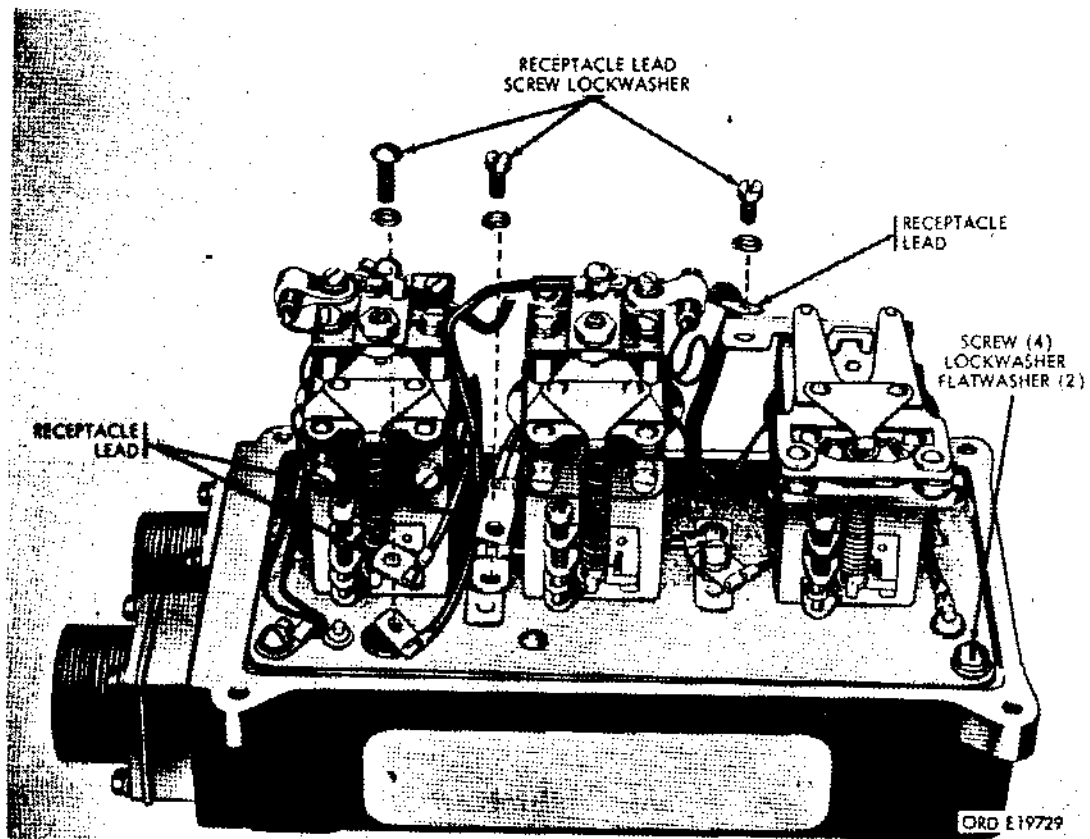


Step 1. Remove four screws and lockwashers securing cover to base assembly.

Note. Two cups on two opposite corner screws are wax filled. Remove wax to remove screws when assembling, and refill cups with wax when cover is installed.

Step 2. Remove two screws from each of two brackets.

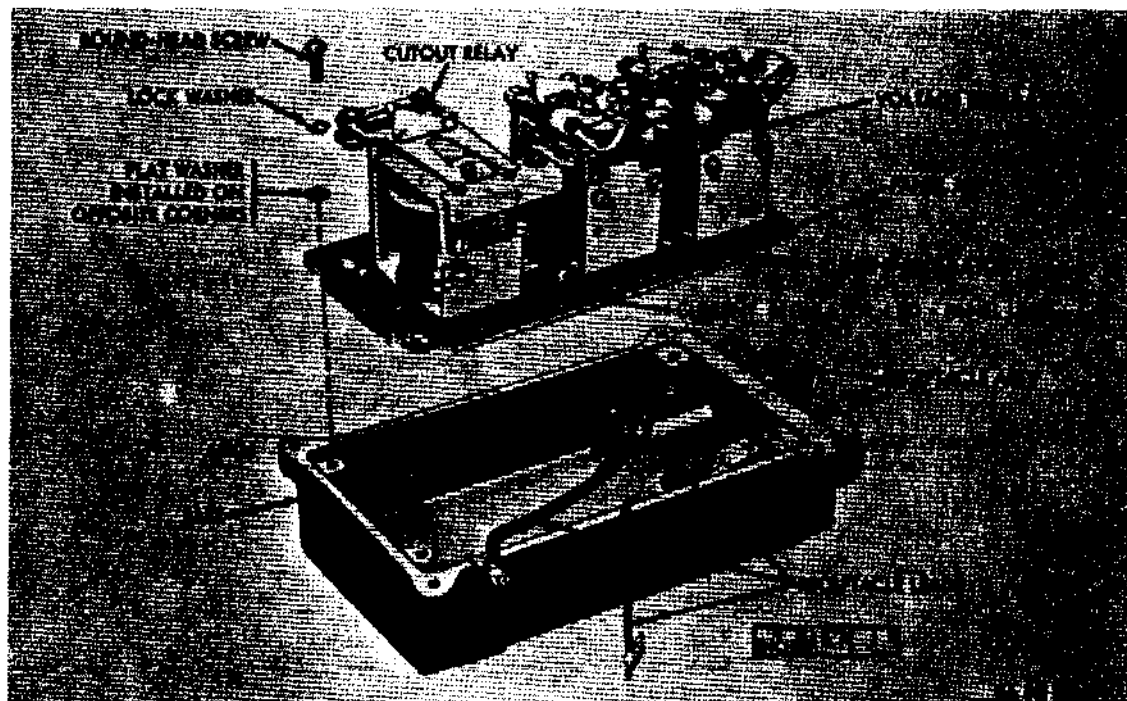
Figure 29. Generator regulator disassembly (1 of 6)



Step 3. Disconnect three receptacle leads.

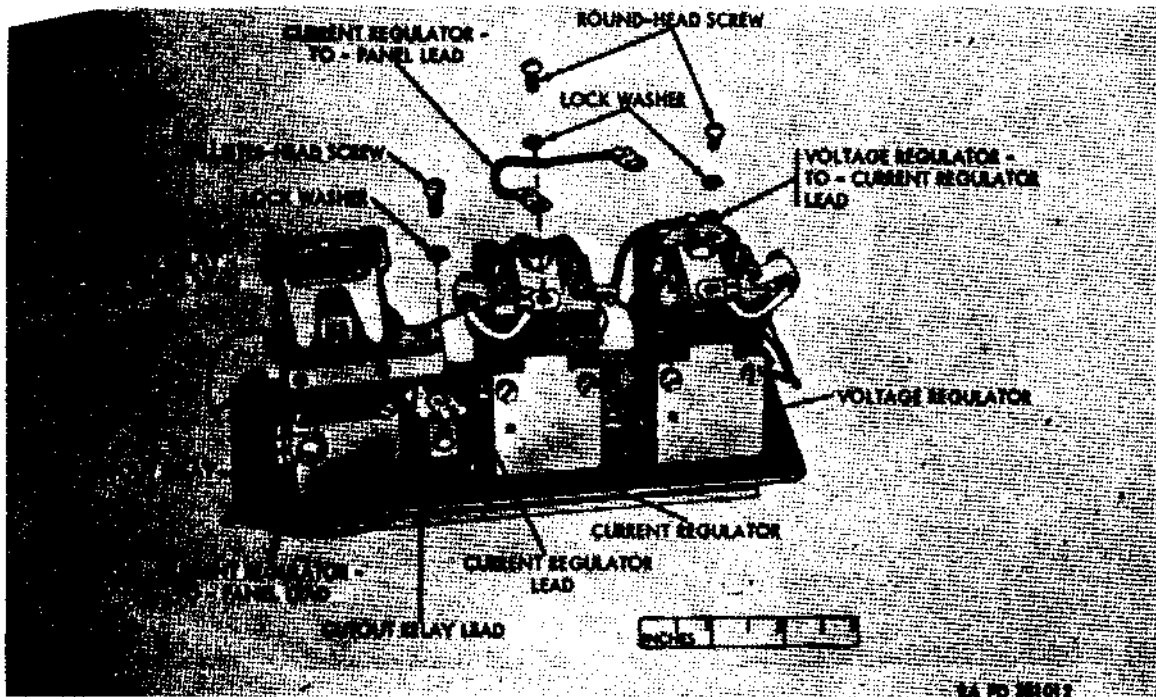
Step 4. Remove four screws, lockwashers and two flatwashers securing unit panel to base.

Figure 29. Generator regulator disassembly (2 of 6)



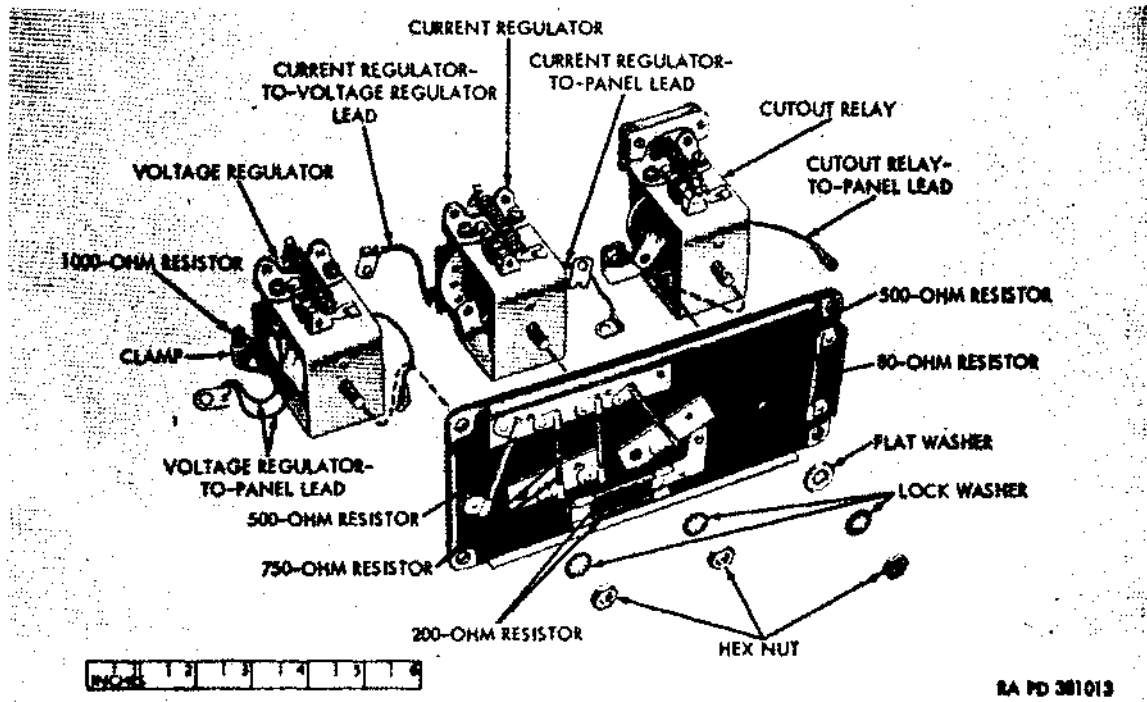
Step 5. Pull receptacle leads out of the way
and lift panel assembly off base.

Figure 29, Generator regulator disassembly (3 of 6)



- Step 6.** Remove screw and lockwasher to disconnect voltage regulator-to-current regulator lead.
- Step 7.** Remove screw and lockwasher and remove current regulator-to-panel lead.
- Step 8.** Remove screw and lockwasher to disconnect current regulator lead and cutout relay at panel.
- Step 9.** Unsolder cutout relay-to-panel lead at panel terminal.

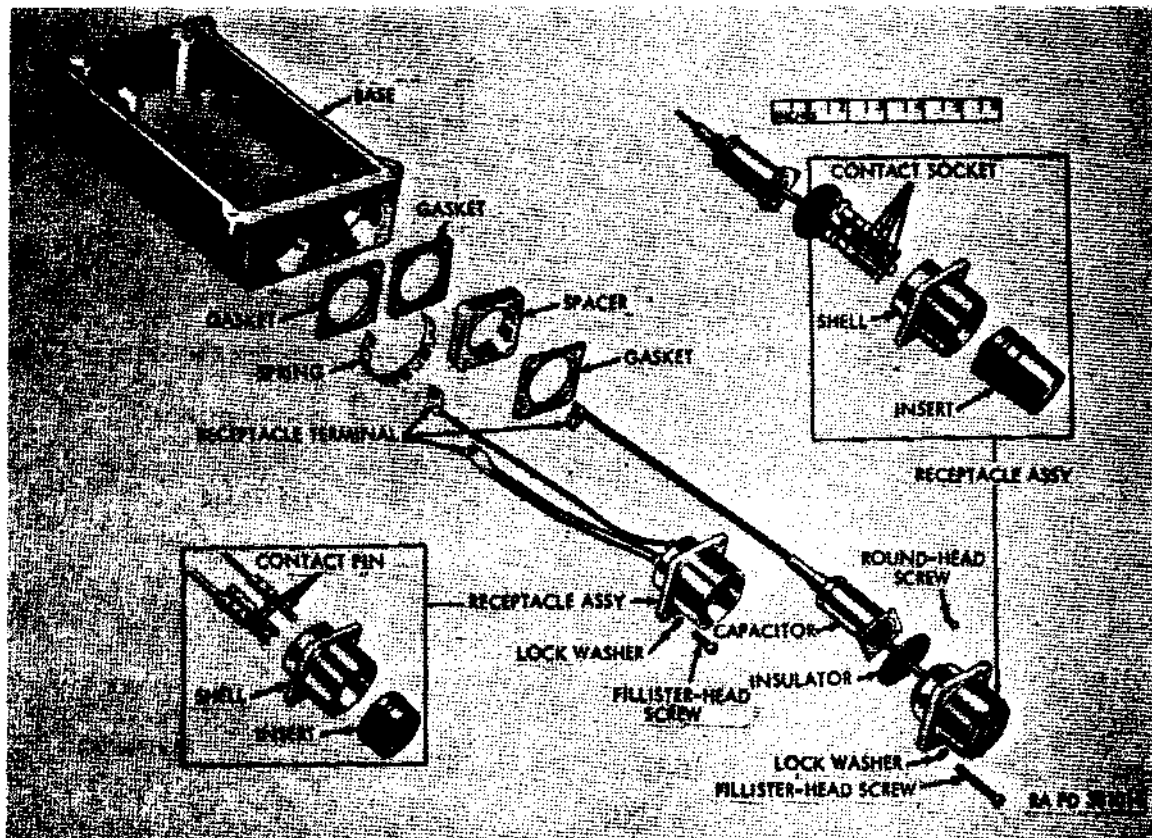
Figure 29. Generator regulator disassembly (4 of 6)



Step 10. Remove nut, lockwasher and flat-washer from each unit stud (bottom of panel) to remove regulator and relay units.

Step 11. Resistor terminals are soldered connections. Unsolder to replace any resistor failing to show specified resistance.

Figure 29. Generator regulator disassembly (5 of 6)



Step 12. Remove four screws and lockwashers from each receptacle.

Step 13. Separate terminal pins or sockets carrying lead from insert. Unsolder lead from pin or socket.

Note. Capacitor and leads must be replaced as an assembly.

Figure 29. Generator regulator disassembly (6 of 6)

(2) Cleaning, inspection and repair. Use procedures shown in TM 9-8627 and inspect components of the voltage regulator shown in figure 30.

(3) Assembly. Assemble generator regulator parts in reverse order of disassembly, proceeding from step 13 through step 1.

(4) Adjustment.

Voltage regulator air gap (fig. 31). The air gap is measured between armature and coil core (not the small pin in the core) with contact points just touching. To adjust, loosen locknut, insert gage, press armature down to hold gage, and turn contact screw until points just touch. Tighten locknut while maintaining adjustment.

(b) Voltage regulator voltage setting. Adjust voltage by turning the adjusting screw at the base of the regulator. The adjusting screw changes the spring tension which in turn changes the setting. Increasing the spring tension increases the voltage.

(c) Current regulator air gap. Refer to (4) (a) above.

(d) Current regulator current setting. The current setting is adjusted with the voltage regulator not operating. Proceed as in (4) (b) above.

(e) Cutout relay air gap (fig. 32). Measure the air gap as described in (4) (a). If the contact points do not close completely, realine the lower contact bracket slightly or bend the armature

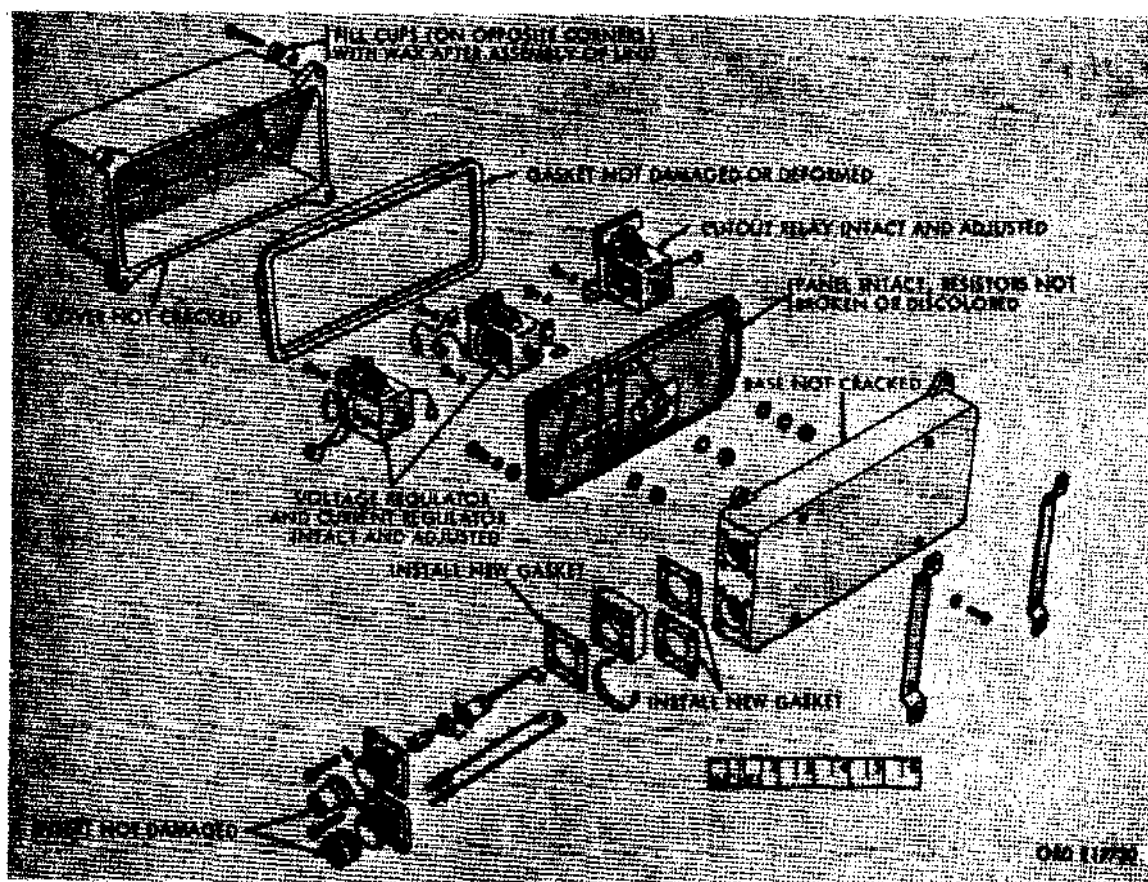


Figure 30. Generator regulator inspection points

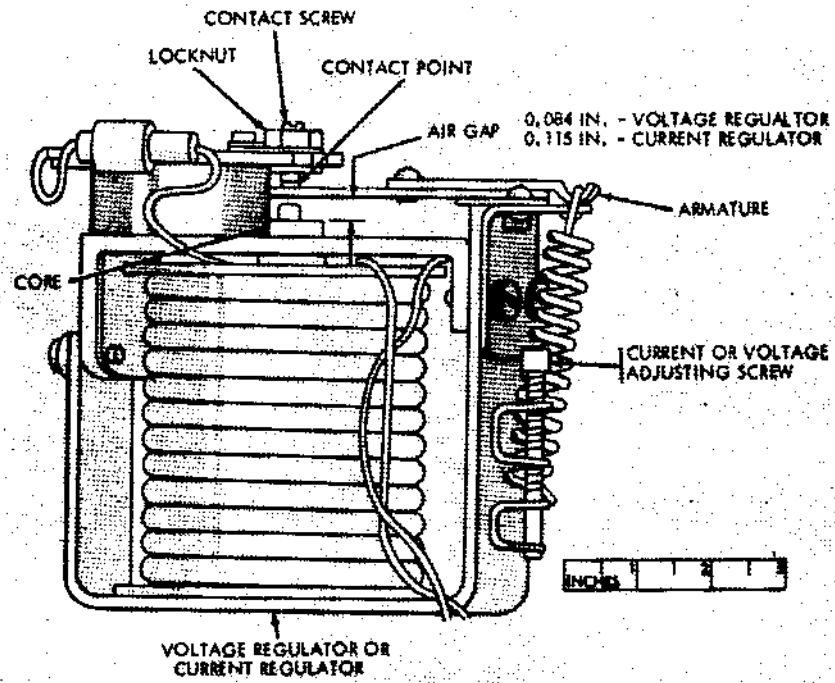


Figure 31. Adjusting voltage regulator or current regulator

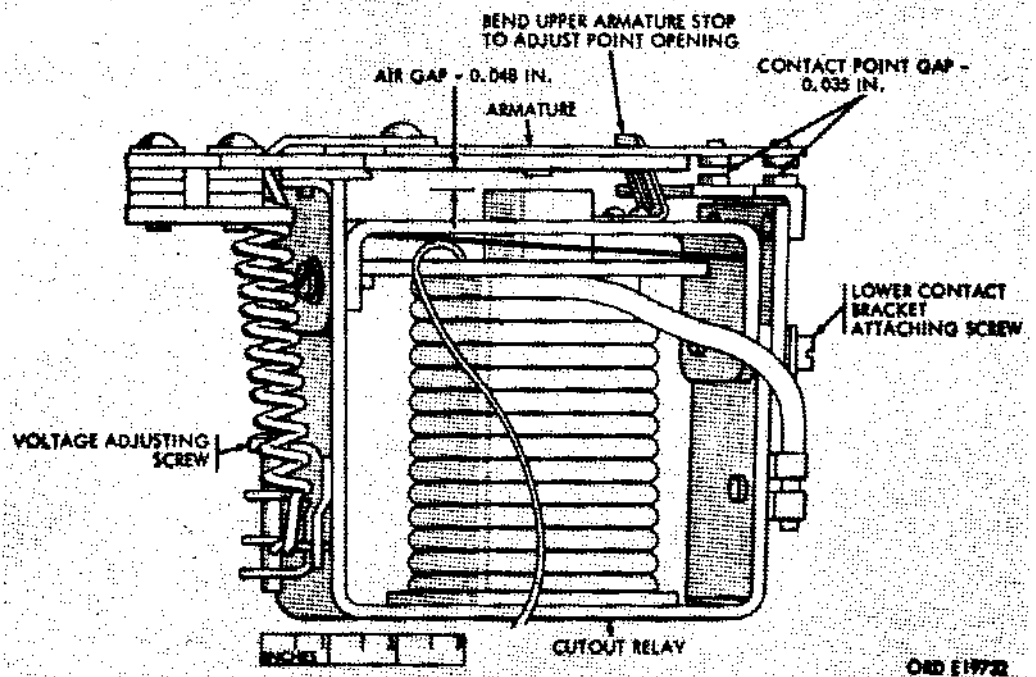


Figure 32. Adjusting cutout relay

spring fingers until all contact points meet simultaneously. With the contact points just touching, adjust air gap by loosening two screws which attach the lower contact bracket and raise or lower contact brackets, as required. Tighten screws while maintaining the adjustment.

- (f) Cutout relay point opening. Measure the point opening and adjust by bending the armature stop.

25. Batteries

Refer to TM 9-6140-200-15 **for repair information.**

26. Horn (Fig. 33)

a. General. The repair of the horn is limited to replacement of the solenoid, if defective, or replacement of the complete horn assembly if any component of the horn assembly is defective other than the solenoid.

b. Disassembly. Unscrew solenoid from horn assembly base.

c. Cleaning, Inspection and Repair.

- (1) Clean outside of case with cloth dampened in mineral spirits paint thinner or dry-cleaning solvent.

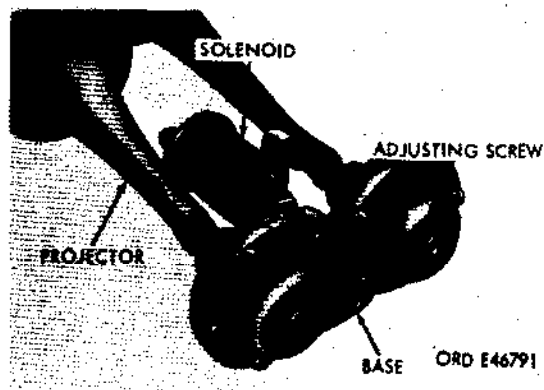


Figure 33. Horn - disassembly

- (2) Inspect horn assembly for damage. Straighten projectors if possible; otherwise replace complete horn assembly.

d. Adjustment. Refer to TM 9-8627.

27. Wiring Harness

Refer to TM 9-2320-211-20 **for repair information.**

CHAPTER 5

HOOD, FENDERS, SIDE PANELS AND BRUSH GUARD

Section I. DESCRIPTION

28. Hood and Side Panels

a. Hood Top Panel. The hood top panel consists of a formed and reinforced sheet metal panel over the top of the engine. This top panel is secured to the cowl by two hinges and eight bolts. The front of the hood panel is secured in the closed position by two spring-type, holddown catches on the right and left sides and a safety catch in the center. Two spring-type, holddown catches are secured to the top of the hood to hold the windshield in the lowered position. The left holddown catch is used to hold the hood in the open position. A hook is mounted on the left side of the cowl to hold the hood in the open position.

b. Hood Side Panels. The hood side panels are of one-piece construction and are hinged to the fenders. Hood side panels can be re-

moved separately or removed and installed with the fenders.

29. Fenders

The fenders are of one-piece construction and are mounted at the front of the vehicle. The fenders are held to supports attached to the frame at the front of the vehicle, and are held at the rear by a special spring-loaded mounting to preclude fenders from cracking under the stress generated while traveling over rough terrain.

30. Brush Guard

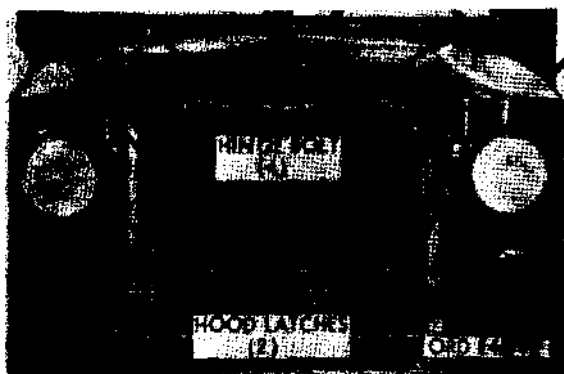
The brush guard is installed in front of the radiator and serves as a protection for the radiator against protruding objects encountered in the field. It is of one-piece construction and requires little repair.

Section II. REMOVAL AND INSTALLATION

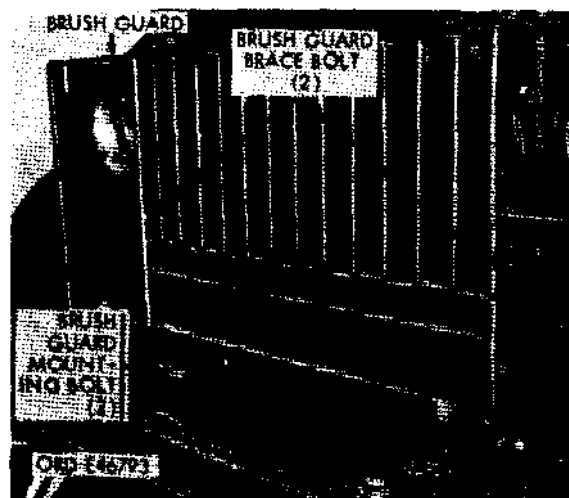
31. Removal

For removal operations refer to figure 34.

FIGURE 34
HOOD, FENDERS, AND BRUSH GUARD
Steps 1 through 13



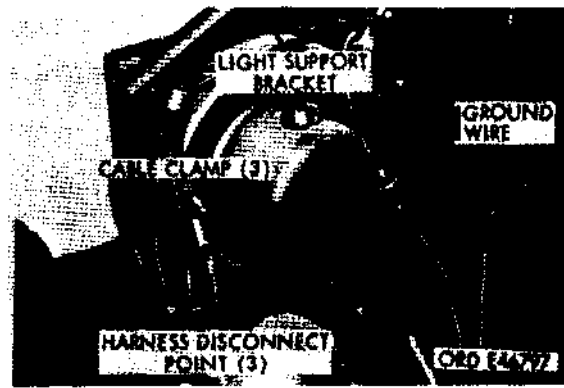
Step 2. Disconnect hood holddown latches (2). Remove four bolts and safety nuts securing hood hinges to cowl. Remove hood.



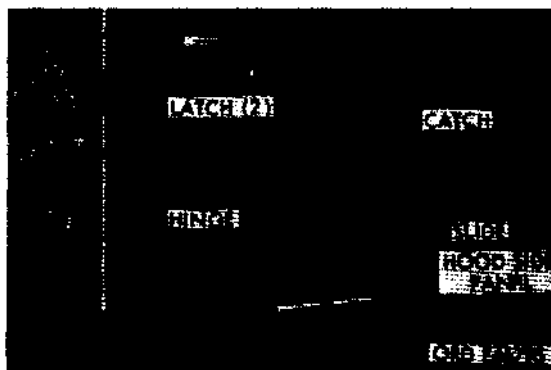
Step 2. Remove two brush guard brace nuts and bolts. Loosen two brush guard mounting bolts. Lift off brush guard.



Step 3. Loosen two (one each side) radiator dust shield bolts and remove shield.

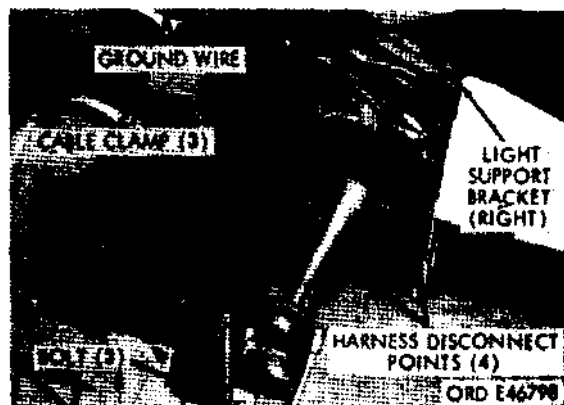


Step 6. Remove three cable clamps. Disconnect ground wire. Disconnect harness at light (left side).



Step 4. Push in catch and slide hood side panel out of hinge assembly (one each side). (Side panel latches (2) must be open.)

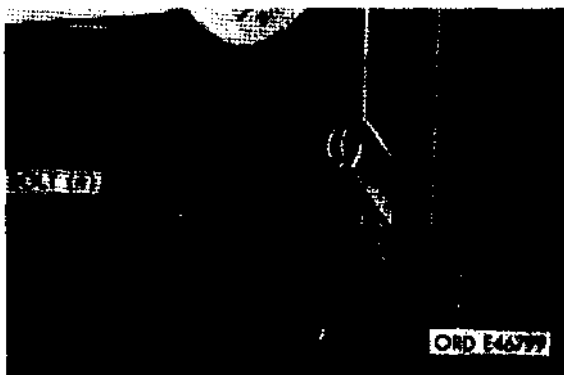
Note. For diesel and multiple engine vehicles, before removing right hood side side panel, remove air cleaner to turbosupercharger air tube. (Refer to TM 9-2320-211-20 and C.1).



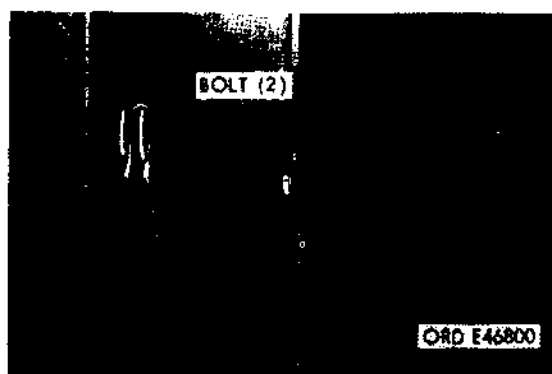
Step 7. Remove three cable clamps. Disconnect ground wire. Remove horn air inlet connection. Disconnect harness at light and horn. Remove three bolts from horn mounting bracket and remove bracket and horn together (right side).



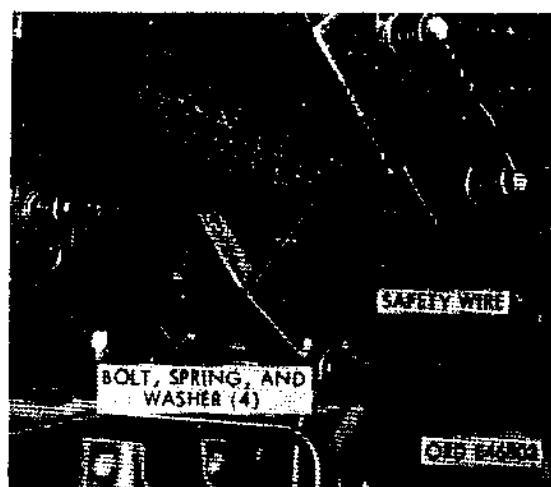
Step 5. Remove two nuts and bolts and remove light support panel brace (each side).



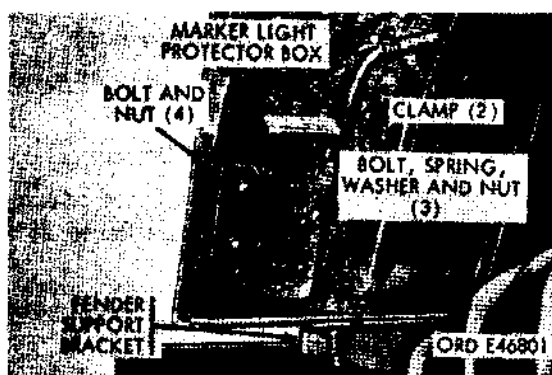
Step 8. Remove four nuts and bolts securing lamp support bracket to fender and remove bracket (right and left side).



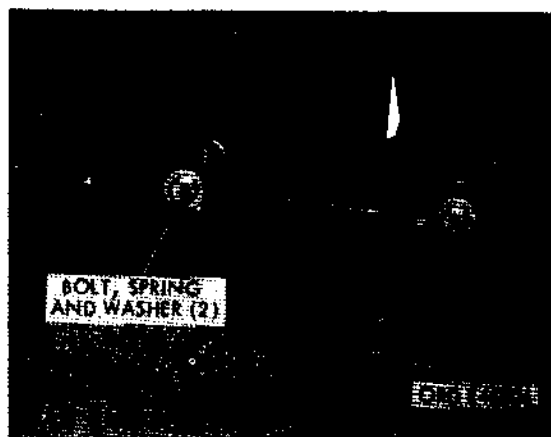
Step 9. Remove two steering reservoir-to-fender mounting bolts.



Step 12. Remove safety wire. Remove four fender-to-cab bolts, springs and washers.



Step 10. Remove four bolts and nuts securing marker light protector box to fender, and remove box. Disconnect three connectors from marker light. Remove two clamps securing insulated wiring assembly to fender and pull out through engine compartment. Remove three bolt, springs, washers, and nuts securing fender-to-fender support bracket.



Step 13. Remove two fender-to-running board bolts, springs, and washers and remove fender.



Step 11. Remove fender-to-frame mounting bolt, spring, and washer.

Figure 34. Hood, fenders, and brush guard.

32. Installation

Install hood, brush guard, and fender assemblies in reverse order of removal, proceeding from step 13 through step 1 of figure 34.

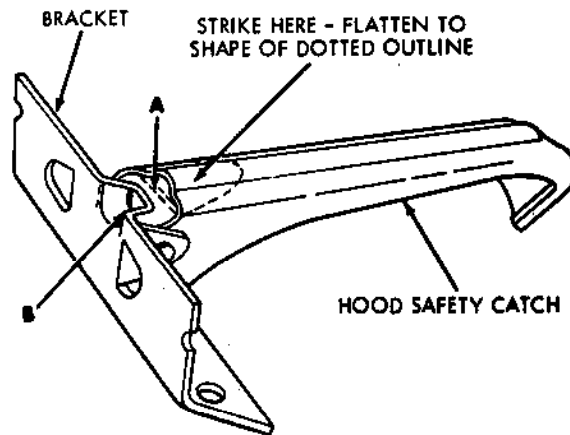
Note. The following operation covers alternation of the hood safety catch to prevent damage to radiator core.

a. Remove two capscrews and safety nuts which secure hood safety catch bracket.

b. Place catch in vise and strike moulded top surface with ball-peen hammer at point shown in figure 35, bending end of catch to depth indicated by dotted line A. Restore free action on hinge pin by squeezing of catch in vise.

c. When hood closes, point A of catch will then strike point B of bracket (fig. 35). This limitation of rearward travel of the catch will prevent rebound contact of catch with radiator core.

d. Install hood safety catch bracket and secure with two cap screws and safety nuts.



ORD E46805

Figure 35. Modified hood safety catch.

Section III. REPAIR

33. Hood, Fenders, and Brush Guard

Inspect the hood, fenders, and brush guard for cracks or dents and bump out or weld as necessary. Major damage to any of these items will render any repairs useless and necessitate replacement.

34. Miscellaneous Associated Items

Brackets, braces, supports, latches, catches, and hinges may be repaired or replaced as required.

CHAPTER 6

FRONT WINCH

Section I. DESCRIPTION AND DATA

35. Description and Operation (Figs. 36 and 37)

The winch is power driven from the power takeoff, mounted on right side of the transmission, and has a direct pull capacity of 20,000 pounds. The winch is a worm geared, jaw clutch, drum type, with an adjustable drag brake on the drum to prevent drum spin when free spooling cable. A hand-operated clutch control lever, located on left rear side of winch, is used to engage and disengage winch drum. A drum lock poppet latch, located on end frame, is used to lock drum

when winch is not in operation. An adjustable automatic brake is also provided on the winch drive worm for holding purposes.

36. Data

Make	Gar Wood
Model	GW-DA615
Capacity	20,000 lb
Cable diameter	5/8 in.
Cable length:	
All models except M62 and M246 ...	200 ft
M62 and M246	280 ft

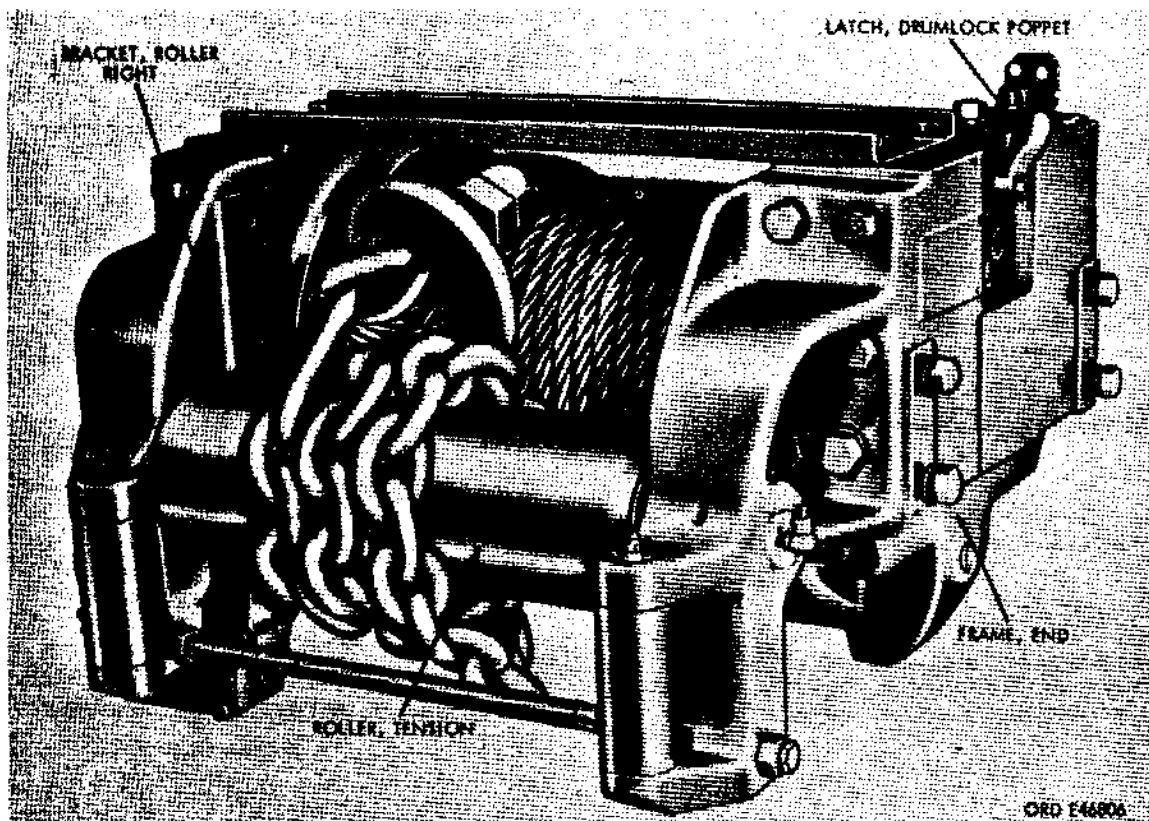


Figure 36. Front winch - left front view

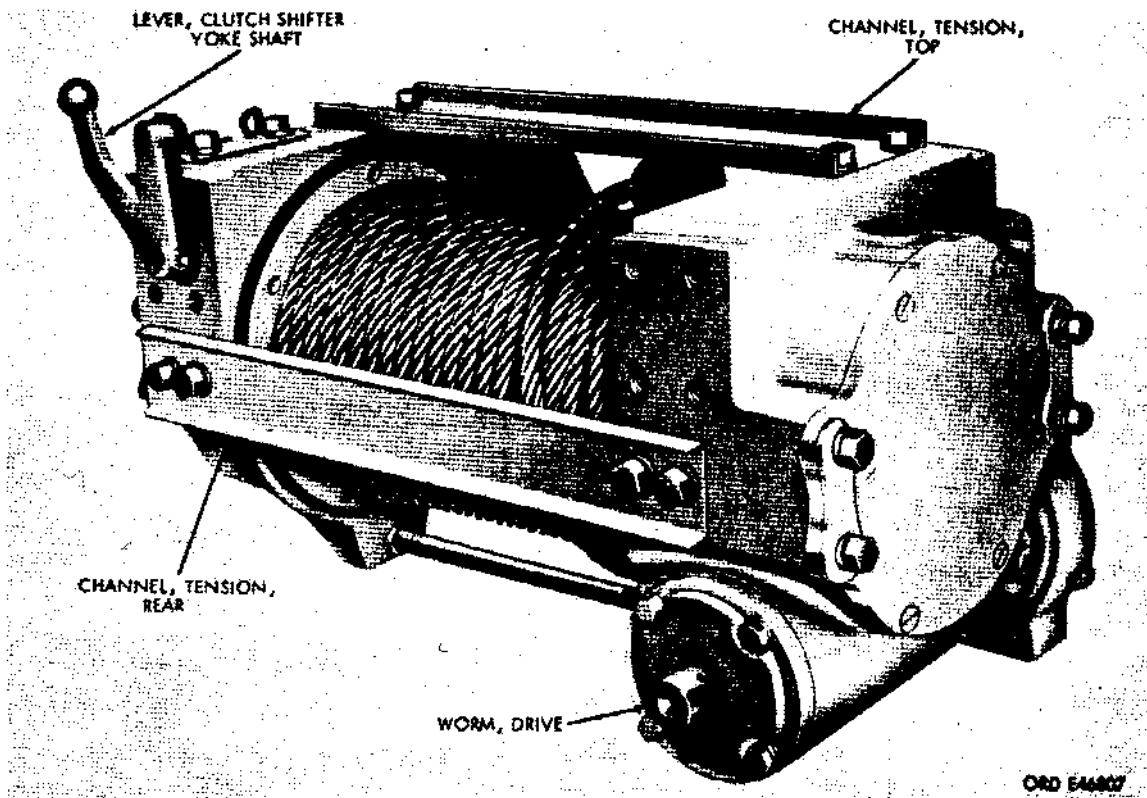


Figure 37. Front winch - right rear view

Section II. TROUBLESHOOTING

37. Troubleshooting Before Removal or Operation

a. General. Do not operate winch prior to completing the procedures given in b below.

b. Inspect for Lubricant Leakage. Visually inspect all gasket joints and plugs for evidence of leakage. Leakage at gasket joints may be corrected by tightening cap screws. If leakage still continues, install new gaskets.

38. Troubleshooting Before Removal and During Operation

If the inspections in paragraph 37 do not reveal causes of failure and the vehicle is operable, then troubleshoot it (Table III). Refer to Chapter 3 for the purpose and scope of these troubleshooting procedures.

39. Removal and Installation

Refer to TM 9-2320-211-20 for removal and installation of the front winch assembly.

Table III. Troubleshooting - Front Winch

Malfunction	Probable causes	Corrective action
1. Winch drum fails to operate with propeller shaft turning.	Broken shear pin.	Remove broken shear pin and replace. Refer to TM 9-2320-211-20.
2. Winch clutch sticks on drum shaft.	Drum shaft rusty or dirty.	Disassemble winch (par. 40), clean and lubricate drum shaft and clutch.
3. Winch jaw clutch slips out.	Clutch jaws or sprocket jaws are worn.	Disassemble winch (par. 40) and replace worn or damaged part.
4. Winch brake band does not hold load.	a. Brake spring too loose. b. Brake lining worn.	a. Adjust brake spring (par. 47). b. Replace brake lining (par. 43).
5. Excessive noise in drive shaft.	a. Shear pin worn. b. Excessive wear at universal joints. c. Bent or damaged drive shaft.	a. Replace shear pin. Refer to TM 9-2320-211-20. b. Repair or replace universal joints (TM 9-2320-211-20). c. Replace drive shaft (TM 9-2320-211-20).

Section III. REPAIR

40. Front Winch Assembly

a. Disassembly. Remove drain plugs from frame end and gearcase and drain lubricant. It is not necessary to remove cable assembly from drum unless inspection warrants replacement. If cable is not removed, an overhead means of lifting the winch assembly must be used to facilitate disassembly.

(1) Tension roller assembly (fig. 39).

- (a) Remove six cap screws and lockwashers from left and right roller bracket (fig. 38) and remove roller assembly.

Note. Cable assembly shown in position for removal of tension assembly.

- (b) Remove socket head setscrew (E) from roller brackets securing tension

roller shaft (L) to brackets. Remove lubricating fittings (A) from each end of shaft.

- (c) Remove bracket tie rod locknut (M) from each end of roller bracket tie rod (K) and pull right roller bracket (D) from tension roller shaft (L).
- (d) Slide tension roller bearing thrust washer (F), felt washer (G), and tension roller bearing (H) from end of tension roller shaft (L) and remove tension roller (J).
- (e) Remove lubricating fitting (B) from side roller pin (Q). Drive out straight pins (P) securing side roller pin (Q) to side brackets and tap out pins. Remove side roller (N) and side roller thrust washers (C) at each end.

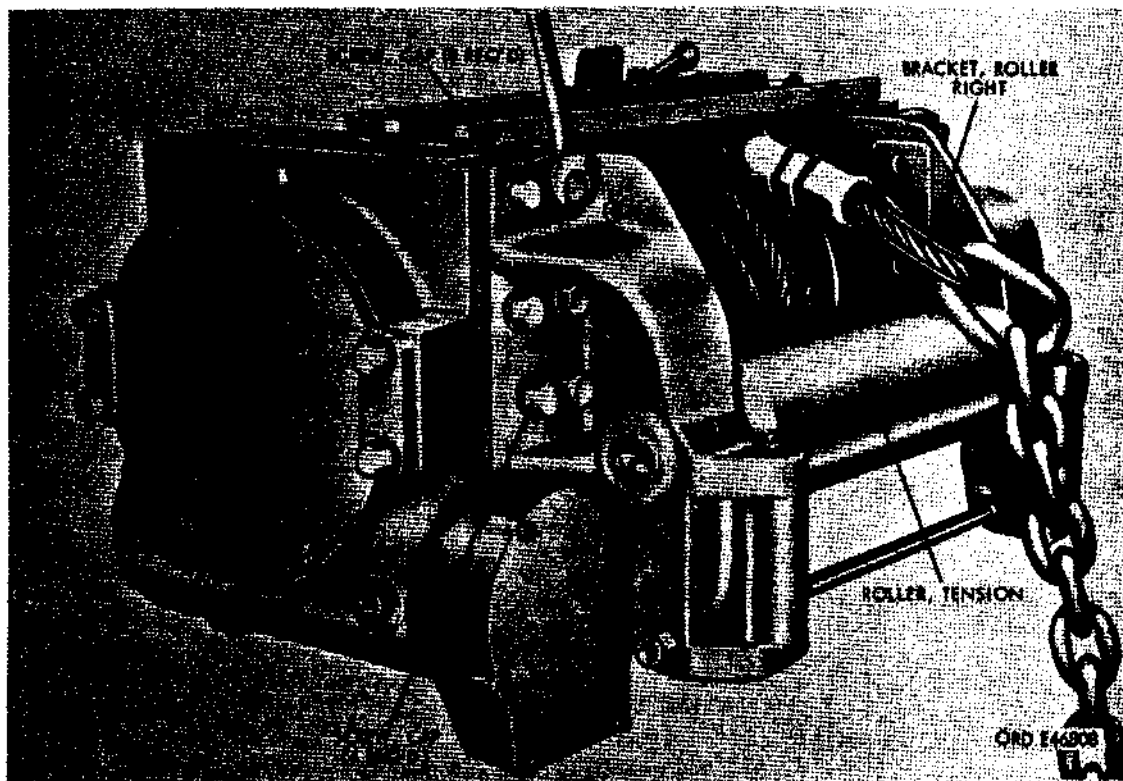


Figure 38. Removing tension roller assembly

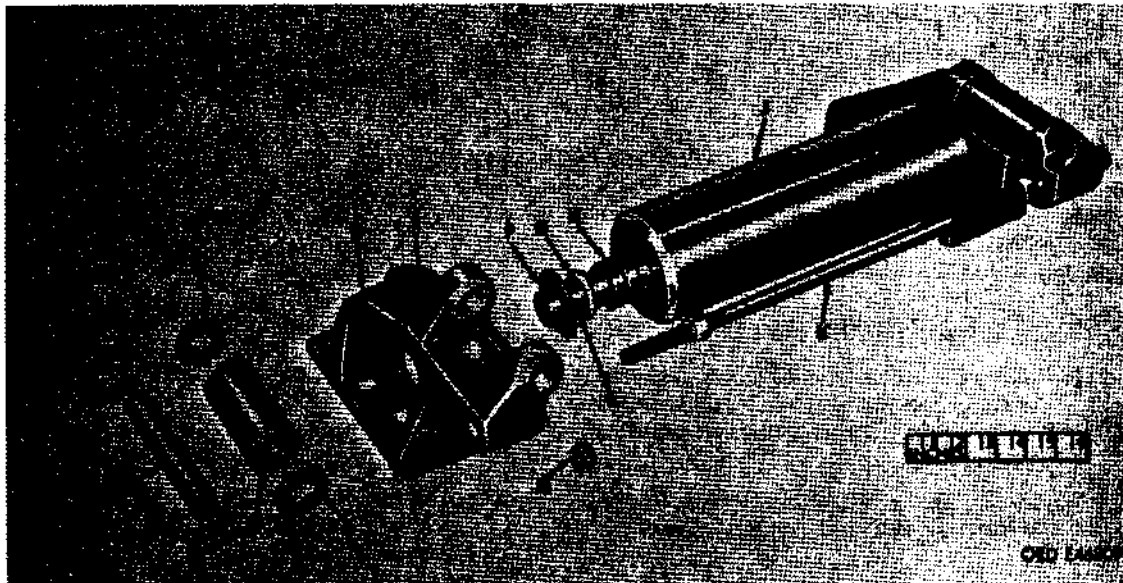


Figure 39. Disassembling tension roller assembly

<u>Key</u>	Item	Key	Item
A	Fitting, lubr, 90 deg		Roller, tension
B	Fitting, lubr, stght		Rod, tie, roller bracket
C	Washer, thrust, side roller		Shaft, tension roller
D	Bracket, roller, right		Nut, lock, bracket tie rod
E	Screw, set		Roller, side
F	Washer, thrust, tension roller bearing		Pin, stght
G	Washer, felt		Pin, side roller
H	Bearing, tension roller		

Figure 39. Disassembling tension roller assembly - legend

(2) Tension channels and line guide rod.

(a) Remove two cap screws and lock-washers from each end of top tension channel and lift off channel (fig. 40)

(b) Remove two cap screws and lock-washers from each end of rear tension channel and lift off rear channel (fig. 37).

(c) Remove end frame locknut (fig. 40) from end frame tie rod. Tie rod can be removed after pulling end frame from the assembly.

(3) End frame assembly.

(a) Support the drum and cable assembly with a chain hoist and lift off end frame (fig. 41).

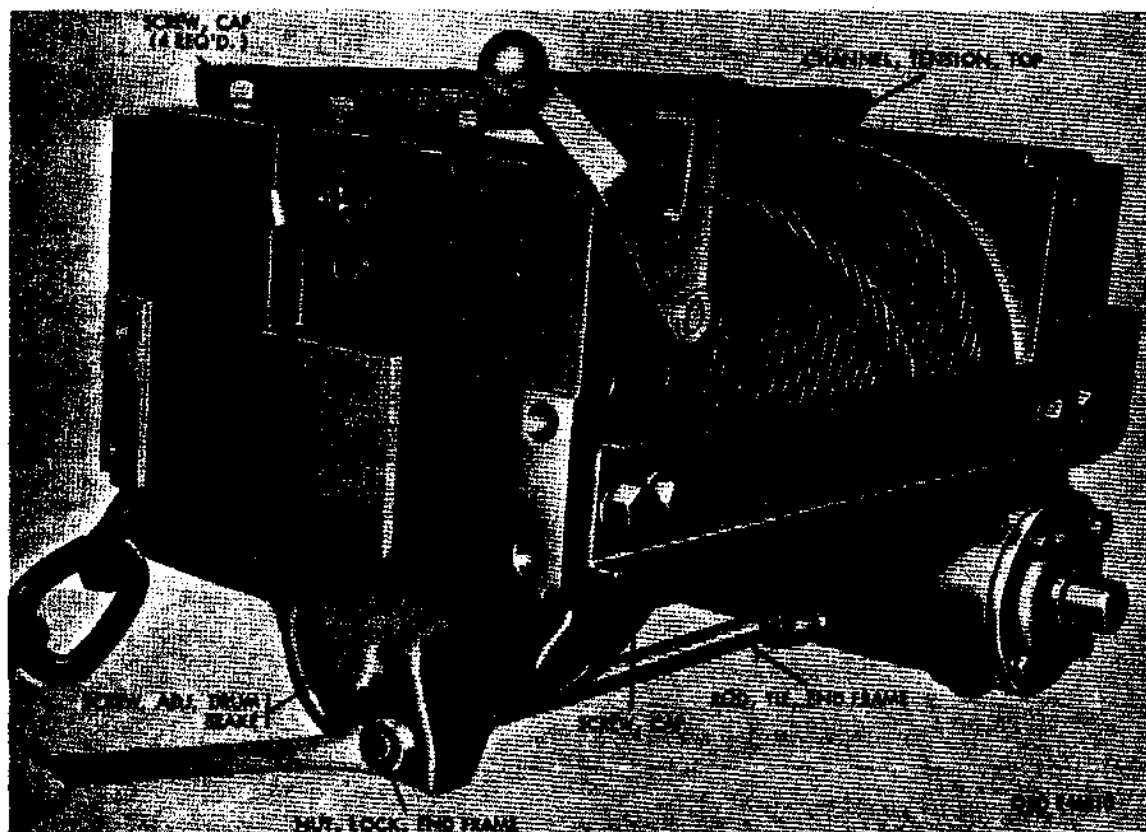


Figure 40. Removing end frame locknut from tie rod

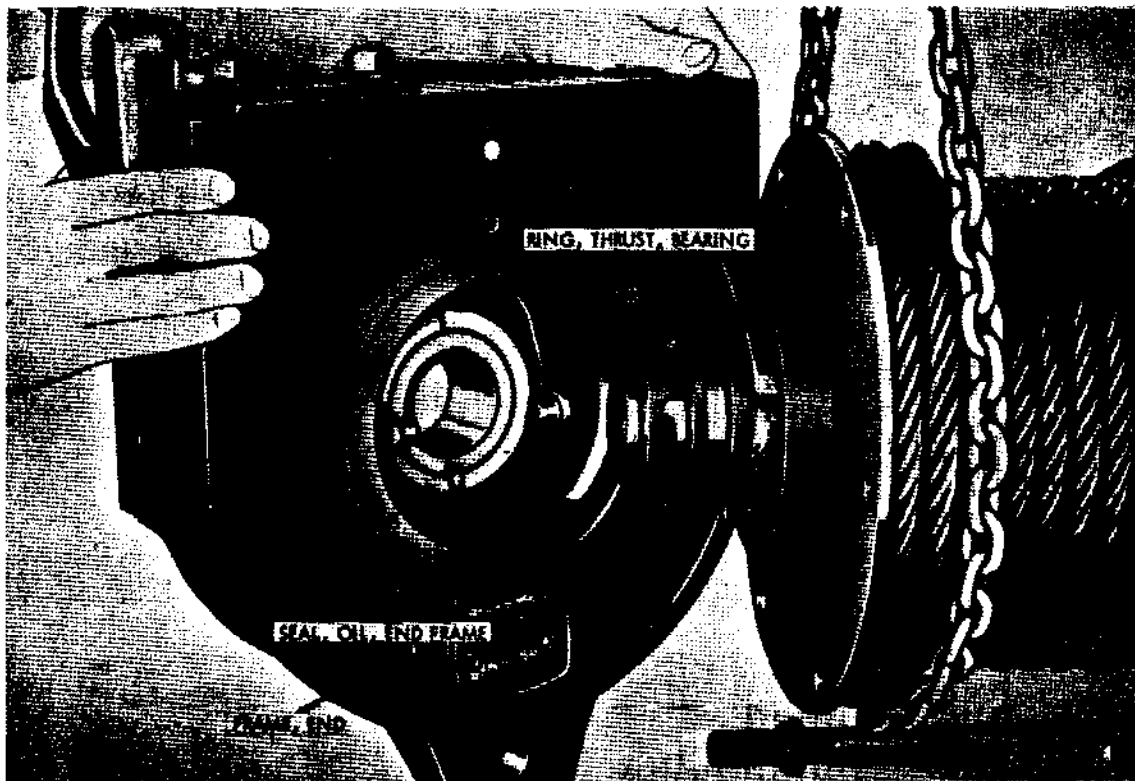


Figure 41. Removing end frame

- (b) Lift out bearing with sleeve assembly (fig. 42) and drag brake with lining assembly (fig. 42) from end frame.

Note. Do not disturb end frame oil seal (fig. 41) unless inspection warrants replacement.

- (c) Remove pipe plug (fig. 43) and square socket head pipe plug on opposite side of end frame. Use a punch to drive straight pin from clutch shifter yoke (fig. 43). Pull clutch shifter yoke shaft from end frame and lift out clutch shifter yoke.

Note. Do not remove shifter shaft oil seal unless inspection warrants replacement.

- (d) Remove drum lock poppet nut and remove drum lock poppet latch (fig. 44). Also remove drum brake adjusting screw (fig. 40).

(4) Drum and cable assembly.

- (a) Slide end bearing thrust ring (fig. 45) and drum sliding clutch (fig. 45) from drum shaft. Remove two drum sliding clutch keys (fig. 45) from drum shaft.

Note. These keys are tempered tool steel.

- (b) Remove bearing thrust ring (fig. 45).
- (c) With the drum and cable assembly supported in a chain hoist, pull drum shaft and gearcase assembly from drum.

(5) Drive worm brake assembly.

- (a) Remove four machine screws and lift off gearcase cover (fig. 46) with bearing assembly.

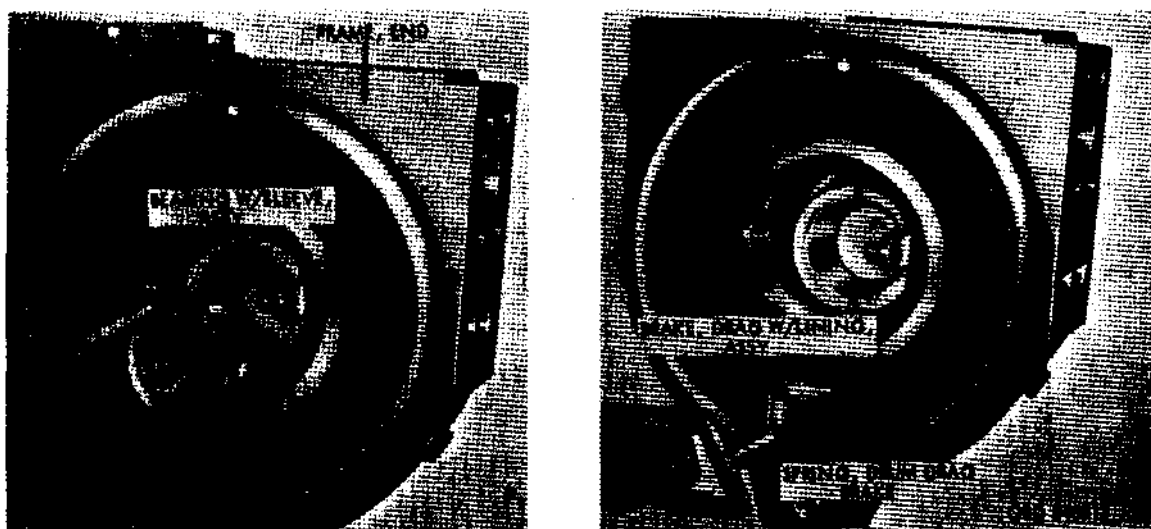


Figure 42. Removing bearing with sleeve and drag brake assemblies

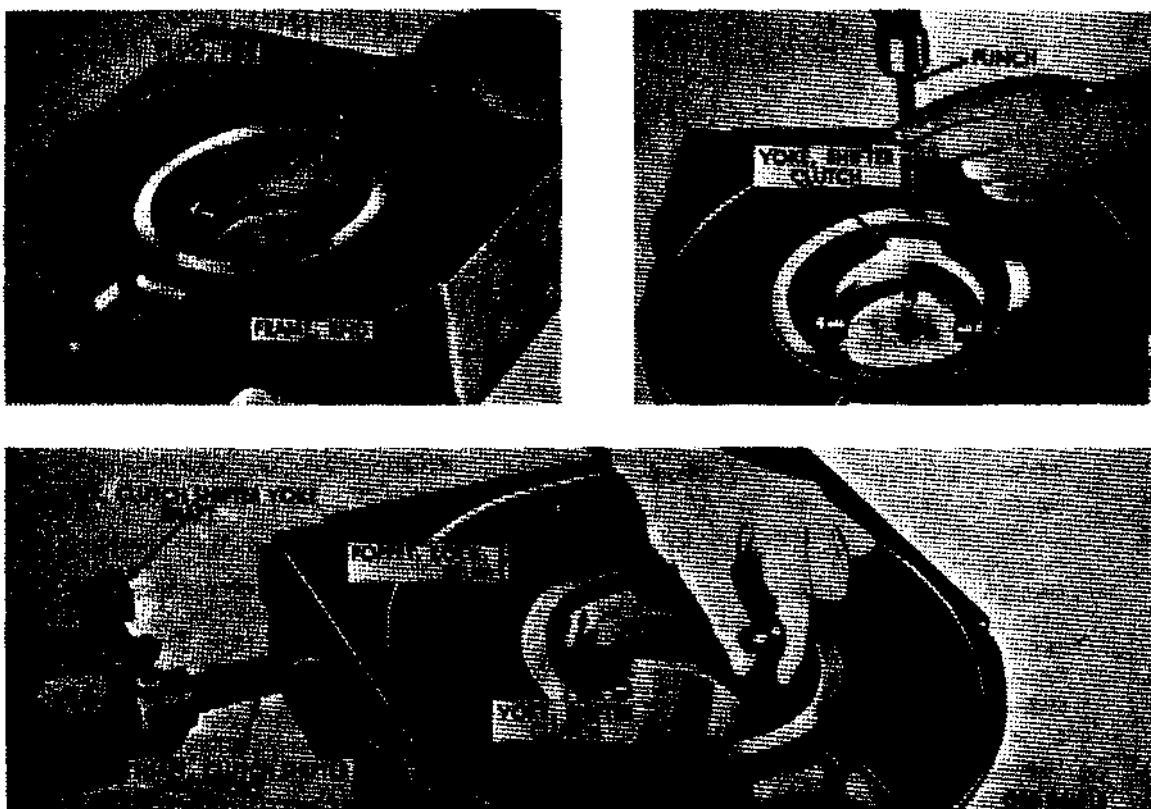


Figure 43. Removing clutch shifter yoke shaft and clutch shifter yoke

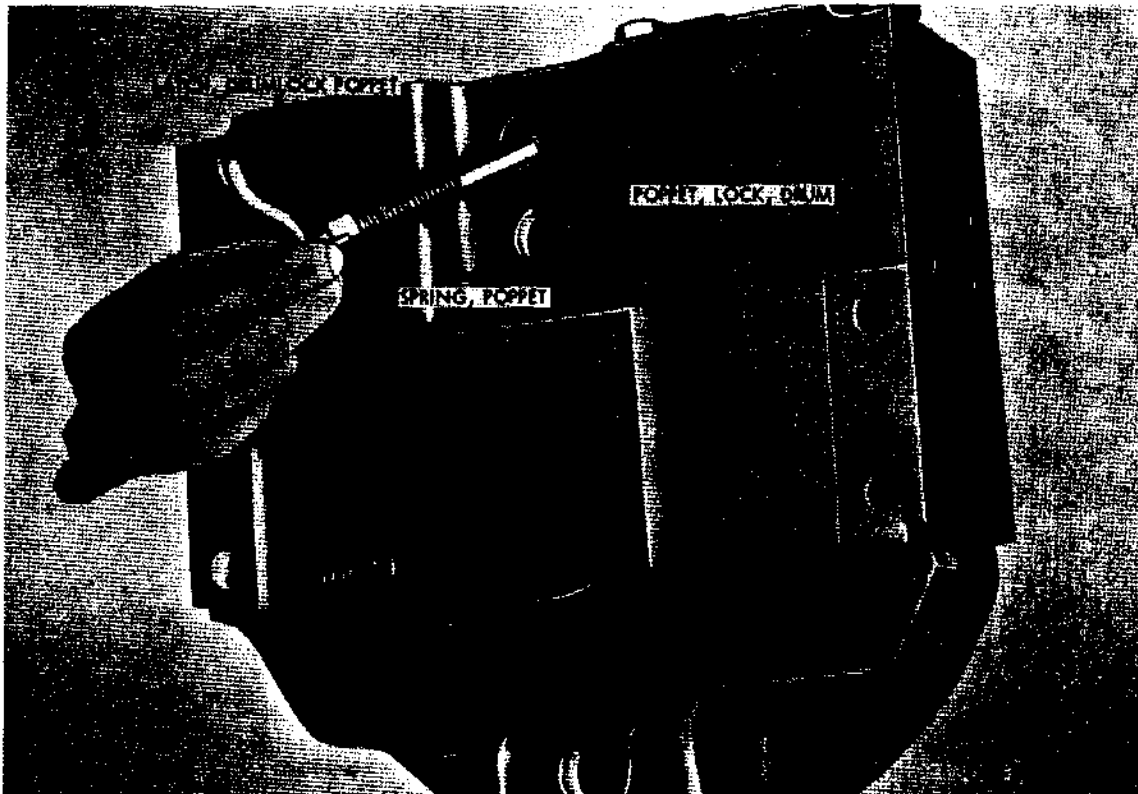


Figure 44. Removing drum lock poppet latch assembly

Remove four cap screws and lockwashers from drive worm bearing cap (fig. 46) and remove bearing cap, drive worm bearing oil seal, and gasket.

Remove six cap screws with external-teeth lockwashers and lift off drive worm brake cover (fig. 47).

Remove the cap screw (fig. 47) used for adjusting the brake band, plain washer, and O-ring gasket. Pull brake band with lining assembly from drive worm brake case.

Remove cap screw, lockwasher, and disk retaining washer and pull drive worm brake disk (fig. 47), using a suitable puller. Remove square key from drive worm.

- (f) Remove four cap screws and lockwashers and remove drive worm brake case (fig. 48) with drive worm bearing oil seal, and gasket.

Note. Do not remove oil seal from brake case unless inspection warrants replacement.

(6) Drive worm and drum shaft assembly.

- (a) Using a soft hammer, tap drive worm (fig. 48) with bearings at drive worm brake end and drop drive worm in gearcase.
- (b) Pull drum shaft and gear assembly (fig. 49) from gearcase.
- (c) Using a brass drift, drive worm ball bearing at drive worm brake end from drive worm. Pull drive worm from gearcase.

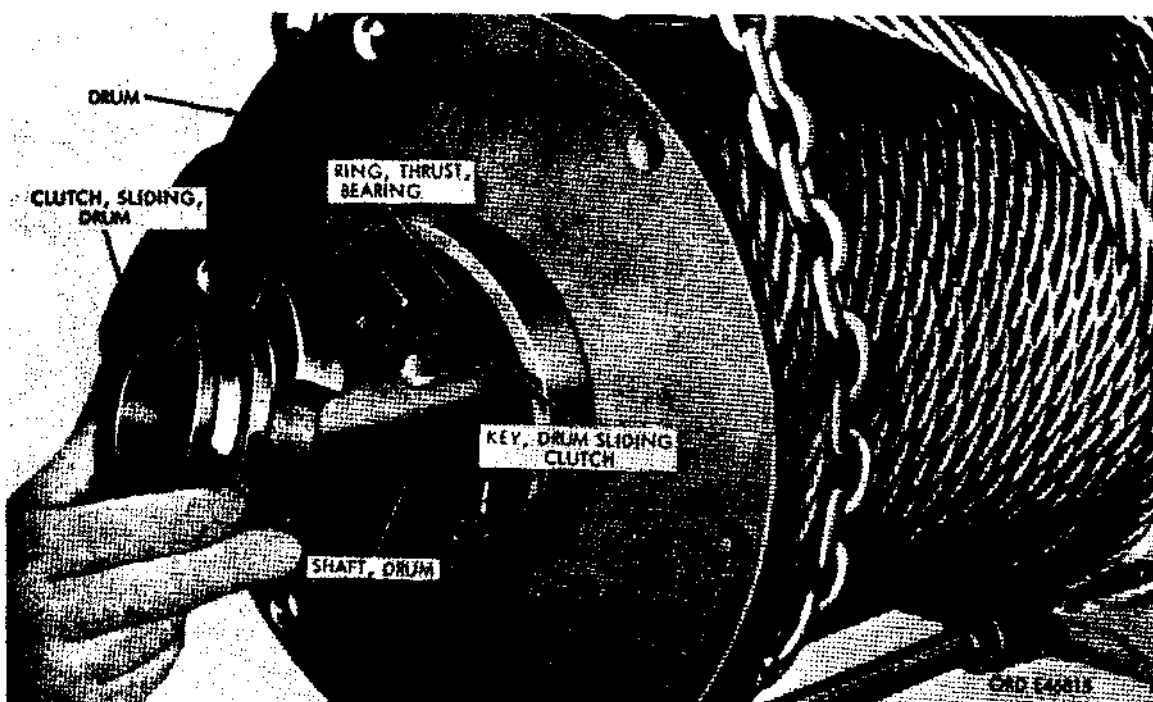


Figure 45. Removing drum sliding clutch and bearing thrust ring

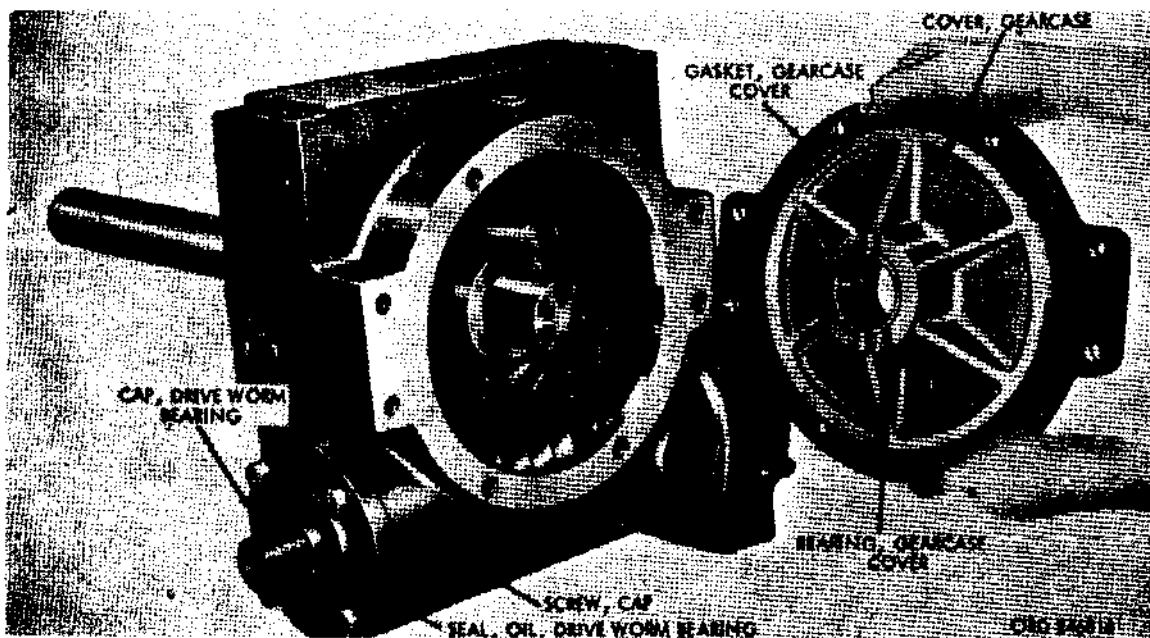


Figure 46. Removing gearcase cover

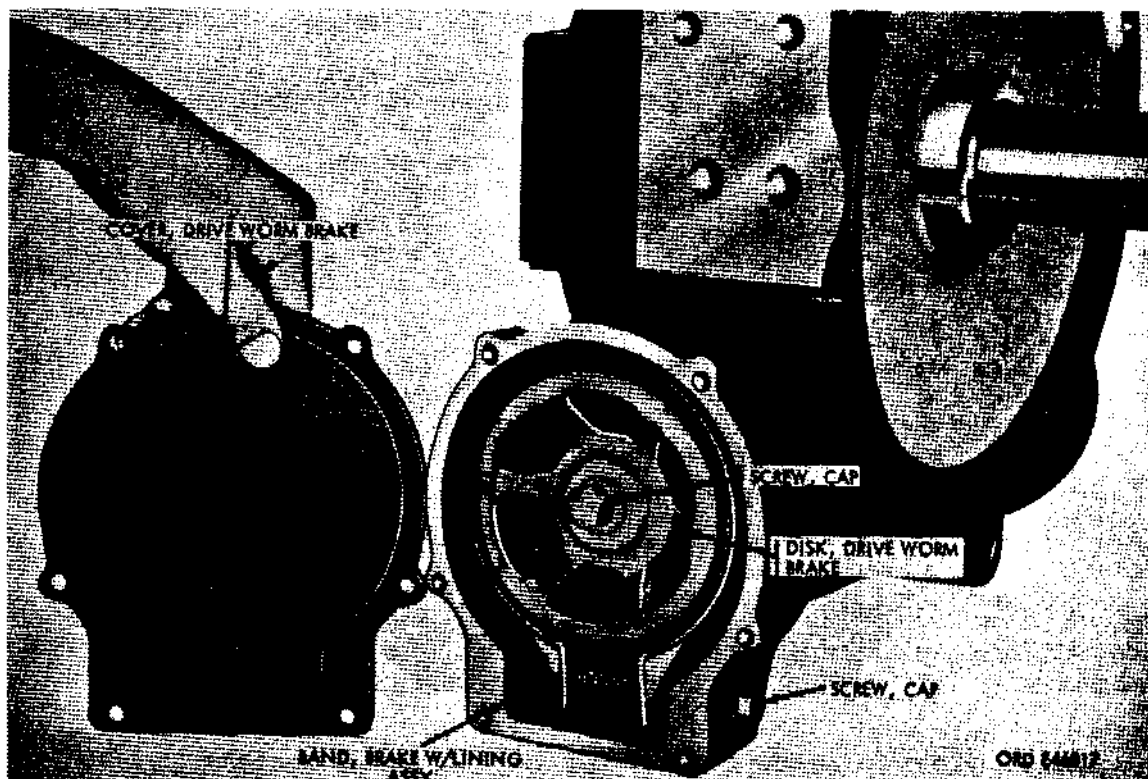


Figure 47. Removing drive worm brake cover

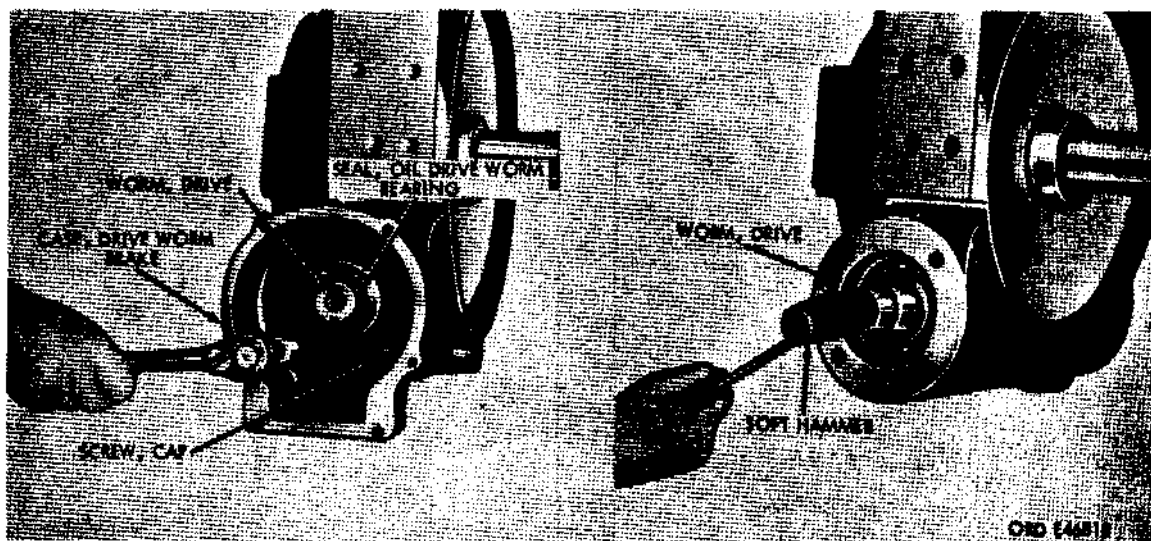


Figure 48. Removing drive worm brake case and freeing drive worm assembly

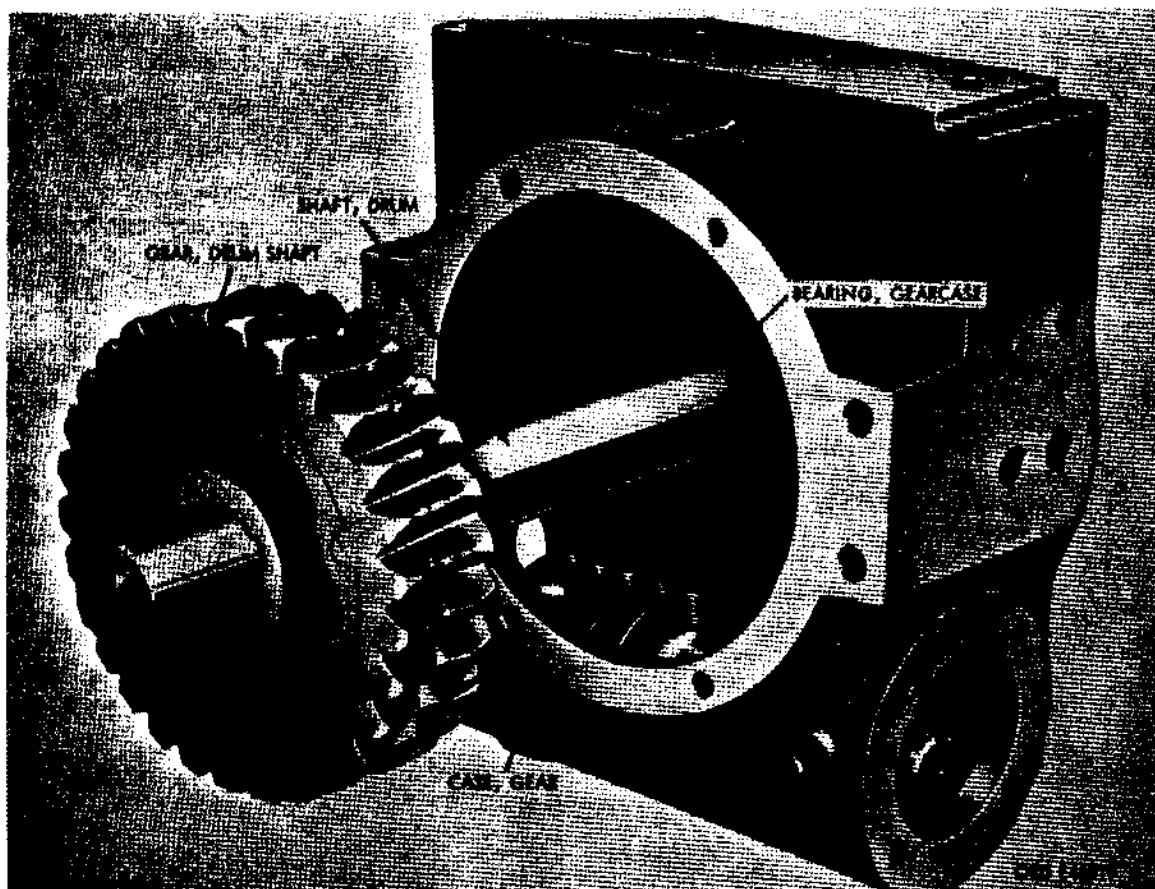


Figure 49. Removing drum shaft and gear assembly from case

- (d) Press drum shaft from drum shaft gear (fig. 50) and remove two drum shaft gear keys from shaft.

b. Cleaning, Inspection, and Repair.

(1) Cleaning.

- (a) Clean all metal parts in mineral spirits paint thinner or dry-cleaning solvent. Use a stiff brush to remove accumulation of dirt or hardened lubricant. Be sure all oil and lubricant passages are open and clean. Keep brake band and lining dry.
- (b) Blow ball bearings dry with compressed air.

Note. Do not spin bearings with the compressed air. Turn bearing slowly with fingers as air is directed at right angles to bearing assembly.

If the bearings are not thoroughly clean after this operation, place them in a pan of mineral spirits paint thinner or dry-cleaning solvent and allow them to remain there until all solid particles are loosened and lubricant dissolved.

(2) Inspection.

- (a) Inspect each ball bearing for rough or scored balls. Replace if balls are damaged. Apply engine oil to acceptable bearing assemblies and

- cover to protect against dust and dirt. Inspect bore of all bushing-type bearings and replace if scored or excessively worn as outlined in serviceability standards (par. 44).
- (b) Inspect gearcase end frame for cracks and damaged threads in tapped holes. Repair or replace defective parts.
 - (c) Inspect lining on drag brake and replace if worn.
 - (d) Inspect drum shaft for scoring and excessive wear. Inspect drum shaft gear teeth and drive worm. If any of the teeth are broken, chipped, or badly scored, and drive worm damaged, the worm or gear must be replaced.
 - (e) Inspect brake surface of drive worm brake disk. If surface is scored or rough, it must be replaced. Inspect brake band assembly. If lining is oil-soaked or worn, it must be replaced.
 - (f) Check sliding clutch, shifter yoke, and thrust rings for excessive wear and replace as required.
 - (g) Inspect drum flange at brake contact surface. If noticeably worn or chipped, replace drum. Be sure all oil passages are open.
 - (h) Inspect cable assembly for broken or frayed strands. Inspect clamp chain and hook for damage. Replace defective parts.
 - (i) Metal cased oil seals normally are long life parts and may be used if in good condition. Inspect seal contact material to make sure it is pliable and shows no evidence of burning. Also inspect the thin featheredge which contacts the rotating parts to make sure it is intact. Replace seals if defects are found.
- (3) Repair.
- (a) General. Remove nicks and burrs from machined gasket surfaces and

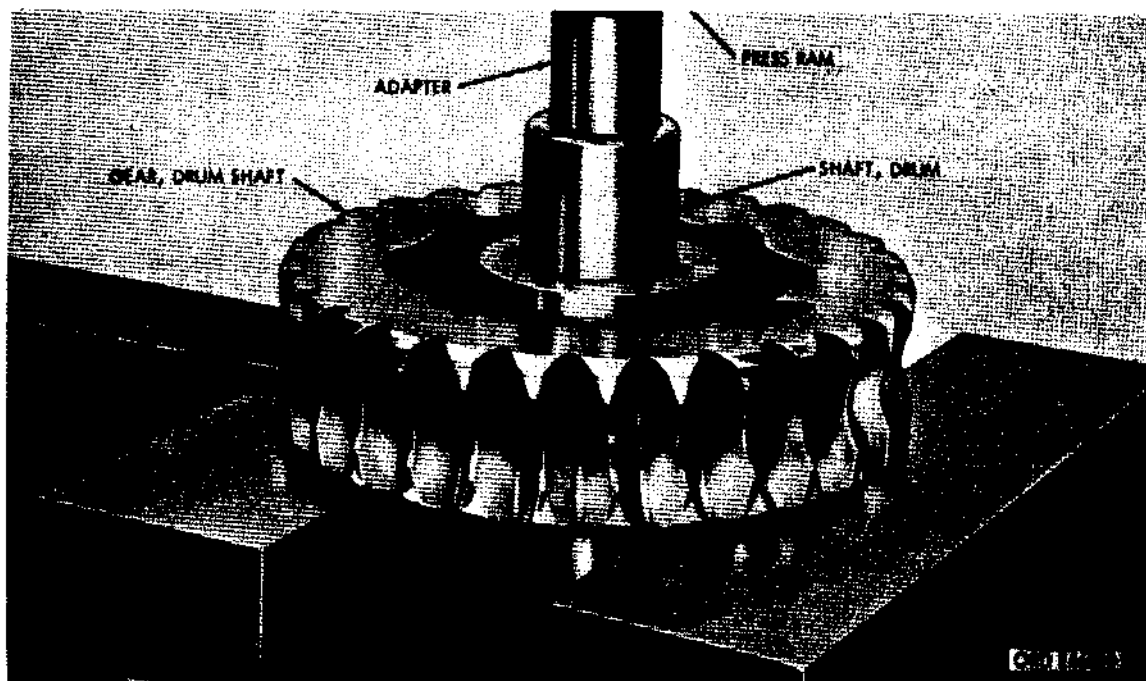


Figure 50. Pressing drum shaft from drum shaft gear

shafts. Pay particular attention to oil seal contact surfaces. Use a fine mill file to repair surfaces.

- (b) Drag brake and drive worm brake linings. Remove old linings and rivets. Use brass tubular rivets to install new linings. On the drive worm brake, install rivets at each end of band first, then alternately until all rivets are installed.

- (c) Drum shaft and gear. To install new drum shaft gear, support gear at hub and position drum shaft in gear. Be sure keys in shaft are properly seated and aligned with keyway in gear hub. Press shaft through gear until keys have entered gear hub.

c. Assembly.

- (1) Press new gearcase bearing (fig. 49) in gearcase. Assemble drum shaft and gear assembly in position in gear housing.
- (2) Install ball bearing on tapped hole end of drive worm. Slide drive worm into gear housing and mesh drive worm thread with drum shaft gear (fig. 49) and tap bearing into position in housing. If oil seal in drive worm brake case (fig. 48) was removed, press new seal into place.
- (3) Position new gasket and install drive worm brake housing and secure with four cap screws (fig. 46) and lockwashers.
- (4) Install rear drive worm bearing. If oil seal in drive worm bearing cap (fig. 46) was removed, press in new oil seal. Use a new drive worm cap gasket and secure cap with four cap screws and lockwashers.
- (5) Position square key in drive worm and press drive worm brake disk (fig. 47) onto worm. Position disk retaining washer and secure disk with cap screw and lockwasher.
- (6) Position brake band with lining assembly (fig. 47) over brake disk and install adjusting screw spring. Place plain washer on cap screw. Place O-ring gasket on cap screw and install screw through drive worm brake case, spring, and lugs on brake band assembly. Tighten cap screw sufficiently to hold brake band. Position drive worm brake cover with new gasket and secure with six cap screws with external-teeth lockwashers.
- (7) If gearcase cover bearing (fig. 46) was removed, press in new bearing. Position new gearcase cover gasket and cover. Install four machine screws and tighten securely. Assemble four gearcase cover bolts and lockwashers. Assemble end frame tie rod (fig. 40) with locknut to gearcase.
- (8) Support drum and cable assembly with a chain hoist. If drum bearings were removed, press in new bearings. Assemble drum and cable assembly on drum shaft.
- (9) Install bearing thrust ring and drum sliding clutch keys (fig. 45). Position drum sliding clutch (fig. 45) on drum shaft and add bearing thrust ring (fig. 45). Slide bearing with sleeve assembly on drum shaft with dowel pin groove in position for end frame assembly.
- (10) If shifter shaft oil seal and end frame oil seal (fig. 41) have been removed, press new seals in place. Install clutch shifter yoke shaft in end frame. At the same time, position clutch shifter yoke (fig. 43) in end frame, being sure shifter shaft engages yoke. A line hole in yoke with hole in shifter shaft and install straight yoke pin. Install square socket head pipe plug in end frame and also on drum side of end frame (fig. 43).
- (11) Install drum lock poppet latch assembly (fig. 44) and tighten securely.
- (12) Install drag brake with lining assembly (fig. 42), spring, and drum brake adjusting screw (fig. 40) in end frame.
- (13) Position end frame assembly on drum and drum shaft (fig. 41). Be sure clutch shifter yoke in end frame engages drum sliding clutch on drum shaft and end frame tie rod (fig. 41) is aligned with frame. Also align sleeve with bearing assembly to dowel pin in end frame.

- (14) Install end frame locknut (fig. 40) temporarily to hold assemblies together.
- (15) Position rear tension channel at rear of winch assembly and install two cap screws (fig. 37) and lockwashers at each end and tighten securely.
- (16) Position top tension channel (fig. 40) on top of winch assembly and install two cap screws and lockwashers at each end, and tighten securely.
- (17) Assemble tension and side rollers (fig. 39).
 - (a) Start tension roller shaft through left roller bracket and add tension roller bearing thrust washer (F), and felt washer (G) on tension roller shaft (L).
 - (b) Position tension roller bearing (H) in bore of roller and slide shaft through tension roller.
 - (c) Add tension roller bearing, felt washer, and thrust washer on opposite end of shaft.
 - (d) Insert roller bracket tie rod in bracket and position left roller bracket on

shaft and tie rod. Insert setscrew (E) in each roller bracket and tighten to secure shaft in brackets. Add bracket tie-rod locknuts (M) on each end of tie rod. Install 90-degree lubricating fittings (A) in each end of tension roller shaft (L).

- (e) Position side rollers with bearings in roller bracket and side roller thrust washer (C) at each end of roller and install side roller pins (Q).

Note. Be sure to align pin hole in pin with hole in roller brackets.

Install straight pins (P), securing side roller pins.

- (18) Assemble roller assembly to winch. Position tension roller assembly (fig. 38) on front of winch and install four cap screws and lockwashers, and two cap screws and lockwashers in each roller bracket and tighten securely.

Note. Tension channels and tie rods may have to be loosened to align bolt holes with roller brackets.

Section IV. TESTS AND ADJUSTMENTS

41. Drag Brake

a. Test. To check drag brake adjustment, disengage winch drum clutch and pull on winch cable. Stop pulling cable and observe whether winch drum stops turning as soon as pulling is stopped. If winch drum continues to turn without pull on the cable, adjust the drag brake (b below).

b. Adjustment. To increase braking action of drag brake, turn adjusting screw (fig. 51) clockwise. Test adjustment as in a above.

42. Automatic Brake

a. Test. To check automatic brake adjustment, park truck at top of a steep grade with truck facing downhill. Attach winch cable to another truck at bottom of hill and, using front winch only, start pulling other truck

uphill. When truck being pulled is part way up incline, shift front winch control lever into neutral. If truck being pulled rolls backward, adjust automatic brake (b below).

b. Adjustment. To increase braking action of automatic brake, turn adjusting bolt (fig. 43) clockwise one-half turn, and test brake adjustment (a above).

Note. Do not tighten more than one-half turn before testing.

Caution: If, after adjustment and testing for several minutes, the hand cannot be held on the brake cover because of heat, loosen the adjusting bolt one-half turn and again test the adjustment. When correctly adjusted, the brake will become warm but should not be too hot to allow the hand to be held on the brake cover.

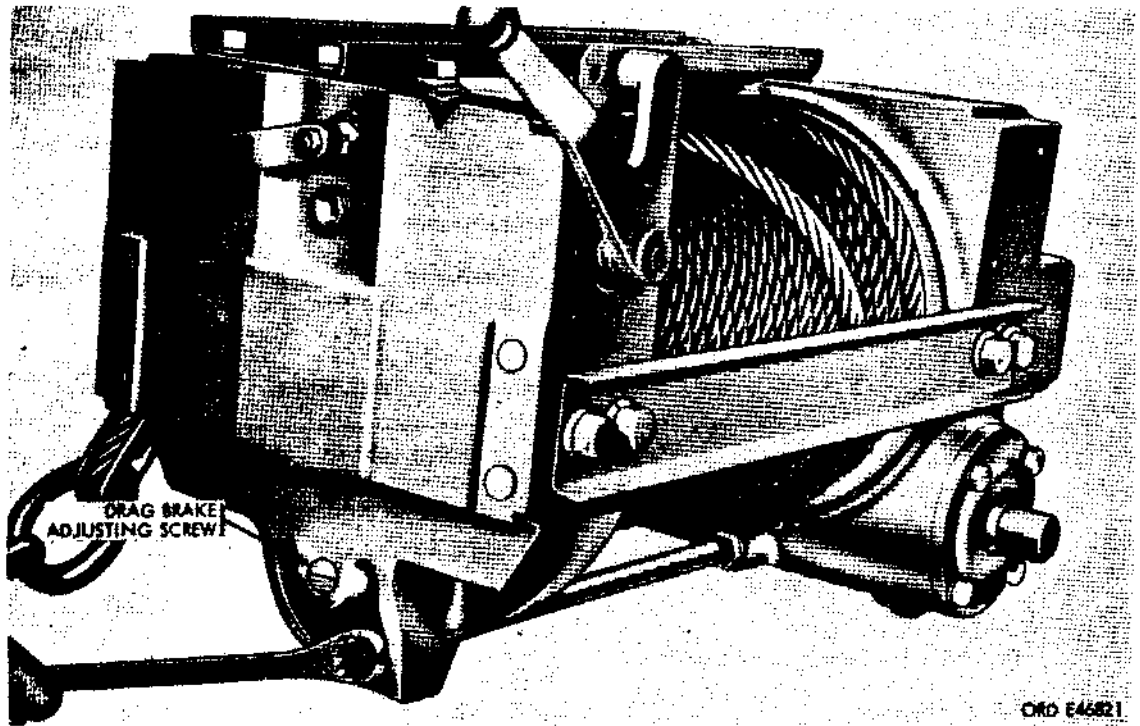


Figure 51. Drag brake adjusting screw

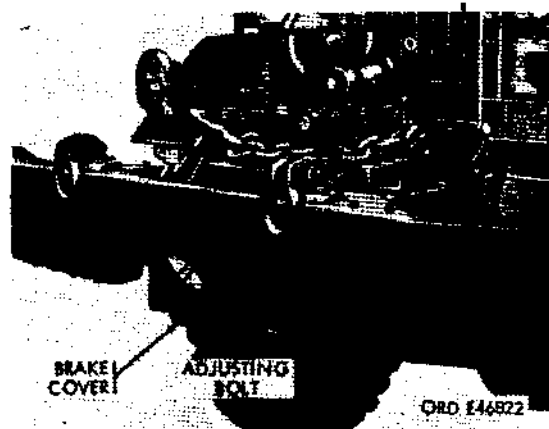


Figure 52. Automatic brake adjustment

Section V. SERVICEABILITY STANDARDS

43. General:

The serviceability standards included herein give the minimum, maximum, and key clearances of new or repaired parts. They also give wear limits which indicate that point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear limits" column

or damaged from corrosion will be approved for service. Dimensions given are in inches unless otherwise indicated. In the "Size and fit of new parts" column, the letter "L" indicates a loose fit (clearance) and the letter "T" indicates a tight fit (interference).

44. Front Winch

Refer to Table IV for serviceability standards pertinent to the front winch.

Table IV. Serviceability Standards - Front Winch

Point of measurement	Size and fit of new parts	Wear limits
End frame bearing	2.127 to 2.130	0.015
Drum shaft	2.123 to 2.125	0.002
End frame bearing to drum shaft	0.002 to 0.007	
Drum bearing	2.127 to 2.130	0.015
Drum bearing to drum shaft	0.002 to 0.007	
Gearcase bearing	2.127 to 2.130	0.008
Gearcase bearing to drum shaft	0.002 to 0.007	
Side roller bearing	1.001 to 1.004	0.015
Side roller pin	0.997 to 1.000	0.030
Side roller bearing to side roller pin	0.001 to 0.007	

CHAPTER 7 POWER PLANT—GASOLINE, DIESEL AND MULTIFUEL MODELS

Section I. DESCRIPTION

45. General.

The power plant consists of three main components: the engine, the transmission, and the radiator. Power developed by the engine is transmitted through the clutch to the transmission. Removal of the three main components as a single unit facilitates replacement of either of these components and their separation for repair.

46. Gasoline Models (Figure 53).

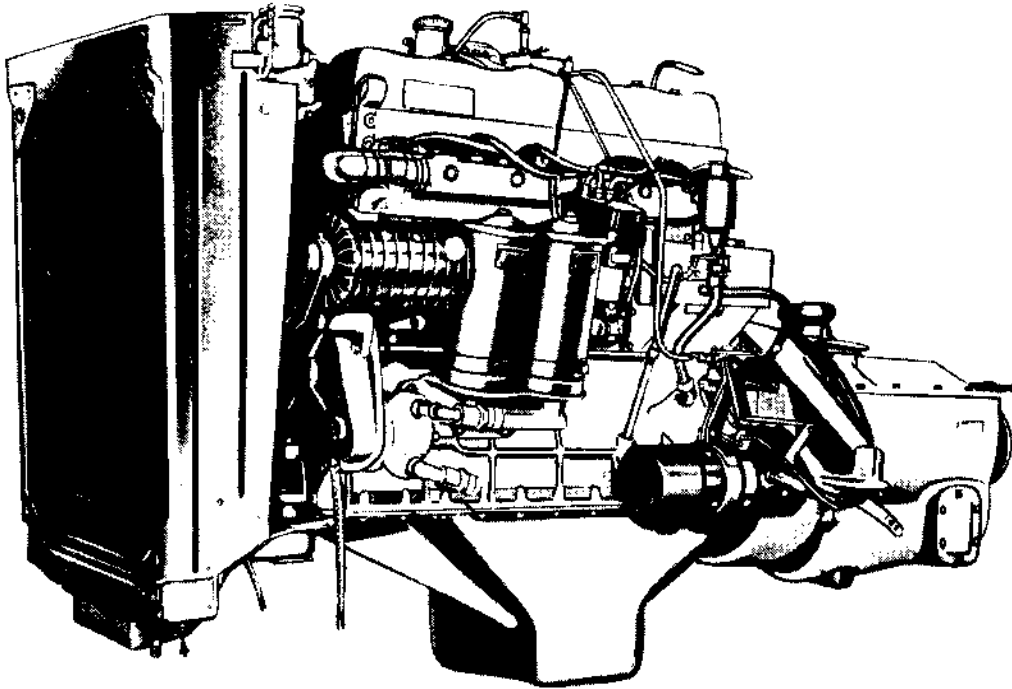
The gasoline models utilize a Continental engine, model R6602, which is a six-cylinder, four-cycle, valve-in-head, water-cooled engine. The transmission is a Spicer synchromesh, model 6352. The clutch is a Rockford model 15TM, single dry plate.

47. Diesel Models (Figure 54).

The Diesel models utilize a Mack engine, model ENDT-673, which is a six-cylinder, four-cycle, valve-in-head, turbocharged, compressor-ignition engine. The transmission is a Spicer synchromesh, model 6453. The clutch is a Rockford model 15 TM single dry plate.

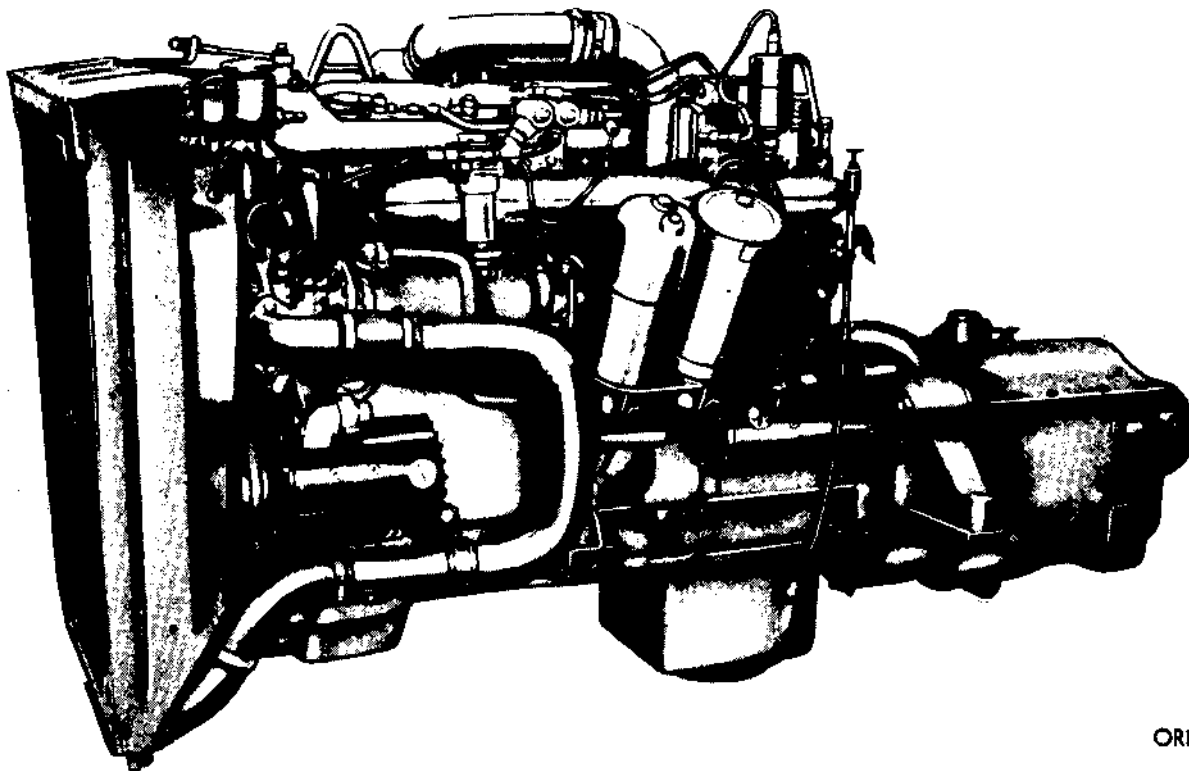
47.1. Multifuel Models.

The multifuel (A2) models utilize a Continental engine, model LDS 465-1 which is a six-cylinder, in line, liquid-cooled, compression ignition engine designed to operate on a variety of fuels. Refer to TM 9-2815-210-35.



ORD E46823

Figure 53. Left front view of power plant (gasoline models).



ORD E46824

Figure 54. Left side view of power plant (diesel models).

Section II. REMOVAL AND INSTALLATION

48. Gasoline Models.

a. Removal.

(1) Preliminary procedures.

(a) Position vehicle. Place vehicle under suitable engine lifting equipment. Arrange to have tools and supports available for use when needed. Block wheels to prevent vehicle from moving.

(b) Open engine compartment (figure 54.1). Pull upward and outward on hood holddown catches (A) to release front end of hood panel (B). Raise panel as far as it will go, and engage left windshield holddown catch (E) with eye of top panel hook (D) to lock panel in raised position. Release latches (F) at front and back of left and right hood side panels (G), and slide side panels forward to disengage hinges (H) and remove.

(c) Drain compressed air system. Refer to TM 9-2320-211-20.

(d) Disconnect battery ground cable (figure 54.25). Remove capscrew and tooth-type lockwasher from outside of frame right side rail under right rear corner of truck cab, and remove battery ground cable. Thoroughly tape end of cable to eliminate hazard of accidental grounding. Replace capscrew and tooth-type lockwasher to prevent loss.

(2) Disconnect procedures at front of vehicle.

(a) Remove front winch level wind (vehicles equipped with front winch only). Refer to TM 9-2320-211-20.

(b) Remove brush guard (figure 54.24). Loosen nut and bolt at left and right frame brackets and at left and right brush guard braces. Pull brush guard forward and lift from truck.

(c) Remove radiator upper shield. Refer to paragraph 31.

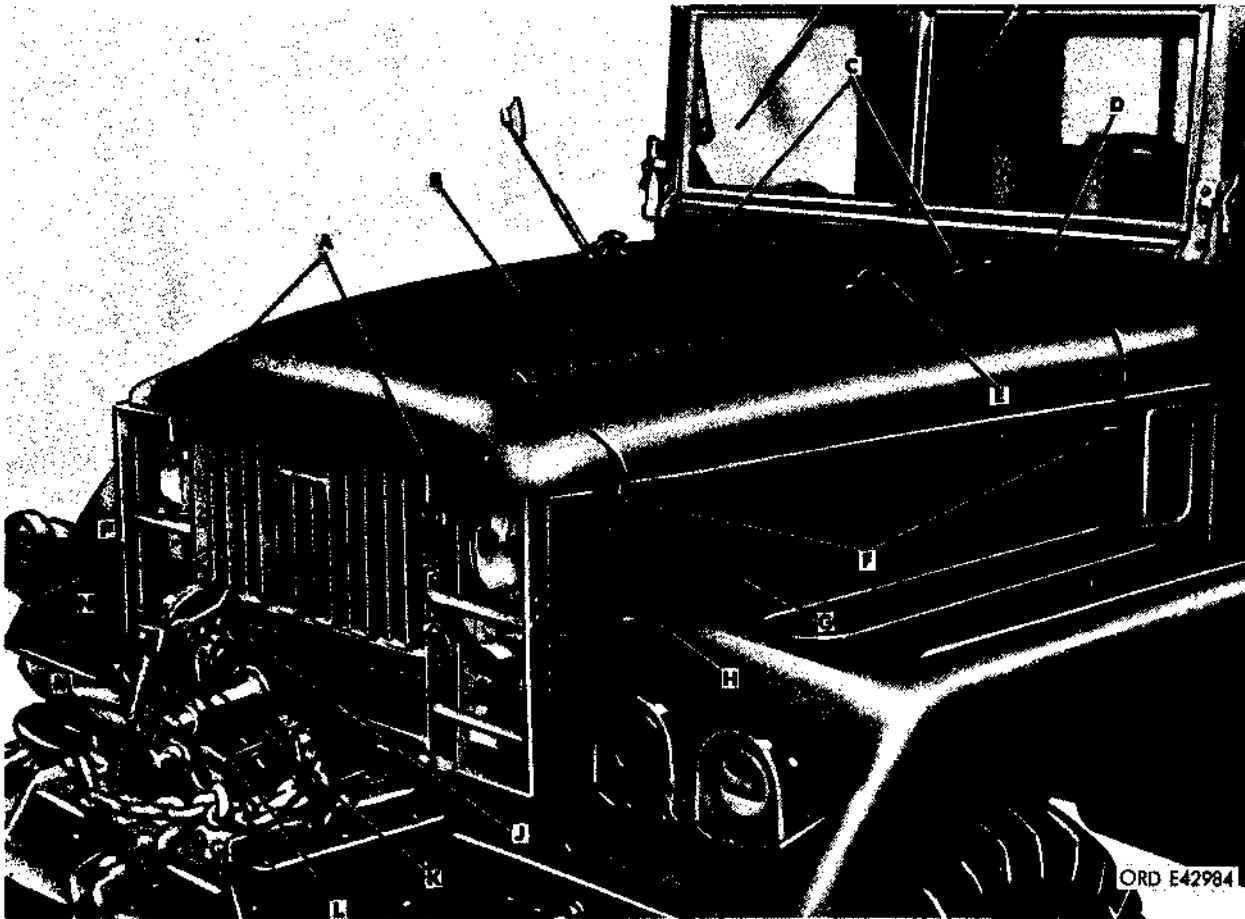


Figure 54.1. View of left front section of truck.

KEY ITEM

- A Top panel holddown catch
- B Hood top panel
- C Hinge
- D Top panel hook
- E Windshield holddown catch
- F Latch
- G Side panel

(3) Disconnect procedures at left side of engine.

(a) Disconnect tachometer flexible shaft. Unscrew connector securing tachometer flexible shaft (Q, figure 54.2) to tachometer sending unit (P, figure 54.2) at front of distributor drive housing, and pull shaft from sending unit.

(b) Disconnect distributor primary wire. Unscrew connector (E, figure 54.2) and remove distributor primary wire (figure 54.2) from rear of distributor, and remove primary wire support clip from mounting bracket attached to crankcase ventilating line connector (G, figure 54.2).

KEY ITEM

- H Hinge
- J Capscrew
- K Swivel sheave frame
- L Trolley track
- M Winch cable
- N Cable guard
- P Swivel sheave

(c) Disconnect generator-to-regulator cable (figure 54.3). Unscrew generator-to-regulator cable connector at receptacle on top of generator and disconnect cable.

(d) Disconnect steering gear hydraulic lines. Unscrew self-sealing couplings (W, figure 54.2) from inlet and outlet at steering gear hydraulic pump (V, figure 54.2) and disconnect steering gear hydraulic lines.

(e) Disconnect engine rear ground strap. Remove nut and tooth-type lockwasher from stud at front cab cowl, and remove engine rear ground strap (H, figure 53 and figure 54.2).

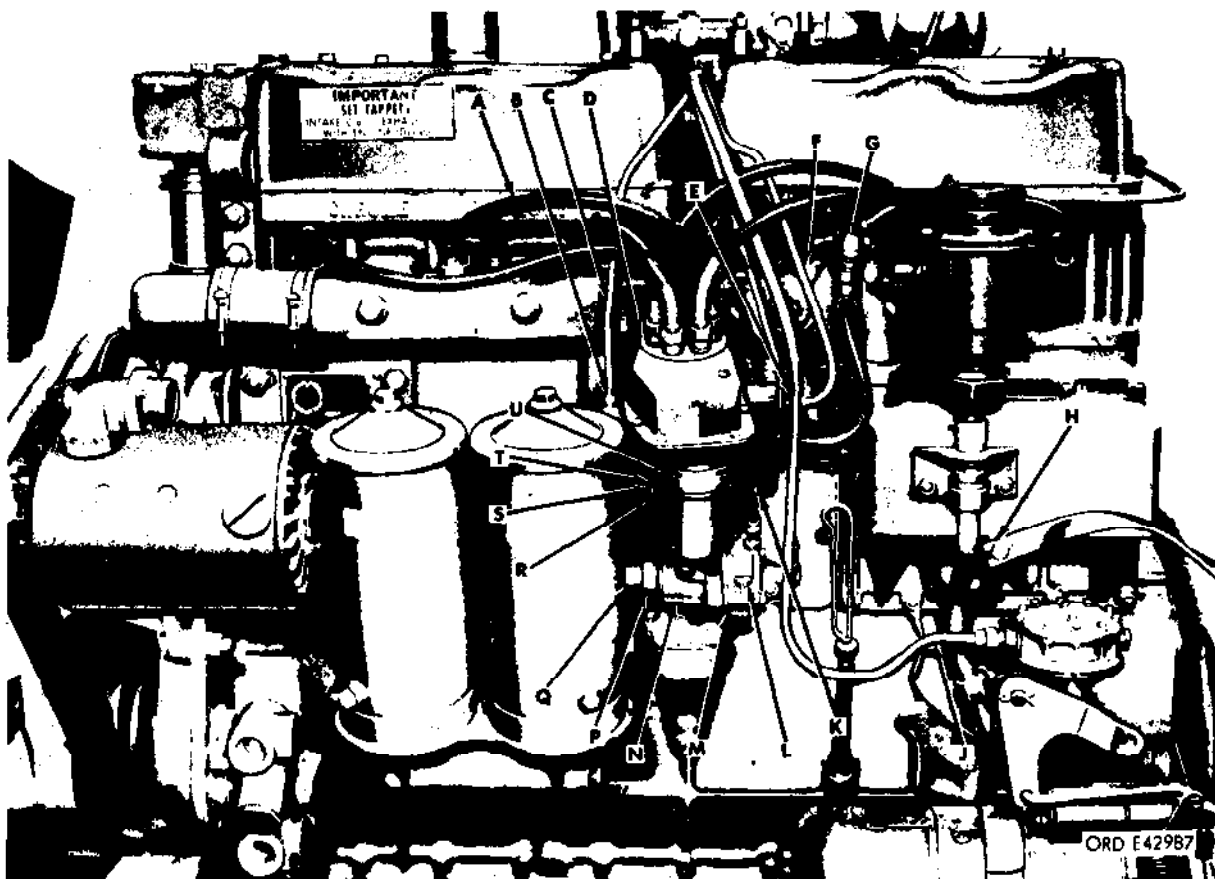


Figure 54.2. View of lower left side of engine (gasoline models).

KEY ITEM

- A Spark plug cable
- B Nut
- C Distributor vent line
- D Distributor and coil assembly
- E Connector
- F Distributor primary wire
- G Oil cooler water inlet seal
- H Engine rear ground strap
- J Carburetor-to-governor-valve line
- K Governor-valve-to-governor line
- L Adjusting hole plug

KEY ITEM

- M Governor valve assembly
- N Distributor drive housing
- P Tachometer sending unit
- Q Tachometer flexible shaft
- R Mounting clamp
- S Lockwasher
- T Capscrew
- U Distributor nameplate
- V Steering gear hydraulic pump
- W Self-sealing couplings

(f) Disconnect starter linkage. Remove cotter pin and yoke pin securing starter control rod (C, figure 54.5) to bellcrank (R, figure 54.5). Pull control rod upward into cab and secure in this position.

(g) Disconnect crankcase ventilating shutoff valve control (vehicles equipped with manually controlled crankcase ventilating system (T M 9-2320-211-20)). Loosen screw securing shutoff valve control wire (figure 54.2) to shutoff valve lever and remove

wire from lever. Remove two retaining nuts and washers from studs at top rear of water inlet header and remove shutoff valves control mounting bracket (figure 54.2).

(h) Disconnect fuel pump inlet line. Unscrew nut (J, figure 54.3) at junction of fuel-pump-to-fuel-filter flexible line (K, figure 54.3) and fuel-pump-to-fuel-filter rigid line (H, figure 54.3), and disconnect lines.

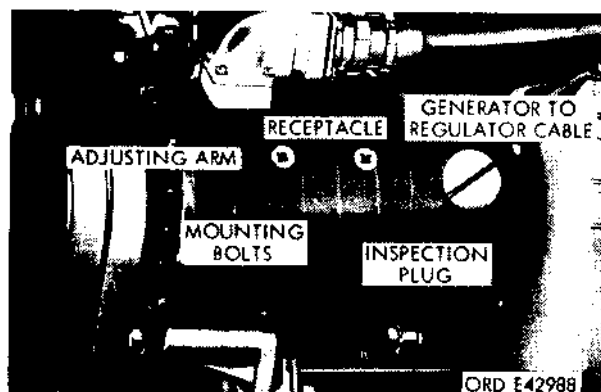


Figure 54.3. View of generator installed on front left side of engine.

(4) Disconnect procedures at right side of engine.

(a) Disconnect air-compressor-to-governor line. Unscrew nut on left side of air compressor governor (A, figure 54.4) and remove air-compressor-to-governor line (T, figure 54.4) from governor.

(b) Disconnect engine temperature gage sending unit. Disconnect bayonet-type connector at temperature gage sending unit (E, figure 54.4) on top of rear water outlet header.

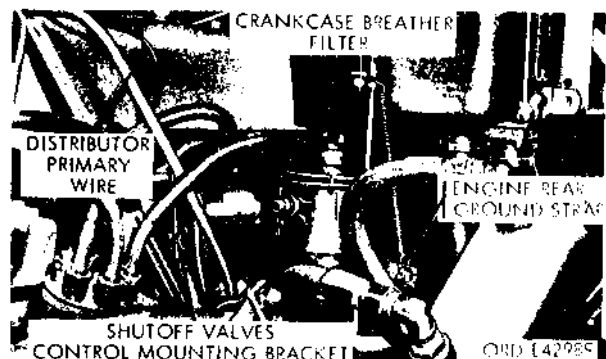


Figure 54.4. View of upper left side of engine.

(c) Disconnect flywheel-housing-to-air-cleaner vent line (vehicles equipped with flywheel housing ventilating system only). Loosen hose clamp securing flywheel housing vent line at rear lower right side of engine (figure 54.5) or 54.6) to air cleaner outlet hose, and remove hose from line.

NOTE

On some vehicles, the vent line is connected to the top right front face of the flywheel housing (figure 54.6). On other vehicles, the vent line is connected to the top of the transmission shifter housing forward of the housing cover (figure 54.5). Current production models are not equipped with a flywheel-housing-to-air-cleaner vent line.

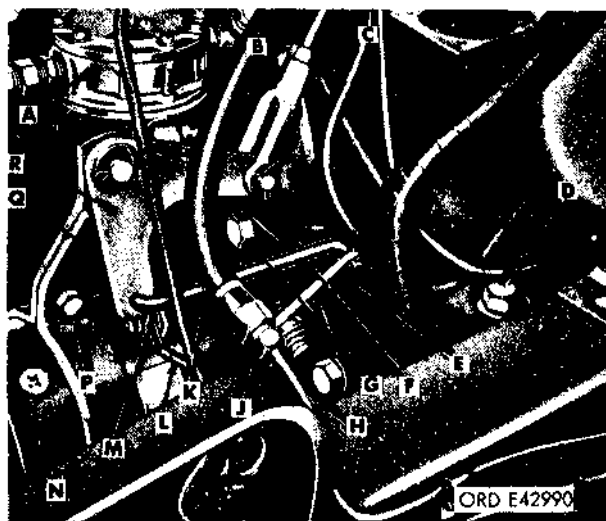


Figure 54.5. Starter and fuel pump installed on rear left side of engine.

KEY ITEM

A	Fuel pump
B	Nut
C	Control rod
D	Capscrew
E	Lever
F	Control link
G	Capscrew
H	Fuel-pump-to-fuel-filter rigid line
J	Nut
K	Fuel-pump-to-fuel-filter flexible line
L	Starter switch primary wire
M	Manual switch
N	Starter
P	Capscrew
Q	Bracket
R	Bellcrank

(d) Disconnect air-cleaner-to-carburetor-inlet hose. Loosen hose clamp (E, figure 54.8) securing air-cleaner-to-carburetor-inlet hose (C, figure 54.8) to carburetor air inlet sleeve, and remove hose from sleeve.

(e) Disconnect throttle-cross-shaft-to-carburetor rod. Refer to TM 9-2320-211-20.

(f) Disconnect choke control wire and conduit. Refer to TM 9-2320-211-20.

(g) Disconnect primer pump injection line (vehicles equipped with fuel primer pump only). Refer to TM 9-2320-211-20.

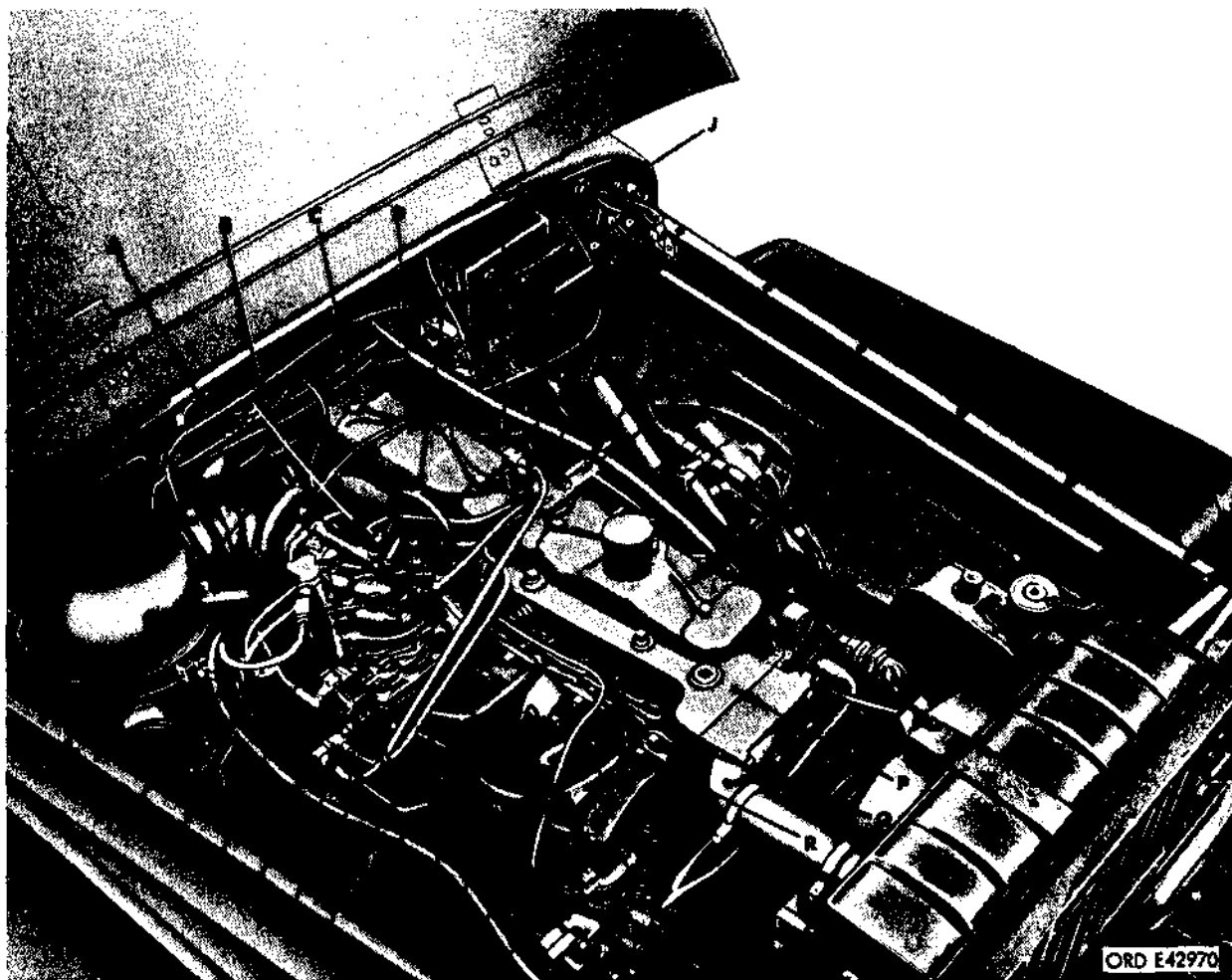


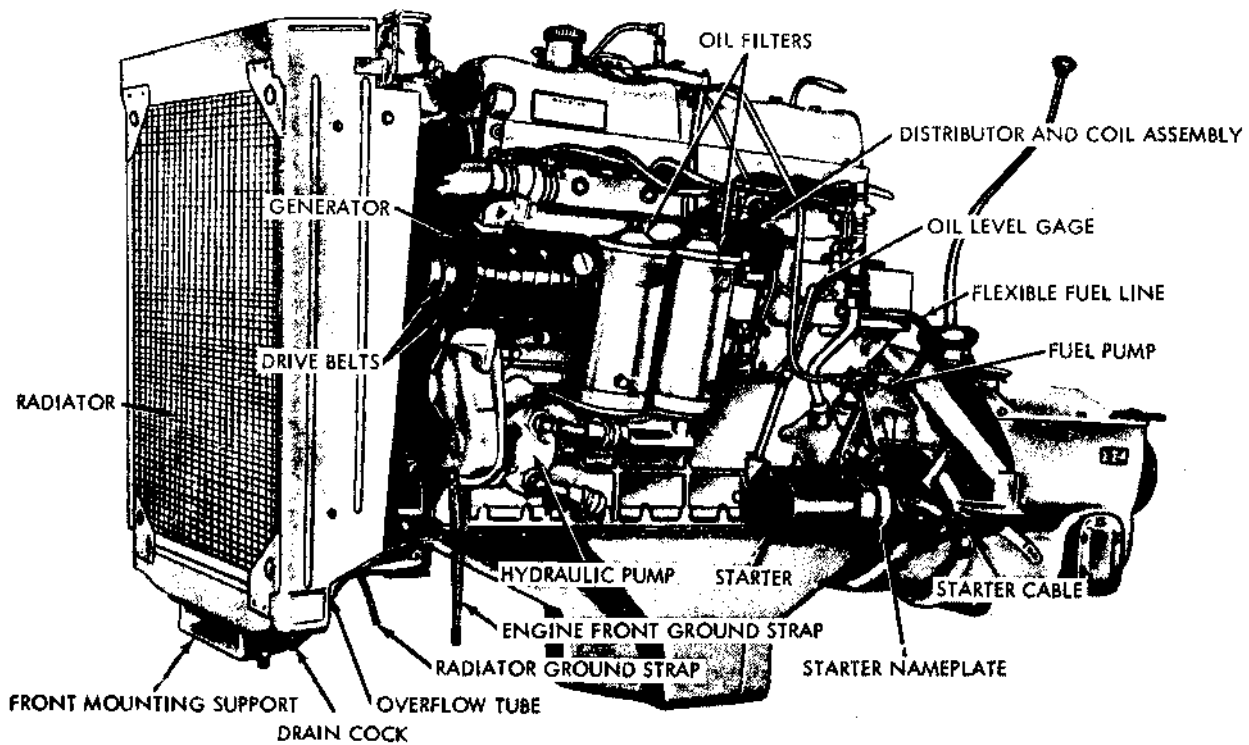
Figure 54.6. Top right view of engine installed in vehicle

KEY ITEM

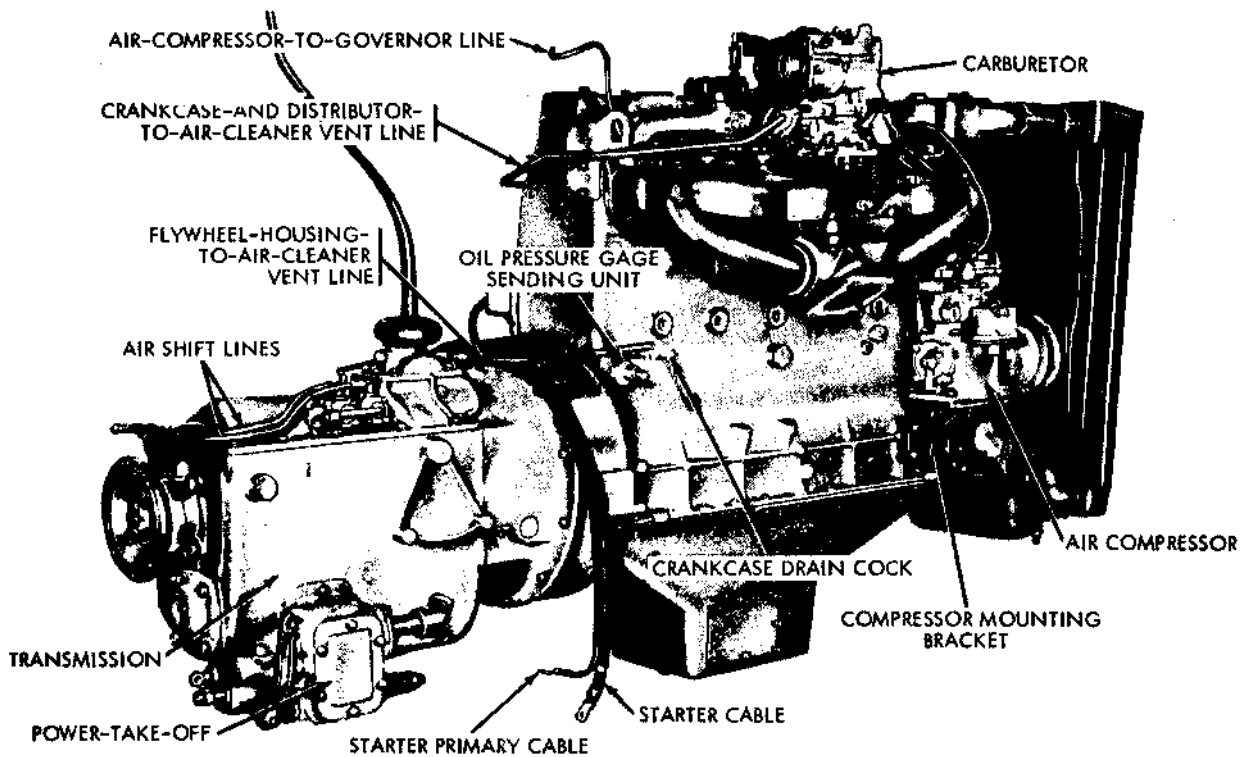
A	Air governor
B	Choke control
C	Capscrew
D	Rear rocker arm cover
E	Temperature gage sending unit
F	Crankcase ventilating metering valve
G	Crankcase ventilating line connector
H	Vacuum line
J	Circuit breaker
K	Mounting bracket
L	Closed clip
M	Front rocker arm cover
N	Lifting eye
P	Water outlet header assembly
Q	Manifold clamp
R	Hex-nut
S	Hex-nut

KEY ITEM

T	Air-compressor-to-governor line
U	Exhaust manifold
V	Intake manifold
W	Heat shield
X	Distributor vent line
Y	Nipple
Z	Exhaust pipe mounting flange
AA	Coupling
BB	Tee
CC	Elbow
DD	Carburetor-to-governor-valve line
EE	Governor-valve-control-valve-to-governor line
FF	Carburetor-to-governor-valve line
GG	Lifting eye
HH	Air cleaner



LEFT FRONT VIEW



RIGHT REAR VIEW

ORD E42983

Figure 54.7. Power plant - removed from vehicle.

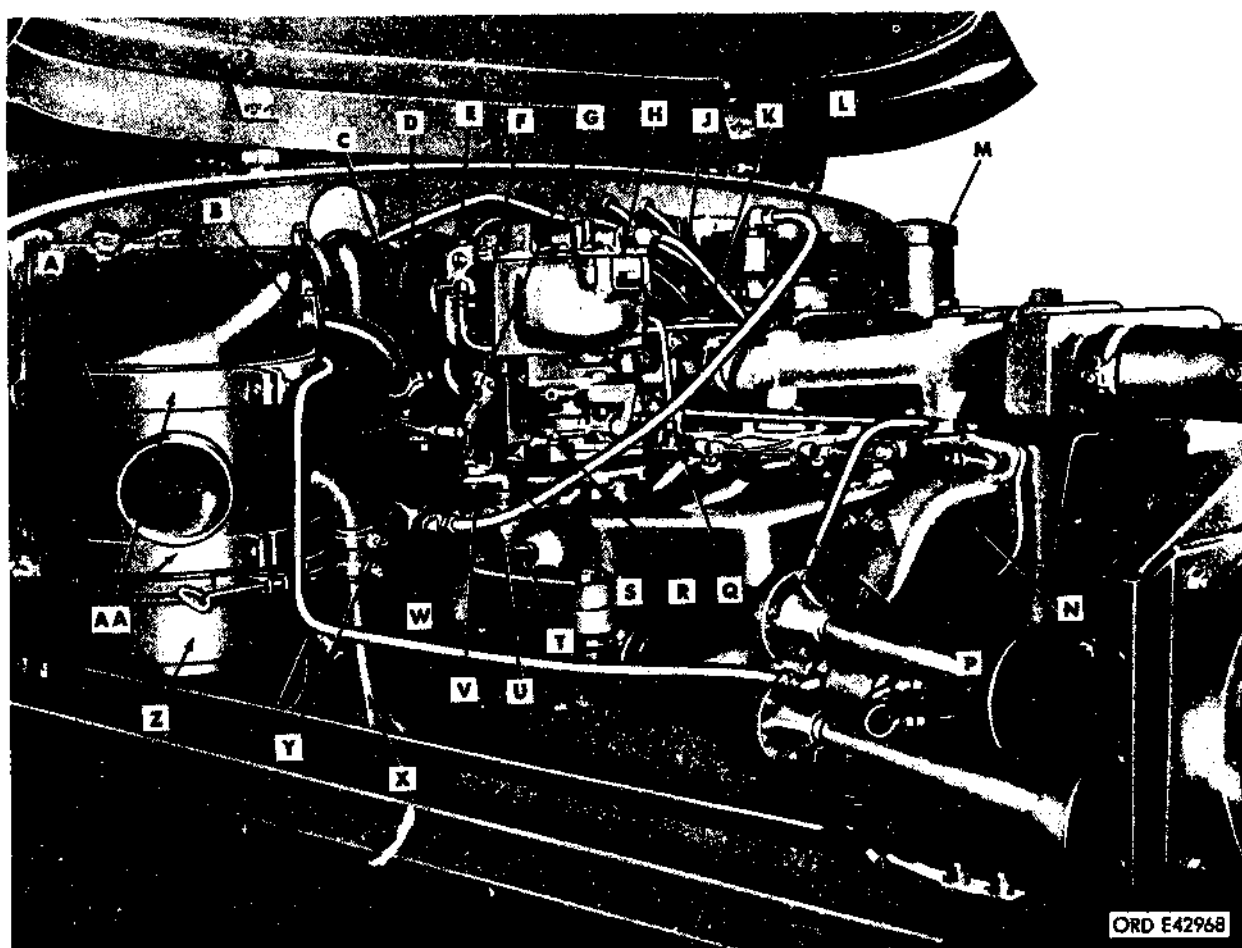


Figure 54.8. Clyburetor and manifolds installed on right side of engine.

KEY ITEM

A	Air cleaner body
B	Air cleaner outlet hose
C	Air-cleaner-to-carburetor-inlet hose
D	Hose clamp
E	Hose clamp
F	Carburetor-to-governor-valve line
G	Throttle valve plate lever
H	Carburetor nameplate
J	Fuel-pump-to-carburetor line
K	Governor-valve-to-governor line
L	Vacuum line
M	Oil filler cap
N	Exhaust manifold

KEY ITEM

P	Intake manifold
Q	Cylinder head priming tee
R	Safety nut
S	Bracket
T	Pipe plug
U	Crankcase ventilating shutoff valve
V	Shutoff valve lever
W	Shutoff valve control wire
X	Air-cleaner-to-air-compressor-intake line
Y	Distributor vent line
Z	Oil cup
AA	Mounting bands

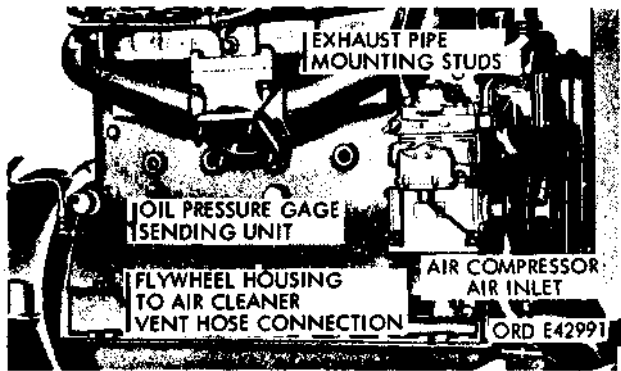


Figure 54.9. Right side of engine

(h) Disconnect crankcase ventilating-shutoff valve control (vehicles equipped with manually controlled crankcase ventilating system (paragraph 48a3(g) only). Loosen screw on top of shutoff valve lever (V, figure 54.8) and remove shutoff valve control wire (W, figure 54.8). Loosen nut and bolt securing clip to control supporting bracket (S, figure 54.8) and remove control.

(i) Disconnect crankcase-and-distributor-to-air-cleaner vent line (Y, figure 54.8 and figure 54.7). Loosen hose clamp at junction of air cleaner outlet hose and crankcase-and-distributor vent line, and remove hose from line.

(j) Disconnect air-compressor-to-air-reservoir line (figure 54.10). Unscrew flare nut at top rear of air compressor cylinder head and remove air-compressor-to-air-reservoir line.

(k) Disconnect air-cleaner-to-air-compressor-intake line (vehicles equipped with air-cleaner-to-air-compressor-intake line only) (X, figure 54.8). Loosen hose clamp at bottom of air compressor air strainer and remove air-cleaner-to-air-compressor-intake line from strainer intake sleeve.

(l) Disconnect engine exhaust pipe. Loosen four nuts on exhaust pipe mounting studs and turn mounting flange (Z, figure 54.6) so that large holes are aligned with washers under mounting nuts. Slide flange over mounting nuts and washers, and remove exhaust pipe from exhaust manifold. Remove and discard exhaust-pipe-to-exhaust-manifold sealing ring.

(m) Disconnect engine oil pressure gage sending unit. Rotate bayonet-type connector, at oil pressure gage sending unit (figure 54.7), on rear right side of crankcase, counterclockwise and remove oil pressure gage cable from sending unit.

(5) Disconnect procedures under vehicle.

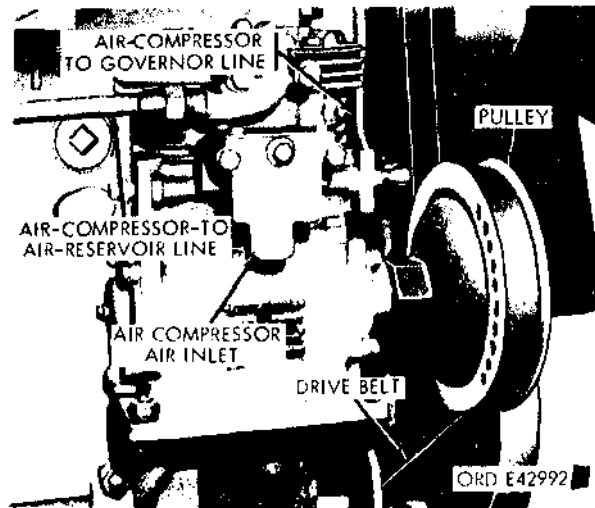


Figure 54.10. Air compressor.

(a) Remove power takeoff. Coordinate with Ordnance Maintenance.

(b) Disconnect transmission-to-transfer propeller shaft (figure 54.11). Remove eight safety nuts and bolts securing universal joint journal adapter flange to companion flange at rear of transmission, and disconnect transmission-to-transfer propeller shaft.

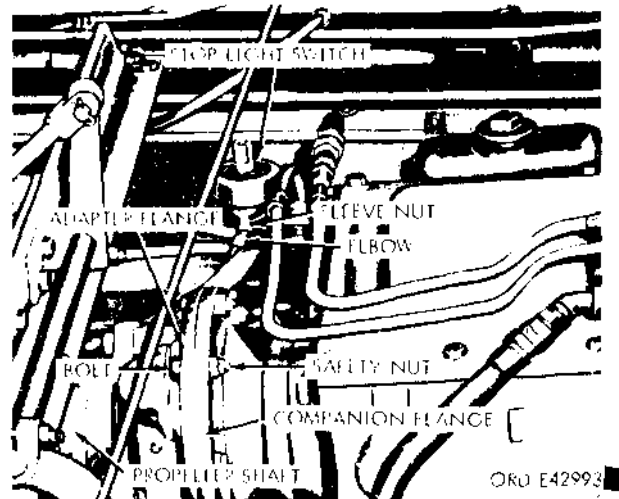


Figure 54.11. View of right rear section of transmission and transmission-to-transfer propeller shaft.

WARNING

Before disconnecting propeller shaft, raise the wheels on one side of both rear axles to relieve torsional strains.

(c) Disconnect clutch linkage (figures 54.12 and 54.13). Pull outward on clutch-control-rod-adjusting-yoke pin at lower end of clutch control rod and remove adjusting yoke from clutch release lever.

(d) Disconnect transmission-to-transfer air shift lines (figure 54.15). Unscrew connectors at junction of rigid and flexible air shift lines and disconnect transmission-to-transfer air shift lines.

(e) Disconnect brake pedal return spring (figure 54.12). Disconnect brake pedal return spring from bracket on left rear side of engine flywheel housing.

(f) Disconnect engine starter cable. Remove nut from terminal on top of starter magnetic switch (Q, figure 54.16), located on inside of frame right side rail, and remove starter cable (figure 54.7), from terminal.

NOTE

On some vehicles, the starter cable and starter primary cable extend from the starter to the magnetic switch over the top of the clutch housing (figure 54.7). On other vehicles, the cables extend from the starter to the magnetic switch around the bottom of the clutch housing (figure 54.14).

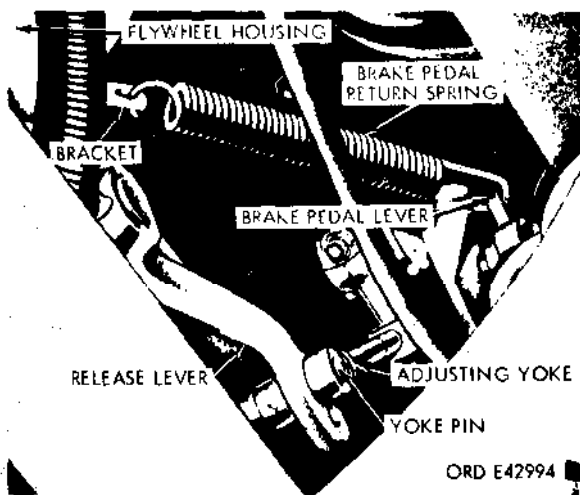


Figure 54.12. View of clutch linkage from underside of vehicle.

(g) Disconnect engine starter primary cable. Remove nut from upper terminal on left side of starter magnetic switch (Q, figure 54.16) and remove primary cable (figure 54.7) from terminal.

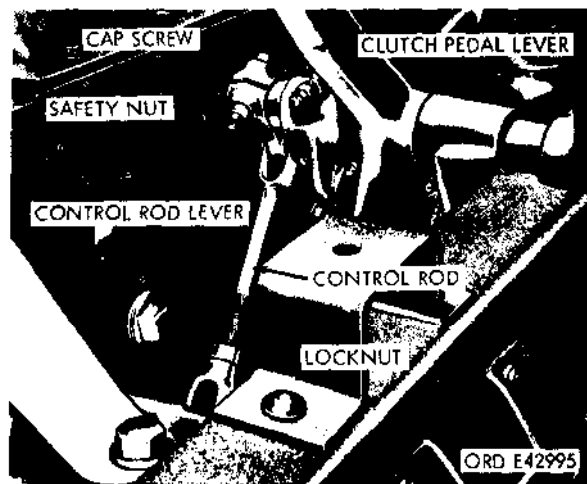


Figure 54.13. Left front view of clutch pedal lever and control rod.

(h) Remove engine rear mounting plat. cap screws. Remove two self-locking nuts from cap screws (D, figure 54.5) securing mounting bosses on left and right sides of flywheel housing to engine rear mounts (figure 54.14).

(i) Disconnect clutch-control-valve-to-rotor-chamber air line (M62 only). Unscrew nut securing air line (figure 54.17) to rear of rotor chamber, and remove air line connecting rotor chamber to clutch control valve at rear of vehicle.

(j) Remove engine front mounting support cap screws (figure 54.18). Remove five cap screws and lockwashers from engine front mounting.

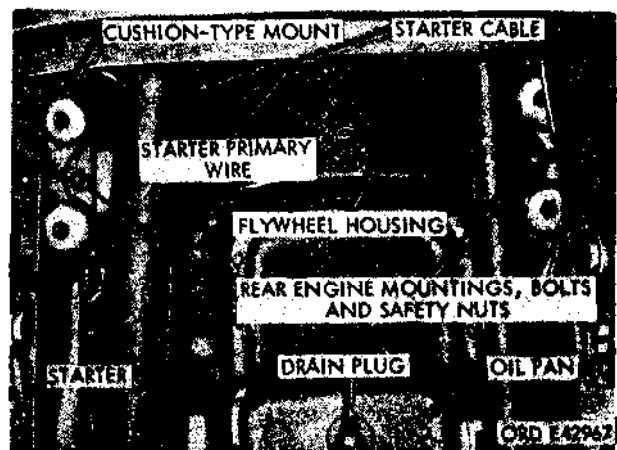


Figure 54.14. View of rear section of engine from underside of vehicle.

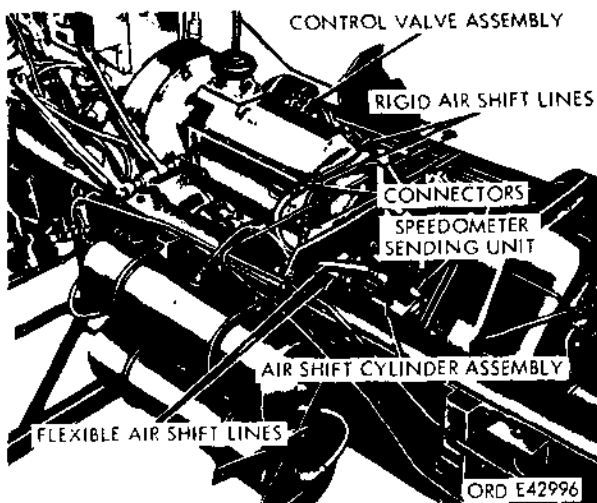


Figure 54.15. Top view of rear section of power plant (installed) from left side of vehicle.

(k) Disconnect front ground straps. Loosen ground strap retaining bolt (H, figure 54.20) at top left side of frame front cross member, and pull engine front ground strap (K, figure 54.20) and radiator ground strap (figure 54.7) away from cross member.

(6) Disconnect procedures inside cab.

(a) Remove cab floor tunnel. Remove 12 capscrews securing cab floor tunnel to cab floor, and remove tunnel.

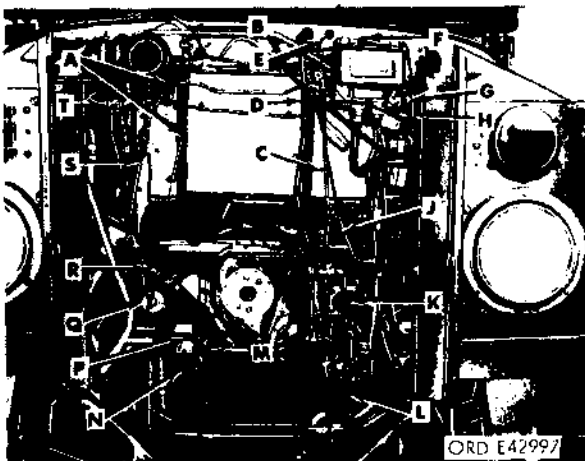


Figure 54.16. Front view of engine compartment with power plant removed.

KEY ITEM

- A Crankcase ventilating shutoff valves control
- B Choke control

- C Engine rear ground strap stud
- D Speedometer flexible shaft
- E Throttle control
- F Distributor primary wire support clip
- G Temperature gage cable connector
- H Distributor primary wire
- J Starter control rod
- K Brake master cylinder
- L Brake air-hydraulic cylinder
- M Muffler
- N Exhaust pipe clamp
- P Front muffler
- Q Starter magnetic switch
- R Oil pressure gage cable
- S Throttle-cross-shaft-to-carburetor rod
- T Coupling and elbow assembly

(b) Remove gear shift lever (figure 54.19). Turn shift-lever-retainer capscrew outward (counter-clockwise) one-half inch and lift gearshift lever and retainer from gear-shifter housing cover.

NOTE

Cover opening in gear-shifter housing cover to prevent entrance of dirt and foreign matter.

Removal procedures.

(a) Attach engine sling. With engine sling (figure 54.21) supported by suitable overhead hoisting equipment, insert hooks on ends of sling in lifting eyes (N and GG, figure 54.6) at left front end of front cylinder head and right rear end of rear cylinder head.

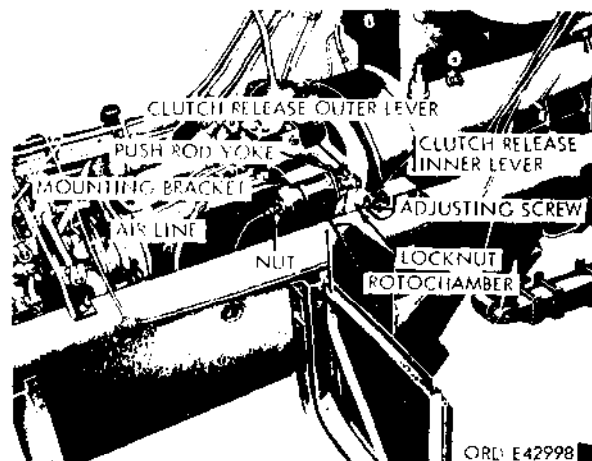


Figure 54.17. View of upper right front section of transmission with roto chamber.

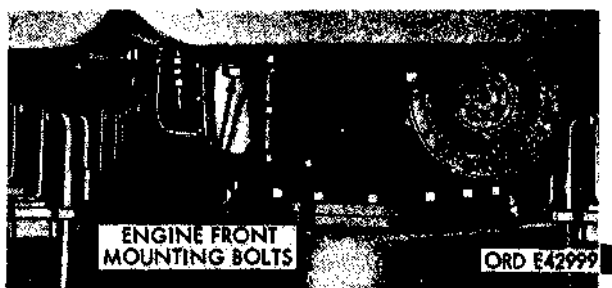


Figure 54.18. Engine front mounting.

(b) Check power plant disconnect points. Check to be sure that all disconnect procedures have been accomplished and that all accessories and lines are clear of power plant.

(c) Remove power plant. Carefully lift power plant, using a series of short lifts, until radiator and front engine support bracket will clear front of vehicle. Continue to raise power plant slowly, at the same time moving it forward (figure 54.21), until the power plant is free of the vehicle.

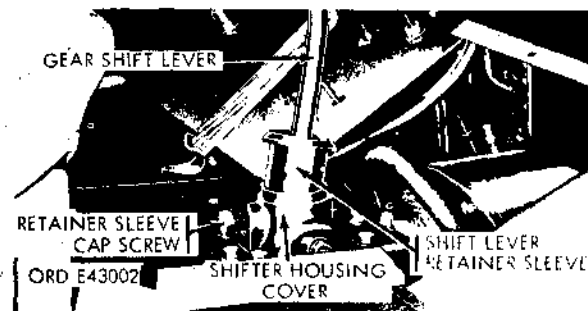


Figure 54.19. Removing gearshift lever.

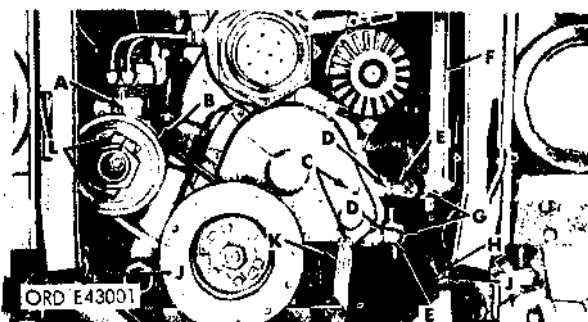


Figure 54.20. Front view of engine with radiator removed.

KEY ITEM

- A** Air compressor
- B** Compressor drive pulley
- C** Capscrew

- D** Bushing
- E** Elbow
- F** Steering gear hydraulic oil reservoir
- G** Self-sealing coupling
- H** Ground strap retaining bolt
- J** Front fender ground strap
- K** Engine front ground strap
- L** Capscrews

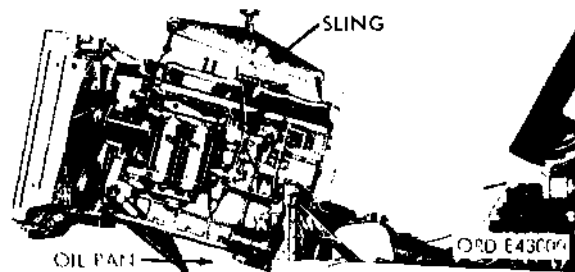


Figure 54.21. Lifting power plant from truck.

CAUTION

Do not rest weight of engine on oil pan; to do so may crack or crush the oil pan.

b. Installation:

(1) Preliminary procedures.

(a) Inspect power plant. Check the following parts and accessories included with the power plant, giving particular attention to any components replaced after removal of the power plant from the vehicle, to be sure that adjustment and/or installation has been accomplished correctly:

1. Air compressor. Refer to TM 9-2320-211-20.
2. Carburetor. Refer to TM 9-2320-211-20.
3. Distributor. Refer to TM 9-2320-211-20.
4. Fuel pump. Refer to TM 9-2320-211-20.
5. Generator. Refer to paragraph 20.
6. Oil filters. Refer to TM 9-2320-211-20.
7. Radiator. Refer to TM 9-2320-211-20.

8. Starter. Refer to T M

9-2320-211-20.

9. Steering gear hydraulic pump. Refer to Ordnance Maintenance.

10. Transmission. Refer to Maintenance Ordnance Maintenance.

(b) Attach engine sling. With engine sling (figure 54.2) supported by suitable engine lifting equipment, insert hooks on ends of sling in lifting eyes (N and GG, figure 54.6) at left front end of front cylinder head and right rear end of rear cylinder head.

(2) Installation procedures.

(a) Lift power plant into truck. Lift power plant high enough to clear front of truck and move part way into engine compartment (figure 54.19). Check to be sure that all lines and accessories are clear of power plant. Continue to lower power plant slowly, at the same time, moving it further into the engine compartment, until mounting bosses on left and right sides of flywheel housing are directly above, but not supported by, the engine rear mounts attached to the left and right frame side rails.

NOTE

Do not rest power plant solidly on engine mounts until (b)(1) and (2) below are accomplished.

(b) Aline power plant and install mounting bolts.

1. With tension on engine lifting sling, aline holes in engine front mounting support with holes in front cross member and install four lockwashers and capscrews (figure 54.18), turning screws in only four or five threads.

2. With tension on engine lifting sling, aline holes in flywheel housing mounting bosses with engine rear mounts. Insert two capscrews (D, figure 54.5), one on each side, and loosely install safety nuts (figure 54.14) on capscrews.

(3) Connect procedures under vehicle.

(a) Connect transmission to transfer propeller shaft. Position universal joint journal adapter flange (figure 54.11) against companion flange at rear of transmission, aline mounting bolt holes in flange and adapter, and insert eight bolts in holes. Install eight bolts in holes. Install eight safety nuts on bolts and tighten.

(b) Install power takeoff. Coordinate with Ordnance Maintenance.

(c) Connect transmission-to-transfer air shift lines. Connect flexible air shift lines (figure 54.15) attached to left front of transfer case to rigid air shift lines at top rear of transmission. Tighten connectors.

(d) Connect clutch linkage. Position yoke on lower end of clutch control rod over clutch release lever and secure with yoke pin (figure 54.12).

(e) Connect brake pedal return spring. Insert lower end of brake pedal return spring in hole in bracket (figure 54.12) on left rear side of engine flywheel housing.

(f) Connect engine starter primary cable. Install starter primary cable (figure 54.7) on upper terminal on left side of starter magnetic switch (Q, figure 54.13) and secure with terminal nut.

(g) Connect engine starter cable. Install starter cable (figure 54.7) on terminal on top of starter magnetic switch (Q, figure 54.16) and secure with terminal nut.

(h) Connect clutch-control-valve-to-rotor-chamber air line (M62 only). Position clutch-control-valve-to-rotor-chamber air line (figure 54.17) at rear of rotor chamber, and tighten connector.

(i) Connect front ground straps. Slide terminals on ends of radiator ground strap (figure 54.7) under head of ground strap retaining bolt (H, figure 54.20) and tooth-type lockwasher at top left side of frame front cross member. Tighten bolt.

(4) Connect procedures at right side of engine.

(a) Connect engine oil pressure gage sending unit. Insert bayonet-type connector on oil pressure gage cable (R, figure 54.16) in terminal socket on oil pressure gage sending unit (figure 54.7) and rotate connector clockwise to lock connector pins in socket slots.

(b) Connect engine exhaust pipe. Install new exhaust-pipe-flange sealing ring at upper end of exhaust pipe, slip exhaust pipe mounting flange (Z, figure 54.6) over the four nuts and washers on exhaust pipe mounting studs, and rotate flange so that small holes are aligned with washers under mounting nuts. Tighten nuts.

(c) Connect air-cleaner-to-air-compressor-intake line (vehicles equipped with air-cleaner-to-air-compressor-intake line only). Slide front end of air-cleaner-to-air-compressor-intake line (X, figure 54.8) over intake sleeve at compressor air strainer (figure 54.9), and tighten clamp screw.

(d) Connect air-compressor-to-air-reservoir line. Connect air-compressor-to-air-reservoir line (Figure 54.10) at top rear of air compressor cylinder head, and tighten flare nut.

(e) Connect crankcase-and-distributor-to-air-cleaner vent line. Slide air cleaner outlet hose (B, figure 54.8) over end of crankcase-and-distributor-to-air-cleaner vent line (figure 54.7) and tighten hose clamp (D, figure 54.8).

(f) Connect crankcase ventilating shutoff valve control (vehicles equipped with manually controlled crankcase ventilating system (paragraph 48(3)(g) only). Position shutoff valve control on bracket (S, figure 54.8) at right rear of carburetor mounting flange, secure with clip, and tighten nut on clip retaining bolt. Insert shutoff valve control wire (W, figure 54.8) in hole in shutoff valve lever swivel pin, but do not tighten retaining screw.

(g) Connect primer pump injection line (vehicles equipped with fuel primer pump only). Connect line from primer pump to cylinder head priming tee (Q, figure 54.8) at left of carburetor, and tighten connector.

(h) Connect choke control. Refer to TM 9-2320-211-20.

(i) Connect throttle-cross-shaft-to-carburetor rod (B, figure 54.26).

(j) Connect air-cleaner-to-carburetor-inlet hose. Slide air-cleaner-to-carburetor-inlet hose (C, figure 54.8) over air inlet sleeve on rear of carburetor, and tighten hose clamp (E, figure 54.8).

(k) Connect flywheel-housing-to-air-cleaner vent line (vehicles equipped with flywheel housing ventilating system only). Slide air cleaner outlet hose over flywheel housing vent line (figure 54.7 or 54.9) at rear lower right side of engine and tighten hose clamp.

(l) Connect engine temperature gage sending unit. Insert cable connector (G, figure 54.16) on end of temperature gage cable in terminal socket on temperature gage sending unit (E, figure 54.6), and rotate connector clockwise to lock connector pins in socket slots.

(m) Connect air-compressor-to-governor line. Connect air-compressor-to-governor line (T, figure 54.6) to left side of air governor (A, figure 54.6), and tighten connector.

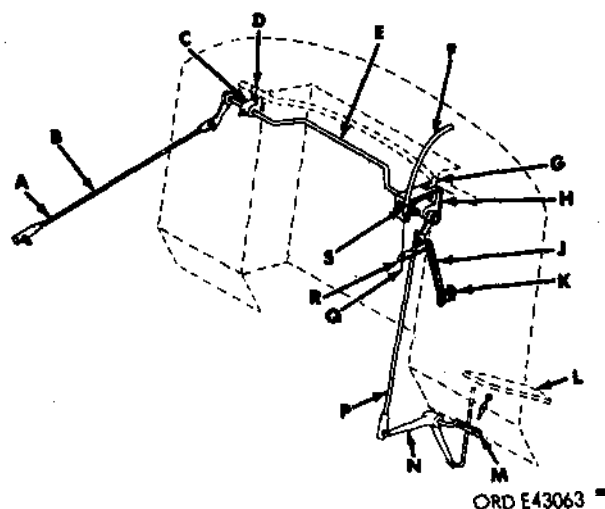


Figure 54.22. Carburetor throttle control linkage.

KEY	ITEM
A	Ball joint
B	Throttle cross-shaft-to-carburetor rod
C	Throttle cross-shaft bracket
D	Wiring harness clip
E	Throttle cross shaft
F	Throttle control
G	Wiring harness clip
H	Throttle cross-shaft bracket
J	Return spring
K	Return spring clip
L	Accelerator pedal
M	Lever bracket
N	Accelerator pedal-rod-to-throttle cross-shaft-link lever
P	Throttle cross-shaft-to-accelerator-pedal-rod-lever rod
Q	Throttle control wire
R	Cross-shaft link clip
S	Throttle control supporting bracket clip.

(5) Connect procedures at left side of engine.

(a) Connect fuel pump inlet line. Connect fuel-pump-to-fuel-filter flexible line (N, figure 54.5) to fuel-pump-to-fuel-filter rigid line (L, figure 54.5), and tighten connector nut.

(b) Connect crankcase ventilating shutoff valve control (vehicles equipped with manually controlled crankcase ventilating system (paragraph 48(a)(3)(g) only). Install shutoff valve control mounting bracket (figure 54.4) on studs at top rear of water inlet header and secure with two retaining nuts and washers. Insert shutoff valve control wire (figure 54.4) in hole in shutoff valve lever swivel pin, but do not tighten retaining screw.

(c) Connect starter linkage. Release starter control rod (TM 9-2320-211-20), position yoke on bellcrank (R, figure 54.5), and secure with yoke pin and cotter pin.

(d) Connect engine rear ground strap. Position terminal on end of engine rear ground strap (H, figure 54.2) on stud (c, figure 54.16), at front of cab cowl, and install tooth-type lockwasher and nut on stud. Tighten nut.

(e) Connect steering gear hydraulic lines. Connect steering gear hydraulic lines (figure 54.23) to inlet and outlet connections at steering gear hydraulic pump (figure 54.7), and tighten self-sealing couplings (figure 54.2).

(f) Connect generator-to-regulator cable. Connect generator-to-regulator cable to receptacle on top of generator (figure 54.3) and tighten connector.

(g) Connect distributor primary wire. Install distributor primary wire support clip (F, figure 54.16) on left front breather connector retaining nut and lockwasher. Insert distributor primary wire (F, figure 54.2) in primary lead-in at rear of distributor and tighten connector.

(h) Connect tachometer flexible shaft. Insert end of tachometer flexible shaft (figure 54.23) in tachometer sending unit (figure 54.2) at front of distributor drive housing and tighten connector.

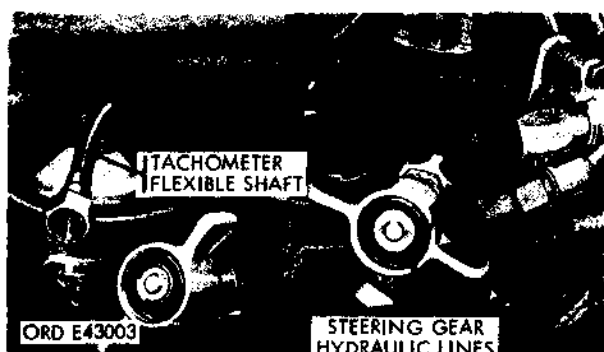


Figure 54.23. Steering gear hydraulic lines and tachometer drive cable (disconnected) at left side of engine.

(6) Connect procedures at front of vehicle.

(a) Install radiator upper shield. Refer to TM 9-2320-211-20.

(b) Install brush guard. Slide guard-to-frame-bracket bolts (figure 54.24) on bottom of brush guard into slots in top of left and right frame brackets. Push top of brush guard toward rear of truck and engage slots in left and right braces with bolts in brush guard. Tighten guard-to-frame-bracket nuts and bolts and guard-to-brace nuts and bolts.

(c) Install front winch level wind (vehicles equipped with front winch only (TM 9-2320-211-20)).

(7) Connection procedures inside cab.

(a) Install gearshift lever. Install gearshift lever (figure 54.19) and retainer, with hole in retainer toward rear of truck, in opening in top of gearshifter-housing cover. Aline hole in rear of retainer with retainer capscrew, and turn capscrew in as far as it will go. Position rubber lever grommet (removed with lever and retainer assembly) on shoulder of shifter-housing cover, to prevent entrance of dirt and foreign matter.

(b) Install cab floor tunnel. Position cab floor tunnel over opening in cab floor and install 12 capscrews. Tighten screws.

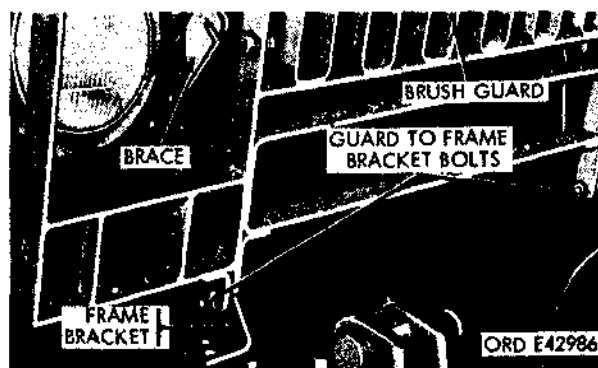


Figure 54.24. Brush guard mountings.

(8) Adjustment and service procedures.

(a) Adjust carburetor choke control.

Refer to TM 9-2320-211-20.

(b) Adjust carburetor throttle control.

Refer to TM 9-2320-211-20.

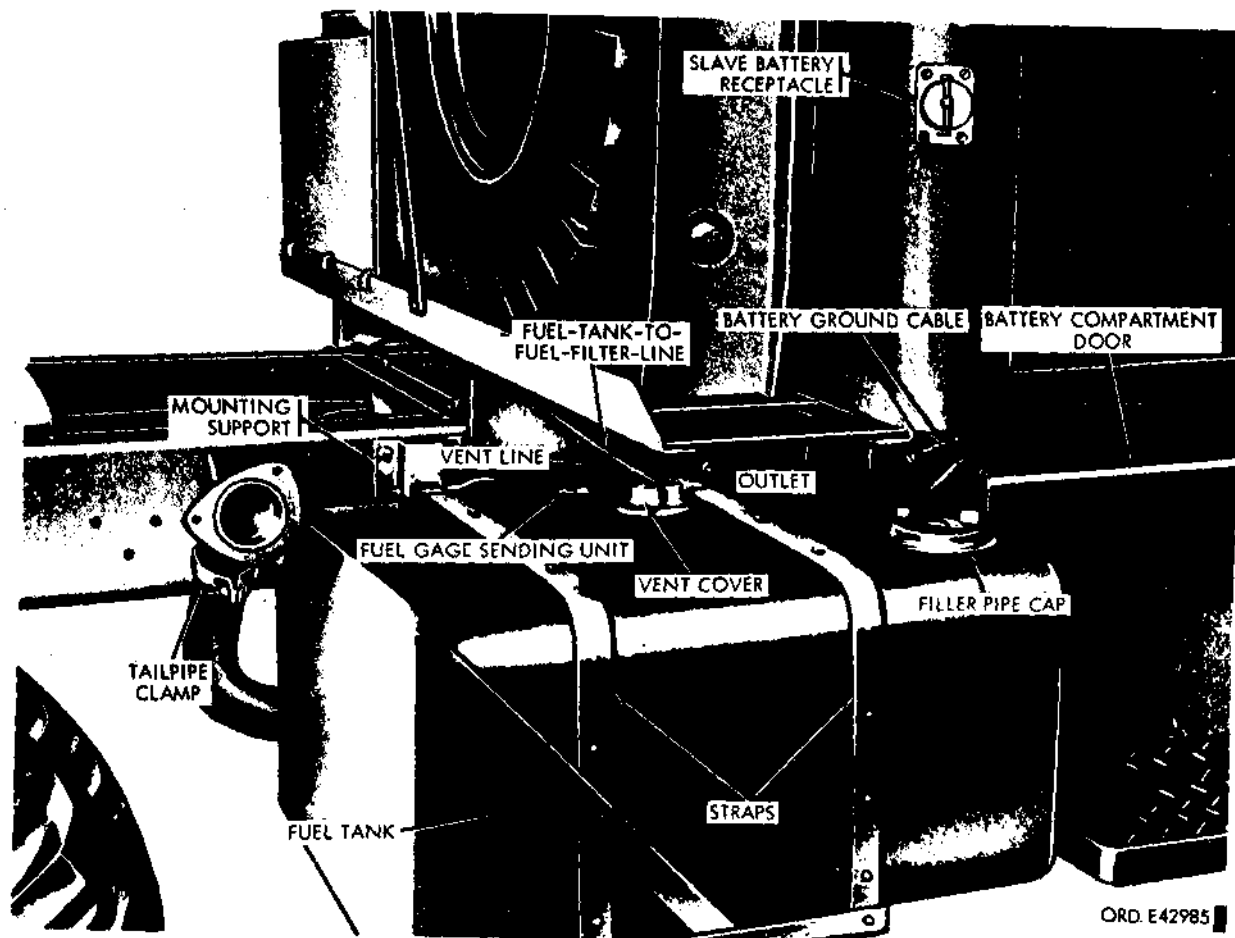


Figure 54.25. View of lower right rear corner of truck cab.

(c) Adjust crankcase ventilating shutoff valves. Adjust crankcase ventilating shutoff valves as follows (vehicles equipped with manually controlled crankcase ventilating system (paragraph 48a(3)(g) only):

1. Push crankcase ventilating shutoff valves control (TM 9-2320-211-20) in against instrument panel as far as it will go.

2. Move levers on both crankcase ventilating shutoff valves (U, figure 54.8) and (figure 54.4) to the open position.

3. Tighten screws securing shutoff valve control wires to swivel pins at shutoff valve levers.

(d) Connect battery ground cable (figure 54.25). Remove capscrew and tooth-type lockwasher from outside of frame right side rail under right rear corner of truck cab. Remove tape from battery ground cable terminal; position terminal on frame side rail, and install capscrew and lockwasher. Tighten capscrew.

(9) Inspection and test.

(a) Check power plant connect points. Check to be sure that all connection procedures have been accomplished.

(b) Start engine and check power plant controls for proper operation and observe instruments for normal readings. Refer to TM 9-2320-211-10.

(c) If operation of engine, controls, and instruments is satisfactory, proceed as in (j) below. If (b) above disclosed any evidence of malfunctioning, refer to Troubleshooting - Section V.

(10) Hood Installation (figure 54.1).

(a) Position left and right hood side panels so as to engage hinges (H), push top edges of panels toward engine, and engage front and rear latches (F) to lock panels in raised position.

(b) Remove left windshield holddown catch (E) from eye of top panel hook, lower hood top panel (B) to closed position, and engage hood top panel holddown catches (A) to lock hood in closed position.

(11) Record of replacement. Record the replacement on DA Form 2408-1 Organizational Equipment File.

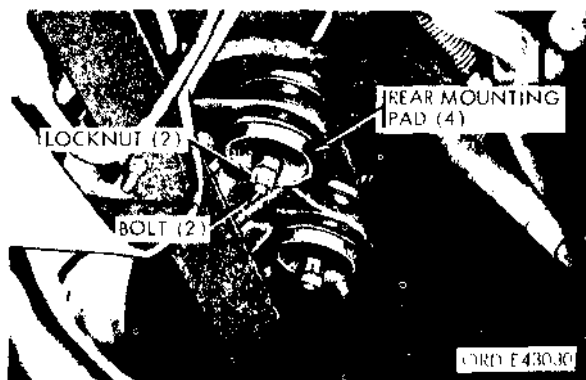
49. Diesel Model.

Removal. Remove power plant as shown in figure 54.29.

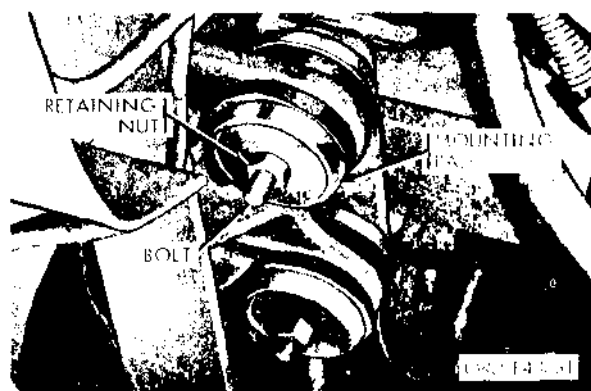
PRIOR OPERATIONS

- (1) Disconnect battery ground cable (TM 9-2320-211-20).
- (2) Drain air system (figure 305).
- (3) Remove air cleaner (TM 9-2320-211-20).
- (4) Remove air compressor (TM 9-2320-211-20).
- (5) Remove power steering lines (paragraph 230).
- (6) Remove front winch (TM 9-2320-211-20).
- (7) Remove sending units (TM 9-2320-211-20).
- (8) Remove brush guard (paragraph 31).
- (9) Remove radiator upper shield (paragraph 31).
- (10) Remove engine front and rear mounting pads and bolts as shown in figures 54.26 and 54.27.
- (11) Disconnect exhaust pipe at turbocharger (TM 9-2320-211-20).

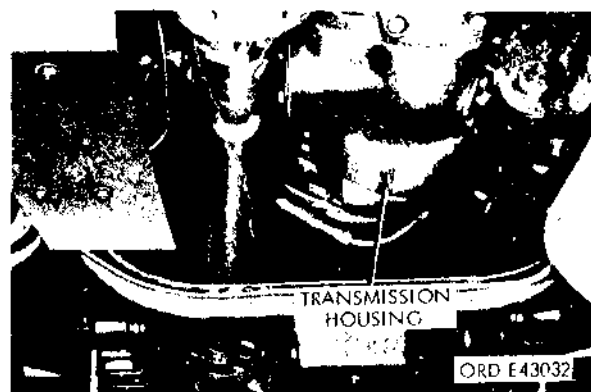
FIGURE 54.26
ENGINE REAR MOUNTING PADS
REMOVAL
Steps 1 through 4



Step 1. Remove locknut from bolt securing rear mounting pads.



Step 2. Remove lower mounting pad retaining nut and remove lower pad and bolt.



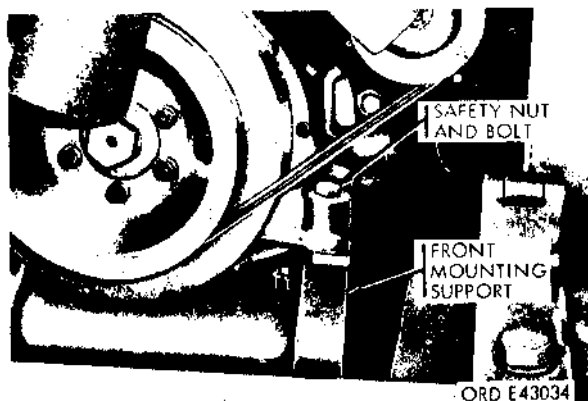
Step 3. Locate jack under transmission housing and raise high enough to allow removal of rear mounting pads.



Step 4. Remove rear mounting pads from support.

Figure 54.26. Rear engine mounting pads removal.

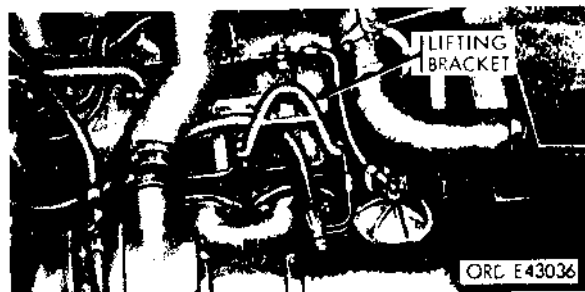
**FIGURE 54.27
ENGINE FRONT MOUNTING PADS
REMOVAL
Steps 1 through 4**



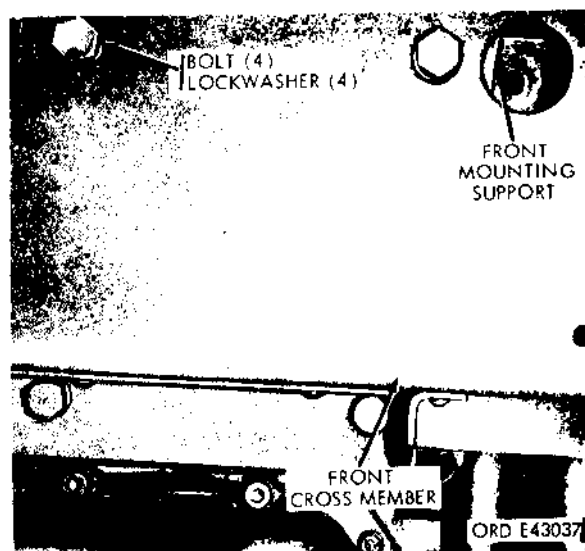
Step 1. Remove safety nut and bolt securing engine front mount to front mounting support on left side of engine.



Step 2. Remove safety nut and bolt securing engine front mount to front mounting support on right of engine.



Step 3. Using lifting bracket at front of engine, raise engine high enough to relieve weight from front mounting support.

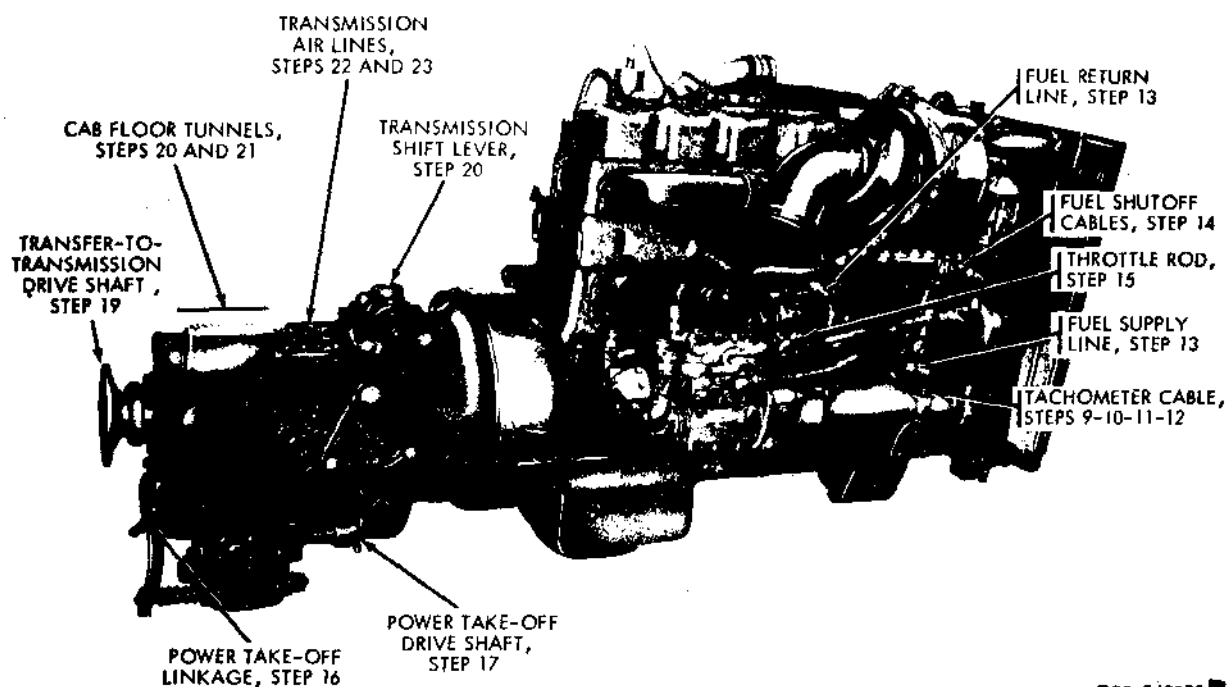
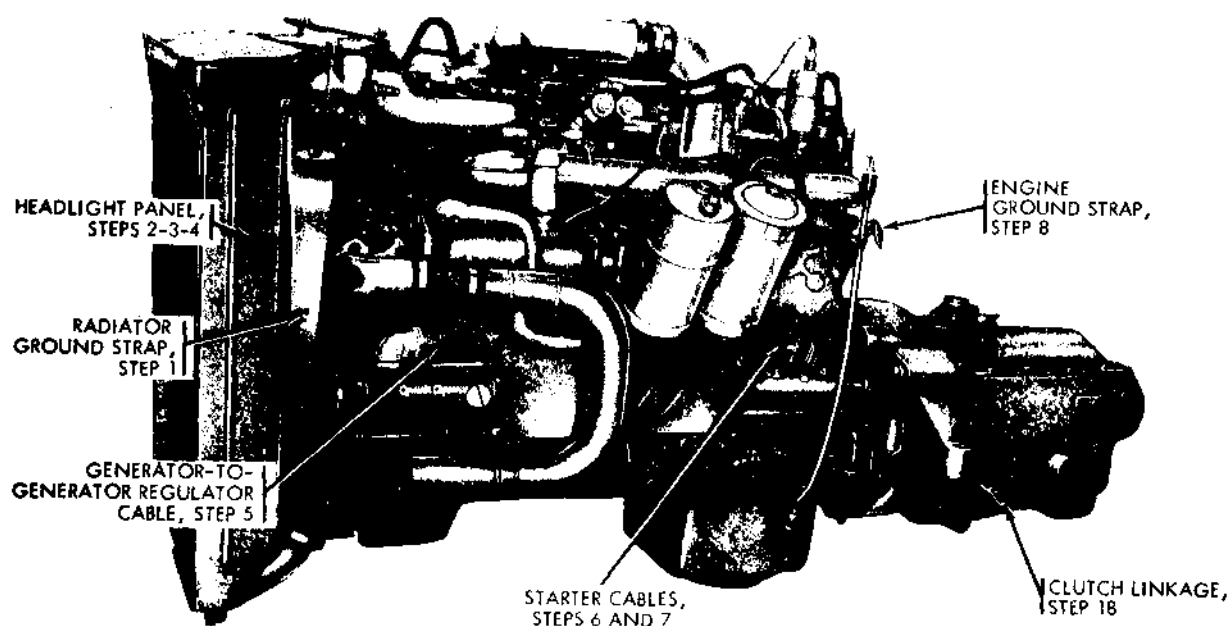


Step 4. Remove bolts and lockwashers securing front mounting bracket to front crossmember and remove front mounting support.

Figure 54.27. Engine front mounting pads removal.

NOTE

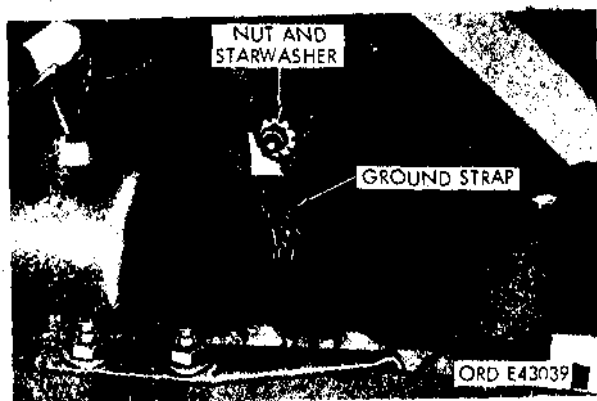
Install engine rear and front mounting pads in reverse order of removal, proceeding from Step 4 to Step 1.



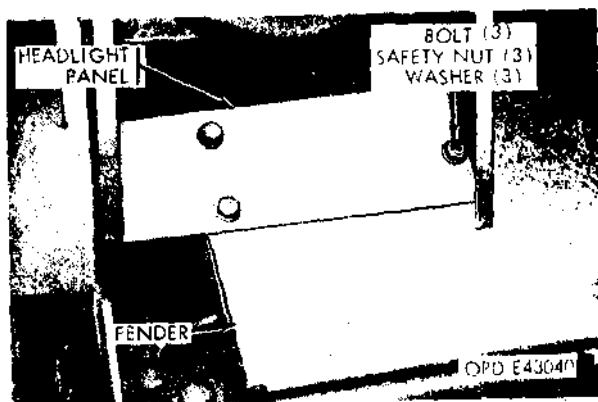
ORD E43038

Figure 54.28. Visual guide to power plant disconnect points (diesel model).

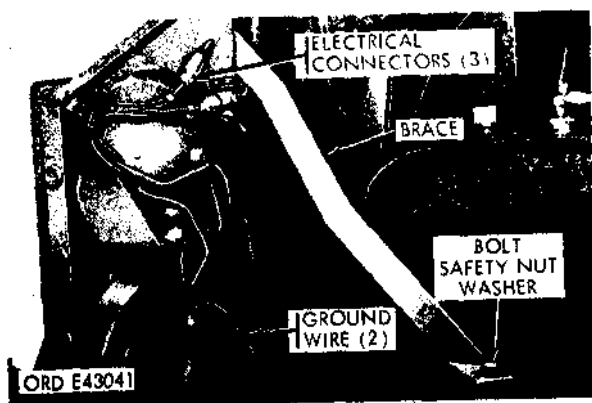
FIGURE 54.29
POWER PLANT REMOVAL
Steps 1 through 24



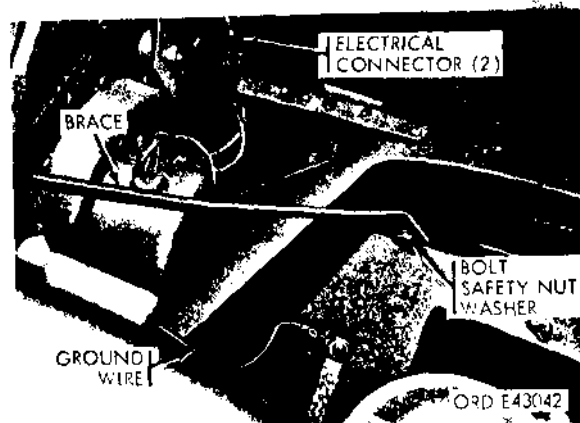
Step 1. Remove nut and starwasher securing radiator to chassis ground strap.



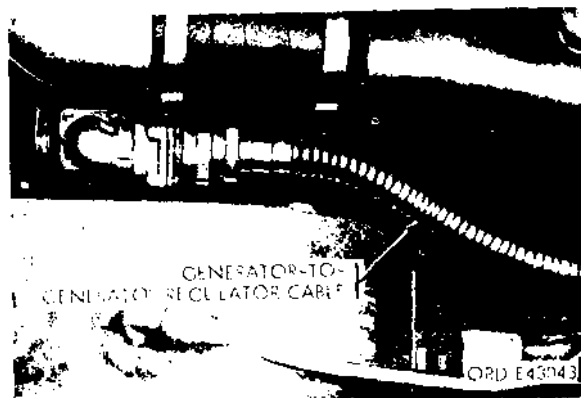
Step 2. Remove bolts, safety nuts, and washers securing headlight panel to fender.



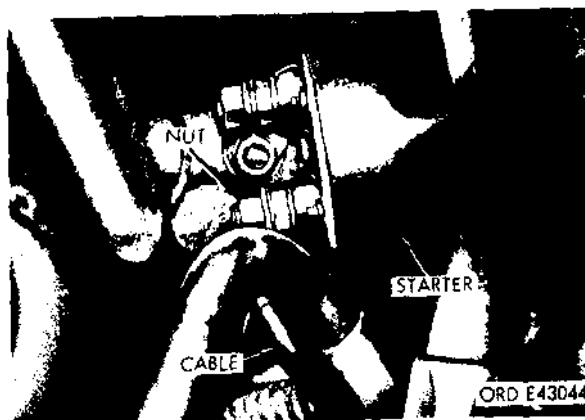
Step 3. Disconnect electrical connectors and ground wires. Remove bolt safety nut and washer securing left headlamp panel brace to fender.



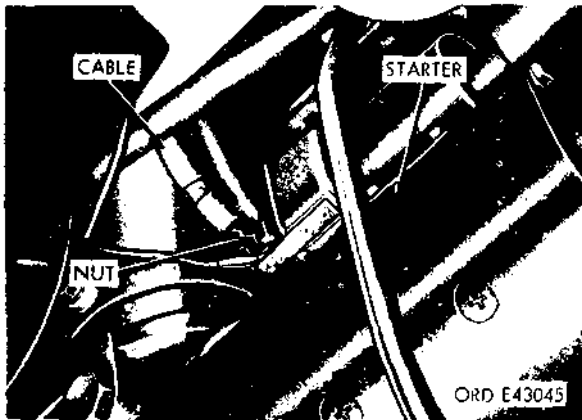
Step 4. Disconnect electrical connectors and ground wire. Remove bolt, safety nut, and washer securing right headlamp panel brace to fender.



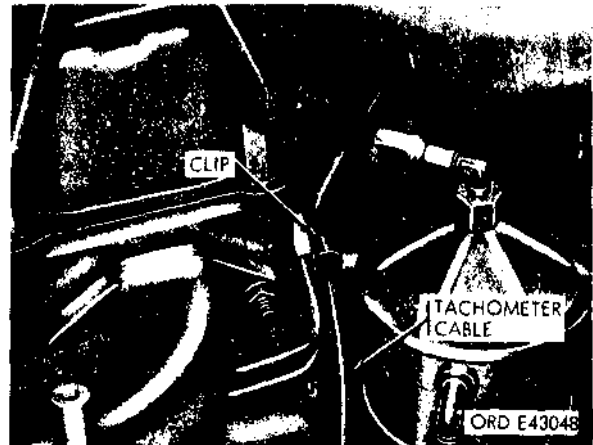
Step 5. Remove generator to generator-regulator cable.



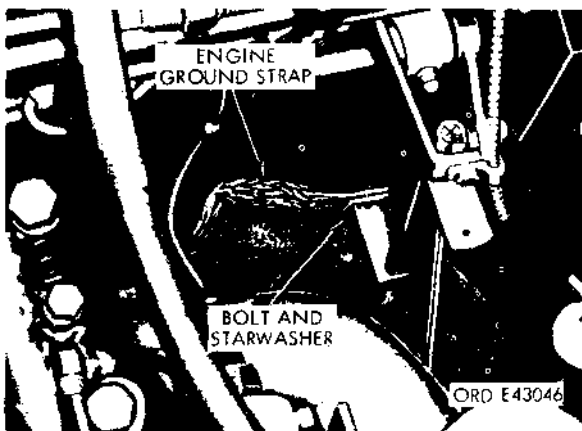
Step 6. Remove nut securing starter cable to starter (from top of starter) and remove cable from starter.



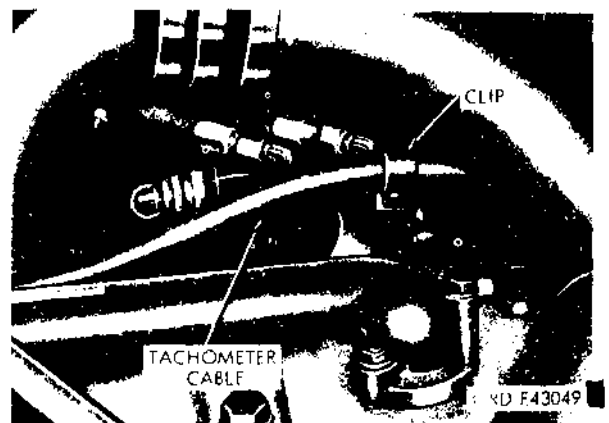
Step 7. Remove nut securing starter cable to starter (under vehicle) and remove cable.



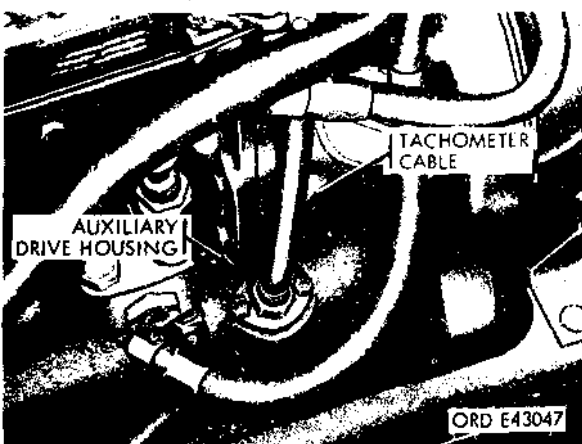
Step 10. Remove clip securing tachometer cable to front of engine.



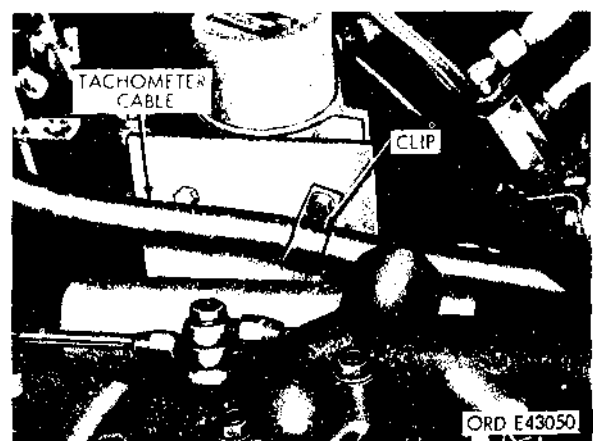
Step 8. Remove bolt and starwasher securing engine ground strap to cowl.



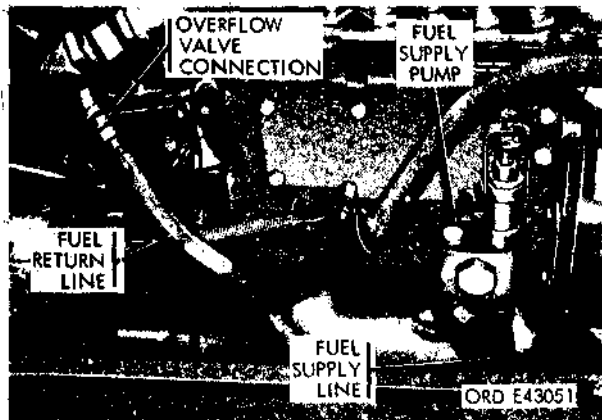
Step 11. Remove clip securing tachometer cable on left side of engine.



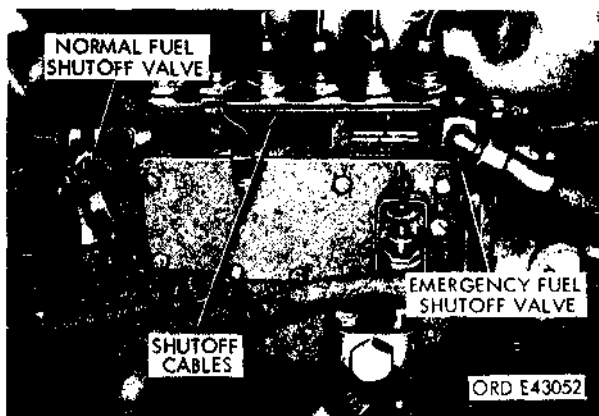
Step 9. Disconnect tachometer cable at auxiliary drive housing.



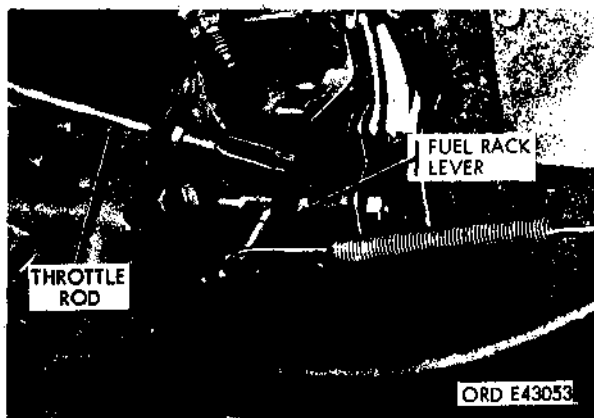
Step 12. Remove clip securing tachometer cable on rear left side of engine.



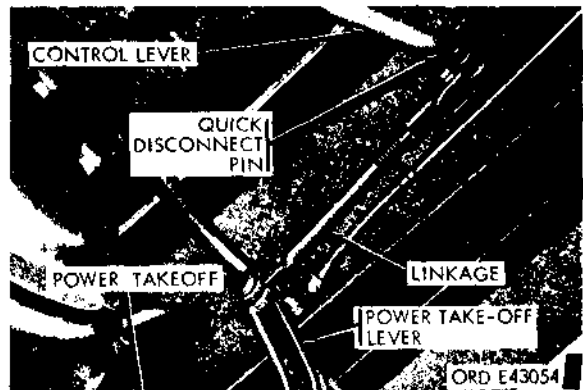
Step 13. Disconnect fuel supply line from fuel supply pump. Disconnect fuel return line from overflow valve connection.



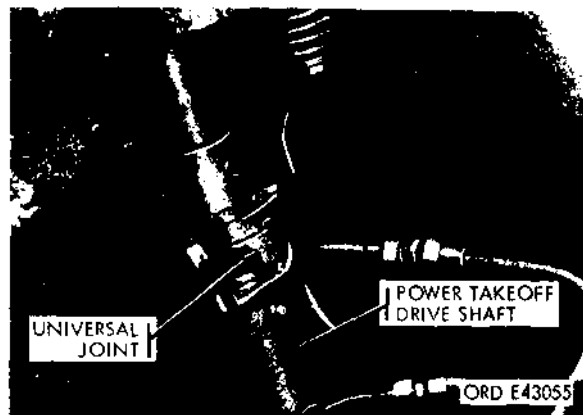
Step 14. Remove shutoff cables from emergency fuel shutoff valve and normal fuel shutoff valve.



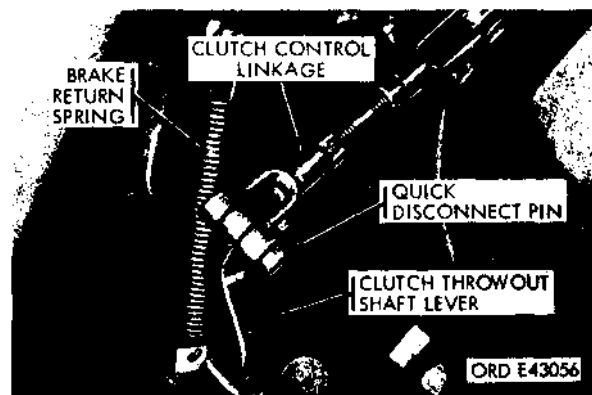
Step 15. Disconnect throttle rod from fuel rack lever.



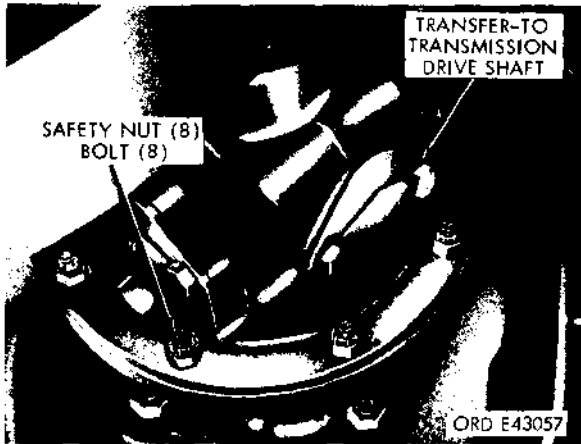
Step 16. Pull out quick disconnect pin securing power takeoff linkage between control lever and power takeoff lever.



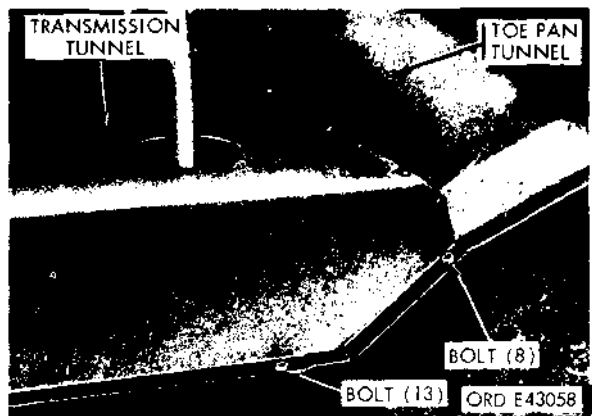
Step 17. Disconnect power takeoff drive shaft at universal joint (paragraph 165).



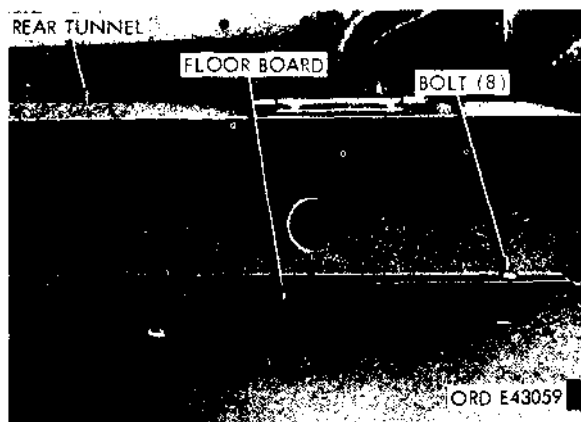
Step 18. Pull out quick disconnect pin securing clutch control linkage to clutch throwout shaft lever. Disconnect brake pedal return spring.



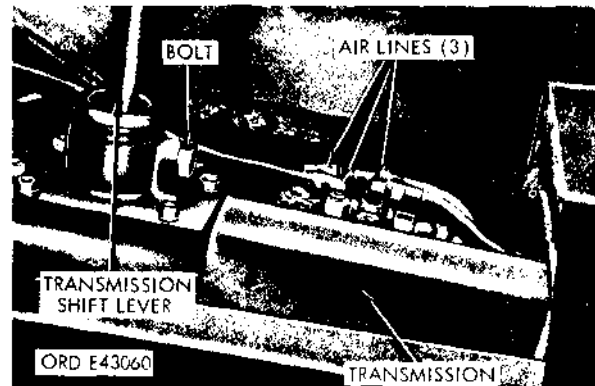
Step 19. Remove safety nuts and bolts securing transfer to transmission drive shaft.



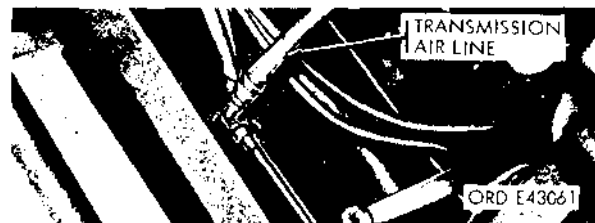
Step 20. Remove bolts securing transmission tunnel and toe pan tunnel and remove tunnels.



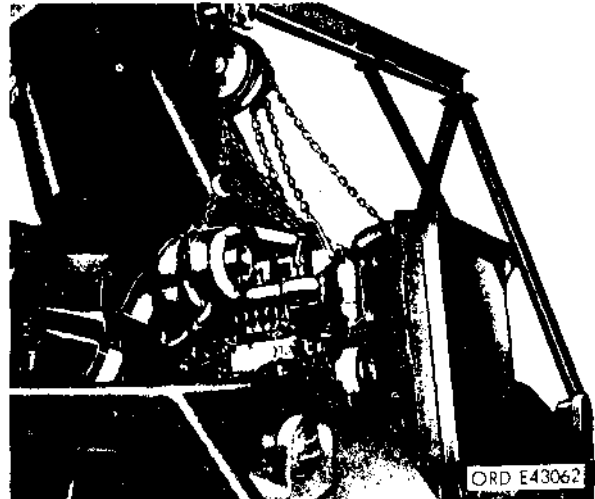
Step 21. Remove bolts securing rear tunnel to floorboard and remove tunnels.



Step 22. Disconnect air lines from top of transmission. Loosen bolt securing transmission shift lever and remove lever.



Step 23. Disconnect transmission airline (under vehicle).



Step 24. Remove power plant from vehicle.

Figure 54.29. Power plant removal.

b. **Installation.** Install power plant in reverse order of removal proceeding from Step 24 through Step 1 and prior operations.

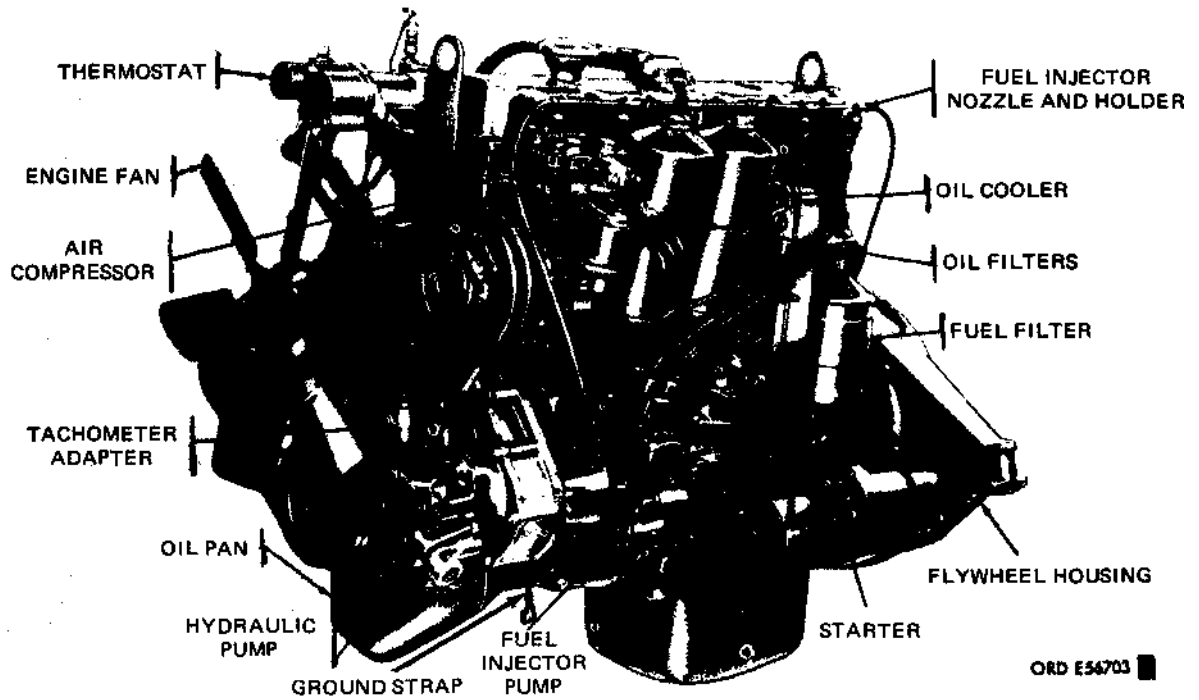


Figure 54.30. Left side of power plant (multifuel).

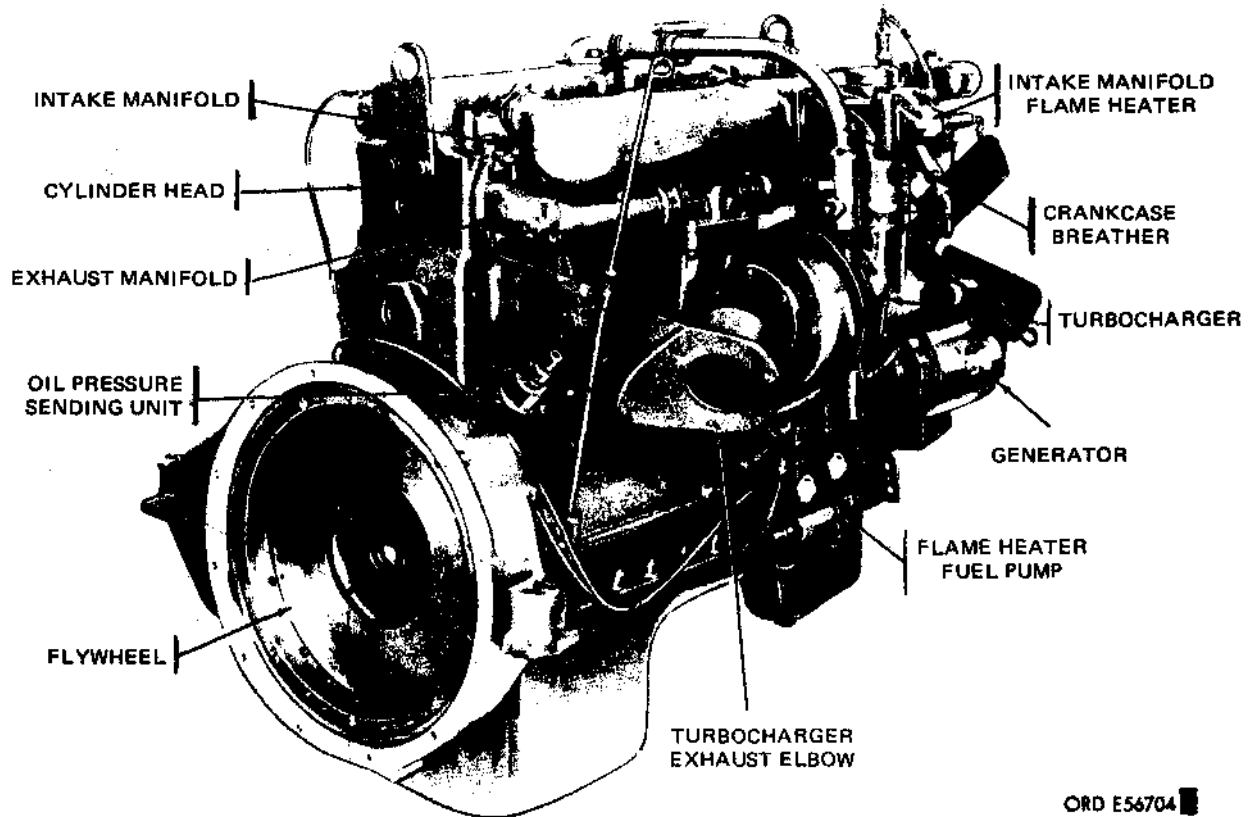


Figure 54.31. Right side of power plant (multifuel).

49.1 Multifuel Models.

a. Removal.

(1) Disconnect battery ground cable (figure 54.24). Remove capscrew and tooth-type lockwasher from outside of frame right side rail under right rear corner of truck cab, and remove battery ground cable. Thoroughly tape end of cable to eliminate hazard of accidental grounding. Replace capscrew and tooth-type lockwasher to prevent loss.

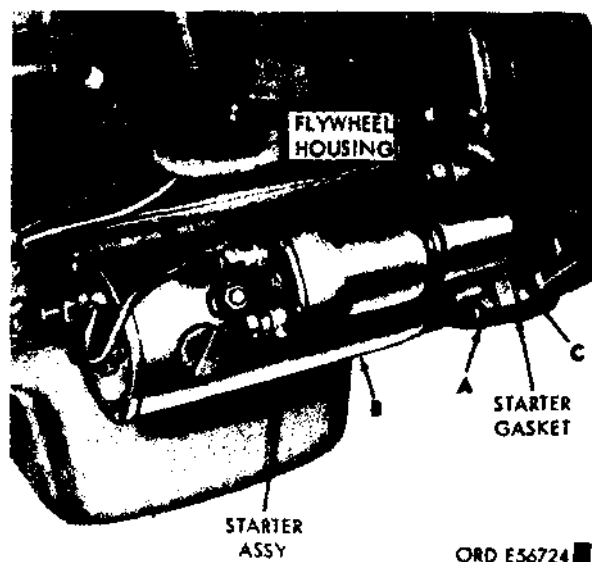


Figure 54.32. Starter.

(2) Disconnect cables at starter by removing nuts securing starter cable to starter (from top of starter and under vehicle). Remove cables from starter (figure 54.32).

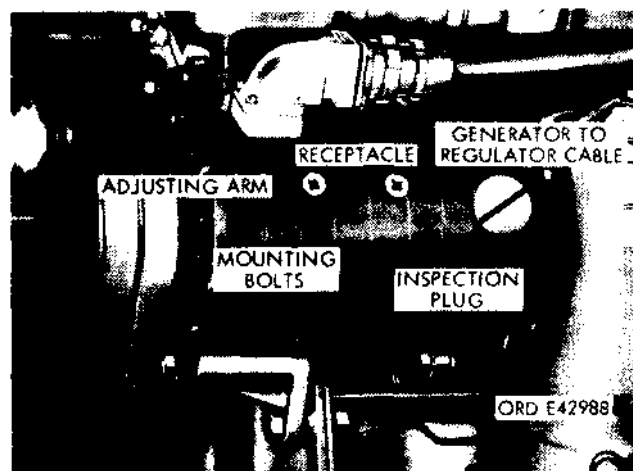


Figure 54.33. Generator.

(3) Disconnect cables at generator by removing the connector nut on the generator-to-regulator harness at the generator output elbow. Slide the nut back on the harness and carefully remove the cables from the generator (figure 54.33).

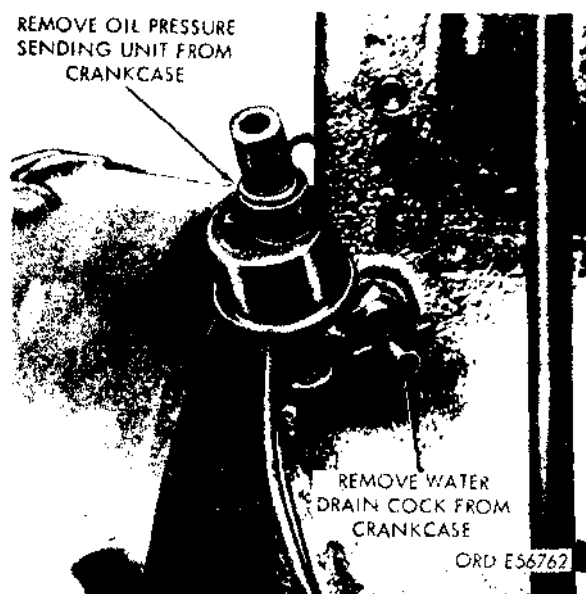


Figure 54.34. Oil pressure sending unit.

(4) Disconnect oil pressure sending unit by unscrewing from fitting in crankcase and removing oil pressure gage cable from sending unit (figure 54.34).

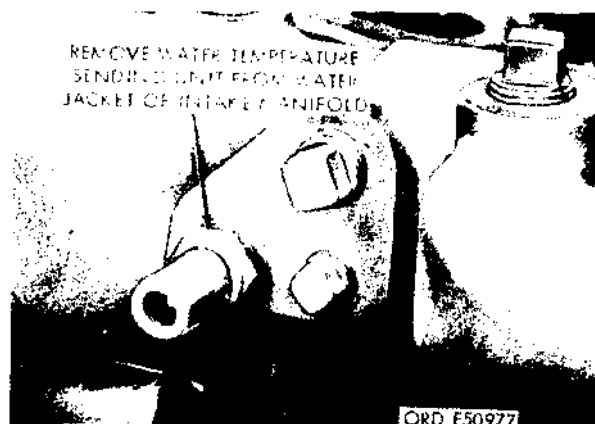


Figure 54.35. Water temperature sending unit.

(5) Remove water temperature sending unit by unscrewing unit from thermostat housing (figure 54.35).

(6) Disconnect engine ground straps (figure 54.30). Remove bolt and starwasher securing engine ground strap to cowl.

(7) Remove brush guard and left and right headlight panels (paragraph 31).

(8) Remove left side panel (paragraph 31).

(9) Disconnect lines at power steering pump (paragraph 102.1).

(10) Remove mounting bolts and lay power steering reservoir on left fender (figure 120).

NOTE

This prevents accidental damage to the reservoir while removing and installing power plant.

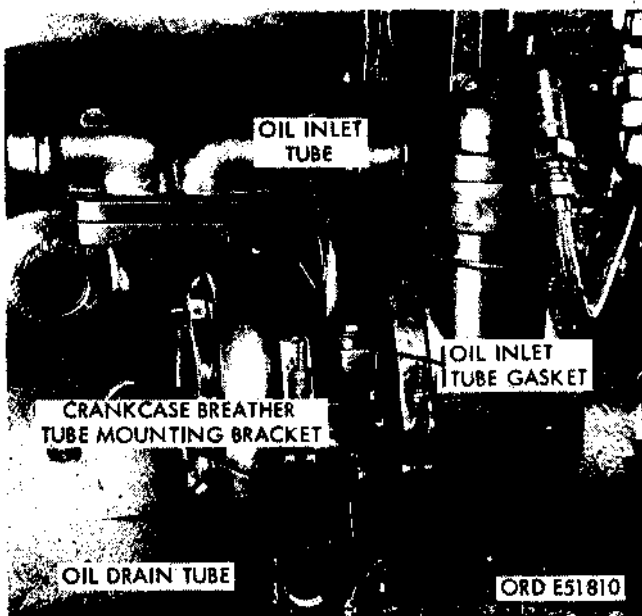


Figure 54.36. Disconnecting lubrication lines at turbocharger - multifuel models.

(11) Disconnect turbocharger inlet and outlet at the connection located on the upper section of the unit (figure 54.36). Loosen lower clamp securing turbocharger inlet hose. Remove capscrew and lockwasher securing oil inlet adapter to turbocharger. Remove nuts and capscrews securing turbocharger to exhaust manifold.

NOTE

Cap turbocharger air and oil opening to prevent entrance of foreign material.

(12) Disconnect tachometer cable (figure 54.29). Remove clip securing tachometer cable to front, left, and right sides of engine.

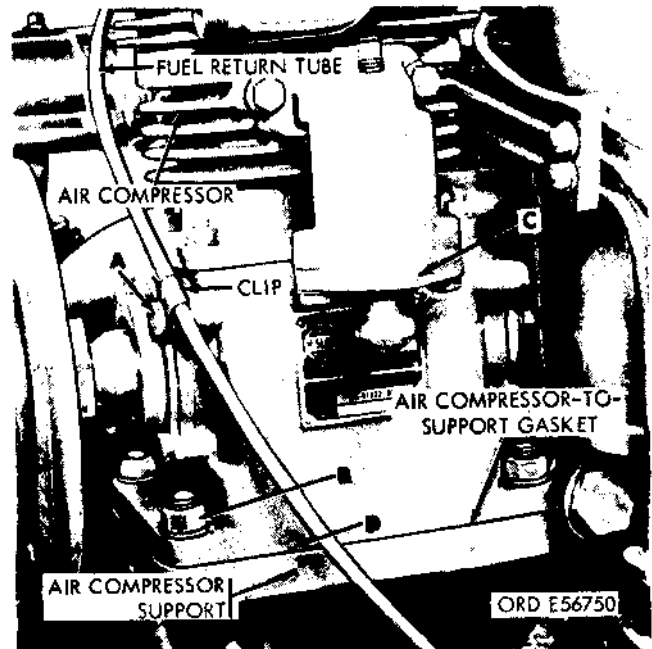


Figure 54.37. Air compressor - Multifuel models.

(13) Disconnect lines at air compressor (figure 54.37). Remove the capscrew and clip holding the fuel return to fuel injector pump overflow valve tube to the air compressor. Install the capscrew on the air compressor tube inlet.

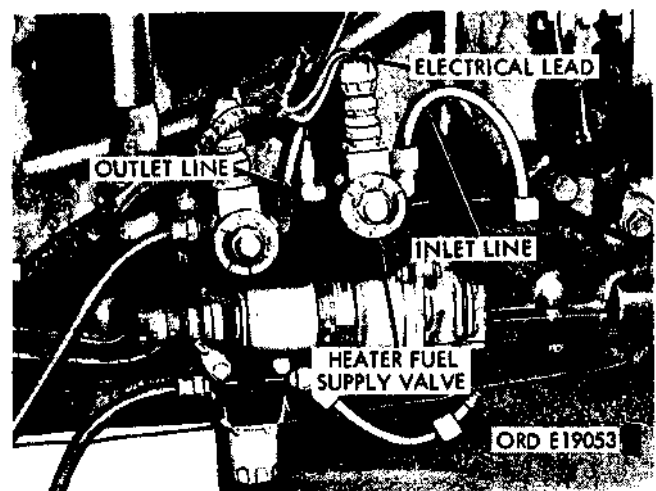


Figure 54.38. Manifold heater supply and fuel return valves - multifuel engine LDS 465-1.

(14) Disconnect the electrical lead and inlet and outlet lines from heater fuel supply valve and/or fuel return valve (figure 54.38).

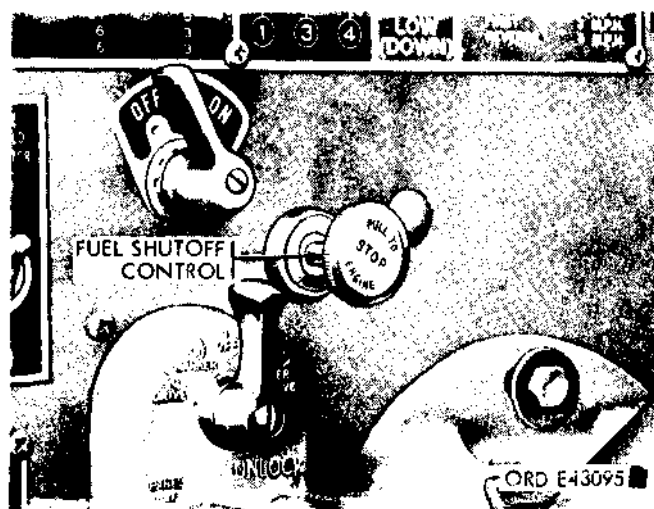


Figure 54.39. Removing fuel shutoff control from instrument panel.

(15) Disconnect fuel shutoff and accelerator linkage at injector pump as follows:

(a) To disconnect fuel shutoff remove the retaining nut and lockwasher securing the shutoff control to the instrument panel (figure 54.39).

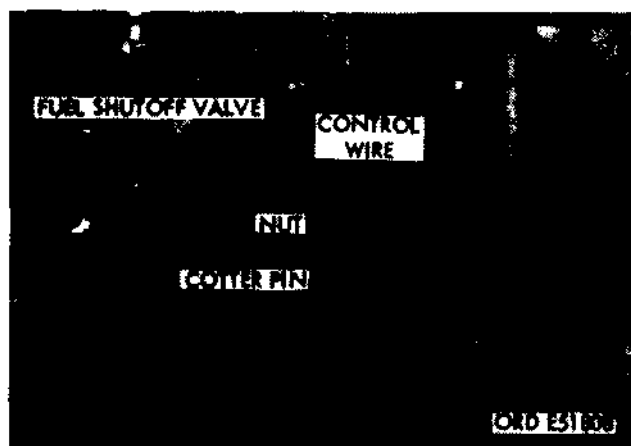


Figure 54.40. Removing fuel shutoff control -multifuel only.

(b) Remove the cotter pin from the pin securing the fuel shutoff control to the fuel shutoff valve (figure 54.40). Remove the castellated nut, washer, and screw, and remove control wire.

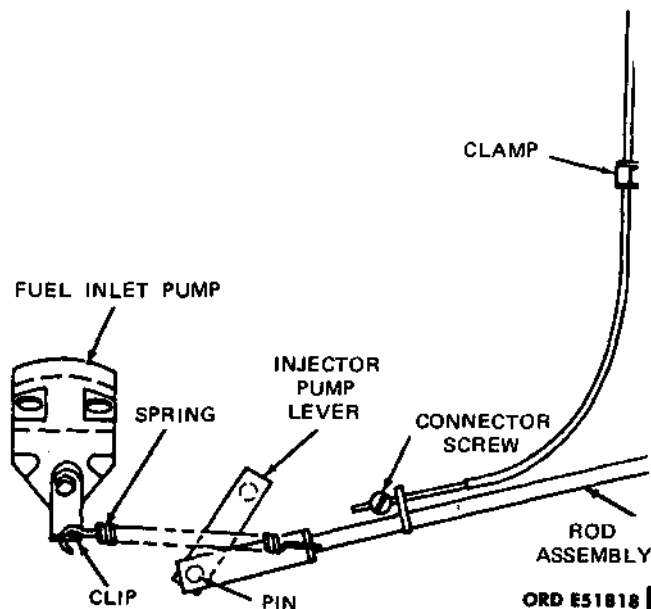


Figure 54.41. Accelerator and throttle linkage at injector pump - diesel and multifuel.

(c) To disconnect accelerator linkage at injector pump, remove the spring from the throttle rod assembly (figure 54.41).

(16) Remove transmission covers (inside cab) as described in paragraph 178.

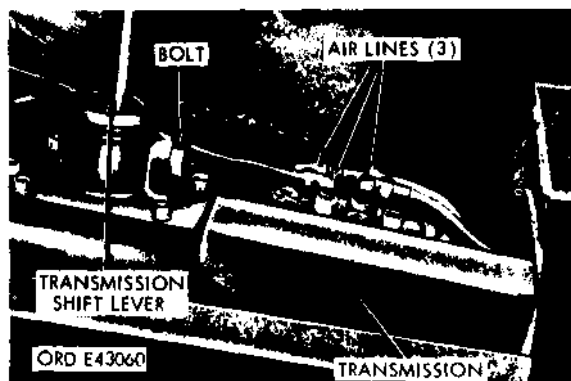


Figure 54.42. Transmission shift lever and air lines above transmission.

(17) Loosen bolt securing transmission shift lever and remove shift lever (figure 54.42).

(18) Disconnect air lines from transmission (figures 54.42 and 54.43).

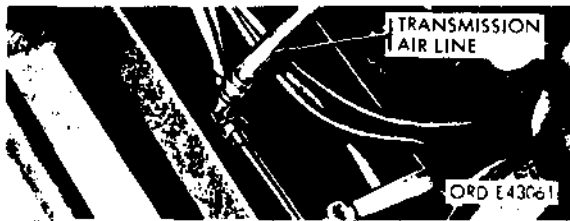


Figure 54.43. Transmission air line under vehicle.

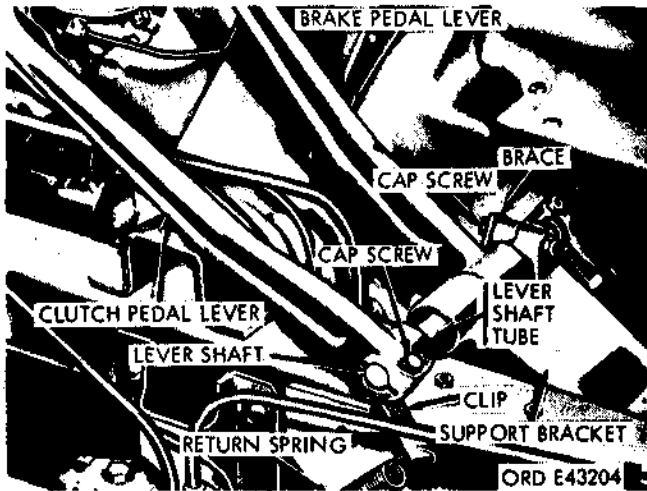


Figure 54.44. Brake and clutch pedal assembly mounted to vehicle.

(19) Disconnect clutch control linkage and return springs (brake and clutch) as follows (figure 54.44).

(a) Unhook the upper end of the clutch pedal return spring from the clip bolted to the lower end of the clutch pedal lever.

(b) Remove the nut and screw from the lower end of the clutch pedal lever, and remove the lever clip and key from the lever shaft.

(c) Unhook the upper end of the brake pedal return spring from the lower end of the brake pedal lever.

(d) Remove the nut and capscrew from the upper right side of the support bracket, and remove the lever shaft tube with the shaft and bushings from the brake pedal lever and support bracket.

(20) Disconnect PTO linkage (paragraph 206), drive shafts (paragraph 205) and hydraulic lines on vehicles which have special equipment.

NOTE

The hydraulic lines between the master cylinder, air hydraulic cylinder and axles are rigid type lines of seamless metal tubing. Flexible type lines are used to connect the axle lines to the wheel cylinders.

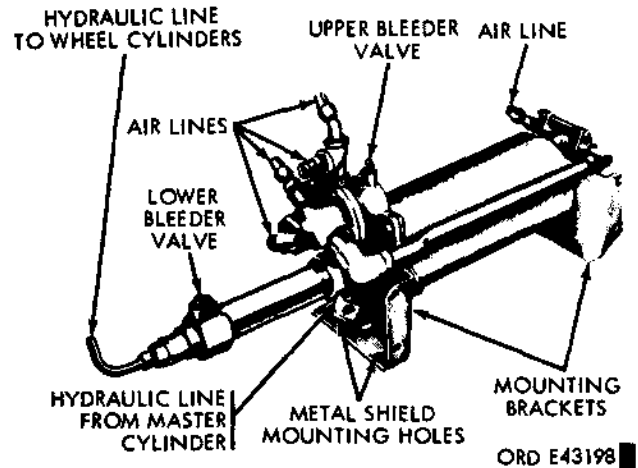


Figure 54.45. Air hydraulic cylinder.

(a) To remove the line, disconnect both of the ends of the line. Remove the retaining clips from the line. Remove the line from the vehicle (figure 54.45).

(21) Remove safety nuts and bolts securing transmission to transfer drive shaft (paragraph 181c).

(22) Attach lifting device. Loosen radiator, engine and transmission mounts and remove power pack from vehicle (figure 54.29, step 24). Place pack on stable foundation for testing or repairing.

b. Installation. Install power plant in reverse order of removal, proceeding from item (21) through (1).

Section III. REPAIR (GASOLINE, DIESEL AND MULTIFUEL ENGINES)

50. Gasoline.

Repairs to the engine may be performed with the engine installed in the vehicle provided the operation can be performed efficiently and is compatible to accessibility and clearance conditions. Refer to TM 9-2805-203-35.

50.1. Multifuel.

Refer to TM 9-2815-210-35.

51. Diesel.

The engine fuel injection pump and other components may be replaced while the engine is installed in the truck. Repairs to the engine may be performed with the engine installed in the vehicle provided the operation can be performed efficiently and is compatible to accessibility and clearance conditions. Refer to TM 9-2815-207-35.

CHAPTER 8

COOLING SYSTEM

Section I. DESCRIPTION AND DATA

52. General

This chapter contains a description and reference to pertinent publications for the removal and installation, and repair of the radiator, and water pump. Removal and Installation Instructions are contained in TM 9-2320-211-20. Instructions for the care and maintenance of the radiator hose, thermostat, and water outlet housing are also contained in TM 9-2320-211-20.

53. Radiator (Fig. 55)

The radiator (N) is composed of a fin-and-tube core housed within a top tank, bottom tank, and auxiliary sides. The filler-neck adapter (A) with filler cap (C) and level cock (M) is mounted on the rear side of top tank at the left. The inlet neck (L) is attached to the rear side of top tank at the right. The outlet neck (P) is attached to the rear side of bottom tank at the right. The filler-neck adapter is closed with a pressure filler cap assembly which maintains a pressure of 3-1/4 to 4-1/4 psi in the cooling system. An overflow and pressure relief tube attached to the filler-neck adapter opens into the space between the radiator cap and cap valve. The

tube extends down the left side of the core and discharges at the bottom. The drain cock (X) is attached to a flange on the bottom of the lower tank at the left.

54. Water Pump (Fig. 56)

The centrifugal-type water pump circulates water through the cooling system. It is located at the front of the engine on two studs (one on the crankcase and one on the front cylinder head) and secured by two nuts and one cap screw. The pump is driven by a fan pulley, mounted on the front of the pump drive shaft, which is connected to the engine crankshaft pulley by a pair of matched drive belts.

55. Data**a. Radiator.**

Make Modine
Type tube and fin

b. Water Pump.

Make Mack
Model 316 GCA - 1108B
Type centrifugal impeller

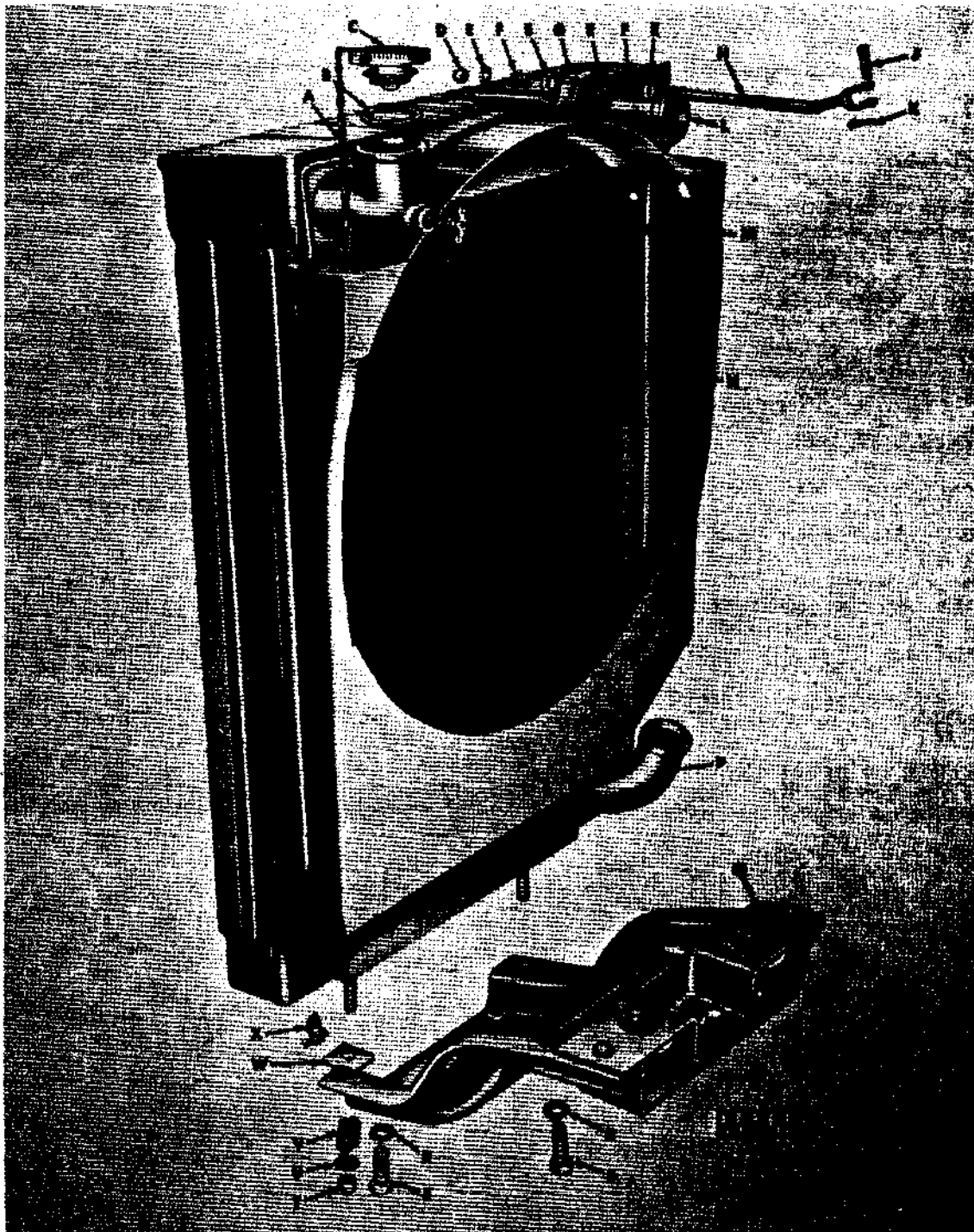


Figure 55. Radiator and mounting parts - exploded view

- | | |
|---|---------------------------------|
| A— Adapter, filler-neck | M— Cock, level |
| B— Gasket, filler cap | N— Radiator |
| C— Cap, filler | P— Neck, outlet |
| D— Nut, safety, 3/8-24NF-3 | Q— Support, mounting |
| E— Washer, plain, 13/32 id, 13/16 od | R— Washer, lock |
| F— Spring, compression, 7/8 in. free lg | S— Screw, cap |
| G— Bracket, stay rod | T— Nut, safety |
| H— Rod, stay | U— Washer, plain |
| J— Pin, clevis | V— Spring, compression, free lg |
| K— Pin, cotter | W— Spacer, support |
| L— Neck, inlet | X— Cock, drain |

Figure 55. Radiator and mounting parts—exploded view.

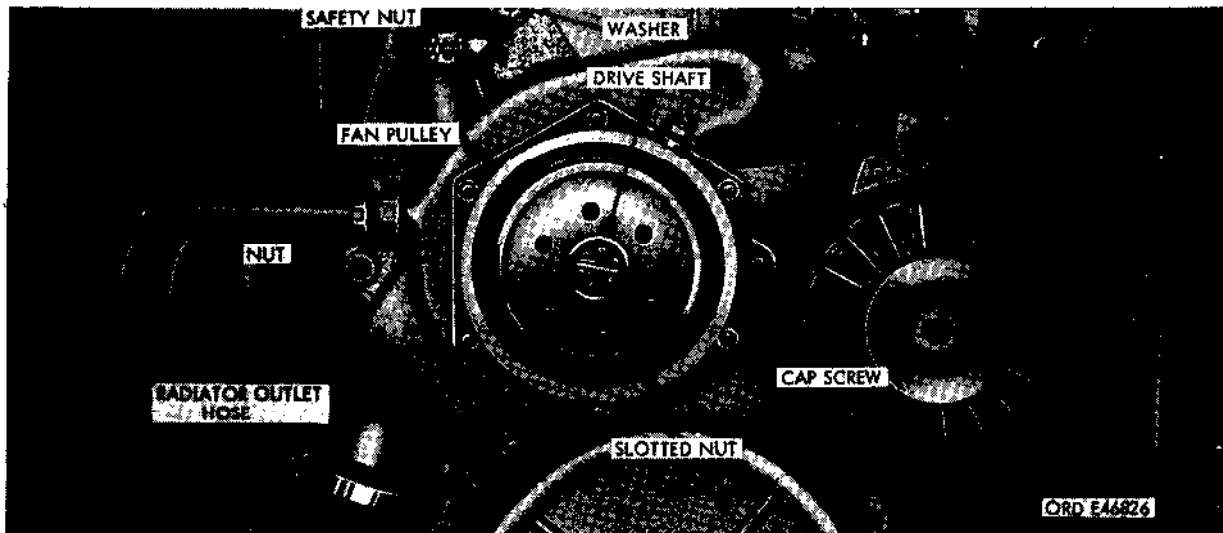


Figure 56. Front view of water pump with fan removed.

Section II. REPAIR

56. Radiator

Radiators will be repaired in accordance with TM 10-450 with the following exceptions: Due to the cooling characteristics of the 5-Ton Multifuel Engine, all tubes on the radiator for that engine must remain functional. No blocking or painting of fins during repair is authorized. Gasoline and Diesel Model radiators are exempted from these restrictions and may be repaired to the extent that up to two tubes maybe blocked

and one light coat of paint maybe applied.

57. Water Pump (Gasoline:

Refer to TM 9-2805-203-85.

58. Water Pump (Diesel)

Refer to TM 9-2815-207-35.

58.1 Water pump multifuel

Refer to TM 9-2815-210-35.

CHAPTER 9 CARGO BODY

Section I. DESCRIPTION AND DATA

59. Description

The open top metal body is mounted on the frame behind the cab. A paulin and two end curtains supported by six bow assemblies provide weather protection. Removable front and side racks include tubes for the six top bows. The removable bows are made of wood with metal reinforcements. Troop seats, incorporated in side racks, can be lowered and supported on hinged legs. Lashing hooks and red-amber reflectors (fig. 57) are bolted to the body. The tailgate is hinged

to the body. When lowered it provides a tailgate step assembly for mounting the cargo area. The spare wheel is mounted on a bracket inside the cargo body at the front end. A side rack gate allows removal of spare wheel assembly. (fig. 62)

60. Data (Cargo Body with Paulin)

Manufacturer.....Gar Wood
Model.....M41
Type.....cargo

Section II. REMOVAL AND INSTALLATION

61. Removal

a. *General.* The body assembly (fig. 57) consists of body, front and side racks, side rack

gate, troop seats, tailgate, bow assemblies, paulin, end curtains, front and rear splash shields, spare wheel carrier, and taillight bracket.

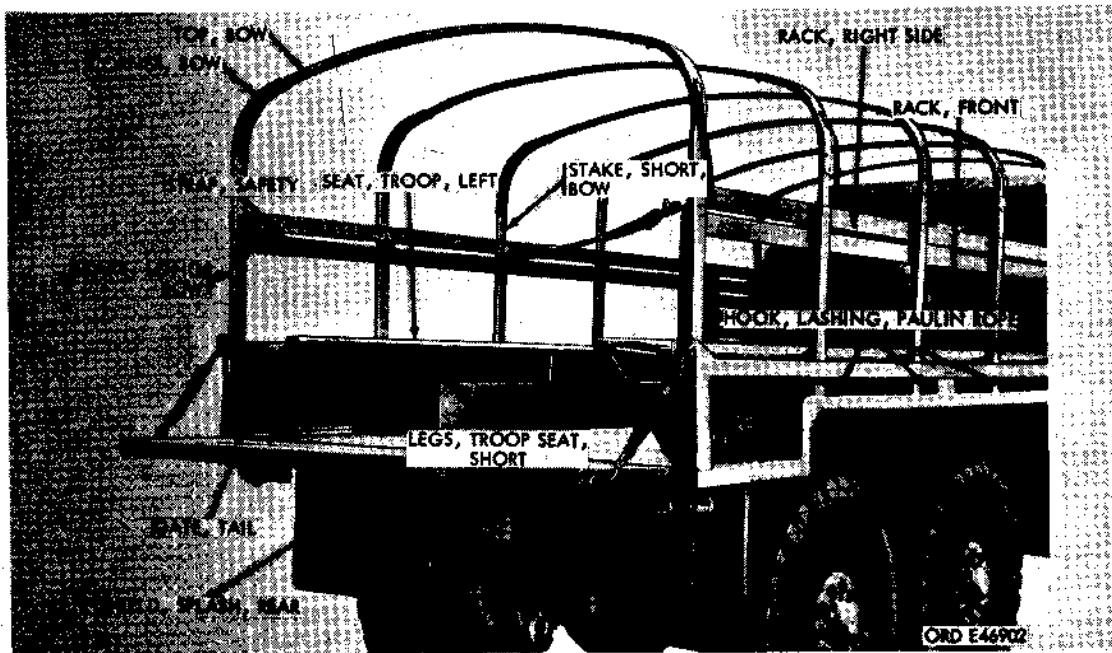


Figure 57. Right rear view of cargo body.

b. Remove Paulin, End Curtains, and Bow Assemblies.

- (1) Untie all paulin lashing ropes from paulin lashing rope hooks (fig. 58). Make first fold of top paulin on each side lengthwise until lower edge of paulin is even with roll-up strap buckles. Make second fold lengthwise on both sides until both folds meet. Bring one folded side over the other fold. At each end, make another equal end fold until folded paulin is supported only on one of the intermediate bow assemblies. Remove folded paulin.
- (2) Untie paulin front and rear curtain lashing ropes. Unwind lashing ropes from end bow assemblies and remove curtains.
- (3) Remove six bow assemblies, consisting of a bow top, bow corner, and bow stake, by lifting bows straight up until end clears tubes in side rack assemblies.

c. Disconnect Electrical Cables. Disconnect electrical wiring to stop- and taillights, trailer connector harness clips, and pull harness free of body.

d. Remove Body. Remove four nuts from mounting bracket bolts, two on each side, and remove bolts, washers, and inner and outer compression springs (fig. 59). Remove six nuts from mounting bracket cap screws (fig. 58), three on each side, and remove screws from side mounting brackets. Lift body assembly from chassis.

Note. Procedure for disassembly of body is progressive, beginning with tailgate. If



Figure 58. Cargo body mounting - intermediate

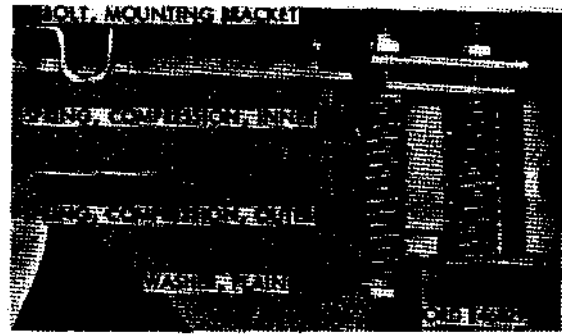


Figure 59. Cargo body mounting - front

inspection (par. (642(2))) reveals damage to an individual part, it may be replaced without complete disassembly.

e. Tailgate Assembly (Fig. 60). Unhook tailgate chains and remove eight cotter pins and washers from four tailgate hinge shafts. Support tailgate and remove tailgate hinge shafts. Remove two machine screws and safety nuts securing tailgate step hinge pins and remove pins and step.

f. Front Rack. Raise front rack (fig. 62) up to free ends of tubes from sockets and remove front rack.

g. Side Rack Assemblies. Fold right and left troop seats against side racks (fig. 62) and engage troop seat clamps. Raise side racks up to free ends of tubes from sockets and remove side racks and troop seats as assemblies. The left side rack assembly includes the side rack gate.

h. Troop Seat Assemblies (Fig. 61). Troop seats are removed with side racks or can be removed separately. To remove troop seats only, remove cotter pins and hinge pins from six hinges attaching each seat to rack tubes. Release seat latches, disengage hinges, and remove troop seats.

i. Front and Rear Splash Shields. Remove two screws and safety nuts connecting each splash-shield brace to body and splash shield. Remove two screws and safety nuts holding each shield to body and remove shield.

j. Bow Assemblies (Fig. 57). Remove screws and nuts holding bow corners to bow

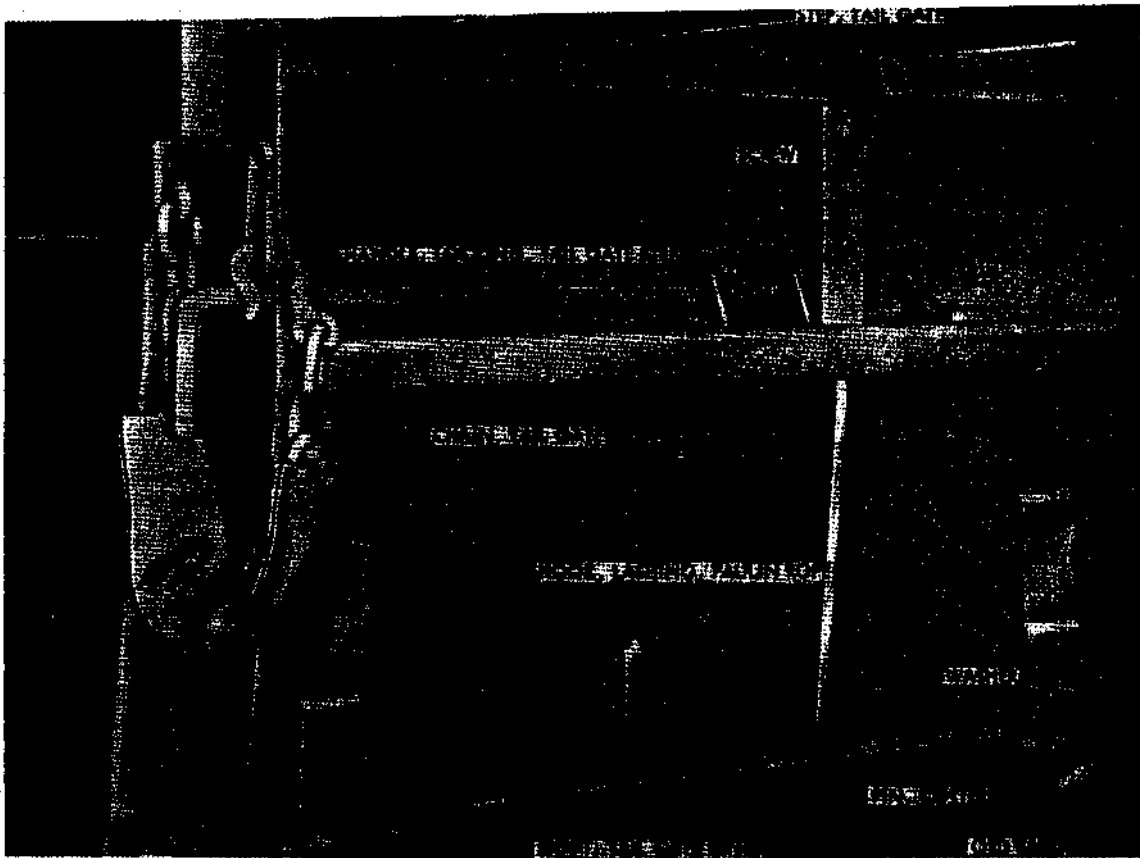


Figure 60. Tailgate assembly

tops and bow stakes. Remove tops and stakes. Remove screws and nuts holding strap assemblies to bow corners.

k. Spare Wheel Assembly. Remove two tire carrier stud nuts (Fig. 62) located inside front end of cargo, releasing spare wheel. A removable side rack gate assembly in the cargo body is provided for convenience of removing spare wheel assembly from body.

62. Installation

a. Front and Rear Splash Shields. Position front and rear splash shields under body and install 3/8-24NF-3 x 2-3/4 cap screws and 3/8-24NF-3 safety nuts. Position splash shield brace on body and shield and install twelve 3/8-24NF-3 x 1 cap screws, four 3/8-24NF-3 x 1-1/4 cap screws, and sixteen 3/8-24NF-3 safety nuts.

b. Troop Seat Assemblies (Fig. 57). Position troop seat assembly on side rack and install six hinge pins attaching seat to rack. Install six 3/32 x 3/4 cotter pins holding hinge pins in place. Raise seat and engage seat clamp to hold seat to rack.

c. Side Rack Assemblies (Fig. 62). Apply a light film of oil to tubes. Position tubes in body sockets and slide side rack into place.

d. Front Rack (Fig. 62). Apply a light film of oil to tubes. Position tubes in body sockets and slide front rack into place.

e. Side Rack Gate (Fig. 62). With the left side rack and front rack in place, slide rack gate in channel on side rack and hook into front rack.

f. Tailgate Assembly (Fig. 60). Support tailgate assembly on rear of body, and install

four tailgate hinge shafts attaching gate to body. Install eight washers and cotter pins to hold shaft in place. Raise tailgate and hook tailgate chain assemblies. Position tailgate step in tailgate and insert step hinge pins. Install screws and safety nuts, to secure the two hinge pins in position.

g. Spare Wheel Carrier. Position wheel and tire assembly to the two hinge-clamp studs and install two tire-carrier stud nuts (fig. 62).

h. Body. Lower body to chassis and align holes in mounting brackets. Install mounting bracket cap screws (fig. 58), three on each side, and install nuts. Install plain washers, inner and outer compression springs to mounting bracket bolts, two on each side, through mounting brackets and install safety nuts to each bolt.

i. Connect Electrical Cables. Connect electrical wiring to stop- and taillights at

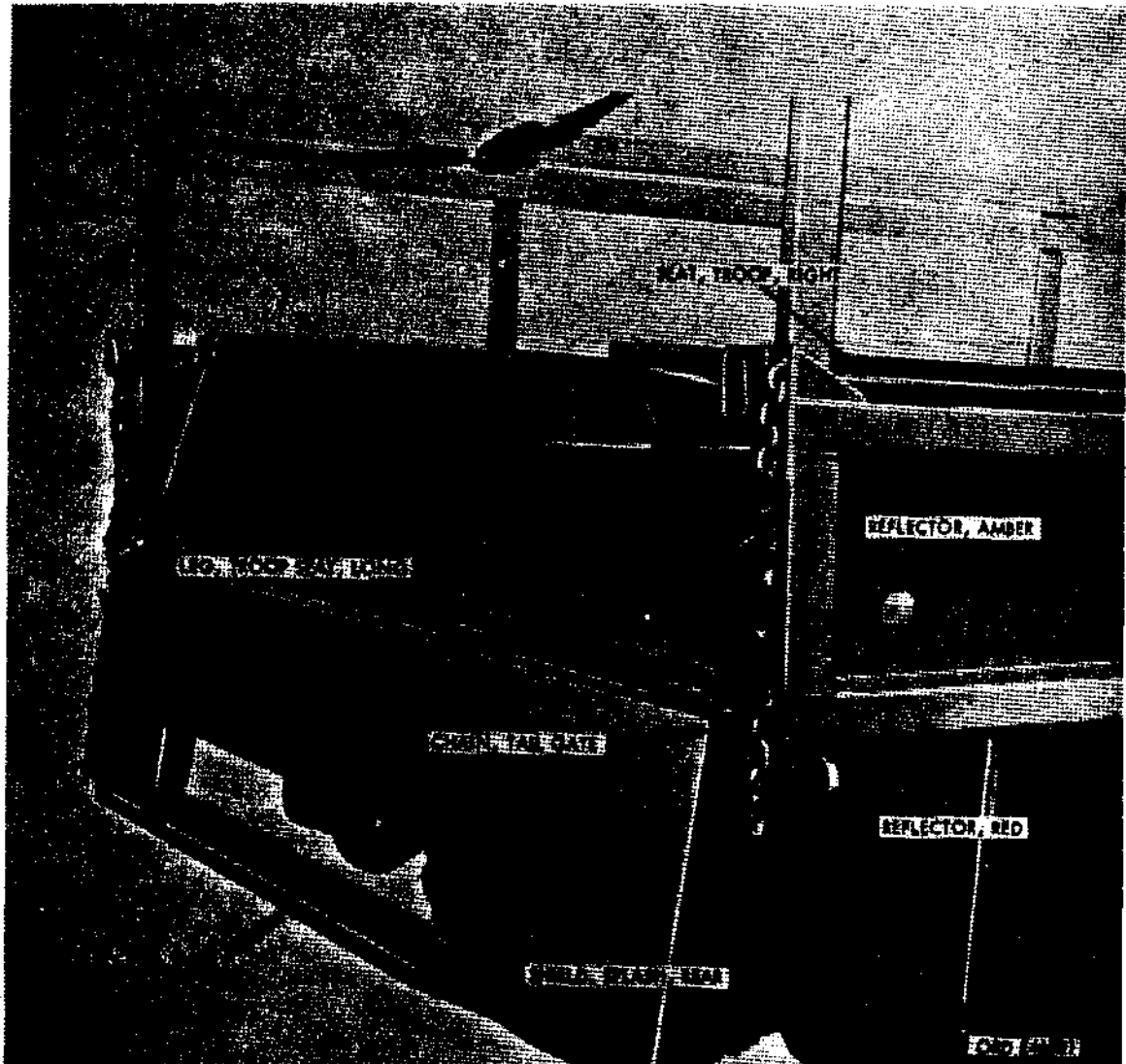


Figure 61. Cargo body tailgate lowered

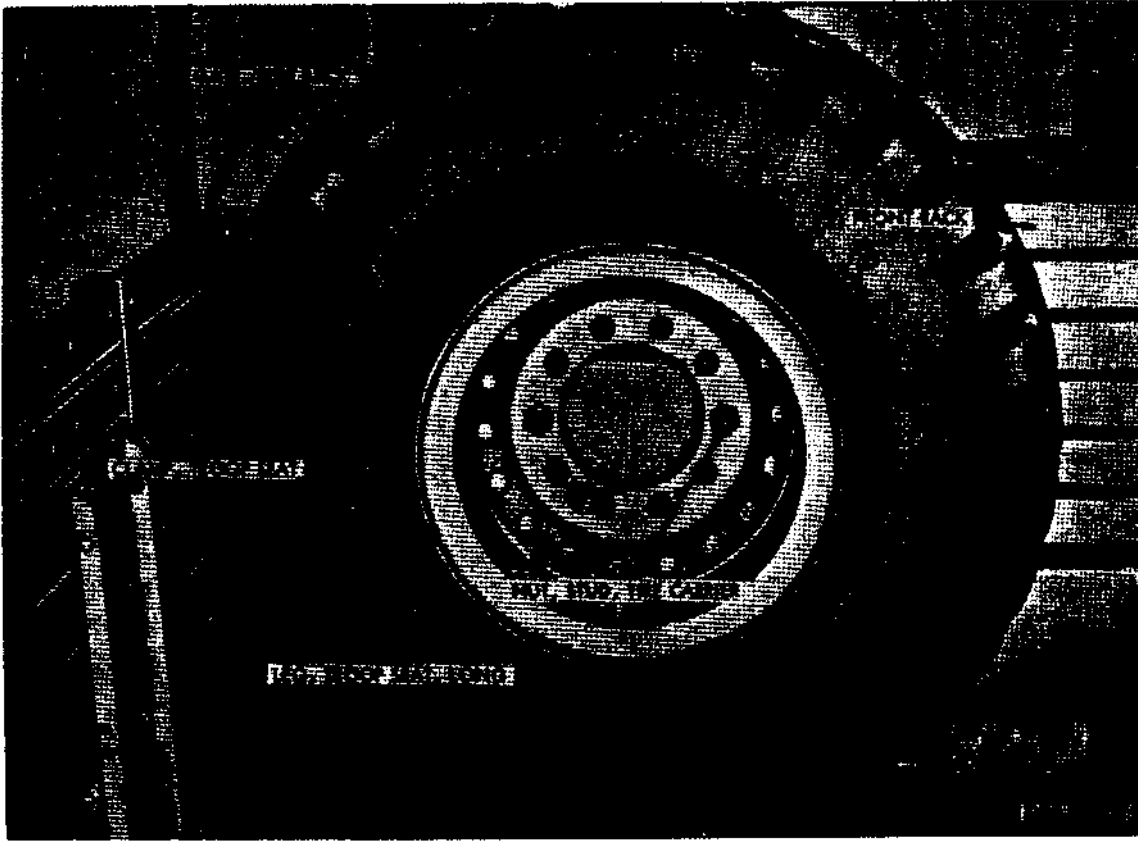


Figure 62. Spare wheel mounted

connectors, located behind units. Install trailer connector harness clips.

1. Install Bow Assemblies, End Curtains, and Paulin.

- (1) All six bow assemblies are installed in the same manner. The first, second, and rear bows are longer than the three intermediate bows. Engage ends of bow assemblies (fig. 57) in tubes in side racks and push down on bows to fully seat ends in tubes.
- (2) Place paulin front and rear curtains in position on front and rear end bow

assemblies. Make certain center of lashing rope is in center eyelet of curtain. Wind lashing rope around bow and through metal grommets in curtain. Tie ends of lashing rope to lashing hooks.

- (3) Place folded paulin across one of the intermediate bow assemblies. Locate end marked "front" and position paulin so this end will be at front of body. Unfold paulin and pull tight with front and rear draw ropes. Secure paulin with end and side lashing ropes.

Section III. REPAIR

63. **Cargo Body** (Fig. 57)

a. Disassembly and Assembly. Disassembly and assembly procedures for the cargo body are limited to those covered in Section II where the body is broken down to its smallest permissible component during removal.

b. Cleaning, Inspection, and Repair.

- (1) **Cleaning.** Use dry -cleaning solvent or mineral spirits paint thinner to clean or wash grease or dirt from body. Steam may be used to remove heavy accumulation of grease or dirt after dry -cleaning solvent or mineral spirits paint thinner has been applied. If steam is not available, a solution of one part grease-cleaning compound to four parts of dry-cleaning solvent or mineral spirits paint thinner may be used for dissolving grease. After cleaning, use cold water to rinse off any solution which remains.
- (2) **Inspection.** Inspect body for bent or dented sections.
- (3) **Repair.** Straighten as required and repair minor cracks. Repair minor fractures by welding.

Caution: Before welding, remove wood parts to avoid charring or burning.

64. **Racks and Troop Seats****a. Disassembly.**

- (1) **Troop seats.** Remove nuts and carriage bolts securing each of the troop seat slats to the seat channels, and remove slats and hinges. Remove self-locking nut and bolt attaching each of the five seat legs to five channels, and remove legs.
- (2) **Racks.** Remove nuts and carriage bolts securing side slats to tubes or front slats to end channels and tubes, and remove slats. Remove troop seat hinge bracket from each tube.

b. Cleaning, Inspection, and Repair.

- (1) **Cleaning.** Wash thoroughly with cold water under pressure or cold water and sponge. Use dry-cleaning solvent or mineral spirits paint thinner to remove grease deposits.
- (2) **Inspection.** Inspect racks and troop seats for cracked or damaged boards.
- (3) **Repair.** Repair wooden parts by splicing with wood or metal cleats. Make sure cleats do not affect function of repaired parts. Parts subject to considerable strain must be replaced and not repaired.

c. Assembly.

- (1) **Racks.** Attach troop seat hinge brackets to tubes. Replace slats and secure with nuts and carriage bolts.
- (2) **Troop seats.** Position seat legs and attach self-locking nut and bolt. Position and attach hinges and troop seat slats with nuts and carriage bolts.

65. **Tailgate**

a. Disassembly and Assembly. Disassembly and assembly procedures for the tailgate are limited to those covered in Section II where the tailgate is broken down to the smallest permissible component during removal.

b. Cleaning, Inspection, and Repair.

- (1) **Cleaning.** Wash thoroughly with cold water under pressure or cold water and sponge. Use dry -cleaning solvent or mineral spirits paint thinner to remove grease deposits.
- (2) **Inspection.** Inspect tailgate for bent or dented sections.
- (3) **Repair.** Parts subject to considerable strain must be replaced and not repaired.

CHAPTER 10

DUMP BODY AND HOIST ASSEMBLY

Section I. DESCRIPTION AND DATA

66. Description

a. Dump Body. The dump body (fig. 10) is of all steel welded construction with a universal-type tailgate which may be opened at either the top or the bottom. Tailgate wing assemblies (fig. 63) are also mounted on the rear of the dump body. These wing assemblies are used to convert the dump body to a rocker-type body with scoop-type rear end. The body is also equipped with a front end mounted cab shield assembly which extends over the cab roof. The cab shield assembly is of steel plate construction with steel reinforcing members.

b. Hoist Assembly (fig. 64). The hoist assembly consists of two double-acting cylinder assemblies; the hydraulic control system and

an oil reservoir are contained within the subframe unit. The cylinders are equipped with cast iron pistons, each of which has three piston rings. Cylinder assemblies are powered by oil from the positive gear-type hydraulic pump. Safety braces (fig. 64) are provided on each subframe side rail. These braces must be used at any time repair work is performed on the hoist unit. All hose used on this hoist assembly is of the double-wire, reinforced high pressure type, and must never be replaced with ordinary low pressure hose. A closed hydraulic system is provided with reservoir built into front end of subframe assembly. An oil level gage (fig. 66) is found directly under the filler cap.

c. Control Linkage (fig. 67). The hoist assembly is operated by a hand lever (U) located to the left of the driver's seat. A hand lever

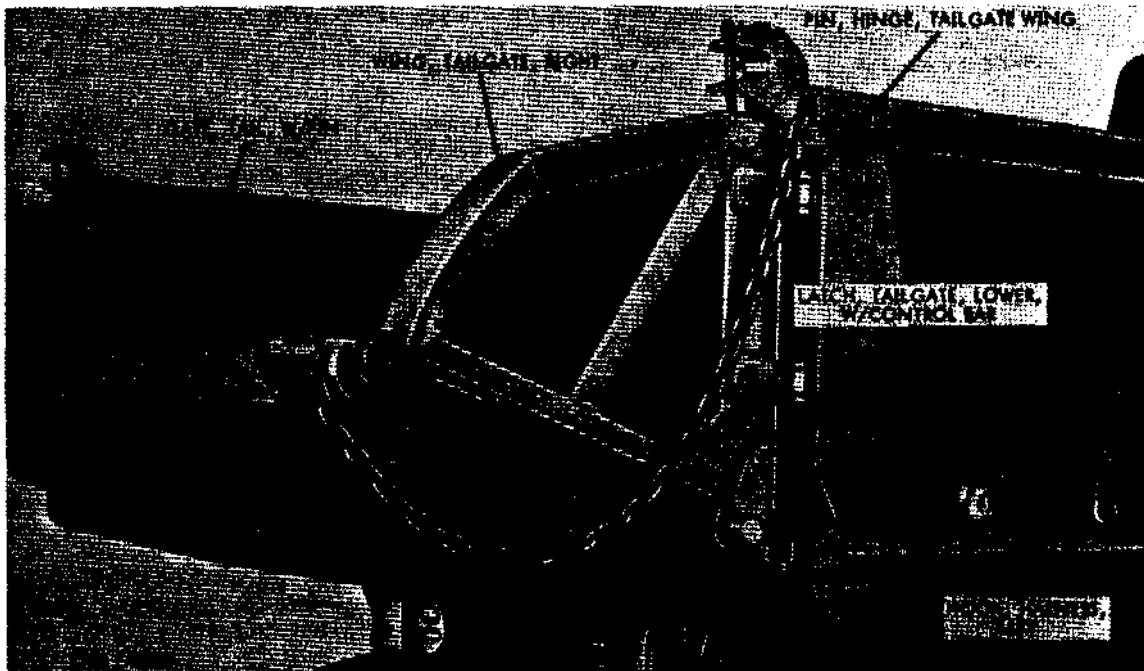


Figure 63. Dump body with tailgate wing assemblies extended

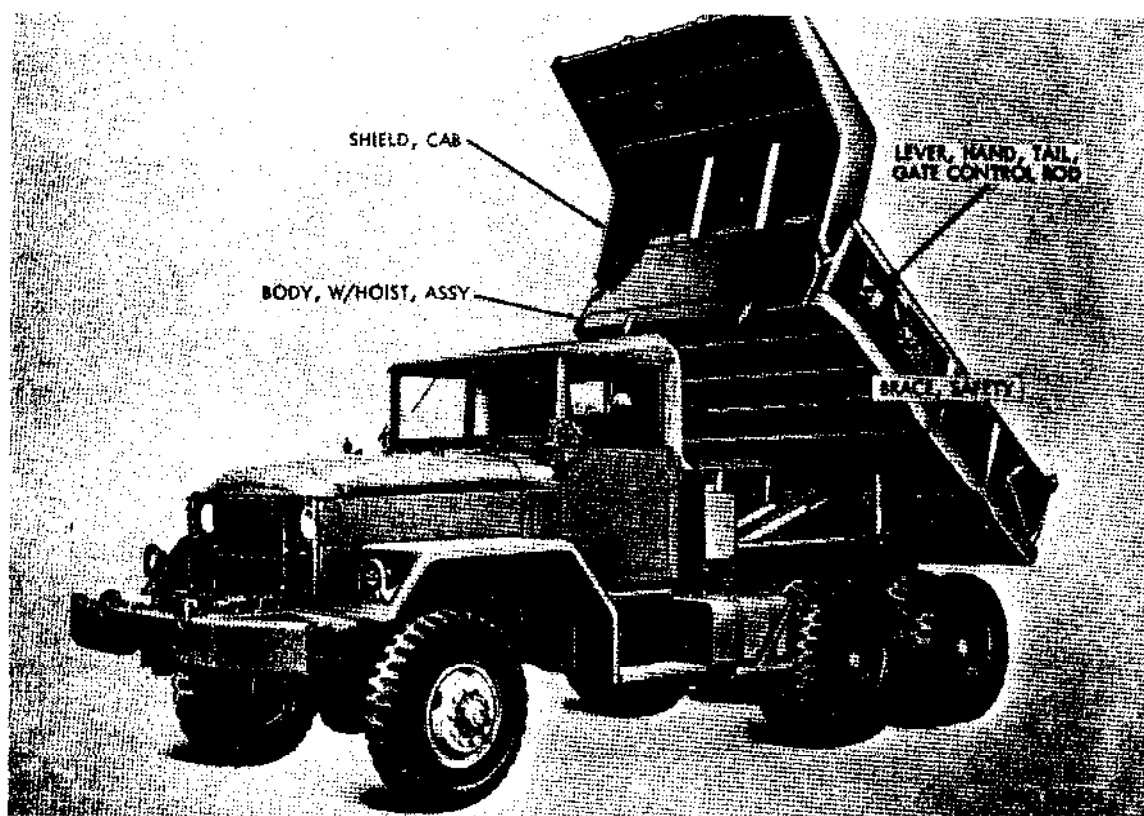


Figure 64. Dump truck M51 (body lifted) - left front view

lock (R) is provided to avoid accidental operation of the hoist assembly. The linkage from the hand lever (U) to relay (M) consists of hand lever cross shaft (V), hand lever cross-shaft lever (X), hand lever cross-shaft rod (W), relay cross shaft (T), relay cross-shaft left lever (Q), relay cross-shaft right lever (S), relay cross-shaft rod (P), and relay lever (N) at relay (M). Linkage from the relay (M) to power takeoff (A) consists of power takeoff relay lever (L), power takeoff relay-lever rod (G), power takeoff control cross shaft (F), power takeoff cross-shaft left lever (D), power takeoff cross-shaft right lever (E), and power takeoff cross-shaft rod (B). Power is transmitted from the power takeoff to the hydraulic pump (H) through a drive shaft assembly (C).

67. Data

Dump body assembly:

Manufacturer	St. Paul
Capacity	5 cu yd
Inside length	125 in.
Inside width	82 in.
Height of sides and ends	23 in.
Maximum dumping angle	70 deg

Hoist assembly:

Manufacturer	St. Paul
Model	ENG-D-7740-19
Hydraulic cylinders	2
Hydraulic pump capacity at 1,000 rpm	30 gal
Fluid capacity	37 qt
Hoist capacity	.5 cu-yd dump body

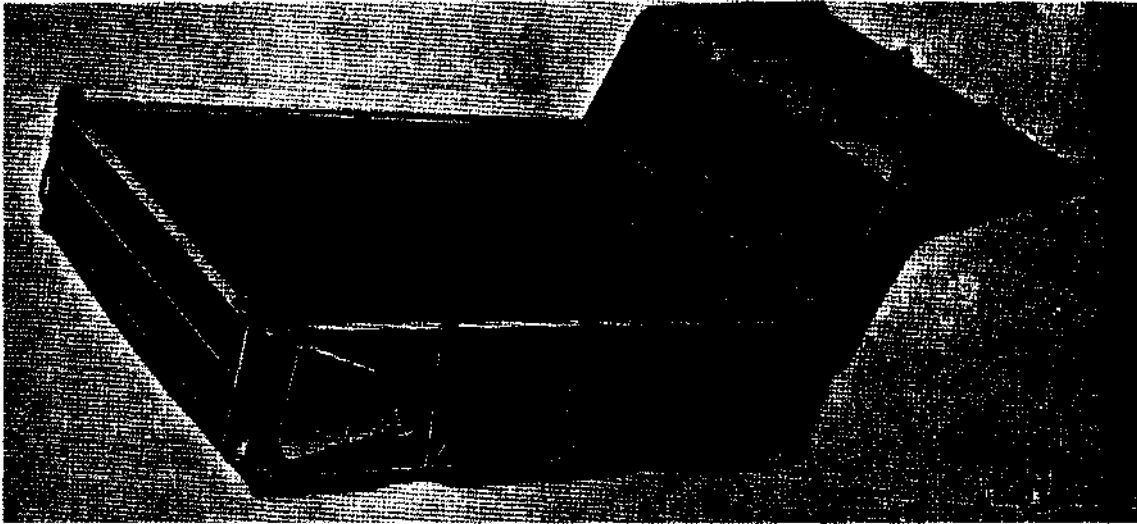


Figure 65. Dump body assembly

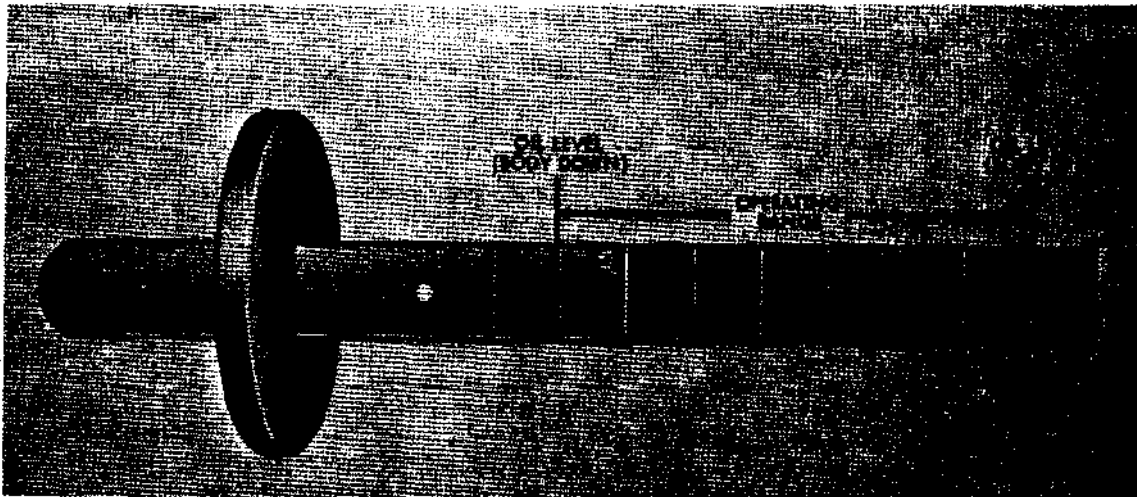
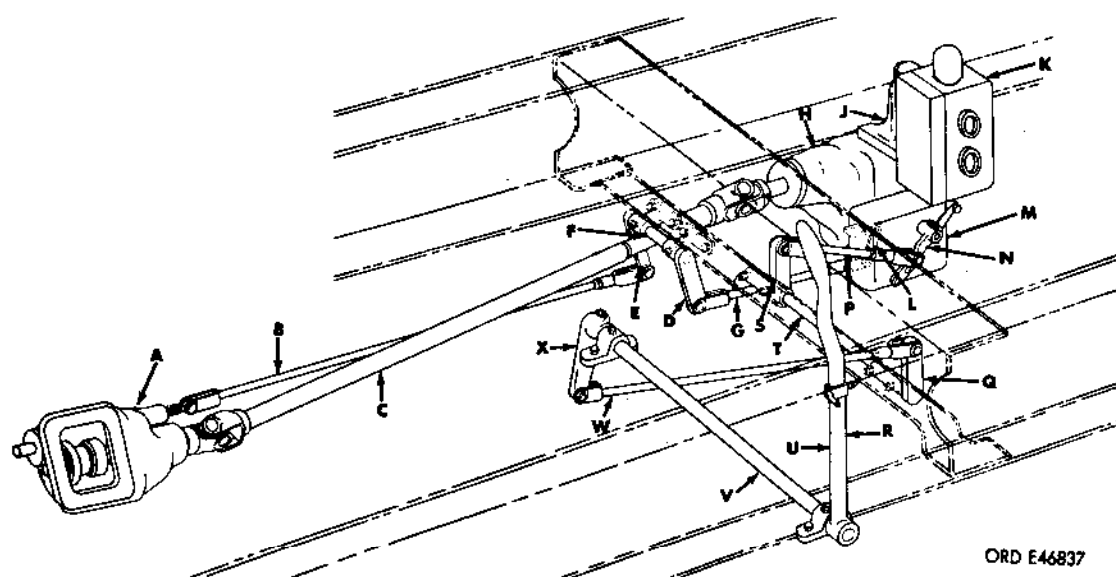


Figure 66. Oil level gage for hoist assembly



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Figure 67. Hoist assembly control linkage

Key	Item	Key	Item
A	Power takeoff	M	Relay
B	Power takeoff cross-shaft rod	N	Relay lever
C	Drive shaft assembly	P	Relay cross-shaft rod
D	Power takeoff cross-shaft left lever	Q	Relay cross-shaft left lever
E	Power takeoff cross-shaft right lever	R	Hand lever lock
F	Power takeoff cross shaft	S	Relay cross-shaft right lever
G	Power takeoff relay-lever rod	T	Relay cross shaft
H	Hydraulic pump	U	Hand lever
J	Valve adapter body	V	Hand lever cross shaft
K	Valve assembly	W	Hand lever cross-shaft rod
L	Power takeoff relay lever	X	Hand lever cross-shaft lever

Figure 67. Hoist assembly control linkage - legend

Section II. TROUBLESHOOTING

68. General

Troubleshooting is for use of Ordnance Maintenance Personnel in conjunction with, and as a supplement to, the troubleshooting table contained in this section. It provides the continuation of instructions where a remedy in the operator's manual refers to ordnance maintenance personnel for corrective action.

Note. By careful inspection and troubleshooting, damage and injury can be avoided

and, in addition, the cause of faulty operation of the vehicle or component can often be determined without extensive disassembly.

69. Troubleshooting the Dump Body

Note. Complete troubleshooting of the dump body consists of visual inspection, and this can be made on the vehicle. If inspection indicates complete replacement necessary, refer to paragraph 73 for removal and installation of the dump body.

a. Before Operation.

Caution: The inspections made while the component is mounted in the vehicle are for the most part visual, and are to be performed before attempting to operate the vehicle. The object of these inspections is to avoid possible damage or injury to personnel, and to determine the condition of, and when possible, what is wrong with the defective component.

- (1) Inspect for lubricant leakage. Visually inspect all gasket joints, plugs, and seals for evidence of lubricant leakage. Pay particular attention to pump shaft and piston rod seals. Tighten all mounting cap screws and, if leakage continues, replace gaskets. Tighten pump packing gland and cylinder packing gland cap screws.
- (2) Drive shaft assembly (fig. 67). Inspect the drive shaft assembly for excessive wear at universal joints or for bent or damaged condition. Repair instructions of the drive shaft assembly will be in paragraph 85 of this manual.
- (3) Hoist hydraulic pump assembly. Inspect the pump assembly for external damage and note if pump shaft will turn freely. If damaged, pump must be repaired (par. 80).
- (4) Flexible lines (fig. 78). Should inspection reveal any signs of weakness or leaking of the flexible lines, replace lines (par. 77).
- (5) Subframe assembly. Inspect subframe for cracked welds or damaged condition. Pay particular attention to lubricant leaks at reservoir. Repair subframe assembly by welding (par. 84).
- (6) Control linkage (fig. 67). Operate the control linkage and note any excessive wear or irregularities in the linkage. Note also if valve spool and control relay are operating properly and power takeoff engages and disengages without interference. Repair or replace worn or damaged components of the linkage (par. 74).

- (7) Further procedures. If these preliminary troubleshooting procedures do not disclose the fault, and the vehicle is operable, proceed as described in paragraph 70b below.

b. During Operation.

Caution: Check the hydraulic system oil level (par. 75) before attempting to operate the hoist assembly.

Note. Since the inspections in the preceding paragraph did not reveal causes of failure and the hoist assembly is operable, then start engine, operate hoist, and troubleshoot during operation.

(1) Power takeoff.

- (a) Fails to engage or disengage. Check control relay and see if both levers are functioning properly. Adjust the control linkage.

Caution: When making any adjustment on the control linkage, always check to see that power takeoff will disengage properly before using unit.

- (b) Noisy. Check lubricant level in transmission. If visual inspection does not reveal the defect, power takeoff must be repaired or rebuilt. Refer to paragraph 203 of this manual for complete troubleshooting and repair of the power takeoff.

- (2) Control linkage. Operate the hoist assembly through the POWER UP, HOLD, POWER DOWN, and NEUTRAL positions. Note any excessive wear at pivot points. Repair, replace, or adjust linkage as outlined in paragraph 85.

- (3) Hoist assembly. After operation, visually inspect for lubricant leaks (par. 75). Refer to paragraph 80 for replacement of hydraulic pump seal, and paragraph 80 for hydraulic cylinder seals.

Note. If units are not used frequently and are allowed to remain idle for any length of time, the packing has a tendency to dry out. If this is the case, operate the hoist assembly several times to lubricate packing.

- (4) Hoist hydraulic pump. A noise in the pump is usually an indication of lack of oil. If oil level is low, body will not raise smoothly, and pump will have a high pitched howling noise caused by starvation. Refill unit and check for leaks. If the pump is still noisy, remove, and repair the pump assembly (par. 80).

(5) Unit fails to function.

- (a) Check power takeoff and drive line to see if pump is running.
- (b) Check controls to valve to see if valve is shifting properly.
- (c) Check oil level in reservoir.

(6) Unit does not raise smoothly.

- (a) If body can be raised to safety braces, check oil level in reservoir.
- (b) If this happens in extremely cold weather, let pump run for a few minutes to warm up the oil.

(7) Dump body raised to full dump position but will not power down.

- (a) Check control valve (refer to fig. 100) to see if valve spool is operating properly.
- (b) Remove end cover (refer to fig. 99); then remove bypass plunger spring retaining plug (refer to fig. 98), spring, and ball. Check for foreign matter on ball seat. Check seat for nicks or burs. Tap ball lightly with a soft rod to preform seat and replace spring and plug.

- (8) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as described in paragraph 71 below.

Note. Inspection after the component is removed from the vehicle is performed to verify the diagnosis made when the component was in the vehicle, to uncover further defects, or to determine faults if the component alone is received by the ordnance establishment. This inspection is particularly important in the latter case, because it is often the only means of determining the trouble without completely disassembling the component.

a. General. After the component has been removed from the truck or if it is received already removed, and the defects are not known, visual inspection of each component is the only means of troubleshooting the hoist assembly. Check each component as listed below.

b. Hoist Hydraulic Pump. If visual inspection does not reveal defect, disassemble hydraulic pump (par. 80) and replace worn or defective parts.

c. Hydraulic Cylinders. The hydraulic cylinders are welded units and must be replaced as a unit should inspection reveal any internal damage. If the oil seals leak at piston rods, replace seals. Paragraph 84 covers detailed instructions of minor and major repair of subframe with cylinder assemblies.

d. Control Valve Adapter, Control Valve Assembly, and Control Relay Assembly. Visually inspect control valve adapter, control valve assembly, and control relay assembly for lubricant leakage or cracked or damaged castings. If inspection does not reveal defects, the units should be removed, disassembled, and rebuilt. References for repair and rebuild follow:

- (1) Control valve adapter. Refer to paragraph 81.
- (2) Control valve assembly. Refer to paragraph 83.
- (3) Control relay assembly. Refer to paragraph 82.

Table V. Troubleshooting - Dump Body and Hoist Assembly

Malfunction	Probable causes	Corrective action
1. Hoist assembly does not raise dump body.	<u>a.</u> Low oil level in hydraulic oil reservoir. <u>b.</u> Leak in hydraulic system. <u>c.</u> Power takeoff inoperative. <u>d.</u> Hydraulic pump inoperative. <u>e.</u> Damaged control linkage.	<u>a.</u> Add oil as specified in LO 9-2320-211-10. <u>b.</u> Inspect and tighten all connections as required. If leak persists replace gaskets. <u>c.</u> Check control relay and adjust control linkage. <u>d.</u> Replace worn or defective parts. <u>e.</u> Repair linkage.
2. Hoist assembly does not raise dump body smoothly.	<u>a.</u> Low oil level in hydraulic reservoir.	Refer to <u>1a.</u>
3. Body raises to full dump but does not power down.	<u>a.</u> Improper control linkage adjustment. <u>b.</u> Leak in hydraulic system.	<u>a.</u> Check control valve. <u>b.</u> Refer to <u>1b.</u>
4. Noisy hydraulic pump.	<u>a.</u> Low oil level in hydraulic oil reservoir. <u>b.</u> Defective pump.	<u>a.</u> Refer to <u>1a.</u> <u>b.</u> Refill unit with oil and check for leaks.

Section III. REMOVAL AND INSTALLATION

72. Safety Precautions

When the dump body is held in a raised position by a hoist, the oil in the system is under pressure. Any movement of the control valve or leakage at hydraulic cylinder line or hose connections can cause body to drop to sub-frame. Therefore, the following safety precautions must be strictly enforced to avoid personal injury or damage to the hoist assembly.

a. Never work under the dump body unless safety braces (fig. 64) are properly positioned. When body is partially raised, always use a strong heavy prop to hold body in a raised position.

b. Never race the engine when operating the hydraulic pump. This will cause air pockets to form in the oil, pump to get overheated and seize, drive shaft to break, and may cause ex-

tensive damage to the power takeoff and transmission.

c. Do not operate hoist assembly unless all mounting bolts are tight.

d. Always use clean oil in the hydraulic system.

e. Never leave hoist assembly engaged while truck is driven to and from a job.

f. Make certain all connections are tight before attempting to operate the dump body and hoist assembly.

73. Dump Body Assembly

Note. Body must be raised and blocked securely with safety braces prior to accomplishing disassembly. Some defective parts may be repaired or replaced without removing

the dump body from the vehicle. If complete replacement is necessary proceed as follows.

a. Removal.

- (1) Remove capscrew, hex-head nut, and lockwasher from each thrust plate lifting pin (fig. 68).
- (2) Raise dump body to permit lowering safety braces (fig. 64), and position body in extreme lowered position.
- (3) Remove lubricating fitting from both thrust plate lifting pins. Drive pins from dump body thrust plates and lifting arm with roller assemblies (fig. 68).
- (4) Remove five capscrews, hex-nuts, and lockwashers from each hinge bracket (fig. 69). Attach a chain hoist and remove dump body assembly.

b. Installation.

- (1) Attach a suitable chain hoist and lift dump body assembly into position on subframe assembly.
- (2) Aline dump body thrust plate holes and lifting arm with roller assembly and install thrust plate lifting pins (fig. 68).

Note. Aline pin hole with thrust plate hole for installation of capscrew.

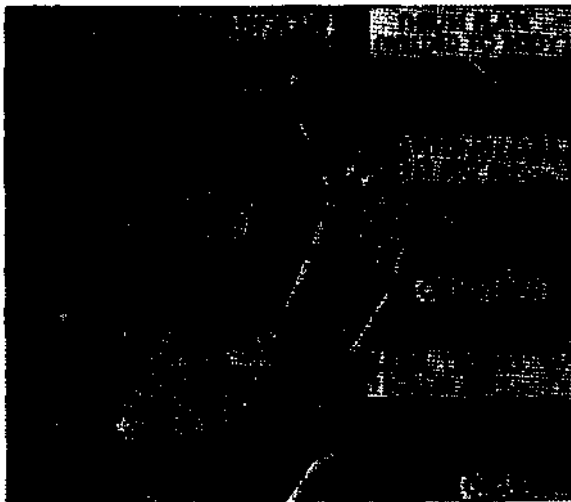


Figure 68. Dump body lifting arms disconnect points.

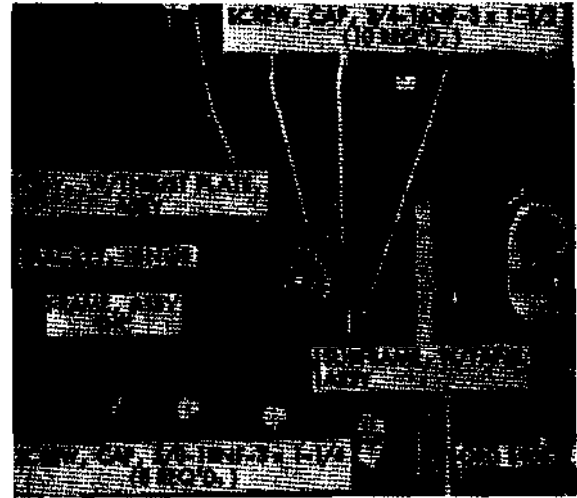


Figure 69. Dump body hinge bracket and subframe to rear frame disconnect points.

- (3) Aline the hinge brackets with dump body and install the five capscrews, lockwashers, and hex-nuts at each hinge bracket (fig. 69). Tighten securely.
- (4) With the thrust plate lifting pins (fig. 68) in position, raise the dump body and secure in the raised position. Use the safety braces (fig. 64) provided.
- (5) Install the capscrews, lockwasher, and hex-nut at each pin, securing thrust plate lifting pins (fig. 68) to thrust plates.
- (6) Install the lubricating fitting (fig. 68) in each thrust plate lifting pin.
- (7) Raise the dump body to permit lowering of safety braces and position body in the extreme lowered position.

74. Hoist Assembly

a. Removal.

- (1) Disconnect control linkage (fig. 67).
 - (a) Disconnect control relay cross-shaft rod (P) at relay lever (N).
 - (b) Disconnect power takeoff relay-lever rod (G) at power takeoff relay lever (L).
 - (c) Loosen setscrew and disconnect drive shaft assembly (C) at hydraulic pump (H).

(2) *Disconnect subframe from frame assembly (fig. 70).*

- (a) Remove eight capscrews, safety nuts, and lockwashers (four on each side) from rear end of subframe assembly.
- (b) Remove two cotter pins, slotted nuts (fig. 70), plain washers, keepers, tension springs, and hex-head bolts at left and right front mounting brackets.
- (c) Attach chain hoist and lift hoist assembly from the vehicle. Also remove mounting sill from each frame side rail.

b. Installation.

- (1) Position mounting sill on each frame side rail.
- (2) Lift hoist assembly in position on frame side rails.
- (3) Aline the front mounting bracket holes. Assemble the four hex-head bolts, eight spring keepers (fig. 70), and four tension springs. Position hex-head bolts with spring and keepers assembled through left and right front mounting brackets. Install plain washers and slotted nuts on left and right hex-head bolts. Tighten the slotted nuts and compress springs until cotter pin hole in bolt is visible at slotted nut. Lock slotted nuts with the cotter pins.
- (4) Install the four capscrews (fig. 70), lockwashers, and safety nuts at each

rear mounting plate on the subframe assembly.

- (5) Control linkage assembly (fig. 67).
 - (a) Install drive shaft assembly (C) on hydraulic pump (H), making certain the Woodruff key is properly aligned. Secure with setscrew.
 - (b) Position control relay cross-shaft rod (P) on relay lever (N) at relay (M), and install clevis pin through lever and secure with cotter pin.
 - (c) Position the power takeoff relay-lever rod (G) on power takeoff relay (L) at relay (M). Install clevis pin through lever and secure pin with cotter pin.

75. Lubrication

a. General. Lubrication of the dump body and hoist assembly for items such as hinge pins, linkage, drive shaft, and power takeoff is covered in LO 9-2320-211-12. Special instructions for checking and filling the reservoir and hydraulic system are covered in *b* and *c* below.

b. Checking Oil Level in Reservoir (fig. 66). The oil reservoir oil level gage is located in the filler neck of the oil reservoir. This gage is painted red, starting from the third notch from the top on down to the bottom of the gage. When the dump body is in its lowered or traveling position, the oil level should show on the top; but not above the top red graduation of the gage. When the dump body is raised, the oil level should show on the lowest, but not above the lowest, red graduation on the gage. When filling of the reservoir is necessary, see the instructions outlined in *c* below.

Caution: If oil in reservoir is above the prescribed levels, the system must be drained to specified limits; otherwise damage to system may result.

c. Reservoir Filling. The filling instructions given below are intended for use after system has been drained. If checking alone is all that is necessary, see *b* above. Because the hydraulic system is closed and not vented, it will be necessary to keep tank pressure to a minimum: To get the lowest possible tank pressure, the following procedure must be observed.

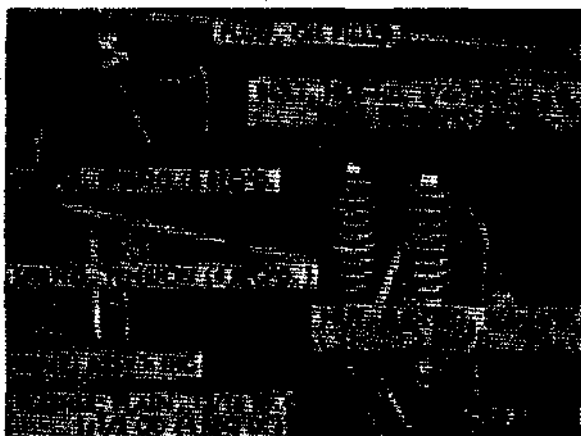


Figure 70. Subframe to frame front disconnect points.

- (1) Completely fill the oil reservoir with hydraulic oil, petroleum base (OHA).
- (2) To raise body, start the truck engine and slowly engage dump body hand control lever at the left rear of the driver's seat.
- (3) Raise dump body sufficiently to rest body on safety braces, and engage braces.
- (4) Remove filler cap and check level of oil on the oil level gage. Fill reservoir until oil appears on gage at the first graduation up from the bottom (fig. 66).
- (5) Install gage and filler cap. Tighten filler cap.
- (6) Lower dump body and slowly loosen the filler cap until all tank pressure has been released. Remove the filler cap.
- (7) Check level of oil again and, if necessary, fill reservoir until oil shows on the top red graduation of the oil level gage (fig. 66).
- (8) Install gage and filler cap. Tighten filler cap.
- (9) To eliminate air in the system, hold the hand control lever in power down position and operate the pump a few seconds after the body is at its down position. Loosen filler cap and release air pressure in reservoir. Tighten filler cap.
- (10) Raise and lower dump body slowly six or seven times and again loosen filler cap to release air pressure in reservoir. Tighten filler cap.
- (11) Repeat (3) through (8) above.

Section IV. DISASSEMBLY INTO AND ASSEMBLY FROM SUBASSEMBLIES

76. Dump Body

a. Disassembly.

- (1) General. Disassembly of the various parts from the dump body will not be necessary unless inspection reveals damaged parts or excessive wear. If repairs are indicated, disassembly is as follows.
- (2) Remove cap shield assembly. Remove the 19 cap screws, nuts, and lockwashers which attach the cap shield (fig. 64) to body. Remove cap shield.
- (3) Remove tailgate wing assemblies (fig. 63). Unlatch the harness hook assembly which fastens tailgate wing in hold back position. Remove two groove pins from each tailgate wing hinge pin and remove the two tailgate wing hinge pins. Lift tailgate wing assemblies from each side of body.

Note. The tailgate wing has a tendency to swing open while the vehicle is in motion due to the tailgate wing chain hook being too wide. To correct this, bend hook to just fit the chain link as shown in figure 71.
- (4) Remove tailgate assembly. Removal of the tailgate with pin (fig. 65) is accomplished with tailgate closed. Pull tailgate control rod hand lever (fig. 67) forward to disengage lower tailgate

latch from tailgate lower pins. Unhook tailgate drop chains from dump body. Remove tailgate upper latch pins from both sides of dump body. Lift off tailgate.

- (5) Remove tailgate hand lever and linkage. Operate tailgate control rod hand lever (fig. 67) to provide maximum clearance for disconnecting control rods. Remove cap screw, nut, and plain washer from control rods fastened to control rod lever on right side of dump body and hand lever on the left side of dump body. Remove cotter pins, slotted nuts, and link bar from link assembly and remove link assembly from each side of body. Remove hex-nut and clevis from both tailgate control rods and remove control rods from front of body. Remove cap screw, hex-nut, and lockwasher from hand lever and remove lever and Woodruff key from cross shaft. Repeat this operation for removal of control rod lever on opposite end of cross shaft. Remove two cap screws, hex-nuts and lockwashers from each of the cross-shaft bearings and take out cross shaft and cross-shaft bearings from underside of dump body. Remove three cap screws, hex-nuts, and lockwashers from each tailgate lower latch with control bar assembly and remove from both sides of dump body.

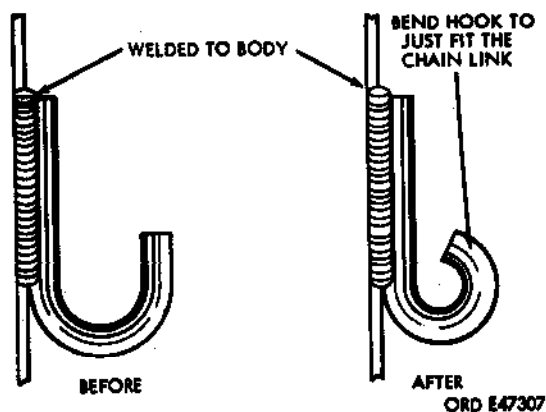


Figure 71. Tailgate wing chain hook

b. Assembly.

- (1) **Tailgate hand lever and linkage.** Position tailgate lower latches with control bar (fig. 67) on body and install three hex-head cap screws, hex-nuts, and lockwashers to secure each in place. Place the three cross-shaft bearings on cross shaft and secure bearings and shaft assembly to underside of body with two hex-head cap screws, two hex-nuts, and two lockwashers at each bearing. Install control rod lever and Woodruff key to cross shaft end at right side of dump body and secure to shaft with one hex-head cap screw, hex-nut, and lockwasher. In a similar manner, secure tailgate control rod hand lever (fig. 67) to cross shaft at left side of dump body. Install one tailgate lower latch with control bar assembly at each side and rear of body and secure each with hex-head bolts, three hex-nuts, and three medium lockwashers. Install link assembly on both right and left sides of body. One stud of link assembly will fasten into body and lower stud will join control bar of lower latch assembly with eye of control rod assembly. Secure link assembly with link bar, two slotted nuts, and two cotter pins. Insert control rods through openings in second cross member from front. Pass control rod on through the openings in each cross member from front to rear until eye on rear end of control rod is positioned between last two cross members. Place clevis on threaded ends of control rods

and secure with hex-nut. Operate hand lever so that lever may be connected to clevis now affixed to control rod on left side of body, and also that control rod lever may be connected to clevis now affixed to control rod on right side of body. Check operation of hand lever to be sure that tailgate lower latch is completely open when hand lever is forward, and also that lower latch is in closed position when hand lever is upright.

- (2) **Install tailgate assembly.** To install tailgate assembly, first make sure that tailgate control rod hand lever (fig. 67) is in the forward or released position. Place tailgate to body with upper hinge pins resting in upper tailgate latch assembly. Insert pin on end of smaller chain through holes in bracket to hold tailgate assembly in place. Insert drop chains in eyes at each side of body. Push tailgate control rod hand lever to upright position to clamp tailgate lower hinge pins to body.
- (3) **Install tailgate wing assemblies** (fig. 63). Position the right tailgate wing assembly onto the tailgate wing brackets on right side of body and insert the two hinge pins. Lock hinge pins in place by installing groove pins into each hinge pin. Swing tailgate wing assembly back against side of body and latch in place with harness hook assembly. Repeat the above operations for installing the left tailgate wing assembly.
- (4) **Install cab shield** (fig. 64). Align mounting holes of cab shield with corresponding holes in dump body and secure shield in place with cap screws, nineteen hex-nuts, and nineteen lockwashers.

77. Hoist Assembly

a. Disassembly.

- (1) **Remove hoist hydraulic pump assembly.**
 - (a) Remove pipe plug (fig. 72) from reservoir tank and drain the hydraulic system. In order to thoroughly drain the hydraulic system, the pistons should be in the extended or raised position.
 - (b) Remove the six cap screws and lockwashers securing hoist hydraulic

pump (fig. 72) to control valve adapter body, and remove pump assembly and gasket. Discard gasket.



Figure 72. Removing hoist hydraulic pump.

(2). Remove control valve adapter assembly.

- (a) Remove the eight capscrews, and lockwashers securing control valve adapter body (fig. 73) to the control valve.
- (b) Remove body and discard gasket.



Figure 73. Removal of control valve adapter assembly.

(3) Remove control relay.

- (a) Remove hex-nut, lockwasher, and capscrew, and remove the two control valve levers (fig. 74).



Figure 74. Remounting control valve control levers.

- (b) Remove two capscrews, lockwashers, and one machine screw; securing control relay (fig. 75) to hoist subframe assembly, and remove control relay.



Figure 75. Removing control relay.

(4) Remove control valve assembly and manifolds.

- (a) Disconnect the four flexible lines (fig. 76) at flexible line unions in upper and lower manifold.
- (b) Remove seven capscrews and lockwashers attaching control valve assembly, with upper and lower manifold, to mounting base, and remove control valve assembly (fig. 77). Discard gaskets.

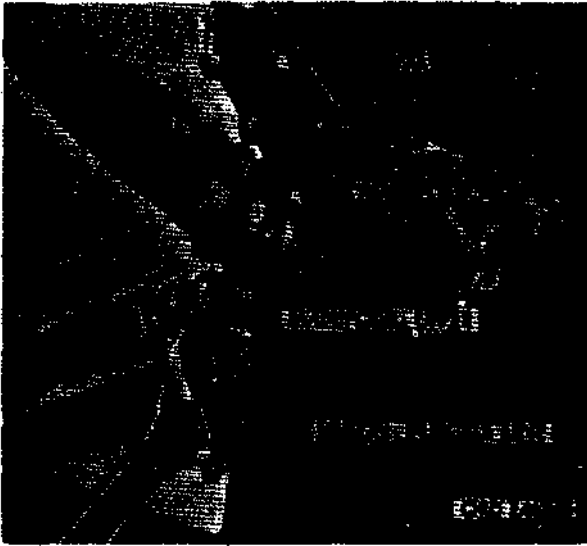


Figure 76. Disconnecting flexible lines at manifolds.

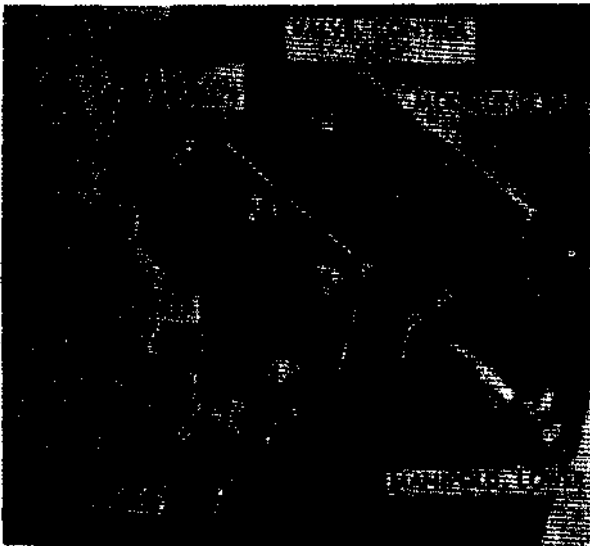


Figure 77. Removing control valve assembly with manifolds.

- (5) Remove hydraulic cylinders.
 - (a) Disconnect the four flexible lines from fittings at ends of hydraulic cylinders (fig. 78).
 - (b) Raise the hydraulic cylinder assemblies, and slide the lifting arm with roller assemblies (fig. 79) from each end of crosshead.
 - (c) Remove the two capscrews and lockwashers from each upper cross-



Figure 78. Location of flexible lines at hydraulic cylinders.



Figure 79. Disconnecting crosshead from hydraulic cylinder piston rods.

- head retainer (fig. 79). Remove the upper and lower retainers and crosshead from end of hydraulic cylinder piston rods.
- (d) Remove the two cap screws and lockwashers from each bearing cap (fig. 80). Remove two bearing caps from each hydraulic cylinder and remove hydraulic cylinder from the subframe assembly.

Caution: Hydraulic cylinders should be supported during removal from subframe due to excessive weight, thereby avoiding possible damage to the hydraulic fluid bypass tubes.



Figure 80. Removing bearing cap

b. Assembly.

- (1) Install control valve assembly. Position the control valve assembly mounting gasket to valve mounting base and place control valve cover gasket and cover on the valve. Install the control valve to mounting base and secure with eight cap screws (fig. 77) and eight lockwashers.

- (2) Install control relay housing.

- (a) Position control relay to subframe assembly and secure relay to subframe, using two cap screws (fig. 75), two lockwashers, and one machine screw.
- (b) Install two control valve control levers (fig. 74) over the spool trunnion and control valve cam shaft, and secure with one cap screw, one lockwasher, and one hex-nut.

- (3) Install control valve adapter assembly. Position new gasket on control valve adapter body (fig. 73) and install the adapter body to the control valve assembly, using eight cap screws, and eight lockwashers.

- (4) Install hoist hydraulic pump assembly.

- (a) Place a new gasket on hoist hydraulic pump, and install pump to control valve adapter body, using six cap screws (fig. 72) and six 1/2-inch lockwashers.
 - (b) Install the pipe plug (fig. 72) in reservoir tank.
- (5) Install flexible lines at manifold. Install four flexible lines to hydraulic cylinders (fig. 78). Install opposite end of flexible lines to upper and lower manifolds at control valve assemblies as shown in figure 76.
 - (6) Install hoist assembly on the vehicle. Refer to paragraph 74.

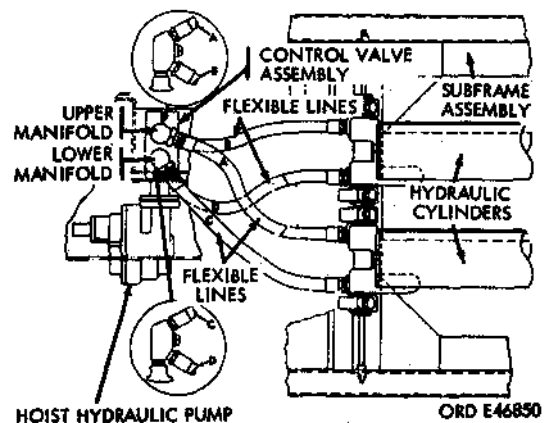


Figure 81. Hoist assembly flexible lines

Section V. REPAIR**78. Dump Body**

a. Disassembly. The disassembly of the various parts from the dump body will not be necessary unless inspection reveals damaged parts or excessive wear. If repairs are indicated, refer to paragraph 76 for disassembly.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Use a stiff brush and cold water under pressure or steam cleaning equipment if available.
- (2) Inspection. Inspect cab shield, dump body, and tailgate assembly for cracks

or dents. Look particularly for broken weld joints or seams. Inspect control linkage for bent or damaged control rods and levers.

Note. Be sure to check control linkage for signs of wear beyond good usage. Fittings must be tight and snug for efficient operation.

Repair. If inspection reveals the need for repair to any of the body parts, the following instructions will apply. Sheet metal parts can be repaired by straightening, brazing, or welding; however, badly damaged sheet metal parts must be replaced. In no case should heat be applied when straightening other dump body parts. Application of heat will weaken the metal structure. Any part bent or buckled enough to show strain or cracks after straightening should be replaced or reinforced.

c. Assembly. Refer to paragraph 76.

79. Hydraulic Hoist Assembly

Refer to paragraphs 80 to 85 below.

80. Hydraulic Pump Assembly

a. Disassembly.

(1) Remove pump packing gland and cover.

- (a) Secure pump housing in vise and remove the three cap screws and lockwashers attaching pump packing gland to pump cover. Slide pump packing gland from pump upper shaft (fig. 82).

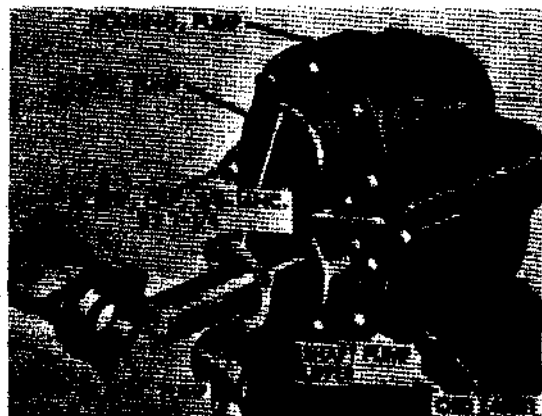


Figure 82. Removing pump packing gland from shaft

- (b) Remove the 12 cap screws (fig. 83) and lockwashers from pump cover. Remove pump cover and pump cover shims from pump housing (fig. 82). Take special care to protect shims.

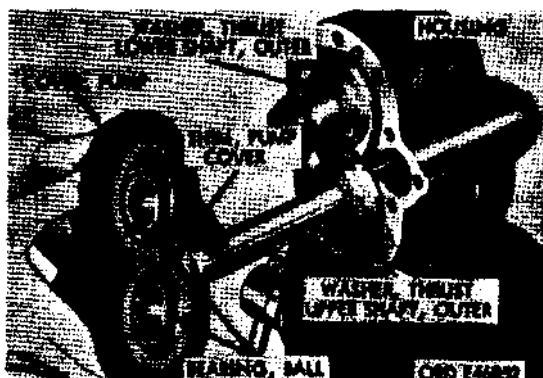


Figure 83. Removing pump cover from pump housing

- (c) Remove pump packing, pump packing gland ring, and compression spring from recess in outside of pump cover (fig. 84). Remove two ball bearings from inside of pump cover (fig. 83).

(2) Remove upper and lower shaft assemblies.

- (a) Before removal of upper and lower shaft outer-thrust washers from pump upper and lower shafts, the washers should be marked along with pump

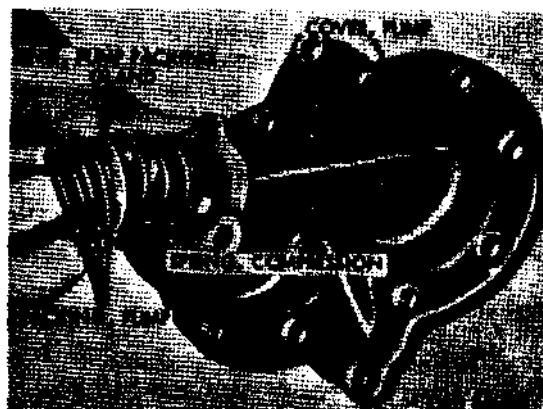


Figure 84. Disassembling pump cover

housing (fig. 85) to determine correct position for reassembly. Remove upper and lower shaft outer-thrust washers.



Figure 85. Pump housing with cover removed

- (b) Remove pump upper and lower shafts with gear assemblies from pump housing (fig. 86). Be careful in handling gears to avoid nicks or burrs.



Figure 86. Removing shafts with gears from pump housing

- (c) Remove upper and lower shaft inner-thrust washers from inside of pump housing (fig. 87).

Note. These thrust washers should also be marked, as in (1) above, to ensure correct assembly.

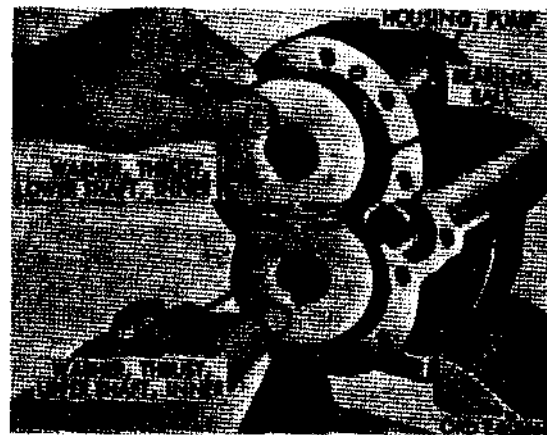


Figure 87. Removing upper and lower shaft inner thrust washers

- (d) Pump upper and lower gears should not be disassembled from shafts unless inspection reveals that replacement is necessary. If replacement is necessary, place each gear and shaft assembly on arbor press and press shaft and Woodruff key from gear.
- (e) Remove the two ball bearings (fig. 87) from rear of pump housing.

b. Cleaning, Inspection and Repair.

(1) Cleaning.

- (a) Thoroughly wash the pump housing cover, and packing gland in mineral spirits paint thinner or dry-cleaning solvent.
- (b) Immerse ball bearings in mineral spirits paint thinner or dry-cleaning solvent and soak sufficiently to remove all accumulations of oil or grease. Dry bearings with compressed air.

Caution: Do not spin bearings with compressed air since this may cause considerable damage to the finely machined surfaces.

- (c) Clean gears, shafts, and thrust washers in mineral spirits paint thinner or dry-cleaning solvent. Be careful not to damage gears while cleaning, since the close tolerance

between gears and housing must be held in order for pump to operate efficiently.

(2) Inspection and repair.

- (a) Inspect inside of pump housing for deep scratches, marks, or other signs of wear. The pump housing need not be replaced for wear in gear counter-bore, except for actual scarring or galling due to foreign matter getting into the hydraulic system. Inspect pump housing and cover for cracks or breaks. If any of these conditions are found, replace the defective part.
- (b) Inspect gears for deep scratches, nicks, or broken teeth. Excessive scarring of the gears will occur only when foreign matter has entered the system. If scarring of gears cannot be removed by honing, gears must be replaced. Inspect shafts for cracks or scoring. If any of these parts are found to be worn beyond serviceability standards (par. 86), replace the parts.
- (c) Thrust washers need not be replaced unless excessive scarring has occurred. Normal wear may be compensated for by reducing the thickness of the cover shims. Cover shims vary in thickness from 0.002- to 0.015-inch. Inspect thrust washers for roughness or broken condition. If any of these defects are found, replace thrust washers.
- (d) Inspect bearings for flat spots, pitted or scored surfaces, or other damaged conditions. Bearings must be replaced if damaged or worn beyond limits as specified in serviceability standards (par. 86).

Note. Always install new gaskets and packing whenever hydraulic pump assembly is in for major repairs.

c. Assembly.

(1) Install pump upper and lower shaft assemblies.

- (a) Install the two ball bearings located inside and at rear of pump housing (fig. 87).

- (b) Aline upper and lower shaft inner-thrust washers (fig. 87) so that they will be installed in housing in the same position from which they were removed, in accordance with paragraph 80a.

- (c) If inspection revealed that replacement of pump lower gear or pump lower shaft was necessary, new gears and shafts must be installed at this time. Install Woodruff key in pump lower shaft and place pump lower gear in arbor press. Aline shaft and Woodruff key with keyway in gear, and press shaft into gear. Remove pump lower shaft with gear from press, and install in pump housing (fig. 86).

- (d) The procedure as described in (c) above may be used for installing pump upper shaft and pump gear (fig. 86).

- (e) Aline upper and lower shaft outer-thrust washers as marked with pump housing (fig. 85), and install thrust washers on pump upper and lower shafts.

(2) Install pump cover and pump packing gland.

- (a) Install two ball bearings into inner side of pump cover (fig. 83).
- (b) Position pump cover shims and pump cover onto pump housing so as to aline mounting holes. Insert twelve cap screws (fig. 82), and twelve lockwashers and tighten to 30-40 pound-feet torque, to hold pump cover securely in place.

Note. Use only enough shims between cover and housing to permit free turning of pump upper shaft.

- (c) Install compression spring, pump packing gland ring, and new pump packing (fig. 84) in cover.
- (d) Install pump packing gland on pump upper shaft and position to pump cover (fig. 84). Install the three cap screws and lockwashers attaching pump packing gland to cover.

81. Control Valve Adapter Assembly

a. Disassembly.

- (1) Remove retaining plug and washer (fig. 88). Remove plunger spring retaining plug and washer from control valve adapter body.
- (2) Remove control valve adapter plunger (fig. 88). Remove plunger spring and control valve adapter plunger from control valve adapter body.

b. Cleaning, Inspection and Repair.

- (1) **Cleaning.** Clean all parts in mineral spirits, paint thinner or dry-cleaning solvent.
- (2) **Inspection and repair.**
 - (a) Inspect control valve adapter body for cracks, and check plunger spring retaining plug for damage to threads. Inspect the plunger bore of the adapter body for scratches, pitting, or excessive wear. If adapter plunger or adapter body is damaged and requires replacement, replace the complete assembly.

- (b) Inspect the control valve adapter plunger for wear as outlined in serviceability standards (par. 86). Check condition of plunger spring and replace spring if defective.

c. Assembly.

- (1) **Install control valve adapter plunger** (fig. 88). Install control valve adapter plunger in end of control valve adapter body and position plunger spring on adapter plunger.
- (2) **Install retaining plug and washer** (fig. 88). Position washer on plunger spring retaining plug and install plug in end of control valve adapter body. Protect this assembly from wind-blown dust or dirt.

82. Control Relay

Note. Repair procedures in this paragraph are for relay control box - 2520-740-9245. Some vehicles are equipped with relay control box - 2520-740-9090. Both boxes are similar with the exception that the levers are located on opposite sides of the box. When assembling either box follow procedures below.

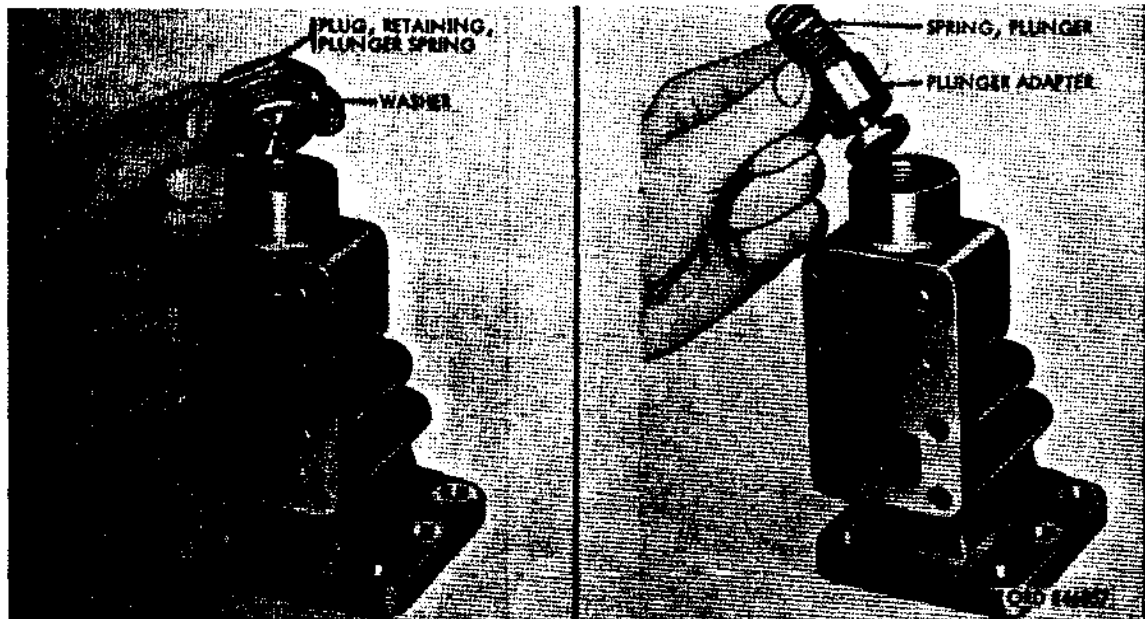


Figure 88. Disassembling control valve adapter

a. Disassembly.

(1) Remove control relay housing cover.

- (a) Position relay housing, with housing cover side up, and loosen hex-nut and cap screw on relay lever (fig. 89).
- (b) Remove relay lever and Woodruff key (fig. 89) from relay cam lever with integral shaft assembly.

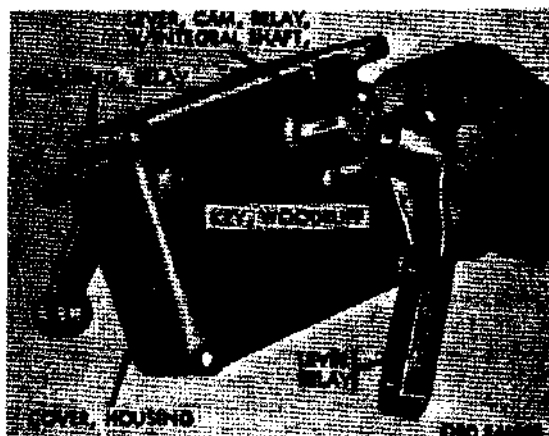


Figure 89. Control relay lever removal

- (c) Remove four machine screws and lockwashers, attaching housing cover to relay housing (fig. 90). Remove cover and gasket. Discard gasket.

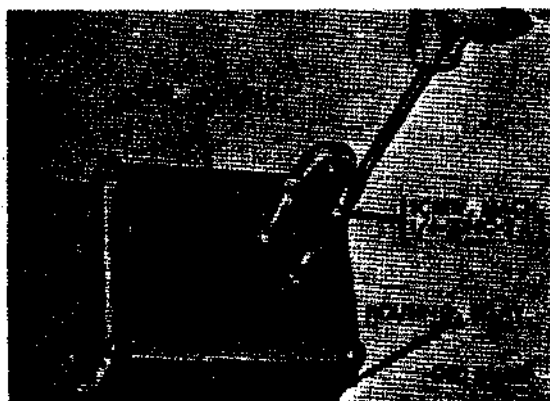


Figure 90. Removal of control relay housing cover

(2) Remove cams, levers, and shafts from control relay housing and shaft.

- (a) Turn relay housing cover and loosen hex-nut and cap screw from power takeoff control lever (fig. 91).
- (b) Remove power takeoff control lever and Woodruff key from power takeoff camshaft (fig. 91).



Figure 91. Power takeoff control lever removal

- (c) Remove control valve cam and shaft assembly from relay housing (fig. 92).
- (d) Remove relay cam lever with integral shaft assembly from relay housing (fig. 93).

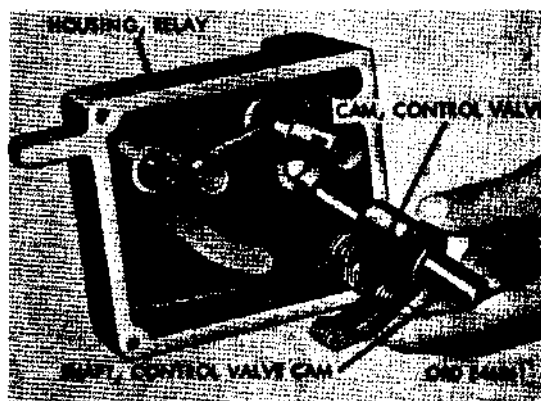


Figure 92. Control valve cam and shaft assembly removal



Figure 93. Control relay cam lever with integral shaft assembly removal

- (e) Remove power takeoff cam and shaft assembly from relay housing (fig. 94).
- (f) Before removing control valve camshaft (fig. 95) from control valve cam, both parts should be marked to facilitate aligning serrations for proper assembly of cam to shaft. Press control valve camshaft from control valve cam.
- (g) Power takeoff cam and power takeoff camshaft (fig. 96) should also be marked to facilitate assembly. Press camshaft from power takeoff cam.

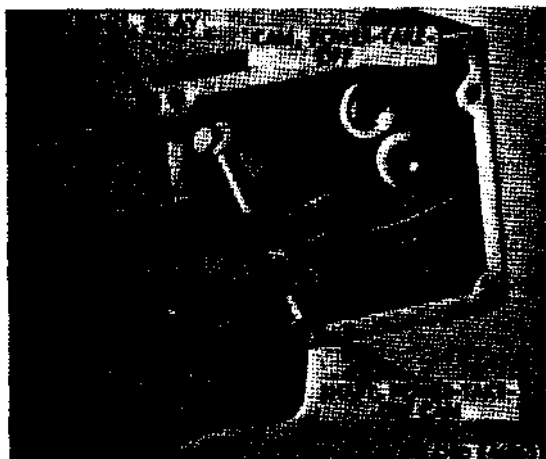


Figure 94. Removing power takeoff cam and shaft assembly



Figure 95. Control valve cam to shaft aligning marks

b. Cleaning, Inspection and Repair.

- (1) **Cleaning.** Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Scrape away old gasket cement or dirt accumulations not readily removed from housing or cover. Rinse thoroughly and blow dry with compressed air.
- (2) **Inspection and repair.**
 - (a) **Shafts and cams.** Inspect cams for defective weld or worn condition.

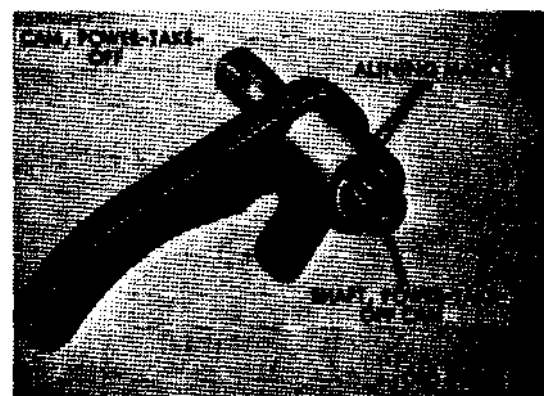


Figure 96. Power takeoff cam to shaft aligning marks

Inspect shafts for nicks, burrs, or damaged serrations. If any of the above conditions are found, shafts and cams must be repaired.

- (b) Relay housing and cover. Inspect relay housing and cover for cracks or damage. Replace parts that are found defective.
- (c) Control levers. Inspect control levers for cracks or bent conditions. If levers are distorted beyond straightening, replace with new levers.

c. Assembly.

- (1) Install cams, levers, and shafts in control relay housing.
 - (a) Position power takeoff camshaft in power takeoff cam (fig. 96), making sure aligning marks are indexed. Press shaft into cam so that ends of serrations on shaft will be flush with hub of cam.
 - (b) Position control valve camshaft in control valve cam (fig. 95), making sure aligning marks are indexed. Press shaft into cam so that ends of serrations on shaft will be flush with hub of cam.
 - (c) Install power takeoff cam and shaft assembly in relay housing (fig. 94).
 - (d) Install the relay cam lever with integral shaft assembly in relay housing (fig. 93).
 - (e) Install the control valve cam and shaft assembly in relay housing (fig. 92).
- (2) Install control relay housing cover and levers.
 - (a) Position the new cover gasket and relay housing cover on relay housing. Install the four machine screws and lockwashers attaching housing cover to relay housing (fig. 91).
 - (b) Install the Woodruff key, on relay cam lever with integral shaft assembly (fig. 91). Position relay lever on shaft and tighten the hex-nut and the

cap screw on relay lever, to secure lever to relay cam lever with integral shaft assembly (fig. 89).

- (c) Turn the relay housing over and install Woodruff key on power takeoff camshaft. Install power takeoff control lever on power takeoff camshaft (fig. 91). Tighten hex-nut and cap screw on power takeoff control lever, to secure lever to relay camshaft

83. Control Valve Assembly

a. Disassembly.

- (1) Remove upper and lower manifolds.
 - (a) Remove the two flexible line unions from the lower manifold and the two unions from the upper manifold (fig. 97).
 - (b) Remove the upper and lower manifolds from control valve body (fig. 97).
- (2) Remove the control valve end cap.
 - (a) Remove the pipe plug, poppet ball spring, and poppet ball (fig. 98) from control valve end cap.
 - (b) Remove the control valve end cap and washer (fig. 99) from control valve body.
- (3) Remove the control valve spool.
 - (a) Loosen spool retaining plug from control valve body. Remove valve spool from control valve body (fig. 100).
 - (b) Remove the jam nut, spool trunnion, spool retaining plug, washer, and O-ring gasket from valve spool (fig. 101). Discard O-ring gasket.

b. Cleaning, Inspection and Repair.

- (1) Cleaning.
 - (a) Control valve spool. Clean valve spool in mineral spirits paint thinner or dry-cleaning solvent. Be especially careful not to damage spool while cleaning; but make certain that oil passages are not restricted.

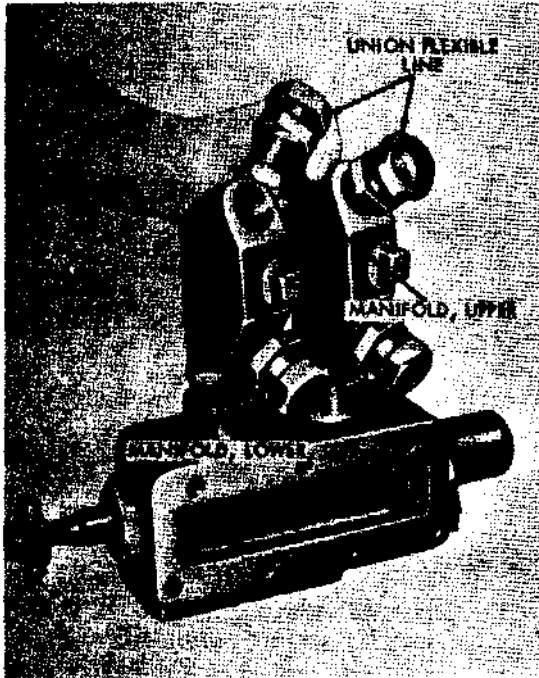


Figure 97. Disassembling manifolds from control valve body

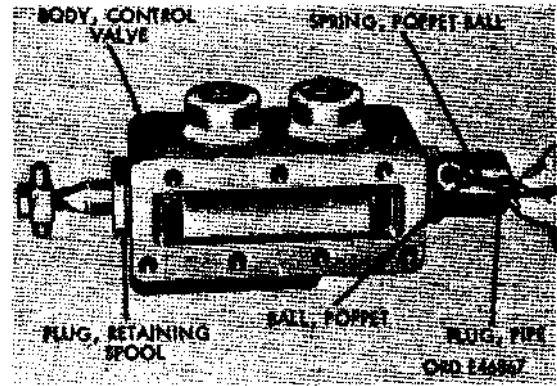


Figure 98. Removing poppet ball

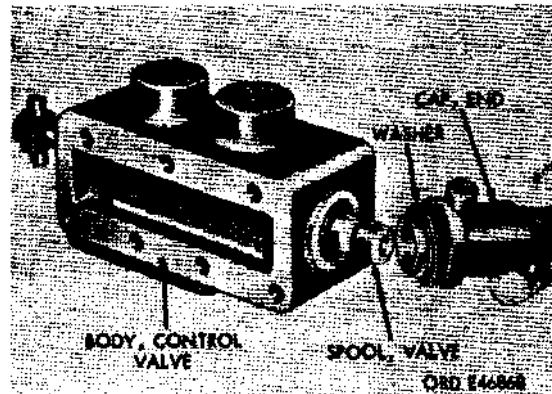


Figure 99. Remove control valve end cap from control valve body

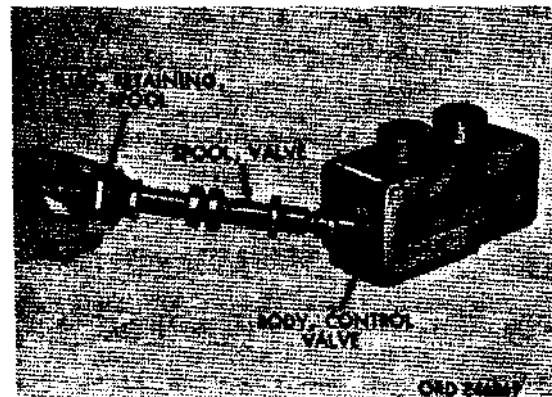
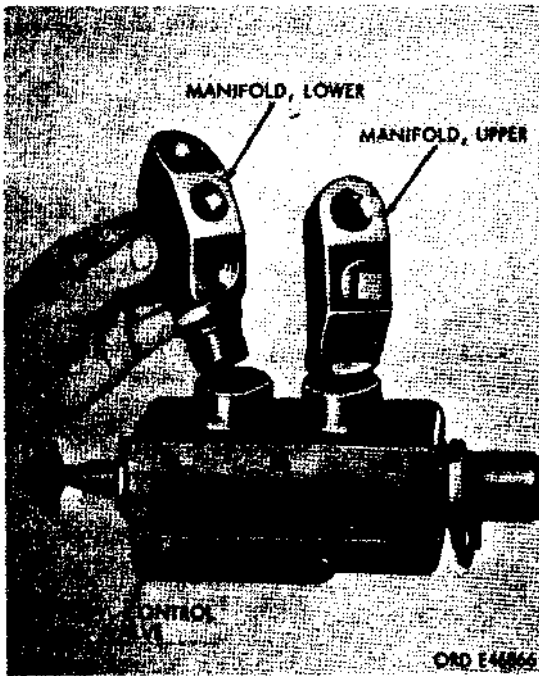


Figure 100. Removing control valve spool

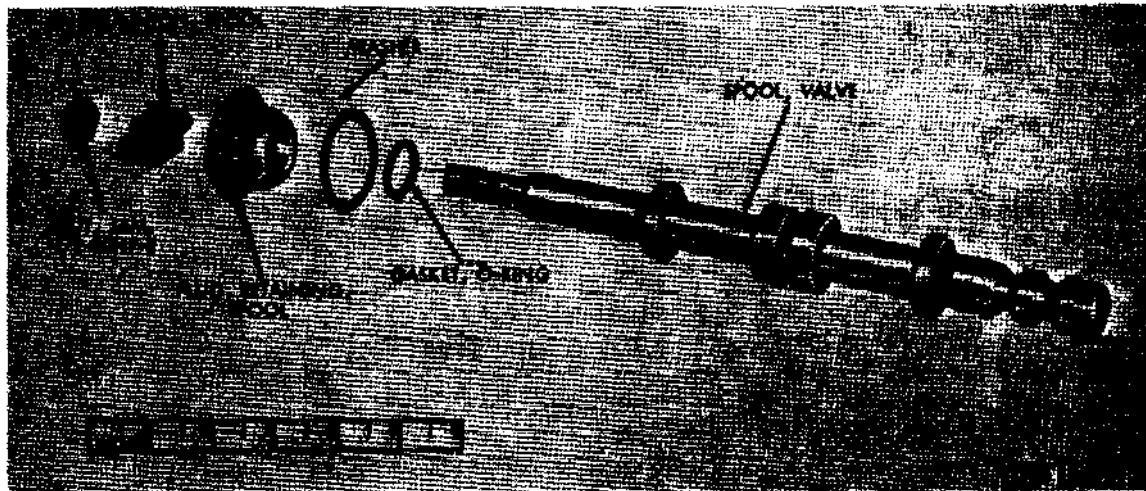


Figure 101. Control valve spool assembly - exploded view

- (b) Control valve body and manifolds. Soak these parts in mineral spirits paint thinner or dry-cleaning solvent. Make sure all ports are open and free of any dirt or grease accumulation. Rinse clean and blow dry with compressed air.

(2) Inspection and repair.

- (a) Manifolds. Inspect the upper and lower manifolds for cracks or damaged threads. Replace manifolds, if found defective.
- (b) Flexible line unions. Inspect the flexible line unions for cross threading or cracks. Replace unions, if any defects are noted.
- (c) Control valve body and end cap. Inspect control valve body for cracks, scratches, or worn condition in spool bore. Inspect threads on the end cap and inside body for damage. Replace defective parts. Refer to Serviceability Standards, paragraph 86.
- (d) Control valve spool. Inspect the control valve spool for scratches, nicks, or burs. Use a fine mill file or soap-stone to remove nicks or burs. If these defects cannot be removed, replace the control valve spool and control valve body.

Note. Control valve spool and control valve body are matched parts and must be replaced as an assembly.

If a minor leak occurs around the spool, the spool retaining plug (fig. 100) can be removed and a new O-ring gasket installed.

c. Assembly.

- (1) Assemble control valve spool (fig. 101). Install washer on spool retaining plug, and position new O-ring gasket and spool retaining plug with washer over threaded end of valve spool onto finished surface of spool. Install spool trunnion and 1/2-20NF-3 jam nut on threaded end of valve spool.
- (2) Install control valve spool (fig. 100). Insert end opposite from trunnion of valve spool into bore of control valve body. Tighten spool retaining plug to body.
- (3) Install control valve end cap.
- (a) Position washer on end cap. Install end cap over end of valve spool (fig. 99) and tighten end cap securely to control valve body.
- (b) Install poppet ball, poppet ball spring, and pipe plug (fig. 98) in control valve end cap.

(4) Install upper and lower manifolds.**(a) Install upper and lower manifolds in control valve body (fig. 97).****(b) Install two flexible line unions (fig. 97) in upper manifold, and two unions in lower manifold.****84. Hydraulic Cylinder**

a. Disassembly. Because of the welded construction of the hydraulic cylinder assembly, disassembly is limited to the procedure given in steps (1) through (6) below.

(1) Remove three cap screws and lock-washers attaching cylinder packing gland to hydraulic cylinder (fig. 102).



Figure 102. Removing cap screws from cylinder packing gland

(2) Slide cylinder packing gland, cylinder packing, cylinder packing gland ring, and end cover bushing to end of piston rod (fig. 103), and remove from piston rod. Discard old cylinder packing.



Figure 103. Cylinder packing gland and bushing disassembled

(3) Remove nine cap screws and copper washers from end cover (fig. 104), and remove end cover and gasket. Discard gasket.

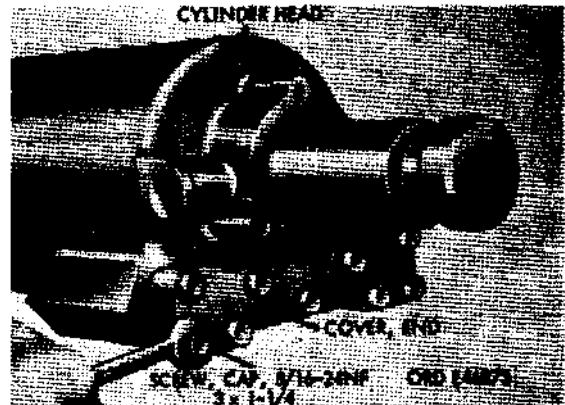


Figure 104. Removing end cover

(4) Remove bypass plunger spring retaining plug from cylinder head (fig. 104). Then remove bypass plunger spring and ball from cylinder head.

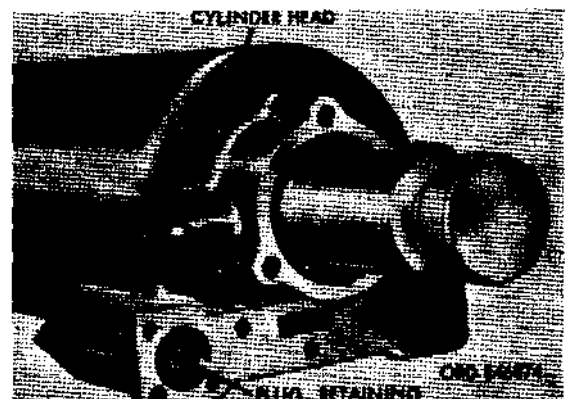


Figure 105. Location of bypass plunger spring retaining plug

(5) Remove acorn nut, jam nut, and copper washer from plug opposite cylinder head end. Remove bypass plunger plug (fig. 106) and washer from cylinder base.

(6) Remove bypass plunger from cylinder base (fig. 107).

(7) Remove straight pin from each end of roller pin and remove pin and roller.

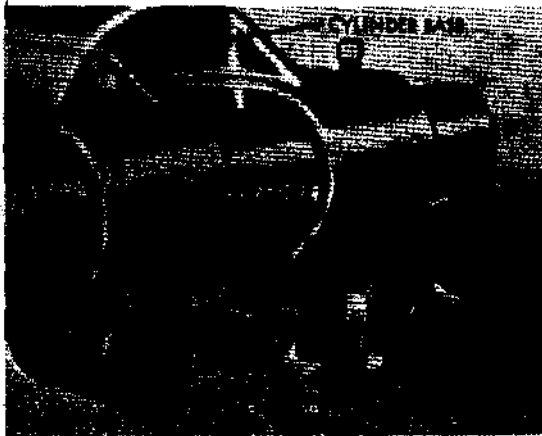


Figure 106. Removing bypass plunger plug and washer

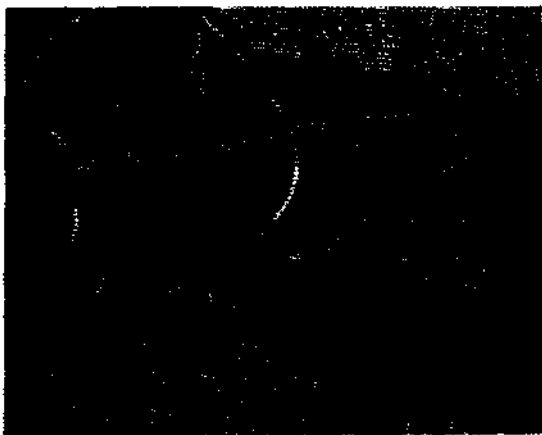


Figure 107. Removing bypass plunger

- (8) Due to the welded construction of the subframe, no further disassembly is recommended.

b. Cleaning, Inspection and Repair.

(1) Cleaning.

- (a) Clean all parts, that can be disassembled from the hydraulic cylinder, in mineral spirits paint thinner or dry-cleaning solvent.
- (b) Use dry-cleaning solvent or mineral spirits paint thinner to clean or wash grease or dirt from subframe. Steam

may be used to remove heavy accumulation of grease or dirt after dry - cleaning solvent or mineral spirits paint thinner has been applied. If steam is not available, a solution of one part grease cleaning compound to four parts dry-cleaning solvent or mineral spirits paint thinner may be used for dissolving grease. After cleaning, use cold water to rinse off any solution which remains.

(2) Inspection and repair.

- (a) Hydraulic cylinders. Inspect hydraulic cylinders for cracks or defective welds. Inspect piston rods for nicks, burrs, or scratches. Any of the above conditions, which are serious enough to cause leakage, must be corrected, or the hydraulic cylinder must be replaced with a new cylinder assembly.
- (b) End cover. Inspect the end cover for cracks, nicks, burrs on machined surface. Remove nicks or burrs with a fine mill file or soap stone. If defect is beyond repair, then the end cover must be replaced with a new cover.
- (c) Subframe. Inspect the subframe for defective welds or damaged reservoir tank. Defective welds can be repaired by welding. If defect is beyond repair, then subframe must be replaced with a new one.
- (d) Lifting arm with roller assemblies. Inspect the rollers for out-of-round or irregular wear. Defective rollers must be replaced. This is a hardened roller and seldom requires replacement. Check the roller pins and lifting arm bushings for excessive wear. These pins and bushings are case hardened and need not be replaced unless galled or worn through case. Use suitable adapter to remove and install arm bushings.

c. Assembly.

(1) Assemble hydraulic cylinder.

- (a) Insert bypass plunger in cylinder base (fig. 107).

- (b) Position washer on bypass plunger plug and install plug in cylinder base (fig. 106). Install copper washer, jam nut, and acorn nut on plug.
 - (c) Install ball, spring, and bypass plunger spring retaining plug (fig. 105) in cylinder head.
 - (d) Position end cover and new gasket on cylinder head and install nine cap screws (fig. 104) and copper washers, securing end cover to cylinder head.
 - (e) Install end cover bushing, cylinder packing gland ring, cylinder packing, and cylinder packing gland over end of position rod (fig. 103). Install three cap screws, and lockwashers securing cylinder packing gland to hydraulic cylinder (fig. 102).
- (2) Install hydraulic cylinders on subframe.
- (a) Support each hydraulic cylinder in position on subframe and install two cap screws and lockwashers on each bearing cap, anchoring hydraulic cylinder to subframe assembly (fig. 80).
 - (b) Install crosshead on end of each hydraulic cylinder piston rod. Install upper and lower crosshead retainers and secure with four cap screws, and four lockwashers, holding crosshead (fig. 79) to hydraulic cylinder piston rods.

Note. Lower crosshead retainers are threaded.

- (c) Lift the hydraulic cylinder assemblies and slide lifting arm with roller assemblies (fig. 68) onto each end of crosshead.
- (d) Install four flexible lines to fittings at base of hydraulic cylinders (fig. 78).

85. Hoist Assembly Control Linkage

a. Disassembly. Disassembly of the hoist assembly control linkage (fig. 67) is ac-

complished during removal from the vehicle. Complete disassembly is not recommended. If inspection reveals damage to an individual part, it may be repaired or replaced on the vehicle.

b. Cleaning, Inspection, and Repair.

- (1) **Cleaning.** Use a stiff brush, or steam cleaning equipment if available, and clean all linkage (fig. 67). Mineral spirits paint thinner or dry-cleaning solvent may be used to remove any accumulation of grease.
- (2) **Inspection** (fig. 67). Inspect connecting rods (D, G, P, and W) for bent or damaged condition. Note any excessive wear at yokes and lever pins. Replace excessively worn pins or yokes. Check levers (D, E, L, N, Q, S, U, and X) for looseness on shafts. Tighten or replace as inspection warrants. Inspect for loose, damaged, or cracked mounting brackets. Inspect drive shaft assembly (C) for excessive wear at universal joints.
- (3) **Repair.** Straighten all bent rods. Any excessive wear at rod yokes, pins, or levers will necessitate replacement. Repairs are limited, and must only be made if inspection step (2), above, warrants. Complete information for the repair of the power takeoff drive shaft assembly will be found in TM 9-

2320-211-35.

c. Assembly. Assembly is accomplished during replacement of components on the vehicle. Refer to figure 67 as a guide for complete linkage replacement. For installations of drive shaft assembly, see paragraph 75.

d. Test and Adjustment. Adjustment of the control linkage can only be made after installation on the vehicle. Start the engine and operate the hoist assembly. Adjust the linkage as required to obtain efficient operation.

Section VI. SERVICEABILITY STANDARDS

86. General

The serviceability standards included herein give the minimum, maximum, and key clearances of new or repaired parts. In the "Size and fit of new parts" column, the letter "L" indicates a loose fit (clearance) and the letter

"T" indicates a tight fit (interference). All dimensions are given in inches unless otherwise specified.

87. Serviceability Standards

Table VI below gives serviceability standards for the dump body and hoist assembly.

Table VI. Serviceability Standards - Dump Body and Hoist

Fig. No.	Point of measurement	Size and fit of new parts
<u>HOIST HYDRAULIC PUMP</u>		
86	Pump gears	3.396 to 3.397
86	Pump housing	3.401 to 3.402
86	Pump gear clearance in housing	0.004L to 0.006L
83	Ball bearing	1.1807 to 1.1811
85	Pump shafts	1.1804 to 1.1808
83	Ball bearing fit on pump shafts	0.0001T to 0.0007L
87	Ball bearing	2.4404 to 2.4409
87	Pump housing and cover bore	2.4415 to 2.4425
87	Ball bearing fit in pump housing and cover	0.0006L to 0.0021L
<u>CONTROL VALVE ADAPTER ASSEMBLY</u>		
88	Adapter plunger	1.154 to 1.155
88	Adapter body	1.156 to 1.157
88	Adapter plunger fit in body	0.001L to 0.003L
<u>CONTROL VALVE ASSEMBLY</u>		
100	Valve spool O.D.	1.2500 to 1.2502
100	Control valve body I.D.	1.2503 to 1.2505
100	Valve spool fit in control valve body	0.001L to 0.0005L*
*Note. The valve spool and control valve body are lapped and, if excessive leakage occurs, they must be replaced as an assembly.		

CHAPTER 11

FIFTH WHEEL ASSEMBLY FOR THE TRACTOR TRUCKS, M52, M52A1 AND M52A2, AND THE TRACTOR WRECKER M246

Section I. DESCRIPTION AND DATA

88. Description

The semitrailer coupler used on the tractor trucks M52, M52A1 and M52A2 and the tractor wrecker M246 is called the fifth wheel. It is located on the frame over the tandem rear axles. Flexibility of coupling is obtained by pivoting the base to a walking beam which is pivoted

on the subbase. This allows movement in all planes.

89. Data

Manufacturer. Dayton Steel Foundry
Size 33 in.

Section II. REMOVAL AND INSTALLATION

90. Fifth Wheel Assembly

For removal and installation of the fifth wheel (fig. 108), refer to TM 9-2320-211-20.

91. Center Deck Plate

a. Removal (Fig. 109). Remove six safety nuts, hex-head bolts, and deck plate clamps, and lift center deck plate from vehicle.

b. Installation. Install in reverse order of a above.

92. Approach plates

a. Removal (Fig. 110). Remove one hex-head bolt and safety nut from front end of each approach plate. Remove eight hex-head bolts and safety nuts, two located at the rear and two on the side of each of the two approach plates, and lift off approach plate assembly.

b. Installation. Install in reverse order of a above.

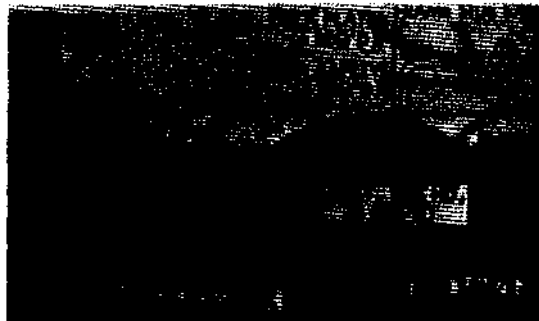


Figure 109. Removal of center deck plate

Note. On the tractor wrecker truck M246, the approach plates are an integral part of the crane body. The fifth wheel is bolted to both the crane body side rails and the truck frame side rails.



Figure 108. Fifth wheel mounting

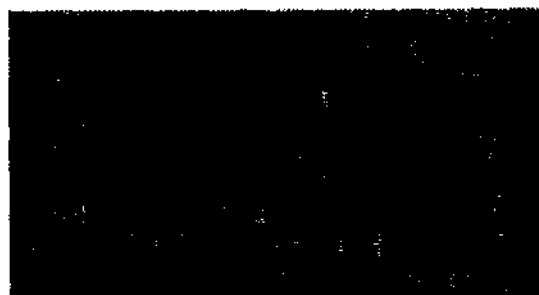


Figure 110. Approach plate assembly mounting

Section III. REPAIR

93. Fifth Wheel Assembly

a. Disassembly.

- (1) Remove hex-head nut (fig. 111) and lockwasher from rocker shaft bolt, and remove bolts. Remove six cap screws and external - teeth lockwashers, three on each side of subbase.



Figure 111. Removing rocker shaft bolt

- (2) Attach a suitable chain hoist to the fifth wheel and drive rocker shaft from the walking beam (fig. 112).

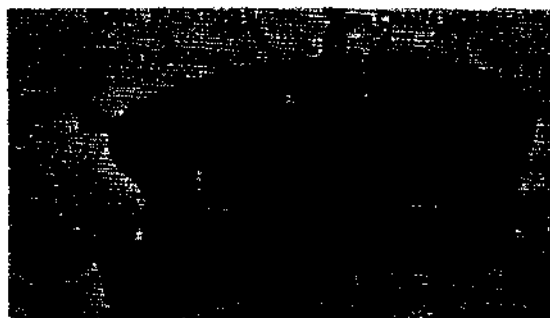


Figure 112. Driving out rocker shaft

- (3) Drive lateral shaft from subbase and walking beam and lift off walking beam (fig. 113).

- (4) Lift two leveling springs (fig. 114) from subbase.

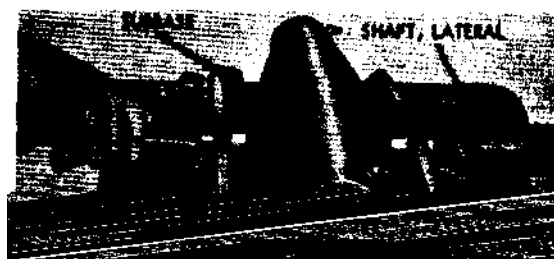


Figure 113. Removing lateral shaft

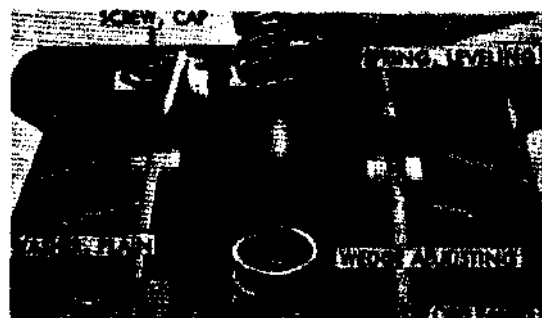


Figure 114. Removing leveling springs

- (5) Remove cap screw, hex-nut, and plain washer. Remove adjusting wedge (fig. 114).
- (6) Remove three cotter pins and slotted nuts (fig. 115) from locking plunger, lever, locking plunger latch, and locking plunger retaining studs. Remove locking plunger latch and locking plunger latch spring.

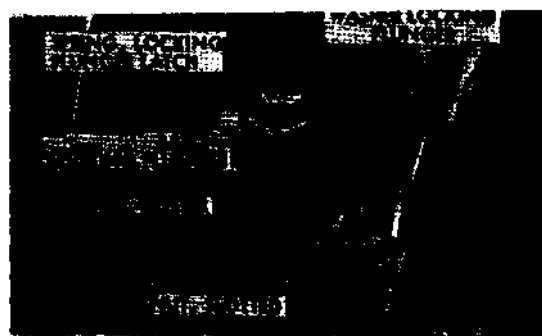


Figure 115. Removing locking plunger latch

- (7) Lift up on locking plunger lever (fig. 116), and remove locking plunger spring and lever.
- (8) Remove latch safety screw (fig. 116) from locking plunger safety latch and remove latch.

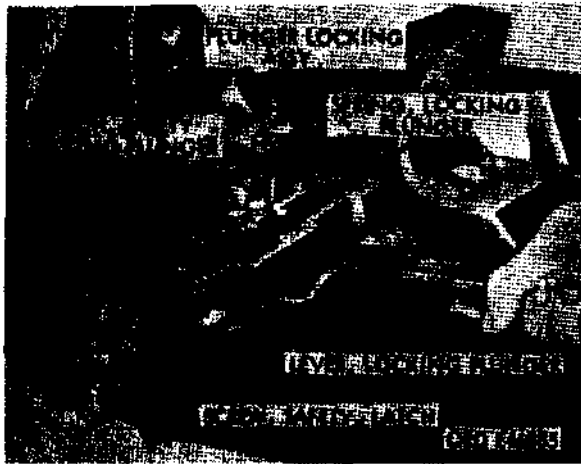


Figure 116. Removing locking plunger.

- (9) Remove cotter pins from jaw coupler pins' (fig. 117) and drive coupler pins out of fifth wheel.
- (10) With the jaw coupler pins removed, pull jaw couplers from fifth wheel.
Note. Be sure to pick up jaw pin washers (fig. 117).

b. Cleaning, Inspection, and Repair.

- (1) *Cleaning.* Clean all parts thoroughly with drycleaning solvent or mineral spirits paint thinner. Dry with com-



Figure 117. Removing jaw coupler pins.

pressed air and be sure all grease passages are open.

(2) Inspection and repair.

- (a) *Inspection.* Inspect shafts and jaw pins carefully for pits, grooves, or breakage. Examine jaws for elongation of coupler holes. Check bores in walking beam for elongation, pits, or scores. Inspect grease passages to be certain they are open so that the pivot points can be properly lubricated. Check the lock latches and jaws for rounded corners at locking points. Examine the walking beam, and subbase for cracks or damage.
- (b) *Repair.* If shafts or jaw pins are unserviceable, replace. Replace the walking beam if it is not suitable for further use. If subbase cannot be placed in serviceable condition by welding, replace as required.

c. Assembly.

- (1) Position leveling springs in position on subbase.
- (2) Position walking beam over leveling springs and apply suitable leverage to compress leveling springs.
- (3) Drive lateral shaft (fig. 118) through subbase and walking beam with grooved side of shaft up. The groove in lateral shaft must align with rocker shaft hole in walking beam.

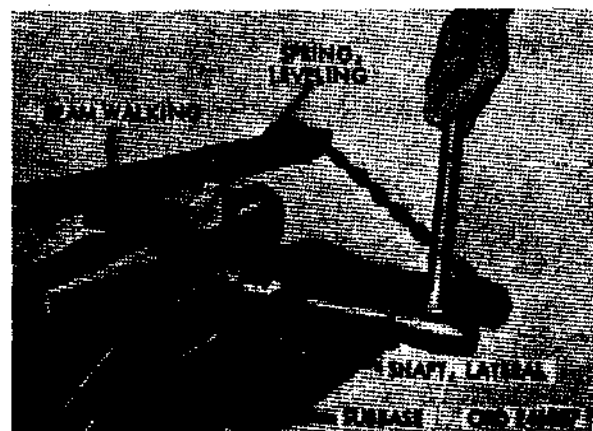


Figure 118. Assembling walking beam to subbase.

- (4) Install adjusting wedges (fig. 114) and secure capscrews, plain washer, and nut.

Note. The adjusting wedges are used between the subbase and the walking beam to lock out the side rocking when the vehicle is used on the highway. Wedges are withdrawn for off-highway use to allow the vehicle frame to flex at will.

- (5) Position left and right jaw couplers (fig. 117) in fifth wheel and align jaw pin washers.
- (6) Install jaw coupler pins (fig. 117) and secure with cotter pins.
- (7) Place locking plunger spring (fig. 116) on locking plunger assembly. Position locking plunger lever in position on stud. Use lever to compress locking plunger spring to position locking plunger assembly.
- (8) Position locking plunger latch (fig. 116) over stud and hook locking plunger latch spring in fifth wheel.
- (9) Position locking plunger washer (fig. 115) over stud and install three slotted nuts, securing locking plunger lever, locking plunger latch, and locking plunger. Secure the three slotted nuts with cotter pins.
- (10) Position locking plunger safety latch (fig. 116) to front of fifth wheel and install latch safety screw.
- (11) Attach a chain hoist to the fifth wheel and raise into position over walking beam.
- (12) Align fifth wheel with walking beam (fig. 12) and drive rocker shaft through walking beam.

- (13) Secure rocker shaft (fig. 111) with rocker shaft bolt and hex-nut.
- (14) Position fifth wheel spacers, one on each frame side rail, and secure to frame with one hex-head bolt and safety nut at the rear.
- (15) Use a chain hoist to lift fifth wheel assembly into position over the fifth wheel spacers (fig. 108). Secure fifth wheel assembly to chassis, at both frame side rails with two hex-head bolts and safety nuts located at front and rear of subbase. Install three capscrews and external-teeth lockwashers, threaded into fifth wheel spacer and tighten securely.

94. Approach Plates

a. Disassembly and Assembly. The approach plates do not require any disassembly.

b. Cleaning, Inspection, and Repair.

- (1) *Cleaning.* Clean with mineral spirits paint thinner or drycleaning solvent.
- (2) *Inspection and repair.* Repair to the approach plates is limited to welding of cracks. Heavy damage requires replacement.

95. Center Deck Plates

a. Disassembly and Assembly. There is no disassembly or assembly of the center deck plate.

b. Cleaning, Inspection, and Repair.

- (1) *Cleaning.* Clean with mineral spirits paint thinner or drycleaning solvent.
- (2) *Inspection and repair.* Repair is limited to welding any cracks found in the center deck plate. Heavy damage requires replacement.

CHAPTER 12

STEERING SYSTEM

Section I. DESCRIPTION AND DATA

96. Description

a. General. The steering system is comprised of the hydraulically assisted steering gear (fig. 119), steering wheel, hydraulic oil reservoir (fig. 120), hydraulic pump (fig. 120), relief valve (fig. 120), and steering linkage (refer to fig. 123).

b. Steering Wheel. The three-spoke steering wheel is mounted on the upper end of the steering shaft (refer to fig. 125) and secured by a hex-nut. The horn button assembly is mounted in the center of the steering wheel.

c. Steering Gear. The steering gear (fig. 119) is of cam and lever type, to which has been added a hydraulic power system. A lever inside the steering gear housing is actuated by rotation of a cam at the lower end of the steering shaft, which turns with the steering wheel. This causes the upper end of the pitman arm (refer to fig. 122), which is secured to the opposite end of the lever shaft, to move either forward or backward, according to the direction of rotation of the steering wheel. The movement of the pitman arm is transmitted through the steering linkage (refer to fig. 123) to the steering knuckles and wheels, steering the

vehicle. Rotation of the steering shaft also changes, by means of a cam actuated lever, the relationship of the inlet and outlet valves inside the control valve assembly mounted on the steering gear jacket. This permits hydraulic oil to be pumped into the appropriate side of the power cylinder piston, which is connected to the lever inside the steering gear housing (fig. 119), to assist in moving the pitman arm (refer to fig. 122).

d. Hydraulic Oil Reservoir. The hydraulic oil reservoir (fig. 120), mounted to the rear of the left headlight support bracket (refer to fig. 128), supplies fluid for the steering gear hydraulic system. The reservoir has a 10-quart capacity.

e. Hydraulic Pump. The gear-type pump (fig. 120) is bolted to the rear of the front crankcase plate. The pump is driven by the engine camshaft gear, and is in operation whenever the engine is running. The pump delivers 750 psi to 1000 psi during normal operation.

f. Relief Valve. The relief valve (fig. 120), mounted on a bracket bolted to the steering gear housing, prevents excessive pressures in the steering hydraulic system. The relief valve is set for a maximum pressure of 750 psi.

g. Steering Linkage. The steering linkage (refer to fig. 123) consists of the upper drag link, relay lever, and lower drag link. Adjustable spring-loaded ball seats at both ends of each drag link (refer to fig. 123) engage ball studs attached to the pitman arm, relay lever, and steering arm.

h. Relay Lever Assembly. The relay lever assembly (refer to fig. 123) consists of a lever with two ball studs, and connects the upper and lower drag links at the front end of frame. A double bushing is used at the frame bracket with a grease seal (refer to fig. 123) on each side.

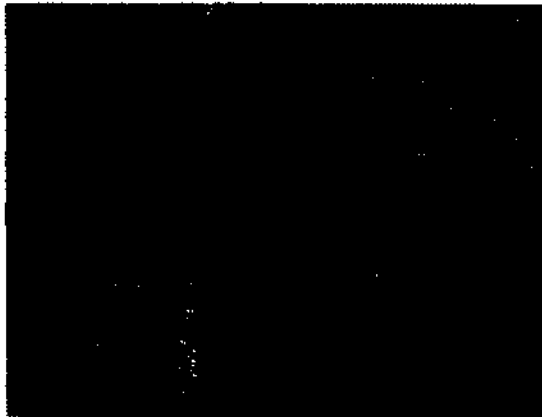
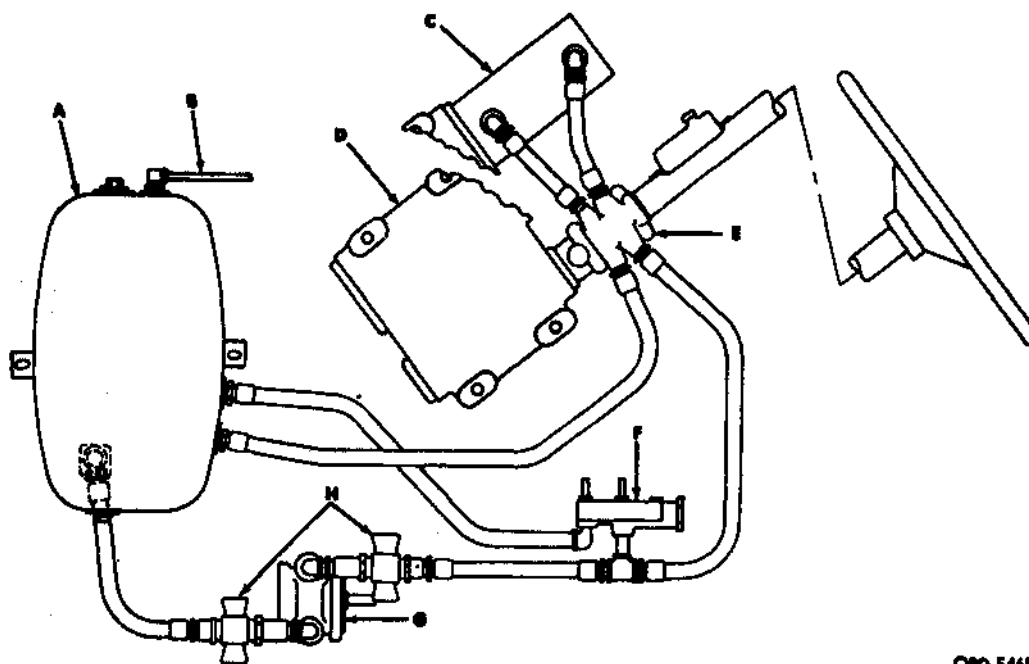


Figure 119. Right side view of steering gear with cover removed



ORD E46897

Figure 120. Steering gear hydraulic piping diagram

i. Drag Links. The drag links (refer to fig. 123) are two tubular members connecting pitman arm to steering arm on the front axle through a relay lever.

j. Pitman Arm. The pitman arm (refer to fig. 122) is a steel forging, broached to fit the splined end of lever shaft. It is held on shaft by a hex-nut and lockwasher.

k. Hydraulic Flexible Lines. Hydraulic flexible lines connect the steering gear hydraulic system. To facilitate service and maintenance of the steering gear, self-sealing couplings are provided. This makes it possible to separate the fluid-carrying lines without loss of fluid upon separation.

97. Data

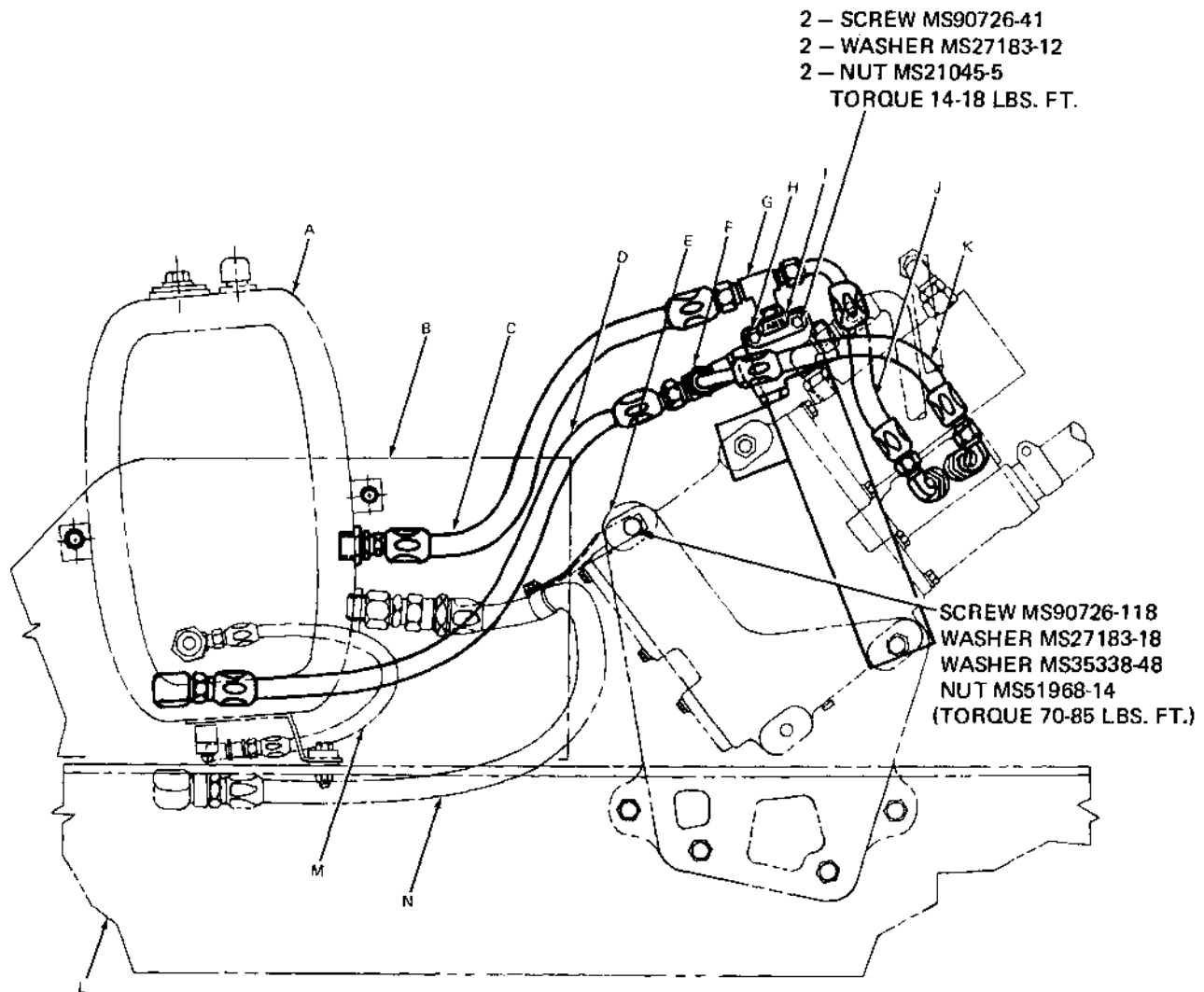
a. Steering Gear.

Manufacturer. . . Ross Gear and Tool Company
Model HP-70
Type hydraulic
Ratios

Extreme left 23:1
Center 18:1
Extreme right 23:1
Steering wheel diameter 20 in.
Pitman arm shaft
angular movement 70°

b. Hydraulic Oil Reservoir.

Make International Harvester Co.
Model 1 HC-10101 2R11

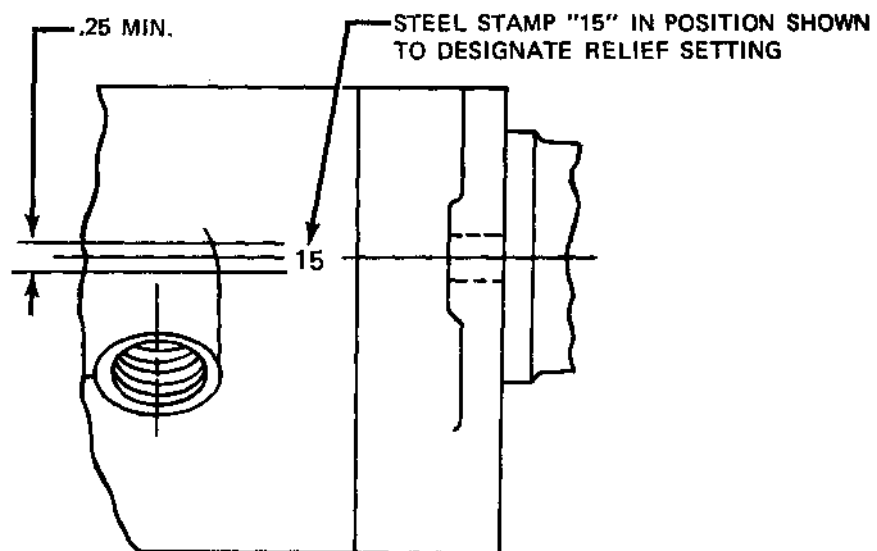


- | | |
|---------------------------|---------------------------|
| A - RESERVOIR ASSY. | H - VALVE |
| B - SPLASH PANEL | I - BRACKET SUPPORT |
| C - HOSE ASSY. (RETURN) | J - HOSE ASSY. (RETURN) |
| D - HOSE ASSY. (PRESSURE) | K - HOSE ASSY. (PRESSURE) |
| E - STEERING BRACKET | L - FRAME |
| F - TEE | M - HOSE ASSY. (BY-PASS) |
| G - TEE | N - HOSE ASSY. (SUPPLY) |

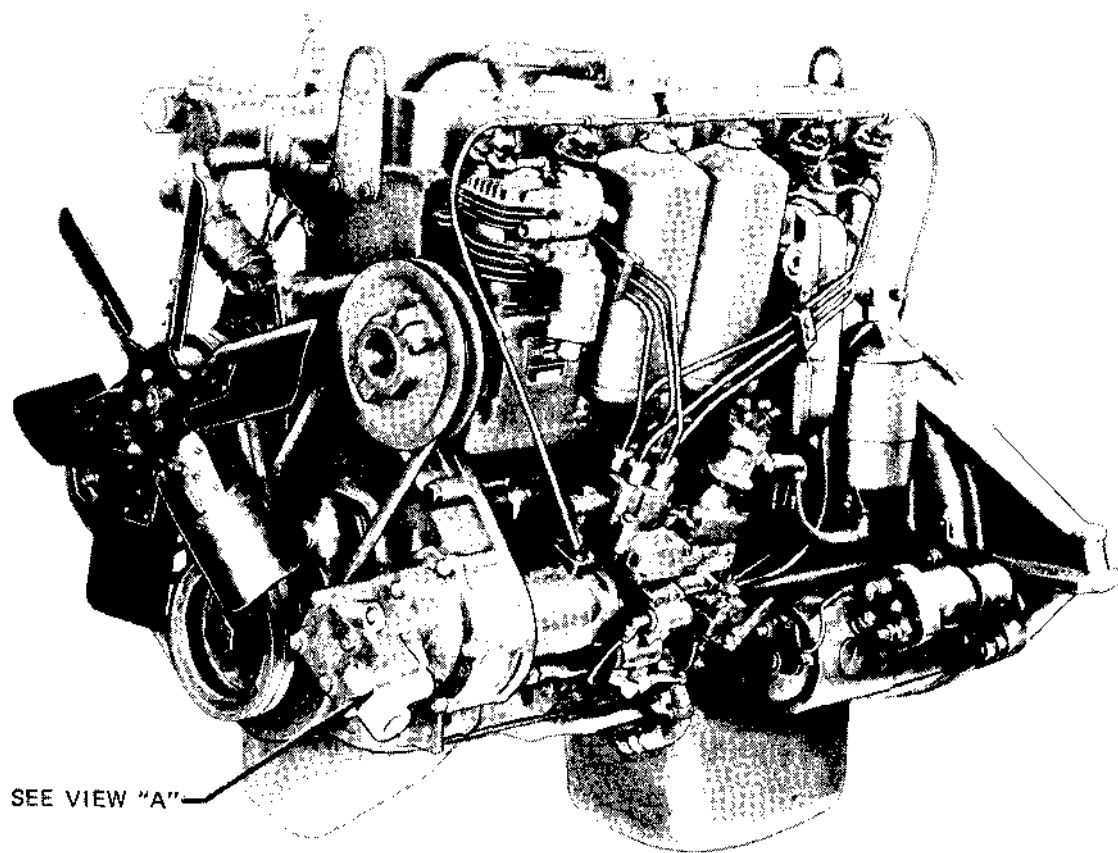
TA 018014

INSTALLATION STEERING PIPING (M39A2 VEH. WITH PUMP P/N 11640923-1)

Figure 120.1. Steering Piping Installation M39A2 Series Trucks.



PUMP HYDRAULIC 11640923-1
VIEW "A"



ENGINE

TA 018015

Figure 120.2. Identification of Power Steering Pump.

Ordance number ----- 7409290
Capacity ----- 8 1/2 qt

c. Relief Valve.

Make ----- Pesco
Model ----- PS-05-2223-020-01
Ordance number ----- 7409294

d. Hydraulic Pump.

Make ----- Pesco
Model ----- PS-052057-50-01
Ordance number ----- 7369967
Type ----- gear

e. Drag Links.

Overall length -----	42 11/16in.	28 3/4in.
Centerline to centerline of ball -----	35 7/8in.	21 15/16in.
Ball seat diameters -----	1-3/4in.	1 3/4in.
Tube diameters -----	1-1/2in.	1 1/2in.
Ordance number -----	7348898	7348899

f. Relay Lever.

Bushing diameter (burnished) ----- 1.222 to 1.124 in.
Ordance number ----- 7409296

Section II. TROUBLESHOOTING

98. General

Operation of a deadlined vehicle without a preliminary examination can cause further damage to a disabled component and possible injury to personnel. By careful inspection and troubleshooting such damage and injury can be avoided and, in addition, the cause of faulty operation of a vehicle or component can often be determined without extensive disassembly.

a. Troubleshooting Before Removal or Operation.

Note. Do not operate the vehicle prior to completing the procedures given in this paragraph. Refer to paragraph 12 for purpose of these inspections. Many steering complaint are actually front axle trouble and are fully covered in paragraph 279.

- (1) *Inspect for lubricant leaks.* Visually inspect cover gasket joint and oil seals for evidence of lubricant leakage. Pay particular attention to the hydraulic system lines (fig. 120) and joints. Leakage at gasket joints may be caused by loose capscrews or on cover. If all cover screws are tight and leakage continues, install new gaskets. Also replace defective hydraulic lines.
- (2) *Inspect for damaged bearings or shafts.* In order to isolate steering gear from axle, disconnect upper drag link (refer to fig. 123) from pitman arm. Revolve steering wheel

from one extreme to the other. If rough spots or bumps are felt or unusual noises heard while revolving the steering wheel, remove steering gear (para 99), disassemble (para 108) and inspect for damaged or worn parts.

b. Troubleshooting Before Removal and During Operation.

Note. If the inspection in the preceding paragraph do not reveal causes of failure and the vehicle is operable, then troubleshoot it. Refer to paragraph 12 for the purpose and scope of these troubleshooting procedures.

- (1) *Hard steering.* Hard steering may be caused by damaged bearings or shafts.
- (2) *Wander or weaving.* Wander or weaving may be caused by incorrectly adjusted or worn parts. Adjust steering gear (para 126), or remove, disassemble (para 99), and replace worn parts.

c. Troubleshooting After Removal and Before Operation.

- (1) After the component has been removed from the vehicle or if it has been received already removed, further inspection is necessary. If the steering gear alone has been received for a preliminary check before being installed in the vehicle or if the oper-

ation of the steering gear has not been satisfactory due to unknown causes, then test it as described in (2) below,

- (2) Visually inspect the steering gear for lubricant leakage and damaged or worn bearings and shafts.

Section III. REMOVAL AND INSTALLATION

99. Steering Gear

(Fig. 119)

a. Removal.

- (1) Remove steering wheel. Refer to TM 9-2320-211-20.
- (2) Remove hand control valve. Refer to TM 9-2320-211-20.
- (3) Remove three safety nuts (fig. 121) and capscrews securing steering gear-jacket, mounting bracket to instrument panel. Remove four screws and lockwashers, securing steering jacket pad and remove pad.
- (4) Remove left front fender assembly. Refer to paragraph 31.
- (5) Remove pitman arm. Refer to TM-9-2320-211-20.
- (6) Remove relief valve (para 103a).
- (7) Disconnect inlet and outlet lines (fig. 124) at left side of control valve.
- (8) Disconnect horn wire at connector (fig. 124) on top of horn-contact-brush cover (fig. 125).
- (9) Remove three safety nuts and capscrews (fig. 124) securing steering gear bracket, and remove steering gear from vehicle (fig. 126).

Note. The driver's seat in the cab must be raised to provide clearance for the steering gear jacket.

- (10) Remove split-lockwasher screw, spacer, capscrew, washer, and safety nut securing relief-valve mounting bracket (fig. 124) to steering gear housing, and remove bracket from housing.

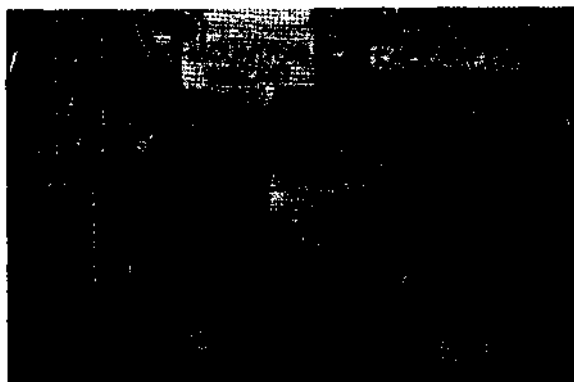


Figure 121. Steering gear jacket mounting bracket.



Figure 122. Removing pitman arm.



Figure 123. Steering linkage installed under left front fender.

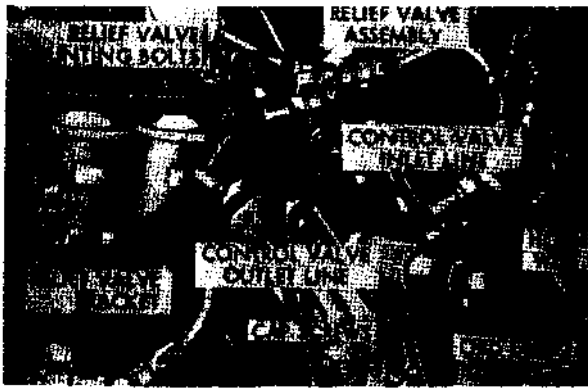


Figure 124. View of steering gear installed with left front fender removed.

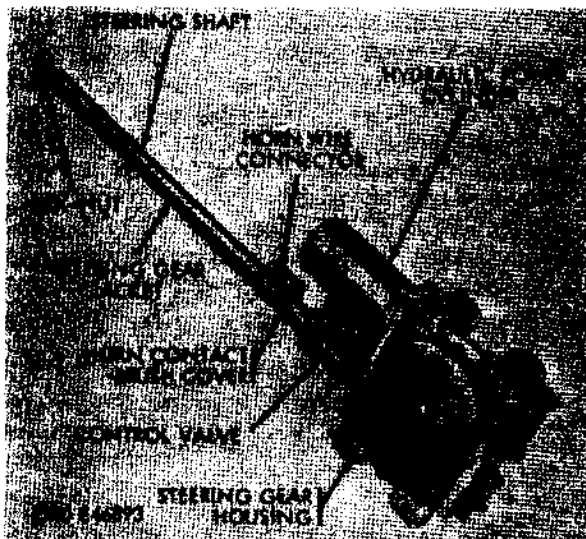


Figure 125. Right side view of steering gear.



Figure 126. Removing steering gear.

- (11) Disconnect both ends of two control-valve-to-power-cylinder lines (fig. 126), and remove lines from steering gear.
- (12) Remove six elbow from control valve and power cylinder inlet and outlet ports.

b. Installation.

- (1) Install six elbows in inlet and outlet ports of control valve (fig. 125) and power cylinder.
- (2) Position two control-valve-to-power-cylinder lines (fig. 126) at inlet-and-out-port elbows on control valve and power cylinder, and tighten connectors.
- (3) Position relief-valve mounting bracket (fig. 124) on right side of steering gear housing, install split-lockwasher screw, spacer, capscrew, washer, and safety nut, and tighten.
- (4) Position steering gear in vehicle at right side of steering gear bracket, install three capscrews (fig. 124) and safety nuts, and tighten.
- (5) Connect horn wire to terminal at top of horn-contact-brush cover (fig. 125).
- (6) Position inlet and outlet lines (fig. 124) at elbows on left side of control valve, and tighten connectors.
- (7) Install relief valve (para 103b).
- (8) Install left front, fender assembly. Refer to paragraph 32.
- (9) Install steering wheel Refer to TM 9-2820-211-20.
- (10) Install steering jacket pad with four pad screws and lockwashers. Loosely install three capscrews and safety nut (fig. 121) in holes in instrument panel and steering-gear-jacket mounting bracket, and adjust steering gear jacket (para 126b).
- (11) Install pitman arm. Refer to TM 9-2320-211-20.
- (12) Adjust pitman arm shaft. Refer to paragraph 126a.
- (13) Fill hydraulic oil reservoir (fig. 127), and check all lines and connections for leaks.

100. Hydraulic Oil Reservoir

a. Removal.

- (1) Remove drain plug from bottom of reservoir and drain oil from reservoir.
- (2) Unscrew connector securing vent line (fig. 120) to top of reservoir, and remove line from reservoir.
- (3) Disconnect two inlet lines at rear end of reservoir
- (4) Disconnect outlet line at right side of reservoir.
- (s) Remove capscrew, washer, two mounting cushions, spacer, and safety nut

securing mounting bracket on bottom of reservoir to top frame left side rail. (6) Support reservoir and remove two capscrews (fig. 128), four washers, and two safety nuts securing mounting brackets on front and rear end of reservoir to left front-fender splash shield. Remove reservoir from vehicle.

b. Installation.

- (1) Position "steering gear hydraulic oil reservoir on top of frame left side rail immediately to the rear of the left headlight support bracket. Secure

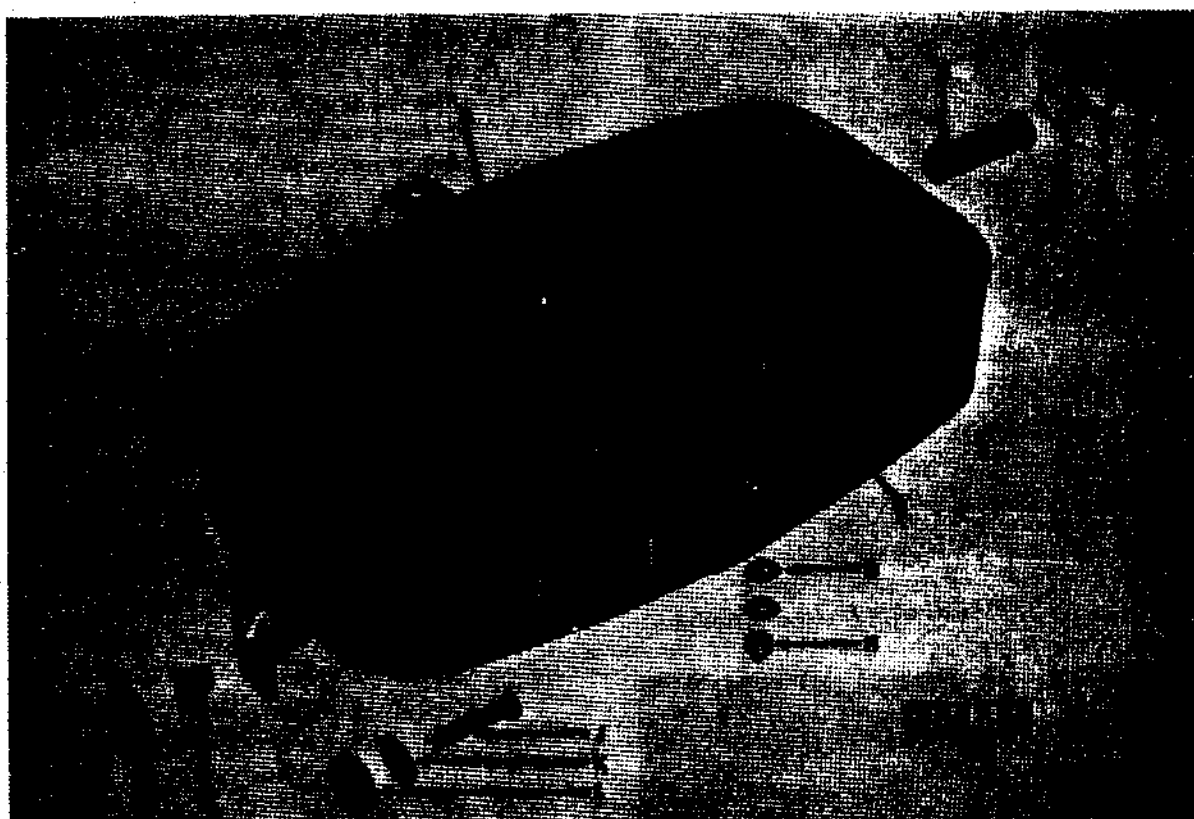


Figure 127. Oil reservoir—exploded view.

Key	Item	Key	Item	Key	Item
A	Reservoir, oil	F	Screw, cap	K	Washer, plain
B	Screw, filler	G	Washer, plain	L	Cushion, mounting
C	Ring, snap	H	Nut, safety	M	Spacer, mounting screw
D	Gasket, filler plug	J	Screw, cap	N	Plug, pipe
E	Plug, filler				

Figure 127. Oil reservoir—exploded view—legend.

mounting brackets on front and rear ends of reservoir to left front-fender splash shield with two capscrews (fig. 128), four washers, and two safety nuts. Tighten nuts.

(2) Secure mounting bracket on bottom of reservoir to top of frame left side rail with capscrew, washer, two mounting cushions, spacer, and safety nut. Tighten nut.

(3) Connect outlet line to fitting at right side of reservoir.

(4) Connect two inlet lines to fittings at rear end of reservoir.

(5) Position vent line at fitting on top of reservoir, and tighten connector.

(6) Fill reservoir, and check connections for leaks.

101. Hydraulic Pump (Diesel Engine)

Refer to TM 9-2320-211-20.

102. Hydraulic Pump (Gasoline Engine)

Refer to TM 9-2320-211-20.

102.1 Hydraulic Pump and Hydraulic Piping (Multifuel Engine)

a. Refer to TM 9-2815-210-35 for removal and installation.

NOTE

The following information is for use of maintenance personnel in conjunction with replacement and identification of a more durable power steering pump. The number "15" stamped on the pump housing (fig. 120.2) designating relief valve setting inside the pump, can also be used for identification. When this pump is installed for the first time, on vehicles originally equipped with other pumps, alteration of the hydraulic piping must also be accomplished (refer to fig. 120.1)

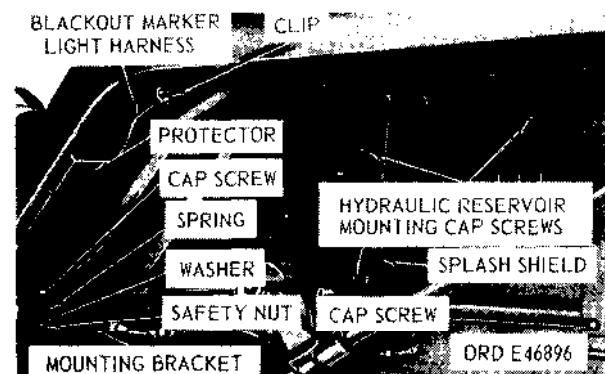


Figure 128. View of underside of left front fender.

b. Alteration Procedure.

(1) Drain and flush entire power steering piping system.

(2) Remove existing pressure hose from the steering pump to inlet port on steering control valve.

(3) Remove existing return hose from outlet port on steering control valve to reservoir.

(4) Install bracket support assembly (I) (fig. 120.1). Install bottom bolt first.

(5) Assemble tee (F) and tee (G) to relief valve (H) (fig. 120.1).

(6) Install relief valve (H) on mounting bracket support (I) (fig. 120.1).

(7) Install hoses (C) (D) (J) (K) in locations indicated (fig. 120.1). Prior to installing hose (K) to inlet port on steering control valve, connect the hydraulic pressure gage (Test Set Power Steering, FSN 4910-627-7043) in series. Leave the pressure gage line fitting to control valve loose for system bleeding.

(8) Fill reservoir (A) with OE/HDO-10 oil (MIL-L-2104B) so that oil covers the bottom of the filler screen. Replace reservoir cap to prevent any dirt entering the system.

c. Power Steering System Bleeding Procedure.

(1) With engine shut off control in the "OUT" (fuel off) position, manifold heater switch in "OFF" position engage starter and crank engine for five (5) seconds. Repeat until solid oil comes out of loose fitting at control valve b (7) above.

(2) Exercise the power steering system with the steering wheel, do not go to the full right or full left rotation. Continue this procedure until the pump noise from air has diminished.

(3) Perform power steering pump tests and adjustments as outlined in para 122 (b, c) page 136-137. (Operating pressure in this system is limited to 1000 psi by the relief valve (H) preset at factory.)

(4) After tests and adjustments are completed, shut down engine, remove pressure gage and connect the hose (K) to the control valve.

(5) Restart engine, exercise steering system and check all fittings for leaks.

103. Relief Valve

(fig. 129)

a. Removal.

(1) Unscrew coupling securing outlet line to relief valve, and remove line from valve outlet elbow.

(2) Remove relief valve from bracket bolted to steering gear housing.

NOTE

On some vehicles, the relief valve is secured to the bracket by two safety nuts installed on studs screwed into the relief valve housing.

(3) Unscrew relief valve from tee, and remove valve from vehicle.

(4) Remove elbow from relief valve outlet.

b. Installation.

(1) Install elbow in relief valve outlet.

(2) Position relief valve inlet port at tee, and screw valve onto tee,

(3) Secure relief valve to bracket bolted to steering gear housing. Refer to note in a (2) above,

(4) Position outlet line at valve outlet elbow, and tighten connector.

104. Steering Linkage

a. Removal.

(1) Upper drag link removal, Refer to TM 9-2320-211-20

(2) Lower drag link removal. Refer to TM 9-2220-211-20.

b. Installation.

(1) Upper drag link installation. Refer to TM 9-2320-211-20.

(2) Lower drag link installation. Refer to TM 9-2320-211-20.

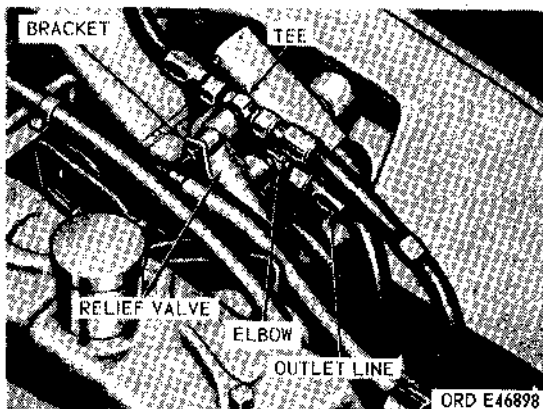


Figure 129. Top right view of relief valve installed.

105. Relay Lever

a. Removal.

(1) Remove front end of upper drag link from lower ball stud at relay lever (para 104 a (1)).

(2) Remove safety nut and capscrew at left side of relay-lever bracket.

(3) Remove lubrication fitting from outer end of relay-lever pin, and install capscrew in lubrication fitting hole. Pulling on capscrew, pull relay-lever from bracket.

NOTE

Some steering relay-lever brackets, due to manufacturer's error, are not of specified

3/8-inch thickness. Steering relay-lever bracket 2530-689-9954 has been incorporated in present production vehicles, and in the supply system, to replace brackets 2620-734-8895 and 2530-513-9644. These brackets are to be replaced only at time of failure. For removal and installation procedures, refer to c below.

b. Installation.

(1) Position relay lever in bracket on frame left side rail, and install relay-lever pin in bore of bracket and lever.

NOTE

Groove in pin must be at bottom of bracket bore.

(2) Install capscrew and safety nut in left side of bracket to clamp pin in bracket. Tighten screw and nut.

(3) Install front end of lower drag link on lower ball stud at relay lever.

(4) Install front end of upper drag link on upper ball stud at relay lever.

(5) Remove capscrew from outer end of relay-lever pin, and install lubrication fitting in hole in end of pin. Lubricate relay lever.

c. Replacement of Steering Relay-Lever Bracket.

(1) Removal of deficient bracket.

(a) Remove left front wheel (TM 9-2320-211-20).

(b) Remove power steering hydraulic oil reservoir from left fender splash shield (pars 100).

NOTE

Disconnect the reservoir to pump inlet line at the quick disconnect coupling. Do not disconnect the other hydraulic lines. Temporarily position reservoir on engine.

(c) Remove left front fender (para 31).

(d) Disconnect and remove air line from left frame side rail and mounting bracket (fig. 130).

(e) Remove relay lever (a above).

(f) Drill heads of mounting rivets (four) securing relay-lever bracket (fig. 131) to frame and remove rivets with a hammer and punch. Discard bracket and rivets.

CAUTION

Do not remove rivet heads with a chisel as hole will become elongated and bolting of new bracket will be weakened.

(2) Installation of new bracket.

(a) Position new relay-lever bracket on frame and enlarge existing 1/2-inch hole (fig. 132) in bracket

and frame with a 3/64-inch drill; and ream hole to a diameter of 9/16-inch.

NOTE

Bracket must be mounted flush against vertical and horizontal faces of frame.

(b) Install new capscrew 5305-716-7454 in enlarged hole in bracket and frame and secure bracket with new lockwasher 5310-012-0698 and nut 6310-7639919.

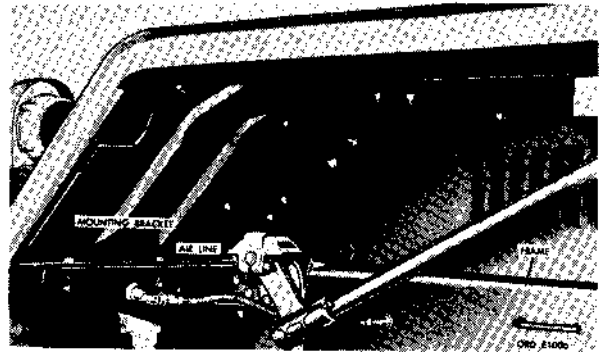


Figure 130. Air line removal.

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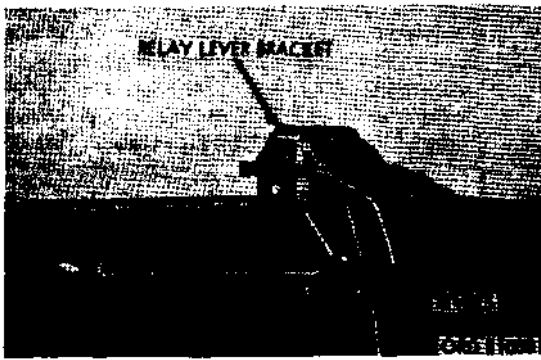


Figure 131. Relay lever bracket to be removed



Figure 132. Relay lever bracket installation

- (c) Using bracket as a drill guide, drill end/for enlarge five remaining holes in bracket and frame with 35/64-inch drill. Ream holes in bracket and frame to a diameter of 9/16-inch.
- (d) Install new cap screws 5305-838-8009, lockwashers 5310-012-0898 and nuts 5310-635-1980. Torque nuts to 195 to 140 pound-feet.
- (e) Install relay-lever assembly (b above) in new relay-lever bracket.
- (f) Install air line (fig. 130).
- (g) Install left front fender (par. 32).
Note. When installing fender it may be necessary to cut out a piece of the splash shield to provide clearance for the new relay lever bracket.
- (h) Install and secure power steering hydraulic reservoir to left front fender splash shield.
- (i) Install left front wheel (TM 9-2320-211-20).

106. Hydraulic Lines and Couplings (Fig. 120)

- a. Removal. Refer to TM 9-2320-211-20.

Warning: Do not start engine after couplings are disconnected as the high pressure will burst the lines.

- b. Installation. Location and proper installation of hydraulic flexible lines are shown in figure 120. The hydraulic lines are assembled at time of installation of the steering gear assembly into the vehicle.

Section IV. DISASSEMBLY INTO AND ASSEMBLY FROM SUBASSEMBLIES

107. General

After the component has been removed from the truck, further inspection is necessary. Visually inspect the assembly for excessive wear or malfunction. Do not disassemble unless inspection warrants replacement.

108. Disassembly

a. Pitman Arm Shaft Assembly (Fig. 123).

- (1) Drain lubricant and loosen adjusting screw nut and adjusting screw (fig. 133).

- (2) Remove eight cap screws and lockwashers and lift off gear housing side cover (fig. 133) and gasket.
- (3) Remove burs from splined end of pitman arm shaft, and then pull pitman arm shaft with integral lever assembly (fig. 134) from gear housing.

b. Power Cylinder Assembly.

- (1) Remove four cap screws and lockwashers from sliding-bar end cover (fig. 135) and lift off cover and sliding bar-end cover gasket.



Figure 133. Removing gear housing side cover



Figure 134. Removing pitman arm shaft with integral lever



Figure 135. Removing integral Lever block and pin

- (2) Loosen hex-jam nut (fig. 135) and hex-socket setscrew, and remove integral lever block and integral lever Mock pin.

- (3) Remove four cap screws and lock-washers from cylinder mounting flange (fig. 136). Turn flange 900 to provide clearance at hydraulic control valve assembly, and slide mounting flange on cylinder to expose cylinder flange snap ring (fig. 136). Remove snap ring.
- (4) Slide cylinder mounting flange from power cylinder and pull power cylinder from piston, adapter, and sliding bar. Then, remove cylinder mounting flange and cylinder flange snap ring from sliding bar.
- (5) Pull sliding bar (fig. 137), piston, adapter with bushing assembly, and gasket from gear housing.



Figure 136. Removing power cylinder Assembly



Figure 137. Removing piston and sliding bar assembly

c. Hydraulic Control Valve.

- (1) Remove four socket-head cap screws and lift off actuating lever cover (fig. 137) and lever cover seal.
- (2) Lift hydraulic control valve assembly (fig. 138) from control housing assembly.

d. Steering Gearshaft, Steering Gear Jacket, and Control Housing Assembly.

- (1) Remove four cap screws (fig. 138) and lockwashers securing steering gearshaft, steering gear jacket, and control housing assembly to gear housing.
- (2) Lift off the assembly.

e. Cam Assembly.

- (1) Remove four cap screws and lockwashers.
- (2) Remove cam end cover, shims, and gaskets.
- (3) Pull cam with cam retainer assemblies (fig. 139) and cam thrust bearings from gear housing.

109. Assemblya. Cam Assembly.

- (1) Assemble cam thrust bearings (fig. 139) and cam retainer assemblies on

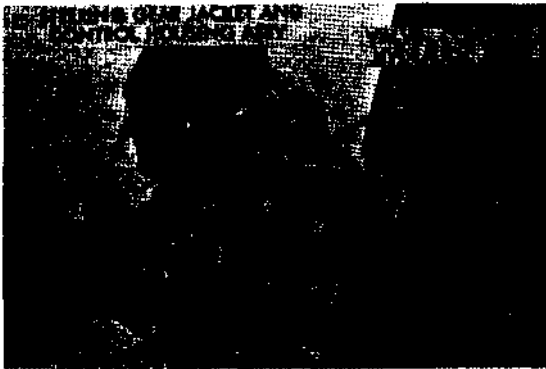


Figure 138. Removing Hydraulic Control valve assembly

each end of cam, with the smaller race of the thrust bearing against the shoulder of the cam. This applies to both ends of the cam. Slide cam assembly in the gear housing.

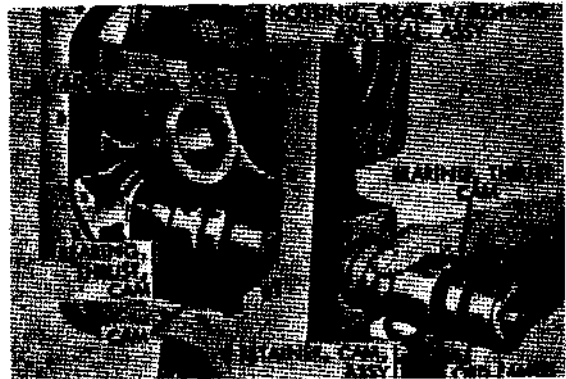


Figure 139. Removing cam

- (2) Assemble control housing assembly (fig. 140) with steering gearshaft and steering gear jacket to gear housing, using new control housing gasket. Install four cap screws and lockwashers, and tighten securely.
- (3) Without using shims or gaskets, place cam end cover (fig. 141) in position and measure gap between gear housing and cover. This can be measured either with feeler gage or shims.

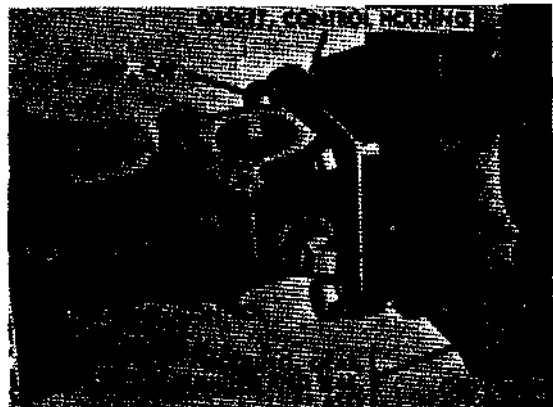


Figure 140. Assembling Control Housing to gear housing



Figure 141. Measuring cam end cover to gear housing clearance

Note. Cam end cover shims are of 0.002-, 0.009-, and 0.010-inch thickness and cam end cover gaskets are of 0.010-inch thickness. In replacing shims, put the required metal shims between two gaskets, to allow the gaskets to seal against the machined surfaces of cam end cover and gear housing. In figuring the total thickness of the shims, figure the gaskets as being of 0.008-inch thickness instead of 0.010 inch as they will compress slightly when cap screws are tightened.

- (4) Remove and install cam end cover (fig. 141) with shims and gaskets in place, and tighten cap screws. Reach into gear housing and turn cam (fig. 142) with the fingers. The cam should turn freely. If the cam is tight, not



Figure 142. Checking cam adjustment

enough shims have been placed under the cam end cover. Determine if any end play is present by alternately pushing and pulling on the cam in a lengthwise direction. If end play is present, too many shims have been placed under the cover. Remove and install cam end cover with more or less shims and check cam for tightness.

b. Hydraulic Control Valve Assembly.

Note. The key letters noted in parentheses are in figure 151 unless otherwise indicated.

- (1) Place hydraulic control valve assembly (fig. 138) in position on the control housing assembly, making sure that the rounded portion of actuating lever (Y) fits into its groove in the cam. Install two socket-head screws (U), at upper end only, and tighten securely.
- (2) Remove spool cover (Q) and spool O-ring gasket (P), and loosen jam nut (D) locking eyebolt with bearing assembly (C) to spool (G).
- (3) Turn the spool (G) with a screwdriver until face of spool is flush with face of spool sleeve (fig. 143). Use a straightedge to align the surface. The purpose of this adjustment is to center the spool in the spool sleeve. This adjustment must be made each time the hydraulic control valve assembly is removed from its position on the control housing, and at any time the valve seems to be out of adjustment. Refer to figure 143 for proper valve adjustment in neutral position.



Figure 143. Adjusting Control valve assembly

- (4) Tighten jam nut (D). Be sure not to change the position between spool (G) and eyebolt with bearing (C). The slightest change will affect adjustment. While tightening jam nut (fig. 144), bearing end of eyebolt must be held securely or else actuating lever (Y) will apply sufficient pressure to force eyebolt pivot bearing dust cap from its position.
- (5) Complete the assembling of the control valve assembly by adding spool cover O-ring gasket (P) and spool cover (Q). Place lever cover seal (B) and actuating lever cover (A) in position over actuating lever (Y), install two socket-head screws (U), and lockwashers (T). Tighten securely.



Figure 144. Locking control valve adjustment.

c. Power Cylinder Assembly.

Note. The key letters noted in parentheses are in figure 146 unless otherwise indicated.

- (1) Place new mounting flange gasket (LL) on adapter with bushing assembly, and loosely place cylinder mounting flange (CC) and cylinder flange snap ring (BB) over sliding bar (U). This will allow clearance at hydraulic control valve when assembling power cylinder (DD) to gear housing (M).
- (2) Slide power cylinder assembly into position and then place cylinder mounting flange (CC) and cylinder

flange snap ring (BB) in position on the power cylinder (DD). Install four capscrews (EE), four lockwashers (FF), and tighten securely.

- (3) Loosen hex-socket setscrew (TT) and hex-jam nut (UU) in end of sliding bar (U).
 - (4) Position integral lever block pin (PP) and integral lever block (QQ) in the sliding bar (fig. 145).
 - (5) Tighten hex-socket setscrew (TT) in end of sliding bar (U). Be sure integral lever block is free to rotate on integral lever block pin and sliding bar, and piston is free to move back and forth, in gear housing (M) and power cylinder (DD).
 - (6) Using a new sliding bar and cover gasket (L), install sliding bar end cover (K) and tighten capscrews securely.
- d. Pitman Arm Shaft Assembly (Fig. 146).*
- (1) Place pitman arm shaft with integral lever assembly (G) in gear housing (M). Exercise care when installing to prevent damage to pitman arm shaft bushings (N) in gear housing. Engage, fork of pitman arm shaft assembly with integral lever block (QQ), and the roller bearing with stud assembly (WW), with the thread in the cam.
 - (2) Install gear housing side cover (F) using a new side cover gasket (F) and the adjusting screw (D) loosened



Figure 145. Assembling integral lever pin and block.

so that it will not bear against the shaft. Install eight capscrews (B), eight lockwashers (A), holding side cover to gear housing (M). Tighten

securely.
(8) Adjust roller bearing stud in cam thread (TM 9-2820-211-20).

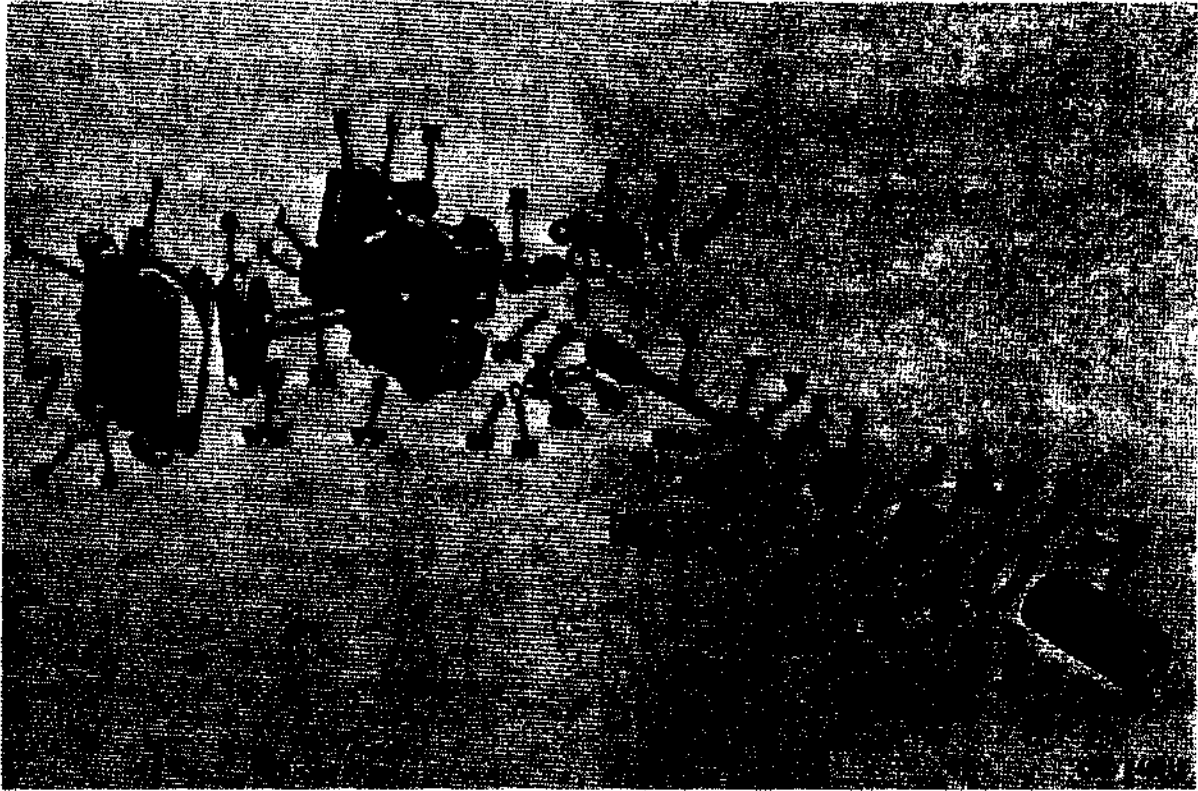


Figure 146. Gear housing, power cylinder and pitman arm shaft assembly exploded view

Key	Item	Key	Item
A	Washer, lock	N	Bushing, pitman arm shaft
B	Screw, cap	P	Arm, pitman
C	Nut, adjusting screw	Q	Washer, lock
D	Screw, adjusting	R	Nut, hex
E	Cover, side, gear housing	S	Seal, pitman arm shaft
F	Gasket, side cover	T	Seal, pitman arm shaft
G	Shaft, pitman arm, w/integral lever assembly	U	Bar, sliding
H	Cover end, cam	V	Ring, snap, oil seal
J	Gasket, cover, cam end	W	Washer, special
K	Cover, end, sliding bar	X	Bushing, adapter
L	Gasket, cover, sliding bar end	Y	Adapter, w/bushing, assembly
M	Housing, gear		

Figure 146. Gear housing, power cylinder and pitman shaft assembly-exploded view-legend.

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
Z	Ring, piston	MM	Seal, oil, adapter
AA	Washer, plain	NN	Washer, plain
BB	Ring, snap, cylinder flange	PP	Pin, integral lever block
CC	Flange, cylinder mounting	QQ	Block, integral lever
DD	Cylinder, power	RR	Washer, plain
EE	Screw, cap	SS	Ring, snap, lever block pin
FF	Washer, lock	TT	Screw, set
GG	Nut, slotted	UU	Nut, jam, hex
HH	Pin, cotter	VV	Plug, pipe
JJ	Piston	WW	Bearing, roller, w/stud assembly
KK	Gasket, O-ring, adapter	XX	Shims, cover, cam end
LL	Gasket, mounting flange		

Figure 146. Gear housing, power cylinder and pitman arm shaft assembly - exploded view - legend - continued

Section V. REPAIR

110. Pitman Arm Shaft with Integral Lever Assembly (G, Fig. 146)

a. Disassembly.

- (1) Place pitman arm shaft with integral lever and bearing assembly in a press and, using an adapter, press roller bearing with stud assembly (fig. 134) from the shaft assembly.
- (2) Roller bearing assembly with stud is furnished as an assembly for replacement.

Note. Flange on bearing race must be located on shaft side of assembly, when assembling.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean pitman arm shaft assembly with mineral spirits paint thinner or dry-cleaning solvent. Special attention must be given to the roller bearing with stud assembly.
- (2) Inspection. If there are any signs of cracks in pitman arm shaft with integral lever assembly, the unit must be replaced. Check roller bearing with stud assembly (fig. 134). If bearings are pitted or show signs of wear or stud is loose in bearings, replace assembly. Check pitman arm shaft for abnormal wear, scratches, abrasions, and scoring. Check splines for

twisted condition or wear, and stripped threads. Refer to serviceability standards (par. 128).

- (3) Repair. Remove any raised metal or scratches with a fine mill file. The roller bearings should be preloaded at all times. Operation of a correctly adjusted unit may initially feel rough to the hands. However, under steering load, the unit will operate smoothly and have the load distributed, assuring normal service life. Adjust as outlined in (a) through (d) below.
 - (a) Straighten out prong of stud nut washer (fig. 147). Replace old washer if new washer is available. If old washer must be used, break off bent prong to prevent using that prong at assembly.
 - (b) Tighten nut as required. Hold stud from turning by using a spanner wrench (fig. 147) on washer, or by clamping stud; do not nick or burr stud surface. Used or replacement units should be set at a minimum of 3 lb.-in. torque. Turn stud back and forth and test adjustment.
 - (c) Lock adjustment by bending a prong of the washer against a side of the nut.

Note. Bend a prong that is at right angles to a side of the nut. Do not

use washer unless the prongs used before have been removed.



Figure 147. Adjusting roller bearings with stud assembly

c. Assembly. If replacement of tapered roller bearing with stud assembly (WW, fig. 146) is necessary, press new assembly into position in the pitman arm shaft with integral lever assembly (G, fig. 146), and with stud toward shaft side. Tapered roller bearing assembly with stud is furnished as an assembly for replacement.

Note. Flange on bearing race must be located on shaft side of assembly, when assembling.

111. Power Cylinder Assembly (DD, Fig. 146)

Note. Make preliminary inspection to determine defective parts, such as excessively worn adapter with bushing assembly (fig. 144)



Figure 148. Removing piston assembly from cylinder

and leaking oil seal. The piston and sliding bar should work freely and smoothly.

a. Disassembly.

- (1) Disassemble piston and sliding bar assembly from cylinder by tapping piston against adapter until both come out of cylinder.

Note. Sliding bar, piston outside diameter, and cylinder wall have precision finished surfaces. Great care should be exercised in handling these parts.

- (2) Clamp sliding bar in a vise and remove cotter pin, slotted nut, plain washer, and piston (fig. 149).
- (3) Slide adapter with bushing assembly (fig. 149) off sliding bar.
- (4) Remove oil seal snap ring, plain and special washers, and adapter oil seal from adapter with bushing assembly. Figure 150 illustrates proper sequence of seal components. Remove adapter O-ring gasket and mounting flange gasket.
- (5) Remove piston ring (fig. 149) from piston. Should preliminary inspection warrant removal of adapter bushing, press bushing from adapter assembly.

b. Cleaning, Inspection and Repair.

- (1) **Cleaning.** Thoroughly clean all components of the power cylinder assem-



Figure 149. Removing piston from sliding bar

bly with mineral spirits paint thinner or dry-cleaning solvent.

- (2) Inspection and repair. Inspect all precision finished surfaces for burs or damages. Place piston on sliding bar and work back and forth in the cylinder. Piston should work freely and smoothly. The adapter oil seal (fig. 150) must have a snug fit on the sliding bar. Inspect integral lever block and integral lever block pin (fig. 135) for excessive wear. Refer to serviceability standards (par. 128).

c. Assembly.

Note. The key letters noted in parentheses are in figure 146 unless otherwise indicated.

- (1) Press new adapter bushing (X) into adapter, leaving bushing flush with face of adapter.
- (2) Install new adapter oil seal (MM), special washer (W), plain washer (NN), and oil seal snap ring (V) in adapter bore in the sequence as illustrated in figure 150. Install new adapter O-ring gasket (KK) on adapter assembly.
- (3) Thoroughly clean piston ring groove and install piston ring (Z) on piston (JJ).
- (4) Slide adapter with bushing assembly (Y) on the sliding bar (U) and position piston (JJ) on sliding bar. Install plain

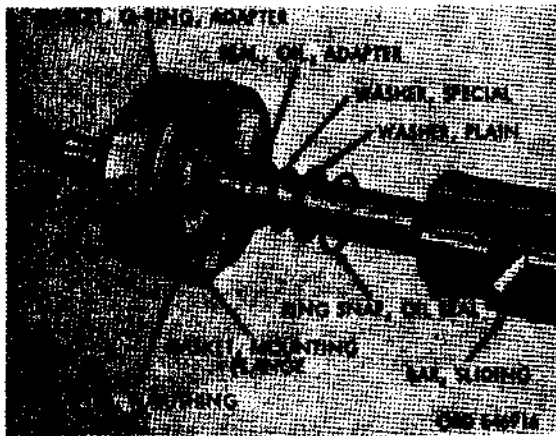


Figure 150. Adapter oil seal assembly

washer (AA), slotted nut (GC), and tighten securely. Insert cotter pin (HH) and lock slotted nut on sliding bar.

- (5) Compress the piston ring (Z) and slide piston (JJ), sliding bar (U), and adapter with bushing assembly (Y) into position in the power cylinder (DD).

Note. Exercise care not to cut adapter O-ring gasket (KK) while positioning adapter in cylinder assembly.

- (6) Cylinder mounting flange (CC) and cylinder flange snap ring (BB) are assembled to the cylinder assembly at time of assembly to the housing.

112. Hydraulic Control Valve (Fig. 151)

a. Disassembly.

Note. Extreme caution must be used in the disassembly of the valve parts, especially the spool sleeve, spool, and O-ring gaskets. The sleeve and spool have precision finished surfaces. Care should be exercised in handling these parts to prevent damage. Sealing edges of the sleeve and spool must not be broken. Breaks would cause excessive leakage and reduced hydraulic power. If seals are cut during assembly, remove and replace.

- (1) Remove actuating lever Pin, (fig. 152) and disassemble valve actuating levers, plain washer, and rubber washer.
- (2) Remove two socket-head screws and lockwasher and lift off spool cover (fig. 153) and spool cover O-ring gasket.
- (3) Loosen two remaining socket-head cap screws and lockwashers holding sleeve retainer (fig. 153) to body.
- (4) Push spool as far toward lever end as possible and remove spool sleeve snap ring (fig. 154).
- (5) Push spool farther toward lever end (about 1/2 in.) until spool O-ring gasket (fig. 158) is exposed, permitting removal. Avoid damage to the gaskets during removal if new gaskets are not available.
- (6) Push spool in the opposite direction to remove spool and spool O-ring gasket (fig. 157) from sleeve.

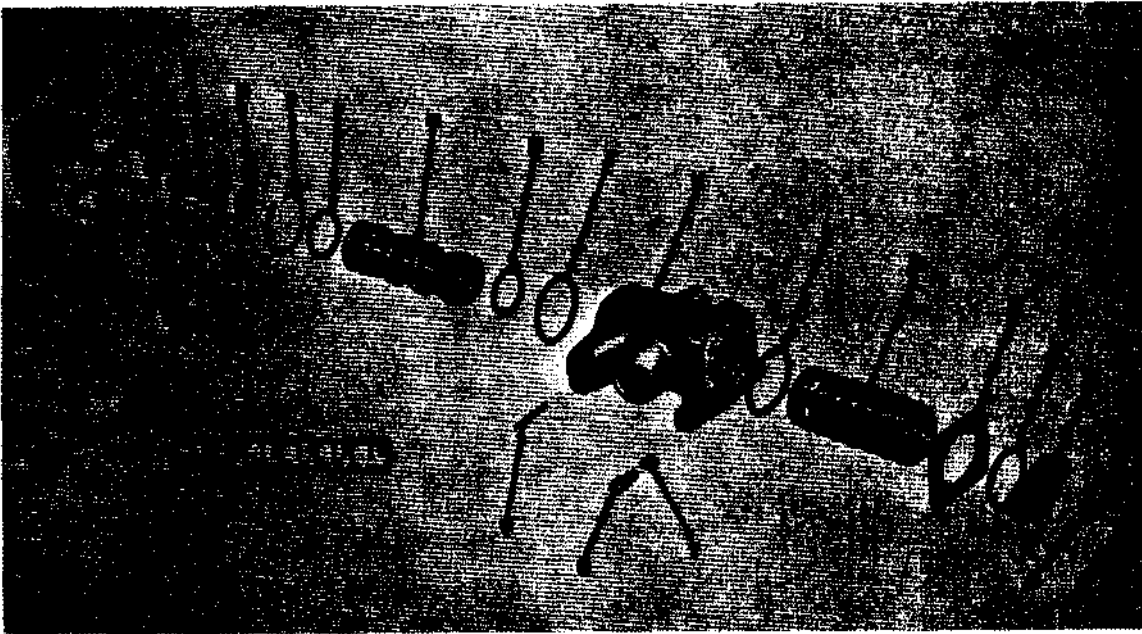


Figure 151. Hydraulic control valve - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Cover, actuating lever	N	Retainer, sleeve
B	Seal, lever cover	P	Gasket, O-ring, spool cover
C	Bolt, eye, w/bearing	Q	Cover, spool
D	Nut, jam	R	Screw, socket head
E	Ring; snap, spool sleeve	S	Washer, lock
F	Gasket, O-ring, spool	T	Washer, lock
G	Spool	U	Screw, socket head
H	Gasket, O-ring, spool	V	Pin, actuating lever
J	Gasket, O-ring, spool sleeve	W	Washer, rubber
K	Body	X	Washer, plain
L	Gasket, O-ring, spool sleeve	Y	Lever, actuating
M	Sleeve, spool		

Figure 151. Hydraulic control valve - exploded view - legend

- (7) Remove sleeve retainer (fig. 157). Remove spool sleeve O-ring gasket in the body by pushing spool sleeve (fig. 156) from lever end until gasket is exposed. Use a pointed instrument to remove gasket, being careful not to damage it.
- (8) Remove remaining spool sleeve O-ring body by pushing on end opposite lever end.
- (9) Remove remaining spool sleeve O-ring gasket (fig. 155) from body.
- (10) Remove jam nut, and eyebolt with bearing (fig. 152) from spool.

b. Cleaning, Inspection, and Repair.

- (i) Cleaning. The importance of cleaning must be thoroughly understood by ordnance maintenance personnel. The presence of dirt or foreign substances is a constant threat to satisfactory performance of the control valve. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent. Protect all



Figure 152. Hydraulic control valve assembly with actuating lever



Figure 153. Illustrating spool cover and sleeve retainer

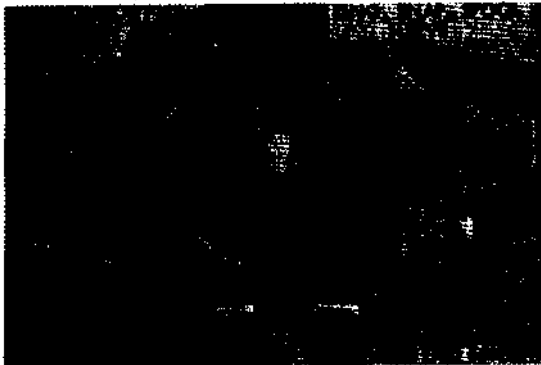


Figure 154. Location of spool sleeve snap ring

parts from accumulation of dust and grit after cleaning.

- (2) **Inspection.** Inspect all precision finished surfaces for burs or scratches and remove with a fine mill file. Place spool in sleeve and slide back and forth. Spool should work freely and smoothly. Check valve body for cracks and discard if any are evident. Inspect inlet and outlet ports for damaged threads.
- (3) **Repair.** Repair or replace as inspection. Refer to serviceability standards (par. 128c).

c. Assembly.

Note. The key letters noted in parentheses are in figure 151 unless otherwise indicated.

- (1) Caution must be used in the repair and assembly of the hydraulic control valve parts, especially the spool and spool sleeve. When installing sleeve in body and spool in sleeve, a twisting motion to the spool or sleeve will facilitate assembly. Before assembling, be sure all parts have been thoroughly cleaned in mineral spirits paint thinner or dry-cleaning solvent. Light lubricating oil should be applied to spool sleeve (M), spool (G), spool O-ring gaskets (F and H), and spool sleeve O-ring gaskets (J and L).
- (2) Place spool sleeve O-ring gasket in groove, opposite lever end of body (fig. 155).
- (3) Assemble spool sleeve (M) in body (K) from lever-end, with step cut end in

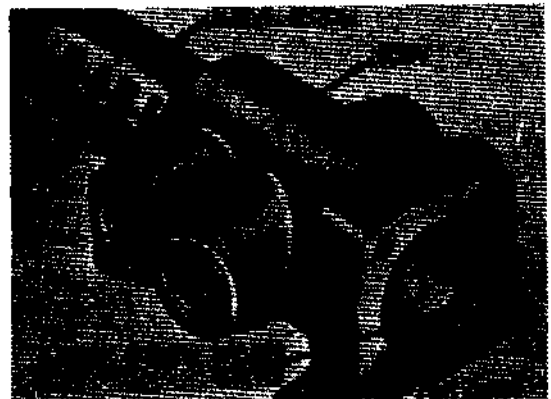


Figure 155. Assembly spool sleeve

first. A slight twisting motion of the sleeve will facilitate assembly.

- (4) Push spool sleeve (M) through body (K) only far enough to uncover spool sleeve O-ring gasket groove in body (fig. 156) at lever end and assemble spool sleeve O-ring gasket (J) in groove.

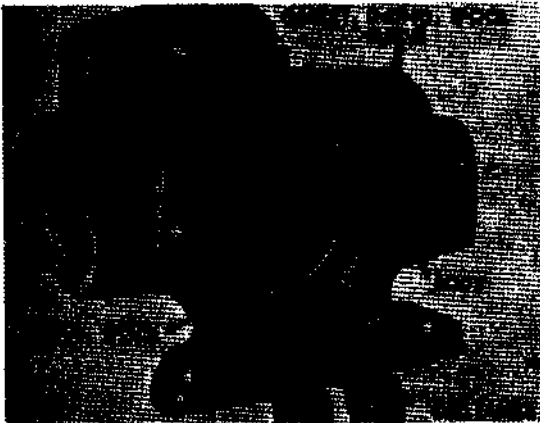


Figure 156. Hydraulic control valve with spool sleeve O-ring gasket installed

- (5) With a twisting motion, center spool sleeve (M) in body (K) and install sleeve retainer (N), lockwashers (S), and socket-head screws (R). Do not tighten screws.
- (6) Place spool O-ring gasket (H) in groove on end of spool (G) opposite eyebolt with bearing (C) end. Assemble spool (fig. 157) in spool sleeve (M) and body assembly from opposite lever end. Use twisting motion to start spool O-ring gasket into spool sleeve.



Figure 157. Assembly spool in spool sleeve

- (7) Push spool (G) through spool sleeve (M) far enough to expose second groove at eyebolt end of spool (fig. 158).
- (8) Install eyebolt with bearing (C), and jam nut (D) in spool (G).
- (9) Assemble spool O-ring gasket (fig. 154) in second groove of valve SPOOL



Figure 158. Spool O-ring gasket at eyebolt end

Push this end of valve spool back into spool sleeve, using a twisting motion to start O-ring gasket into spool sleeve, until O-ring gasket has just entered the spool sleeve.

- (10) Slip spool sleeve snap ring (F) into first groove of spool (G) and push on spool at the same time compressing snap ring into groove of body (K).
- (11) Tighten two socket-head screws (R) holding sleeve retainer (N). Loosely assemble spool cover (Q), spool cover O-ring gasket (P), and socket-head screws. The spool cover will have to be removed for valve adjustment, after installation on the control housing.
- (12) Insert valve actuating lever (Y) in eyebolt with bearing (C) and install actuating lever pin (V) through clevis and valve actuating lever. Assemble plain washer (X) and rubber washer (W) over rounded portion of valve actuating lever (fig. 152).

113. Wheel Shaft, Stowing Jacket, and Control Housing (Fig. 159)

a. Disassembly.

- (1) Steering wheel and horn button assembly. Refer to TM 9-2320-211-20.
- (2) Contact brush cover, seal, and contact brush. Remove four machine screws and lockwashers and lift off



Figure 159. Wheel shaft, jacket, control housing, and cam - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Gasket, control housing cover	P	Housing, control assembly
B	Shims, control housing cover	Q	Gasket, control housing
C	Cover, control housing assembly	R	Bearing, thrust, cam
D	Clamp, steering gear jacket	S	Retainer, cam assembly
E	Bolt, hex	T	Cam
F	Screw, math	U	Ball, bearing, steering gear shaft
G	Washer, lock	V	Washer, lock
H	Cover, contact brush w/cable	W	Screw, cap
J	Seal, cover, contact brush	X	Nut, hex
K	Screw, cap	Y	Washer, lock
L	Washer, lock	Z	Jacket, steering gear
M	Cup, bearing, steering gear shaft	AA	Shaft, steering gear
N	Ring, snap, steering gear shaft bearing		

Figure 159. Wheel shaft, jacket, control housing, and cam - exploded view - legend

contact brush cover and contact brush cover seal (fig. 160). Remove two machine screws from contact brush plate and lift out contact brush (fig. 160).

(3) Steering gear jacket and bearing assembly.

Nets. Check steering gear jacket bearing and make certain new bearing as-

sembly is available if the old assembly is removed from the jacket.

(a) Loosen steering gear jacket clamp (fig. 160) and pull steering gear jacket assembly from wheel shaft.

(b) A ball-type bearing is used at upper end of steering gear jacket. Make

certain a new bearing assembly is available before removing old bearing. Insert along bar in end opposite bearing and tap out old bearing assembly.

(4) Wheel shaft assembly and control housing

(a) Remove four cap screws and lockwashers securing control housing cover assembly (fig. 161) to control housing assembly, and separate the two units. Keep the control housing cover metal shims (fig. 161) intact.

(b) Remove two wheel shaft bearing snap rings, and remove the wheel shaft bearing cup and 14 ball bearings from each bearing assembly.

b. Cleaning, Inspection and Repair.

(1) **Cleaning.** Wash all parts thoroughly with mineral spirits paint thinner or dry-cleaning solvent.

Note. The steering gear jacket bearing is prelubricated at time of assembly and unless replaced, do not wash steering tube at bearing end.

(2) Inspection and repair. Check steering shaft for cracks or excessive wear. Pay particular attention to bearing races and if worn or pitted, replace wheel shaft. Check control housing assembly (P, fig. 159) for cracks or defective threads and replace if either exist. The steering gear jacket bearing must be replaced, as it is usually damaged during removal operation.

c. Assembly (Fig. 159).

(1) Assemble bearings on steering gear shaft (AA) and install snap ring. Place

control housing cover assembly (C) in position on steering gear shaft.

(2) Place control housing cover shims (B) and control housing cover gaskets (A) in position. Place steering gear and shaft bearings assembly in the control housing assembly (P), install four cap screws (W), four lockwashers (V), and tighten securely. The purpose of this adjustment is to obtain proper tension of steering gear shaft (AA) in its thrust bearings. Control housing cover shims (B) are of 0.002-, 0.003-, and 0.010-inch thickness, and control housing cover gaskets (A) are 0.010 inch. Place required metal shims between control housing gaskets. This allows the gasket to seal against machined surfaces.

(3) Remove or install metal shims, and tighten cap screws, until proper movement of the steering gear shaft is obtained.

(4) Place steering gear jacket (Z) and bearing assembly over steering gear shaft (AA) and tighten steering gear jacket clamp (D).

(5) Install contact brush cover with cable assembly (H) and contact brush cover seal (J). Tighten roundhead machine screws (F).

(6) Install steering wheel and horn button assembly as shown in TM 9-2320-211-20.

114. Cam Assembly (T, Fig. 159)

a. Disassembly. To disassemble the cam, remove cam retainer assemblies and cam thrust bearings (fig. 139) from each end of cam.

b. Cleaning and Inspection.

(1) **Cleaning.** Clean all parts thoroughly with mineral spirits paint thinner or



Figure 160. Removing contact brush cover



Figure 161. Removing wheel shaft assembly

dry-cleaning solvent. Give special attention to the cam retainer assemblies, making certain they are free of all grit and dirt.

Note. The cam retainers are serviced as an assembly and cannot be disassembled.

- (2) Inspection. Check cam groove for "brinelling" and other unsatisfactory conditions. Also, check splines for twist or wear. The groove in the cam is copper plated for initial service. Disregard worn condition of copper plating. Inspect cam retainers for wear or loose condition. Also, check cam thrust bearings for roughness and irregularities.

c. Repair. Remove all nicks and burs with a fine mill. No further repairs can be made. Cam retainer assemblies, and cam thrust bearings must be replaced if malfunction or damage of parts is noted during inspection.

115. Steering Gear Housing with Bushing and Seal Assembly (M, Fig. 146)

Note. Further disassembly of the steering gear housing is not required, unless excessive wear (par. 128) is evident at pitman arm shaft bushings or pitman arm shaft seal is leaking lubricant.

a. Disassembly.

- (1) Pry out pitman arm shaft seal (fig. 162) from gear housing assembly.

Note. Seal must be replaced when removed in this manner.

- (2) Do not press pitman arm shaft bushings from gear housing at this time as old bushings must be used as pilot for reaming operation on new bushings. (c below).



Figure 162. Removing pitman arm shaft seal

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Thoroughly clean the gear housing with mineral spirits paint thinner or dry-cleaning solvent.
- (2) Inspection and repair. Inspect gear housing for cracks or sand holes, paying particular attention to areas adjacent to threaded holes. Replace if cracks or damaged threads are evident. Check mating surfaces for scratches, dents, or burs; remove burs with fine mill file. Fit sliding bar (fig. 137) in guide. The bar should slide freely.

c. Assembly.

Note. The key letters noted in parentheses are in figure 146 unless otherwise indicated.

- (1) To install new pitman arm shaft bushings, use remover and replacer tool 5120-795-0137, reamer 5110-795-0248 and burnishing tool 5120-795-0139. Press inner pitman arm shaft bushings (N) from gear housing (M), using remover and replacer 5120-795-0137 (fig. 163).

Note. Do not press inner brushing entirely from housing. Stop pressing operation when bushing extends approximately one-half inch beyond housing. This will permit using old bushing as a pilot for reamer when new inner bushing is installed.

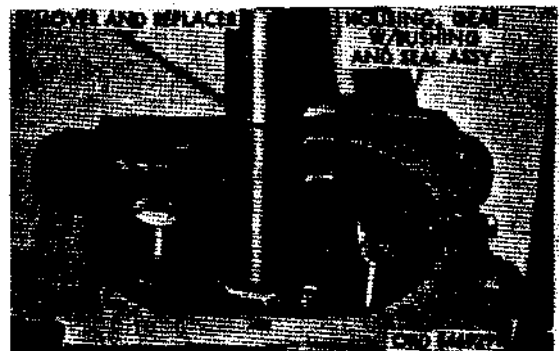


Figure 163. Pressing out pitman arm shaft bushing

- (2) Press new inner pitman arm shaft bushing (N) in flush with gear housing (fig. 164), using remover and replacer 5120-795-0137.

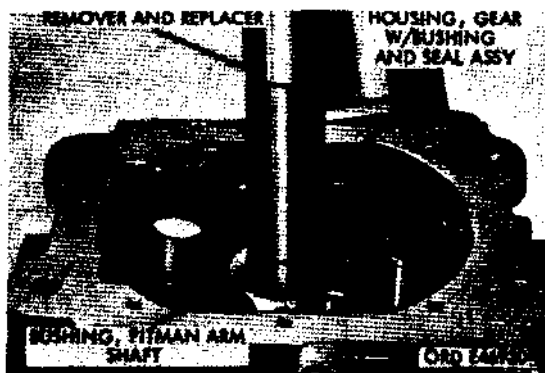


Figure 164. Installing inner pitman arm shaft bushing

- (3) Ream new inner bushing with reamer 5110-795-0246 (fig. 165), using old bushing as a pilot on opposite end.



Figure 165. Reaming inner pitman arm shaft bushing

- (4) Remove old inner bushing, used as an outer bearing and pilot, by grasping firmly with pliers and collapsing the split-type bushing.
- (5) Install new outer bushings, using remover and replacer 5120-795-0137. Press bushing in flush with bottom of pitman arm shaft seal recess.
- (6) Ream outer pitman arm shaft bushing (N) with reamer 5110-795-0248, using new inner bushing as pilot for reamer.

- (7) Burnish new bushings, using burnisher 5120-795-0139 (fig. 166).



Figure 166. Burnishing new pitman arm shaft bushings

- (8) Press new pitman arm shaft seals (S and T) into gear housing (M), using replacer 5120-795-0139 (fig. 167).



Figure 167. Installing new pitman arm shaft seal

116. Hydraulic Pump Assembly (Fig. 168)

Note. It is not necessary to disassemble the hydraulic pump unless malfunction has been reported or inspection indicates parts must be replaced. If necessary to replace parts, refer to (1) and (2) below.

a. Disassembly.

- (1) Removal of main drive gear (C, fig. 165). Remove huglock nut (A) and internal teeth lockwasher (B). Using a suitable puller, remove m&d drive gear (c) and Woodruff key (K).

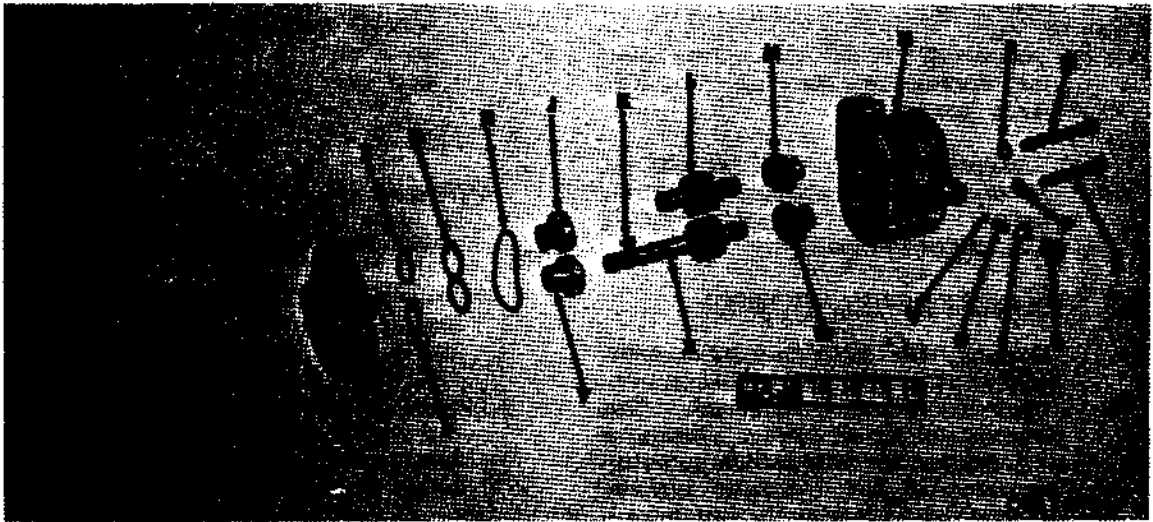


Figure 168. Hydraulic pump assembly - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Nut, huglock	P	Washer, lock
B	Washer, lock, ext teeth	Q	Screw, cap
C	Gear, drive, main	R	Screw, cap
D	Seal, oil, drive gear	S	Retainer, spring
E	Cover	T	Gasket, spring retainer
F	Gasket, O-ring, cover	U	Spring, poppet ball
G	Spring, cover bearing	V	Ball, poppet
H	seal, oil housing	W	Bearing, bushing-type (drive gear housing)
J	Bearing, bushing-type (driven gear cover)	X	Gear, drive
K	Key, woodruff	Y	Bearing, bushing-type (drive gear housing)
L	Gear, driven	Z	Washer, lock
M	Bearing, bushing-type (driven gear housing)	AA	Screw, cap
N	Housing		

Figure 168. Hydraulic pump assembly - exploded view - legend

(2) Removal of pump gears and miscellaneous parts (fig. 168).

- (a) Remove one cap screw (R), five cap screws (Q), lockwashers (P) securing cover (E) to housing (N), and lift off cover.

Note. Identify each bushing-type bearing (J, M, W, and Y) before disassembly so that they can be assembled in their original position.

- (b) Remove drive gear oil seal (D) from cover (E) by using a suitable arbor press and a piece of brass rod.

Note. The drive gear oil seal (D) must be replaced at each repair to ensure against leakage.

Remove housing oil seal (H) from housing (N), lift off cover O-ring, gasket (F), cover bearing spring (G), and drive and driven gear cover bushing-type bearings (Y and J).

- (d) Remove drive gear (X) and driven gear (L).
- (a) Remove drive and driven gear housing bushing-type bearings (W and M) from housing (N).
- (f) Disassemble pump relief valve by removing spring retainer (S), spring retainer gasket (T), poppet ball spring (U), and poppet ball (V).

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. The importance of cleaning must be thoroughly understood by ordnance maintenance personnel. The presence of dirt or foreign substances is a constant threat to satisfactory performance of the hydraulic system. Clean all parts thoroughly with mineral spirits paint thinner or dry-cleaning solvent. Protect all parts from accumulation of dust and grit after cleaning.

(2) Inspection.

- (a) Visually inspect gear journals and gear teeth for wear or scoring. Also, inspect the gear teeth for chipping due to foreign material passing through the pump.
- (b) Visually inspect body and cover for cracks and mutilation of threads.
- (c) Inspect body gear bore for excessive gear sweep.
- (d) Inspect bearings for damaged or obstructed oil grooves and replace bearing if necessary.

(3) Repair.

- (a) Bearing faces may be dressed on a piece of fine abrasive paper held to a true flat surface plate.
- (b) Check bearings in pairs, in their respective positions, for wedging or binding. If bearing flats must be re-finished or new bearings installed, proceed as follows: hold the bearings on the journals of a discarded gear from which the teeth have been removed, and lightly dress the flats against a piece of fine abrasive paper held to a true flat surface plate. Dress a little at a time and repeat

check of bearings in their respective positions until they slide into position without wedging or binding. Clearance between flats should not exceed 0.0006 inch.

c. Assembly.

- (1) Replace all rubber seals and gaskets at time of repair. Cleanliness is of utmost importance during assembly.
- (2) If poppet ball seat has been removed, install a new seat by heating body to 250° F. and inserting seat.

Note. If new seat is installed, place the poppet ball (V) on the seat in the housing (N) and tap with a piece of brass rod and mallet to preform seat.

- (3) Insert poppet ball (V), poppet ball spring (U), spring retainer gasket (T), and secure with spring retainer (S).
- (4) Slide drive gear bushing-type bearings (W and M) into their previously identified positions in the housing (N).
- (5) Slide drive gear (X) and driven gear (L) into their respective bushing-type bearings.
- (6) Install drive and driven gear bushing-type bearings (Y and J) into their positions in the cover (E) and add cover bearing spring (G) with the pronged side towards the bearings. Install new housing oil seal (H).
- (7) Using an arbor press, install new drive gear oil seal (D). Install cover (E) on housing (N), and secure with one cap screw (R), five cap screws (Q), and six lockwashers (P).
- (8) Install Woodruff key (K) in slot in drive gear shaft, slide main drive gear (C) over shaft, and secure with external teeth lockwasher (B) and huglock nut (A).

117. Hydraulic Relief Valve Assembly (Fig. 169)

a. Disassembly.

- (1) Remove four cap screws (M) and lockwashers (N) securing cover (P) to lower housing (B).

- (2) Remove two hex-nuts (L) and lockwashers (N) from studs (C), and separate cover (P) from housing (B). Remove cover gasket (D).
- (2) Remove spring retainer (W), spring retainer gaskets (T), tension spring (S), spring guide (R), and relief valve ball (Q).

Note. The two studs (C) need not be removed from lower cover unless damaged or unserviceable.

b. Cleaning Inspection, and Repair.

- (1) Cleaning. Clean all parts thoroughly with mineral spirits paint thinner or dry-cleaning solvent. Protect all parts from accumulation of dust and grit after cleaning.

- (2) Inspection.

- (a) Inspect housing and cover for dents, cracks, or stripped screw threads.
- (b) Inspect relief valve ball for scratches, grooving, or improper seating.
- (c) Inspect valve seat for grooving and evidence of improper ball seating.

- (d) Repair.

- (a) Lightly dress faces on a piece of fine abrasive paper held to a flat surface plate.
- (b) If ball must be replaced, tap from the back side with a suitable punch. To install anew ball, put the ball in the housing with the spring guide over the ball and tap guide with a soft-faced mallet. Housing should be resting on the bench top or a piece of fiber to prevent injury to the ball.

- (c) Valve seat may be removed from the housing by tapping the inside of the seat with a suitable tap. Insert a bolt of sufficient length to protrude

beyond the housing then heat the housing to 250°F., insert the head of the bolt in a vise, and withdraw the seat. To insert new seat, heat housing to 250°F. and press in new seat, using a suitable arbor press and a piece of brass rod, taking care to start seat at right angle to bore to prevent shearing of metal.

c. Assembly.

- (1) If square socket pipe plug (A), and two studs (C) were removed, install plug and two studs into housing (B).

- (2) Install relief valve ball (Q) in housing (B).

Note. Using a piece of brass rod and a mallet, tap the ball to preform the seat.

- (3) Install the spring guide (R), tension spring (S), spring retainer gaskets (T), and secure with spring retainer (U).

Note. Spring retainer gaskets (T) are used (as required) to change the relief setting of the valve; therefore, it may be necessary to add or remove shims to obtain proper setting.

- (4) Position new cover gasket (D) on housing (B) and install cover (P). Use four cap screws (M), two hex-nuts (L) on studs (C), and six lockwashers (N) to secure cover to housing.

- (5) Install mounting bracket (H) over studs (C) and secure with safety nuts (E).

- (6) Split-lockwasher screw (J), cap screws (K), mounting screw spacer (G), plain washer (F), and safety nut (E) are used to mount relief valve assembly on steering gear housing.

118. Drag Links (Fig. 170)

Note. The ball stud opening is closer to the end of the upper drag link at relay lever end. The lower drag link ball stud opening is closer to the end at steering arm.

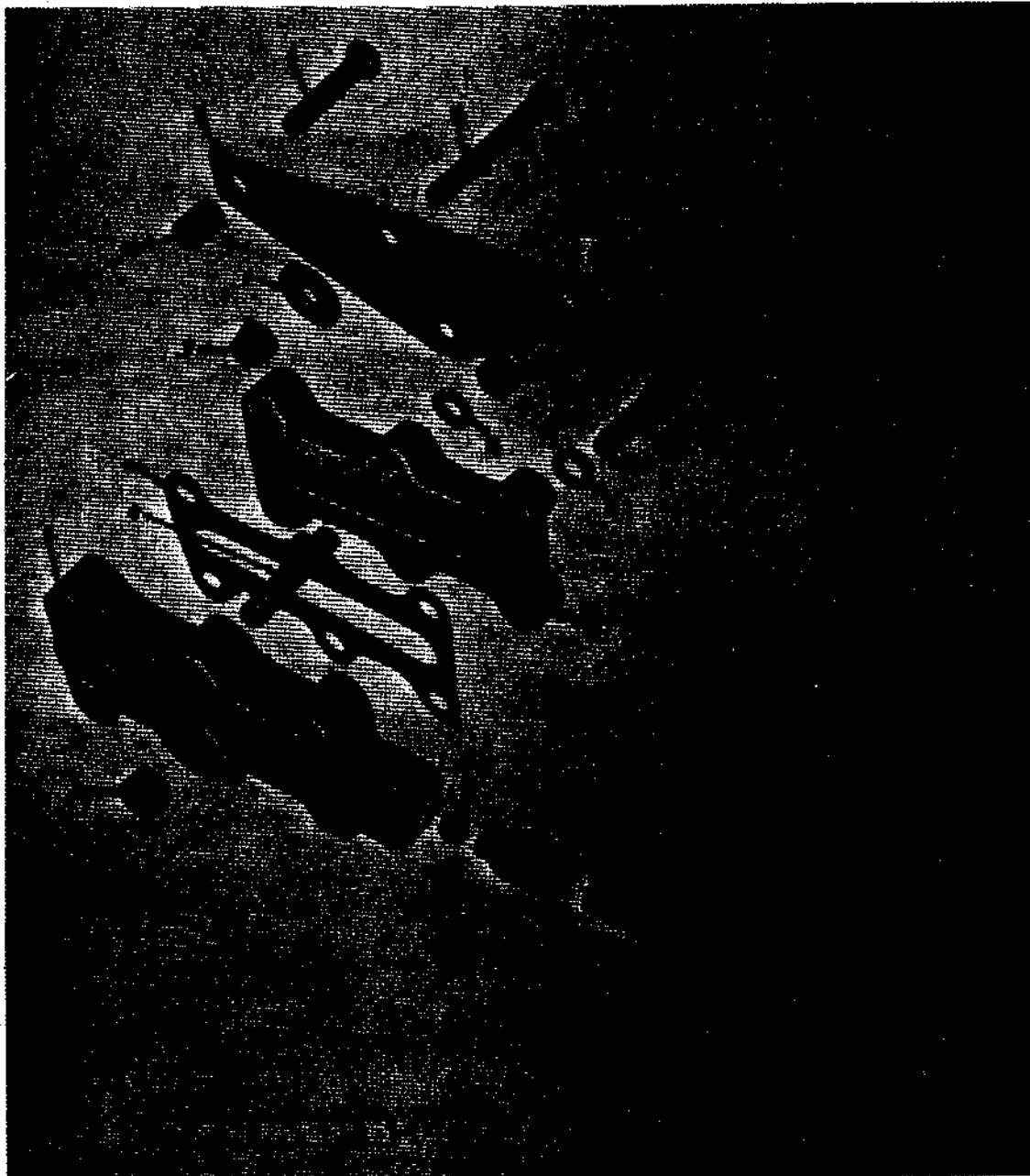


Figure 169. Relief valve assembly - exploded view

<u>Key</u>	<u>Item</u>
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A	Plug, pipe
B	Housing
C	Stud
D	Gasket, cover
E	Nut, safety
F	Washer, plain
G	Spacer, mounting screw
H	Bracket, mounting
J	Screw, split lockwasher
K	Screw, cap

<u>Key</u>	<u>Item</u>
------------	-------------

L	Nut, hex
M	Screw, cap
N	Washer, lock
P	Cover
Q	Ball, relief valve
R	Guide, spring
S	Spring, tension
T	Gasket, spring retainer
U	Retainer, spring

Figure 169. Relief valve assembly - exploded view - legend

a. Disassembly.

- (1) Remove adjusting plug, spring seat, drag link spring, and ball seats from one end of drag link; and remove adjusting plug ball seats, drag link spring, and spring seat from opposite end of drag link.
- (2) Components used in each end are identical and disassembled in order named. Remove lubricating fittings (F).

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean all parts thoroughly with mineral spirits paint thinner or dry-cleaning solvent.
- (2) Inspection. Check ball seats for excessive wear, cracks, or chipping. Inspect ball seat springs for weakness or failure. Examine threads in end of drag link and note if tube is damaged or bent.

- (3) Repair. Replace all worn or damaged parts. Do not attempt to repair damaged or worn parts.

c. Assembly.

Note. The ball stud onening is closer to the end of the upper drag link at relay lever end.

- (1) Install two lubricating fittings (F) in drag link. Insert spring seat (B), drag link spring (C), ball seats (D), and adjusting plug (A) in one end of drag link, and ball seats (D), drag link spring (C), spring seat (B), and adjusting plug (A) in opposite end.
- (2) Components used in each end are identical.

119. Relay Lever Assembly (Fig. 171)

a. Disassembly. If inspection indicates repair, use a suitable adapter and press out relay lever bushings and grease seals.



Figure 170. Drag link assembly - exploded view

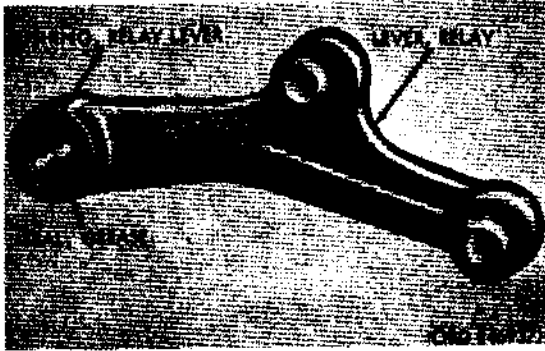


Figure 171. Relay lever assembly

b. Cleaning, Inspection, and Repair

- (1) Cleaning. Clean all parts thoroughly with dry-cleaning solvent.
- (2) Inspection. Examine ball studs for excessive wear or looseness in *relay* lever. Inspect bushings and oil seals; replace as inspection indicates.
- (3) Repair. Refer to a above.

c. Assembly. Press in new *relay* lever bushings. Recess bushings approximately

three-sixteenths of an inch into lever from each side to allow for grease seals. Press in grease seals, one on each side to complete the assembly.

120. Oil Reservoir (Fig. 127)

a. Disassembly. Refer to paragraph 100a.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean all parts thoroughly with mineral spirits paint thinner or dry-cleaning solvent. Dry thoroughly.
- (2) Inspection and repair. **Inspect oil reservoir for leaks and damaged threads. Solder all leaks. If threads are damaged beyond repair, replace the assembly.**

c. Assembly. Refer to paragraph 100b.

121. Hydraulic Flexible Lines Fig. 120)

a. Disassembly. Refer to paragraph 106a.

b. Cleaning, Inspection, and Repair. Check hydraulic flexible lines for damaged threads and leaks. Replace lines that show signs of weakness.

c. Assembly. Refer to paragraph 106b.

Section VI. TESTS AND ADJUSTMENTS

122. Steering Gear Hydraulic System

a. General. Fill the hydraulic system with SAE 10 (OE)-engine oil as specified in LO 9-2320-211-12. Start the engine and operate until engine reaches normal operating temperature. At this time, the hydraulic system oil should reach normal operating temperature.

b. Hydraulic Pressure Test.

- (1) **Connect the hydraulic pressure gage (test set power steering FSN 4910-627-7043) in hydraulic system. There are two different types of pressure pumps and relief valves used on the 5-ton trucks, therefore the following connection is advisable: Disconnect the hydraulic hose at control valve oil inlet**

elbow. To this elbow, connect a second hose drawn from supply. Connect a Tee between this hose and the original hose removed from the control valve. At the center of the Tee, connect the pressure gage using the short hose provided in the test kit.

- (2) **Start the engine and warm up to operating temperature. Watch for rapid pressure buildup on the pressure gage. If this happens, shut the engine off immediately as pressure may increase to where the hydraulic hoses are ruptured or the gage ruined. Turn the steering wheel in right turn and increase engine speed to 1000 rpm. Continue turning the steering wheel until the right turn stop on the front axle is reached. Hold the wheel tight in**

this turn for only a few seconds. The gage should read 750 psi with the early production pumps 2530-040-2230 or 2530-040-2203. At the same engine speed, the new pump 2530-318-8205 (gasoline), as well as the diesel and multifuel hydraulic pumps should register between 850 and 1000 psi.

Note. If the pressure drops off sharply when full left turn is reached, the left turn test should be repeated, but with an assistant holding a 1/4-inch thick piece of iron between the front axle left turn stop. This loss of pressure in left turn is due to the power cylinder piston traveling far enough forward to allow the hydraulic pressure to escape past the piston ring into the front cylinder port, to the oil reservoir. Restricting the turn radius of the front wheels restricts the piston travel so that a proper test can be made.

c. Hydraulic Pump Assembly. The hydraulic pump assembly is checked in the same manner as b above. No external leakage is allowed during test. Check all joints and hydraulic lines. Pump should maintain pressures indicated (b above) in the system during operation of the steering gear.

Note. To determine whether the hydraulic pump or relief valve is at fault in the early production gasoline models, it will be necessary to by-pass the separate relief valve.

123. Lever Shaft Stud in Cam Groove

a. Disconnect drag link at pitman arm (TM 9-2320-211-20). Loosen column clamp at instrument panel (par. 99a(3)). Loosen adjusting screw locknut (fig. 129).

b. Turn the steering wheel from one extreme to the other, counting the number of revolutions between the two extremes. Turn the steering wheel clockwise as far as it will go; then turn steering wheel counterclockwise one-half the number of revolutions counted between the extreme right and left positions. This places the steering wheel in the middle of its range of travel, which is the correct position for straightahead steering.

Note. Do not adjust in positions off mid-position as backlash at these positions is

normal and not objectionable. The groove of the cam is purposely cut shallower; therefore, it is narrower in the mid-position range of stud travel to provide a close adjustment, where straightahead driving takes place. This also makes the close adjustment possible after normal wear occurs without causing a bind elsewhere in the cam.

c. Tighten side cover adjusting screw (fig. 172) until a very slight drag is felt when turning the steering wheel with a light grip of the thumb and forefinger.

Note. Wheel should turn freely with just a perceptible drag.

d. Hold the adjusting screw and tighten locknut (fig. 172). Recheck the drag of the wheel through full travel of the gear.

e. Reconnect drag link to pitman arm and tighten clamp on steering gear column at instrument panel.

124. Steering Gear Column

a. Loosen three cap screws and safety nuts (fig. 120) securing steering gear jacket mounting clamp to dash panel, and note whether column moves to a different position.

b. Tighten three safety nuts on cap screws securing "steering gear jacket mounting bracket to dash panel in position as aligned by the column.

Note. The column must not be sprung in any direction from its free position. A bind in the column assembly, due to misalignment, may prevent the cam and control valve from centering into center position.

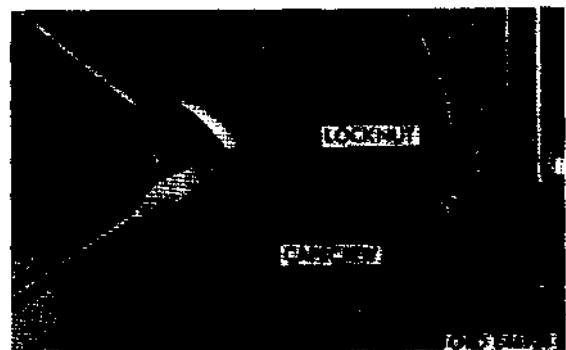


Figure 172. Adjusting pitman arm shaft

c. If column has been permanently bent, replacement is required.

125. Drag Links

Note. Be sure ball seats are thoroughly lubricated before making adjustment.

a. Remove cotter pin (fig. 170) and turn adjusting plug in tight; then back off one-half turn, or less, until new cotter pin can be installed.

b. Repeat adjustment at other end.

126. Steering Gear

a. Pitman Arm Shaft Adjustment.

- (1) Disconnect upper drag link at pitman arm (TM 9-2320-211-20).
- (2) Loosen three cap screws and safety nuts (fig. 120) securing steering-gear-jacket mounting bracket to dash panel.
- (3) Loosen locknut (fig. 172) at right side of steering gear housing.
- (4) Turn the steering wheel from one extreme to the other, counting the number of revolutions between the two extremes. Turn steering wheel clockwise as far as it will go; then turn steering wheel counterclockwise one-half the number of revolutions counted between the extreme right and left positions. This places the steering wheel in the middle of its range of travel, which is the correct position of the steering wheel for straightahead steering.

Caution: Do not adjust pitman arm shaft with steering wheel in any other position.

- (5) Tighten adjusting screw (fig. 172) until a very slight drag is felt when turning the steering wheel with a light grip of the thumb and forefinger. Wheel should turn freely with just a perceptible drag.
- (6) Holding the adjusting screw to prevent further turning, tighten the locknut (fig. 172).

(7) Adjust steering-gear jacket ((b) below).

(8) Connect rear end of upper drag link to pitman arm (TM 9-2320-211-20).

b. Steering-Gear Jacket Adjustment.

- (1) Loosen three cap screws and safety nuts (fig. 120) securing steering-gear jacket mounting clamp to dash panel, and note whether jacket moves to a different position.
- (2) Tighten three safety nuts on cap screws securing steering-gear jacket mounting bracket to dash panel in position as aligned by the jacket.

Note. The column must not be sprung in any direction from its free position. Binding of the steering shaft inside the jacket may prevent proper operation of the steering gear hydraulic system. If the jacket has been permanently bent as the result of severe misalignment, replacement is required.

Section VII. SERVICEABILITY STANDARDS

127. General

The serviceability standards included herein give the minimum, maximum, and key clearances of new or repaired parts. They also give wear limits which indicate that point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear Limits" column or damaged from corrosion will be

approved for service. In the "Size and fit of new parts" column, the letter "L" indicates a loose fit (clearance) and the letter "T" indicates a tight fit (interference). All measurements are in inches, unless otherwise indicated.

128. Serviceability Standards

Serviceability Standards for steering system are shown in table VII below.

Table VII. Serviceability Standards - Steering System

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts
<u>PITMAN ARM SHAFT ASSEMBLY</u>			
175	B	Diameter of shaft	1.747 to 1.748
175	C	Inside diameter of bushing	1.7485 to 1.750
175	C-B	Fit in bushing	0.0005 to 0.003
175	A	Integral lever fork	1.5025 to 1.5035
175	H	Integral lever block	1.495 to 1.5005
175	A-H	Block fit in lever fork	0.002 to 0.004
<u>POWER CYLINDER ASSEMBLY</u>			
175	D	Sliding bar shaft	0.9994 to 1.000
175	E	Inside diameter of bushing	1.002 to 1.004
175	E-D	Fit in lambing	0.002 to 0.0046
<u>HYDRAULIC CONTROL VALVE ASSEMBLY</u>			
173	A	Valve spool	1.2476 to 1.2482
173	D	Inside diameter of spool sleeve	1.249 to 1.25
173	C	Outside diameter of spool sleeve	1.4975 to 1.4985
173	B	Inside diameter of valve body	1.499 to 1.500
173	E	Actuating lever ball	0.467 to 0.468
173	F	Cam groove dimension	0.4685 to 0.4690
173	D-A	Clearance of spool in sleeve	0.0008L to 0.0024L
173	B-C	Clearance of sleeve to body	0.0005L to 0.0025L
173	F-E	Clearance of actuating lever in groove	0.0005L to 0.002L
<u>HYDRAULIC PUMP ASSEMBLY</u>			
174	A	Inside diameter of bushing-type bearings	0.6250 to 0.6255
174	B	Gear shaft diameter	0.6235 to 0.6240
174	E	Body bores	1.4505 to 1.4510
174	C	Outside diameter of gears	1.4495 to 1.450
174	D	Free length of compression spring	33/64
174	D	Compression spring compressed to 11/32 in.	12 to 1402
174	B-A	Clearance of shaft in bearing	0.001L to 0.002L
174	E-C	Clearance of gears in body	0.0005L to 0.0015L
<u>HYDRAULIC CYLINDER ASSEMBLY</u>			
175	F	Outside diameter of piston	3.867 to 3.869
175	G	Inside diameter of cylinder	3.875 to 3.877
175	G-F	Piston fit in cylinder	0.008L to 0.010L
<u>PRESSURE RELIEF VALVE</u>			
169	s	Free length of tension spring	2.328
169	s	Tension spring compressed to 1.781 in.	57 to 59 lb

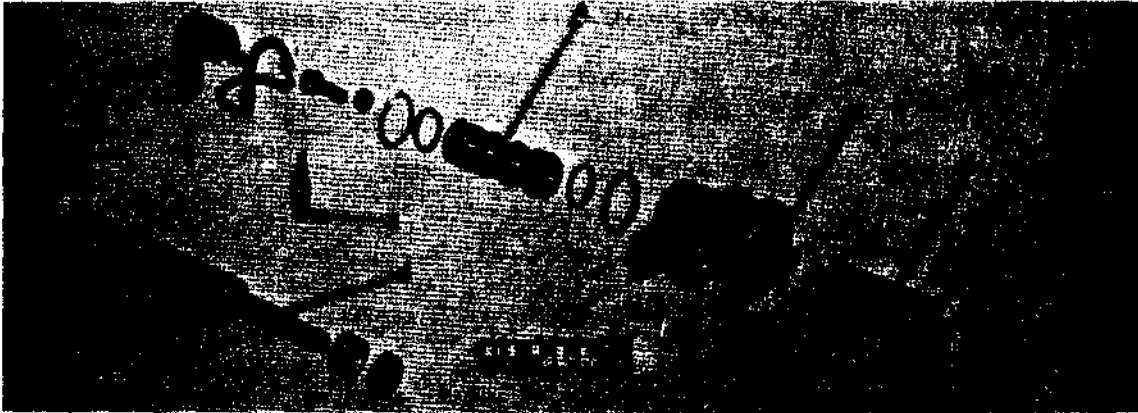


Figure 173. Serviceability standard points measurement for hydraulic control valve

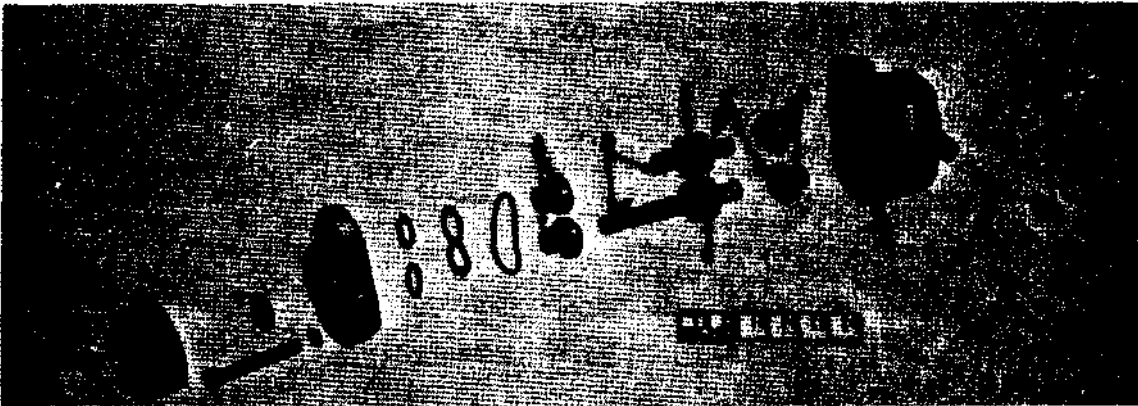


Figure 174. Serviceability standard points of measurement for hydraulic pump

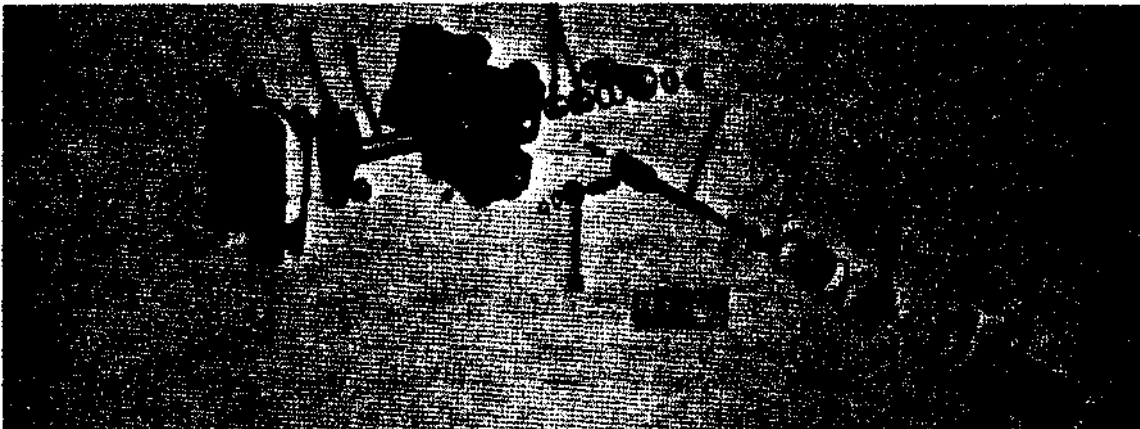


Figure 175. Serviceability standard points of measurements for steering gear assembly

Section VIII. STEERING SYSTEM COMPONENTS REMOVAL AND INSTALLATION (NEW TYPE)

128.1. General.

This section provides procedures for removal, disassembly, cleaning, inspection and repair, assembly and installation of the new type steering system components.

128.2. Lower Steering Column Assembly.

a. Removal.

(1) Remove capscrew (12, fig. 175.1,) lockwasher (11) and nut (10) securing steering shaft extension U-joint to steering gear input shaft.

NOTE

Mark position of input shaft to U-joint.

(2) Remove capscrew (16), lockwasher (15), and nut (14) securing steering shaft extension U-joint to upper steering column and remove lower steering column (13). Loosen capscrews (7) securing upper steering column to bracket assemblies (6). Remove horn wire (18) and horn switch cover (17) and slide splined end of upper

steering column from universal joint of lower steering column. Slide lower steering column from steering gear input shaft.

b. Cleaning, Inspection and Repair.

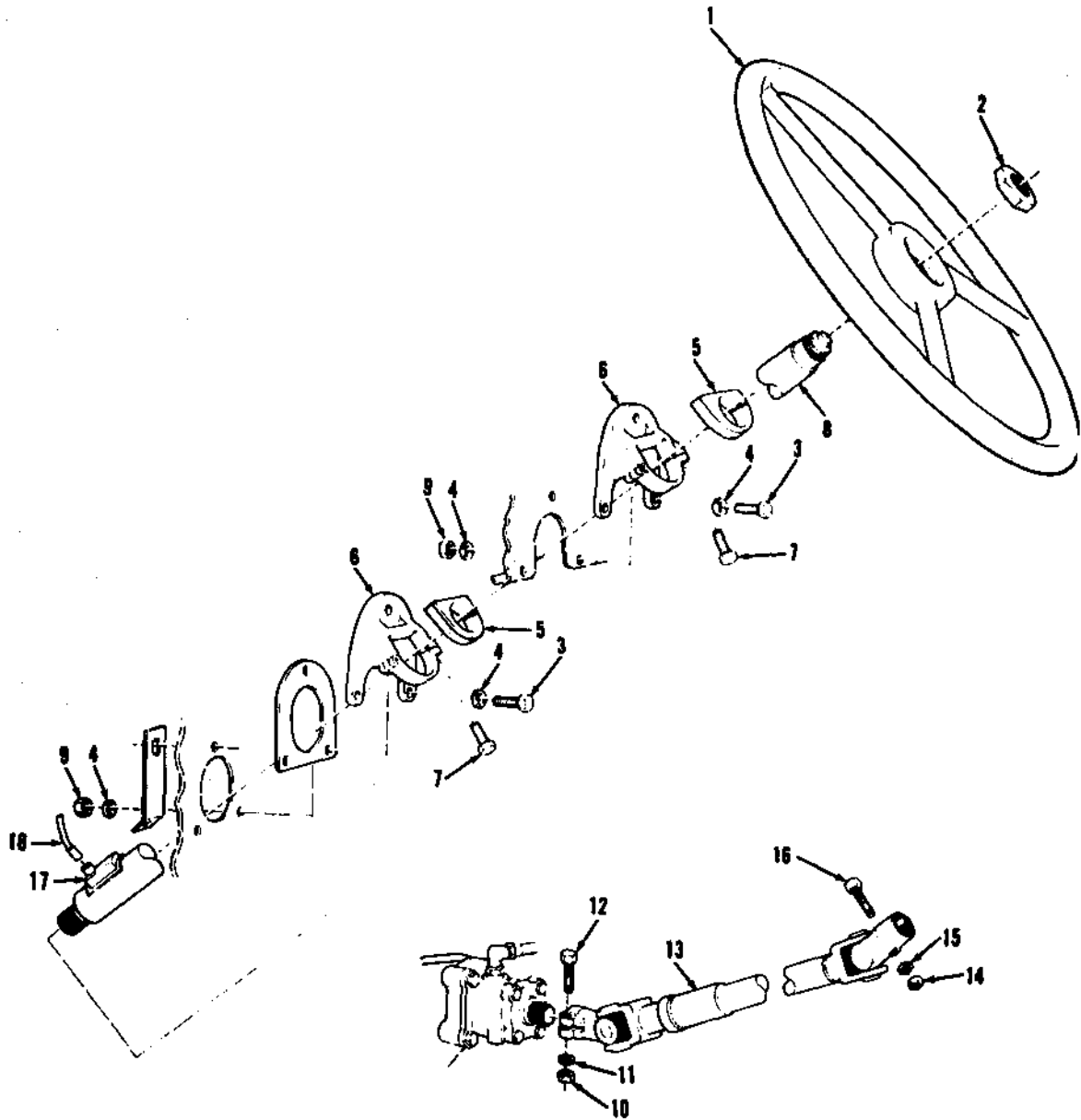
(1) *Cleaning.* Clean all metal parts with dry cleaning solvent or mineral spirits paint thinner. Use a wire brush and approved cleaning solvent to remove grease accumulation. Dry thoroughly.

(2) *Inspection and Repair.* Inspect all parts for defects or damage. Inspect U-joints for excessive wear. If defects, damage, or excessive wear are evident, replace lower steering column.

c. Installation. Install lower steering column by reversing procedures in paragraph 128.2 *a.* above.

NOTE

For unspecified torque values of capscrews or bolts, refer to Appendix 1.



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Figure 175.1. Lower and upper steering column and related parts - exploded view.

Legend for fig. 175.1:

1. Steering wheel
2. Nut
3. Capscrew
4. Lockwasher
5. Bushing
6. Bracket assembly
7. Capscrew
8. Upper steering column
9. Nut
10. Nut
11. Lockwasher
12. Capscrew
13. Lower steering column
14. Nut
15. Lockwasher
16. Capscrew
17. Horn switch cover
18. Horn lead wire

128.3. Upper Steering Column and Bracket Assemblies.

a. Removal.

NOTE

Key numbers in this paragraph refer to figure 175.1 unless otherwise indicated.

(1) Remove steering wheel nut (2) and remove steering wheel (1) using wheel puller and adapter 5120-00-303-1195.

(2) Disconnect horn lead wire (18) and remove horn switch cover (17).

(3) Remove two capscrews (7) from two bracket assemblies (6). Remove two bushing (5) and remove upper steering column (8) from vehicle.

(4) Remove six capscrews (3), 12 lockwashers (4) and six nuts (9) securing two bracket assemblies (6) to vehicle and remove both bracket assemblies (6).

b. Cleaning, Inspection and Repair.

(1) *Cleaning.* Clean all metal parts with dry cleaning solvent or mineral spirits paint thinner. Dry thoroughly.

(2) *Inspection and Repair.* Inspect all parts for defects, damage, or excessive wear. If defects, damage, or excessive wear is evident, replace parts as necessary.

c. Installation.

NOTE

For unspecified torque values of capscrews or bolts refer to Appendix I.

(1) Install steering column (13, fig. 175. 1) in vehicle to proper lateral position and connect universal joint of lower steering column to splined end of upper steering column and secure with capscrew (16), washer (15), and nut (14).

(2) Install two bracket assemblies by reversing procedures given in paragraph 128.3 a. (4) above.

(3) Position bushing (5) in two bracket assemblies (6) and install steering column (8) in bracket assemblies (6) and secure with capscrew (7). Torque capscrew (7) to specified torque.

CAUTION

Use brace or holding fixture attached to universal joint to prevent lateral movement of steering column. (Failure to follow this procedure will cause disassembly of lower column shaft seat).

(4) Attach steering wheel (1) and torque wheel nut (2) to 55-60 lb.-ft.

(5) Install horn switch cover and connect horn wire.

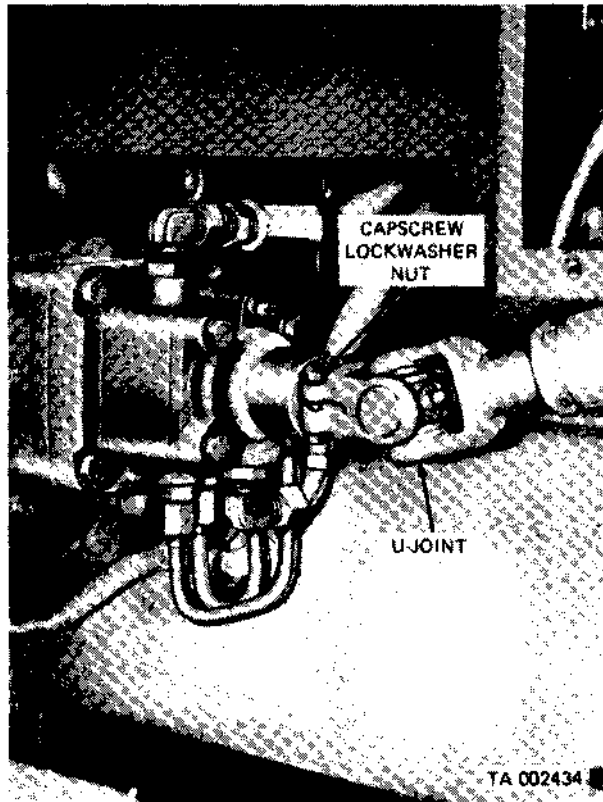


Figure 175.2 Steering shaft extension U-joint.

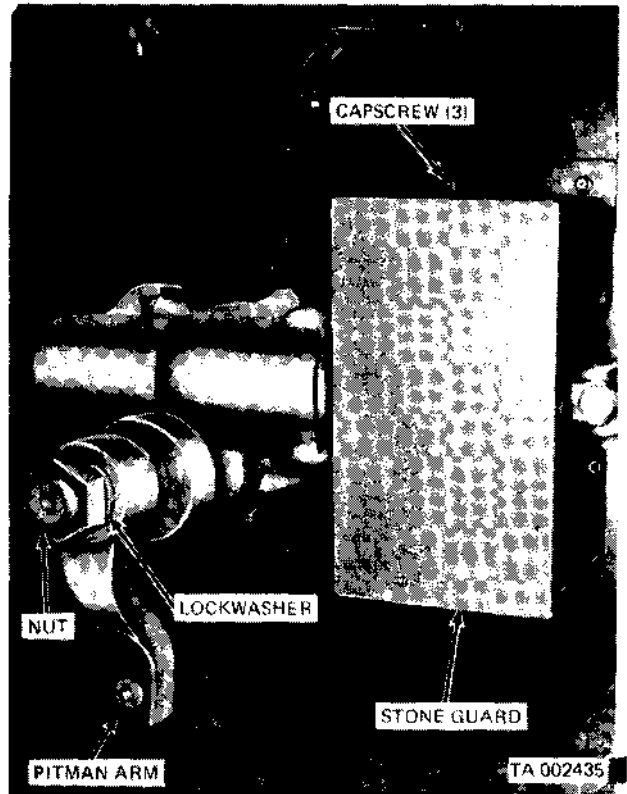


Figure 175.3. Removing and installing pitman arm.

128.4. Steering Gear Assembly.

a. Removal.

NOTE

Clean hydraulic fittings and area around hydraulic fittings.

(1) Remove capscrew, lockwasher, and nut securing steering shaft extension U-joint to power steering control valve stub shaft (fig. 175.2).

NOTE

Mark position of stub shaft to U-joint.

(2) Remove pitman arm retaining nut and lockwasher (fig. 175.3).

(3) Using pitman arm puller, pull pitman arm from steering gear cross-shaft.

(4) Remove three capscrews securing stoneguard to frame and remove stoneguard.

(5) Remove power steering gear hydraulic oil pressure hose (fig. 175.4).

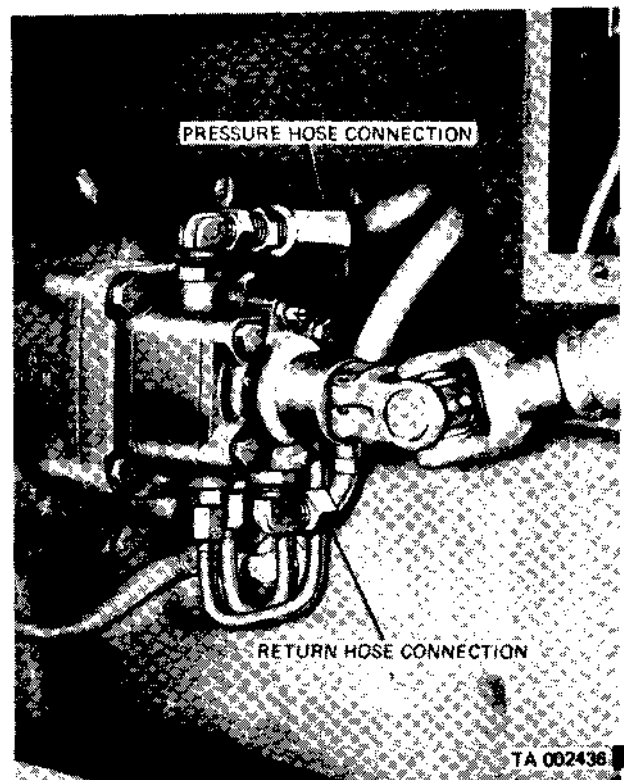
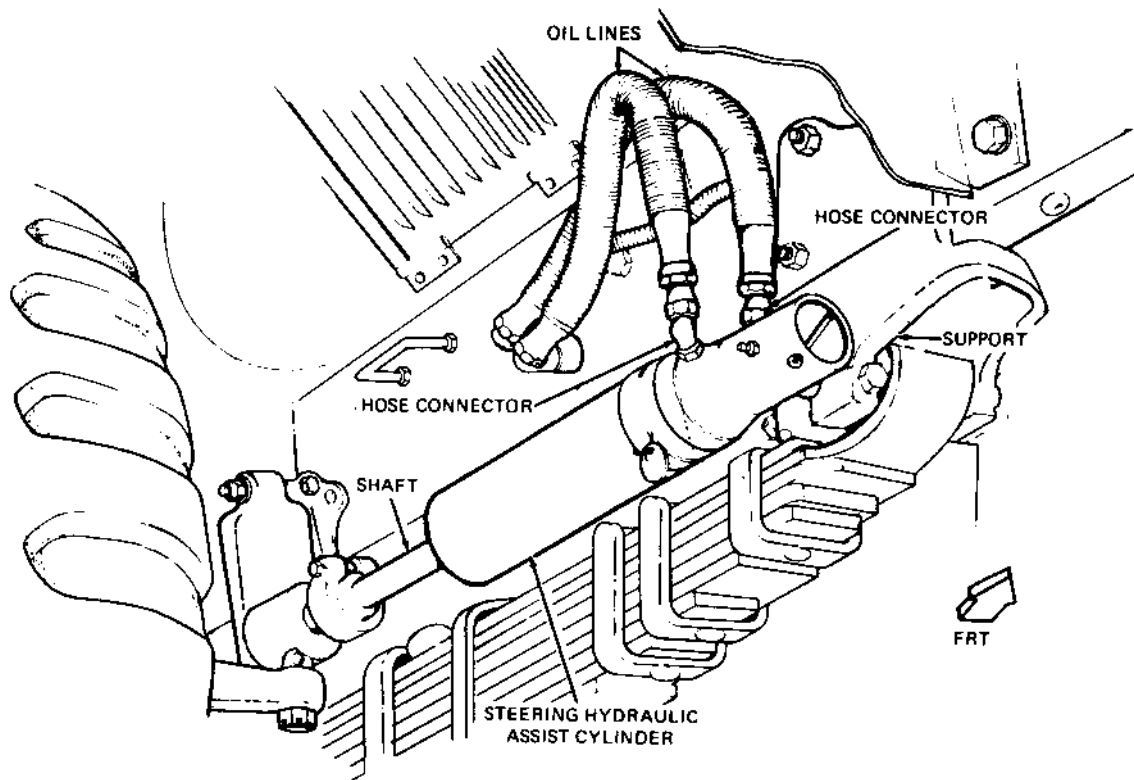


Figure 175.4. Steering gear hydraulic oil pressure and return hoses.



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Figure 175.5. Removing and installing steering gear assist cylinder hydraulic lines.

(6) Remove power steering gear hydraulic oil return hose.

(7) Disconnect both power steering gear assist cylinder hydraulic oil lines (fig. 175-5).

(8) Remove radiator assembly, refer to TM 9-2320-211-20.

(9) Remove four capscrews and lockwashers securing steering gear assembly to vehicle frame and remove mounting plate (fig. 175.6).

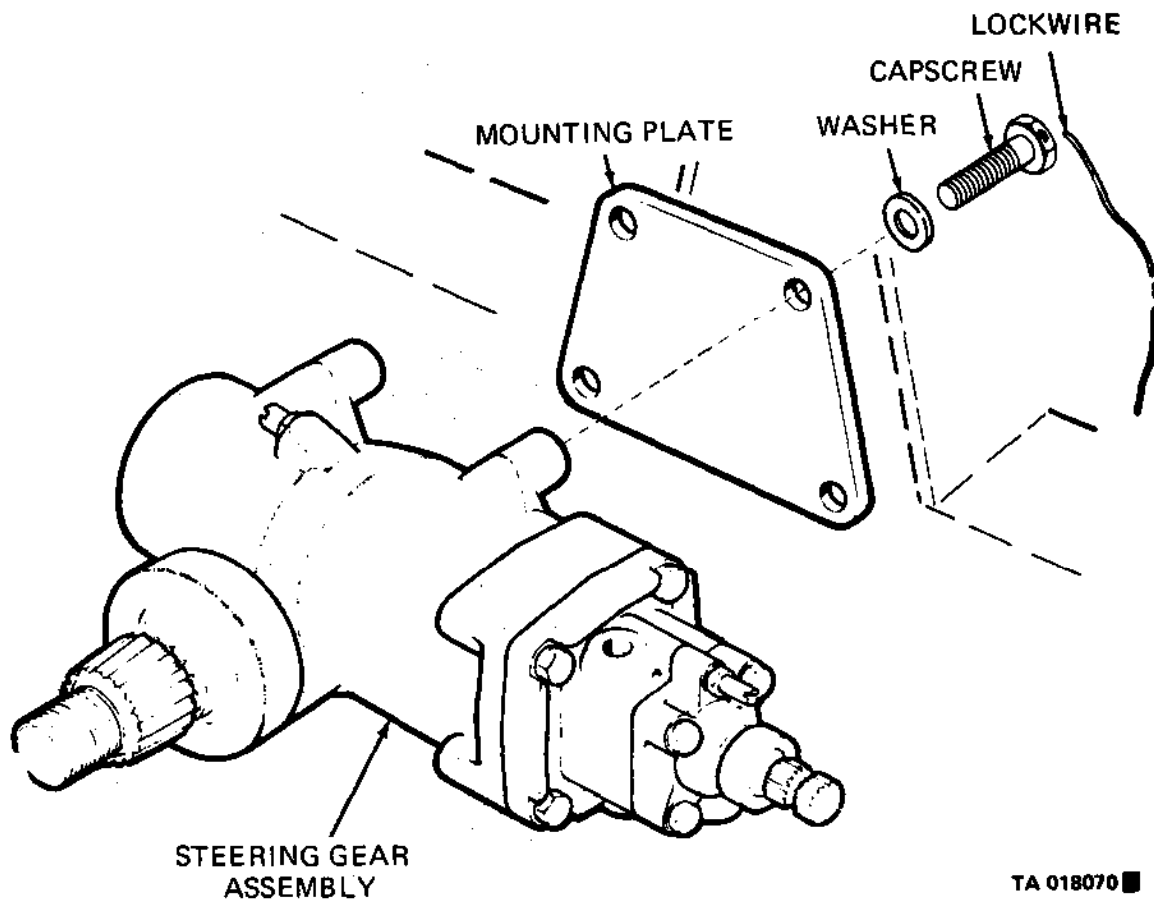


Figure 175.6. Steering gear assembly and attaching parts - exploded view.

NOTE

Cap and plug all steering gear fittings and hose connections before removing steering gear or immediately upon removal to prevent entrance of foreign material.

(10) Slide steering gear stub shaft from steering extension shaft universal joint and remove steering gear.

b. Disassembly.

CAUTION

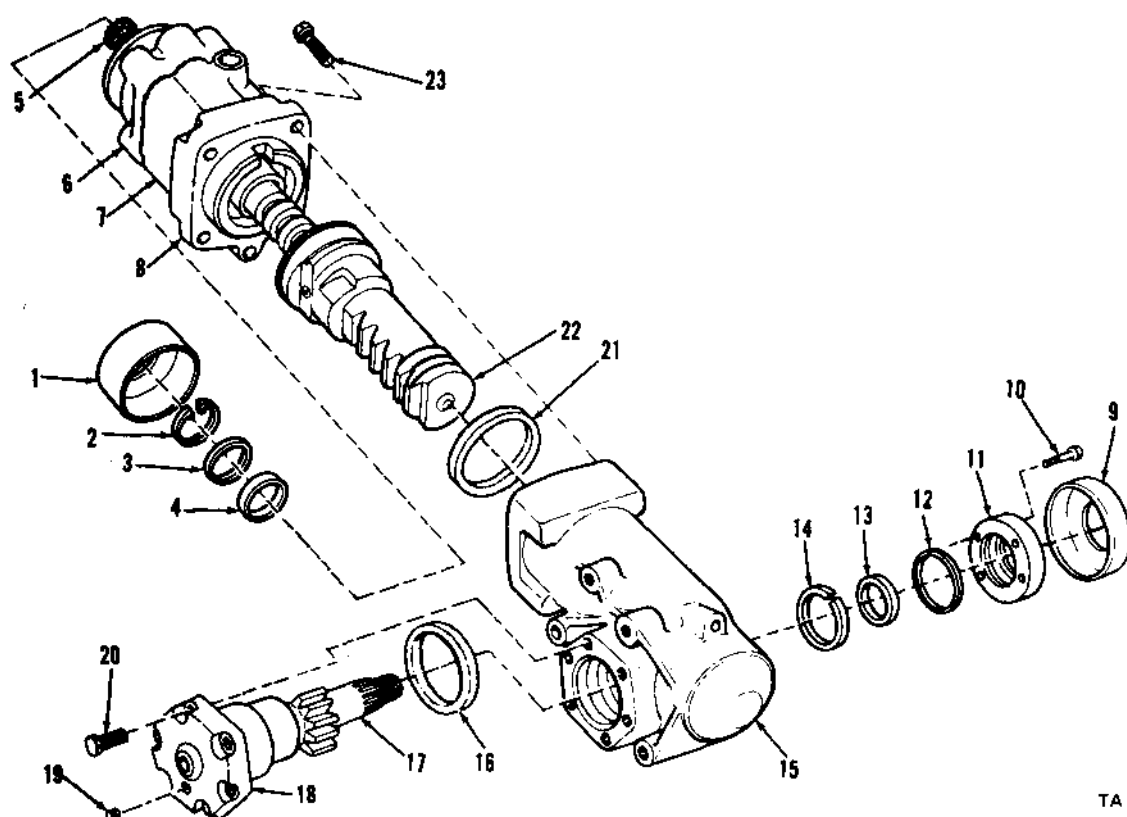
To prevent the entrance of moisture between closely fitted parts do not steam clean hydraulic steering assemblies.

(1) Completely drain steering gear assembly. Thoroughly clean all fittings and connections. Cap all connections and hoses. Finish cleaning and air dry steering gear assembly before placing on work bench. Insure that a clean work bench or table is used or use a large piece of clean wrapping paper for a table top cover or bench cover.

(2) Rotate input shaft (5, fig. 175.7) so that index mark on end of sector shaft (17) is perpendicular to centerline of gear (straight-ahead-position).

(3) Remove six side cover capscrews (20).

(4) Tap lightly with soft face hammer on end of section shaft to disengage side cover flange face seal (16) and left gear drain.



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Figure 175.7. Steering gear assembly - exploded view.

Legend for fig. 175.7:

- | | |
|---------------------------------------|--------------------------------------|
| 1. Dirt and water seal | 13. Seal, leather backup |
| 2. Retaining ring | 14. Seal assembly |
| 3. Backup washer | 15. Housing |
| 4. Oil seal | 16. Face seal, side cover to housing |
| 5. Input shaft | 17. Sector shaft |
| 6. Upper cover | 18. Side cover |
| 7. Control valve | 19. Vent plug |
| 8. Control valve adapter | 20. Capscrew (6) |
| 9. Dust seal | 21. Seal, adapter to housing |
| 10. Allen head capscrew (4) | 22. Piston rack |
| 11. Trunnion carrier | 23. Capscrew (4) |
| 12. Seal, trunnion carrier to housing | |

(5) After draining, carefully pull assembly, as a unit, out of housing (15) noting position of gear tooth mesh.

(6) Remove sector shaft dust seal (9). Remove trunnion carrier (11) by removing four allen head capscrews (10).

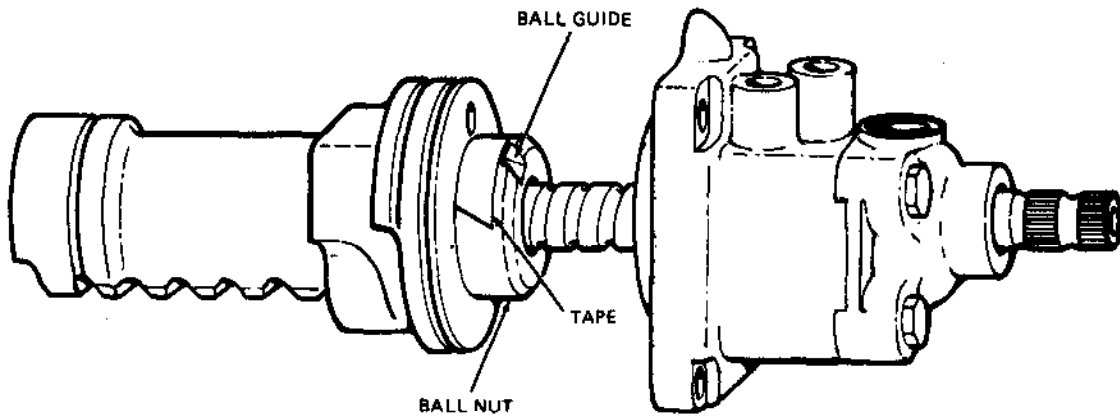
(7) Remove seal (12), seal (13), seal assembly (14) and face seal (16).

(8) Remove four control valve adapter capscrews

(23). As a unit, pull out input shaft (5), upper cover (6), control valve (7) and control valve adapter (8), 3/4 inches and let drain.

(9) After draining, carefully slide unit out of housing and lay aside for inspection, placing a piece of tape around ball nut O.D. to retain balls and ball guide (fig. 175.8).

(10) Remove seal (1, fig. 175.7), retaining ring (2), backup washer (3), and oil seal (4).



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Figure 175.8. Taping ball nut O.D.

c. Cleaning, Inspection and Repair.

CAUTION

To prevent the entrance of moisture between closely fitted parts do not steam clean hydraulic steering components.

(1) *Cleaning.* Clean all metal parts with dry cleaning solvent or mineral spirits paint thinner. Dry thoroughly.

(2) *Inspection and Repair.* Visually, inspect all wear and sealing surfaces on all components for scoring and excessive wear and replace as required. Replace all seals.

d. Assembly.

(1) Assemble oil seal (4, fig. 175.7), backup washer (3), retaining ring (2) and seal (1) on input shaft (5).

(2) Carefully clamp clean housing in a position to allow access to all bores.

(3) Position oil seal (21) and insert rack piston into housing and position teeth to be visible through housing side cover opening. As rack piston enters lubricated bore, compress piston ring and push into assembled position.

(4) Recheck position of seal in control valve adapter (8) alining oil transfer holes and move adapter into contact with housing (15).

(5) Install four capscrews (23) into adapter (8) and housing (15) and torque to 70 lb.-ft.

(6) Lightly coat large face seal (16) with oil and assemble in recessed groove of side cover flange face.

(7) Look through side cover opening, turn input shaft and position teeth on rack piston to aline center tooth space (mark piston center gear tooth space as identification mark on centerline).

(8) Lubricate bearing surface of sector shaft (17) with oil and start into housing bore (through side cover opening). Aline center tooth of sector shaft to enter marked space on rack piston.

(9) Recheck position of face seal (16) and push side cover (18) into position against housing (15).

(10) Install six capscrews (20) and torque to 45 lb.-ft.

(11) Install seal assembly (14), seal (13), seal (12), and trunnion carrier (11) on sector shaft (17) at other side of housing and secure with four allen head capscrews (10). Torque capscrews (10) to 18-20 lb.-ft.

(12) Install dust seal (9).

(13) Rotate gear by input shaft (5) to center or straight ahead position.

(14) Loosen jam nut on side cover adjusting screw and adjust per following procedure:

(a) Adjust screw in side cover to engage gear teeth in a no lash, no bind condition.

(b) After rotating input shaft through its full travel for a minimum of five cycles, adjust sector shaft adjusting screw to provide 20-25 in. lb torque as input shaft is rotated 90° each side of center. Back out adjusting screw one turn and note torque required to move input shaft 90° each side of center position. Move adjusting screw in to provide an increase in torque of 2-4 lb.-in. at point within 45° each side of center after adjusting screw jam nut is first tightened snug and then final torque tightened to 20-25 lb.-ft.

NOTE

Input torque of completely assembled gear minus oil should not exceed 15 in. lb for full travel of output shaft.

e. Installation.

(1) Install mounting plate and steering gear assembly to truck chassis with four capscrews and

washers. Torque capscrews (dry threads) to 260-280 lb.-ft (fig. 175.6). Lockwire top two (2) bolts together and bottom two (2) bolts together.

(2) Install radiator assembly, refer to TM9-2320-211-20.

CAUTION

Do not drive or impact on end of steering gear output shaft to start nut.

(3) Assemble pitman arm by alining index marks. Secure arm with lockwasher and nut. Torque nut to 475-500 lb.-ft. (dry threads) (fig. 175.3).

(4) Connect both power steering gear assist cylinder hydraulic oil lines and torque lock nuts to 25 lb.-ft. (fig. 175.5).

(5) Connect steering column U-joint to steering gear input shaft. Install capscrew, lockwasher, and nut (fig. 175.2). Refer to Appendix I.

(6) Install power steering hydraulic oil pressure hose (fig. 175.4).

(7) Install stone guard with three capscrews (fig. 175.3).

(8) Fill system with OE 10 or OES. Refer to LO 9-2320-211-12.

(9) Check vehicle for equal wheel cut from straight ahead position and check wheel stops for contact in relationship to gear travel.

128.5. Power Steering Cylinder (Fig. 175.9).**a. Power Steering Cylinder Removal.**

- (1) Remove shield guard.
- (2) Remove two hoses from top of power steering cylinder.

NOTE

When removing hoses, have a suitable container (two quart capacity) to drain oil from hoses. Also cap all hoses and ports immediately to prevent dirt or foreign-matter from entering power steering system.

- (3) Disconnect dust shield and felt pad. Remove cotter pin from front of power steering cylinder.

- (4) Loosen front adjustable plug as far as possible without completely removing it from power steering cylinder,

- (5) Remove dust shield and felt pad from socket at steering knuckle arm.

- (6) Remove cotter pin from rear of power steering cylinder socket assembly.

- (7) Loosen rear adjustable plug as far as possible without completely removing from power steering cylinder.

- (8) Tap power steering cylinder at both ends to loosen ball seats from ball studs and remove power steering cylinder from vehicle.

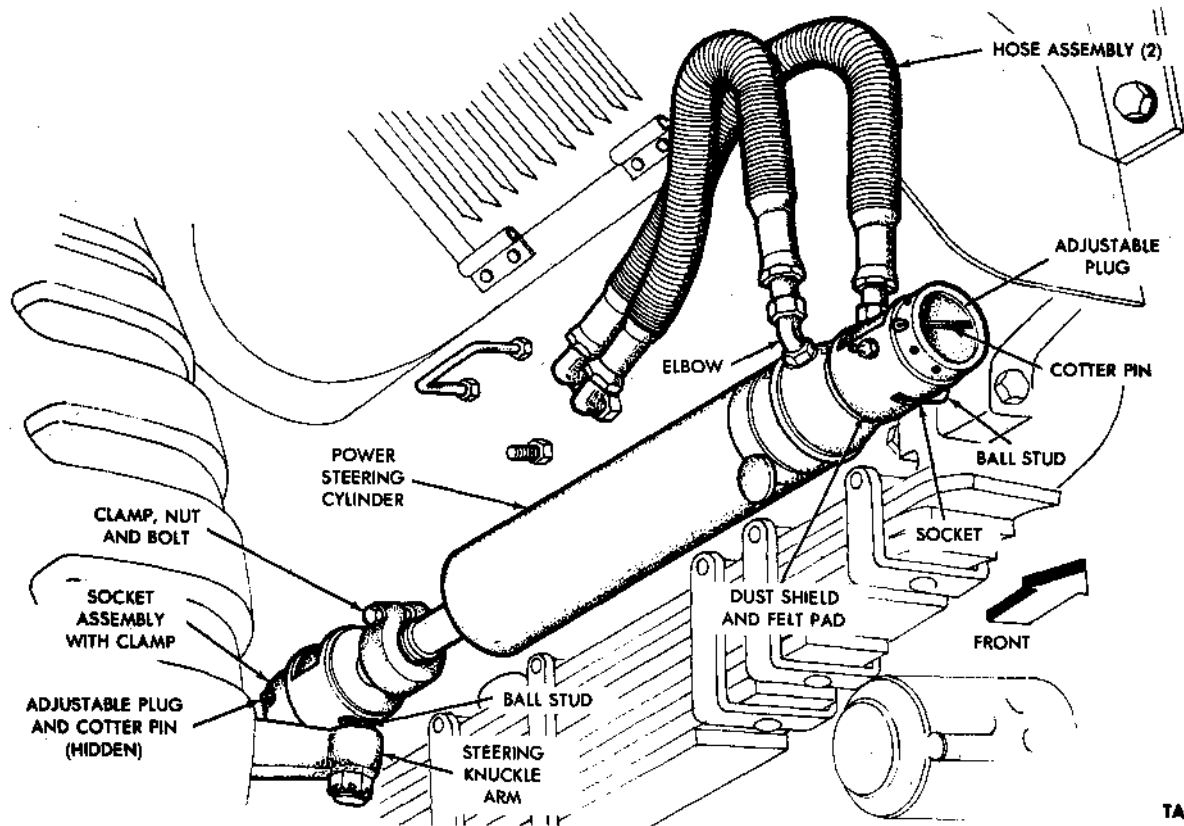


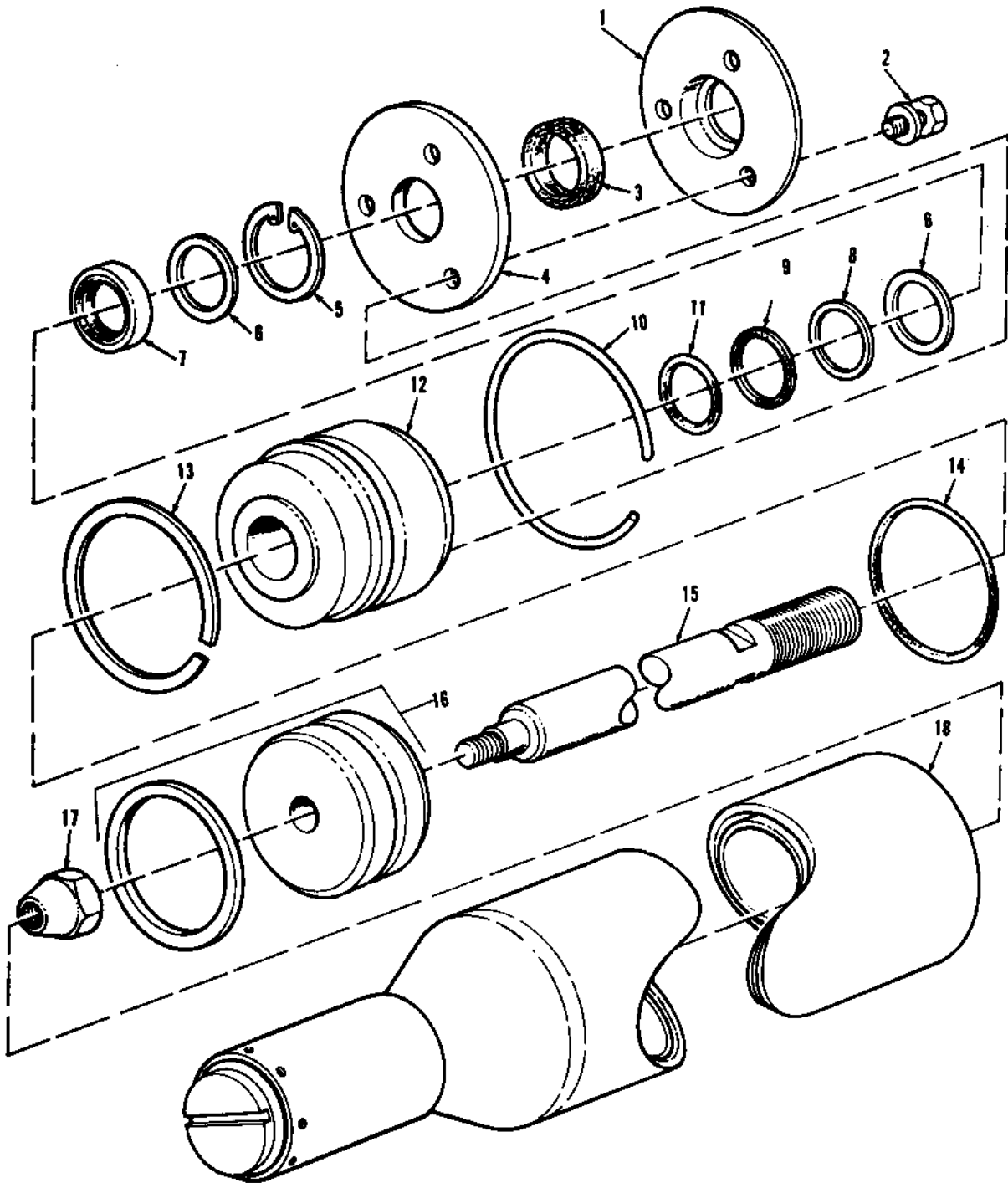
Figure 175.9. Power steering cylinder, hoses, and fittings.

b. Disassembly.

- (1) Stoke piston rod full travel holding ports down, to remove oil from cylinder assembly. Plug ports and remove all dirt and contaminants from outside of assembly, paying particular attention to piston rod end.

- (2) Carefully clamp cylinder in vise with piston rod end up.

- (3) Remove three end plate retaining capscrews (2, fig. 175. 10), seal (3), and end plate (4).



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Figure 175.10. Power steering cylinder assembly - exploded view.

Legend for fig. 175.10:

- | | |
|-------------------|---------------------|
| 1. Retainer | 10. Backup ring |
| 2. Capscrews (3) | 11. Packing |
| 3. Seal | 12. Gland |
| 4. End plate | 13. Backup ring |
| 5. Retaining ring | 14. Packing |
| 6. Retaining ring | 15. Piston rod |
| 7. Oil seal | 16. Piston assembly |
| 8. Retaining ring | 17. Nut |
| 9. Retaining ring | 18. Cylinder |

(4) To remove gland retaining ring (5), push gland (12) into cylinder bore to relieve pressure on retaining ring. With a punch entered through knock out hole in cylinder barrel wall, remove retaining ring (5).

(5) Examine threaded end and wrench slot of piston rod (15) for burrs, nicks, corrosion, etc. Remove these if present, to allow gland and seal assembly to slide off of piston rod without damage.

(6) Pull on piston rod (15) only far enough to disengage gland (12) and remove over piston rod (15). Push piston rod back into cylinder (18).

(7) Wrap one layer of cellophane tape over piston rod thread and wrench slot to prevent damage to seals when assembling new gland and seal assembly.

(8) Remove retaining ring (6), oil seal (7), retaining ring (8), retaining ring (9), backup ring (10), and packing (11). Remove backup ring (13) and packing (14) from gland (12).

(9) Remove piston rod (15) with piston assembly (16) and nut (17) from cylinder (18). Remove nut (17) and piston assembly (16) from rod (15).

c. Cleaning, Inspection and Repair.

CAUTION

To prevent the entrance of moisture between closely fitted parts do not steam clean hydraulic steering components.

(1) *Cleaning.* Clean all metal parts with dry cleaning solvent or mineral spirits paint thinner. Dry thoroughly with compressed air.

(2) *Inspection and Repair.* Inspect all parts for distortion, scored, or excessively worn condition. Replace as required.

d. Assembly.

(1) Assemble piston assembly (16, fig. 14-14) on piston rod (15) and install nut (17).

(2) Lubricate cylinder bore and place piston assembly (16), rod (15), and nut (17) into cylinder (18).

(3) Assemble packing (14) and backup ring (13) on gland (12). Assemble packing (11), backup ring (10), retaining ring (9), retaining ring (8), oil seal (7), and retaining ring (6) in gland (12). Lubricate piston rod (15), cylinder bore (18) and inside diameter of gland (12) and position over piston rod (15) into cylinder (18). Secure with retaining ring (5). Assemble end plate (4), seal (3), retainer (1), and secure with three capscrews (2).

e. Power Steering Cylinder Travel Adjustment.

NOTE

The power cylinder is properly adjusted when, with wheels positioned straight ahead, distance between center lines of the spring shackle bolt ball stud and steering knuckle arm ball stud is 25.50 inches.

(1) Loosen clamping nut and bolt to release pressure on threaded end of power steering cylinder.

(2) Turn socket assembly counterclockwise to extend travel of power steering cylinder.

(3) Turn socket assembly clockwise to decrease travel of power cylinder.

(4) When travel of power cylinder has been adjusted, tighten clamp nut and bolt on threaded end of power steering cylinder. Torque to 85 ft lb.

f. Power Steering Cylinder Installation.

(1) Position power steering cylinder ball seat on ball stud of spring shackle bolt, make sure that ball stud is encircled by ball seats.

(2) Screw in adjustable plug just enough to hold ball seats on ball stud.

(3) Position ball seats on ball stud of upper steering knuckle arm.

(4) Screw adjustable plug into rear socket tight onto ball seats and then back off until slot in adjustable plug is aligned with holes in socket. Insert cotter pin.

(5) Screw adjustable plug into front socket tight onto ball seats and then back off until slot on adjustable plug is aligned with holes in socket. Install cotter pin.

(6) Install two hoses on power steering cylinder. Be certain connections are clean and tightened firmly.

(7) Bleed steering system, refer to paragraph 128.5g.

(8) Start engine, turn steering wheels in both directions to check for proper adjustment of power steering cylinder and proper seating of ball seats on ball studs.

(9) Install dust shield and felt pad on both ends of power steering cylinder.

g. Bleeding Steering System.

(1) Add hydraulic oil, as necessary, to bring level of oil to full mark on oil reservoir sight gage.

(2) Start engine and run at idle speed for 2 or 3 minutes. Stop engine, add hydraulic oil if necessary.

(3) Start engine, run at idle speed and turn wheels slowly from side to side several times to completely bleed air out of system. Place wheel in straight ahead position. Stop engine and add hydraulic oil, if necessary, to bring level of oil to full mark.

128.6. Socket Assembly with Clamp.

a. General. The socket assembly with clamp is attached to rod end of power steering cylinder on one end, and to steering knuckle ball stud on the other end (fig. 175.9).

b. Removal of Socket Assembly with Clamp.

(1) Disconnect dust shield and felt pad from socket.

(2) Remove cotter pin from socket.

(3) Loosen adjustable plug to allow ball seats to release steering knuckle ball stud.

(4) Remove socket from steering knuckle ball stud.

(5) Loosen clamping nut and bolt to release pressure on threaded end of power steering cylinder rod and remove socket from rod.

(6) Remove and discard dust shield and felt pad.

c. Repair of Socket Assembly.

(1) Remove socket. Refer to *b* above.

(2) Remove and discard adjustable plug, two ball seats and the spring.

(3) Install a new spring, two ball seats and the adjustable plug.

(4) Install socket on power steering rod end. Refer to *d* below.

d. Installation of Socket Assembly with Clamp.

(1) Thread socket on rod end of power steering cylinder.

(2) Position new dust shield and felt pad on steering knuckle ball stud.

(3) Install socket on steering knuckle ball stud. Refer to paragraph 128.5f (3) through (5).

(4) Check and adjust travel of power steering cylinder as necessary. Refer to paragraph 128.5 *e*.

(5) Secure dust shield and felt pad on socket.

128.7. Drag Link.

a. Drag Link Removal (fig. 175.11 and 175.12).

(1) Set front wheels in straight ahead position and steering wheel in midposition.

(2) Remove and discard cotter pins from both ends of drag link.

(3) Disconnect dust shield from both ends of drag link.

(4) Loosen adjustable plugs at both ends of drag link, but do not remove plugs.

(5) Turn steering wheel in both directions to loosen drag link ends. Remove front end of drag link from pitman arm ball stud and rear end of drag link from steering knuckle arm ball stud.

NOTE

If the adjustable plugs are removed, make sure that plugs and springs are kept free of dirt.

(6) Remove and discard dust shields and felt pads from pitman arm ball stud and steering knuckle arm ball stud.

b. Drag Link Installation (fig. 175.11 and 175.12).

NOTE

Front end of drag link assembly is the end that has greatest distance between ball stud opening and end of drag link.

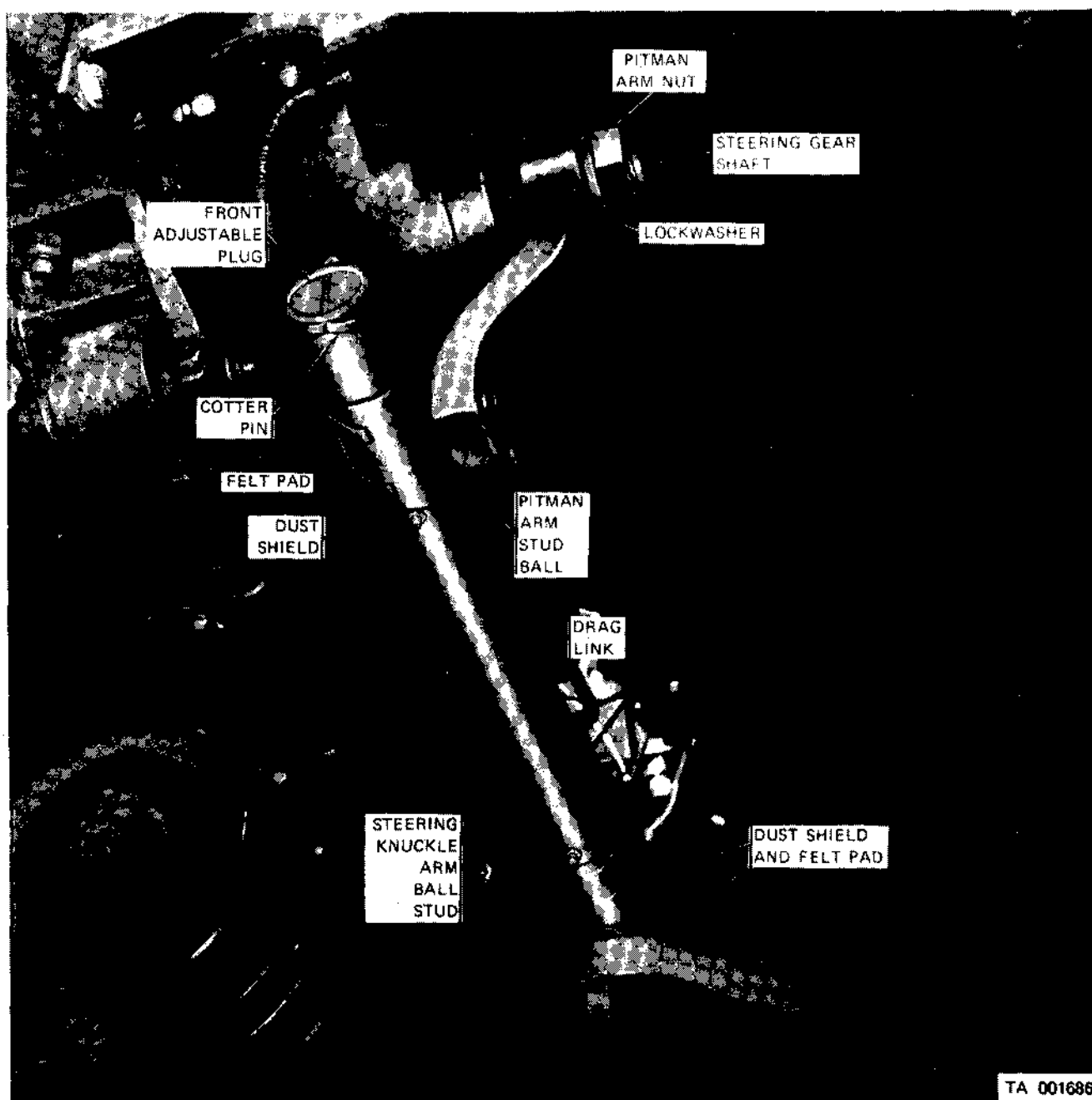


Figure 175.11. Steering linkage removal and installation.

(1) Install a new dust shield and a new felt pad on pitman arm ball stud and on steering knuckle arm ball stud.

(2) Place drag link on pitman arm ball stud, make sure that drag link ball seats encircle pitman arm ball stud.

(3) Screw front adjustable plug into front of drag link but do not tighten.

(4) Place drag link on steering knuckle arm ball stud, make sure ball seats encircle knuckle arm ball stud.

(5) Screw rear adjustable plug into rear of drag link tight onto the ball seats and then back off until slot in

adjustable plug is aligned with holes in socket, install new cotter pin.

(6) Screw front adjustable plug into front of drag link tight onto ball seats and then back off until slot in adjustable plug is aligned with holes in socket, install cotter pin.

(7) Turn steering wheel in both directions to make sure that ball seats and ball studs are seated.

(8) Connect dust shield on both ends of drag link.

(9) Lubricate drag link according to LO 9-2320-211-12.

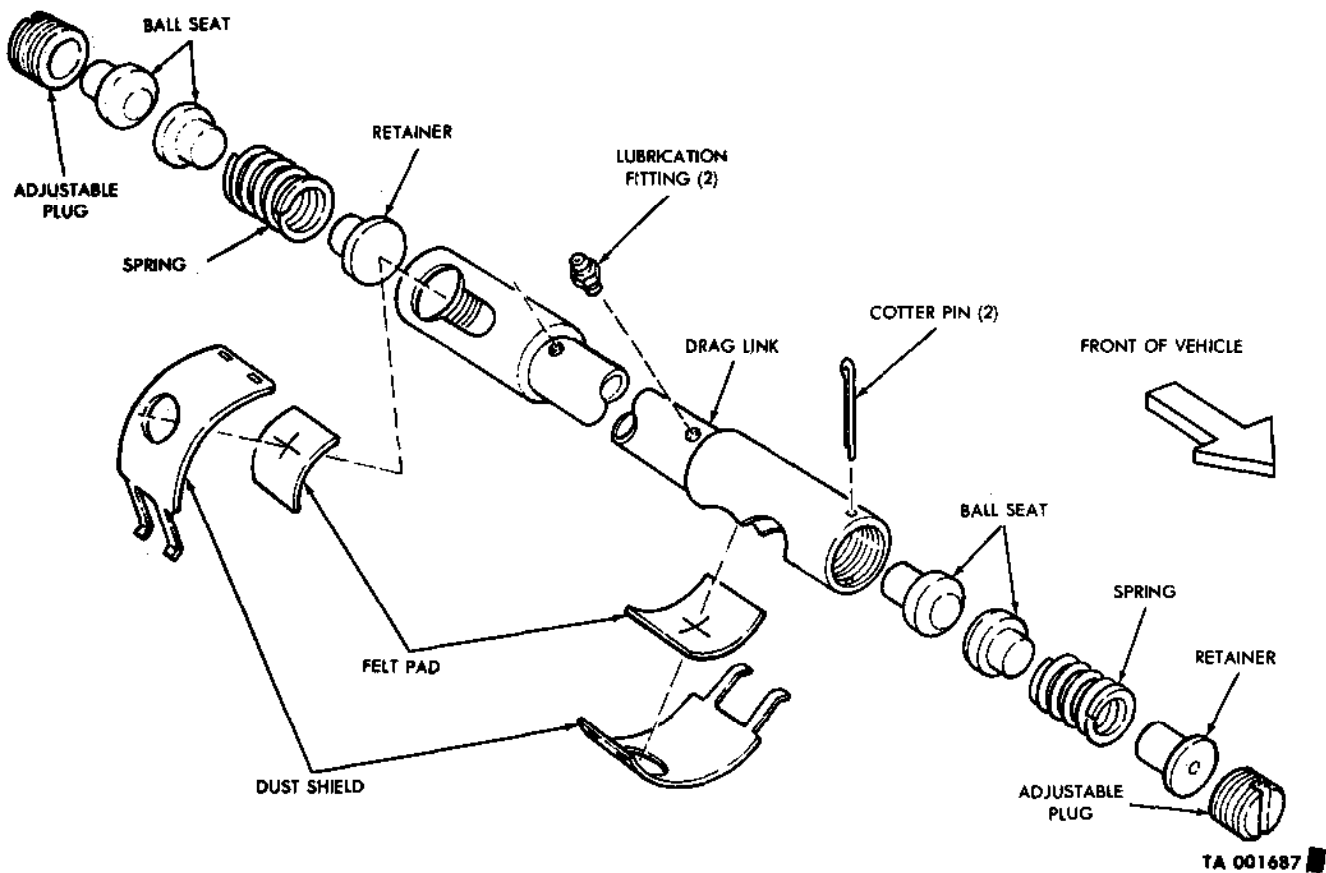


Figure 175.12. Drag link - exploded view.

c. Drag Link Repair Parts Kit Installation (fig. 2-234).

(1) Remove drag link assembly. Refer to a above.

(2) Remove and discard adjustable plugs from both ends of drag link.

(3) Remove and discard retainer, spring, and two ball seats from each end of drag link.

(4) Install components of repair parts kit in drag link, as illustrated by fig. 175.12.

(5) Install drag link assembly. Refer to b above.

Section IX. TEST AND ADJUSTMENTS

128.8. Steering Adjustment.

CAUTION

Failure to observe the following procedure will materially reduce life of power steering pump and all steering system seals due to excess heat.

CAUTION

Care must be exercised not to hold pressure for longer than 15 seconds while this adjustment is being made or damage to the pump will result from heat.

NOTE

The above procedure should be applied only after the steering system has reached normal operating temperature, otherwise false readings (high) may result. As a precaution, the steering wheel can be rotated from extreme left to right for approximately five minutes with the engine running at 800-900 rpm in order to insure that normal operating temperature has been reached. In order to insure proper setting temperature, a more precise check can be made by inserting a

thermometer into the oil in the steering pump reservoir and perform the adjustment within a temperature range of 120° to 150° F.

a. Install pressure gage 4910-00-792-8304 in the pump discharge line and idle engine at 500-650 rpm. Rotate steering wheel to extreme left turn position and note reading on pressure gage. If pressure is between 800 and 900 psi, no adjustment is necessary. If pressure is greater than 900 psi, turn adjusting screw in until pressure drops to between 800 and 900.

b. Repeat procedure for opposite turn.

128.9. Road Test.

Road test vehicle to insure steering gear and power steering pump are operating correctly. Insure steering gear has a positive feel and will turn to maximum left and right position without hesitation or binding and will return to center (straight ahead) position properly. Check steering gear and pump, hydraulic hoses, connections, and fittings for oil leaks. Check all belts for proper tension.

Section X. REPAIR AND REPLACEMENT STANDARDS

128.10. General.

a. Wear limits and points of measurement for wear limits are not available for the steering system assemblies and component parts. The modular maintenance concept, which embodies the ability to rapidly diagnose failures or deficiencies of a component which is easily removed installed and which facilitates the rapid return of equipment to a serviceable condition will be utilized whenever possible. Every consideration will be given to inspection and repair procedures requiring the least

expenditure of time, personnel, skills, tools and test equipment.

b. In the absence of wear limit data, simplified go-no-go gages, standards and inspection techniques, will be locally devised to economically and efficiently return equipment to a serviceable condition in accordance with the objectives of Maintenance Support Positive (MS+).

CHAPTER 13

CAB ASSEMBLY AND RELATED PARTS

Section I. DESCRIPTION AND DATA

129. Description

a. General. The cab assembly (figs. 176 and 177) consists of the cowl, dash panel, toeboard, cowl ventilator assemblies, floor side, and rear panels, door assemblies and the necessary supports, braces, brackets, gussets, reinforcements, etc. Rear gun mount brackets, grab handles, lashing hooks, rear view mirrors, instrument panel, and front intermediate and rear tunnel sections are bolted to the basic cab.

b. Door Assemblies. The left and right cab door assemblies contain door glass that is raised or lowered by a door glass regulator assembly operated by the regulator handle. Door lock assemblies hold the door in a closed position. Each door has inside and outside door handles to operate the lock that opens the door. To permit removal of the

door glass regulator, an inspection plate is located on the inside of each door. The door lock is also removed through the inspection plate. Each door is equipped with a door check, and is hinged to a pillar on the side of the cab.

c. Instrument Panel. The instrument panel is made of sheet metal. The panel is used to mount the switches, information and data plates, hand controls, and instrument cluster assembly with speedometer, lights, and gages, used in operation of the vehicle.

130. Data

Capacity	3 men
Overkill width	97 in.
Top	canvas or hard top
Glass	safety
Windshield	two piece

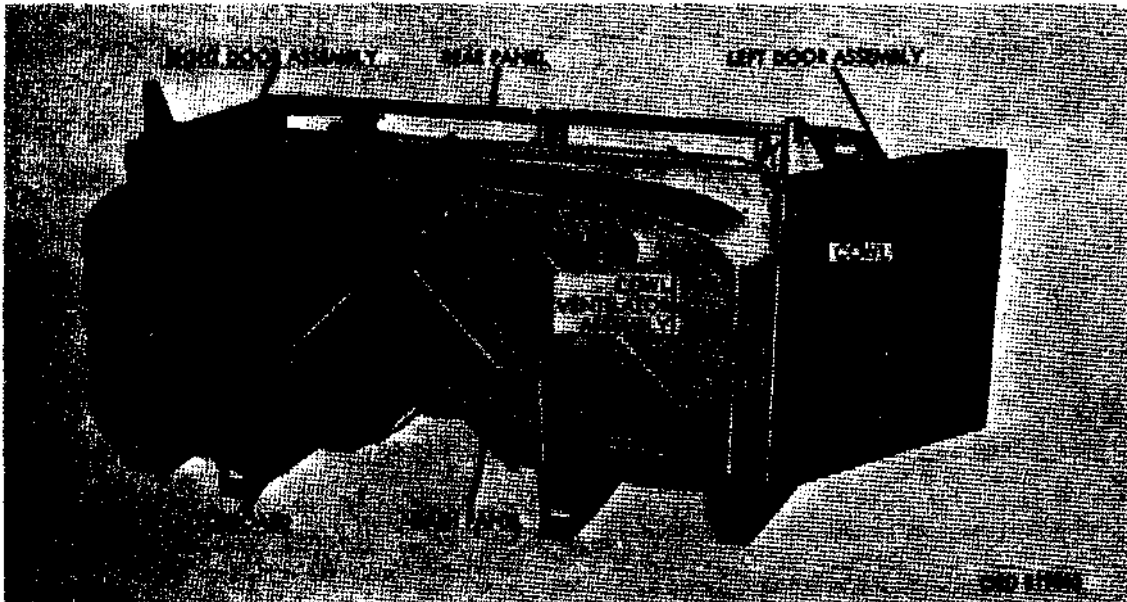


Figure 176. Cab assembly - front view

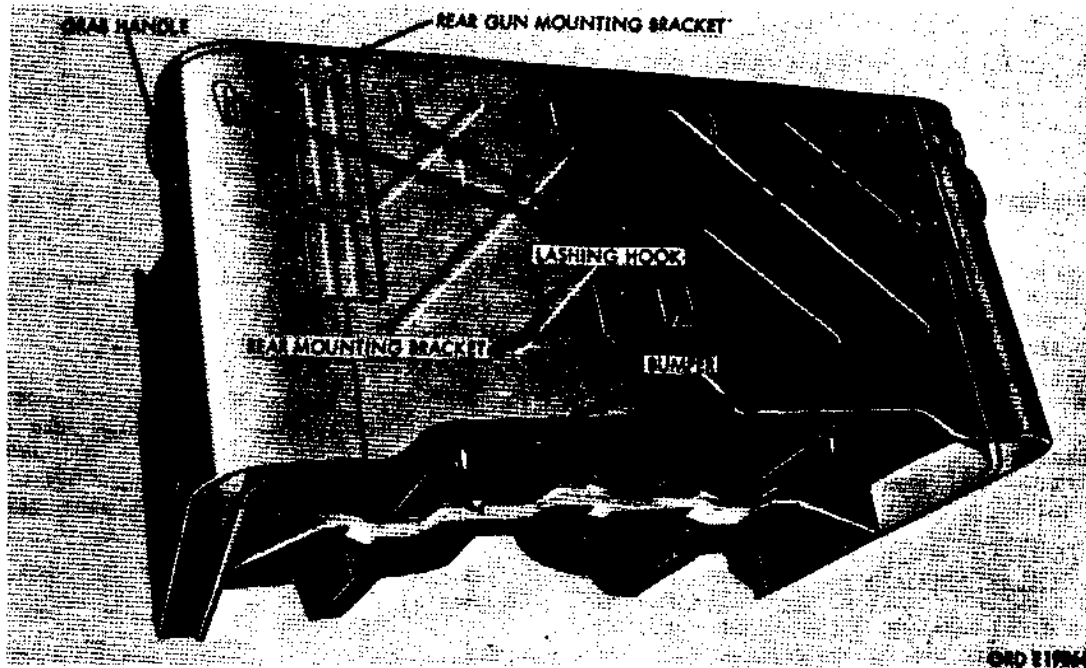


Figure 177. Cab assembly - rear view

Section II. REMOVAL AND INSTALLATION

131. Cab Assembly

a. Removal.

(1) Refer to TM 9-2320-211-20 for the following operations ((a) through (m)).

- (a) Remove paulin top from cab.
- (b) Remove windshield assembly.
- (c) Remove air cleaner from cowl (gasoline models only).
- (d) Remove generator-regulator from cowl.
- (e) Remove brake and clutch pedals.
- (f) Disconnect engine ground strap.
- (g) Remove fuel shutoff control cables (diesel models only).

(h) Remove transmission shift lever and tunnels from cab floor.

(i) Remove speedometer drive cable.

(j) Remove tachometer drive cable.

(k) Disconnect hand primer pump line.

(l) Disconnect accelerator linkage and choke control wire at carburetor (gasoline model only);

(m) Disconnect starter control linkage.

(2) Remove hood and fenders (par. 31).

(3) Remove screw and lockwasher and open steering column clamp at instrument panel (fig. 178).

(4) Remove screws securing steering column dust cover to cowl.



Figure 178. Steering column clamp.

- (5) Remove horn contact brush cover from steering column (fig. 179).
- (6) Remove capscrews securing control housing end plate to control housing (fig. 179). From inside of cab, pull steering column up through the cowl

Note. When removing steering column, make sure not to lose shims and gaskets between control housing and gear housing.



Figure 179. Removal of steering column.

- (7) Remove cotter pin and shaft securing transfer and power takeoff control levers to linkage and remove control linkage (fig. 180).
- (8) Remove electrical wiring harness from cab (para. 23).

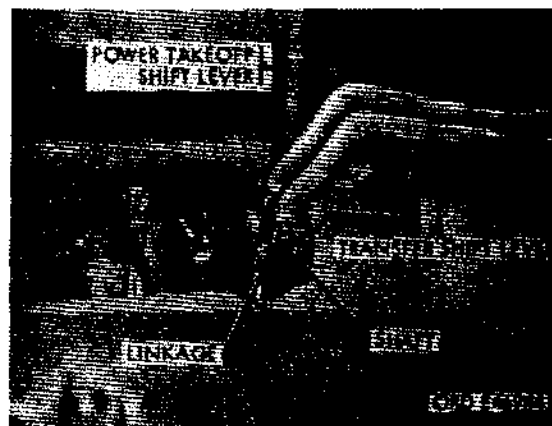


Figure 180. Transfer and power takeoff control levers.

- (9) Remove cotter pin and clevis pin securing handbrake linkage to handbrake (fig. 181).
- (10) Remove safety nuts and bolts securing handbrake cable clamp to bracket under cab and pull handbrake cable from cab.

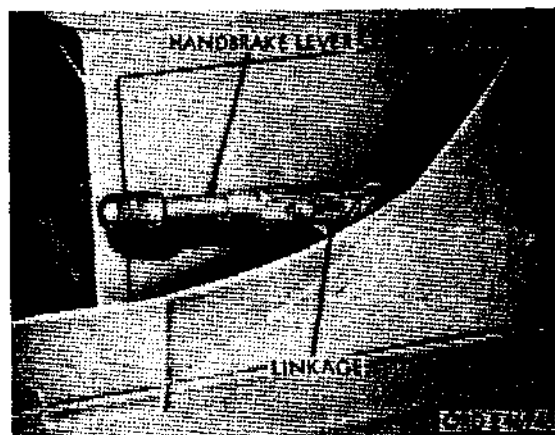


Figure 181. Handbrake lever and linkage.

- (11) Remove cotter pin and nut securing cab front to frame (fig. 182).
- (12) Remove cab mounting bolts, springs, insulators, washers and safety nuts (figs. 182 and 183).
- (13) Disconnect air line, remove nuts and lockwashers, and remove horn and bracket assembly from cowl (fig. 184).

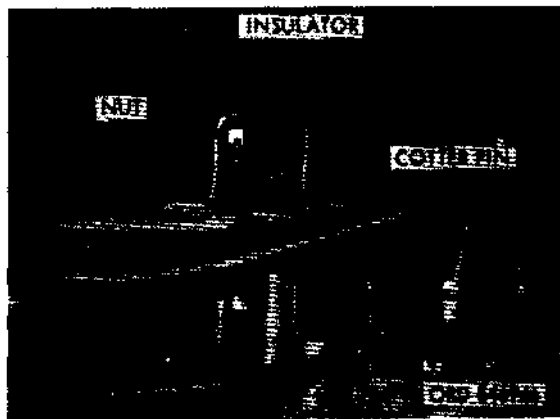


Figure 182. Cab front mounts.

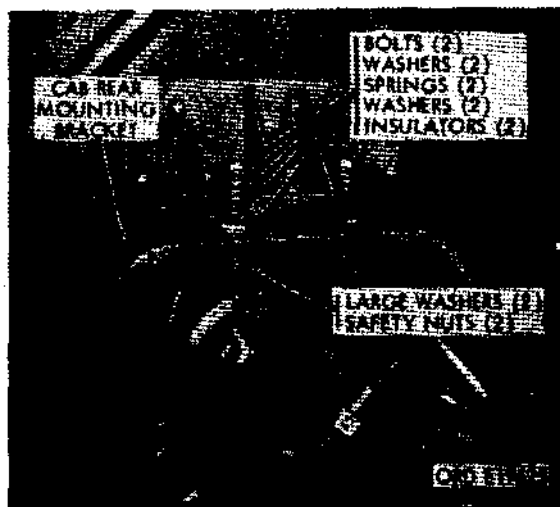


Figure 183. Cab rear mounts.



Figure 184. Component mounted on cab cowl.

- (14) Disconnect air lines from air governor, remove capscrews and lockwashers, and remove air governor from cowl (fig. 184).
 - (15) Remove all air lines, couplings, cables, linkage, and clamps from cowl.
 - (16) Disconnect dump body control linkage (para 74).
 - (17) Lift cab off frame using suitable hoist and A frame.
- b. Installaztion. Install cab assembly in reverse order of removal.

Section III. DISASSEMBLY INTO AND ASSEMBLY FROM SUBASSEMBLIES

132. Disassembly

Disassemble cab assembly as shown in figure 185.

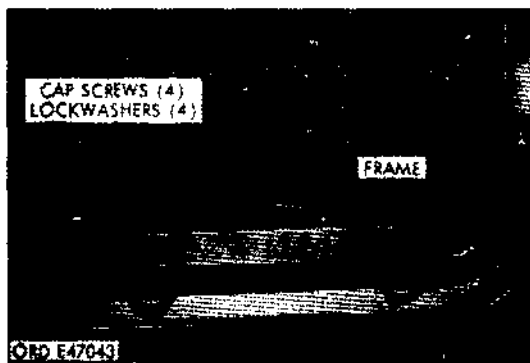
FIGURE 185
CAB DISASSEMBLY AND ASSEMBLY
Steps 1 through 16



Step 1. Remove door check (right and left door).



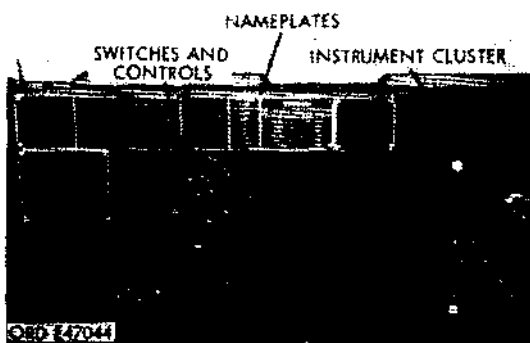
Step 2. Remove door assembly (right and left).



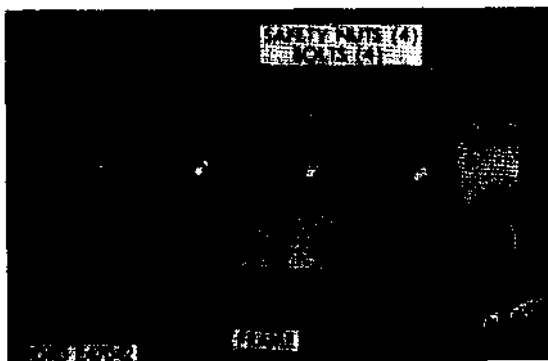
Step 5. Remove driver's seat frame.



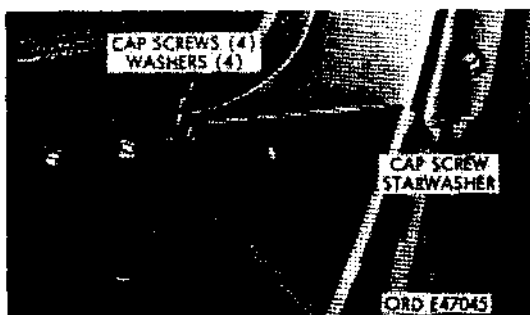
Step 3. Remove companion seat frame (right side).



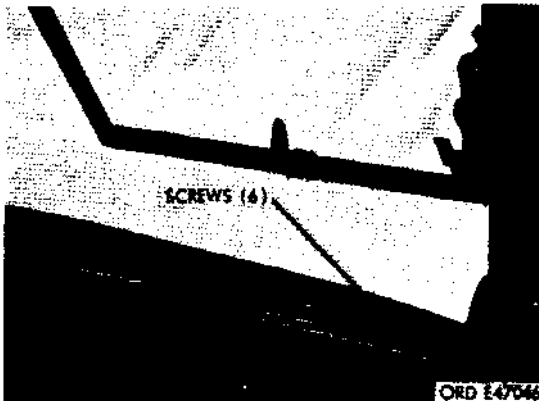
Step 6. Remove instrument cluster, nameplates, switches, and controls. Refer to TM 9-2851.



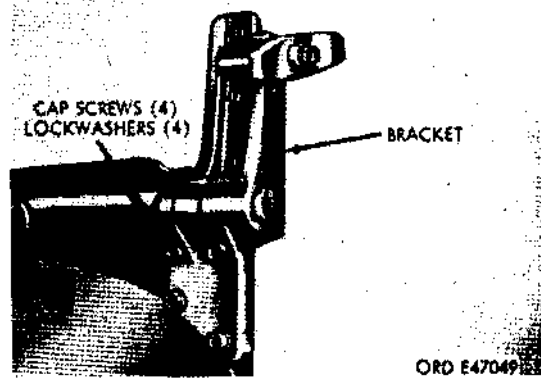
Step 4. Remove companion seat frame (left side).



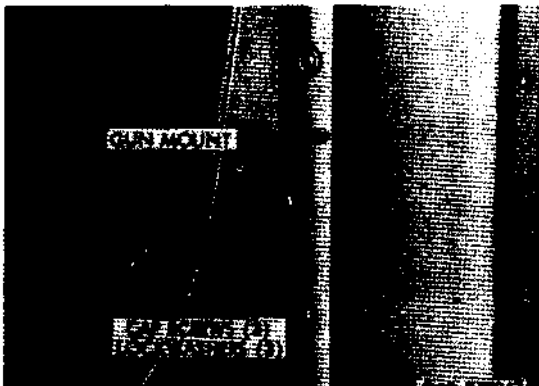
Step 7. Remove instrument panel support bracket, cap screws and washers (right side only), and instrument panel to hinge pillar cap screw and starwasher (right and left sides).



Step 8. Remove instrument panel to cowl pan head screws.



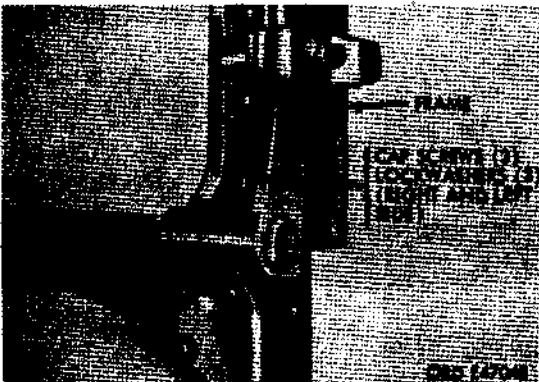
Step 11. Remove windshield support brackets (left and right).



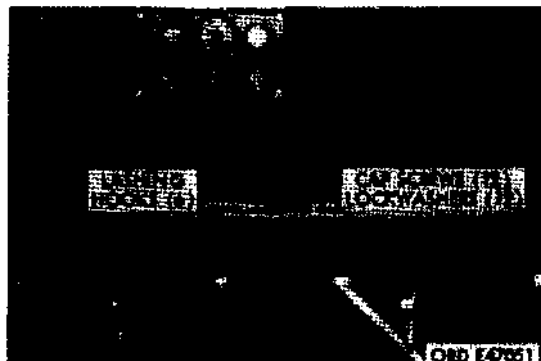
Step 9. Remove gun mount (right side only).



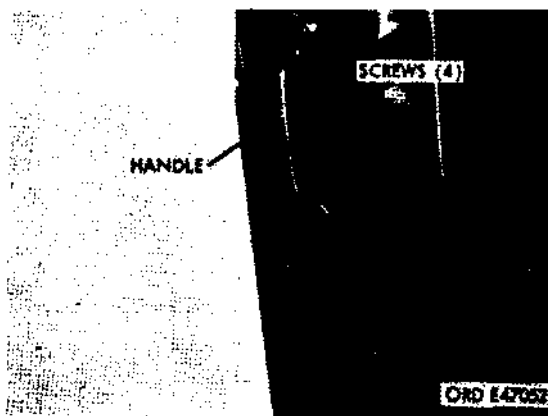
Step 12. Remove cowl ventilator screens (left and right) .



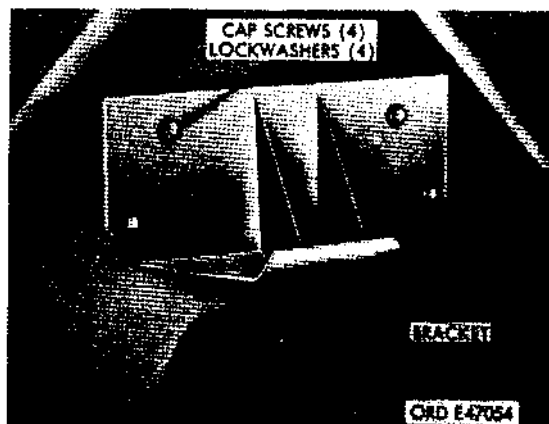
Step 10. Remove windshield frame.



Step 13. Remove lashing hooks.



Step 14. Remove grab handle (right and left side).



Step 16. Remove rear mounting bracket.



Step 15. Remove rear gun mount bracket (right and left side).

Figure 185. Cab disassembly and assembly

* * *

133. Assembly

Assemble cab assembly in reverse order of disassembly, proceeding from step 16 through step 1 of figure 185.

Section IV. REPAIR

134. Door Assembly

a. Disassembly. Procedures for assembly of the door assembly are shown in figures 186 and 187. The nature of the damage to

these items is generally irreparable; therefore, damaged parts shall be replaced rather than repaired. For dents or cracks in sheet metal, bump out or weld, as necessary.

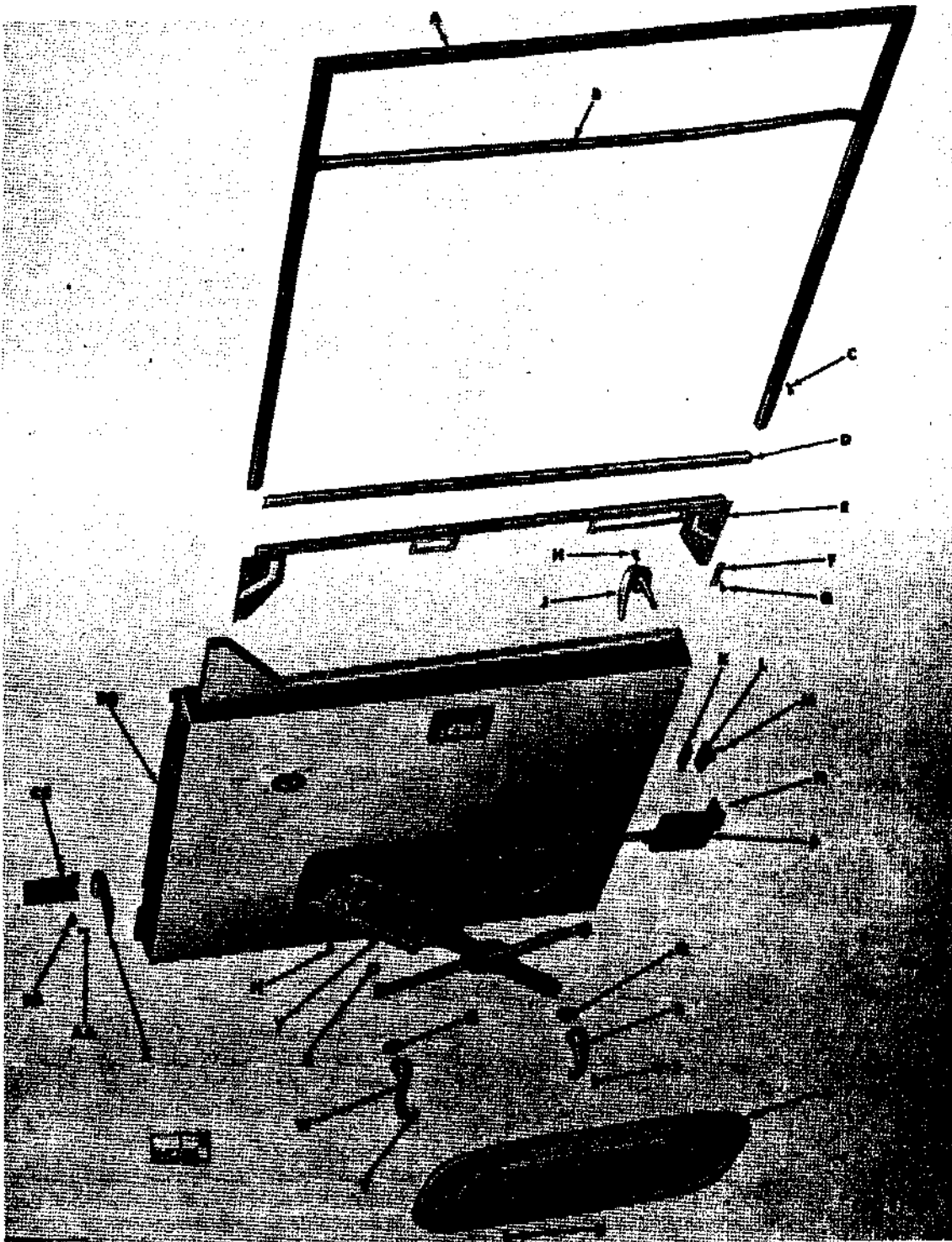
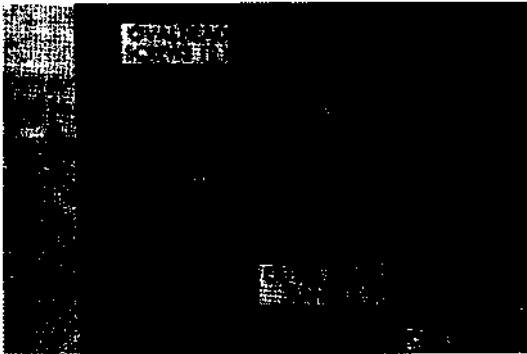


Figure 186. Cub right door assembly - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Glass frame	Q	Handle spacer
B	Glass frame seal	R	Inner handle
C	Flat head screws	S	Fil-hd lock screw
D	Glass regulator rubber channel	T	Inspection cover
E	Glass regulator channel	U	Panhead sheel metal screw
F	Glass regulator stop bracket	V	Fil-hd lock screw
G	Panhead screw	W	Glass regulator handle
H	Ovalhead screw	X	Glass regulator pin fastener
J	Outer handle	Y	Glass regulator assembly
K	Male dovetail shim	Z	Door half-door hinge
L	Male dovetail	AA	Binding head lock screw
M	Ovalhead ext-teeth lockwasher screw	BB	Hinge pin
N	Int-teeth lockwasher screw	CC	Pillar half-door hinge
P	Door lock w/remote control assembly	DD	Right door

Figure 186. Cab right door assembly - exploded view - legend

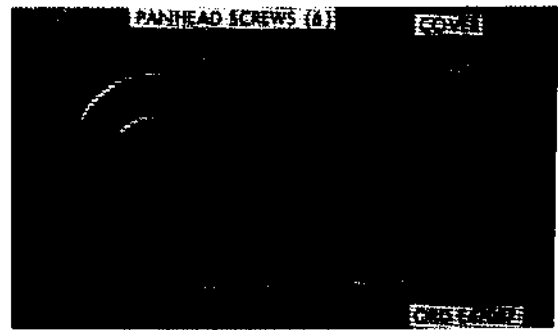
FIGURE 187.
CAB DOOR-DISASSEMBLY AND ASSEMBLY
Steps 1 through 13



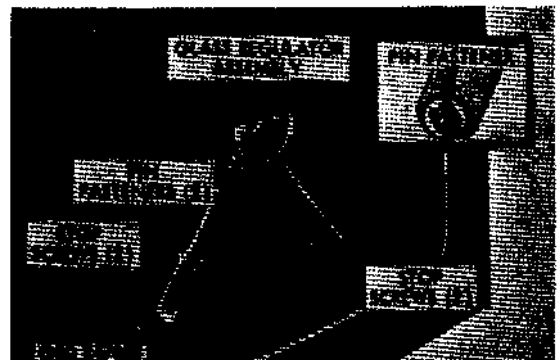
Step 1. Remove door outer handle.



Step 2. Remove door inner handle and spacer.

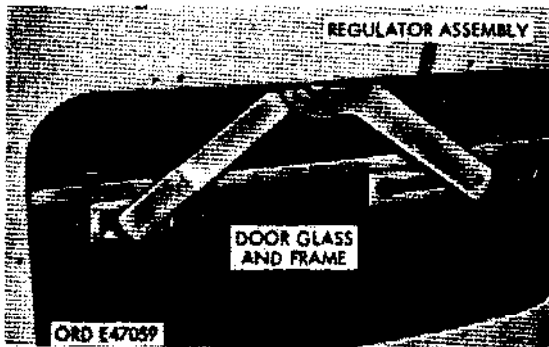


Step 3. Remove inspection cover.

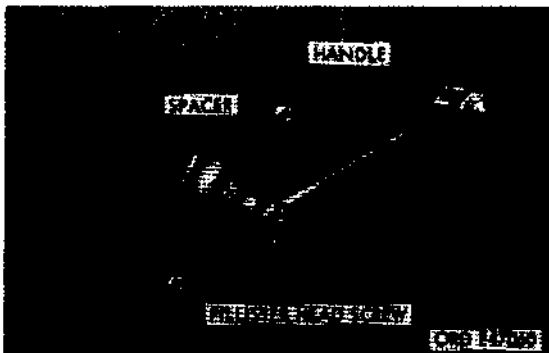


Step 4. Remove glass regulator assembly, pin fasteners and stops (2 each).

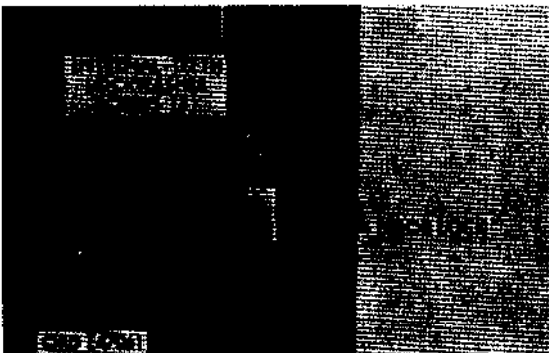
Note. During installation, install pin fasteners as shown in insert photo.



Step 5. Remove door glass and frame. Hold door glass frame and pull regulator assembly guides from glass regulator channel. Remove door glass and frame from top of door.



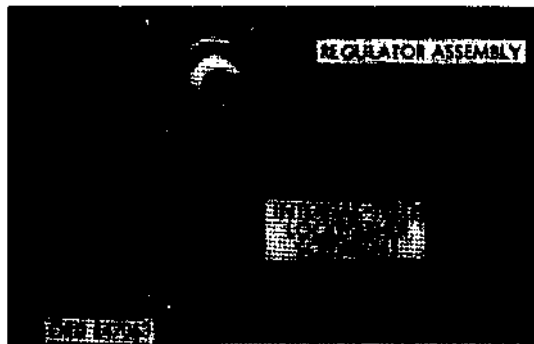
Step 6. Remove door glass regulator handle and spacer.



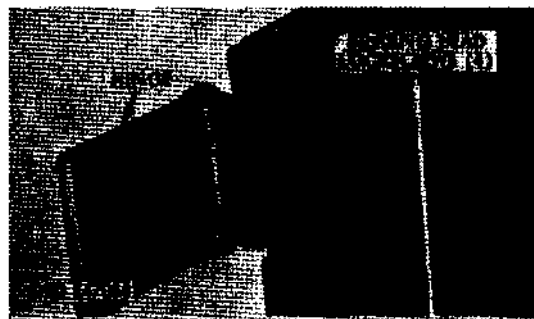
Step 7. Remove door lockplate.



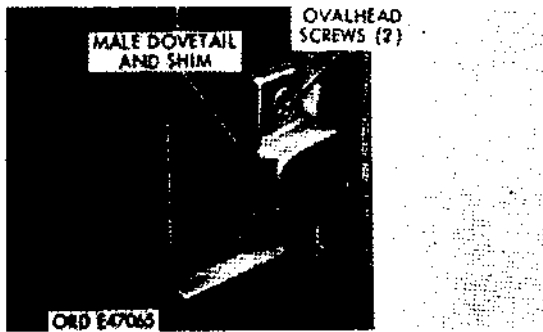
Step 8. Remove control plate and door lock assembly. When plate is removed, complete lock assembly will ordinarily fall out. However, it may be necessary to loosen the assembly by reaching in through top of door with a screwdriver or other tool.



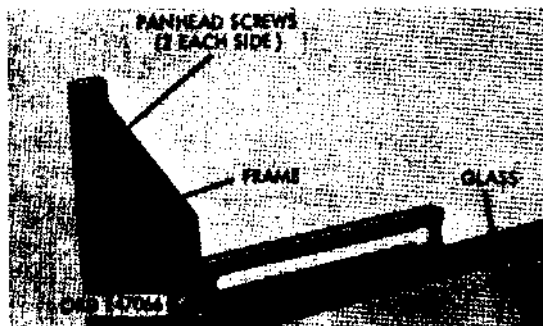
Step 9. Remove door glass regulator assembly.



Step 10. Remove door hinges (2).



Step 11. Remove male dovetail and shim.



Step 12. Remove door glass. Remove screws securing glass regulator channel to glass frame and remove channel. Slide glass from frame and remove upper glass frame seal and lower regulator rubber channel.



Step 13. Remove door weather stripping.

Figure 187. Cab door - disassembly and assembly

* * *

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean door assembly thoroughly with steam under pressure. Remove grease and clean all other metal parts in mineral spirits paint thinner. Dry with compressed air. Wash glass with warm water and soap or soap substitute. Dry thoroughly.
- (2) Inspection and repair. Refer to TM 10-450 for repair of sheet metal parts of door assembly. Replace broken glass in door assembly. Replace damaged or unserviceable parts.

c. Assembly. Assemble door assembly in reverse order of disassembly, proceeding from step 13 through step 1.

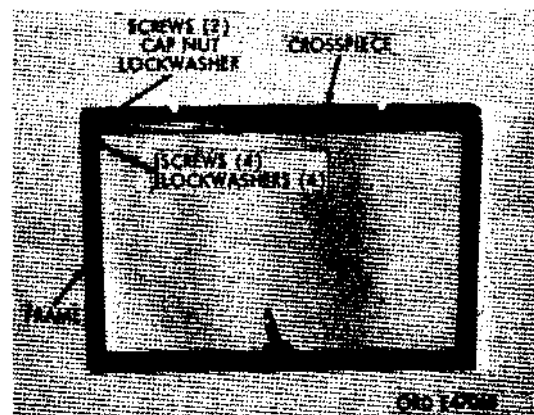
135. Instrument Panel

Refer to TM 9-2320-211-20 for removal and installation of instruments, controls, and name - and instruction plates.

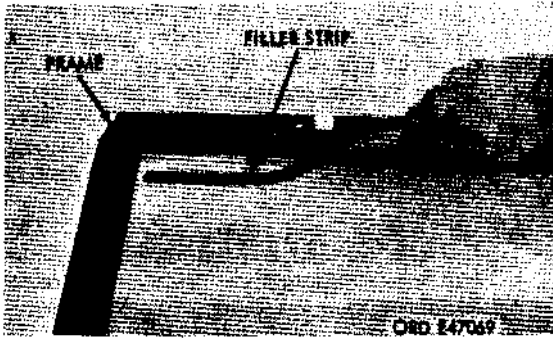
136. Windshield Assembly

a. Disassembly. Procedure for disassembly of the windshield assembly is shown in figure 188.

FIGURE 188
WINDSHIELD DISASSEMBLY AND ASSEMBLY
Steps 1 through 5

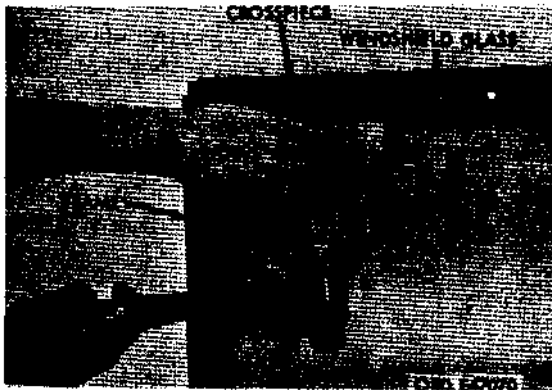


Step 1. Remove windshield inner frame upper crosspiece attaching parts.

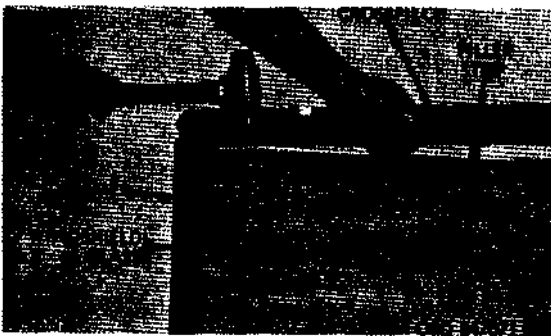


Step 2. Remove trimming filler strip.

Note. For installation use knife to trim filler strip even with frame edges.

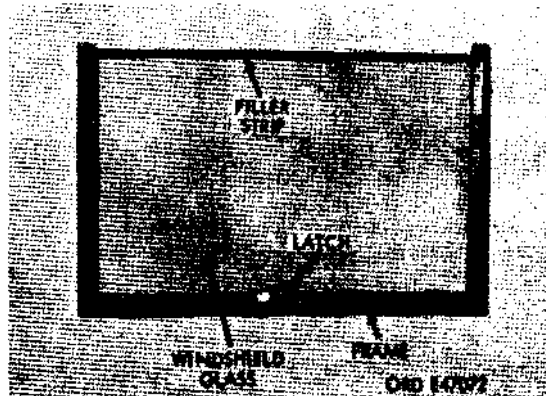


Step 3. Remove crosspiece. Use wooden block and hammer to remove crosspiece from windshield glass and frame.



Step 4. Remove frame alignment and crosspiece.

Note. For installation, align frame side pieces attaching screw holes with crosspiece holes before tapping crosspiece on glass.



Step 5. Remove locking latch, windshield glass and filler strip. Loosen or remove latch attaching screws prior to removing windshield glass. Pry frame side pieces away from glass at upper corners and pry up on glass to remove.

Note. For installation encircle filler strip around windshield glass, place glass in frame and using rubber hammer, tap glass into position in frame channels, using due care that filler strip does not tear and that it surrounds the glass edges evenly. Use new filler strip.

Figure 188. Windshield disassembly and assembly

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean windshield assembly frame with mineral spirits paint thinner. Dry with compressed air. Wash glass with warm water and soap or soap substitute. Dry thoroughly.
- (2) Inspection and repair. Replace damaged frames and filler strips and broken glass.

c. Assembly. Assemble windshield assembly in reverse order of disassembly, proceeding from step 5 through step 1.

137. Seats

Refer to TM 9-2320-211-20.

138. Seat Supports and Frames

Repair or replace any damaged parts.

139. Seat Cushions

Refer to TM 10-269 for repair of canvas and webbing. Refer to TM 10-455 for cushion major repair and upholstery.

CHAPTER 14

TRANSFER

Section I. DESCRIPTION AND DATA

140. Description and Operation

a. Description. The transfer (figs. 189 and 190) is essentially a two-speed auxiliary unit which is driven by the engine, through the transmission, and distributes power through propeller shafts to each of the three driving axles. The transfer is located immediately back of the transmission and mounted on two support brackets under the cab.

b. Operation.

Note. Key letters in this paragraph refer to figure 193 unless otherwise indicated.

- (1) General. In addition to high and low speeds, the transfer unit automatically engages or disengages the front axle as operating conditions require. Driver's control for high or low range (refer

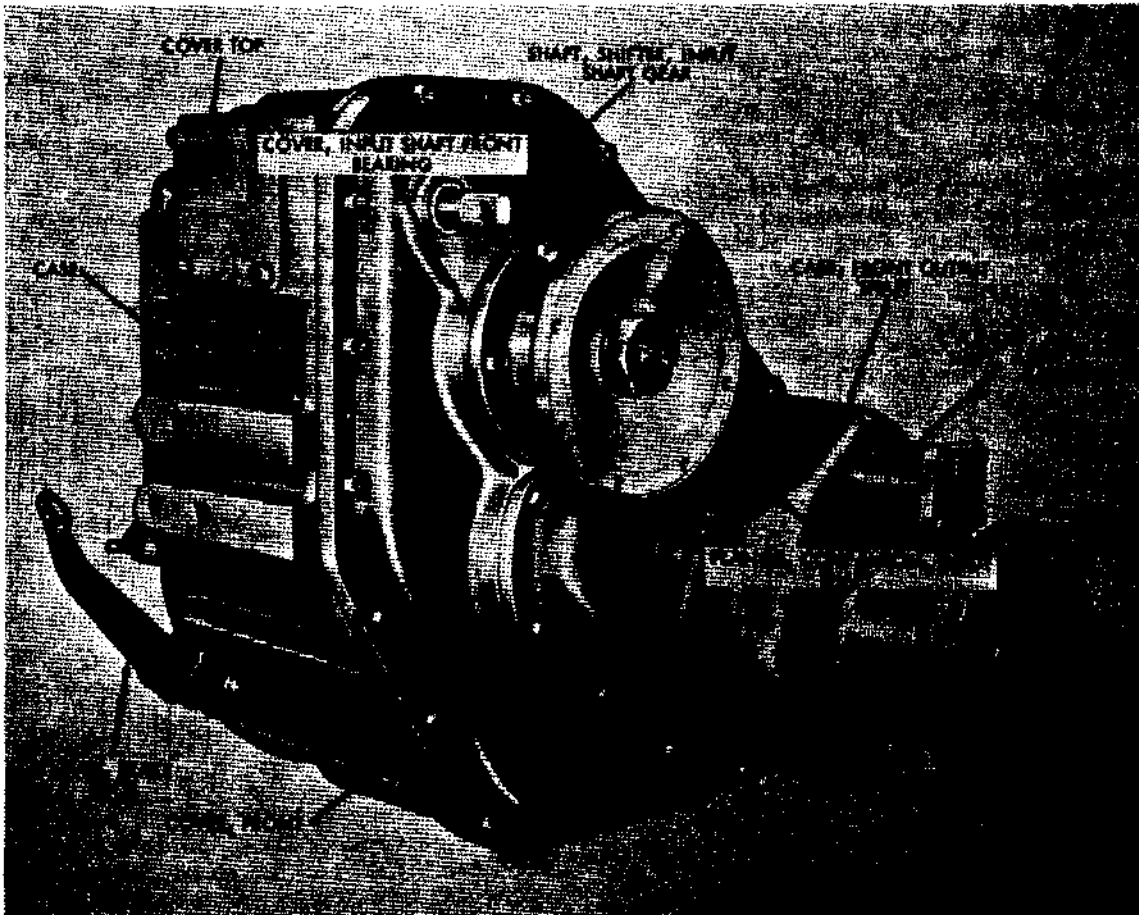


Figure 189. Transfer - right front view

to power flow diagram, fig. 191) is by shift lever in cab. Transfer gearing is designed to drive front axle at lower speed than rear axles. This feature, in addition to sprag unit (fig. 192) automatically eliminates delivery of power to front axle during normal operation. This same feature is made applicable to driving in reverse by the use of an air valve on the transmission low and reverse shift rail, which automatically shifts the transfer sprag unit to forward or reverse motion whenever the main transmission is shifted to forward or reverse.

- (2) Operation of the transfer air control system. The direction of driving torque or free rotation of the front wheels-is controlled by two sprag unit assemblies (F) located in the transfer (D) on the front output shaft (J). These sprag units (one for reverse and the other for forward rotation) are engaged by a reverse shift collar (E) actuated in turn by a shift air cylinder assembly (H), which is controlled by shift rail position in the main transmission (C). Any air pressure in the vehicle compressed air system will tend to engage the sprag unit so selected by transmission shift lever

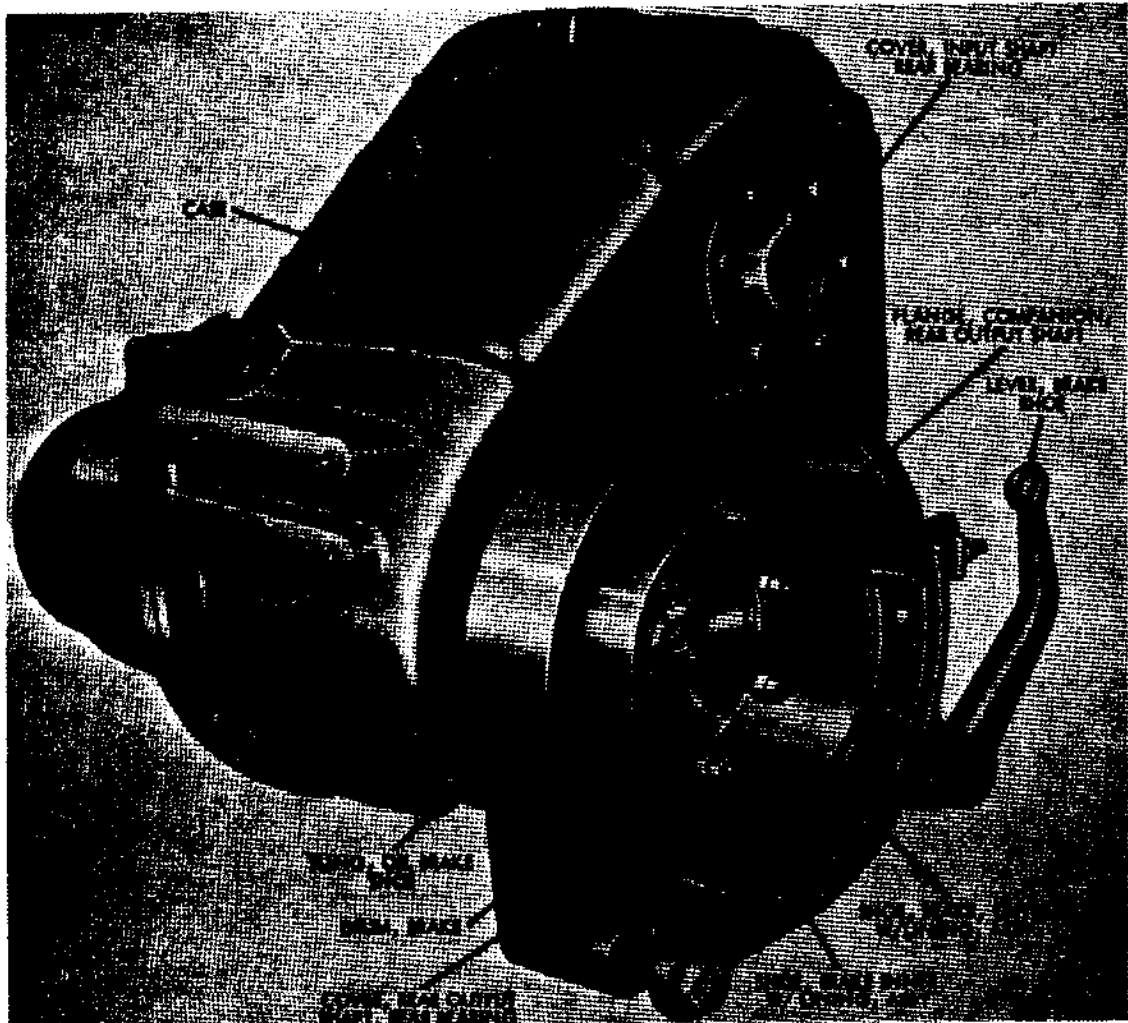


Figure 190. Transfer - left rear view

position. The shift air cylinder assembly has a balanced spring loading (G) for either of the two directions of shift, and will only return to neutral when no air pressure exists in the system or when binding torque load on the drive line is not efficient to overcome the spring disengagement force. Any air pressure in the system will shift the shift air cylinder to one or the other of two possible positions (forward and reverse). The direction of desired operation, forward or reverse, is controlled by an air cylinder control valve (A) functioning off the reverse shift rail (B) in the main transmission (C). When the transmission is in neutral, the air cylinder control valve is actuated for any forward direction of operation (all forward gears); however, when the transmission is in reverse, the opposite direction of cylinder movement engages the sprag unit assembly for reverse operation. Whichever of the two direction of the sprag units are shifted to operate (forward or reverse),

the front wheels will not free wheel in the opposite of that direction. For example, if sprag unit assembly is shifted for reverse operation, the front wheels cannot be turned in a forward direction. Also, if a vehicle with air pressure in the system is parked with the transmission shift lever in neutral position, it cannot be pushed backward until transmission shift lever is shifted to reverse.

141. Data

Type two speed with automatic front axle drive
 Manufacturer Timken
 Model T-138
 Ratio to rear:
 High range 1.000 to 1
 Low range 2.024 to 1
 Ratio to front:
 High range 1.068 to 1
 Low range 2.163 to 1
 Lubricant capacity 5 qt

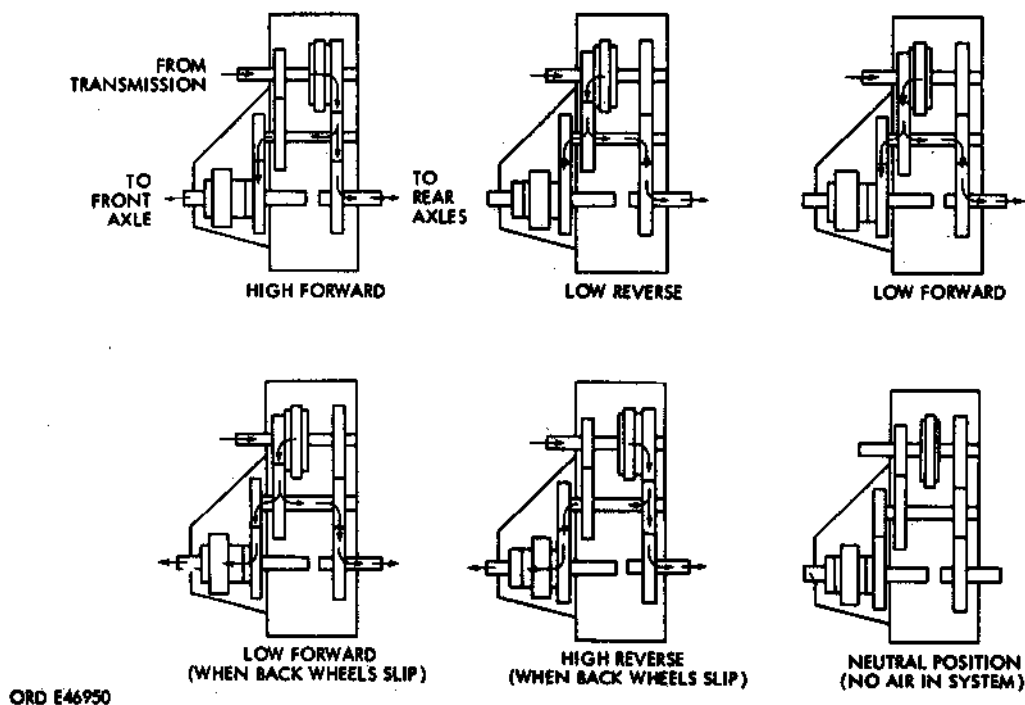


Figure 191. Principle of transfer sprag unit

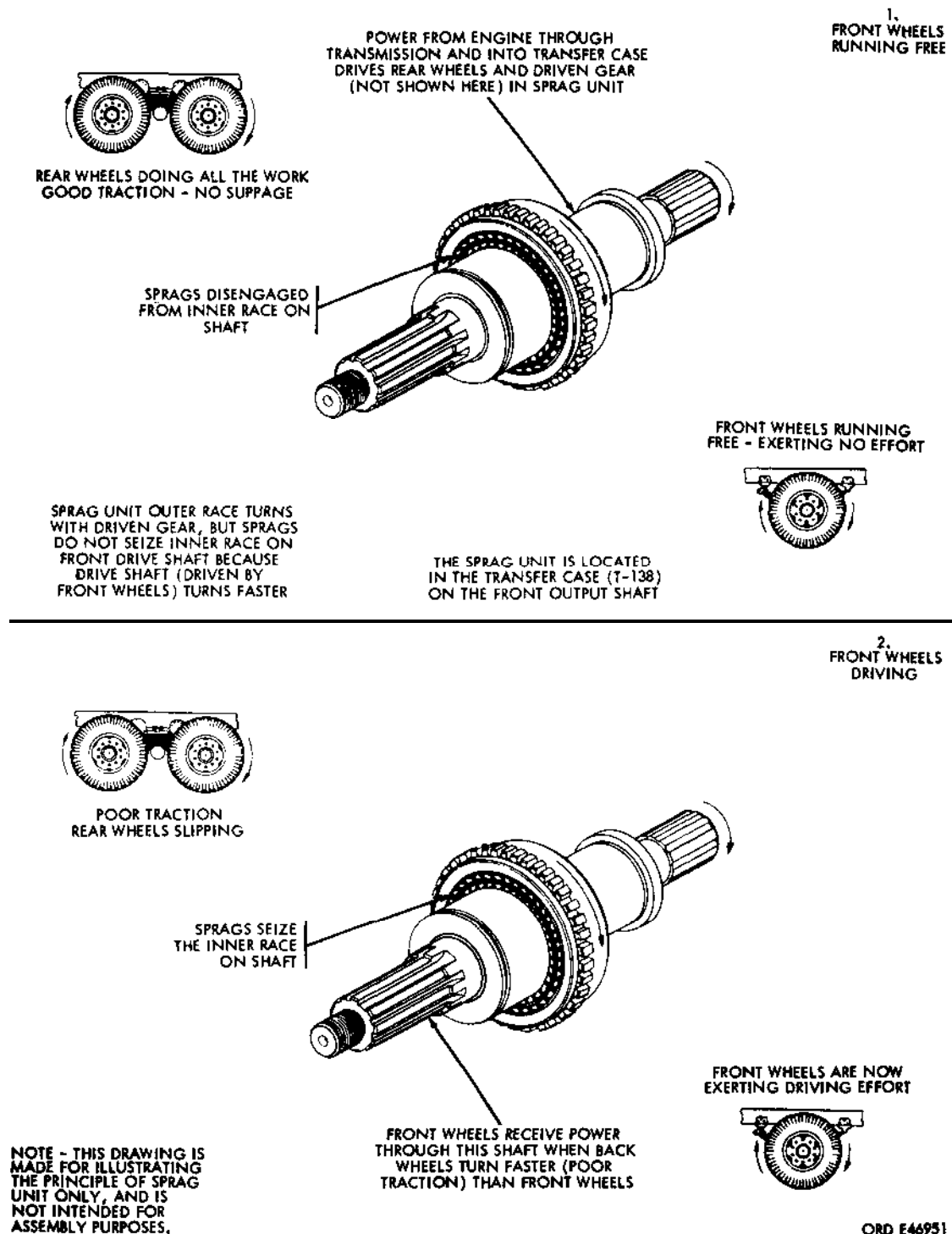
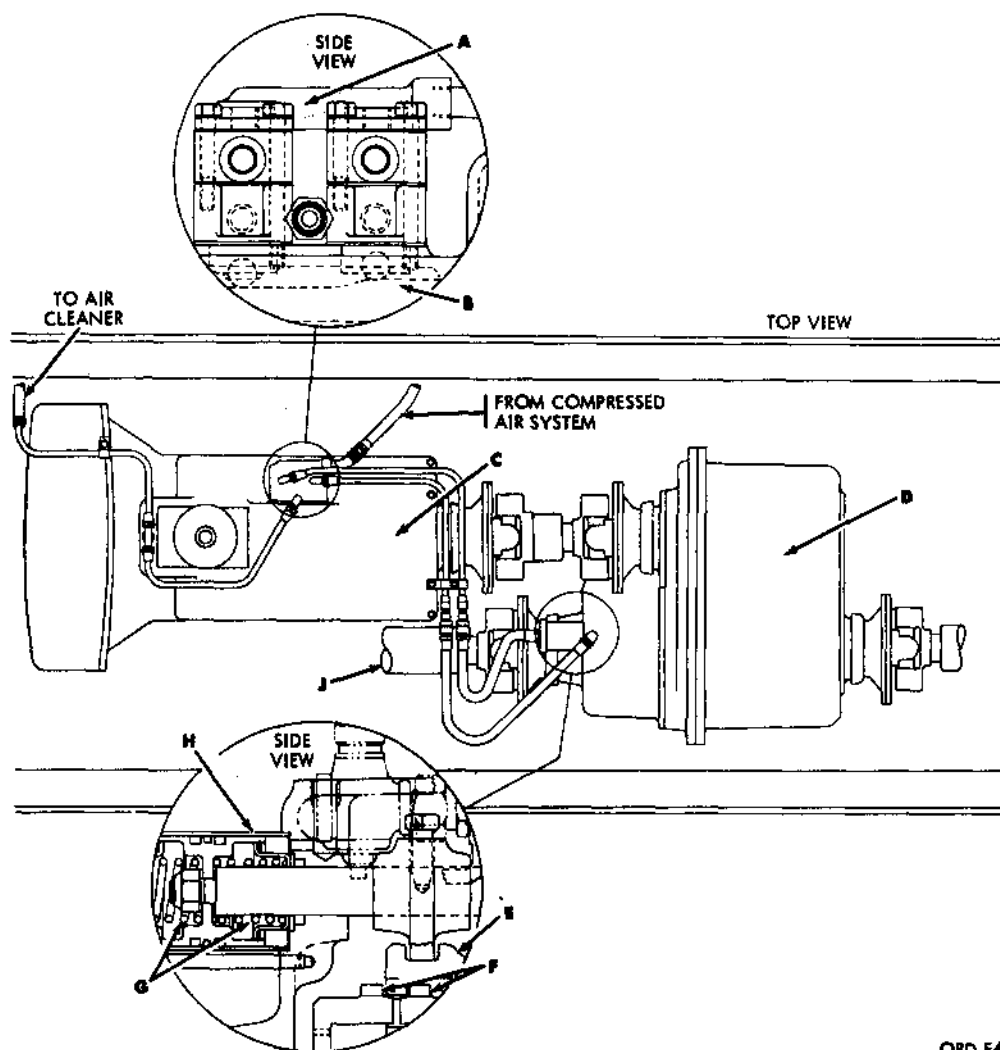


Figure 192. Transfer power flow diagram



ORD E46952

Figure 193. Front axle engagement air control diagram

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Air cylinder control valve	F	Sprag unit assy
B	Reverse shift rail	G	Balanced spring loading
C	Transmission	H	Shift air cylinder assy
D	Transfer	J	Front output shaft
E	Reverse shift collar		

Figure 193. Front axle engagement air control diagram - legend

Section II. TROUBLESHOOTING

142. General

This section contains inspection and troubleshooting procedures to be performed while a disabled component is still mounted in the vehicle and after it has been removed.

143. Operating Characteristics

a. General.

- (1) The following operation characteristics are given to enable the mechanic to distinguish between normal and abnormal functioning of the transfer.
- (2) The transfer is a two-speed unit with gearing designed to drive front axle at lower revolutions-per-minute than the rear axles. Overrunning sprag unit on drive to front axle automatically eliminates delivery of power to the front axle during normal operation.

b. Operations. Driver control of the transfer is by shift lever, in the cab, for high or low range. An air valve assembly, operated from transmission low and reverse shifter shaft, automatically shifts declutch unit (air operated) into forward or reverse position as selected by transmission lever.

144. Troubleshooting Before Removal or Operation

a. General. Do not operate the vehicle prior to completing procedures given in this paragraph.

b. Inspect for Lubricant Leakage. Visually inspect all gasket joints, oil seals, and plugs (refer to figs. 230 and 231) for evidence of lubricant leakage. Leakage at gasket joints may be caused by loose mounting bolts or defective gaskets. Tighten all mounting bolts and plugs where leakage has occurred. If mounting bolts are tight and leakage continues, install new gaskets. Install new gaskets without removing transfer, when possible.

c. Inspect for Water in Transfer. Inspect for water in transfer by removing drain plug and noting if water flows from the opening. If there is water, drain and refill transfer (LO 9-2320-211-12). If no water is evident, install drain plug promptly to prevent further loss of lubricant.

145. Troubleshooting Before Removal and During Operation

a. General. If the inspections in the preceding paragraph do not reveal causes of failure and the vehicle is operable, then troubleshoot it.

Caution: Check lubricant level in transfer before attempting to operate vehicle.

b. Troubleshooting Table. The troubleshooting procedure is arranged in tabular form in table VIII.

146. Troubleshooting After Removal and Before Operation

a. General After the component has been removed from the truck or if it has been received already removed, further inspection is necessary. If the transfer alone has been received for a preliminary check before being installed in the vehicle or if the operation of tie transfer has not been satisfactory due to unknown causes, then test it as described below.

b. Inspection. Visually inspect the transfer for lubricant leakage and cracked or damaged case or covers.

c. Transfer Shift Test.

- (1) With transfer shifter shaft in either low or high range, turn input shaft by hand. Observe if rear output shaft and brakedrum revolve. If rear output shaft and brakedrum do not revolve, disassemble transfer (pars. 155 through 156) and replace worn or damaged gears (par. 161).
- (2) With transfer shifter shaft in either low or high range, turn input shaft by hand. Front output shaft should not revolve. If front output shaft revolves, remove front output shaft case assembly (par. 156b) and check shifter shaft centering springs and shifter fork for looseness on the shaft and replace worn or broken parts.
- (3) With transfer in either high or low range, use air under pressure to shift sprag assembly to reverse position.

Table VIII. Troubleshooting - Transfer

Malfunction	Probable causes	Corrective action
1. Transfer slips out of gear.	<u>a.</u> Shifter fork loose on shifter shaft. <u>b.</u> Shifter shaft poppet ball notches worn. <u>c.</u> Gear teeth worn.	<u>a.</u> Remove top cover (fig. 222) and tighten setscrew (fig. 225). <u>b.</u> Disassemble transfer (pars. 155 and 156) and install new shifter shaft (fig. 232). <u>c.</u> Disassemble transfer (pars. 155 and 156) and replace worn gears (par. 161).
2. Transfer will not shift.	Defective gear synchronizer.	Disassemble transfer (pars. 155 and 156) and replace gear synchronizer (M, fig. 229).
3. Front wheels do not drive when rear wheels lose traction.	Defective sprag units.	Remove transfer front output shaft case assembly (par. 156 and replace sprag units and other excessively worn parts.
4. Front wheels do not drive in reverse.	Defective sprag units.	Disassemble transfer (pars. 155 and 156) and replace sprag units and worn or damaged gears.

Turn input shaft by hand. Observe if front output shaft revolves. If output shaft does not revolve, remove front output shaft case assembly and replace worn or damaged components.

d. Sprag Unit Test. The sprag unit assembly is air operated and shifting is controlled by a control valve on transmission. Attach airlines

to shift cylinder and follow test procedure outlined in (3) above. Without air pressure application to shift cylinder, the front drive shaft should turn freely. This is due to action of opposed springs designed to keep shifter shaft in neutral if the air supply is shut off. Refer to paragraph 140 for operation of air shift system.

Section III. REMOVAL AND INSTALLATION

147. Removal (All Models Except M51, M51A2, M62 and M246)

a. Remove right front wheel and tire assembly from front axle (TM 9-2320-211-20).

b. Remove tailpipe (TM 9-2320-211-20).

c. Remove four cap screws securing slip yoke (fig. 194) at front end of transfer-to-for-

ward-rear-axle propeller shaft to universal-joint journal, and remove yoke from journal.

Warning: Before removing cap screws from slip yoke, raise the wheels on one side of both rear axles to relieve torsional strains.

d. Secure front end of propeller shaft to frame left side rail to avoid interference when removing transfer.



Figure 194. Universal joint and handbrake mechanism at rear of transfer

e. Remove 12 cap screws securing cab floor tunnel to cab floor, and remove tunnel.

f. Disconnect transmission-to-transfer propeller shaft from transfer-input-shaft companion flange (fig. 195), refer to paragraph 160).

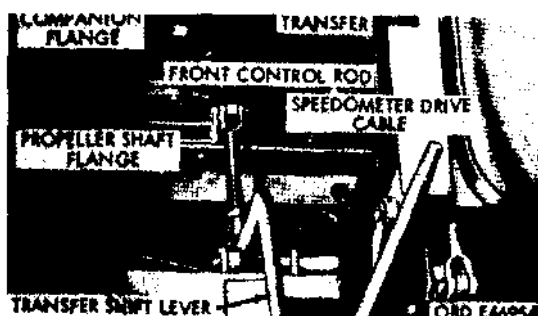


Figure 195. Top view of transfer front end from inside of cab

g. Remove cotter pin from end of control-rod-yoke pin (fig. 196), remove yoke pin, and remove control rod from shifter shaft.

h. Unscrew connector securing speedometer flexible shaft to sending unit on front of transfer, and pull shaft from sending unit.

i. Unscrew connectors at junction of rigid and flexible air shift lines and disconnect lines.

Note. Place identification tags on air shift lines to facilitate assembly.

j. Disconnect transfer-to-front-axle propeller shaft at front-output-shaft companion flange (par.160). Secure rear end of propeller shaft to frame left side rail.

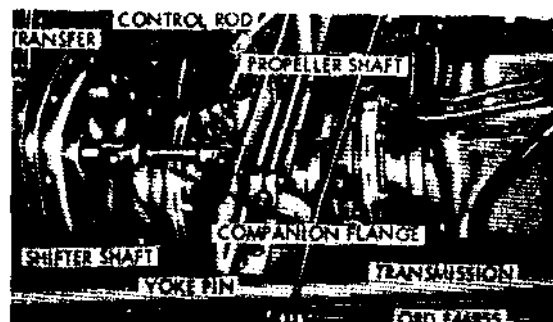


Figure 196. Transmission-to-transfer propeller shaft and shift linkage

k. Unhook retracting spring from brake-shoe lever (fig. 194) at rear of transfer. Remove adjusting nut and locknut from hand-brake cable, and remove cable from brake-shoe lever.

l. Position hydraulic jack with transfer fixture under transfer, and raise jack until weight of transfer is just supported by jack (fig. 197).

m. Remove three cap screws securing transfer to right mounting bracket (fig. 197), and remove four cap screws securing transfer to left mounting bracket.

n. Lower jack to permit removal of transfer from underneath truck (fig. 198).

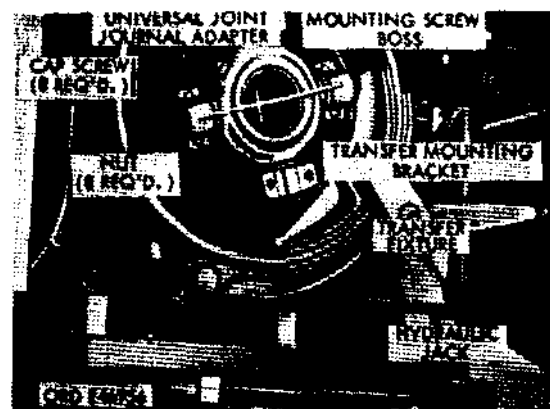


Figure 197. Supporting transfer with hydraulic jack

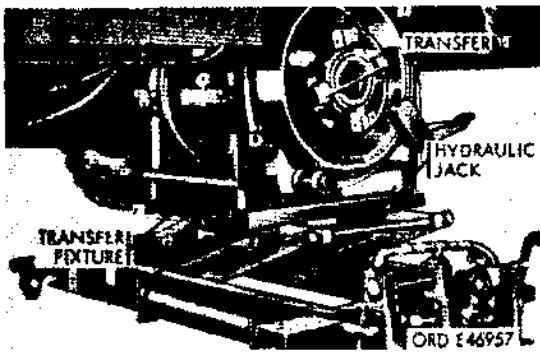


Figure 198. Lowering transfer on hydraulic jack

o. Turn hydraulic jack until right side of transfer is parallel to forward rear axle (fig. 199), and pull jack and transfer from under right side of truck.

p. Remove eight nuts (fig. 197) and washers from cap screws securing universal-joint journal adapter to rear-output-shaft companion flange, and remove adapter from flange.

148. Installation (All Models Except M51, M51A2, M62, and M246)

a. Position universal-joint journal adapter (fig. 197) on cap screws at rear-output-shaft companion flange, install eight nuts and washers on cap screws, and tighten nuts. With transfer supported in lowered position on hydraulic jack, push jack and transfer under right side of truck immediately forward of and parallel to forward rear axle (fig. 199).

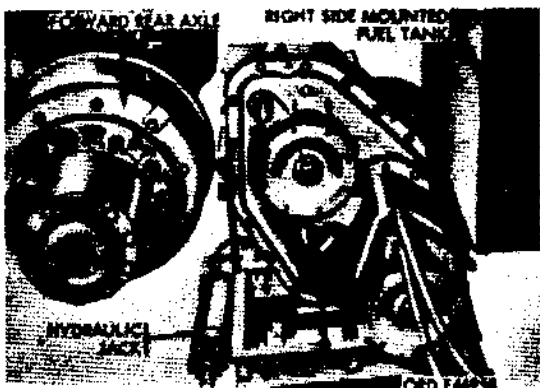


Figure 199. Pulling transfer from under right side of truck

b. Turn jack until front of transfer is toward front of truck, raise jack, and align mounting screw bosses (fig. 197) on left and right sides of transfer case with left and right transfer mounting brackets.

c. Install three cap screws in holes in right mounting bracket and mounting screw boss, and install four cap screws in holes in left mounting bracket and mounting screw boss. Tighten cap screws. Lower jack and remove from underneath truck.

d. Hook end of retracting spring (fig. 194) in eye provided on brakeshoe lever. Insert end of handbrake cable in hole at upper end of brakeshoe lever, and install adjusting nut on end of cable. Adjust handbrake and install locknut on end of cable.

e. Position slip yoke (fig. 194) on front end of transfer-to-forward-rear-axle propeller shaft at universal-joint journal, and install four cap screws in holes in slip yoke and journal bearings.

f. Position flange on rear end of transfer-to-front-axle propeller shaft at companion flange on front output shaft, and install eight bolts and self-locking nuts. Tighten nuts. Connect flexible air shift lines attached to left front of transfer to rigid air shift lines at top rear of transmission. Tighten connectors.

g. Insert end of speedometer flexible shaft in sending unit on front of transfer, making sure that key on end of shaft is aligned with keyway in sending unit, and tighten connector.

h. Position control rod yoke on front end of shifter shaft (fig. 196), and secure with yoke pin and cotter pin.

i. Adjust transfer shift linkage as in j through n below.

j. Remove cotter pin and yoke pin securing front control rod (fig. 195) to transfer shift lever.

k. Move transfer shifter shaft (fig. 196) toward the rear of the vehicle as far as it will go.

l. Place the transfer shift lever (fig. 195) in the HIGH RANGE.

m. If the front control rod yoke can be attached to the transfer shift lever without moving either the control rod or lever, proceed as in n below. Otherwise, loosen the locknut on the control rod, and turn yoke on the rod until the yoke can be attached to the shift lever.

n. Position the front control rod yoke on the shift lever, install the yoke pin, and secure with cotter pin. Tighten the locknut on the control rod against the yoke.

o. Connect transmission-to-transfer propeller shaft to transfer-input-shaft companion flange (fig. 195).

p. Position cab floor tunnel over opening in cab floor, and install 12 cap screws. Tighten screws.

q. Install tailpipe (TM 9-2320-211-20).

r. Install right front wheel and tire assembly on front axle (TM 9-2320-211-20).

s. Lower rear wheels.

149. Removal (Dump Truck M51, M51A2 Only)

a. Perform a, b, and c, paragraph 147.

b. Remove power-takeoff-to-hydraulic-hoist-pump propeller shaft. (Refer to TM 9-2320-211-20.)

c. Perform d through p, paragraph 147.

150. Installation (Dump Truck M51, M51A2 Only)

a. Perform a through d, paragraph 148.

b. Install power-takeoff-to-hydraulic-hoist-pump propeller shaft. (Refer to TM 9-2320-211-20.)

c. Perform e through q, paragraph 148.

151. Removal (Medium Wrecker Truck M62 Only)

a. Perform a, b, and c, paragraph 147.

b. Disconnect power-takeoff-to-power-divider propeller shaft at universal-joint yoke on power takeoff. (Refer to TM 9-2320-211-20.)

c. Perform d through o, paragraph 147.

d. Remove power takeoff. (Refer to TM 9-2320-211-20.)

152. Installation (Medium Wrecker Truck M62 Only)

a. Install power takeoff. (Refer to TM 9-2320-211-20.)

b. Perform a through c, paragraph 148.

c. Connect power-takeoff-to-power-divider propeller shaft at universal-joint yoke on power takeoff. (Refer to TM 9-2320-211-20.)

d. Perform d through p, paragraph 148.

153. Removal (Tractor Wrecker Truck M246 Only)

Note. The key letters noted in parentheses are in figure 200.

a. Perform a, b, and c, paragraph 147.

b. Unscrew connector securing governor-valve-to-control-valve line (J), to elbow installed in outlet port of governor valve (G). Remove the line from the governor valve.

c. Unscrew connector securing carburetor-to-governor-valve line (K), to inlet port of governor valve (G). Remove the line from the governor valve.

d. Remove cotter pin and yoke pin (Q) securing governor-valve-control-valve control rod (P) to the power takeoff shift lever (R). Remove the control rod from the shift lever.

e. Remove cotter pin and yoke pin (A) securing power takeoff rear control rod (B) to power takeoff shift lever (R). Remove the control rod from the shift lever.

f. Disconnect power-takeoff-to-hydraulic-pump propeller shaft at transfer. (Refer to TM 9-2320-211-20.)

g. Perform d through p, paragraph 147.

h. Remove power takeoff. (Refer to TM 9-2320-211-20.)

154. Installation (Tractor Wrecker Truck
M246 Only)

Note. The key letters noted in parentheses are in figure 154 unless otherwise indicated.

a. Install power takeoff. (Refer to TM 9-2920-211-20.)

b. Perform a through c paragraph 148.

c. Connect power-takeoff-to-hydraulic-pump propeller shaft at transfer. (Refer to TM 9-2320-211-20.)

d. Adjust and connect power takeoff rear control rod (B) (1) through (4) below.

- (1) Pull power takeoff control lever (fig. 200) up and back as far as it will go.
- (2) Move the power takeoff shift lever (R) forward as far as it will go.
- (3) If the rear-control rod yoke can be attached to the shift lever without moving either the rod or the lever, proceed as in (4) below. Otherwise, loosen the locknut on the rear control rod (B) and turn the yoke on the rod until the yoke can be attached to the shift lever.
- (4) Position the control rod yoke on the shift lever, install the yoke pin (A), and secure with cotter pin. Tighten the locknut against the rear control rod yoke.

e. Adjust and connect the control-valve control rod (P) (1), (2), and (3) below.

- (1) With power takeoff shift lever (R) in its extreme forward position, move the governor-valve control valve lever (N) forward as far as it will go.
- (2) If the control-valve control rod (P) can be attached to the shift lever (R) without moving either the rod or lever, proceed as in (3) below. Otherwise, loosen the locknut on the control rod and turn the yoke on the control rod until the yoke can be attached to shift lever.
- (3) Position the control rod yoke on the shift lever, install the yoke pin (Q), and

secure with cotter pin. Tighten the locknut against the control rod yoke.

f. Position carburetor-to-governor-valve line (K) at inlet port on side of governor valve (G), and tighten connector.

g. Position governor-valve-to-control-valve line (J) at elbow installed in governor valve outlet port, and tighten connector.

h. Perform d through o. paragraph 148.

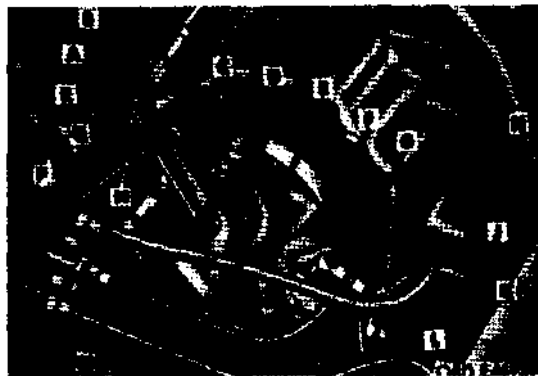


Figure 200. Power takeoff mounted on transfer - M246 only

Key	Item
A	Yoke pin
B	Rear control rod
C	Lubricant line
D	Power takeoff
E	Hex-head nut
F	Cap screw
G	Governor valve
H	Transfer
J	Governor-valve-to-control-valve line
K	Carburetor-to-governor-valve line
L	Governor-valve-to-control-valve line
M	Control-valve-to-governor line
N	Governor-valve control valve lever
P	Control-valve control valve
Q	Yoke pin
R	Shift lever

Figure 200. Power takeoff mounted on transfer - M246 only - legend

Section IV. DISASSEMBLY INTO AND ASSEMBLY FROM SUBASSEMBLIES

155. Preparation of Transfer for Disassembly

Inspect unit thoroughly for oil leaks around all drive shafts, the shift shaft, and the shift air cylinder assembly. Drain lubricant. Clean outside of case with mineral spirits paint thinner or dry cleaning solvent to remove all lubricant or foreign material. Mount transfer case in a suitable stand for ease of disassembly operations. Solvent containers should be provided to clean all disassembled parts. Clean rags and compressed air should also be available, particularly for inspection and assembly.

156. Disassembly

a. Removal of Parking Brake Assembly.

- (1) General. The parking brake is mounted on the transfer and must be removed prior to any further disassembly of the transfer. However, be sure to use the parking brake to hold shafts from turning while loosening the three companion flange retaining nuts.

(2) Disassembly.

- (a) Disconnect brakeshoe retracting spring from outer end of shoe stop screw (fig. 201).
- (b) Remove locknut and unscrew hex-head bolt, which is threaded into



Figure 201. Removing brakeshoe retracting spring

bracket, mounted integrally with rear output shaft rear bearing cover (fig. 202).

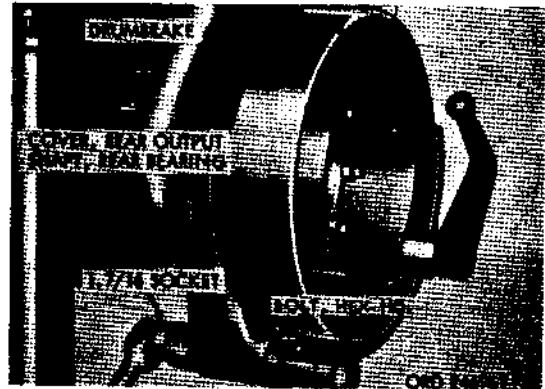


Figure 202. Removing parking brake anchor bolt

- (c) Operate brakeshoe lever sufficiently to free outer brakeshoe with lining assembly from bracket, and pull the brakeshoe lever (fig. 203) and shoe assembly away from the brakedrum.
- (3) Remove rear output shaft companion flange.
 - (a) Remove flange retaining nut from rear output shaft.

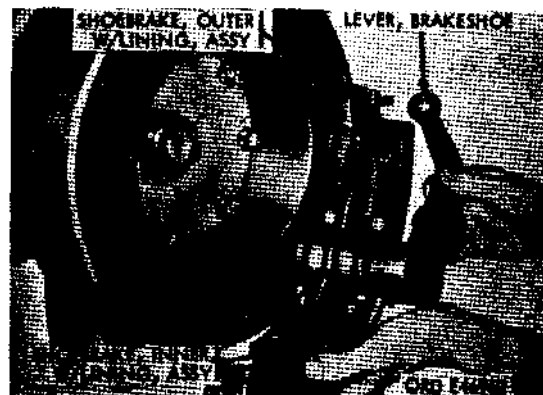


Figure 203. Parking brakeshoe lever and shoe assembly removed

- (b) Using suitable puller or lead hammer, remove flange, brakeshoe oil slinger (fig. 200), and brakedrum from rear output shaft.

b. Removal of Front Output Shaft Case Assembly.

- (1) In order to provide clearance for the removal of the front output shaft and case assembly, the input shaft companion flange (fig. 204) must first be removed. Unscrew slotted nut and remove companion flange with suitable puller.



Figure 204. Removing input shaft companion flange

- (2) Revolve transfer in mounting stand so that front output shaft case assembly (fig. 205) is on top, and remove the ten cap screws used for mounting front output shaft case assembly to transfer.

- (3) Insert two of these same cap screws in the threaded puller holes provided for removing the front output shaft case. Turn down puller screws (fig. 206) un-

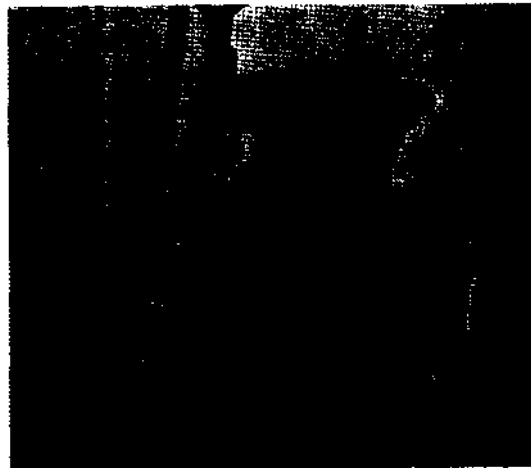


Figure 205. Loosening front output shaft case assembly from transfer



Figure 206. Lifting front output shaft case assembly from transfer

til front output shaft case assembly is raised off transfer case cover and dowels.

- (4) Using chain hoist or similar means, lift off front output shaft case assembly (fig. 205). Discard gasket.

c. Removal of Air Control System.

- (1) Shift air cylinder control valve. Remove shift air cylinder control valve (par. 159(3)).

- (2) Shift air cylinder assembly.

(a) Remove cylinder end cover (fig. 207).

(b) Remove cylinder tube and cylinder piston (fig. 207), using 5/8-inch straight socket wrench.

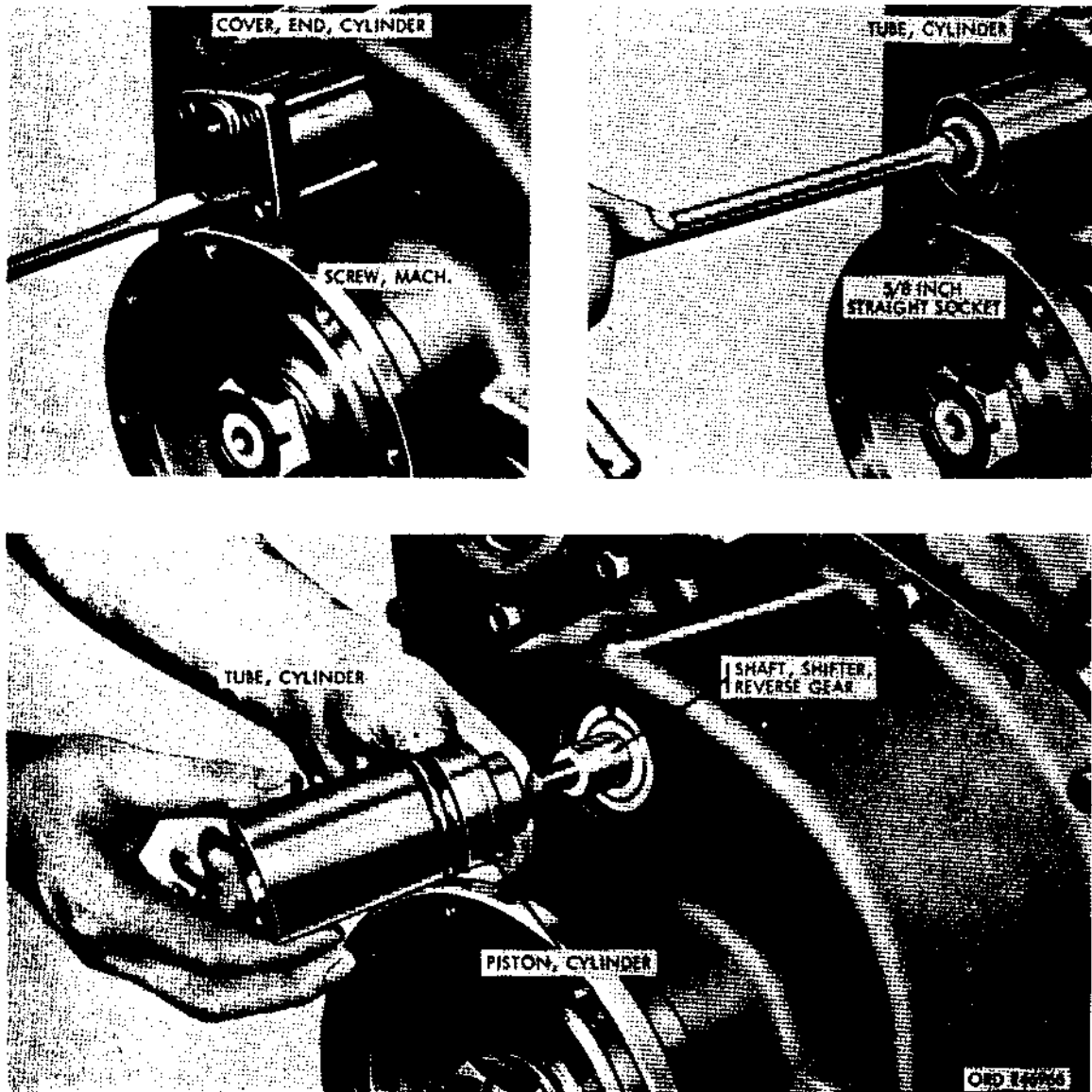


Figure 207. Removing shift air cylinder assembly

d. Removal of Transfer Shift Lever Linkage.

- (1) General. It will be unnecessary to disassemble shift lever linkage unless inspection indicates shift lever, adjustable yoke, link rods, or cross shaft must be replaced. If replacement of any of these parts is necessary, disassemble (see 2 and 3 below).
- (2) Hand lever removal. Hand lever is pivoted in a bracket immediately below the cab. Remove cotter pins, take out the clevis pin from the adjustable yoke, the pivot pin from the hand lever mounting bracket, and lift out hand control lever.
- (3) Disassemble linkage. Remove cotter pins from clevis pins in the relay lever to transfer control rod (fig. 207) and the hand control lever to relay lever rod. Remove clevis pins and control rods. Loosen cap screws and nuts from relay levers and slide relay levers from relay lever shaft. Remove relay lever shaft.

157. Assembly

a. Installation of Front Output Shaft Case Assembly. Use new front output shaft-case-to-transfer-case gasket (M, fig. 230) and align front output shaft case assembly to front cover (F, fig. 230). Tap cover into place with soft hammer and install ten cap screws (R, fig. 230) and lockwashers (S, fig. 230). Tighten down with 20 to 25 lb.-ft. torque.

b. Installation of Parking Brakedrum and Shoe Assembly.

- (1) General. The following procedures cover parking brake and drum installation only. For rebuild information, refer to paragraph 158. Since disassembly of the drum from the companion flange was unnecessary at time of the removal, it is now only necessary to install the brakedrum (J, fig. 231), rear output shaft companion flange (L, fig. 231), and brakeshoe oil slinger (K, fig. 231) assembly on the rear output shaft. Install plain washer (M, fig. 231) and

slotted nut (N, fig. 231) on end of shaft and tighten nut firmly. Secure nut with cotter pin.

- (2) Install parking brakeshoe assembly. Position inner brakeshoe with lining assembly (Q, fig. 231) and outer brakeshoe with lining assembly (U, fig. 231) on drum, so that shoes are to right side when viewed from rear of transfer (fig. 190). Aline holes in lower end of outer shoe assembly with hole in rear output shaft rear bearing cover (G, fig. 231) for rear output shaft. Insert hex-head bolt (T, fig. 231) through outside flange of shoe assembly and screw into place in rear output shaft rear bearing cover. Tighten until slight bind is felt when brakeshoe lever (S, fig. 231) is operated; then back off one-half turn. Install jam nut (AA, fig. 231) to bolt. Hook brakeshoe retracting spring in hole in top end of outer shoe and place other end of spring over shoe stop screw (fig. 201).

c. Install Companion Flange Assemblies.

If companion flanges were disassembled, slide flange dust slingers on companion flanges and install companion flange assemblies to the input shaft and the front output shaft. Use companion flange replacer 5120-795-0147 to install flanges. Install plain washers and slotted nuts. Tighten nuts and secure with cotter pins.



Figure 208. Transfer shift lever linkage

Section V. REPAIR

158. Parking Brake Assembly

a. Disassembly. Disassembly of the parking brake was accomplished at time of removal from transfer. Further disassembly is not required unless inspection warrants replacement of the brakeshoe linings. For complete instructions on maintenance and repair of brakeshoes and linings, refer to TM 9-1827C.

b. Cleaning, Inspection, and Repair. Linings used on parking brakeshoes are similar to those used on service brakeshoes. Refer to TM 9-1827C for cleaning, inspection, and repair of the parking brake.

c. Assembly. The assembly of the parking brake is accomplished at time of assembly to the transfer.

159. Air Control System

a. Disassembly.

- (1) General. In order to determine whether or not the transfer air control system

requires repair, a thorough understanding of the principle of the front axle forward and reverse operation is necessary. This operation is covered in paragraph 140(2).

- (2) Shift air cylinder assembly. Complete disassembly of the shift air cylinder assembly (fig. 209) will not be necessary unless it is known to be defective. If rebuild is indicated, proceed as in (a) and (b) below.

(a) Piston removal. During the removal of the shift air cylinder assembly from the transfer, the cylinder piston and the cylinder tube (fig. 207) were removed together. Push piston out of tube.

(b) Disassemble piston. Remove snap ring retainers and springs from inside of piston. Remove neoprene seals from outside of piston.

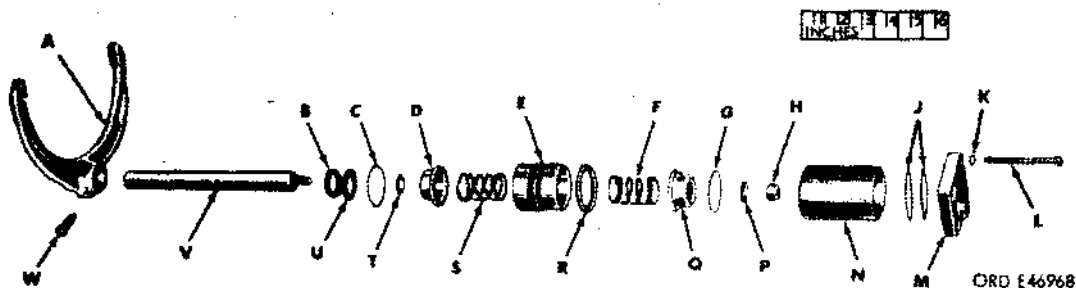


Figure 209. Shift air cylinder assembly - exploded view

Key	Item	Key	Item
A	Fork, shifter, reverse shift collar	M	Cover, end, cylinder
B	Seal, oil, reverse gear shifter shaft	N	Tube, cylinder
C	Ring, snap, piston spring retainer	P	Washer, plain
D	Retainer, piston spring	Q	Retainer, piston spring
E	Piston, cylinder	R	Seal, air cylinder piston
F	Spring, compression, piston	S	Spring, compression, piston
G	Ring, snap, piston spring retainer	T	Washer, plain
H	Nut, safety	U	Washer, reverse gear shifter shaft oil seal
J	Gasket, cylinder end cover	V	Shaft, shifter, reverse gear
K	Washer, lock, int-teeth	W	Screw, set, sq-hd
L	Screw, mach		

Figure 209. Shift air cylinder assembly - exploded view - legend

- (3) Shift air cylinder control valve. Complete disassembly of the shift air cylinder control valve will not be necessary unless it is known to be defective. If repairs are indicated, proceed as follows:

(a) Disassemble air inlet valve housing.

Directly opposite from each of the four mounting cap screws, are four hex-head cap screws (B, fig. 210). Remove cap screws.

- (b) Disassemble shift air cylinder control valve (fig. 210). The air inlet housing will be loosened from the two air inlet bodies when the cap screws ((a) above) are removed. The two bodies are identical in construction and disassembly procedures given here apply to both. If the outer body does not readily separate from the inner body, install cap screws ((a) above) halfway into the body section. Hold body section in hand with screw

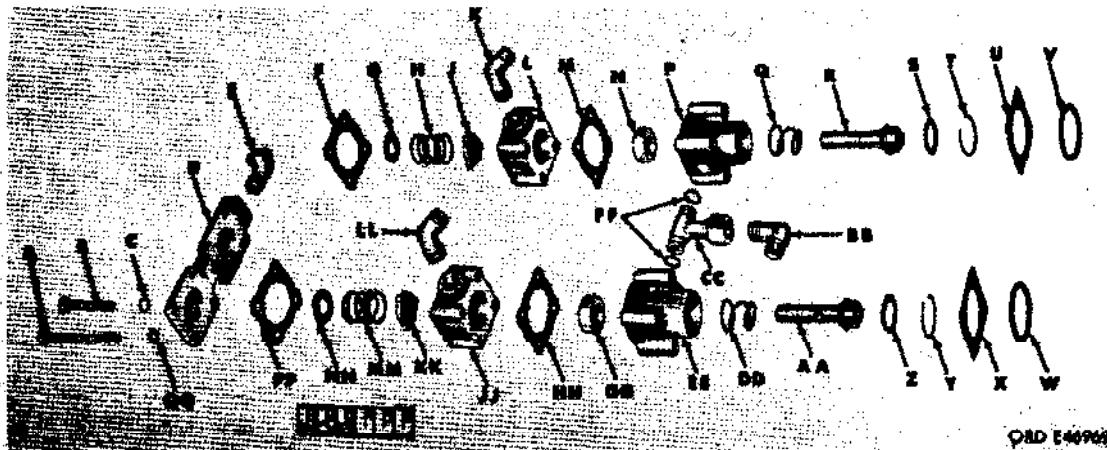


Figure 210. Shift air cylinder control valve - exploded view

Key	Item	Key	Item
A	Screw, cap	W	Gasket, O-ring, valve to transmission
B	Screw, cap	X	Plate, mounting
C	Washer, lock int-teeth	Y	Ring, snap, retaining washer
D	Housing, air inlet	Z	Washer, retaining, plunger spring
E	Elbow, street, 45 deg	AA	Plunger, valve
F	Gasket, housing to outer body	BB	Elbow, tube, 90 deg
G	Washer, plain	CC	Tee, air exhaust
H	Spring, compression, air inlet seal	DD	Spring, compression, plunger
J	Seal, air inlet	EE	Body, inner
K	Elbow, tube	FF	Gasket, O-ring, air exhaust tee
L	Body, outer	GG	Seal, air, plunger
M	Gasket, outer body to inner body	HH	Gasket, outer body to inner body
N	Seal, air plunger	JJ	Body, outer
P	Body, inner	KK	Seal, air inlet
Q	Spring, compression, plunger	LL	Elbow, tube, 90 deg
R	Plunger, valve	MM	Spring, compression air inlet seal
S	Washer, retaining, plunger spring	NN	Washer, plain
T	Ring, snap, retaining washer	PP	Gasket, housing to outer body
U	Plate, mounting	QQ	Washer, int teeth
V	Gasket, O-ring, valve to transmission		

Figure 210. Shift air cylinder control valve - exploded view - legend

heads down and strike screw heads against a flat wood surface. Separate outer body from inner body and discard outer body to inner body gasket.

- (c) Remove valve plunger. Press down on valve plunger and remove snap ring. Lift out plunger spring retaining washer, valve plunger, and plunger compression spring.
- (d) Remove plunger air seal. The removal of the plunger air seal will of necessity damage the seal; therefore, it should definitely be determined that seal is defective before removing. If defective, use remover and push plunger air seal from inner body.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Wash all parts in dry-cleaning solvent or mineral spirits paint thinner.
- (2) Inspection. Examine all parts for damage or wear. Look especially for dents in the cylinder tube, or cracks in the housing and body sections of the air cylinder control valve. Compare all compression springs with similar new ones to determine whether suitable for use or not. Seals of questionable value should be discarded.
- (3) Repair. There is no repair or adjustment to individual parts of either the shift air cylinder assembly or the air cylinder control valve. Any defective parts must be replaced.

c. Assembly.

- (1) General. Extreme care must be exercised in the assembly of all parts of the air control system. The following general rules will apply.
 - (a) Keep all parts clean during assembly. Protect from wind-blown dust. Keep hands free of dirt and grease while assembling valves and air cylinder.
 - (b) Apply general-purpose lubricating grease (CG) to plungers at assembly.
 - (c) New gaskets will be used, and oil seals, if removed, will be discarded

and replaced with new ones. Handle seals carefully while installing to avoid damage.

- (2) Assemble shift air cylinder assembly (fig. 209).

- (a) Assemble cylinder piston. If air cylinder piston seals (R) were removed from the cylinder piston (E), install air seals. Insert piston compression springs (F and S) and piston spring retainers (D and Q) into each end of piston, and secure with piston spring retainer snap rings (C and G).

- (b) Install air shift cylinder piston assembly to transfer. Position reverse gear shifter shaft oil seal washer (U) and plain washer (T) on end of reverse gear shifter shaft (V) and install assembly ((1) above) on shaft. Place plain washer (P) on shaft and secure piston assembly with safety nut (H).

- (c) Install shift air cylinder tube and end cover. Slide cylinder tube (N) onto piston assembly ((1) and (2) above), making sure that lips of air cylinder piston seals (R) on piston fully contact the inner surface of the cylinder tube. Place cylinder end cover gaskets (J) on cylinder end cover (M) and install cover on end of cylinder tube. Secure cover with four machine screws (L).

- (3) Assemble shift air cylinder control valve (fig. 210).

- (a) Install plunger air seal. If plunger (N and GG) were removed, install new seals with replacer into inner bodies (P and EE).

- (b) Assemble inner body. Insert plunger compression springs (Q and DD) into inner bodies (P and EE). Slide valve plungers (R and AA) into inner bodies and secure with plunger spring retaining washers (S and Z), and retaining washer snap rings (T and Y).

- (c) Assemble inner body, outer body, and air inlet housing. To complete air cylinder control valve assembly, install new outer body to inner body gasket (HH) between outer body (JJ)

and inner body assembly ((b) above). Position air inlet seal (KK), compression air inlet seal spring (MM), plain washer (NN), and new housing to outer body gasket (PP) between outer body (JJ) and air inlet housing (D). Secure air inlet housing to body sections with two cap screws (B). Slide air exhaust tee O-ring gasket (FF), one for each end, onto air exhaust tee (CC) and combine other inner body (P) to the inner and outer body sections and housing already assembled. Position new outer body to inner body gasket (M), outer body (L), air inlet seal (J), air inlet seal compression spring (H), plain washer (G), and new housing to outer body gasket (F) and secure in place with two cap screws (B).

160. Front Output Shaft Case Assembly

a. Disassembly.

- (1) Use puller and remove output shaft companion flange (fig. 189).
- (2) Place front output shaft case assembly on arbor press and push front output shaft (fig. 211), races, and gears free of bearing in front output shaft case. During this operation, the reverse gear

shifter shaft and reverse shift collar shifter fork will likewise be removed from the case. Remove the screw securing the shifter fork to the shifter shaft and separate them.

- (3) Align gear teeth of both sprag units with similar teeth on the front output shaft driven gear and lift off reverse shift collar (fig. 212).
- (4) Disassemble sprag unit from front output shaft in the following order.
 - (a) Remove sprag unit outer race snap ring and lift off front half of the sprag unit outer race (fig. 213). Use sprag unit retaining washer to prevent sprags from falling out, and turn assembly to left while withdrawing.
 - (b) Remove rear half of the sprag unit outer race (fig. 214) again using sprag unit retaining washer to hold sprags. Turn this assembly to right as it is withdrawn.
 - (c) To remove sprag unit inner race, place remainder of unit in arbor press and press shaft free of inner race and front output shaft driven gear (fig. 214). Remove Woodruff key.

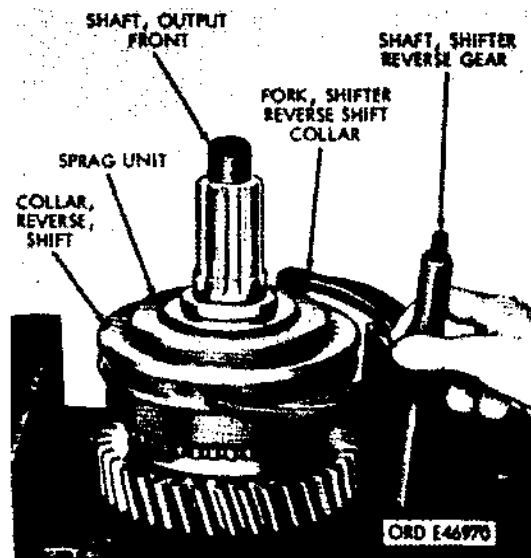
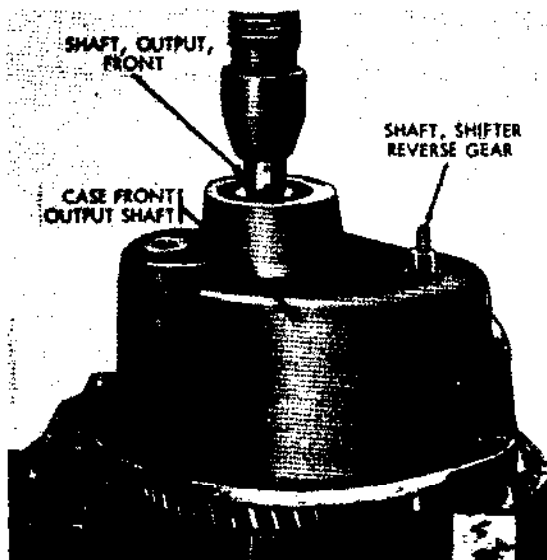


Figure 211. Disassembly of front output shaft case assembly

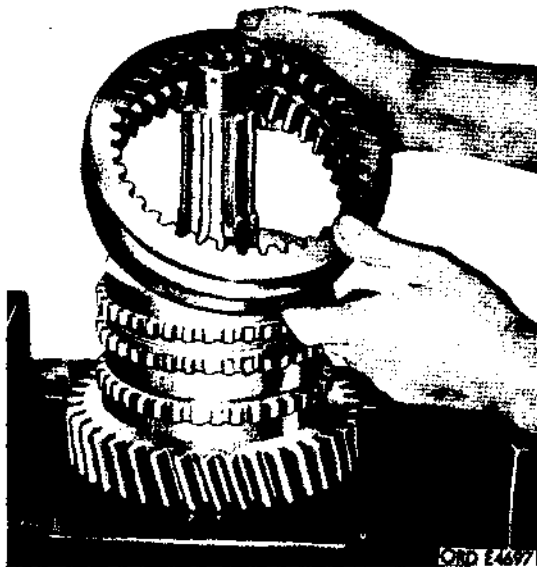


Figure 212. Removing reverse shift collar

- (5) The sprag unit outer race (fig. 213) is only partially disassembled during the removal from the transfer. If complete disassembly of the halves of the outer race is necessary or desired, each half contains 41 sprags and 2 energizing springs which must be removed. The sprag referred to in figure

192 is a small blocklike part having a notch at each end to receive the energizing springs. One face of the sprag is pointed or "V"-shaped and bears against the flat face of the sprag located immediately ahead when installed in the sprag unit outer race. The contour or shape of each sprag permits a rocking motion within the sprag unit which in turn locks or releases the sprag unit inner race to the sprag unit outer race. A free turning unit is in effect in one direction, while the unit is locked and turns as a complete unit in another direction. It will not be necessary to remove all 41 sprags and 2 energizing springs from each half of the sprag unit outer race, unless inspection indicates that replacement is necessary. If the sprags should accidentally fall out during the removal of the unit, clean all parts thoroughly and reassemble the unit at once to reduce the possibility of losing any of the sprags. Place one-half of the sprag unit outer race on a flat surface so that the open end will be up. Position one energizing spring in bottom of race and insert sprags. When placing sprags into race, make sure the energizing spring fits into notch in ends of sprags and that the pointed sides face in a clockwise direction around the race. Note also that one side of notch end is

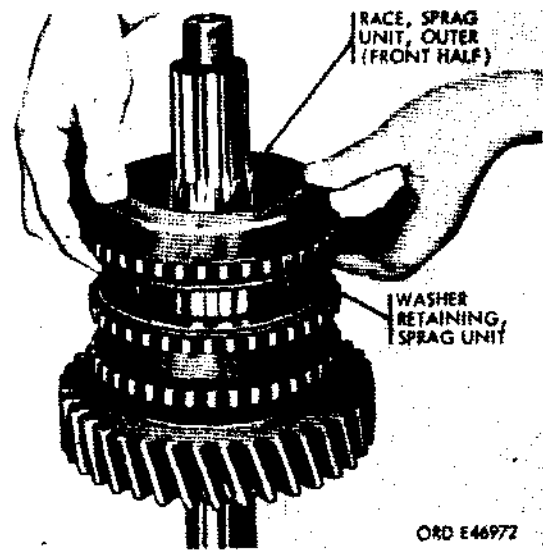
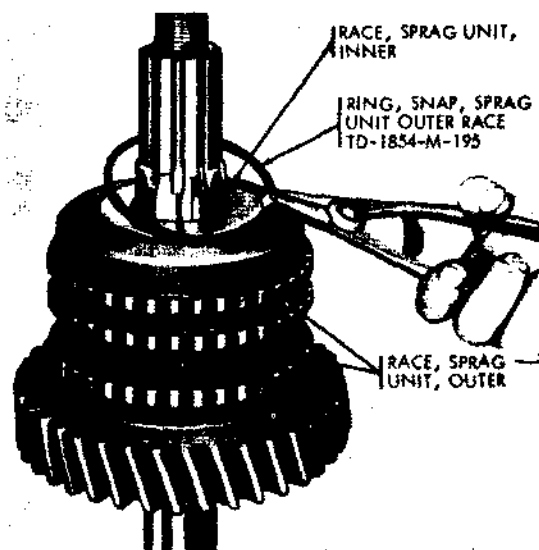


Figure 213. Removing front half of sprag unit outer race

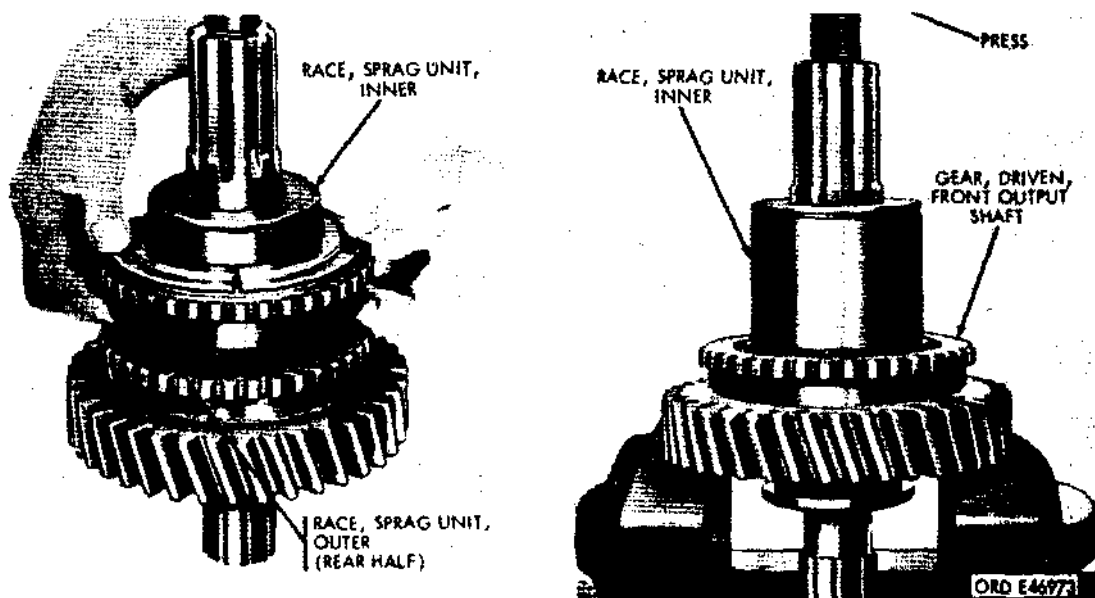


Figure 214. Completion of sprag unit disassembly

undercut slightly deeper and this undercut side must be installed away from center. The correct positioning of the sprags is also imprinted on the face of the outer race. When all 41 sprags are in place, insert outer energizing spring into exposed ends of sprags. Gently work slack of spring into groove until all of spring is in place to hold sprags in position. Make sure all sprags are in position and not cocked or twisted. Since both halves of the sprag unit outer race are identical, both will be assembled in the same manner.

b. Cleaning, Inspection, and Repair. Refer to paragraph 161b. for general cleaning, inspection, and repair of the transfer assembly components.

c. Assembly.

- (1) Install front output shaft ball bearing. If front output shaft ball bearing (NN, fig. 229) was removed from front output shaft case (N, fig. 230), insert front output shaft bearing front snap ring (PP, fig. 229) from outside of case into lower groove of shaft opening. Press front output shaft ball bearing (NN, fig. 229) into opening until it is

flush against snap ring. Insert front output shaft bearing rear snap ring (MM, fig. 229) in upper groove of shaft opening.

- (2) Install oil seals. If oil seals were removed from the front output shaft case, installation is as follows:
 - (a) Front output shaft oil seal. Use replacer 7950152 and install front output shaft oil seal (P, fig. 230).
 - (b) Gear shifter shaft oil seal. Use wooden block or other suitable adapter and tap gear shifter shaft oil seal C, fig. 232) into front output shaft case.
- (3) Install front output shaft driven gear. Coat bore of front output shaft driven gear (HH, fig. 229) with white lead and install on front output shaft (FF, fig. 229).
- (4) Install sprag unit assembly.
 - (a) Inner race. Insert Woodruff key (GG, fig. 229) into groove in front output shaft (FF, fig. 229) and install sprag unit inner race (fig. 214) onto shaft.

if lower snap ring has been removed, install new snap ring in groove on sprag unit inner race.

Note. If difficulty is encountered when installing outer race onto inner race, check the alinement of the sprags within the outer race. One sprag out of place will prevent assembly. Refer to a(5) above for correct assembly.

(b) Outer races (fig. 213). Using the sprag unit retaining washer to hold individual sprags in place, install the rear half of the sprag unit outer race. Turn assembly to right as it is shipped onto inner race. Remove the sprag unit retaining washer and place on the open end of front half of the sprag unit outer race. This will retain individual sprags as the assembly is turned over for installing to shaft. Turn assembly to left while sliding onto inner race. Install new sprag unit outer race snap ring. Slide front output shaft bearing inner spacing washer (LL, fig. 229) over end of shaft.

(5) Install reverse shift collar. Aline gear teeth on both front and rear outer races of the sprag unit (KK, fig. 229) with similar teeth on the front output shaft driven gear (HH, fig. 229), and slide reverse shift collar (JJ, fig. 229) over

the sprag unit (KK, fig. 229) on the front output shaft (FF, fig. 229).

- (6) Install reverse shift collar shifter fork. Place reverse shift collar shifter fork (A, fig. 209) on reverse shift collar (JJ, fig. 229).
- (7) Install front output shaft and gear into front output shaft case. Insert splined end of front output shaft assembly through front output shaft ball bearing and oil seal in case. Now support cover with open end up and press shaft assembly into front output shaft ball bearing in case.
- (8) Install reverse gear shifter shaft. Insert reverse gear shifter shaft (V, fig. 209) through oil seal in front output shaft case from the outer side. Rotate shaft while inserting to avoid damage to seal. Slide shaft through hub of reverse shift collar shifter fork (A, fig. 209). Aline set screw hole in shaft with like hole in hub of fork and fasten solidly together with square head setscrew (W, fig. 209).

161. Transfer Case, Shafts, and Gears

a. Disassembly.

(1) Remove rear bearing covers.

- (a) Remove six cap screws and remove rear output shaft rear bearing cover (fig. 215). Take special care to protect shims on removal.

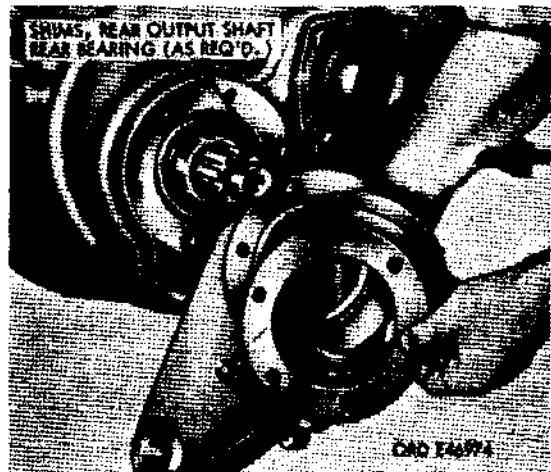


Figure 215. Removing rear output shaft bearing cover

- (b) Remove four cap screws and lift off intermediate shaft rear bearing cover (fig. 216) and shims. Note also that shoe stop screw bracket for parking brake will also be removed at this time.
 - (c) Remove six cap screws and lift off input shaft rear bearing cover (fig. 216) and gasket. Discard gasket.
- (2) Remove transfer front cover assembly.
- (a) Remove locking wire, cap screws, retaining washer (used also as speedometer drive plate), and intermediate shaft drive gear (fig. 214). Use suitable puller, if necessary, to remove gear.
 - (b) Remove five cap screws, input shaft front bearing cover with seal assembly, and gasket.
 - (c) Remove the 17 cap screws and nuts and the single cap screw (fig. 218) used for mounting front cover to case.
 - (d) Insert cap screws into three puller screw holes and free front cover (fig. 219) from dowels and case.



Figure 216. Removing intermediate and input shaft rear bearing covers



Figure 217. Preparing front cover for removal

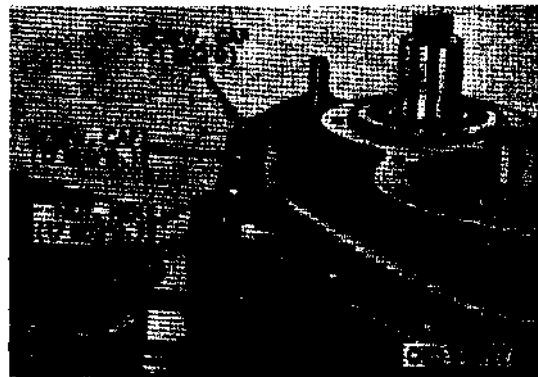


Figure 218. Removing cover mounting cap screws

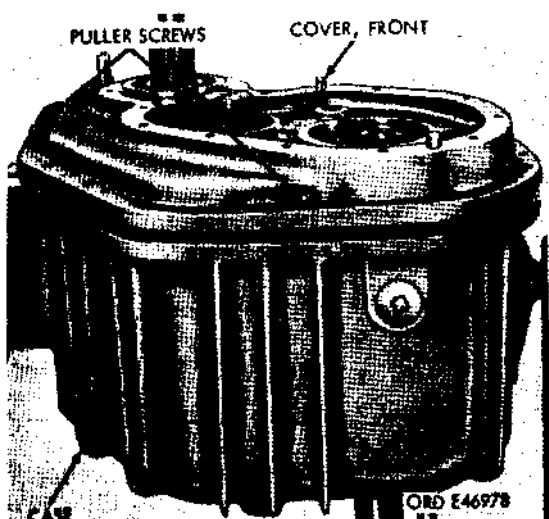


Figure 219. Using puller screws to raise front cover from case

- (e) Fasten chain hoist to cover and lift off from case. Tap lightly on end of input shaft (fig. 220) with lead hammer to free bearing from shaft, and use pry bar on cover to assist in removing. Discard gasket.

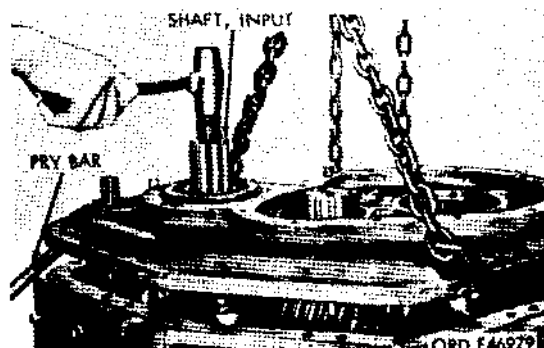


Figure 220. Lifting front cover from case

- (3) Remove rear output shaft and intermediate shaft (fig. 221).

- (a) Lift out rear output shaft.
(b) Lift out intermediate shaft.

- (4) Remove input shaft gear, shifter shaft, shifter fork, and input shaft assembly.

- (a) Remove the four top cover hex-head bolts (fig. 222).

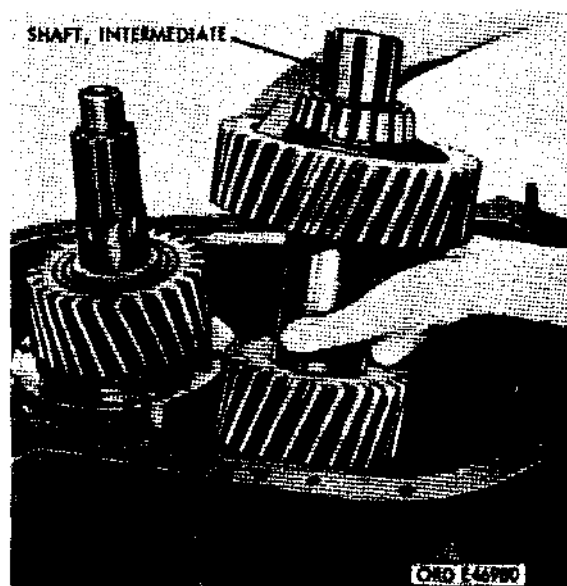
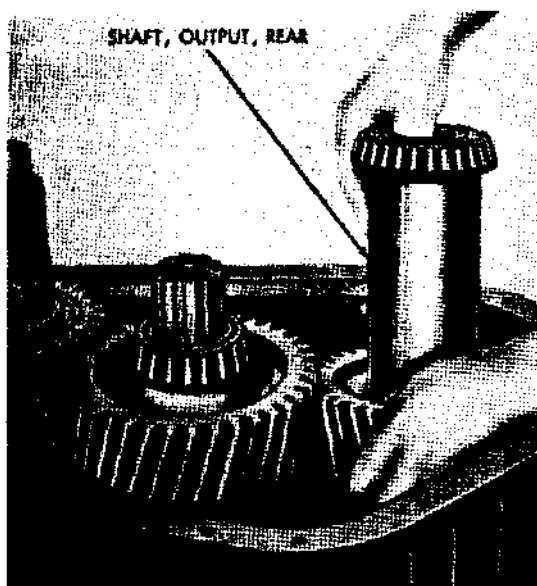


Figure 221. Rear output and intermediate shaft removal

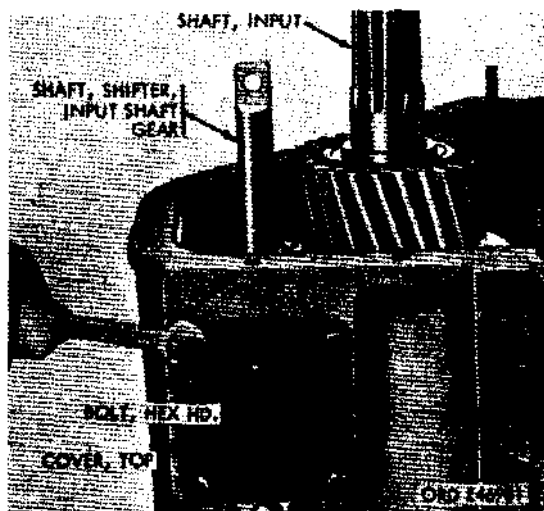


Figure 222. Removing top cover

- (b) Loosen shifter shaft poppet spring plunger screw (fig. 223).
- (c) Remove plunger screw, poppet ball compression spring, poppet ball plunger, and poppet ball (D, fig. 223 and fig. 232).
- (d) Remove headless setscrew and loosen high and low speed gear shifter fork

stop screw (fig. 224). The purpose of the stop screw is to center the shifter fork around the gear synchronizer. Turning setscrew away from shifter fork will provide clearance for removing input shaft assembly.

- (e) Sever locking wire and remove square head setscrew (fig. 225) which secures shifter fork to shifter shaft. This is necessary to provide clearance for input shaft removal.
- (f) Using two crowfoot bars, pry up on input shaft high-speed gear (fig. 226) so as to free bearing from case.
- (g) Grasp input shaft gear shifter shaft in one hand and high-speed gear with other and lift out of case.

Caution: Because of the heavy weight of the input shaft, bearings, gears, and synchronizer assembly, special care should be taken to prevent injury to any personnel performing this removal operation.

- (5) Disassembly of rear output shaft assembly. Unless inspection of the rear output shaft assembly reveals some defective parts, do not disassemble this unit. If disassembly is necessary, proceed as in (a) and (b) below.

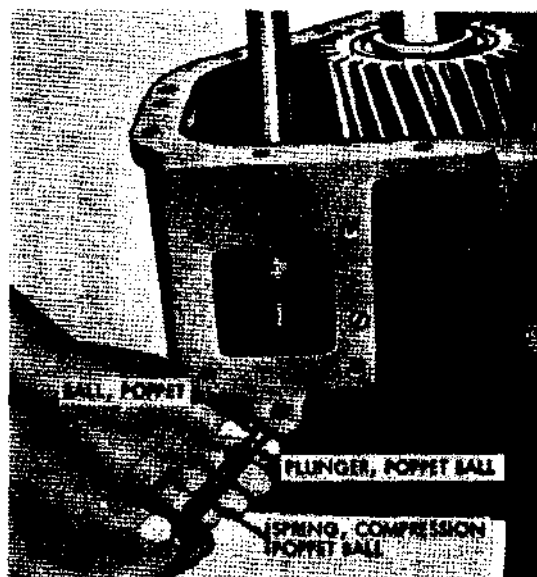
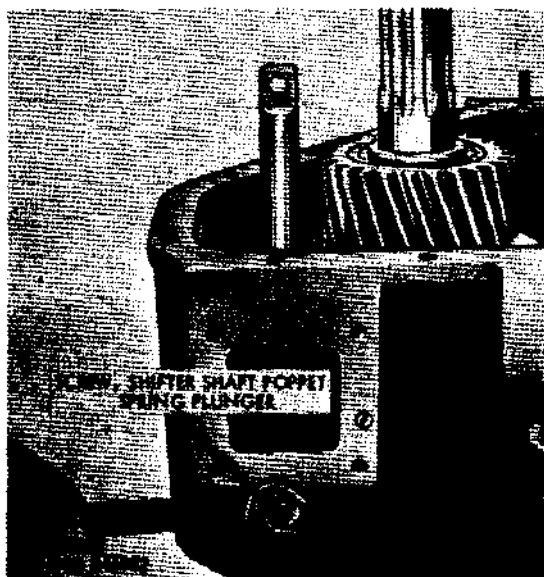


Figure 223. Removing shifter shaft poppet ball

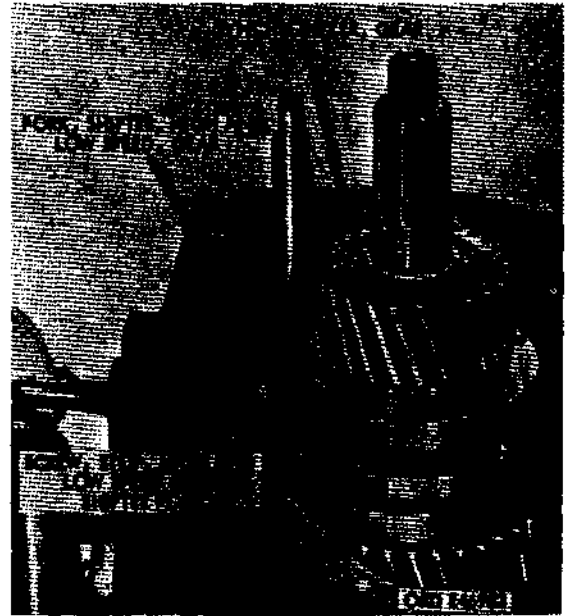


Figure 224. Removing headless setscrew and loosening stop screw

- (a) Remove front bearing cone. Place rear output shaft assembly in vise, and by using suitable puller together with special adapter 5120-795-0090, remove rear output shaft front bearing cone (fig. 227).

- (b) Remove rear bearing cone. Place rear output shaft assembly in arbor press with rear output shaft gear (Z, fig. 229) and rear output shaft rear bearing cone (Y, fig. 229) up. Press on end of shaft to free shaft from bearing cone gear and spacing washer. Remove Woodruff key (AA, fig. 229) from shaft.

- (6) Disassembly of intermediate shaft assembly. Unless inspection of the intermediate shaft assembly reveals some defective parts, do not disassemble this unit. If disassembly is necessary, proceed as outlined in (a) and (b) below.

- (a) Remove rear bearing retaining washer. Remove locking wire from cap screws in end of intermediate shaft and take out cap screws. Remove rear bearing retaining washer (AL, fig. 229) from intermediate shaft (AG, fig. 229).

- (b) Remove intermediate shaft high-speed gear and rear bearing cone. Place intermediate shaft assembly in arbor press so that intermediate



Figure 225. Shifter shaft locking wire removal

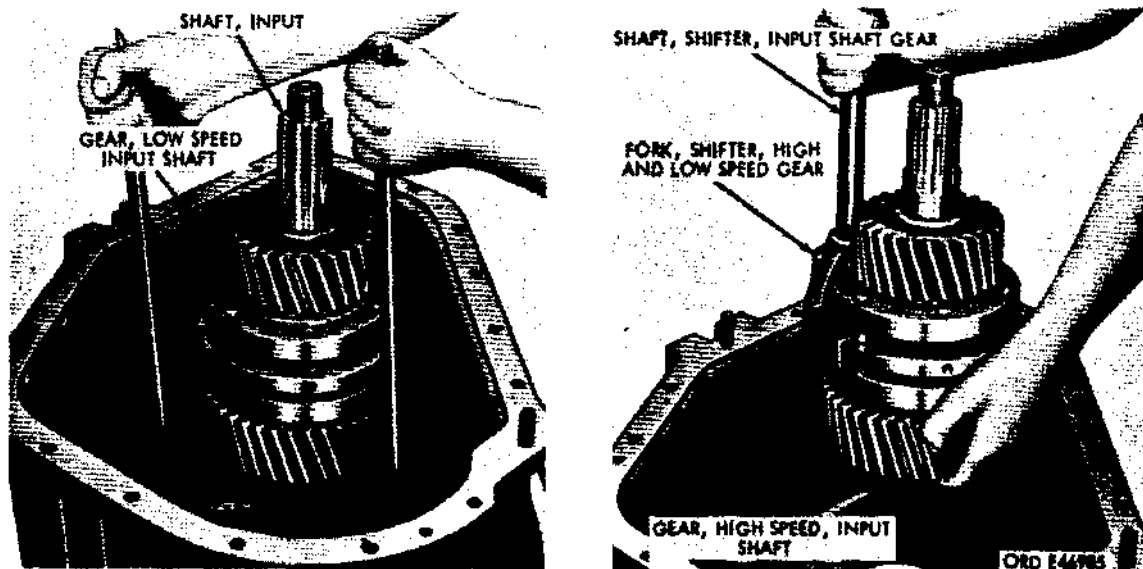


Figure 226. Removing input shaft from case

shaft high-speed gear (AH, fig. 229) and rear bearing intermediate rear bearing cone (AJ, fig. 229) are up and supported at inside of gear. Press on end of shaft to free gear and bearing cone from shaft. Remove Woodruff key (AF, fig. 229) from shaft.

- (c) Remove intermediate shaft low-speed gear and front bearing cone. Place intermediate shaft assembly in arbor press so that intermediate shaft low-speed gear (AD, fig. 229) and intermediate shaft front bearing cone (AC, fig. 229) are up and supported on press plate at inside of gear. Press on

end of shaft to free gear and bearing cone from shaft. Remove Woodruff key (AE, fig. 229) from shaft.

(7) Disassembly of input shaft assembly.

- (a) Remove input shaft rear ball bearing and high-speed gear. Input shaft rear bearing snap ring (V, fig. 229) must first be removed from rear end of input shaft (N, fig. 229). Position input shaft assembly in arbor press so that rear end is up and input shaft high-speed gear (R, fig. 229) is supported at inside. Press shaft from rear bearing. Remove input shaft rear bearing spacer (T, fig. 229) and lift off high-speed gear assembly. Now press input shaft-high-speed gear rear ball bearing (S, fig. 229) and input shaft high-speed gear front bearing spacer (Q, fig. 229) from bore of high-speed gear. Again place shaft in arbor press and support shaft on press plate at inside of input shaft high-speed gear front ball bearing (P, fig. 229). Press on end of shaft to remove bearing.

- (b) Remove gear synchronizer. The gear synchronizer (M, fig. 229) slides freely on the splines between the input shaft high- and low-speed gears (R

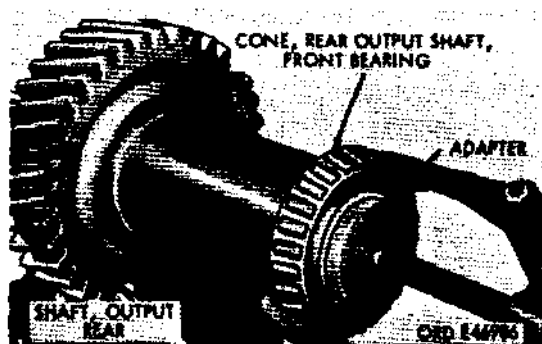


Figure 227. Removing rear output shaft front bearing cone

and K, fig. 229). After removal of the high-speed gear and bearings, slide gear synchronizer from shaft.

(c) Remove input shaft low-speed gear.

Place input shaft again in arbor press, but this time place front end up. Support on press plate at inside of input shaft low-speed gear (K, fig. 229). Press shaft out of gear and input shaft low-speed gear rear ball bearing (L, fig. 229); input shaft front bearing spacer (G, fig. 229) will also come off. Press ball front input shaft low-speed gear bearing (H, fig. 229), and input shaft low-speed gear spacer (J, fig. 229) from bore of low-speed gear. Press remaining ball bearing from shaft.

(8) Transfer case and covers.

- (a) The transfer case and the front cover (F, fig. 230) has, for all practical purposes, been disassembled during the preceding disassembly operations. There are, however, various bearing cups and seals which may yet be removed from the case and the front cover. Unless these parts are known to be defective or inspection indicates that they are damaged or worn, they should not be removed. If

further disassembly of the case is necessary, the removal of these parts can best be accomplished with the special tools which are available to the mechanic. Then proceed as follows:

- (b) To remove bearing cups, insert bearing cup remover and replacer in bearing cup (fig. 228), and remove bearing cups from cover and case.
- (c) A larger remover and replacer 5120-795-0159 (fig. 228) is required to remove the rear output shaft front bearing cup in the front cover.
- (d) The seals in the transfer case and case cover should be replaced if they are known to be leaking or if they are damaged during the disassembly of the transfer. If repairs to the seals are not indicated, they should remain in place.

b. Cleaning.

- (1) Bearings. Soak bearings in dry-cleaning solvent or mineral spirits paint thinner. Saturate bearing sufficiently to loosen old lubricant and revolve bearings occasionally while immersed. If lubricant still remains, strike bearing flat against wooden block or clap

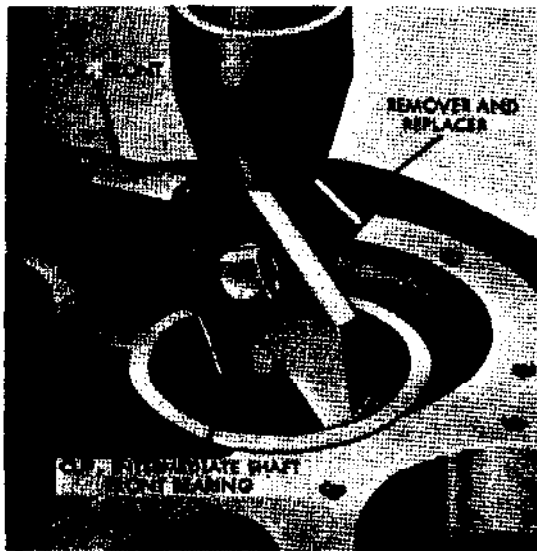


Figure 228. Bearing cup removal

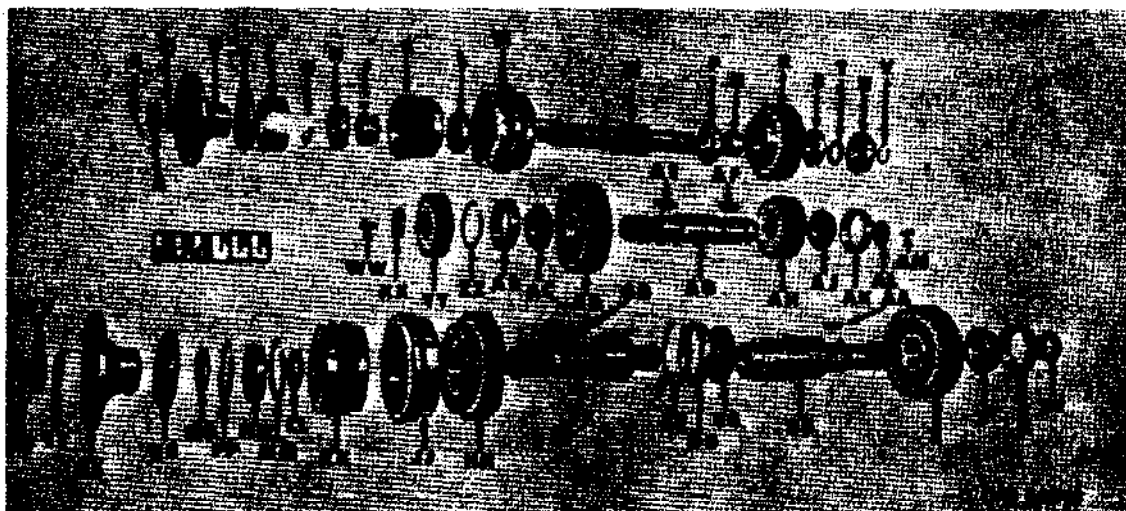


Figure 229. Transfer shafts, bearings, and gears - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Nut, sltd	FF	Shaft, output, front
B	Pin, cotter	GG	Key, Woodruff
C	Washer, plain	HH	Gear, driven, front output shaft
D	Flange, companion, input shaft	JJ	Collar, reverse shift
E	Slinger, dust, flange	KK	Sprag unit
F	Bearing, ball, input shaft, front	LL	Washer, spacing, front output shaft bearing, inner
G	Spacer, input shaft front bearing	MM	Ring, snap, front output shaft bearing, rear
H	Bearing, ball, input shaft low-speed gear, front	NN	Bearing, ball, front output shaft
J	Spacer, input shaft low-speed gear	PP	Ring, snap, front output shaft bearing, front
K	Gear, low-speed, input shaft	QQ	Washer, spacing, bearing, outer
L	Bearing, ball, input shaft low-speed gear, rear	RR	Slinger, dust, flange
M	Synchronizer, gear	SS	Flange, companion, front output
N	Shaft, input	TT	Washer, plain
P	Bearing, ball, input shaft high-speed gear, front	UU	Pin, cotter
Q	Spacer, input shaft high-speed gear front bearing	VV	Nut, sltd
R	Gear, high-speed, input shaft	WW	Screw, cap
S	Bearing, ball, input shaft high-speed gear, rear	XX	Washer, retaining
T	Spacer, input shaft rear bearing	YY	Gear, drive, intermediate shaft
U	Bearing, ball, input shaft, rear	ZZ	Ring, snap, intermediate shaft front bearing
V	Ring, snap, input shaft rear bearing	AB	Cup, intermediate shaft front bearing
W	Washer, spacing, rear output shaft rear bearing	AC	Cone, intermediate shaft front bearing
X	Cup, rear output shaft rear bearing	AD	Gear, low-speed, intermediate, shaft
		AE	Key, Woodruff
		AF	Key, Woodruff

Figure 229. Transfer shafts, bearings, and gears - exploded view - legend

Y-Cone, rear output shaft rear bearing
 Z-Gear, rear output shaft
 AA-Key, Woodruff
 BB-Shaft, output, rear
 CC-Cone, rear output shaft front bearing
 DD-Cup, rear output shaft front bearing
 EE-Ring, snap, rear output shaft front bearing

AG-Shaft, Intermediate
 AH-Gear, high-speed, intermediate shaft
 AJ-Cone, intermediate shaft rear bearing
 AK-Cup, intermediate shaft rear bearing
 AL-Washer, retaining, rear bearing
 AM-Screw, cap

Figure 229. Transfer shafts, bearings, and gears-exploded view - continued

against heel of hand to loosen lubricant. Repeat soaking and striking operations until bearings are free of old lubricant. Dry with compressed air.

CAUTION

Do not spin bearing races with compressed air. Otherwise damage will result to these finely machined surfaces.

(2) *Bearing cones.* Refer to (1) above.

(3) *Case, case cover, and bearing covers.*

Clean case and covers thoroughly with dry-cleaning solvent or mineral spirits paint thinner. Scrape old gasket and gasket sealing compound from cover flanges. Give special attention to oil passages and rinse all parts clean. Blow dry with compressed air.

(4) *Gears and shafts.* Wash each gear and shaft in dry-cleaning solvent or mineral spirits paint thinner to remove old lubricant. Make sure oil passages are open.

(5) *Miscellaneous parts.* Soak all other parts such as forks, springs, poppet balls, spacers, sprags, cap screws, nuts, and washers in dry-cleaning solvent or mineral spirits paint thinner. When all dirt and old grease have been removed, dry with compressed air.

c. *Inspection and Repair.*

(1) *Bearings and bearing cones* (fig. 228). When a bearing or bearing cone has been cleaned and dried, take it in hand and revolve it slowly. Inspect for pitting, scoring, or excessive wear. Replace any assembly which shows damage or wear. Bearings and bearing cones, which are to

be used, must turn freely and smoothly. Apply engine oil (OE) and keep protected from dust and dirt.

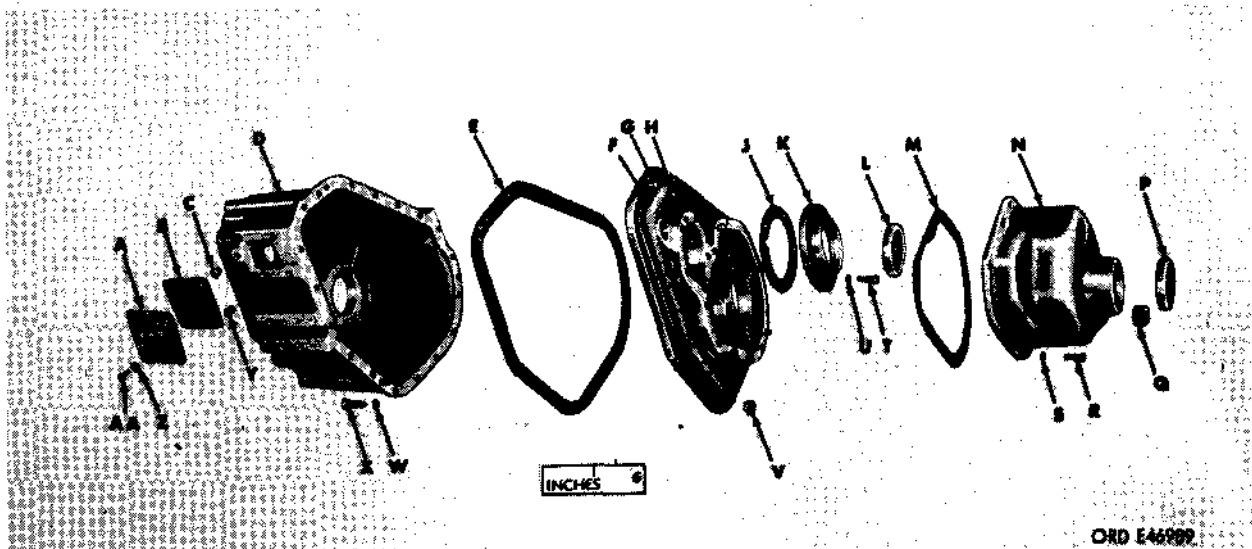
(2) *Bearing covers* (fig. 230). Inspect bearing covers for cracks around bolt holes and for deep scratches or burs on machined shim or gasket surfaces. If scratches or burs cannot be removed with fine mill file, replace defective cover.

(3) *Bearing cups* (fig. 229). Look for chipped spots, cracks, or wear from contact with rollers on bearing cups. Replace if worn or defective.

(4) *Case and front covers* (fig. 230). Carefully go over case and front cover for cracks. Look especially for cracks around bearing and bearing cup openings and bolt holes. Replace if cracks are found. Look for deep scratches or burs on all machined surfaces; if present, remove with fine mill file. Replace if nicks or scratches will interfere with a good seal. Inspect magnetic drain plug for damaged thread, and replace if not in serviceable condition.

(5) *Gears* (fig. 229). Inspect gear teeth for damage and excessive wear (par. 169). Use a hone stone to remove small nicks or burs. Replace any gears with chipped, cracked, broken, or excessively worn teeth.

(6) *Oil seals.* Oil seals, which have not been removed, may be used if in good condition. Seals, however, are oftentimes damaged during disassembly and when removed, a new seal will be used. Inspect seal contact surface to be sure it is pliable.



A-Cover, top
 B-Gasket, top cover
 C-Screw, shifter shaft poppet spring plunger
 D-Case
 E-Gasket, front cover
 F-Cover, front
 G-Pin, taper
 H-Vent, air
 J-Gasket input shaft front bearing cover
 K-Cover, input shaft front bearing
 L-Seal, oil, input shaft front bearing
 M-Gasket, front output shaft case to transfer case
 N-Case, front output shaft

P-Seal, oil, front output shaft
 Q-Plug, pipe, sq socket
 R-Screw, cap
 S-Washer, lock
 T-Screw, cap
 U-Washer, lock
 V-Nut, hex
 W-Washer, lock
 X-Screw, cap
 Y-Screw, set, headless
 Z-Washer, lock
 AA-Bolt, hex-hd

Figure 230. Transfer case and front covers-exploded view.

(7) *Shafts* (fig. 229). Machined surfaces on shafts must not be scored or pitted. If this condition exists, replace shaft. Check splines on ends of shaft for twisting and replace if damaged in this manner. Slide synchronizer assembly across input shaft to make sure it slips evenly and smoothly. If interference is noted, replace shaft and synchronizer. Inspect screw threads on ends of input and output shafts and if damaged in any way, repair or replace shaft. Refer to paragraph 169 for serviceability standards.

(8) *Sprags and energizing springs.*

(a) Wear on the sprags will normally be most uniform. For that reason, it will only be necessary to check two or three sprags for wear. Replace complete unit if worn.

(b) Energizing springs must be free of kinks or bends. Replace complete unit if damage is evident.

(9) *Gear synchronizer assembly.* Look for nicked, broken, cracked, or worn

teeth on the synchronizer. No repairs are permitted on the synchronizer and if any defects are found, it must be replaced.

- (10) Thrust washers, spacers, and snap rings. Inspect these miscellaneous parts and replace any which are damaged.

d. Assembly.

- (1) General. Satisfactory performance will depend to a large degree on attention to the following basic rules.
- (a) Keep all parts clean during assembly. Protect subassemblies from wind-blown dust, for even the slightest particles of dust and dirt are abrasive. Keep hands free of grease, and wear no greasy clothing while assembling the transfer.
 - (b) Apply engine oil (OE) to all gears, shafts, and bearings prior to assembly. This will ensure lubrication of moving parts for initial operation.
 - (c) Apply white lead to shaft and bore of gears before pressing gears on shaft. This will prevent scoring.
 - (d) New gaskets will be used on joints which confine oil. Oil seals, if in good condition, may be used. Saturate seal with warm engine oil (OE) before installing and handle seal carefully to avoid damage while installing.
 - (e) Secure all nuts and bolts with lockwashers, locking wires, or cotter pins when specified.

(2) Assemble the case assembly.

- (a) Install intermediate shaft rear bearing cup. If intermediate shaft rear bearing cup (AK, fig. 229) has been removed, press cup into case opening using remover and replacer. Be sure cup is not "cocked" as it is pressed into position, otherwise damage will result.
- (b) Install rear output shaft rear bearing cup (X, fig. 229). If this bearing cup has been removed, press cup into case opening ((a) above).

- (c) Install intermediate shaft rear bearing cover. Position intermediate shaft rear bearing cover (FF, fig. 231) and shims (GG, fig. 231) on case so that oil passages are in alignment. Insert two hex-head bolts (CC, fig. 231), two hex-head bolts (DD, fig. 231), four lockwashers (C, fig. 231), and tighten down with 20 to 25 lb.-ft. torque.

- (d) Install input shaft rear bearing cover. Position input shaft rear bearing cover (D, fig. 231), and new input shaft rear bearing cover gasket (B, fig. 231) on case with care taken to assure alignment of oil passage. Insert six cap screws, lockwashers, and tighten down with 20 to 25 lb.-ft. torque.

- (e) Install rear output shaft bearing cover. Position rear output shaft rear bearing cover (G, fig. 231), and rear output shaft rear bearing shims (BB, fig. 231) on case. Aline so that pin in case enters hole in cover. Insert six cap screws, lockwashers, and tighten down with 20 to 25 lb.-ft. torque.

(3) Assemble the case cover.

- (a) Install intermediate shaft front bearing cup. If intermediate shaft front bearing cup (AB, fig. 229) has been removed from the front cover (F, fig. 230), insert intermediate shaft front bearing snap ring (ZZ, fig. 229) in groove in cover opening. Press bearing cup into opening until it bottoms against snap ring. Use remover and replacer (fig. 228) for this operation and take special care to keep cup from becoming "cocked."
- (b) Install rear output shaft front bearing cup in case cover. If rear output shaft front bearing cup (DD, fig. 229) was removed from front cover (F, fig. 230), insert rear output shaft front bearing snap ring (EE, fig. 229) in groove in front cover opening. Press bearing cup into opening until it bottoms against snap ring. Use remover and replacer 5120-795-0159 and take special care to keep cup from becoming "cocked."

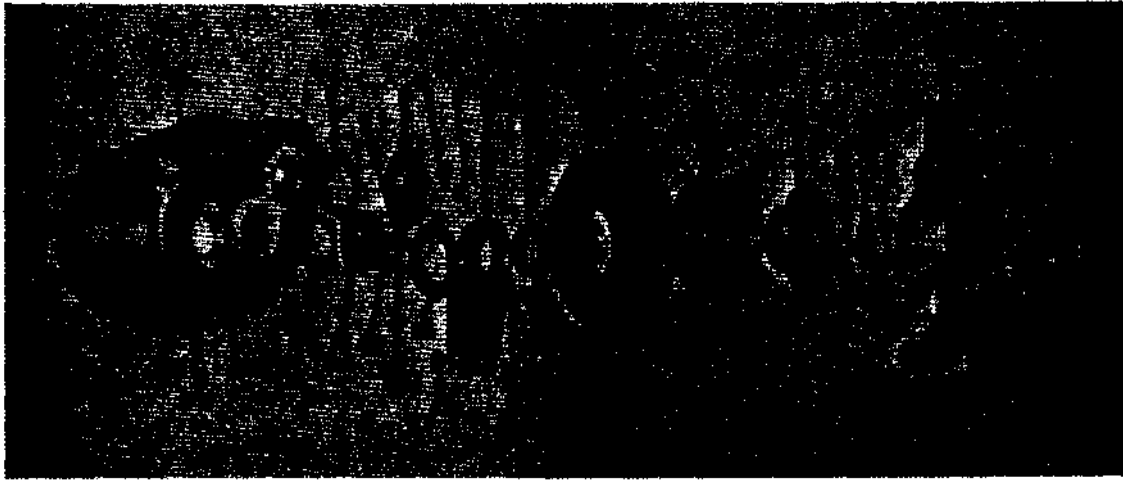


Figure 231. Transfer case, rear covers, and parking brake - exploded view

Key	Item	Key	Item
A	Case	T	Bolt, hex-hd
B	Gasket, input shaft rear bearing cover	U	Shoe, brake, outer, w/lining, assy
C	Washer, lock	V	Washer, lever pin
D	Cover, input shaft rear bearing	W	Nut, safety
E	Washer, lock	X	Bolt, hex-hd
F	Screw, cap	Y	Screw, cap
G	Cover, rear output shaft rear bearing	Z	Washer, lock
H	Seal, rear output shaft rear bearing	AA	Nut, jam
J	Drum, brake	BB	Shim, rear output shaft rear bearing
K	Slinger, oil, brakeshoe	CC	Bolt, hex-hd
L	Flange, companion, rear output shaft	DD	Bolt, hex-hd
M	Washer, plain	EE	Washer, lock
N	Nut, sltd	FF	Cover, intermediate shaft rear bearing
P	Pin, cotter	GG	Shim, intermediate shaft rear bearing
Q	Shoe, brake, inner, w/lining, assy	HH	Pin, dowel, rear output shaft cover
R	Pin, brakeshoe lever	JJ	Plug, drain, sq-socket
S	Lever, brakeshoe		

Figure 231. Transfer case, rear covers, and parking brake - exploded view - legend

- (c) Install shifter shaft oil seal. If shifter shaft oil seal was removed from front cover, press seal into opening, using a wooden block or adapter to press seal into place. Seal must be firmly seated in cover.
- (4) Assembly of the input shaft assembly.
- (a) Install high-speed gear bearings. Press front input shaft high-speed gear ball bearing (P, fig. 229), front input shaft high-speed gear bearing spacer (Q, fig. 229), and the rear input shaft high-speed gear ball bearing (S, fig. 229) into bore of the input shaft high-speed gear (R, fig. 229). Press at inner race of bearing only.
- (b) Install input shaft high-speed gear assembly. Place high-speed gear assembly ((a) above) on rear or snap ring groove end of input shaft (N, fig. 229). Now place input shaft rear bearing spacer (T, fig. 229) on shaft and press against spacer to install gear assembly on shaft.

- (c) Install rear input shaft ball bearing. Press rear input shaft ball bearing (U, fig. 229) on end of input shaft (N, fig. 229). Press at inner race only. Insert input shaft rear bearing snap ring (V, fig. 229) in groove.
- (d) Install low-speed gear ball bearings. Press front input shaft low-speed gear ball bearing (H, fig. 229), input shaft low-speed gear spacer (J, fig. 229), and rear input shaft low-speed gear ball bearing (L, fig. 229) into bore of the input shaft low-speed gear (K, fig. 229). Protect from dust and set aside until case is ready for final assembly.
- (e) Install high- and low-speed gear fork. Place high- and low-speed gear shifter fork (A, fig. 232) on shifting collar of gear synchronizer (M, fig. 225). Protect from dust and set aside with front input shaft low-speed gear (F, fig. 229) until case is ready for final assembly.
- (5) Assembly of intermediate shaft assembly. If intermediate shaft, gears, and bearings (fig. 229) were disassembled, assemble as outlined in (a) through (d) below:
- (a) Install intermediate shaft high-speed gear. Insert Woodruff key (AF, fig. 229) into slot near end of intermediate shaft (AG, fig. 229). Now place intermediate shaft high-speed gear (AH, fig. 229) flat side up, on arbor press and insert intermediate shaft into bore of gear with keyway alined with key. Splined end of shaft must be up. Press shaft into gear until shoulder on the shaft is firm against hub of gear.
- (b) Install intermediate shaft low-speed gear. Insert Woodruff key (AE, fig. 229) into slot near splined end of intermediate shaft (AG, fig. 229). Now place intermediate shaft low-speed gear (AD, fig. 229) in arbor press and insert splined end of shaft in bore of gear so that key in shaft is alined with keyway in gear. Press shaft into gear until shoulder on the shaft is firm against hub of gear.
- (c) Install intermediate shaft bearing cones. Place intermediate shaft front bearing cone (AC, fig. 229) and one intermediate shaft rear bearing cone (AJ, fig. 229), one on each end of shaft, with large side of cones facing toward the center of the shaft, and press cones flush against each gear. Apply pressure to inner race only.
- (d) Install rear bearing retaining washer. Position rear bearing retaining washer (AL, fig. 229) on rear end of intermediate shaft (AG, fig. 229) and secure in place with two cap screws (AM, fig. 229). Install locking wire through leads of cap screws.
- (6) Assembly of the rear output shaft assembly. If rear output shaft, gears, and bearings (fig. 229) were disassembled, assemble as outlined in (a) and (b) below:

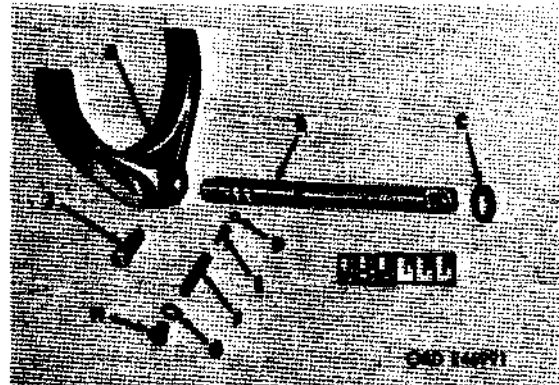


Figure 232. High low shifter shaft and fork - exploded view

Key	Item
A	Fork, shifter, high- and low-speed gear
B	Shaft, shifter, input shaft gear
C	Seal, oil, gear shifter shaft
D	Ball, poppet
E	Plunger, poppet ball
F	Spring, compression, poppet ball
G	Washer, lock internal teeth
H	Screw, plunger
J	Screw, set sq-hd

Figure 232. High low shifter shaft and fork exploded view - legend

- (a) Install rear output shaft gear. Insert Woodruff key (AA, fig. 229) in slot near splined end of rear output shaft (BB, fig. 229). Position rear output shaft gear (Z, fig. 229) in arbor press with long end of hub up. Now slide splined end of rear output shaft into bore of gear so that key in shaft is alined with keyway in gear. Press shaft into gear until shoulder on shaft is flush with hub of gear.
 - (b) Install rear output shaft bearing cones. Place rear output shaft front bearing cone (CC, fig. 229) on front of rear output shaft (BB, fig. 229) so that large end of cone faces to center of shaft. Position assembly in arbor press and press cone firmly against shoulder on shaft. In like manner, place rear output shaft rear bearing cone (Y, fig. 229) on rear or splined end of rear output shaft so that large end of cone faces to center of shaft. Position assembly in arbor press and press cone until it is flush against hub of rear output shaft gear (Z, fig. 229).
- (7) Final assembly of input, intermediate, and rear output shafts.
- (a) Install input shaft assembly. Position the partially assembled input shaft assembly ((4) above) into the case so that high-speed gear end is down, and tap on splined end of shaft with lead hammer until shaft is partly in place.
 - (b) Install rear output shaft assembly. Place rear output shaft assembly ((6) above), gear end down, into the case.
 - (c) Install intermediate shaft assembly. Place intermediate shaft assembly ((5) above), splined end up, in position in case and at the same time slide gear synchronizer (M, fig. 228) and shifter shaft fork assembly ((4) (c) above), long hub up, onto the end of the input shaft. Now tilt the intermediate shaft enough to provide clearance for placing low-speed gear ((4) (d) above), and input shaft front bearing spacer (G, fig. 229) on the input shaft. With all gears enmeshed and the gear synchronizer sliding freely on the input shaft, the transfer is ready for the front cover.
- (8) Installation of front cover assembly.
- (a) Install front cover (fig. 230). Place new front cover gasket (E) and aline front cover (F) on case. Insert seventeen cap screws (X) into openings around flange of case and secure with hex-nuts (V) and lockwashers (W) to hold cover firmly to case. Install cap screw in threaded hole. Tighten down nuts and cap screw alternately and evenly with torque.
 - (b) Install intermediate shaft drive gear. Place intermediate shaft drive gear (YY, fig. 229) on intermediate shaft (GG, fig. 229) and fasten in place with retaining washer (XX, fig. 229) and two cap screws (WW, fig. 229). Install locking wire through heads of cap screws.
 - (c) Install input shaft front bearing oil seal into input shaft front bearing cover. If input shaft front bearing oil seal (fig. 233) has been removed, place bearing cover in arbor press and position front bearing oil seal into recess in cover. Using replacer 5120-795-0152, press seal into cover.
 - (d) Install input shaft front bearing cover. Position input shaft front bearing cover (K, fig. 230), and new input shaft front bearing cover gasket (J, fig. 230), onto front cover (F, fig. 230). Secure with five cap screws

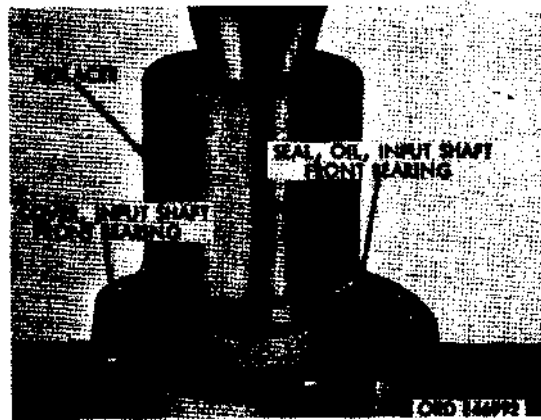


Figure 233. Replacing oil seal in the input shaft front bearing cover

(T, fig. 230), and lockwashers (U, fig. 230), and tighten down with 20 to 25 lb.-ft. torque.

(9) Installation of input shaft gear shifter shaft.

- (a) Install shifter shaft (fig. 232). Insert input shaft gear shifter shaft (B), poppet ball grooves down, through gear shifter shaft oil seal (C) in front cover (F, fig. 230) Rotate shaft while inserting to avoid damage to seal. Slide shifter shaft through hub of high- and low-speed gear shifter fork (A). Aline setscrew hole in shaft with hole in fork and secure shaft to fork with square head setscrew (J). Tighten firmly and install locking wire.
- (b) Adjust high- and low-speed gear shifter fork stop screw. Turn high- and low-speed gear shifter fork stop screw (fig. 224) toward shifter fork until fork is centered around the gear synchronizer. Install headless setscrew to lock shifter fork setscrew in adjustment.
- (c) Install poppet ball. Insert poppet ball (fig. 223), poppet ball plunger, compression spring, and shifter shaft poppet spring plunger screw into hole at top of case.
- (d) Install top cover. Place new top cover gasket (B, fig. 230) and top cover (A, fig. 230) on case. Secure top cover to case with four hex-head bolts and lockwashers.
- (e) Adjustment of intermediate and rear output shaft bearings. Refer to paragraph 166.

Note. In some instances, the location of the poppet ball grooves on the shifter shaft will not permit the internal teeth of the input shaft (synchronizer) gear to fully engage the external teeth of either the high- or low-speed gear. If this situation occurs, discard the shifter shaft and replace with new shifter shaft 2520-591-5827. This shaft can be readily identified by the letter "G" stamped on the linkage end of the shaft.

162. Shift Lever Linkage

a. Disassembly. The shift lever linkage must be disassembled in order to remove linkage from the vehicle. Removal of the link-

age from the vehicle is not recommended unless inspection reveals damaged, bent, or broken parts. Remove and replace or straighten damaged parts as inspection indicates. Refer to paragraph 156d for removal and disassembly of linkage.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Wash all parts in dry-cleaning solvent or mineral spirits paint thinner.
- (2) Inspection. Examine hand lever, adjustable yoke, control rode, relay lever, and relay lever shaft for cracks or bends. Look for stripped threads on the hand lever to relay lever control rod and in the adjustable yoke.
- (3) Repair. Straighten bent rods or shafts. Replace any parts having damaged threads or any parts which cannot be reconditioned.

c. Assembly.

- (1) General. If hand lever and linkage were disassembled (par. 156), assembly is as follows:
- (2) Assemble linkage. Install relay lever shaft in support brackets on frame and secure in place by installing one relay lever on each end of shaft and tightening cap screws and nuts. Position relay lever to transfer control rod (fig. 208) and insert clevis pins. Secure clevis pins with cotter pins. Position welded yoke-end of hand lever to relay lever control rod on relay lever and secure with clevis pin and cotter pin. Screw jam nut and adjustable yoke onto control rod.
- (3) Install hand lever. Place hand lever on hand lever mounting bracket. Insert pivot pin and secure pin with cotter pin. Position adjustable yoke on control rod ((2) above) with hand lever and insert clevis pin. Secure pin with cotter pins.
- (4) Adjustment. The adjustment of the shift lever linkage is determined after all parts have been installed. Adjustment is made by shortening or lengthening hand lever to relay lever control rod (fig. 208) by means of the adjustable yoke. The hand lever should shift the transfer through high, neutral, and low range without interference to the lever from the seat or the floorboard.

Section VI. TESTS AND ADJUSTMENTS

163. Lubricate

Install square socket drain plug (JJ, fig. 231) and tighten securely. Turn the transfer up-right and pour in 1/2-pint of universal gear lubricant (GO) through filler plug opening. Indicate this incomplete lubrication on a suitable tag and fasten tag to case. Complete lubrication of the transfer will be accomplished after its installation in the vehicle. Refer to LO 9-2320-211-12.

164. Shift Test

a. Neutral. Move shifter shaft (fig. 208) to neutral. Position between "low" (shifter shaft out) and "high" (shifter shaft in). Turn input shaft clockwise by hand. Front and rear output shafts should not turn.

b. Low. Pull shifter shaft out to low. Turn input shaft by hand and note if rear output shaft turns approximately one-half the number of turns that input shaft turns.

c. High. Push shifter shaft into high. Turn input shaft and note that the rear output shaft turns same number of turns as input shaft.

d. Sprag Unit Test. In order to test the sprag unit, compressed air must be passed through the shift air cylinder, by an outside means or the vehicle's own compressed air system. With air pressure on the rear end of the piston in the shift air cylinder, the transfer sprag unit will be shifted for forward operation. Place shifter shaft in either the low or high position. The front output shaft should turn freely in a clockwise direction but should not turn counterclockwise when input shaft is held stationary. If air pressure is exhausted on rear end of cylinder piston and exerted on the front end of the piston, the front output shaft should turn freely in a counterclockwise direction but should not turn clockwise when input shaft is held stationary.

165. Parking Brake Test and Adjustment

a. Operate brakeshoe lever (fig. 190) to cause brakeshoes to set against brakedrum. Release lever and make sure shoe return spring pulls shoes free of drum.

b. If shoes do not clear drum, check adjustment of shoe stop screw. Loosen locknut and

turn shoe stop screw clockwise to gain sufficient shoe to drum clearance. When adjustment has been made, tighten locknut.

166. Intermediate Shaft Bearings Adjustment

Note. Fixture for the following operation must be improvised locally. Refer to Chapter 2, "Improvised Tools."

a. Remove four hex-head capscrews, and lockwashers, from rear bearing cover (FF, fig. 231) and lift cover and shim pack from case.

b. Place shim pack on adjusting fixture and add an additional 0.030-inch thickness shim to provide ample end play to obtain a true reading.

c. Assemble adjusting fixture (fig. 234), including shim pack, to case with four hex-head capscrews previously removed with bearing cover. Tighten screws alternately and evenly to 20 to 25 lb.-ft. torque.

d. Turn two adjusting screws on fixture into threaded holes in end of intermediate shaft, until tight.

e. Seat front bearing cup tight against snap ring by turning forward nuts on fixture adjusting screws until tight, then loosen.

f. Seat rear bearing cup tight against shoulder of fixture flange, by turning rear nuts on fixture adjusting screws until tight, then loosen.

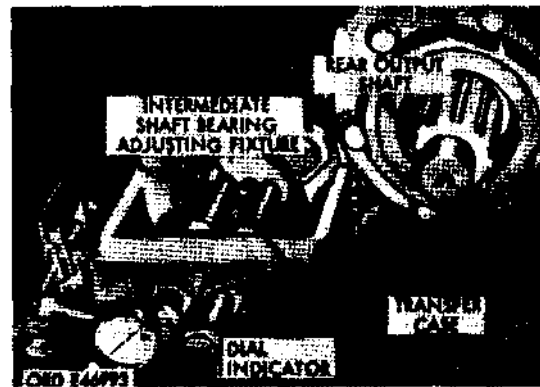


Figure 234. Adjusting intermediate shaft bearings

g. Attach a dial indicator gage to fixture with pointer resting on end of adjusting screw; pry opposite adjusting screw in and out with small pry bar and end play will be indicated. Record end play.

h. Remove fixture and shim pack from case and set entire shim pack aside.

i. Using a depth micrometer (fig. 235) measure shoulder height on fixture flange and bearing cover flange.

j. If shoulder measurement on fixture is smaller than shoulder measurement on cover, subtract difference from end play reading of shaft. The remainder is the thickness of shims that will be removed from shim pack to establish zero clearance.

k. If shoulder measurement on fixture is larger than shoulder measurement on cover, add difference to recorded end play reading of shaft. This sum is thickness of shims to be removed from shim pack to establish zero clearance.

l. After zero clearance has been established, 0.003-inch shim must be added to shim pack to obtain specified end play.

m. Position intermediate shaft rear bearing cover (FF, fig. 231) and shim pack on case so that oil passages are in alignment. Insert four hex-head capscrews, and lockwashers, and tighten screws alternately and evenly to 20 to 25 lb.-ft. torque.

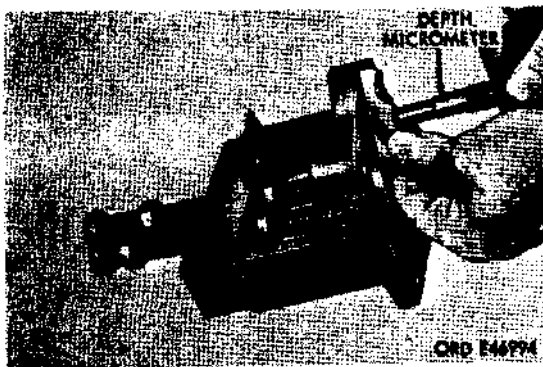


Figure 235. Measuring shoulder height on adjusting fixture flange

167. Rear Output Shaft Bearings Adjustment

Note. Fixture for the following operation must be improvised locally. Refer to Chapter 2, "Improvised Tools."

a. Remove six hex-head capscrews, and lockwashers, from rear bearing cover (G, fig. 231) and lift cover and shim pack from case.

b. Place shim pack on adjusting fixture. Add an additional 0.030-inch thickness shim to provide ample end play to obtain a true reading.

c. Assemble adjusting fixture (fig. 236), including shim pack, to case with six hex-head capscrews previously removed with bearing cover. Tighten screws alternately and evenly to 20 to 25 lb.-ft. torque.

d. Turn the adjusting screw capnut onto threaded end of rear output shaft until tight.

e. Seat front bearing cup tight against snap ring by turning forward nut on fixture adjusting screw until tight, then loosen.

f. Seat rear bearing cup tight against shoulder of fixture flange, by turning rear nut on fixture adjusting screw until tight, then loosen.

g. Attach a dial indicator gage to fixture and with pointer resting on end of adjusting screw, pry adjusting screw in and out with small pry bar and end play will be indicated. Record end play.



Figure 236. Adjusting rear output shaft bearings

h. Remove fixture and shim pack from case and set entire shim pack aside.

i. Using a depth micrometer (fig. 235), measure shoulder height on fixture flange and bearing cover flange.

j. To establish zero clearance and obtain the required end play, the same computations

will be utilized as that used in j, k, and l, paragraph 166.

k. Position rear output shaft rear bearing cover (G, fig. 231), and shim pack in case. Aline so that pin in case enters hole in cover. Insert six hex-head capscrews, and lock-washers, and tighten screws alternately and evenly to 20 to 25 lb.-ft. torque.

Section VII. SERVICEABILITY STANDARDS

168. General

The serviceability standards included herein give the minimum, maximum, and key clearances of new or repaired parts. They also give wear limits which indicate that point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. In the "Size and Fit of New Parts" column, the letter "L"

indicates a loose fit (clearance) and the letter "T" indicates a tight fit (interference). Measurements are in inches, unless indicated otherwise.

169. Serviceability Standards

Figure 237 and Table IX give the serviceability standards for the transfer.

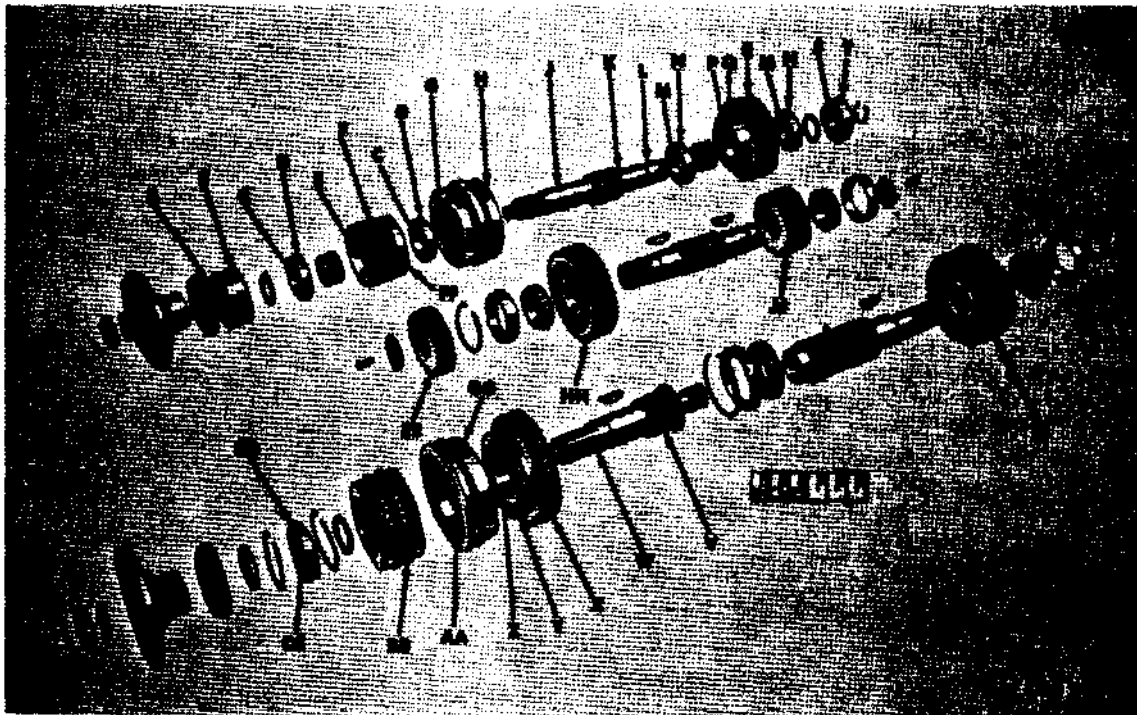


Figure 237. Serviceability standard points of measurement for transfer gears and shafts

Table IX. Serviceability Standards - Transfer

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts
<u>BEARINGS</u>			
237	A-J	Front input shaft bearing to shaft	0.0003L to 0.0008T
237	B	Input shaft bearing to front cover	0.0014L to 0.0002T
237	E-D	Low-speed gear bearing to gear	0.0007L to 0.0009T
237	C-J	Low-speed gear bearing to input shaft	0.0003L to 0.0008T
237	Q-N	High-speed gear bearing to gear	0.0007L to 0.0009T
237	N-K	High-speed gear bearing to input shaft	0.0003L to 0.0008T
237	S-L	Rear input shaft bearing to shaft	0.0006L to 0.0009T
237	T	Rear input shaft bearing to case	0.0016L to 0.0010T
237	CC-W	Front output shaft bearing to shaft	0.0002L to 0.0009T
237	DD	Front output shaft bearing to case	0.0012L to 0.0002T
<u>SHAFTS AND GEARS</u>			
Diameters and Clearance			
237	Z	Front output shaft driven gear	3.001 to 3.002
237	V	Front output shaft	2.990 to 2.9985
237	Z-V	Driven gear clearance on front output shaft	0.001 to 0.0035
Backlash			
237	FF to G	Low-speed gear to synchronizer	0.004 to 0.010
237	F to HH	Low-speed gear to low-speed intermediate gear	0.005 to 0.010
237	EE to X	Front intermediate drive gear to front output driven gear	0.005 to 0.010
237	P to H	High-speed gear to synchronizer	0.004 to 0.010
237	R to JJ	High-speed gear to high-speed intermediate gear	0.005 to 0.010
237	JJ to U	High-speed intermediate gear to rear driven gear	0.005 to 0.010
237	Y to GG	Front output driven gear to sprag clutch shift collar	0.017
237	AA to BB	Sprag clutch shift collar to sprag clutch outer race	0.017

CHAPTER 15

TRANSMISSIONS

Section I. DESCRIPTION AND DATA

170. Scope

This chapter covers the field and depot maintenance for the model 6453 transmission (used on diesel models) and the model 6352 transmission (used on gasoline models).

171. Description

a. The transmissions (figs. 238 and 239) are manually shifted, synchromesh, selective-gear type, with five forward speeds and one reverse speed. Fifth forward speed is direct drive on the 6352 transmission (gasoline models) and an overdrive gear on the 6453 transmission (diesel models). Refer to figures 240 and 241 for power flow charts. A power takeoff, mounted on right side of transmission, transmits power to the drum winch and power hoist on vehicles so equipped. Vehicles on which power takeoff is not required have the opening in transmission sealed with a gasket

and hole cover. The transmission assembly is mounted to and supported by the engine and flywheel housing. Gear shifting is by conventional gearshift lever which activates sliding shafts with attached forks and lugs. The shafts and forks are located in the shifter shaft housing located on the top of the transmission case.

b. The clutch housing is located at and bolted to the front of the transmission case. The clutch housing is not an integral part of the transmission assembly, but when the transmission is received for repair the clutch housing will be attached.

c. The splined section of the transmission input shaft extends outward from the transmission case through the clutch housing, and meshes with the corresponding spline section of the clutch driven disk transmitting the power output from the engine to the transmission.

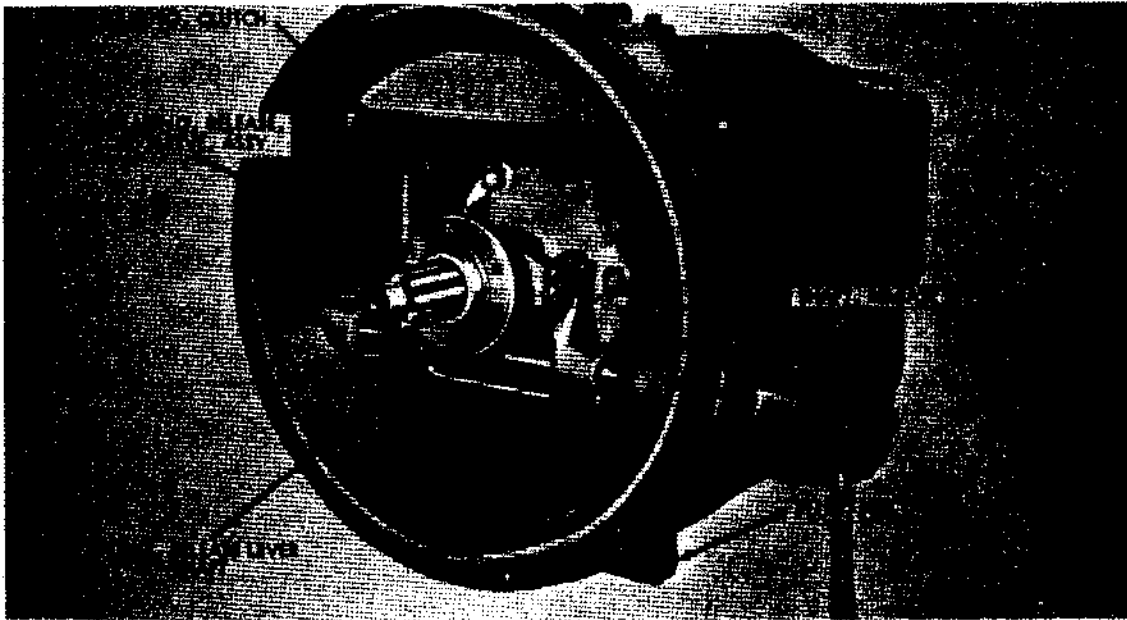


Figure 238. Transmission assembly - left front view

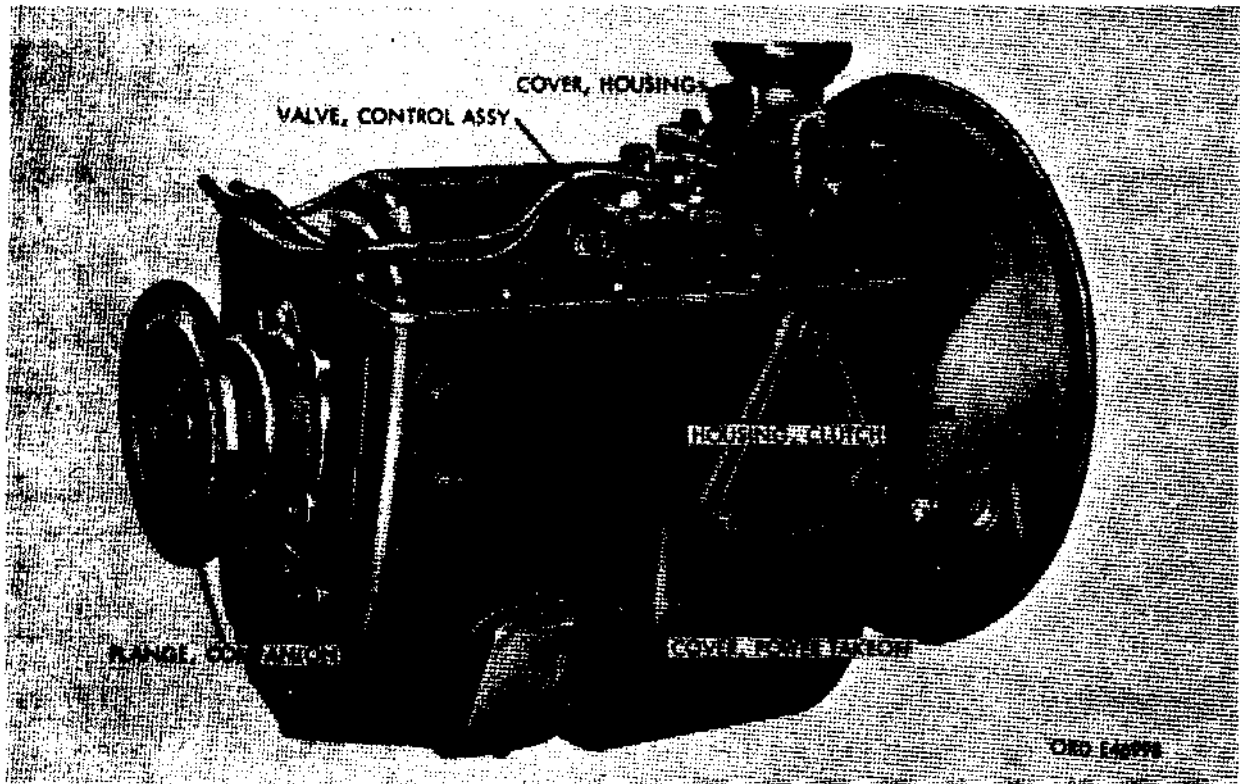


Figure 239. Transmission assembly-right rear view.

d. The transmission output is coupled to the remaining sections of the power train by a companion flange which is splined to the rear of the main shaft. The rear of the main shaft extends outward from the rear of the transmission case, enabling the companion flange and locknut to be installed.

e. All maintenance of the transmission will be the same with the exception of the difference stated in *a* above. For this reason, maintenance procedures contained in this chapter will be for the model 6352 transmission.

172. Data

Manufacturer ----- Spicer
 Models ----- 6352 and 6453
 Type ----- synchromesh
 Gear Ratios:
 Model 6352
 Reverse ----- 7.33 to 1.00

First -----	7.31 to 1.00
Second -----	4.08 to 1.00
Third -----	2.41 to 1.00
Fourth -----	1.43 to 1.00
Fifth -----	1.00 to 1.00

Model 6453

Reverse -----	6.09 to 1.00
First-----	6.07 to 1.00
Second -----	3.40 to 1.00
Third -----	1.79 to 1.00
Fourth-----	1.00 to 1.00
Fifth-----	.78 to 1.00

Gear Types:

Input gear and countershaft gears----- helical
 First and reverse speed gears ----- spur
 Second, third, and fourth speed gears ----- helical

Lubricant capacity:

Without power takeoff ----- 13 pt
 With power takeoff ----- 14 pt

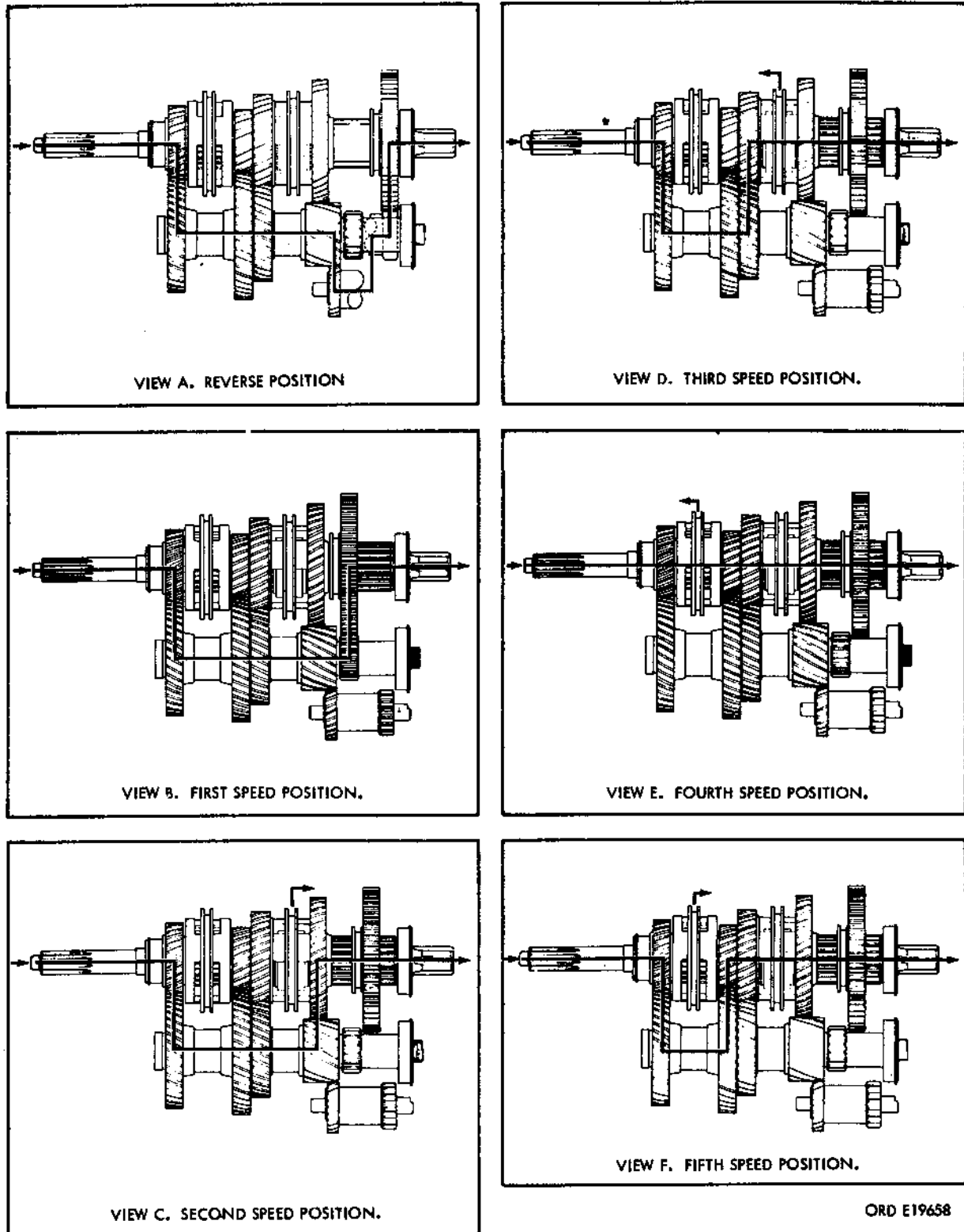


FIGURE 240. POWER FLOW - MODEL 6453 TRANSMISSION

Figure 240. Power flow-model 6453 transmission.

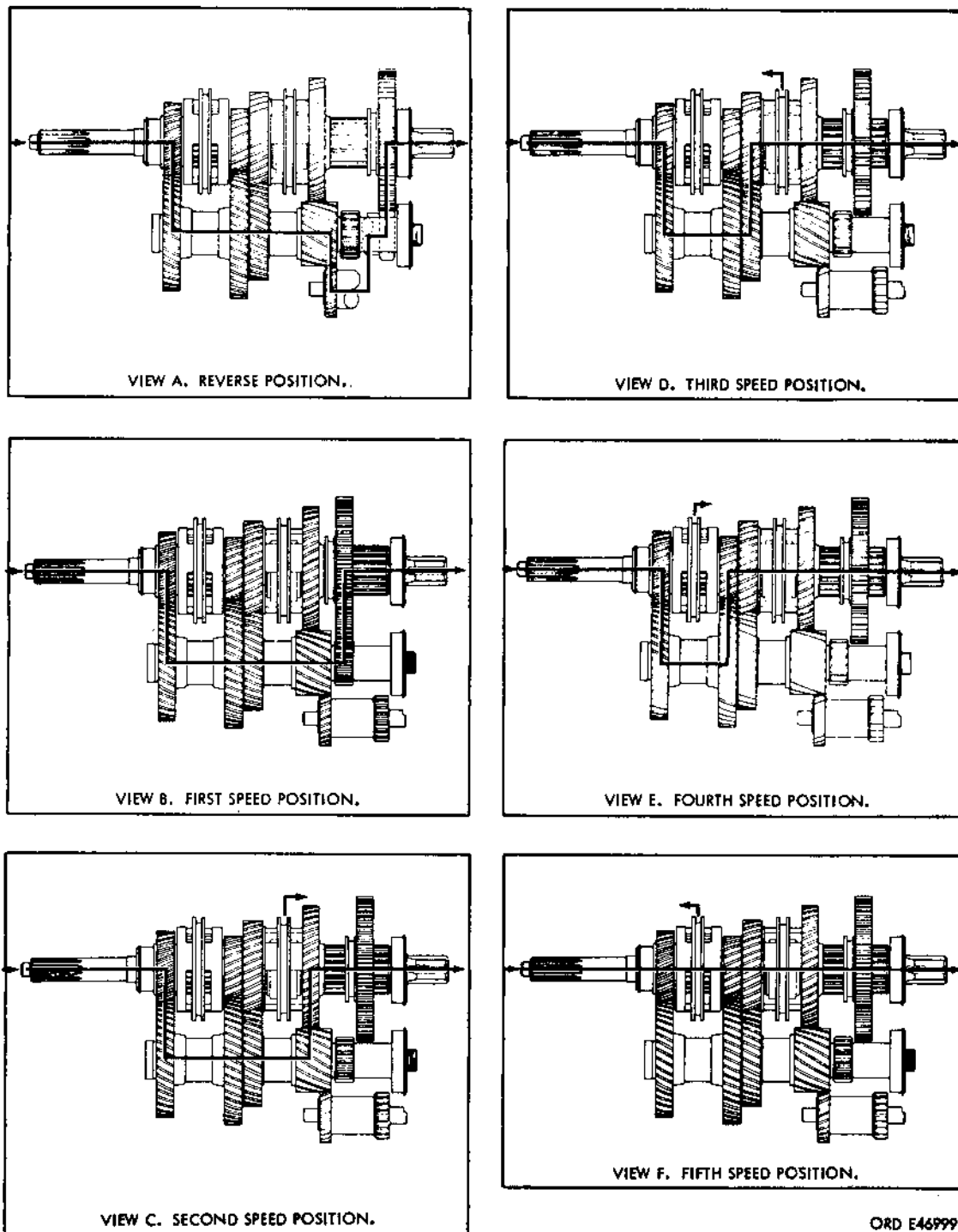


Figure 241. Power flow - model 6352 transmission

Section II. TROUBLESHOOTING

173. General

This section contains inspection and trouble - shooting procedures to be performed while a disabled component is still mounted in the vehicle and after it has been removed.

174. Troubleshooting Before Removal or Operation

a. General. Do not operate the vehicle prior to completing the procedures given in this paragraph.

b. Inspect for Lubricant Leakage. Visually inspect all gasket joints and plugs for evidence of lubricant leakage. Leakage at gasket joints may be caused by loose mounting bolts or defective gaskets. Tighten all mounting bolts and plugs where leakage has occurred. If mounting bolts and plugs are tight and leakage continues, install new gasket. Install new gasket, when possible, without removing transmission from truck.

c. Inspect for Water in Transmission. Inspect for water in transmission by removing

pipe plug (fig. 238) and noting if water flows from the opening. If there is water, drain and refill transmission (LO 9-2320-211-12). If no water is evident, install pipe (drain) plug promptly to prevent further loss of lubricant.

d. Further Procedure. If these trouble-shooting procedures do not disclose the fault, and the vehicle is operable, proceed as described in paragraph 175.

175. Troubleshooting Before Removal and During Operation

a. General. If the inspections in the preceding paragraph do not reveal causes of failure and the vehicle is operable, then troubleshoot it.

Caution: Check transmission oil level before attempting to operate the vehicle (LO 9-2320-211-12).

b. Troubleshooting Table. The trouble-shooting procedure is arranged in tabular form in Table X below.

Table X. Troubleshooting - Transmissions

Malfunction	probable causes	Corrective action
1. Transmission slips out of gear.	<p>a. Shifter forks loose on shifter shafts.</p> <p>b. Shifter shaft detent grooves worn.</p> <p>c. Gear teeth worn.</p> <p>d. Excessive end play in main drive shaft.</p>	<p>a. Remove shifter housing and tighten shifter forks set-screws (fig. 270) and replace locking wires.</p> <p>b. Remove shifter housing (fig. 271) and install new shifter shafts.</p> <p>c. Disassemble transmission (par. 181) and replace worn gears (fig. 280).</p> <p>d. Tighten main shaft companion flange nut.</p>
2. Transmission operates satisfactorily in reverse and first, but will not shift to second or third.	Defective second and third speed gear synchronizer.	Disassemble transmission (par. 181) and replace gear synchronizer (fig. 278).
3. Transmission operates satisfactorily in reverse, first, second, and third, but will not shift into fourth or fifth.	Defective fourth and fifth speed synchronizer assembly.	Disassemble transmission (par. 181) and replace synchronizer assembly (fig. 252).

176. Troubleshooting After Removal and Before Operation

a. General. After the component has been removed the truck or if it has been received already removed, further inspection is necessary. If the transmission alone has been received for a preliminary check before being installed in the vehicle, or if the operation of the transmission has not been satisfactory due to unknown causes, then test it on a dynamometer as described in paragraph 177.

b. Inspection. Visually inspect the transmission for lubricant leakage and cracks or damaged case, covers, or bearing caps (fig. 261).

177. Troubleshooting After Removal and During Operation

a. General. This paragraph discusses those symptoms which can be diagnosed by operating the transmission on the dynamometer test stand. During these tests be on the alert for any unusual gear noise and lubricant leaks. If any unusual gear noise should develop, immediately stop operation and determine the cause.

b. Oil Level Check. Make sure transmission is filled to proper level with correct lubricant before operating (TM 9-2320-211-10).

c. Shift Test. With an input speed of 1000 to 1100- rpm and no load applied, shift transmission through entire gear range. There should be a definite change in gear noise between each shift. Shifter level should snap into each shift position with no tendency to slip into neutral (par. 175).

d. Power Test. Increase input speed to approximately 1500 rpm and operate transmission for 30 seconds in each shift position with varying torque on input shaft (fig. 260). Be on the alert for unusual gear noises or tendency to slip into neutral (par. 175).

e. Lubricant Leakage. While making the power test (d above), check outside of case for evidence-of lubricant leakage at gasket joints (par. 174). Leakage at bearing cap gaskets may be caused by drain-back holes between bearing caps and case being stopped up. Check drain holes and gaskets to make sure openings are clean.

Section III. REMOVAL AND INSTALLATION

178. Removal

a. Preliminary Operation. Drain transmission and remove power takeoff (par. 203), if so equipped. Remove exhaust pipe (refer to TM 9-2320-211-20).

b. Propeller Shafts. Disconnect front axle drive propeller shaft at transfer case (par. 160). Remove seal retainer on slip joint assembly (fig. 242) from splined stub to allow clearance for transmission removal. Remove transmission-to-transfer case propeller shaft (par. 160).

c. Transfer DeClutch Shift Lines. Disconnect transfer declutch shift lines (fig. 239) at rear of transmission.

Note. Identify each declutch shift line to avoid incorrect reassembly.

Disconnect air supply line at transmission declutch control valve.

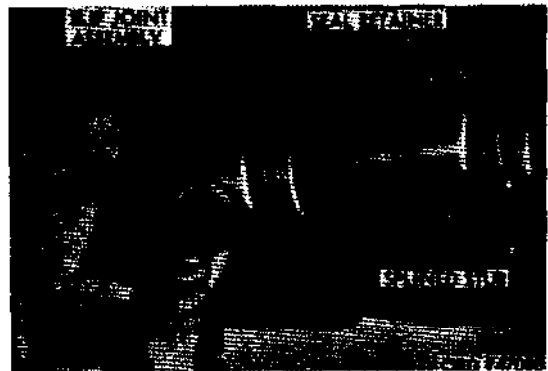


Figure 242. Removing slip joint assembly

d. Disconnect Points Inside Cab.

- (1) Remove cab floor tunnel and gearshift lever. Refer to TM 9-2320-211-20.
- (2) Disconnect transmission vent line (fig. 239) at tee connection and clutch lever linkage.

- (3) Loosen top two (2) transmission-to-flywheel housing cap screws and remove remaining ten (10) cap screws (fig. 243).

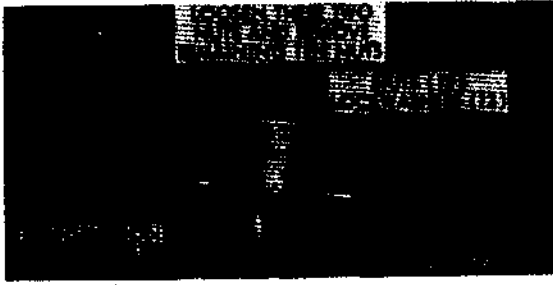


Figure 243. Transmission to flywheel housing cap screws

e. Positioning of Hoist Assembly.

- (1) Install chain around transmission (fig. 244)
- (2) Position hoisting unit over transmission and attach chain to hoist (fig. 244).
- (3) Operate hoist to absorb weight of transmission.

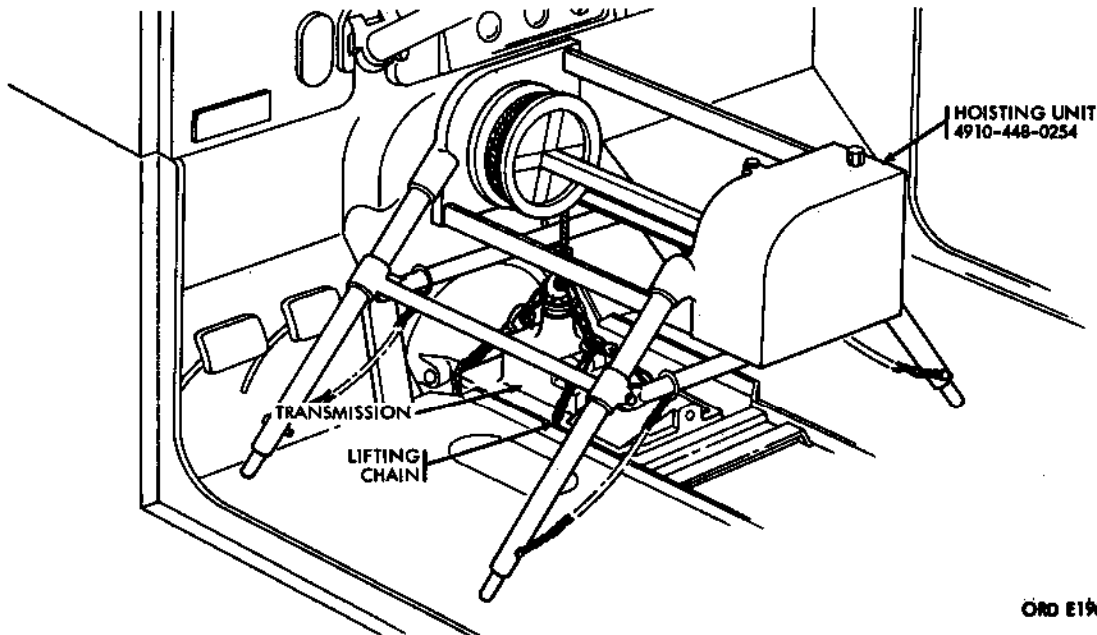


Figure 244. Transmission hoisting unit

f. Removing Transmission.

- (1) Remove two (2) top cap screws securing transmission to flywheel housing (fig. 243).
- (2) Pull transmission toward rear of truck to free main drive gear splines from clutch driven member.

Note. Extreme care should be taken to support weight of the transmission until it is completely removed, so that the main drive gear splines will clear the driven member. Otherwise, there is a possibility of distorting the driven member which will not permit a free release of the clutch.

- (3) Using hoist, lower transmission on to low wheel dolly and remove from under vehicle.

179. Installation

Install transmission in reverse order of removal.

Note. Raise transmission so that the input shaft will slide straight into clutch. Line up and match splines of input shaft and clutch as nearly as possible. If splines do not match properly, place transmission in 4th (or 5th) gear and turn output shaft slightly to match splines.

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Section IV. DISASSEMBLY INTO AND ASSEMBLY FROM SUBASSEMBLIES

180. Preliminary Operations

Before attempting repair operations, thoroughly clean the complete transmission assembly. Remove drain and filler pipe plugs from case and allow lubricant to drain from transmission. Remove side cover, or if transmission is equipped with power takeoff (par. 197), remove six cap screws and lockwashers which hold power takeoff to right side of case. Remove power takeoff and discard gasket.

181. Disassembly

a. Clutch Throwout Shaft Yoke and Release Bearing (Fig. 238).

- (1) Remove screws securing spring clips to release bearing sleeve (one each side) and remove spring clips and release bearing with sleeve assembly.
- (2) Remove cap screws and lockwashers securing release lever yoke to release lever shaft. Slide shaft out from clutch housing far enough to remove yoke. Remove keys from shaft and remove shaft.

b. Shifter Housing and Cover Assembly.

- (1) Remove four cap screws securing shift air cylinder control valve assembly (fig. 245) to transmission shifter housing and lift off the valve assembly.

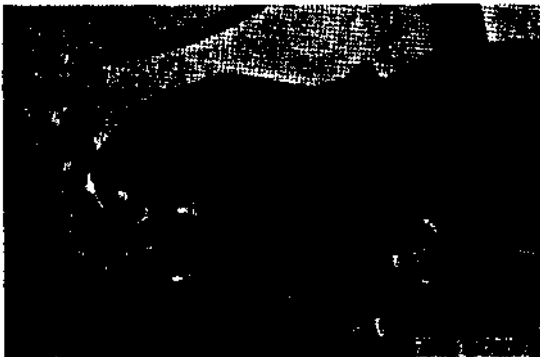


Figure 245. Removing shift air cylinder control valve assembly from shifter housing

- (2) Remove 14 cap screws securing shifter housing assembly (fig. 246) to transmission case after first placing shifter lever in neutral position. Lift shifter housing assembly from transmission case.

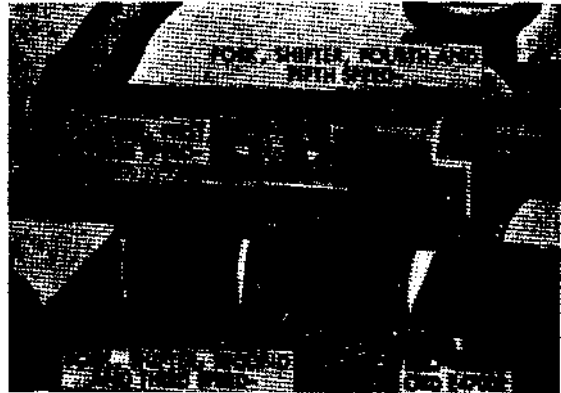


Figure 246. Removing shifter housing assembly

c. Transmission Gears and Shafts.

(1) Input shaft.

- (a) Remove six split lockwasher cap screws securing input shaft bearing cover (fig. 247) to transmission case. Use two cap screws as puller screws in threaded holes to loosen input shaft from case.

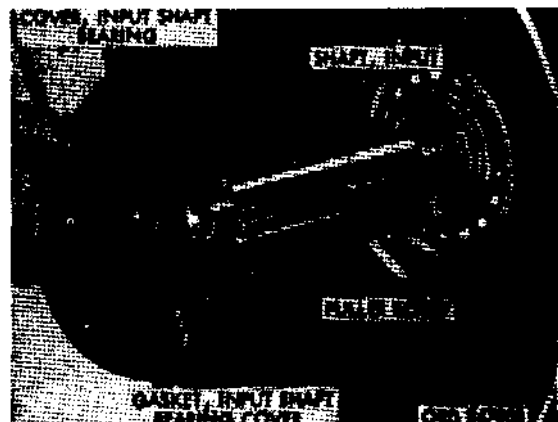


Figure 247. Removing input shaft bearing cover

- (b) Tap input gear lightly with a soft hammer and pull input shaft and ball bearing assembly (fig. 248) from transmission case.

Note. The pilot bearing rollers (14) for the main shaft, will fall into bottom of case and can be removed later.



Figure 248. Removing input shaft ball bearing assembly

(2) Main shaft assembly.

- (a) Remove cotter pin and slotted nut. Use a universal puller to remove companion flange (fig. 249) from main shaft.

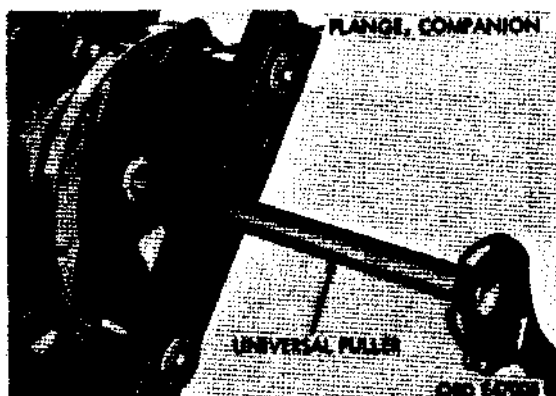


Figure 249. Removing companion flange

- (b) Remove four cap screws and lock washers and lift off rear bearing cover (fig. 250). Discard gasket

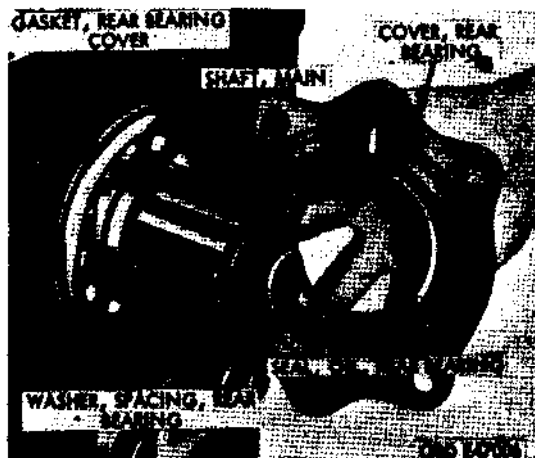


Figure 250. Removing rear bearing cover

- (c) Start main shaft assembly and bearing assembly from transmission case and attach universal puller to main shaft rear ball bearing (fig. 251). Pull bearing from main shaft.

Note. Puller can be attached to outer race only. Exercise care to prevent bearing damage.



Figure 251. Removing main shaft rear ball bearing

- (d) Slide main shaft assembly with gears to the rear of the transmission case and lift out fourth and fifth speed gear synchronizer (fig. 252).

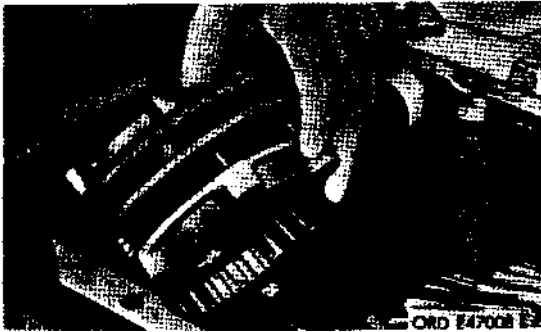


Figure 252. Remove fourth and fifth speed gear synchronizer from main shaft

- (e) Secure rope sling to front and rear end of main shaft assembly with "gears (fig. 253) and lift the assembly from the transmission case.



Figure 253. Lifting main shaft, with gears, from transmission case

(3) Reverse idler gear and shaft assembly.

- (a) Remove four cap screws securing countershaft rear bearing cover (fig. 254) and lift off cover assembly.
- (b) Use a pinch bar to start reverse idler gear shaft (fig. 255) out of transmission case.



Figure 254. Removing countershaft rear bearing cover

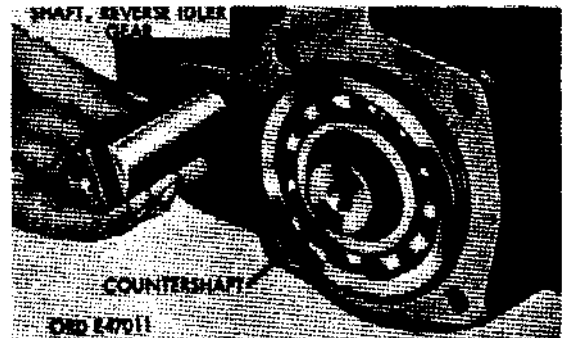


Figure 255. Removing reverse idler gear shaft

- (c) Pull reverse idler gear, shaft from transmission case and lift out reverse idler gear (fig. 256) and reverse idler gear bearings.

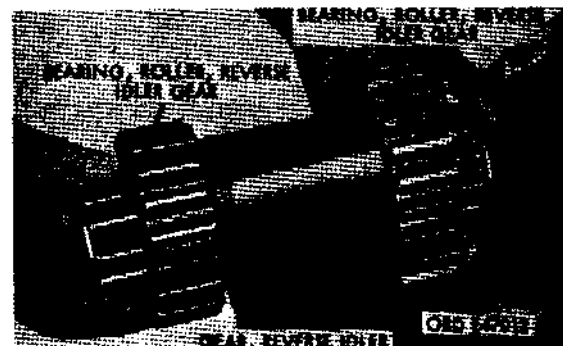


Figure 256. Removing reverse idler gear assembly

(4) Countershaft assembly.

- (a) Remove cotter pin and slotted nut. Using a pry bar, force the countershaft assembly with gears toward rear of transmission case (fig. 257), forcing countershaft rear ball bearing from case. Attach a universal puller and pull rear bearing from countershaft. Refer to note in (2)(c) above.

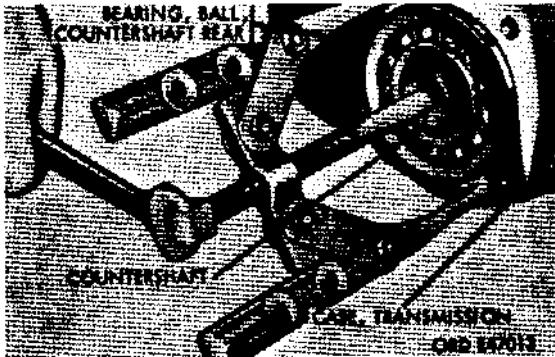


Figure 257. Pulling countershaft rear bearing

- (b) Attach a rope sling and lift countershaft (fig. 258) with gears from transmission case.



Figure 258. Lifting countershaft with gears from transmission case

- (c) If clutch housing is not removed, use a pinch bar to remove countershaft front roller bearing (fig. 259).



Figure 259. Removing countershaft front roller bearing from transmission case

182. Assembly

a. Transmission Gears and Shafts.

(1) Countershaft assembly.

- (a) Place countershaft front roller bearing (NN, fig. 260) in front bearing bore of transmission case (H, fig. 261).
- (b) Place countershaft and gear assembly in transmission case (H, fig. 261) by lowering rear end of countershaft into case first, and then sliding countershaft assembly forward into position in countershaft front roller bearing (NN; fig. 260).
- (c) Install countershaft rear ball bearing (Z, fig. 280) in rear bearing bore of transmission case. Install slotted nut (Y, fig. 260) and tighten securely. Place cotter pin (S, fig. 260) in countershaft and locknut.

(2) Reverse idler gear assembly.

- (a) Place reverse idler gear (DD, fig. 260) with the two reverse idler gear roller bearings (BB, fig. 260) in transmission case (H, fig. 261), with the largest gear towards front of transmission and in mesh with countershaft gears.
- (b) Place reverse idler gear shaft (AA, fig. 260) in hole provided in rear of

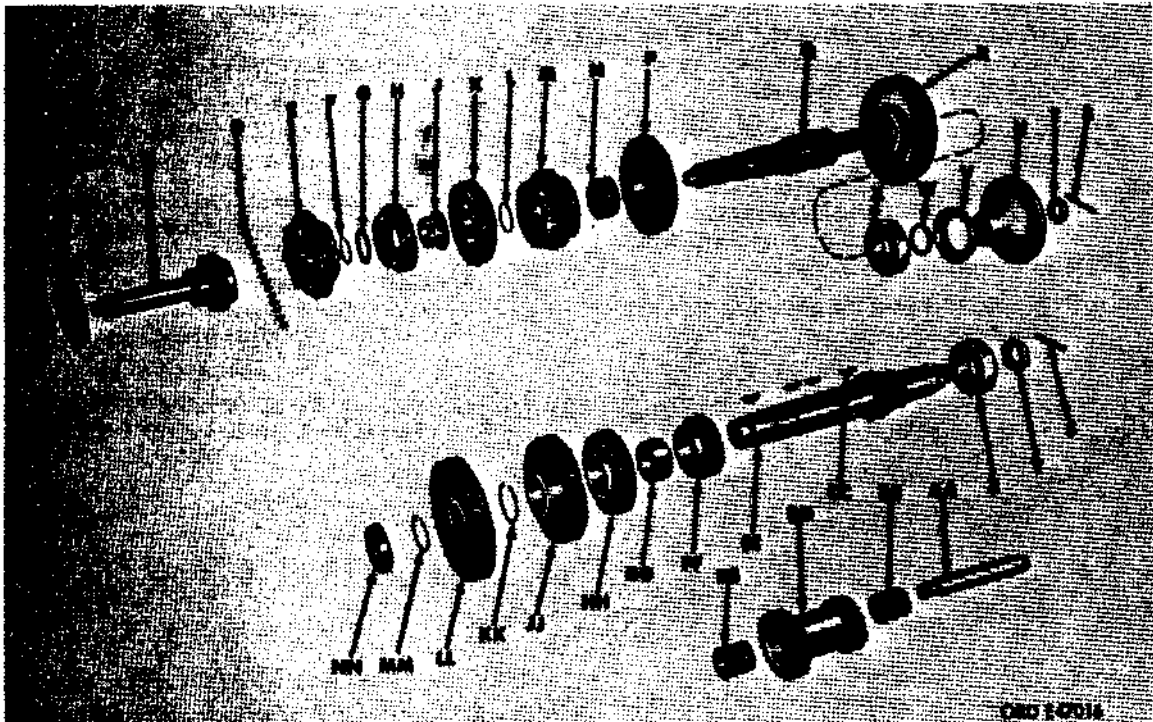


Figure 260. Transmission gears and shafts - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Ring, snap, bearing	U	Flange, companion
B	Bearing, ball, input shaft	V	Slinger, dust
C	Shaft, input	W	Washer, spacing, rear bearing
D	Roller, pilot, bearing	X	Bearing, ball, main shaft, rear nut, slotted
E	Synchronizer, fourth and fifth speed gear	Z	Bearing, ball, countershaft, rear
F	Ring, snap, fourth speed gear	AA	Shaft, reverse idler gear
G	Washer, thrust	BB	Bearing, roller, reverse idler gear
H	Gear, fourth speed	CC	Key, Woodruff
J	Sleeve, fourth speed gear	DD	Gear, reverse, idler
K	Gear, third speed	EE	Countershaft
L	Ring, snap, second and third speed clutch gear	FF	Gear, second speed, countershaft
M	Synchronizer, second and third speed gear	GG	Spacer, countershaft
N	Gear, second and third speed clutch	HH	Gear, third speed, countershaft
P	Gear, second speed	JJ	Gear, fourth speed, countershaft
Q	Shaft, main	KK	Ring, snap, fourth speed gear, countershaft
R	Gear, first and reverse speed	LL	Gear, drive, countershaft
S	Pin, cotter	MM	Ring, snap, drive gear, countershaft
T	Nut, slotted	NN	Bearing, roller, countershaft, front

Figure 260. Transmission gears and shafts - exploded view - legend

transmission case and align reverse idler shaft with flat milled side toward countershaft (EE, fig. 260), so that countershaft rear bearing cover (R, fig. 261) will lock shaft.

- (c) Place countershaft rear bearing cover gasket (S, fig. 261) in position and install countershaft rear bearing cover (R, fig. 261). Add five lockwashers (Q, fig. 261) and cap screws (P, fig. 261) and tighten securely.

Note. The protruding part on countershaft rear bearing cover (R, fig.

261) must lock reverse idler gear shaft (AA, fig. 260).

(3) Main shaft assembly.

- (a) Remove fourth and fifth speed gear synchronizer (E, fig. 260) and attach a rope sling to main shaft assembly.
- (b) Place main shaft assembly in transmission case by lowering rear end of main shaft first through main shaft rear bearing bore in case, and then lowering the front end into position with countershaft gears.

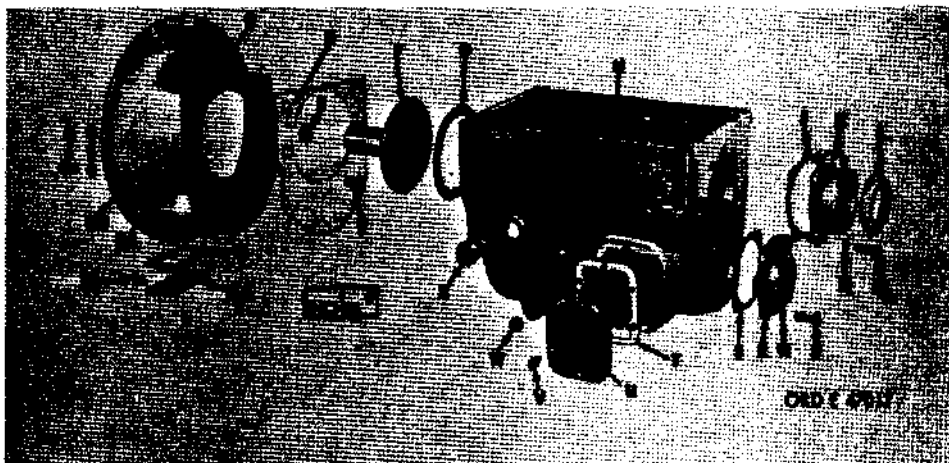


Figure 261. Transmission case and bearing caps - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Screw, cap	R	Cover, countershaft rear bearing
B	Washer, lock	S	Gasket, countershaft rear bearing cover
C	Housing, clutch	T	Gasket, power takeoff cover
D	Gasket, clutch housing	U	Cover, power takeoff hole
E	Plug, expansion	V	Screw, split lockwasher
F	Cover, input shaft bearing	W	Plug, pipe
G	Gasket, input shaft bearing cover	X	Plug, pipe
H	Case, transmission	Y	Screw, cap, split lockwasher
J	Gasket, rear bearing cover	Z	Gasket, clutch housing inspection cover
K	Cover, rear bearing	AA	Cover, inspection, clutch housing
L	Seal, oil, rear bearing	BB	Screw, split lockwasher
M	Screw, cap	CC	Fitting, lubricating
N	Washer, lock	DD	Seal, oil, release lever shaft
P	Screw, cap		
Q	Washer, lock		

Figure 261. Transmission case and bearing caps - exploded view - legend

- (c) Install main shaft rear ball bearing (X, fig. 260) on main shaft with bearing snap ring towards rear of case.
- (d) Press main shaft rear ball bearing (X, fig. 260) on main shaft (Q, fig. 260) and into rear bore of transmission case (H, fig. 261). Place rear bearing spacing washer (W, fig. 260) next to main shaft rear ball bearing.
- (e) Place fourth and fifth speed gear synchronizer (E, fig. 260) on front end of main shaft (Q, fig. 260) with the smaller diameter bronze cone towards the front.

(4) Input shaft assembly.

- (a) Place a generous amount of grease (general purpose lubricating grease (CG) into pocket of input shaft (fig. 262). Position pilot bearing rollers (14 required) into pocket of input shaft, the last roller being placed into position endwise due to the construction of the bearing.

Note. The general purpose lubricating grease (CG) will provide lubricant for initial start.

- (b) Position input shaft (fig. 262) in transmission case front end.

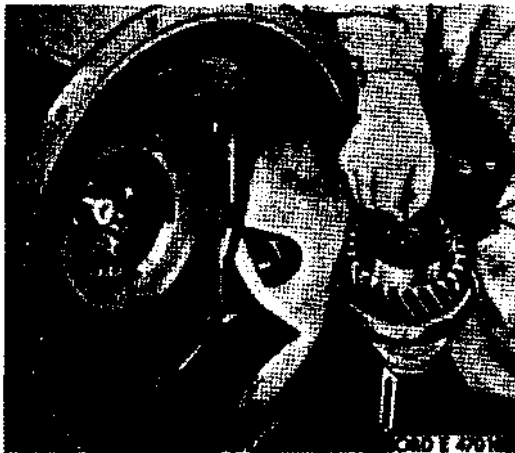


Figure 262. Assembling pilot bearing rollers into input shaft pocket

Note. A slight twisting motion of the input shaft will facilitate proper seating of pilot bearing rollers.

- (c) Tap input shaft ball bearing (B, fig. 260) into position in front bore of transmission case.
 - (d) Use a new input shaft bearing cover gasket (G, fig. 261) and position input shaft bearing cover (F, fig. 261) with oil channel towards lower part of case, over input shaft (C, fig. 260). Install six split lockwasher cap screws (Y, fig. 261) and tighten securely.
 - (e) Use new rear bearing cover gasket (J, fig. 261); install rear bearing cover (K, fig. 261) and oil seal assembly.
- Caution: Anne oil holes in case, gasket, and rear bearing cover. See that oil seal lip is toward transmission; if not, install new seal.
- Install four cap screws (M, fig. 261) and lockwashers (N, fig. 261) and tighten securely.
- (f) Install companion flange (U, fig. 260) on salines at rear end of main shaft (Q, fig. 260). Use flange replacer 5120-795-0147 (fig. 263) to install flange. Assemble slotted nut (T, fig. 260) and tighten securely, Anne cotter pin hole and install cotter pin (S, fig. 260).

b. Shifter Housing and Cover Assembly.

- (1) Place shifter lever (B, fig. 273) in neutral position and use new shifter housing gasket (X, fig. 272).
- (2) With the new shifter housing gasket in position on the transmission case (H, fig. 261), place shifter housing assembly over case, making sure all shifter forks are properly aligned with shift collars in transmission. Refer to figure 246 for proper alignment of forks and gears.
- (3) Install fourteen split lockwasher screws (A, fig. 272) and tighten securely.

- (4) Install control valve housing.

c. Power Takeoff or Side Covers. Install power takeoff hole covers (U, fig. 261) with new power takeoff cover gaskets (T, fig. 261) and secure with six split lockwasher screws (V, fig. 261). If transmission is equipped with a power takeoff, place power takeoff and new gasket in position on right side of transmission case. Install split lockwasher screws and tighten securely.

d. Clutch Throwout Shaft, Yoke, and Release Bearing.

- (1) Start clutch throwout shaft into clutch housing from left side.
- (2) Place a small amount of lubricant, comparable to general purpose lubricating grease (CG), in clutch throwout bearing sleeve bore and slide bearing assembly onto input shaft bearing cover.

- (3) Hold clutch throwout shaft yoke in position and slide shaft through yoke. Install keys and lock yoke on shaft with two cap screws and lockwashers.



Figure 263. Installing companion flange using flange replacer -5120-795-0147

Section V. REPAIR

183. Shifter Housing and Cover Assemblies

a. Disassembly.

(1) Housing cover.

- (a) Remove finger plunger spring retainer (fig. 264) from side of shifter housing and pull out finger plunger compression spring and finger plunger.

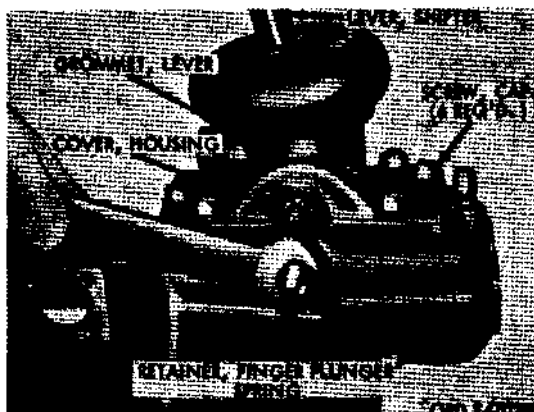


Figure 264. Removing finger plunger spring retainer

- (b) Remove six cap screws and lockwashers securing housing cover assembly (fig. 265) to shifter housing, and lift off cover assembly.

- (c) Slide lever grommet (fig. 266) onto shifter lever. Use a screwdriver to pry spring snap ring loose from its

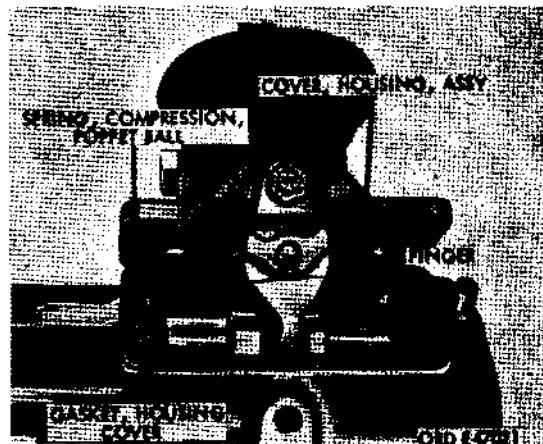


Figure 265. Removing housing cover assembly

seat in the housing cover. Loosen screw (fig. 266) and pull shifter lever free of housing cover.

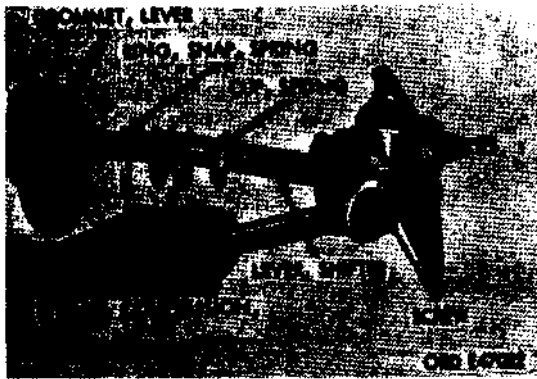


Figure 266. Disassembling shifter lever from housing

- (d) Use a punch to drive pivot pin (fig. 267) securing lever retainer to shifter lever and disassemble.

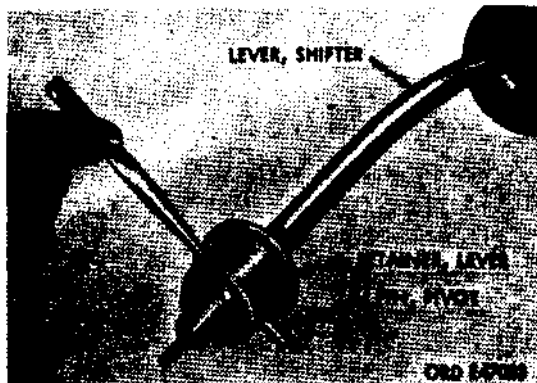


Figure 267. Removing pivot pin from shifter lever retainer

- (e) Remove hex-nut and lockwasher from shoulder bolt securing finger (fig. 268) to housing cover and remove finger.
- (2) Shifter housing.
- (a) Remove finger plunger (fig. 269) from shifter housing. Turn housing over

and remove poppet ball compression spring and balls.

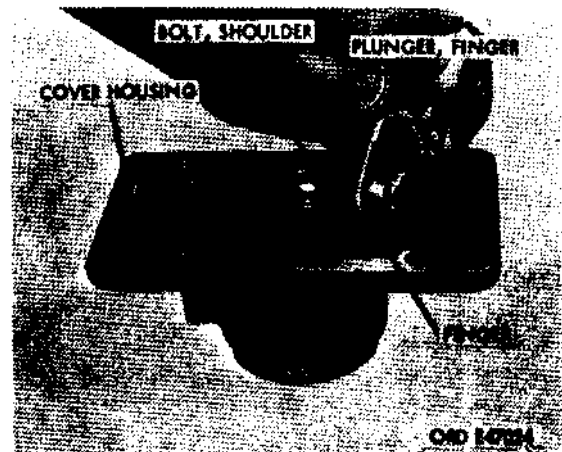


Figure 268. Disassembling finger from housing cover



Figure 269. Removing poppet ball compression springs, balls, and finger plunger

- (b) Cut locking wires and remove five setscrews (fig. 270).
- (c) Use shifter shafts to tap out expansion plugs (fig. 271) from shifter housing. Pull fourth and fifth speed shifter shaft from shifter housing and lift out shifter fork. Remove first and reverse, second and third speed shifter shafts and forks in the

same manner, Shifter shaft interlocks will fall out at time shifter shafts are removed.

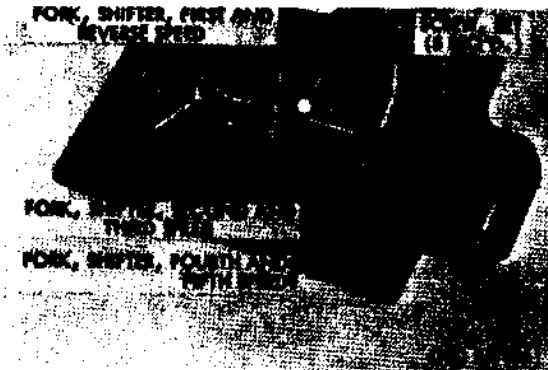


Figure 270. Disassembling shifter forks and shafts

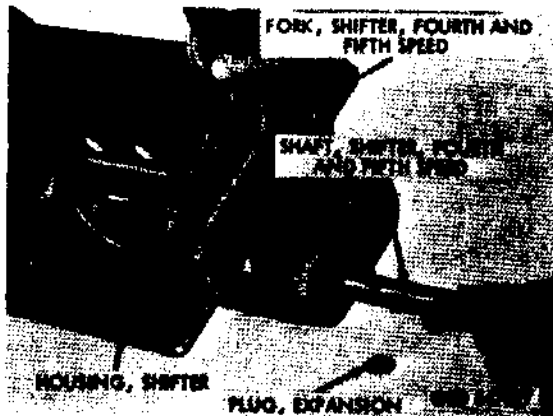


Figure 271. Removing shifter shafts and forks

b. Cleaning, Inspection and Repair.

- (1) **Cleaning.** Clean all parts thoroughly mineral spirits paint thinner or dry-cleaning solvent. If available, steam may be used to remove accumulation of grease and dirt after solvent has been applied. Rinse all parts in clean solvent and blow dry with compressed air.
- (2) **Inspection and repair.**
 - (a) Inspect shifter housing and housing cover for cracks and replace if cracks exist.

- (b) Examine shifter shafts and forks for excessive wear on scoring. Replace shifter forks that are bent, scored, or excessively worn.
- (c) Check poppet springs, finger plunger spring, and shifter lever spring for proper tension (par. 190) and replace, if defective.
- (d) Inspect shifter lever for indications of excessive wear, especially at ball. Replace lever if wear is evident.

c. Assembly.

(1) Shifter housing assembly (fig. 272).

- (a) Place shifter housing (B) upside down on bench, with front end of cover to the right. Install first and reverse speed shifter shaft (F) in shifter housing (B), through the upper front shifter shaft hole. Slide shifter shaft through first and reverse speed shifter shaft bracket (S), and on through the shifter housing and add first and reverse speed shifter fork (E). Install shifter fork setscrews (T and U, fig. 269 and fig. 270) and secure with locking wires.
- (b) Install shifter shaft interlock (Q) in shifter housing (B).
- (c) Start second and third speed shifter shaft (H) in center hole in front of shifter housing (B). Add second and third speed shifter shaft bracket (N) and second and third speed shifter fork (G). Install setscrews (P and R, fig. 272) and lock with locking wire.
- (d) Install shifter shaft interlock (J) in shifter housing (B).
- (e) Start fourth and fifth speed shifter shaft (K) in front of shifter housing (B) and slide shaft through fourth and fifth speed shifter fork (L). Install setscrew (M, fig. 272) and secure in place with locking wire.
- (f) Install expansion plugs (W) into openings at front end of shifter housing (B). Tap plugs with a ball peen hammer to lock into place.

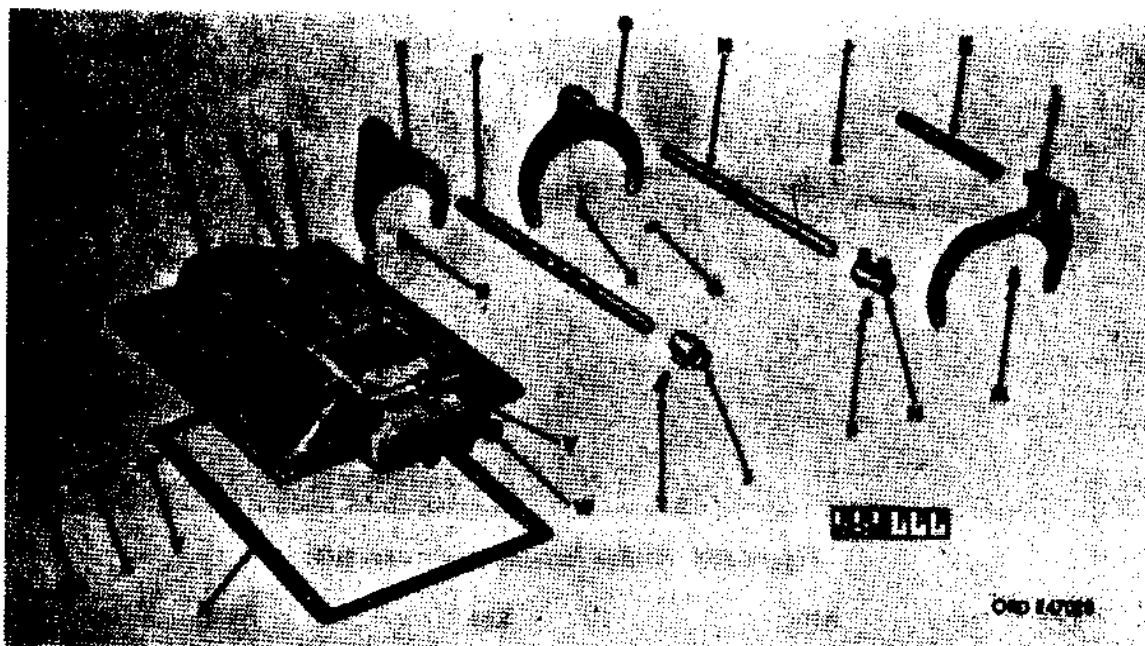


Figure 272. Shifter housing assembly - exploded view

Key	Item	Key	Item
A	Screw, split lockwasher	P	Screw, set
B	Housing, shifter	Q	Interlock, shifter shaft
C	Ball, poppet	R	Screw, set
D	Spring, compression, poppet ball	S	Bracket, first and reverse speed shifter shaft
E	Fork, shifter, first and reverse speed	T	Screw, set
F	Shaft, shifter, first and reverse speed	u	Screw, set
G	Fork, shifter, second and third speed	v	Vent, air, assembly
H	Shaft, shifter, second and third speed	w	Plug, expansion
J	Interlock, shifter shaft	x	Gasket, shifter housing
K	Shaft, shifter, fourth and fifth speed	Y	Plunger, finger
L	Fork, shifter, fourth and fifth speed	z	Spring, compression, finger plunger
M	Screw, set	AA	Retainer, finger plunger spring
N	Bracket, second and third speed shifter shaft		

Figure 272. Shifter housing assembly - exploded view - legend

(2) Shifter housing cover assembly (fig. 273).

- (a) Place shoulder bolt (Q) through-finger (N) and through housing cover (S). Install lockwasher (R) and hex-nut (L) and tighten securely.
- (b) Place shifter lever (B) in lever retainer (H) and install pivot pin (G).

(c) Place shifter lever (B) and lever retainer (H) assembly in housing cover (S) and secure with external teeth lockwasher (T) and screw (U).

(d) Place spring cup (F), lever compression spring (E), and spring snap ring (D) on shifter lever (B) in order named. Secure spring snap ring (D) in housing cover (S).

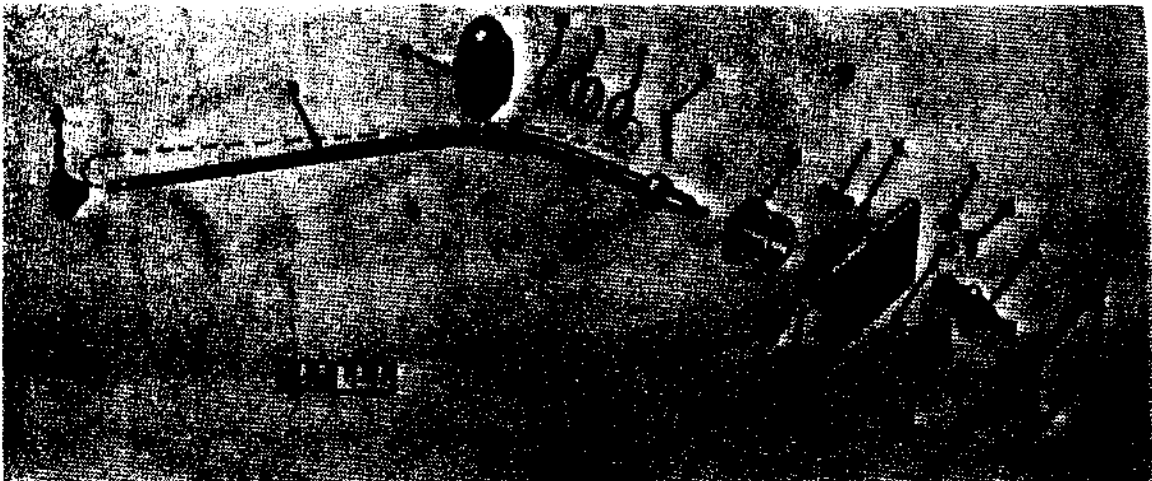


Figure 273. Shifter housing cover assembly

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Knob, lever	L	Nut, hex
B	Lever, shifter	M	Plunger, finger
C	Grommet, lever	N	Finger
D	Ring, smp, spring	P	Gasket, housing cover
E	Spring, compression, lever	Q	Bolt, shoulder
F	cup, spring	R	Washer, lock
G	Pin, pivot	S	Cover, housing
H	Retainer, lever	T	Washer, lock, external teeth
J	Screw, cap	U	Screw
K	Washer, lock		

Figure 273. Shifter housing cover assembly - legend

- (e) Place lever grommet (C) over shifter lever (B) and onto cover housing (S).

(3) Housing cover assembly to shifter housing.

(a) Place finger plunger (M, fig. 273) in finger (N, fig. 273).

(b) Place shifter shaft poppet balls (C, fig. 272) and poppet balls compression springs (D, fig. 272) in position in shifter housing (B, fig. 272).

(c) Use a new housing cover gasket (P, fig. 273) and place housing cover assembly in position on shifter housing (B, fig. 272). Install six lockwashers (K, fig. 273) and cap screws (J, fig. 273) and tighten securely.
- (d) Place finger plunger (Y, fig. 272) and finger plunger compression spring (Z, fig. 272) in shifter housing (B, fig. 272). Install finger plunger spring retainer (AA, fig. 272) and tighten securely.

184. Transmission Gears and Shafts

a. Disassembly.

(1) Input shaft assembly.

- (a) Remove bearing snap ring (fig. 274) securing input shaft ball bearing to input shaft. Use a universal puller to pull input shaft ball bearing from input shaft.

speed gear synchronizer from main shaft.

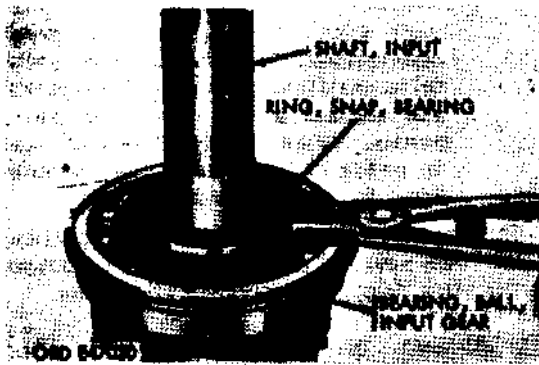


Figure 274. Disassembling input shaft assembly

- (b) Use a universal puller or arbor press to remove input shaft ball bearing from input shaft. Refer to note in paragraph 181(2)(c).

(2) Main shaft assembly.

- (a) Slide first and reverse speed gear (fig. 275) from main shaft.



Figure 275. Removing first and reverse speed gear

- (b) Remove fourth speed gear snap ring (fig. 276).
- (c) Remove thrust washer (fig. 277) and lift off fourth speed gear from main shaft.
- (d) Install universal puller on third speed gear (fig. 278) and pull fourth speed gear sleeve and third speed gear from main shaft. Slide second and third

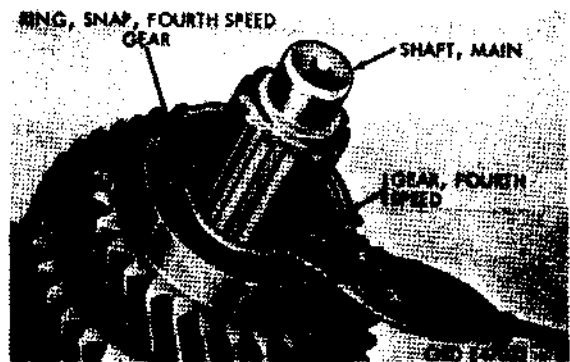


Figure 276. Removing fourth speed gear snap ring



Figure 277. Disassembling fourth speed gear and thrust washer



Figure 278. Disassembling fourth speed gear sleeve

- (e) Remove second and third speed clutch gear snap ring (fig. 279); and slide second and third speed clutch gear and second speed gear from main shaft.

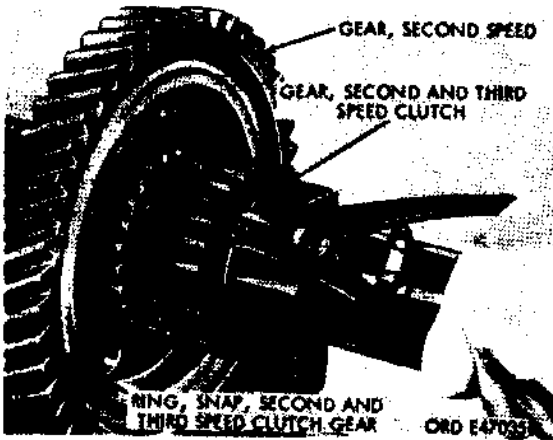


Figure 279. Removal of second and third speed clutch gear

(3) Countershaft assembly.

- (a) Remove countershaft drive gear snap ring (fig. 280). Place the countershaft assembly in a press and press countershaft drive gear from countershaft. Remove Woodruff key and hone any nicks or burrs from the shaft with a hone stone.



Figure 280. Removing countershaft drive gear

- (b) Remove countershaft fourth speed gear snap ring (fig. 281) and press countershaft from fourth speed gear, third speed gear, countershaft spacer, and second speed gear, in order named. Remove the Woodruff key in order and hone any nicks or burrs from the shaft with a hone stone.
- (4) Reverse idler gear assembly. Pull the two reverse idler gear roller bearings (fig. 256) from reverse idler gear.

b. Cleaning, Inspection and Repair.

- (1) **Cleaning.** Clean shafts, gears, sleeves, washers, and bearings in **dry-cleaning solvent or mineral spirits paint thinner** to remove all grease and dirt. Dry with compressed air.

Caution: Direct compressed air at right angle to bearing races. Do not allow compressed air to spin bearing races.

(2) Inspection and repair.

- (a) Bearings. Apply clean engine oil (OE) to bearings. Turn bearings slowly. Ball bearings must turn freely and smoothly if they are to be used again. Replace any assembly which is pitted, scored, rough, or excessively worn. Replace all main shaft pilot rollers which show signs of pitting, scoring, or excessive wear.

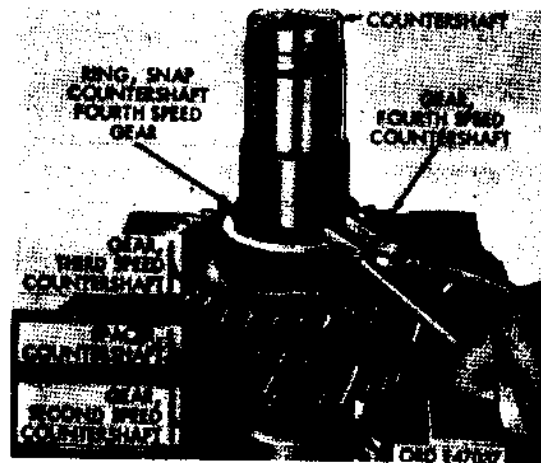


Figure 281. Disassembling countershaft assembly

(b) Shafts. Inspect the machined surfaces on each shaft on which gears, sleeves, or bearings turn. Shafts which are scored or pitted at these points must be replaced. Examine the input shaft splines for wear or twist. Place gears on splines and check for clearance. If excessive clearance at splines or evidence of twisted or cracked splines is noted, replace shafts. Also check for cross threading or other damage on shafts.

(c) Gears. Examine the gear teeth for damage and wear. Gears with broken, chipped, cracked, or excessively worn teeth must be replaced. Small defects such as nicks or burrs can be corrected with a hone stone.

Caution: If defects cannot readily be corrected, replace gear.

(d) Synchronizer assemblies. Inspect synchronizer assemblies for nicks, scratches, or excessive wear, paying particular attention to the splines. The synchronizer units are not to be repaired. Replace complete assembly if defects are found.

(e) Thrust washers, sleeves, and snap rings. Inspect thrust washers and snap rings; discard those which are damaged. Measure thrust washer thickness (par. 190); replace if found to be worn.

c. Assembly (Fig. 260).

(1) Reverse idler gear assembly. Place the two reverse idler gear roller bearings (BB), one in each end, in the reverse idler gear (DD).

(2) Countershaft assembly.

(a) Place Woodruff key (CC) for countershaft second speed gear (FF) in position in the countershaft (EE). Coat countershaft and bore of gear with white lead pigment, and press countershaft second speed gear on countershaft with long hub of gear toward the front.

(b) Add countershaft spacer (GG) and position Woodruff key (CC) in counter-

shaft (EE). Coat countershaft third speed gear (HH) bore with white lead pigment, and press into position on countershaft with the long hub toward front.

(c) Place the Woodruff key (CC) in position in the countershaft and press countershaft fourth speed gear (JJ) on countershaft (EE) with long hub toward the front. Install new countershaft fourth speed gear snap ring (KK).

(d) Place the Woodruff key (CC) in countershaft (EE). Coat bore of countershaft drive gear (LL) with white lead pigment, and press countershaft drive gear with long hub towards rear on countershaft (EE). Add new countershaft drive gear snap ring (MM).

(3) Input shaft assembly.

(a) Coat input shaft and bore of roller bearing with white lead pigment, and press input shaft ball bearing (B) into position on input shaft (C).

Caution: Do not press on outer race of bearing. Use a sleeve or adapter and press on inner race.

(b) Install new bearing snap ring (A) securing input shaft ball bearing (B) to input shaft (C).

(4) Main shaft assembly.

(a) Slide second speed gear (P) on main shaft (Q) with synchronizer cone towards the front.

(b) Slide second and third speed clutch gear (N) into position on main shaft (Q), and install new second and third speed clutch gear snap ring (L).

(c) Slide second and third speed gear synchronizer (M) onto main shaft (Q), and into position over second and third speed clutch gear (N).

(d) Slide third speed gear (K), with synchronizer cone towards the rear, onto main shaft (Q).

(e) Coat bore of fourth speed gear sleeve (J) with white lead pigment, and press

into position on main shaft (Q) with the collar end towards the rear.

- (f) Place fourth speed gear (H) with synchronizer cone towards the front, into position over the fourth speed gear sleeve (J). Position thrust washer (G) on main shaft (Q) and add new fourth speed gear snap ring (F).
- (g) Place first and reverse speed gear (R) on splines at rear end of main shaft (Q) with the shift fork collar towards front end of main shaft.
- (h) The fourth and fifth speed gear synchronizer (E) can temporarily be placed onto main shaft, but must be removed to facilitate lifting main shaft assembly into transmission case.

185. Transmission Case and Clutch Housing Assembly

a. Disassembly.

- (1) General. It is not necessary to remove the clutch housing from the transmission case unless it is cracked or damaged and must be replaced. If clutch housing must be removed, the following procedure will apply.
- (2) **Remove clutch release bearing assembly. Slide clutch release bearing from input shaft bearing cover.**
- (3) Remove clutch throwout shaft. Remove two cap screws, lockwashers, and keys holding clutch throwout shaft

yoke to throwout shaft. Pull shaft from housing and remove yoke.

- (4) Remove clutch housing. Remove seven cap screws and lockwashers securing clutch housing to transmission case. Remove clutch housing and discard clutch housing gasket.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Use suitable scraper to remove gasket cement and portions of gaskets from case, cover, clutch housing, and bearing caps. Wash case and housing thoroughly with mineral spirits paint thinner.
- (2) Inspection and repair. Carefully inspect transmission case and clutch housing for cracks. Replace if any are evident. Inspect all machined surfaces for nicks or deep scratches. Remove nicks or raised metal with a fine mill file. Replace case or housing if scratches or nicks are too deep to provide good sealing surfaces. Check plug threads for wear or damage. Install plugs in transmission case to avoid loss.

c. Assembly (Fig. 261). Place new clutch housing gasket (D) in position on transmission case (H). Position clutch housing (C) on front of transmission case and install seven cap screws (A) and lockwashers (B). Tighten securely. The clutch throwout shaft, yoke, and release bearing are assembled to the transmission after transmission assembly has been completed, and prior to installation on the vehicle.

Section VI. TESTS AND ADJUSTMENTS

186. Preparation for Tests

Fill transmission with correct lubricant (TM 9-2320-211-10) to proper level before testing. Assemble transmission to a dynamometer or engine.

187. Shift Test

Shift transmission through entire gear range while in operation. Shifter lever should snap into each position with no tendency to slip into neutral. There should be a definite change in gear noise between each shift.

188. Power Test

a. Operate transmission in each shift position with varying torque on input shaft and listen for unusual gear noises that would indicate gears not fully in mesh or more than normal clearance between teeth. Also watch for any tendency to slip out of gear and into neutral.

b. While making the power test, check outside of case for lubricant leakage at gasket joints.

Section VI. SERVICEABILITY STANDARDS

189. General

The serviceability standards included herein give the minimum, maximum, and key clearances of new or repaired parts. They also give wear limits which indicate that point to which apart or parts maybe worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear limits" column *or* damaged from corrosion will be approved for

service. In the "Size and fit of new parts" column, the letter "L" indicates a loose fit (clearance) and the letter "T" indicates a loose fit (interference). All measurements are given in inches, unless indicated otherwise.

190. Serviceability Standards

Serviceability standards for the transmission are listed in figure 282 and Table XI.

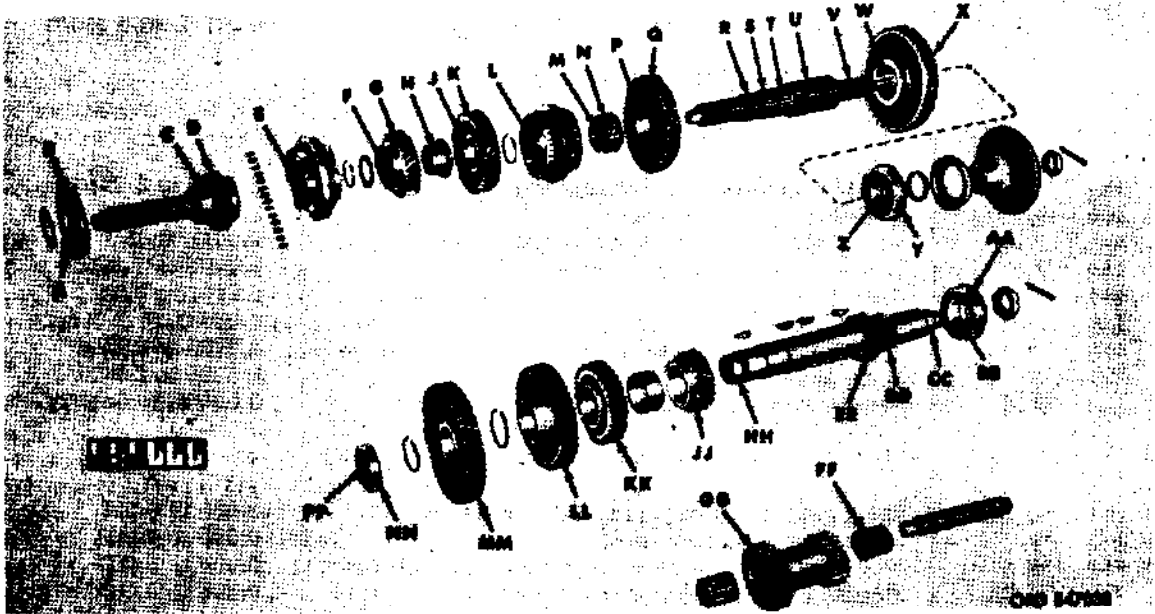


Figure 282. Serviceability standard points of measurement for transmission gear and shafts

Table XI. Serviceability Standards - Transmissions

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts
		<u>SHIFTER HOUSING AND COVER ASSEMBLY</u>	
272	D	Free length of compression spring (shifter shaft) Compression spring (shifter shaft) compressed to 31/32 in.	1-23/64 in. 21 to 25 lb
272	Z	Free length of compression spring (finger plunger) Compression spring (finger plunger) compressed to 1-5/8 in.	2-1/32 in. 56 to 64 lb

Table XI. Serviceability Standards - Transmission - Continued

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts
<u>BEARINGS</u>			
282	A-C	Input gear bearing to shaft	0.0001L to 0.001T
282	B	Input gear bearing to case	0.0000 to 0.002L
282	Z-V	Main shaft bearing to shaft	0.0004L to 0.0007T
282	BB-CC	Countershaft rear bearing to shaft	0.0002L to 0.0007T
282	AA	Countershaft rear bearing to case	0.0016L to 0.000T
282	PP-HH	Countershaft front bearing to shaft	0.0005L to 0.0015L
282	NN	Countershaft front bearing to case	0.0018L to 0.000T
<u>SHAFTS AND GEARS</u>			
Diameters and Clearances			
282	F	Inside diameter of fourth speed gear	2.7535 to 2.7540
282	H	Fourth speed gear sleeve	2.7490 to 2.7495
282	F-H	Fit on sleeve of fourth speed gear	0.004L to 0.005L
282	J	Inside diameter of third speed gear	2.6250 to 2.6255
282	R	Main shaft	2.2610 to 2.2615
282	J-R	Third speed gear to shaft	0.0035L to 0.0045L
282	P	Inside diameter to second speed gear	2.8725 to 2.8730
282	T	Main shaft	2.6735 to 2.8730
282	P-T	Second speed gear to shaft	0.0035L to 0.0045L
Backlash			
282	D-MM	Input gear to countershaft drive gear	0.006 to 0.009
282	E	Input gear to synchronizer	0.004 to 0.009
282	E-F	Fourth speed gear to synchronizer	0.004 to 0.007
282	G-LL	Fourth speed gear to countershaft gear	0.006 to 0.009
282	K-KK	Third speed gear to countershaft gear	0.0006 to 0.009
282	L	Third speed gear to synchronizer	0.004 to 0.009
282	N-L	Second and third speed clutch gear to synchronizer	0.004 to 0.007
282	M-S	Second and third speed clutch gear to shaft	0.000 to 0.003
282	L	Second speed gear to synchronizer	0.004 to 0.009
282	Q-JJ	Second speed gear to countershaft gear	0.006 to 0.009
282	U-W	First and reverse speed gear to main shaft	0.004 to 0.007
282	X-DD	First and reverse speed gear to countershaft gear	0.008 to 0.011
282	EE-GG	Reverse idler gear to countershaft gear	0.008 to 0.011
282	X-FF	Reverse idler gear to mainshaft gear	0.005 to 0.011
<u>FOURTH SPEED GEAR THRUST WASHER</u>			
282	G	Thickness -- sides must be parallel	0.151 to 0.153

CHAPTER 16

CLUTCH CONTROLS AND LINKAGE

16 Section I. DESCRIPTION AND DATA

191. Description

The clutch is a single plate, dry-disk unit secured to the rear of the engine flywheel by 12 cap screws. When installed in the power plant, the clutch is completely enclosed by the clutch housing and the flywheel housing, which is bolted to the front of the transmission. The clutch permits operation of the engine when the vehicle is at a standstill and permits the selection of different transmission gear ratios when the vehicle is in motion. Depressing the clutch pedal causes the release fork to move the release bearing forward on the transmission input shaft and contact the release levers. Pressure of the bearing on the release

levers relieves pressure of the compression springs on the pressure plate. Therefore, when the clutch pedal is fully depressed, the clutch is fully released. When the clutch pedal is fully released, the clutch is fully engaged. Removal and installation procedures for the clutch, controls, and linkage are covered in TM 9-2320-211-20.

192. Data

Make	Rockford
Model	15 TT
Type	single dry plate
Size	15 in.
Weight75lb

Section II. REPAIR

193. Pilot Bearing

Refer to TM 9-2815-207-35.

194. Clutch Driven Disk

Refer to TM 9-2815-207-35.

195. Pressure Plate

Refer to TM 9-2815-207-35.

196. Clutch Release Bearing

Refer to paragraph 185.

CHAPTER 17

POWER TAKEOFF, DRIVE SHAFT, AND CONTROLS AND LINKAGE

Section I. DESCRIPTION AND DATA

197. Description

a. General. Four models of power takeoff, when required for operation of auxiliary equipment, are used on the vehicles covered by this manual. Two models are mounted on the lower right side of the transmission; one is used to power the front winch, while the other is used to power both the front winch and the dump-body hoist hydraulic pump. The other two power takeoffs are mounted on the rear of the transfer, and are used on the medium wrecker truck M62, M543 and M543A2 to operate the power divider and on the M246 to power the hydraulic pump. The transfer mounted power takeoffs are covered in the wrecker crane chapters for the M62, M543, M543A2 and M246.

b. Power Takeoff (Mounted on Transmission) (All Vehicles Equipped with Front Winch Except M51, M51A2). The power takeoff (fig. 283) mounted on the transmission for powering the front winch only is a three-speed (two-wind speed and one-unwind speed) unit. The output shaft on the front of the unit is connected to the input shaft on the rear of the winch by a propeller shaft. The power takeoff is controlled by a lever in the cab.

c. Power Takeoff (Mounted on Transmission; Dump Truck M51, M51A2 Only) (Fig. 284). The

power takeoff mounted on the transmission and used for powering the front winch and the dump-body hydraulic hoist pump is equipped with two output shafts; one on the front and one on the rear of the unit. The front output shaft has three operating speeds, ((b) above), and is controlled by a lever in the cab. The rear output shaft speed varies with the speed of the engine. Operation of this shaft is controlled by a separate lever in the cab.

d. Drive Shaft. A tubular-type drive shaft, having universal joint assemblies at each end, transmits torque from the power takeoff to the winch. Possible elongation is provided for by means of a slip joint located on the drive shaft between the two universal joints. The rear universal joint yoke is attached to the power takeoff by a setscrew. The front universal joint yoke is connected to the winch driveworm by a shearpin.

e. Shifting Lever and Linkage. The power takeoff control lever, for winch operation only, is mounted to the cross member of the cab. It is positioned directly behind the transmission control lever and is connected to the power takeoff linkage. Relay levers, rod assembly, adjustable yoke, and shaft are assembled together to make up the linkage.

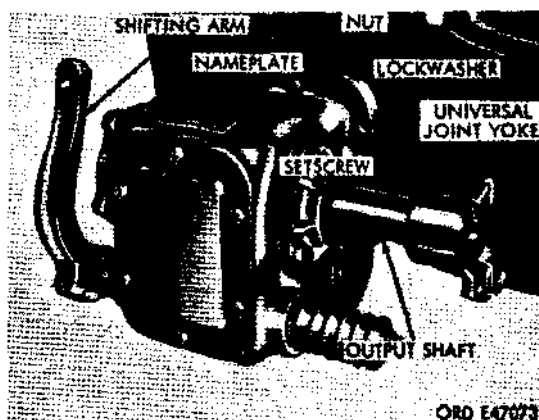


Figure 283. Transmission mounted power takeoff (all models except M51, M51A2).

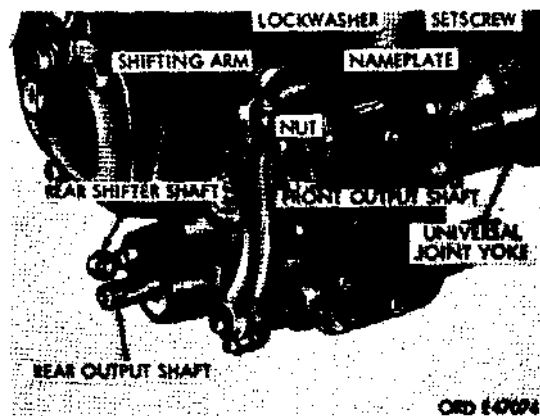


Figure 284. Transmission mounted power takeoff (dump truck M51, M51A2 only)

198. Data**a. Power Takeoff (All Except M51, M51A2).**

Dive transmission
 Make Spicer
 Model WN-6N
 Ordnance number 7409588
 Output shaft front

b. Power Takeoff (Dump Truck M51, M51A2)

Drive transmission
 Make Spicer

Model WND-6N
 Ordnance number 7409589
 Output shaft front and rear

c. Drive Shaft.

Manufacturer Mechanics
 Ordnance number 7409575
 Type double universal
 Universal size 2CR

Section II. TROUBLESHOOTING**199. General**

This section contains inspection and troubleshooting procedures to be performed while a disabled component is still mounted in the vehicle and after it has been removed.

200. Troubleshooting Before Removal or Operation

a. General. Do not operate the vehicle prior to completing the procedures given in this paragraph.

b. Inspect for Lubricant Leakage. Visually inspect gasket joints and front-and rear-output-shaft oil seals. Refer to figure 290 for evidence of lubricant leakage. Leakage at gasket joints may be caused by loose mounting bolts or defective gaskets. Tighten all mounting bolts and if leakage continues, install new gaskets.

c. Further Procedures. If these troubleshooting procedures do not disclose the fault and the vehicle is operable, proceed as described in the following paragraph.

201. Troubleshooting Before Removal and During Operation

If the inspections in paragraph 200 do not reveal causes of failure and the vehicle is operable, then troubleshoot it. Refer to troubleshooting Table XII below.

Caution: Check lubricant level in transmission before attempting to operate power takeoff (LO 9-2320-211-12).

202. Troubleshooting After Removal and Before Operation

a. General. After the component has been removed from the truck or it has been received already removed, further inspection

Table XII. Troubleshooting - Power Takeoff

Malfunction	Probable causes	Corrective action
1. Noisy power takeoff.	a. Stripped gears. b. Worn bearings. c. Worn shaft splines.	a. Replace defective gears (par. 207). b. Replace defective bearings (par. 207). c. Replace shafts (par. 207).
2. Slipping out of gear.	a. Gears partially engaged, b. Weakened poppet springs.	a. Correct shift linkage (par. 203). b. Replace springs (par. 207).

is necessary. If the power takeoff alone has been received for a preliminary check before being installed in the vehicle or if the operation of the power takeoff has not been satisfactory due to unknown causes, then test it as described below.

b. Inspection. Visually inspect power takeoff for lubricant leakage (par. 200b) and cracked or damaged case or covers.

c. Gears. Gears which are damaged by gear clashing which have galled surfaces on the

faces of the gear teeth must be replaced (par. 207).

d. Splines on Drive Shafts. Examine the splines on the drive shaft and the drive gear for evidence of scoring or twisting. Also check clearance of gears on splined shaft. Replace scored, twisted, or damaged shafts (par. 207).

e. Thrust Washers. If the thrust washers are scored or worn sufficiently to permit excessive end play, replace thrust washers (par. 207).

Section III. REMOVAL AND INSTALLATION

203. Power Takeoff (All Vehicle Equipped with Front Winch Except M51, M51A2 (Fig. 222))

a. Removal.

- (1) Drain transmission.
- (2) Remove cotter pin from end of power takeoff-control-rod yoke pin, remove yoke pin, and remove control rod from power takeoff shifting arm.
- (3) Loosen hex-socket setscrew in universal joint yoke on output shaft at front of power takeoff.
- (4) Remove six nuts and lockwashers securing power takeoff to transmission. Slide power takeoff free of mounting studs.
- (5) Tap yoke on output shaft lightly to remove front winch propeller shaft from power takeoff.
- (6) Remove and discard power takeoff mounting gasket.

Note. Exercise care to prevent dirt from entering either transmission or power takeoff while performing operations.

b. Installation.

- (1) Clean gasket surfaces on transmission and power takeoff and install new gasket on studs on transmission.

- (2) Align key on front output shaft with keyway in yoke on rear of front winch propeller shaft, and tap lightly on yoke to slide it onto output shaft.
- (3) Position power takeoff on mounting studs on side of transmission, and install six lockwashers and nuts on shaft. Tighten nuts 90 to 40 pound-feet torque.
- (4) Drive yoke onto front output shaft until inner end of key is flush with end of yoke, and tighten hex-socket setscrew in yoke.
- (5) Adjust and connect power takeoff control rod (a) through (d) below.
 - (a) Move power takeoff shifting arm forward as far as it will go.
 - (b) Move the power takeoff-control-rod front yoke toward the shifting arm as far as it will go.
 - (c) If the yoke can be assembled to the shifting arm without moving either the control rod or the shifting arm, proceed as in (d) below. Otherwise, loosen the locknut on the control rod and turn the yoke on the rod until the yoke can be attached to the shifting arm.
 - (d) Position the control rod yoke on the shifting arm, install the yoke pin, and secure with cotter pin. Tighten the locknut on the control rod against the yoke.

- (6) Fill transmission. Refer to LO 9-2320-211-12.

204. Power Takeoff (Dump Truck M51, M51A2 only) (Fig. 284)

a. Removal

- (1) Drain transmission.
- (2) Remove cotter pin from end of power takeoff-control-rod yoke pin, remove yoke pin, and remove control rod from power takeoff shifting arm.
- (3) Loosen hex-socket setscrew in universal joint yoke on output shaft at front of power takeoff.
- (4) Remove cotter pin from end of power takeoff-cross-shaft-rod yoke pin, remove yoke pin, and remove cross-shaft rod from rear shifter shaft (fig. 284).
- (5) Cut locking wire on setscrew securing universal joint yoke to rear output abaft (fig. 284), and loosen setscrew.
- (6) Remove six nuts and lockwashers securing power takeoff to transmission. Slide power takeoff free of mounting studs.
- (7) Tap yoke on output shaft lightly to remove front winch propeller shaft from power takeoff.
- (8) Tap yoke on rear output shaft lightly to remove hydraulic-hoist-prep propeller shaft from power takeoff.
- (9) Remove and discard power takeoff mounting gasket.

Note. Exercise care to prevent dirt from entering either transmission or power takeoff while performing other operations.

b. Installation.

- (1) Clean gasket surfaces on transmission and power takeoff and install new gasket on studs on transmission.
- (2) Aline key on front output shaft with keyway in yoke on rear of front winch pro-

peller shaft, and tap lightly on yoke to slide it onto output shaft.

- (3) Aline key on rear output shaft (fig. 284) with keyway in yoke on front of hydraulic-hoist-pump propeller shaft, and tap lightly on yoke to slide it onto-output shaft.
- (4) Position power takeoff on mounting studs on side of transmission, and install six lockwashers and nuts on studs. Tighten nuts 30 to 40 pound-feet torque.
- (5) Drive yoke onto front output shaft until inner end of key is flush with end of yoke, and tighten hex-socket setscrew in yoke.
- (6) Adjust and connect power takeoff control rod (a) through (d) below.
 - (a) Move power takeoff shifting arm forward as far as it will go.
 - (b) Move the power takeoff control-rod front yoke toward the shifting arm as far as it will go.
 - (c) If the yoke can be assembled to the shifting arm without moving either the control rod or the shifting arm, proceed as in (d) below. Otherwise, loosen the locknut on the control rod and turn the yoke on the rod until the yoke can be attached to the shifting arm.
 - (d) Position the control rod yoke on the shifting arm, install the yoke pin, and secure with cotter pin. Tighten the locknut on the control rod against the yoke.
- (7) Drive yoke onto rear output shaft until inner end of key is flush with end of yoke, tighten hex-socket setscrew in yoke, and lock setscrew in position with wire.
- (8) Adjust and connect cross shaft rod to rear shifter shaft (fig. 284) using same procedures as in (6) above.
- (9) Fill transmission. Refer to LO 9-2320-211-12.

205. Drive Shaft

Refer to TM 9-2320-211-20 for removal and installation instructions.

- (1) General. It is not necessary to disassemble shift lever or linkage unless inspection indicates shift lever, adjustable yoke, relay levers, or rod with welded yoke must be replaced. If replacement of any of these parts is necessary, disassembly is as follows
- (2) Remove floor tunnel in cab. Refer to TM 9-2320-211-20.
- (3) Control lever. The control lever is pivoted in a bracket directly below the cab floor. Remove the cab floor tunnel to obtain access to the hand lever and disconnect from linkage. Remove cotter pin from clevis pin connecting control rod to hand control lever. Take out clevis pin and let control rod suspend from left relay lever (fig. 285). Remove cotter pin and flat washer from clevis pin holding control lever to bracket. Slide control lever off of clevis pin and remove from inside of cab.
- (4) Linkage (fig. 285). Remove cotter pine from clevis pine connecting hand control lever to relay lever rod at left relay lever, and rod assembly connected to right relay lever. Remove clevis pine and rods. Loosen safety nut on right and left relay levers. Remove relay levers, keys, and shaft. Tap clevis pin from rod assembly at shifting arm and remove rod assembly.

(1) Linkage. Install relay lever shaft (fig. 285) in support and install Woodruff

key in shaft at each end. Install right and left relay levers and tighten safety nuts to secure relay levers on shaft. Position hand control lever to relay lever rod and install clevis pin at left relay lever. Install cotter pin in clevis pin. Position rod assembly at right relay lever and install clevis pin. Install cotter pin in clevis pin. Position rod assembly to shifting arm (fig. 285) and insert clevis pin and cotter pin.

- (2) Control lever. Position control lever on clevis pin and install flat washer and cotter pin to secure lever on shaft. Connect hand control lever to relay lever rod, to hand lever and install clevis pin. Install cotter pin securing clevis pin. After all linkage is connected, floor tunnel in cab can be installed. Refer to TM 9-2320-211-20.



Figure 285. Power takeoff linkage

Section IV. REPAIR

(1) Remove front shifter shaft.

- (a) Remove six cap screws and lockwashers from cover (fig. 286). Remove cover and cover gasket and discard gasket. Remove spring retainer, front shifter-shaft-ball compression spring, and ball from case.

- (b) Loosen safety nut from shifting arm (fig. 287) and remove arm. Remove cap screws and plain washer from end of front shifter shaft. Use side cutters and cut locking wire from cap screw at front output sliding gear fork, and remove locking wire and cap screws. Pull front shifter shaft out through rear of case and remove front-output-sliding gear fork from case. It is not necessary to remove front-

shifter-shaft oil seal, boot and boot retainer from case unless inspection reveals replacement is necessary. To remove oil seals, drive out with suitable punch.

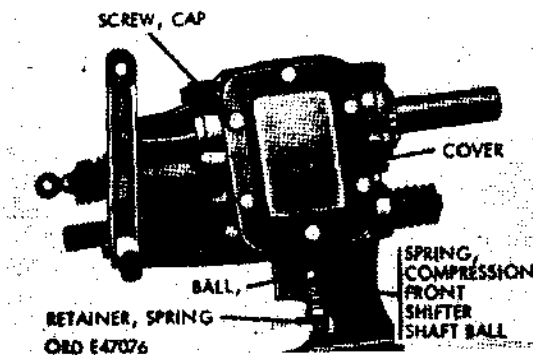


Figure 286. Removing front shifter shaft ball and spring retainer

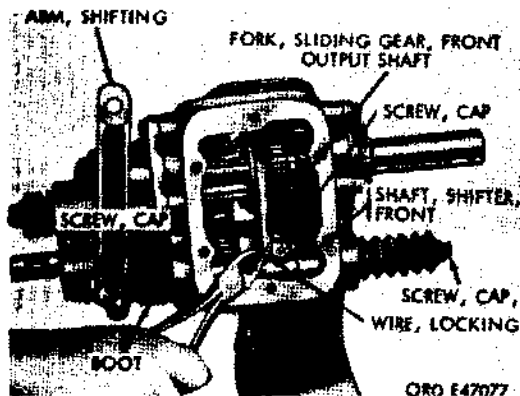


Figure 287. Power takeoff cover removed

- (2) Remove input shaft. Remove cotter pin (fig. 288) from case holding input gear shaft in position. Use a soft bar and tap input gear shaft at opposite end from cotter pin until shaft is removed from case. Remove two input gear thrust washers and input gear from case. Remove two roller - bearings (AE, fig. 295) from bore of input gear.
- (3) Remove rear output housing.

Note. Key letters in this paragraph refer to figure 295 unless otherwise indicated.

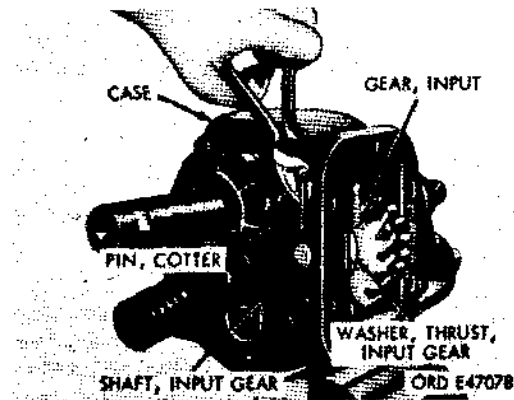


Figure 288. Removing input gear

- (a) Remove five cap screws and lock-washers from rear output shaft housing (fig. 289). Remove housing and rear output-shaft housing gasket. Discard gasket.



Figure 289. Removing rear output shaft housing

- (b) Place rear output shaft housing (G, fig. 294) in vise and remove plug (Z), rear shifter-shaft-ball compression spring (AA), and ball (BB) from housing. Loosen jam nut (H-H) and remove eye-bolt (JJ) and plain washer (GG) from rear shifter shaft (CC). It is not necessary to remove boot (FF), rear shifter-shaft oil seal (DD), and boot retainer (EE) from housing, unless inspection reveals replacement is necessary. Cut locking wire from cap screw (X) and remove screw. Tap

rear shifter shaft with a soft hammer to rear of housing. Remove rear output-shaft-sliding gear fork (Y) from inside of housing. Remove rear output-shaft oil seal (H, fig. 204) from rear output shaft (W).

Note. This oil seal will be damaged during removal. Make certain replacement oil seal is available before removal.

Remove rear output-shaft snap ring (YY) from rear output shaft. Use soft hammer and tap shaft to front of housing and remove. Remove rear output-shaft sliding gear (UU) from inside of housing. Remove rear output-shaft-bearing snap ring (ZZ) securing rear output-shaft ball bearing (XX) in housing. Remove ball bearing from bore in rear output shaft housing (G, fig. 294) and snap ring (WW) securing ball bearing on opposite side.

(4) Remove front output shaft.

- (a) Remove four cap screws and lockwashers holding front bearing cap (fig. 290) to case. Remove front bearing cap and front bearing cap gasket. Discard gasket. It is not necessary to remove front output-shaft oil seal from cap unless inspection (par. 207b) reveals replacement is necessary. To remove oil seal, drive out with suitable punch.

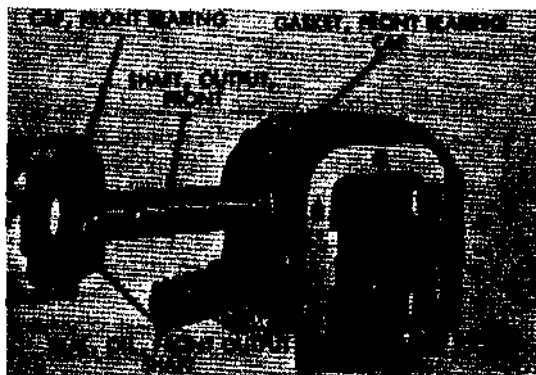


Figure 290. Removing front cap

- (b) Tap front output shaft with a soft hammer, with front output-shaft ball bearing towards rear of case far enough to permit removal of front output-shaft rear ball bearing (fig. 291). Use a suitable puller to remove ball bearing from shaft. Slide shaft and front ball bearing to front of case and remove through front bearing bore in case. Remove front output-shaft sliding gear from case. Place front output-shaft and front output-shaft front-bearing assembly in press and press shaft from front ball bearing. Remove high-speed gear snap ring (P, fig. 295), high-speed gear thrust washer (Q, fig. 295), and high-speed gear from shaft.

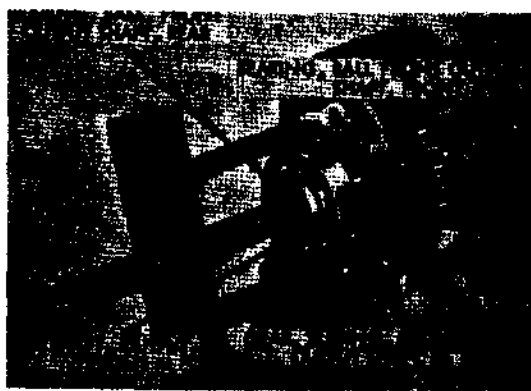


Figure 291. Removing front shaft rear ball bearing

(5) Remove reverse gear shaft

- (a) Remove rear output-shaft snap ring from splined end of reverse gear shaft (fig. 292). Remove cotter pin from clevis pin. Remove clevis pin.
- (b) Use a soft hammer and tap reverse gear shaft at splined end to front of case. Remove reverse gear and reverse gear thrust washers (RR end PP, fig. 295) from case. Reverse gear shaft front needle bearing (fig. 293) will be removed as reverse shaft is pressed from case. Use suitable adapter and remove reverse gear shaft rear needle bearing from case.

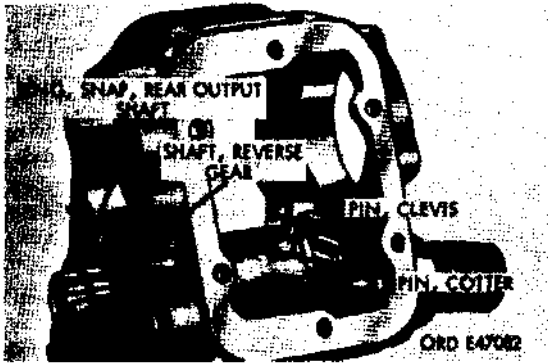


Figure 292. Removing clevis pin from reverse gear

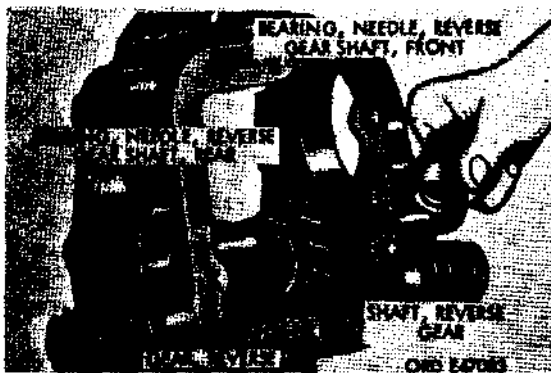


Figure 293. Removing reverse gear and shaft

b. Cleaning, Inspection and Repair.

(1) Cleaning.

- (a) Soak bearings in drycleaning solvent or mineral spirits paint thinner to loosen all hardened grease and foreign matter. Then strike the bearings flat against a block of wood several times and again immerse in cleaning solvent. Repeat operation until the bearings are clean; then blow them dry with compressed air.

Note. Do not spin races of the ball bearings with compressed air.

- (b) Clean all parts of the power takeoff thoroughly with a dry-cleaning solvent or mineral spirits paint thinner

to remove all hardened grease and foreign matter.

(2) Inspection and repair.

- (a) Bearings. Inspect each bearing assembly for rough or scored balls or races. Replace if damaged in any way. Apply engine oil to bearings that are to be used, and cover to protect from dirt until they are assembled.
- (b) Shafts. Inspect surfaces on each shaft for scoring or pitting. Replace noticeably worn or, damaged parts.
- (c) Gears. Inspect all gears for chipped, cracked, or broken teeth. Inspect bore of reverse gear and input gear for pitting or scoring. Examine splines on drive shaft and drive gear for evidence of scoring or twisting. Place the gear on shaft and check clearance along the splines. If this clearance is excessive, or if shaft is badly scored or twisted, new parts should be installed.
- (d) Case and sliding gear forks. Inspect case and sliding gear forks for cracks or damage. Replace defective parts.
- (e) Thrust washers. If thrust washers are scored or worn, these parts should be replaced.

- (f) Oil seals. Inspect oil seals for damage. Inspect seal contact material to make sure it is pliable and shows no evidence of burning. Also inspect the thin, featheredge which contacts the rotating part to make sure it is intact. Replace oil seal if defects are found. Oil seal at rear output shaft bearing will be damaged during removal. Install new oil seal when reassembling. Inspect boots for split condition. Replace if **found** defective.

c. Assembly.

- (1) Install reverse shaft (fig. 295). Install Woodruff key (MM) in reverse gear shaft (NN). Place case (E, fig. 294) in press and position reverse gear (QQ) in case. Position splined end of reverse

gear shaft in front end of case. Install reverse gear thrust washer (PP) on reverse gear shaft and press shaft into reverse gear. Press reverse shaft until it extends through reverse gear and install reverse gear thrust washer (RR) on shaft. Continue pressing shaft until clevis pin hole in shaft is in line with hole in reverse gear. Install clevis pin (AB) through reverse gear and shaft. Install cotter pin (LL) in end of clevis pin. Install reverse gear-shaft- rear-needle bearing (SS) on rear of reverse gear shaft and press into bore of case. Position reverse gear-shaft-front-needle bearing (KK) at front of reverse gear shaft and press bearing into case.

(2) Install front output shaft (fig. 295).

- (a) Place high-speed gear (R) on front output shaft (T) with spiral end of gear toward front of case (E, fig. 294). Place high-speed gear thrust washer (Q) on front output shaft next to high-speed gear and install high-speed gear snap ring (P) to hold thrust washer and gear on shaft.
- (b) Install front output-shaft-front ball bearing (N) on front output shaft (T) end insert splined end of shaft into front end of case. Place front output shaft sliding gear (U) on shaft inside case with fork groove side toward rear of case. Continue inserting shaft,

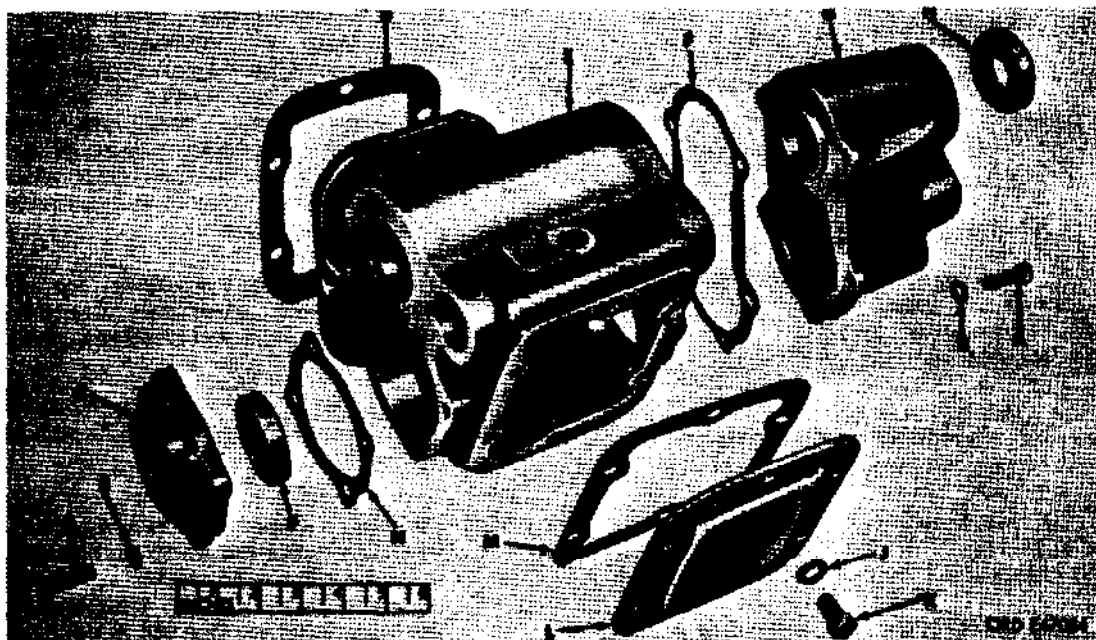


Figure 294. Power takeoff case - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Screw, cap	H	Seal, oil, rear output
B	Washer, lock	J	Washer, lock
C	Cap, front bearing	K	Screw, cap
D	Gasket, power takeoff to transmission case	L	Cover
E	Case	M	Gasket, cover
F	Gasket, housing, output shaft, rear	N	Gasket, front bearing
G	Housing, rear output shaft	P	Seal, oil, front output

Figure 294. Power takeoff case - exploded view - legend

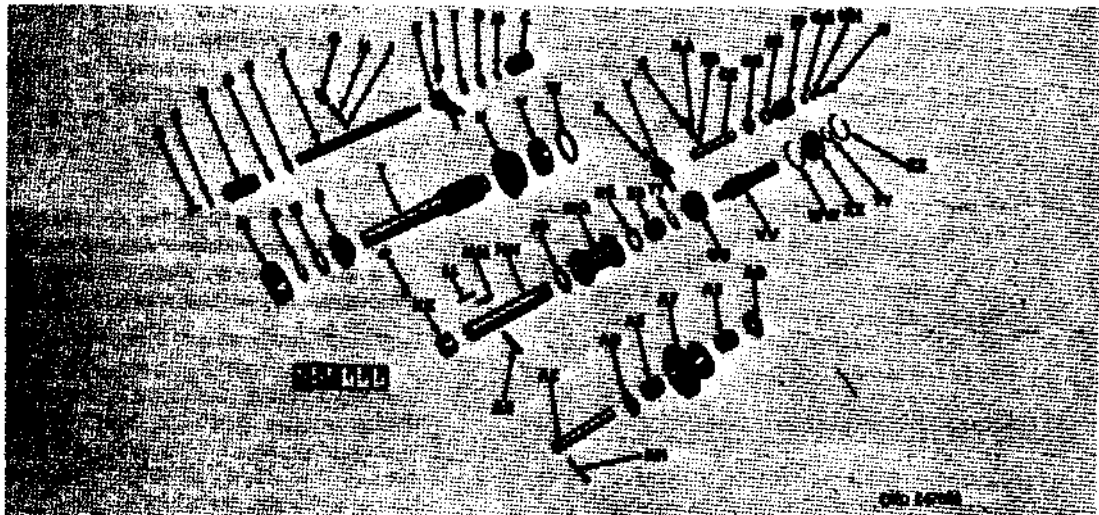


Figure 295. Power takeoff gears - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Screw, cap	EE	Retainer, boot
B	Washer, plain	FF	Boot
C	Boot	GG	Washer, plain
D	Retainer, boot	HH	Nut, jam
E	Seal, oil, front, shifter shaft	JJ	Bolt, eye
F	Shaft, shifter, front	KK	Bearing, needle, reverse gear shaft, front
G	Retainer, spring	LL	Pin, cotter
H	Spring, compression, front shifter shaft ball	MM	Key, Woodruff
J	Ball	NN	Shaft, reverse gear
K	Fork, sliding gear, front output shaft	PP	Washer, thrust, reverse gear
L	Screw, cap	QQ	Gear, reverse
M	Washer, plain	RR	Washer, thrust, reverse gear
N	Bearing, ball, front output shaft, front	SS	Bearing, needle, reverse gear shaft, rear
P	Ring, snap, high-speed gear	TT	Ring, snap, rear output shaft
Q	Washer, thrust, high-speed gear	UU	Gear, sliding, rear output shaft
R	Gear, high-speed	VV	Shaft, output, rear
S	Key, Woodruff	WW	Ring, snap, rear output shaft bearing
T	Shaft, output, front	XX	Bearing, ball, rear output shaft
U	Gear, sliding, front output shaft	YY	Ring, snap, rear output shaft
V	Bearing, ball, front output shaft, rear	ZZ	Ring, snap, rear output shaft bearing
W	Spacer, bearing	AB	Pin, clevis
X	Screw, cap	AC	Shaft, input gear
Y	Fork, sliding gear, rear output shaft	AD	Washer, thrust, input gear
Z	Plug	AE	Bearing, roller
AA	Spring, compression, rear, shifter shaft ball	AF	Gear, input
BB	Ball	AG	Washer, thrust, input gear
CC	Shaft, shifter, rear	AH	Pin, cotter
DD	Seal, oil, rear shifter shaft		

Figure 295. Power takeoff - exploded view - legend

guiding shaft through rear bearing bore in case. Install front output-shaft-rear ball bearing (V) on rear of front output shaft (T). Press shaft with bearings assemblies back into bore of case. Install bearing spacer (W) at rear bearing.

- (c) Install new front output-shaft oil seal (P, fig. 294) in front bearing cap (C, fig. 294). Install new front bearing cap gasket (N, fig. 294) and position cap on shaft. Install four cap screws (A, fig. 294) and lockwashers (B, fig. 294) and secure cap to case.

(3) Install front shifter shaft (fig. 295).

- (a) If front shifter-shaft oil seals (E) in shifter shaft openings in case (E, fig. 294) were removed, install new seals in case with lips of seals toward inside of case.
- (b) Slide front shifter shaft (F) in opening at rear of case with the end opposite step - cut in first. Be careful not to damage oil seal when pushing front shifter shaft in case. Position front output shaft sliding gear fork (K) in case on front output shaft sliding gear (U) and press shaft through sliding gear fork until one of the poppet ball milled slots in the shaft is visible through the ball spring retainer opening in case. Position fork on shaft and align slot in shaft with fork. Install cap screw (L) and locking wire holding fork on shaft.
- (c) Install ball (J), front shifter-shaft ball compression spring (H), and spring retainer (G) in case, making certain the ball engages the milled slot in shaft. Position cover (L, fig. 294) with new cover gasket (M, fig. 294) on case and install six cap screws (K, fig. 294) and lockwashers (J, fig. 294). If boots (C) and boot retainers (D) were removed, install retainers on boots and press into housing. Install cap screw (A) and plain washer (B) on front end of front shifter shaft (F). Install shifting arm (fig. 287) at rear of shifter shaft and tighten safety nut. Install cap screw in end of shifter shaft to secure shifting arm in position.

- (4) Install input shaft (fig. 295). Install two roller bearings (AE) in input gear (AF) and position input gear and bearing assembly in case (E, fig. 294) with spiral gear toward front of case. Install input gear shaft (AC) in from front end of case with slotted end in first.

Note. Screwdriver slot in end of shaft may be used to rotate shaft if necessary to align recess in shaft with cotter pin hole in case after shaft is installed.

Install input gear thrust washer (AD) and press shaft through input gear. Install input gear thrust washer (AG) and continue pressing shaft until slot on side of shaft is in line with hole in case for cotter pin (AH). Secure shaft to case with cotter pin.

(5) Install rear output shaft housing.(fig. 295.

- (a) Secure rear output shaft housing (G, fig. 294) in vise and install rear output-shaft-bearing snap ring (WW) in housing. Insert rear output-shaft ball bearing (XX) in rear of housing bore and install rear output shaft bearing snap ring (ZZ) to secure bearing in housing. Slide rear output shaft (W) in housing from front end and position rear output-shaft sliding gear (UU) inside of case on shaft. Continue sliding shaft through ball bearing until groove for rear output shaft snap ring is visible. Install rear output-shaft snap ring (YY). Install new rear-output shaft oil seal (H, fig. 294) in rear output shaft ball bearing bore in housing.
- (b) If rear shifter-shaft oil seal (DD) in rear output shaft housing (G, fig. 294) was removed, install new oil seal with lip toward inside of housing. Slide rear shifter shaft (CC) in at rear of housing. Position rear output-shaft sliding gear fork (Y) inside of housing on rear output-shaft sliding gear (UU). Continue sliding shaft through until detent on shaft is in line with cap screw (X) on fork. Tighten screw and install locking wire. If boot (FF) was removed, install boot retainer (EE) on boot (FF) and slip boot over end of shaft. Press retainer in housing.

- (c) Install new rear output-shaft housing gasket (F, fig. 294) and position rear output shaft housing (G, fig. 294) on rear of case (E, fig. 294). Install five cap screws (A, fig. 294) and lock-washer (B, fig. 294) and secure rear output shaft housing to case.

208. Power Takeoff (Model WN-6N)

The repair procedure for the model WN-6N power takeoff will be the same as the model WND-6N with the following exceptions.

a. The WN-6N model contains only a front output shaft.

b. A rear bearing cap is used on the WN-6N instead of the rear output shaft housing used on the WND-6N.

c. During repair procedures for the WN-6N follow the procedures given in paragraph 207b. Do not perform steps in paragraphs 207a(3) and 207c(5). It will only be necessary to remove and install bearing caps and gasket during procedures in said paragraphs.

209. Drive Shafts

a. Disassembly (Fig. 296).

- (1) Remove slip yoke assembly. Position and clamp drive shaft (K) in vise. Insert screwdriver under clips on dust cap (L) and slide dust cap back onto splined stub. Remove slip yoke (P) from splined stub end of drive shaft. Remove split retaining washer (M) and cork washer (N) from dust cap. Remove dust cap from splined stub end of drive shaft and lubricating fitting (Q) from slip yoke assembly.
- (2) Disassembly of universal joint. Two universal joints are used on the winch drive shaft. Disassembly, which is the same for each universal joint, follows. Position and secure slip yoke (P) in vise. Bend lip on locking strap (B) from four hex-head bolts (A) and remove these four bolts which attach two flanged journal bearings (D) to yoke (R). Remove snap ring (H) securing round journal bearing (T and J) by placing a punch against one end of the snap ring loop and then tapping the end of the punch with a hammer until the

snap ring is removed from bearing. After snap rings are removed, rest universal joint journal (G) on vise and leave slip yoke (P) suspended. Strike the suspended yoke with a soft hammer until yoke comes in contact with journal. This will leave round journal bearing (J) protruding from yoke. Turn slip yoke assembly over in vise and clamp protruding round journal bearing (J) in vise and strike yoke until bearing is completely released from its snug fit in yoke. Turn slip yoke assembly around, clamp opposite round journal bearing (T) in vise, and strike yoke until this bearing is also released. Remove universal joint journal (G) from slip yoke assembly. Remove cork washer (E) and dust shield (F) from journal.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean all parts in dry-cleaning solvent or mineral spirits paint thinner. Allow journal bearings to soak in solvent long enough to loosen all particles of hard grease. Use a small, stiff bristle brush and remove any particles still remaining. Make sure journal bearing surfaces and slip joint splines are thoroughly clean. Rinse parts in clean solvent and dry with compressed air. Protect parts from any wind-blown dust or dirt until parts are completely assembled.
- (2) Inspection and repair.
 - (a) Yoke assembly. Inspect yoke for cracks, wear, or bent condition. Remove slight nicks or burs with a fine stone. Check journal bearing opening in yoke for possible distortion and replace if damaged in this manner. Install yoke assembly on splines of matching shaft and check backlash with dial indicator. If backlash exceeds 0.010 inch, replace worn parts.
 - (b) Journal assembly. Inspect journal bearing surfaces for nicks, burs, and scratches. Remove light marks with fine stone, but replace journal if marks cannot be removed. Check diameter of journal bearing surfaces. Replace journal assembly if wear exceeds 0.005 inch. If journal assembly is replaced, replace bearings also.

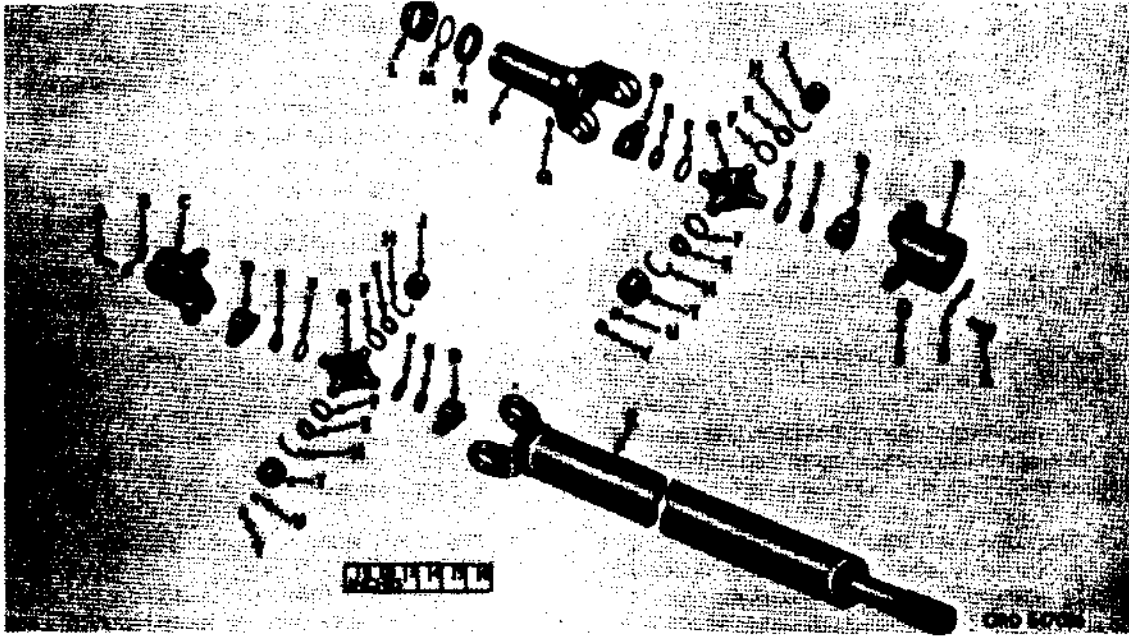


Figure 296. Winch drive shaft and universal joint- exploded view

<u>Item</u>	<u>Key</u>	<u>Item</u>
Bolt, hex-head	L	Cap, dust
Strap, locking	M	Washer, retaining, split
Yoke	N	Washer, cork
Bearing, journal, flanged	P	Yoke, slip
Washer, cork	Q	Fitting, lubricating
Shield, dust	R	Yoke
Journal, universal joint	S	Screw, set
Ring, snap	T	Bearing, journal, round
Bearing, journal, round	U	Washer
Shaft, drive	V	Plug

Figure 296. Winch drive shaft and universal joint - exploded view - legend

- (c) Bearing assemblies. Inspect each bearing assembly for wear. Worn condition is usually indicated -if needles drop out of retainer, or if journal bearing surfaces show marks of needles. Replace all four bearing assemblies and journal if wear is evident.
- (d) Dust shield and cork washers. Inspect dust shield for bent condition. Replace if damaged. Always replace the cork washer with a new one.

c. Assembly (Fig. 296).

- (1) Assemble universal joint. Grasp slip yoke (P) in hand and rest one fork of the slip yoke on a flat piece of iron so that other fork is directly below iron and free of any interference. Position round journal bearing (J) over journal bearing opening on yoke fork and use soft hammer to drive bearing into yoke fork until the open end of bearing is flush with the inside of yoke fork. Place dust shield (F) and thick cork

washers (E) on opposite ends of universal joint journal (G) and insert one end of the journal ends through inside of opposite fork of slip yoke (P). Insert opposite journal end into partially installed round journal bearing (J). Next, rest the partially assembled bearing, journal, and yoke assembly on flat surface and position other round journal bearing (T) on its opening in slip yoke fork. Again, use soft hammer and drive this bearing into place. Alternately tap on both bearings until journal is centered in yoke and install snap , rings (H), one on each bearing. Install dust shield (F) and thick cork washer (E) on remaining journal ends. Position flanged journal bearings (D) on journal ends, and secure yoke (R) to slip yoke (P) with bearings and journal assembly by means of four hex-head bolts (A), through locking strap (B), yoke (R), and into flanged journal bearing (D).

- (2) Install slip yoke. Position split retaining washer (M) and thick cork washer (N) inside of dust cap (L). Slide dust cap onto splined end of drive shaft (K). Install slip yoke (P) on splined end of shaft and snap dust cap over end of slip yoke.

210. Controls and linkage

a. General. Disassembly and assembly procedures are accomplished at time of removal and installation. Refer to paragraph 206.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Clean all parts in dry-cleaning solvent or mineral spirits paint thinner.
- (2) Inspection and repair. Inspect shifting lever for breaks, cracks, and bends. Inspect rod for bent condition and adjustable yoke for damaged threads. Replace defective parts.

Section V. SERVICEABILITY STANDARDS

211. General

The serviceability standards included herein give the minimum, maximum, and key clearances of new or rebuilt parts. They also give wear limits which indicate that point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear limits" column or damaged from corrosion will be

approved for service. In the "Size and fit of new parts" column, the letter "L" indicates a loose fit (clearance) and the letter "T" indicates a tight fit (interference). Dimensions are given in inches, unless otherwise indicated.

212. Serviceability Standards

Serviceability standards for the power-take-off are listed in Table XIII below.

Table XIII. Serviceability Standards - Power Takeoff

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts	Wear limits	
				Field	Depot
295	KK	Inside dia of bearing	1.2510-1.2520	0.001	0.005
295	NN	Outside dia of shaft	1.2495-1.2505	0.003	0.001
295	KK-NN	Fit of bearing shaft	0.0005L-0.0025L	0.004	0.0015
295	QQ	Reverse gear to input	0.006L-0.009L	0.016L	0.013L

Table XIII. Serviceability Standards - Power Takeoff - Continued

Fig. No.	Ref letter	Point of measurement	Size and fit of new parts	Wear limits	
				Field	Depot
295	QQ	Reverse gear to output	0.008L-0.011L	0.018L	0.018L
295	RR-PP	Thickness of thrust washer (See Note c)	0.061-0.063	(*)	(*)
295	QQ	Inside dia of reverse gear	1.252-1.253	(*)	(*)
295	NN-QQ	Fit of gear on shaft	0.0015L-0.0035L	0.0055L	0.0045L
295	AC	Diameter of shaft	0.7495-0.7500	0.003	0.001
295	AD-AG	Thickness of thrust washer	0.061-0.063	See Note c	
295	AE	Inside diameter of bearing	0.7500	(*)	(*)
295	AC-AE	Fit of bearing on shaft	0.0000L-0.0005L	0.004L	0.0015L
295	AE	Outside diameter of bearing	1.250	(*)	(*)
295	AF	Inside diameter of gear	1.250-1.251	0.007	0.003
295	AE-AF	Fit of bearing in gear	0.0000L-0.001L	0.004L	0.0015L
295	AF	Input low gear to output	0.008L-0.011L	0.0172	0.013L
295	T	Input gear to output	0.008L-0.009L	0.018L	0.015L
295	R	High-speed gear (backlash)			
295	U	Diameter of outer end of shaft	0.7510-0.7515	See Note d	
295	V	Outside dia of bearing (rear)	2.8346	(*)	(*)
295		Dia of bearing bore in housing	2.8346-2.8356	0.001	0.0006
295		Fit of bearing in housing bore	0.0000L-0.0010L	(*)	(*)
295	V	Inside dia of bearing (rear)	1.3780	(*)	(*)
295	Q	Thickness of thrust washer	0.122-0.124	0.006	0.002
295	T	Dia of output shaft	1.3785-1.3795	(*)	(*)
295	T-V	Fit of bearing on shaft	0.0005T-0.0015T	(*)	(*)
295	T	Dia of output shaft	1.3985-1.4000	0.003	0.0015
295	T-R	Fit of gear on shaft	0.008L-0.008L		

Table XIII. Serviceability Standards - Power Takeoff - Continued

Fig. No.	Ref letter	Point of measurement	Size and fit of new parts	Wear limits	
				Field	Depot
295	T-U	Fit of gear to shaft and gear splines	0.004L-0.007L	0.011	0.008
295	N	Outside dia of bearing (front)	2.8346	(*)	(*)
		Dia of bearing bore in housing	2.8346-2.8356	0.0008	0.0004
295		Fit of bearing in housing bore	0.0000L-0.0010L	0.0018L	0.0014L
295	N	Inside dia of bearing (front)	1.3780	(*)	(*)
295	U	Sliding gear to input low	0.008L-0.011L	0.017L	0.013L
295	U	Sliding gear to reverse	0.008L-0.017L	0.017L	0.013L
295	R	Gear (backlash)			
295	T	Diameter of shaft	1.3785-1.3795	(*)	(*)
295	T-V	Fit of bearing on shaft	0.005T-0.0015T	(*)	(*)
295	R	High-speed gear to	0.006L-0.009L	0.018L	0.015L
295	R	Input gear (backlash)			
<p>* Replace parts when worn beyond limits given in "SIZE AND FIT OF NEW PARTS" column.</p> <p>‡ Replace when bronze facing is partially or entirely worn off.</p> <p># Press fit in case.</p>					

CHAPTER 18

WHEELS AND TIRES

Section I. DESCRIPTION

213. Wheels

The wheels (figs. 297 and 298) used on these vehicles are of the offset-disk type, and are interchangeable between front and rear axles and on opposite sides of the vehicle. Two types of tire mountings are used. Some of the wheels are equipped with bolted-on-type side rings, and some are equipped with snap-on-type side rings. Wheels are secured by capnuts installed on mounting studs at hub flanges. These capnuts are interchangeable

between hubs on the same side but not between hubs on opposite sides of the vehicle. Studs and nuts are stamped "R" and "L" indicating right-hand or left-hand threads.

214. Tires

Tires are non-directional cross-country (NDCC). They are of various sizes, some being 11:00, 12:00 or 14:00 x 20, depending on use required. Tire sizes and the vehicles they are used on are described in TM 9-2320-211-20.

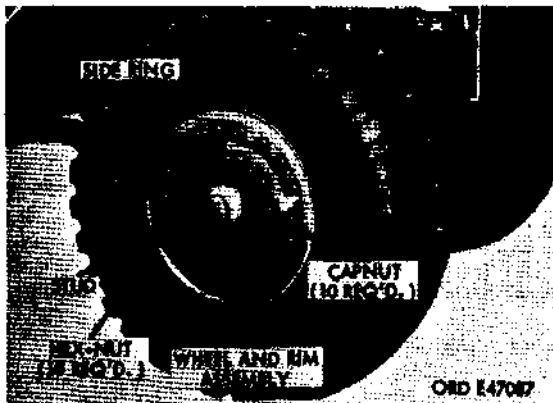


Figure 297. Wheel and tire assembly with bolted-on-type side ring (14:00 x 20 tires)



Figure 298. Wheel and tire assembly with snap-on-type side ring (11:00 x 20 tires)

Section II. REMOVAL AND INSTALLATION

215. Removal

Refer to TM 9-2320-211-20.

216. Installation

Refer to TM 9-2320-211-20.

Section III. REPAIR

217. Disassembly of Wheel and Tire Assembly

Refer to TM 9-2320-211-20.

219. Assembly of Wheel and Tire Assembly

Refer to TM 9-2320-211-20.

218. Cleaning, Inspection, and Repair

Refer to TM 9-1871.

CHAPTER 19

BRAKE SYSTEM

Section I. DESCRIPTION AND DATA

220. Description

a. General. The brake system includes two separate systems: service brakes and parking brake.

b. Service Brake System. The service brake system includes brake pedal linkage (fig. 299), master cylinder, air hydraulic cylinder, hydraulic lines to all wheels, wheel cylinders, brakedrums, and shoes.

c. Parking Brake System. The handbrake or parking brake system consists of the hand brakedrum and a pair of brakeshoes mounted at the rear of the transfer and actuated by a cable connected to the handbrake lever in the cab.

d. Brake Pedal Linkage (Figs. 299 and 300). The brake pedal linkage is comprised of a pedal secured to a lever, which is pivoted on a bracket bolted to the frame left side rail. The lower end of the pedal lever is pinned to a yoke on the front end of the master-cylinder piston rod. The upper end of the pedal lever

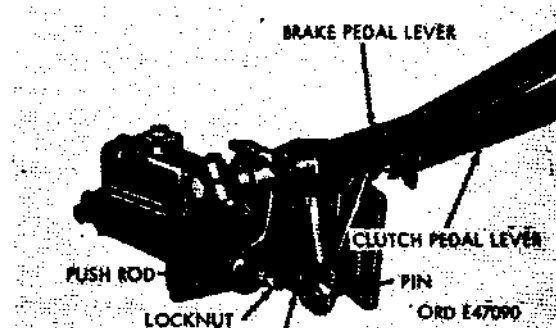


Figure 300. Right front view of brake pedal linkage

is secured to the brake pedal, which extends through the floorboard into the cab.

e. Master Cylinder. The master cylinder (fig. 299), bolted to the rear of the pedal lever bracket, consists of a hydraulic fluid reservoir, hydraulic cylinder with spring-loaded piston, and a check valve mechanism. Movement of the brake pedal linkage causes the piston inside the master cylinder to force fluid from the cylinder outlet through a connecting line into the air-hydraulic cylinder ((f)below).

f. Air-Hydraulic Cylinder (Power Brake Unit). The air-hydraulic cylinder (fig. 301), mouted directly below the master cylinder,

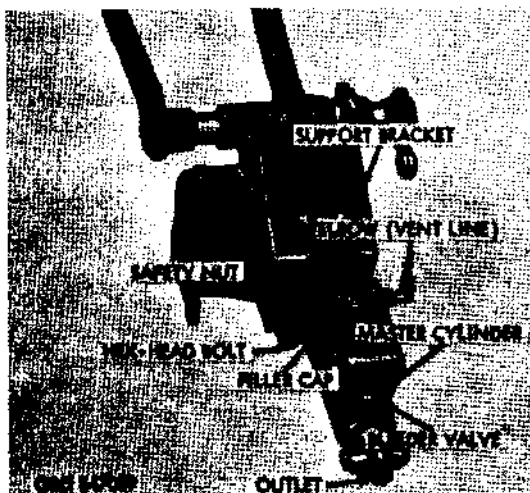


Figure 299. Rear view of brake pedal linkage and master cylinder

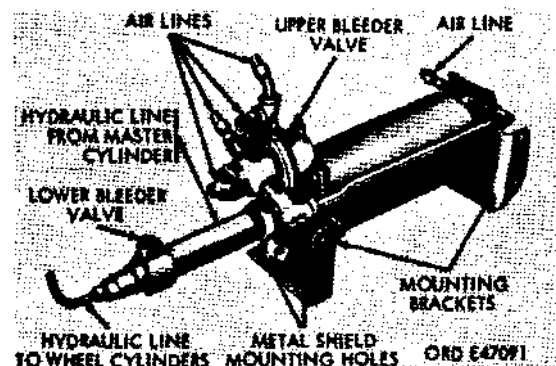


Figure 301. Air-hydraulic cylinder

consists of an air valve, air cylinder, hydraulic cylinder, and piston assembly. The piston assembly is comprised of the air-cylinder piston and hydraulic-cylinder piston mounted at opposite ends of a common piston rod. Pressure of the fluid forced from the master cylinder ((e) above) causes the air valve to open, thereby admitting air from the compressed air system into the air cylinder. This causes movement of both the air-cylinder piston and the hydraulic-cylinder piston, since they are mounted on the same shaft, which causes the hydraulic-cylinder piston to force fluid from the hydraulic cylinder through connecting lines to the wheel cylinders ((Q) below).

g. Hydraulic Lines and Hoses. The hydraulic lines between the master cylinder, air-hydraulic cylinder, and axles are rigid-type lines of seamless metal tubing. Flexible-type lines are used to connect axle lines to wheel cylinders.

h. Wheel Cylinders. The wheel cylinder (fig. 302), mounted on the backing plate assembly at both ends of each axle assembly, consists of two opposed rubber cups and pistons inclosed in a cast housing. A rubber boot installed at each end of the housing prevents dirt or foreign matter from entering the cylinder. The two rubber cups installed between the pistons inside the housing prevent fluid from leaking past the pistons. Push rods extending through the rubber boots provide connection between the wheel cylinder pistons and brakeshoes ((i) below). The fluid forced from the air hydraulic cylinder ((f) above) enters the wheel cylinder at a point between the rubber cups and pistons. This causes the cups and pistons to move outward away from the center of the cylinder bore so as to exert pressure through the push rods on the upper ends of the brakeshoes ((i) below).

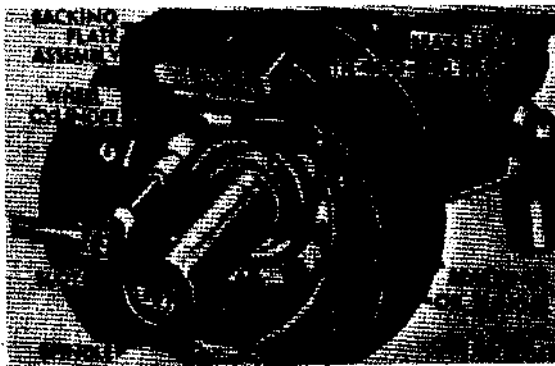


Figure 302. Wheel cylinder and brakeshoes

i. Brakeshoes. Two brakeshoes (fig. 302) are mounted on the backing plate at both ends of each axle assembly. The lower ends of the shoes are secured to the backing plate by anchor pins and locknuts. The upper ends of the shoes are retained in position by C-washers installed on guide pins attached to the backing plate. This permits each shoe to pivot on its anchor pin. The outer ends of the wheel-cylinder push rod engage slots in the upper ends of the brakeshoes. Therefore, when pressure is exerted on the inner ends of the push rods by the wheel-cylinder pistons ((h) above), the push rods force the upper ends of the brakeshoes away from the wheel cylinders. This causes the entire brake lining surface of both shoes to contact the braking surface of the brakedrum, thereby creating friction between the brakeshoes and brakedrum to reduce or stop the rotation of the drum (and wheel).

j. Handbrake. The handbrake consists of a brakedrum (fig. 303) and a pair of brakeshoes mounted at the rear of the transfer and actuated by a cable connected to the handbrake lever (par. 131) in the cab. The drum is bolted to the transfer rear output shaft, and the two brakeshoes are pinned together and then bolted to a bracket extending from the transfer rear-output-shaft-bearing cover. Operation of the handbrake lever causes the cable to pull the upper end of the brakeshoe lever toward the center of the brakedrum. This causes the

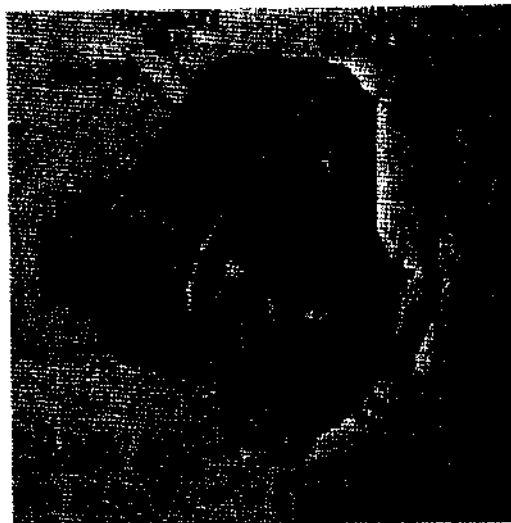


Figure 303. Handbrake mounted on rear of transfer

entire brake lining surface of both shoes to contact the braking surfaces of the drum with a squeezing action, thereby creating friction between the shoes and drum to reduce or stop the rotation of the drum (and transfer output shaft).

k. Handbrake Controls. Handbrake controls consists of a handbrake lever connected by a cable to the brakeshoe lever (fig. 304) at the rear of the transfer. The handbrake is properly adjusted when it will hold the truck on an incline with at least one-third of the handbrake-lever travel in reserve, or if application of the brake at a speed of 10 mph stops the truck within a reasonable distance.

l. Compressed Air System. The compressed air system (fig. 305) consists of the air compressor, air governor, air reservoirs, hand control valve, trailer brake couplings, air supply valves, and air lines and fittings.

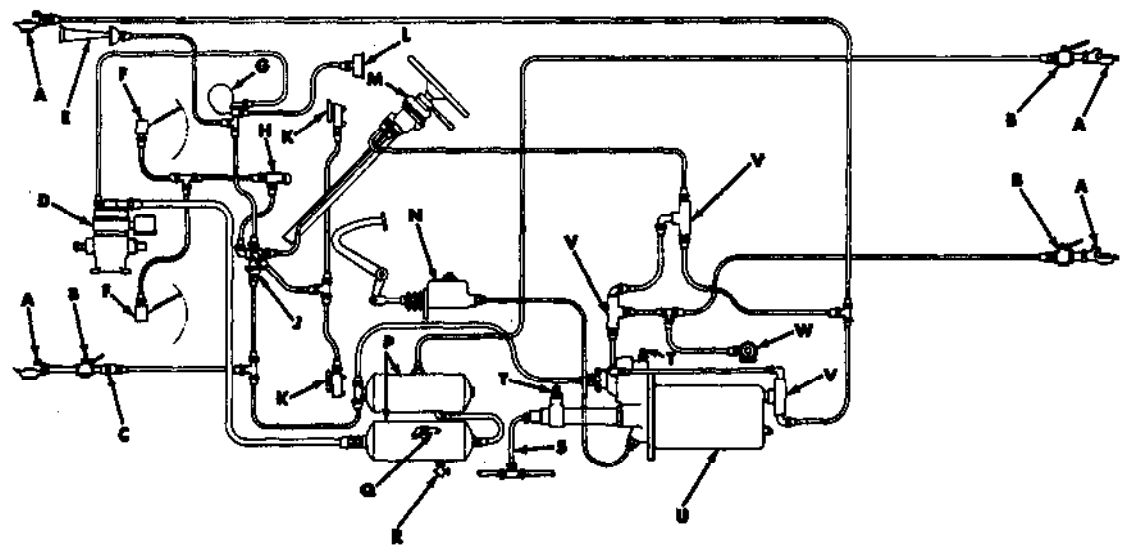
- (1) **Air compressor.** The air compressor (D, fig. 305) is a two-cylinder, single acting, piston-type. It is mounted on a bracket bolted to the lower right side of the engine crankcase, and driven by a belt from the crankshaft pulley. The compressor cylinder head is water cooled, coolant being circulated through it directly from the water pump. An unloading mechanism mounted on top of the cylinder-head body and connected to the air governor ((2) below) unloads the compression stroke whenever the pressure in the system reaches a pre-determined maximum.
- (2) **Air governor.** The air governor (G, fig. 305) is mounted on the right front side of the cab cowl. A line from the upper air reservoir (P, fig. 305), delivers compressed air to the governor

(G, fig. 305). When the pressure in this line reaches 120 psi, a valve inside the governor opens. This allows compressed air to be delivered from the governor through a line to the unloader valve on top of the compressor (D, fig. 305), which opens and prevents further compression of air by the compressor. When the pressure in the line from the upper air reservoir to the air governor drops below 105 psi, the valve inside the governor closes, causing the unloader valve at the compressor to close also, which allows the compressor to resume the compression of air.

- (3) **Air reservoirs.** Two air reservoirs (P, fig. 305), which are cylindrical steel tanks, are mounted one above the other, on the outside of the frame left side rail. The purpose of the reservoirs is to maintain an adequate supply of compressed air in the system whenever the truck is in operation. A safety valve (Q, fig. 305) is installed on the lower reservoir to protect the system against excessive air pressures. When the pressure in the reservoir reaches 150 psi, the safety valve opens and reduces the pressure in the system. The lower reservoir is also equipped with a drain cock (R, fig. 305) for the purpose of draining the condensation which normally collects in the reservoirs, and to provide a safe means of manually exhausting the compressed air from the system.
- (4) **Hand control valve.** The hand control valve (M, fig. 305), located on the steering column, is used to control the brakes on the towed vehicle.
- (5) **Trailer brake couplings.** Air brake hose coupling assemblies are provided on the front (A, fig. 305) and rear (A, fig. 305) of the vehicle to enable the compressed air system to be connected to the compressed air system of another vehicle, or to a trailer air-brake system. Identification tags bearing the words "SERVICE" and "EMERGENCY" are attached to the appropriate couplings on the vehicle to identify the air lines. Dummy couplings are provided for blocking off the hose couplings when not in use, to prevent the entrance of dirt or other foreign matter into the air lines.



Figure 304. Handbrake controls



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Figure 305. Compressed air system piping diagram

Key	Item	Key	Item
A	Trailer coupling	M	Hand control valve
B	Trailer coupling cutout cock	N	Master cylinder
C	Single check valve	P	Air reservoir
D	Air compressor	Q	Air reservoir safety valve
E	Horn	R	Air reservoir drain cock
F	Windshield wiper	S	Hydraulic line to wheel cylinder
G	Air governor	T	Hydraulic bleeder valve
H	Windshield wiper control valve	U	Air hydraulic brake cylinder
J	Junction block	V	Double check valve
K	Air supply valve	W	Stoplight switch
L	Air pressure gage sending unit		

Figure 305. Compressed air system piping diagram - legend

- (6) Air supply valves. Two air supply valves (K, fig. 305) are mounted under the instrument panel, one at each end, in the cab. These valves are connected in the line between the air governor and the upper air reservoir.
- (7) All lines and fittings. Air lines between the components of the compressed air system, air-hydraulic cylinder (par. 220f), horn, windshield wipers, and stoplight switch are copper tubes with threaded fittings at both ends.

Manually operated cutout cocks (B, fig. 305) are installed in the lines to the trailer brake couplings to provide a means of closing off these couplings when not in use. One single check valve (G, fig. 305) and three double check valves (V, fig. 305) are installed in the lines to control the flow of air through the system.

221. Data

a. Brakes (service):

Manufacturer Timken
Type Air actuated hyd

b. Brakes (parking):
Type dual-grip; mounted on transfer case

c. Master Cylinder.
 Manufacturer Wagner Electric Corp.
 Manufacturer's No. LO-FF-14130B
 Type combination

d. Air-Hydraulic Cylinder.
 Manufacturer. Bendix Products Div.
 Manufacturer's No. BX-375844

e. Wheel Cylinder.
 Manufacturer Wagner Electric Corp.
 Manufacturer's No. LO-FC-1012

f. Air Compressor.
 Make Bendix-Westinghouse
 Manufacturer's No. BWE-224618
 Type 2-UE-7-1/4 V.W.

g. Air Governor.
 Make Bendix-Westinghouse
 Manufacturer's No. BWE-224053
Type 0-1 (waterproof)

h. Air Reservoirs.
 Make Bendix-Westinghouse
 Manufacturer's No. BWE-224627
 Size 7-inch diameter

i. Safety Valve.
 Make Bendix-Westinghouse
 Manufacturer's No. BWE-205105

j. Air Reservoir Drain Cock
 Make Bendix-Westinghouse
 Manufacturer's No. BWE-215310

k. Hand Control Valve.
 Make Bendix-Westinghouse
 Manufacturer's No. BWE-224649
 Type HP

l. Air Supply Valve.
 Make Bendix-Westinghouse
 Manufacturer's No. BWE-221351

m. Single Check Valve.
 Make Bendix-Westinghouse
 Manufacturer's No. BWE-220306

n. Double Check Valve.
 Make Bendix-Westinghouse
 Manufacturer's No. BWE-217698

Section II. TROUBLESHOOTING

222. Troubleshooting Before Removal or Operation

- a. General. Do not operate the vehicle prior to completing the procedures given in this paragraph.
- b. Inspect Brake System.
- (1) Visually inspect all brake lines to see that they are securely connected, properly supported, and in good condition. Tighten loose connections and replace damaged lines.
 - (2) Inspect for signs of fluid leaks at master cylinder, air-hydraulic cylinder, wheel cylinders, and brake lines. Correct the leaks and refill master cylinder.

inder. Refer to paragraph 250 for bleeding the brake system.

- (3) Check brake pedal adjustment (par. 249). Free travel should be one-fourth to one-half inch before pressure stroke starts. If brake pedal goes to the floorboard, adjust brakes.
- (4) Inspect brakedrums for cracks or damage; replace if evidence of either is present (par. 242).

223. Troubleshooting Before and During Operation

a. If the inspections in the preceding paragraph do not reveal causes of failure and the vehicle is operable, then troubleshoot it.

b. Pedal has less than 2 inches floorboard clearance. Adjust clearance between brake-shoes and drums (par. 249)

c. Pedal goes to floorboard and can be built up by pumping. If pressure can be built up, hold down hard to see if pressure will decrease. After holding one-half minute, reduce pressure on foot without releasing pedal, and press lightly to see if pedal moves down under light pressure. This test will reveal a master cylinder cup which is permitting fluid to bypass within the master cylinder without showing signs of leaking on the outside of the master cylinder.

d. Pedal goes to floorboard- and cannot be built up by pumping. Check fluid level in master cylinder reservoir. If insufficient fluid is present, fill with brake fluid. If sufficient

fluid is present, fill with brake fluid. If sufficient fluid is present, then check lines and hoses for leaks. Note the bottom edges of all brake flanges and inner wall of tires for brake fluid. If no external fluid losses are found, but pedal "eases down" under constant but light foot pressure, it is a good indication that trouble is within the master cylinder. In this case, repair or replace the master cylinder. If master cylinder is not faulty, repair air-hydraulic cylinders.

e. Handbrake fails to hold. Worn inner or outer brakeshoe lining. Replace worn inner or outer brakeshoe lining (par. 246), and adjust handbrake cable and shoes (par. 245).

f. Handbrake drags or overheats. Inspect for out-of-round brakedrum. Replace damaged drum (par. 233) if necessary.

Section III. REMOVAL AND INSTALLATION

224. Service Brake Linkage

Note. The close relationship of clutch and service brake linkages, and the manner of installation on the vehicle make necessary the combination of removal and disassembly procedures of both linkages. Refer to paragraph 236.

225. Wheel Cylinder

Removal and installation of the wheel cylinder is given in TM 9-2320-211-20.

226. Master Cylinder

For removal and installation of master cylinder, refer to TM 9-2320-211-20.

227. Air Hydraulic Cylinder

For removal and installation of the air-hydraulic cylinder, refer to TM 9-2920-211-20.

228. Brakedrums

For removal and installation of service brakedrums, refer to TM 9-2320-211-20.

229. Brakeshoes

For removal and installation of service brakeshoes, refer to TM 9-2320-211-20.

230. Hydraulic Lines (Fig. 305)

a. Removal

Note. Hydraulic lines are not ordinarily removed except for replacement, and lines remain attached to truck frame.

- (1) To remove hydraulic lines (fig. 305) open drain cock on underside of lower air reservoir to relieve pressure in compressed air system. Unscrew connectors at both ends of line, remove safety nut and cap screw securing air line closed clip to vehicle, where used, and remove line from vehicle.
- (2) Unscrew connectors securing air lines to inlet and outlet on fittings, and remove fittings from truck.

b. Installation. To install hydraulic line, position line between hydraulic system components to be connected, secure line with retaining and connect line at both ends. Tighten all connections, and bleed the brake hydraulic system (par. 250).

231. Parking Brake Hand Lever

a. Removal.

- (1) Remove cotter pin from cable clevis pin at lever end and remove clevis pin.
- (2) Remove two safety nuts securing parking brake hand lever assembly to seat base.
- (3) Remove five safety nuts and bolts securing parking brake hand lever assem-

bly to floorboard and remove hand lever assembly.

Note. Further disassembly of the parking brake hand lever is not required unless inspection reveals damaged components. If damaged, refer to paragraph 245.

b. Installation.

- (1) Position handbrake lever assembly on top and cable clamp bracket (with cable clamped in place) on underside of cab floor, install five cap screws and safety nuts through lever assembly, cab floor, and clamp bracket, and tighten.
- (2) Install two safety nuts on studs at left end of driver's "seat to secure handbrake lever assembly to seat, and tighten nuts.

232. Cable Assembly

a. Removal. Refer to paragraph 245.

b. Installation.

- (1) Position cable clevis on lower end of handbrake lever link, insert clevis pin in holes in clevis and link, and install cotter pin in clevis pin.
- (2) Insert free end of cable in hole at upper end of brakeshoe lever, end install adjusting nut and locknut on end of cable.
- (3) Position cable on cable clamp bracket (fig. 303) at rear of transfer, making sure that cable clamp spacer is in place on bracket under cable. Position cable anchor clamp over cable, insert two cap screws and tighten.
- (4) Place closed clip on cable, and position clip and cable on clip extension at left end of rear cab cross member.
- (5) Insert cap screw in holes in clip and extension, install safety nut on cap screw, and tighten. Adjust handbrake (par. 245).

233. Hand Brakedrum

a. Removal

- (1) Block wheels to keep truck from moving.

- (2) Disconnect cable from brakeshoe fork.
- (3) Remove four trunnion cap screws from propeller shaft flange (note warning in paragraph 147 on removing propeller shaft) and swing shaft out of the way.
- (4) Remove anchor locknut and bolt and slide shoe assembly from drum.
- (5) Remove eight bolts and self-locking nuts separating propeller shaft flange.
- (6) Remove cotter pin and nut from end of transfer-output shaft and pull flange and drum assembly, and lift off drum.

b. Installation.

- (1) Position drum and shield over transfer-output shaft flange. Press flange end drum assembly on transfer-output shaft.
- (2) Install locknut and cotter pin at end of shaft. Install propeller shaft flange and universal joint assembly and tighten securely.
- (3) Position propeller shaft and install four trunnion bolts and tighten securely.
- (4) Position brakeshoe and fork assembly in position and install anchor bolt and locknut.
- (5) Connect cable assembly and adjust handbrake lever and linkage (par. 245).

234. Hand Brakeshoes

a. Removal.

- (1) Block wheels to prevent truck from moving.
- (2) Unhook brakeshoe retracting spring (fig. 304) from outer end of shoe stop screw. Unhook brakeshoe lever retracting spring from upper end of brakeshoe lever.
- (3) Remove locknut (fig. 304) and adjusting nut from end of cable at brakeshoe lever, and remove cable from lever.
- (4) Remove locknut from front end of shoe anchor bolt (fig. 303), and unscrew

bolt from bracket integral with transfer rear-output-shaft bearing cover. Remove shoe anchor bolt from bore at lower end of outer shoe.

- (5) Spread inner and outer shoes (fig. 306), and remove shoe and lever assembly from brakedrum.
- (6) Remove C-washer from front end of two brakeshoe-lever pins (fig. 306), and remove inner and outer shoes from pins.

b. Installation.

- (1) Position inner and outer brakeshoes (fig. 306) on brakeshoe-lever pins, and install C-washer at front end of both pins.
- (2) Position shoe and lever assembly on brakedrum (fig. 303).
- (3) Insert shoe anchor bolt (fig. 303) in bore at lower end of outer shoe, screw bolt through bracket integral with transfer rear-output-shaft bearing cover, and loosely install locknut on anchor bolt. Screw anchor bolt into bracket until slight bind is felt when operating brakeshoe lever, then back off bolt one-half turn, and tighten locknut.
- (4) Insert end of handbrake cable (fig. 304) in hole in upper end of brakeshoe lever, and install adjusting nut and locknut on end of cable.

- (5) Hook end of brakeshoe retracting spring (fig. 304) over outer end of shoe stop screw. Hook end of brakeshoe lever retracting spring in eye at upper end of brakeshoe lever.
- (6) Adjust handbrake (par.245).
- (7) Remove wheel blocks.

235. Air Governor (G, Fig. 305)

For removal and installation of the air compressor air governor, refer to TM 9-2320-211-20.

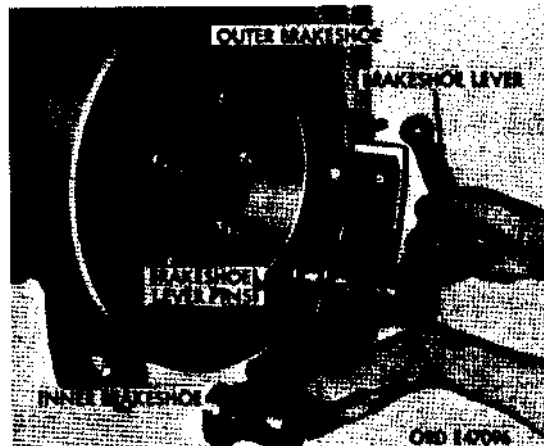


Figure 306. Removing hand brakeshoe and lever assembly

Section IV. REPAIR

236. Service Brake Linkage

Note. The close relationship of clutch and service brake linkages, and the manner of installation on the vehicle make necessary the combination of removal and disassembly procedures of both linkages.

Note. Key letters in this paragraph refer to figure 307 unless otherwise indicated.

a. Removal and Disassembly.

(1) Clutch pedal linkage.

- (a) Remove safety nuts and cap screws clamping clutch pedal lever to pedal

stem. Pull pedal stem out of lever and bumper and remove pad from pedal.

- (b) Remove clutch pedal return spring from clip on clutch pedal lever and from clip on running board support.
- (c) Remove safety nut and cap screw clamping clutch pedal lever to pedal shaft. Remove pedal return spring clip from cap screw. Remove pedal lever and Woodruff key from pedal shaft.

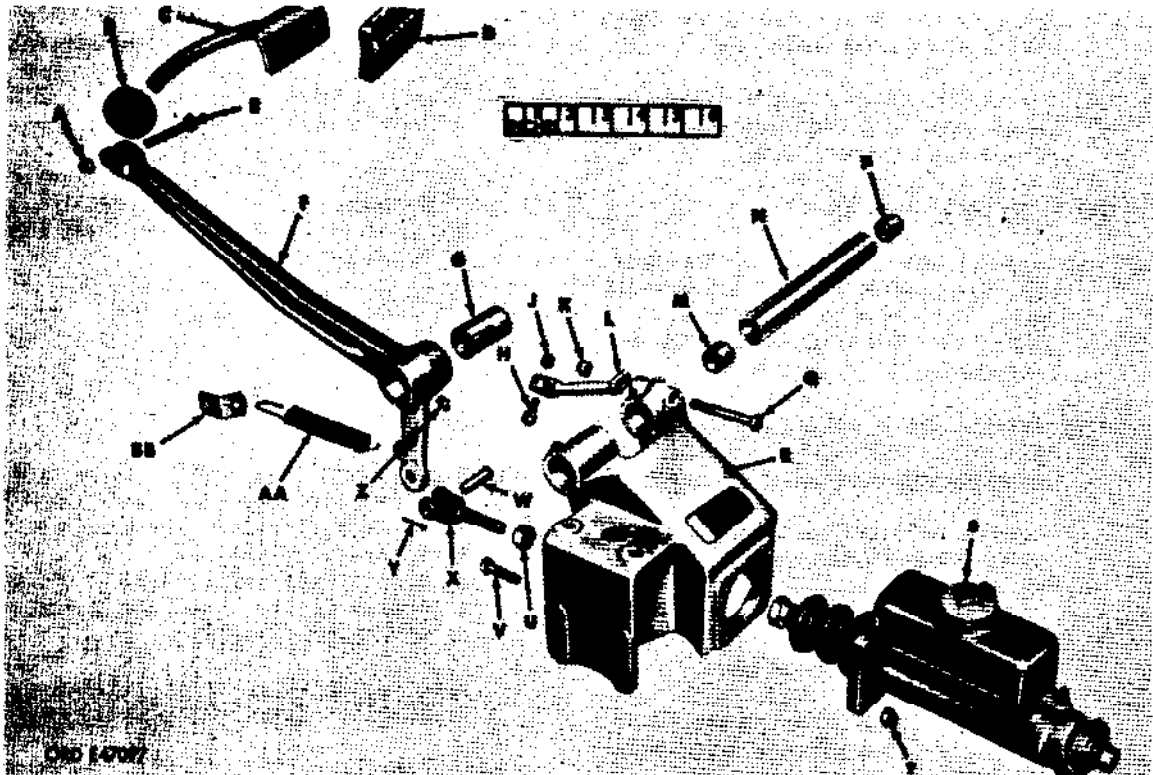


Figure 307. Brake pedal linkage and master cylinder - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Nut, safety	P	Bushing, lever shaft
B	Bumper, lever	Q	Screw, cap
C	Stem, pedal	R	Bracket, supporting, lever
D	Pad	S	Cylinder, hydraulic, master, assembly
E	Screw, cap	T	Nut, safety
F	Lever, pedal	U	Nut, hex
G	Bushing, lever	V	Screw, cap
H	Screw, cap	W	Pin, clevis
J	Nut, safety	X	Yoke, rod end
K	Nut, safety	Y	Pin, cotter
L	Brace, lever supporting bracket	Z	Fitting, lubricating
M	Bushing, lever shaft	AA	Spring, return
N	Shaft, lever 1HC	BB	Clip, spring

Figure 307. Brake pedal linkage and master cylinder - exploded view - legend

(d) Remove cotter Pin from clutch control rod pin and remove pin connecting control rod to pedal shaft lever.

(e) Remove safety nut and cap screw clamping clutch pedal shaft control rod lever to pedal shaft. Remove

control rod lever and Woodruff key from pedal shaft. Pull pedal shaft out of brake pedal shaft tube.

- (f) Disconnect clutch control rod at release shaft lever by removing clevis pin. Remove control rod.

(2) Brake pedal linkage.

- (a) Remove safety nut (A) and cap screw (E), clamping pedal lever (F) to pedal stem (C). Pull pedal stem cut. of pedal lever and lever bumper (B) and remove pad (D) from pedal.
- (b) Remove safety nut (SC) and cap screw (Q) which clamps lever shaft (N) to lever supporting bracket (R).
- (c) Remove return spring (M) from pedal lever (F) and from spring clip (BB) on clutch housing.
- (d) Remove cotter pin (Y) from clevis pin (W). Remove clevis pin.
- (e) Pull lever shaft (N) out of lever supporting bracket (R) and out of pedal lever (F).
- (f) Remove lever bushing (G) from pedal lever (F). Remove lubricating fitting (Z) from lever.
- (g) Remove lever shaft bushings (M and P) from lever shaft (N).
- (h) Remove safety nut (J) and cap screw (H) attaching lever-supporting bracket brace (L) at frame assembly. Remove brace.
- (i) Loosen hex-nut (U) and remove rod end yoke (X) from master-hydraulic cylinder assembly (S). Remove hex-nut from rod end yoke.
- (j) Remove safety nuts (T) and cap screws (V) attaching master-hydraulic cylinder assembly (S) to lever supporting bracket (R).
- (k) Remove lubricating fitting from lever supporting bracket.
- (l) Remove safety nuts and cap screws attaching lever supporting bracket (R) to frame assembly.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean mud and dirt from all parts with water and a stiff brush. Remove grease with dry-cleaning solvent or mineral spirits paint thinner.
- (2) Inspection. Inspect all parts for defects or damage. Inspect for bent pedal lever and pedal stem. Check pedal lever and lever shaft bushings for wear as outlined in serviceability standards (par. 258). Thoroughly inspect lever supporting bracket for damage or cracks and replace if either are evident. Check return spring and replace if damaged or weak.
- (3) Repair. Straighten pedal lever and pedal stem if inspection reveals them to be bent. If inspection indicates, excessive wear of pedal lever and lever shaft bushings, replace bushings, using a suitable adapter. Install new bushings flush with ends of tube.

Note. Be sure lubricant hole in lever bushing is aligned with hole in lever.

c. Assembly.

- (1) Brake pedal linkage (fig. 307).
 - (a) Place lever supporting bracket (R) on frame assembly and install cap screws and safety nuts. Tighten securely.
 - (b) Install lubricating fitting into lever supporting bracket.
 - (c) Install cap screw (V) and safety nuts (T) attaching hydraulic master cylinder (S) to lever supporting bracket (R) and tighten securely.
 - (d) Install safety nut (J) on rod end yoke (X) and install yoke in master hydraulic cylinder assembly (S). Adjust rod end yoke to desired length after installation of linkage is completed, then tighten safety nut securely.
 - (e) Position pedal lever (F) in lever supporting bracket (R) and insert lever shaft (N) through bore in lever supporting bracket and pedal lever. Index notch in lever shaft with cap screw

hole in lever supporting bracket to permit insertion of cap screw. Install cap screw (Q) into bracket and place lever-supporting bracket brace (L) on cap screw. Install safety nut (K) loosely on cap screw. Attach lower end of lever-supporting bracket brace (L) to frame assembly, using cap screw (H) and safety nuts (J). Tighten safety nuts (J and K) alternately and securely.

(f) Connect pedal lever (F) to rod end yoke (X), using clevis pin (W). Install cotter pin (Y) in clevis pin.

(g) Install spring clip (BB) on clutch housing. Install return spring (AA) on spring clip and into eye on pedal lever(F).

(h) Install pad (D) on pedal stem(C) and insert stem through opening in toeboard. Install lever bumper (B) on pedal stem. Install pedal stem into pedal lever (F) and attach thereto by using cap screw (E) and safety nut (A).

(i) Lubricate lever bushing (G) through lubricating fitting (Z).

(2) *Clutch pedal linkage.*

(a) Install clutch pedal shaft into lever shaft of brake pedal. Install Woodruff key and clutch pedal-shaft-control-rod lever on clutch pedal shaft. Install cap screw and safety nut securing control rod lever to pedal shaft. Tighten nut securely.

(b) Install clutch control rod to pedal shaft control rod lever, using control rod clevis pin and cotter pin.

(c) Connect lower end of clutch control rod to release shaft lever, using control rod adjustable yoke pin attached to yoke.

(d) Install clutch pedal lever, Woodruff key, and pedal lever on pedal shaft. Install pedal return spring clip on cap screw. Install this cap screw with clip to secure pedal lever on pedal shaft, Install safety nut on cap screw and tighten nut securely.

(e) Install clutch pedal return spring to clip on pedal lever retaining cap screw and clip on

running board support.

(f) Install clutch pedal pad on pedal, and insert pedal stem through opening in toeboard. Install bumper on pedal stem. Install pedal stem into lever and attach lever to stem, using cap screw and safety nut. Tighten nut securely.

(g) Lubricate clutch pedal shaft through lubricating fitting in lever support bracket.

237. Wheel Cylinder (Fig. 308)

a. Disassembly.

(1) Remove bleeder valve (F) and drain cylinder body (D).

(2) Remove piston push rods and boots (A) from each end of wheel cylinder body.

(3) Push out pistons (B), piston cups (C) and piston return spring (E) from cylinder body.

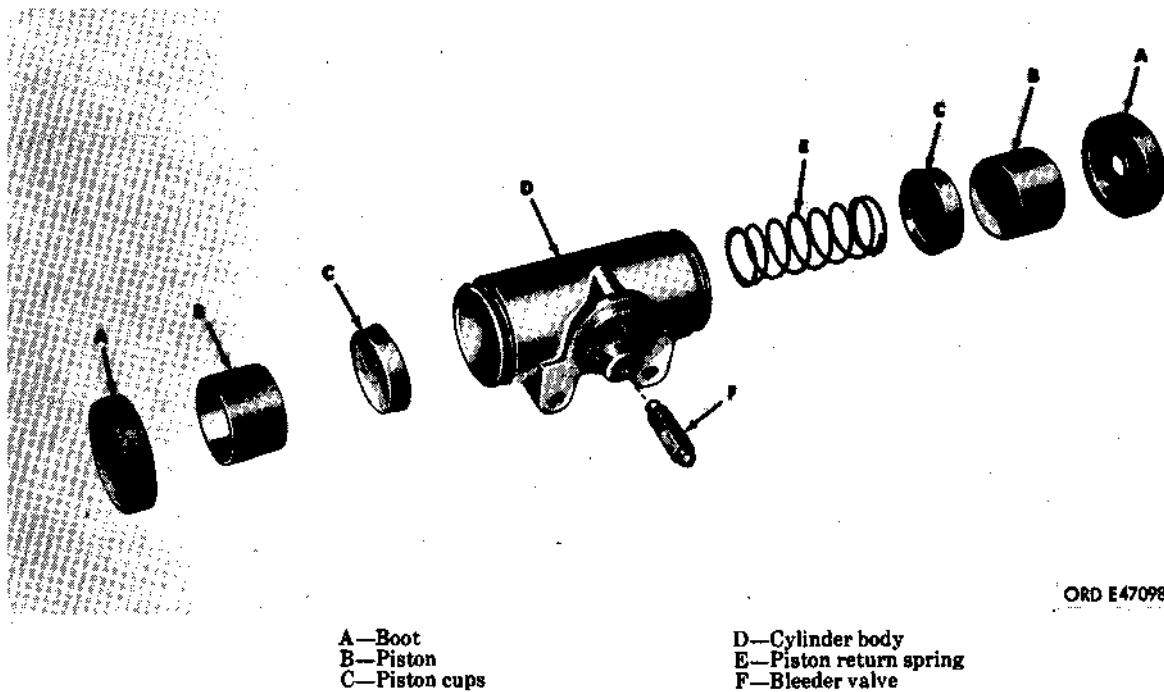
b. Cleaning, Inspection, and Repair.

(1) *Cleaning.* Wash the cylinder and all parts in drycleaning solvent or mineral spirits paint thinner and dry thoroughly with filtered, compressed air.

CAUTION

It is of utmost importance that all hydraulic cylinders be immaculately clean. The presence of any foreign substance will hinder proper operation and eventually result in failure. Drycleaning solvent or mineral spirits paint thinner must not be permitted to come in contact with the rubber parts. Any petroleum product base will cause the rubber elements to expand, become spongy, and deteriorate. Dip all usable rubber elements in denatured alcohol after cleaning.

(2) *Inspection.* After the wheel cylinder has been thoroughly cleaned, inspect for pits, scratches, or roughness inside cylinder bore. Inspect rubber elements for a spongy or deteriorated condition. Replace cylinder assembly if cups or boots are deteriorated.



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Figure 308. Wheel cylinder assembly-exploded view.

(3) **Repair.** If the cylinder bore is rough, scratched, or pitted, replace wheel cylinder assembly.

c. Assembly.

(1) Dip cylinder body and all internal parts in brake fluid. Insert piston cups with piston return spring between them, making sure lips of cups face each other.

(2) Insert pistons by placing them in cylinder body, with open ends out.

(3) Install rubber boots on each end of cylinder body.

(4) Insert piston push rods through rubber boots, with slotted end out. Install bleeder valve.

238. Master Cylinder (Fig. 309)

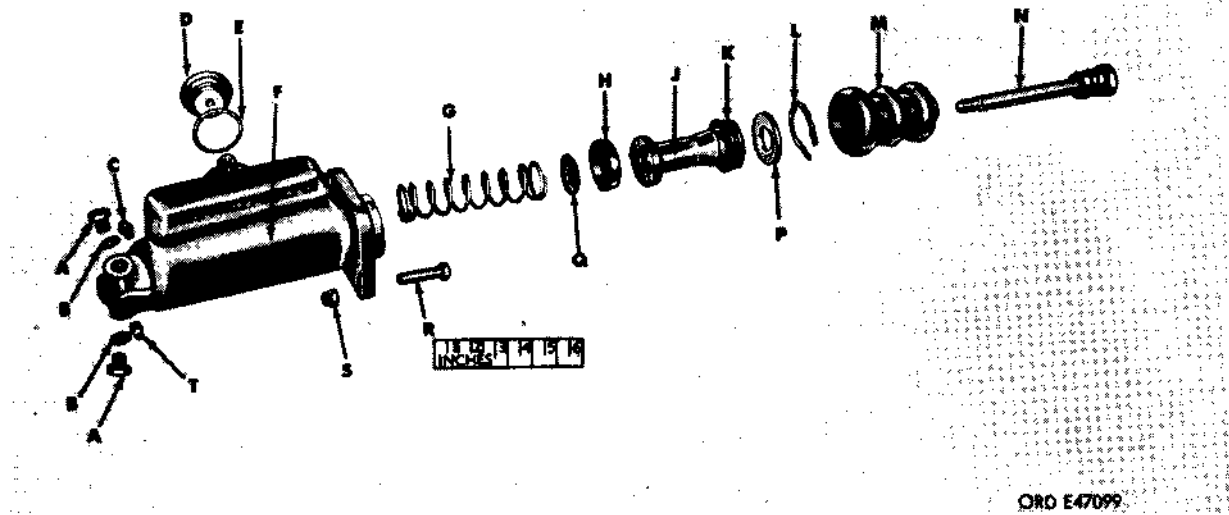
a. Disassembly.

(1) Remove reservoir filler cap (D) and gasket (E). Drain fluid from master cylinder reservoir. Remove piston push rod (N) and rubber boot (M) and remove boot from push rod.

(2) Remove wire (L) and plate (P). Remove piston (J) and cup assembly (K).

(3) Remove piston cup (H), spring retainer (Q), and piston return spring (G) from cylinder (F).

(4) Remove one plug (A) and one washer (B) from each side of cylinder. Remove plug (T) and screw (C).



- | | |
|--------------------|------------|
| A—Plug | K—Cup |
| B—Gasket | L—Wire |
| C—Screw | M—Boot |
| D—Cap | N—Rod |
| E—Gasket | P—Plate |
| F—Cylinder | Q—Retainer |
| G—Spring | R—Screw |
| H—Cup | S—Nut |
| J—Piston, assembly | T—Plug |

Figure 309. Master cylinder assembly—exploded view.

b. Cleaning, Inspection, and Repair.

- (1) *Cleaning.* Refer to paragraph 237b.
- (2) *Inspection.* Refer to paragraph 237b.
- (3) *Repair.* If the cylinder bore is rough, scratched or pitted, replace cylinder assembly.

c. Assembly.

- (1) Install plug (T) and screw (C) in cylinder body. Install gasket (B) on plugs (A) and install in each side of cylinder. Insert spring (G) and retainer (Q) in housing.

- (2) Dip primary piston cup (H) in brake fluid and insert with flared end first. Dip piston assembly (J) and secondary cup assembly (K) into brake fluid and insert with secondary cup (K) toward open end of cylinder.

- (3) Install retainer (Q) and retainer wire (L) to secure piston in cylinder housing.

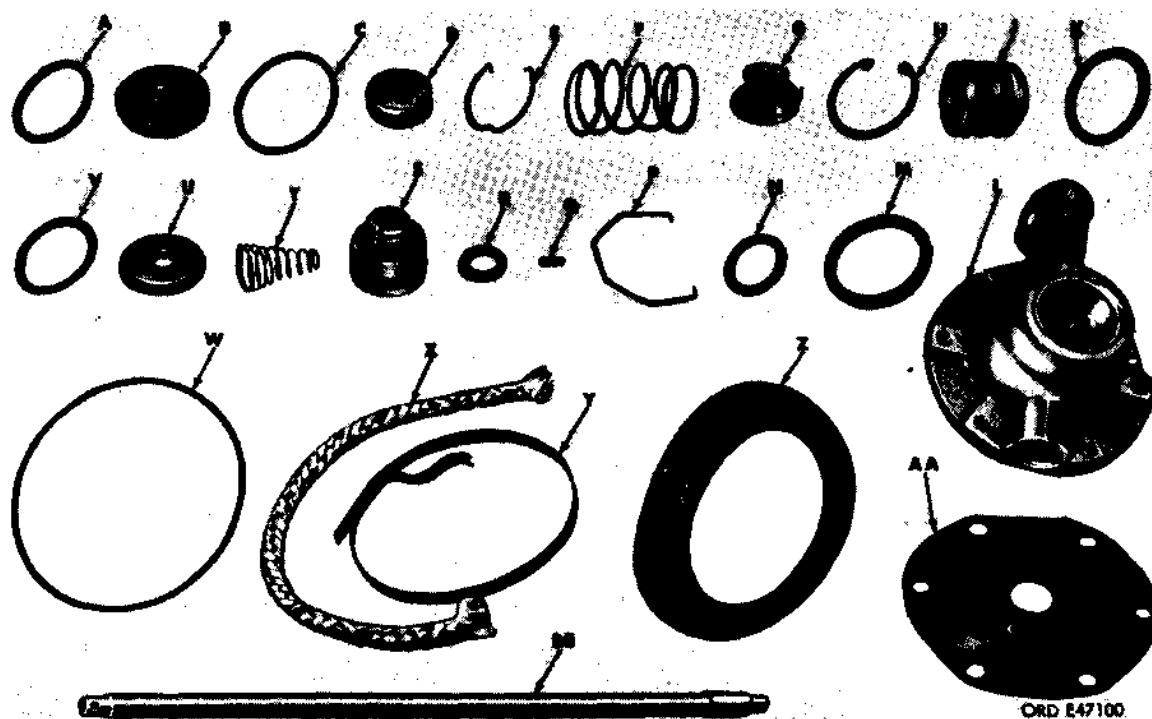
- (4) Position rubber boot (M) on push rod (N). Install push rod and boot. Install gasket (E) on cap (D) and install in cylinder (F).

239. Air Hydraulic Cylinder

A typical repair kit for the air-hydraulic cylinder is shown in figure 310. The items contained in the repair kit will replace similar discarded items whenever the unit is disassembled for repair.

240. Power Piston**NOTE**

The key letters noted in parentheses are in figure 311 unless otherwise indicated.



- A—Relay piston sleeve gasket
- B—Push rod sealing cup
- C—Push rod oil seal gasket
- D—Push rod oil seal
- E—Residual line check valve snap ring
- F—Residual line check valve spring
- G—Residual line check valve assembly
- H—Relay piston stop snap ring
- J—Relay piston w/cups
- K—Slave cylinder gasket
- L—Control valve housing and poppets assembly
- M—Slave cylinder jamnut seal
- N—Air inlet plug gasket

- P—Push rod sealing cup washer snap ring
- Q—Hydraulic piston pin
- R—Air control line seal
- S—Hydraulic piston assembly
- T—Poppet return spring
- U—Push rod sealing cup washer
- V—Hydraulic outlet fitting cap gasket
- W—End plate gasket
- X—Piston packing oil wick
- Y—Piston packing expansion ring
- Z—Piston packing
- AA—Diaphragm
- BB—Push rod w/snap ring

Figure 310. Typical repair kit for air-hydraulic (Air-pak) power cylinder.

a. Disassembly.(1) Remove cylinder body.

- (a) Unscrew the two fitting nuts securing the control line (E) to the control valve and the cylinder body (D). Unscrew the elbow (C) in the check valve (B). Remove the control line. Remove and discard the gasket (K).
- (b) Remove the nuts (U) and lockwashers (V) from the six screws (F and G) securing the cylinder body (D) to the end plate (W). Pull the cylinder body from the end plate (W). If the body sticks to the end plate, dislodge it by tapping around the body with a plastic or rawhide hammer or rubber mallet.
- (c) Remove the plug (A) from the cylinder body.
- (d) Unscrew the valve from the body (D) and remove the elbow (C) from the check valve assembly.

(2) Remove hydraulic piston and end plate.

- (a) Loosen the jam nut (AA, fig. 314) on the slave cylinder (R) and unscrew the cylinder from the end plate (W).
- (b) Clamp the piston plate nut (H) in a vise. Press down on the end plate to compress the piston return spring (Z) and clamp the piston to the plate with two C-type clamps engaged over the piston and the end plate (fig. 312).
- (c) Compress the small spring (K, fig. 314) on the hydraulic piston (T) to provide access to the pin (S) that secures the piston to the push rod (Y) and remove the pin. Remove the hydraulic piston. Discard the pin and the piston.
- (d) Hold the end plate against spring tension and carefully remove the clamps that were used to hold the piston return spring.

Caution: Do not remove the clamps without holding the parts against spring action to avoid injury to personnel when the spring is released.

- (e) Remove the end plate assembly (W) from the push rod carefully to avoid damaging the rod.

- (f) Remove the return spring (Z).

- (g) Remove and discard the gasket (X) from the end plate.

- (h) Remove the power piston assembly from the vise.

(3) Disassemble power piston.

- (a) Pull the push rod (Y, fig. 311) snap ring (BB) and washer (AA) from the piston (Q) and discard the push rod, snap ring, and washer.
- (b) Place the power piston (Q) over an improvised holding fixture (fig. 313) with the fixture straddling two opposite ribs in the piston. Clamp the improvised fixture in a vise (fig. 315). Remove the piston plate nut (H) and the wick retaining plate (J). Remove the expansion ring (L) securing the wick (H) in the piston packing (P), and remove the wick. Remove the plate (N) and packing (P). Discard the packing, oil wick, and expansion ring. Remove the piston from the holding fixture.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Wash all parts thoroughly in clean mineral spirits paint thinner. Be sure to remove all traces of shellac and gasket material from gasket surfaces. Dry the parts with compressed air and wipe with a clean, lint-free cloth.

(2) Inspection.

- (a) Inspect the cylinder body for dents, cracks, corroded or scored inner surface, damaged gasket surface or screw holes, and stripped threads in the bosses.
- (b) Inspect the air control line for cracks, dents, and damaged threads on the fitting nuts. See that the tube is properly flared to provide airtight connections.
- (c) Inspect the power piston and plates for breaks and distortion and inspect the return spring for cracks and proper tension (par. 250)

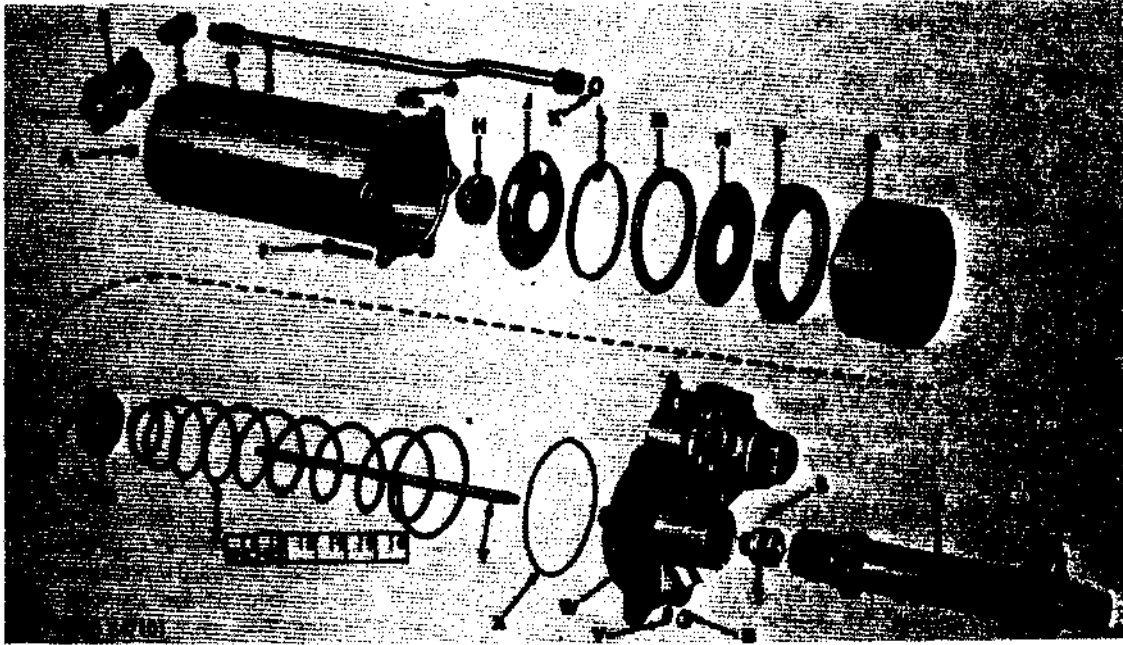


Figure 311. Air-hydraulic (Air-Pak) power cylinder with double check valve - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Lubricating plug	P	Piston packing
B	Check valve assembly	Q	Power piston
C	Control line elbow	R	Slave cylinder assembly
D	Cylinder body	S	Hydraulic piston pin
E	Control line	T	Hydraulic piston assembly
F	Cylinder body screw (long)	U	Cylinder body screw nut
G	Cylinder body screw (short)	V	Lockwasher
H	Piston plate nut	W	End plate and control valve assembly
J	Wick retaining plate	X	End plate gasket
K	Control line gasket	Y	Push rod
L	Expansion ring	Z	Piston return spring
M	Piston packing wick	AA	Return spring washer
N	Packing retaining plate	BB	Snap ring

Figure 311. Air-hydraulic (Air-Pak) power cylinder with double check valve - exploded view - legend

- (3) Repair. Remove minor abrasions and corrosion from the inner surface of the cylinder body by polishing with crocus cloth or No. 00 steel wool. Remove minor scratches or abrasions from the gasket surface with a fine file or hand honing stone.

c. Assembly.

Note. The key letters noted in parentheses are in figure 311, unless otherwise indicated.

- (1) General. Soak the new power piston packing and wick in neat's-foot oil

and allow excess to drain. Coat piston assembly with one ounce of MIL-G-10924 grease before assembly.

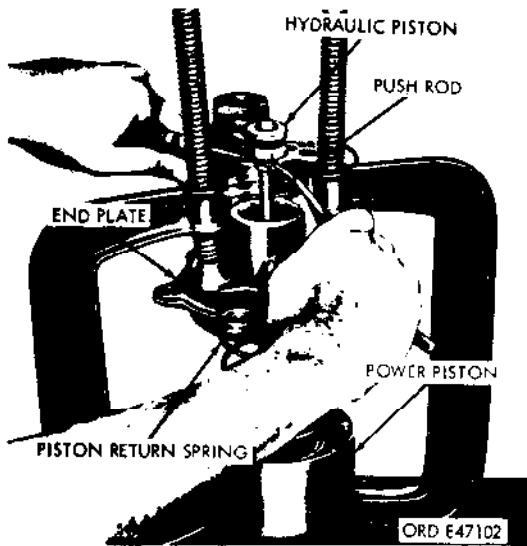


Figure 312. Removing or installing hydraulic piston for air-hydraulic (Air-Pak) power cylinder

(2) Assemble power piston.

(a) Place the power piston (Q) in a holding fixture and clamp the fixture in a vise (figure 313).

(b) Assemble the piston packing and related parts in the correct size improvised assembly ring (figure 316) as shown in figure 317. Install the new piston packing (P) in the ring with the lip facing up. Place the packing retaining plate (N) over the packing with the concave side toward the packing. Fit the new piston packing wick (M) inside the lip of the packing, and install the new expansion ring (L).

NOTE

If the wick is too long or if bulk material is supplied for the wick, fit the wick into the packing before cutting it, to ensure correct length of wick.

(c) Place the wick retaining plate (J) over the wick, centering the lock of the expansion ring in the cutout of the plate.

(d) Place the assembled packing and plates (in the improvised assembly ring) on the power piston (Q) with the packing next to the piston. Install the piston plate nut (H) on the piston. Tighten the nut and remove the assembly ring. Remove the piston from the holding fixture.

(e) Install a new snap ring (BB) on the new push rod (Y).

(f) Install the new return spring washer (AA) on the push rod with the flat side next to the snap ring.

(g) Fit the end of the push rod (Y) into the power piston (Q).

(3) Assemble power piston, end plate, and slave cylinder.

(a) Clamp the piston plate nut (H) in a vise. Insert the small end of the piston return spring (Z) into the power piston (Q), fitting the spring into the return spring washer on the push rod.

(b) Install a new end plate gasket (X) in the recess of the end plate control valve assembly (W).

(c) Hold the end plate in position over the piston and return spring, and carefully insert the push rod through the oil seal in the plate. While pressing the end

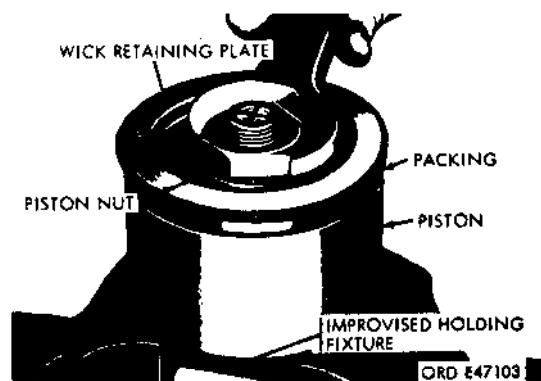


Figure 313. Disassembling air-hydraulic (Air-Pak) power cylinder piston, using improvised holding fixture.

plate toward the power piston to compress the return spring. Clamp the end plate (W, figure 311) to the power piston to hold the piston return spring (Z).

(d) Install the new hydraulic piston (T) on the end of the push rod, aligning the pin holes. Compress the small spring on the hydraulic piston and install the new

hydraulic piston pin (S). Release the spring.

(e) Remove the C-type clamps that were used to compress the piston return spring.

(f) Fit a new gasket (J, figure 314) in the slave cylinder bore of the end plate.

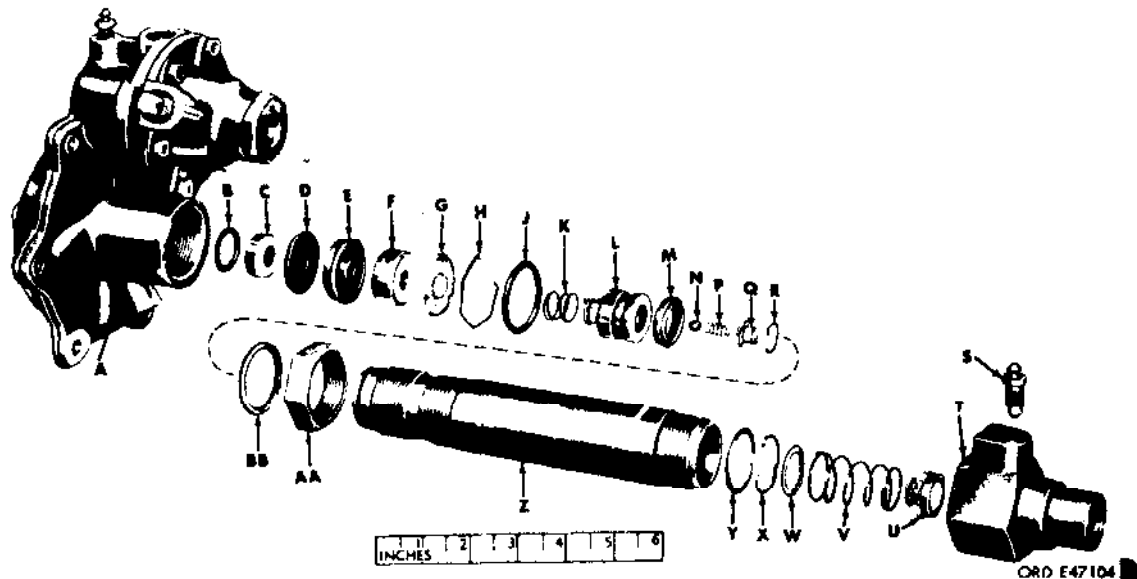
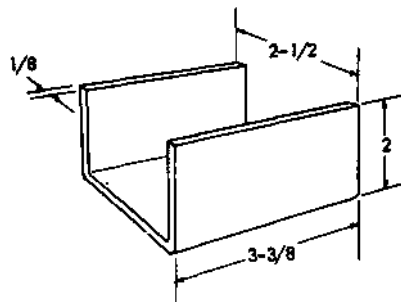


Figure 314. Air-hydraulic (Air-Pak) power cylinder slave cylinder - exploded view.

KEY	ITEM	KEY	ITEM
A	End plate assembly	P	Ball return spring
B	Oil seal gasket	Q	Spring retainer
C	Oil seal	R	Snap ring
D	Sealing cup washer	S	Bleeder valve
E	Sealing cup	T	Hydraulic outlet fitting cap
F	Sealing cup spacer	U	Residual line check valve
G	Piston stop washer	V	Check valve return spring
H	Stop washer snap ring	W	Check valve washer
J	Slave cylinder gasket	X	Check valve snap ring
K	Pin retaining spring	Y	Outlet fitting eep gasket
L	Hydraulic piston assembly	Z	Housing
M	Piston sealing cup	AA	Jam nut
N	Check valve ball	BB	Jam nut seal



NOTE: ALL DIMENSIONS
SHOWN
ARE IN INCHES

ORD E47105

Figure 315. Improved piston holding fixture - detail drawing

Slide the slave cylinder assembly (R) over the hydraulic piston (T) and thread the slave cylinder housing into the end plate. Tighten the slave cylinder until the housing bottoms and the bleeder valve in the slave cylinder points in the same direction as the valve in the end plate. Tighten the jam nut (AA, fig. 314) on the slave cylinder firmly against the end plate. Remove the parts from the vise.

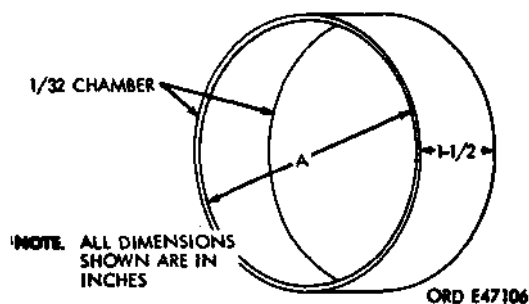


Figure 316. Improved assembly rings - detail drawings

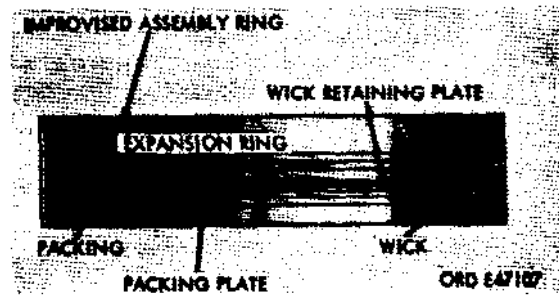


Figure 317. Assembling air-hydraulic (Air-Pak) power cylinder piston packing and plates, using improvised assembly ring - sectional view

(4) Assemble and install cylinder body.

- (a) Install the lubricating plug (A) in the end of the cylinder body (D).
- (b) Coat the threads of the check valve boss in the cylinder body with liquid type gasket cement. Install the check valve assembly (B), screwing it to the boss in the cylinder body so that the opening for the control line elbow (C) will be in position for installing the elbow and the air control line. Install the elbow (C), but do not tighten at this time.
- (c) Install the cylinder body over the piston, being careful not to damage the piston packing. Position the cylinder body on the end plate and control valve assembly (W) matching alining marks made at disassembly.
- (d) Install the two short cylinder body screws (G) and four long cylinder body screws (F) from the body side, being sure to install the long screws in the same positions from which they were removed. Install the identification tag on the screws. Install a lockwasher (V) and cylinder body screw nut (U) on each screw, and tighten the nuts evenly.
- (e) Install a new control line gasket (K) on the control valve end of the control line (E). Position the line, with the tube inserted, in the opening in the end plate and the opposite end alined

with the boss in the elbow (C) in the double check valve. Tighten the elbow in the valve so that it will line up with the control line. Screw the two nuts on the control line into their respective fittings.

241. Slave Cylinder, Control Valve, and End Plate Plate

a. Disassembly.

Note. The key letters noted in parentheses are in figure 314 unless otherwise indicated.

(1) Disassemble slave cylinder (fig. 314).

- (a) Remove the bleeder valve (S) from the cap (T) and clamp the cap in a vise with the housing (Z) up.
- (b) Remove the seal (BB) and nut (AA) from the housing (Z). Discard the seal. Using a suitable wrench on the milled flats of the housing (Z), unscrew the housing from the cap (T). Remove and discard the copper gasket (Y).
- (c) Remove and discard the snap ring (X) securing the check valve washer (W) in the cap (T), and remove the washer (W), spring (V), and valve (U). Discard the check valve and spring. Remove the cap from the vise.
- (d) Remove and discard the snap ring (H) securing the washer (G) in the bore of the end plate, and remove the washer. Remove the cup spacer (F) and cup (E) as a unit. Remove the cup from the spacer. Discard the _{CUP}.
- (e) Remove and discard the sealing cup washer (D).

Note. Do not remove the oil seal (C) and gasket (B) until the control valve has been removed ((2) below).

(2) Remove and disassemble control valve.

Note. The key letters noted in parentheses are in figure 318 unless otherwise indicated.

- (a) Evenly loosen the six screws (G) securing the valve housing assembly (E)

to the end plate (A). Hold the housing against tension of the diaphragm return spring, and remove the six screws and lockwashers (F). Do not loosen the identification tag. Remove the housing, spring (D) and assembled diaphragm (N) stem (P) and plate (Q).

- (b) Remove the jam nut (L) and washer (M) securing the diaphragm (N) on the stem (P) and separate the parts. Discard the diaphragm.
- (c) Remove the plug (K) and spring (H) from the housing assembly. Remove the gasket (J) from the plug. Discard the gasket and the spring.
- (d) Remove the plug (C) from the housing.

Note. Do not attempt to remove the two poppets from the valve housing, as replacement poppets are not available as separate items. When disassembling for repair, discard the housing assembly.

- (e) Using an improvised offset screwdriver (fig. 319), engage the slots in the sleeve (S) and unscrew the sleeve from the bore in the end plate (fig. 320). Remove and discard the gasket (T).
- (f) Remove and discard the snap ring (R) from the sleeve. If a "spirolox" ring is used at this point, it will be necessary to break the ring to remove it. A "true-arc" ring can be removed with commercial-type snap ring pliers.
- (g) Push the relay piston (V) with cups (U and W) from the sleeve and discard them.
- (h) Remove the bleeder valve (B) from the end plate (A).

(3) Remove push rod oil seal.

- (a) Screw a bolt of suitable length through the oil seal (C, fig. 314) from the slave cylinder end of the bore of the end plate (A, fig. 314). Clamp the end plate in a vise and insert a suitable punch into the end plate from the opposite side.

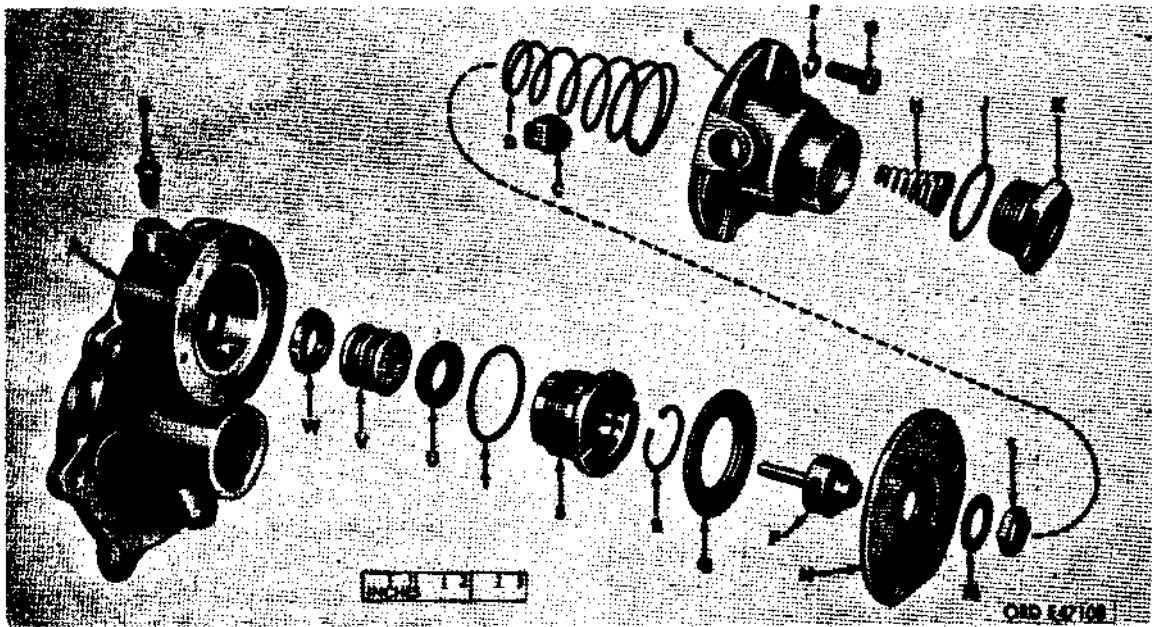


Figure 318. Air-hydraulic (Air-Pak) Power cylinder control valve - exploded view

Key	Item	Key	Item
A	End plate	M	Diaphragm washer
B	Bleeder valve	N	Diaphragm
C	Pipe plug (trailer connection)	P	Diaphragm stem
D	Diaphragm return spring	Q	Diaphragm plate
E	Housing and poppet assembly	R	Relay piston snap ring
F	Lockwasher	S	Relay piston sleeve
G	Housing screw	T	Sleeve gasket
H	Poppet return spring	U	Relay piston sealing cup (outer)
J	Fitting plug gasket	V	Relay piston
K	Air inlet fitting plug	W	Relay piston sealing cup (inner)
L	Diaphragm stem jam nut		

Figure 318. Air-hydraulic (Air-Pak) power cylinder control valve - exploded view - legend

- (b) Hold the punch against the bolt in the oil seal and drive the oil seal (C, fig. 314) and bolt from the end plate (fig. 321). Discard the oil seal and oil seal gasket (B, fig. 314),
- (4) Disassemble double check valve (fig. 322).
- (a) Remove the two nuts (fig. 322), lockwashers, and screws attaching the caps to the valve body, and remove the cap from each end of the body.
- (b) Remove the two body gaskets and slide the piston from the body. Discard the gaskets.
- b. Cleaning, Inspection, and Repair.
- (1) Cleaning. Refer to paragraph 237.
- (2) Inspection.
- (a) Inspect the slave cylinder housing for corrosion and scoring of the inner



- (b)** Inspect the slave cylinder outlet cap for cracks, stripped threads, and damaged check valve seat.
- (c)** Inspect the control valve body and poppet for corrosion of poppet seats, damaged flange surface, and stripped threads. Inspect the diaphragm return spring for cracks and proper tension (par. 258).
- (d)** Inspect the relay piston sleeve for corrosion, scoring, and stripped threads. Check the bore for wear (par. 258).
- (e)** Inspect the diaphragm stem for corrosion and stripped threads.



Figure 320. Removing relay piston sleeve, using improvised offset screwdriver

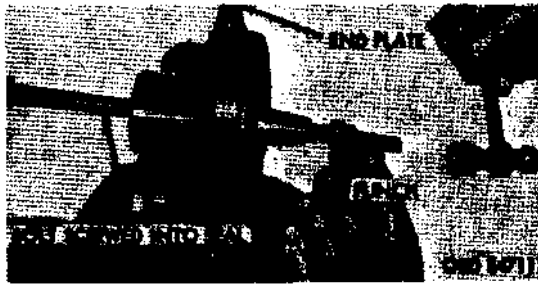


Figure 321. Removing push rod oil seal

- (f) Inspect the end-plate for cracks, distortion, damaged gasket surfaces, stripped threads, and corrosion or scratches in the bores. Check the interval passage for any signs of restriction and remove.
- (g) Inspect the bleeder valves for corrosion and stripped threads.
- (h) Inspect the double check valve for scored piston, corrosion, bent flanges, and stripped threads.
- (i) Inspect all nuts, screws, washers, and miscellaneous parts for breaks, wear, and stripped threads.

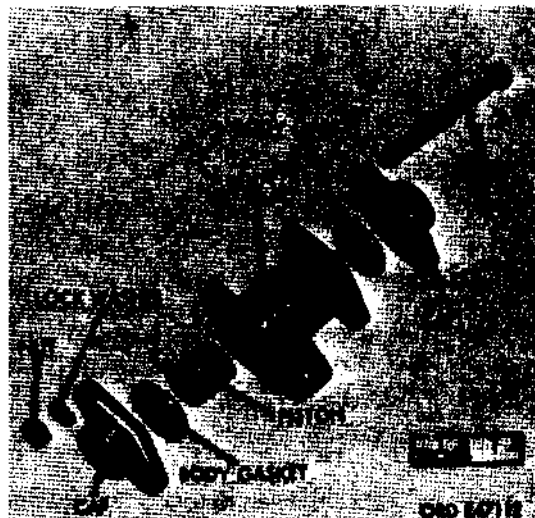


Figure 322. Double check valve

(2) Repair.

- (a) Remove minor corrosion and abrasions from the bores of the slave cylinder housing and the relay piston sleeve by polishing with No. 00 steel wool.

Caution: Do not attempt to hone the bores, as the resulting enlargement of the bores might necessitate oversize pistons and piston cups which are not procurable. Replace parts that are cracked or damaged beyond repair.

- (b) Polish the poppet seats of the valve housing with No. 00 steel wool to remove minor corrosion. If the poppets and/or poppet seats are damaged, replace the housing assembly. Dress the gasket surface with a fine file or hand-honing stone to remove minor abrasions.
- (c) Remove minor corrosion from the bleeder valves and the diaphragm stem by polishing with No. 00 steel wool. Replace these items if they are badly corroded or M threads are stripped.
- (d) Polish the check valve piston and the check valve piston bore in the valve body with No. 00 steel wool to remove minor corrosion or scratches. Remove minor scratches from mating surfaces of the body and end caps by dressing with a fine file or hand-honing stone. If parts are damaged or worn beyond repair, replace the complete check valve assembly.
- (e) After completing repairs, clean the parts with compressed air, removing all dust resulting from polishing operations.
- (f) Rinse hydraulic parts in clean alcohol, dry with compressed air, and wipe all parts with a clean, lint-free cloth. Place the parts in a covered container in readiness for assembly.

c. Assembly.

- (1) Assembly of double check valve (fig. 322).

- (a) Slip the piston into the valve body. Place a new gasket at each end of the body and fit the two caps over the ends of the check valve body.

- (b) Install the two hex-head screws through the screw holes, install a lockwasher and nut on each screw, and tighten evenly.

- (2) Install push rod oil seal (fig. 314). Place a new oil seal gasket (B, fig. 314) in the bore of the end plate, and install a new oil seal (C) with the lip of the seal toward the gasket. Press the seal in with an arbor press or drive it into place with a suitable drift.

- (3) Assemble and install control valve (fig. 323).

Note. The key letters noted in parentheses are in figure 318, unless otherwise indicated.

- (a) Install the bleeder valve (B) in the end plate (A), and tighten.
- (b) Install a new relay piston snap ring (R) in the relay piston sleeve (S).
- (c) Dip two new sealing cups for the relay piston in clean hydraulic brake fluid (HB) and allow excess fluid to drain. Apply a film of hydraulic brake fluid (HB) to the bores of the relay piston sleeve.
- (d) Install the two new outer and inner relay piston seating cups (W and U)



Figure 323. Installing air-hydraulic power cylinder (Air-Pak) control valve

on the new relay piston (V) with the lips of the cups facing away from each other.

Note. The two cups are not interchangeable. The inner cup (W) is identified by a yellow dot and the outer cup (U) is identified by a red dot. Install the inner cup (yellow dot) nearer the chamfered end of the piston. Push the piston and cup into the sleeve (S) from the inner end with the hole toward the snap ring (R).

- (e) Fit a new sleeve gasket (T) on the sleeve (S). Secure the end Plate (A) in a vise, and install the sleeve-in the end plate. Tighten with the improvised offset screwdriver.
- (f) Place a new diaphragm (N) on the threaded portion of the diaphragm stem (P) with the concave side toward the threads. Install the diaphragm washer (M) with the convex side next to the diaphragm, and install the diaphragm stem jam nut (L). Tighten the nut while holding the stem, being careful not to distort or mar the stem. Stake the nut in two places.
- (g) Dip the threads of the pipe plug (C) in liquid-type gasket cement, install the plug in the new housing and poppet assembly (E), and tighten.
- (h) Place a new fitting plug gasket (J) on the air inlet fitting plug (K). Position a new poppet return spring (H) with the smaller diameter inside the housing and poppet assembly (E), and install and tighten the plug.
- (i) Place the diaphragm plate (Q) in the end plate (A) with the flat side out. Install the assembled diaphragm with the stem inserted in the relay piston, the straightedge matching that of the plate and the screw holes aligned with those in the end plate. Install the diaphragm spring (D) with the small diameter next to the diaphragm, and position the housing and poppet assembly (E) over the spring, matching the edges and the screw holes as described above. Press the valve

housing toward the end plate to compress the spring and install two screws in opposite screw holes to serve as pilot screws. Tighten the two pilot screws evenly, and install a housing screw (G) with lockwasher (F) in each of the far remaining screw holes. Tighten the identification tag previously loosened. Tighten the four screws fingertight, remove the two pilot screws, and install the two remaining screws (G) with lockwashers (F). Tighten the six screws evenly.

(4) Assemble slave cylinder (fig. 314).

- (a) Apply a film of hydraulic brake fluid (HB) to the bores of the slave cylinder housing (Z, fig. 314). Dip oil seal gaskets and oil seals in clean hydraulic brake fluid (HB) and allow excess fluid to drain.
- (b) Install the new plastic sealing cup washer (D, fig. 314) with the chamfered side next to the oil seal in the end plate. Fit the counter-bored side of the sealing cup spacer (F) into the new sealing cup (E) and install these parts with the flat side of the cap next to the plastic washer. Add the piston stop washer (G) and secure the parts with a new stop washer snap ring (H), making sure that the ring seats securely in its recess in the end plate.
- (c) Clamp the hydraulic outlet fitting cap (T) in a vise with the large opening uppermost. Install the new residual line check valve (U) in the cap, install the new check valve return spring (V) and check valve washer (W) and secure the parts with a new check valve snap ring (X).
- (d) Place a new outlet fitting cap gasket (Y) in the hydraulic outlet fitting cap (T), and install the housing (Z) with the milled flats toward the cap. Tighten the housing with a wrench held on the flats of the housing.
- (e) Install the jam nut (AA) on the housing, turning it to the ends of the threads, and install a new jam nut seal (BB) in the offset between the two threaded sections.

CAUTION

Be careful not to damage the seal when slipping it over the threads.

(f) Remove the assembled slave cylinder from the vise, and install the bleeder valve (S) in the cap (T).

242. Service Brakedrums

a. *Disassembly.* Refer to TM 9-2320-211-20.

b. *Cleaning, Inspection, and Repair.*

(1) *Cleaning.* Wash with mineral spirits paint thinner and dry with compressed air. Remove rust or corrosion from brakedrum with wire brush.

(2) *Inspection.* After brakedrum has been thoroughly cleaned, inspect for warping, cracks, or scored braking surface. Place drum in lathe and check runout of braking surface. Runout must not exceed 0.007-inch total indicator reading.

(3) *Repair.* Refinish braking surface in lathe if scores or runout is excessive. Standard inside diameter of drum braking surface is $16.495 + 0.010$ inches. Cut surface only as necessary, until all scores, and pits are removed. Record the amount cut from drum for shoe relining purpose. If refinishing requires more than 1/16-inch metal removal (1/8 inch on diameter), replace drum.

c. *Assembly.* Refer to TM 9-2320-211-20.

243. Service Brakeshoes

a. *Disassembly.* Refer to TM 9-2320-211-20.

b. *Cleaning, Inspection, and Repair.*

(1) *Cleaning.* Clean mud and dirt from all parts with water and a stiff brush.

(2) *Inspection.* Inspect brake lining for wear and brakeshoe for damage. If lining surface has worn close to heads of rivets, lining should be replaced. All linings on any one axle must be replaced at the same time.

NOTE

Linings are to be replaced in pairs, not singly.

(3) *Repair.* Repair consists of relining brake-shoes.

(a) Remove rivets and strip lining from shoe. Clean face of shoe thoroughly.

(b) If brakedrums have been machined (b(3) above), shims of the thickness of metal removed are to be installed between shoes and linings.

(c) Aline end rivet holes with holes in shoe and clamp lining in place with suitable applier. Install end rivets, remove applier and install remaining rivets.

(d) Check contact of lining with shoe after riveting. A 0.010-inch feeler gage should not enter between shoe and lining at any point.

(e) If necessary, grind brake lining to be concentric with drum, using a suitable grinder after installation on truck.

c. *Assembly.* Refer to TM 9-2320-211-20.

244. Hydraulic Lines

a. *Disassembly and Assembly.* Refer to paragraph 230.

b. *Cleaning, Inspection, and Repair.*

(1) *Cleaning.* Refer to paragraph 237.

(2) *Inspection.*

(a) Excessively corroded, bent, leaking, or damaged hydraulic lines must be replaced. Check hose for cracks and deterioration, replace as needed.

(b) Inspect connections for crossed threads and damaged seats and replace as needed.

(3) *Repair.*

NOTE

When cutting hydraulic lines from stock tubing, do not use guesswork. Make correct calculations as to length, how many bends, and their locations. Ends must be square; use a tubing cutter.

(a) Ream ends to remove all burrs and blow out cut lines after reaming, with compressed air.

(b) Make all bends with a bending fixture. Make preliminary check for length before flaring ends. Do not install lines which are too short or too long; cut and bend to fit. Make flares carefully and blow out lines with compressed air before installation.

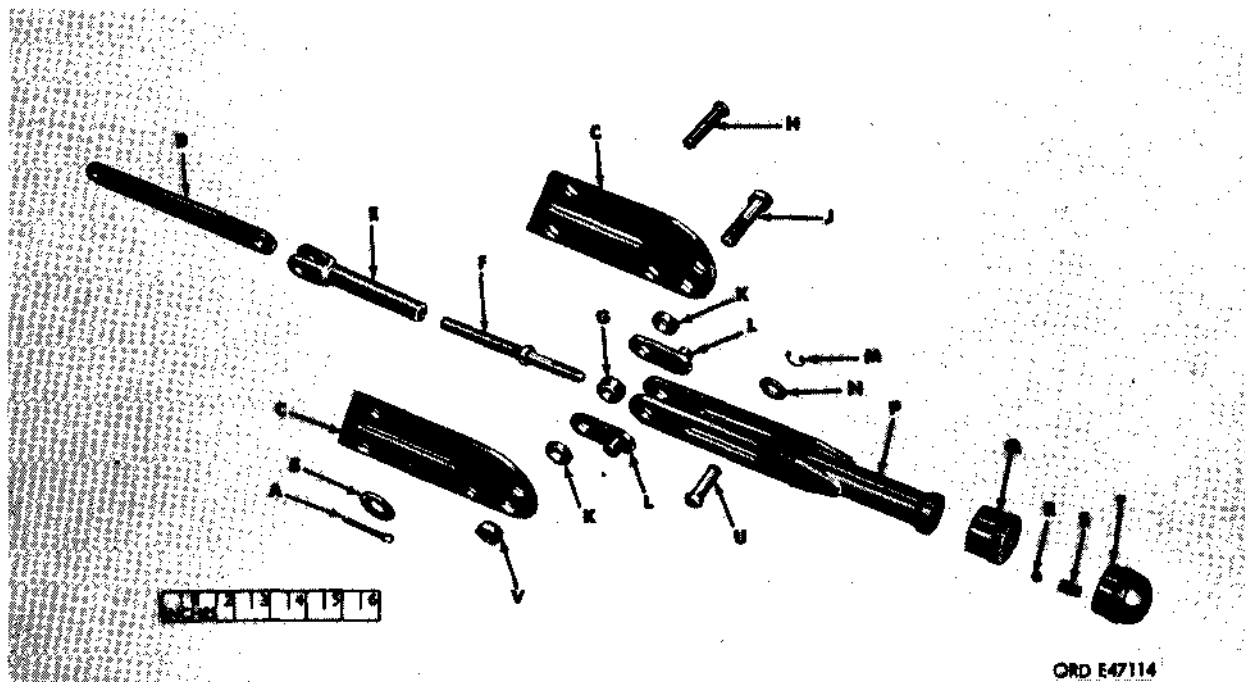
245. Parking Brake Linkage

a. Disassembly.

(1) *Parking brake hand lever assembly* (fig. 324).

(a) Remove cotter pin (A) and plain washer (B) from clevis pin (H) and remove pin.

(b) Remove hex-nut (V) from cap screw (J) and remove cap screw, releasing



A—Pin, cotter
B—Washer, plain
C—Bracket, mounting
D—Link, lever
E—Tube, adjusting screw w/yoke
F—Screw, adjusting
G—Spacer, inner
H—Pin, clevis
J—Screw, cap
K—Spacer, outer

L—Bracket, pivot
M—Ring, snap
N—Washer, plain
P—Lever, hand
Q—Housing, poppet ball spring
R—Ball, poppet
S—Spring, compression
T—Cap, adjusting
U—Pin, clevis
V—Nut, hex

Figure 324. Parking broke hand lever assembly-exploded view.

outer spacers (K), pivot brackets(L), inner spacer (G), hand lever (P), and mounting brackets (C).

- (c) Remove adjusting cap (T) at handle end, releasing compression spring (S) and poppet ball (R).
- (d) Remove adjusting screw (F) from poppet ball spring housing (Q). Remove snap ring (M) and plain washer (N) from clevis pin (U). Remove clevis pin and adjusting screw (F) from adjusting screw tube with yoke (E).

(2) Remove cable assembly.

- (a) Remove safety nut and cap screw from cable clip at rear cab cross member.
- (b) Remove adjusting nut and locknut at brakeshoe lever.
- (c) Remove two cap screws and safety nuts securing cable anchor clamp to cable clamp bracket at rear of transfer case and remove cable assembly.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean all parts thoroughly with mineral spirits paint thinner or dry-cleaning solvent.

Note. Do not submerge cable assembly in cleaning solvent as cable is pre-lubricated at time of assembly.

- (2) Inspection. Inspect cable assembly for damaged condition. Pay particular attention to stud ends secured to cable. Inspect threads for worn condition. Inspect hand lever assembly and replace all defective parts.
- (3) Repair. Cable assembly must be replaced if damage is evident.

c. Assembly.

- (1) Parking brake hand lever assembly (fig. 324).

- (a) Turn adjusting screw tube with yoke (E) on adjusting screw (F) and position into hand lever (P). Install poppet ball spring housing (Q).

- (b) Place poppet ball (R) and compression spring (S) in poppet ball spring housing (Q) and install adjusting cap (T).

- (c) Place lever link (D) into yoke of adjusting screw tube with yoke (E), and install clevis pin (U), od plain washer (N), and snap ring (M).

- (d) Hook pivot brackets (L) in lower end of hand lever (P). Position pivot bracket inner spacer (G) and outer spacers (K). Insert cap screw (J) through mounting bracket (C), outer spacer, pivot bracket, inner spacer, opposite pivot bracket, outer spacer, and through opposite mounting bracket. Install hex-nut (V).

- (e) Place clevis yoke end of cable assembly on lever link (D), and install clevis pin (H), plain washer (B), and secure with cotter pin (A).

(2) Assembling parking brake linkage to vehicle (fig. 325).

- (a) Place cable assembly (D) through hole in cab, and secure mounting bracket (C, fig. 324) to seat base. Place cable clamp bracket (C) over cable assembly and into position under cab floor. Secure cable clamp bracket (C) and lever assembly to cab floor with five cap screws (A) and safety nuts (J).

- (b) Position cable clamp spacer (M) and anchor cable clamp (B) in cable clamp bracket (C), and secure with two cap screws (A) and safety nuts (J).

- (c) Place closed clip (F) over cable assembly (D), and secure to clip extension (N) with cap screw (G) and safety nut (E).

- (d) Position cable clamp spacer (M) and cable anchor clamp (B) over cable assembly (D) at cable clamp bracket (L) at transfer case and secure with two cap screws (A) and safety nuts (J).

- (e) Position cable through brakeshoe lever, and install adjusting nut and locknut.

- (f) Adjust parking brake linkage as outlined in TM 9-2320-211-20.

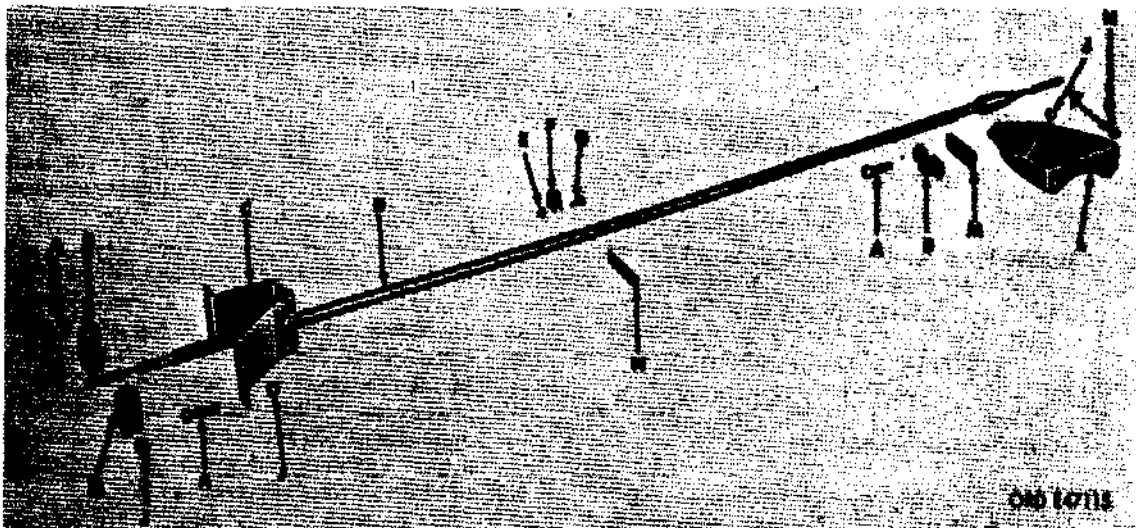


Figure 325. Parking brake cable assembly and brackets - exploded view

Key	Item	Key	Item
A	Screw, cap	H	Bolt, hex
B	Clamp, anchor cable	J	Nut, safety
C	Bracket, cable clamp (cab end)	K	Washer, lock
D	Cable, assembly	L	Bracket, cable clamp (transfer end)
E	Nut, safety	M	Spacer, cable clamp
F	Clip, closed	N	Extension, clip
G	Screw, cap		

Figure 325. Parking brake cable assembly and brackets - exploded view - legend

246. Shoe Assembly

a. Disassembly and Assembly. Remove washer from shoe lever pins and slide outer and inner shoe assemblies from lever pins.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Clean mud and dirt from parts with water and a stiff brush.

Note. Do not immerse shoe assemblies in dry-cleaning solvent or mineral spirits paint thinner.

- (2) Inspection. Examine brakeshoe lining for glazing, burning, or excessive wear. Minimum thickness before relining is necessary, cannot be specified exactly and is a matter of judgment.

In any event, if braking surface is near heads of rivets, replace lining as given in (3) below.

- (3) Repair. Repair consists of relining brakeshoes.

(a) Remove rivets and strip lining from shoe. Clean face of shoe thoroughly.

(b) Aline end rivet holes with holes in shoe, and clamp lining in place with suitable applier. Install end rivets, remove applier, and install remaining rivets.

(c) Check contact of lining with shoe after riveting. A 0.0104-inch feeler gage should not enter between shoe and lining at any point.

247. Hand Brakedrums

a. Disassembly and Assembly. Refer to paragraph 233.

b. Cleaning, Inspection, and Repair.

- (1) Cleaning. Remove rust or corrosion from brakedrum with wire brush.
- (2) Inspection. Inspect brakedrum for warpage, cracking, or scoring. If drum is warped or cracked, replace with new drum.
- (3) Repair. Refer to paragraph 242.

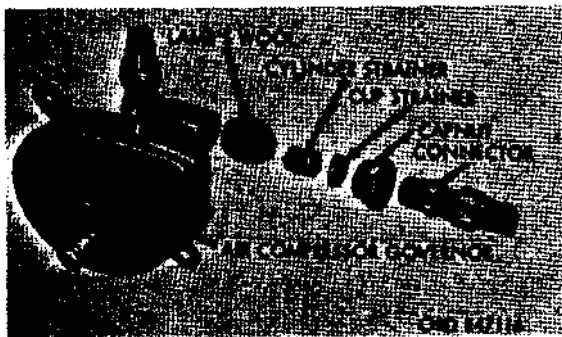


Figure 326. Air-compressor air governor with air strainer disassembled

248. Air Governor

Servicing of the air governor (fig. 326) consists of cleaning and oiling the lamb's wool pad inside the governor air strainer.

a. Disassembly. Remove capnut from governor strainer body, and pull cup strainer, cylinder strainer, and lamb's wool from strainer body.

b. Cleaning, Inspection and Repair.

(1) Cleaning.

(a) Wash cup strainer, cylinder strainer, and lamb's wool in dry-cleaning solvent or mineral spirits paint thinner.

(b) Saturate lamb's wool with engine oil, squeeze out excess oil, and place lamb's wool in cylinder strainer.

(2) Inspection and repair. Inspect all components for serviceability and replace rather than repair all parts found to be defective.

c. Assembly. Insert cylinder strainer and cup strainer in strainer body, and install capnut.

Section V. TESTS AND ADJUSTMENTS

249. Service Brake Adjustments

Note. Adjustment of components of the service brake system consists of adjusting the brake pedal linkage to obtain proper brake pedal free travel, and of adjusting the brake-shoes at each wheel. Adjustment of the brake-shoes to compensate for normal lining wear only is termed minor adjustment. Adjustment of the brake-shoes following removal and installation of the shoes, which require adjustment of the brakeshoe anchor pins, is termed major adjustment.

a. Brake Pedal Free Travel Adjustment. Brake pedal free travel is the distance the brake pedal is depressed before the master cylinder push rod, pinned to the lower end of the pedal lever (fig. 300), moves before

contacting the piston inside the master cylinder. The distance must be between one-fourth and one-half inch. Excessive free travel reduces the usable stroke of the master cylinder piston, and insufficient free travel will cause the brakes to drag after several applications. Check brake pedal free travel and adjust, if necessary, (1) through (6) below.

- (1) Remove pin (fig. 300) securing push rod yoke to pedal lever.
- (2) Hold push rod to prevent it from turning, and loosen locknut on yoke.
- (3) Holding push rod, turn yoke until desired brake pedal free travel is obtained.

Note. To increase free travel, turn yoke clockwise. To decrease free travel, turn yoke counterclockwise.

- (4) Position push rod yoke on pedal lever and install yoke pin.
- (5) Check brake pedal free travel. If necessary, repeat (1), (3), and (4) above until correct free travel is obtained.
- (6) Tighten locknut on push rod yoke, holding push rod to prevent it from turning.

b. Minor Adjustment.

- (1) Adjust wheel bearings (par. 251) at one wheel.
- (2) Turn rear adjusting shoe cam (fig. 327) on back side of backing plate counterclockwise until brake drags slightly when wheel is turned by hand. Then turn adjusting cam clockwise just enough to allow wheel to rotate freely.
- (3) Turn forward adjusting shoe cam (fig. 327) clockwise until brake drags slightly when wheel is turned by hand. Then turn adjusting cam counterclockwise just enough to allow wheel to rotate freely. Make adjustment of both cams as uniform as possible.
- (4) Lower wheel, and repeat above procedures at each remaining wheel.

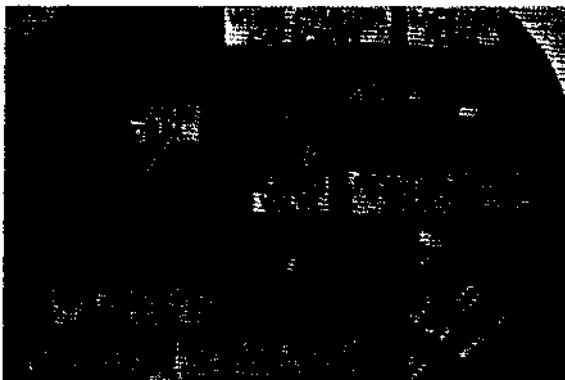


Figure 327. Turning adjusting shoe cam

c. Major Adjustment.

- (1) With wheel and tire assembly removed, remove nut and lockwasher from stud securing inspection cover (fig. 328) to brakedrum, and remove cover.

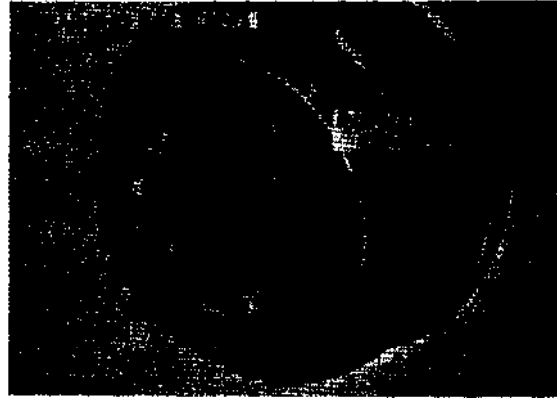


Figure 328. Hub and drum assembly with wheel and tire assembly removed

- (2) Rotate brakedrum until inspection hole is 1-1/2 inches above lower end of rear brakeshoe. Insert feeler gage in inspection hole (fig. 329) to determine clearance between brakeshoe and drum. Clearance should be 0.010 inch at this point.



Figure 329. Checking clearance between brakeshoe and drum

- (3) If clearance between shoe and drum is incorrect, adjust clearance (a) and (b) below.

- (a) Loosen rear anchor pin locknut (fig. 330) at back side of backing plate.

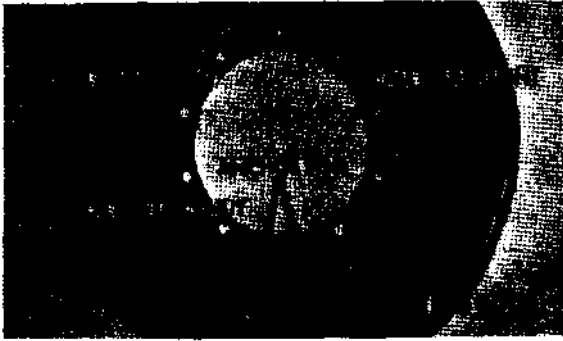


Figure 330. Removing anchor pin locknuts at backside of backing plate assembly

- (b) Holding locknut, turn anchor pin until 0.010-inch clearance between shoe and drum is obtained. To reduce clearance, turn anchor pin clockwise. To increase clearance, turn anchor pin counterclockwise.
- (4) Rotate brakedrum until inspection hole is 1-1/2 inches below upper end of rear brakeshoe. Insert feeler gage in inspection hole to determine clearance between brakeshoe and drum. Clearance should be 0.020 inch at this point.
- (5) If clearance between shoe and drum is incorrect, adjust clearance ((a) and (b) below).
- (a) Turn rear adjusting shoe cam (fig. 327) until clearance between shoe and drum, measured by feeler gage, is 0.020 inch. To reduce clearance, turn cam counterclockwise. To increase clearance, turn cam clockwise.
- (b) Recheck to be sure that 0.010-inch clearance is maintained at lower end of rear shoe.
- (6) Adjust clearance between lower and upper ends of front brakeshoe and drum ((2), (3), (4), and (5) above).

Note. Clearance between lower end of front shoe and drum is decreased by turning pin clockwise. Clearance

between upper end of front shoe is increased by turning front shoe adjusting cam counterclockwise and decreased by turning cam clockwise.

- (7) Holding anchor pins (fig. 330), to prevent them from turning, tighten both anchor pin locknuts and check brake-shoe clearances again.
- (8) Position inspection cover (fig. 328) on brakedrum stud, install lockwasher and nut on stud, and tighten nut.

250. Bleeding Service Brake System

a. General. Since operation of the service brake is dependent upon the incompressibility of hydraulic brake fluid, it is important that the lines and cylinders of the system be filled solidly with fluid that is free of air, which can be compressed sufficiently to impair operation of the service brakes. Therefore, whenever air is permitted to enter the system, due to failure to maintain correct fluid level in master cylinder, loose connections or faulty seals, or replacement of any component of the system, bleeding is necessary. Bleeding is the systematic removal of air or contaminated fluid from the brake hydraulic system by forcing brake fluid from bleeder valves mounted on the master cylinder, air-hydraulic cylinder and wheel cylinders in that order. The need for bleeding the system is generally indicated by a springy, spongy, brake pedal action. Two men are required to bleed the system, one to maintain a constant supply of brake fluid in the master cylinder and to pump the brake pedal, and the other to open and close the bleeder valves and to observe the condition of the brake fluid as it is forced from the system.

b. Bleeding Master Cylinder (Fig. 299).

- (1) Clean the bleeder tube over end of valve. Allow other end of tube to hang into a clean container, such as a pint glass jar.
- (2) Unscrew bleeder valve three-fourths of a turn and depress brake pedal slowly, checking for air bubbles in the fluid flowing from the end of the bleeder tube. Hold pedals in depressed position.
- (3) Tighten bleeder valve, and slowly release brake pedal.

Note. Make sure that master cylinder is kept filled with brake fluid during bleeding operation. Do not use fluid removed during bleeding operation to fill master cylinder.

- (4) Repeat (2) and (3) above until all air bubbles cease to appear or when fluid flows from bleeder tube in a solid stream.

- (5) Remove bleeder tube from bleeder valve, and check valve again to be sure that it is closed tightly. Perform bleeding operation at air-hydraulic cylinder (c below).

c. Bleeding Air-Hydraulic Cylinder (Fig. 301). Perform bleeding operations at air-hydraulic cylinder (b above), bleeding upper bleeder valve first and lower bleeder valve last.

d. Bleeding Wheel Cylinders (Fig. 308). Perform bleeding operations at each wheel cylinder (b above).

e. Partial Bleeding of Service Brake System. **When a brake line has been disconnected at only one wheel, only the wheel cylinder at that wheel must be bled. Perform bleeding operations at that wheel only (b above).**

251. Hub and Drum Assembly

a. Checking Wheel Bearing Adjustment. Raise wheel installed on hub to be checked until tire is clear of ground. Grasp top of tire and alternately push and pull on tire, observing the amount of wheel wobble or bearing play. When bearings are correctly adjusted, movement of the brakedrum (fig. 327) in relation to the top edge of the backing plate is just perceptible, with wheels turning freely. If movement appears to be excessive, proceed as in (b) below; otherwise, lower wheel and remove jack.

b. Adjustment of Wheel Bearings.

- (1) With wheel raised, remove 10 drive flange retaining cap screws (fig. 328), and remove flange from hub.

Note. Rear axle shaft is also removed when removing drive flange from rear hub.

- (2) Using wheel nut wrench (fig. 331), remove outer-bearing adjusting nut and bearing nut washer.

- (3) While turning wheel, tighten inner-bearing adjusting nut (fig. 331), using large end of wrench, until wheel binds; then back off nut approximately one-eighth turn. Recheck wheel bearing adjustment ((a) above).

- (4) Using wheel nut wrench, install bearing nut washer (fig. 331) and outer-bearing adjusting nut. Tighten outer nut.

- (5) Check adjustment. Position drive flange (fig. 328) on hub, and install 10 retaining cap screws. Tighten cap screws.

Note. When installing drive flange at rear hubs, rear axle shaft must be installed also (par. 281).

- (6) Lower wheel and remove jack.

252. Adjustment of Master Cylinder linkage

a. General. The brake pedal is linked to the master cylinder by an adjustable push rod and should be adjusted only to remove excessive play in brake pedal travel.

b. Adjustment (Fig.300)

- (1) Check brake pedal free travel. Free travel should be not less than one-

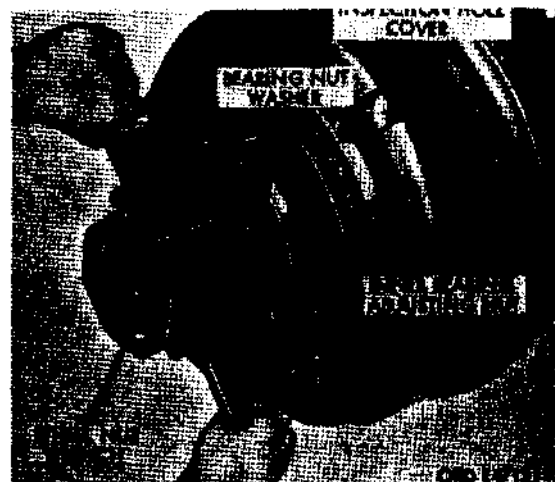


Figure 331. Removing outer-bearing adjusting nut

quarter and not more than one-half inch. Adjust free travel to these limits by adjusting master cylinder push rod.

- (2) Remove cotter pin and clevis pin attaching push rod yoke to brake pedal lever. Hold push rod from turning, loosen jam nut, and turn yoke to obtain desired setting.
- (3) Tighten jam nut and connect yoke to pedal lever.

253. Master Cylinder Test

a. Preparation For Test.

- (1) Fill an open tank or receptacle with brake fluid so that the master cylinder can be totally submerged and observed during the test.
- (2) Connect a compressed air line to the outlet of the master cylinder.
- (3) In order to test the limit, the piston must be in the applied position. Im - provide a suitable means by which the primary cup and the forward end of the piston can be held in the forward end of the cylinder bore, so that the cup and the piston are forward of the bypass port.

Caution: The holding device must be strong enough to hold the piston with an air pressure of 100 psi on the face of the cup. Any failure of the holding device is liable to cause injury to personnel.

b. Test. Submerge the master cylinder in the brake fluid, and apply compressed air (approx. 100 psi) to the outlet port of the cylinder. Carefully observe if any air bubbles leak from the unit. Air bubbles indicate that the unit is defective and requires repair.

254. Handbrake Adjustment

To increase braking action of handbrake, turn the adjusting cap at the end of the handbrake lever clockwise. To decrease braking action (to prevent dragging of brakeshoes), turn the adjusting cap counterclockwise. If braking action cannot be increased sufficiently by turning adjusting cap clockwise, turn adjusting cap counterclockwise, adjust cable tension at brakeshoe lever, and then turn adjusting cap clockwise until correct brake adjustment is obtained. To adjust cable at

brakeshoe lever, hold adjusting nut (fig. 304) on transfer end of cable, loosen locknut, turn adjusting nut clockwise on cable, and tighten locknut.

255. Air Compressor

a. Unloader Valve Clearance Adjustment.

- (1) Remove unloader - valve cover from compressor cylinder head. Remove cover gasket from cylinder head and discard.
- (2) Using feeler gage, check clearance of unloader valves. Clearance should be 0.010- to 0.015-inch. If clearance is not within these limits, adjust valves ((3) below). If clearance is correct, proceed as in (4) below.
- (3) Loosen locknut on both adjusting screws, turn screws until 0.12-inch clearance is obtained, and tighten locknuts.
- (4) Position new gasket on compressor cylinder head, and install unloader-valve cover.

b. Drive Belt Tension Adjustment.

- (1) Check compressor drive belt tension by applying pressure to the belt at a point midway between the compressor pulley and the crankshaft pulley. Belt deflection at this point should be one-half inch. If deflection is found to be more or less than one-half inch, adjust belt tension ((2) below).
- (2) Loosen two cap screws on front flange of compressor drive pulley. Using a wrench turn flange in or out on threaded hub until correct belt tension ((1) above) is obtained. Tighten the two cap screws on front flange.

256. Air Leakage Tests

Excessive leakage at components or at connections in the compressed air system can be detected by the soapsuds method. With the compressed air system fully charged, coat outside of components and connections with, soapsuds to check for leakage. A 3-inch bubble formed in 3 seconds is maximum leakage permissible. If excessive leakage is found, tighten connection or replace component.

Section VI. SERVICEABILITY STANDARDS

257. General

The serviceability standards included herein give the minimum and maximum sizes of new or rebuilt parts. They also give wear limits which indicate that point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the

dimensions shown in "Wear limits" column or damaged from corrosion will be approved for service. Dimensions are given in inches, unless otherwise indicated.

258. Serviceability Standards

Table XIV below gives the serviceability standards for the brake system.

Table XIV. Serviceability Standards - Brake System

	Model	Reference	Minimum	Maximum	Wear limit
Slave Cylinder Housing Bore	All	Z, fig. 314	1.125	1.126	0.001
Relay Piston Sleeve Bore	A 65-11-148	S, fig. 318	1.2505	1.2520	0.001
			Free length	Compressed length	Load (lb)
Power Piston Return Spring	A 65-11-148	Z, fig. 311	12-3/8	2-3/4	45 ± 4-1/4
Diaphragm Return Spring	All	D, fig. 318	3-1/2	1-9/32	7-1/2 ± 3/4

CHAPTER 20

FRONT AXLE

Section I. DESCRIPTION. AND DATA

259. Description

a. General. The front axle assembly (fig. 332) is a hypoid, double reduction, full-floating type. The differential and carrier assembly is mounted on top of the axle housing and is interchangeable with the two rear axle differential and carrier assemblies. Power is transmitted from differential and carrier assembly to wheels through axle shafts and universal joint assemblies. The universal joints, in the front axle shafts permit delivery of power to front wheels when truck is turned to right or left. The over-running sprag unit on the transfer front output shaft automatically eliminates delivery of power to front axle during normal operation.

b. Housing. The housing is one-piece construction with an opening near the center for installing the differential and carrier assembly. The housing is sphere-shaped at each end to provide a support for steering

knuckles, and to provide a suitable base for the steering knuckle bolts.

c. Drive Shaft and Universal Joint Assembly (Bendix). Each drive shaft and universal joint assembly consists of an inner shaft and an outer shaft built integrally with a constant velocity universal joint. The wheel end of the outer shaft has splines for drive flange. Differential end of inner shaft has splines for differential, side gear. Outer shaft has a thrust washer pressed onto joint yoke. Outer shafts are the same for both left and right sides, but inner shafts are different lengths, due to the differential being off center in axle housing. Each universal joint contains four drive balls and one center ball. The drive balls are a selective fit, while the center ball is standard size. Races in the universal joint yokes retain the drive balls. Universal joint assemblies are enclosed in steering knuckles and are protected against damage by the axle housing ends and sealed by the steering knuckle joint boots.

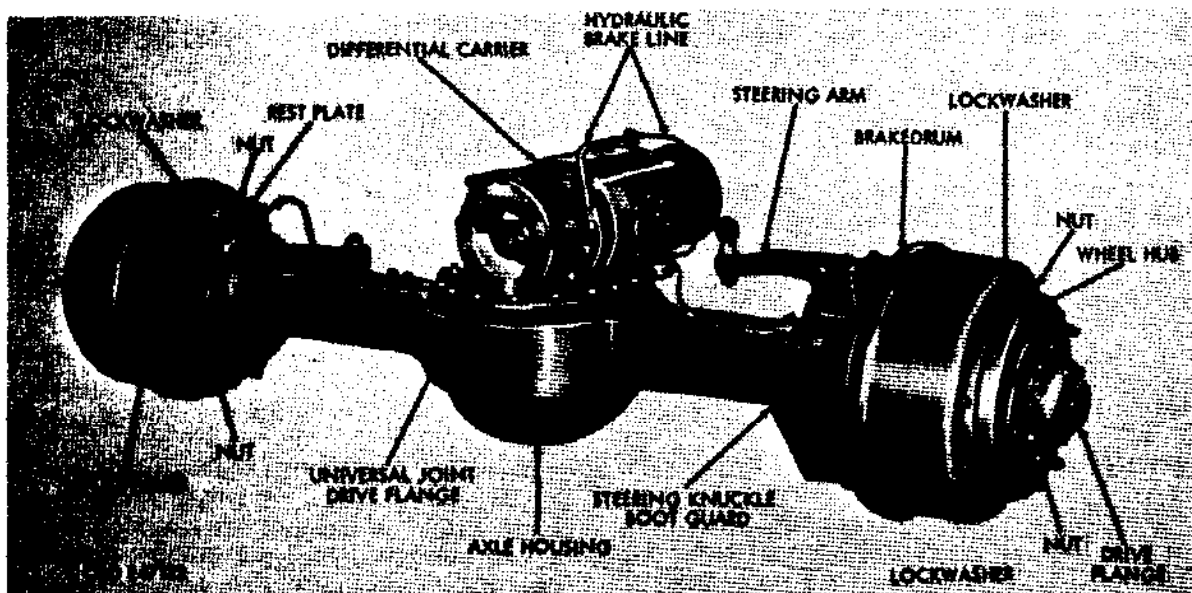


Figure 332. Front axle assembly

d. Drive Shaft and Universal Joint Assembly (Rzeppa). Each drive shaft and universal joint consists of an inner and outer drive shaft. The outer shafts are identical and consist of a universal joint bell built integrally with the shaft, which contains the universal joint balls, inner race, and cage. The inner shafts differ in length because the front axle differential is mounted off center on the axle housing. Each universal joint contains six balls, inner shaft pilot, and pilot pin. Universal joint assemblies are enclosed in steering knuckles. They are protected against damage by the axle housing ends and sealed by a steering knuckle boot.

e. Steering Knuckle. Steering knuckles are supported on housing spherical ends by bushing-type bearings in upper and lower sleeves, which provide pivot points when front wheels are turned from side to side. Steering knuckle arms are integral with steering knuckle. Boots clamped to inner sides of steering knuckles and to spherical ends of axle housing prevent entrance of dirt.

f. Front Wheel Spindles. Front wheel spindles are attached to steering knuckles in conjunction with oil slingers and brake backing plate assemblies. Wheel bearings are mounted on wheel bearing spindles. The front wheel spindles transfer the turning force from the steering knuckles to the wheel and hub assemblies. The outer ends of spindles are threaded for wheel bearing adjusting nuts. Wheel spindle bushing-type bearings are pressed into inner end of each spindle. A groove in spindle flange permits escape of any lubricant which may leak past the shaft oil seal.

g. Tie Rod End Assembly. The tie rod assembly is connected to steering knuckle by end studs and tie rod ends threaded onto end of tie rod. Tie rod assemblies are secured in place on tie rod tube by two hex-head bolts, nuts and

lockwashers at each end. In addition to controlling front wheel toe-in, the tie rod transmits turning force from left steering knuckle to right steering knuckle.

h. Differential and Carrier Assembly. The differential and carrier assembly is the same for the front and both rear axles. The differential is four-pinion type, assembled in a two-piece differential case. Differential side bearing assemblies are tapered roller type and take thrust as well as radial loads. Bearings are supported in machined supports on the carrier assembly. Thrust loads are taken against differential bearing-adjusting nuts threaded into supports and carrier case caps. The helical drive pinion is driven by a hypoid drive gear. The hypoid drive gear is driven by hypoid drive pinion installed on a hypoid pinion drive shaft. The differential case assembly, helical drive pinion, hypoid pinion drive shaft assembly, and bearings are in a carrier assembly mounted in the axle housing.

260. Data

Manufacturer Timken-Detroit
Model FM 240-B-2
Type double-reduction, hypoid, full-floating
Gear ratio except M139C. 6.443 to 1.00 and M139D
Gear ratio M139C and. 10.26 to 1.00 M139D
Spring centers 39-3/4 in.
Alignment angles:
Toe-in $1/8 \pm 1/18$
Caster $.3^\circ$
Camber 1
Kingpin inclination 8°
Lubricant capacity 12 pt
Universal joint:
Manufacturer Bendix or Rzeppa
Lubricant capacity. 3-1 2 lb (each knuckle)

Section II. REMOVAL AND INSTALLATION

261. Removal

a. Position Truck. Place truck on a level surface and apply handbrake to prevent truck from rolling. Place a floor jack under differential housing and raise front end of truck high enough to permit withdrawing axle assembly.

Warning: Weight of vehicle must remain supported by overhead hoisting equipment floor jacks, or support SW at all times. Do not attempt to support weight of truck on hydraulic jack. Adjust two support stands to the desired height, locate them under frame side rails at rear of front spring brackets, and lower truck on stands.

b. Remove Wheel and Tire Assemblies. Remove left and right front wheel and tire assemblies. Refer to TM 9-2320-211-20. Place a support stand under left and right front hubs (fig. 334) and remove floor jack from under differential housing.

c. Remove Shock Absorbers (Fig. 333).

- (1) Remove upper and lower self-locking nut and washer (right and left side).
- (2) Remove shock absorber and rubber grommets (right and left side).

d. Disconnect Drag Link. Disconnect lower drag link from steering arm ball. Refer to TM 9-2320-211-20.

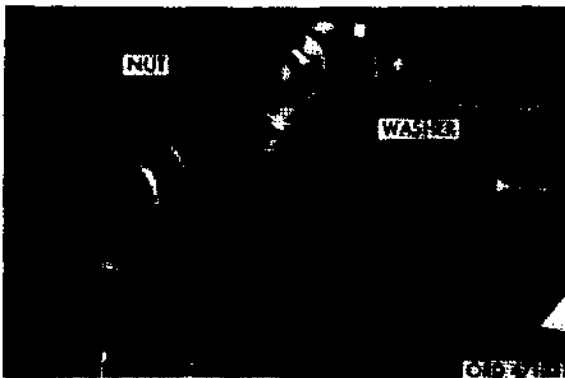


Figure 333. Shock absorber self-locking nut and washers



Figure 334. Truck support stand positioned for front axle removal

e. Disconnect Propeller Shaft (Fig. 335). Disconnect adapter flange on front end of transfer-to-front-axle propeller shaft from companion flange at rear of front-axle differential.

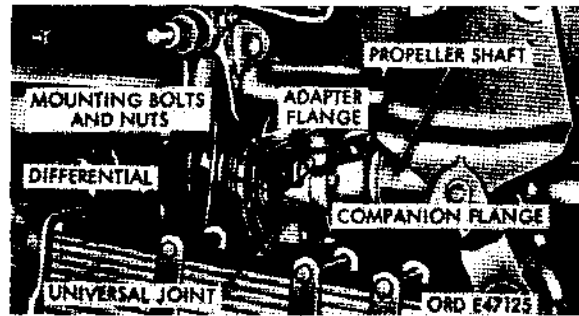


Figure 335. Disconnecting transfer-to-front axle propeller shaft

f. Remove U-bolt Clamp Plates (Fig. 336). Remove four nuts and lockwashers from two U-bolts securing axle housing to right front spring, and remove clamp plate from U-bolts. Repeat above operations at left front spring.

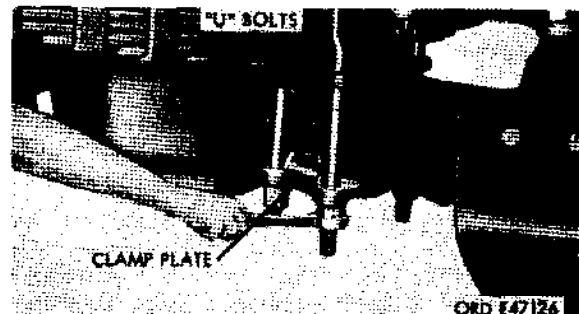


Figure 336. Removing U-bolt clamp plate

g. Position Hydraulic Jack. Position hydraulic jack (fig. 337) with axle fixture under the front axle (fig. 334), raise jack sufficiently to release support stands under the wheel hubs, and remove the stands.

h. Disconnect Brake Line (Fig. 338). Lower axle, unscrew connector securing rigid brake line to flexible brake line at bracket on top of differential housing, and separate lines. Remove cap screw securing bracket to top of differential housing, and remove flexible brake line and bracket from housing.



Figure 337. Hydraulic jack positioned for front axle removal



Figure 338. Front axle lowered for disconnecting flexible brake line

i. Remove Front Axle (Fig. 339). Lift the four U-bolts, two on each front spring, free of the spring seats, and lower hydraulic jack sufficiently to allow removal of axle from under truck. Pull jack with axle assembly forward and out from under front of truck. Remove spring seats from axle assembly.

262. Installation

a. Position Front Axle. With front axle supported by hydraulic jack (fig. 337) in lowered position, push jack and axle assembly under front of truck. Place left and right spring seats on axle, making sure that all U-bolts are properly aligned and that spring center bolt heads enter alignment holes in spring seats, and raise axle sufficiently to permit assembly of brake lines.

b. Connect Brake Line (Fig. 338). Position flexible brake line and bracket on top of

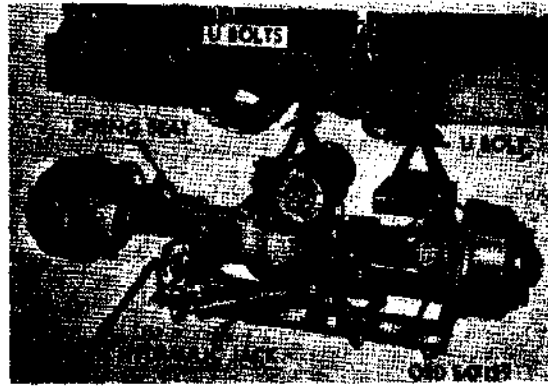


Figure 339. Removing front axle assembly

differential housing, install cap screw, and tighten. Position rigid brake line at flexible brake line and tighten connector.

c. Connect Propeller Shaft (Fig. 335). Connect adapter flange on front end of transfer-to-front-axle propeller shaft to companion flange at rear of front axle differential.

d. Install U-bolt Clamp Plates. Raise front axle sufficiently to permit placing support stands under front wheel hubs, and place stands in position (fig. 334).

Warning: Weight of vehicle must remain supported by overhead hoisting equipment, floor jacks, or support stands at all times. Do not attempt to support weight of truck on hydraulic jack. Release hydraulic jack and pull out from under truck. Position clamp plate (fig. 336) on the two U-bolts at underside of right end of axle housing, and install two lockwashers and nuts on each U-bolt. Repeat above operation at left end of axle housing. Tighten the eight clamp plate retaining nuts (on four U-bolts), using a torque wrench, to 300 to 400 pound-feet torque.

e. Connect Drag Link. Connect lower drag link to steering arm ball. Refer to TM 9-2320-211-20.

f. Install Shock Absorbers (Fig. 333). Place shock absorber on studs, and install upper and lower self-locking nut and washer (right and left side).

g. Install Wheel and Tire Assemblies. Install left and right front wheel and tire assemblies (refer to TM 9-2320-211-20), after

removing support stands from under front axle hubs. Place a floor jack under differential housing, raise front axle, and remove support stands from under frame side rails. Lower front axle and remove floor jack from under truck.

h. Bleed Brakes. Refer to TM 9-2320-211-20.

i. Lubrication. Lubricate front axle assembly and propeller shafts in accordance with LO 9-2320-211-12.

Section III. DISASSEMBLY

263. General

Before disassembly, inspect the front axle assembly thoroughly for lubricant leakage. Make a note of all points of leakage for later reference. Thoroughly clean the front axle assembly before starting disassembly procedures to prevent dirt and grit from getting into bearings during removal.

264. Disassembly

a. Remove Tie Rod Assembly (Fig. 340).

- (1) Remove cotter pin and nut from tie rod end.
- (2) With suitable tools remove tie rod end from steering knuckle.

b. Remove Axle Shaft With Universal Joint Assembly.

- (1) Remove drive flange. Remove the cap screws and lockwashers that attach drive flange to wheel hub and remove axle shaft drive flange (fig. 342).
- (2) Remove wheel hub and brakedrum assembly. Remove wheel bearing locknut with a wheel wrench (fig. 341). Lift

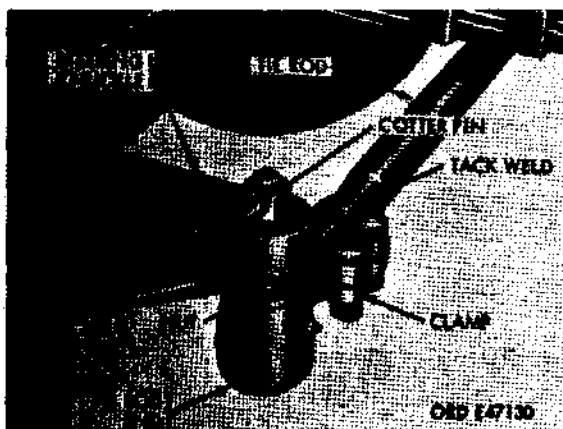


Figure 340. Tie rod assembly

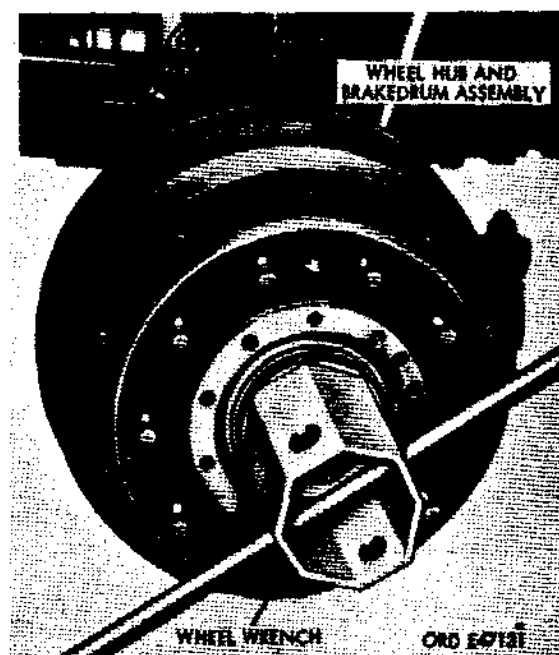


Figure 341. Removing wheel bearing locknut

wheel bearing-adjusting-nut lockwasher (fig. 342) off wheel spindle. Remove wheel bearing-adjusting nut from wheel spindle. Carefully lift the wheel hub and brakedrum assembly off the wheel spindle. Slip wheel inner bearing cone off spindle.

- (3) Remove brakeshoes. Disconnect brakeshoe return spring with brake spring pliers (fig. 343). Remove guide pin C washers and plain washers with a pair of snap ring pliers (fig. 344). Remove brakeshoe anchor pin locknuts which are located at the lower rear end of brake backing plate. Remove the plain washer from each guide pin. Lift the brakeshoes, brakeshoe anchor pins, and brakeshoe anchor pin link

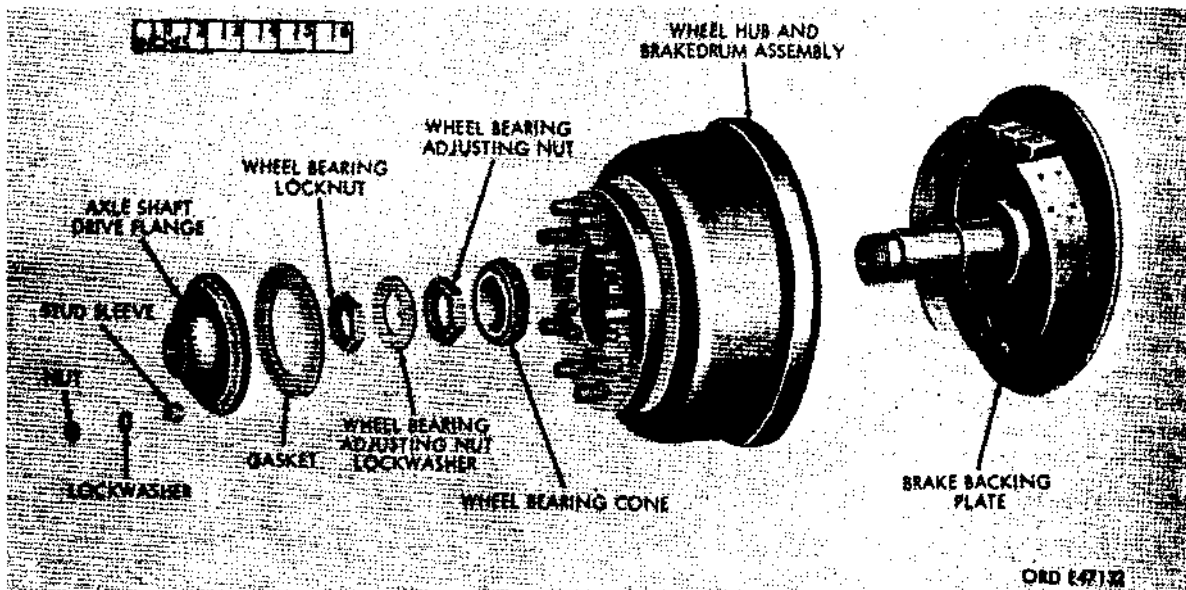


Figure 342. Brakedrum removed - exploded view

- from the brake backing plate (fig. 345) as an assembly.
- (4) Remove oil slinger and brake plate. Remove the nuts and lockwashers that attach the oil slinger and brake backing plate to steering knuckle, and remove oil slinger and backing plate.
 - (5) Remove wheel spindle. Remove wheel spindle from steering knuckle by tapping with a soft hammer and then driving wedges between spindle and steering knuckle.
 - (6) Remove axle shaft and universal joint assembly. Withdraw axle shaft and universal joint assembly (fig. 346) from steering knuckle.

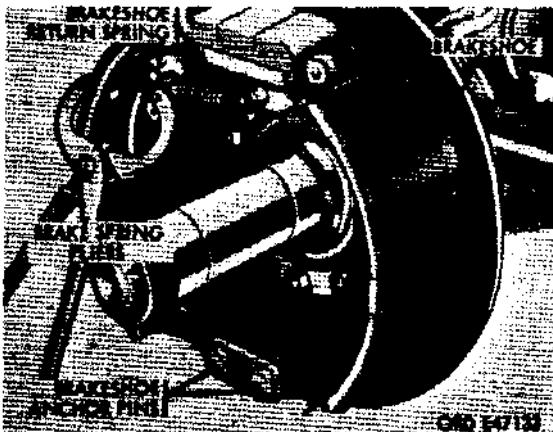


Figure 343. Removing brakeshoe return spring

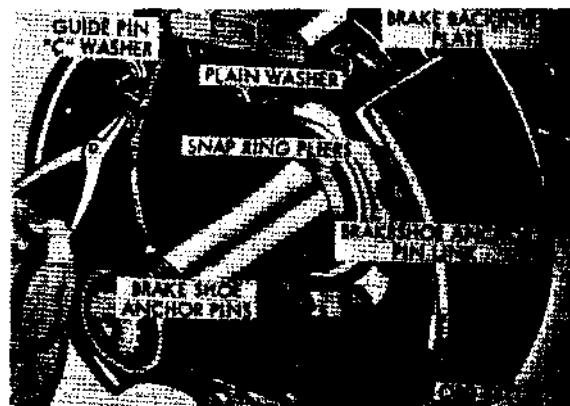


Figure 344. Removing brakeshoe C washers

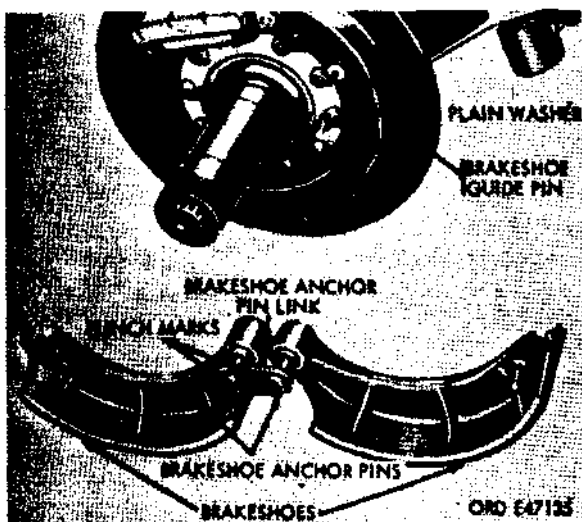


Figure 345. Brakeshoes removed

c. Steering Knuckle Assembly.

- (1) Remove tie rod assembly. (Refer to a above.)
- (2) Remove steering knuckle boot guard (GG, fig. 347). Remove the cap screws (HH) and lockwashers (JJ) that attach steering knuckle boot guard (GG) to steering knuckle (M) and remove boot guard.
- (3) Remove steering knuckle boot (CC, fig. 347). Remove the screws (AA) that attach steering knuckle boot retainer (BB) to steering knuckle (M) and remove retainer. Fold steering knuckle

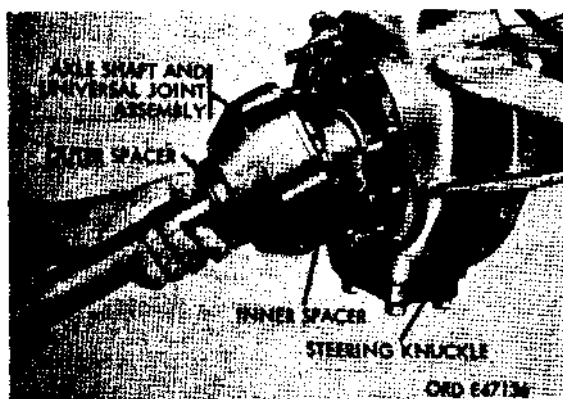


Figure 346. Removing axle shaft and universal joint assembly

boot back on axle housing. Loosen steering knuckle boot clamp (EE), and slide boot and clamp away from steering knuckle.

- (4) Remove steering arm (S, fig. 347). Remove the nuts (V), lockwashers (U), and steering arm stud sleeves (T) that attach steering arm (S) to steering knuckle (M). Tap steering arm lightly with a soft hammer to loosen stud sleeves. Remove steering arm and stud sleeves from steering knuckle. Lift steering knuckle sleeve (Q) and steering socket pin spacer (R) from steering knuckle.

Note. Steering arm is provided on left side of axle only. Steering arm is replaced by a steering knuckle sleeve rest plate on right side. Refer to e below for removal.

- (5) Remove steering knuckle upper rest plate. Remove the nuts, lockwashers, and stud sleeves that attach the upper rest plate to steering knuckle. Tap the rest plate with a soft hammer to loosen steering knuckle stud sleeves. Remove rest plate and stud sleeves from steering knuckle. Lift sleeve and steering socket pin spacer from steering knuckle.
- (6) Remove steering knuckle lower rest plates. Remove the cap screws (KK) and lockwashers (LL) that attach lower rest plates (MM) to steering knuckles. Remove rest plate (MM) and steering knuckle sleeve (AE) from steering knuckle.
- (7) Remove steering knuckle. Lift steering knuckle (M) from steering socket pins at outer end of axle housing.

d. Differential Carrier Assembly (Fig. 348).

- (1) Support the axle assembly on wood blocks. Place a container under axle housing. Remove drain plug and allow lubricant to drain.
- (2) Remove the nuts and lockwashers that attach differential carrier to axle housing.
- (3) Attach a suitable sling to the differential carrier and lift the assembly out of axle housing.

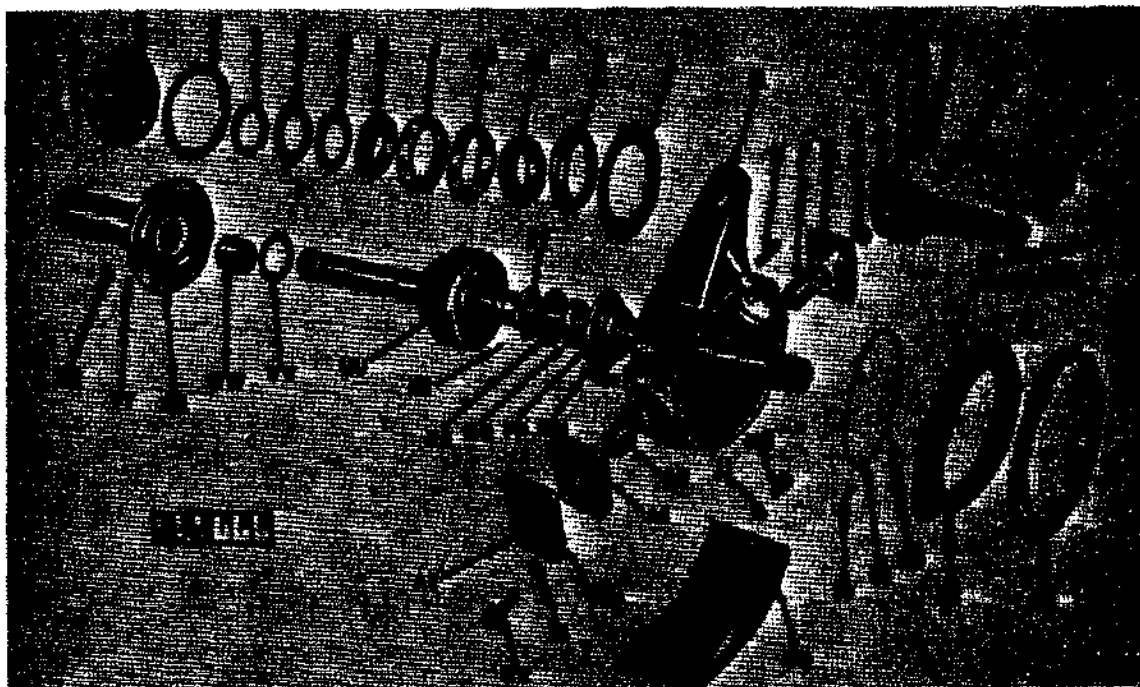


Figure 347. Steering knuckle assembly - exploded view

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Cap screw	FF	Machine screw
B	Lockwasher	GG	Steering knuckle boot guard
C	Drive flange	HH	Cap screw
D	Drive flange gasket	JJ	Lockwasher
E	Wheel bearing locknut	KK	Cap screw
F	Wheel bearing-adjusting-nut lockwasher	LL	Lockwasher
G	Wheel bearing-adjusting nut	MM	Rest plate
H	Wheel bearing cone	NN	Wheel spindle stud
J	Wheel bearing cup	PP	Universal joint oil seal retainer
K	Wheel hub oil seal	QQ	Universal joint oil seal
L	Oil slinger	RR	Universal joint inner spacing washer
M	Steering knuckle	SS	Universal joint spacer retaining screw
N	Steering arm stud	TT	Universal joint spacer
P	Steering knuckle sleeve bearing	UU	Axle shaft and universal joint assembly
Q	Steering knuckle sleeve	VV	Universal joint outer spacing washer
R	Steering socket pin spacer	WW	Wheel spindle bearing (bushing type)
S	Steering arm	XX	Wheel spindle
T	Steering arm stud sleeve	YY	Lockwasher
U	Lockwasher	ZZ	Hex-nut
V	Hex-nut	AB	Wheel bearing cup
W	Lubrication fitting		
X	Steering arm ball stud		
Y	Slotted nut		
Z	Cotter pin		

Figure 347. Steering knuckle assembly - exploded view - legend

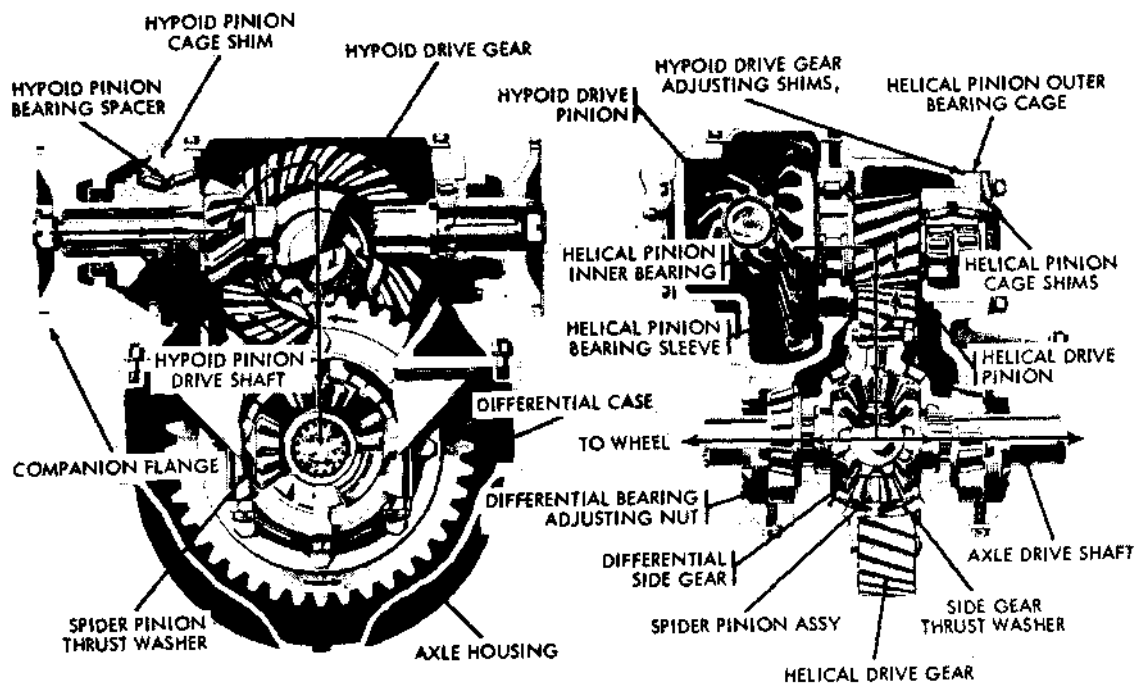
KEY ITEM

AA Machine screw
 BB Steering knuckle boot retainer
 CC Steering knuckle boot
 DD Hex-nut
 EE Steering knuckle boot clamp

KEY ITEM

AC Wheel bearing cone
 AD Steering knuckle sleeve bearing
 AE Steering knuckle sleeve
 AF Lubrication fitting

Figure 347. Legend (continued).



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Figure 348. Differential and carrier assembly - cutaway view.

265. Assembly.

- a. Tie rod assembly (figure 340).

(1) Screw tie rod end on tie rod.

(2) Torque tie rod clamp nuts to 45 to 55 feet-pounds.

NOTE

Do not tack weld tie rod end to tie rod.

(3) Position tie rod end bolt on steering knuckle and secure with nut. Torque nut to 140 to 180 feet-pounds. Secure with cotter pin.

- b. Axle shaft and universal joint assembly.

(1) Assemble shaft oil seal retainer (figure 347). Place shaft oil seal retainer (PP) on press and press

new shaft, oil seal (QQ) into retainer until seal is firmly seated. Install concave side of seal toward spacing washer (RR). Use suitable adapter to install seal. Place spacing washer in retainer, chamfered side toward seal. Press spacing washer into seat in retainer.

(2) Install inner drive shaft oil seal assembly. Remove retainer and seal assembly from press, and install in one end of front axle housing. Retainer must be installed with small end toward differential. Repeat procedure outlined in (1) above to assemble other seal retainer and install in opposite end of front axle housing.

(3) Install drive shaft and universal joint assembly (figure 347). Using care not to damage oil seal in housing outer end, install left universal joint drive assembly in left end of axle housing, guiding splined end of inner drive shaft into differential side gear. Install right drive shaft assembly in right end of housing. Fill drive shaft universal joint chamber at each end of front axle housing with general purpose grease (CG). Also coat ground portion of outer shafts next to yokes with liberal amount of general purpose grease. If temperatures below 0°F. are expected, use OG 00. This is necessary to ensure initial and immediate lubrication at wheel spindle bushing-type bearing (WW).

(4) Install front wheel spindle (figure 347). Position front wheel spindle (XX) on studs (NN). Milled slot on threaded end of wheel spindle must be at top. Place brake backing plate assembly on steering knuckle studs with anchor pin holes at bottom. Position oil slinger (L) on studs. Install ten external teeth lockwashers (YY) and hex-nuts (ZZ). Torque nuts to 90 to 115 feet-pounds.

(5) Install brake line. Connect flexible brake lines to inlet fitting behind brake backing plate.

(6) Install hub and drum assembly. Install hub and drum assembly and adjust wheel bearings as outlined in TM 9-2320-211-20.

(7) Install drive flange (figure 347). Place new drive flange gasket (D), coated with grease, in position on hub. Install drive flange (C) over splined outer end of left universal joint drive shaft assembly and position against hub. Aline holes in gasket, flange, and hub, and install ten capscrews (A) and lockwashers (B). Tighten capscrews.

c. Steering knuckle assembly.

(1) Install steering knuckle (figure 347). Place steering knuckle (M) over steering socket pins in outer end of front axle housing assembly with steering knuckle arms toward rear. Widest part of steering knuckle must be toward top of axle.

(2) Install steering knuckle sleeve assemblies (figure 347). Position steering knuckle sleeve (AE) and lower steering knuckle plate (MM) on steering knuckle and aline holes. Install two capscrews (KK) and lockwasher (LL), and tighten only enough to hold parts in position until universal joint boot guard (GG) and remaining two capscrews are installed. Place steering knuckle sleeve (Q) in position on studs (N). Drop steering knuckle arm spacer (R) in place. Place steering arm (S) with four steering arm stud sleeves (T) in position on studs. Install four lockwashers (U) and hex-nuts (V) and tighten only enough to hold steering arm (S) in place.

(3) Install steering knuckle boot (figure 347). Position new boot (CC) on axle housing with zipper to front of axle. Close zipper and fold boot back so it is wrong side out. Aline mark or molded line on boot with notch at top of groove in axle housing, and be sure boot is firmly seated in groove in entire circumference. Install boot clamp (EE) with opening at top. Make sure clamp engages boot and groove in axle housing end, and tighten washer face round-head screw (FF) and hex-nut (DD). Fold boot over boot clamp and install boot retaining ring (BB) with opening at top. Aline holes in boot and retaining ring with holes in steering knuckle. Install twelve machine screws

(AA), tighten securely, and install locking wire to secure screws in place.

NOTE

A one-piece boot (not split) is also available (left and right). Installation of this type boot differs from the split-type installation only in that boot must be placed over end of axle housing before steering knuckle is installed.

(4) Install universal joint boot guard (figure 347). Position boot guard (CC) over lower steering knuckle plate (MM). Install remaining two capscrews (KK) and lockwashers (LL), and tighten lightly. Install two capscrews (HH) and washers (JJ), and tighten firmly. Torque all four capscrews to 105 to 135 foot-pounds.

(5) Tighten steering knuckle sleeve cap screws and steering arm stud nuts (figure 347). Tighten capscrews to 160 to 175 foot-pounds torque. Torque hex nuts to 115 to 200 foot-pounds. Install lubricating fitting in lower steering knuckle plate (MM) and lubricating fitting

in steering arm (S). This completes assembly of left steering knuckle. See paragraph 274 for testing and adjusting steering knuckle end play.

NOTE

Assembly procedure for right steering knuckle is the same as (1) through (5) above, except steering arm is replaced by steering knuckle plate on top of right knuckle. Also split dowels are not used, and capscrews in place of studs mount plate to top of steering knuckle.

(1) Place a new carrier to housing gasket in position on axle housing. Position differential and carrier assembly on axle housing. Install four split dowels. Complete installation by installing 18 nuts and lockwashers on studs. Tighten to 140-155 foot-pounds torque. Torque nuts to 130 to 170 foot-pounds.

(2) Using new gaskets, install drain and filler plugs in axle housing. Refill with specified lubricant. Refer to LO 9-2320-211-12.

Section IV. REPAIR

266. Tie Rod Assembly.

a. Disassembly.

(1) General. The tie rod assembly need not be disassembled unless inspection reveals that parts must be replaced. The following procedure will apply when disassembling.

(2) Loosen tie rod end capscrews (figure 349). Loosen the two capscrews (R), and nuts (U) holding the tie rod end at each end of tie rod tube (S). Loosen tie rod tube from the tie rod ends by using a chisel to remove tack weld at each tie rod assembly. Do not damage threads.

(3) Remove tie rod end assemblies (figure 349). Remove tie rod end assemblies from tie rod tube (S).

NOTE

One end of tie rod tube has right-hand thread

and the other end has left-hand thread. The tie rod end assemblies are threaded in a similar manner. The right tie rod end assembly is assembled to the right-hand threaded end of the tie rod tube and assembled to axle at right steering knuckle.

(4) Disassembly of tie rod end assemblies (figure 349). If necessary to disassemble tie rod end assemblies to replace worn or damaged parts, remove end plug snap ring (A) from base of tie rod end. This will permit removal of end plug (B), compression spring (C), spring seat (D), felt washer (E), end stud bearing (F), and end stud (G) from inside of tie rod end.

b. Cleaning, inspection and repair.

(1) Cleaning. Clean all parts thoroughly with dry-cleaning solvent or mineral spirits paint thinner.

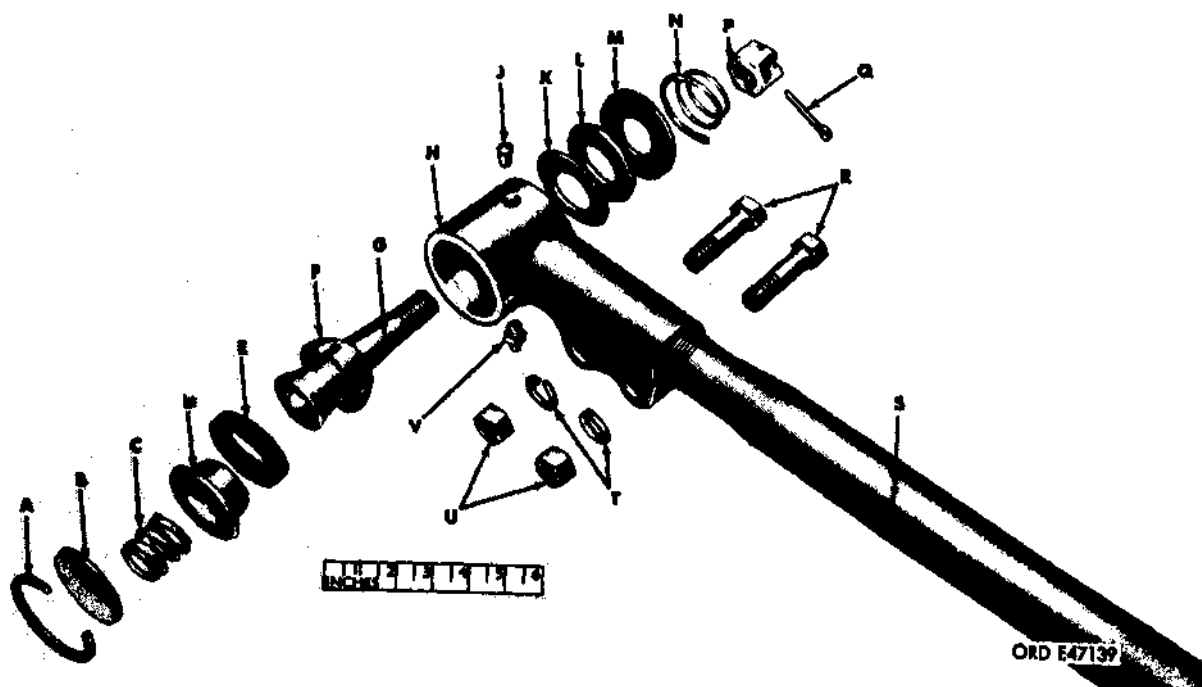


Figure 349. Tie-rod end assembly- exploded view

KEY	ITEM
-----	------

- | | |
|---|-----------------------|
| A | Ring, snap, end plug |
| B | Plug, end |
| C | Spring, compression |
| D | Seat, spring |
| E | Washer, felt |
| F | Bearing, end stud |
| G | Stud, end |
| H | End, tie rod |
| J | Pin, end stud bearing |
| K | Washer, plain |

KEY	ITEM
-----	------

- | | |
|---|------------------------------|
| L | Seal, shield |
| M | Shield, stud |
| N | Spring, compression, tapered |
| P | Nut, slotted |
| Q | Pin, cotter |
| R | Straw, cap |
| S | Tube, tie rod |
| T | Washer, lock |
| U | Nut, hex |
| V | Fitting, lubricating |

(2) Inspection and repair.

(a) Tie rod ends. Inspect stud shield for cracks or damage. Inspect end studs and tie rod ends for damaged threads and replace if damaged. Check stud seats and tie rod end bodies for looseness and excessive wear. Replace if worn.

(b) Tie rod tube. Inspect threads for damage. Inspect tube for twisted or bent condition. Replace tube if any defects are found.

c. Assembly (figure 349).

(1) Install end stud bearing (F) in tie rod end notch in bearing over end stud bearing pin (J).

(2) Install end stud (G) from bottom of tie rod end.

(3) Place felt washer (E) over spring seat (D) and enter assembly from bottom of tie rod end until spring seat contacts end stud (G). Closed end of seat must be toward end stud.

- (4) Insert compression spring (C) in spring seat (D). Install end plug (B) and secure with end plug snap ring (A).
- (5) Install two cap screws (R), lockwashers (T), and hex-nuts (U) in tie rod end. Tighten fingertight only, as toe-in must be adjusted after axle is installed on truck.
- (6) Repeat operations (1) through (5) above for other tie rod end.
- (7) Install tie rod ends on end of tie rod tube (S). Tube is threaded left-hand thread one end, right-hand thread at other end. Right tie rod mounts on right-hand thread end of tube. Install each tie rod end same number of turns on tube.
- (8) Install washer (K), shield seal (L), stud shield (M), and tapered compression spring (N) over thread end of end stud (G). Spring must be installed with large diameter toward stud shield. Install slotted nut (P) to hold spring and seal assembly on tie rod end stud until tie rod is assembled to front axle.
- (9) Repeat operation (8) above for other tie rod end.

267. Universal Joint Drive Shaft Assembly (Bendix)

a. Disassembly.

- (1) General. It is not necessary to disassemble universal joint assembly unless check for excessive play or backlash (3 below) indicates sufficient wear requiring replacement of parts or further inspection. If disassembly is necessary, follow procedure outlined in (2) through (7) below.
- (2) Wash universal joint drive shaft assembly. Wash universal joint drive shaft assembly in mineral spirits paint thinner or dry-cleaning solvent to remove grease from joint. When inspection of parts is completed, immediately coat all parts to be used again with lubricant to prevent damage from rust.
- (3) Check universal joint for excessive play or backlash. To determine if ex-

cessive play or backlash exists in the universal joint, place assembly in vise in a vertical position with outer drive shaft up, and vise gripping inner drive shaft just below the universal joint. Use soft metal protectors in jaws of vise. Firmly push down on outer shaft so it rests on center ball, and at the same time attempt to twist the joint in both directions. If end play or backlash is evident, oversize drive balls must be installed.

- (4) Remove groove pin (fig. 350). Position drive shaft and universal joint assembly in a vise equipped with copper jaws. Using a suitable punch, drive out groove pin.
- (5) Dislodge center ball pin. After removing groove pin ((4 above); hold universal joint drive shaft assembly in a vertical position and bounce end of outer drive shaft on a wood block to dislodge center ball pin (fig. 351), allowing pin to drop farther into the passage in outer drive shaft.
- (6) Remove drive balls (fig. 352). With the universal joint drive shaft assembly in a vertical position, and outer drive shaft up, clamp inner drive shaft in a vise. Swing inner drive shaft to one side and at the same time, raise it slightly to loosen the center ball. Turn center ball with thumb and finger

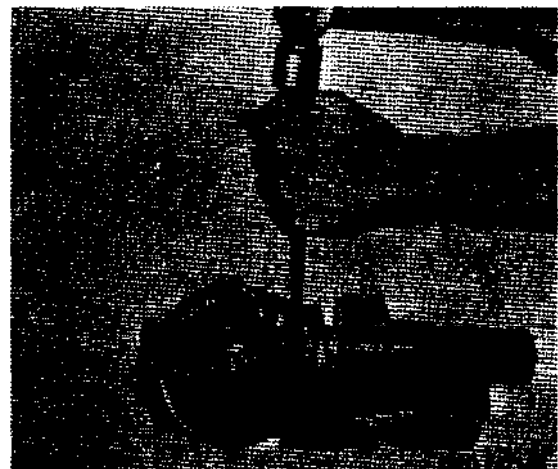


Figure 350. Removing groove pin

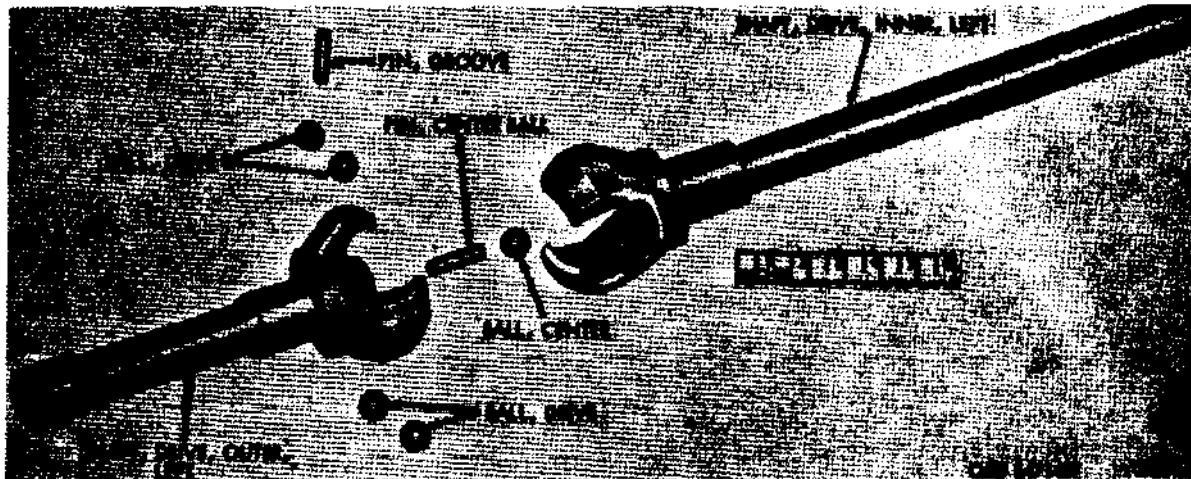


Figure 351. Drive shaft and universal joint assembly (Bendix) - exploded view

so the depression at pin hole in ball lines up with one of the drive balls. The drive ball can then be removed by pulling it past the center ball depression with thumb and finger. By bending the shaft sharply in the opposite direction, the remaining drive balls and the center ball will be released, and the two shafts will separate.

- (7) Remove center ball pin. Tap joint end of outer drive shaft on a wood block to allow center ball pin to drop out of drilled passage in drive shaft.

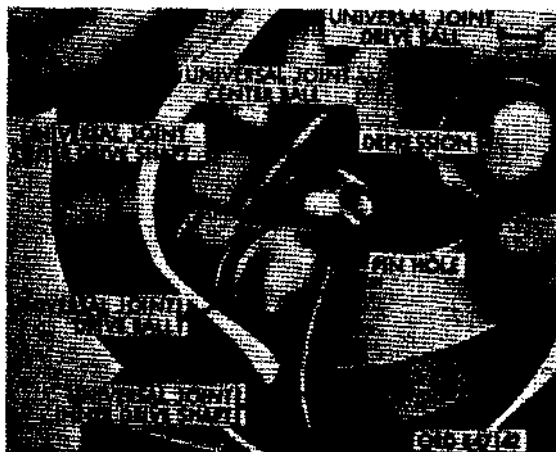


Figure 352. Removing or installing (Bendix) universal joint drive balls

Caution: Components of the right and left shaft assemblies must be kept separate, so they will be assembled in the respective assembly from which they were removed.

b. Cleaning, Inspection and Repair.

- (1) Cleaning. Thoroughly clean drive shafts with mineral spirits paint thinner or dry-cleaning solvent, paying particular attention to the splines. Be sure drilled passage in outer shaft is clean to permit free movement of center ball pin. Clean balls and center ball pin, being sure pin works freely in hole in center ball.
- (2) Inspection and repair. Inspect drive shaft splines for damage. Check shafts for twisted or bent condition. Examine ball races in yokes for excessive wear. If either the inner or outer shaft is damaged or excessively worn, a complete new universal joint drive shaft assembly must be installed. Check balls for cracks, chips, or rough spots. Use a micrometer and check balls for out-of-round condition. Replace damaged balls with new balls of same diameter unless check indicated the necessity of installing oversize balls. Inspect outer universal joint spacer washer which is pressed on outer shaft yoke. If worn excessively or damaged, replace washer.

c. Assembly.

- (1) Select correct size drive balls. If play has developed from wear in universal joint and ball races are in good condition, the play may be eliminated by instillation of larger drive balls. Drive balls are available in kits of seven sizes 0.001-, 0.002-, 0.003-inch under-size, standard, and 0.001-, 0.002-, and 0.003-inch oversize. Measure diameter of original balls with a micrometer to determine size of each ball. Select one or two balls 0.001-inch larger than smallest ball originally used in the assembly. It is desirable to keep drive balls within 0.001-inch of same size, and variation should not exceed 0.002-inch. As universal joint is being assembled, the two largest outer balls should be installed diagonally from each other.
- (2) Place inner drive shaft in vise. Place inner drive shaft in vise with universal joint end up. Use soft metal protectors on vise jaws. Do not grip shaft on machined surfaces.
- (3) Position center ball. Place center ball (the one with hole and depression around hole) on seat at center of inner drive shaft yoke.
- (4) Install center ball pin. Insert center ball pin in drilled passage in center of outer drive shaft.
- (5) Position outer drive shaft. Place outer drive shaft in position over inner drive shaft, being sure that center ball pin does not drop out during this operation.
- (6) Install three drive balls. Bend outer drive shaft to an extreme angle at joint and slip three outer balls into races. Drive balls selected as in 1 above.
- (7) Install fourth drive ball. Tilt outer drive shaft in opposite direction to give clearance for installation of fourth drive ball. Rotate center ball to line up depression around pin hole with race, thereby providing clearance for installation of remaining drive ball. Slip fourth drive ball past center ball into race and return outer drive shaft to straight position.
- (8) Position center ball pin. Raise outer drive shaft to free center ball and rotate ball until center ball pin drops into drilled hole.
- (9) Check universal joint play or backlash. When oversize drive balls have been installed in used races, it is only necessary to see that no play or backlash exists when drive shaft is in vertical position, and that a pull of not more than 35 pounds is required to move shaft through its normal operating range as follows:
 - (a) Determine play or backlash. Firmly push down on outer drive shaft so it rests on center ball and at the same time attempt to twist joint in both directions. Presence of play or backlash indicates the need of still larger drive balls.
 - (b) Determine pull required to move drive shaft through its normal operating range. With assembly still mounted in vise, attach a spring scale to the extreme outer end of outer drive shaft. With spring scale, pull drive shaft through its normal operating range and note reading on spring scale. A pull of more than 35 pounds indicates that drive balls of too large an oversize have been installed, or that there is excessive wear in ball races. Ideal conditions when oversize outer balls are installed in used races are:
 - Vertical or straight position - free with no lash.
 - A turn of 10° to 15° -slight drag, not to exceed 35 pounds.
 - A full turn of 15° to 30° -free with some lash permissible.
- (10) Install groove pin. Install new groove pin in hole drilled in outer drive shaft and drive into position. Remove drive shaft and universal joint assembly from vise and lay on bench or anvil so as to support one end of groove pin. Strike other end of groove pin sharply with prick punch to expand end of the pin and lock it in position. Turn assembly over and expand other end of groove pin in like manner.