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

Change

No. 5

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

**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, M746A1, 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	INSERT PAGES
v and 1	v and 1
1A and 2	1A and 2
65 and 66	65 and 66
None	66.1 through 66.27/(66.28 blank)
None	140.1 through 140.16
253 and 254	253 and 254
279 through 282	279 through 282

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

By Order of the Secretary of the Army:

BERNARD W. ROGERS
*General, United States Army
Chief of Staff*

Official:

J. C. PENNINGTON
*Brigadier General, United States Army
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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*This manual supersedes TB 9-2520-204-30/1, 20 March 1958, TB 9-2520-204-30/2, 21 March 1958, TB 9-2570-204-30/1, 28 March 1958, TB 9-837-2, 20 November 1952, TB 9-837-11, 14 October 1955, MWO 9-2320-211-30/3, 26 September 1958, TM 9-1837B, 19 September 1952 (including all changes), TM 9-8029-3, 17 February 1954, TB 9-1837B-2, 13 December 1957 and so much of TB 9-2855-19, 3 March 1954, TB 9-2855-18, 30 June 1954 and TB 9-2855-42, 26 November 1956 as pertains to field maintenance instructions.

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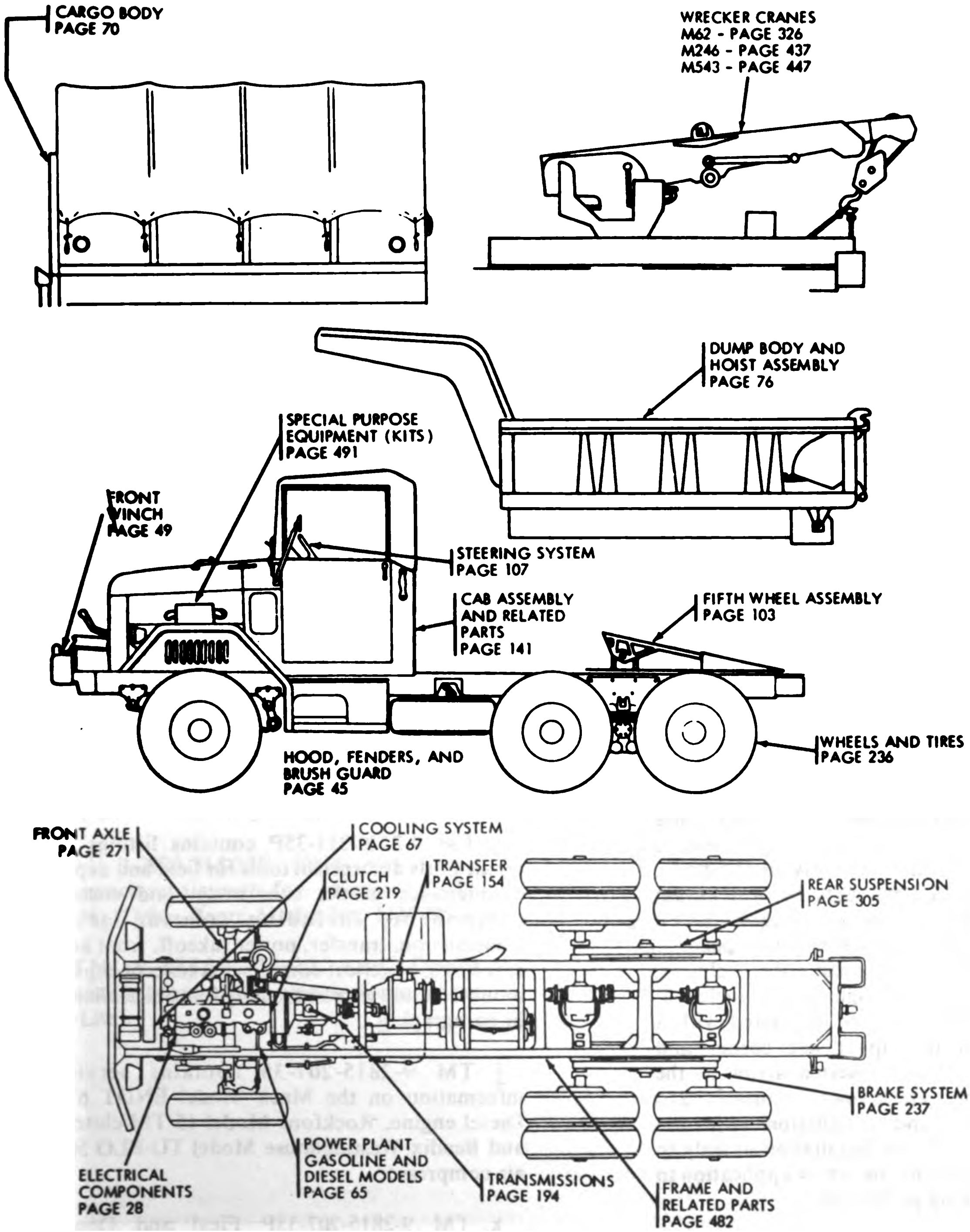


VISUAL GUIDE TO CONTENTS

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, assemby 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 (Holley).

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 9-2320-211-20, 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 M51, and M51A2; tractor trucks M52, M52A1; tractor-wrecker truck M246; and medium 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.

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.

c. Chassis Trucks M40C. The 5-ton, 6 x 6 chassis truck M40C 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 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 11:00 x 20. 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 and 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.

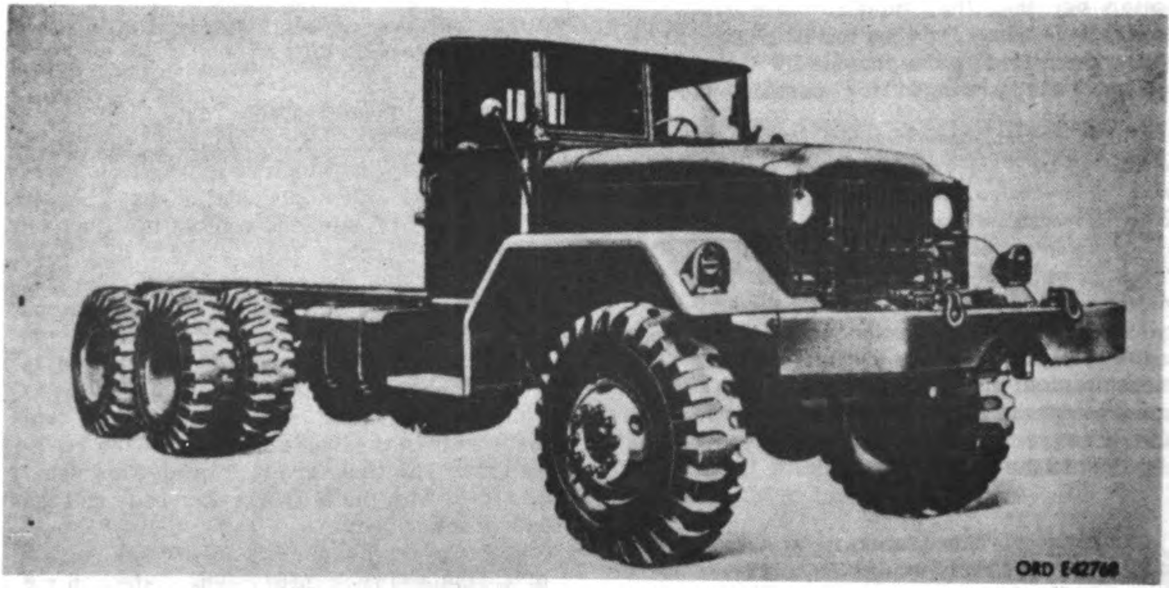


Figure 1. Truck, chassis, M39, M40, M61, M63, M139, - right front view

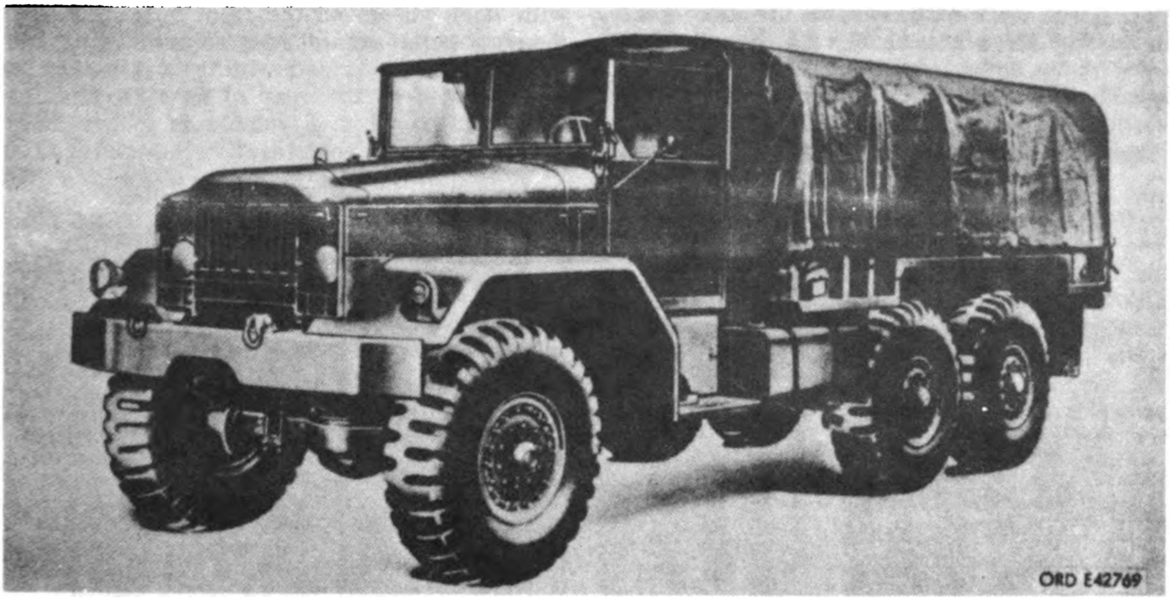


Figure 2. Truck, cargo, M41 - left front view

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 M54A1, 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 materiel.

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.

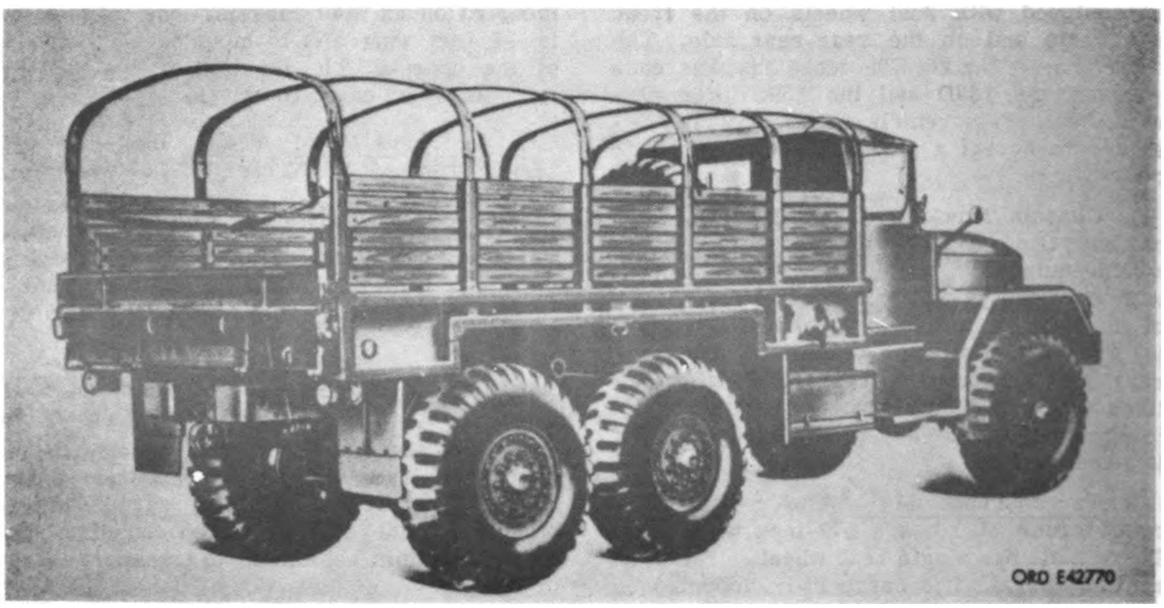


Figure 3. Truck, cargo, M41 - right rear view

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.

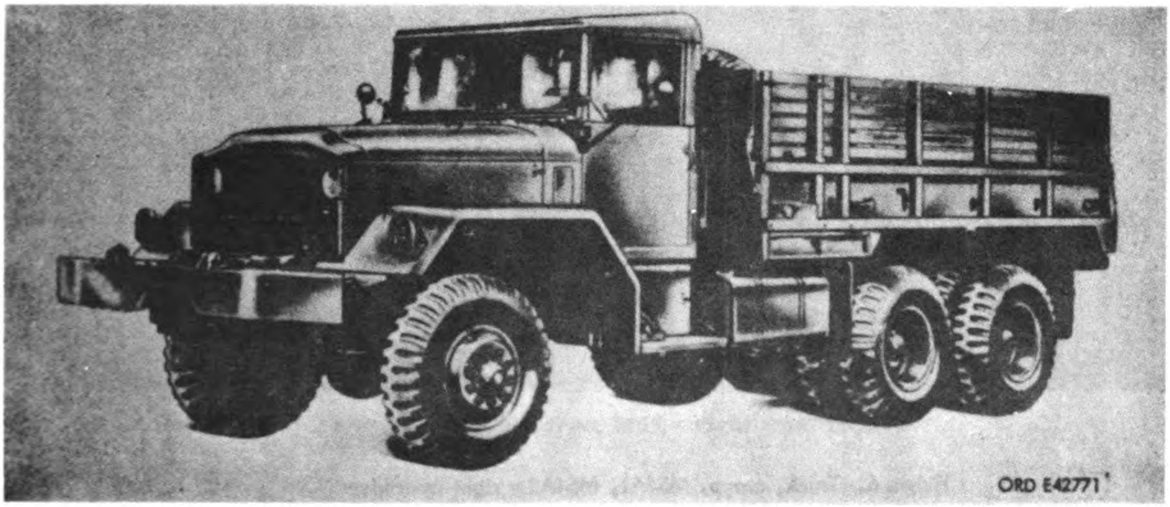


Figure 4. Truck, cargo, flat bed M54 - left front view

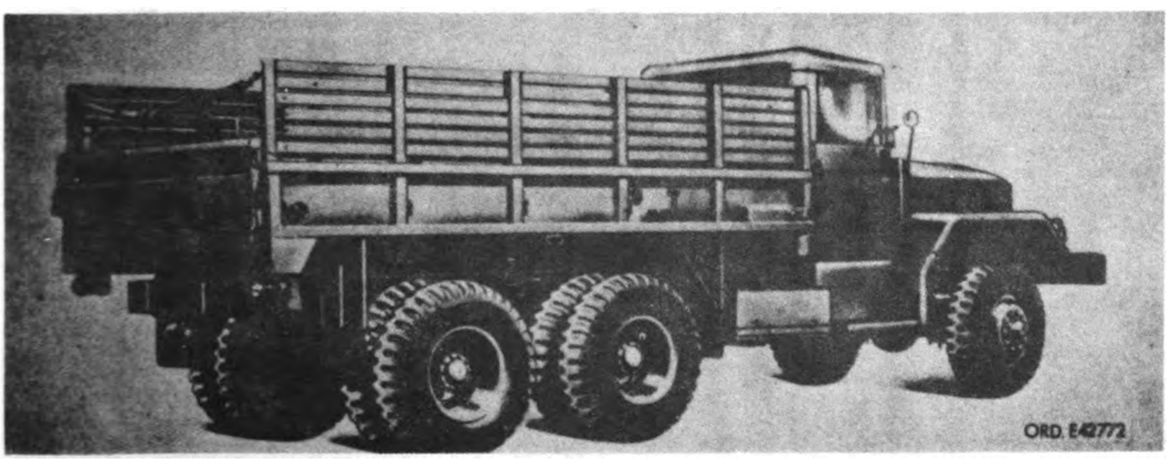


Figure 5. Truck, cargo, flat bed M54 - right rear view

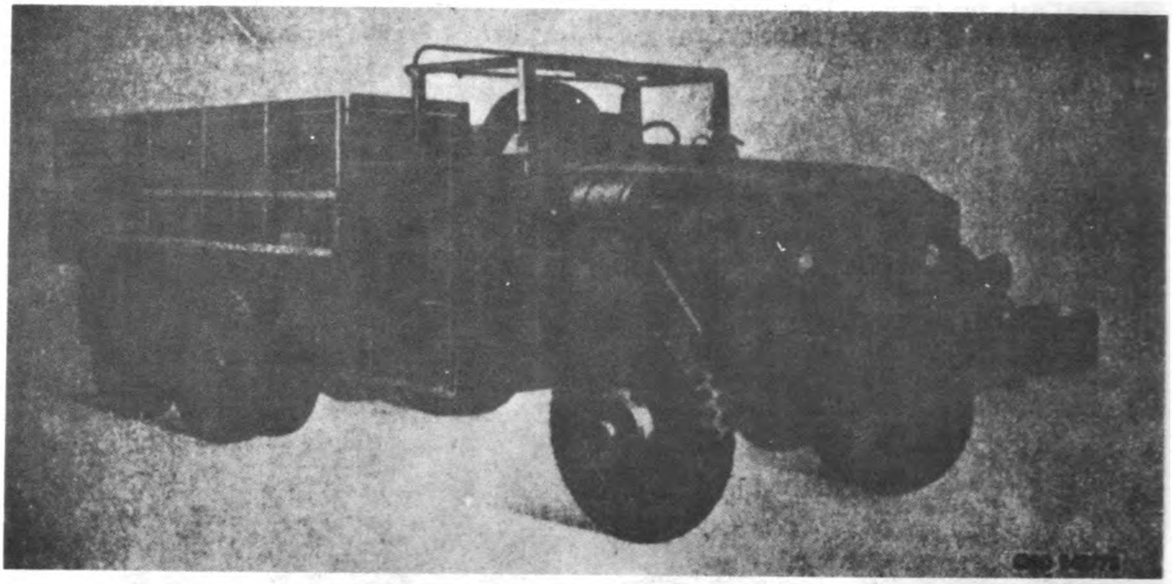


Figure 6. Truck, cargo, M54A1, M54A2 - right front view

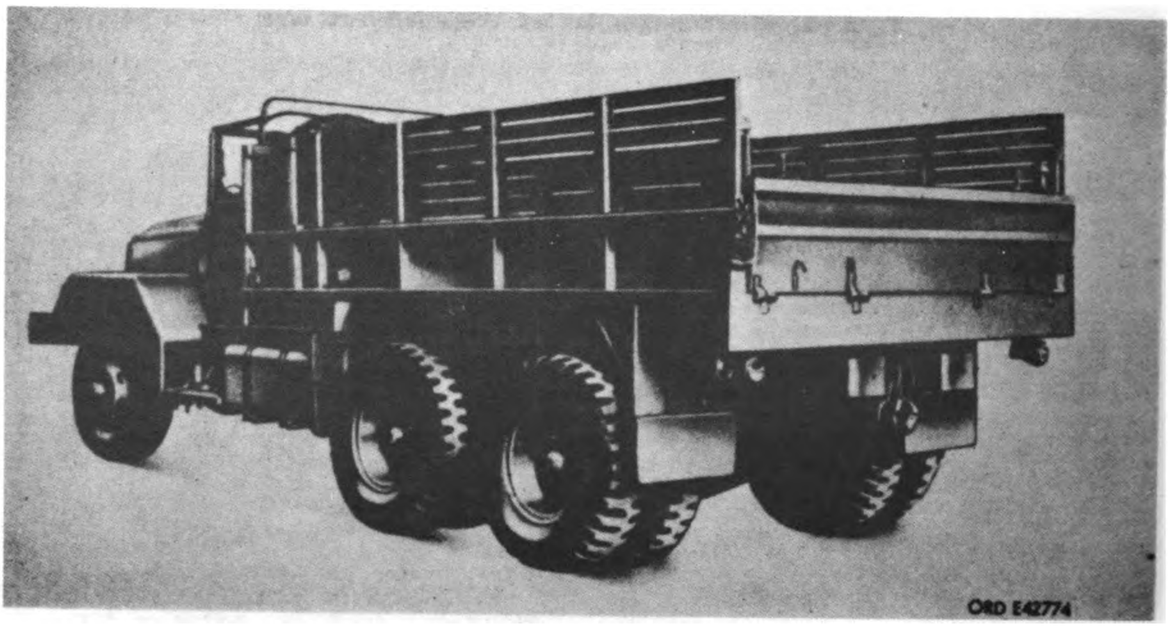


Figure 7. Truck, cargo, flat bed, M54A1, M54A2 - left rear view

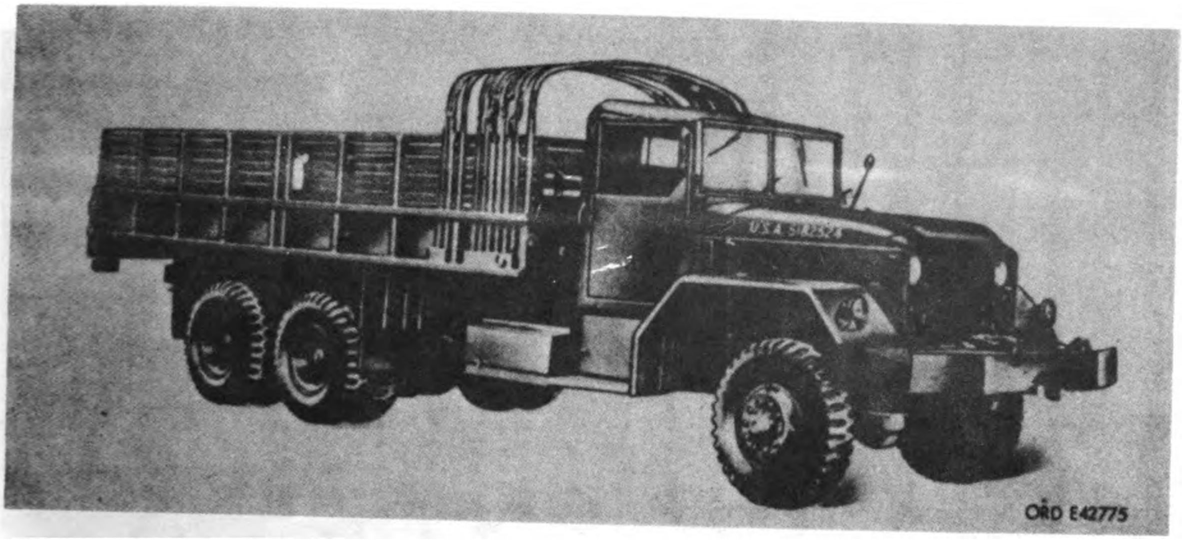


Figure 8. Truck, cargo, M55 - right front view

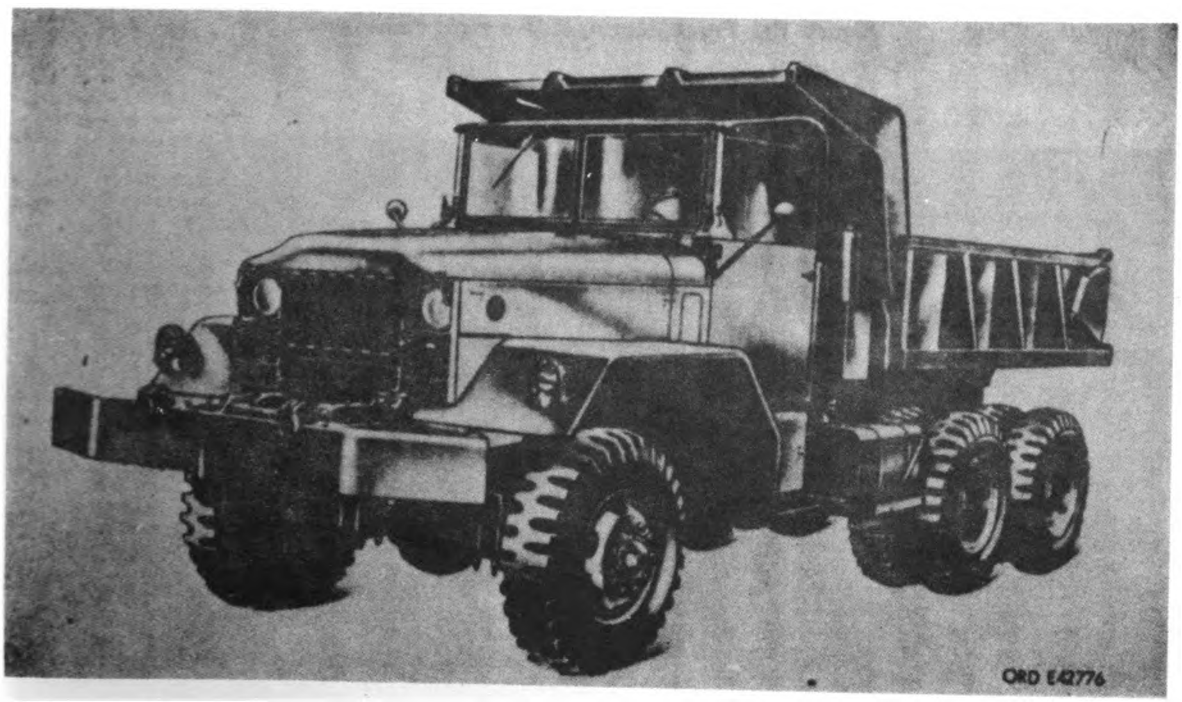


Figure 9. Truck, dump, M51 - left front view

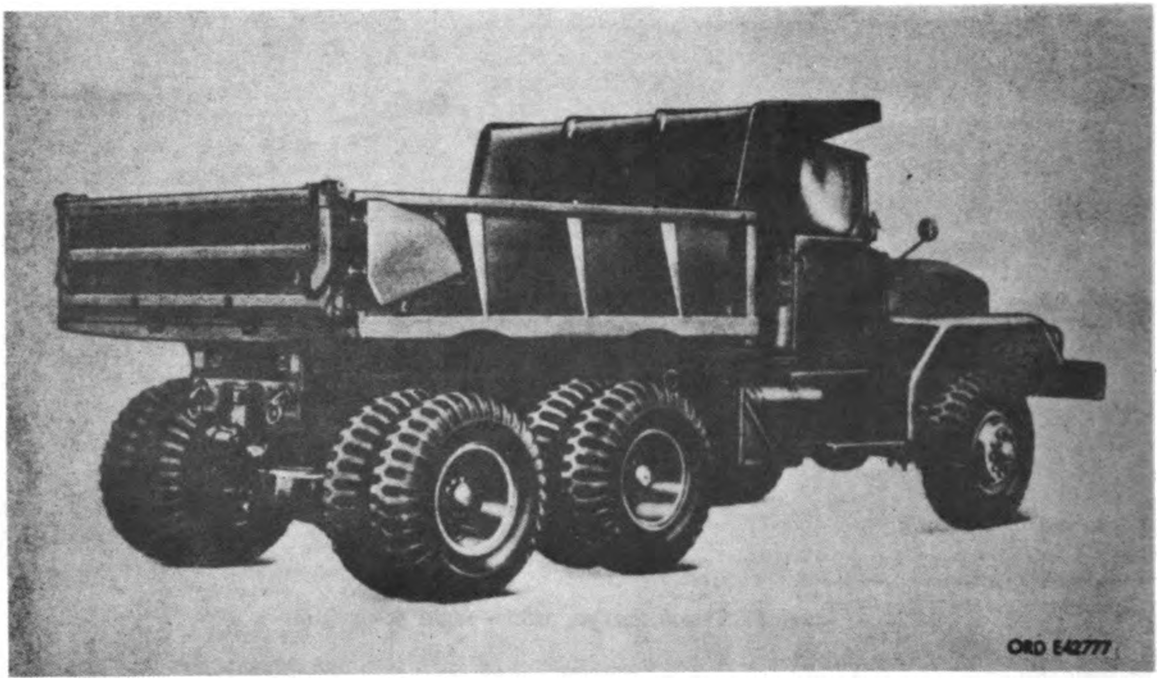


Figure 10. Truck, dump, M51 - right rear view

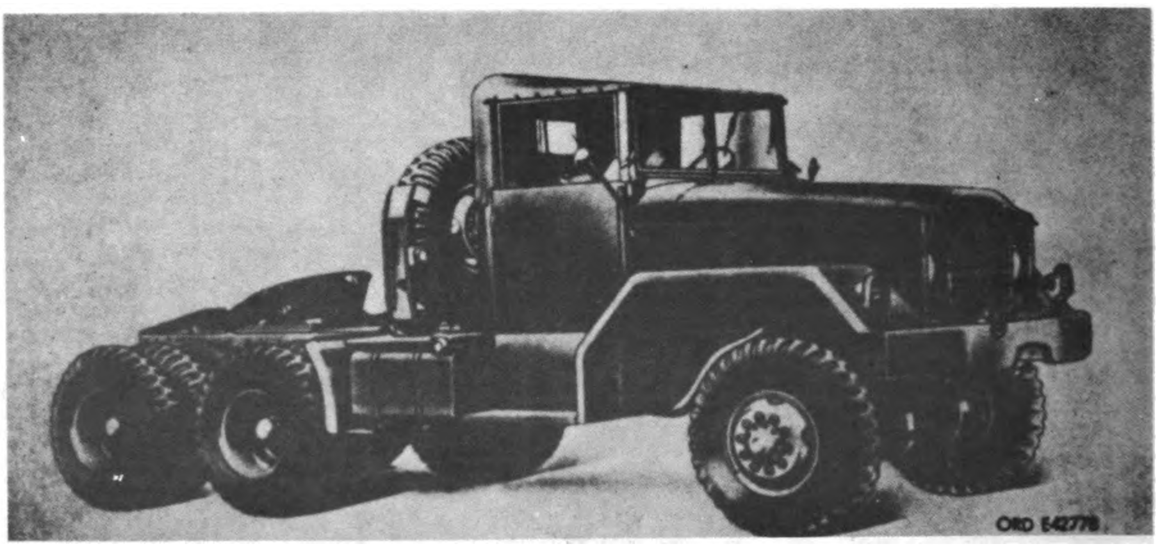


Figure 11. Truck, tractor, M52 - right front view

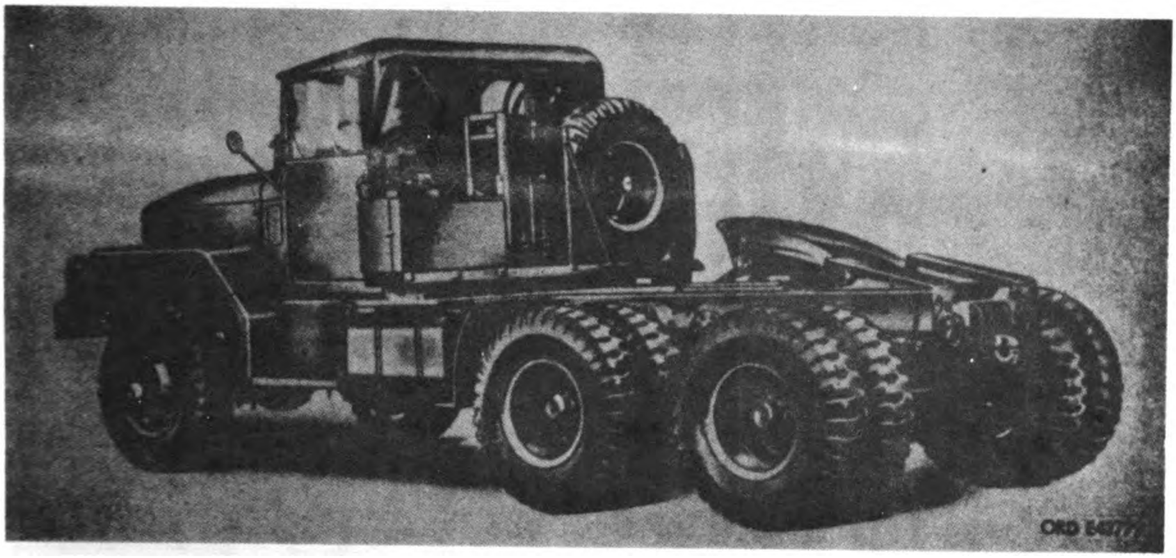


Figure 12. Truck, tractor, M52 - left rear view

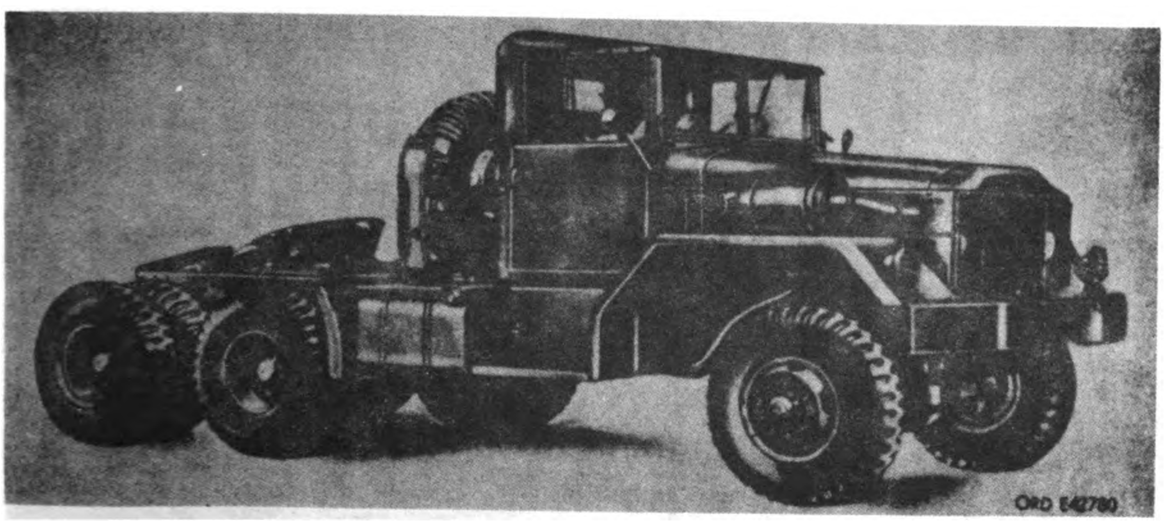


Figure 13. Truck, tractor, M52A1, M52A2 - right front view

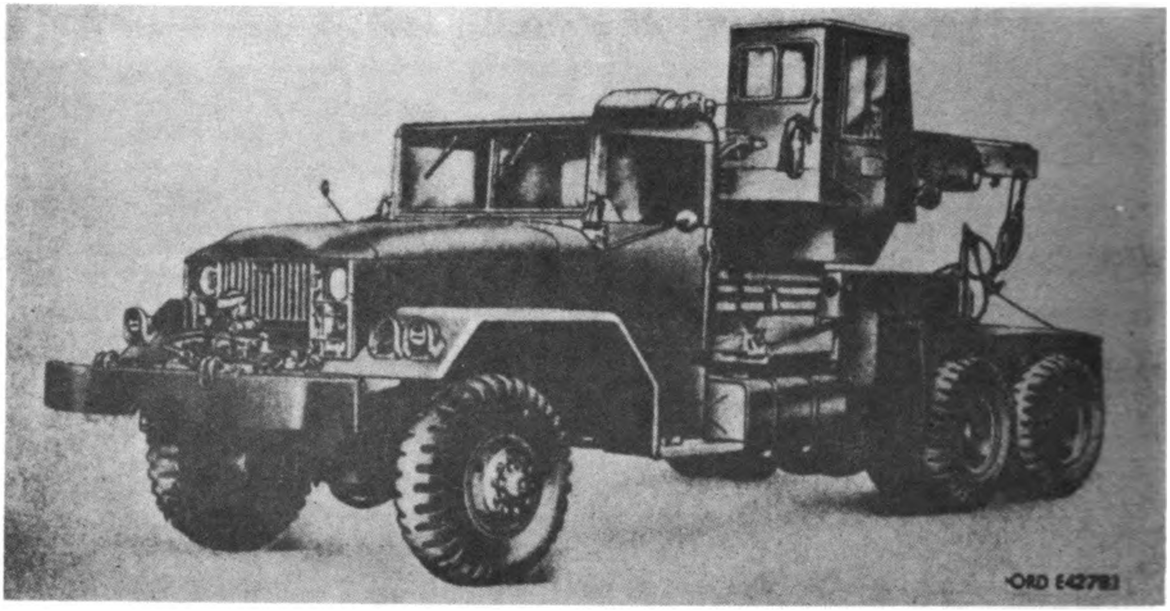


Figure 14. Truck, tractor, wrecker, M246 - left front view

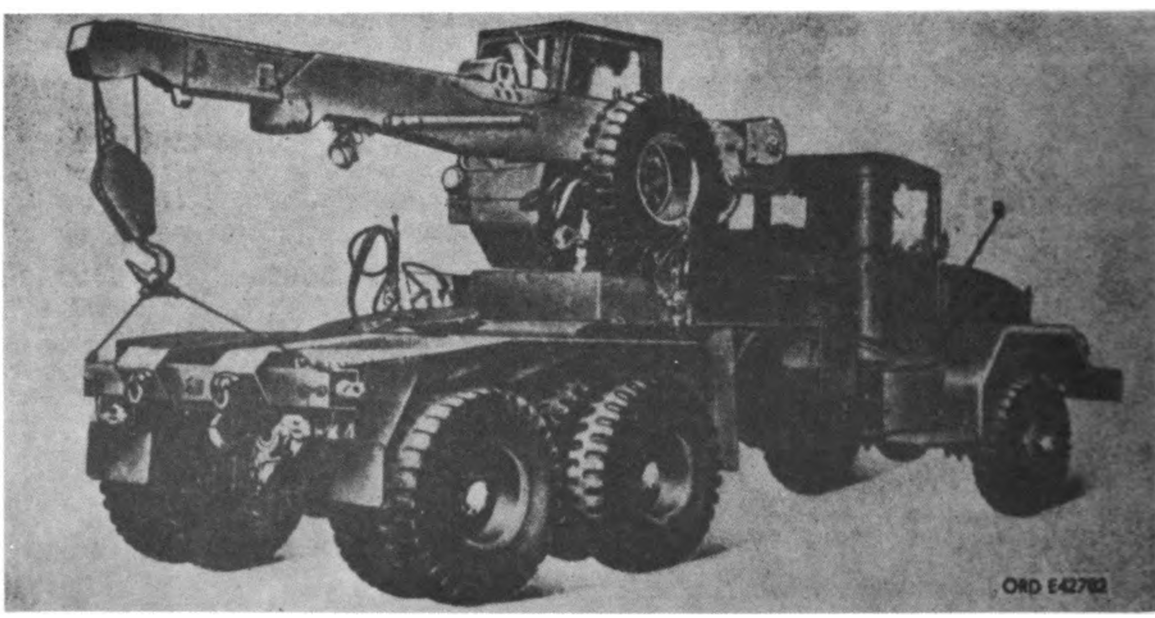


Figure 15. Truck, tractor, wrecker, M246 - right rear view

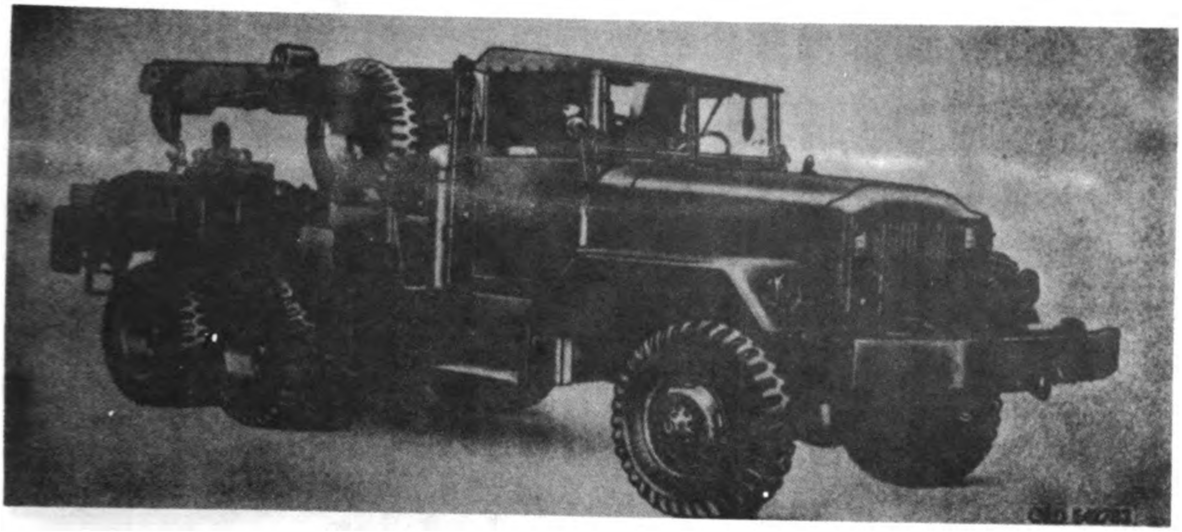


Figure 16. Truck, tractor, wrecker, M62 - right front view

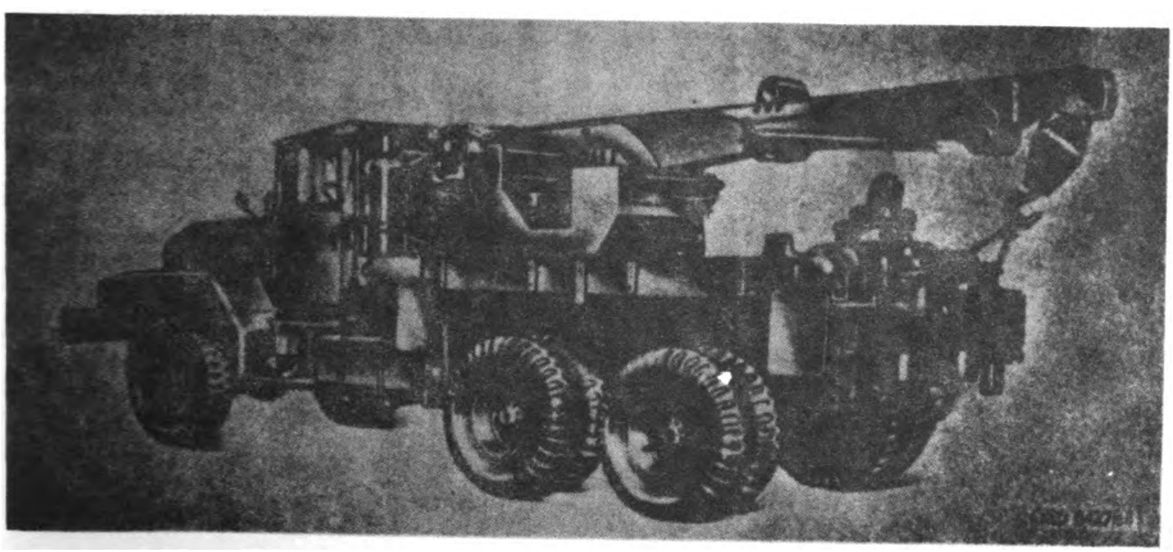


Figure 17. Truck, tractor, wrecker, M62 - left rear view

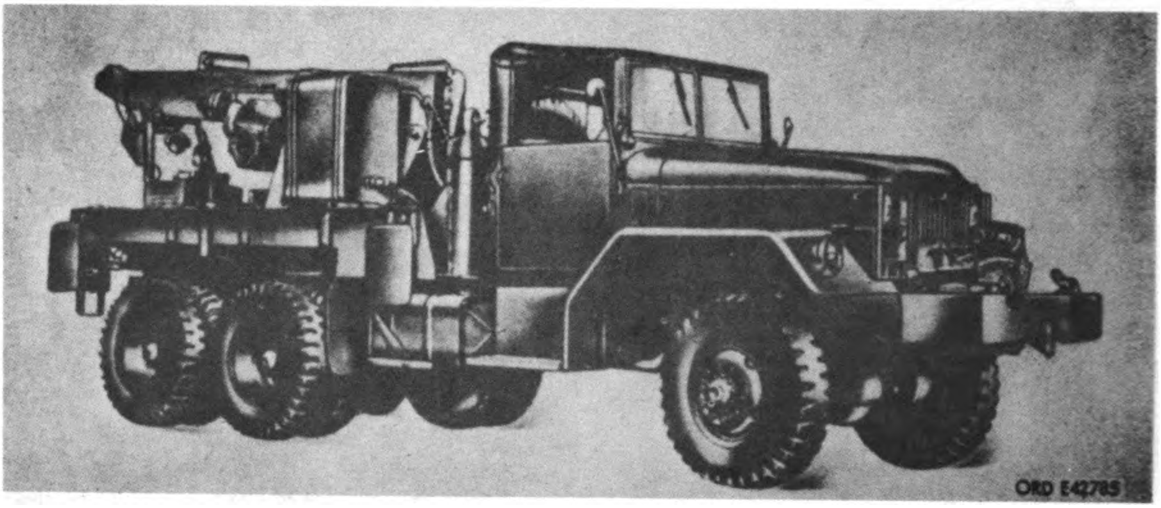


Figure 18. Truck, tractor, wrecker, M543 - right front view

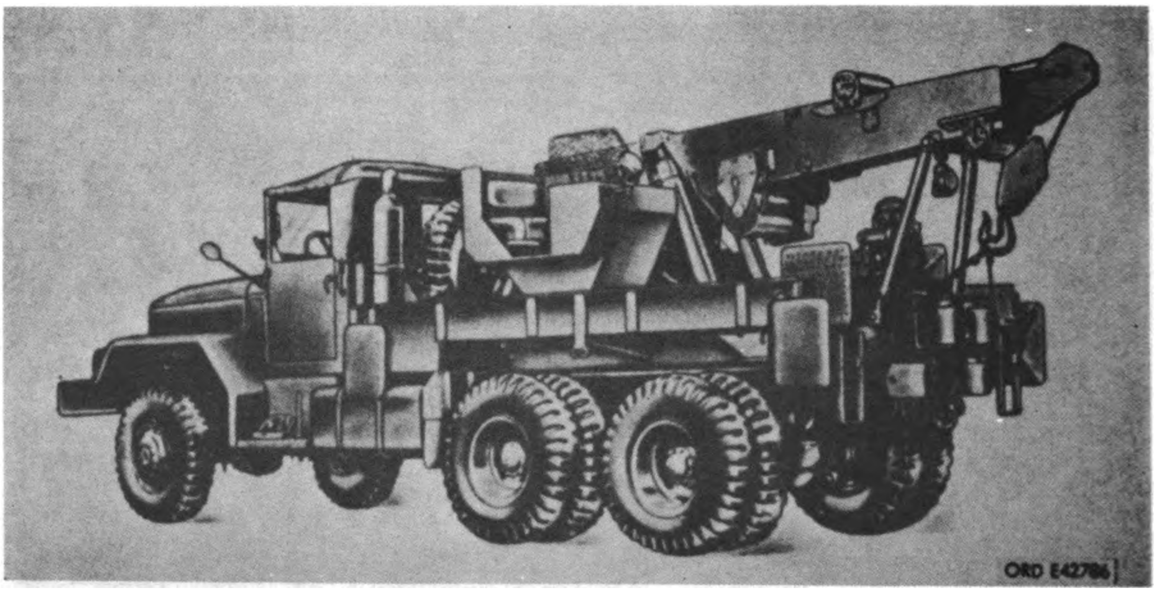


Figure 19. Truck, tractor, wrecker, M543 - left rear view

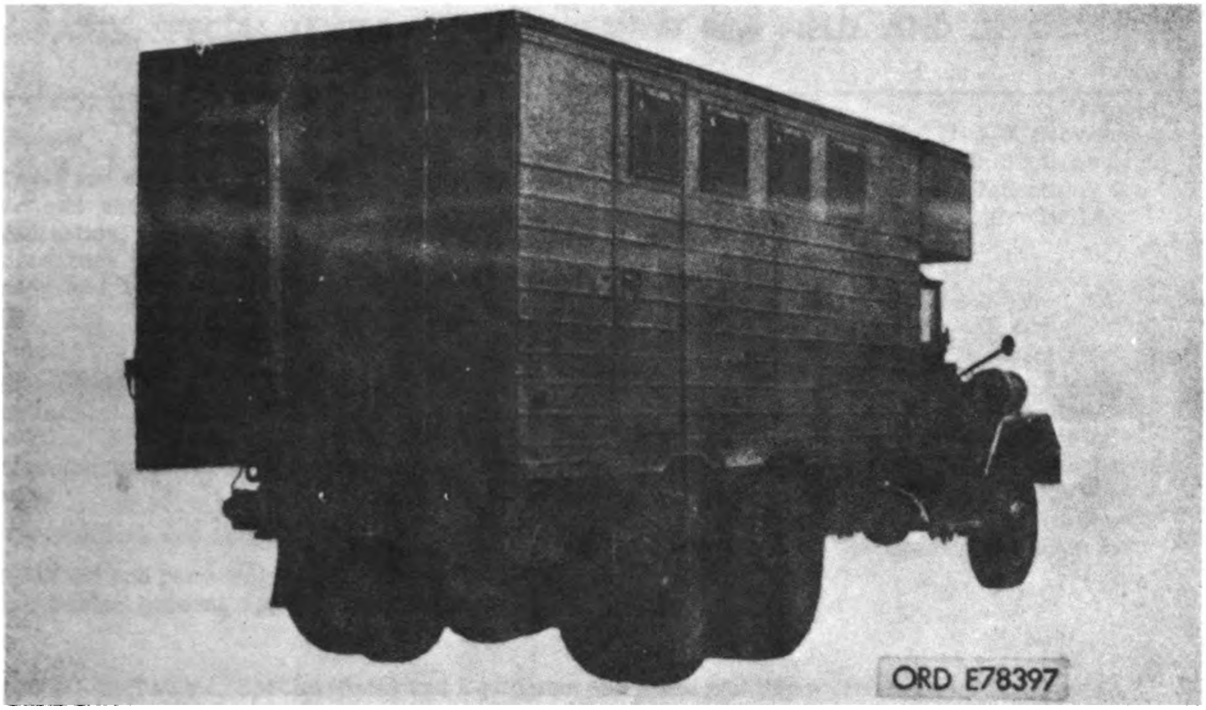


Figure 19.1 (Added) Truck, van: expansible, M291A2.

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 materiel 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 5120-422-8510 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	133 315	To remove or replace front drive gear oil seal.
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 engaged 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	References		Use
	Fig.	Par.	
Adjusting fixture	234	166	Adjusting transfer intermediate shaft bearings.
	236	166	Adjusting transfer rear output shaft bearings.

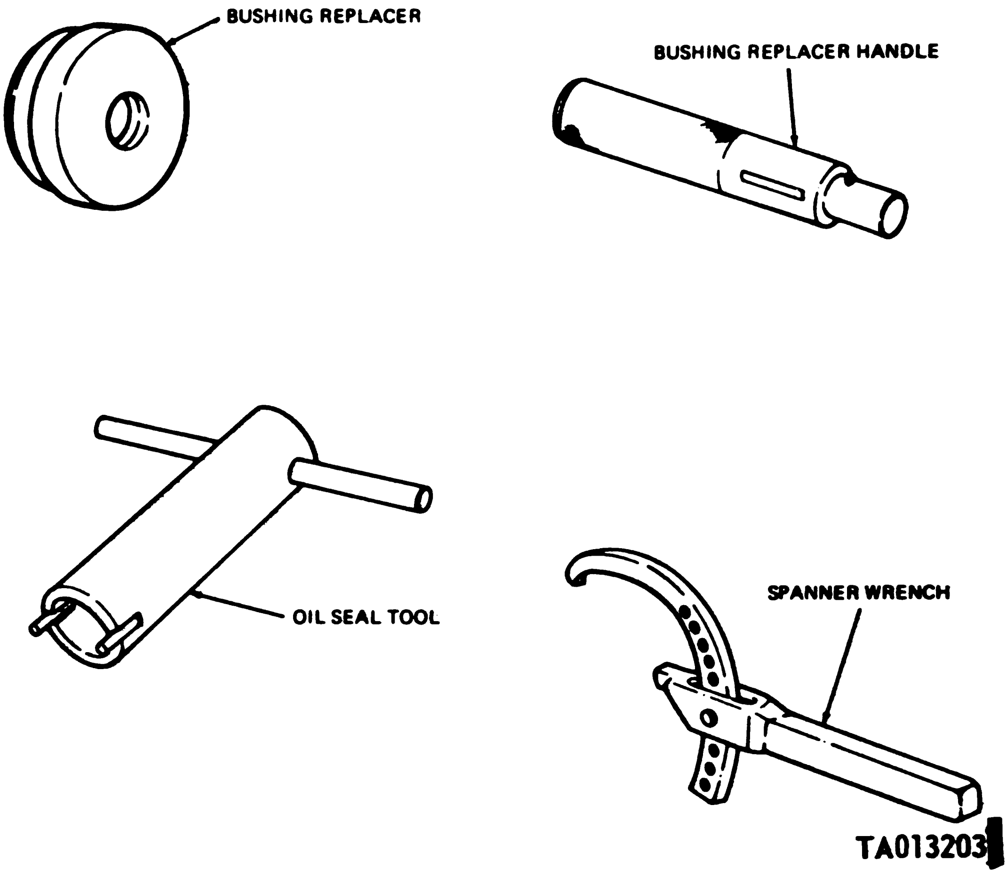


Figure 19.2. Special tools and equipment.

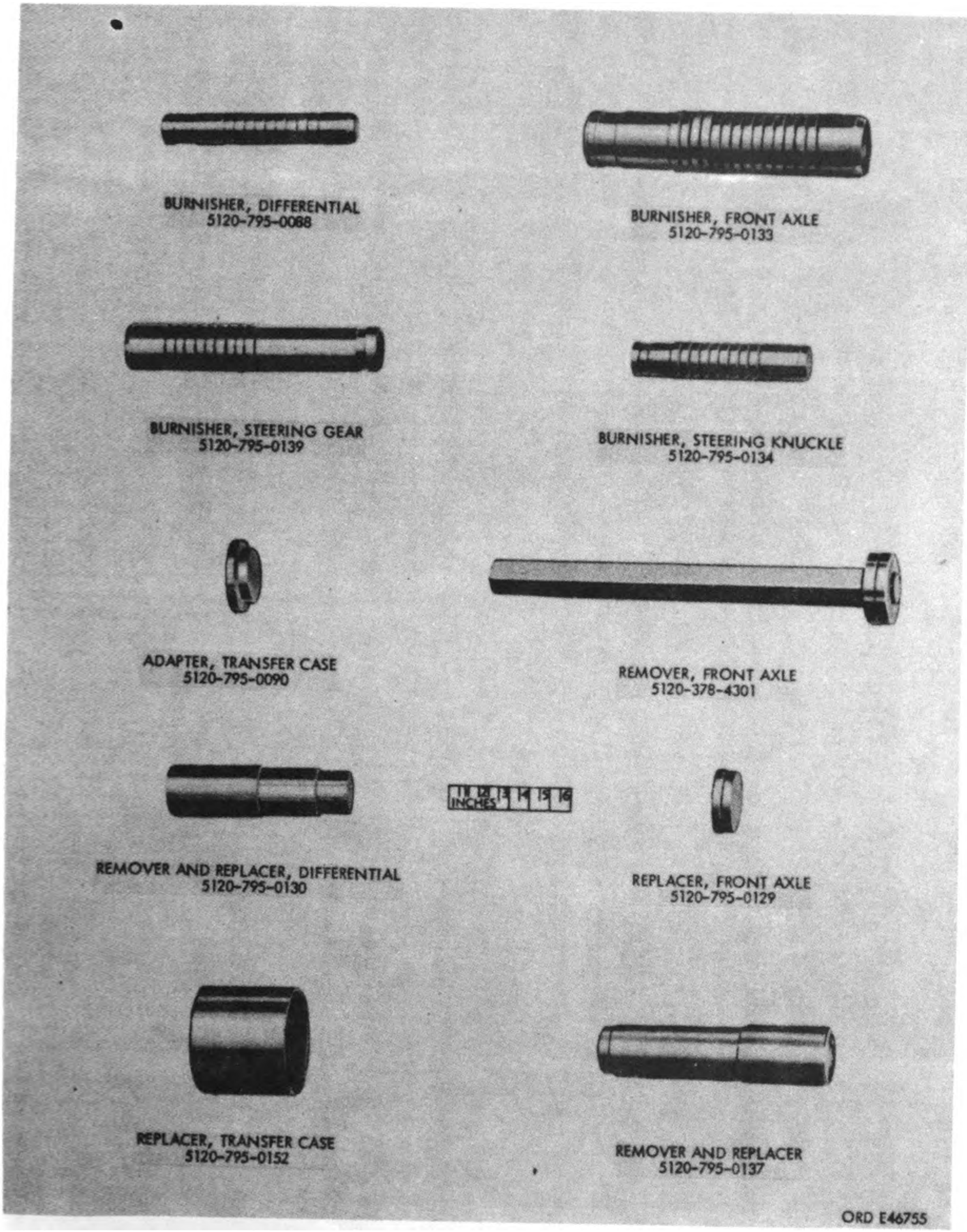


Figure 20. Special tools and equipment for field and depot maintenance (1 of 5).

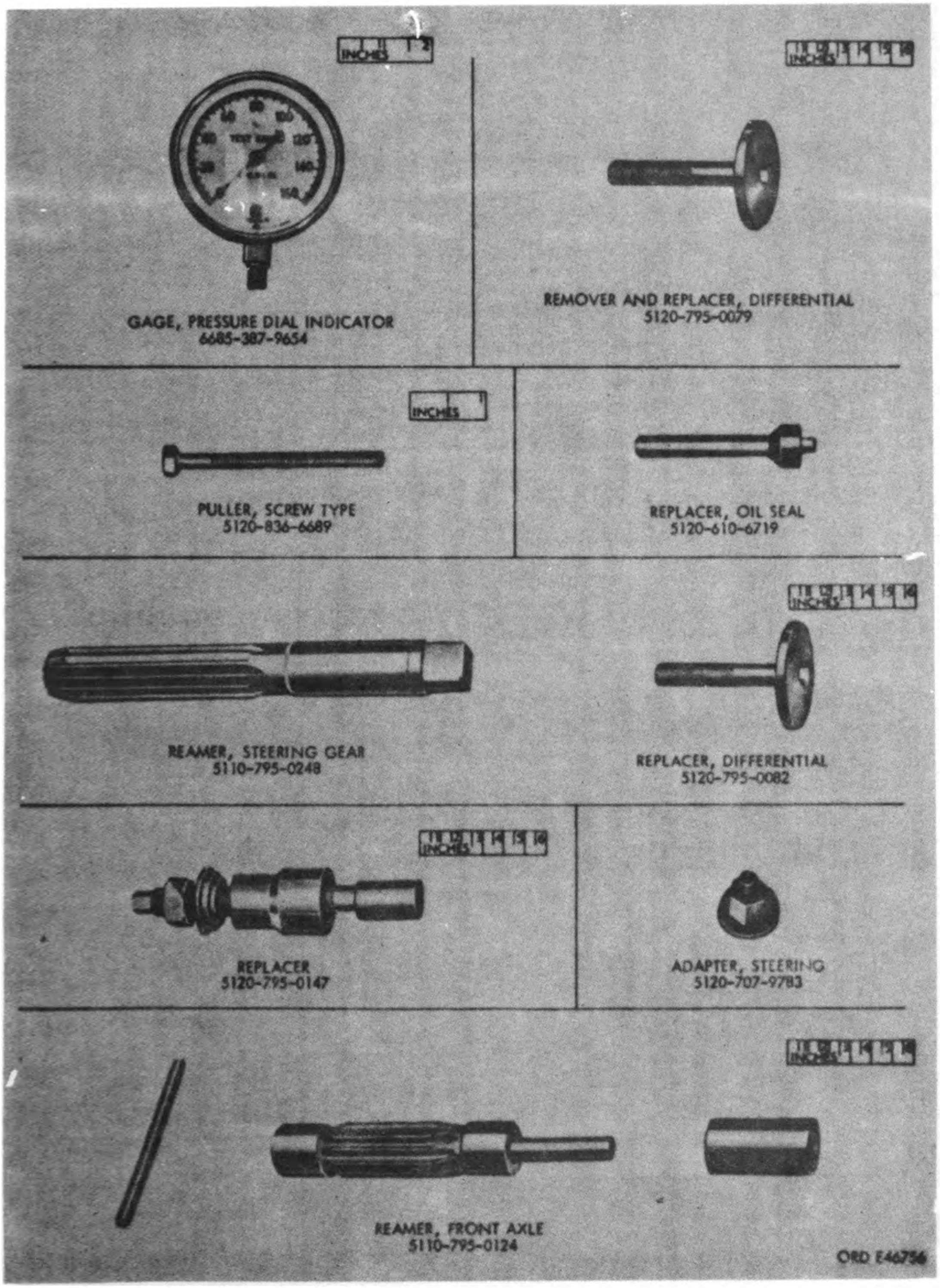


Figure 20. Special tools and equipment for field and depot maintenance (2 of 5)

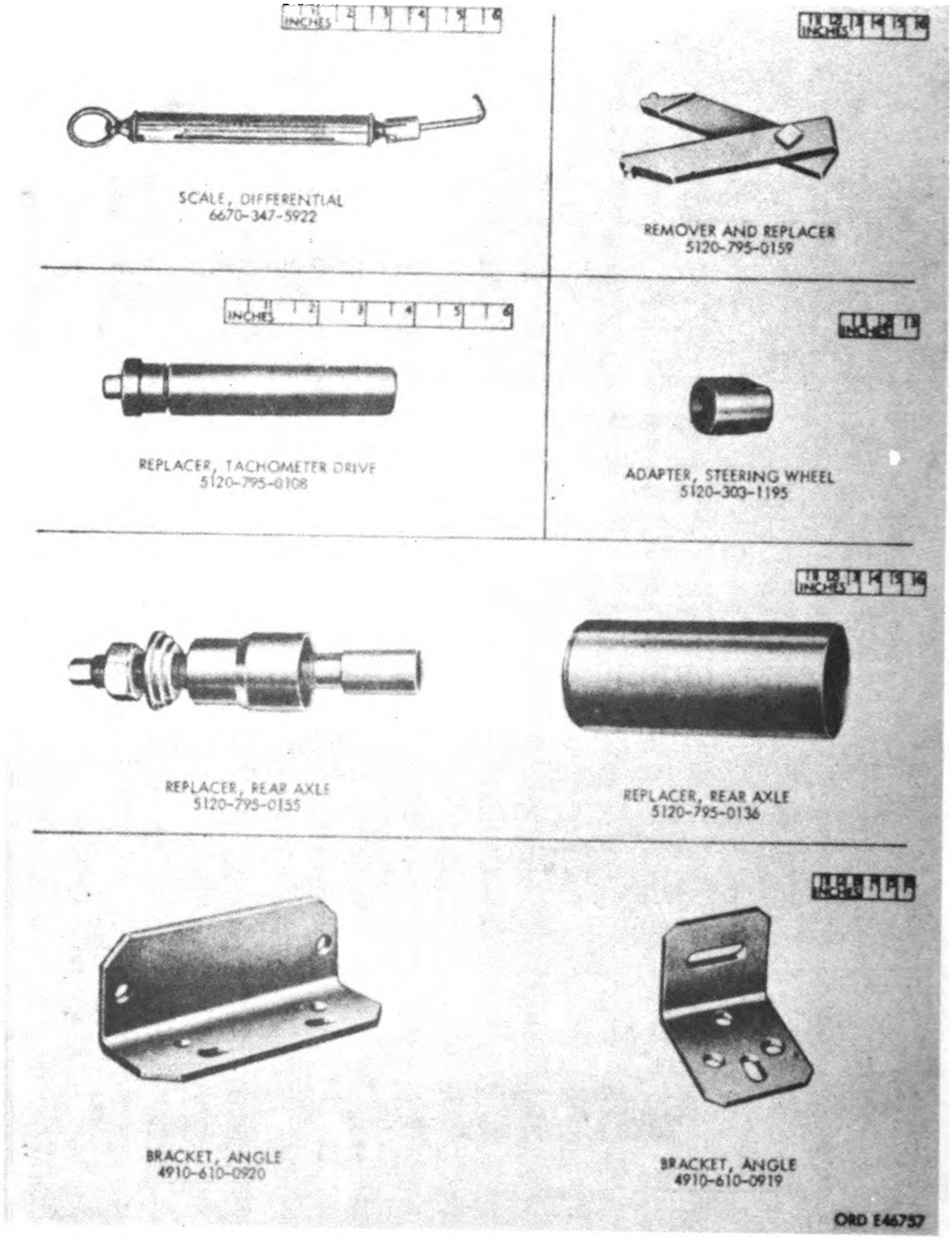


Figure 20. Special tools and equipment for field and depot maintenance (3 of 5)

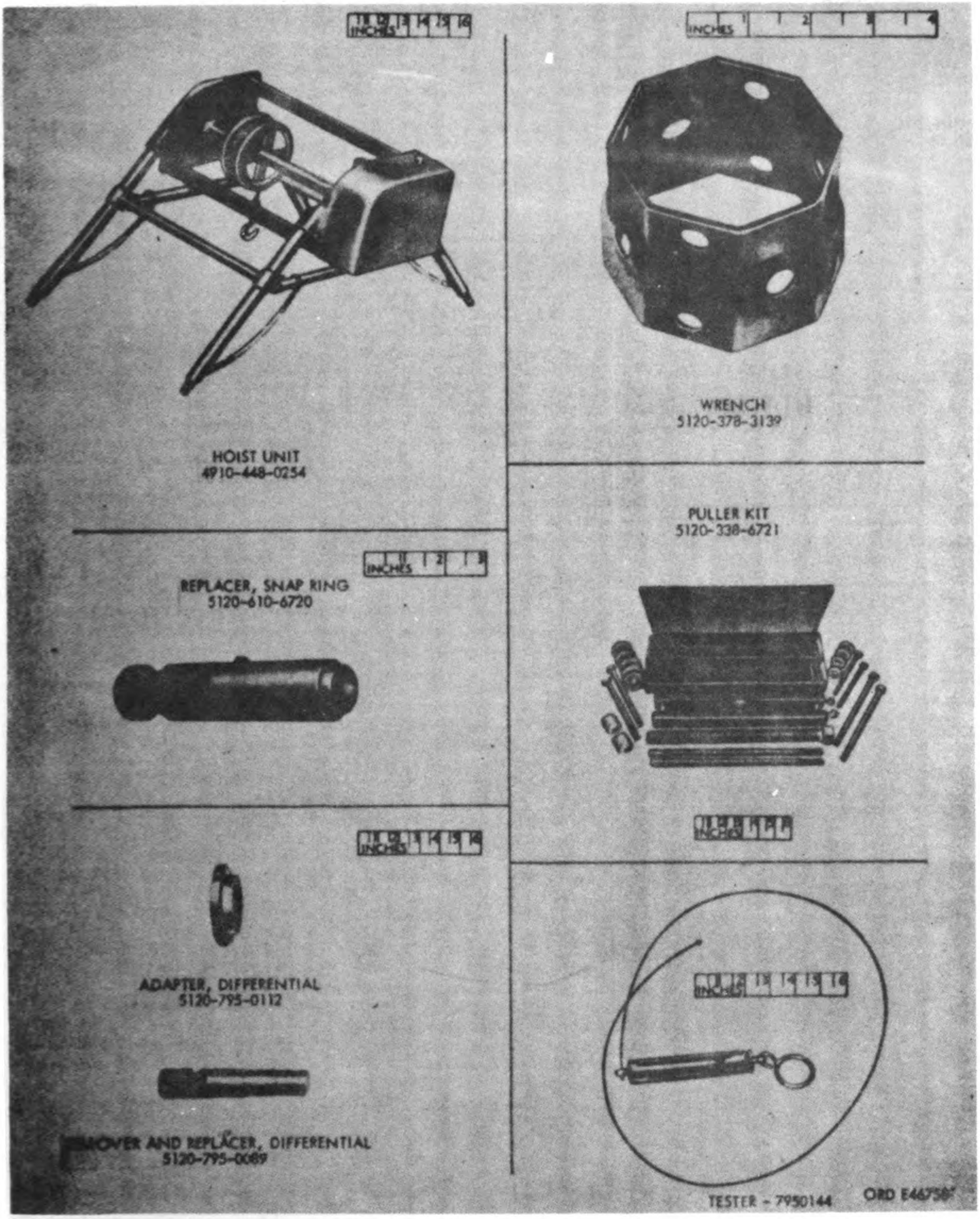


Figure 20. Special tools and equipment for field and depot maintenance (4 of 5)

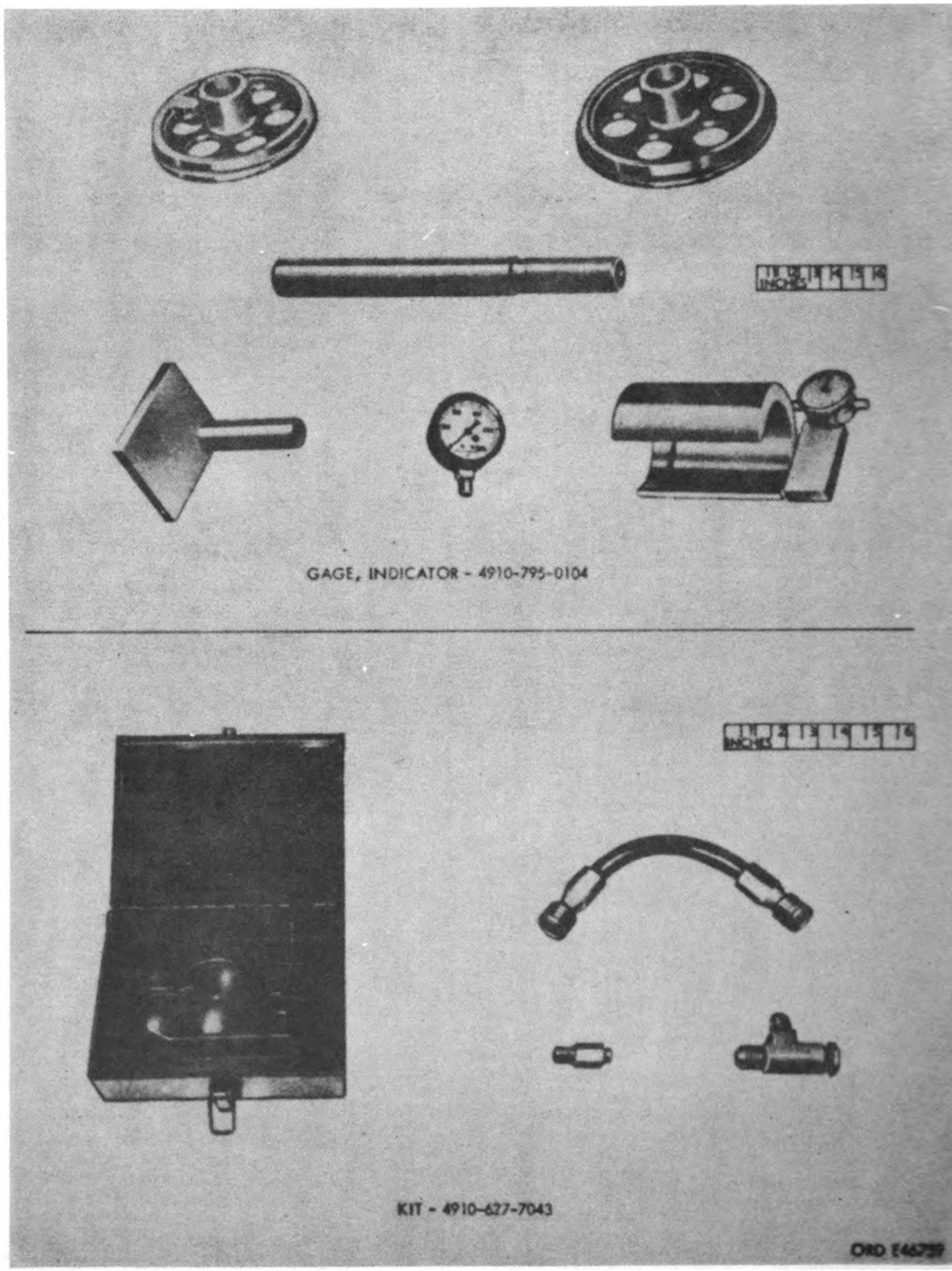
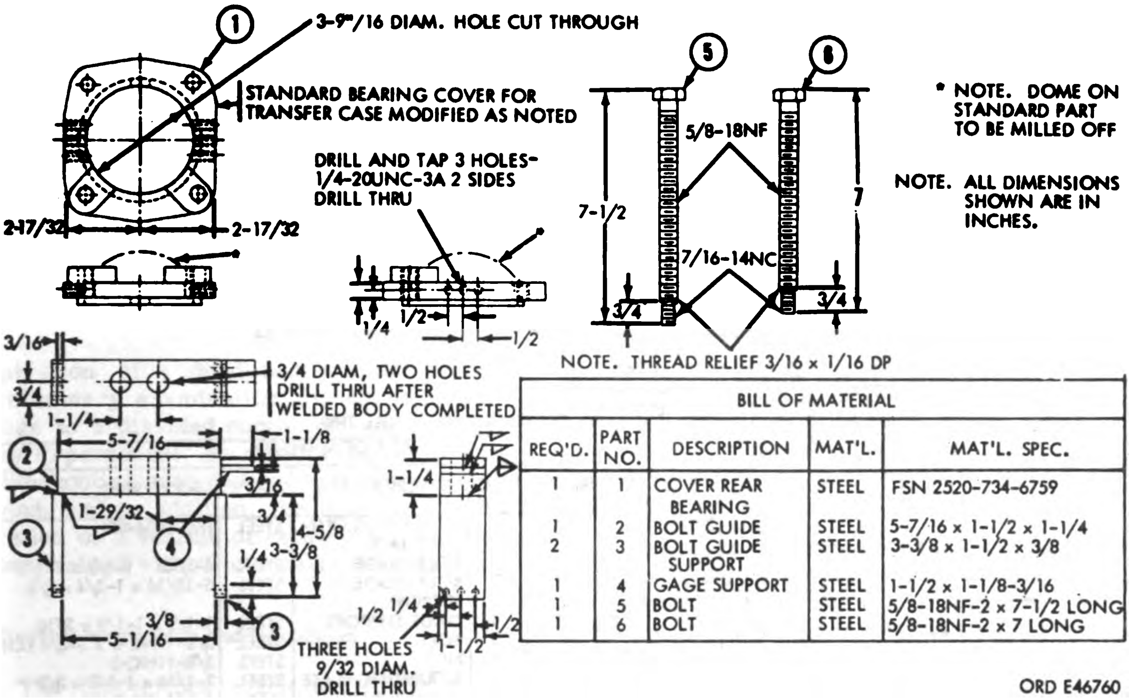


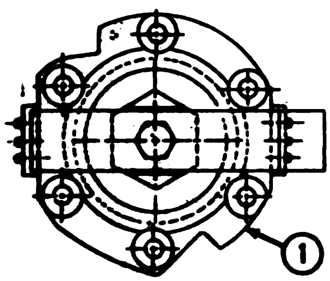
Figure 20. Special tools and equipment for field and depot maintenance (5 of 5)



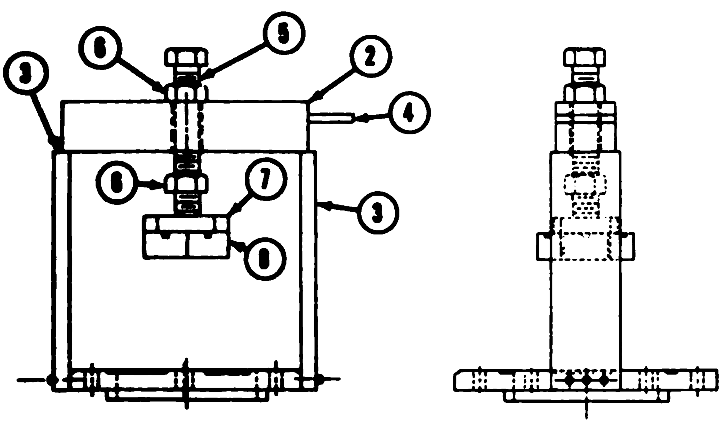
BILL OF MATERIAL				
REQ'D.	PART NO.	DESCRIPTION	MAT'L.	MAT'L. SPEC.
1	1	COVER REAR BEARING	STEEL	FSN 2520-734-6759
1	2	BOLT GUIDE	STEEL	5-7/16 x 1-1/2 x 1-1/4
2	3	BOLT GUIDE SUPPORT	STEEL	3-3/8 x 1-1/2 x 3/8
1	4	GAGE SUPPORT	STEEL	1-1/2 x 1-1/8-3/16
1	5	BOLT	STEEL	5/8-18NF-2 x 7-1/2 LONG
1	6	BOLT	STEEL	5/8-18NF-2 x 7 LONG

ORD E46760

Figure 21. Fabricating adjusting fixture for intermediate shaft bearings



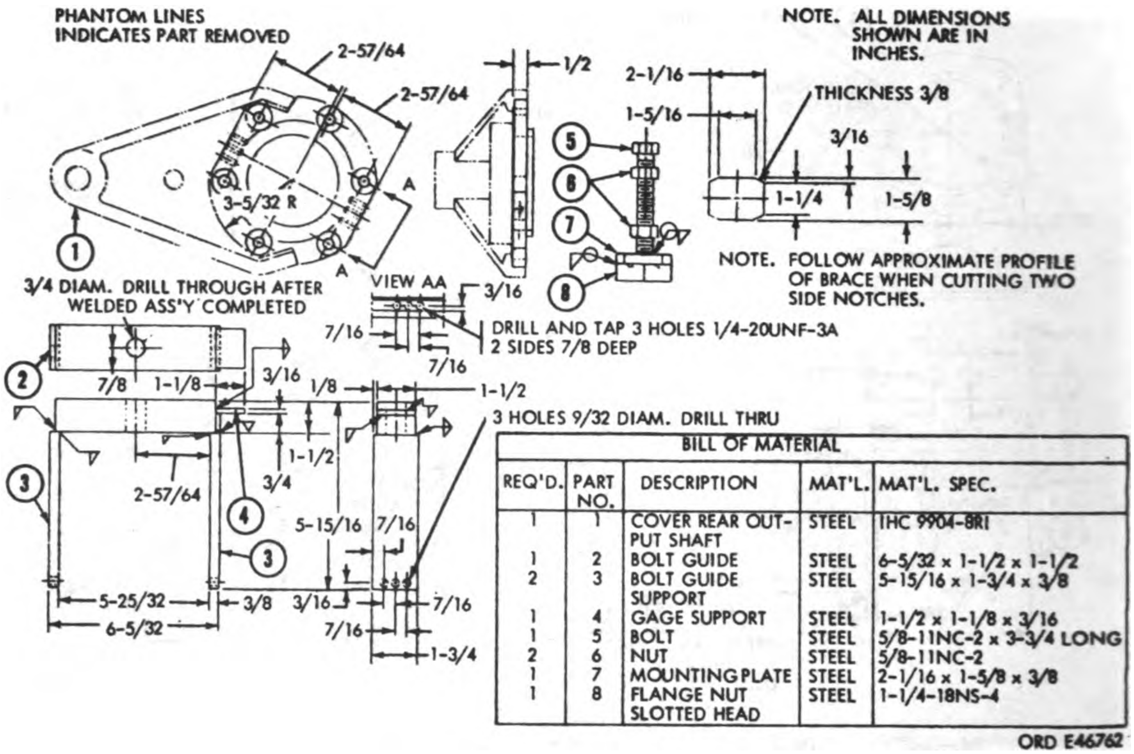
BILL OF MATERIALS				
REQ'D.	PART NO.	DESCRIPTION	MAT'L.	MAT'L SPEC.
1	1	COVER REAR OUTPUT SHAFT	STEEL	IHC 9904-8RI
1	2	BOLT GUIDE	STEEL	6-5/32 x 1-1/2 x 1-1/2
2	3	BOLT GUIDE SUPPORT	STEEL	5-15/16 x 1-3/4 x 3/8
1	4	GAGE SUPPORT	STEEL	1-1/2 x 1-1/8 x 3/16
1	5	BOLT	STEEL	5/8-11NC-2 x 3-3/4 LONG
2	6	NUT	STEEL	5/8-11NC-2
1	7	MOUNTING PLATE	STEEL	2-1/16 x 1-5/8 x 3/8
1	8	FLANGE NUT, SLOTTED HD.	STEEL	1-1/4-18NS-4
6	9	SCREW CAP SOCKET HEAD	STEEL	1/4-20UNC-3AX-1



NOTE. ALL DIMENSIONS SHOWN ARE IN INCHES.

ORD E46761

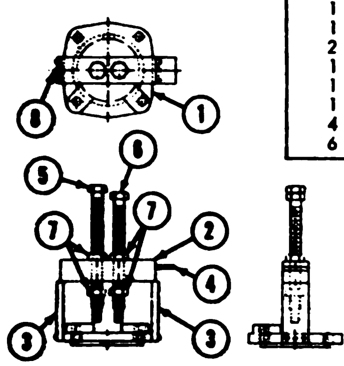
Figure 22. Assembling adjusting fixture for intermediate shaft bearings



REQ'D.	PART NO.	DESCRIPTION	MAT'L.	MAT'L. SPEC.
BILL OF MATERIAL				
1	1	COVER REAR OUTPUT SHAFT	STEEL	IHC 9904-8RI
1	2	BOLT GUIDE	STEEL	6-5/32 x 1-1/2 x 1-1/2
2	3	BOLT GUIDE SUPPORT	STEEL	5-15/16 x 1-3/4 x 3/8
1	4	GAGE SUPPORT	STEEL	1-1/2 x 1-1/8 x 3/16
1	5	BOLT	STEEL	5/8-11NC-2 x 3-3/4 LONG
2	6	NUT	STEEL	5/8-11NC-2
1	7	MOUNTING PLATE	STEEL	2-1/16 x 1-5/8 x 3/8
1	8	FLANGE NUT SLOTTED HEAD	STEEL	1-1/4-18NS-4

ORD E46762

Figure 23. Fabricating adjusting fixture for rear output shaft bearings



REQD.	PART NO.	DESCRIPTION	MAT'L	MAT'L SPEC.
BILL OF MATERIALS				
1	1	COVER REAR BEARING	STEEL	FSN 2520-734-6759
1	2	BOLT GUIDE	STEEL	5-7/16 x 1-1/2 x 1-1/4
2	3	BOLT GUIDE SUPPORT	STEEL	3-3/8 x 1-1/2 x 3/8
1	4	GAGE SUPPORT	STEEL	1-1/2 x 1-1/8 x 3/16
1	5	BOLT	STEEL	5/8-18NF-2 x 7-1/2 LONG
1	6	BOLT	STEEL	5/8-18NF-2 x 7 LONG
4	7	NUT	STEEL	5/8-18NF-2
6	8	SCREW CAP SOCKET HD.	STEEL	1/4-20UNC 3A x 1

NOTE. ALL DIMENSIONS SHOWN
ARE IN INCHES.

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 defective, 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 Remy 1118656
1118606
Auto-Lite VBC-4006-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 range . . . . . . 23-27 amp*
If outside range adjust to . . . . . . 25 amp*

Cutout Relay:
Air gap . . . . 0.048 in.
Point opening . . . . 0.035 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 9-2320-211-20.

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.

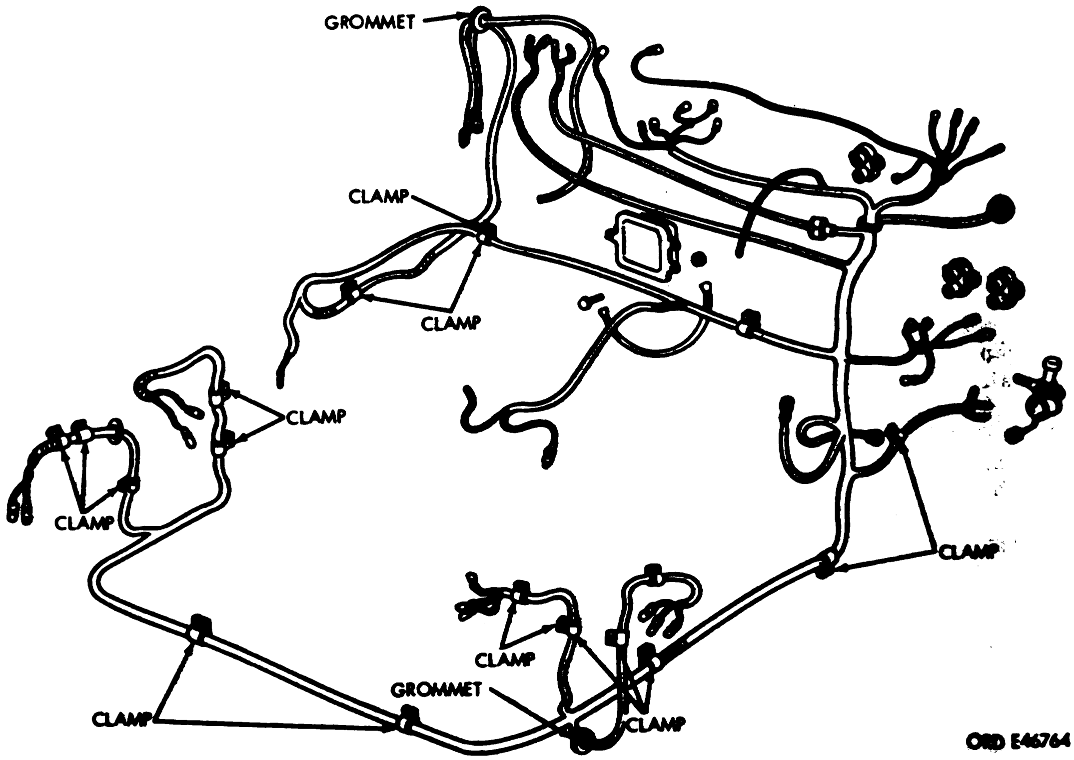


Figure 25. Schematic drawing of front electrical harness

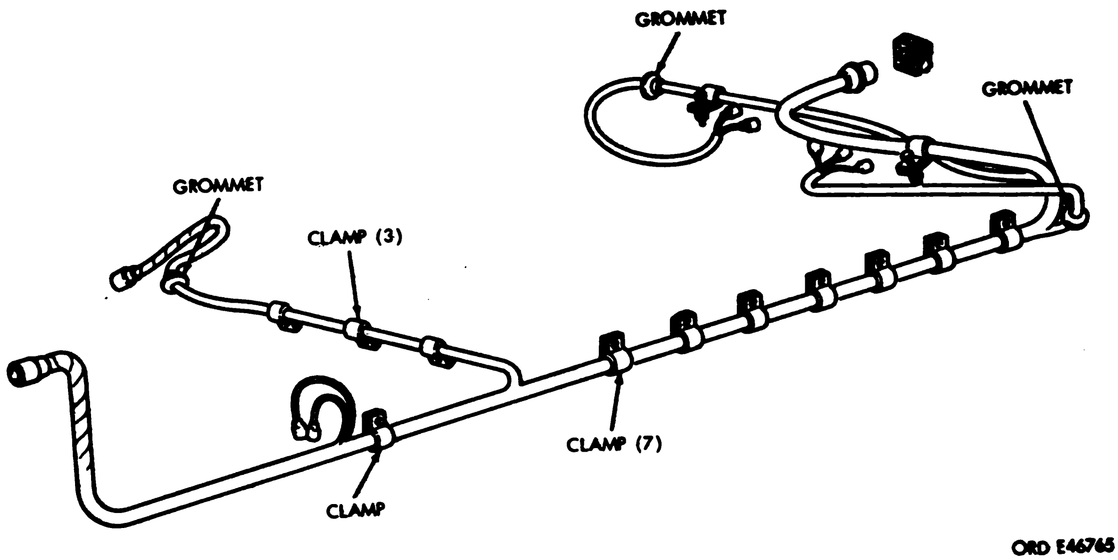
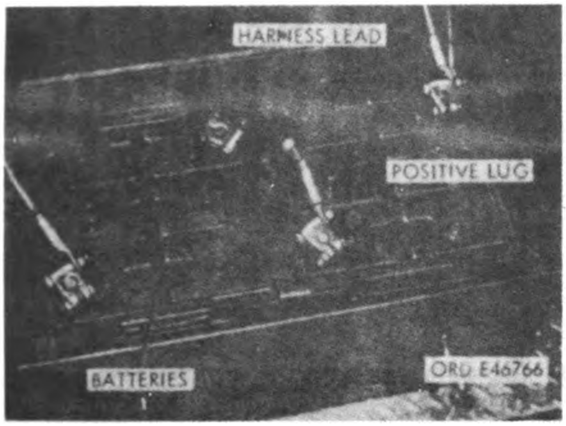
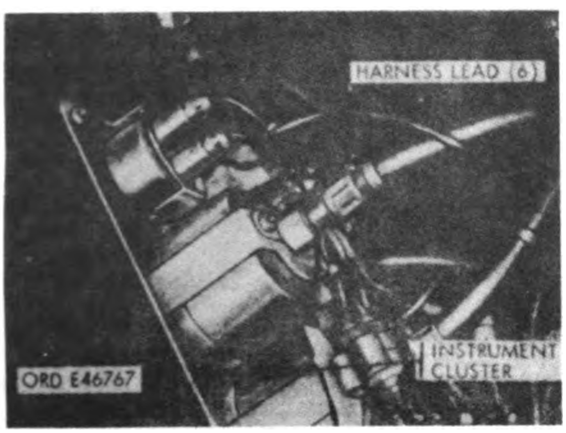


Figure 26. Schematic drawing of rear electrical harness

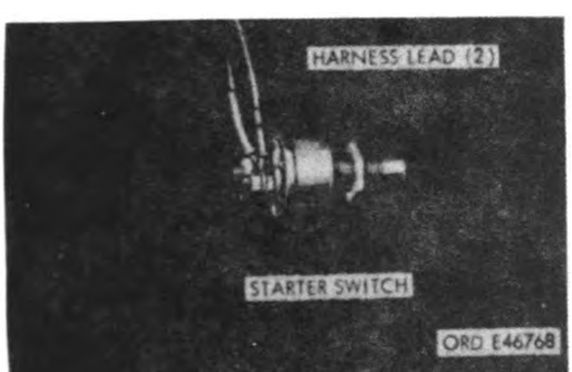
FIGURE 27
FRONT WIRING HARNESS REPLACEMENT
Steps 1 through 24



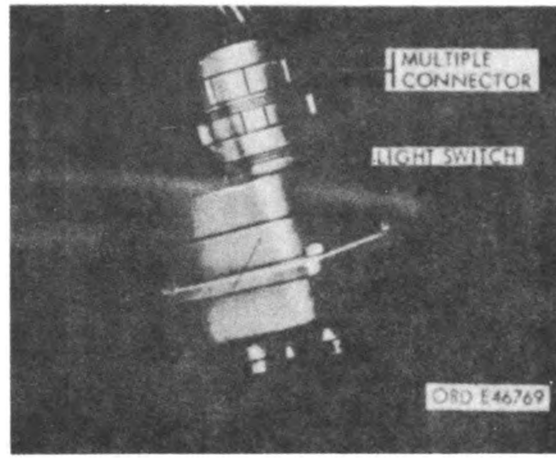
Step 1. **Remove nut and lockwasher at battery positive lug and remove front harness lead.**



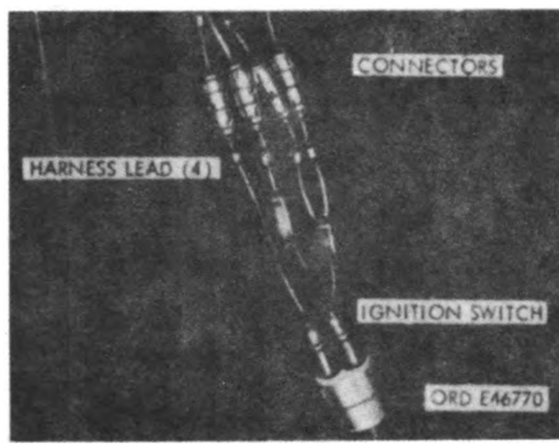
Step 2. **Disconnect front harness leads at instrument cluster.**



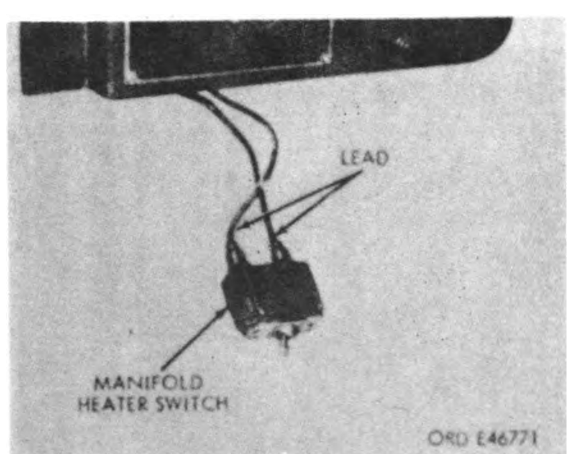
Step 3. **Disconnect front harness leads at starter switch (Diesel models only).**



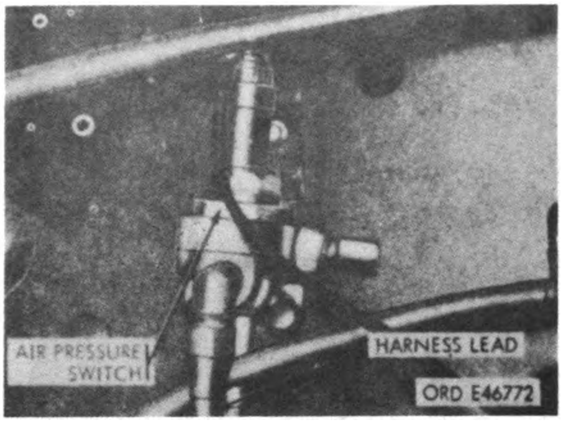
Step 4. **Disconnect multiple connector at light switch.**



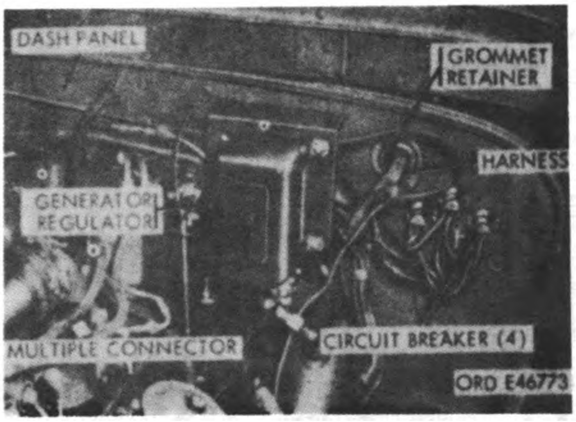
Step 5. **Disconnect front harness lead from ignition switch at connectors.**



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



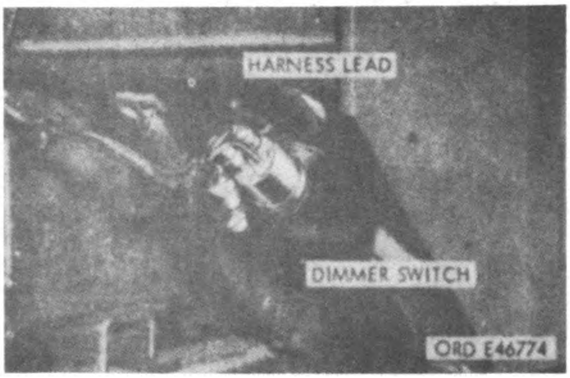
Step 7. **Disconnect front harness lead at low pressure switch.**



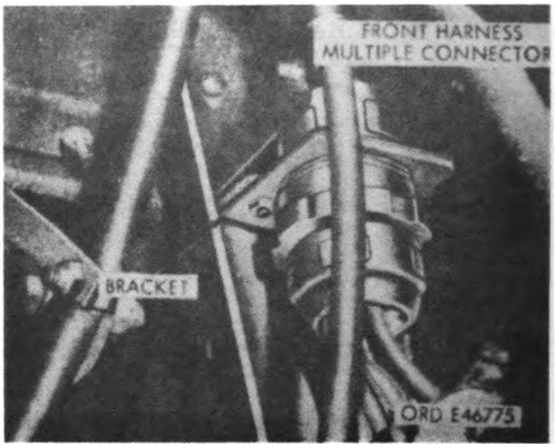
Step 8. Open grommet retainer for clearance and pull harness through dash panel opening.

Step 9. Disconnect front harness leads at circuit breakers.

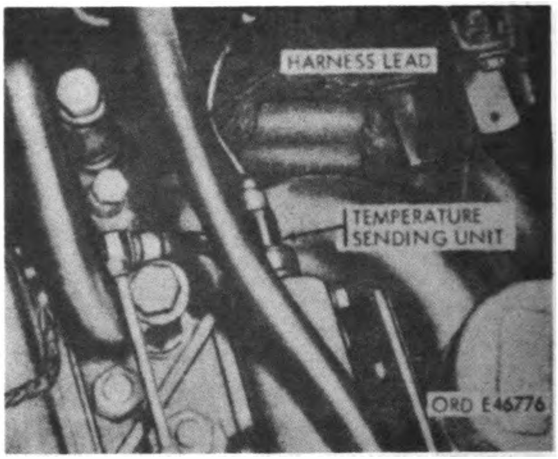
Step 10. Disconnect multiple connector at generator regulator.



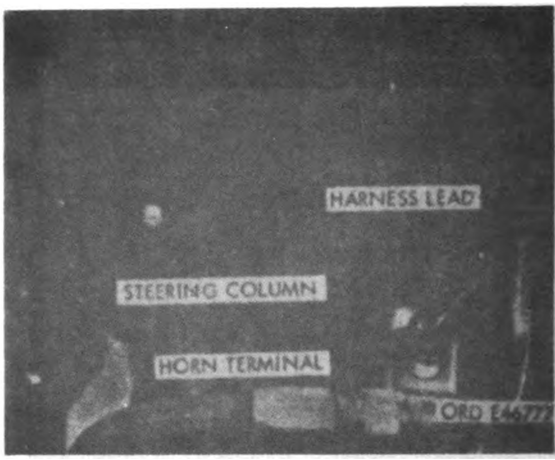
Step 11. Disconnect front harness leads at dimmer switch.



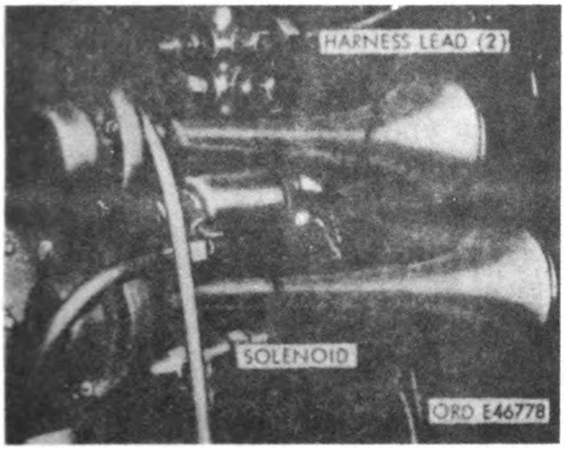
Step 12. **Disconnect front harness from rear harness at bracket on dash panel.**



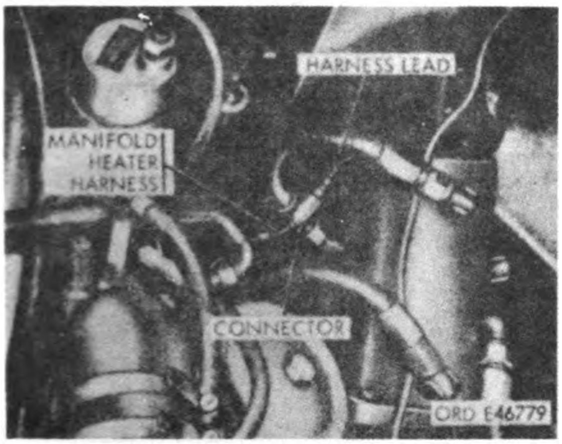
Step 13. **Disconnect front harness lead at temperature sending unit.**



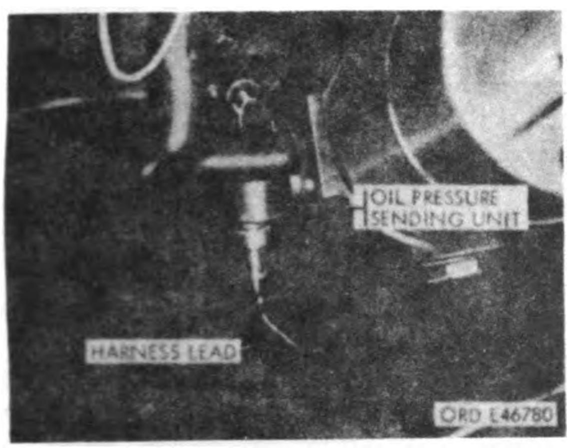
Step 14. **Disconnect front harness lead at horn terminal on steering column**



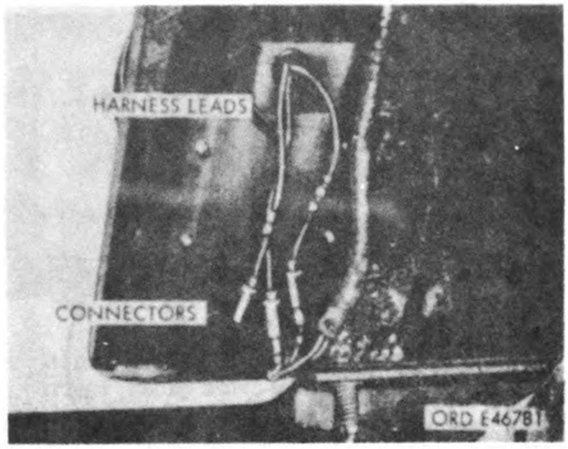
Step 15. **Disconnect front harness leads at horn solenoid on dash panel (Diesel models only).**



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

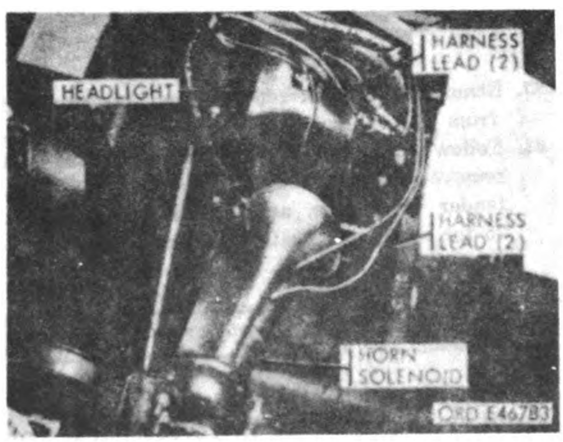


Step 17. **Disconnect front harness lead from oil pressure sending unit.**



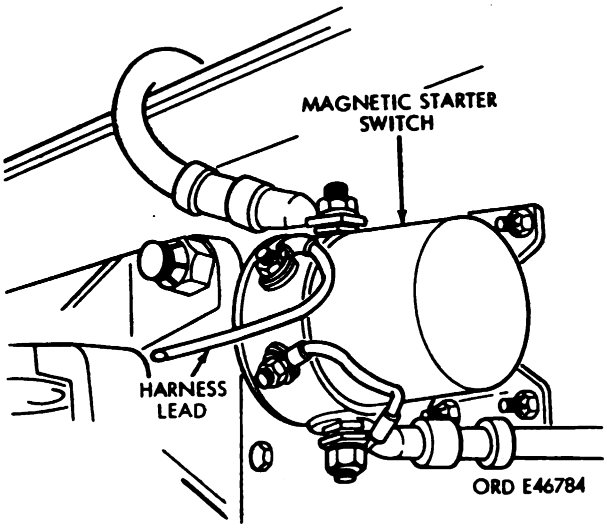
Step 18. **Disconnect front harness leads from left and ~~right B.O~~ marker light at connectors.**

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

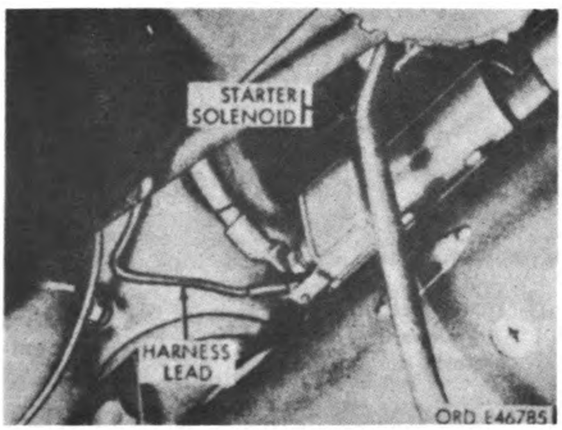


Step 20. **Disconnect front harness leads from right headlight pigtails at connectors.**

Step 21. Disconnect fron 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.

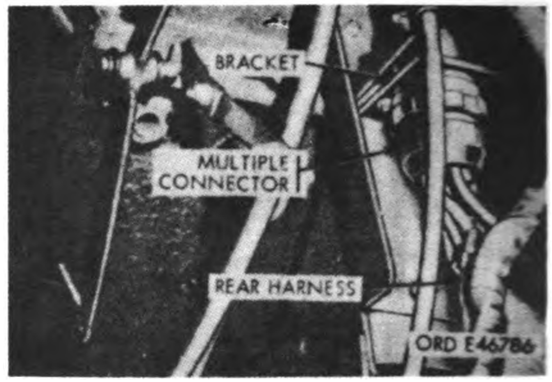
Figure 27. Front wiring harness replacement.

* * *

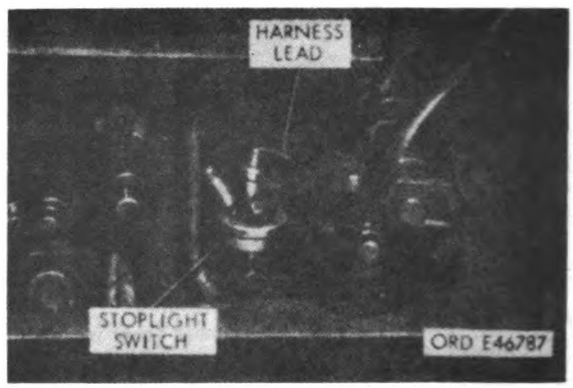
c. Installation (Front Wiring Harness). Install front wiring harness in reverse order of removal proceeding from step 24 through step 1.

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

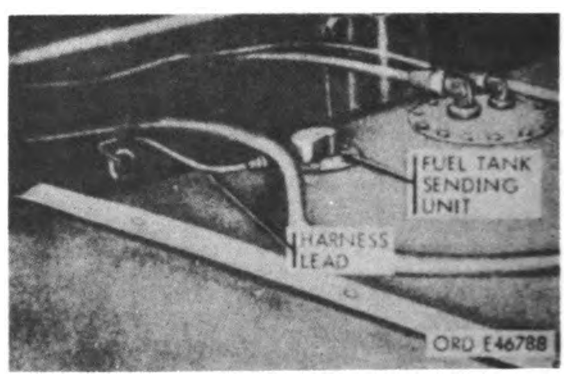
FIGURE 28
REAR WIRING HARNESS REPLACEMENT
Steps 1 through 8



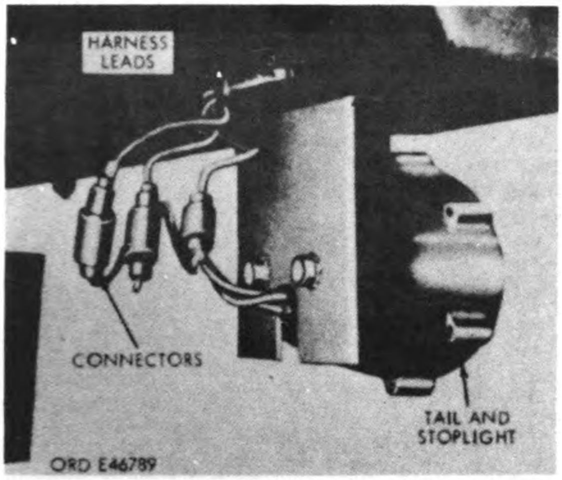
Step 1. Disconnect multiple connector from bracket at dash panel.



Step 2. Disconnect rear harness leads at stoplight switch.



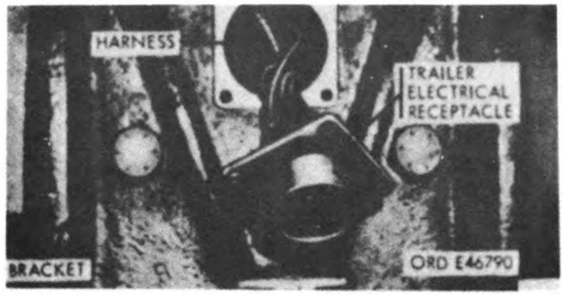
Step 3. Disconnect rear harness leads at fuel tank sending unit.



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

* * *

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

Section III. REPAIR

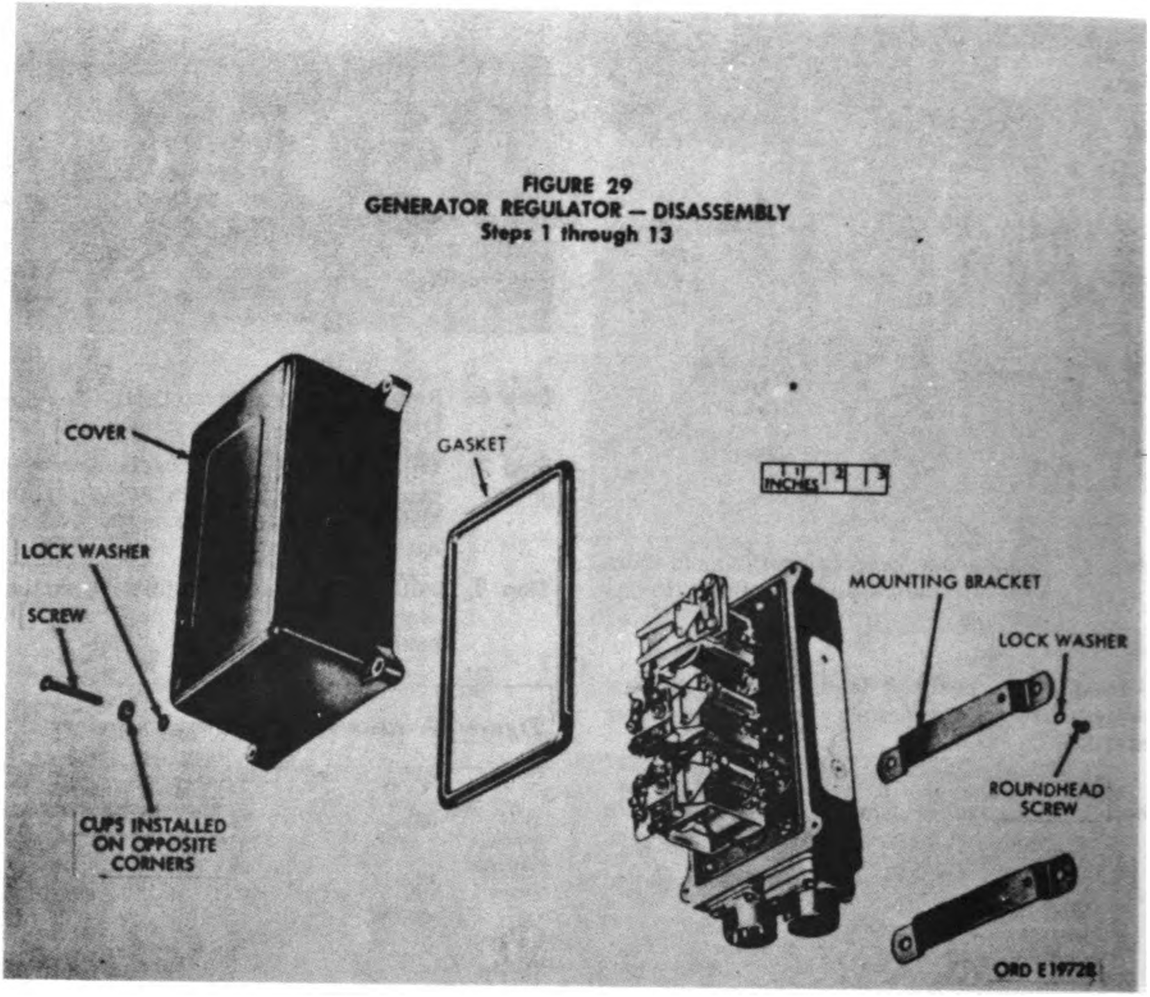
24. Generator Regulator

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

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

c. Delco-Remy 1118656 Regulator.

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

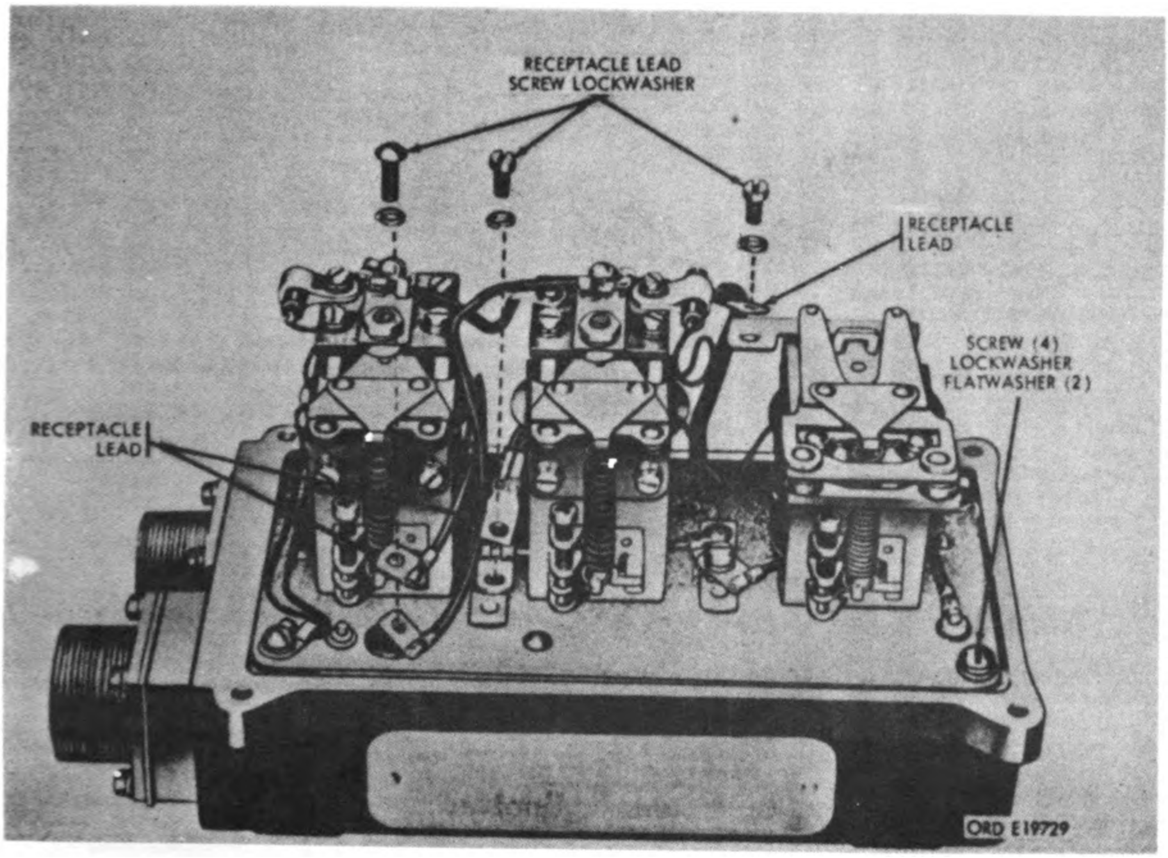


Step 1. Remove four screws and lockwashers securing cover to base assembly.

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.

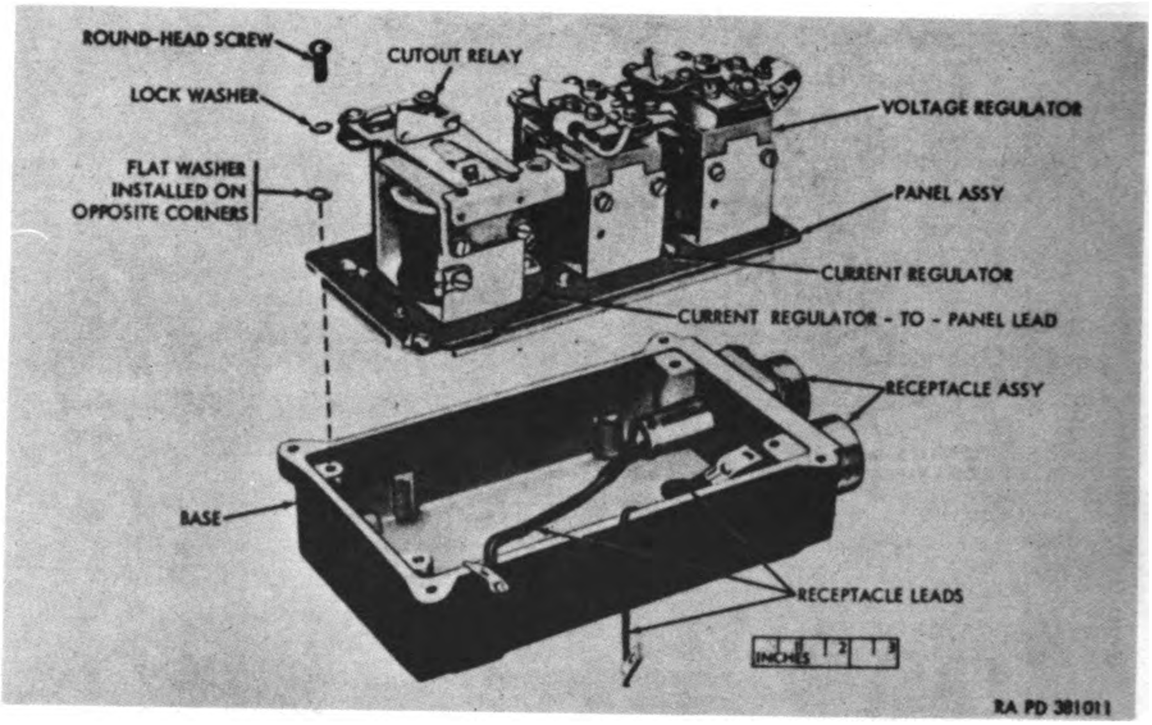
Figure 29. Generator regulator disassembly (1 of 6)



Step 3. **Disconnect three receptacle leads.**

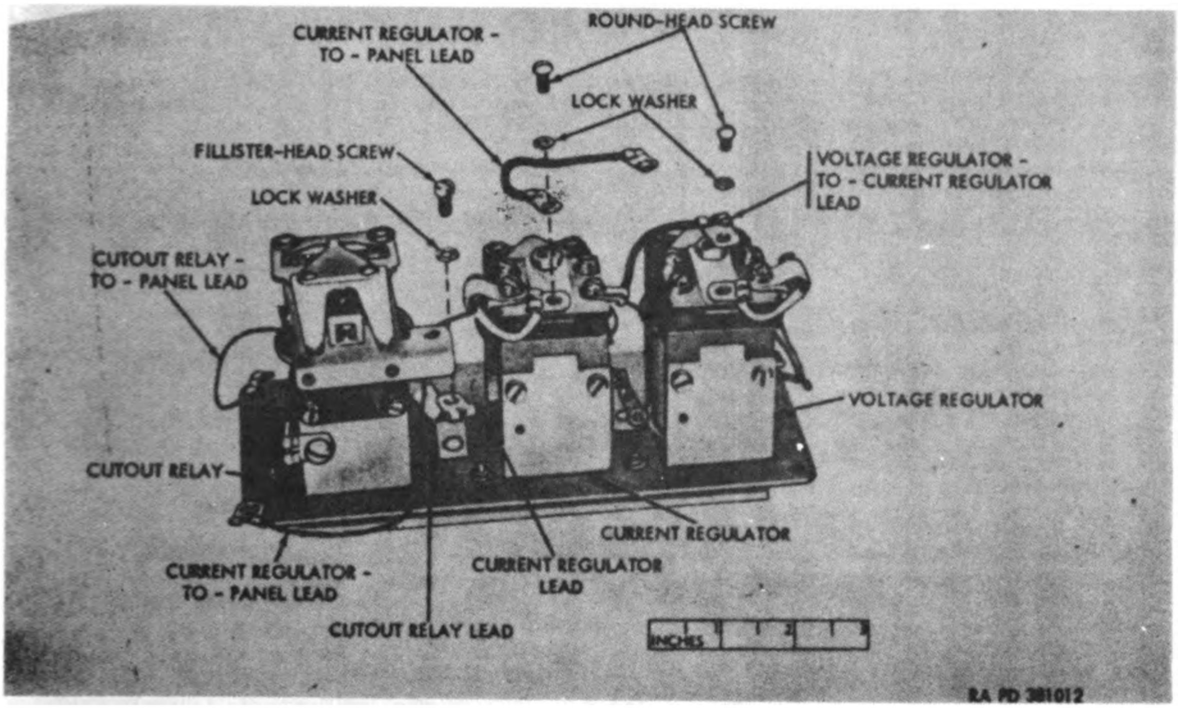
Step 4. **Remove four screws, lockwashers and two flatwashers securing unit panel to base.**

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)



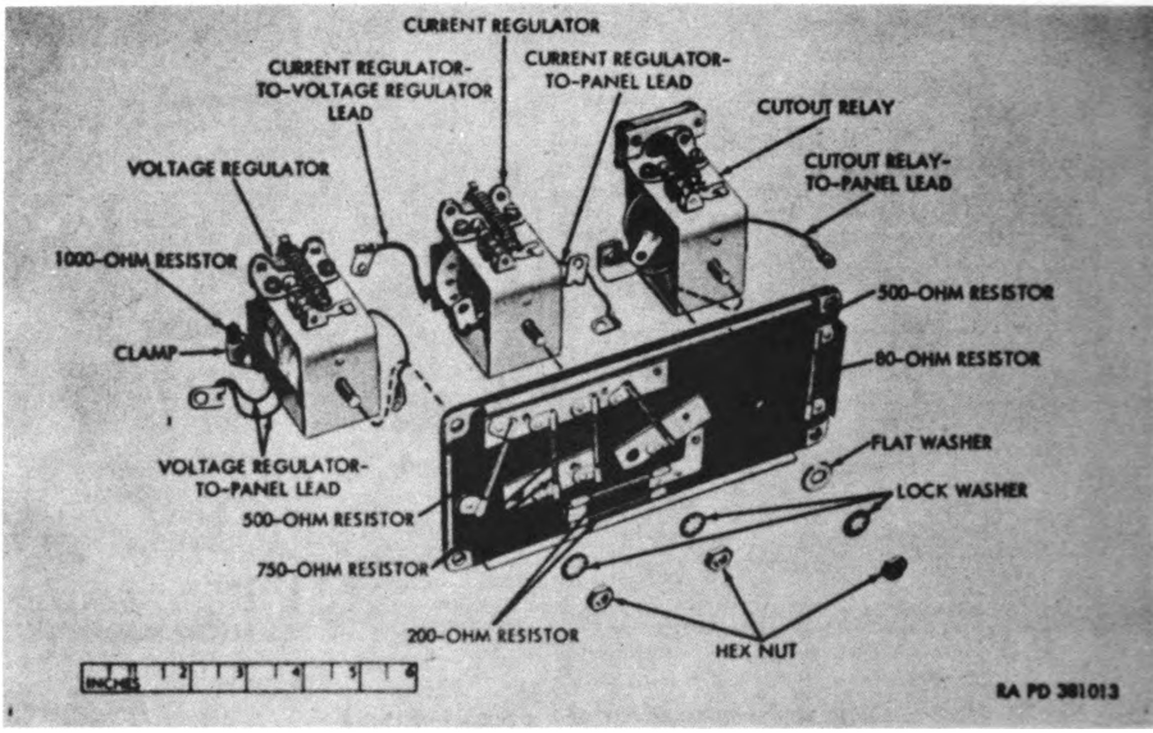
Step 6. Remove screw and lockwasher to disconnect voltage regulator-to-current regulator lead.

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.

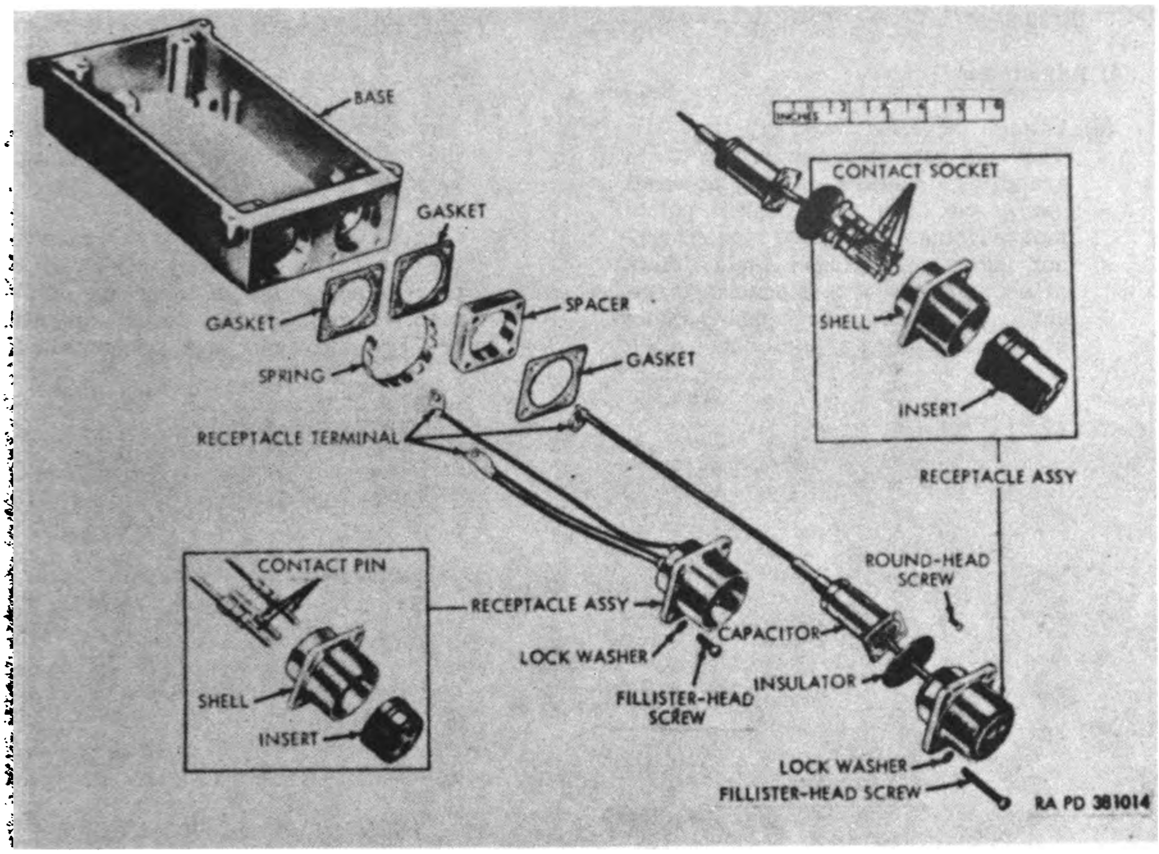
Figure 29. Generator regulator disassembly (4 of 6)



Step 10. Remove nut, lockwasher and flatwasher 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.

(a) 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

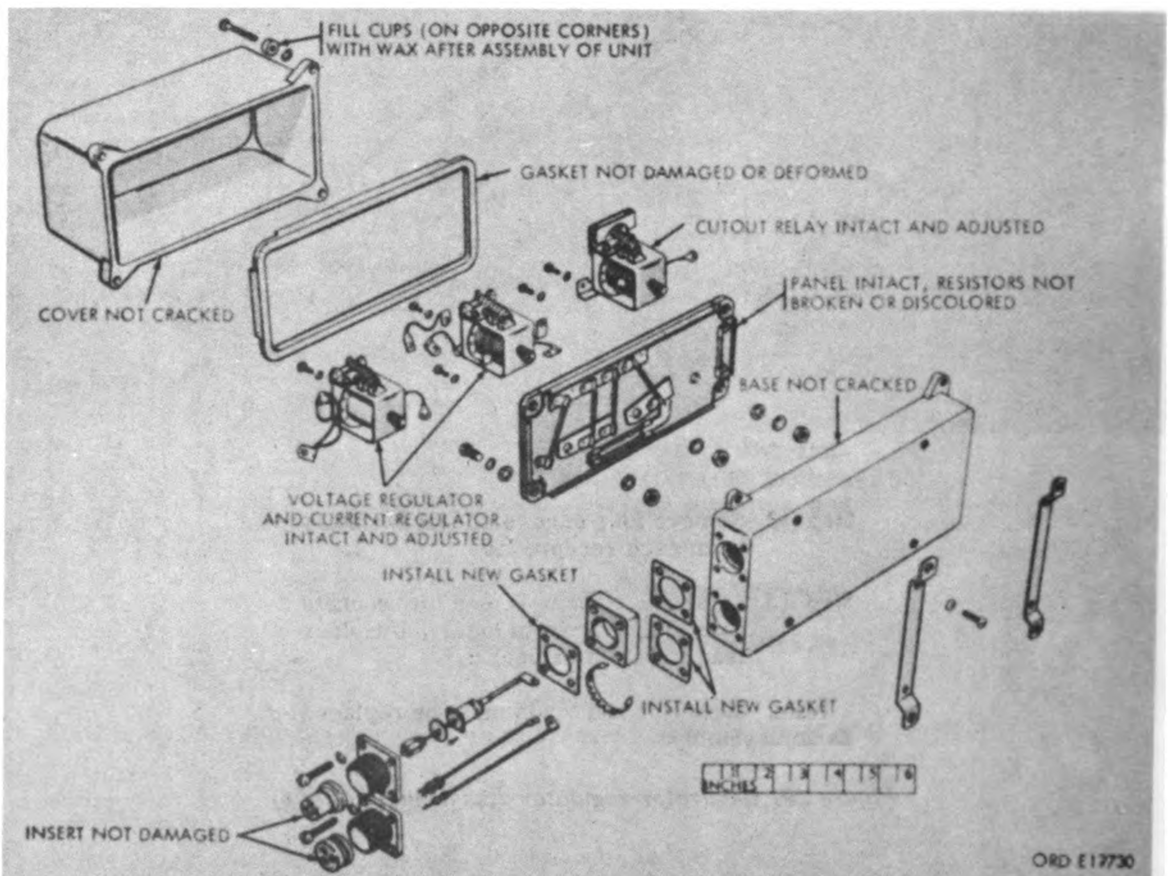


Figure 30. Generator regulator inspection points

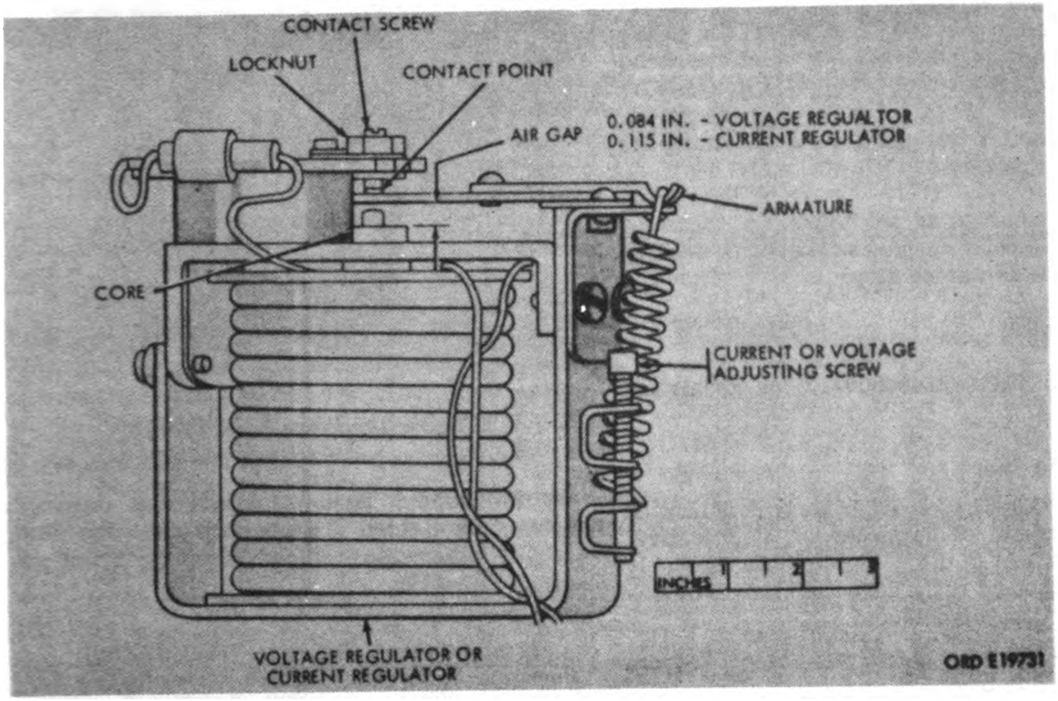


Figure 31. Adjusting voltage regulator or current regulator

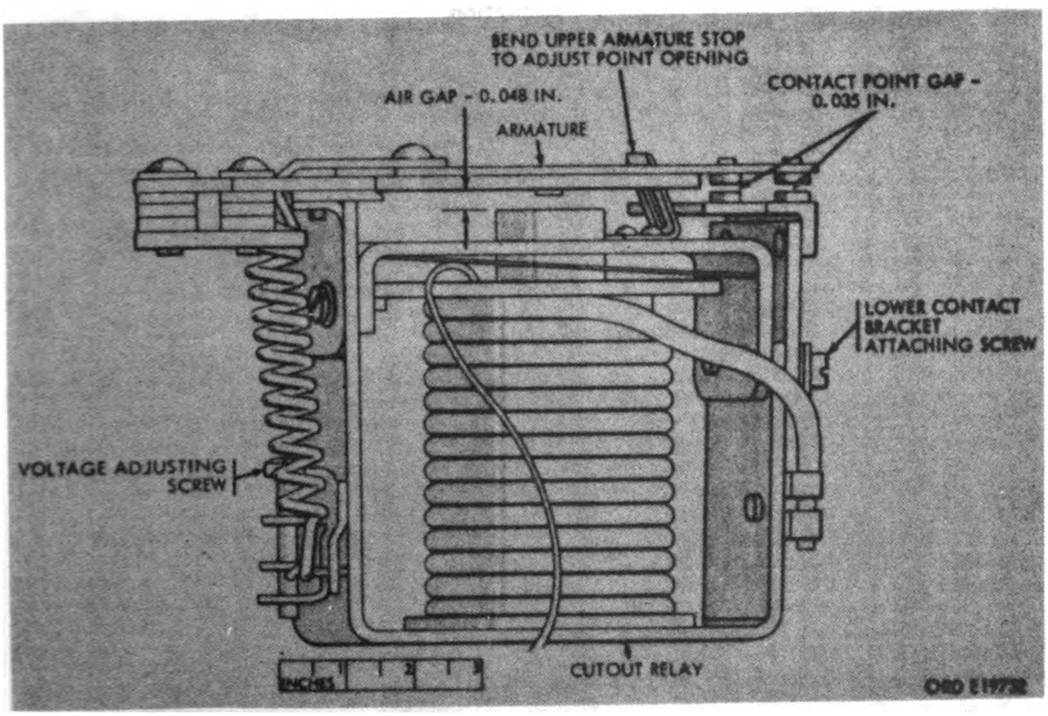


Figure 32. Adjusting cutout relay

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.

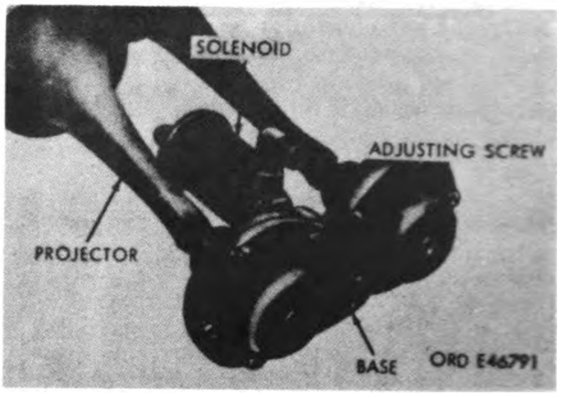


Figure 33. Horn - disassembly

(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 removed 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

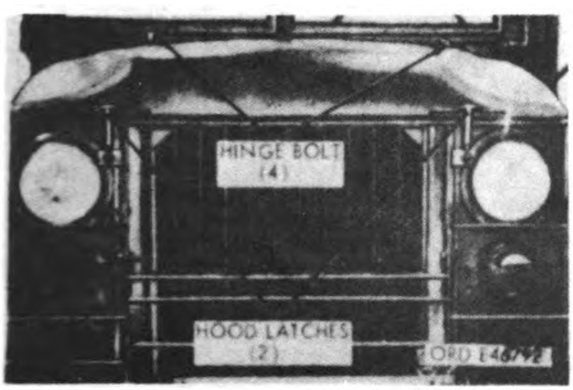
The brush guard is installed in front of the radiator and serves as a protection for the radiator against protruding objects encountered in the field. It is of one-piece construction and requires little repair.

Section II. REMOVAL AND INSTALLATION

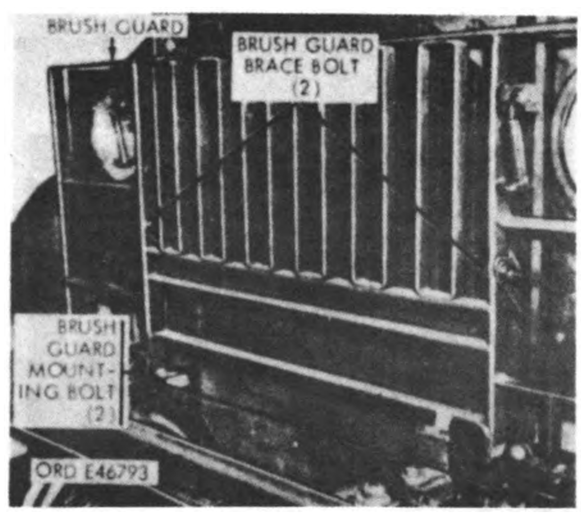
31. Removal

For removal operations refer to figure 34.

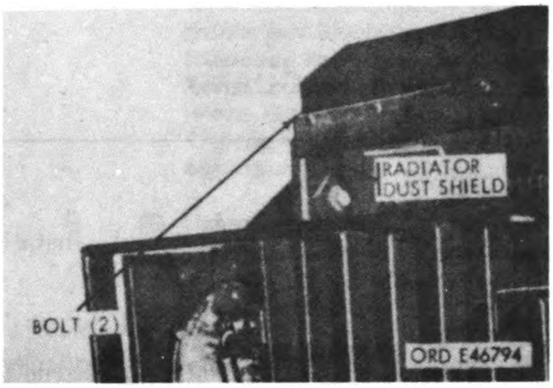
FIGURE 34
HOOD, FENDERS, AND BRUSH GUARD
Steps 1 through 13



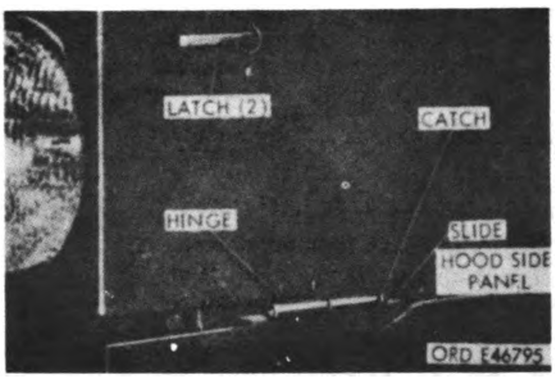
Step 1. **Disconnect hood holddown latches (2). Remove four bolts and safety nuts securing hood hinges to cowl. Remove hood.**



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

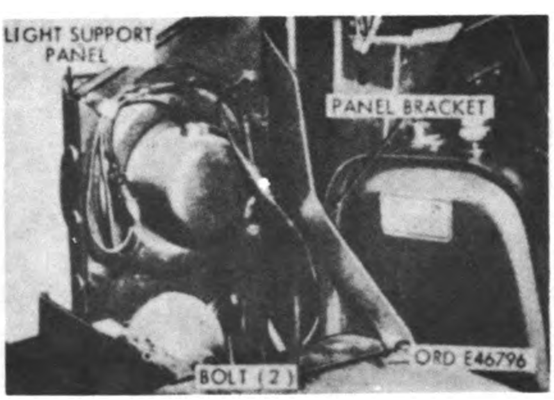


Step 3. **Loosen two (one each side) raidiator dust shield bolts and remove shield.**

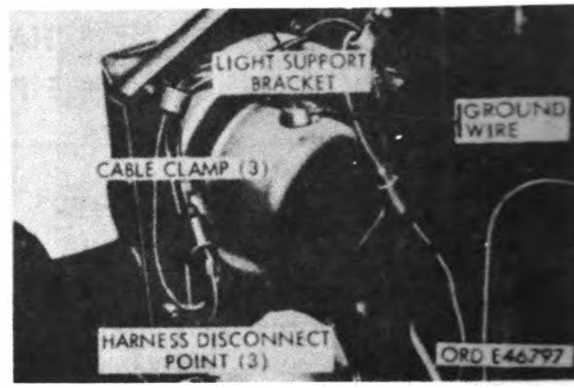


Step 4. **Push in catch and slide hood side panel out of hinge assembly (one each side). (Side panel latches (2) must be open.)**

***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).**



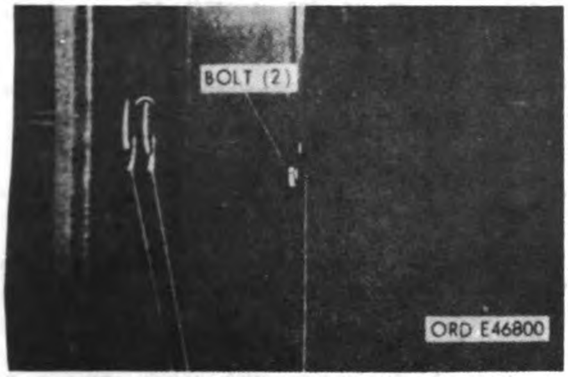
Step 5. **Remove two nuts and bolts and remove light support panel brace (each side).**



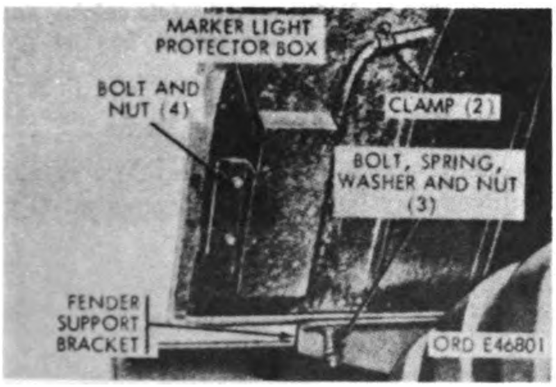
Step 6. **Remove three cable clamps. Disconnect ground wire. Disconnect harness at light (left side).**

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

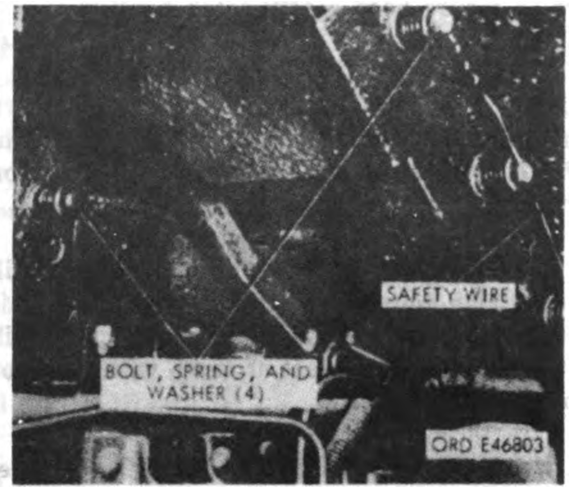


Step 9. **Remove two steering reservoir-to-fender mounting bolts.**

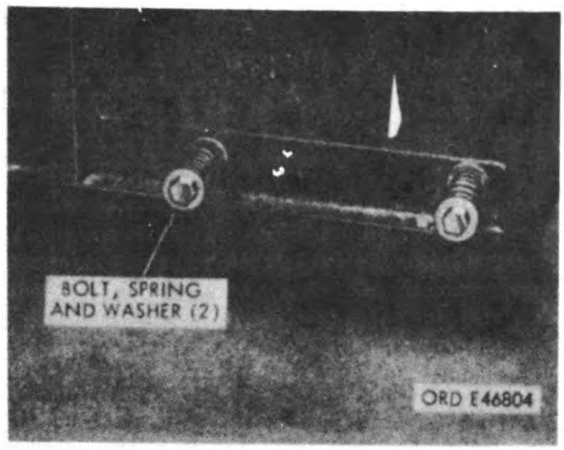


Step 10. **Remove four bolts and nuts securing marker light protector box to fender, and remove box. Disconnect three connectors from marker light. Remove two clamps securing insulated wiring assembly to fender and pull out through engine compartment. Remove three bolt, springs, washers, and nuts securing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

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



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



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

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.

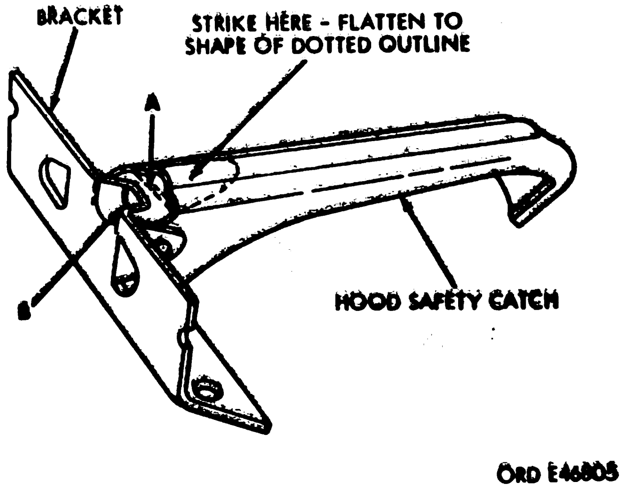


Figure 35. Modified hood safety catch.

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

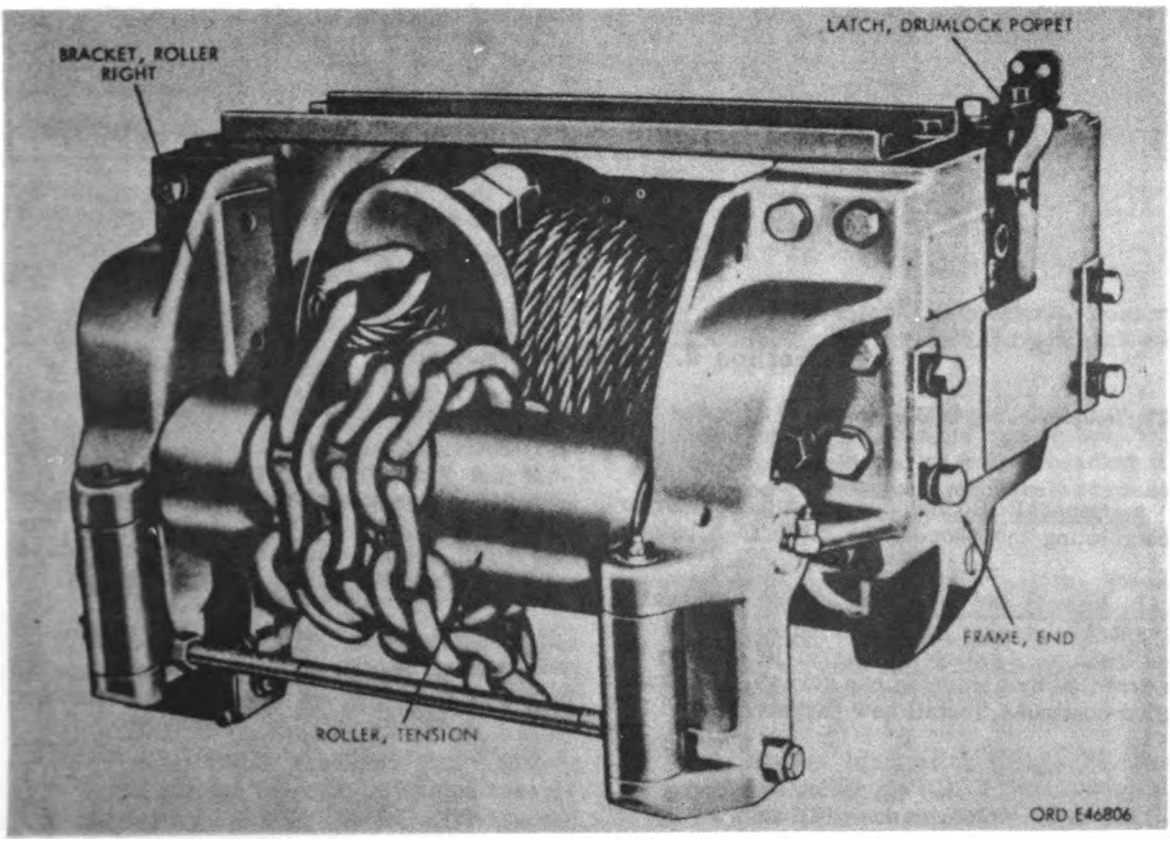


Figure 36. Front winch - left front view

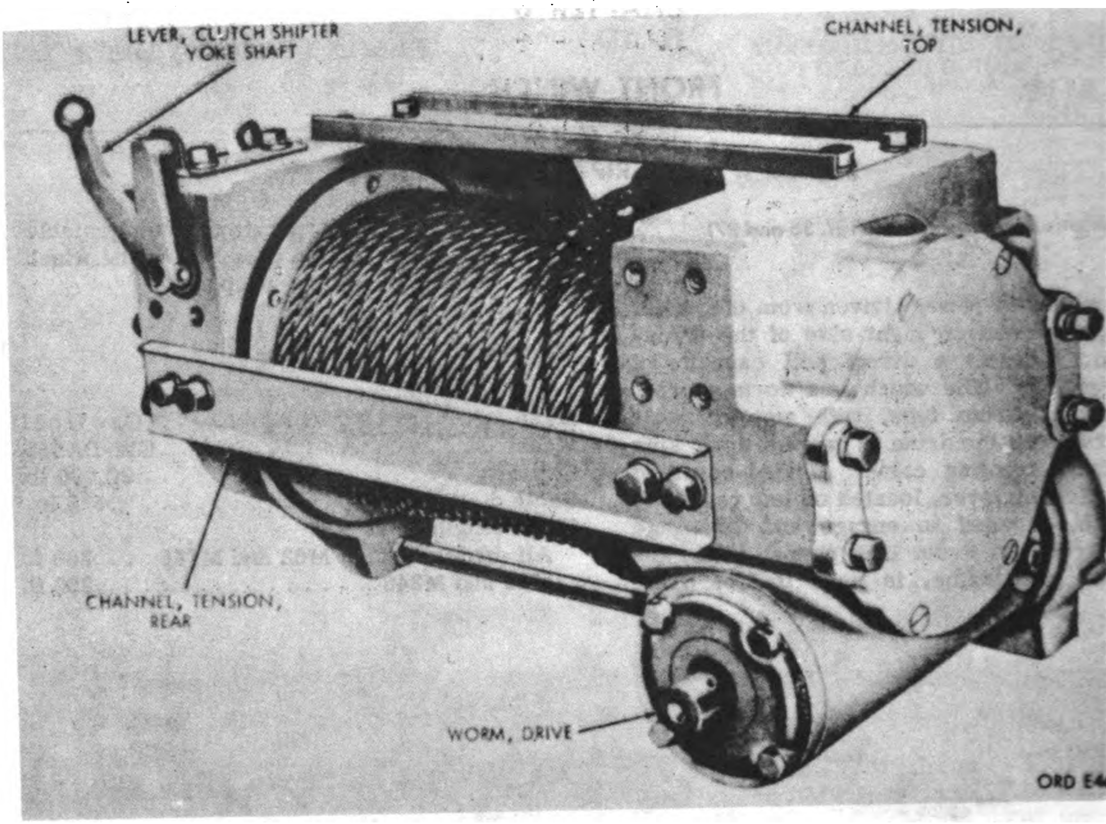


Figure 37. Front winch - right rear view

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.

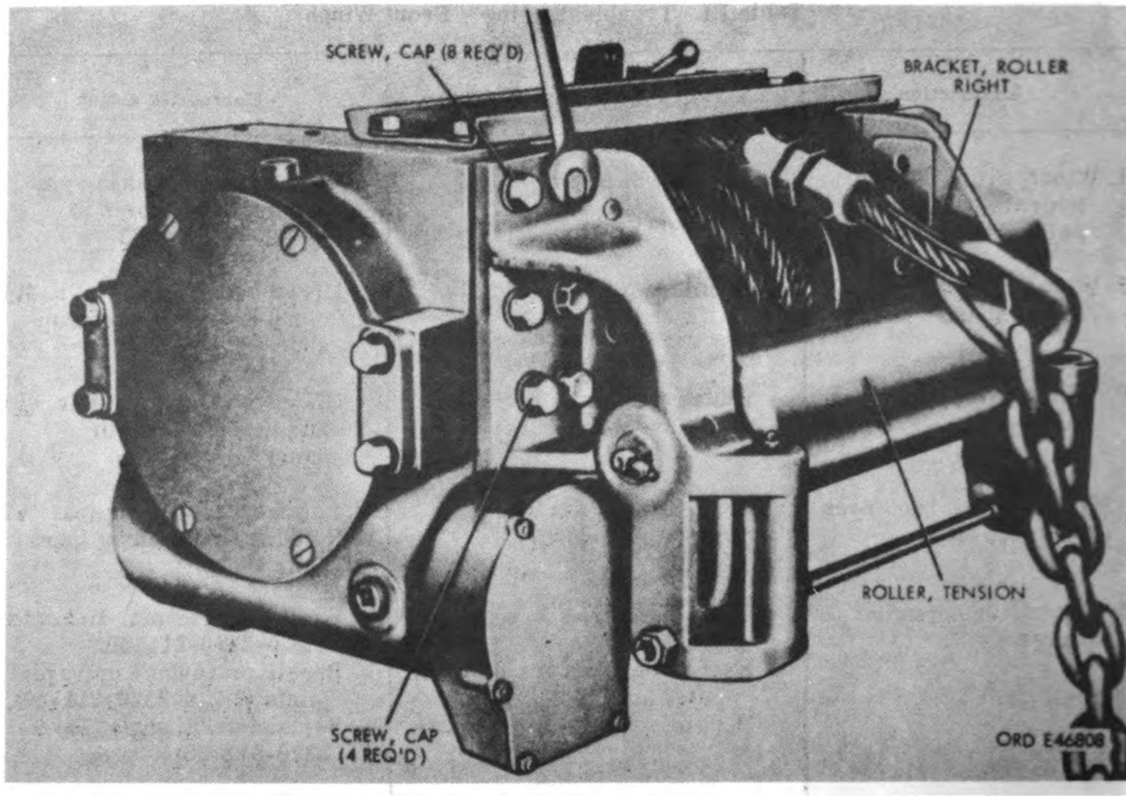


Figure 38. Removing tension roller assembly

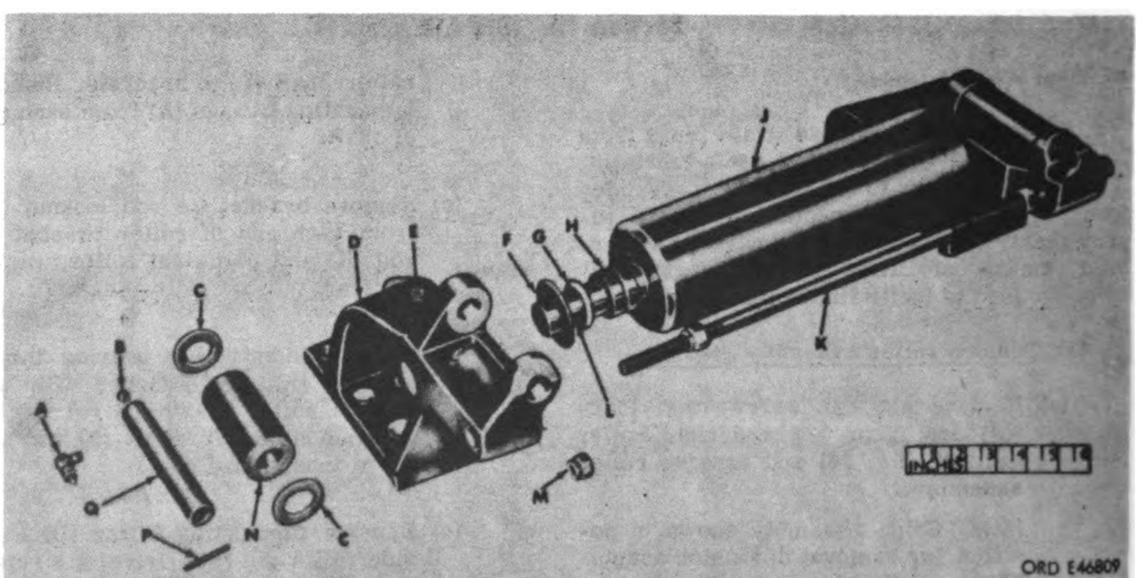


Figure 39. Disassembling tension roller assembly

Key	Item	Key	Item
A	Fitting, lubr, 90 deg	J	Roller, tension
B	Fitting, lubr, stght	K	Rod, tie, roller bracket
C	Washer, thrust, side roller	L	Shaft, tension roller
D	Bracket, roller, right	M	Nut, lock, bracket tie rod
E	Screw, set	N	Roller, side
F	Washer, thrust, tension roller bearing	P	Pin, stght
G	Washer, felt	Q	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).

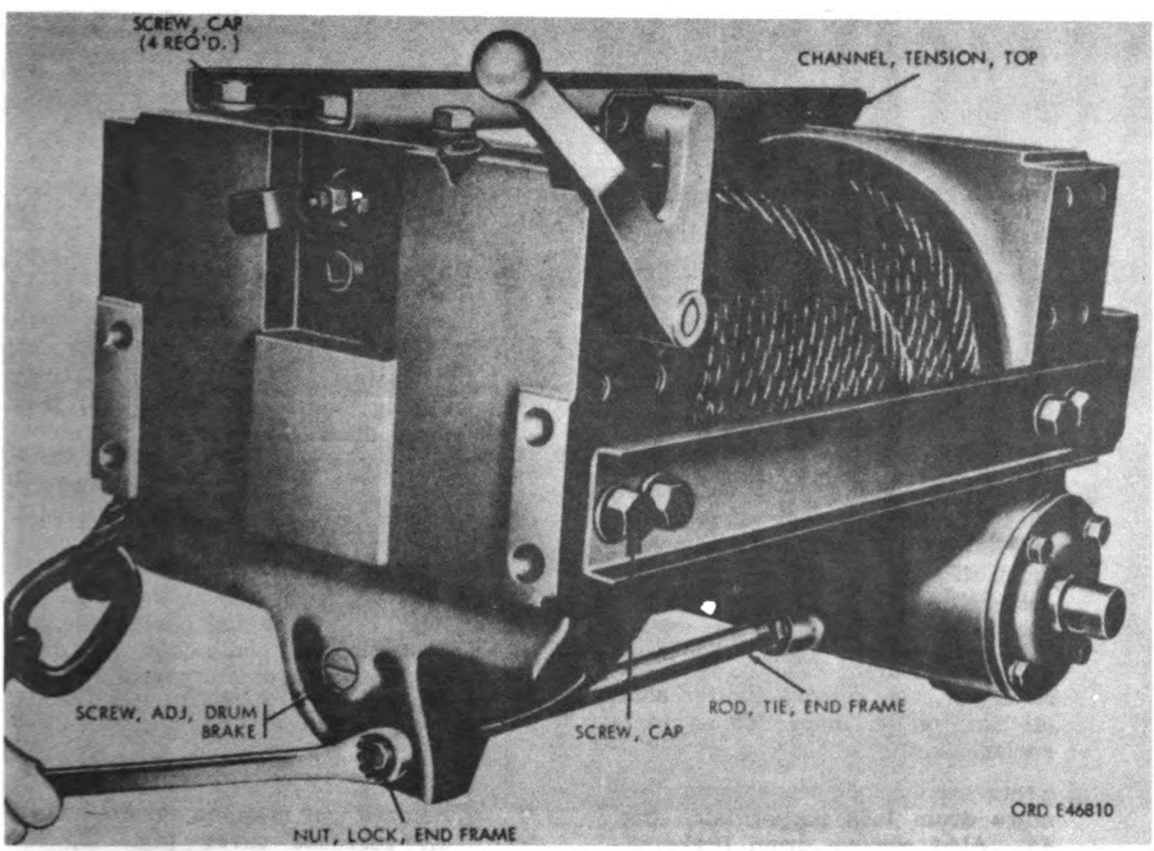


Figure 40. Removing end frame locknut from tie rod

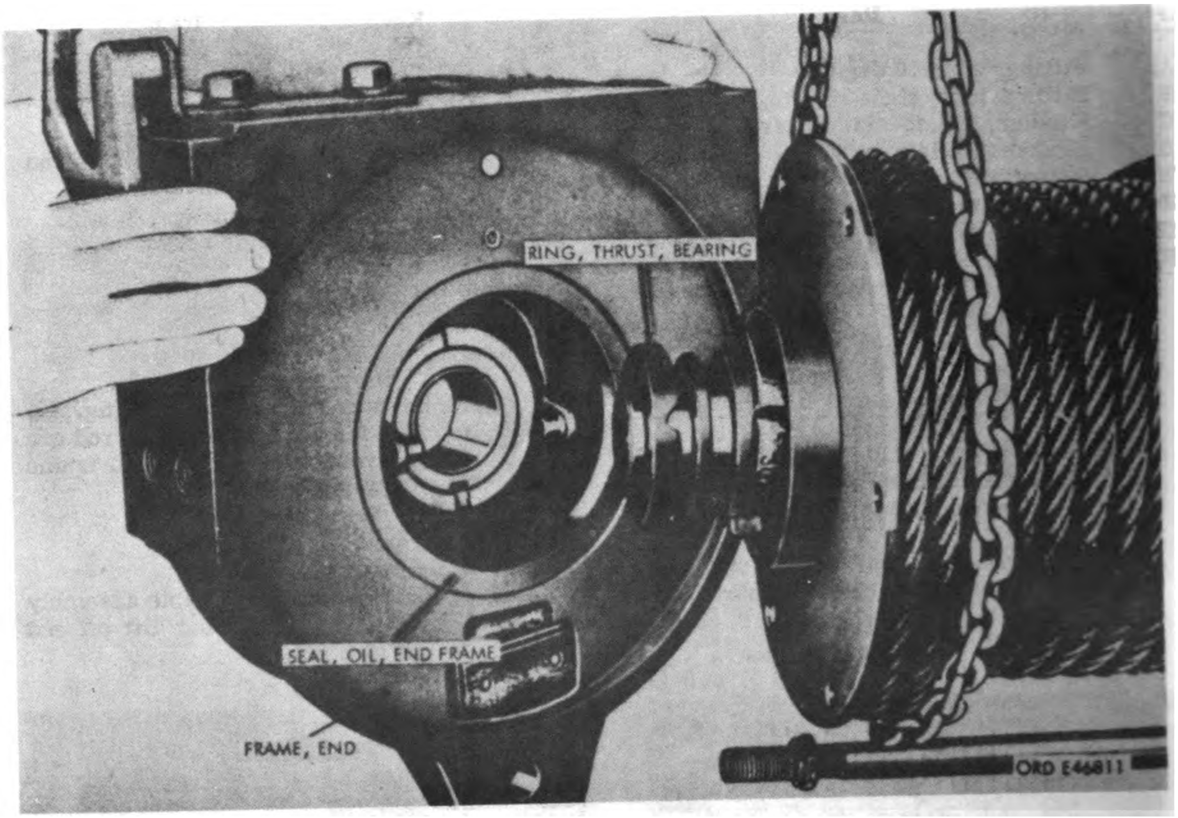


Figure 41. Removing end frame

(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

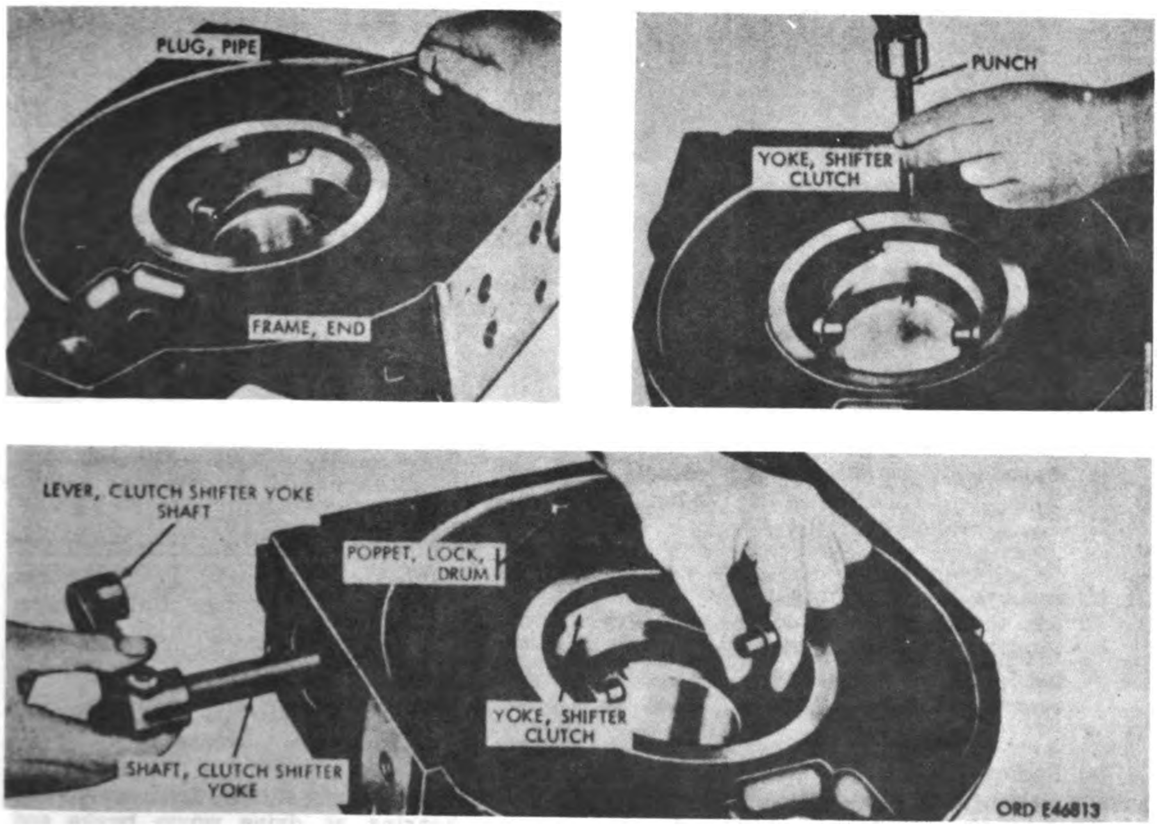


Figure 43. Removing clutch shifter yoke shaft and clutch shifter yoke

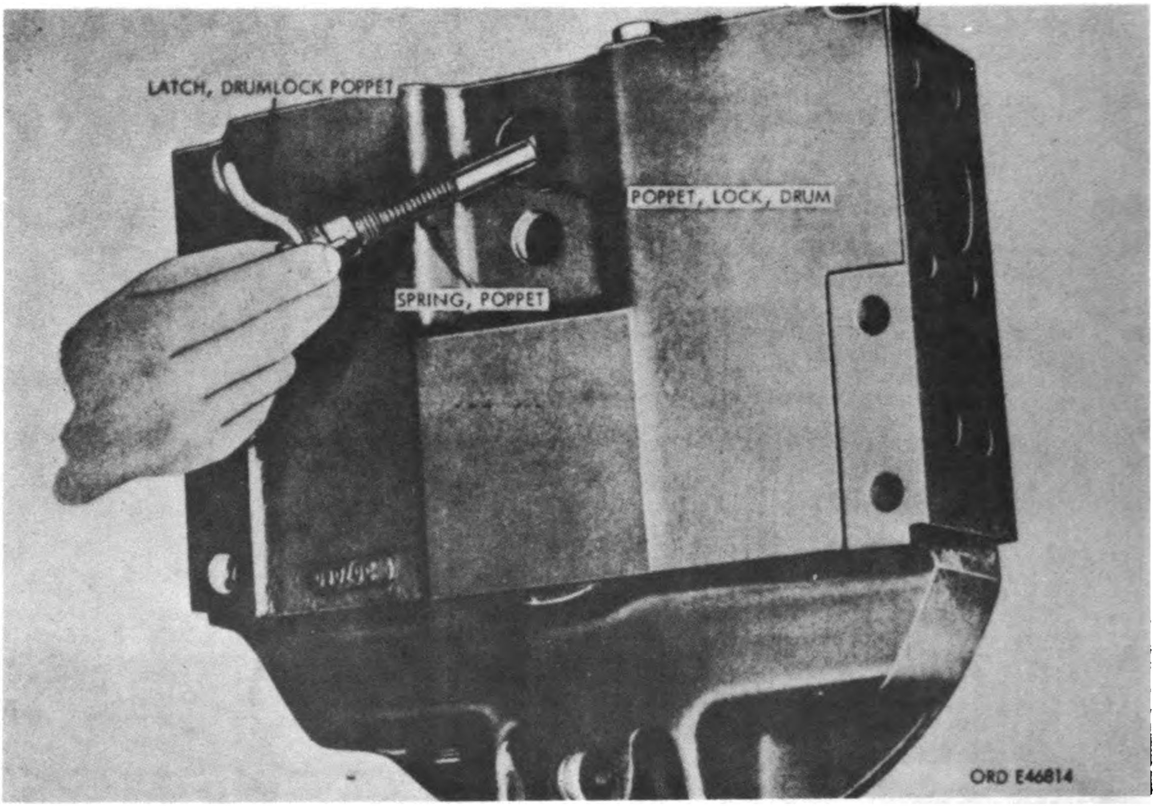


Figure 44. Removing drum lock poppet latch assembly

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

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

(d) 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.

(e) 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.

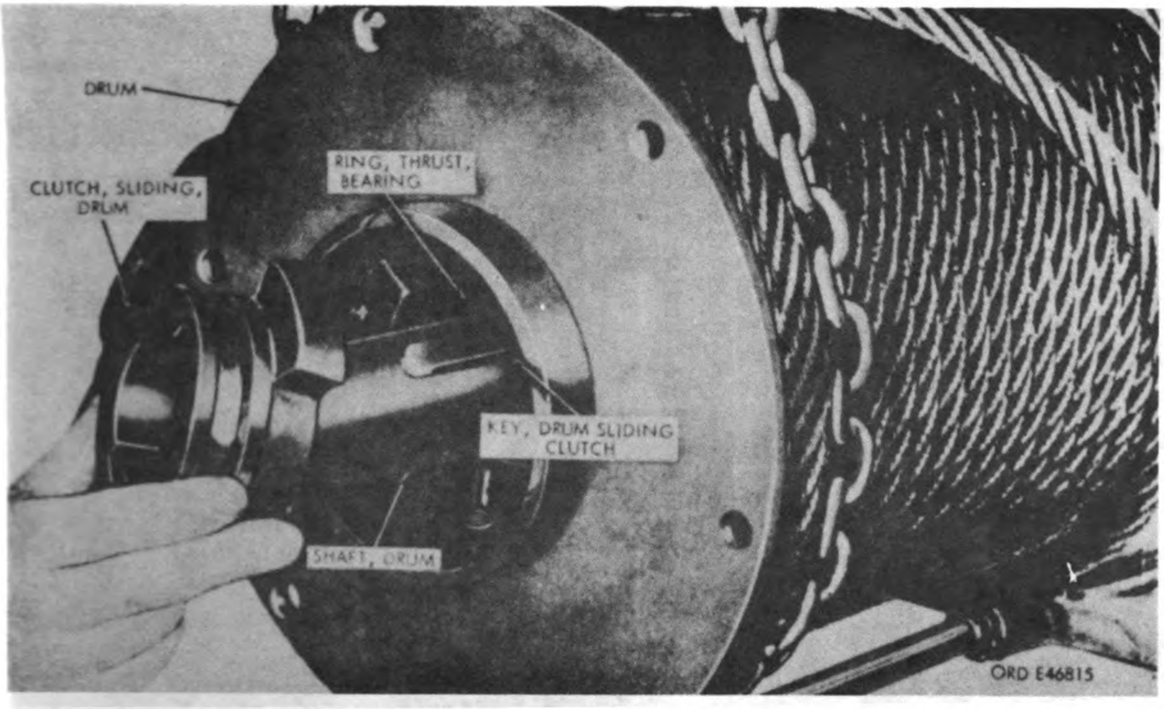


Figure 45. Removing drum sliding clutch and bearing thrust ring

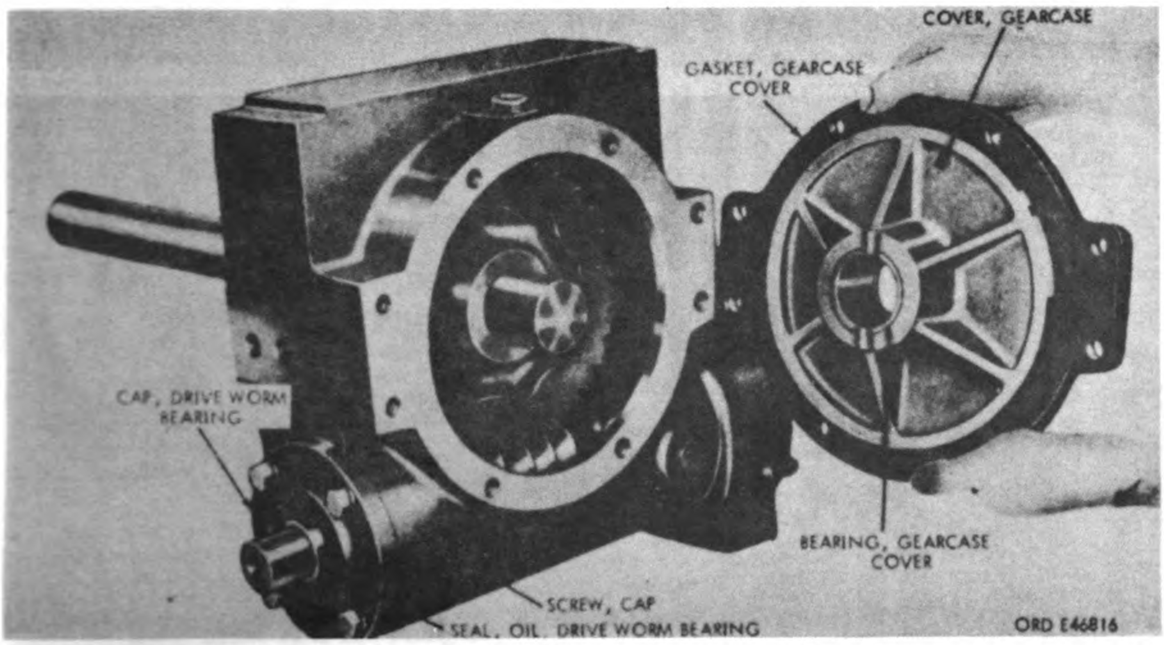


Figure 46. Removing gearcase cover

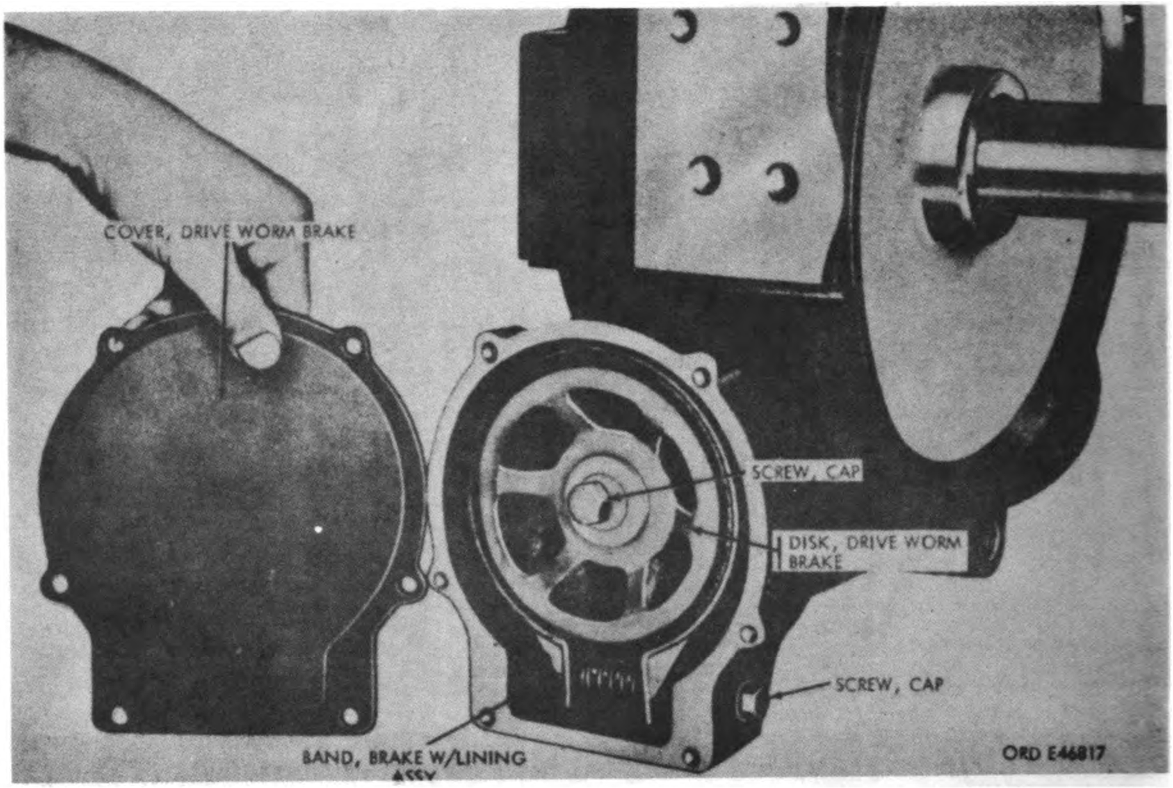


Figure 47. Removing drive worm brake cover

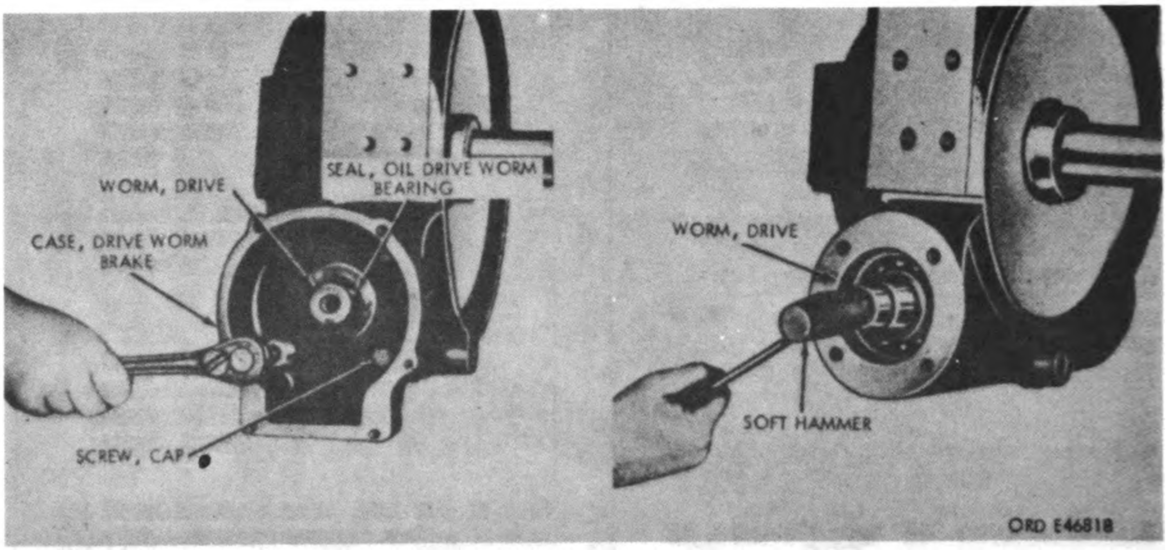


Figure 48. Removing drive worm brake case and freeing drive worm assembly

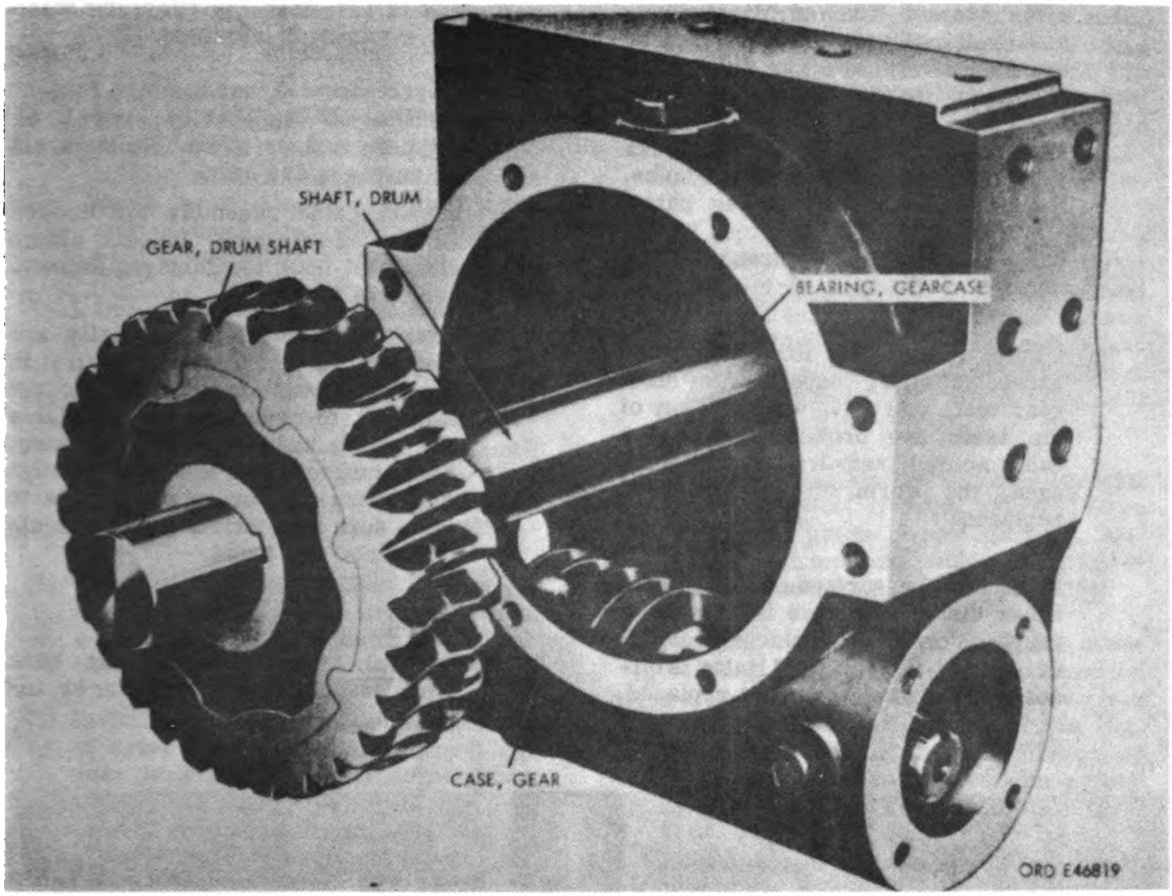


Figure 49. Removing drum shaft and gear assembly from case

(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 burs from machined gasket surfaces and

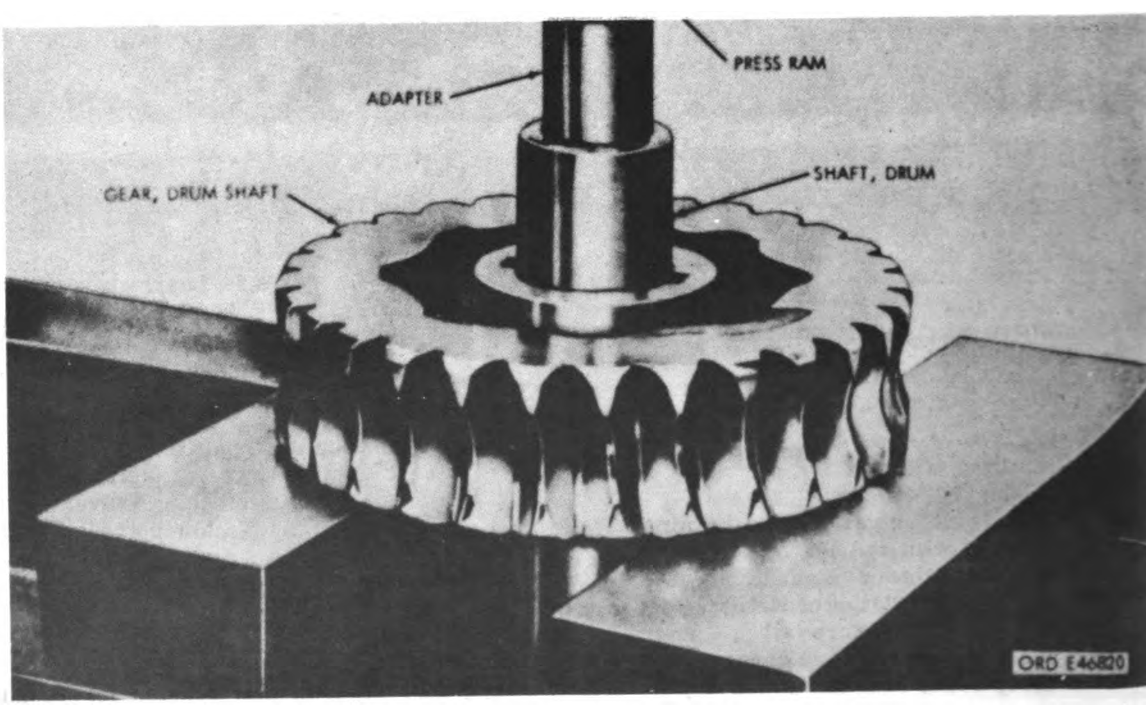


Figure 50. Pressing drum shaft from drum shaft gear

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 alined 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. Aline 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 alined with frame. Also aline 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 aline 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 aline 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.

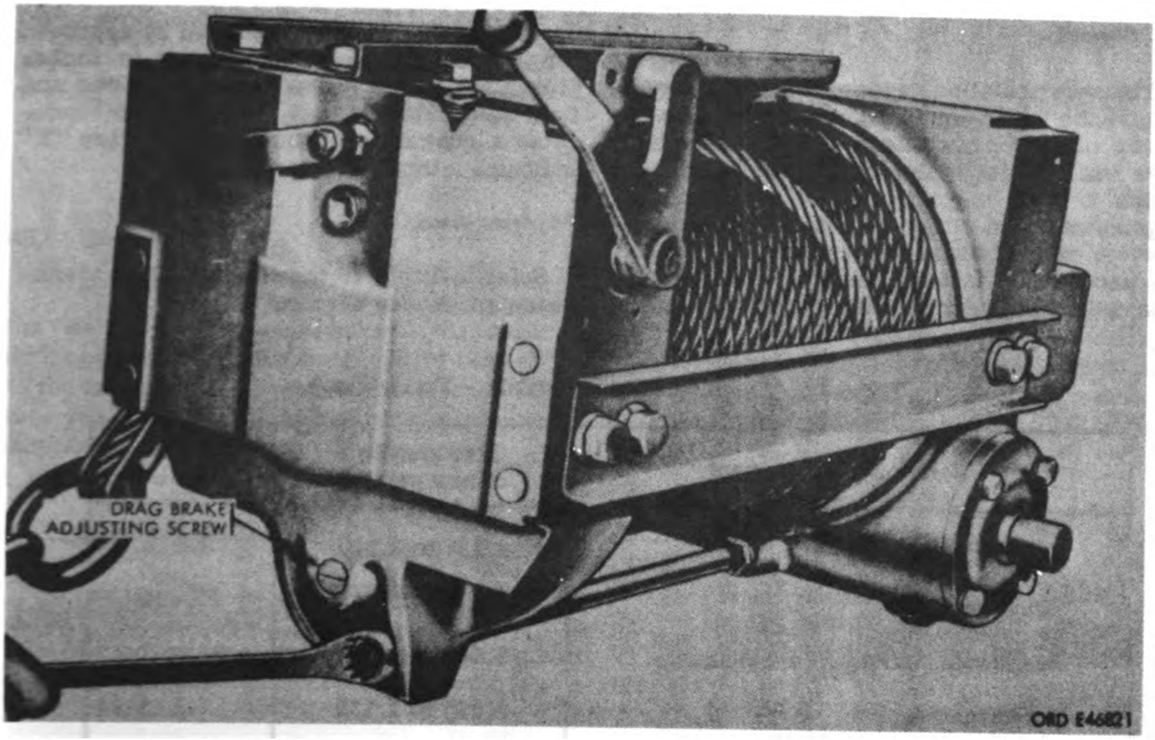


Figure 51. Drag brake adjusting screw

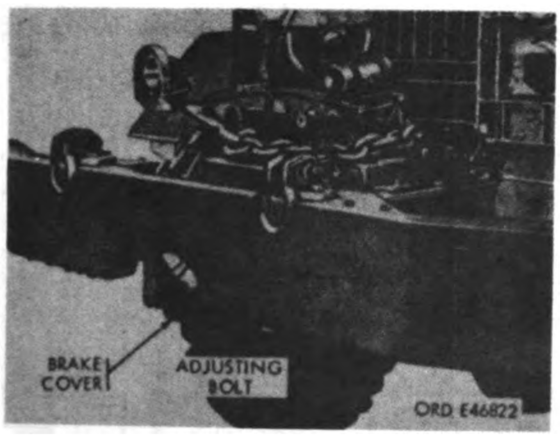


Figure 52. Automatic brake adjustment

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.

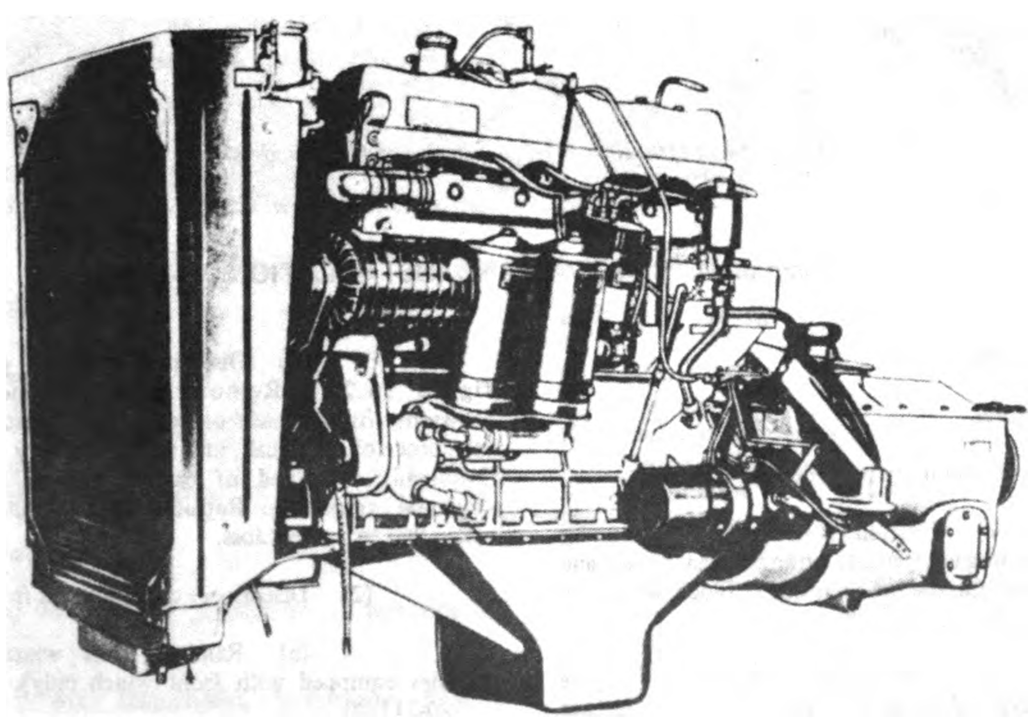


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Figure 53. Left front view of power plant (gasoline models).

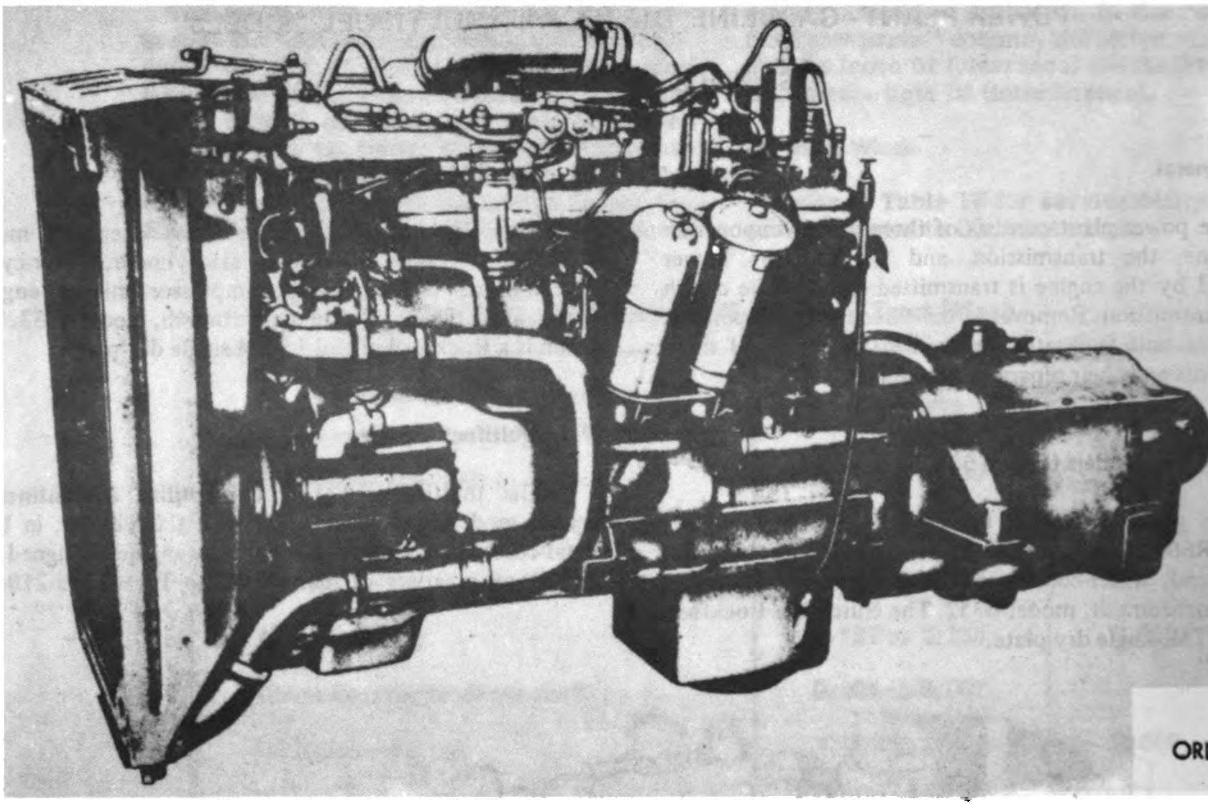


Figure 54. Left side view of power plant (diesel models).

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.

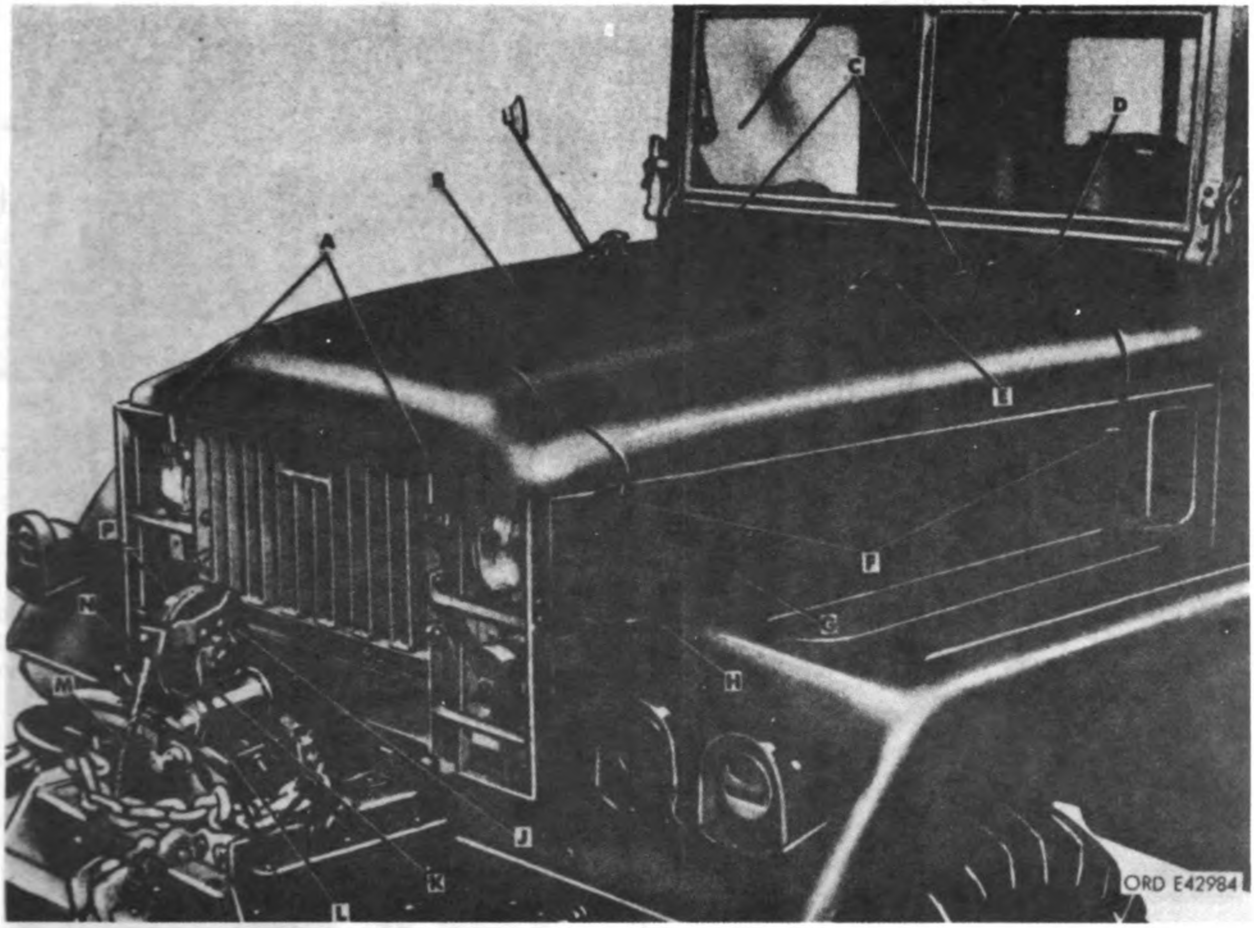


Figure 54.1. View of left front section of truck.

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

(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).

(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).

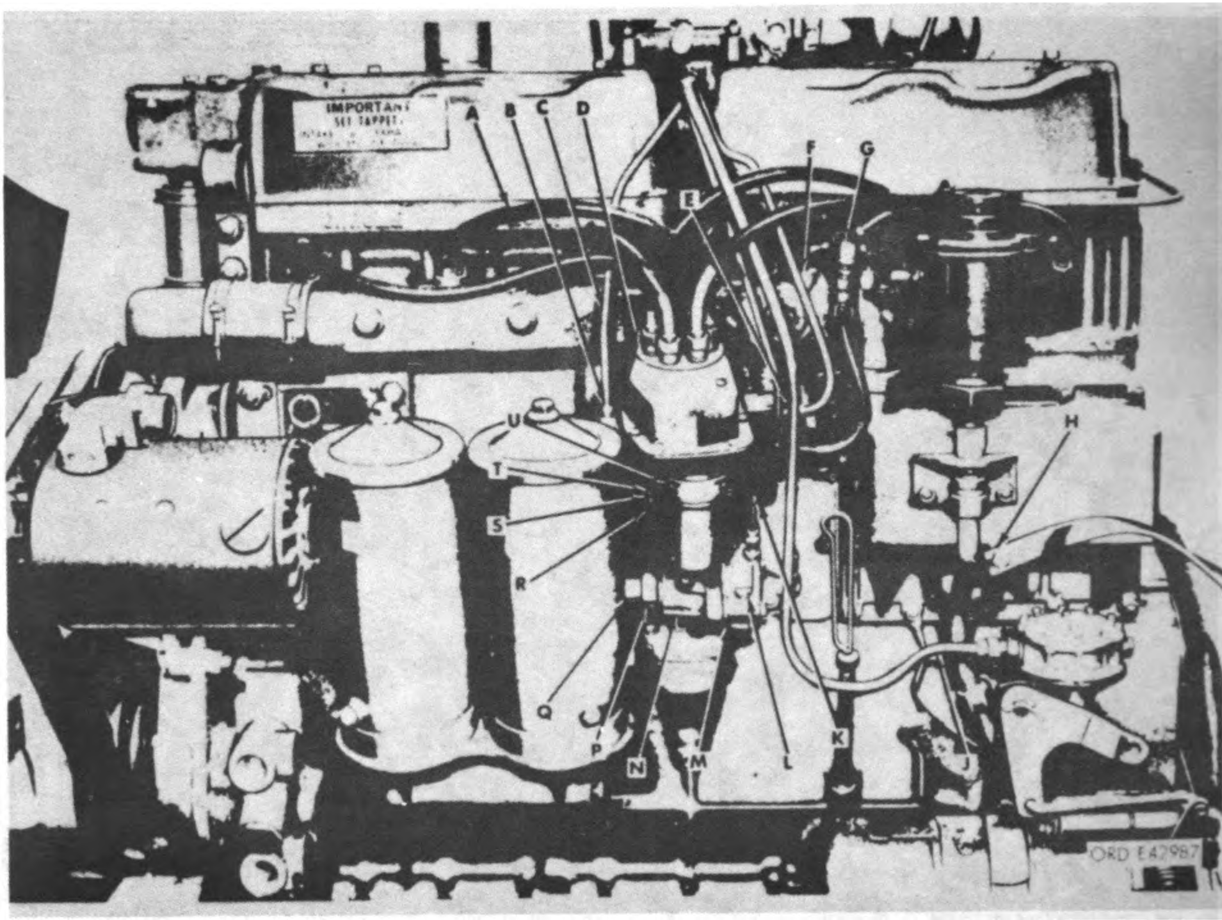


Figure 54.2. View of lower left side of engine (gasoline models).

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 (TM 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.

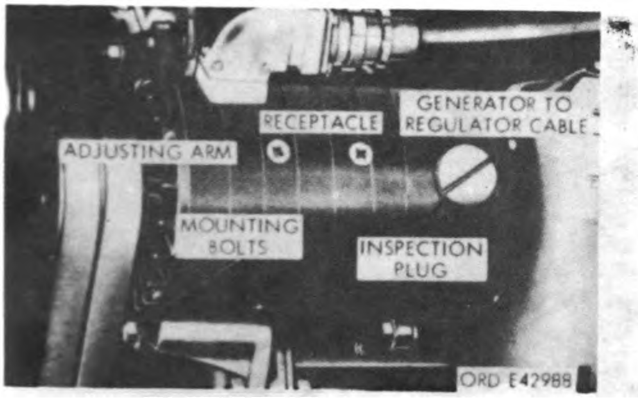


Figure 54.3. View oj generator installed on front left side of engine.

(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 ear water outlet header.

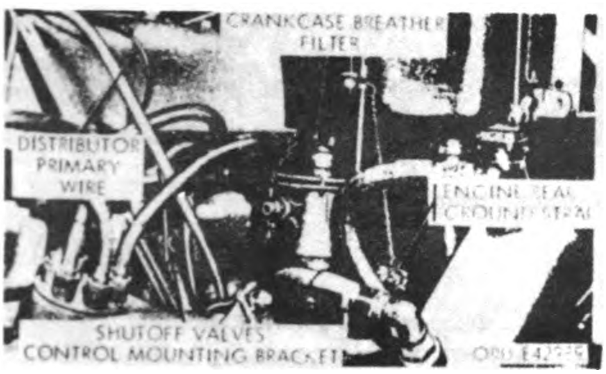


Figure 54.4. View of upper left side of engine.

(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.

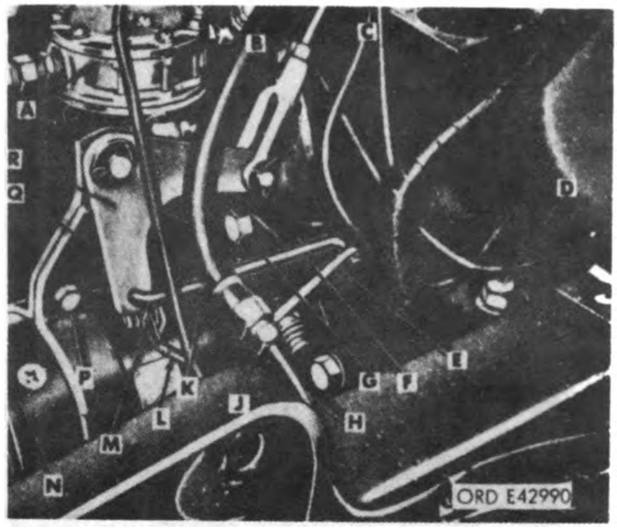


Figure 54.5. Starter and fuel pump installed on rear left side of engine.

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.

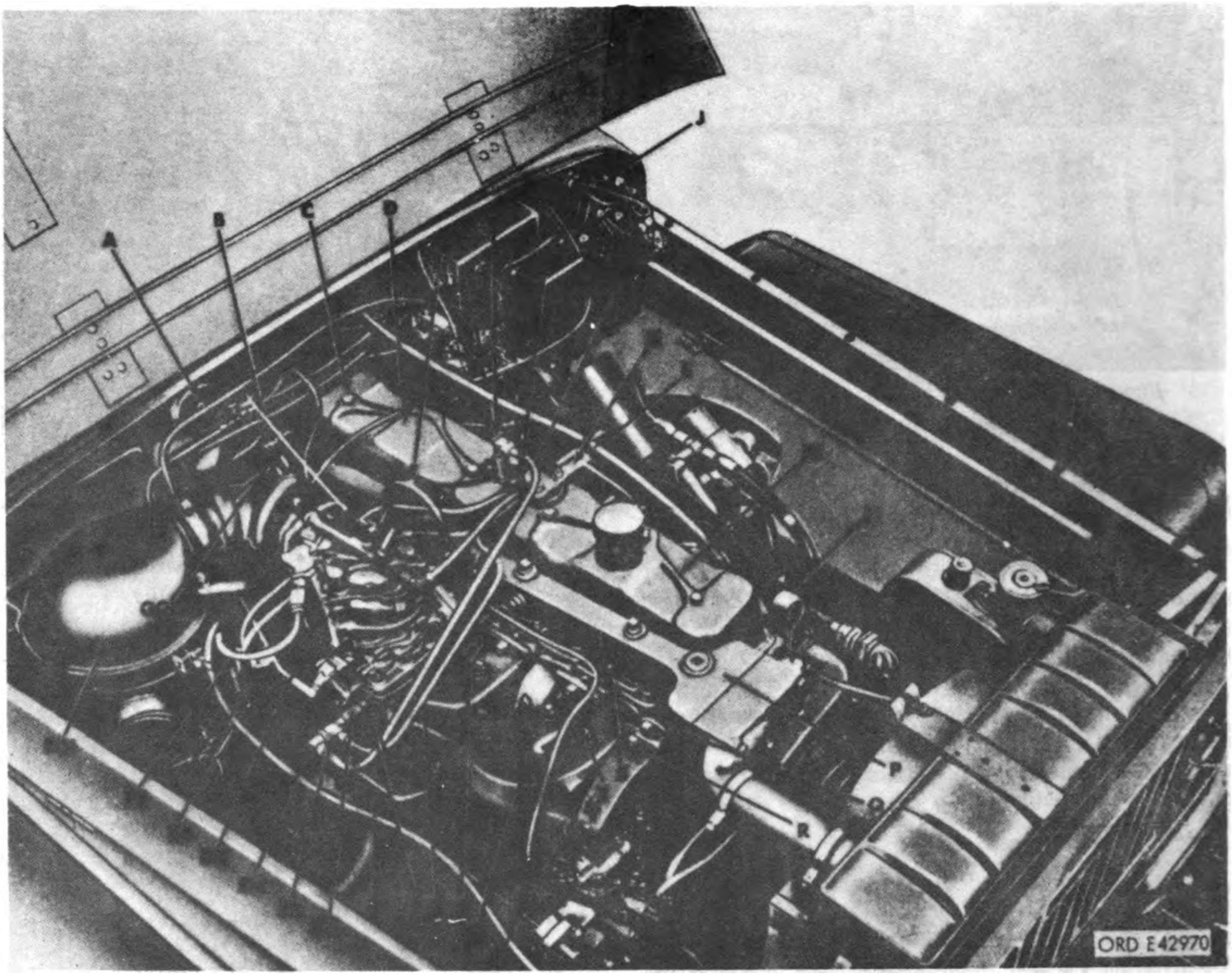


Figure 54.6. Top right view of engine installed in vehicle

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-compresser-to-governor line
U	Exhuast 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

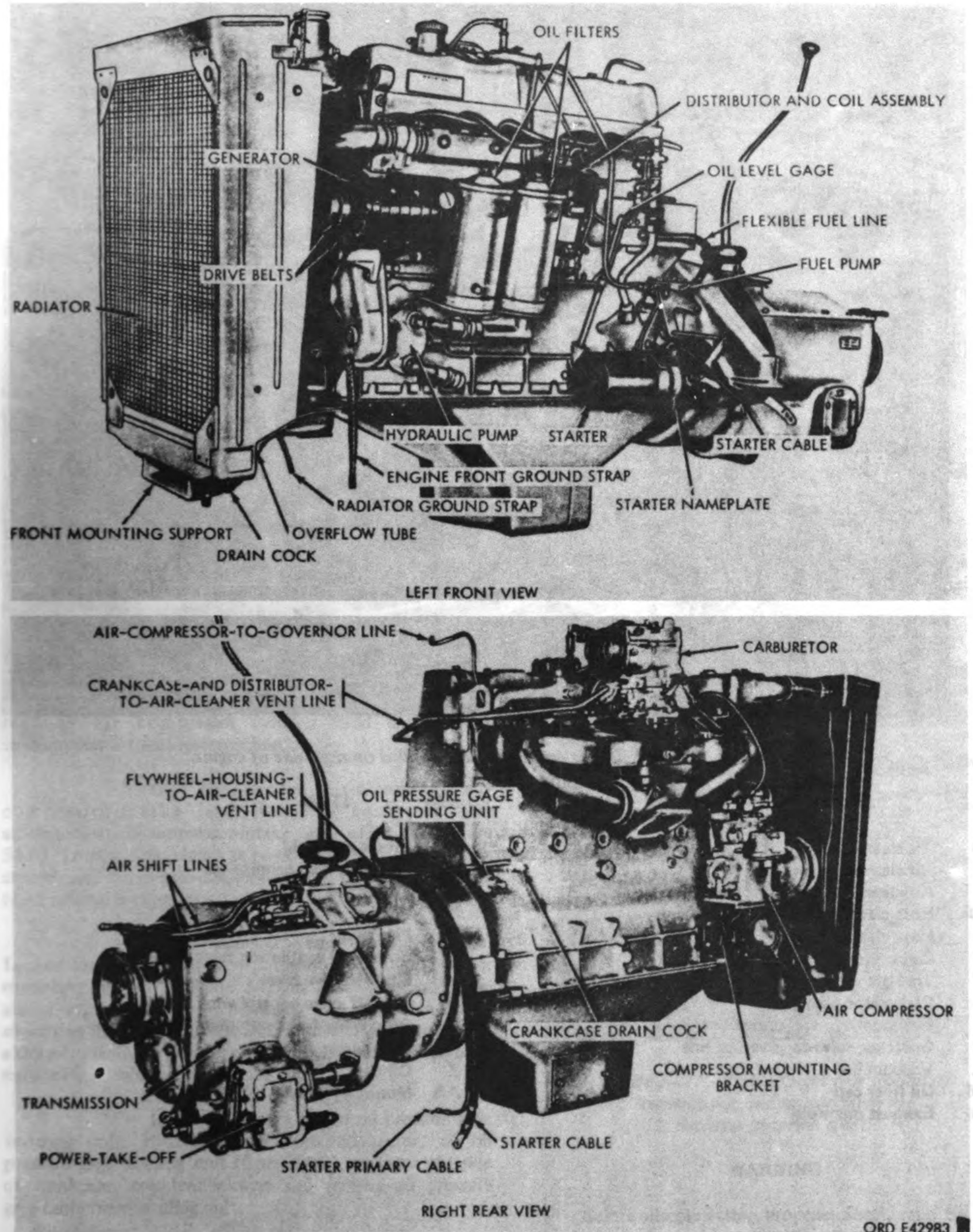


Figure 54.7. Power plant – removed from vehicle.

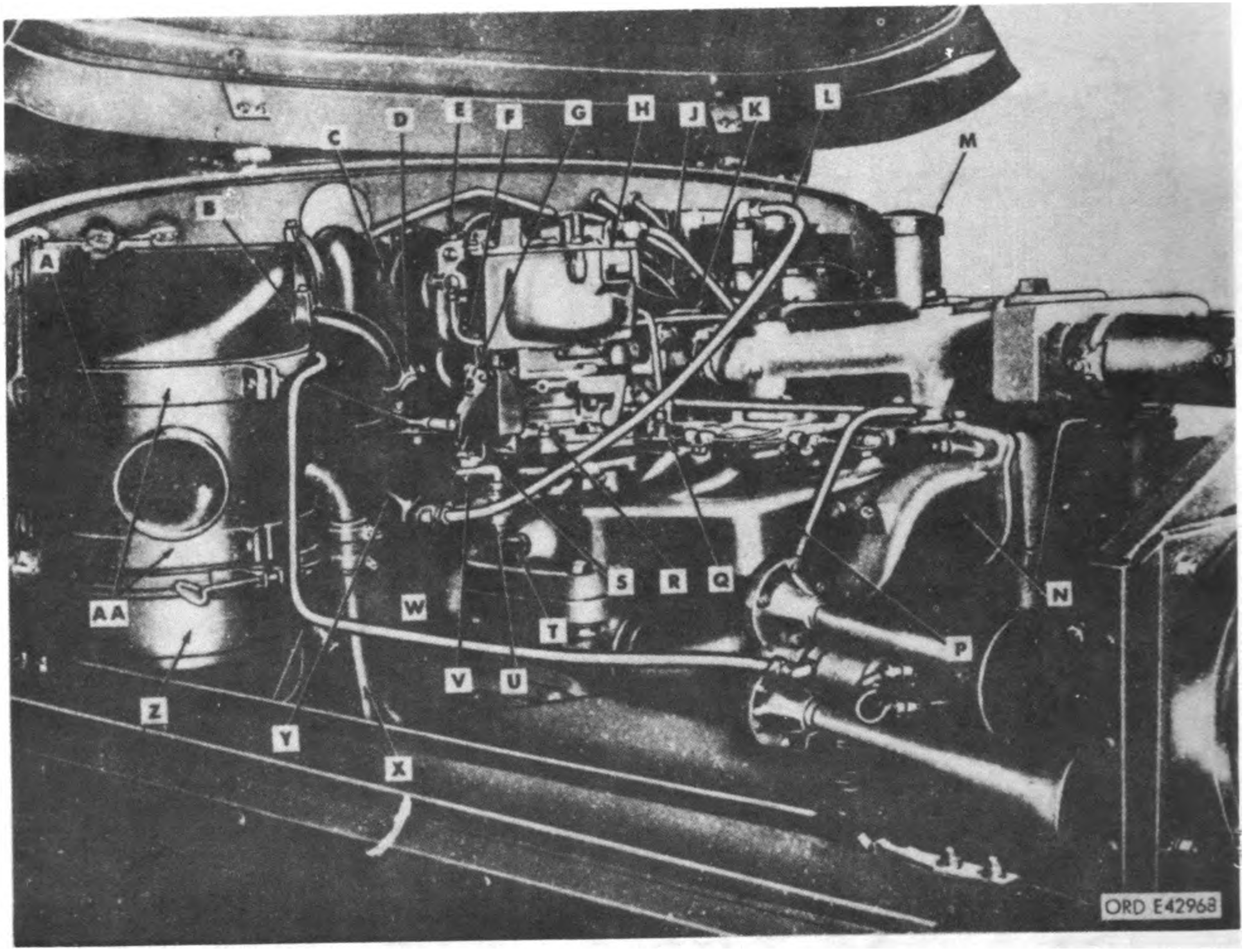


Figure 54.8. Carburetor and manifolds installed on right side of engine.

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

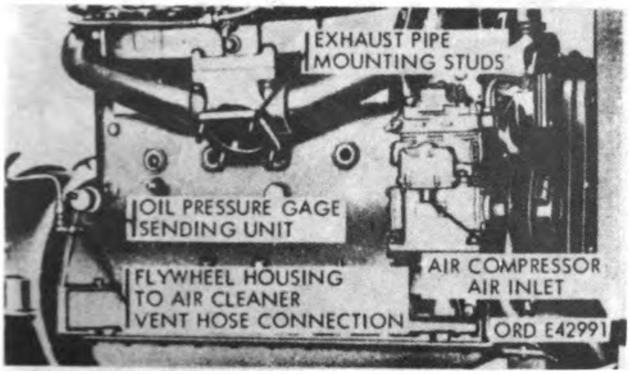


Figure 54.9. Right side of engine

(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 ıose 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 alined 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.

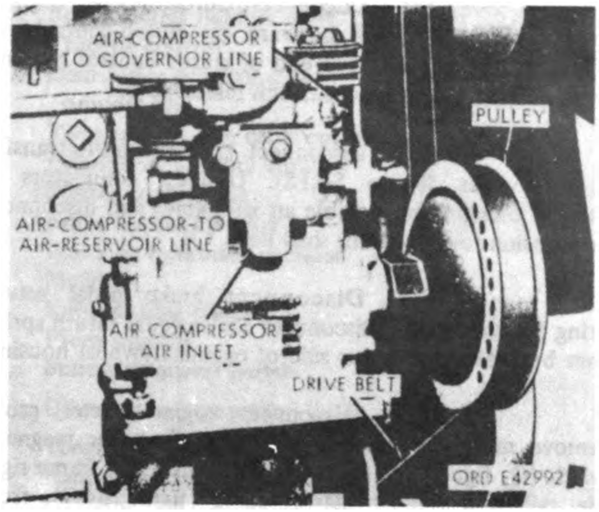


Figure 54.10. Air compressor.

(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.

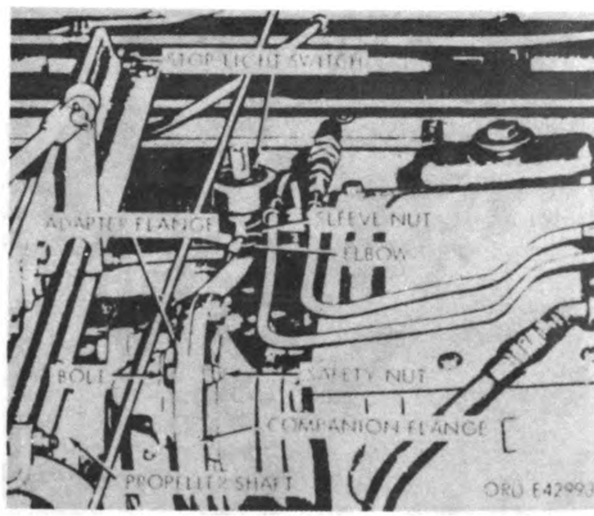


Figure 54.11. View of right rear section of transmission and transmission-to-transfer propeller shaft.

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).

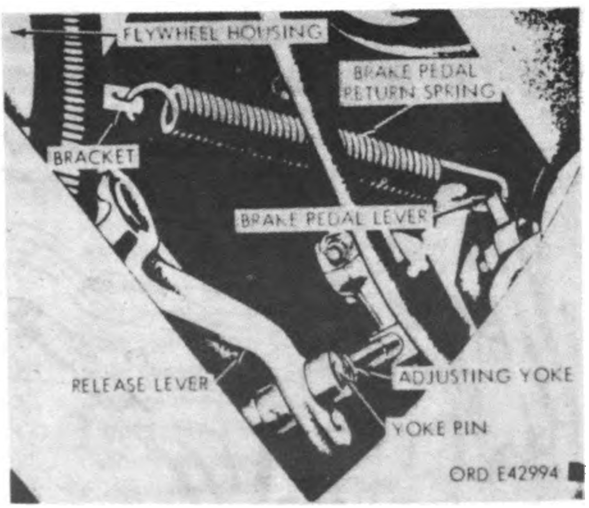


Figure 54.12. View of clutch linkage from underside of vehicle.

(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.

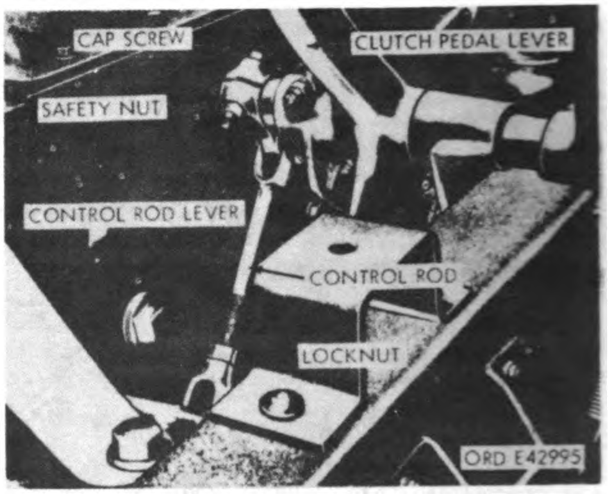


Figure 54.13. Left front view of clutch pedal lever and control rod.

(h) Remove engine rear mounting plat. capscrews. Remove two self-locking nuts from capscrews (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-roto-chamber air line (M62 only). Unscrew nut securing ai line (figure 54.17) to rear of roto chamber, and remove air line connecting roto chamber to clutch control valve at rear of vehicle.

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

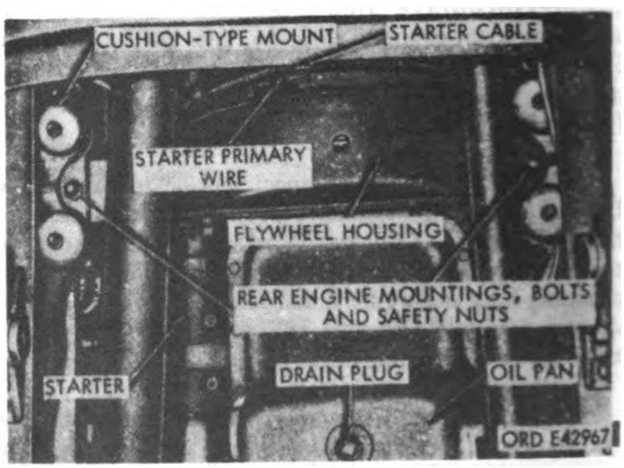


Figure 54.14. View of rear section of engine from underside of vehicle.

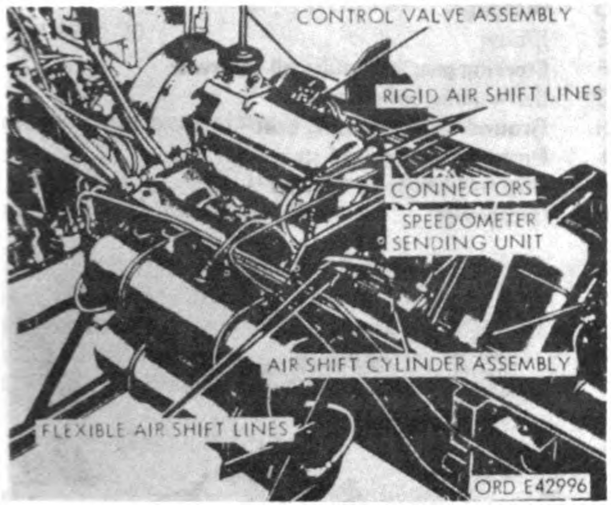


Figure 54.15. Top view of rear section of power plant (installed) from left side of vehicle.

(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.

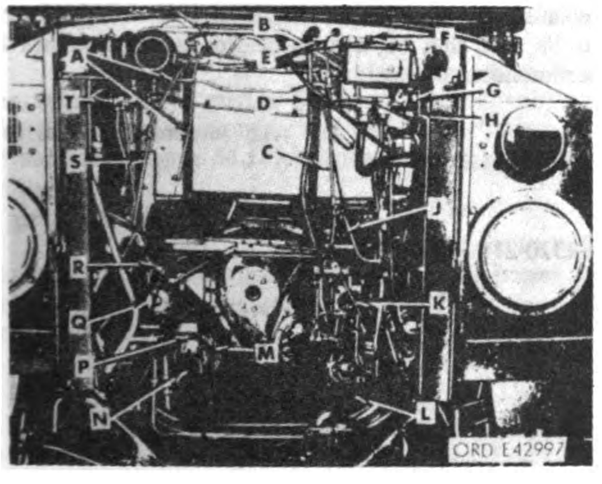


Figure 54.16. Front view of engine compartment with power plant removed.

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 gearshift 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.

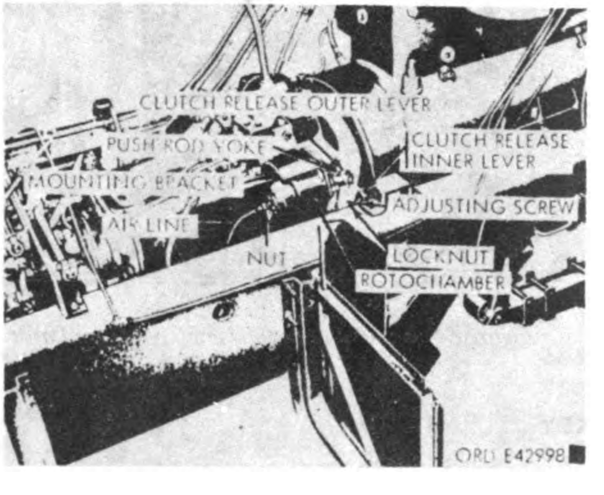


Figure 54.17. View of upper right front section of transmission with roto chamber.

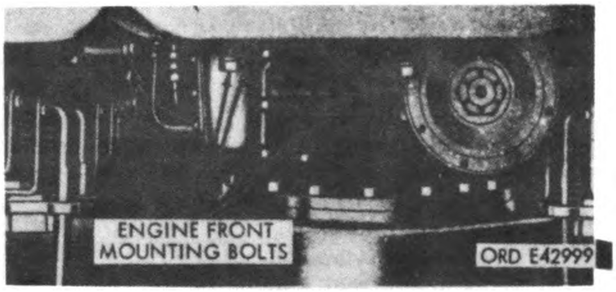


Figure 54.18. Engine front mounting.

(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.

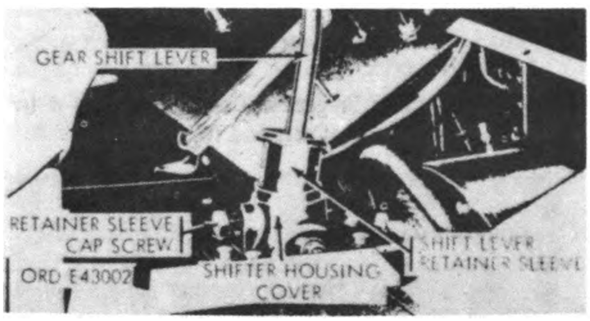


Figure 54.19. Removing gearshift lever.

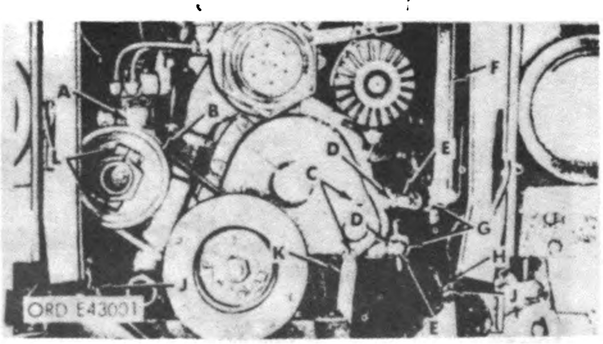


Figure 54.20. Front view of engine with radiator removed.

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

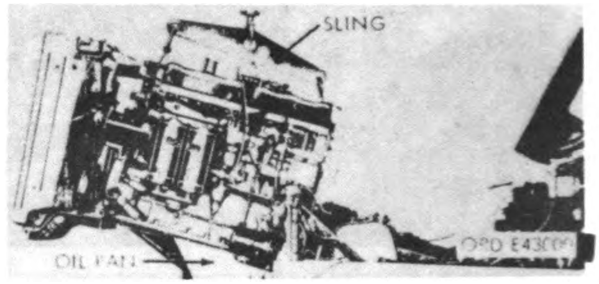


Figure 54.21. Lifting power plant from truck.

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 TM 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-roto-chamber air line (M62 only). Position clutch-control-valve-to-roto-chamber air line (figure 54.17) at rear of roto 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 alined 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.

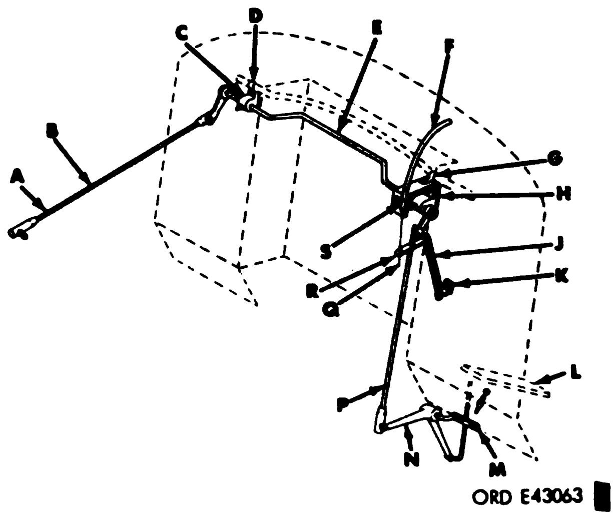


Figure 54.22. Carburetor throttle control linkage.

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.

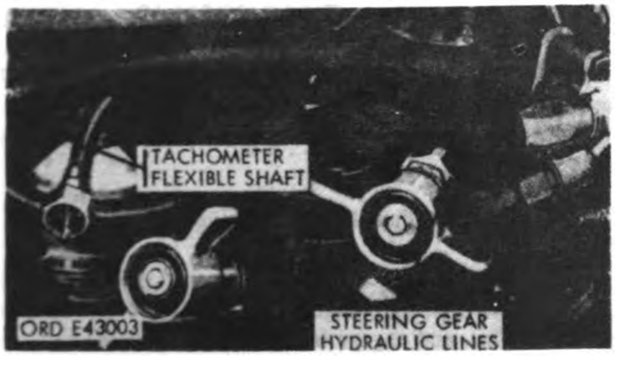


Figure 54.23. Steering gear hydraulic lines and tachometer drive cable (disconnected) at left side of engine.

(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.

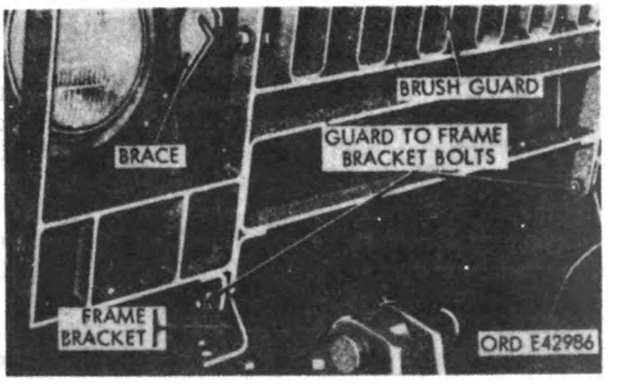


Figure 54.24. Brush guard mountings.

(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.

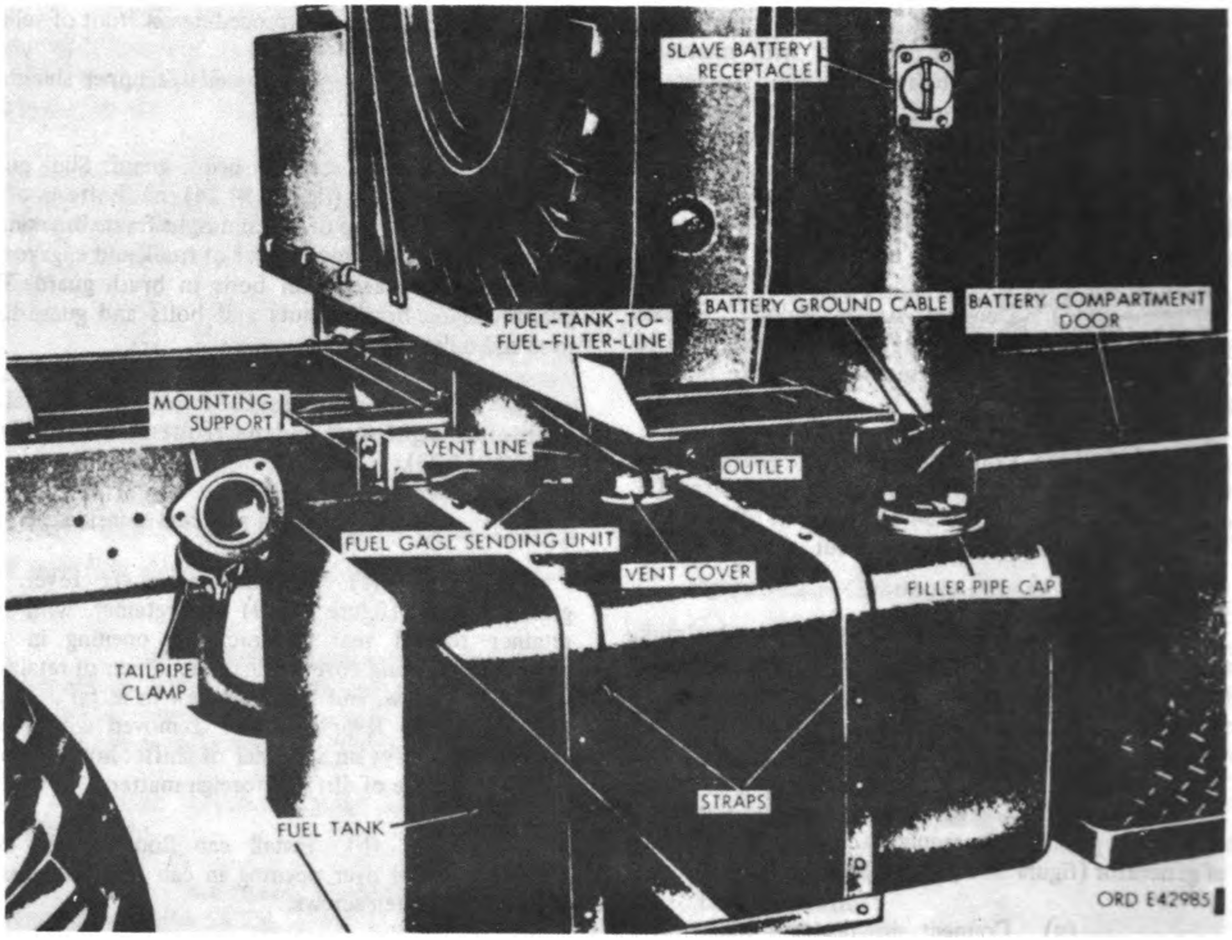


Figure 54.25. View of lower right rear corner of truck cab.

(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.

a. 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).

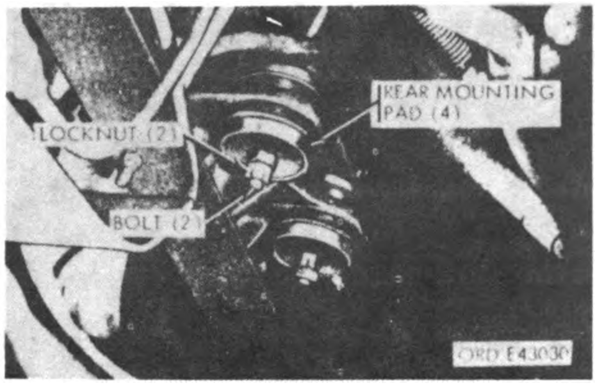
(8) Remove brush guard (paragraph 31).

(9) Remove radiator upper shield (paragraph 31).

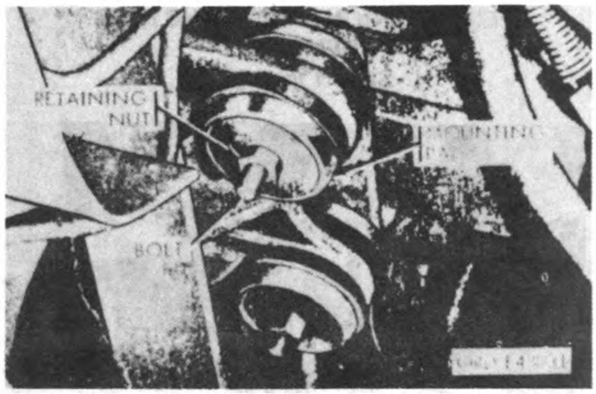
(10) Remove engine front and rear mounting pads and bolts as shown in figures 54.26 and 54.27.

(11) Disconnect exhaust pipe at turbocharger (TM 9-2320-211-20).

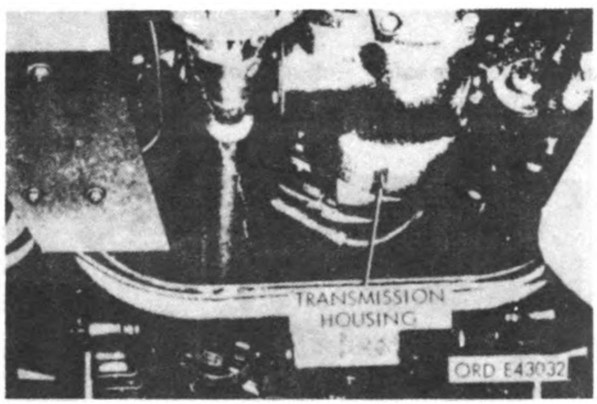
FIGURE 54.26
ENGINE REAR MOUNTING PADS
REMOVAL
Steps 1 through 4



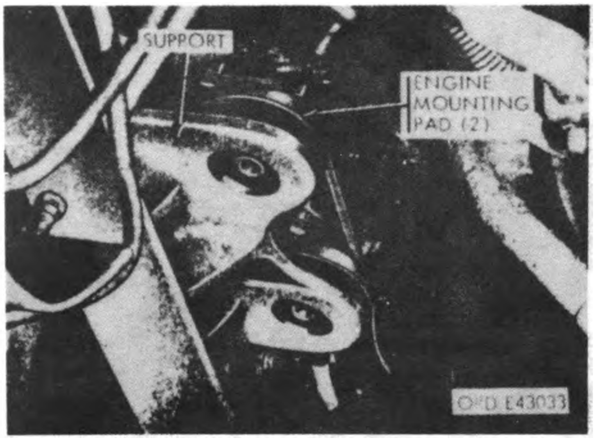
Step 1. Remove locknut from bolt securing rear mounting pads.



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



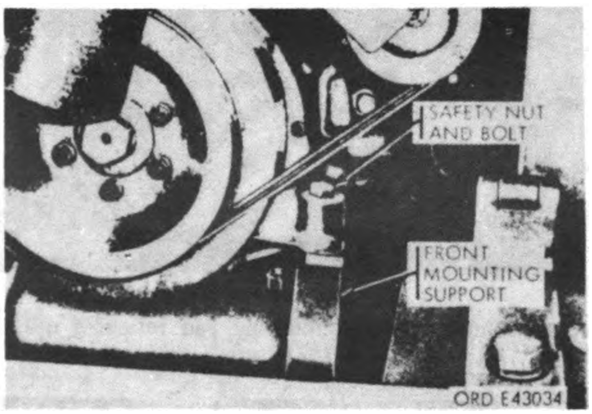
Step 3. Locate jack under transmission housing and raise high enough to allow removal of rear mounting pads.



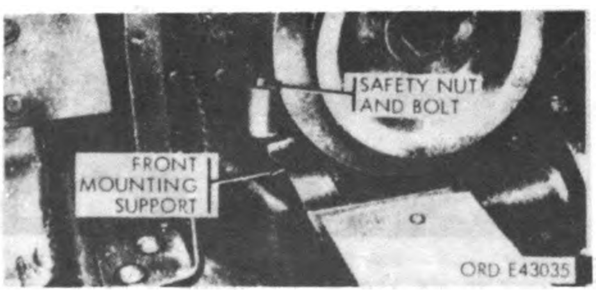
Step 4. Remove rear mounting pads from support.

Figure 54.26. Rear engine mounting pads removal.

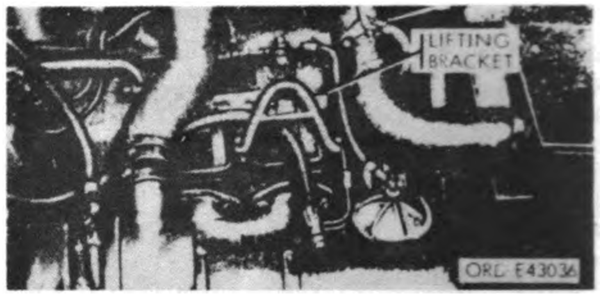
FIGURE 54.27
ENGINE FRONT MOUNTING PADS REMOVAL
Steps 1 through 4



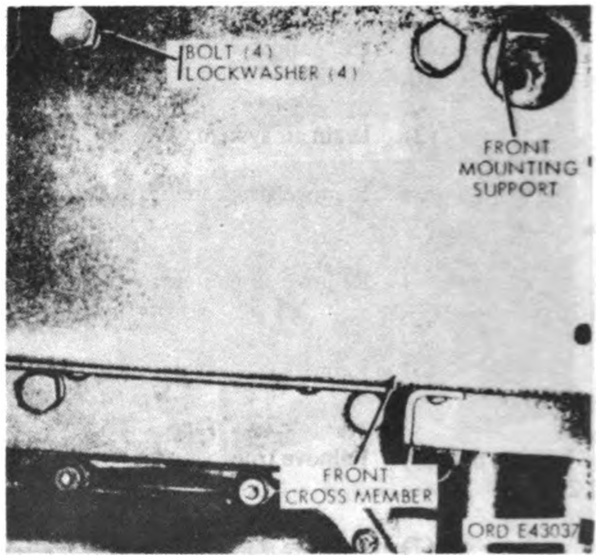
Step 1. Remove safety nut and bolt securing engine front mount to front mounting support on left side of engine.



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.

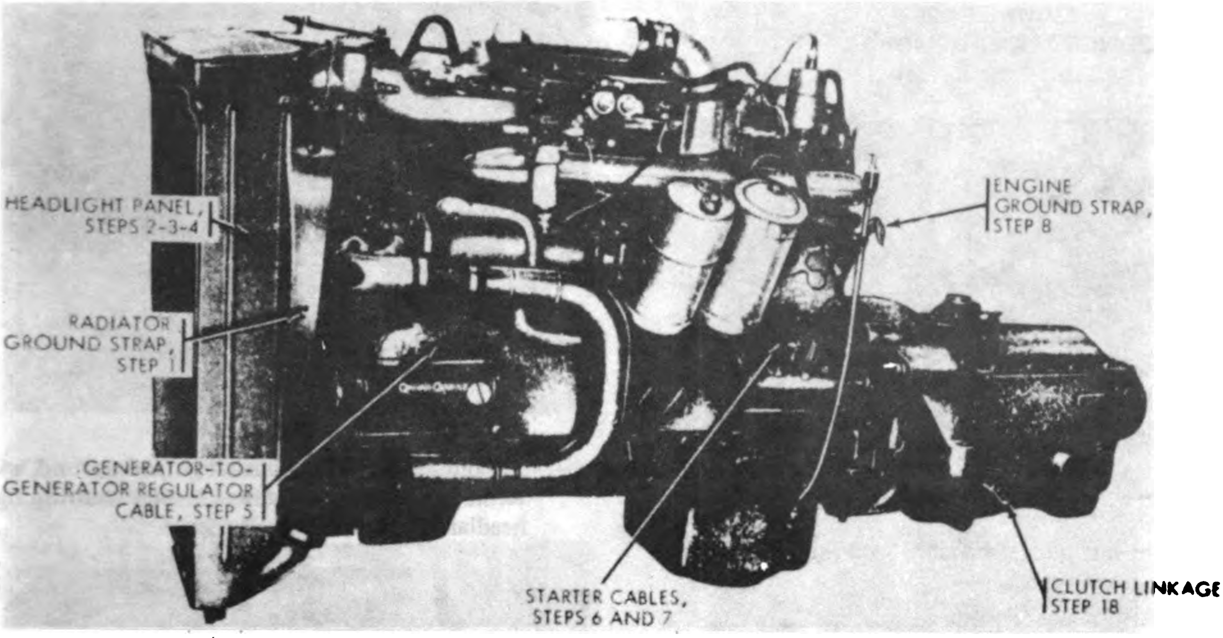


Step 4. Remove bolts and lockwashers securing front mounting bracket to front crossmember and remove front mounting support.

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.



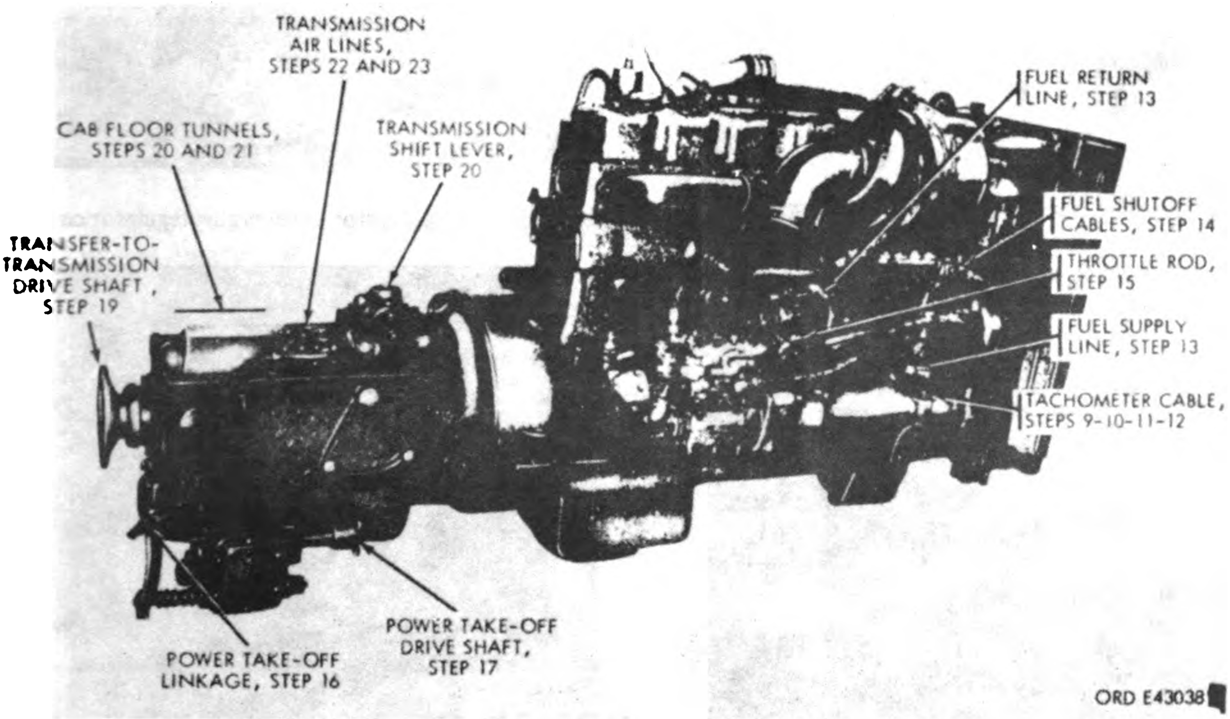
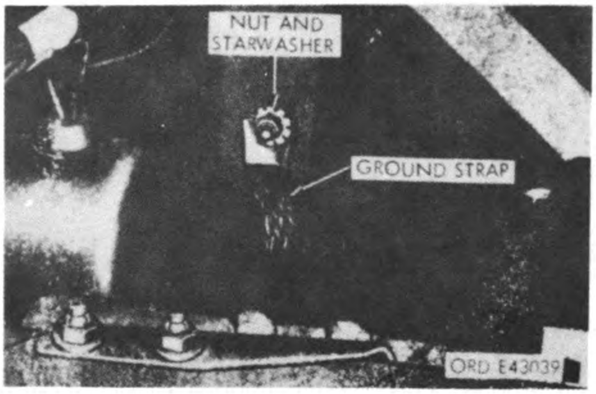
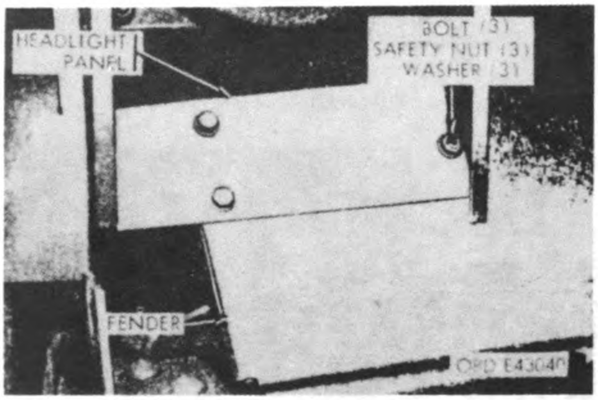


Figure 54.28. Visual guide to power plant disconnect points (diesel model).

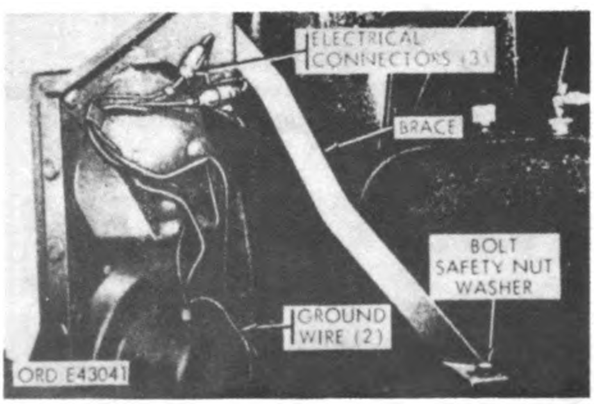
FIGURE 54.29
POWER PLANT REMOVAL
Steps 1 through 24



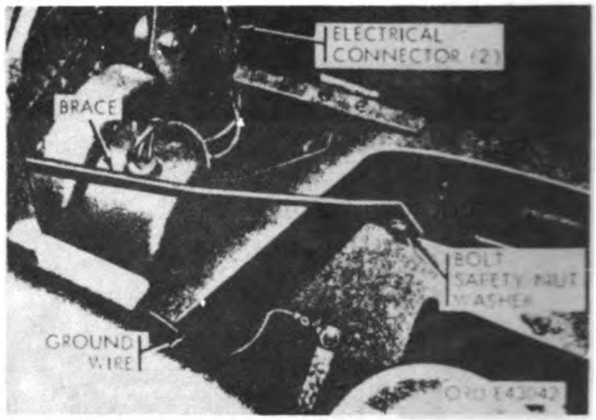
Step 1. Remove nut and starwasher securing radiator to chassis ground strap.



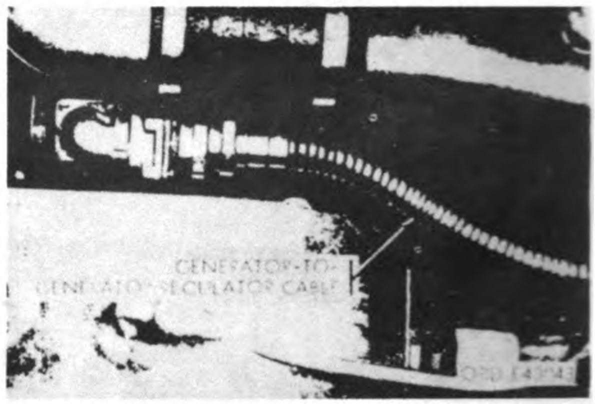
Step 2. Remove bolts, safety nuts, and washers securing headlight panel to fender.



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

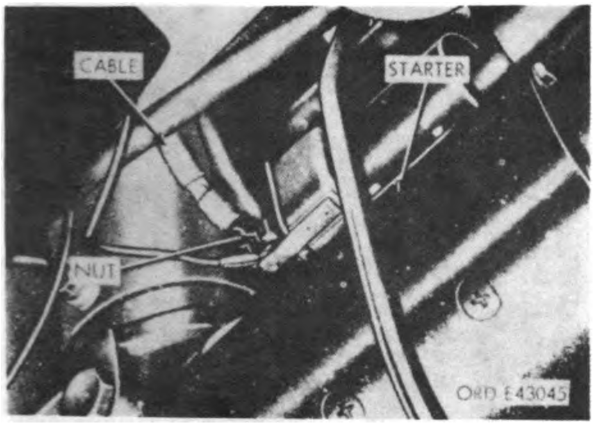


Step 4. Disconnect electrical connectors and ground wire. Remove bolt, safety nut, and washer securing right headlamp panel brace to fender.

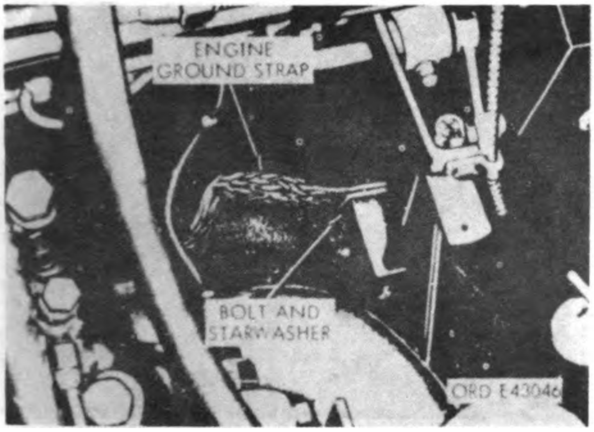


Step 5. Remove generator to generator-regulator cable.

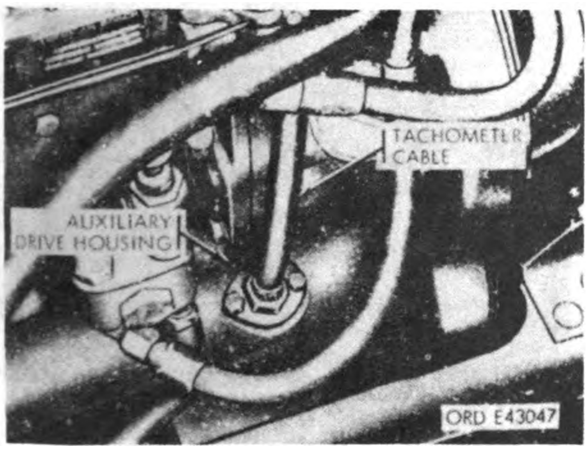
Step 6. Remove nut securing starter cable to starter (from top of starter) and remove cable from starter.



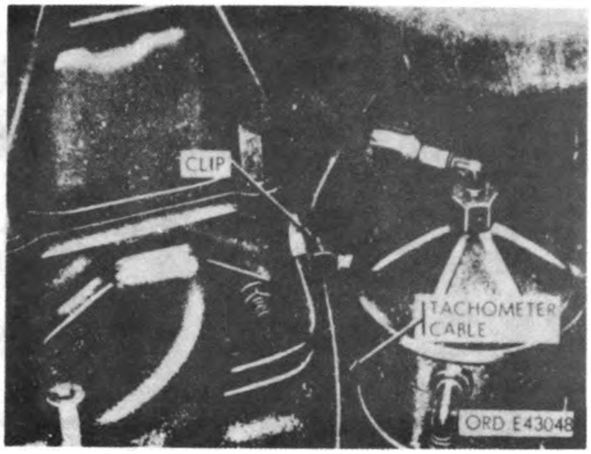
Step 7. Remove nut securing starter cable to starter (under vehicle) and remove cable.



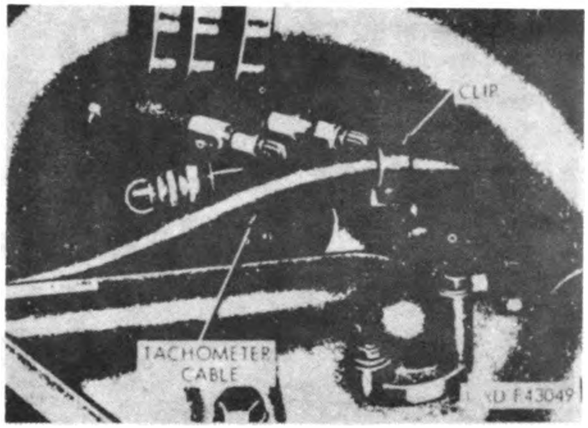
Step 8. Remove bolt and starwasher securing engine ground strap to cowl.



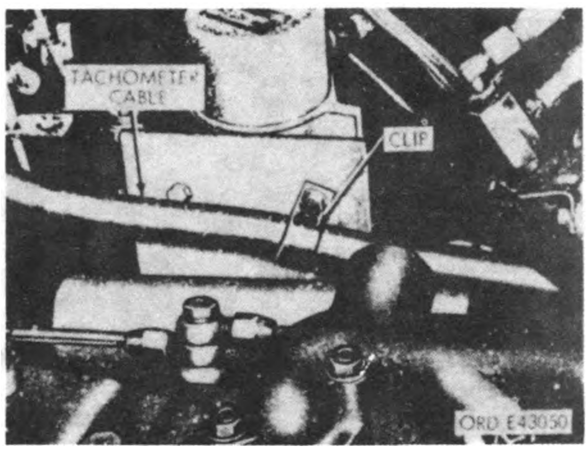
Step 9. Disconnect tachometer cable at auxiliary drive housing.



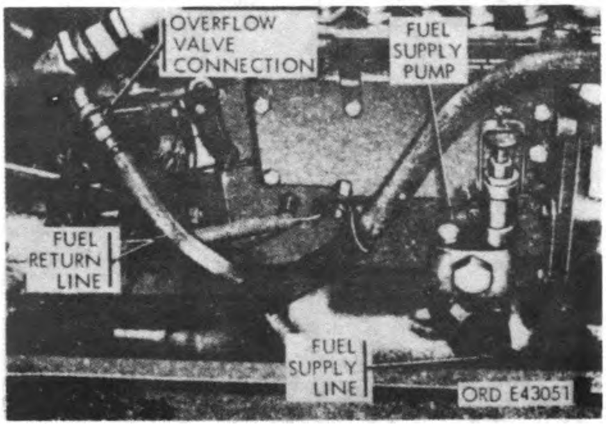
Step 10. Remove clip securing tachometer cable to front of engine.



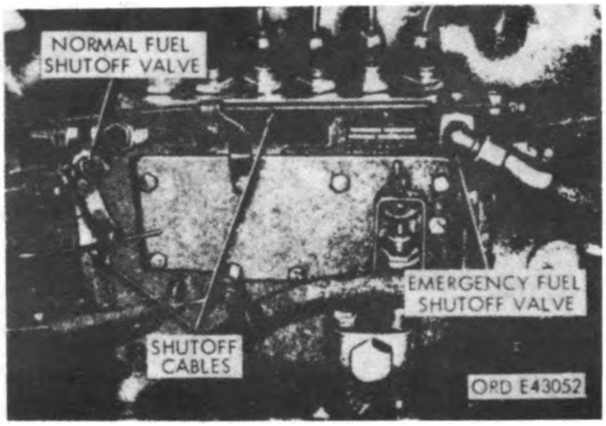
Step 11. Remove clip securing tachometer cable on left side of engine.



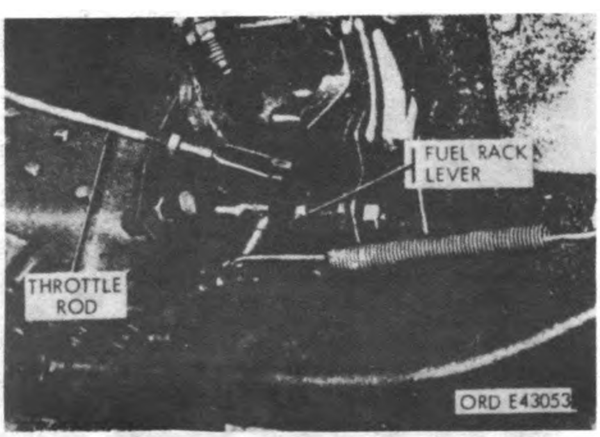
Step 12. Remove clip securing tachometer cable on rear left side of engine.



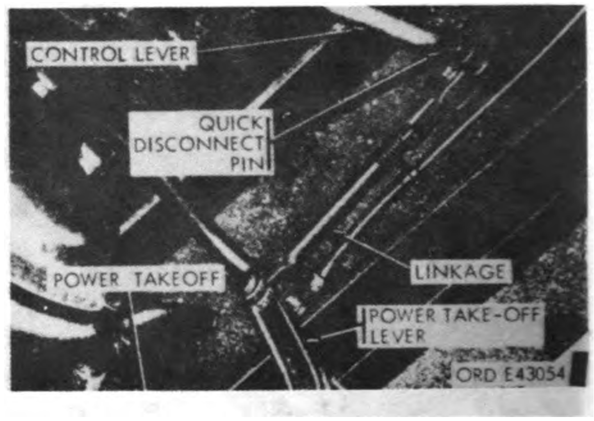
Step 13. Disconnect fuel supply line from fuel supply pump. Disconnect fuel return line from overflow valve connection.



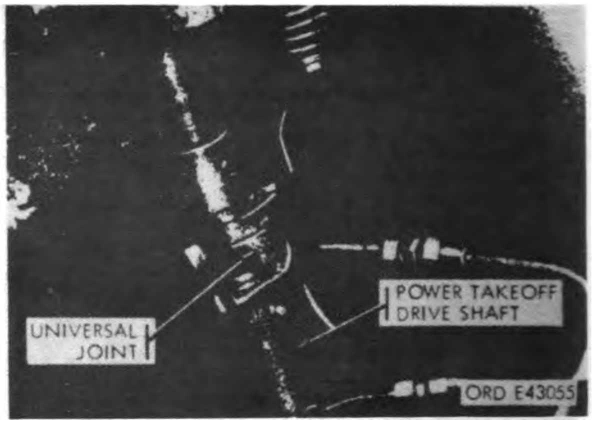
Step 14. Remove shutoff cables from emergency fuel shutoff valve and normal fuel shutoff valve.



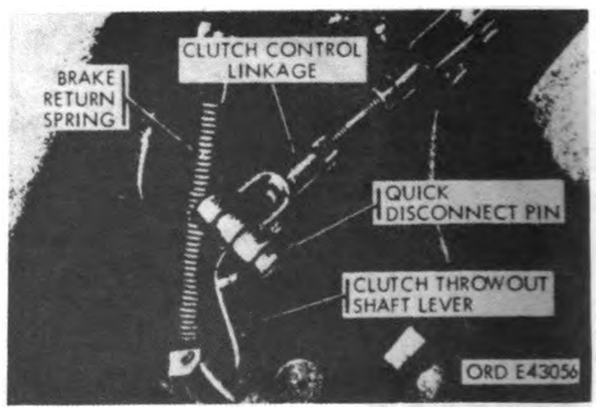
Step 15. Disconnect throttle rod from fuel rack lever.



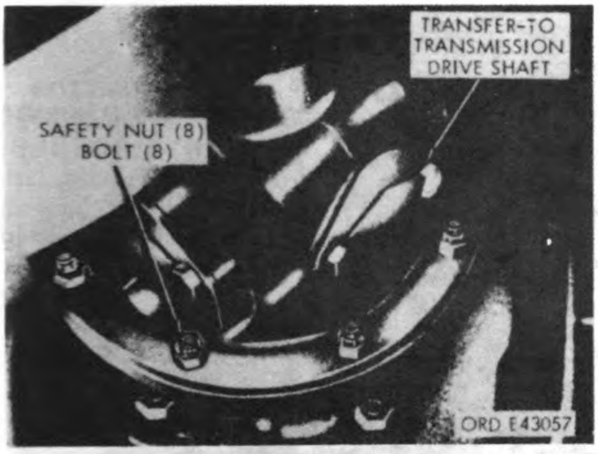
Step 16. Pull out quick disconnect pin securing power takeoff linkage between control lever and power takeoff lever.



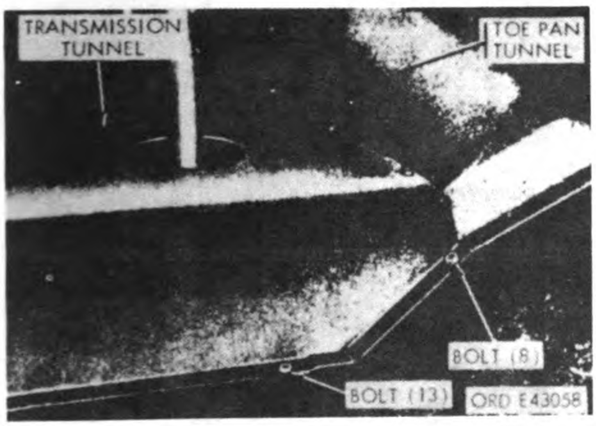
Step 17. Disconnect power takeoff drive shaft at universal joint (paragraph 165).



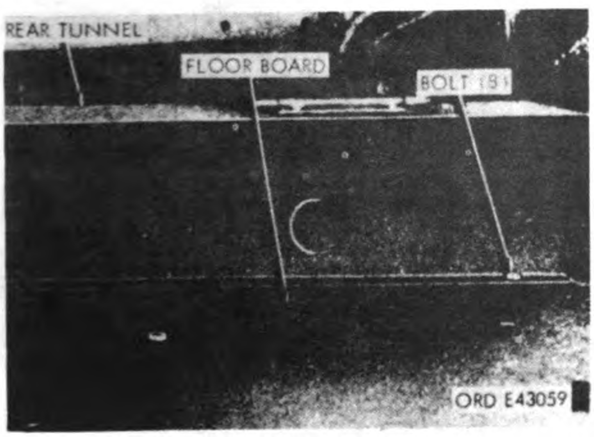
Step 18. Pull out quick disconnect pin securing clutch control linkage to clutch throwout shaft lever. Disconnect brake pedal return spring.



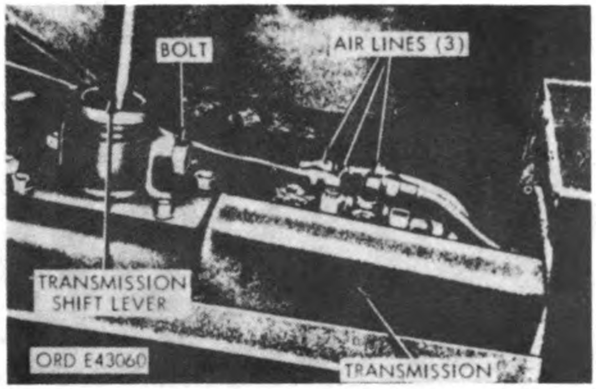
Step 19. Remove safety nuts and bolts securing transfer to transmission drive shaft.



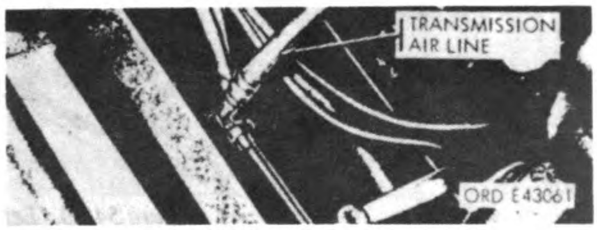
Step 20. Remove bolts securing transmission tunnel and toe pan tunnel and remove tunnels.



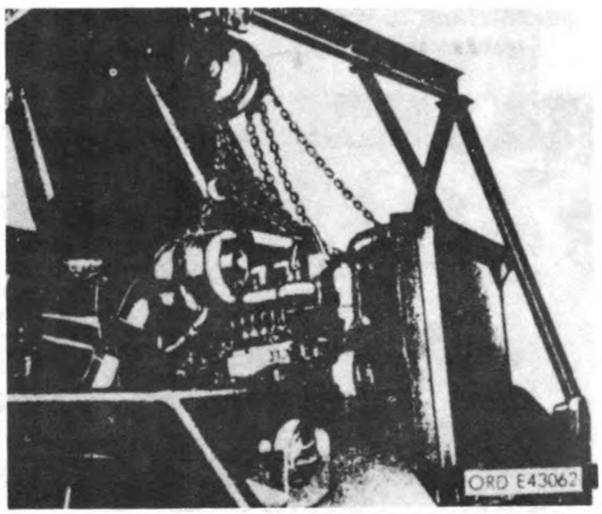
Step 21. Remove bolts securing rear tunnel to floorboard and remove tunnels.



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.

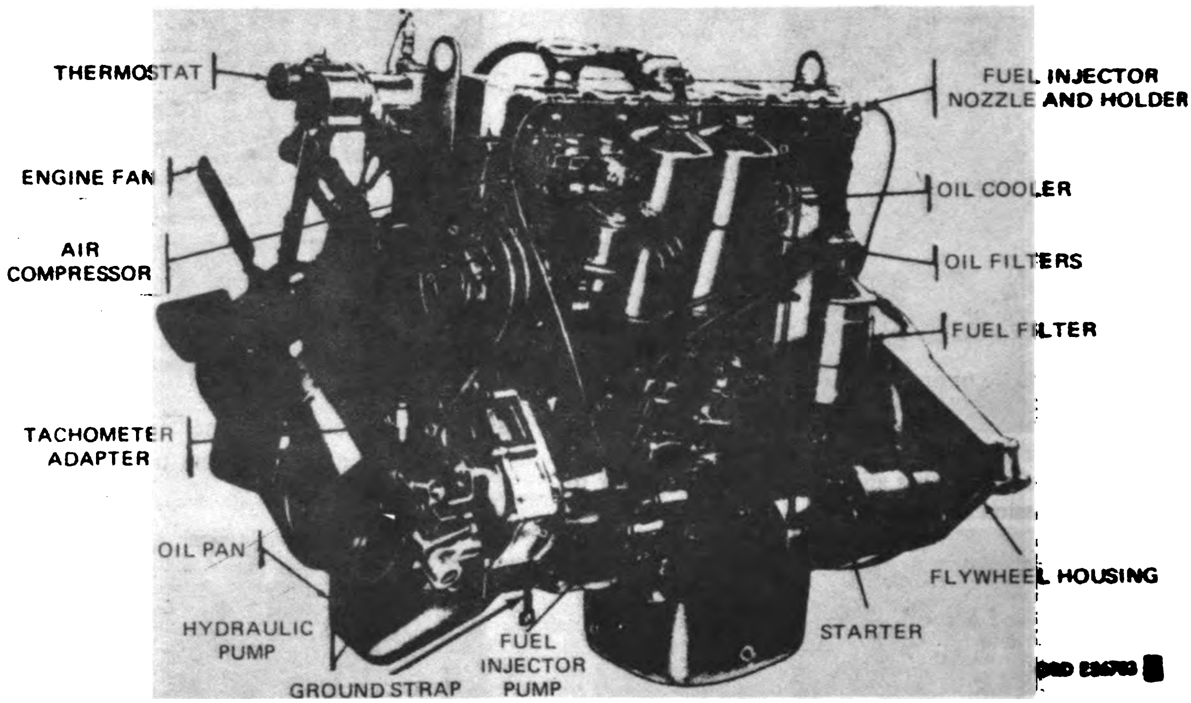


Figure 54.30. Left side of power plant (multifuel).

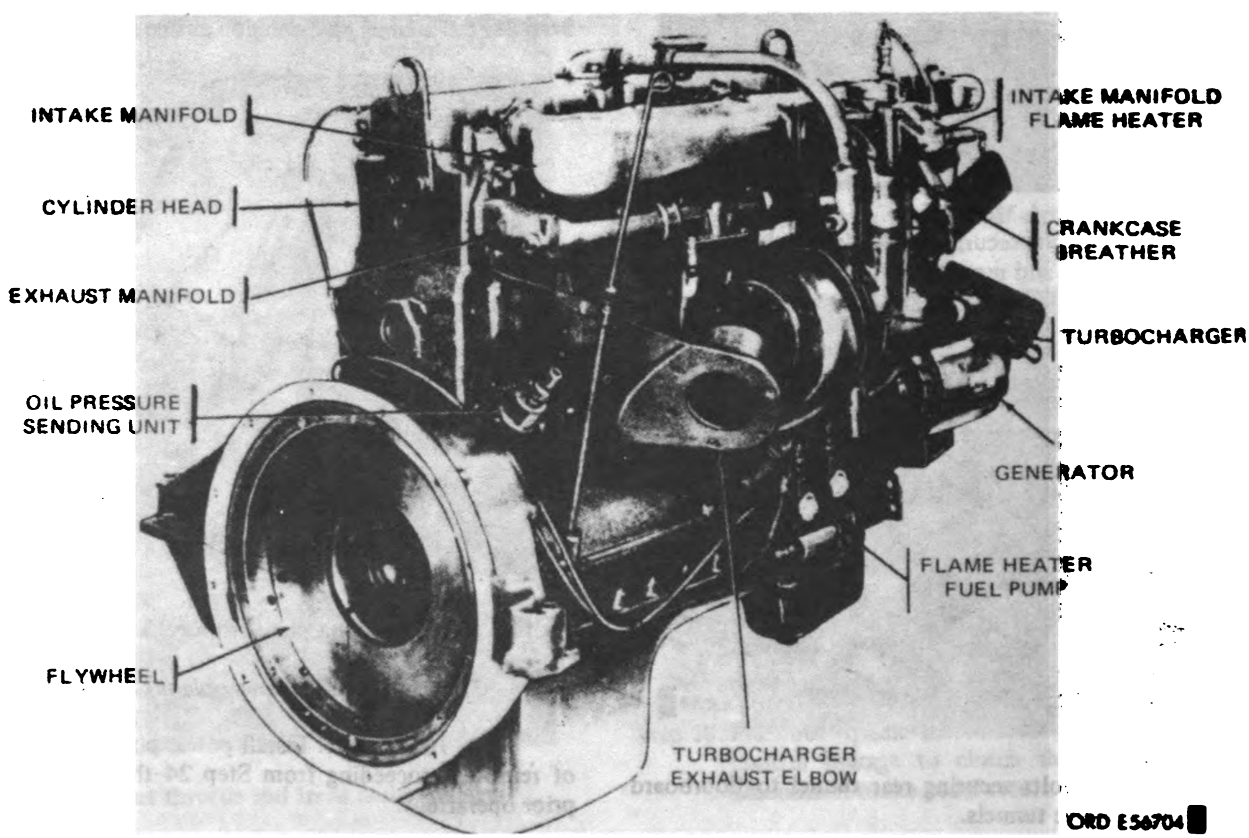


Figure 54.31. Right side of power plant (multifuel).

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.

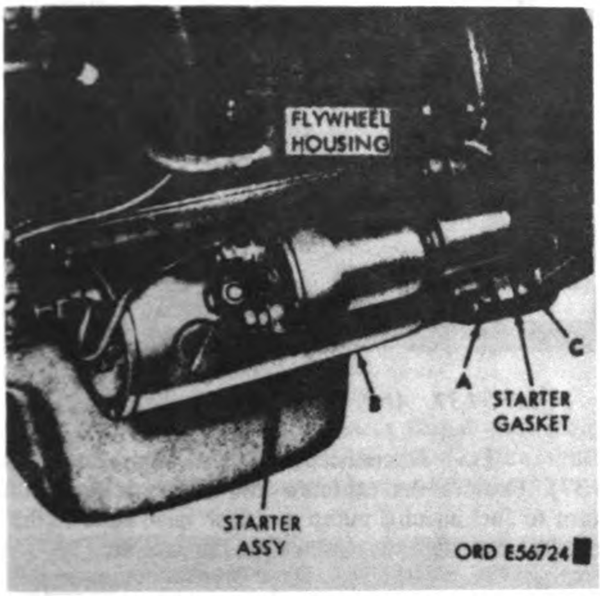


Figure 54.32. Starter.

(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).

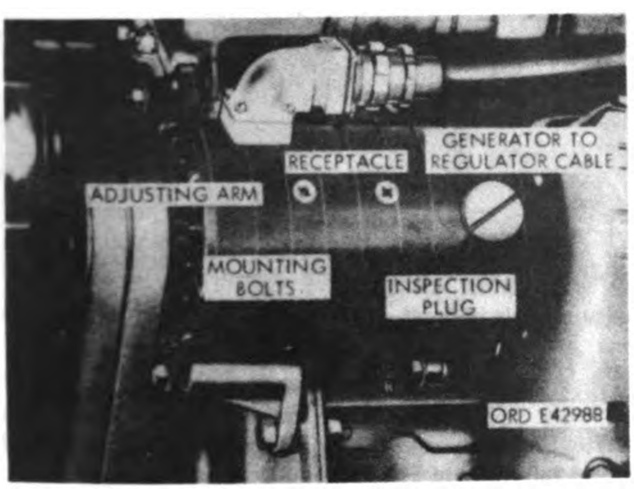


Figure 54.33. Generator.

(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.

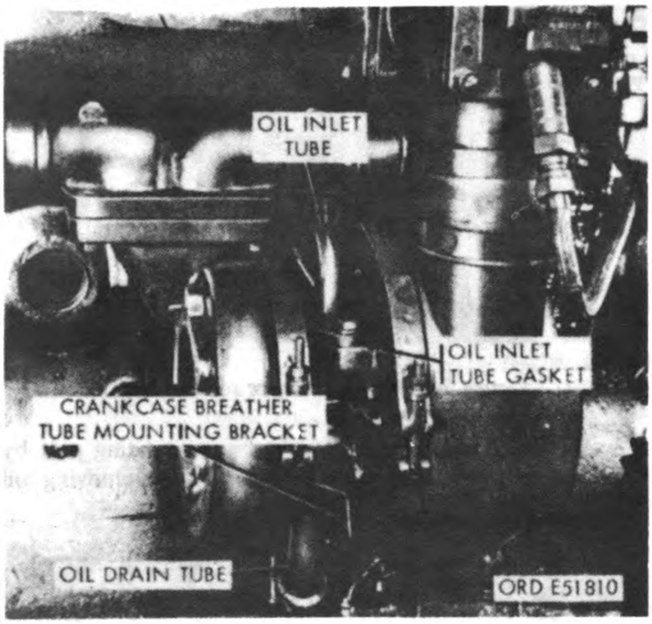


Figure 54.36. Disconnecting lubrication lines at turbocharger – multifuel models.

(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.

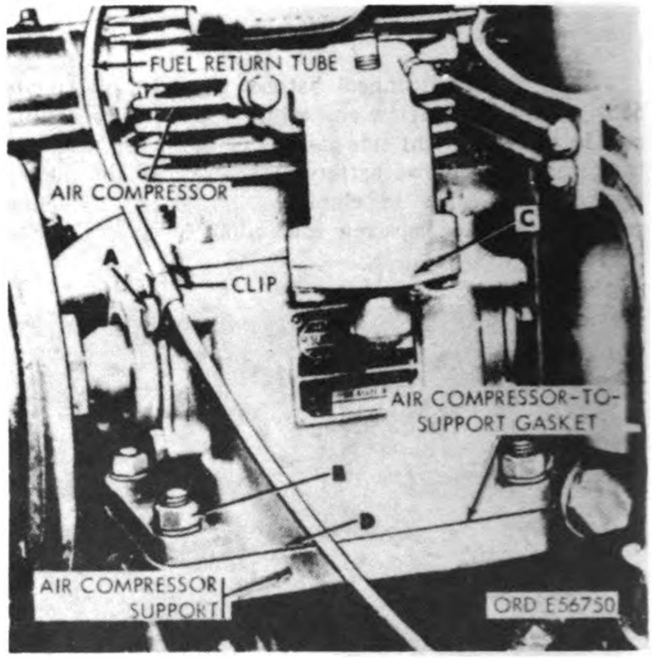


Figure 54.37. Air compressor – Multifuel models.

(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.

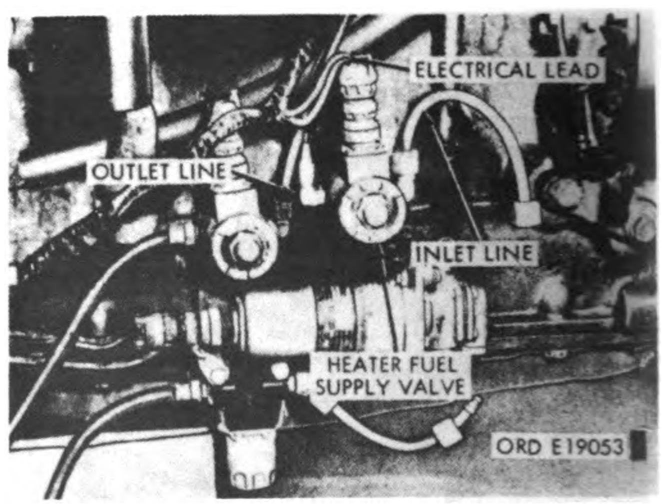


Figure 54.38. Manifold heater supply and fuel return valves – multifuel engine LDS 465-1.

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

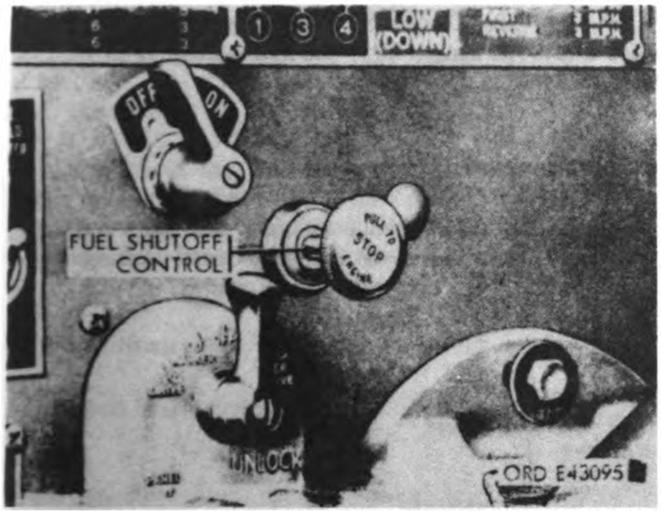


Figure 54.39. Removing fuel shutoff control from instrument panel.

(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).

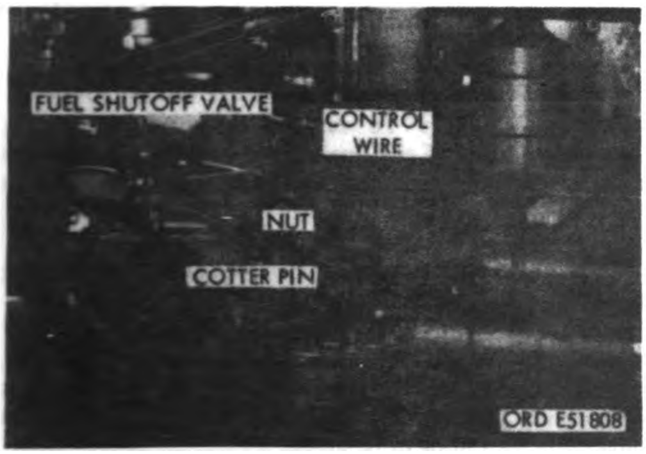


Figure 54.40. Removing fuel shutoff control –multifuel only.

(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.

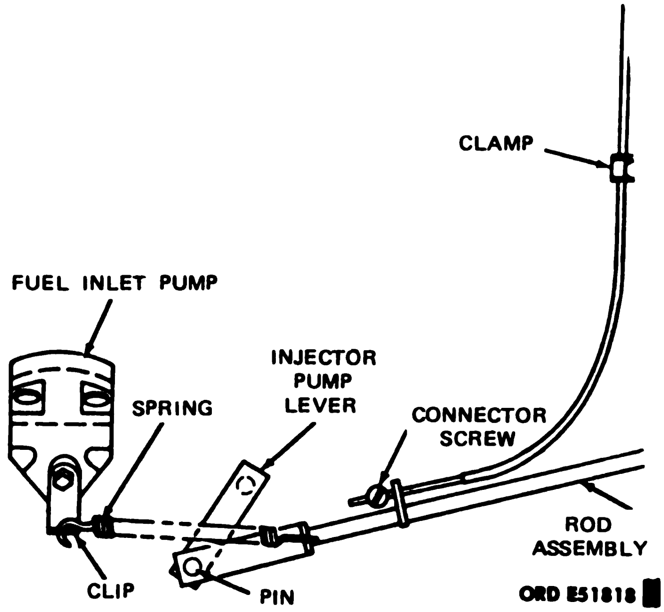


Figure 54.41. Accelerator and throttle linkage at injector pump – diesel and multifuel.

(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.

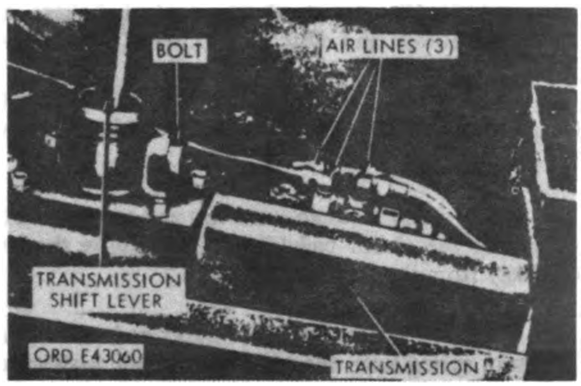


Figure 54.42. Transmission shift lever and air lines above transmission.

(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).

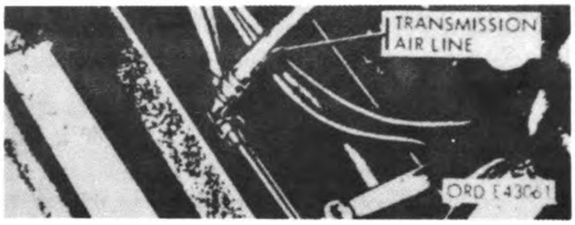


Figure 54.43. Transmission air line under vehicle.

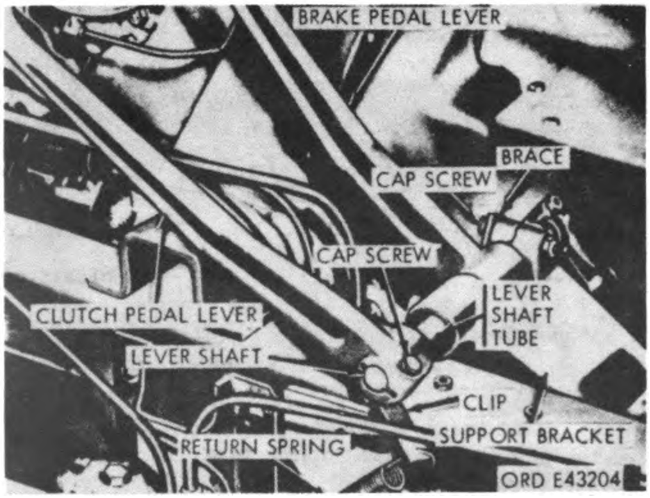


Figure 54.44. Brake and clutch pedal assembly mounted to vehicle.

(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.

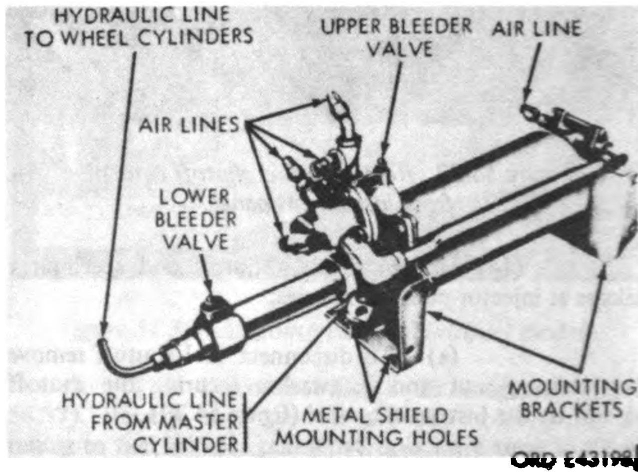


Figure 54.45. Air hydraulic cylinder.

(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

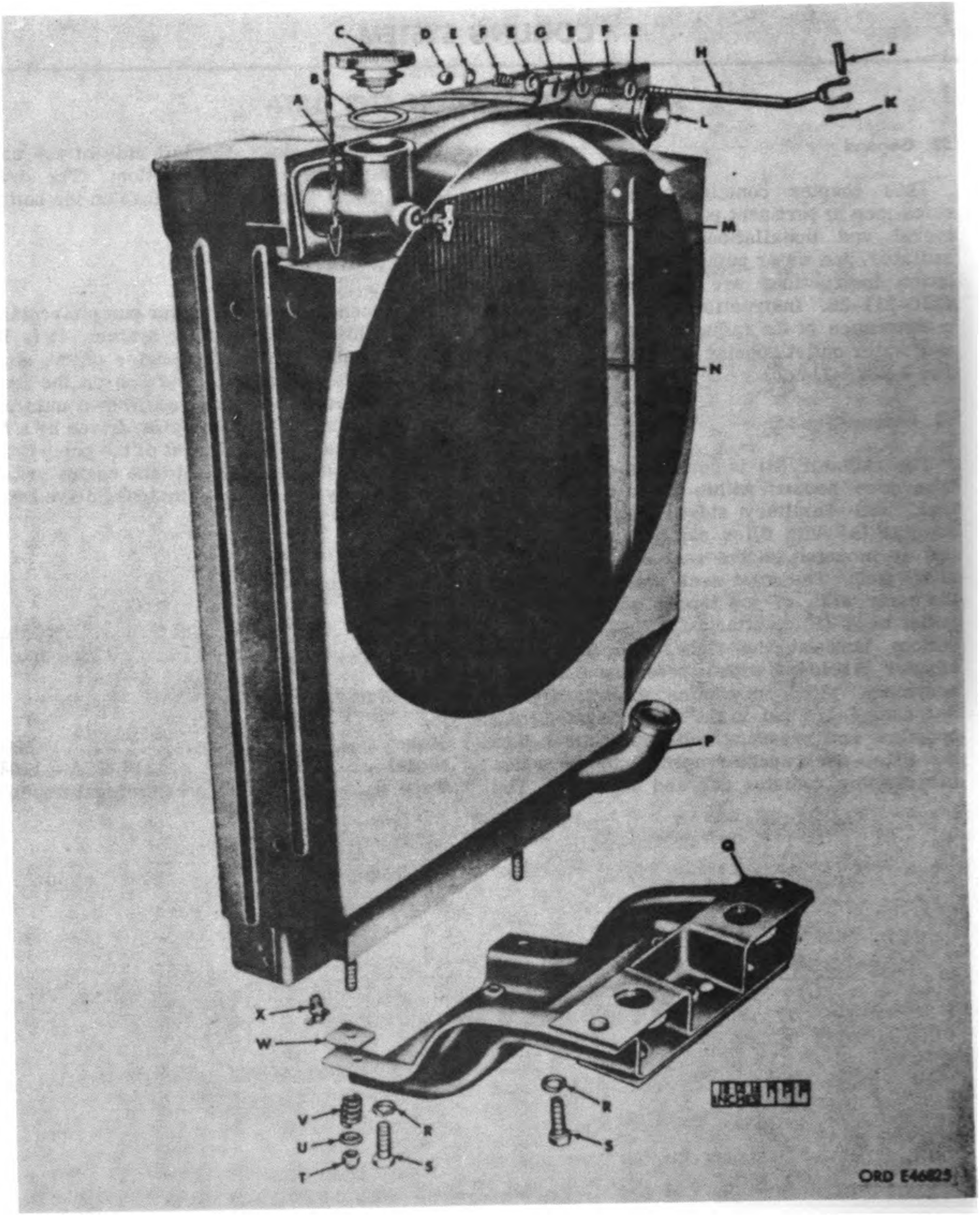


Figure 55. Radiator and mounting parts - exploded view

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

Figure 55. Radiator and mounting parts—exploded view.

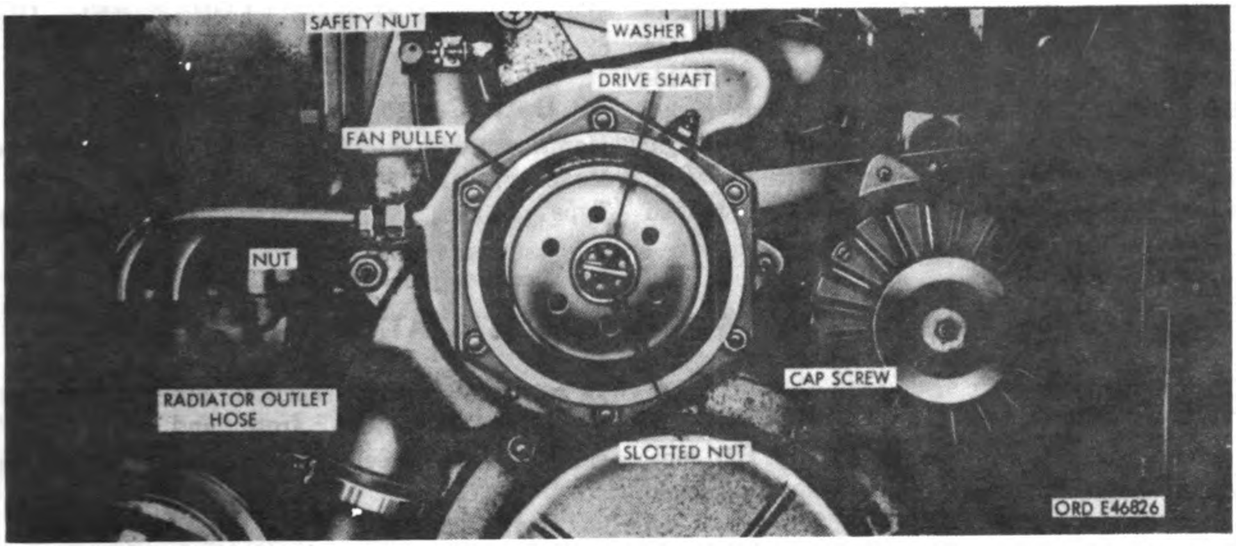


Figure 56. Front view of water pump with fan removed.

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 Multi-fuel 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 may be blocked and one light coat of paint may be applied.

57. Water Pump (Gasoline)

Refer to TM 9-2805-203-35.

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 brackets.

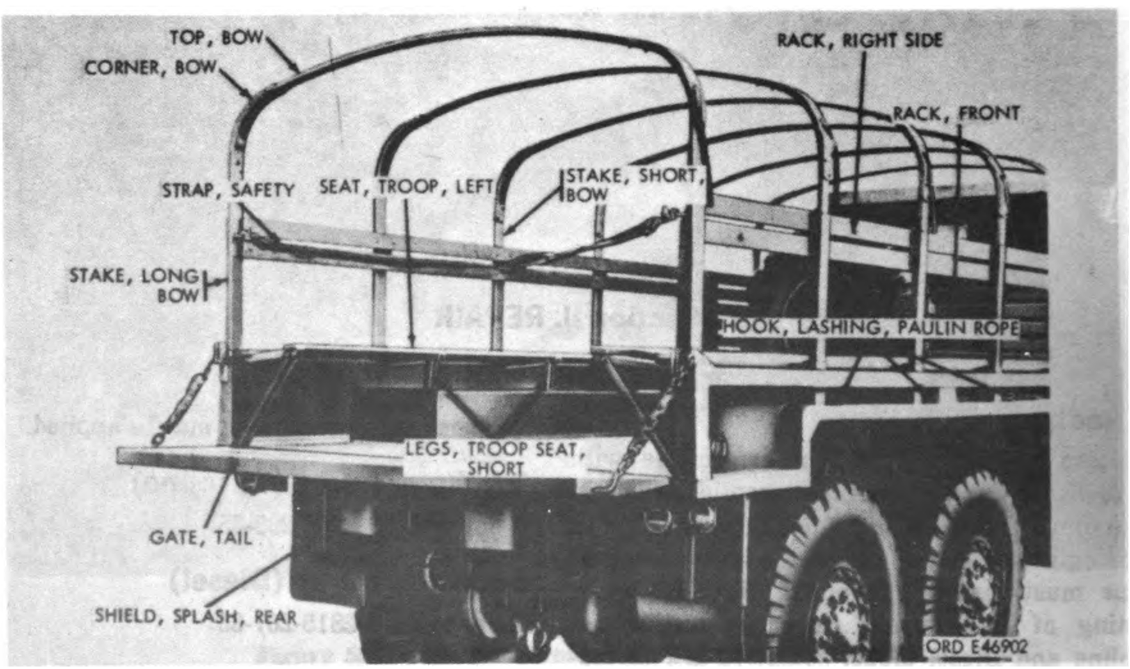


Figure 57. Right rear view of cargo body.

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

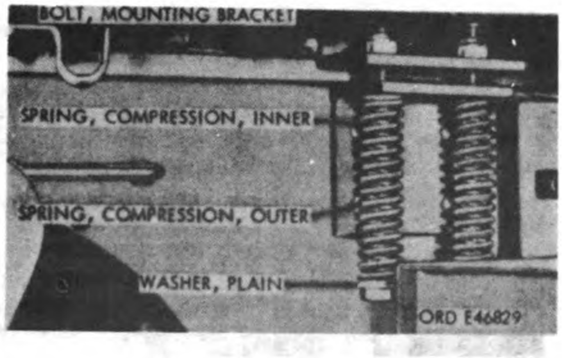


Figure 59. Cargo body mounting - front

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

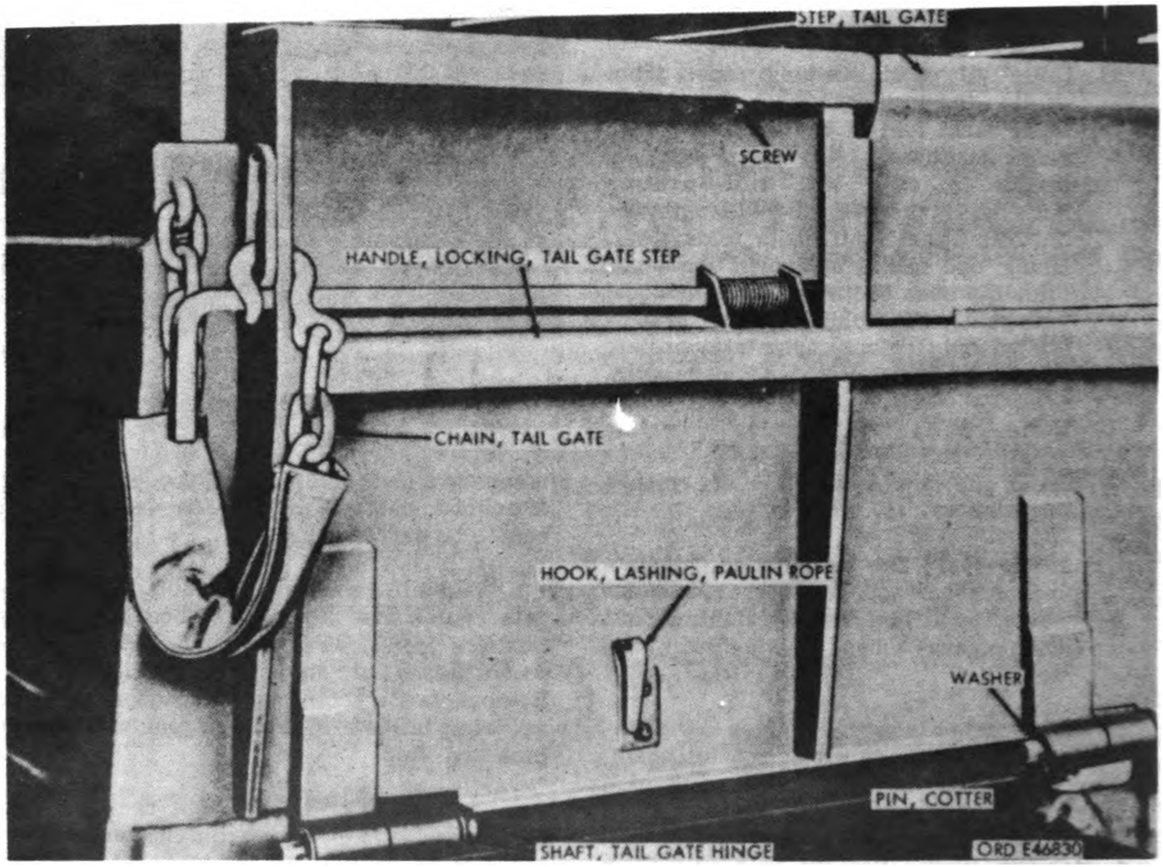


Figure 60. Tailgate assembly

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 aline 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

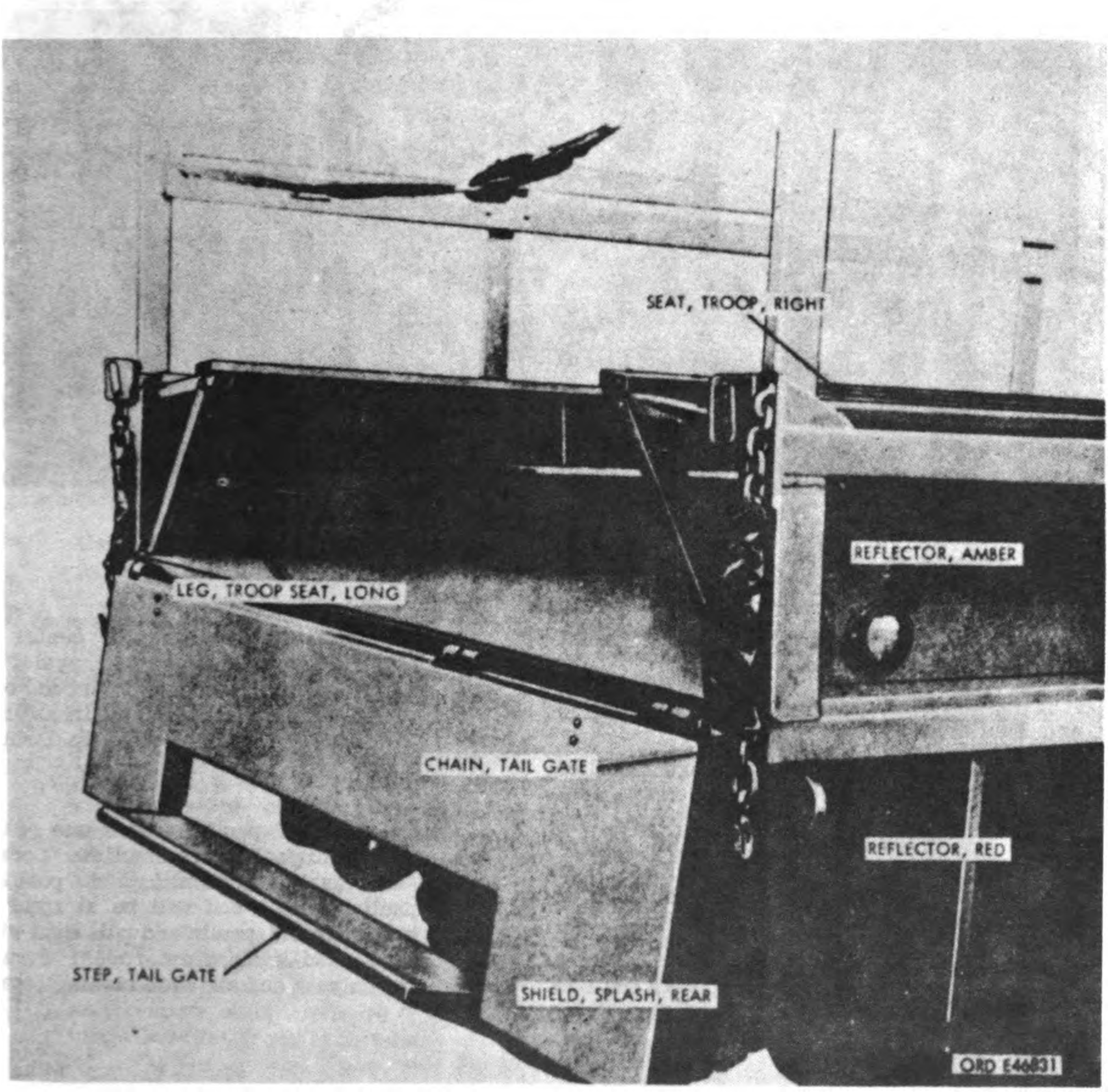


Figure 61. Cargo body tailgate lowered

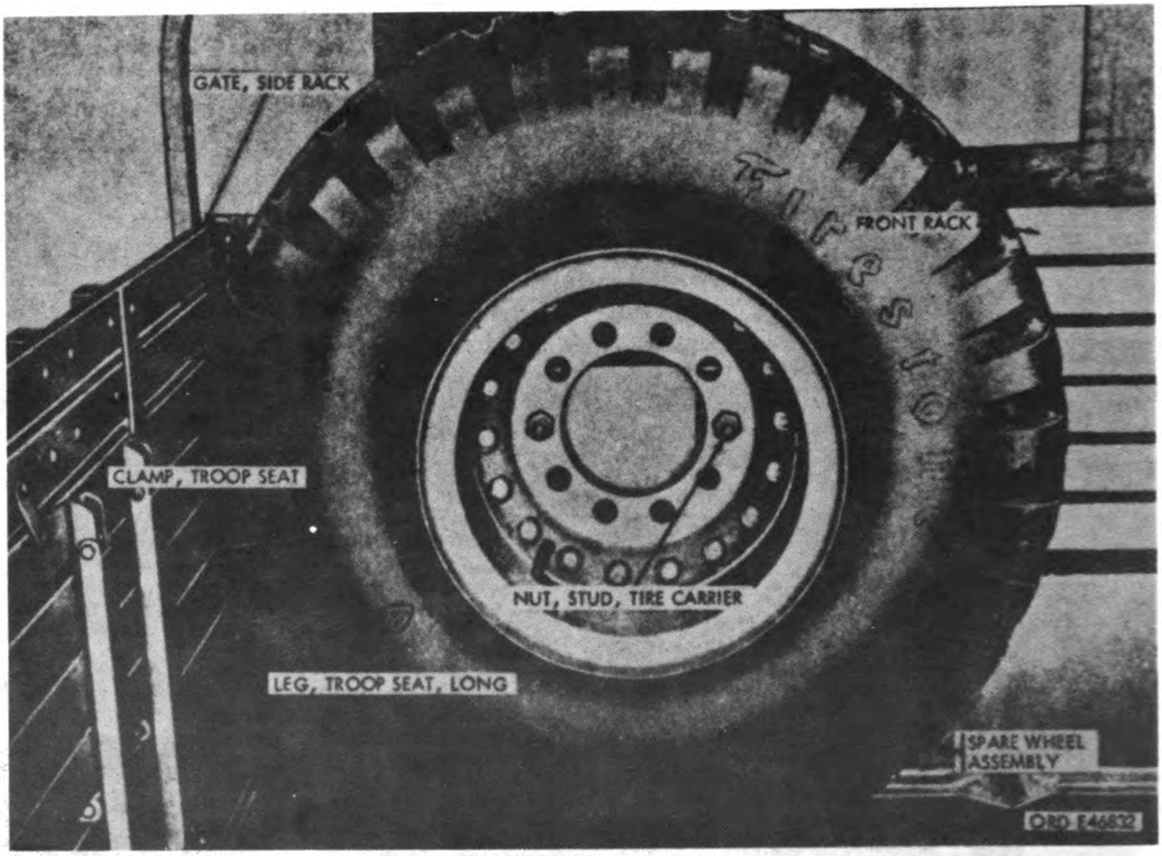


Figure 62. Spare wheel mounted

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

j. 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

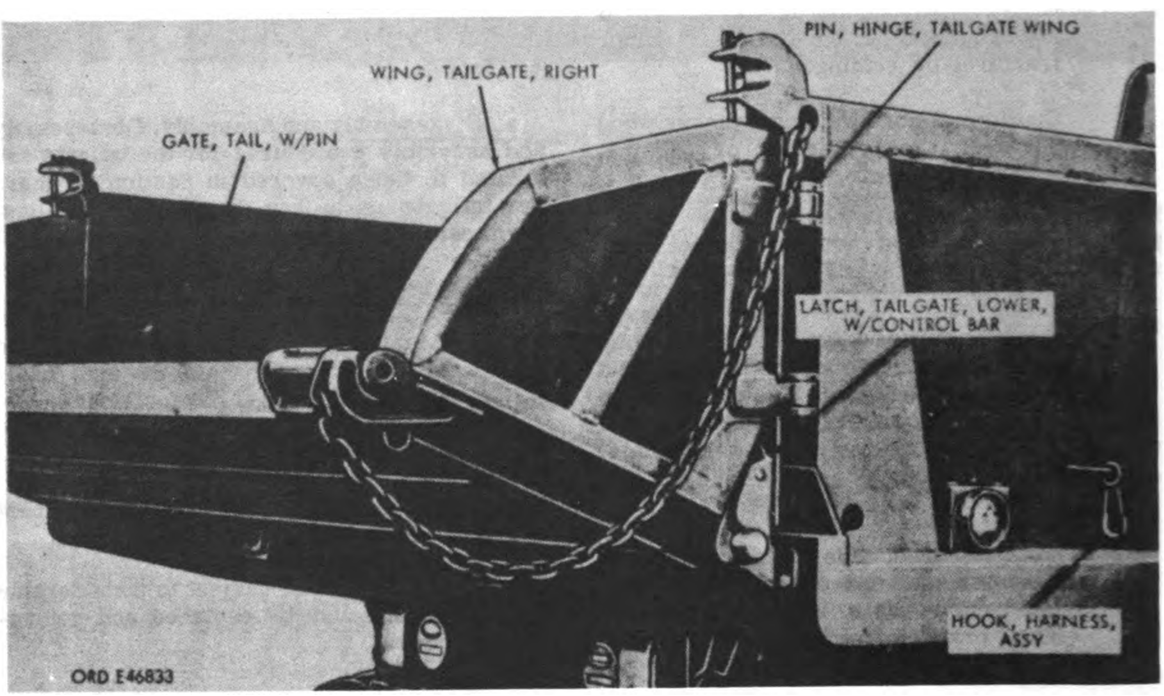


Figure 63. Dump body with tailgate wing assemblies extended

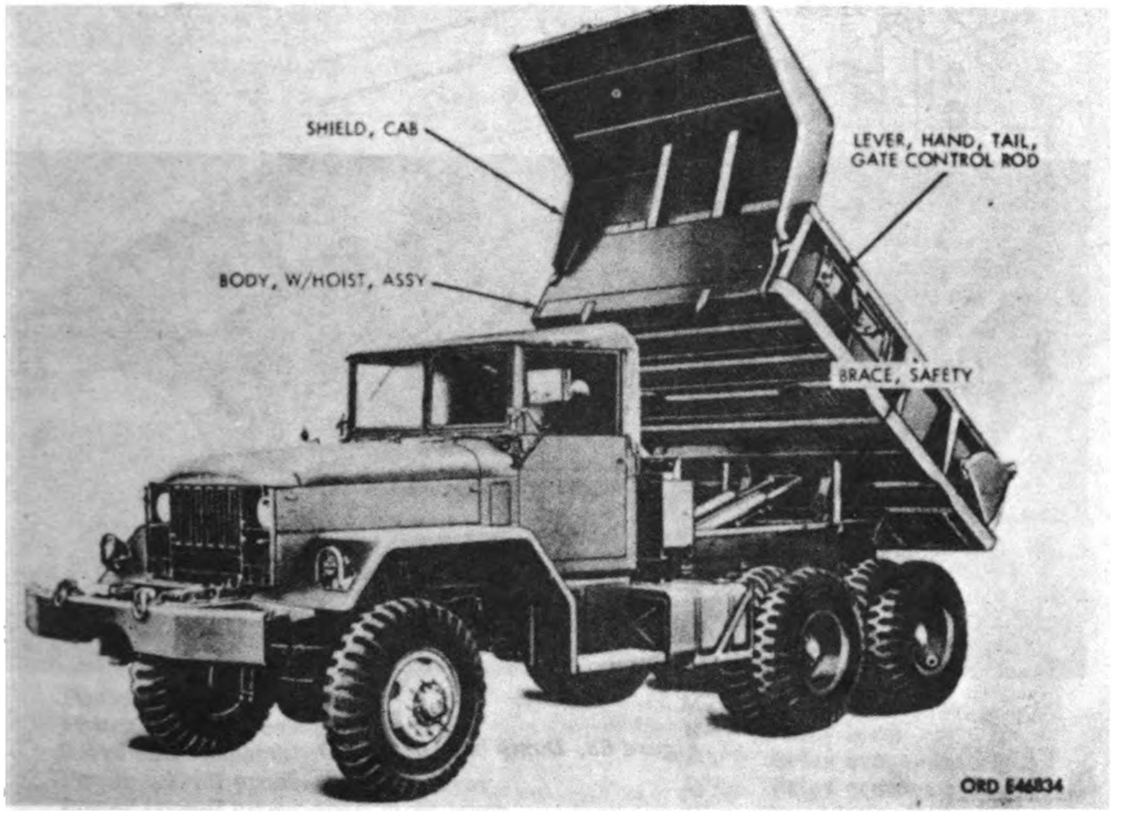


Figure 64. Dump truck M51 (body lifted) - left front view

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

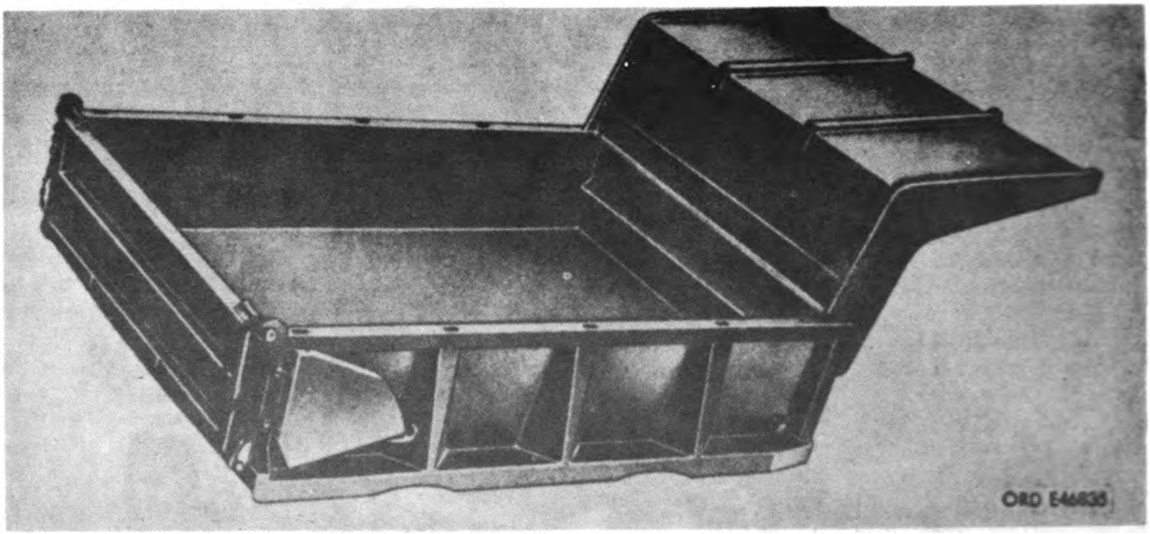


Figure 65. Dump body assembly

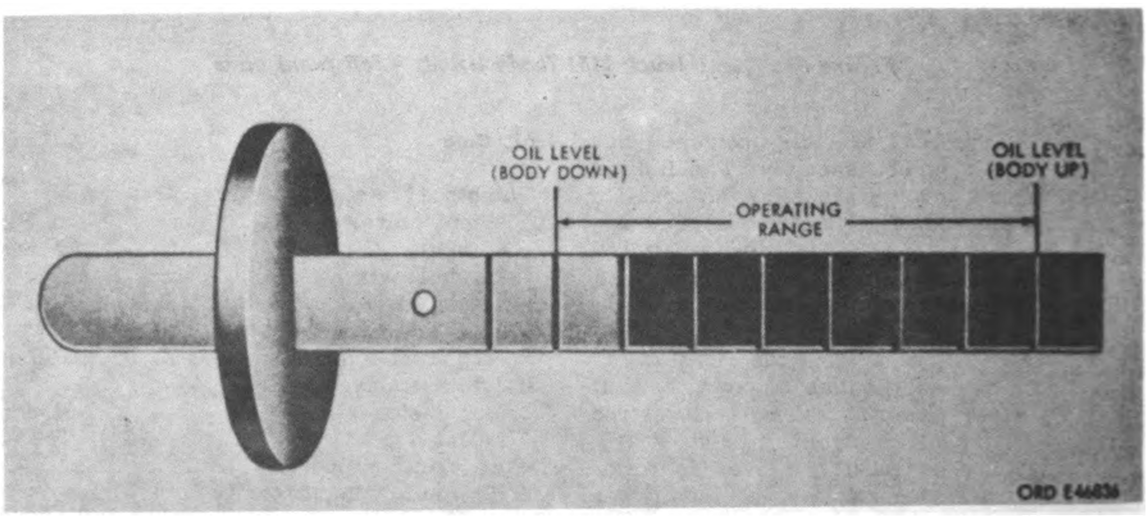


Figure 66. Oil level gage for hoist assembly

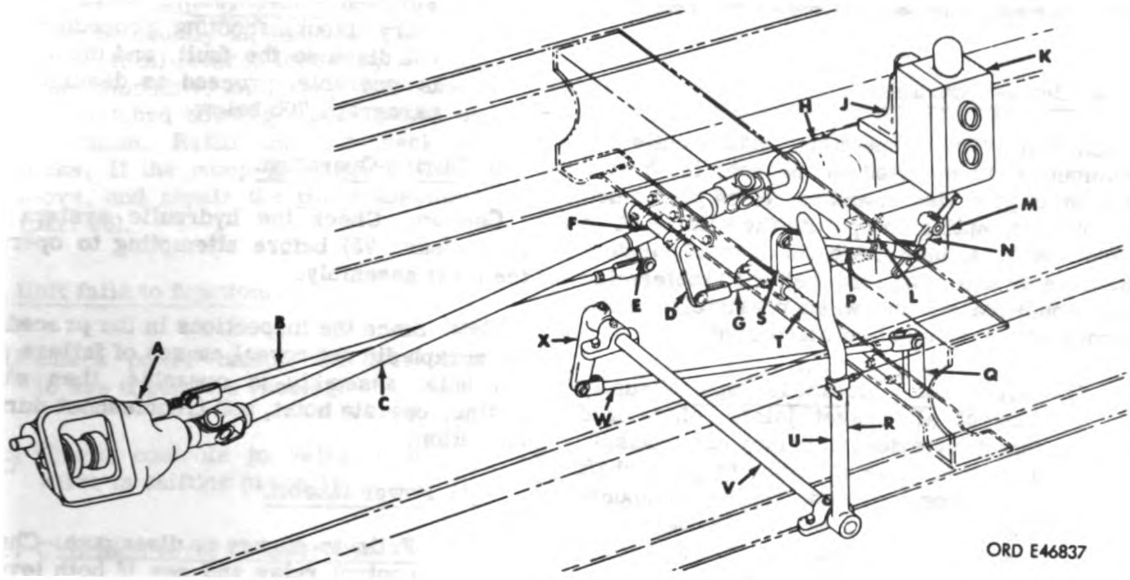


Figure 67. Hoist assembly control linkage

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.

70. Troubleshooting Hoist Assembly Before Removal

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.

71. Troubleshooting Hoist Assembly After Removal

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

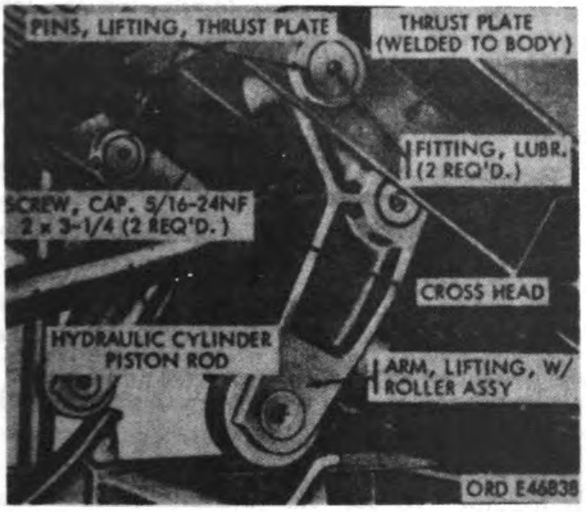


Figure 68. Dump body lifting arms disconnect points.

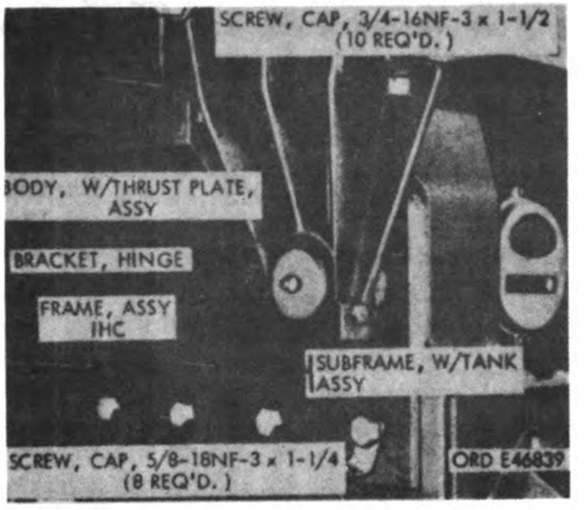


Figure 69. Dump body hinge bracket and subframe to rear frame disconnect points.

(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.

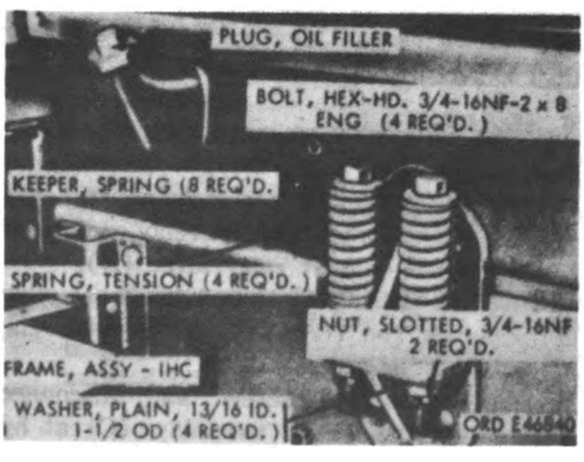


Figure 70. Subframe to frame front disconnect points.

(5) Control linkage assembly (fig. 67).

(*a*) Install drive shaft assembly (C) on hydraulic pump (H), making certain the Woodruff key is properly alined. 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.

(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 cab shield (fig. 64) to body. Remove cab 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. 63) 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.

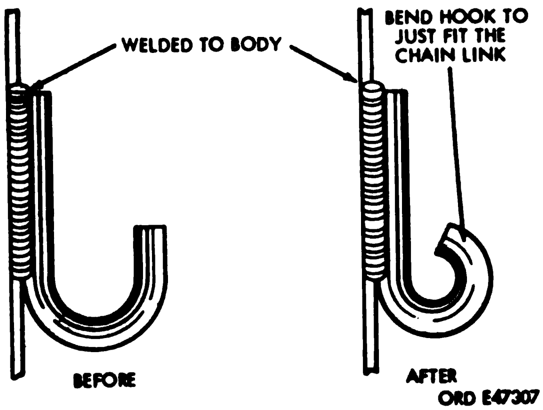


Figure 71. Tailgate wing chain hook

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). Aline 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.

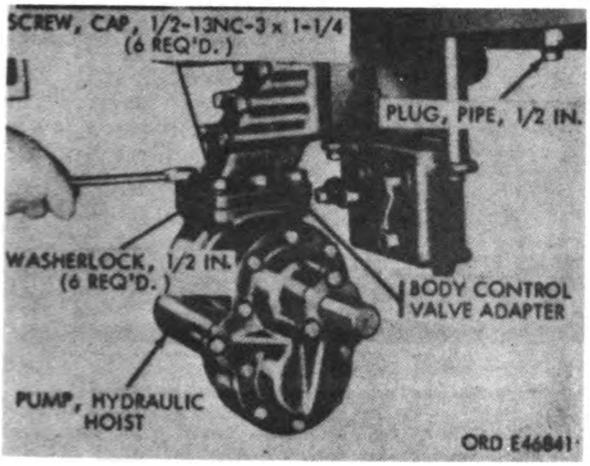


Figure 72. Removing hoist hydraulic pump.

(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.

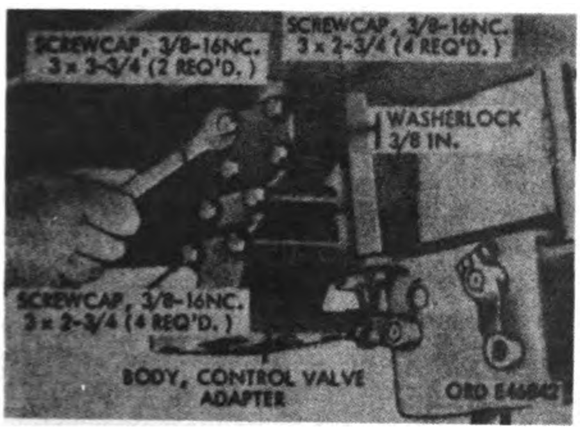


Figure 73. Removal of control valve adapter assembly.

(3) *Remove control relay.*

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

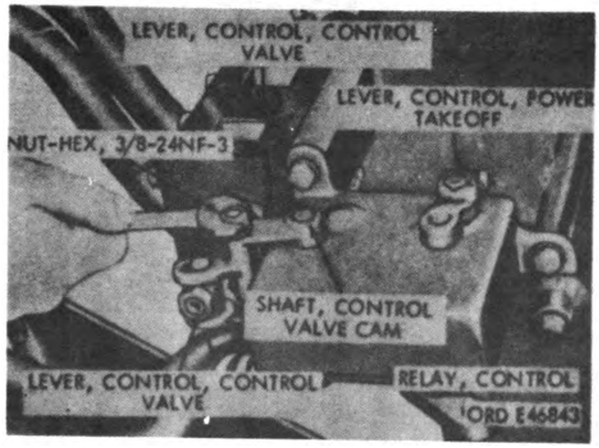


Figure 74. Remounting control valve control levers.

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

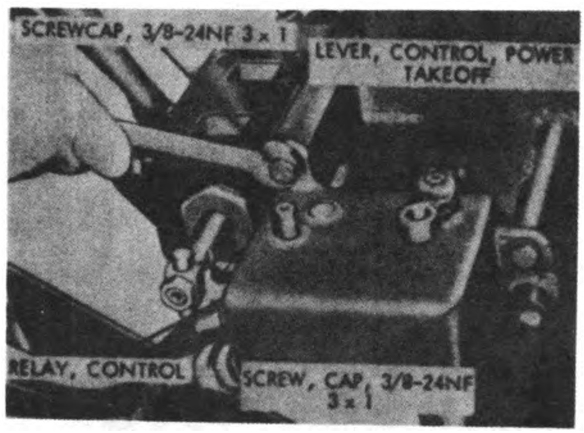


Figure 75. Removing control relay.

(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.

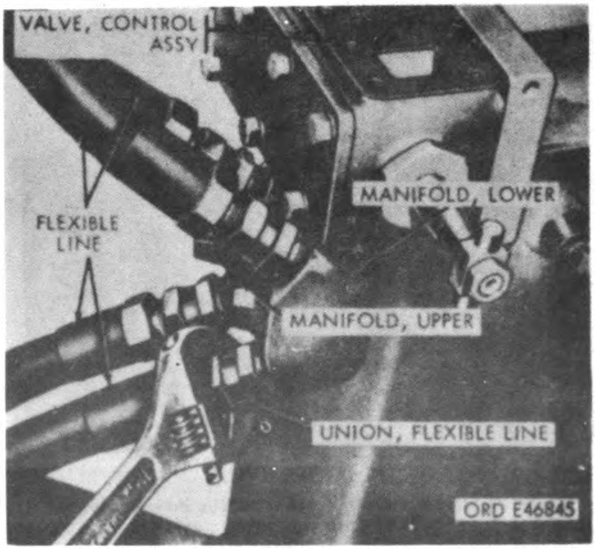


Figure 76. Disconnecting flexible lines at manifolds.

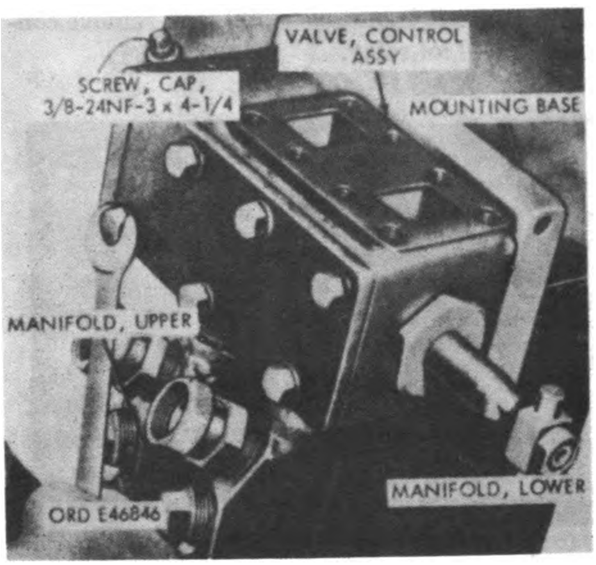


Figure 77. Removing control valve assembly with manifolds.

(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 crosshead retainer (fig. 79). Remove the upper and lower retainers and crosshead from end of hydraulic cylinder piston rods.

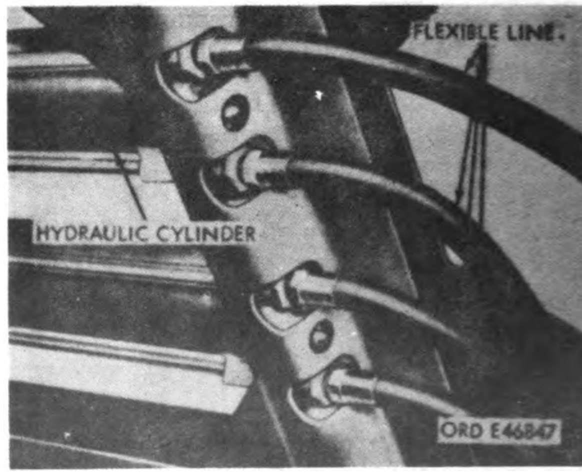


Figure 78. Location of flexible lines at hydraulic cylinders.

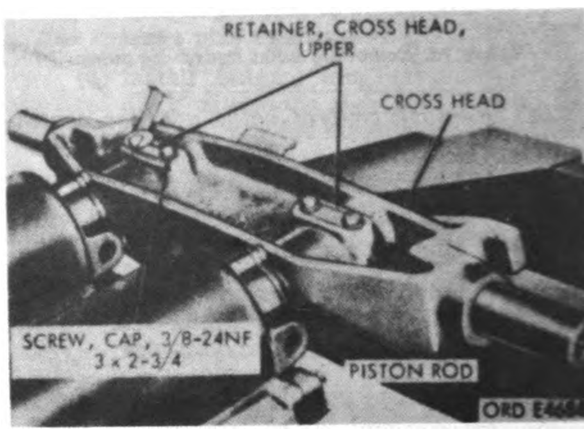


Figure 79. Disconnecting crosshead from hydraulic cylinder piston rods.

(*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.**

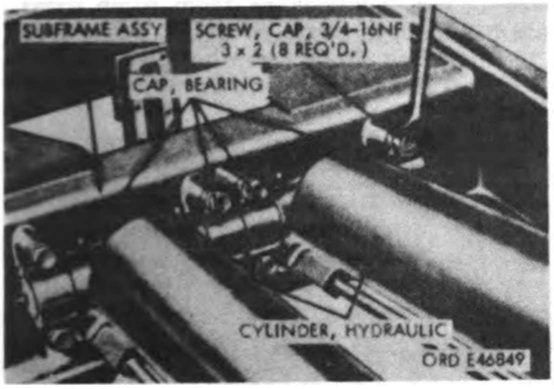


Figure 80. Removing bearing cap

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.

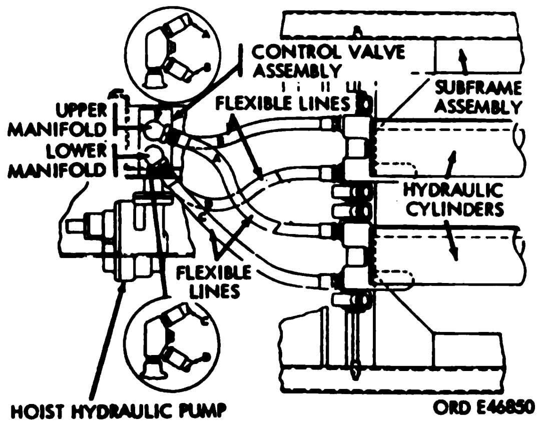


Figure 81. Hoist assembly flexible lines

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.

(3) 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).

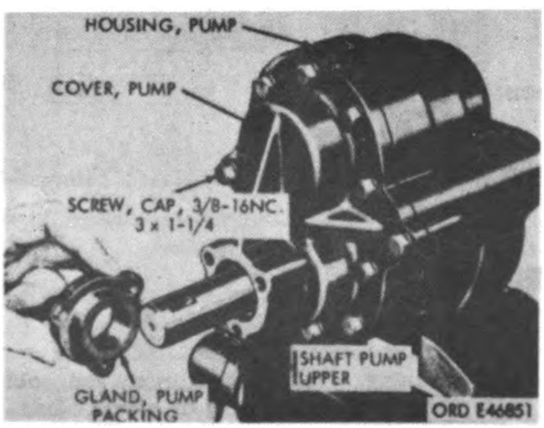


Figure 82. Removing pump packing gland from shaft

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

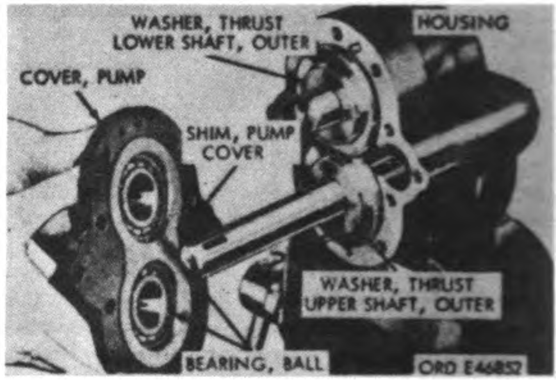


Figure 83. Removing pump cover from pump housing

(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

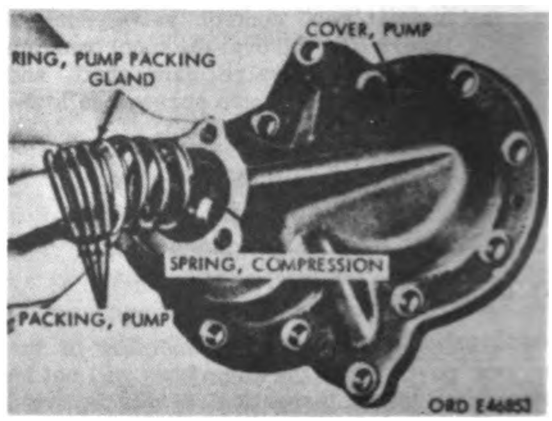


Figure 84. Disassembling pump cover

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

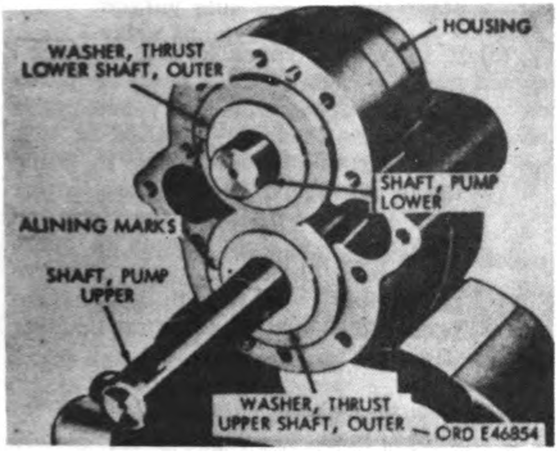


Figure 85. Pump housing with cover removed

(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.

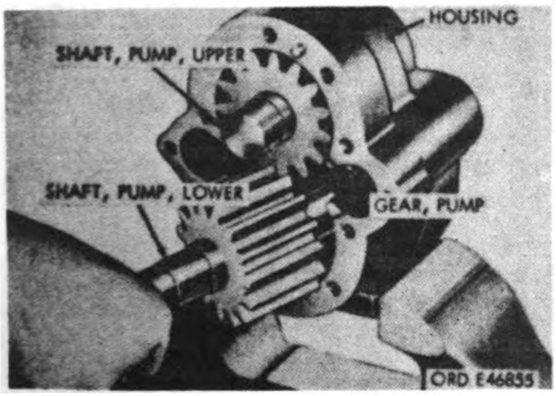


Figure 86. Removing shafts with gears from pump housing

(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.

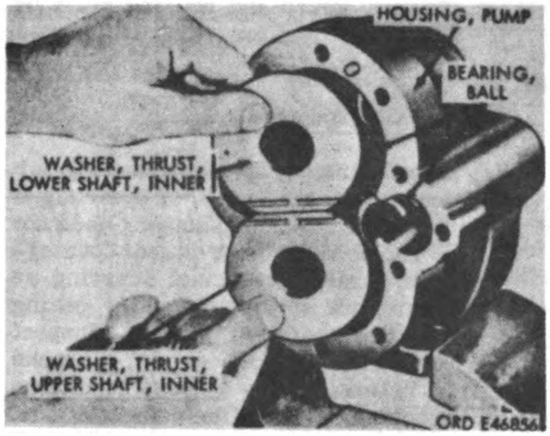


Figure 87. Removing upper and lower shaft inner thrust washers

(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, mars, or other signs of wear. The pump housing need not be replaced for wear in gear counterbore, 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.

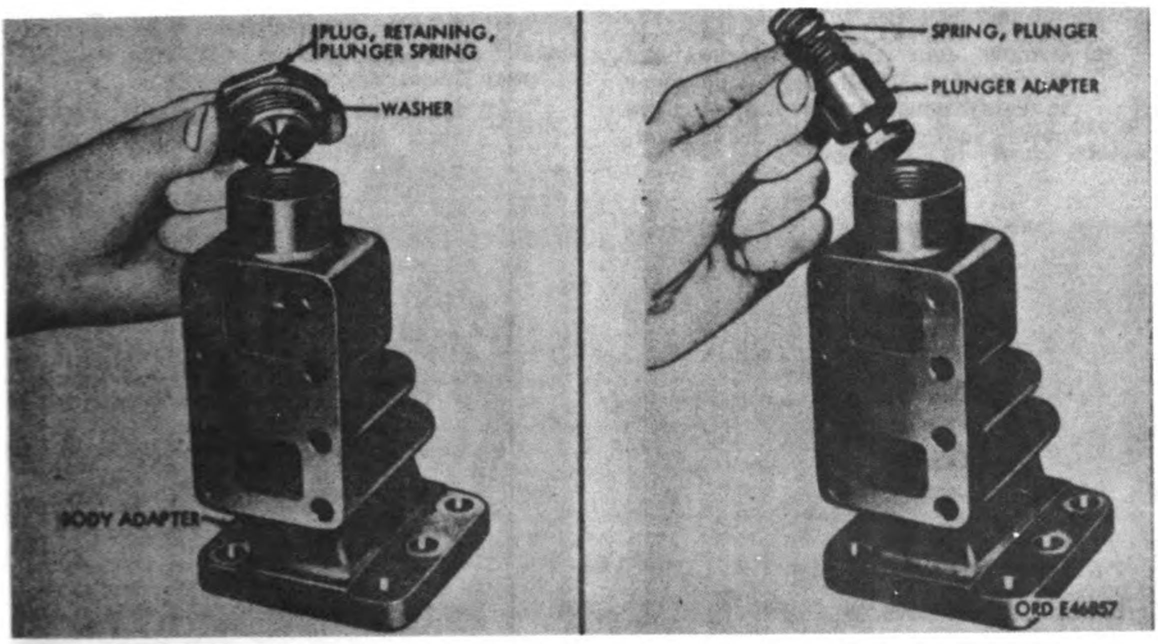


Figure 88. Disassembling control valve adapter

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.

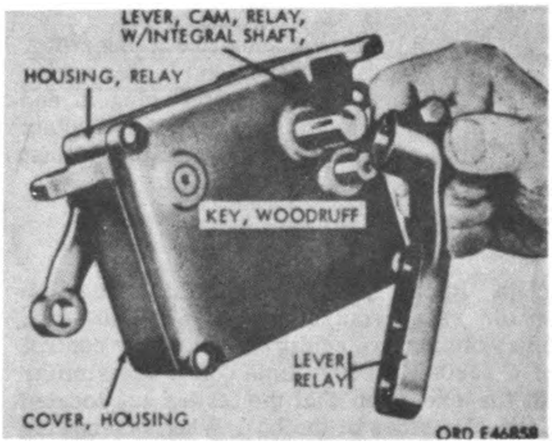


Figure 89. Control relay lever removal

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

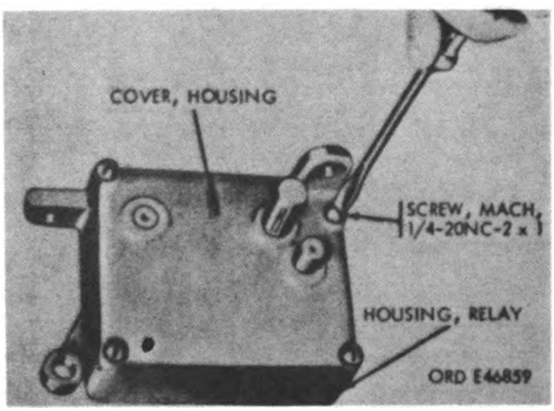


Figure 90. Removal of control relay housing cover

(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).

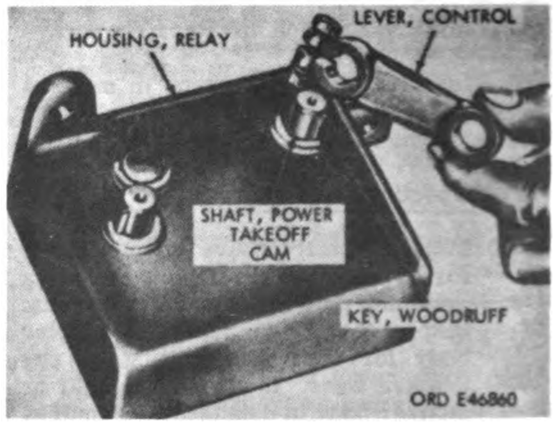


Figure 91. Power takeoff control lever removal

(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).

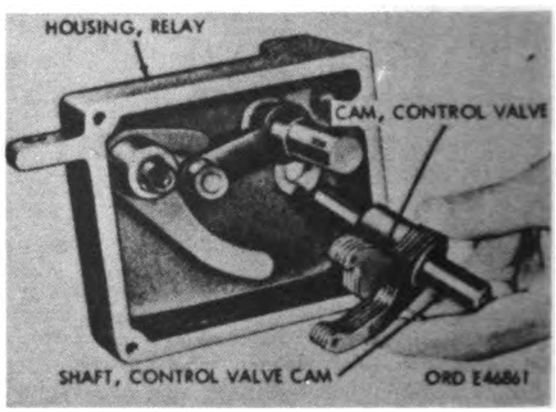


Figure 92. Control valve cam and shaft assembly removal

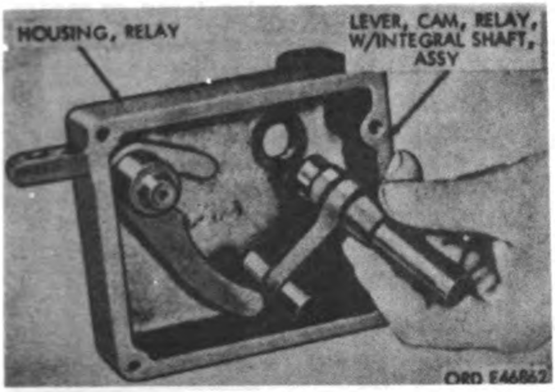


Figure 93. Control relay cam lever with integral shaft assembly removal

(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 alining 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.

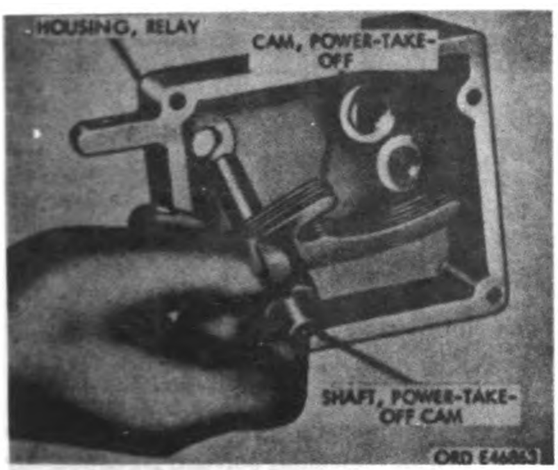


Figure 94. Removing power takeoff cam and shaft assembly

Figure 95. Control valve cam to shaft alining 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 alining marks

Inspect shafts for nicks, burs, 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 alining 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 alining 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.

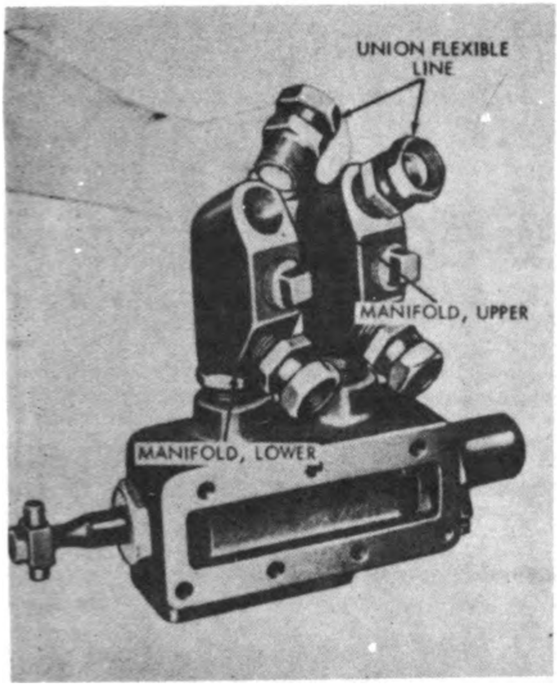
(a) Loosen spool retaining plug from control valve body. Remove valve spool from control valve body (fig. 100).

(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.



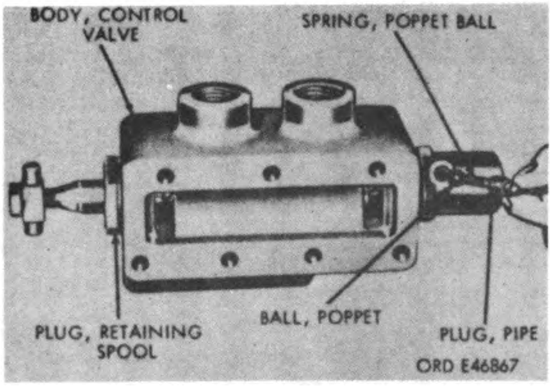


Figure 98. Removing poppet ball

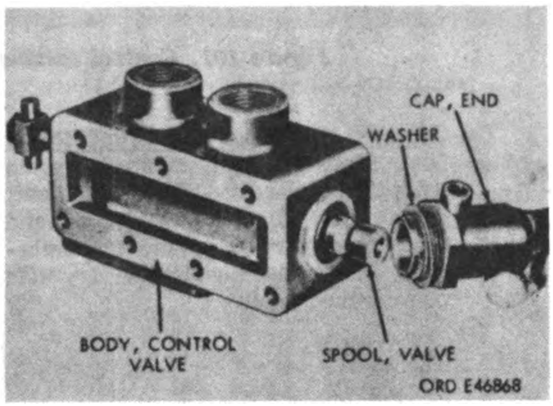


Figure 99. Removing control valve end cap from control valve body

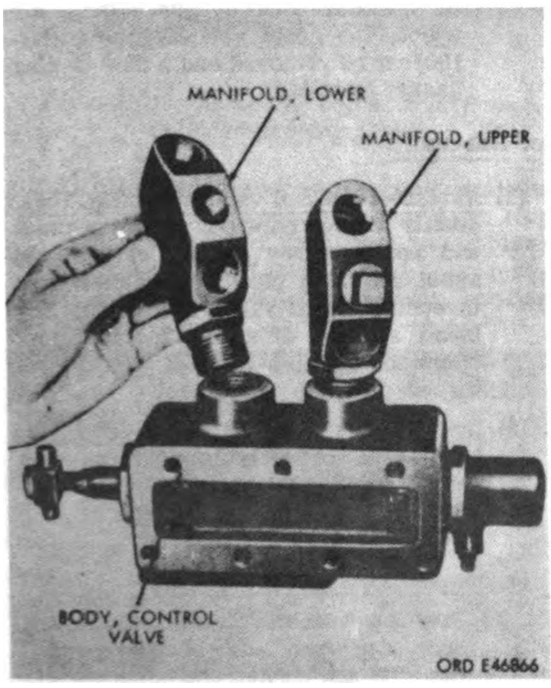


Figure 97. Disassembling manifolds from control valve body

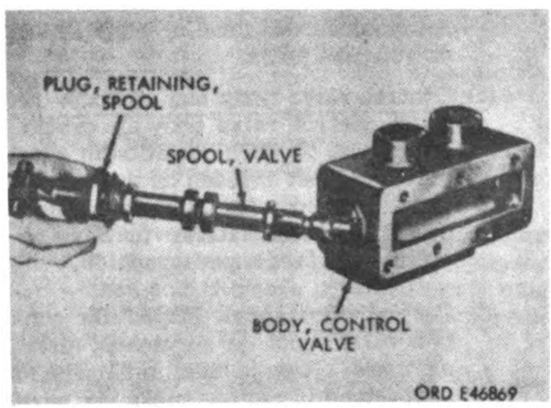


Figure 100. Removing control valve spool

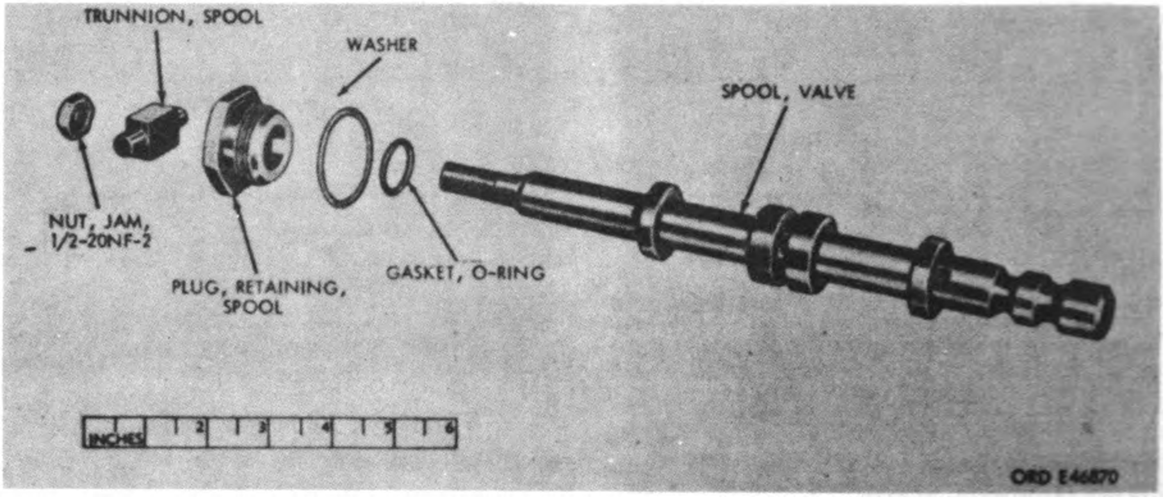


Figure 101. Control valve spool assembly - exploded view

(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 lockwashers attaching cylinder packing gland to hydraulic cylinder (fig. 102).

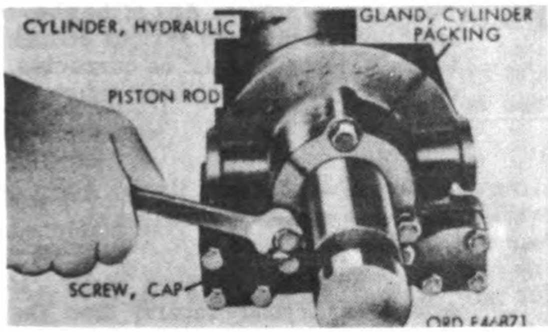


Figure 102. Removing cap screws from cylinder packing gland

(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.

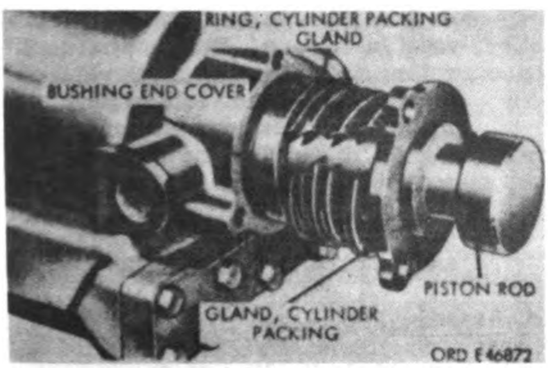


Figure 103. Cylinder packing gland and bushing disassembled

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

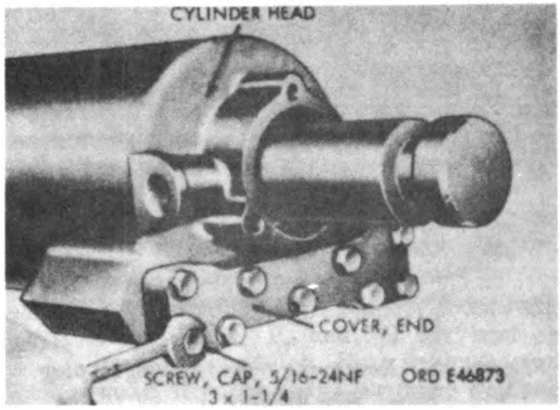


Figure 104. Removing end cover

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

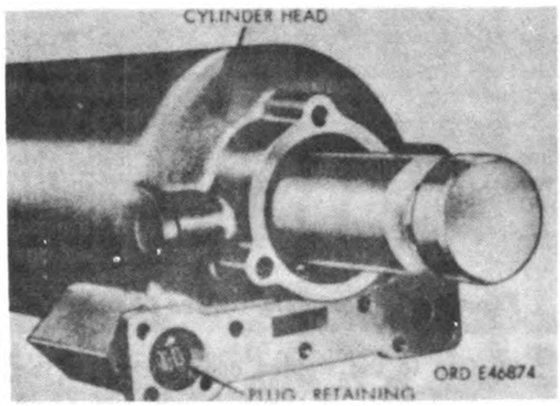


Figure 105. Location of bypass plunger spring retaining plug

(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.

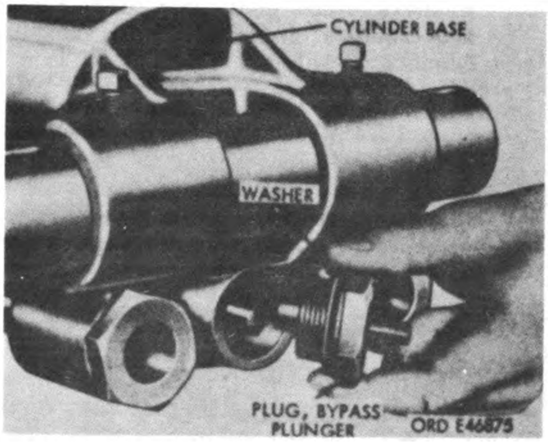


Figure 106. Removing bypass plunger plug and washer

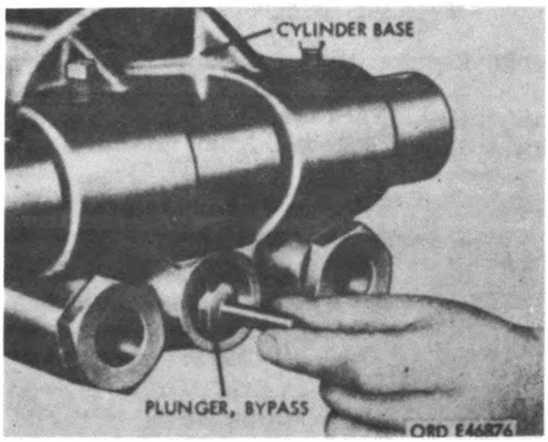


Figure 107. Removing bypass plunger

(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, burs, 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, burs on machined surface. Remove nicks or burs 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 accomplished 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 (B, 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
	HOIST HYDRAULIC PUMP	
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
	CONTROL VALVE ADAPTER ASSEMBLY	
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
	CONTROL VALVE ASSEMBLY	
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.

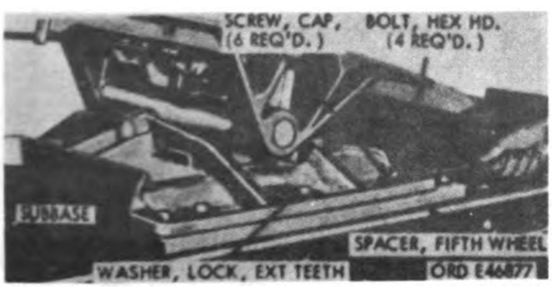


Figure 108. Fifth wheel mounting

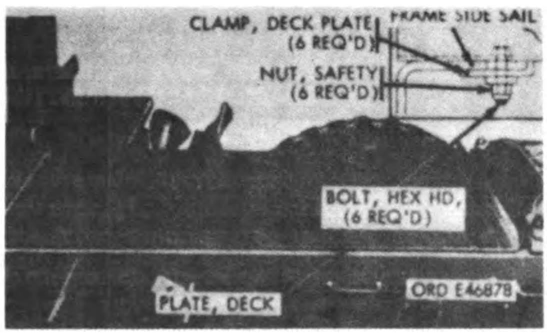


Figure 109. Removal of center deck plate

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.

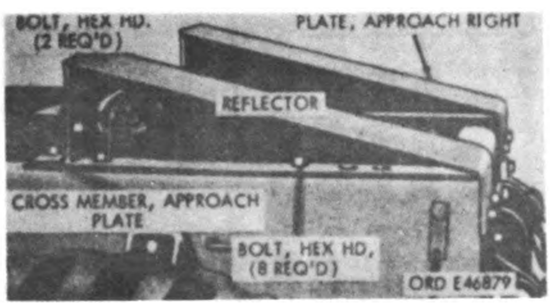


Figure 110. Approach plate assembly mounting

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).

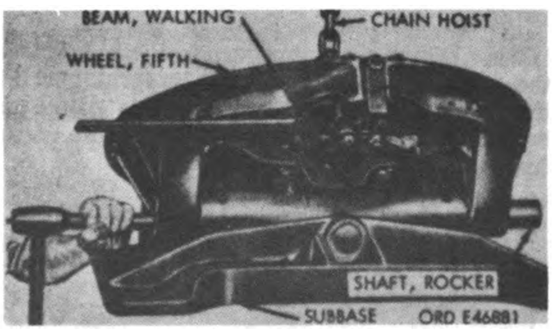


Figure 112. Driving out rocker shaft

(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.

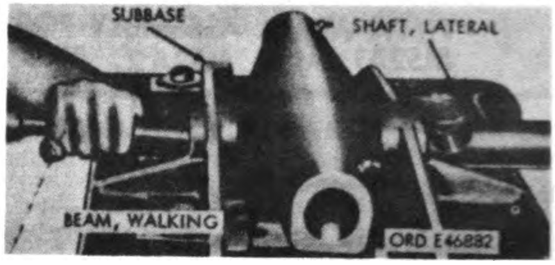


Figure 113. Removing lateral shaft

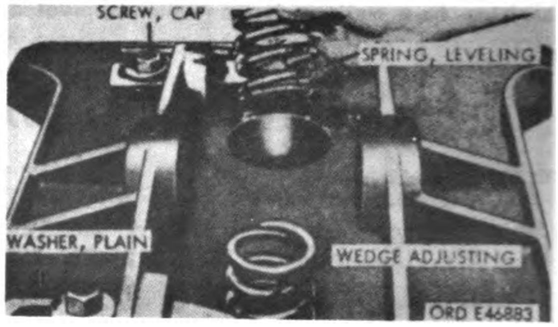


Figure 114. Removing leveling springs

(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.

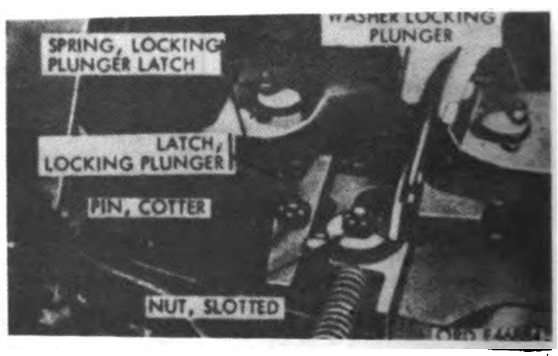


Figure 115. Removing locking plunger latch

(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.

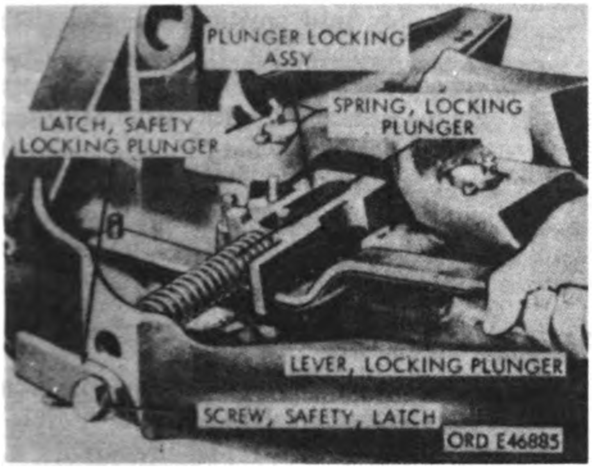


Figure 116. Removing locking plunger.

(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 compressed 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 aline with rocker shaft hole in walking beam.

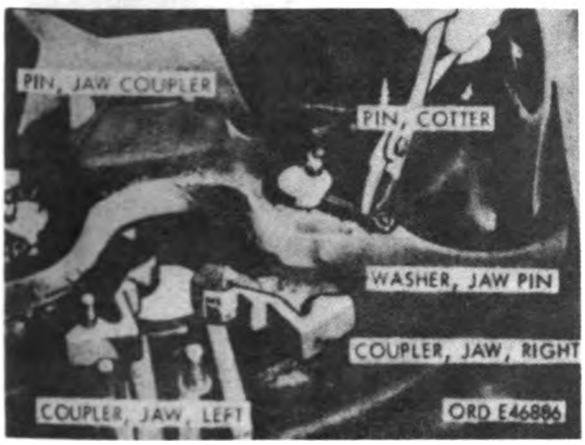


Figure 117. Removing jaw coupler pins.

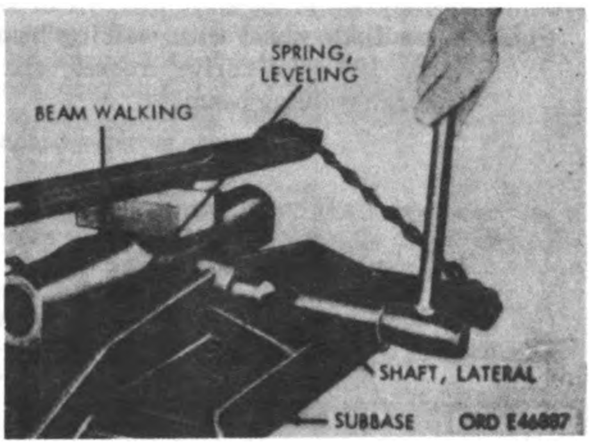


Figure 118. Assembling walking beam to subbase.

(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 aline 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 lätch, 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) Aline 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).

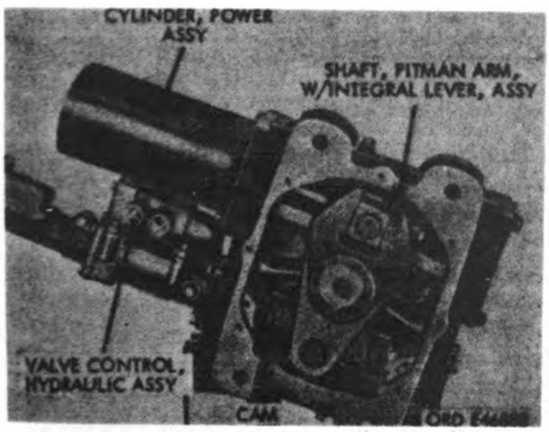


Figure 119. Right side view of steering gear with cover removed

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.

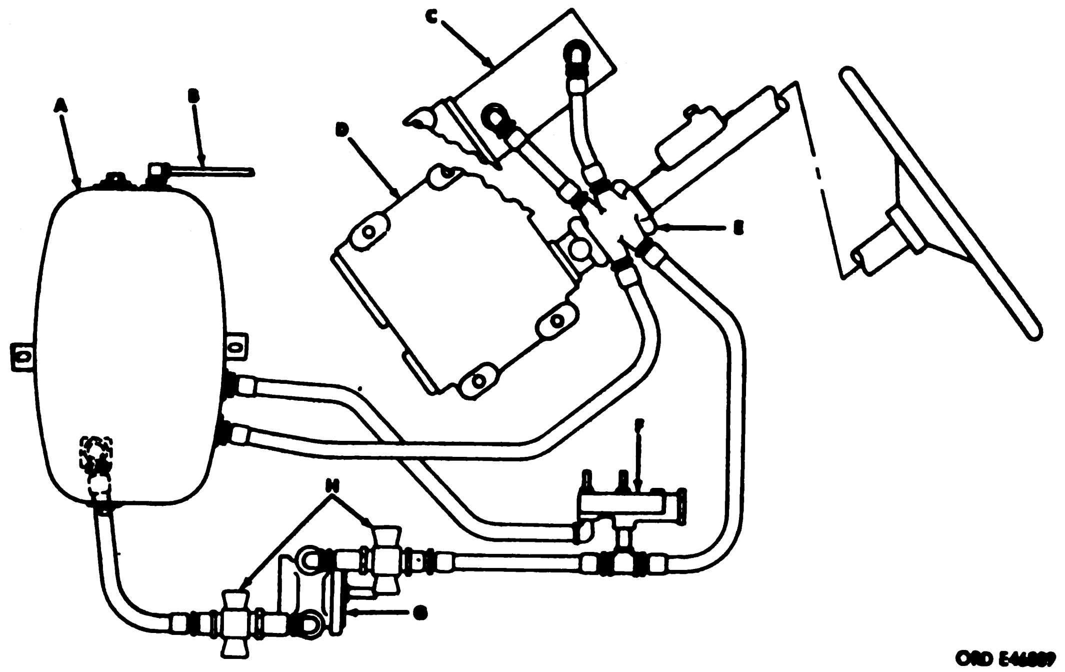


Figure 120. Steering gear hydraulic piping diagram

Key		Key	
A	Oil reservoir	E	Hydraulic control valve
B	Vent line	F	Relief valve assembly
C	Power cylinder assembly	G	Hydraulic pump assembly
D	Steering gear housing	H	Self-sealing couplings

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.

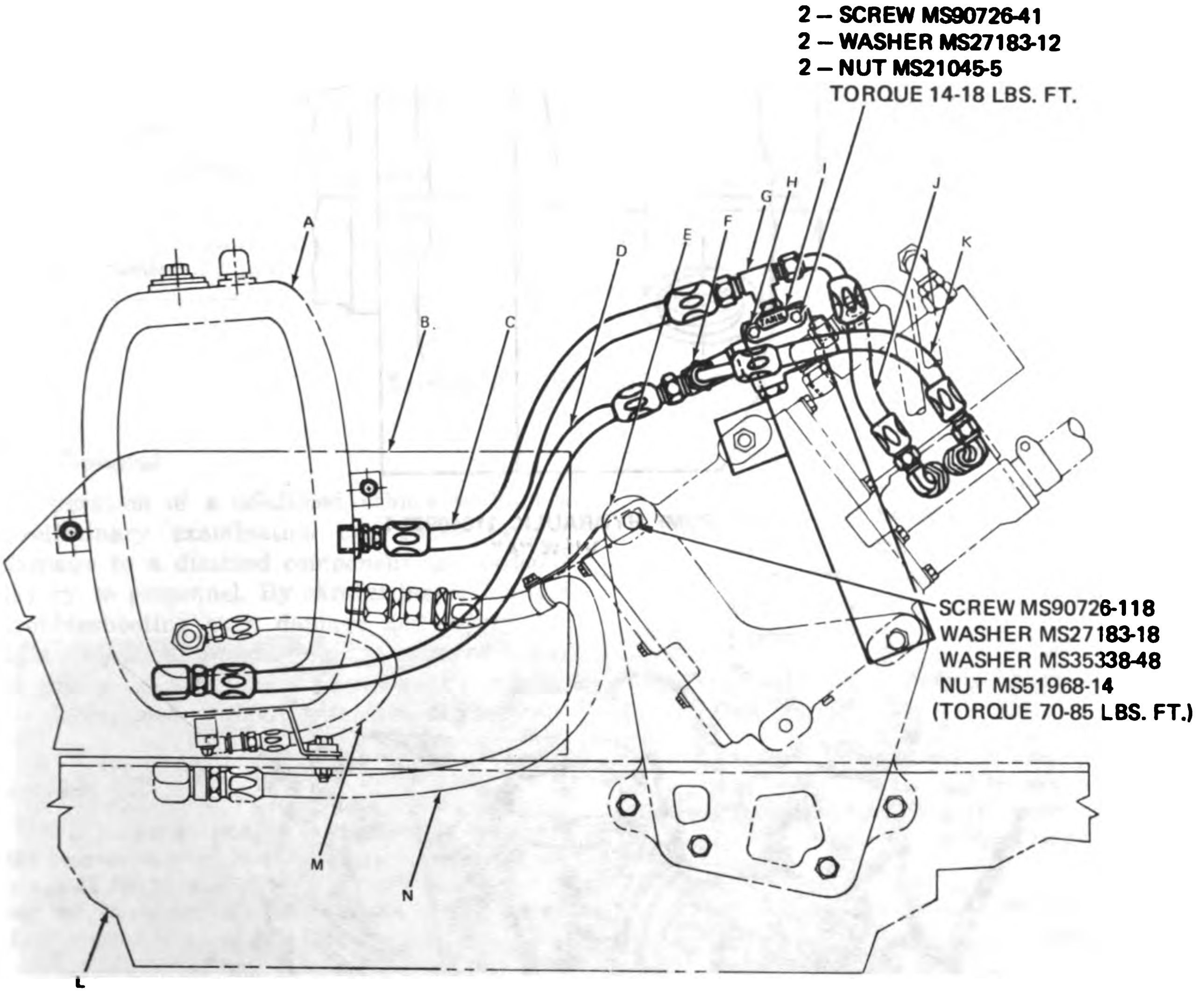
97. Data

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)

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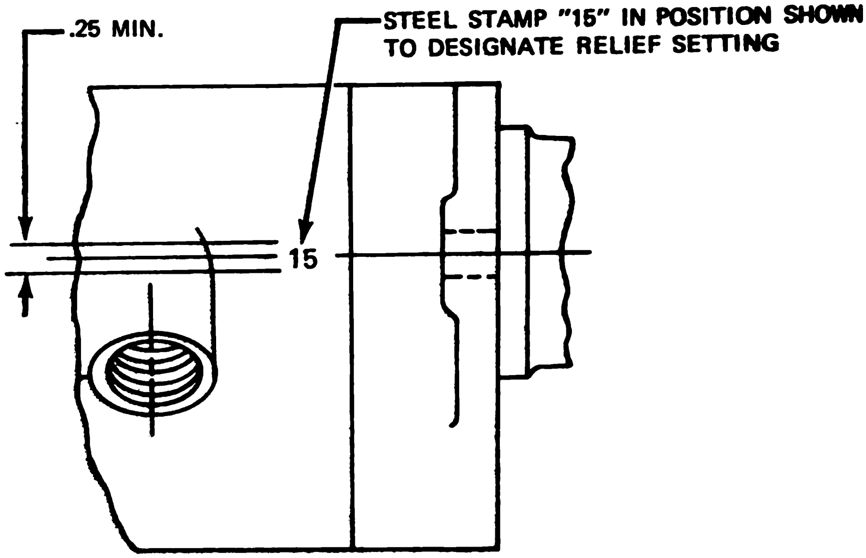
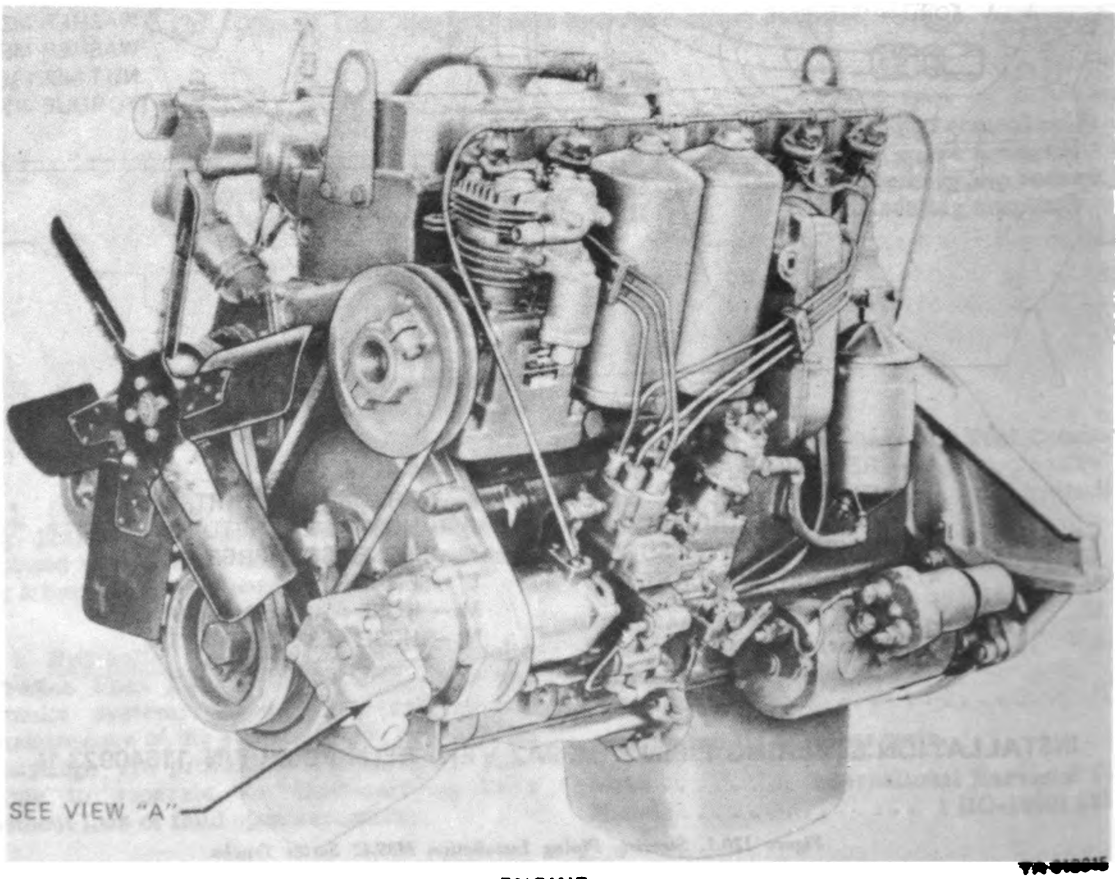
INSTALLATION STEERING PIPING (M39A2 VEH. WITH PUMP P/N 11640923-1)

Figure 120.1. Steering Piping Installation M39A2 Series Trucks.



PUMP HYDRAULIC 11640823-1
VIEW "A"



ENGINE

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
Ordnance number	7409294

d. Hydraulic Pump.

Make	Pesco
Model	PS-052057-50-01
Ordnance 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.
Ordnance 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 complaints 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 inspections 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 103*a*).

(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.

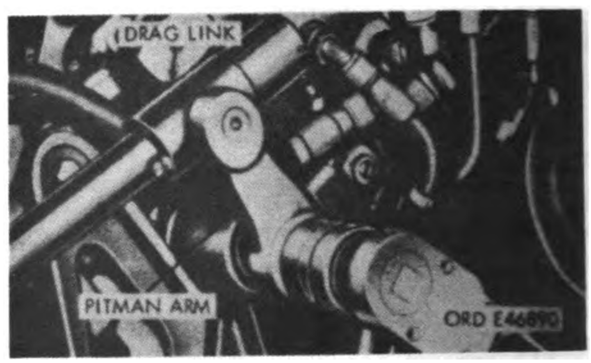


Figure 122. Removing pitman arm.

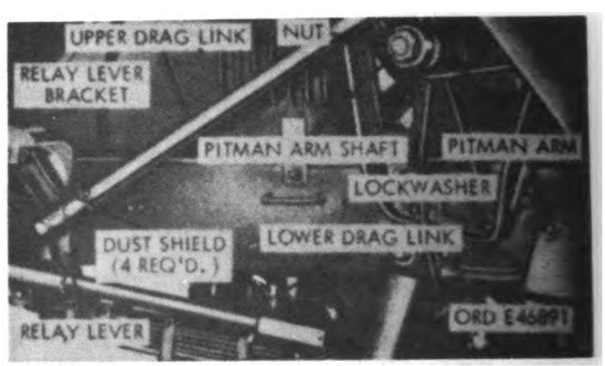


Figure 123. Steering linkage installed under left front fender.

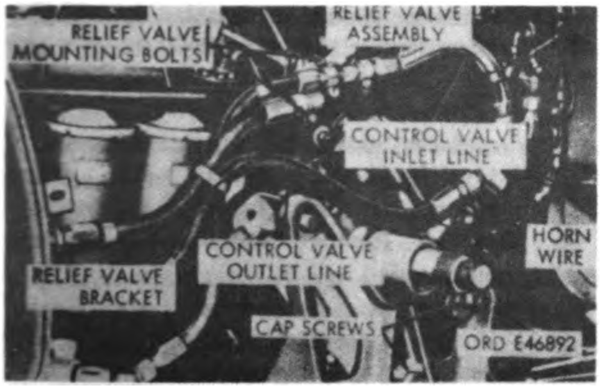


Figure 124. View of steering gear installed with left front fender removed.

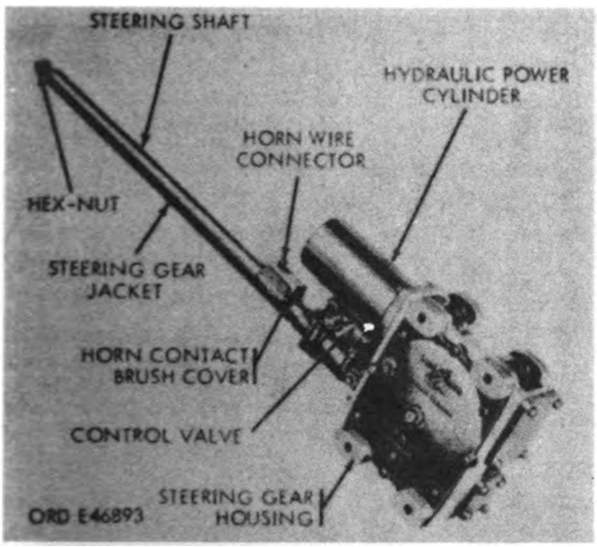


Figure 125. Right side view of steering gear.

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 103*b*).

(8) Install left front fender assembly. Refer to paragraph 32.

(9) Install steering wheel. Refer to TM 9-2320-211-20.

(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 126*b*).

(11) Install pitman arm. Refer to TM 9-2320-211-20.

(12) Adjust pitman arm shaft. Refer to paragraph 126*a*.

(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 remore line from reservoir.

(3) Disconnect two inlet lines at rear end of reservoir

(4) Disconnect outlet line at right side of reservoir.

(5) 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

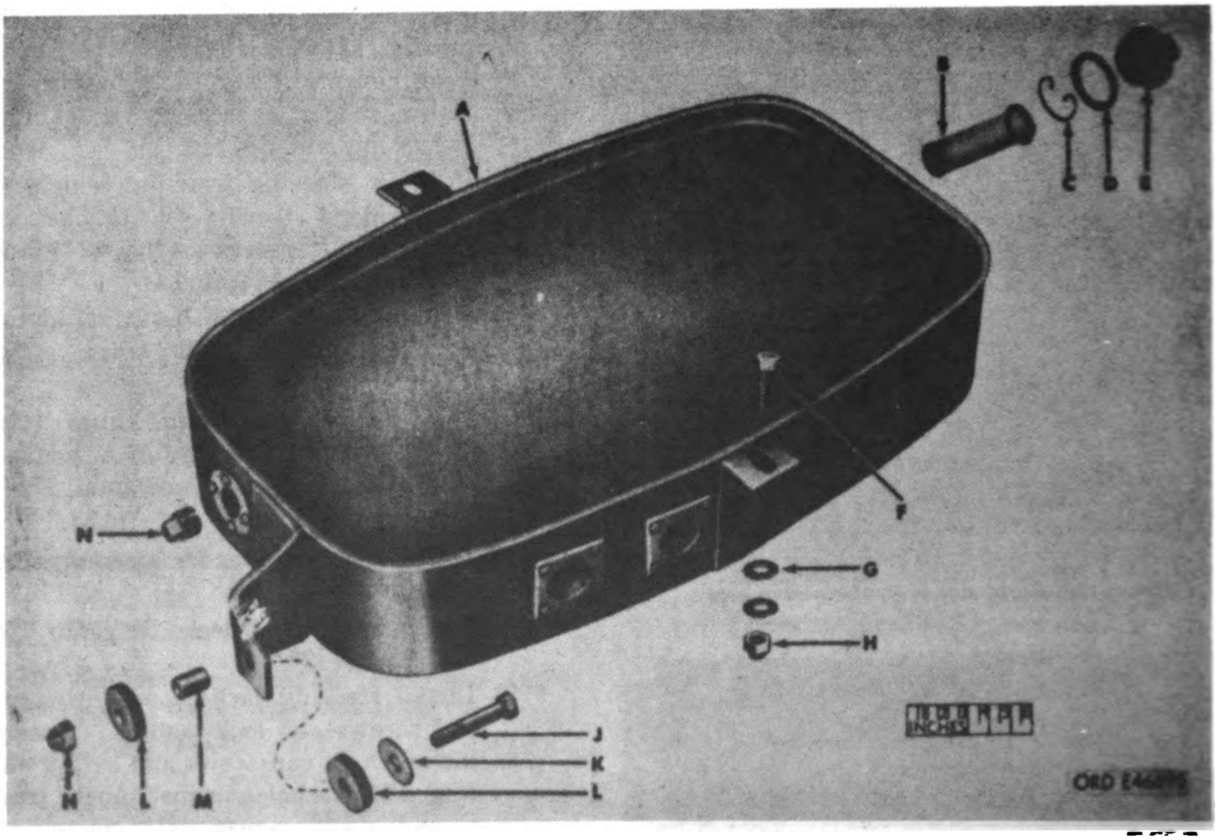


Figure 127. Oil reservoir—exploded view.

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—exploued 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)

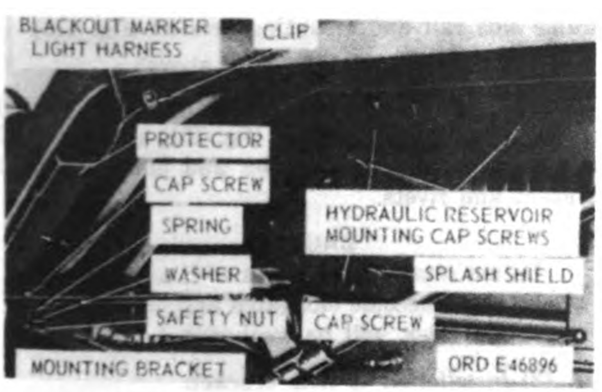


Figure 128. View of underside of left front fender.

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 9-2320-211-20.

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.

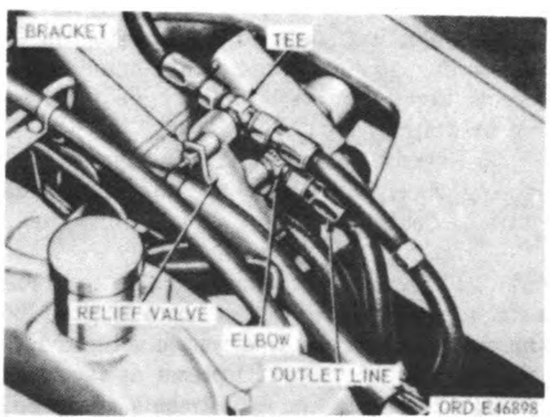


Figure 129. Top right view of relief valve installed.

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 2530-734-8895 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 (para 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 5310-012-0898 and nut 5310-763-8919.

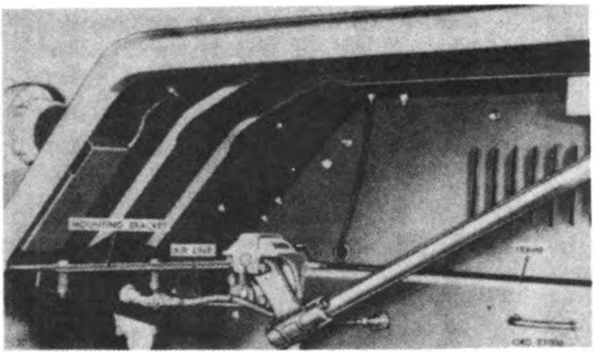


Figure 130. Air line removal.

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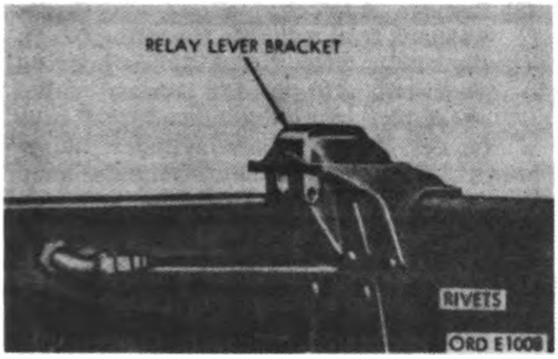

Figure 131. Relay lever bracket to be removed

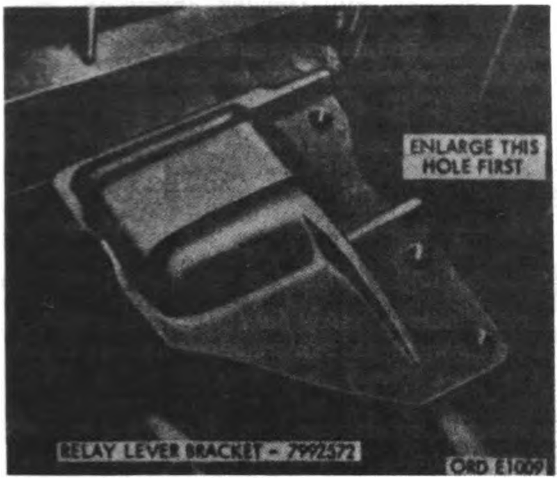

Figure 132. Relay lever bracket installation

(c) Using bracket as a drill guide, drill and/or 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 5310-835-1980. Torque nuts to 135 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.

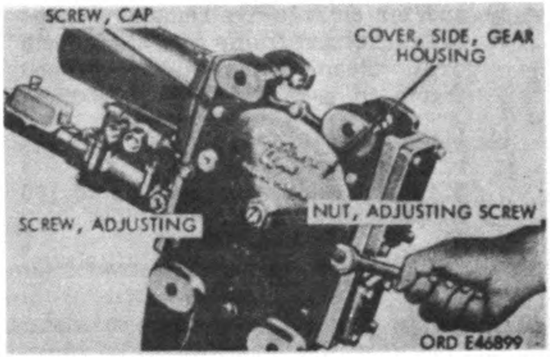

Figure 133. Removing gear housing side cover

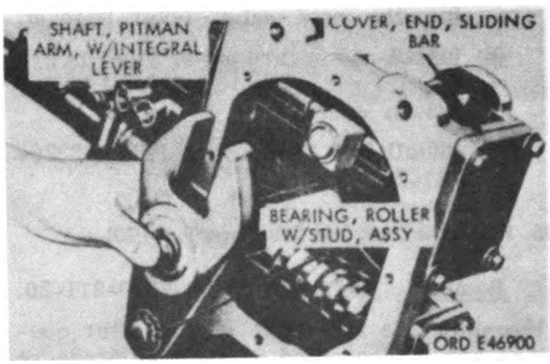

Figure 134. Removing pitman arm shaft with integral lever

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 block pin.

(3) Remove four cap screws and lock-washers from cylinder mounting flange (fig. 136). Turn flange 90° 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.

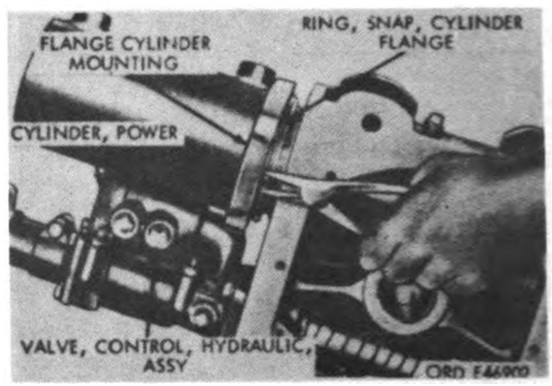

Figure 136. Removing power cylinder Assembly

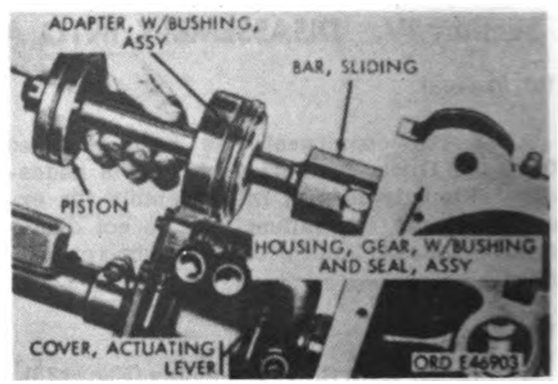

Figure 137. Removing piston and sliding bar assembly

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. Assembly

a. Cam Assembly.

(1) Assemble cam thrust bearings (fig. 139) and cam retainer assemblies on 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.

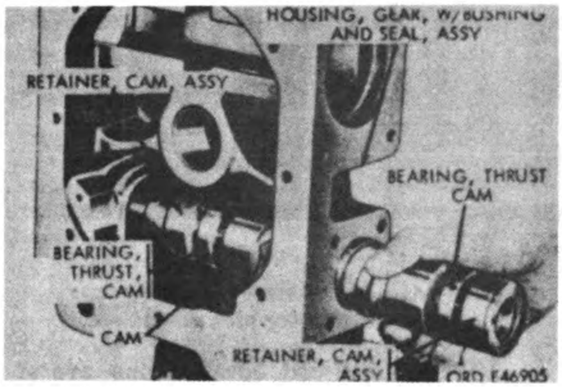

Figure 139. Removing cam

(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.

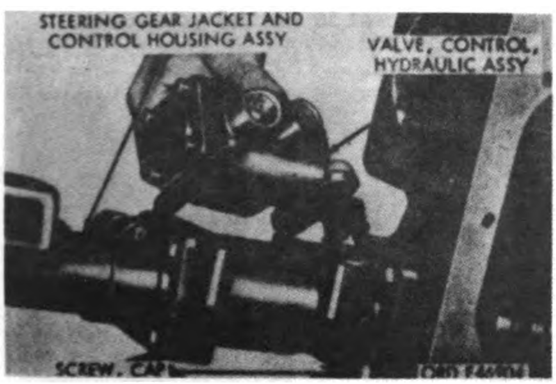

Figure 138. Removing Hydraulic Control valve assembly

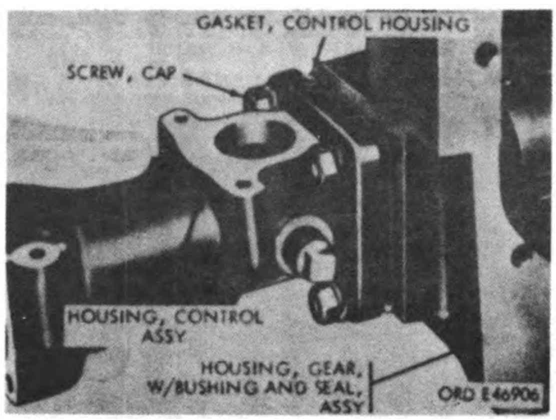

Figure 140. Assembling Control Housing to gear housing

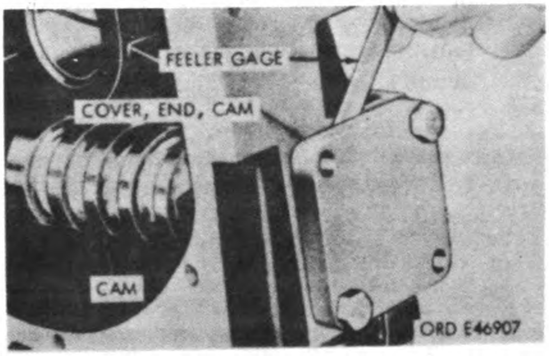

Figure 141. Measuring cam end cover to gear housing clearance

Note. Cam end cover shims are of 0.002-, 0.003-, 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 0.006-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 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 aline 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.

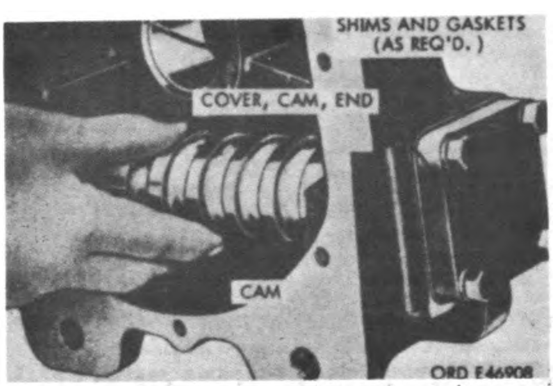

Figure 142. Checking cam adjustment

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.

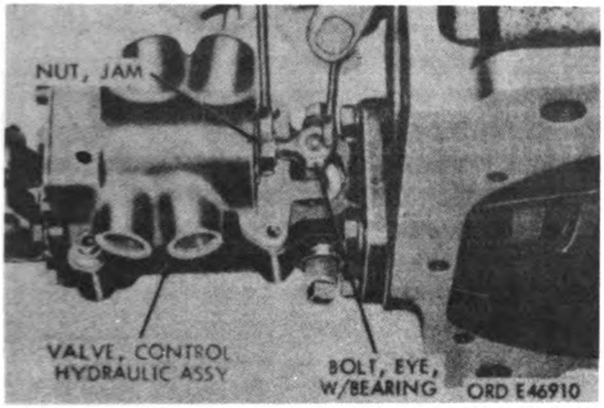

Figure 144. Locking control valve adjustment.

c. Power Cylinder Assembly.

Note. The key letters noted in parentheses are in figure 146 unless other wise 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.

(3) Adjust roller bearing stud in cam thread (TM 9-2320-211-20).

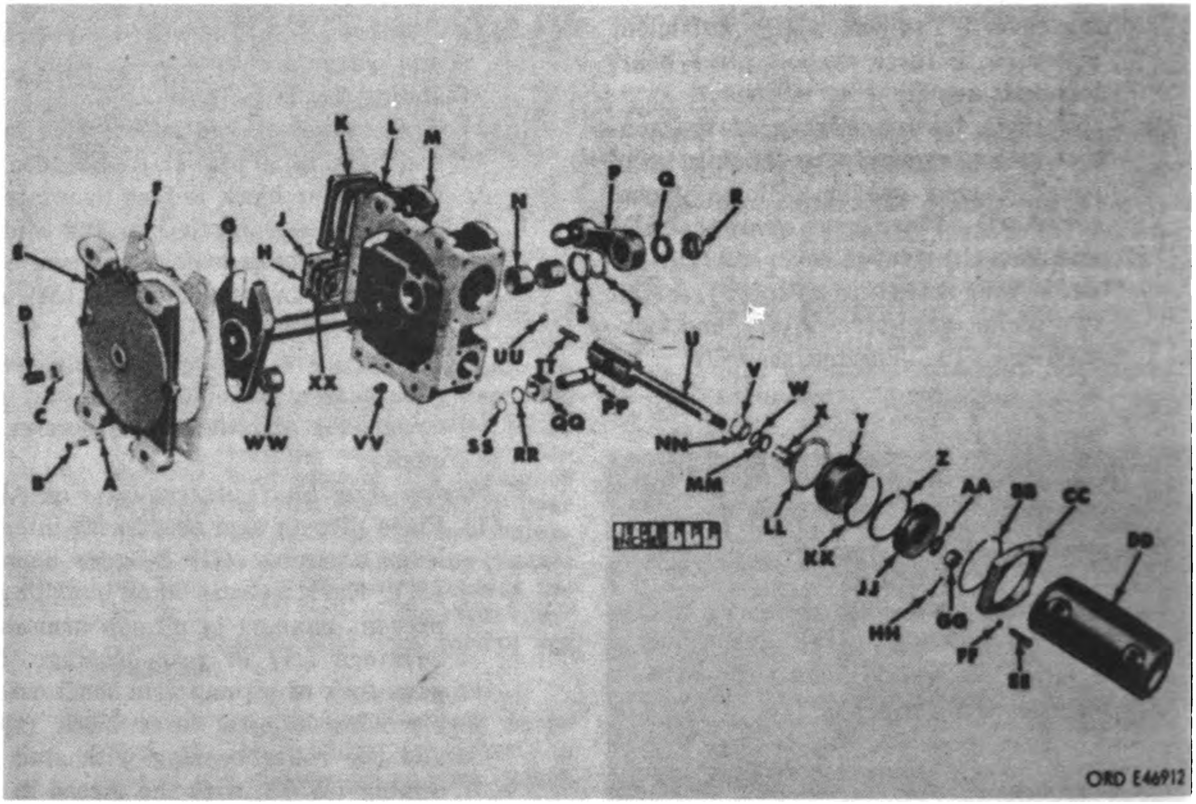

Figure 146. Gear housing, power cylinder and pitman arm shaft assembly—exploded view

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 arm shaft assembly—exploded view—legend.

Key	Item	Key	Item
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.

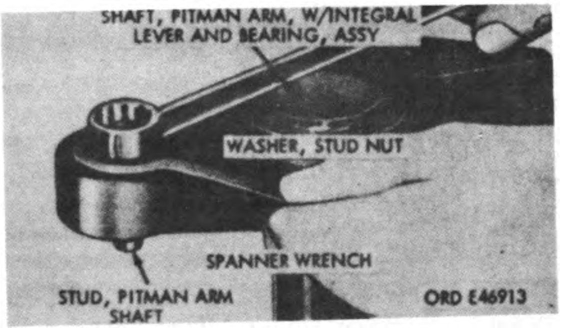

Figure 147. Adjusting roller bearings with stud assembly

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. 148) and leaking oil seal. The piston and sliding bar should work freely and smoothly.

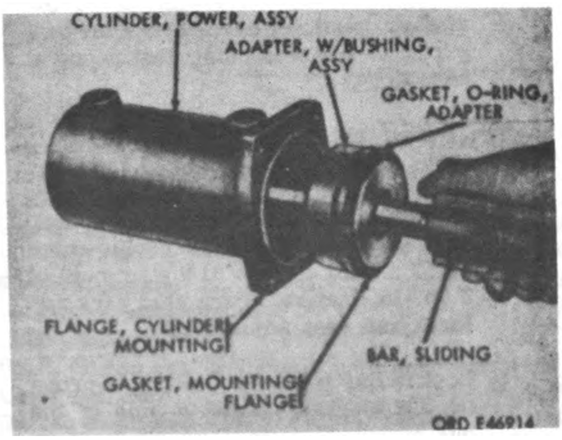

Figure 148. Removing piston assembly from cylinder

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-

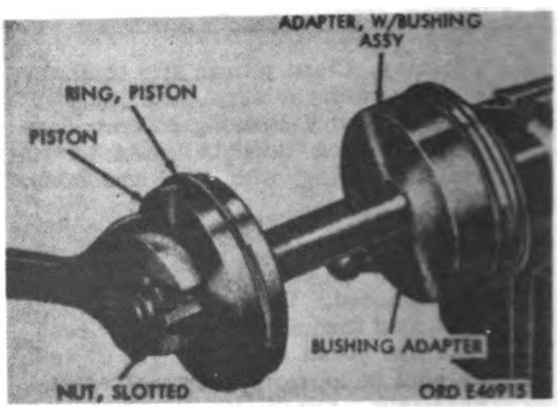

Figure 149. Removing piston from sliding bar

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 washer (AA), slotted nut (GG), 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.

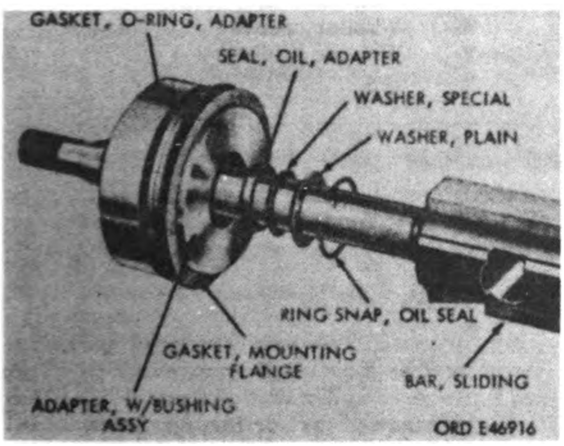

Figure 150. Adapter oil seal assembly

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 lever, 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.

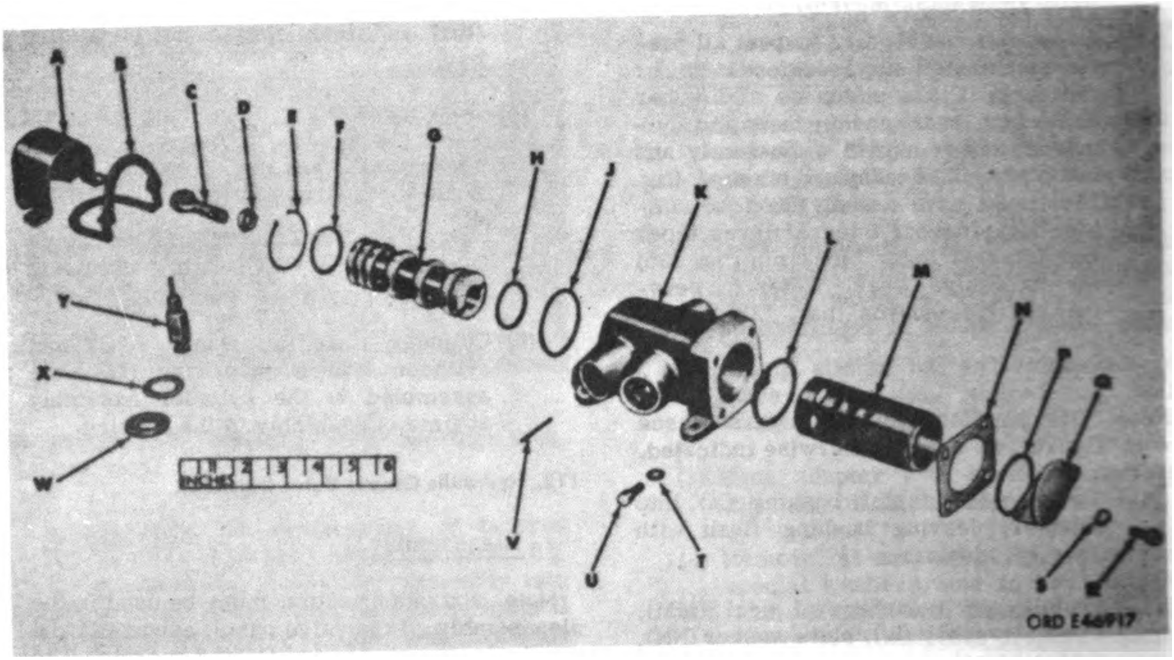

Figure 151. Hydraulic control valve - exploded view

Key	Item	Key	Item
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.

(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 control valve. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent. Protect all

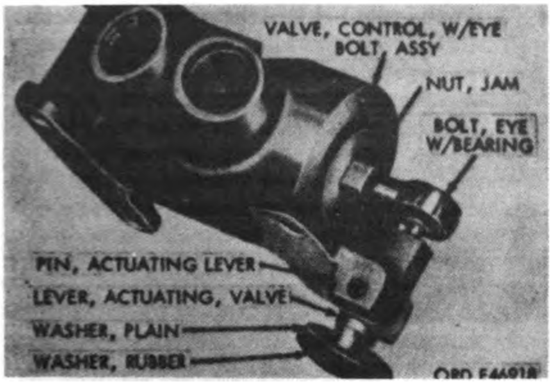

Figure 152. Hydraulic control valve assembly with actuating lever

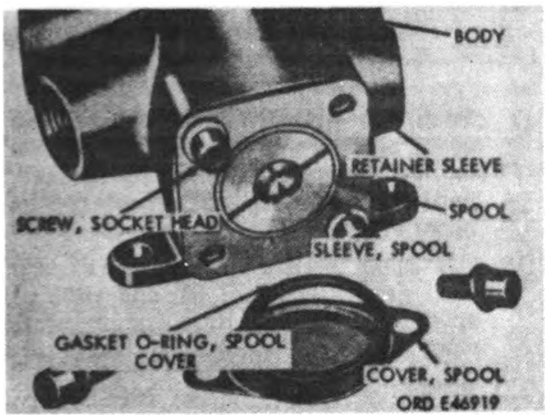

Figure 153. Illustrating spool cover and sleeve retainer

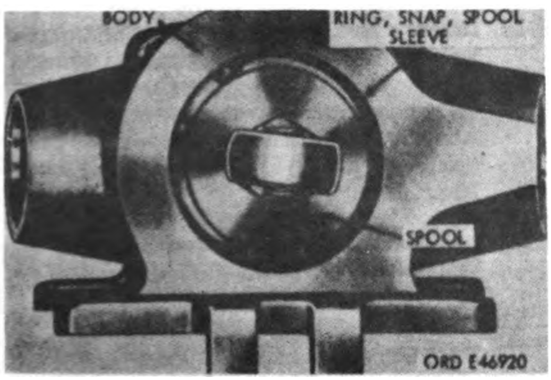

Figure 154. Location of spool sleeve snap ring

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 indicates. 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

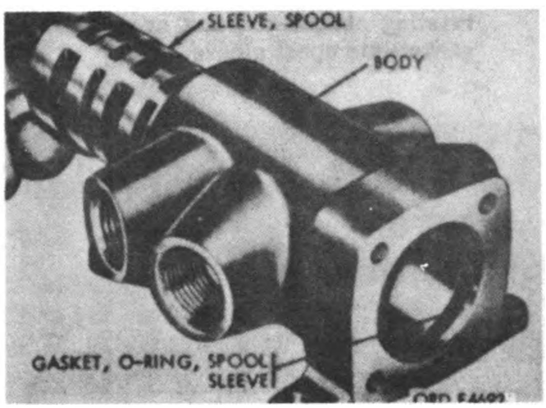

Figure 155. Assembling spool sleeve

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.

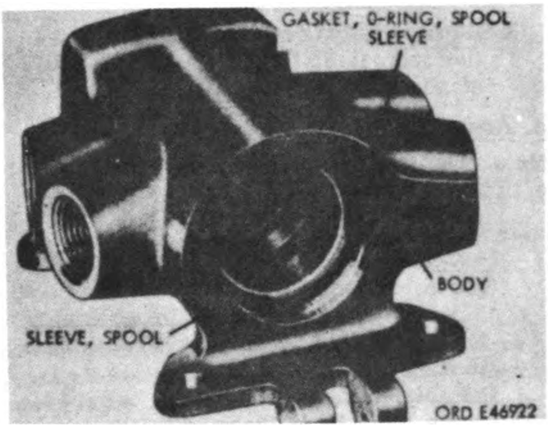

Figure 156. Hydraulic control valve with spool sleeve O-ring gasket installed

(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.

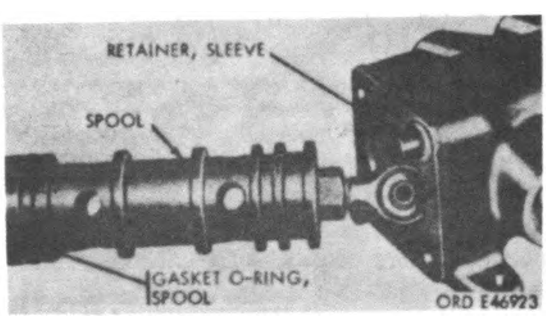

Figure 157. Assembling spool in spool sleeve

(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, Steering 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

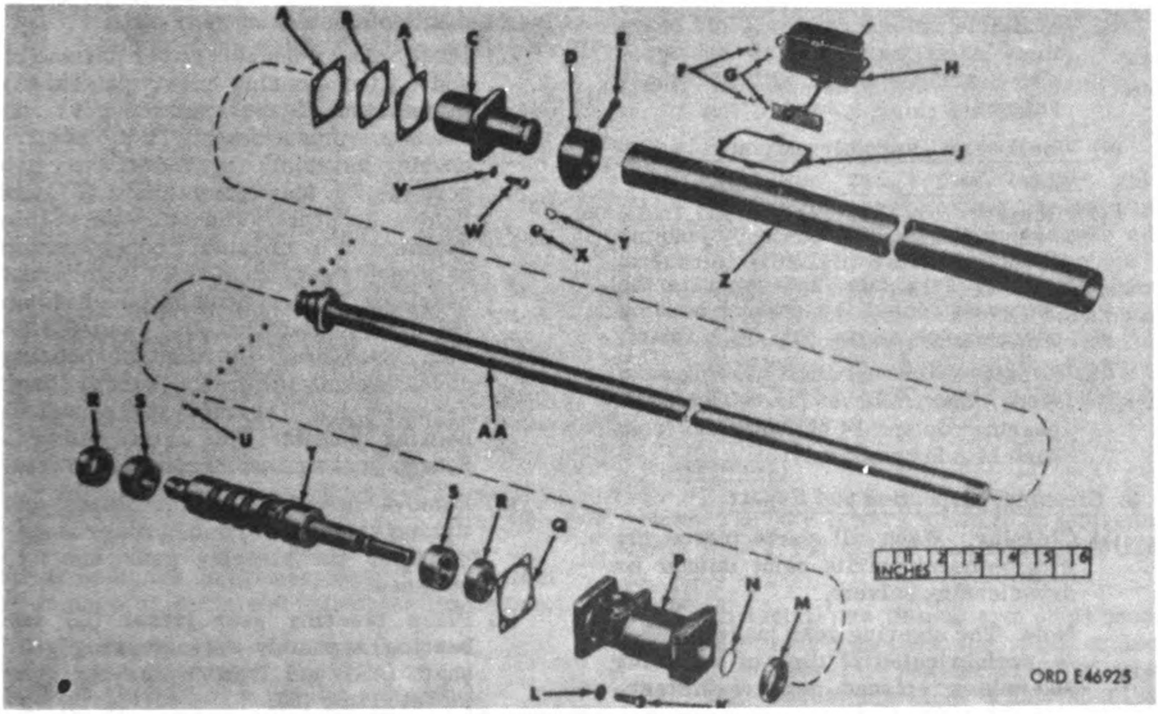

Figure 159. Wheel shaft, jacket, control housing, and cam - exploded view

Key	Item	Key	Item
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, mach	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.

Note. Check steering gear jacket bearing and make certain new bearing assembly 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 gaskets 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

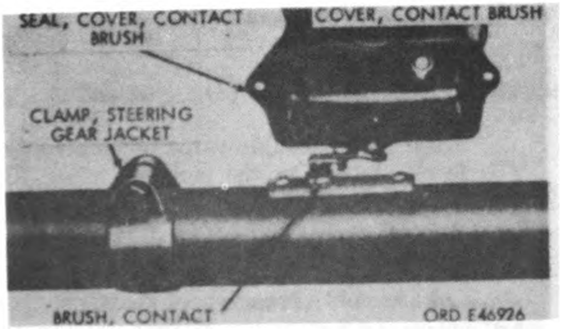

Figure 160. Removing contact brush cover

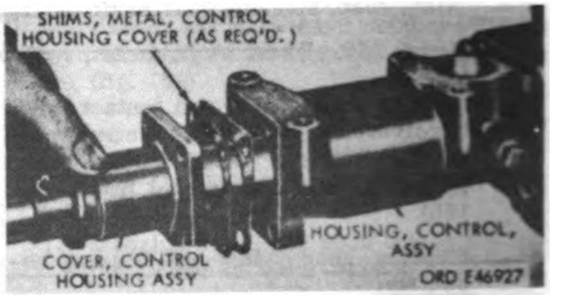

Figure 161. Removing wheel shaft assembly

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 file. 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 bushing 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.

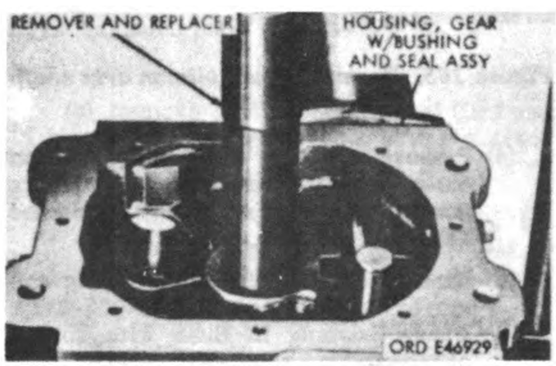

Figure 163. Pressing out pitman arm shaft bushing

(2) Press new inner pitman arm shaft bushing (N) in flush with gear housing (fig. 164), using remover and replacer 5120-795-0137.

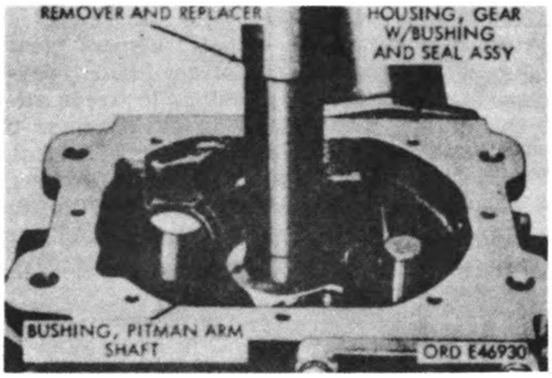

Figure 164. Installing inner pitman arm shaft bushing

(3) Ream new inner bushing with reamer 5110-795-0248 (fig. 165), using old bushing as a pilot on opposite end.

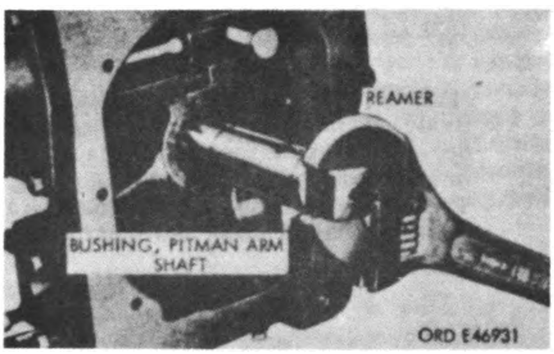

Figure 165. Reaming inner pitman arm shaft bushing

(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).

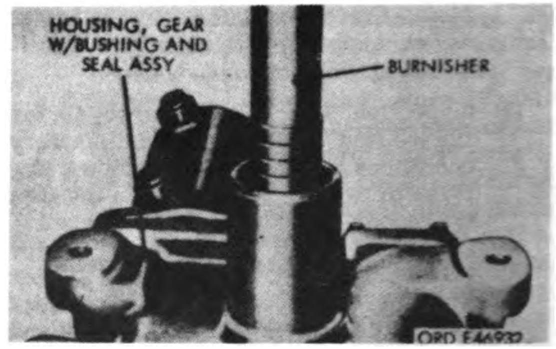

Figure 166. Burnishing new pitman arm shaft bushings

(8) Press new pitman arm shaft seals (S and T) into gear housing (M), using replacer 5120-795-0139 (fig. 167).

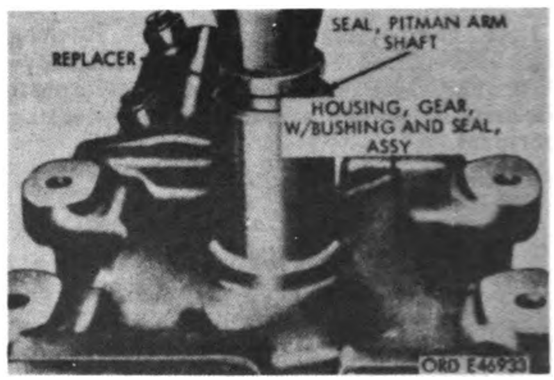

Figure 167. Installing new pitman arm shaft seal

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 external teeth lockwasher (B). Using a suitable puller, remove main drive gear (C) and Woodruff key (K).

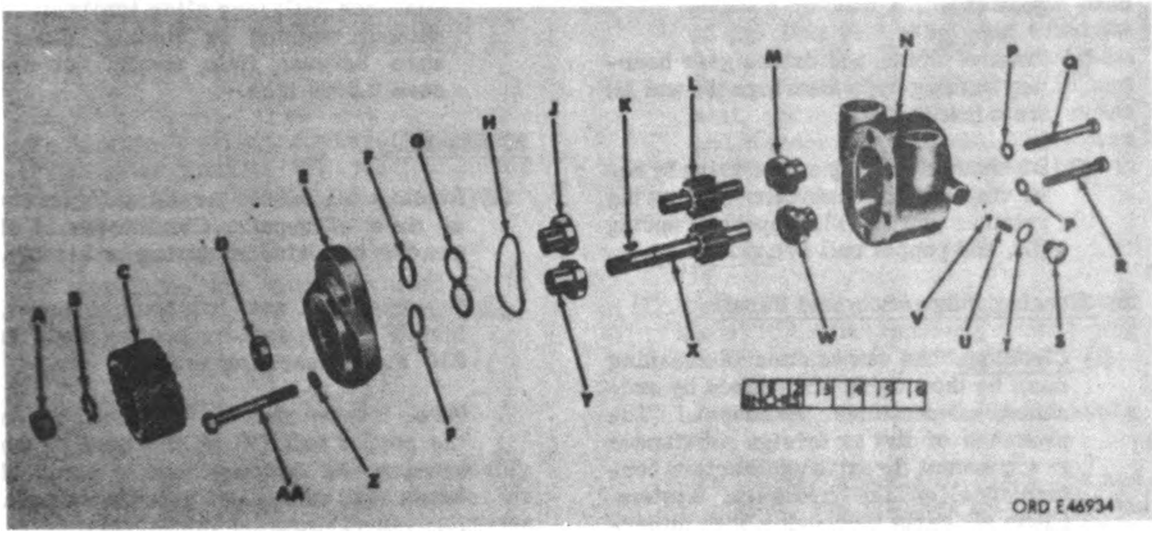

Figure 168. Hydraulic pump assembly - exploded view

Key	Item	Key	Item
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.

(c) 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).

(e) 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 minerals 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 refinished 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).

(3) Remove spring retainer (U), 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.

(3) 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 a new 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.

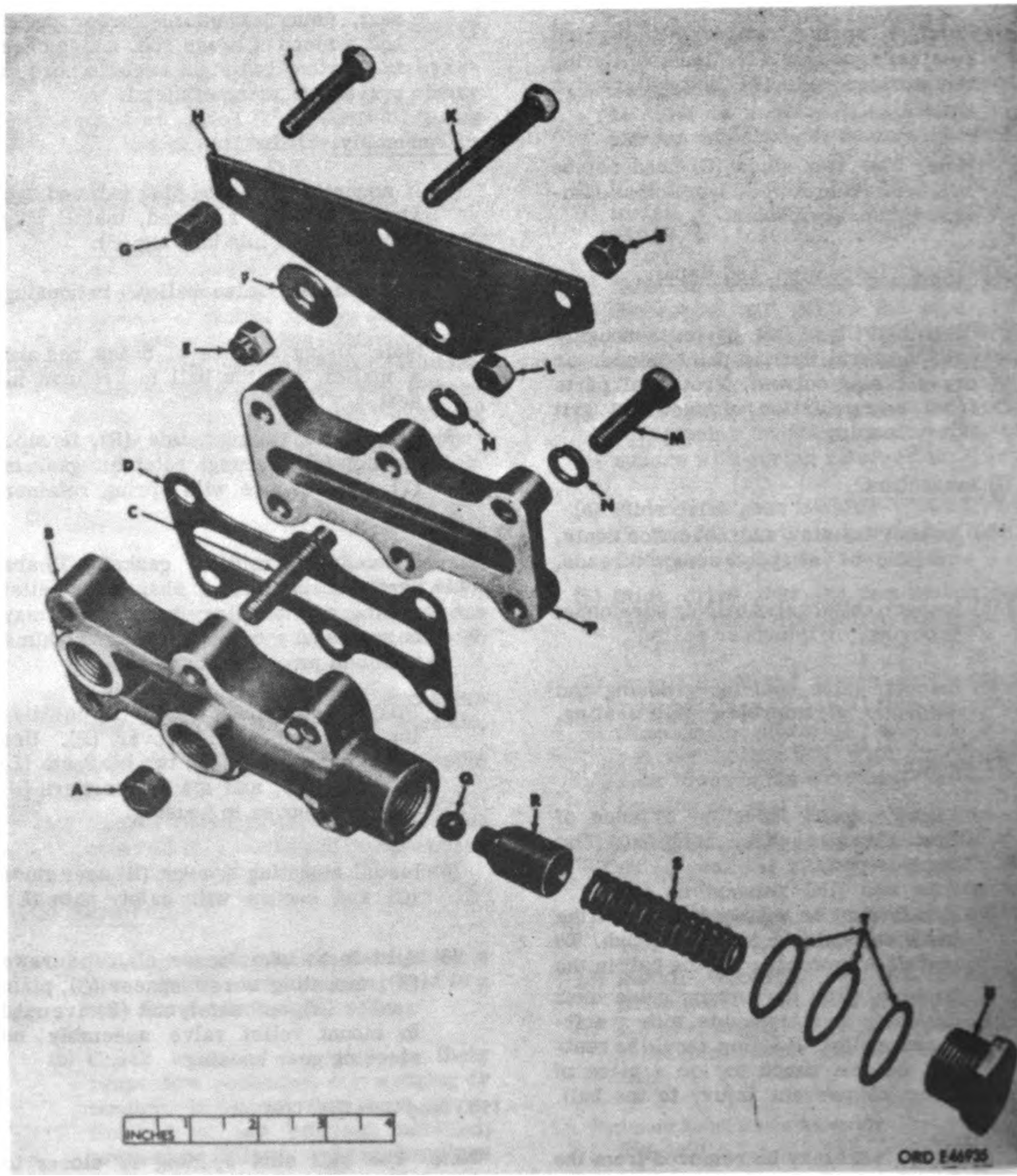

Figure 169. Relief valve assembly - exploded view

Key	Item	Key	Item
A	Plug, pipe	L	Nut, hex
B	Housing	M	Screw, cap
C	Stud	N	Washer, lock
D	Gasket, cover	P	Cover
E	Nut, safety	Q	Ball, relief valve
F	Washer, plain	R	Guide, spring
G	Spacer, mounting screw	S	Spring, tension
H	Bracket, mounting	T	Gasket, spring retainer
J	Screw, split lockwasher	U	Retainer, spring
K	Screw, cap		

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 opening 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 and assembled in order named.

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.

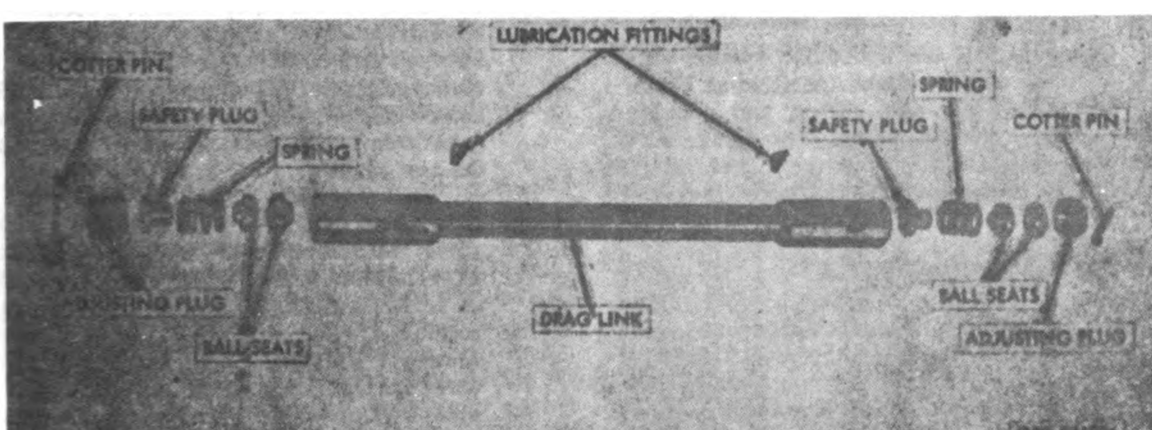

Figure 170. Drag link assembly - exploded view

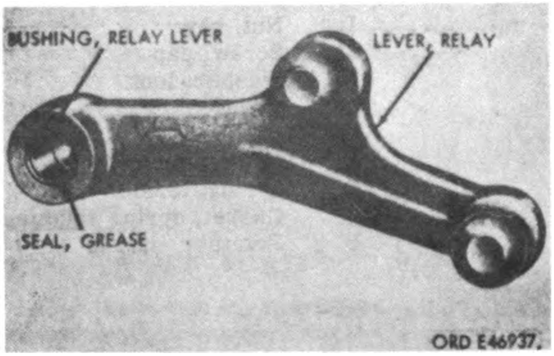

Figure 171. Relay lever assembly

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean all parts thoroughly with mineral spirits paint thinner or 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 2530-040-2293. 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 manndr 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 alined 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 misalinement, may prevent the cam and control valve from centering into center position.

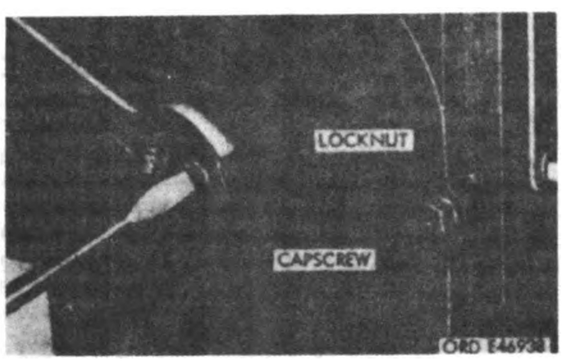

Figure 172. Adjusting pitman arm shaft

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 alined 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 misalinement, 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
		PITMAN ARM SHAFT ASSEMBLY	
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
		POWER CYLINDER ASSEMBLY	
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 bushing	0.002 to 0.0046
		HYDRAULIC CONTROL VALVE ASSEMBLY	
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
		HYDRAULIC PUMP ASSEMBLY	
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 14 oz
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
		HYDRAULIC CYLINDER ASSEMBLY	
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	0.006L to 0.010L
		PRESSURE RELIEF VALVE	
169	S	Free length of tension spring	2.328
169	S	Tension spring compressed to 1.781 in.	57 to 59 lb

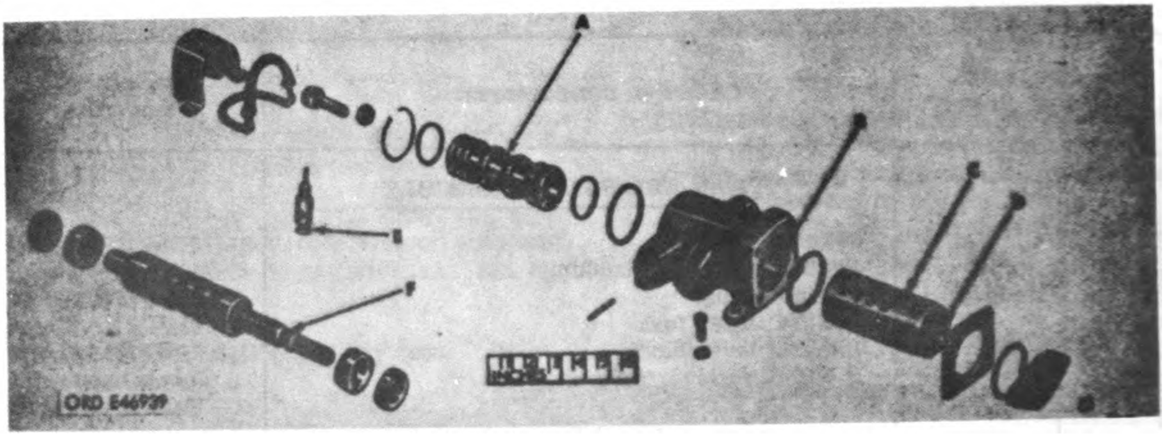

Figure 173. Serviceability standard points of measurement for hydraulic control valve

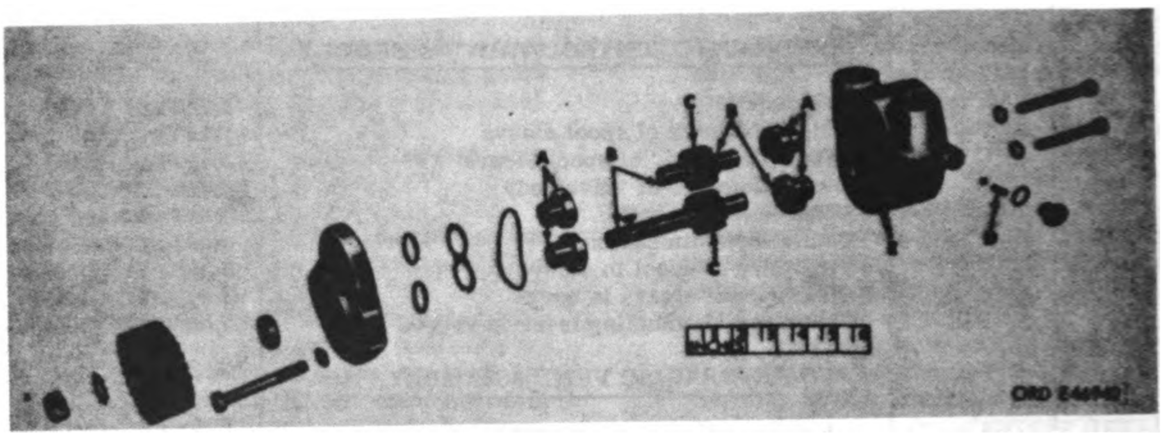

Figure 174. Serviceability standard points of measurement for hydraulic pump

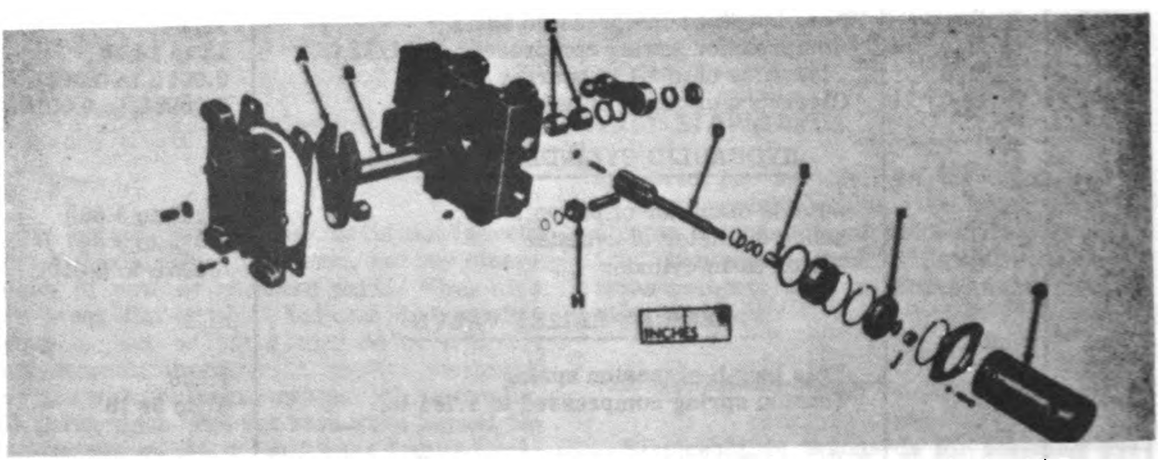

Figure 175. Serviceability standard points of measurement for steering gear assembly

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. Installation 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.

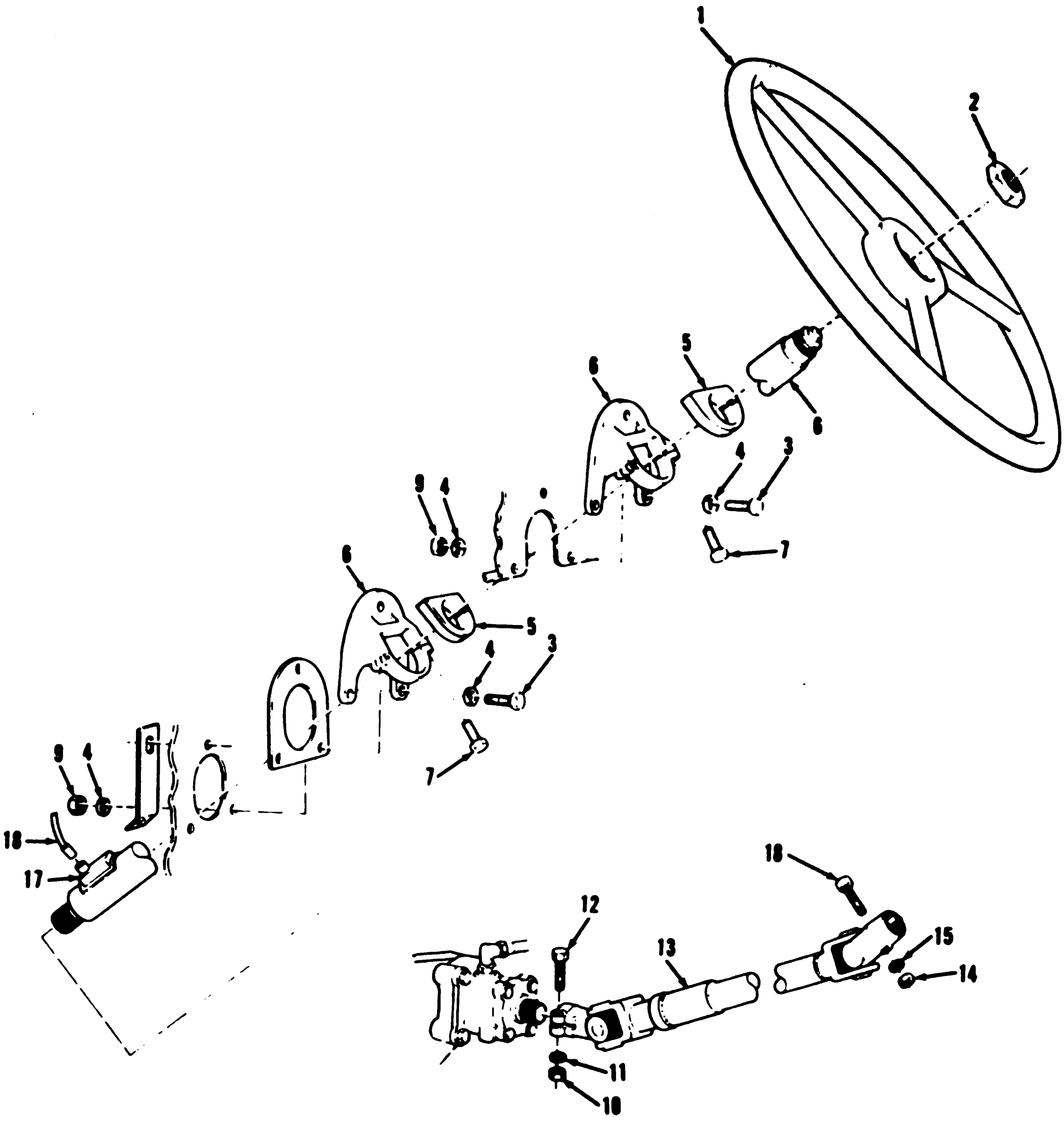

Figure 175.1. Lower and upper steering column and related parts — exploded view.

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 throughly.

(2) *Inspection and Repair.* Inspect all parts for defects, damage, or excessive wear. If defects, damage, or excessive wear is evident, replace parts asnecessary.

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.

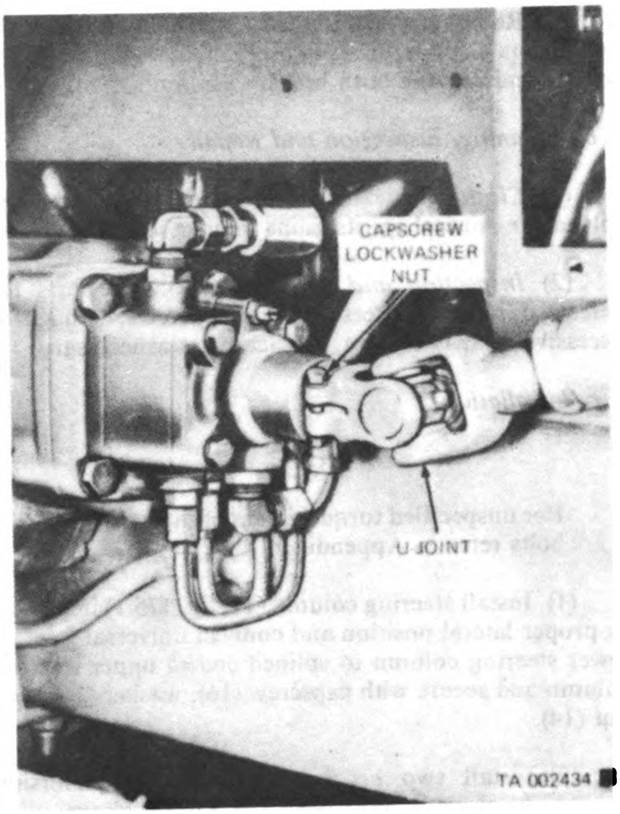

Figure 175.2 Steering shaft extension U-joint

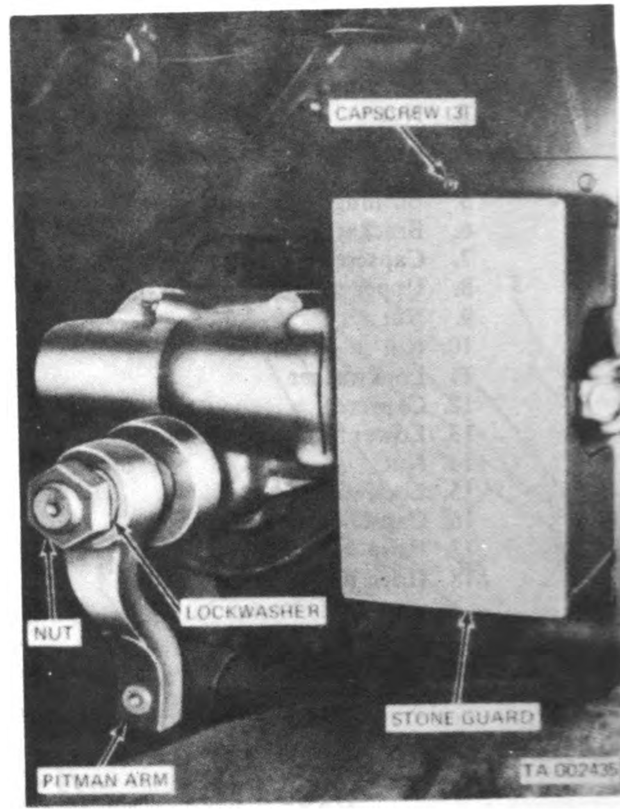

Figure 175.3. Removing and installing pitman arm.

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).

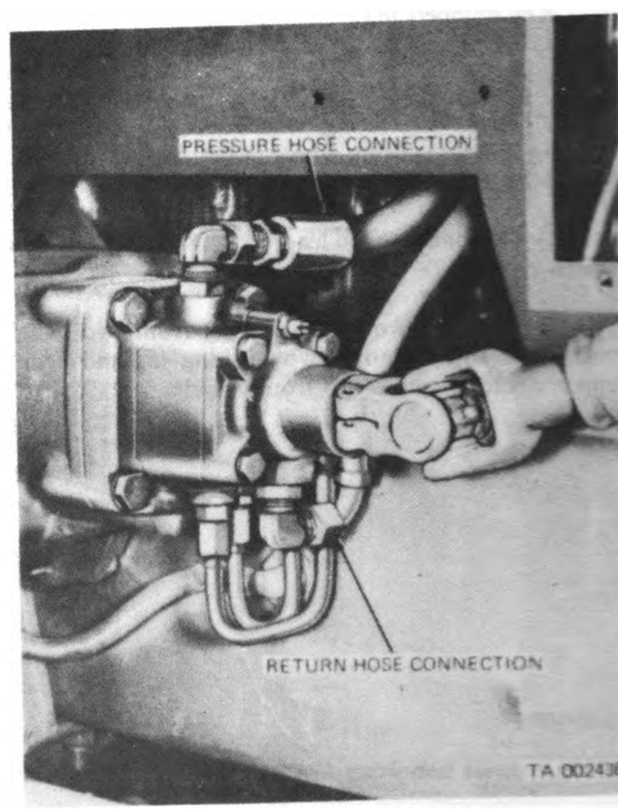

Figure 175.4. Steering gear hydraulic oil pressure and return hoses.

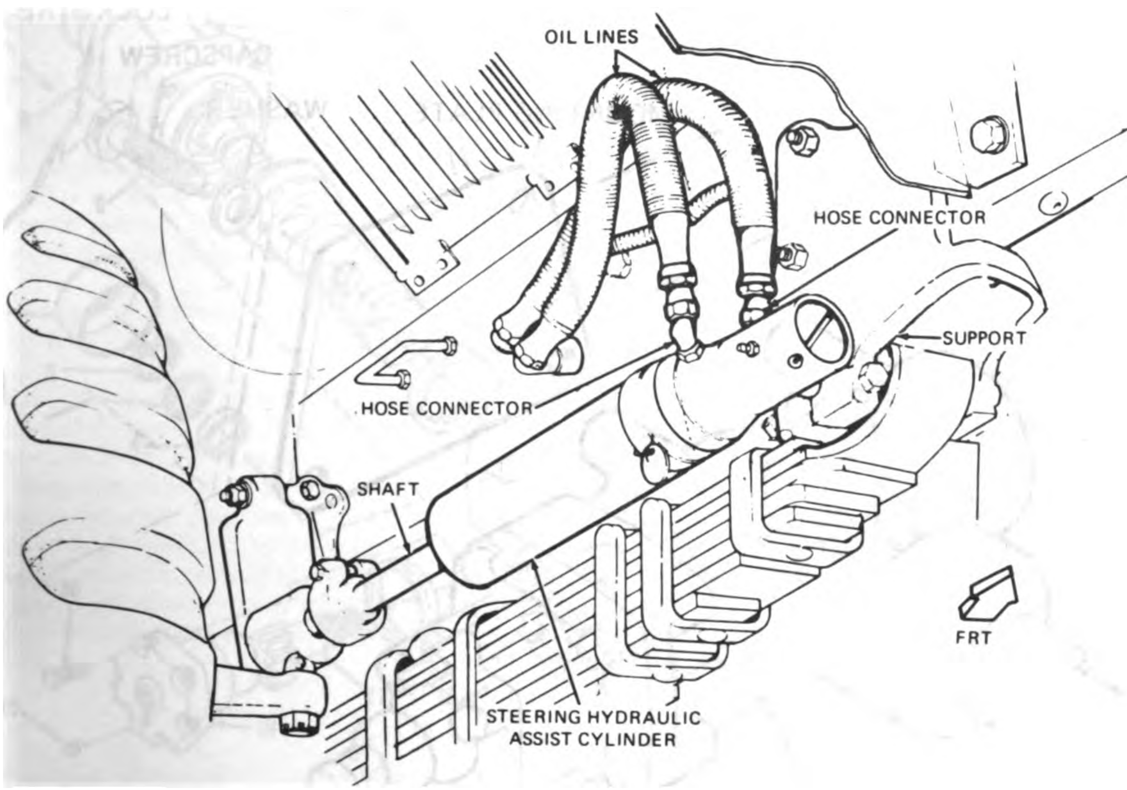

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Figure 175.5. Removing and installing steering gear assist cylinder hydraulic lines.

(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).

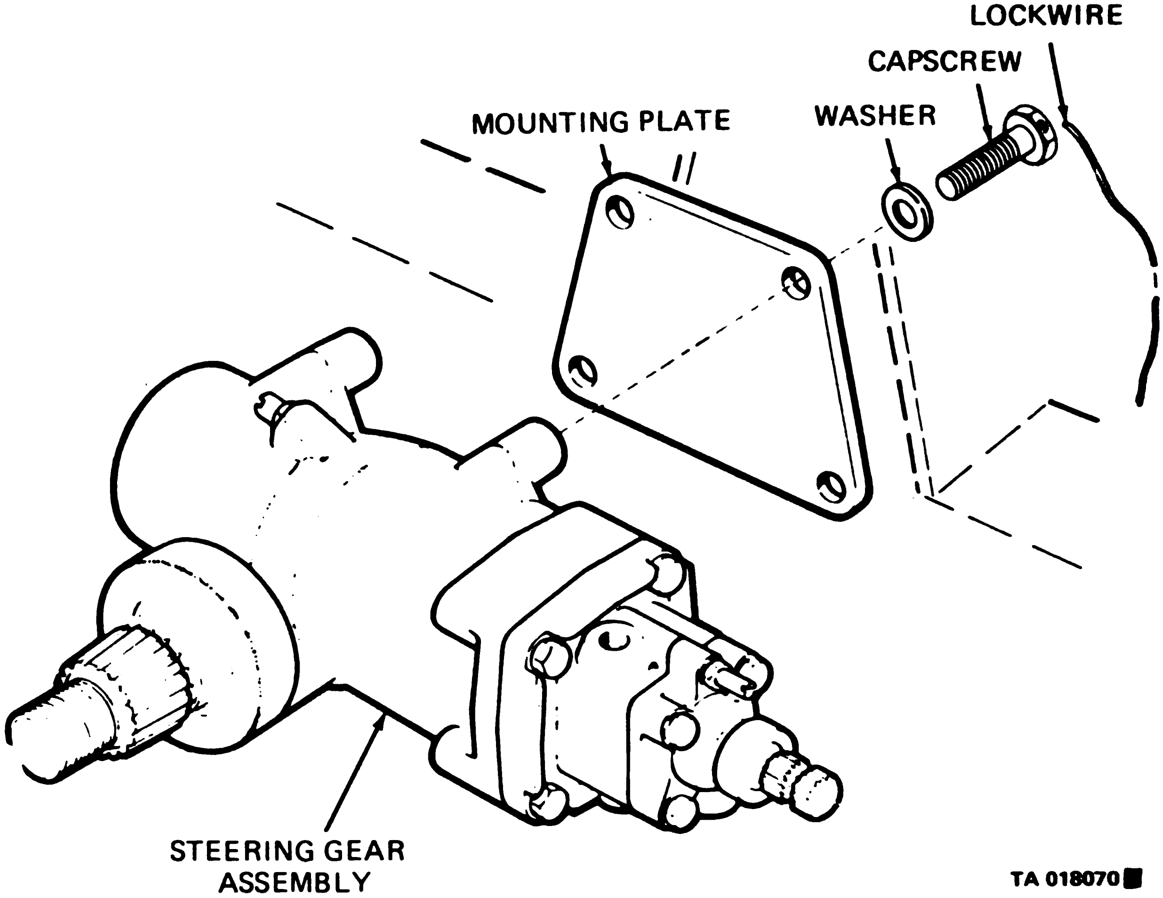


Figure 175.6. Steering gear assembly and attaching parts — exploded view.

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.

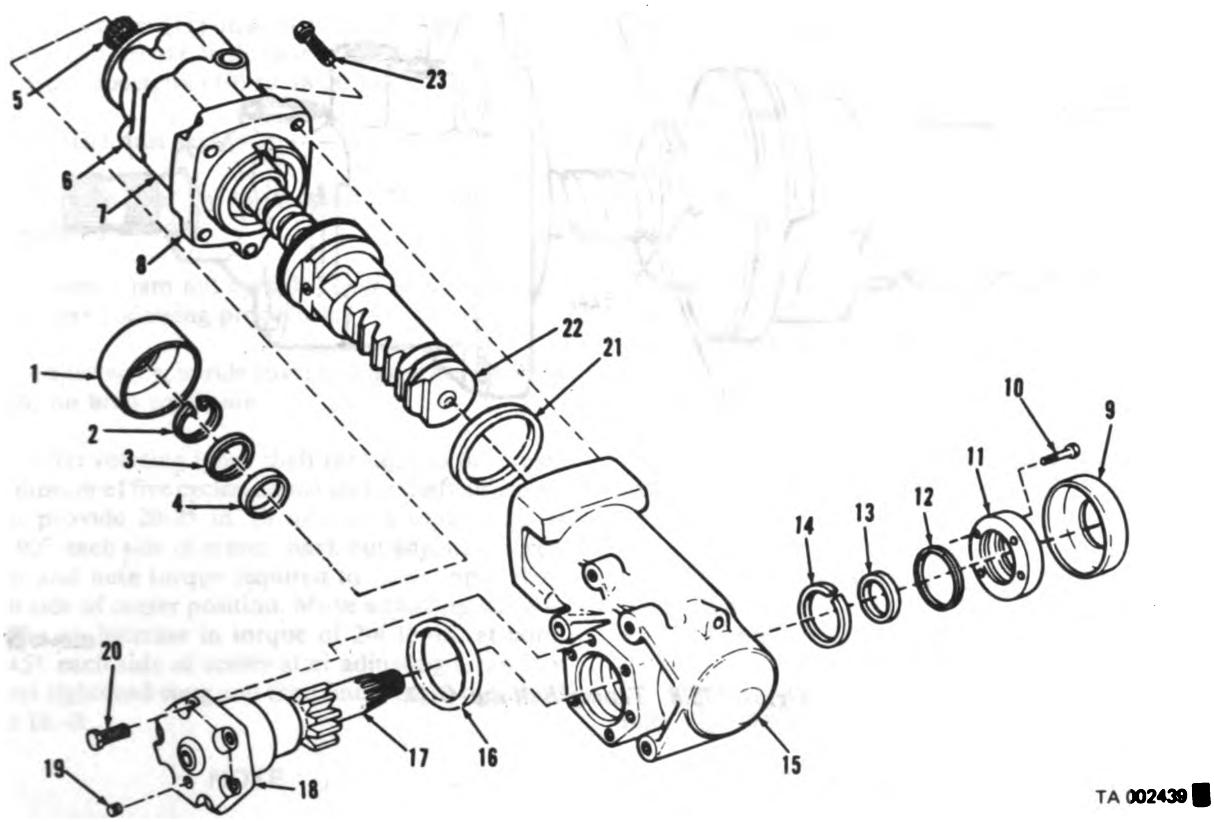


Figure 175.7. Steering gear assembly — exploded view.

Legend for fig. 175.7:

1. Dirt and water seal
2. Retaining ring
3. Backup washer
4. Oil seal
5. Input shaft
6. Upper cover
7. Control valve
8. Control valve adapter
9. Dust seal
10. Allen head capscrew (4)
11. Trunnion carrier
12. Seal, trunnion carrier to housing
13. Seal, leather backup
14. Seal assembly
15. Housing
16. Face seal, side cover to housing
17. Sector shaft
18. Side cover
19. Vent plug
20. Capscrew (6)
21. Seal, adapter to housing
22. Piston rack
23. Capscrew (4)

(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), ¾ 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).

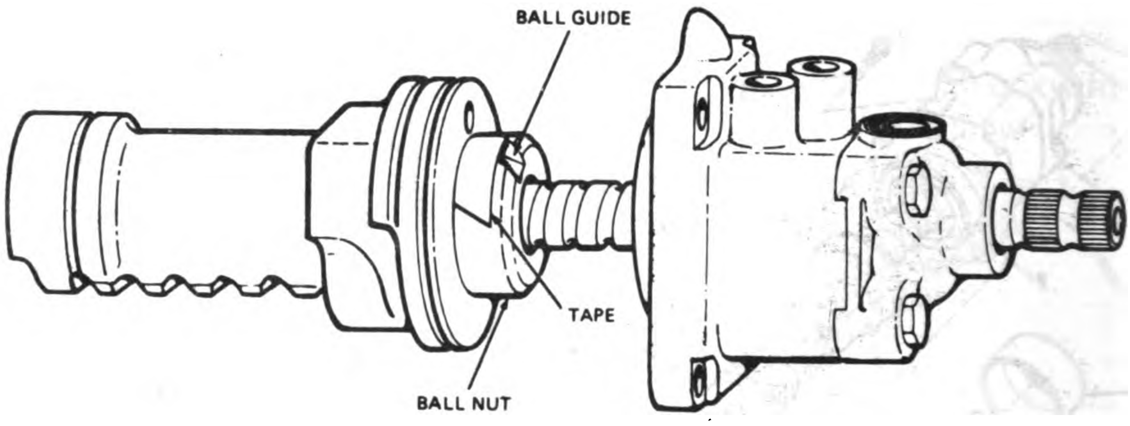


Figure 175.8. Taping ball nut O.D.

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.

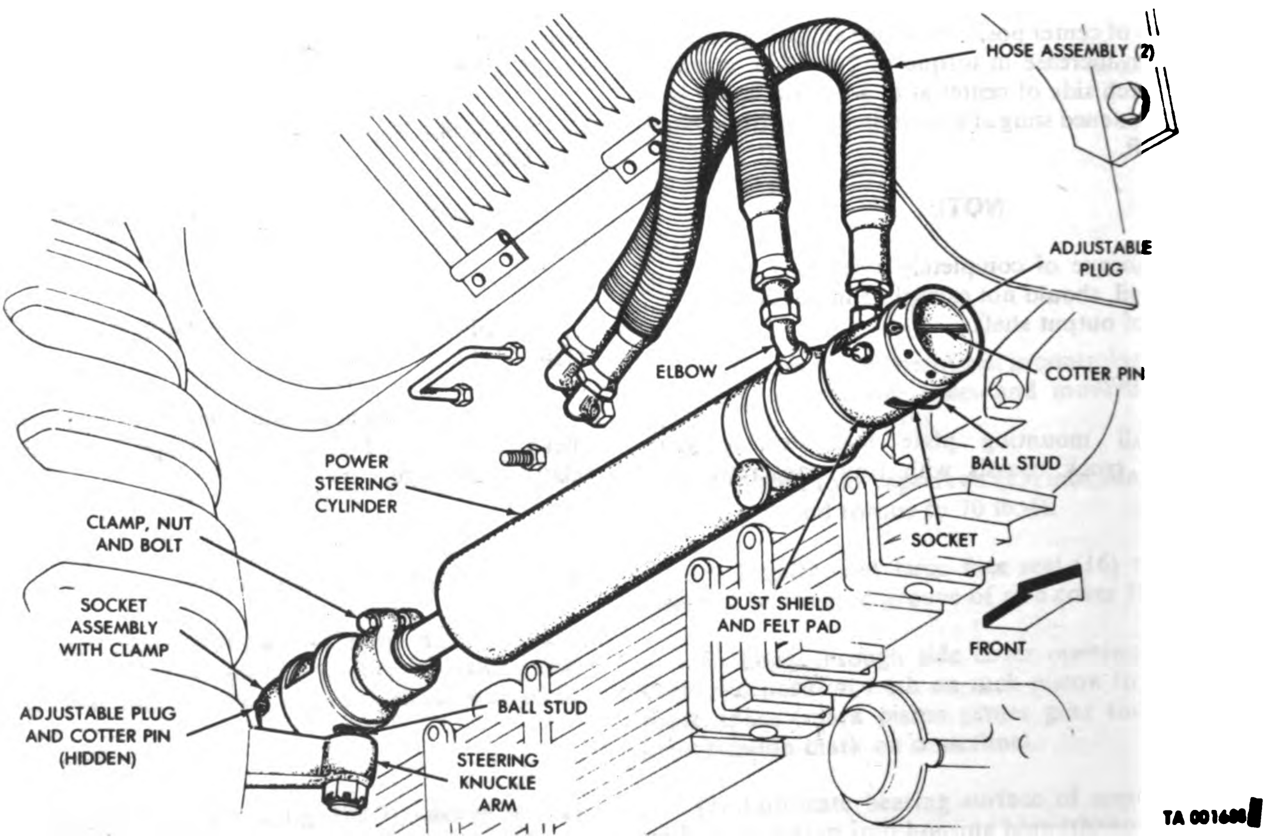


Figure 175.9. Power steering cylinder, hoses, and fittings.

b. Disassembly.

(1) Stoke piston rod full travel holding ports down, to remove oil from cylinder assembly. Plug ports and remove all dirt and contaminates 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).

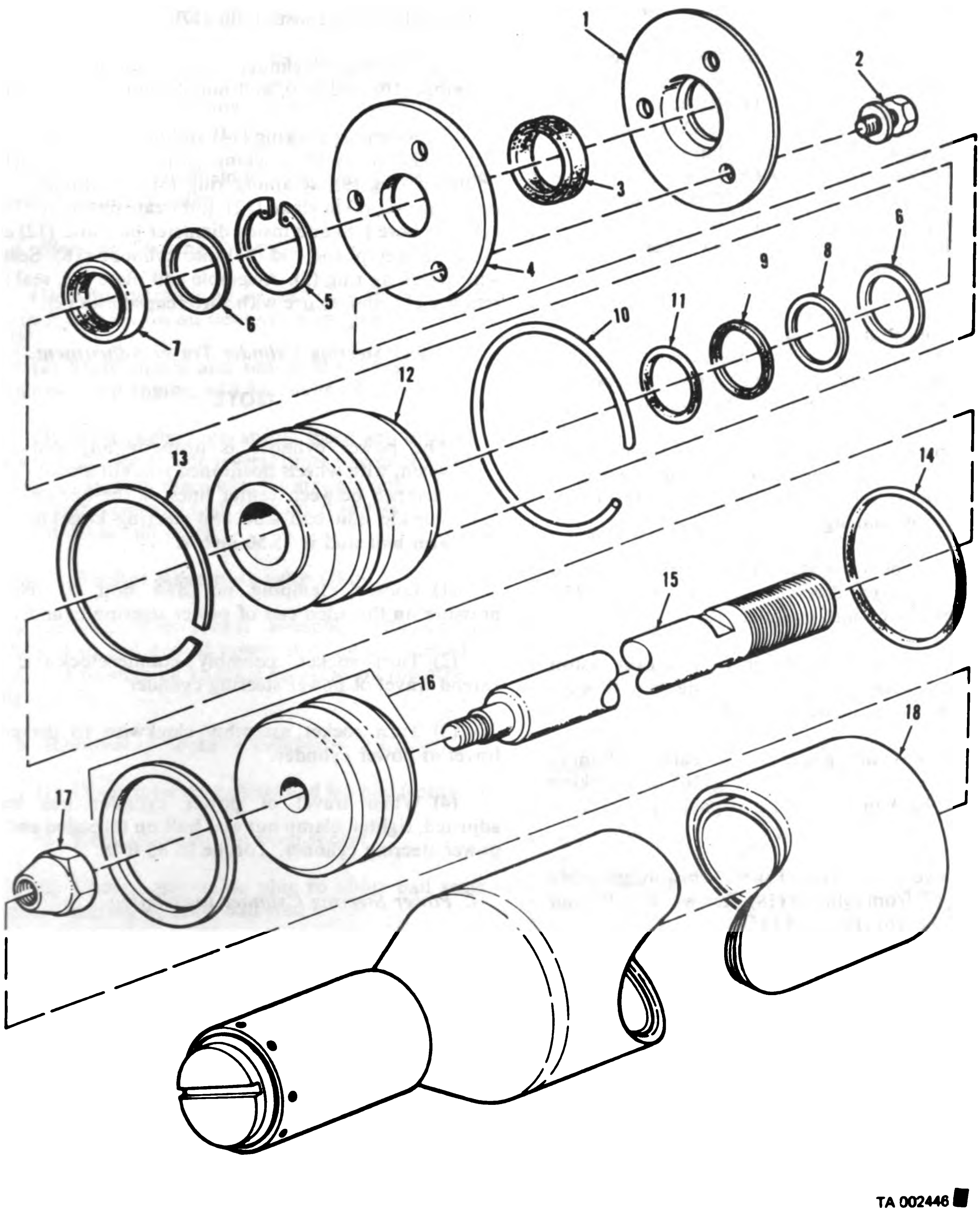


Figure 175.10. Power steering cylinder assembly — exploded view.

Legend for fig. 175.10:

1. Retainer
2. Capscrews (3)
3. Seal
4. End plate
5. Retaining ring
6. Retaining ring
7. Oil seal
8. Retaining ring
9. Retaining ring
10. Backup ring
11. Packing
12. Gland
13. Backup ring
14. Packing
15. Piston rod
16. Piston assembly
17. Nut
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 alined 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 alined 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 128.5*g*.

(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 128.5*f* (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.

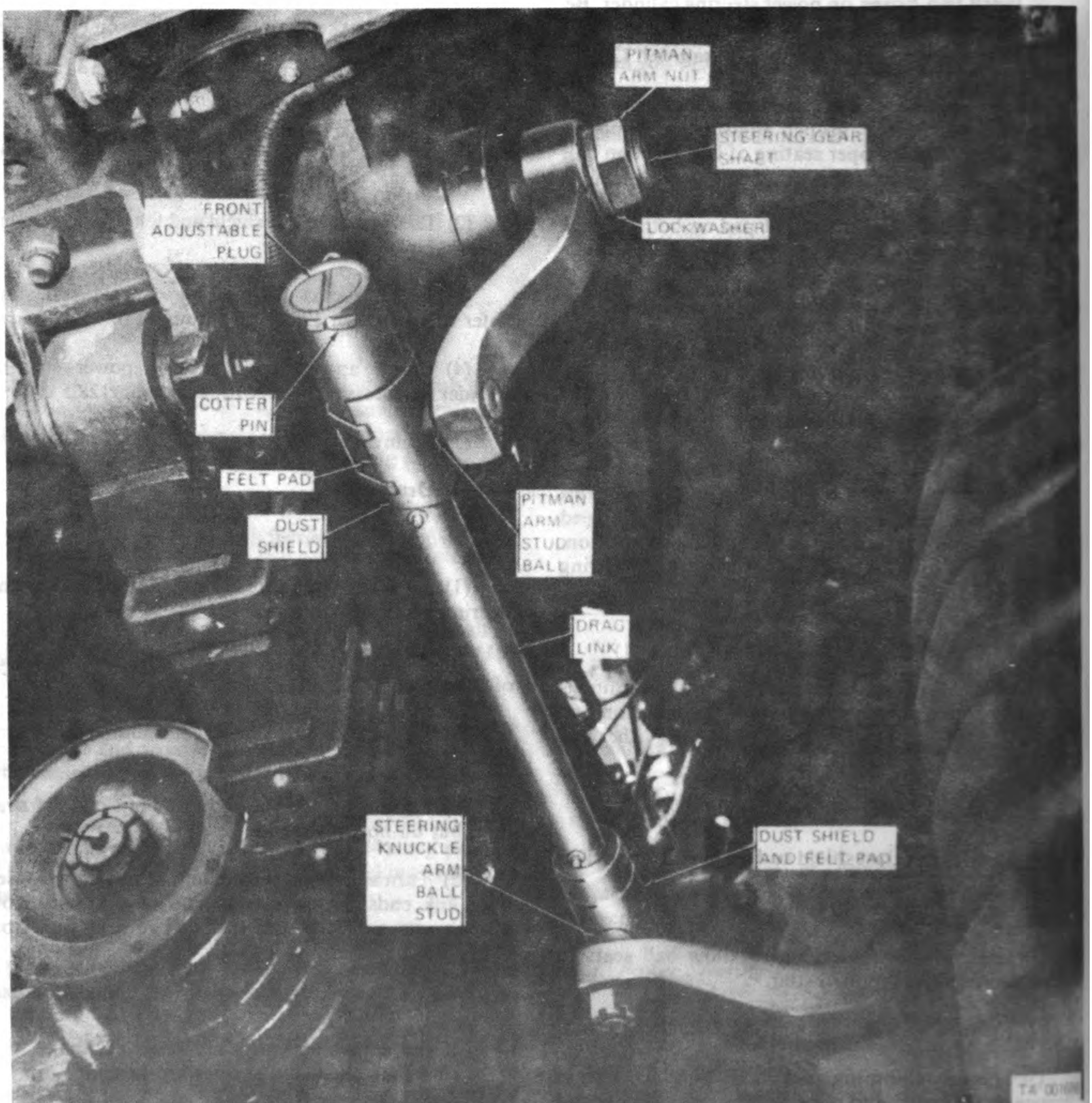


Figure 175.11. Steering linkage removal and installation.

(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 alined 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 alined 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.

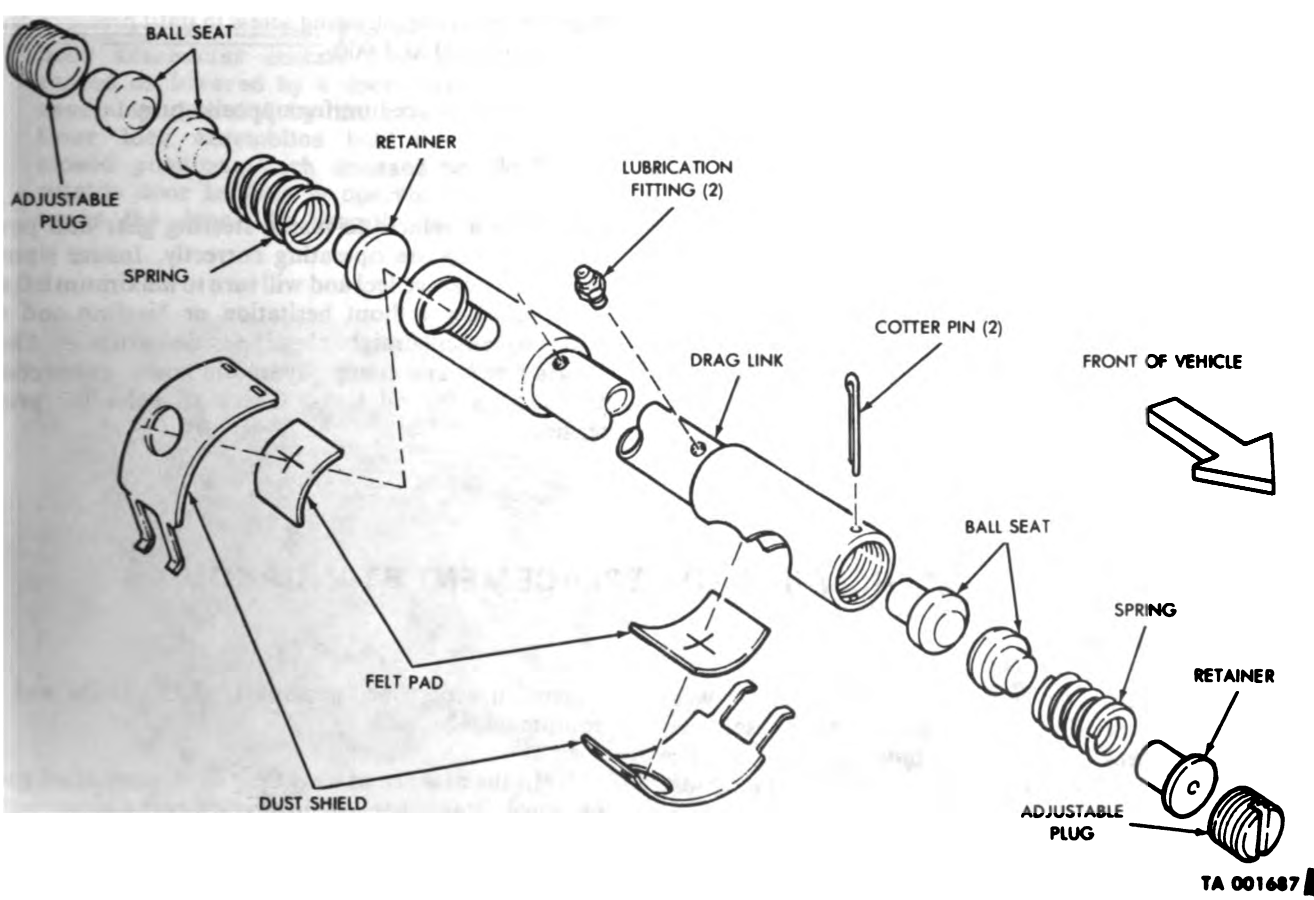


Figure 175.12. Drag link — exploded view.

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
Overall width	97 in.
Top	canvas or hard top
Glass	safety
Windshield	two piece

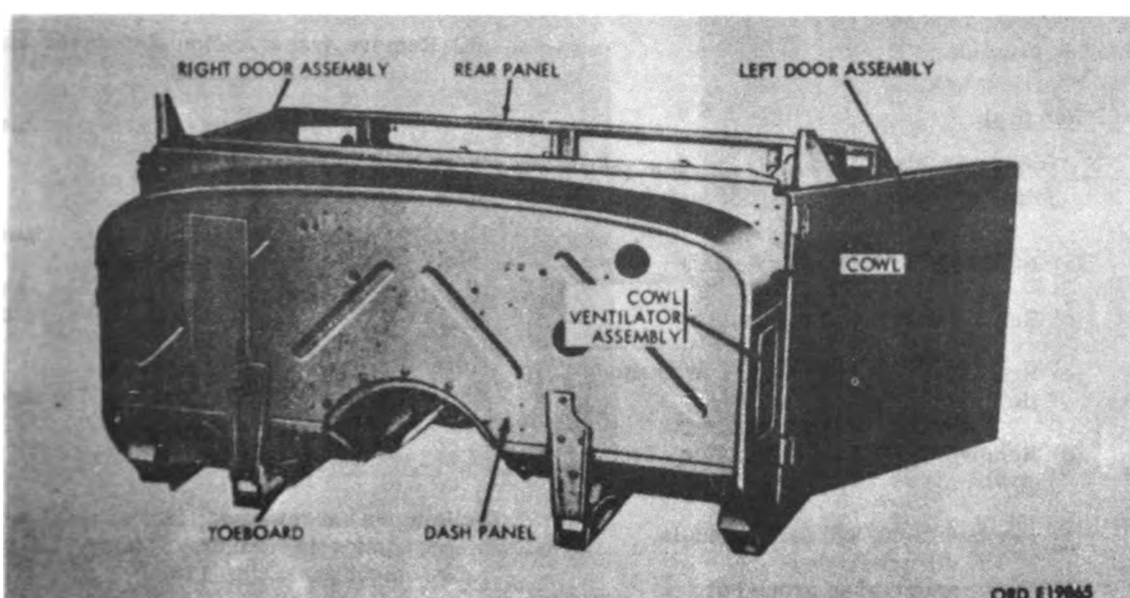


Figure 176. Cab assembly - front view

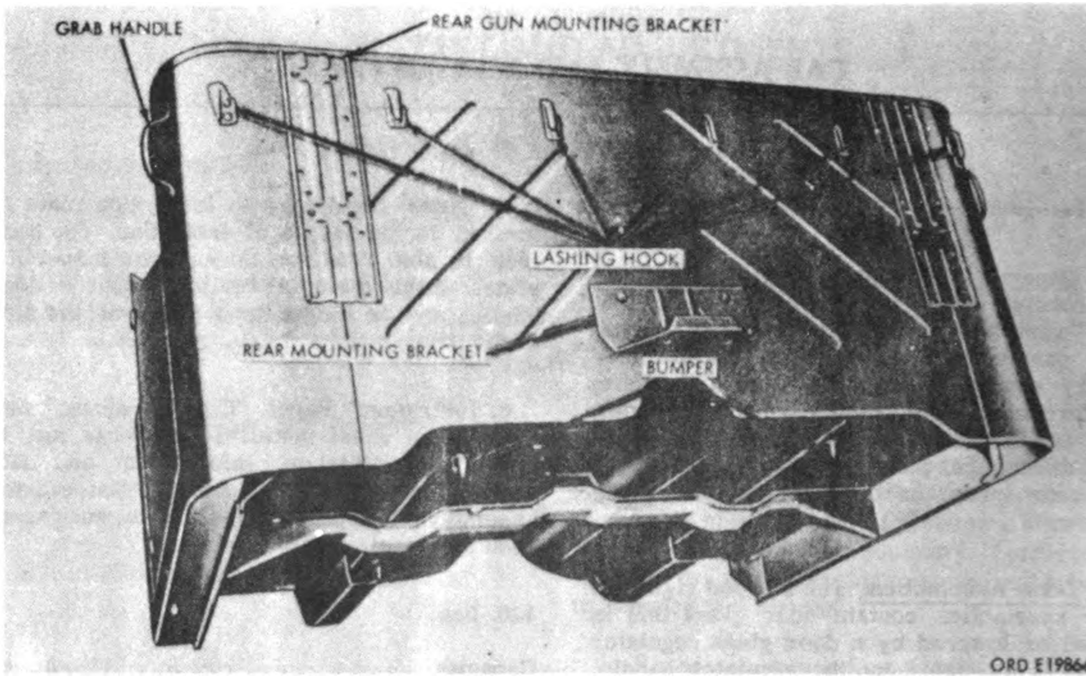


Figure 177. Cab assembly - rear view

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.

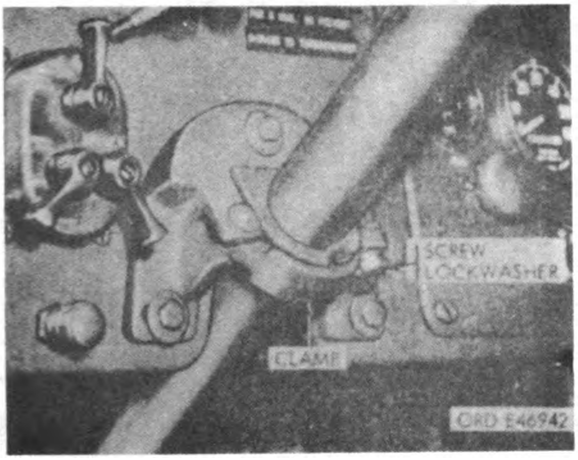


Figure 178. Steering column clamp.

(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.

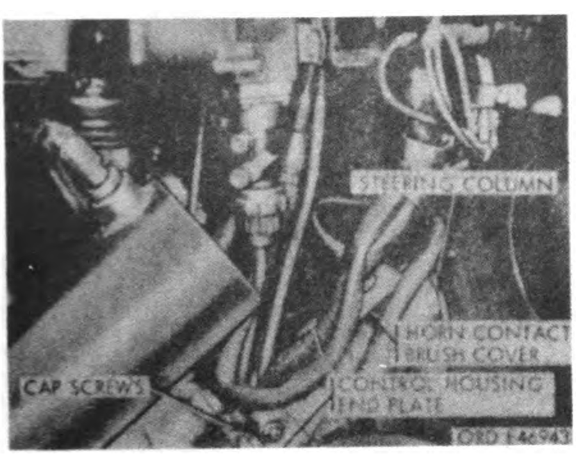


Figure 179. Removal of steering column.

(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).

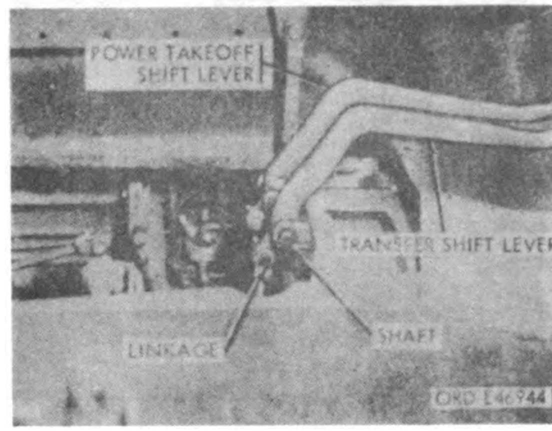


Figure 180. Transfer and power takeoff control levers.

(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.

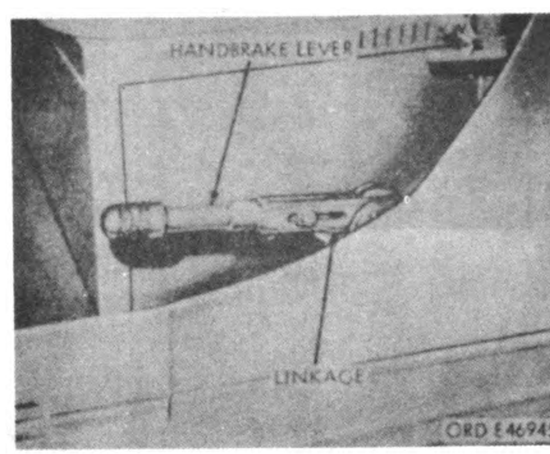


Figure 181. Handbrake lever and linkage.

(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).

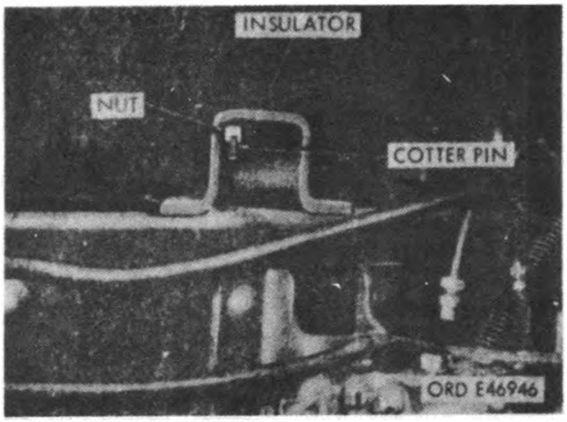


Figure 182. Cab front mounts.

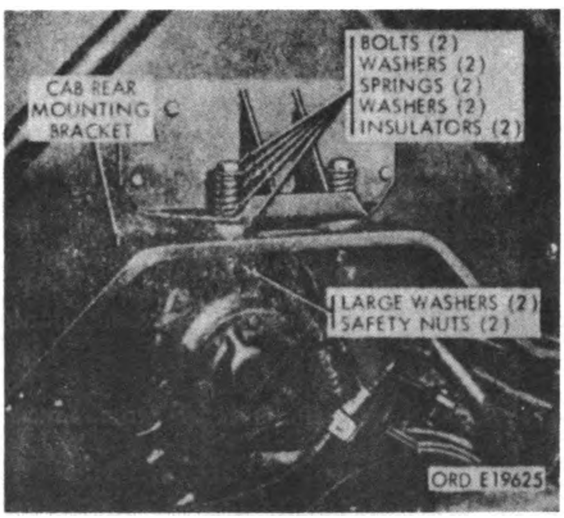


Figure 183. Cab rear mounts.

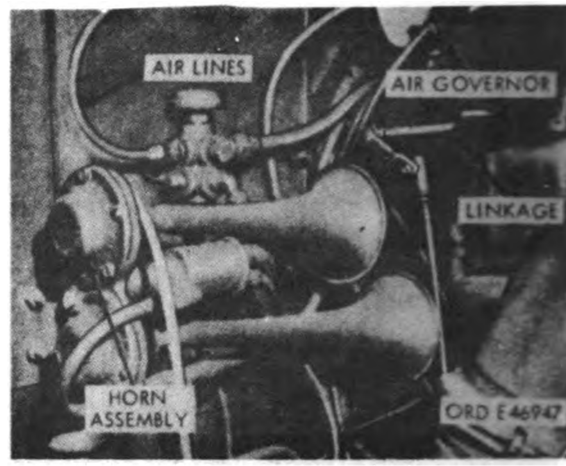


Figure 184. Components mounted on cab cowl.

(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. Installation. Install cab assembly in reverse order of removal.

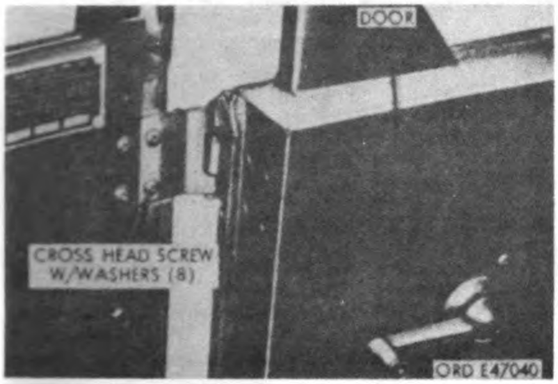
Section III. DISASSEMBLY INTO AND ASSEMBLY FROM SUBASSEMBLIES

132. Disassembly

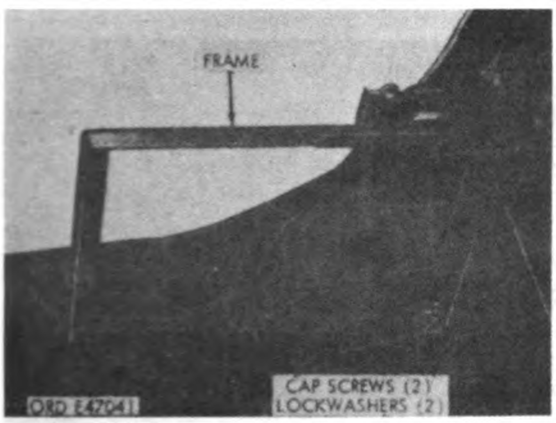
Disassemble cab assembly as shown in figure 185.

FIGURE 185
CAB DISASSEMBLY AND ASSEMBLY
Steps 1 through 16

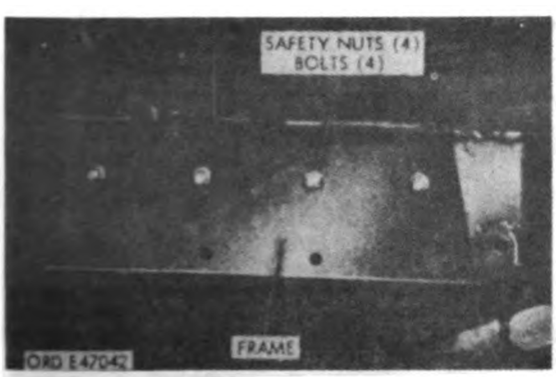
Step 1. Remove door check (right and left door).



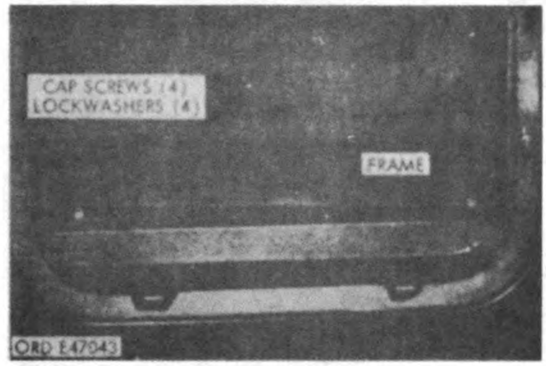
Step 2. Remove door assembly (right and left).



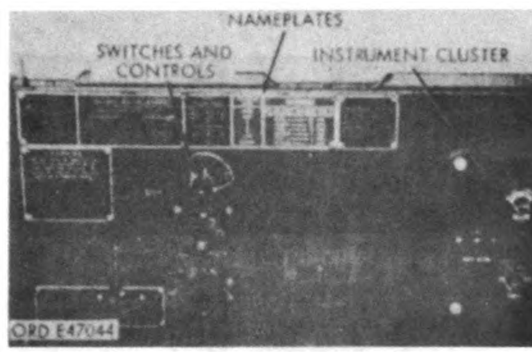
Step 3. Remove companion seat frame (right side).



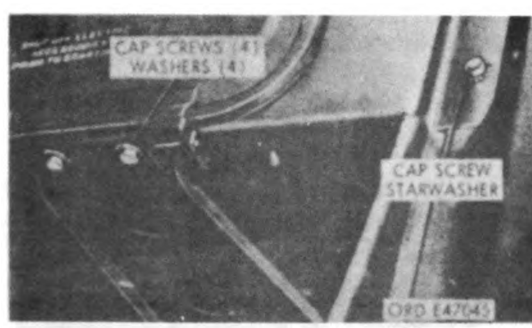
Step 4. Remove companion seat frame (left side).



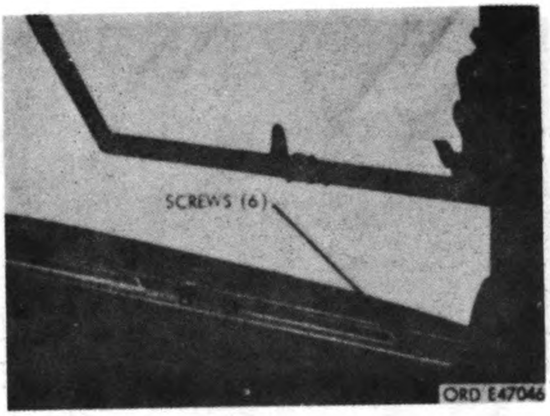
Step 5. Remove driver's seat frame.



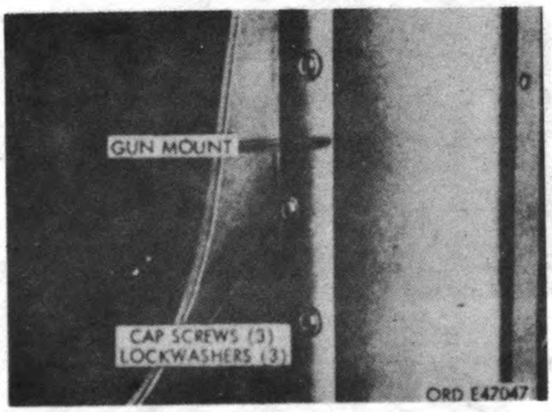
Step 6. Remove instrument cluster, nameplates, switches, and controls. Refer to TM 9-2851.



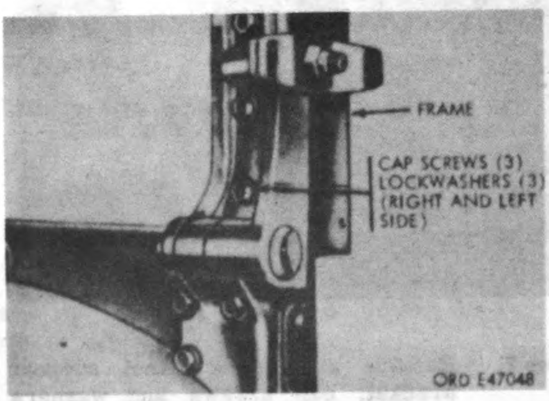
Step 7. Remove instrument panel support bracket, cap screws and washers (right side only), and instrument panel to hinge pillar cap screw and starwasher (right and left sides).



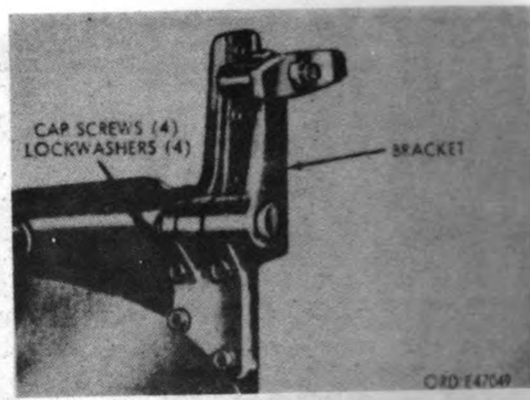
Step 8. Remove instrument panel to cowl pan head screws.



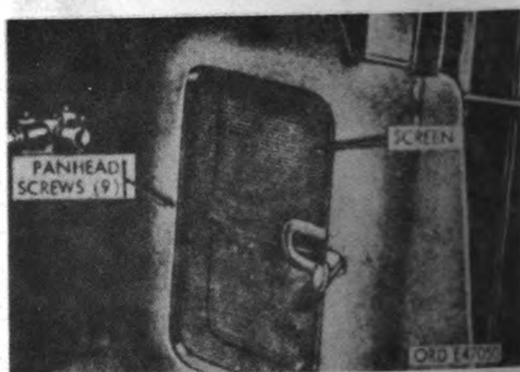
Step 9. Remove gun mount (right side only).



Step 10. Remove windshield frame.

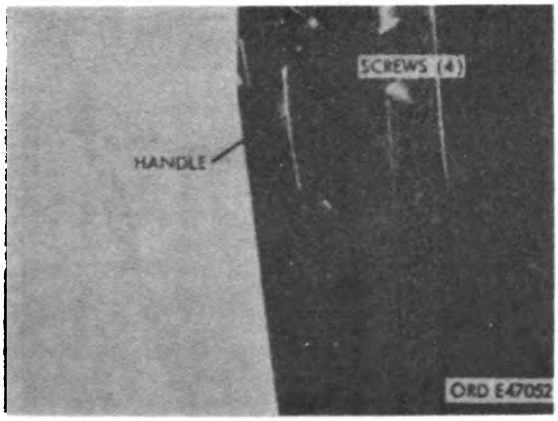


Step 11. Remove windshield support brackets (left and right).

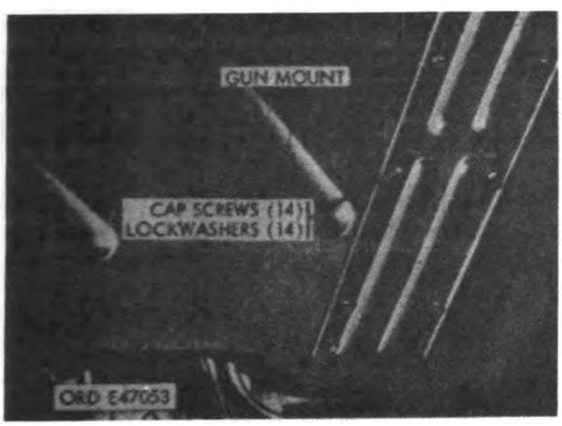


Step 12. Remove cowl ventilator screens (left and right).

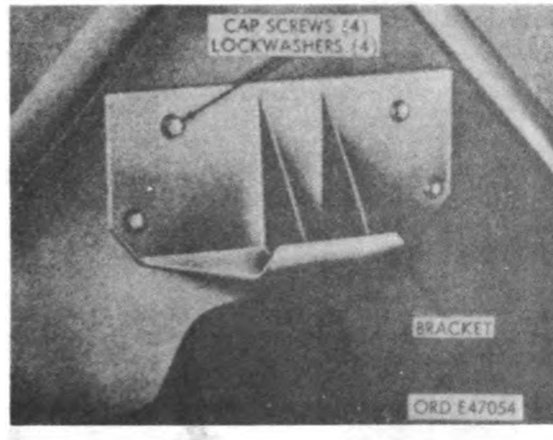
Step 13. Remove lashing hooks.



Step 14. Remove grab handle (right and left side).



Step 15. Remove rear gun mount bracket (right and left side).



Step 16. Remove rear mounting bracket.

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.

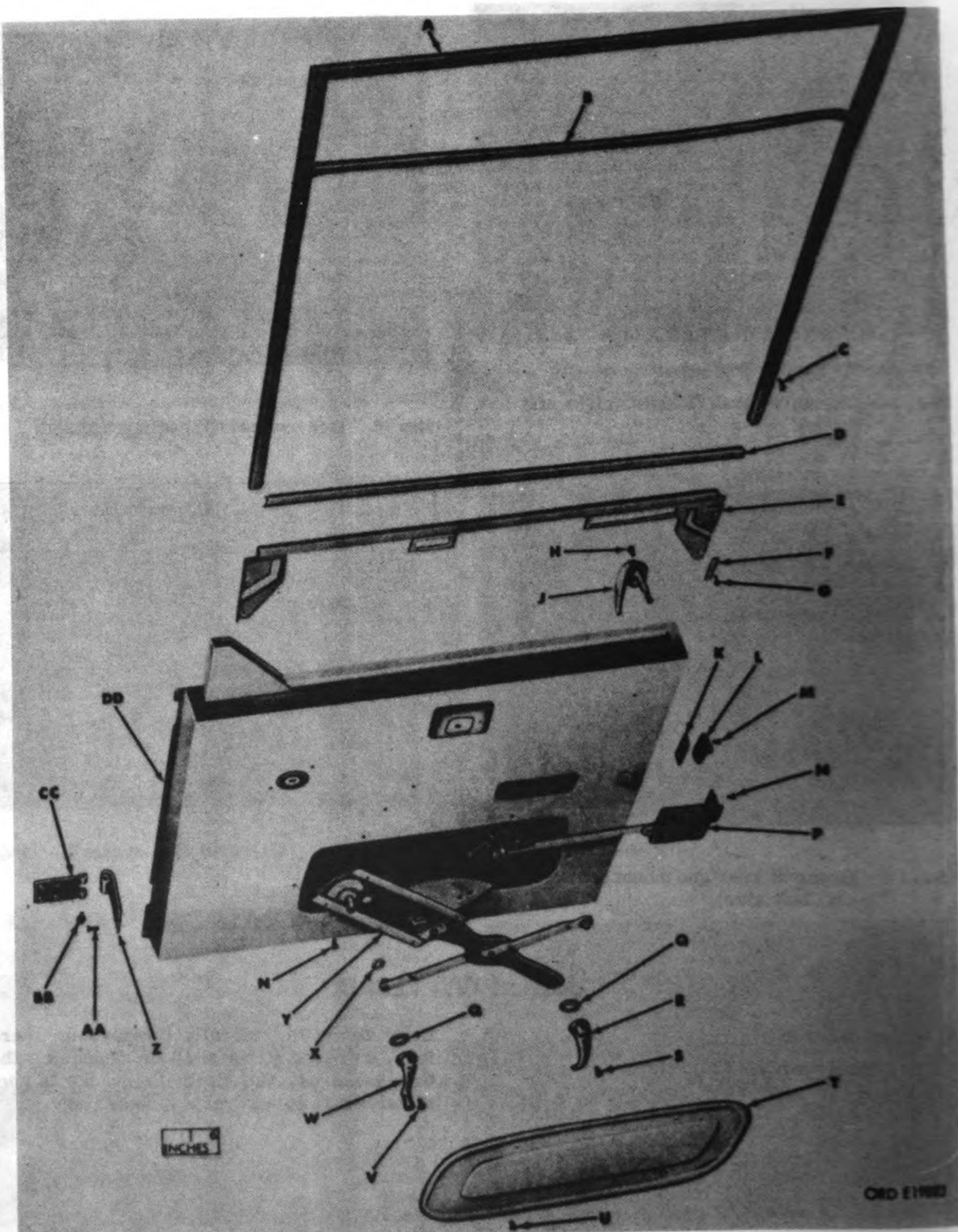
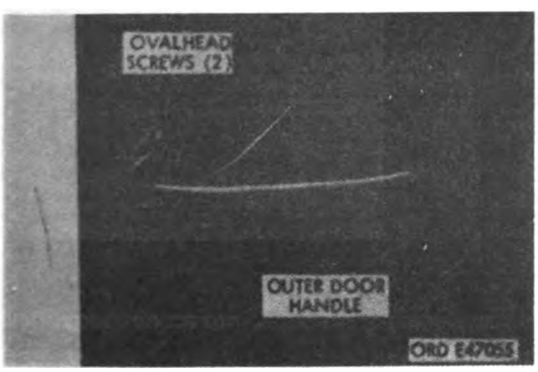


Figure 186. Cab right door assembly - exploded view

Key	Item	Key	Item
A	Glass frame	Q	Handle spacer
B	Glass frame seal	R	Inner handle
C	Flat head screws	S	Fil-hd lockscrew
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 lockscrew
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 lockscrew
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

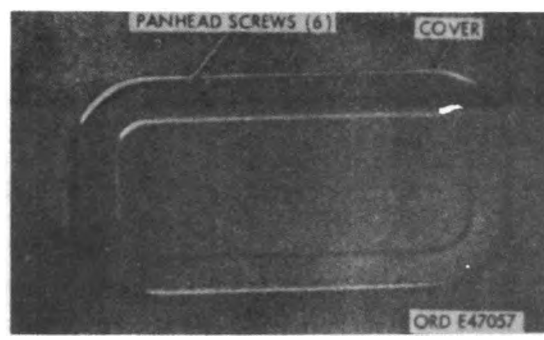
Figure 186. Cab right door assembly - exploded view - legend

FIGURE 187.
CAB DOOR—DISASSEMBLY AND ASSEMBLY
Steps 1 through 13

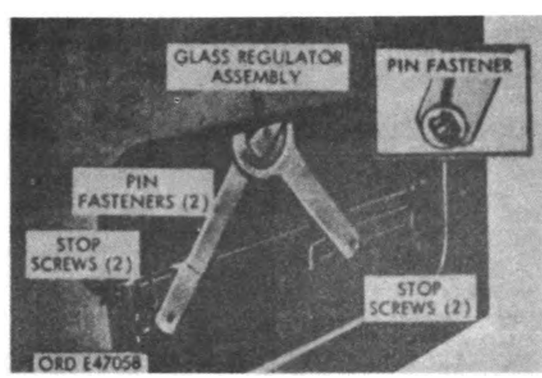


Step 1. Remove door outer handle.

Step 2. Remove door inner handle and spacer.

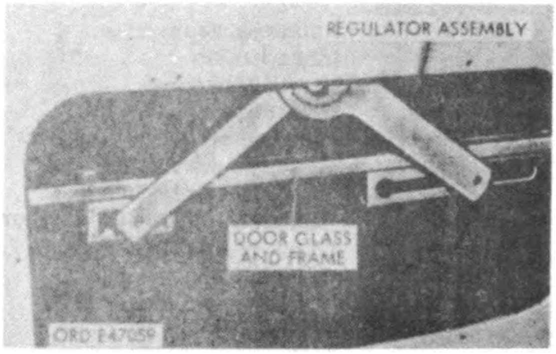


Step 3. Remove inspection cover.

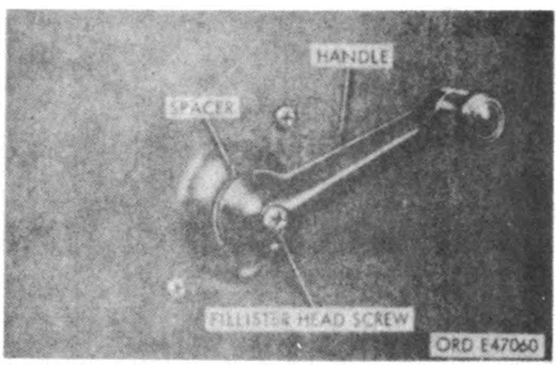


Step 4. Remove glass regulator assembly, pin fasteners and stops (2 each).

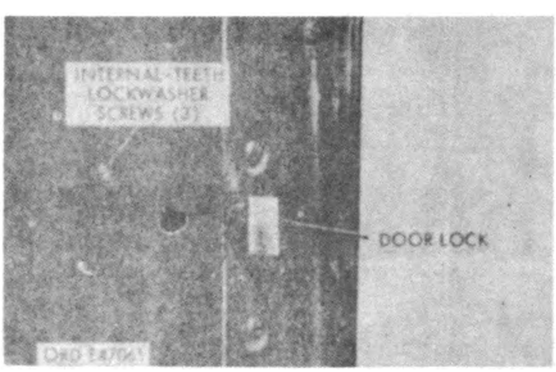
Note. During installation, install pin fasteners as shown in insert photo.



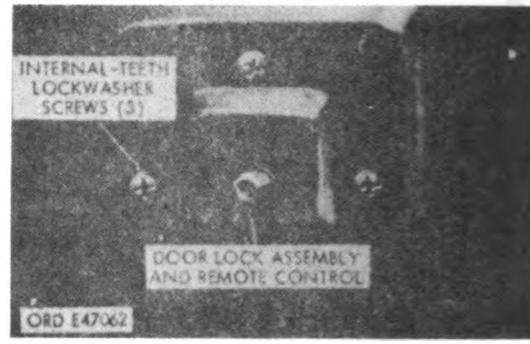
Step 5. Remove door glass and frame. Hold door glass frame and pull regulator assembly guides from glass regulator channel. Remove door glass and frame from top of door.



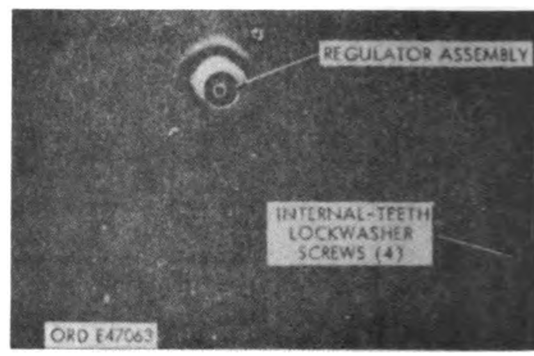
Step 6. Remove door glass regulator handle and spacer.



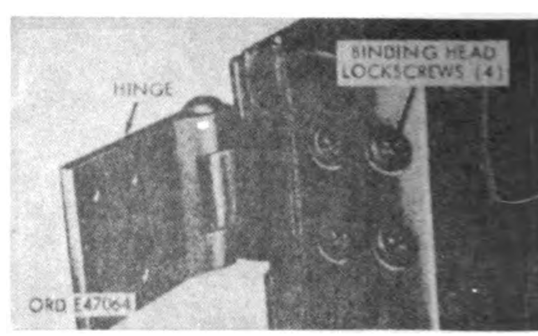
Step 7. Remove door lockplate.



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.

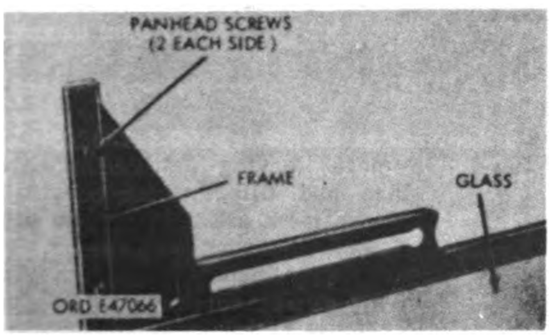


Step 9. Remove door glass regulator assembly.



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.

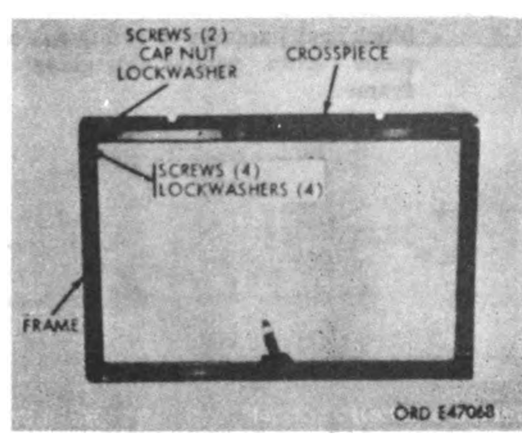
135. Instrument Panel

Refer to TM 9-2320-211-20 for removal and installation of instruments, controls, and name- and instruction plates.

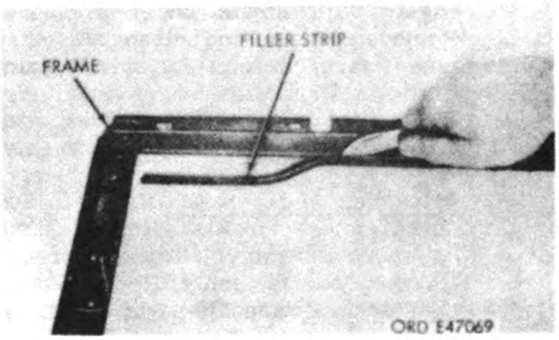
136. Windshield Assembly

a. Disassembly. Procedure for disassembly of the windshield assembly is shown in figure 188.

FIGURE 188
WINDSHIELD DISASSEMBLY AND ASSEMBLY
Steps 1 through 5

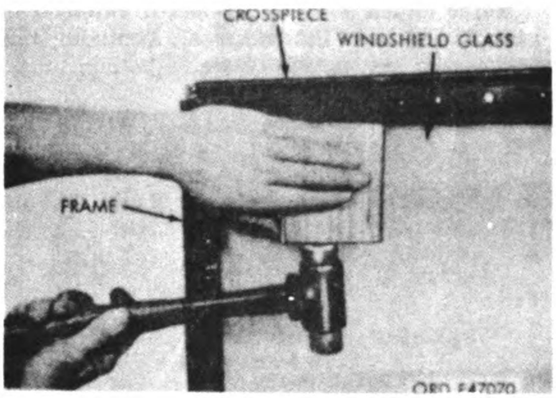


Step 1. Remove windshield inner frame upper crosspiece attaching parts.

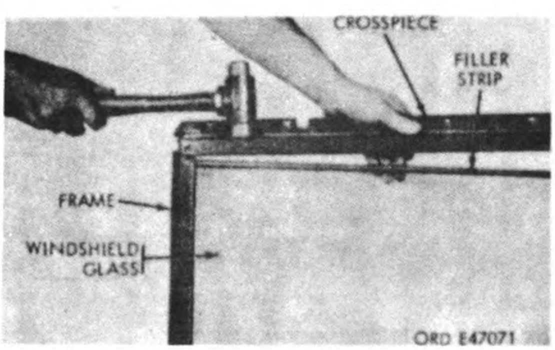


Step 2. Remove trimming filler strip.

Note. For installation use knife to trim filler strip even with frame edges.

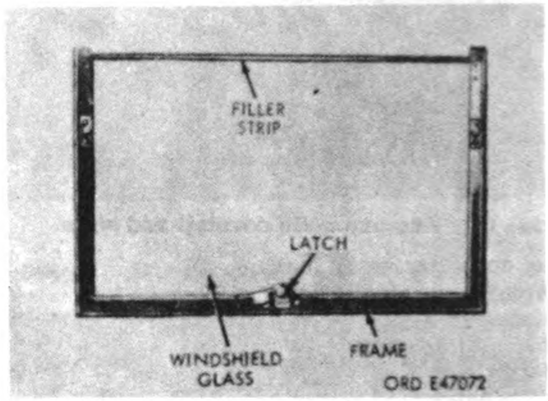


Step 3. Remove crosspiece. Use wooden block and hammer to remove crosspiece from windshield glass and frame.



Step 4. Remove frame alinement and crosspiece.

Note. For installation, aline 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 Cusions

Refer to TM 10-269 for repair of canvas and webbing. Refer to TM 10-455 for cushion major repair and upholstering.

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

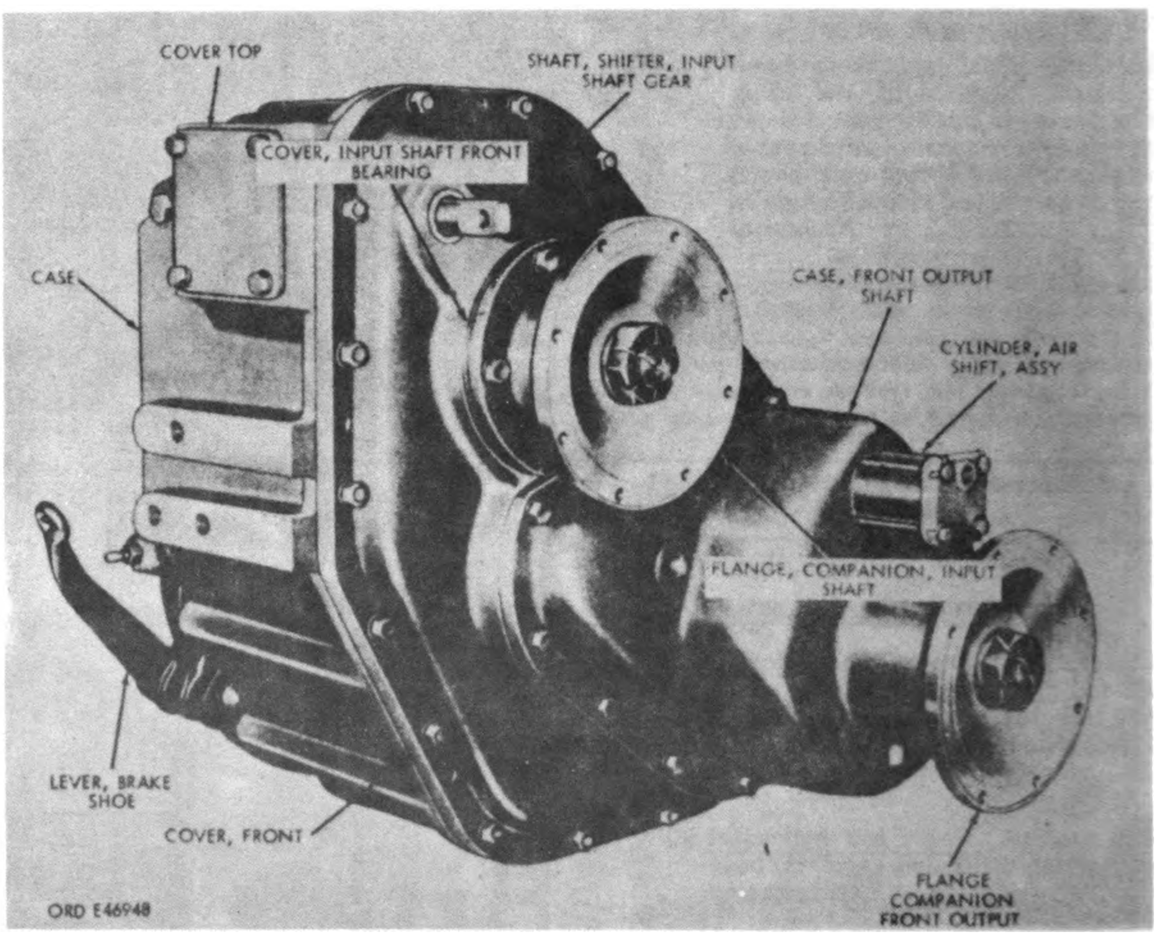


Figure 189. Transfer - right front view

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

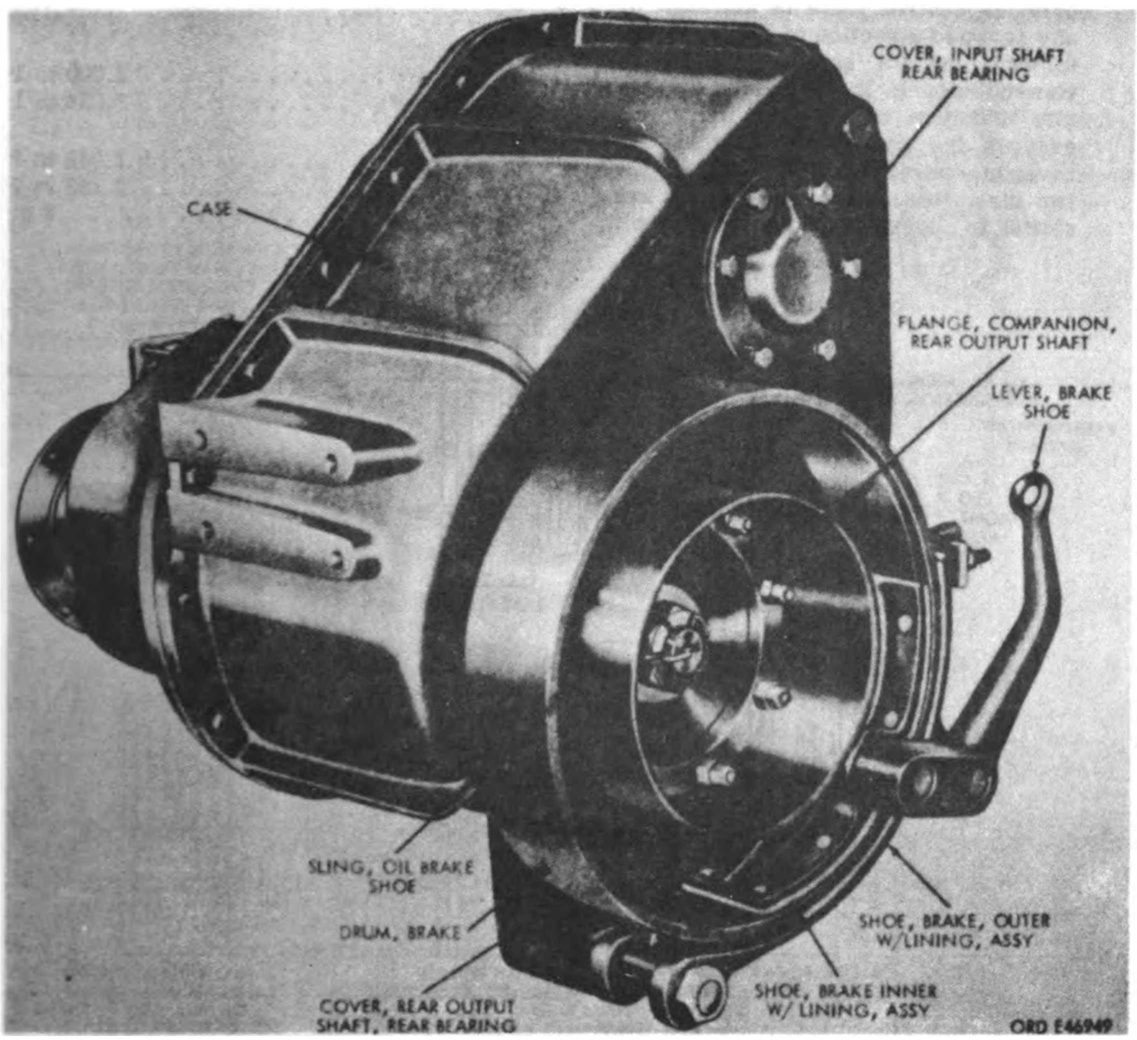


Figure 190. Transfer - left rear view

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 sufficient 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 directions 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

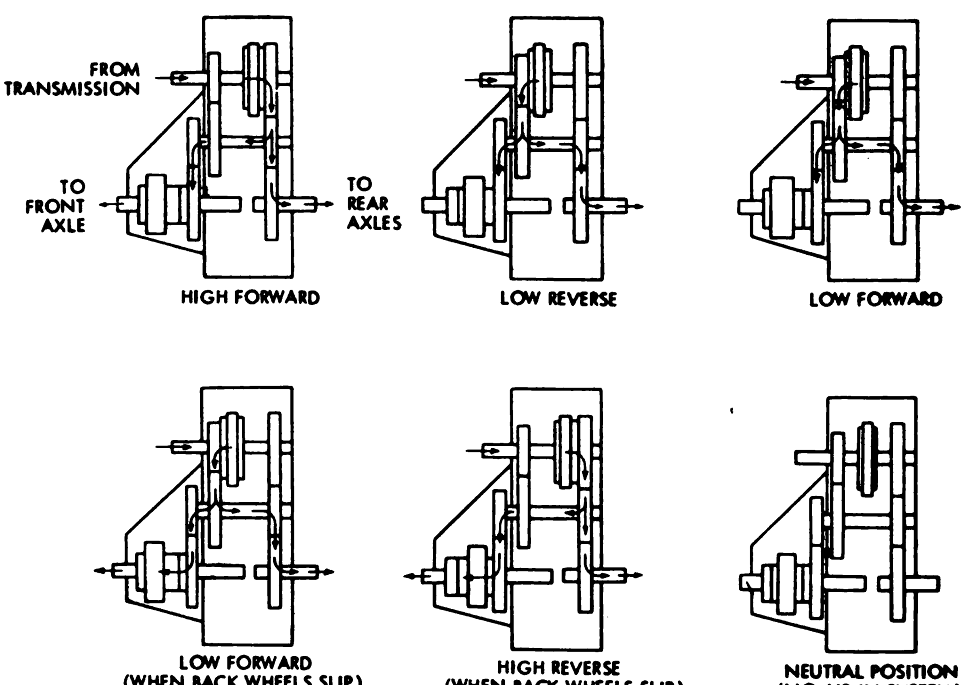


Figure 191. Principle of transfer sprag unit

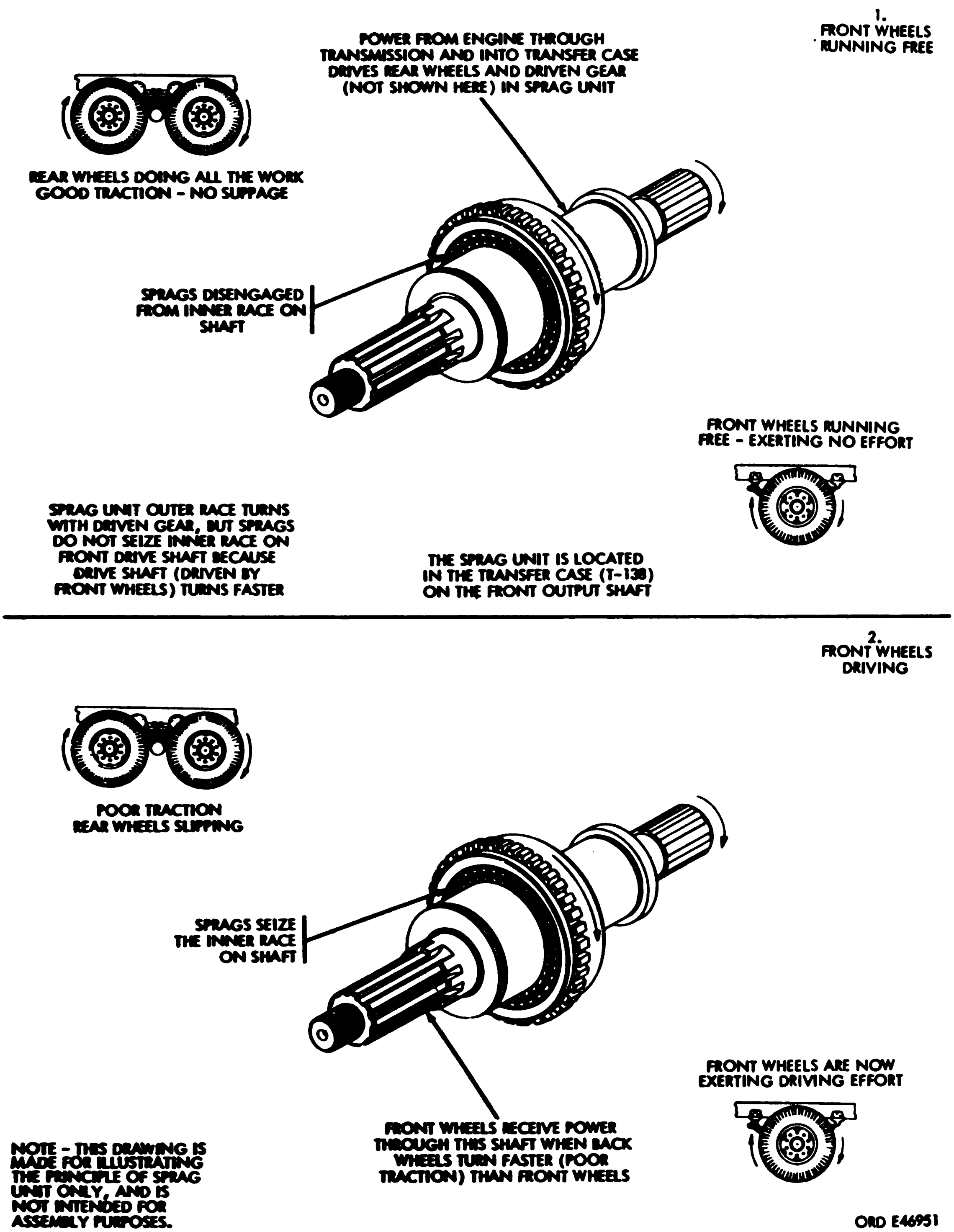


Figure 192. Transfer power flow diagram

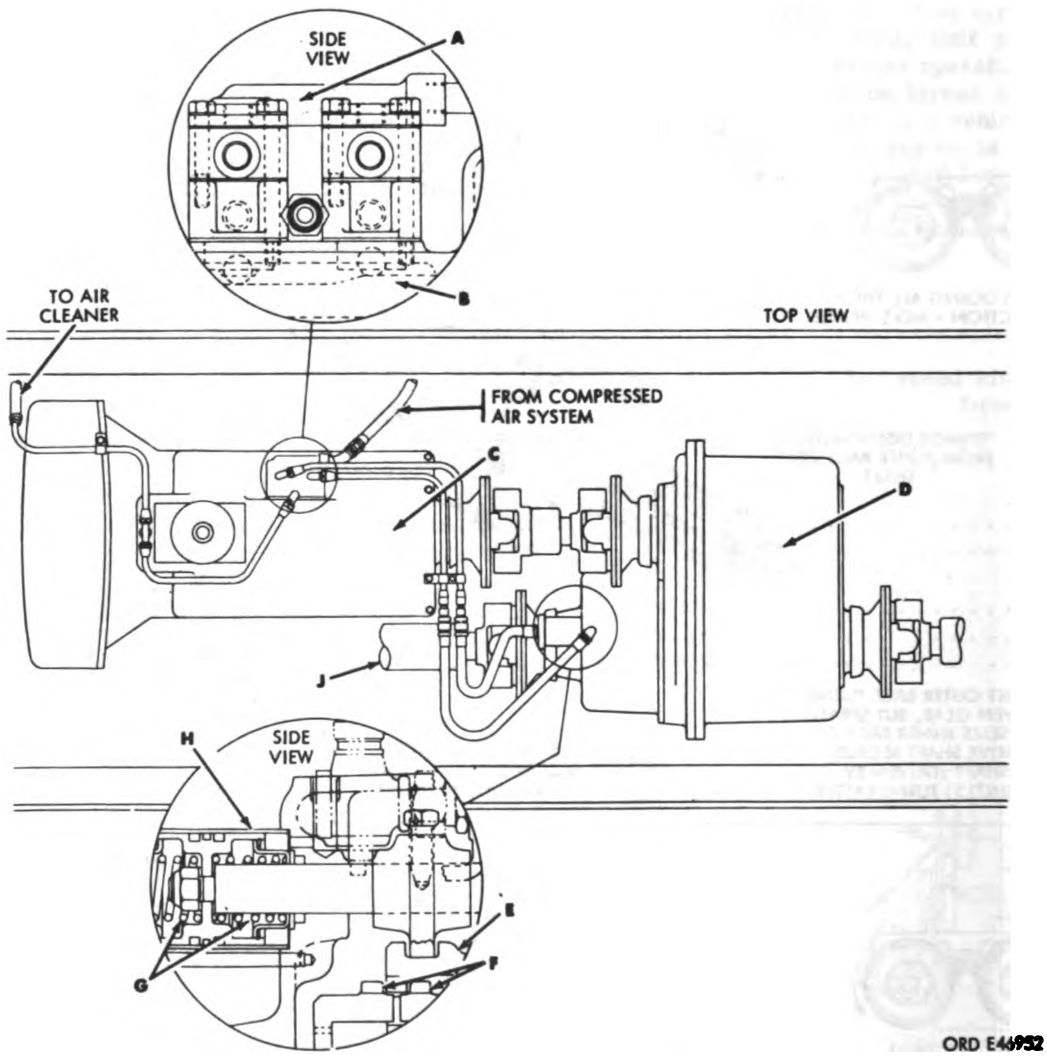


Figure 193. Front axle engagement air control diagram

Key	Item	Key	Item
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 the 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.	a. Shifter fork loose on shifter shaft. b. Shifter shaft poppet ball notches worn. c. Gear teeth worn.	a. Remove top cover (fig. 222) and tighten setscrew (fig. 225). b. Disassemble transfer (pars. 155 and 156) and install new shifter shaft (fig. 232). c. 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 loss 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 air lines 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-forward-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).

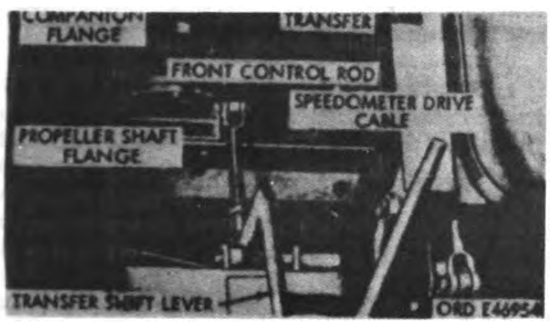


Figure 195. Top view of transfer front end from inside of cab

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.

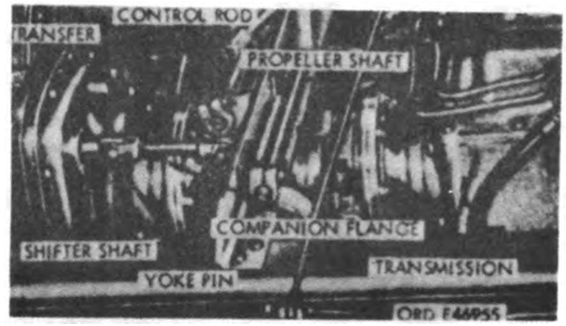


Figure 196. Transmission-to-transfer propeller shaft and shift linkage

k. Unhook retracting spring from brakeshoe lever (fig. 194) at rear of transfer. Remove adjusting nut and locknut from handbrake cable, and remove cable from brakeshoe 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).

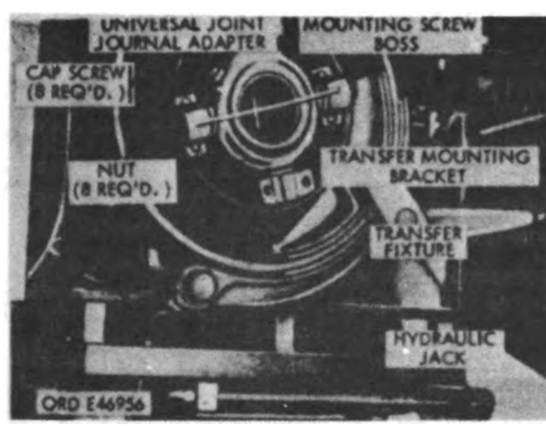


Figure 197. Supporting transfer with hydraulic jack

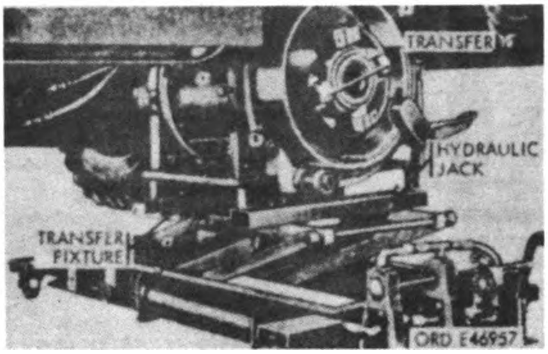


Figure 198. Lowering transfer on hydraulic jack

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).

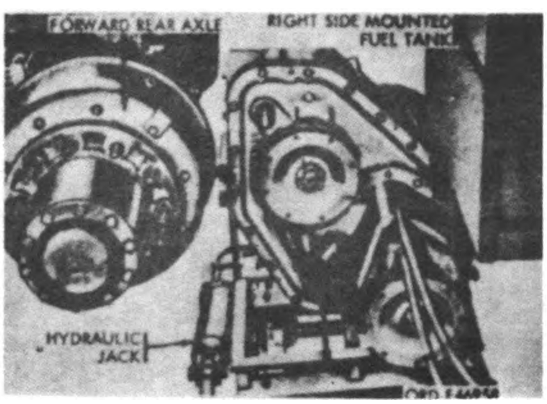


Figure 199. Pulling transfer from under right side of truck

b. Turn jack until front of transfer is toward front of truck, raise jack, and aline 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 alined 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. 196).

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 9-2320-211-20.)

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.

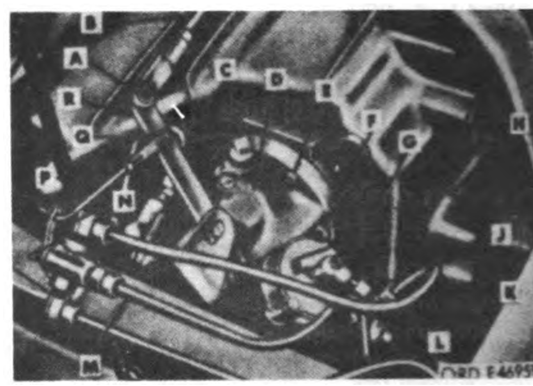


Figure 200. Power takeoff mounted on transfer - M246 only

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 bracket, mounted integrally with rear output shaft rear bearing cover (fig. 202).

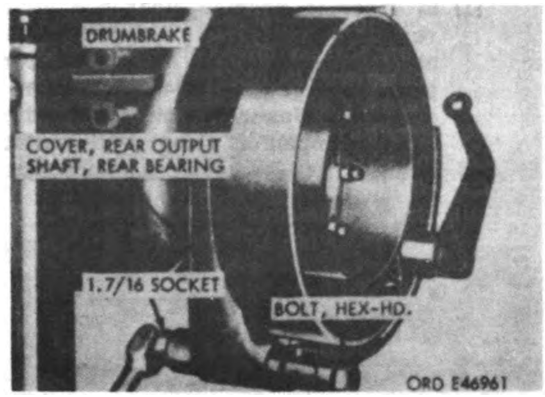


Figure 202. Removing parking brake anchor bolt

(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.

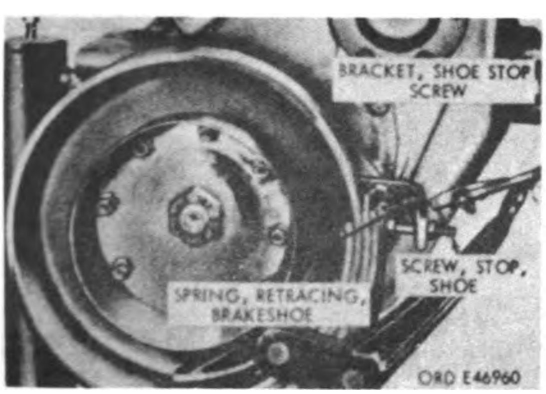


Figure 201. Removing brakeshoe retracting spring

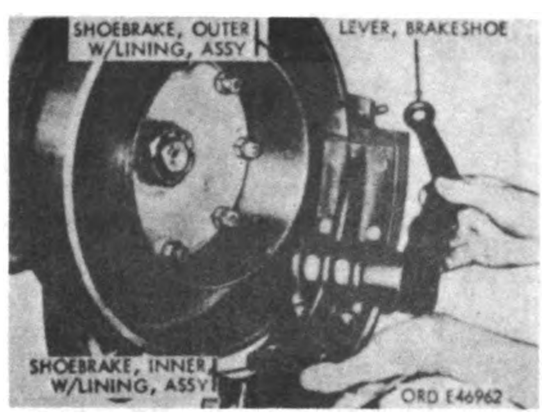


Figure 203. Parking brakeshoe lever and shoe assembly removed

(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.

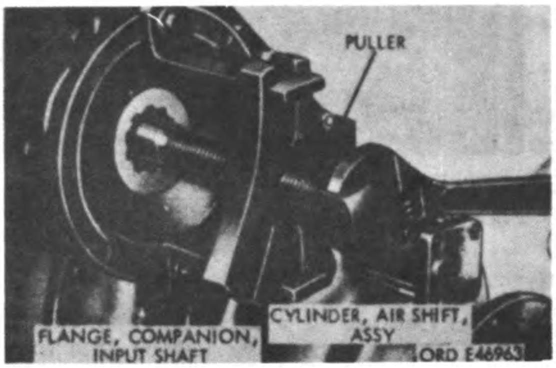


Figure 204. Removing input shaft companion flange

(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-

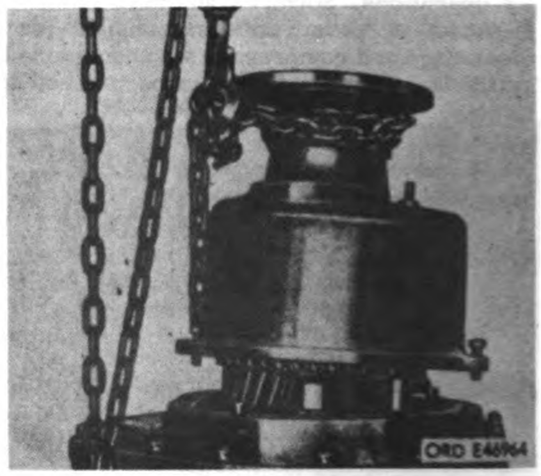


Figure 205. Loosening front output shaft case assembly from transfer

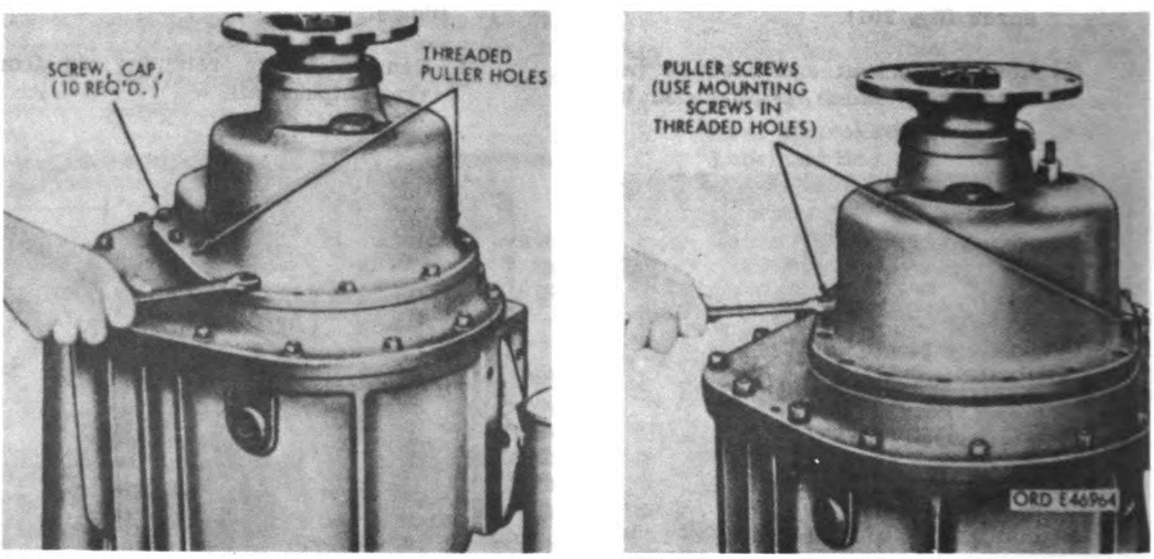


Figure 206. Lifting front output shaft case assembly from transfer

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.

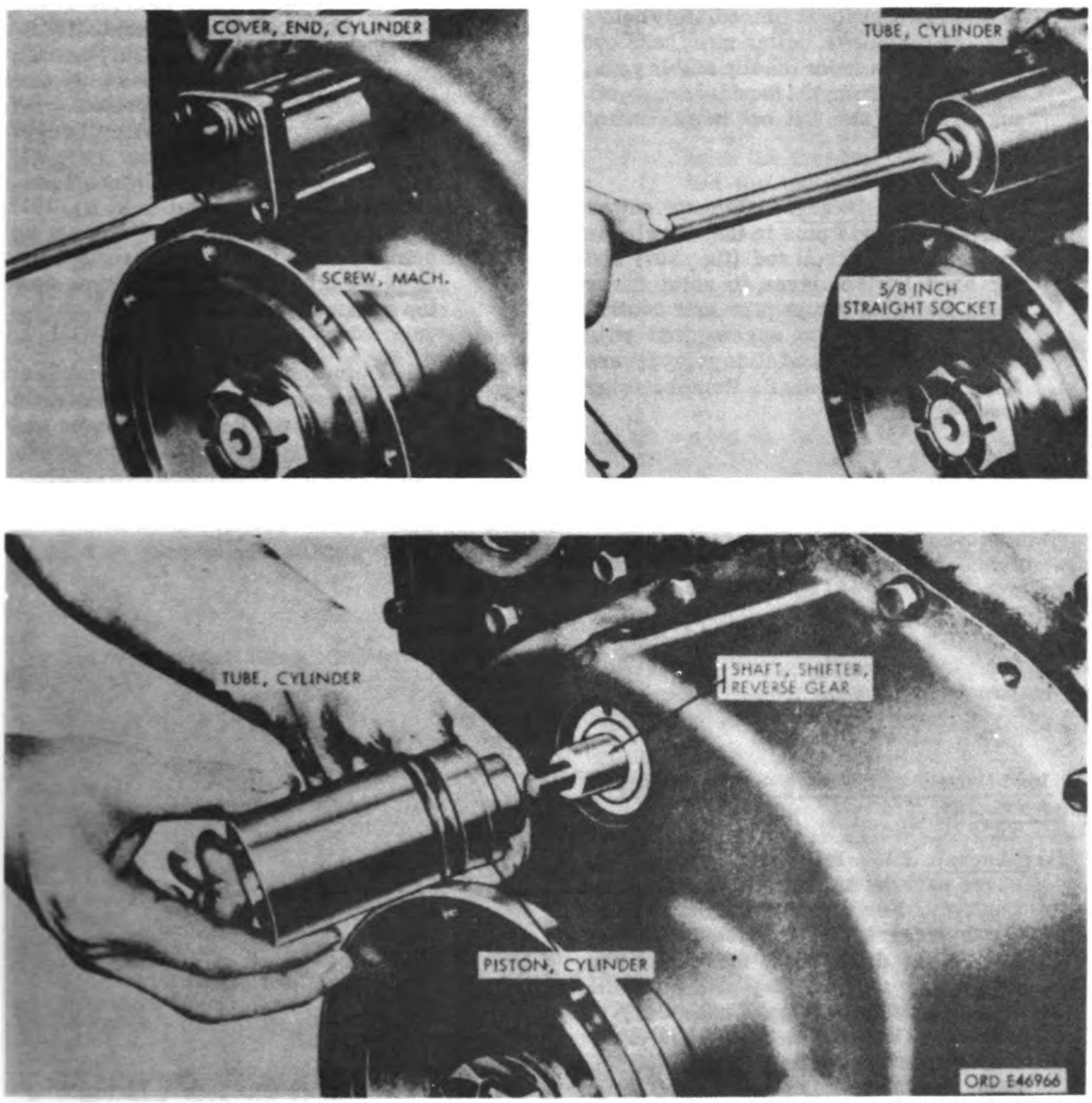


Figure 207. Removing shift air cylinder assembly

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 aline 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.

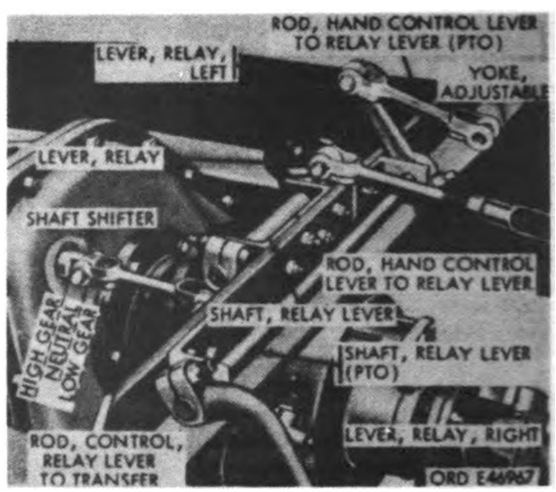


Figure 208. Transfer shift lever linkage

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.

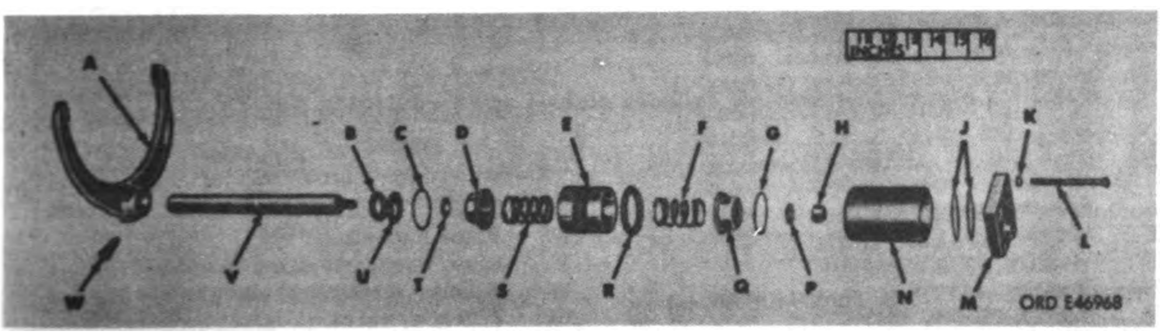


Figure 209. Shift air cylinder assembly - exploded view

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

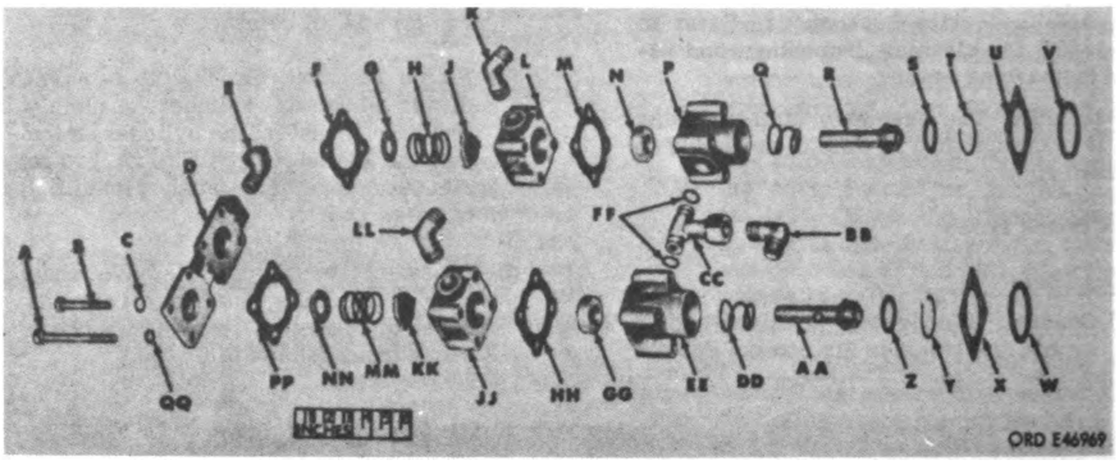


Figure 210. Shift air cylinder control valve - exploded view

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 air seals (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) Aline 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.

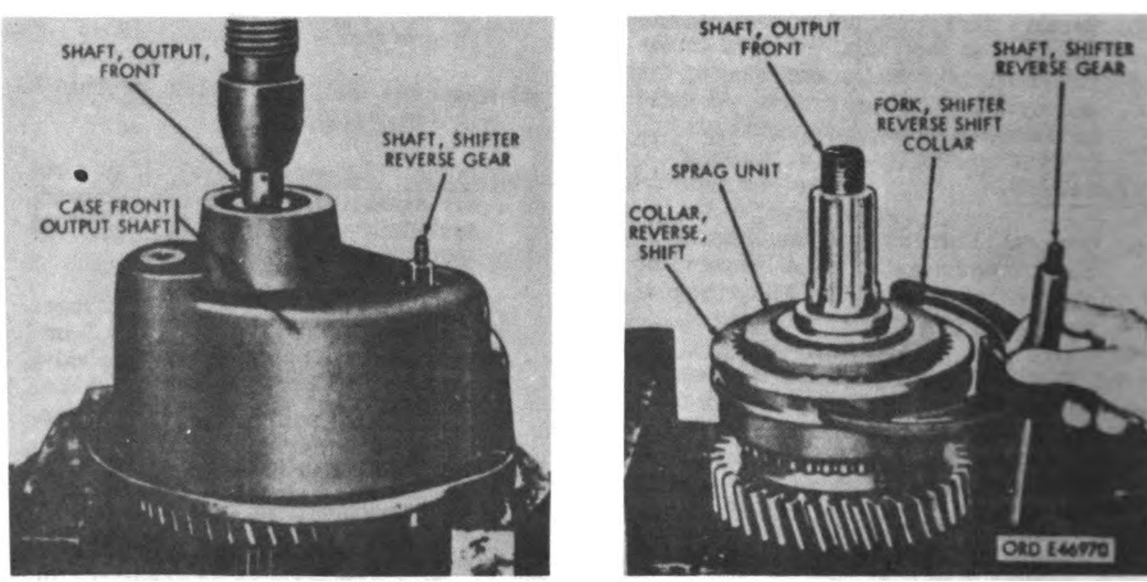


Figure 211. Disassembly of front output shaft case assembly

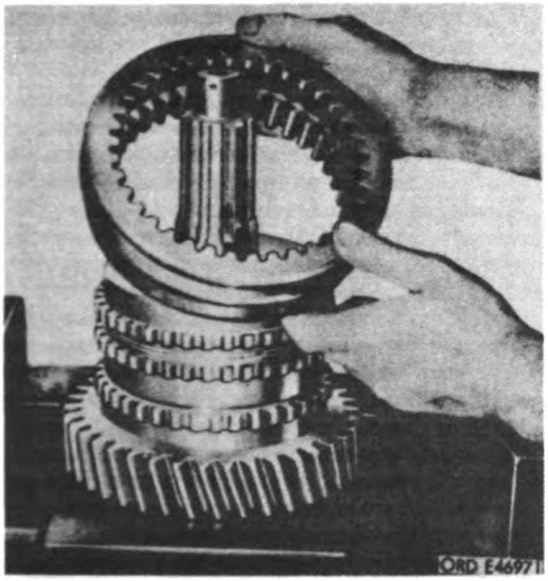


Figure 212. Removing reverse shift collar

(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

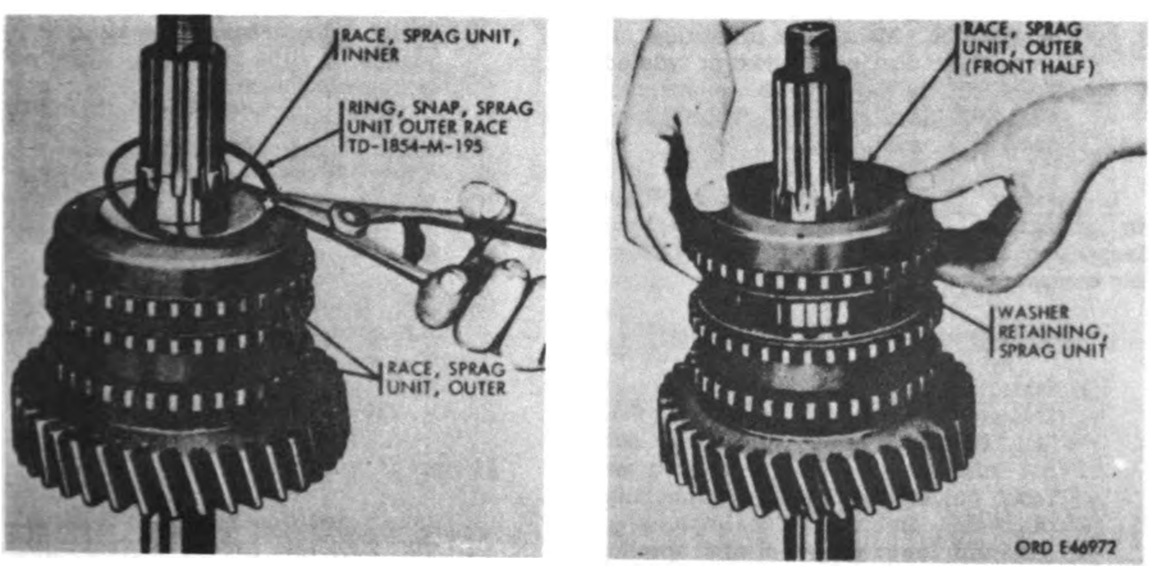


Figure 213. Removing front half of sprag unit outer race

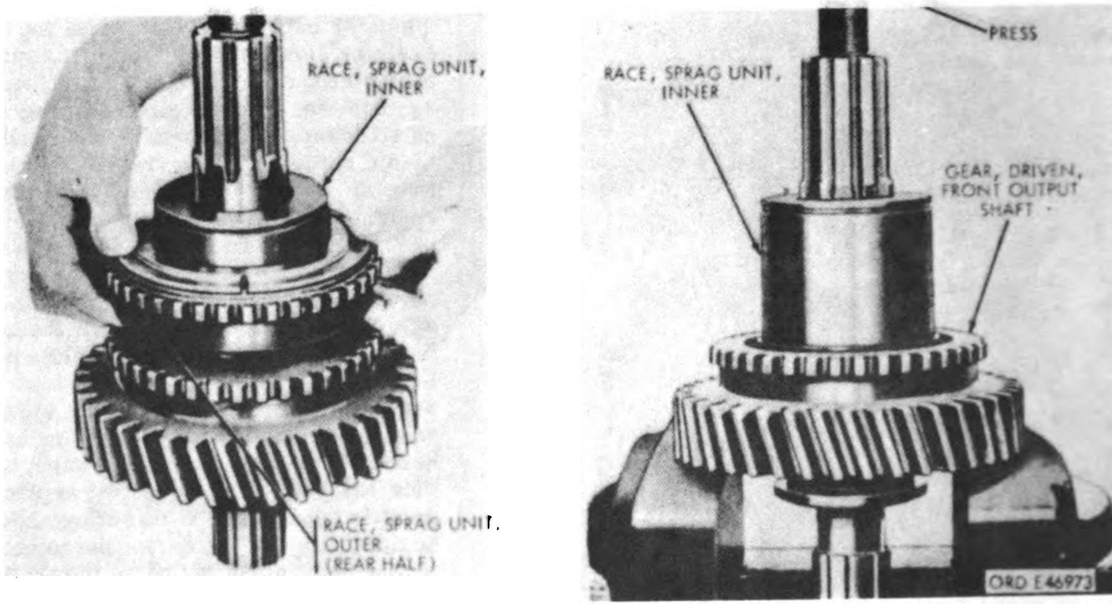


Figure 214. Completion of sprag unit disassembly

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 slipped 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.

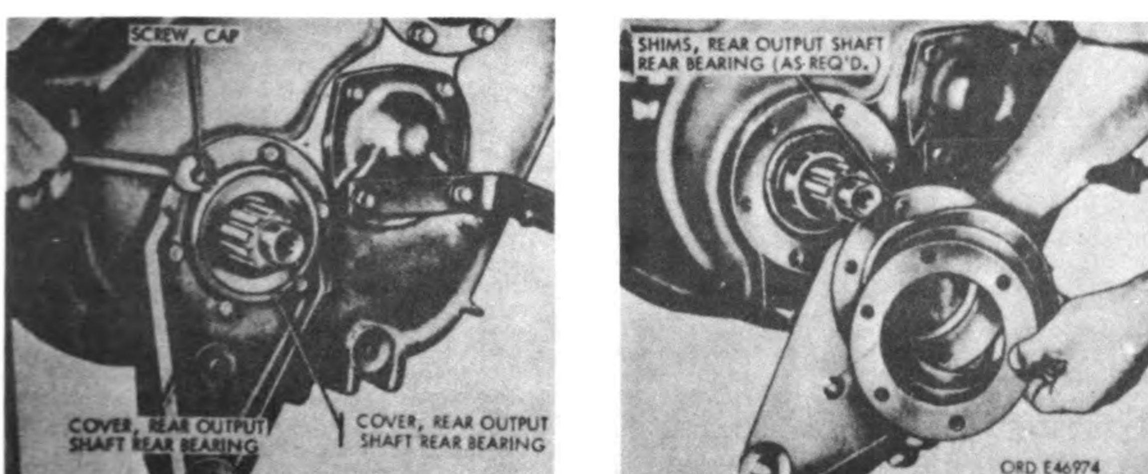


Figure 215. Removing rear output shaft bearing cover

(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.

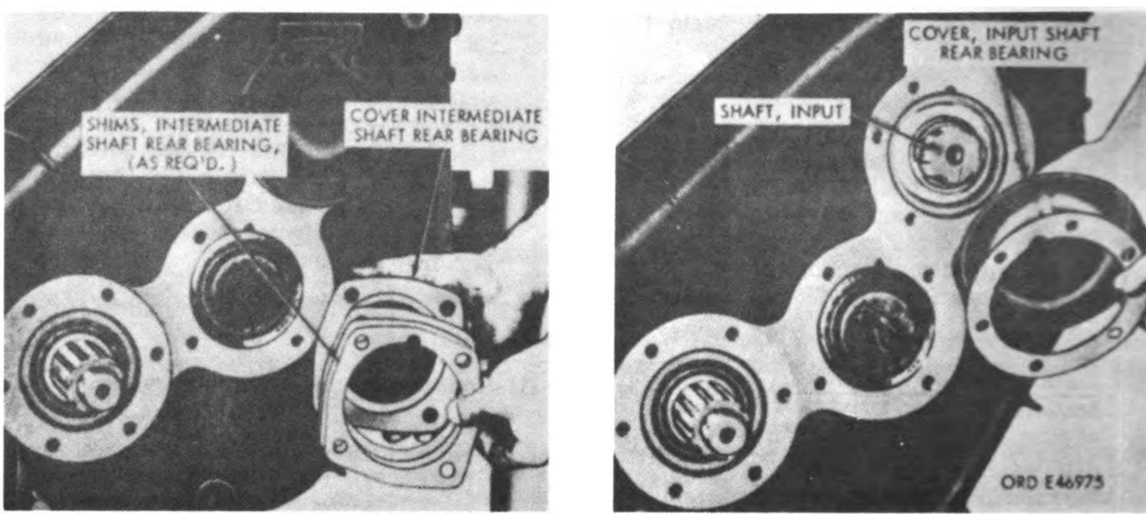


Figure 216. Removing intermediate and input shaft rear bearing covers

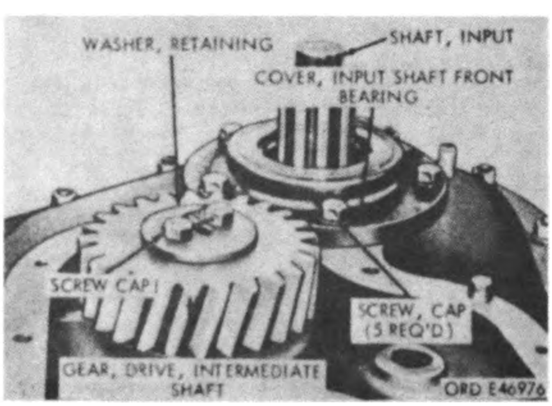


Figure 217. Preparing front cover for removal

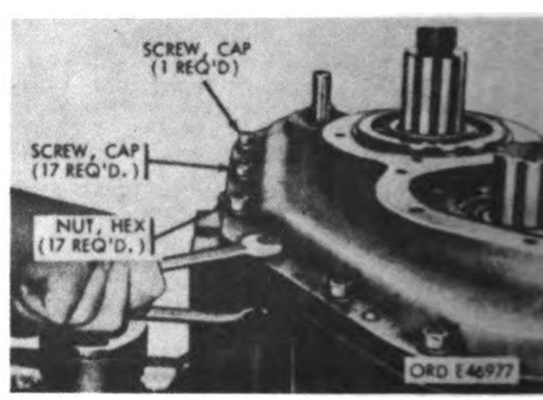


Figure 218. Removing cover mounting cap screws

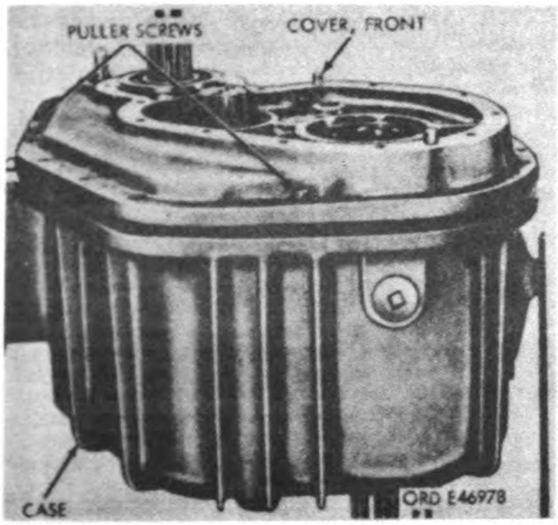


Figure 219. Using puller screws to raise front cover from case

(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.

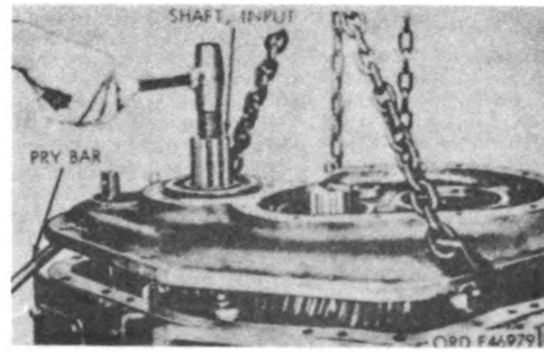


Figure 220. Lifting front cover from case

(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).

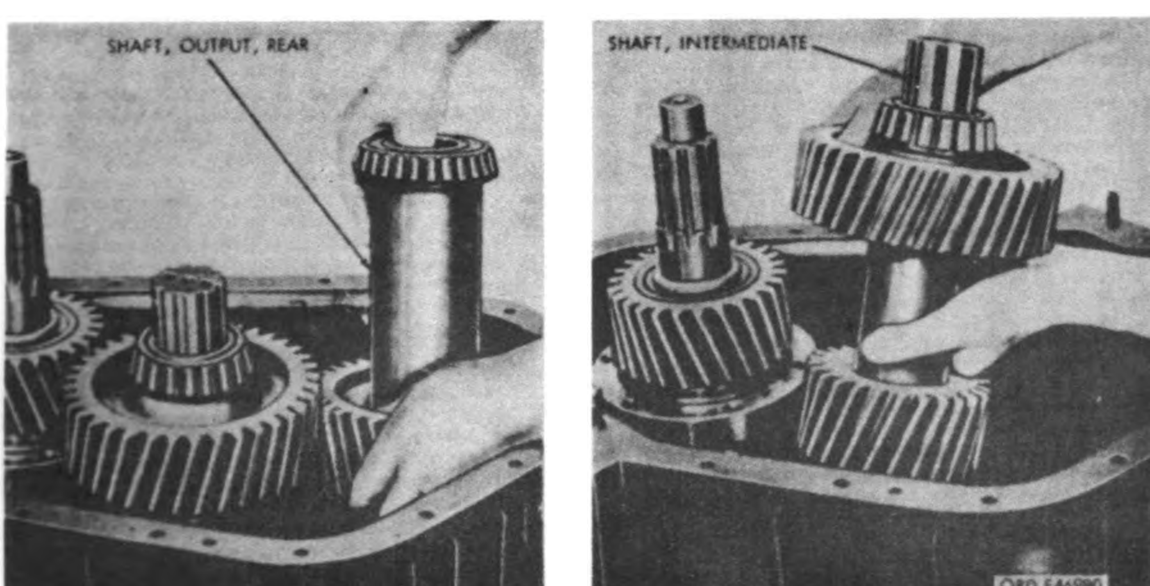


Figure 221. Rear output and intermediate shaft removal

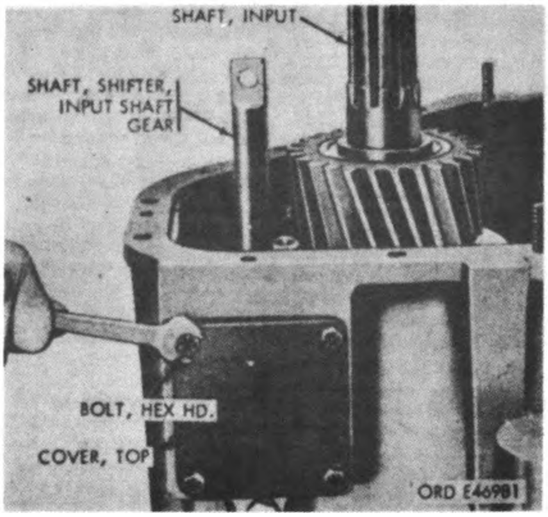


Figure 222. Removing top cover

(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.

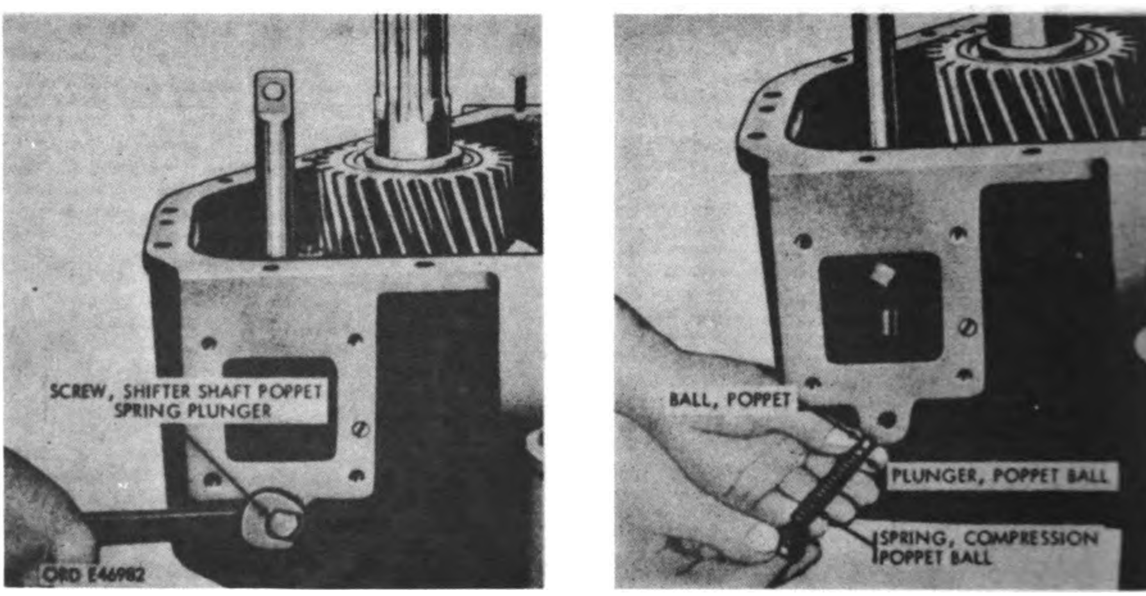


Figure 223. Removing shifter shaft poppet ball

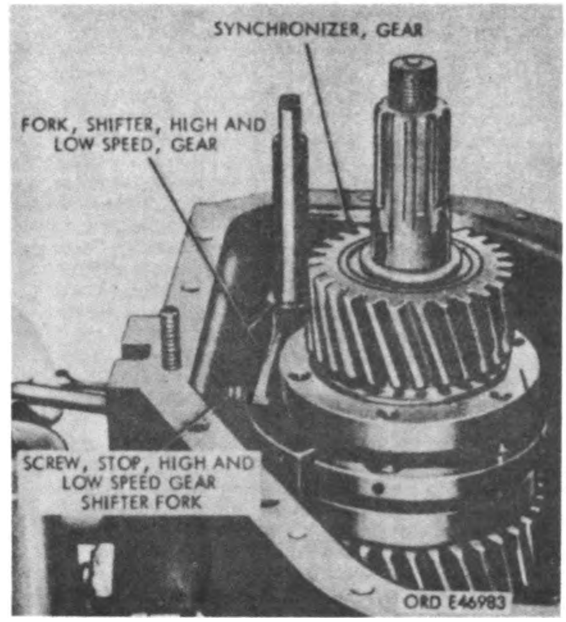


Figure 224. Removing headless setscrew and loosening stop screw

(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).

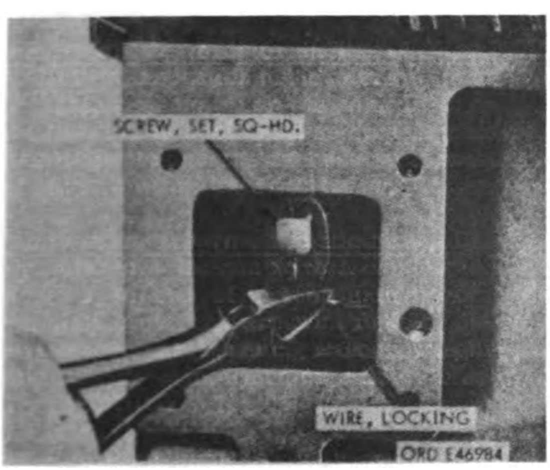


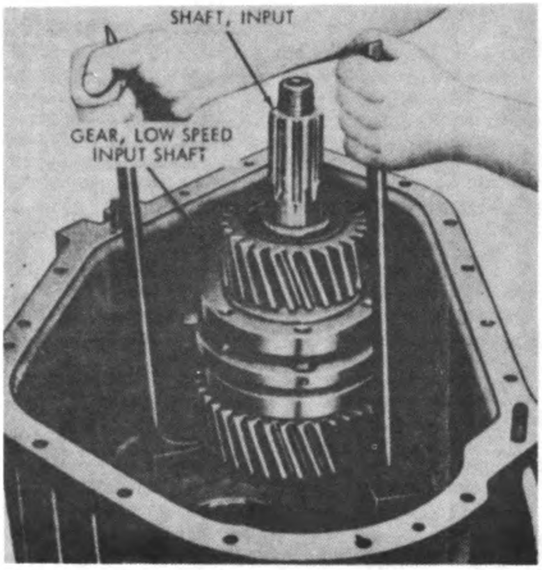
Figure 225. Shifter shaft locking wire removal

(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



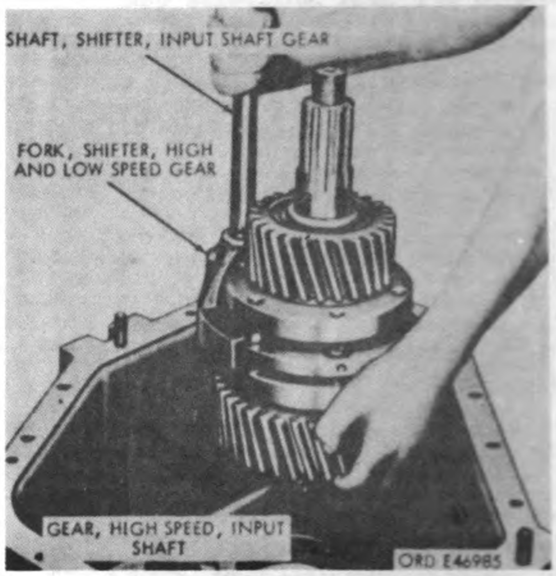


Figure 226. Removing input shaft from case

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.

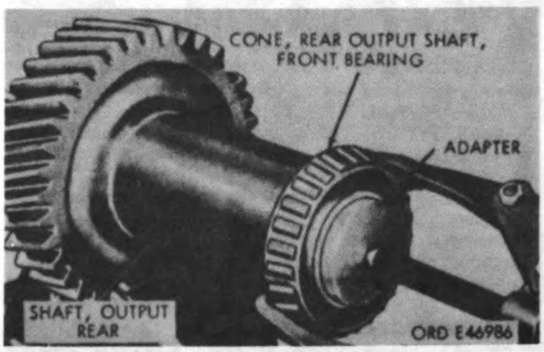


Figure 227. Removing rear output shaft front bearing cone

(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 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

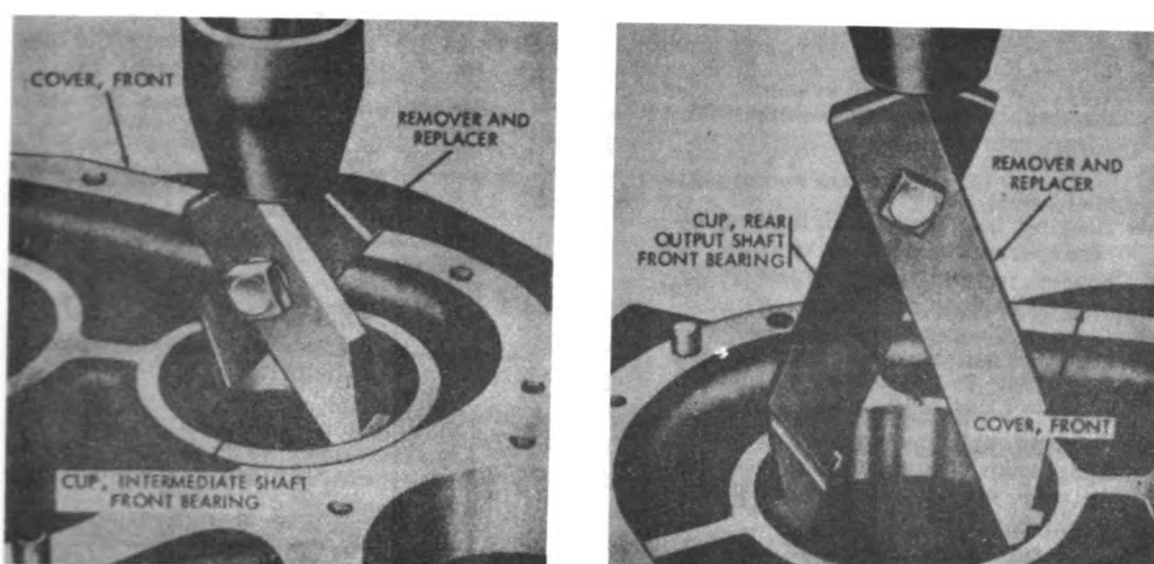


Figure 228. Bearing cup removal

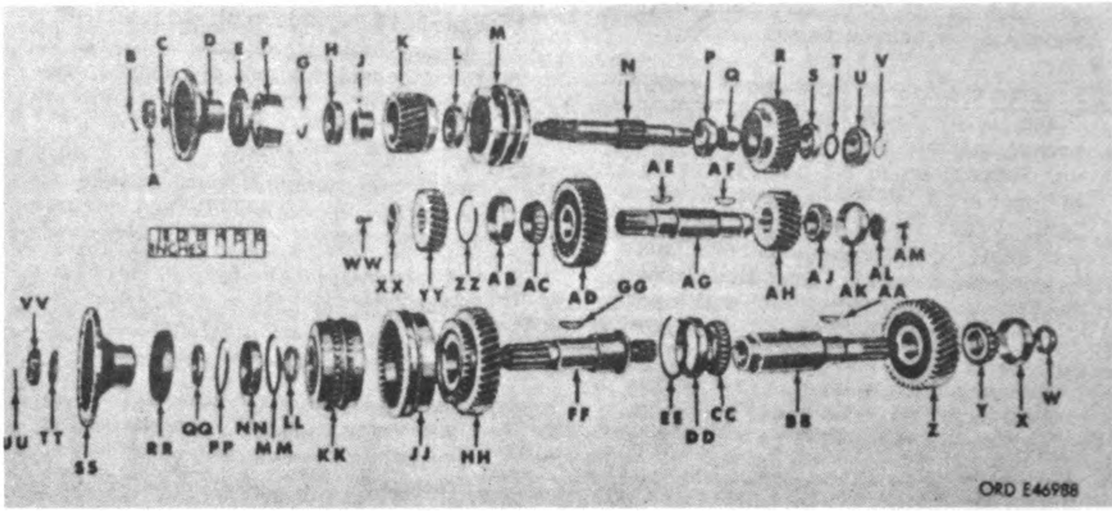


Figure 229. Transfer shafts, bearings, and gears - exploded view

Key	Item
A	Nut, sltd
B	Pin, cotter
C	Washer, plain
D	Flange, companion, input shaft
E	Slinger, dust, flange
F	Bearing, ball, input shaft, front
G	Spacer, input shaft front bearing
H	Bearing, ball, input shaft low-speed gear, front
J	Spacer, input shaft low-speed gear
K	Gear, low-speed, input shaft
L	Bearing, ball, input shaft low-speed gear, rear
M	Synchronizer, gear
N	Shaft, input
P	Bearing, ball, input shaft high-speed gear, front
Q	Spacer, input shaft high-speed gear front bearing
R	Gear, high-speed, input shaft
S	Bearing, ball, input shaft high-speed gear, rear
T	Spacer, input shaft rear bearing
U	Bearing, ball, input shaft, rear
V	Ring, snap, input shaft rear bearing
W	Washer, spacing, rear output shaft rear bearing
X	Cup, rear output shaft rear bearing
FF	Shaft, output, front
GG	Key, Woodruff
HH	Gear, driven, front output shaft
JJ	Collar, reverse shift
KK	Sprag unit
LL	Washer, spacing, front output shaft bearing, inner
MM	Ring, snap, front output shaft bearing, rear
NN	Bearing, ball, front output shaft
PP	Ring, snap, front output shaft bearing, front
QQ	Washer, spacing, bearing, outer
RR	Slinger, dust, flange
SS	Flange, companion, front output
TT	Washer, plain
UU	Pin, cotter
VV	Nut, sltd
WW	Screw, cap
XX	Washer, retaining
YY	Gear, drive, intermediate shaft
ZZ	Ring, snap, intermediate shaft front bearing
AB	Cup, intermediate shaft front bearing
AC	Cone, intermediate shaft front 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.

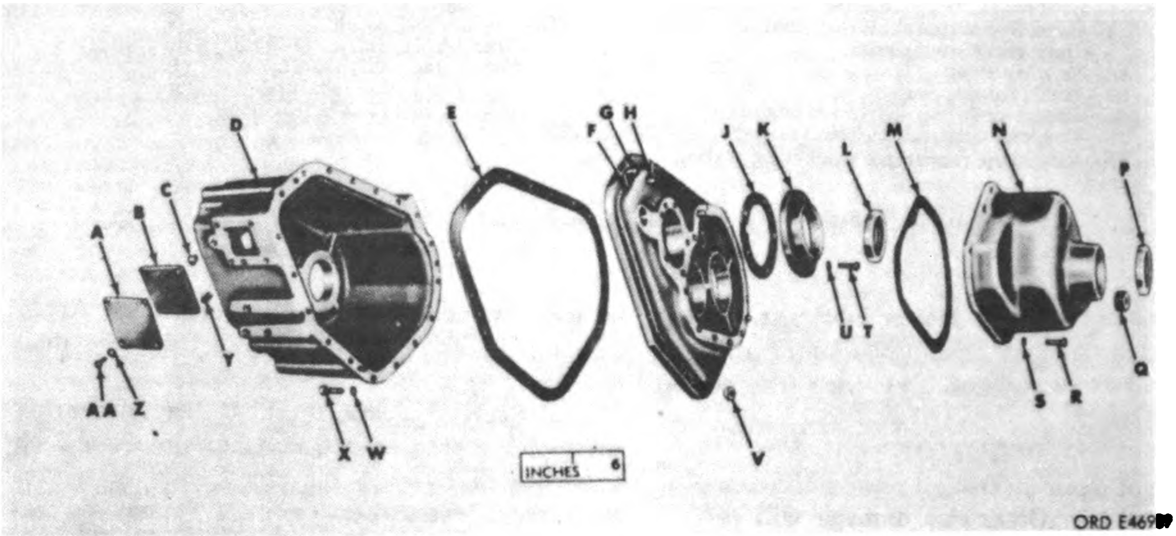
(2) *Bearing covers* (fig. 230). Inspect bearing covers for cracks around bolt holes and for deep scratches or burs on machined shim or gasket surfaces. If scratches or burs cannot be removed with fine mill file, replace defective cover.

(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 windblown 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 alinement. 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 alinement 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 read 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 from 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."

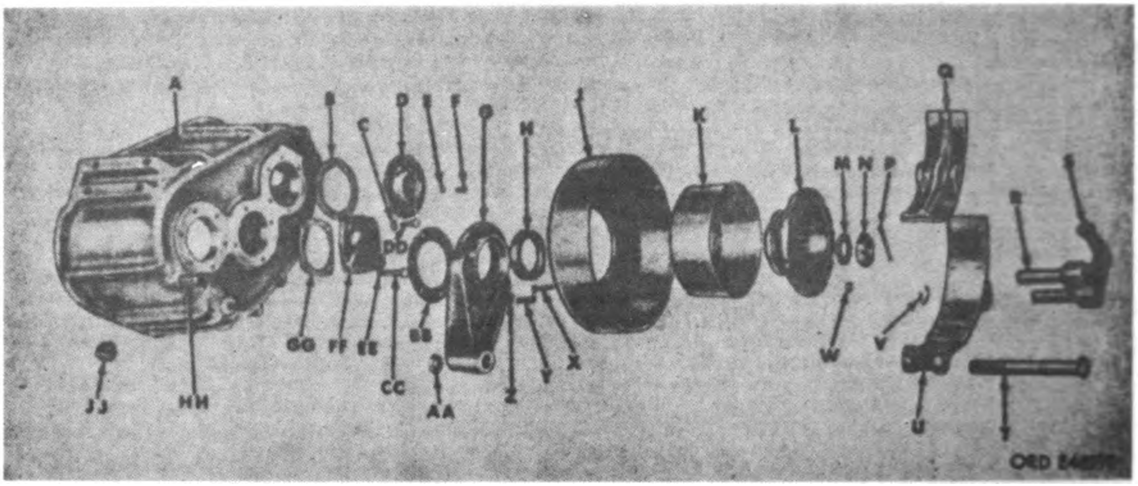


Figure 231. Transfer case, rear covers, and parking brake - exploded view

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:

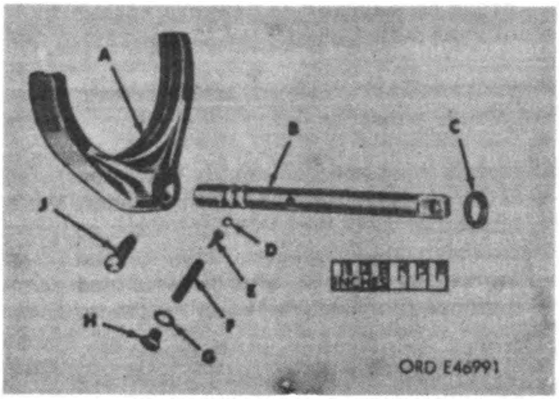


Figure 232. High low shifter shaft and fork - exploded view

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) (e) 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

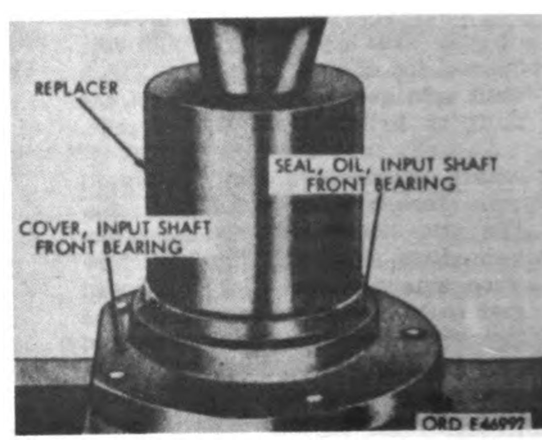


Figure 233. Replacing oil seal in the input shaft front bearing cover

(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 linkage 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 rods, 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 upright 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.

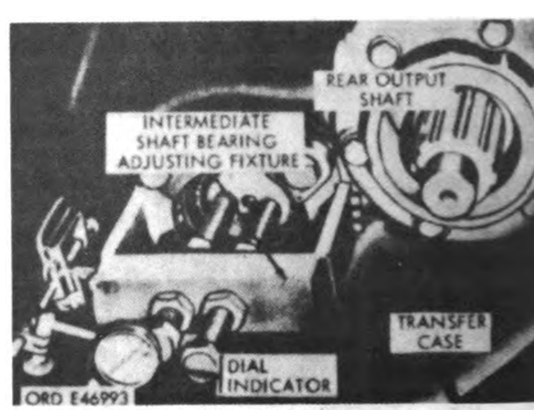


Figure 234. Adjusting intermediate shaft bearings

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 alinement. Insert four hex-head capscrews, and lockwashers, and tighten screws alternately and evenly to 20 to 25 lb.-ft. torque.

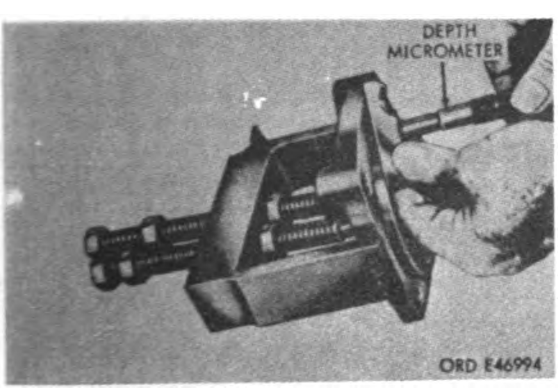


Figure 235. Measuring shoulder height on adjusting fixture flange

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.

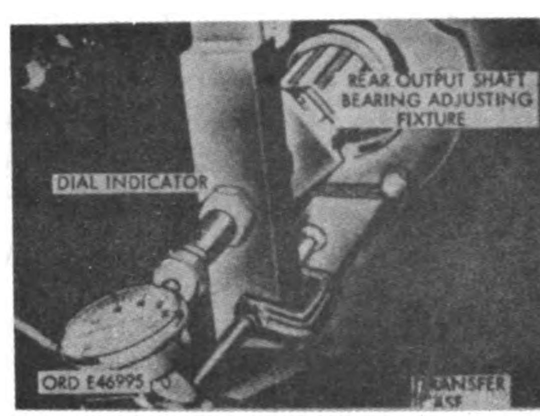


Figure 236. Adjusting rear out[illegible] bearings

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.

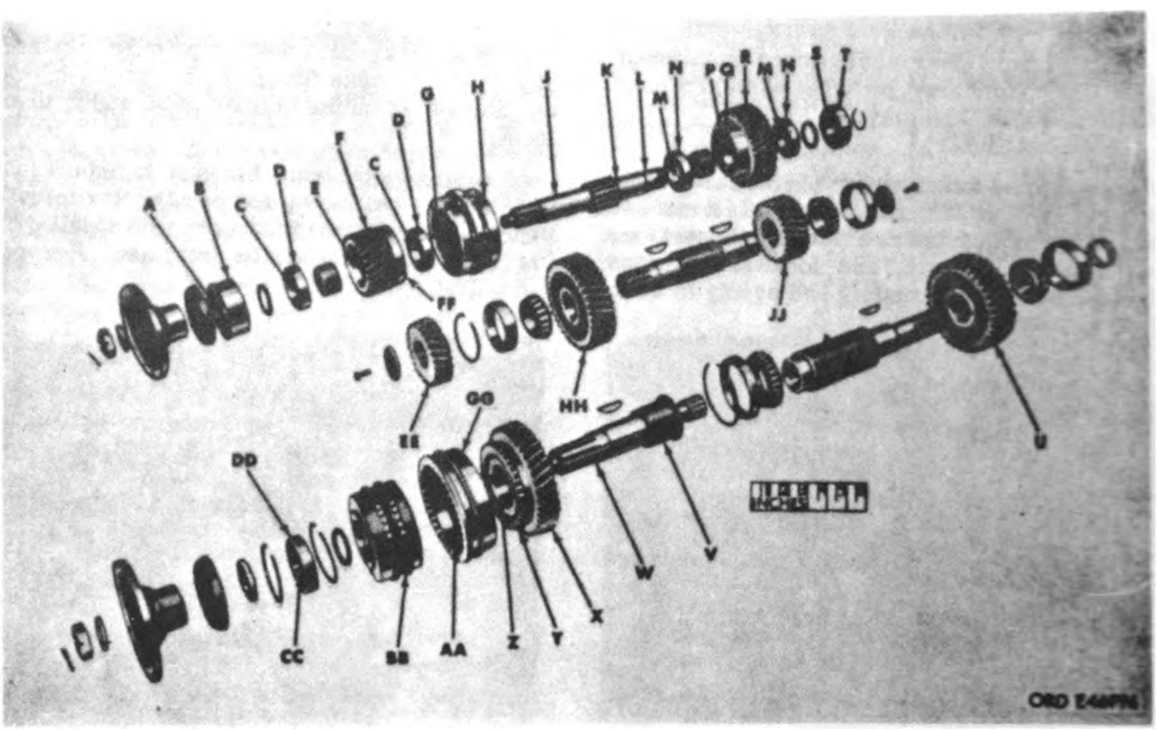


Figure 237. Serviceability standard points of measurement for transfer gears and shafts

Table IX. Serviceability Standards - Transfer

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts
		BEARINGS	
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
		SHAFTS AND GEARS	
		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 0.0025
		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
	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.

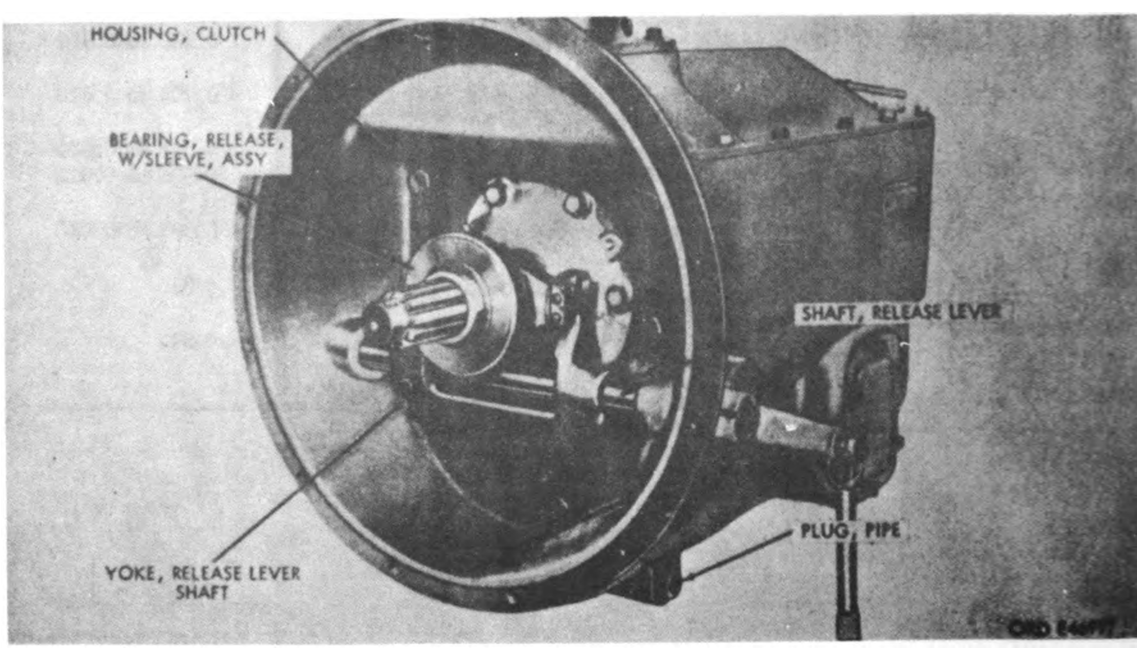


Figure 238. Transmission assembly - left front view

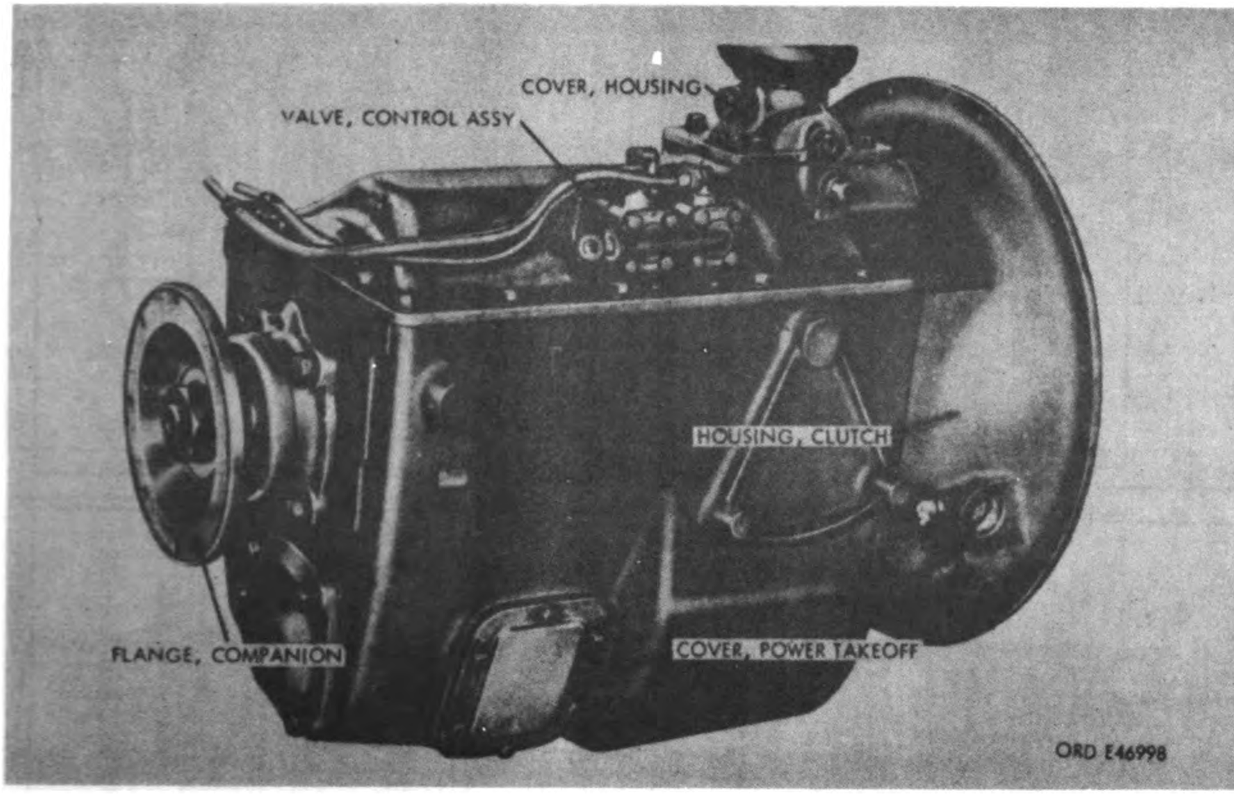


Figure 239. Transmission assembly—right rear view.

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.

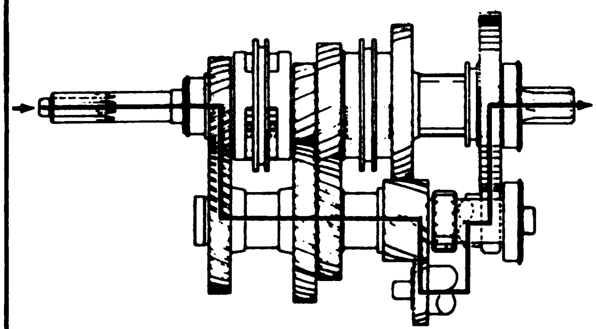
172. Data

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

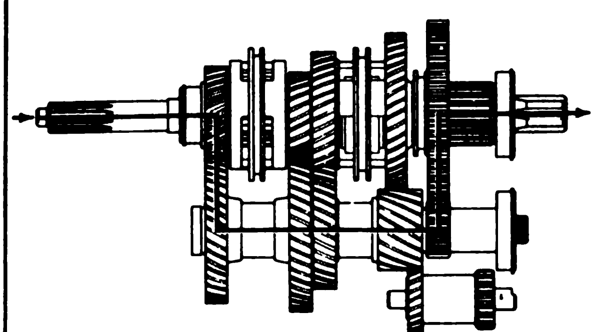
Model 6453
Reverse ---------- 6.09 to 1.00
First ---------- 6.07 to 1.00
Second ---------- 3.40 to 1.00
Third ---------- 1.79 to 1.00
Fourth ---------- 1.00 to 1.00
Fifth ---------- .78 to 1.00

Gear Types:
Input gear and countershaft gears ---------- helical
First and reverse speed gears ---------- spur
Second, third, and fourth speed gears ---------- helical

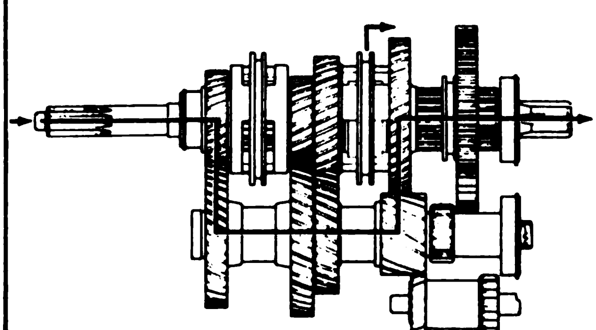
Lubricant capacity:
Without power takeoff ---------- 13 pt
With power takeoff ---------- 14 pt



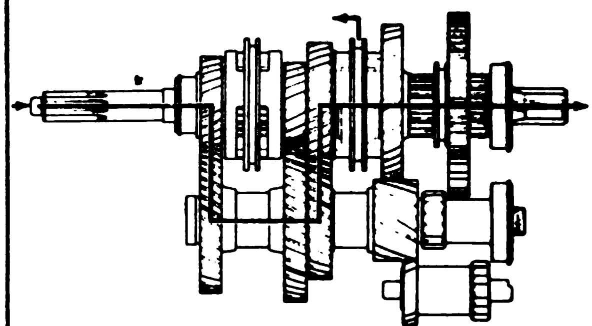
VIEW A. REVERSE POSITION



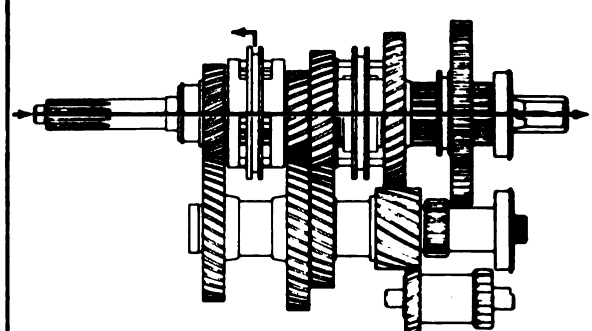
VIEW B. FIRST SPEED POSITION.



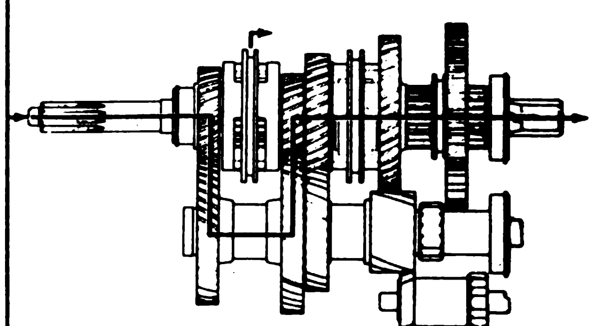
VIEW C. SECOND SPEED POSITION.



VIEW D. THIRD SPEED POSITION.



VIEW E. FOURTH SPEED POSITION.



VIEW F. FIFTH SPEED POSITION.

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FIGURE 240. POWER FLOW - MODEL 6453 TRANSMISSION

Figure 240. Power flow—model 6453 transmission.

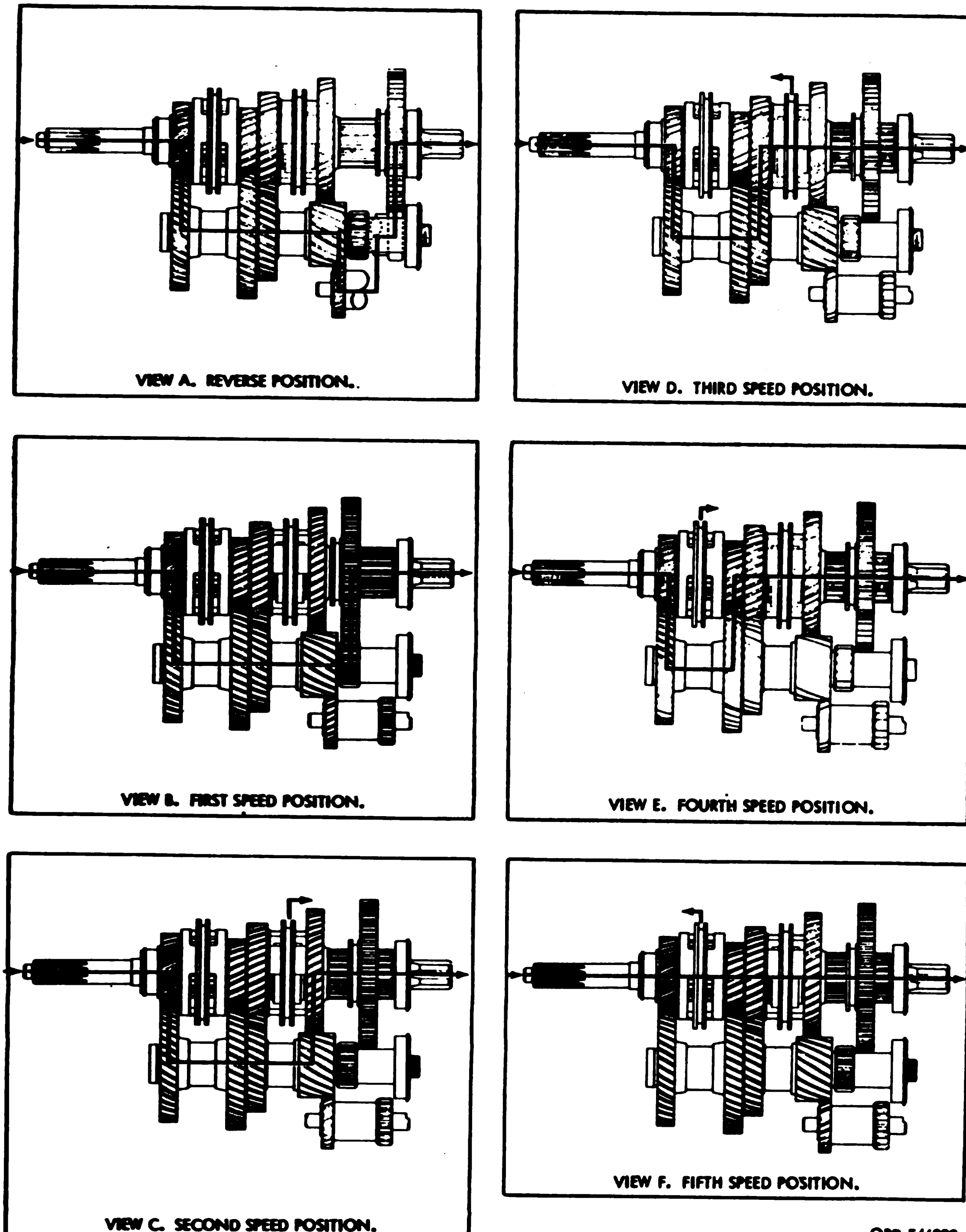

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Figure 241. Power flow - model 6352 transmission

Section II. TROUBLESHOOTING

173. 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.

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 troubleshooting 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 troubleshooting 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.	a. Shifter forks loose on shifter shafts.	a. Remove shifter housing and tighten shifter forks setscrews (fig. 270) and replace locking wires.
	b. Shifter shaft detent grooves worn.	b. Remove shifter housing (fig. 271) and install new shifter shafts.
	c. Gear teeth worn.	c. Disassemble transmission (par. 181) and replace worn gears (fig. 260).
	d. Excessive end play in main drive shaft.	d. Tighten main shaft companion flange nut.
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 from 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.

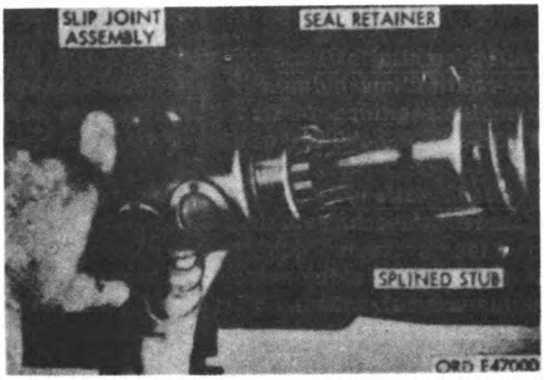

Figure 242. Removing slip joint assembly

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).

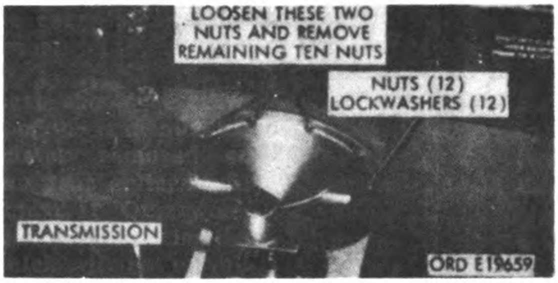

Figure 243. Transmission to flywheel housing cap screws

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.

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.

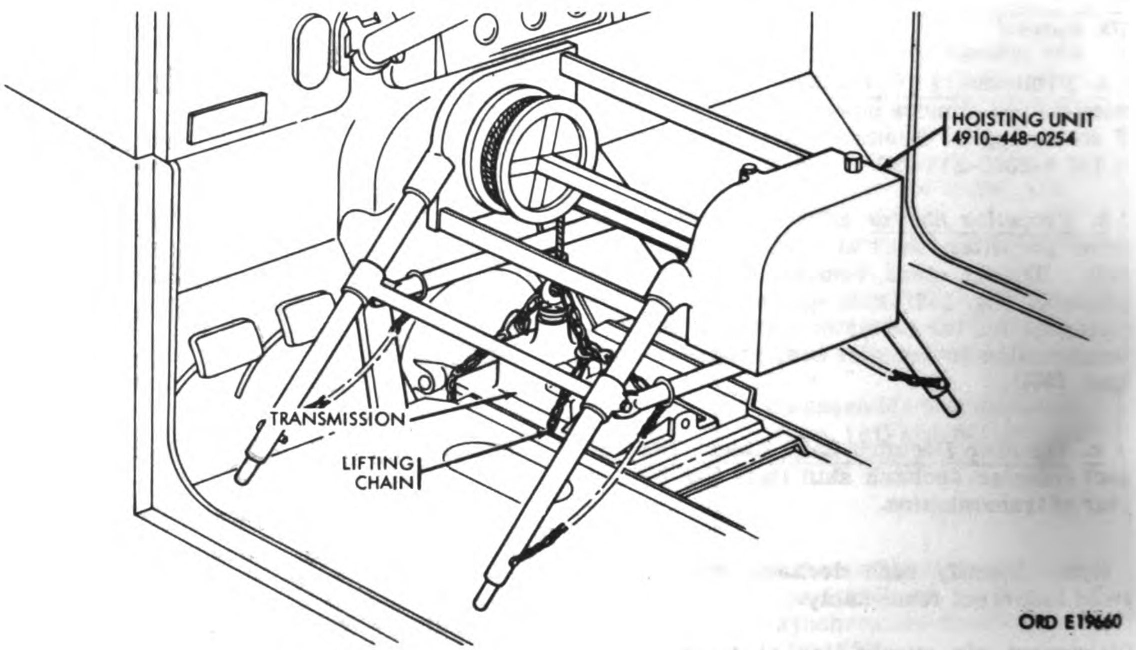

Figure 244. Transmission hoisting unit

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.

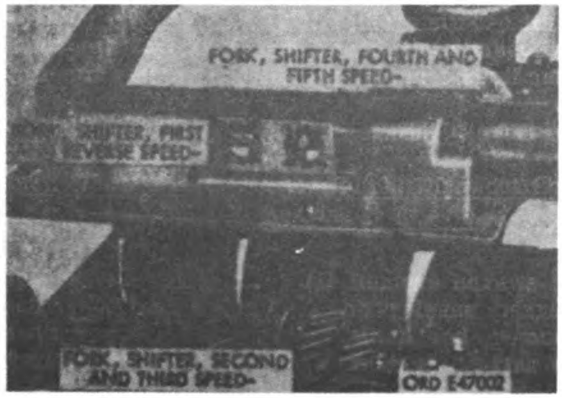

Figure 246. Removing shifter housing assembly

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.

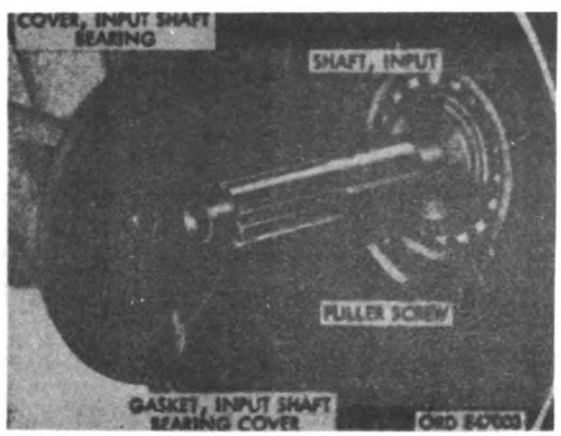

Figure 247. Removing input shaft bearing cover

(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.

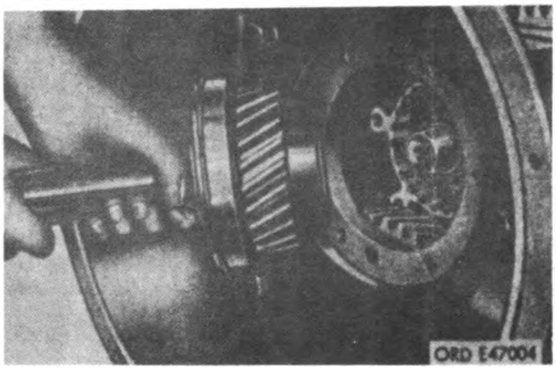

Figure 248. Removing input shaft ball bearing assembly

(2) Main shaft assembly.

(a) Remove cotter pin and slotted nut. Use a universal puller to remove companion flange (fig. 249) from main shaft.

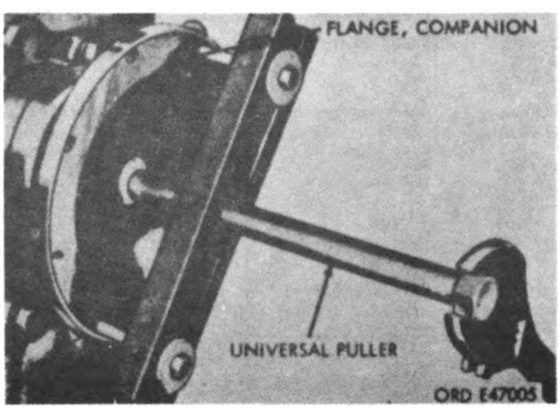

Figure 249. Removing companion flange

(b) Remove four cap screws and lockwashers and lift off rear bearing cover (fig. 250). Discard gasket.

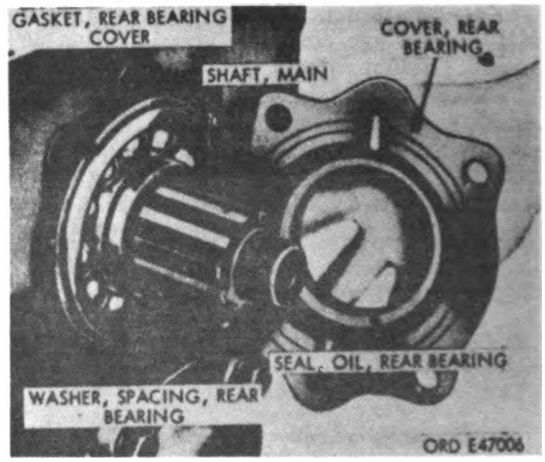

Figure 250. Removing rear bearing cover

(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.

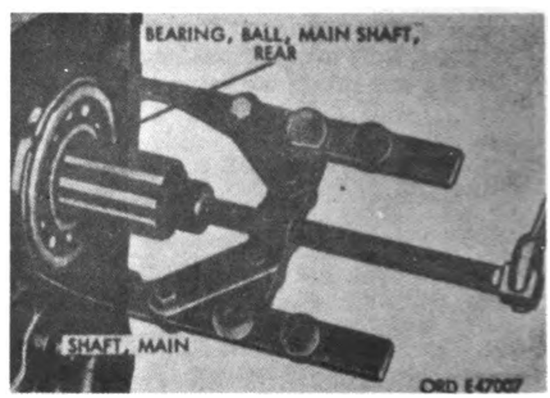

Figure 251. Removing main shaft rear ball bearing

(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).

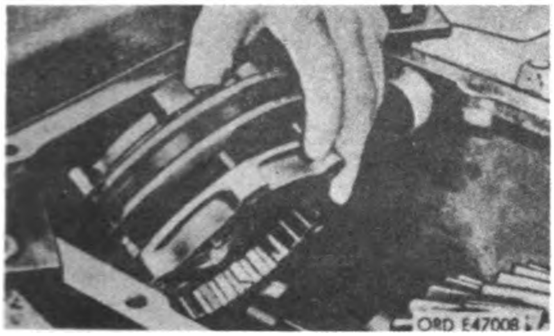

Figure 252. Remove fourth and fifth speed gear synchronizer from main shaft

(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.

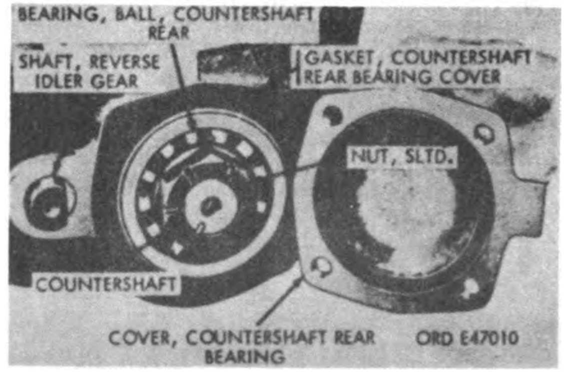

Figure 254. Removing countershaft rear bearing cover

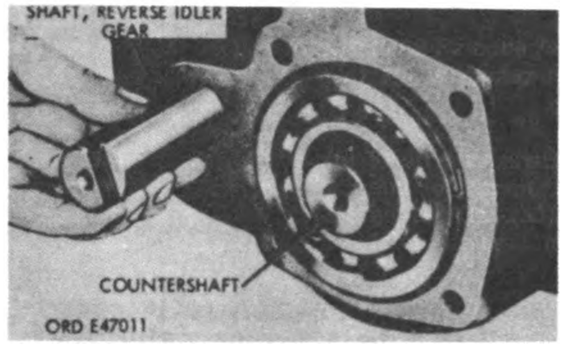

Figure 255. Removing reverse idler gear shaft

(c) Pull reverse idler gear shaft from transmission case and lift out reverse idler gear (fig. 256) and reverse idler gear bearings.

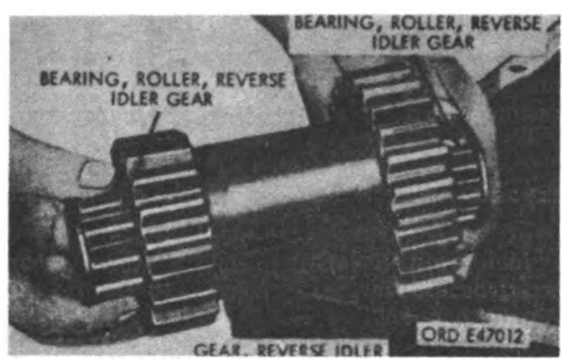

Figure 256. Removing reverse idler gear assembly

(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.

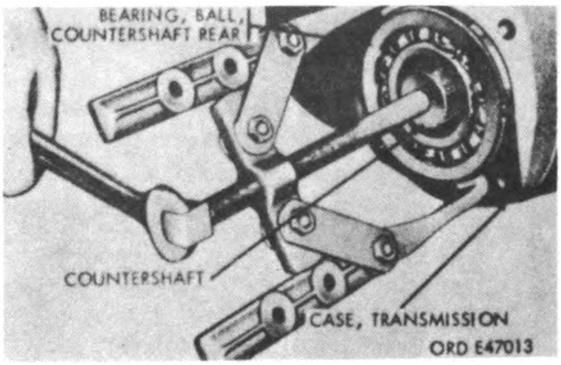

Figure 257. Pulling countershaft rear bearing

(b) Attach a rope sling and lift countershaft (fig. 258) with gears from transmission case.

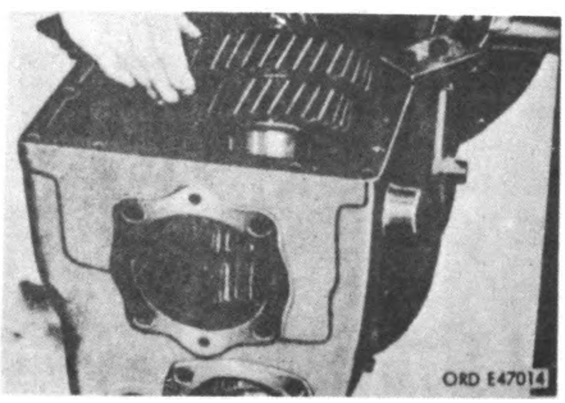

Figure 258. Lifting countershaft with gears from transmission case

(c) If clutch housing is not removed, use a pinch bar to remove countershaft front roller bearing (fig. 259).

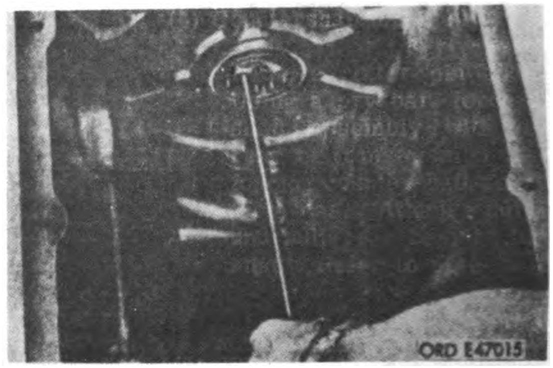

Figure 259. Removing countershaft front roller bearing from transmission case

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. 260) 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

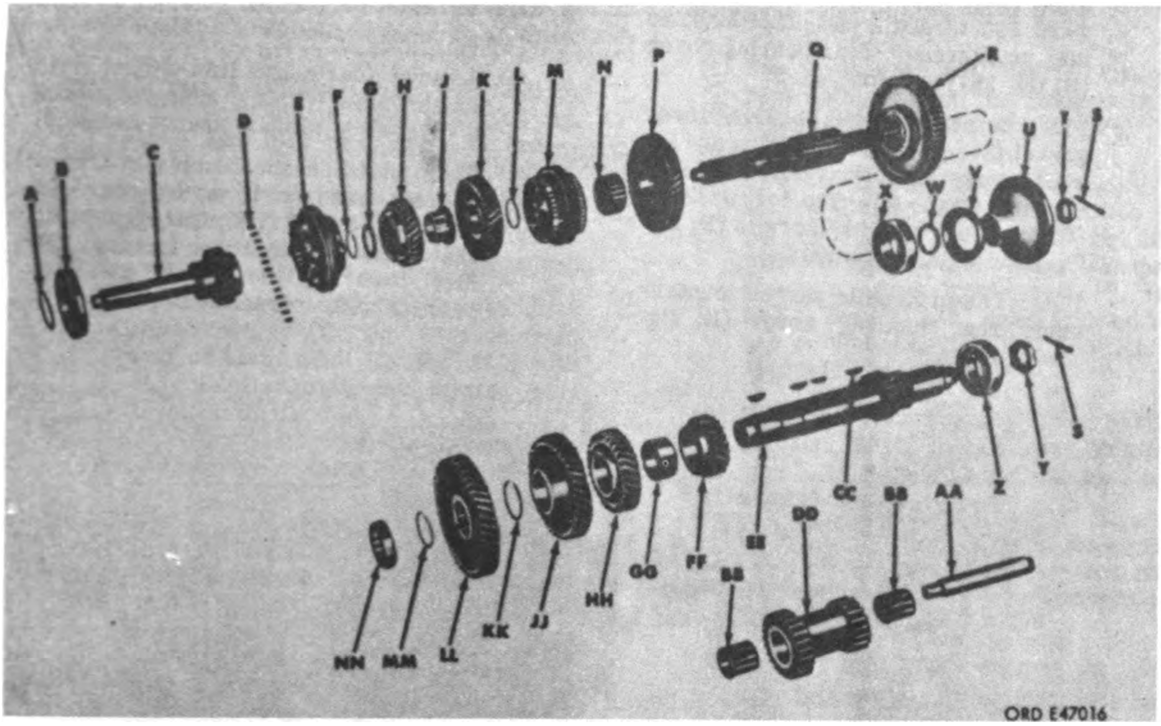

Figure 260. Transmission gears and shafts - exploded view

Key	Item
A	Ring, snap, bearing
B	Bearing, ball, input shaft
C	Shaft, input
D	Roller, pilot, bearing
E	Synchronizer, fourth and fifth speed gear
F	Ring, snap, fourth speed gear
G	Washer, thrust
H	Gear, fourth speed
J	Sleeve, fourth speed gear
K	Gear, third speed
L	Ring, snap, second and third speed clutch gear
M	Synchronizer, second and third speed gear
N	Gear, second and third speed clutch
P	Gear, second speed
Q	Shaft, main
R	Gear, first and reverse speed
S	Pin, cotter
T	Nut, slotted

Key	Item
U	Flange, companion
V	Slinger, dust
W	Washer, spacing, rear bearing
X	Bearing, ball, main shaft, rear nut, slotted
Z	Bearing, ball, countershaft, rear
AA	Shaft, reverse idler gear
BB	Bearing, roller, reverse idler gear
CC	Key, Woodruff
DD	Gear, reverse, idler
EE	Countershaft
FF	Gear, second speed, countershaft
GG	Spacer, countershaft
HH	Gear, third speed, countershaft
JJ	Gear, fourth speed, countershaft
KK	Ring, snap, fourth speed gear, countershaft
LL	Gear, drive, countershaft
MM	Ring, snap, drive gear, countershaft
NN	Bearing, roller, countershaft, front

Figure 260. Transmission gears and shafts - exploded view - legend

transmission case and aline 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.

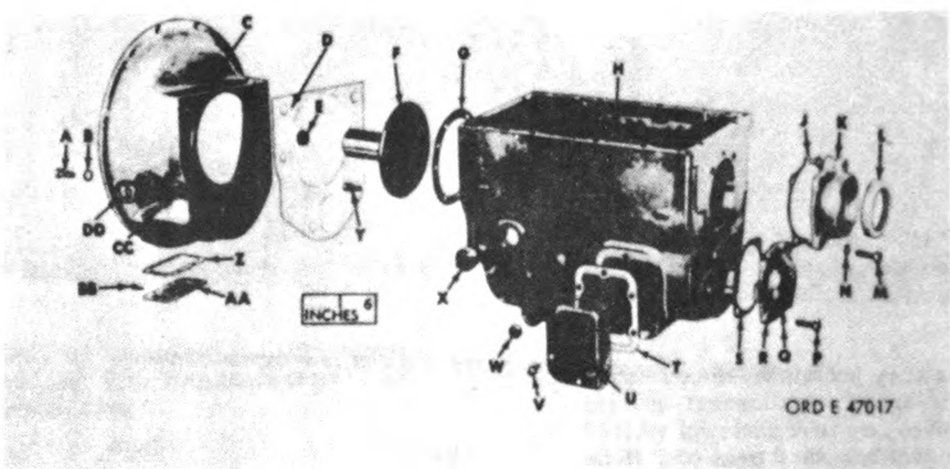

Figure 261. Transmission case and bearing caps - exploded view

Key	Item	Key	Item
A	Screw, cap	R	Cover, countershaft rear bearing
B	Washer, lock	S	Gasket, countershaft rear bearing cover
C	Housing, clutch		
D	Gasket, clutch housing	T	Gasket, power takeoff cover
E	Plug, expansion	U	Cover, power takeoff hole
F	Cover, input shaft bearing	V	Screw, split lockwasher
G	Gasket, input shaft bearing cover	W	Plug, pipe
H	Case, transmission	X	Plug, pipe
J	Gasket, rear bearing cover	Y	Screw, cap, split lockwasher
K	Cover, rear bearing	Z	Gasket, clutch housing inspection cover
L	Seal, oil, rear bearing		
M	Screw, cap	AA	Cover, inspection, clutch housing
N	Washer, lock	BB	Screw, split lockwasher
P	Screw, cap	CC	Fitting, lubricating
Q	Washer, lock	DD	Seal, oil, release lever shaft

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.

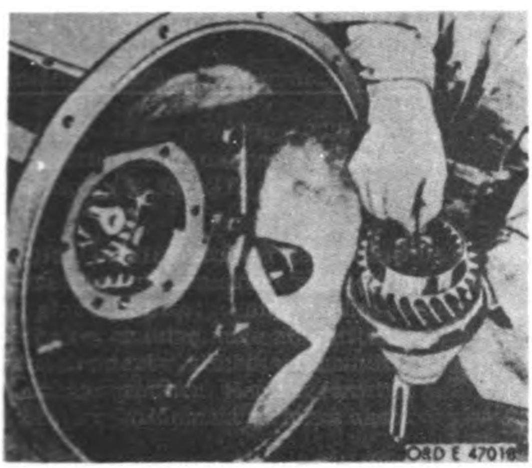

Figure 262. Assembling pilot bearing rollers into input shaft pocket

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: Aline 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 splines 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. Aline 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 alined with shift collars in transmission. Refer to figure 246 for proper alinement 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.

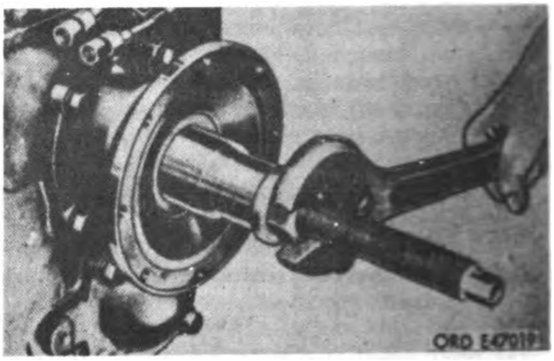

Figure 263. Installing companion flange using flange replacer - 5120-795-0147

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.

(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

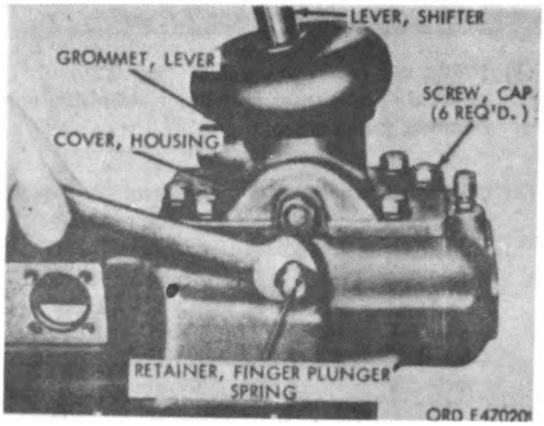

Figure 264. Removing finger plunger spring retainer

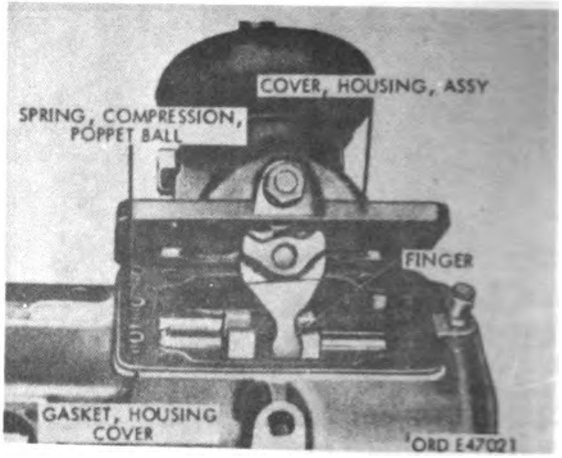

Figure 265. Removing housing cover assembly

seat in the housing cover. Loosen screw (fig. 266) and pull shifter lever free of housing cover.

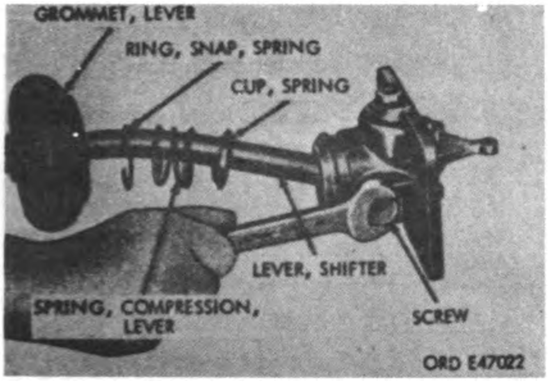

Figure 266. Disassembling shifter lever from housing

(d) Use a punch to drive pivot pin (fig. 267) securing lever retainer to shifter lever and disassemble.

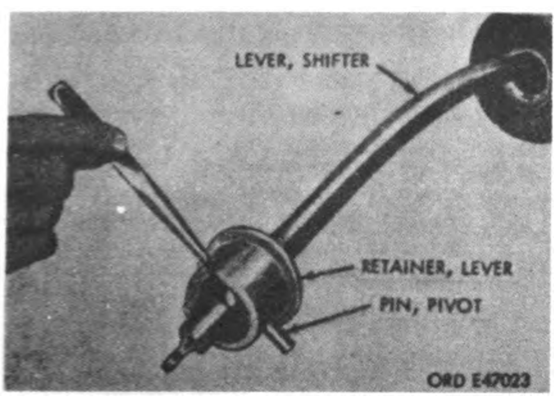

Figure 267. Removing pivot pin from shifter lever retainer

(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.

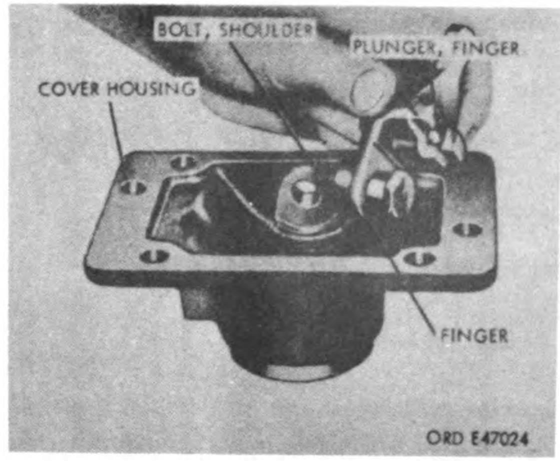

Figure 268. Disassembling finger from housing cover

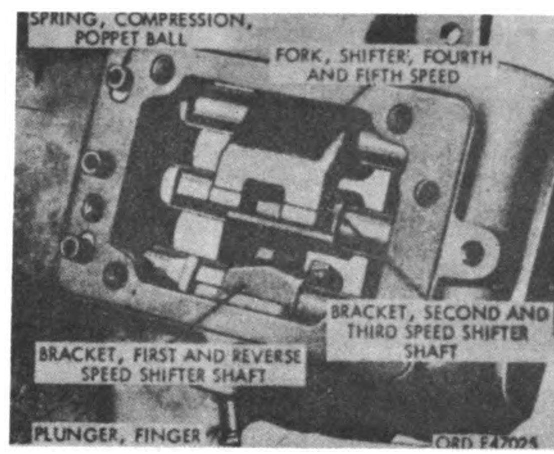

Figure 269. Removing poppet ball compression springs, balls, and finger plunger

(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.

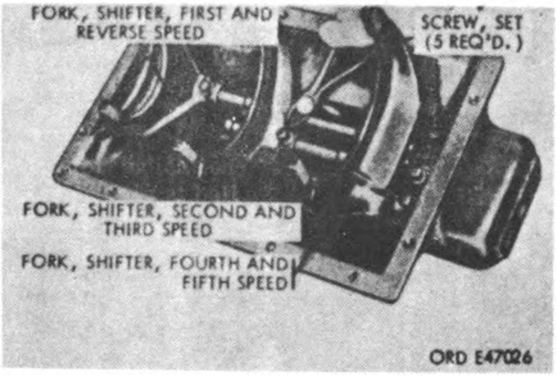

Figure 270. Disassembling shifter forks and shafts

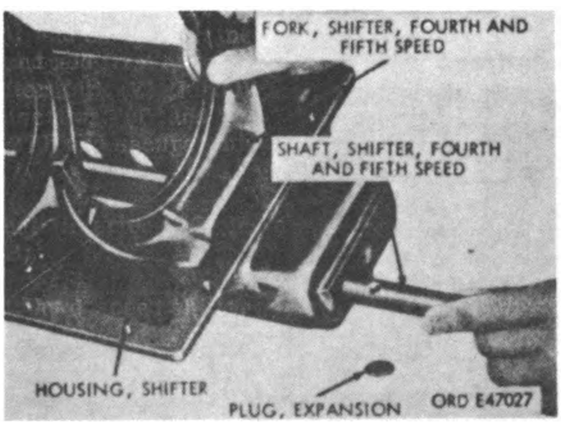

Figure 271. Removing shifter shafts and forks

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts thoroughly with 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.

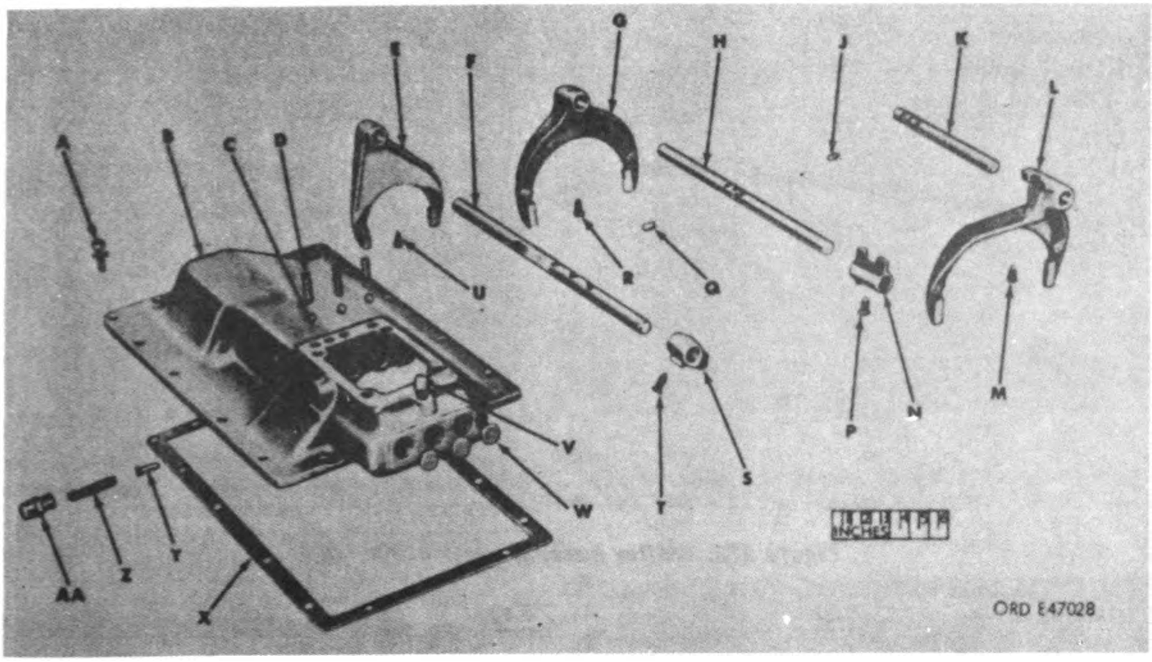

Figure 272. Shifter housing assembly - exploded view

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).

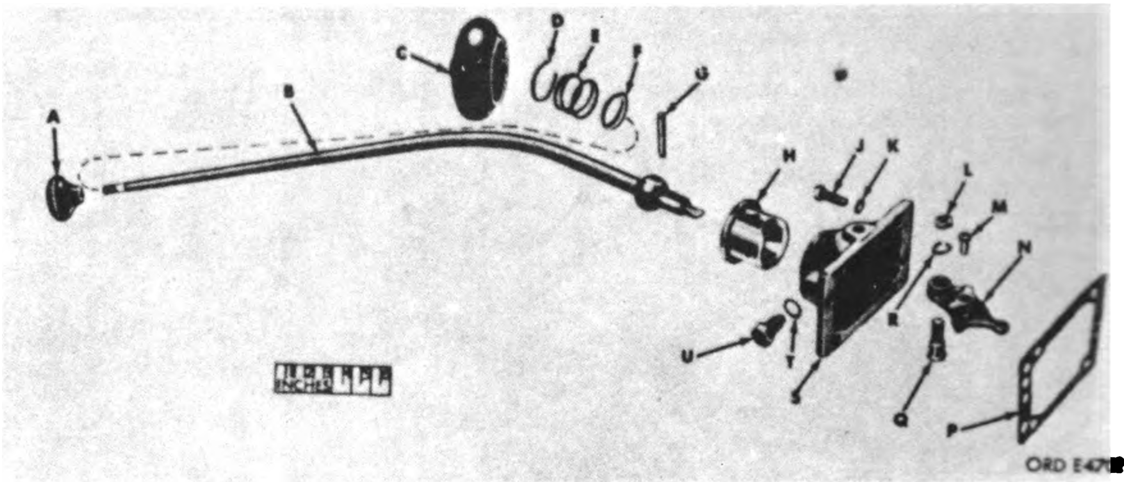

Figure 273. Shifter housing cover assembly

Key	Item	Key	Item
A	Knob, lever	L	Nut, hex
B	Lever, shifter	M	Plunger, finger
C	Grommet, lever	N	Finger
D	Ring, snap, 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.

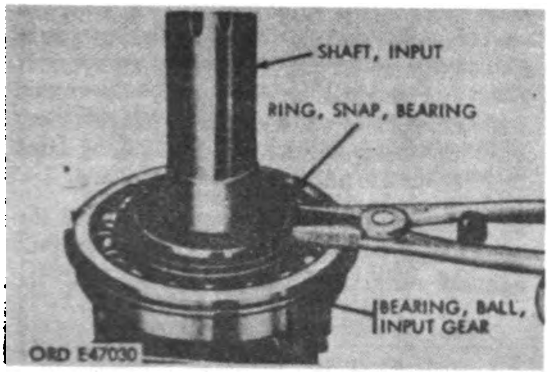

Figure 274. Disassembling input shaft assembly

(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.

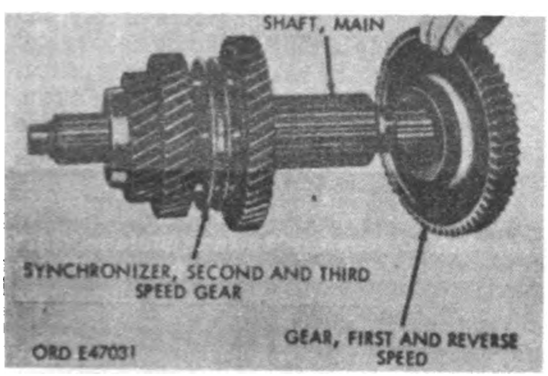

Figure 275. Removing first and reverse speed gear

(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 speed gear synchronizer from main shaft.

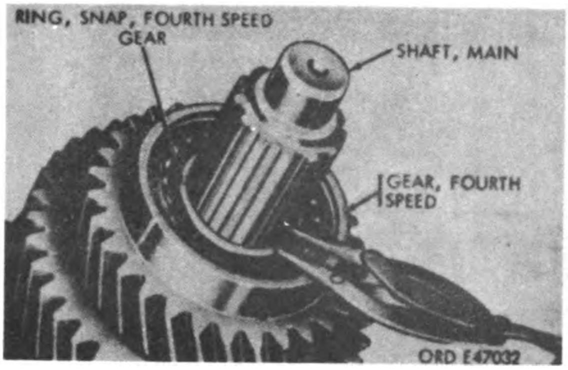

Figure 276. Removing fourth speed gear snap ring

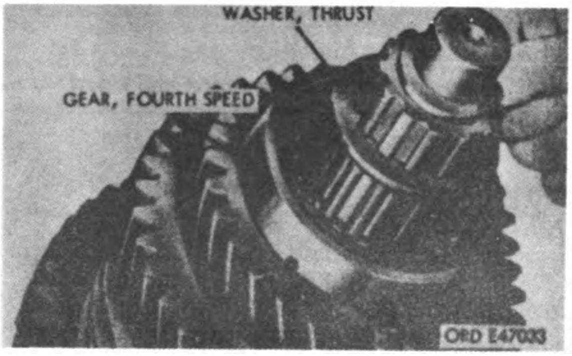

Figure 277. Disassembling fourth speed gear and thrust washer

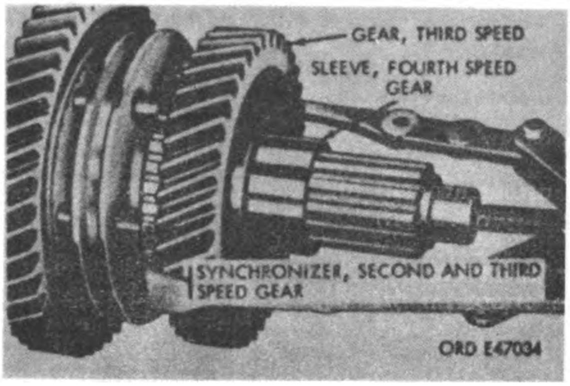

Figure 278. Disassembling fourth speed gear sleeve

(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.

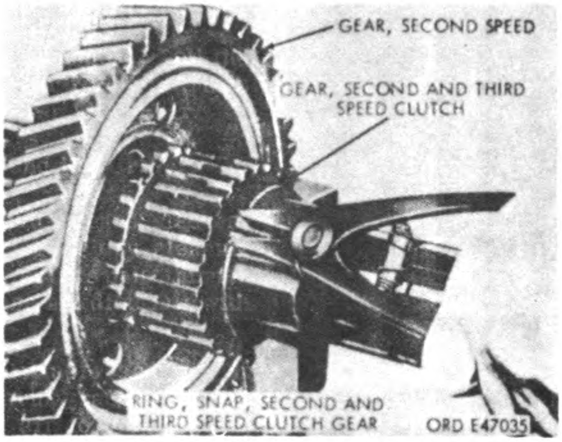

Figure 279. Removal of second and third speed clutch gear

(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.

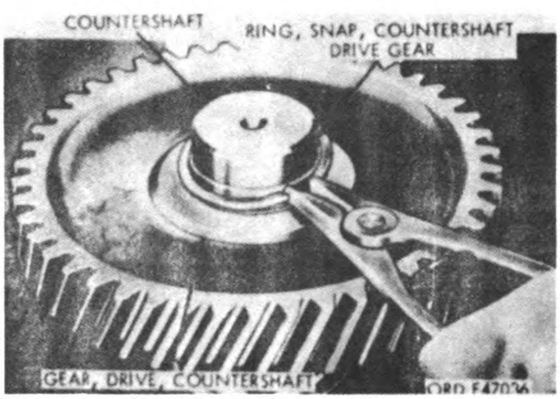

Figure 280. Removing countershaft drive gear

(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 burs 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.

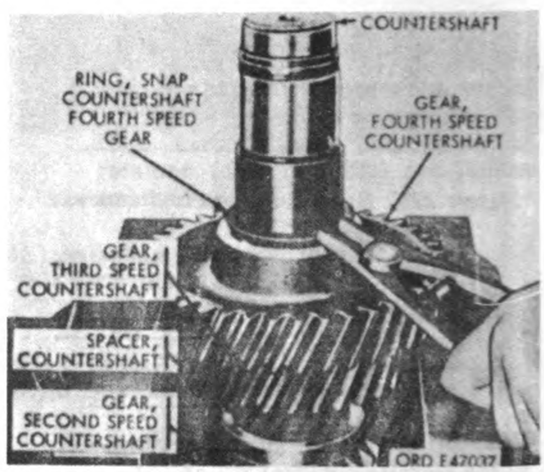

Figure 281. Disassembling countershaft assembly

(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 countershaft (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 (E). 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 VII. 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 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 loose fit (interference). All measurements are given in inches, unless indicated otherwise.

190. Serviceability Standards

Serviceabiltiy standards for the transmission are listed in figure 282 and Table XI.

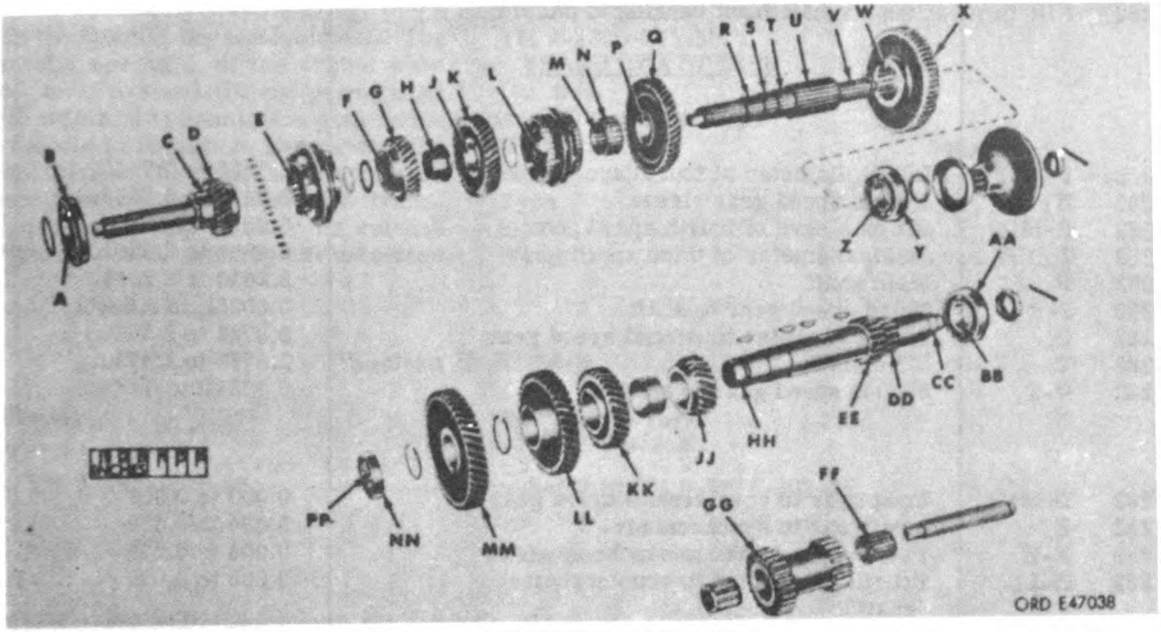

Figure 282. Serviceability standard points of measurement for transmission gear and shafts

Table XI. Serviceability Standards - Transmissions

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts
		SHIFTER HOUSING AND COVER ASSEMBLY	
272	D	Free length of compression spring (shifter shaft)	1-23/64 in.
		Compression spring (shifter shaft) compressed to 31/32 in.	21 to 25 lb
272	Z	Free length of compression spring (finger plunger)	2-1/32 in.
		Compression spring (finger plunger) compressed to 1-5/8 in.	56 to 64 lb

Table XI. Serviceability Standards - Transmission - Continued

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts
		BEARINGS	
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 0.0000T
		SHAFTS AND GEARS	
		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	2.8725 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	0.006 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
		FOURTH SPEED GEAR THRUST WASHER	
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.
Weight	75 lb

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.

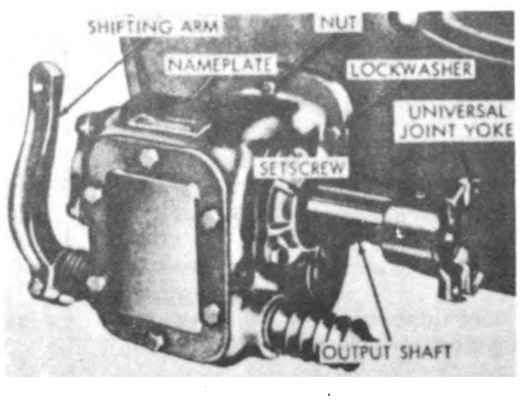

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Figure 283. Transmission mounted power takeoff (all models except M51, M51A2).

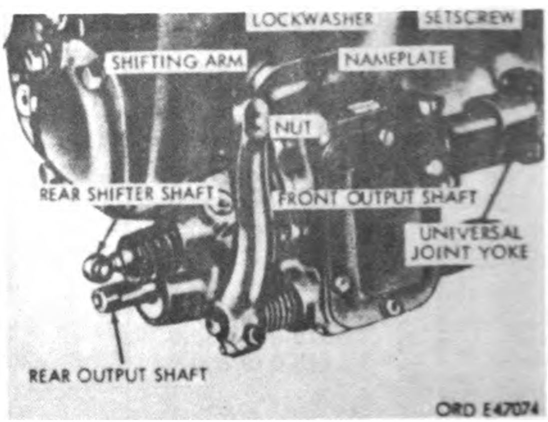


Figure 284. Transmission mounted power takeoff (dump truck M51, M51A2 only)

198. Data

a. Power Takeoff (All Except M51, M51A2).

Drive . . . . 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.	a. Replace defective gears (par. 207).
	b. Worn bearings.	b. Replace defective bearings (par. 207).
	c. Worn shaft splines.	c. Replace shafts (par. 207).
2. Slipping out of gear.	a. Gears partially engaged.	a. Correct shift linkage (par. 203).
	b. Weakened poppet springs.	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 or 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 Vehicles Equipped with Front Winch Except M51, M51A2 (Fig. 283)

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) Aline 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 studs. Tighten nuts 30 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 shaft (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-pump 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 propeller 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.

206. Controls and Linkage

a. Removal.

(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 pins from clevis pins connecting hand control lever to relay lever rod at left relay lever, and rod assembly connected to right relay lever. Remove clevis pins 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.

b. Installation.

(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

207. Power Takeoff (Model WND-6N)

a. Disassembly.

(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.

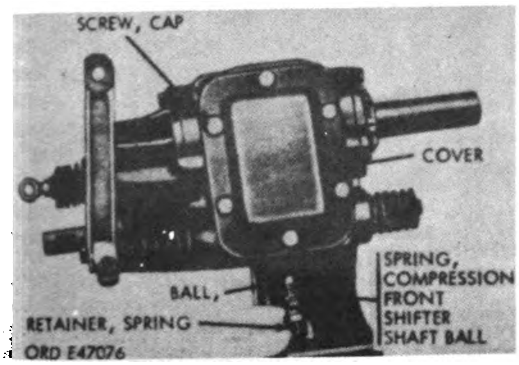


Figure 286. Removing front shifter shaft ball and spring retainer

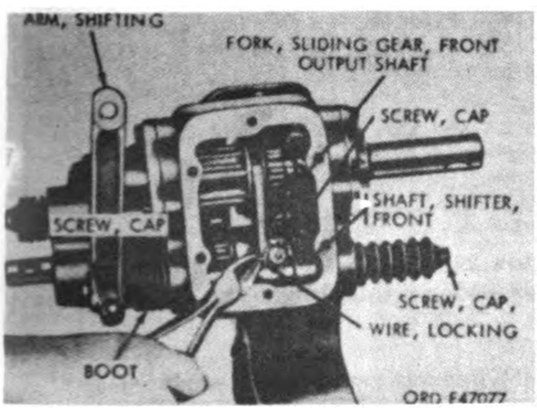


Figure 287. Power takeoff cover removed

(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.

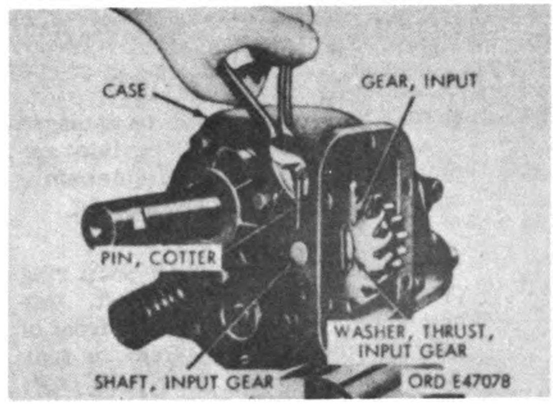


Figure 288. Removing input gear

(a) Remove five cap screws and lockwashers from rear output shaft housing (fig. 289). Remove housing and rear output-shaft housing gasket. Discard gasket.

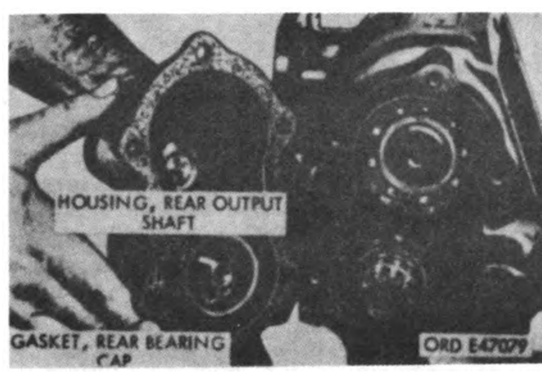


Figure 289. Removing rear output shaft housing

(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 (HH) 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. 294) from rear output shaft (VV).

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.

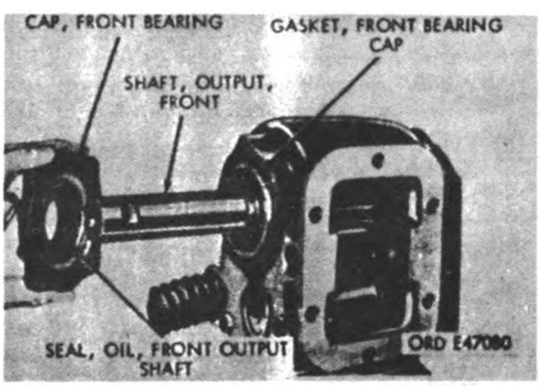


Figure 290. Removing front bearing cap

(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.

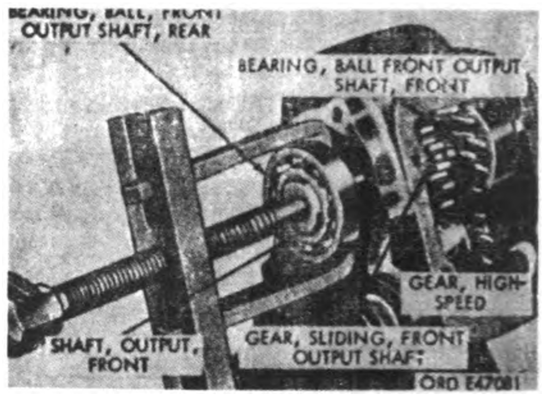


Figure 291. Removing front output shaft rear ball bearing

(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 and 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.

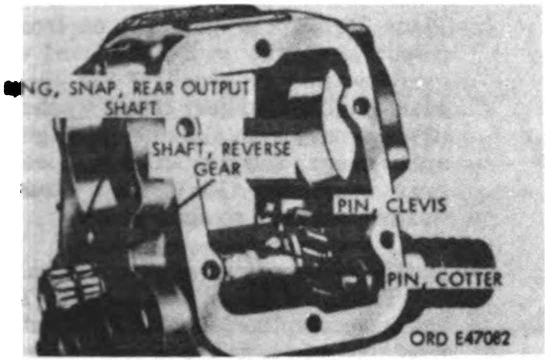


Figure 292. Removing clevis pin from reverse gear

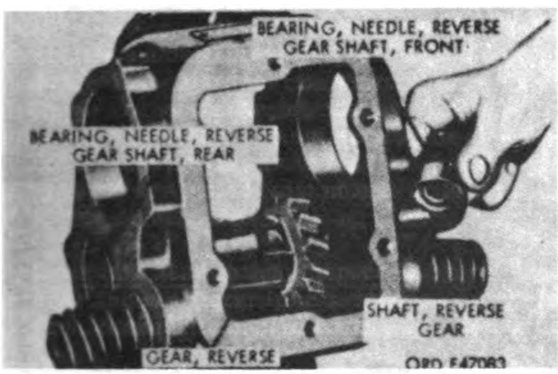


Figure 293. Removing reverse gear and shaft

b. Cleaning, Inspection and Repair.

(1) Cleaning.

(a) Soak bearings in dry-cleaning 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) and 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,

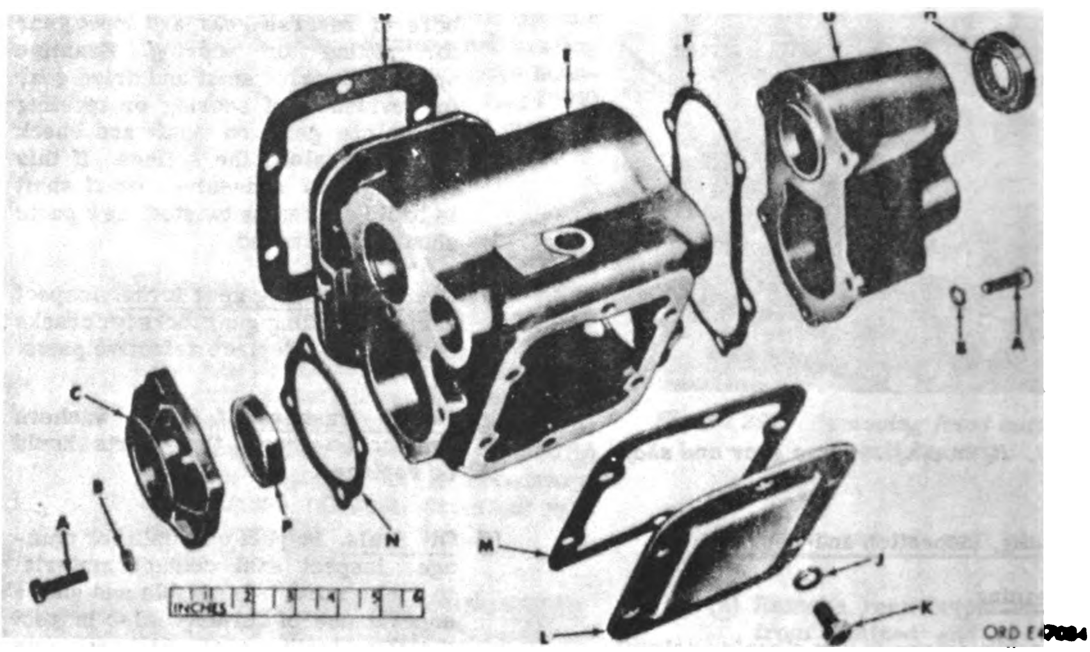


Figure 294. Power takeoff case - exploded view

Key	Item	Key	Item
A	Screw, cap	H	Seal, oil, rear output shaft
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 cap
G	Housing, rear output shaft	P	Seal, oil, front output shaft

Figure 294. Power takeoff case - exploded view - legend

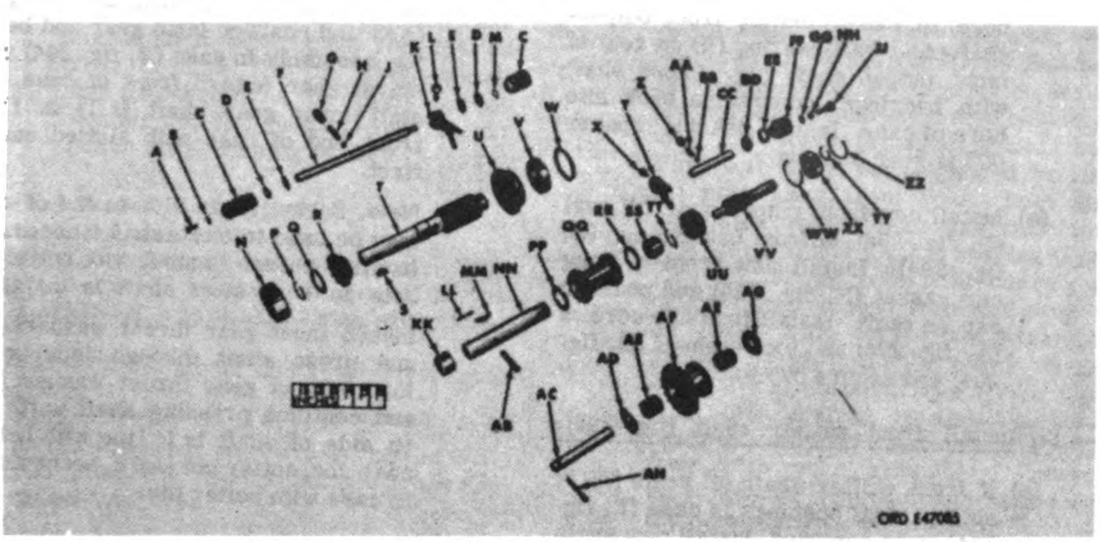


Figure 295. Power takeoff gears - exploded view

Key	Item	Key	Item
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 gears - 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 aline 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 aline 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 (VV) 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.

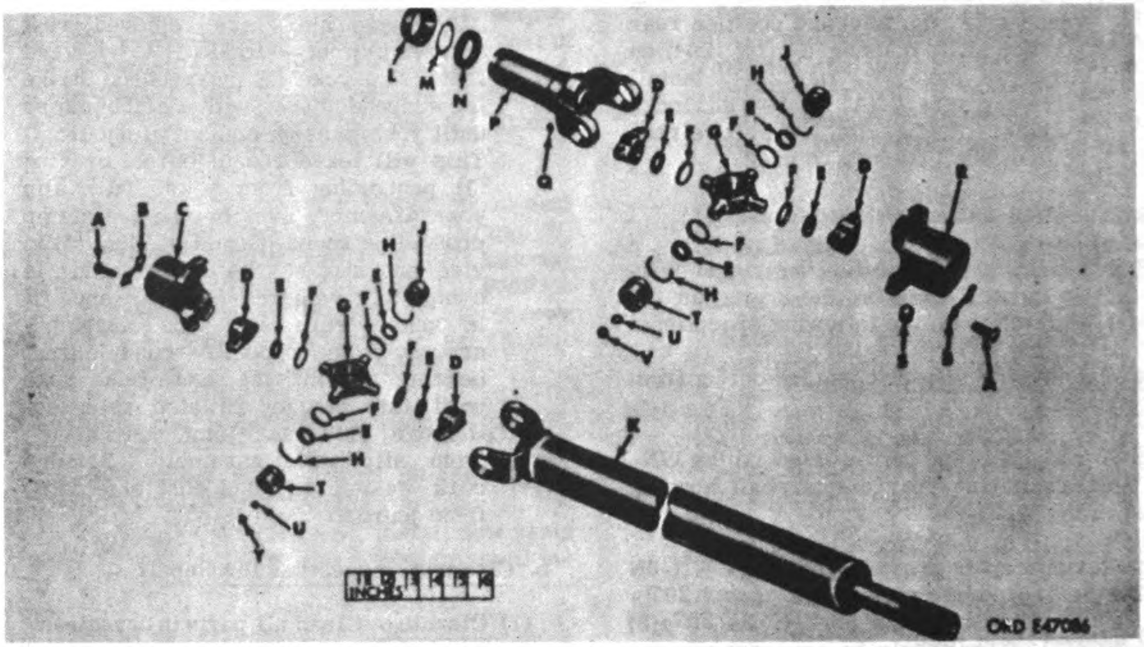


Figure 296. Winch drive shaft and universal joint - exploded view

Key	Item	Key	Item
A	Bolt, hex-head	L	Cap, dust
B	Strap, locking	M	Washer, retaining, split
C	Yoke	N	Washer, cork
D	Bearing, journal, flanged	P	Yoke, slip
E	Washer, cork	Q	Fitting, lubricating
F	Shield, dust	R	Yoke
G	Journal, universal joint	S	Screw, set
H	Ring, snap	T	Bearing, journal, round
J	Bearing, journal, round	U	Washer
K	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	0.015L
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 ¢	
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	0.006L-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 #	
295	V	Outside dia of bearing (rear)	2.8346	(*)	(*)
295		Dia of bearing bore in housing	2.8346-2.8356	0.001	0.0005
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	0.006	0.0015
295	T-R	Fit of gear on shaft	0.006L-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)			

* Replace parts when worn beyond limits given in "SIZE AND FIT OF NEW PARTS" column.

¢ Replace when bronze facing is partially or entirely worn off.

Press fit in case.

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.

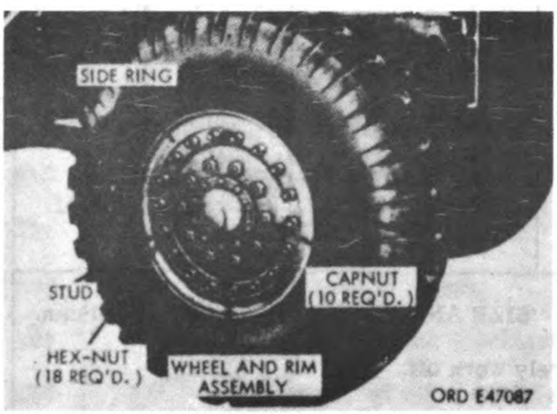


Figure 297. Wheel and tire assembly with bolted-on-type side ring (14:00 x 20 tires)

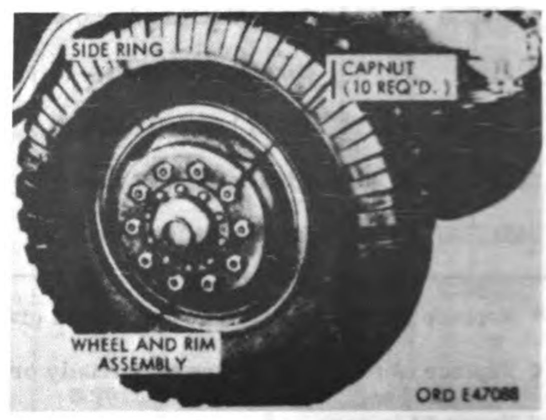


Figure 298. Wheel and tire assembly with snap-on-type side ring (11:00 x 20 tires)

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.

218. Cleaning, Inspection, and Repair

Refer to TM 9-1871.

219. Assembly of Wheel and Tire Assembly

Refer to TM 9-2320-211-20.

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 is secured to the brake pedal, which extends through the floorboard into the cab.

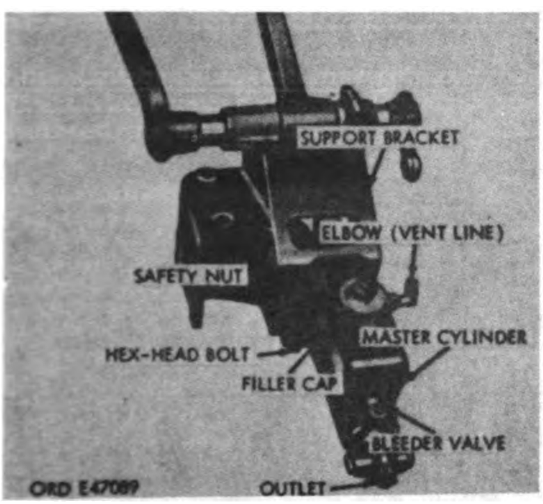


Figure 299. Rear view of brake pedal linkage and master cylinder

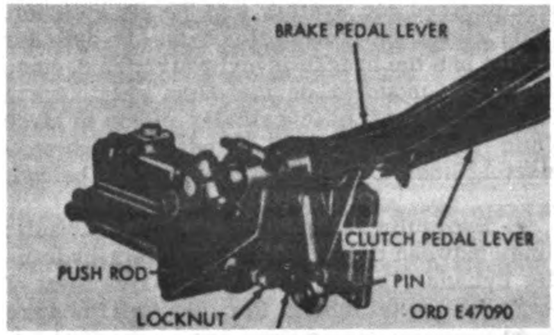


Figure 300. Right front view of brake pedal linkage

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), mounted directly below the master cylinder,

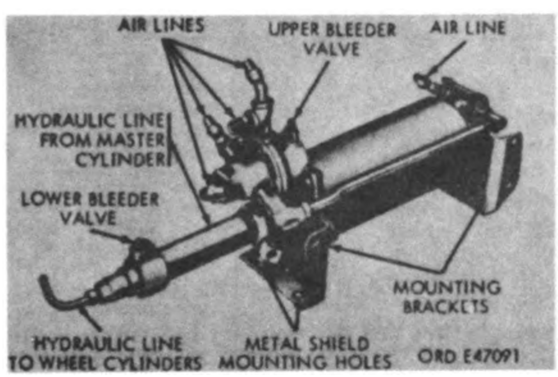


Figure 301. Air-hydraulic cylinder

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 ((h) 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).

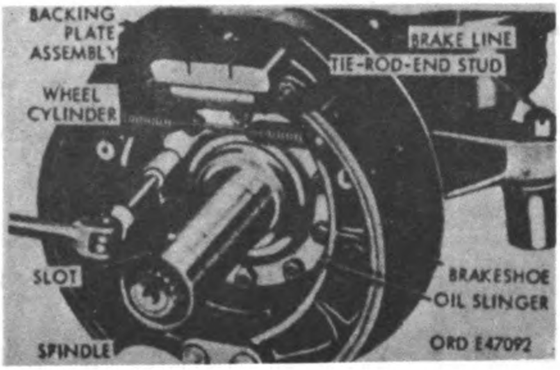


Figure 302. Wheel cylinder and brakeshoes

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 rods 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

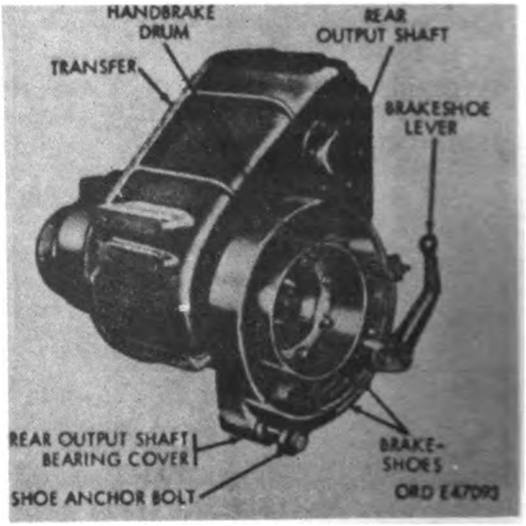


Figure 303. Handbrake mounted on rear of transfer

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 predetermined 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.

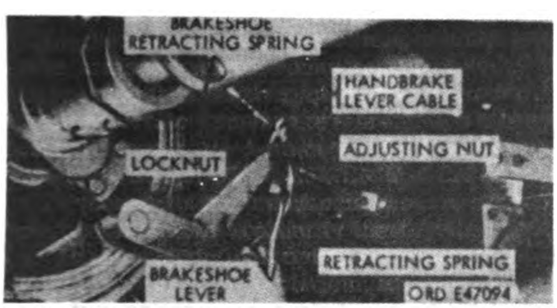


Figure 304. Handbrake controls

(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.

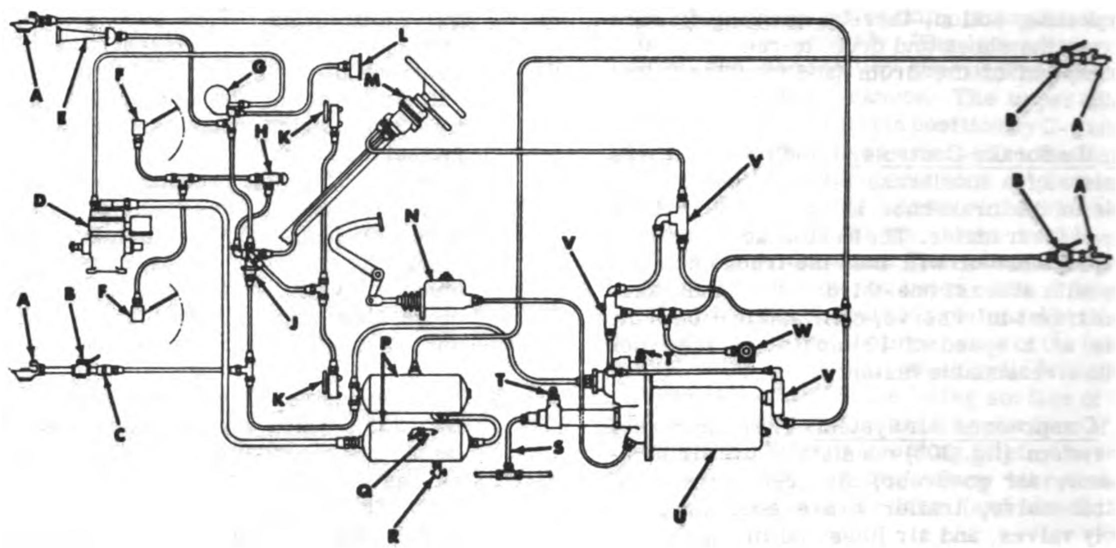


Figure 305. Compressed air system piping diagram

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		
H	Windshield wiper control valve	T	Hydraulic bleeder valve
J	Junction block	U	Air hydraulic brake cylinder
K	Air supply valve	V	Double check valve
L	Air pressure gage sending unit	W	Stoplight switch

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. 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 brakeshoes 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 9-2320-211-20.

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 clips, 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, and 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 and 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 throught 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.

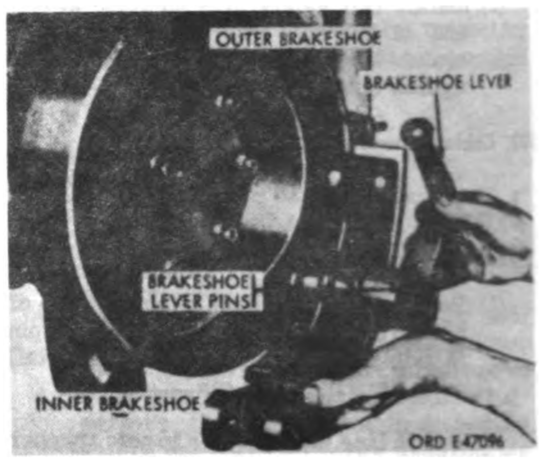


Figure 306. Removing hand brakeshoe and lever assembly

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.

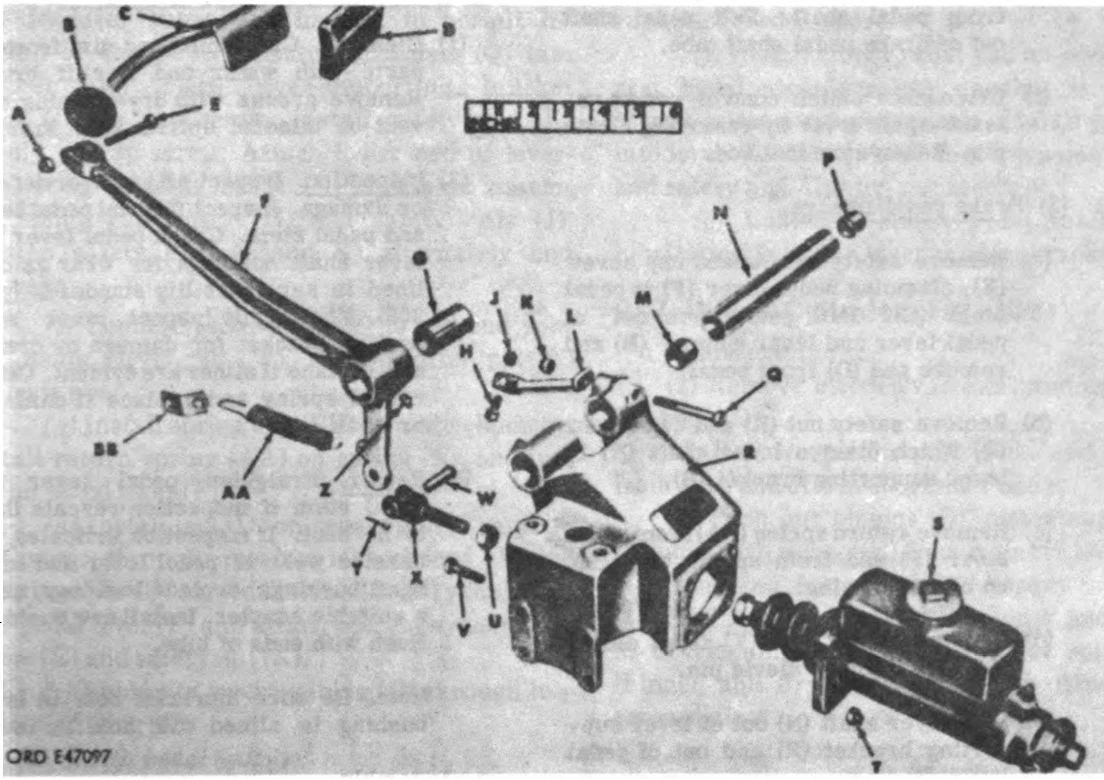


Figure 307. Brake pedal linkage and master cylinder - exploded view

Key	Item	Key	Item
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 out of pedal lever and lever bumper (B) and remove pad (D) from pedal.

(b) Remove safety nut (K) and cap screw (Q) which clamps lever shaft (N) to lever supporting bracket (R).

(c) Remove return spring (AA) 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 bruch. 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 alined 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.

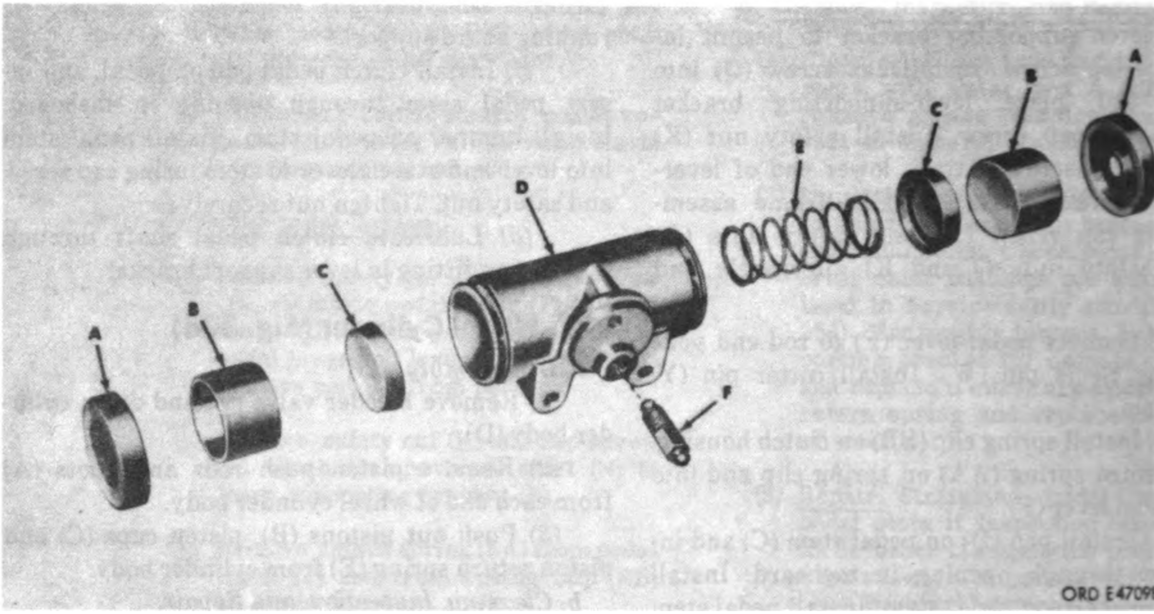
b. Cleaning, Inspection, and Repair.

(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.



A—Boot
B—Piston
C—Piston cups
D—Cylinder body
E—Piston return spring
F—Bleeder valve

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)

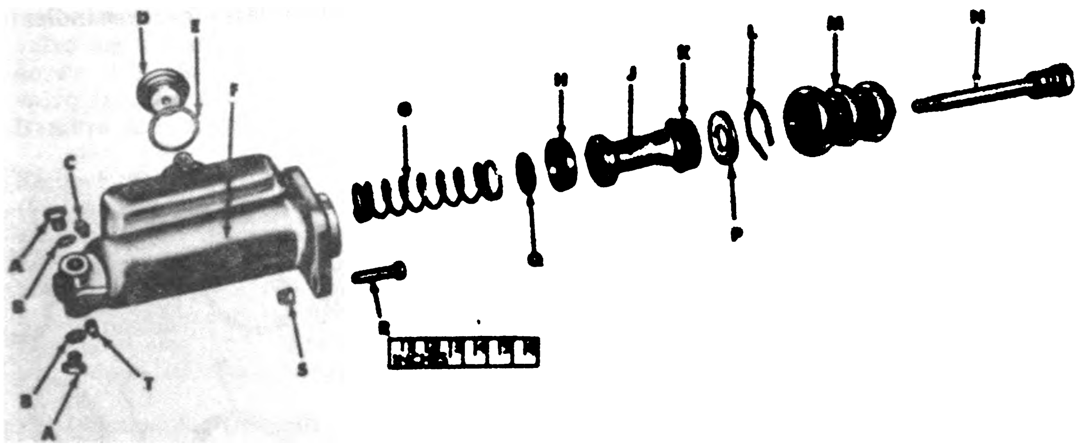
a. Disassembly.

(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).



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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 237*b*.

(2) *Inspection.* Refer to paragraph 237*b*.

(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).

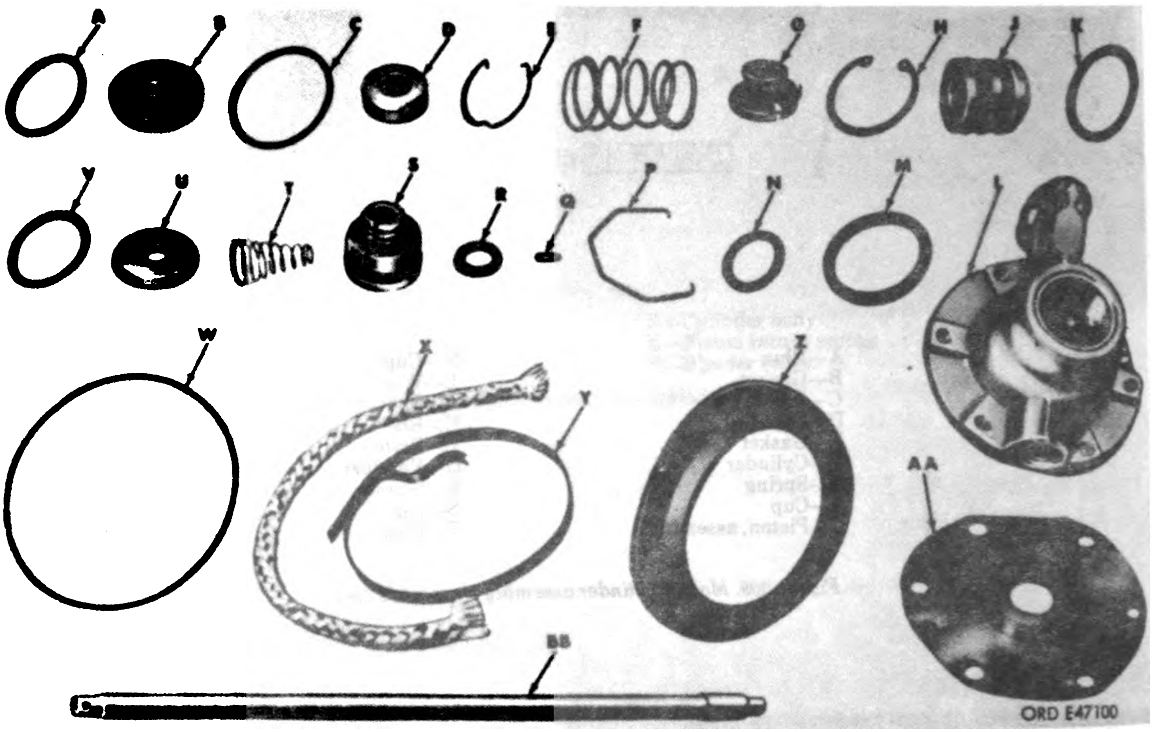
239. Air Hydraulic Cylinder

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. 258).

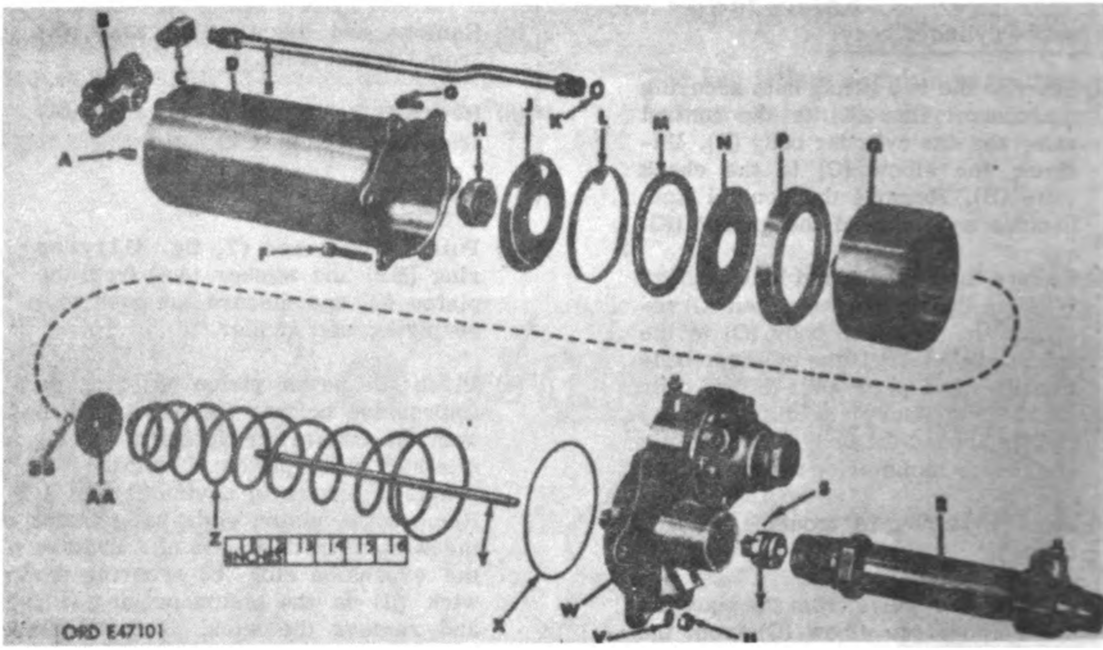


Figure 311. Air-hydraulic (Air-Pak) power cylinder with double check valve - exploded view

Key	Item	Key	Item
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.

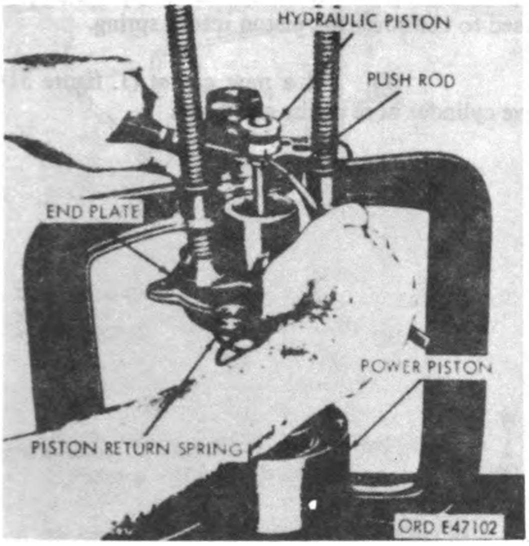


Figure 312. Removing or installing hydraulic piston for air-hydraulic (Air-Pak) power cylinder

(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 powe1 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

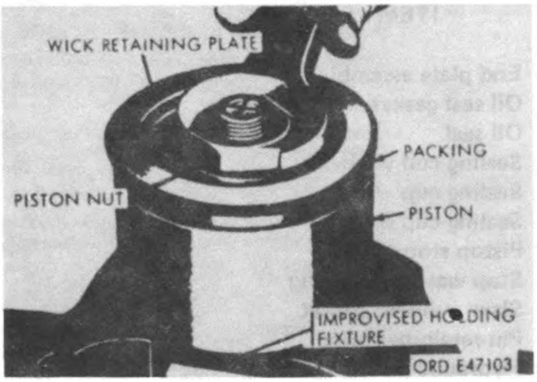


Figure 313. Disassembling air-hydraulic (Air-Pak) power cylinder piston, using improvised holding fixture.

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, alining 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.

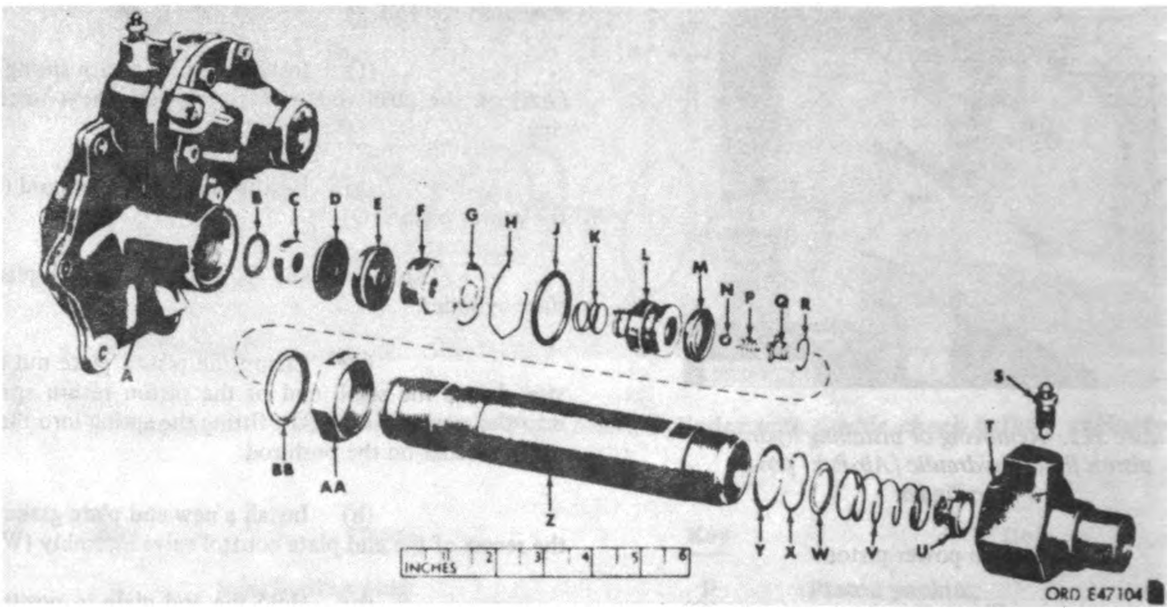


Figure 314. Air-hydraulic (Air-Pak) power cylinder slave cylinder – exploded view.

KEY	ITEM
A	End plate assembly
B	Oil seal gasket
C	Oil seal
D	Sealing cup washer
E	Sealing cup
F	Sealing cup spacer
G	Piston stop washer
H	Stop washer snap ring
J	Slave cylinder gasket
K	Pin retaining spring
L	Hydraulic piston assembly
M	Piston sealing cup
N	Check valve ball

KEY	ITEM
P	Ball return spring
Q	Spring retainer
R	Snap ring
S	Bleeder valve
T	Hydraulic outlet fitting cap
U	Residual line check valve
V	Check valve return spring
W	Check valve washer
X	Check valve snap ring
Y	Outlet fitting cap gasket
Z	Housing
AA	Jam nut
BB	Jam nut seal

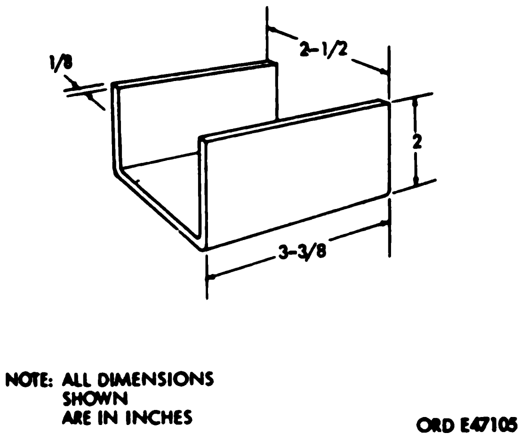


Figure 315. Improvised piston holding fixture - detail drawing

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.

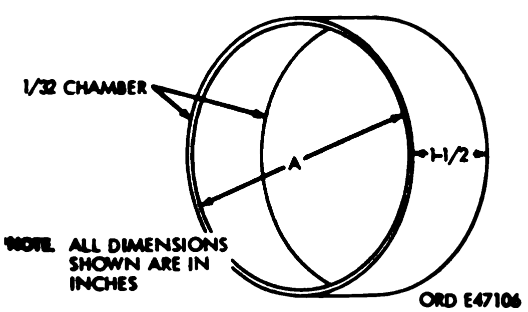


Figure 316. Improvised assembly rings - detail drawings

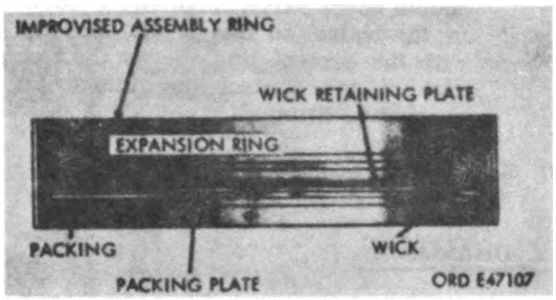


Figure 317. Assembling air-hydraulic (Air-Pak) power cylinder piston packing and plates, using improvised assembly ring - sectional view

(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.

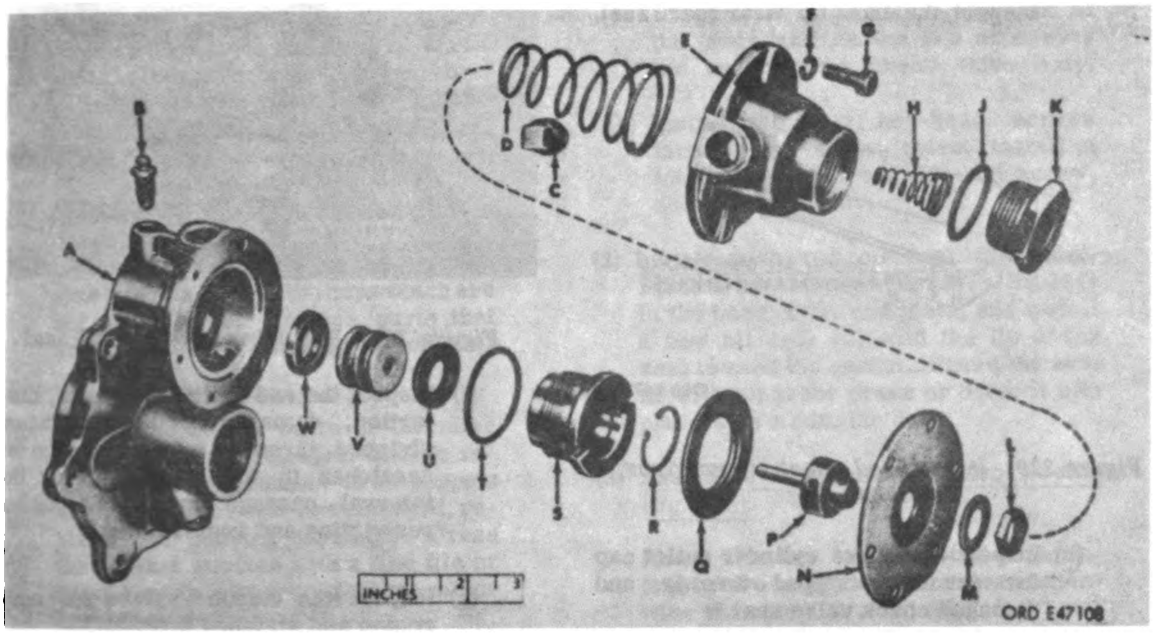


Figure 318. Air-hydraulic (Air-Pak) power cylinder control valve - exploded view

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 surface, cracks, and stripped threads. Inspect the bore for wear (par. 258).

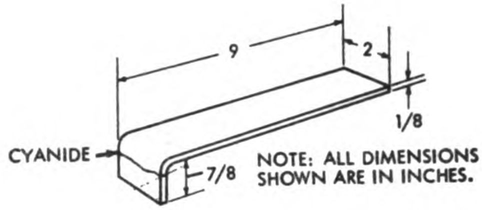


Figure 319. Improvised offset screwdriver - detail drawing

(b) Inspect the slave cylinder outlet cap for cracks, stripped threads, and damaged check valve seat.

(c) Inspect the control valve body and poppets 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.

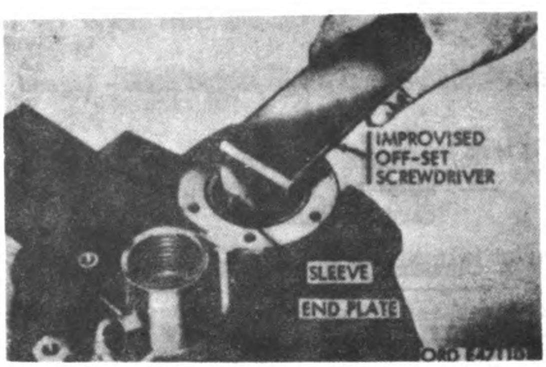


Figure 320. Removing relay piston sleeve, using improvised offset screwdriver

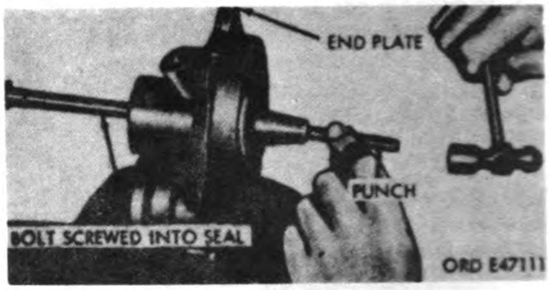


Figure 321. Removing push rod oil seal

(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.

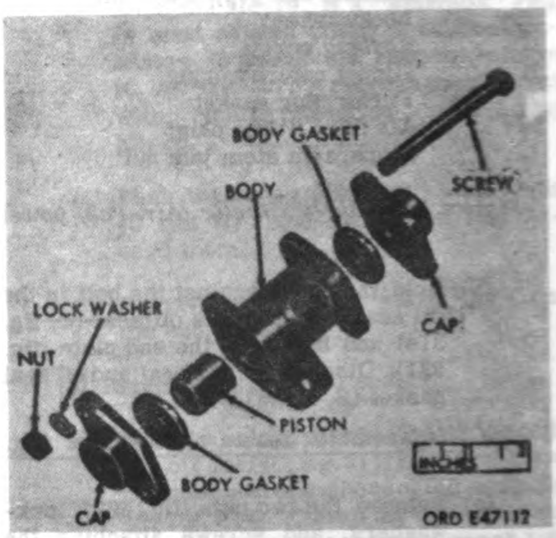


Figure 322. Double check valve

(3) 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 if 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)

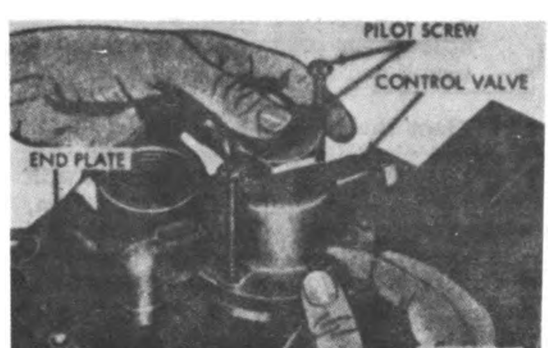


Figure 323. Installing air-hydraulic power cylinder (Air-Pak) control valve

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 alined 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 four 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 cup 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 brakeshoes.

(*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.

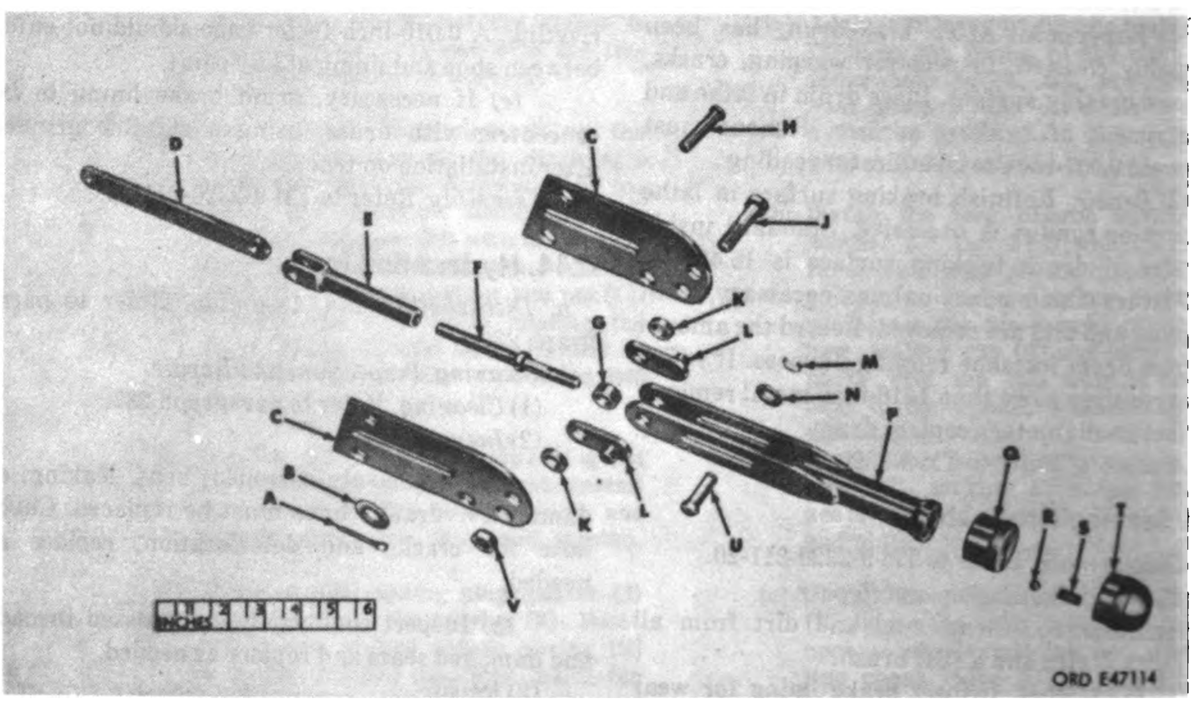
245. Parking Brake Linkage

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 brake 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 prelubricated 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.

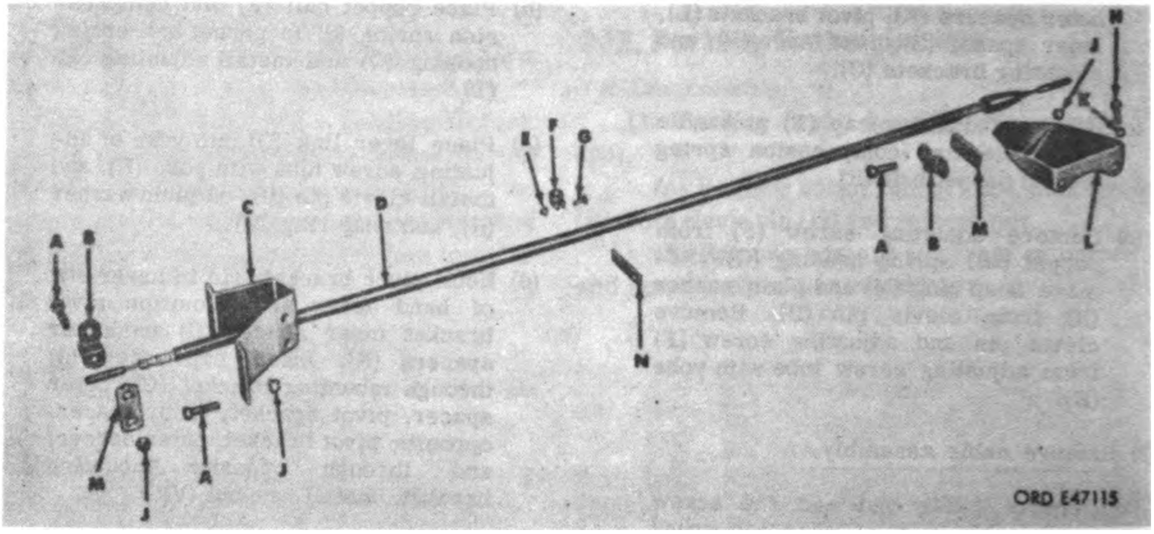


Figure 325. Parking brake cable assembly and brackets - exploded view

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 all 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 0.010-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.

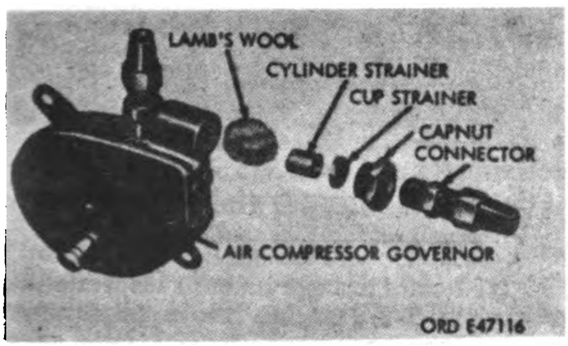


Figure 326. Air-compressor air governor with air strainer disassembled

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 brakeshoes at each wheel. Adjustment of the brakeshoes to compensate for normal lining wear only is termed minor adjustment. Adjustment of the brakeshoes 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.

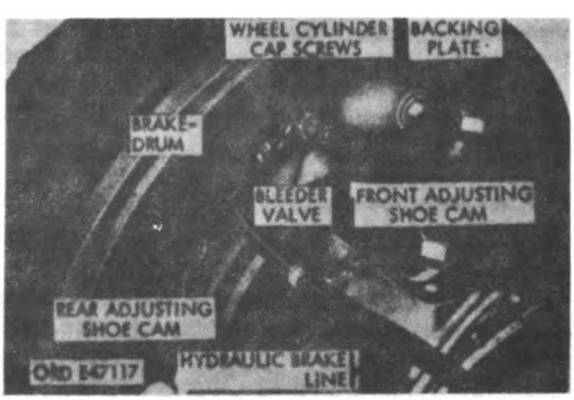


Figure 327. Turning adjusting shoe cam

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.

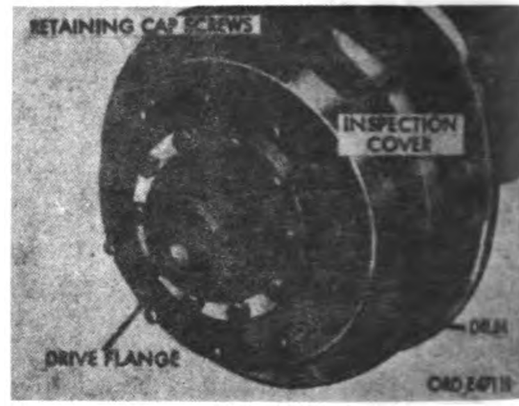


Figure 328. Hub and drum assembly with wheel and tire assembly removed

(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.

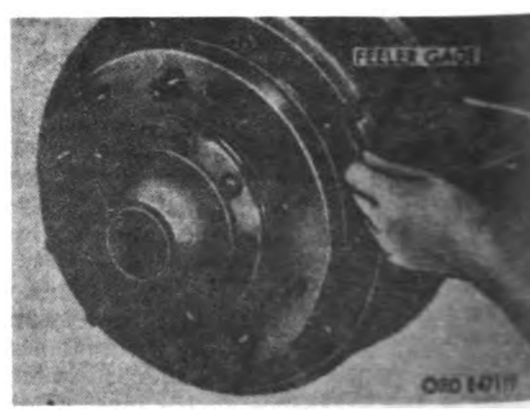


Figure 329. Checking clearance between brakeshoe and drum

(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.

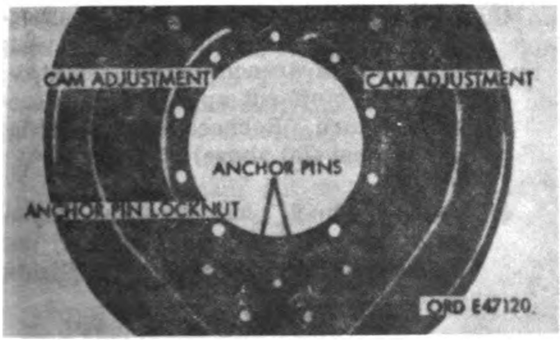


Figure 330. Removing anchor pin locknuts at backside of backing plate assembly

(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 brakeshoe 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 system 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-

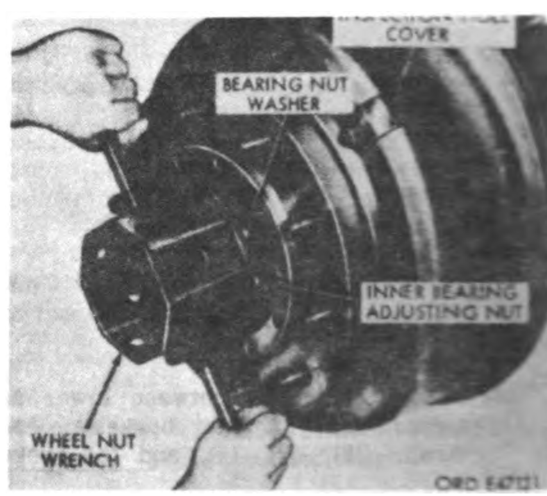


Figure 331. Removing outer-bearing adjusting nut

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. Improvise 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 tank of 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 overrunning 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.

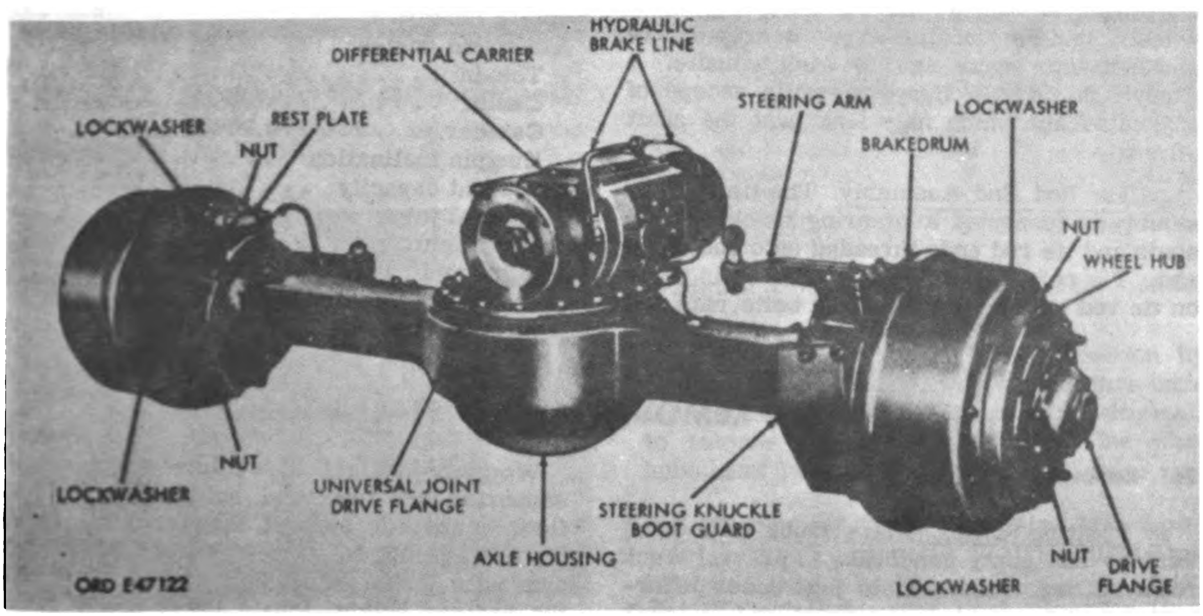


Figure 332. Front axle assembly

d. Drive Shaft and Universal Joint Assembly (Rzeppa). Each drive shaft and universal joint assembly 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 and 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 and M139D	6.443 to 1.00
Gear ratio M139C and M139D	10.26 to 1.00
Spring centers	39-3/4 in.
Alinement angles:	
Toe-in	1/8 ± 1/16
Caster	3°
Camber	1°
Kingpin inclination	8°
Lubricant capacity	12 pt
Universal joint:	
Manufacturer	Bendix or Rzeppa
Lubricant capacity (each knuckle)	3-1 2 lb

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 stands 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.

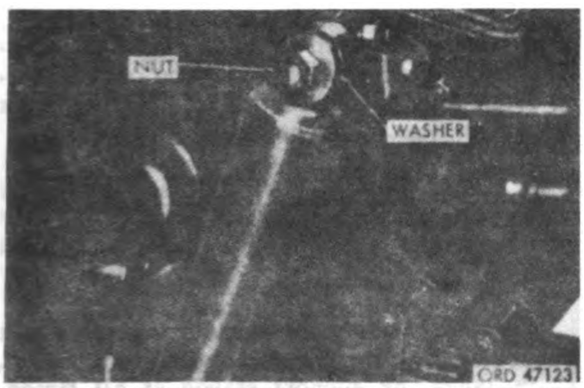


Figure 333. Shock absorber self-locking nut and washers

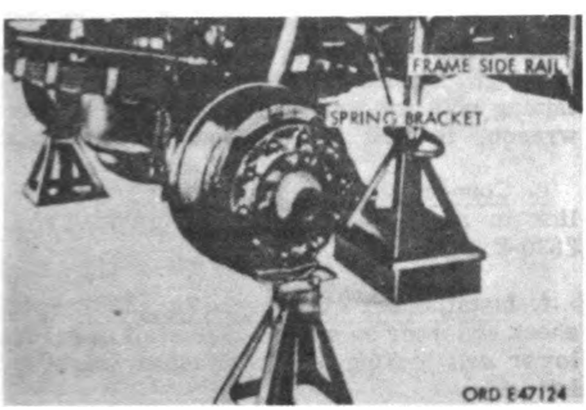


Figure 334. Truck support stand positioned for front axle removal

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.

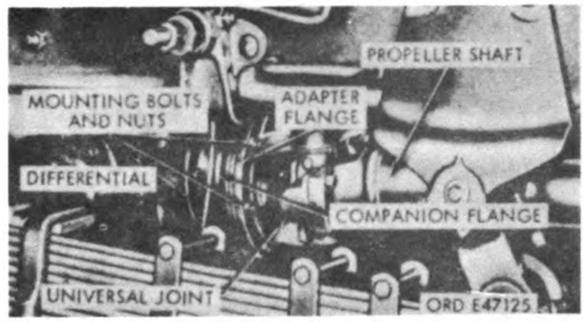


Figure 335. Disconnecting transfer-to-front axle propeller shaft

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.

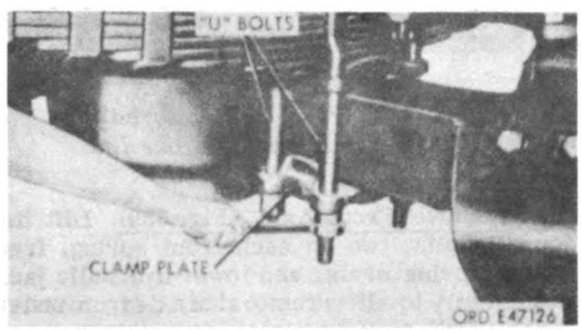


Figure 336. Removing U-bolt clamp plate

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.

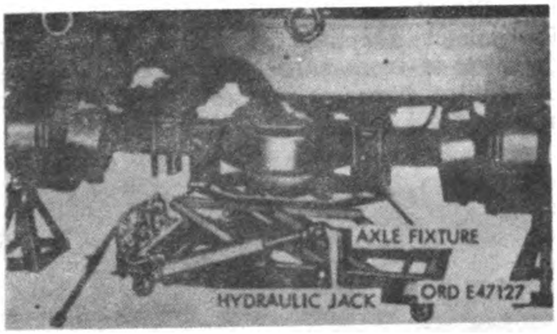


Figure 337. Hydraulic jack positioned for front axle removal

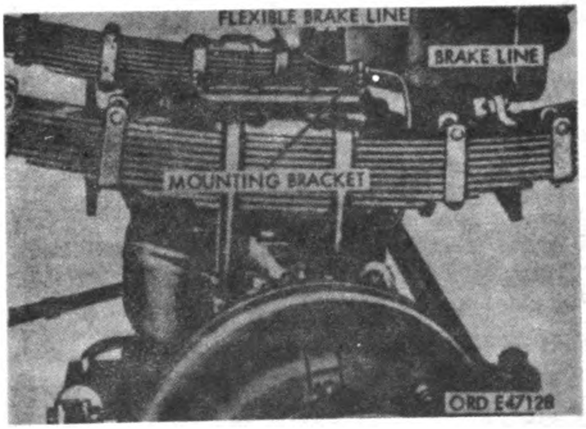


Figure 338. Front axle lowered for disconnecting flexible brake line

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 alined and that spring center bolt heads enter alinement 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

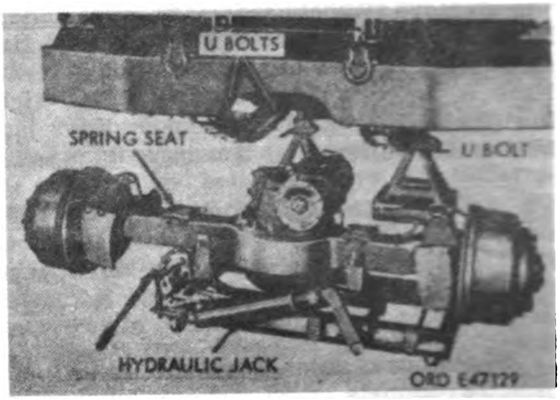


Figure 339. Removing front axle assembly

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 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.

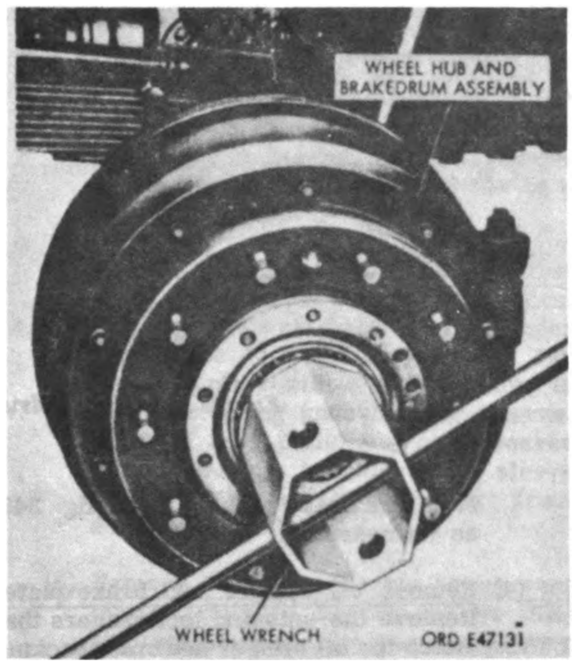


Figure 341. Removing wheel bearing locknut

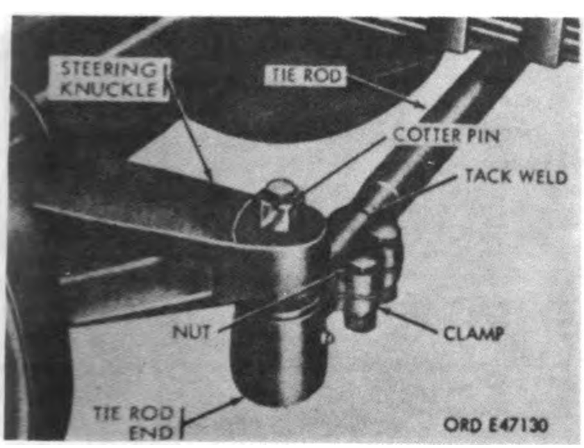


Figure 340. Tie rod assembly

(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

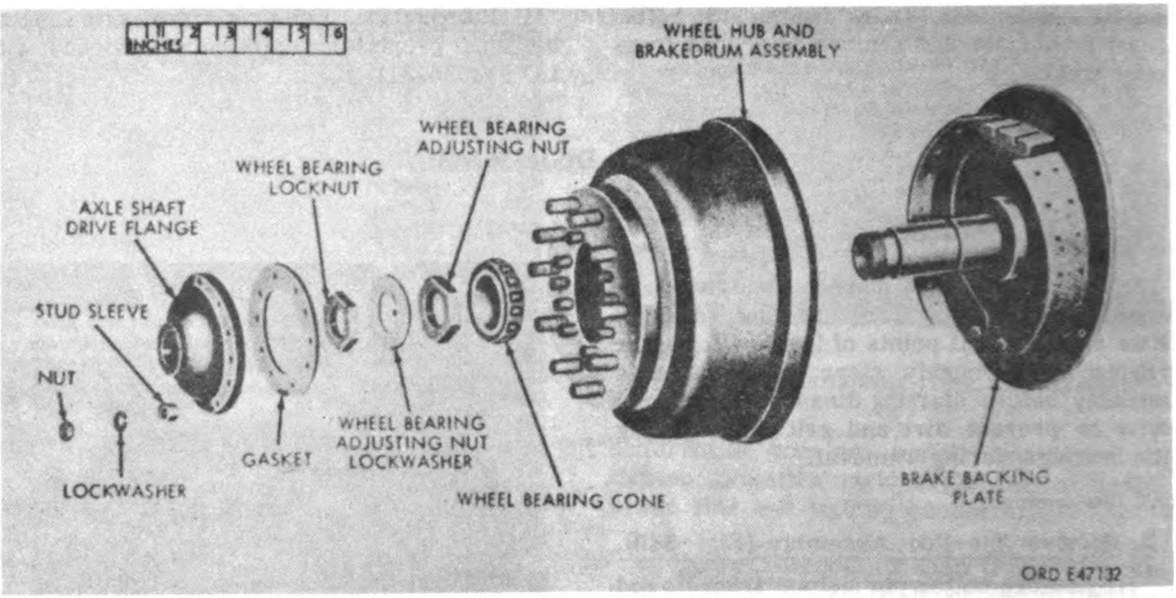


Figure 342. Brakedrum removed - exploded view

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.

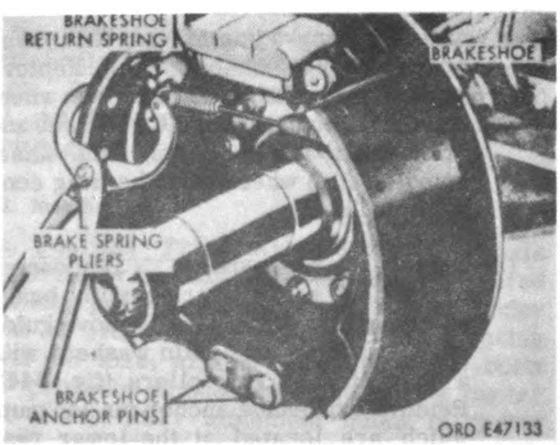


Figure 343. Removing brakeshoe return spring

(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.

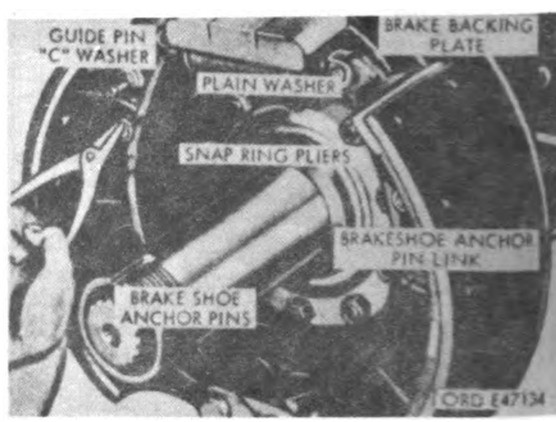


Figure 344. Removing brakeshoe C washers

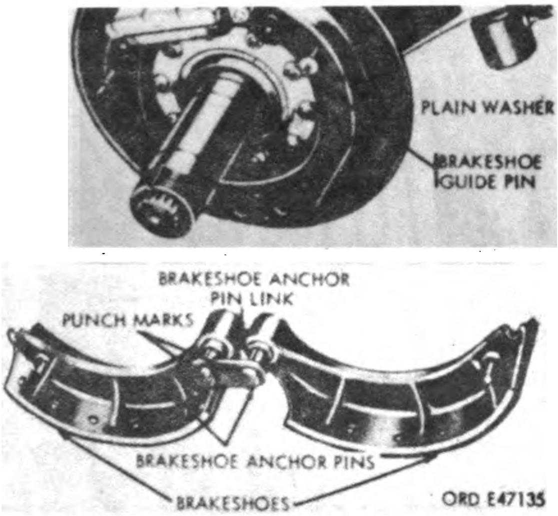


Figure 345. Brakeshoes removed

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 remover retainer. Fold steering knuckle boot back on axle housing. Loosen steering knuckle boot clamp (EE), and slide boot and clamp away from steering knuckle.

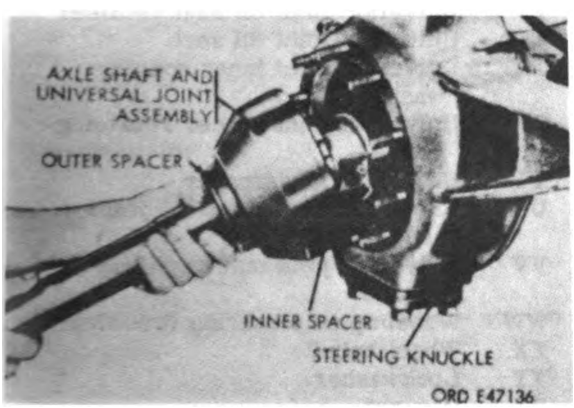


Figure 346. Removing axle shaft and universal joint assembly

(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 ot axle housing.

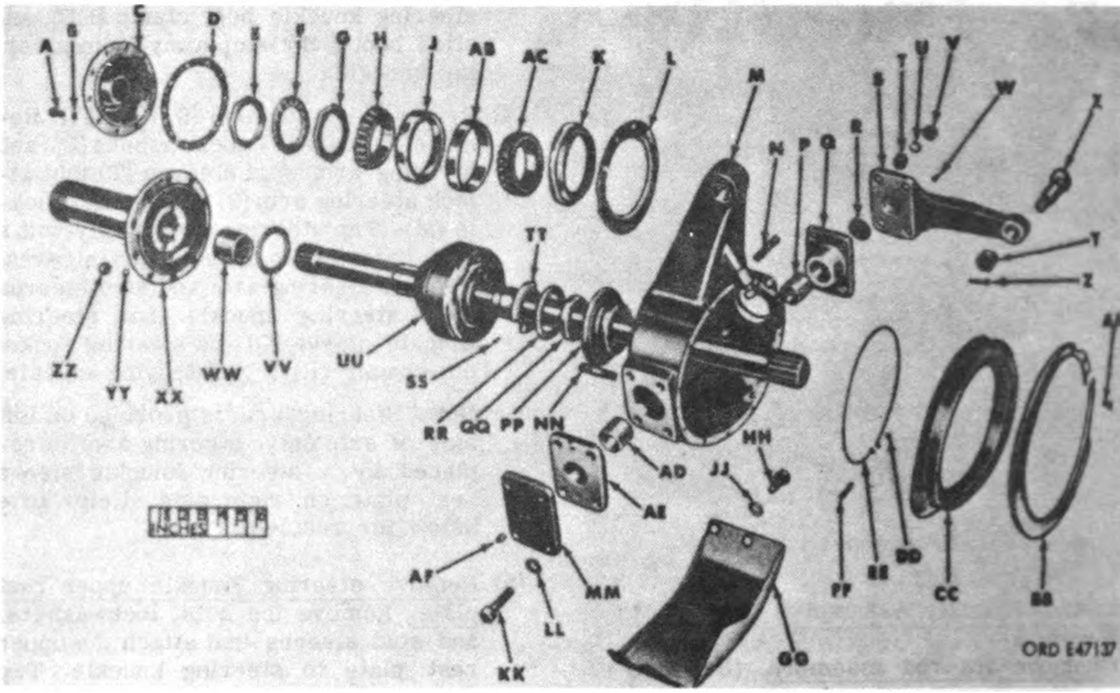


Figure 347. Steering knuckle assembly - exploded view

Key	Item	Key	Item
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		
N	Steering arm stud	SS	Universal joint spacer retaining screw
P	Steering knuckle sleeve bearing		
Q	Steering knuckle sleeve	TT	Universal joint spacer
R	Steering socket pin spacer	UU	Axle shaft and universal joint assembly
S	Steering arm		
T	Steering arm stud sleeve	VV	Universal joint outer spacing washer
U	Lockwasher		
V	Hex-nut	WW	Wheel spindle bearing (bushing type
W	Lubrication fitting	XX	Wheel spindle
X	Steering arm ball stud	YY	Lockwasher
Y	Slotted nut	ZZ	Hex-nut
Z	Cotter pin	AB	Wheel bearing cup

Figure 347. Steering knuckle assembly - exploded view - legend

KEY	ITEM	KEY	ITEM
AA	Machine screw	AC	Wheel bearing cone
BB	Steering knuckle boot retainer	AD	Steering knuckle sleeve bearing
CC	Steering knuckle boot	AE	Steering knuckle sleeve
DD	Hex-nut	AF	Lubrication fitting
EE	Steering knuckle boot clamp		

Figure 347. Legend (continued).

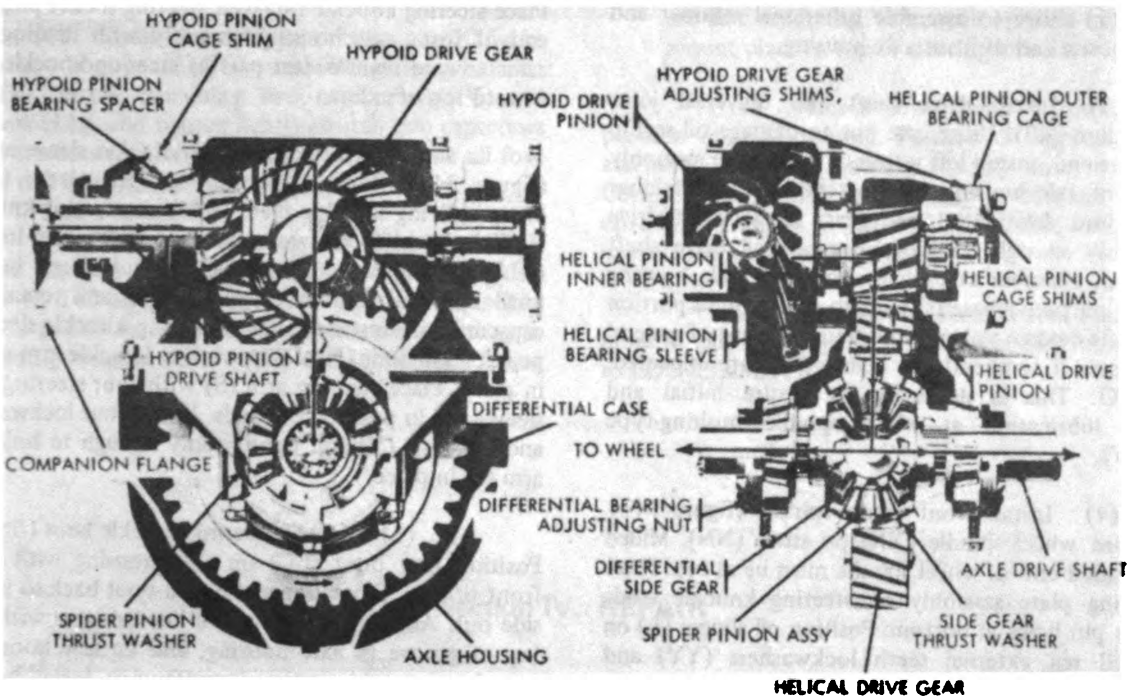


Figure 348. Differential and carrier assembly – cutaway view.

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 OO. 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 the 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 (GG) 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 feet-pounds.

(5) Tighten steering knuckle sleeve cap screws and steering arm stud nuts (figure 347). Tighten capscrews to 160 to 175 pound-feet torque. Torque hex nuts to 115 to 200 feet-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 pound-feet torque. Torque nuts to 130 to 170 feet-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

286. 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.

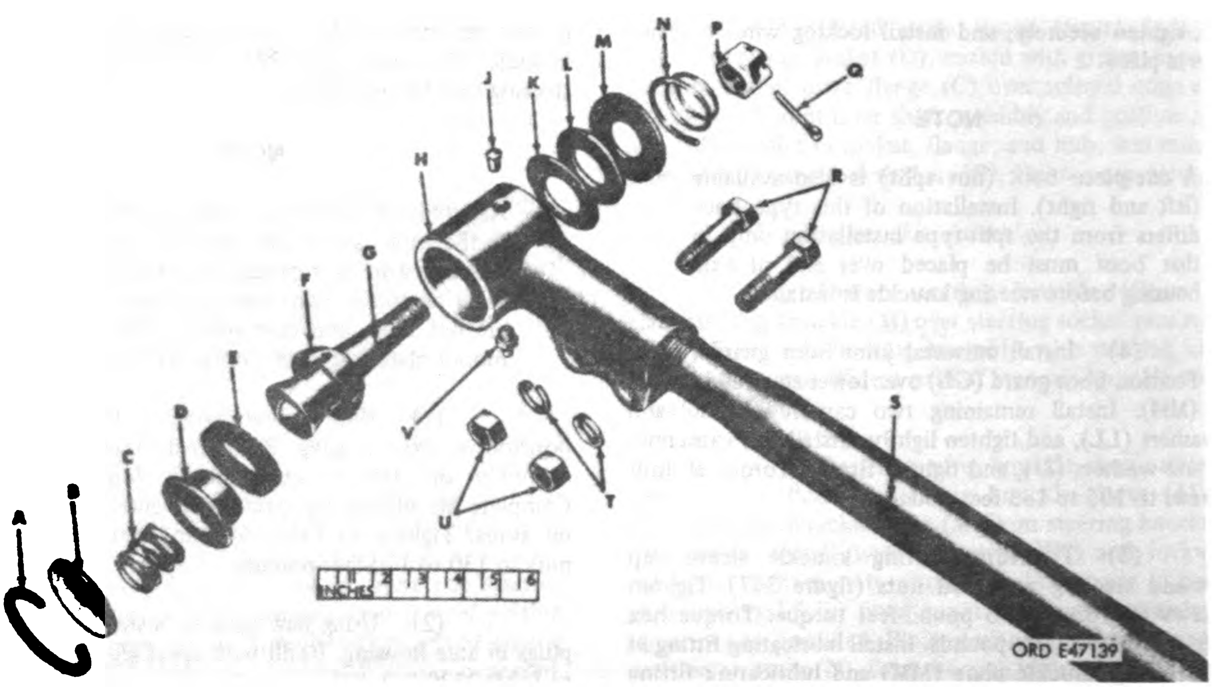


Figure 349. Tie-rod end assembly – exploded view.

KEY	ITEM
A	Ring, snap, end plug
B	Plug, end
C	Spring, compression
D	Seat, spring
E	Washer, flat
F	Bearing, end stud
G	Stud, end
H	End, tie rod
J	Pin, end stud bearing
K	Washer, plain
L	Seal, shield
M	Shield, stud
N	Spring, compression, tapered
P	Nut, slotted
Q	Pin, cotter
R	Screw, 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 excessive 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

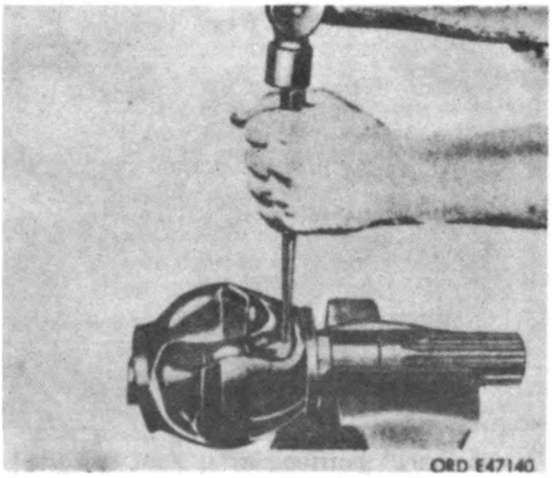


Figure 350. Removing groove pin

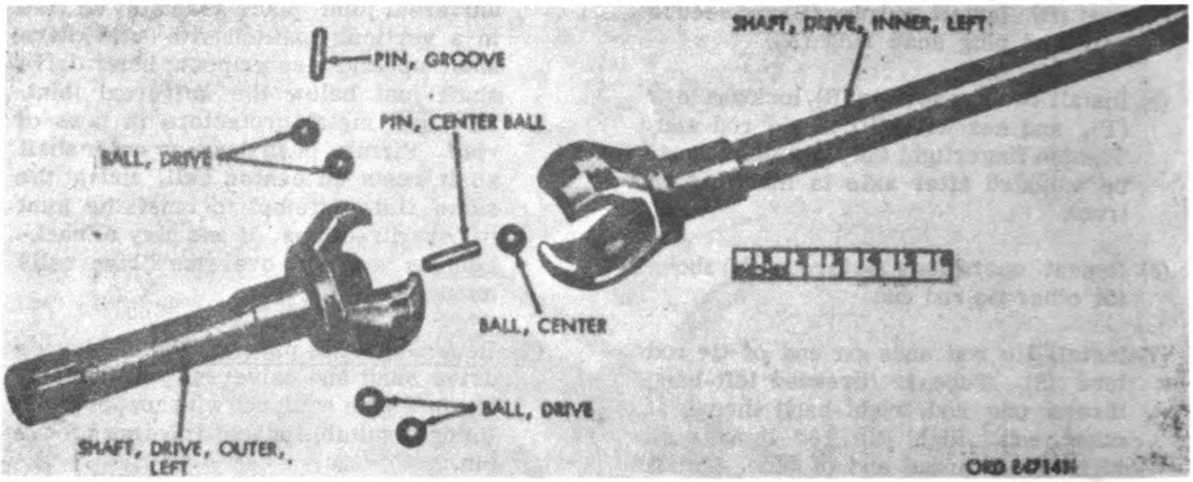


Figure 351. Drive shaft and universal joint assembly (Bendix) - exploded view

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.

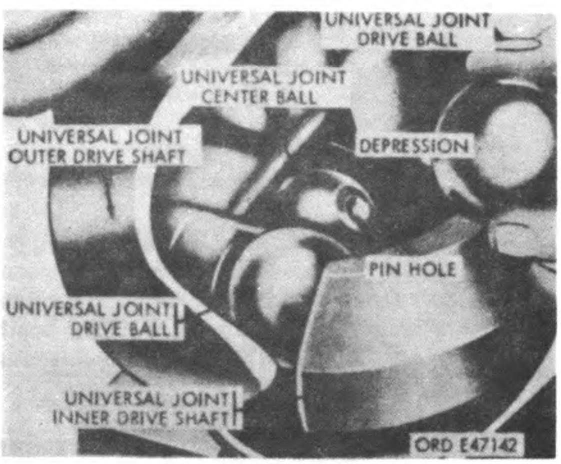


Figure 352. Removing or installing (Bendix) universal joint drive balls

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 over size 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 installation of larger drive balls. Drive balls are available in kits of seven sizes 0.001-, 0.002-, 0.003-inch undersize, 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.

268. Universal Joint Drive Shaft Assembly (Rzeppa)

a. Disassembly.

(1) Clean drive shaft and universal joint assembly. Clean drive shaft and universal joint assembly in mineral spirits paint thinner or dry-cleaning solvent to remove grease from joint. As soon as inspection and wear limit checks are completed, all parts to be used again must immediately be coated with oil to prevent damage from rust.

(2) Check universal joint for excessive play or backlash. To determine if excessive play or backlash exists in the universal joint, place assembly in vise, with vise jaws gripping outer drive shaft just ahead of universal joint. Use soft metal protectors in jaws of vise. Firmly grasp inner drive shaft and attempt to twist the joint in both directions. If excessive play or backlash is evident in universal joint, all parts must be replaced.

(3) Remove universal joint spacer. Remove two setscrews (fig. 353) from universal joint spacer and slide spacer off inner drive shaft.

(4) Remove ball retainer. Remove locking wire (fig. 354) from slotted head screws. Remove the three slotted head screws and slide ball retainer of inner drive shaft away from the ball race.

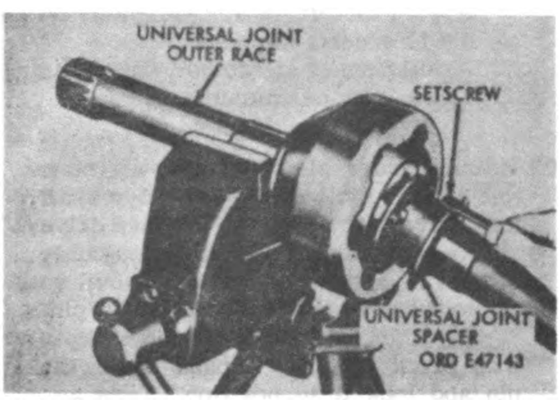


Figure 353. Universal joint spacer removal

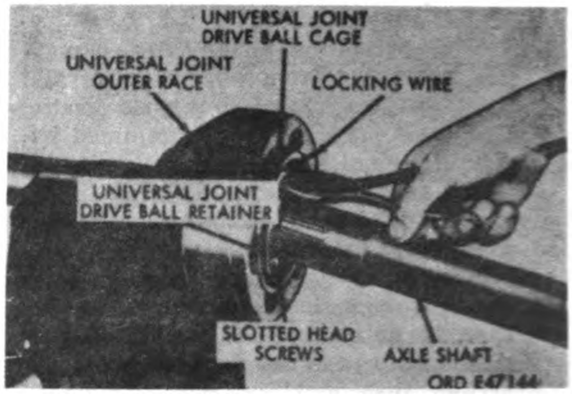


Figure 354. Locking wire removal

(5) Remove inner drive shaft from universal joint ball race. Remove inner drive shaft from universal joint ball race. Remove retaining ring and ball retainer from inner drive shaft.

(6) Remove pilot pin. Withdraw pilot pin (fig. 355) from universal joint bell.

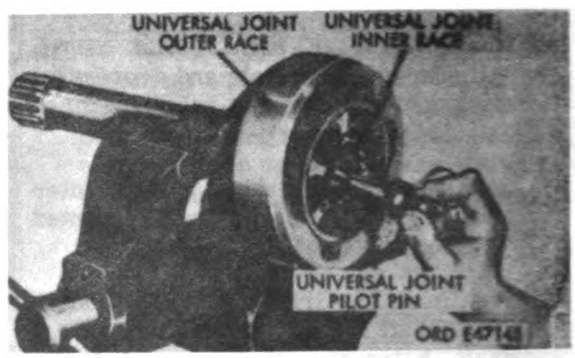


Figure 355. Removing pilot pin

(7) Remove universal joint balls (fig. 356). Tilt ball race in universal joint bell until one universal joint ball can be lifted out. Then tilt the ball race until the next ball can be removed, and continue until all the balls are removed.

(8) Remove inner shaft pilot. Turn ball cage and ball race assembly completely over and remove inner shaft pilot (fig. 357).

(9) Remove ball cage and ball race (fig. 358). Roll the ball cage and ball race

assembly at right angles to universal joint bell with the two elongated openings in cage in line with opposite teeth in universal joint bell. Then lift ball cage and ball race from universal joint bell.

(10) Separate ball race from ball cage (fig. 359). To separate ball race from ball cage, turn race at right angle to cage, aline tooth on race with elongated hole in cage and roll race from cage.

(11) Remove outer spacing washer (fig. 360). Remove outer spacing washer (A) from outer drive shaft (B). Washer is a pressed fit and must be removed with care to prevent damage to outer drive shaft.

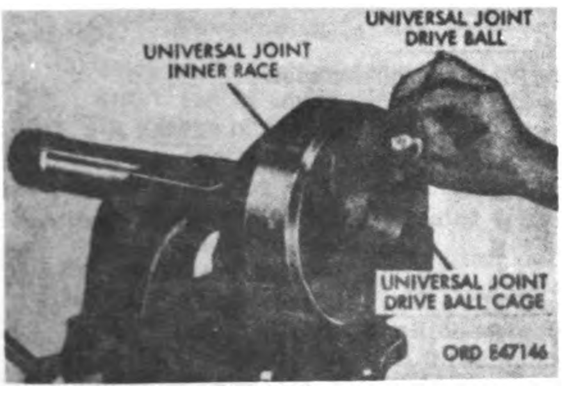


Figure 356. Universal joint drive ball removal

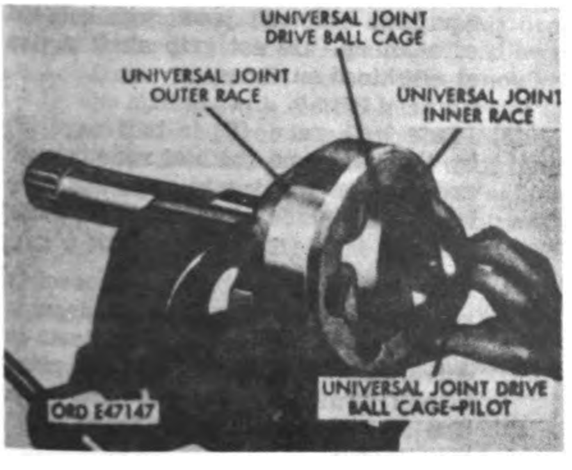


Figure 357. Removing universal joint drive ball cage pilot

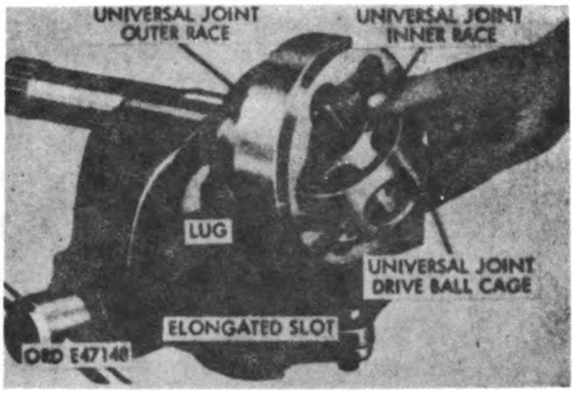


Figure 358. Removing ball cage and inner race

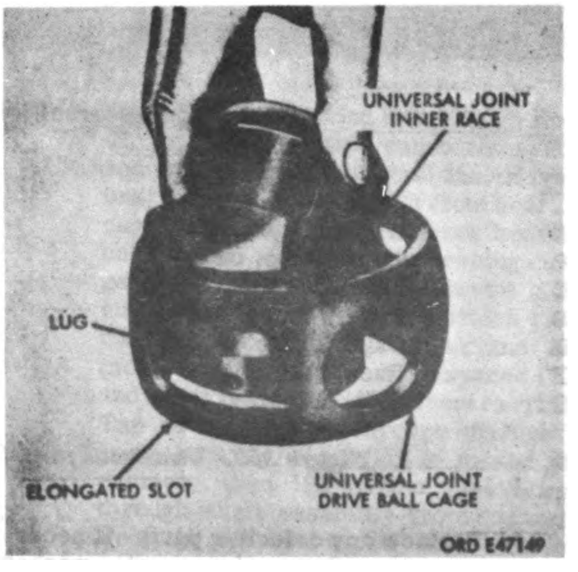


Figure 359. Separating inner ball race from ball cage

b. Cleaning, Inspection and Repair.

(1) Cleaning. Use dry-cleaning solvent or mineral spirits paint thinner to thoroughly clean splines on drive shafts. Thoroughly clean the universal joint bell, balls, ball race, and ball cage.

(2) Inspection and repair. Inspect ball cage and ball race for excessive wear or cracks. Check balls for cracks, chips, or rough spots. Use micrometer to check balls for out-of-round condition. Examine splines for damage or twist.

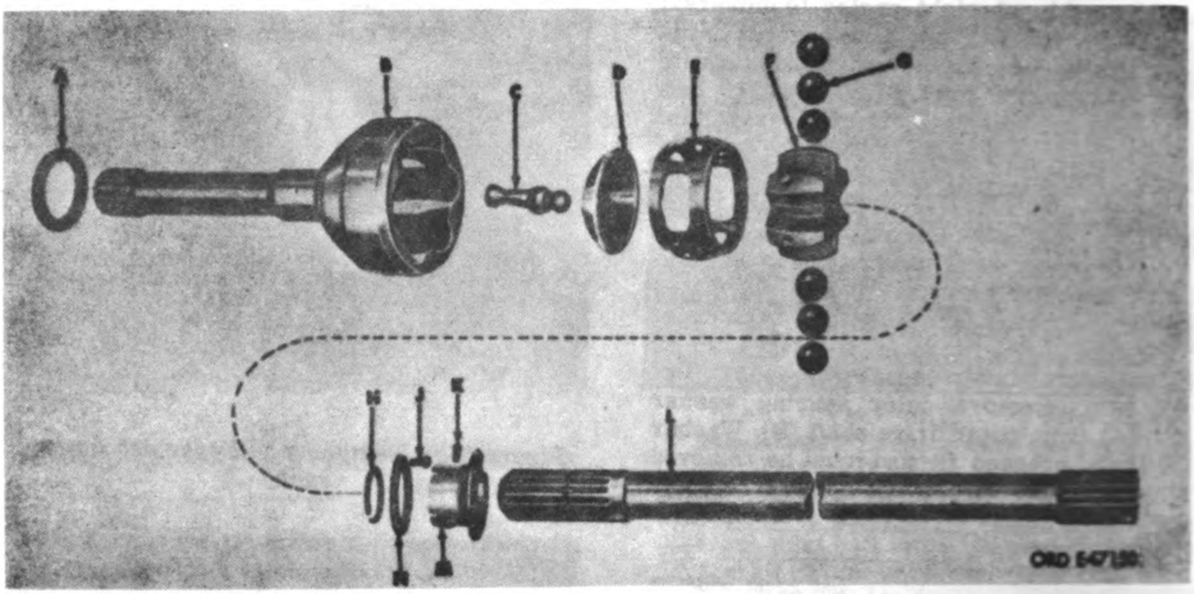


Figure 360. Universal joint (RZEPPA) - exploded view

Key	Item	Key	Item
A	Washer, spacing	H	Ring, retaining, inner shaft
B	Shaft, drive, outer	J	Screw, sltd-hd
C	Pin, pilot	K	Screw, set
D	Pilot, inner shaft	L	Shaft, drive, inner, left
E	Cage, ball	M	Spacer, universal joint
F	Race, ball	N	Retainer, ball
G	Ball, universal joint		

Figure 360. Universal joint (RZEPPA) - exploded view - legend

Replace any defective parts. If necessary to replace outer spacing washer (A, fig. 360) on outer drive shaft, remove old washer. Press new outer spacer washer onto outer drive shaft. Make certain chamfered side of bore faces universal joint bell or yoke. Further repair of the universal joint drive shaft assembly is a matter of replacing the defective parts.

c. Assembly. Before assembling, be sure all parts are serviceable and free of all defects. Obtain new parts to be used in place of damaged or worn parts.

Note. Key letters in this paragraph refer to figure 360 unless otherwise indicated.

(1) Lubricate all parts to facilitate assembly.

(2) Place outer drive shaft (B) in a vise equipped with soft jaws, with bell end of shaft up. Do not grip shaft in vise at machined surfaces.

(3) Place ball race (F) in ball cage (E) by inserting one tooth of race through rectangular opening in cage and rolling it into place. Race must fit freely in cage.

(4) Hold ball race and ball cage assembly so that the rectangular openings in cage aline with two opposite teeth in universal joint bell. Lower into place in bell. Turn cage and race into position in bell, and make sure all parts turn freely.

(5) Turn ball cage (E) and ball race (F) in universal joint bell so that drilled holes

in race are down. Install inner shaft pilot (D). Again, turn cage and race with pilot turning into bottom of bell and aline grooves in race with openings in cage. Aline cage and race assembly with grooves in bell.

(6) Tilt ball race (F) and ball cage (E) so that one universal joint ball (G) can be inserted into race through openings in cage. Rotate ball race enough to permit installing another ball in groove adjacent to first ball. Continue until all six balls are installed.

(7) Turn ball race (F) so that side with drilled holes is flush with edges of universal joint bell. Insert pilot pin (C) through ball race (F) and inner shaft pilot (D), with flat end of pin down.

(8) Slide inner shaft retaining ring (H) onto outer end of inner drive shaft (L) and in groove on splines. Insert splines of drive shaft into splines of ball race (F) vertically so that pilot pin (C) will be centered and contact center of inner drive shaft.

(9) Slide ball retainer (N) over end of inner drive shaft (L) and position retainer on ball race (F). Install three slotted head screws (J) and tighten firmly. Thread wire through drilled heads of slotted head screws and twist ends of wire together.

(10) Slip universal joint spacer (M) over inner drive shaft (L), flanged end away from universal joint. Aline notches in spacer with slotted head screws (J) to allow spacer to contact ball retainer (N). Pull inner drive shaft until inner shaft retaining ring (H) is firmly against ball retainer (N). Then slide universal joint spacer (M) tight against ball retainer, tighten both set screws (K) in spacer securely and thread locking wire through drilled holes in setscrews. Twist ends of locking wire together to secure assembly in place.

269. Differential Carrier Assembly

a. Disassembly.

(1) Remove differential carrier assembly (fig. 361). Punch an index mark on each differential carrier cap, and another mark directly opposite on the differential carrier to ensure proper installation. Remove the locking wire from differential bearing cap bolts (T). Remove the cap screw (U) that attaches differential bearing adjusting ring lock (V) to differential bearing caps (W and S) and remove lock. Remove bolts (T). Remove differential bearing caps (S and W). Lift differential carrier assembly and differential bearing adjusting rings from carrier.

(2) Remove companion flanges (B and Z, fig. 362). Remove cotter pins (BB and GG) from slotted nuts (A, and AA) and remove slotted nuts. Pull companion flanges (B and Z) from hypoid pinion and through shaft (S) with a suitable puller.

(3) Remove hypoid pinion and through shaft (S, fig. 362). Remove cap screws (FF) and lockwashers (EE) that attach front bearing cage cover (D) to front bearing cage (M), and remove front bearing cage cover (D) and front bearing cage gasket (L). Remove cap screws (CC) and lockwashers (DD) that attach rear bearing cover (X) to carrier and remove cover, rear bearing spacer (V), and rear cover gasket (W) from carrier. Tap on rear end of through shaft until front bearing cage (M) is forced off carrier, then lift hypoid pinion and through shaft assembly from carrier. Remove rear bearing (U) from carrier with a suitable remover. Remove rear bearing race (T) from through shaft with a suitable puller.

(4) Remove hypoid pinion front bearing cage from through shaft (fig. 362). Place hypoid pinion and through shaft (S) in vise (equipped with soft jaws) and remove front bearing locknut (F), front bearing lockwasher (G), and front bearing adjusting nut (H). Using a soft hammer, tap lightly on front bearing cage (M) to remove front outer bearing cone (J) from through shaft, and remove bearing cage from through shaft. Remove front bearing spacer (P). Pull front inner bearing cone (R) from shaft, using a suitable puller.

(5) Remove hypoid pinion bearing cups from cage (fig. 362). Using bearing

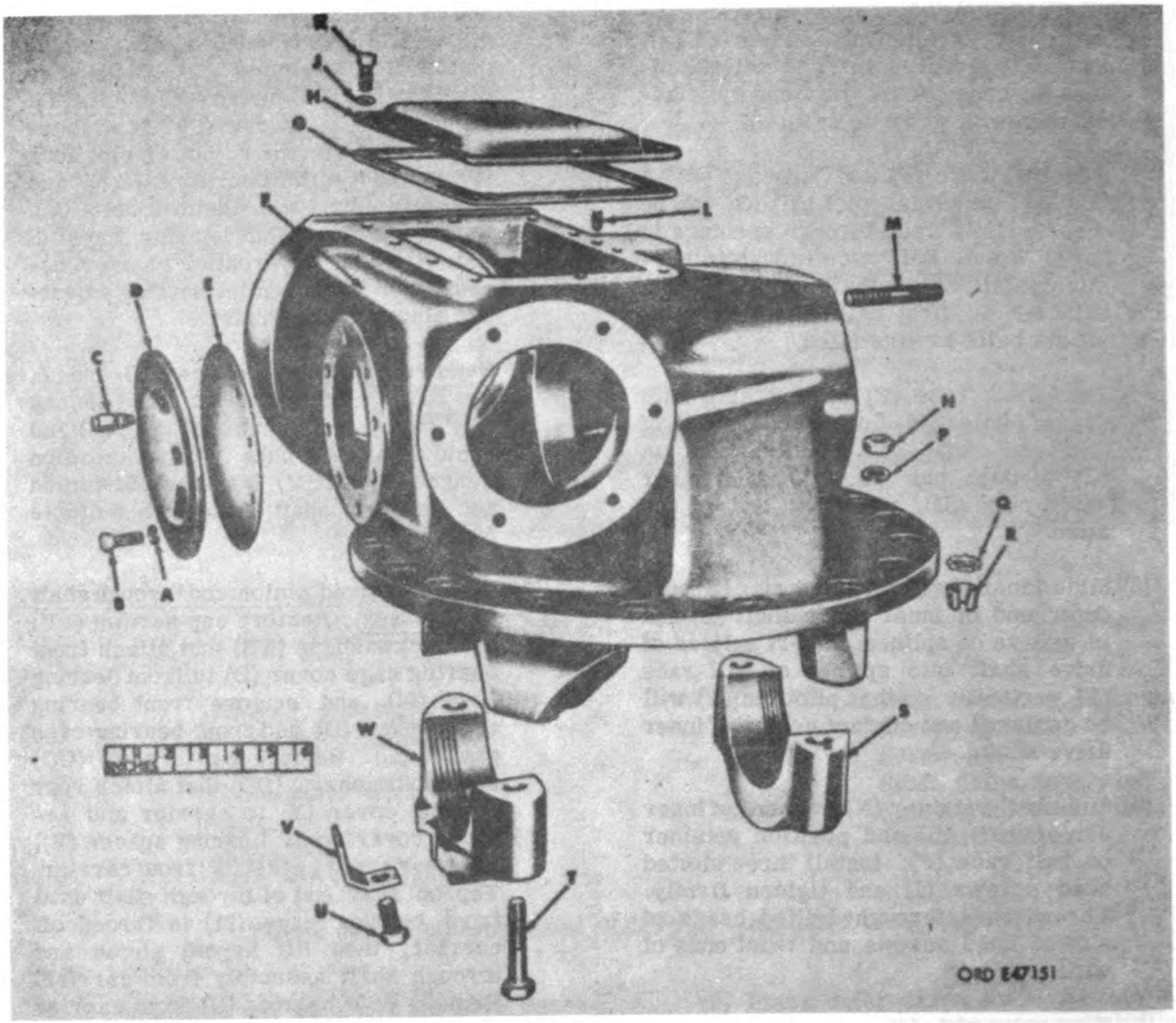


Figure 361. Differential carrier - exploded view

Key	Item	Key	Item
A	Lockwasher	M	Outer bearing cover stud
B	Cap screw	N	Nut
C	Air vent	P	Lockwasher
D	Side cover	Q	Lockwasher
E	Side cover gasket	R	Adapter sleeve
F	Differential carrier	S	Differential bearing cap (right)
G	Top cover gasket	T	Differential bearing cap bolt
H	Top cover	U	Cap screw
J	Lockwasher	V	Differential bearing adjusting ring lock
K	Cap screw	W	Differential bearing cap (left)
L	Setscrew		

Figure 361. Differential carrier - exploded view - legend

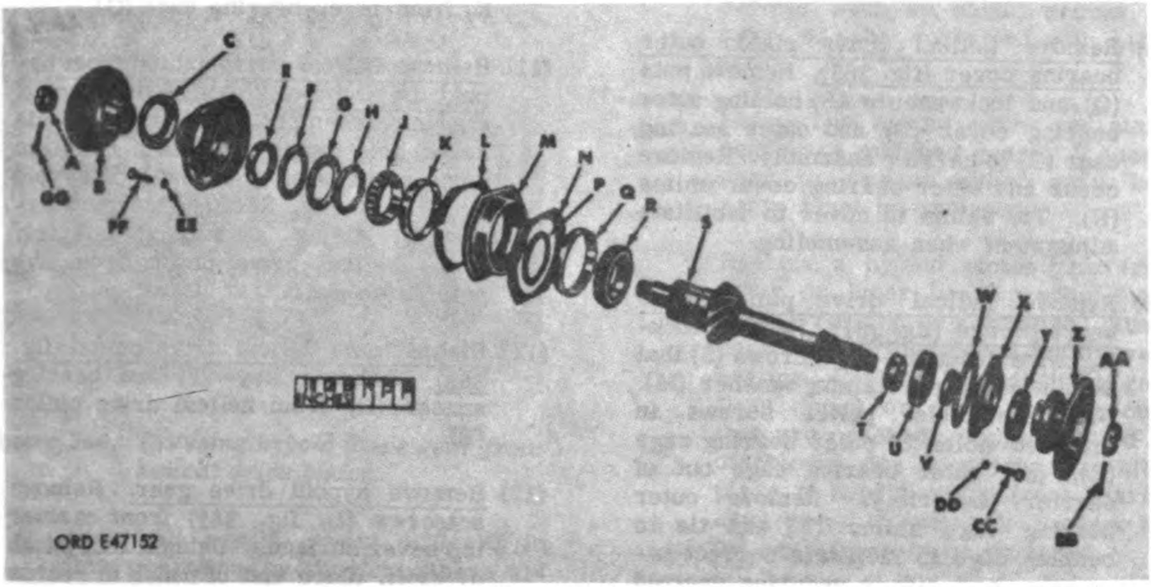


Figure 362. Hypoid pinion assembly - exploded view

Key	Item	Key	Item
A	Slotted nut	S	Hypoid pinion and through shaft
B	Companion flange	T	Rear bearing race
C	Companion flange dust slinger	U	Rear bearing
D	Front bearing cage cover	V	Rear bearing spacer
E	Oil seal	W	Rear cover gasket
F	Front bearing locknut	X	Rear bearing cover
G	Front bearing lockwasher	Y	Oil seal
H	Front bearing adjusting nut	Z	Companion flange
J	Front outer bearing cone	AA	Slotted nut
K	Front outer bearing cup	BB	Cotter pin
L	Front bearing cage gasket	CC	Cap screw
M	Front bearing cage	DD	Lockwasher
N	Front bearing cage shim	EE	Lockwasher
P	Front bearing spacer	FF	Cap screw
Q	Front inner bearing cup	GG	Cotter pin
R	Front inner bearing cone		

Figure 362. Hypoid pinion assembly - exploded view - legend

remover and replacer 5120-795-0159, press front outer bearing cup (K) from front bearing cage (M). Use a small punch to move front inner bearing cup (Q) from its seat in cage. This will permit full contact between bearing cup and the shoulders on bearing remover. Complete disassembly of pinion bearing cage by pressing front inner bearing cup (Q) from cage with a suitable remover.

(6) Remove hypoid pinion from through shaft carefully. Support hypoid drive firmly on arbor press and press through shaft from pinion. Remove key from shaft.

(7) Remove differential carrier side cover (fig. 361). Remove cap screws (B) and lockwasher (A) securing side cover (D) to differential carrier (F) and remove side cover (D). Remove and dis-

card side cover gasket (E). Remove air vent (C) from cover.

(8) Remove helical drive pinion outer bearing cover (fig. 363). Remove nuts (Q) and lockwashers (R) holding outer bearing cover (P) and outer bearing cage (G) to carrier assembly. Remove cover and outer bearing cover shims (N). Tie shims to cover to facilitate adjustment when assembling.

(9) Remove helical drive pinion outer bearing cage (fig. 361). Remove locking wire from the cap screws (S) that attach bearing retaining washer (M). Using suitable puller screws in threaded holes of outer bearing cage (G), pull outer bearing cage out of carrier assembly. Remove outer bearing cage shims (F) and tie to bearing cage to facilitate correct assembly, and aid in securing desired tooth contact between hypoid pinion and hypoid drive gear (A) at assembly.

(10) Disassemble helical drive pinion outer bearing cage (fig. 363). Using suitable adapter, press outer bearing cups (H and L) and outer bearing cones (J and K) from outer bearing cage (G).

(11) Remove helical drive pinion from hypoid drive gear. Position differential carrier assembly on press with side cover hole facing up. Place two iron spacers between rear face of hypoid drive gear (fig. 364) and carrier assembly. Using a suitable adapter, press helical drive pinion from hypoid drive gear.

(12) Disassemble helical drive pinion (fig. 363). Remove key (T) and bearing spacer (D) from helical drive pinion (E).

(13) Remove hypoid drive gear. Remove setscrew (L, fig. 361) from carrier top cover surfaces. Using a long punch or drift, place end of punch in recess or notch provided in opposite sides of bearing sleeve (B, fig. 363). Drive bearing sleeve from carrier. Do not permit bearing sleeve to become cocked in carrier case, as damage to

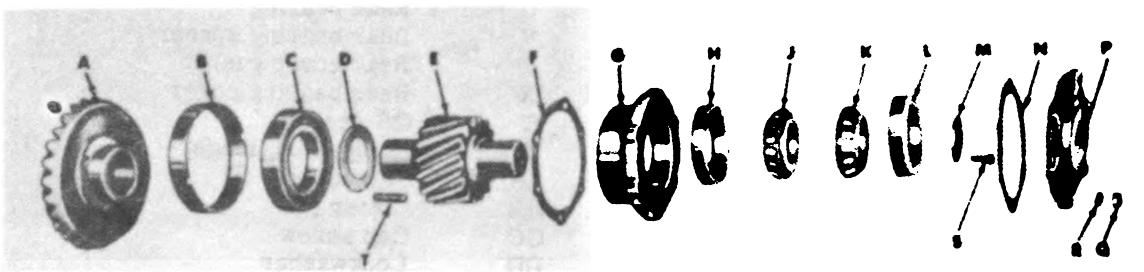


Figure 363. Helical drive pinion assembly - exploded view

Key	Item	Key	Item
A	Hypoid drive gear	K	Outer bearing cone
B	Bearing sleeve	L	Outer bearing cup
C	Inner bearing	M	Bearing retaining washer
D	Bearing spacer	N	Outer bearing cover shim
E	Helical drive pinion	P	Outer bearing cover
F	Outer bearing cage shim	Q	Nut
G	Outer bearing cage	R	Lockwasher
H	Outer bearing cup	S	Cap screw
J	Outer bearing cone	T	Key

Figure 363. Helical drive pinion assembly - exploded view - legend

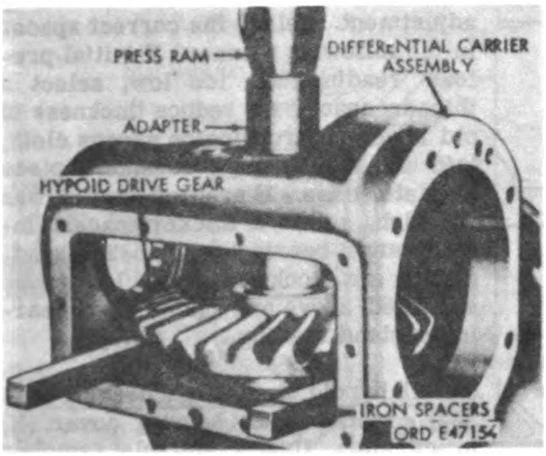


Figure 364. Pressing hypoid drive gear from helical drive pinion

case will result. Avoid difficulty in this operation by driving sleeve alternately at one recess and then the other. Drive sleeve only enough to obtain sufficient clearance between sleeve and shoulder in carrier, and then use bearing remover and replace 5120-795-0159 to remove sleeve and hypoid drive gear.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts thoroughly with dry-cleaning solvent or mineral spirits paint thinner. Apply a light grade of oil to all polished surfaces to prevent rusting.

(2) Inspection and repair.

(a) Differential carrier. Check differential carrier for cracks or distortion. Inspect stud threads and cap screw hole threads for damage. Replace studs if broken or damaged. Clean up damaged threads of carrier with a tap. Replace carrier if differential adjusting ring threads are damaged beyond repair.

Note. Carrier and caps cannot be replaced as separate items.

(b) Hypoid drive and pinion gears. Examine the hypoid drive and pinion gears carefully for chipped, cracked, or scored teeth. Gears with broken, chipped, cracked, or excessively worn teeth must be replaced. Small defects such as nicks, scores, or burs may be corrected with a fine stone.

Note. The hypoid drive and pinion gears are matched gears. If necessary to replace either gear, both gears must be replaced.

Replace a hypoid pinion gear front outer or inner bearing cone if any of the rollers are missing, pitted, corroded, or discolored due to overheating. Replace hypoid pinion gear front inner or outer bearing cups that are cracked, chipped, pitted or discolored due to overheating. Replace a hypoid pinion front bearing cage cover if damaged. Replace the oil seals if worn or damaged.

(c) Helical pinion gear and related parts. Replace a helical pinion gear if the teeth are broken, chipped, or visibly worn. Small nicks may be polished with a fine stone. Replace a helical pinion gear if the threaded holes in end of shaft are stripped or damaged beyond repair. Replace the outer bearing cone or cups if worn or damaged. Replace the outer bearing cage if cracked or damaged. Replace the inner bearing or bearing sleeve if worn or damaged.

c. Assembly.

Note. When replacing differential gears on the chassis truck M139C and M139D, be sure to order a complete axle set to meet specified gear ratios (10.26- to 1.00).

(1) Install pinion front bearing cups (fig. 362). Press front outer bearing cup (K) and front inner bearing cup (Q) into front bearing cage (M) until firmly seated.

(2) Install hypoid pinion front inner bearing cone (fig. 362). Press front inner bearing cone (R) on hypoid pinion and through shaft (S) until seated against the pinion gear.

(3) Assemble hypoid pinion front bearing cage on pinion (fig. 362). Place front

bearing cage (M) over front inner bearing cone (R), with the hub side of cage facing in. Install front bearing spacer (P) on hypoid pinion and through shaft (S). Install front outer bearing cone (J), with the small diameter of cone facing toward cage. Install front bearing adjusting nut (H) (nut with dowel), on hypoid pinion and through shaft (S). Tighten to approximately 500 pound-feet torque. Slip front bearing lockwasher (G) into position over dowel on front bearing adjusting nut. It may be necessary to remove lockwasher and turn nut in order to get hole in lockwasher to index with dowel on adjusting nut. Install front bearing locknut (F) and tighten to 500 pound-feet torque.

(4) Adjust hypoid pinion bearing preload (fig. 365). Use bearing preload tester 6670-347-5022 to check hypoid pinion front bearing preload reading. When new bearings and cups are used, correct bearing preload should be 12- to 18-inch-pounds maximum. When original bearings are used, the bearing preload should be 4- to 8-inch-pounds maximum. If correct preload is not secured on initial adjustment, remove front bearing locknut (F, fig. 362), front bearing lockwasher (G, fig. 362), front bearing adjusting nut (H, fig. 362), and front outer bearing cone (J, fig. 362). This will permit removal of front bearing spacer (P, fig. 362) which controls the bearing preload adjustment. Select the correct spacer in the following manner. If initial preload reading was too low, select a thinner spacer or reduce thickness of old spacer by rubbing on crocus cloth, laid on a face plate or upon a piece of plate glass. If preload reading was too high, select a thicker spacer. Install outer bearing cone, bearing adjusting nut, lockwasher and locknut as specified above and again take a bearing preload reading.

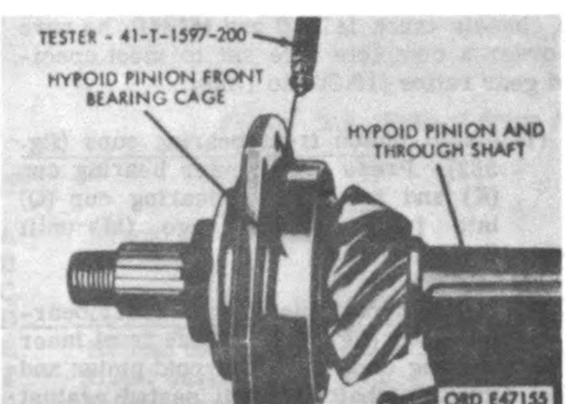


Figure 365. Checking hypoid drive pinion bearing preload

(5) Install hypoid pinion rear bearing (fig. 362). Install rear bearing cover (X) in carrier. Use a suitable remover and replacer and install rear bearing race (T) on end of through shaft.

(6) Install hypoid pinion shaft assembly in carrier (fig. 362).

(a) Install front bearing cage shims (N) which control gear lash, and which were tied to bearing cage at time of disassembly. Place shims in position on pinion side of front bearing cage (M). Carefully aline openings in shims with oil passage in bearing cage.

(b) Install hypoid pinion and through shaft assembly in carrier through front bearing cage opening of through shaft chamber. Aline rear bearing race (T), (installed in c above) with center of rear bearing (U). Continue installation of hypoid drive pinion assembly until front bearing cage (M) is seated against carrier and rear bearing race (T) is in position in rear bearing (U).

(7) Adjust hypoid pinion to correct location in carrier.

(a) The hypoid pinion is adjusted for proper location in relationship to the hypoid drive gear, using gage 4910-795-0104as shown in figure 366. The adjustment is made after the hypoid pinion preload is established as outlined above, and with the hypoid drive gear and bearing assembly out of the differential case. The hypoid pinion and through shaft and the front bearing cage assembly are temporarily installed in the dif-

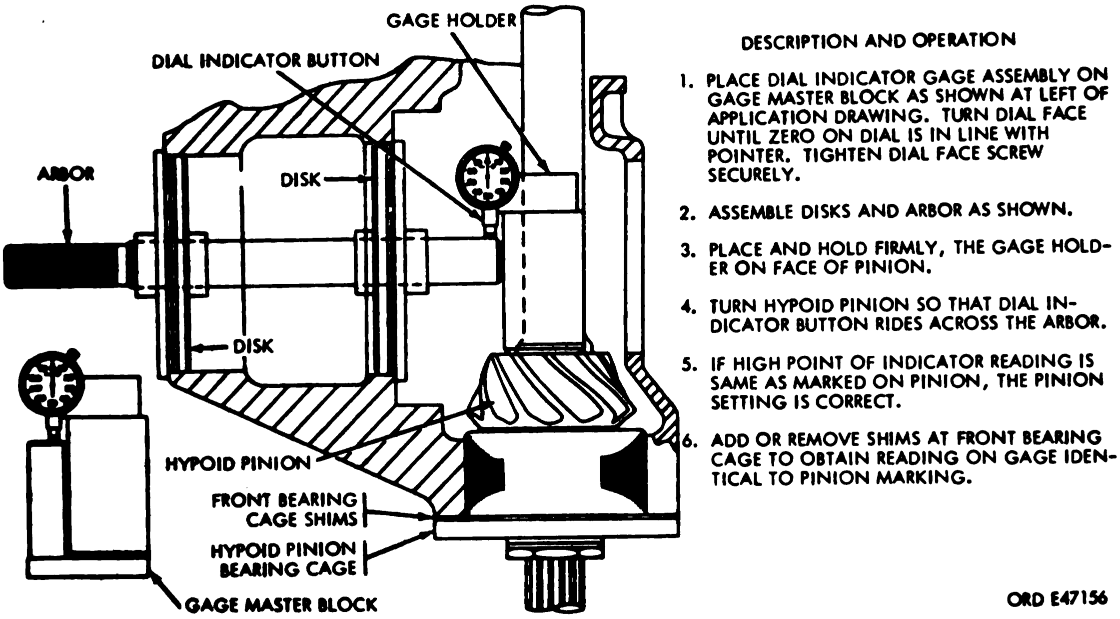


Figure 366. Locating hypoid drive pinion using gage 4910-795-0104

ferential case with the front bearing shims (N, fig. 362) located between the differential case and front bearing cage. Use of the old shim pack will provide a starting point to secure the correct reading.

(b) The gage holder of gage 4910-795-0104 is placed on the gage master block (fig. 366) for the purpose of setting the dial indicator to zero. This establishes the basic or nominal dimension to which the gears were manufactured or cut. Any variation from this nominal dimension will be found marked on the tooth end of the hypoid pinion. The hypoid pinion must be moved in (minus) or out (plus) so that the marking shown on the dial indicator matches the marking on the hypoid pinion. Add or remove front bearing cage shims (N, fig. 362) between the differential case and hypoid front bearing cage (M, fig. 362) to attain the correct dial gage reading.

(c) After locating the hypoid pinion, the hypoid pinion and through shaft assembly, together with the front bearing cage, must be removed from the differential case and the hypoid drive gear assembly installed.

(8) Install helical drive pinion assembly.

Note. The key letters noted in parentheses are in figure 363, except where otherwise indicated.

(a) Place hypoid drive gear (A) in press and press inner bearing (C) onto hub of hypoid drive gear.

(b) Place carrier assembly in press with outer bearing cage side down. Position sleeve (B) in carrier assembly with notches in sleeve towards shoulder of bore. Aline setscrew hole in sleeve with setscrew hole in carrier. Press sleeve into carrier bore until it seats firmly against shoulder in carrier assembly, using remover and replacer 5120-795-0159.

(c) Turn carrier assembly over, with the outer bearing cover opening up. Support hypoid drive gear (A) with suitable sleeve or adapter. Slide bearing spacer (D) over keyway end of helical drive pinion (E). Install key (T) in keyway in pinion shaft, and coat this end of shaft with white lead pigment. Insert helical drive pinion (E) through outer bearing cage opening in carrier assembly. Aline key with keyway in hypoid drive gear, and press pinion into gear. Position inner bearing (C) in bearing sleeve (B).

(d) Press outer bearing cup (H) in outer bearing cage (G). Place outer bearing cones (J and K) in outer bearing cage with large diameters together. Press remaining outer bearing cup (L) into outer bearing cage.

(e) Place original outer bearing cage shims (F), which control gear backlash and which were tied to outer bearing cage at time of disassembly, in position over studs. Be sure oil passage in shims is toward top of carrier assembly and alined with oil recess on inside of carrier. Place outer bearing cage assembly over end of helical drive pinion (E). Aline oil recess in bearing cage with oil recess in carrier mentioned above, and press bearing cage onto pinion shaft and into carrier.

(f) Position original outer bearing cover shims (N), which control outer bearcone preload, and which were tied to outer bearing cover (P) at time of disassembly over studs (M, fig. 361), next to outer bearing cage (G). Be sure oil passage in shims is alined with oil hole in top of outer bearing cage. Place outer bearing cover (P) in position over studs with oil passage alined with oil hole in cage and shims. Install lockwashers (R) and nuts (Q) and tighten firmly.

(g) Using bearing preload tester 6670-347-5922 check bearing preload reading as shown in figure 363. For new bearings, cups, and cones, the correct preload should be 12- to 18-inch-pounds maximum. When the original or used bearings are being assembled, the bearing preload should be 4- to 8-inch pounds maximum. If correct preload is not obtained at first trial, remove shims (N) to increase bearing preload or add shims to decrease bearing preload. When specified bearing preload is obtained, make sure nuts (Q) are tight.

(h) Place new differential carrier side cover gasket (E, fig. 361) and differential carrier side cover (D, fig. 361) in position on differential carrier (F, fig. 361). Install lockwashers (A, fig. 361) and cap screws (B, fig. 361) to secure cover to carrier. Tighten cap screws securely. Install air vent (C, fig. 361) in cover.

(i) Position the hypoid pinion and through shaft assembly; then adjust the location of hypoid drive gear to obtain correct tooth contact. Refer to figures 368 and 369 for correct procedure. Coat two or three teeth of the hypoid pinion with Prussian blue. Turn the hypoid pinion by hand and check the hypoid drive gear for tooth contact pattern.

(j) Position front bearing cage gasket (L, fig. 362) against front bearing cage (M). Aline gasket to avoid obstructing oil passages. Place front bearing cage cover (D) and oil seal (E) over gasket. Install the cap screws (FF) and lockwashers (EE) to secure cover assembly and tighten screws.

(k) Install rear cover gasket (W) and rear bearing cover (X) on carrier assembly and tighten cap screws.

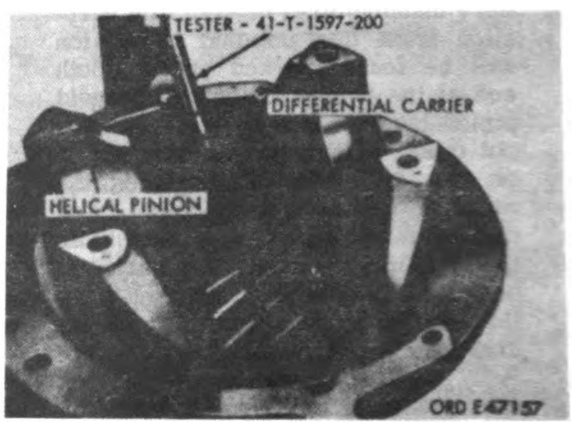


Figure 367. Checking helical pinion bearing preload

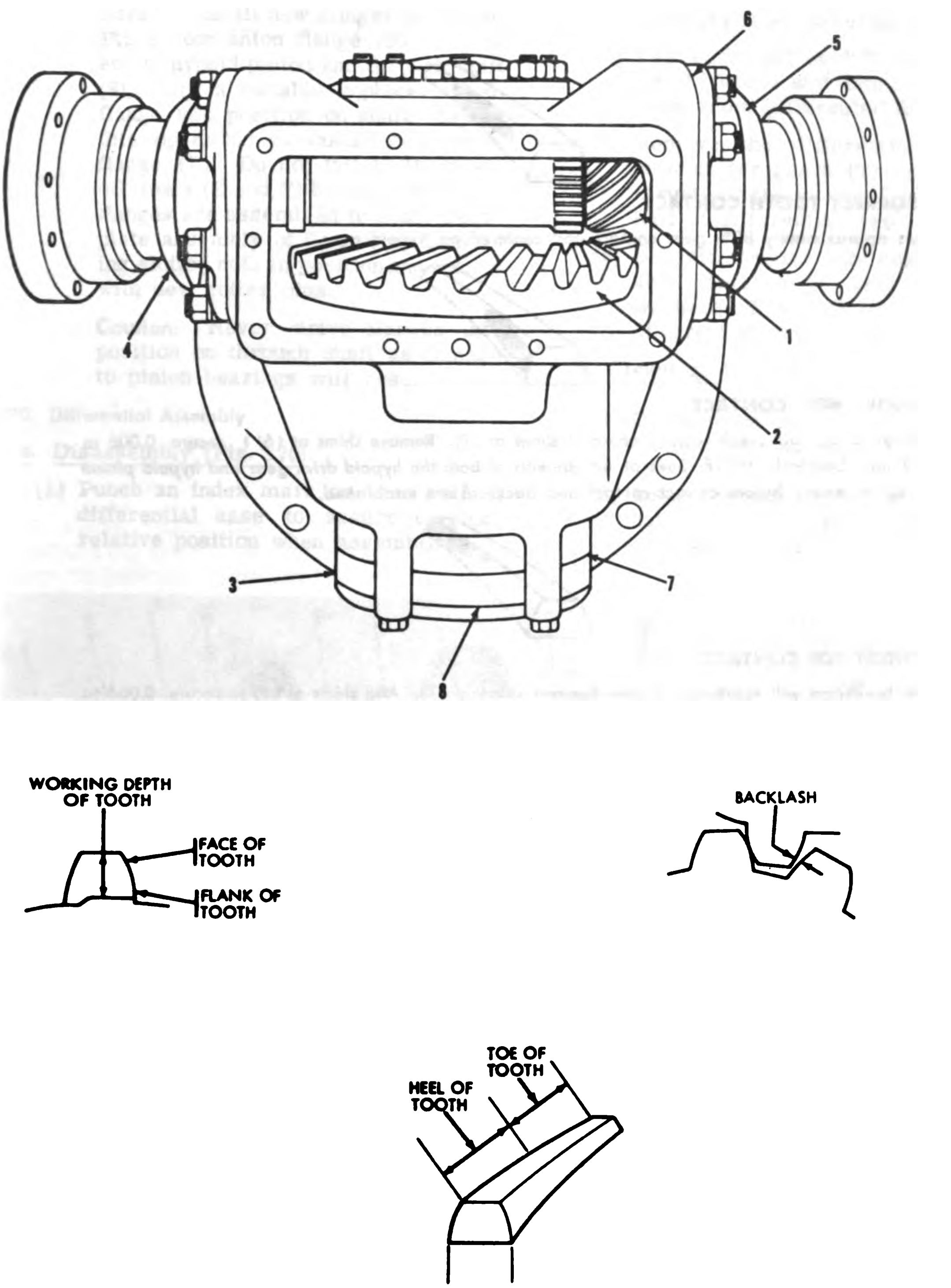
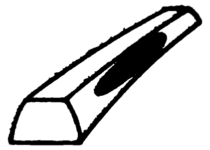
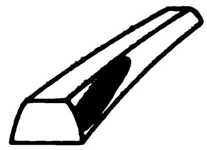


Figure 368. Hypoid gear and pinion tooth contact



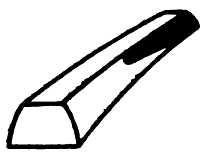
A—CORRECT TOOTH CONTACT

Shows approximately 80% gear contact and centered on hypoid gear.



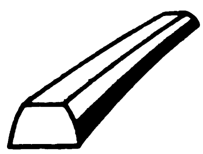
B—SHORT HEEL CONTACT

Tooth breakage will result—correction—add shims at (7). Remove shims at (6) to secure 0.006 to 0.012 inch backlash. NOTE: *Several adjustments of both the hypoid drive gear and hypoid pinion may be necessary before correct contact and backlash are established.*



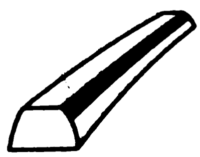
C—SHORT TOE CONTACT

Tooth breakage will result—correction—Remove shims at (7). Add shims at (6) to secure 0.006 to 0.012 backlash. NOTE: *Several adjustments of both the hypoid drive gear and hypoid pinion may be necessary before correct contact and backlash are established.*



D—LOW NARROW TOOTH CONTACT

Gears will be noisy—correction—Remove shims at (6). Add shims at (7) to secure 0.006 to 0.012 inch backlash. NOTE: *Several adjustments of both the hypoid drive gear and hypoid pinion may be necessary before correct contact and backlash are established.*



E—HIGH NARROW TOOTH CONTACT

Gears will be noisy—correction—Add shims at (6). Remove shims at (7) to secure 0.006 to 0.012 inch backlash. NOTE: *Several adjustments of both the hypoid drive gear and hypoid pinion may be necessary before correct contact and backlash are established.*

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Figure 369. Hypoid gear and pinion tooth contact adjustment

(1) If companion flange dust slinger (C) has been removed from companion flanges, install new slinger on flange. Place companion flange (B) on front end of hypoid pinion and through shaft (S), using a suitable replacer. Push flange into position on shaft. Repeat this operation to install companion flange (Z). Do not fail to lubricate oil seals (E and Y) before companion flanges are assembled to shaft. Complete assembly of flanges by installing slotted nuts in position and secure with new cotter pins.

Caution: Never drive flanges into position on through shaft as damage to pinion bearings will result.

270. Differential Assembly

a. Disassembly (Fig. 370).

(1) Punch an index mark on each half of differential case to assure original relative position when assembling.

(2) Remove the cotter pin (Q) from slotted nuts (P). Remove slotted nuts (P) and bolts (V) from differential case.

(3) Tap each half of differential case (D and K) with a soft hammer to separate them from differential drive gear (U).

(4) Remove the differential spider (G) with spider gears (T) and spider gear thrust washers (R) from whichever half of differential case remains.

(5) Lift differential side gears (F and H) and differential side gear thrust washers (E and J) from each half of differential cases (D and K).

b. Cleaning, Inspection and Repair.

(1) Clean all parts in dry-cleaning solvent or mineral spirits paint thinner.

(2) Inspection and repair. Replace a helical drive gear that is chipped, broken, or visibly worn. Replace all four spi-

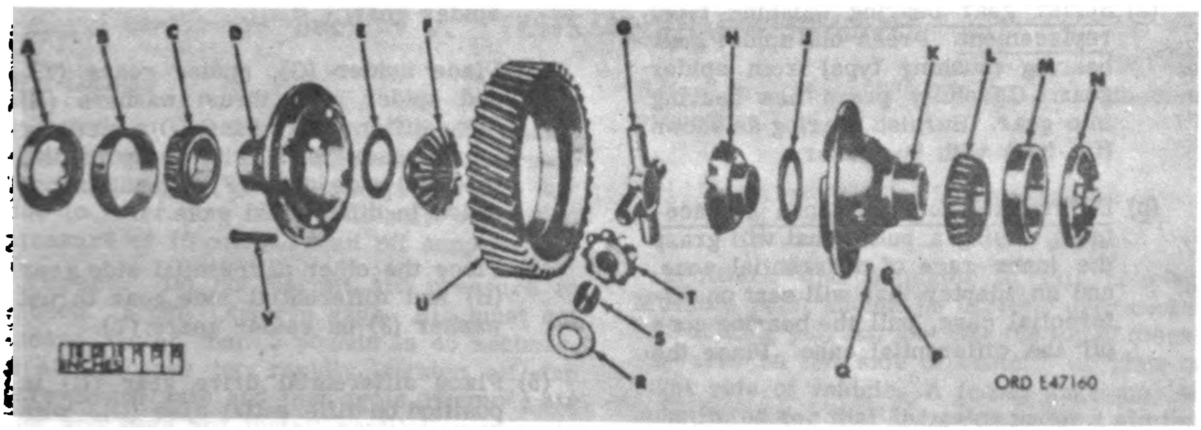


Figure 370. Differential assembly - exploded view

Key	Item	Key	Item
A	Differential bearing adjusting ring	L	Differential bearing cone
B	Differential bearing cup	M	Differential bearing cup
C	Differential bearing cone	N	Differential bearing adjusting ring
D	Differential case	P	Slotted nut
E	Differential side gear thrust washer	Q	Cotter pin
F	Differential side gear	R	Spider gear thrust washer
G	Spider	S	Spider gear bearing
H	Differential side gear	T	Spider gear
J	Differential side gear thrust washer	U	Differential drive gear
K	Differential case	V	Bolt

Figure 370. Differential assembly - exploded view - legend

der gear thrust washers if any are worn or scored. Replace both differential side gear thrust washers if either is worn or scored. Position the spider gears on the spider. If any looseness is noted between spider and gears, replace the spider gear bearings and/or spider. Position the spider in the differential case. If any radial movement is noted, replace spider and/or case, whichever is at fault. Replace a differential case if scored. Replace both differential side gears if either gear is visibly worn, broken or chipped. Replace differential bearing cones if any of the rollers are missing, pitted, corroded, or discolored due to overheating. Replace differential bearings cups that are cracked, pitted, corroded, or discolored due to overheating. Replace a differential bearing adjusting ring if the threads are stripped, or if the rings are broken or damaged.

(a) Spider gear bearing (bushing type) replacement. Press old spider gear bearing (bushing type) from spider gear. Carefully press new bearing into gear. Burnish bearing as shown (fig. 371) with burnisher.

(b) Differential bearing cone replacement. Using a puller that will grasp the inner race of differential cone, and an adapter that will seat on differential case, pull the bearing cone off the differential case. Place the differential case in a press. Press the bearing cone onto the differential case, making sure all pressure is exerted on inner race of bearing cone.

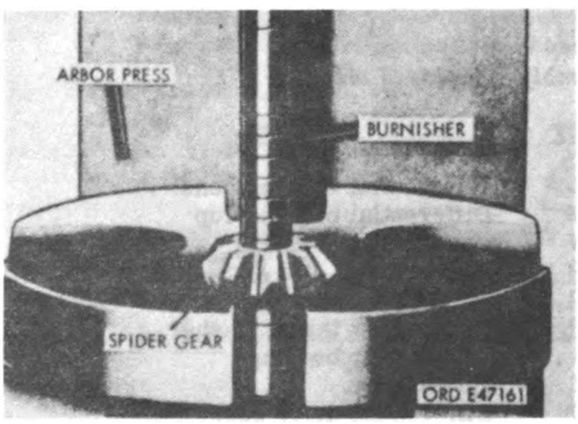


Figure 371. Burnishing differential spider gear bearing

c. Assembly.

Note. The key letters noted in parentheses are in figure 370.

(1) Both halves of differential case (D and K) were marked for correct assembly at time of disassembly (par. 270a). Note that differential case mounting flange inside differential drive gear (U) is off center. Lay differential case (D) on bench with flange side up and place differential side gear thrust washer (E) and differential side gear (F) into differential case (D).

(2) Assemble the four spider gears (T) on spider (G) with a spider gear thrust washer (R) on top (or outside) of each spider gear.

(3) Place spider (G), spider gears (T), and spider gear thrust washers (R) into differential case (D), meshing spider gear teeth with those of differential side gear (F) already in position in differential case.

(4) Place the other differential side gear (H) and differential side gear thrust washer (J) on spider gears (T).

(5) Place differential drive gear (U) in position on differential case (D), with recess side of gear up, and aline bolt holes.

(6) Install differential case (K) on the differential drive gear (U), making sure index marks made at time of disassembly (par. 270a) are alined. Install the bolts (V) through differential case (D). Install and tighten slotted nuts (P). Install new cotter pins (Q) to secure each slotted nut.

(7) Lift differential assembly into differential carrier.

(8) Install differential bearing cups (B and M) on differential bearing cones (C and L). Use a short bar inserted

through differential side gear to lift differential assembly slightly while placing bearing cups in position. This will prevent injury to hands while performing this operation.

(9) Position differential carrier caps on differential carrier, according to index mark made at time of disassembly (par. 270a). Install a differential bearing cap bolt and tighten just enough to hold cap in place (fingertight). Install other carrier cap and bolt.

(10) Install differential bearing adjusting rings (A and N). After adjusting rings have been started, tighten the cap bolts just enough to hold bearing differential caps snugly, but still permit turning the adjusting rings. Use a wrench to tighten adjusting rings alternately until both rings are threaded into case and caps equally.

(11) Using dial indicator at side face of differential gear, adjust differential assembly to zero side play in differential bearings. Rotate assembly several revolutions to assure normal bearing contact. Check differential side play and again adjust to zero if necessary. If runout exceeds 0.008 inch, remove differential assembly and check cause of runout.

(12) Tighten adjusting rings one notch each after zero end play has been established to secure the correct bearing preload. Tighten the four differential bearing cap bolts. Install differential bearing adjusting ring locks and cap screws. Install locking wire in differential carrier cap bolts and cap screws to secure assembly in place.

(13) Refer to figure 361 as reference for installing differential carrier top cover gasket (G), top cover (H), lockwashers (J), and cap screw (K).

Section V. TESTS AND ADJUSTMENTS

271. Leakage

Install a suitable air pressure gage in ventilating valve hole in carrier case side cover. Using a suitable adapter attach air line to filler plug hole. Fill axle with air to pressure of 15 psi and shut off supply.

Caution: Do not permit air pressure to exceed 15 psi. Observe gage. Air must not escape faster than 5 pounds in 45 seconds. If air escapes too rapidly, tighten all cap screws and nuts and test again. Remove air line and gage and install ventilating valve in carrier side cover.

272. Lubricate Axle Assembly

If differential was not filled with type and quantity of lubricant as directed at time differential was assembled to housing, add the lubricant at this time. Remove square socket pipe plug and be sure universal joint housings are filled with recommended lubricant. Rotate the pinion shaft to make certain there is no binding in the gear train. Be sure wheel bearings were properly lubricated at time of installation.

273. Front Wheel Alinement

After front axle is installed on the truck, correct wheel alinement must be maintained. Refer to TM 9-2320-211-20 for alinement procedure.

274. Testing and Adjusting Steering Knuckle End Play

a. Attach dial indicator to axle housing. Movable point should be directly over center line of king pin, and touching the top of steering arm on left side of vehicle, or plate on right side of vehicle. A feeler gage may be substituted for dial indicator under a similar set-up.

b. Raise front axle from ground.

c. Reading on indicator should read between 0.005 and 0.013.

d. A lesser reading indicates top spacer is too thick.

e. If reading is over 0.013, top spacer is too thin. In either case, steering arm or plate must be removed and reassembled with new spacers of proper thickness to obtain required clearance. Upper end lower steering plates must be properly torqued prior to checking clearance.

Section VI. SERVICEABILITY STANDARDS

275. General

The serviceability standards included herein give the minimum, maximum, and key clearances of new or repaired parts. All measurements are given 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).

276. Serviceability Standards

Serviceability standards for the front axle assembly are in table XV below.

Table XV. Serviceability Standards - Front Axle Assembly

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts
		STEERING KNUCKLE	
372	C	Inside diameter of steering knuckle bushing	1.500 to 1.501
372	D	Steering knuckle pin	1.4985 to 1.4990
372	C-D	Clearance of steering knuckle pin in bushing	0.001 to 0.0025
		FRONT AXLE SPINDLE	
372	A	Front spindle bushing	2.249 to 2.251
372	B	Outer drive shaft	2.234 to 2.231
372	A-B	Clearance of outer drive shaft in bushing	0.015 to 0.020
		DIFFERENTIAL CASE AND GEARS	
375	C	Differential spider	1.123 to 1.122
375	D	Differential spider pinion bushing	1.127 to 1.129
375	D-C	Clearance of differential spider to bushing	0.004 to 0.007
		BACKLASH	
374 375	E	Helical drive gear to helical drive pinion	0.007 to 0.014
		BEARINGS	
374	D to A	Inner helical drive pinion bearing to hypoid drive gear	0.006T to 0.0011L
374	C to B	Inner helical drive pinion bearing to bearing sleeve	0.0020L to 0.0042L
374	G to F	Outer helical pinion bearing cone to helical drive pinion	0.000 to 0.0015T
373	A to C	Outer hypoid drive pinion bearing cone to hypoid drive pinion	0.0002L to 0.0022L
373	B to D	Inner hypoid drive pinion bearing cone to hypoid drive pinion	0.0010T to 0.0025T
373	E to F	Hypoid pinion shaft rear bearing to hypoid drive pinion shaft	0.0006T to 0.0013T
373	G	Hypoid pinion shaft rear bearing to carrier	0.0005L to 0.0007T
375	A to B	Differential bearing cone to differential case	0.0015T to 0.0035T

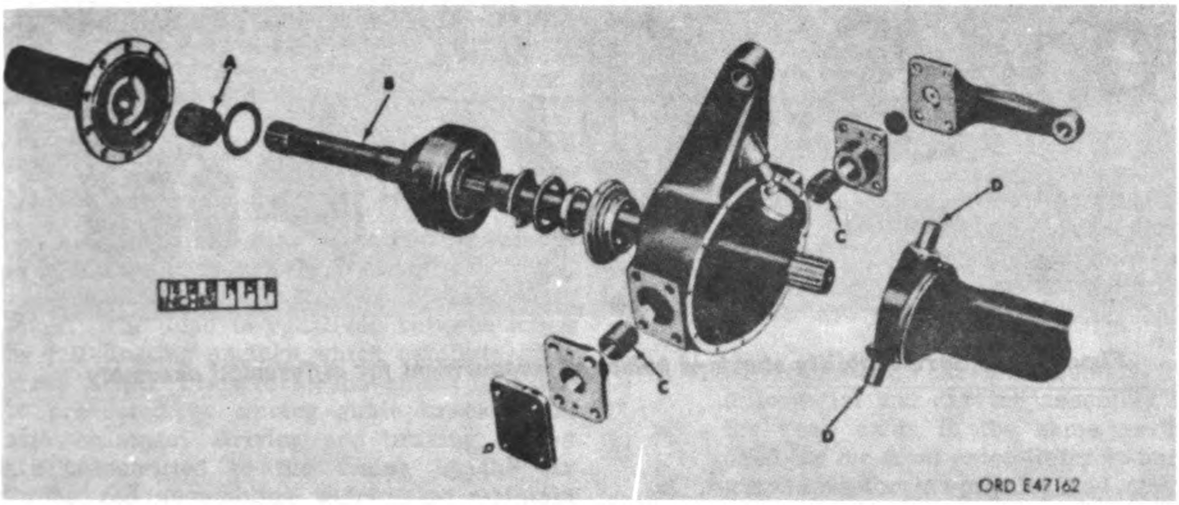


Figure 372. Serviceability standard points of measurement for steering knuckle

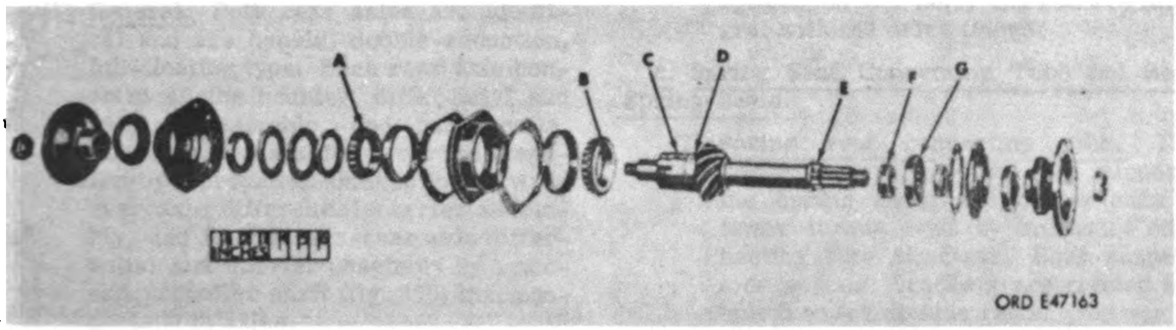


Figure 373. Serviceability standard points of measurement for pinion shaft assembly

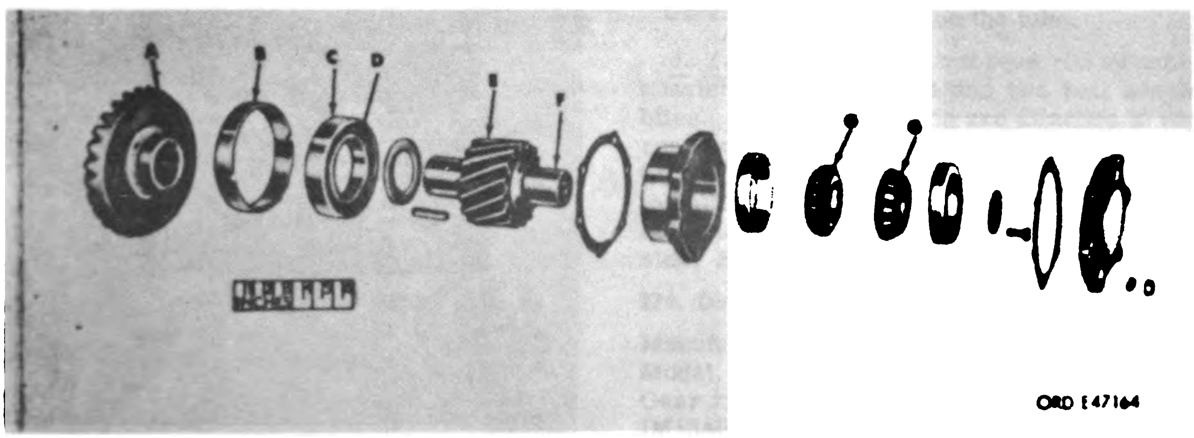


Figure 374. Serviceability standard points of measurement for helical shaft assembly

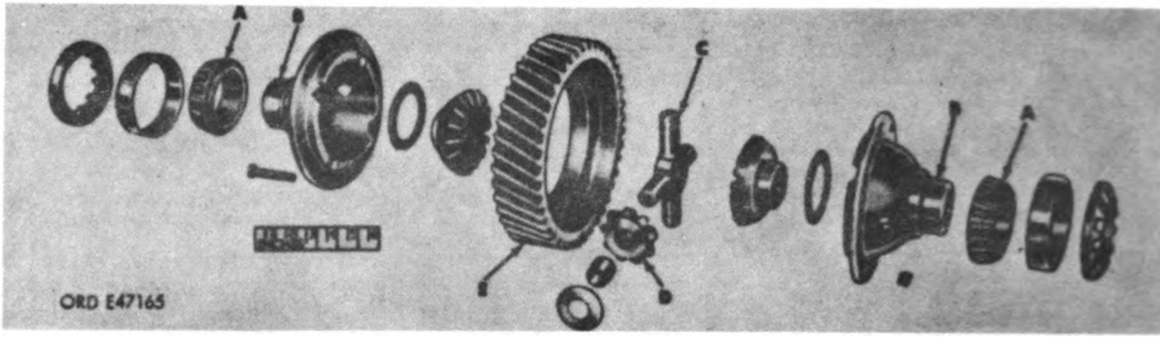


Figure 375. Serviceability standard points of measurment for differential assembly

CHAPTER 21

REAR SUSPENSION

Section I. DESCRIPTION AND DATA

277. Description

a. General. The rear suspension assembly is a tandem hookup using six identical torque rod assemblies (fig. 376), two upper and four lower. The load is equalized between axles by full-floating springs which oscillate on a cross shaft. Transverse movement of axles is prevented by spring guide brackets on axle housings. Driving and braking forces are transmitted to the frame by the six torque rod assemblies which also maintain correct vertical position of axles and prevent weight transfer between axles.

b. Rear Axles.

(1) General. Both rear axles are identical and are hypoid, double-reduction, full-floating type. Each rear axle consists of the housing, differential and carrier assembly, and axle shafts. Power is transmitted from the transfer by a propeller shaft to the forward rear axle differential carrier assembly, and to the rear-rear axle differential and carrier assembly by a second propeller shaft (fig. 376) that connects both axles.

(2) Housing assembly. The rear axle housing assembly is one-piece construction with a center opening for mounting the differential and carrier assembly. The forged steel outer ends are welded in position; brake backing plates are riveted to the outer ends.

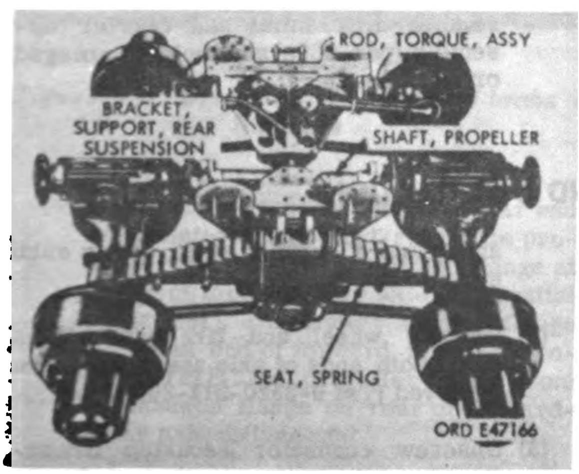


Figure 376. Rear suspension assembly

(3) Differential and carrier assembly. The differential and carrier assembly for the rear axles is the same as that used for the front axle. Refer to paragraph 259h for description and operation.

(4) Rear axle shafts. The axle shafts are all of equal length. They have 16 splines on the inner end and are integral with the drive flange.

c. Spring Seat Connecting Tube and Rear Spring Seats.

(1) Spring seat connecting tube. The spring seat connecting tube supports the spring seats and center ends of lower torque rods by means of connecting tube brackets. Rear suspension support brackets are riveted and bolted to frame side rails.

(2) Spring seats. Spring seats are mounted on the outer ends of spring seat connecting tube. Spring seats hold springs securely at the center section and oscillate freely on the tube.

d. Torque Rods. Each torque rod assembly consists of torque rod and two ball assemblies. Three torque rods are attached to each rear axle, and transmit driving and braking forces to frame. Upper and lower rods are installed on the right side of the rear suspension assembly, and lower rods only on left side. All torque rods are identical.

278. Data

Manufacturer	Timken-Detroit
Model	M-240-C-3
Gear ratio (M134C and M139D)	6.443 to 1
(M134C and M139D)	10.26 to 1
Lubricant capacity	12 qt
Spring centers	39-3/4 in.
Type	double-reduction, hypoid, full-floating

Section II. TROUBLESHOOTING

279. Axle Differential and Carrier Assemblies

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the vehicle prior to completing the procedures given in this paragraph.

(2) Inspect for lubricant leaks. Visually inspect gasket joints and oil seals for evidence of lubricant leakage. Leakage at gasket joints may be caused by loose cap screws or a defective gasket. Tighten all cap screws. If leakage still continues, replace gasket, preferably without removing the component from the vehicle.

(3) Inspect for damaged bearings or gears. Raise one wheel of axle and rotate forward and reverse. Inspect for excessive play or backlash in gears. Pay particular attention to hypoid pinion drive shaft for excessive wear. Note any irregularities during the inspection.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in the preceding paragraph do not reveal causes of failure and the vehicle is operable, then troubleshoot it.

(2) Gear backlash. Start vehicle slowly in forward motion and depress and release accelerator alternately. If backlash is present, a distinct clash will be audible at differential as torque is relieved and applied. Refer to paragraph 289c for differential and carrier assembly repair.

(3) Damaged or worn bearings. Start vehicle slowly in forward motion and note any unusual axle noises. A constant rumble or chatter of the differential is, in all probability, due to worn or damaged bearings.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the component has been removed from the truck or if it has been received already removed, further inspection is necessary. If the differential alone has been received for a preliminary check before being installed in the vehicle or if the operation has not been satisfactory due to unknown causes, then test it as described below.

(2) Inpsection. Visually inspect the differential and carrier assembly for lubricant leakage and cracks or damaged case or covers.

(3) Gear teeth worn. Disassemble differential and carrier assembly (par. 289c) and replace worn gears.

(4) Damaged or worn bearings. Disassemble differential and carrier assembly (par. 289c) and replace damaged or worn bearings.

Section III. REMOVAL AND INSTALLATION

280. Wheels and Tires

Refer to TM 9-2320-211-20.

281. Rear Axle Assembly

a. Removal (Forward Rear Axle).

(1) Place truck on a level surface and block front wheels to prevent truck from rolling. Raise rear end of truck and place a support stand under each spring seat (fig. 377).

(2) Remove wheel and tire assemblies from both ends of axle assembly to be removed (TM 9-2320-211-20).

(3) Unscrew connector securing brakeline hose to tee connection at frame rear suspension cross member, and remove line from tee (fig. 378). Re-

move brake line hose clamps from upper torque rod, and remove hose from rod.

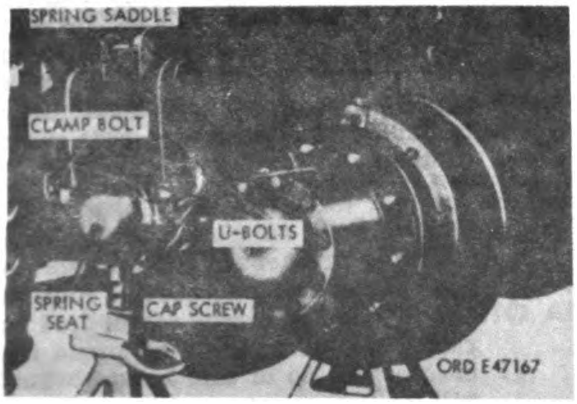


Figure 377. Rear suspension assembly raised for axle removal

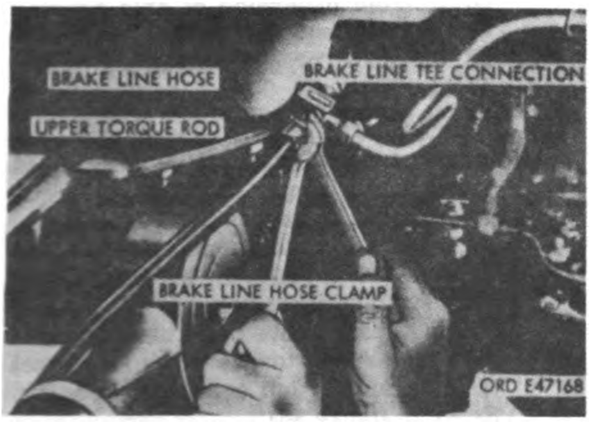


Figure 378. Disconnecting hydraulic brake line hose

(4) Disconnect adapter flange on rear end of transfer-to-forward-rear-axle propeller shaft from companion flange at front of forward-rear axle differential (par. 261). Disconnect adapter flange on front end of forward-rear-axle-to-rear-rear-axle propeller shaft from companion flange on rear of forward-rear axle differential.

(5) Remove four nuts and lockwashers from four bolts securing upper torque rod bracket (fig. 379) and clamping plate to right end of axle housing. Remove the clamping plate from underside of axle housing. Remove the two front bolts and the right rear bolt from the torque rod bracket.

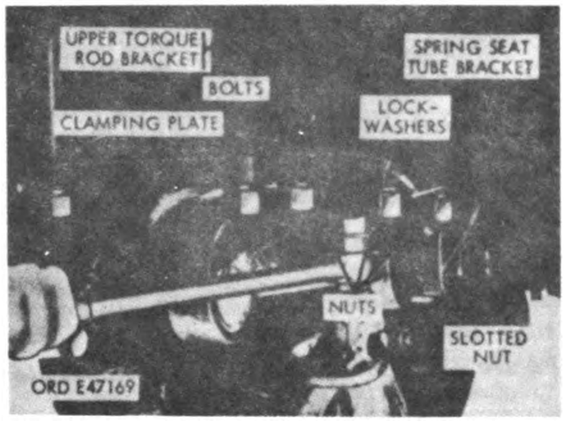


Figure 379. Disconnecting upper torque rod

(6) Remove brake-line tee from mounting bracket. Raise upper torque rod clear of axle, and support in raised position with a short bar placed between frame side rails. Wire brake-line tee mounting bracket and left rear torque-rod bracket bolt to upper torque rod (refer to fig. 380).

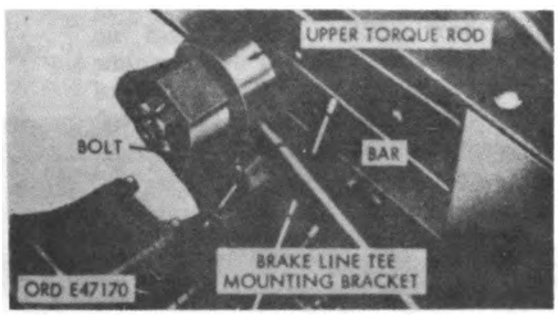


Figure 380. Upper torque rod positioned for forward - rear axle removal

(7) Remove cotter pin and slotted nut securing front end of lower torque rod to bracket at underside of right end of axle housing. Rap bracket sharply to loosen tapered stud in torque rod bracket and, using a bar, pry torque

rod from bracket. Repeat above operation to remove left torque rod from bracket on underside of left end of axle housing. Refer to figure 381.

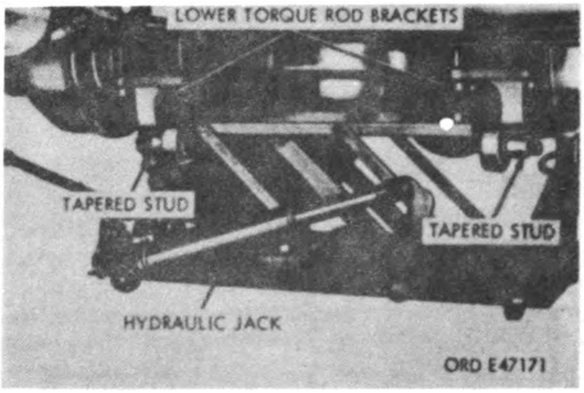


Figure 381. Lower torque rods disconnected

(8) Position hydraulic jack with axle fixture under the forward rear axle. Raise axle on hydraulic jack enough to release front ends of rear springs in spring guide brackets, and roll axle on hydraulic jack toward front of truck.

(9) Lower hydraulic jack sufficiently to allow removal of axle from under truck. Pull jack with axle assembly sideways and out from under side of truck. Refer to figure 382.

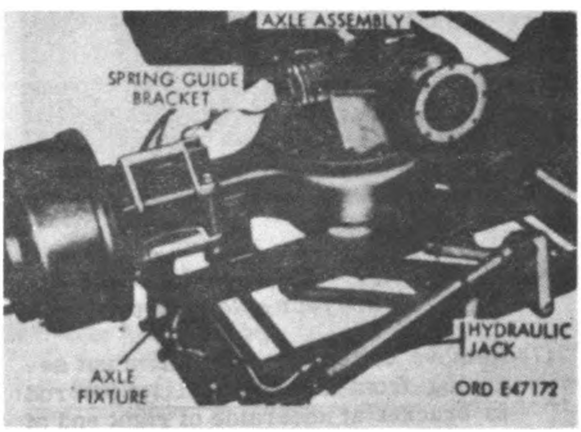


Figure 382. Removing forward - rear axle assembly

b. Installation (Forward Rear Axle).

(1) With forward rear axle supported by hydraulic jack in lowered position, push jack and axle assembly under side of truck. Raise axle on jack until front ends of rear springs are alined with spring guide brackets on top of axle housing. Push axle toward rear of truck so that spring ends enter guide brackets.

(2) Remove wire securing brake-line tee mounting bracket and left-rear-torque rod bracket bolt to torque rod. Remove bar securing upper torque rod in raised position. Position torque rod bracket on top of axle housing. This will secure axle in position and permit removal of hydraulic jack. Lower hydraulic jack and remove from under truck. Install the two front bolts and the right rear bolt in torque-rod bracket holes. Install clamping plate on bolts from underside of axle housing and install four lockwashers and nuts on the four bracket mounting bolts. Tighten nuts.

(3) Insert tapered stud at front end of lower right torque rod through torque rod bracket on underside of axle housing. Install slotted nut on stud and tighten nut to 350 to 400 pound-feet torque. Install cotter pin in end of stud. Repeat above operations to connect lower left torque rod to bracket on underside of left end of axle housing. Refer to figure 381.

(4) Connect adapter flange on rear end of transfer to-forward-rear-axle propeller shaft to companion flange at front of forward-rear axle differential (par. 262). Connect adapter flange of front end of forward-rear-axle-to-rear rear-rear-axle propeller shaft to companion flange on rear of forward-rear axle differential.

(5) Position brake line at tee connection on frame rear suspension cross member and tighten connector. Position braks hose on upper torque rod and install two clamps. Refer to figure 378.

(6) Bleed rear wheel brakes. Refer to TM 9-2320-211-20.

(7) Install wheel and tire assemblies. Refer to TM 9-2320-211-20.

(8) Lubricate axle assembly and propeller shaft universal joints. Refer to LO 9-2320-211-20.

(9) Raise rear end of truck, remove support stand under each spring seat, and lower rear end of truck.

Note. Procedures for removal and installation of the rear-rear axle assembly are the same as those for the forward-rear axle assembly.

282. Torque Rods

Refer to TM 9-2320-211-20.

283. Springs

Refer to TM 9-2320-211-20.

284. Spring Seats

Refer to TM 9-2320-211-20.

Section IV. DISASSEMBLY INTO AND ASSEMBLY FROM SUBASSEMBLIES

285. Wheels and Tires

Refer to TM 9-2320-211-20.

286. Rear Axle Assembly

a. Hub and Drum Assembly and Brake Components. Refer to TM 9-2320-211-20.

b. Torque Rod and Spring Guide Brackets. Refer to TM 9-2320-211-20.

c. Carrier and Differential Assembly.

(1) Removal.

(a) Drain lubricant.

(b) Remove 18 nuts and lockwashers holding differential and carrier assembly to axle housing assembly. Remove four axle to differential split dowels and withdraw assembly from housing. Remove and discard gasket.

(2) Installation.

(a) Install new gasket.

(b) Position assembly in housing and install six axle to differential split dowels. Install 18 nuts and lockwashers to secure carrier assembly to axle.

(c) Fill to proper level with lubricant (LO 9-2320-211-20).

Note. The differential and carrier assembly on the M139C and M139D contains a gear ratio different from that of the other vehicles. When a gear set is required for the differential on the M139C or M139D, requisition the 10:26 to 1 ratio gears. When in need of a housing the complete standard housing assembly used on the M139 will be issued. The axle gears with the 10:26 to 1 ratio gears on the existing M139D front axle which house the strut assembly and brackets will have to be removed from the old housing and installed on the new one.

287. Springs

No disassembly is required.

Section V. REPAIR

288. Wheels and Tires

Refer to SM 9-1-2600.

289. Rear Axle

a. Hub and Drum Assembly and Brake Components. The hub and drum assembly and brake components require replacement if damaged. Refer to TM 9-2320-211-20.

b. Torque Rod and Spring Guide Brackets. The torque rod and spring guide brackets also require replacement if damaged.

c. Carrier and Differential Assembly.

(1) Disassembly (fig. 383).

(a) Install differential and carrier assembly in suitable stand or holding

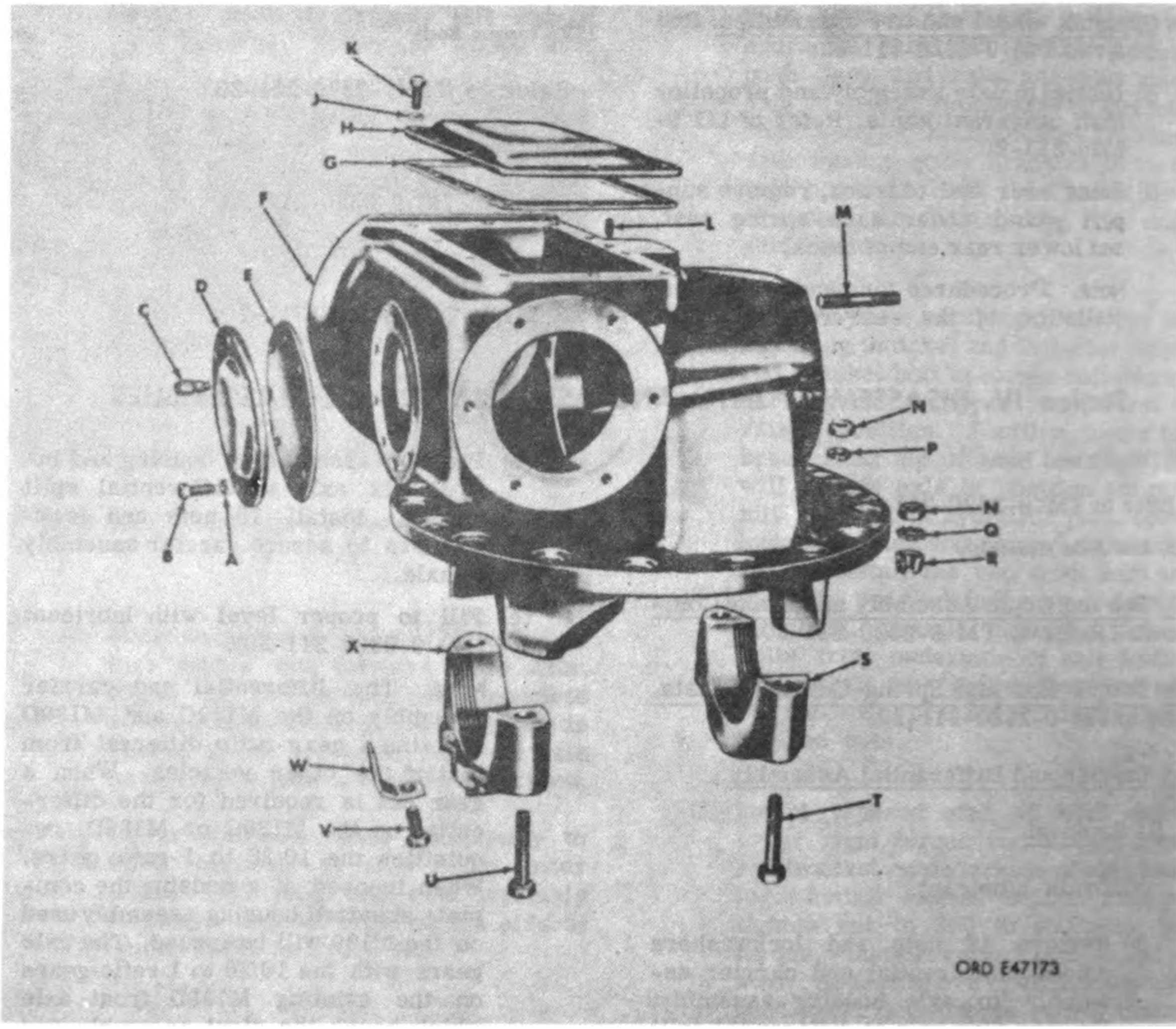


Figure 383. Carrier assembly - exploded view

Key	Item	Key	Item
A	Washer, lock	M	Stud
B	Screw, cap	N	Nut, hex
C	Vent, air, assembly	P	Washer, lock
D	Cover, side, carrier	Q	Washer, lock, ext-teeth
E	Gasket, carrier side cover	R	Dowel, split
F	Carrier, assembly	S	Cap, carrier
G	Gasket, carrier top cover	T	Bolt
H	Cover, top carrier	U	Bolt
J	Washer, lock	V	Screw, cap
K	Screw, cap	W	Lock, differential bearing adjusting nut
L	Screw, set	X	Cap carrier

Figure 383. Carrier assembly - exploded view - legend

fixture to prevent injury and to facilitate the disassembly and assembly operations.

(b) Remove locking wire. Remove four bolts (T and U), from carrier caps (S and X) and two cap screws (V) from differential bearing adjusting nut locks (W). Caps and carrier assembly must be punch marked to ensure installation in their original position. Lift caps from carrier assembly. Remove differential bearing adjusting nuts (refer to A and N, fig. 384).

(c) Using a short bar, lift each side of case assembly slightly and remove differential bearing cups (refer to (B and M, fig. 384). This will permit removal of assembly without interference. Lift differential case assembly from carrier.

(d) Remove differential case halves (D and K) and helical drive gear (T) from carrier assembly (refer to F, fig. 383). Mark differential case halves to ensure assembly in original relative positions. Remove locking wire from eight hex bolts (U) holding ring gear to case. Remove bolts and slotted nuts (P) and remove helical drive gear (T). Refer to figure 384.

(e) To disassemble differential case, remove two differential side gears (F and H), two side gear thrust washers (E and J), four spider pinion assemblies (Q), four spider pinion thrust washers (S), and differential spider (G) (refer to fig. 384).

(f) Use adapter 5120-795-0112 and universal puller to remove differential bearing cones from differential case halves.

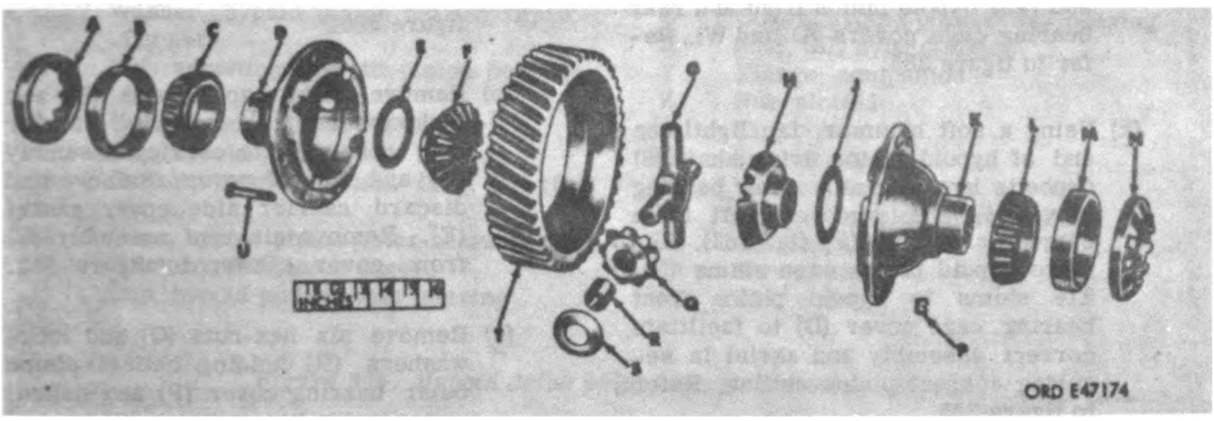


Figure 384. Differential case and helical drive gear assembly - exploded view

Key	Item	Key	Item
A	Nut, adjusting, differential bearing	L	Cone, differential bearing
B	Cup, differential bearing	M	Cup, differential bearing
C	Cone, differential bearing	N	Nut, adjusting, differential bearing
D	Case, differential (half)	P	Nut, slotted
E	Washer, thrust, side gear	Q	Pinion, spider, assembly
F	Gear, side, differential	R	Bearing, bushing type
G	Spider, differential	S	Washer, thrust, spider pinion
H	Gear, side, differential	T	Gear, drive, helical
J	Washer, thrust, side gear	U	Bolt, hex
K	Case, differential (half)		

Figure 384. Differential case and helical drive gear assembly - exploded view - legend

(g) Remove cotter pins (AA and GG) and slotted nuts (A and Z), from each end of the hypoid pinion drive shaft (S). Pull companion flanges (B and Y) from pinion drive shaft splines, using universal puller. Refer to figure 385.

(h) Remove eight cap screws (FF) and lockwashers (EE), from hypoid pinion front bearing cage cover (D), and remove cover assembly and hypoid pinion outer bearing gasket. Refer to figure 385.

(i) Remove eight cap screws (BB) and lockwashers (CC) from hypoid pinion rear bearing cover (W), and remove cover assembly and hypoid pinion rear bearing gasket (V). Refer to figure 385.

(j) Using a punch, drive the hypoid pinion oil seals (E and X) from front and rear hypoid pinion front and rear bearing cage covers (D and W). Refer to figure 385.

(k) Using a soft hammer, tap lightly on end of hypoid pinion drive shaft (S) opposite hypoid pinion outer bearing cage (M) and remove shaft from carrier assembly (F, fig. 383). Remove hypoid pinion cage shims (N). Tie shims to hypoid pinion front bearing cage cover (D) to facilitate correct assembly and assist in securing correct pinion setting. Refer to figure 385.

(l) Using remover and replacer 5120-795-0079, drive rear hypoid pinion bearing (T) from carrier. Remove hypoid pinion bearing inner race from hypoid pinion drive shaft (S). Refer to figure 385.

(m) Place hypoid pinion drive shaft (S) in vise (equipped with soft jaws) and remove outer hypoid-bearing adjusting nut (F), hypoid pinion bearing adjusting nut washer (G), and inner hypoid pinion-bearing adjusting nut (H). Using a soft hammer, tap lightly on hypoid pinion outer bearing cage (M) to remove hypoid pinion outer bearing cone (J) from shaft and permit removal of bearing cage from shaft. Remove hypoid pinion bearing spacer (DD). Pull hypoid pinion inner bearing cone (Q) from shaft, using a suitable puller. Refer to figure 385.

(n) Using bearing remover and replacer 5120-795-0159, press hypoid pinion outer bearing cup (K) from hypoid pinion outer bearing cage (M). Use a small punch to dislodge hypoid pinion inner bearing cup (P) from its seat in cage. This will permit full contact between bearing cup and the shoulders on bearing remover. Complete disassembly of pinion bearing cage by pressing inner cup from cage with remover. Refer to figure 385.

(o) Support hypoid drive pinion (R) firmly on arbor press and press hypoid pinion drive shaft (S) from pinion. Remove key from shaft. Refer to figure 385.

(p) Remove eight cap screws (B) and lockwashers (A) securing carrier side cover (D) to carrier assembly (F) and lift off cover. Remove and discard carrier side cover gasket (E). Remove air vent assembly (C) from cover. Refer to figure 383.

(q) Remove six hex-nuts (Q) and lockwashers (R) holding helical pinion outer bearing cover (P) and helical pinion outer bearing cage (G) to carrier assembly. Remove cover and helical pinion cage shims (N). Tie shims to cover. Refer to figure 386.

(r) Remove locking wire from the three hex-head screws (S) holding bearing assembly lock to end of helical drive pinion (E). Remove cap screws and bearing retaining washer (M). Using suitable puller or two puller screws in threaded holes of helical pinion outer bearing cage (G), pull bearing off helical drive pinion and cage out of carrier assembly. Remove helical pinion cage shims (F) and tie to bearing cage to facilitate correct assembly and aid in securing desired

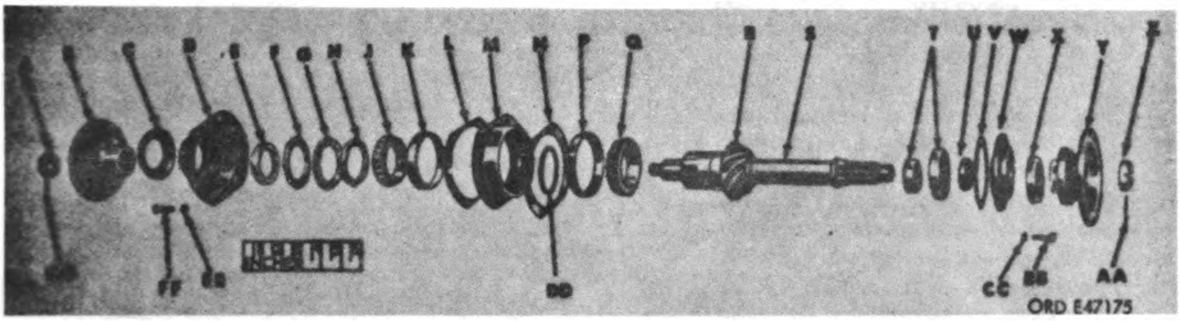


Figure 385. Hypoid drive pinion - exploded view

Key	Item	Key	Item
A	Nut, slotted	Q	Cone, hypoid pinion inner bearing
B	Flange, companion	R	Pinion, drive hypoid
C	Slinger, dust	S	Shaft, drive, hypoid pinion
D	Cover, hypoid pinion front bearing cage	T	Bearing, hypoid pinion, rear
E	Seal, oil, hypoid pinion	U	Spacer, hypoid pinion rear bearing
F	Nut, adjusting, hypoid pinion bearing, outer	V	Gasket, hypoid pinion rear bearing cover
G	Washer, hypoid pinion bearing adjusting nut	W	Cover, hypoid pinion rear bearing
		X	Seal, oil, hypoid pinion
H	Nut, adjusting, hypoid pinion bearing, inner	Y	Flange, companion
		Z	Nut, slotted
J	Cone, hypoid pinion outer bearing	AA	Pin, cotter
K	Cup, hypoid pinion outer bearing	BB	Screw, cap
L	Gasket, hypoid pinion front bearing cage	CC	Washer, lock
		DD	Spacer, hypoid pinion bearing
M	Cage, hypoid pinion outer bearing	EE	Washer, lock
N	Shim, hypoid pinion cage	FF	Screw, cap
P	Cup, hypoid pinion inner bearing	GG	Pin, cotter

Figure 385. Hypoid drive pinion - exploded view - legend

tooth contact between hypoid drive pinion (R, fig. 385) and hypoid drive gear (A). Refer to figure 386.

(s) Using adapter 5120-795-0112, press helical pinion outer bearing cups (H and L) and cones (J and K) from helical pinion outer bearing cage (G). Refer to figure 386.

(t) Position differential carrier assembly on press, inspection hole up. Place two soft iron spacers between rear face of hypoid drive gear (fig. 387) and case. Using a suitable adapter, press helical drive pinion from hypoid drive gear.

(u) Remove key (T) and helical pinion bearing spacer (D) from helical drive pinion (E). Refer to figure 386.

(v) Remove hypoid drive gear (A, fig. 386) from carrier assembly by applying a short pry bar between rear face of gear and carrier alternately on opposite sides of drive gear. Use suitable puller equipment to remove inner helical pinion bearing (C) from hypoid drive gear (A).

(w) Remove setscrew (L, fig. 383) from carrier top cover surface. Using a long punch or drift, place end of

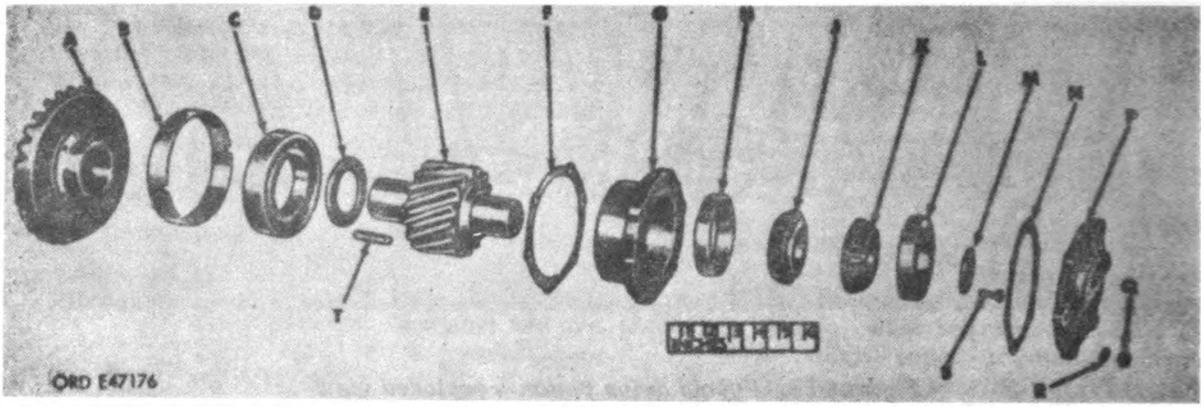


Figure 386. Helical drive pinion - exploded view

Key	Item	Key	Item
A	Gear, drive, hypoid	K	Cone, helical pinion outer bearing
B	Sleeve, helical pinion bearing	L	Cup, helical, pinion outer bearing
C	Bearing, helical pinion, inner	M	Washer, retaining, bearing
D	Spacer, helical pinion bearing	N	Shim, helical pinion cage
E	Pinion, drive, helical	P	Cover, helical pinion outer bearing
F	Shim, helical pinion cage	Q	Nut, hex
G	Cage, helical pinion outer bearing	R	Washer, lock
H	Cup, helical pinion outer bearing	S	Screw, hex-head
J	Cone, helical pinion outer bearing	T	Key

Figure 386. Helical drive pinion - exploded view - legend

punch in recess or notch provided in opposite sides of helical pinion bearing sleeve (B, fig. 386). Drive bearing sleeve from carrier. Do not permit bearing sleeve to become cocked in carrier case, as damage to case will result. Avoid difficulty in this operation by driving sleeve alternately at one recess and then the other. Drive sleeve only enough to secure sufficient clearance between sleeve and shoulder in carrier and then use bearing remover and replacer 5120-795-0159 to remove sleeve.

(2) Cleaning, inspection, and repair.

(a) Cleaning. Clean differential case and carrier assembly thoroughly with dry cleaning solvent or mineral spirits paint thinner, giving special attention to oil passages. Use a suitable scraper to remove portions of old gaskets and gasket cement from carrier. If available, steam may be used to advantage for removing accumulations of grease and dirt after solvent has been applied. Rinse all parts in solvent and blow dry with compressed air. If steam is not available, use a solution of one part grease cleaning compound to four parts of dry-cleaning solvent, mineral spirits paint thinner, or kerosene. After cleaning, use cold water to rinse off any solution which remains. Clean hypoid pinion driver shaft, helical drive pinion, and gears thoroughly with dry-cleaning solvent or mineral spirits paint thinner. Dry with compressed air. Soak bearing cones in dry-cleaning solvent or mineral spirits paint thinner. After soaking to loosen lubricant, turn rollers slowly while immersed, to remove all traces of old lubricant. If bearing is not thoroughly clean, repeat soaking and turning operation until all bearing surfaces are free of old lubricant. Dry with compressed

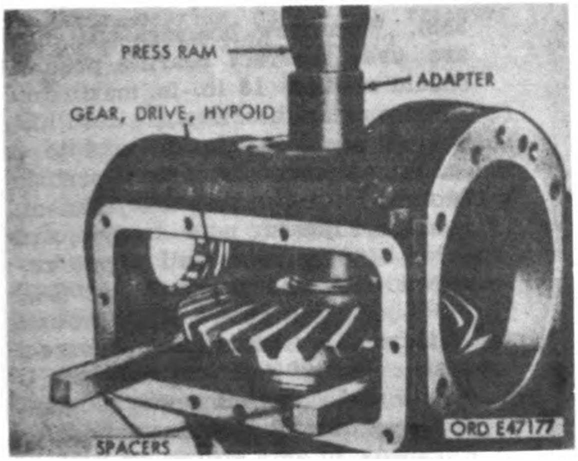


Figure 387. Pressing hypoid drive gear from helical drive pinion

air. Direct compressed air across bearing in such a manner that it does not spin the bearing.

(b) Inspection. Check carrier assembly for cracks or distortion. Inspect stud threads and cap screw hole threads for damage. Replace if defects are found. Inspect helical pinion bearing sleeve for scored or worn condition. Replace sleeve if scored or excessively worn (par. 293). Inspect outer and inner hypoid pinion bearing adjusting nuts and carrier assembly for crossed or damaged threads. If damaged, replace adjusting nuts.

Note. Carrier and caps cannot be replaced as separate items.

Apply clean engine oil (OE) to cones. Turn bearing rollers slowly. Cones must turn freely and smoothly if they are to be used again. Replace any cone which is pitted, scored, chipped, rough or excessively worn (par. 293). Inspect bearing cups for cracks, chipped spots, pitted spots, or wear caused by contact with bearing rollers. Replace damaged or worn cups. Examine all gears and pinions carefully for chipped, cracked or scored teeth. Gears with broken, chipped, cracked, or excessively worn teeth must be replaced. Small defects such as nicks, scores, or burrs may be corrected with a hone. If any one of the differential side gears or spider pinions must be replaced, replace all six in order to avoid noise and wear which would result from mating worn with new parts. Inspect bushing-type bearing in spider pinions for excessive wear, rough spots, or damage. Replace bearing if defects are found. Inspect spider pinion and side gear thrust washers for excessive wear. If damaged or worn excessively, replace the washers. Inspect each differential case flange face for runout. Place dial indicator against flange face (surface on differential case that mounts to helical drive gear) to check. If not within specified limits of 0.002 inch, repair case as instructed in (c) below. It is advisable to replace the hypoid pinion oil seals and the inner drive shaft universal joint oil seal at time of complete disassembly. However, if new seals are not available and oil seal is found to be in good condition, the old seal may be used. Replace seal if defects are found. Refer to c (1)(j) above for removal of hypoid pinion oil seals. Use seal replacer 5120-795-0152 to install pinion shaft oil seal in hypoid front bearing cage covers. Refer to c (3)(r) below for replacement of inner hypoid oil seal. Use adapter to press new oil seal into retainer.

(c) Repair. If bushing-type bearing (R, fig. 384) must be replaced, use arbor press and with bearing remover and replacer 5120-795-0089, press bearing out of spider pinion assembly (Q fig. 384). Use bearing remover and replacer 5120-795-0089 and press new bearing into pinion and burnish with burnisher 5120-795-0088. If differential case flange face runout is not within specified limits of 0.002 inch, place each half of differential case (D and K, fig. 384) in lathe and remove sufficient metal from flange to correct excessive runout. Metal must be cut on a true plane, removing only enough metal to bring runout within specified limits. After machining, remove burrs and clean thoroughly.

(3) Assembly.

(a) Install hypoid pinion outer bearing cup (K) in hypoid pinion bearing cage (M) on flange side of cage with thick side of cup toward cage shoulder. Install hypoid pinion inner bearing cup (P) in bearing cage from other side of cage with thick side of cup toward cage shoulder. Use remover and replacer 5120-79ᴗ-0159 to assemble bearing cups to cage. Refer to figure 385.

(b) If hypoid drive pinion (R) has been removed from hypoid pinion drive shaft (S), press hypoid pinion inner bearing cone (Q) onto hypoid drive pinion (R) with large radius of bearing toward gear. Install key in pinion drive shaft. Coat long spline end of hypoid pinion drive shaft (S) with white lead pigment and press pinion and bearing assembly onto shaft (gear end first). Continue pressing operation until pinion is firmly seated against shoulder on shaft. Install inner race of rear hypoid pinion bearing (T) on opposite end of shaft, large radius of inner race toward pinion end of shaft.

(c) Place hypoid pinion outer bearing cage assembly over hypoid pinion inner bearing cone (Q), flange side out. Install hypoid pinion bearing spacer (DD). Install hypoid pinion outer bearing cone (J), small radius of cone toward cage. Install inner hypoid pinion bearing adjusting nut (H) (nut w/dowel) on hypoid drive pinion (R). Tighten to approximately 500 lb.-ft. torque. Slip hypoid pinion bearing adjusting nut washer (G) into position over dowel on inner adjusting nut. It may be necessary to remove and turn washer in order to get hole in washer to index with dowel. Install outer hypoid pinion bearing adjusting nut (F) and tighten to 500 lb.-ft. torque. Use bearing preload tester 6670-347-5922 to secure pinion bearing preload reading (fig. 388). When new bearings and cups are used, correct bearing preload should be 12 to 18 lb.-in. maximum. When original bearings are used, the bearing preload should be 4 to 8 lb.-in. maximum. If correct preload is not secured on initial adjustment, remove adjusting nuts, washer, and outer bearing. This will permit removal of hypoid pinion spacer (DD) which controls the bearing preload adjustment. Select the correct spacer in the following manner. If initial preload reading was too low, select a thinner spacer or reduce thickness of old spacer by rubbing on crocus cloth laid on a face plate or upon a piece of plate glass. If preload reading was too high, select a thicker spacer. Use micrometers to measure original spacer, new spacer, or modified spacer so that exact variation in bearing adjustment is known. Install outer bearing cone, bearing adjusting nuts, and washers as specified above and again take a bearing preload reading. Increasing thickness of spacer reduces bearing preload and decreasing thickness increases preload.

(d) Install rear hypoid pinion bearing outer race assembly (T, fig. 385) in carrier assembly opposite pinion

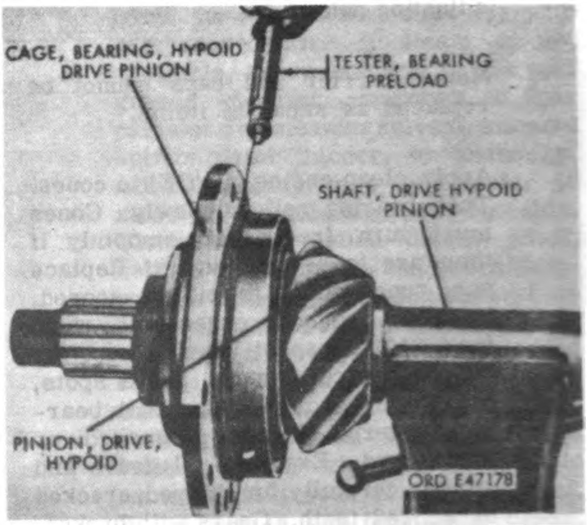


Figure 388. Checking hypoid drive pinion bearing preload

outer bearing cage. Use remover and replacer 5120-795-0079.

(e) Install hypoid pinion cage shims (N) which control gear lash, and which were tied to bearing cage at time of disassembly. Place shims in position on pinion side of hypoid pinion outer bearing cage (M, fig. 385). Carefully aline openings in shims with oil passages in bearing cage. Install hypoid pinion shaft assembly in carrier assembly (F, fig. 383) through pinion bearing cage end of through-shaft chamber. Aline rear hypoid pinion bearing inner race with center of roller bearing outer race assembly. Continue installation of hypoid drive pinion assembly until hypoid pinion outer bearing cage (M, fig. 385) is seated against carrier and rear hypoid pinion bearing inner race is in position in bearing outer race assembly.

(f) The hypoid drive pinion is adjusted for proper location in relationship to the hypoid drive gear, using gage 4910-795-0104 (fig. 389). The adjustment is made after the hypoid drive pinion preload is established and with the hypoid drive gear and bearing assembly out of the differential case. The hypoid drive pinion, shaft, and cage assembly is temporarily installed in the differential case with the hypoid pinion cage shims (N) located between the differential case and hypoid pinion bearing cage. Use of the old shim pack will provide a starting point to secure the correct reading.

(g) The gage holder for gage 4910-795-0104 is placed on the gage master block (fig. 389) for the purpose of setting the dial indicator to zero. This establishes the basic or nominal dimension to which the gears were manufactured or cut. Any variation from this nominal dimension will be found marked on the tooth end of the hypoid drive pinion. The hypoid drive pinion must be moved in (minus) or out (plus) so that the marking shown on the dial indicator matches the marking on the hypoid drive pinion. Add or remove hypoid pinion cage shims (N, fig. 385) be-

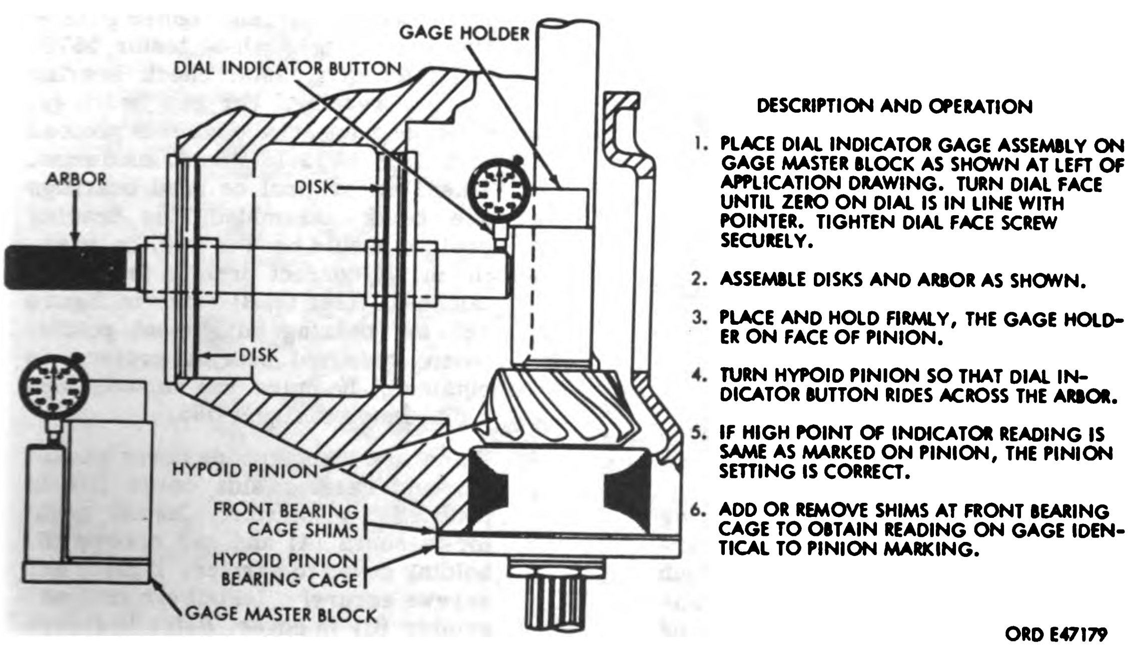


Figure 389. Tool application for hypoid drive pinion

tween the differential case and hypoid pinion outer bearing cage to attain the correct dial gage reading.

(h) After locating the hypoid drive pinion, the hypoid drive pinion and shaft assembly, together with the cage, must be removed from the differential case and the hypoid drive gear and bearing case assembly installed.

(i) Place hypoid drive gear (A) on press, and press inner helical pinion bearing (C) onto hub of drive gear. Refer to figure 386.

(j) Place carrier assembly on press, helical pinion outer bearing cage side down. Position helical pinion bearing sleeve (B) in carrier assembly with notches in sleeve toward shoulder of bore. Aline screw hole in sleeve with screw hole in carrier. Press sleeve into carrier bore until it seats firmly against shoulder in carrier assembly, using remover and replacer 5120-795-0159. Refer to figure 386.

(k) Turn carrier assembly over, helical pinion outer bearing cover opening up. Support hypoid drive gear (A) with suitable sleeve or adapter. Slide helical pinion bearing spacer (D) over keyway end of helical drive pinion (E). Install key (T) in keyway in pinion, and coat this end of shaft with white lead pigment. Insert helical drive pinion (E) through pinion outer bearing cage opening in carrier assembly. Aline key with keyway in hypoid drive gear, and press pinion into gear. Position inner helical pinion bearing (C) in helical pinion bearing sleeve (B). Refer to figure 386.

(l) Install helical pinion outer bearing cup (H) in helical pinion outer bearing cage (G). Place cage on bench with outer flange end up. Place helical pinion outer bearing cones (J and K) in bearing cage with large diameters together. Install helical pinion outer bearing cup (L), using bearing replacer 5120-795-0082 to install both bearing cups. Refer to figure 386.

(m) Place original helical pinion cage shims (F), which control gear backlash and which was tied to bearing cage at time of disassembly, in position over long studs (M, fig. 383). Be sure oil passage cutout in shims is toward top of carrier assembly and alined with oil recess on inside of carrier. Place helical pinion outer bearing cage assembly over and of helical drive pinion (E). Aline oil recess in bearing cage with oil recess in carrier and press bearing cage onto pinion and into carrier. Refer to figure 386.

(n) Position original helical pinion cage shims (N), which control helical pinion outer bearing cones (J and K) preload, and which were tied to cover at time of disassembly, over long studs (M, fig. 383) next to helical pinion outer bearing cage (G). Be sure oil passage cutout is alined with oil hole in top of cage. Place helical pinion outer bearing cover (P) in position over studs with oil passage alined with oil hole in cage and shims. Install six lockwashers (R) and hex-nuts (Q), and tighten firmly. Using bearing preload tester 6670-347-5922 (fig. 390), check bearing preload reading. For new bearings, cups, and cones, the correct preload should be 12 to 18 lb.-in. maximum. When the original or used bearings are being assembled, the bearing preload should be 4 to 8 lb.-in. maximum. If correct preload is not obtained at first trial, refer to figure 387 for bearing adjustment points. When specified bearing preload is obtained, be sure cap screws are tight. Refer to figure 385.

(o) Place new carrier side cover gasket (E) and carrier side cover (D) in position on carrier. Install eight lockwashers (A) and cap screws (B) holding cover to carrier. Tighten cap screws securely. Install air vent assembly (C) in cover. Refer to figure 383.

(p) Position the hypoid drive pinion and cage assembly; then adjust the lo-

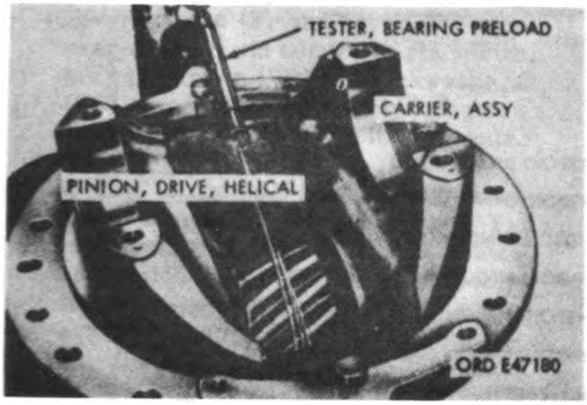


Figure 390. Checking helical drive pinion bearing preload

cation of hypoid drive gear to obtain correct tooth contact. Refer to figure 392 for correct procedure. Coat two or three teeth of the hypoid drive pinion with Prussian blue. Turn the hypoid drive pinion by hand and check the hypoid drive gear for tooth contact pattern.

(q) Press hypoid pinion oil seal into hypoid pinion front bearing cage cover. Seal is installed from inside of cover with replacer 5120-795-0152.

(r) Press hypoid pinion oil seal (X) into hypoid pinion rear bearing cover (W) with replacer 5120-795-0152. Refer to figure 385.

(s) Position hypoid pinion front bearing cage gasket (L) against hypoid pinion outer bearing cage (M). Aline gasket to avoid obstructing oil passages. Place hypoid pinion front bearing cage cover (D) and seal assembly over gasket. Insert eight cap screws (FF) and lockwashers (EE), and install cover assembly. Tighten cap screws with 78 to 88 lb.-ft. torque. Refer to figure 385.

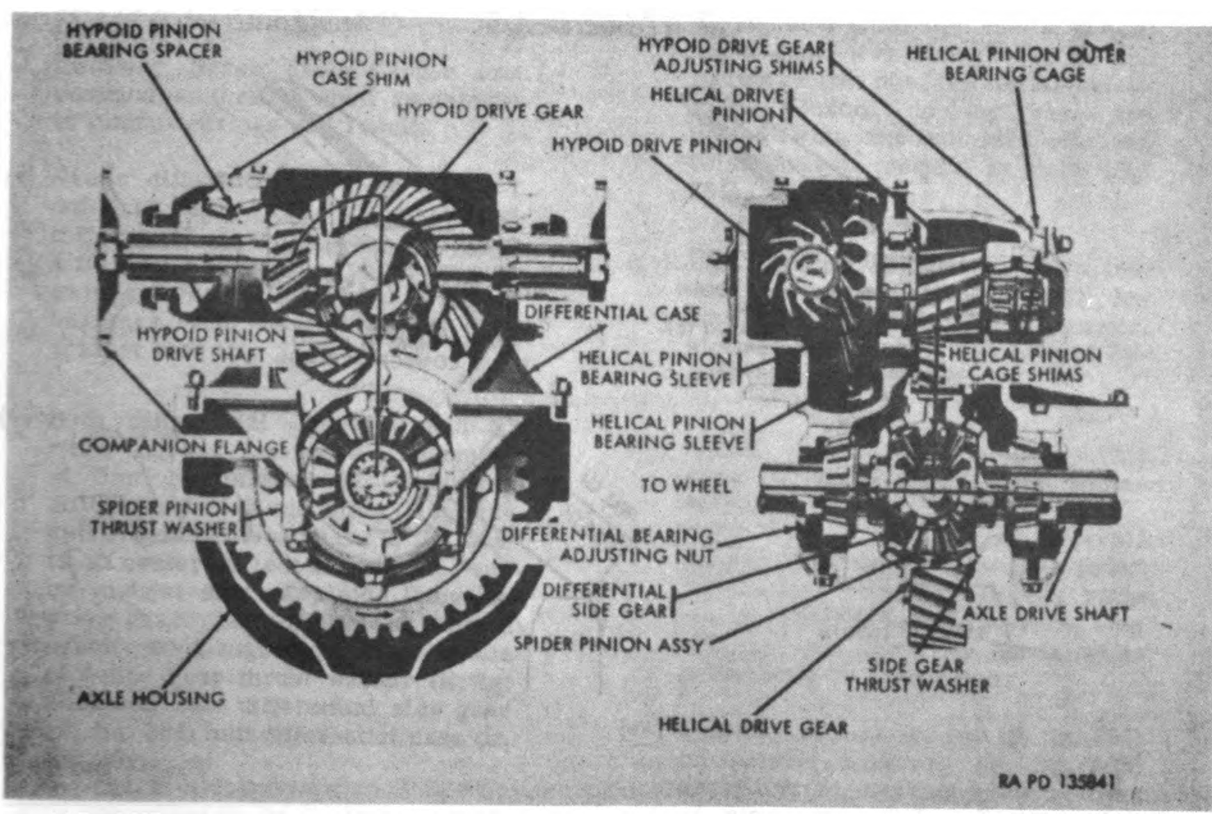
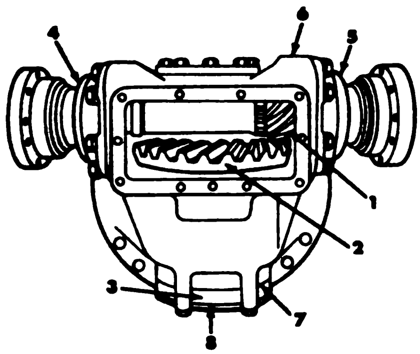
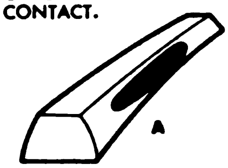


Figure 391. Carrier and differential assembly - cutaway view



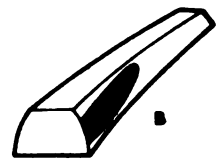
1. HYPOID DRIVE PINION
2. HYPOID DRIVE GEAR
3. HELICAL PINION OUTER BEARING CAGE
4. HYPOID PINION REAR BEARING COVER
5. HYPOID PINION FRONT BEARING CAGE COVER
6. HYPOID PINION CAGE SHIMS
7. HELICAL PINION CAGE SHIMS
8. HELICAL PINION CAGE SHIM

ALWAYS ADD OR REMOVE SHIMS OF EQUAL THICKNESS AND NUMBER WHEN CORRECTING HYPOID DRIVE AND PINION GEAR TOOTH CONTACT.



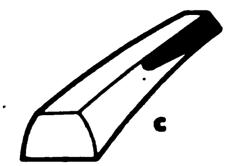
CORRECT TOOTH CONTACT

SHOWS BLUE OVER TWO-THIRDS OF TOOTH (CENTERED).



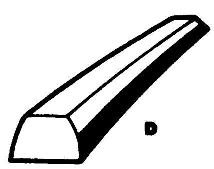
INCORRECT TOOTH CONTACT

SHOWS BLUE AT HEEL OF TOOTH CAUSES TOOTH BREAKAGE. CORRECTION-ADD SHIMS AT (7). REMOVE SHIMS AT (6) TO SECURE CORRECT BACKLASH.



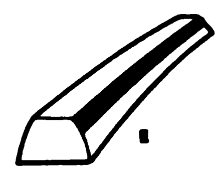
INCORRECT TOOTH CONTACT

SHOWS BLUE AT TOE OF TOOTH CAUSES TOOTH BREAKAGE. CORRECTION-ADD SHIMS AT (7). REMOVE SHIMS AT (6) TO SECURE CORRECT BACKLASH.



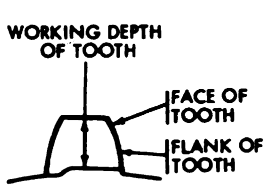
INCORRECT TOOTH CONTACT

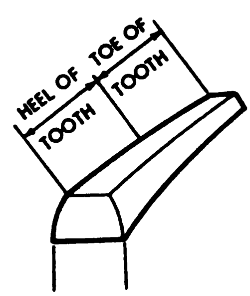
SHOWS BLUE AT FLANK OF TOOTH GEARS WILL BE NOISY. CORRECTION-REMOVE SHIMS AT (6). ADD SHIMS AT (7) TO SECURE CORRECT BACKLASH.



INCORRECT TOOTH CONTACT

SHOWS BLUE AT FACE OF TOOTH GEARS WILL BE NOISY. CORRECTION-ADD SHIMS AT (6). REMOVE SHIMS AT (7) TO SECURE CORRECT BACKLASH.





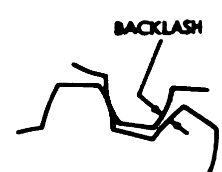


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Figure 392. Hypoid drive gear and pinion tooth contact

(t) Install hypoid pinion rear bearing cover gasket (V) and cover (W) over rear of shaft and secure in place with six cap screws (BB) and lockwashers (CC) on carrier assembly. Tighten capscrews to 25 to 35 lb-ft. torque.

(u) If dust slinger (C) has been removed from companion flanges (B and Y), install new slinger on flange. Place companion flange (B) on pinion bearing cage end of hypoid pinion drive shaft (S), using differential companion flange replacer 5120-795-0155. Push flange into position on shaft. Repeat this operation to install companion flange (Y), being sure that hypoid pinion rear bearing spacer (U) has been installed. Do not fail to lubricate seals before flanges are assembled to shaft. Complete assembly of flanges by installing slotted nut (A) on front flange, tighten to 800 lb.-ft. torque, and lock nut in position with cotter pin (GG). Repeat operation at rear flange, install nut (Z), tighten to specified torque, and secure with cotter pin (AA).

Caution: Never drive flanges into position on through shaft as damage to pinion bearings will result.

(v) Press differential bearing cone (C) onto differential case (D) and press differential bearing cone (L) onto differential case (K). Apply pressure to inner race of bearings only. Install bearings with large side of cone against case (fig. 384).

(w) Both differential cases (D and K) were marked for correct assembly at time of disassembly. Note that differential case mounting flange inside of helical drive gear (T, fig. 384) is off center. Select case that mounts on highest side of inside flange in drive gear. Lay differential case on bench with flange side up and place one side gear thrust washer (E, fig. 384) and one differential side gear (F, fig. 384) into differential case (D, fig. 384).

(x) Assemble four spider pinion assemblies (Q) on differential spider (G) with a spider pinion thrust washer (S) on top (or outside) of each pinion (fig. 384).

(y) Place differential spider (G), spider pinion assembly (Q), and spider pinion thrust washer (S) into case, meshing pinion teeth with those of differential side gear (F) already in position in differential case (fig. 384).

(z) Place other differential side gear (H) and side gear thrust washer (J) on spider assembly (fig. 384).

(aa) Place helical drive gear (T) in position on differential case (D), with recess side of gear up, and aline bolt holes (fig. 384).

(bb) Install other side of differential case (K, fig. 384) on helical drive gear (T, fig. 384), making sure marks made at time of disassembly (par. 289c) are alined. Install eight hex bolts (U, fig. 384) from high side of helical drive gear ((w) above). Install and tighten slotted nuts (P) to 115 lb.-ft. torque. Install locking wire and thread wire through all bolts and twist ends to secure in place (fig. 384).

(cc) Lift differential case assembly into carrier assembly (F, fig. 383). Install assembly with differential slotted nuts (P, fig. 384) toward hypoid pinion drive shaft.

(dd) Install tapered differential bearing cups (B and M, fig. 384) on differential bearing cones (C and L, fig. 384). Use a short bar inserted through differential side gear to lift differential assembly slightly while placing bearing cups in position. This will prevent injury to hands while performing this operation.

(ee) Position one carrier cap (S, fig. 383) on carrier assembly (F, fig. 383) according to marking made at time of disassembly. Install two bolts (T, fig. 383) and tighten just enough to hold cap in place (fingertight).

Install other carrier cap (X, fig. 383). Secure with two bolts (U, fig. 383) fingertight only.

(ff) Install differential bearing adjusting nuts (A and N, fig. 384). After adjusting nuts have been started, tighten the four bolts (T and U, fig. 383) just enough to hold bearing cups snugly, but still permit turning the adjusting nuts. Use a spanner wrench to tighten adjusting nuts alternately until both nuts are threaded into case and cap equally. Using dial indicator at side face of helical drive gear (T, fig. 384), adjust differential assembly to zero end play in differential bearings. Rotate assembly several revolutions to assure normal bearing contact. Check differential end play and adjust to zero if necessary. Check drive gear runout with dial indicator. If runout exceeds 0.008 inch, remove differential assembly and check for cause.

(gg) Tighten adjusting nuts one notch each from 0.000-inch end play to secure the correct differential bearing preload. Tighten four bolts (T and U, fig. 383) to 300 lb.-ft. torque. Install differential bearing adjusting nut locks (W, fig. 383) and cap screws (V, fig. 383). Install locking wire in carrier cap bolts and adjusting nut lock cap screws to secure assembly in place.

(hh) Refer to figure 383 as reference for installing carrier top cover gasket (G), carrier top cover (H), ten lockwashers (J), and ten cap screws (K). Tighten cap screw to 25 to 35 lb.-ft. torque.

290. Springs (Fig. 393)

a. General. The rear springs (fig. 393) are semielliptic type, mounted with the arch up. They are attached to the rear suspension assembly by U-bolts (E). The spring leaves are held together as an assembly by a center bolt (BB). Leaves are alined with four spring leaf clips (H and K). The ends of springs rest on axle housing and are free to slide in guide bracket (B and Q) with plate assemblies. Rear spring assemblies require no repair unless inspection indicates broken or wear on leaves.

b. Disassembly (Fig. 393). Place rear spring assemblies in vise or install heavy C-clamps, clamping assembly near center bolts (BB) to hold leaves compressed together. Remove nut, bolt, and spacer from spring leaf clips (H and K). Remove nuts from center bolts (BB). Release vise or C-clamps to allow leaves to spread. Remove center bolts (BB) and disassemble leaves.

c. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all spring leaves thoroughly with dry-cleaning solvent or mineral spirits paint thinner. Use wire brush and remove all rust and corrosion from spring leaves.

(2) Inspection and repair. Inspect all spring leaves for cracks and breaks. Replace defective leaves. Replace center bolts at time of each repair.

d. Assembly.

(1) Spring leaves (fig. 393). Make sure that all rust has been removed from spring leaves. Apply a small amount of powdered graphite to each side of spring leaves. Assemble leaves, starting with the longest spring leaf. Aline holes for center bolt.

(2) Install center bolts. Place the assembled spring leaves in arbor press or install heavy C-clampe. Compress leaves tightly together, and install center bolts.

Note. Keep spring holes alined for center bolts (BB).

291. Spring Seats

Refer to TM 9-2320-211-20.

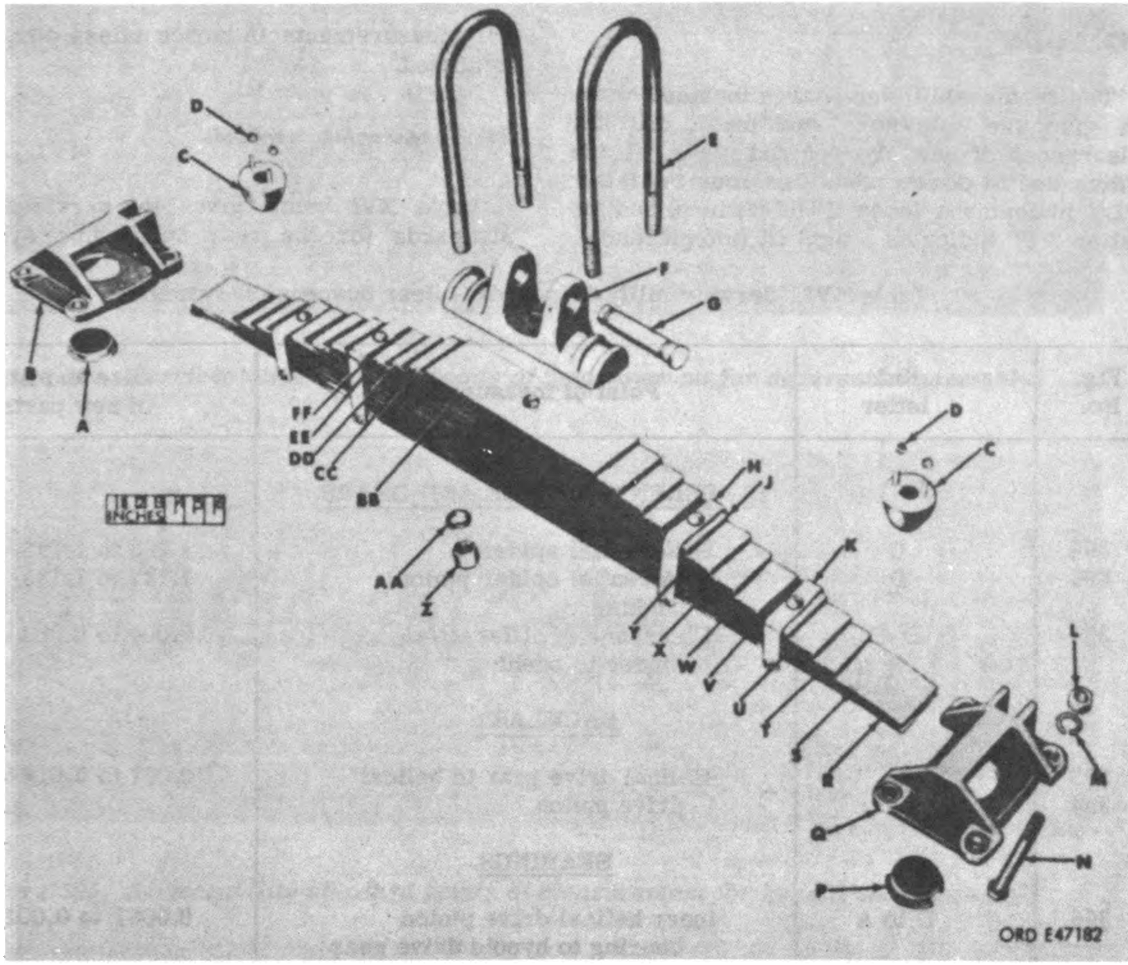


Figure 393. Rear spring and mounting parts - exploded view

Key	Item	Key	Item
A	Plate, spring guide, bottom	R	Leaf, spring
B	Bracket, guide	S	Leaf, spring
C	Bumper, rubber	T	Leaf, spring
D	Nut, hex	U	Leaf, spring
E	Bolt, U-	V	Leaf, spring
F	Saddle, spring	W	Leaf, spring
G	Pin, lifting, spring saddle	X	Leaf, spring
H	Clip, spring leaf	Y	Leaf, spring
J	Leaf, spring	Z	Nut, hex
K	Clip, spring leaf	AA	Washer, lock
L	Nut, hex	BB	Bolt, center
M	Washer	CC	Leaf, spring
N	Bolt, hex	DD	Leaf, spring
P	Plate, spring guide, bottom	EE	Leaf, spring
Q	Bracket, guide	FF	Leaf, spring

Figure 393. Rear spring and mounting parts - exploded view - legend

Section VI. SERVICEABILITY STANDARDS

292. 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 measurements in inches unless otherwise indicated.

293. Serviceability Standards

Table XVI below gives the serviceability standards for the rear suspension system.

Table XVI. Serviceability Standards - Rear Suspension System

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts
		DIFFERENTIAL CASE AND GEARS	
394	C	Differential spider	1.123 to 1.122
394	D	Differential spider pinion bushing	1.127 to 1.129
394	D-C	Clearance of differential spider to bushing	0.004 to 0.007
		BACKLASH	
395 394	E	Helical drive gear to helical drive pinion	0.007 to 0.014
		BEARINGS	
395	D to A	Inner helical drive pinion bearing to hypoid drive gear	0.006T to 0.0011L
395	C to B	Inner helical drive pinion bearing to bearing sleeve	0.0020L to 0.0042L
395	G to F	Outer helical pinion bearing cone to helical drive pinion	0.000 to 0.0015T
396	A to C	Outer hypoid pinion bearing cone to hypoid drive pinion	0.0002L to 0.0022L
396	B to D	Inner hypoid drive pinion bearing cone to hypoid drive pinion	0.0010T to 0.0025T
396	E to F	Hypoid pinion shaft rear bearing to hypoid drive pinion shaft	0.0006T to 0.0013T
396	G	Hypoid pinion shaft rear bearing to carrier	0.0005L to 0.0007T
394	A to B	Differential bearing cone to differential case	0.0015T to 0.0035T

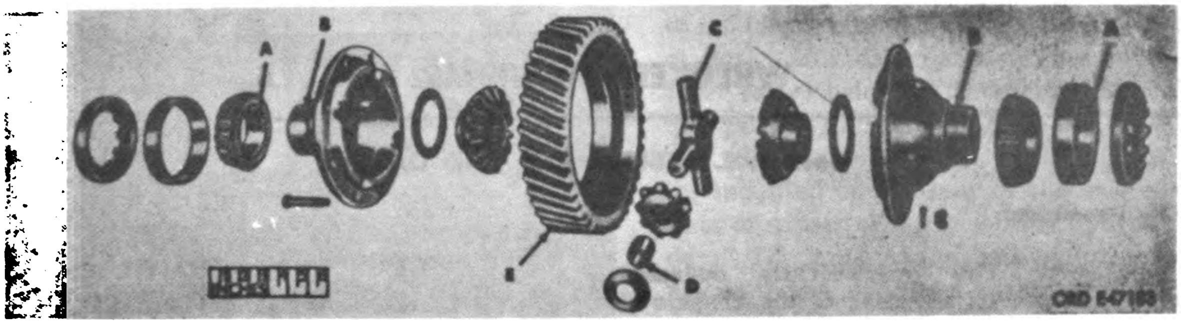


Figure 394. Serviceability standard points of measurement for differential assembly

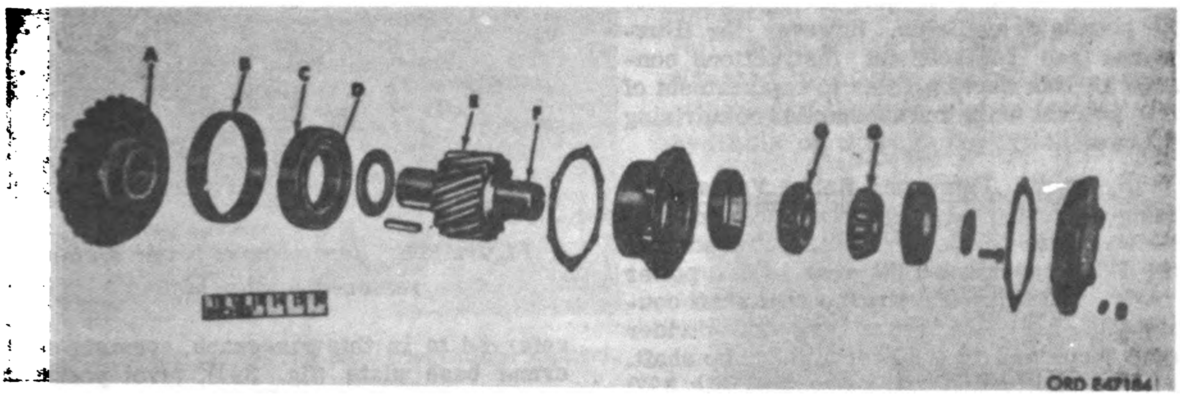


Figure 395. Serviceability standard points of measurement for helical shaft assembly

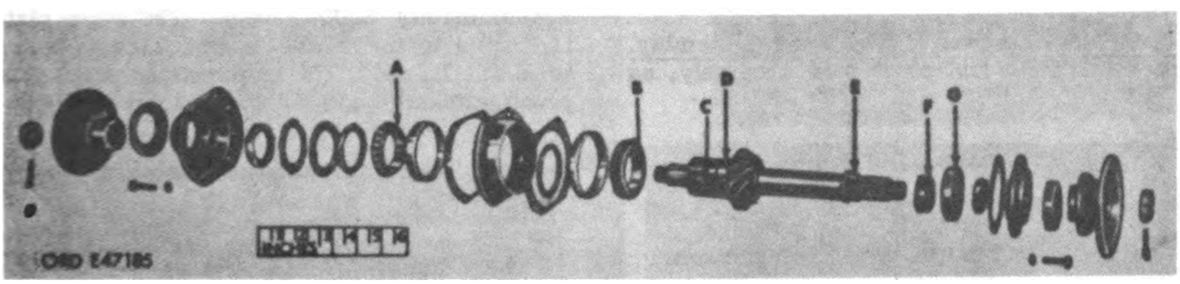


Figure 396. Serviceability standard points of measurement for pinion shaft assembly

CHAPTER 22

WRECKER CRANE M62

Section I. DESCRIPTION AND DATA

294. Description

a. General. The hydraulically operated crane mounted on the rear of the chassis of the medium wrecker truck M62 consists primarily of the assemblies described in (b) through (t) below. The complete crane can be replaced as a single unit, provided hoisting equipment having a capacity of approximately 8000 pounds is available. However, the illustrations and replacement instructions contained in this section refer to replacement of the individual units and assemblies comprising the crane.

b. Hydraulic Pump and Relief Valve. The flange-mounted vane-type hydraulic pump (fig. 397) is bolted to the hydraulic pump adapter (fig. 398) mounted on the rear of the power divider. The hydraulic pump output shaft coupling (fig. 398) is keyed to the power-divider output shaft and to the hydraulic-pump shaft. The adjustable relief valve assembly (fig. 397) is connected to the hydraulic pump outlet port. The purpose of this valve is to protect the crane hydraulic system from excessive (above 1200 psi) pump pressures.

c. Base Plate and Pivot Post Assembly. The base plate and pivot post assembly, as referred to in this paragraph, consists of the crane base plate (fig. 399), pivot post (fig. 399), shipper support (fig. 400), swivel valve assembly (fig. 401), and operator's compartment and control valve bank assembly (fig. 401). The combined weight of these units is approximately 3500 pounds. The base plate is bolted to the crane body, which is bolted to the left and right frame side rails. The pivot post, which is hollow, is internally sup-

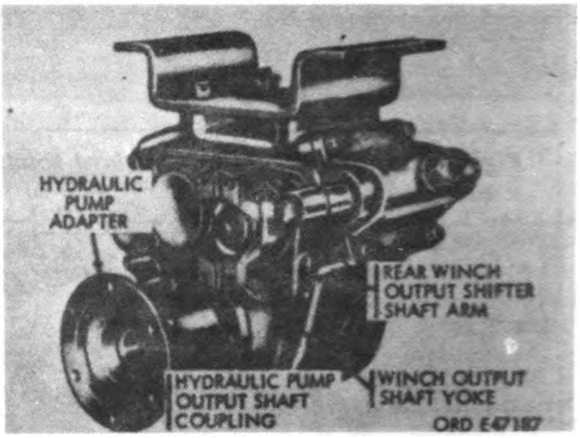


Figure 398. Rear view of power divider removed from vehicle

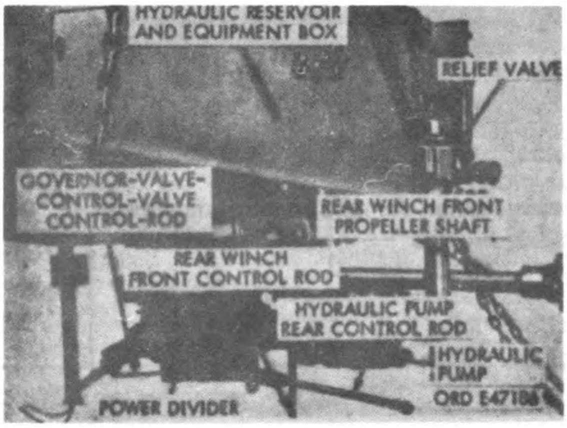


Figure 397. Hydraulic reservoir with power divider, pump, and relief valve removed from vehicle (M62)

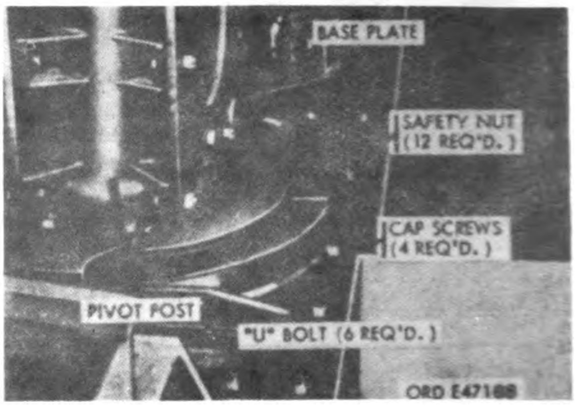


Figure 399. Lower end of pivot post and base plate

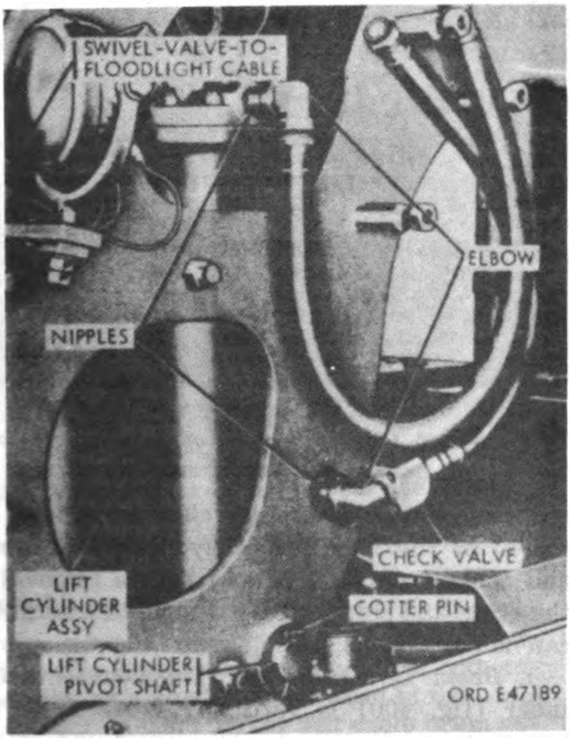


Figure 400. Left side of pivot post shipper support, and boom lift cylinder.

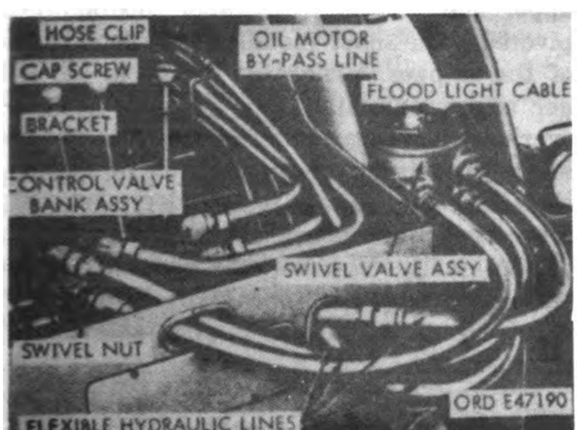


Figure 401. Front view of operator's compartment and control valve bank assembly.

ported at the top and bottom by tapered roller bearings, which are installed on a tubular support member attached to the base plate. The pivot post support cap (fig. 402) bolted to the top of the pivot post support, anchors the pivot post to the support while permitting the pivot post to rotate freely on its vertical axis. The shipper support, on which the boom and shipper assembly ((*f*) below) are pivoted, is bolted to mounting bosses cast on the sides of the pivot post. For description of the swivel valve, refer to (*e*) below. For description of the control valve bank refer to (*j*) below.

d. Swing Motor (fig. 403). The swing motor mounted on the rear of the base plate consists of a pair of double-acting hydraulic cylinders. The front end of both piston rods is connected to the pivot post drive pinion crank. The drive pinion at the lower end of the crank drives the ring gear at the bottom of the pivot post through an idler gear. The rear end of both cylinders is anchored by a pin to a bracket welded to the base plate. A spring-loaded valve spool inside the cylinder bodies, which is actuated by a lever operating against a roller attached to the base plate, controls the flow of hydraulic oil through the cylinder.

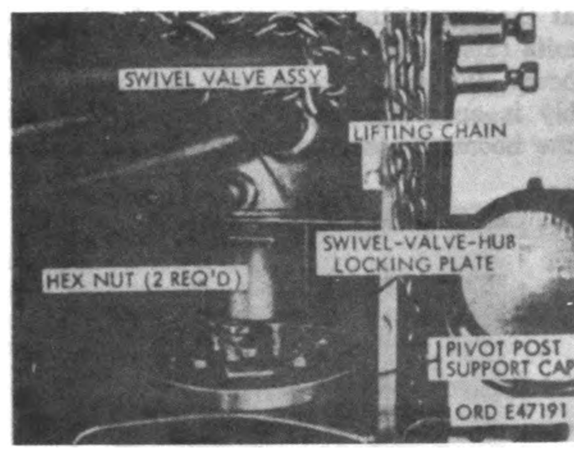


Figure 402. Front view of upper end of pivot post with swivel in raised position.

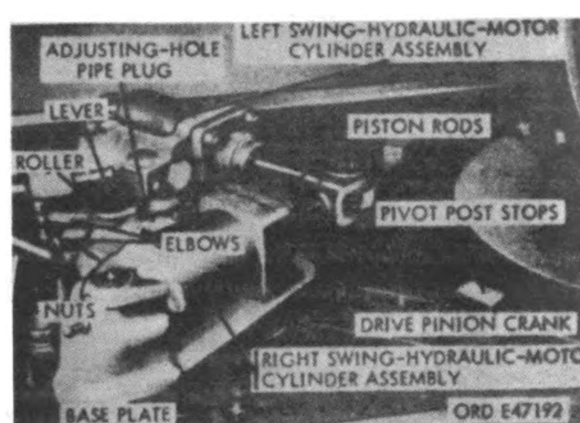


Figure 403. Hydraulic swing motor (M62).

e. Swivel Valve Assembly (figs. 401 and 402). The swivel valve assembly (fig. 401) is installed on top of the pivot post support cap (fig. 402) with its lower end extending into the pivot post support. A locking plate secures the valve assembly to the support cap. The swivel valve assembly permits 360° rotation of the crane without twisting or breaking the hydraulic lines from the pump to the driving motor, hoist hydraulic oil motor ((*i* below), boom lift cylinder ((*g*) below), boom crown cylinder ((*h*) below), and control valve bank assembly ((*j*) below).

f. Boom and Shipper Assembly. The boom and shipper assembly consists of the boom (fig. 404) and shipper, which are telescoping tubular steel members having a rectangular-shaped cross section, held together by the boom crowd cylinder ((*h*) below). The rear end of the shipper is pivoted on a pin (fig. 405) installed at the top of the shipper support, which permits raising and lowering the front end of the boom. Weight of the shipper and boom assembly is approximately 2150 pounds. Although the boom and shipper assembly removal pro-

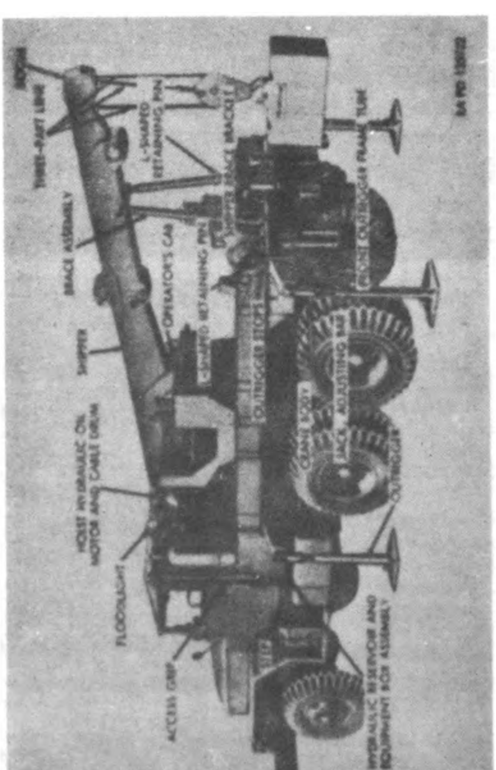


Figure 404. Medium wrecker truck M62 with outriggers down and shipper braces rigged.

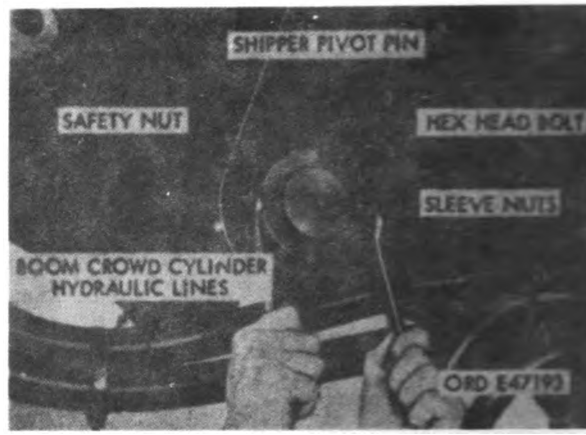


Figure 405. View of right end of shipper pivot pin installed in shipper support.

cedures (para 315) in this chapter require removal of the boom hoist hydraulic oil motor and cable drum ((*i*) below) before removal of the boom and shipper assembly, both assemblies can be removed as a single unit.

g. Boom Lift Cylinder. The boom lift cylinder (fig. 400) is vertically mounted to the rear of the pivot post. The lower end of the cylinder is pivoted on a shaft installed between the sides of the shipper support. The upper end of the lift-cylinder piston rod is pivoted on a shaft installed between the sides of the shipper. Weight of the boom lift cylinder is approximately 265 pounds. By using overhead hoisting equipment to raise the front end of the boom to its position of maximum elevation, the boom lift cylinder can be removed without removal of the boom and shipper assembly. However, the boom lift cylinder removal procedures (para 316) in this section require removal of the shipper and boom assembly.

h. Boom Crowd Cylinder. The boom crowd cylinder (fig. 406) is mounted horizontally inside the boom and shipper assembly. The rear end of the crowd-cylinder piston rod is secured to the anchor (welded to the rear end of the shipper) by two nuts and a locking plate. A collar welded to the crowd cylinder at a point midway between the ends is secured to the boom by two pins inserted through the sides of the boom and the collar.

i. Boom Hoist Hydraulic Oil Motor and Cable Drum Assembly. The boom hoist hydraulic oil motor and cable drum assembly (fig. 404) is bolted to the rear of the shipper. Either the oil

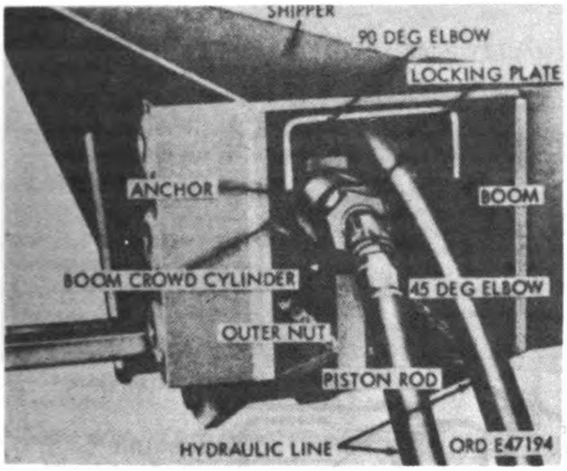


Figure 406. Rear view of boom and shipper assembly with cable drum removed

motor or the cable drum can be removed separately. However, the removal procedures (par. 318) in this chapter cover removal of both assemblies as a single unit. Weight of the boom hoist hydraulic oil motor and cable drum assembly is approximately 730 pounds.

j. Control Valve Bank Assembly. The control valve bank assembly (fig. 407) is bolted to a shelf at the front of the operator's compartment. Wrecker crane operating instruction and caution plates are mounted on the control valve bank cover.

k. Hydraulic Lines and Fittings. The tubing used in the crane hydraulic lines is of butt-welded steel construction and the fittings are Ermeto flareless. Flexible lines are high-pressure-type rubber hose with swaged on couplings.

l. Hydraulic Reservoir and Equipment Box (fig. 404). The hydraulic reservoir and equipment box assembly is bolted to brackets attached to the frame side rails. Although the reservoir and equipment box removal procedures (par. 321) require removal of the power divider, hydraulic pump, and relief valve before removal of the reservoir and equipment box, these assemblies can be removed with the reservoir as a single unit.

m. Crane Body (Fig. 404). The crane body is bolted at the rear to the left and right frame side rails by two U-bolts, one at each side. The front of the crane body is bolted to two brackets, one on each side, attached to the left and right frame side rails. The approximate weight of the crane body, including the outriggers, is 2100 pounds. The base plate and pivot assembly must be removed before the crane body can be removed. However, the crane body can be removed without first removing the rear winch assembly, in which case the approximate weight of the body and winch assembly is 3700 pounds.

n. Hydraulic System. The wrecker crane hydraulic system (fig. 408) is completely sealed except for the breather-type reservoir filler cap. A bayonet-type oil level gage attached to a square-head pipe plug is installed in the top of the reservoir.

o. Clutch Control Valve. The clutch control valve is a two-way air valve connected in the compressed air system (fig. 413) between the air supply line and the roto chamber ((p) below). The valve is bolted to a bracket attached to the front of the wrecker body floor plate. When the valve lever is in the DISENGAGE position, compressed air is permitted to pass through the valve and control-valve-to roto-chamber air line into the rear end of the roto chamber.

p. Roto Chamber. The roto chamber is a single-acting air cylinder having a spring-loaded piston, which causes the piston to move to and remain at the rear end of the cylinder whenever the clutch control valve lever is in the ENGAGE position. The front end of the roto chamber push rod is connected by an

Figure 407. Rear view of operator's compartment and control valve bank assembly with cover removed (M62)

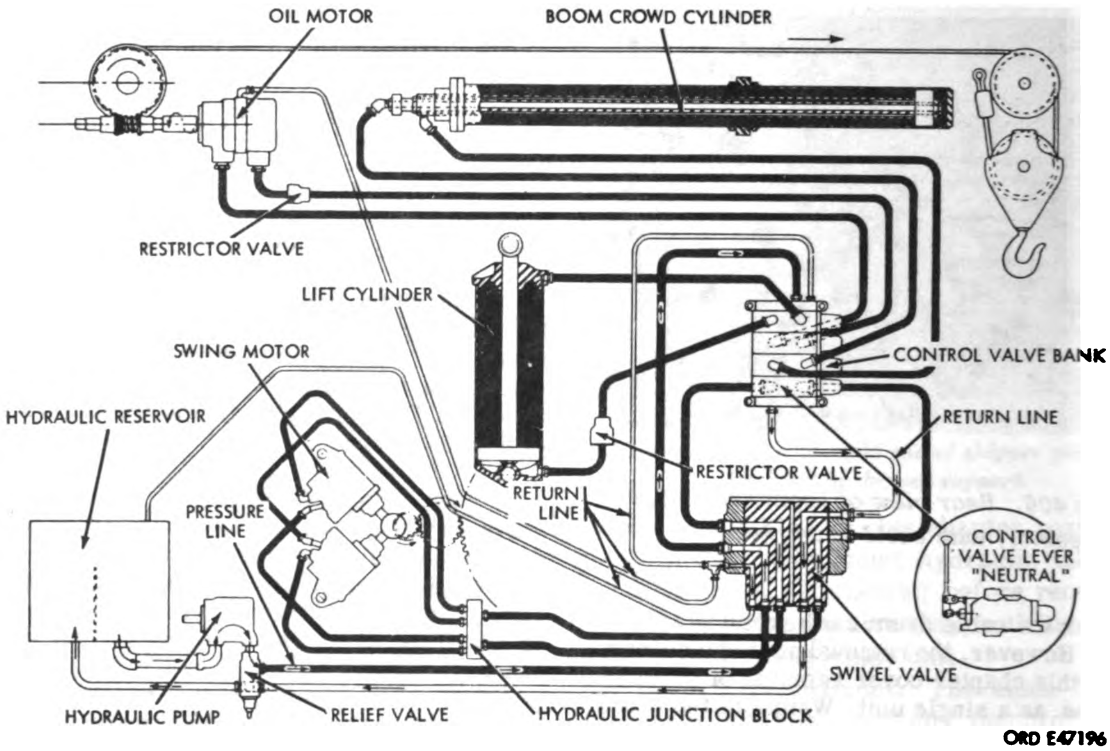


Figure 408. Crane hydraulic system (M62)

adjustable yoke and pin to the clutch release outer lever. Compressed air admitted into the rear end of the roto chamber through the clutch control valve ((o) above) causes the piston inside the roto chamber to move forward. This causes the push rod and outer lever to contact and push the clutch release inner lever forward, thereby disengaging the clutch.

q. Power Divider Assembly. The power divider assembly (figs. 398 and 411) is a single speed gear box with one input (drive) shaft and two output shafts. It is mounted by a bracket to the bottom of the hydraulic reservoir (fig. 397). The drive shaft yoke (fig. 411) is connected by a propeller shaft and universal joint to the power takeoff mounted on the rear of the transfer. The winch output shaft yoke (fig. 398) is connected by a universal joint to the front end of the rear winch front propeller shaft. The hydraulic pump output shaft is connected by a coupling (fig. 398) to the hydraulic pump input shaft. When the hydraulic pump control lever is in the DISENGAGE position, the air passages inside the governor-valve control valve (fig. 413) are arranged so that the engine speed governor (fig. 413) is controlled by the governor valve (fig. 413) mounted on the rear of the distributor drive housing. This valve is adjusted to govern the engine speed at 2950 rpm (maximum no-load speed) for truck operation. When the hydraulic pump control lever is in the ENGAGE position, the air passages inside the governor-valve control valves are arranged so that the engine speed governor is controlled by the governor valve (W, fig. 417) mounted on the front of the power divider. This valve is adjusted to govern the engine speed at 1600 rpm (no-load) for crane operation. The power divider, hydraulic pump, and relief valve are removed from the vehicle as a single unit.

r. Power Divider Controls. The power divider controls consist of the rear winch control linkage and hydraulic pump control linkage. The hydraulic pump control linkage is comprised of the hydraulic pump control lever (fig. 414), rear control rod (fig. 415), relay lever (fig. 416), front control rod (K, fig. 417), and governor-valve-control-valve control rod

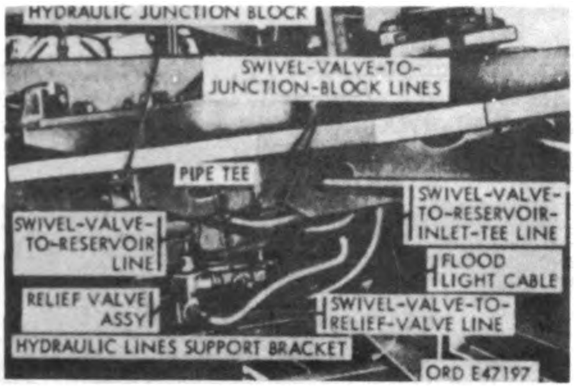


Figure 409. Left front view of base plate and pivot post assembly partially removed (M62)

(G, fig. 417). The rear end of the rear control rod is connected to the lower end of the control lever (fig. 418) by a yoke and pin. The front end of the rear control rod is connected to the left lever of the relay lever assembly by a yoke and pin. The rear end of the front control rod is connected to the right lever of the relay lever assembly by a yoke and pin. The front end of the front control rod (fig. 411) is connected to the pump-output-shifter-shaft arm and to the rear end of the governor-valve-control-valve control rod. The front end of the governor-valve-control-valve control rod is connected to the valve lever (U, fig. 417).

s. Rear Winch. The rear-mounted winch is power driven from a power divider mounted behind the transfer case and has a direct maximum pulling capacity of 45,000 pounds on the first layer of cable. The winch is equipped with a cable level wind and a cable tensioner (fig. 414) to assure proper winding of cable. The winch is worm-geared and power must be used when paying out cable. An adjustable automatic brake is provided on the winch drive worm for holding purposes. Controls for operating the winch are mounted on the body directly behind the winch. For operating instructions refer to TM 9-2320-211-10.

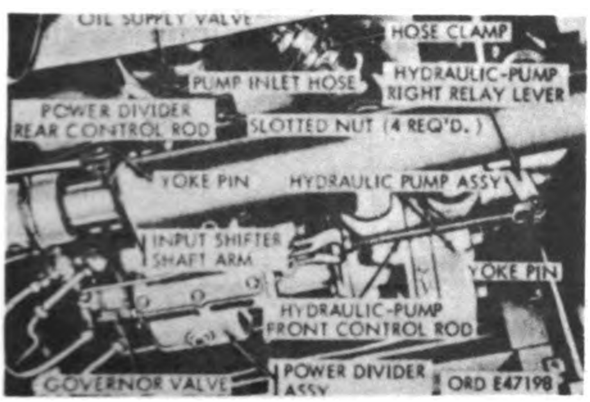


Figure 410. Bottom view of right side of power divider installed (M62)

t. Power Train. The power train (fig. 412) consists of those units which are mounted beneath the wrecker crane and transmit driving torque to the wrecker crane and rear-mounting winch. Initially, the power is taken from the truck's own transfer by means of a flange-mounted power takeoff. Power is then transmitted to the power divider where it can be used for driving either the crane or rear-mounted winch. Drive shafts and universal joints are used between the various units. A drive sprocket and chain is used in the drive line to the rear-mounted winch. The large drive shaft is supported by a drive sprocket bearing assembly and pillow block.

295. Data

a. Wrecker Crane.

Make	Austin-Western
Type	hydraulic
Manufacturer's number	AWR-HCF-1830
Capacity rating	5 ton

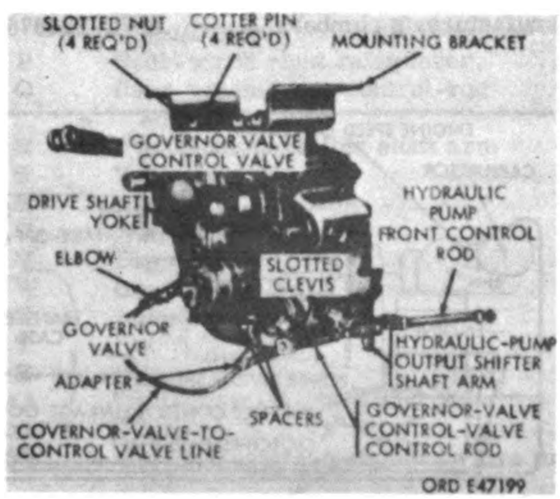


Figure 411. Front view of power divider removed from vehicle

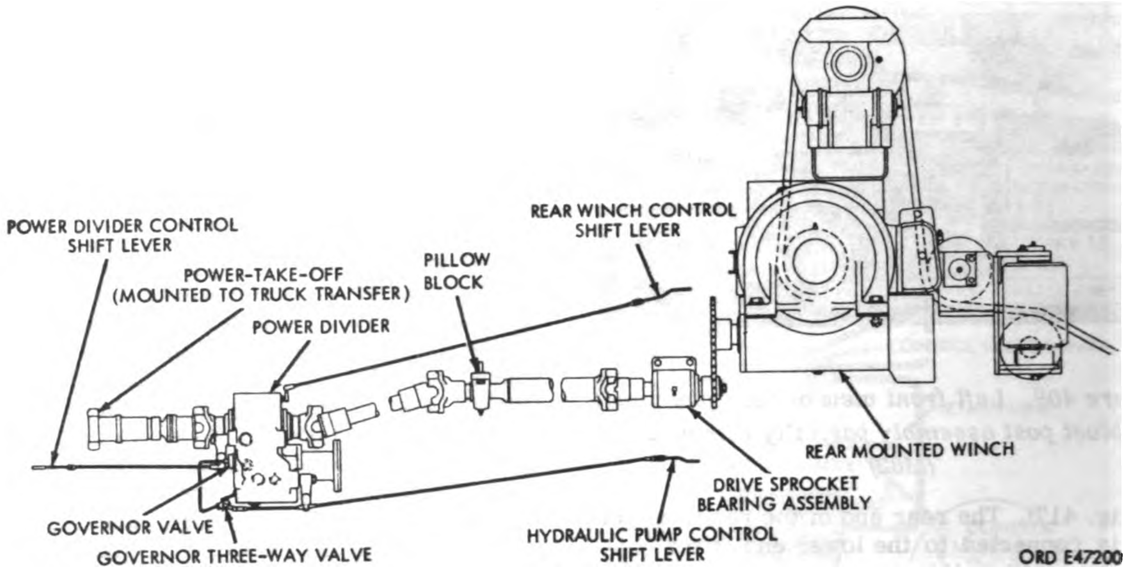


Figure 412. Schematic diagram of power train

b. Clutch Control Valve.

Make . . . . Bendix-Westinghouse
Manufacturer's number BWE-225004

c. Roto Chamber.

Make . . . . Bendix-Westinghouse
Ordnance number 7413932
Manufacturer's number BWE-224875

d. Hydraulic Pump.

Make . . . . Vickers
Type . . . . vane
Manufacturer's number VKR-U-430-36-1C-11
Ordnance number 7409847

e. Relief Valve.

Make . . . . Hydreco
Ordnance number 7409655
Manufacturer's number HDE-VR-5-C

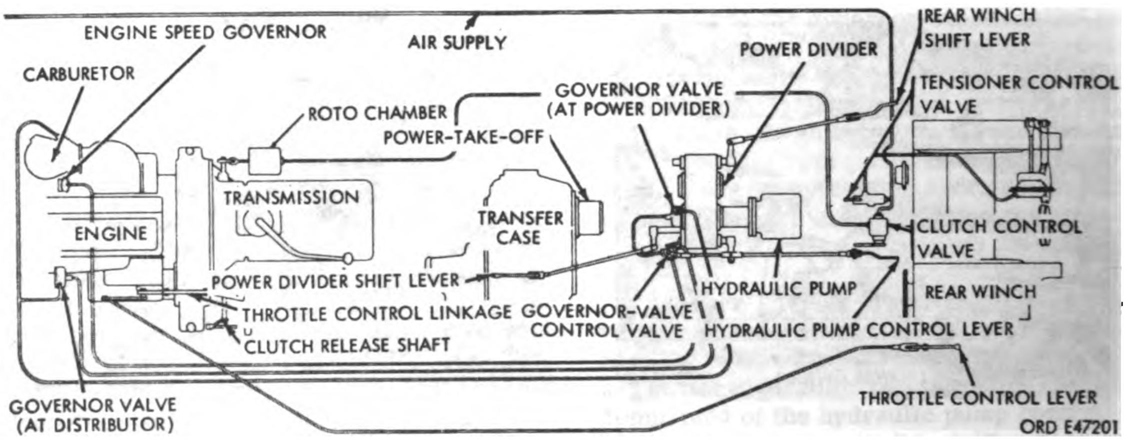


Figure 413. Wrecker crane air lines (M62)

f. Swivel Valve.

Make . . . . .Austin-Western
Ordnance number. 7409923
Manufacturer's number. AWR-HCU-242

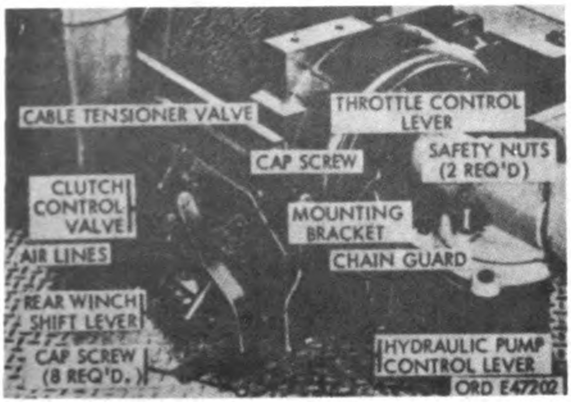


Figure 414. Rear winch controls

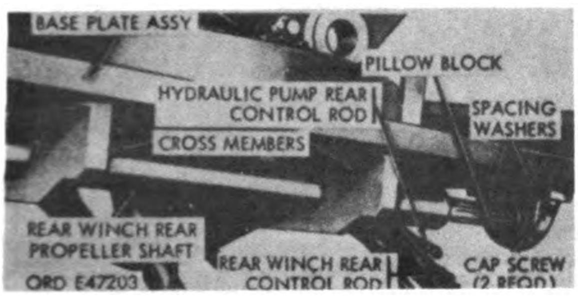


Figure 415. Right side view of underside of crane base plate removed from vehicle - M62

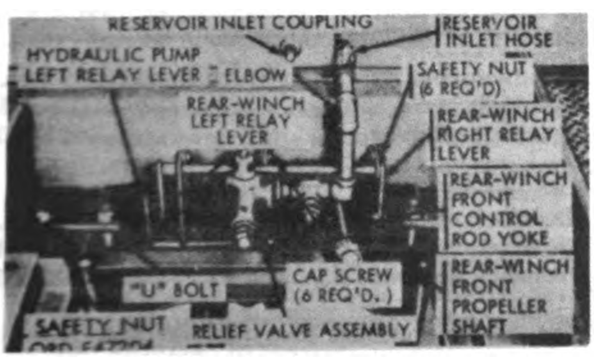


Figure 416. Rear view of forward end of wrecker body with crane removed - M62

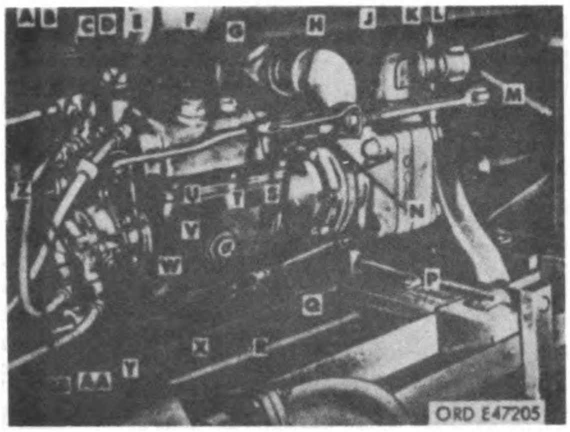


Figure 417. Left side view of rear end of wrecker body with floor plate raised - M62

Key	Item
A	Control-valve-to-governor line
B	Governor-valve-to-control-valve line
C	Safety nut
D	Adapter
E	Governor-valve control valve
F	Control-valve mounting bracket
G	Control-valve control rod
H	Slotted clevis
J	Nut
K	Hydraulic-pump front control rod
L	Hydraulic-pump right relay lever
M	Pillow block
N	Hydraulic-pump-output-shifter-shaft arm
P	Rear-winch right relay lever
Q	Rear-winch-front-control-rod adjustable yoke
R	Winch-output shifter shaft arm
S	Yoke
T	Nut
U	Control valve lever
V	Cap screws
W	Governor valve
X	Adjusting hole plug
Y	Nut
Z	Elbows
AA	Carburetor-to-governor-valve line
BB	Governor-valve-to-control valve line

Figure 417. Left side view of rear end of wrecker body with floor plate raised - M62 - legend

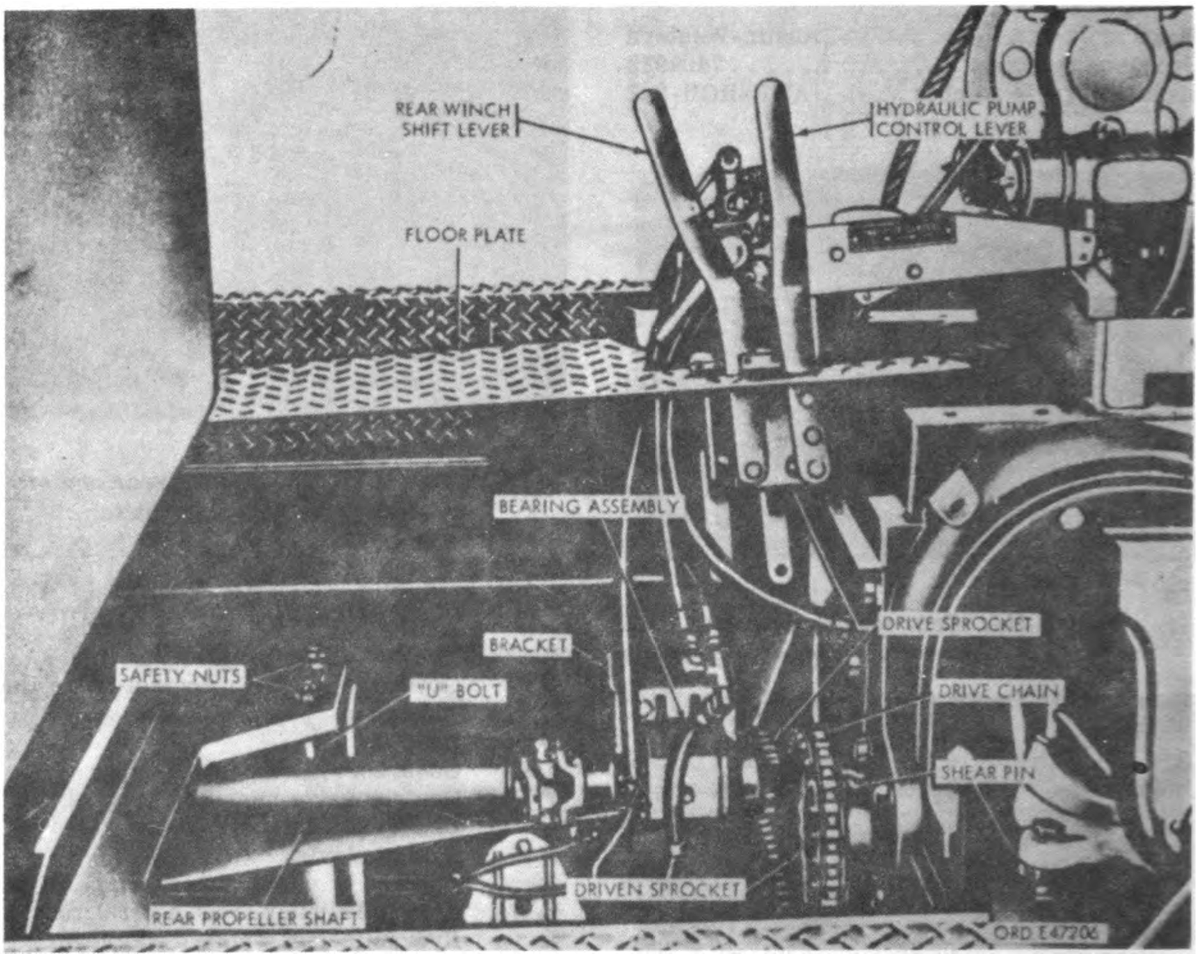


Figure 418. Left side view of rear end of wrecker body with floor plate raised - M62

g. Swing Motor.

Make	Austin-Western
Ordnance number	7409871
Manufacturer's number	AWR-HCU-244

h. Boom Hoist Hydraulic Motor.

Make	Vickers
Type	vane
Ordnance number	7409635
Manufacturer's number	VKR-M2-540-150-6FC-11

i. Control Valve Bank Assembly.

Make	Austin-Western
Ordnance number	8330173
Manufacturer's number	AWR-HCU-310

j. Power Takeoff.

Manufacturer .....Timken Detroit Axle Co.
Manufacturer's number........ TD-P138A

k. Power Divider.

Manufacturer..... Gar Wood Industries Inc.
Manufacturer's number...... GW-M306098
Ordnance number..............7413950

l. Pillow Block.

Manufacturer... Stephens-Adamson Mfg. Co.
Manufacturer's number........ SAH-NP24
Ordnance number..............7409905

m. Drive Sprocket Bearing Assembly.

Manufacturer..... Gar Wood Industries Inc.
Manufacturer's number...... GW-M305897
Ordnance number..............7409904

Section II. TROUBLESHOOTING

296. Purpose

Note. Information in this section is for use of Ordnance maintenance personnel in conjunction with and as a supplement to the troubleshooting section in the pertinent operator's manual. It provides the continuation of instructions where a remedy in the operator's manual refers to Ordnance maintenance personnel for corrective action.

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.

297. General Instructions and Procedures

This chapter contains inspection and troubleshooting procedures to be performed while a disabled component is still mounted in the vehicle and after it has been removed.

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 avoid possible damage or injury and also to determine the conditions of and, when possible, what is wrong with the defective component.

b. The troubleshooting performed while the component is mounted in the vehicle is that which is beyond the normal scope of using organization. These troubleshooting operations are used to determine if the fault can be remedied without removing the component from the vehicle and also, when subsequent removal is necessary, to indicate when repair can be made without complete disassembly of the component.

Note. Thoroughly check for oil leakage of each component while mounted in the vehicle as all units operate under 1200 psi during normal operation. This pressure cannot be applied after removal.

c. 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 last case because it is often the only means of determining the trouble without completely disassembling the component.

298. Lift Cylinder

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 296 for the purpose of these inspections.

(2) Detailed procedures.

(a) Inspect for oil leakage. Visually inspect all gasket joints, oil seals, and fittings for evidence of oil leakage. Leakage at gasket joints may be caused by loose mounting bolts or defective gaskets. Tighten all mounting bolts where leakage has occurred. If mounting bolts are tight and leakage continues, install new gasket (par. 333). When possible, replace gaskets without removing unit from the vehicle.

(b) Inspect for damaged castings. Visually inspect the cylinder and head for damaged or cracked castings. Replace all damaged castings.

(3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal causes of failure, and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Boom will not raise. Start the wrecker crane in operation and pull the boom control valve to UP position. Should the boom fail to raise, check oil level in reservoir and for oil leakage at connectors. If no leakage is evident, reservoir contains proper oil level, and pump is delivering proper pressure (par. 294), replace lift cylinder (par. 316).

(b) Scored or damaged piston rod. Place the boom in the extreme UP position and note any damaged or scored condition of the piston rod. If damage is evident, replace (par. 333).

(c) Piston rod bushings worn. Replace bushings (par. 333).

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the left cylinder has been removed from the wrecker crane or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

(2) Detailed procedures.

(a) Piston rod bushings worn. Replace bushings (par. 333).

(b) Piston rod scored. Replace (par. 333).

(c) Cracked cylinder or casting. Replace defective component (par. 333).

(d) Defective gaskets or packing. Disassemble and replace defective gaskets and packing (par. 333).

(e) Evidence of internal damage. Rebuild the lift cylinder assembly (par. 333).

299. Swivel Valve

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 296 for the purpose of these inspections.

(2) Detailed procedures.

(a) Inspect for oil leakage. Visually inspect for oil leakage (par. 297b).

(b) Inspect for damaged castings. Visually inspect swivel valve body and inner hub for cracks or other damage. Note any defective threads at hydraulic line connections. If damage is evident, replace (par. 314).

(3) Further procedures. If these inspections do not disclose the fault, and the wrecker is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal causes of failure, and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 296a for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Inspect for oil leakage. With the wrecker crane in operation and the hydraulic system at operating pressures, inspect all hose connections and gasket joints. Tighten connections or replace damaged connections and gaskets as required (par. 334).

(b) Defective castings. Replace swivel valve body and inner hub (par. 334).

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the swivel valve has been removed from the wrecker crane or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purposes and scope of these procedures.

(2) Detailed procedures.

(a) Inspect for oil leakage. With the swivel valve removed, leakage inspections are limited as the unit operates under 1200 psi in the system. Tighten hose connections and swivel valve cap.

(b) Excessively worn or damaged inner hub. Replace swivel valve body and inner hub (par. 334).

(c) Damaged swivel valve body. Replace swivel valve body and inner hub (par. 334).

300. Swing Motor

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 296 for the purpose of these inspections.

(2) Detailed procedures.

(a) Inspect for oil leakage. See paragraph 298a.

(b) Damaged or cracked components. Inspect for damaged or cracked swing motor body. For cracked bodies, damaged or scored piston rods, the swing motor must be rebuilt (par. 338).

(3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal causes of failure, and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Inspect for oil leakage. Start the wrecker crane and operate the swing motor. Inspect for leakage at piston rods and hydraulic line connections. If leakage is still evident after tightening, replace gaskets (par. 338).

(b) Damaged motor bodies and scored piston rods. Inspect piston rods for scored condition while swing motor is in operation. Note any irregularities of operation. Replace damaged components (par. 338).

(c) Sticking control valve spool. Revolve the pivot post of the wrecker crane and note if control valve actuating lever of the swing motor is in constant contact with roller on base plate. If this lever does not contact roller at all times, remove spool (par. 338) and check for dirt or burs.

(d) Irregularity of operation. Swing motor out of timing. Time swing motor (par. 351).

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the swing motor has been removed from the wrecker crane or if it has been received already removed, further inspection is necessary. Refer to paragraph 297b for purpose and scope of these procedures.

(2) Detailed procedures.

(a) Inspect for oil leakage. With the swing motor removed, oil leakage inspection is limited. See paragraph 298a.

(b) Defective castings and covers. Thoroughly inspect covers and bodies for cracks or damaged screw threads. Defective units must be replaced (par. 338).

(c) Scored piston rods. Replace piston rods (par. 338).

(d) Sticking control valve spool. Disassemble and check for dirt or burs (par. 338).

301. Control Valve Bank

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 297a. for the purpose of these inspections.

(2) Detailed procedures.

(a) Inspect for oil leakage. Visually inspect all hydraulic flexible line connections, gaskets, and castings for evidence of oil leakage.

(b) Control valve spool sticking. Operate each control valve and note any sticking or irregularities in their operation. Generally a binding condition in any of the control valves may be removed by backing off one turn the hex-head cap screw and hex nut which hold the control valve front cover to the control valve body. If binding condition still persists, remove the sticking spool and inspect for displaced chevron seals, dirt, burs, or scored condition. Damaged spool requires replacement of body and spool (par. 336).

(c) Control valve body. Inspect control valve body for cracks, defective threads, and sealing between bodies. Replace valve body and spool if either is found defective (par. 336).

(3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal causes of failure, and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Inspect for oil leakage. If the visual inspections (par. 298a) do not reveal leakage, start the wrecker crane and operate each control lever of the control valve bank. Thorough inspection must be made at this time while the system is under full pressure. If any leaks are evident, after operating all four control valves, remove control valve spool from any defective unit and replace damaged seals or gaskets (par. 336).

(b) Defective valve bodies and spools. Inspect in same manner as (a) above and if found defective the control valve bank must be rebuilt (par. 336).

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the control valve bank has been removed from the vehicle or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

(2) Detailed procedures.

(a) Oil leakage. After thorough cleaning of the complete control valve bank, inspect all gasket joints and seals for damage or evidence of leakage. Replace any defective seals and gaskets (par. 336).

(b) Control valve bodies and spools. Check each spool for scored condition or burs at edges. Replace body and spools in pairs if damage is evident (par. 336). Inspect threads at hydraulic line connections and general condition of each component.

302. Hydraulic Oil Motor

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 297a for purpose of these inspections.

(2) Detailed procedures.

(a) Inspect for oil leakage. Visually inspect the hydraulic oil motor for evidence of oil leakage around motor housing and flexible lines. Tighten any connections or mounting bolts found leaking (par. 330).

(b) Inspect for defective castings. Visually inspect cover, cam ring, and body for defective castings or damaged threads. Defective components must be replaced (par. 330).

(3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal causes of failure and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Oil leakage. Operate the hydraulic oil motor under full load and watch for oil leakage at connectors, lines, and body gaskets. Defective gaskets must be replaced (par. 330).

(b) Inspect cover, cam ring, and body. During operation, check for evidence of cracks in castings and leaks around fittings. Defective components must be replaced (par. 330).

(c) Motor will not turn. This may be due to dirt, seized components, or other internal damage. Rebuild motor (par. 330).

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the hydraulic oil motor has been removed from the wrecker crane or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

(2) Detailed procedures.

(a) Motor will not turn. Rebuild hydraulic oil motor (par. 330).

(b) Damaged motor body, cover, or cam ring. Thoroughly clean the complete assembly and inspect screw threads at line connections. Replace any defective or damaged components (par. 330).

(3) Drive shaft loose in pump. Loose drive shaft may be due to worn bearings. Install new bearings (par. 330). If any other irregularities are noted while turning the drive shaft, motor must be disassembled (par. 330) to locate the cause.

(4) Inspection after disassembly of hydraulic motor. Check the condition of the cam ring. The internal contour must be smooth. Any distortion or roughness on this surface will require replacement of the ring. Revolve bearings and if any indication of roughness is present, replace bearings. Pay particular attention to sealing edges of oil seal. Replace any damaged seals (par. 330).

303. Hydraulic Pump

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 297a for purpose of these inspections.

(2) Detailed procedures. Inspect the hydraulic pump in the same manner as described in paragraph 302, hydraulic oil motor.

(3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal causes of failure, and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Inspect for oil leakage. See paragraph 302a.

(b) Pump will not turn. Adjust pump control linkage (see TM 9-837).

(c) Pump speed erratic. Shift linkage at governor 3-way valve out of adjustment. Adjust linkage (TM 9-837).

(d) Noisy hydraulic pump (cavitation). Check oil level in reservoir and make certain oil supply valve is open.

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the hydraulic pump has been removed from the wrecker crane or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

(2) Detailed procedures. Troubleshoot the hydraulic pump in the same manner as prescribed for the hydraulic oil motor (par. 302).

304. Hoist Drum and Worm and Drive Gear Set

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 297a for the purpose of these inspections.

(2) Detailed procedures.

(a) Inspect for lubricant leakage. Check the gear case for lubricant leakage at gasket joints. Tighten all mounting bolts and if leakage is still evident, install new gaskets (par. 331).

(b) Inspect cable drum and mountings. Visually inspect drum mounting to shipper. Also check for any defects in the drum and whether cable properly follows cable grooves. Any defective components must be replaced or rebuilt (par. 331).

(3) Further procedures. If these inspections do not disclose the fault, and the vehicle is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal cause of failure and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Hoist drum will not turn. Prepare the wrecker crane for operation and operate the hoist control lever to UP or DOWN position. If the drum does not turn, check hydraulic system.

(b) Hoist drum turns and cable slips. Remove cable from drum and tighten hoist cable wedge in drum.

(c) Noise worm and gear. Gear noise is usually due to lack of lubricant. Check lubricant level. If the gear case has proper lubricant level and noise is still present, rebuild hoist drum and worm and drive gear set (par. 331).

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the hoist drum and worm and drive gear set has been removed from the wrecker crane or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

(2) Detailed procedures.

(a) Inspect gear case and hoist drum. Thoroughly clean the gear case, drum housing and drum, and inspect for cracked or damaged castings. Cracked castings must be replaced (par. 331).

(b) Excessive wear at worm. Turn the worm and note any excessive clearance or faulty alinement between worm and drive gear. Adjust worm and drive gear set (par. 331).

(c) Loose or worn bearings. Install new bearings (par. 331).

(d) Lubricant leakage at hoist drum hub. Install new seal (par. 331).

305. Base Plate and Pivot Post Assembly

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 297a for the purpose of these inspections.

(2) Detailed procedures. Troubleshooting of the base plate and pivot post assembly before operation is limited to visual inspection of the components. Check for defective weld, cracked posts, or support plates. Check for proper lubrication of the ring gear. Repair broken welds if inspection warrants.

(3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal causes of failure and the wrecker crane is operable, start the wrecker crane and continue to troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Excessive end play in pivot post. With the wrecker crane in operation, swing the boom to the right and left. Excessive looseness in pivot post will require adjustment of pivot post bearings (par. 356).

(b) Shipper supports loose at pivot post. Tighten shipper support bolts (par. 312).

(c) Inspection of ring gear, pivot bearings, drive pinion, and idler gear. Any irregularities noticed during operation pertaining to the internal parts will require disassembly for further inspection (par. 335).

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the base plate and pivot post assembly has been removed from the truck or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for the purpose and scope of these procedures.

(2) Detailed procedures.

(a) Bearings and cups. Inspect bearing cups for pitted, scratched, or scored condition. Replace any defective bearings and cups (par. 335).

(b) Drive pinion, idler gear, and ring gear. Inspect drive pinion, idler gear, and ring gear for broken, cracked, or chipped teeth. Replace defective gears (par. 335).

(c) Base plate and pivot post. Inspect base plate for defective welds or cracks. Minor defects can be repaired by welding. Also check pivot posts for cracks or other defects and replace as inspection warrants (par. 335).

304. Shipper and Boom Assembly

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the wrecker crane prior to completing the procedures given in this paragraph. Refer to paragraph 297a for the purpose of these inspections.

(2) Detailed procedures.

(a) Oil leakage. Inspect the boom cylinder for oil leakage, paying particular attention to the hydraulic line connections.

(b) Boom. Check boom for cracked welds or bent condition. Defective welds can be repaired by welding. Replace boom if damage is excessive (par. 332).

(c) Rollers. Inspect the boom rollers for worn or damaged condition. Replace defective rollers (par. 332).

(d) Pivot shafts and pins. Inspect the pivot shafts and pins for excessive wear and replace if inspection warrants (par. 332).

(3) Further procedures. If these inspections do not disclose the fault and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal causes of failure and the wrecker crane is operable, start the wrecker crane and continue to troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Boom will not extend or retract. Operate the crowd control lever to EXTEND and RETRACT position. If boom does not respond, check oil level in the hydraulic system. Note any binding of the boom in the shipper. Bent boom or shipper must be replaced (par. 332).

(b) Excessive looseness at boom rollers. Inspect the boom rollers for free turning or defective bearings. Replace defective parts (par. 332).

(c) Boom will not respond to control valve. The shipper and boom must be disassembled (par. 332) and further inspection is necessary.

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the shipper and boom assembly has been removed from the wrecker crane, or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

(2) Detailed procedures.

(a) Boom cylinder. Inspect the boom cylinder and piston rod for nicks, scratches, or scoring. Check the cylinder head seals and gaskets for evidence of leakage. Inspect piston cups for worn condition, and the piston for looseness on end of piston rod. Also note any broken welds. Replace or repair damaged components (par. 332).

(b) Boom rollers. Inspect boom rollers for wear or damaged bearings. Pitted or worn bearings must be replaced (par. 332).

(c) Boom. Turn the boom sheaves and note condition of needle bearings. Replace defective bearings and sheaves (par. 332). Broken welds on the boom may be repaired by welding.

(d) Shipper. Inspect shipper pivot shaft bushings for wear or scoring. Replace damaged bushings. Examine rear bottom roller for excessive wear and replace damaged bearings or worn shaft (par. 332). Examine hoist drum and worm and drive gear mounting brackets on the rear for broken welds. Repair by welding

307. Wrecker Body Outriggers, and Oil Reservoir

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the vehicle prior to completing the procedures given in this paragraph. Refer to paragraph 297a for the purpose of these inspections.

(2) Detailed procedures.

(a) Oil leakage. Inspect the oil reservoir for leakage at welds. Minor cracks at welds can be repaired.

(b) Wrecker body and outriggers. Inspect the wrecker body and outriggers for damaged or bent condition. Minor damage may be repaired. Any extensive damage will require replacement of the damaged components.

(3) Further procedures. If these inspections do not disclose the fault, and the wrecker crane is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in the preceding paragraph do not reveal causes of failure and the wrecker crane is operable, then troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures. Visually inspect the wrecker body, outriggers, and oil reservoir during operation and note any distortion or damaged welds not revealed before operation. Repair or

replace damaged components as inspection warrants.

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c. below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the wrecker body, outriggers, and oil reservoir have been removed from the vehicle, or if they have been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

(2) Detailed procedures. After thoroughly cleaning the complete assemblies, further troubleshooting is limited to visual inspection of the components. Check closely for damage not revealed during procedures covered in a and b above. Repair minor broken welds and straighten bent sheet metal. Major damage to any component will require replacement of the component (par. 339).

308. Rear Mounted Winch

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the rear mounted winch prior to completing the procedure given in this paragraph. Refer to paragraph 297a for the purpose of these inspections.

(2) Detailed procedures. Troubleshooting before removal or operation is limited to visual inspection of the complete assembly. Check the mounting bolts, alinement, and general condition of the winch assembly. Replace any damaged components.

(3) Further procedures. If these inspections do not disclose the fault, and the rear mounted winch is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not reveal causes of failure and the rear mounted winch is operable, then troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Winch drum will not turn. This condition can be caused by linkage out of adjustment or shear pin failure. Adjust linkage or replace shear pin as necessary. Refer to TM 9-2320-211-20.

(b) Noisy operation. Check lubricant level (LO 9-2320-211-12).

(c) Excessive heat of brake case. Adjust automatic brake (par. 42).

(d) Winch fails to hold load. This condition is caused by the automatic brake lining becoming excessively worn or in need of adjustment. Adjust brake (par. 42) or replace brake band assembly.

(e) Broken drive chain. Replace broken link.

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the rear-mounted winch has been removed from the vehicle or if it has been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

(2) Detailed procedures.

(a) Oil leakage at gear case. Replace gaskets.

(b) Drive worm will not turn. Disassemble and replace defective components (par. 337).

(c) Drum turns on drum shaft. Disassemble and replace drum.

(d) Miscellaneous inspections. Inspect the rear-mounted winch after it has been removed, paying particular attention to cracked or damaged castings. Make sure bearings are free in level wind rollers. Rebuild the assembly as inspection indicates (par. 337).

309. Wrecker Power Train

a. Troubleshooting Before Removal or Operation.

(1) General. Do not operate the vehicle prior to completing the procedures given in this paragraph. Refer to paragraph 297a for the purpose of these inspections.

(2) Detailed procedures.

(a) Power divider. Inspect the power divider for oil leakage. Visually inspect gasket joints and seals on power divider. Tighten all mounting bolts and if leakage continues, disassemble and replace gaskets or seals (par. 343).

(b) Drive sprockets bearing assembly. Visually inspect the bearing assembly for general overall condition. If evidence of excessively worn bearings is found, replace damaged components (par. 346).

(c) Pillow block. Visually inspect the pillow block for cracked castings and general overall condition. Repair or replace defective parts.

(d) Drive shafts. Check the universal joints on the drive shafts. Repair or replace defective drive shafts.

(3) Further procedures. If these inspections do not disclose the fault, and the vehicle is operable, proceed as specified in b below.

b. Troubleshooting Before Removal and During Operation.

(1) General. If the inspections in a above do not disclose causes of failure, and the vehicle is operable, then troubleshoot it. Refer to paragraph 297b for the purpose and scope of these troubleshooting procedures.

(2) Detailed procedures.

(a) Drive line will not turn. Shift linkage out of adjustment. Adjust linkage.

(b) Pump speed erratic. Adjust governor at power divider.

(c) Noisy drive line. Check lubricant level in power divider. (See lubrication chart.) Also inspect universal joint journal bearings for looseness or worn condition. Replace as inspection indicates.

(d) Lubricant leakage. After operation inspect gasket joints and seals for leakage. Replace leaking seals and gaskets (par. 343).

(e) High temperature in pillow block or drive sprocket bearing assembly. High temperature is usually an indication of lack of lubricant. (See lubrication chart.)

(3) Further procedures. If these troubleshooting procedures do not disclose the fault, proceed as specified in c below.

c. Troubleshooting After Removal and Before Operation.

(1) General. After the power divider, drive sprocket bearing assembly, drive shafts, and pillow block have been removed from the vehicle, or if they have been received already removed, further inspection is necessary. Refer to paragraph 297c for purpose and scope of these procedures.

(2) Power divider.

(a) Lubricant leakage. Inspect gasket joints and seals for damage and lubricant leakage and replace as required (par. 343).

(b) Internal defects. Shift the power divider into the various ranges and turn by hand. Note any roughness, such as scored shafts, loose bearings, burred or chipped gear teeth. Any defects noted on internal parts during inspection will require disassembly and rebuild of the power divider (par. 343).

(3) Drive shafts. Inspect drive shafts for bent condition. Also note universal joints bearing journals for excessive wear. Replace damaged components.

(4) Pillow block. Inspect bearing in pillow block for free rotation. If bearing binds, replace (par. 342). Also inspect for cracked castings or broken condition. If defects are noted, replace (par. 342).

(5) Drive sprocket bearing assembly.

(a) Housing. Inspect housing for cracks or breaks. Replace if any are detected (par. 346).

(b) Shaft. Inspect shaft for cracks or damaged splines. Replace if inspection warrants (par. 346).

(c) Bearings. Rotate shaft and check for scored or seized condition of bearings. Defective bearings must be replaced (par. 346).

(d) Oil seals. Inspect oil seal contact material to see that it is pliable and shows no evidence of burning. Replace defective seals (par. 346).

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

310. General

a. This section contains information for the guidance of personnel performing major repair work on the 5-ton, 6 x 6, wrecker truck, M62. It provides an assembly line procedure for the disassembly of the hydraulic crane into its major components. It designates what constitutes a major component and also identifies the points of connection between major components.

b. Before cleaning or washing, inspect the entire wrecker crane and rear winch for cracks, leaks, and loose or shifted parts or assemblies, as these will be more evident if surfaces are soiled or dusty. Take note of any defects for later use in repair operations.

311. Hydraulic Pump and Relief Valve

a. Removal (Fig. 419).

(1) Remove power divider assembly (par. 327).

(2) Remove six cap screws and lockwashers securing hydraulic pump and relief valve assembly to pump adapter at rear of power divider.

(3) Remove pump to relief valve hydraulic piping, with hydraulic pump assembly attached, from relief valve.

(4) Remove relief-valve-to-reservoir hydraulic piping from relief valve.

(5) Remove reservoir-to-pump hydraulic piping from pump.

(6) Remove pump-to-relief-valve hydraulic piping from pump.

b. Installation (Fig. 419).

(1) Install pump-to-relief-valve hydraulic piping in pump outlet port.

(2) Install reservoir-to-pump hydraulic piping in pump inlet port.

(3) Install relief-valve-to-reservoir hydraulic piping in relief valve output port.

(4) Install relief valve, with relief-valve-to-reservoir hydraulic piping attached on pump-to-relief-valve hydraulic piping.

(5) Position new gasket on pump flange, aline key on pump shaft with keyway in hydraulic pump output shaft coupling, and position pump on adapter at rear of power divider. Install six cap screws with lockwashers in holes

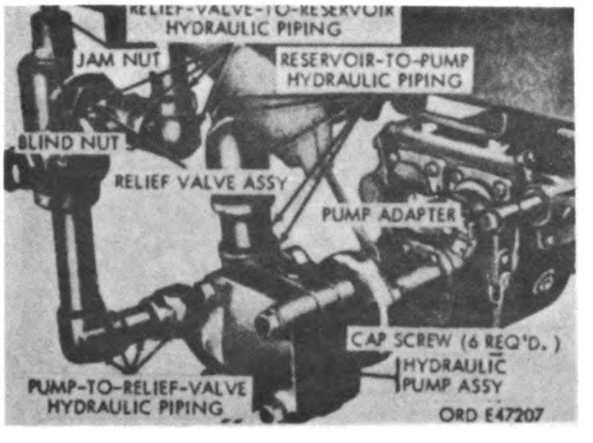


Figure 419. Removing hydraulic pump and relief valve assembly from power divider (M62)

in adapter and pump flanges, and tighten screws.

(6) Install power divider assembly (par. 327).

312. Base Plate and Pivot Post Assembly

a. Removal.

(1) Remove boom and shipper assembly (par. 315).

(2) Remove boom lift cylinder (par. 316).

(3) Remove swing motor (par. 313).

(4) Remove eight cap screws (fig. 414) and lockwashers securing floor plate to crane body. Remove two cap screws (fig. 420) and safety nuts securing floor plate to support bracket. Remove two cap screws (fig. 414) and safety nuts securing mounting bracket to crane body.

(5) Remove cotter pin and yoke pin securing rear-winch rear control rod (fig. 415) to lower end of rear winch shift lever (fig. 418) and remove rod from lever.

(6) Remove cotter pin and yoke pin securing hydraulic-pump rear control rod (fig. 415) to lower end of hydraulic pump control lever (fig. 418), and remove rod from lever.

(7) Remove cotter pin and yoke pin securing rear-winch rear control rod (fig. 415) to rear-winch left relay lever (fig. 416), and remove rod from lever.

(8) Remove cotter pin and yoke pin securing hydraulic-pump rear control rod (fig. 415) to hydraulic-pump left relay lever (fig. 416), and remove rod from lever.

(9) Raise floor plate (fig. 418) to permit access to base plate rear U-bolts, and prop plate in raised position.

(10) Remove 12 safety nuts (fig. 399) from six U-bolts and remove two cap screws and lockwashers securing base plate to crane body.

(11) Disconnect rear-winch front propeller shaft (fig. 416) from rear-winch rear propeller shaft (fig. 415). Refer to paragraph 327.

(12) Disconnect rear propeller shaft from bearing assembly (fig. 418). Refer to paragraph

(13) Disconnect swivel-valve-to-relief-valve line (fig. 409) from relief valve outlet, and disconnect swivel-valve-to-reservoir-inlet-tee line from pipe tee at relief valve.

(14) Disconnect swivel-valve-to-reservoir line (fig. 409) from reservoir inlet coupling (fig. 416), remove clamp securing line to top of relief valve, and remove line from valve.

(15) Disconnect floodlight cable (fig. 409) from wiring harness.

(16) Remove hex-nut from cap screw (fig. 421) securing base plate to hydraulic lines support bracket (fig. 409).

(17) Place a chain under the operator's compartment and between the shipper support (fig. 421), and using overhead hoisting equipment, remove base plate and pivot post assembly from crane body.

(18) Remove slip yoke from splined end of rear-winch rear propeller shaft (fig. 415), and remove shaft from pillow block and cross members welded to underside of base plate.

(19) Remove rear-winch rear control rod and hydraulic-pump rear control rod

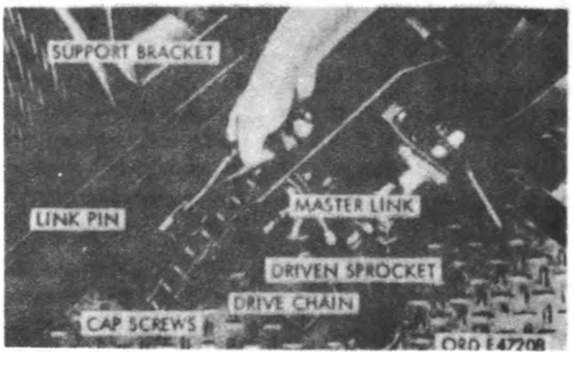


Figure 420. Separating rear winch drive chain (M62)

from cross members welded to underside of base plate (fig. 415).

b. Installation.

(1) Insert rear-winch rear control rod (fig. 415) and hydraulic-pump rear control rod through holes in right end of cross members, and position rods on underside of base plate.

(2) Insert rear-winch rear propeller shaft (fig. 415) through holes in left end of cross members, and position shaft on underside of base plate with splined end of shaft extending through pillow block.

(3) Using overhead hoisting equipment, lift base plate and pivot post assembly into position on crane body and guide base plate mounting U-bolts (fig. 399) through holes in base plate.

(4) Install 12 safety nuts (fig. 399) on the six U-bolts, and install four cap screws with lockwashers in holes in base plate and crane body. Tighten nuts and screws.

(5) Place hydraulic lines over support bracket (fig. 409), and secure bracket to base plate with cap screw (fig. 421) and hex-nut.

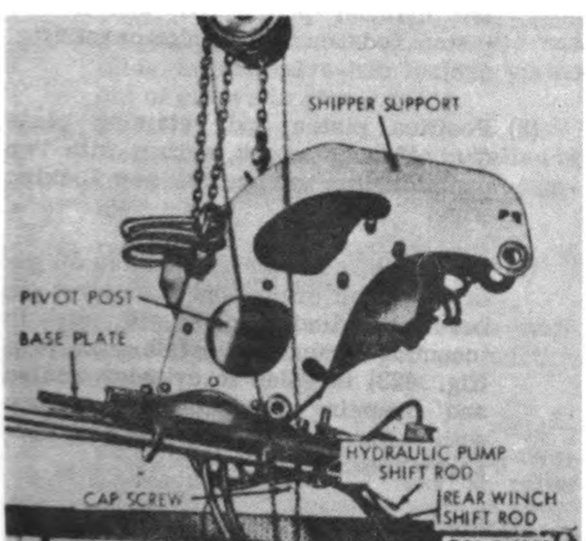


Figure 421. Removing base plate and pivot post assembly from crane body (M62)

(6) Connect floodlight cable (fig. 409) to wiring harness.

(7) Connect swivel-valve-to-reservoir line (fig. 409) to reservoir inlet coupling (fig. 416), position line at top of relief valve (fig. 409) and secure with clamp.

(8) Connect swivel-valve-to-relief-valve line (fig. 409) to relief valve outlet, and connect swivel-valve-to-reservoir-inlet-tee line to pipe tee at relief valve.

(9) Connect rear-winch rear propeller shaft (fig. 418) to yoke at bearing assembly.

(10) Slide slip yoke on splined end of rear propeller shaft (fig. 415) and connect yoke to rear-winch front propeller shaft (fig. 416). Refer to paragraph 327.

(11) Remove prop supporting floor plate (fig. 418) in raised position, and position floor plate on crane body. Secure with eight cap screws (fig. 414) and lockwashers.

(12) Secure floor plate to support bracket (fig. 420) with two cap screws and safety nuts, and secure mounting bracket (fig. 414) to crane body with two cap screws and safety nuts.

(13) Position hydraulic-pump rear control rod (fig. 415) on hydraulic-pump left relay lever (fig. 416), and secure with yoke pin and cotter pin.

(14) Position hydraulic-pump rear control rod on lower end of hydraulic pump control lever (fig. 418), and secure with yoke pin and cotter pin.

(15) Position rear-winch rear control rod (fig. 415) on rear-winch left relay lever (fig. 416), and secure with yoke pin and cotter pin.

(16) Position rear-winch rear control rod on lower end of rear winch shift lever (fig. 418), and secure with yoke pin and cotter pin.

(17) Install swing motor (par. 313).

(18) Install boom lift cylinder (par. 316).

(19) Install boom and shipper assembly (par. 315).

(20) Lubricate hydraulic crane and rear winch drive (LO 9-2320-211-12).

313. Swing Motor

a. Removal.

(1) Rotate pivot post and boom assembly 90° to the left so that boom is extended over right side of truck.

(2) Remove eight cap screws (fig. 422) and lockwashers securing swing motor cover to crane body, and lift cover from body.

(3) Cut locking wire, remove two cap screws securing piston rod retaining plate (fig. 423) to drive pinion crank, and remove plate from crank.

(4) Unscrew four nuts (fig. 423) securing hydraulic lines to elbows installed in swing - hydraulic - motor cylinder assemblies, and remove lines from elbows.

Note. Place identification tags on lines and elbows to facilitate swing motor installation.

(5) Loosen two locknuts (fig. 423) and setscrews securing pivot pins in mounting brackets welded to base plate, and drive pins from cylinder bodies and brackets, and remove from underside of base plate.

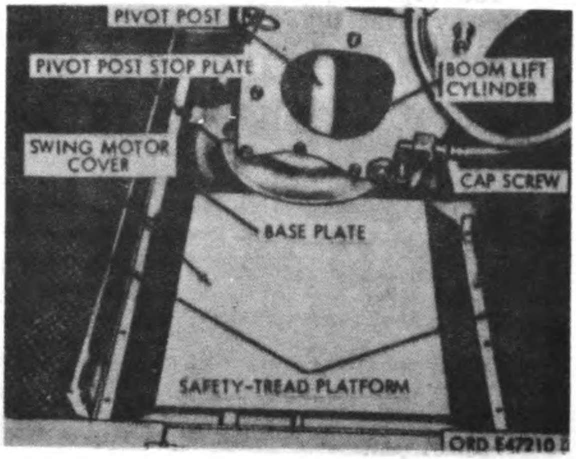


Figure 422. View of lower section of crane revolving structure

Figure 423. Removing piston retaining plate from drive pinion crank (M62)

(6) Pivot each of the cylinder assemblies on the drive pinion crank to free cylinder bodies from the mounting brackets. Lift the two cylinder assemblies together from the drive pinion crank. Pull the piston rods apart to separate the cylinder assemblies.

b. Installation.

(1) Position right cylinder piston rod over left cylinder piston rod, and install piston rods on drive pinion crank (fig. 423).

(2) Position piston rod retaining plate (fig. 423) on crank, secure with two cap screws, and install new locking wire.

(3) Pivot both cylinder assemblies on the drive pinion crank, and aline pivot pin bores in cylinder bodies with holes in mounting brackets. Install pivot pins (fig. 423) in holes in cylinder bodies and mounting brackets, and secure with setscrews. Tighten the two setscrew locknuts.

(4) Position four hydraulic lines at elbows installed in left and right cylinder assemblies, and tighten connector nuts (fig. 423).

(5) Time swing motor (refer to par. 351).

(6) Position swing motor cover (fig. 422) on crane body, and secure with eight cap screws and lockwashers.

314. Swivel Valve

a. Removal.

(1) Disconnect floodlight cable (fig. 401) from connector at rear of floodlight.

(2) Disconnect oil motor bypass line (fig. 424) at hoist oil motor. Loosen cap screw (fig. 401) securing hose clip to bracket, and remove oil motor bypass line from clip and bracket.

(3) Using overhead hoisting equipment, raise the shipper and boom assembly to the extreme upward position.

Note. When raising boom, hold boom control lever in "UP" position to permit the oil in the lift cylinder to bypass.

(4) Disconnect four flexible hydraulic lines (fig. 401) and one return line (fig. 407) at control valve bank assembly.

Note. Place identification tags on hydraulic lines and control valve bank elbows to facilitate swivel valve installation.

(5) Loosen two hex-nuts (fig. 402), and slide swivel-valve-hub locking plates out of groove in swivel valve.

Note. One locking plate is installed at front and rear of swivel valve assembly.

(6) Disconnect floodlight cable (fig. 409) from wiring harness.

(7) Disconnect two swivel-valve-to-junction-block lines (fig. 409) at junction block.

(8) Disconnect swivel-valve-to-relief-valve lines (fig. 409) and swivel-valve-to-reservoir-inlet-tee line at relief valve.

(9) Disconnect swivel-valve-to-reservoir line (fig. 409) from reservoir inlet coupling (fig. 416), remove clamp securing line to top of relief valve (fig. 409), and remove line from valve.

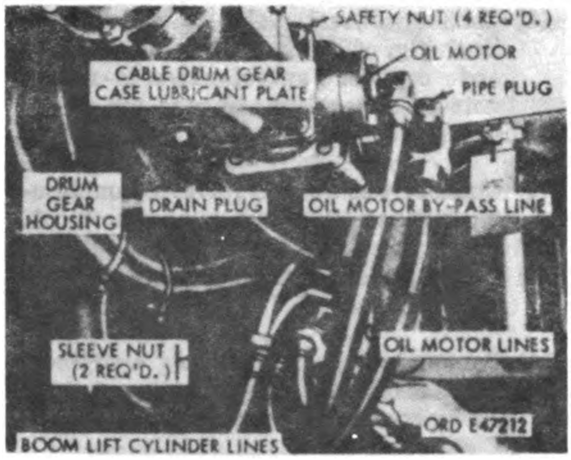


Figure 424. Disconnecting boom hoist hydraulic oil motor lines

(10) Using overhead hoisting equipment, lift swivel valve assembly (fig. 402), together with hydraulic lines, from pivot post, and remove from vehicle.

b. Installation.

(1) Using overhead hoisting equipment, support swivel valve assembly (fig. 402) over pivot post and feed floodlight cable and hydraulic lines attached to bottom of swivel valve through center of pivot post.

(2) Lower swivel valve assembly into position on top of pivot post support cap (fig. 402), and engage the two locking plates in groove in swivel valve. Tighten locking plate retaining nuts.

(3) Connect four flexible hydraulic lines (fig. 401) and one return line (fig. 407) at control valve bank assembly.

(4) Position oil motor bypass line (fig. 401) on bracket on left side panel in operator's compartment, and secure with clip. Tighten clip retaining cap screw.

(5) Connect oil motor bypass line (fig. 424) to hoist oil motor.

(6) Connect floodlight cable (fig. 401) to connector at rear of floodlight.

(7) Connect swivel-valve-to-reservoir line (fig. 409) to reservoir inlet coupling.

(8) Connect swivel-valve-to-relief-valve line (fig. 409) to relief-valve outlet, and connect swivel-valve-to-reservoir-inlet-tee line, to pipe tee at relief valve.

(9) Connect two swivel-valve-to-junction-block lines (fig. 409) at junction block.

(10) Connect floodlight cable (fig. 409) to wiring harness.

(11) Remove overhead hoisting equipment from boom and shipper assembly, and lower boom.

315. Boom and Shipper Assembly

a. Removal.

(1) Secure boom to shipper with a chain (fig. 425) to prevent boom from rolling out of shipper during removal of assembly.

(2) Remove boom hoist hydraulic oil motor and cable drum (par. 318).

(3) Using overhead hoisting equipment, raise the shipper and boom assembly to expose the lift cylinder pivot shaft (fig. 426).

Note. When raising boom, hold boom control lever in "UP" position to permit the oil in the lift cylinder to bypass.

(4) Loosen locknut (fig. 426) and setscrew and drive out lift cylinder pivot shaft.

(5) Lower boom and shipper assembly to the horizontal position, and remove overhead hoisting equipment.

Note. When lowering boom, hold boom control lever in "DOWN" position to permit the oil in the lift cylinder to bypass.

(6) Attach a chain sling to boom and shipper assembly (fig. 425), and using overhead hoisting equipment, raise hoist chain or cable just enough to support weight of boom and shipper assembly.

(7) Position a container to catch oil drainage from boom crowd cylinder, and disconnect two boom crowd cylinder hydraulic lines (fig. 405) at sleeve nuts. Insert corks or plugs in lines to prevent oil leakage.

(8) Remove safety nut (fig. 405) and hexhead bolt securing shipper pivot pin to shipper support, and drive pin from shipper support and from shipper.

(9) Lift boom and shipper assembly from shipper support (fig. 425), and remove from vehicle.

b. Installation.

(1) Using overhead hoisting equipment and chain sling (fig. 425), lift boom and shipper assembly into position between sides of shipper support.

(2) Aline pivot pin holes in shipper with holes in shipper support, and insert

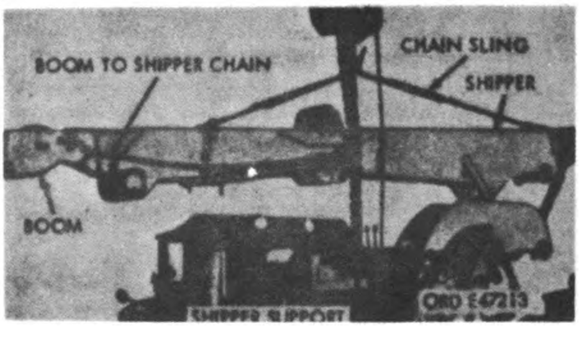


Figure 425. Removing boom and shipper assembly (M62)

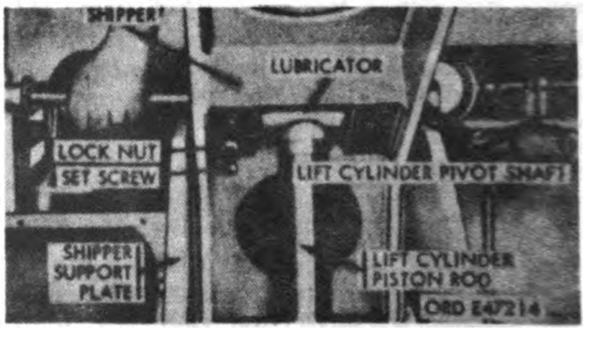


Figure 426. Removing lift cylinder pivot shaft (M62)

shipper pivot pin (fig. 405) in holes. Aline hole through right end of pin with holes in shipper support, insert hex-head bolt (fig. 405) through holes, and install safety nut on bolt.

Note. A nut is welded to left end of pivot pin to facilitate alining holes for hex-head bolt.

(3) Remove overhead hoisting equipment and chain sling from boom and shipper assembly, attach hoist to front end of boom and raise boom to expose lift cylinder pivot shaft holes.

(4) Aline pivot shaft bore in upper end of lift cylinder piston rod (fig. 426) with pivot shaft holes in shipper, and install lift cylinder pivot shaft (fig. 426). Tighten locknut and setscrew on underside of shipper.

(5) Remove plugs from the two boom crowd crowd cylinder hydraulic lines (fig. 405), and connect lines at sleeve nuts.

(6) Lower boom and shipper assembly to the horizontal position, and remove hoist.

Note. When lowering boom, hold boom control lever in "DOWN" position to permit the oil in the lift cylinder to bypass.

(7) Remove chain securing boom to shipper.

(8) Install boom hoist hydraulic oil motor and cable drum (par. 318).

(9) Lubricate hydraulic crane. (Refer to LO 9-2320-211-12.)

316. Boom Lift Cylinder

a. Removal.

(1) Disconnect two boom lift cylinder lines (fig. 424) at sleeve nuts directly below boom hoist hydraulic oil motor.

(2) Using overhead hoisting equipment, raise the boom and shipper assembly to the extreme upward position.

(3) Loosen locknut (fig. 426) and setscrew, and drive out lift cylinder pivot shaft.

(4) Remove the two lift cylinder lines, with nipples (fig. 400) and elbows attached, from lift cylinder ports.

(5) Remove cotter pin (fig. 400), and drive lift cylinder pivot shaft from shipper and lower end of cylinder.

(6) Using a chain hoist (fig. 427), lift the boom lift cylinder from shipper support, and remove from vehicle.

b. Installation.

(1) Using a chain hoist (fig. 427), lift the boom lift cylinder into position between the sides of the shipper support.

(2) Aline pivot shaft bore in lower end of cylinder (fig. 400) with holes in sides of shipper support, and install lift cylinder pivot shaft. Install cotter pin in end of shaft.

(3) Install lift cylinder lines, with nipples (fig. 400) and elbows, in lift cylinder ports.

Caution: The check valve installed in line connected to lower cylinder port restricts dropping speed of the load. Be sure that the lines are installed as shown in figure 400.

(4) Aline pivot shaft bore in upper end of lift cylinder piston rod (fig. 426) with

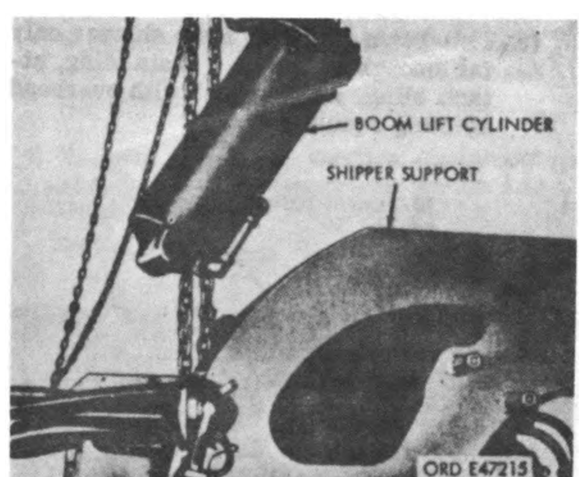


Figure 427. Removing boom lift cylinder

pivot shaft holes in shipper, and install lift cylinder pivot shaft. Tighten locknut and setscrew on underside of shipper.

(5) Lower boom and shipper assembly to the horizontal position, and remove overhead hoisting equipment.

(6) Connect the two boom lift cylinder lines (fig. 424) at sleeve nuts directly below boom hoist hydraulic oil motor.

(7) Lubricate upper lift cylinder pivot shaft. (Refer to LO 9-2320-211-12.)

317. Boom Crowd Cylinder

a. Removal.

(1) Remove boom and shipper assembly (par. 315), and place on suitable supports.

(2) Remove overhead hoisting equipment, chain, sling (fig. 425), and boom-to-shipper chain.

(3) Remove 45° elbow (fig. 406) with hydraulic line attached from piston rod.

(4) Bend lip on locking plate (fig. 406) away from outer nut, and remove outer nut, locking plate, and inner nut (located between locking plate and cylinder anchor) from piston rod.

(5) Pull boom (fig. 428) from shipper only far enough to attach a chain sling, attach sling, and support with overhead hoisting equipment.

Caution: When pulling boom from shipper to attach sling, support front (sheave) end of boom to prevent tilting which could cause serious injury to personnel.

(6) Pull boom from shipper, place boom on suitable supports, and remove hoist and chain sling.

(7) Remove cotter pins (fig. 429) and crowd-cylinder-collar-to-boom, and pull cylinder from boom far enough to permit attaching a chain sling.

(8) Attach chain sling (fig. 429) and overhead hoisting equipment to crowd cylinder, and remove cylinder from boom.

(9) Remove 90° elbow (fig. 429) with hydraulic line attached from crowd cylinder.

b. Installation.

(1) Install 90° elbow (fig. 429) with hydraulic line attached in port on top of crowd-cylinder head.

Note. Elbow and line cannot be installed after cylinder is anchored in boom.

(2) Supporting crowd cylinder with chain sling (fig. 429) and overhead hoisting equipment, slide cylinder into position inside boom. Remove hoist and chain sling.

(3) Aline holes in crowd-cylinder collar (fig. 429) with holes in sides of boom

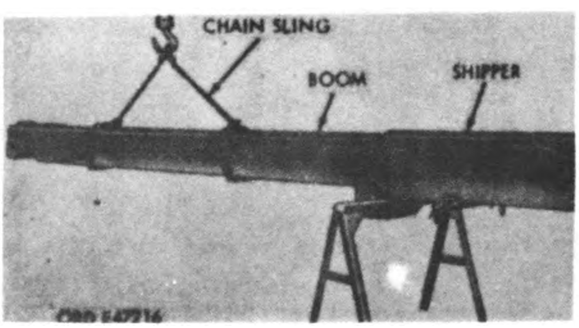


Figure 428. Removing boom from shipper

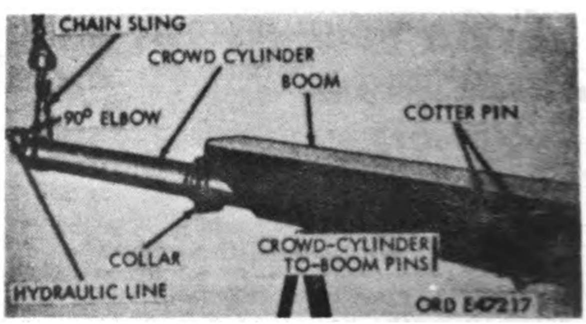


Figure 429. Removing boom crowd cylinder from boom

and install the two crowd-cylinder-to-boom pins. Secure pins with two cotter pins.

(4) Attach chain sling (fig. 418) to boom and support boom with overhead hoisting equipment. Insert end of boom in shipper, and slide boom inside shipper as far as it will go, guiding piston rod through hole in anchor (fig. 406) at rear of shipper.

(5) Install inner nut on piston rod (fig. 406) and tighten. Install locking plate and outer nut on piston rod. Tighten outer nut, and bend lip on locking plate against nut.

(6) Install 45° elbow (fig. 406) with hydraulic line attached in end of piston rod.

(7) Secure boom (fig. 425) to shipper with a chain to prevent boom from rolling out of shipper during installation of assembly, and attach a chain sling to shipper. Attach overhead hoisting equipment to sling, and support boom and shipper assembly.

(8) Install boom and shipper assembly (par. 315).

318. Boom Hoist Hydraulic Oil Motor and Cable Drum

a. Removal.

(1) Remove hoist cable from drum (c below).

(2) Attach a chain sling (fig. 430) to oil motor and cable drum assembly, attach overhead hoisting equipment to sling, and just support weight of assembly with hoist.

(3) Disconnect two oil motor lines (fig. 424) at sleeve nuts, and disconnect oil motor bypass line at oil motor.

Note. Place identification tags on oil lines to facilitate oil motor and cable drum installation.

(4) Remove three cap screws (fig. 430) and lockwashers securing right end of cable drums to shipper.

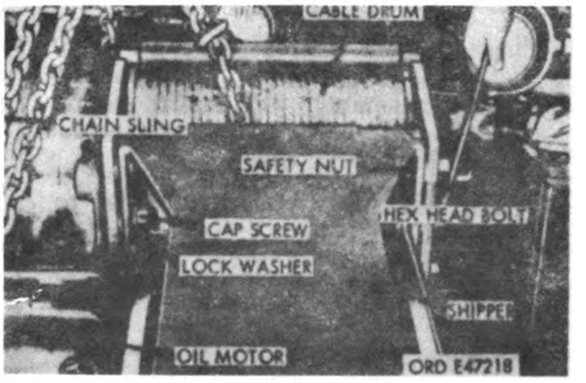


Figure 430. Removing boom hoist hydraulic oil motor and cable drum

(5) Remove three safety nuts (fig. 420) and hex-head bolts securing left end of cable drum to shipper, lift oil motor and drum assembly from shipper, and remove from vehicle.

b. Installation.

(1) Using overhead hoisting equipment, lift boom hoist hydraulic oil motor and cable drum (fig. 430) into position at rear of shipper.

(2) Aline mounting holes in left end of cable drum with holes in shipper (fig. 430), and insert three hex-head bolts through holes. Install three safety nuts on bolts and tighten.

(3) Install three cap screws (fig. 430) with lockwashers in holes in shipper and right end of cable drum, and tighten screws.

(4) Remove overhead hoisting equipment and chain sling from oil motor and cable drum.

(5) Connect two oil motor lines (fig. 424) at sleeve nuts, and connect oil motor bypass line to oil motor.

c. Hoist Cable Removal.

(1) Unwind hoist cable from drum. Refer to TM 9-2320-211-10.

(2) Drive cable wedge from drum, and remove cable from boom and boom sheaves.

d. Hoist Cable Installation.

(1) Thread hoist cable around boom sheaves, position on top of boom and shipper assembly, and insert end of cable in hole in drum. Secure cable to drum with cable wedge.

(2) Wind hoist cable on drum. Refer to TM 9-2320-211-10.

319. Control Valve Bank

a. Removal.

(1) Remove four cap screws and lockwashers securing control valve bank cover to operator's cab, and remove cover from cab.

(2) Disconnect all hydraulic lines from control valve bank (fig. 407) at sleeve nuts.

Note. Place identification tags on all hydraulic lines and connections to facilitate control valve bank installation.

(3) Remove four cap screws (fig. 407) and safety nuts securing control valve bank to cab, and lift bank from cab.

Note. The control valve bank is mounted in the cab on two mounting straps.

b. Installation.

(1) Position control valve bank (fig. 407) on mounting straps in crane operator's cab, and secure with four cap screws and safety nuts.

(2) Connect all hydraulic lines at sleeve nuts (fig. 407). Refer to paragraph 320.

(3) Position control valve bank cover in cab over control valve bank, and secure with four cap screws and lockwashers.

320. Hydraulic Lines and Fittings

a. Removal. Unscrew sleeve nut at both ends of flexible line or tube, remove clamps or brackets securing line or tube to crane, where used, and remove line or tube from vehicle.

Caution: Before disconnecting any hydraulic line, place identification tag on line and its corresponding port to prevent incorrect installation of hydraulic lines and crane components.

b. Installation. Position flexible line or tube on crane, secure with clamps or brackets where provided, and connect both ends of line or tube as given in (1) or (2) below.

(1) Using wrench, tighten all flexible-line sleeve nuts.

(2) Pull tube-fitting sleeve nuts up fingertight, then give nut a one-eighth turn only with a wrench.

Note. When installing new tubes and fittings, never tighten over two turns after sleeve has shouldered in body of fitting. Otherwise, the sleeve and tubing will be distorted, which will prevent a leak-proof seal.

321. Hydraulic Reservoir and Equipment Box

a. Removal.

(1) Remove power divider assembly (par. 327).

(2) Disconnect swivel-valve-to-reservoir line (fig. 409) from reservoir inlet coupling (fig. 416).

(3) Remove four safety nuts (fig. 431), two on each side, securing hydraulic reservoir and equipment box to mounting brackets attached to left and right frame side rails.

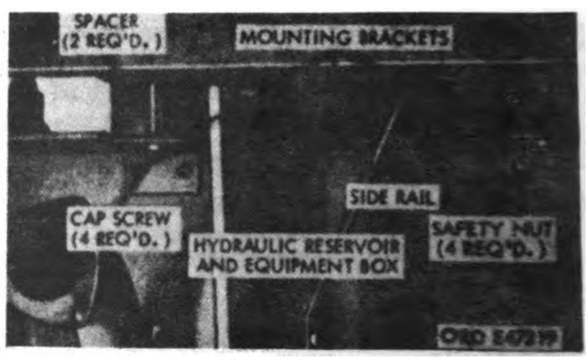


Figure 431. Hydraulic reservoir and equipment box mounting at right side rail

(4) Attach a chain sling (fig. 432) and overhead hoisting equipment to reservoir, and lift reservoir from mounting brackets and remove from vehicle.

Note. Be careful not to lose spacers (fig. 432).

(5) Remove four cap screws (fig. 432), two at each end, from reservoir.

b. Installation.

(1) Insert four cap screws (fig. 432), two at each end, in holes in reservoir and equipment box.

(2) Make sure that spacers (fig. 432) are in position on mounting brackets and, using chain sling and hoist, position hydraulic reservoir and equipment box on brackets.

(3) Install four safety nuts (fig. 431), two at each side, on cap screws. Tighten nuts.

(4) Connect swivel-valve-to-reservoir line (fig. 409) to reservoir inlet coupling (fig. 416).

(5) Install power divider assembly (par. 327).

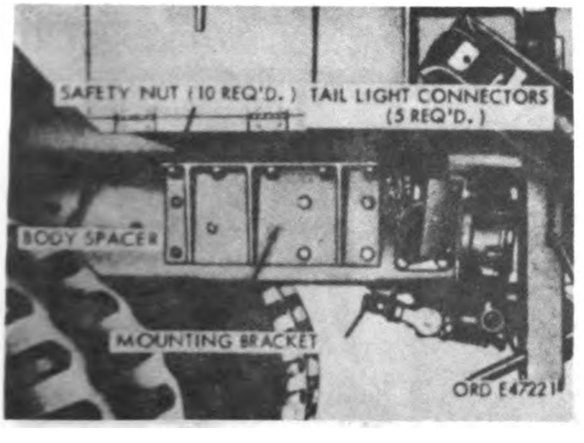


Figure 433. Crane body mounting at rear of left frame side rail (M62)

322. Crane Body

a. Removal.

(1) Remove base plate and pivot post assembly (par. 312).

(2) Remove six safety nuts (fig. 416) and cap screws, securing hydraulic pump and rear winch relay levers and bracket to crane body, and remove levers and bracket from body.

(3) Loosen hose clamp securing reservoir inlet hose (fig. 416) to inlet pipe at rear of reservoir, and remove hose from pipe. Turn elbow 45° to allow clearance for removal of crane body.

(4) Remove four safety nuts (fig. 416) from two U-bolts securing rear of crane body to left and right frame side rails.

(5) Remove ten safety nuts (fig. 433), five from each side, securing front of crane body to mounting brackets bolted to rear of left and right frame side rails.

(6) Disconnect five bayonet-type taillight cable connectors (fig. 433), three at left rear corner of vehicle and two at right rear corner. Remove two clamps securing taillight cables to each side of crane body, and pull cables and connectors through body.

(7) Attach a chain sling (fig. 434) and overhead hoisting equipment to crane body, and lift body from vehicle.

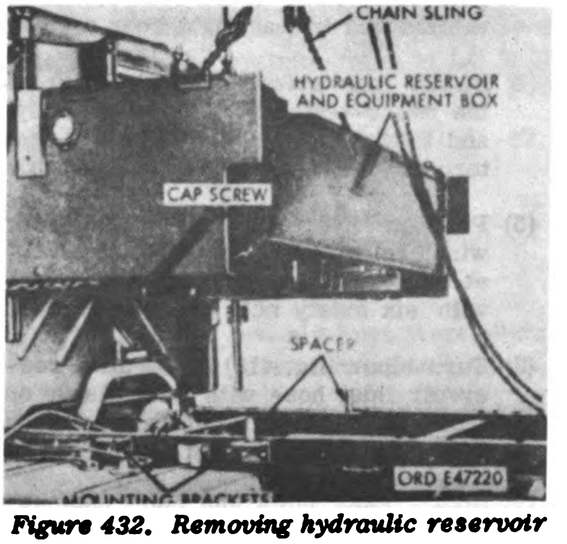


Figure 432. Removing hydraulic reservoir and equipment box (M62)

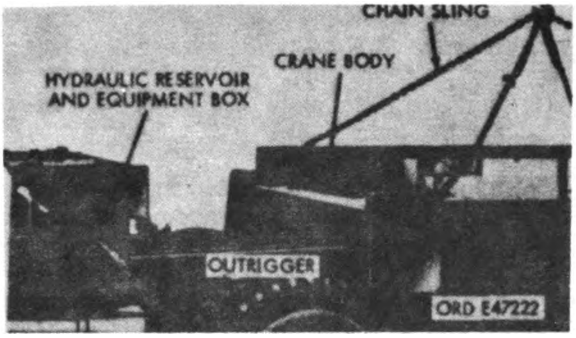


Figure 434. Removing crane body

b. Installation.

(1) Using chain sling (fig. 434) and hoist, lift crane body into position on truck chassis.

Note. Before lowering body, make sure that body spacers (fig. 433) are in position on frame side rails, and aline U-bolts (fig. 416) with holes in body.

(2) Install ten safety nuts (fig. 433), five on each side, on hex-head bolts extending through body and brackets bolted to left and right frame side rails.

(3) Pull taillight cables through crane body, and secure with two clamps to each side of body. Connect five bayonet-type taillight cable connectors (fig. 433), three at left rear corner of vehicle and two at right rear corner.

(4) Install four safety nuts (fig. 416) on the two U-bolts at rear of crane body, and tighten nuts 100 to 150 pound-feet torque.

(5) Position hydraulic pump and rear winch relay levers (fig. 416) and bracket on rear of crane body, and secure with six safety nuts and cap screws.

(6) Turn elbow (fig. 416) 45° to aline reservoir inlet hose with inlet sleeve on front of reservoir, install hose on sleeve, and tighten hose clamp.

(7) Install base plate and pivot post assembly (par. 312).

328. Floodlights, Cables, and Switches

a. Floodlights.

(1) Lamp unit replacement (fig. 435).

(a) Remove three screws securing door to floodlight body, and pull door and lamp unit assembly from body.

(b) Loosen two terminal screws on back of lamp unit, remove two cables from terminals, and remove door and lamp unit assembly from floodlight.

(c) Remove four springs securing lamp unit to door, and remove lamp unit from door. Discard lamp unit.

(d) Insert new lamp unit in door, and secure with four retaining springs.

(e) Position door and lamp unit assembly in front of floodlight body, and insert cable terminals under lamp unit terminal-screw heads. Tighten terminal screws.

(f) Insert lamp unit in floodlight body, aline door-mounting screw holes, and

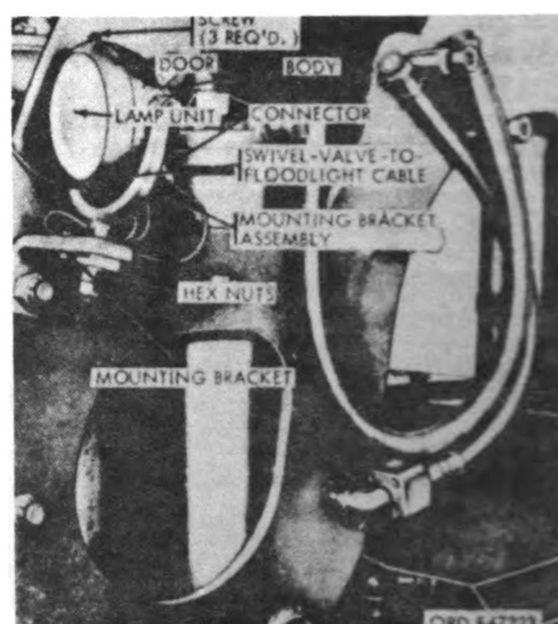


Figure 435. Floodlight mounted on left side of shipper support (M62)

:ure door to body with three screws.

(2) *Floodlight switch removal.*

(*a*) Remove floodlight lamp unit ((1) (*a*) and (*b*) above).

(*b*) Disconnect two bayonet-type connectors (fig. 435) securing floodlight cables to rear of floodlight.

(*c*) Remove two screws securing contact bracket and switch assembly to inside of floodlight body (fig. 435). Remove bracket and switch assembly (with cables) from body.

(*d*) Pull switch cable plug-type terminal from contact bracket socket.

(*e*) Disconnect switch cable bayonet-type connector from lamp unit cable connector.

(*f*) Remove two screws and lockwashers securing switch assembly to contact bracket, and remove switch assembly from bracket.

(3) *Floodlight switch installation.*

(*a*) Position floodlight switch assembly on contact bracket, and secure with two screws and lockwashers.

(*b*) Insert switch cable plug-type terminal in contact bracket socket.

(*c*) Connect switch cable bayonet-type connector to lamp unit cable connector.

(*d*) Position contact bracket and switch assembly in floodlight body (fig. 435), and secure bracket to body with two screws.

(*e*) Connect two floodlight cable bayonet-type connectors (fig. 435) to connectors at rear of flood light.

(*f*) Install floodlight lamp unit ((1) (*e*) and (*f*) above).

(4) Floodlight removal (floodlight mounted at shipper support, illustrated) (fig. 435).

(*a*) Disconnect two bayonet-type connectors securing floodlight cables to rear of floodlight.

(*b*) Remove two hex-nut and plain washer securing floodlight mounting bracket assembly to mounting bracket bolted to shipper support. Remove floodlight assembly from mounting bracket.

(5) Floodlight installation (floodlight mounted at shipper support, illustrated) (fig. 435).

(*a*) Insert floodlight mounting bracket stud through hole in mounting bracket bolted to shipper support, and install plain washer and two hex-nuts on stud.

(*b*) Connect two floodlight cable bayonet-type connectors to connectors at rear of floodlight.

b. Floodlight Cables. For removal and installation procedures, refer to TM 9–2320–211–20.

c. Floodlight Switch (at Instrument Panel). Fro removal and installation procedures, refer to TM 9–2320–211–20.

324. Hydraulic System

a. Draining. Whenever the oil in the hydraulic system is to be removed, it will be necessary to drain all hydraulic lines and cylinders as well as the hydraulic reservoir. To completely drain the system, refer to LO 9–2320–211–12.

b. Filling. Refer to LO 9–2320–211–12.

325. Clutch Control Valve

(fig. 414)

a. Removal.

(1) Remove two air lines from elbows at left end of clutch control valve.

Note. Place identification tags on both lines to facilitate installation of valve.

(2) Remove two capscrews and safety nut securing valve to mounting bracket, and remove valve from bracket.

b. Installation.

(1) Position clutch control valve on rear of mounting bracket, and secure with two capscrews and safety nuts.

(2) Connect the two air lines to elbows at left end of valve.

326. Roto Chamber

(fig. 436)

a. Removal.

(1) Remove cotter pin and yoke pin securing push rod yoke on front end to clutch release outer lever, and remove yoke from lever.

(2) Unscrew nut securing air line to rear of roto chamber, and remove line from roto chamber.

(3) Remove two capscrews and lockwashers securing roto chamber mounting bracket to upper right side of transmission, and remove roto chamber and bracket assembly from transmission.

(4) Remove two nuts and lockwashers at front of mounting bracket, and remove roto chamber from bracket.

b. Installation.

(1) Insert the two studs on front end of roto chamber in mounting holes in front end of mounting bracket, and install two nuts and lockwashers on studs. Tighten nuts.

(2) Position roto chamber and mounting bracket assembly at upper right side of transmission, and secure with two capscrews and lockwashers.

(3) Position air line at rear of roto chamber, and tighten connector nut.

(4) Position roto chamber push rod yoke on upper end of outer lever, and secure with yoke pin and cotter pin.

(5) Check roto chamber adjustment (para 352), and adjust roto chamber, if necessary.

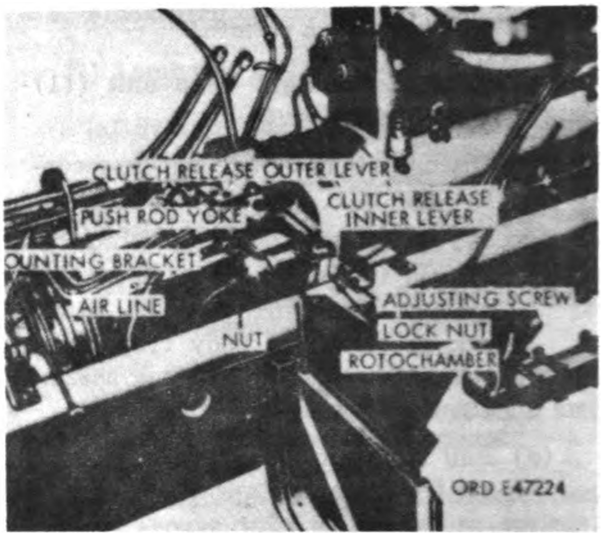


Figure 436. View of roto chamber.

327. Power Divider Assembly

a. Governor Valve.

(1) *Removal.*

Note. The key letters noted in parentheses are in figure 417, except where otherwise indicated.

(*a*) Unscrew two nuts securing governor-valve-to-control-valve line (B) and carburetor-to-governor-valve line (AA) to governor-valve (W) inlet and outlet port elbows, and remove lines from elbows.

Note. Place identification tags on lines to facilitate governor valve installation.

(*b*) Unscrew two nuts (Y) and remove two lockwashers from studs securing governor valve (W) to front of power divider. Remove valve from studs.

(2) *Installation.*

(*a*) Turn shaft inside governor valve so that slot in end of shaft will be alined with key on front end of hydraulic pump output shaft when governor valve is installed on power divider.

(*b*) Slide governor valve (W) on mounting studs on front of power divider, and secure with two lockwashers and nuts (Y).

(c) Position carburetor-to-governor-valve line (AA) and governor-valve-to-control-valve line (B) at governor-valve inlet and outlet port elbows, and tighten connector nuts.

(d) Adjust governor valve (par. 354).

b. Governor Valve Control Valve.

(1) Removal.

(a) Unscrew three nuts securing control-valve-to-governor line (A), governor-valve-to-control-valve line (B), and governor-valve-to-control-valve line (BB) to control-valve (E) inlet and outlet port elbows (Z) and adapter (D), and remove lines from elbows and adapter.

(b) Remove cotter pin from end of control-valve control rod (G), and remove control rod from control valve lever (U).

(c) Remove two cap screws (V) and lockwashers securing mounting bracket (F) to front of power divider, and remove bracket and control valve assembly from power divider.

(d) Remove two safety nuts (C) from cap screws securing control valve (E) to mounting bracket, and remove two cap screws, control valve, and two spacers (fig. 411) from bracket.

(2) Installation.

(a) Insert two cap screws through hole in mounting bracket control valve (F), install two spacers (fig. 411) and governor-valve control valve (E) on cap screws, and secure with two safety nuts (C).

(b) Position bracket and control valve assembly on front of power divider, and install two cap screws (V) with lockwashers in holes in bracket and power divider.

(c) Insert front end of control-valve control rod (G) in hole in lower end of control valve lever (U), and install cotter pin in end of rod.

(d) Position control-valve-to-governor line (A) at control-valve outlet port elbow (Z), position governor-valve-to-control-valve line (B) at control-valve inlet port adapter (D), and position governor-valve-to-control-valve line (BB) at control-valve inlet port elbow (Z). Tighten the three connector nuts.

c. Power Divider.

(1) Removal.

(a) Loosen hose clamp securing reservoir inlet hose (fig. 416) to inlet pipe at rear of reservoir, and remove hose from pipe. Turn elbow 45° to allow clearance for removal between relay lever assemblies.

(b) Remove cotter pin and yoke pin securing rear-winch-front-control-rod yoke (fig. 416) to rear-winch right relay lever, and remove yoke from lever.

(c) Disconnect swivel-valve-to-relief-valve line (fig. 409) from relief valve outlet, and disconnect swivel-valve-to-reservoir-inlet-tee line from pipe tee at relief valve.

(d) Remove clamp securing swivel-valve-to-reservoir line (fig. 409) to top of relief valve and remove line from valve.

(e) Close oil supply valve (fig. 410) at underside of hydraulic reservoir.

(f) Loosen two hose clamps securing pump inlet hose (fig. 410) to reservoir outlet.

(g) Remove cotter pin and yoke pin (fig. 410) securing hydraulic-pump-front-control-rod yoke to hydraulic-pump right relay lever, and remove yoke from lever.

(h) Disconnect power-takeoff-to-power divider propeller shaft from drive shaft yoke (fig. 411) at front of power divider.

(i) Disconnect rear-winch front propeller shaft (fig. 416) from winch output shaft yoke (fig. 398) at rear of power divider.

(j) Remove cotter pin and yoke pin (fig. 410) securing power-divider-rear-control-rod yoke to input shifter shaft arm, and remove yoke from arm.

(k) Unscrew nut securing carburetor-to-governor-valve line (AA) to governor-valve (W) inlet port elbow, and remove line from elbow.

(l) Unscrew nut securing governor-valve-to-control-valve line (BB) to control-valve inlet port elbow (Z) and remove line from elbow.

(m) Unscrew nut securing control-valve-to-governor line (A) to control-valve outlet port elbow (Z) and remove line from elbow.

(n) Support power divider, pump, and relief valve assembly, and remove four cotter pins and slotted nuts (fig. 410) securing power divider mounting bracket (fig. 411) to studs on bottom of reservoir. Remove power divider, pump, and relief valve assembly from under vehicle.

(o) Remove hydraulic pump from pump adapter at rear of power divider (par. 311).

(p) Remove governor valve from front of power divider (a(1) (b) above).

(q) Remove governor-valve control valve from front of power divider (b(1) above).

(r) Remove four cotter pins (fig. 411) and slotted nuts from studs securing mounting bracket to power divider, and remove bracket from studs.

(s) Remove cotter pin, clevis pin, and washer securing hydraulic-pump-front-control-rod slotted clevis (fig. 411) to hydraulic-pump-output shifter shaft arm, and remove clevis, with control-valve control rod attached, from arm.

(t) Remove cotter pin and yoke pin securing rear-winch-front-control-rod yoke (Q) to rear-winch output shifter shaft arm (R) and remove yoke from arm.

(2) Installation.

(a) Position rear-winch-front-control-rod adjustable yoke (Q) on rear-winch output shifter shaft arm (R) and secure with yoke pin and cotter pin.

(b) Position hydraulic-pump-front-control-rod slotted clevis (fig. 411), with governor-valve-control-valve control rod attached, on left side of hydraulic-pump output shifter shaft arm, and secure with clevis pin and cotter pin.

(c) Position mounting bracket (fig. 411) on studs on top of power divider, and secure with four slotted nuts and cotter pins.

(d) Install governor-valve control valve on front of power divider (b(2) (a) through (c) above).

(e) Install governor valve on front of power divider (a(2) (a) and (b) above).

(f) Position governor-valve-to-control-valve line (fig. 411) at governor-valve outlet port elbow and at control-valve inlet port adapter, and tighten connector nuts.

(g) Install hydraulic pump on pump adapter at rear of power divider (par. 311).

(h) Position power divider, pump, and relief valve assembly under vehicle, and secure power-divider mounting bracket to studs on underside of hydraulic reservoir with four slotted nuts (fig. 310) and cotter pins.

(i) Position control-valve-to-governor line (A) at control-valve outlet port elbow (Z) and tighten connector nut.

(j) Position governor-valve-to-control valve line (BB) at control-valve inlet port elbow (Z), and tighten connector nut.

(k) Position carburetor-to-governor-valve line (AA) at governor-valve inlet port elbow (Z), and tighten connector nut.

(l) Position power-divider-rear-control-rod yoke on input shifter shaft arm (fig. 410), and secure with yoke and cotter pin.

(m) Connect rear-winch front propeller shaft (fig. 416) to winch output shaft yoke (fig. 398) at rear of power divider.

(n) Connect power-takeoff-to-power-divider propeller shaft to drive shaft (fig. 411) at front of power divider

(o) Position hydraulic-pump-front-control-rod yoke on hydraulic-pump right relay lever (fig. 410), and secure with yoke pin and cotter pin.

(p) Install pump inlet hose (fig. 410) on reservoir outlet, and tighten two hose clamps.

(q) Position swivel-valve-to-reservoir line (fig. 409) at top of relief valve and secure with clamp.

(r) Connect swivel-valve-to-relief-valve line (fig. 409) to relief valve outlet, and connect swivel-valve-to-reservoir-inlet-tee line to pipe tee at relief valve.

(s) Position rear-winch-front-control-rod yoke (fig. 416) on rear-winch right relay lever, and secure with yoke pin cotter pin.

(t) Turn elbow (fig. 416) 45° to aline reservoir inlet hose with inlet sleeve on front of reservoir, install hose on sleeve, and tighten hose clamp securely.

(u) Open oil supply valve (fig. 410) at underside of hydraulic reservoir.

(v) Adjust hydraulic pump control linkage (par. 353).

(w) Adjust rear winch control linkage. Refer to TM 9-2320-211-20.

(x) Check governor valve adjustment, and adjust valve, if necessary (par. 354).

328. Power Divider Controls

Note. The key letters noted in parentheses are in figure 417, except where otherwise indicated.

a. Hydraulic Pump Control Linkage.

(1) Removal

(a) Hydraulic pump front control rod.

1. Remove cotter pin and yoke pin securing front control rod (K) to hydraulic-pump right relay lever (L) and remove rod from lever.

2. Loosen nut (J), and turn control rod from clevis (H).

(b) Relay levers. Refer to paragraph 322.

(c) Hydraulic pump rear control rod.

1. Remove base plate and pivot post assembly (par. 312).

2. Pull hydraulic-pump rear control rod (fig. 415) from underside of base plate.

(2) Installation.

(a) Hydraulic pump rear control rod.

1. Insert hydraulic-pump rear control rod (fig. 415) through holes in cross members welded to underside of base plate.

2. Install base plate and pivot post assembly (par. 312).

(b) Relay levers. Refer to paragraph 322.

(c) Hydraulic pump front control rod.

1. Install threaded end of hydraulic-pump front control rod (K) in clevis (H).

2. Adjust hydraulic pump control linkage (par. 353).

b. Rear Winch Control Linkage.

(1) Removal.

(a) Rear winch front control rod.

1. Remove cotter pin and yoke pin securing rear-winch-front-control-rod adjustable yoke (Q) to winch output shifter shaft arm (R), and remove yoke from arm.

2. Remove cotter pin and yoke pin securing rear-winch front control rod to rear-winch right relay lever (P), and remove rod from lever.

(b) Relay levers. Refer to paragraph 322.

(c) Rear winch rear control rod.

1. Remove base plate and pivot post assembly (par. 312).

2. Pull rear-winch rear control rod (fig. 415) from underside of base plate.

(2) Installation.

(a) Rear winch rear control rod.

1. Insert rear-winch rear control rod (fig. 415) through holes in cross members welded to underside of base plate.

2. Install base plate and pivot post assembly (par. 312).

(b) Relay levers. Refer to paragraph 322.

(c) Rear winch front control rod.

1. Position rear-winch-front-control-rod yoke on rear-winch right relay lever (P), and secure yoke pin and cotter pin.

2. Adjust rear winch control linkage Refer to TM 9-2320-211-20.

Section IV. REPAIR OF MAJOR COMPONENTS

329. General

Because the various units of the wrecker crane and power train are so closely related and interconnected, it is not practical to remove the wrecker crane as a single unit. For this reason, the disassembly and assembly of the wrecker crane, follow closely the procedures used for the original assembly.

330. Hydraulic Oil Motor (Fig. 437)

a. Disassembly.

(1) Disassemble the hydraulic oil motor (fig. 438) by removing the four hex-head cap screws (A) and plain washers (B) to release the cover. When the cover (C) is removed, the pressure plate, spring washer (D), and two O-ring gaskets (X) will also be removed. Remove the two shuttle valve retaining pins (W) to remove the two shuttle valve ball seats (E) and the two shuttle valve balls (V) from the pressure plate (F). Lift the cam ring (fig. 439), locating pins (J), rotor, and vanes from the body and drive shaft assembly. Do not remove rocking beams, pins, or bushings from rotor.

(2) Removal of drive shaft and ball bearings. To remove the drive shaft and ball bearing assemblies from the body, first remove the snap ring (fig. 440). Tap on exposed or splined end of drive shaft with soft hammer to remove drive shaft (M) and ball bearing assembly (N) from the body (fig. 440). Use a suitable flat surfaced tool and tap out oil seal (L) by tapping from the inside. Check the relative position of this oil seal before removal so that it can be replaced by a new one at reassembly. The ball bearing assembly (R) at inner recess of body (K) may now be removed.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Immerse all parts except the sealed ball bearing assembly in clean dry-cleaning solvent or mineral spirits paint thinner. Soak long enough to loosen all old lubricant and to be sure oil passageways are not plugged. Blow dry with compressed air and protect from any dust or dirt.

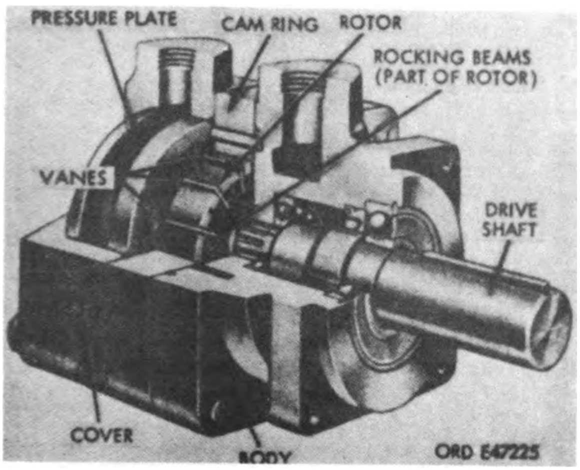


Figure 437. Hydraulic oil motor (cutaway view)

Note. Handle all parts carefully to avoid any nicks or burs on machined surfaces.

(2) Inspection and repair. Inspect the condition of both ball bearing assemblies. The larger of the two is permanently sealed and requires no further lubrication, while the smaller is lubricated by the hydraulic fluid. Check for wear by slowly rotating each bearing under load. If any indication of roughness exists, the bearing should be replaced. Check the condition of the cam ring. The internal contour of this part must be smooth and if distortion or roughness exists on this surface, the cam ring must be replaced. Vanes must be free of nicks or burs and if cam ring is replaced, vanes must also be replaced. Check the condition of the shuttle valve balls and their seats. If these show evidence of wear (damaged or pitted surface on the balls or worn face of the seat), replace with new parts. New oil seal and O-ring gaskets must be used at assembly.

c. Assembly (Fig. 438).

(1) General. Special care must be taken to avoid nicks and burs when assembling the hydraulic oil motor. Avoid the entrance of any grit or dirt into the unit. Add a small amount of No. 10W engine oil into motor and temporarily seal openings until motor is once again mounted on the vehicle.

(2) Procedure. Use a flat surfaced tool and press ball bearing assembly (R) into body (K). Apply pressure to outer race to seat bearing squarely. Similarly, press oil seal (L) into body noting that the three small oil holes located on the face of the seal and, adjacent to the seal inside diameter, will face toward the inside of the motor when installed. Press ball bearing assembly (N) onto drive shaft (M). Be sure that pressure is applied to inner race only. Install bearing and drive shaft assembly into body and insert snap ring (P). Insert locating pins (J) and new O-ring gasket (S) into face of body. Place 12 vanes (T) into rotor assembly (H) and note that radius end of vanes will contact the cam ring (G). Slide rotor and vanes into cam ring and engage ends of rocking beams on both sides of rotor with inner ends of vanes, so that all vanes will be held outward against the cam ring. Aline and install cam ring, rotor, and vanes assembly to locating pins on body (fig. 434). Be sure that rotation arrows on cam ring have not been changed. Insert two shuttle valve balls (V) and two shuttle ball seats (E) into pressure plate (F) and secure in place with two shuttle valve retaining pins (W). Place spring washer (D) and O-ring gasket (X) on pressure plate (F). Install in cover (C) and aline cover to the assembled body and cam ring. Secure cover with four hex-head cap screws (A) and plain washers (B). Tighten cap screws to torque specifications prescribed in paragraph

331. Hoist Drum and Worm and Drive Gear (Fig. 441)

a. Disassembly. Refer to figure 442.

(1) General. No special tools beyond normal maintenance shop facilities are required for disassembling the hoist drum and worm and drive gear set (fig. 441). An overhead crane will be of great help in this operation.

Caution: These are heavy parts and more than ordinary care should be exercised to avoid personal injury that might be caused by careless handling.

(2) Remove drum bearing cap (fig. 443). Remove four safety nuts and lift off

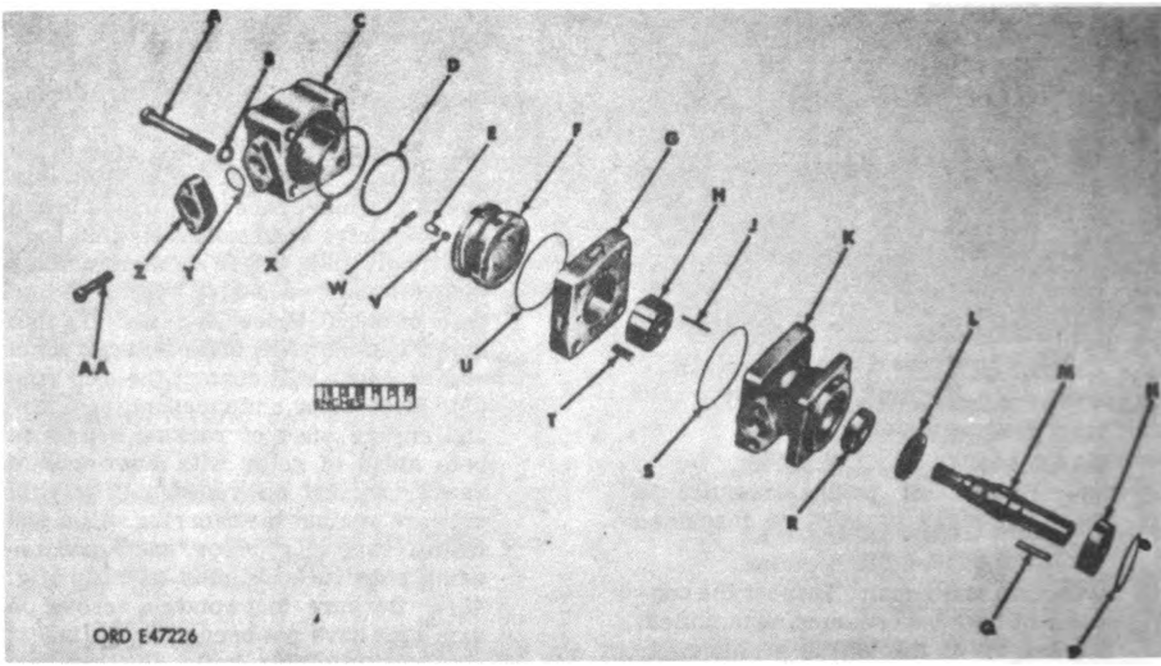


Figure 438. Hydraulic oil motor - exploded view

Key	Item	Key	Item
A	Screw, cap, hex-hd	N	Bearing, ball, assy
B	Washer, plain	P	Ring, snap
C	Cover	Q	Key
D	Washer, spring	R	Bearing, ball, assy
E	Seat, ball, shuttle valve	S	Gasket, O-ring
F	Plate, pressure	T	Vane
G	Ring, cam	U	Gasket, O-ring
H	Rotor, with rocking beams, pins, and bushing, assy	V	Ball, shuttle valve
J	Pin, locating	W	Pin, retaining, shuttle valve
K	Body	X	Gasket, O-ring
L	Seal, oil	Y	Gasket, O-ring
M	Shaft, drive	Z	Flange
		AA	Screw, cap, hex-hd

Figure 438. Hydraulic oil motor - exploded view - legend

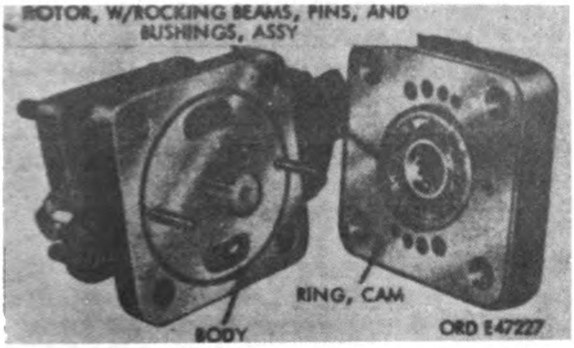


Figure 439. Cam ring and motor separated from body

drum bearing cap and drum bearing-cap gasket from side of drum housing.

(3) Separate hoist drum from worm and drive gear set.

(a) Remove drive shaft nut (fig. 443) and drive shaft bearing washer.

(b) Fasten chain hoist around drum housing at shaft end and raise housing from ground sufficiently to loosen shaft from drum and housing. If some difficulty is encountered in freeing shaft from drum, tap on end of shaft with a soft hammer and raise drum and housing from worm and drive gear set (fig. 438). Hoist drum will roll out of drum housing as soon as shaft is clear.

(4) Disassemble worm and drive gear set.

(a) Remove six safety nuts (C) and take off gear case bearing cap (D), gasket (E), and shims (fig. 442).

(b) Remove six safety nuts and take off worm bearing cap (fig. 445) and gasket.

(c) Remove eight safety nuts and take off gear case cover (fig. 446) and gasket.

(d) Lift out drive gear (M), shaft (AX), spacers (AW and AY), and bearing cones (AV and L) assembly.

(e) Place a brass drift on the forward end of worm and tap the drift with a hammer to drive the worm bearings, slingers, shims, gasket, and cage assembly from the gear case. Discard gaskets. Figure 447 shows worm partially removed from case.

(f) Mount worm (AL), bearings, slingers, and cage assembly in an arbor press and press worm, slinger, and bearings from worm bearing cage (fig. 448).

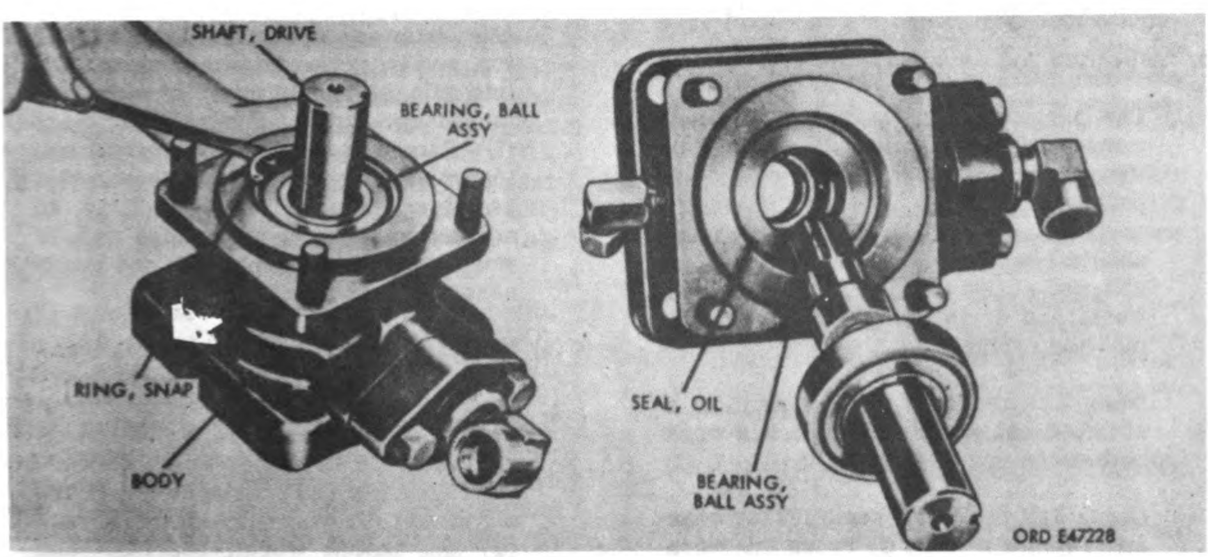


Figure 440. Removing drive shaft and bearing

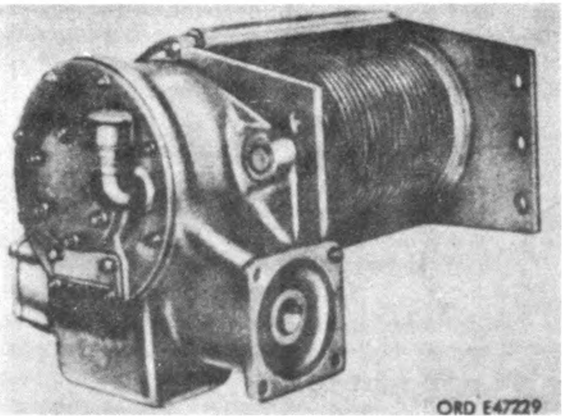


Figure 441. Hoist drum and worm and drive gear set

(g) The condition of the remaining parts will determine whether further disassembly is necessary. If disassembly is necessary, this may be accomplished with a suitable puller and adapter.

(h) No special cleaning is required other than to soak all parts in dry-cleaning solvent or mineral spirits paint thinner. Be sure bearings are free of all old lubricant to facilitate inspection. Blow dry with compressed air.

Caution: Never spin bearings with compressed air as damage to the finely machined surfaces will result.

b. Inspection and Repair.

(1) The parts used in the hoist drum and worm and drive gear set are built to withstand severe usage. However, each part should be gone over thoroughly to check for defects. The gear case should be checked for cracks or stripped screw threads in the case. The worm and drive gear if visibly worn, must be replaced.

Note. The worm and drive gear is a matched set and if either part is worn both parts must be replaced.

(2) Check ball bearing assemblies for wear and replace if balls or races are worn or pitted. Check rollers and races of drive-gear bearing cone assemblies for wear and replace if found defective. Inspect drive shaft for worn splines or stripped screw threads. Replace if defective. If old oil seal was removed from gear case, it shall be replaced. Check other miscellaneous parts for defects and replace any damaged part.

c. Assembly. Refer to figure 442.

(1) General. The assembly of this unit will require the same attention to avoiding personal injury or damage to parts as was pointed out in the disassembly. Be particularly careful to avoid the entrance of dirt into the assembly. The use of No. 10 SAE engine oil (OE) on sliding fits and screw threads will greatly facilitate assembly.

(2) Install bearings and worm in worm bearing cage. Place worm bearing assemblies (R and X) back-to-back on arbor press so that inner race will be supported. Place worm bearing oil slinger (Q) on top of bearings with recessed side toward bearing. Insert splined end of worm (AL) into slinger and bearings and press worm into place. Install special locknut (S) flat side down on worm and tighten securely. Lock in place with special lockwasher (W) and special locknut (T), flat side up.

(3) Similarly, mount bearing assembly (AP) in press with oil slinger (AM) on top, and insert keyed end of worm (AL) into slinger and bearing. Press shaft into place. Support worm bearing cage (Y), flanged side up, on arbor press and insert worm and bearing assembly, keyed end down, into cage. Use an adapter to press on the outside race of worm bearing assembly (X) and press assembly into cage.

(4) Install worm, bearings, and cage assembly into gear case. If worm bearing cage studs (AS) were removed from gear case (CC), make sure all six studs are securely in place. Position bearing cage shim (AT) and new worm bearing gasket (P) over worm bearing cage (Y) and install worm, bearings, and worm bearing cage into gear case. Aline worm bearing cage with stud in

gear case and tap into place. Use new worm bearing gasket (P) and install worm bearing cap (U). Secure with six safety nuts (V). Tighten to torque specifications Appendix I.

(5) Install drive gear shaft and bearing cone assembly into gear case. If drive gear bearing cup (AU) has been removed, install cup by tapping into place with soft hammer until seated securely in the gear case. If drive gear (M) has been removed from drive shaft (AX), press shaft into gear, noting that gear will be returned to the same position from which it was removed. Be careful not to bur splines. Place left-hand drive gear bearing spacer (AW) and bearing cone (AV) onto shaft and install into gear case. Place right-hand drive gear bearing spacer (AY) and drive gear bearing cone (L) on end of shaft. If drive gear bearing cup (AZ) has been removed from gear case cover (BA), install cup. If gear case cover studs have been removed from gear case, install six gear case cover studs (N) around upper circumference of gear case drive gear opening, and two inspection hole cover studs (BC) into two lower stud holes. Aline new gear case cover gasket (K) and gear case cover (BA) on gear case and secure with six safety nuts (J). Allow two safety nuts (J) and inspection hole cover (BE) to remain disassembled until final adjustment has been made (par. 355). Insert six studs (H) into gear case cover (BA) and turn down tight. Install new gear case bearing cap gaskets (E), gear case bearing cap shims (F), and gear case cover with six safety nuts (C). Install 90° street elbow (BH) into gear case cover (BA), gear case filler tube (B), and filler tube breather cap (A).

(6) Assemble drive shaft bearing seal. Assemble drive shaft bearing seal (DD), drive shaft bearing seal cage (AJ), new drive gear bearing gasket (EE), and drive gear bearing shims (FF). If studs (AK) were removed from gear case, install six studs (AK) and tighten securely. Install drive shaft bearing seal cage (AJ), to gear case with six safety nuts (AH). Tighten nuts securely.

(7) Install hoist drum and drum housing. Place hoist drum (AC) into drum housing (AG) and secure in position by inserting drive shaft (AX) end of the assembled worm and drive gear set through the drum and housing. If the four studs (PP) were removed from drum housing, be sure these are securely in place and install new drum bearing cage gasket (QQ).

(8) Install bearing assembly. If bearing assembly (SS) has been removed, use an arbor press to position bearing in drum bearing cage (RR). Position bearing so that sealed side will face toward drum when installed, and also be sure that pressure is applied to outer race while installing in cage. Install drive shaft bearing spacer (YY), flat side down on end of drive shaft, and aline bearing and cage assembly on studs. Place drive shaft bearing washer (XX) and drive shaft nut (TT) on end of drive shaft and draw down until secure. Install new drum bearing cap gasket (WW) and drum bearing cap (UU) and secure with four safety nuts (VV). Install square head pipe plug (AR) in gear case (CC). Refer to LO 9-2320-211-12 for correct lubricant and capacity.

332. Shipper and Boom Assembly

a. Disassembly.

(1) Removing boom from shipper.

(a) Remover 45° elbow with hose assembly from end of piston rod. Bend lip on piston rod lockplate (fig. 449) from piston rod nut and remove both nuts and plate.

(b) Pull boom from shipper only far enough to attach a chain sling. Attach chain to an overhead hoist and remove boom from shipper (fig. 450).

Caution: When extending boom from shipper to attach chain, boom must be supported at sheave end to prevent tilting which could cause serious injury to personnel.

(2) Removing boom cylinder from boom (fig. 451).

(a) Remove cotter pins from cylinder collar pins and remove pins.

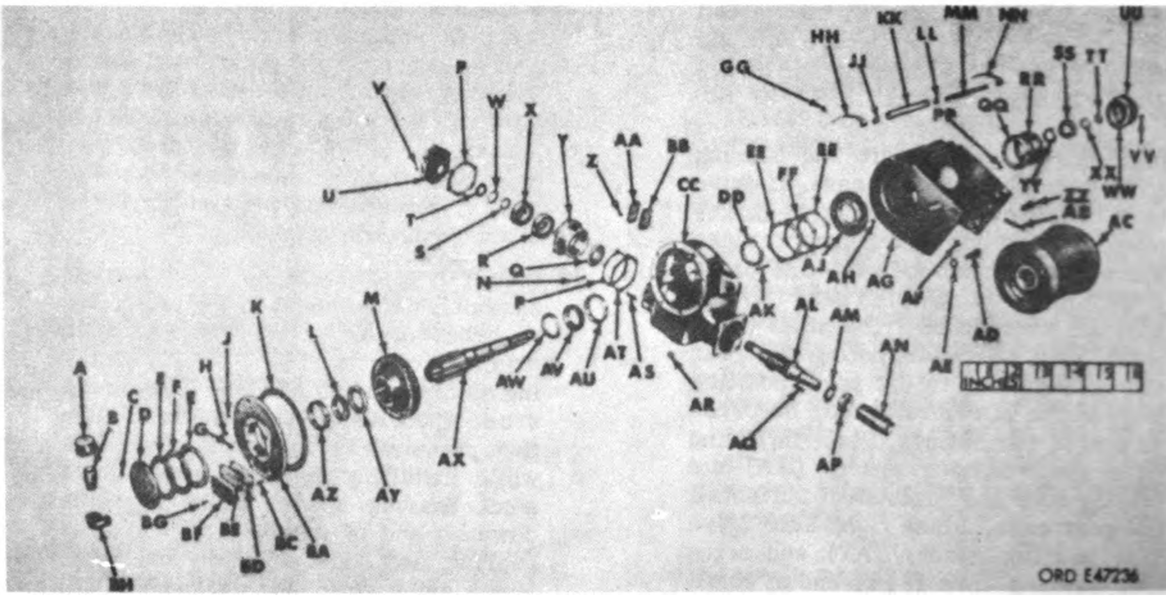


Figure 442. Hoist drum and worm and drive gear set - exploded view

Key	Item	Key	Item
A	Cap, breather, filler tube	DD	Seal, drive shaft bearing
B	Tube, filler, gear case	EE	Gasket, drive gear bearing
C	Nut, safety	FF	Shims, drive gear bearing
D	Cap, bearing, gear case	GG	Screw, hex-hd, machine
E	Gasket, gear case bearing cap	HH	Spring, cable guide, right hand
F	Shims, gear case bearing cap	JJ	Bushing, cable guide
G	Plug, pipe, sq-hd	KK	Roller, cable guide
H	Stud	LL	Bushing, cable guide
J	Nut, safety	MM	Shaft, cable guide
K	Gasket, gear case cover	NN	Spring, cable guide, left hand
L	Cone, bearing, drive gear	PP	Stud
M	Gear, drive	QQ	Gasket, drum bearing cap
N	Stud, gear case cover	RR	Cage, bearing drum
P	Gasket, worm bearing	SS	Bearing, assembly
Q	Slinger, oil, worm bearing	TT	Nut, drive shaft
R	Bearing, worm assembly	UU	Cap, drum bearing
S	Nut, lock, special	VV	Nut, safety
T	Nut, lock, special	WW	Gasket, drum bearing cap
U	Cap, worm bearing	XX	Washer, drive shaft bearing
V	Nut, safety	YY	Spacer, drive shaft bearing
W	Washer, lock special	ZZ	Screw, cap, hex-hd
X	Bearing, worm, assembly	AB	Wedge, cable
Y	Cage, worm bearing	AC	Drum, hoist
Z	Screw, cap, assembly	AD	Screw, cap, hex-hd
AA	Cover, inspection hole	AE	Washer, lock
BB	Gasket, inspection hole cover	AF	Nut, safety
CC	Case, gear	AG	Housing, drum

Figure 442. Hoist drum and worm and drive gear set - exploded view - legend

Key	Item	Key	Item
AH	Nut, safety	AV	Cone, bearing
AJ	Cage, drive shaft bearing seal	AW	Spacer, drive gear bearing, left hand
AK	Stud	AX	Shaft, drive
AL	Worm	AY	Spacer, drive gear bearing, right hand
AM	Slinger, oil	AZ	Cup, bearing, drive gear
AN	Coupling, drum drive	BA	Cover, gear case
AP	Bearing, assembly	BC	Stud, inspection hole cover
AQ	Key, cable drum drive coupling	BD	Gasket, inspection hole cover
AR	Plug, pipe, sq-hd	BE	Cover, inspection hole
AS	Stud, worm bearing cage	BF	Plate, drum case lubrication
AT	Shim, bearing cage	BG	Screw, cap, assembly
AU	Cup, bearing, drive gear	BH	Elbow, street

Figure 442. Hoist drum and worm and drive gear set - exploded view - legend - continued

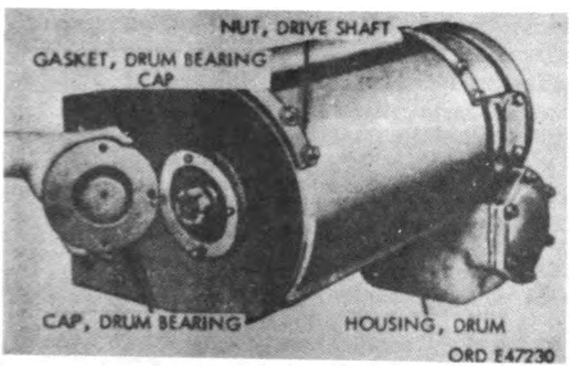


Figure 443. Drum bearing cap removed

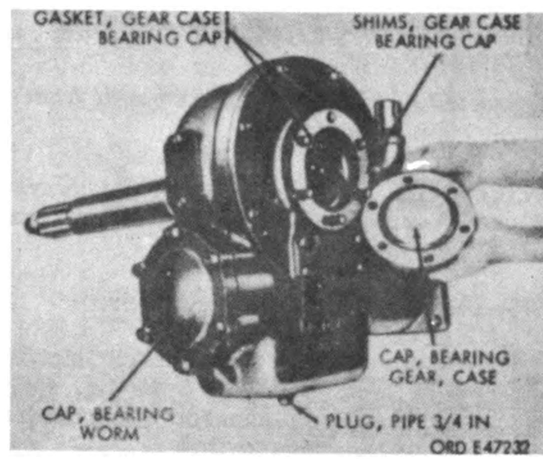


Figure 445. Gear case bearing cap removed

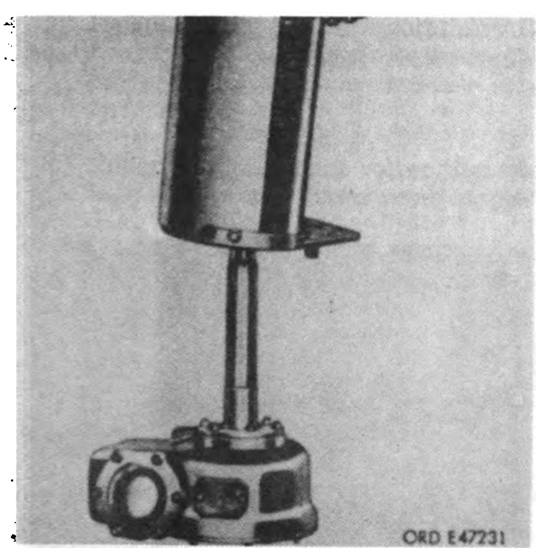


Figure 444. Separating hoist drum from worm and drive gear set

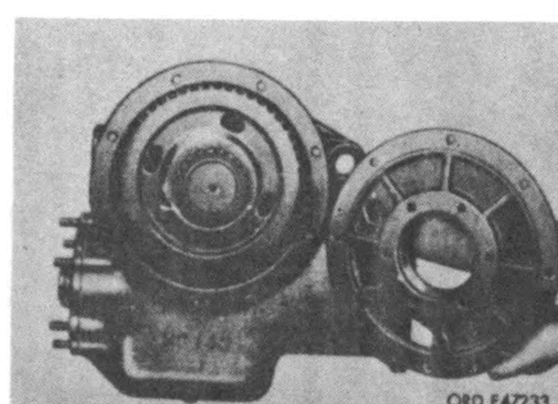


Figure 446. Gear case cover and worm bearing cap removed

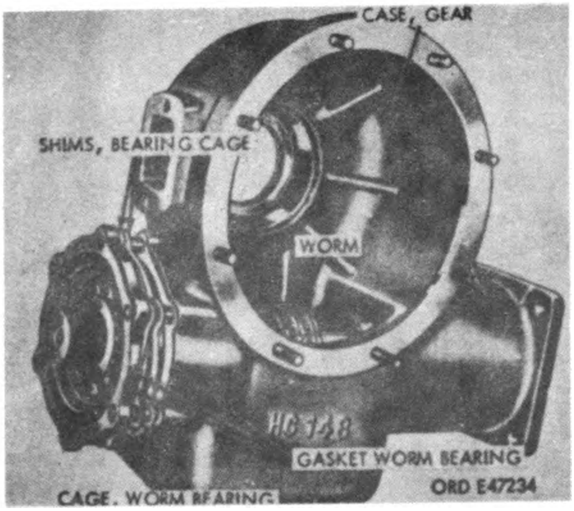


Figure 447. Worm partially removed from gear case

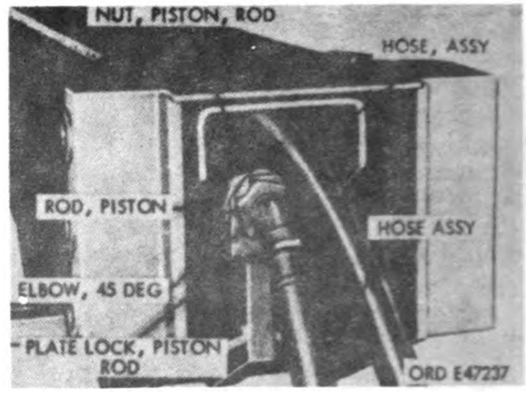


Figure 449. Disconnect points from boom removal

(b) Attach a chain to support boom cylinder. Remove boom cylinder from boom.

(3) Disassembly of boom cylinder.

(a) Remove cotter pins and four slotted nuts from cylinder head (fig. 452), and separate piston rod with cylinder head from boom cylinder.

(b) Remove two piston nuts, piston rod cup spreaders, piston rod cups, and one piston rod cup spacer (fig. 453) from piston rod.

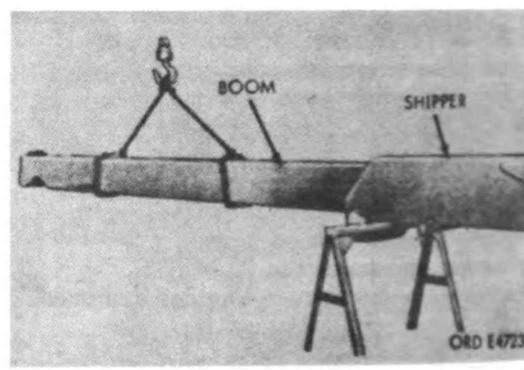


Figure 450. Removing boom from shipper

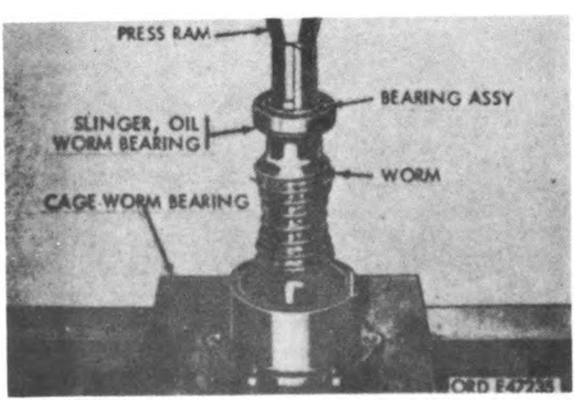


Figure 448. Removing worm and bearings from worm bearing cage

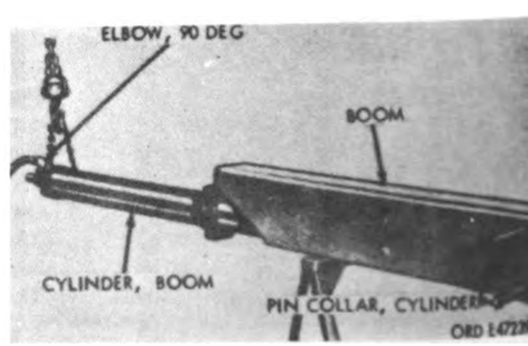


Figure 451. Removing boom cylinder from boom

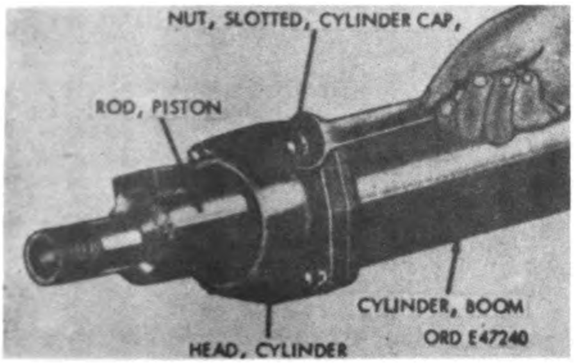


Figure 452. Removing cylinder head

(c) Slide cylinder head to piston end of piston rod and remove cylinder head snap ring, washer, piston rod leather wiper, felt wiper, and O-ring gasket from cylinder head (fig. 454). Remove cylinder head O-ring gasket (fig. 454) from cylinder head.

(4) Disassembly of shipper.

(a) Remove four cap screws and lockwashers from each front bottom roller cap. Remove front bottom roller cap and shims from each side of shipper (fig. 455).

Note. Keep each shim pack intact to facilitate final assembly.

(b) Install puller on front bottom roller bearing cone and remove bearing. Remove opposite bearing in same manner.

(c) Remove front bottom roller (fig. 455) with collars and shims from shipper.

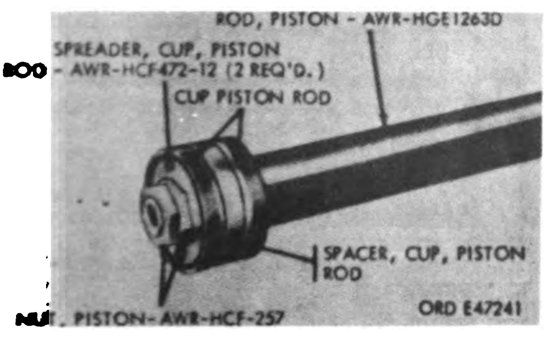


Figure 453. Piston assembly

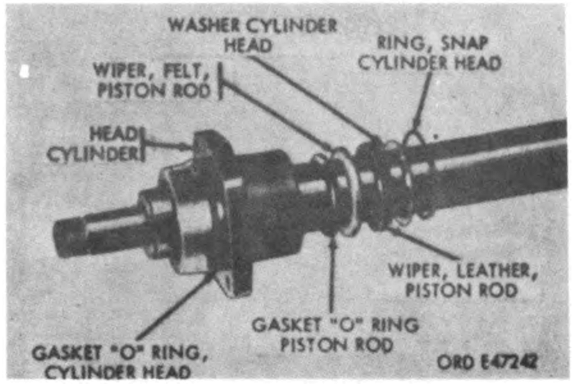


Figure 454. Cylinder head and seal assembly

Note. Keep each shim pack intact to facilitate final assembly.

(d) Remove cap screw and lockwasher from rear bottom roller shaft. Remove shaft and rear bottom roller (fig. 456) from shipper.

(e) Do not remove rear bottom roller bushings unless inspection warrants replacement. To remove, use suitable adapter and press bushing from roller.

(f) Remove three cap screws and lockwashers on each side of upper roller housing (fig. 457) and remove housing assembly from shipper.

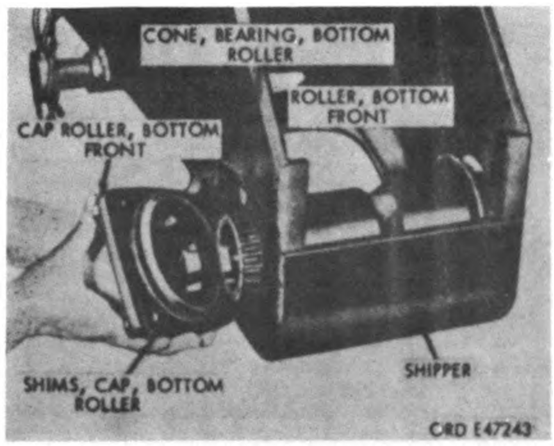


Figure 455. Front bottom roller cap and shims installed

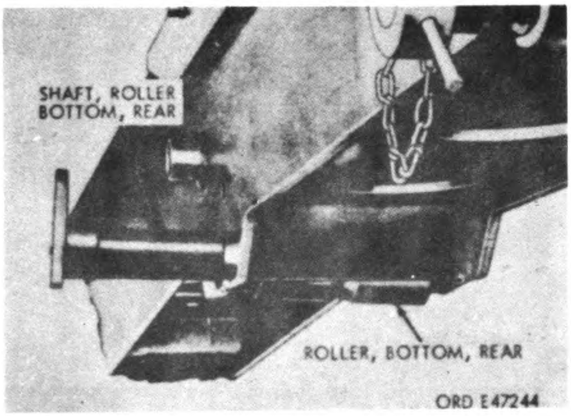


Figure 456. Rear bottom roller and shaft partially removed

(g) Remove four cap screws and lockwashers from upper roller cap. Remove upper roller cap, shims, and bearing cone from upper roller bushing (fig. 458). Remove opposite cap and bearing in same manner.

Note. Keep each bearing shim pack intact to facilitate final assembly.

(h) Remove upper rollers (fig. 458) and upper roller pin from housing. Slide upper rollers and upper roller shims from pin. Do not remove upper roller bearing cap from roller unless inspection warrants replacement.

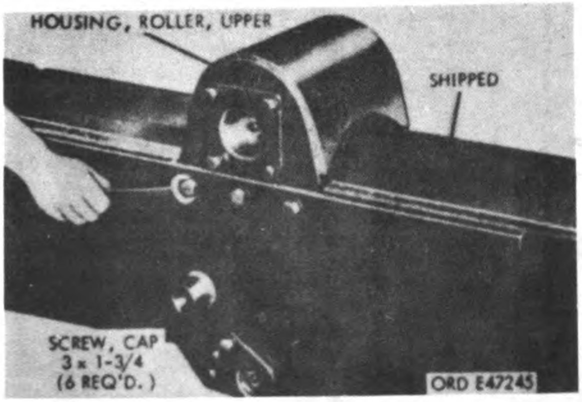


Figure 457. Removing upper roller housing assembly

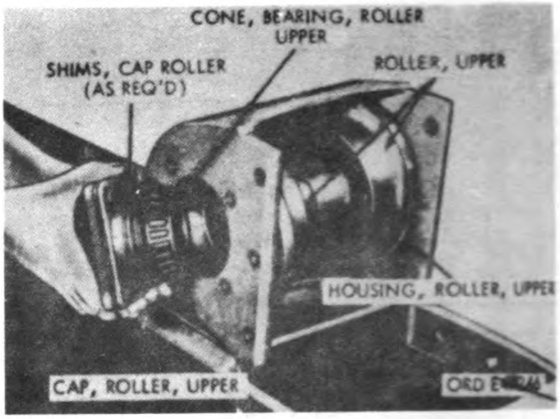


Figure 458. Removing upper roller cap, shims and bearing

Note. Keep each shim pack intact to facilitate assembly.

(i) Use suitable adapter and remove shipper pivot shaft bushings (CC and DD, fig. 459) from shipper, if inspection warrants replacement.

(5) Disassembly of boom and crane block sheave (fig. 461).

(a) Remove cap screw and lockwasher securing boom sheave pin to boom. Remove two boom sheaves, four needle bearings (E, F, J and K), and washers (B, C, G and L) from boom (fig. 461).

(b) Remove pin clip (R), and drive boom cable anchor pin (S) from boom.

(c) Remove pin clips (Z) and crane block cable anchor pin (EE) from crane block. Remove tapping screw (BB) and block washer, crane block sheave pin (AA), crane block sheave (FF), crane block sheave bearings (V and W), and sheave washers (X and GG) from crane block.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Use a stiff bristle brush and clean all parts with mineral spirits paint thinner. Rinse bearings in clean mineral spirits paint thinner and cover bearings to protect from dirt.

(2) Inspection and repair.

(a) Bearings. Inspect bearings for pitted, scored, or scratched condition. Replace any defective bearings.

(b) Rollers. Inspect rollers for worn or damaged condition. Replace worn or damaged rollers.

(c) Boom. Inspect boom for cracked welds or bent condition. In general, defective welds can be repaired by welding. If not, replace boom.

(d) Pin assemblies. Inspect pins for worn condition and replace defective pins.

(e) Cylinder. Inspect bore of cylinder for scratches or scoring. Replace damaged cylinder.

(f) Piston rod. Inspect piston rod for nicks or scratches. Remove slight nicks or scratches with a soapstone or fine mill file. Replace piston rod if distorted or damaged.

(g) Shipper. Inspect shipper for cracked welds or bent condition. Defective welds can be repaired by welding. Replace shipper if bent, twisted, or damaged.

c. Assembly.

(1) Boom cylinder assembly (fig. 462).

(a) Install piston rod wiper spring (R) on leather wiper (S).

(b) Position piston rod O-ring gasket (P), felt wiper (Q), leather wiper (S), and cylinder head washer (T) in cylinder head (L). Secure with cylinder head snap ring (U). Position cylinder head O-ring gasket (K) on cylinder head.

(c) Slide cylinder head (L) on piston rod (V). Assemble piston rod cup spreaders (E and J), cups (F and H), and cup spacer (G) on piston rod as shown in figure 453. Secure with piston rod nuts (D and C).

(d) Install four cylinder head studs (A) in boom cylinder (B). Apply a coat of light engine oil to piston and install piston and piston rod assembly in boom cylinder. Secure cylinder head (L) to boom cylinder with four cylinder cap slotted nuts (M) and lock with new cotter pins (N).

(2) Assemble shipper (fig. 459).

(a) Assemble front and rear bottom rollers.

1. Position bottom roller collar shims (L and N) and front bottom roller collars (K and P) on front bottom roller (M). Position roller with collar and shims in end of shipper (D) and install bottom roller bearing cones (G and R) on each end of roller as shown in figure 455.

2. Use suitable adapter and press bottom roller bearing cup (H) in front bottom roller cap (J). Install bottom roller bearing cup (S) in front bottom roller cap (T) in the same manner.

3. Position bottom roller cap shims (Q) as removed, and front bottom roller cap (T) on shipper (D), and secure with four cap screws (W) and lockwashers (V). Follow same procedure for installing bottom roller cap shims (F) and front bottom roller cap (J).

4. If bushings were removed, press rear bottom roller bushing (MM and NN) in each end of rear bottom roller (LL). Position roller in shipper (D) and secure with rear bottom roller shaft (KK). Secure shaft with cap screws (HH) and lockwashers (JJ).

5. Use suitable adapter and install shipper pivot shaft bushings (CC and DD) in each side of shipper (D).

(b) Assemble upper roller (fig. 463).

1. Use suitable adapter and press upper roller bearing cup (V) in upper roller (U) and upper roller bearing cup (N) in upper roller (P).

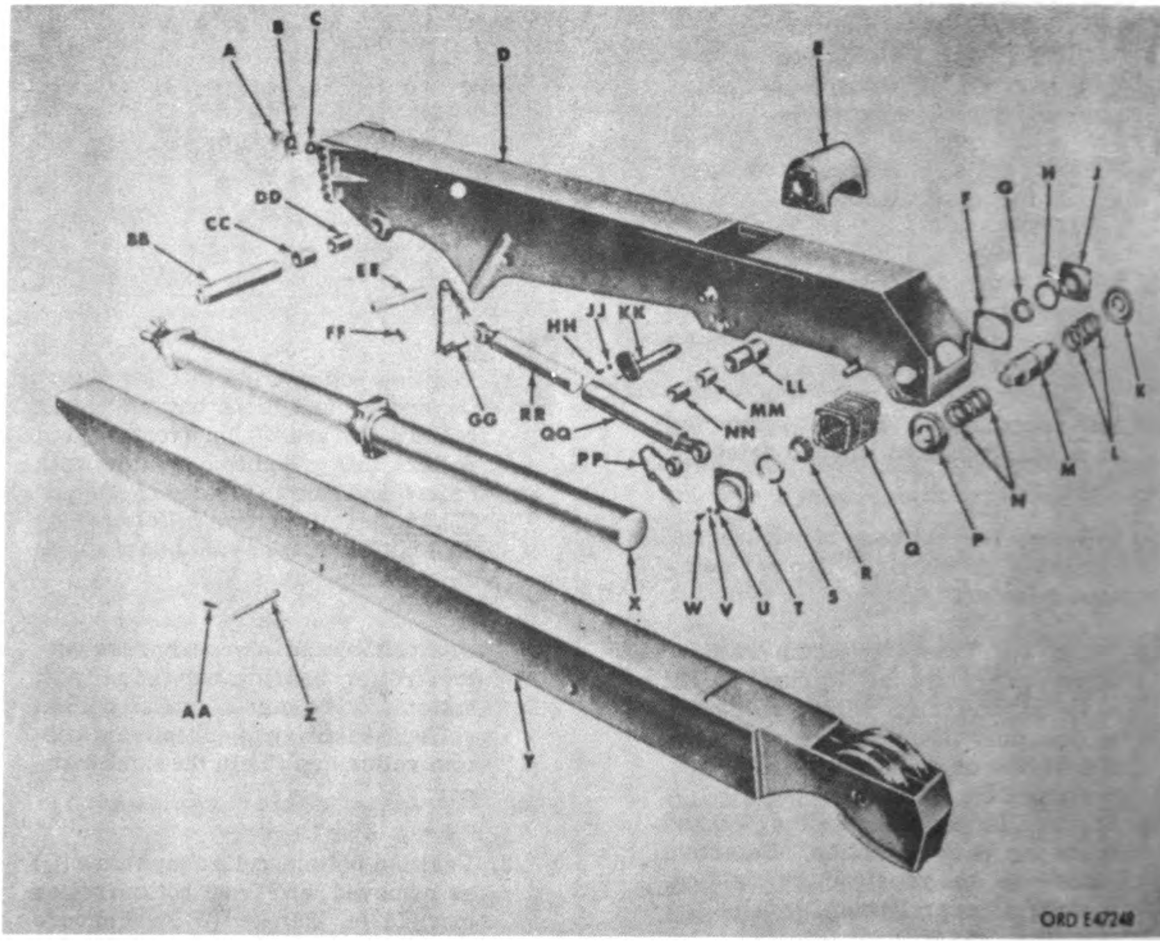


Figure 459. Shipper and boom assembly - exploded view

Key	Item	Key	Item
A	Nut, piston rod	R	Cone, bearing, bottom roller
B	Plate, lock, piston rod	S	Cup, bearing, bottom roller
C	Nut, piston rod	T	Cap, roller, bottom, front
D	Shipper	U	Fitting, lubricating
E	Housing, roller, upper	V	Washer, lock
F	Shims, cap, bottom roller	W	Screw, cap
G	Cone, bearing, bottom roller	X	Cylinder, boom
H	Cup, bearing, bottom roller	Y	Boom
J	Cap, roller, bottom, front	Z	Pin, collar, cylinder
K	Collar, roller, bottom, front	AA	Pin, cotter
L	Shim, collar, bottom roller	BB	Pin, pivot, shipper
M	Roller, bottom, front	CC	Bushing, shaft, pivot, shipper
N	Shim, collar, bottom roller	DD	Bushing, shaft, pivot, shipper
P	Collar, roller, bottom, front	EE	Shaft, pivot, lift cylinder
Q	Shims, cap, bottom roller	FF	Screw, set, sq-hd

Figure 459. Shipper and boom assembly - exploded view - legend

Key	Item	Key	Item
GG	Pin, brace, shipper	NN	Bushing, roller, bottom, rear
HH	Screw, cap	PP	Collar, pin, brace, shipper
JJ	Washer, lock	QQ	Brace, shipper, female
KK	Shaft, roller, bottom, rear	RR	Brace, shipper, male
LL	Roller, bottom, rear	SS	Fitting, lubrication
MM	Bushing, roller, bottom, rear		

Figure 459. Shipper and boom assembly - exploded view - legend - continued

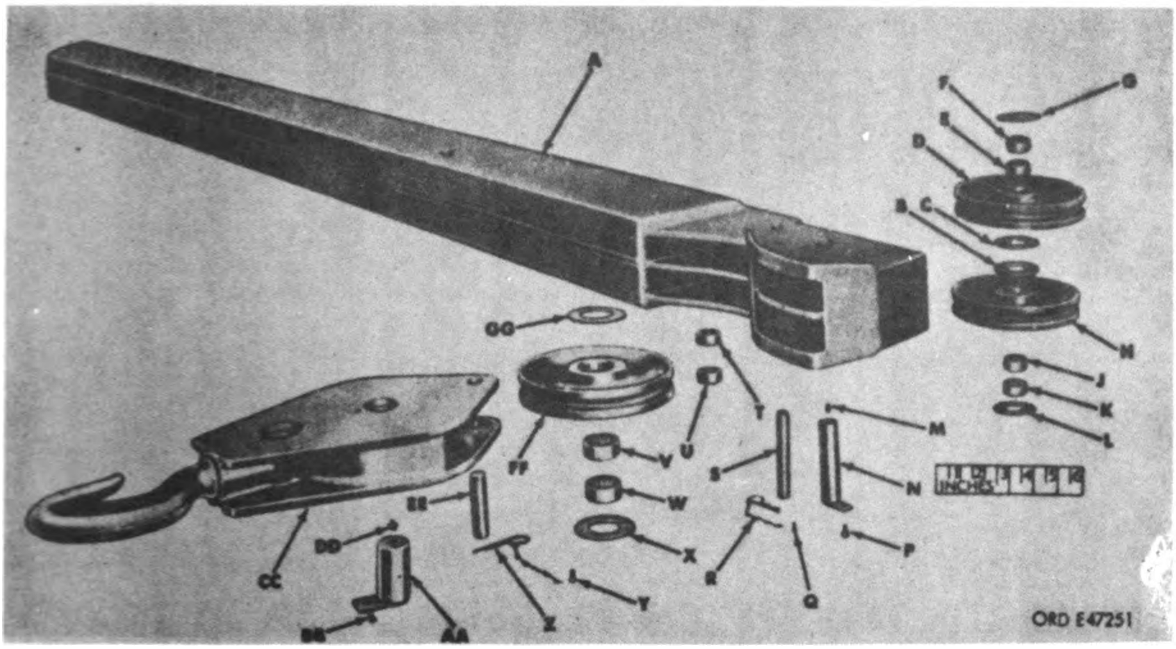


Figure 460. Boom and crane block sheaves - exploded view

Key	Item	Key	Item
A	Boom	S	Pin, anchor, cable boom
B	Washer, sheave, boom	T	Spacer, sheave, boom
C	Washer, sheave, boom	U	Spacer, sheave, boom
D	Sheave, boom	V	Bearing, sheave, crane block
E	Bearing, needle, sheave, boom	W	Bearing, sheave, crane block
F	Bearing, needle, sheave, boom	X	Washer, sheave, crane block
G	Washer, sheave, boom	Y	Screw, tapping
H	Sheave, boom	Z	Clip, pin
J	Bearing, needle, sheave, boom	AA	Pin, sheave, crane block
K	Bearing, needle, sheave, boom	BB	Screw, tapping
L	Washer, sheave, boom	CC	Block, crane
M	Fitting, lubricating	DD	Fitting, lubricating
N	Pin, sheave, boom	EE	Pin, anchor, cable, crane block
P	Bolt, hex-hd, w/washer	FF	Sheave, crane block
Q	Screw, tapping, hex-hd	GG	Washer, sheave, crane block
R	Clip pin		

Figure 460. Boom and crane block sheaves - exploded view - legend

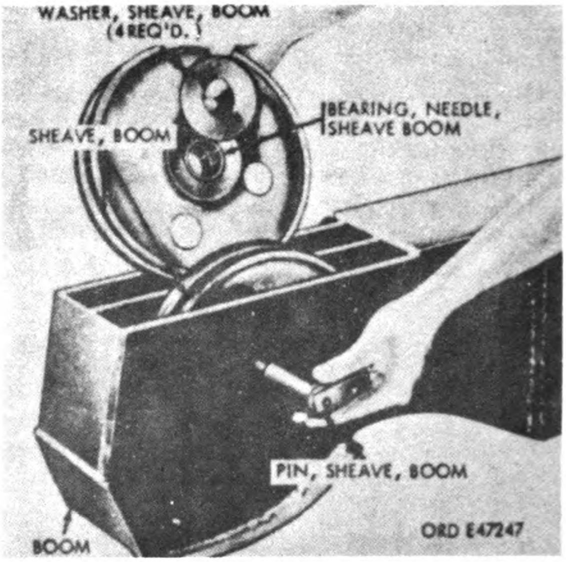


Figure 461. Removing boom sheave pin, sheaves, and bearings

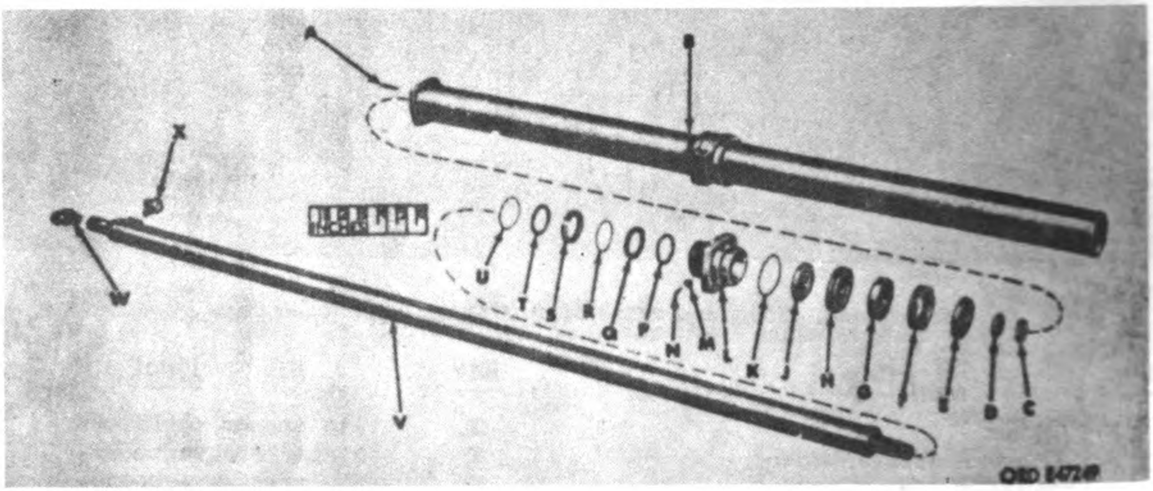


Figure 462. Boom cylinder assembly - exploded view

Key	Item	Key	Item
A	Stud, cylinder head	H	Cup, piston rod
B	Cylinder, boom	J	Spreader, cup, piston rod
C	Nut, piston rod	K	Gasket, O-ring, cylinder head
D	Nut, piston rod	L	Head, cylinder
E	Spreader, cup, piston rod	M	Nut, slotted, cylinder cap
F	Cup, piston rod	N	Pin, cotter
G	Spacer, cup, piston rod	P	Gasket, O-ring, piston rod

Figure 462. Boom cylinder assembly - exploded view - legend

Key	Item	Key	Item
Q	Wiper, felt, piston rod	U	Ring, snap, cylinder head
R	Spring, wiper, piston rod	V	Rod, piston
S	Wiper, leather, piston rod	W	Elbow, 45 degree
T	Washer, cylinder head	X	Elbow, 90 degree

Figure 462. Boom cylinder assembly - exploded view - legend - continued

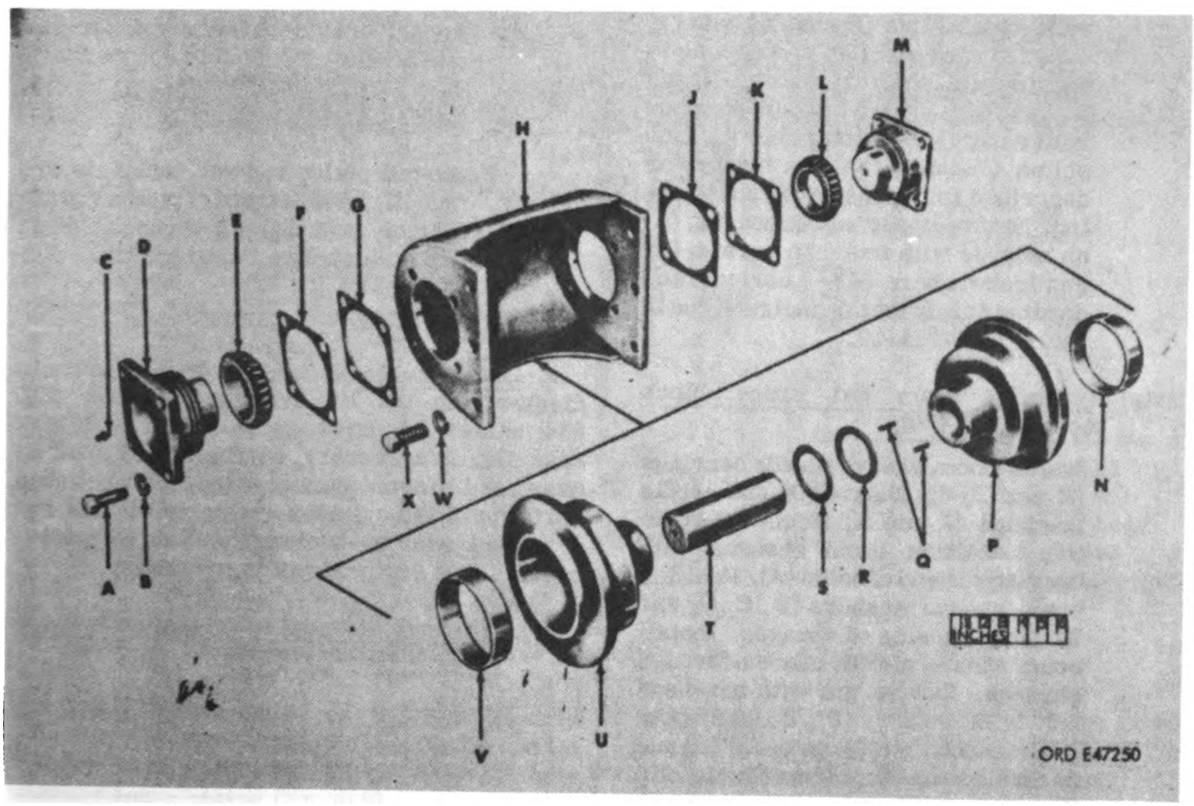


Figure 463. Upper roller assembly - exploded view

Key	Item	Key	Item
A	Washer, lock	M	Cap, roller, upper
B	Screw, cap	N	Cup, bearing, roller, upper
C	Fitting, lubricating	P	Roller, upper
D	Cap, roller, upper	Q	Pin, dowel, roller, upper
E	Cone, bearing, roller, upper	R	Shim, spacing, roller, upper
F	Shim, cap, roller, upper	S	Shim, spacing, roller, upper
G	Shim, cap roller, upper	T	Shaft, roller, upper
H	Housing, roller upper	U	Roller, upper
J	Shim, roller, upper	V	Cup, bearing, roller, upper
K	Shim, roller, upper	W	Washer, lock
L	Cone, bearing, roller, upper	X	Screw, cap

Figure 463. Upper roller assembly - exploded view - legend

2. Install upper roller dowel pins (Q) in upper roller (P) and position spacing shims (S and R) on dowel pins. Install upper rollers (P and U) on shaft (T). Aline dowel pin holes in upper roller (U) with dowel pins on roller (P) and butt end of rollers together.

3. Place upper rollers (U and P) assembled on shaft (T) into upper roller housing (H). Position upper roller cap shims (F and G), bearing cone (E), and cap (D), and secure to housing with four cap screws (B) and lockwashers (A). Assemble upper roller cap (M), bearing cone (L), and shims (J and K) in same manner as described for opposite cap and bearing. Secure upper roller housing (H) on shipper with four cap screws (X) and lockwashers (W). Lubricate according to lubrication instructions in LO 9-2320-211-12.

(c) Assemble boom and crane block sleeve (fig. 460).

1. Install boom sheave needle bearings (E and F) in sheave (D) and needle bearings (J and K) in sheave boom (H). Position boom sheaves with bearings in end of boom (A). Position boom sheave washers (B, C, G, and L) on each side of sheaves. Install boom sheave pin (N) in boom through sheaves. Secure pin with hex-head bolt with washer (P). Install boom cable anchor pin (S) in boom (A) and secure each end of pin with pin clip (R).

2. Install crane block sheave bearings (V and W) in crane block sheave (FF). Place sheave with bearing in crane block (CC). Position crane block sheave washers (X and GG) on each side of sheave in block. Install crane block sheave pin (AA) in block through sheave. Secure pin with tapping screw (BB) and lockwasher. Install crane block cable anchor pin (EE) in block and secure pin on each end with pin clip (Z).

(d) Install boom cylinder in boom.

1. Install hose assembly (fig. 449) with 90° elbow (fig. 451) on side of piston rod, as hose cannot be installed after cylinder is anchored in boom.

2. Support boom cylinder with a chain hoist and position in boom (fig. 451). Anchor cylinder by installing cylinder collar pins (fig. 451) through collar on cylinder. Secure pins with two new cotter pins.

(e) Install boom in shipper.

1. Attach boom with a chain sling. Pick up boom with an overhead hoist and insert end of boom in shipper (fig. 450). Slide boom into shipper until boom cylinder is seated against cylinder anchor in shipper.

2. Install piston rod nut, lockplate, and nut (fig. 449) on end of piston rod assembly and tighten securely. Bend lip on lockplate to secure nut.

333. Lift Cylinder

a. Disassembly. It will not be necessary to disassemble the lift cylinder assembly (fig. 464) unless it is known to be defective. If disassembly is necessary, extreme care must be exercised to avoid damage to the highly polished surfaces of the cylinder assembly. Do not remove oil seal or bushings unless inspection reveals that replacement is necessary.

(1) Remove lift cylinder piston and rod (fig. 465).

(a) Remove 12 safety nuts (D) and remove lift cylinder head (E) with piston and rod from lift cylinder (Q).

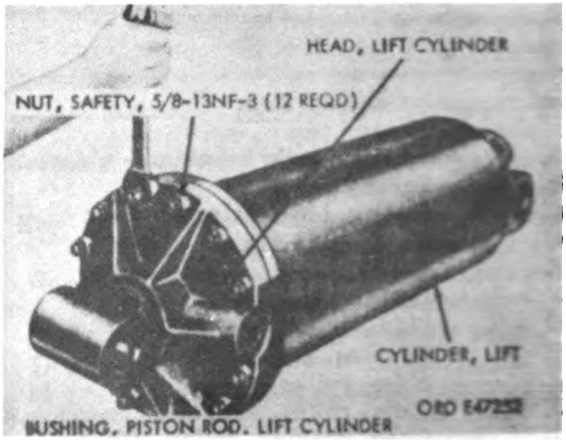


Figure 464. Lift cylinder assembly

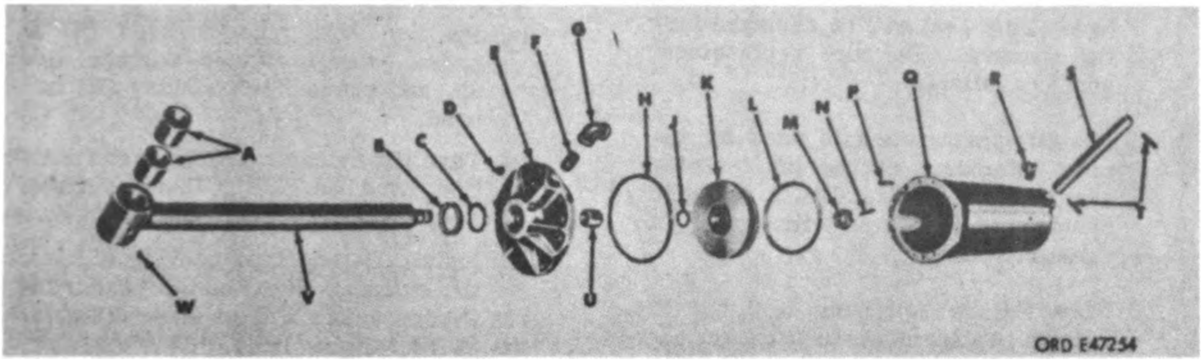


Figure 465. Lift cylinder assembly - exploded view

Key	Item	Key	Item
A	Bushing, piston rod	M	Nut, piston rod
B	Seal, head	N	Pin, cotter
C	Packing, O-ring type	P	Stud
D	Nut, safety	Q	Cylinder, lift
E	Head, lift cylinder	R	Elbow, 90 deg
F	Nipple	S	Shaft, pivot
G	Elbow, 90 deg	T	Pin, cotter
H	Gasket, O-ring, outer, head	U	Bushing, head
J	Gasket, O-ring, inner, piston	V	Rod, piston
K	Piston, lift cylinder	W	Fitting, lubricating
L	Gasket, O-ring, outer, piston		

Figure 465. Lift cylinder assembly - exploded view - legend

(b) Insert screwdriver or similar tapered tool under piston outer O-ring gasket (L) and remove gasket from lift cylinder piston (fig. 466).

Note. Care must be exercised to avoid damage to O-ring gasket and piston during this removal operation.

(c) Remove cotter pin (fig. 466) and piston rod nut (M) from stub end of piston rod (V). Slide lift cylinder piston (K) from rod.

(d) Use a small screwdriver or similar tapered tool and remove piston inner O-ring gasket (J) from the inner diameter of piston.

(e) To remove lift cylinder piston rod bushings (A), use suitable adapter and press out both bushings.

(2) Disassemble lift cylinder head.

(a) Remove head outer O-ring gasket (H) from cylinder head (E).

(b) Using a small screwdriver, remove O-ring type packing (C) from inner diameter of lift cylinder head.

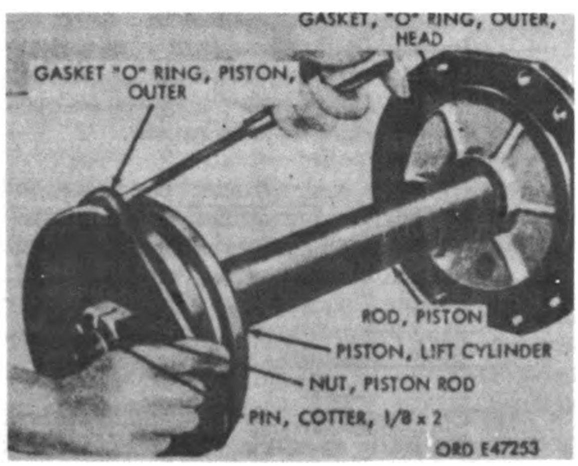


Figure 466. Removing O-ring gasket from lift cylinder piston

(c) To remove lift cylinder head seal (B), use a pinch bar and pry out seal.

Note. This seal will be damaged during removal. Be sure replacement seal is available.

(d) A split-type bushing is used for the inner diameter of the lift cylinder head. Use a small chisel to collapse bushing and remove with a pair of vise grip pliers.

Note. Before removing bushing, be certain replacement bushing is available.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Blow dry with compressed air. Apply a coat of light engine oil to the highly polished surfaces to prevent rust.

(2) Inspection and repair.

(a) O-ring gaskets. Inspect O-ring gaskets for cuts, scratches, or indications of wear. Replace damaged gaskets.

(b) Bushings. Inspect bushings for excessive wear. Replace bushings if worn.

(c) Piston and rod. Inspect piston and rod for scratches, nicks, or burs. Remove scratches with a soapstone or fine mill file. Replace if scratches are still evident or if piston and rod are damaged beyond repair.

(d) Cylinder and cylinder head. Inspect cylinder for scratches and nicks. Remove with a soapstone or fine mill file. If scratches and nicks are still evident, replace. Inspect cylinder head for cracked or broken condition. Replace as inspection warrants.

(e) Oil seal. The metal cased oil seal normally is a long-life part. Inspect the thin, featheredge which contacts piston rod to be sure it is intact. Replace seal if defects are found.

c. Assembly.

(1) Assemble lift cylinder head (fig. 466).

(a) Position lift cylinder head (E) in press, with machined surface side up, and press head bushing (U) into head.

(b) Turn lift cylinder head over and position head seal (B). Use a suitable adapter and press seal into head.

(c) Install O-ring type packing (C) into lift cylinder head. Install head outer O-ring gasket (H) on outer diameter of lift cylinder head.

(2) Install lift cylinder piston and rod.

(a) Position piston rod (V) in press and press piston rod bushings (A) into piston rod, one from each side.

(b) Install piston inner O-ring gasket (J) into inner diameter of lift cylinder piston (K).

(c) Slide lift cylinder head (E) onto piston rod (V) so that machined surface side of head is toward piston end of rod.

(d) Slide lift cylinder piston (K) on end of piston rod (V) and install piston rod nut (M). Insert new cotter pin (N) to secure nut.

(e) Install piston outer O-ring gasket (L) on outer diameter of lift cylinder piston (K).

(f) Apply a coat of light oil to wall of lift cylinder (Q) and to piston outer O-ring gasket (L). Insert lift cylinder piston with piston rod in cylinder and aline holes in lift cylinder head (E) with studs (P) in cylinder. Install twelve safety nuts (D) and tighten according to torque specifications Appendix I.

334. Swivel Valve

a. Disassembly (Fig. 467).

(1) General. Although the swivel valve (fig. 468) is one of the most essential units furnished with the wrecker crane, it is one of the most simple units in con-

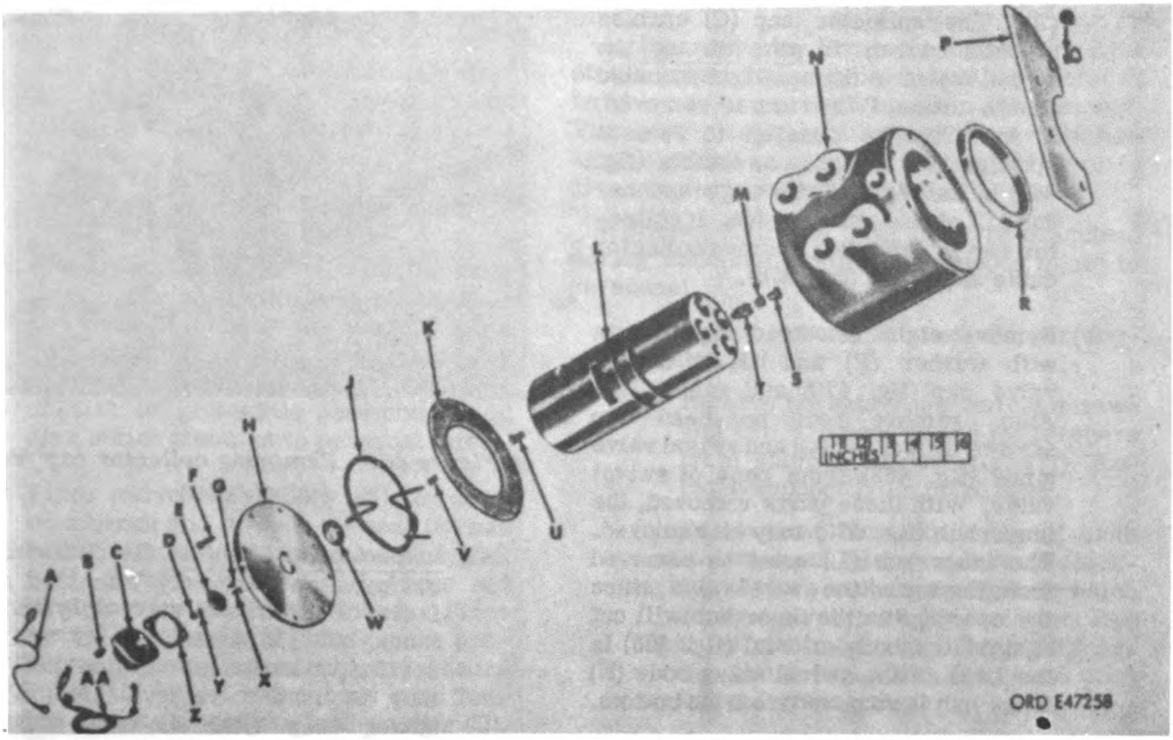


Figure 467. Swivel valve assembly - exploded view

Key	Item	Key	Item
A	Cable, upper, spotlight, assy	P	Guide, swivel valve
B	Screw, cap	Q	Screw, cap, hex-hd, w/washer
C	Cap, collector	R	Seal, oil, body
D	Nut, contact, collector	S	Grommet, terminal connector
E	Insulator, collector cap	T	Shell, male connector
F	Screw, cap, hex-hd, w/washer	U	Cup, spring
G	Screw, machine	V	Spring, light cable
H	Cap, swivel valve	W	Seal, light cable
J	Cable, lower spotlight, assy	X	Screw, contact, collector
K	Gasket, cap	Y	Washer, lock, internal tooth
L	Hub, inner	Z	Gasket, collector cap
M	Bushing, terminal connector	AA	Cable, collector, assy
N	Body, swivel valve		

Figure 467. Swivel valve assembly - exploded view - legend

struction. Self-lubricated by the oil which it helps to deliver, this unit will require little servicing. If grit or dirt is kept from entering the hydraulic system, the swivel valve will last the life of the crane. For this reason, when disassembling the unit, take special care to prevent the entrance of dirt or foreign matter and protect the finished surfaces from any nicks or burs.

Warning: When disassembling the swivel valve, handle parts carefully to avoid possible personal harm. The accidental sliding of the sharply machined edges together might easily cause a painful injury.

(2) Procedure.

(a) Remove two cap screws and lockwashers and lift off collector cap (fig. 469) and collector cap gasket (Z). The collector cap (C) enables electric current to pass through the swivel valve to the spotlight mounted on the crane. When cap is removed, it will then be possible to remove spotlight lower cable assembly (fig. 468) by threading up through the inner hub (L) of the swivel valve. If collector cap is defective, remove collector cable assembly (fig. 468).

(b) Remove eight hex-head cap screws with washer (F) and lift off swivel valve cap (fig. 470) and gasket (K). Also, remove four hex-head cap screws or washer (Q) and swivel valve guide (fig. 468) from base of swivel valve. With these parts removed, the inner hub (fig. 470) may be removed. The inner hub (L) must be removed from the top of the swivel valve, since the openings in the inner hub will cut against the body oil seal (fig. 468) in the base of the swivel valve body (N) if the hub is removed from the bottom.

b. Cleaning, Inspection and Repair.

(1) Cleaning. If cleaning is required, parts may be cleaned by immersing them in clean dry-cleaning solvent or mineral spirits paint thinner. The swivel valve parts are precision parts and extra care must be practiced in handling. Metal-to-metal contact must be avoided and every precaution possible taken to protect the machined surfaces. If parts are not to be assembled immediately, apply a thin coat of oil and protect from dust and dirt.

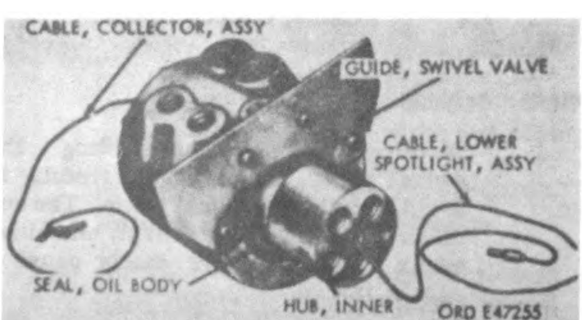


Figure 468. Swivel valve with cable assembly

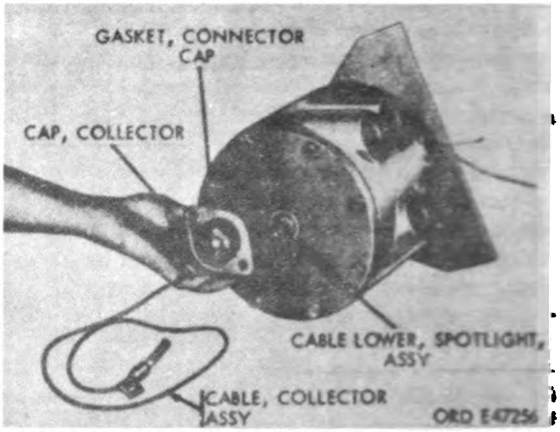


Figure 469. Removing collector cap from swivel valve

(2) Inspection and repair. Check for nicks or burs on the finely machined surfaces of the swivel valve body and the inner hub. If these defects are not serious, a soapstone or fine mill file may be used to remove them. Parts having deep nicks or burs must be replaced. For checking wear between swivel valve body and inner hub, refer to serviceability standards (par. 358). Inspect the screw threads in both the swivel valve body and the base of the inner hub for cross threading. If threads cannot be repaired, the parts must be replaced. Inspect the oil seal thoroughly and if frayed or worn, replace. Be sure swivel valve cap is not cracked or damaged in any way. Check the electrical cable and replace if frayed or worn. Electrical connec-

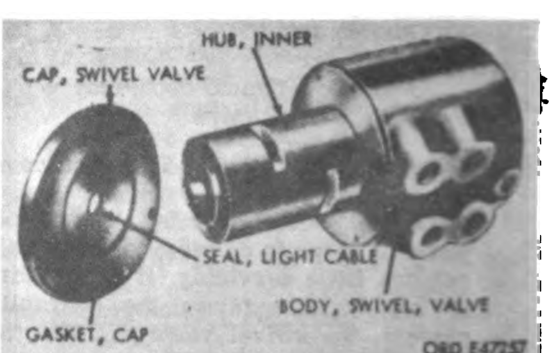


Figure 470. Cap and inner hub removed from swivel valve body

tions in connector cap must be clean and bright.

Note. The swivel valve body and inner hub are matched parts. If either part must be replaced, the matching part must also be replaced.

c. Assembly (Fig. 467).

(1) The assembly of the swivel valve must be accomplished with the same attention and care to protect the various parts as was pointed out in the disassembly procedure. Keep hands and clothes free of dirt or grit while assembling and give strict attention to personal safety.

(2) Place swivel valve body (N) top down on a bench and, if body oil seal (R) has been removed, install new body oil seal. Insert inner hub (L), large end first, into swivel (N) valve body. Place swivel valve guide (P) into groove provided around inner hub and secure guide to swivel valve body with four hex-head cap screws with washer (Q). Turn assembly unit over and place swivel valve cap gasket (K) and swivel cap on top of swivel valve body. Secure with eight hex-head cap screws with washer (F). Tighten to torque specifications (Appendix I).

(3) Insert spring cup (U), light cable spring (V), and light cable seal (W) into center of swivel valve cap (H). Thread spotlight lower cable assembly (J) down through these installed parts so that contact end will rest against light cable spring (V). Install male connector shell (T), terminal connector bushing (M), and terminal connector grommet (S) to opposite end of spotlight lower wire with terminal assembly. If collector cap (C) has been disassembled, insert collector cable assembly (AA) through collector cap opening and secure to collector cap insulator (E) with collector contact screw (X), internal-tooth lockwasher (Y), and collector contact nut (D). Secure insulator to collector cap with two screws (G).

(4) Place collector cap gasket (Z) and collector cap assembly in position on swivel valve cap and secure with two hex-head cap screws (B).

335. Pivot Post and Base Plate Assembly

a. Disassembly. Due to the excessive weight of the pivot post and base plate, an overhead hoist must be provided to aid in disassembly. The base plate should be positioned on blocks approximately eight inches from the floor to give access to underneath side.

Warning: Extreme care must be exercised during disassembly to avoid serious injury to personnel.

(1) Remove pivot post and shipper support.

(a) Remove ten safety nuts and cap screws and two cap screws and lockwashers from shipper support (fig. 471). Remove support from pivot post.

(b) Remove two hex-nuts, external-tooth lockwashers, plain washers, and locking plates, and six safety nuts which secure pivot post support cap. Remove pivot post support cap and spacing shims (fig. 472). Keep shim pack intact for assembly.

(c) Remove 18 cap screws with washers. Remove pivot post gear shield and gear shield felt from base plate (fig. 473).

(d) Attach chain hoist to pivot post and lift high enough to permit removal of bearing cone. Remove bearing cone (fig. 474). Continue lifting pivot post until it is free from pivot post support (fig. 475).

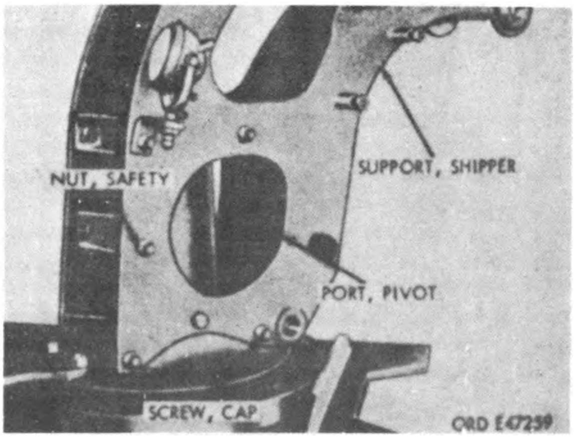


Figure 471. Disconnect points for shipper support removal

(e) It is unnecessary to remove bearing cup in base of pivot post unless inspection warrants replacement. If inspection reveals replacement is needed, remove two lubricating fittings on base of of pivot post. The tapped holes for fittings are in line with the bearing cup. Insert a drift punch (fig. 476) in each hole and tap alternately until cup is removed.

(f) It is unnecessary to remove bearing cup in swivel valve end of pivot post unless inspection warrants replacement. If inspection reveals replacement of cup is needed, use suitable puller and remove bearing cup from pivot post.

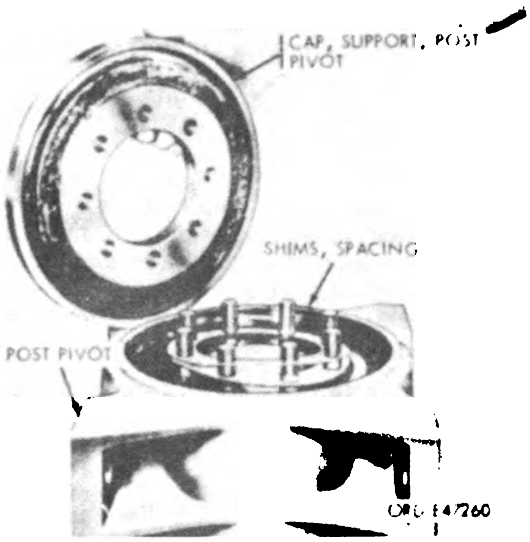


Figure 472. Removing pivot post support cap and spacing shims

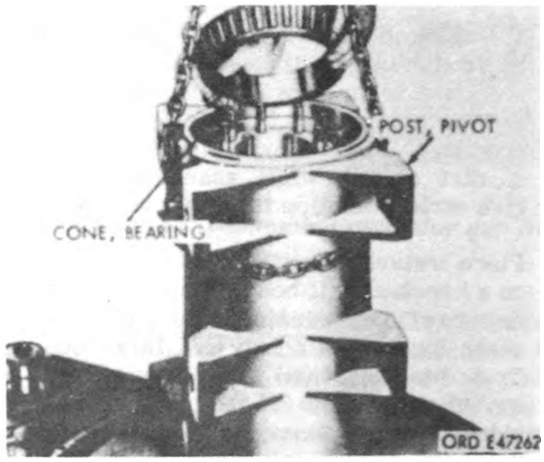


Figure 474. Removing bearing cone from pivot post

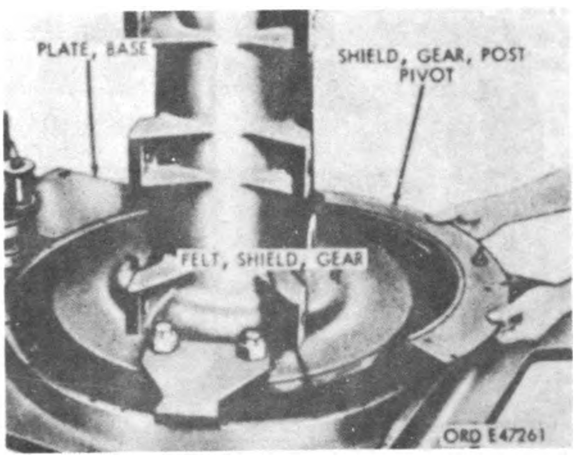


Figure 473. Removing pivot post gear shield from base plate

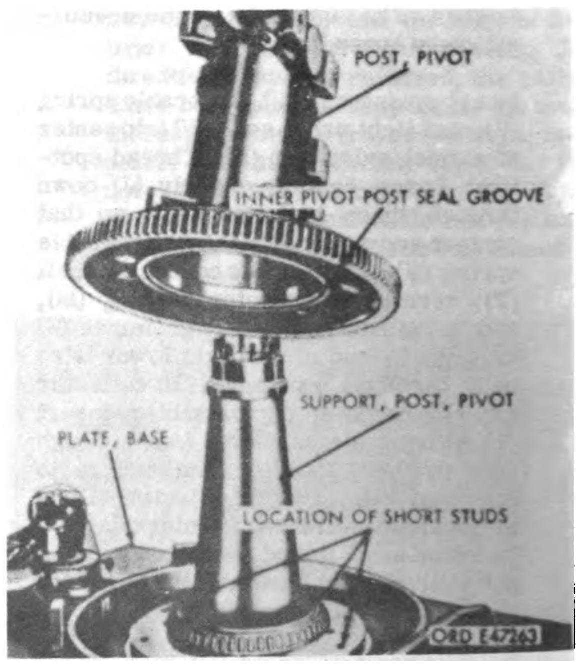


Figure 475. Removing pivot post from base plate

(2) Removal of drive pinion and pivot post support (fig. 477).

(a) Remove 13 safety nuts and three hexnuts securing pivot post support to base plate. Attach on overhead hoist to pivot post support and remove from base plate.

(b) Remove two cap screws (X) securing retaining plate (V) and spacer shims (R, S, T, and U) to drive pinion idler gear shaft, and four cap screws and lockwashers securing drive pinion lower bearing cover and gasket to base plate. Remove two cap screws securing drive pinion adjusting plate and spacing shims to drive pinion (fig. 478). Remove plate and shims.

(c) Remove four cap screws and lockwashers from idler gear housing cover. Remove idler gear housing cover, gasket, and felt. Remove drive pinion, drive pinion crank, and bearing cone. Also remove drive pinion idler gear shaft, drive pinion idler gear, and bearing cone assembly from base plate (fig. 479).

(d) Support drive pinion crank in arbor press and press drive pinion from drive pinion crank. Remove bearing cone from drive pinion crank. It is not necessary to remove bearing cups from base plate unless inspection (b below) reveals replacement is required.

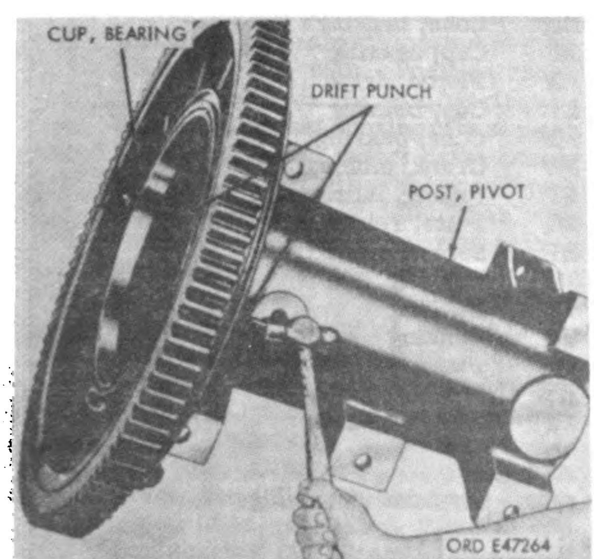


Figure 476. Removing bearing cup from base of pivot post

(e) Remove bearing cones (C and P) from each side of drive pinion idler gear (L). It is not necessary to remove bearing cups (D and N) in drive pinion idler gear unless inspection warrants replacement of gear or cups. If inspection reveals replacement of cups or gear is necessary, remove two cups and snap rings from gear.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Due to the heavy gear lubricant which is used to lubricate the drive pinion, drive pinion idler gear, and welded-on ring gear at base of the pivot post, steam clean all parts to remove oil lubricant.

(2) Inspection and repair.

(a) Base plate. Inspect base plate for defective welds or cracks. Minor weld failures can be repaired by rewelding. If other cracks are evident, replace base plate.

(b) Pivot post. Inspect ring gear on base of pivot post for broken, cracked, or chipped teeth. Replace pivot post if any of these conditions are found.

(c) Bearings and cups. Inspect bearings and cups for pitted, scratched, or scored condition. Replace bearing or cup if any of these conditions exist.

(d) Drive pinion and idler gear. Inspect drive pinion and idler gear for broken, cracked, or chipped teeth. Replace defective gears.

c. Assembly. Before proceeding with the final assembly of the base plate and pivot post assembly, bearing adjustments must be made individually and without gear contact of mating part as outlined in paragraph 356. Use shim packs as therein prescribed to maintain specified bearing preloads.

Note. Bearing adjustments require temporary assembly and removal of the adjusted parts. Pack all tapered roller bearings with

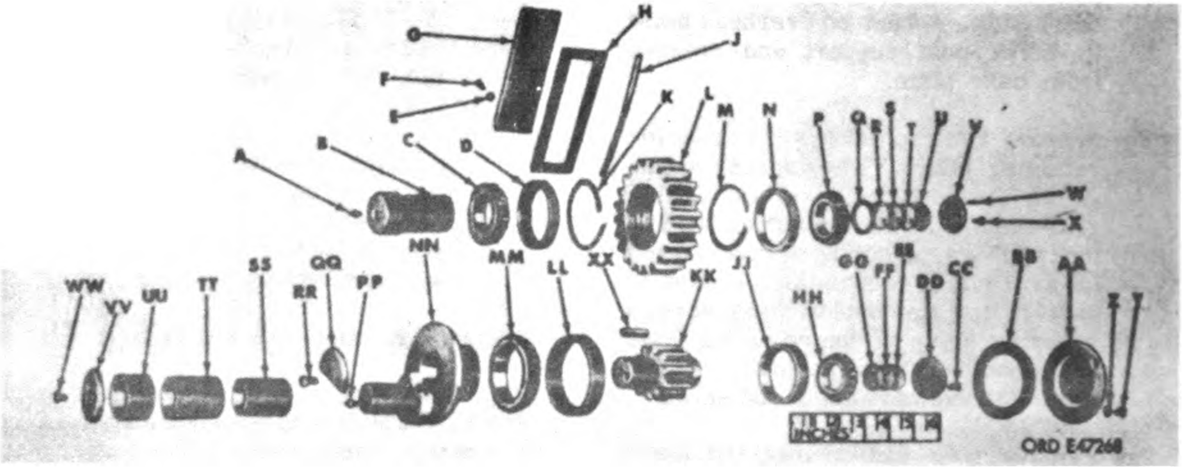


Figure 477. Drive pinion and idler gear - exploded view

Key	Item	Key	Item
A	Fitting, lubricating	Z	Washer, lock
B	Shaft, gear, idler, pinion, drive	AA	Cover, bearing, lower, pinion, drive
C	Cone, bearing	BB	Gasket, cover, bearing, lower, pinion, drive
D	Cup, bearing	CC	Screw, cap
E	Washer, lock	DD	Plate, adjusting, pinion, drive
F	Screw, cap	EE	Shim, spacing
G	Cover, housing, gear, idler	FF	Shim, spacing
H	Gasket, cover, housing, gear, idler	GG	Shim, spacing
J	Felt, cover, housing, gear, idler	HH	Cone, bearing
K	Ring, snap, bearing, gear, idler, pinion, drive	JJ	Cup, bearing
L	Gear, idler, pinion, drive	KK	Pinion, drive
M	Ring, snap, bearing, gear, idler, pinion, drive	LL	Cup, bearing
N	Cup, bearing	MM	Cone, bearing
P	Cone, bearing	NN	Crank, pinion, drive
Q	Washer, spacing	PP	Fitting, lubricating
R	Shim, spacing	QQ	Plate, retaining, pinion, drive
S	Shim, spacing	RR	Screw, cap
T	Shim, spacing	SS	Bushing
U	Shim, spacing	TT	Bushing
V	Plate, retaining	UU	Bushing
W	Pin, dowel	VV	Plate, retaining
X	Screw, cap	WW	Screw, special
Y	Screw, cap	XX	Key, Woodruff

Figure 477. Drive pinion and idler gear - exploded view - legend

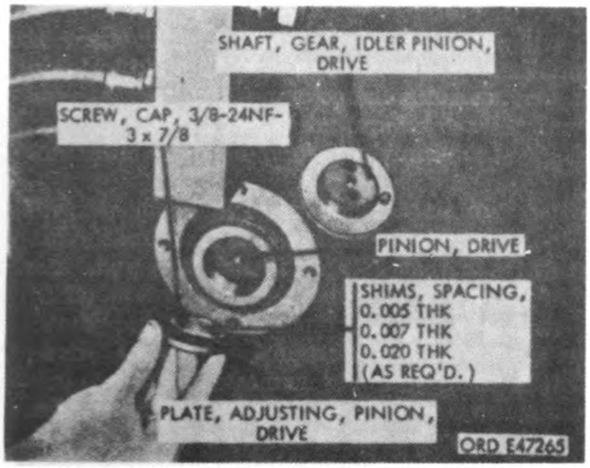


Figure 478. Removing drive pinion adjusting plate and spacing shims

artillery and automotive grease before final assembly.

(1) Install drive pinion idler gear (fig. 477).

(a) Install drive pinion idler gear bearing snap rings (K and M), on inner diameter of drive pinion idler gear (L). If bearing cups were removed, press bearing cups (D and N) in drive pinion idler gear (L). Position bearing cones (C and P) in cups.

(b) Install spacing washer (Q) in the bore for idler gear shaft, located in base plate (J, fig. 480). Position drive pinion idler gear (L), with bearing assemblies, in gear housing of base plate (J, fig. 480) and insert drive pinion idler gear shaft (B) as shown in figure 473. Aline bore of idler gear with shaft and install shaft through gear in base plate.

(c) Aline spacing shims (R, S, T, and U), as established in paragraph 356, with retaining plate (V) and insert two cap screws (X) through shims and plate. On the underside of base plate (J, fig. 480), aline retaining plate with dowel pin (W) and secure to drive pinion idler gear shaft (B) with two cap screws (X). Install lubricating fitting (A) on upper end of idler gear shaft.

(2) Install drive pinion and crank (fig. 477).

(a) If inspection revealed that replacement of bearing cups (LL and JJ) was necessary, install new bearing cup in bore for drive pinion on top and bottom side of base plate (J, fig. 480).

(b) Install upper bearing cone (MM) on drive pinion crank (NN). Install Woodruff key (XX) on drive pinion (KK). Aline pinion and key with keyway on drive pinion crank and press these parts together. Position and aline drive pinion retaining plate (QQ) on drive pinion crank and secure to drive pinion with two special cap screws (RR).

(c) Position drive pinion (KK) with drive pinion crank (NN) in base plate (J, fig. 480). Install bearing cone (HH) from underside of base plate on drive pinion. Aline spacing shims (EE, FF, and GG), as established in paragraph 356 with drive pinion adjusting plate (DD). Insert two cap screws (CC) through shims and adjusting plate and secure to drive pinion.

(3) Install pivot post support and pivot post (fig. 480).

(a) There are 16 studs installed in the the pivot post support to mount it to

Figure 479. Pivot post drive pinion and drive pinion idler gear removed

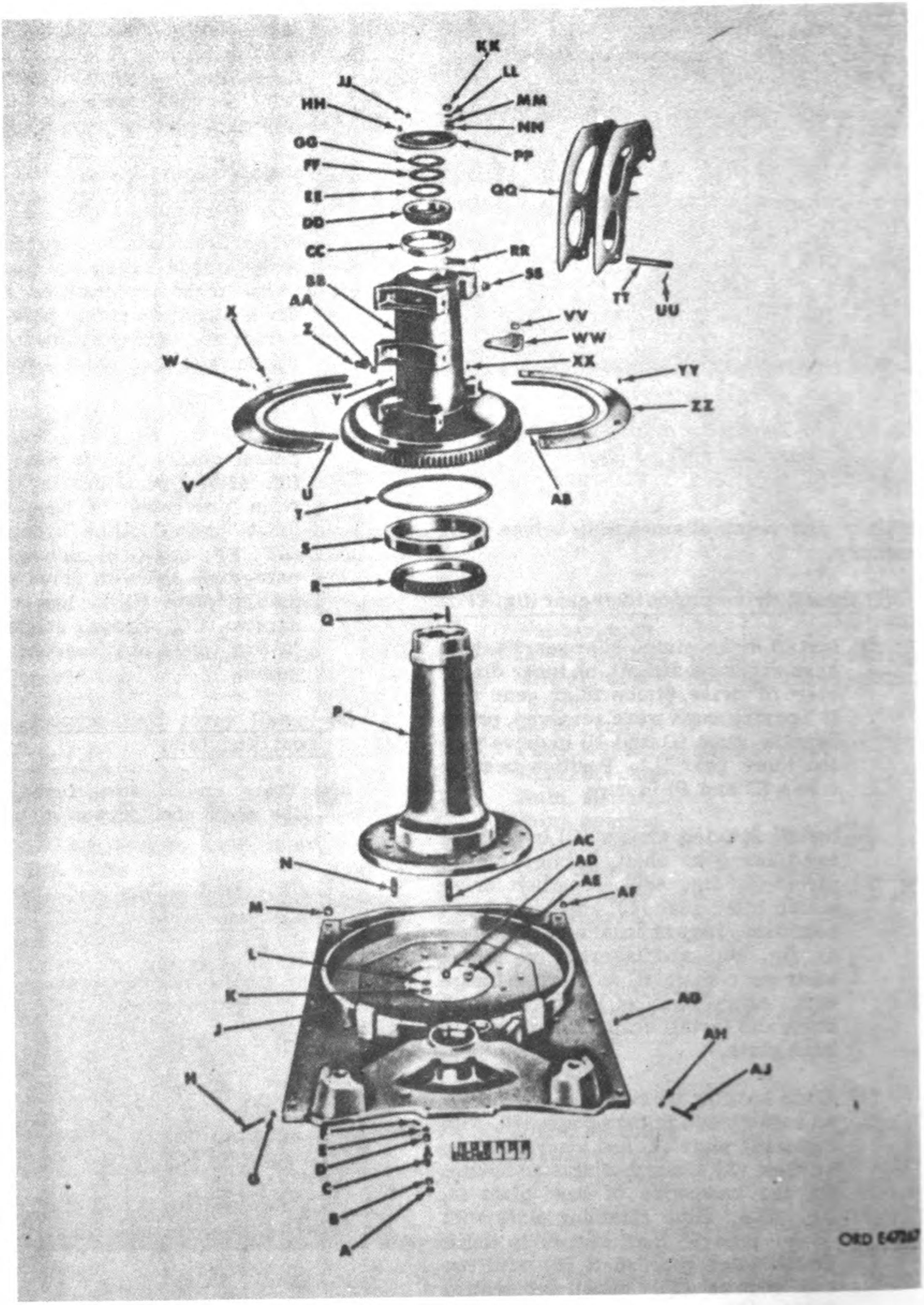


Figure 480. Pivot post and base plate - exploded view

Key	Item	Key	Item
A	Nut, jam	EE	Shim, spacing, 0.005 thk
B	Nut, hex	FF	Shim, spacing, 0.007 thk
C	Pin	GG	Shim, spacing, 0.020 thk
D	Roller	HH	Fitting, lubricating
E	Washer	JJ	Nut, safety
F	Pin, cotter	KK	Nut, hex
G	Nut, jam	LL	Washer, ext-tooth
H	Screw, set, special	MM	Washer, plain
J	Plate, base	NN	Plate, locking, swivel valve hub
K	Nut, hex	PP	Cap, support, post, pivot
L	Washer	QQ	Support, shipper
M	Nut, safety	RR	Screw, cap, special
N	Stud, mounting	SS	Nut, safety
P	Support, post, pivot	TT	Shaft, anchor, lift cylinder
Q	Stud	UU	Pin, cotter
R	Cone, bearing	VV	Nut, safety
S	Cup, bearing	WW	Plate, stop
T	Seal, post, pivot, inner	XX	Fitting, lubricating
U	Felt, shield, gear	YY	Fitting, lubricating
V	Shield, gear, post, pivot	ZZ	Shield, gear, post, pivot
W	Screw, cap, w/washer	AB	Felt, shield, gear
X	Fitting, lubricating	AC	Stud, mounting
Y	Fitting, lubricating	AD	Plug, pipe, sq-hd
Z	Screw, cap	AE	Nut, safety
AA	Washer, lock, med, 1 in.	AF	Nut, safety
BB	Post, pivot	AG	Fitting, lubricating
CC	Cup, bearing	AH	Nut, jam
DD	Cone, bearing	AJ	Screw, set, special

Figure 480. Pivot post and base plate - exploded view - legend

the base plate. Three of these studs are slightly shorter than the others in order to provide clearance. For installation position of short mounting studs, refer to figure 475.

(b) Install 13 mounting studs (AC) and three mounting studs (N) on bottom side of pivot post support (P). Attach on overhead hoist to pivot post support and position on base plate (J). Install 13 safety nuts (AE) on long mounting studs and three hex-nuts (K) on short mounting studs. Tighten according to torque specification table in Appendix I.

(c) Install bearing cone (R) at base of pivot post support (P). Position bearing cup (S) in pivot post (BB). Tap cup lightly around edges with a soft hammer until it is seated in pivot post. Make sure cup does not become cocked. Install bearing cup (CC) in swivel valve end of pivot post in same manner. Install inner pivot post seal (T) in groove (fig. 475) in base of pivot post. Install eight studs (Q) in swivel valve end of pivot post support, for securing pivot post support cap.

(d) Attach an overhead hoist to pivot post (BB) and position over pivot post support (P). Lower pivot post until it is about 4 inches from being seated. While suspended over pivot post support, tilt pivot post enough to engage its ring gear teeth with drive pinion idler gear (L, fig. 477). Continue lowering pivot post until seated on bearing cone (R).

(e) Position and install bearing cone (DD) in swivel valve end of pivot post (BB). Aline spacing shims (EE, FF, and GG) with pivot post support cap (PP). Position cap with shims, as adjusted in paragraph 356, on studs (Q). Install two swivel valve hub locking plates (NN), plain washers (MM), external-tooth lockwasher (LL), hex-nuts (KK), and six safety nuts (JJ) to secure cap. Install two lubricating fittings (HH).

(f) Position shipper support (QQ) on pivot post (BB) and secure with ten special cap screws (RR), safety nuts (SS), two cap screws (Z), and medium lock-washers (AA).

(g) Position gear shield felt (U and AB) and pivot post gear shield (V and ZZ) on base plate (J). Install 18 cap screws with washers (W) to secure shields.

Note. Prepack ring gear with artillery and automotive grease before assembling pivot post gear shield to base plate.

336. Control Valve Bank (Fig. 481)

a. Disassembly (Fig. 482).

(1) General. The control valve bank assembly (fig. 481) has been carefully assembled and will require a minimum

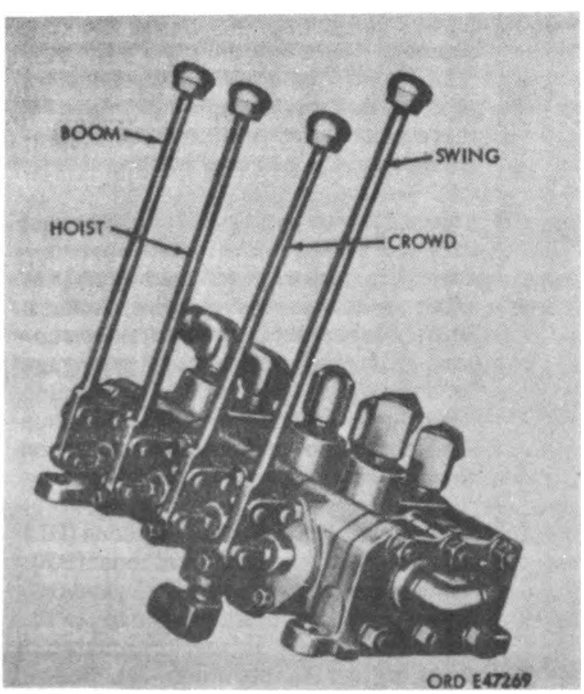


Figure 481. Control valve bank assembly

of servicing. The oil seals in the valve spool end shall be replaced if damaged. Any accumulation of dirt around the ends of the spool shall be removed. The tie rods used to bolt the separate valves together are set with a torque wrench. 85 pounds-feet of torque is used for the two center rods and 120 pounds-feet of torque is used for the four end rods.

(2) Disassemble control valve bank assembly. Remove six hex-nuts and lock-washers from end of control valve bank assembly and remove control-valve bank end cover (fig. 483). Separate valve bank into individual control valves.

(3) Disassemble individual control valve.

(a) Remove four cap screws (UU) and washers and lift off control valve end cover (TT) and gasket (fig. 484).

(b) Compress spring slightly and remove horseshoe-type washer (fig. 484), spacer, spring, and plain washer from rear end of (swing) control valve spool.

(c) Remove cotter pins from the two lever retaining pins and take off control valve lever (P) and linkage from front end of control valve. Remove cap screw (H) beneath control valve spool and eyebolt (R) above control valve spool. Take off control valve spool, front cover (F).

(d) Slide control valve spool together with adapter ring (Z), chevron ring (AA), and three chevron seals (E), out through front end of control valve body (fig. 485).

(e) Remove control valve spool yoke (fig. 485) and locking nut (Y) from end of (swing) control valve spool (D).

(f) Disassemble each control valve as described in (a) through (e) above.

b. Cleaning, Inspection and Repair.

(1) Cleaning. The control valve bank assembly must be treated with care. A clearance of 0.0002 to 0.0004-inch

exists between the control valve spool and the control valve body. When handling the control valve spool, be sure to prevent scratches, nicks, or burs. Immerse parts in clean dry-cleaning solvent or mineral spirits and wash away dirt. Note particularly the chamber into which the control valve spool slides and be sure all oil passageways are open.

(2) Inspection and repair. Examine the control valve spool to be sure there are no scratches, nicks, or burs. Slight defects may be removed with a fine mill file or soapstone, but if spool is of questionable service, it must be replaced. Refer to paragraph 358 for serviceability standards. Examine the control valve body for cracks, nicks, and burrs on machined surfaces. Cracked or damaged control valve body must be replaced.

Note. Control valve spool and control valve body must be replaced in matched sets.

c. Assembly (Fig. 482).

(1) General. Before beginning the assembly of the control valve bank assembly, be sure that all parts are free of any grit.

(2) Assemble hydraulic control valve.

(a) Turn control valve spool yoke (J) and locking nut (Y) into end of control valve (swing) spool (D). Tighten securely. Insert control valve spool into control valve body (BB) and push through until just enough space is left on spool to arrange three chevron seals (E), adapter ring (Z), and chevron ring (AA), as shown in figure 479. Completely push spool into place in body, install control valve spool front cover (F), and secure with hex-head cap screw (H), special eyebolt (R), and one locking nut (W).

(b) Assemble control valve lever (P) to control valve spool yoke and eyebolt and secure in place with three rod end pins (K, L, and M), two control valve links (N and S), and three new cotter pins (T, V, and X). Place control valve spring washer (XX), sleeve (RR), and spring (WW) on end of control valve spool, which extends out the rear end of control valve body. Compress spring sufficiently to secure spool, and associated parts, with horseshoe-type washer (SS).

(c) Install control valve end cover (TT) and gasket (VV), and secure with four cap screws (UU).

(d) Tighten to torque specifications, Appendix I. Each of the four control valves is assembled in like manner. Control valve bodies and spools are not interchangeable, and must be kept in the same position in the valve bank for the function they are to control. Be sure to note the function of the control valve being replaced and order the parts accordingly.

(3) Assemble control valve bank assembly (fig. 482). The assembling of the control valve bank assembly will require special attention so as to place control valves in the same position in the valve bank from which they were removed. When these units were originally assembled, precompressed gaskets were used. To accomplish this in the field, the following steps must be taken. Place control valve body gasket (C) between each control valve and the control valve bank end covers (B and QQ). Insert the five valve body tie rods (A) and one drilled valve body tie rod (ZZ) through the complete assembly, and secure tie rods at each end with 12 tie-rod washers (AB) and hex-nuts (AC and LL). Alternately tighten nuts on ends of tie rods so that control valve bank assembly will be drawn up evenly. Tighten two center rods to 85 pounds-feet of torque and 120 pounds-feet for the four end rods. Allow valve bank to set overnight and then check nuts to see if nuts are still at previous torque setting. Install five palnuts (AE and NN) to each end of tie rods and wire seals (AD and MM) to ends of drilled valve body tie rod (ZZ). If the two pipe plugs (HH and AF) were removed coat each with a hardening type sealing compound (Litharge or Permatex No. 1) and install into valve bank end covers.

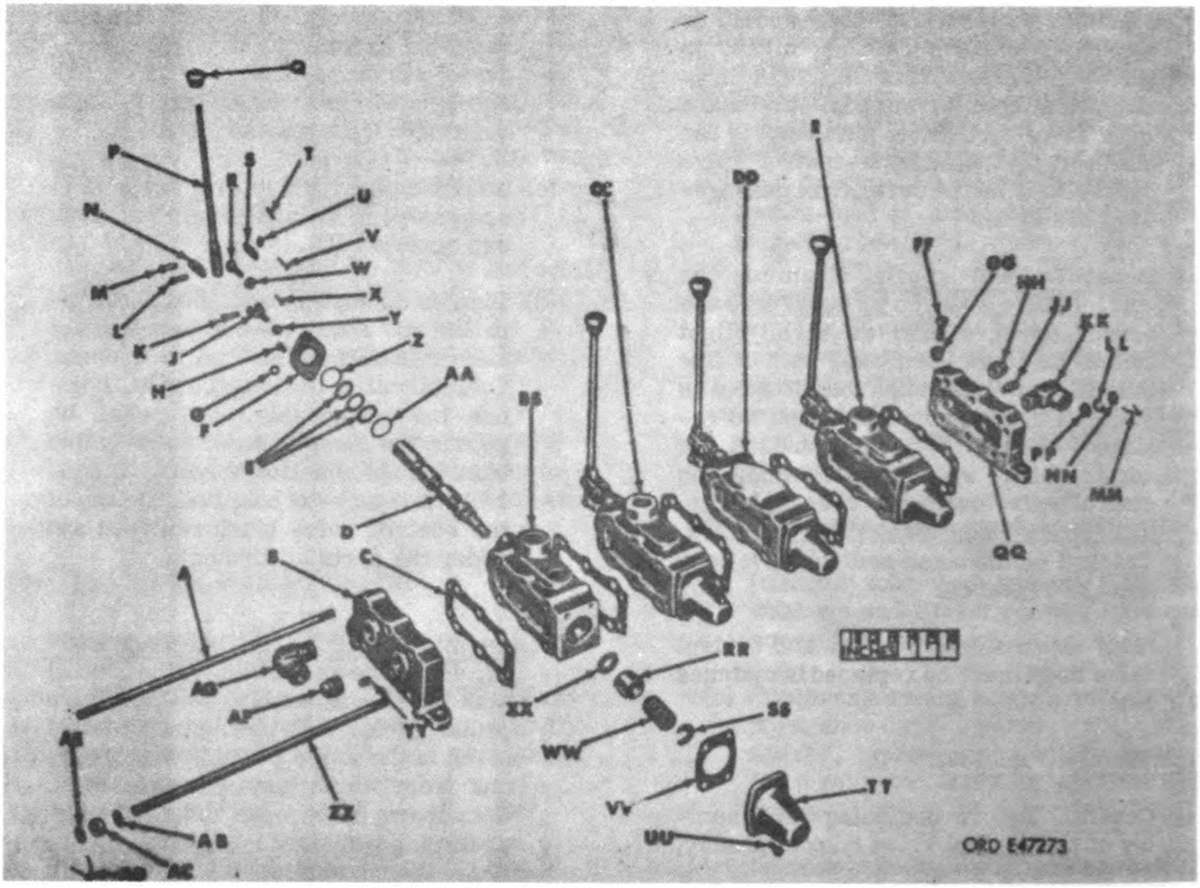


Figure 482. Control valve bank assembly - exploded view

Key	Item	Key	Item
A	Rod, tie, valve body	T	Pin, cotter
B	Cover, end, control valve bank	U	Washer, plain od
C	Gasket, control valve body	V	Pin, cotter
D	Spool, control valve (swing)	W	Nut, locking
E	Seal, chevron	X	Pin, cotter
F	Cover, front, control valve spool	Y	Nut, locking
G	Washer, lock	Z	Ring, adapter
H	Screw, cap, hex-hd	AA	Ring, chevron
J	Yoke, control valve spool	BB	Body, control valve
K	Pin, rod end	CC	Valve, control, assembly (crowd)
L	Pin, rod end	DD	Valve, control, assembly (hoist)
M	Pin, rod end	EE	Valve, control, assembly (boom)
N	Link, control valve	FF	Bolt
P	Lever, control valve	GG	Nut, safety
Q	Ball, control valve lever	HH	Plug, pipe, 1 in.
R	Bolt, eye, special	JJ	Adapter, bypass line
S	Link, control valve	KK	Elbow, 90 deg.

Figure 482. Control valve bank assembly - exploded view - legend

Key	Item	Key	Item
LL	Nut, hex	WW	Spring
MM	Seal, wire	XX	Washer, control valve spring
NN	Palnut	YY	Plug, pipe
PP	Washer, plain	ZZ	Rod, tie, valve body (drilled)
QQ	Cover, end, control valve bank	AB	Washer, tie rod
RR	Sleeve	AC	Nut, hex
SS	Washer, horseshoe-type	AD	Seal, wire
TT	Cover, end, control valve	AE	Palnut
UU	Screw, cap	AF	Plug, pipe
VV	Gasket, end cover, control valve	AG	Elbow, 90 deg, end cover

Figure 482. Control valve bank assembly - exploded view - legend continued

17. Rear Winch (Fig. 486)

a. Disassembly.

(1) Drain lubricant. Remove drain plug from gear case, and drain lubricant. It is not necessary to remove wire rope assembly from drum unless inspection warrants replacement. If wire rope is not removed, an overhead means of lifting the assembly must be used to facilitate disassembly.

(2) Remove and disassemble level wind (fig. 487).

(a) Remove four cap screws (DD), lock-washers (MM), and lift level wind assembly from winch.

(b) Loosen four jam nuts (NN) and turn setscrews (PP) in trolley frame (AJ). Remove trolley frame from trolley track (EE).

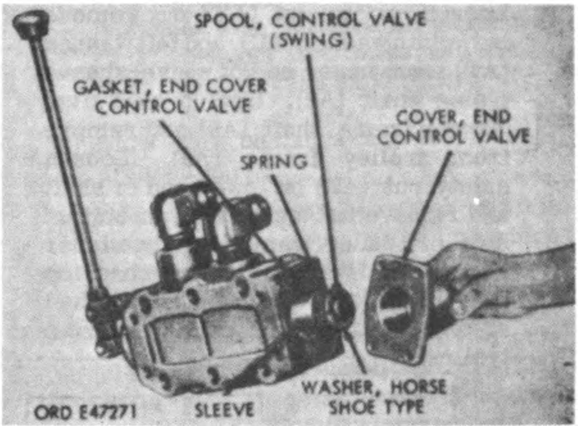


Figure 484. Removing control valve end cover

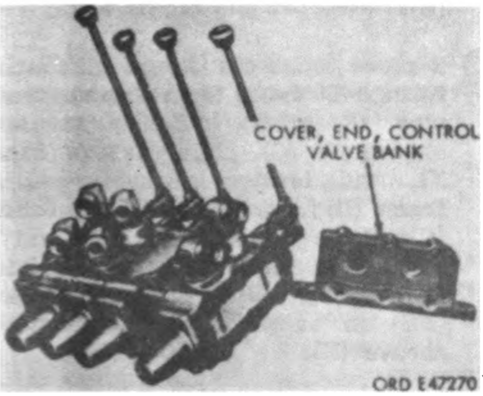


Figure 483. Control valve bank end cover separated from control valve bank assembly

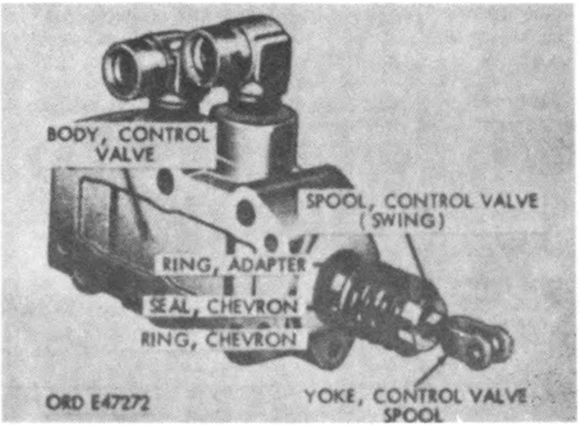


Figure 485. Control valve spool and chevron seals removed

(c) Remove four cap screws (B) and lockwashers (A) securing cable guard (AZ). Remove cable guard.

(d) Use suitable snap ring pliers and remove two snap rings (K and AR) from swivel sheave shaft (J). Remove shaft with dowel pin (H) and, at the same time, remove swivel sheave (AY), two swivel sheave bearing spacers (F and AW), and plain washers (E and AX) from swivel sheave frame (AQ). Remove swivel sheave sleeve (D) and needle bearing (C) from bore of sheave.

(e) Loosen safety nut (AV) and remove nut, plain washer (AU), and felt washer (AT) from upper end of swivel sheave frame shaft (AS). Lift up on swivel sheave frame shaft (AS) and remove from trolley frame (AJ). Loosen safety nut (AK) on lower end of shaft and remove nut and shaft from bottom side of trolley frame. Remove inner and outer swivel sheave thrust bearing ball race (AN and AL) and swivel sheave thrust bearing balls (AM) from trolley.

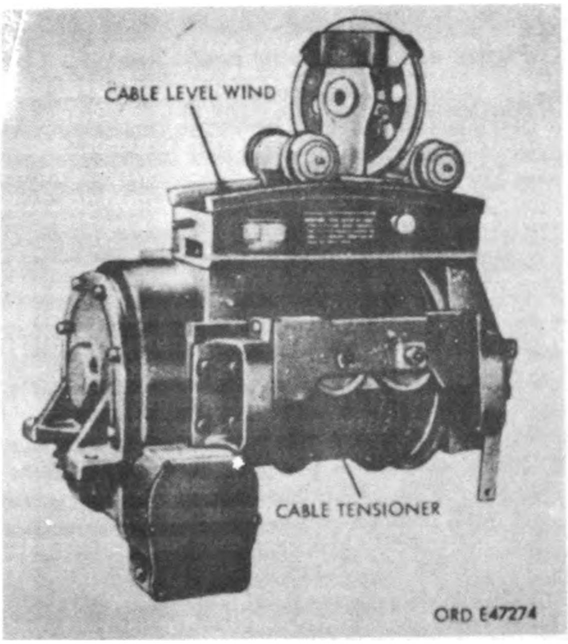


Figure 486. Rear mounted winch

Note. It is not necessary to remove needle bearing (AP) from swivel sheave frame (AQ) unless inspection warrants replacement of bearing.

(f) Remove lubricating fittings (T and YY), snap rings (S and ZZ), and plain washers (R and AB) from ends of trolley axle (AH). Slide trolley wheels (P and AD) and plain washers (L and AG) from trolley axle. Remove felt washers (M and Q) and needle bearing (N) from trolley wheel (P). Remove felt washers (AC and AF) and needle bearing (AE) from trolley wheel (AD). Remove trolley axle (AH) from trolley frame (AJ). Remove trolley axle (CC) in same manner as trolley axle (AH).

(3) Remove and disassemble cable tensioner (fig. 488).

(a) Remove four hex-head cap screws (A) and lockwashers (FF) at gear case end, and four hex-head cap screws (A), lockwashers (FF), and two hex-nuts (DD) at end frame and remove tensioner assembly.

(b) Remove cotter pin (N) from pin (P), and cotter pin (Q) from pin (R). Remove pins and tension sheave lever (M).

(c) Remove two hex-head cap screws (L), lockwashers (FF), and hex-nuts (DD), from right tension frame bracket (K). Use the same procedure for removing left tension frame bracket (B).

(d) Remove cotter pin (J) and lubricating fittings (D and F) from tension sheave pins (E and G). Remove tension sheave pin (G), plain washers (S and X), and tension sheave adjusting frame (H) from tension sheave frame (C). Remove felt washers (W and T) and needle bearing (V) from tension sheave (U). Remove tension sheave (BB) in same manner as tension sheave (U).

(e) Remove four hex-head cap screws, (fig. 488) lockwashers, and one hex-nut (DD fig. 488) and remove tension channel.

(4) End frame assembly (fig. 489).

(a) Support drum and wire rope with a chain hoist and lift off end frame.

(b) Remove plain thrust washer and slide end frame bearing sleeve and bushing-type bearing from end frame.

Note. Do not remove oil seal unless inspection warrants replacement. If inspection warrants replacement of bearing, use suitable adapter and press bearing from sleeve.

(5) Gear case assembly.

(a) Remove drum and wire rope assembly (fig. 490). Turn gear case on end with drum in a vertical position. Attach a chain around drum and wire rope. With the use of an overhead hoist, lift up on drum. Use a wooden block on end of drum shaft and tap until drum is free on shaft. Remove drum from shaft.

(b) Drum shaft keys (fig. 483). Remove two square keys and plain thrust washers from drum shaft.

(c) Removal of sprocket and drive worm bearing cap (fig. 490). Drive out shear pin from sprocket and remove sprocket from drive worm. Remove four hex-head cap screws and lockwashers from drive worm bearing cap. Remove cap and gasket.

Note. Do not remove oil seat in drive worm bearing cap unless inspection warrants replacement.

(d) Gear case cover (fig. 491).

1. Remove six cap screws and lockwashers and two machine screws from gear case cover. Remove gear case cover and gasket.

2. A bushing-type bearing is used in the gear case cover. Do not remove bearing unless inspection warrants replacement. To remove, collapse bearing and remove from gear case cover.

Note. Be sure replacement bearing is available before removing, as damage to bearing will occur during removal.

(e) Automatic brake. Refer to paragraph 41.

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 accummulation 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 bearings 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 clean 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) Bearings. 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. 358).

(b) Gear case and end frame. Inspect gear case and end frame for cracks and damaged threads in tapped holes. Repair or replace defective parts.

(c) Drum shaft, gear, and drive worm. 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 is damaged, the worm or gear must be replaced.

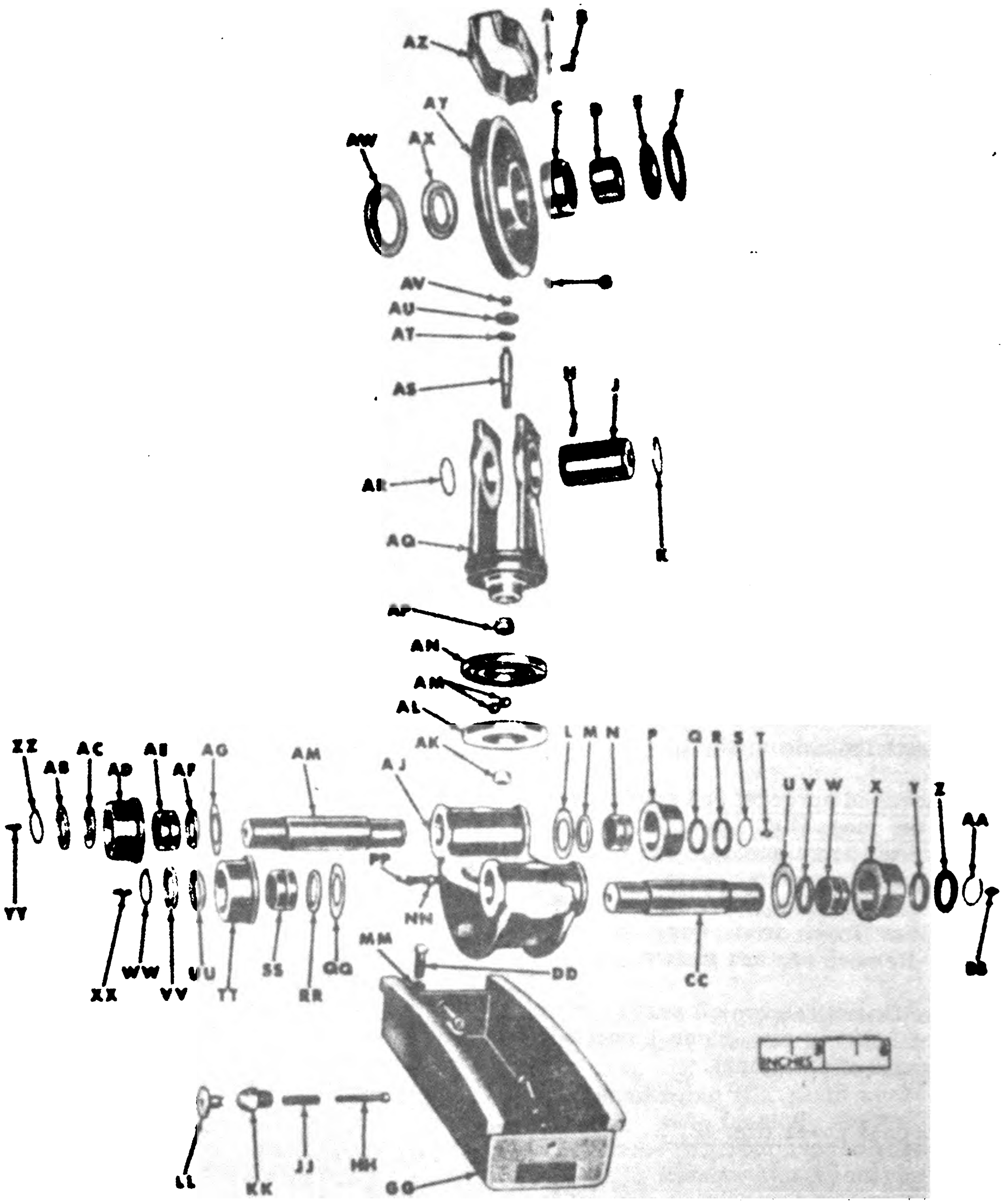


Figure 487. Cable level wind - exploded view

Key	Item	Key	Item
A	Washer, lock	PP	Screw, set
B	Screw, cap	QQ	Washer, plain
C	Bearing, needle	RR	Washer, felt
D	Sleeve, sheave, swivel	SS	Bearing, needle
E	Washer, plain	TT	Wheel, trolley
F	Spacer, bearing, sheave, swivel	UU	Washer, felt
G	Fitting, lubricating	VV	Washer, plain
H	Pin, dowel	WW	Ring, snap
J	Shaft, sheave, swivel	XX	Fitting, lubricating
K	Ring, snap	YY	Fitting, lubricating
L	Washer, plain	ZZ	Ring, snap
M	Washer, felt	AB	Washer, plain
N	Bearing, needle	AC	Washer, felt
P	Wheel, trolley	AD	Wheel, trolley
Q	Washer, felt	AE	Bearing, needle
R	Washer, plain	AF	Washer, felt
S	Ring, snap	AG	Washer, plain
T	Fitting, lubricating	AH	Axle, trolley
U	Washer, plain	AJ	Frame, trolley
V	Washer, felt	AK	Nut, safety
W	Bearing, needle	AL	Race, ball, bearing, thrust, sheave, swivel, outer
X	Wheel, trolley		
Y	Washer, felt	AM	Ball, bearing, thrust, sheave, swivel
Z	Washer, plain	AN	Race, ball, bearing, thrust, sheave, swivel, inner
AA	Ring, snap		
BB	Fitting, lubricating	AP	Bearing, needle
CC	Axle, trolley	AQ	Frame, sheave, swivel
DD	Screw, cap	AR	Ring, snap
EE	Track, trolley	AS	Shaft, frame, sheave, swivel
FF	Bolt, hex-head	AT	Washer, felt
GG	Nut, jam	AU	Washer, plain
HH	Poppet, lock, frame, trolley	AV	Nut, safety
JJ	Spring, compression	AW	Spacer, bearing, sheave, swivel
KK	Nut, poppet, lock, frame, trolley	AX	Washer, plain
LL	Knob, poppet, lock, frame, trolley	AY	Sheave, swivel
MM	Washer, lock	AZ	Guard, cable
NN	Nut, jam		

Figure 487. Cable level wind - exploded view - legend

(d) Drive worm brake. Inspect brake surface or 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.

(e) Wire rope. Inspect wire rope for broken or frayed strands. Inspect clamp chain and hook for damage. Replace defective parts.

(f) Oil seals. Normally, metal-cased oil seals are long-life parts and may be reused if in good condition. Inspect seal contact material to make sure it is pliable and shows no evidence of burning. 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 burs from machined gasket surfaces. Pay particular attention to oil seal contact surfaces. Use a fine mill file to repair surfaces.

(b) Drive worm brake lining. Remove oil lining and rivets. Install rivets at each end of band first, then alternately until all rivets are installed.

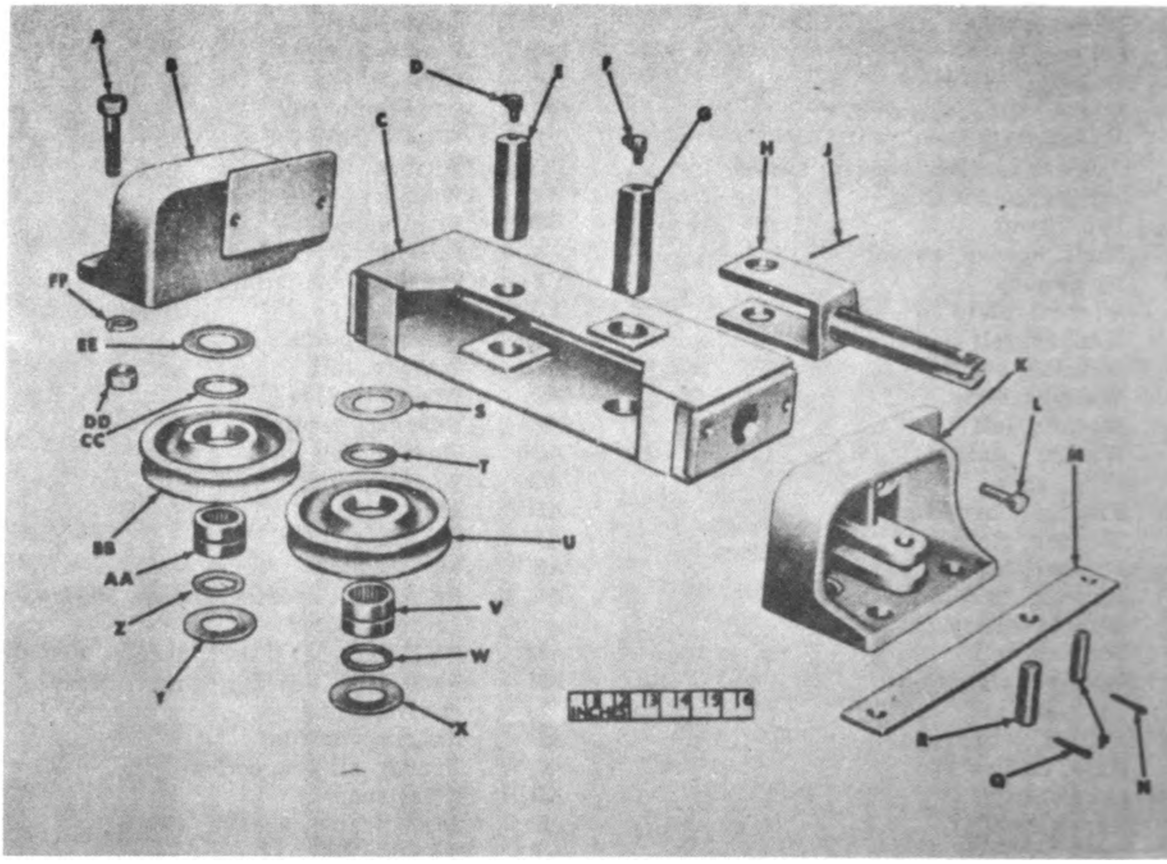


Figure 488. Cable tensioner - exploded view

Key	Item	Key	Item
A	Screw, cap, hex-head	R	Pin
B	Bracket, frame, tension, left	S	Washer, plain, 1.260 id, 2-1/2 od
C	Frame, sheave, tension	T	Washer, felt
D	Fitting, lubricating	U	Sheave, tension
E	Pin, sheave, tension	V	Bearing, needle
F	Fitting, lubricating	W	Washer, felt
G	Pin, sheave, tension	X	Washer, plain
H	Frame, adjusting, sheave, tension	Y	Washer, plain
J	Pin, cotter	Z	Washer, felt
K	Bracket, frame, tension, right	AA	Bearing, needle
L	Screw, cap, hex-head	BB	Sheave, tension
M	Lever, sheave, tension	CC	Washer, felt
N	Pin, cotter	DD	Nut, hex
P	Pin	EE	Washer, plain
Q	Pin, cotter	FF	Washer, lock

Figure 488. Cable tensioner - exploded view - legend

(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 alined with keyway in gear hub. Press shaft through gear until keys have entered gear hub.

c. Assembly (Fig. 488).

(1) Assemble cable tensioner.

(a) Install needle bearing (V) in tension sheave (U). Position felt washers (T and W) on each side of bearing.

(b) Position lever end of tension sheave adjusting frame (H) in end of tension sheave frame (C). Also position tension sheave (U) and plain washers (S and X) in tension sheave frame. Secure tension sheave (U) and tension sheave adjusting frame (H) with tension sheave pin (G), and install new cotter pin (J) in tension sheave pin. Assemble tension sheave (BB) in same manner as tension sheave (U).

(c) Position right tension frame bracket (K) on end of tension sheave frame (C), and secure with two hex-head cap screws (L), lockwashers (FF), and hex-nuts (DD). Position left tension frame bracket (B) and secure in same manner.

(d) Position tension sheave lever (M) to right tension frame bracket (K) and install pin (R) to secure in place. Install new cotter pins (Q) at each end of pin (R). Insert pin (P), which connects tension sheave lever (M) to tension sheave adjusting frame (H), and secure pin with two new cotter pins (N).

(2) Assemble level wind (fig. 487).

(a) Position trolley axle (AH) in trolley frame (AJ). Install needle bearing (AE), with felt washers (AC and AF) on each side of bearing in trolley wheel (AD). Position plain washer (AG), trolley wheel with bearing and felt washers, and plain washer (AB) on end of trolley axle (AH). Install snap ring (ZZ) to secure wheel on axle. Install needle bearing (N) with felt washers (M and Q) on each side of bearing in trolley wheel (X). Position plain washer (L), trolley wheel with bearing and felt washers, and plain washer (R) on opposite end of trolley axle (AH). Install snap ring (S) to secure wheel in axle. Follow same procedure for installing trolley axle (CC).

(b) Install outer-swivel-sheave thrust bearing ball race (AL) in trolley frame (AJ). Position 45 swivel sheave thrust bearing balls (AM) on outer race and install inner-swivel-sheave thrust bearing ball race (AN) over bearing balls. Install swivel sheave frame shaft (AS) in trolley frame and secure at lower end with safety nut (AK). If needle bearing (AP) was removed, install new bearing in swivel sheave frame (AQ). Position swivel sheave frame over swivel sheave frame shaft (AS), in trolley frame (AJ) and install felt washer (AT), plain washer (AU), and safety nut (AV).

(c) Install swivel sheave sleeve (D) in needle bearing (C). Install bearing in swivel sheave (AY). Position and aline sheave in swivel sheave frame (AQ). At the same time, position plain washers (E and AX) and swivel sheave bearing spacer (F and AW) on each side of swivel sheave (AY) in swivel sheave frame. Install swivel sheave shaft (J) in frame through sheave. Install snap rings (K and AR), one at each end of shaft. Position swivel sheave cable guard (AZ) and secure with four cap screws (B) and lockwashers (A).

(3) Install drum shaft gear (AM) and drive worm (P) (fig. 492).

(a) Install two square keys (T and NN) in drum shaft (V). Position plain thrust washer (AL) and drum shaft gear (AM) on shaft. Aline keyways in gear with keys and press shaft into the gear.

(b) If bushing-type bearing (R) was removed from gear case (Q), press new bearing into place. Position drum shaft (V) with gear in case. After shaft and gear are positioned in case, slide plain thrust washer (S) onto end of shaft and next to case. Install two square keys (U and MM) in shaft.

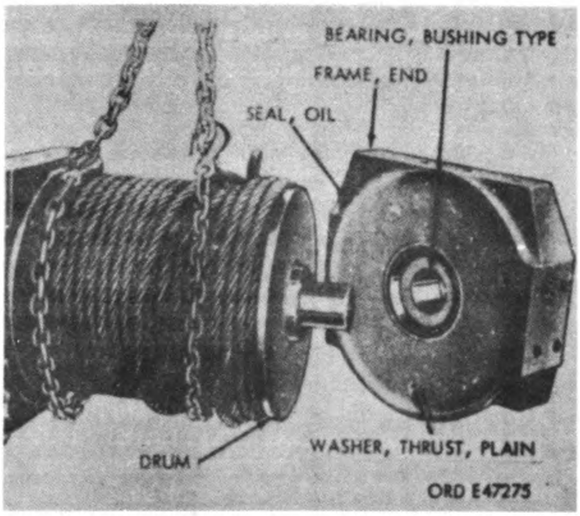


Figure 489. Removing end frame assembly

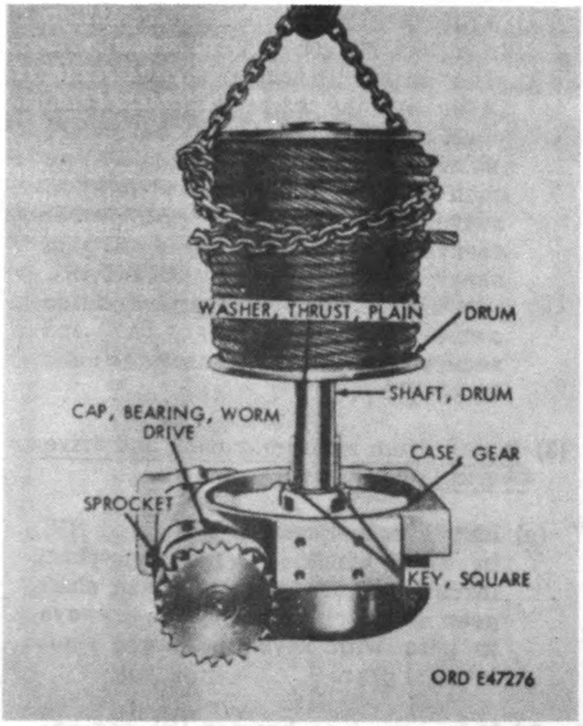


Figure 490. Removing drum assembly from drum shaft

(c) Install ball bearing (N) on sprocket end of drive worm (P). Slide drive worm into gear case (Q) and while sliding worm into case, enmesh drive worm threads with drum shaft gear (AM) and tap bearing into position. If oil seal (M) was removed, install new oil seal in drive worm bearing cap (F).

(d) Position drive-worm bearing cap gasket (E) and drive-worm bearing cap (F) to gear case (Q). Secure cap with four cap screws (H) and lockwashers (G). Install sprocket (L) on end of drive worm and secure with shear pin (J) and new cotter pin (K).

(e) Install ball bearing (QQ) on opposite end of drive worm (P). If oil seal (RR) was removed, install new seal in drive worm brake case (SS). Position drive-worm brake case gasket (PP) and brake case to gear case (Q) and secure with four cap screws (AH) and lockwashers (AJ). Position square key (AK) in drive worm and aline keyways of drive-worm brake disk (TT) with the key. Install brake disk on drive worm. Secure disk with bearing retaining washer (UU), cap screw (WW) and lockwasher (VV).

(f) Position drive-worm brake band (XX) over drive-worm brake disk (TT) and install compression spring (AC).

Figure 491. Gear case cover removed

Place plain washer (ZZ) on cap screw (YY). Place O-ring gasket (AB) on cap screw and install screw through drive-worm brake case (SS), compression spring (AC), and lugs on drive-worm brake band (XX). Tighten screw sufficiently to hold brake band. Position drive-worm brake case cover (AE) with gasket (AG) to drive-worm brake case. Install two hex-head screws with external-tooth lockwashers (AD) and four flat-head screws with external-tooth lockwashers (AF) to secure cover.

(g) If bushing-type bearing (AP) was removed from gear case cover (C), press in new bearing. Install plain thrust washer (AL) on gear end of drum shaft (V). Position gear case cover (C) and gasket (D). Install six cap screws (A), six lockwashers (B), and two machine screws (AU), securing cover.

(4) Install seals and bearings (fig. 492).

(a) If oil seals (W and LL) were removed, install new seal in end of drum (X) and end frame (FF). Install dowel pin (GG) in bore of end frame (FF). If bushing-type bearing (JJ) was removed from end frame bearing sleeve (HH), press new bearing into sleeve.

(b) Position drum (X) on drum shaft (V) and aline keyways in bore of drum with square keys (U and MM) on shaft. Aline and install end frame bearing sleeve (HH) with dowel pin (GG), previously installed ((a) above), in end frame (FF).

(c) Position plain thrust washer (KK) on drum shaft (V) and install end frame (FF). Position tension channel (Z) and secure with cap screw (EE), hex-nut (CC), lockwasher (DD), three cap screws (BB), and lockwashers (AA).

(5) Install cable tensioner. Position cable tensioner assembly on front of winch and install eight cap screws (A, fig. 488), lockwashers (FF, fig. 488) and two hex-nuts (DD, fig. 488) to secure in place.

(6) Install level wind. Position level wind on winch and secure with four cap screws (DD, fig. 487) and lockwashers (MM, fig. 487).

338. Swing Motor

a. Disassembly.

(1) General. The cylinder assemblies of the swing motor (fig. 493) are removed from the base plate as one assembly. Separation procedure of the cylinder assemblies is described in (2) below. Disassembly procedures for both cylinder assemblies are identical; however, only the right cylinder disassembly is illustrated.

(2) Separation of cylinder assemblies. Position piston rod ends of cylinder assemblies in press. Support cylinder assemblies with rod ends in line with ram on press. Use suitable adapter and press sleeve and bushing (fig. 493) from yoke end of piston rod.

Warning: The shape and weight of each cylinder assembly make it difficult to handle. Extreme care must be exercised when separating cylinder assemblies to avoid serious injury to personnel. Use suitable adapter and press bushing from sleeve.

(3) Disassembly of right cylinder assembly.

Note. The key letters noted in parentheses are in figure 498 unless otherwise indicated.

(a) Remove control-valve spool end plug (S), gasket (R), and control valve spool spring (Q) from right cylinder body (M). Remove control valve spool (fig. 494) from valve chamber in right cylinder body.

(b) Remove actuating-lever-adjusting screw end plug (fig. 495), gasket (GG), and pipe plug (HH) from valve chamber in right cylinder body.

(c) Use a thin wall socket wrench and remove cap screws (NN) and lockwasher (MM) from valve actuating lever (KK).

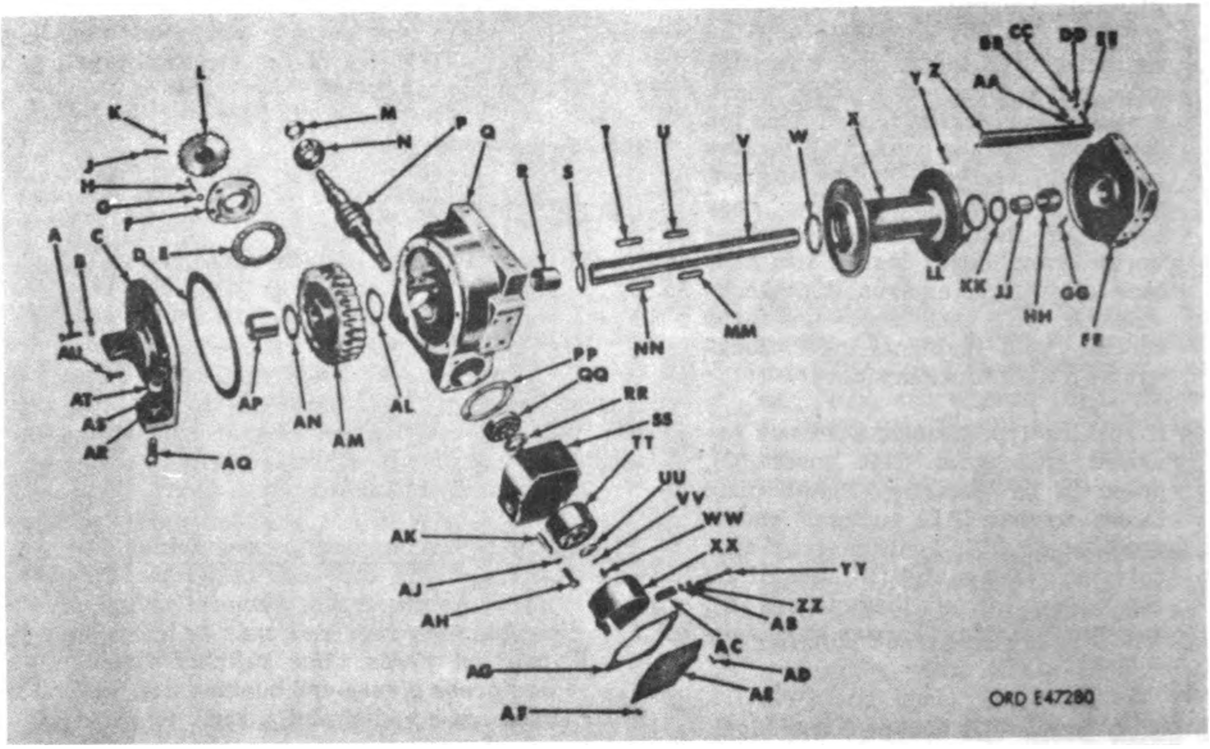


Figure 492. Rear mounted winch - exploded view

Key	Item	Key	Item
A	Screw, cap	AA	Washer, lock
B	Washer, lock	BB	Screw, cup
C	Cover, case gear	CC	Nut, hex
D	Gasket, cover, case, gear	DD	Washer, lock
E	Gasket, cap, bearing, worm, drive	EE	Screw, cap
F	Cup, bearing, worm, drive	FF	Frame, end
G	Washer, lock	GG	Pin, dowel
H	Screw, cap	HH	Sleeve, bearing, frame, end
J	Pin, shear	JJ	Bearing, bushing-type
K	Pin, cotter	KK	Washer, thrust, plain
L	Sprocket	LL	Seal, oil
M	Seal, oil	MM	Key, square
N	Bearing, ball	NN	Key, square
P	Worm, drive	PP	Gasket, case, brake, worm, drive
Q	Case, gear	QQ	Bearing, ball
R	Bearing, bushing-type	RR	Seal, oil
S	Washer, thrust, plain	SS	Case, brake, worm, drive
T	Key, square	TT	Disk, brake, worm, drive
U	Key, square	UU	Washer, retaining bearing
V	Shaft, drum	VV	Washer, lock
W	Seal, oil	WW	Screw, cap
X	Drum	XX	Band, brake, worm, drive
Y	Screw, set, hex-socket	YY	Screw, cap
Z	Channel, tension	ZZ	Washer, plain

Figure 492. Rear mounted winch - exploded view - legend

Key	Item	Key	Item
AB	Gasket, O-ring	AK	Key, square
AC	Spring, compression	AL	Washer, thrust, plain
AD	Screw, hex-head, w/external-tooth lockwasher	AM	Gear, shaft, drum
AE	Cover, case, brake, worm, drive	AN	Washer, thrust, plain
AF	Screw, flat-head, w/external-tooth lockwasher	AP	Bearing, bushing-type
AG	Gasket, cover, case, brake, worm, drive	AQ	Screw, cap
AH	Screw, cap	AR	Washer, mounting
AJ	Washer, lock	AS	Washer, lock
		AT	Nut, hex
		AU	Screw, machine

Figure 492. Rear mounted winch - exploded view - legend - continued

(d) Before removal of right control valve lever with shaft (LL), shaft must be marked with right cylinder body (M) to facilitate alining serrations for proper reassembly of shaft to valve actuating lever (KK). Position valve actuating lever in a vertical position and mark shaft with body. Tap shaft with a soft hammer and remove control valve lever with shaft from body. This operation will permit valve actuating lever to rest at the bottom of the valve chamber. Remove lever from body. Remove valve actuating lever O-ring gaskets (J and JJ) from body.

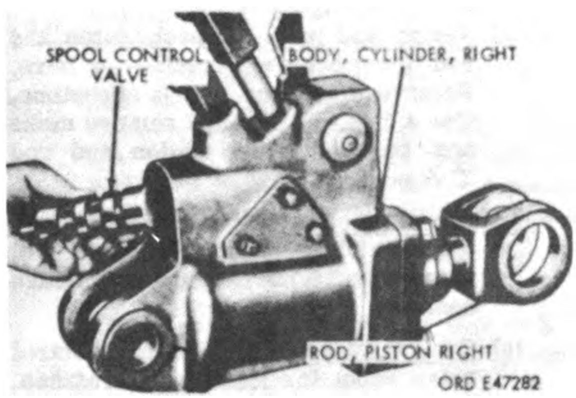


Figure 494. Removing control valve spool

(4) Piston and cylinder body cap.

(a) Remove four locknuts and hex-nuts (fig. 495) from cylinder body cap (C). Remove cylinder body cap, cap gasket, piston, and right piston rod from right cylinder body (fig. 496).

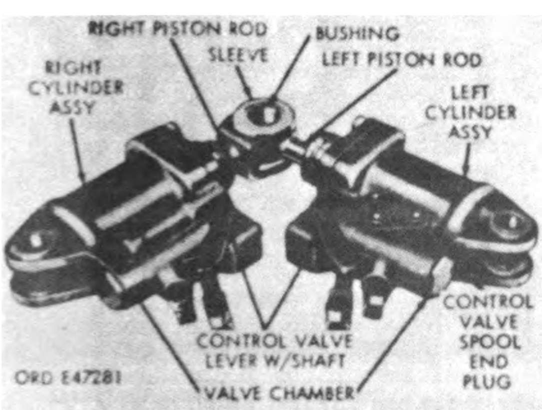


Figure 493. Swing motor - bottom view

(b) Remove cotter pin (H), slotted hex-nut (G), and piston (F) from piston rod.

(c) Insert a tapered tool under piston O-ring gasket (fig. 496) and remove gasket from piston (F).

(d) Remove piston rod cap (Z), piston rod wiper (X), felt washer (W), felt washer retainer (V), chevron seal ring (U), and five chevron seals (T) from cylinder body cap (fig. 497).

(e) Use suitable adapter and press pivot pin bushings (N) from right cylinder body (M).

(f) Follow same procedure for disassembling left cylinder assembly.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts in mineral spirits paint thinner or dry-cleaning

solvent. Apply a coat of light engine oil to the machined surface of cylinder body to prevent rusting.

(2) Inspection and repair.

(a) Cylinder body. Inspect cylinder bore for scratches, nicks, or burs. Remove with soapstone or fine mill file. Replace cylinder if damage is beyond repair.

(b) O-ring gaskets. Inspect gaskets for scratches, flat spots, and indications of wear. Replace gaskets if any of these conditions exist.

(c) Piston and rod. Inspect piston and rod for scratches, nicks, or burs. Remove scratches with a soapstone. Use a fine mill file and remove nicks and burs. Replace piston and rod if damage is beyond repair.

(d) Chevron seals. Inspect chevron seals for scratches and nicks. If either of these conditions is found, replace seals.

(e) Control valve spool. Inspect control valve spool for nicks and scratches. Use a soapstone or fine mill file and remove slight nicks and scratches. Inspect oil passages in spool to see that they are not plugged. Clean passages. Inspect spool for evidence of wear.

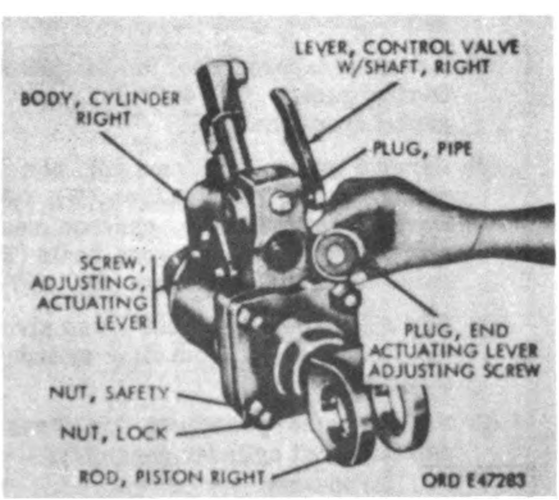


Figure 495. Removing actuating lever adjusting screw end plug

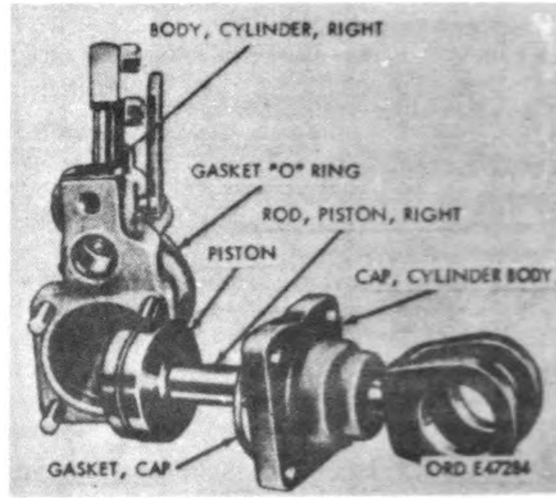


Figure 496. Piston and rod removed from right cylinder body

c. Assembly.

(1) Assemble valve assembly (fig. 498).

(a) The bore in the cylinder body for right control valve lever with shaft (LL) is recessed for installation of two O-ring gaskets. Install valve-actuating-lever O-ring gasket (JJ) on lever side of right cylinder body (M) and valve-actuating-lever O-ring gasket (J) in recess on opposite side of cylinder body.

(b) Position valve actuating lever (KK) in position in valve chamber of right

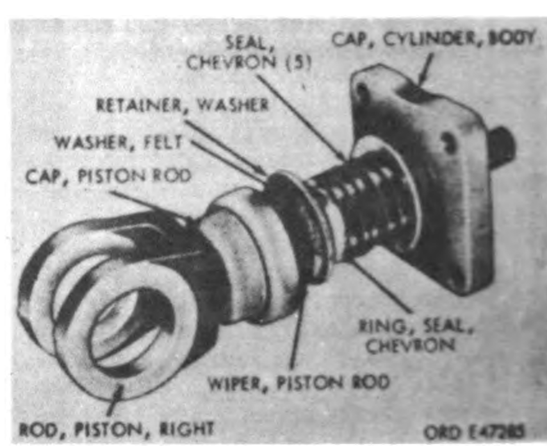


Figure 497. Piston rod and cylinder body cap assembly

cylinder body (M). Insert shaft of right control valve lever with shaft (LL) in cylinder body and aline a-lining mark on shaft of right control valve lever with alining mark on cylinder body. Press right control valve lever with shaft (LL) into cylinder body. Install cap screw (NN) and lockwasher (MM) on valve actuating lever (KK) to secure lever to shaft. Install actuating - lever - adjusting screw jam nut (QQ) on actuating lever adjusting screw (PP) and install on actuating lever. Install actuating - lever - adjusting screw end plug (FF), gasket (GG), and pipe plug (HH) in cylinder body.

(c) Install control valve spool (P) in valve chamber of right cylinder body (M). Insert control valve spool spring (Q) in cylinder body and secure with control-valve-spool end plug gasket (R) and end plug (S).

(2) Install piston and rod assembly.

(a) Position piston rod wiper spring (Y) on piston rod wiper (X). Install piston rod cap (Z), piston rod wiper (X), felt washer (W), felt washer retainer (V), chevron seal ring (U), five chevron seals (T), and cylinder body cap (C) on right piston rod (AA). Install piston rod cap on cylinder body cap.

(b) Position piston (F) on right piston rod (AA) and install slotted hex-nut (G). Insert new cotter pin (H) in end of rod to secure nut.

(c) Install piston O-ring gasket (E) on outer diameter of piston (F).

(d) Install four studs (K) in right cylinder body (M). Position cap gasket (D) in cylinder body. Apply a coat of light engine oil to the outer surface of piston (F) and piston O-ring gasket (E). Insert piston in cylinder body and install four hex-nuts (B) and locknuts (A) to secure cylinder body cap (C) to cylinder body.

(e) Use suitable adapter and press pivot pin bushings (N) into right cylinder body (M).

(3) Connect cylinder assemblies (fig. 493).

(a) Use suitable adapter and press bushing into sleeve.

(b) Position pin end of left piston rod in clevis end of right piston rod. Press sleeve with bushing into ends of piston rods to connect cylinder assemblies together.

339. Wrecker Body and Outriggers

a. Disassembly.

(1) General. The wrecker body is of all welded steel construction and disassembly is limited to removal of the four outrigger assemblies (fig. 499) and the upper, lower, and vertical cable guide rollers (fig. 500). Replacement of the wrecker body necessitates removal of the complete wrecker crane and rear mounted winch.

(2) Outriggers (fig. 499).

(a) Remove two cap screws and lockwashers from outrigger stop, and remove stop.

(b) Remove outrigger pin and remove the outrigger assembly.

Caution: With outrigger stop removed, the complete outrigger assembly must be supported during removal operation.

(c) Proceed in the same manner as outlined in (a) and (b) above and remove the other three outrigger assemblies.

(3) Cable guide rollers.

(a) Upper rollers (fig. 501). Remove two cap screws (A) and lockwashers (B) from keeper plate (C) and remove plate. Drive roller shaft (E) out and lift roller (G) with bearings, felt washers (D and J), and roller thrust washers (K and M) from mounting bracket.

(b) Vertical rollers (fig. 502). Remove two cap screws (B) and lockwashers (C) from keeper plate (D) at upper end of roller shaft (E). Use a pinch

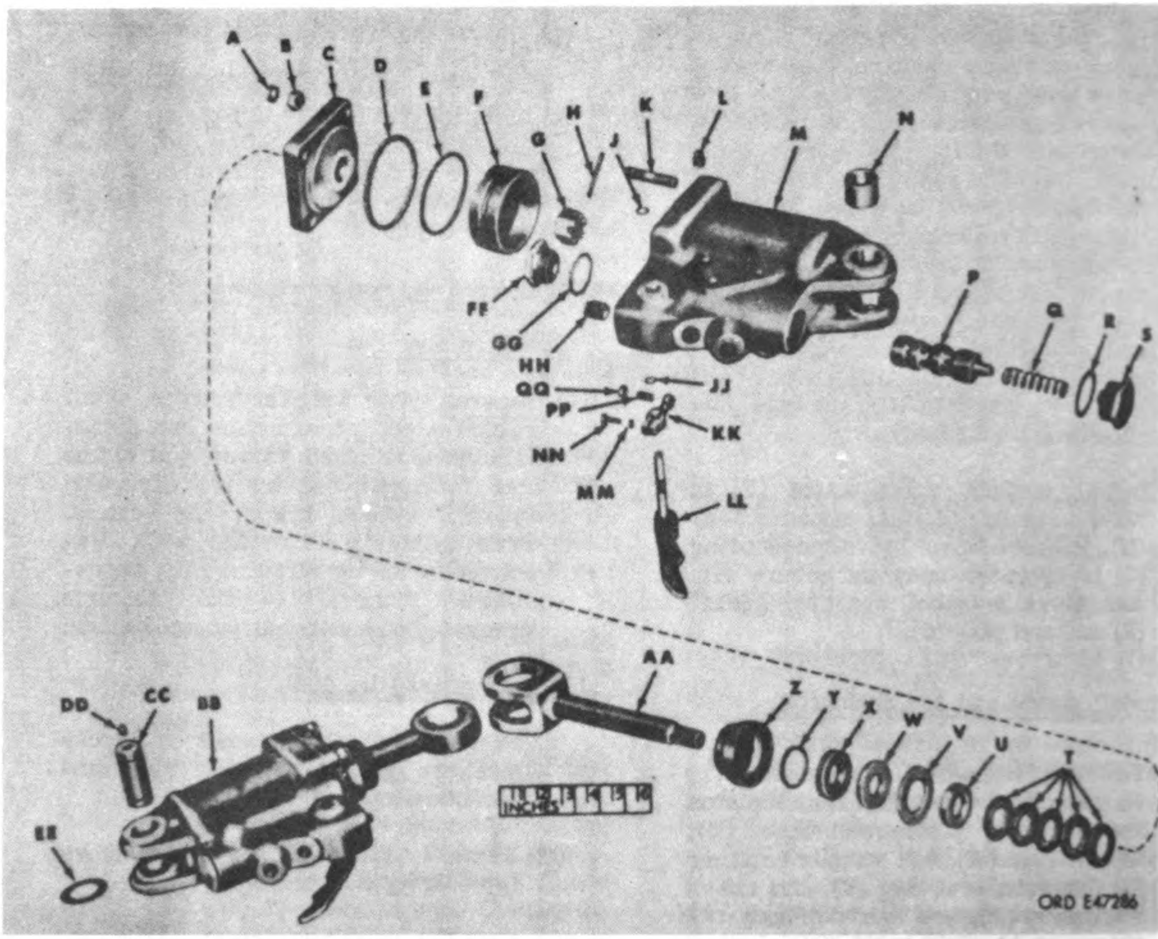


Figure 498. Swing motor - right cylinder assembly - exploded view

Key	Item	Key	Item
A	Nut, lock	P	Spool, control valve
B	Nut, safety	Q	Spring, control valve spool
C	Cap, cylinder body	R	Gasket, plug, end, control valve spool
D	Gasket, cap	S	Plug, end, control valve spool
E	Gasket, O-ring, piston	T	Seal, chevron
F	Piston	U	Ring, chevron seal
G	Nut, hex, slotted	V	Retainer, felt washer
H	Pin, cotter	W	Washer, felt
J	Gasket, O-ring, valve actuating lever	X	Wiper, piston rod
K	Stud, cylinder	Y	Spring, piston rod wiper
L	Plug, pipe	Z	Cap, piston rod
M	Body, cylinder, right	AA	Rod, piston, right
N	Bushing, pivot pin	BB	Cylinder, assembly

Figure 498. Swing motor - right cylinder assembly - exploded view - legend

Key	Item	Key	Item
CC	Pin, pivot, mounting, cylinder	JJ	Gasket, O-ring, valve-actuating-lever
DD	Fitting, lubricating	KK	Lever, valve actuating
EE	Shim, mounting, cylinder	LL	Lever, control valve, w/shaft, right
FF	Plug, end, actuating-lever-adjusting screw	MM	Washer, lock
		NN	Screw, cap
GG	Gasket, plug, end, actuating-lever-adjusting screw	PP	Screw, adjusting, actuating lever
		QQ	Nut, jam, actuating-lever-adjusting-screw
HH	Plug, pipe		

Figure 498. Swing motor - right cylinder assembly - exploded view - legend continued

bar and pull shaft from the roller assembly. Remove roller assembly with roller thrust washers (G and N), felt washers (H and M), and roller bearing assemblies (J and L). Remove two cap screws (S) and lockwashers (R) from filler plate (Q) and remove roller shaft spacer (P). Remove both vertical rollers in the same manner.

(c) Lower roller (fig. 501). Remove two cap screws (A) and lockwashers (B) from keeper plate (C) and remove lower roller shaft (E). Lift out roller (G) with roller bearing assemblies (F and H), felt washers (D and J), and roller thrust washer (K).

Note. The two vertical rollers must be removed before lower roller (fig. 500) can be removed.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean outriggers with mineral spirits paint thinner or dry-cleaning solvent, paying particular attention to the screw jacks. Clean cable guide rollers, bearings, and thrust washers. Clean wrecker body thoroughly.

(2) Inspection

(a) Outriggers. Inspect outriggers for defective threads on screw jacks. Check for bent or damaged condition of components. Pay particular attention to welds and note for cracks or damage.

(b) Cable guide rollers. Inspect cable guide rollers for defective welds or damaged bores. Check thrust washers for scoring and wear. Place roller

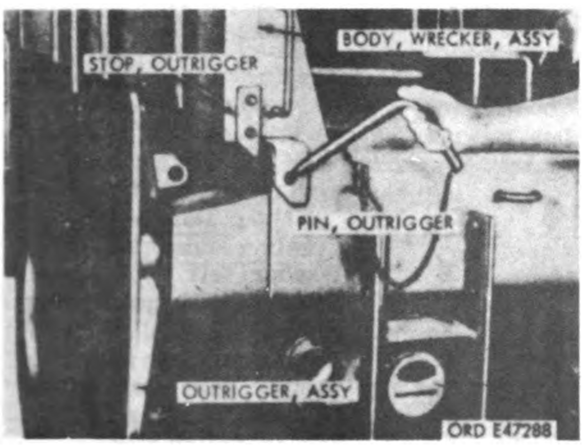


Figure 499. Removing outrigger assembly

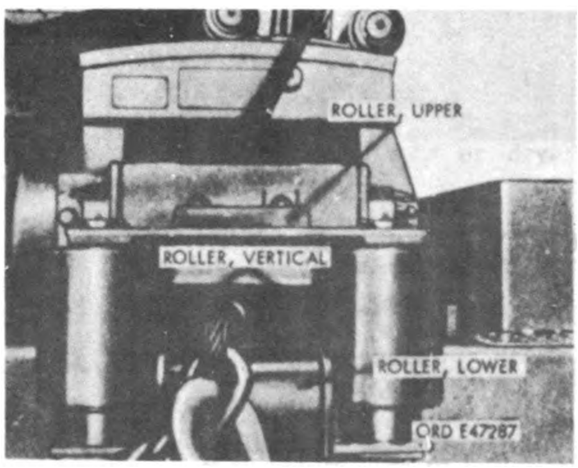


Figure 500. Rear winch cable guide rollers

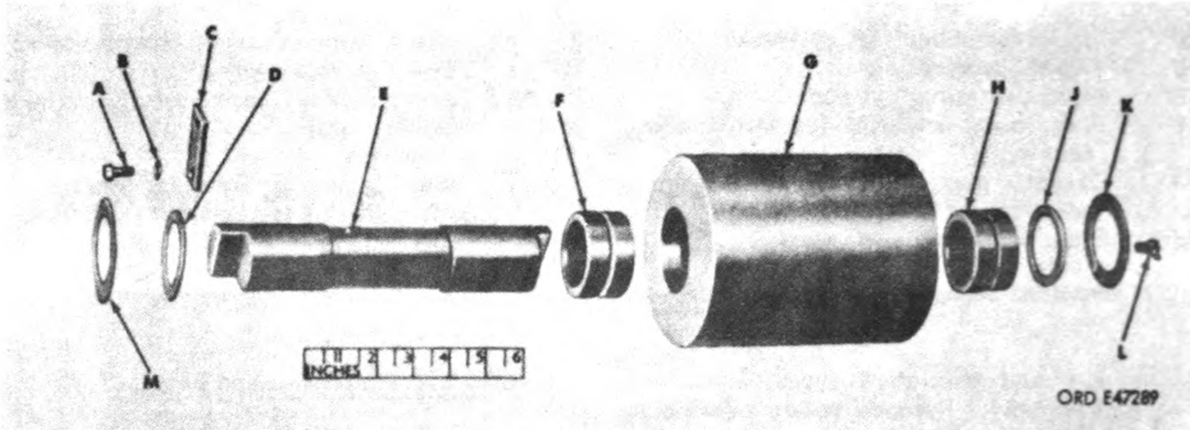


Figure 501. Lower cable guide roller - exploded view

Key	Item	Key	Item
A	Screw, cap	G	Roller
B	Washer, lock	H	Bearing, roller, assembly
C	Plate, keeper	J	Washer, felt
D	Washer, felt	K	Washer, thrust, roller
E	Shaft, rolled, lower	L	Fitting, lubr
F	Bearing, roller, assembly	M	Washer, thrust, roller

Figure 501. Lower cable guide roller - exploded view - legend

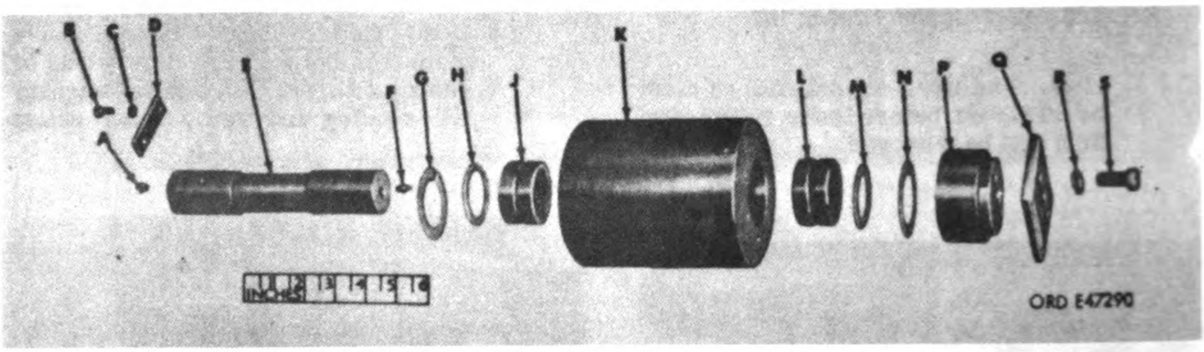


Figure 502. Vertical cable guide roller - exploded view

Key	Item	Key	Item
A	Fitting, lubrication	H	Washer, felt
B	Screw, cap	J	Bearing, roller, assembly
C	Washer, lock	K	Roller
D	Plate, keeper	L	Bearing, roller, assembly
E	Shaft, roller	M	Washer, felt
F	Fitting, lubrication	N	Washer, thrust, roller
G	Washer, thrust, roller	P	Spacer, roller shaft

Figure 502. Vertical cable guide roller - exploded view - legend

Key	Item	Key	Item
Q	Plate, filler	S	Screw, cap
R	Washer, lock		

Figure 502. Vertical cable guide roller - exploded view - legend - continued

bearing assemblies on roller shafts and make sure they turn free and are not scored.

(c) Wrecker body. Inspect condition of all welds, paying particular attention to the cable guide roller brackets at the rear. Also inspect outrigger tubes for cracked welds or other damage.

(3) Repair.

(a) Outriggers. Repairs are limited to welding and depending on extent of damage, straightening or replacing bent components.

(b) Cable guide rollers. Repairs consist chiefly of replacing the damaged components. The rollers can be welded if cracks are evident in the old welds.

(c) Wrecker body. Limited damage to wrecker body can be repaired by straightening or welding. Extensive damage to the body will require replacement of the complete assembly.

c. Assembly.

(1) Outriggers (fig. 499). Attach suitable hoisting equipment and lift outrigger assembly into wrecker body outrigger tube. Position outrigger stop on body and secure with two cap screws and lockwashers. Secure outrigger assembly to body with outrigger pin.

(2) Cable guide rollers.

(a) Lower roller (fig. 501). Position roller bearing assemblies (F and H) in each end of roller (G). Place felt washers (D and J) and roller thrust washers (M and K) on each end of roller. Place the roller assembly in bracket at rear of wrecker body and install lower roller shaft (E). Position keeper plate (C) in slot of shaft and secure with two cap screws (A) and lockwashers (B).

(b) Upper roller. Assemble upper roller in the same manner as the lower roller (a) above, with the exception of using roller shaft (E, fig. 502) in place of roller shaft (E, fig. 501).

(c) Vertical rollers (fig. 502). Position roller shaft spacer (P) on bracket and secure with filler plate (Q), two lockwashers (R), and cap screws (S). Assemble roller bearing assemblies (J and L), felt washers (H and M), and roller thrust washers (G and N) in roller (K). Position the roller assembly in the wrecker body roller bracket and install roller shaft (E). Secure shaft with keeper plate (D), two lockwashers (C) and cap screws (B). The left and right vertical rollers are assembled in the same manner.

340. Hydraulic Reservoir and Stowage Compartments

a. Disassembly and Assembly. The hydraulic reservoir and stowage compartments do not require disassembly as they are of welded sheet metal construction.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all surfaces with mineral spirits paint thinner or dry-cleaning solvent.

(2) Inspection and repair.

(a) Inspection. Check for cracked welds.

(b) Repair. Repair is limited to welding.

341. Power Takeoff

a. Disassembly (Fig. 505).

(1) Remove four hex-head bolts (Q) and medium lockwashers (R) and lift the oil pump body (S) from the case (fig. 503).

(2) Remove 90° elbow (P), releasing inlet check ball (N) and inlet ball spring (M).

(3) Remove outlet ball plug (K), releasing outlet ball spring (L) and outlet check ball (J).

(4) Remove shaft nut (A) and flange washer (B) and remove companion flange.

Note. Shaft nut should be loosened before removal of the power takeoff from transfer case.

(5) Remove four hex-head bolts (Z), medium lockwashers (Y), and remove bearing cap (fig. 504).

(6) Remove oil pump plunger (G) from cam on shaft (U) and pull shaft assembly from case (fig. 504).

(7) Press shaft ball bearing (F) from shaft (U) and remove shaft snap ring (fig. 504).

(8) If inspection (b below) warrants replacement, press oil seal assembly (C) from bearing cap (D).

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts thoroughly with mineral spirits paint thinner or dry-cleaning solvent.

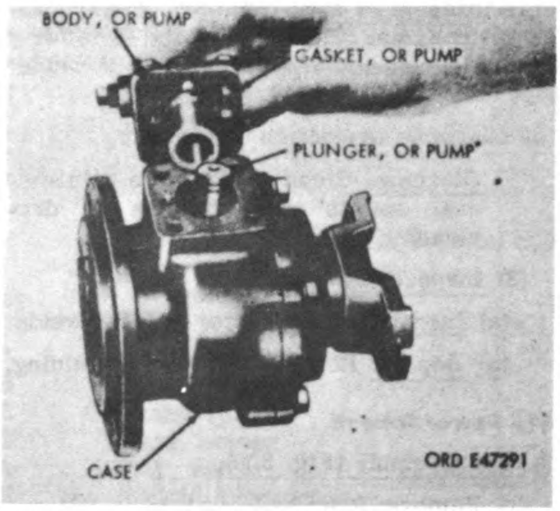


Figure 503. Removing power takeoff oil pump body

(2) Inspection and repair.

(a) Inspection. Check oil pump body and plunger for evidence of wear and scoring. Place oil pump plunger in body and check for smoothness of operation. Inspect splines on shaft and shaft coupling sleeve for excessive wear. Inspect oil seal for worn or feathered edges. Check case for cracks or damaged bolt holes.

(b) Repair. Repairs are limited and for the most part will require replacement of the defective component. Small nicks and burs may be removed with a fine mill file. Defective oil seals are replaced by removing the old seal assembly and pressing a new seal into the bearing cap.

c. Assembly (Fig. 505).

(1) If the oil seal assembly (C) was removed from the bearing cap (D), press new seal into cap.

(2) Press the shaft ball bearing (F) on shaft (U), making certain the inner hub of bearing is supported during this operation.

(3) Install shaft snap ring (V) on shaft (U) and position shaft coupling sleeve (W) on shaft.

(4) Position oil pump plunger (G) in case (T) and place shaft with bearing assembly in case. Place oil pump plunger (G) on cam groove in shaft (U).

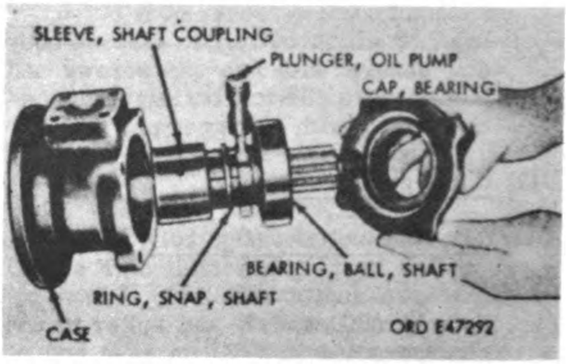


Figure 504. Power takeoff case components removed

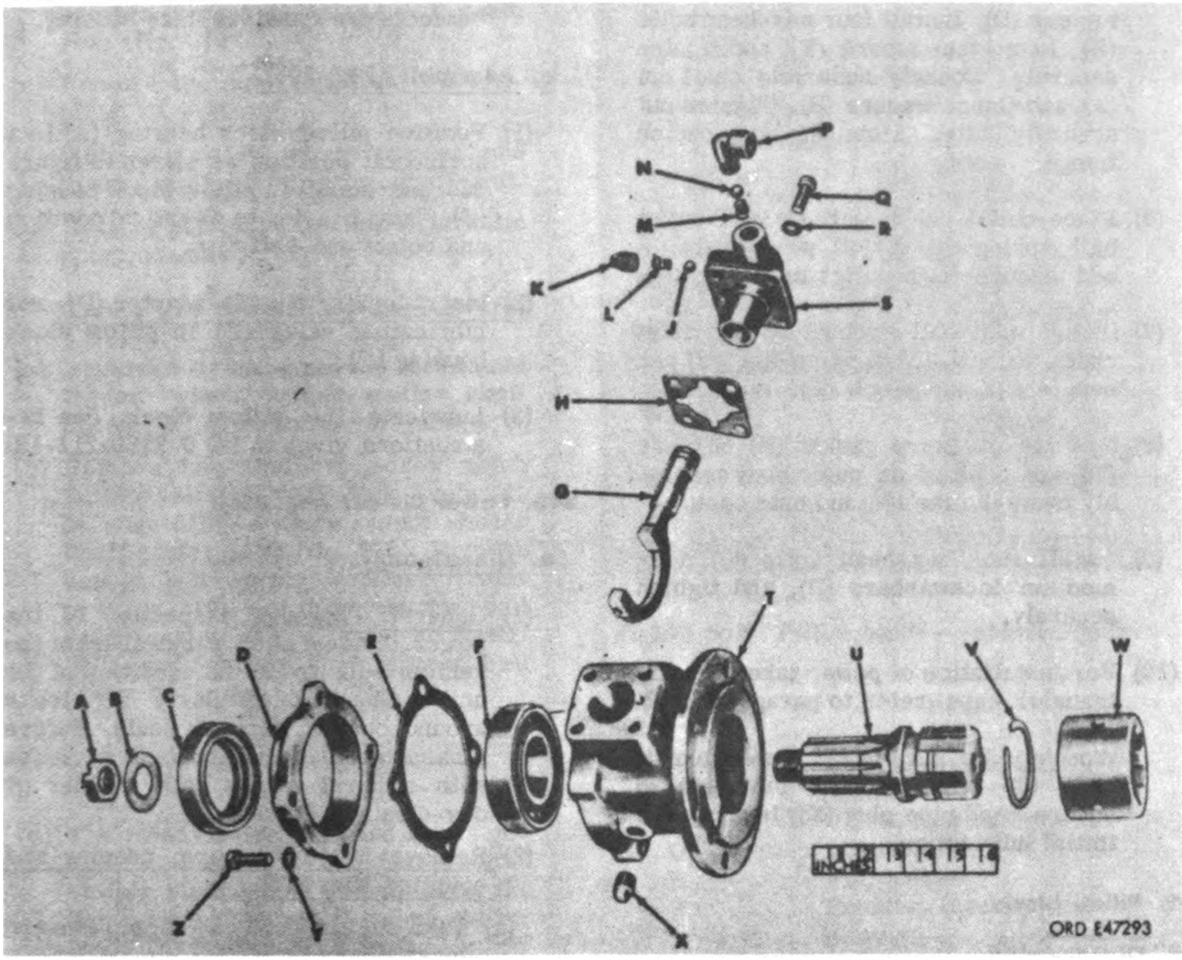


Figure 505. Power takeoff (M62) - exploded view

Key	Item	Key	Item
A	Nut, shaft	N	Ball, check inlet
B	Washer, flange	P	Elbow, 90 degree
C	Seal, oil, assy	Q	Bolt, hex-hd
D	Cap, bearing	R	Washer, lock
E	Gasket, cap, bearing	S	Body, oil pump
F	Bearing, ball, shaft	T	Case
G	Plunger, oil pump	U	Shaft
H	Gasket, oil pump	V	Ring, snap, shaft
J	Ball, check, outlet	W	Sleeve, shaft coupling
K	Plug, outlet ball	X	Plug, pipe, case, sq-hd
L	Spring, outlet ball	Y	Washer, lock
M	Spring, inlet ball	Z	Bolt, hex-hd

Figure 505. Power takeoff (M62) - exploded view - legend

(5) Position new bearing cap gasket (E) on case (T) and aline holes with bearing cap (D). Install four hex-head bolts (Z), four lockwashers (Y), and tighten securely. Loosely assemble shaft nut (A) and flange washer (B). Tighten nut securely after installing companion flange.

(6) Place outlet check ball (J) and outlet ball spring (L) in oil pump body (S) and secure with outlet ball plug (K).

(7) Install inlet ball spring (M) and inlet check ball (N) in oil pump body (S) and secure with 90° elbow (P).

(8) Position oil pump gasket (H) on case (T), and position oil pump body assembly over plunger (G) and onto case.

(9) Install four hex-head bolts (Q), four medium lockwashers (R), and tighten securely.

(10) For installation of power takeoff to the transfer case, refer to paragraph 152.

Warning: Be sure to fill power takeoff case (T) with correct lubricant to square-head pipe plug (X); level for the initial lubrication.

342. Pillow Block

a. Disassembly.

(1) Loosen and remove lubricating valve and adapter from pillow block housing (fig. 506). Invert pillow block to remove locking pin.

(2) Rotate pillow block bearing in pillow block housing one-half turn. Turn bearing to a horizontal position as shown in figure 507 and remove from housing.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean bearing and housing in mineral spirits paint thinner or dry-cleaning solvent and blow dry with compressed air.

(2) Inspection and repair.

(a) Bearing. Inspect bearing for free rotation. If bearing binds or does not rotate freely, replace bearing.

(b) Pillow block housing. Inspect housing for cracks or broken condition. If defects are found, replace housing.

c. Assembly (Fig. 508).

(1) Position pillow block bearing (A) in a horizontal position as shown in figure 508 and install in pillow block housing (F). Turn bearing to a vertical position and rotate one-half turn.

(2) Insert locking pin (E), adapter (D), and lubricating valve (C) in pillow block housing (F).

(3) Lubricate the pillow block. See instructions given in LO 9-2320-211-12.

343. Power Divider (Fig. 509)

a. Disassembly.

(1) General. Thorough inspection of the power divider after removal from the vehicle will reveal the condition of the unit. Check particularly for leaks around covers, caps, or seals. Before disassembly, clean all outside surfaces with mineral spirits paint thinner or dry-cleaning solvent.

(2) Remove hydraulic pump adapter and coupling (fig. 510).

(a) Take out six hex-head capscrews and lockwashers.

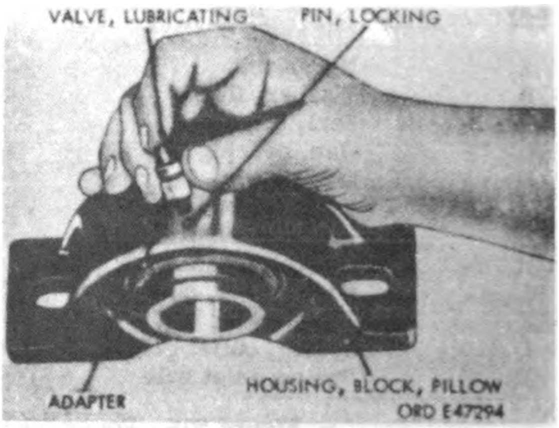


Figure 506. Removing lubricating valve, adapter, and locking pin

(b) Remove square-socket pipe plug from top side of hydraulic pump adapter to provide access to setscrew beneath plug (fig. 510).

(c) Remove the setscrew from the coupling.

(d) Slide hydraulic pump adapter and pump coupling from pump output shaft.

(e) Remove pump coupling from hydraulic pump adapter.

(3) Remove and disassemble case covers.

(a) Remove four hex-head cap screws and takeoff winch, output shifter shaft cover (fig. 511), and cover gasket.

(b) Remove hex-head cap screw which fastens sliding gear fork (refer to M, fig. 518) to winch output shifter shaft (refer to Q, fig. 518). Remove poppet ball spring retainer (refer to E, fig. 518), and take out poppet ball compression spring (refer to F, fig. 518) and shifter shaft poppet ball (refer to G, fig. 518).

(c) Slide out winch output shifter shaft from cover.

(d) The removal (fig. 511) and disassembly of the input- and pump-output shifter shaft cover is essentially the same as for the winch output shifter shaft ((a) through (c) above).

(4) Bearing covers and caps (fig. 512). Remove hex-head cap screws, lockwashers, bearing covers, and bearing caps, and discard gaskets.

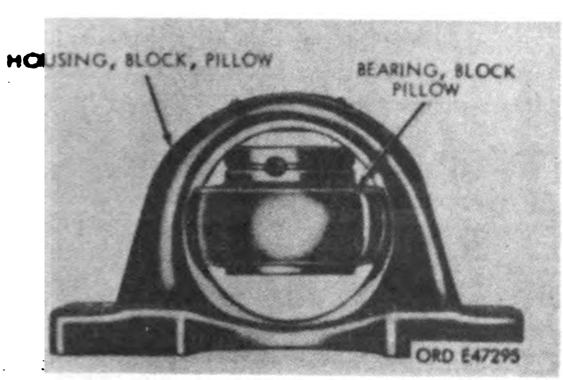


Figure 507. Positioning pillow block bearing for removal

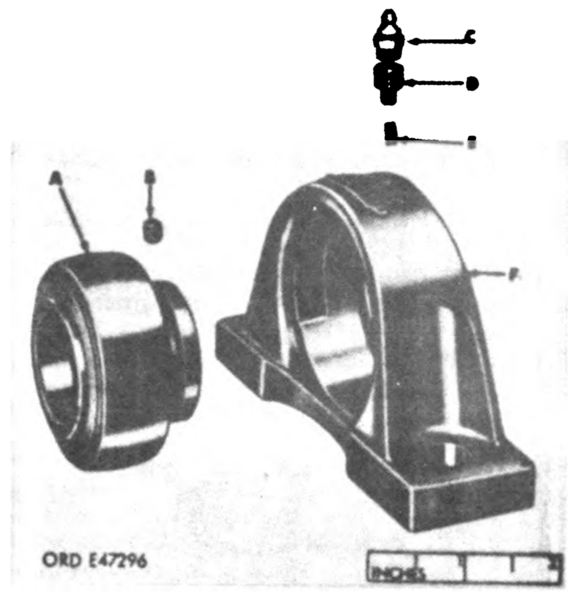


Figure 508. Pillow block - exploded view

Key	Item
A	Bearing, block, pillow
B	Screw, set
C	Valve, lubricating
D	Adapter
E	Pin, locking
F	Housing, block, pillow

Figure 508. Pillow block - exploded view - legend

(5) Remove shaft and bearing (fig. 513).

(a) Use a brass drift and tap on forward end of winch output shaft to drive shaft and ball bearing assembly to the rear.

(b) Continue tapping on end of shaft until shaft is also free of ball bearing assembly on front end of shaft.

(c) The other ball bearing assembly remaining on shaft is removed by placing shaft and bearing assembly in an arbor press. Position bearing so that inner race will be supported, and then press out shaft.

(6) Remove pump output shaft and bearing (fig. 514).

(a) In a similar manner to (5) above, drive pump output shaft to rear, and remove from case.

(b) Remove ball bearing assembly from pump output shaft as in (5) (c) above.

(7) Remove input shaft (fig. 515).

(a) Turn power divider case on its side and block up so that input shaft may be tapped out to rear, using brass drift and hammer.

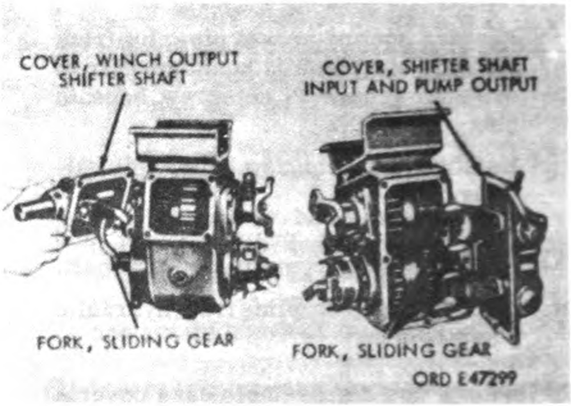


Figure 511. Case covers and shifter shafts removed

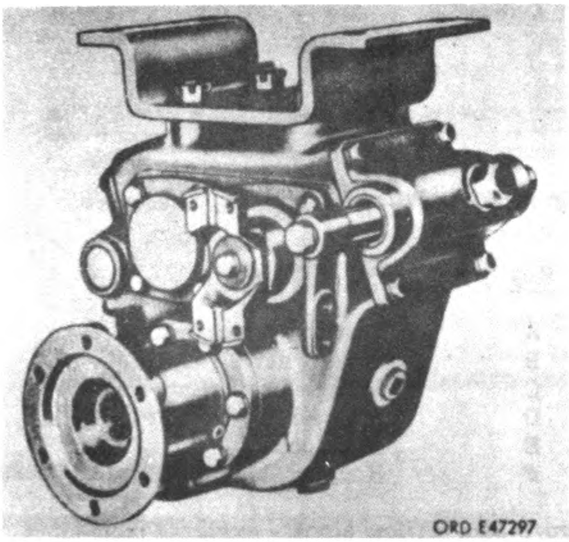


Figure 509. Power divider - right rear view

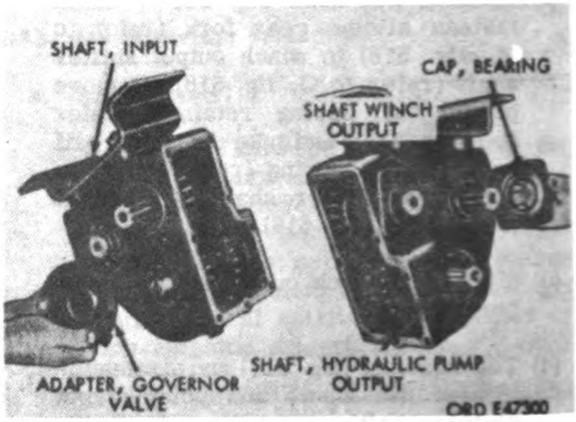


Figure 512. Bearing covers and caps removed

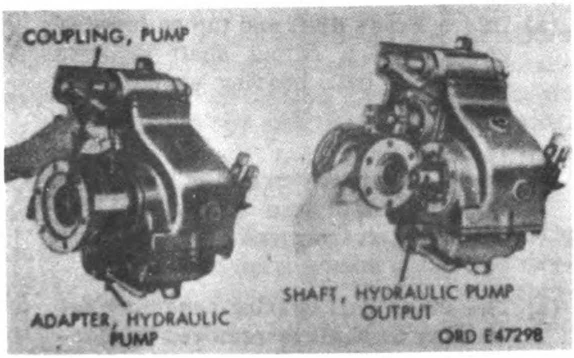


Figure 510. Hydraulic pump adapter and coupling removal

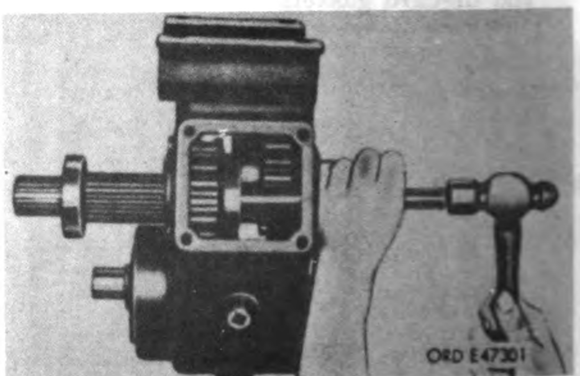


Figure 513. Removing winch output shaft and bearings

(b) Support the input shaft gear inside of case and tap input shaft out of bearings, gears, and case.

(c) Remove ball bearing assembly from input shaft as in (5) (c) above.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. No specialized cleaning is required for these parts other than to immerse them in mineral spirits paint thinner or dry-cleaning solvent. Soak long enough to remove all old lubricant, then blow dry with compressed air. Keep parts protected from dust or dirt.

(2) Inspection.

(a) Bearings. Inspect bearings assemblies for scored spots, chips, or cracks. Replace if worn or damaged in any way.

(b) Gears. Inspect gear teeth and internal splines of sliding gears for chipped places, galled spots, or excessive wear. If any defects are noted, parts must be replaced.

(c) Case and covers. Carefully inspect case and covers for cracks, warpage, or stripped screw threads. If damaged in this manner, parts must be replaced.

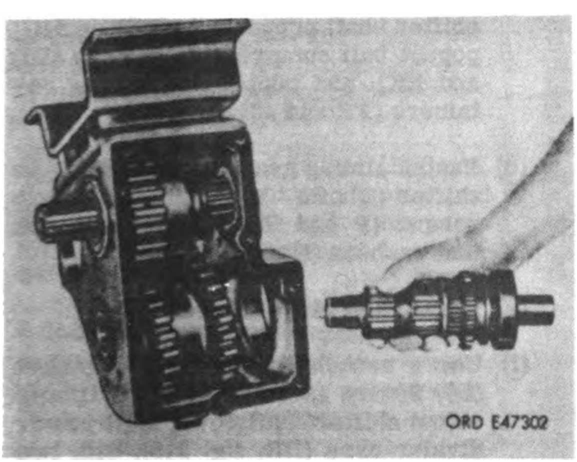


Figure 514. Pump output shaft and bearings removed

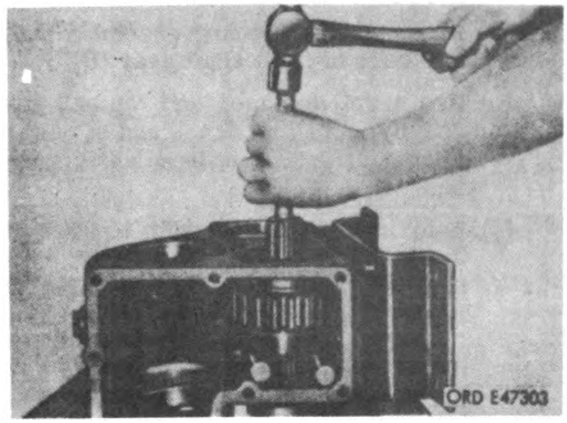


Figure 515. Removing input shaft

(d) Shafts. Inspect shaft splines for twists, chips, or wear. If any evidence of wear or damage exists, parts must be replaced.

(e) Shifter shafts and forks. Make sure that sliding gear forks fit securely on the shifter shafts, and that shafts and forks are not cracked or broken.

(f) Oil seals. Inspection of oil seals in the shifter shaft covers and bearing caps may be accomplished without complete removal. However, make sure that lips of seals are not worn or frayed, and that they contact firmly around the shafts. If seals are removed, they must be replaced.

(3) Repair. Repairs to the power divider will, for the most part, be a matter of replacing defective parts and using new gaskets and seals. However, slight nicks or burs may be removed from the various parts with a fine mill file or soapstone. Damage beyond this will necessitate part replacement.

c. Assembly.

(1) General. All moving parts such as gears, shafts, and bearings must be prelubricated at assembly, with seasonal grade gear oil (GO). This will prevent the possibility of scoring before lubricant in the case is circulated to all parts. Refer to LO 9-2320-211-12 for lubrication recommendations. Take special care to prevent the entry of dirt into the finished assembly.

(2) Install input shaft (fig. 516).

(a) Press needle bearing assembly (AS) into bore of input shaft gear (U).

(b) Use a soft hammer and tap ball assembly (AT) into front end of power divider case (RR) at input shaft opening.

(c) Hold input shaft gear with input shaft thrust washers (V and AR) on each side, inside of case. Then, insert input shaft (W), splined end first, through bore of input shaft gear and thrust washers into previously installed bearing.

(d) Slide input shaft sliding clutch (X) and ball bearing assembly (Y) onto shaft, and use soft hammer to tap bearing into place in case.

(3) Install pump output shaft (fig. 516).

(a) Use a soft hammer and tap ball bearing assembly (ZZ) into front of power divider case at pump output shaft opening.

(b) Place thrust washer (UU) on hydraulic pump output shaft (QQ) and press roller bearing assembly (VV), bearing spacer (XX), and roller bearing assembly (YY) onto shaft and next to thrust washer.

(c) Hold drive gear (WW) with thrust washer (AG) on front side of gear, inside of case, and insert hydraulic pump output shaft with bearings on shaft, through bore of gear and thrust washer, and into bearing.

(d) Place sliding clutch (TT) and ball bearing assembly (NN) onto rear end of shaft, and tap bearing into position in case.

(4) Install winch output shaft (fig. 516).

(a) Tap ball bearing assembly (H) into rear of power divider case at winch output shaft opening.

(b) Hold winch output shaft sliding gear (F) inside of case and insert winch output shaft (G), splined end first, through bore of gear and into bearing.

(c) Slide ball bearing assembly (E) onto shaft and tap into place in case.

(5) Install bearing covers and cages (fig. 516). Bearing covers (C and AA), governor valve adapter (AE), and bearing caps (N and AU) are all assembled in a similar manner. Oil seals (M, AF, AQ, and LL), if removed, must be inserted in bearing caps before installing on shafts. Maintain end play of 0.010-inch minimum to 0.033-inch maximum when installing bearing caps. Use new bearing cover gaskets (D, L, and Z), bearing cap gasket (AN), governor valve adapter gasket (AB), and adapter gasket (HH) when assembling and, if necessary, use additional gaskets to secure the correct end play. Also pack space between bearing cap (AU) and ball bearing assembly (AT) with grease (GAA) to prelubricate this point.

(6) Assemble and install input and pump output shifter shafts and cover (fig. 517).

(a) If shifter shaft oil seals (E and T) were removed, install new seals in the input and pump output shifter shaft cover (J).

(b) Slide input shifter shaft (D) and hydraulic-pump output shifter shaft (U) into cover, taking care not to damage seals.

(c) Secure shifter shafts in cover with shifter shaft poppet balls (BB and HH), poppet ball compression springs (DD and KK), and poppet ball spring retainers (FF and JJ).

(d) Fasten sliding gear forks (M and Q) to shifter shafts with hex-head cap screws (P and R) and external-tooth lockwashers (N and S).

(e) Install dust plugs (K and GG).

(f) Use a new shifter shaft cover gasket (L). Secure assembled input and pump output shifter shaft cover (J) to power divider case (RR, fig. 516), with two hex-head cap screws (EE), six hex-head cap screws (Z), and eight lockwashers (Y and CC).

(7) Assemble and install winch output shifter shaft cover (fig. 518).

(a) Install new shifter shaft oil seals (H and P) into winch output shifter shaft cover (N), if inspection revealed that replacement was necessary.

(b) Slide winch output shifter shaft (Q) through oil seals taking special care to protect seal.

(c) Secure shifter shaft in cover with shifter shaft poppet ball (G), poppet ball compression spring (F), and poppet ball spring retainer (E).

(d) Fasten sliding gear fork (M) to shifter shaft with one hex-head cap screw (K) and external-tooth lockwasher (L).

(e) Use a new cover gasket (J) and secure assembled winch-output shifter shaft cover (N) to power divider case (RR, fig. 516), with four hex-head cap screws (D), and medium lockwasher (C).

(8) Install shifter shaft arms. If shifter shaft arms (A and X, fig. 517 and B, fig. 518) were removed, secure these to shifter shaft with hex-head cap screws (B and W, fig. 517, and A, fig. 518), and medium lockwashers (C and V, fig. 517, and R, fig. 518).

(9) Install hydraulic pump adapter and coupling (fig. 516).

(a) Insert pump coupling (KK) into hydraulic pump adapter (DD).

(b) Use a new adapter gasket (HH) and slide hydraulic pump adapter and pump coupling over hydraulic pump output shaft (QQ) and up to power divider case.

(c) Locate opening in coupling through opening in adapter, and secure coupling to hydraulic pump output shaft with hex socket setscrew (JJ).

(d) Install headless-square socket pipe plug (GG) into opening in hydraulic pump adapter.

(e) Secure hydraulic pump adapter to power divider case with six hex-head cap screws (EE) and lockwashers (FF).

Caution: Be sure that drain and fill plugs are tight and lubricant is at specified level as prescribed in LO 9-2320-211-12 before initial operation.

344. Hydraulic Pump

a. Disassembly (Fig. 522).

(1) Disassembly of the hydraulic oil pump (fig. 519) is accomplished by removing the four cap screws (A) and plain washers (T) that hold the pump cover in place. This will release the pump cover (B), the pressure plate (C), O-ring gaskets, and the pump ring (fig. 520). Discard O-ring gaskets (R). In addition to the cap screws, the pump ring is held in place by two locating pins (F) which are a slip fit in the pump ring and pump body. Make a note of the relative position of rotor (E), vanes (Q), and pump ring (D), so that they may be returned to this same location upon assembly.

(2) To remove pump shaft from pump body, remove the snap ring that holds the outer-bearing assembly in place and tap on the splined or rotor end of the pump shaft, or stand the splined end on a soft block and press downward on the unit. The outer-bearing assembly and pump shaft (fig. 521) will be removed by this action.

(3) The outer-bearing assembly (H) is a press fit and to remove from pump shaft (L) use an arbor press. The oil seal is pressed in place and removal will cause its destruction. The small inner-bearing assembly (G) is a very close fit into the pump body (N). Its removal is accomplished by tapping with a drift punch from the pump ring side of the body.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Immerse all parts except the sealed ball bearing assembly, in dry-cleaning solvent or mineral spirits

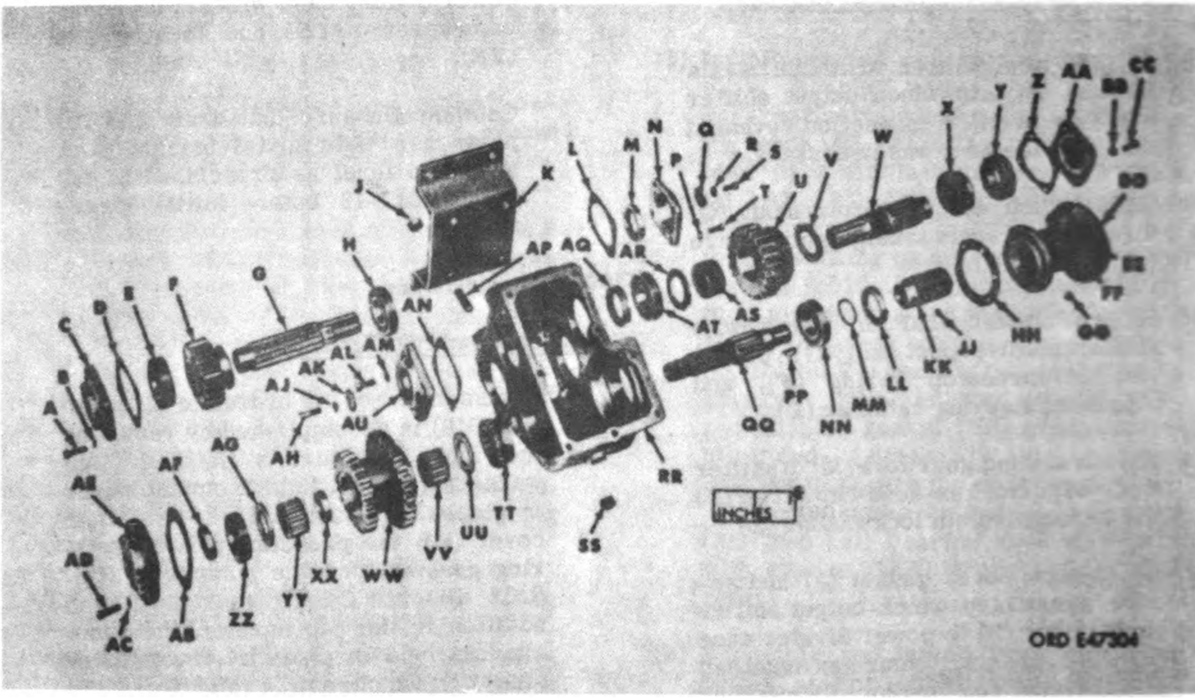


Figure 516. Power divider with mounting bracket assembly - exploded view

Key	Item	Key	Item
A	Screw, cap, hex-head	Z	Gasket, bearing cover
B	Washer, lock	AA	Cover, bearing
C	Cover, bearing	BB	Washer, lock
D	Gasket, bearing cover	CC	Screw, cap, hex-head
E	Bearing, ball, assembly	DD	Adapter, hydraulic pump
F	Gear, sliding, winch ouput shaft	EE	Screw, cap, hex-head
G	Shaft, winch output	FF	Washer, lock
H	Bearing, ball, assembly	GG	Plug, pipe, square-socket, headless
J	Nut, slotted	HH	Gasket, adapter
K	Bracket	JJ	Screw, set, hex socket
L	Gasket, bearing cover	KK	Coupling, pump
M	Seal, oil	LL	Seal, oil
N	Cap, bearing	MM	Seal, static, pump coupling
P	Washer, lock	NN	Bearing, ball, assembly
Q	Washer, plain	PP	Key, Woodruff
R	Washer, lock	QQ	Shaft, hydraulic pump output
S	Screw, cap, hex-head	RR	Case, power divider
T	Screw, cap, hex-head	SS	Plug, pipe
U	Gear, input shaft	TT	Clutch, sliding
V	Washer, thrust, input shaft	UU	Washer, thrust
W	Shaft, input	VV	Bearing, roller, assembly
X	Clutch, sliding, input shaft	WW	Gear, drive
Y	Bearing, ball, assembly	XX	Spacer, bearing

Figure 516. Power divider with mounting bracket assembly - exploded view - legend

Key	Item	Key	Item
YY	Bearing, roller, assembly	AK	Washer, plain
ZZ	Bearing, ball, assembly	AL	Screw, cap, hex-head
AB	Gasket, governor valve adapter	AM	Washer, lock
AC	Washer, lock	AN	Gasket, bearing cap
AD	Screw, cap, hex-head	AP	Stud
AE	Adapter, governor valve	AQ	Seal, oil
AF	Seal, oil	AR	Washer, thrust, input shaft
AG	Washer, thrust	AS	Bearing, needle, assembly
AH	Screw, cap, hex-head	AT	Bearing, ball, assembly
AJ	Washer, lock	AU	Cap, bearing

Figure 516. Power divider with mounting bracket assembly - exploded view - legend - continued

paint thinner. Soak long enough to loosen all oil lubricant, and make sure oil passageways are not plugged. Blow dry with compressed air and protect from any dust or dirt.

Note. Handle all parts carefully to avoid any nicks or burs on machined surfaces.

(2) Inspection and repair. Examine each part carefully to make sure there are no cracks. Check the machined surfaces to be certain there are no nicks or burs. The oil seal must have no frayed edges and lips must seal around shaft firmly. Except for the replacing of defective parts, few repairs can be performed on this unit. Slight nicks, burs, or scratches may be removed with fine mill file, soapstone, or crocus cloth.

c. Assembly (Fig. 522).

(1) The same attention to avoiding nicks and burs must be practiced while assembling the hydraulic oil pump as was practiced for the disassembly. Take special care to avoid the entrance of any grit or dirt into the assembled unit and as soon as assembly is completed, add a slight amount of No. 10W engine oil (OE) into unit. Seal openings until hydraulic vane-type pump is again mounted on the vehicle.

(2) Install inner-bearing assembly (G) into pump body (N) and make sure it is firmly seated. Insert pump shaft seal (M) and solidly seat with an adapter that contacts only the outside diameter of the seal. Also make certain the sealing lip of the seal will face the outer-bearing assembly (H). Press the outer-bearing assembly into pump shaft (L). Make sure that pressure is applied to the inner race only when pressing bearing onto shaft. Insert two locating pins (F) and new O-ring gasket (P) into face of pump body. Place pump ring (D), vanes (Q), and rotor (E) onto pump body.

(3) Make certain the pump ring, vanes, and rotor are correctly assembled in relation to each other for the desired rotation. Also note that the radius edge of the vanes faces the pump ring. Install pressure plate (C) into the pump cover (B) and at the same time place spring (S) between pressure plate and pump cover. Make sure the spring is retained in correct location, and install new O-ring gasket (R) into recess in pump cover around pressure plate and place cover on pump body. Secure pump cover to pump body with four hex-head cap screws (A) and plain washers (T). Tighten cap screws as prescribed in torque specifications, Appendix I.

345. Controls and Linkage

a. Disassembly. After removal there is little disassembly of the controls and linkage.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent.

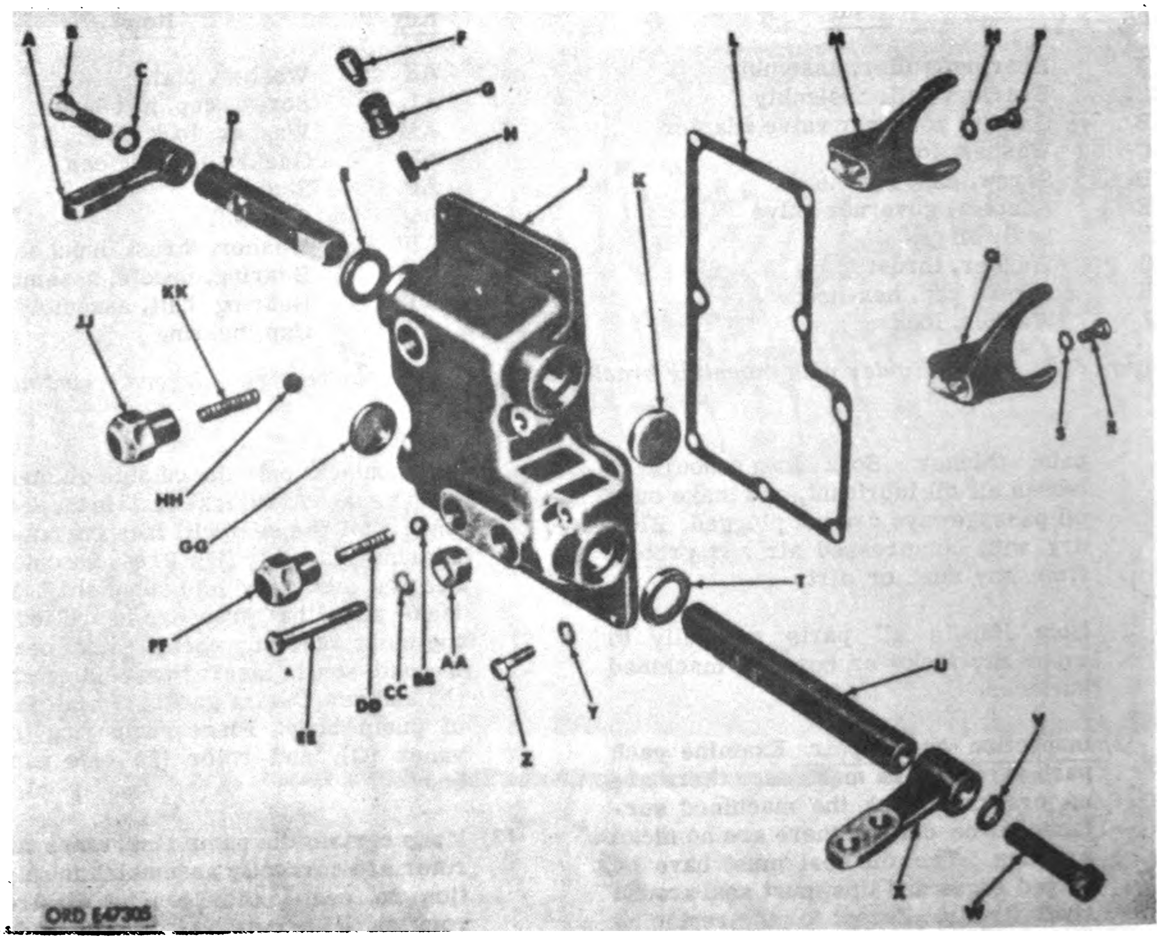


Figure 517. Input and pump output shifter shafts and cover - exploded view

Key	Item	Key	Item
A	Arm, shifter shaft	P	Screw, cap, hex-head
B	Screw, cap, hex-head	Q	Fork, sliding gear
C	Washer, lock	R	Screw, cap, hex-head
D	Shaft, shifter, input	S	Washer, lock, ext-tooth
E	Seal, oil, shifter shaft	T	Seal, oil shifter shaft
F	Vent, air	U	Shaft, shifter, hydraulic pump output
G	Coupling, pipe	V	Washer, lock
H	Nipple, pipe	W	Screw, cap, hex-head
J	Cover, shifter shaft, input and pump output	X	Arm, shifter shaft
K	Plug, dust	Y	Washer, lock
L	Gasket, shifter shaft cover	Z	Screw, cap, hex-head
M	Fork, sliding gear	AA	Plug, pipe
N	Washer, lock, ext-tooth	BB	Ball, poppet, shifter shaft
		CC	Washer, lock

Figure 517. Input and pump output shifter shafts and cover - exploded view - legend

Key	Item	Key	Item
DD	Spring, compression, poppet ball	HH	Ball, poppet, shifter shaft
EE	Screw, cap, hex-head	JJ	Retainer, poppet ball spring
FF	Retainer, poppet ball spring	KK	Spring, compression, poppet ball
GG	Plug, dust		

Figure 517. Input and pump output shifter shafts and cover - exploded view - legend - continued

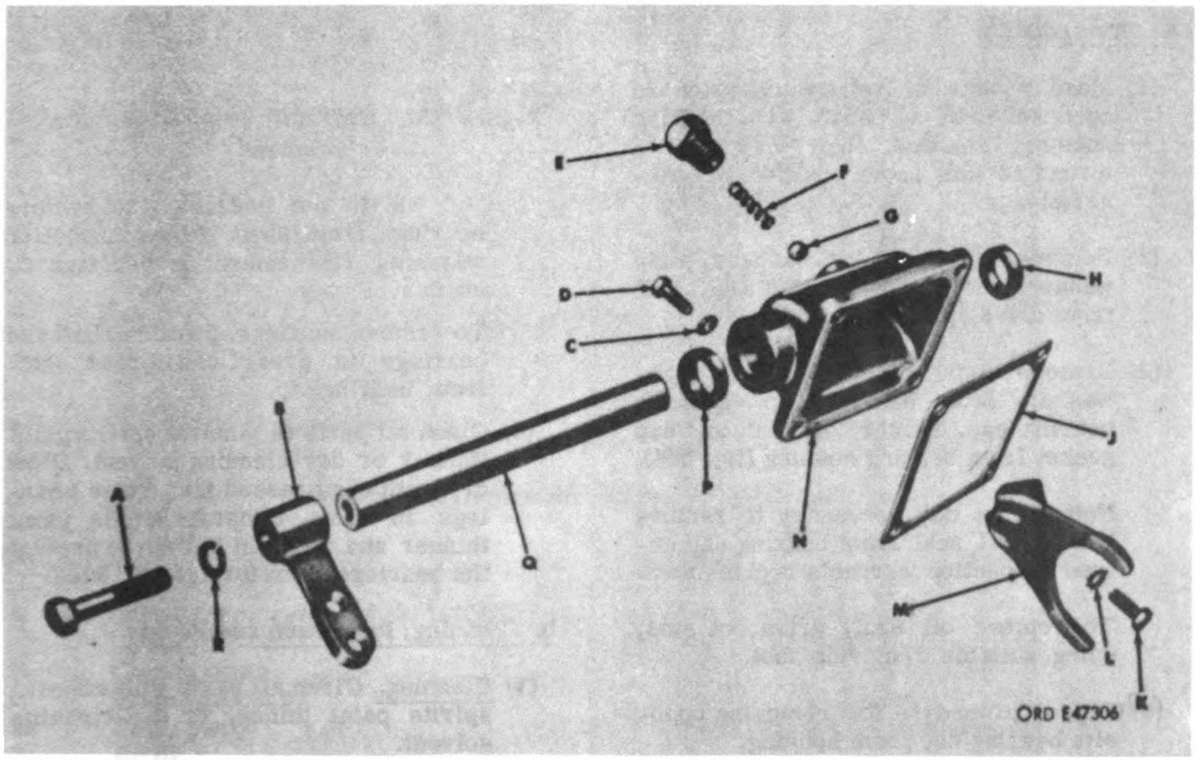


Figure 518. Winch output shifter shaft and cover - exploded view

Key	Item	Key	Item
A	Screw, cap, hex-head	J	Gasket, cover
B	Arm, shifter shaft	K	Screw, cap, hex-head
C	Washer, lock	L	Washer, lock, ext-tooth
D	Screw, cap, hex-head	M	Fork, sliding gear
E	Retainer, poppet ball spring	N	Cover, winch-output shifter shaft
F	Spring, compression poppet ball	P	Seal, oil shifter shaft
G	Ball, poppet, shifter shaft	Q	Shaft, shifter, winch output
H	Seal, oil, shifter, shaft	R	Washer, lock

Figure 518. Winch output shifter shaft and cover - exploded view - legend

(2) Inspection and repair. Because of their construction, controls and linkage require only a visual inspection for bends or cracks. Repair is limited to straightening bent linkage or replacement. Adjustment of bent linkage is covered in paragraph 85.

346. Drive Sprocket Bearing Assembly

a. Disassembly.

(1) Make a note of relative position of sprocket end of shaft with bearing housing, so that shaft may be returned to this same position at reassembly.

(2) Remove cap screw, lockwashers, plain washer, and drive sprocket (fig. 523) from drive sprocket shaft.

(3) Remove four cap screws and lockwashers from bearing cap. Remove bearing cap, spacer, oil seal, and cap gasket from bearing housing (fig. 524).

Note. It is not necessary to remove bearing oil seal from bearing cap unless inspection warrants replacement.

To remove oil seal, drive out seal, using suitable removing tool.

(4) Repeat procedure for removing opposite bearing cap from housing.

(5) Remove drive sprocket shaft with ball bearings from bearing housing (fig. 525).

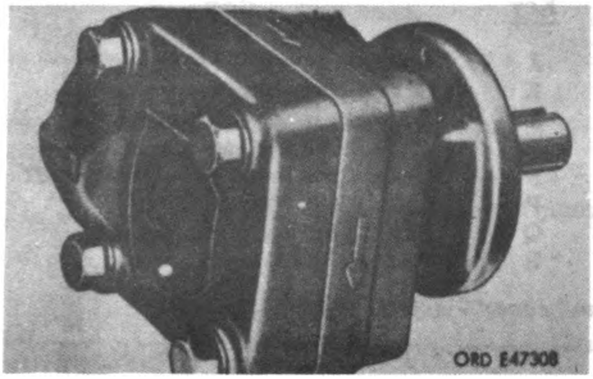


Figure 519. Hydraulic oil pump

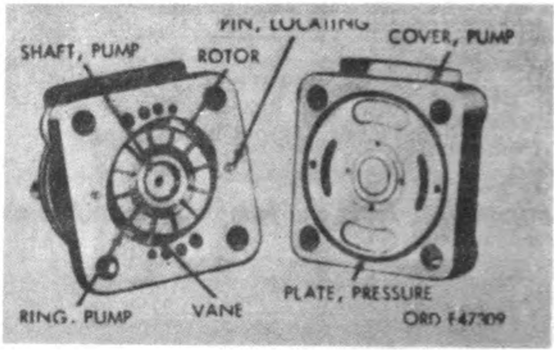


Figure 520. Hydraulic pump with cover removed

It is not necessary to remove bearings from shaft unless inspection warrants replacement of bearings or shaft.

To remove bearings, position shaft and bearings in press and press shaft from bearings.

(6) Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Blow dry with compressed air. Rinse bearings in clean mineral spirits paint thinner and wrap in a cloth to protect the bearings from foreign particles.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent.

(2) Inspection and repair.

(a) Housing. Inspect bearing housing for cracks or breaks. Replace bearing housing if cracks or breaks are detected.

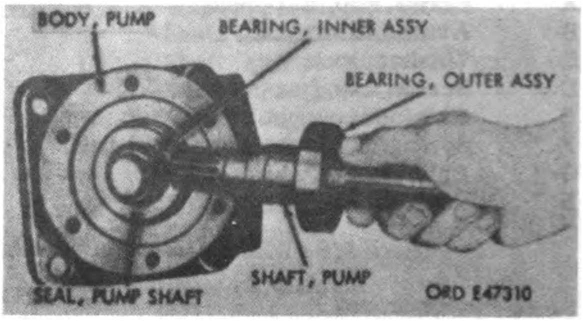


Figure 521. Pump shaft and outer bearing removed

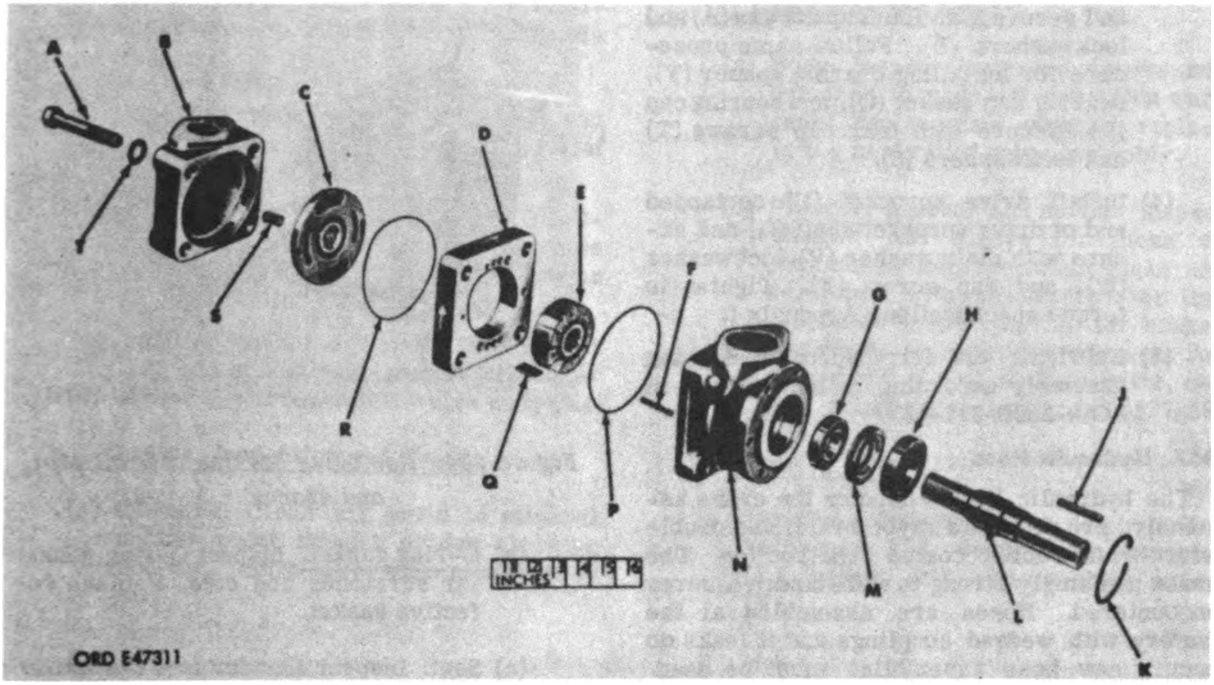


Figure 522. Hydraulic oil pump - exploded view

Key	Item	Key	Item
A	Screw, cap, hex-head, 3/4-10NC-3 x 4-1/2	K	Ring, snap
B	Cover, pump	L	Shaft, pump
C	Plate, pressure	M	Seal, pump shaft
D	Ring, pump	N	Body, pump
E	Rotor	P	Gasket, O-ring
F	Pin, locating	Q	Vane
G	Bearing, inner, assy	R	Gasket, O-ring
H	Bearing, outer, assy	S	Spring
J	Key, square, 1/4 x 1/4 x 2	T	Washer, plain 49/64 id 1-5/16 od

Figure 522. Hydraulic oil pump - exploded view - legend

(b) Shaft. Inspect drive sprocket shaft for damaged splines or cracks. Replace drive sprocket shaft if these conditions are found.

(c) Bearings. Inspect bearings for seized or scored condition. Replace damaged bearings.

(d) Oil seals. Inspect oil seal contact material to make sure it is pliable and shows no evidence of burning. Inspect thin featheredge which contacts rotating part to make sure it is intact. Replace seal if defects are found.

c. Assembly (Fig. 526).

(1) If inspection revealed that replacement of ball bearings (F and N) was necessary, press new bearings on drive sprocket shaft (G). Position shaft with bearings in bearing housing (K).

(2) If bearing oil seal (E) was removed, use suitable adapter and install new oil seal in bearing cap (C). Follow same procedure for installing bearing oil seal (P) in bearing cap (R).

(3) Position bearing spacer (CC) in bearing cap (C). Install bearing cap gasket (D)

and bearing cap on bearing housing (K) and secure with four cap screws (A) and lockwashers (B). Follow same procedure for installing bearing spacer (Y), bearing cap gasket (Q), and bearing cap (R). Secure with four cap screws (T) and lockwashers (S).

(4) Install drive sprocket (U) on tapped end of drive sprocket shaft (G) and secure with plain washer (V), lockwasher (W), and cap screw (X). Tighten to torque specifications, Appendix I.

(5) Lubricate the drive sprocket bearing assembly according to instructions in LO 9-2320-211-12.

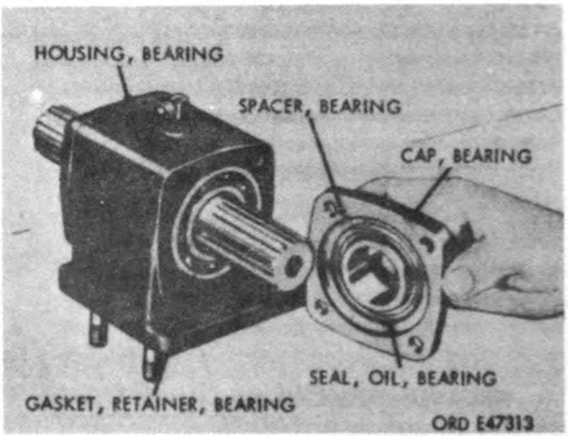


Figure 524. Removing bearing cap, oil seal, and spacer

347. Hydraulic Hose

The hydraulic hoses, used on the crane assembly, are of double rayon braid, and double wire braid rubber coated construction. The hoses are amply strong to withstand pressures encountered. Hoses are assembled at the factory with wedged couplings and if leaks do occur, new hose assemblies must be used.

348. Restrictor Valve (Fig. 527)

a. Disassembly. Remove four cap screws and washers from restrictor valve head and remove head and restrictor valve seat from body. Remove restrictor valve head O-ring gasket from head.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts in mineral spirits paint thinner or dry-cleaning solvent.

(2) Inspection and repair.

(a) Body and head. Inspect threads in body and head for damage. Replace if threads are damaged.

(b) O-ring gasket. Inspect O-ring gasket for scratches and cuts. Replace defective gasket.

(c) Seat. Inspect seat for free movement in body. Replace seat if not free.

c. Assembly. Install restrictor valve seat (fig. 527) in body. Position restrictor valve head O-ring gasket in head and secure head to body with four socket head cap screws and external-tooth lockwashers.

349. Relief Valve (Fig. 528)

a. Disassembly (Fig. 529).

(1) The relief valve setting is made at the factory and if valve is disassembled, a pressure gage must be used to reset valve.

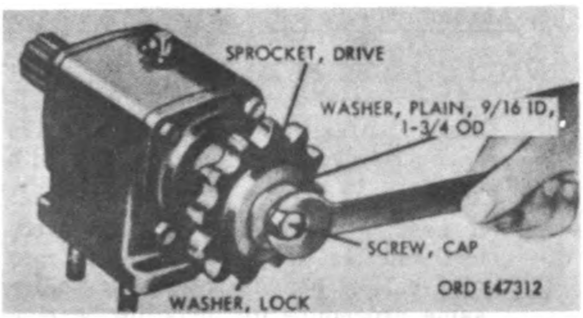


Figure 523. Removing drive sprocket

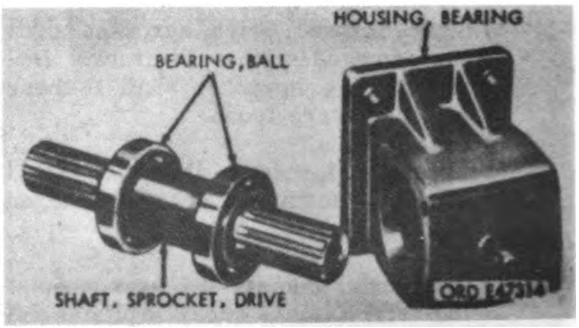


Figure 525. Removal of drive sprocket shaft and bearings from bearing housing

Note. If a pressure gage is not available, do not attempt to disassemble this unit.

(2) Remove capnut (A), locknut (B), and adjusting setscrew (C) from relief valve retainer (D).

(3) Remove relief valve retainer (D), O-ring packing (E), spring seat (F), guide spring (G), and relief valve plunger (H) from relief valve body (K).

(4) Remove machine screw (N), gasket (M), and setscrew (L), and slide plunger sleeve (J) from relief valve body (K).

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Blow dry with compressed air.

(2) Inspection and repair.

(a) Body. Inspect body for cracks and damaged threads. If inspection warrants replacement of body, replace with a new relief valve assembly.

(b) Plunger, sleeve, and spring. Inspect plunger and sleeve for nicks or scratches. Remove slight nicks and scratches with a soapstone or fine mill file. Inspect spring for broken condition. If inspection warrants replacement of any of these parts, obtain relief valve repair kit 8327028.

c. Assembly (Fig. 529).

(1) Position plunger sleeve (J) in relief valve body (K). Secure with setscrew (L), gasket (M), and machine screw (N).

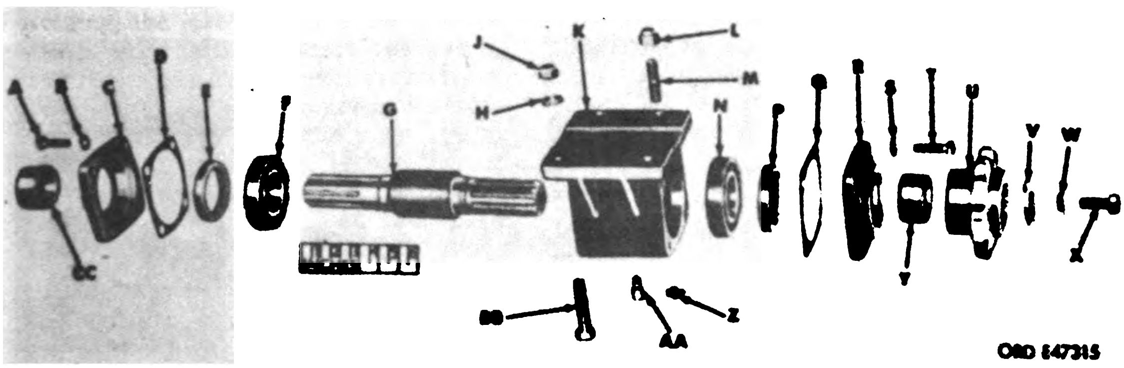


Figure 526. Drive sprocket bearing assembly - exploded view

Key	Item	Key	Item
A	Screw, cap	Q	Gasket, cap, bearing
B	Washer, lock	R	Cap, bearing
C	Cap, bearing	S	Washer, lock
D	Gasket, cap, bearing	T	Screw, cap
E	Seal, oil, bearing	U	Sprocket, drive
F	Bearing, ball	V	Washer, plain
G	Shaft, sprocket, drive	W	Washer, lock
H	Washer, lock	X	Screw, cap
J	Nut, hex	Y	Spacer, bearing
K	Housing, bearing	Z	Fitting, lubricating
L	Nut, safety	AA	Elbow
M	Stud	BB	Screw, cap
N	Bearing, ball	CC	Spacer, bearing
P	Seal, oil, bearing		

Figure 526. Drive sprocket bearing assembly - exploded view - legend

(2) Place relief valve plunger (H), guide spring (G), and spring seat (F) in relief valve body (K). Position O-ring packing (E) on relief valve retainer (D) and install on body. Install adjusting setscrew (C) in retainer and secure with locknut (B) and capnut (A).

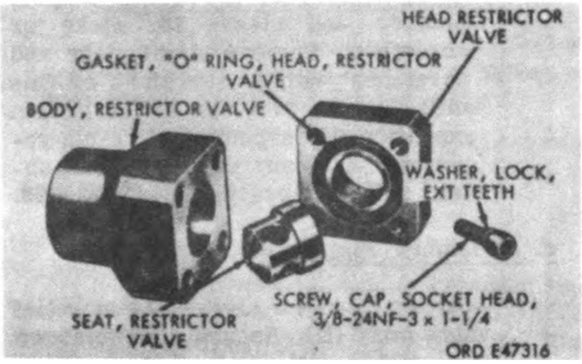


Figure 527. Restrictor valve assembly

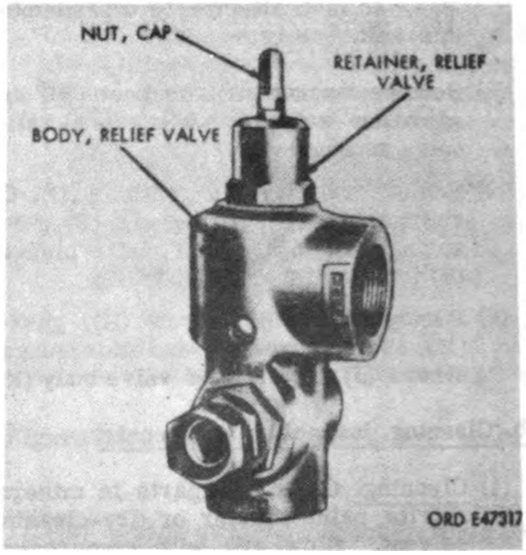


Figure 528. Relief valve assembly

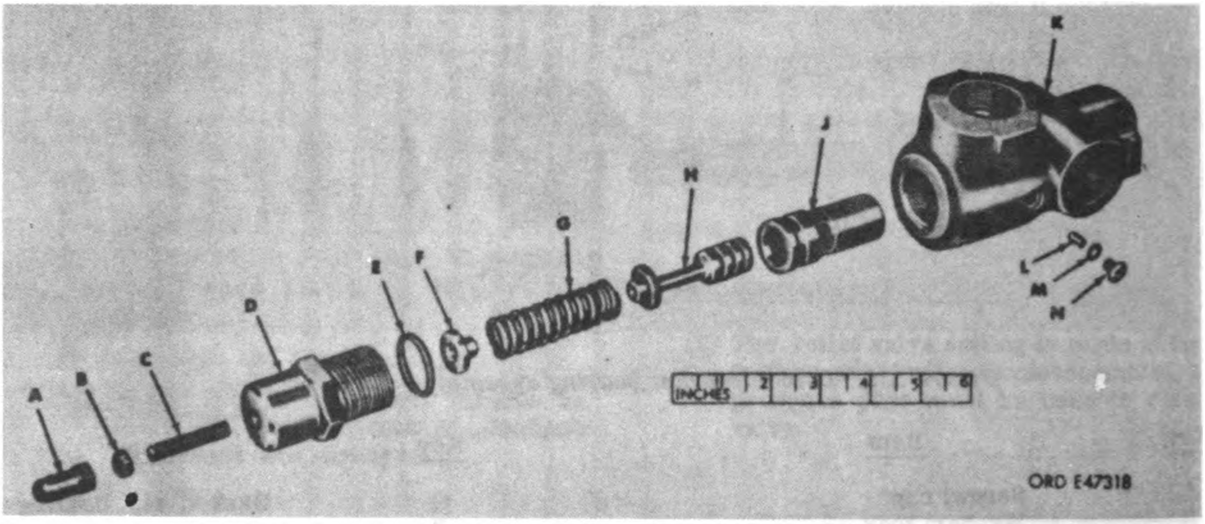


Figure 529. Relief valve assembly - exploded view

Key	Item	Key	Item
A	Nut, cap	H	Plunger, relief valve
B	Nut, lock	J	Sleeve, plunger
C	Screw, set, adjusting	K	Body, relief valve
D	Retainer, relief valve	L	Screw, set
E	Packing, O-ring	M	Gasket
F	Seat, spring	N	Screw, machine
G	Spring, guide		

Figure 529. Relief valve assembly - legend

Section V. TESTS AND ADJUSTMENTS

350. Hydraulic Pump and Relief Valve Assembly

a. Relief Valve Test.

(1) Remove pipe plug from elbow at boom hoist hydraulic motor, and install hydraulic pressure gage in hole in elbow.

Note. Install gage so that it can be read from crane operator's compartment.

(2) Lower hoist cable hook to ground to prevent fouling of hoist cable block with boom sheaves while testing relief valve.

(3) With the boom fully retracted, move the crowd control lever to the RETRACT position, and move the hoist control lever to the UP position.

(4) Holding the crowd and hoist control levers in positions described above, observe pressure indicated on hydraulic pressure gage. The pressure indicated on the gage is the pressure at which the relief valve is opening. If gage indicates incorrect relief valve setting (more or less than 1200 psi), adjust relief valve (b, below).

Caution: Do not adjust relief valve so that opening pressure exceeds 1200 psi as too high a relief valve setting will materially shorten the life of the crane hydraulic system components.

b Relief Valve Adjustment.

(1) Remove clamp securing swivel-valve-to-reservoir line (fig. 409) to top of relief valve, and remove line from valve.

(2) Remove blind nut (fig. 528) from relief valve adjusting setscrew, and loosen jam nut on setscrew.

(3) Using a screwdriver, turn setscrew as necessary to obtain the correct relief valve setting of 1200 psi.

Note. Turning the setscrew clockwise increases the pressure required to open the relief valve. Turning the setscrew counterclockwise decreases the relief valve opening pressure.

(4) After correct relief valve setting is obtained, hold setscrews and tighten jam nut. Install blind nut (fig. 528) on setscrew.

Note. Be sure that jam nut and blind nut are tight on setscrew so that parts will not loosen during operation.

(5) Position swivel-valve-to-restrictor line (fig. 409) at top of relief valve, and secure with clamp (fig. 409).

351. Timing Swing Motor

Note. The key letters noted in parentheses are in figure 530, except where otherwise indicated.

a. Remove swing motor cover (par. 313).

b. Rotate pivot post and boom assembly until right swing-hydraulic-motor cylinder assembly (fig. 403) is in the dead center position (piston rod fully retracted). When cylinder is correctly positioned, the centering hole (H) in the rim of the drive pinion crank (fig. 403) is alined with the centering hole in the base plate (under the crank).

c. Install a pin in centering holes in crank and base plate to prevent movement of piston (K), and stop engine.

d. Place identification tags on the two hydraulic lines connected to the elbows (fig. 403) installed in valve chamber ports (A and C). Unscrew two nuts (fig. 403), and remove the lines from the elbows.

e. Remove the adjusting-hole pipe plug (fig. 403) from the top of the control valve body.

f. Remove the front control-valve body plug (F) from the control valve body.

g. Loosen adjusting-screw jam nut (E) on actuating-lever adjusting screw (G).

h. Attach a compressed air hose to control valve body at adjusting-hole pipe plug (B), and adjust air pressure as low as possible.

i. Using a screwdriver, turn adjusting screw (G) until the amount of air blown from the two valve chamber ports (A and C) is equal. This indicates that the control valve spool (D) is in the NEUTRAL position (center of its range of travel) when the piston (K) is on dead center.

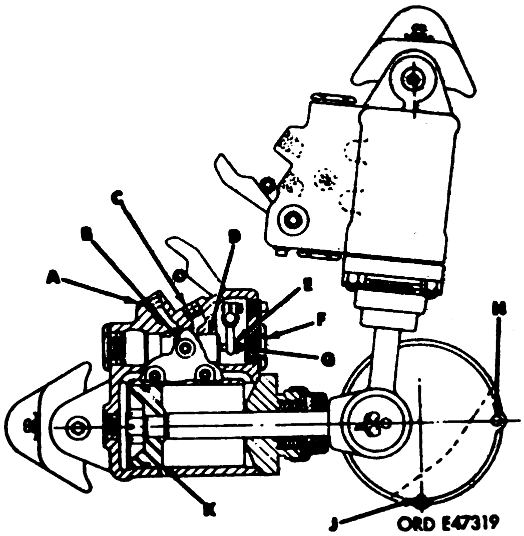


Figure 530. Swing motor timing diagram (M62)

Key	Item
A	Valve chamber port
B	Adjusting-hole pipe plug
C	Valve chamber port
D	Control valve spool
E	Adjusting-screw jam nut
F	Front control-valve body plug
G	Actuating-lever adjusting screw
H	Centering hole
J	Centering hole
K	Piston

Figure 530. Swing motor timing diagram (M62) - legend

j. Hold adjusting screw to prevent it from turning, and tighten jam nut on screw.

k. Remove compressed air hose from control valve body, and install adjusting-hole pipe plug (fig. 403) in body.

l. Install front control-valve body plug (F) in control valve body.

m. Position the two hydraulic lines at elbows (fig. 403) installed in valve chamber ports, and tighten connector nuts.

n. Remove pin from centering hole (H) in rim of drive pinion crank and from base plate.

o. Rotate pivot post and boom assembly until left swing-hydraulic-motor cylinder assembly (fig. 403) is in the dead center position. When cylinder is correctly positioned, the centering hole (J) in rim of drive pinion crank is alined with centering hole in base plate (under crank).

p. Install a pin in centering holes in crank and base plate to prevent movement of piston (K), and stop engine.

q. Adjust left swing-hydraulic-motor cylinder assembly ((d) through (n) above).

Note. Adjusting-hole pipe plug for left cylinder assembly is installed on underside of control valve body.

Caution: Be sure to remove pin from centering holes in drive crank and base plate after completing timing procedures.

352. Rotor Chamber Adjustment (Fig. 531)

a. Check clutch pedal free travel and adjust, if necessary.

b. Loosen locknut on adjusting screw installed in clutch release outer lever.

c. Turn adjusting screw until clearance between adjusting-screw head and upper end of inner lever is between three thirty-seconds and one-fourth inch. Figure 531 illustrates point of measurement between adjusting-screw head and inner lever.

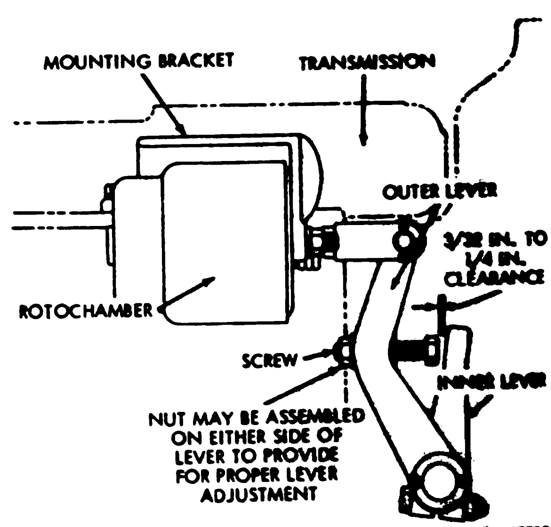


Figure 531. Roto chamber adjustment diagram

d. Hold adjusting screw to prevent it from turning, and tighten locknut.

353. Hydraulic Pump Control Linkage Adjustment (Refer to Fig. 417)

a. Remove cotter pin and yoke pin securing hydraulic-pump front control rod (K) to hydraulic-pump right relay lever (L), and remove rod from lever.

b. Place hydraulic pump control lever (fig. 414) in DISENGAGE position, and secure lever with locking hinge attached to wrecker body floor plate.

c. Remove cotter pin securing control-valve control rod (G) to control valve lever (U), and remove rod from lever.

d. Loosen nut (J) on front control rod (K).

e. Using front control rod, pull output shifter shaft arm (N) as far as possible toward rear of vehicle (to DISENGAGE position).

Note. Total travel of arm from ENGAGED to DISENGAGE position is five-eighths of an inch.

f. With clevis (H) moved as far as possible toward rear of vehicle, so that pin securing clevis to output shifter shaft arm is against front end of clevis slot, turn front control rod (K) in clevis until front control rod yoke can be connected to hydraulic-pump right relay lever.

Note. If linkage is so far out of adjustment that this cannot be done, adjust hydraulic-pump rear control rod (fig. 415), using adjustable yoke securing rear control rod to lower end of hydraulic pump control lever (fig. 418).

g. Position front control rod yoke on relay lever, and secure with yoke pin and cotter pin.

h. Holding control rod, tighten nut (J) against clevis (H).

i. Move control valve lever (U) as far as possible toward rear of vehicle.

j. Loosen nut (T) on control-valve control rod (G), and turn control rod in yoke (S) until front end of rod can be inserted in hole in lower end of lever.

k. Insert control rod end through hole in control valve lever, and install cotter pin in end of rod.

l. Holding control rod, tighten nut (T) against yoke (S).

354. Governor Valve Adjustment

a. Start engine.

b. After engine coolant temperature reaches normal operating range power divider.

c. Pull throttle control all the way out and leave in LOCKED OUT position. Observe engine speed (rpm) indicated by tachometer, which is the engine speed at which the governor valve (W) mounted on the power divider controls the engine speed governor.

d. Stop engine.

e. If engine governed speed (no-load) indicated by c above is not within range of satisfactory governor operation (1550 to 1650 rpm when governor is controlled by governor valve at power divider), adjust governor valve at power divider f through k below.

f. Remove adjusting-hole plug seal, and remove plug (X) from side of governor valve housing.

g. Place the transmission gearshift lever in "5" gear position, place the transfer shift lever in neutral position, and place the power divider control lever in ENGAGE position. With the ignition switch off, crank engine by small increments (by momentarily depressing starter button) until adjusting screw inside governor is alined with adjusting hole.

h. Insert a screwdriver in the adjusting hole and turn the adjusting screw clockwise to increase engine governed speed or counterclockwise to decrease engine governed speed. One full turn of the adjusting screw in either direction will result in a change in the engine governed speed of approximately 150 rpm.

i. Install plug (X) in adjusting hole, and check governor valve adjustment by repeating (a) through (d) above.

j. If necessary, repeat 1 through 4 above until governor valve adjustment is satisfactory.

k. Attach a new locking wire and lead seal to the adjusting hole plug and the fin on the control valve housing adjacent to the adjusting hole.

355. Worm and Drive Gear

a. Adjustment.

(1) The worm and drive gear set has been adjusted at the factory and should require adjusting only after repair. For this reason, special care should be taken to retain the same tooth contact as established at original manufacture, whenever the worm and drive gear set undergoes major repair. The two adjustments which affect tooth contact are end position of the worm and side position of the gear. As a general rule the shim pack removed at disassembly, when used intact in the assembly, will provide the correct tooth contact.

(2) Method of checking adjustment (fig. 442). As soon as the worm and drive gear set has been assembled in the gearcase to the correct relative position, the adjustment for tooth contact is checked as follows:

(a) Lightly paint both sides of teeth of drive gear (M) with Prussian blue. Usually, coating about five to six teeth is sufficient for checking purposes. When the worm (AL) is rotated, the Prussian blue is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape, and location of the contacts. Sharper contact readings can be obtained by applying a small amount of resistance to the drive shaft (AX) when rotating the worm. Rotate the worm by hand in the direction it will run when under full load, letting the blued teeth pass through the worm threads several times. Worm threads should now show a bearing reading on the drive side for approximately three-quarters of the length of the worm thread. Center of threads should be as near to dead center of gear as possible.

(b) Rotate the worm again, but mesh this time with unblued teeth of the drive gear. The gear teeth should now indicate a bearing reading in the center of each tooth, and covering approximately one-half of the tooth width, looking from the rear on the drive side. The coat side of the threads and teeth should also show very nearly the same reading as the drive side, when similarly checked by reversing the rotation.

b. Procedure for Making Adjustment (Fig. 442). If the worm and drive gear set is not correctly alined, it should be adjusted by removing or adding shims. This is done in the following manner:

(1) If the worm is out of end position (not centered under axis of drive gear), bearing cage shims (AT) should be added or removed as necessary between the worm bearing cage (Y) and the gearcase (CC).

(2) If the drive gear is out of side position, shims (F or FF) should be added on one side and an equal amount removed on the other side so that the drive gear will be centered directly over the worm when meshed.

(3) Shim or gasket thickness between the bearing cap (D) and the gearcase (CC) should be such that drive gear bearing cones (L and AV) are given a light preload: Preload should be 0.005-to 0.001-inch on each bearing.

(4) After a short run under full load, recheck the adjustment, using the procedures as outlined in b above. Worm and drive gear set adjustment will be correct if a bearing reading shows for approximately three-quarters of the width of the drive gear teeth and the full length of the worm thread.

356. Drive Pinion, Idler Gear, and Pivot Post Bearings

a. General. Bearing adjustments must be made individually without drag or gear contact with mating part. Pivot post seals must be removed to establish a proper preload adjustment.

Note. Keep all shim packs intact for final assembly.

b. Drive Pinion Idler Gear Adjustment (Fig. 477).

(1) Assemble drive pinion idler gear (L) with bearings in housing of base plate as outlined in paragraph 335. Adjust bearings by removing or adding spacing shims (R, S, T, and U) until a very slight drag is felt when the idler gear is revolved.

(2) Remove the idler gear assembly and keep the shim pack intact for final assembly.

c. Drive Pinion and Crank (Fig. 477).

(1) Assemble drive pinion (KK) and drive pinion crank (NN) with bearings in housing of base plate as described in paragraph 335. Adjust bearings by removing or adding spacing shims (EE, FF, and GG) until a very slight drag is felt when the drive pinion is revolved.

(2) Removal of the drive pinion and crank, after the adjustment, is not required.

d. Pivot Post and Support (Fig. 480).

(1) The pivot post bearings must be adjusted with the drive pinion idler gear removed from the base plate. The pivot post gear shields (V and ZZ), gear shield felt (U and AB), and inner pivot post seal (T) must not be assembled, to avoid drag for bearing preload adjustment.

(2) Assemble pivot post and bearings to pivot post support as outlined in paragraph 335, omitting inner post seal (T).

(3) Attach a rope to one of the large studs, used for mounting the stop plate (WW), and feed rope down into the gear shield felt groove of the pivot post (BB). Attach a scale to the rope. Adjust bearings by removing or adding spacing shims (EE, FF, and GG) under the pivot post support cap (PP), until a 12-to 15-pound pull is required on the scale to turn the pivot post.

(4) The pivot post must then be removed for installation of the inner pivot seal (T). Keep the shim pack intact for final assembly.

(5) After all adjustments are made and size of shim packs is determined, assemble as described in paragraph 335.

Section VI. SERVICEABILITY STANDARDS

357. General

The serviceability standards 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. 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. An asterisk (*) in the "Wear limits" column indicates that the part or parts should be replaced when worn beyond the limits given 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 in inches, unless otherwise indicated.

358. Serviceability Standards

Table XIV below gives the serviceability standards for the wrecker crane assembly.

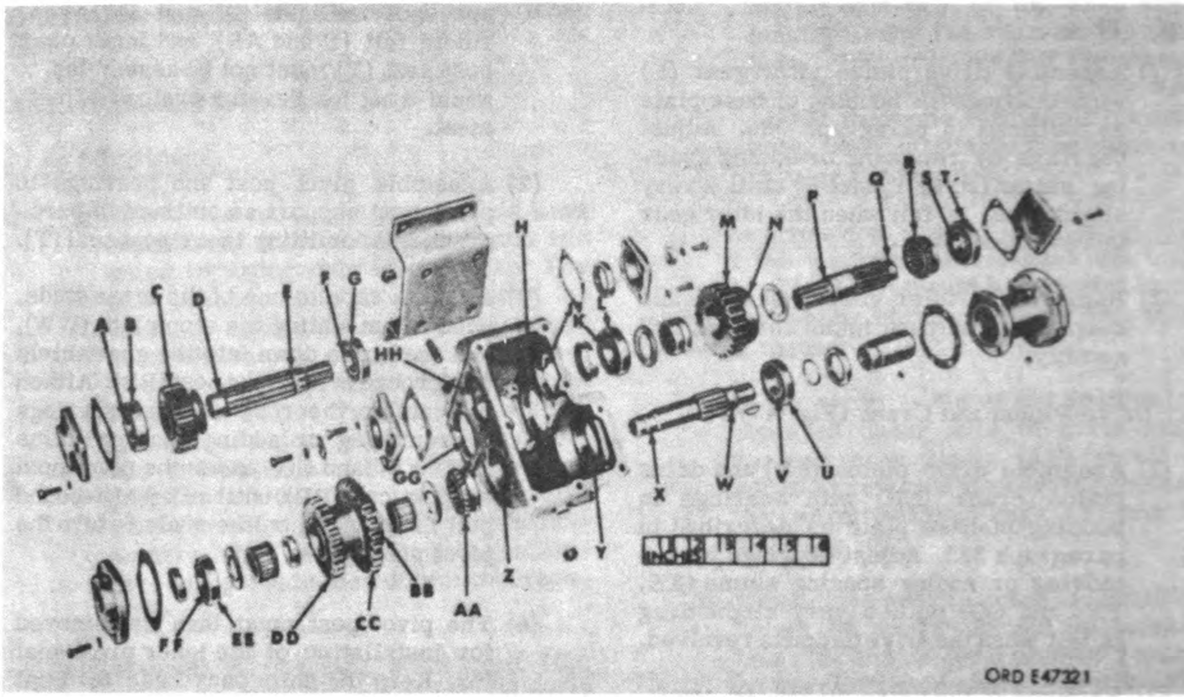


Figure 532. Power divider shafts and gears tolerances

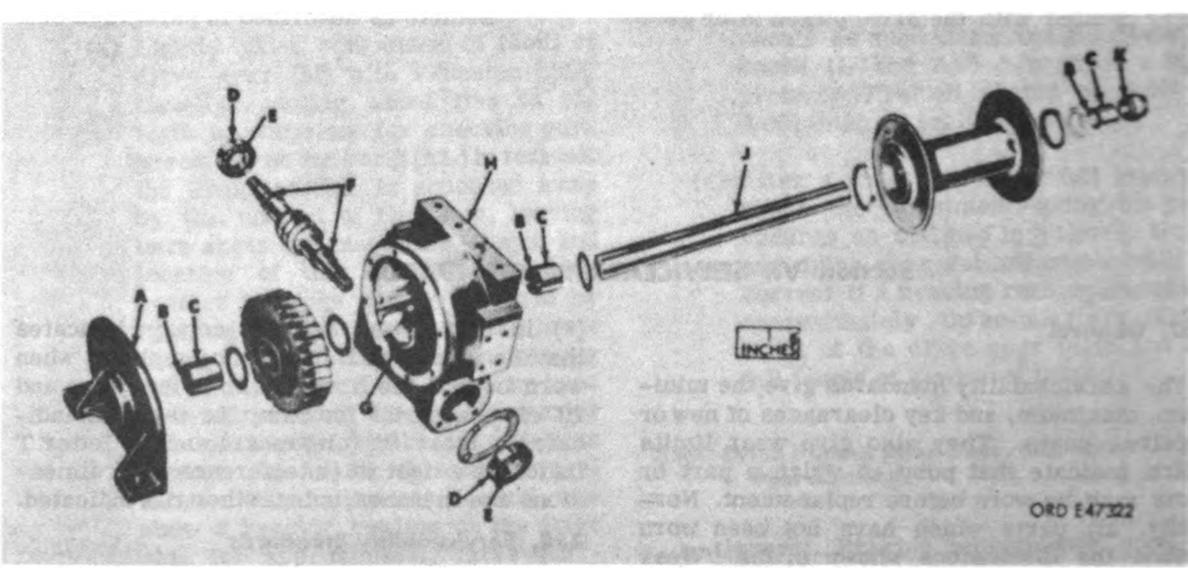


Figure 533. Rear mounted winch tolerances

Table XVII. Serviceability Standards - Wrecker Crane Assembly

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts	Wear limits
POWER DIVIDER				
Input and Pump Output Shifter Shaft and Cover				
517	DD	Compression spring (pump output shift shaft)	Free length 1-21/32 in. compressed to 1 in. 38 lb	
517	KK	Compression spring (input shifter shaft)	Free length 1-21/32 in. compressed to 1 in. 38 lb	
Winch Output Shifter Shaft and Cover				
518	F	Compression spring (winch output shifter shaft)	Free length 1-21/32 in. compressed to 1 in. 38 lb	
532	D	Winch output gear shaft	1.5747-1.5752	1.5732
532	A	Winch output gear bearing id	1.5744-1.5748	(*)
532	D-A	Bearing to shaft clearance	0.0001L-0.0008T	0.0011L
532	GG	Output gear bearing bore in case	3.1495-3.1503	3.1513
532	B	Output gear bearing od	3.1491-3.1496	(*)
532	GG-B	Bearing to case clearance	0.0012L-0.0001T	0.0022
532	F	Winch output gear bearing id	1.5744-1.5748	(*)
532	E	Winch output gearshaft	1.5747-1.5752	1.5737
532	F-E	Bearing to shaft clearance	0.0001L-0.008T	0.0011L
532	G	Winch output gear bearing od	3.1491-3.1496	(*)
532	H	Winch output gear bearing bore in case	3.1495-3.1503	3.1513
532	H-G	Bearing to case clearance	0.0012L-0.0001T	0.0022
532	K	Input gearshaft bearing id	1.5743-1.5748	(*)
532	P	Input gearshaft	1.5747-1.5752	1.5737
532	K-P	Bearing clearance on shaft	0.0001L-0.0009T	0.0011L
532	L	Input gearshaft bearing od	3.1491-3.1496	(*)
532	HH	Input gear bearing bore in case	3.1495-3.1503	3.1513

Table XVII. Serviceability Standards - Wrecker Crane Assembly - Continued

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts	Wear limits
		POWER DIVIDER - Continued		
		Winch Output Shifter Shaft and Cover - Continued		
532	HH-L	Bearing to case clearance	0.0012L-0.0001T	0.0022
532	S	Input gearshaft bearing id	1.5743-1.5748	(*)
532	Q	Input gearshaft	1.5757-1.5752	1.5732
532	S-Q	Bearing clearance on shaft	0.0001L-0.0009T	0.0011L
532	T	Input gearshaft bearing od	3.1491-3.1496	(*)
532	J	Input gear bearing bore in case	3.1495-3.1503	3.1513
532	T-J	Bearing to case clearance	0.0012L-0.0001T	0.0022
532	V	Pump output shaft bearing id	1.5744-1.5748	(*)
532	W	Pump output shaft	1.5747-1.5752	1.5732
532	V-W	Bearing clearance on shaft	0.0001L-0.0008T	0.0011L
532	U	Pump output shaft bearing od	3.1491-3.1496	(*)
532	Y	Pump output bearing bore in case	3.1495-3.1503	3.1513
532	U-Y	Bearing to case clearance	0.0012L-0.0001T	0.0022L
532	FF	Pump output shaft bearing id	1.3775-1.3780	(*)
532	X	Pump output shaft	1.3779-1.3784	1.3764
532	FF-X	Bearing fit on shaft	0.0001L-0.0009T	0.0011L
532	EE	Pump output shaft bearing od	2.8341-2.8346	(*)
532	Z	Pump output bearing bore in case	2.8345-2.8353	2.8363
532	EE-Z	Bearing to case clearance	0.0012L-0.0001T	0.0022
		Gear Backlash		
532	C-M	Winch output gear to input shaft gear	0.006-0.010	0.035
532	DD-M	Power divider drive gear to input shaft gear	0.006-0.010	0.035
532	C-C	Power divider drive gear to winch output gear	0.006-0.010	0.035

Table XVII. Serviceability Standards - Wrecker Crane Assembly - Continued

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts	Wear limits
		POWER DIVIDER - Continued		
		Gear Backlash - Continued		
532	N-R	Input shaft sliding clutch to input shaft gear	0.006-0.010	0.035
532	AA-BB	Power divider sliding clutch to power divider drive gear	0.006-0.010	0.035
		REAR MOUNTED WINCH		
		Drum Shaft and Bearings		
533	J	Drum shaft	2.998-3.000	2.983
533	B	Drum shaft bearings id	3.002-3.005	3.020
533	B-J	Drum shaft to bearing clearance	0.002L-0.007L	0.020L
533	A	End cover bearing bore	3.250-3.251	(*)
533	H	Gear case bearing bore	3.250-3.251	(*)
533	K	End frame bearing sleeve id	3.250-3.251	(*)
533	C	Drum shaft bearing od	3.256-3.258	(*)
533	A,H, K-C	Bearing fits in end cover, gear-case, and sleeve bores	0.005T-0.008T	(*)
		Drive Worm and Bearings		
533	E	Drive worm bearing id	2.3616-2.3622	(*)
533	F	Drive worm	2.3615-2.3625	2.3595
533	E-F	Drive worm bearing fit on worm	0.0007L-0.0009T	0.0017L
533	D	Drive worm bearing od	5.1173-5.1181	(*)
533	G	Gearcase bearing bore	5.1179-5.1191	5.1201
533	G-D	Bearing fit in gear case bore	0.0018L-0.0002T	(*)
		HYDRAULIC VALVES		
		Swivel Valve		
467	L	Inner hub	4.750	
467	N	Body	4.750-4.7503	

Table XVII. Serviceability Standards - Wrecker Crane Assembly - Continued

Fig. No.	Ref. letter	Point of measurement	Size and fit of new parts	Wear limits
HYDRAULIC VALVES - Continued				
Swivel Valve - Continued				
	N-L	Clearance after matching hub and body	0.0005L-0.0006L	
Control Valve				
	D	Spool	1.3755	
	BB	Body	1.3757	
	BB-D	Clearance after matching spool and body	0.0004L-0.0007L	
Swing Motor Control Valve				
	P	Spool	1.3755	
	M	Body	1.3757	
	M-P	Clearance after matching spool to body	0.0004L-0.0007L	

Note. Parts shown above are available only in matching pairs. For this reason, the clearance between parts after matching will be the only limits given. Wear between parts is negligible and parts should only be replaced if scored or cut by abrasives which might enter the hydraulic system.

CHAPTER 23

WRECKER CRANE M246

Section I. DESCRIPTION AND DATA

359. Description

a. General. The hydraulically operated crane, mounted on the rear of the chassis of the tractor wrecker truck M246, consists primarily of the assemblies described in b through n below. The complete crane can be replaced as a single unit, provided hoisting equipment having a capacity of approximately 8000 pounds is available. However, the illustrations and replacement instructions contained in this section refer to replacement of the individual units and assemblies comprising the crane.

b. Hydraulic Pump and Relief Valve Assembly. The flange-mounted vane-type hydraulic pump (fig. 534) is bolted to a bracket attached to the underside of the rear outrigger frame tube. The pump is driven by a propeller shaft (fig. 534) extending from the power takeoff on the rear of the transfer to the pump input shaft. The adjustable relief valve (fig. 534) is connected to the hydraulic pump outlet port. The purpose of this valve is to protect the crane hydraulic system from excessive (above 1200 psi) pump pressures.

c. Base Plate and Pivot Post Assembly. The base plate and pivot post assembly, as referred to in this paragraph, consists of the crane base plate (fig. 535), pivot post, shipper support, swivel valve (fig. 401), and operator's cab and control valve bank assembly (fig. 401). The combined weight of these units is approximately 3920 pounds. The base plate is bolted to both the crane body and to the truck frame. The pivot post, which is hollow, is internally supported at the top and bottom by tapered roller bearings, which are installed on a tubular support member attached to the base plate. The pivot post support cap (fig. 402), bolted to the top of the pivot post support, anchors the pivot post to the support while permitting the pivot post to rotate freely on its vertical axis. The shipper support, on which the boom and shipper assembly (f below) are pivoted, is bolted to mounting bosses cast on the sides of the pivot post. For description of the swivel valve, refer to paragraph 294e. For description of the control valve bank, refer to paragraph 294j.

d. Swing Motor and Drive Gearcase. The flange-mounted vane-type hydraulic swing motor (fig. 536) is secured to the drive gearcase by six safety nuts installed on studs screwed into the motor housing. The drive gearcase is secured to the crane base plate by three safety nuts installed on studs screwed into the gearcase. The swing motor drive shaft is connected to the drive worm inside the gearcase by a keyed coupling. Although the procedures in this section cover removal of the swing motor and drive gearcase as a unit, the swing motor can be removed without removing the drive gearcase.

e. Swivel Valve. Refer to paragraph 294e.

f. Boom and Shipper Assembly. The boom and shipper assembly consists of the boom, boom extension, and shipper, which are telescoping tubular steel members having a rectangular shaped cross section, held together by two boom-extension retaining pins and the boom crowd cylinder (h below). The rear end of the shipper is pivoted on a pin (fig. 405)

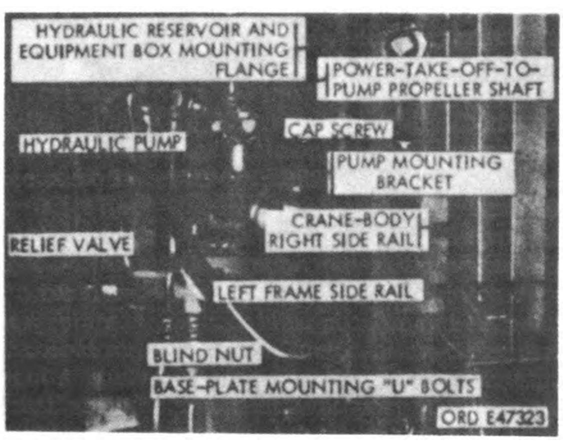


Figure 534. Bottom view of hydraulic pump and relief valve assembly installed M246

installed at the top rear of the shipper support, which permits raising and lowering the front end of the boom. Weight of the shipper and boom assembly is approximately, 2620 pounds. Although the boom and shipper removal procedures (par. 367) require removal of the boom hoist hydraulic oil motor and cable drum before removal of the boom and shipper assembly, both assemblies can be removed as a single unit.

g. Boom Lift Cylinder. Refer to paragraph 294g.

h. Boom Crowd Cylinder. Refer to paragraph 294h.

i. Boom Hoist Hydraulic Oil Motor and Cable Drum Assembly. Refer to paragraph 294i.

j. Control Valve Bank. Refer to paragraph 294j.

k. Hydraulic Lines and Fittings. Refer to paragraph 294k.

l. Hydraulic Reservoir and Equipment Box. The hydraulic reservoir and equipment box (fig. 536) is secured to the crane body by four cap screws installed through holes in the top

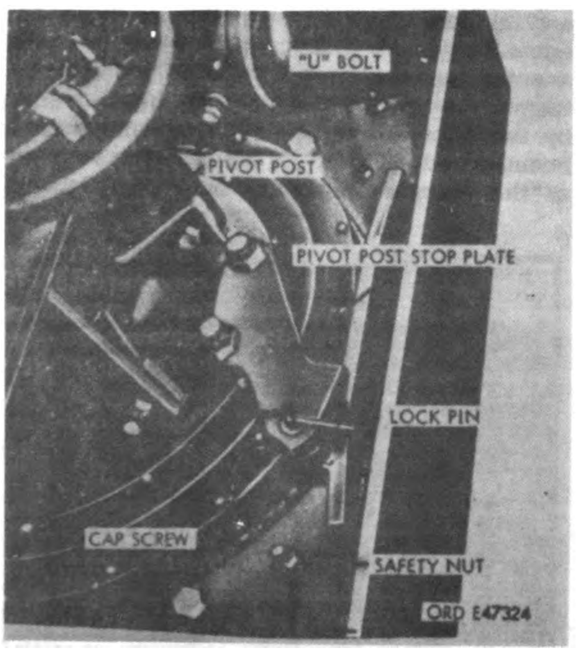


Figure 535. Lower section of crane pivot post and base plate (M246) - left rear view

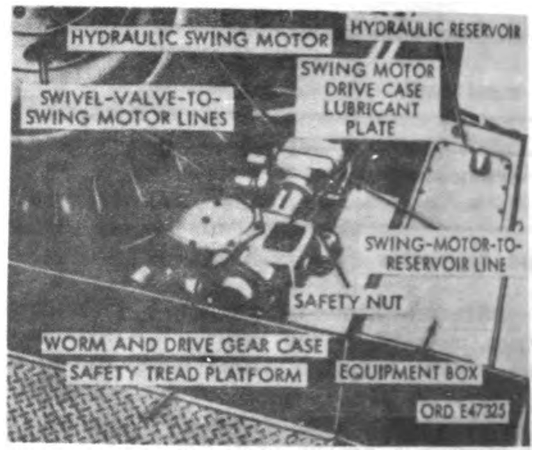


Figure 536. Crane hydraulic swing motor (M246)

flange of the crane-body side rails (fig. 534) and into tapped blocks welded to the top side of the hydraulic-reservoir-and-equipment-box mounting flanges. Weight of the reservoir and equipment box is 185 pounds.

m. Crane Body. The crane body (fig. 537) is bolted to the truck frame (after removal of the base plate and pivot post assembly) by four cap screws and safety nuts, installed two on each side through brackets bolted to the truck frame. In addition, the fifth wheel approach plates at the front of the crane body are bolted to the top flange of the truck frame side rails by six cap screws and safety nuts, three on each side. The approximate weight of the crane body, including the outriggers, is 2200 pounds.

n. Hydraulic System. The wrecker crane hydraulic system (fig. 538) is completely sealed except for the breather-type reservoir filler cap. A bayonet-type oil level gage attached to a square-head pipe plug is installed in the top of the reservoir.

360. Data

a. Wrecker crane.

Make . . . . Austin-Western
Type . . . . hydraulic
Capacity rating . . . . 5 ton

b. Hydraulic pump.

Make . . . . Vickers
Type . . . . vane

c. Relief valve.

Make . . . . .Hydreco

d. Swivel valve.

Make . . . . Austin-Western

e. Swing hydraulic oil motor.

Make . . . . Vickers

f. Boom hoist hydraulic oil motor.

Make . . . . Vickers
Type . . . . vane

g. Control valve bank assembly.

Make . . . . .Austin-Western

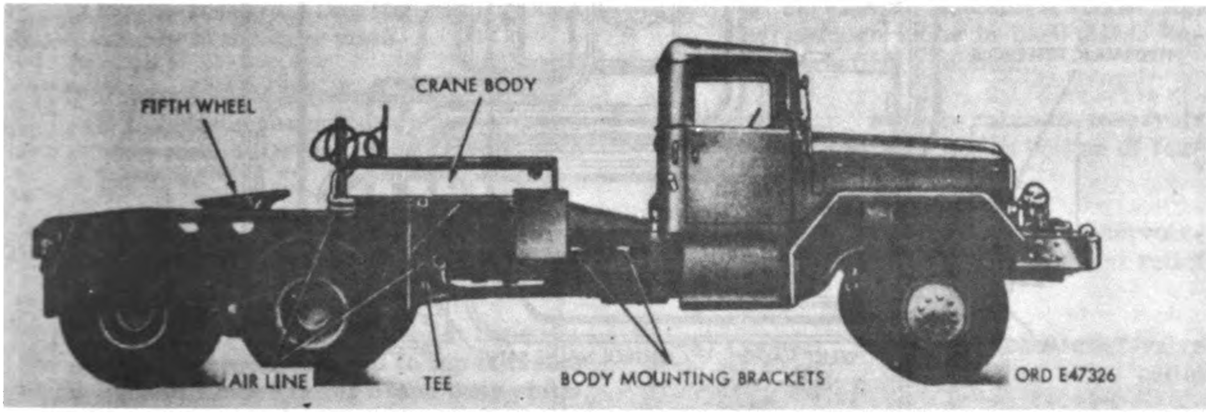


Figure 537. Right side view of tractor wrecker truck M246 with hydraulic crane and reservoir removed

Section II. TROUBLESHOOTING

361. General

Troubleshooting is a systematic isolation of defective components by means of an analysis of vehicle trouble symptoms, testing to determine the defective component, and applying the remedies.

362. Troubleshooting Procedures

Troubleshooting procedures for the Wrecker Crane M246 are the same as those for the Wrecker Crane M62. Refer to paragraph 296 for this information.

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

363. Hydraulic Pump and Relief Valve Assembly

a. Removal.

(1) Disconnect swivel-valve-to-relief-valve line (fig. 539) from relief valve outlet port.

(2) Disconnect swivel-valve-to-reservoir-inlet-tee line (fig. 539) from tee at relief valve.

(3) Loosen two hose clamps securing reservoir inlet hose (fig. 539) to sleeve on bottom of reservoir, and remove hose from sleeve.

(4) Loosen two hose clamps securing pump inlet hose (fig. 539) to oil supply valve outlet port.

(5) Remove power takeoff-to-pump propeller shaft (fig. 534) from pump propeller shaft (TM 9-2320-211-20).

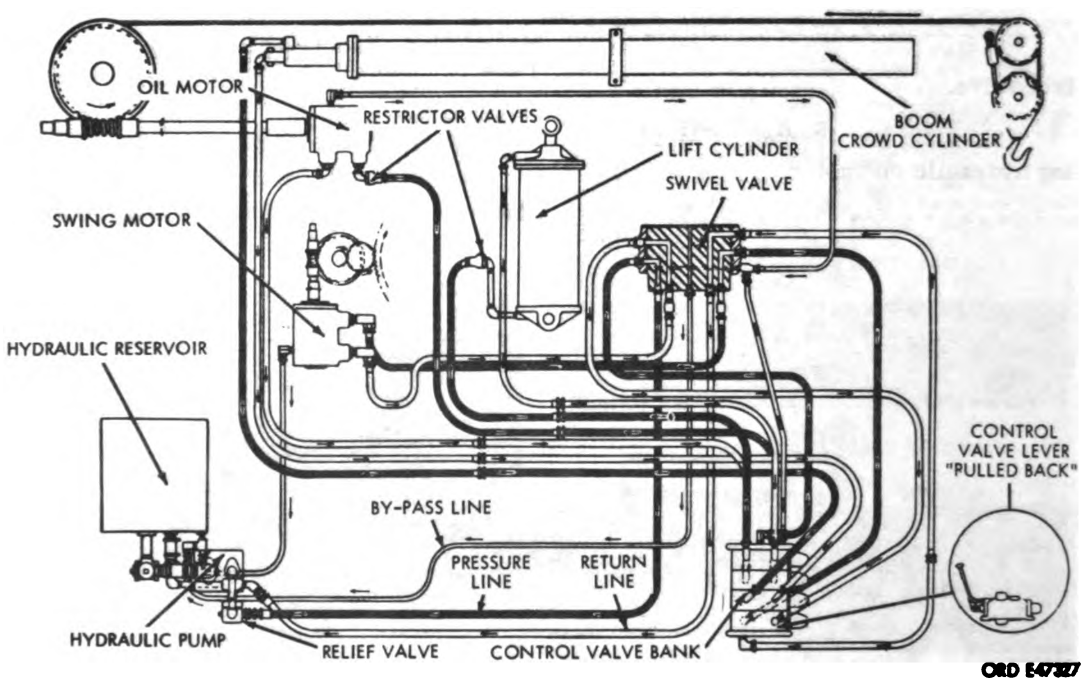


Figure 538. Crane hydraulic system M246

(6) Remove six cap screws (fig. 534) and lockwashers securing pump-to-pump-mounting bracket, pull pump from bracket, sliding pump inlet hose (fig. 539) from oil supply valve outlet port, and remove hydraulic pump and relief valve assembly from vehicle.

(7) Remove reservoir—to—pump piping from pump inlet port.

(8) Remove pump-to-relief-valve piping from pump outlet port.

(9) Remove pump-to-relief-valve piping from relief valve inlet port.

(10) Remove relief-valve-to-reservoir piping from relief valve outlet port.

b. Installation.

(1) Install relief-valve-to-reservoir piping in relief valve outlet port.

(2) Install pump-to-relief-valve piping in relief valve inlet port.

(3) Install pump-to-relief-valve piping in pump outlet port.

(4) Install reservoir-to-pump piping in pump inlet port.

(5) Position pump and relief valve assembly under front outrigger frame tube, and secure pump (fig. 539) to pump mounting bracket with six cap screws and lockwashers. Tighten cap screws.

(6) Install power-takeoff-to-pump propeller shaft (fig. 534) on pump drive shaft (TM 9-2320-211-20).

(7) Connect swivel-valve-to-reservoir-inlet-tee line (fig. 539) to tee at relief valve.

(8) Connect swivel-valve-to-relief-valve line (fig. 539) to relief valve outlet port.

(9) Install reservoir inlet hose (fig. 539) on sleeve at bottom of reservoir, and tighten the two hose clamps.

(10) Install pump inlet hose (fig. 539) on oil supply valve outlet port, and tighten the two hose clamps. Open oil supply valve.

364. Base Plate and Pivot Post Assembly

a. Removal.

(1) Remove boom and shipper assembly (par. 367).

(2) Remove boom lift cylinder (par. 368).

(3) Remove swing motor and drive gearcase (par. 365), and drop swing-motor-to-reservoir line (fig. 536) through hole in crane base plate.

(4) Remove 16 safety nuts (fig. 535) from 8 U-bolts securing base plate to crane body side rails and truck frame side rails.

(5) Remove four cap screws (fig. 535) and lockwashers securing base plate to crane body.

(6) Disconnect floodlight cable at bayonet-type connector clipped to top of frame cross member under crane base plate.

(7) Disconnect swivel-valve-to-relief-valve line (fig. 538) from relief valve outlet port.

(8) Disconnect swivel-valve-to-reservoir-inlet-tee line (fig. 539) from tee at relief valve.

(9) Disconnect swivel-valve-to-reservoir line (fig. 538) from tee on bottom of reservoir.

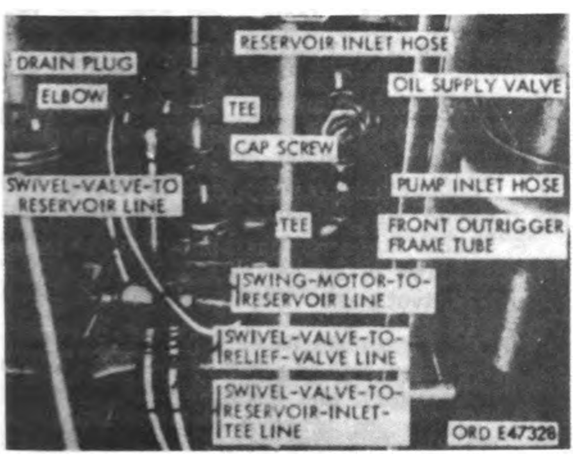


Figure 539. Front bottom view of hydraulic pump and relief valve assembly installed M246

(10) Place a chain under the operator's cab and between the shipper support (fig. 421), and using overhead hoisting equipment, lift base plate and pivot post assembly from crane body.

b. Installation.

(1) Using overhead hoisting equipment, lift base plate and pivot post assembly into position on crane body, guiding base plate mounting U-bolts (fig. 534) through holes in base plate. Remove hoisting equipment.

(2) Connect swivel-valve-to-reservoir line (fig. 539) to tee on bottom of reservoir.

(3) Connect swivel-valve-to-reservoir-inlet-tee line (fig. 539) to tee at relief valve.

(4) Connect swivel-valve-to-relief-valve line (fig. 539) to relief valve outlet port.

(5) Connect floodlight cable to bayonet-type connector clipped to top of frame cross member under crane base plate.

(6) Install 16 safety nuts (fig. 535) or 8 U-bolts, and tighten.

(7) Install four cap screws (fig. 535) and lockwashers in holes in base plate and crane body side rails.

(8) Insert swing-motor-to-reservoir line (fig. 539) through hole in crane base plate, and install swing motor and drive gearcase (par. 365).

(9) Install boom lift cylinder (par. 368).

(10) Install boom and shipper assembly (par. 367).

(11) Lubricate hydraulic crane (refer to LO 9-2320-211-12.

365. Swing Motor and Drive Gearcase

a. Removal.

(1) Disconnect swing-motor-to-reservoir line (fig. 536) from elbow on rear of swing motor.

(2) Disconnect two swivel-valve-to-swing-motor lines (fig. 536) from elbows on front of swing motor.

(3) Remove three safety nuts (one at left side and two at right side) from studs securing drive gearcase to crane base plate, and remove swing motor and drive gearcase from vehicle.

(4) Remove six safety nuts (fig. 536) securing swing motor to drive gearcase, and remove motor from gearcase.

b. Installation.

(1) Aline key on swing-motor drive shaft with keyway in coupling on drive worm, position swing motor (fig. 536) on drive gearcase, and secure with six safety nuts. Tighten nuts (on motor mounting studs).

(2) Position drive gearcase on crane base plate, with studs on bottom of case entering holes in base plate, and secure with three safety nuts.

(3) Connect two swivel-valve-to-swing-motor lines (fig. 536) at elbows on front of swing motor.

(4) Connect swing-motor-to-reservoir line (fig. 536) at elbow on rear of swing motor.

366. Swivel Valve

a. Removal.

(1) Disconnect floodlight cable from connector at rear of floodlight (TM 9-2320-211-20).

(2) Disconnect oil motor bypass line (fig. 424) at hoist oil motor. Loosen cap screw (fig. 401) securing hose clip to bracket, and remove oil motor bypass line from clip and bracket.

(3) Using overhead hoisting equipment, raise the shipper and boom assembly to the extreme upward position.

Note. When raising boom, hold boom control lever in up position to permit the oil in the lift cylinder to bypass.

(4) Disconnect four flexible hydraulic lines (fig. 401) and one return line (fig. 407) at control valve bank assembly.

Note. Place identification tags on hydraulic lines and control valve bank elbows to facilitate swivel valve installation.

(5) Loosen two hex nuts (fig. 402), and slide swivel-valve-hub locking plates out of groove in swivel valve.

Note. One locking plate is installed at front and rear of swivel valve assembly.

(6) Disconnect floodlight cable at bayonet-type connector clipped to top of frame cross member under crane base plate.

(7) Disconnect two swivel-valve-to-swing-motor lines (fig. 536) from elbows on front of swing motor.

(8) Disconnect swivel-valve-to-relief-valve line (fig. 539) from relief valve outlet.

(9) Disconnect swivel-valve-to-reservoir-inlet-tee-line (fig. 539) from tee at relief valve.

(10) Disconnect swivel-valve-to-reservoir line (fig. 539) from tee at bottom of reservoir.

(11) Using overhead hoisting equipment, lift swivel valve assembly (fig. 402) together with hydraulic lines and floodlight cable, from pivot post, and remove from vehicle.

b. Installation.

(1) Using overhead hoisting equipment, support swivel valve assembly (fig. 402) over pivot post and feed floodlight cable and hydraulic lines attached to bottom of swivel valve through center of pivot post.

(2) Lower swivel valve assembly into position on top of pivot post support cap (fig. 402), and engage the two locking plates in groove in swivel valve. Tighten locking plate retaining nuts.

(3) Connect four flexible hydraulic lines (fig. 401) and one return line (fig. 407) at control valve bank assembly.

(4) Position oil motor bypass line (fig. 401) on bracket on left side panel in operator's compartment, and secure with clip. Tighten clip retaining cap screw.

(5) Connect oil motor bypass line (fig. 424) to hoist oil motor.

(6) Connect floodlight cable to connector at rear of floodlight (TM 9-2320-211-20).

(7) Connect two swivel-valve-to-swing-motor lines (fig. 536) at elbows on front of swing motor.

(8) Connect floodlight cable to bayonet-type connector clipped to top of frame cross member under crane base plate.

(9) Connect swivel-valve-to-reservoir line (fig. 539) at tee on bottom of reservoir.

(10) Connect swivel-valve-to-reservoir-inlet-tee line (fig. 539) at tee at relief valve.

(11) Connect swivel-valve-to-relief-valve line (fig. 539) to relief valve outlet port.

(12) Remove overhead hoisting equipment from boom and shipper assembly, and lower boom.

367. Boom and Shipper Assembly

a. Removal. Refer to paragraph 315a.

b. Installation. Refer to paragraph 315b.

368. Boom Lift Cylinder

a. Removal. Refer to paragraph 316a.

b. Installation. Refer to paragraph 316b.

369. Boom Crowd Cylinder

a. Removal. Refer to paragraph 317a.

b. Installation. Refer to paragraph 317b.

370. Boom Hoist Hydraulic Oil Motor and Cable Drum

a. Removal. Refer to paragraph 318a.

b. Installation. Refer to paragraph 318b.

371. Control Valve Bank

a. Removal. Refer to paragraph 319a.

b. Installation. Refer to paragraph 319b.

372. Hydraulic Lines and Fittings

a. Removal. Refer to paragraph 320a.

b. Installation. Refer to paragraph 320b.

373. Hydraulic Reservoir and Equipment Box

a. Removal.

(1) Disconnect swivel-valve-to-reservoir line (fig. 539) at tee on bottom of reservoir.

(2) Disconnect swing-motor-to-reservoir line (fig. 539) at elbow on bottom of reservoir.

(3) Loosen two hose clamps securing reservoir inlet hose (fig. 539) to sleeve on bottom of reservoir, and remove hose from sleeve.

(4) Loosen two hose clamps securing pump inlet hose (fig. 539) to oil supply valve outlet port, and remove hose from valve.

(5) Remove four cap screws and lockwashers (from inside of crane body side rails) securing reservoir mounting flanges (fig. 534) to crane body side rails.

(6) Attach a chain sling and overhead hoisting equipment to reservoir, and lift reservoir from crane body and remove from vehicle.

b. Installation.

(1) Using chain sling and hoist, position hydraulic reservoir and equipment box on crane body, and aline holes in crane body side rails (fig. 534) with holes in reservoir mounting flanges. Install four cap screws with lockwashers in mounting holes, and tighten.

(2) Slide pump inlet hose (fig. 539) on oil supply valve outlet port, and tighten the two hose clamps.

(3) Slide reservoir inlet hose (fig. 539) on sleeve at bottom of reservoir, and tighten the two hose clamps.

(4) Connect swivel-valve-to-reservoir line (fig. 539) at tee on bottom of reservoir.

(5) Connect swing-motor-to-reservoir line (fig. 539) at elbow on bottom of reservoir.

374. Crane Body

a. Removal.

(1) Remove base plate and pivot post assembly (par. 364).

(2) Remove fifth wheel. (Refer to TM 9-2320-211-20.)

(3) Remove hydraulic pump and relief valve assembly (par. 363).

(4) Drain air reservoir (TM 9-2320-211-20).

(5) Disconnect both ends of air line (fig. 537) connecting elbow (fig. 540) at base of trailer hose and cable supports to tee (fig. 537) at truck-frame side rails. Remove clips securing air lines to crane body, and remove lines,

(6) Remove trailer coupling receptacle from bracket attached to front outrigger frame tube. (Refer to TM 9-2320-211-20.)

(7) Remove trailer coupling receptacle at base of right trailer hose and cable support. (Refer to TM 9-2320-211-20.)

(8) Disconnect five bayonet-type taillight cable connectors, three at left rear corner of vehicle and two at right rear corner.

(9) Remove four cap screws and safety nuts securing rear of crane body (fig. 537) to brackets, two on each side of vehicle, bolted to frame side rails.

(10) Remove six cap screws and lockwashers, located under fifth wheel approach plates (fig. 541) three on each side, securing front of crane body to truck-frame side rails.

Figure 540. Front view of left trailer hose and cable support M246

(11) Attach a chain sling and overhead hoisting equipment to crane body, and remove body from vehicle.

b. Installation.

(1) Using a chain sling and overhead hoisting equipment, lift crane body into position on truck-frame side rails, and aline mounting holes.

(2) Install six cap screws and lockwashers under fifth wheel approach plates (fig. 541) in holes in crane-body side rails and truck-frame side rails. Tighten cap screws.

(3) Install four cap screws and safety nuts through holes in rear of crane body (fig. 537) and brackets bolted to truck-frame side rails. Tighten cap screws and nuts.

(4) Connect five bayonet-type taillight cable connectors, three at left rear corner of vehicle and two at right rear corner.

(5) Install trailer coupling receptacle at base of right trailer hose and cable support. (Refer to TM 9-2320-211-20.)

(6) Install trailer coupling receptacle at bracket attached to front outrigger frame tube. (Refer to TM 9-2320-211-20.)

(7) Position air lines (fig. 537) on left and right sides of crane body, and secure to body with clips. Connect both lines to elbow (fig. 540) at base of trailer hose and cable supports and to tee (fig. 537) at truck-frame side rails.

(8) Install hydraulic pump and relief valve assembly (par. 363).

(9) Install fifth wheel. (Refer to TM 9-2320-211-20.)

(10) Install base plate and pivot post assembly (par. 364).

375. Floodlights, Cables, and Switches

a. Floodlights.

(1) Lamp-unit replacement. (Refer to TM 9-2320-211-20.)

(2) Floodlight switch removal. (Refer to TM 9-2320-211-20.)

(3) Floodlight switch installation. (Refer to TM 9-2320-211-20.)

(4) Floodlight removal. (Refer to TM 9-2320-211-20.)

(5) Floodlight installation. (Refer to TM 9-2320-211-20.)

b. Floodlight Cables.

(1) Removal. Refer to TM 9-2320-211-20.

(2) Installation. Refer to TM 9-2320-211-20.

c. Floodlight Switch (at Instrument Panel).

(1) Removal. Refer to TM 9-2320-211-20.

(2) Installation. Refer to TM 9-2320-211-20.

376. Hydraulic System

a. Draining. Refer to paragraph 324a.

b. Filling. Refer to LO 9-2320-211-12.

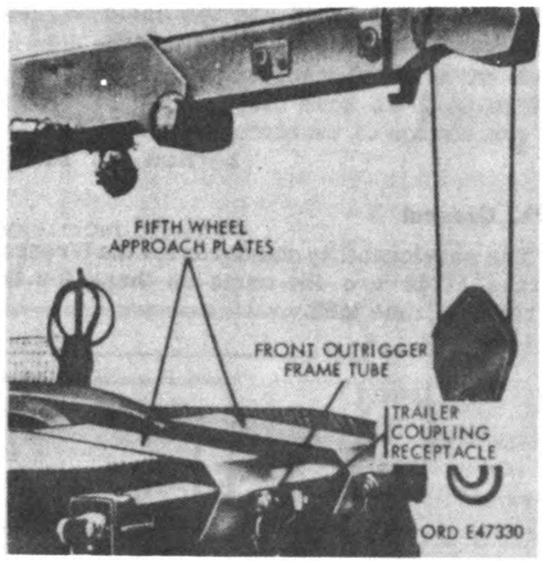


Figure 541. Front view of right front corner of crane boey

Section IV. REPAIR

377. Hydraulic Pump and Relief Valve Assembly

Refer to paragraph 344 for repair procedures.

378. Base Plate and Pivot Post Assembly

Refer to paragraph 335 for repair procedures.

379. Swing Motor and Drive Gearcase

Refer to paragraph 338.

380. Swivel Valve

Refer to paragraph 334.

381. Boom and Shipper Assembly

Refer to paragraph 332.

382. Boom Lift Cylinder

Refer to paragraph 333.

383. Boom Crowd Cylinder

Refer to paragraph 332.

384. Boom Hoist Hydraulic Oil Motor and Cable Drum Assembly

Refer to paragraph 330.

385. Control Valve Bank

Refer to paragraph 336.

386. Hydraulic Lines and Fittings

Refer to paragraph 347.

387. Hydraulic Reservoir and Equipment Box

Refer to paragraph 340.

388. Crane Body

Refer to paragraph 339.

Section V. TESTS AND ADJUSTMENTS

389. General

Tests and adjustments required for the Wrecker Crane M246 are the same as those required for the Wrecker Crane M62.

390. Tests and Adjustments

Refer to Chapter 22 Section V for complete and detailed instructions.

Section VI. SERVICEABILITY STANDARDS

391. General

The serviceability standards for the Wrecker Crane M246 are the same as those for the Wrecker Crane M62.

392. Serviceability Standards

Refer to paragraph 357 for complete serviceability standards.

CHAPTER 24

WRECKER CRANE M543, M543A2

Section I. DESCRIPTION AND DATA

393. Description

a. General. This chapter is written specifically for the wrecker crane, rear mounted winch, and wrecker crane power train for the 5-ton, 6 x 6 medium wrecker truck M543, M543A2 (figs. 18 and 19). This wrecker equipment is mounted on a six-wheeled drive truck and the hydraulic system is powered by the truck engine. Refer to TM 9-2320-211-20 for detailed description of truck chassis.

b. Wrecker Crane. The wrecker crane consists of that part of the wrecker unit which is mounted above the truck chassis with the exception of the rear mounted winch. The various functions of the wrecker crane are dependent on all of the hydraulic and mechanical units which are built into the crane. Figure 542 is a schematic diagram of the complete hydraulic system. The power for the wrecker crane is supplied by the truck power plant through a bevel gearbox hydraulic pump. This pump forces fluid under pressure to each of the hydraulic actuated units. The control of the various functions is in the control valve bank. From here the fluid is directed under high pressure to operate any of

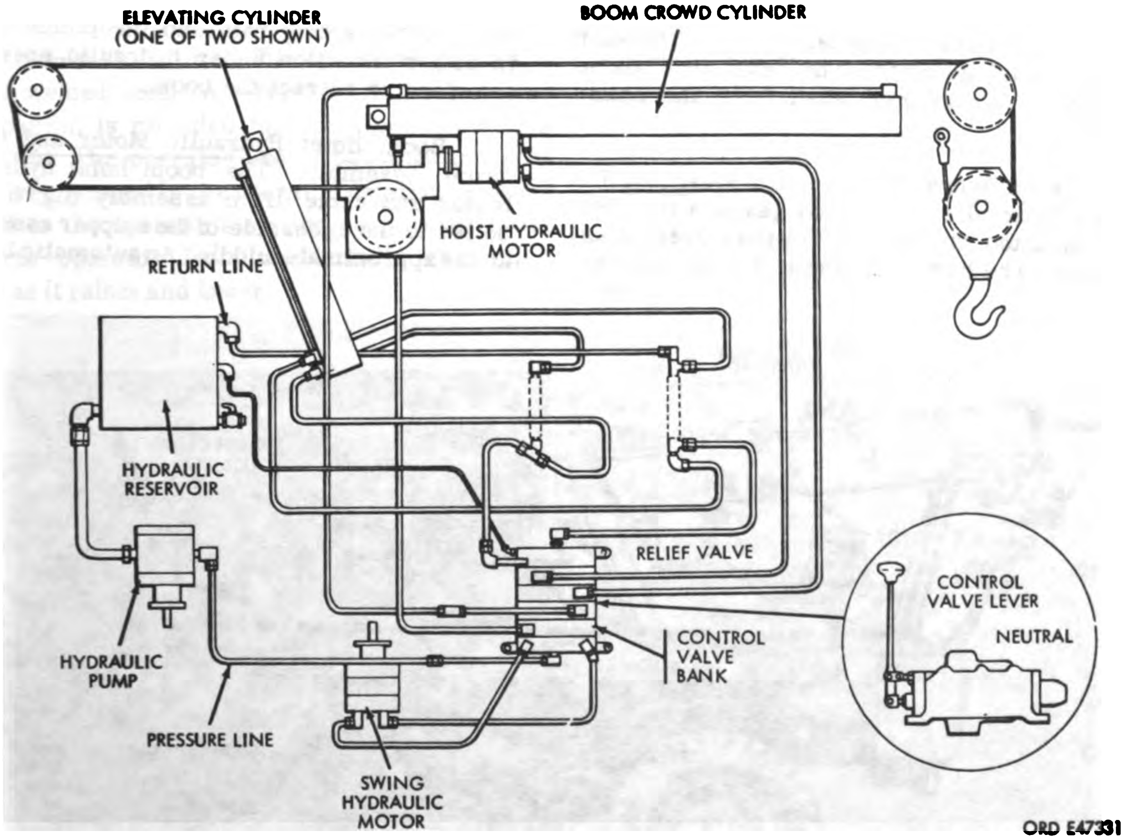


Figure 542. Schematic diagram of hydraulic system

the following: the elevating cylinders for raising or lowering the boom, the boom crowd cylinder for extending or retracting the boom, the swing motor for revolving the crane, and the hoist motor for winding and unwinding the hoist cable. A special cone-type worm and drive gear transmits the power for turning the hoist drum and revolving the crane. The complete crane can be replaced as a single unit provided that hoisting equipment having a capacity of approximately 8000 pounds is available. The illustrations, replacement, and repair instructions contained in this section refer to the individual units and assemblies comprising the crane. Refer to paragraph 294 o through s, for description of clutch control valve, rotochamber, power-divider assembly, power divider controls and rear winch assembly.

c. Hydraulic Pump and Bevel Gearbox. The gear-type hydraulic pump (fig. 547) is bolted to the hydraulic pump adapter mounted on the turntable assembly and is driven by the bevel gearbox mounted below the truck body. The hydraulic pump shaft is driven by a splined flexible coupling connected to the output shaft of the bevel gearbox. The bevel gearbox is driven by a universal shaft from the power divider.

d. Swing Hydraulic Motor and Gearbox. The swing hydraulic motor and gearbox (fig. 548) are mounted on the rear of the turntable assembly. The hydraulic motor drives the gearbox pinion which engages and drives against the bull gear bolted to the turntable. The swing motor has a 57 gallon-per-minute capacity.

e. Boom Assembly. The boom assembly (fig. 543) consists of the inner boom and outer boom which are telescoping tubular steel members having a rectangular shaped cross section, held together by the boom crowd cylinder. The rear end of the outer boom is pivoted on a pin which permits raising and lowering the front end of the boom assembly.

f. Boom Elevating Cylinders. The boom elevating cylinders (fig. 543) are vertically mounted on each side of the boom. These are single-acting types of cylinders whose pistons are extended by hydraulic pressure to elevate the boom. The pistons are retracted by the weight of the boom when the pressure is released.

g. Boom Crowd Cylinder. The boom crowd cylinder (fig. 543) is mounted horizontally inside the boom and shipper assembly. This is a double-acting ram and the piston works in either direction under hydraulic pressure to extend or retract the boom.

h. Boom Hoist Hydraulic Motor and Cable Drum Assembly. The boom hoist hydraulic motor and cable drum assembly (fig. 543) is bolted to the underside of the shipper assembly at the approximate middle. An automatic brake,

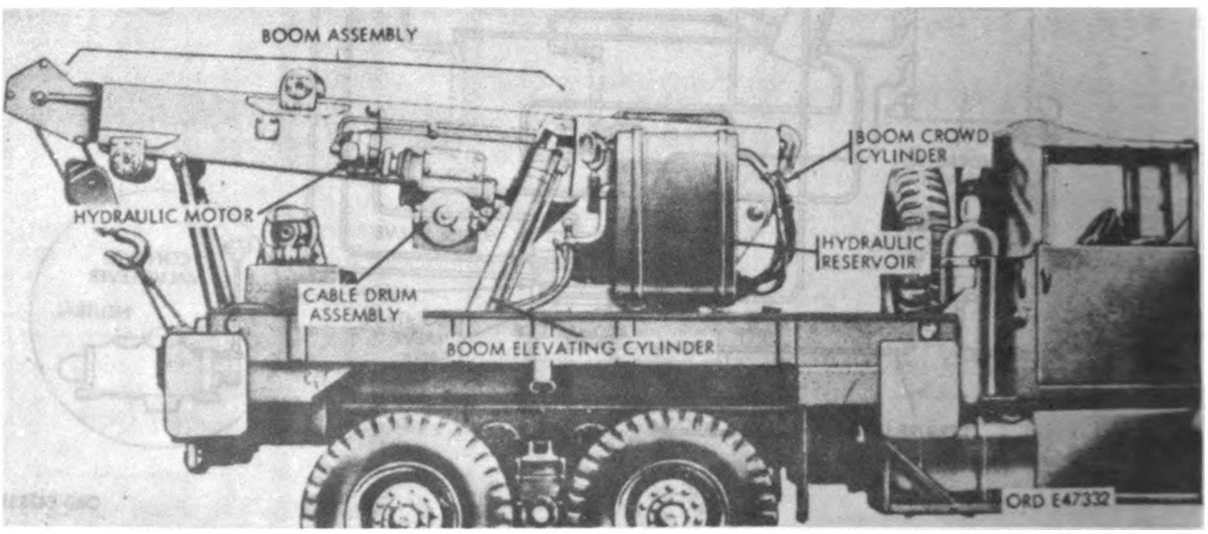


Figure 543. Crane and body assembly

which is attached to the rear end of the drive (worm gear) shaft of the cable drum assembly sustains the hoist load whenever the delivery of power to the drive shaft is interrupted. The hoist hydraulic motor has a 42 gallon-per-minute capacity.

i. Control Valve Bank Assembly. The control valve bank assembly (fig. 544) is bolted to a shelf at the front of the operator's station. This assembly consists of four spring-centered valve spool sections with an inlet body at one end and an outlet body with an adjustable relief valve at the other end. Each spring-centered valve spool section is actuated by a control lever. Hydraulic oil flows from the pressure inlet of one section to the hydraulic cylinder of motor to be operated, and returns to the section through the discharge port to the pressure inlet of the next section.

j. Hydraulic Reservoir. The hydraulic reservoir (fig. 543) is attached to the turntable frame. A bayonet-type oil level gage attached to the filler cap is installed in the top of the reservoir.

k. Operator's Station. The operator's station is of all welded steel construction. A metal frame and paulin, is provided for operator's protection (fig. 545). The operator's seat, backrest and controls are mounted in the operator's station. A guard bolted to the operator's station next to the boom protects operator from accidentally contacting boom as it raises and lowers.

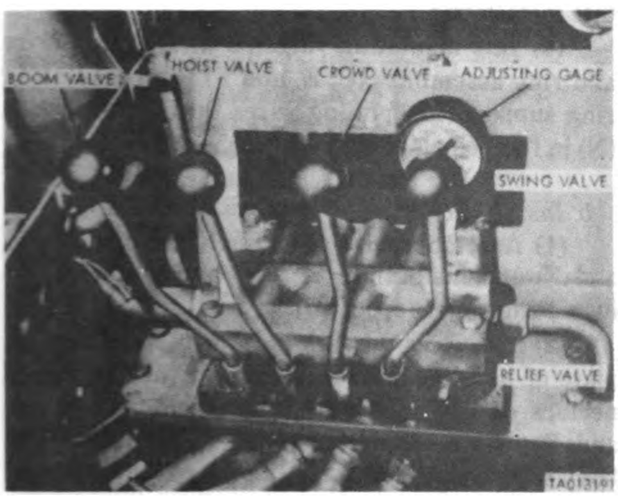


Figure 544. Control valve bank assembly, shown with cover removed and adjusting pressure gage installed.

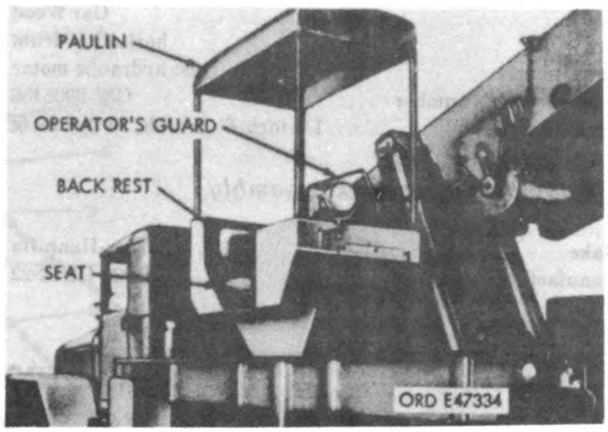


Figure 545. Operator's Station.

394. Data

a. Wrecker Crane.

Make	Gar Wood
Type	hydrualic
Manufacturer's number	GW-3005200
Capacity rating	10,000 lb

b. Clutch Control Valve.

Make	Bendix-Westinghouse
Manufacturer's number	BWE-225004

c. Roto Chamber.

Make	Bendix-Westinghouse
Manufacturer's number	BWE-224951

d. Hydraulic Pump.

Make	Gar Wood
Type	gear
Manufacturer's number	GW-2048342

e. Swing Motor.

Make	Gar Wood
Type	gear
Manufacturer's number	GW-2048340

f. Hoist Motor.

Make	Gar Wood
Type	gear
Manufacturer's number	GW-2048341

g. Hoist Winch.

Make	Gar Wood
Type	horizontal drum
Power source	hoist hydraulic motor
Manufacturer's number	GW-3005456
Cable size	1/2 inch, 6 x 9 cable, 95 ft, 5 in. lg

h. Control Valve Bank Assembly.

Make	Parker-Hannifin
Manufacturer's number	VDSP24-DDDS22

i. Elevating Cylinder.

Make	Gar Wood
Manufacturer's number	GW-2046069

j. Boom Crowd Cylinder.

Make	Gar Wood
Manufacturer's number	GW-2046068

Section II. TROUBLESHOOTING

395. General

Troubleshooting procedures and tests are used to locate the malfunction, provide information, and designate the corrective procedures to be taken. Each symptom of trouble or malfunction given for an individual unit or system helps to simplify the repair of the unit or system involved.

396. Troubleshooting Procedures

Troubleshooting procedures applicable to the Wrecker Crane M543 and M543A2 are identical to those used for the Wrecker Crane M62. Refer to paragraph 296 for the troubleshooting procedures.

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

397. Engine Governor Override Solenoid

Procedures for removal and installation of engine governor override solenoid are covered in TM 9-2320-211-20.

398. Floodlight Assembly

Procedures for removal and installation of the floodlight assembly are covered in TM 9-2320-211-20.

399. Slipring Assembly

NOTE

The key letters shown below in parentheses refer to figure 546 unless otherwise indicated.

a. Removal.

(1) Remove hydraulic pump assembly (para 401).

(2) Remove brushes from slipring assembly (TM 9-2320-211-20).

(3) Remove brush support plate with wiring from hydraulic pump support.

(4) Disconnect the three connectors of the wire and ring assemblies (C, E, and F) located under crane body at bevel gearbox (J) and tag to facilitate installation.

(5) Lift insulating rings (B and D) and wire and ring assemblies (C, E, and F) from insulating ring support (M), pulling wires through grommet (N) in flanged plate of bevel gearbox (I).

b. Installation.

(1) Assemble wire and ring assemblies (C, E, and F) and insulating rings (B and D) on to the insulating ring support (M).

(2) Pull wires through grommet (H) in flanged plate of bevel gearbox and connect the three connectors of the wire and ring assemblies (C, E, and F) to proper mating connectors under crane body at bevel gearbox.

(3) Install brush support plate with wiring to hydraulic pump support.

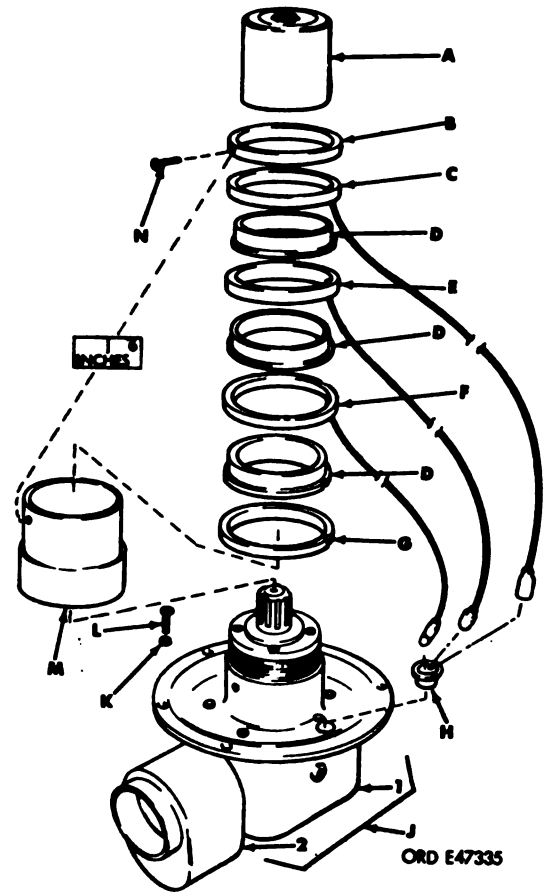


Figure 546. Slipring and insulator assembly - removal and installation

Key	Item	Key	Item
A	Coupling	J	Bevel gearbox assembly
B	Insulating retainer ring		1. Bevel gearbox
C	Wire and ring, hot		2. Seal housing
D	Insulating ring	K	Lockwasher
E	Wire and ring, hot, solenoid	L	Cap screw
F	Wire and ring, ground	M	Insulating ring
G	Insulating ring	N	Screw
H	Grommet		

Figure 546. Slipring and insulator assembly - removal and installation - legend

(4) Install brushes for slipring assembly (TM 9-2320-211-20).

(5) Install hydraulic pump assembly (par. 401).

400. Hydraulic Oil Reservoir Tank Assembly

a. Removal.

(1) Connect hose to drain valve (fig. 547, view A) and drain hydraulic oil from tank. Remove drain plug from bottom of tank to drain tank completely.

(2) Disconnect hydraulic lines at tank as shown in figure 347, views A and B.

(3) Remove bolts from tank straps (fig. 547, view B) and remove tank.

b. Installation. Reverse procedure in a above, and fill tank to proper level with hydraulic oil (LO 9-2320-211-12).

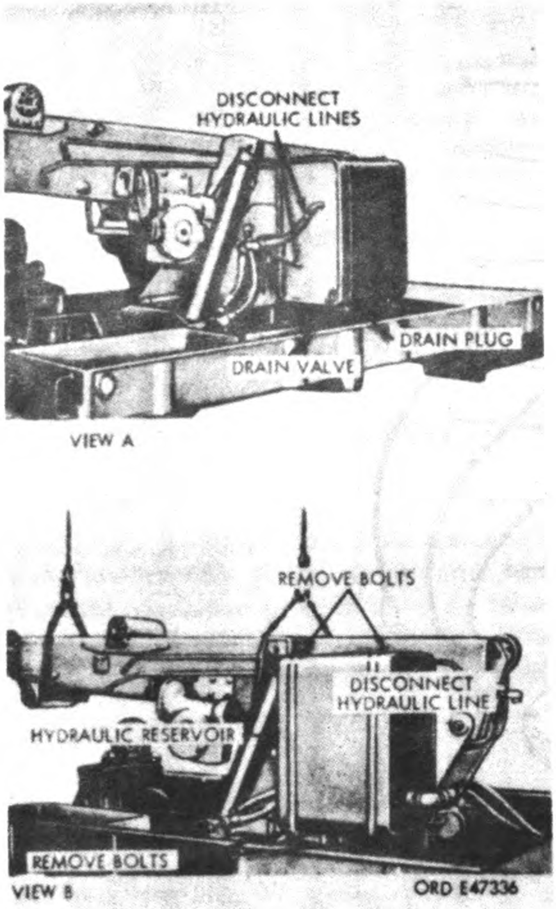


Figure 547. Hydraulic oil reservoir tank - removal and installation

Caution: Be sure plug is replaced in drain valve of tank.

401. Hydraulic Oil Pump Assembly

a. Removal.

(1) Drain hydraulic oil reservoir tank (par. 400) and disconnect hoses (par. 402).

(2) Remove four cap screws that fasten pump to pump support (fig. 548), and remove pump assembly.

(3) Remove pump coupling from bevel gearshaft.

b. Installation. Reverse procedure in a above and fill tank to proper level (LO 9-2320-211-12).

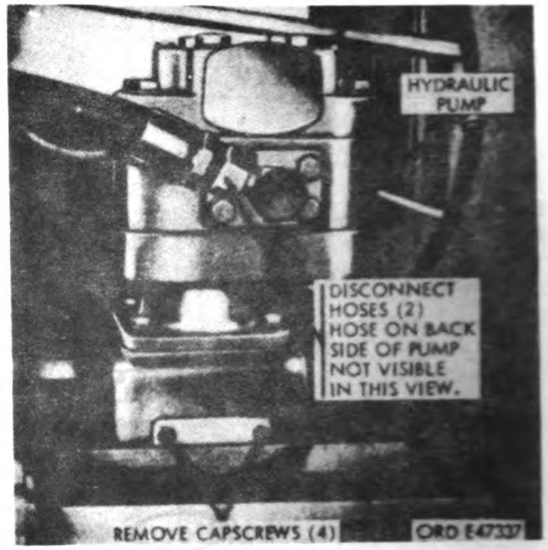


Figure 548. Hydraulic pump - removal and installation

402. Swing Hydraulic Motor and Gearbox

a. Removal.

(1) Disconnect the two hydraulic hoses to the motor as shown in figure 549. Some oil may be lost. Have a container available in which to place disconnected hoses.

(2) Remove the four cap screws that attach motor to swing gearbox as shown in figure 549 and remove motor assembly.

(3) Remove the six cap screws securing gearbox to turn table and remove gearbox.

b. Installation. Reverse procedure in a above and refill hydraulic oil tank to proper level (LO 9-2320-211-12).

403. Hoist Hydraulic Motor (Fig. 550)

a. Removal.

(1) Disconnect two hydraulic lines to the motor as shown in figure 550.

(2) Remove four cap screws attaching motor to hoist gearbox as shown in figure 550 and remove motor assembly.

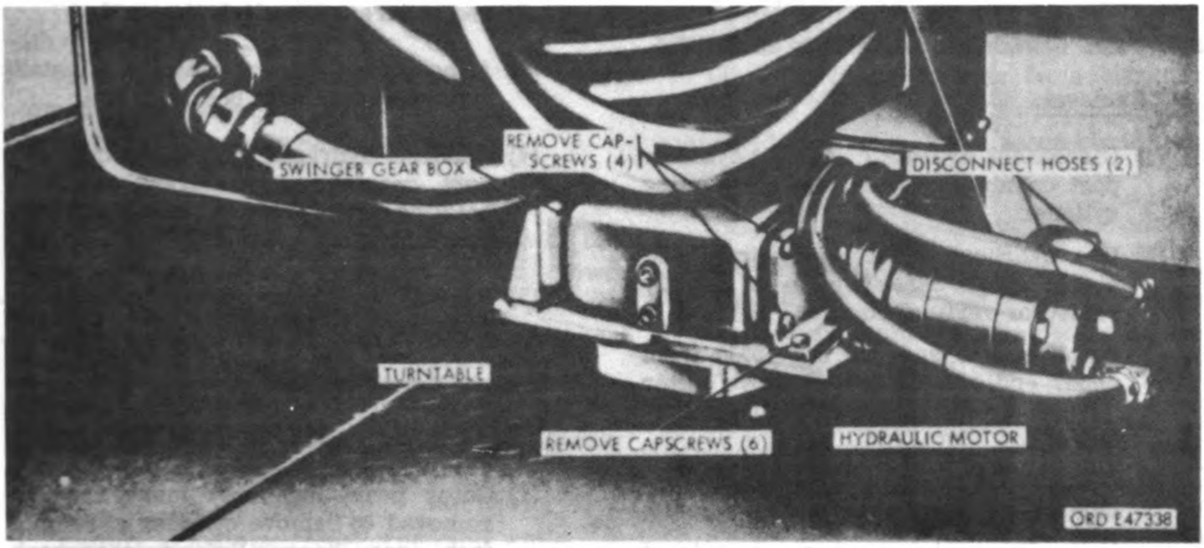


Figure 549. Removing and installing swinger hydraulic motor and gearbox

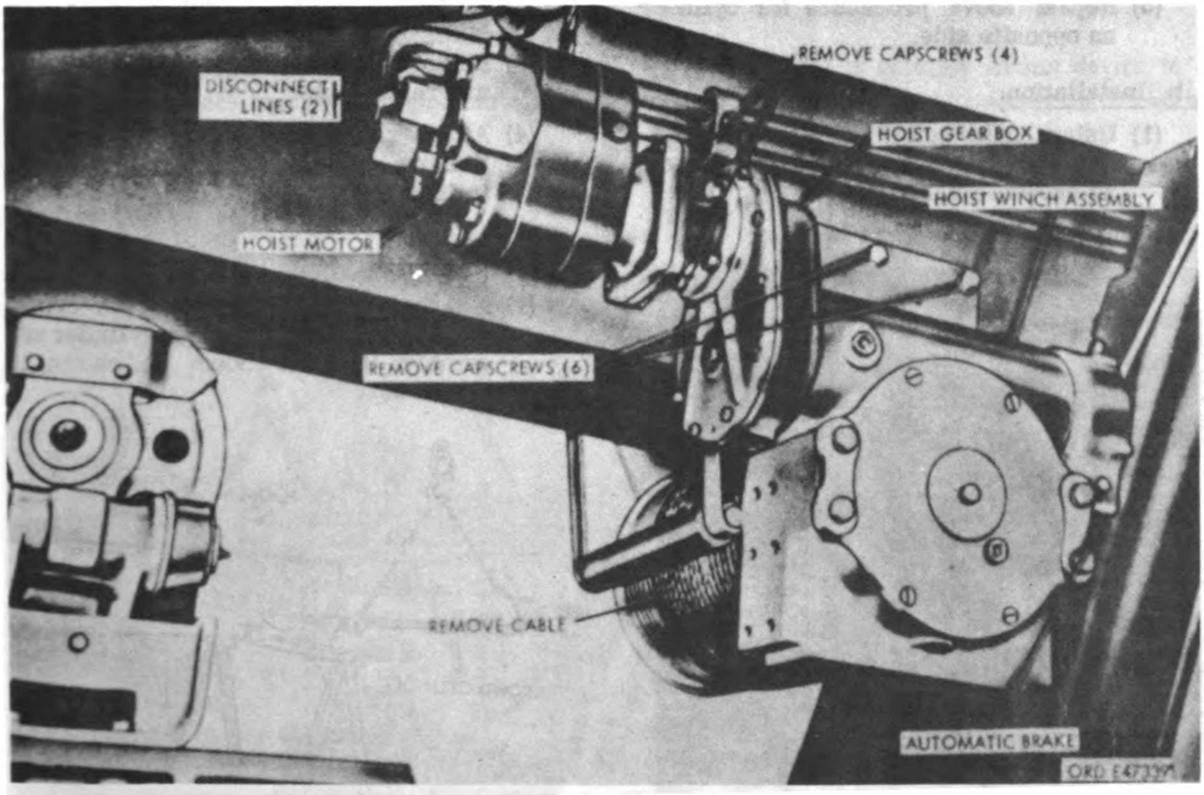


Figure 550. Removing and installing hoist hydraulic motor and hoist winch assembly

b. Installation. Reverse procedure in a above.

404. Boom Elevating Cylinder (Fig. 551)

a. Removal.

(1) Disconnect hydraulic lines at cylinder port openings near bottom of elevating cylinder.

(2) Use overhead hoisting equipment, or block boom assembly in a slightly raised or vertical position.

(3) Remove bolt and pin (fig. 551) from upper end of cylinder. Remove cotter pin and drive out lower pin from cylinder.

(4) Using chain hoist, lift elevating cylinder clear and remove from vehicle.

Note. It may be necessary to retract cylinder (force piston rod "in") slightly to provide clearance to remove cylinder.

(5) Repeat above procedure for cylinder on opposite side.

b. Installation.

(1) Using chain hoist, lift elevating cylinder and place in position on vehicle as shown in figure 551.

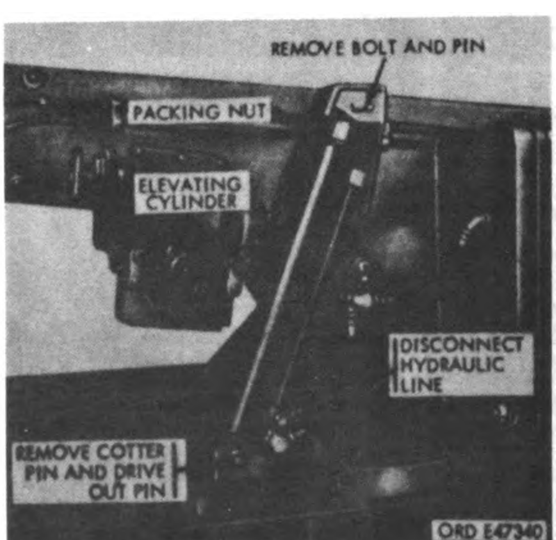


Figure 551. Boom elevating cylinder - removal and installation

(2) Aline lower holes of turn table and cylinder, install lower pin for cylinder and secure with cotter pin.

(3) Aline upper end of cylinder, install pin and secure with bolt.

(4) Connect hydraulic lines at cylinder port openings and unhook overhead hoisting equipment used to secure boom assembly.

(5) Repeat above procedure for cylinder on opposite side.

405. Boom Crowd Cylinder

a. Removal.

(1) Outer boom assembly must first be removed to remove cylinder assembly from inner boom. Refer to paragraph 406.

(2) Remove inner boom assembly from outer boom assembly. Refer to paragraph 423.

(3) Remove cotter pin from cylinder pin and remove pin.

(4) Attach a chain to support boom cylinder. Remove cylinder from boom as shown in figure

b. Installation.

(1) Attach a chain hoist to boom crowd cylinder. Lift and position cylinder assembly in inner boom as shown in figure 552.

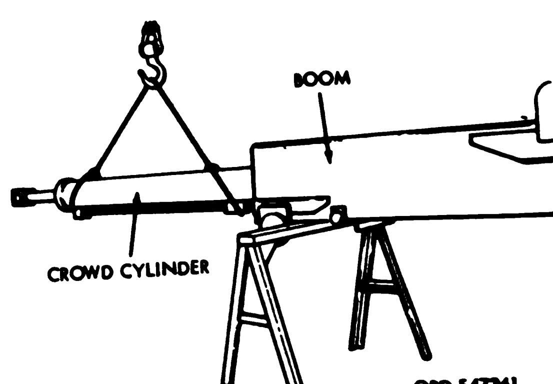


Figure 552. Removing and installing crowd cylinder in boom

(2) Install pin in end of cylinder and secure with cotter pin (fig. 552).

(3) Install inner boom assembly in outer boom. Refer to paragraph 423.

(4) Install boom assembly (par. 406).

406. Boom Assembly

a. General. The boom assembly consists of the inner boom, outer boom, boom rollers, crowd cylinder, hoist winch assembly, cable, sheaves and necessary hydraulic lines and fittings to connect and operate these components.

b. Removal (Fig. 553).

(1) Remove cable from hoist winch drum (refer to TM 9-2320-211-20).

NOTE

Failure to maintain tension on cable while drum is turning will cause the cable to become snarled on the drum and in the boom structure.

(2) Disconnect hydraulic lines to crowd cylinder and hoist winch hydraulic motor as shown in figure 553.

(3) Disconnect boom floodlight cable at connector (refer to TM 9-2320-211-20).

(4) Attach a suitable lifting device to boom assembly as shown in figure 553.

(5) Remove upper pins from elevating cylinders and remove pivot pin from foot end of boom and turntable. Boom assembly is now free to be lifted from turntable.

CAUTION

Secure inner boom to outer boom with chain or other suitable means to prevent inner boom from extending when assembly is tilted, which could cause injury to personnel.

c. Installation.

CAUTION

Secure inner boom, to outer boom with chain, or other suitable means to prevent inner boom from extending when the assembly is lifted, which could cause injury to personnel.

(1) Attach a suitable lifting device to boom assembly and lift into position on turntable as shown in figure 553.

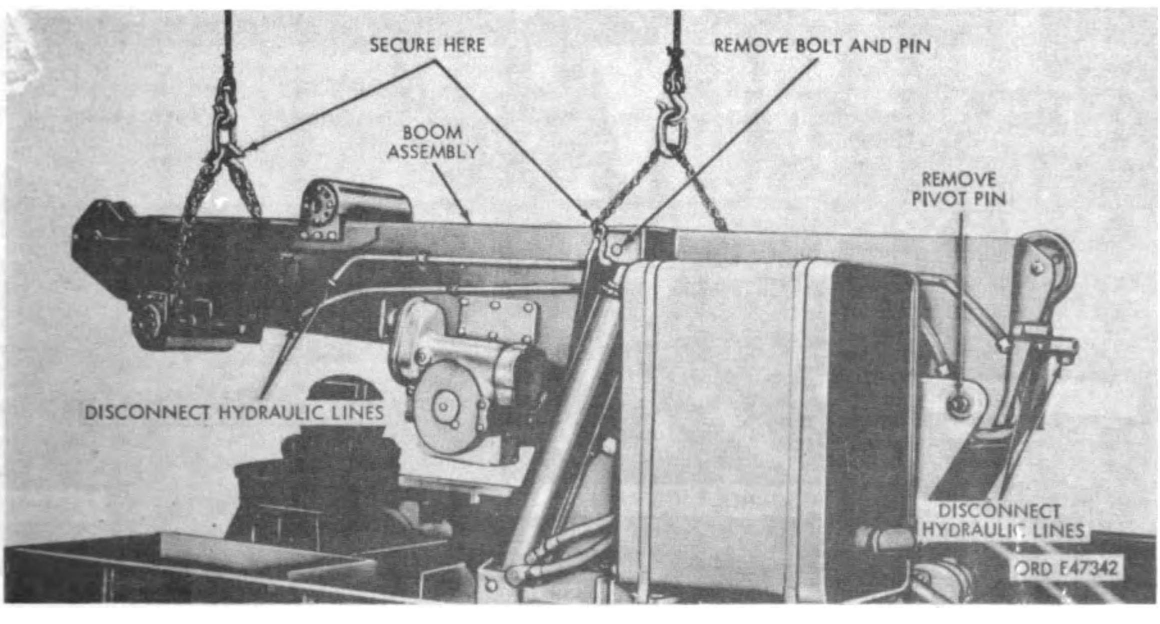


Figure 553. Removing and installing boom assembly.

(2) Position elevating cylinders and install upper pins to secure elevating cylinders and install pivot pin in foot end of boom securing it to the turntable (fig. 553).

(3) Connect boom floodlight cable to connector (refer to TM 9-2320-211-20).

(4) Connect hydraulic lines to crowd cylinder and hoist winch hydraulic motor as shown in figure 553.

(5) Install cable on hoist winch drum (refer to TM 9-2320-211-20).

407. Boom Roller Assemblies

a. General. The inner boom rolls on two roller assemblies (fig. 553) mounted on the outer boom. These assemblies are identical in design and construction.

b. Removal.

(1) Remove boom assembly (para 406).

(2) Remove inner boom (para 423).

(3) Remove the six screws securing the upper roller assembly and remove assembly (fig. 553).

(4) Remove the six screws securing the lower roller assembly and remove assembly (fig. 553).

c. Installation.

(1) Install the upper roller assembly and secure with six screws (fig. 553).

(2) Install the lower roller assembly and secure with six screws (fig. 553).

(3) Install the inner boom (para 423).

(4) Install the boom assembly (para 406).

408. Control Valve Bank Assembly

a. Removal.

(1) Disconnect all oil lines. Refer to TM 9-2320-211-20.

(2) Remove four capscrews (30, fig. 566) nuts (28), and lockwashers (27) securing control valve bank assembly (1) to gondola and remove control valve bank.

b. Installation. Reverse procedures in *a* above.

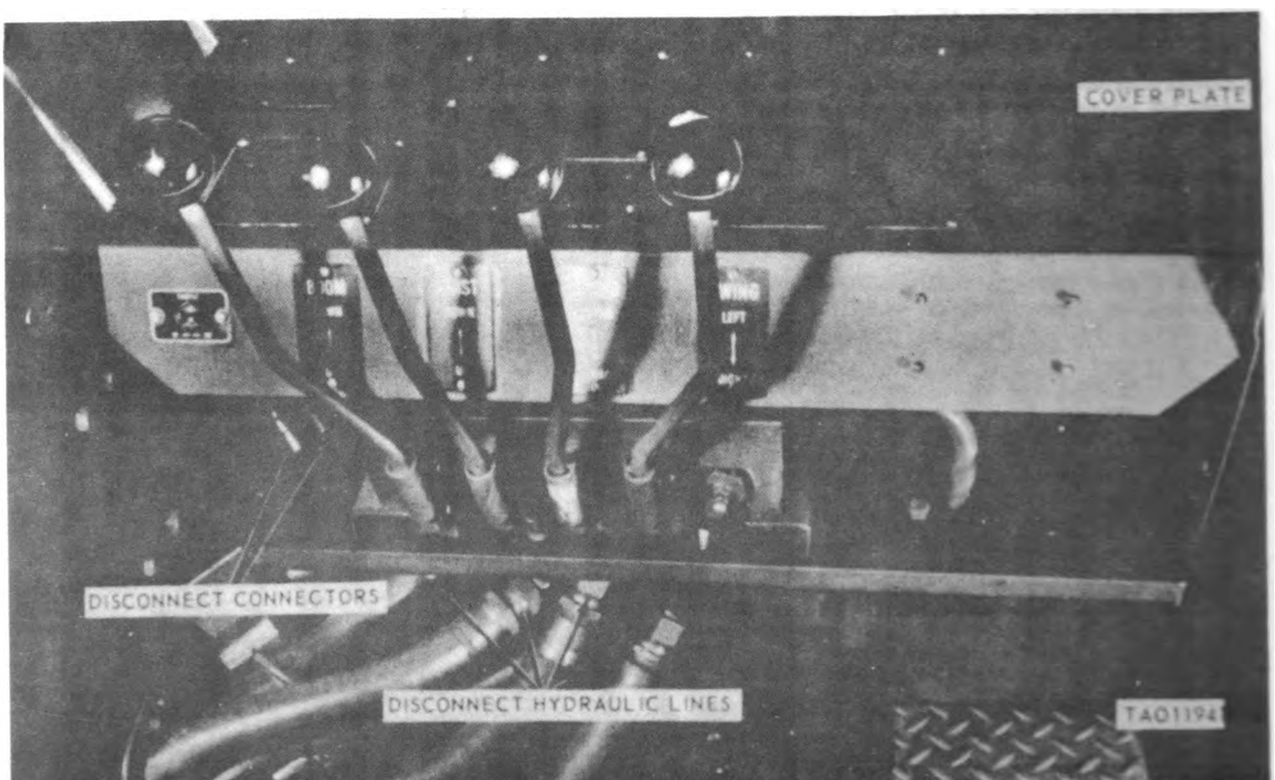


Figure 554. Control valve bank assembly (M543, M543A1, M543A2).

a. Removal.

NOTE

The key letters shown in parentheses refer to figure 567 unless otherwise indicated.

(1) Remove propeller shaft to bevel gearbox (TM 9-2320-211-20).

(2) Remove the six bolts (A), and lockwashers (B), that attach drive housing (E), and seal housing (W) assemblies to power divider and remove from under vehicle.

b. Installation. Reverse procedures in *a* above.

NOTE

To install the control valve bank, mounting brackets FSN 5340-491-0329 and FSN 5340-491-0331 must be requisitioned as a separate item. These brackets do not come with the control valve bank.

410. Bevel Gearbox

a. Removal.

NOTE

The key letters shown in parentheses refer to figure 568 unless otherwise indicated.

(1) To remove bevel gearbox assembly it is first necessary to remove the complete boom assembly (para 406) from the turntable.

(2) Remove hydraulic pump (para 401).

(3) Disconnect electrical cables to slipring assembly at connectors, located at bevel gearbox beneath truck body.

(4) Remove the six bolts (B) and lockwashers (C) and remove pump support.

(5) Remove turntable assembly (para 412).

(6) Remove propeller shaft to bevel gearbox (TM 9-2320-211-20).

(7) Provide a suitable device to lift bevel gearbox assembly and remove the six cap screws that secure bevel gearbox to crane body. Lift gearbox assembly up, and maneuver back, out of understructure, and remove from crane body.

b. Installation.

(1) Attach a suitable lifting device and lift bevel gearbox assembly into position over the mounting hole in the crane body. Slowly lower and maneuver bevel gearbox into position through the opening in the crane body and secure with the six bolts (DD, fig. 568).

(2) Install propeller shaft to bevel gearbox (TM 9-2320-211-20).

(3) Install turntable assembly (para 412).

(4) Install pump support and secure with six bolts (B) and lockwashers (C).

(5) Connect electrical cables to slipring assembly at connectors located at bevel gearbox beneath truck body.

(6) Install hydraulic pump (para 401) and install boom assembly (para 406).

411. Hoist Winch Assembly

(Fig. 550)

a. General. The hoist winch assembly consists of the speed reduction gearbox, the hoist worm gearbox with automatic brake assembly, and the winch drum.

b. Removal.

(1) Remove cable from hoist drum (TM 9-2320-211-20).

(2) Remove hoist hydraulic oil motor from gearbox (para 403).

(3) Using a suitable lifting device, secure hoist winch assembly so the six cap screws (fig. 550) may be removed from the winch side plates.

(4) Hoist winch assembly may now be removed from boom.

c. Installation. Reverse procedure in *b* above.

412. Turntable and Swing Drive

a. General. The turntable and swing drive consist of the turntable base plate with bull gear bearing, side plates, and swing gearbox as shown in figure 555.

b. Removal (Turntable Assembly).

(1) Remove boom assembly (para 406).

(2) Remove hydraulic oil reservoir tank (para 400).

(3) Remove boom elevating cylinders (para 404).

(4) Remove operator's station (para 413).

(5) Remove swing drive gearbox (para 402).

(6) Remove hydraulic pump (para 401).

(7) Remove hydraulic pump support (para 410).

(8) Remove side plates from turntable base plate as shown in figure 555.

(9) Remove socket head cap screws that attach bull gear bearing to body assembly. These cap screws are reached through hole (fig. 556) in turntable. Remove a cap screw, then turn turntable until next cap screw is accessible through hole.

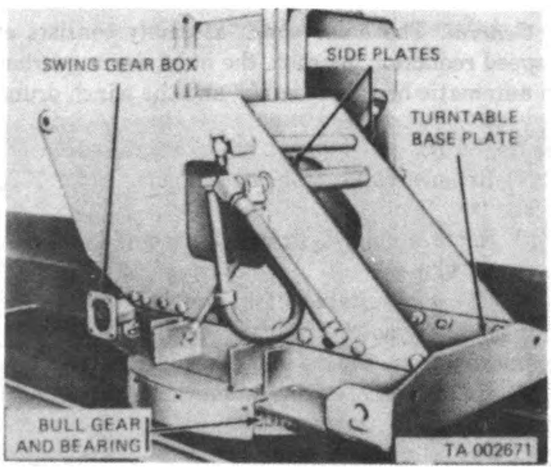


Figure 555. Turntable and swinger drive assembly.

(10) Attach overhead lifting device as shown in figure 556 and remove turntable base plate from body.

c. Installation.

(1) Attach overhead lifting device to turntable base plate assembly, and lift into position on vehicle body as shown in figure 556.

(2) Aline holes and install socket head cap screws that attach bull gear bearing to body assembly. These cap screws are installed through the hole (fig. 556) in turntable. Install a cap screw, then turn turntable until next cap screw hole is accessible through hole in turntable.

NOTE

The socket head cap screws that attach bull gear bearing to body assembly must be torqued to 170 to 180 foot pounds.

(3) Install side plates to turntable base plate as shown in figure 555.

(4) Install hydraulic pump support (para 410) and install hydraulic pump (para 401).

(5) Install swing drive gearbox (para 402).

(6) Install operator's station (para 413), the boom elevating cylinders (para 404).

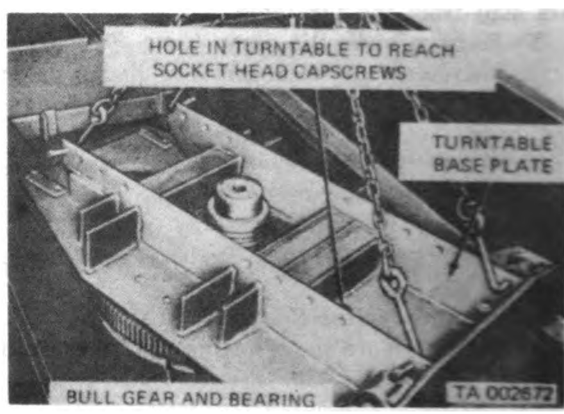


Figure 556. Removing and installing turntable base plate assembly.

and the hydraulic oil reservoir tank (par. 400).

(7) Install boom assembly (par. 406).

413. Operator's Station

a. Removal.

(1) Remove control valve bank assembly (par. 408).

(2) Remove floodlight assembly (TM 9-2320-211-20).

(3) Remove guard (fig. 545) by raising it up and removing from sockets mounted to operator's station.

(4) Move hydraulic lines clear for removal of operator's station.

(5) Disconnect solenoid override switch (TM 9-2320-211-20).

(6) Secure a suitable lifting device to the operator's station and take up slack so it will not shift.

(7) Remove cap screws anchoring operator's station to turntable side plates and remove operator's station.

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

Section IV. REPAIR OF MAJOR COMPONENTS

414. Engine Governor Override Solenoid

Repair consists of replacement of a damaged or unsatisfactory solenoid unit.

415. Floodlight Assembly

a. Repair. Repair of the floodlight assembly consists only of replacement of a damaged or unsatisfactory unit. For switch replacement refer to TM 9-2320-211-20.

b. Cleaning. Clean light body and door assembly with mineral spirits paint thinner or dry-cleaning solvent. Clean electrical parts with soap and water. Dry all parts thoroughly.

c. Inspection. Inspect light body and door assembly for cracks or evidence of leakage. Replace body or door if damaged. Check to be sure sockets, cables, and connectors are in good condition. Check switch assembly for damaged or unsatisfactory condition. Replace damaged or unsatisfactory parts where necessary.

416. Hydraulic Oil Reservoir Tank

The hydraulic oil reservoir requires little or no disassembly; only cleaning, inspection, and repair as follows:

a. Cleaning.

(1) Flush the tank several times with an approved cleaning solvent. Hot water or steam under pressure will loosen excess scale or sediment. Make sure all scale sediment is drained from tank.

(2) Clean all parts except gaskets in mineral spirits paint thinner or dry-cleaning solvent. Dry all parts thoroughly.

b. Inspection.

(1) To test for leaks, plug all outlets except the filler opening.

(2) Insert an airhose in the filler neck and cover the opening.

(3) Submerge the tank in water and apply 5-psi air pressure through the filler opening. Leaks will be indicated by bubbles.

(4) Fill the tank with water and weld or braze any leaks.

Warning: Never repair a defective or damaged tank near an open flame. Be sure tank is filled with water before welding or brazing any leaks.

(5) Inspect all washers, screws, and nuts for damage. Replace damaged parts.

(6) Fill tank to proper level after installation (refer to LO 9-2320-211-12).

417. Hydraulic Oil Pump

a. Disassembly (Fig. 557).

(1) Remove the eight bolts (A and Z) and flat washers (B) holding rear cover

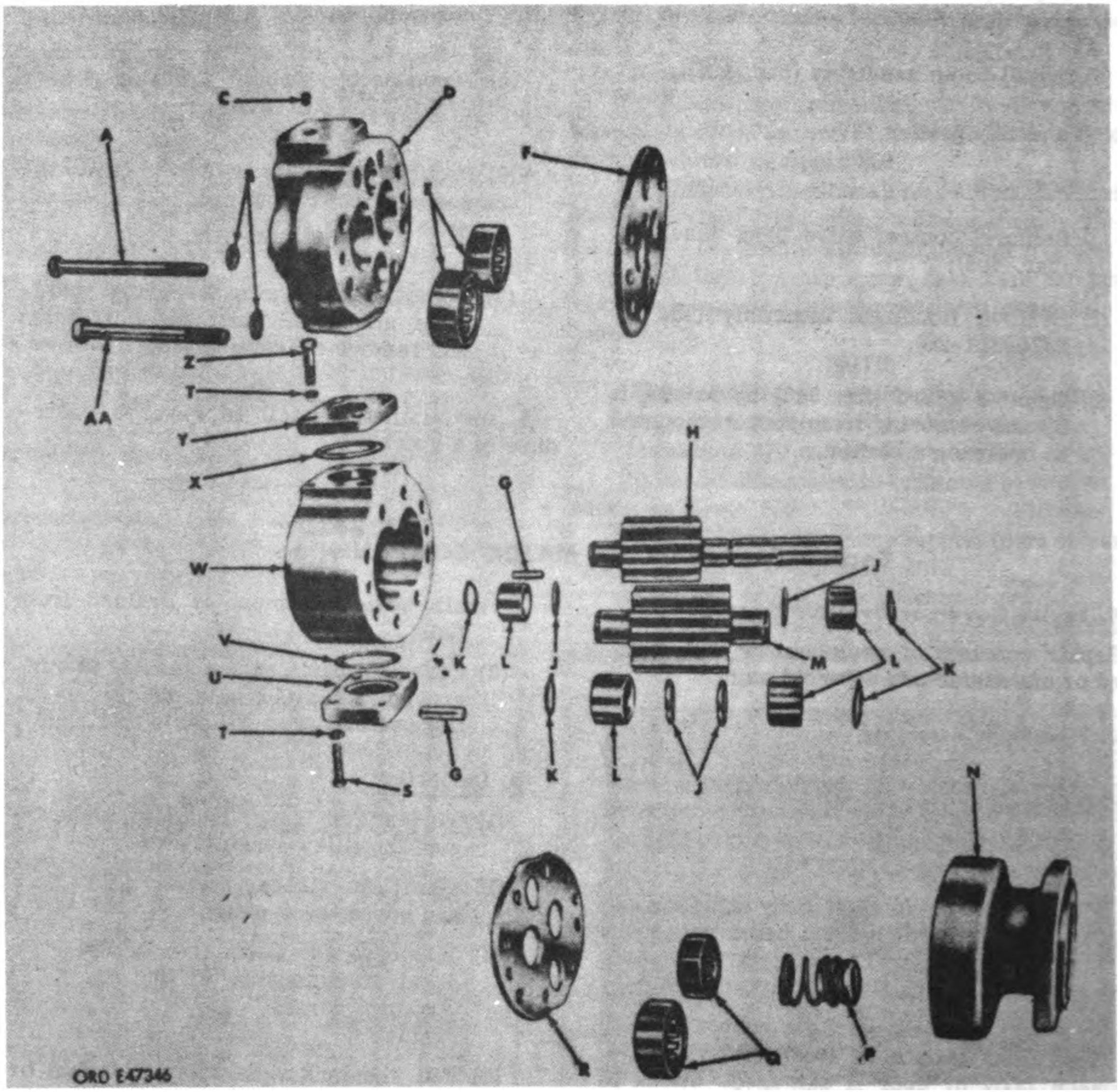


Figure 557. Hydraulic oil pump assembly - exploded view

Key	Item	Key	Item	Key	Item
A	Bolt	K	Snap ring	T	Lockwasher
B	Washer	L	Bearing inner race	U	Adapter
C	Pipe plug	M	Gearshaft, driven	V	O-ring
D	Rear cover	N	Front cover	W	Body
E	Bearing, LH	P	Seal	X	O-ring
F	Wear plate, LH	Q	Bearing, RH	Y	Adapter
G	Dowel pin	R	Wear plate, RH	Z	Bolt
H	Gear shaft, drive	S	Bolt	AA	Bolt
J	Spacer				

Figure 557. Hydraulic oil pump assembly - exploded view - legend

(D) and front cover (N) to pump body (W). The covers (D and N) are now held on by dowel pins (G).

(2) Use a small block of wood and tap alternately against the top, bottom and sides of the inner edges of the front cover (N). This will allow removal of the cover without injuring the alloy metal wear plate (R).

(3) Use a small block of wood and tap right wear plate (R) from body. Remove drive and driven shaft right-hand bearings (Q) and seal (P) from cover (N). It is not necessary to remove dowel pins (G) from body (W), unless inspection (d below) indicates replacement is necessary.

(4) Remove drive gearshaft (H) and driven-gearshaft (M) assemblies from body (W). Remove snap rings (K) and remove inner bearing races (L) and spacers (J) from gearshafts (H and M).

(5) Tap rear cover (D) and left wear plate (F) loose from pump body (W), using a small block of wood. Remove drive and driven shaft, left-hand bearings (E), and pipe plug (C) from cover (D).

(6) Remove bolts (S and Z), washers (T), and remove adapters (U and Y) and O-rings (V and X) from body (W).

b. Cleaning, Inspection and Repair.

(1) Cleaning. Wash all parts, using dry-cleaning solvent or mineral spirits paint thinner. Dry the parts except the bearings, using dry compressed air.

Caution: Bearings must not be dried or spun with compressed air.

(2) Inspection and repair.

(a) Inspect pump covers and pump body mating surfaces for raised metal caused by dents or scratches. Bores in covers and body must be clean and smooth. Replace body and covers if defective. Inspect dowel pins in body for damage, and replace if necessary.

(b) Check surfaces of gear teeth carefully and replace gearshafts showing surface cracks.

(c) Inspect drive shaft and driven shaft for scratches or raised metal. Remove raised metal with fine mill file. Replace gearshafts, if necessary.

(d) Inspect faces of wear plates for nicks, burs, dents or distortion. Replace defective or excessively worn parts. If wear plates show wear exceeding 0.003 inch, they must be replaced.

(e) Turn bearings slowly to determine if any roughness is present in bearings. Inspect inside and outside diameter of bearings for scoring or pitting. Replace defective bearings.

(f) Inspect drive shaft oil seal assembly for damaged seat or spring. Replace seals, if defective in any way.

c. Assembly (Fig. 557).

(1) Install pipe plug (C) in rear cover (D).

Note. Dip all O-rings and seals in clean hydraulic oil before assembling.

(2) Install O-rings (V and X), adapters (U and Y), with bolts (S and Z) and washers (T) to body (W). Install dowel pins (G) in body (W) if they were removed.

(3) Install spacers (J), inner bearing races (L) on drive gearshaft (H) and on driven gearshaft (M) and secure with snap rings (K).

(4) Install drive gearshaft (H) and driven gearshaft (M) in pump body (W). Position wear plates (F and R) on dowel pins in body with relief recesses in plates away from covers.

Note. Relief recesses in wear plates must be directly opposed. The bronze sides of the plates must face in, toward the gears, when the assembly is completed.

(5) Position seal assembly (P) in drive shaft bore of front cover (N) and install right-hand bearings (Q).

(6) Install rear cover (D), on body (W), with body notch toward rear cover, mating inner race ends of gearshafts with bearings in cover.

(7) Install front cover (N) on body (W), inserting long end of drive gearshaft (H) through seal (P) and mating inner race ends of gearshafts with bearings in cover. Secure covers with the eight bolts (A and Z) and flat washers (B). Tighten bolts alternately.

418. Sliprings

a. Disassembly. There is no disassembly of the sliprings.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean sliprings and insulation rings with mineral spirits paint thinner or dry-cleaning solvent. If necessary to clean electrical parts, use soap and water. Dry parts thoroughly.

(2) Inspection. Inspect sliprings and insulator rings for cracks and evidence of electrical leakage and shorting between slipring. Check sliprings where brushes make contact for glazed or worn surface that may cause malfunction. Check soldered connection of cables to sliprings and check cable connectors.

(3) Repair. If individual cables are broken or unsoldered to slipring, and slipring is in good condition, repair by soldering in correct position to slipring. Replace any damaged or unsatisfactory parts where necessary.

419. Swing Hydraulic Oil Motor

a. General. The hydraulic motor used to power the swing gearbox and the hydraulic motor on the hoist winch are identical in design and construction. Maintenance procedures are the same for each motor.

b. Disassembly (Fig. 558).

(1) Remove the eight bolts (S and T) and flat washers (R) holding front cover (A) and rear cover (Q) to motor body (M). The covers (A and Q) are now held on by dowel pins (B).

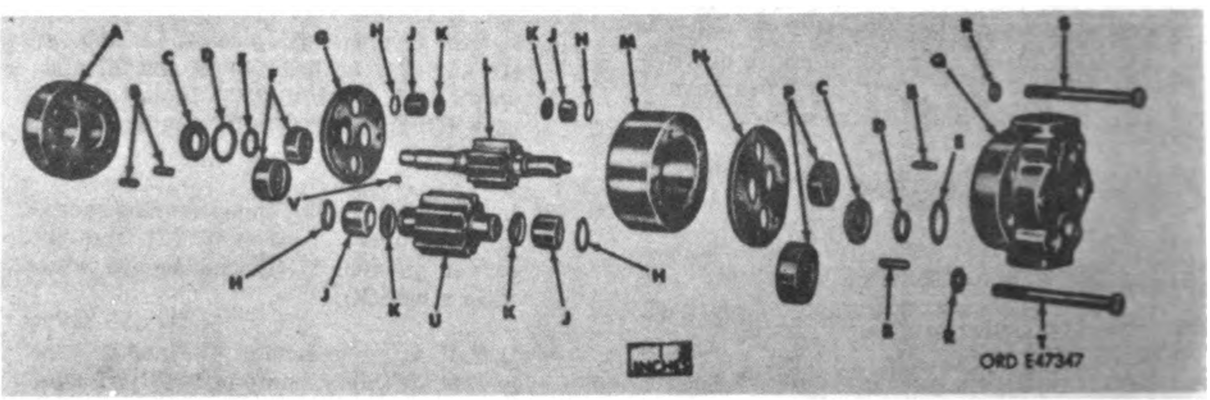


Figure 558. Hydraulic motor assembly - exploded view

Key	Item	Key	Item
A	Front cover	L	Gearshaft, drive
B	Dowel pin	M	Body
C	Oil seal adapter	N	Wear plate, RH
D	O-ring, inner	P	Bearing, RH
E	O-ring, outer	Q	Rear cover
F	Bearing, LH	R	Washer
G	Wear plate, LH	S	Bolt
H	Snap ring	T	Bolt
J	Bearing, inner race	U	Gearshaft, driven
K	Spacer	V	Key

Figure 558. Hydraulic motor assembly - exploded view - legend

(2) Use a small block of wood and tap alternately against the top, bottom and sides of the inner edges of the front cover (A). This will allow removal of the cover without injuring the alloy metal wear plate (G).

(3) Use a small block of wood and tap left wear plate (G) from body. Remove drive and driven shaft left hand bearings (F) and oil seal adapter (C) with O-rings (D and E) from cover (A). It is not necessary to remove dowel pins (B) from body (M), unless inspection ((b)(2) below) indicates replacement is necessary.

(4) Remove drive gearshaft (L) and driven gearshaft (U) assemblies from body (M). Remove snap rings (H) and remove inner bearing races (J) and spacers (K) from gearshafts (L and U).

(5) Tap rear cover (Q) and right wear plate (N) loose from motor body (M), using a small block of wood. Remove drive and driven shaft right-hand bearings (P) and oil seal adapter (C) with O-rings (D and E) from rear cover (Q).

c. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent. Dry thoroughly before inspection or installing. Apply a coat of light engine oil to highly polished surfaces to prevent rust.

(2) Inspection.

(a) Motor body and covers. Inspect motor body and cover mating surfaces for raised metal caused by dents or scratches. Bores in body and covers must be clean and smooth. Replace body and covers if defective. Inspect dowel pins in covers for damage and replace if necessary.

(b) Drive and driven gearshafts. Check surfaces of gear teeth carefully and replace gearshafts showing surface cracks. Inspect shafts for scratches or raised metal. Remove raised metal with a fine mill file. Replace defective gearshafts.

(c) Wear plates. Inspect faces of wear plates for nicks, burs, dents, or distortion. Wear plates showing wear exceeding 0.003 inch must be replaced. Replace defective parts.

(d) Drive and driven shaft ball bearings. Turn bearings slowly to determine if any roughness is present in bearings. Inspect inside and outside diameter of bearings for scoring or pitting. Replace defective bearings.

(e) Drive shaft oil seal assemblies. Inspect drive shaft oil-seal assemblies for damaged O-rings. Replace O-rings, if defective in any way.

d. Assembly (Fig. 558).

(1) Install oil seal adapter (C) with O-rings (D and E) in drive shaft bore of front cover (A). Install bearings (F) in cover.

(2) Install the other oil seal adapter (C) with O-rings (D and E) in bore of rear cover (Q) and install bearings (P).

Note. Dip all O-rings and seal rings in clean hydraulic oil before assembling.

(3) Install dowel pins (B) in motor body (M), if they were removed. Install spacers (K), inner bearing races (J) on drive gearshaft (L) and driven gearshaft (U) and secure with snap rings (H).

(4) Install drive gearshaft (L) and driven gearshaft (U) assemblies in motor body (M). Position wear plates (G and N) on dowel pins in body with relief recesses in plates away from covers.

Note. Relief recesses in wear plates must be directly opposed and the bronze side of the plate face in, toward the gears, when the assembly is completed.

(5) Install rear cover (Q) on body (M) with body notch toward rear cover, mating inner race ends of gearshafts with bearings in cover.

(6) Install front cover (A), on body (M) inserting long end of drive gearshaft

(L) through seal (C) and mating inner race ends of gearshafts with bearings in cover. Secure covers with the eight bolts (S and T) and flat washers (R). Tighten bolts alternately.

420. Boom Hoist Hydraulic Motor

Refer to paragraph 419 for repair of the boom hoist hydraulic motor.

421. Boom Elevating Cylinder

a. General. It will not be necessary to disassemble the boom elevating cylinder unless it is known to be defective. The cylinder packing may be replaced without complete disassembly by following procedures in b below. If further disassembly is required for replacement of parts, follow procedures outlined in c below.

b. Boom Elevating Cylinder Packing.

(1) Removal (Fig. 551).

(a) Raise boom assembly to a slightly vertical position and block, or secure with overhead hoist in this position.

(b) Relieve all hydraulic pressure from elevating cylinders by actuating control lever.

(c) Loosen packing nut and slide back on piston rod to expose packing.

(d) With screwdriver or similar tool, dig out all old packing and remove from cylinder.

Note. Exercise care so as not to scratch or mar piston rod's polished surface.

(2) Installation.

(a) Coat new packing set with grease and install in cylinder head around piston rod.

Note. Packing comes in sets. Each ring is split to allow easy installation. Be sure to stagger joints around piston rod to assure a tight seal.

(b) Be sure packing set is firmly seated, then slide packing nut down and tighten. Tighten to 1/8-inch clearance between packing nut and cylinder head. This clearance provides for further tightening or adjusting after use.

(c) Remove blocking or hoist equipment used to hold boom in upward position.

c. Disassembly (Fig. 559).

(1) Loosen and unscrew cylinder head (B1, view A) from cylinder body (A), using spanner wrench 5120-713-2624.

(2) Pull out piston-rod assembly (B) from cylinder body (A), view (A).

(3) Remove lockwire (D7, view B) from piston rod nut (D8) and remove nut.

(4) Remove washer (D6), retainer (D5), U-cup (D4), O-ring (D1) and piston (D3) from piston rod (B).

(5) Slide cylinder head and packing assembly (C) off piston rod, being careful not to damage wiper strip (C1) when passing over threads at end of piston rod.

(6) Remove packing nut (C2), packing (C3), O-ring (C6) and piston rod bushing (C4) from cylinder head (C5).

(7) Remove piston ring (D2) from piston (D3).

d. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean all metal parts with dry-cleaning solvent or mineral spirits paint thinner. Thoroughly dry before inspection or installing. Apply a coat of light engine oil to highly polished surfaces to prevent rust.

(2) Inspection. Inspect all parts and replace any found to be damaged. It is always advisable to install new O-rings when repairing cylinder.

(3) Repair. Repair is limited to replacement of parts and packing except for removing scratches, nicks, or burs from piston rod and piston with a fine mill file.

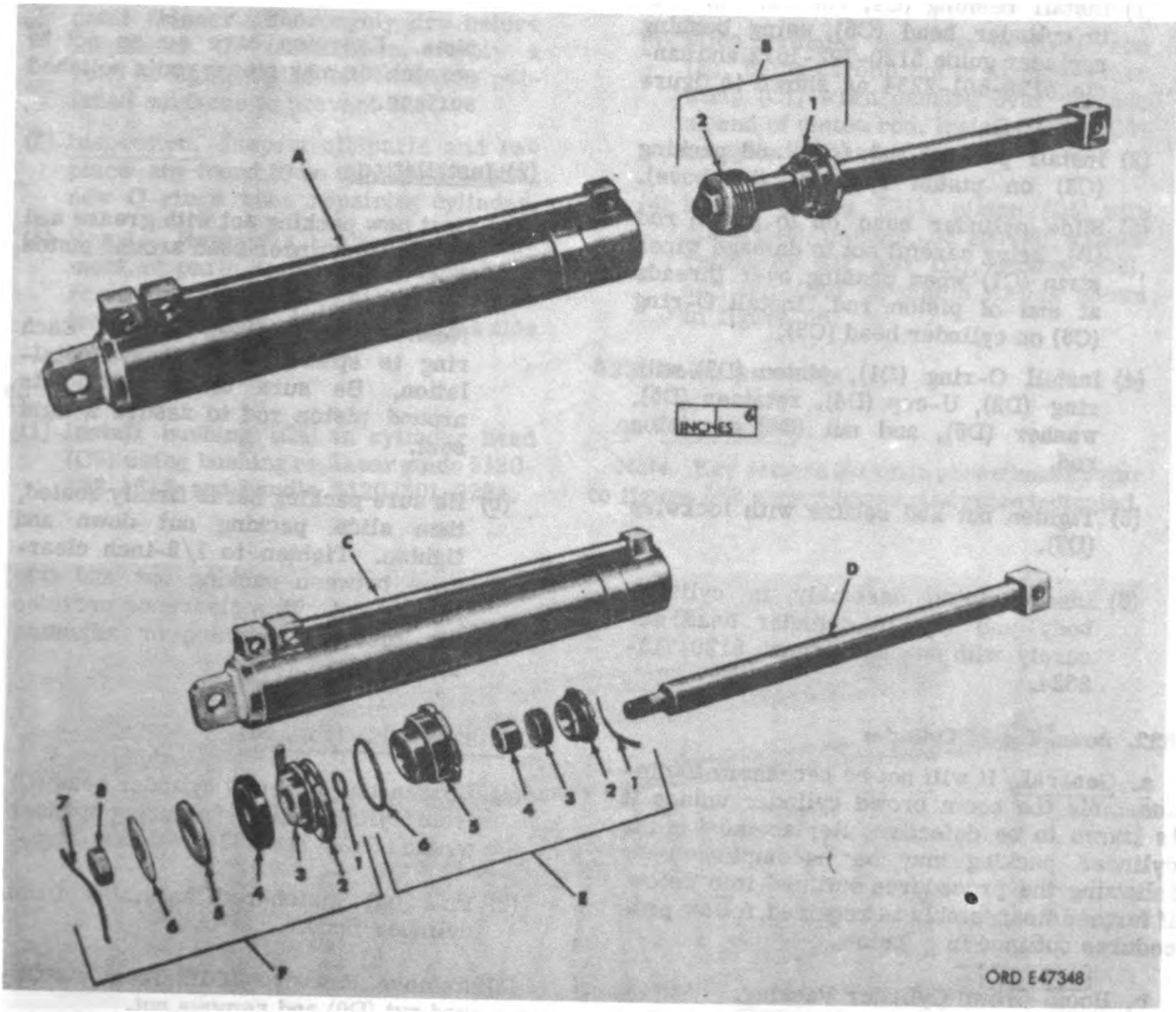


Figure 559. Boom elevating cylinder - exploded view

Key	Item
A	Cylinder body
B	Piston rod assembly
	1 - Cylinder head assembly
	2 - Piston assembly
C	Cylinder
D	Piston rod
E	Cylinder head assembly
	1 - Wiper strip
	2 - Packing nut
	3 - Packing
	4 - Piston rod bushing
	5 - Cylinder head
	6 - O-ring
F	Piston assembly
	1 - O-ring
	2 - Piston ring
	3 - Piston
	4 - 'U' cup
	5 - Retainer
	6 - Washer
	7 - Lockwire
	8 - Nut

Figure 559. Boom elevating cylinder - exploded view - legend

e. Assembly.

(1) Install bushing (C4, view 3, fig. 559) in cylinder head (C5), using bushing replacer guide 5120-792-1612 and handle 5120-601-2234 as shown in figure 560.

(2) Install packing nut (C2) and packing (C3) on piston rod (B) (b above).

(3) Slide cylinder head on to piston rod (B), being careful not to damage wiper strip (C1) when passing over threads at end of piston rod. Install O-ring (C6) on cylinder head (C5).

(4) Install O-ring (D1), piston (D3) with ring (D2), U-cup (D4), retainer (D5), washer (D6), and nut (D8) on piston rod.

(5) Tighten nut and secure with lockwire (D7).

(6) Insert piston assembly in cylinder body and tighten cylinder head securely with spanner wrench 5120-713-2624.

422. Boom Crowd Cylinder

a. General. It will not be necessary to disassemble the boom crowd cylinder unless it is known to be defective. Replacement of the cylinder packing may be accomplished by following the procedures outlined in b below. If further disassembly is required, follow procedures outlined in c below.

b. Boom Crowd Cylinder Packing.

(1) Removal.

(a) Loosen packing nut and slide back on piston rod to expose packing.

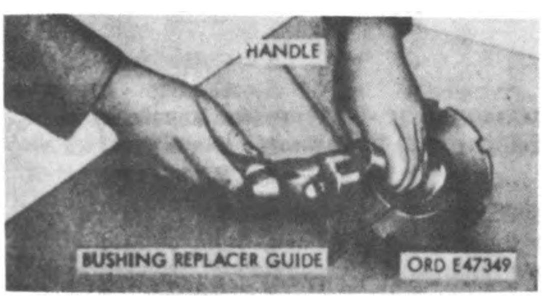


Figure 560. Using busher replacer guide 5120-792-1612 and handle 5120-601-2234

(b) With screwdriver or similar tool, dig out all old packing and remove from cylinder.

Note. Exercise care so as not to scratch or mar piston rod's polished surface.

(2) Installation.

(a) Coat new packing set with grease and install in cylinder head around piston rod.

Note. Packing comes in sets. Each ring is split to allow easy installation. Be sure to stagger joints around piston rod to assure a tight seal.

(b) Be sure packing set is firmly seated, then slide packing nut down and tighten. Tighten to 1/8-inch clearance between packing nut and cylinder head. This clearance provides for further tightening or adjusting after use.

c. Disassembly (Fig. 561).

(1) Loosen and unscrew cylinder head (C) from cylinder body (A) using spanner wrench 5120-713-2624.

(2) Pull out piston-rod assembly from cylinder body.

(3) Remove lockwire (D10) from piston-rod nut (D9) and remove nut.

(4) Remove washer (D8), washer retainers (D7 and D2), U-cups (D6 and D3), piston (D5) and O-ring (D1) from piston rod (B).

(5) Slide cylinder head and packing assembly (C) off piston rod, being careful not to damage wiper strip (C1) when passing over threads at end of piston rod.

(6) Remove packing nut (C2), packing (C3), O-ring (C6) and piston rod bushing (C4) from cylinder head.

(7) Remove piston ring (D4) from piston (D5).

d. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean all metal parts with dry-cleaning solvent or mineral spirits paint thinner. Thoroughly dry before inspection or installation. Apply a coat of light engine oil to highly polished surfaces to prevent rust.

(2) Inspection. Inspect all parts and replace any found to be damaged. Install new O-rings when repairing cylinder.

(3) Repair. Repair is limited to replacement of parts and packing except for removing scratches, nicks, or burs from piston rod and piston with a fine mill file.

e. Assembly.

(1) Install bushing (C4) in cylinder head (C5) using bushing replacer guide 5120-792-1612 and handle 5120-601-2234.

(2) Install packing nut (C2) and packing (C3) on piston rod (B). (Refer to b above.)

(3) Slide cylinder head on to piston rod (B), being careful not to damage wiper strip (C1) when passing over threads at end of piston rod. Install O-ring (C6) on cylinder head (C5).

(4) Install O-ring (D1), piston (D5) with rings (D4), U-cups (D3 and D6), washer retainers (D2 and D7), washer (D8), and nut (D9) on piston rod as shown in figure 561.

423. Boom Assembly

a. Disassembly.

Note. Key letters shown in parentheses refer to figure 562 except where otherwise indicated.

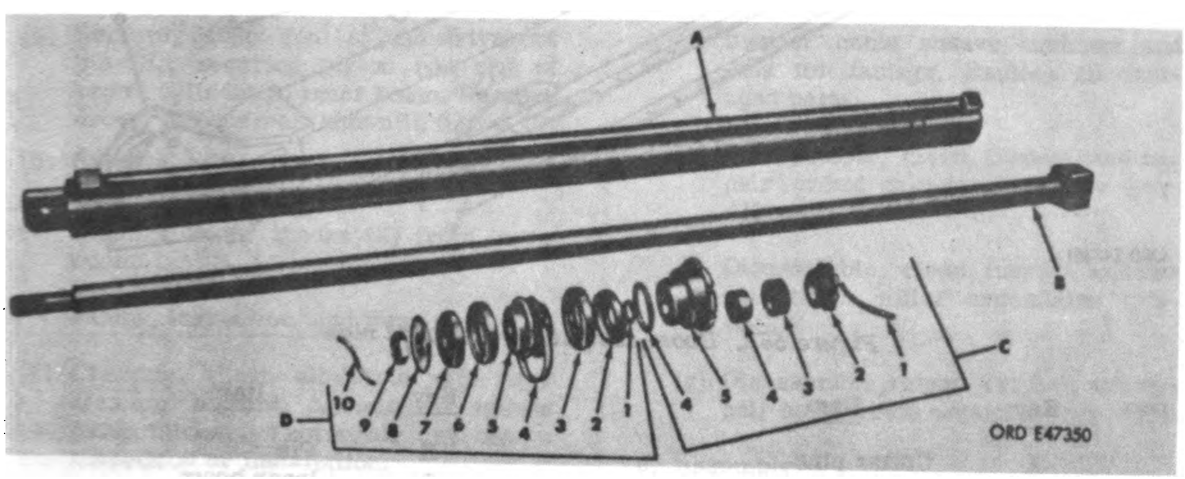


Figure 561. Boom crowd cylinder - exploded view

Key	Item
A	Cylinder body
B	Piston rod
C	Cylinder head assembly
	1 - Wiper strip
	2 - Packing nut
	3 - Packing
	4 - Piston rod bushing
	5 - Cylinder head
	6 - O-ring
D	Piston assembly
	1 - O-ring
	2 - Retainer
	3 - U-cup
	4 - Piston ring
	5 - Piston
	6 - U-cup
	7 - Retainer
	8 - Washer
	9 - Nut
	10 - Lockwire

Figure 561. Boom crowd cylinder - exploded view - legend

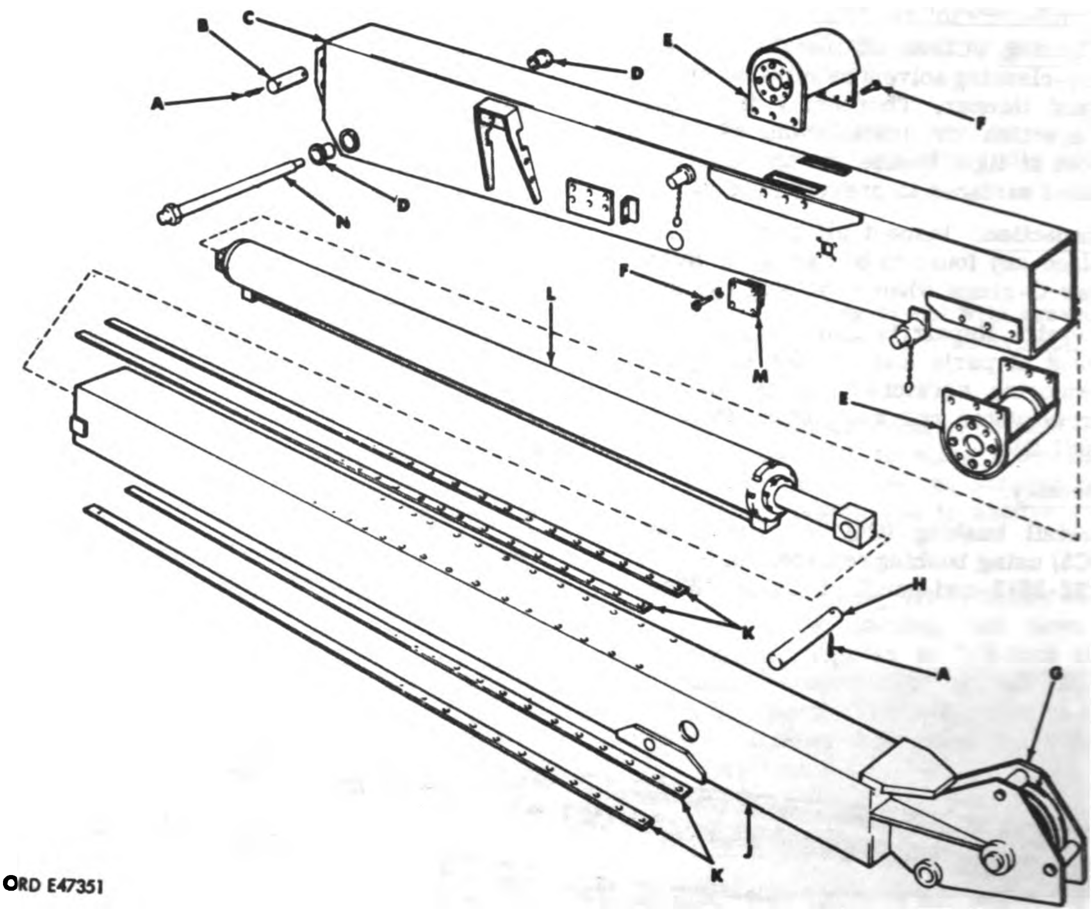


Figure 562. Boom assembly - exploded view

Key	Item	Key	Item
A	Cotter pins	H	Pin
B	Pin	J	Inner boom
C	Outer boom	K	Boom tracks
D	Bushing	L	Crowd cylinder
E	Roller assembly	M	Boom stop
F	Cap screw	N	Pivot pin
G	Sheaves		

Figure 562. Boom assembly - exploded view - legend

(1) Remove cotter pin (A) and pin (B) anchoring the crowd cylinder (L) in the outer boom (C). Remove boom stops (M) from outer boom.

(2) Pull inner boom from outer boom only far enough to attach a chain sling. Attach chain to an overhead hoist and remove inner boom assembly from outer boom as shown in figure 563.

Caution: When extending inner boom from outer boom to attach chain, inner boom must be supported at sheave end to prevent tilting, which could cause injury to personnel.

(3) Remove boom roller assemblies (E) from outer boom.

(4) Remove hoist winch assembly from outer boom.

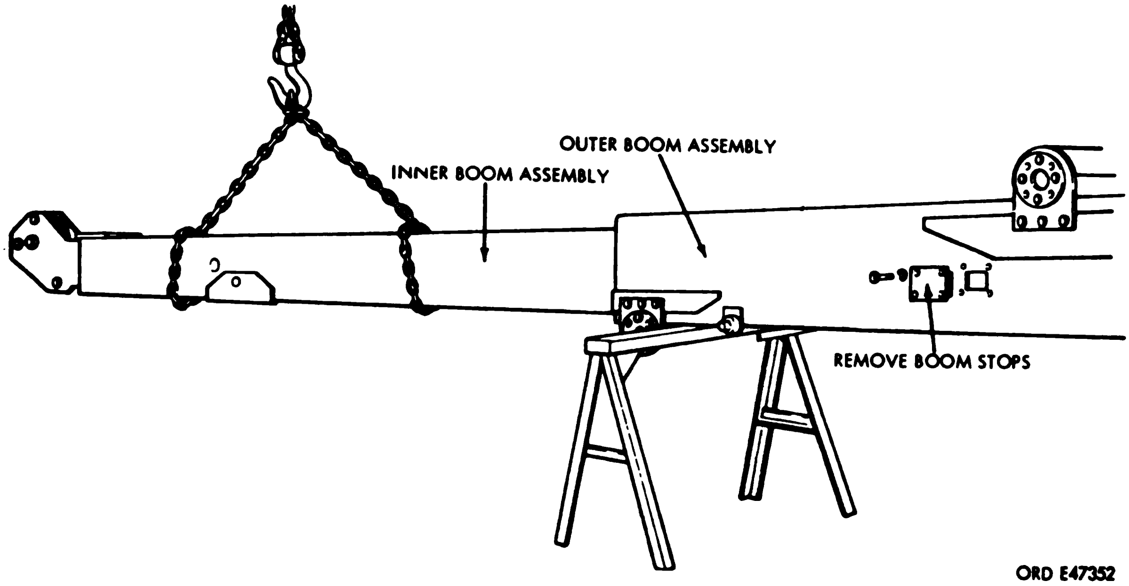


Figure 563. Removing and installing inner boom assembly

(5) Remove cotter pin (A) and drive out pin (H), securing piston rod end of crowd cylinder to inner boom. Remove crowd cylinder as shown in figure 17.

(6) Remove cable sheaves (G) from head end of inner boom.

(7) Remove boom tracks (K) from inner boom.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts with dry-cleaning solvent, or mineral spirits paint thinner. Thoroughly dry before inspection or installation.

(2) Inspection and repair.

(a) Inspect inner and outer booms for cracked welds or bent conditions. In general, defective welds can be repaired by welding. If not, replace defective or excessively damaged parts.

(b) Inspect inner boom tracks for cracks or breaks, and replace damaged parts as necessary.

(c) Inspect pins and replace if defective.

(d) Inspect cable sheaves for cracks, breaks, or damaged cable grooves. Inspect cable sheave bushings and pins for damage. Replace all damaged parts.

(e) Disassemble, clean, inspect, and repair crowd cylinder assembly (par. 422).

(f) Disassemble, clean, inspect, and repair boom roller assemblies (par. 424).

(g) Disassemble, clean, inspect, and repair hoist winch assembly (par. 425).

c. Assembly.

(1) Install boom tracks (K, fig. 562) and cable sheaves (G) to inner boom.

(2) Install crowd cylinder in inner boom (fig. 563) (L, fig. 562) to inner boom with pin (H) and secure with cotter pins (A).

(3) Install hoist winch assembly on outer boom. (Refer to par. 411.)

(4) Install boom roller assemblies (E, fig. 562) to outer boom.

(5) Attach overhead hoisting device and install inner boom assembly in outer boom as shown in figure 563. With inner boom in full retracted position, install boom stops.

(6) Secure anchor end of crowd cylinder (L, fig. 562) to outer boom (C) with pin (B) and secure with cotter pin (A).

424. Boom Roller Assembly

a. Disassembly. Disassemble boom roller assemblies as shown in figure 564.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean all parts in mineral spirits paint thinner or dry-cleaning solvent. Dry all parts thoroughly before inspection or installation.

(2) Inspection.

(a) Inspect bearings for pitted, scored, or scratched condition. Replace any defective bearings.

(b) Inspect flanged roller for damaged condition. Replace damaged rollers.

(c) Inspect shafts and flanged eccentric mountings for cracks, breaks, or other damage. Replace defective parts.

(d) Inspect housing assembly for cracks or breaks in weld. In general, defective welds can be repaired by welding. If not, replace defective or damaged parts.

(3) Repair. Replace damaged rollers.

c. Assembly. Assemble boom roller assembly as shown in figure 564.

425. Hoist Winch Assembly

a. Disassembly.

(1) Disassemble the winch drum as shown in view B, figure 565.

(2) Disassemble the hoist worm gearbox as shown in view C, figure 565.

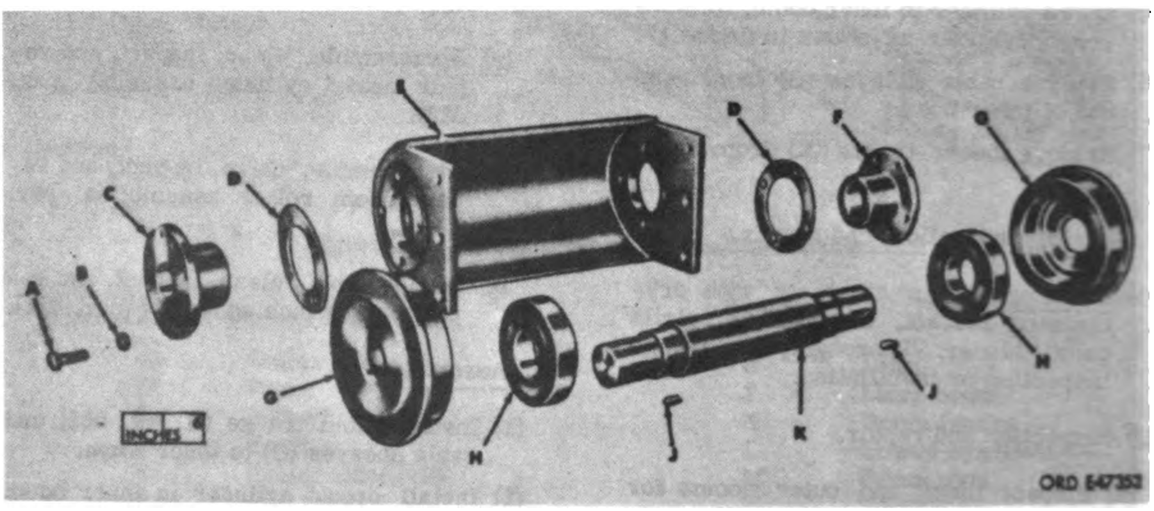


Figure 564. Boom roller assembly - exploded view

Key	Item	Key	Item
A	Bolt	F	Mounting cap, RH
B	Lockwasher	G	Roller
C	Mounting cap, LH	H	Ball bearing
D	Shim	J	Woodruff key
E	Frame	K	Shaft

Figure 564. Boom roller assembly - exploded view - legend

NOTE

Place identification marks on side of automatic brakecase (RR) and gearcase (R) with a center punch, so that during assembly brakecase will be installed on proper end of gearcase.

(3) Disassemble the speed reduction gearbox as shown in view A, figure 565.

b. Cleaning, Inspection, and Repair.

(1) *Cleaning.* Clean all metal parts in a dry-cleaning solvent, or mineral spirits paint thinner. Thoroughly dry before inspection or installation.

(2) *Inspection.*

(a) Inspect drum shaft gear and worm for broken, chipped, or scored teeth. If worm or shaft is damaged, it must be replaced.

(b) Inspect drum shaft for nicks or burs. A damaged shaft must be replaced.

(c) Inspect drum bushing-type bearings for cracks and scoring, and replace if defective.

(d) Inspect ball bearings for pitted, scored, or scratched condition. Replace if damaged in any way.

(e) Carefully inspect worm gearcase and cover for cracks, warpage, or stripped screw threads. If damaged in this manner, parts must be replaced.

(f) Inspect braking surface of automatic brake disk, and replace disk if surface is scored. Inspect brake band assembly for worn-out brake lining. Lining must be replaced if worn down to head of rivets or if oil soaked.

(g) Inspect automatic brakecase for cracks or breaks. If defective it must be replaced.

(h) Inspect speed reduction gearbox for cracks, breaks or damage. If defective it must be replaced.

(i) Inspect speed reduction gears for cracked or damaged teeth. Defective parts must be replaced.

(j) Inspect bearings and shafts for cracks, breaks, and scoring.

(3) *Repair.* Repairs to the hoist winch assembly will for the most part be a matter of replacing defective parts, and using new gaskets and seals. However, sligh′ nicks or burs may be removed from the various parts with a fine mill file. Damage beyond this will necessitate replacement.

c. Assembly.

(1) Assemble hoist worm gearbox as shown in view C, figure 565. Install automatic brakecase assembly (RR, view C. fig. 565), making sure identification marks placed on gearcase and brakecase to aid in proper installation are alined.

(2) Check worm gear end play between shoulder or worm gear (XX, view C) and bushing (T, view C). If end play is less than 0.005 inch, add sufficient number of cover gaskets (AB, view C) so that end play will be greater than 0.005 inch, but less than 0.015 inch.

(3) Assemble winch drum as shown in view B, figure 565. Shim between support valve (BB, view B) and retaining washer (CC, view B) and allow 1/64-inch running clearance at both ends.

(4) Assemble speed reduction gearbox shown in view A, figure 565.

(5) Adjust automatic brake (refer to TM 9-2320-211-20).

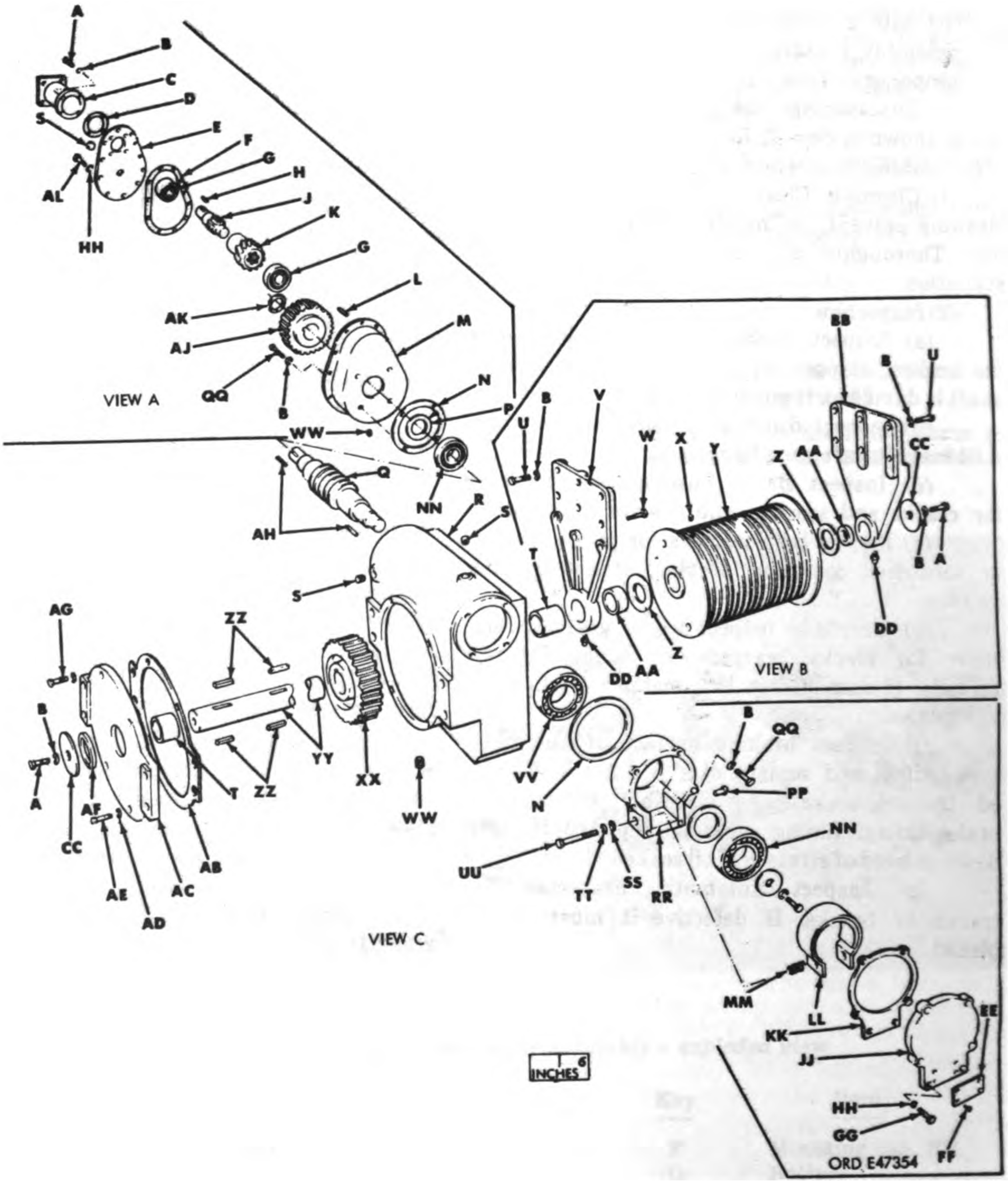


Figure 565. Hoist winch assembly—exploded view.

A—Bolt (6 reqd)
B—Washer, lock (15 reqd)
C—Adapter
D—Gasket
E—Cover
F—Gasket
G—Bearing (2 reqd)
H—Key
J—Shaft input
K—Gear
L—Pin, dowel (2 reqd)
M—Case, gear
N—Gasket
P—Seal, oil
Q—Worm hoist lh
R—Case, gear
S—Plug, pipe (4 reqd)
T—Bushing (2 reqd)
U—Bolt
V—Support, drum
W—Screw, mach.
X—Screw, sh
Y—Drum, hoist
Z—Washer, thrust (2 reqd)
AA—Bushing (2 reqd)
BB—Support, drum
CC—Washer, retaining
DD—Fitting, lub (2 reqd)
EE—Plate, data
FF—Rivet (4 reqd)
GG—Bolt (6 reqd)
HH—Washer, lock (6 reqd)
JJ—Cover
KK—Gasket
LL—Brake band
MM—Spring brake
NN—Drum, brake
PP—Plug, expansion
QQ—Bolt (8 reqd)
RR—Case auto. brake
SS—O-ring
TT—Washer, lock
UU—Bolt
VV—Bearing (2 reqd)
WW—Plug magnetic (2 reqd)
XX—Worm gear lh
YY—Shaft, drum
ZZ—Key (4 reqd)
AB—Gasket (4 reqd)
AC—Cover, gear case
AD—Washer, lock (4 reqd)
AE—Bolt (4 reqd)
AF—Seal, oil
AG—Screw, mach.
AH—Key (2 reqd)
AJ—Gear
AK—Snap ring
AL—Bolt, (10 reqd)

Figure 565. Hoist winch assembly—exploded view.

426. Control Valve Bank

a. Disassembly. (Fig. 566)

(1) Remove eight pins (9) and rings (8) securing four operating handles (3, 5, 6, and 7) to base (34) and control valve bank (10) and remove operating handles.

(2) Remove four knobs (4) from each operating handle (3, 5, 6, and 7).

(3) Remove four screws (2), nuts (25), and lockwashers (27) securing brace (34), right control bracket (14), and left control bracket (29) to control valve bank (10). Remove brackets and brace.

(4) Remove nipple (33) and nipple adapter (31) from control valve bank (10) and discard preformed packing (32).

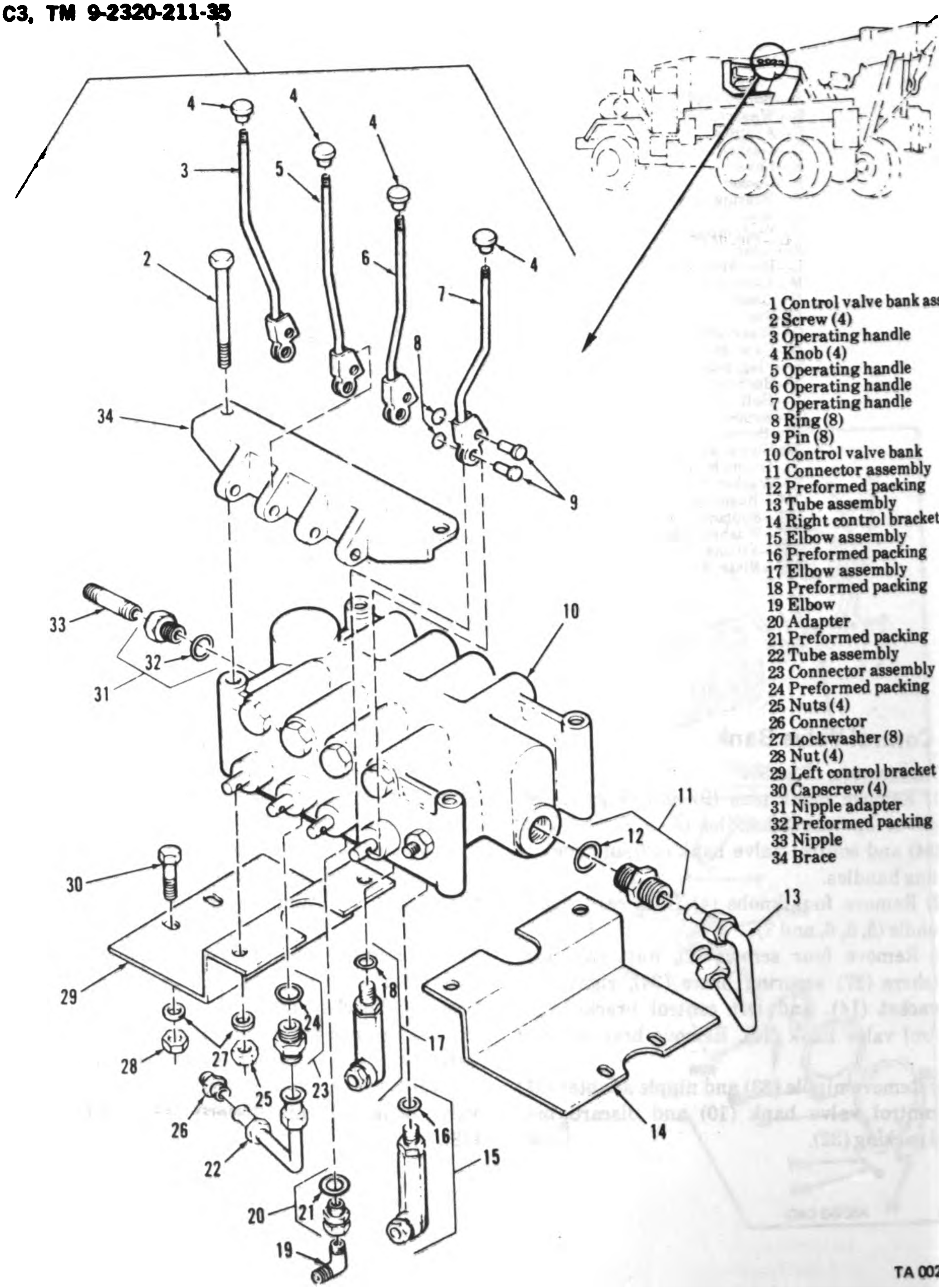
(5) Remove tube assembly (13) and connector assembly (11) from control valve bank (10) and discard preformed packing (12).

(6) Remove connector (26), tube assembly (22), and connector assembly (23) from control valve bank (10) and discard preformed packing (24).

(7) Remove elbow (19) and adapter assembly (20) from control valve bank (10) and discard preformed packing (21).

(8) Remove elbow assembly (15) from control valve bank (10). Discard preformed packing (16).

(9) Remove elbow assembly (17) from control valve bank (10) and discard preformed packing (18).



1 Control valve bank assembly
2 Screw (4)
3 Operating handle
4 Knob (4)
5 Operating handle
6 Operating handle
7 Operating handle
8 Ring (8)
9 Pin (8)
10 Control valve bank
11 Connector assembly
12 Preformed packing
13 Tube assembly
14 Right control bracket
15 Elbow assembly
16 Preformed packing
17 Elbow assembly
18 Preformed packing
19 Elbow
20 Adapter
21 Preformed packing
22 Tube assembly
23 Connector assembly
24 Preformed packing
25 Nuts (4)
26 Connector
27 Lockwasher (8)
28 Nut (4)
29 Left control bracket
30 Capscrew (4)
31 Nipple adapter
32 Preformed packing
33 Nipple
34 Brace

Figure 566. Control valve bank assembly (M543, M543A1, M543A2) — exploded view.

NOTE

Thoroughly clean the exterior of the control valve bank before starting disassembly. All spring centered valve spools in the control valve bank are removed and disassembled in a similar manner. Three spools are stamped with a "D" double action) on the shank at the control handle end. The fourth spool is stamped with an "S" (single action) and is located next to the oil outlet port in the control valve bank.

(10) Remove spool cap (1, fig. 566.1) and valve spool assembly (11) from control valve bank (31).

NOTE

Valve spools are handlapped precision fit in the body and are not interchangeable. Control valve spools and control valve body are replaced as a complete assembly.

(11) Clamp spool in a soft jawed vise with an improvised spring compression tool and remove snapring (3), outer spacer (2), spring (4), travel limit washer (5), and inner spacer (2) from spool (11).

(12) Using special tool 5120-150-5950, remove seal (10), retainers (6 and 9), and preformed packings (7 and 8) from control valve bank (31).

(13) Remove two check valve caps (32), springs (38), and poppets (39) from control valve bank.

NOTE

Do not remove check seat sleeve (40) from control valve bank (31). Check valve parts should be identified so that they will be returned to original positions at reassembly.

(14) Remove preformed packings (33, 35, and 37) and back-up rings (34 and 36) from check valve cap (32).

NOTE

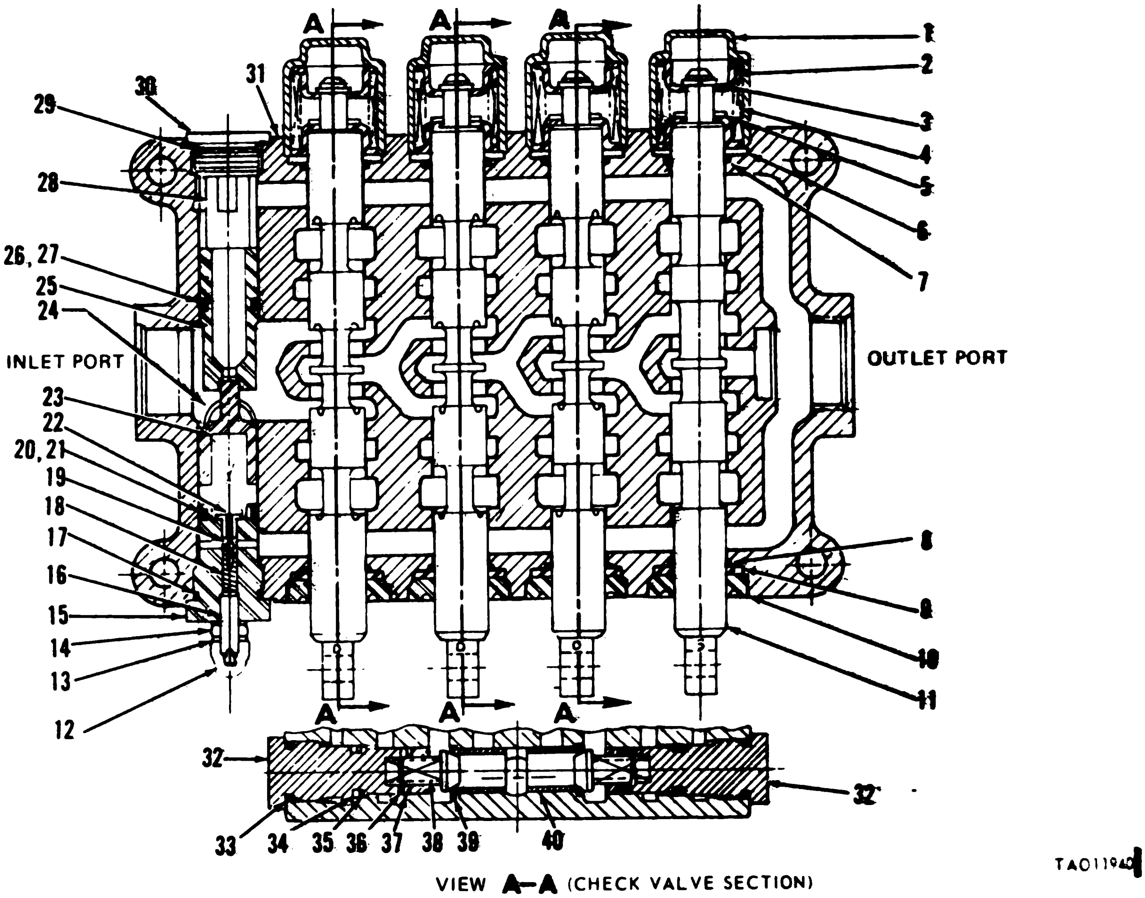
All check valves in the control valve bank are removed and disassembled in a similar manner. Check valves located adjacent to valve spools (11) marked with a "D" (double action) are identical. The check valve located by the valve spool marked "S" (single action) contains one spring (38) and poppet (39). All other components the same as the "D" type spools.

(15) Remove acorn nut (12), two seals (13), jam nut (14), and adjusting screw (16) from valve cap (15).

(16) Remove valve cap (15) and take off preformed packings (17 and 21) and back-up ring (20). Do not remove pilot seat (22) from cap.

(17) Remove pilot plunger spring (18), pilot plunger (19), and poppet spring (23).

(18) Remove relief valve plug (30), preformed packing (29), drain sleeve (28), relief seat adapter (25), seat preformed packing (26), and back-up ring (27) from control valve bank (31).



1 Spool cap (4)
2 Spacer (8)
3 Snapring (4)
4 Spring (4)
5 Travel limit washer (4)
6 Retainer (4)
7 Preformed packing (4)
8 Preformed packing (4)
9 Retainer (4)
10 Seal (4)
11 Spool assembly (4)
12 Acorn nut
13 Seal (2)
14 Jamnut
15 Valve cap
16 Adjusting screw
17 Preformed packing
18 Pilot plunger spring
19 Pilot plunger
20 Back-up ring
21 Preformed packing
22 Pilot seat
23 Poppet spring
24 Poppet assembly
25 Relief seat adapter
26 Preformed packing
27 Back-up ring
28 Drain sleeve
29 Preformed packing
30 Relief valve plug
31 Control valve bank
32 Cap (8)
33 Preformed packing (8)
34 Back-up ring (8)
35 Preformed packing (8)
36 Back-up ring (16)
37 Preformed packing (8)
38 Spring (7)
39 Poppet (7)
40 Check seat sleeve (7)

Figure 566.1. Control valve bank disassembly and assembly.

b. Cleaning, Inspection, and Repair.

(1) Clean all parts in drycleaning solvent or mineral spirits paint thinner.

(2) Inspect control valve bank and spools for deep scratches, grooves, and excessive wear. Spools should fit without perceptible side clearance. Replace complete unit if damage is evident.

(3) Inspect the check valve poppet and its seating face in the control valve bank for grooves or defects which may cause leakage. Check the poppet for free movement in the cap bore. If the poppet appears to be faulty, replace complete unit. Small nicks and grooves can be removed from the poppet seating face in the body by lapping poppet in the body seat using a fine grain grinding compound. Lap seat sufficiently to remove all defects. Clean seat thoroughly to remove all traces of grinding compound. Extreme care should be exercised to keep poppet concentric in bore when lapping in seat face.

(4) Inspect the relief valve plunger and seat for ridges or scoring which may cause improper seating and leakage. Replace parts if worn or damaged.

(5) Inspect seat adapter for ridges and scoring which may cause leakage. Replace parts when worn or damaged.

(6) Discard all preformed packings. Replace when reassembling the control valve.

(7) Use repair parts kits as appropriate.

c. Assembly.

(1) *Control valves.*

(a) To reassemble spring centered spool, clamp the spool (11) in a soft jawed vise, place inner spring spacer (2), travel limit washer (5), spring (4), and outer spring spacer (2) on spool. Compress spring and install new snapring. Make sure snapring is fully seated in groove before releasing spring tension.

(b) Install preformed packing retainer (6) and preformed packing (7) on spool assembly and install spool and spool cap (1) in control valve bank.

(c) Install preformed packing (8), retainer (9), and seal (10) in other end of control valve bank over the eye end of the spool and secure using special tool.

(d) Repeat above procedures for remaining control valves.

(2) *Check valve.*

(a) Install preformed packings (33, 35, and 37), and back-up rings (34 and 36) on cap (32). Place spring (38) in poppet (39) and install complete assembly in control valve bank.

(b) Screw cap assembly into control valve bank until it bottoms.

(3) *Relief valve.*

(a) Install preformed packing (26) and back-up ring (27) on relief seat adapter (25) and install assembly in control valve bank.

(b) Install drain sleeve (28) in control valve bank against relief seat adapter.

(c) Install preformed packing (29) on relief valve plug (30) and install assembly in control valve bank.

NOTE

Drain sleeve (28) should go in control valve bank far enough to expose two or three full threads. Installing relief valve plug (30) at this point sets the relief seat adapter (25) to the proper depth.

(d) Install poppet (24) so that the plunger shaft points towards the relief seat adapter. Place poppet spring (23) inside of poppet assembly.

(e) Install pilot seat (22) in cap (15). Place preformed packing (21) and back-up ring (20) on cap (15). Insert pilot plunger (19) into spring (18) and install assembly into bore of cap (15) with pilot plunger (19) pointing towards pilot seat (22).

(f) Install preformed packing (17), adjusting screw (16), jamnut (14), and seal (13) in cap (15).

(g) Reassemble the remainder of the control valve bank by reversing the procedures in paragraph 427*a*. (1) through (9).

d. Installation. Install the control valve bank by reversing procedures given in paragraph 408.

e. Pressure Relief Valve Adjustment.

(1) Remove 1/8 inch pipe plug located on top of valve bank at right side.

(2) Install a hydraulic pressure gage 4910-627-7043 (0-2000 psi) into pipe plug hole.

(3) Remove acorn nut (12) and seal (13) located to the right of the swing motor lever. After removing the nut and preformed packing, the adjusting screw (16) will be visible. Loosen adjusting screw jamnut (14).

(4) Start engine and engage hydraulic pump. Allow approximately 10 minutes for hydraulic system to warm up.

(5) Extend boom to maximum and hold against stop temporarily and observe pressure reading. Reading should be between 1210 and 1215 psi.

(6) If pressure reading is incorrect, turn the adjusting screw clockwise to increase pressure and counterclockwise to decrease.

(7) When correct pressure is attained, hold adjusting screw while tightening jamnut.

(8) Replace acorn nut and preformed packing.

427. Seal Housing and Drive Housing on Power Divider

a. General. After removal of the seal housing and drive housing from the vehicle, disassembly is as follows in *b* below.

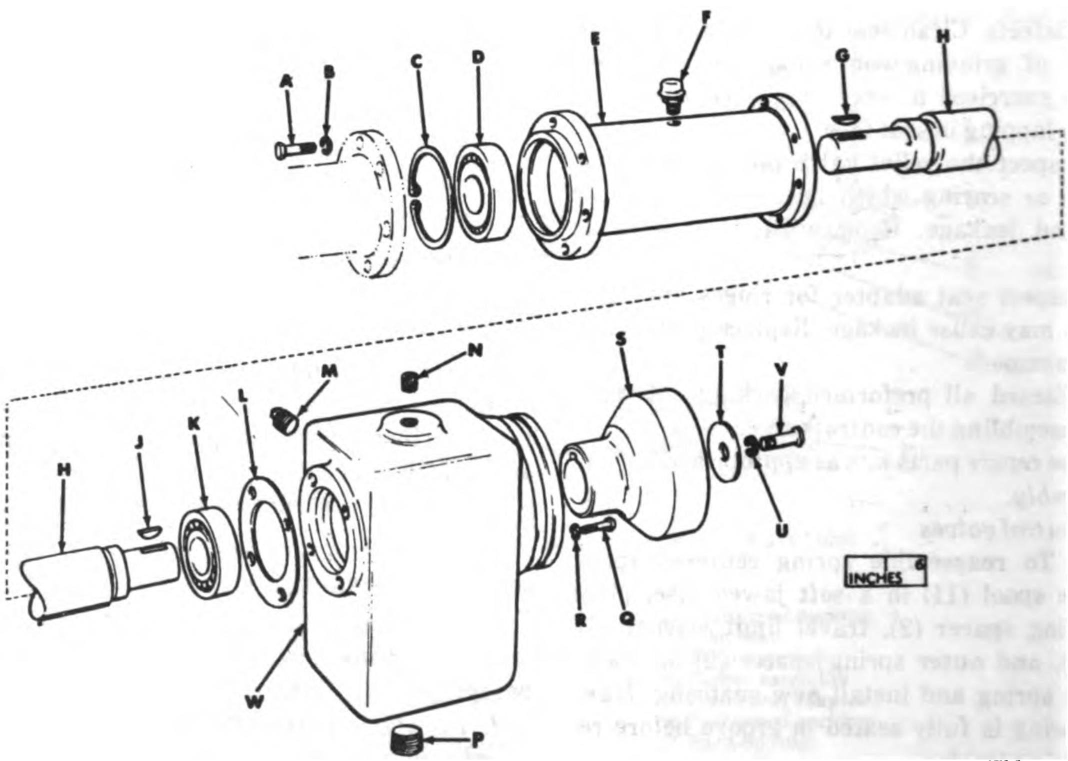
b. Disassembly (Fig. 567).

(1) Remove retaining ring (C) and bearing (D) from drive housing (E).

(2) Remove air vent (F) and Woodruff keys (G) and (J) from drive shaft (H).

(3) Remove bearing (K) and gasket (L). Remove pipe plugs (M), (N), and (P).

(4) Remove bolt (V), lockwashers (U), and retaining washer (T) from yoke fitting.



A—Bolt, 3/8-24 x 1-1/2
B—Lockwasher, 3/8
C—Ring, retaining
D—Bearing
E—Housing, drive
F—Air vent
G—Key
H—Drive shaft
J—Key
L—Bearing
L—Gasket
M—Pipe plug, 3/4
N—Pipe plug, 1/8
P—Pipe plug, mag., 3/4
Q—Bolt, 3/4-24, 1-1/2
R—Lockwasher, 3/8
S—Fitting yoke
T—Washer, retaining
U—Lockwasher
V—Bolt, 1/2-20 x 1
W—Housing, seal

Figure 567. Seal housing and drive housing—exploded view.

(S). Remove bolt (Q) and lockwasher (R).

c. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts with dry-cleaning solvent or mineral spirits paint thinner. Dry all parts thoroughly before inspection or installation.

(2) Inspection and repair.

(a) Inspect bearings for scored spots, chips, or cracks. Replace bearings if found to be damaged in any way.

(b) Inspect drive shaft, fitting yoke and keys for cracks, breaks, or signs of damage. Replace damaged parts.

(c) Inspect seal housing and drive housing for cracks, breaks, or stripped bolt threads. If damaged, parts must be replaced.

d. Assembly (Fig. 567).

(1) Install fitting yoke (S) to seal housing (W) with bolts (Q) and lockwashers (R). Position retaining washer (V) and secure with bolt (V) and lockwasher (U).

(2) Install pipe plugs (M), (N), and (P).

(3) Position gasket (L), bearing (K), and Woodruff key (J) on drive shaft (H). Position Woodruff key (G), bearing (D), and retainer ring (C) and secure with bolts (A) and lockwashers (B).

428. Bevel Gearbox

a. Disassembly. Disassemble bevel gearbox as shown in figure 568.

Note. Bevel gears are right and left hand, and their position on the respective shafts should be noted for proper assembly.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent. Dry thoroughly before inspection or installation.

(2) Inspection.

(a) Inspect bearings for scored spots, chips or cracks. Replace a defective, or damaged part.

(b) Inspect bevel gear teeth for chipped places or excessive wear. If any defects are noted, parts must be replaced.

(c) Carefully inspect case and cover for cracks, warpage, or stripped screw threads. If damaged in this manner, parts must be replaced.

(d) Inspect shafts and shaft splines for twists, chips or damage. If any evidence of damage exists, parts must be replaced.

(3) Repair. Repairs to the bevel gearbox will for the most part be a matter of replacing defective parts, and using new gaskets and seals. However, slight nicks, or burs may be removed from the various parts with a fine mill file. Damage beyond this will necessitate part replacement.

c. Assembly. Assemble bevel gearbox as shown in figure 568.

Note. The bevel gears are right and left hand and must be assembled on the proper shaft as shown in figure 568.

429. Turntable Assembly

a. Disassembly.

(1) Turn turntable base plate over (bull gear bearing up, fig. 569) and remove cap screws anchoring bull gear bearing to base plate.

(2) Remove bull gear bearing from turntable base plate.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Clean all parts with dry-cleaning solvent or mineral spirits paint thinner. Dry parts thoroughly. Coat bull gear and bearing assembly, with a light coat of oil to prevent rusting.

(2) Inspection and repair.

(a) Inspect turntable base plate for cracks, breaks, or signs of distortion or warpage. Defective welds can be repaired by welding. If turntable is found to be warped or distorted it should be replaced.

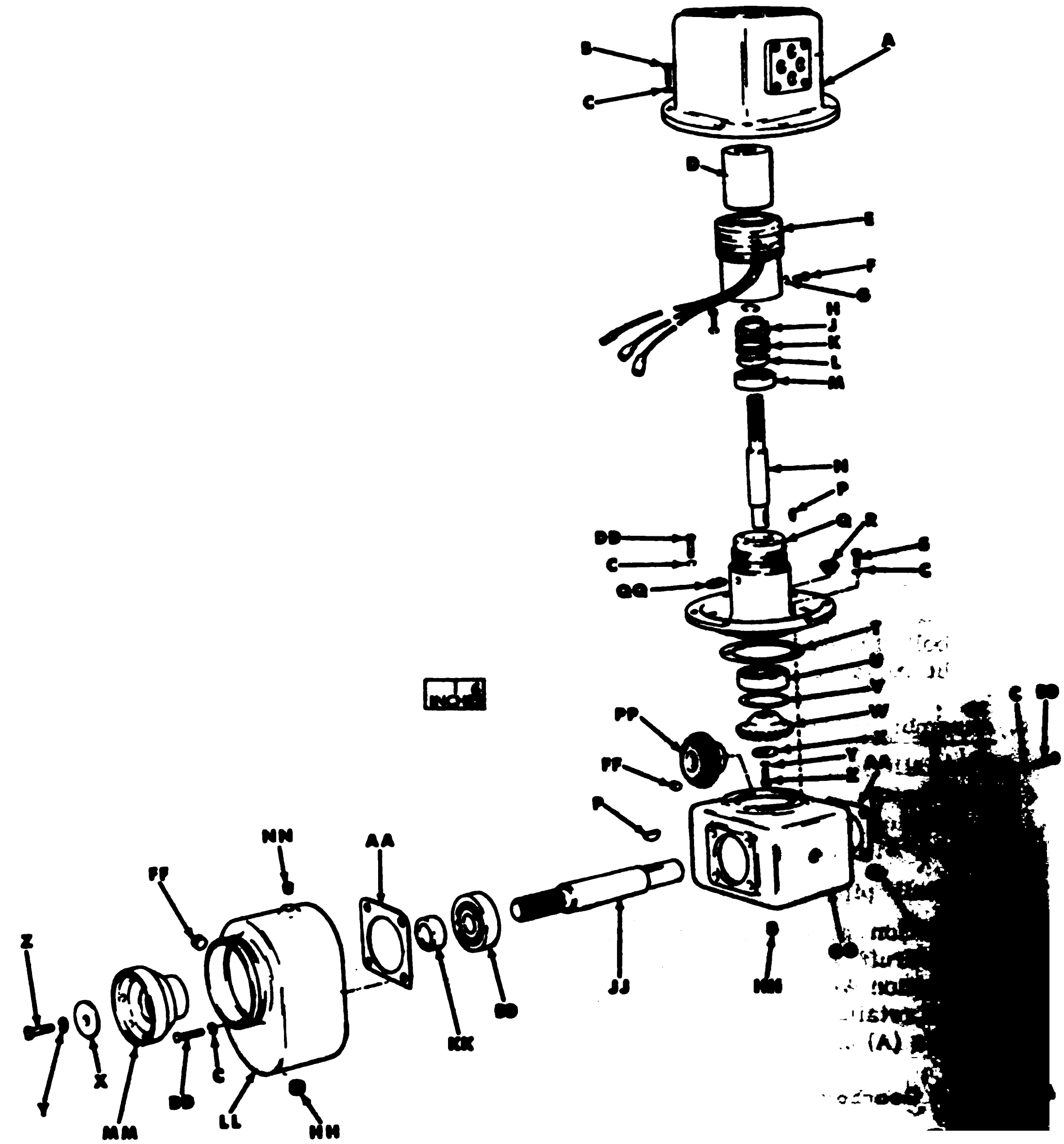


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Figure 568. Bevel gearbox assembly - exploded view

Key	Item	Key	Item
A	Pump support	H	Ring retaining
B	Bolt	J	Cover, seal
C	Washer, lock	K	Gasket
D	Coupling assembly	L	Oil seal
E	Support insulating ring assembly	M	Bearing
F	Bolt	N-	Shaft, pump drive
G	Washer, lock	P	Key

Figure 568. Bevel gearbox assembly - exploded view - legend

Key	Item	Key	Item
Q	Cover, bevel gearbox	DD	Bolt
R	Grommet, rubber	EE	Shim
S	Bolt	FF	Plug
T	Gasket	GG	Case, bevel gear
U	Bearing	HH	Plug, magnetic
V	Ring, retaining	JJ	Shaft, input
W	Gear, spiral miter, LH	KK	Spacer
X	Washer	LL	Housing, drive seal
Y	Washer	MM	Yoke, fitting
Z	Bolt	NN	Plug
AA	Gasket	PP	Gear, spiral miter, RH
BB	Bearing	QQ	Fitting vent
CC	Cover		

Figure 568. Bevel gearbox assembly - exploded view - legend - continued

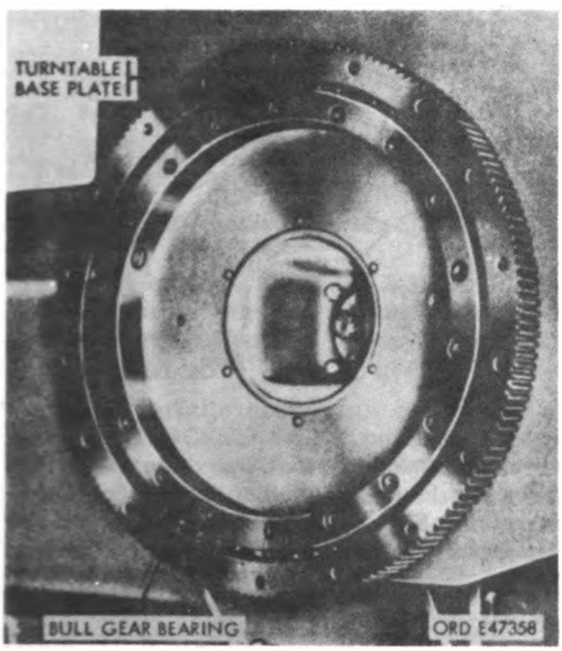

Figure 569. Removing and installing bull gear bearing to turntable base plate

(b) Inspect bull gear bearing for cracked, broken, or damaged gear teeth. Carefully inspect bearing for pitted, scored or cracked balls and replace if bull-gear bearing is found to be in any way defective.

c. Assembly. Assemble turntable by reversing procedures in a above.

430. Swing Drive Gearbox

a. Disassembly. Disassemble swing drive gearbox as shown in figure 570.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent. Dry thoroughly before inspection or installation.

(2) Inspection.

(a) Inspect each bearing assembly for rough or scored condition. Replace if damaged.

(b) Inspect gearcase, end caps, and cover for cracks, breaks, or signs of damage. Replace damaged or defective parts.

(c) Inspect pinion shaft for cracked or broken teeth. Replace if damaged.

(d) Inspect worm gear and drive worm for broken, chipped, or badly scored teeth. Replace if damaged.

(e) Inspect thrust bushings and thrust washers for scoring or damage, and replace defective parts.

(3) Repair. Repairs to the swing drive gearbox will for the most part be a matter of replacing defective parts, and using new gaskets and seals. However, slight nicks or burs may be

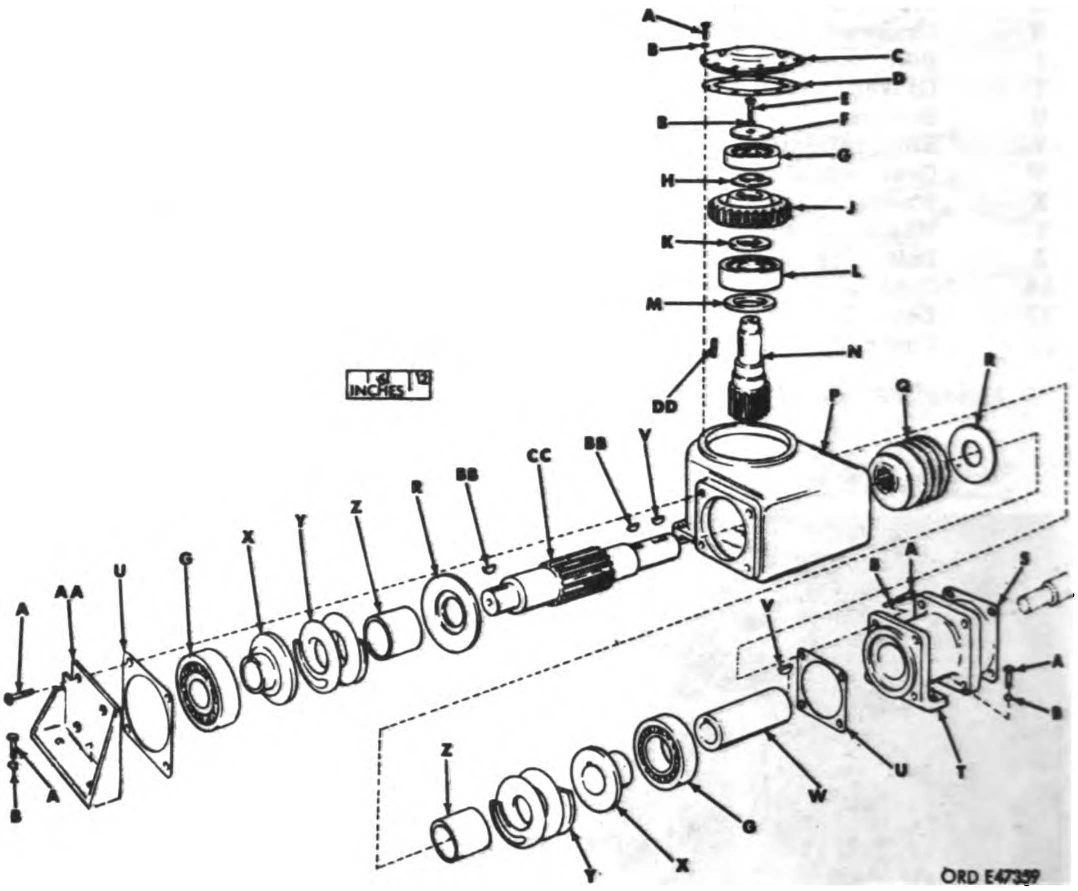

Figure 570. Swing drive gearbox - exploded view

Key	Item	Key	Item
A	Bolt (14 reqd)	Q	Worm, rh
B	Washer, lock, 1/2'' (15 reqd)	R	Washer, spring(2 reqd)
C	Cover, gear case	S	Gasket
D	Gasket	T	End cap, motor mtg
E	Bolt	U	Gasket (2 reqd)
F	Washer, retaining	V	Key (2 reqd)
G	Bearing, ball (3 reqd)	W	Coupling
H	Washer, thrust	X	Bushing, thrust (2 reqd)
J	Gear, worm, rh	Y	Spring (2 reqd)
K	Washer	Z	Spacer (2 reqd)
L	Bearing ball	AA	End cap, gearcase
M	Seal, oil	BB	Key (2 reqd)
N	Shaft, swing pinion	CC	Shaft, swing worm
P	Case, swing gear	DD	Key

Figure 570. Swing drive gearbox - exploded view - legend

removed from the various parts with a fine mill file. Damage beyond this will necessitate replacement.

c. Assembly. Assemble swing drive gearbox as shown in figure 570.

431. Operator's Station (Fig. 545)

a. Disassembly.

(1) Unbolt backrest from operator's station.

(2) Remove seat from operator's station.

b. Cleaning and Inspection.

(1) Cleaning. Clean all parts with mineral spirits paint thinner or dry-cleaning solvent. Dry thoroughly before inspection or installation.

(2) Inspection.

(a) Inspect operator's station for dents, rips, distortion or broken welds. Straighten, weld or repair as necessary. Replace a badly damaged operator's station.

(b) Inspect seat and backrest for general condition of covering and padding. A badly damaged part should be replaced.

c. Assembly. Assemble in reverse of a above.

Section V. TESTS AND ADJUSTMENTS

432. Boom Roller Adjustment

Refer to TM 9-2370-211-20.

433. Engine Governor Override Solenoid

a. Start engine (TM 9-2320-211-10). After engine coolant temperature reaches normal operating range, engage power divider with transmission in "4" (fourth) gear.

b. Pull throttle control all the way out and leave in "LOCKED OUT" position. Observe engine speed (rpm) indicated by tachometer, which is the engine speed at which the governor valve mounted on the power divider controls the engine speed governor. Stop engine.

c. If engine governed speed (no-load) indicated by (b) above is not within range of satisfactory governor operation (1600 to 1700 rpm when governor is controlled by governor valve at power divider), adjust governor valve at power divider ~~a~~ (1) through ~~e~~ (5) below.

(1) Remove adjusting hole plug seal, and remove plug from side of governor valve housing.

(2) Place the transmission gearshift lever in "4" gear position, place the transfer shift lever in neutral position, and place the power divider control lever in "ENGAGE" position. With the ignition switch off, crank engine in small increments (by momentarily depressing starter button), until adjusting screw inside governor is alined with adjusting hole.

(3) Insert a screwdriver in the adjusting hole and turn the adjusting screw clockwise to increase engine governed speed, or counterclockwise to decrease engine governed speed. One full turn of the adjusting screw in either direction will result in a change in the engine governed speed of approximately 150 rpm.

(4) Install plug in adjusting hole, and check governor valve adjustment by repeating (1) through (4) above.

(5) Attach a new locking wire and lead seal to the adjusting hole plug and the fin on the control valve housing adjacent to the adjusting hole.

Section VI. SERVICEABILITY STANDARDS

434. General

Construction details of the wrecker crane M62 and wrecker crane M543 and M543A2 are similar.

435. Serviceability Standards

Refer to wrecker crane M62 Serviceability Standards (par. 359).

CHAPTER 25

FRAME AND RELATED PARTS

Section I. DESCRIPTION AND DATA

436. Description

a. General. The frame and related parts consist of those parts which support the vehicle and tie the various units together. The frame (figs. 571 and 572) consists of left and right side members (fig. 571) which are pressed steel channel sections. To these sections, the cross members, gussets, brackets, reinforcements, and rear engine mounts are riveted. The related parts which are included with the frame are as follows:

b. Brake Devices. The various devices of the brake system which are mounted to the frame are the master cylinder and the air hydraulic cylinder.

c. Clutch and Brake Pedal Shaft. The clutch and brake pedal shaft is supported by the lever supporting bracket which is mounted on the left side member of the frame.

d. Exhaust Pipe, Tailpipe, and Muffler. The exhaust pipe, tailpipe, and muffler are supported to the frame and must be removed whenever repairs to the frame are necessary.

e. Front Bumper, Rear Bumperettes, and Lifting Shackles. The bumper, bumperettes, and lifting shackles are bolted directly onto the frame.

f. Fuel Tank. The fuel supply is stored in fuel tanks, which are held up by two mounting supports, bolted to the frame. Tanks are held in supports by two straps, and are shielded by protector plate fastened to the fuel tank mounting supports.

g. Pintle. The pintle is fastened to a mounting bracket bolted to the rear cross member. The pintle includes a locking device, which secures the hook when in a closed position.

h. Piping. The pipes included with and mounted on the frame are pipes for the compressed air lines, the hydraulic brake lines, and the ventilation lines. Clips are used to mount piping to frame.

i. Spare Wheel Carrier. The model M41 (cargo) has a spare wheel carrier welded to the cargo body at the inside front end of the body. Two hinged clamp bolts maintain the spare wheel and tire in an upright position. The M51 has a spare wheel carrier mounted directly behind the cab. This carrier is supported by two brackets which are bolted to the frame. The spare wheel and tire are held in an upright position by a clamp and clamp bolt.

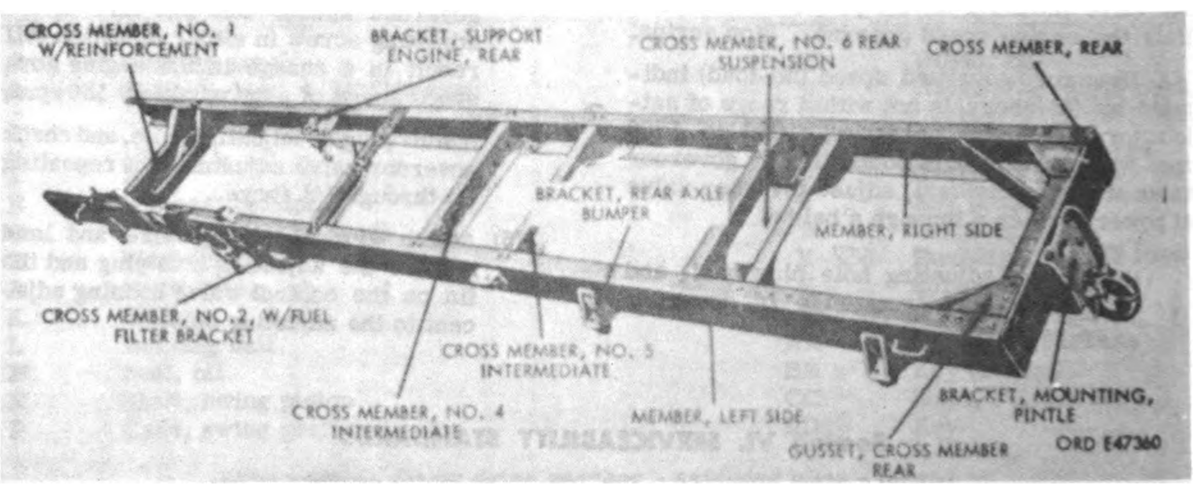

Figure 571. Frame and mounting brackets

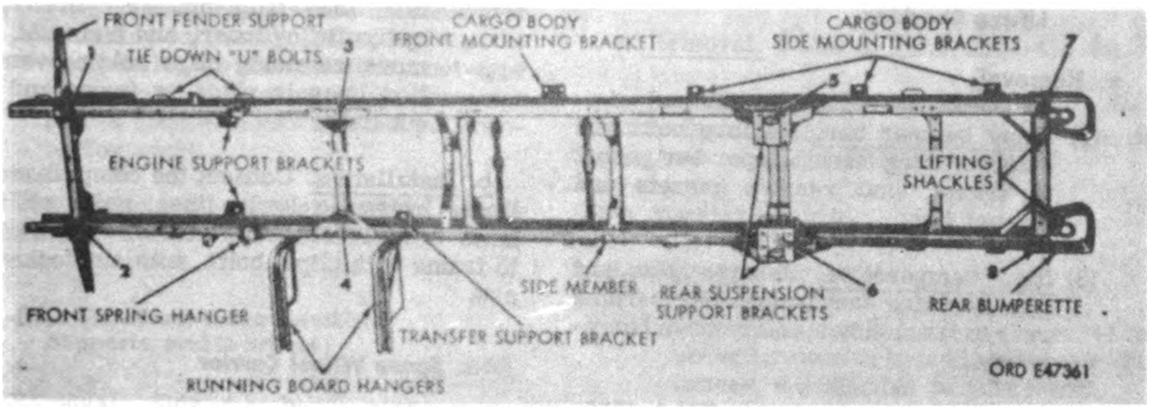

Figure 572. Vehicle frame -- bottom view

j. Wiring Harness. The wiring harness is secured to the frame with clips.

k. Running Boards. The running boards are pressed steel and are bolted to braces extending from the frame side members.

437. Data

a. M41 (Cargo) Frame.

Channel dimensions . . . . 9 x 3 x 5/16 in.
Length w/winch . . . . 300-13/16 in.
Length w/o winch . . . . 285-7/16 in.
Number of cross members 7

b. M51, M51A2 (Dump) Frame.

Channel dimensions . . . . 9 x 3 x 5/16 in.
Length w/winch . . . . 264-11/16 in.
Length w/o winch . . . . 249-5/16 in.
Number of cross members 6

c. M139 (Chassis) Frame.

Channel dimensions . . . . 9 x 3 x 5/16 in.
Length w/winch . . . . 359-9/16 in.
Length w/o winch . . . . 344-3/16 in.
Number of cross members 8

d. M52, M52A2 (Tractor) Frame.

Channel dimensions . . . . 9 x 3 x 5/16 in.
Length w/winch . . . . 264-11/16 in.
Length w/o winch . . . . 249-5/16 in.
Number of cross members 6

Section II. REMOVAL AND INSTALLATION OF ASSOCIATED PARTS

438. Brake Devices

a. Removal.

(1) Master cylinder. For removal, refer to TM 9-2320-211-20.

(2) Air-hydraulic cylinder. For removal, refer to TM 9-2320-211-20.

b. Installation.

(1) Master cylinder. For installation, refer to TM 9-2320-211-20.

(2) Air-hydraulic cylinder. For installation, refer to TM 9-2320-211-20.

439. Brake and Clutch Pedal Shaft

a. Removal. Refer to TM 9-2320-211-20.

b. Installation. Refer to TM 9-2320-211-20.

440. Exhaust Pipe, Tailpipe, and Muffler

a. Removal. Refer to TM 9-2320-211-20 for removal of the exhaust pipe, tailpipe, and muffler.

b. Installation. Refer to TM 9-2320-211-20 for installation of the exhaust pipe, tailpipe and muffler.

441. Front Bumper and Rear Bumperettes and Lifting Shackles

a. Removal.

(1) Front bumper bar. Remove bolts and nuts securing each bumper bar gusset to frame, and remove gussets and bumper bar.

(2) Rear bumperettes. Remove bolts and nuts securing each bumperette to frame rear cross member, and remove bumperettes.

(3) Lifting shackles. Refer to TM 9-2320-211-20 for removal of the lifting shackles.

b. Installation.

(1) Lifting shackles. Refer to TM 9-2320-211-20 for installation of the lifting shackles.

(2) Rear bumperettes. Aline bolt holes and secure each bumperette to frame with bolts and self-locking nuts.

(3) Front bumper bar. Aline bolt holes in gussets with holes in frame, and secure each gusset to frame with bolts and self-locking nuts.

442. Fuel Tank

For removal and installation of fuel tank, refer to TM 9-2320-211-20.

443. Pintle

Refer to TM 9-2320-211-20 for removal and installation of the pintle.

444. Piping

a. Removal.

(1) Compressed air lines. Disconnect compressed air lines at the fittings, remove retaining clips, and take out piping from frame.

(2) Hydraulic brake lines. After disconnecting hydraulic lines from the brake devices, remove clips holding line to cross members and frame, and remove hydraulic lines.

(3) Ventilation lines. Disconnect ventilation lines from master cylinder, air hydraulic cylinder, and fuel tank. Remove retaining clips holding ventilation lines in place on frame and take out lines.

b. Installation. Connect the compressed air lines, hydraulic brake lines, and ventilation lines to their respective units. Fasten piping to frame with clips, bolts, nuts, and lockwashers.

445. Spare Wheel Carrier

a. Removal.

(1) Spare wheel carrier (M51, M51A2) dump. Remove four cap screws and four safety nuts, two each for each mounting bracket and lift off spare wheel carrier assembly with tool box.

(2) Spare wheel carrier M41 cargo. Remove two hinged clamp-bolt-nuts located inside front end of cargo body, releasing spare tire. A removable section in cargo rack is provided for convenience of removing spare tire assembly from body.

b. Installation.

(1) Spare wheel carrier (M51) dump. Position spare wheel carrier on frame of truck so that it will be directly behind cab. Aline holes of mounting bracket with holes in frame and install bolts and nuts. Tighten nuts securely.

(2) Spare wheel carrier (M41) cargo. Position carrier at mounting bracket inside front end of cargo body and install two retaining nuts on hinged clamp bolts and tighten securely.

444. Wiring Harness

a. Removal.

(1) All electrical cables and harnesses are removed in essentially the same manner. Disconnect the cable (single or multiple) at both ends, remove cable from clamps securing it to the various points on the vehicle, and remove cable.

(2) To disconnect plug- and receptacle-type connectors, unscrew the connector retaining nut, and pull the plug from the receptacle. To disconnect bayonet-type connectors, rotate one of the connector halves counterclockwise, and pull connector apart.

b. Installation. For installation of wiring harness, refer to TM 9-2320-211-20.

447. Side Members, Cross Members, Supports, and Brackets

a. Removal. Side members, cross members, supports and brackets that are damaged or broken must be replaced. Cut off and drive out all rivets from parts to be replaced. Remove parts to be replaced.

b. Installation. Install new parts to be replaced, using new rivets to secure in place.

448. Frame

a. Removal. Refer to TM 9-2320-211-20.

b. Installation. Raise and support frame assembly high enough to permit installation of axles (refer to TM 9-2320-211-20).

449. Running Boards

a. Removal.

(1) Remove four self-locking nuts and bolts securing running board to running board braces, and remove running board.

(2) Repeat process and remove the other running board in the same way.

b. Installation. Position running boards on running board braces and aline bolt holes. Secure each running board to braces with four bolts and self-locking nuts.

Section III. REPAIR

450. Brake Devices

a. Disassembly.

(1) Master cylinder. Refer to paragraph 238a.

(2) Air-hydraulic cylinder. Refer to paragraph 239.

b. Cleaning, Inspection, and Repair.

(1) Master cylinder. Refer to paragraph 238b.

(2) Air-hydraulic cylinder. Refer to paragraph 239.

c. Assembly.

(1) Master cylinder. Refer to paragraph 238c.

(2) Air-hydraulic cylinder. Refer to paragraph 239.

451. Clutch and Brake Lever Shaft

a. Disassembly. Refer to TM 9-2320-211-20.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Refer to paragraph 236.

(2) Inspection. Inspect the lever supporting bracket which is mounted on the left side member of the frame. Refer to paragraph 236.

(3) Repair. Refer to paragraph 236.

c. Assembly. Refer to TM 9-2320-211-20.

452. Exhaust Pipe, Tailpipe, and Muffler

Refer to TM 9-2320-211-20.

453. Front Bumper, Rear Bumperettes, and Lifting Shackles

a. Disassembly. Refer to paragraph 441.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean all parts in mineral spirits paint thinner. Dry with compressed air.

(2) Inspection.

(a) Inspect front bumper bar for cracks, bends, distortion, and other damage.

Inspect gussets for cracks and other damage.

(b) Inspect rear bumperettes for cracks, bends, and distortion.

(c) Inspect each shackle bracket for cracks and wear at pinhole. Inspect pin for wear.

(3) Repair.

(a) Straighten bends, and repair cracks by welding. Replace bumper bar if it cannot be made serviceable. Replace damaged gussets.

(b) Replace bumperettes if they cannot be made serviceable.

(c) Replace shackle brackets if cracked or worn. Replace pin if worn. Replace unserviceable shackle.

c. Assembly. Refer to paragraph 441.

454. Fuel Tank (Fig. 573)

Note. It is not necessary to disassemble fuel tank unless inspection reveals damage.

a. Disassembly. Remove drain plug from bottom of tank. Remove screws from vent cover assembly and fuel tank sending unit and remove from tank. Discard oil gaskets. Remove filler cap and lift out filler pipe sleeve from tank.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean outside of tank with dry-cleaning solvent or mineral spirits

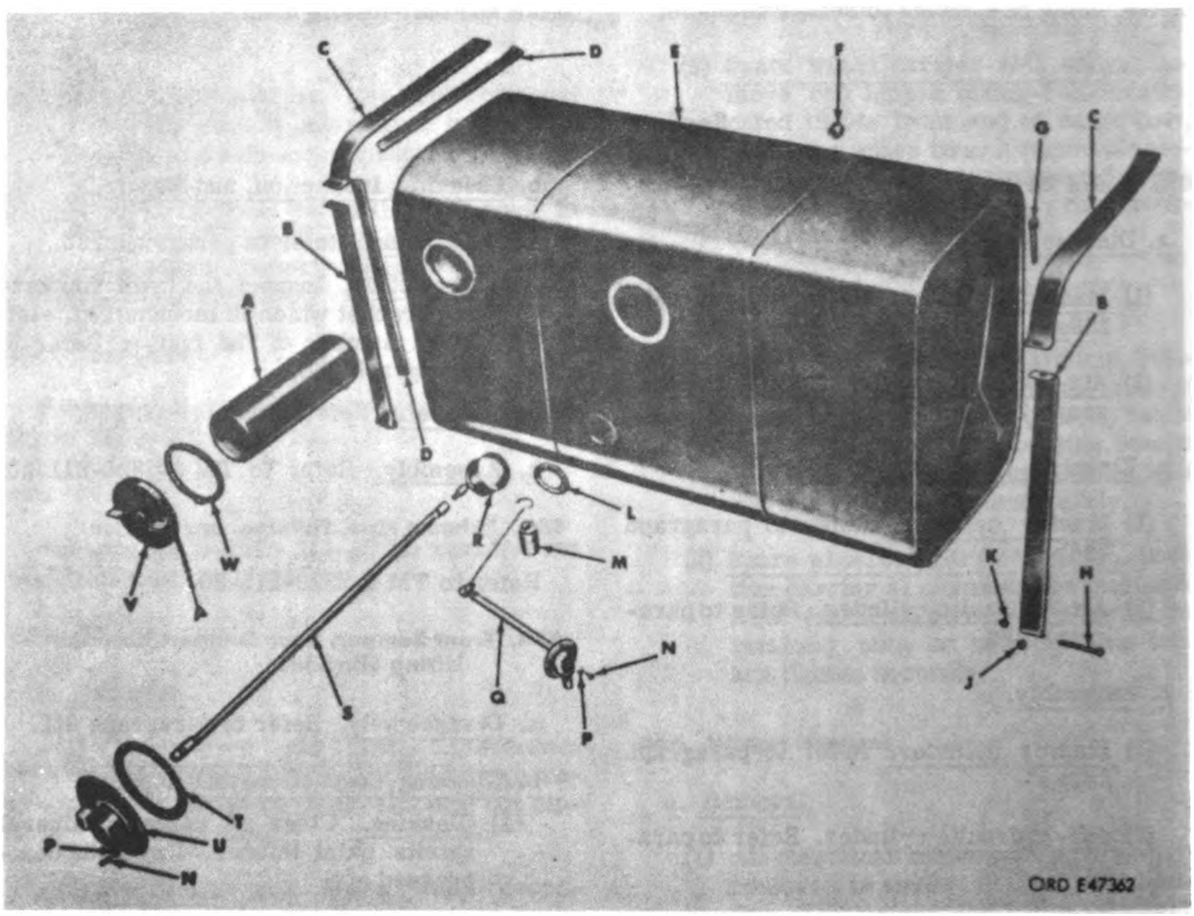

Figure 573. Fuel tank - exploded view

paint thinner. Wash filter with paint thinner. Remove sediment from interior of tank, using small amount of mineral spirits paint thinner.

(2) Inspection. Inspect tank for cracks or damage. Tank may be tested for leaks by plugging all openings, except one, and applying air pressure of 6 psi. Inspect filler cap and sleeve for damage.

(3) Repair. Small leaks by welding. Replace defective parts.

Warning: Do not attempt repair unless tank has been cleaned and properly treated to expel all inflammable or explosive fumes. Merely draining tank does not make it safe for welding. An "empty" tank can be more dangerous than a full one. Before repairing, thoroughly steam tank or use other approved method to completely remove all fumes.

c. Assembly. Install filler pipe sleeve and filler cap with a new gasket. Place a new gasket on vent cover and install vent and filler assembly in position on tank. Aline holes, install screws and washers, and tighten. Position new gasket on fuel tank sending unit assembly and place assembly on tank. Install screws and washers and tighten. Install drain plug in bottom of tank.

455. Pintle (Fig. 574)

a. Disassembly. It is necessary to completely disassemble the pintle to remove it from the frame. Refer to TM 9-2320-211-20 for disassembly procedures.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean all parts in dry-cleaning solvent or mineral spirits paint thinner.

(2) Inspection. Inspect shaft on hook for signs of excessive wear or damage. Inspect hook, lock, and latch for damage.

(3) Repair. Remove raised metal or scores with fine stone. Replace latch chain if missing or broken. Replace defective parts.

c. Assembly.

(1) Place outer bracket (one with lubricating fitting) on shaft end of hook and insert shaft through frame.

(2) Place inner bracket on shaft inside frame with the flat side of bracket against frame. Install bolts attaching brackets to frame, being sure the lubricating fitting is on the bottom.

(3) Install safety nuts and tighten securely. Install plain washer, slotted nut, and cotter pin on end of shaft.

(4) Position hook lock on hook and install special bolt, jam nut, and cotter pin. Position latch spring and hook latch in lock and press pin in place.

456. Piping

a. Disassembly. Refer to paragraph 444. After removal, no further disassembly is required.

b. Cleaning, Inspection and Repair.

(1) Cleaning. Flush with warm water and soapsuds.

(2) Inspection and repair.

(a) Check fuel lines and fittings to see that they are in good condition and securely supported. Check for leaks and replace if damaged. Inspect vent line for security of attachment.

(b) Check brake lines, assemblies, and fittings underneath the truck to see that they are properly supported, securely connected, and not chafing or leaking. Replace if damaged.

457. Spare Wheel Carrier (M51, M51A2)

a. Disassembly. Disassembly of spare wheel carrier is not necessary as the carrier is welded together and no mechanical devices are involved.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean carrier with mineral spirits paint thinner. Dry with compressed air.

(2) Inspection and repair. Inspect carrier for cracks, breaks, or damage. Repair cracks and breaks by welding.

458. Frame

a. Disassembly.

Note. The disassembly of the frame is considered complete when all associated parts have been removed. No cross members, gussets, brackets, reinforcements, or engine mounts will be removed unless inspection reveals that replacement or repair is necessary.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Use dry-cleaning solvent or mineral spirits paint thinner to clean grease or dirt from all parts of the frame. Steam may be used to remove heavy accumulation of dirt or grease 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.

(a) Inspect frame side members for any cracks, bends, or misalinement. Inspect cross members for cracks or

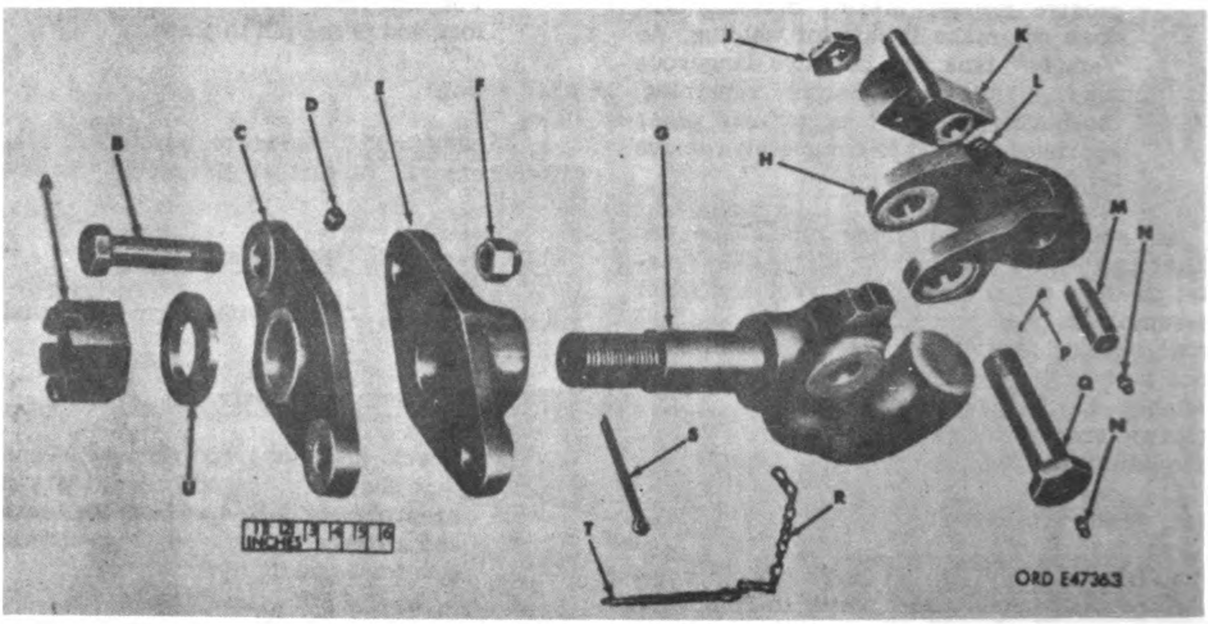

Figure 574. Pintle - exploded view

Key	Item	Key	Item
A	Nut, slotted	L	Spring, latch
B	Bolt, hex-head	M	Pin, latch
C	Bracket, outer	N	Fitting, lubricating
D	Fitting, lubricating	P	Pin, cotter
E	Bracket, inner	Q	Bolt, special
F	Nut, safety	R	Chain, latch
G	Hook	S	Pin, cotter
H	Lock, hook	T	Pin, cotter
J	Nut, jam	U	Washer, plain
K	Latch, hook		

Figure 574. Pintle - exploded view - legend

damage. Inspect riveted joints for cracks or broken rivets. Inspect all bolted brackets and supports for cracks or damage. Inspect running-board hangers and running boards for damage.

(b) Check the frame for misalinement as follows: measure and compare the distance between 1 and 4, and 2 and 3 of figure 572. Similarly, measure and compare the distance between points 3 and 6, 4 and 5, 5 and 8, and 6 and 7. Measurements between the pairs of points designated shall be constant to within one-eighth of an inch. Variation in excess of one-eighth of an inch indicates distortion of side frames, or damaged cross members, causing misalinement.

(3) Repair.

(a) The use of heat is not recommended when straightening frames. Where possible, straightening should be done cold and with pressure. Frame side members, which are bent or buckled sufficiently to show strain after straightening, must be repaired or replaced.

(b) No established rules can be made on the necessity, length, or kinds of reinforcement to install on frame members which have been bent, broken, or cracked. Reinforcement can be made with channel, angle, or flat stock. Use electric arc welding when reinforcing damaged side members. Do not weld on gussets of frame, or edges of frame members as this will weaken the frame and encourage development of new cracks.

(c) Cross members, brackets, or gussets that are damaged or broken must be replaced. Cut off all rivets to remove bolts from parts to be replaced. Install new part and use new rivets or bolts to secure in position.

489. Side Members, Cross Members, Supports, and Brackets

a. Disassembly. Refer to paragraph 447.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Refer to paragraph 458b. (1).

(2) Inspection.

(a) Inspect side members for cracks, bends, and distortion.

(b) Inspect cross members for cracks, bends, and for missing rivets at points of attachment to side members.

(c) Inspect all bolted and riveted supports and brackets, including transverse cab support member; spring hangers; rear suspension support brackets, running board, fuel tank, and front fender supports; and shock absorber, engine, transfer, and body mounting brackets for cracks, bends, and for loose bolts or rivets at attachment points.

(3) Repair.

Caution: Do not weld or apply heat to frame side rails or cross members. Any method of welding will destroy heat treatment of frame, causing metal adjacent to weld to be weakened.

(a) Straighten bent side and cross frame members if possible.

(b) Repair cracked members by welding, using plate or angle stock for reinforcing damaged sections.

(c) Replace frame members which cannot be repaired.

(d) Straighten bent supports and brackets.

(e) Repair damaged items by welding, but replace items that are damaged severely.

(f) Replace loose or missing rivets. Replace missing bolts. Tighten loose bolts.

c. Assembly. Refer to paragraph 447.

460. Running Boards

a. Disassembly. Refer to paragraph 449.

b. Cleaning, Inspection, and Repair.

(1) Cleaning. Clean running boards with soap and water, using stiff brush to remove accumulations of grease and dirt. Dry with compressed air.

(2) Inspection. After running boards have been thoroughly cleaned, inspect for dents, distortion, cracks, loose welds, and holes.

(3) Repair. Remove dents, using suitable sheet metal working tools. Repair cracks, and broken welds by welding. Patch holes with material of same thickness as that to which it is applied and of sufficient size to lap approximately two inches all around the hole. Paint surface after repair. Replace parts damaged beyond repair.

CHAPTER 25.1 (Added) EXPANSIBLE VAN BODY M291A2 AND M291A2C

Section I SCOPE AND DESCRIPTION

460.1. Scope

These sections provide the procedure for the replacement of mechanical and electrical components on the expansible van body. For other repair procedures of the expansible van body components, refer to TM 9–2320–211–20.

460.2. Description

For a description of the expansible vans M291A2 and M291A2C, refer to TM 9–2320–211–20, and changes thereto.

Section II REMOVAL, REPAIR AND INSTALLATION

460.3. Retractable Beam Drive Shaft and Sprockets

Note. The key letters noted in parentheses refer to figure 574.1, except where otherwise indicated.

a. General. The procedure below covers the replacement of an individual retractable beam drive shaft. Use the same procedure to replace the other shaft.

b. Removal.

(1) Remove six screws (AA) from each of the sprocket box covers (AB) and remove the covers.

(2) Remove 30 rivets from each of the protective covers under the center of the expansible van body and remove the covers.

(3) Make a careful note of the arrangement of the bushings (C, AF), sprockets (AH) and spacers (AG, Y) on the shaft (T). Notice that there are four bushings (C) with setscrews (B), located in the transverse frame members (D) midway between the operating mechanism boxes (AL), and nine bushings (AF) without setscrews, located in the sidewalls of the operating mechanism boxes (AL).

(4) Using the retractable beam drive shaft wrench (S), rotate the shaft (T) until the setscrews (B) in the bushings (C) are accessible for removal.

(5) Loosen the setscrews (B) in each of the four bushings (C).

(6) Examine the shaft for burs, nicks or corrosion which would hamper easy withdrawal. Remove or reduce the burs, nicks or corrosion with a file or emery cloth. Lubricate the entire shaft to facilitate withdrawal.

(7) Attach a suitable pulling device to the drive shaft locking ratchet (V). Be careful not to damage the ratchet teeth.

(8) Station one man under the van body to remove the components from the shaft as it is withdrawn from the body. Pull the shaft out slowly, releasing one component at a time from the front end of the shaft.

Caution: **If the shaft is to be re-used, do not bend or strain the shaft. It must be kept absolutely straight at all times.**

(9) Remove the pulling device from the ratchet.

(10) Drive out the taper pin (U) securing the ratchet (V) and the ratchet hub bushing (W) to the shaft (T) and remove the ratchet and ratchet hub bushing.

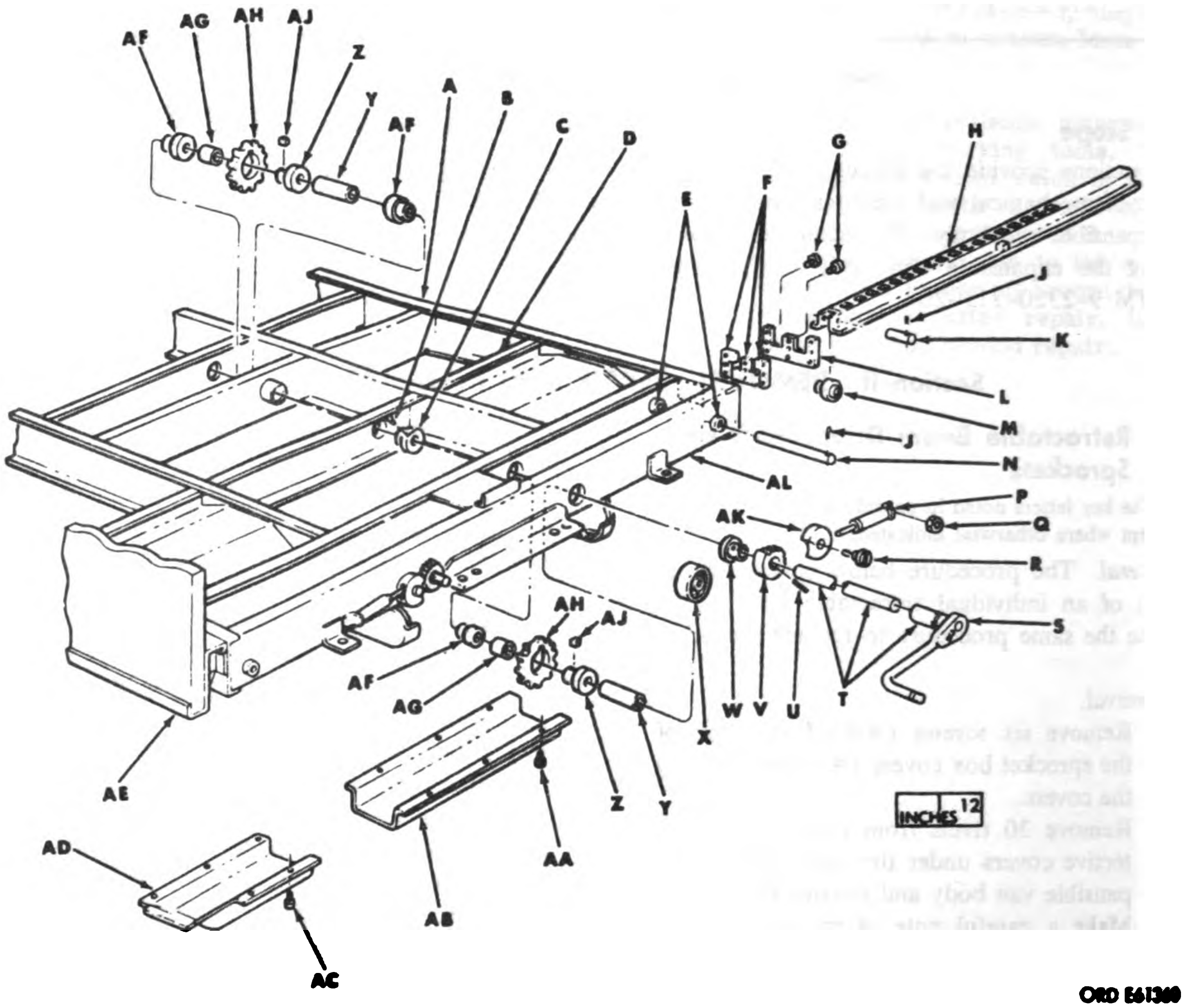

Figure 574.1. Expansible van body retractable beam operating mechanism—exploded view.

Key	Item	Key	Item
A	Underframe assembly	U	Ratchet locking pin
B	Setscrew	V	Ratchet
C	Bushing, setscrew type	W	Ratchet hub bushing
D	Transverse frame member	X	Beam support roller
E	Support roller shaft bushing	Y	Spacer, long
F	Seal assembly	Z	Sprocket hub
G	Screw	AA	Cover screw
H	Retractable beam	AB	Sprocket box cover
J	Cotter pin	AC	Cover screw
K	Beam end roller shaft	AD	Roller compartment cover
L	Seal retaining plate	AE	Van body movable side
M	Beam end roller	AF	Bushing, non-setscrew type
N	Support roller shaft	AG	Spacer, short
P	Lock assembly	AH	Sprocket
Q	Nut	AJ	Sprocket key
R	Screw	AK	Pawl
S	Retractable beam shaft wrench	AL	Operating mechanism box
T	Retractable beam shaft		

c. Installation.

Note. If the retractable beams (par. 460.5) or rectractable beam rollers (pars. 460.4 and 460.6) are to be replaced, this should be done before the drive shaft and sprockets are installed.

(1) Examine the entire length of the retractable beam drive shaft (T) for burs, nicks or other defects which would prevent easy insertion. Bevel the forward end of the shaft slightly with a fine-tooth file to permit easy insertion of the bushings (B, AF) and the sprocket and hub assemblies (AH, Z).

(2) If the retractable beams (H) have been replaced, make sure they are all in correct position to receive the sprocket teeth.

(3) Raise the shaft into position, providing adequate support to prevent sagging or bending. Keep the shaft straight at all times.

(4) Lubricate about two feet of the portion of the shaft being inserted.

(5) Station a man under the van body to assemble a set of bushings (AF), sprocket and hub assembly (AH, Z), and spacers (AG, Y) and hold them in position in the operating mechanism box (AL). Use figure 574.1 and legend as a guide.

(6) Push the shaft slowly through the van body frame (A) and the bushings, spacers and sprocket hub until the front end of the shaft protrudes beyond the front of the operating mechanism box.

(7) Install a setscrew-type bushing (C) on the shaft, with the setscrew (B) facing downward to facilitate tightening. Do not tighten the setscrew at this time.

(8) Repeat steps (4), (5), (6) and (7) until the end of the shaft is flush with the end of the final forward bushing.

Caution: **As the components are added to the shaft, increased pushing resistance will be encountered. If the shaft comes to an abrupt stop, do not use excessive force. Investigate each componnent for nicks, burs, or misalinement. Make necessary corrections before proceeding with the installation of the shaft.**

(9) Install the ratchet (V) and hub (W) on the rear end of the shaft (T) so that all the taper pin holes are alined and the ratchet teeth face the pawl (AK) when the van body sides are fully retracted. Secure the ratchet to the shaft with a No. 6 taper pin (U).

Note. If a new shaft is being installed, it may be necessary to ream the taper pin hole in the shaft with a No. 6 taper pin reamer for a tight fit.

(10) Adjust all four setscrew-type bushings (C) to allow 1/16- to 1/8-inch end play on the retractable beam drive shaft (T).

(11) Lubricate all moving parts with GAA at assembly. Operate the mechanism several times to see that it is operating properly. Make readjustments where necessary.

(12) Install all covers removed in *b*(1) above.

460.4. Retractable Beam Support Roller

a. General. The retractable beam support roller may be replaced without removing the retractable beam or the retractable beam drive shaft.

b. Removal (Fig. 574.1).

(1) Remove seven screws (AC) from the roller compartment cover (AD) and remove the cover from the roller compartment.

(2) Remove the cotter pin (J) from each end of the support roller shaft (N).

(3) Raise retractable beam (H) slightly to relieve the weight on the support roller (X).

(4) Slide the support roller shaft (N) from the support roller.

c. Installation (Fig. 574.1)

(1) Lubricate the support roller shaft (N) with a thin layer of GAA grease.

(2) Position the support roller (X) under the retractable beam (H), with hub alined along the axis of the support roller shaft (N).

(3) Raise the retractable beam (H) slightly to relieve the weight on the support roller (X).

(4) Slide the support roller shaft (N) through the support roller hub (X) into the shaft bushings (E) on each side of the operating mechanism box (AL).

(5) Install a new cotter pin (J) in the hole provided near each end of the roller shaft (N).

(6) Install the cover (AD) on the roller compartment with seven screws (AC).

460.5. Retractable Beam

a. General. The expansible van body movable side is supported solely by the five retractable beams. Replace the retractable beams one at a time so that the side is supported by the remaining four retractable beams. All ten retractable beams are replaced by using the same procedure.

b. Removal.

(1) Expand the van body movable side (fig. 574.2) to its extreme outward limit (refer to TM 9–2320–211–10 and changes thereto.

(2) Remove the retractable beam drive shaft and sprockets (par. 460.3).

(3) Support the van body movable side assembly with suitable hoisting equipment, slings and/or jacks.

(4) Remove the retractable beam support roller (par. 460.4).

(5) Remove nine screws (G, fig. 574.1) from the retaining plate (L) and remove the retaining plate (L) and seals (F) from the van body under frame (A).

(6) Separate the end of the retractable beam from the lower frame of the van body movable side (fig. 574.2) with a welding torch.

(7) Lower the outer end of the beam (H) sufficiently to clear the bottom of the movable side and withdraw it from the body underframe (A).

c. Installation.

Note. If the retractable beam end roller (par. 460.6) is to be replaced, this should be done before the retractable beam is installed.

(1) Position the retractable beam (with end roller installed) in alinement with the entry slot at the lower edge of the van body underframe (fig. 574.2).

(2) Insert the retractable beam about halfway into the underframe.

(3) Weld the protruding end of the retractable beam to the frame of the van body side.

(4) Install the seals (F, fig. 574.1) and retaining plate (L) to the retractable beam entry slot (fig. 574.2) with nine screws (G, fig. 574.1).

(5) Install the retractable beam support roller (par. 460.4).

(6) Remove the supporting equipment (*b*(3) above) from the van body movable side.

(7) Install the retractable beam drive shaft and sprockets (par. 460.3).

(8) Operate the retracting mechanism several times to see that all parts are alined properly. Make adjustments where necessary.

460.6. Retractable Beam End Roller

Note. The key letters noted in parentheses refer to figure 574.1, except where otherwise indicated.

a. General. The retractable beam end roller (M), can be replaced only when the retractable beam has been removed from the van body underframe assembly. When a replacement of the retractable beam is made, inspect the end roller carefully and replace roller (M) and shaft (K) if excessive wear is noted.

b. Removal.

(1) Remove the retractable beam (par. 460.5).

(2) Remove the cotter pin (J) from each end of the roller shaft (K).

(3) Slide the end roller shaft (K) from the end roller (M) and remove the roller and shaft.

c. Installation.

(1) Lubricate the end roller shaft (K) with a thin layer of GAA grease.

(2) Position the end roller (M) between the split end of the retractable beam (H) with the roller hub alined with the roller shaft holes.

(3) Slide the end roller shaft (K) through the shaft holes in the retractable beam and the end roller (M).

(4) Install a new cotter pin (J) in the hole provided near each end of the end roller shaft.

(5) Install the retractable beam (par. 460.5).

460.7. Electrical Wiring Harness, 24-Volt

a. General. The 24-volt wiring circuits include only the wiring for the exterior blackout and clearance lights. The 24-volt wiring harness is routed as shown in figure 574.3.

b. Removal.

(1) Remove the clearance and blackout lights. Refer to TM 9–2320–211–20, and changes thereto.

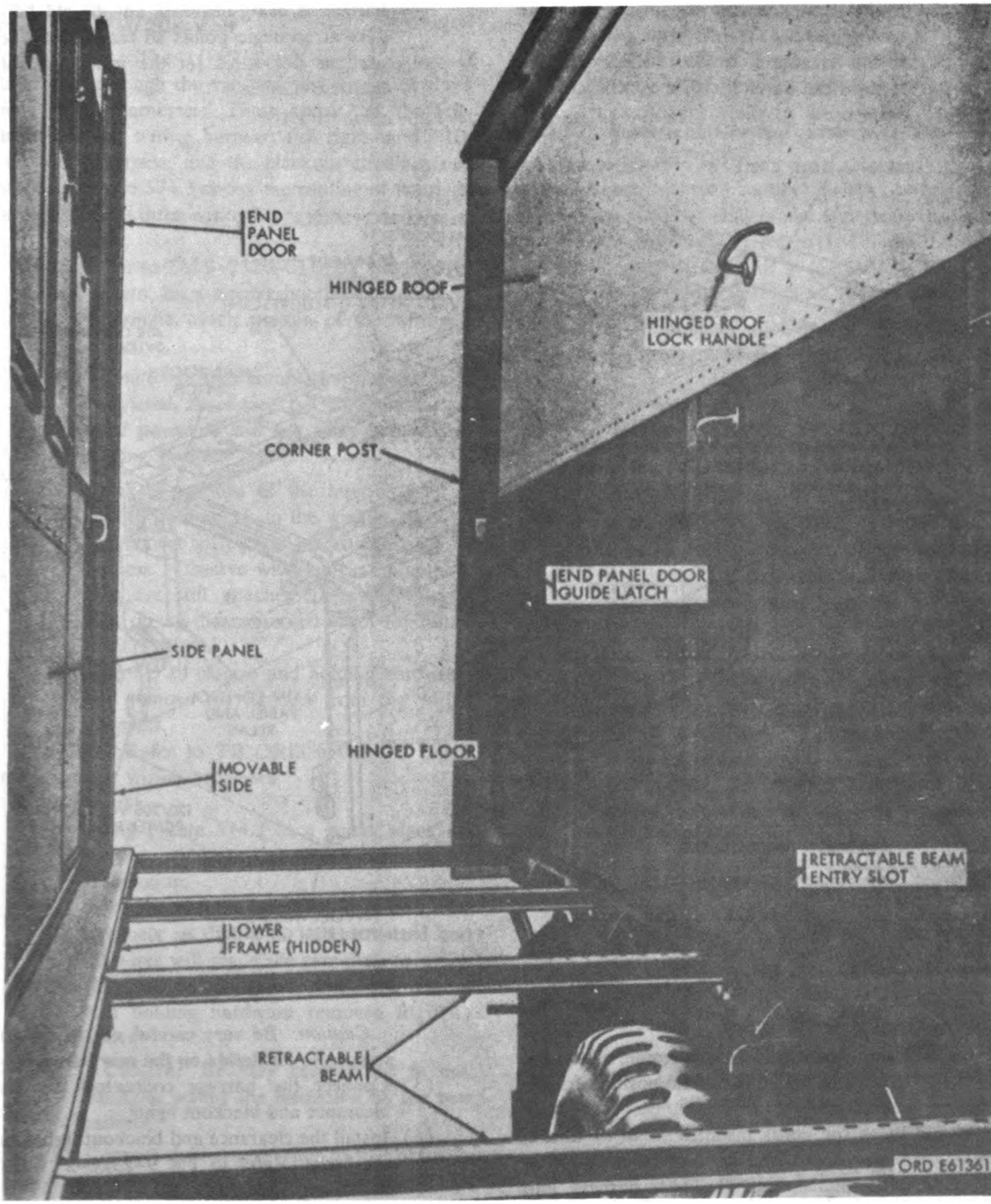

Figure 574.2. Expansible van body retractable beams and movable side.

(2) Disconnect the harness connector at each blackout and clearance light.
(3) Remove portions of the interior wall or roof where necessary to gain access to the wiring harness.
(4) If the harness is to be re-used, pull the harness out carefully. Tie a stout cord to each end to provide a means of pulling in the replacement harness.
(5) If the harness is being discarded and a new harness is being installed, cut the old harness at strategic points so that it may be used as pull-wires for the installation of the new harness.

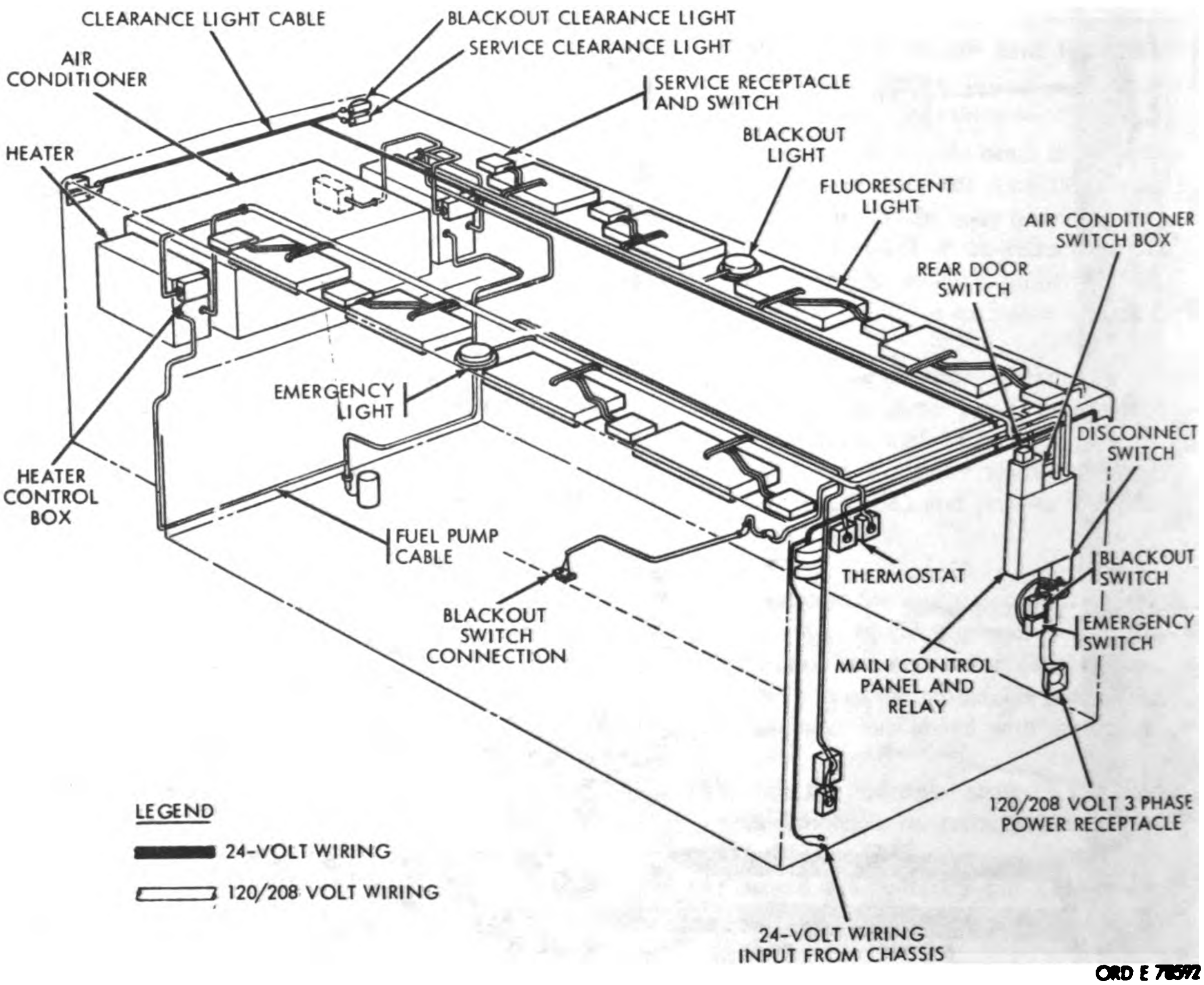

Figure 574.3. Expansible van body wiring harness routing.

c. Installation.

(1) Using figure 574.3 as a guide, place the harness in the approximate position for installation.
(2) Using the cords installed in *b*(4) above, or portions of the old harness prepared in *b*(5) above, pull the new harness into place.

Caution: **Be very careful not to cut or scrape the insulation on the new harness.**

(3) Connect the harness connectors to the clearance and blackout lights.
(4) Install the clearance and blackout lights on the body. Refer to TM 9-2320-211-20, and changes thereto.
(5) Refer to TM 9-2320-211-20, and changes

thereto, for the test procedure to determine if the lights are operating properly.

460.8. Electrical Wiring Harness, 110/208-Volt

a. General. The 110/208-volt wiring system is distributed through the van body by means of three main wiring harnesses. These consist of the left-hand 110-volt wiring harness, the right-hand 110-volt wiring harness, and the blackout circuit wiring harness. Figure 574.3 shows the routing of the main branches of the three wiring harnesses.

b. Removal.

(1) Refer to TM 9-2320-211-20, and changes thereto, for a troubleshooting procedure to determine which portion of the wiring is defective.

Caution: **After troubleshooting has been completed, disconnect all sources of electrical power to the van body before proceeding further.**

(2) Remove portions of the interior wall or roof to gain access to the wiring harness.

(3) Disconnect all equipment attached to the harness. Observe whether circuit number tabs are still attached. Replace missing tabs or tag the unmarked wires for future identification.

(4) Remove all clamps and holding hardware, and remove the harness from the wiring channels.

c. Repair. Refer to TB ORD 650 for a repair procedure for wiring harnesses.

d. Installation.

(1) Using Figure 574.3 as a guide, place the harness in the approximate position for installation.

(2) Feed the harness into the ducts or wiring channels so that it is well protected and all wires will reach the terminals to which they will be connected. Install all clamps and holding hardware removed in *b*(4) above.

Caution: **Be very careful not to cut, pinch, or scrape the insulation on the new harness.**

(3) Connect the harness wires to the terminals of the van body auxiliary equipment. Be sure to match the circuit number tabs on each wire to the numbers on the equipment terminals. Tighten all connections securely.

(4) Make sufficient tests to determine that all electrical equipment is operating properly.

(5) Install the portions of the interior wall or roof removed in *b*(2) above.

460.9. Electrical Control Switch Boxes (Fig. 574.4)

a. General. Three control switch boxes are mounted on the rear wall of the van body adjacent to the right rear door. Refer to TM 9-2320-211-20, and changes thereto, for a complete description of these units.

Warning: **Disconnect all external power supply cables before removal of any electrical components.**

b. Removal.

Note. The three control switch boxes are interlocked by means of pipe nipples and wiring. Removal must be accomplished in the sequence shown in (1) through (11) below.

(1) Disconnect all sources of electrical power to the van body.

(2) Remove four screws securing the cover of the air conditioner circuit breaker box, and remove the cover (fig. 574.5).

(3) Remove two screws and open the large door of the 110-volt circuit breaker box.

(4) Open the door of the main power switch.

(5) Remove the door blackout switch bracket (fig. 574.4) from the air conditioner circuit breaker box.

(6) Disconnect and remove the wires and cables from the air conditioner circuit breaker box.

(7) Remove the four screws securing the air conditioner circuit breaker box to the wall, and the locknut and pipe nipple between the air conditioner circuit breaker box and the 110-volt circuit breaker box. Remove the air conditioner circuit breaker box.

(8) Disconnect and remove the wires and cables from the 120-volt circuit breaker box. Observe whether circuit number tabs are still attached. Replace missing tabs or tag the wires for future identification.

(9) Remove the four screws securing the 110-volt circuit breaker box to the wall, and the locknut and pipe nipple between the

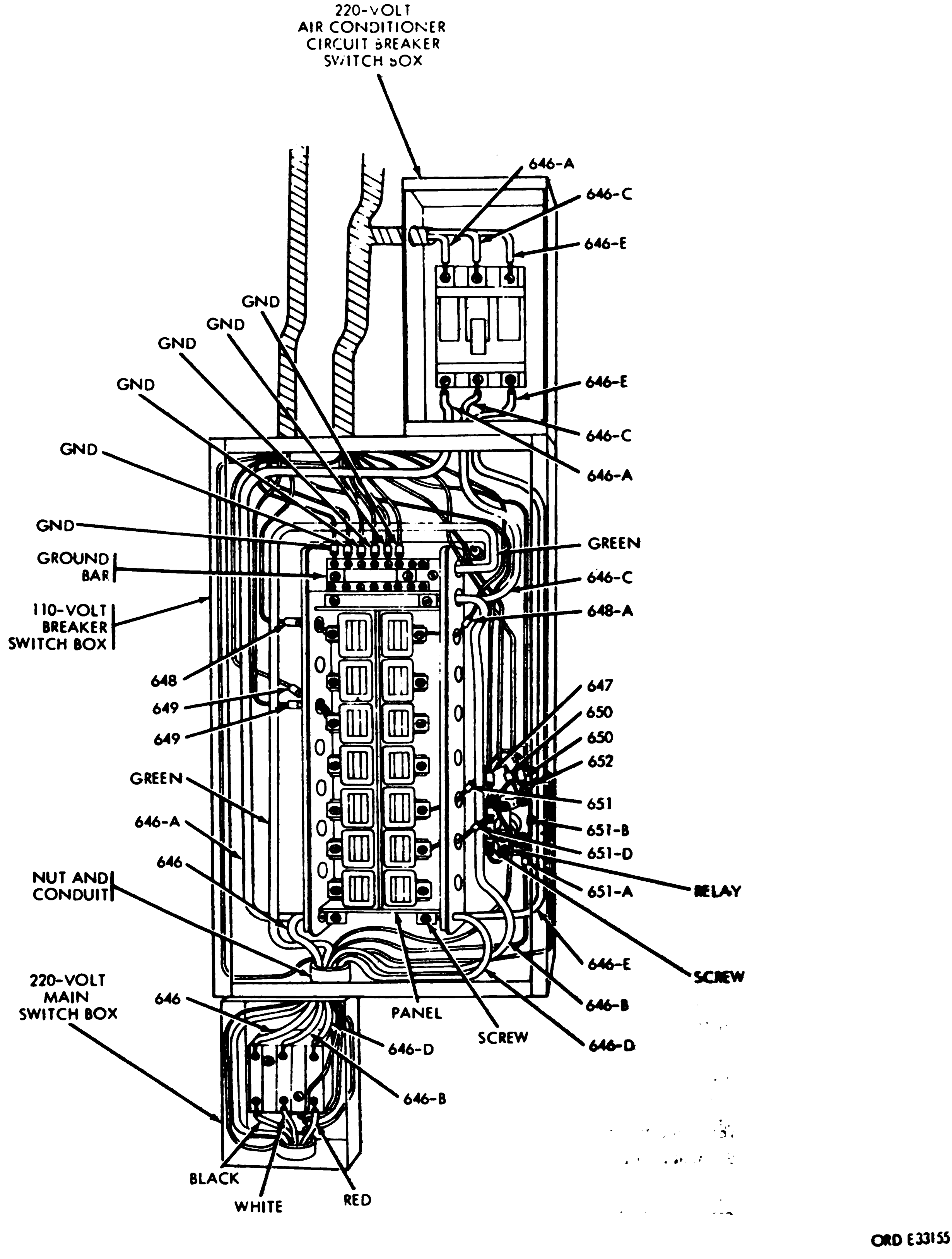

Figure 574.4. Expansible van body electrical control and switch boxes—removal and installation.

110-volt circuit breaker box and the main switch box. Remove the 110-volt circuit breaker box.

(10) Disconnect and remove the wires and cables from the main switch box.

(11) Remove the four screws securing the main power switch box to the wall, and the locknut securing the box to the entrance conduit. Remove the main power switch box.

c. Installation. Install the main power switch box, the 110-volt circuit breaker box and the air conditioner circuit breaker box in the reverse order of removal. Make sure all connections are tight and bare wire ends do not touch any metallic parts of the boxes.

460.10. Power Entrance Receptacle

a. Removal.

(1) Disconnect all external power sources to the van body.

(2) Disconnect the three entrance wires (black, white, and red) in the main power switch box (fig. 574.5). Disconnect the green entrance wire in the 120-volt circuit breaker box.

(3) Remove four bolts, nuts and lockwashers securing the power entrance receptacle to the rear wall of the van body (fig. 574.5).

(4) Unscrew the locking nut securing the power entrance conduit to the power entrance receptacle.

(5) Remove the van interior and van exterior components of the power entrance receptacle, pulling the power entrance cable out of the power entrance conduit.

b. Installation. Install the power entrance receptacle in the reverse order of removal. Make sure all connections are tight, and bare wire ends do not touch any metallic parts of the boxes or receptacle.

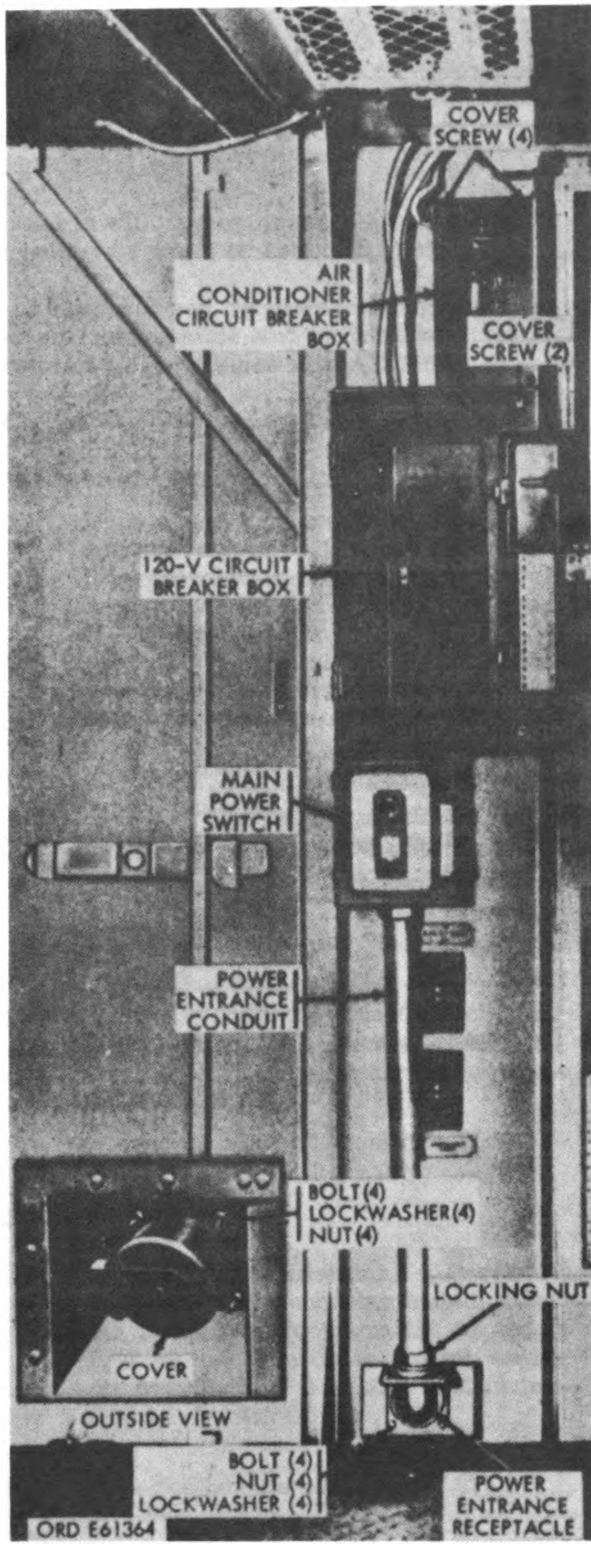

Figure 574.5 110/208-volt power entrance receptacle, control and switch boxes.

CHAPTER 26

SPECIAL PURPOSE EQUIPMENT (KITS)

Section I. INTRODUCTION

461. Scope

This chapter contains field and depot maintenance instructions for deep-water fording and winterization equipment including necessary kits designed for use on the 5-ton 6 x 6 vehicles covered by this manual. No instructions for modifying the vehicle are included herein. Refer to the pertinent modification work order for prior preparation of the vehicle before attempting any installation. This chapter also contains a description of the major units of each kit and their function in relation to other components of the vehicle. Further, the major components of each kit are listed herein.

Note. These listings are not to be used for requisitioning purposes. Refer to TM 9-2320-211-35P for initial requisitioning of kits or repair parts in support of kit-equipped vehicles.

462. Authorization

a. Installation of kits is authorized under criteria defined in SB 9-16 for winterization kits, and SB 9-155 for the deep-water fording kit.

b. Records of unit replacement of components of this equipment should be kept separate from those pertaining to the basic vehicle, and turned in with the equipment when removed for inspection, repair, or returned to stock.

c. Disposal and requisitioning of parts removed from vehicle and/or not used from kit are to be in accordance with AR 755-5.

463. Service Upon Receipt of Material

a. Inspection and Cleaning.

(1) When a new or reconditioned kit is received, determine if it has been properly prepared for service and that all necessary parts are present. Inspect all assemblies, subassemblies, and parts for proper assembly and condition. If any exterior surfaces are coated with rust-preventive compound, remove the compound with dry cleaning solvent or mineral spirits paint thinner.

(2) Ordinary deficiencies disclosed during preliminary inspection, servicing, or during installation will be corrected by maintenance personnel performing the installation.

b. Correction of Deficiencies. Serious deficiencies detected in the equipment, which occur under the circumstances indicated in AR-700-38, should immediately be reported in accordance with TM 38-750.

Section II. PERSONNEL (GASOLINE) HEATER KIT

464. Description and Data

a. Description.

(1) General. The 978 series personnel heater kits are supplied for use in areas where the normal temperatures during the coldest period of the year is 5°F. and lower. In addition to the heater, heat controls, and accessories covered in this section, these kits also contain all mounting parts, ducts, fuel lines, and other equipment required for individual installations. Personnel heaters provide uncontaminated, heated air and are used primarily to supply heat to the crew compartment, engine oil pan, battery box, and to the windsheld defrosters.

(2) Gasoline burning heater (fig. 575).

(a) The Model 978 heater has a rated heat output of 20,000 BTU per hour and is of the fuel metering type.

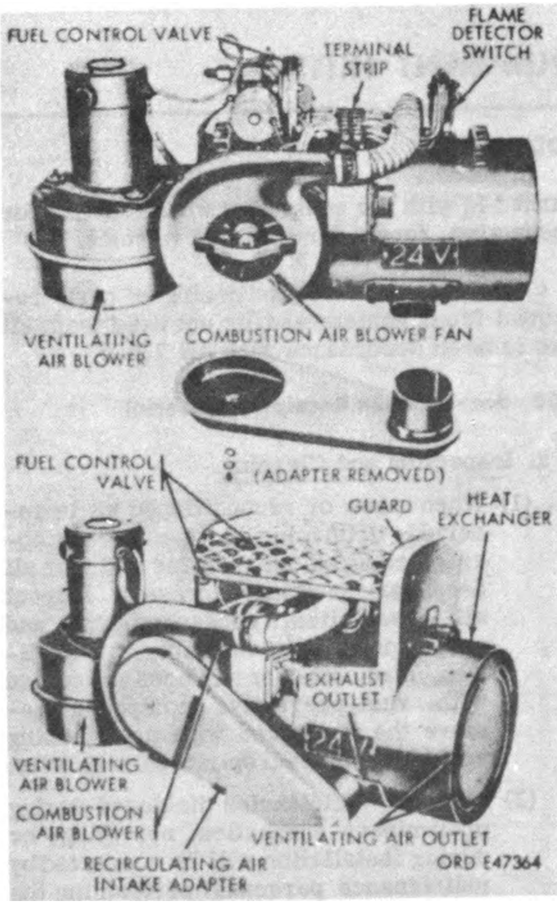

Figure 575. Personnel heater model 978 MR-24

(b) For operation, the heater requires fuel under pressure of 1 to 15 pounds per square inch, electric current for ignition, and a flow of combustion and ventilating air.

(c) The heater is of sealed, all welded, stainless steel construction. The combustion air, ventilating air, and exhaust passages are completely separated so that products of combustion cannot enter the ventilating air stream. The necessary connections for fuel and electric current are outside the heater housing.

(d) Principal components of the heater are: The heat exchanger, heater housing, flame detector switch, fuel control valve, standpipe and vaporizer pad, fuel preheater, igniter, overheat switch, combustion air blowe assembly, ventilating air blower assembly, terminal strip, and recirculating combustion air inlet adapter.

(3) Heat exchanger (fig. 576).

(a) The heat exchanger is made of stainless steel and consists of a cylinder-shaped central chamber and an outer chamber which encases the central chamber. The two chambers are connected at the top by a slot that extends the full length of the exchanger, and at the bottom by a small opening which serves as a drain tube in the event any gasoline should accumulate in the exchanger.

(b) One end of the exchanger contains the igniter pocket which has openings for the igniter and fuel standpipe. Two tubes extend from the exchanger and provide passage for the combustion air at the top and exhaust gases at the

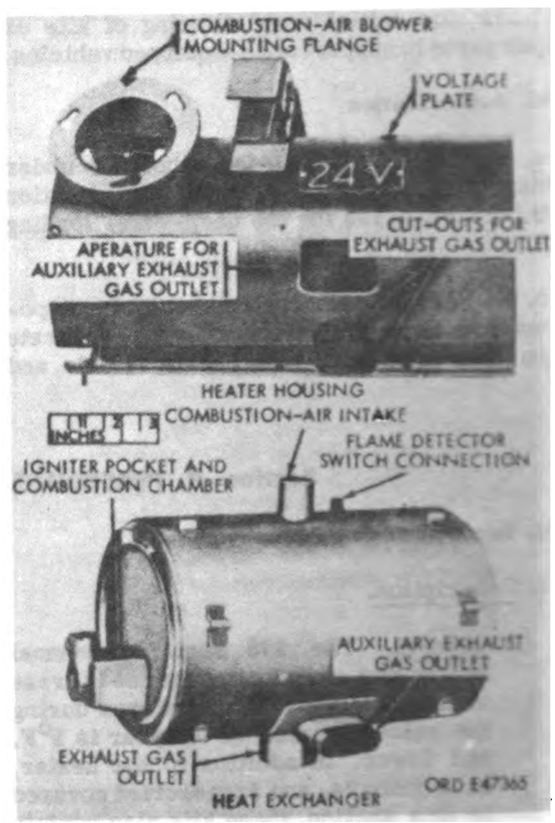

Figure 576. Heater housing and heat exchanger

bottom. The exhaust tube is connected to the outer chamber while the combustion air tube extends into the portion of the central chamber, known as the combustion chamber.

(c) The combustion chamber is located inside the central chamber near the igniter pocket. It consists of a stainless steel cone with a semicircular baffle welded inside.

(d) A steel baffle, between the combustion chamber and the rod of the flame detector switch prevents the direct flame from striking the flame detector rod to prolong service life.

(e) The heat exchanger of the Model 978-MR heaters has an auxiliary exhaust outlet at right angles to the regular outlet on the bottom of the heat exchanger. This is an oval tube which is welded into the side of the heat exchanger, for use with the recirculating combustion air intake adapter (see fig. 575).

(4) Heater housing (fig. 576). The one-piece heater housing fits around the heat exchanger. A formed edge extends the full length of the housing at the centerline of the exhaust tube, to simplify removal and replacement.

(5) Igniter (fig. 577).

(a) The igniter which screws into the igniter well, is a resistance coil of the "glow plug" type that heats red hot when current is passed through it.

(b) The igniter is a 6 volts DC unit. On 12- and 24-volt heaters, a series dropping resistor is used to reduce the voltage to the proper value. In this way, the igniter is interchangeable on all models.

(6) Flame detector switch (fig. 578).

(a) The flame detector switch consists of a quartz rod encased in a metal tube with a mounting bracket, which supports a microswitch and adjusting spring.

(b) The quartz rod and tube extend into the central chamber of the heat exchanger where they are subjected to the heat of the flame. The heat causes the tube to expand and allows the quartz rod, which does not expand, to move downward and release the pressure on the microswitch button.

(7) Overheat switch (fig. 578). The overheat switch will automatically close the shutoff solenoid of the fuel control valve

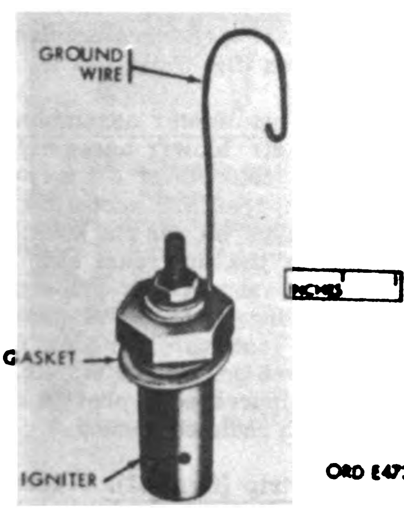

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Figure 577. Igniter

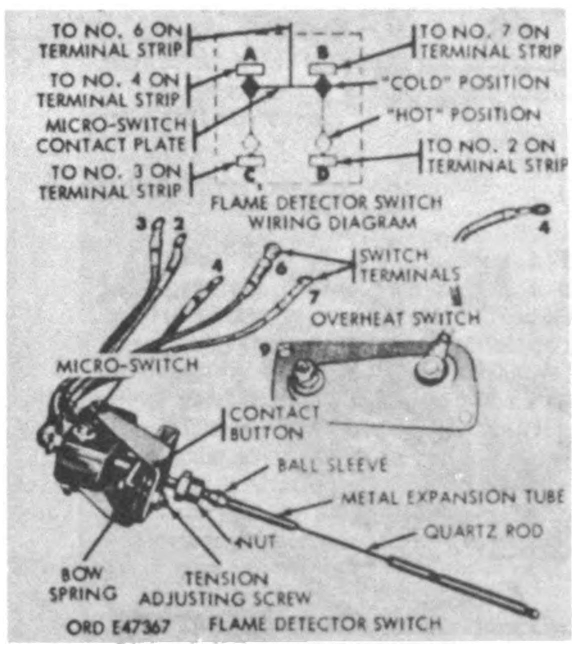


Figure 578. Flame detector switch and overheat switch

and stop the fuel flow in the event the heater becomes overheated. It consists of a fixed contact point and a bi-metal blade which is mounted directly in the ventilating air stream.

(8) Fuel control valve (fig. 579). The fuel control valve consists of a valve body, pressure regulator, two solenoid-operated valves and an orifice or metering plate. Its purpose is to control and meter the quantity of fuel flowing into the heat exchanger. (Refer to TM 9-8662.)

(9) Standpipe and vaporizer wick (fig. 580). The fuel valve standpipe connects the fuel valve (fig. 575) to the igniter pocket in the heat exchanger (fig. 575). The vaporizer wick is a stainless steel wire mesh pad and is partially threaded into the heat exchanger end of the standpipe. When the standpipe is screwed into the igniter pocket, the pad extends inside where it is saturated by the fuel flowing from the valve to the exchanger.

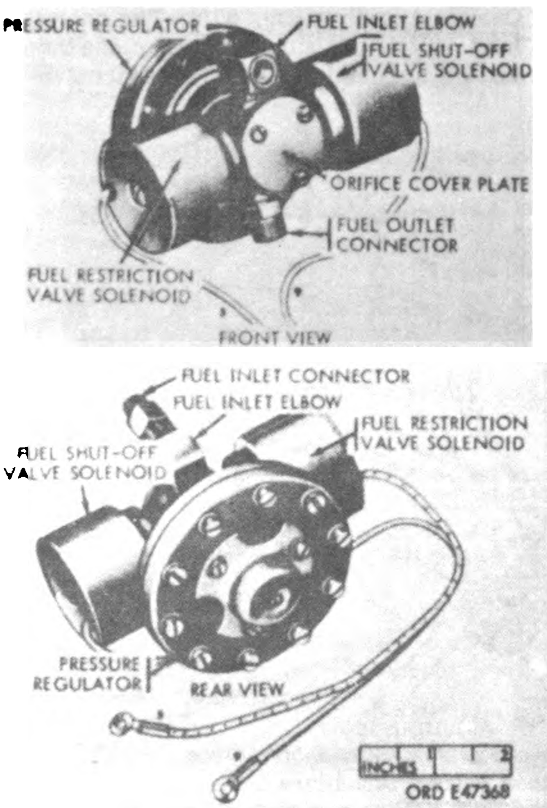


Figure 579. Fuel control valve

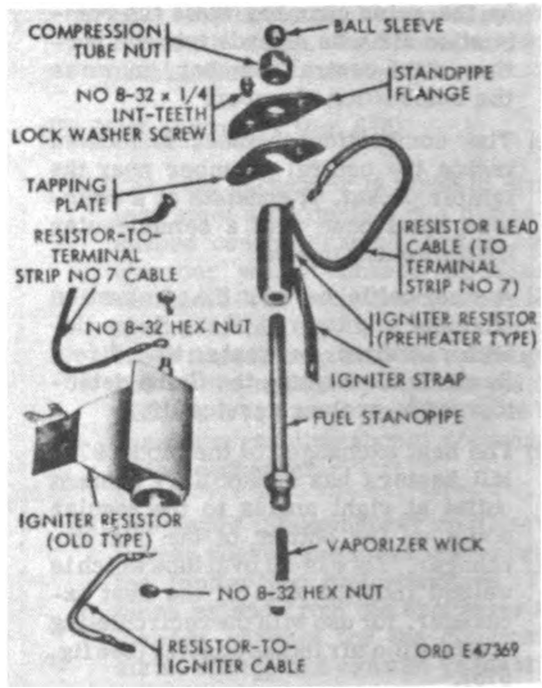


Figure 580. Standpipe and vaporizer wick

(10) Combustion air blower assembly (fig. 581). The combustion air blower assembly consists of a motor, blower wheel and housing. It is designed to supply the proper amount of air to maintain the correct fuel-air ratio. The blower assembly can be removed from the heater housing in one piece due to the type of mounting provided. An adapter is used to effect recirculation of exhaust gases (fig. 575).

(11) Ventilating air blower assembly. The ventilating air blower assembly (fig. 581) which consists of a heavy-duty, ball bearing, 1/40 H.P. motor, "squirrel cage"-type blower and housing, is mounted on the upstream end of the heater by means of four studs on the heater housing. This blower assembly provides a ventilating air flow of approximately 6 pounds per minute. The blower is suppressed to prevent interference with radio equipment.

(12) Terminal strip (fig. 582). A terminal strip consisting of six terminals, is provided on top of the heater housing to facilitate disassembly.

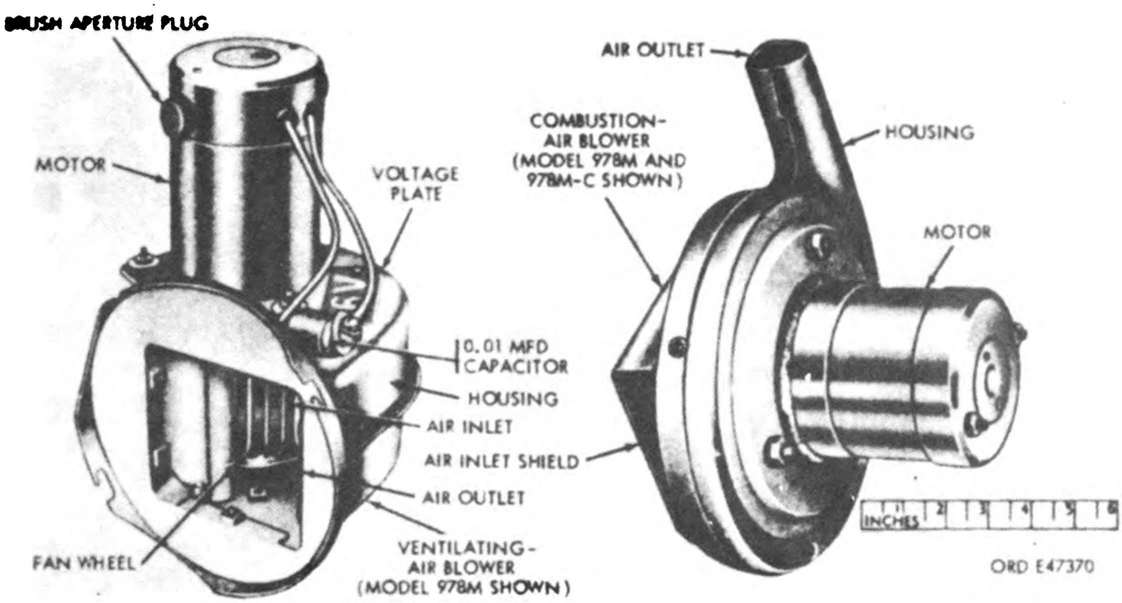


Figure 581. Ventilating-air and combustion-air blowers

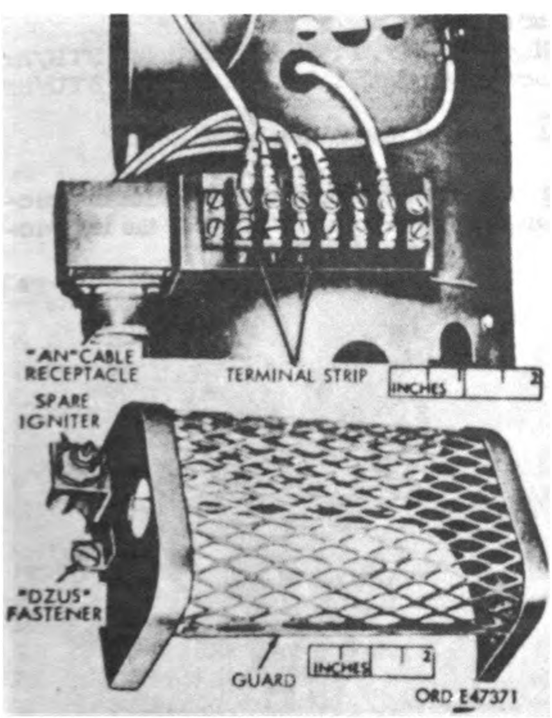


Figure 582. Terminal strip and guard

(13) Protective cover guard. A heavy mesh protective cover guard (fig. 582) is secured to the top of the heater housing by means of two Dzus fasteners. This cover protects the heater components located on the top of the housing. The heater wiring diagram is mounted inside the cover.

(14) Control box (fig. 583).

(a) The control box contains a heater switch, HI-LO switch, and a circuit breaker to protect the heater assembly. On installations which contain a safety valve, a safety prime switch is used in addition to the other switches. The HI-LO switch is omitted if a thermostat is used to regulate temperature. If an electric fuel pump is used, the prime switch also starts the fuel pump when placed in the prime position.

(b) This box is designed so that the electrical receptacle can be mounted on the back or on the bottom of the box by relocating the mounting screws and grommet without unsoldering wires.

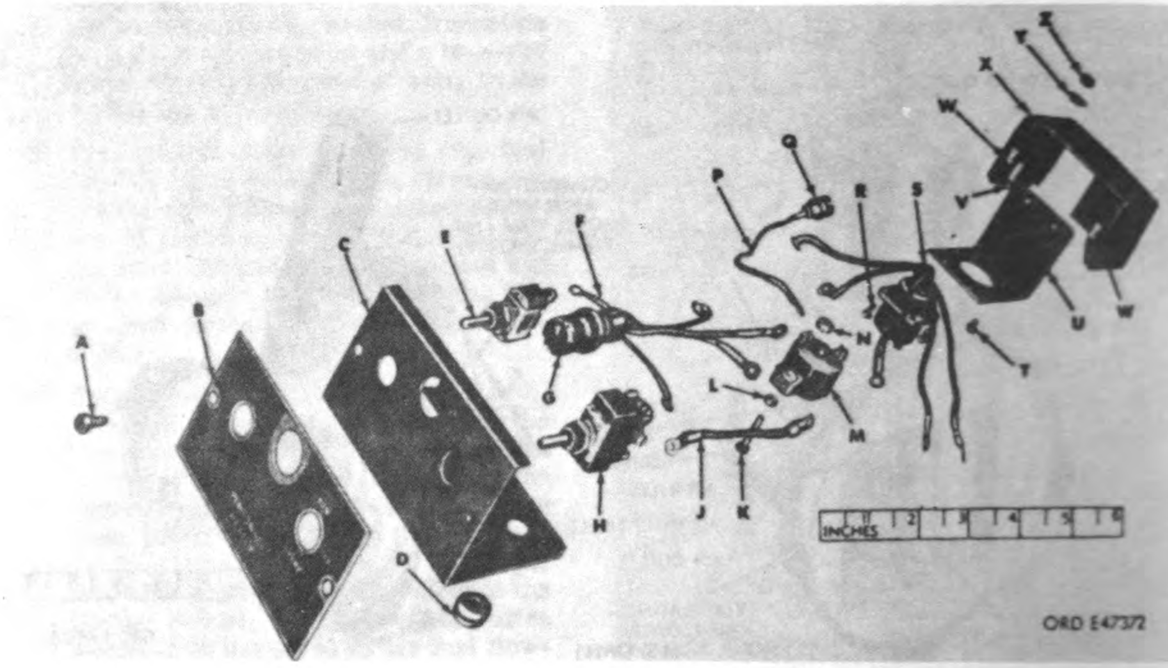


Figure 583. Heater control box-exploded view

(15) Safety valve. The safety valve (fig. 584) consists of a shutoff solenoid and a casting, which houses a large diaphragm and spring. The safety valve provides just the initial flow of fuel for ignition. Additional fuel to sustain combustion is received only after the shutoff solenoid of the safety valve is energized when the ventilating air blower comes on.

Note. Latest type control box (fig. 583) with press-to-test indicator light does not have safety valve reset switch because the safety valve has been eliminated.

b. Data.

Weight . . . . approx 23 lb
Dimensions:
  Width . . . . approx 8-1/4 in.
  Length . . . . approx 18-1/2 in.
  Height . . . . approx 9-3/4 in.
Electrical supply . . . . 24 V DC
Current consumption:
  Starting load . . . . 11 amp
  Operating . . . . 2.5 amp
Fuel . . . any automotive or aviation gasoline
Fuel pressure . . . . 1 to 15 lb-sq in.
Fuel consumption:
  High heat . . . . 1 gal/4 hr
  Low heat . . . . 1 gal/8 hr
Heat output:
  High heat . . . . 20,000 BTU/hr
  Low heat . . . . 10,000 BTU/hr

465. General Installation Instructions

a. Complete illustrated installation instructions are packed in each kit. Use the instruc-

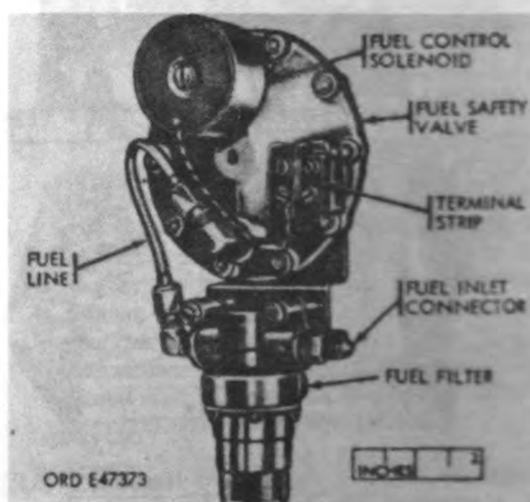


Figure 584. Fuel safety valve and fuel filter

tion booklet as a reference when making a specific installation, since there may be variations due to engineering changes. Differences in individual kits may occur, even though the kits bear the same Ordnance numbers and were designed for the same vehicle.

b. If it is anticipated that the winterization equipment will subsequently be removed from the vehicle at the same station where installed, store the empty boxes and cartons for use in future shipments or storage. In repacking, all fuel apertures in tubes and accessories should be plugged to prevent entrance of foreign matter.

466. Installation of Heater Kit Components (Fig. 585)

a. Install Heater Fuel Line (Fig. 586). Connect the heater fuel line to the fuel pump outlet

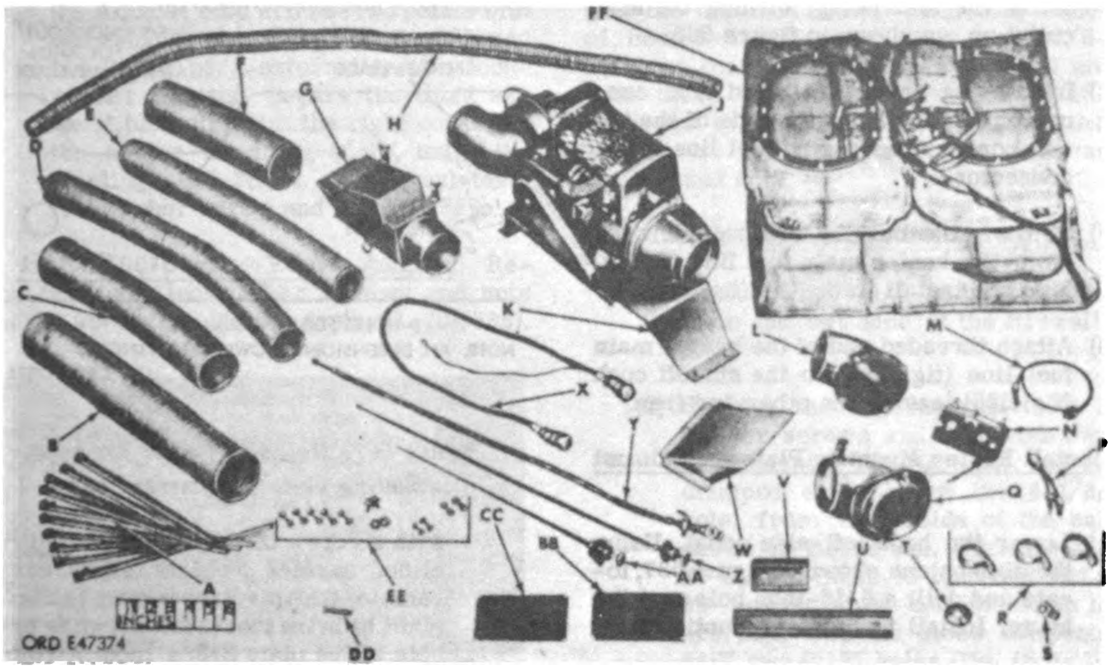


Figure 585. Personnel heater kit components

Key	Item	Key	Item
A	Heat duct clamps	S	3/8-inch tube x 3/8-inch male pipe end inverted flared tube connector
B	22-1/2-inch heat duct		
C	19-1/2-inch heat duct	T	Wiring harness grommet
D	29-inch defroster duct	U	Fender brace
E	26-inch defroster duct	V	Control cable mounting bracket
F	14-inch heat duct	W	Air inlet hood
G	Heat diverter with four 1/4-20 x 3/4 screws, lockwashers and nuts	X	Heater wiring harness
		Y	Heater main fuel line with shutoff cock, bushing, and tee
H	70-inch heater exhaust tube		
J	Personnel heater	Z	Diverter heat control cable
K	Heater mounting plate	AA	Adapter heat control cable
L	90-degree elbow adapter	BB	Heater operating instructions plate
M	Control box cable	CC	Heater wiring diagram plate
N	Heater control box	DD	Cotter pin
P	Y-connector	EE	Attaching hardware
Q	Heat duct adapter	FF	Brush guard cover
R	Exhaust tube clamps		

Figure 585. Personnel heater kit components - legend

by performing the procedure given in paragraphs (1) to (4) below.

Note. If heat is required without operating vehicle engine, an electric fuel pump must be installed. For instructions see paragraph 477.

(1) Disconnect the engine fuel line at the outlet of the fuel pump (fig. 586). Remove the tee from the heater main fuel line (fig. 585) and install it in the outlet of the fuel pump, turning the side outlet up, as shown in figure 586.

(2) Install the inverted flared tube connector (fig. 586) in the side of the tee and connect the engine fuel line to the connector.

(3) Remove the bushing and shutoff cock from the heater main fuel line (Y, fig. 585) and install in the tee (fig. 586).

(4) Attach threaded end of the heater main fuel line (fig. 585) to the shutoff cock (fig. 586) leaving the other end free.

b. Install Heater Mounting Plate and Exhaust Tube.

(1) Lower the hood left-side panel. Using the dimensions shown in figure 587, locate and drill a 5/16-inch hole near the hinge. Install the heater mounting plate

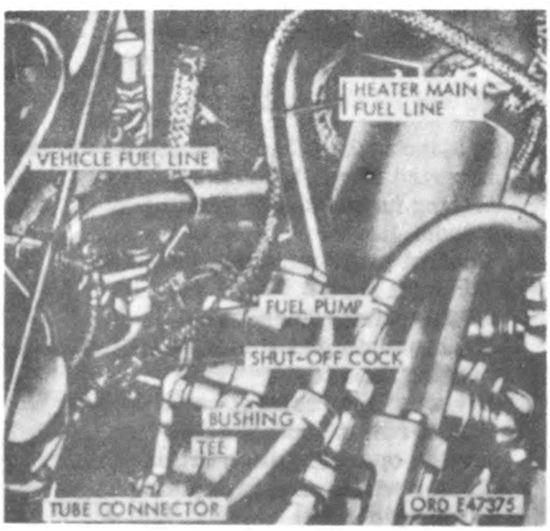


Figure 586. Heater main fuel line connected to fuel pump outlet

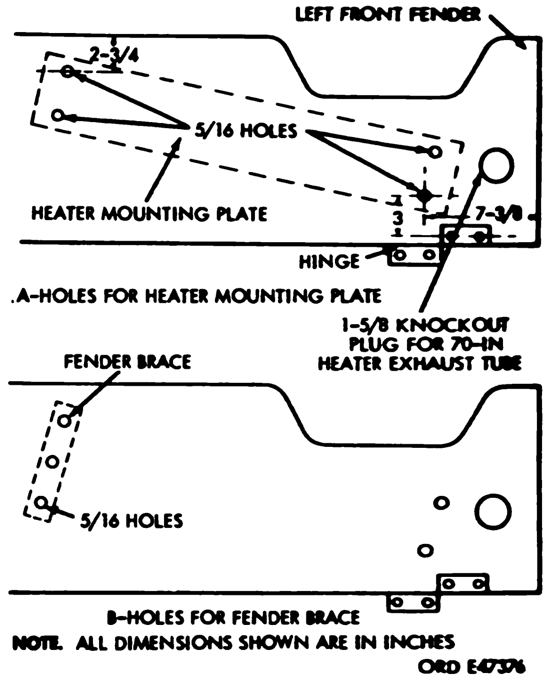


Figure 587. Holes in fender for heater mounting plate and fender brace

with a screw through this hole, with inclined surface on plate toward rear of vehicle; then pivot the forward end of the plate to bring the inside mounting screw hole of the plate 2-3/4-inches from the edge of the fender, as shown in A, figure 588. With the mounting plate in this position, mark the three remaining holes and remove the plate.

(2) Use the fender brace (U, fig. 585) as a template and locate the fourth hole in the front fender, as shown in B, figure 587. Drill the four holes with a 5/16-inch drill.

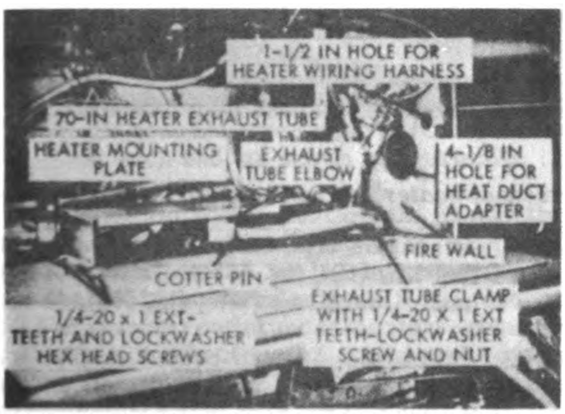
(3) Remove the 1-5/8-inch knockout plug for 70-inch heater exhaust tube (A, fig. 587).

(4) Secure the 70-inch heater exhaust tube elbow (H, fig. 585) on the bottom of the heater mounting plate with a new cotter pin (DD, fig. 585), as shown in figure 588. Pass the end of the exhaust tube through the 1-5/8-inch hole in the left front fender and attach the fender brace and heater mounting plate to the fender

with five 1/4-20 x 1 external-teeth lockwasher, and hex-head screws and nuts (fig. 588). Place the fender brace underneath the fender, at the left end of the mounting plate.

(5) Run the heater exhaust tube down and around the inside edge of the fender and over the running board hanger. Drill two 5/32-inch holes at the approximate locations shown in figure 588 and secure the exhaust tube at these two points with two exhaust tube clamps (R, fig. 585) and 1/4-20 x 5/8-external-teeth lockwasher screws. Secure the third exhaust tube clamp at the right corner of the heater mounting plate, using the existing 1/4-20 x 1-external-teeth lockwasher screw and nut (fig. 588).

c. Install 90-Degree Elbow Adapter. Remove the four lockwasher screws and nuts from the 90-degree elbow adapter (L, fig. 585).



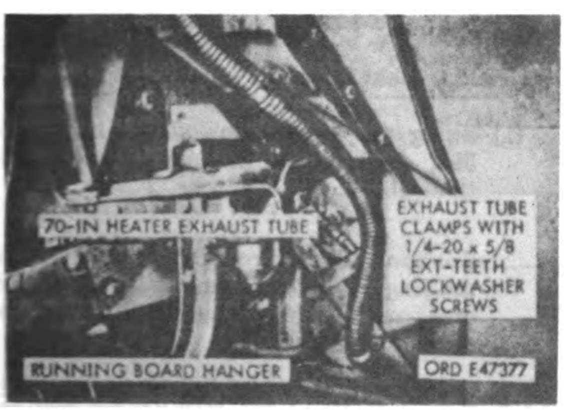


Figure 588. Heater mounting plate and heater exhaust tube installed

Remove the knockout plug from the hood left-side panel, position the adapter on inside of panel, over the 4-1/8-inch hole, with elbow straight back toward the heater, and locate the four holes. Drill the holes with a No. 7 drill. Secure the elbow adapter with the air screen, to the hood left-side panel with the four external-teeth lockwasher, screws and nuts (fig. 589).

d. Install Air Inlet Hood (Fig. 589). Position the air inlet hood (W, fig. 585) on outside of hood left-side panel, over the 4-1/8-inch hole, so that the inlet faces forward and locate three holes. Drill the three 5/16-inch holes and secure inlet hood to panel with three 1/4-20 x 5/8 external-teeth lockwasher, screws and nuts.

e. Install Heat Duct Adapter (Q, Fig. 585).

(1) Remove the 4-1/8-inch knockout plug from the left side of the firewall (fig. 588).

(2) Remove the two external-teeth lockwasher screws and nuts from the heat duct adapter (Q, fig. 585) and fit the crimped end through the 4-1/8-inch hole, from the inside of the cab, as shown in figure 589. Turn the adapter so that it faces to the right and about 30° upward in the cab, as shown in figure 590. Use the elbow to locate and drill two 0.177 holes (No. 16 drill) and secure the elbow to the firewall with the two No. 8-32 x 1-1/2 external-teeth lockwashers, screws and nuts (fig. 590).

f. Install Personnel Heater and Ducts (Fig. 591).

(1) Place the personnel heater (J, fig. 585) on the heater mounting plate, position the heater spacer and heater holddown clamp, and secure with the two clamp bolts; install heater retaining clamp (fig. 589).

(2) Connect the heater-to-filter fuel line from the outlet of the heater fuel filter.

(3) Attach the 22-1/2-inch heat duct (B, fig. 585) to the 90-degree elbow adapter and the air inlet adapter with a heat duct clamp (A, fig. 585) at each end, as shown in figure 591.

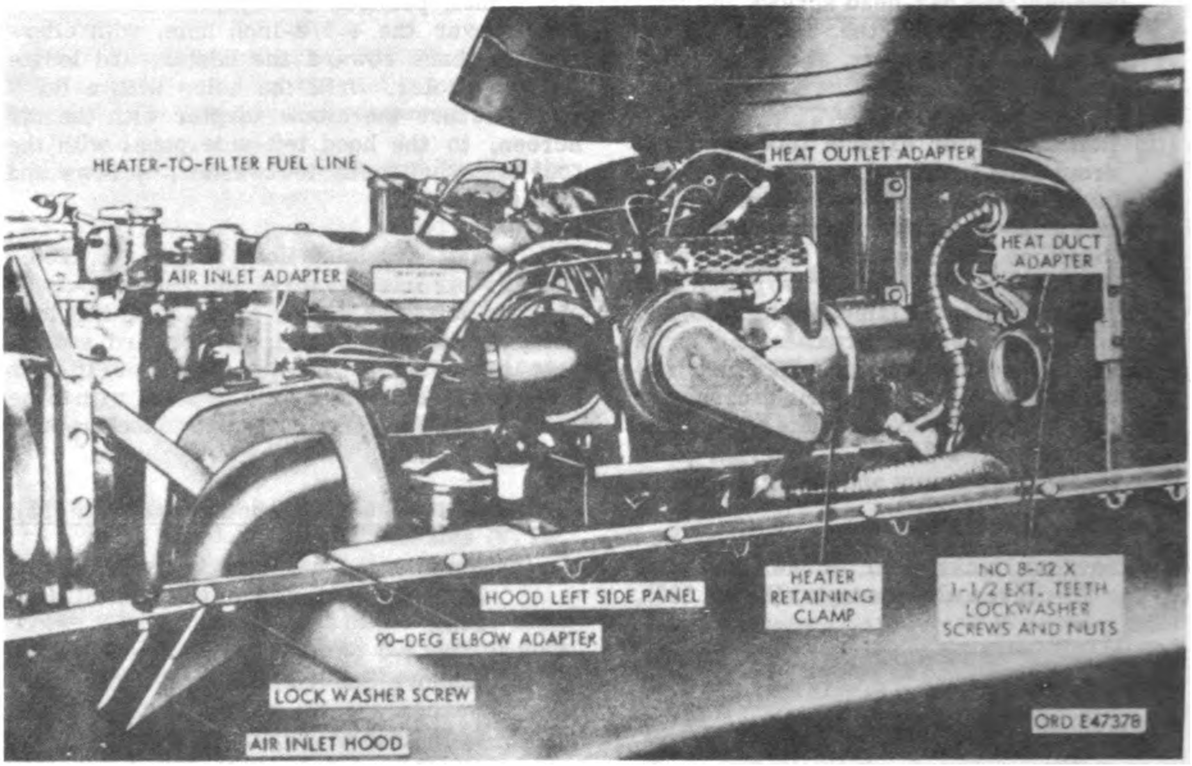


Figure 589. Air inlet hood, elbow adapter, personnel heater and air adapter installed

Figure 590. Heat duct adapter installed

(4) Attach the free end of the heater main fuel line (NN, fig. 585) to the inlet of the heater fuel filter (WW, fig. 585).

(5) Attach the 14-inch heat duct (F, fig. 585) to the heat outlet adapter and to the inlet of the heat duct adapter with a heat duct clamp at each end, as shown in figure 591.

g. Install Heat Diverter (G, Fig. 585).

(1) Using the dimensions shown in figure 592, drill four 9/32-inch holes in the firewall.

Caution: Be extremely careful when drilling, to avoid damage to cables or other components attached to the engine side of the firewall.

(2) Secure the heat diverter (Q, fig. 593) to the firewall with four 1/4-20 x 3/4-screws, lockwashers, and nuts (S, fig. 593).

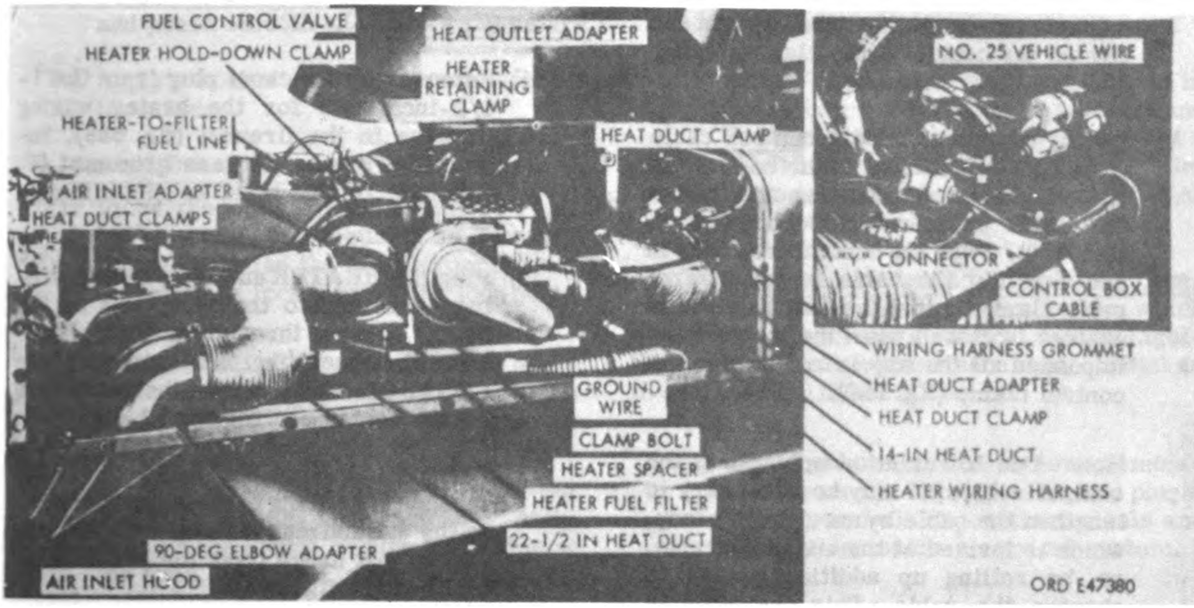


Figure 591. Personnel heater, heat ducts, and wiring harness installed

(3) Secure the 19-1/2-inch heat duct (T, fig. 593) to the heat duct adapter and to the heat diverter with a heat duct clamp at each end, as shown in figure 593.

h. Install Defroster Heat Ducts. Secure the 29-inch defroster duct (D, fig. 585) to the right diverter outlet and to the left defroster nozzle, and the 26-inch defroster duct (E, fig. 585) to the left diverter outlet and to the right defroster nozzle with two heat duct clamps at each end, as shown in figure 593. The defroster ducts are crossed.

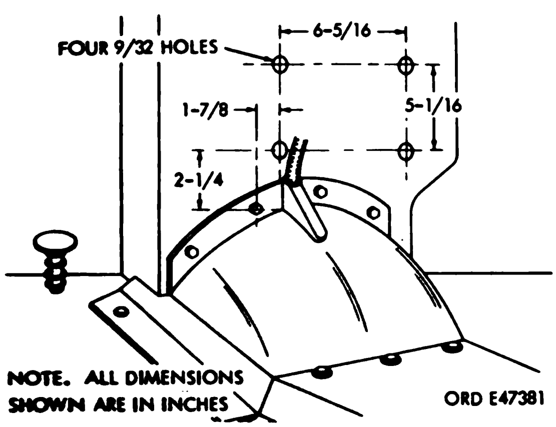


Figure 592. Location of heat diverter mounting holes

i. Install Control Cables.

(1) Using the dimensions shown in figure 594, drill two 5/16-inch holes in the underedge of the instrument panel and attach the control cable mounting bracket (V, fig. 585) with two No. 2 10-32 x 5/8-screws and nuts (M, fig. 593).

(2) Insert the diverter heat control cable (Z, fig. 585) through the left hole in the bracket and connect it to the diverter control arm (P, fig. 593). Push the control knob fully in and position the cable

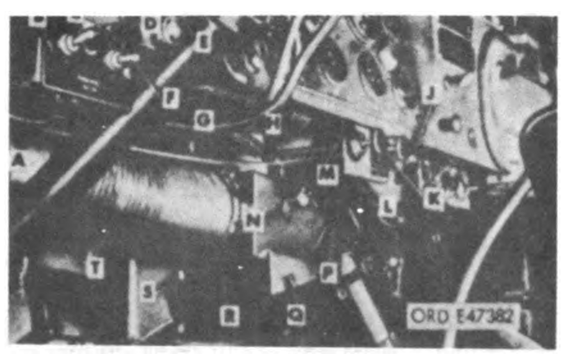


Figure 593. Heat diverter, defroster heat ducts, control box, and control cables installed

in the control cable clamp so that the control arm is on the extreme right and tighten the control cable clamp (N, fig. 593).

(3) Insert the adapter heat control cable (AA, fig. 585) in the right hole of the mounting bracket and connect the end of this cable to the adapter control arm (fig. 590). Push the control knob fully in and position the cable in the control cable clamp so that the butterfly in the adapter is closed when the control knob is pushed all the way in and tighten the control clamp (fig. 590).

Note. Due to variation in length of the control cables, it may be necessary to lengthen the cable by unrolling the loop, which is formed at the end of the cable, or by rolling up additional wire to shorten the cable. This operation is done with long-nose pliers. If necessary, the end of the wire can be clipped off and a new loop formed when the cable cannot be shortened sufficiently by rolling up the existing loop.

j. Install Heater Control Box (N, Fig. 585).

(1) Using the dimensions shown in figure 594, drill two 5/16-inch holes in the underedge of the instrument panel.

Caution: Be careful when drilling the second hole, to avoid damage to the windshield wiper tube.

(2) Attach the heater control box (N, fig. 585) with the two screws (furnished with the box), as shown in figure 593.

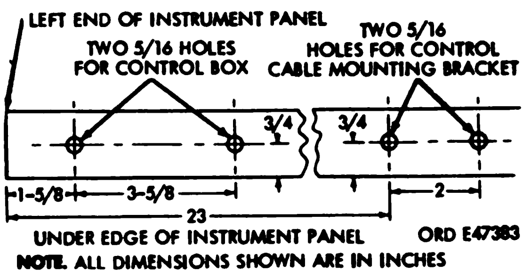


Figure 594. Location of mounting holes for control cable, mounting bracket and control box

k. Install Wiring Harness and Instruction Plates (X, Fig. 585).

(1) Remove the knockout plug from the 1-1/2-inch hole for the heater wiring harness in the firewall (fig. 588). Install the wiring harness grommet (T, fig. 585) in this hole, as shown in figure 591.

(2) Plug the HEATER end of the heater wiring harness into the receptacle on the heater, pass it through the wiring harness grommet (fig. 591) and plug the CONTROL BOX end into the receptacle on the heater control box (B, fig. 593).

(3) Pass the control box cable (fig. 591) through the wiring harness grommet into the cab and plug the connector into the fitting that hangs from the heater control box (B, fig. 593).

(4) On the engine side of the firewall, break the vehicle No. 25 wire (fig. 591) at the Douglas connector on the firewall, install the Y-connector (P, fig. 585) in this line, and then attach the control box cable (M, fig. 585) to the Y-connector.

(5) Attach the ground wire (fig. 591) from the heater wiring harness to the heater mounting plate, using the same lockwasher screw that secures the 70-inch heater exhaust tube clamp (fig. 588).

(6) Mount the heater operating instructions plate (BB, fig. 585) and heater wiring diagram plate (CC, fig. 585) on the inside of the left-side door, using the No. 10-32 x 3/8 self-tapping screws.

l. Procedure.

(1) Type (or hand print) on white paper, in red capital letters the following:

WARNING:

DO NOT OPERATE HEATER IF EXHAUST FUMES ARE DETECTED

(2) On or near the personnel heater control panel, cover an area the size of the typed warning notice with varnish FSN 8010-263-3196 and allow to dry until tacky.

(3) Place warning notice on varnished area and press smooth and allow to dry.

(4) Apply a coat of varnish over the warning notice.

m. Install Brush Guard Cover (Fig. 595).

(1) Place the brush guard cover (FF, fig. 585) over the brush guard, as shown in figure 595. Use the metal grommets on the cover to locate mounting loop positions.

(2) Drill mounting screw holes with a 11/64-inch drill and secure the loops to the brush guard with the self-tapping screws provided in the kit.

(3) Fit the brush guard cover over the mounting loops and lace the strip through the loops. Secure the strips at the ends, as shown in figure 595.

(4) Fold the cover back at the two sides of the radiator shell and locate and drill two 1/4-inch holes for the two retaining springs at each side. Hook the springs into the holes to secure the cover, as shown in figure 595.

(5) Install the two remaining springs at the other end of the cover.

Note. When the personnel heater is in operation, the springs are released and hooked onto the brush guard cover at a convenient point so that the air inlet hood of the personnel heater installation will not be covered.

n. Application of Ignition Insulation Compound. As a protection against moisture, which adversely affects the electrical system, ignition insulation compound should be applied as prescribed in (1) and (2) below.

(1) Thoroughly clean and remove all moisture from the exterior of spark plugs, wiring, and all exposed terminals and connections of the electrical system.

(2) Spray thoroughly and carefully with ignition insulation compound the interior of the engine compartment, including exterior of engine, carburetors, fuel pump, air cleaners, spark plugs, generator regulator, generator,

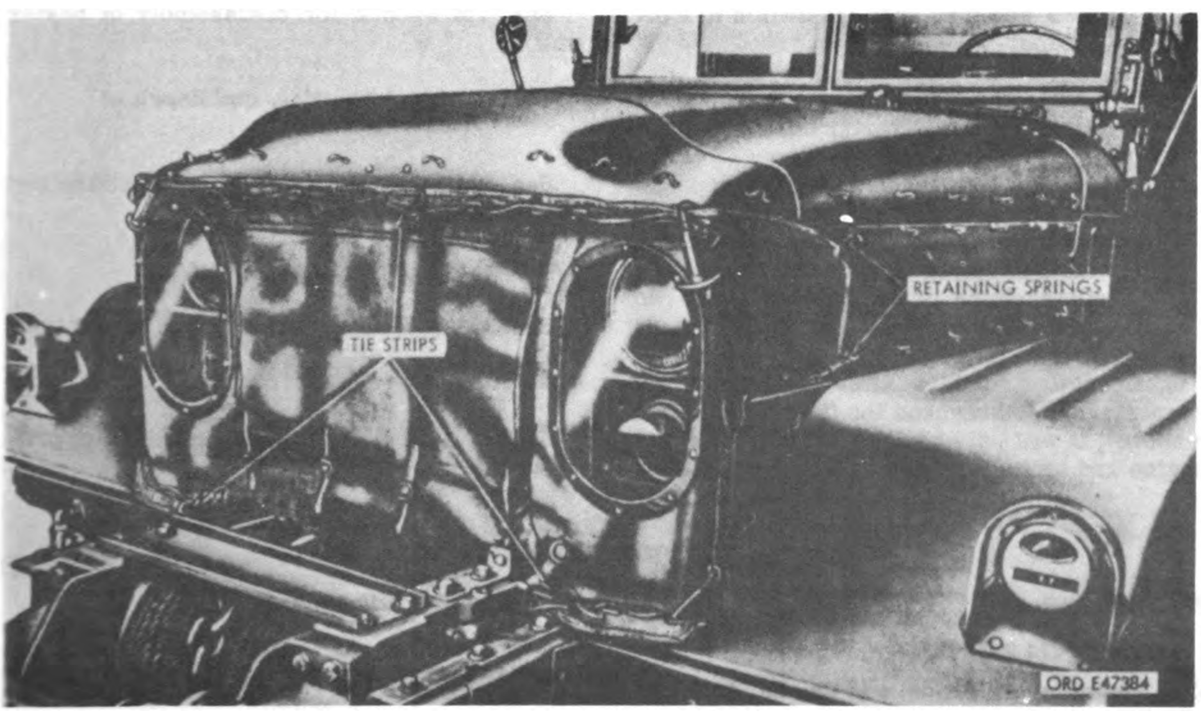


Figure 595. Brush guard cover installed

starter, engine manifolds, and all components within the engine compartment. Spray all components of the kit after completion of tests (par. 467).

Note. It is recommended that the spark plugs and high-tension cables be sprayed with ignition insulation compound a second time, after first application has dried, to assure a thorough seal against penetration of moisture.

467. Installation, Tests and Adjustments

a. Bleeding Fuel Line. Bleed the heater fuel line by starting the engine and loosening the fuel line at the inlet of the heater fuel control valve. Tighten the fitting as soon as fuel starts to flow from the line.

b. Initial Starting. After bleeding the fuel line, start the heater as prescribed in (1) through (4) below.

(1) Turn the HI-LO switch (C, fig. 593) to HI position.

(2) Turn heater switch (F, fig. 593) to START position and hold in this position until the indicator light (D, fig. 593) glows and then snap the switch to RUN position.

(3) Within two minutes, warm air should be felt at the heat diverter outlet.

(4) After the heater has been in full operation for three or four minutes, turn the heater switch off. Burning in the heater will stop within 45 seconds, but the fans will continue to operate for about two minutes to cool and purge the heater.

c. Operating Heater. After the heater has been started and checked the first time (a and b above), it will only be necessary to start the engine and turn the heater switch on for subsequent starts, if shutdown periods are not sufficiently long to chill the system. If the heater fails to start in this manner, repeat the initial starting procedure (b above).

Note. If heater does not ignite after three attempts to start, no more attempts should be made to start the heater; heater requires servicing.

d. Stopping Heater.

(1) Snap the heater switch to OFF position.

(2) Burning in the heater will stop within 45 seconds but the fans will continue to operate for about two minutes to cool and purge the heater.

468. Removal of Heater Unit

Remove the heater unit by reversing paragraph 466 (a) through (m).

Note. Holes left in vehicle after permanent removal of heater are to be covered with improvised closures.

469. Disassembly of Heater Unit

See TM 9-8662 for disassembly of heater unit.

470. Cleaning, Inspection, and Repair of Heater Unit

See TM 9-8662 for cleaning, inspection and repair of the heater.

471. Assembly of Heater Unit

See TM 9-8662 for assembly of heater unit.

472. Troubleshooting

Refer to TM 9-8662 for troubleshooting procedures.

Section III. FUEL PREHEATER KIT

473. Description

Refer to TM 9-8662.

474. Cleaning, Inspection, and Repair

Refer to TM 9-8662.

475. Test and Adjustment

Refer to TM 9-8662.

Section IV. ELECTRIC FUEL PUMP

476. Description

a. The electric fuel pump is used when the heater is required to operate without operating the engine.

b. The pump is located in the heater fuel supply line, between the hand operated shut-off valve and the fuel filter (fig. 596).

c. Two different types of electric fuel pumps are used with 978 series personnel heaters. They are the Stewart-Warner Model and the Bendix-Eclipse Model (fig. 597).

477. Installation and Removal

a. Installation.

(1) Install one end of fuel line into vehicle fuel filter on the left side of the frame cross member (fig. 598) and the other into the electric fuel pump.

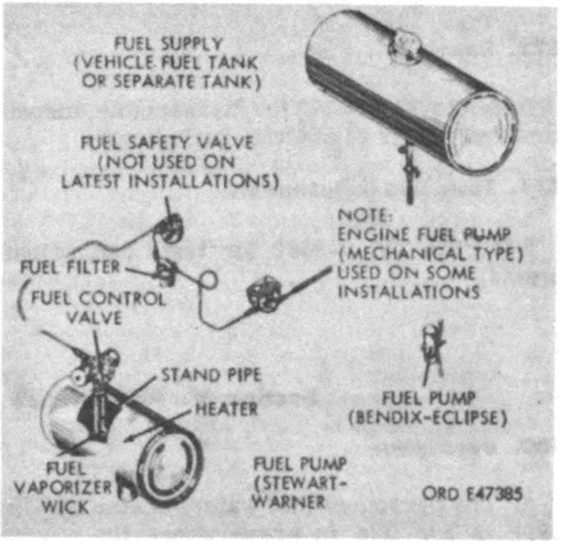


Figure 596. Schematic view of fuel system

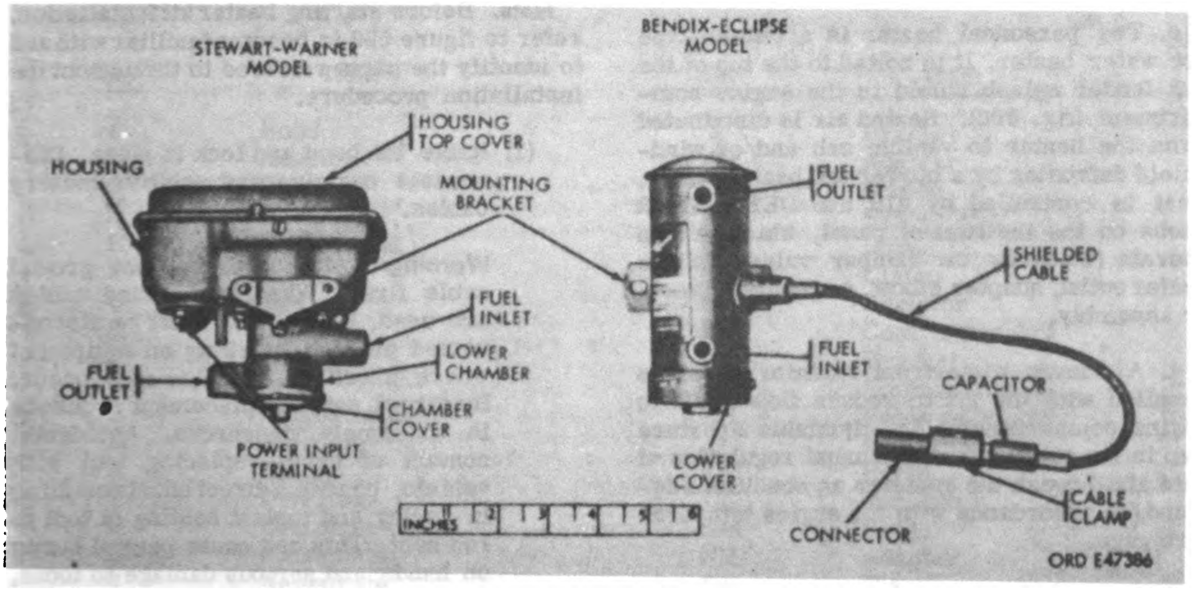


Figure 597. Electric fuel pumps

(2) Connect the heater main fuel line to the electric fuel pump, then proceed with instructions contained in paragraph 466.

b. Removal. Remove the electric fuel pump by reversing the installation procedures.

478. Repair

Refer to TM 9-8662 for disassembly, inspection and repair of electric fuel pumps.

479. Tests and Adjustments

Refer to TM 9-8662 for tests and adjustments.

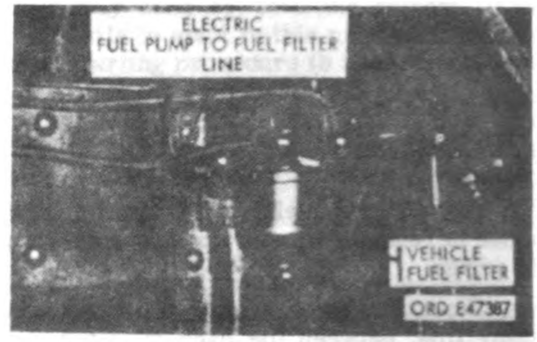


Figure 598. Installation and removal of electric fuel pump

Section V. PERSONNEL (HOT WATER) HEATER KIT

480. Description

a. The personnel (hot water) heater kit (fig. 599) is for use in areas where the normal ambient temperature is from 40° to -20°F.

b. The kit is to be installed by Ordnance maintenance units or by troop units under supervision of ordnance mechanics.

c. The personnel heater is a blower-type hot water heater. It is bolted to the top of the left fender splash shield in the engine compartment (fig. 600). Heated air is distributed from the heater to vehicle cab and/or windshield defroster by a blower and heat diverter. Heat is controlled by AIR and DEFROSTER knobs on the instrument panel, which in turn operate butterfly or damper valves in the heater outlet, adapter elbow, and heater diverter assembly.

d. A canvas winterfront radiator cover is supplied with the kit to reduce flow of air to engine compartment. An adjustable aperture flap in the cover permits manual regulation of cold air through the radiator as conditions demand, in accordance with the engine temperature gage.

e. Complete illustrated installation instructions are packed in each kit. Use the instruction booklet as a reference when making a specific installation since there may be variations due to engineering changes. Differences in individual kits bear the same Ordnance numbers and were designed for the same vehicle.

f. For other instructions pertaining to winterization equipment, installation instructions, and methods, refer to TM 9-207.

481. Installation of Hot Water Heater Kit

a. Under Hood Operations.

Note. Before starting heater kit installation, refer to figure 599 to become familiar with and to identify the parts referred to throughout the installation procedure.

(1) Raise the hood and lock in place. Disconnect negative and positive battery cables.'

Warning: Always disconnect ground cable first. When two ground cables are used, both cables must be disconnected prior to working on equipment where shorting of cables may occur. Incorrect cable replacement sequence is extremely dangerous. Accidental contact of cable replacing tool with vehicle, causes a direct short resulting in arcing and instant heating of tool to red heat. This can cause painful burns on hands and serious damage to tools, vehicle, and battery. Moreover, the shorted battery may explode, spraying hot acid over the surrounding area.

(2) Open radiator drain cock and allow coolant to drain into a suitable container.

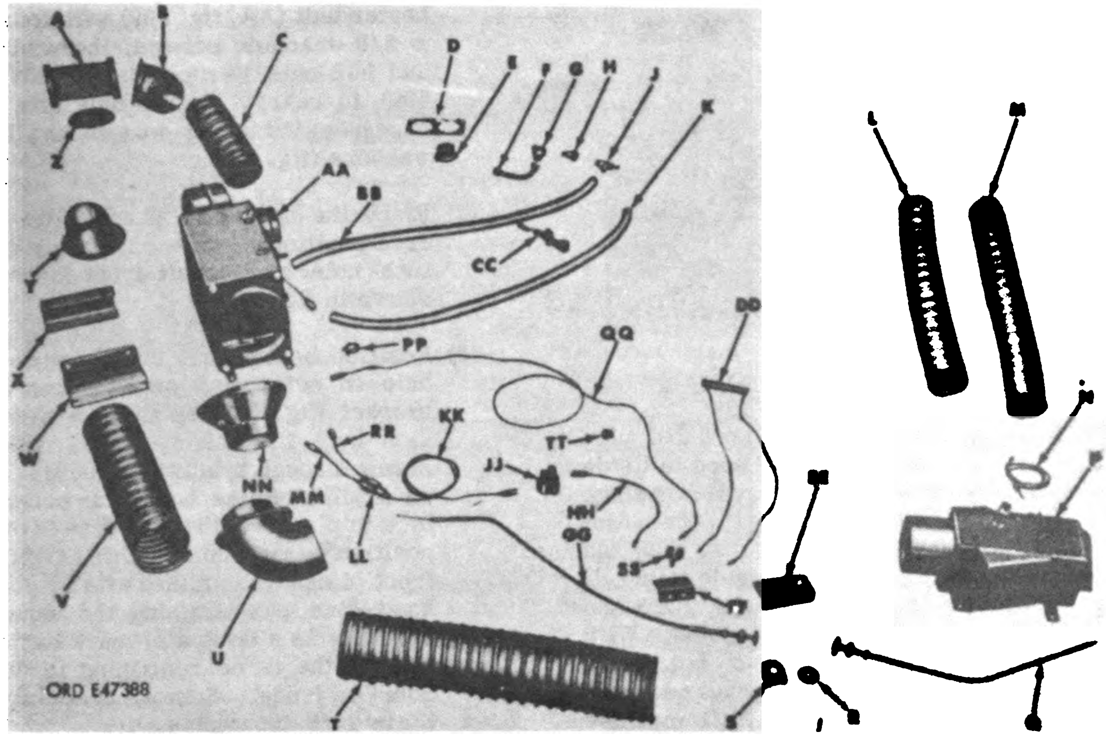


Figure 599. Personnel heater kit (hot water)

Key	Item	Key	Item
A	Hood	X	Bracket
B	Adapter	Y	Adapter
C	Duct	Z	Screen
D	Gasket	AA	Heater unit
E	Thermostat	BB	Hose
F	Tube	CC	Clamp
G	Tee	DD	Resistor
H	Elbow	EE	Control bracket
J	Cock	FF	Bracket
K	Hose	GG	Control cable
L	Defroster duct	HH	Cable assembly
M	Defroster duct	JJ	Circuit breaker
N	Clamp	KK	Cable
P	Diverter	LL	Connector
Q	Defroster cable	MM	Cable
R	Nameplate	NN	Adapter
S	Nameplate	PP	Clamp
T	Duct	QQ	Cable
U	Adapter	RR	Cable
V	Duct	SS	Heater switch
W	Bracket	TT	Bushing

Figure 599. Personnel heater kit (hot water) - legend

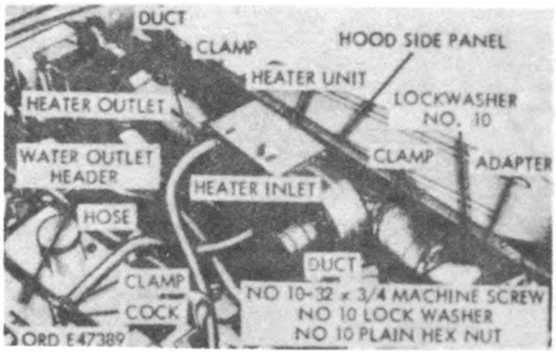


Figure 600. Heater installed

(3) Remove the 4-1/8-inch knockout plug from the forward end of hood left side panel. Hold adapter (B, fig. 599) in place on inner side of panel with the outlet opening toward firewall (fig. 600) and inlet opening alined with hole in panel. Using adapter as a template, mark and drill four 13/64-inch holes. With screen (Z, fig. 599) between side panel and adapter (B, fig. 599) secure adapter to panel with four No. 10 machine screws, lockwashers, and nuts.

(4) Center hood (fig. 601) over screen on side panel and mark location of three mounting holes. Drill three 5/16-inch holes in side panel. Secure hood to side panel with three 1/4 x 5/8 machine screws, lockwashers, and hex-nuts.

(5) Secure brackets (W and X, fig. 599) to heater unit (AA, fig. 599) with four 5/16 x 1 machine screws, lockwashers, and hex-nuts (fig. 603).

(6) Secure adapter (Y, fig. 599) to front of heater unit (AA, fig. 599) with four 1/4 x 3/8 machine screws, lockwashers, and hex-nuts. Secure adapter (NN, fig. 599) to rear of heater unit with four No. 8 x 1 tapping screws and lockwashers (fig. 603).

(7) Place the hood side panel in the lowered position. Locate and drill a 5/16-inch hole on the left front fender as shown in figure 602.

(8) Position heater unit on fender so that hole in outer end on rear mounting bracket (fig. 603) is alined with 5/16-inch hole in fender. Insert machine screw through bracket and hole for use as a pilot. Raise hood side panel and lock in place. With pilot screw in place, position heater unit so that adapter on front of heater is alined with adapter on hood side panel. Using the mounting brackets as a template, mark the location of the three remaining mounting holes on fender. Remove heat and drill three 5/16-inch holes.

(9) Position heater unit on fender and secure with four 5/16 x 1 machine screws, lockwashers, and hex-nuts (fig. 603).

(10) Remove water outlet tube that connects air compressor and water pump (fig. 604). Remove connector from water pump. Coat the threads of tee, elbow, and cock with a suitable sealing compound and install them in the water pump as shown in figure 604. Coat connector with sealing compound and install in the

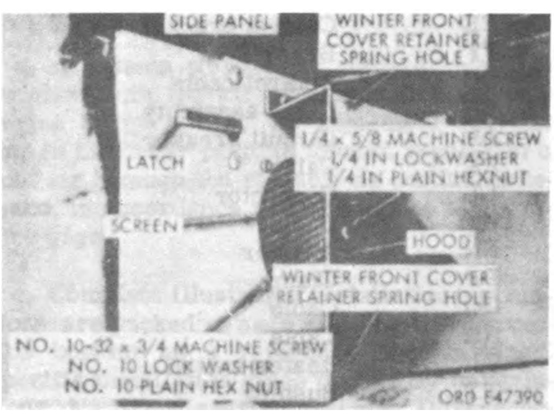


Figure 601. Side panel with hood installed

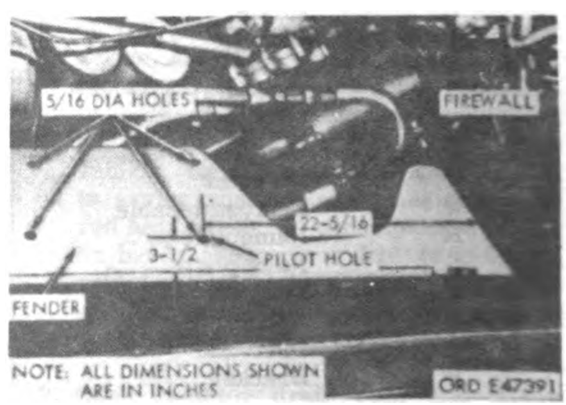


Figure 602. Locating heater unit

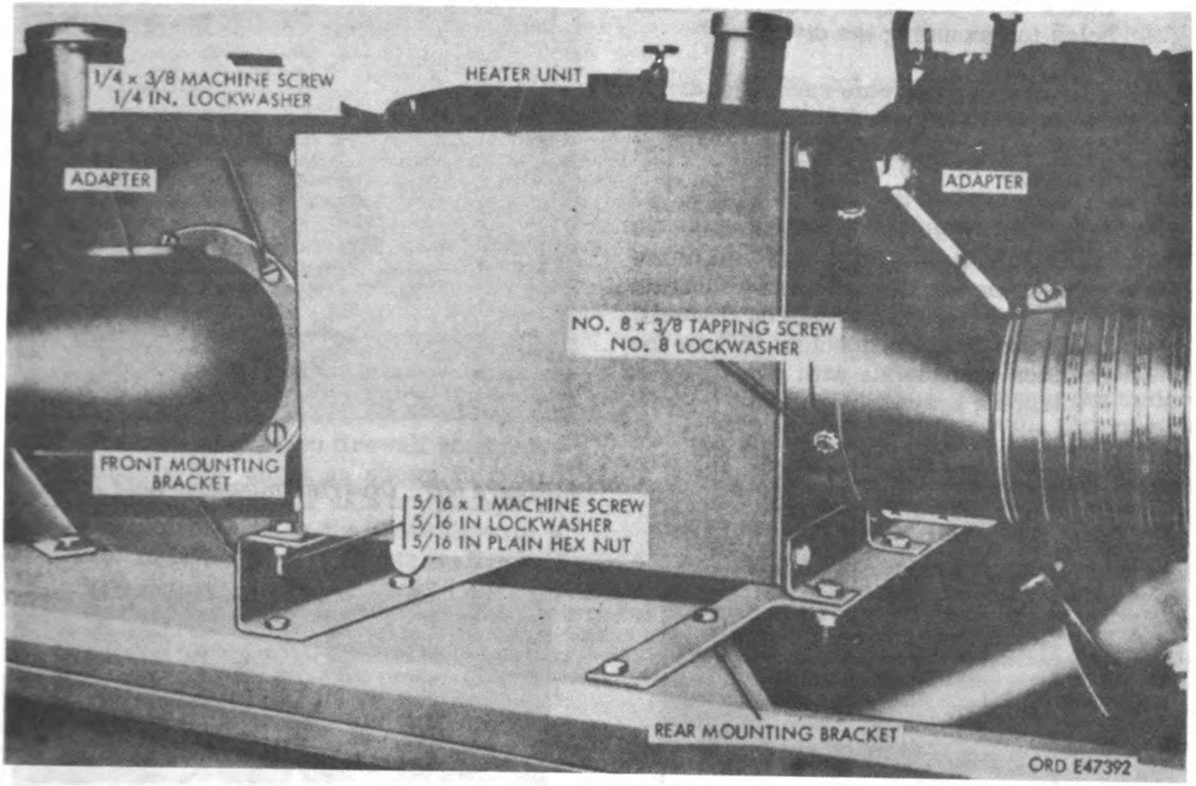


Figure 603. Heater unit installed

tee. Install new water outlet tube (fig. 604) between air compressor and water pump.

(11) Remove plug from water outlet header. Coat bushing and cock (fig. 604) with sealer and install in water outlet header.

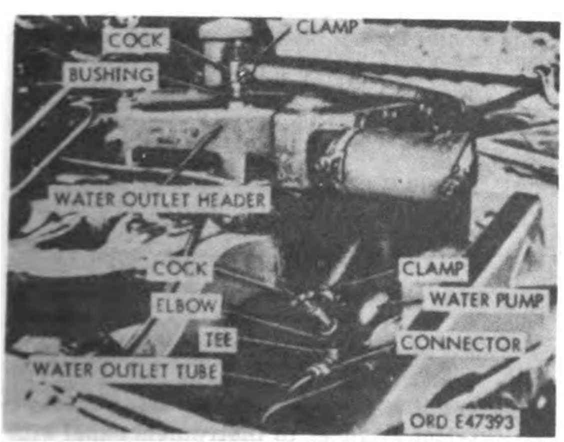


Figure 604. Heater hose connections

(12) Cut both lengths of hose to 36 inches. Connect one hose to heater unit inlet and to cock on water outlet header (fig. 600). Secure hose with two clamps. Connect the remaining hose to the header outlet and to the cock located on the water pump (fig. 604) in the same manner.

(13) Remove the upper nut and lockwasher from engine lifting eye (fig. 605). Secure hose clamp to cylinder block with nut and lockwasher. Secure hose to clamp as shown in figure 605.

(14) Install thermostats (E, fig. 599) and gasket (D, fig. 599) in accordance with instructions contained in TM 9-2320-211-20.

b. In the Cab Operation.

(1) Remove the two knockout plugs (fig. 606) from left side of firewall. Make

a layout on the firewall as shown in figure 607 and drill four 9/32-inch holes for mounting the diverter.

Caution: Use extreme care when drilling to avoid damage to cables or other components attached to engine side of firewall.

(2) Hold the resistor approximately 10 inches above the floor and just to the right of the air lines and mark location of the two mounting holes on firewall. Drill two 3/32-inch holes. Secure the resistor to firewall with two No. 6 x 1/2 tapping screws (fig. 608).

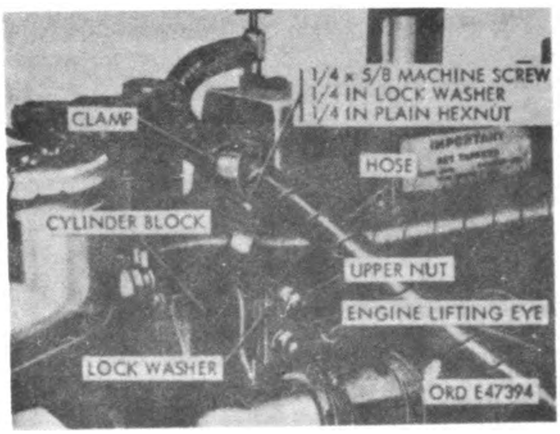


Figure 605. Hose clamp installed

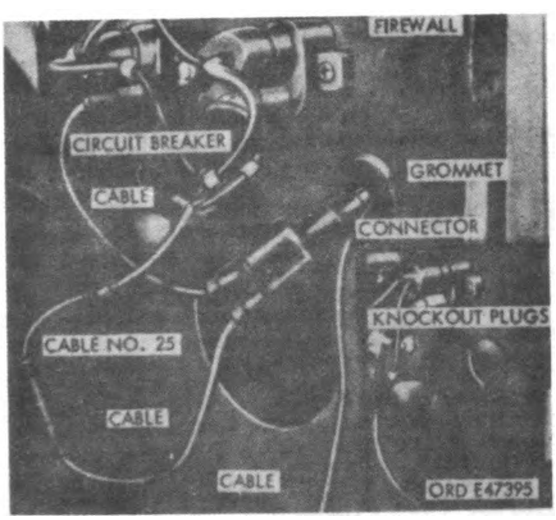


Figure 606. Knockout plugs on firewall

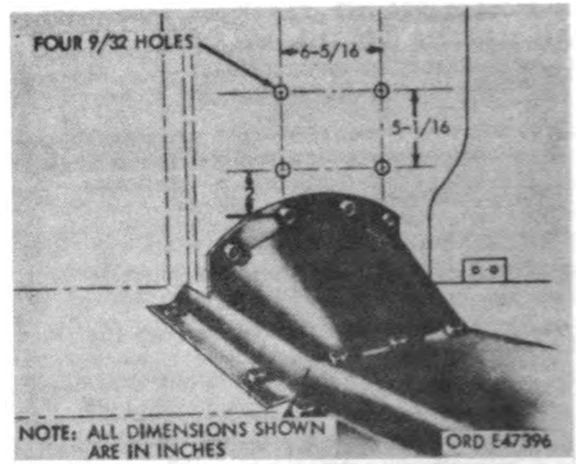


Figure 607. Diverter mounting hole layout

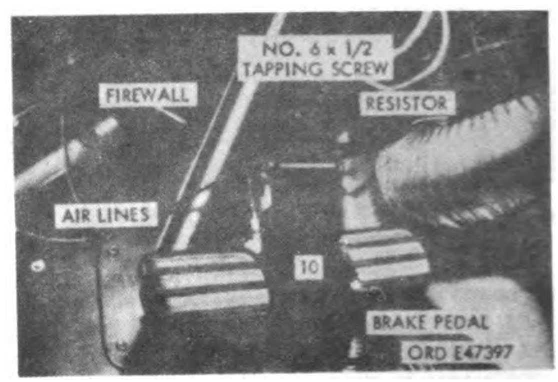


Figure 608. Resistor installed

(3) Make a layout on instrument panel for control mounting bracket heater switch, mounting bracket and circuit breaker as shown in figure 609. Drill one hole for each bracket and circuit breaker, then mount the brackets and circuit breaker and use as a template to drill another mounting hole. Secure circuit breaker to rear side of instrument panel with No. 8 x 7/8 machine screws, lockwashers, and nuts.

(4) Secure control bracket to instrument panel (fig. 610) with two No. 10 x 5/8 machine screws and nuts. Secure switch bracket to instrument panel with two 1/4 x 1/2 machine screws, lockwashers and nuts.

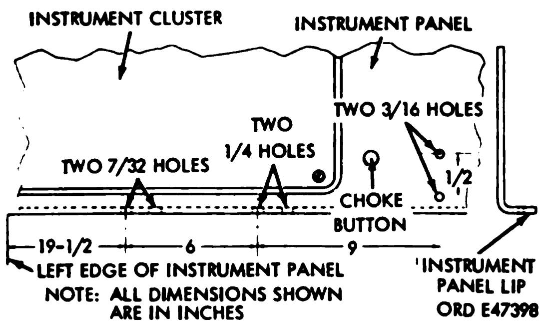


Figure 609. Layout for installing switch brackets and circuit breaker

(5) Position adapter on firewall at approximately 30° angle as shown in figure 611. Using adapter as a template, drill two holes through the firewall with a No. 16 drill. Secure adapter to firewall with two No. 8 x 1-1/4 machine screws, lockwashers, and nuts.

(6) Secure diverter (fig. 610) to firewall with four 1/4 x 3/4 machine screws, lockwashers, and nuts.

(7) Slip defroster duct (M, fig. 599) over right outlet on diverter and over end of left defroster nozzle. Install defroster duct (L, fig. 599) in the same manner, except connecting it to the left outlet on diverter and on the right defroster nozzle. Secure ducts to defroster nozzles and diverter outlets with clamps (fig. 599).

(8) Connect duct to adapter (fig. 611) and to diverter (fig. 610) and secure with clamps.

(9) Remove nut and lockwasher from control cable (GG, fig. 599). Slip nameplate (S, fig. 599) onto cable, then thread cable through left hole in control bracket (EE, fig. 599) and secure with nut and lockwasher. Move the control arm forward to close valve in adapter (fig. 611). Push control cable in all the way. Connect cable to control arm and secure with clamp.

(10) Remove nut and lockwasher from defroster cable (Q, fig. 599). Slip nameplate (R, fig. 599), onto cable, then thread cable through right hole in control bracket (E, fig. 599) and secure with nut and lockwasher. Move control arm on diverter (fig. 610) to the right as far as possible. Push defroster cable in all the way. Connect cable to control arm and secure with clamp.

(11) Remove nut and lockwasher from heater switch (SS, fig. 599). Hold heater switch in bracket (fig. 610), slip lockwasher onto switch and secure switch with the nut.

(12) Install duct (V, fig. 599) between outlet on heater unit and adapter on firewall. Secure duct with clamps (N, fig. 599).

(13) Install duct between adapter on hood side shield and front end of heater (fig. 601). Secure duct with two clamps.

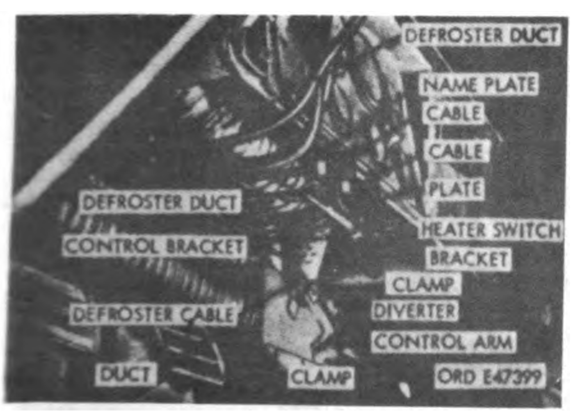


Figure 610. Heater controls

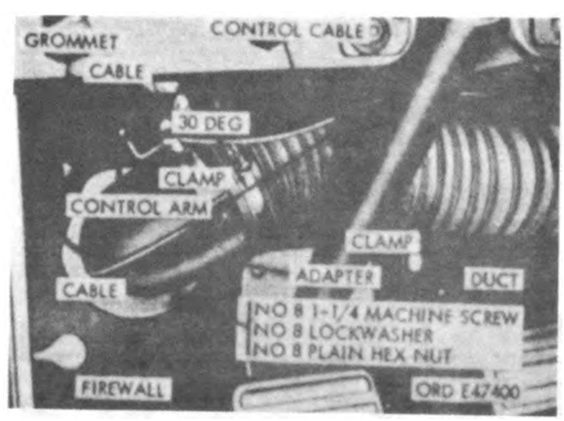


Figure 611. Duct mounted on firewall

c. Wiring Operations.

(1) Connect cable (QQ, fig. 599) to socket on heater unit. Thread other end of cable through 1-1/2-inch hole in firewall and connect to heater switch (fig. 612).

(2) Connect cable (KK, fig. 599) to single end of connector (LL, fig. 599). Connect cable (RR and MM, fig. 599) to double end of connector. Thread cable on single end of connector through the 1-1/2-inch hole in firewall (engine side of cab side) and connect to terminal on circuit breaker (fig. 612). Fit grommet in firewall (fig. 606).

(3) Connect resistor leads to high and low sides of heater switch (fig. 612).

(4) Connect cable (HH, fig. 599) to center pole heater switch and other end to circuit breaker (fig. 612).

(5) Disconnect cable No. 25 (fig. 606) from circuit breaker and connect it to cable leading from connector (LL, fig. 599). Connect other cable leading from connector (LL, fig. 599) to the circuit breaker from which No. 25 cable was disconnected.

d. Radiator Winterfront Installation.

(1) Position winterfront cover (fig. 613) on brush guard. Using metal grommets in the cover as a template, mark the location of the mounting loop positions on the top of brush guard and on the fenders.

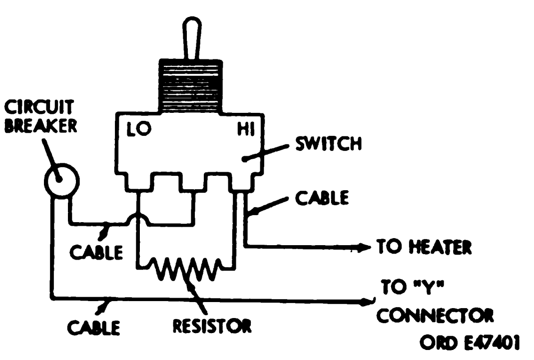


Figure 612. Wiring diagram

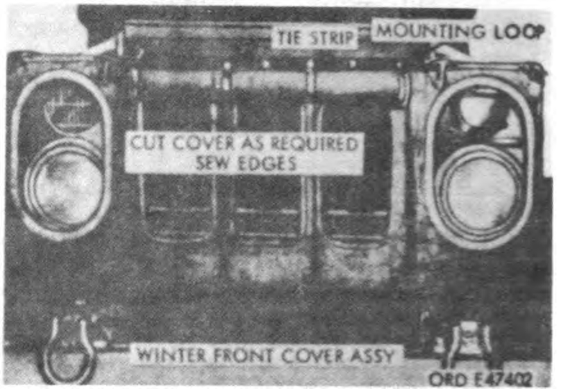


Figure 613. Winterproof cover assembly installed

(2) Using a No. 27 drill and the mounting loops as a template, drill the necessary holes. Secure mounting loops to fenders and top of brush guard with No. 8 x 1/2-tapping screws (fig. 61·).

Note. On the late production vehicles, the hood holddown hooks are mounted on brush guard. On this type of installation, the mounting loops directly above the holddown hooks are eliminated and the cover must be cut as shown in figure 613, and the edges must be sewed to prevent fraying of material.

(3) Fit the cover over the mounting loops and lace the tie strips through the mounting loops. Secure the ends of tie strips with the buckles provided.

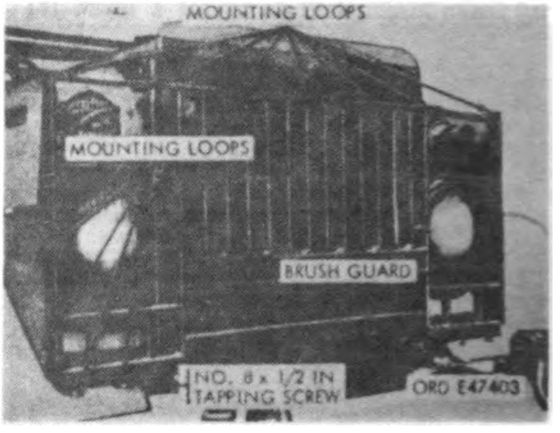


Figure 614. Mounting loops installed

(4) Fold each side of cover back over side panel (fig. 615). Pull each winterfront cover retaining spring backward to apply tension on cover. Locate and drill four 1/8-inch holes for retaining springs. Attach springs to holes.

e. Preparations for Service.

(1) Fill cooling system as detailed in TM 9-2320-211-10.

(2) Connect battery cables.

(3) Open cock on water outlet header and water pump (fig. 604). Operate engine until coolant reaches normal operating temperature. Open air bleed valve on heater unit (fig. 616) to expel all air from the cooling system. Close valve when a steady stream of water flows from valve.

(4) Replenish coolant in cooling system.

482. Test and Adjustment

a. General. Follow instructions on cable nameplate to see that when the defroster knob is pulled all the way out, the damper closes completely to direct the heated air onto the windshield. Push the knob all the way in to test the opening of the heat outlet to make certain that the heated air flows directly into the cab.

b. Radiator Winterfront Adjustments.

(1) During "standby" periods, the radiator winterfront should be completely closed.

(2) During vehicle operation, the driver should note the reading on the engine temperature gage. To perform the work for which it is designed in an efficient and economical manner, the engine must operate at temperatures of 180°F. Extreme cold will adversely affect engine performance by preventing the coolant from attaining the desired temperature.

(3) Keep the radiator winterfront cover closed until the engine temperature increases above 180°F.

(4) If temperature exceeds 180°F., raise the aperture flap on winterfront and strap in position (fig. 613). If temperature continues to increase after flap is fully open, remove cover completely to prevent overheating. If the temperature continues above 180°F., refer to TM 9-837.

(5) When winterfront cover is removed, it must be stowed carefully in the vehicle for further use. The retaining springs must be securely attached to the flaps.

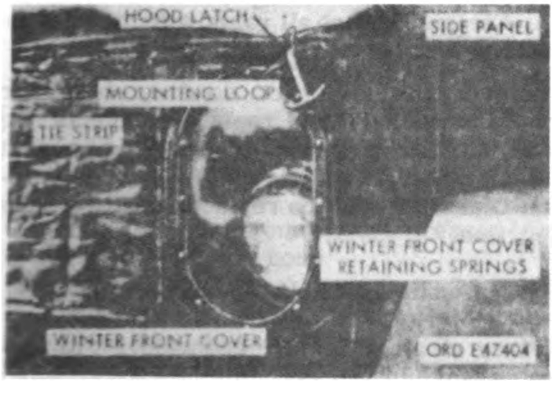


Figure 615. Winterfront cover retaining springs

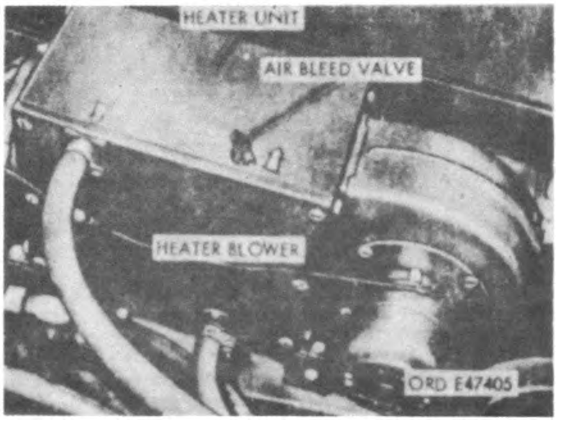


Figure 616. Heater assembly installed

Section VI. ALCOHOL EVAPORATOR KIT

483. Description

a. The alcohol evaporator (fig. 617) is used to protect an air brake system from freezing during service in below freezing temperatures. The alcohol evaporator permits vaporized alcohol to be drawn into the air brake system.

b. The alcohol evaporator is connected to the air compressor intake manifold (fig. 618) and consists of a filler cap, strainer, tube and glass or metal receptacle to hold methyl alcohol.

484. General Installation Instructions

Be sure to inspect the alcohol evaporator kit before installation for signs of cracks or damage.

485. Installation of Alcohol Evaporator Kit

a. Hold the evaporator mounting bracket (U, fig. 618) on the upper right side of the fan shroud, flush with the top, and drill three 5/16-inch holes in the fan shroud. Install the evaporator mounting bracket with three 1/4-inch bolts, lockwashers, and nuts.

b. Mount the alcohol evaporator jar and vaporator jar bracket (V, fig. 618) on the evaporator mounting bracket with three 1/4-inch bolts, lockwashers, and nuts.

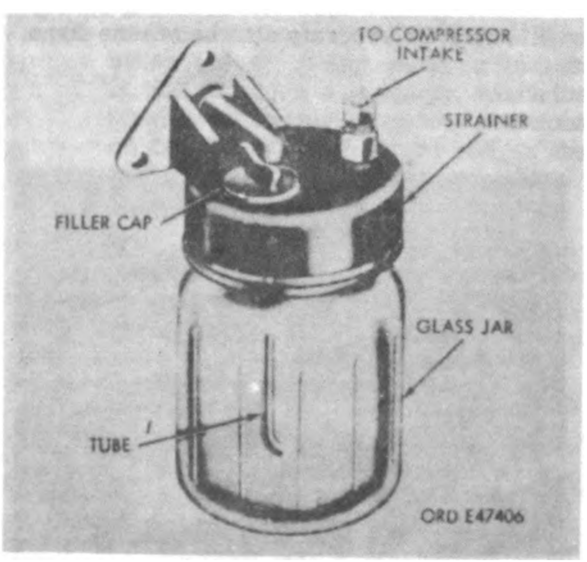


Figure 617. Alcohol evaporator

c. Remove the small plate from the lower front end of the air compressor and install the small adapter plate (A, fig. 618).

d. Uncoil the evaporator-jar-to-air compressor tube (E, fig. 618) and cut off a section approximately 34 inches long.

e. Install tube fittings and connect one end of the 34-inch tube to the evaporator jar bracket, form a vibration loop, and connect the other end to the small adapter plate on air compressor. Tighten all connections.

486. Removal of Alcohol Evaporator Kit

a. Loosen tube fitting connecting alcohol evaporator from small adapter plate (A) on air compressor intake manifold. Disconnect and remove evaporator-jar-to-air compressor tube (E) and small adapter plate.

b. Remove the evaporator mounting bracket (U, fig. 618) from the upper right side of the fan shroud. Remove the evaporator jar bracket (V, fig. 618) from the evaporator mounting bracket and remove the alcohol evaporator jar.

487. Disassembly of Alcohol Evaporator Kit (Fig. 617)

Unscrew glass jar from strainer body and discard gasket. Remove retaining ring and strainer from body. Unscrew filler cap and discard gasket. Remove tubing connector and evaporator tube from body.

488. Cleaning and Inspection

a. Cleaning. Wash all parts with dry-cleaning solvent or mineral spirits paint thinner.

b. Inspection. Inspect strainer body for cracks or damage and replace if defects are found. Check the evaporator tube and be sure it is not plugged or restricted with foreign matter. Glass jar must be replaced if any cracks are found.

489. Assembly of Alcohol Evaporator Kit

Place strainer in body and secure with retaining ring. Install evaporator tube and tubing connector. Install new gasket in body and screw glass jar in place. Install filler cap with new gasket.

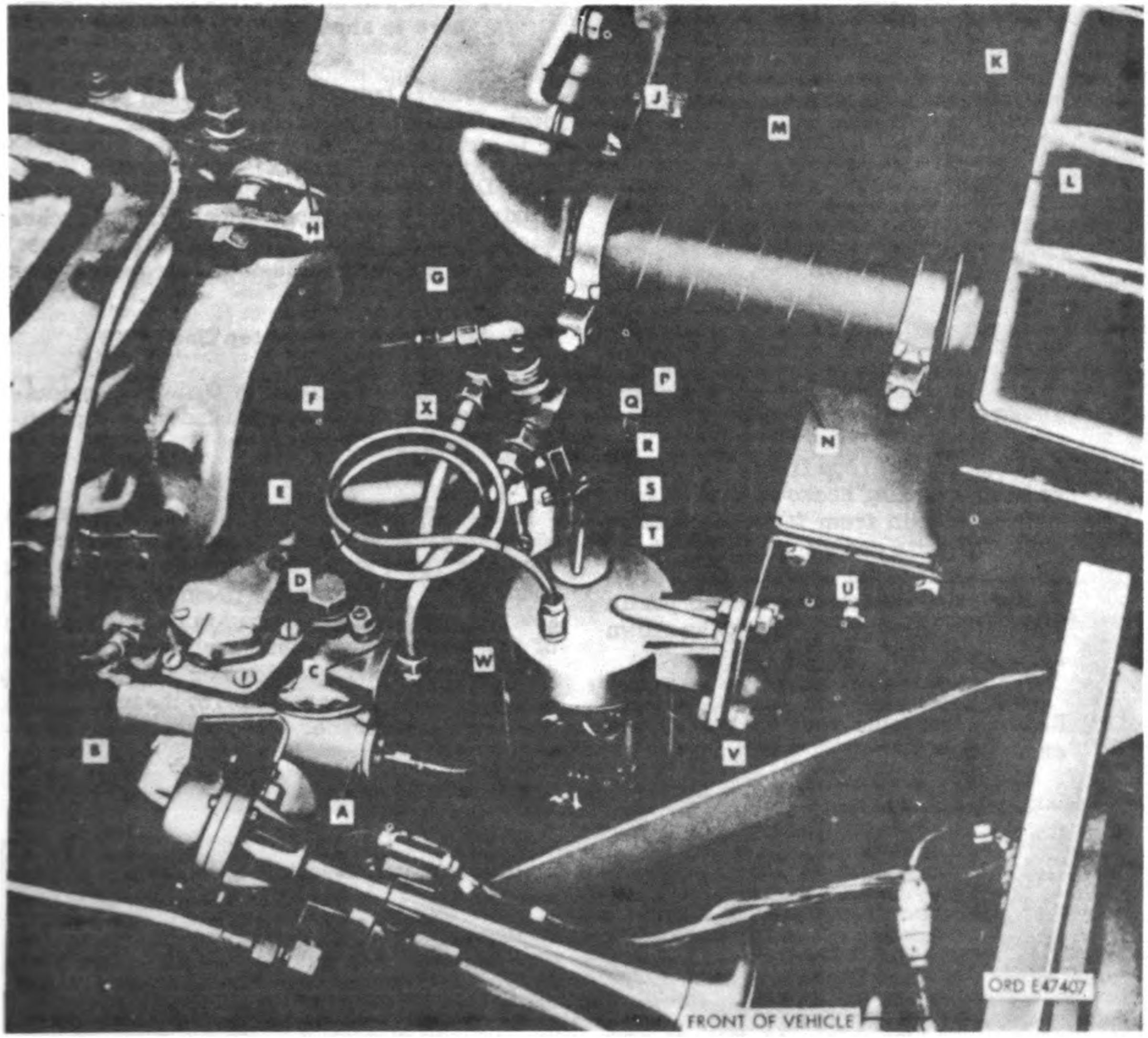


Figure 618. Alcohol evaporator installed

Key	Item	Key	Item
A	Adapter plate	M	Hose clamps
B	Air compressor	N	Radiator inlet hose
C	1/2-inch line from air compressor to aquastat	P	Water pump
D	83-inch coolant hose	Q	Aquastat
E	Evaporator line	R	Bypass hose clamp
F	Front heater aquastat wire	S	Shutoff cock
G	Aquastat connector	T	Bypass hose
H	Water manifold	U	Evaporator mounting bracket
J	Thermostat housing	V	Evaporator jar bracket
K	Radiator stayrod bracket	W	Hose clamp
L	Fan shroud	X	3/8 x 1/2-inch flared tube connector

Figure 618. Alcohol evaporator installed - legend

Section VII. HARD-TOP CLOSURE KIT

490. Description

a. The hard-top closure kit is for use in areas where the normal temperature range during the coldest period for the year is -25°F. to 65°F. or lower. It is installed in conjunction with the power plant heater kit.

b. The hard-top closure kit (figs. 619 and 620) consists of a back panel, roof panel, two rubber strip seals, and attaching hardware.

491. Preliminary Preparation of Vehicle

a. Remove the cab top paulin as prescribed in (1) through (3) below.

(1) Release lashing rope from side handles and from lashing hooks at rear of cab. Release paulin from fastener studs in side roof rails and slip paulin off channels in pillar post assemblies. Throw paulin over windshield and pull paulin edge off channel of windshield, as shown in figure 621.

(2) Remove the side-roof rails and the crossbars (fig. 622).

(3) Place paulin, side-roof rails and crossbars in storage.

b. Remove buttons at top of each windshield post. Retain for possible future use.

c. Drill two 7/16-inch holes clear through windshield frame upper panel, 21-7/8 inches each way from center of windshield frame post, using the existing 0.199-inch hole, as a guide.

492. Installation of Hard-top Closure Kit

a. The kit is installed by Ordnance maintenance units or by troop units under the supervision of ordnance mechanics.

b. The sequence of operations given herein is the result of trial installations; however, deviation from strict adherence thereto to suit individual conditions is permissible. When interference is encountered in the installation of the kit because of the peculiar shape of the vehicle due to modifications or damage, a field expedient may be resorted to by the installation personnel to correct the particular interference.

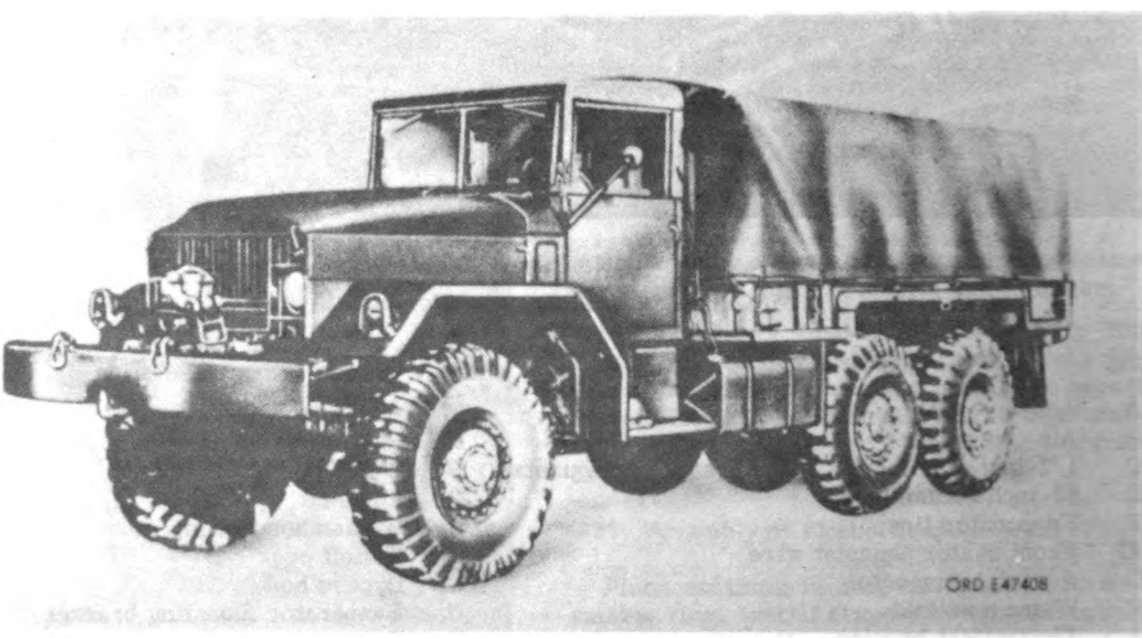


Figure 619. 5-Ton 6 x 6 cargo truck M-41 with hard-top enclosure kit installed

c. Back panel (fig. 623) will be installed as prescribed in (1) and (2) below.

(1) Place a rubber strip seal on the cab body so that the holes in the seal and cab body aline.

(2) Install the back panel so that the bolt holes in the panel, seal, and cab body aline and secure with fourteen 1/4-20 x 3/4-bolts, plain washers, and safety nuts. Do not tighten the bolts.

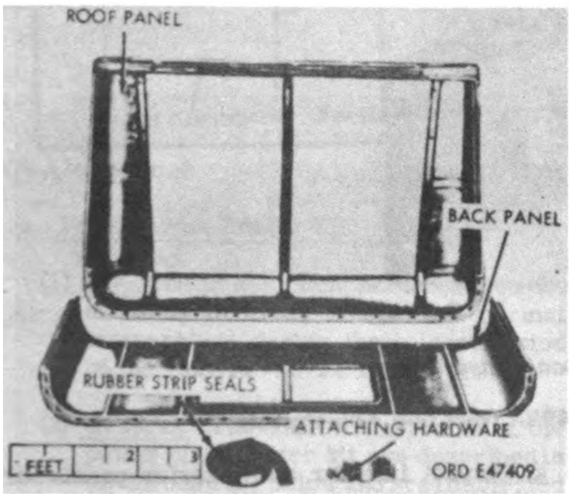


Figure 620. Hard-top closure kit components

Figure 621. Removing cab top paulin from windshield channel

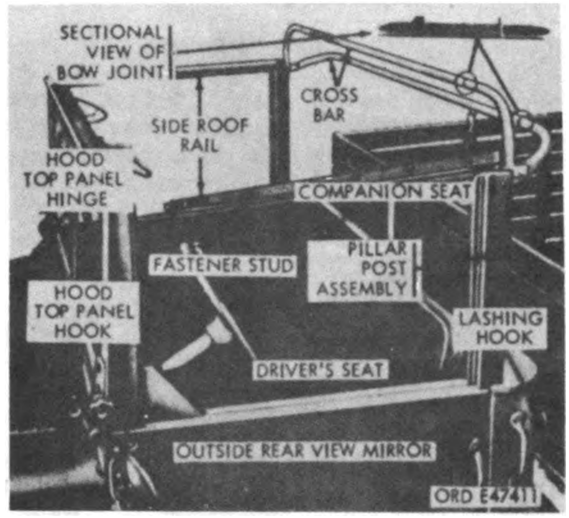


Figure 622. Removing cab top frame

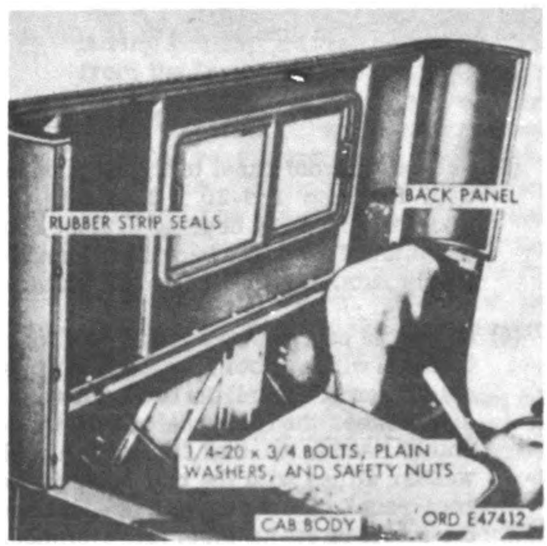


Figure 623. Back panel installed

d. Roof panel (fig. 624) will be installed as prescribed in (1) through (6) below.

(1) Place a rubber strip seal on top of the back panel (fig. 623) so that the holes in the seal and the back panel aline.

(2) Install the roof panel so that the bolt holes in the seal and panels aline and the front edge of the roof rests on the windshield header.

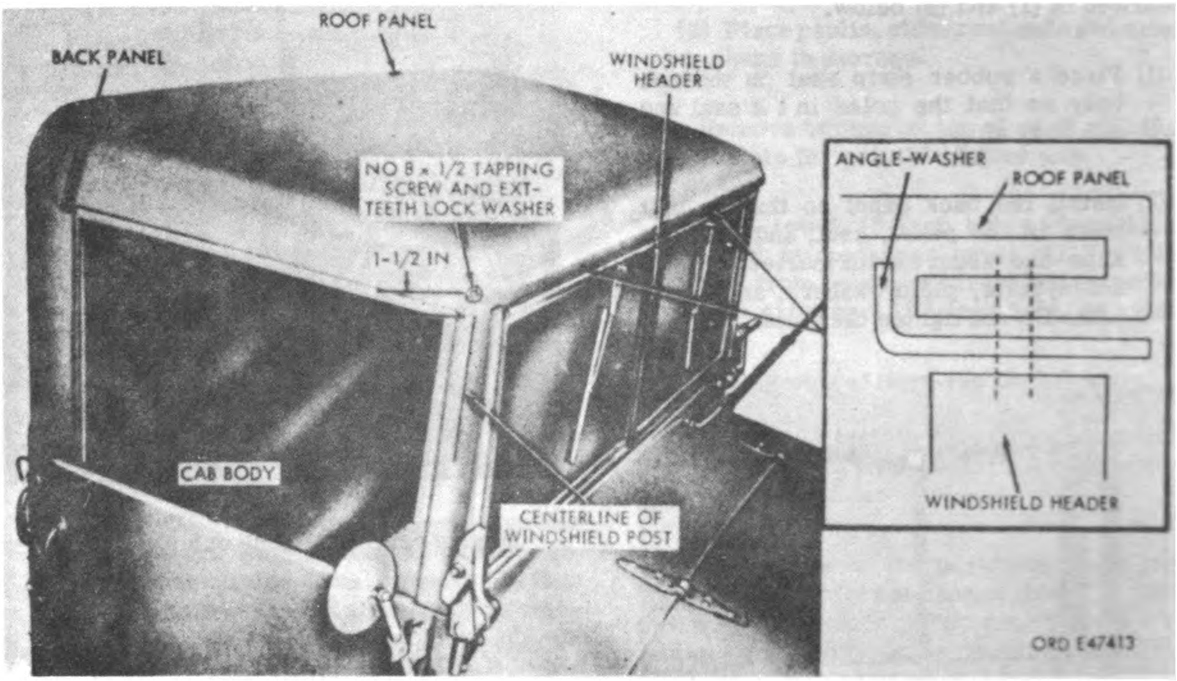


Figure 624. Roof panel installed

(3) Secure the roof panel to the back panel with fourteen 1/4-20 x 3/4 bolts, 28 plain washers (14 bearing against roof panel and 14 against back panel), and 14 safety nuts. Do not tighten the bolts.

(4) Close the cab windows and fit roof panel to top of window door frame and to windshield posts. Install the two anglewashers between the roof panel and the windshield header so that the hole in each washer alines with the bolt holes in the roof panel and windshield header, and the flange on each washer faces up under the roof panel.

(5) Secure the front of the roof panel to the windshield header (fig. 624) with two 3/8-24 x 2 bolts and safety nuts. Adjust windshield, if necessary. Do not tighten the bolts.

(6) Drill a hole, with a No. 17 drill, on each side of the roof panel, along centerline of windshield post and 1-1/2 inches above bottom edge of roof panel. Secure roof panel to the windshield posts with two No. 8 x 1/2 tapping external-teeth lockwashers.

493. Tests and Adjustments

a. Inspect interior and exterior panels for scratches, dents or abrasions to prevent corrosion or possible harm to the body.

b. Check rubber strip seals for air leaks. Trim overhang of rubber strip seals.

c. Inspect all bolts, nuts, and attaching parts for security of attachment and tightness.

d. Check door operation; adjust if necessary.

494. Removal of Hard-top Closure Kit

a. Roof Panel (Fig. 624).

(1) Remove the two No. 8 x 1/2 tapping screws and the two external-teeth lockwashers from windshield posts. Remove the two safety nuts and bolts to loosen roof panel from windshield header. Remove the two anglewashers between the roof panel and the windshield header.

(2) Remove the safety nuts, bolts, and washers that fasten the roof panel to

the back panel. Remove the roof panel from the windshield header and back panel and remove the rubber strip seal.

b. Back Panel (Fig. 623).

(1) Remove the safety nuts, washers and bolts securing back panel to cab body.

(2) Lift back panel off cab body and remove rubber seal.

c. Install Buttons. Install buttons previously removed from vehicle to top of each windshield post. Install crossbars, side roof rails, and paulin to vehicle.

495. Inspection, Cleaning and Repair

a. Use mineral spirits paint thinner or dry-cleaning solvent to clean or wash grease from all metal parts of hard-top enclosure kit. Use a soap solution of one-fourth pound of soap chips to a gallon of hot water to clean the rubber strip seals and for all general cleaning purposes.

b. Inspect the roof and back panel for chips, cracks and concentricity. Check panels for concentricity. If warped or otherwise damaged beyond minor repair, replace with new component.

Section VIII. POWER PLANT HEATER KIT

496. Description

a. Power Plant Heater Kit.

(1) Kit. The power plant heater kit is for use only in areas where the normal temperature during the coldest period of the year is -25°F. and lower.

(2) General. The chief components of the power plant heater kit are described in (3) through (7) below and are illustrated in figures 625, 626, 627, and 629.

(3) Engine thermostats. The standard bellows-type thermostats, which start to open within 140° to 155°F. and are fully open at 170°F., are replaced by either bellows or element-type engine thermostats that start to open at 180°F.

(4) Slave receptacle. The slave receptacle serves to receive the plug of the service cable leading from the cold-starting aid kit (slave kit), when auxiliary battery starting power is needed. Boosting of batteries may be required in subzero temperatures, particularly when batteries are "cold-soaked" from long exposure.

Note. The slave receptacle was installed on early vehicles only; if required for later vehicles, it will be supplied separately.

(5) Engine heaters. Two electrically operated heaters, using gasoline from the vehicle fuel system, are mounted on the frame in the battery compartment of the vehicle. These heat the coolant to facilitate starting and to maintain near-normal engine operating temperature during standby periods. Exhaust gases from the front heater pass through tubing to the oil pan shroud for warming the crankcase lubricant; exhaust gases from the rear heater pass through tubing to the transmission housing for warming the transmission lubricant. The heaters are not designed for use while the vehicle is in motion, but for overnight or standby heating of the coolant and the crankcase lubricant when the engine is stopped.

Caution: This type of heater must not be used in closed areas occupied by personnel.

(6) Battery box and accessories. The battery box and cover are provided with complete interior insulation and heating pad to maintain batteries at temperatures necessary for normal input and output voltages of the battery. Separate lines attached to the battery box heating pad and engine block permit heated coolant to circulate through the heating pad in the battery of the batter box.

(7) Covers. Covers are attached to the engine hood, brush guard, and the hood right-and-left-side panels to help retain heat in the engine compartment. These covers do not interfere with the opening of the hood.

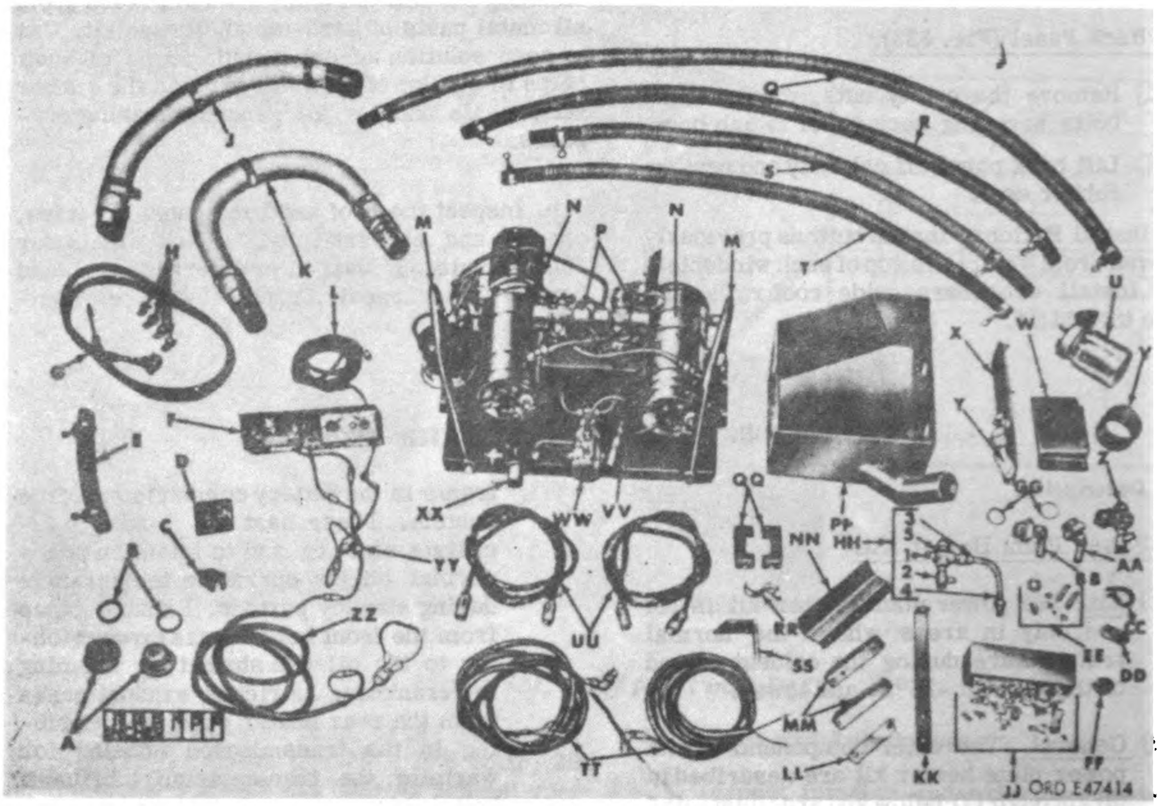


Figure 625. Power plant heater components

Key	Item	Key	Item
A	Engine thermostats	T	51-in. coolant hose
B	Thermostat rubber gaskets	U	Alcohol evaporator jar and evaporator jar bracket
C	Tube retainer	V	Evaporator-to-air compressor tube
D	Harness grommet	W	Power plant heater instruction plate
E	11-1/2-in. coolant hose	X	Coolant hose support
F	Heater control boxes	Y	Hose clamps
G	Heater fuel line with tee	Z	Aquastat, shutoff cock, bushing, and switch element
H	Harness clamps	AA	Bushing with 45-degree hose connection
J	31-in. rear heater exhaust tube, clamp, and mounting bracket	BB	Bushing with 90-degree hose connection
K	33-in. front heater exhaust tube	CC	1-1/4-in. rubberized clamp
L	Fuel pump power lead	DD	Large adapter plate
M	Carrying handles	EE	Evaporator attaching parts
N	Engine heaters	FF	Small adapter plate
P	Fuel control valves		
Q	83-in. coolant hose		
R	62-in. coolant hose		
S	50-in. coolant hose		

Figure 625. Power plant heater components - legend

Key	Item	Key	Item
GG	Bushing rubber gaskets	PP	Oil pan shroud
HH	Aquastat with line assembly	QQ	Grommet retainers
	1 - Aquastat	RR	1-1/2-in. harness clamp
	2 - Shutoff cock	SS	Evaporator mounting bracket
	3 - 3/8 x 1/2 connector	TT	Front and rear heater aquastat wires
	4 - 1/2-in. line		
	5 - Switch element nut	UU	Engine heater control cables
JJ	Attaching hardware	VV	Accessory bracket
KK	Oil-pan-shroud mounting strap	WW	Fuel pump
LL	Pivot bar	XX	Fuel filter
MM	Leg extensions	YY	"Y" -connector
NN	Heat shield	ZZ	Heater power leads

Figure 625. Power plant heater components - legend - continued

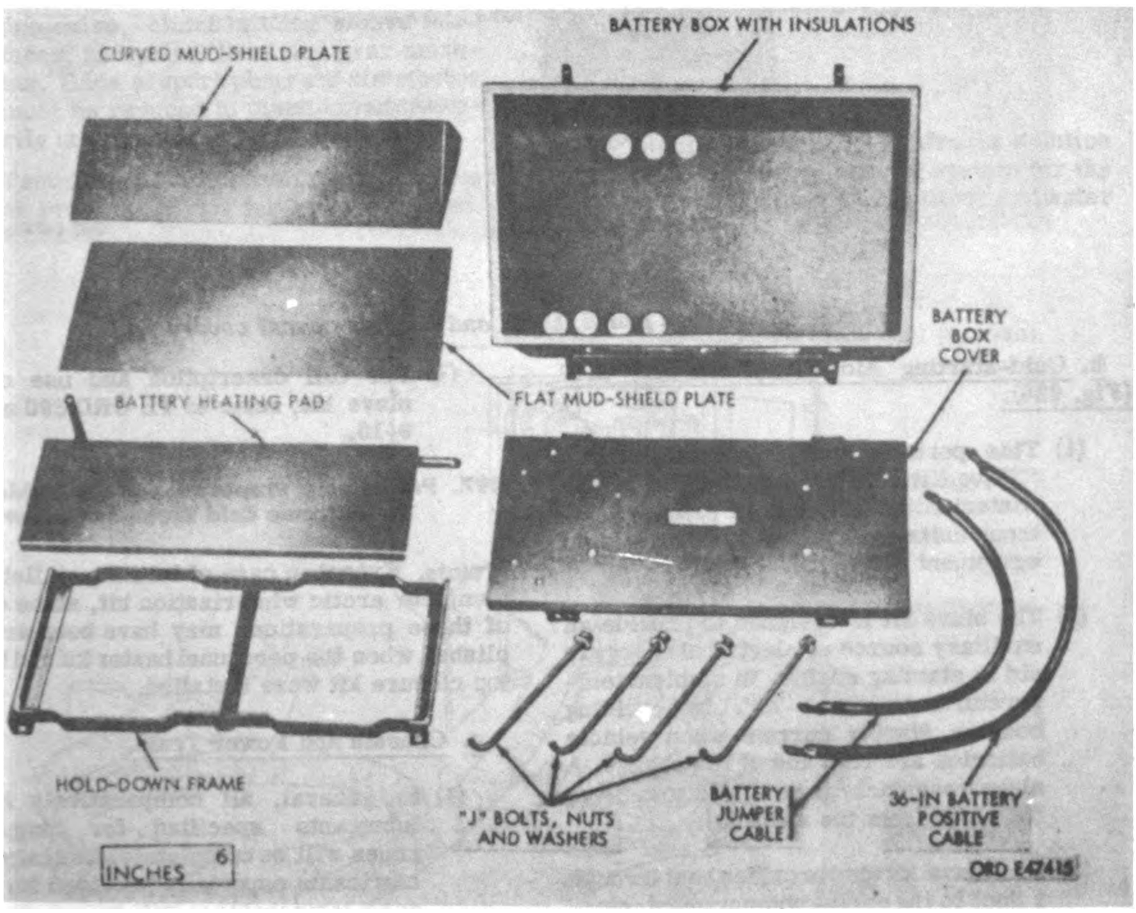


Figure 626. Battery box components

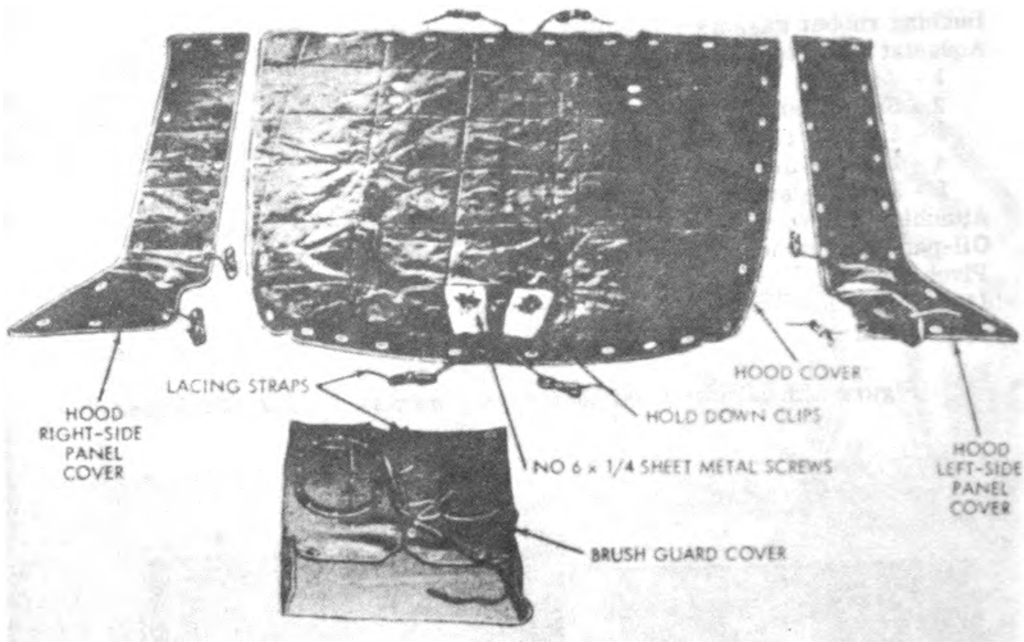


Figure 627. Brush guard, hood, and hoodside panel covers

b. Cold-starting Aid Kit (Slave Kit) M40 (Fig. 628).

(1) This portable unit, commonly called "Slave Kit," is not a part of the arctic winterization kit, but is provided for troop units equipped with winterization equipment (SB 9-16).

(2) The slave kit is designed to provide an auxiliary source of electrical energy to aid in starting engines in ambient temperatures as low as -70°F. by providing booster starter current when vehicle batteries are cold and of low charge. A slave receptacle is provided to receive the cable from the slave kit.

(3) The slave kit also provides heat through a duct to the engine compartment, storage batteries, improperly lubricated sealed bearing, and other locations, where lubricant may have congealed or ice may have formed sufficiently to impede proper functioning.

(4) For full description and use of the slave kit, refer to TB ORD 390 and SB 9-16.

497. Preliminary Preparation of the Vehicle for Extreme Cold Weather Operations

Note. Except in case of initial installation of complete arctic winterization kit, some or all of these preparations may have been accomplished when the personnel heater kit and hard-top closure kit were installed.

a. Chassis and Power Train.

(1) In general, all comparatively heavy lubricants specified for temperate zones will be completely eliminated and lubricants especially provided for subzero temperatures will be substituted. In some cases, parts are to be left with normal temperate zone lubricant, as in the case of the clutch throwout bearings. Transmission, transfer, differentials, steering gear, and universal joints will

all be thoroughly flushed of all old, temperate zone lubricants and filled with lubricants specified for subzero operation. Partial disassembly to accomplish this work is authorized; complete disassembly will be avoided unless absolutely necessary.

(2) As soon as the vehicle is completely arctic lubricated, it will be marked in accordance with SR 746-30-10.

b. Engine and Accessories.

(1) The engine will be flushed several times in order to force all possible old, temperate zone lubricants out of all orifices, pockets, and bearing surfaces of the lubrication system. All lubricant and collected grit must be removed from the armature shafts, Bendix drive, clutch sliding sleeve surfaces, and points involving gear meshing. Gaps at spark plugs and distributor must be reduced to function satisfactorily under extreme cold conditions.

(2) Test fan belts for condition and degree of brittleness and for proper tension. Tension should be less than for normal service conditions.

(3) Test wiring for condition and degree of brittleness, as shown by cracked insulation and a lack of flexibility. Spray all exposed terminals and cable ends with ignition insulation compound, using care not to coat any contact surfaces (par. 466N).

(4) Inspect distributor cap, coil, and other plastic items for cracks and accumulation of ice.

c. Storage Batteries. For operation in subzero weather, lead-acid type storage batteries will be in good condition and in a fully charged state, i.e., 1.275 to 1.300 specific gravity, readings adjusted to a battery solution temperature of 80°F. A fully charged battery will not freeze at -80°F., but a discharged battery will freeze at 10°F.

d. Cooling System.

(1) Before introducing antifreeze solution into the engine cooling system for the first time, flush the radiator and water

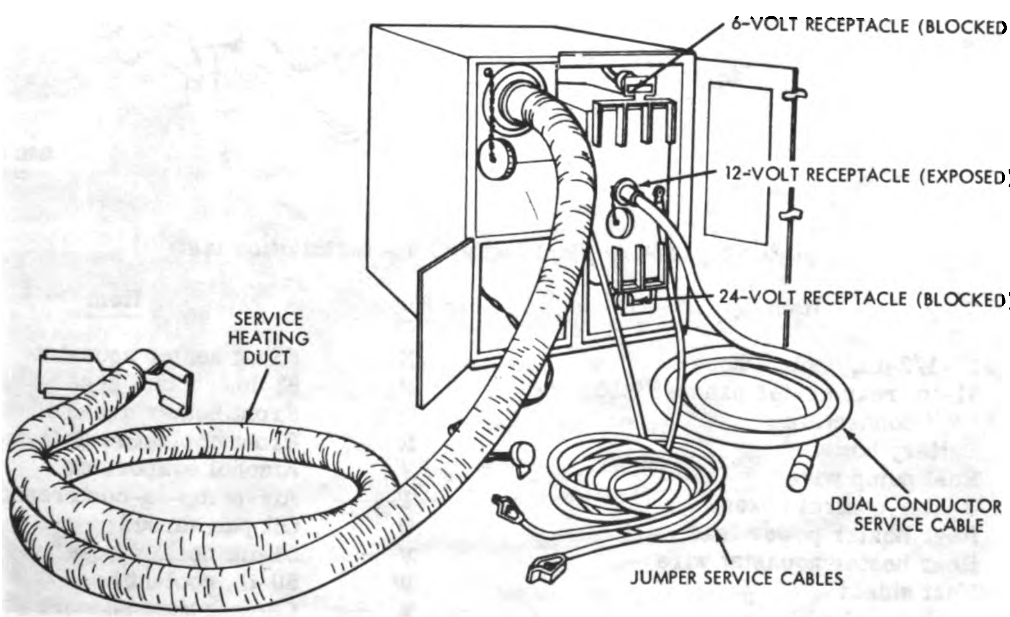


Figure 628. Cold-starting aid kit (slave kit) M40

jackets thoroughly in a reverse direction to normal flow (TM 9-2858). Add water and engine cooling system cleaning compound, start engine, and allow the mixture to circulate at fast idling speed for about 30 minutes. Disconnect the hoses, as necessary to flush in a reverse direction to normal flow, both the radiator and the cylinder water jackets. Connect the hoses, replacing

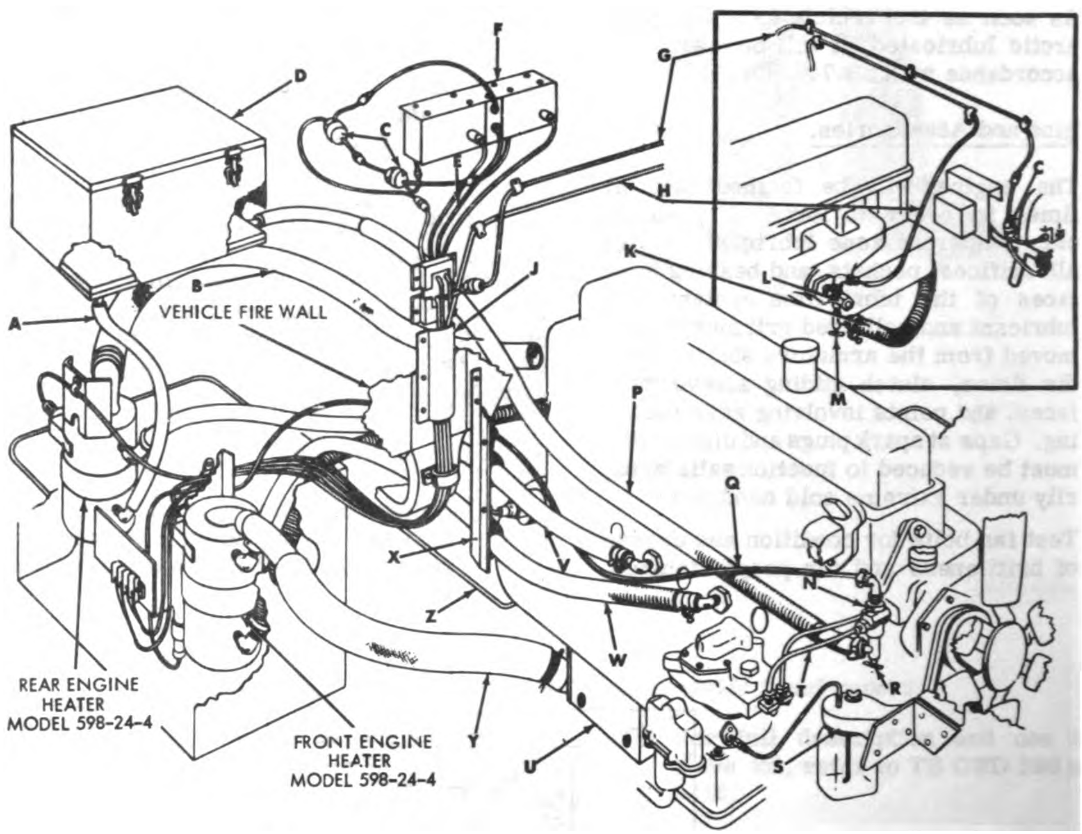


Figure 629. Power plant heater kit - installation view

Key	Item	Key	Item
A	11-1/2-in. coolant hose	N	Front heater aquastat
B	31-in. rear heater exhaust tube	P	83-in. coolant hose
C	"Y" connectors	Q	Front heater aquastat wire
D	Battery box	R	Front coolant shutoff cock
E	Fuel pump wire	S	Alcohol evaporator
F	Heater control boxes	T	Air-pump-to-compressor tube
G	Rear heater power lead	U	Oil pan shroud
H	Rear heater aquastat wire	V	51-in. coolant hose
J	Heat shield	W	50-in. coolant hose
K	62-in. coolant hose	X	Coolant hose support
L	Rear heater aquastat	Y	33-in. front heater exhaust tube
M	Rear coolant shutoff cock	Z	Heater fuel line

Figure 629. Power plant heater kit - installation view - legend

any that are not in good condition and using a light coating of liquid cement when installing. Make certain that the water pump is in good condition. Look for signs of leaks at the cylinder-head gasket or coolant fittings. Check the radiator core, upper and lower tanks, drain cock, and all connections for assurance of continuous service under hot engine, arctic weather conditions.

(2) Use ethylene glycol-type antifreeze compound, diluted with water in correct proportion for the anticipated temperature range, when temperatures not lower than -25°F. are anticipated. Use arctic antifreeze compound when temperatures as low as -65°F. are anticipated. In an emergency, when no antifreeze compound is available, denatured alcohol may be used as an antifreeze in the cooling system.

(3) Drain the entire cooling system (TM 9-2320-211-20).

(4) Remove the two engine thermostats (TM 9-2320-211-20).

e. Shock Absorbers.

(1) Remove the shock absorbers (TM 9-2320-211-20).

(2) Disassemble the shock absorbers, clean, fill with petroleum base hydraulic oil and assemble.

(3) Install the shock absorbers.

f. Air Cleaner. Remove air cleaner (TM 9-2320-211-20).

g. Batteries and Battery Box.

(1) Remove the two batteries (TM 9-2320-211-20).

(2) Discard battery box.

(3) Remove the four hanger bolts from the top inner sides of the running board hangers (fig. 630).

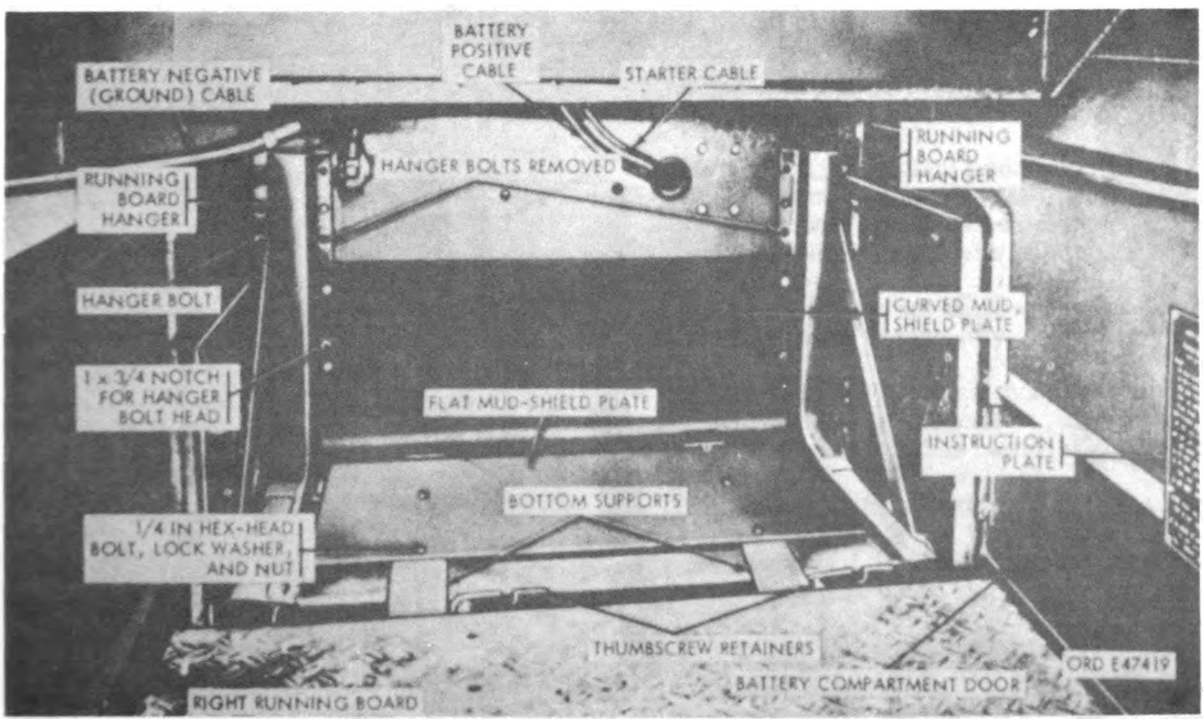


Figure 630. Mud-shield plates installed in original battery compartment

h. Assistant Driver's (Companion) Seat. Remove seat (TM 9-2320-211-20).

498. Installation of Power Plant Heater Kit

a. Mud-shield Plates.

(1) Curved mud-shield plate.

(a) Position the curved mud-shield plate (fig. 626) in the battery compartment, against the running board hangers, so that the curve at the bottom of the plate rests inside the curve of the running board hangers (fig. 630). Scribe the location of the hanger bolt head on the plate, cut out a notch 1-inch wide by 3/4-inch deep, and install hanger bolt (fig. 630).

(b) Using the holes in the plate as a template, scribe and drill four 5/16-inch holes through running board hangers and install the four 1/4-inch hex-head bolts, lockwashers, and nuts (fig. 630).

(2) Flat mud-shield plate.

(a) Position the flat mud-shield plate (fig. 626) on the two bottom supports in the battery compartment, with edges equally spaced, as shown in figure 630.

(b) Using the holes in the plate as a template scribe and drill four 5/16-inch holes through the bottom supports, and install the four 1/4-inch hex-head bolts, lockwashers, and nuts (fig. 630).

b. Battery Box.

(1) Remove the three oblong knockout plugs from the floor of cab (fig. 631).

Note. If there are no oblong knockout plugs, use dimensions shown in figure 631 to locate holes.

(2) Remove the knockout plug from the right side of transmission tunnel rear section (fig. 631).

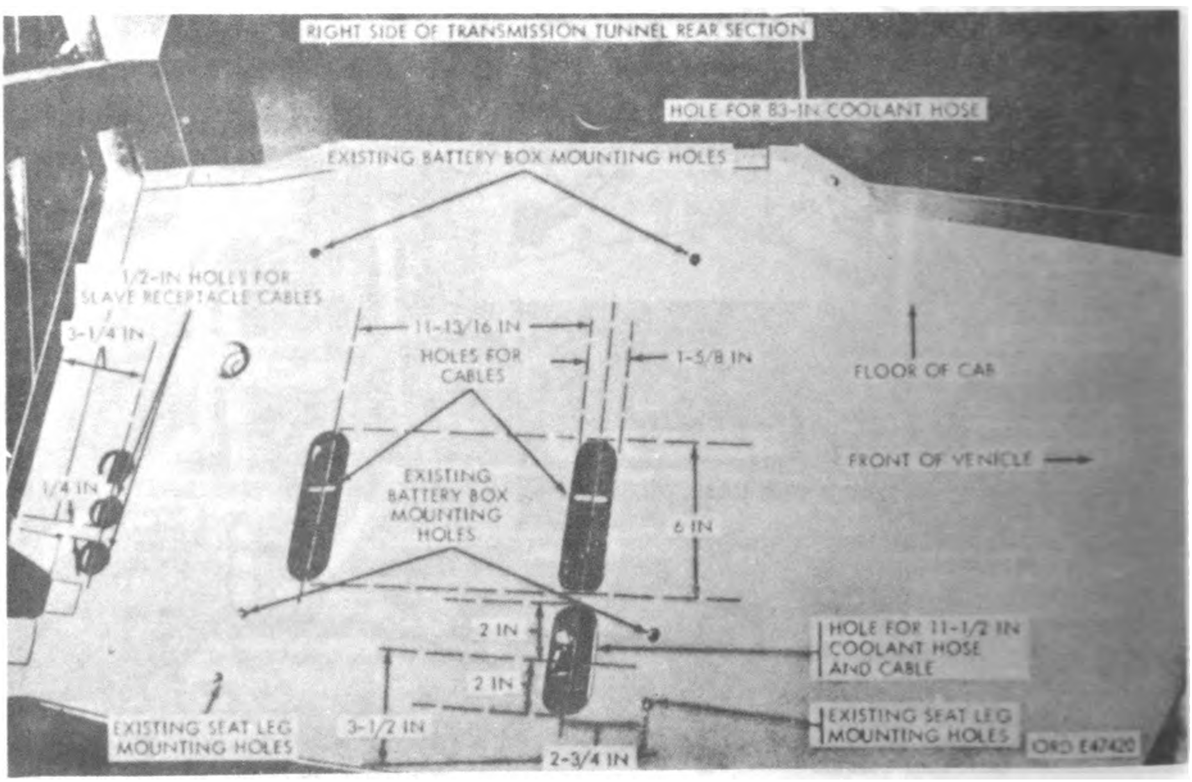


Figure 631. Holes for coolant hoses and cables in floor of cab

(3) Remove the two knockout plugs from the slave receptacle cable holes on the floor of cab (fig. 631).

Note. If there are no knockout plugs, use the dimensions shown in figure 631 to locate the holes.

(4) Position the battery box (fig. 626) on the floor where assistant driver's seat was removed so that the holes in battery box are over the holes in the floor, as shown in figure 632.

(5) Remove a hose clamp from one end of the 83-inch coolant hose (Q, 625) and place the clamp between the right side of transmission tunnel rear section and the battery box (fig. 632), in line with the coolant hose holes in the box and rear section.

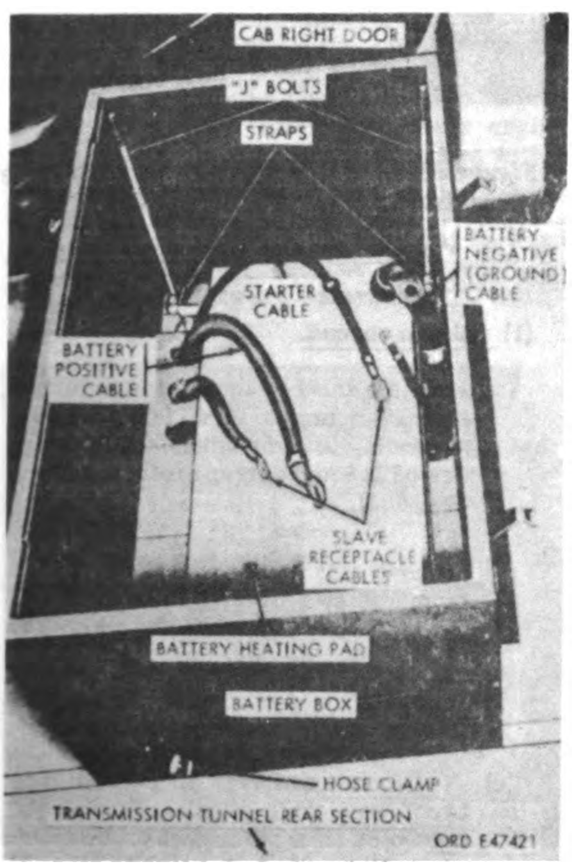


Figure 632. Battery box installed

(6) Secure the battery box through the existing battery box mounting holes in floor cab, using the four 3/8 x 1 bolts and lockwashers supplied with the battery box. Install insulations in battery box.

(7) Remove 33-inch positive battery cable coming from the brake solenoid and connect the 36-inch cable furnished in the kit.

(8) Slide the battery heating pad (fig. 626) into the battery box so that the hose connection on the end of the pad passes through the opening in the left end of the box and also through the hose clamp between battery box and transmission tunnel rear section (fig. 632).

(9) Hook the four "J" bolts to the straps at the corners on the bottom of the battery box (fig. 632).

(10) Pass all battery cables from battery compartment up through the holes in floor of cab and through the bottom of the battery box, as shown (fig. 632).

(11) Place all battery cables out of the way and install the two batteries in the battery box, with the positive (+) terminal posts toward the front, as shown (fig. 633).

(12) Install the original holddown frame over the batteries and the "J" bolts and secure with the 3/8-inch plain washers, lockwashers, and nuts (fig. 633).

Caution: Do not tighten the nuts on the "J" bolts excessively.

(13) Install the terminal post lugs on the battery posts and connect battery cables to the lugs on the batteries (fig. 633).

(14) Connect the original 6-inch battery jumper cable to the positive (+) and negative (-) terminal posts of the batteries (fig. 633).

Caution: Be sure the lugs and the cable terminals do not touch any part of the battery box or holddown frame.

(15) Latch the battery box cover (fig. 626) to the battery box (fig. 634).

c. Engine Heaters and Accessory Bracket.

(1) Remove the 3-inch knockout plug from battery compartment front panel (fig. 635). If there is no knockout plug, cut out a 3-inch hole, using the dimensions shown (fig. 635).

(2) Lift the engine heaters and accessory bracket by the carrying handles (M, fig. 625) and hold in battery compartment, alining the two top holes in the accessory bracket with the top holes in the running board hanger and install hanger bolts, internal-external teeth lockwashers, and nuts (A, fig. 636). Install the two bottom hanger bolts, internal-external teeth lockwashers, and nuts. Tighten all nuts securely.

(3) Remove the two heater carrying handles from the accessory bracket and discard.

Note. The twin heaters are identified as front engine heater (I, fig. 636) and rear engine heater (C, fig. 636).

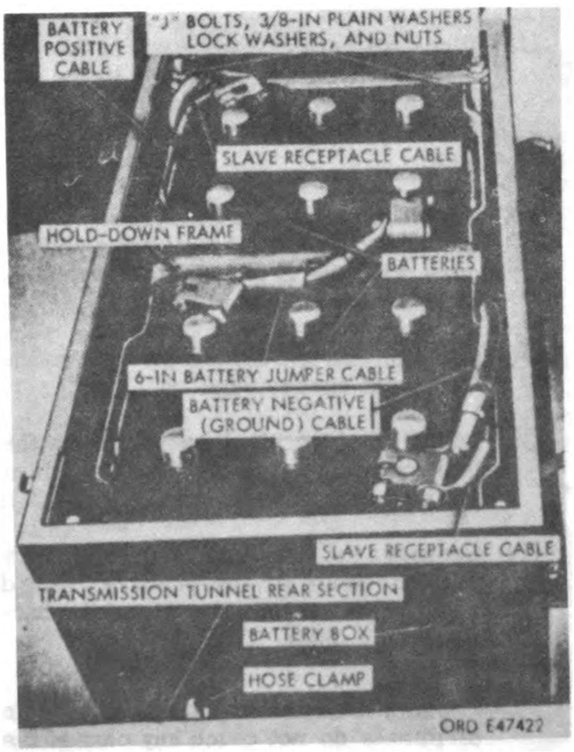


Figure 633. Battery box with batteries installed

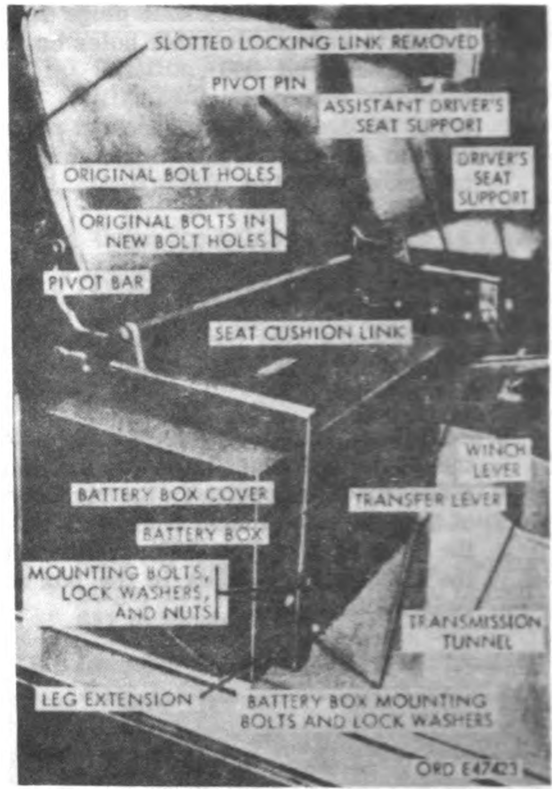


Figure 634. Battery box with cover and assistant driver's seat installed

d. Oil Pan Shroud and Engine Heater Exhaust Tubes.

(1) Oil pan shroud.

(a) Relocate the 1/4-inch holes in oil pan shroud mounting strap (KK, fig. 625) according to dimensions shown in figure 637. Secure strap to oil pan shroud (fig. 637).

(b) Remove the nuts and lockwashers from the two lower studs of the oil pan inspection plate on the right side of oil pan. Remove oil pan bolt and lockwasher on left side of oil pan (fig. 637).

(c) Position shroud over oil pan, with the two lower studs passing through the two holes in right side of shroud. Secure oil pan shroud mounting strap at left side of oil pan with oil pan bolt and lockwasher (fig. 637).

(2) Front heater exhaust tube.

(a) Pass one end of the 33-inch front heater exhaust tube (K, fig. 625) through the 3-inch hole in the battery compartment front panel (P, fig. 636), slip it over the exhaust tube outlet at the top of the front engine heater, and secure with a new 1/8 x 3-cotter pin (M, fig. 636).

(b) Pass the exhaust tube down and under the frame right side member (fig. 638), insert it into the exhaust tube outlet of oil pan shroud, and secure with a new 1/8 x 3 cotter pin (fig. 637).

(3) Rear heater exhaust tube.

(a) Remove the exhaust tube mounting bracket from the 31-inch rear heater exhaust tube clamp (J, fig. 625) and install bracket on the lower right bolt of the transmission bearing cover (fig. 639).

(b) Slip the adapter end of the 31-inch rear heater exhaust tube on the exhaust tube outlet of the rear engine heater (C, fig. 636) and secure with a new 1/8 x 3 cotter pin.

(c) Pass exhaust tube down and forward so that the exhaust tube plain end points forward underneath the transmission housing and secure the exhaust tube clamp to the exhaust tube mounting bracket with a 1/4 x 1 hex-head cap screw, lockwasher, and nut (fig. 639).

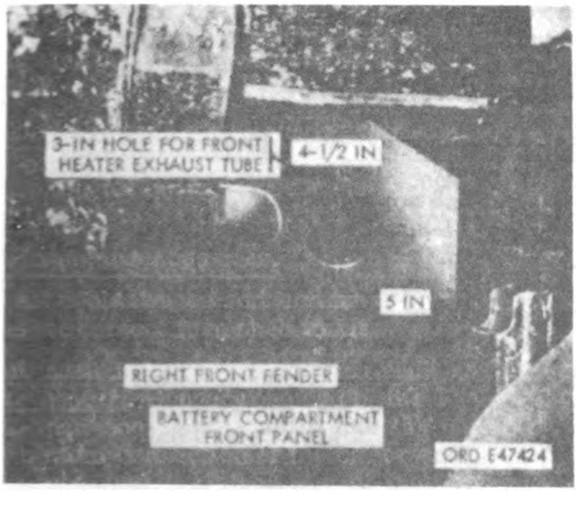


Figure 635. Front heater exhaust tube hole

e. Fuel Line.

(1) Disconnect the vehicle fuel line from the inlet side of the fuel filter on the left side of the frame cross member (fig. 640).

(2) Remove the tee and connector from the end of the heater fuel line (G, fig. 625) and install the tee into the inlet side of the vehicle fuel filter (fig. 640).

(3) Connect the free end of the vehicle fuel line to the top end of the tee (fig. 640).

(4) Connect one end of the heater fuel line to the bottom end of the tee on vehicle fuel filter (fig. 640). Pass the line under the vehicle alongside the frame cross member, then rearward behind the curved mud-shield plate toward heater fuel filter (V, fig. 636). Connect fuel line to the filter.

(5) Use two harness clamps (J, fig. 625) to secure fuel line to frame cross-member and two harness clamps to secure line to existing bolts on curved mud-shield plate.

Note. There must be adequate clearance between the heater fuel line and vehicle exhaust pipe. All fuel line connections must be tightened securely to prevent leakage when heaters are in operation.

f. Engine Thermostats. Install engine thermostats (A, fig. 625) and thermostat rubber gasket (B, fig. 625), following the procedure in TM 9-2320-211-20.

g. Coolant Hoses and Aquastats.

Note. Coat all coolant hose connections witl liquid-type gasket cement furnished in kit.

(1) Coolant hose from battery heating pad to rear heater. Connect one end of the 11-1/2-inch coolant hose (E, fig. 625) to the bottom connection of the battery hesting pad and the other end of the lower hose connection on rear engine heater (figs. 626 and 636). Tighten hose clamps.

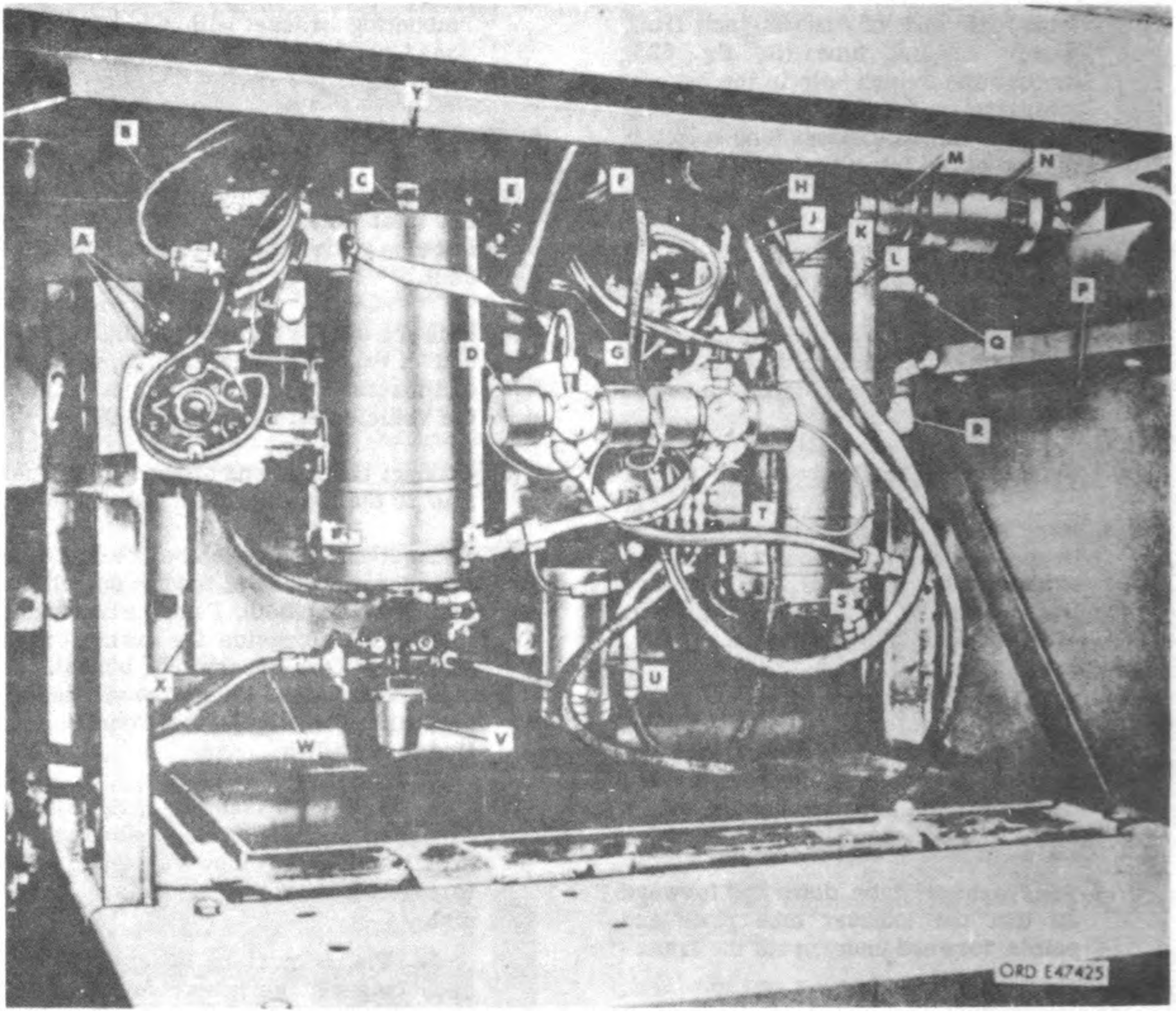


Figure 636. Engine heaters installed

Key	Item	Key	Item
A	Hanger bolts, internal-external teeth lockwashers, and nuts	M	1/8 x 3 cotter pin
B	Rear heater control cable	N	33-inch front heater exhaust tube
C	Rear engine heater	P	Battery compartment front panel
D	Lower hose connection	Q	Front heater upper hose connection
E	Upper hose connection	R	Front heater lower hose connection
F	11-1/2-inch coolant hose	S	Fuel pump power lead
G	Front heater control cable	T	Terminal strip
H	Front heater wire support and 1-1/2-inch clamp	U	Heater fuel pump
J	Front heater aquastat wire	V	Heater fuel filter
K	Rear heater aquastat wire	W	Heater fuel line
L	Front engine heater	X	Accessory bracket
		Y	Rear heater wire support and harness clamps

Figure 636. Engine heaters installed - legend

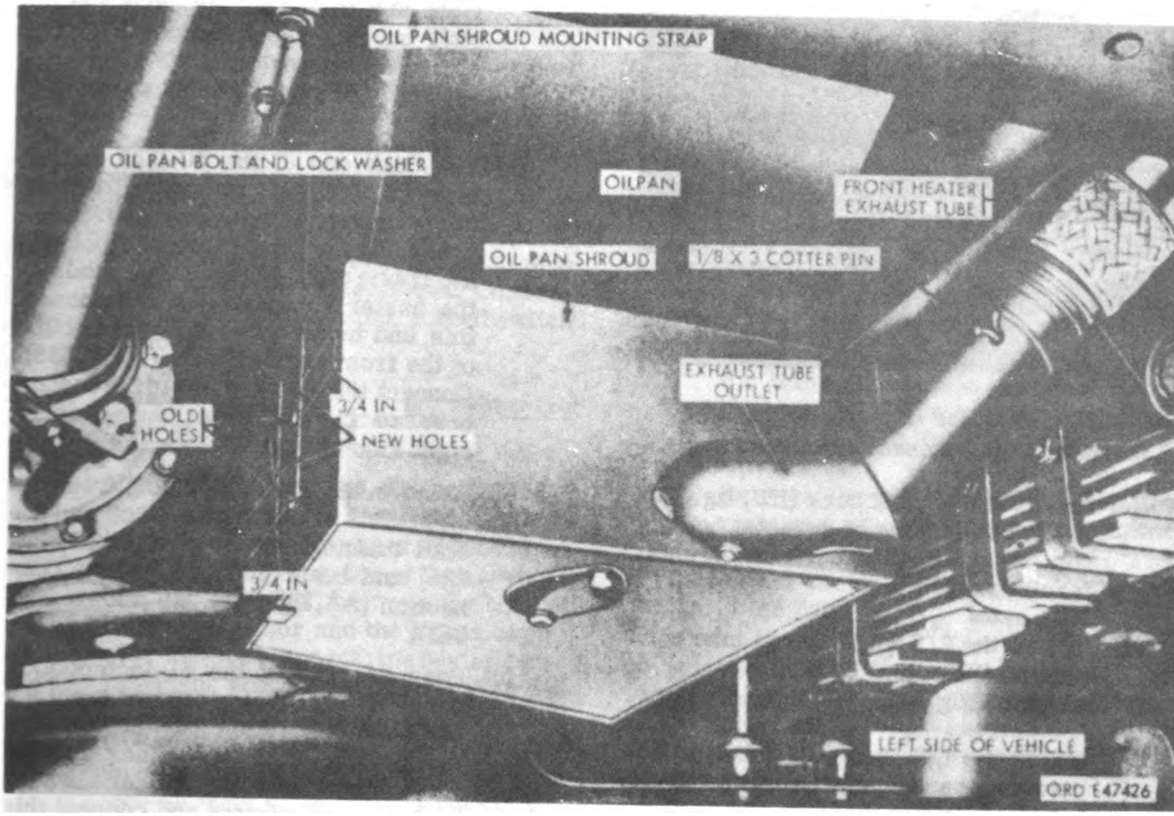


Figure 637. Engine oil-pan shroud and end of front heater exhaust tube installed

(2) Water pump-to-air compressor line. Disconnect the 1/2-inch coolant line from the water pump and the air compressor on the right side of the engine and discard line.

(3) Front heater aquastat.

(a) Remove the shutoff cock, 1/2-inch line, and switch element from aquastat with line assembly (HH, fig. 625).

Caution: Handle switch element carefully.

Note. In some kits, the shutoff cock and 1/2-inch line may not be assembled to the aquastat.

(b) Screw the male pipe end of the aquastat into the water pump (fig. 641) in place of the original 1/2-inch line and install switch element.

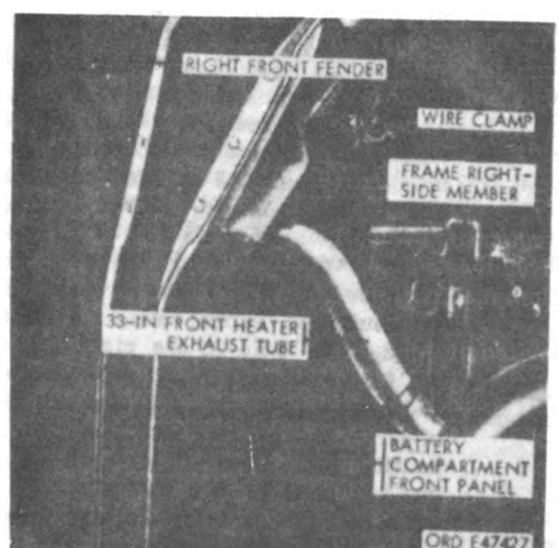


Figure 638. Front heater exhaust tube installed through panel hole

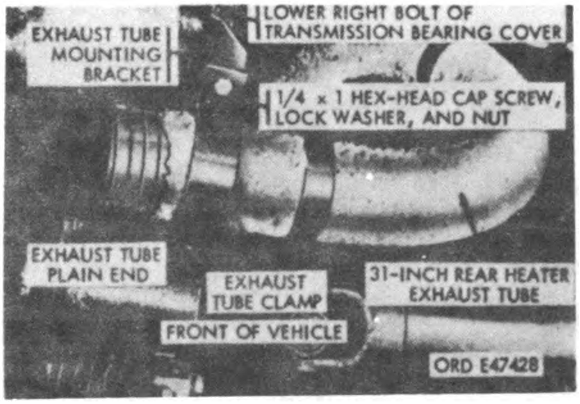


Figure 639. Rear heater exhaust tube installed under transmission housing

(c) Install the shutoff cock (HH, fig. 625) in bottom opening of aquastat housing (fig. 641). Shutoff cock outlet must face rearward.

(d) Install the 3/8 x 1/2 flared tube connector (HH, fig. 625) in opening of aquastat (fig. 641). Tighten connector.

(e) Install the 1/2-inch line (HH, fig. 625) between the aquastat housing and air compressor (fig. 641).

(4) Coolant hose from battery heating pad to right heater aquastat.

(a) Remove transmission tunnel front section, as shown (fig. 642).

(b) Remove the hose clamp from one end of the 83-inch coolant hose (Q, fig. 625) working from right-hand side of engine, pass the end without the hose clamp between the exhaust manifold and the engine block, rearward underneath the tunnel to the left of the gear shift lever (fig. 642), between the transfer and winch levers under the transmission tunnel rear section, through the hole in the right side of the transmission tunnel rear section and hose clamp (fig. 633) and slip end of hose on hose connection of battery heating pad. Connect forward end of coolant hose to the shutoff cock on aquastat (fig. 641). Tighten hose clamps (figs. 633 and 641).

(5) Coolant hoses from heaters to engine block.

(a) Remove the rear pipe plug from the right side of the engine block and install bushing rubber gasket (GG, fig. 625) and bushing with 90° hose connection (BB, fig. 625), as shown (fig. 643).

(b) Pass one end of the 50-inch coolant hose (T, fig. 625) rearward from the 90° hose connection, then outward between the bottom of the cab floor and the frame right-side member, and into the heater compartment and connect this end to the upper hose connection of the front engine heater (L, fig. 636). Connect the forward end of the coolant hose to the 90° hose connection on right side of engine block (fig. 643).

(c) Remove the front pipe plug from the right side of the engine block and install bushing rubber gasket (GG, fig. 625) and bushing with 45° hose connection (AA, fig. 625), as shown (fig. 643).

(d) Pass one end of the 51-inch coolant hose (U, fig. 625) rearward from the 45° hose connection, outward between the bottom of the cab floor and the frame right-side member and into the heater compartment and connect this end of the upper hose connection of the rear engine heater (C, fig. 636). Connect the forward end to the 45° hose connection on right side of engine block (fig. 643).

(6) Rear heater aquastat.

(a) Remove the 1-inch pipe plug from the outer side of the water manifold and to the rear of the ignition distributor.

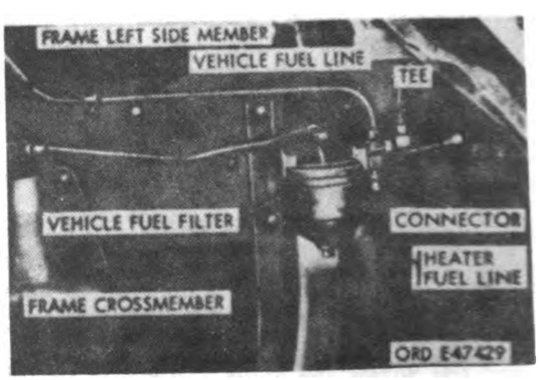


Figure 640. Heater fuel line connection at vehicle fuel filter

Note. Remove the No. 6 spark plug lead at the distributor.

(b) Remove switch element from aquastat (Z, fig. 625).

Caution: Handle switch element carefully.

(c) Screw the bushing with aquastat (Z, fig. 625) in place of the 1-inch pipe plug, as shown in figure 644. Connector nut should be on top. Install switch element.

(7) Coolant hose from front heater to aquastat.

(a) Pass one end of the 62-inch coolant hose (R, fig. 625) from the aquastat rearward behind the rear end of engine block, across the top of the flywheel housing (fig. 642) between the bottom of the cab floor and the frame right-side member, and into the heater compartment and connect the end of the coolant hose to the lower hose connection of the front engine heater (L, fig. 636). Connect the other end of the coolant hose to the shutoff cock on the aquastat (fig. 644). Tighten hose clamps.

(b) Install the transmission tunnel front section.

(8) Coolant hose support.

(a) Drill two 5/16-inch holes in firewall, using the dimensions shown in figure 642, and secure the coolant hose support (X, fig. 625) and hose clamps (Y, fig. 625) with two 1/4-inch bolts, lockwashers, and nuts as shown (figs. 642 and 645).

(b) Clamp the 50-inch coolant hose and the 51-inch coolant hose to the coolant hose support (fig. 645).

h. Assistant Driver's Seat (Fig. 634).

(1) Secure a leg extension (MM, fig. 625) to each seat leg at the right end of the seat frame.

(2) Place seat frame in the raised position over battery box.

(3) Install the four original bolts through the bolt holes along the lower edge of the assistant driver's seat support and through the original bolt holes in the driver's seat support and secure with lockwashers and nuts.

Note. If there is only an upper set of bolt holes in the assistant driver's seat support, hold the support level in the new position, scribe through the four bolt holes in the driver's seat support, remove the support, and drill new bolt holes. The 5/16 x 3/8-hex-head bolt for the seat cushion pivot and the new bar furnished in the kit are not needed for this installation.

(4) Remove the slotted locking link from right end of seat and return to stock.

(5) Attach the leg extensions to the floor of the cab.

(6) Place seat cushion in position in seat frame and insert pivot pins in place at each end of seat cushion. Secure seat cushion link at left end of the seat to the cushion brace.

i. Aquastat Wires (Fig. 646).

(1) Front heater aquastat wire.

(a) Pass the two-terminal end of the front heater aquastat wire (TT, fig. 625) (wire is tagged No. 2) from the front heater aquastat rearward between the engine block and the exhaust manifold, down between the cab floor and the frame right-side member, and into the engine heater compartment. Connect the two-terminal leads of the aquastat wire to the two lower front terminal posts of the terminal strip (T, fig. 636).

(b) Attach the electrical connector on the other end of the aquastat wire to the top of the aquastat (fig. 641).

(c) Clamp the aquastat wire to the coolant hose support with a harness clamp (fig. 645). The upper hose clamp bolt in the coolant hose support is also used to mount the harness clamp.

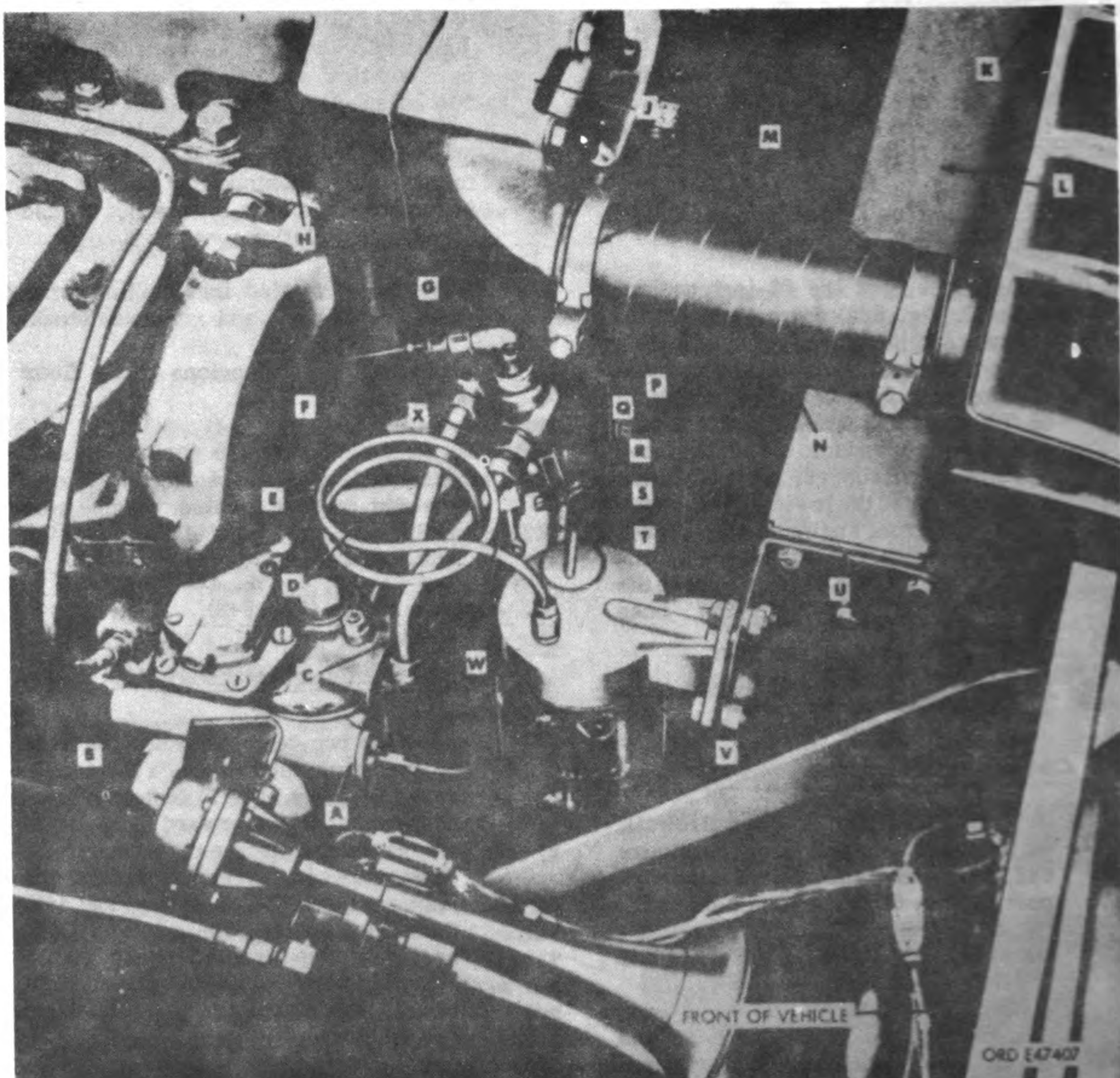


Figure 641. Engine thermostat housing, front heater aquastat, and alcohol evaporator installed

Key	Item	Key	Item
A	Adapter plate	M	Hose clamps
B	Air compressor	N	Radiator inlet hose
C	1/2-inch line from air compressor to aquastat	P	Water pump
D	83-inch coolant hose	Q	Aquastat
E	Evaporator line	R	Bypass hose clamp
F	Front heater aquastat wire	S	Shutoff cock
G	Aquastat connector	T	Bypass hose
H	Water manifold	U	Evaporator mounting bracket
J	Thermostat housing	V	Evaporator jar bracket
K	Radiator stay rod bracket	W	Hose clamp
L	Fan shroud	X	3/8 x 1/2-inch flared tube connector

Figure 641. Engine thermostat housing, front heater aquastat, and alcohol evaporator installed - legend

(2) Rear heater aquastat wire.

(a) Pass the two-terminal end of the left aquastat wire (TT, fig. 625) (wire is tagged No. 1) from the aquastat on the left side of the engine, rearward to the firewall, along the front of the firewall to the right side of the engine, then downward and rearward between the cab floor and the frame right-side member, and into the heater compartment. Connect the two terminal leads

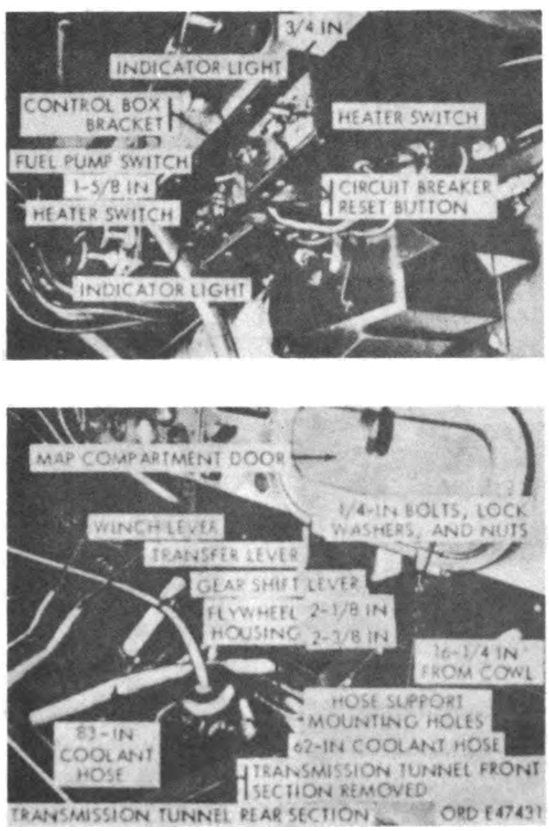


Figure 642. Left and right coolant hose passing over flywheel housing

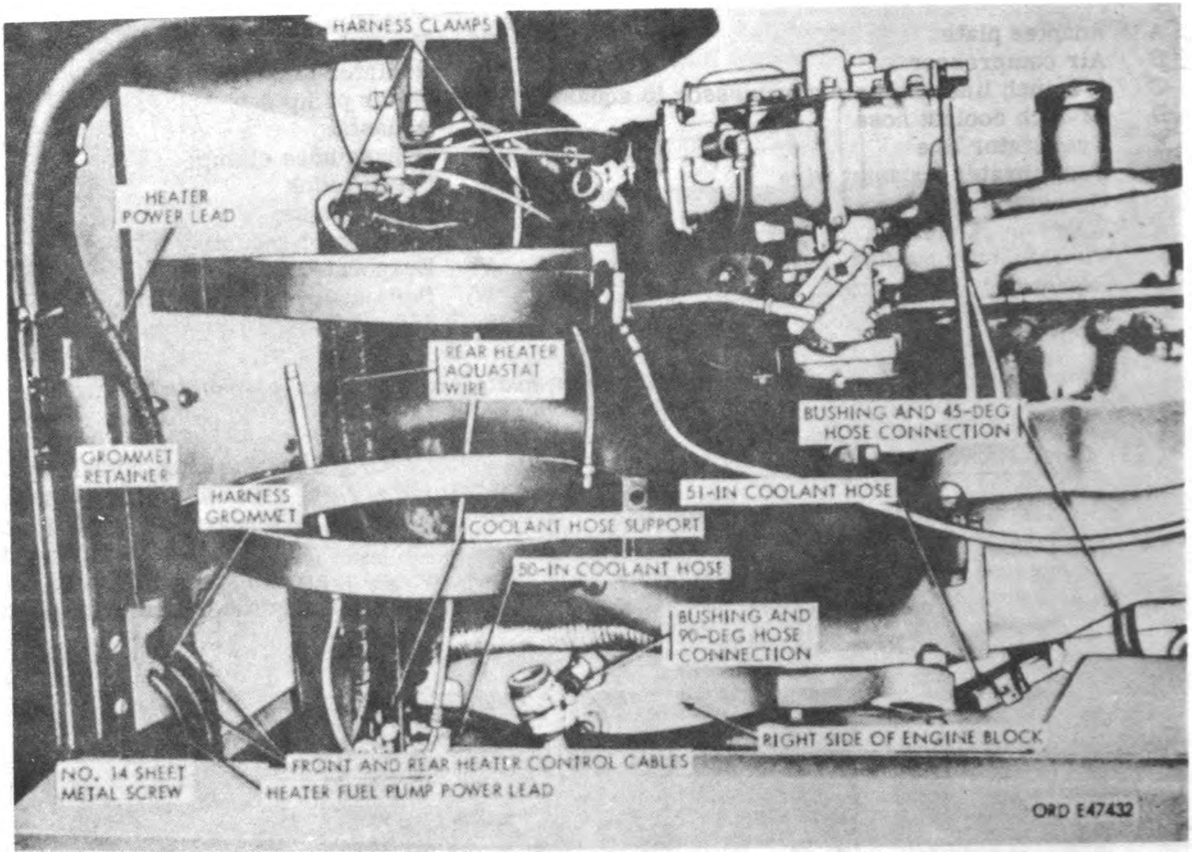


Figure 643. Front and rear coolant hose connections installed on right side of engine block

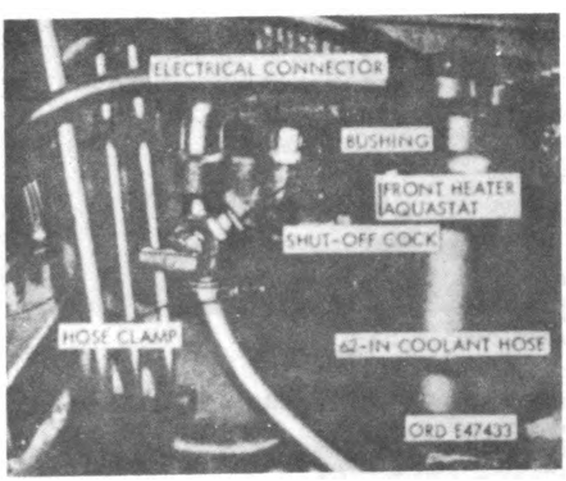


Figure 644. Aquastat installed on left side of engine

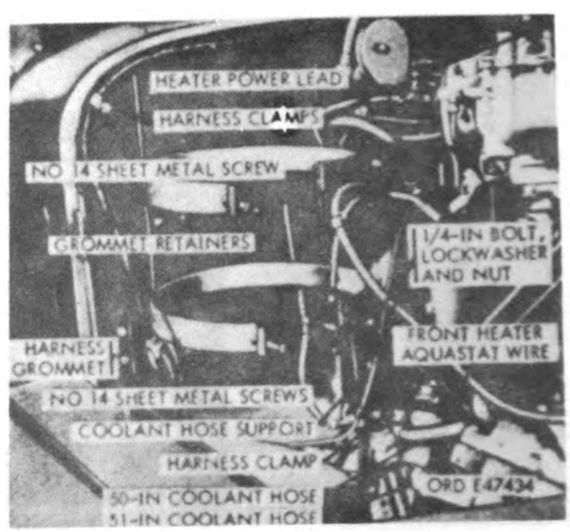


Figure 645. Coolant hose support installed

of the aquastat wire to the lower rear terminal posts of the terminal strip (T, fig. 636).

(b) Place two harness clamps over the aquastat wire, as shown in figure 642, scribe holes and drill two 1/8-inch holes through firewall, and secure harness clamps with two No. 14 sheet metal screws.

(c) Attach the electrical connector on the other end of the aquastat wire to the top of the aquastat (fig. 644).

j. Heater Control Boxes and Electrical Connections.

(1) Control boxes.

(a) Reposition the heater control boxes on the control box bracket so that right heater control box with fuel pump switch panel is 3/4-inch and left heater control box is 1-5/8 inches back of lip on control box bracket (fig. 642). Hold the control box bracket, with two heater control boxes, on the bottom flange of the instrument panel, leaving at least 1/2-inch clearance between the right edge of the control box and the left edge of the glove compartment door (fig. 642), and scribe and drill four 7/32-inch mounting holes in the bottom of the instrument panel.

(b) Attach the control box bracket and the boxes, to the bottom flange with two No. 10 screws.

(2) Electrical connections (fig. 646).

(a) Check the location of the 2-inch knockout plug on the right-hand side of the firewall. If the plug is in the lower right corner, near the lower supporting band (fig. 647), proceed as in (b) below; if the plug is between the air cleaner mounting brackets (fig. 647), proceed as in (c) below.

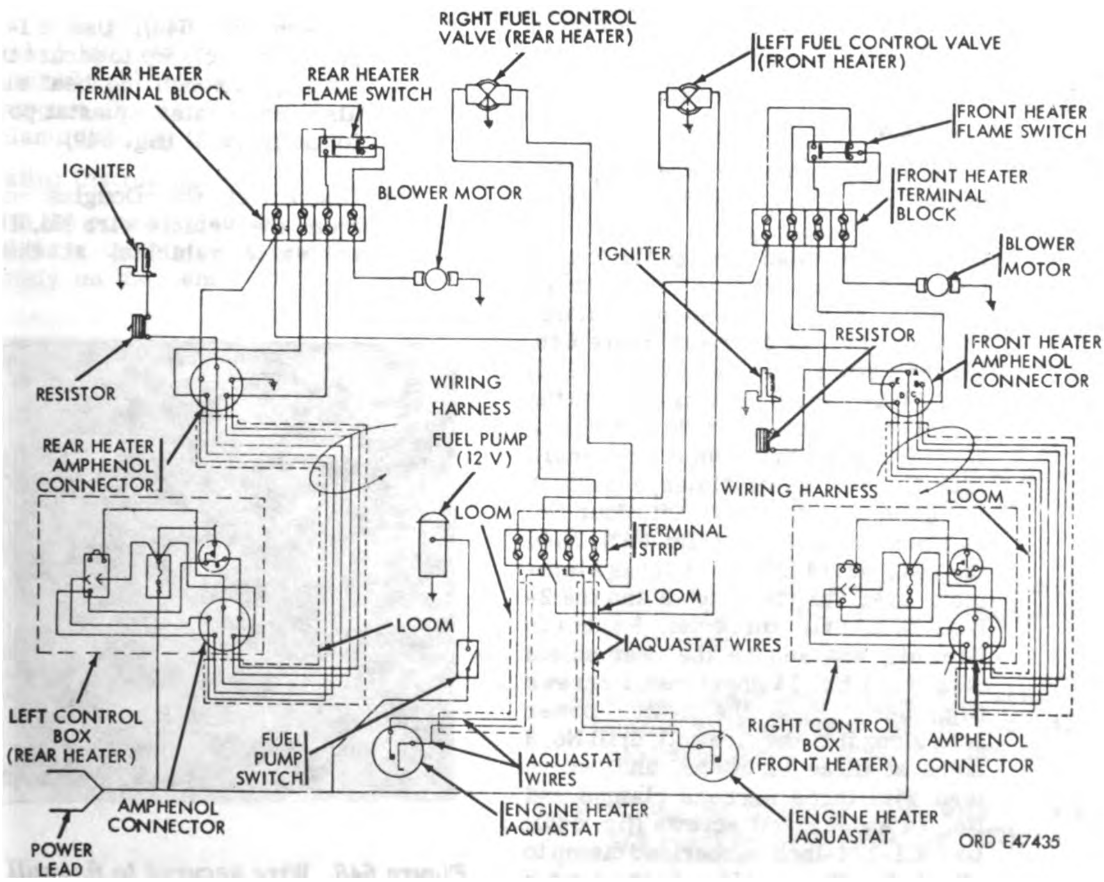


Figure 646. Wiring diagram

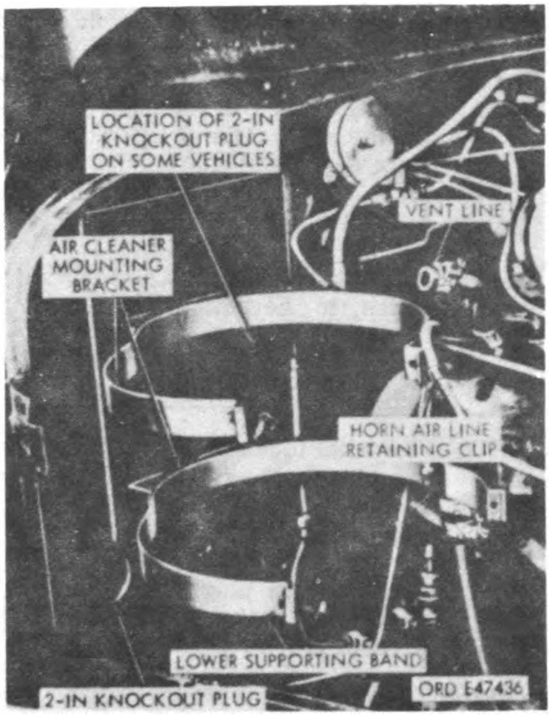


Figure 647. Location of 2-inch knockout plugs on right side of firewall

(b) Remove the knockout plug, pass the heater fuel pump power lead, front and rear heater power cables, and heater power lead through the 2-inch hole, and clamp all four cables to the firewall with a 1-1/2-inch clamp, bolt, and nut, as shown in figure 648. Fit the harness grommet (D, fig. 625) to the four cables passing through the 2-inch hole, drill four No. 8 holes in firewall, using the grommet retainers (QQ, fig. 625) as templates, and attach the grommet retainers with four No. 14 sheet metal screws (fig. 643). Hold the heat shield (NN, fig. 625) as a template over the four cables and the 2-inch hole, drill three No. 8 holes in firewall, and secure the heat shield with three No. 14 sheet metal screws (fig. 648). Pass the heater power lead alongside the firewall, drill No. 8 holes at three locations, and secure lead with three harness clamps and No. 14 sheet metal screws (fig. 645). Use a 1-1/4-inch rubberized clamp to attach the three cables to the fender splash pan.

Remove the knockout plug from firewall, between air cleaner mounting brackets, pass the heater fuel pump power lead, front and rear heater power cables, and heater power lead through the 2-inch hole and clamp all four cables to the bottom of the map compartment with a 1-1/2-inch clamp, bolt, and nut. Fit the harness grommet (D, fig. 625) to the four cables passing through the 2-inch hole, drill four No. 8 holes in firewall, using the grommet retainers (PP, fig. 625) as templates, and attach the grommet retainers with four No. 14 sheet metal screws (fig. 649). Hold the heat shield (NN, fig. 625) as a template over the four cables about 1-1/2-inches below the 2-inch hole, drill three No. 8 holes, and attach the heat shield with three No. 14 sheet metal screws (fig. 649). Pass the heater power lead alongside the firewall, drill No. 8 holes at three locations, and secure lead with three harness clamps and No. 14 sheel metal screws (fig. 645). Use a 1-1/4-inch rubberized clamp to secure the cables passing through the heat shield and also rear heater aquastat power wire to the firewall (fig. 649)

(d) Disconnect the Douglas connector from the vehicle wire No. 15 (No. 37 on early vehicles) at the circuit

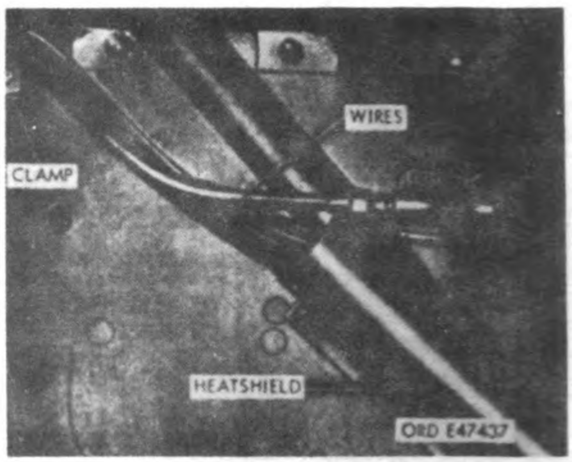


Figure 648. Wire secured to firewall and heat shield installed

breaker on left-hand side of firewall and connect one end of the "Y"-connector to the circuit breaker and the other end to the connector on the vehicle wire No. 15 (or No. 37) as shown (fig. 650).

(e) Pass the front and rear heater control cables and the heater fuel pump power lead rearward between the cab floor and the frame right-hand member into the engine compartment.

(f) Connect the rear heater control cable to the rear engine heater and the front heater control cable to the front engine heater. Pass the heater fuel pump power lead through the grommet and hole in the fuel control valve bracket and connect it to the Douglas connector on the heater fuel pump (U, fig. 636).

(g) Attach the front and rear heater control cables, front and rear heater aquastat wires, and heater fuel pump lead to the rear side of the front heater wire support (H, fig. 636) with a 1-1/2-inch clamp. Clamp rear heater control cables to the rear heater wire support (Y, fig. 636) with a harness clamp (RR, fig. 625).

k. Operating Instruction Plate and Air Filter.

(1) With the operating instruction plate (in kit) as a template positioned approximately on the center of the inside of

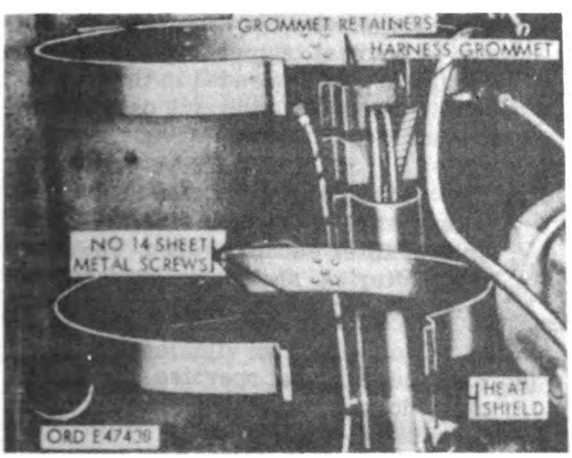


Figure 649. Heat shield harness grommet, and retainers installed

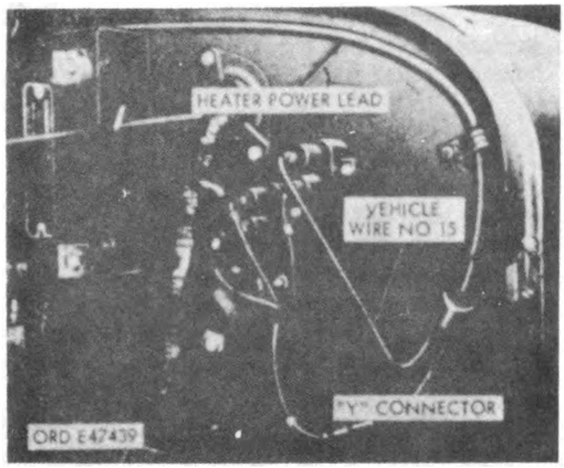


Figure 650. "Y" connections.

the heater compartment door, drill four 3/16-inch holes. Attach the plate to the door.

(2) Install the vehicle air cleaner and connect all air lines (TM 9-2320-211-20).

l. Slave Receptacle. Remove the slave receptacle cover plate from right-rear corner of cab body and install the slave receptacle.

m. Installation of Hood Covers (Figs. 651 and 652).

(1) Place the hood cover (fig. 627) on engine hood, and mark the location of each grommet on the edge of hood.

(2) Place the hood side panel covers (fig. 627) against the side panels and mark the location of the grommets on the side panels.

(3) Place the brush guard cover against brush guard and mark location of grommets.

(4) Using a tie-down clip (fig. 627) at location of each grommet, scribe and drill mounting holes with a 1/8-inch drill.

(5) Mount the tie-down clips with No. 6 x 1/4 sheet metal screws (fig. 627).

(6) Mount the covers in place and lace the tie straps through the tie-down straps.

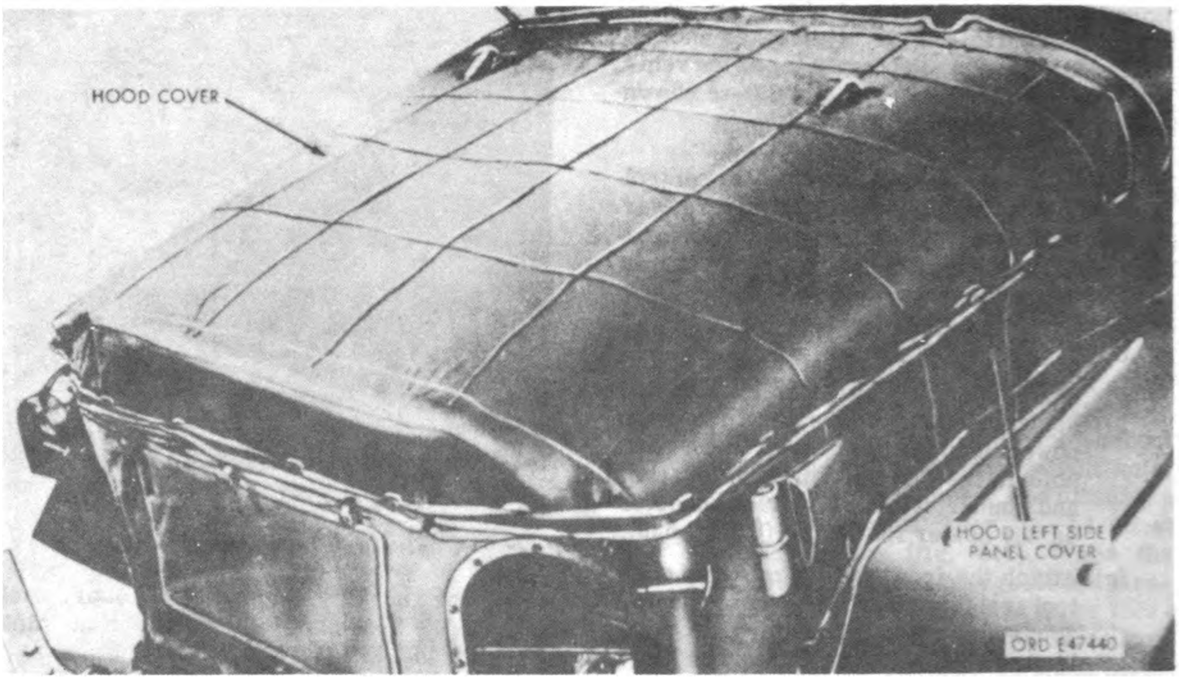


Figure 651. Hood cover brush guard cover, and hood left-side panel cover installed

Note. Fold under the left end of brush guard cover to clear air inlet for personnel heater.

(7) Test the hood opening, with cover in place.

499. Application of Ignition Insulation Compound

See paragraph 466n for application of ignition insulation compound.

500. Tests and Adjustments

a. Operating Cautions.

(1) Do not attempt to operate the engine heater until the cooling system is filled with coolant. Immediately after installation of the kit, run the vehicle engine to assure complete removal of any air which may have been trapped in the cooling system.

(2) When filling the cooling system, be sure that the shutoff cocks in the engine heater's coolant system are open to allow the engine heater and the battery heating pad to fill with coolant. Remove the 1/4-inch pipe plug from the top of the water pump housing to bleed air from the pump.

(3) The shutoff cocks in the coolant lines of the engine heater system must be open at all times when the engine heaters are operating. The shutoff cocks must be closed whenever the vehicle is operating in ambient temperatures above the minimum recommended in the locality of operations. This avoids overheating the battery.

(4) The vehicle fuel tank should be filled with arctic grade fuel and the shutoff cock at filter should be open. The storage batteries should be charged and properly connected.

(5) Each control box operates one heater only; do not start both heaters at the same time.

(6) Heater compartment door must be open when heaters are operating. Close the door when heaters are not in operation.

b. To Start (One Heater Only).

(1) Press in circuit breaker reset button (fig. 642).

(2) Check electrical circuit by pressing in knob on indicator light (fig. 642).

(3) Move fuel pump switch (fig. 642) to ON position.

(4) Hold heater switch (fig. 642) in START position until indicator light glows.

5) Move heater switch to RUN position.

c. Failure to Start. If either heater fails to start within 5 minutes, stop the heater (d below). Heater will require servicing.

d. Stop Heater.

(1) Move fuel pump switch to OFF position.

(2) Move heater switch to OFF position and wait for indicator light to go out.

e. Manual Ignition. In the event of failure of the electric igniter, the heater can be ignited manually. Proceed as outlined in (1) through (7) below.

(1) Hold the heater switch in START position for 1 to 2 minutes and then move to OFF position.

(2) Unlatch and lower the cover on heater to expose the burner.

(3) Turn and remove igniter plate (resistor retainer) at bottom of burner.

(4) Soak a small piece of waste, rag, or asbestos in gasoline.

(5) Light the improvised torch with a match, push up into burner bowl, and immediately install igniter plate.

(6) Move heater switch to START position and hold until indicator light glows.

(7) Move heater switch to RUN position and heater will operate normally.

501. Removal of Power Plant Heater Unit (Fig. 636)

Note. The key letters noted in parentheses are in figure 625 except where otherwise indicated.

a. Disconnect Electrical Connections.

Note. A 5-wire cable from the control panel to the heater, with multiple conductor connectors at each end, permits removal of either the heater or the control panel without disturbing the control installation.

(1) Remove 5-wire engine heater control cables (UU, fig. 625) from front and rear engine heaters.

(2) Disconnect the heater fuel pump power lead (L) from heater fuel pump (WW) and from No. 1 terminal on terminal strip (T, fig. 636).

(3) Disconnect the two-terminal ends of the front heater aquastat wire (TT, fig. 625) from the two lower front terminal posts of the terminal strip (T, fig. 636).

(4) Disconnect the two-terminal leads of the rear heater aquastat wire (tagged No. 1) from the lower terminal posts of the terminal strip (T, fig. 636).

b. Disconnect Coolant Lines.

(1) 11-1/2-inch coolant hose (E, fig. 625). Loosen hose clamps and disconnect hose from rear engine heater.

(2) 50-inch coolant hose (S). Disconnect end of 50-inch coolant hose from upper hose connection of the front engine heater (L, fig. 636).

(3) 51-inch coolant hose (U, fig. 625). Disconnect 51-inch coolant hose from the upper hose connection of the rear engine heater (C, fig. 636).

(4) 62-inch coolant hose (R). Loosen hose clamp to permit removal of the 62-inch coolant hose from front engine heater (L, fig. 636).

c. Disconnect Exhaust Tubes.

(1) 31-inch rear heater exhaust tube (J, fig. 625). Pull out cotter pin, and remove exhaust tube from top outlet of rear engine heater (C, fig. 636).

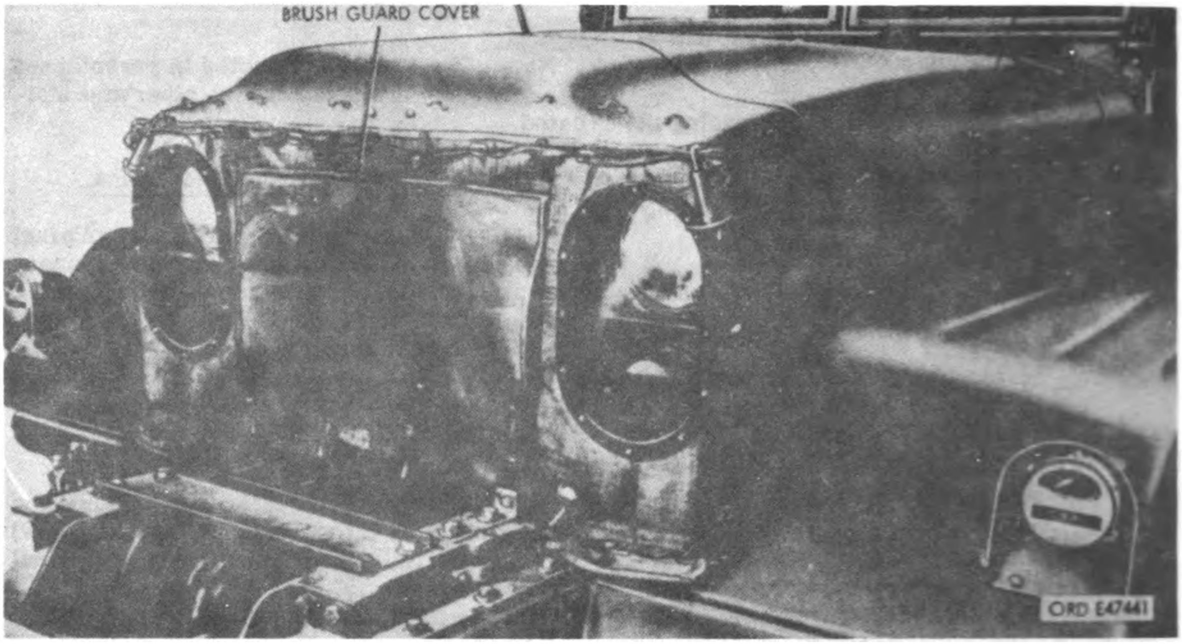


Figure 652. Brush guard cover and hood right-side panel cover installed

(2) 33-inch front heater exhaust tube (K, fig. 625). Pull out 1/8 x 3-inch cotter pin (M, fig. 636) and slip off 33-inch front heater exhaust tube from top outlet of front engine heater.

d. Disconnect Fuel Line (G, Fig. 625). Loosen heater fuel line (W, fig. 636) at heater fuel filter (V, fig. 636) and detach from filter.

e. Remove Engine Heaters (N, Fig. 625). Remove four nuts, four internal-external-teeth lockwashers, and four hanger bolts (A, fig. 636) to free the accessory bracket (VV, fig. 625) from the running board. Lift out engine heaters by the carrying handles (M) and remove heater unit from the running board of the vehicle.

502. Disassembly of Power Plant Heater Unit

See TM 9-8662 for disassembly of power plant heater.

503. Inspection, Cleaning, and Repair of Heater Unit

See TM 9-8662 for inspection, cleaning and repair of heater unit.

504. Assembly of Power Plant Heater Unit

See TM 9-8662 for assembly of power plant heater unit.

505. Troubleshooting

Refer to TM 9-8662 for troubleshooting procedures on power plant heater.

Section IX. DEEP-WATER FORDING KIT

506. Description

a. The deep-water fording kit provides for engine air intake and exhaust gases above expected water level to enable the vehicle to ford hard-bottom water crossings up to five feet in depth (fig. 653).

b. Deep-water fording kits (fig. 654) installed on vehicles being used for a single fording operation may be removed and disposed of in accordance with AR 755-5.

c. Installation of kits is authorized under criteria defined in SB 9-155 for the deep-water kit.

507. Installation of Air Cleaner Extension (Fig. 655)

Note. Refer to TM 9-238 before installation.

a. Diesel.

(1) Install air cleaner inlet tube hose (fig. 654).

(a) Unclasp the three air cleaner cover fasteners (fig. 655) on the air cleaner, located on the right front fender of the vehicle. Twist cover upwards one-third of a turn, moving cover from indicated normal position to fording position as indicated on air cleaner.

(b) Slip the air cleaner inlet tube hose over the flange of the open end of the air cleaner cover but do not tighten the two hose clamps (fig. 654) until the air cleaner inlet tube is installed.

(2) Install air cleaner inlet tube (fig. 654). Push the metal air cleaner inlet tube (fig. 655) inside the rubber air cleaner inlet tube hose and secure the metal tube to the rubber hose with the two inlet tube hose clamps.

(3) Install air cleaner inlet tube cap (fig. 654). Slide the cap (fig. 658) on top of the air cleaner inlet tube and tighten clamp with clamp nut to secure cap to air cleaner inlet tube.

(4) Install air cleaner inlet tube support bracket (fig. 654).

(a) Loosen the two air cleaner clamps (fig. 655) one on each side of the air cleaner cover, so that the air cleaner inlet tube support bracket can slide under the air cleaner clamps mounted on the fender. Tighten the clamp nuts.

(b) Secure upper section of the support bracket to air cleaner inlet tube but do not tighten bottom clamp until the support brace is installed.

(5) Install air cleaner inlet tube support brace (fig. 655). Bolt one end of the support brace (fig. 655) to the gun mount bracket and extend the brace out so that it touches lower clamp of support bracket and bolt this end of the brace to the clamp. Now tighten both clamps.

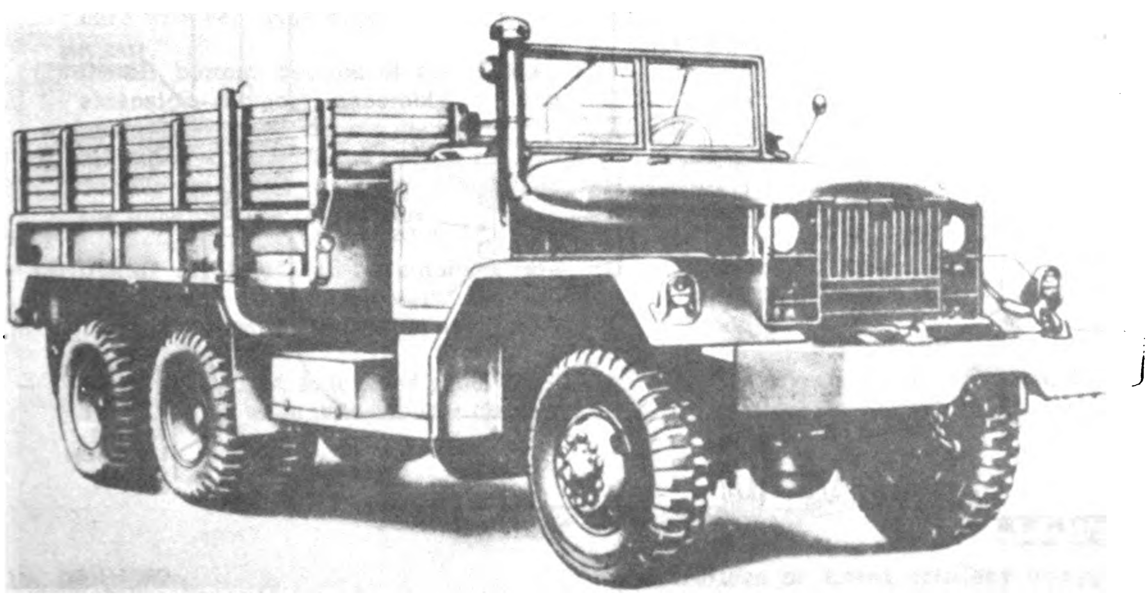


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Figure 653. Deep-water fording kit installed - gasoline engine wheeled vehicle

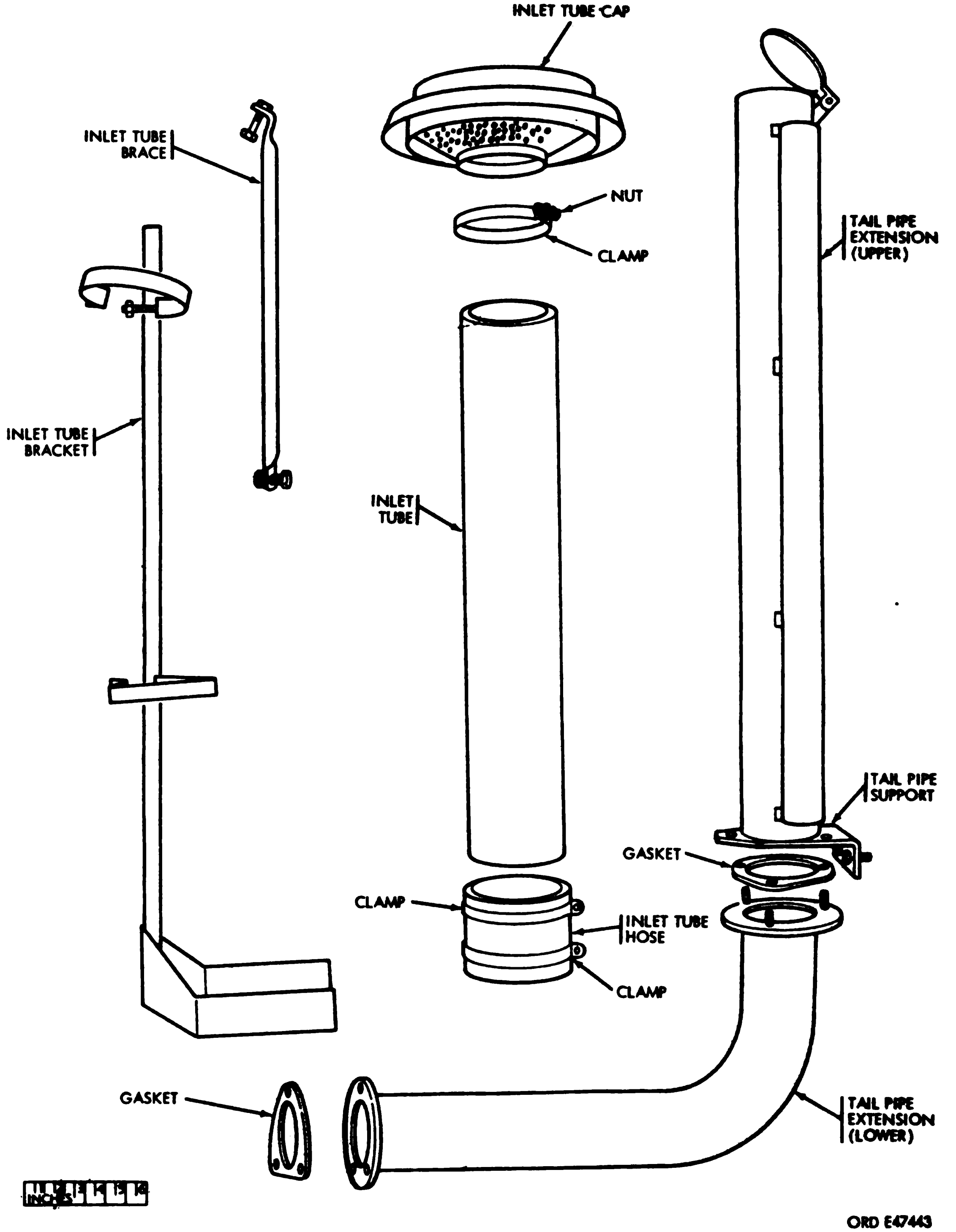


Figure 654. Air cleaner and tailpipe extensions - diesel

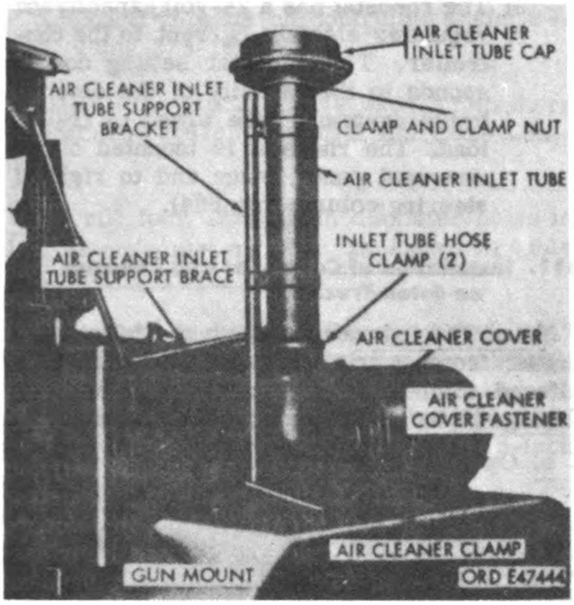


Figure 655. Air cleaner extension installed - diesel

b. Gasoline Engine (Fig. 656).

(1) Install air cleaner air inlet extension (fig. 656). Slide the three clamps on the air cleaner air inlet extension but do not tighten. Install lower end of extension on air cleaner inlet neck and secure with vent pipe clip.

(2) Install bottom section of air cleaner extension support assembly to gun mount panel and the top section to the air inlet extension and secure the assembly using two connector clamps for the top as shown (fig. 656).

(3) Install air inlet cap assembly on air cleaner extension assembly by tightening the cap on the extension assembly.

Note. The right side hood panel must remain open when using the air cleaner inlet extension on the gasoline engine wheeled vehicle.

508. Installation of Tailpipe Extension (Fig. 659)

a. Install Exhaust Tailpipe Extension (Lower End) (Fig. 657). Attach flange of tailpipe extension (lower end) to flange of vehicle exhaust tube using a new gasket and secure firmly with three hex-head bolts, three hex locknuts and three plain washers.

b. Install Exhaust Tailpipe Extension (Upper End) (Fig. 658).

(1) Position the tailpipe support of the tailpipe extension to the two 13/22-inch drilled holes (fig. 657) on the vehicle and secure to the vehicle using two 3/8-24-hex-head bolts, two 3/8-24-hex-head locknuts and two plain washers.

(2) Install tailpipe extension (upper section) to tailpipe extension (lower section) at the tailpipe support (fig. 658) using a new gasket and three hex-head bolts, three hex-head locknuts and three plain washers.

509. Tests and Adjustments

a. Air Cleaner Inlet Tube.

(1) Check air cleaner inlet tube for security of attachment to body.

(2) Check for tightness of connection to air cleaner.

b. Exhaust Tailpipe Extensions.

(1) Check exhaust tailpipe extension (upper section) for security of attachment of body.

(2) Check exhaust tailpipe extension (lower section) for watertight connections.

Section X. ELECTRIC BRAKE KIT

510. Description

a. General. The electric brake kit for the 5-ton, 6 x 6, trucks has been designed as an accessory on trucks utilized as prime movers for trailers or towed artillery equipped with electric brakes. Since the kit has been designed for installation on more than one type of vehicle, some of the brass fittings, standard hardware, and brackets are discarded at time of installation of the kit. The installations are similar, differing mainly in the location of the controller assembly and the rheostat and the manner in which the main harness is installed.

b. Controller Assembly and Rheostat. The two main components of the electric brake kit are the controller assembly (C) and the rheostat (F) (fig. 660).

(1) The controller assembly is waterproof, 24-volt capacity, and air operated. It transmits an electric current to M and N terminals (figs. 665 and 666) of the truck trailer receptacle. The controller is mounted inside of the left side frame member just rear of the cab (fig. 662).

(2) The rheostat has a 24-volt capacity and regulates electric current to the controller. The rheostat setting corresponds to the capacity of the electric brake system on the towed or trailer load. The rheostat is mounted on instrument panel flange and to right of steering column (fig. 664).

511. Installation of Controller and Rheostat on 5-ton Trucks

Note. The operations sequence herein resulted from a trial installation and may be altered slightly if previous modification or damage to the vehicle causes interference.

a. Open air reservoir drain cocks.

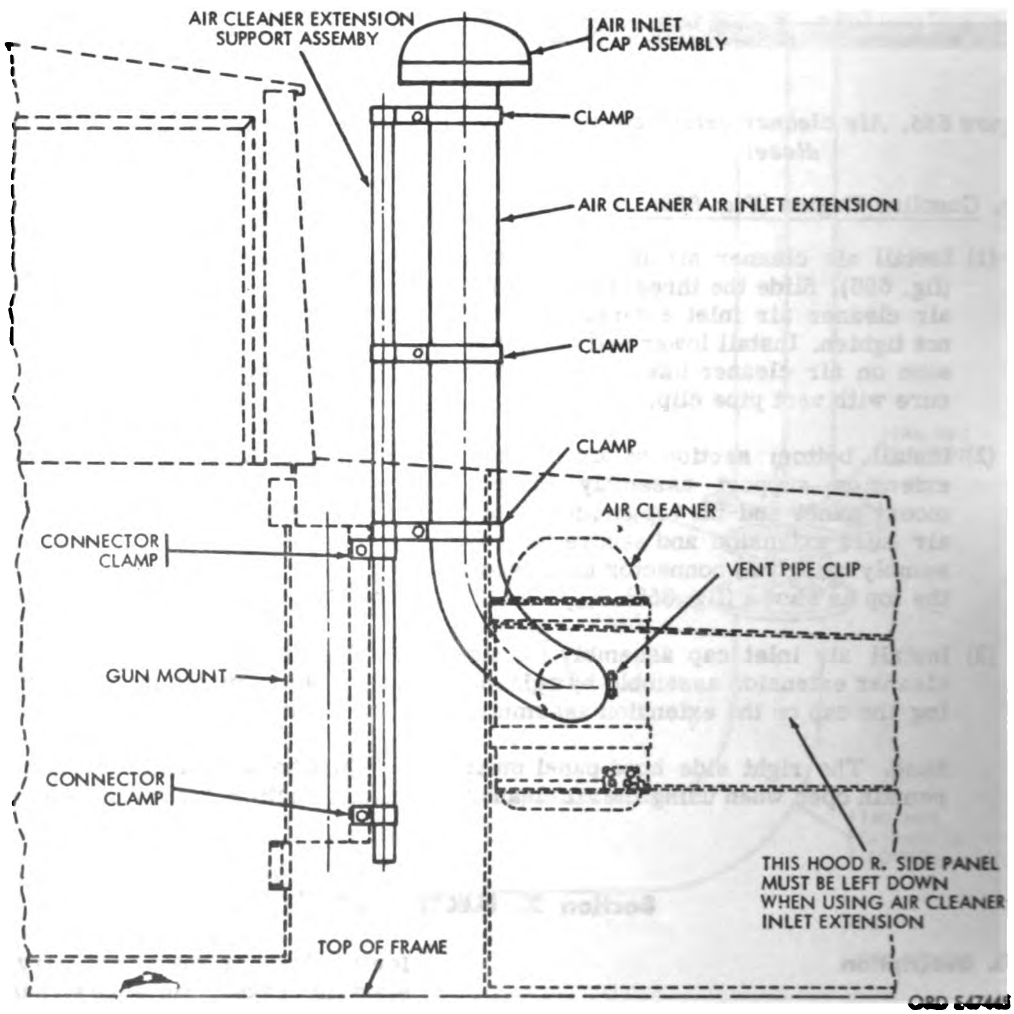


Figure 656. Air cleaner air inlet extension installed - gasoline engine wheeled vehicle

b. Extend threads on controller studs 3/8-inch, using 3/8-16UNC die.

Note. If die is unavailable, use plain washers as spacers between controller and frame member.

c. Drill four 13/32-inch diameter holes in left side frame member as shown in table (fig. 661).

Note. Fuel tank (fig. 661) must be removed to drill holes in medium wrecker truck M62.

d. Install controller mounting bracket (Q) on frame member (fig. 662), using four 3/8-inch

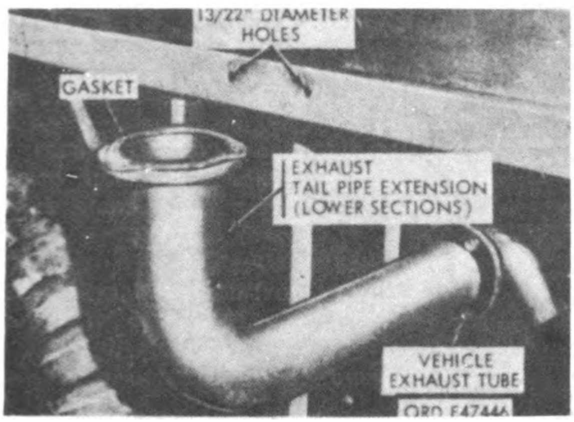


Figure 657. Exhaust tailpipe extension (lower section) installed

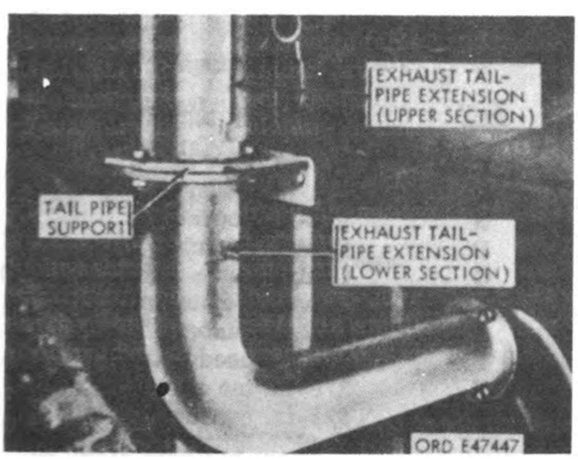


Figure 658. Exhaust tailpipe extensions installed - upper and lower sections

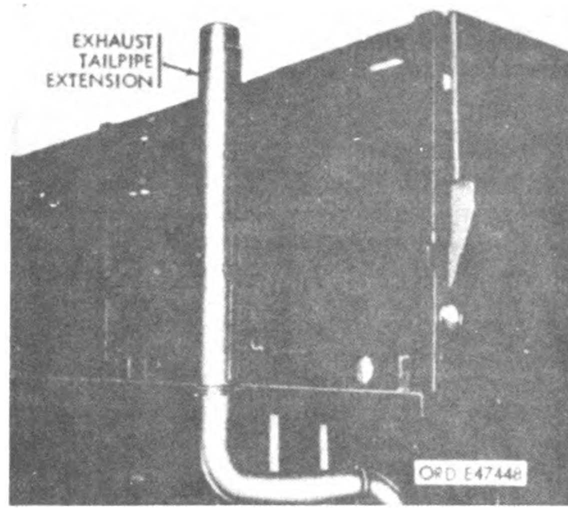


Figure 659. Tailpipe extension installed

machine bolts and self-locking nuts. Install controller (C) on mounting bracket, using the three existing nuts and washers on controller studs.

e. Cut out 1-1/8-inch section from existing air line as shown (fig. 661).

Caution: Be sure to cut from air line and not hydraulic line.

f. Install 3/8-inch tee (U, fig. 660) to air line and to controller, using pipe (B, fig. 660) and 3/8-inch connector (V, fig. 660).

g. Drill two 9/32-inch diameter holes in flange on instrument panel as shown in table (fig. 663). Install rheostat mounting bracket (H, fig. 660) on instrument panel, using two 1/4 x 1/2-inch machine bolts and self-locking nuts.

h. Install rheostat (E, fig. 660) on mounting bracket, first removing operating lever, retaining nut, lockwasher, and nameplate from rheostat to facilitate installation. Be sure positioning pin (fig. 664) is inserted in small hole at bottom of bracket and nameplate.

i. Close air reservoir drain cocks.

j. In accordance with provisions of AR 755-5 or AR 755-10, as applicable, return following components of kit to stock:

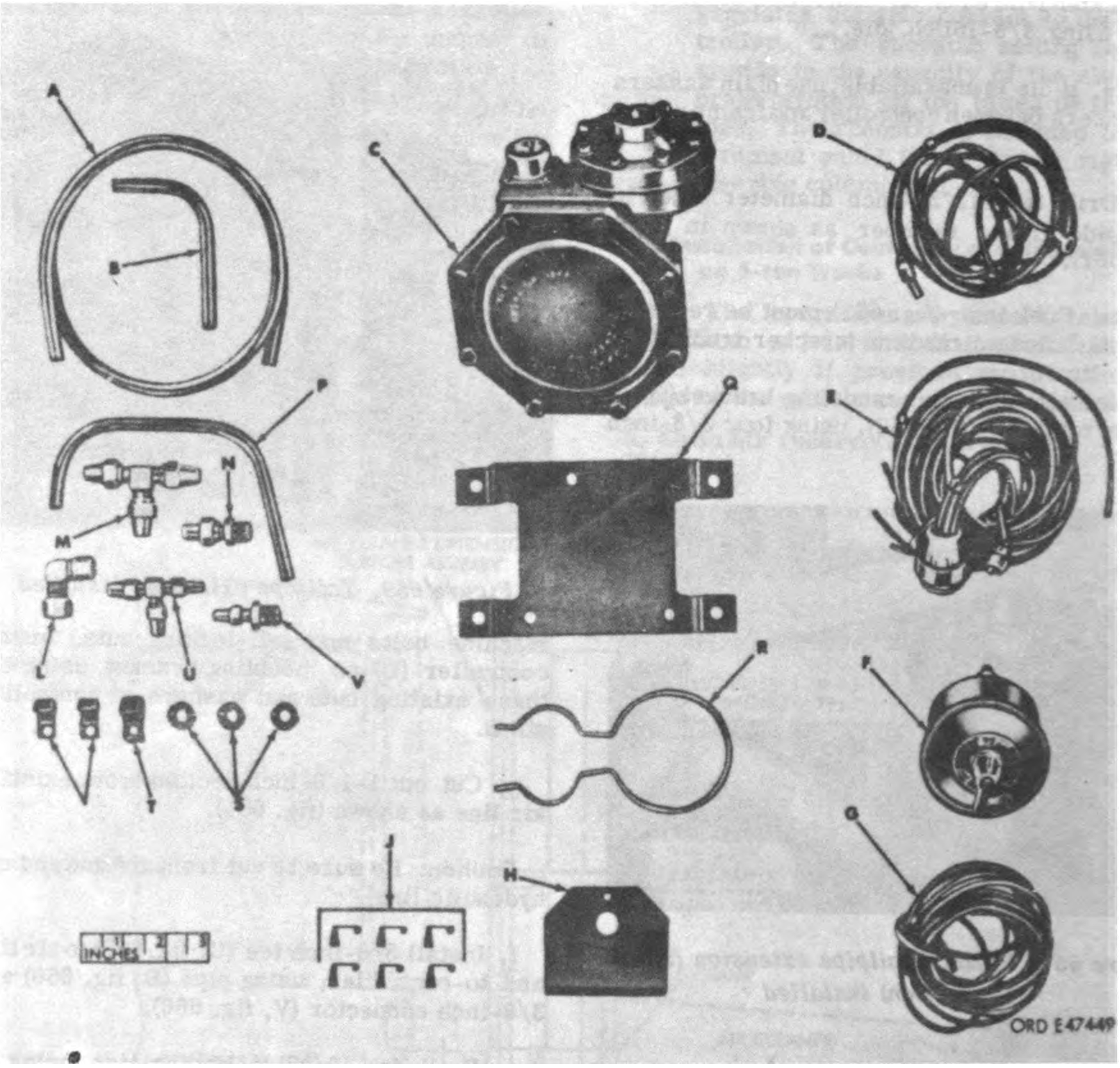


Figure 660. Principal components of kit

Key	Item	Key	Item
A	Controller tube	L	1/2-in. tube elbow
B	Connector pipe	M	1/2-in. tee assembly
C	Controller assembly	N	1/2-in. connector
D	Rheostat harness	P	Controller tube
E	Controller cable	Q	Controller mounting bracket
F	Rheostat	R	Rheostat mounting bracket
G	Cable	S	Spacer washer
H	Rheostat mounting bracket	T	No. 8 closed clamp
J	Cable splicer	U	3/8-in. tee assembly
K	Retaining clip	V	3/8-in. connector

Figure 660. Principal components of kit - legend

TABLE

MAJOR ITEM	DIMENSIONS
ALL 5 TON TRUCKS EXCEPT M52, M62 & M246	18-3/16
MEDIUM WRECKER TRUCK M62	26-3/16
TRUCK TRACTOR M52 & TRACTOR WRECKER TRUCK M246	13-5/16

NOTE: ALL DIMENSIONS SHOWN ARE IN INCHES

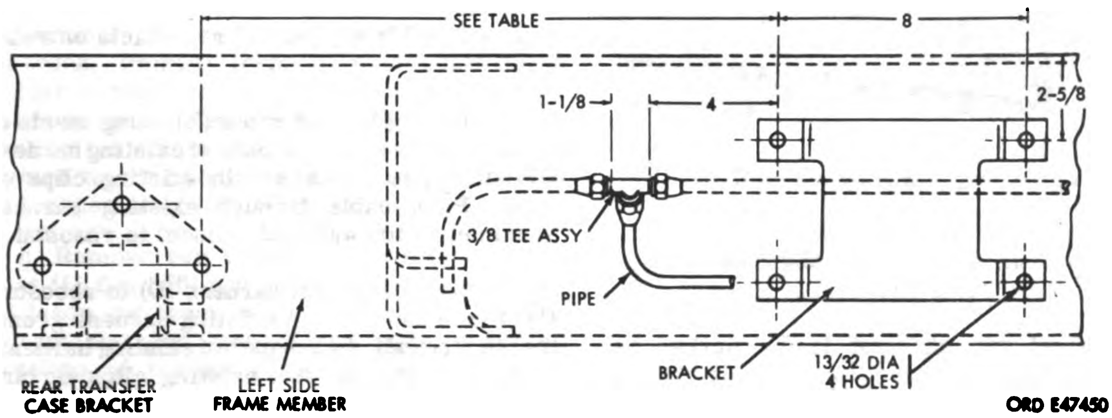


Figure 661. Bracket installation details

Name	Qty.
BOLT, MACHINE: hex-hd, low-carb-S, cd- or zn-pltd, 5/16-18NC-2A x 1	2
BOLT, MACHINE: hex-hd, med-carb-S, cd- or zn-pltd, 1/4-28UNF-2A x 5/8	2
BRACKET: mounting, rheostat	1
CLAMP: closed, cushioned, No. 8, 1/8 dia, 3/8 bolt	1
CLIP: retaining, harness	2
CONNECTOR: tube, compression, ball sleever, air service, 1/2-in. tube, 1/2-in. male pipe end, assy	1
ELBOW: tube, compression, safety sleever, 90-deg, 1/2-in. male pipe end, assy	1
NUT, PLAIN, HEXAGON: S, cd- or zn-pltd, 5/16-18UNC-2B, 1/2 w, 17/64 thk	2
NUT, SELF-LOCKING, HEXAGON: S, cd- or zn-pltd, 1/4-28UNF-3B, 7/16 w, 5/16 thk	2
TEE: tube, stght, compression, ball sleever, air service, br, 1/2-in., assy	1
TUBE: air line tee-to-controller	2
WASHER, FLAT: S, cd- or zn-pltd, 11/32 id, 11/16 od, 0.065 thk	4
WASHER, LOCK: ext-teeth, S, cd- or zn-pltd, 5/16-in. bolt size	2
WASHER: special spacer	3

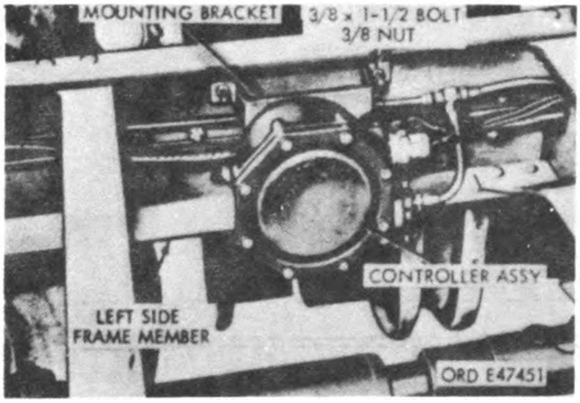


Figure 662. Controller installed

512. Wiring Procedure for All Trucks Except Truck Tractors M52, M52A1, M52A2 and Tractor Wrecker M246

a. Cut off two shortest leads marked 53 (fig. 665) from rheostat-to-controller cable (E, fig. 660) at molded splice and tape ends to make waterproof. Connect cable to controller.

b. Disassemble trailer receptacle located at rear of truck. Remove terminal pins (M and N, fig. 665) and solder to two remaining short leads of controller cable (E). Install leads in receptacle, making sure controller terminals (B and C, fig. 665) are connected to receptacle terminals N and M, respectively (fig. 665).

c. Remove trailer receptacle terminal pin (L, fig. 665) and solder to required length of lead cut from cable (G). Install lead in receptacle and connect free end to ground location of trailer receptacle terminal D, using transparent tube 7056633 and terminal 7056705 (fig. 665).

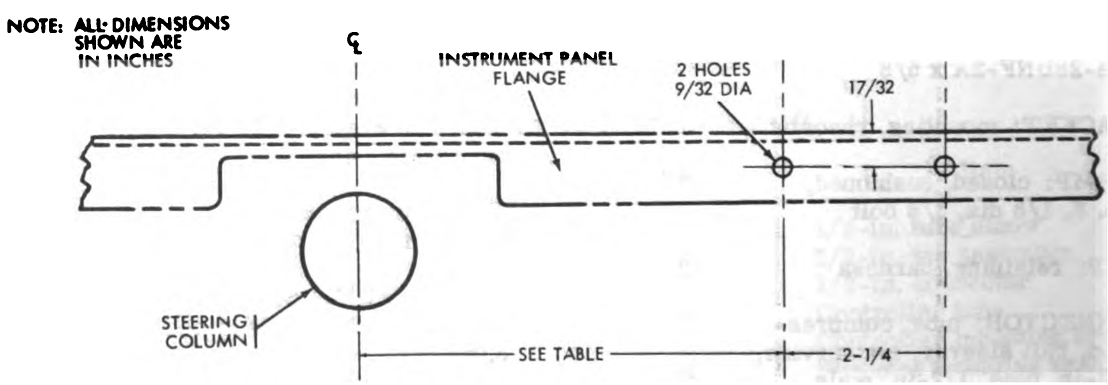
d. Assemble and install receptacle on vehicle.

e. Run long lead of cable (E) along inside of frame member, follow path of existing harness and attach to harness with existing clips or tape. Pass cable through existing harness grommet in firewall and connect to rheostat.

f. Connect rheostat harness (D) to rheostat. Pass free end through existing harness grommet in firewall, follow path of existing harness, attach to harness with existing clips or bind with tape, and connect to positive battery terminal.

Note. On all 5-ton trucks except M62, connect rheostat harness to positive battery terminal of magnetic starter switch.

g. Loop and tape any excess cable to existing harness. Do not cut excess cable as it may



TABLE

MAJOR ITEM	DIMENSIONS
ALL 5-TON TRUCKS EXCEPT M52 AND M246	9-1/2
5-TON TRUCKS M52 & M246	10

ORD E47452

Figure 663. Flange drilling details

be required for future installation on another vehicle. If any leads are too short, increase to desired length by using cable (G, fig. 660) and cable splicer (J, fig. 660). Cut off tightening tab flush with splicer, and tape splice to make waterproof.

513. Wiring Procedure for Truck Tractors M52, M52A1 and Tractor Wrecker M246

a. Do not cut off the two shortest leads marked "53" from rheostat-to-controller cable (E, fig. 660). Disassemble two trailer receptacles, located at rear of cab and at rear of truck. Remove terminal pins M and N and solder to four short leads of cable (E). Install leads in receptacles, making sure the two controller terminals (B and C, fig. 666) are connected to the two receptacle terminals N and M, respectively (fig. 666).

b. Remove two trailer receptacle terminal pins (L, fig. 666) and solder to required length of leads cut from cable (G). Install leads in receptacles and connect free ends to ground location of trailer receptacle terminals (D, fig. 666) using two transparent tubes and terminals.

c. Assemble and install receptacles on vehicle.

d. Run lead along inside of frame member, follow path of existing harness, and attach to harness with existing clips or bind with tape. Pass cable through existing harness grommet in firewall and connect to rheostat.

e. Connect rheostat harness (D) to rheostat. Pass free end through existing harness grom-

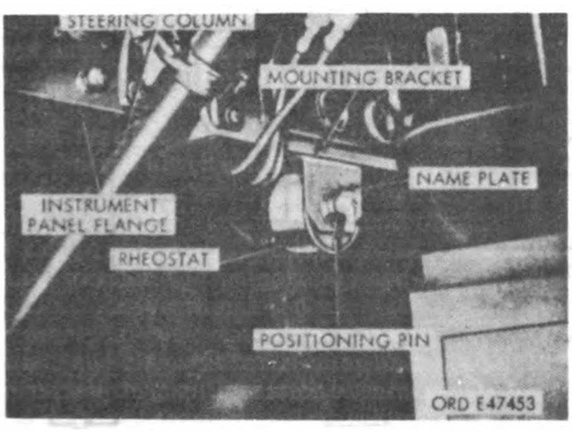


Figure 664. Rheostat installed on instrument panel flange

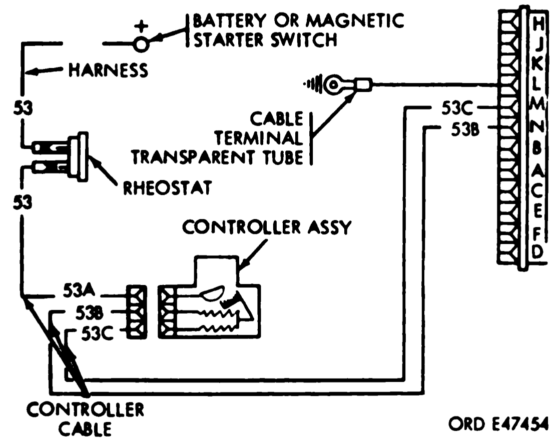


Figure 665. Wiring diagram for one-receptacle trucks

met in firewall, follow path of starter switch cable, and connect to positive battery terminal.

f. Connect rheostat harness (D, fig. 660) to the positive terminal of the magnetic starter switch.

g. Loop and tape any excess cable to existing harness. Do not cut excess cable as it may be required for future installation on another vehicle. If any leads are too short, increase to desired length by using cable (G, fig. 660) and cable splicer (J, fig. 660). Cut off tightening tab flush with splicer and tape splice to make waterproof.

514. Tests and Adjustments

Note. The manipulation of the rheostat on the instrument panel is not intended to operate the electric brakes on the towed load. The purpose of the rheostat is to regulate the amount of current going into the controller assembly (mounted on the frame) and, in turn, to the electric brakes on the towed load through the trailer receptacle when the brake pedal is depressed. The rheostat setting is directly dependent on the towed load. The lighter the towed load, the smaller the numerical rheostat setting. The heavier the towed load, the greater the numerical rheostat setting. The precise setting of the rheostat for a given load would be determined through operation experience. It should be noted that maximum braking effort is obtained with the highest rheostat setting and with 61 psi, plus or minus 5, in the compressed air system. The electric brake control kit is so designed that the electric brakes on the towed load should operate ONLY when the brake pedal is depressed, as the electric circuit is closed only then and not when the rheostat on the instrument panel is manipulated.

a. General. Field reports and investigations identify loose contact screws, nuts, washers, and presence of dried varnish or lacquer flakes in the electrical mechanism as the most common causes of malfunction of the controller. These conditions impair the operating efficiency of the controller and result in reduced braking control of the towed vehicle.

b. Field Maintenance Instructions. The procedures contained in paragraphs 615 through 617 below will be applied by field maintenance personnel (3d echelon) or higher.

(1) Before installation of new or used controllers.

(2) Every six months or 6000 miles, whichever occurs first.

515. Disassembly of Controller

a. Open air reservoir drain cocks.

b. Remove controller assembly from vehicle.

c. Thoroughly clean exterior of controller to remove grease and dirt.

d. Remove diaphragm cover and diaphragm (fig. 667) from controller.

e. Remove cover from body. Remove and discard packing (fig. 668).

f. Before proceeding further with disassembly, push shaft head (fig. 667) into body several times to test compression of diaphragm return spring. Replace controller if spring fails to return the shaft head forcibly to its fully extended position.

g. Again push shaft head into body and observe contact between contact arm assembly and contact leaves of stack and brush resistor assembly (fig. 668). If failure to contact is obviously due to looseness of leaves, continue with disassembly, but if failure to contact is due to damage to leaves, replace stack and brush resistor assembly (fig. 668).

Note. It is not necessary to replace resistor if damaged intermediate leaves fail to make contact with contact arm. Adjust leaves to make full contact with arm.

h. Remove connecting cable (fig. 668) from stack and brush resistor.

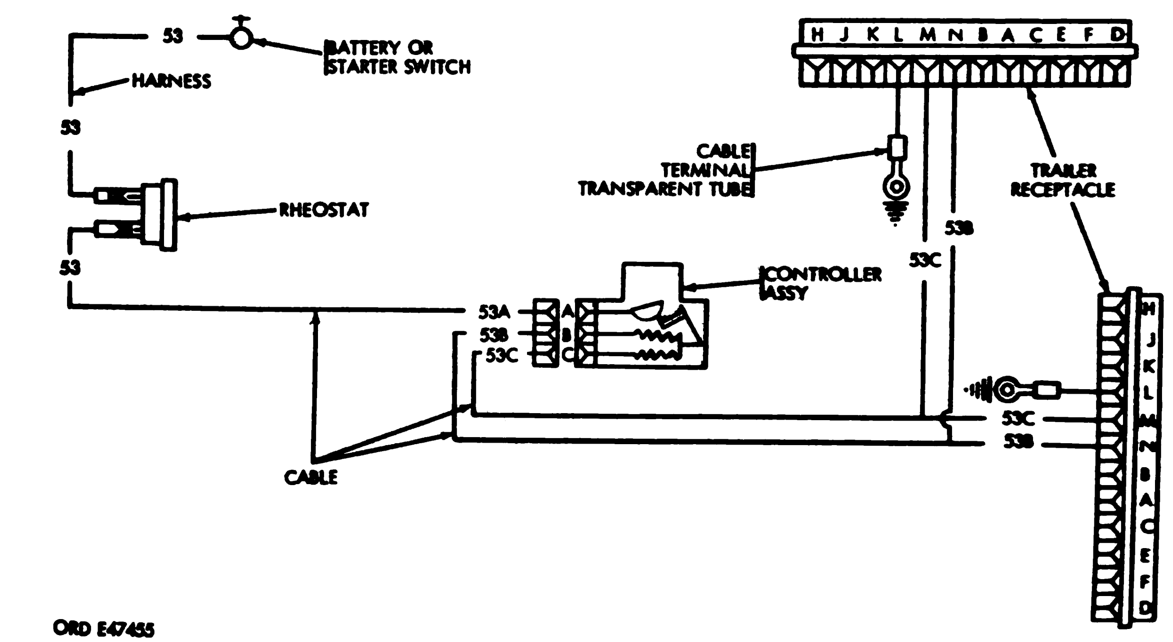


Figure 666. Wiring diagram for two-receptacle trucks

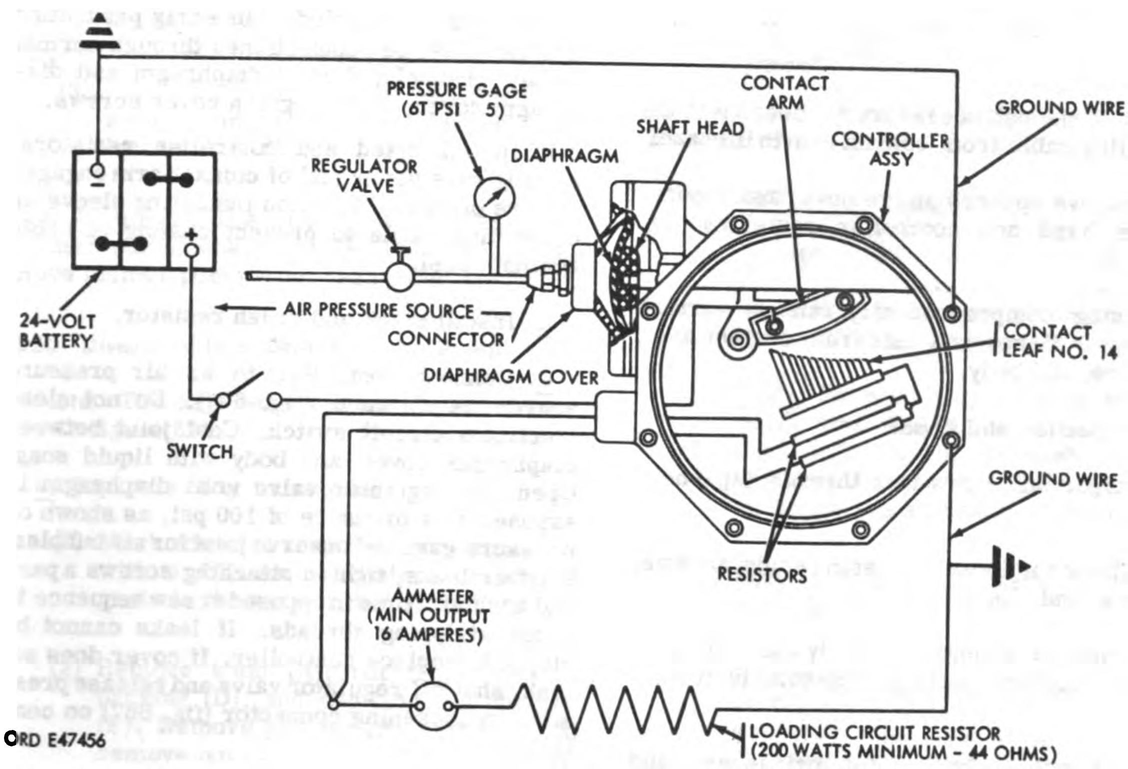


Figure 667. Wiring diagram for tests

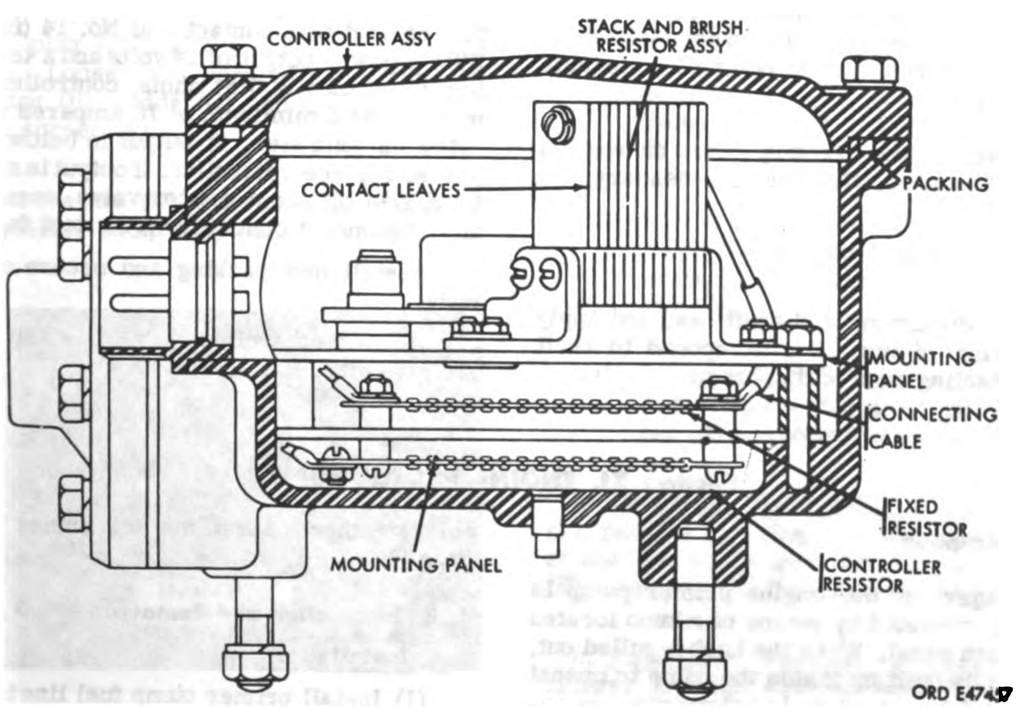


Figure 668. Resistor mounting details

i. Loosen and lift two panels, mounting contact arm and stack and brush resistor assemblies.

Note. It is not necessary to disconnect the connecting cable from contact arm to lift panel.

j. Remove spacers and remove panel mounting the fixed and controller resistors (fig. 668).

k. Using compressed air, remove varnish or lacquer flakes and dust from contact arm, resistors, and body.

516. Inspection and Repair

a. Inspect all screw hole threads, tap if necessary.

b. Check for loose or missing studs, screws, washers, and plugs.

c. Inspect the controller body and covers for cracks. Replace controller assembly if necessary.

d. Inspect diaphragm for brittleness and cracked fabric, especially at flexing points. Replace diaphragm if unserviceable.

e. Inspect fixed and controller resistors for broken or cracked fiber and broken windings. Replace fixed resistor or controller resistor if necessary.

f. Inspect cable-attaching rivet on contact arm for looseness. Re-rivet if necessary.

517. Assembly of Controller

a. Wipe diaphragm and shaft head and apply thin coating of insulating compound to shaft head contacting area of diaphragm.

Note. Insulating compound used on diaphragm was not included in early production kits and must be requisitioned through normal supply channels. Install diaphragm and diaphragm cover; do not tighten cover screws.

b. Install fixed and controller resistors, making sure upper end of contact arm engages collars on shaft. Position insulating sleeve on connecting cable to prevent chafing of cable against panel.

c. Install stack and brush resistor.

d. Connect controller to an air pressure source as shown in (fig. 667). Do not close electrical circuit switch. Coat joint between diaphragm cover and body with liquid soap. Open air regulator valve until diaphragm is exposed to a pressure of 100 psi, as shown on pressure gage and observe joint for air bubbles. If cover leaks, tighten attaching screws a partial turn at a time in opposed screw sequence to avoid stripping threads. If leaks cannot be stopped, replace controller. If cover does not leak, shut off regulator valve and release pressure by loosening connector (fig. 667) on controller.

e. Close electrical circuit switch. Open air regulator valve until diaphragm is exposed to a pressure of 61 psi, plus or minus 5. Observe action of contact arm to be sure that it is in full contact with contact leaf No. 14 (fig. 667). With a power output of 24 volts and a test loading resistance of 0.44 ohms, controller output must be at a minimum of 16 amperes as indicated on ammeter. If output is below 16 amperes, replace controller. If output is satisfactory, shut off air regulator valve, open switch, and disconnect controller from test facilities.

f. Install new packing and secure cover on body.

g. Install controller on vehicle and restore air pressure.

Section XI. ENGINE PRIMER PUMP

518. Description

A plunger on the engine primer pump is manually operated by means of a knob located on the dash panel. When the knob is pulled out, pressure is built up inside the pump to unseat a steel ball to permit fuel to flow from the engine fuel pump to the inlet manifold thereby providing additional fuel to the engine during cold weather operations for easier starting (fig. 669).

519. Installation and Removal

a. Installation.

(1) Install primer pump fuel line into vehicle fuel filter located on left side of frame.

(2) Connect manifold fuel line to priming tee on manifold.

(3) Connect primer pump to fuel lines, and secure pump to dash panel using outer locknut (fig. 670).

b. Removal. Disconnect fuel lines from primer pump, unscrew outer locknut, and remove primer pump from dash panel (fig. 670).

520. Disassembly of Engine Primer Pump

Note. The key letters noted in parentheses are in figure 670.

a. Separate body from plunger.

(1) Mark edges of body (L) and plunger (F) with a file to facilitate assembly of parts in the same relative position.

(2) Remove knob (A), nut (B), ring (C), packing (D), and cap (E) from plunger (F). Remove plunger from body (L) and remove nut (J), washer (H), and cup (G) from plunger.

b. Disassemble body. Remove nut (K) from body (L). Remove nut (Y) and connector (X). Remove plug (U) and lift out spring (V) and ball (W). Loosen and remove cap (S) and lift out spring (R), guide (Q) and diaphragm (P). Remove screen (T).

c. Remove nut (N) and connector (M) from engine primer pump body (L).

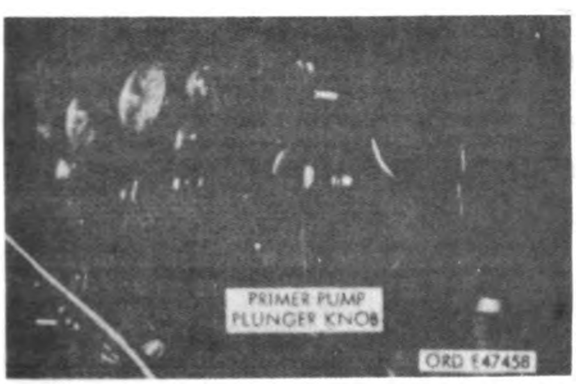


Figure 669. Primer pump installed

521. Cleaning, Inspection and Repair

a. Clean All Parts. Clean all metal parts in dry-cleaning solvent or mineral spirits paint thinner. Blow out all passages with compressed air.

b. Inspection and Repair.

(1) Plunger. Discard the plunger if cracked, broken, or warped. Inspect for stripped or cross threads and correct with thread chaser, if practical.

(2) Body. Discard body if flange is warped more than 0.010 inch. If warped less than 0.010 inch, refinish with disk grinder. Discard cap if threaded holes in flange are stripped or crossed.

(3) Screen. Replace, if distorted or otherwise damaged.

(4) Diaphragm and spring. Whenever pump is disassembled, diaphragm should be replaced. Examine diaphragm spring for resiliency of performance and replace if weak or otherwise defective.

522. Assembly of Engine Primer Pump

a. Assemble Body (Fig. 670).

(1) Seat the ball (W) inside engine primer pump body (L) and install with spring (V) and plug (U) as shown (fig. 670).

(2) Insert the screen (T), diaphragm (P), guide (Q) inside body. Compress the spring (R) on the guide and install the cap (S).

(3) Insert the two connectors (M) and (X) and secure with nuts (N) and (Y). Attach nut (K) on the threaded end of body (L).

b. Assemble Plunger (Fig. 670). Install cap (E), packing (D), ring (C), nut (B), and knob (A) at one end of plunger. Install cup (S), washer (H), and nut (J) at the other end of the plunger.

c. Assemble Plunger to Body. Install plunger (F) (fig. 670), to body (L) (fig. 670), making sure that file marks on cover, line up with file marks on the body.

523. Test

Test operation of primer pump by attaching pressure gage to pump outlet. Operate pump plunger until gage shows 3 psi. Discontinue building up pressure and observe time required for gage pointer to drop from 3 psi to 2 psi. A time lapse of five seconds or more indicates a satisfactory pump.

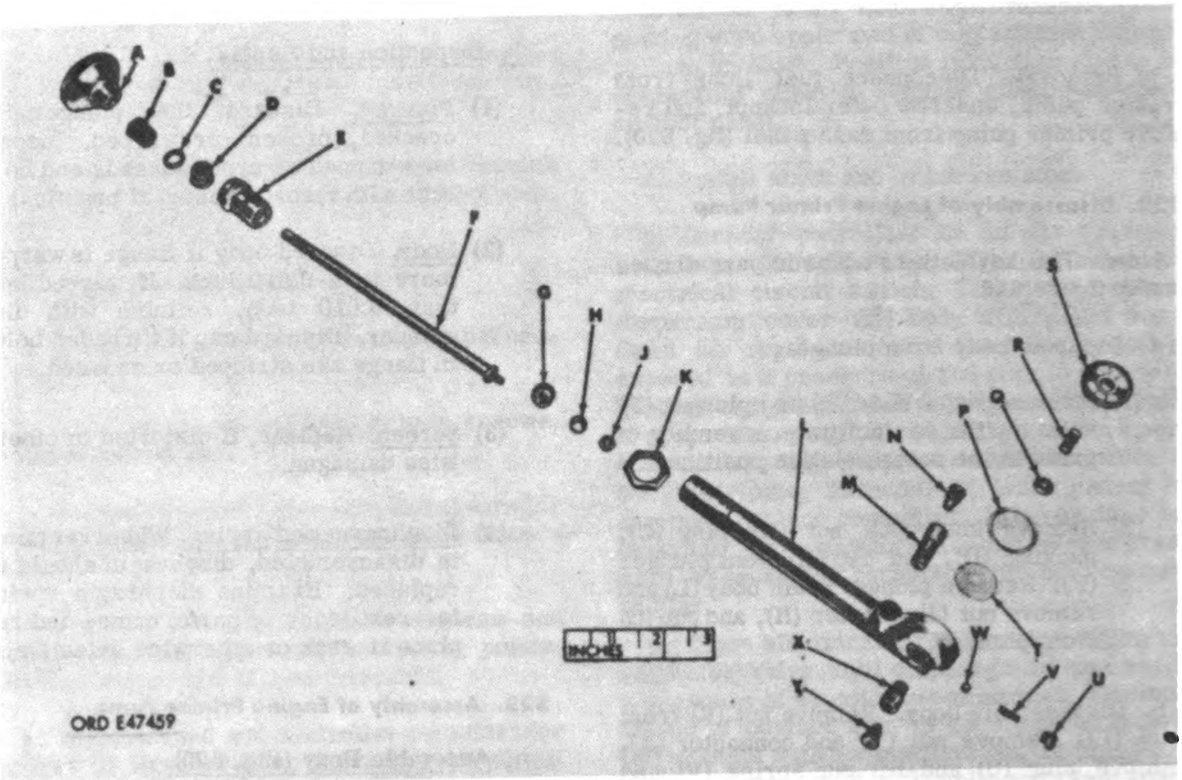


Figure 670. Engine primer pump - exploded view

Key	Item	Key	Item	Key	Item
A	Knob	J	Nut	S	Cap
B	Nut	K	Nut	T	Screen
C	Ring	L	Body	U	Plug
D	Packing	M	Connector	V	Spring
E	Cap	N	Nut	W	Ball
F	Plunger	P	Diaphragm	X	Connector
G	Cup	Q	Guide	Y	Nut
H	Washer	R	Spring		

Figure 670. Engine primer pump - exploded view - legend

Section XII (Added)

THERMAL BARRIER KIT (ALL MODELS)

524. Description

The thermal barrier kit consists of eighteen vinyl resin base pads with a vinyl film cemented to one side. The other side is cemented to the cab inside surfaces to help insulate the cab and thus maintain heat for the crew.

525. Installation Instructions

a. Place vehicle in well lighted, well ventilated area.

b. Remove seats (par. 132).

c. Remove glove box.

d. Remove dust and dirt from inside cab.

e. Place supplementary fans and/or blowers in and around cab to provide adequate, positive ventilation.

Warning: **The methyl-ethyl-ketone used to activate the thermal barrier cement creates toxic vapor, not to be inhaled. Provide rubber gloves for personnel handling methyl-ethyl-ketone soaked rags or brushes.**

f. Install thermal barrier.

Note. The general procedure outlined below will be used in conjunction with individual heater installations, both hot water and fuel burning. Thus, where necessary, additional slits or cutouts will be made in barrier, using a sharp knife or scissors.

(1) Select barrier part for individual placement as indicated in figure 671.

(2) Make a trial placement temporarily positioning barrier in place, and make slits and

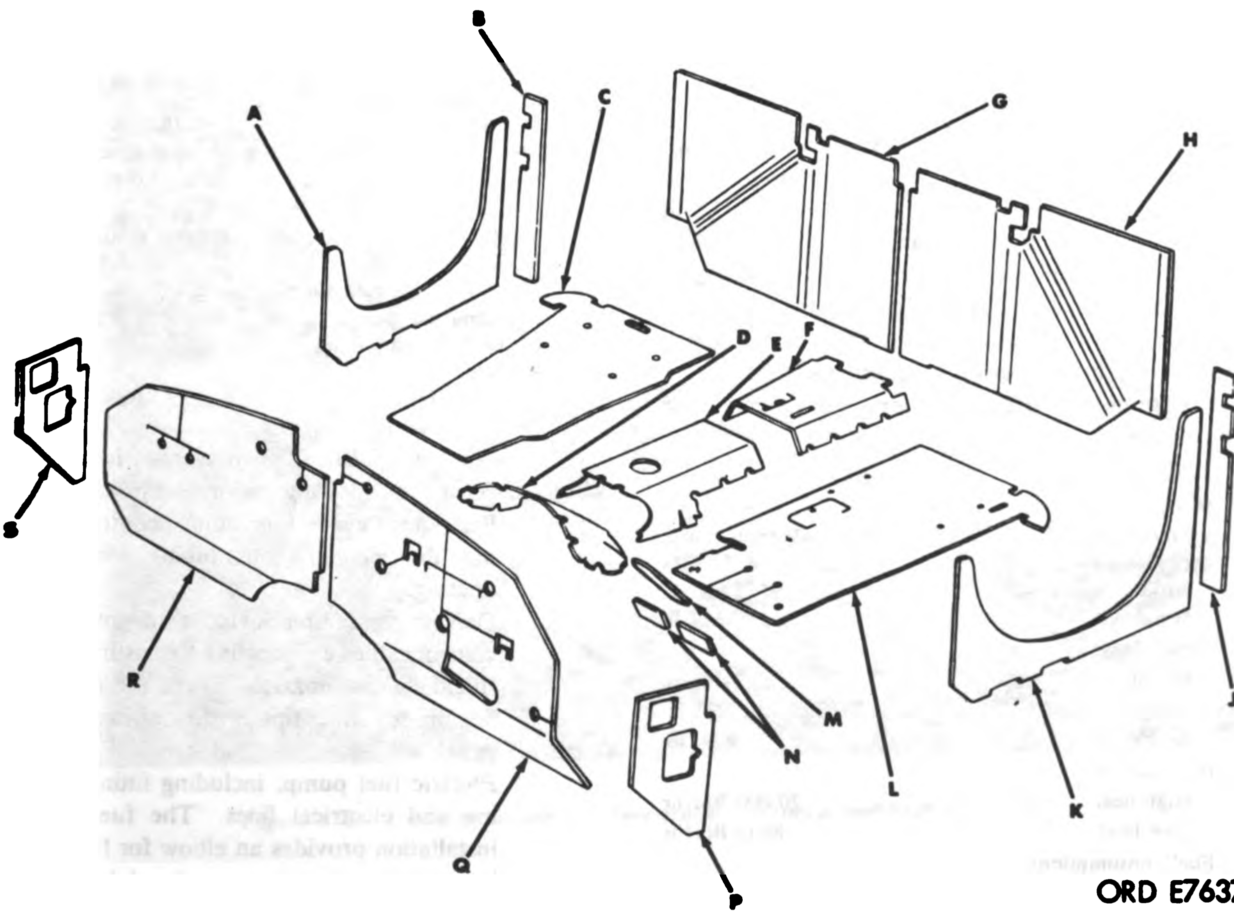


Figure 671. Thermal barrier kit

Key	Item	Key	Item
A	Right door support hinge cover	K	Left door support hinge cover
B	Right lock pillar cover	L	Left floormat
C	Right floormat	M	Gas pedal cover
D	Front tunnel cover floormat	N	Clutch and brake pedal covers
E	Center tunnel cover floormat	P	Left air duct panel cover
F	Rear tunnel cover floormat	Q	Left firewall
G	Right rear cab panel cover	R	Right firewall
H	Left rear cab panel cover	S	Right air duct panel cover
J	Left lock pillar cover		

Figure 671. Thermal barrier kit (legend)

cutouts required for a particular location, if necessary.

Note. Locations definitely requiring barrier or vehicle modification before cementing barrier include diverter mounting holes (personnel heaters), firewall knockouts, transmission tunnel knockouts and lever boots, battery box knockouts and receptacle opening and cable clamp holes. Others may be expected.

Caution: **All barrier parts are cemented to inside of cab, including lock pillar cover 10938245, which is placed behind lock pillar.**

(3) Brush methyl-ethyl-ketone on cab section to be covered and brush it also on the inner side of barrier part to be cemented.

Note. The dull side is the inside.

(4) Press part firmly into place.

Caution: **Part must be properly placed, as no movement is possible after placement.**

Section XIII (Added)
FUEL BURNING PERSONNEL HEATER KIT (MULTIFUEL)

526. Description and Data

a. Description. The personnel heater kits are supplied for use in areas where the normal temperatures during the coldest period of the year is 5°F. and lower. In addition to the heater, heat controls, and accessories covered in this section, these kits also contain all mounting parts, ducts, fuel lines, and other equipment required for individual installations. Personnel heaters provide uncontaminated, heated air and are used primarily to supply heat to the crew compartment.

b. Data.

Heater:
- Manufacturer .... Stewart-Warner Corp.
- Model no. 8420-C24
- Ordnance part no. 8364020
- Weight .... 17 lb

Dimensions:
- Width .... 7-½ in.
- Length .... 15 in.
- Height .... 9-¾ in.

Heat output:
- High heat .... 20,000 Btu/hr
- Low heat .... 8000 Btu/hr

Fuel consumption:
- High heat .... 0.272 gph
- Low heat .... 0.122 gph
- Fuel pressure required .... 3 to 15 psi
- Operating voltage .... 24 v

Current consumption:
- Starting .... 16.0 to 19.5 amp
- Low heat .... 3.0 to 7.5 amp
- High heat .... 3.0 to 7.5 amp

Blower motor:
- Manufacturer .... Stewart-Warner Corp.
- Model no. 701646
- Manufacturer's part no. G700139
- Operating voltage .... 24 v
- Current consumption .... 2.7 amp

Fuel filter:
- Manufacturer .... Bendix Corp.
- Ordnance part no. 7761059

c. Composition of Kit. The personnel heater kit is comprised of the following major groups of items:

(1) Personnel heater including control box, mounting plate, exhaust tubing, wiring and ducting.

(2) Defroster assembly including diverter box, control cables and ducting to existing windshield defrost nozzles. There are also deflectors for mounting on top of instrument panel.

(3) Electric fuel pump, including fittings, tubing and electrical lines. The fuel pump installation provides an elbow for fuel tubing to the coolant (power plant) heater so only one fuel pump is used for both kits.

(4) A canvas radiator cover attached to the radiator brush guard controls the flow of

air through the radiator and protects the engine from windblown snow. An adjustable flap in the cover can be opened or closed to control the amount of air flowing through the radiator for engine cooling, and to help maintain engine coolant temperatures at near normal operating temperature.

(5) An alcohol evaporator, used to permit vaporized alcohol to be drawn into the vehicles compressed air system. Drawing alcohol into the air system guards against the freezing of moisture in the system when the vehicle is operating in freezing temperatures. The alcohol evaporator is mounted to a bracket near the personnel heater and has tubing to connect it with the vehicle's air compressor. Figures 672 through 674 illustrate the major parts of the personnel heater kit.

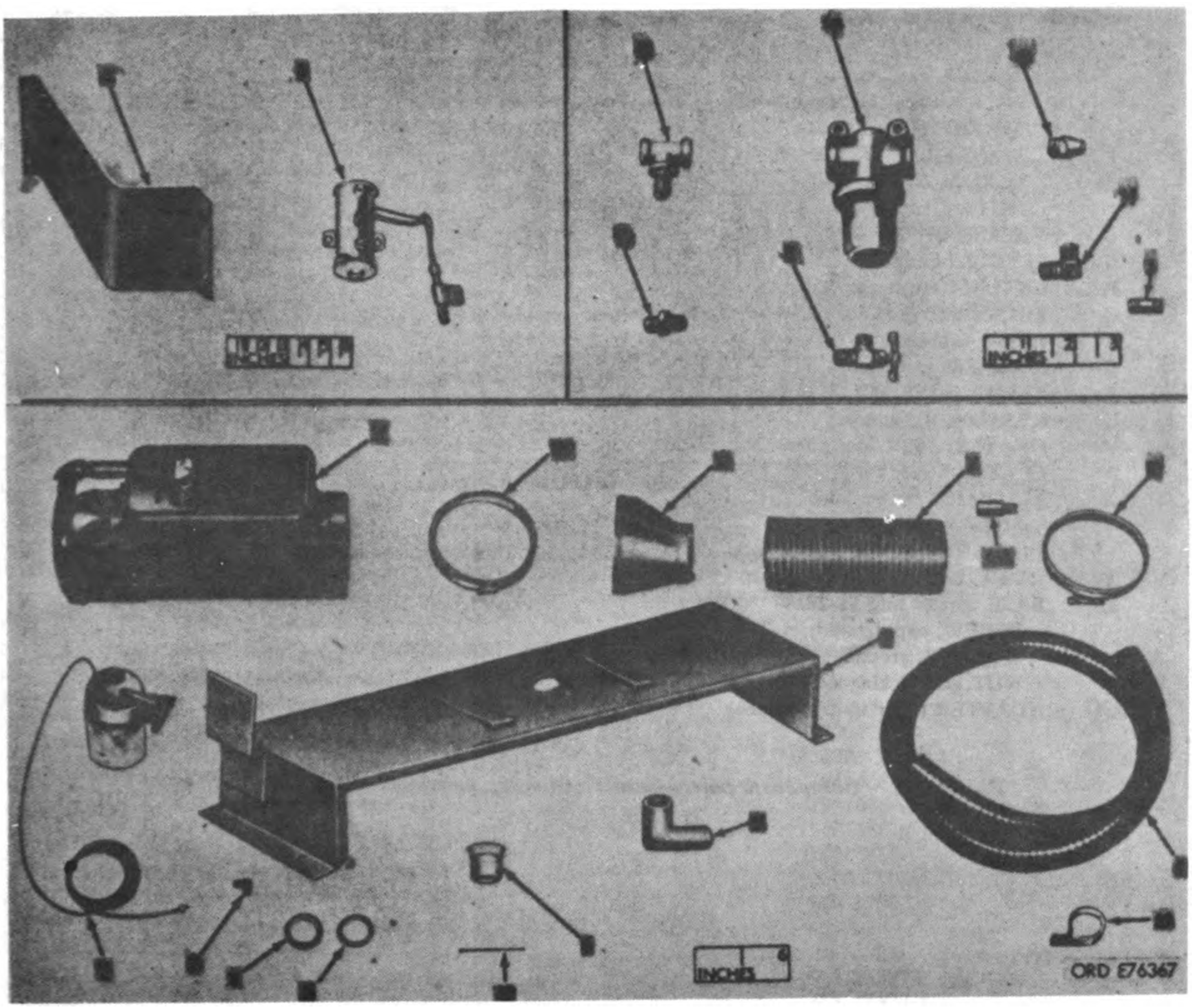


Figure 672. Component parts—winterization kit, personnel heater (1 of 3).

Key	Item	Part Number	Quantity
A	SHIELD, fuel pump	10932116	1
	SCREW, cap, hex-hd, ¼-28x½	MS 35207-279	4
	NUT, self-locking, hex, ¼-28	96906-51922-5	4

Key	Item		Part Number	Quantity
B	PUMP ASSY, fuel		7748814	1
	SCREW, cap, hex-hd, ¼-28x½		MS 35292-3	2
	NUT, self-locking, hex, ¼-28		96906-51922-5	2
C	CONNECTOR ASSY, 5/16, pump inlet and outlet (Adapter)		MS 39206-4	2
D	TEE int-ext, (at pump)		444147	1
E	COCK ASSY, fuel shutoff, 5/16 tube x ⅛ pipe		543852	1
F	FILTER ASSY, fuel		MS 51085-1	1
	SCREW, mach, pan-hd, no. 10-32x1-¾		96906-35207-270	2
	NUT, safety no. 10-32		503209	2
G	CONNECTOR ASSY, 5/16 tube x ⅛ pipe, filter outlet (Adapter)		MS 39206-4	1
H	ELBOW, filter, inlet		MS 39202-4	1
J	PLUG (pump tee)		444571	1
K	CLAMP, hose, 2-½-6-⅛ (for duct to wall)		96906-35842-4	2
L	TUBE, exhaust, 70 in.		7986268	1
M	CLAMP, 1-21/32 dia x 5/16 dia hole (for exhaust)		MS 21333-99	4
	SCREW, cap, hex-hd, ¼-28x½	for 1st,	96906-35292-3	3
	NUT, self-locking, hex, ¼-28	2nd &	96906-51922-5	3
	WASHER	4th	MS 35338-27	3
	WASHER	clamps	MS 27183-14	3
	SCREW, ¼-28x1	for	MS 35292-8	1
	NUT	third	MS 51922-5	1
	WASHER	clamp	MS 27183-10	1
N	ELBOW, heater exhaust		7951084	1
P	EXTENSION, heater exhaust		7700245	1
Q	PIN, cotter, ⅛ x 3		MS 24665-363	2
R	RING, rubber		7700242	1
S	WASHER, extension		7700243	1
T	ELBOW ASSY, 90°, 3/16 tube x ⅛ pipe, compressor		444038	1
U	EVAPORATOR ASSY		7408773	1
V	HEATER ASSY, personnel		8364020	1
W	CLAMP, heater mtg, 5-⅝ - 6-½		7951827	2
X	ADAPTER, heater (air)		7524078	1
	SCREW, mach, pan-hd, no. 8-32x5/16		96906-35206-242	4
	WASHER, lock int-ext tooth		96906-35335-17	4
Y	DUCT, flexible, 4 in. id, 14 in. lg		8711056	1
Z	BASE, heater mtg ¼-28x¾		10931988	1
	SCREW, cap, hex-hd, ¼-28x¾		96906-35292-6	4
	WASHER, ground		96906-45904-68	2
	NUT, self-locking, ¼-28		96906-51922-5	4
AA	ADAPTER (filter to heater tube)		MS 39203-4	1

Figure 672. Component parts—winterization kit, personnel heater (1 of 3) (Legend).

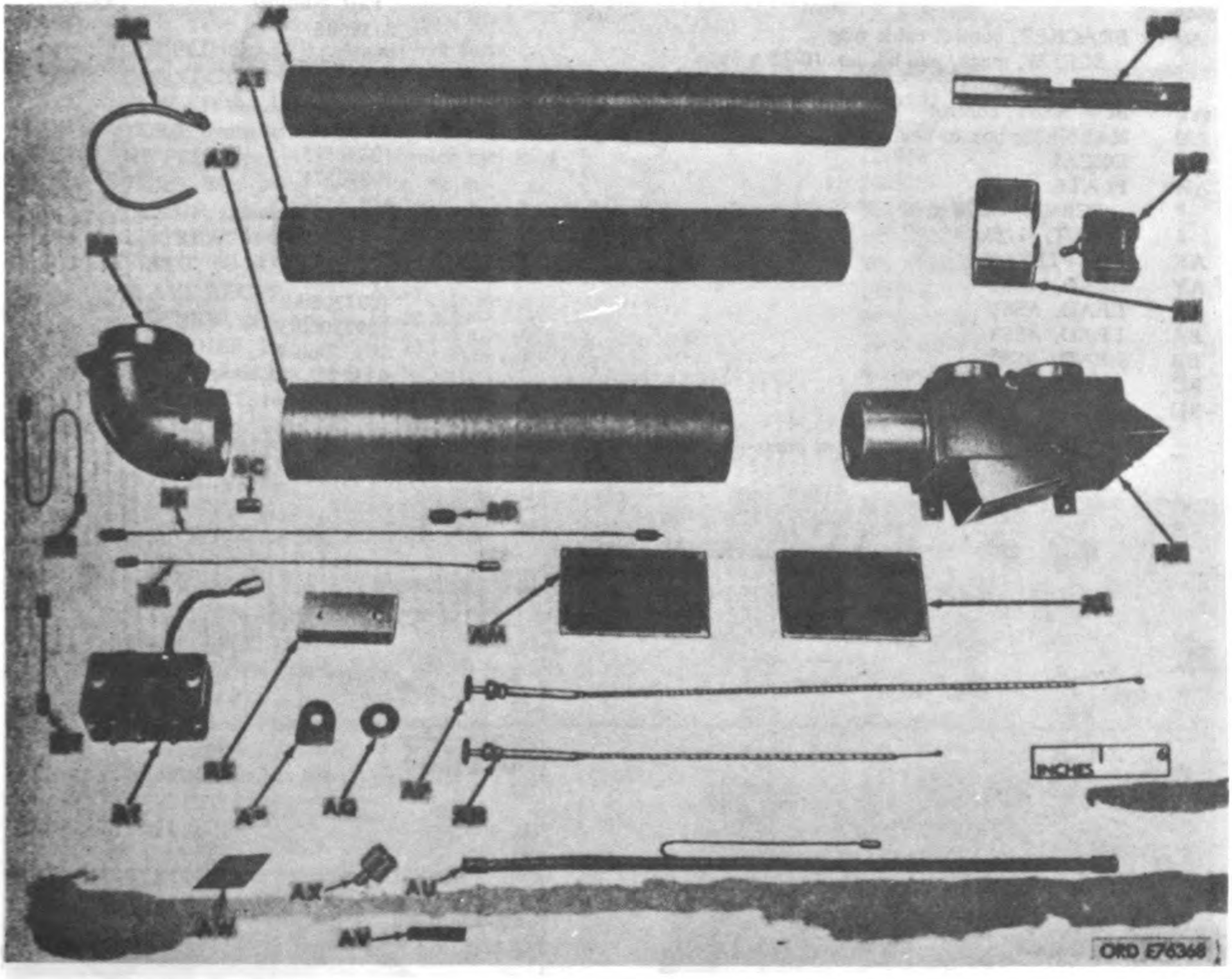


Figure 673. Component parts—winterization kit, personnel heater (2 of 3).

Key	Item	Part Number	Quantity
AB	ELBOW, personnel heater	7700374	1
AC	CLAMP, hose, 2-½ - 6-⅛	96906-35842-4	6
AD	DUCT, 4 in. id, 19-½ in. lg	7951506	1
AE	DUCT, 3 in. id, 26-½ in. lg	7951086	1
AF	DUCT, 3 in. id, 29-½ in. lg	7401666	1
AG	DEFLECTOR, defroster	10896487	2
	SCREW, tapping no. 4-24 x ½	96906-24641-14	10
AH	SWITCH, emergency	MS 390C1-1	1
	SCREW AND LOCKWASHER ASSY 8-32 x ½	425302	2
AJ	GUARD, emergency sw	10896521	1
	2 SCREW, ¼-28 x ¾	MS 35292-3	
	2 NUT	MS 51922-5	
AK	DIVERTER, defroster	7700251	1
AL	PLATE, wiring dia	7951661	1
	SCREW, tapping, pan-hd, no. 10-16 x ⅜	MS 24637-33	4
AM	PLATE, operating instruction	7951717	1
	SCREW, tapping pan-hd, no. 10-16 x ⅜	MS 24637-33	4
AN	CABLE ASSY, heater control, 19 in. lg	7700353	1
AP	CABLE ASSY, defroster control, 28 in. lg	7700248	1
AQ	NAMEPLATE, defroster control	7700351	1
AR	NAMEPLATE, heater control	7951468	1

Key	Item	Part Number	Quantity
AS	BRACKET, control cable mtg	8359586	1
	SCREW, mach, pan-hd, no. 10-32 x 5/8	96906-35226-64	2
	NUT, no. 10-32	7951286	2
AT	BOX ASSY, control	10885798	1
AU	HARNESS, box to heater	8359927	1
AV	DECAL	10896515	1
AW	PLATE	10896371	1
	SCREW, 1/4-28 x 3/4	MS 35292-3	2
	NUT, 1/4-28	MS 51922-5	2
AX	ADAPTER, Y	MS 27147-1	3
AY	LEAD, ASSY	10932060-1	1
AZ	LEAD, ASSY	10932060-2	1
BA	LEAD, ASSY	10932060-3	2
BB	LEAD, ASSY	10932060-4	1
BC	SHELL	8338561	2
BD	PLUG	7982907	2

Figure 673. Component parts—winterization kit, personnel heater (2 of 3) (Legend).

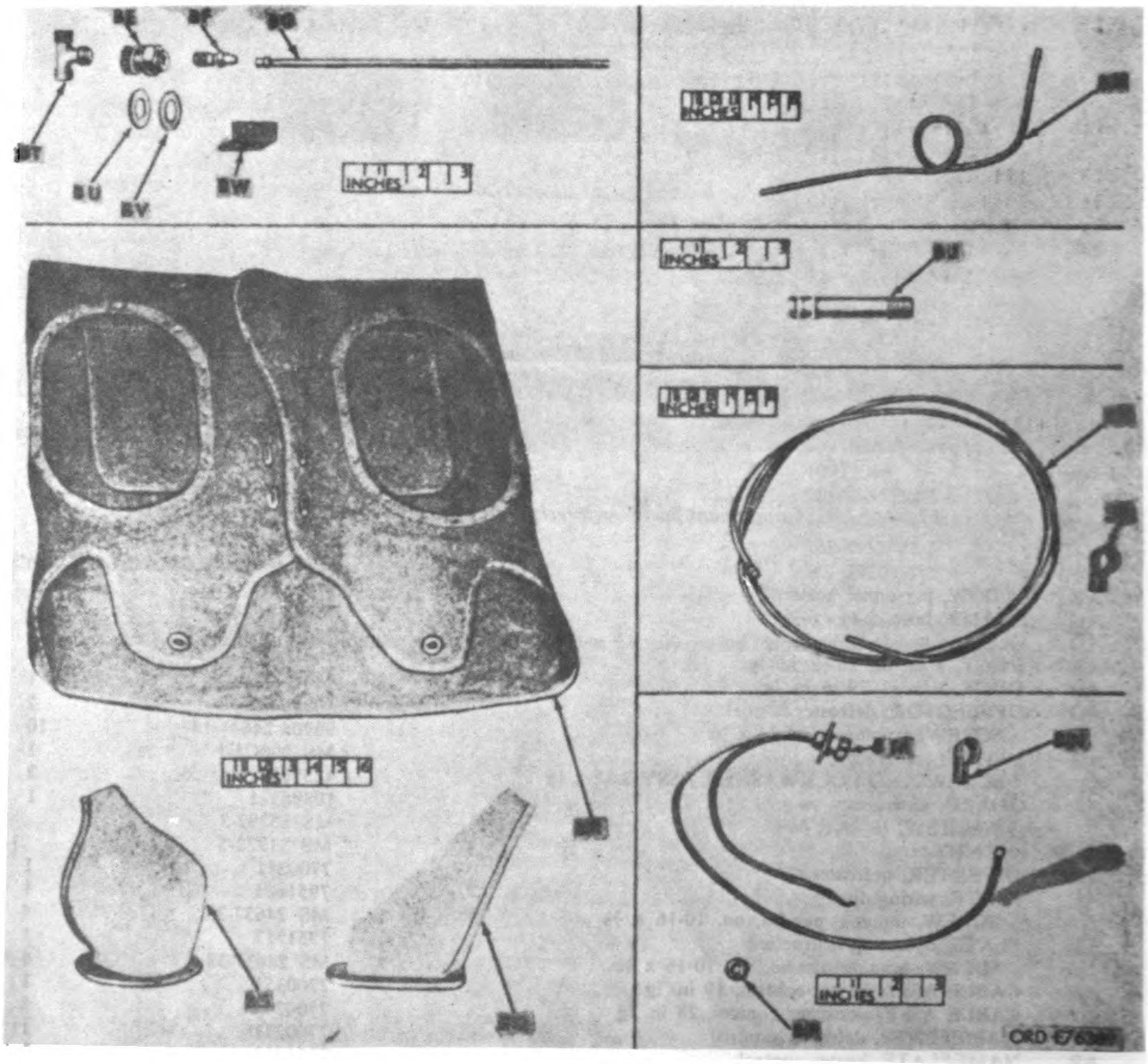


Figure 674. Component parts—winterization kit, personnel heater (3 of 3).

Key	Item	Part Number	Quantity
BE	COUPLING ASSY, adapter, veh filter	444014	1
BF	CONNECTOR ASSY, ⅜ tube x ¼ pipe (adapter at vehicle filter)	MS 39206-6	1
BG	TUBE, 18 in., heater to filter	8689207	1
BH	TUBE, pump to vehicle filter 68 in. lg	8689207	1
BJ	NIPPLE, pipe, ⅛ x 1-½, heater fuel inlet	121830	1
BK	TUBE, filter pump to heater, 88 in.	8689207	1
BL	CLAMP, tubing	MS 21333-99	4
	SCREW, ¼-28 x ½	MS 35292-3	4
	NUT, ¼-28	MS 51922-5	4
BM	SLAVE RECEPTACLE ASSY	7731421	1
	SCREW, cap, hex-hd, ¼-20 x 1	96906-35291-8	4
	WASHER, lock, split, ¼ in.	96906-35337-25	4
	NUT, plain hex, ¼-20	96906-35690-405	4
BP	GROMMET, receptacle cable	7373246	2
BN	CLAMP (for slave receptacle)	MS 21333-39	2
	SCREW, tapping, 5/16 x ¾	No No.	2
BQ	COVER ASSY, transfer lever	7389745	1
	SCREW, tapping, fillister hd, 10-24 x ½	MS 24629-46	4
BR	COVER ASSY, radiator	7978798	1
	LOOP, radiator cover	7716428	4
	SCREW, tapping, pan-hd, no. 8-32 x ½	MS 24649-35	30
	SPRING ASSY, radiator cover	7717706	7
BS	BOOT ASSY, gear lever	8370841	1
	SCREW, tapping, pan-hd, no. 10-16 x ⅜	MS 24617-30	4
BT	TEE (2nd filter)	444120	1
BU	GROMMET (tool compartment)	MS 35489-75	1
BV	GROMMET (firewall)	7951712	1
BW	BRACKET, filter mounting	10931990	1
	SCREW, 10-32 x ¾	MS 35207-265	2
	NUT, 10-32	503209	2

Figure 674. Component parts—winterization kit, personnel heater (3 of 3) (Legend)

527. Installation of Kit

a. Install Heater Fuel Pump.

Note. One fuel pump is used for both personnel heater and coolant heater.

(1) Unscrew four hinge screws retaining tool compartment door (under the vehicle left door) and remove door.

(2) Lay out location of two holes for pump shield, on back wall of compartment (Figure 675).

(3) Punch and drill two 5/16 dia. holes located in (1) above. Prime and paint drilled holes.

(4) Locate one 1-⅜ dia. tubing hole (for pump to coolant heater tube) in the same rear wall.

(5) Using a Greenlee punch or hole saw, cut out 1-⅜ dia. hole located in (4) above. Prime and paint hole edge, and insert grommet MS 35489-75.

(6) Locate three holes in tool compartment side wall as indicated in figure 675.

(7) Center punch and drill three 5/16 dia. holes located in (6) above.

(8) Locate one hole for pump electrical lead in top of tool box as indicated in figure 675.

(9) Center punch and drill ⅝ dia. hole at location marked in (8) above. Prime and paint bare metal.

(10) Lay out and scribe oblong hole in tool compartment top as indicated in figure 675.

(11) Center punch and drill three pilot holes in oblong area so three cuts with 1-1/16 dia. hole saw (or greenlee punch) will fall within the indicated oblong.

(12) Make three cuts as indicated in (11) above, then file off remaining metal within scribed oblong. Prime and paint bare metal.

(13) Locate two tubing clamp holes in top of

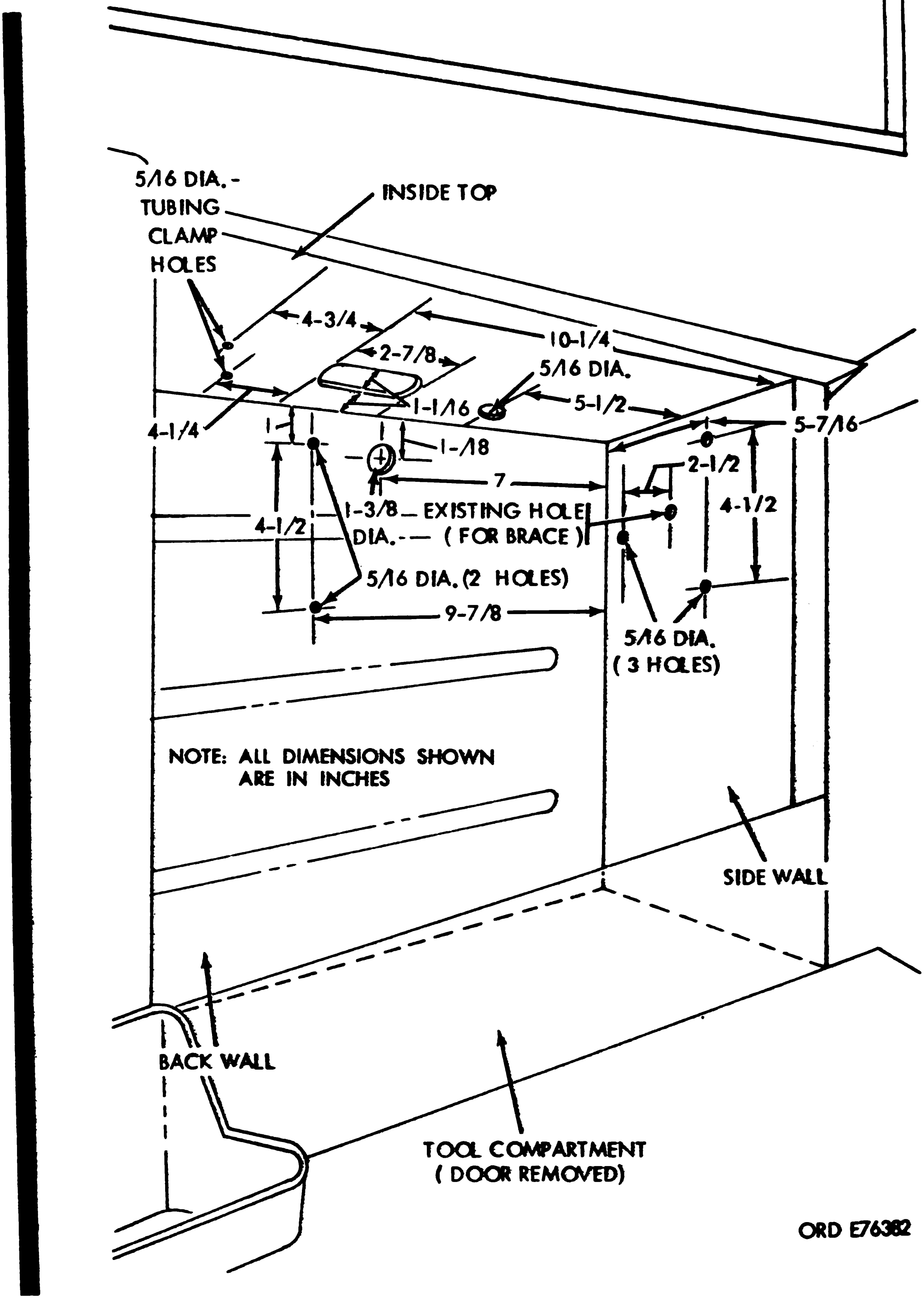


Figure 675. Fuel pump mounting and tubing layout.

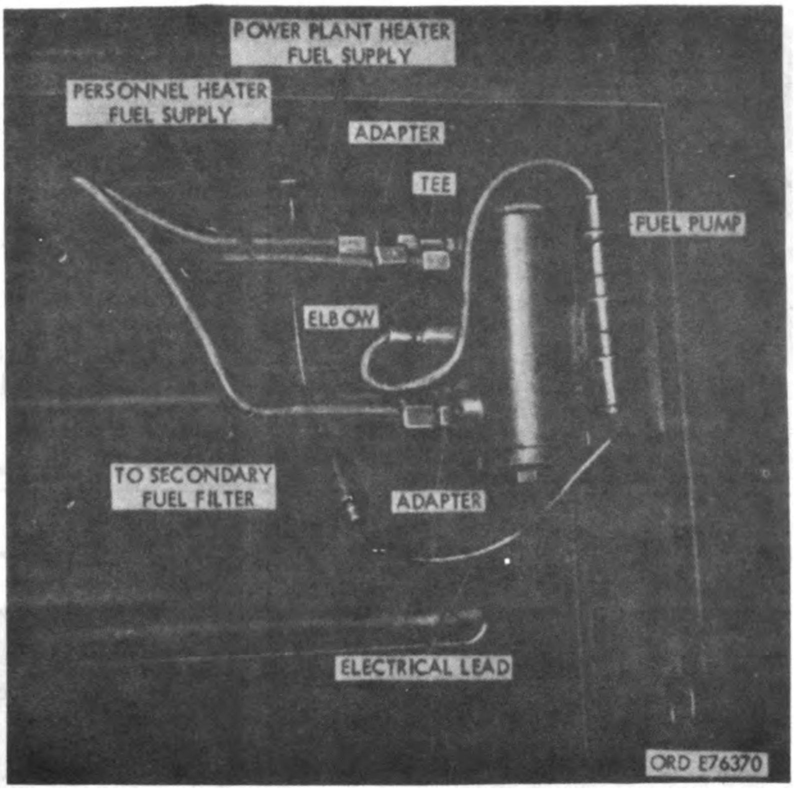


Figure 676. Electric fuel pump installed.

tool compartment as indicated in figure 675.

(14) Center punch and drill two 5/16 dia. holes located in (13) above. Prime and paint bare metal.

(15) Attach fuel pump 7748814 to side wall of tool compartment using one existing hole for bracket (fig. 675) and one 5/16 dia. hole drilled in (7) above. Use ¼-28x½ screw (MS 96906-35292-3) and nut (MS 96906-51922-5).

Install Heater Mounting Base 10931988.

(1) Drill one 9/32 locator hole in left vehicle fender inside engine compartment as indicated in Figure 677.

(2) Place heater base on left front fender with the evaporator bracket facing front of vehicle.

(3) Aline locator hole drilled in (1) above with corresponding hole in base and temporarily drop in a ¼-28 screw for a pivot.

(4) With base pivoted as in (3) above, move forward end of base until left front base hole is 3-½ inches from hinge line (fig. 677).

(5) Using base holes as template, center punch and drill remaining base holes to 9/32 diameter. Prime and paint bare metal, except heater ground hole.

(6) Secure heater base to fender using four ¼-28 x ¾ hex-head screws MS 96906-35292-6 and locknuts MS 96906-51922-5.

Note. Leave forward left mounting base screw loose for installation of heater ground wire.

c. Install Diverter (Figure 678).

Note. Prior to beginning operations in vehicle cab, remove complete seat assembly. (TM 9-2320-211-35).

(1) Locate, center punch and drill four 9/32 dia. holes as indicated in figure 678.

Note. It may be necessary to rotate hose clamp 180 degrees to the right as indicated in figure 678.

(2) Aline diverter with the drilled holes and fasten to firewall using four screws attached to diverter.

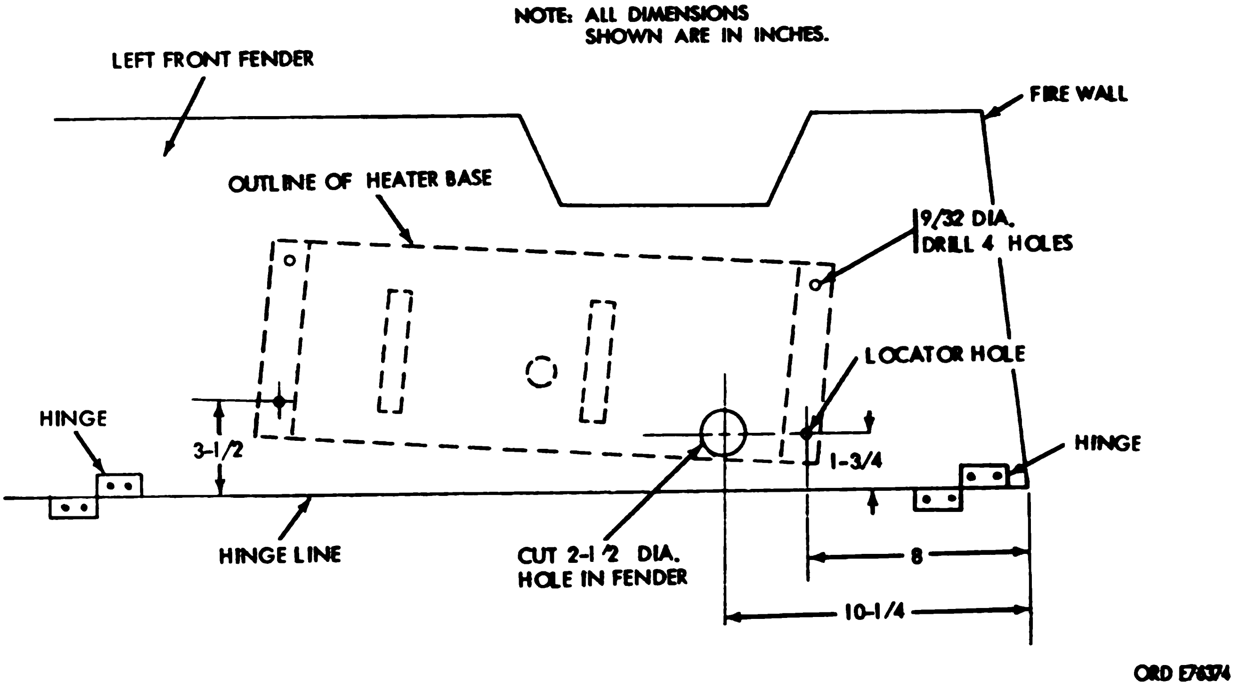


Figure 677. Personnel heater mounting base installation diagram.

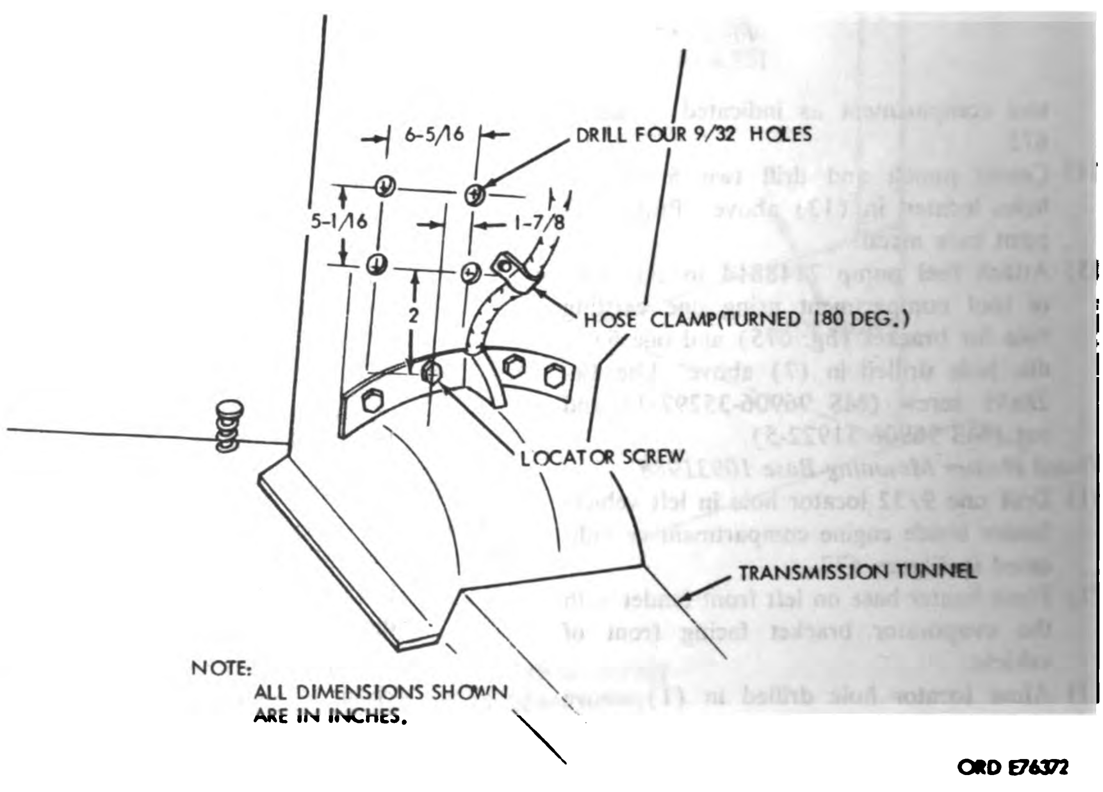


Figure 678. Location of heat diverter mounting holes.

Note. Bend diverter mounting tabs to fit, if necessary.

d. Install Heater Duct Elbow (Figure 679).

(1) Remove the 4-⅛ inch knockout plug from the left side of firewall (Fig. 682).

(2) Remove and retain the two screws and nuts and four lockwashers which came with the heater duct elbow.

(3) Place elbow flanged end through knockout. with other end of elbow facing right toward diverter, as indicated in figure 679. Set angle of elbow about 20 degrees from horizontal.

(4) Mark location of mounting holes to be drilled and remove elbow.

(5) Center punch and drill two 3/16 dia. holes

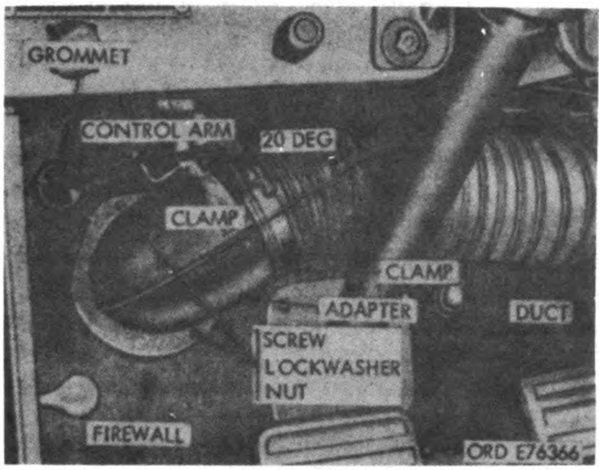


Figure 679. Heater duct elbow.

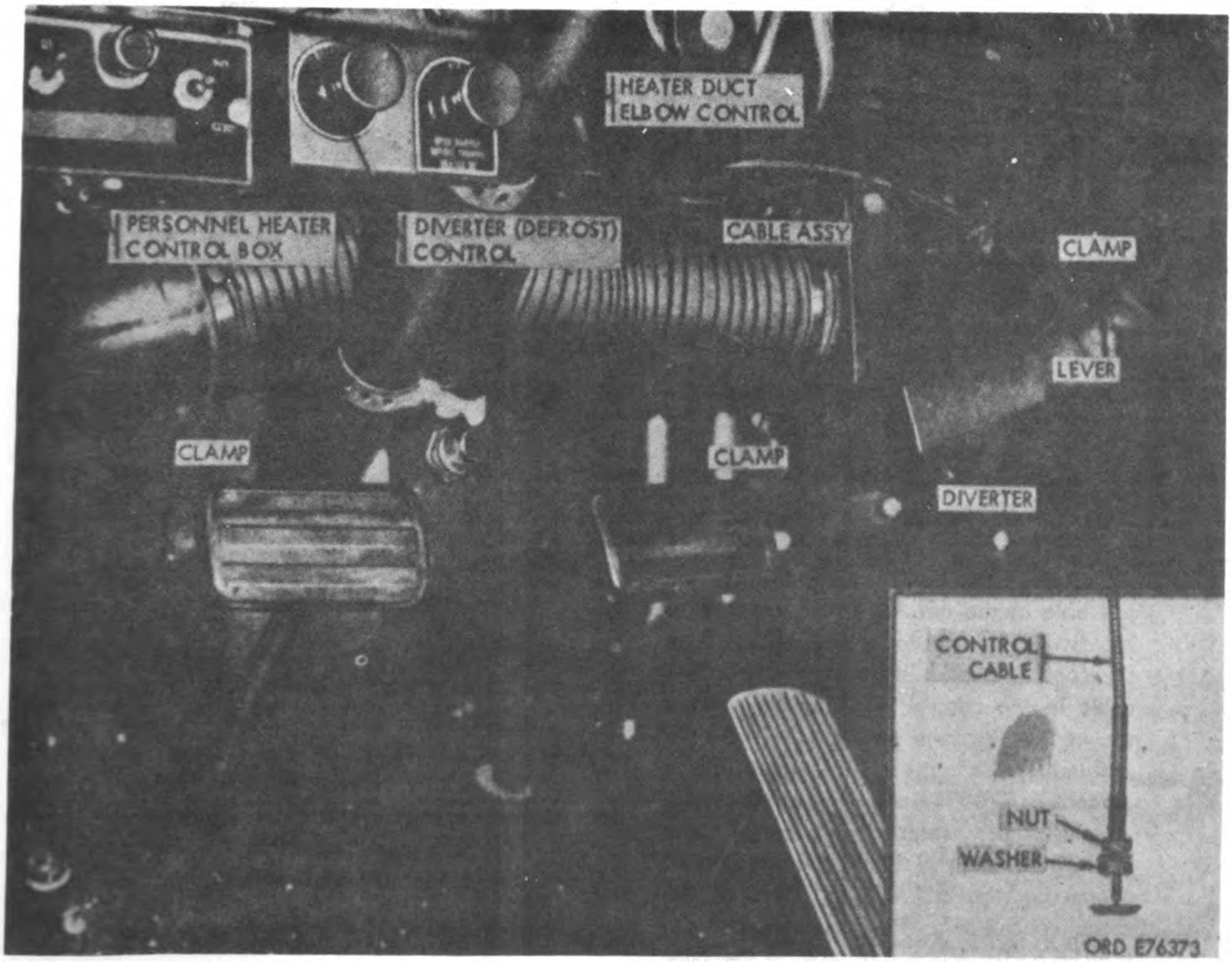


Figure 680. Control box and control cable installation.

in firewall. Attach elbow to firewall using hardware removed in (2) above.

e. Install Heater Control Box.

(1) Attach plate 10896371 to control box 10885798 using existing nuts and washers on control box studs. Attach box to center plate holes with holes for mounting to dash at front of box.

(2) Butt plate and box assembly against left side of cab, with plate mounting holes against lower lip of instrument panel (Fig. 680).

(3) With plate as template, mark location of mounting holes.

(4) Center punch and drill two 9/32 dia. holes located in (3) above.

(5) Mount box with plate to dash panel lip using two ¼-28x¾ screws MS 96906-35292-3 and nuts MS 96906-51922-5.

(6) Install decal 10896515 on front panel of control box, ¼ in. above the phrase "HEATER CONTROL".

f. Install Diverter and Elbow Control Cables.

(1) Place control cable bracket 8359586 against underside of instrument panel (figure 680) next to the control box.

(2) Using any two of three holes in bracket, mark location of mounting holes in panel lip which will not interfere with windshield wiper switch or switch air tubes.

(3) Center punch and drill two 3/16 dia. holes located in (2) above and attach with two 10-32x⅝ screws MS 96906-35226-64 and nuts 7951286.

(4) Place nameplate 7951468 (marked Defroster) over left bracket hole, and insert the diverter heat control cable through the left hole in the bracket and connect it to the diverter control lever (Fig. 680). Push the control knob fully in and position the cable in the control cable clamp so that the control lever is on the extreme right and tighten the control cable clamp. Place nameplate 7700351 over right bracket hole and insert the heater elbow control cable in the right hole of the mounting bracket connecting the end of this cable to the elbow control arm. Push the control knob fully in and position the cable in the control cable clamp so that the butterfly in the elbow is closed when the control knob is pushed all the way in and tighten the control clamp.

Note. Due to variation in length of the control cables, it may be necessary to lengthen the cable by unrolling the loop, which is formed at the end of the cable, or by rolling up additional wire to shorten the cable. This operation is done with long-nose pliers. If necessary, the end of the wire can be clipped off and a new loop formed when the cable cannot be shortened sufficiently by rolling up the existing loop. To unlock controls, turn knobs counterclockwise; to lock, turn knobs clockwise.

g. Install Elbow to Diverter Duct (Figure 680).

(1) Slide one end of 4 in. x 19-½ in duct 7951506 onto end of elbow (*d* above) and secure with clamp MS 96906-35842-4.

(2) Slide other end of ducting onto diverter opening (Fig. 680) and secure duct to diverter with another clamp MS 96906-35842-4.

h. Install Personnel Heater and Duct.

(1) Assemble large flat washer 7700243 rubber ring 7700243 and metal exhaust ex-

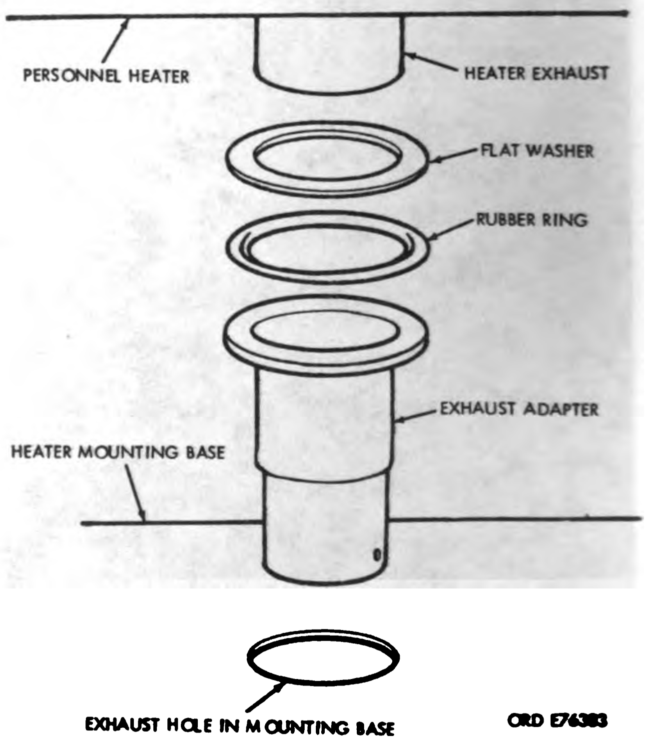


Figure 681. Heater exhaust adapter installation.

tension 7700245 to exhaust pipe on heater, and place heater on mounting base, passing extension through exhaust hole in base (Fig. 681).

(2) Thread heater retaining clamps MS 96906-35842-4 though slots in bracket welded to base and under valve protective cover atop heater and tighten clamps to secure heater.

Note. Valve protective cover is retained with two fasteners.

(3) Attach adapter 7524078 to heater as indicated in figure 681, using four screws MS 96906-35206-242 and washers MS 96906-35335-17.

(4) Attach the 14 inch long duct 8711056 to the heater duct elbow (inside engine compartment) (fig. 682). Attach the other end to heater duct (fig. 682). Secure with clamp MS 96906-35842-4 at each end.

i. Install Heater Exhaust Tube.

(1) Locate and cut out 2-½ inch hole in fender as indicated in figure 677. Use a hole saw or Greenlee punch for cut.

(2) Secure heater exhaust elbow 7951084 to exhaust extension 7700245 using ⅛ x 3 cotter pin MS 96906-24665-363.

(3) Run the 70 in. long heater exhaust tube 7986268 up through hole cut in (1) above

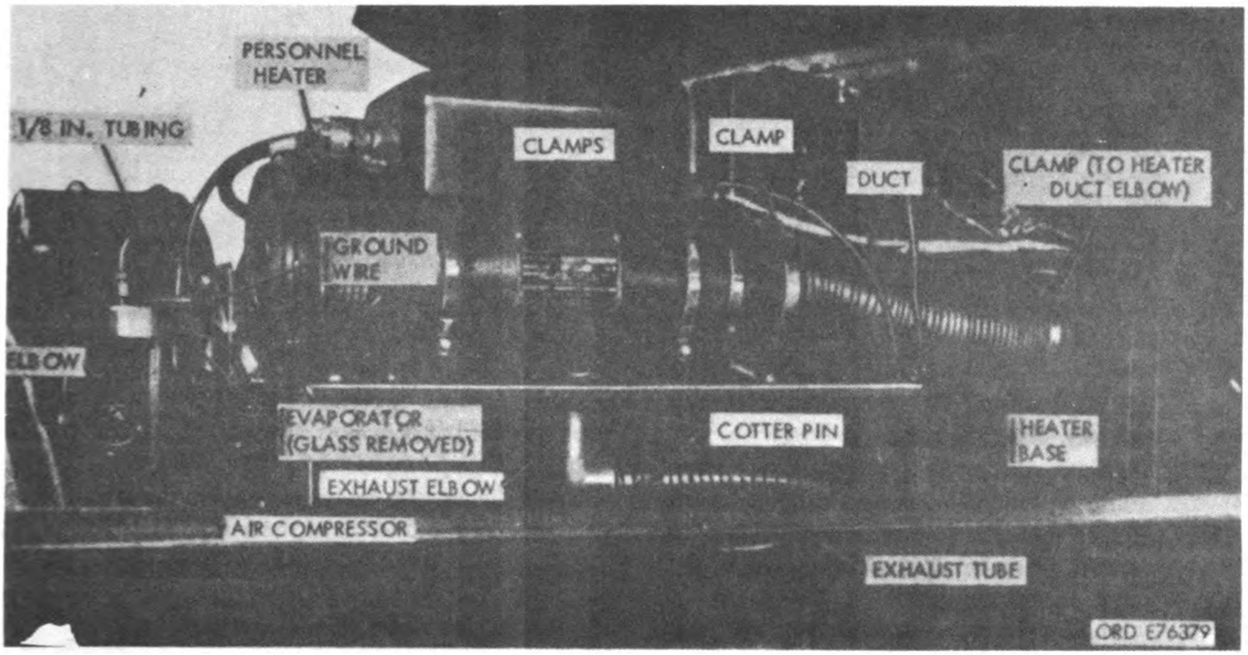


Figure 682. Installing personnel heater.

and place exhaust tube onto elbow so tube covers at least 1-¼ inch of elbow.

Note. It may be necessary to turn tube onto elbow to get it on.

(4) Drill 5/32 dia. hole through tube and elbow about 1 inch from edge of tube and insert ⅛ x 3 cotter pin MS 96906-24665-363.

(5) Place four clamps MS 96906-21333-99 around exhaust tube 7986268 approximately as indicated in Figure 683. Attach upper 2 clamps to existing holes in fender reinforcement (Fig. 683) using ¼-28x½ screw MS 96906-35292-3, large flat washer MS 96906-35333-27, lockwasher MS 96906-27183-14 and nut MS 96906-51922-5.

(6) Drill a 5/32 dia. hole in other arm of same fender reinforcement approximately 3-¼ inches from bottom of reinforcement (Fig. 683) and attach clamp to fender reinforcement with ¼-28x1 screw MS 96906-

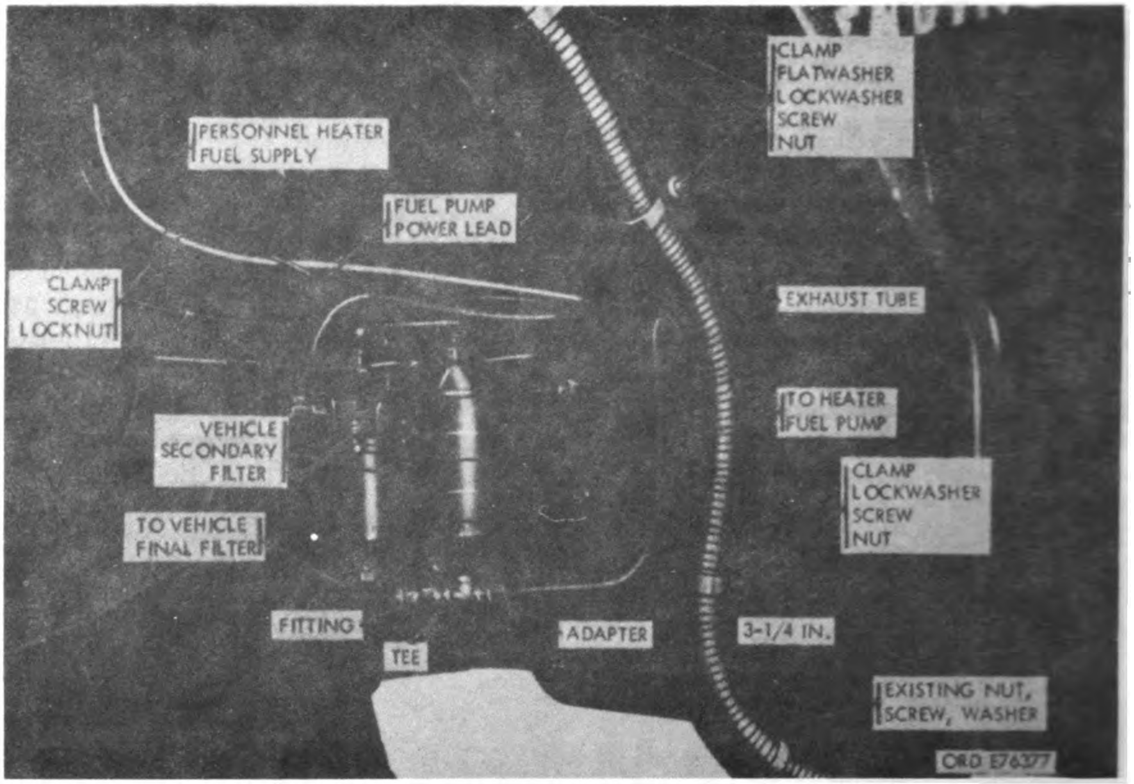


Figure 683. Attaching heater exhaust hose to fender.

35292-8, washer MS 96906-27183-10 and nut MS 96906-51922-5.

(7) Remove and retain one nut and washer attaching fender bracket to running board hanger and attach final, lowest clamp to bracket using original, existing screw and nut retained above.

k. Install Defrost Reflectors (Fig. 684).

(1) Lay right defrost deflector 10896407 along top of instrument panel so that window handle can be operated within deflector cut out.

Note. Top edge of deflector is ⅜ inch from window.

(2) Using deflector holes as a template, drill holes with No. 38 drill into top of instrument panel.

Note. Do not attempt to drill through second layer of metal; approximately ⅜ inch below first.

(3) Secure deflector with five 4-24x½ self-tapping screws MS 96906-24641-14.

(4) Repeat operation on left side with other defrost deflector.

l. Install Defroster Ducts (Figure 685).

(1) Secure 26-½ inch long x 3 inch diameter duct 7951086 to the right windshield defroster nozzle installed at factory using clamp MS 96906-35842-4.

Figure 684. Defrost deflector installation details.

(2) Secure 29-½ inch long x 3 inch diameter duct 7401666 to the left windshield defrost nozzle with clamp MS 96906-35842-4.

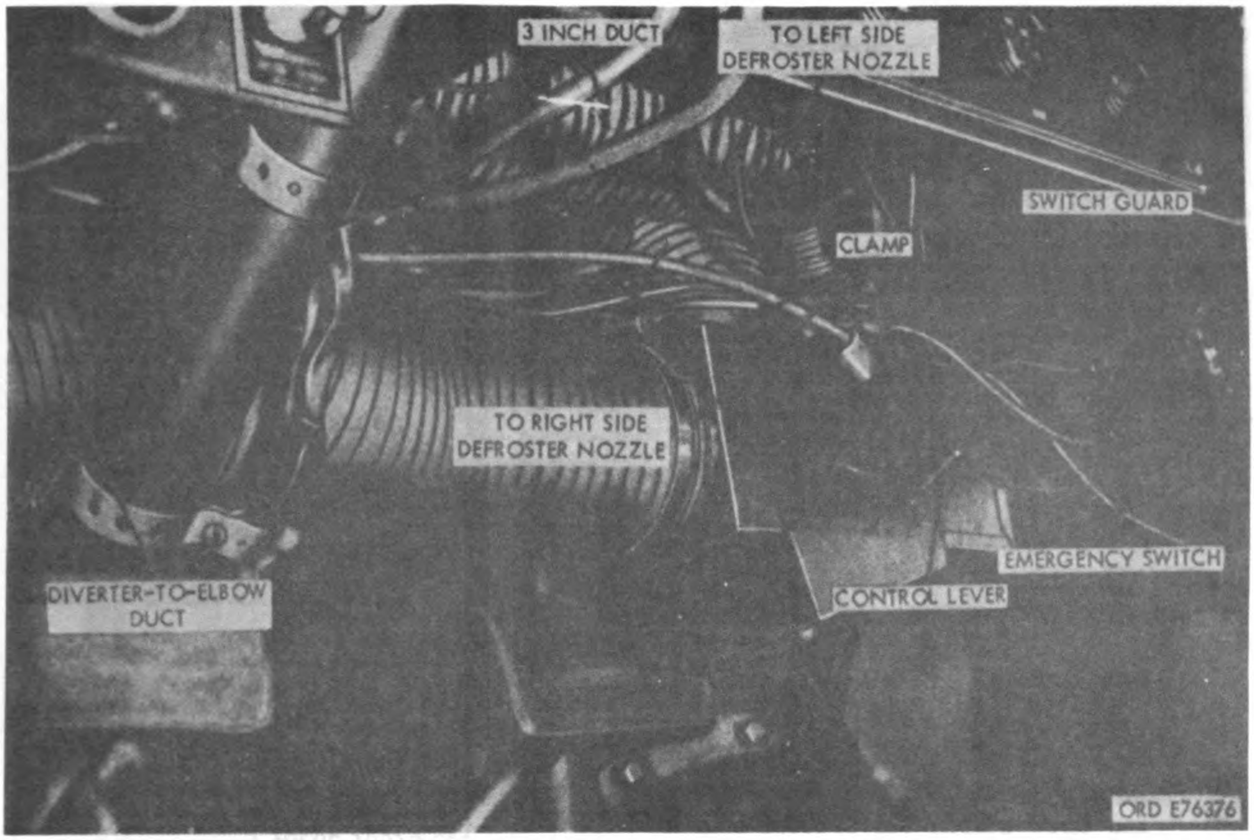


Figure 685. Defrost duct installation.

(3) Attach right side duct to left diverter opening and left side duct to right diverter opening. Clamp each duct to its diverter opening using clamp MS 96906-35842-4.

m. Install Emergency Switch (690).

(1) Locate center of switch protective guard on under lip of instrument panel approximately 23 inches from right edge of panel.

(2) Locate two holes for attaching screws using guard as a template.

(3) Punch and drill two 9/32 dia. holes as located in (2) above and attach guard using two ¼-28x¾ screws MS 96906-35292-3 and nut MS 96906-51922-5.

(4) Attach emergency switch MS 96906-39061-1 to guard with two 8-32x½ screw and lockwasher assembly 425302.

Note. Be sure switch "on" position is UP.

n. Install Fuel Lines.

(1) Attach one arm of tee 444147 to upper opening of fuel pump (Fig. 676) with opening facing out and downward some 10 degrees.

(2) Attach elbow MS 39202-4 (for coolant heater line) to leg of tee installed in (1) above.

Caution: **When installing tubing, check ends for burs in the I.D. and remove carefully. Burs cause a wax build up which will clog the tubing.**

(3) Attach one adapter MS 39206-4 to other arm of tee installed in (1) above and attach other adapter MS 39206-4 to lower opening of fuel pump.

(4) Attach filter bracket 10931990 to forward, inner side of heater mounting base (Fig. 686) using two 10-32x¾ screws (MS 35207-265) and nuts 503209.

(5) Attach filter MS 51085-1 to bracket installed in (4) above using two 10-32x1-¾ screws MS 35207-270 and nuts 503209.

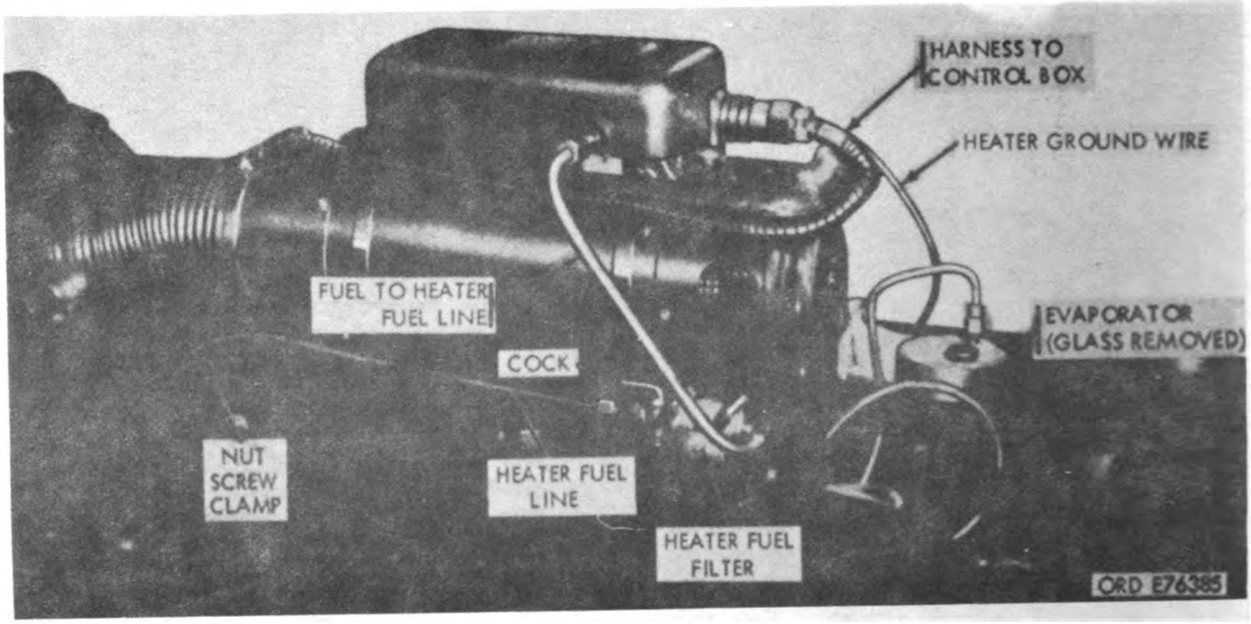


Figure 686. Heater fuel lines at heater.

Caution: **Make certain arrow on filter points to front of truck.**

(6) Insert nipple 121830 into heater fuel inlet and screw adapter MS 39203-4 onto it (Fig. 686).

(7) Attach elbow MS 39202-4 to forward opening of heater filter.

(8) Attach cock 543852 to rear opening of heater filter and attach adapter MS 39206-4 to cock.

(9) Loosen tube from bottom of vehicle secondary filter and remove existing elbow. Discard elbow (Fig. 683).

(10) At the opening of filter (9) above, screw on tee 444120, with one arm pointing in direction of elbow removed in (9) above.

(11) Insert adapter MS 39206-6 into rearward arm of tee.

(12) Insert fitting 137409 into forward arm of tee, and reattach vehicle secondary filter to final filter tubing disconnected in (9) above.

(13) Attach pump-to-secondary filter tube.

Note. Bottom all tubing in fittings before tightening to prevent leaks.

(*a*) Take 68 in. long 1/4 tubing 8689207 and lay it along top of tool compartment, inserting it through oval hole cut in *a*(5) above (Fig. 675). Bend tubing to meet lower adapter on pump and attach thereto; bend the other end down to secondary filter and attach to adapter MS 96906-39206-6.

Caution: **Remove all burs inside tube ends.**

(*b*) Fasten tubing to top of compartment and left running board brace as indicated in Figure 675 using clamps MS 96906-21333-99, 1/4-28x1/2 screws, MS 35292-3 and nut MS 51922-5.

(14) Attach fuel pump-to-heater tubing.

(*a*) Place 1/4 tubing 8689207 (88 in. long) along top of tool compartment and snap it into oblong hole in top cut in *a*(5) above.

(*b*) Attach tubing to arm of tee in upper part of pump (Fig. 676); run other end of tubing over vehicle filters and up through opening in inner fender (Fig. 683) and along side inner edge of heater mounting base and into cock inserted into heater filter in (8) above. Attach end of tubing to cock.

(*c*) Clamp tubing at heater base (Fig. 686), fender opening (Fig. 683) and atop tool compartment (Fig. 675), using clamps

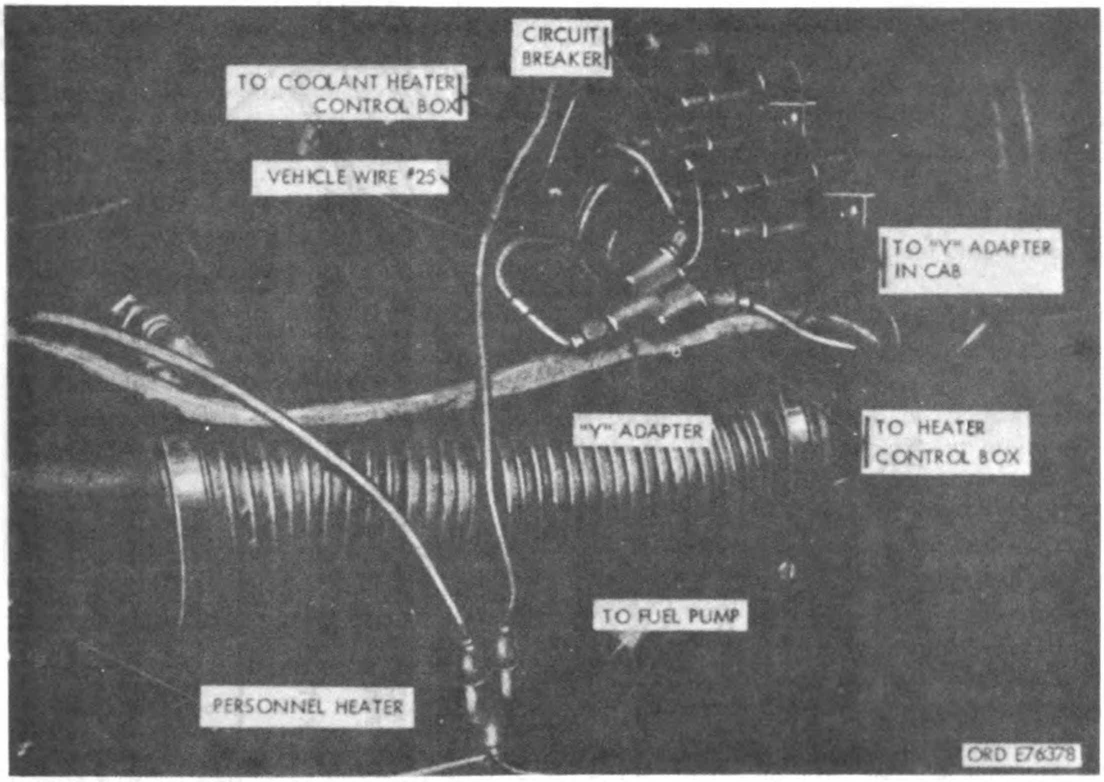


Figure 687. Vehicle to heater power connections.

MS 96906-21333-99, ¼-28x½ screws MS 96906-35292-3 and nuts MS 96906-51922-5.

Caution: **Make certain tubing is not being abraded by sharp edges or corners.**

(15) Attach filter to heater tube.

(*a*) Bend 18 in. long ¼ tube 8689207 to fit from exit of heater filter to heater fuel inlet.

(*b*) Attach tube to elbow installed in filter (7) above; attach other end to nipple and adapter installed in (6) above.

p. Installation of Alcohol Evaporator (Figure 686).

(1) Attach alcohol evaporator to the bracket welded to heater mounting base using 3 screws and locknuts provided with evaporator.

(2) Remove pipe plug in top side of air compressor intake body (Fig. 682) and replace with elbow 444038. Discard plug.

(3) Attach ⅛ tubing to fitting on evaporator; attach the other end to elbow installed in (2) above. Tighten nuts securely.

q. Installation of Harness and Wiring (Figure 689).

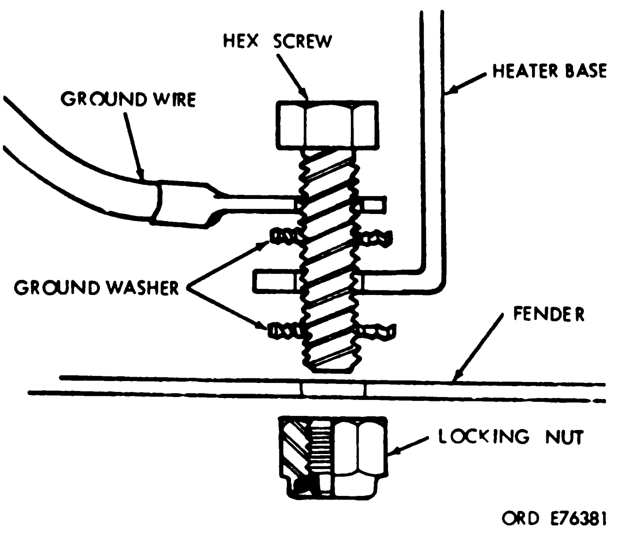


Figure 688. Heater ground wire installation.

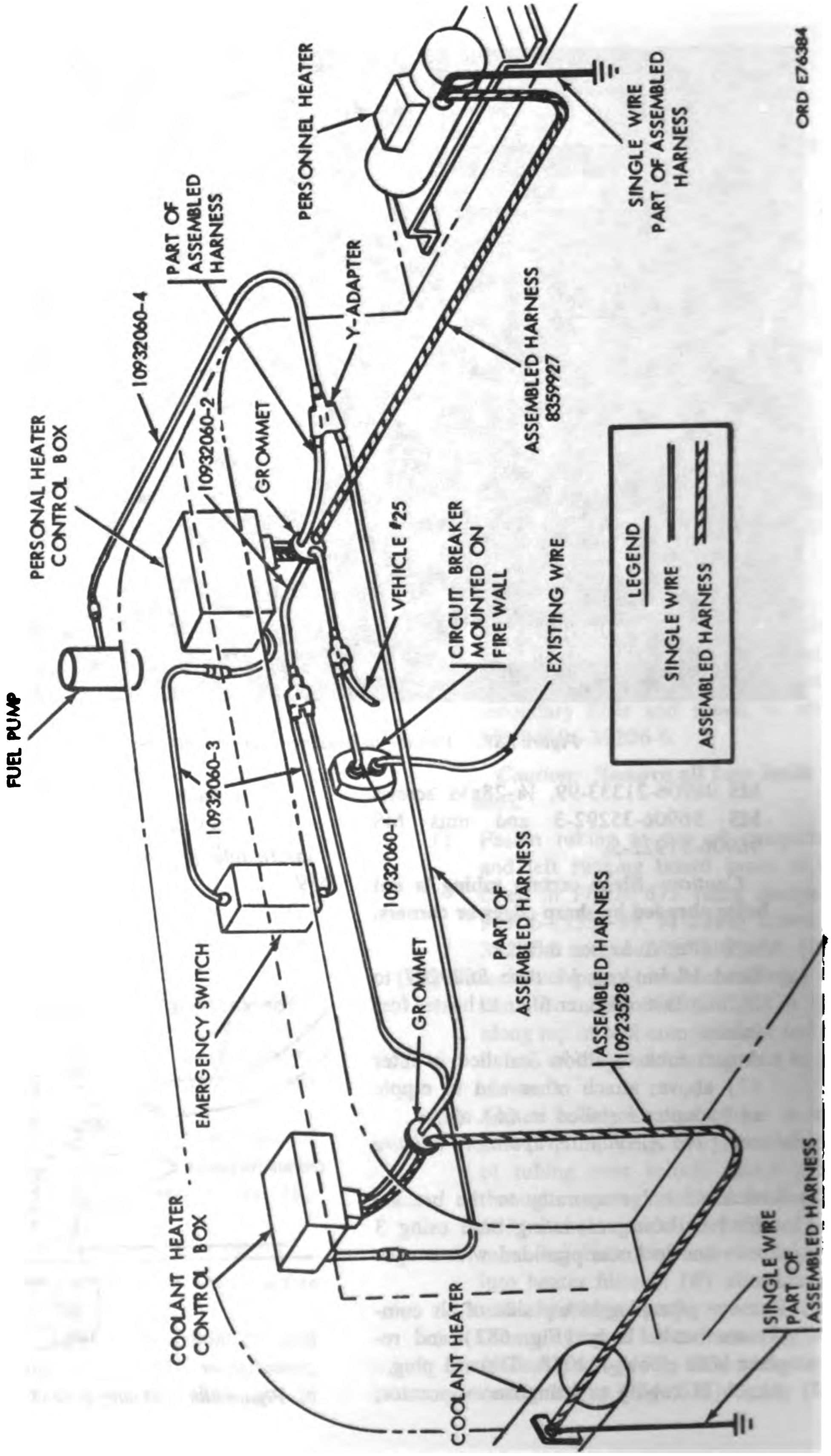


Figure 659. Personnel and coolant heater wiring perspective.

(1) Remove 1-⅜ inch knockout on firewall above and near the heater duct (Figure 687).

(2) Plug heater-to-control box harness 8359927 into heater receptable.

Note. Each harness end is labeled.

(3) Remove left front mounting base screw and nut (installed earlier) and attach heater ground line to base as indicated in Figure 688, using two grounding screws MS 96906-45904-68.

Caution: **Make certain a good ground is obtained.**

(4) Lead heater to control box harness into cab through knockout hole obtained in (1) above, and plug it into control box receptacle.

(5) Plug attached lead of harness into one arm of Y adapter MS 96906-27147-1 (Fig. 687).

Note. Use shell 8338561 and plug 7982907 as and where necessary in installing wiring.

(6) Plug 72 inch lead assy 10932060-4 (Fig. 687) into other arm of Y adapter MS 96906-27147-1 (5) above, and lead it down inside fender and along side pump to heater tubing, on the top of tool compartment right side and into ⅝ dia. hole drilled in *a.* above. Connect lead to fuel pump lead and install grommet 7951712 in hole.

(7) Locate vehicle No. 25 lead (hanging loose on inner firewall) and plug it into leg of a Y adapter (Fig. 687).

(8) Plug 6 inch lead assy 10932060-1 into one arm of adapter installed in (7) above (Fig. 687).

(9) Plug other end of 6 inch lead assy 10932060-1 into vacant orifice of circuit breaker (Fig. 687).

(10) Plug 13 inch lead assy 10932060-2 into the other arm of Y adapter MS 96906-27147-1 and insert other end of lead assy through 1-⅜ knockout hole in firewall (knocked out in (1) above) into cab. Attach to leg of another Y adapter MS 96906-27147-1. Install grommet around control box to heater harness and 13 inch lead and insert in 1-⅜ inch hole knocked out in (1) above.

Figure 690. Wiring hook-up in cab.

(11) Plug 38 inch lead assy 10932060-3 into one arm of Y adapter installed in (10) above. Plug the other end of 38 inch lead assy into bottom terminal of emergency switch ,Fig. 690).

(12) Plug another 38 inch lead assy 10932060-

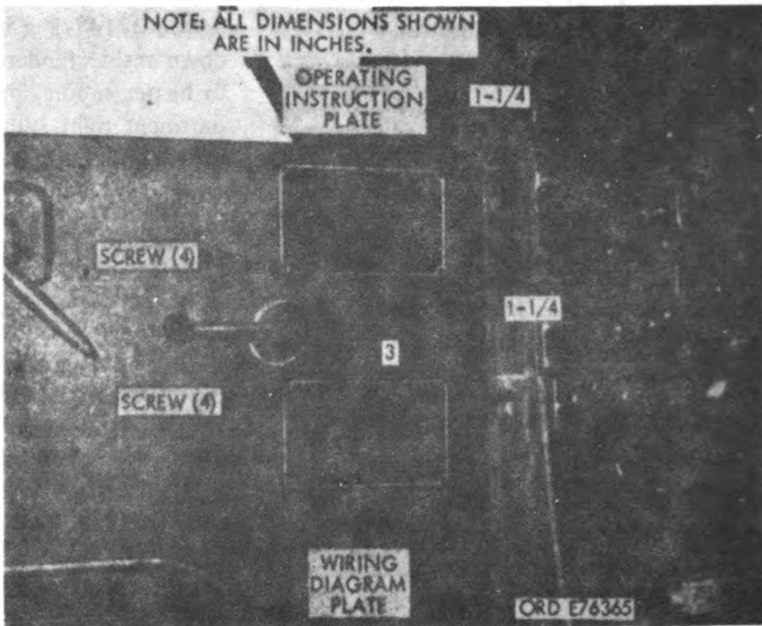


Figure 691. Installation of data and instruction plates.

3 into top terminal of emergency switch (Fig. 690) and plug the other end into the personnel heater control box lead.

r. Installation of Data and Instruction Plates (Figure 691).

(1) Attach operating instruction plate 7951717 to inside of left door, using four No. 10-16 x ⅜ sheet metal screws MS 96906-24637-33.

(2) Attach wiring diagram plate 7951661 to inside of left door, using four 10-16 x ⅜ sheet metal screws MS 96906-24637-33.

s. Installation of Slave Receptacle. Refer to paragraph 528.

Note. Although slave receptacle is part of personnel heater kit, it cannot be installed until battery box is installed, part of coolant heater installation (par. 528).

t. Installation of Shield.

Note. Do not install shield until after trial operation to detect leaks.

(1) Place shield 10932116 over the fuel pump, aligning shield holes with holes drilled in tool compartment side and back.

(2) Fasten shield in place using four ¼-28 x ½ screws MS 96906-35207-279 and locking nuts MS 96906-51922-5 (Fig. 692).

u. Installation of Gear Shift Lever Boot and Transfer Lever Cover.

Note. Thermal barrier (par. 525) is installed first.

(1) Position gear shift lever in neutral and position boot 8370841 over lever, with curved seam toward instrument panel.

(2) Hold boot in place and shift gears to determine lever can be shifted without stress.

(3) Using boot base as template, center punch and drill 7/64 dia. mounting screw holes through thermal barrier and transmission tunnel.

(4) Secure boot to transmission tunnel with four No. 10-12 x ¾ self-tapping screws 5305-012-8151.

(5) Position transfer lever in high range and place cover 7389745 over lever with seam toward instrument panel.

(6) Shift lever to determine whether lever can be shifted without stress.

(7) Using cover base as template, center punch and drill four 7/64 dia. holes through thermal barrier and transmission tunnel.

(8) Secure cover to tunnel with four No. 10-12 x ¾ self-tapping screws 5305-012-8151.

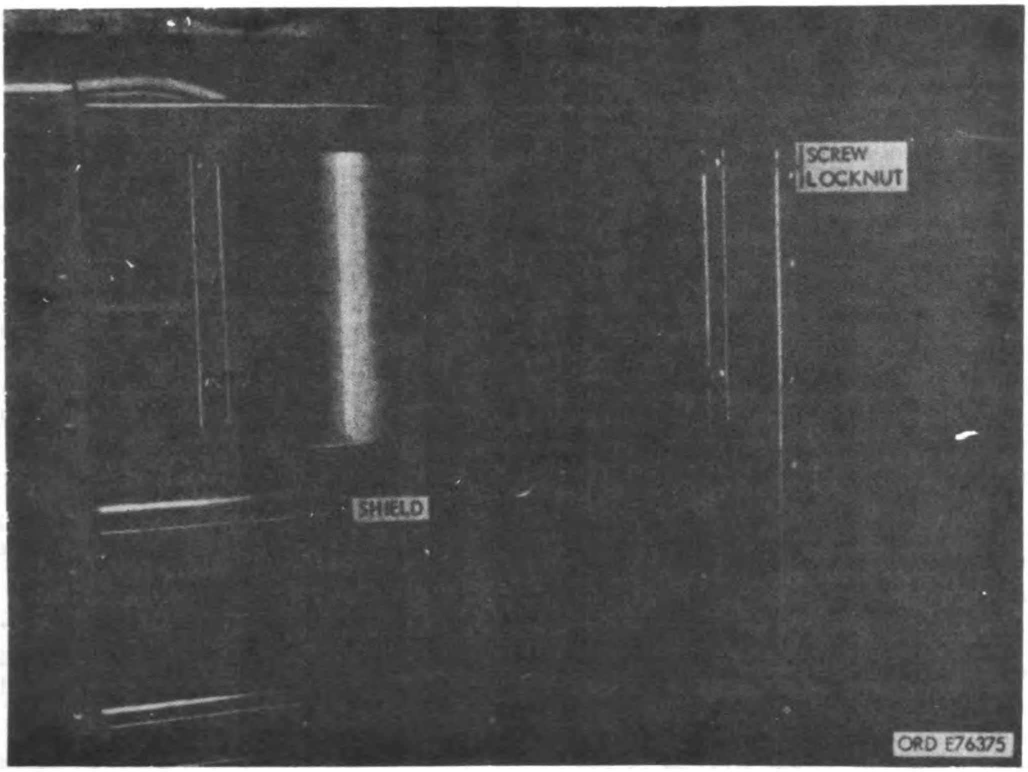


Figure 692. Installation of pump shield.

v. Installation of Radiator Cover. The cover assembly is installed by using the procedures given in paragraph 481*d* of this manual.

w. Operating Test After Personnel Heater Kit Installation.

(1) Preliminary checks before starting heater.

(*a*) Open the personnel heater fuel shutoff cock, located at the fuel pump tee in the vehicle battery compartment to the fully counterclockwise position.

(*b*) Be sure the personnel heater emergency switch is in the "ON" position.

(*c*) Use the "push-to-test" feature of the personnel heater control box indicator lamp. The lamp should light; if the lamp does not light, troubleshoot the heater circuit. Refer to paragraph 530 for troubleshooting.

(2) Checking personnel heater operation.

(*a*) Start to operate the personnel heater according to procedures given in TM 9–2320–211–10.

(*b*) Operate all personnel heater controls as directed in TM 9–2320–211–10. If the heater fails to operate properly, refer to troubleshooting, this manual to correct the defect.

Section XIV. (Added) POWER PLANT (COOLANT) HEATER KIT (MULTIFUEL MODELS)

528. Description, Data and Installation Instructions

a. Description.

(1) *Coolant heater.* An electrically operated heater using fuel from the vehicle fuel system is mounted on the frame in the battery compartment of the vehicle. This heats the coolant to facilitate starting and to maintain near-normal engine operating temperature during standby periods. Exhaust gases from the heater pass through tubing to the oil pan shroud for warming the crankcase lubricant. The heaters are not designed for use while the vehicle is in motion, but for overnight or standby heating of the coolant and the crankcase lubricant when the engine is stopped.

Warning: **This type of heater must not be used in closed areas occupied by personnel.**

(2) *Battery box and accessories.* The battery box and cover are provided with complete interior insulation and heating pad to maintain batteries at temperatures necessary for normal input and output voltages of the battery. Separate lines attached to the battery box heating pad and engine block permit heated coolant to circulate through the heating pad in the bottom of the battery box.

(3) *Covers.* Covers are attached to the engine hood, brush guard, and the hood right-and-left-side panels to help retain heat in the engine compartment. These covers do not interfere with the opening of the hood.

b. Data.

Heater:	
Manufacturer	Stewart-Warner Corp.
Model no.	939-F24
Ordnance part no.	10914540
Weight	15 lb
Dimensions:	
Width	6-¾ in.
Length	15-5/16 in.
Height	9-½ in.
Heat output (coolant):	
High heat	16,000 Btu/hr
Low heat	5500 Btu/hr
Heat output (exhaust):	
High heat	8000 Btu/hr
Low heat	4500 Btu/hr
Fuel consumption:	
High heat	0.260 gph
Low heat	0.110 gph
Fuel pressure required	3 to 15 psi
Operating voltage	24 v
Current consumption:	
Starting	11 amp
Low heat	1.0 amp
High heat	1.0 amp
Blower motor:	
Manufacturer	Stewart-Warner Corp.
Model no.	G 700139
Ordnance part no.	8359780
Operating voltage	24 v
Current consumption	0.7 amp
Fuel filter:	
Manufacturer	Bendix Corp.
Ordnance part no.	7761059

c. Composition of Kit. The kit is comprised of a coolant heater, battery box and covers, with necessary wiring controls and piping. Figures 693 through 696 indicate kit contents.

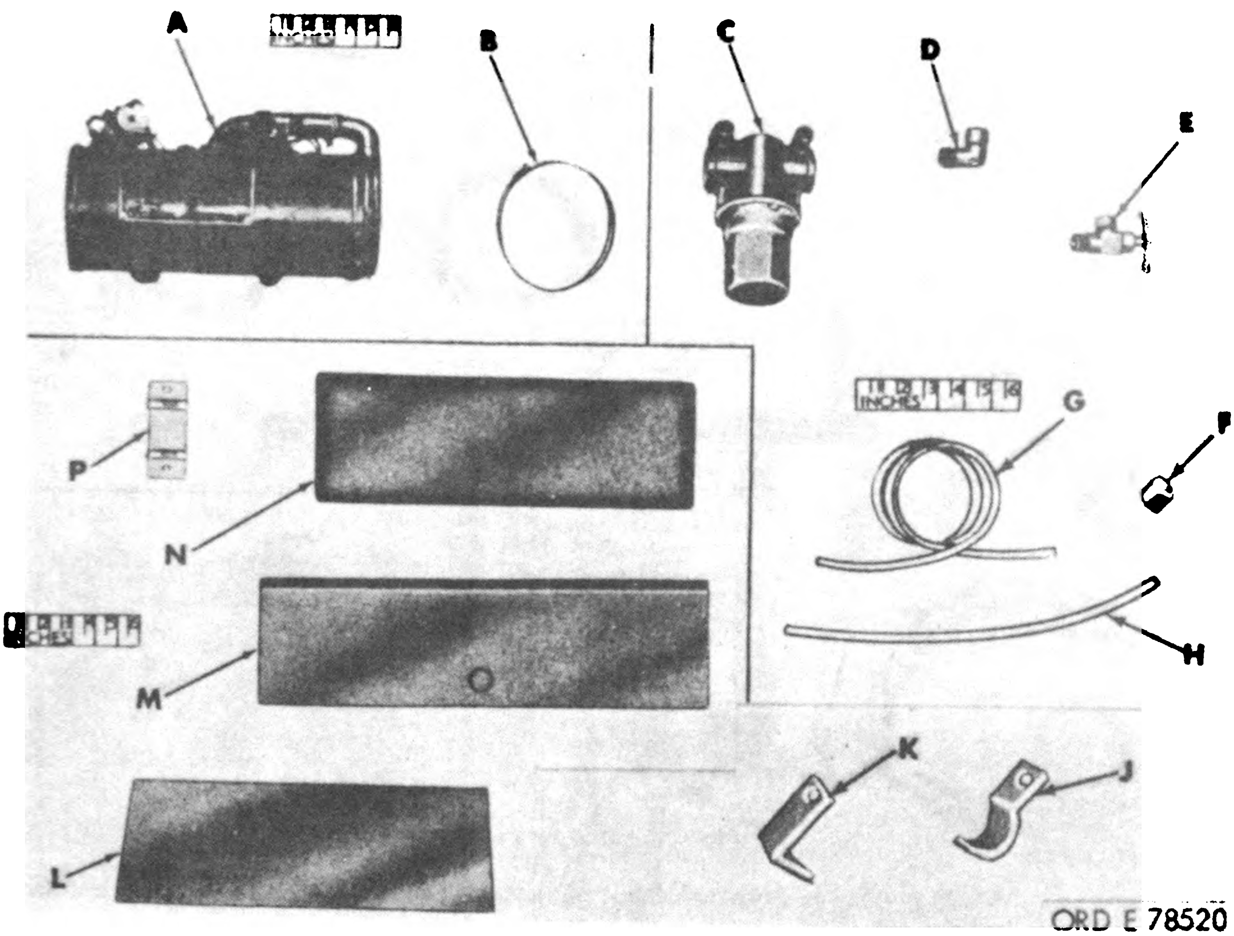


Figure 693. Major parts—winterization kit, power plant heater (1 of 4).

Key	Item	Part Number	Quantity
A	HEATER ASSY, power plant	10914540	1
B	CLAMP, 5-5/8 - 6-1/2 heater mounting	7951827	2
C	FILTER ASSY, fuel	MS 51085-1	1
	SCREW, mach, pan-hd, no. 10-32x1-1/2	96906-35207-269	2
	WASHER, lock, flat, ext tooth	96906-35335-18	2
D	ELBOW ASSY, 5/16 tube x 1/8 pipe, filter outlet and inlet	MS 39202-4	2
E	COCK ASSY, shutoff, 5/16 tube x 1/8 pipe	543852	1
F	ADAPTER	MS 39206-4	1
G	TUBE, 64 in. pump to filter	8689207	1
H	TUBE, 20 in. filter to heater	8689207	1
J	CLAMP, tube	MS 21333-99	
	SCREW	MS 35292-4	
	NUT	MS 51922-5	
K	BRACKET, tube clamp mounting	10931984	1
L	BAFFLE, bottom	7700424	1
	SCREW, cap, hex-hd, 1/4-28x5/8	96906-35292-5	4
	NUT, self-locking, 1/4-28	96906-51922-5	4
M	SHIELD	10931983	1
	SCREW, cap, hex-hd, 1/4-28x5/8	96906-35292-5	4
	NUT, self-locking 1/4-28	96906-51922-5	4
N	PLATE, heater mtg	10896366	1
P	SADDLE, heater mtg	10896477	2
	SCREW, cap, hex-hd, 3/8-24x5/8	96906-35292-57	4
	WASHER, int - ext tooth, 3/8 in.	96906-35335-21	4

Figure 693. Component parts—winterization kit, power plant heater (1 of 4) (Legend).

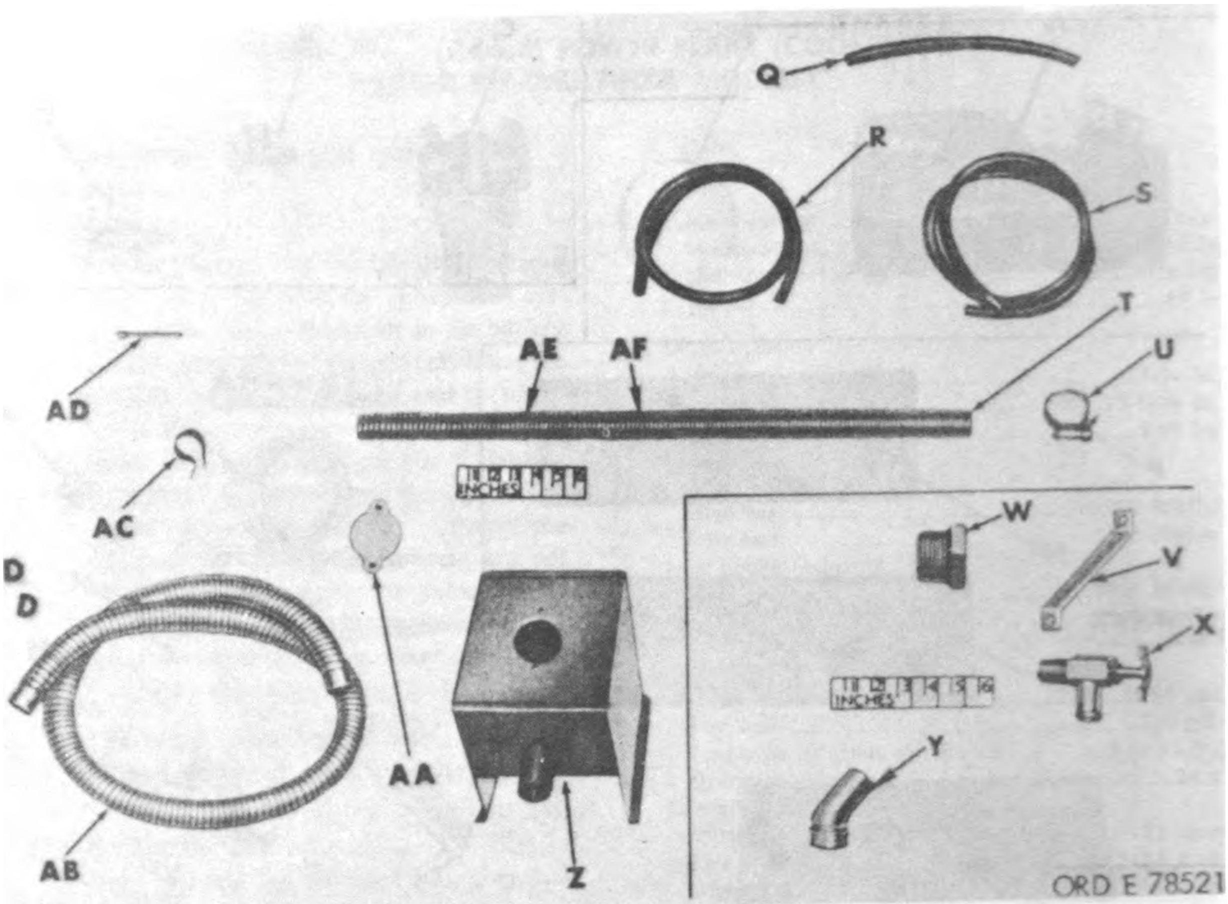


Figure 694. Component parts—winterization kit, power plant heater (2 of 4)

Key	Item	Part Number	Quantity
Q	HOSE, 24 in. lg. coolant return	8376141	1
R	HOSE, 54 in. lg. coolant outlet	8376141	1
S	HOSE, 78 in. lg. coolant inlet	8376141	1
T	TUBE, hose, shield 52 in. lg.	7986268	1
U	CLAMP, hose ⅞ - 1-⅝	96906-35842-2	6
V	BRACKET, heater exhaust	10931985	1
	CLAMP (See AE)		
	SCREW	MS 35291-60	1
	NUT	MS 51922-17	1
W	BUSHING, coolant outlet	120322	3
X	COCK, shutoff, ⅜ pipe, ⅝ hose	596800	2
Y	ELBOW, 45°, coolant outlet	MS 24518-7	1
Z	SHROUD, oil pan	10896359	1
	SCREW, cap, hex-hd, ⅜-16x1¾	96906-35291-65	4
	WASHER, lock, split, ⅜ in.	96906-35335-21	4
AA	PLATE, shroud access	10896364	1
	SCREW, cap, hex-hd, ¼-28x7/16	96906-35292-2	2
	WASHER, lock, split, ¼ in.	96906-35335-19	2
AB	TUBE ASSY, exhaust, 56 in. lg.	7986268	1
AC	CLAMP, 2-⅜ in. (exhaust tube)	8707524	5
	SCREW, cap, hex-hd, ¼x28x⅞	96906-35292-8	5
	NUT, self-locking, hex, ¼-28	96906-51922-5	5
	WASHER	96906-27183-10	5
AD	PIN, cotter, 5/32x2-¾	MS 24665-363	2
AE	TUBE, hose shield, 76 in. lg	7986268	1
AF	TUBE, hose shield, 22 in. lg	7986268	1

Figure 694. Component parts—winterization kit, power plant heater (2 of 4) (Legend)

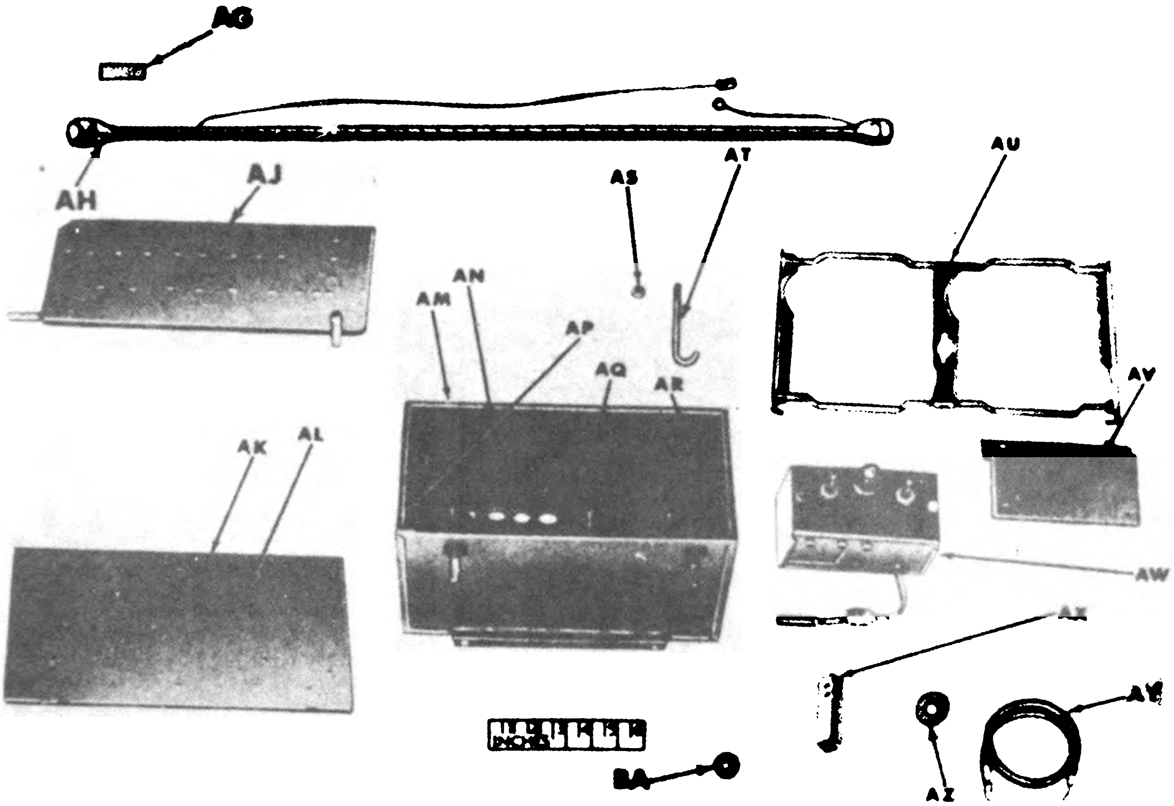


Figure 695. Component parts, winterization kit, power plant heater (3 of 4)

Key	Item	Part Number	Quantity
AG	DECAL	10896514	1
AH	HARNESS (box to heater)	10923528	1
AJ	HEAT PAD ASSY, battery box	7700422	1
AK	COVER, battery box	7700387	1
AL	INSULATION, cover	7700413	1
AM	BOX, battery-assy	7700422	1
AN	INSULATION, front and rear	7700412	2
AP	INSULATION, left end	7700448	1
AQ	INSULATION, bottom	7700410	1
AR	INSULATION, right end	7700411	1
	CLIP, insulation	7954865	8
	RETAINER, clip	8366948	8
AS	SPACER, battery box	7700455	2
	SCREW, cap, hex-hd, ⅜-24x1	96906-35292-60	4
	WASHER, lock, split, ⅜ in.	96906-35337-27	4
AT	J BOLT, battery, ⅜-16x10-¼	7700409	4
AU	FRAME, battery	7700398	1
	WASHER, flat, round, ⅜ in.	96906-27183-15	4
	WASHER, lock, split, ⅜ in.	96906-35337-027	4
	NUT, plain, hex, ⅜-16	96906-35690-605	4
AV	PLATE, control box mtg	10931992	1
	SCREW, cap, hex-hd, ¼-28x½	96906-35292-3	2
	NUT, self-locking, hex, ¼-28	96906-51922-5	2
AW	BOX ASSY, control	10885798	1
AX	EXTENSION, companion seat	7700444	2
	SCREW, cap, hex-hd, ¼-20x¾	96906-35291-6	4
	WASHER, lock, split, ¼ in.	96906-35337-25	4
	NUT, plain, hex, ¼-20	96906-35690-405	4
AY	CABLE ASSY, battery jumper	10938140-1	1
AZ	GROMMET (thru firewall)	795-1712	1
BA	GROMMET (battery box) (3) (tunnel) (1) (tool compt) (1)	96906-35489-23	5

Figure 695. Component parts, winterization kit, power plant heater (3 of 4) (Legend)

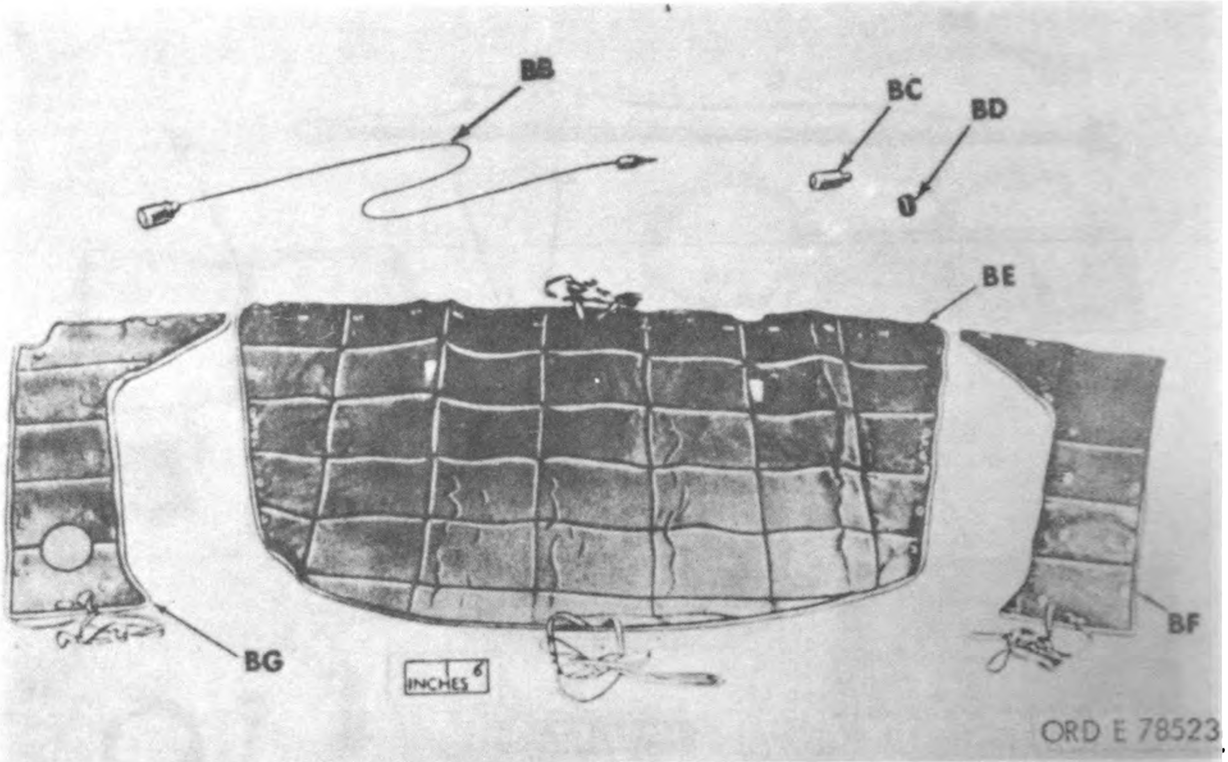


Figure 696. Component parts, winterization kit, power plant heater (4 of 4)

Key	Item	Part Number	Quantity
BB	LEAD	10932060-3	1
BC	PLUG	7982907	1
BD	SHELL	8338566	1
BE	COVER, hood	7978825	1
BF	COVER, left side	10938119	1
BG	COVER, right side	10938122	1
	LOOP, cover	7716428	55
	SCREW, no. 8-32x½	145327	110

Figure 696. Component parts, winterization kit, power plant heater (4 of 4) (Legend)

529. Power Plant Heater Installation Instructions.

Note. Power plant heater uses fuel pump used for the personnel heater. See personnel heater installation instructions for pump installation details.

a. Prepare Vehicle.

(1) Disconnect batteries (TM 9-2320-211-20).

(2) Loosen thumb screws on battery box, turn thumb screw retainers down and slide out entire battery box with batteries. Remove battery jumper cable and discard. Tighten retainers in the lowered position.

(3) Remove batteries from box, discard box.

(4) Remove 8 capscrews, lockwashers and nuts securing driver and companion seat to cab floor and remove both seats as one unit (paragraph 132).

(5) Knock out three oblong holes in vehicle floor (Fig. 708) and one 1-½ dia. circular knockout in rear transmission tunnel.

(6) Remove tape covering welded nut holes (Fig. 708) for attaching battery box.

b. Prepare Battery Compartment.

(1) Place baffle 7700424 on battery box support as indicated in figure 697.

(2) Using baffle as a template, locate four baffle mounting holes.

Note. Aline outer baffle edge w/inner edge of outer channel bar which supports slide bar.

(3) Center punch and drill four 9/32 dia. holes located in (2) above. Prime and paint bare metal.

(4) Fasten baffle to slide bar using four ¼-28x⅝ screws, MS 96906-35292-5 and four self-locking nuts, MS 96906-51922-5.

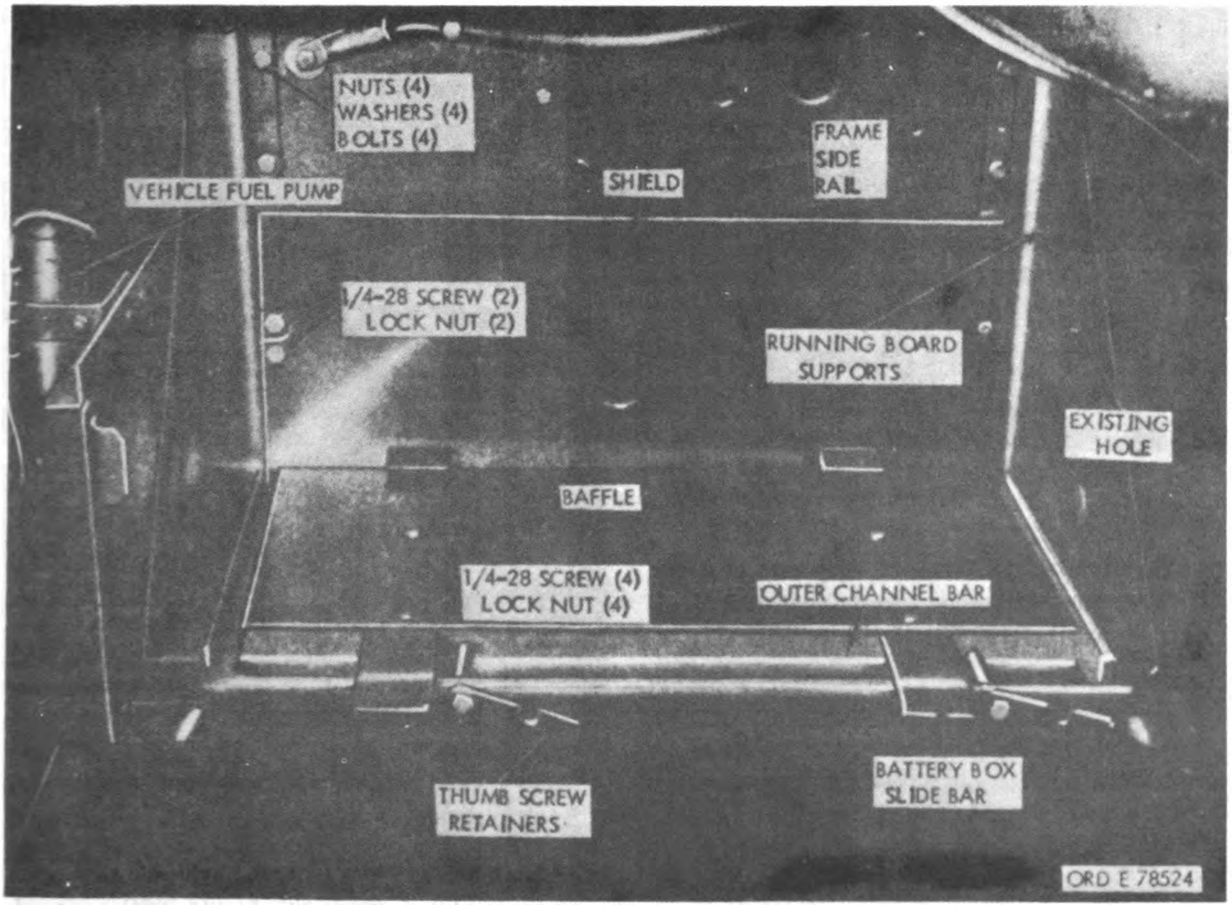


Figure 697. Installation of baffle and shield.

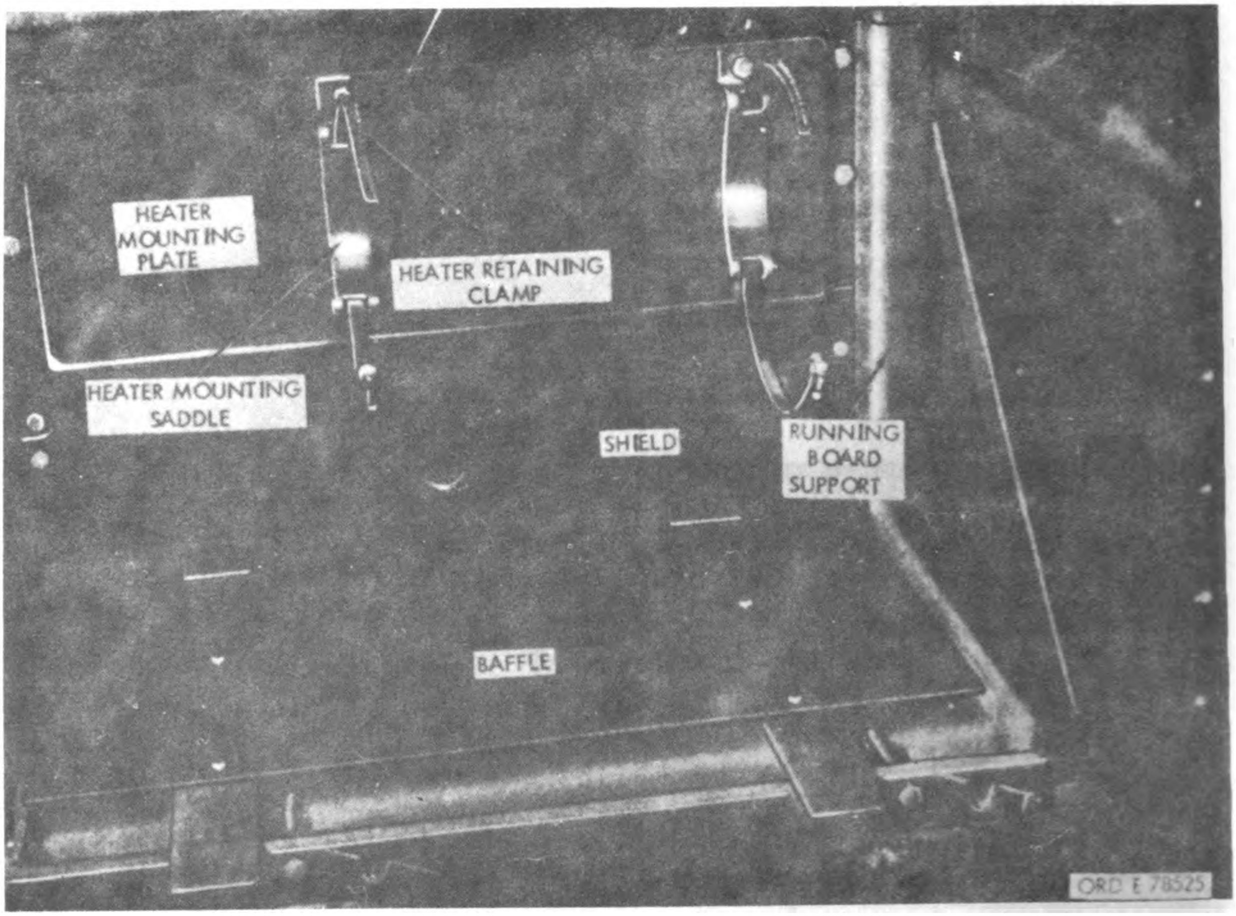


Figure 698. Installation of heater mounting plate and clamps.

(5) Place shield 10931883 against and between the running board supports as indicated in figure 697.

Note. Semi-circular cut-out is positioned around existing bolt and nut which secures vehicle exhaust pipe bracket (fig. 697).

(6) Using shield placed above as a template, locate two shield mounting holes on running board supports. Remove shield.

(7) Center punch and drill two 9/32 dia. holes located in (6) above. Prime and paint bare metal.

(8) Fasten shield to supports using two ¼-28x⅝ screws, MS 96906-35292-5 and two locking nuts, MS 96906-51922-5.

(9) Attach heater mounting saddles 10896477 to heater mounting plate, using ⅜-24x⅝ screws, MS 96906-35292-57 and internal-external tooth washers, MS 96906-35335-21 (fig. 698).

(10) Remove the four nuts, washers and bolts from the top inner sides of running board hangers (fig. 697).

(11) Secure heater mounting plate 10896366 to running board supports using nuts, washers, and bolts removed in (10) above.

c. Install Oil Pan Shroud (Figure 699).

(1) Temporarily place shroud against oil pan well to determine which oil pan bolts need removal.

Note. It may be necessary to drop the front winch prop shaft (see TM 9-2320-211-20) to get shroud on oil pan.

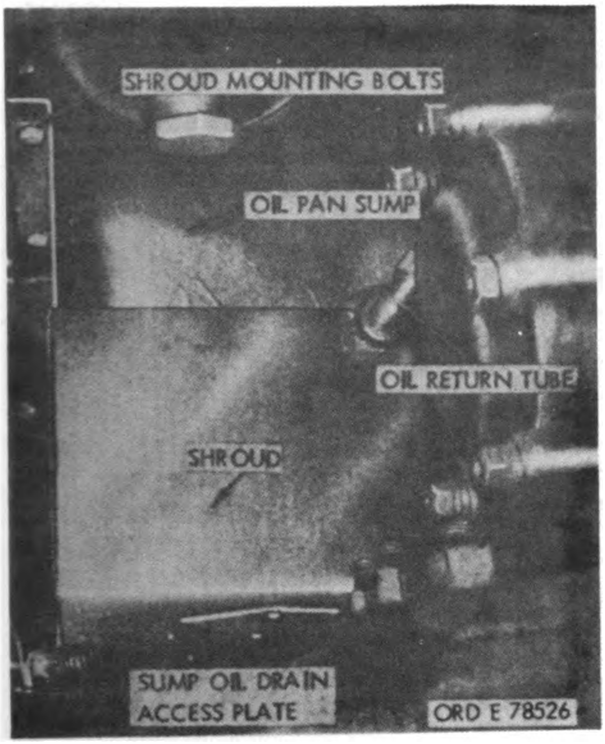


Figure 699. Shroud showing cut-out around oil return tube.

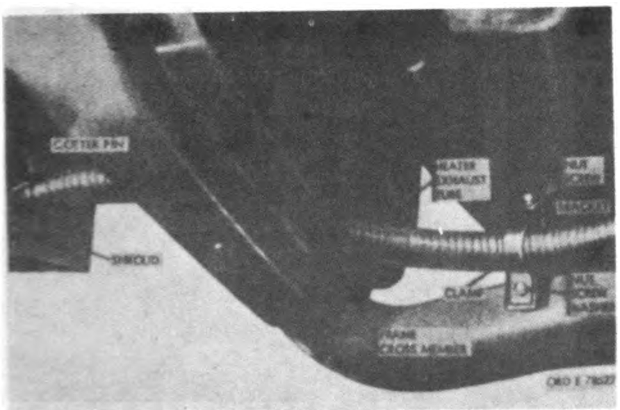


Figure 700. Exhaust tube to shroud installation.

(2) Place shroud 10938376 against oil pan sump, aligning holes in shroud with pan holes and attach shroud to block using four screws MS 96906-35291-65 and washers MS 96906-35335-21.

(3) Attach oil drain access plate 10896364 to bottom of shroud with two screws MS 96906-35292-65 and washers MS 96906-35291-65.

d. Install Power Plant Heater and Exhaust Tube.

(1) Before attaching heater to mounting plate, slide one end of (56 in. long) heater-to-shroud exhaust tube (7986268) onto exhaust pipe of heater. Drill a 5/32 dia. hole, 3/8 in. from end, through tube and heater pipe (fig. 701) and insert cotter pin MS 96906-24665-363.

(2) Run exhaust tube through hole in curved shield until heater abuts on plate. Attach heater to plate with round clamps through saddles (fig. 701).

(3) Attach exhaust tube 7986268 to shroud tube attachment and drill through tube and shroud tube with 5/32 dia. drill, 3/8 in. from end. Fasten with cotter pin, MS 96906-24665-363.

(4) Fasten bracket 10931985 to existing forward bottom screw hole in forward right running board support (fig. 697), using screw MS 96906-35291-60 and nut MS 96906-51922-17 (figs. 699 and 700). Secure tubing to bracket with clamp 8707524 1/4-28x7/8, screw MS 96906-35292-8, nut MS 96906-51922-5 and washer MS 96906-27183-10.

Note. At lowest point of exhaust tubing, drill 1/8 in. dia. hole to drain water condensation.

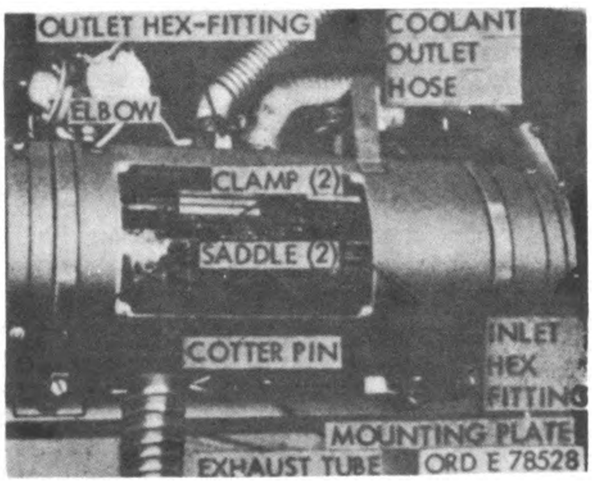


Figure 701. Mounting power plant heater.

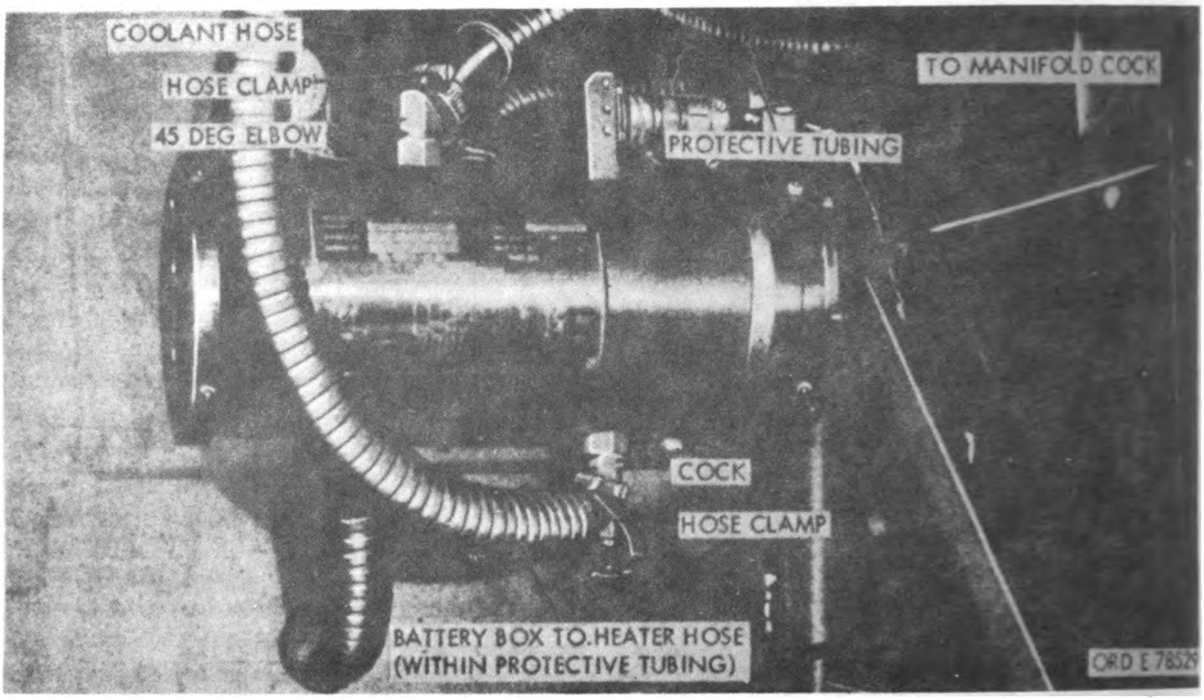


Figure 702. Completing installation in battery compartment.

e. Install Coolant Hoses.

(1) Drain radiator coolant (TM 9-2320-211-20).

(2) Remove sending unit and forward lower plug in water manifold. Install cock 543352 (fig. 703) and replace sending unit.

(3) Remove block plug at turbocharger (fig. 704) and install cock 543852.

(4) Screw 45 degree elbow MS 96906-24518-7 into outlet hex-fitting on top of heater (fig. 701).

Caution: **Hold hex-fitting with wrench to prevent breakage when installing elbow.**

(5) Screw cock 596800 and bushing 120322 into bottom of coolant heater (fig. 702).

Note. See Caution above.

(6) Place 76 in. long protective tubing 7986268 around 78 in. long hose 8376141 and thread hose and tube from battery compartment, along lower part of engine block and up to water manifold cock installed in (2) above (figs. 703, 704, 705, 706). Attach hose to 45° elbow atop heater and to cock installed in water manifold using clamp MS 96906-35842-2.

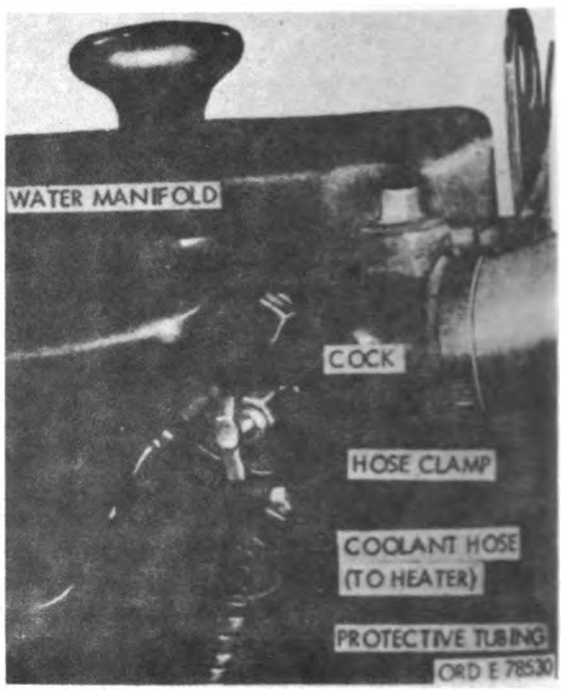


Figure 703. Inlet for heated coolant.

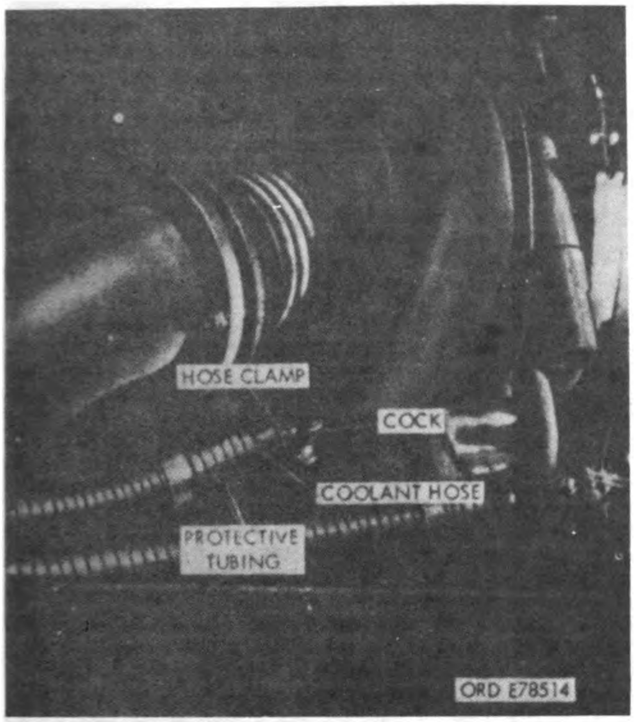


Figure 704. Outlet for heated coolant.

(7) Remove thirteen screws securing mid-portion of transmission tunnel (fig. 707).

(8) Place 52 in. long protective tubing 7986768 around 54 in. long hose 8376141 and thread hose and tube from cock under turbocharger (installed in (3) above) and up into transmission tunnel along right side of transfer lever. Run hose through knock-out.

Note If vehicle has power-take-off lever tubing will run between levers (fig. 707).

(9) Attach hose to cock at turbocharger using clamp MS 96906-35842-2.

(10) Attach hose to battery heating pad using the following procedure:

(*a*) Clean flooring on right side of cab.

(*a*) Reactivate "dry back" cement area of thermal barrier 8737708 by moistening surface with Methyl-ethyl-ketone.

Warning: **Perform this operation in a well ventilated area; observe no smoking regulations.**

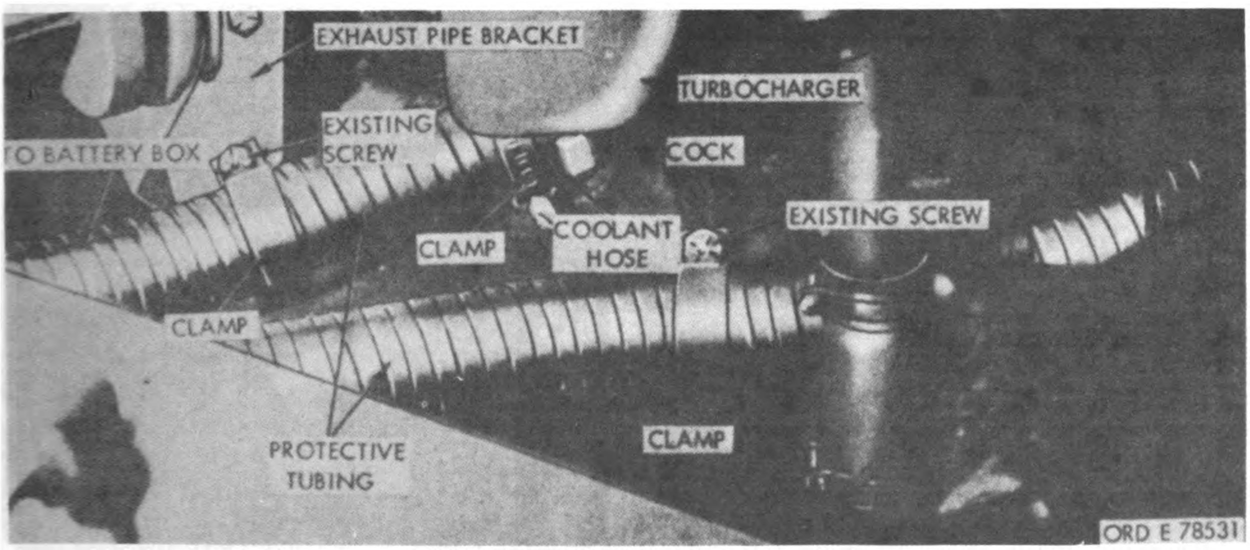


Figure 705. Coolant hoses installed.

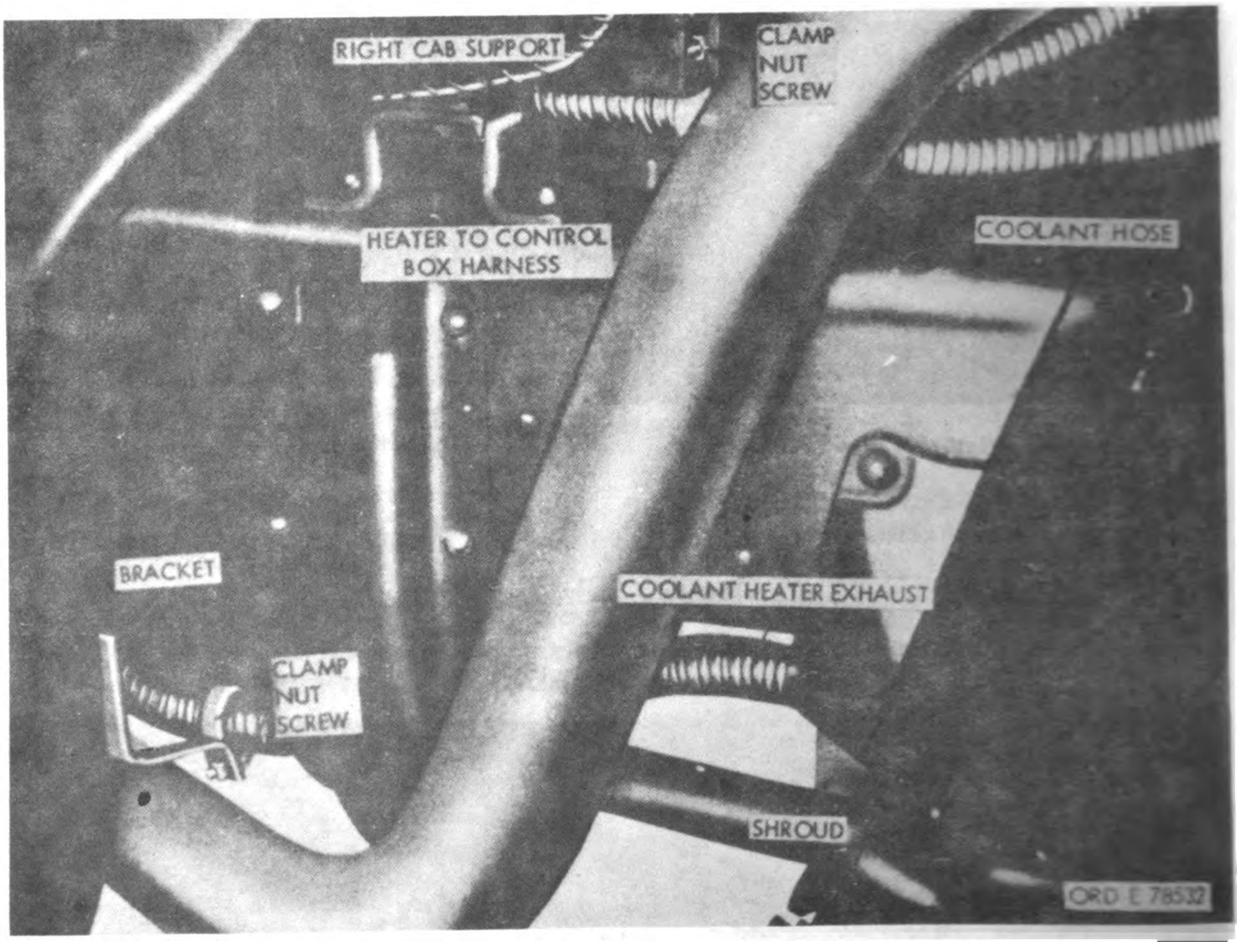


Figure 706. Clamping hose and tube.

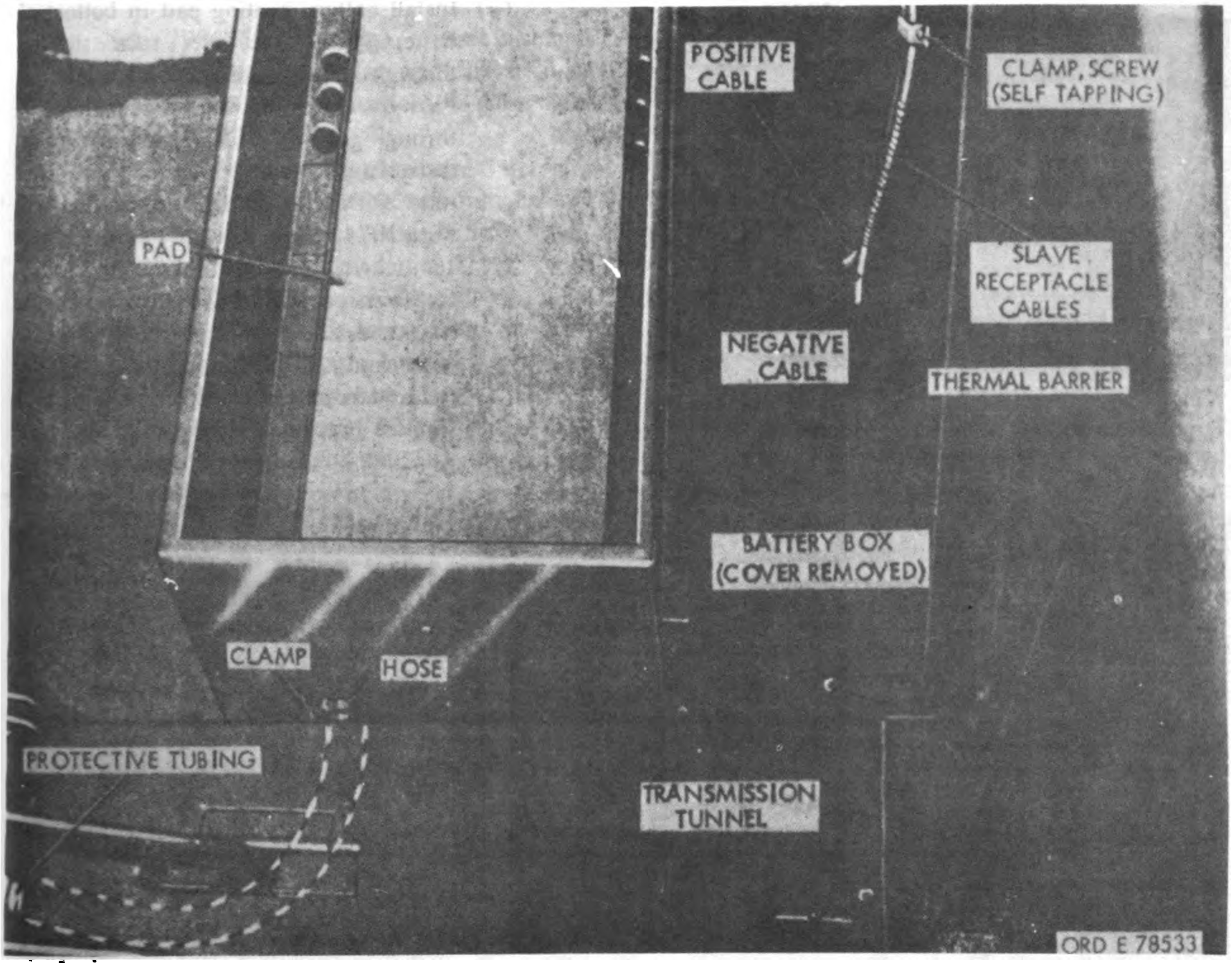


Figure 707. Location of hose and tubing in transmission tunnel.

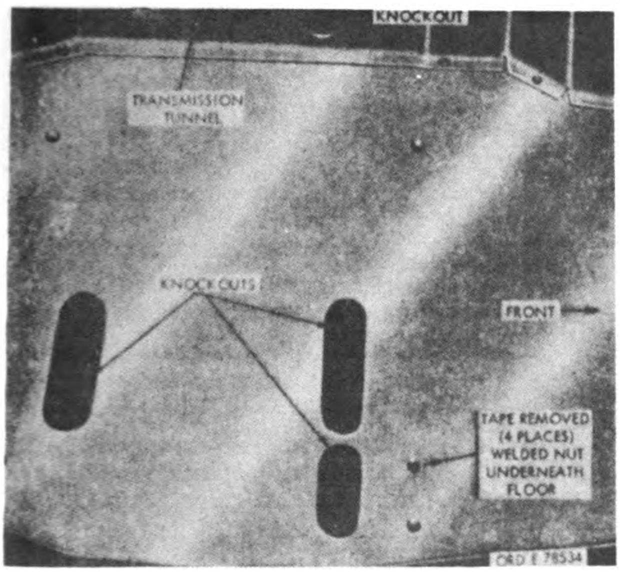


Figure 708. Diagram of cab interior knockouts and taped holes.

(*c*) Paint floor area to be covered also, and lay barrier in place on vehicle floor, alining holes in barrier with holes in floor (fig. 709).

Note. Leave access to floor pan bolts by careful alinement of barrier cut-outs.

(*d*) Install grommet MS 96906-35489-23, in hole in transmission tunnel.

(*e*) Clean transmission tunnel flooring and install barrier 8737707 as directed in (*b*) and (*c*) above.

(*f*) Place battery box assembly in place in cab and install three grommets in bottom of battery box (one in left rear hole, two in left and center front hole) (fig. 709) and place five pieces of insulation along bottom of box, trimming as necessary to provide free cable access to grommeted holes.

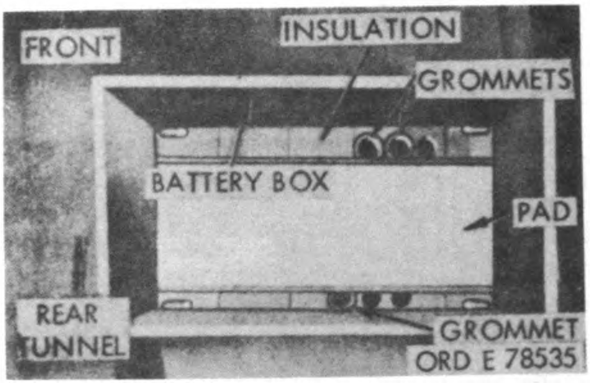


Figure 709. Battery box installation.

(*g*) Install battery heating pad in bottom of battery box with inlet tube sticking through box at transmission tunnel.

(*h*) Pass end of 54 in. long hose 8376141 through grommeted hole in transmission tunnel and attach to battery pad inlet tube with clamp MS 96906-35842-2 (fig. 707).

(*j*) Remove screw from right rear corner of transmission shift lever cover. Secure hose and tube assy to shift lever cover with clamp 8707524.

(*k*) Remove bottom screw from exhaust pipe support bracket. Secure hose and tube

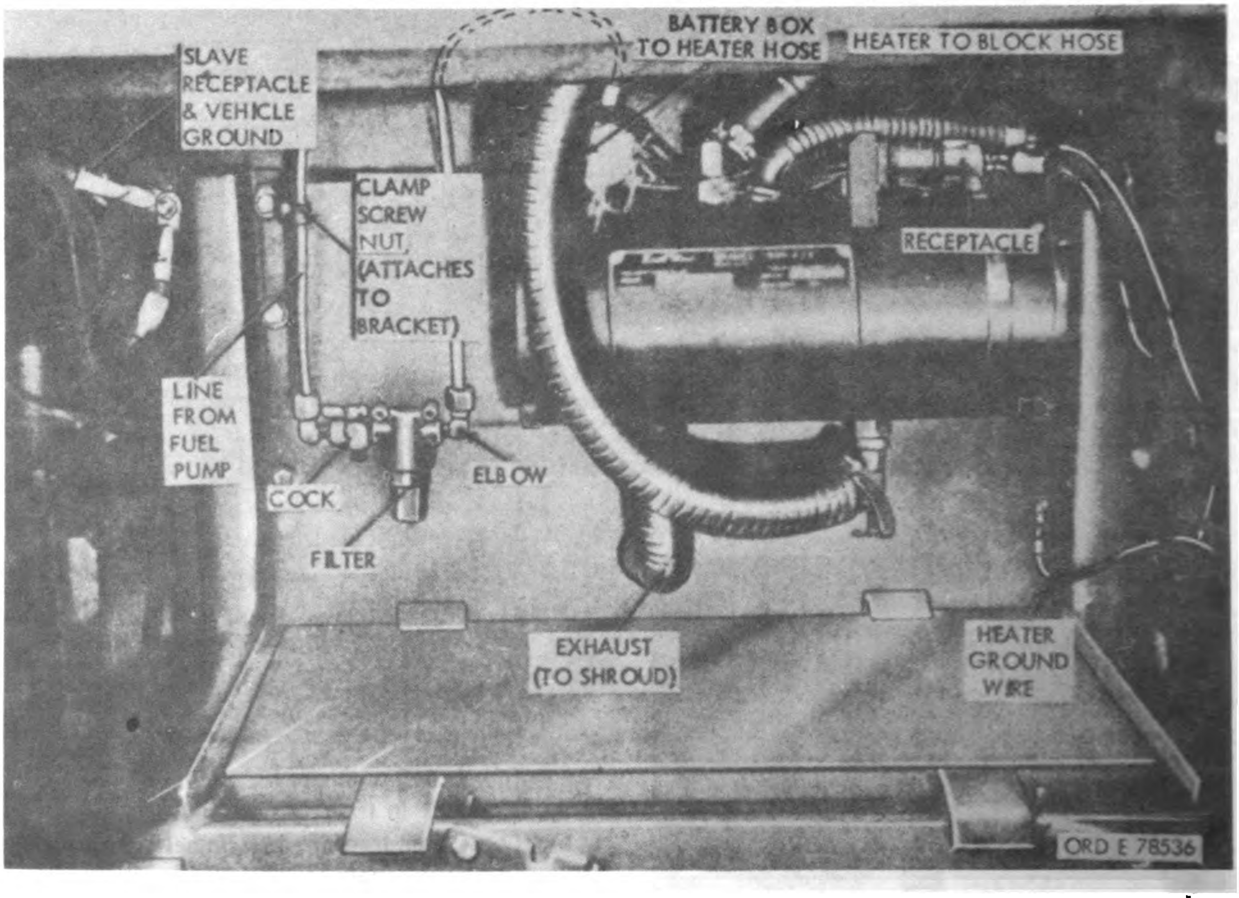


Figure 710. Power plant heater installed.

assy to exhaust pipe support bracket with clamp 8707524 (fig. 704).

(11) Place one end of 24 in. long coolant return tube over battery outlet tube beneath vehicle floor (through oblong hole) and secure with clamp MS 96906-35842-2.

(12) Place 22 in. long protective tube 7986268 over hose attached in (*j*) above, and attach other end of hose to cock 596800 in heater previously installed. Secure with clamp 96906-35842-2.

(13) Insert hose 8376141 (78 in. lg) inside of

tube 7986268 (76 in. lg). Install hose and tube assy by connecting one end of hose to cock on engine manifold. Secure with clamp MS 35842-2.

(14) Route assy under supercharger to right side of flywheel housing and into battery compartment. Connect end of hose to elbow on top of heater and secure with clamp MS 35842-2.

(15) Remove bottom left screw from oil pressure regulator. Secure hose and tube assy to oil regulator assy with clamp 8707524.

(16) Drill a 5/16 in. dia. hole through both sides of lower right cab support, ⅞ in. from bottom and ¾ in. from edge (fig. 705). Secure hose and tube assy to inside surface of cab support with clamp 8707524, screw MS 35292-8, washer, MS 27183-10 and nut MS 51922-5.

(17) Replace coolant in radiator.

f. Affix Battery Box.

(1) Remove tape on cab floor covering hole and welded nut (fig. 708). Place battery box flange over holes with welded nuts.

(2) Place spacers 7700455 under battery box toward outside of vehicle (to level box) and attach box to floor and welded nuts using four ⅜-24x1 screws MS 96906-35292-60 and washers MS 96906-35337-27.

g. Install Slave Receptacle.

Note. Slave receptacle is part of personnel kit, but must be installed after battery box.

(1) Remove four screws and nuts securing slave receptacle opening cover to the right rear corner post of cab.

(2) Insert cables of slave receptacle assembly through hole in cab floor adjacent to right hand door (fig. 707), and secure receptacle to cab, using four ¼-20x1 screws MS 96906-35291-8, washers 96906-35337-25 and nuts MS 96906-35690-405.

(3) Route positive (long) receptacle cable through hole in floor (fig. 707) nearest the door, under the cab floor and up through center hole in forward edge of battery box, making certain grommet MS 35489-23 is first installed.

(4) Route negative (short) receptacle cable through other hole in floor and attach to new ground post (fig. 710) located on running board bracket support.

h. Install Heater Control Box.

(1) Butt heater control box mounting plate 10931992 against instrument panel lip (fig. 711) on reinforcing bracket center plate on bracket.

(2) Using plate 10931992 as template, locate mounting holes.

(3) Center punch and drill two 5/16 dia. holes located in (2) above.

(4) Attach plate 10931992 to control box 10885798 using existing screws and nuts on control box.

(5) Attach plate and box assembly to bracket using two ¼-28x½ screws MS 96906-

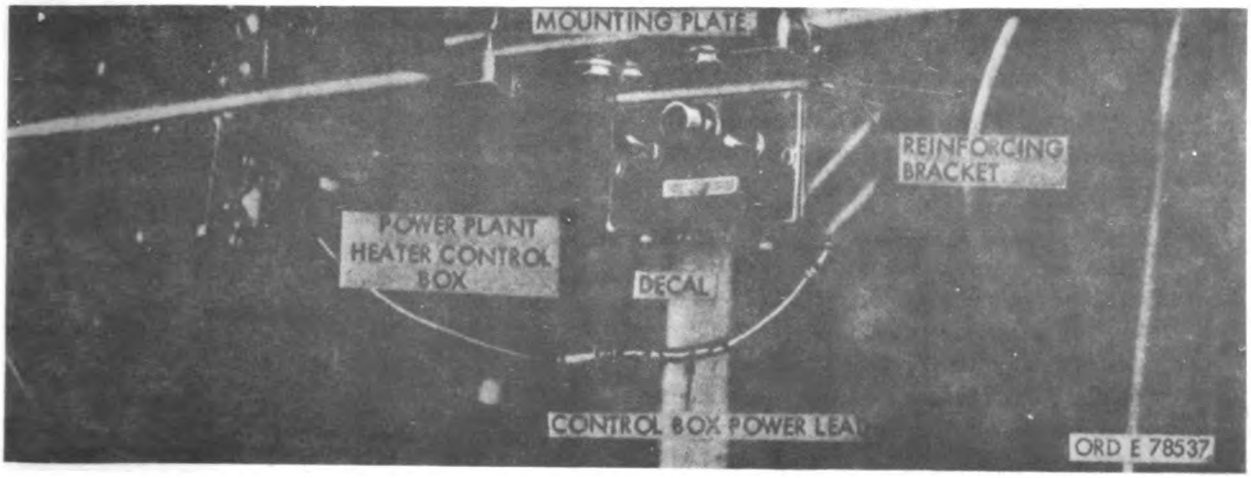


Figure 711. Installation of power plant heater control box.

35292-3 and self-locking nuts MS 96906-51922-5.

(6) Place decal 10896514 on front of heater control box panel, approximately as indicated in figure 711.

j. Install Fuel Filter and Fuel Lines.

(1) Install elbow MS 96906-39202-04 in outlet side of filter MS 96906-51085-1 with opening directed up.

(2) Install cock 543852 in inlet side of filter with control handle located on top.

(3) Install elbow MS 96906-39202-4 in cock (2) above, with outlet directed up.

(4) Install filter with attached cocks and elbows on lower left side of plate 10896366 (fig. 710) using two 10-32x1-½ screws MS 96906-35207-269, and washers MS 96906-35335-18.

(5) Install tube 8689207 (20 in. long) from filter outlet to heater control valve (fig. 710).

Caution: **Tubing ends must be smooth and free of any ridge or obstruction before being installed.**

(6) Install tube 8689207 (64 in. long) to fuel pump.

(7) Cover both ends of tubing to prevent entrance of foreign matter.

(8) Snake tube under cab from battery compartment through grommeted hole in tool box on left side of vehicle (where fuel pump is installed).

(9) Attach one end of tube to elbow MS 96906-39202-4 in battery compartment. Attach other end to adapter tee 44417 attached to fuel pump.

Caution: **Make sure all tubing is bottomed in fittings and tighten all connections securely to prevent leakage.**

(10) Fasten tubing to bracket 10931984 (fig. 710) with clamp MS 96906-213333-99, ¼-28x9/16 screw MS 96906-35292-4 and nut MS 96906-51922-5.

(11) Install shield 10932116 (part of personnel heater kit) over fuel pump and secure to tool box with four ¼-28x½ screws MS 96906-35-207-279 and locking nuts MS 96906-51922-5.

k. Install Electrical Connections.

(1) Cut a 1-⅜ in. dia. hole in bottom right corner of firewall 5 in. from cab sidewall and 3-½ inches above junction of floor panel and firewall.

(2) Install heater end of harness 10923528 in heater receptacle. Attach ground lead as indicated in figure 710.

Note. Harness is marked.

(3) Route control box end of harness to right rear side of battery compartment, over top of frame side rail into engine compartment and through hole made firewall (end of single very long lead is to remain in engine compartment).

(4) Install grommet 7951712 around harness and lead in firewall.

(5) Install shell 8338566 on very long lead from control box end of harness and attach to Y-connector (adapter) at personnel heater duct (See schematic, par. 527).

(6) Connect coolant heater control box lead (from box, not harness) to one arm of Y-connector (adapter) under steering column within cab (fig. 712).

(7) Secure loose wires to existing harnesses where possible using suitable tape (fig. 710).

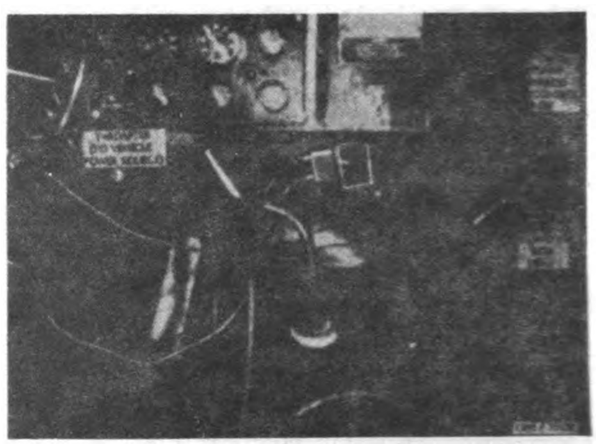


Figure 712. Connecting coolant heater control box.

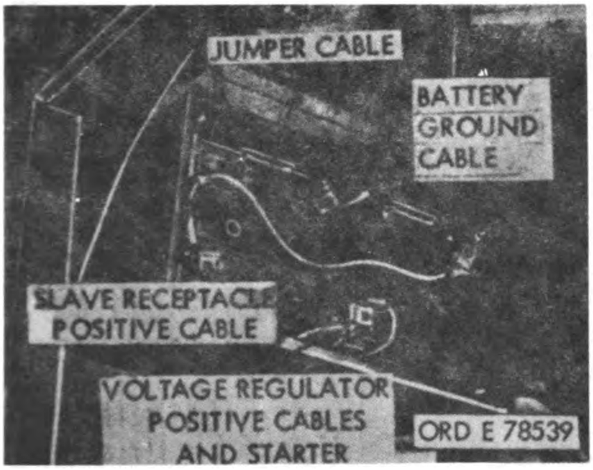


Figure 713. Battery box connections.

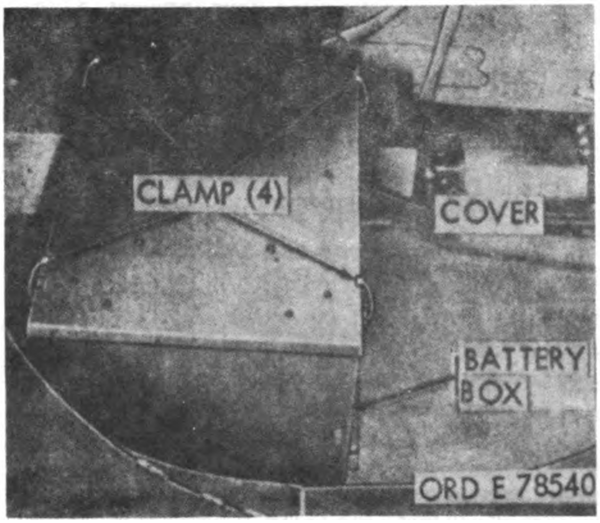


Figure 714. Installing battery box cover.

l. Install Batteries.

(1) Remove battery ground cable terminal clamp and pass cable up through rear left hole into battery box (fig. 709). Install terminal clamp.

(2) Remove battery positive cable terminal clamp and pass positive cable up through front right hole; voltage regulator cable through center hole; and slave receptacle positive cable through front left hole (fig. 709). Connect regulator and battery positive cables to one side of clamp and slave receptacle cable to other side (fig. 713).

(3) Hook four "J" bolts into the straps in bottom corners of battery box.

(4) Place the four cables out of the way and install the vehicle batteries with positive terminals toward the front.

(5) Position battery holddown frame over the batteries and "J" bolts and secure frame, using four flat washers MS 96906-27183-15, four split washers MS 96906-35337-027, and four nuts MS 96906-35690-605.

(6) Connect jumper cable between the two outer terminal clamps and connect positive cable terminal clamp to the positive terminal post of the battery (fig. 713).

Caution: **Battery ground cable should be left disconnected until the winterization kit is completely installed.**

(7) Install battery box cover on battery box by latching the four clamps (fig. 714).

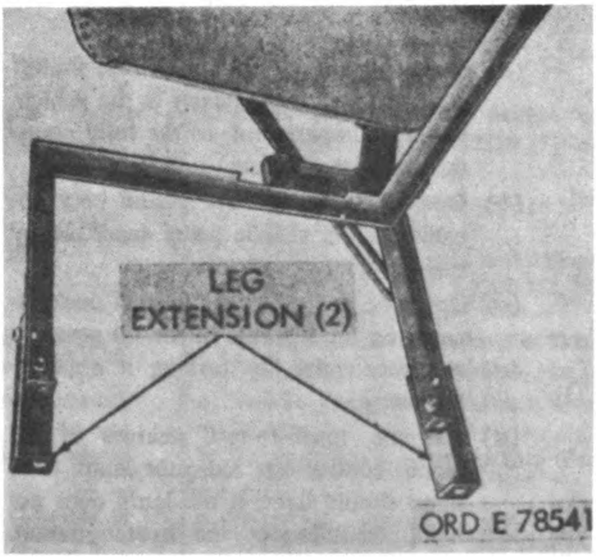


Figure 715. Installing companion seat leg extension.

m. Modification of Companion Seat.

(1) Secure a leg extension to both right hand legs of the companion seat, using two ¼-20x¾ screws MS 96906-35291-6, lockwashers MS 96906-35337-25, and nuts MS 96906-35690-405 (fig. 715).

(2) Place the seat frame in position and secure the leg extensions to the floor panel, using two original ⅜-16x1 screws and internal-tooth lockwashers.

(3) Secure companion seat support to driver seat support, using four original 5/16-18x¾ screws, washers, and locknuts through the lower four holes in the seat support (fig. 716).

(4) Remove slotted link (fig. 716).

Note. Install companion seat cushion; intermediate tunnel.

n. Installation of Hood and Side Covers. Install hood and side covers as indicated in paragraph 498, (one side) except that air intake duct (one side) must be freed to fit right side cover on. Duct is freed by loosening clamp.

p. Operating Test After Power Plant Heater Installation.

Note. Prior to performing the operating test for the winterization kit, lubricate and service the vehicle as outlined in LO 9 2320 211 12 and TM 9-2320-211-10 and changes hereto.

(1) *Preliminary checks before starting the heater.*

(*a*) Open the power plant heater fuel shutoff cock, located at the heater in the vehicle battery compartment, to the fully counterclockwise position.

(*b*) Open the coolant inlet shutoff cock located on the vehicle water manifold by turning it counterclockwise.

(*c*) Open the coolant outlet shutoff cock located on the left side of the oil pressure regulator valve by turning it counterclockwise.

(*d*) Use the "push-to-test" feature of the heater control box indicator lamp. The lamp should light; if the lamp does not light, troubleshoot the heater circuit.

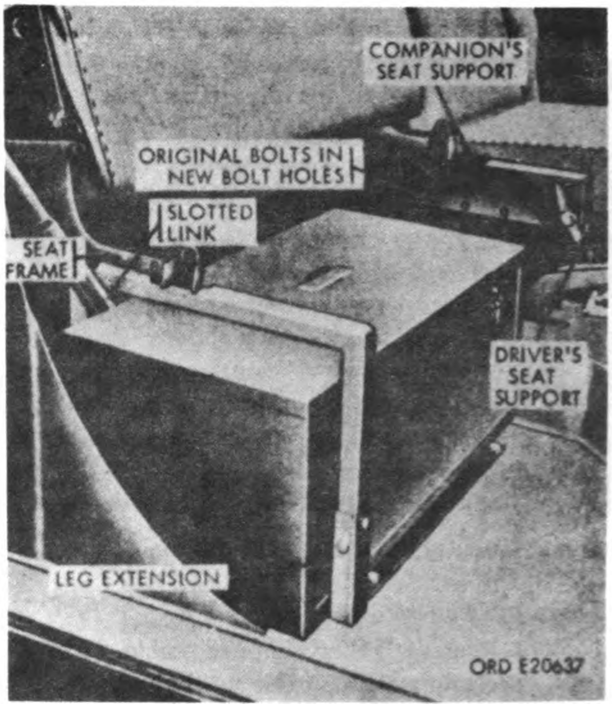


Figure 716. Companion seat installed.

Refer to Table XVIII for troubleshooting.

(2) *Checking power plant heater operation.*

(*a*) Start and operate the heater according to the procedures given in TM 9-2320-211-10.

(*b*) Operate all heater controls as directed in TM 9-2320-211-10. If the heater fails to operate properly, refer to Troubleshooting, Table XVIII, and Maintenance Section XVI of this manual to correct the defect.

Section XV. (ADDED) TROUBLESHOOTING THE WINTERIZATION KIT (MULTIFUEL MODEL VEHICLES)

530. General

This section contains troubleshooting procedures for the winterization kit installed in multifuel model vehicles only. The troubleshooting procedures given in Table XVIII are arranged to assist repair personnel in locating malfunctions and directing them to the proper procedure for corrective action.

531. Precautions to Prevent Fire or Explosion

Before operating the winterization heater, determine from the using organization or the vehicle equipment log the exact nature of the trouble. If the malfunction involves excess or leaking fuel, make a through visual inspection to make sure explosive vapors have not accumulated in or near the vehicle. Raise the hood and open the doors of the cab; ventilate the area thoroughly, with forced air (if available). Have a fire extinguisher of the type approved for volatile fuels at hand when troubleshooting fuel problems in heating units.

Table XVIII. (Added) Troubleshooting-Winterization Kit

Malfunction	Probable Causes	Corrective Action
	PERSONNEL HEATER	
1. Heater fails to start when control switch is turned on.	a. Emergency switch off.	a. Snap switch to ON position.
	b. No fuel pressure.	b. Open fuel shutoff cock.
	c. Defective electrical circuit.	c. Repair defective wiring harness.
	d. Defective heater component.	d. Repair or replace defective component or replace heater (Par 532).
2. No heat output, or low heat output.	a. No fuel pressure.	a. Open fuel shutoff cock.
	b. Ice in fuel system.	b. Remove ice from fuel line. Clean fuel filter element, and replace if damaged (TM 9-2320-211-20 and changes thereto).
	c. Defective component.	c. Repair or replace defective component or replace heater (Par 532)
	d. HI-LO switch in LO position.	d. Switch to H1 position.
3. Indicator light inoperative.	a. Defective lamp.	a. Use press-to-test feature. Replace lamp if defective (TM 9-2320-211-20, and changes thereto).
	b. Defective wiring or lamp holder.	b. Repair defective wiring harness or replace lamp (TM 9-2320-211-20, and changes thereto).
4. Indicator light always on.	Defective component.	Repair defective component or replace heater (Par 533).
5. Heater operates several minutes, then stops	a. Restriction in fuel line.	a. Clean fuel filter element, and replace if damaged (TM 9-2320-211-20, and changes thereto).
	b. Defective fuel control valve.	b. Replace fuel control valve (Par 533).
	c. Defective flame detector switch.	c. Replace flame detector switch.
6. Blower will not stop when heater is turned off.	a. Defective flame detector switch.	a. Replace flame detector switch (Par 533).
	b. Defective blower motor wiring.	b. Repair defective wiring harness (Par 533).
7. Heater smokes excessively or "bangs" upon starting.	a. Starting with HI-LO switch in HI position.	a. Refer to operating instructions (TM 9-2320-211-10, and changes thereto).
	b. Defective fuel control valve.	b. Replace fuel control valve (fig. 718).
8. Blower runs, but heater fails to ignite.	a. No or low fuel pressure.	a. Check fuel shutoff cock position.
	b. Restriction in fuel line.	b. Clean fuel filter element and replace if damaged (TM 9-2320-211-20, and changes thereto).
	c. Defective electrical wiring.	c. Repair defective wiring harness (Par 533).
	d. Defective preheat resistor.	d. Replace preheat resistor (Par 533).
	e. Defective ignitor.	e. Replace ignitor assembly (Par 533).
	f. Defective fuel.	f. Replace fuel control valve (Par 533).
9. Inadequate heat output.	a. Fuel pump filter element restricted.	a. Clean fuel pump filter element and replace if damaged (TM 9-2320-211-20, and changes thereto).

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Table XVIII. (Added) Troubleshooting-Winterization Kit — Continued

Malfunction	Probable Causes	Corrective Action
	PERSONNEL HEATER Continued	
	b. Ice crystals in fuel.	b. Remove ice from fuel system. Clean fuel filter element and replace if damaged (TM 9-2320-211-20, and changes thereto).
	c. Extreme cold weather.	c. Adjust radiator cover (TM 9-2320-211-10, and changes thereto).
	d. Defective component.	d. Repair defective component or replace heater (fig. 718).
10. Inadequate windshield defrosting.	a. Improperly adjusted heater control cable.	a. Adjust cable (Par 527)
	b. Improperly adjusted defroster control cable.	b. Adjust cable (Par 527).
	c. Defroster ducting loose or damaged.	c. Tighten clamps or repair ducting (TM 9-2320-211-20, and changes thereto).
11. Heater overheats, but continues to run.	a. Defective overheat switch.	a. Replace overheat switch (Par 533).
	b. Defective fuel control valve.	b. Replace fuel control valve (Par 533).
12. Fuel odor.	a. Fuel leak.	a. Tighten fuel lines or replace defective component.
	b. Defective component.	b. Replace defective component.
13. Burned fuel odor.	a. Restriction in exhaust.	a. Remove restriction. Replace exhaust tube if damaged (Par 527).
	b. Too heavy grade of fuel.	b. Change to suitable grade of fuel (TM 9-2320-211-10, and changes thereto).
	c. Defective heat exchanger.	c. Replace heat exchanger (Par 533).
	POWER PLANT HEATER	
14. Heater fails to start when control switch is turned on.	a. No fuel pressure.	a. Open fuel shutoff cock (Par 537).
	b. Defective electrical circuit.	b. Repair defective electrical harness.
	c. Defective heater component.	c. Repair or replace defective component or replace heater (Par 538).
15. No heat output, or low heat output.	a. No fuel pressure.	a. Open fuel shutoff cock (Par 537).
	b. Ice in fuel system.	b. Remove ice from fuel line. Clean fuel filter element and replace if damaged (TM 9-2320-211-20, and changes thereto).
	c. HI-LO switch in LO position.	c. Switch to HI position. (Par 537).
	d. Defective heater component.	d. Repair or replace defective component or replace heater (Par 538).
16. Indicator light inoperative.	a. Defective lamp.	a. Use press-to-test feature. Replace lamp if defective (TM 9-2320-211-20, and changes thereto).
17. Heater operates several minutes, then stops.	a. Restriction in fuel line.	a. Clean fuel filter element and replace if damaged (TM 9-2320-211-20, and changes thereto).
	b. Defective fuel control valve.	b. Replace fuel control valve (Par 538).

Table XVIII. (Added) Troubleshooting-Winterization Kit — Continued

Malfunction	Probable Causes	Corrective Action
	POWER PLANT HEATER Continued	
	c. Defective flame detector switch.	c. Replace flame detector switch (Par 538).
18. Blower will not stop when heater is turned off.	a. Defective flame detector switch.	a. Replace flame detector switch (Par 538).
	b. Defective wiring.	b. Repair defective wiring harness.
19. Heater smokes excessively or "bangs" upon starting.	a. Defective flame detector switch.	a. Replace flame detector switch (Par 538).
	b. Defective fuel control valve.	b. Replace fuel control valve (Par 538).
20. Blower runs, but heater fails to ignite.	a. No fuel pressure or low fuel pressure.	a. Check fuel shutoff cock position (Par 529).
	b. Restriction in fuel line.	b. Clean fuel filter element and replace if damaged (TM 9-2320-211-20, and changes thereto).
	c. Defective electrical wiring.	c. Repair defective wiring harness.
	d. Defective preheat resistor.	d. Replace preheat resistor (Par 538).
	e. Defective ignitor.	e. Replace ignitor assembly (Par 538).
	f. Defective fuel control valve.	f. Replace fuel control valve (Par 538).
21. Inadequate heat output.	a. Coolant shutoff cocks partially or fully closed.	a. Open shutoff cocks fully (Par 527).
	b. Ice crystals in fuel.	b. Remove ice from fuel system. Clean fuel filter element and replace if damaged (TM 9-2320-211-20, and changes thereto)
	c. Extreme cold weather.	c. Adjust radiator cover.
	d. Defective heater component.	d. Repair defective component or replace heater (Par 538).
22. Heater overheats but continues to run.	a. Defective overheat switch.	a. Replace heater assembly (Par 538).
	b. Defective fuel control valve.	b. Replace fuel control valve (Par 538).
23. Fuel odor.	a. Fuel leak.	a. Tighten fuel lines or replace defective component.
	b. Defective component.	b. Replace defective component.
	HARDTOP CLOSURE	
24. Excessive rattles.	a. Loose parts or joints.	a. Tighten all nuts and screws (Par 492).
	b. Worn or damaged glass channel.	b. Repair or replace glass channel.
25. Excessive air leaks	a. Loose parts or joints.	a. Tighten all nuts and screws (Par 492).
	b. Worn or damaged weatherseals.	b. Reseal weatherseals.
	c. Broken glass or damaged glass channel.	c. Replace glass or channel.
26 Water leaks.	a. Loose parts or joints.	a. Tighten all nuts and screws (Par 492).
	b. Worn or damaged glass channels.	b. Repair or replace glass channel.
27. Cracked glass.	Worn or damaged glass channels.	Repair or replace glass channel.

Section XVI. (ADDED) MAINTENANCE INSTRUCTIONS FOR PERSONNEL HEATER KIT COMPONENTS (MULTIFUEL MODEL VEHICLES

532. Disassembly of Personnel Heater Kit Into Subassemblies

a. Removal of Personnel Heater Assembly.

(1) Turn off the personnel heater fuel shutoff cock by turning it clockwise.

(2) Disconnect the electrical harness connector from the personnel heater by turning it counterclockwise.

(3) Disconnect the fuel line from the elbow extending from the heater assembly. Remove the elbow and the nipple from the heater assembly.

(4) Loosen the clamp securing the air duct to the heater adapter and slide duct from the adapter flange.

(5) Disconnect the mounting clamps securing the heater assembly to the mounting saddles and remove heater.

(6) Remove the "O" ring packing and flat steel washer from the heater exhaust flange, figure 717.

b. Removal of Personnel Heater Blower Assembly.

Note. The key letters noted in parentheses refer to figure 718, except where otherwise indicated.

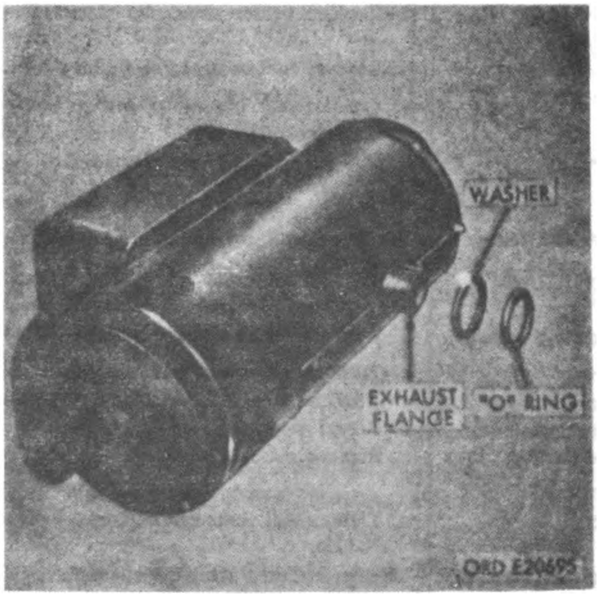

Figure 717. Removal of "O" ring packing and flat washer.

(1) Remove the guard assembly (DD) by loosening the two Dzus fasteners and lifting it off the personnel heater.

(2) Disconnect the blower electrical lead from the terminal labeled "COMM" of the flame detector switch.

(3) Remove the four screws (NN) from the heater housing at the end of the blower (LL), then carefully pull the blower straight off the heater.

(4) Remove the screw (A) from the bracket of the combustion air tube (C). The tube (C), elbow (D) and sealing washer (E) can then be lifted from the heater.

Caution: **Do not bend or twist the air tube or blower from side to side, since this may damage the ventilating air blower wheel on the end of the motor shaft.**

(5) To further disassemble and repair blower motor assembly, refer to *j* below.

c. Removal of Personnel Heater Preheat Resistor and Fuel Control Valve (Fig. 718)

Warning: **Do not permit smoking, sparks or open flame within 50 feet of the work area during any operation involving fuel line removal.**

(1) Disconnect valve wires from terminal 30 of the overheat switch, from the screw terminal at the connector assembly and the ground stud on the heater housing.

(2) Remove the short fuel tube (S) by loosening the two compression fittings.

(3) Disconnect leads of the preheat resistor (M) from the flame detector switch and overheat switch. Also free the strap from the ignitor terminal. Slide the preheat resistor off the fuel tube (N).

(4) Remove three mounting screws (P) from the fuel control valve mounting bracket and lift the valve (Q) with the fuel tube (N) in the outlet. Remove the tube from the valve.

Caution: **Hold the valve by the body casting when removing the tube. Do not apply pressure to solenoid caps, since this may break the seal and cause fuel leakage.**

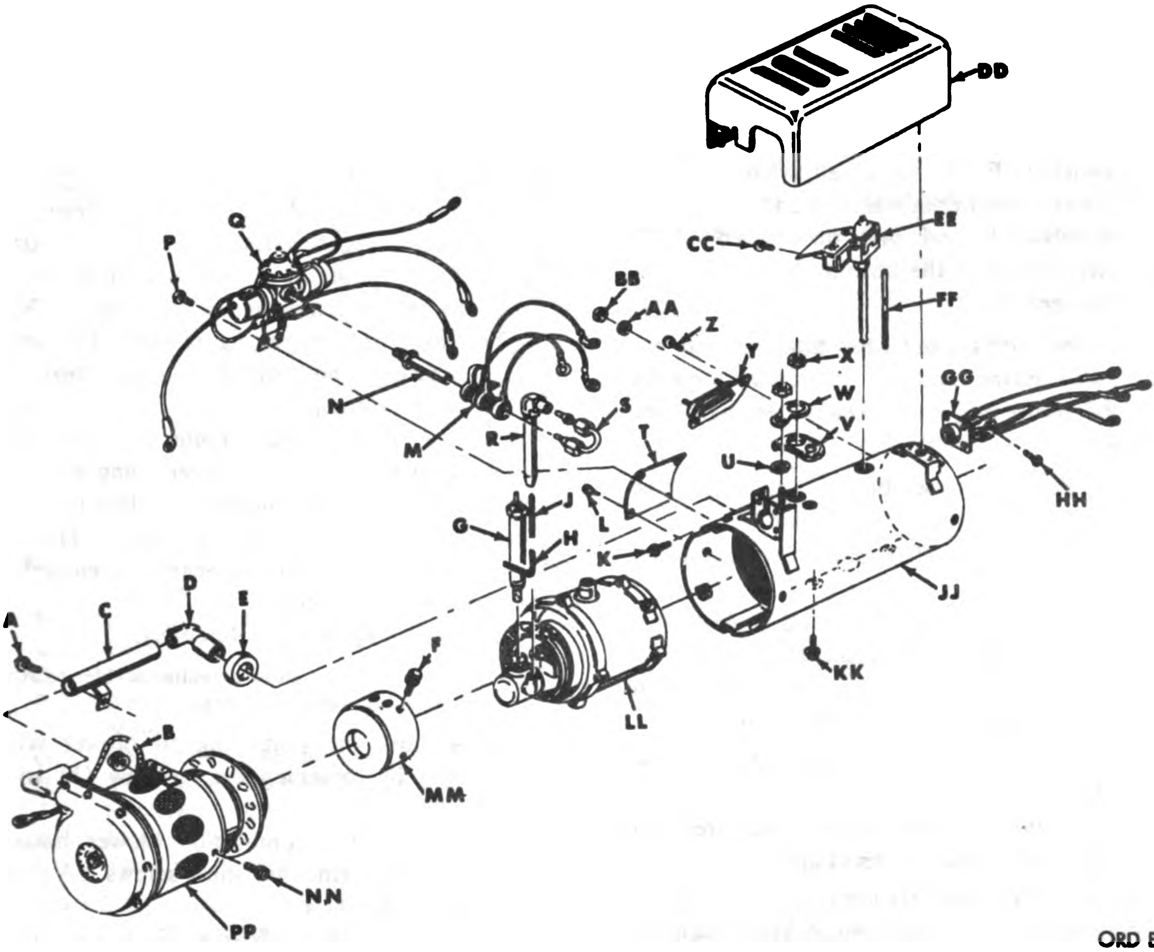

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Figure 718. Disassembly of personnel heater—exploded view

Key	Item	Key	Item
A	Screw	V	Hatch cover
B	Grommet	W	Ground strap
C	Combustion air tube	X	Nut (2 req'd)
D	Elbow	Y	Overheat switch
E	Sealing washer	Z	Screw (2 req'd)
F	Screw (3 req'd)	AA	Lockwasher (2 req'd)
G	Ignitor	BB	Nut (2 req'd)
H	Wick	CC	Screw (5 req'd)
J	Wick	DD	Guard assy
K	Screw (4 req'd)	EE	Flame detector switch
L	Rivet (4 req'd)	FF	Quartz rod
M	Preheat resistor	GG	Receptacle assy
N	Fuel tube	HH	Screw
P	Screw (3 req'd)	JJ	Housing
Q	Fuel control valve	KK	Screw (3 req'd)
R	Standpipe	LL	Heat exchanger assy
S	Fuel tube	MM	Combustion air housing
T	Nameplate	NN	Screw (4 req'd)
U	Lockwasher	PP	Blower assy

Figure 718. Disassembly of personnel heater—exploded view (Legend)

(5) To further disassemble and repair fuel control valve, refer to *k* (below).

d. Removal of Personnel Heater Flame Detector Switch (Fig. 718).

(1) Disconnect wires from the flame detector switch (EE), if not already removed.

(2) Loosen the hexagonal nut underneath the microswitch and pull the switch (EE) straight out of the bushing of the heat exchanger.

Caution: **Do not bend tube of flame detector during removal. It contains a quartz rod which may be broken by flexing of the tube.**

(3) To further disassemble and repair, refer to paragraph 386*c* of this chapter.

e. Removal of Personnel Heater Overheat Switch (Fig. 718).

(1) Remove the nuts (BB) and lockwashers (AA) from the terminals of the overheat switch (Y). Disconnect any wires which may be connected to the terminals.

(2) Remove the two mounting screws (Z) and lift off the switch (Y).

(3) To further disassemble and repair, refer to paragraph 386*d* of this chapter.

f. Removal of Personnel Heater Ignitor (Fig. 718).

(1) Using a 13/16-inch deep socket, loosen the ignitor (G) until it turns easily by hand, then work it through the hatch cover (V).

Note. Replace the ignitor at each overhaul.

(2) When reinstalling the ignitor, start threads by hand, then tighten securely.

g. Removal of Personnel Heater Standpipe (Fig. 718).

(1) Using a wrench on the flats at the top of the standpipe (R), free the threads from the heat exchanger and pull it through the hatch cover (V) which will also be freed. Remove the wick (J). Another wick (H) is shown above the heat exchanger. This wick extends into the heat exchanger as an extension of the standpipe wick and can be removed after the heat exchanger is removed from the housing.

(2) When replacing the standpipe, place the hatch cover (V) in position first, then start threads by hand. Tighten with a wrench, turning the inlet at a right angle to the housing, facing away from the fuel control valve.

Note. This is a fuel seal; tighten carefully.

h. Removal of Personnel Heater Receptacle and Nameplate (Fig. 718).

(1) It is not necessary to remove the receptacle assembly (GG) for overhaul unless damage is apparent. If damaged, it can be removed by removing the four screws (K).

(2) Never remove the nameplate (T), unless it becomes necessary to change information by steel stamping.

i. Removal of Personnel Heater Housing (Fig. 718). Remove housing (JJ) by removing the three screws (KK) from the seam and spreading the metal just enough to permit the heat exchanger (LL) to slide out. Do not spread the seam far enough to cause permanent distortion.

j. Disassembly of Blower Assembly.

Note. The key letters noted in parentheses refer to figure 719, except where otherwise indicated.

(1) Remove the ventilating air blower wheel (H) by loosening the setscrew (J) in its hub.

(2) Remove the combustion blower housing (B) by removing nine screws (A) and speed nut (L).

(3) Remove the combustion air blower wheel (C) by loosening the setscrew (J) in its hub. This will uncover the motor mounting nuts (D).

(4) Remove the two nuts (D) to free the motor (F) and slide out the motor with the housing (G) attached, then remove housing by removing four screws (K). Ordinarily there will be no need to remove the screen from the blower housing (E) unless damage is evident.

k. Disassembly of Fuel Control Valve.

Note. Normally, the fuel control valve should be tested in a fully assembled condition during overhaul and should be reinstalled without repair, except as noted under Cleaning, Inspection, and Repair (par. 533b). Disassembly should be attempted only after the valve is proved defective, and should progress only to the extent necessary to effect repairs. The key letters noted in parentheses refer to figure 720, unless otherwise indicated.

(1) Disassemble pressure regulator side of the fuel control valve in order of item letters

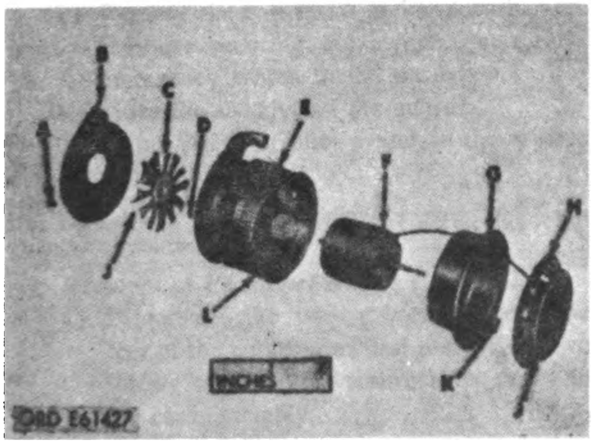

Figure 719. Disassembly of blower assembly—exploded view.

Key	Item
A	Screw (9 req'd)
B	Combustion blower housing
C	Combustion blower wheel
D	Nut (2 req'd)
E	Blower housing with screen
F	Motor
G	Ventilating blower housing
H	Ventilating blower wheel
J	Setscrew (2 req'd)
K	Screw (4 req'd)
L	Speed nut (9 req'd)

Figure 719. Disassembly of blower assembly—exploded view (legend)

(A) through (L) if repairs to this section are required.

Caution: **Use clean tools and work on a clean surface when making valve repairs. It is extremely important to prevent entry of even the smallest particles of foreign matter, since they may clog the needle valve or cause leakage at solenoid valve seating surfaces. Do not smoke while performing this operation; keep tobacco ashes away from the area.**

(2) If the diaphragm cap (F) is removed, always install new gaskets (K) to ensure a satisfactory seal.

(3) Do not remove valve assembly (M) unless absolutely necessary. The screen (P) need not be replaced during overhaul unless the inlet screen (Q) shows evidence of clogging or gum formation. If it is necessary to remove the valve, use only a socket or box wrench. Install a new screen (P) and new gaskets (N) if the valve is removed. Tighten the valve carefully, but do not use excessive torque which may distort the soft brass valve body.

Note. Disassembly of both solenoids is the same.

Caution: **If disassembled, use a new gasket (S) and tighten screws (X) very carefully to apply an even pressure on the valve body. This is a fuel seal and leakage will result from careless reassembly.**

l. Personnel Heater Emergency Switch Replacement.

(1) Disconnect the personnel heater control box wiring harness, and circuit breaker harness from the rear of the emergency switch.

Key	Item
A	Nut
B	Cable assy
C	Screw (6 req'd)
D	Adjusting screw
E	Stud
F	Diaphragm cap
G	Adjusting cap
H	Spring
J	Diphragm assy
K	Gasket (2 req'd)
L	Heating element
M	Valve assy
N	Gasket (2 req'd)
P	Screen
Q	Screen
R	Valve body
S	Gasket (2 req'd)
T	Plunger assy (2 req'd)
U	Spring (2 req'd)
V	Sleeve and core (2 req'd)
W	Solenoid cup (2 req'd)
X	Screw (6 req'd)
Y	Washer (2 req'd)
Z	Coil assy (2 req'd)
AA	Lockwasher (2 req'd)
BB	Screw (2 req'd)
CC	Gasket
DD	Screen
EE	Orifice plate
FF	Gasket
GG	Cover
HH	Adapter
JJ	Thermostat
KK	Clamp
LL	Screw (3 req'd)
MM	Cable assy

Figure720. Disassembly of fuel control valve—exploded view (legend)

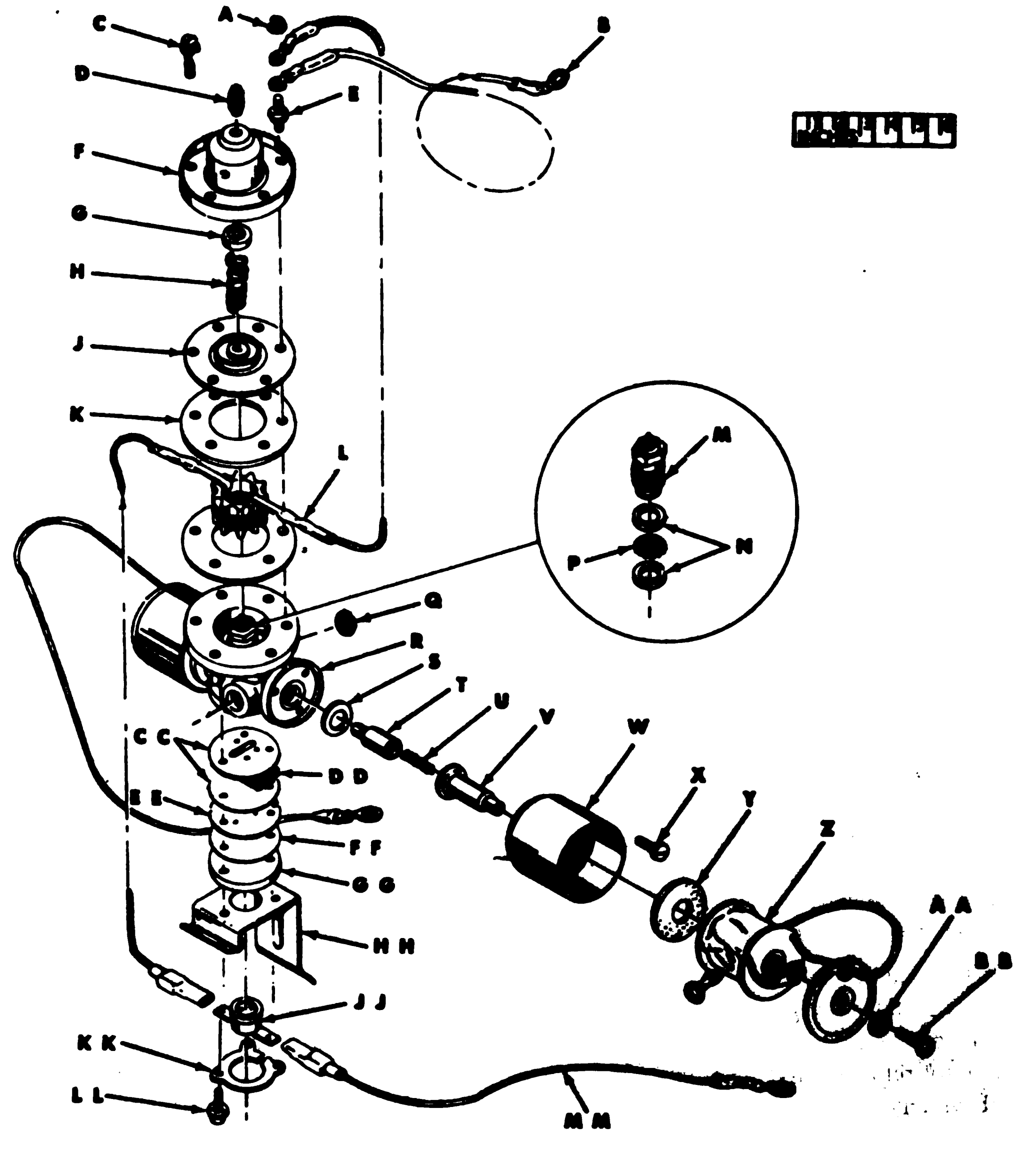

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Figure 720. Disassembly of fuel control valve—exploded view.

(2) Remove the two screw and lockwasher assemblies securing the switch guard and emergency switch to the dash panel. Remove the switch and the guard.

(3) Install the emergency switch in the reverse order of removal.

Note. When assembling, be sure "OFF" side of switch is facing downward.

m. Removal of Personnel Heater Control Box.

(1) Disconnect the wiring harness from the rear of the control box and remove the two screws securing the control box panel to the case assembly.

(2) Remove the control box panel and controls from the case.

n. Removal of Fuel Pump Assembly. Refer to paragraph 527*a* and reverse the installation procedures therein to remove the fuel pump from the battery compartment.

533. Cleaning, Inspection and Repair of Personnel Heater Components

a. Heat Exchanger.

(1) Inspect the heat exchanger for possible damage or leaks. If the heat exchanger is burned through, or shows evidence of cracks, it must be replaced.

(2) Scrape as much carbon out of the ignitor pocket as possible, using a sharp tool, and blow out with compressed air.

(3) Combustion residue in the heat exchanger caused by burning leaded gasoline is best removed by soaking in a 20% (by weight) solution of ammonium acetate at a temperature of 180°F. for a period of 5 to 10 hours. Drain and rinse thoroughly after cleaning. For other types of fuel, such as diesel fuel, JP4, CIE, etc., a commercial solvent such as "Oakite," or a similar product should be used according to the manufacturer's instructions. Regardless of the type of cleaning solution used, it is important to rinse the heat exchanger thoroughly to remove all traces of solvent and dry it carefully before the unit is reassembled.

b. Fuel Control Valve.

Note. The key letters noted in parentheses refer to figure 720, except where otherwise indicated.

(1) Remove the three screws (LL), clamp (KK) and thermostat (JJ) to free the adapter (HH) and orifice plate (EE) with gaskets (FF and CC). Also remove screen (BB) and the small screen (Q) from valve inlet. Disassembly should normally proceed no farther than this point for overhaul.

(2) Clean the orifice plate with compressed air and inspect with a magnifier.

Caution: **Do not force any tool, wire, or other object through the orifice plate openings. The slightest distortion of these calibrated holes, even removal of a bur, may cause serious overheating when the heater is reassembled.**

(3) Test continuity through heating element (L) with an ohmmeter and inspect condition of electric leads very carefully at the points where they emerge from gaskets. Replace heating element if it shows an open circuit, or if electric leads are badly bent or twisted.

(4) Inspect all electric leads for condition of connectors and tightness of terminals. Resolder if loose.

(5) The contacts of the thermostat (JJ) open at 70 plus or minus 5°F. and may be open at room temperature. Since the contacts will not close until the temperature is reduced to 30 plus or minus 10°F., it may be necessary to refrigerate this unit to determine if it is operating properly. This test should not be necessary if the thermostat is known to be operating properly, but can be conducted if the heater has poor starting characteristics at low temperatures. Test as follows if required:

(6) Connect a test light or other indicating device to the thermostat contacts. If room temperature is 75°F., the thermostat contacts must be open. Closed contacts at this temperature indicate a defective thermostat. If the contacts are open at room temperature, place the thermostat in a refrigerator set for a temperature of 20°F. The contacts must close at this temperature. The exact closing temperature is unimportant so long as contacts are closed at not less than 20°F., and open at not

more than 75°F. Replace the thermostat if not within limits. It is not adjustable.

Caution: **Do not immerse the thermostat in any liquid as a refrigerant. It is not waterproof and may be destroyed by such practice.**

c. Flame Detector Switch.

(1) Completely remove the adjusting screw of the flame detector switch and clean off cement used to seal the adjustment.

(2) Turn the switch over and let the quartz rod slide out through the threaded opening from which the adjusting screw was removed.

(3) Inspect the quartz rod and clean it. The rod must not be chipped or cracked. Discard the rod if defective. If quartz rod is broken, be sure all pieces are removed from the tube.

(4) Clean the tube of the flame detector switch with a wire brush and inspect it for straightness and the presence of corrosion. Replace the entire switch if the tube is bent or badly corroded, or if the microswitch is defective.

(5) Replace the rod in the tube and reinstall the adjusting screw, making sure the rod is centered in the depression in the end of the screw.

(6) Adjust switch as follows:

(*a*) Turn the screw in until the switch just clicks.

(*b*) Turn in ½ turn past the click point.

(*c*) Cement the adjusting screw to the lever arm with G.E. No. 1201 Glyptol cement or Ambroid.

Caution: **Do not allow cement to run over side of lever arm and touch pin or bracket.**

d. Overheat Switch. Inspect the overheat switch for damage and clean contacts by sliding a clean strip of bond paper between points. Do not use an abrasive. Do not attempt to bend the blade or contact arm or change the setting of the adjusting screw. Replace the entire switch if defective.

e. Fuel Filter. Clean fuel filter at each overhaul according to the procedures contained in TM 9-2320-211-20.

f. Blower Assembly.

(1) Immerse fans in dry-cleaning solvent and dry. Also clean housing and motor-mounting bracket in the same manner. Wipe off outside of motor but do not immerse in cleaning solvent since this may dissolve lubricant.

(2) This motor is permanently lubricated with a low-temperature grease at the factory. No lubrication is required nor should be attempted.

g. Wiring.

(1) Inspect all wiring for condition of insulation and tightness of electric connectors.

(2) Inspect terminal strip for cracks and condition of threaded inserts.

h. Heater Case. Clean heater case inside and out and inspect for dents and roundness. Also inspect condition of threads of weld nuts.

i. Control Box. For cleaning, inspection, repair and test of the control box, refer to TM 9-8662.

j. Fuel Pump. For cleaning, inspection, repair and test of fuel pump, refer to TM 9-8662.

534. Reassembly of Personnel Heater Kit

Reassembly is the reverse of disassembly with the precautions and exceptions noted throuhgout the disassembly procedure.

535. Personnel Heater Testing

a. Test Equipment. The following equipment will be required to properly test the heater:

(1) A source of 24 volts dc.

(2) A suitable rack or cradle to support the heater during test with provision to dispose of the exhaust gases.

(3) A test wiring setup similar to the one illustrated in figure 721.

(4) A fuel tank and electric fuel pump to supply fuel under pressure to the heater.

(5) A flowmeter, which should be installed in the fuel system to measure fuel flow while the heater is burning. If a flowmeter is not available, it is possible to remove the fuel control valve from the heater and test fuel by means of a glass graduate.

(6) A strobe-light type of tachometer, to determine speed of the blower motor.

b. Mounting Bracket.

(1) Fuel flow of the heater is adjusted at the

factory for a specific mounting position and it is necessary to test heaters in the same position that they will have when installed in the vehicle. If several heaters are being used in different mounting positions, it will be necessary to identify each heater with respect to its position, since a heater which has been tested and adjusted for any position other than normal will not operate properly in the normal position and vice versa.

(2) The heater test-mounting bracket, or cradle, should be permanently mounted, if possible, and should be designed so that the heater can be removed and replaced with a minimum of effort. The exhaust fitting should be a part of the mounting fixture, and the total length of exhaust tubing should not be more than ten feet. Keep bends and turns to a minimum.

c. Fuel System (Fig. 720).

(1) The fuel flowmeter should be installed in the fuel line between the fuel pump and the heater assembly. A fuel shutoff valve must be included near the outlet end of the fuel line. A flexible section will be helpful in making connections to the heaters.

(2) In the absence of a flowmeter, a glass graduate and watch may be used to determine fuel flow through the fuel control valve. It is necessary to remove the valve when testing in this manner but, when carefully timed, this test provides an accurate check on fuel flow and may be used to check a flowmeter of doubtful accuracy.

d. Electrical System.

(1) The source of direct current must be capable of continuous operation without excessive change in voltage with variations in load. If a transformer and rectifier are used without storage batteries, it will usually be necessary to provide some means of regulating voltage at the heater test panel. A bank of storage batteries without regulation should be satisfactory, provided the charging rate is sufficient to keep batteries in a fully charged condition and wiring is of sufficient size to prevent an excessive voltage drop in the line. In any system, an ammeter and voltmeter must be provided at the test panel to indicate total current draw and applied voltage during the test.

(2) A suggested wiring diagram for the heater test panel is shown in figure 721. The control switches, meters, flowmeter, and voltage regulator should be mounted in a group on one panel so that all can be observed at one time. An electric timer is also useful, but a watch can be used instead.

e. Test Procedure. A complete test of the heater consists of the following:

(1) A burn test of the general heater performance.

(2) Measurement of fuel flow through the fuel control valve.

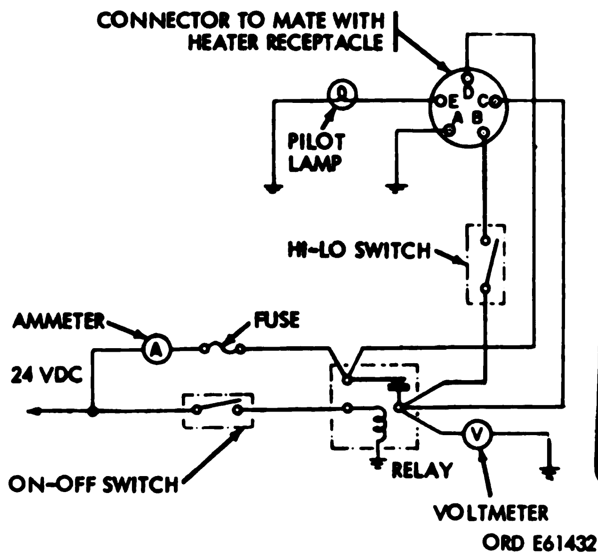

Figure 721. Test wiring set-up for 8420-C heater tests.

(3) A check of the overheat switch action.

(4) Timing of the blower fan to determine motor speed.

f. Burn Test.

(1) Install the heater on the test bench mounting bracket (*b* (2) above).

(2) Make fuel, electric and exhaust connections to the heater. The heater must be mounted in the same position it normally occupies in the vehicle, since the mounting position affects the fuel flow through the control valve.

(3) If the power source is adjustable, preset the voltage control by trial and error so that voltage will be 24 volts with the full starting load of the heater. If a nonadjustable power supply is used, make sure the voltage is at least 22 volts under starting conditions. The test will not be valid unless starting voltage is within these limits, since ignition time is affected by voltage.

(4) With the above conditions established, set the HI-LO switch to LO, and then turn heater control switch to ON. Start timing heater operation from the instant the switch is turned on.

(5) Standards.

(*a*) Current draw must not exceed 16 amperes at 24 volts.

(*b*) Note fuel flow during the starting cycle. Flow must be more than 0.012, but less than 0.014 lb./min.

(*c*) The heater should ignite within 40 seconds.

(*d*) The flame detector switch must transfer within 2.5 minutes from the moment the heater control switch was turned on.

Note. Ignition may be inaudible. If so, transfer time of the flame detector switch will be used as the limiting factor for test.

(*e*) Immediately after the flame detector switch transfers, turn the HI-LO switch to HI and note current draw. Draw must not exceed 3.25 amperes.

Note. The current draw will be 3 amperes more if test is conducted at a temperature that will maintain the fuel valve thermostat in a closed position.

(*f*) Observe high heat fuel flow on the flowmeter. Flow must be more than 0.026, but less than 0.032 lb./min.

(*g*) If fuel rates for high heat are not within limits, turn adjusting screw of the fuel control valve clockwise to increase fuel flow, or counterclockwise to decrease flow and retest. If, after adjusting fuel flow for high heat, it is found that low heat flow is not within limits, it is an indication that one of the metering holes in the orifice plate is clogged. Remove plate, clean, and retest. Both high and low heat flow must be within limits to ensure proper starting and satisfactory heat output.

g. Overheat Test. While the heater is burning on high heat, block off all flow of ventilating air by covering the heater outlet with sheet metal. The overheat switch must open and shut off fuel flow in more than 15 seconds, but less than 30 seconds from the moment air flow was shut off. Replace the overheat switch if not within limits.

h. Purge Test. With the heater burning on high heat, turn the heater control switch off. Fuel flow must drop to zero immediately. The blower must continue to run for more than one minute, but less than 3-½ minutes, and must then automatically stop. Reset, or replace the flame detector switch if not within limits.

i. Blower Test. To time the blower, remove the guard and mark the combustion blower fan with chalk. Start the heater and time the fan with a tachometer. Blower speed must be 5600 rpm minimum with no restriction on the heater outlet, and with an applied voltage of 24 volts.

j. Fuel Control Valve Tests (Fig. 722).

(1) If a flowmeter is not available to test fuel flow, the fuel control valve can be removed from the heater and tested separately by measuring the amount of fuel which passes through the valve in a specified time.

(2) The fuel control valve must be tested in its actual operating position. The test setup illustrated in figure 722 is suitable for a valve which will operate in the normal position only. If the heater operates in any other position, it will be necessary to attach the fuel tube and standpipe to the valve, or to simulate these parts with tubing of not less than 3/16-inch diameter. This entire assembly must then be tested in its actual operating position.

(3) In addition to the tubing, a 50- or 100-cc glass graduate with accurate calibrations will be required. A fixture to hold the valve should be provided and two test leads with alligator clips and a panel switch must be provided to energize the solenoids.

Warning: **Dripping fuel is extremely explosive. Do not permit smoking, sparks or open flame within 50 feet of work area during this test. Be extremely careful that all electrical connections are tight. Use the approved switch for starting and stopping the**

solenoids; DO NOT operate the solenoids by connecting and disconnecting the test clips.

(4) To test fuel flow proceed as follows:

(*a*) Mount the valve in the holding fixture and connect the fuel line and test leads according to figure 722. Place a container under the valve and apply fuel pressure.

(*b*) Turn on the switch to energize the solenoids and permit fuel to flow for a few seconds until conditions are stabilized, then place the graduate under the outlet tube and start timing flow. One minute can be used as a timing interval if the graduate has sufficient capacity.

(*c*) Snap the solenoid switch off at the end of the timing interval and place the graduate on a flat surface to read the contents. The amount of fuel must be within the limits shown in Table XIX for high heat. If fuel flow is not within limits, turn the adjusting screw in to increase flow or out to reduce flow. Recheck flow after adjusting.

(*d*) After high heat flow has been brought within limits, turn the switch to "FF" position and disconnect the lead to the restriction solenoid and repeat test to measure low heat flow. If the low heat flow is not within limits, it will be necessary to clean or replace the orifice plate and then test and readjust the valve. Repair or replace the valve if this does not correct the condition.

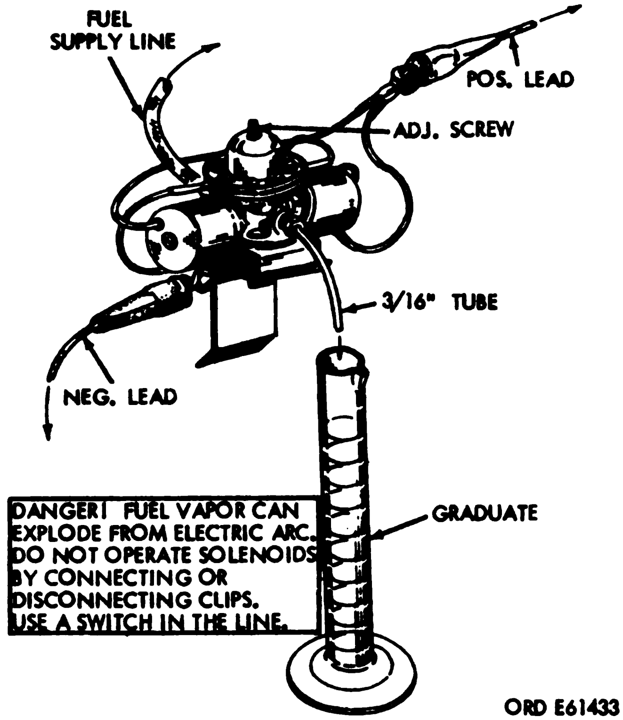

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Figure 722. Fuel control valve test setup.

Table XIX. Fuel Flow

Solenoid position	Fuel Rate lb/min		Fuel Rate in cc/min				
			DFA	DFI	Gasoline MIL-G-3056	CIE MIL-F-46121	DF 2
High Heat	0.029	0.003	16 ± 2	16 ± 2	17 ± 2	16 ± 2	16 ± 2
Low Heat	0.013	0.001	7 ± 1	7 ± 1	8 ± 1	7.5 ± 1	7.5 ± 1

k. Fuel Flow Rates.

(1) Two methods are used in this manual to show fuel flow rates. It will be noted that flow rates for use with a flowmeter are shown in pounds per minute and rates for separate testing of a detached valve are shown in cubic centimeters per minute. All fuels intended for use with this heater should flow at the same rate in pounds per minute, regardless of mounting position. Because of the variation in density, the flow, when measured in cubic centimeters per minute, will vary from one fuel to another.

(2) All fuel rates are specified for fuel at room temperature. Fuel valves should not be adjusted at extremely low or high temperatures.

(3) When the heater is to operate in the "normal" operation position (that is with the exhaust tube pointed straight down), the high heat fuel rate is set at the factory according to the chart below. If a heater set for normal operation is subsequently

mounted in any other position, the fuel rate will be less than this amount as a result of back pressure caused by the weight of fuel in the standpipe. This is the reason the actual mounting position must be taken into consideration when adjusting the fuel rate. It should be noted that the converse of this condition (where a heater is set for an alternate position and then burned in the upright position) will cause the fuel rate to be too high and may cause a serious overheat condition.

(4) Mounting positions of the heater are defined as falling within the areas indicated in figure 723. If the heater is both tilted and rotated, the rotation will define the mounting position unless the tilt exceeds 45°, in which case the mounting position is considered to be "vertical." Heater positions should be specified as "Normal," "Rotated 90°' or "Vertical," according to the areas illustrated in figure 723 if special adjustment is desired at the factory.

(5) These heaters are not designed for use in any installation where the exhaust outlet is above the horizontal level and must never be installed in the vertical position with the blower at the bottom, since this may interfere with proper operation or cause leakage of fuel through the combustion air inlet.

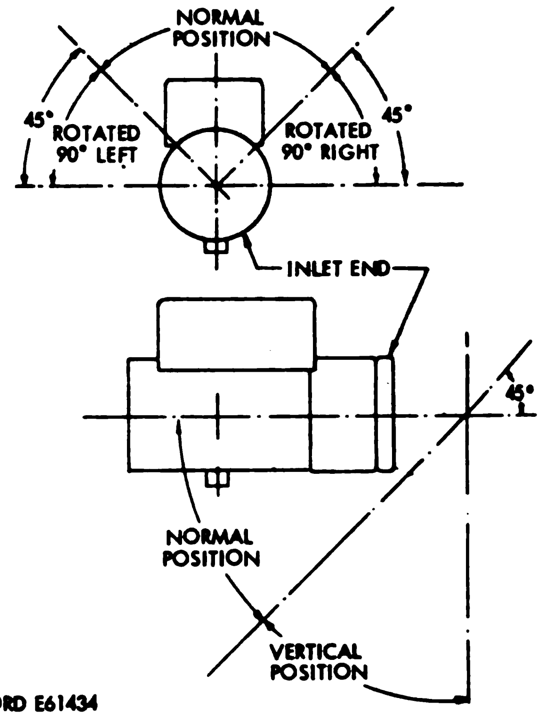

Figure 723. Heater mounting positions.

536. Installation of Personnel Heater

Install the heater assembly by following the procedures in paragraph 527 of this manual.

Section XVII. (ADDED) MAINTENANCE INSTRUCTIONS FOR POWER PLANT HEATER KIT COMPONENTS (MULTIFUEL MODEL VEHICLES)

537. Disassembly of Power Plant Heater Kit Into Subassemblies

a. Removal of Power Plant Heater Assembly

(1) Turn the inlet and outlet shutoff cocks fully to the right.

(2) Turn the power plant heater shutoff cock fully to the right.

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

(3) Disconnect the fuel line from the fitting in the fuel control valve. Remove the fitting from the control valve.

(4) Disconnect the electrical harness connector from the heater by turning it counterclockwise.

(5) Remove the cotter pin securing the exhaust tube extension elbow to the heater. Separate the elbow from the heater.

(6) Remove the clamp securing the hose to the bottom of the heater and remove the hose from the heater, then remove the elbow.

(7) Loosen the hose clamp securing the heater coolant inlet hose to the elbow on top of the heater assembly. Remove the heater inlet hose and, then remove the 45-degree elbow.

(8) Hold the heater assembly to prevent it

from falling and disconnect the two heater mounting clamps. Remove the heater assembly from the mounting saddles.

Note. The key letters noted in parentheses refer to figure 724, except where otherwise indicated.

b. Removal of Blower Assembly.

(1) Compress the clamp (K) of the combustion air hose (J) with hose clamp pliers and disconnect hose from the heat exchanger or ignition tee (AH) if used. Remove hose from the blower (GG) by loosening clamp (H).

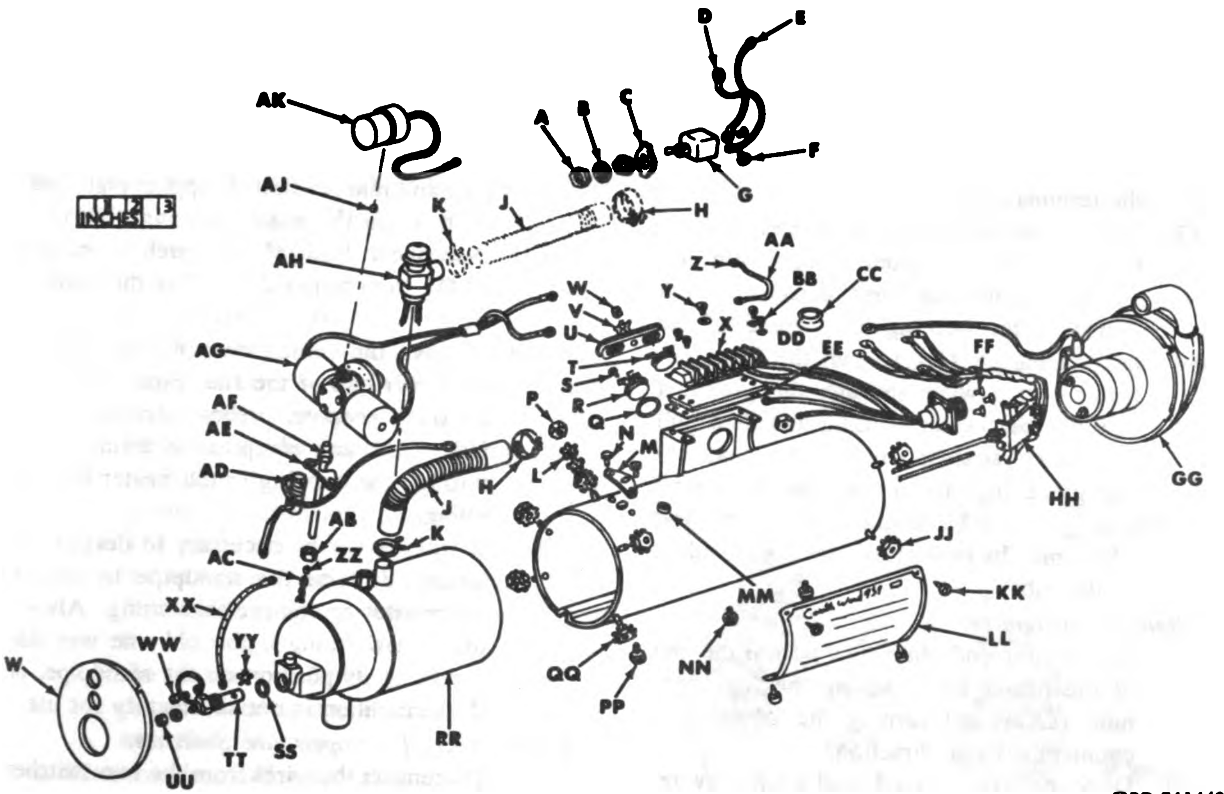

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Figure 724. Power plant heater disassembly—exploded view.

Key	Item	Key	Item
A	Nut (2 req'd)	V	Lockwasher
B	Lockwasher	W	Nut
C	Switch plate	X	Terminal strip and receptacle
D	Wire assembly	Y	Screw (11 req'd)
E	Wire assembly	Z	Wire assembly
F	Screw (2 req'd)	AA	Wire assembly
G	Switch	BB	Screw (4 req'd)
H	Clamp	CC	Grommet
J	Hose	DD	Marker strip
K	Clamp	EE	Terminal marker support
L	Lockwasher	FF	Screw (4 req'd)
M	Plate	GG	Blower assembly
N	Screw (2 req'd)	HH	Flame detector switch
P	Nut	JJ	Nut (4 req'd)
Q	"O" ring	KK	Rivet (4 req'd)
R	Restriction switch	LL	Name plate and wiring diagram
S	Screw (4 req'd)	MM	Grommet
T	Overheat switch	NN	Heater housing
U	Thermostat cover		

Figure 724. Power plant heater disassembly—exploded view (legend).

(2) Disconnect the electrical lead of the blower (GG) from terminal No. 6 of the terminal strip.

(3) Loosen, but do not remove, the four hex-nuts (JJ) on the studs at the end of the heater case. Turn the blower (GG) counterclockwise to disengage the bayonet slots and pull the entire assembly off the end of the heater. Do not twist or move the assembly from side-to-side.

c. *Removal of Flame Detector Switch.*

(1) Disconnect flame detector switch electrical leads from terminals 2, 3, 4, 6 and 7 to the terminal strip.

(2) Using a short ½-inch open end wrench, back off the hexagonal compression nut which attaches the flame detector switch (HH) to the bushing on the end of the heat exchanger (RR). Pull the flame detector switch wires through the grommet (CC) in the heater housing and then pull the switch straight out of the heat exchanger, being careful not to bend the steel tube. This tube contains a quartz rod which may be broken by excessive bending of the tube.

d. *Removal of Ignitor.*

(1) Remove the end plate (VV) from the end of the heater by loosening the four hex-nuts (QQ) and turning the cover in a counterclockwise direction.

(2) Disconnect the ground lead (XX) by removing nut (P) and lockwasher (L) from inside the heater housing and bend ignitor ground wire so that it will fit inside a deep socket.

(3) Disconnect the copper connecting strap of the preheat resistor (AD) and remove the ignitor, using 13/16-inch deep socket.

(4) When it is desired to change the ignitor alone, without disassembly of the heater, this can be accomplished through the opening in the end of the heater case.

e. *Removal of Fuel Control Valve.*

(1) Disconnect fuel control valve leads from the overheat switch and HI-LO switch.

(2) Loosen the hexagonal compression fitting (AB) at the lower end of the standpipe (AF) until the standpipe will turn freely in the fitting.

(3) Hold the fuel control valve (AG) firmly and unscrew the standpipe from the valve, using an open-end wrench on the hexagon at the upper end of the standpipe (AF). Lift off the valve when the threads are clear. Avoid unnecessary pressure on the solenoid cups of the fuel valves since fuel leakage may result if the cups are loosened from the surface of the valve body.

f. *Removal of Standpipe and Fuel Preheater.*

(1) Remove the two screws (N) from the plate (M) which surrounds the standpipe (AF). Leave one plate loose on the standpipe and remove slotted tapping plate (AE) from inside the heater housing (NN).

(2) Disconnect lead of the preheat resistor (AD) from terminal No. 7 of the terminal strip.

(3) Remove the compression fitting (AB) at the lower end of the standpipe (AF) and lift out standpipe, preheat resistor (AD), plate (M) and compression fitting (AB) through the opening in the heater housing fitting.

(4) It will usually be necessary to destroy the fitting (ZZ) on the standpipe to remove the resistor or compression fitting. Always use a new fitting if the old one was disturbed in its position on the standpipe, or if its condition is not satisfactory for use.

g. *Removal of Temperature Switches.*

(1) Disconnect the wires from the two switches (T) and (R) underneath the terminal strip. Disconnect wire from the overheat switch (T) and note its position for reassembly.

(2) Remove the hex-nut (W) from the stud between the switches and lift off the thermostat cover (u). Remove switches and "O" rings (Q). These switches are identical except for temperature setting. They can be distinguished by the part number stamped on the switch, since the last three numbers indicate the temperature setting. Part No. 700220 is set for 220°F. Part No. 700245 is set for 245°F. and is the overheat switch. When replacing these switches, make sure they go into the proper socket on the heat exchanger. The overheat switch must be installed in the socket

toward the blower end of the heater to obtain proper temperature control.

Caution: **When replacing switches (or switch), make sure the "O" ring is in place under the switch to seal out dirt and grease, and also make sure the heat exchanger is reasonably clean at the point of contact. An accumulation of foreign matter, or failure to reinstall "O" rings may result in switch failure or unsatisfactory operation.**

h. Removal of Terminal Strip and Connector. If it becomes necessary to remove the terminal strip and connector, these parts can be removed by removing the two screws (BB) at each end of the terminal strip and the four screws (FF) which secure the connector. Parts can then be separated with a hot soldering iron.

i. Removal of Heater Housing.

(1) To remove the heater housing (NN), remove the three screws (PP) from the seam and spread the housing so that it will clear the exhaust tube and coolant fittings. Avoid spreading the housing so far as to cause permanent distortion of its shape.

(2) The heater is now completely disassembled for service purposes and no attempt should be made to remove other components from the housing or heat exchanger. However, the blower and fuel control valve may be disassembled as directed below if parts are available for repair.

j. Disassembly of Blower Assembly.

Note. The key letters noted in parentheses refer to figure 725, except where otherwise indicated.

(1) Remove the nine screws (J) and speed nuts (E) from the flange of the blower.

(2) Lift off the front of the blower housing (A) and loosen the setscrew (H) in the hub of the blower wheel (B). Lift the wheel off the motor shaft.

(3) Remove three screws (G) which attach the combustion air elbow and plate assembly (C) to the bell end of the motor (D). Lift the motor off, being careful not to lose the screws (G) and spacers (F).

(4) Do not attempt to disassemble or lubricate the motor since it is packed with a special low-temperature lubricant. Replace the entire motor if it is found to be defective.

k. Disassembly of Fuel Control Valve. The fuel control valve is disassembled by following the procedures contained in paragraph 532*k*.

538. Cleaning, Inspection and Repair of Power Plant Heater Components

a. Heat Exchanger.

(1) Inspect the heat exchanger for possible damage or leaks. If the heat exchanger is badly corroded, or shows evidence of leakage, it must be replaced.

(2) Scrape as much carbon out of the ignitor pocket as possible, using a sharp tool, and blow out with compressed air.

(3) Remove combustion residue from the heat exchanger by soaking it in a 20% (by weight) solution of ammonium acetate at a temperature of 180°F. for a period of 5 to 10 hours. Drain and rinse the heat exchanger thoroughly after soaking, then dry with compressed air.

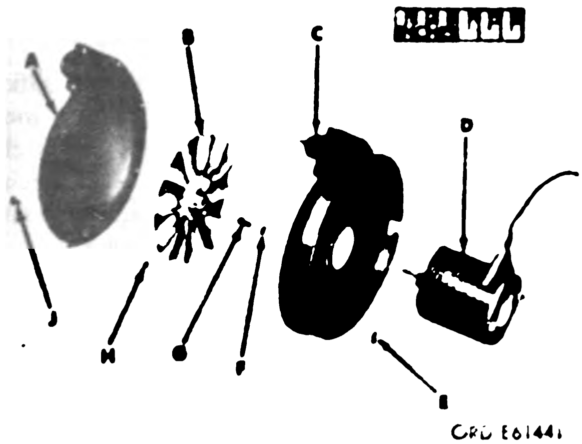

Figure 725. Disassembly of blower assembly—exploded view.

Key	Item
A	Blower housing
B	Blower wheel
C	Combustion air elbow and plate assy
D	Motor
E	Speed nut (9 req'd)
F	Spacer (3 req'd)
G	Screw (3 req'd)
H	Setscrew
J	Screw (9 req'd)

Figure 725. Disassembly of blower assembly—exploded view (legend).

b. Ignitor. Replace the ignitor at each overhaul.

c. Fuel Control Valve.

(1) Replace the fuel inlet screen and install a new one.

(2) Be very careful to note the positions of the orifice plate and gaskets so that they can be properly reassembled. Then remove the three screws from the side of the valve and separate the gaskets from the orifice plate. Clean the screen and orifice plate with compressed air.

(3) Inspect the vaporizer wick in the standpipe. If the wick is clogged with lead from the gasoline, it must be replaced.

(4) Do not disassemble the pressure regulator side of the valve or change adjustment of the diaphragm screw, since special equipment is required to calibrate the valve.

Caution: **Do not force any tool or other object through the orifice plate openings. The slightest distortion of these calibrated holes, even removal of burs, will destroy the plate and may cause serious overheating when the unit is reassembled.**

d. Standpipe and Wick Assembly.

(1) Do not attempt to disassemble the orifice from the end of the standpipe and wick assembly. Remove the screen and wick, but do not disturb the orifice, since special tools are required to install and calibrate this part.

(2) Blow out the orifice with compressed air (applied at valve end of the standpipe) and inspect for corrosion, using a magnifier. Replace the entire wick and standpipe assembly if evidence of corrosion or damage is found.

Caution: **Do not insert any tool through the orifice opening. The slightest distortion of this calibrated hole will destroy the standpipe and wick assembly and may cause overheating when the heater is reassembled.**

e. Blower Assembly.

(1) Wash the two halves of the blower housing and the fan in dry-cleaning solvent or mineral spirits paint thinner and dry. Wipe off the motor but do not immerse in solvent. This motor is permanently lubricated with a special low-temperature lubricant and no attempt at lubrication should be made.

(2) When reassembling the blower, mount the motor on the blower housing, using the screws and spacers, and then install the fan on the motor shaft. Adjust the fan so that the hub is flush with the end of the motor shaft and tighten the set-screw. Hold the other half of the housing in position and spin the fan with the end of the Allen wrench or a piece of wire to make sure the fan does not scrape before installing the screw in the housing flange.

f. Flame Detector Switch.

(1) Completely remove the adjusting screw of the flame detector switch and loosen the two microswitch mounting nuts.

(2) Turn the microswitch back and remove the bow spring. Turn the switch over and let the quartz rod slide out of the tube. Examine the quartz rod for chipped or broken condition. Replace the rod if it is defective. Clean the tube of the switch with a wire brush and check it for straightness. If the tube is warped, replace the flame detector switch.

(3) Reinstall the quartz rod and turn the switch back into position, then install the bow spring and adjusting screw. Tighten the mounting nuts so that the switch is held in position but is not locked.

(4) Press up on the bow spring to permit the quartz rod to center itself in the tube.

(5) Adjust the switch as follows:

(*a*) Back off the adjusting screw until the switch clicks.

(*b*) Turn the adjusting screw in slowly until the switch just clicks, then turn the screw exactly three-fourths of a turn past the click point.

(*c*) Hold screws and tighten mounting nuts to lock the microswitch firmly in place.

g. Temperature Control Switches. Inspect the temperature control switches for corrosion. If the switches are damaged, or are known to be operating at a temperature which is not correct, they must be replaced, since they are not repairable. Excessive bending or rough handling of these switches may cause distortion and permanent loss of calibration, even in a new switch.

h. Fuel Filter. To clean fuel filter, remove bowl by unscrewing counter-clockwise, and clean inside of bowl. Clean filter elements by washing thoroughly in dry-cleaning fluid or mineral spirits paint thinner. When reassembling, be sure gasket is in place between bowl and filter body.

i. Wiring.

(1) Inspect for cracks and worn insulation. Repair defective wiring where possible; otherwise replace wiring. If wiring is permanently attached to a component and cannot be repaired satisfactorily, replace entire component.

(2) Inspect terminal strip for possible damage. Replace where necessary.

539. Reassembly of Power Plant Heater Kit

For sequence of reassembly, reverse the procedure under disassembly unless otherwise noted in the disassembly procedure.

540. Power Plant Heater Testing

a. Test Equipment. The following equipment will be necessary to properly test the heater after overhaul:

(1) A source of 24 volts dc.

(2) A suitable rack, or cradle, to support the heater with provision to dispose of the exhaust.

(3) A control box and wiring harness.

(4) An electric fuel pump, or a fuel supply tank with a head of 15 inches. Tests with a greater or smaller head will not be a valid indication of proper heater operation.

(5) A tank or container for coolant, and associated tubing and fittings to make connections to the heater.

(6) A thermometer, or thermocouple and potentiometer indicator, to measure coolant temperature.

(7) A water manometer to measure static pressure of the combustion air blower.

b. Coolant System.

(1) To speed up testing of the temperature control switches, the coolant system should not contain more than about five gallons of coolant. The coolant should be the same as that used in the engines which are being heated. Water cannot be used to test action of the control switches, since they are set at a temperature above the boiling point of water.

(2) It will be necessary to allow the coolant to cool between heater tests. For this reason, a method of changing coolant quickly is advisable if it is anticipated that several heaters will require testing in rapid succession. The coolant system should have a drain valve at its lowest point.

(3) The coolant container may be open or closed but must be vented to the air. A thermosyphon type of circulation is satisfactory and no pump will be required.

c. Electrical System.

(1) The power plant heater should be wired as shown in figure 721, using the regular wiring harness, except that a voltmeter must be connected across the circuit and an ammeter should be included between the HOT lead of the control box and the source.

(2) The source of electric power should preferably have a means of adjusting the voltage, especially if a transformer and rectifier are used, but a fully charged storage battery should be satisfactory without regulation.

(3) Provision must be made for a thermometer or thermocouple pair in the outlet fitting of the heater so that the temperature can be read at this point. A thermocouple pair can be installed by running wires underneath the connecting hose at the heater outlet, being careful not to damage the insulation of the thermostat wires.

d. Exhaust Collector. Provision must be made to conduct the heater exhaust gases outside the building in which tests are being conducted. The exhaust extension may be made of a flexible exhaust tube and should not be more than ten feet long.

e. Scope of Tests.

(1) A complete test of the power plant heater consists of the following:

(*a*) Fuel flow test.

(*b*) Burn test.

(*c*) Overheat switch test.

(*d*) HI-LO thermostat test.

(*e*) Combustion air blower test.

(2) Since equipment for the combustion air blower test may be difficult to obtain in the

field, this test can be eliminated, provided the heater burns properly and the ingitor cavity does not show an excessive deposit of carbon. If the heater goes out during test, or if it smokes excessively and has heavy carbon deposits within the ignitor cavity, it can be assumed that the blower is not delivering sufficient air and the blower motor should be changed. Moderate carbon deposits are normal and do not indicate a defective blower.

f. Fuel Flow Test. The fuel control valve of the power plant should always be tested after cleaning, and fuel flow should be tested when the heater is put on the test block after repair. If the test setup includes a flowmeter, fuel flow can be checked during the burn test; otherwise, it must be removed from the heater and tested as follows:

(1) Connect the fuel control valve to the fuel supply at a pressure of 1 to 15 psi. Fuel should be turned off at the shutoff valve.

Warning: **Dripping fuel is extremely explosive. Do not permit smoking, sparks or open flame within 50 feet of work area during this test. Be extremely careful that all electrical connections are tight. Use the approved switch for starting and stopping the solenoids; DO NOT operate the solenoids by connecting and disconnecting the test clips.**

(2) Place the outlet of the control valve over a glass graduate calibrated in cubic centimeters. A suitable container to catch overflow must be provided.

(3) Ground the body of the valve to a 24-volt source and energize both solenoids of 939-A valve, or the single solenoid of the 939-C, by placing lead wires in the clip of a positive wire connected to the electric power source controlled by an enclosed switch a few feet from the test area. This will open the solenoids and permit high heat fuel flow.

(4) Switch on the solenoid and then turn the fuel supply on and permit fuel flow into the overflow container for a few seconds to bleed the line and stabilize fuel flow.

(5) After flow is stabilized, place the graduate under the outlet of the valve for a period of exactly one minute, then shut off fuel first and switch off solenoid. Read the contents of the graduate at eye level. The contents must be within the limits of 14 to 18.5 cc.

(6) For 939-A only, repeat the above procedure by energizing the shutoff solenoid with the restriction solenoid disconnected. The quantity of fuel for low heat operation must be within the range of 5.5 to 8.5 cc. If a flowmeter is used during the burn test, flow rates can be determined by the following chart.

High Heat	0.023 to 0.029 lb./min. or 14 to 18.5 cc/min
Low Heat 939-A Only	0.009 to 0.013 lb./min. or 5.5 to 8.5 cc/min

(7) If flow rates are not within limits, replace the fuel control valve. Do not atempt to adjust the pressure regulator.

g. Leak Test. Using the same setup described for the fuel flow test, energize solenoid valve, or valves, to obtain high heat fuel flow and permit fuel to flow for a few seconds. Switch off the solenoid and observe the fuel control valve outlet, or outlet of the standpipe, for evidence of leakage. One or two drops may form and fall after the switch is off, but flow should then stop entirely. Observe the valve for about one minute and then repeat the test. No leakage is permitted and the valve must be replaced if any occurs.

h. Burn Test.

(1) Place the fully assembled heater on the test bench and make fuel, coolant, electrical and exhaust connections. Do not attempt to burn the heater unless there is an unrestricted supply of coolant.

(2) Before starting the burn test, remove the cover from the end of the heater housing and look inside for evidence of heat exchanger leakage. Replace the heat exchanger if leakage is indicated.

(3) Replace the cover on the heater housing and place the heater control switch in the ON position. Start timing heater from the moment the switch is placed in START position, or from the moment the switch is turned on. Note current draw on the ammeter.

(4) Current draw should be approximately 11 amperes at 24 volts.

(5) The heater should ignite within 20 seconds from the moment the switch was turned ON.

(6) The flame detector switch must transfer in more than eight seconds, but less than 25 seconds from the instant of ignition. Transfer of the switch will be indicated by the pilot lamp and by a drop in current draw. Reset voltage to 24 volts after the flame detector switch transfers. Current draw should then be approximately one ampere at 24 volts.

(7) If the heater fails to ignite, or is slow in establishing flame, clean the ignitor cavity and install a new ignitor. Insufficient fuel flow or a clogged vaporizer wick can also cause slow ignition.

(8) If the flame detector switch does not transfer within limits (*h*(6) above), reset the switch, or the quartz rod if defective.

(9) Allow the heater to burn one minute on high heat, then snap the control box switch to LO. Burning within the heater should be reduced in intensity, but the heater must continue to burn. If the heater goes out, replace the fuel control valve and repeat the test.

(10) Turn the heater control switch to OFF position. Burning should stop immediately and fuel flow should also stop; but the blower should continue to run for more than one minute, but less than two minutes, and then automatically stop. If blower operation is not within limits, reset the flame detector switch and repeat the test. If the blower fails to stop, the quartz rod of the flame detector switch is broken and must be replaced.

Note. All the above specifications are based on a room temperature above 65°F. If the room temperature is very cold, the starting time and blower overrun time may not be as specified.

i. HI-LO Thermostat and Overheat Switch Test.

(1) Turn the heater on and allow it to run until the coolant is heated sufficiently to cause the heater to cycle from high to low heat. Permit conditions to stabilize and observe the temperature at the coolant outlet of the heat exchanger. This temperature must be between 200° and 225° F. If temperature is not within limits, replace the HI-LO thermostat.

(2) After testing the HI-LO thermostat, connect a test wire across the terminals of the HI-LO switch so that the heater will remain on high heat. Allow the coolant to heat until the overheat switch cuts out (burning will stop). Observe the temperature immediately when the switch opens. This temperature must not be less than 230° or more than 260°F. Replace the overheat switch if not within limits.

j. Blower Assembly Test.

(1) Due to its concealed position, testing of the blower is difficult on the 939 Coolant Heater and this test is not required unless there is reason to believe that difficulty is being experienced as a result of insufficient combustion air.

(2) If it becomes necessary to test the combustion air blower, its condition can be determined by measuring static pressure in the combustion air duct with a water manometer. To make this test, install a short section of tubing with a pressure tap on the combustion air inlet of the exchanger and attach a water manometer to the tap. The Part No. ST-890039 pressure test elbow is suitable for making this test, but any pressure tap is satisfactory, provided no sharp bends are introduced into the duct, and the pressure tap opening is smooth and flush inside the tube. Reconnect the blower hose to the pressure tap.

(3) Disconnect the No. 6 blower lead from the terminal strip and energize the blower at 24 volts. Check carefully for air leaks and then read the static pressure as indicated on the manometer. This static pressure should be at least 1.8 inches of water. If static pressure is less, replace the blower motor.

541. Installation of Power Plant Heater

Install the heater assembly by following the procedures in paragraph 529 of this manual.

APPENDIX I

TORQUE CHART 5-TON, 6 x 6 TRUCKS

Component(s)	Thread Size	Torque req'd ft-lb
AXLE AND DIFFERENTIAL		
Carrier top cover to carrier	3/8-16	25-35
Drive flange to hub	1/2-13	85-95
Differential to axle housing stud	5/8-18	140-155
Carrier bearing cap to carrier	3/4-16	280-325
AXLE SUSPENSION		
Front spring U-bolts	7/8-14	300-400
Rear spring U-bolts	1-14	350-450
Torque rod end ball nuts	1-1/2-12	350-400
TRANSFER		
Sprag unit housing to case cover	7/16-14	20-25
Input shaft front bearing cover to case	7/16-14	20-25
Input shaft rear bearing cover to case	7/16-14	20-25
Rear output shaft rear bearing cover to case	7/16-14	20-25
Front cover to case	7/16-20	20-25
Intermediate shaft rear bearing cover to case	1/2-13	20-25
TRANSMISSION		
Power-takeoff housing to transmission case	3/8-16	30-40
Input shaft bearing cover to case	3/8-16	30-40
Shifter housing to case	3/8-16	30-40
Shifter housing cover to shifter housing	7/16-14	35-45
Mainshaft rear bearing cover to case	1/2-13	35-45
Countershaft rear bearing cover to case	1/2-13	35-45
POWER TAKEOFF		
Front bearing cap to case	5/16-18	15-20
Rear output shaft housing to case	5/16-18	15-20
Cover to case	3/8-16	30-40
PROPELLER SHAFT		
Yoke to journal bearing	7/16-20	45-55
Journal adapter to journal bearing	7/16-20	45-55
STEERING GEAR		
Steering arm ball stud retaining nut	7/8-14	140
Side cover to gear housing	3/8-16	25-35
Control housing to gear housing	3/8-16	25-35
Cylinder mounting flange to gear housing	3/8-16	25-35
End cover to gear housing	3/8-16	25-35
Piston to sliding bar	3/4-16	90-100
Pitman arm hex-nut to shaft	1-1/4-12	175-200

TORQUE CHART - Continued

Component(s)	Thread Size	Torque req'd ft-lb
WHEELS		
Wheel hub stud nut	3/4-16	400-450
Front and rear wheel bearing locknut	2-7/16-16	100-150
Front wheel brakedrum to adapter bolt nut	3/8-24	40-44
Rear wheel brakedrum to adapter bolt nut	3/8-24	40-44
Rear wheel brakedrum adapter to hub screw	1/2-13	52-58
CAB		
Seat supports	5/16-18	10-13
Seat supports	3/8-24	25-29
Floor pan screws	1/4-20	5-8
Cab doorscrews	1/4-20	5-8
Cab mounting bolts - front	1/2-20	40-60
Cab mounting bolts - rear		3/8" of bolt thru nut
Grab handle screw	1/4-20	5-8
W/S pivot bolts	3/8-24	25-29
W/S holddown latches	1/4-28	6-10
Side view mirror	5/16-24	12-15
Slave receptacle	1/4 28	6-10
Cab guard mounting bolt	1/2-20	62-68
Gun mount bolts	1/2-20	15-20
Panel instruments	10-32 Screws	Secure
Windshield safety arms		Secure
CHASSIS		
Clutch pedal lever clamp bolt	7/16-20	42-47
Tie-down handles	1/2-20	5-8
Trailer connector socket	1/4-28	6-10
Tool box mounting bolts	3/8-24	25-29
Liquid container carrier mounting	3/8 24	25-29
Lashing hooks	5/16-18	10-13
Running board mounting bolts	5/16-24	12-15
B.O. lite guard mounting bolts	5/16-24	12-15
Bumper mounting bolts	1/2-20	62-68
Brush guard bracket mounting bolt	9/16-18	62-90
Hook hinges	1/4-28	6-10
Radiator braces	3/8-24	25-29
Battery compt. splash shield	5/16-24	12-15
Battery supports to rng. board supports	3/8-24	25-29
Air reservoirs mounting clamps	5/16-24	12-15
Spare tire carrier mounting bolts	3/8-24	25-29
Pioneer tool rack mounting bolts	3/8-24	25-29
Tow shackles	1/2-20	62-68
Taillights (service)	3/8-16	23-26
Fender to cab cap screws	3/8-16	8 Min. - Washer not flat
Headlight bracket mounting bolt	3/8-24	10-20

TORQUE CHART - Continued

Component(s)	Thread Size	Torque req'd ft-lb
CHASSIS - Continued		
Headlight wiring clips	3/8-24	10-20
Brush guard hinge bolts	1/2-20	40-60
Tire carrier hinge		Secure
Winch prop. shaft U-bolt	Setscrew	Secure
BODY		
Body mounting bolts	9/16-18	82-90
Body mounting shear bolts	3/4-16	5/8" bolt thru nut
Splash guard mounting bolts	3/8-24	25-29
Reflector screws	5/16-24	Secure
Body pivots	3/4-16	150-170

GENERAL TORQUE CHART (LUG LOCKNUTS)

Size	Thds/In.	Torque	Size	Thds/In.	Torque
1/4	20	5-8	9/16	12	68-75
	28	6-10		18	82-90
5/16	18	10-13	5/8	11	100-115
	24	12-15		18	120-135
3/8	16	23-26	3/4	10	170-190
	24	25-29		16	210-230
7/16	14	34-39	7/8	9	290-310
	20	42-47		14	340-360
1/2	13	42-58	1	8	420-440
	20	62-68		14	500-520

APPENDIX II REFERENCES

1. Indexes

The following indexes should be consulted frequently for latest changes to or revisions of references given in this appendix and for new publications or instructions relating to materiel covered in this manual.

Index of Army Motion Pictures, Film Strips, Slides, and Phono Recordings .... DA Pam 108-1

Military Publications:

Index of Administrative Publications .... DA Pam 310-1
Index of Blank Forms .... DA Pam 310-2
Index of Graphic Training Aids and Devices .... DA Pam 310-5
Index of Supply Manuals - Ordnance Corps .... DA Pam 310-29
Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders .... DA Pam 310-4
Index of Training Publications .... DA Pam 310-3

2. Forms

DA Form 2028, Recommended Changes to DA Technical Manual Parts Lists or Supply Manual 7, 8, or 9, is used to report publication errors or omissions. For use of maintenance forms refer to TM 38-750, the Army Equipment Record Systems and Procedures. Forms pertaining to the Army Safety Program are prescribed in SR 385-10-40.

3. Other Publications

Deep-water Fording of Ordnance Materiel .... TM 9-238
Driver's Manual .... TM 21-305
Driver Selection and Training .... TM 21-300
Explosives and Demolition .... FM 5-25
Operation and Maintenance of Ordnance Materiel in Extreme Cold Weather .... TM 9-207
Operation in Arctic .... FM 31-71
Painting Instructions for Field Use .... TM 9-213
Storage Batteries, Lead-Acid .... TM 9-6140-200-15
Tires and Tubes, Pneumatic .... SM 9-1-2600
Stenciling Identification Markings .... TM 9-2851
Lubrication .... LO 9-2320-211-12
Operation .... TM 9-2320-211-10
Organizational Maintenance .... TM 9-2320-211-20
Organizational Spare Parts and Special Tools List .... TM 9-2320-211-20P
Field and Depot Spare Parts and Special Tools List .... TM 9-2320-211-35P
Field and Depot Maintenance for Engine and Clutch (Diesel) .... TM 9-2815-207-35
Field and Depot Spare Parts and Special Tool List for Engine and Clutch (Diesel) .... TM 9-2815-207-35P
Field and Depot Maintenance for Engine and Clutch (Gasoline) .... TM 9-2805-203-35
Field and Depot Spare Parts and Special Tool List .... TM 9-2805-203-35P
Inspection, Care and Maintenance of Anti-friction Bearings .... TM 9-214
Welding Theory and Application .... TM 9-237
Material Used for Brazing, Welding, Soldering, Arc Cutting and Metalizing .... TM 9-237/1
Direct Support, General Support and Depot Maintenance for Engine, Multifuel, LDS 465-1 .... TM 9-2815-210-34
Direct Support, General Support and Depot Maintenance Repair Parts and Special Tool List for Engine, Multifuel, LDS 465-1 .... TM 9-2815-210-34P
Direct Support, General Support and Depot Maintenance Repair Parts and Special Tool List for Fuel Injector Pump .... TM 9-2910-226-35

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For explanation of abbreviations used, see AR 320-50.

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