# TM 9-1786B

**WAR DEPARTMENT TECHNICAL MANUAL**

*ORDNANCE MAINTENANCE*

# Power Train, Track, uspension, and Equipment For 13-Ton, High-Speed Tractor M5

(International Harvester)

*WAR DEPARTMENT* • *25 FEBRUARY 1944*

**FOR ORDNANCE PERSONNEL ONLY**

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Washington 25, D. C., 25 February 1944

TM 9-1786B, Ordnance Maintenance: Power Train, Track, Suspension, and Equipment for 13-ton, High Speed Tractor M5 (International Harvester), is published for the information and guidance of all concerned.

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

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# CHAPTER 1

# INTRODUCTION



## 1. SCOPE.

**a.** The instructions contained in this manual are for the information and guidance of personnel charged with the maintenance and repair of the transmission, differential, final drives, electrical system, air system, suspension, winch frame, and body, for the 13-ton, High-speed Tractor M5. These instructions are supplementary to field and technical manuals prepared for the using arms. This manual does not contain information which is intended primarily for the using arms, since such information is available to ordnance maintenance personnel in 100-series technical manuals or field manuals.

**b.** This manual contains a description of, and procedure for, disassembly, inspection, repair, rebuilding, and assembly of the transmission, differential, final drive, transmission lubricating system, electrical system, and winch for the 13-ton, High-speed Tractor M5. It also contains a description of, and procedure for, inspection and repair of the suspension, frame, and body; and for removal and installation of the transmission and differential.

**c.** TM 9-786 contains vehicle operating and maintenance instructions.

**d.** TM 9-1786A contains maintenance and repair information for the Continental R6572 Engine, cooling system, fuel system, clutch group, and propeller shaft.

**e.** TM 9-1825A contains maintenance and repair information for the distributor, generator, cranking motor, and regulator.

**f.** TM 9-1826C contains maintenance and repair information for Zenith Carburetors.

**g.** TM 9-1828A contains maintenance and repair information for AC Fuel Pumps.

**h.** TM 9-1829A contains maintenance and repair information for the speedometer and tachometers.

## 2. MWO AND MAJOR UNIT ASSEMBLY REPLACEMENT RECORD.

**a. Description.** Every vehicle is supplied with a copy of AGO Form No. 478, which provides a means of keeping a record of each Modification Work Order completed, or major unit assembly re-

placed. This form includes spaces for the vehicle name and U.S.A. registration number, instructions for use, and information pertinent to the work accomplished. It is very important that the form be used as directed, and that it remain with the vehicle until the vehicle is removed from service.

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

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

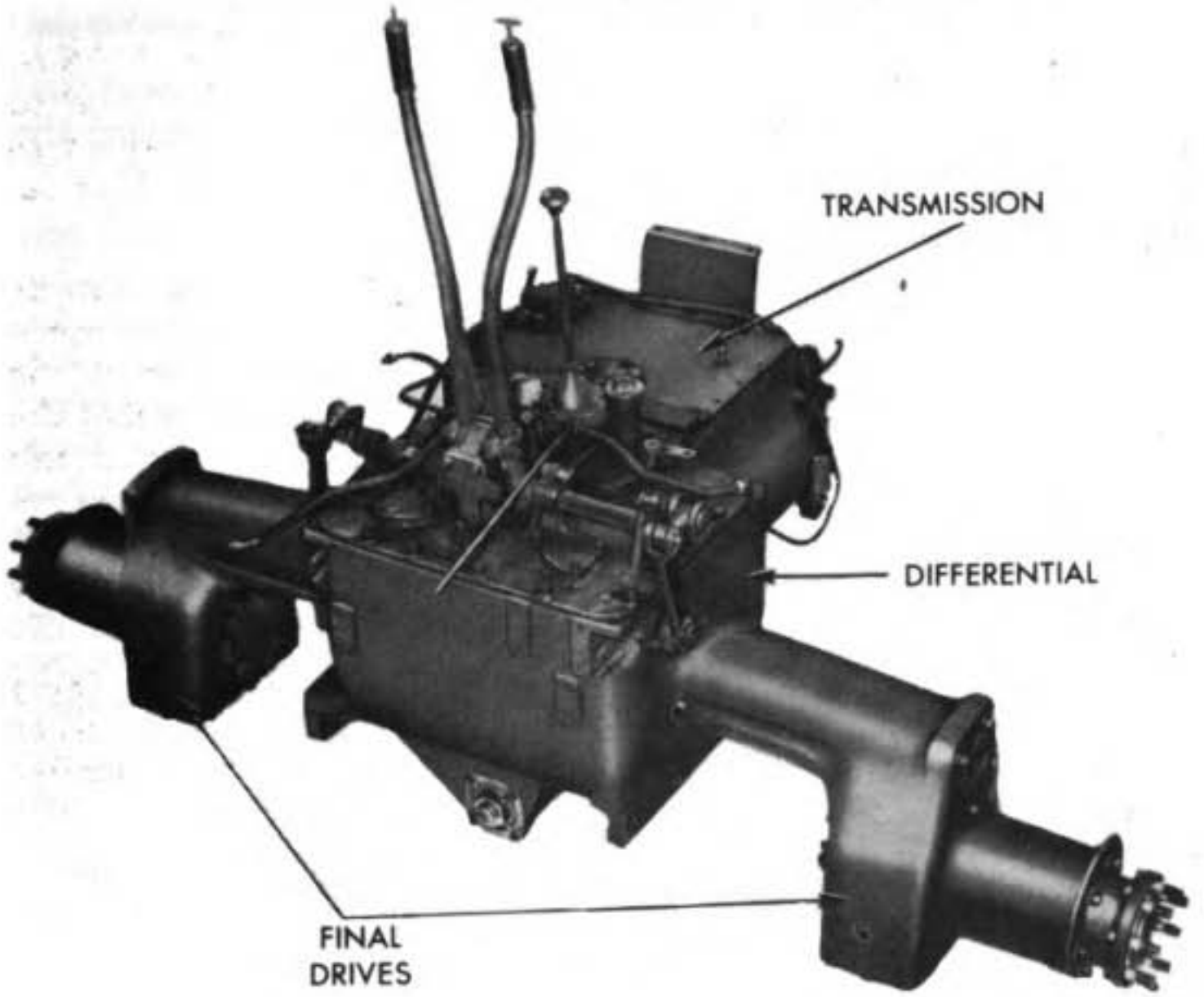


*Figure 1 — Transmission, Differential, and Final Drives*

## CHAPTER 2

# TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

### Section I

## DESCRIPTION



**3. DESCRIPTION** (fig. 1).

**a.** The transmission case is attached to the differential and final drive housing. Together they encase the drive between the propeller shaft and sprockets. The cast steel differential and final drive housing is mounted to the left and right frame side channels at the front of the vehicle by dowel pins and bolts. The transmission case is secured to the rear face of the differential and final drive housing. The differential and final drive housing is divided into three com-

partments: the center compartment containing the differential and steering brake bands, and the two side compartments containing the final drives.

**b.** Engine power enters the transmission at the rear from the propeller shaft. When the transmission is shifted into one of its four forward speeds, the power passes through a train of gears to the transmission output bevel pinion and differential. The differential is of the controlled type; that is, it is equipped with brake drums and brake bands on each side. Braking one side causes that side to slow down, and the opposite side to speed up. This provides the means by which the tractor is steered. The brake bands are connected by suitable linkage to two steering levers mounted on the differential and final drive housing cover. The final drive pinion shafts are spline-connected to the two compensating gears in the differential, and the two final drive shafts are flange-connected to the hubs with sprockets which drive the tracks.

**c.** Removal and installation of the transmission, differential, and final drives as a unit are described in TM 9-786.

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## Section II

# TRANSMISSION



## 4. DESCRIPTION AND OPERATION.

**a. Description** (fig. 2). The transmission is a constant-mesh type with helical gears. It has four forward speeds, one reverse speed, and includes the winch drive. The transmission has five shafts which are mounted in ball bearings in the transmission case. The case is bolted to the rear side of the differential and final drive housing. Shifting of the gears is accomplished by a lever mounted on the differential and final drive housing cover. This lever operates selectively any one of the three shifting shafts. Two of these shifting shafts have shifting yokes which engage sliding gear clutches to obtain the four forward speeds.

The third shifting shaft has a head mounted on it which engages an intermediate shaft. The intermediate shaft actuates a reverse gear shifting fork which engages the sliding reverse gear clutch to obtain reverse speed. The winch drive is engaged by a lever located at the lower right corner of the driver's seat. This lever is connected by a rod to the transmission winch shifting lever shaft which actuates the shifting fork on the sliding winch gear clutch.

**b. Mechanical Operation.**

(1) NEUTRAL (fig. 3). In neutral position, the following parts of the transmission all rotate when the engine is running and engine clutch is engaged: The input drive shaft, engine countershaft including the constant mesh gear and the third speed gear, winch wind and unwind gears, reverse idler gear and shaft, and third speed gear. Whenever the input drive shaft rotates, the countershaft and reverse shaft also rotate, and the reverse shaft operates the transmission oil pump. The oil pump circulates the oil supply through the filter and cooler, and maintains oil pressure in the transmission rear oil chamber. Lubricant is forced from this chamber through drilled holes in all the transmission shafts, except the reverse shaft, to the free running gears on the shafts. The reverse shaft has a drilled hole in the front end that is supplied with lubricant from a trough at the front of the transmission case.

(2) FIRST SPEED (fig. 4). Power enters through the input drive shaft, and passes through the constant mesh gear to the countershaft. From the countershaft, power passes through the countershaft first and second speed gear clutch, and the two first speed gears, out to the output shaft with bevel pinion.

(3) SECOND SPEED (fig. 5). The line of power in second speed is the same as for the first speed, except that the countershaft first and second speed gear clutch is engaged with the second speed gear on the countershaft.

(4) THIRD SPEED (fig. 6). Power enters through the input drive shaft, and passes through the constant mesh gear to the countershaft. From the countershaft it goes through the two third-speed gears. The third and fourth speed gear clutch is engaged with a third speed gear, and power from the third speed gear is transmitted to the output shaft with bevel pinion.

(5) FOURTH SPEED (fig. 7). The third and fourth speed clutch is engaged with the gear on the end of the input drive shaft. Power from the input drive shaft is transmitted straight through the output shaft with bevel pinion.

(6) REVERSE (fig. 8). The reverse gear clutch is engaged with the reverse idler gear. Power enters the input drive shaft, and is transmitted through the constant mesh gear, countershaft, third speed

**ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

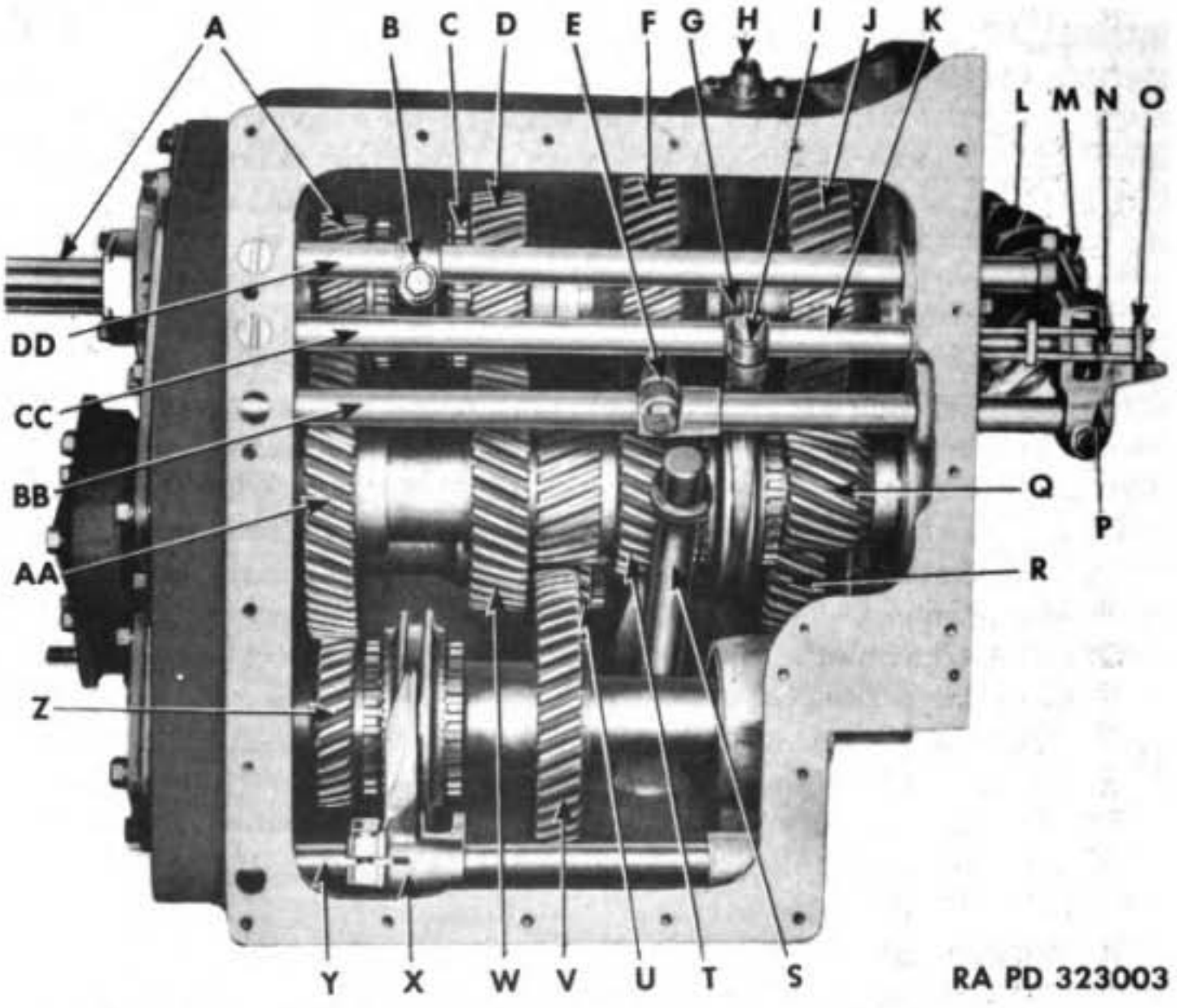


*Figure 2—Transmission with Cover Removed (Top View)*

gear, reverse idler gear, reverse pinion, and first speed gear, out to the output shaft with bevel pinion.

(7) WINCH UNWIND GEAR (fig. 9). The winch gear clutch is engaged with the winch unwind gear. Power enters the input drive shaft, and is transmitted through the constant mesh gear, and winch unwind gear, to the winch drive shaft.

(8) WINCH WIND GEAR (fig. 10). The winch gear clutch is engaged with the winch wind gear. Power enters the input drive shaft, and is transmitted through the constant mesh gear, countershaft, third speed gear, reverse idler gear, and winch wind gear, to the winch drive shaft.

## 5. REMOVAL.

**a. Preliminary Instructions.** A feature of this transmission is that it can be completely disassembled and assembled while the transmission case is installed in the vehicle, without disconnecting it from the differential and final drive housing. If, however, it is necessary to replace the transmission case, or replace a matched-set bevel pinion

**TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES**

**A.** INPUT DRIVE SHAFT
**B.** THIRD AND FOURTH SPEED GEAR SHIFTING FORK
**C.** FOURTH SPEED GEAR
**D.** THIRD SPEED GEAR
**E.** REVERSE GEAR UPPER SHIFTING SHAFT HEAD—REAR
**F.** SECOND SPEED GEAR
**G.** SPEEDOMETER WORM
**H.** SPEEEDOMETER DRIVE SHAFT BEARING SLEEVE
**I.** FIRST AND SECOND SPEED GEAR SHIFTING FORK
**J.** FIRST SPEED GEAR
**K.** FIRST AND SECOND SPEED GEAR SHIFTING SHAFT
**L.** OUTPUT SHAFT WITH BEVEL PINION
**M.** THIRD AND FOURTH SPEED GEAR SHIFTING SHAFT HEAD
**N.** FIRST AND SECOND SPEED GEAR SHIFTING SHAFT HEAD
**O.** GEAR SHIFTING GUIDE
**P.** REVERSE GEAR UP SHIFTING SHAFT HEAD—FRONT
**Q.** COUNTERSHAFT FIRST SPEED GEAR
**R.** REVERSE PINION
**S.** REVERSE GEAR INTERMEDIATE SHIFTING SHAFT
**T.** COUNTERSHAFT SECOND SPEED GEAR
**U.** REVERSE IDLER GEAR
**V.** WINCH WIND GEAR
**W.** COUNTERSHAFT THIRD SPEED GEAR
**X.** WINCH GEAR SHIFTING FORK
**Y.** WINCH SHIFTING SHAFT
**Z.** WINCH UNWIND GEAR
**AA.** CONSTANT MESH GEAR
**BB.** REVERSE GEAR SHIFTING SHAFT—UPPER
**CC.** FIRST AND SECOND SPEED GEAR SHIFTING SHAFT
**DD.** THIRD AND FOURTH SPEED GEAR SHIFTING SHAFT

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***Legend for Figure 2***

and drive gear, the complete transmission must be removed before it is disassembled. This is done so that the distance between the end of the bevel pinion and the transmission case (fig. 50) can be accurately measured before the output shaft with bevel pinion is removed from the case. The measurement is needed when installing the same output shaft with bevel pinion in a new transmission case, in order to get the pinion settings the same as in the old case. When a new output shaft with bevel pinion is installed in the same or a new transmission case, it is also necessary to consider the markings on the end of the pinion to obtain the correct pinion setting, as described in paragraph 8 c. Whenever a new output shaft with bevel pinion is installed, it is also necessary to install a new matched bevel drive gear in the

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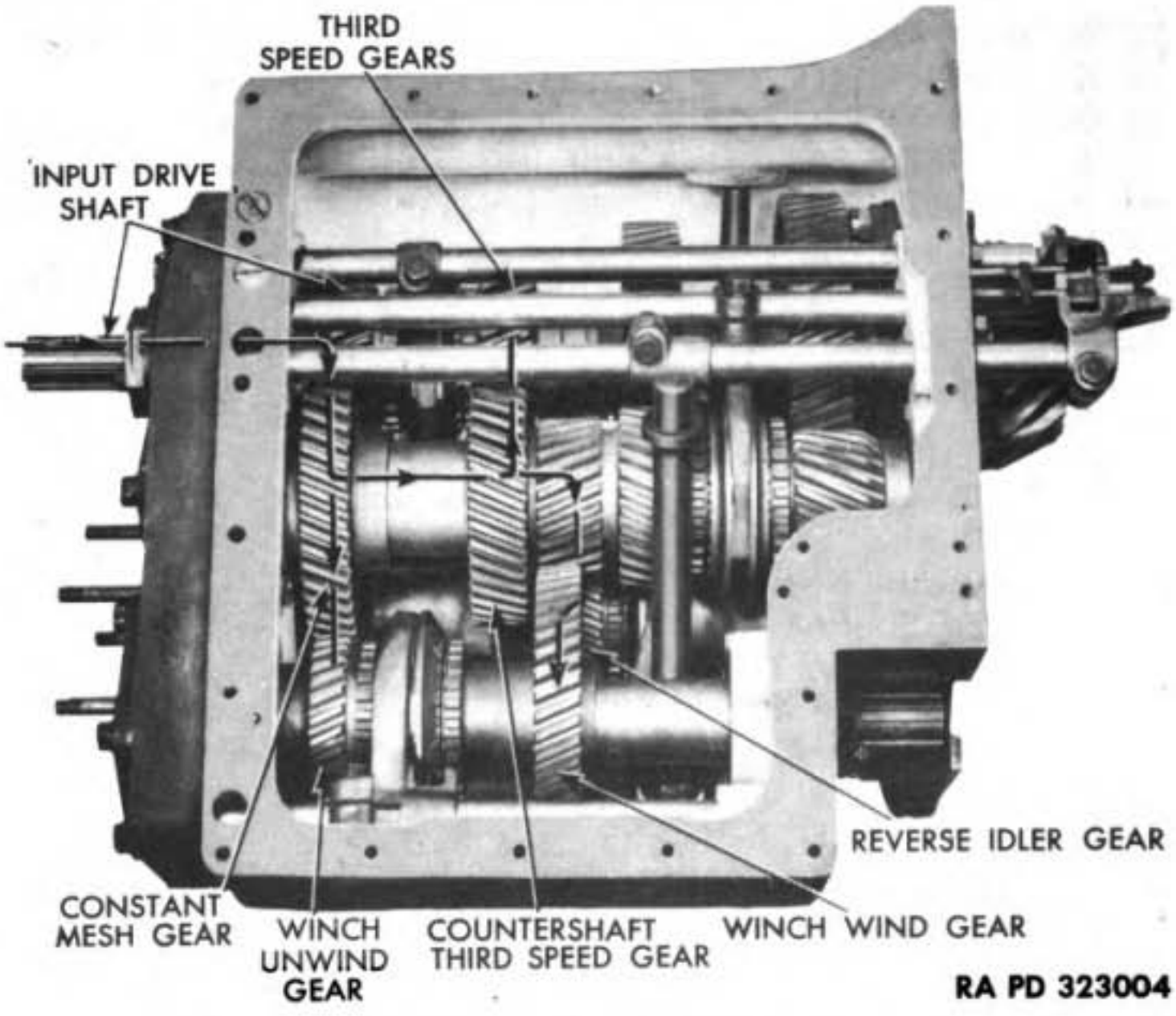



***Figure 3 — Transmission in Neutral Position***

differential, as these units are furnished in matched Sets. Refer to differential removal and disassembly procedures, paragraphs 12 and 13.

**b. Remove Center Bottom Plates, Front and Center.** Remove 18 cap screws and lock washers attaching front center bottom plate. Remove 18 cap screws and lock washers attaching center bottom plate, center.

**c. Drain Transmission and Differential.** Refer to TM 9-786. Also remove drain plug at bottom of transmission oil gallery, and remove vent plug at top of transmission oil cooler to provide better drainage of oil from cooler and pipes.

**d. Remove Transmission and Differential Oil Screen.** Refer to TM 9-786.

**e. Remove Driver's Seat.** Refer to TM 9-786.

**f. Remove Shell Box.** Refer to TM 9-786.

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

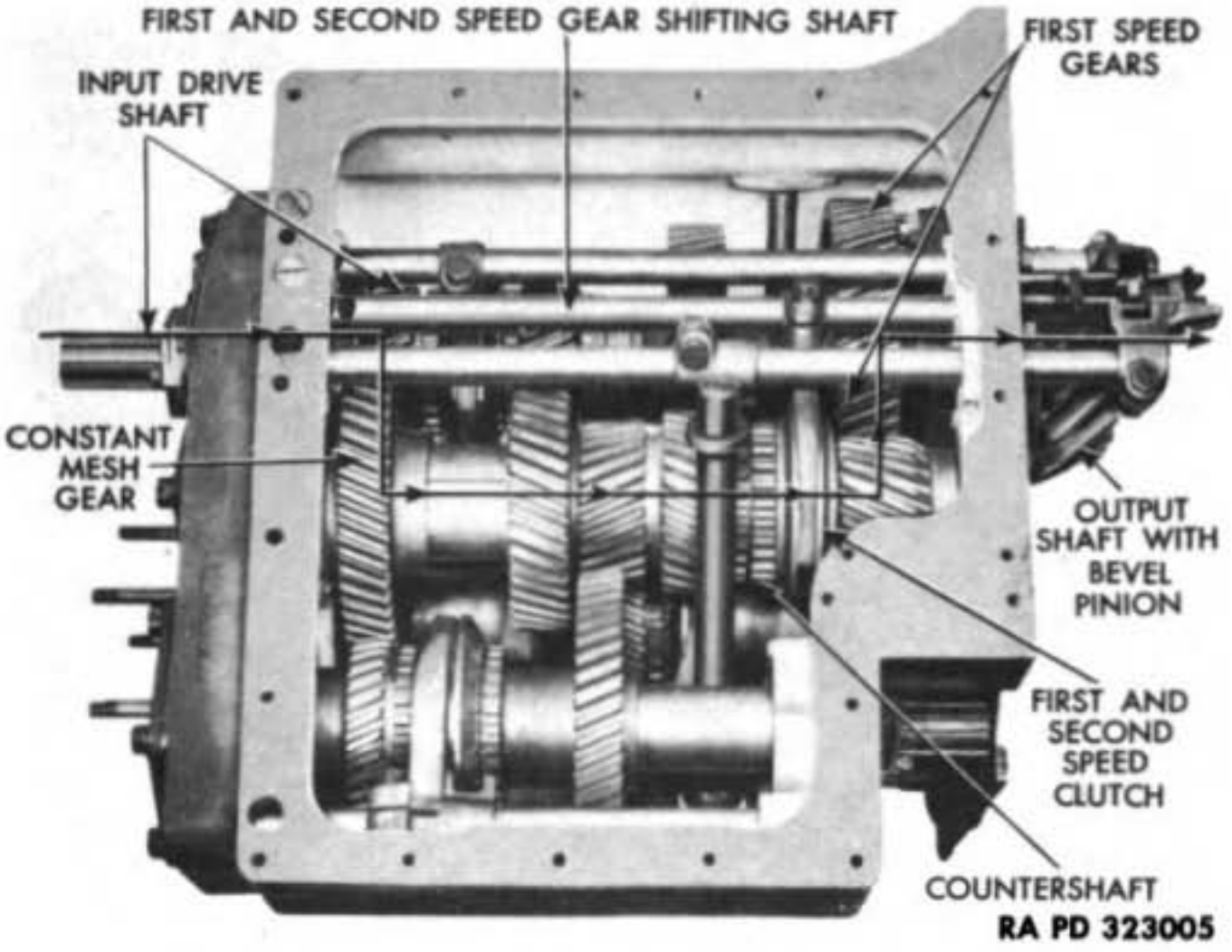



***Figure 4 — Transmission in First Speed Gear***

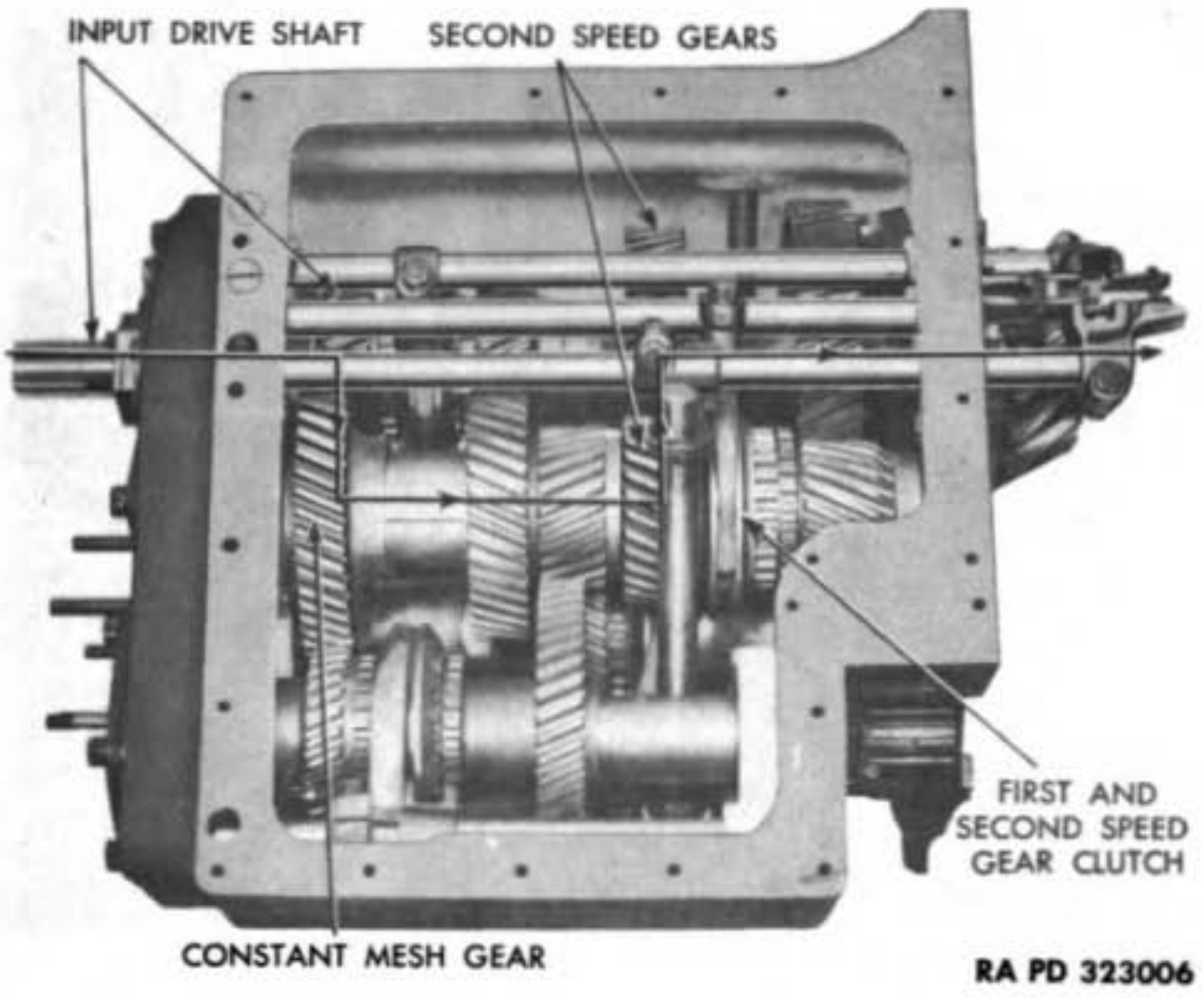



***Figure 5 — Transmission in Second Speed Gear***

**ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

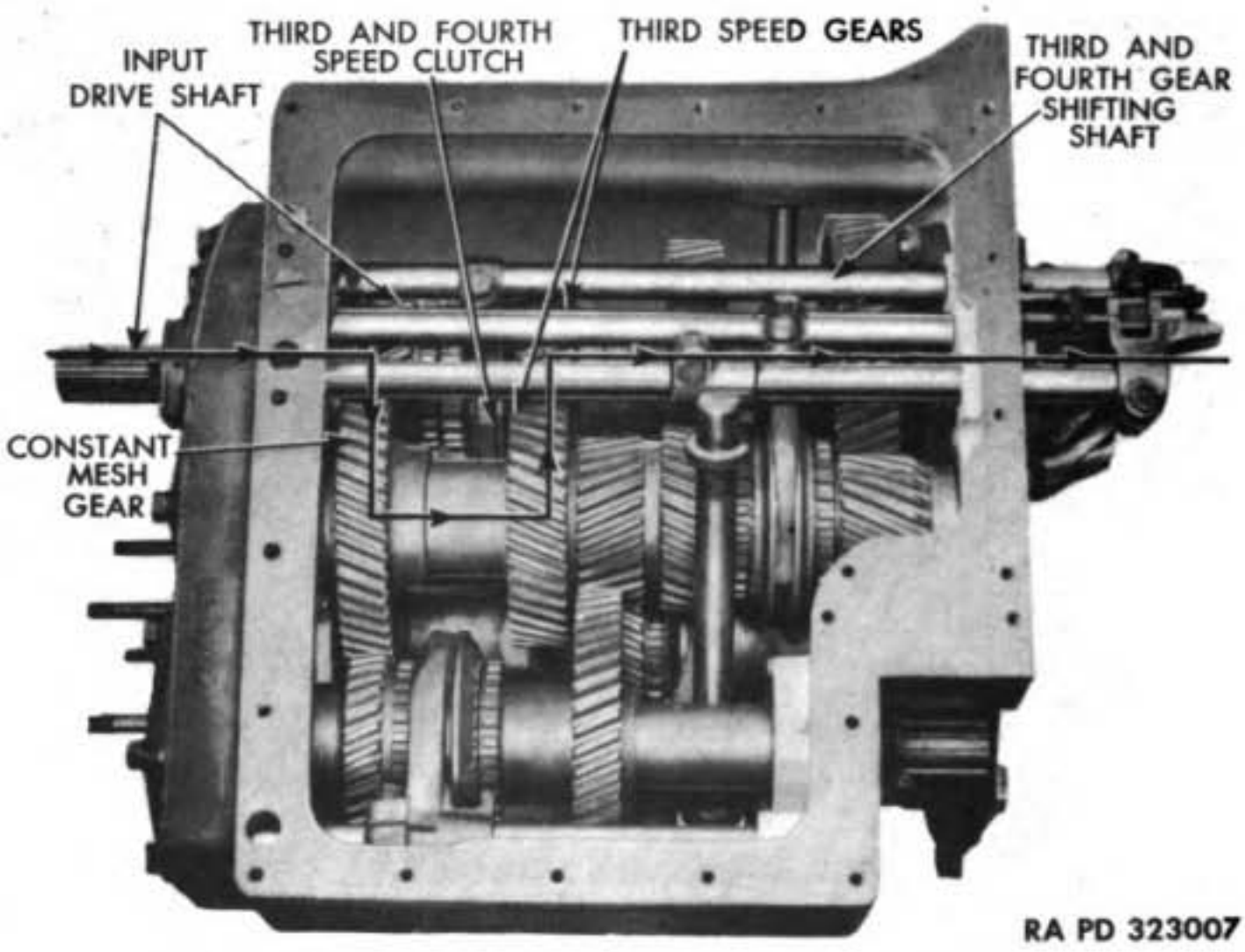



***Figure 6 — Transmission in Third Speed Gear***

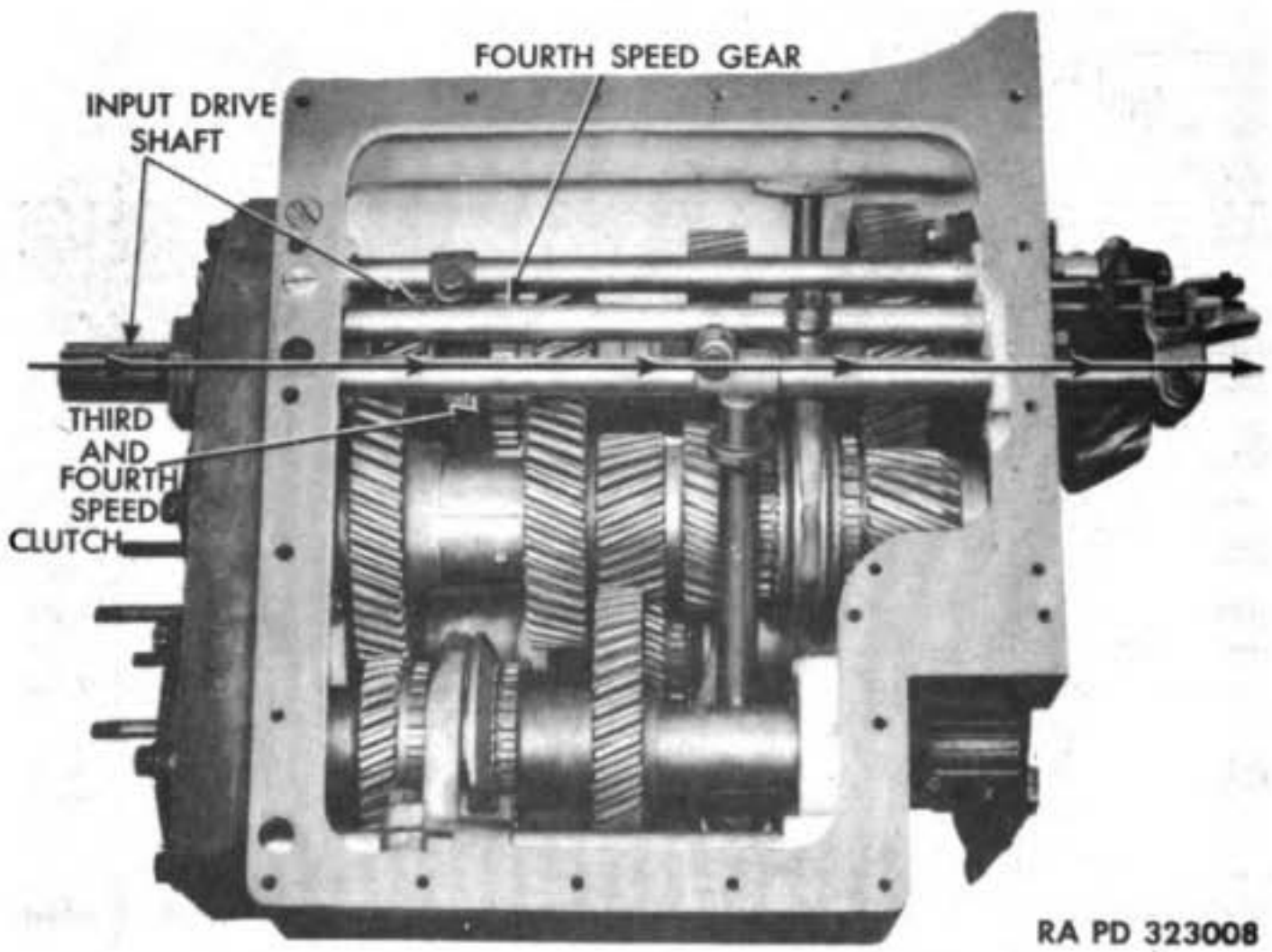



***Figure 7 — Transmission in Fourth Speed Gear***

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

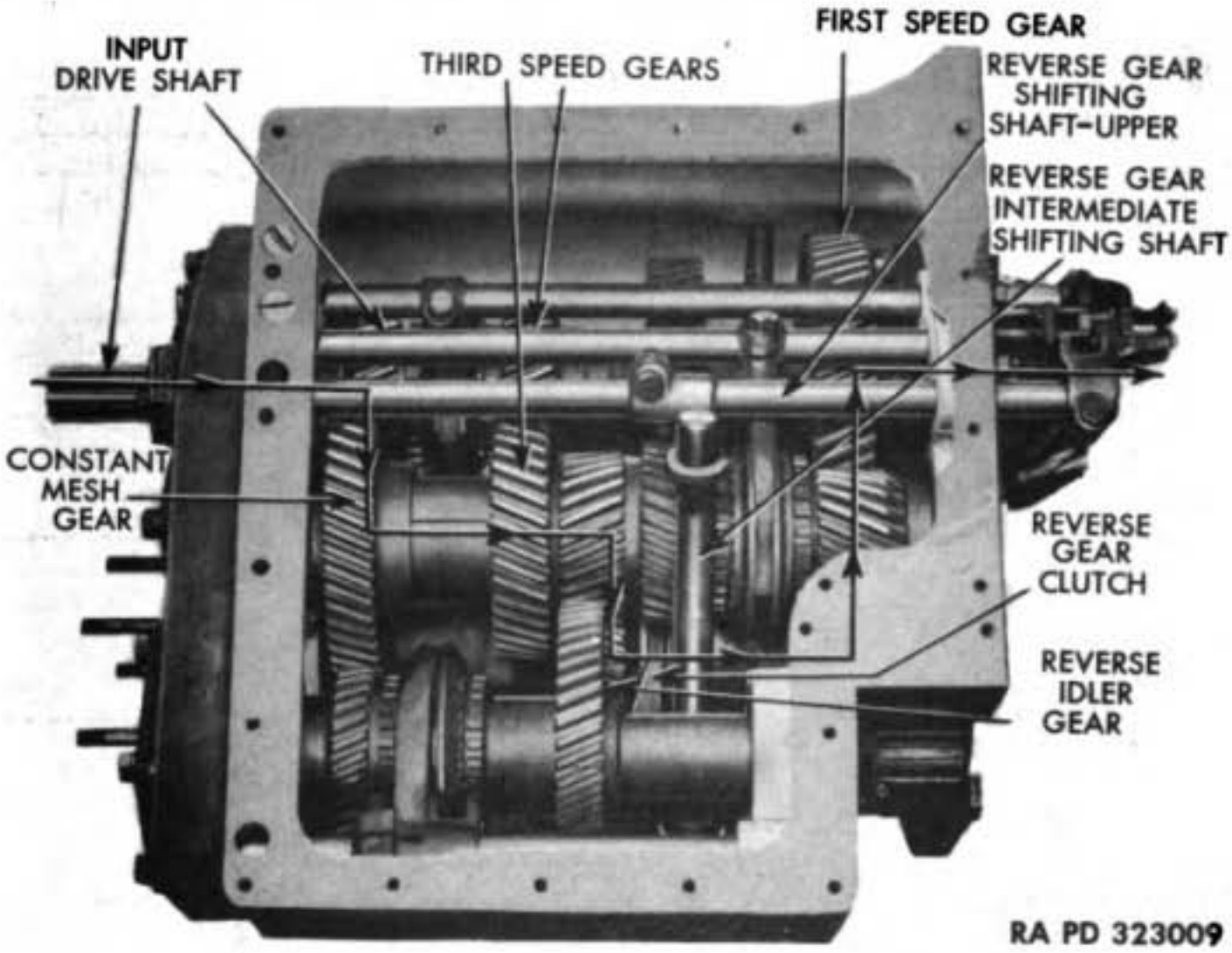



***Figure 8 — Transmission in Reverse Gear***

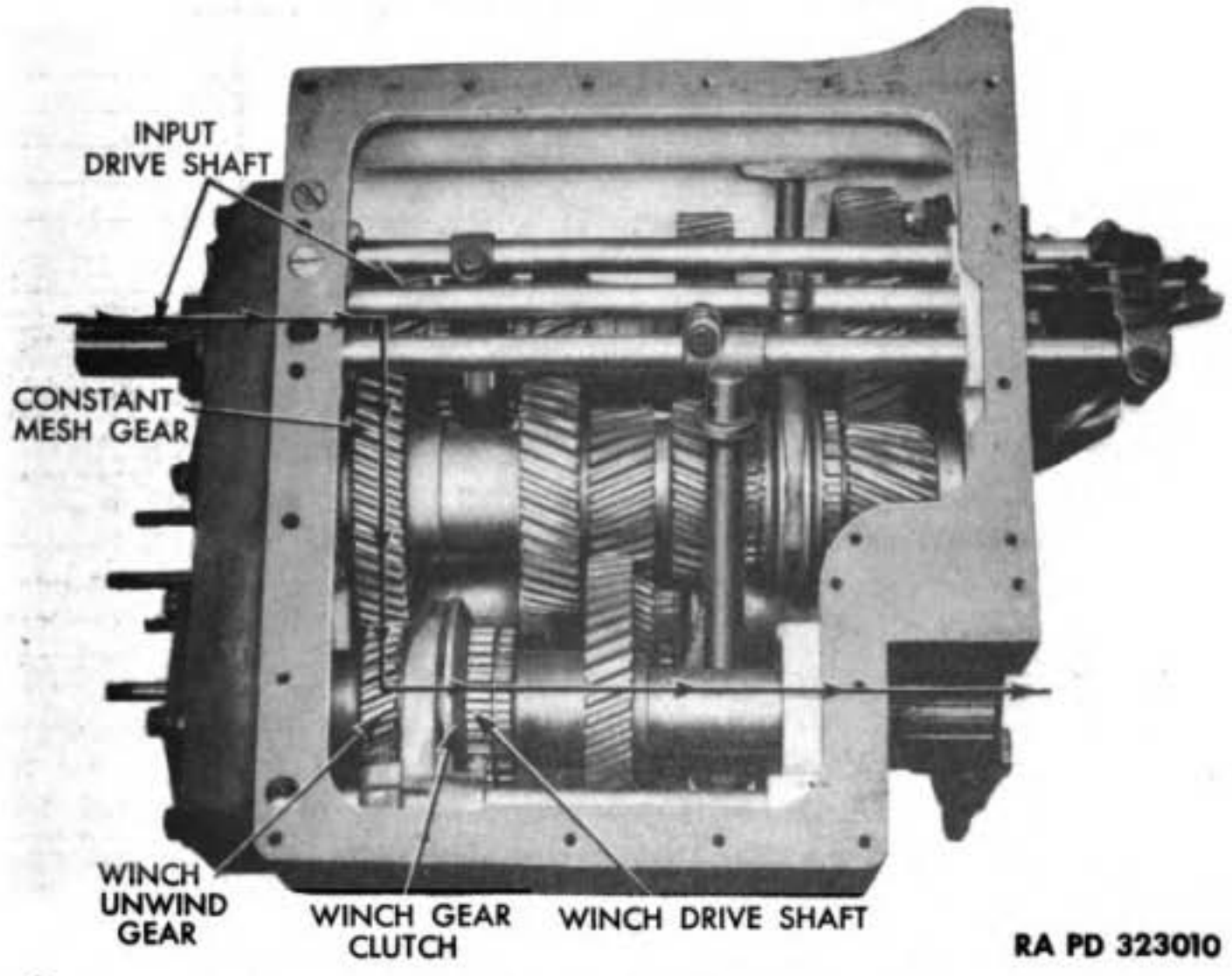



***Figure 9 — Transmission in Winch Unwind Gear***

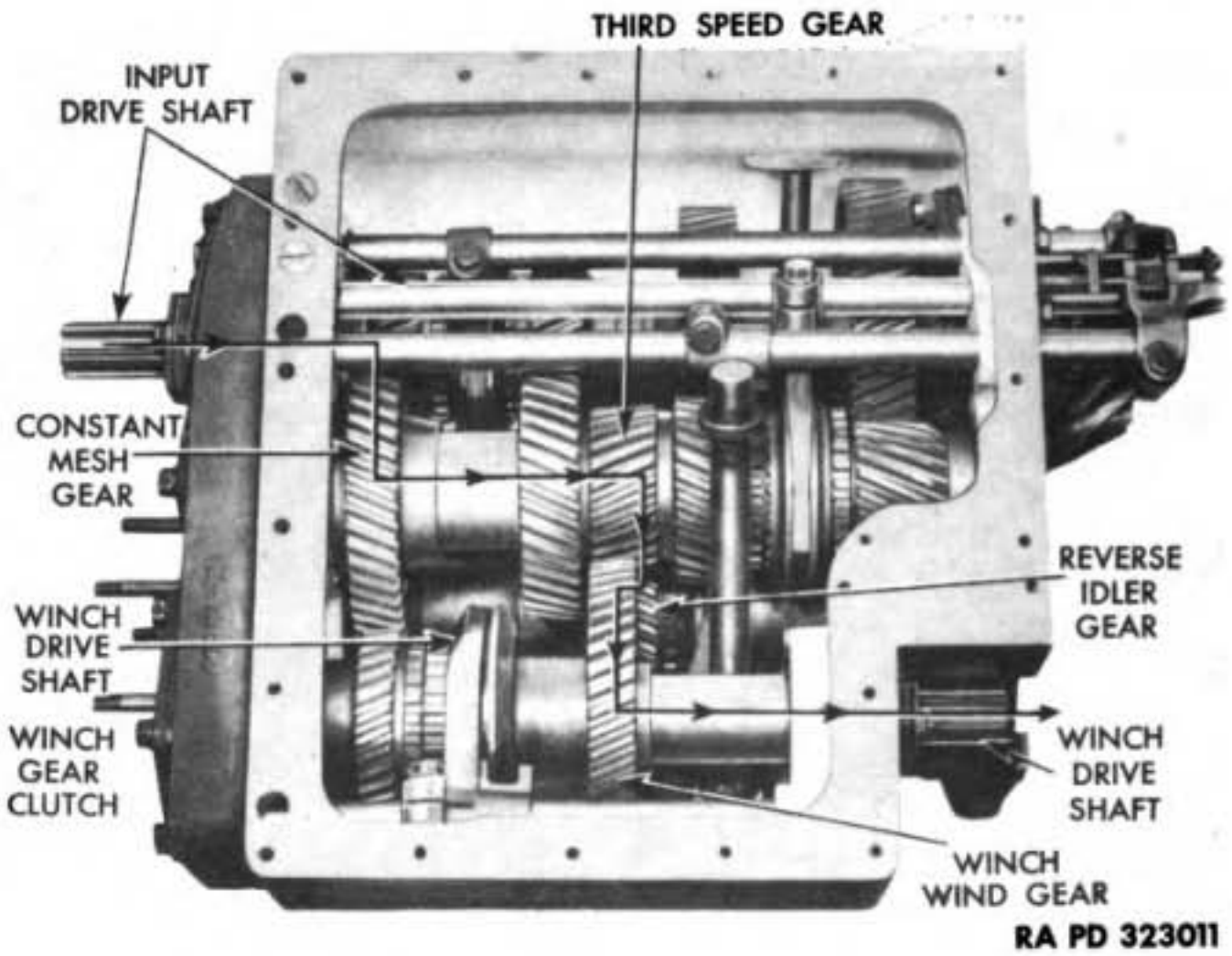



*Figure 10 — Transmission in Winch Wind Gear*

**g. Remove Shell Box Support** (fig. 11). Open drain valve at bottom of gear reduction unit, and drain cooling system. Remove the two cap screws and lock washers attaching coolant elbow to left side of clutch housing. Loosen hose clamp attaching hose to coolant return pipe, and remove left elbow with hose and elbow gasket. Remove nut and lock washer attaching left fuel gage cable to terminal, and remove cable from terminal, removing one clip, and pulling cable through shell box support opening. Repeat operation on right fuel gage cable. Remove left cable harness from five cable clips, and right cable harness from three cable clips on shell box support. Remove tachometer cable and engine heat indicator cable from two clips on shell box support. Disconnect transmission oil filter control rod from ratchet handle by removing cotter pin. Remove cotter pin and pin connecting air tank drain control rod to cross lever. Remove two cap screws and lock washers attaching gear reduction oil filler tube to shell box support. Loosen one clamp attaching hose to oil filler tube, and remove tube from hose. Remove eight cap screws and lock washers attaching shell box support to frame side channels. Remove shell box support by first raising front end, then moving it off of coolant pipe in left rear corner.

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

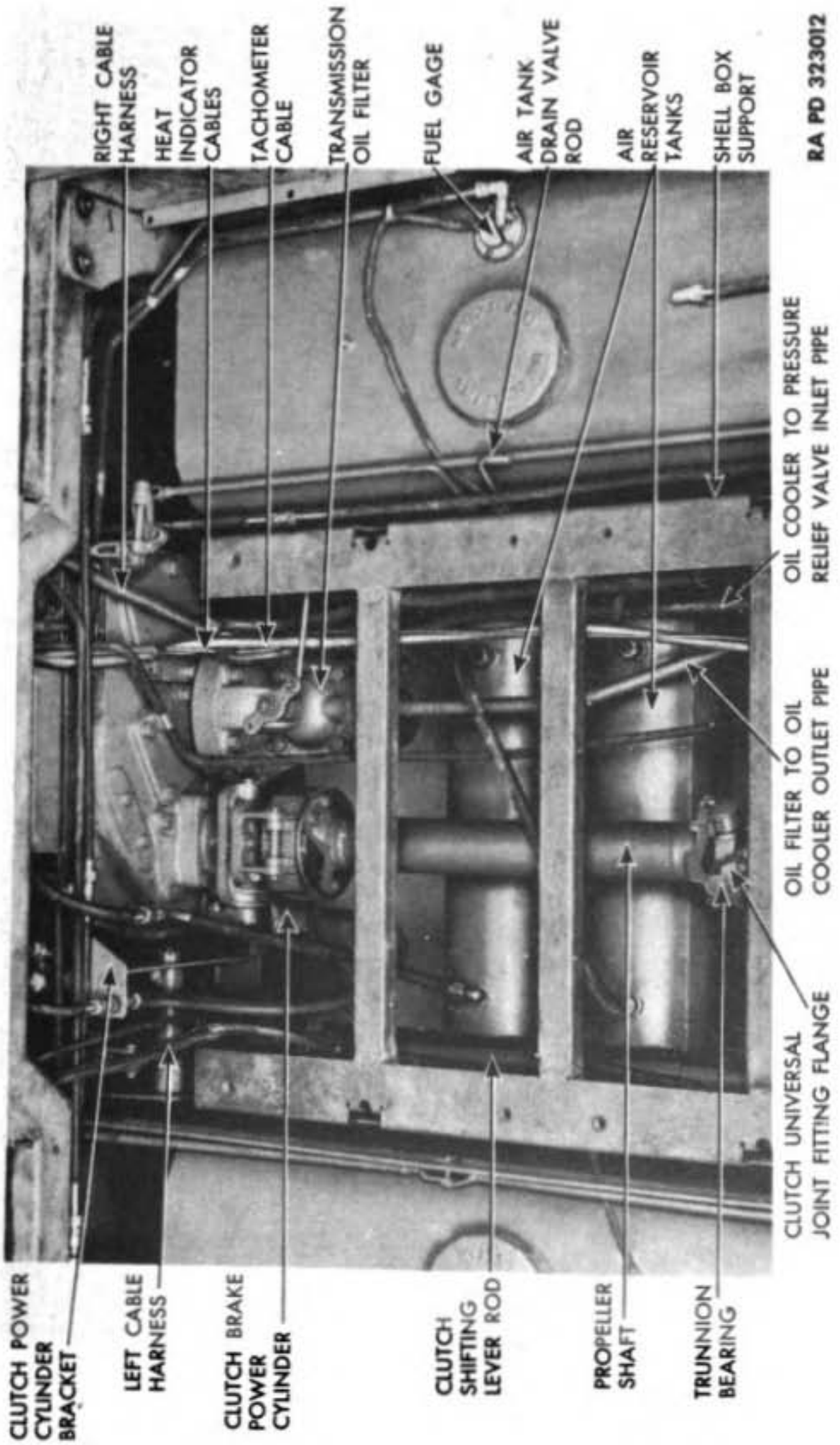
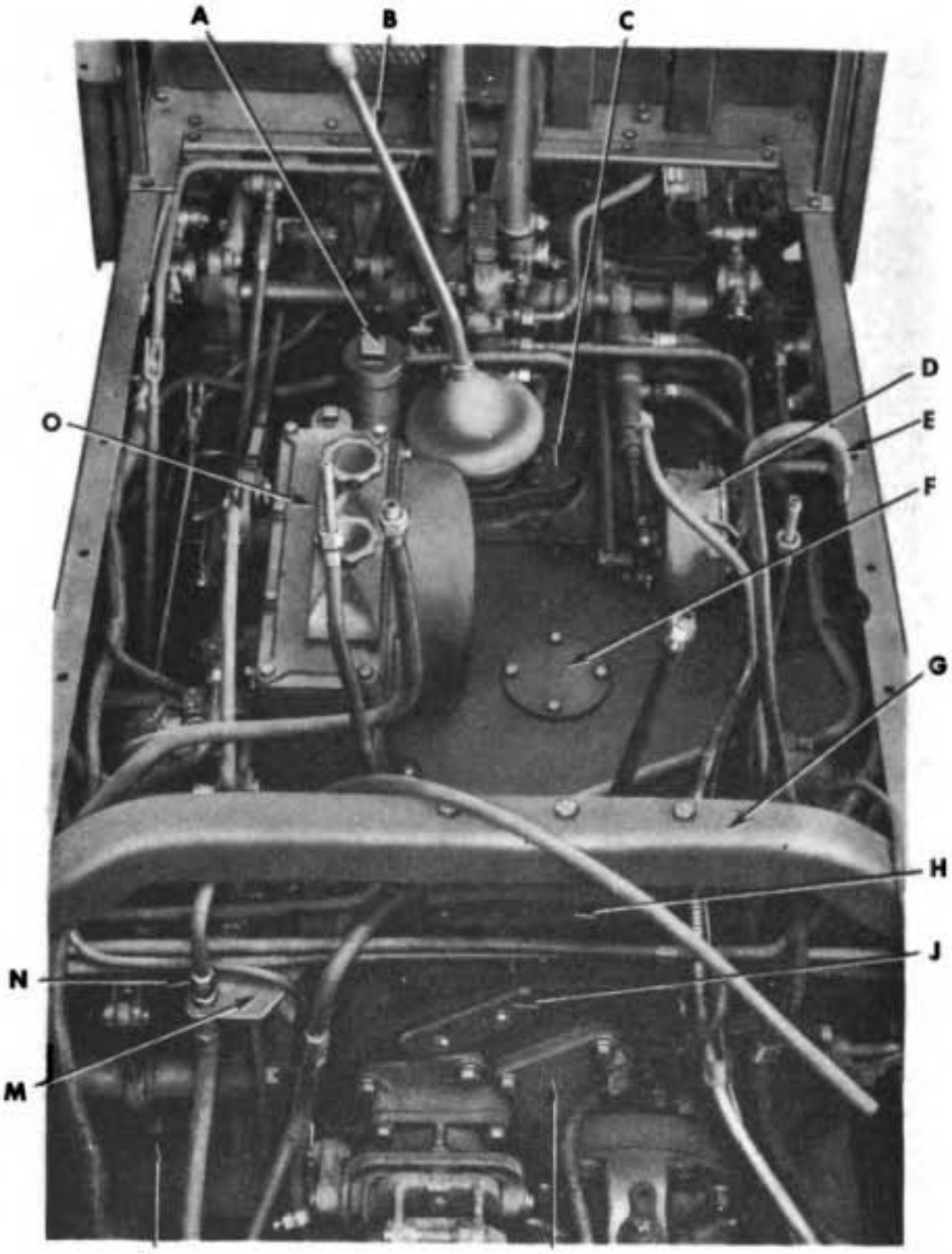



***Figure 11 — Shell Box Support and Air Reservoir Tanks***

## ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)




A—TRANSMISSION OIL GAGE
B—GEARSHIFT LEVER
C—GEARSHIFT LEVER SWIVEL HOUSING
D—ELECTRIC BRAKE CONTROLLER
E—WINCH SHIFTING LEVER VENT TUBE
F—REVERSE GEAR INTERMEDIATE SHIFTING SHAFT BEARING
G—FENDER SUPPORT CROSSMEMBER
H—CROSSMEMBER BRACE
J—SHIFTING SHAFT SEALING PLATE
K—COUNTERSHAFT BEARING RETAINER
L—CLUTCH POWER CYLINDER LEVER
M—CLUTCH POWER CYLINDER BRACKET
N—ADAPTER
O—CLUTCH SELECTOR UNIT

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***Figure 12 — Top and Rear View of Transmission with Sea and Shell Box Removed***

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

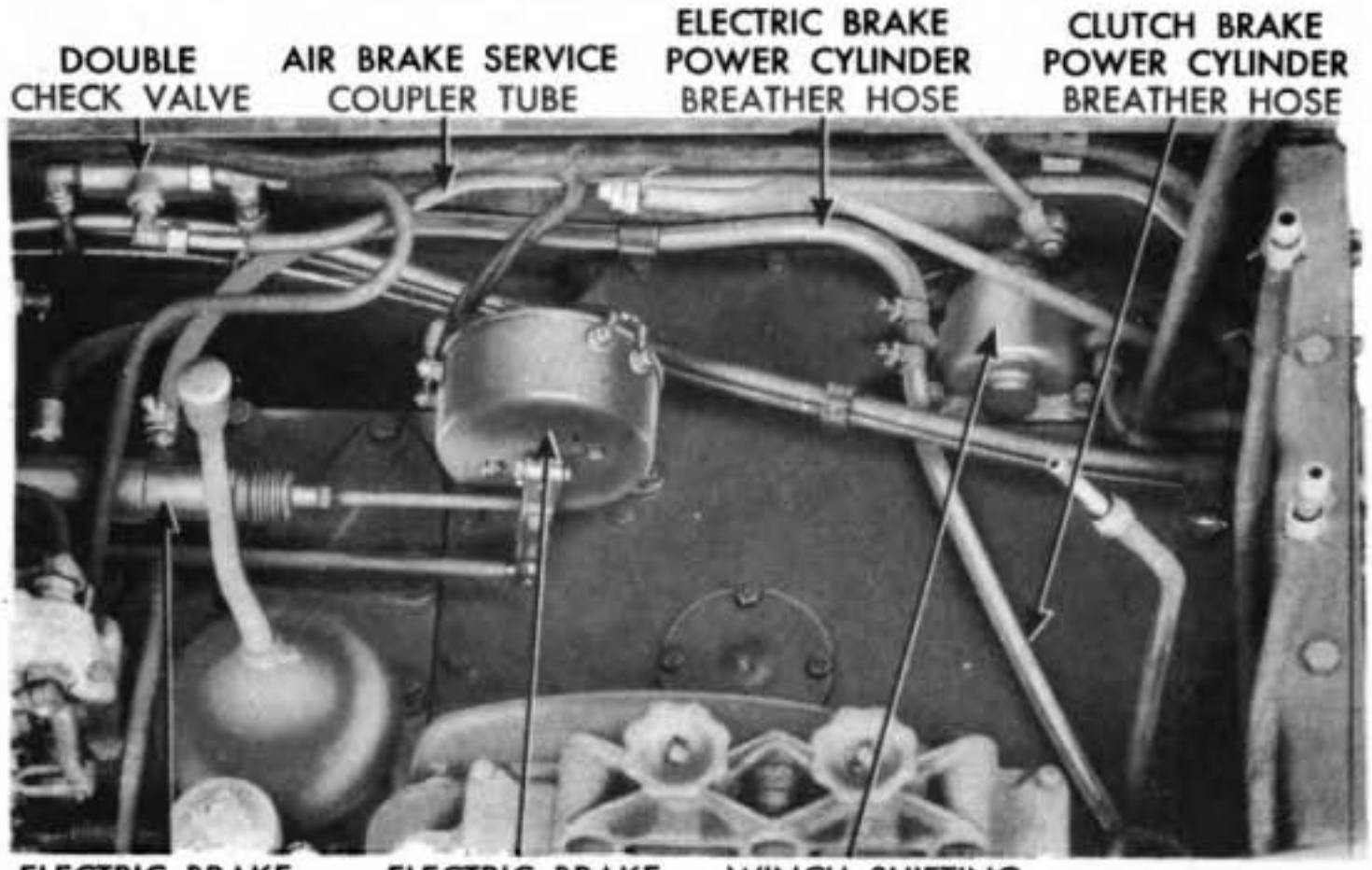


***Figure 13 — Tubing and Cables Along Right of Driver's Seat Support***

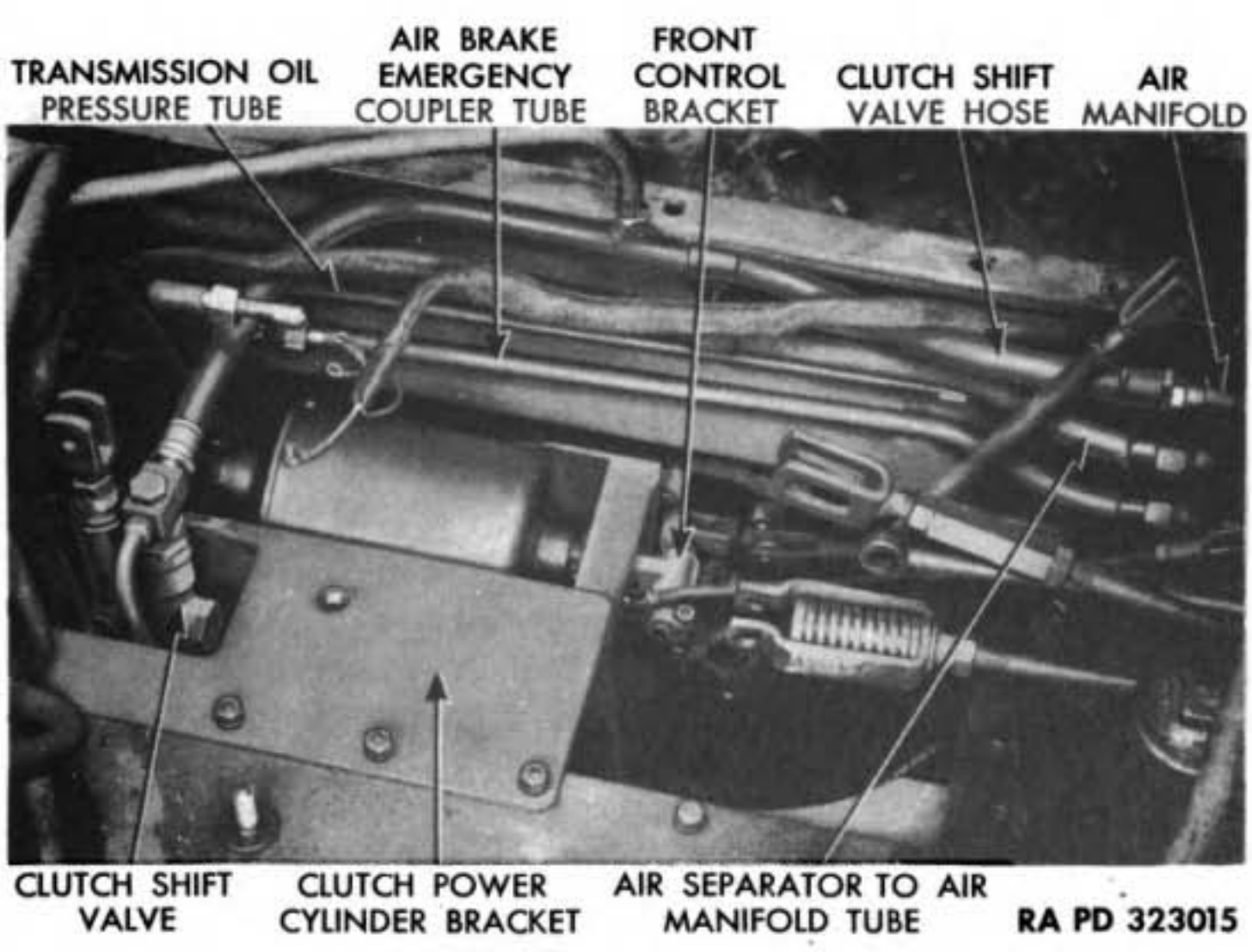


***Figure 14 — Clutch Power Cylinder Bracket Assembly — Installed***

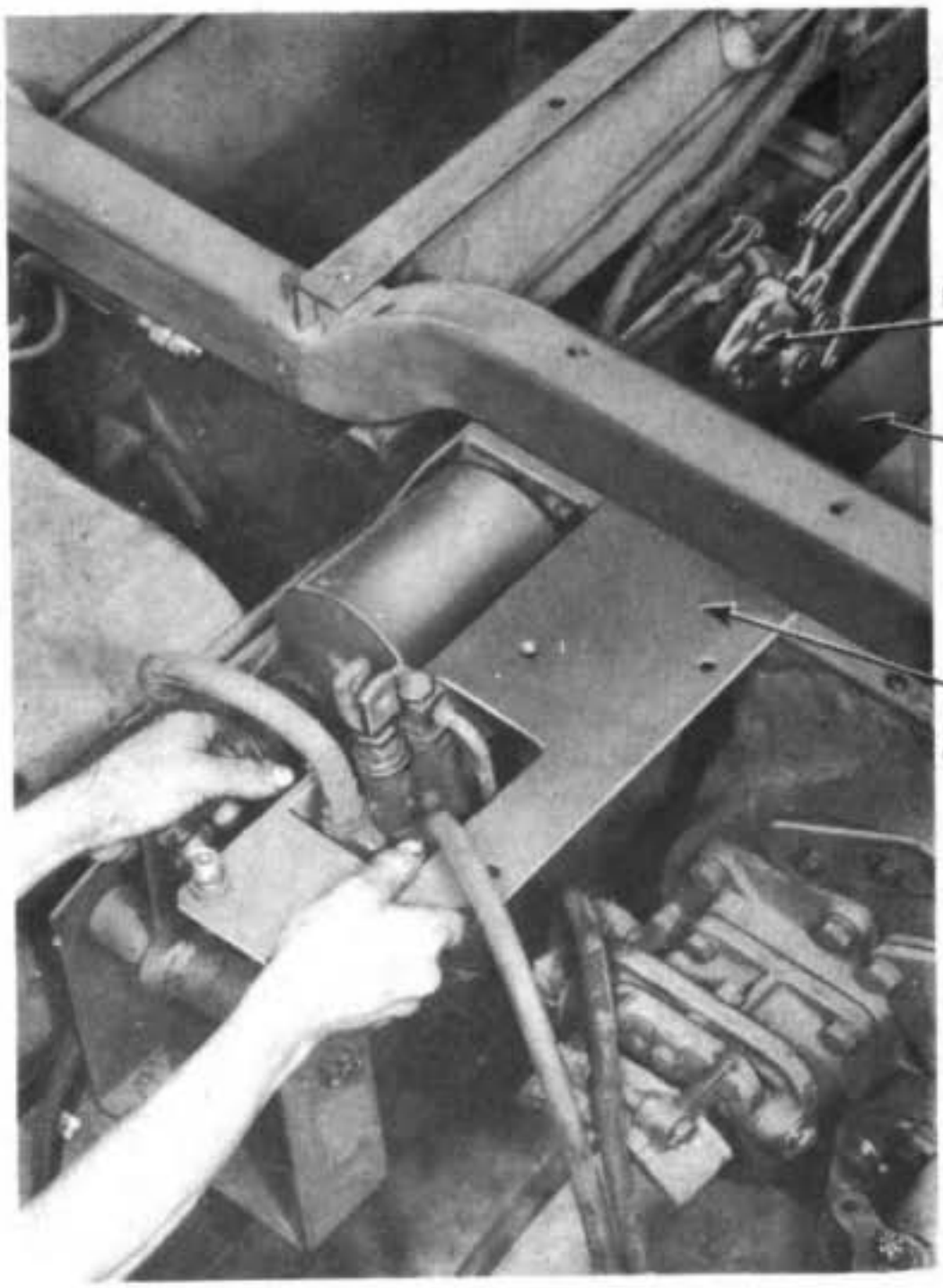


*Figure 15 — Removing Clutch Power Cylinder Bracket*

**h. Remove Propeller Shaft.** Refer to TM 9-786.

**i. Remove Air Reservoir Tanks.** Refer to TM 9-786.

**j. Remove Clutch Selector Unit.** Refer to TM 9-786.

**k. Remove Electric Brake Controller.** Refer to TM 9-786.

**l. Remove Clutch Power Cylinder Bracket Assembly.** Remove clutch shifting valve hose (fig. 14). Remove clutch brake application valve to adapter tube (fig. 12). Remove air separator to manifold tube (fig. 14). Remove air brake emergency coupler tubes with tee (fig. 14). Remove transmission oil pressure tube (fig. 14). Remove air brake service coupler tube (fig. 13). Remove left and right fuel filter to fuel tank tubes. Remove three cap screws, nuts, and lock washers attaching front control bracket to clutch power cylinder bracket (fig. 14). Remove two cap screws and lock washers from inside left front compartment, permitting forward end of compart-

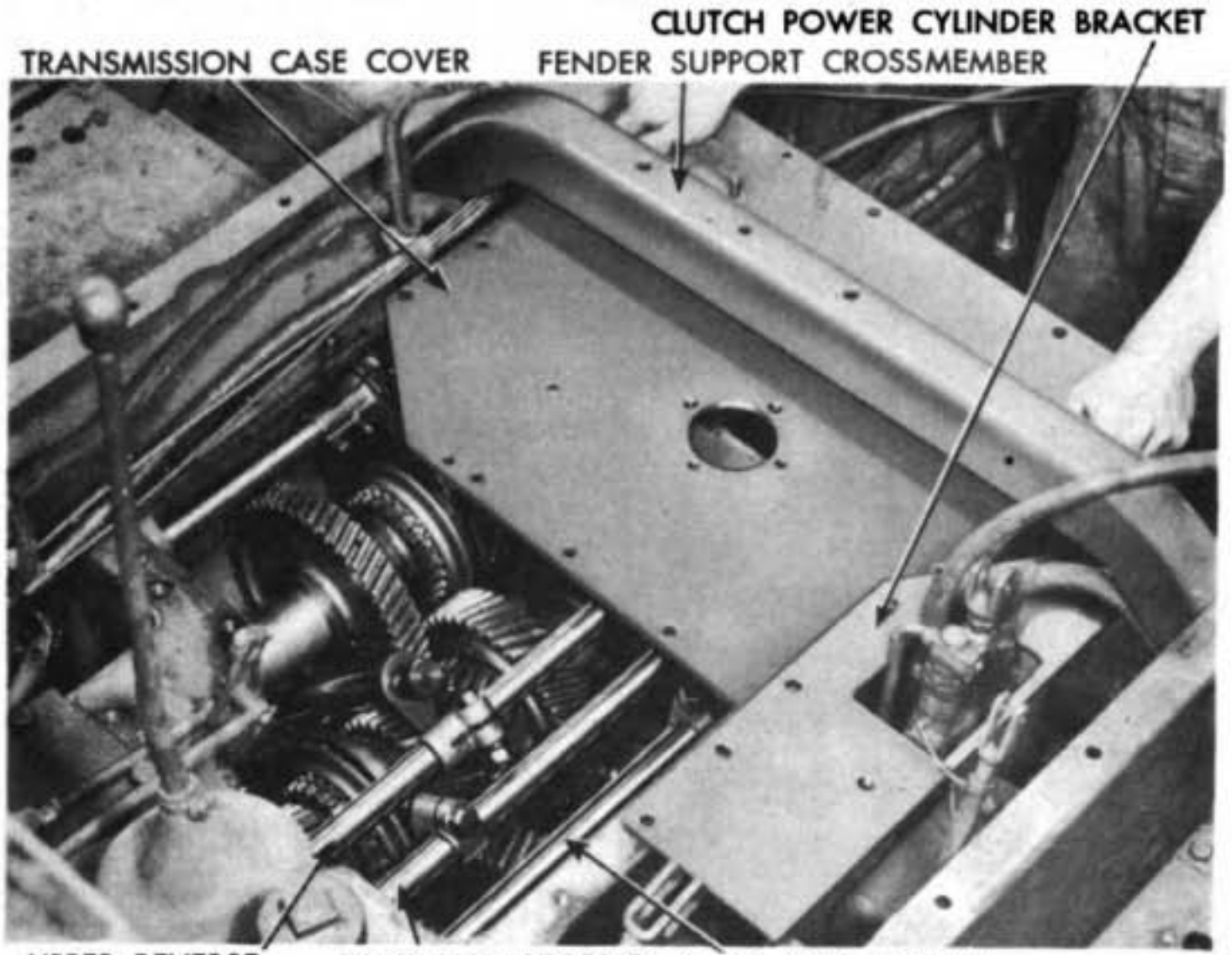


***Figure 16 — Removing Transmission Case Cover***

ment rear side sheet to be moved aside so that the power cylinder bracket attaching screws can be reached with a wrench. Remove four cap screws, nuts, and lock washers attaching power cylinder bracket to left frame side channel (fig. 12). Remove four cap screws and lock washers attaching power cylinder bracket to transmission cover (fig. 14). Remove two pins and cotter pins attaching clutch shifting lever rod, and remove rod (fig. 11). Disconnect clutch brake power cylinder hose from adapter on power cylinder bracket (fig. 12). Slide power cylinder bracket along left frame side channel, and remove from vehicle (fig. 15).

**m. Remove Transmission Oil Pump.** Refer to TM 9-786.

**n. Remove Transmission Case Cover.** Remove six cap screws, three nuts, and six lock washers attaching crossmember brace (fig. 12) to rear of transmission cover and to crossmember, and remove brace. Remove winch shifting lever vent tube (fig. 12). Remove two hoses attached to tee on winch shifting lever housing (fig. 13). Remove four nuts and lock washers attaching winch shifting lever housing (fig. 13) to transmission cover, and lift winch shifting lever housing and gasket from studs in cover. Remove four cap screws and lock

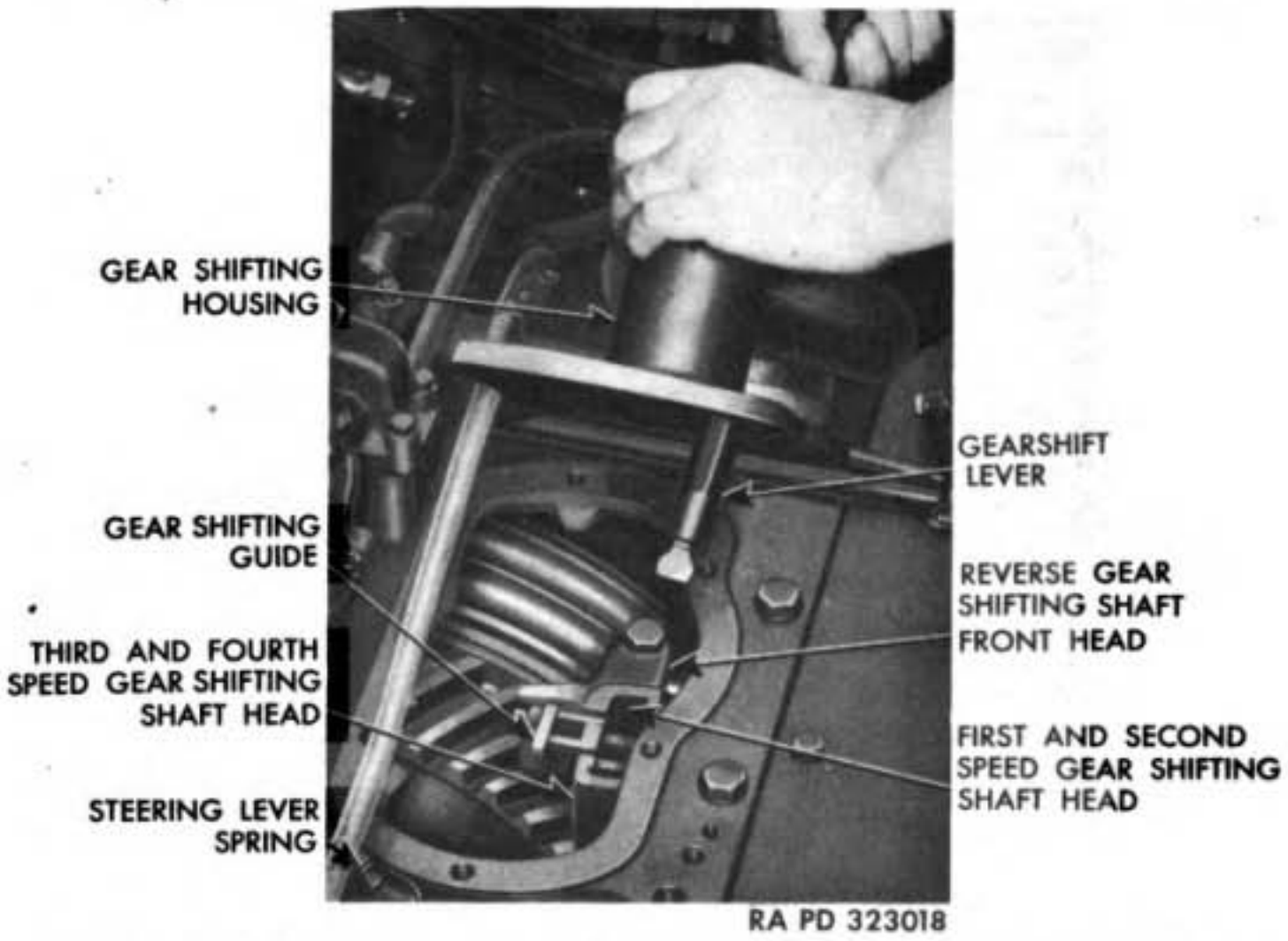


***Figure 17 — Removing Gearshift Lever Swivel Housing Assembly***

washers attaching shifting shaft bearing (fig. 12). Remove bearing and gasket from transmission cover. Remove 13 cap screws and lock washers attaching transmission cover to transmission housing, and lift cover from housing (fig. 16). NOTE: *Transmission case cover can be removed without removing clutch power cylinder bracket assembly, as shown in figure 16.*

**o. Remove Gear Shifting Lever Swivel Housing Assembly** (fig. 17). Unhook two steering lever springs from anchors. Remove transmission oil level rod from shifting lever housing. Remove six cap screws and lock washers attaching shifting lever housing to differential housing cover, and lift shifting lever housing assembly from differential cover. Peel off gasket.

**p. Remove Gear Shifting Heads and Guide.** Remove two cap screws and lock washers attaching shifting shaft sealing plate to rear of transmission housing, and remove sealing plate and gasket (fig. 12). Remove two clamping cap screws with lock washers from the two transmission gear shifting forks ("B" and "G", fig. 2). Remove clamping cap screw, nut, and lock washer from shifting head ("M", fig. 2), and remove head from shaft. Repeat operation for removing heads "N" and "P" (fig. 2). Push the three shifting shafts into the transmission until they disengage the differential housing. Turn re-

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

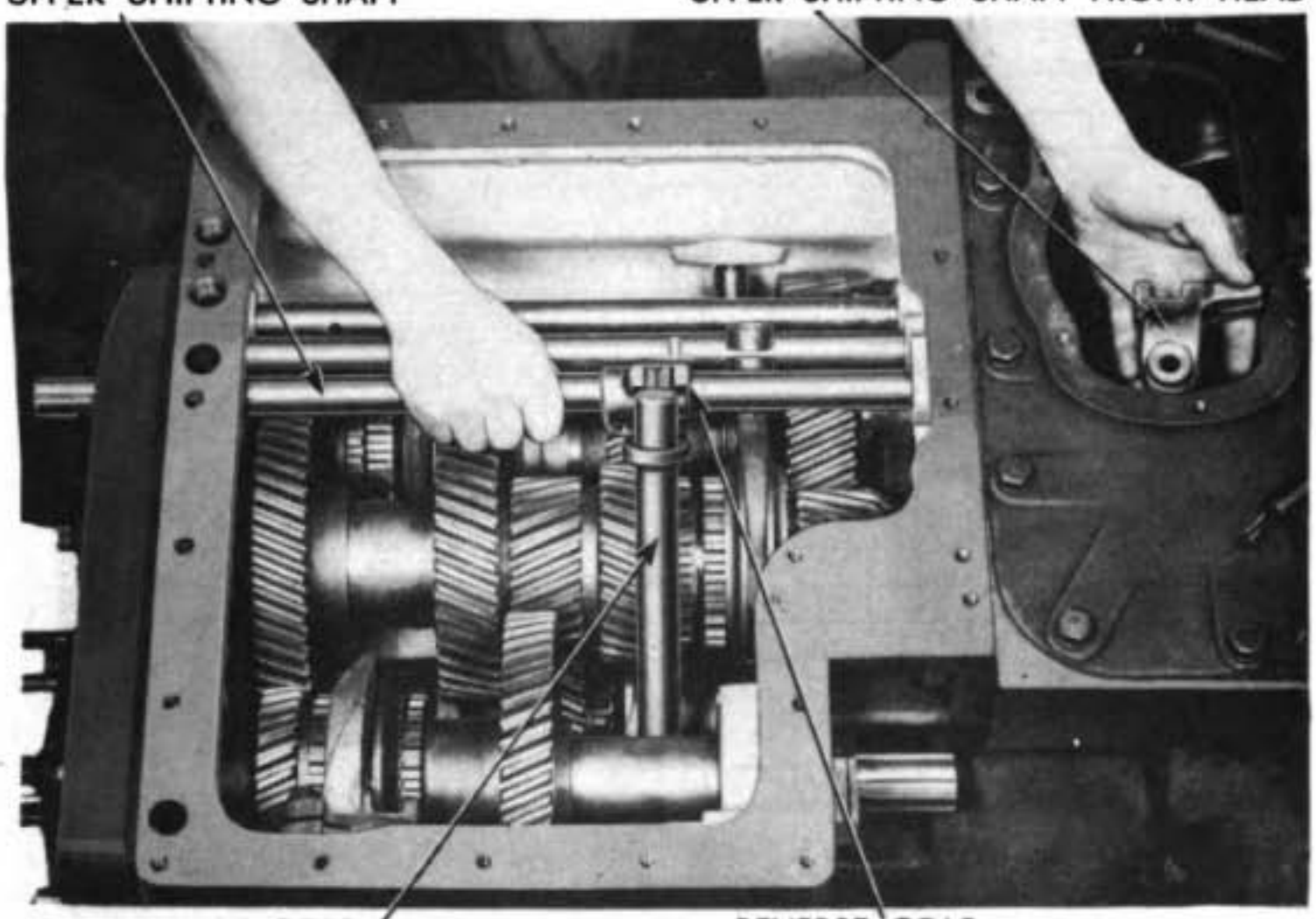


***Figure 18 — Removing Reverse Gear Upper Shifting Shaft Rear Head***

verse gear shifting shaft housing (fig. 18). Remove two attaching cap screws and lock washers, and remove shifting guide.

**q. Remove Transmission Assembly.** Remove four cap screws and lock washers attaching transmission countershaft rear bearing retainer to transmission case, and remove retainer (fig. 12). Install rear transmission lifting bracket (41-B-1926-755) in place of rear bearing retainer, and attach with four cap screws and lock washers (fig. 19). Install front lifting bracket (41-B-1926-750) to top rear of transmission with four cap screws and lock washers. Attach wire rope around both lifting brackets, and attach a hoist hook so that transmission will balance when lifted. Raise hoist hook until wire ropes are taut. Remove retaining nut, and disconnect speedometer cable from adapter on left side of transmission. Remove cotter pin and pin in winch drive shaft coupling, and slide coupling forward on drive shaft. Remove 7 cap screws, 3 nuts, and 10 lock washers attaching transmission case to differential housing. Suspend transmission with hoist, and move it toward rear of vehicle so that it clears between frame crossmember and fender support crossmember. When front wire rope reaches fender support crossmember, block up rear of transmission on frame, and set front edge of transmission on frame

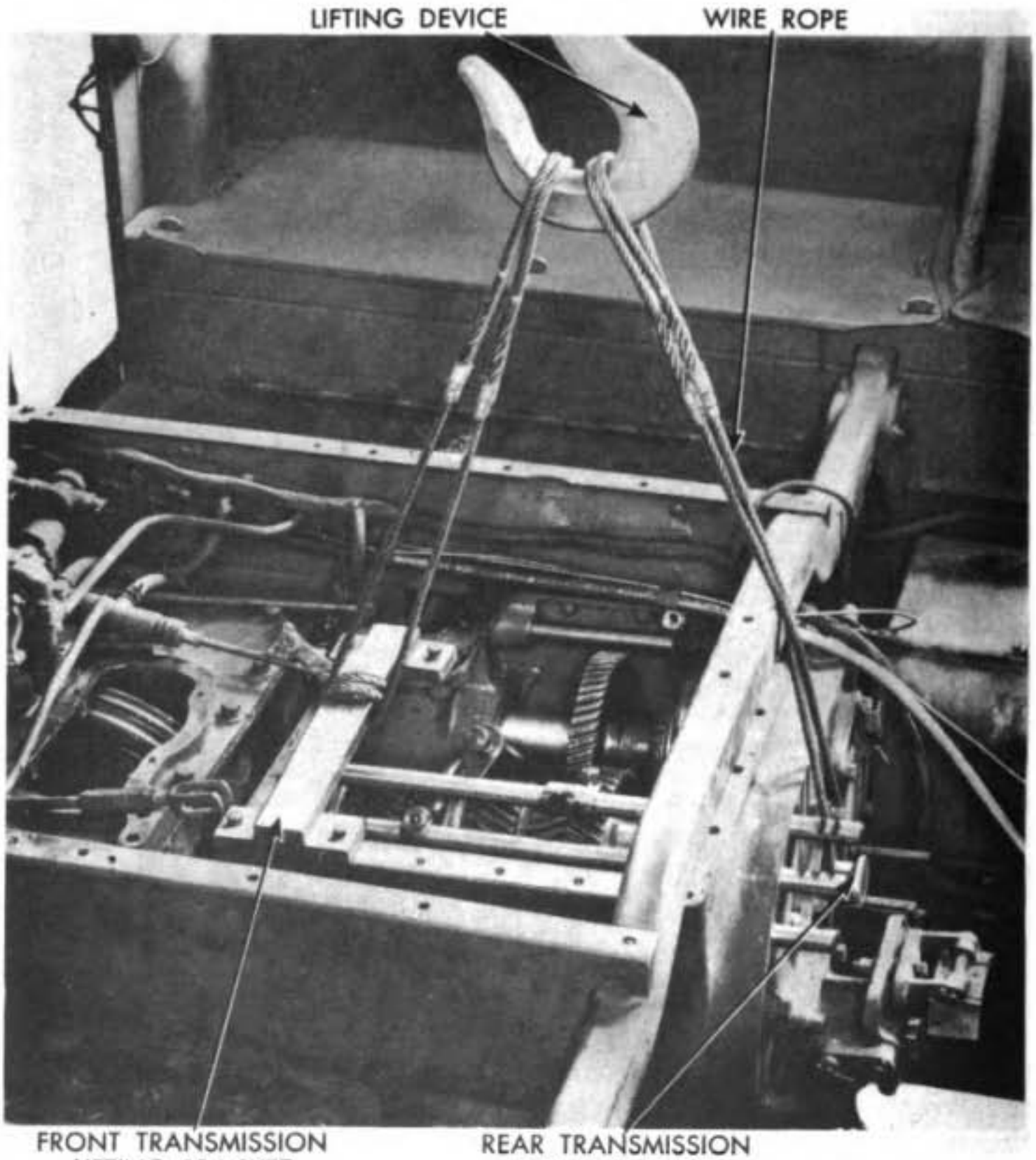


***Figure 19 — Removing Transmission with Lifting Brackets***

crossmember. Remove wire rope from front lifting bracket. Remove front lifting bracket by taking out four cap screws and lock washers. Place a wire rope sling around transmission case, and adjust it so that transmission will balance (fig. 20). Lift transmission from vehicle, with sling around transmission and rear lifting bracket.

## 6. DISASSEMBLY.

**a. Preliminary Instructions.** If transmission is to be disassembled while in vehicle, it is first necessary to perform the operations

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

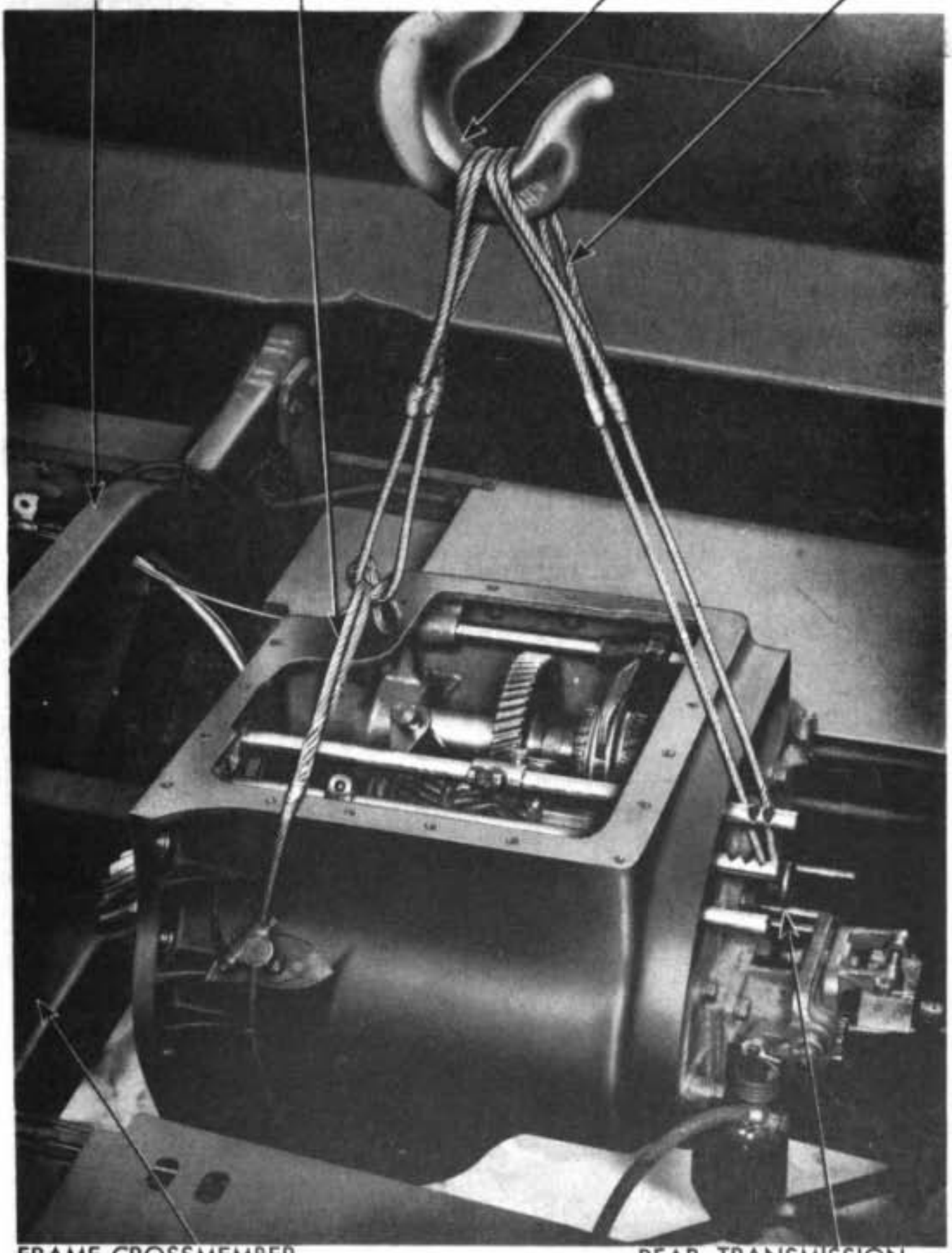


***Figure 20 — Lifting Transmission Out of Vehicle with Sling and Rear Lifting Bracket***

**ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

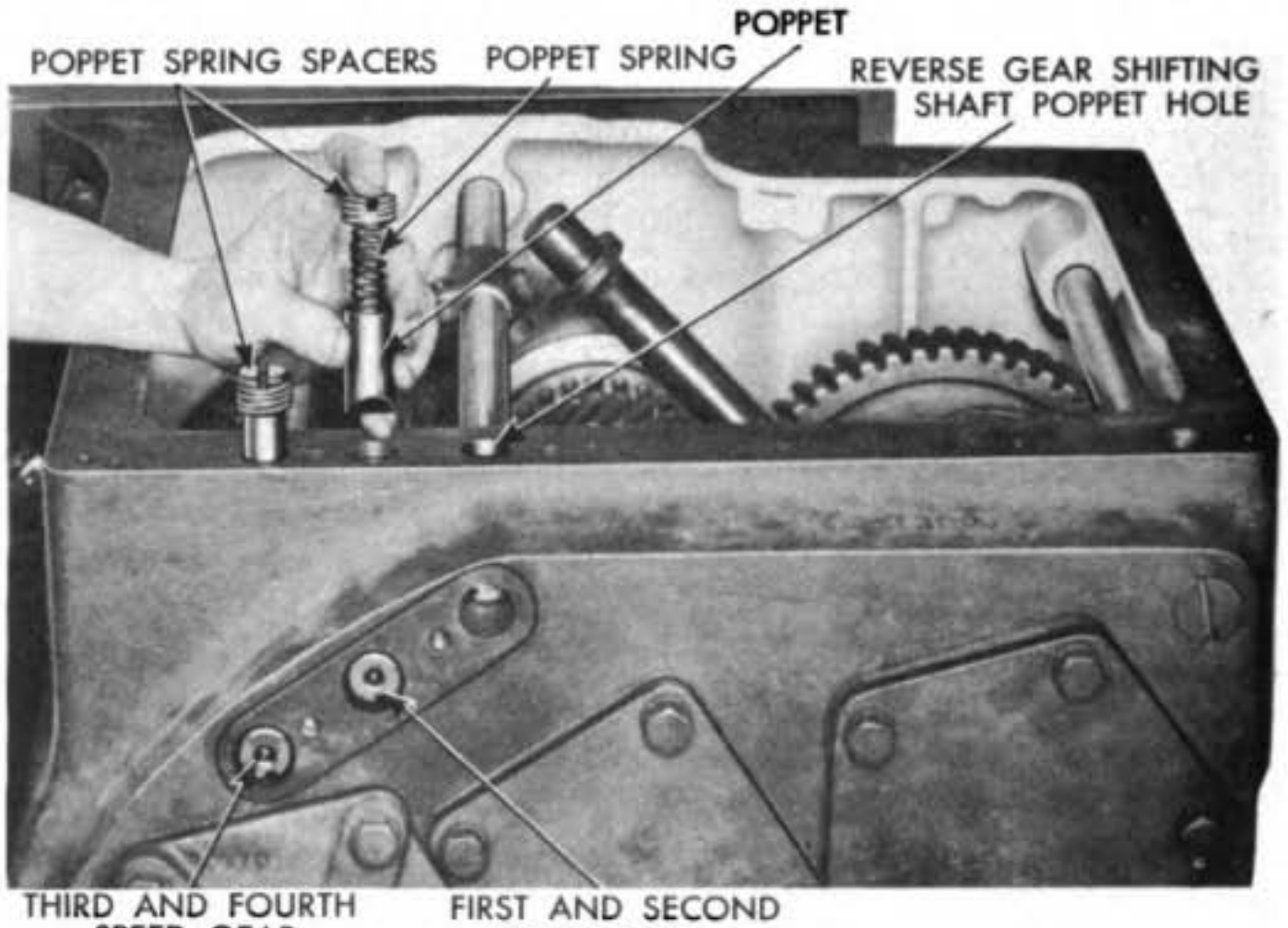


***Figure 21 — Removing Shifting Shaft Poppet, Spring, and Spacer***

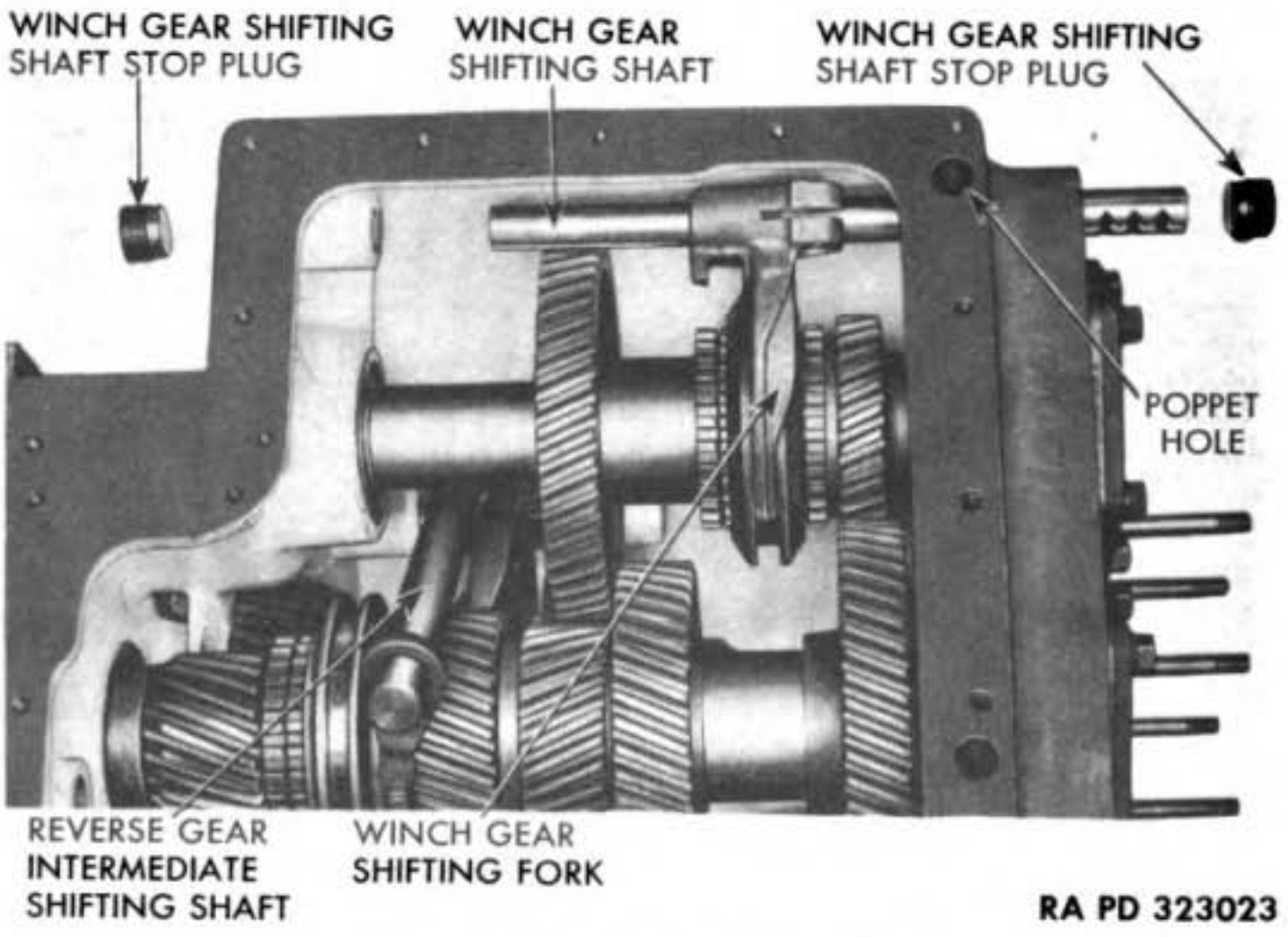


***Figure 22 — Transmission Winch Gear Shifting Shaft Partially Removed***

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

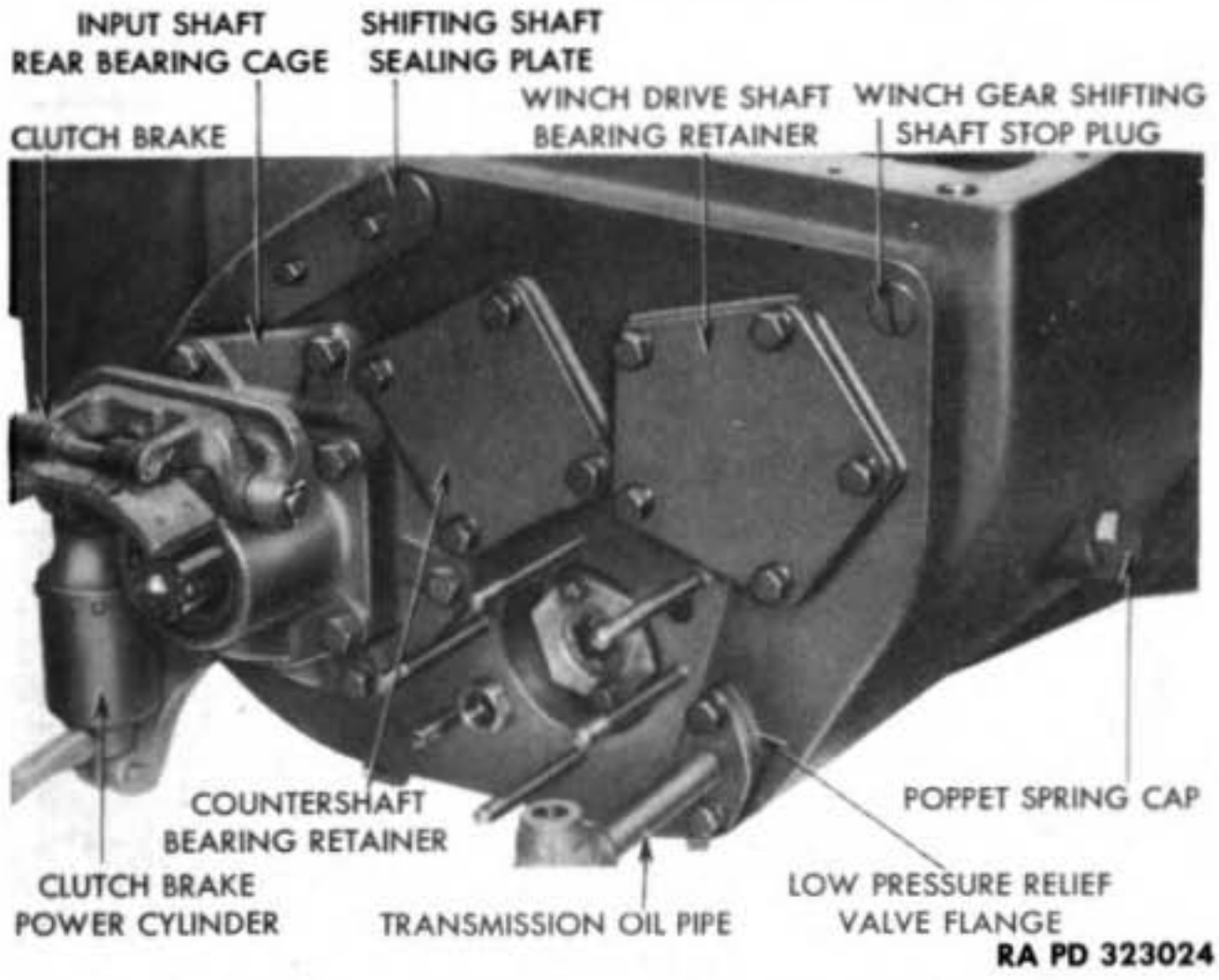


***Figure 23 — Rear of Transmission with Oil Filter and Oil Pump Removed***

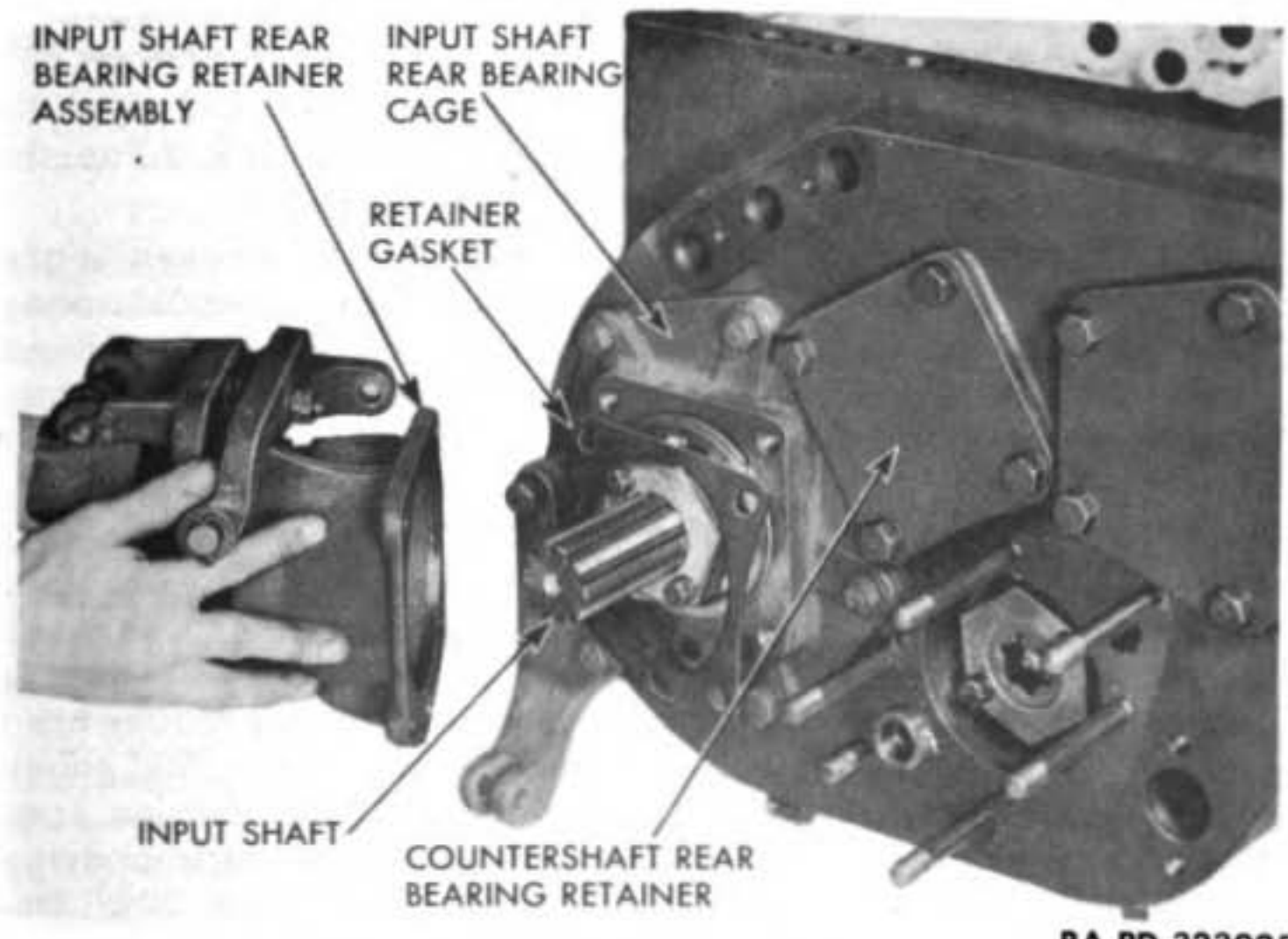


***Figure 24 — Transmission Input Shaft Rear Bearing Retainer Assembly Removed***

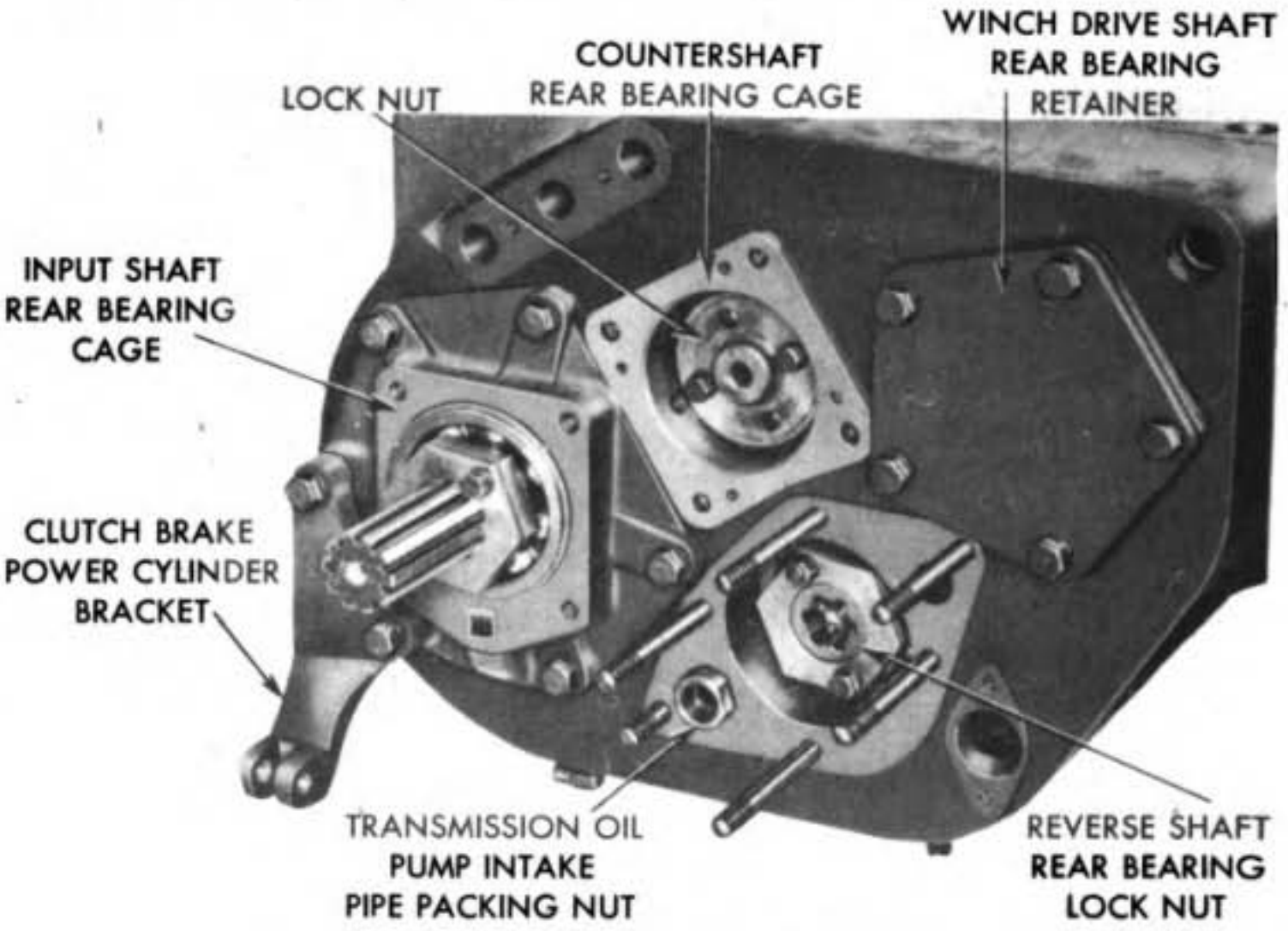


***Figure 25 — Rear View of Transmission***

explained in paragraph 5 **b** to **p**, inclusive, and then proceed as follows:

**b. Remove Transmission First and Second, Third and Fourth, Winch Gear, and Reverse Speed Gear Shifting Shafts.**

(1) REMOVE FIRST AND SECOND, AND THIRD AND FOURTH SPEED GEAR SHIFTING SHAFT POPPETS (fig. 21). Remove poppet spring spacers from transmission case. When spacers are about screwed out of case, hold hand over them so that they do not fly out due to poppet spring pressure. Insert finger into spring holes in poppets, and lift them out.

(2) REMOVE SHIFTING SHAFTS (fig. 2). Remove cap screw and lock washer from winch gear shifting fork. Remove cap screw, lock washer, and nut from reverse gear upper shifting shaft rear head. Slide first and second, third and fourth, and reverse gear shifting shafts toward rear of transmission while detaching from shifting head and forks. If forks or head bind on shafts, spread with a cold chisel. When removing reverse shaft from rear end of transmission case, place hand over poppet hole to prevent poppet and spring from flying out. Remove reverse gear intermediate shifting shaft (fig. 22). Remove winch gear stop plugs from transmission case at each end of winch shifting shaft. Turn shaft to disengage poppet from slots in shaft, and slide it out toward rear of transmission case, removing fork

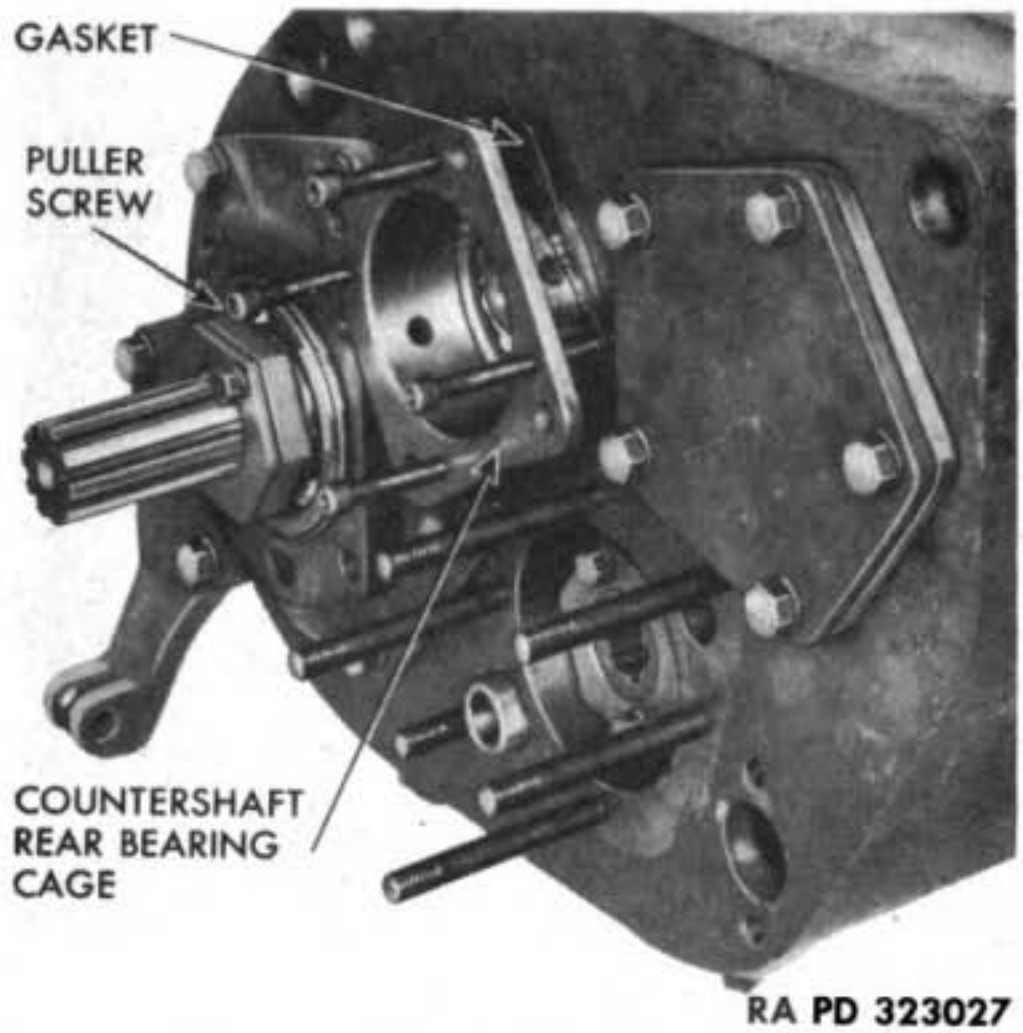


***Figure 26 — Removing Transmission Countershaft Rear Bearing Cage and Bearing***

at same time. Hold hand over poppet hole to prevent poppet and spring from flying out.

**c. Remove Input Shaft Rear Bearing Retainer.** Remove cotter pin and pin attaching clutch brake power cylinder to bracket (fig. 23). Remove four cap screws and lock washers securing retainer assembly to input shaft rear bearing cage, and remove retainer assembly and gasket (fig. 24).

**d. Remove Countershaft Rear Bearing Retainer and Case with Rear Bearing.** NOTE: *If the transmission is removed from the vehicle, the rear lifting bracket will have to be removed instead of the rear bearing retainer.* Remove four cap screws and lock washers securing retainer and cage to case (fig. 24), and remove retainer. Remove two cap screws and lock washers from rear bearing lock nut (fig. 25). With wrench (41-W-3247-170), remove countershaft rear bearing lock nut. NOTE: *Lock nut is removed in same manner shown for removing winch drive shaft lock nut* (fig. 35). Screw four puller screws (⅜ NC-2 x 3½) into rear bearing cage tapped holes (fig. 26). Turn each screw a small amount at a time to pull bearing cage evenly so as not to strain cage flanges to breaking point. Rear bearing is removed with cage. Bearing is a loose fit in cage, and can readily be removed.

**ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

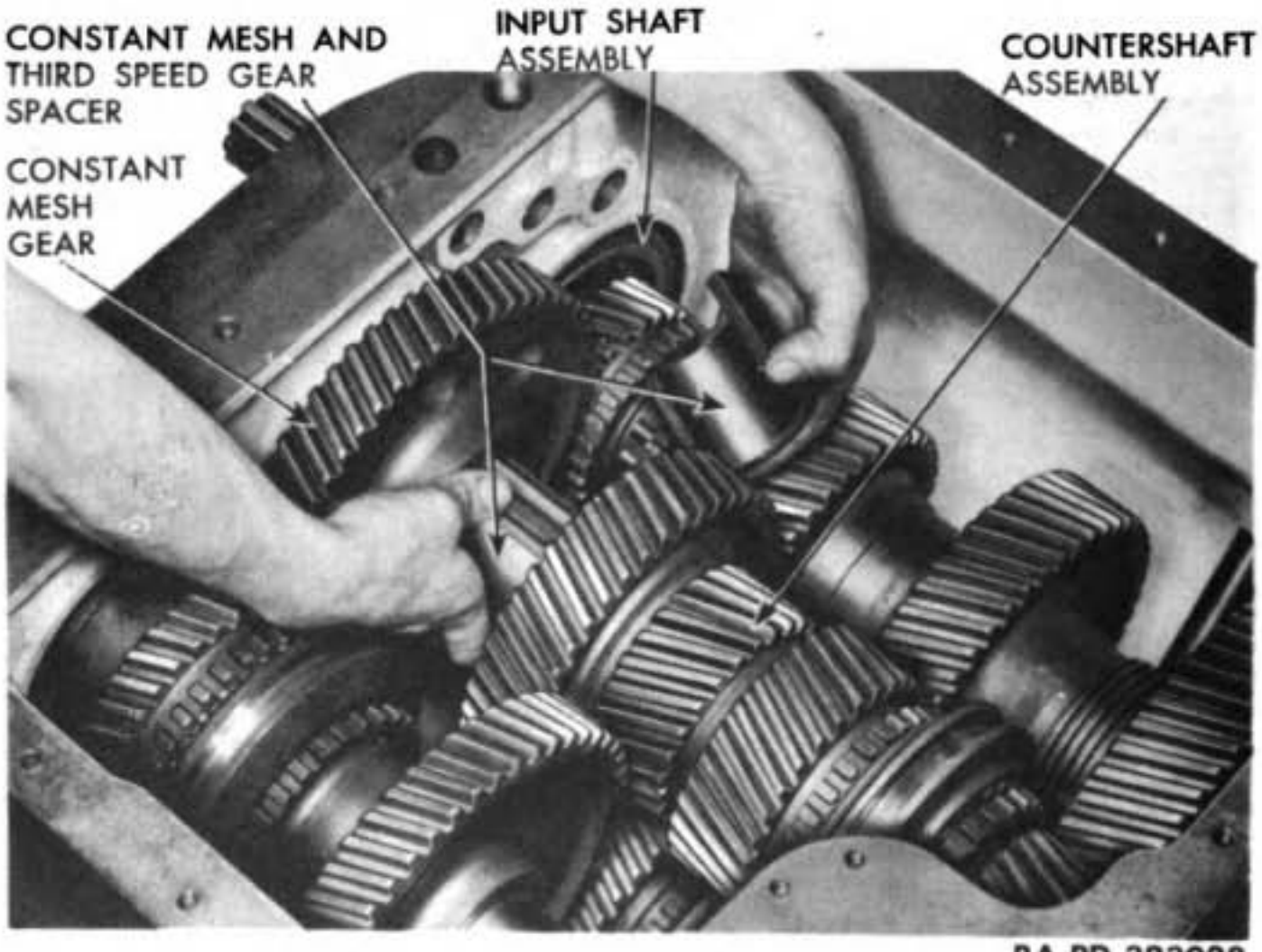


***Figure 27 — Removing Transmission Constant Mesh and Third Speed Gear Spacer***

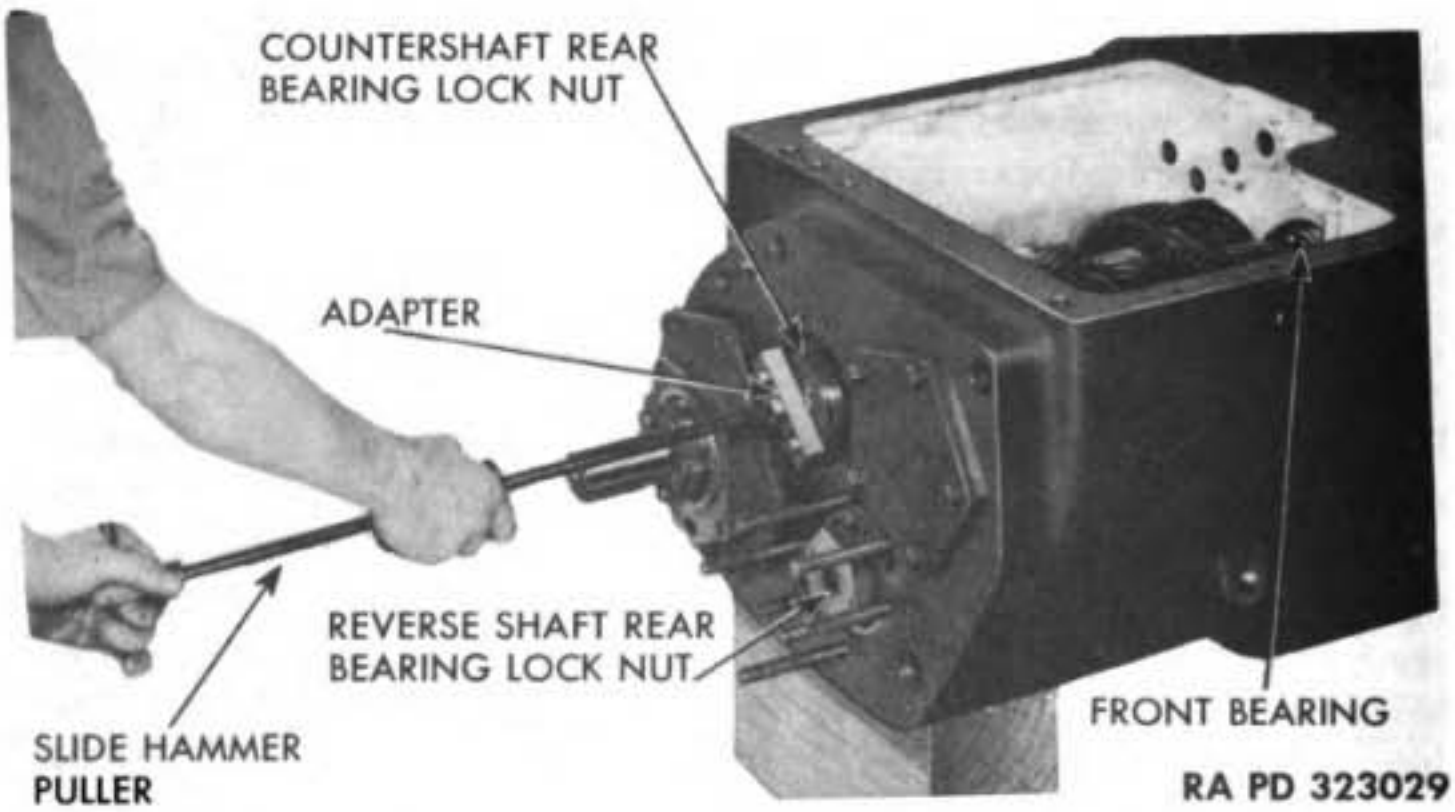


***Figure 28 — Removing Countershaft Front Bearing from Transmission Case, Using Puller (41-P-2957)***

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

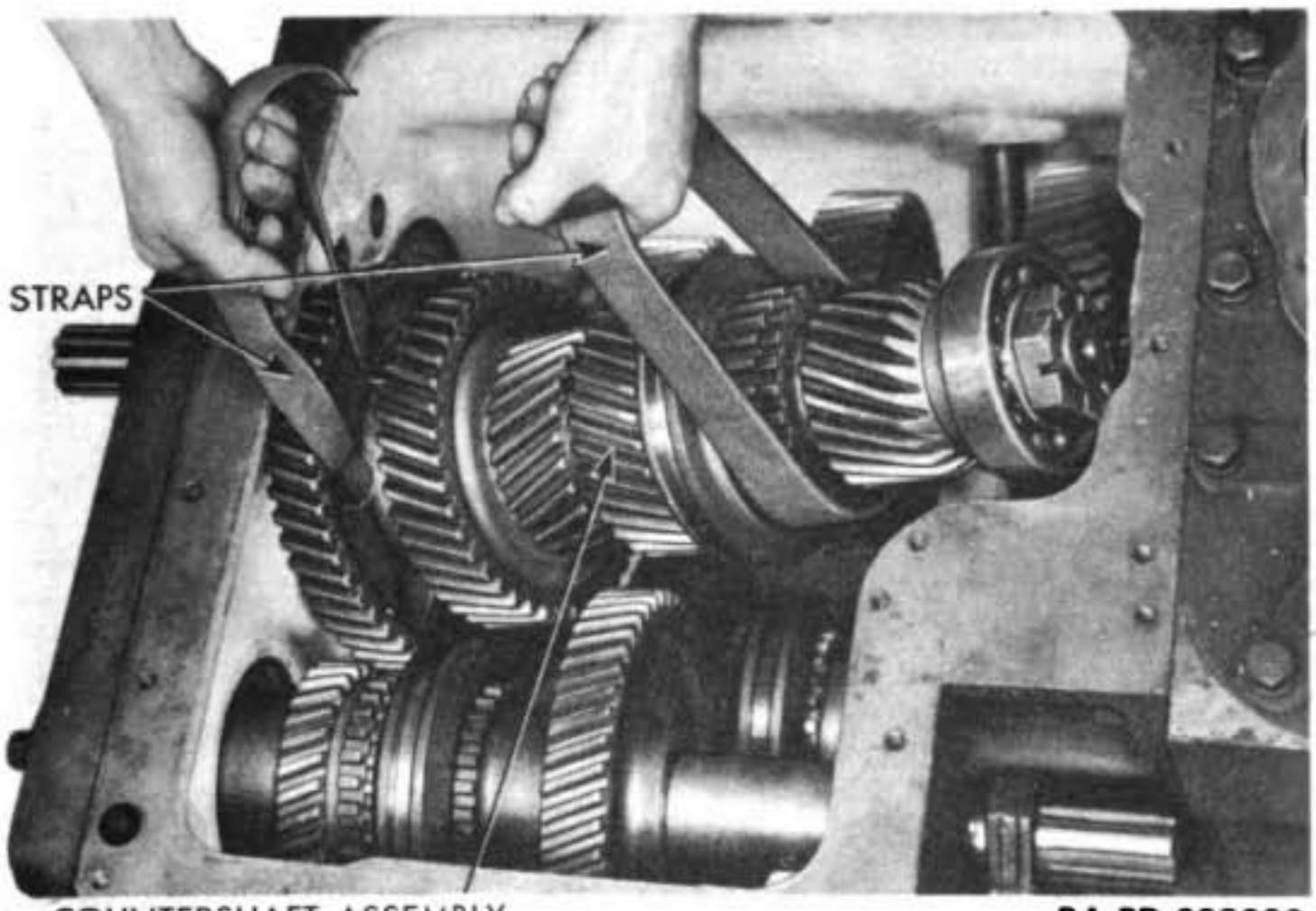


***Figure 29 — Removing Transmission Countershaft Assembly***

**e. Partly Remove Input Shaft Rear Bearing Cage.** Remove six cap screws and lock washers securing input shaft bearing cage to transmission case (fig. 24). Two of these cap screws also attach clutch brake power cylinder bracket (fig. 25). Screw a slide hammer puller into one of four tapped holes in input shaft rear bearing cage, and pull cage out of transmission case until cage is flush with

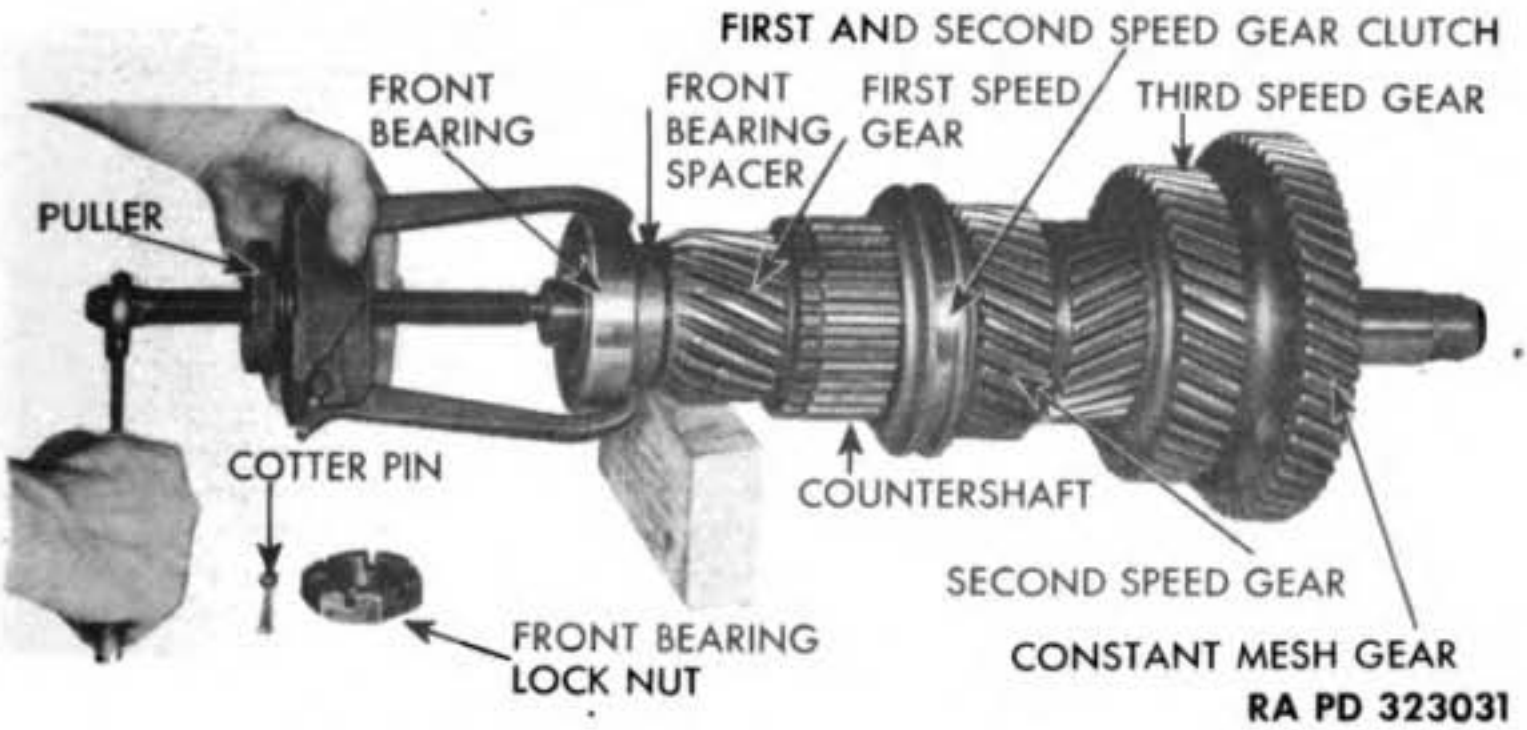


***Figure 30 — Removing Front Countershaft Bearing, Using Puller (41-P-2911)***

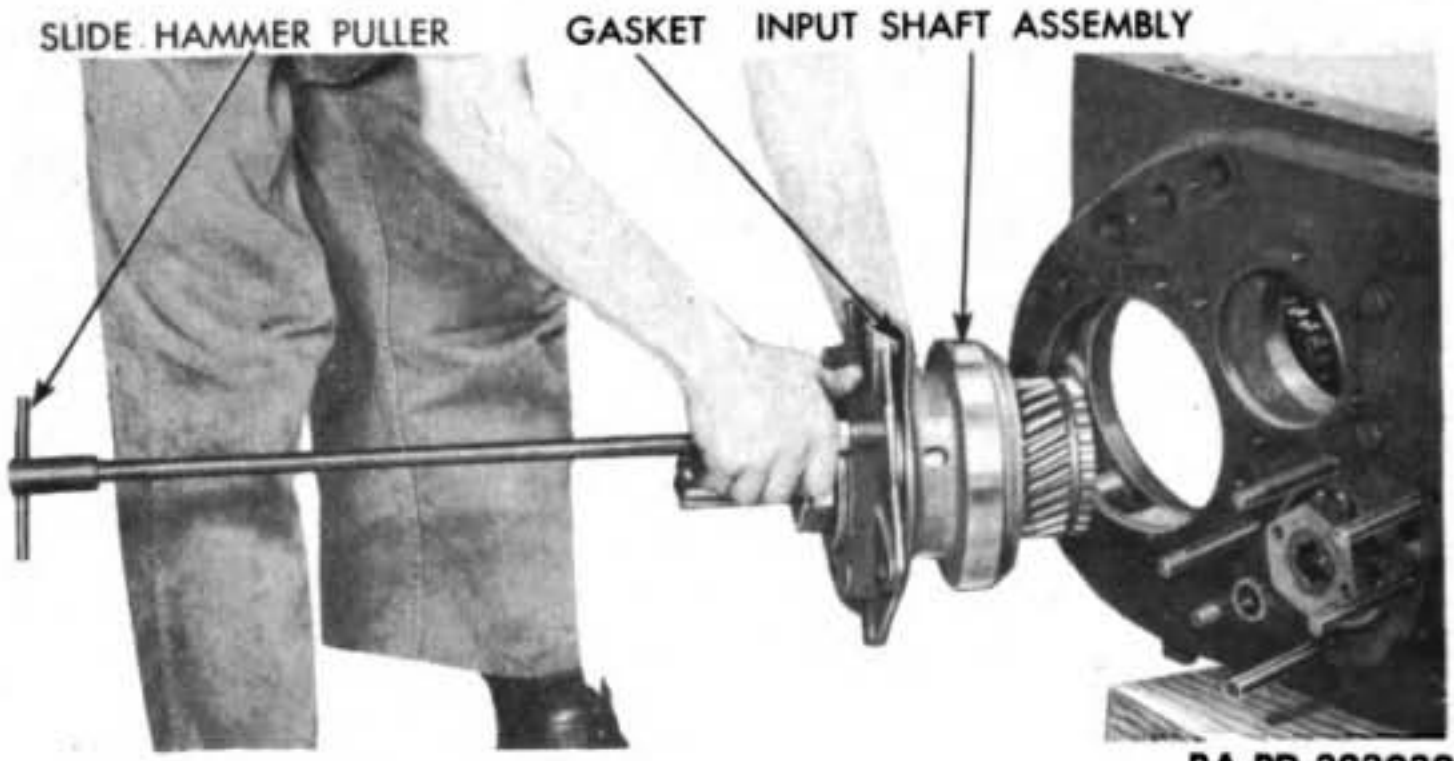


*Figure 31 — Removing Input Shaft Assembly, Using Puller (41-P-2957)*

inside of case. Constant mesh gear (fig. 27) must be slid toward end of shaft as cage is being partially removed.

**f. Remove Countershaft Assembly.** Slide constant mesh gear against side of transmission case, and lift out two halves of constant mesh and third speed gear spacer (fig. 27). Pry or pull reverse shaft (fig. 28) toward rear of transmission case until front bearing drops


*Figure 32 — Driving Input Shaft Out of Rear Bearing and Cage*

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

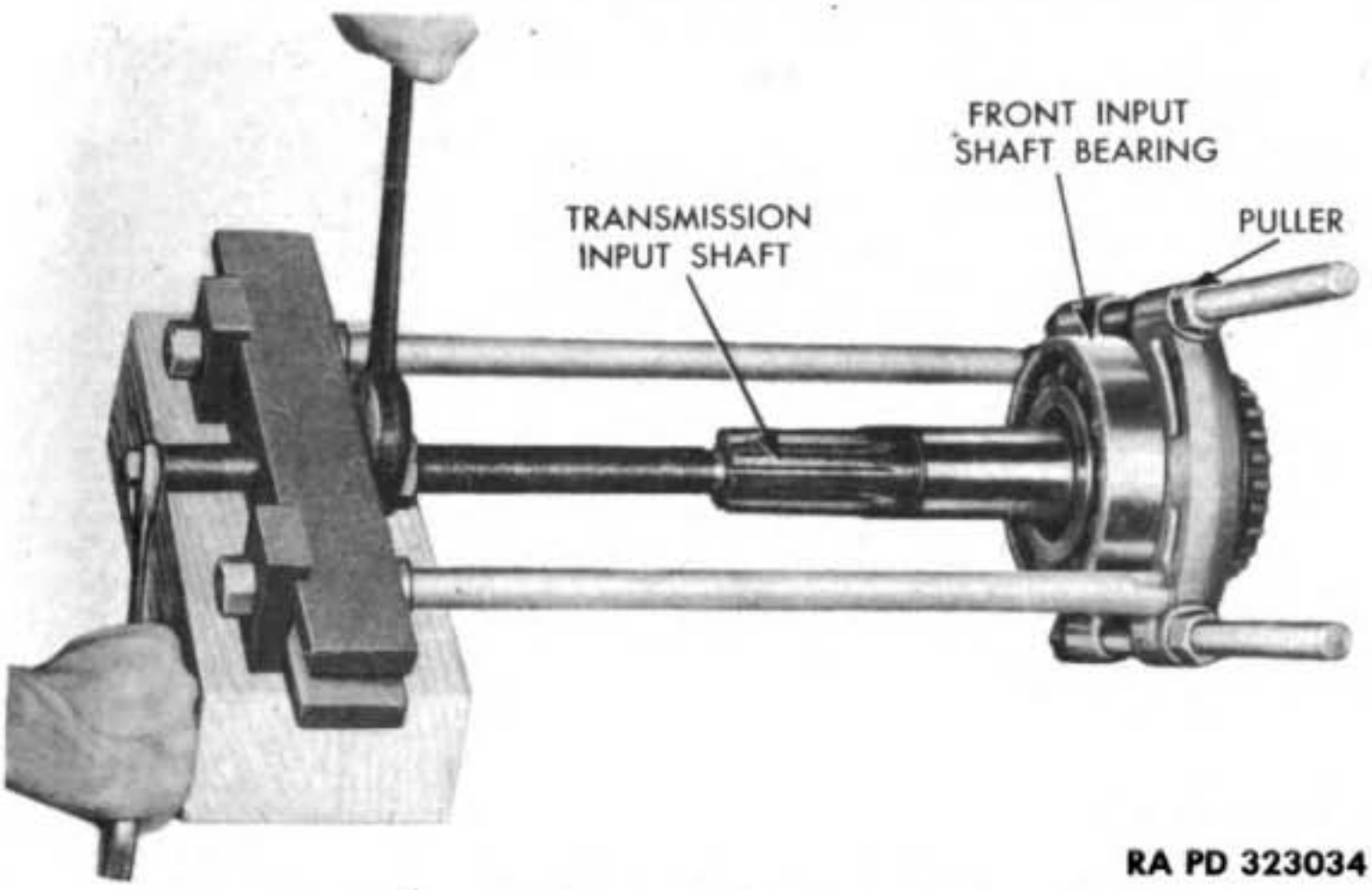


***Figure 33 — Removing Transmission Front Input Shaft Bearing, Using Puller (41-P-2905-60)***

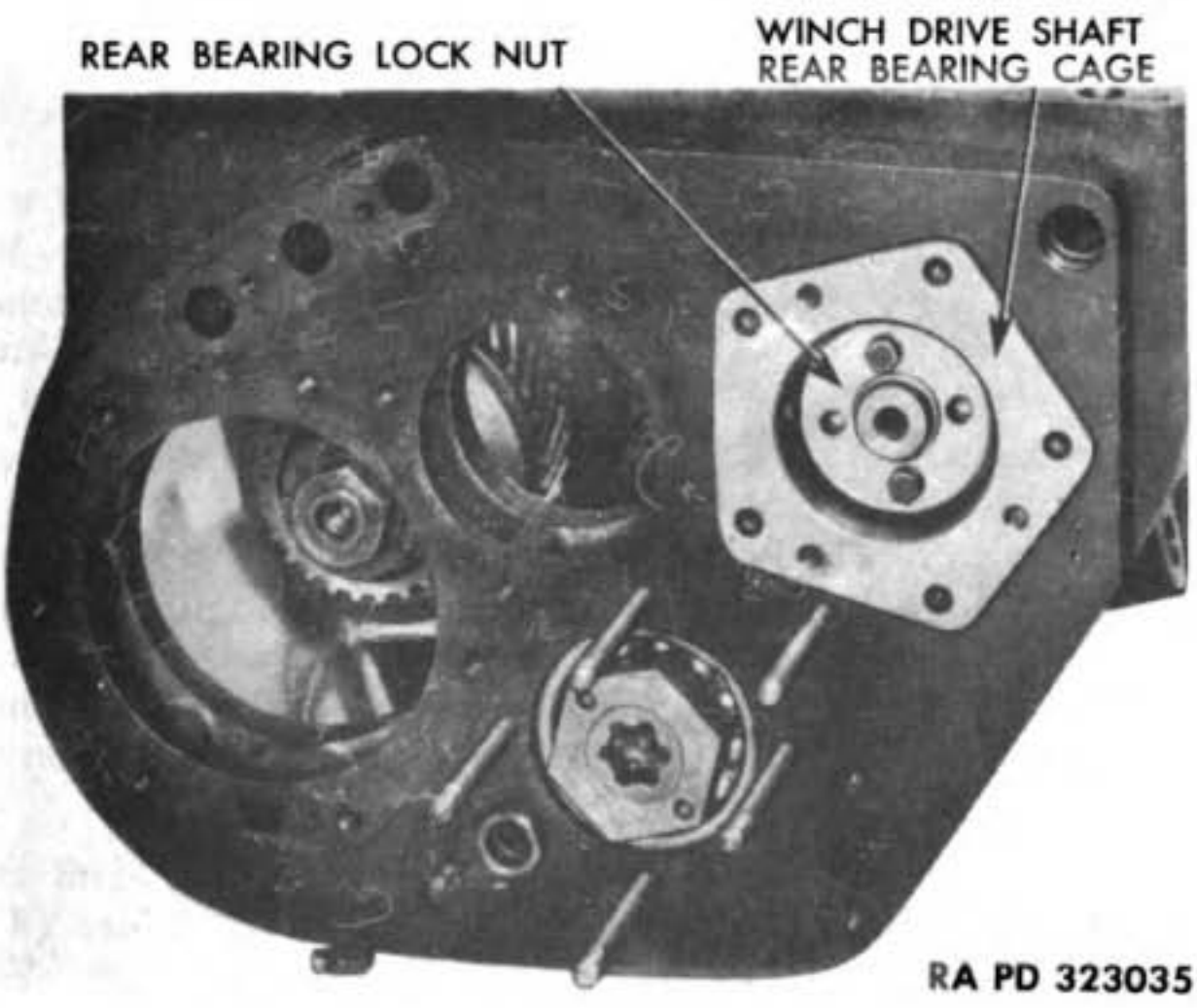


***Figure 34 — Transmission Winch Drive Shaft Rear Bearing Cage After Bearing Retainer Is Removed***

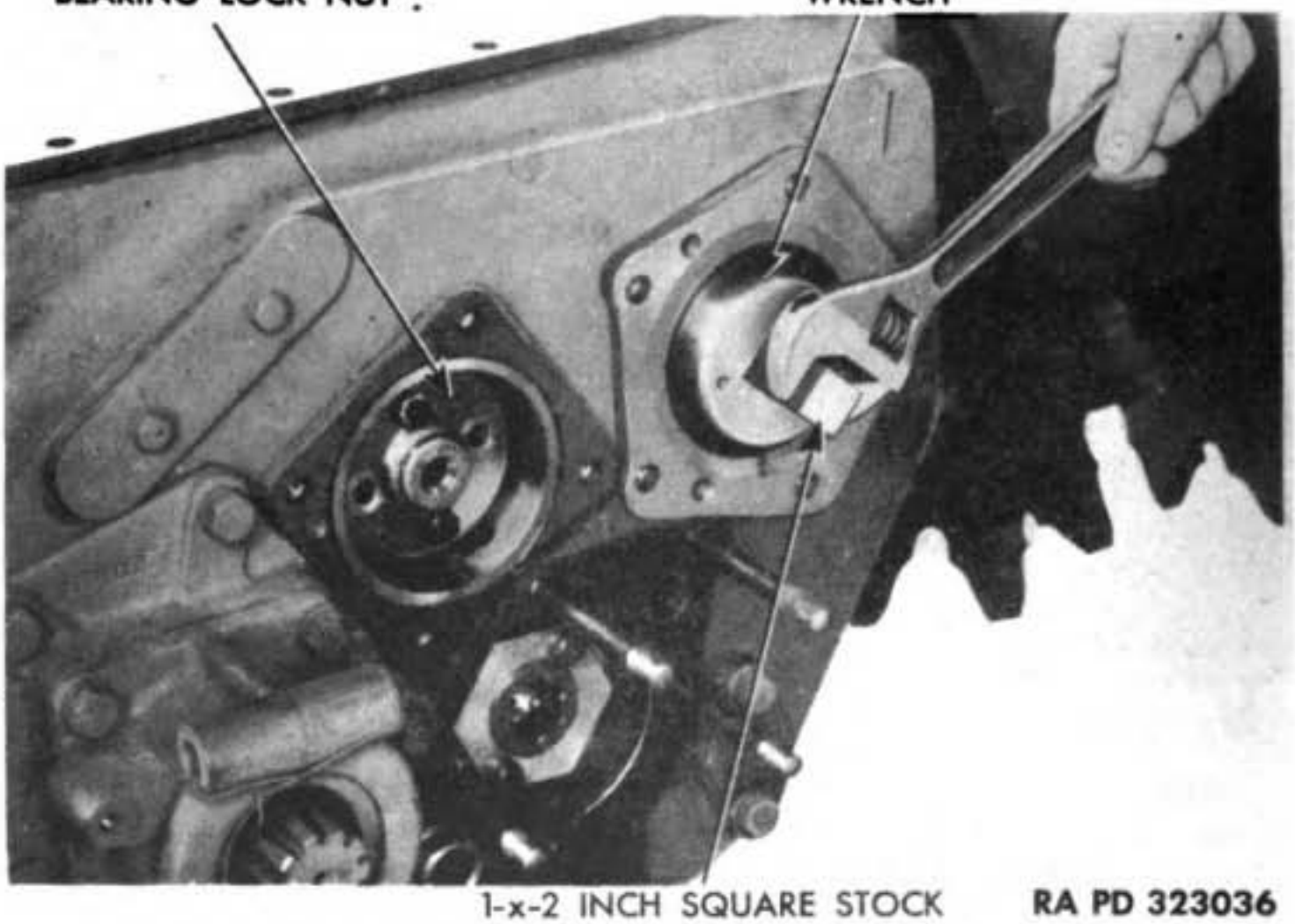


***Figure 35 — Removing Winch Drive Shaft Rear Bearing Lock Nut, Using Wrench (41-W-3247-170)***

out of its seat in case. Pull or pry countershaft toward rear of transmission case until front bearing is pulled out of its seat in case. Both countershaft and reverse shaft can be pulled with a slide hammer puller and adapter (41-P-2957). An adapter must be made with a tapped hole in the center (to fit the slide hammer puller) and two slotted mounting screw holes, for attaching to rear bearing lock nuts of both countershaft and reverse shafts. Pull shafts as shown in figure 28. Place a strap or light rope around countershaft in front of first and second speed clutch, and a second strap or rope through holes in constant mesh gear (fig. 29). Slide the gear toward front of transmission, and lift countershaft assembly out of case. Lift front or bearing end of shaft out first, and at same time keep tension on rear strap to hold gears from sliding apart.

**g. Disassemble Countershaft.** Remove cotter pin and front bearing lock nut. Pull front bearing from shaft with puller (41-P-2911) (fig. 30). Slide the gears, spacers, and clutch off shaft. Without removing front bearing, slide constant mesh, third and second speed gears, and gear clutch off shaft.

**h. Remove and Disassemble Input Shaft Assembly.** Pull shaft

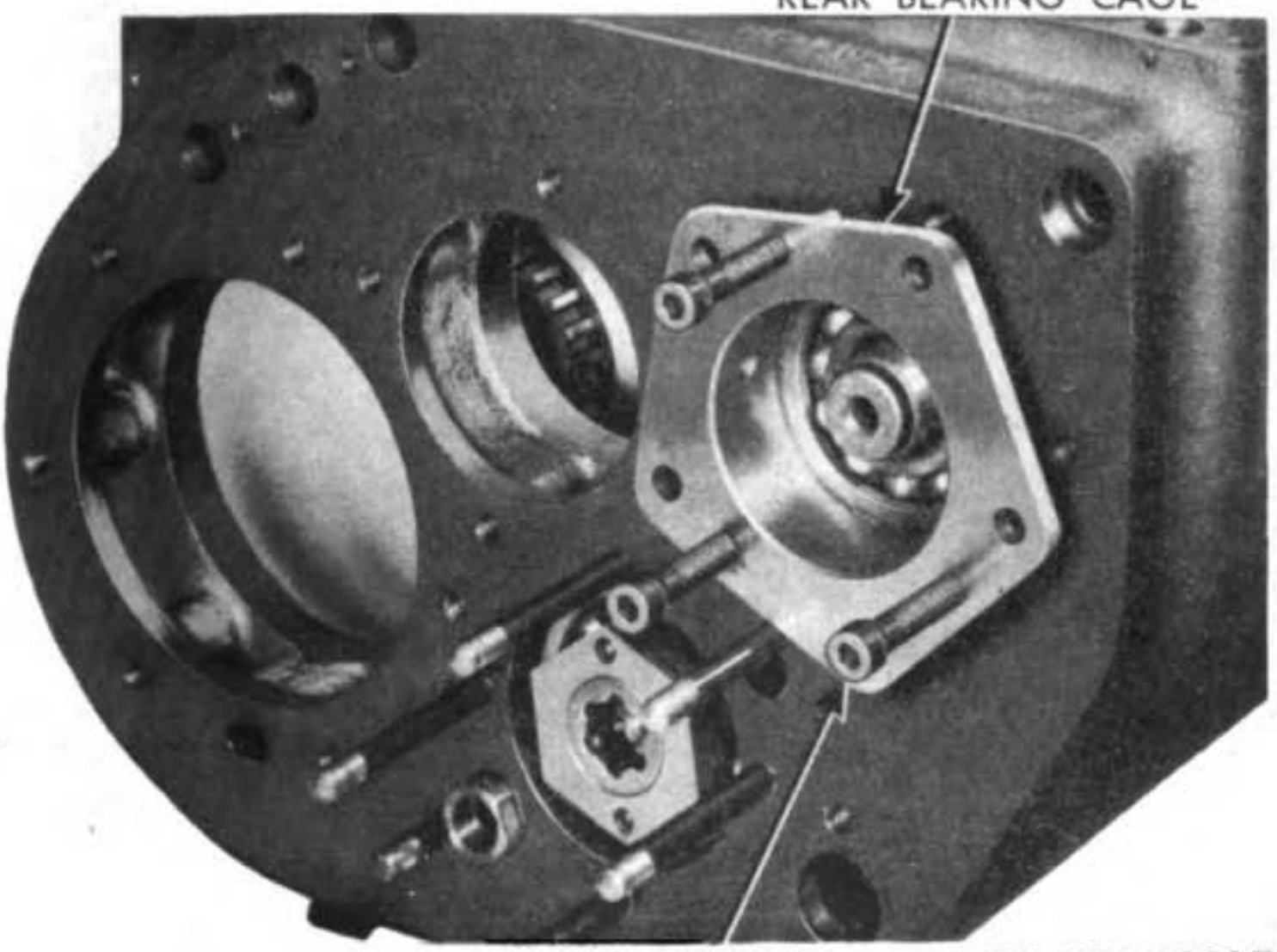


***Figure 36 — Removing Winch Drive Shaft Rear Bearing Cage***


***Figure 37 — Removing Winch Drive Shaft Unwind Gear***


***Figure 38 — Removing Transmission Winch Drive Shaft Front Bearing Lock Nut***

assembly all the way out of case with puller, (41-P-2957) (fig. 31). Loosen two cap screws in input shaft lock nut, and remove lock nut from input shaft. Place input shaft bearing cage on three blocks, and drive shaft out of rear bearing (fig. 32). Tap rear bearing out of cage. Pull front bearing off input shaft with a puller (41-P-2905-60) (fig. 33).

**i. Remove and Disassemble Winch Drive Shaft Assembly.** Remove five cap screws and lock washers securing winch drive shaft rear bearing retainer and rear bearing cage to transmission case (fig. 23). Remove two cap screws and lock washers from rear bearing lock nut (fig. 34). With wrench (41-W-3247-170), remove lock nut from shaft (fig. 35). Insert three puller screws (½-NC-2 x 3) into rear bearing cage tapped holes (fig. 36), and screw in evenly to remove rear bearing cage with bearing from transmission. Slide winch drive shaft unwind gear off shaft and out of transmission (fig. 37). Place lock nut on rear end of shaft and, using the adapter made for pulling the countershaft and reverse shaft nuts, start pulling shaft as shown in figure 28. Shaft cannot be pulled until front bearing lock nut is removed. Remove two cap screws with lock washers from front bearing lock nut. With special wrench (41-W-3336-900) loosen front bearing lock nut (fig. 38). Unscrew lock nut by turning shaft

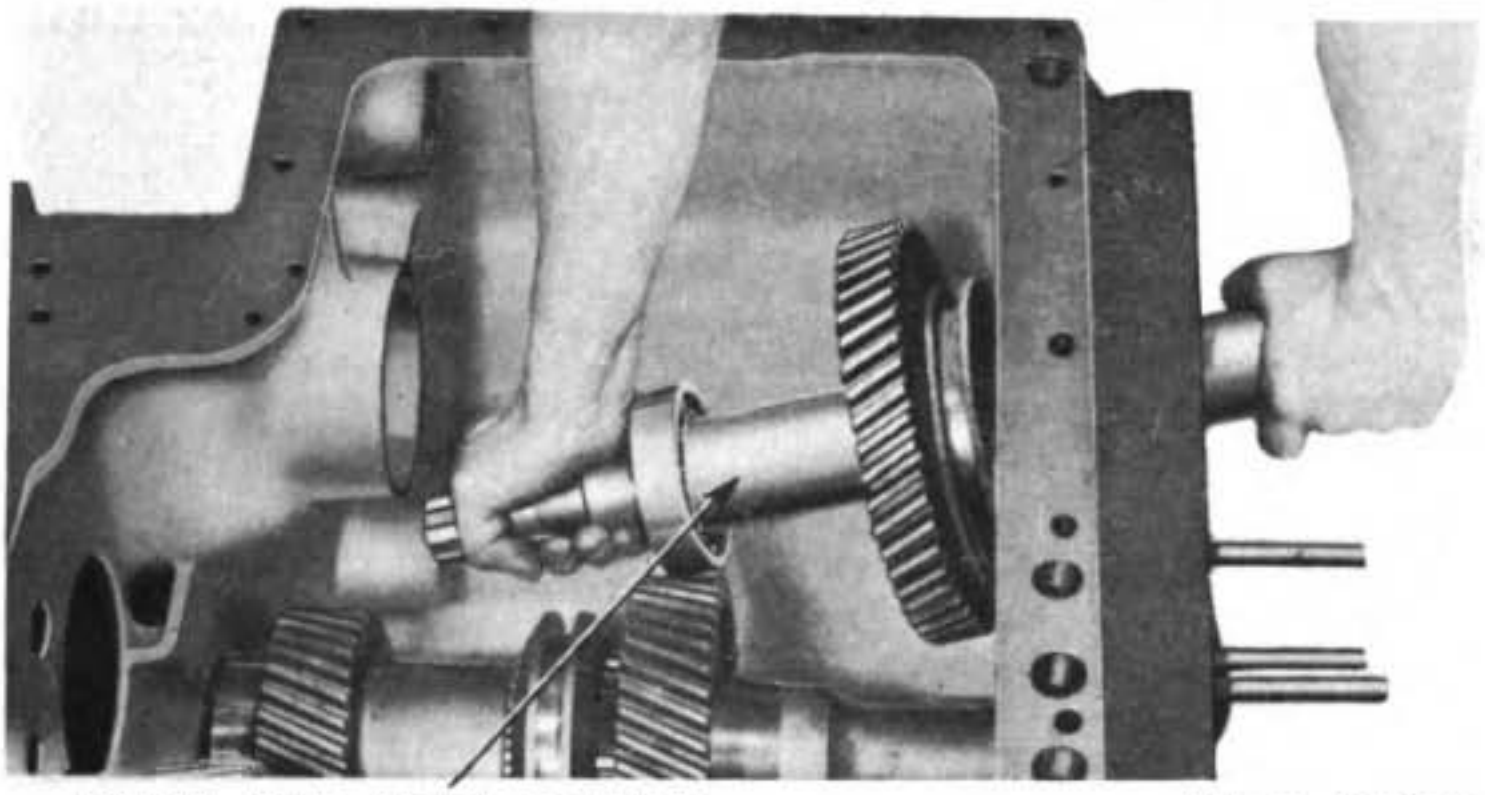


***Figure 39 — Removing Transmission Winch Drive Shaft Assembly***

while holding wrench. If transmission is in the vehicle, the winch drive shaft coupling pin must be removed, and the coupling slid ahead on the shaft. Pull or drive winch drive shaft toward the rear of transmission. If slide hammer puller was used, remove it, and remove rear bearing lock nut. Move winch drive shaft as far rearward as possible, then tip front or spline end of shaft down and out of front bearing bore in transmission case (fig. 39). Lift winch drive shaft assembly

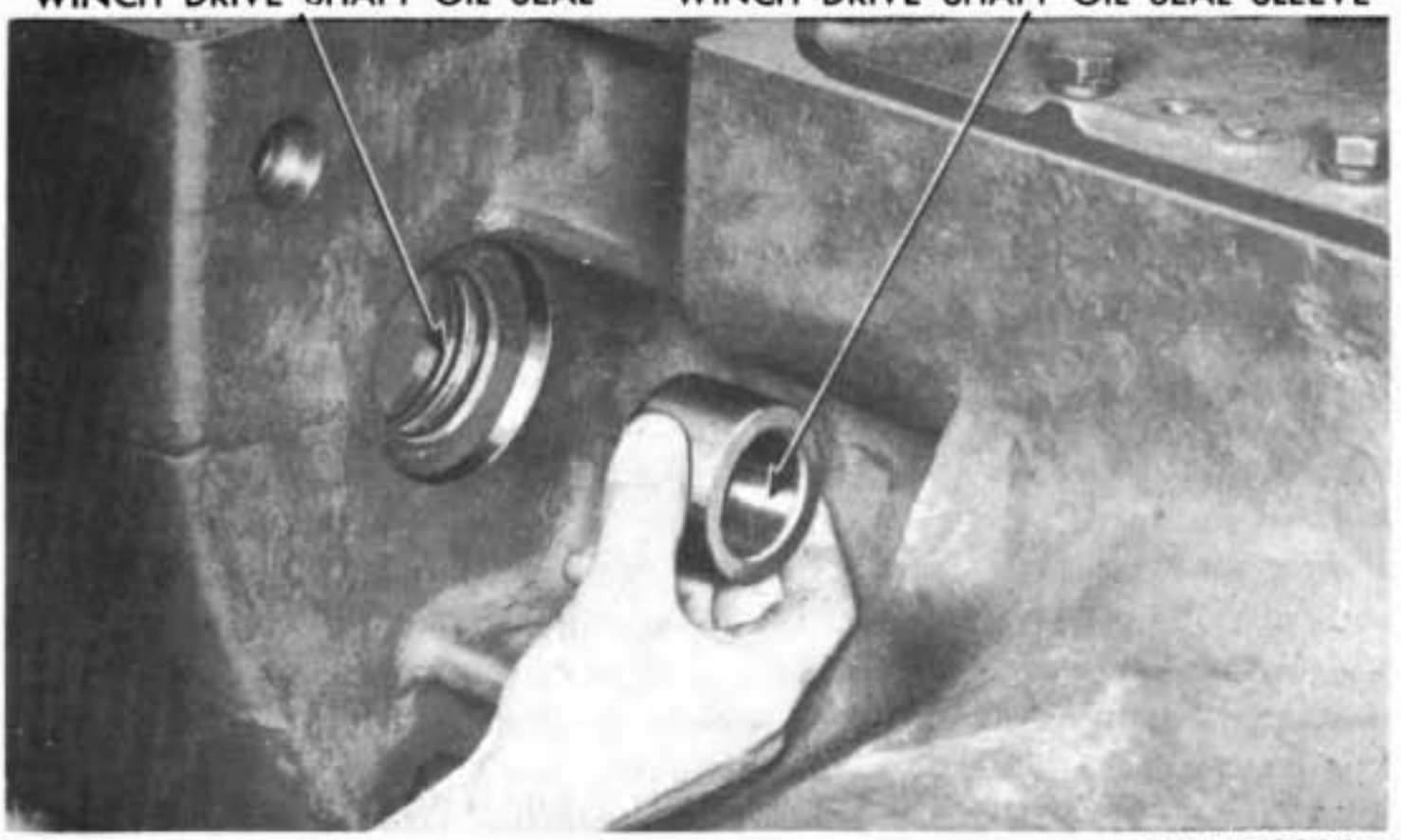


***Figure 40 — Winch Drive Shaft Oil Seal and Sleeve***

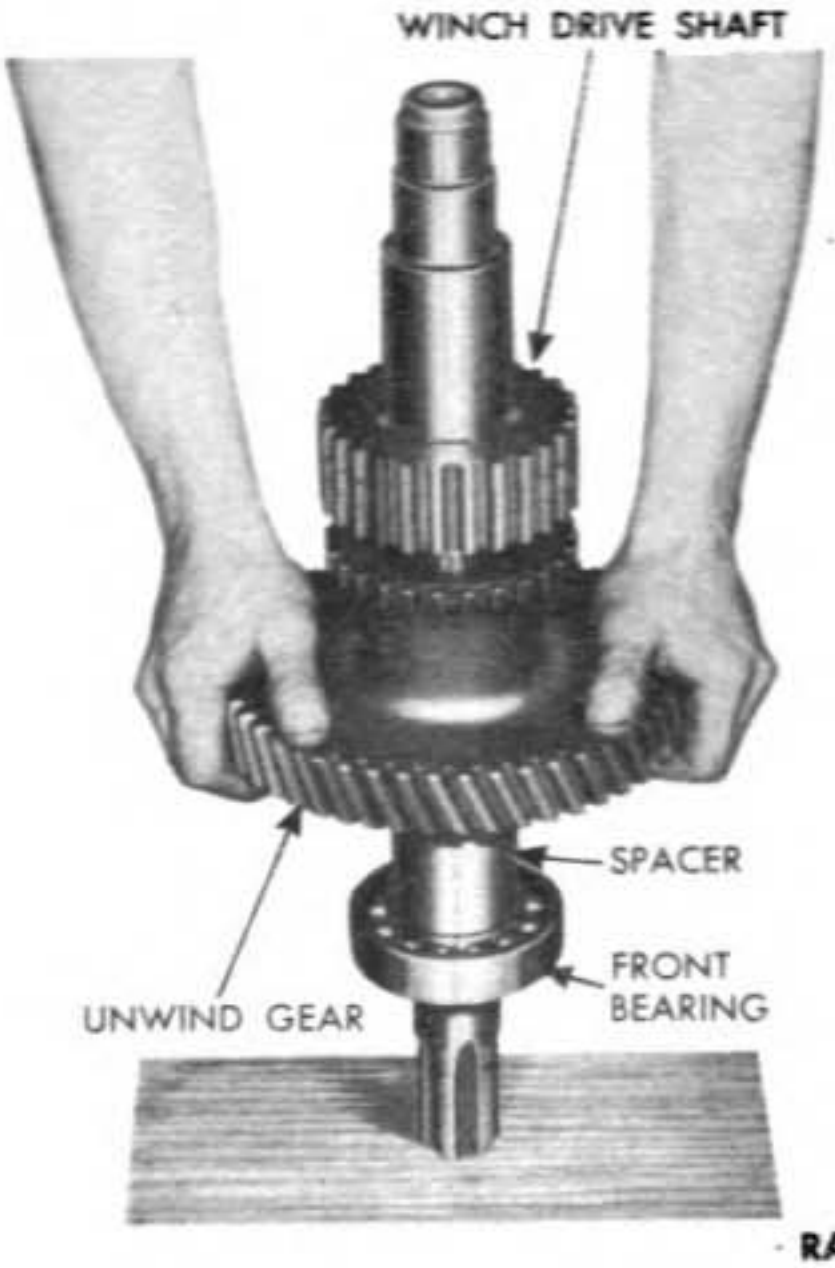


***Figure 41 — Removing Transmission Winch Drive Shaft Front Bearing***

out by lifting front end toward front of transmission. Remove winch drive shaft oil seal sleeve from oil seal (fig. 40). Remove front bearing from winch drive shaft by grasping unwind gear in both hands, and pounding spline end of shaft on a hardwood block (fig. 41).

**j. Remove and Disassemble Reverse Shaft Assembly.** Remove reverse gear lower shifting shaft poppet spring cap (fig. 23). **NOTE:** *Make sure poppet spring does not fly out of hole when cap is removed.* Insert finger in hole and remove poppet. Remove cap screw and lock washer clamping reverse gear shifting fork to shifting shaft. Slide reverse shifting shaft toward rear of transmission, and remove shaft and fork (fig. 42). Pull or drive reverse shaft rear bearing out of its bore toward rear of transmission. A slide hammer puller can be used as described in subparagraph f. Remove rear bearing lock nut (fig. 25) from shaft. Pull rear bearing from shaft with a puller (41-P-2911) (fig. 43). Place a strap or rope around reverse pinion, and lift reverse shaft assembly out of transmission case (fig. 44). Remove two cap screws and lock washers from front bearing lock nut, and

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

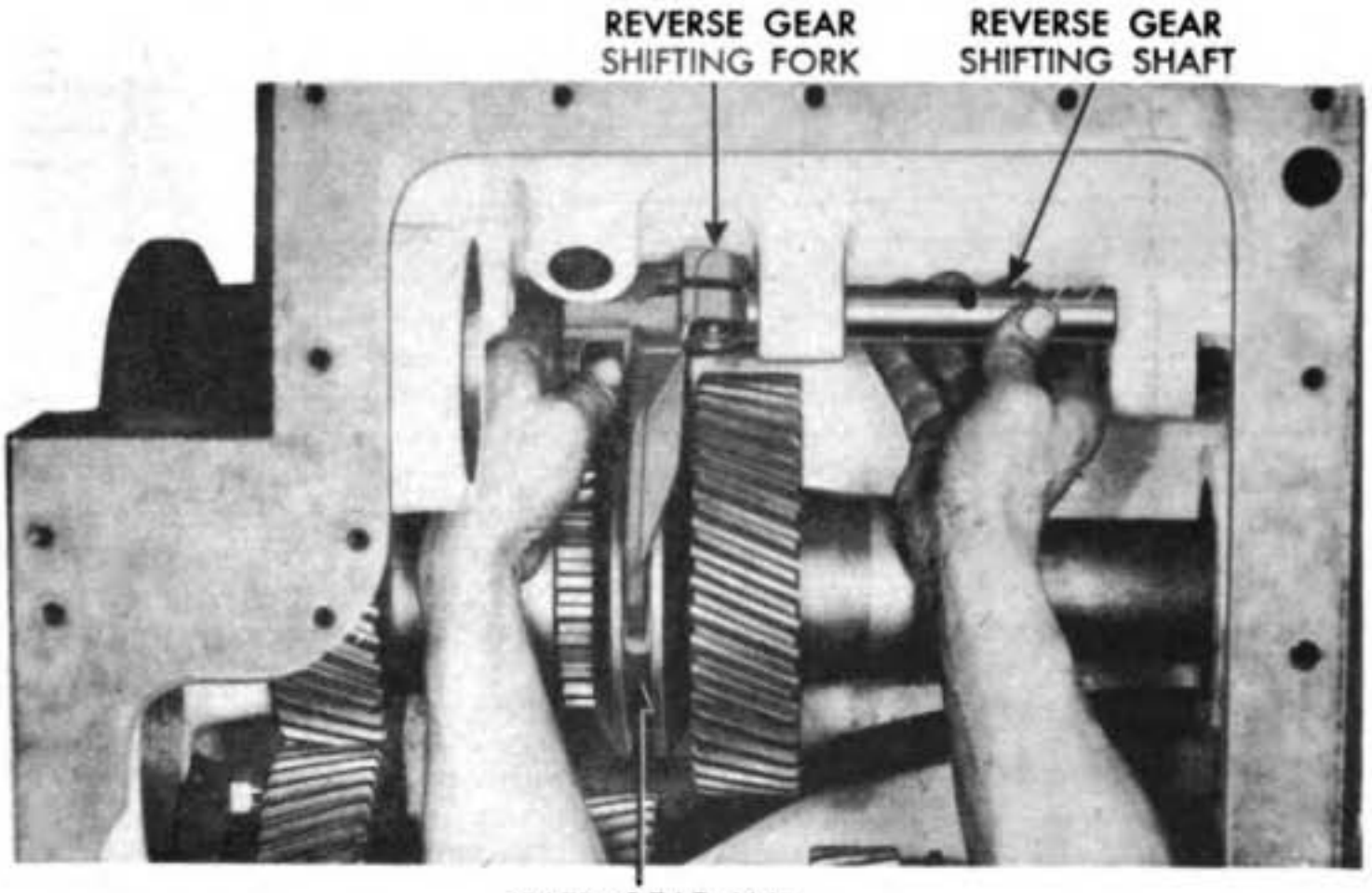


***Figure 42 — Removing Reverse Gear Shifting Fork***

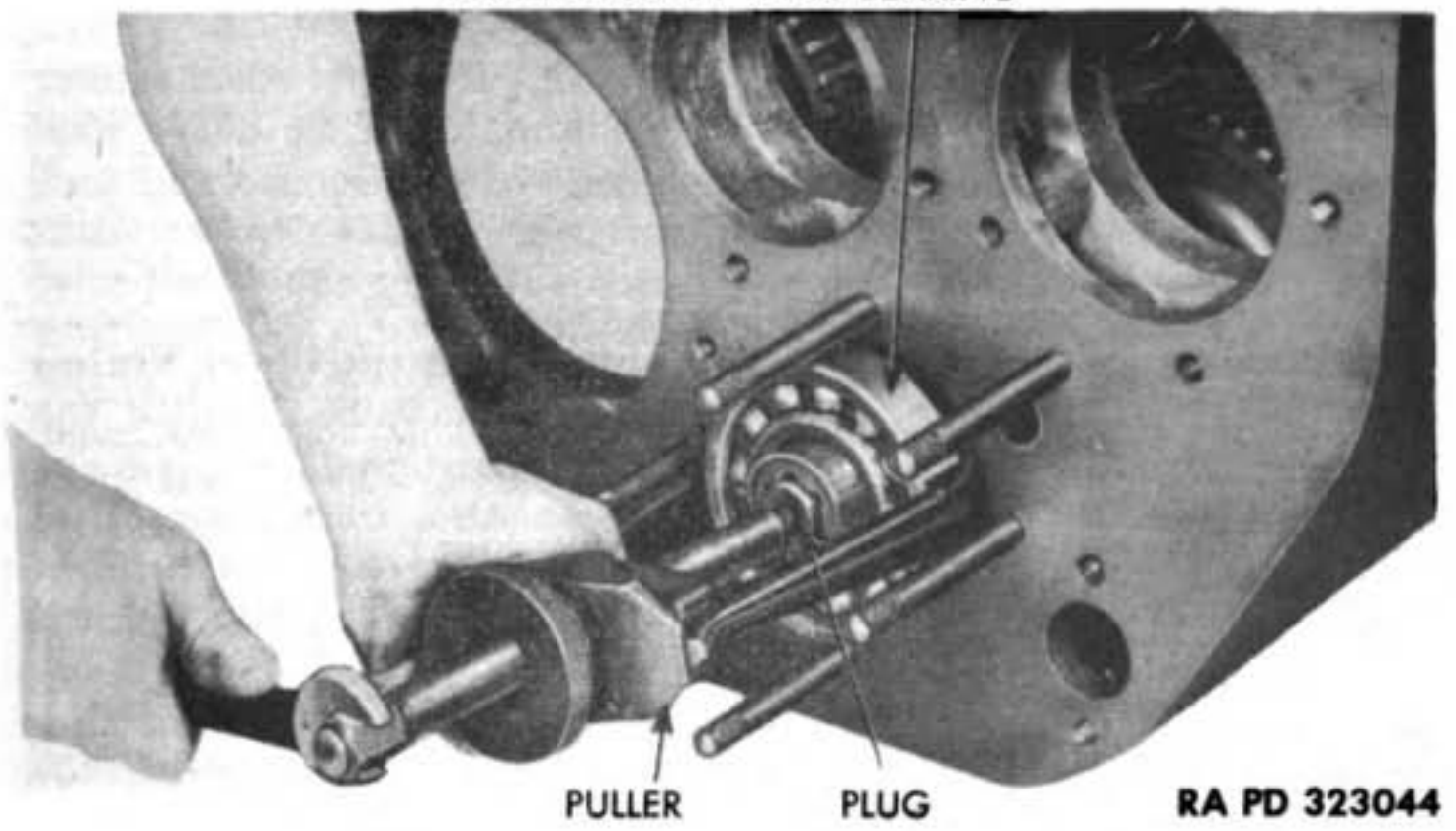


***Figure 43 — Removing Reverse Shaft Rear Bearing, Using Puller (41-P-2911)***

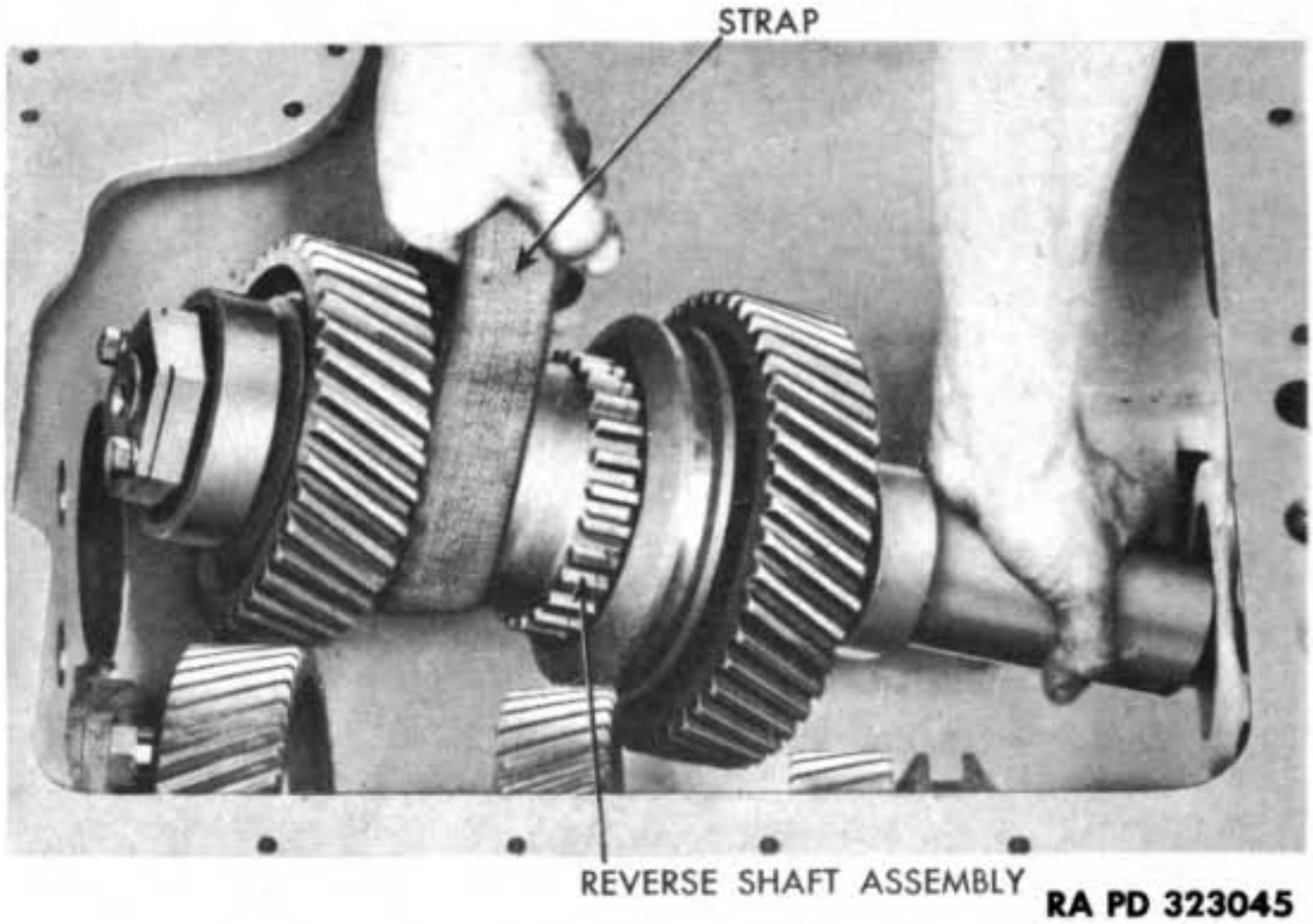


*Figure 44 — Removing Reverse Shaft Assembly*

remove lock nut. With a puller, remove reverse shaft front bearing the same way as shown for removing countershaft bearing in figure 30. Slide the gears, pinions, and spacers off shaft (fig. 64).

**k. Remove Speedometer Drive Shaft.** Remove speedometer drive cable adapter from speedometer drive shaft bearing sleeve after loosening adapter coupling nut. Remove two cap screws and lock washers attaching bearing sleeve to transmission case (fig. 2). Lift sleeve and drive shaft out of transmission case (fig. 45).

**l. Remove and Disassemble Output Shaft with Bevel Pinion Assembly.** NOTE: *If a new transmission case is to be installed, the old case must be removed from the differential and final drive housing before removing the output shaft assembly. After transmission case is removed, check the dimension from end of bevel pinion to front face of case, using tool (41-C-304) (fig. 46). If the same bevel pinion and drive gear are used again, the dimension from the end of bevel pinion to front face of new transmission case must be the same. Remove or add shims to the shim pack until dimension is correct. If the dimension with the new case is greater, add shims; if it is less, remove shims. This is necessary to secure the proper bevel pinion and bevel drive gear tooth contact.* Remove third and fourth speed gear clutch from fourth speed gear (fig. 47). Straighten rear bearing


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***Figure 45 — Removing Speedometer Drive Shaft***

nut lock, and remove nut from end of shaft. Remove rear bearing by striking against teeth of third speed gear with a soft hammer. Slide fourth speed gear, third speed gear, and spacers off shaft. Slide second speed gear, speedometer worm gear, and first speed gear toward end of shaft. Remove five cotter pins and nuts from bolts securing front bearing retainer and cage to transmission case (fig. 48). Insert three puller screws (½ NC-2 x 3½) in tapped holes in front bearing cage. Remove bearing cage by screwing in evenly on three puller screws (fig. 49). Place one strap or rope around shaft next to front bearing cage, and one strap or rope around rear end of shaft. Lift output shaft assembly out of transmission case (fig. 50). Be sure to wire the shim pack together as soon as it is removed, so that there is no possibility of losing a shim. Slide second speed gear, speedometer worm, and first speed gear off output shaft. Place bearing cage with front bearing and output shaft in arbor press (fig. 51), and press shaft out of bearing. Tap bearing out of cage.

**m. Remove Transmission Oil Pump Intake Pipe.** Remove packing nut from rear of transmission case. Working through opening in differential and final drive housing from which transmission oil screen was removed, remove pipe extension and packing. Slide pipe to rear of transmission case, then up and out of case (fig. 52). Remove rear packing and packing washer from transmission case.

**n. Disassemble Transmission Gear Lever Swivel Housing** (fig. 53). Unscrew knob from top of gearshift lever. Loosen clamps at top and bottom of lever boot. Slide boot off lever. Drive rivet

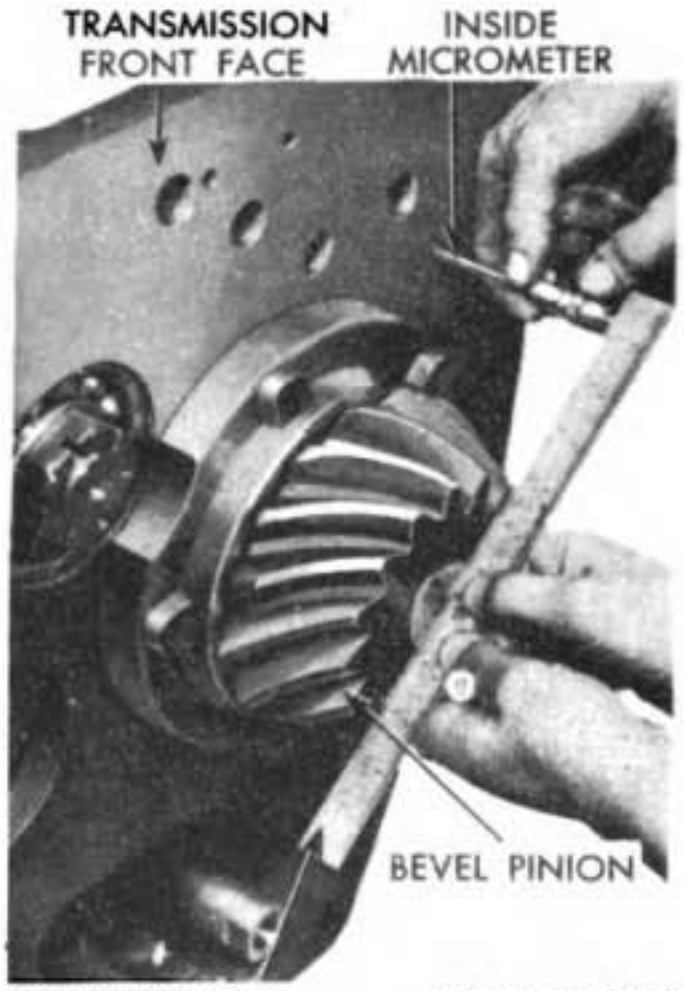


***Figure 46 — Checking Distance from End of Bevel Pinion to Face of Transmission Case, Using Tool (41-C-304)***

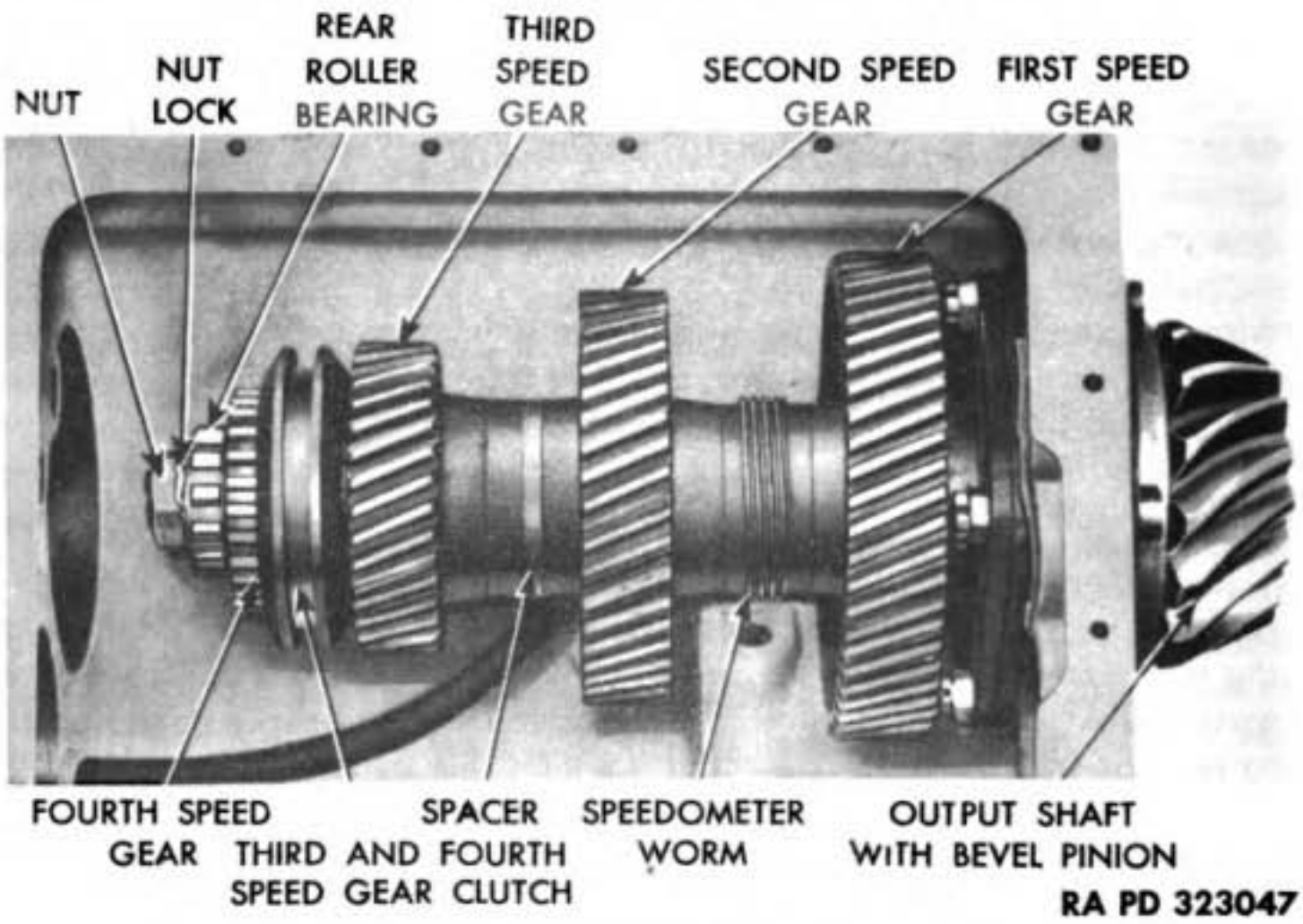


***Figure 47 — Output Shaft Assembled***

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

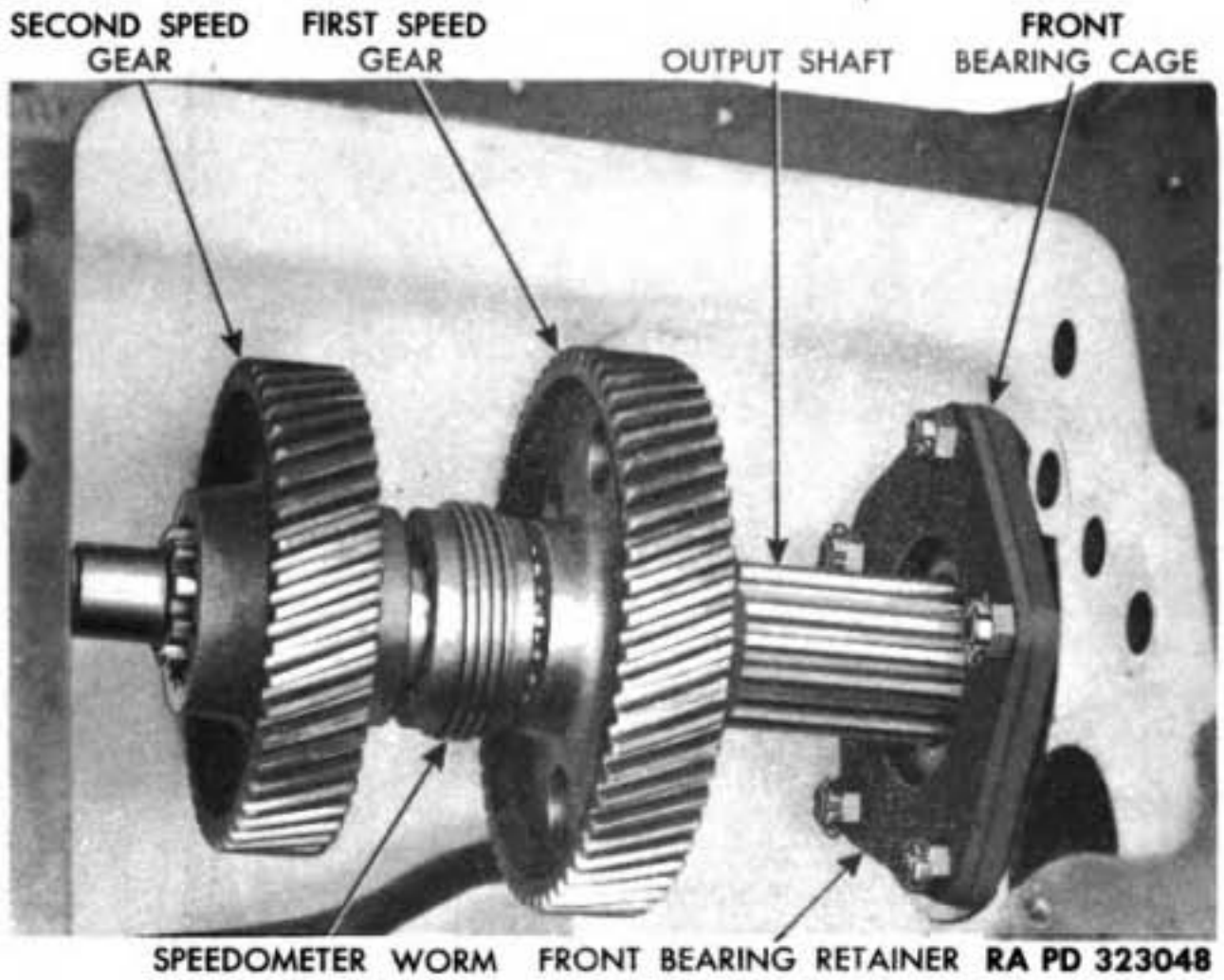


***Figure 48 — Output Shaft Installation***

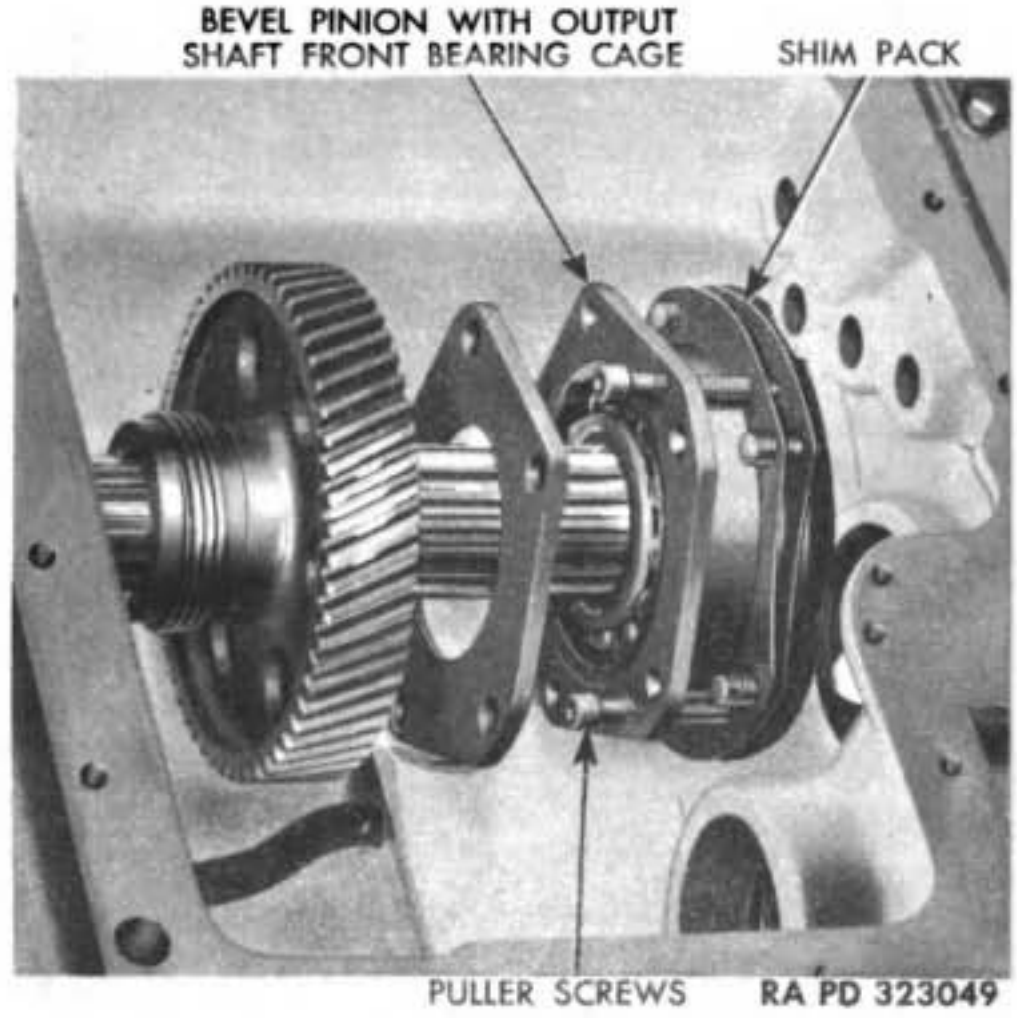


***Figure 49 — Pulling Transmission Output Shaft Front Bearing Cage***

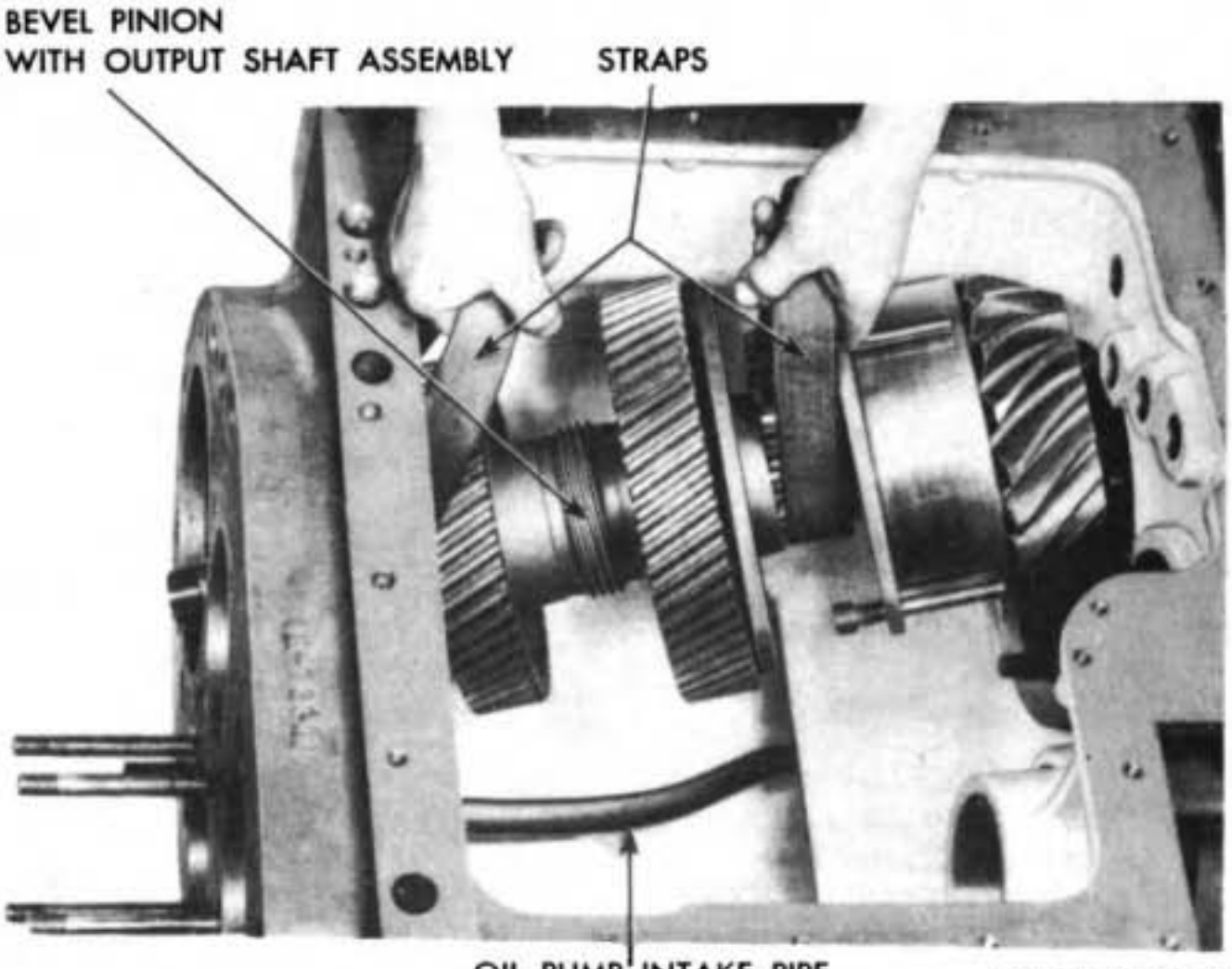


***Figure 50 — Removing Output Shaft Assembly***

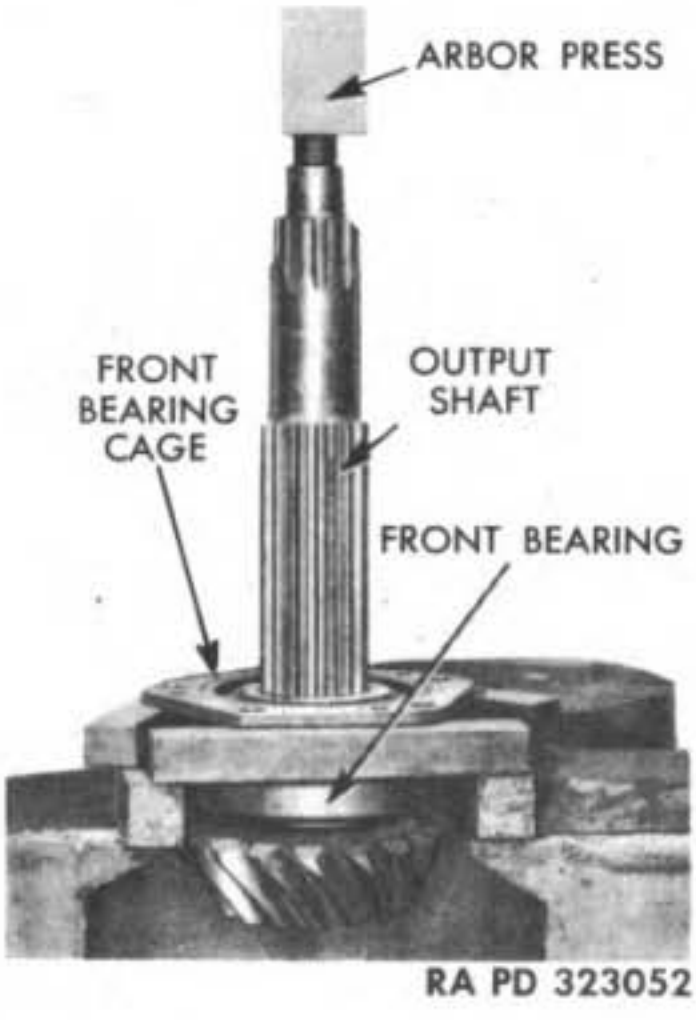


***Figure 51 — Removing Front Bearing from Transmission Output Shaft***

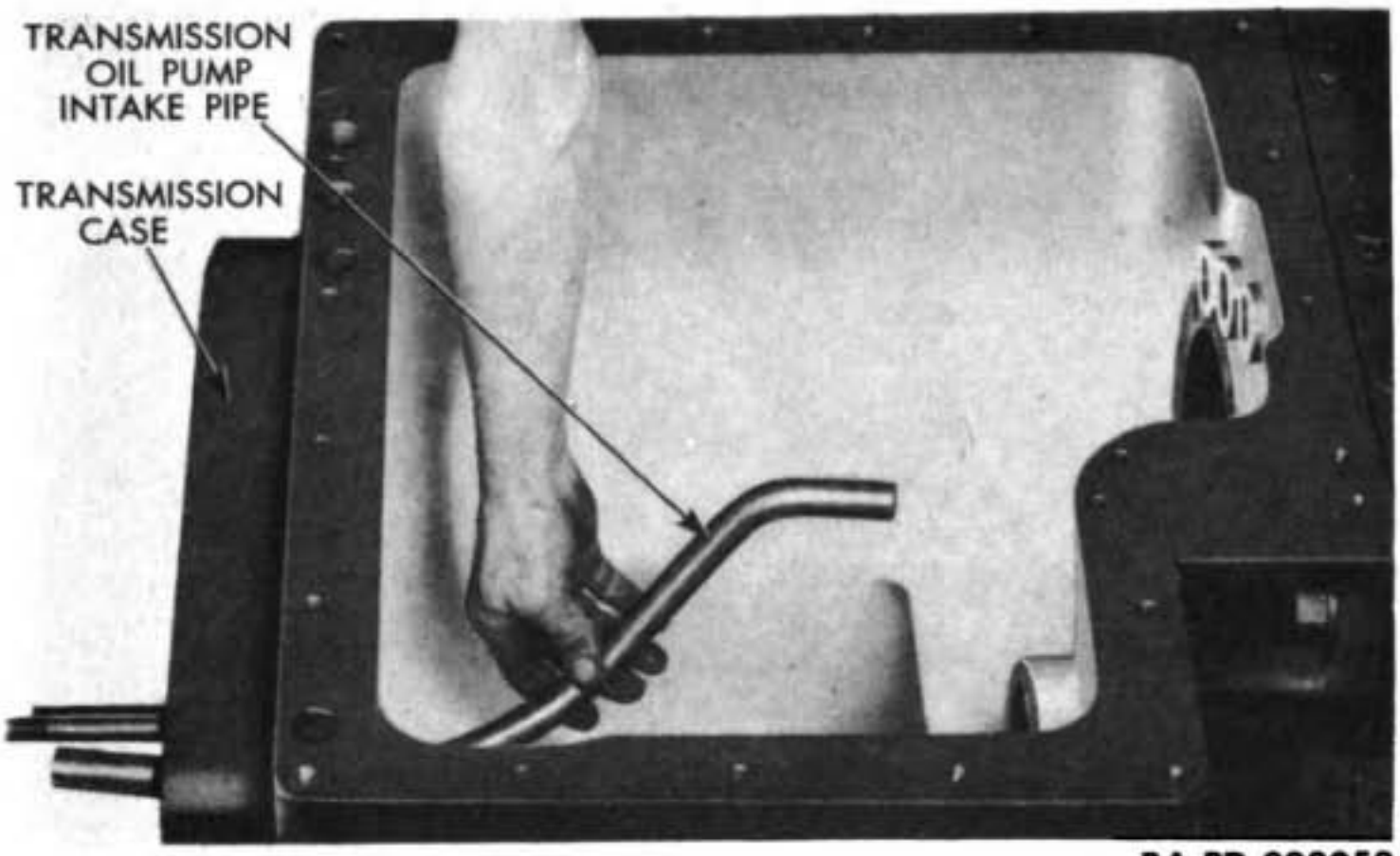


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***Figure 52 — Removing Transmission Oil Pump Intake Pipe***

out of upper spring stop. Remove upper stop, spring, lower stop, and swivel housing shield from gearshift lever. Remove expansion plug and small swivel shaft from gearshift lever housing. Remove gearshift lever with large swivel shaft from housing.

## 7. CLEANING, INSPECTION, AND REPAIR.

### a. Clean.

(1) Place all parts except transmission case in dry-cleaning solvent, and allow them to remain long enough to loosen old grease and lubricant. Dry with compressed air.

(2) BEARINGS. After soaking thoroughly, bearings should be alternately slushed up and down and spun slowly below surface of dry-cleaning solvent to remove as much of the oil as possible. Blow out bearings with compressed air, being careful to direct air pressure across bearings, to remove last trace of old lubricant and to dry, without spinning bearings.

### b. Inspect and Repair.

(1) BEARINGS. Inspect rollers, balls, and races carefully for chips, cracks, or worn spots to determine fitness of bearings for future use. Replace worn or damaged bearings with new ones. Bearings that are to be used again must be dipped in engine oil and wrapped or covered until ready for use. The lubricant prevents rusting, and also prevents scoring during initial period of operation before transmission oil has been able to penetrate. CAUTION: *Keep bearings free of dust and dirt after they have been cleaned and lubricated.*

**ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

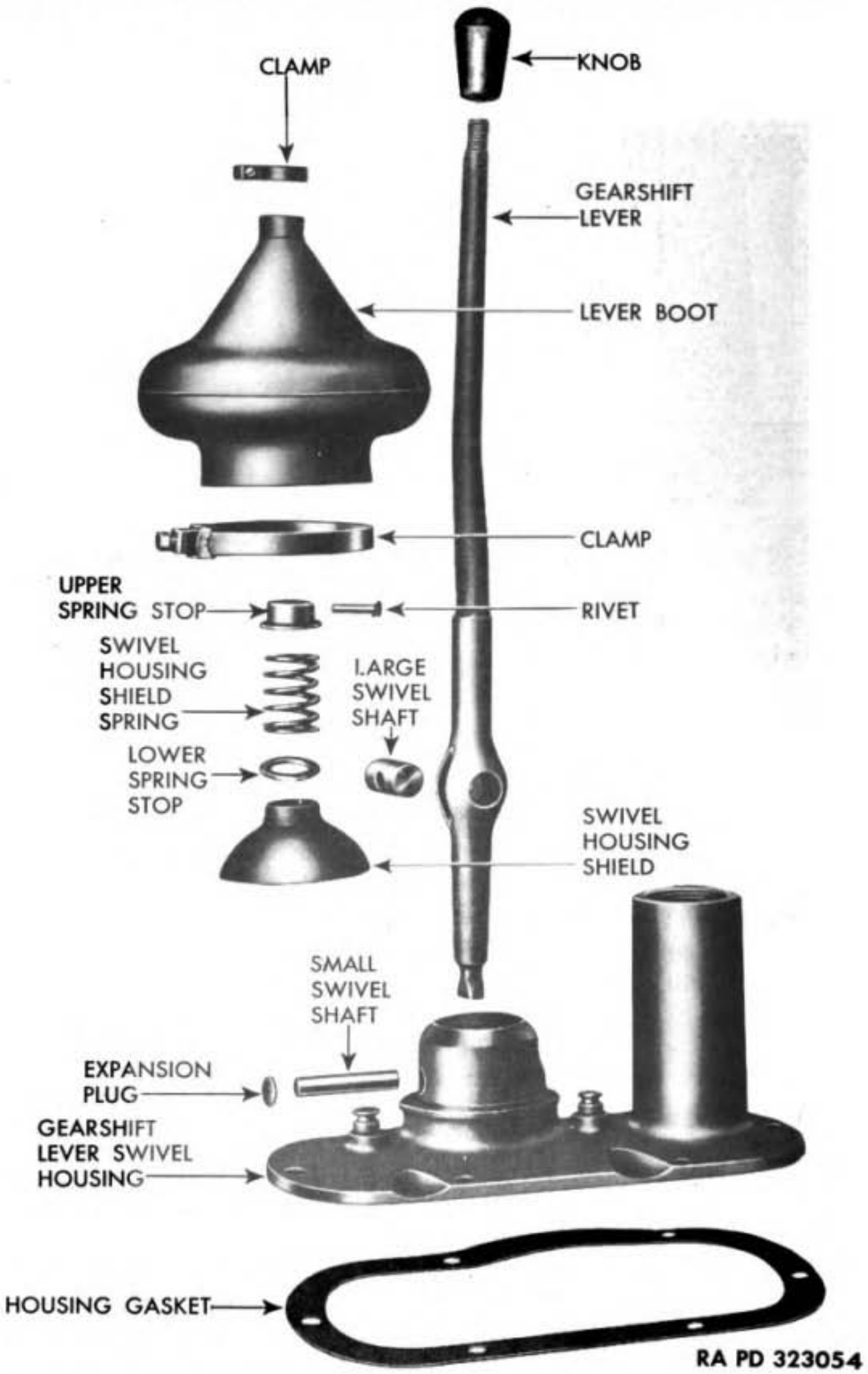


***Figure 53 — Transmission Gear Shift Lever Swivel Housing Components***

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

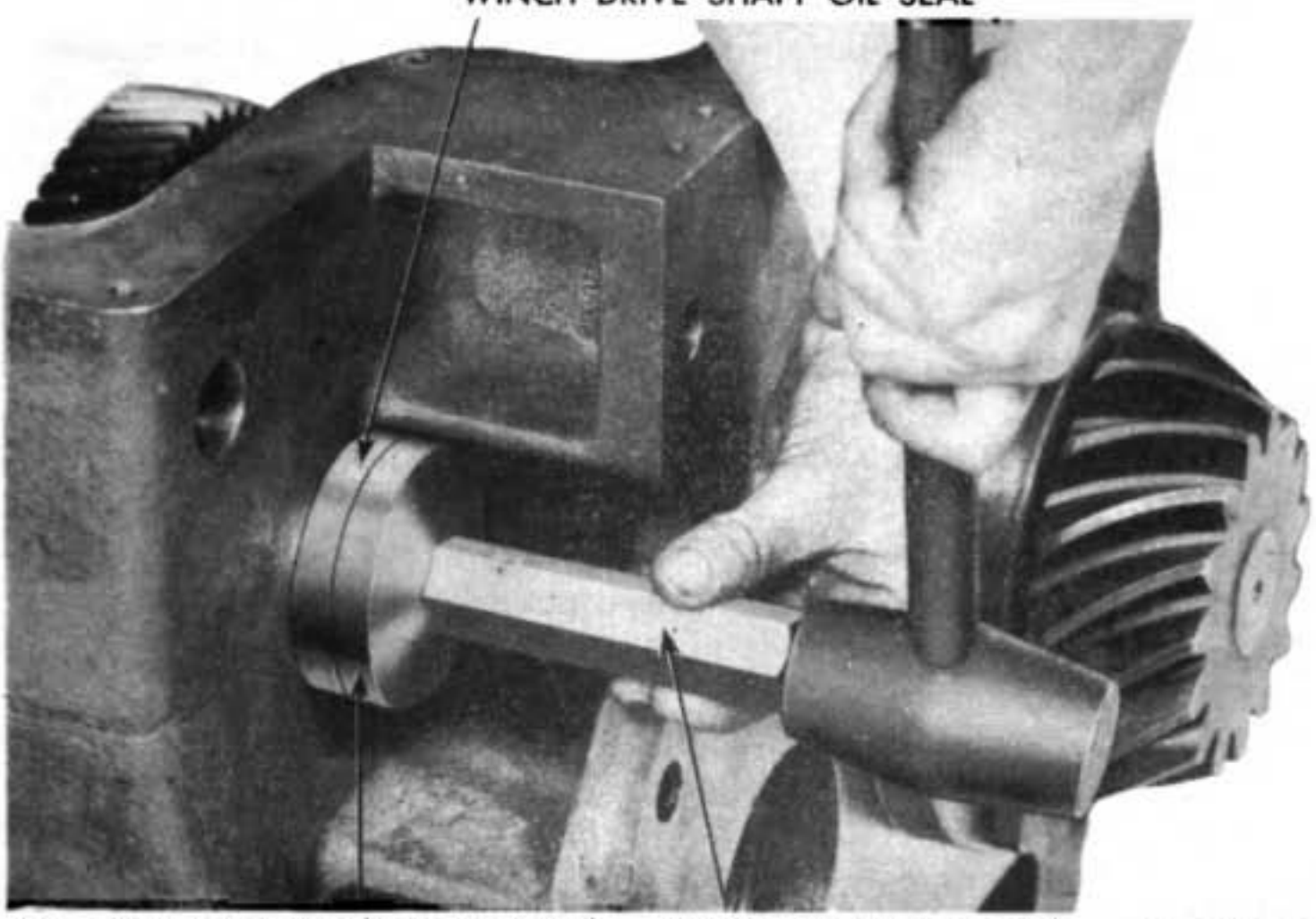


***Figure 54 — Installing Winch Drive Shaft Oil Seal***

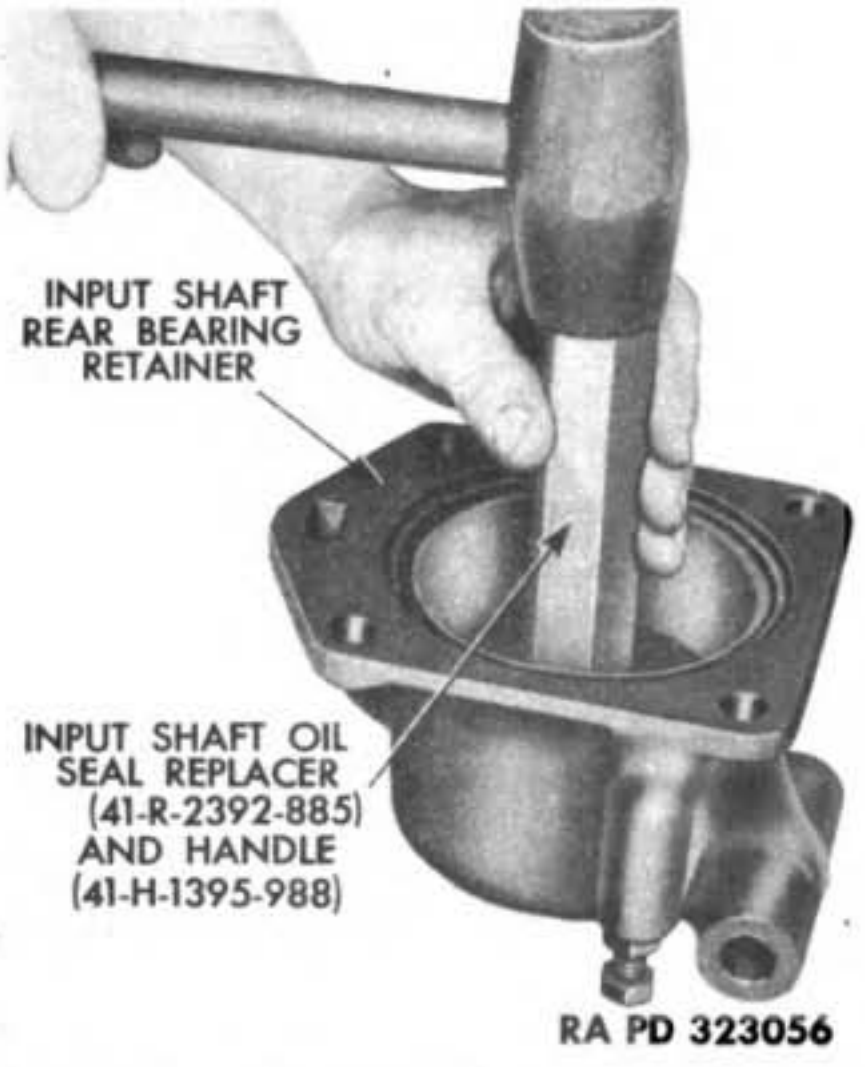


***Figure 55 — Installing Input Shaft Oil Seal***

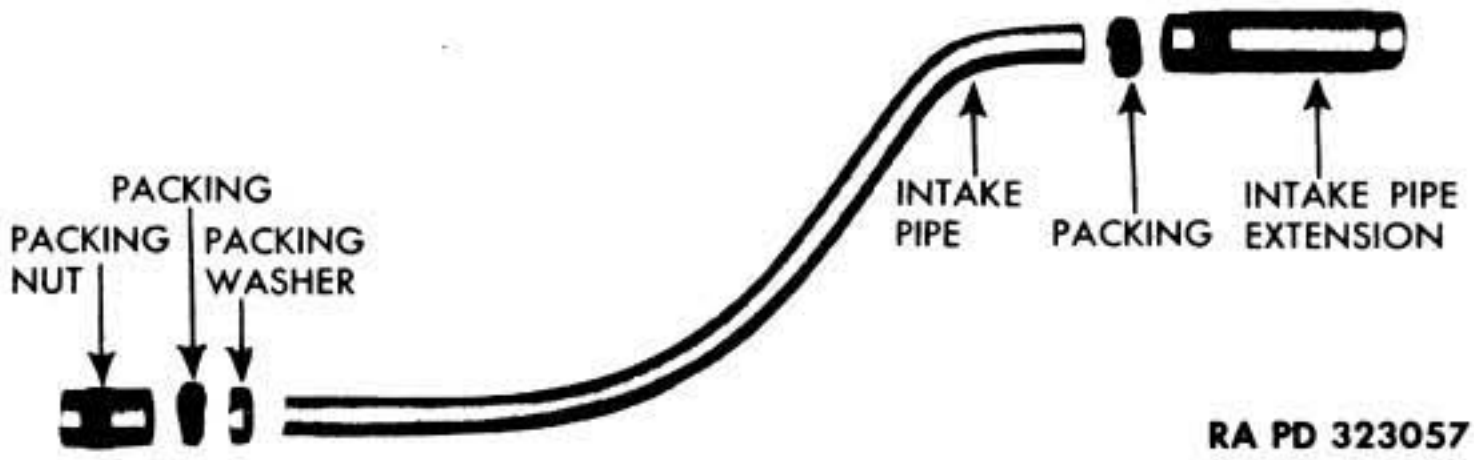


*Figure 56 — Transmission Oil Pump Intake Pipe Components*

(2) OIL SEALS. Two spring-loaded, leather-type oil seals are used. The input shaft oil seal is located in the input shaft rear bearing retainer, and the winch drive shaft oil seal is located in the right front side of the transmission case. Inspect these seals carefully at disassembly for evidence of failure. Replace damaged seals with new ones to prevent possible failure of bearings and gears. Before installing oil seals, soak them in neat's-foot oil or warm engine oil, until the leather lips are soft and pliable. This assures an efficient leakproof seal, and assists installation. Using input shaft oil seal replacer (41-R-2392-885), install oil seal in input shaft rear bearing retainer (fig. 54) with felt washer end of seal toward outside of retainer (seal can also be installed from inside of case). Install winch drive shaft oil seal in front side of transmission case (fig. 55) with felt washer in seal toward outside of case. NOTE: *Handle (41-H-1395-988) is used with replacer (41-R-2392-885).*

(3) GASKETS. It is advisable to replace all gaskets with new ones when assembling transmission.

(4) TRANSMISSION CASE. Thoroughly clean case with dry-cleaning solvent. Inspect case for cracks, and all machined surfaces for burs. Remove burs with a file.

(5) GEARS. Check all gear teeth for chips, nicks, and wear. This includes all transmission gear teeth, teeth in gear clutches, and teeth on shafts. If gear teeth show wear, the affected part must be replaced. Check splines and bushings in gears for wear. If splines are worn, indicating that part was loose on shaft, both gear and shaft must be replaced. Replace worn bushings, and machine to size. The manufacturing tolerances of bushings in gears are as follows: Countershaft, first speed gear, winch wind gear, and winch drive unwind gear bushings are 2.2515 to 2.2525 inches inside diameter. Countershaft second speed gear, output shaft third speed gear, and reverse idler pinion bushings are 3.1265 to 3.1275 inches inside diameter.

(6) SHAFTS AND SPACER. Inspect oil holes in shafts to see that they are clean, and allow free passage of lubricant to gear bushings.

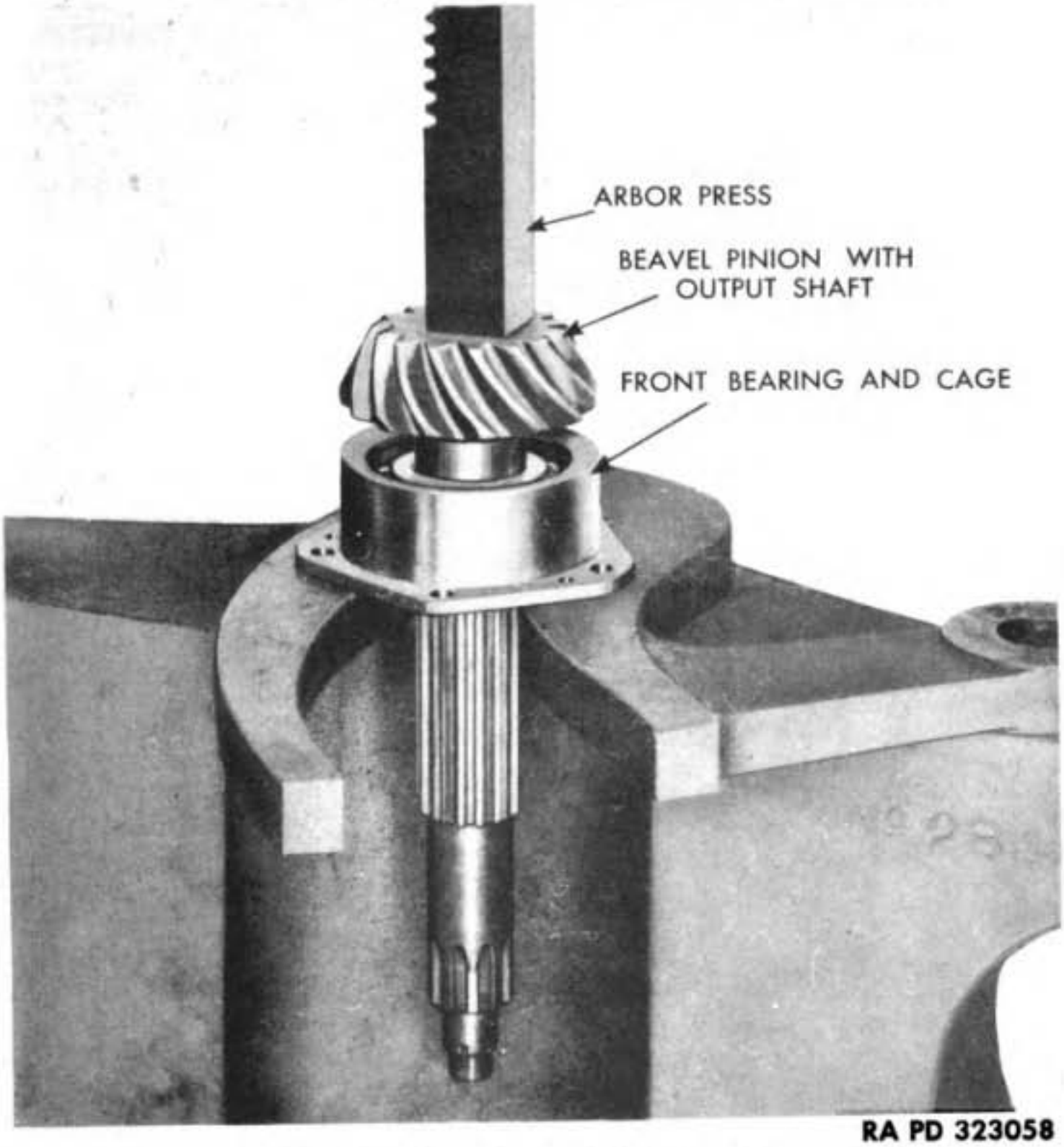


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***Figure 57 — Pressing Output Shaft Into Front Bearing***

Check surfaces on which gears rotate for wear. Manufacturing diameter tolerance of shafts and sleeves on which the transmission gears with bushings rotate, are as follows: Winch drive shaft wind and unwind gears, and countershaft first speed gear bearing surfaces are 2.2465 to 2.2475 inches outside diameter. Countershaft second speed gear and reverse idler gear spacer bearing surfaces are 3.1215 to 4.1225 inches outside diameter. Worn shafts must be replaced. Check to see that inner races of ball bearings have not been turning on shaft. Check threads in bearing lock nuts and threads on ends of shafts.

(7) SHIFTING FORKS AND HEADS. Inspect forks for wear, and re-replace if worn. Inspect shifting shaft heads, and replace if worn.

(8) BEARING CAGES AND RETAINERS. Inspect cages for cracks and burs. Remove burs with a file, and replace cracked cages and retainers.

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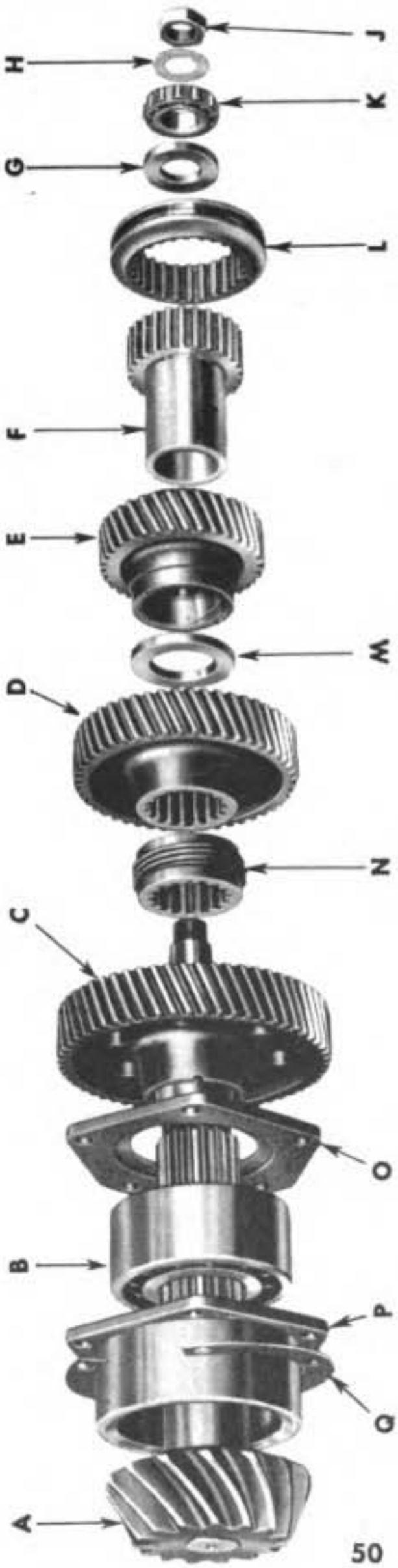


A—BEVEL PINION WITH OUTPUT SHAFT
B—FRONT BEARING
C—FIRST SPEED GEAR
D—SECOND SPEED GEAR
E—THIRD SPEED GEAR WITH BUSHING
F—FOURTH SPEED GEAR
G—REAR BEARING SPACER
H—REAR BEARING NUT LOCK
J—REAR BEARING NUT
K—REAR BEARING
L—THIRD AND FOURTH SPEED GEAR CLUTCH
M—SECOND AND THIRD SPEED GEAR SPACER
N—SPEEDOMETER WORM
O—FRONT BEARING RETAINER
P—FRONT BEARING CAGE
Q—SHIMS

***Figure 58 — Transmission Output Shaft Disassembled***

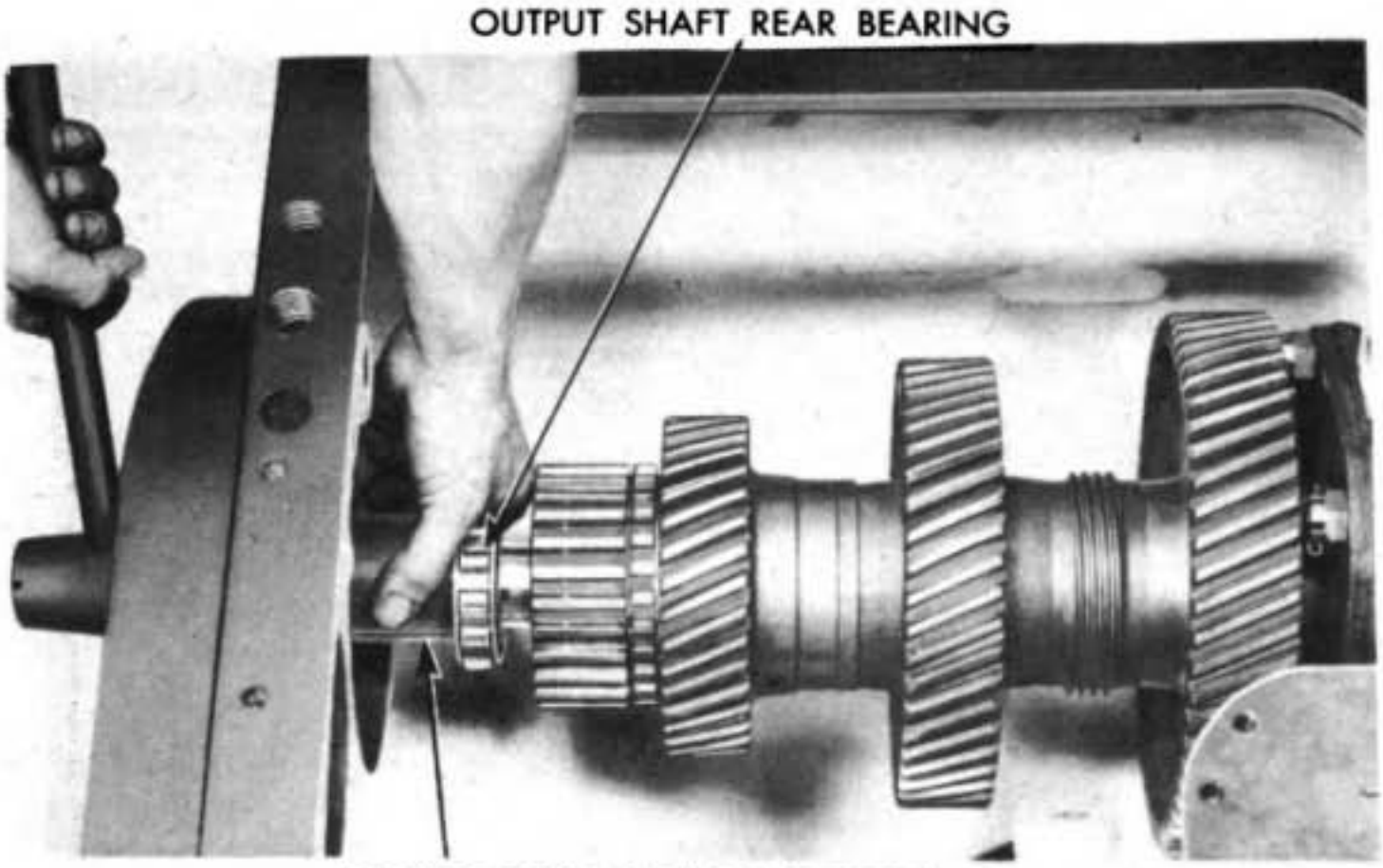


***Figure 59 — Installing Output Shaft Rear Bearing***

(9) OIL PRESSURE RELIEF VALVE SPRING. Inspect spring for compression. It must test 16 to 18 pounds when compressed to $1\frac{25}{32}$ inches.

(10) INSPECT GEAR LEVER SWIVEL HOUSING ASSEMBLY. For a preliminary inspection, remove the lever boot, and inspect parts for wear and looseness. Disassemble (par. 5 o) and replace defective parts. Inspect general condition of lever boot and clamp. Replace boot if it leaks, or will not make a tight dust seal between housing and gear shifting lever.

## 8. ASSEMBLY.

**a. Assemble Gear Lever Swivel Housing** (fig. 53). Insert gearshift lever with large swivel shaft into position in housing. Insert small swivel shaft into housing and through large swivel shaft, and install expansion plug. Place swivel housing shield, lower spring stop, spring, and upper spring stop on gearshift lever. Install rivet in upper spring stop. Place boot with clamps in place on lever and housing, and tighten clamps. Screw knob onto top of lever.

**b. Install Oil Pump Intake Pipe.** Slide pipe through hole in rear of transmission case (fig. 52). Install packing washer and packing on pipe. Install packing nut, but do not tighten. Slide pipe through hole in front of case, and install packing and pipe extension (fig. 56). Tighten extension nut at front of case, and packing nut at rear of case.

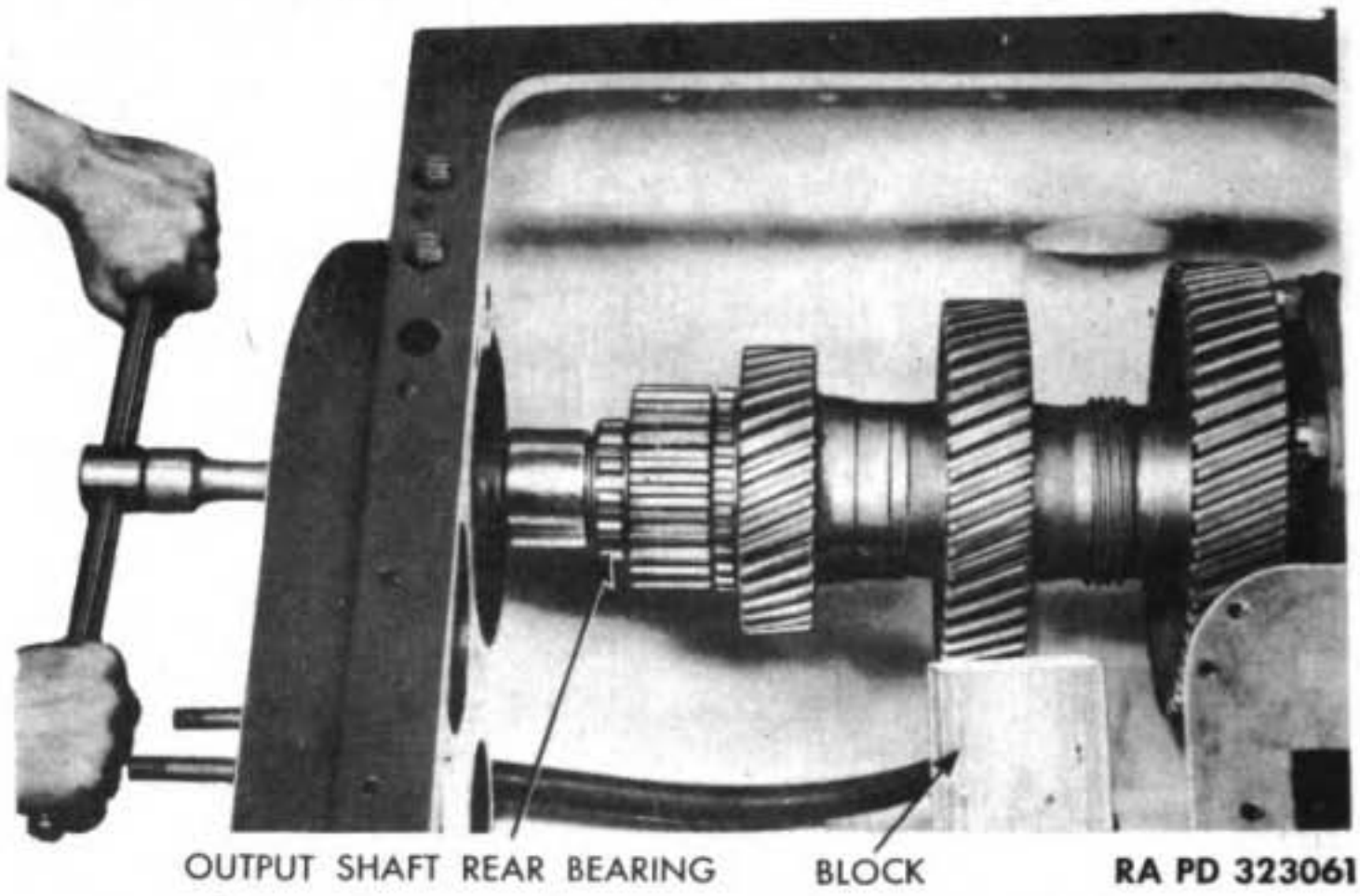


***Figure 60 — Tightening Output Shaft Rear Bearing Nut***

**c. Assemble and Install Output Shaft.**

(1) Press front bearing into cage. Press output shaft into bearing (fig. 57). Be sure shoulder in back of pinion is tight against inner race of bearing. Slide front bearing retainer first speed gear, speedometer worm, and second speed gear onto shaft (fig. 58). NOTE: *Long hub of second speed gear must be toward threaded end of shaft.* Place one strap or rope around shaft in front of first speed gear, and another strap or rope around rear end of shaft; lower shaft into transmission case (fig. 50).

(2) Line up bearing cage with bolt holes, and start bearing cage into transmission case. Insert four bearing cage attaching bolts through the transmission oil screen hole in front of differential and final drive housing. One bolt cannot be removed or installed unless the differential assembly is removed. Slip shim pack around bearing cage and onto bolts so that opening is toward left side of case. NOTE: *If the same matched output shaft with bevel pinion and bevel drive gear set, and the same transmission case and differential and final drive housing are used again, install same thickness of shims as were removed. If a new transmission case is installed, refer to paragraph 5* **a.**

(3) If a new matched bevel pinion and bevel drive gear set is to be installed, compare the numbers following the letter "C" on front face of old and new pinions. All bevel pinions and bevel drive gears are run in a gear-testing machine at the factory to determine the proper

setting of bevel drive gear in relation to pinion in order to have the best tooth contact. After this setting is found, the front face of the bevel pinion is marked with a letter "C" and a plus ( + ) or minus ( – ) number. The number indicates the distance in thousandths of an inch that the bevel pinion is set toward ( + ) or away from ( – ) the bevel drive gear, as compared to a set dimension. If there is a difference of more than 2, it will be necessary to add or remove shims to provide the correct setting between bevel pinion and bevel drive gear. For example: If the pinion removed is marked "C + 2", and the pinion to be installed is marked "C – 3", this indicates that there is a difference of 0.005 inch. It will be necessary to install the new pinion 0.005 inch farther away from the gear by increasing the shim pack thickness 0.005 inch.

(4) Strike end of shaft to drive bearing cage against inside of case. Install bearing retainer on bolts. Install and securely tighten five nuts on bolts attaching bearing retainer and cage to case (fig. 48). Before proceeding with assembling the transmission, install a new bevel drive gear in the differential, and adjust correct backlash between bevel pinion and drive gear (par. 16 **d**). Also preload differential bearings at the same time. Check tooth contact (subpar. **d**). Install five cotter pins in bolts.

(5) Coat third speed gear bearing surface and fourth speed gear bearing surface with engine oil. Install third speed gear and fourth speed gear. Slide second and third speed gear spacer, and third and fourth speed gear assembly onto shaft. Install rear bearing spacer. Using bearing driver (41-R-2383-785), drive rear roller bearing onto shaft (fig. 59). Install nut lock and rear bearing nut. Securely tighten nut (fig. 60), and bend washer over one hexagon face of nut to lock it. Install third and fourth speed clutch. NOTE: *Two of the three gear clutches used in the transmission are identical. The third and fourth speed gear clutch has teeth the full width of the clutch, whereas the first and second speed gear clutch and the winch gear clutch have a groove cut in the teeth.*

**d. Bevel Pinion and Bevel Drive Gear Adjustment.** If the correct thickness of shims is used between the bevel pinion front bearing cage and the transmission case, and if the two gears are adjusted to the correct backlash, there will be proper tooth contact between the teeth of the bevel pinion and the bevel gear. Proper tooth contact distributes the load over a considerable area of the teeth, keeps gearing pressure low, and minimizes wear. If contact is not correct, the load will be concentrated on small areas of the teeth, and breakage, chipping, or undue wear will result. Check tooth contact as follows: Paint bevel drive gear teeth with light coating of prussian blue in oil. This will show up tooth contacts. Turn the output shaft with bevel pinion,

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***Figure 61 — Tooth Contact Bearing Surfaces***

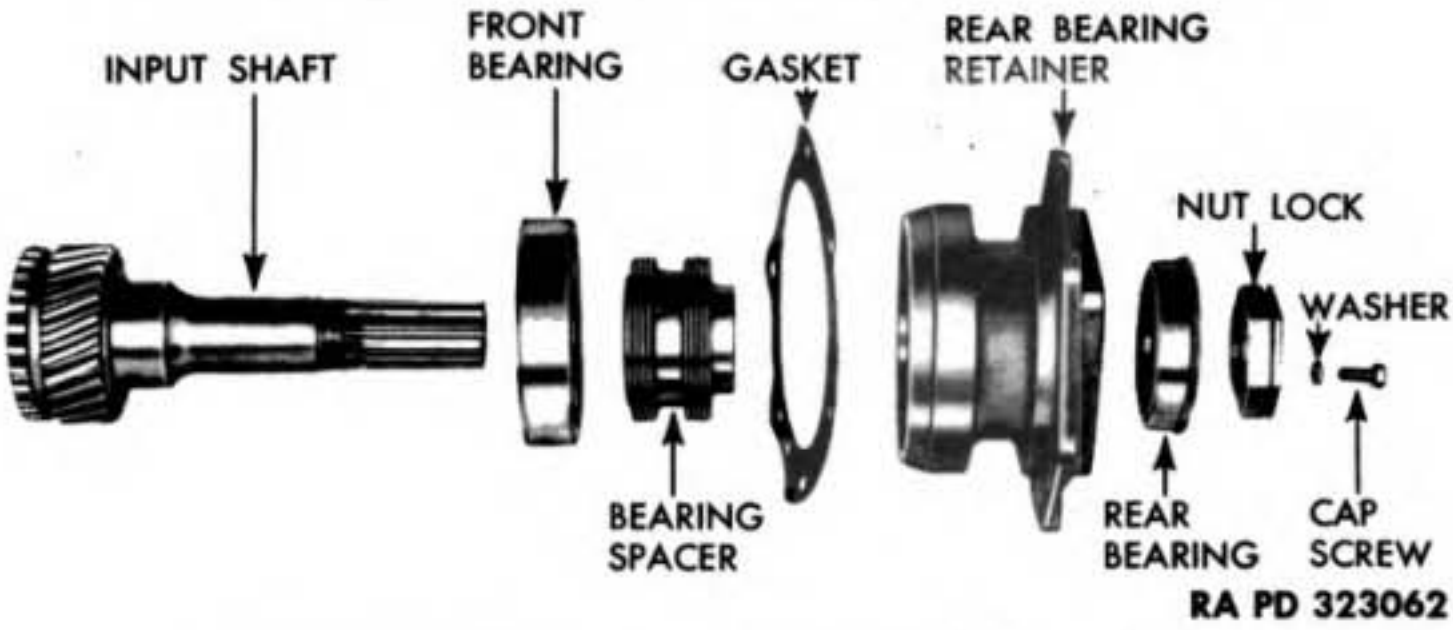


***Figure 62 — Transmission Input Shaft Disassembled***

and if possible apply a load to the bevel drive gear. One way of doing this is by fastening two sections of brake lining on two boards, then using the boards as a pry to apply the brake lining to the steering brake drums. Observe the tooth bearing contact on the bevel drive gear. Following is an explanation of the various tooth markings:

(1) Condition **A** (fig. 61) shows a bearing on the bevel drive gear which is considered satisfactory. The area of contact starts close to the toe or inside end, and extends out toward the heel or outside end on the drive side of the teeth. If only a little load is applied when turning gears, the tooth contact area is small and well toward the toe of the teeth.

(2) Condition **B** (fig. 61) shows a high narrow contact on the gear teeth which is not desirable. If gears are operated with an adjustment of this kind, galling, noise, and a rolling over of the top edges of the teeth will result. To obtain a correct contact, move the pinion toward the gear by removing shims, and correct the backlash by moving the gear away from the pinion.

(3) Condition **C** (fig. 61) shows a low narrow contact on the gear teeth. If gears are operated with an adjustment of this kind, galling, noise, and grooving of the teeth will result. To obtain a correct contact, move the pinion away from the gear by installing shims, and correct the backlash by moving the gear toward the pinion.

(4) Condition **D** (fig. 61) shows a short contact on the toe of the gear teeth. If gears are operated with this adjustment, the teeth will chip at the edges, and there will be excessive wear, due to the small contact area. To obtain correct contact, move the gear away from the pinion, and correct the backlash by moving the pinion toward the gear by removing shims.

(5) Condition **E** (fig. 61) shows a short contact on the heel of the gear teeth. If gears are operated with this adjustment, chipping, exces-

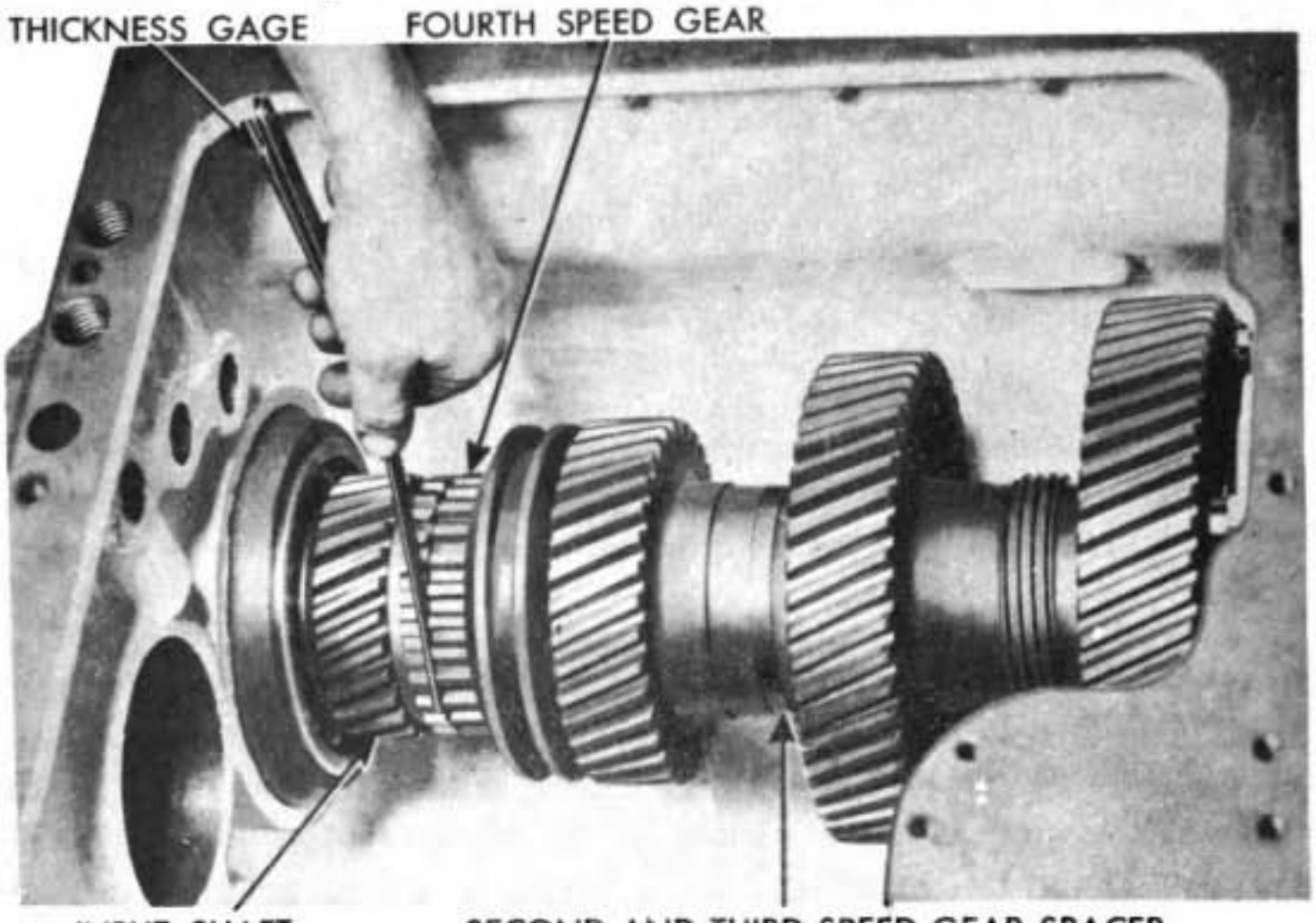


***Figure 63 — Checking Clearance Between Fourth Speed Gear and Input Shaft with a Thickness Gage***

sive wear, and noise will result. To obtain a correct contact, move the gear toward the pinion, and correct the backlash by moving the pinion away from the gear by installing shims.

**e. Assemble Input Shaft** (fig. 62). Press or drive front bearing onto input shaft. Tap input shaft and bearing into bearing cage. Slide bearing spacer onto shaft with long hub of spacer toward splined end of shaft. Press or drive rear bearing onto shaft and into bearing cage. Install bearing lock nut, tighten securely, and install two cap screws and lock washers in nut. Install rear bearing retainer and a new gasket on input shaft assembly, and secure with four cap screws and lock washers.

**f. Install Input Shaft Assembly to Check Clearance Between Fourth Speed Gear and Front End of Input Shaft.** Shellac a new gasket on bearing cage, and install input shaft assembly in transmission case. Secure with five cap screws and lock washers. With a thickness gage, check clearance between fourth speed gear and front end of input shaft (fig. 63). This clearance must be $\frac{1}{16}$ (0.0625) inch plus or minus $\frac{1}{64}$ (0.0156) inch. If clearance does not come within this tolerance, input shaft assembly and third and fourth speed assembly must be removed, and second and third speed gear spacer replaced with one of correct thickness, to provide proper clearance. Five spacers are avail-

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

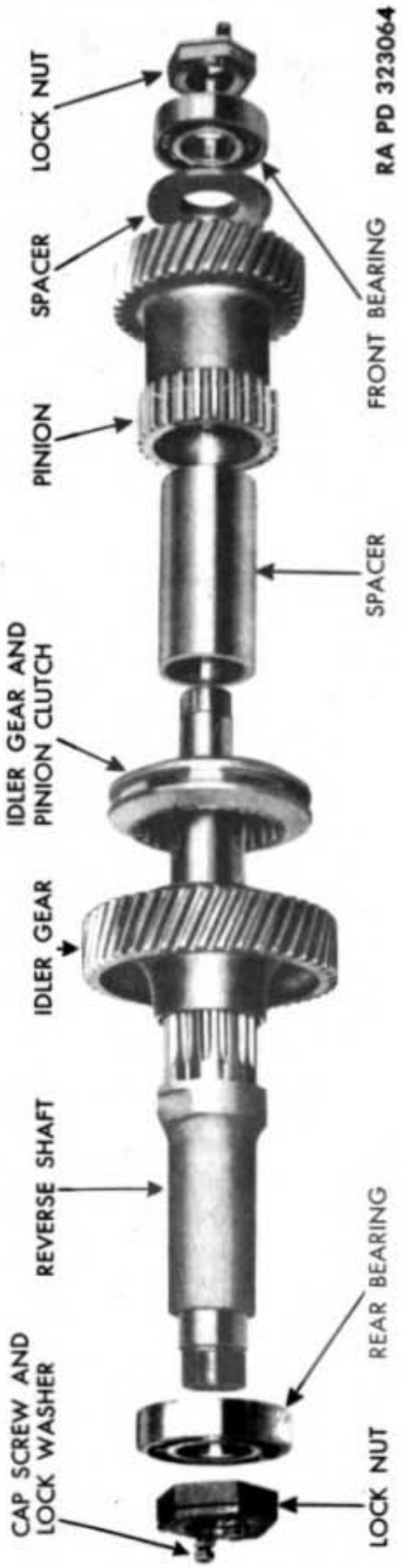


*Figure 64 — Transmission Reverse Shaft Disassembled*

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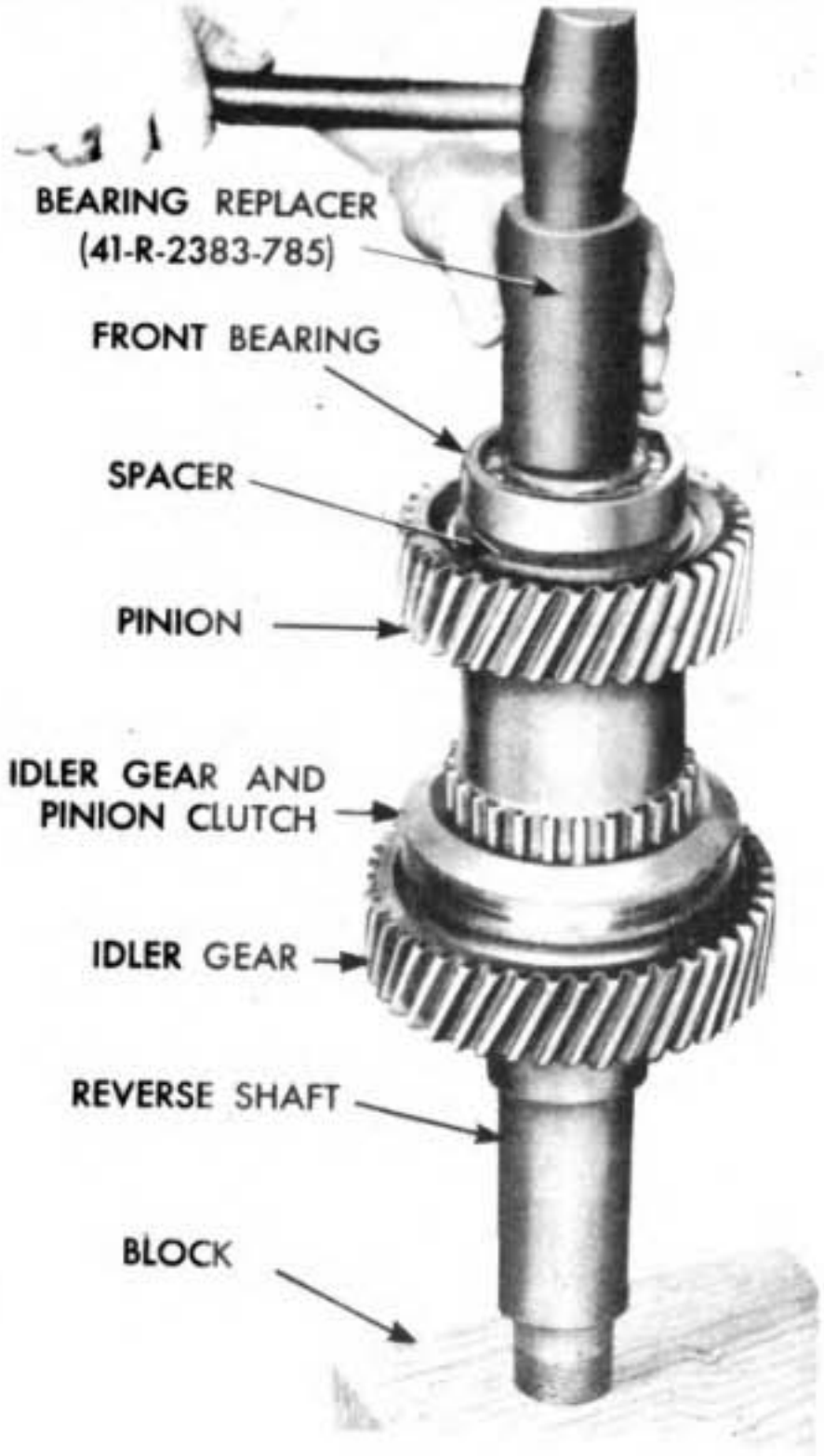



***Figure 65 — Installing Reverse Shaft Front Bearing***

able, varying $\frac{1}{64}$ inch in thickness from $\frac{22}{64}$ to $\frac{26}{64}$ inch. After correct clearance has been secured, remove five cap screws securing input shaft bearing cage to transmission, and pull cage out until it is flush with inside of case.

**g. Install Speedometer Drive Shaft.** Insert shaft through hole in left side of transmission case (fig. 45), and into bearing in bottom of case. Attach drive shaft bearing sleeve to case with two cap screws and lock washers (fig. 2).

**h. Assemble Reverse Shaft** (fig. 64). Slide reverse idler gear onto shaft with long hub toward shoulder on shaft. Slide reverse

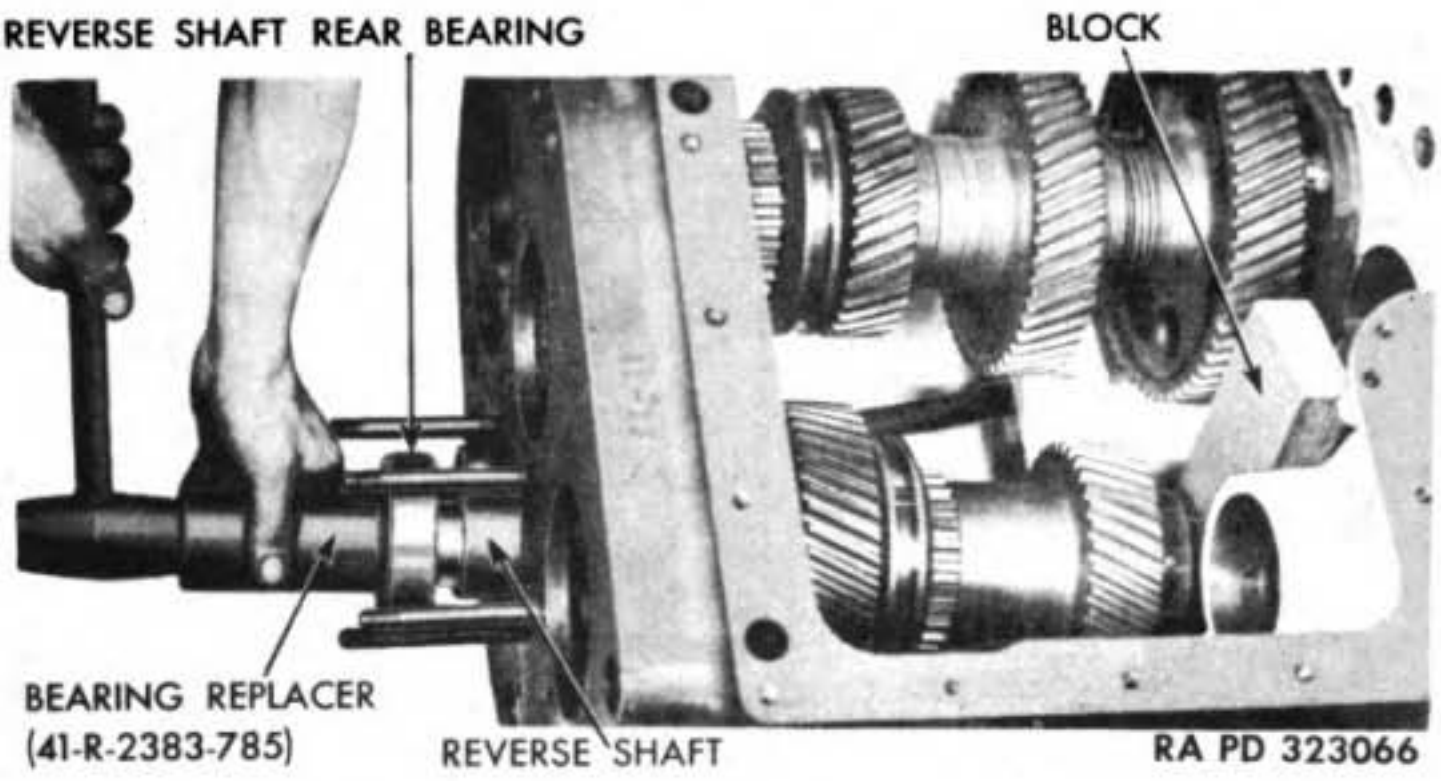



***Figure 66 — Installing Reverse Shaft Rear Bearing***

idler pinion spacer onto shaft, and coat with engine oil. Install reverse idler gear and pinion clutch onto pinion, and slide pinion onto spacer. Install front bearing spacer on shaft and with bearing replacer (41-R-2383-785), drive on front bearing (fig. 65). Install front bearing lock nut on end of reverse shaft, and tighten securely. Install two cap screws and lock washers in lock nut.

**i. Install Reverse Shaft Assembly.** Hitch a strap or rope around reverse pinion, and lower shaft assembly into transmission case (fig. 44). Slide rear end of shaft through bearing bore in rear of transmission, and place hardwood block between front end of shaft and transmission case. With bearing replacer (41-R-2383-785), drive rear bearing onto end of shaft (fig. 66). Install and securely tighten rear bearing lock nut. Install two cap screws and lock washers in lock nut. Remove wood block and drive reverse shaft assembly toward front of transmission case until front bearing just starts into case. NOTE: *Do not drive front bearing all the way into case, as it would have to be removed again to install countershaft.*

**j. Install Reverse Gear Shifting Fork and Shaft** (fig. 42). Place shifting fork in position on reverse idler gear and pinion clutch. Slide shifter shaft through hole in boss on transmission case, through shifting fork, and into hole in front of case. Install cap screw and lock washer in fork, clamping fork to shaft. Install poppet, poppet spring, and cap in hole in right side of transmission case (fig. 23).

**k. Install Winch Drive Shaft.** Slide wind gear with gear clutch onto splined end of shaft (fig. 67). Coat shaft surface on which gear rotates, with engine oil. Slide wind gear spacer washer and gear spacer onto shaft. Press or drive front bearing onto shaft. Lift winch

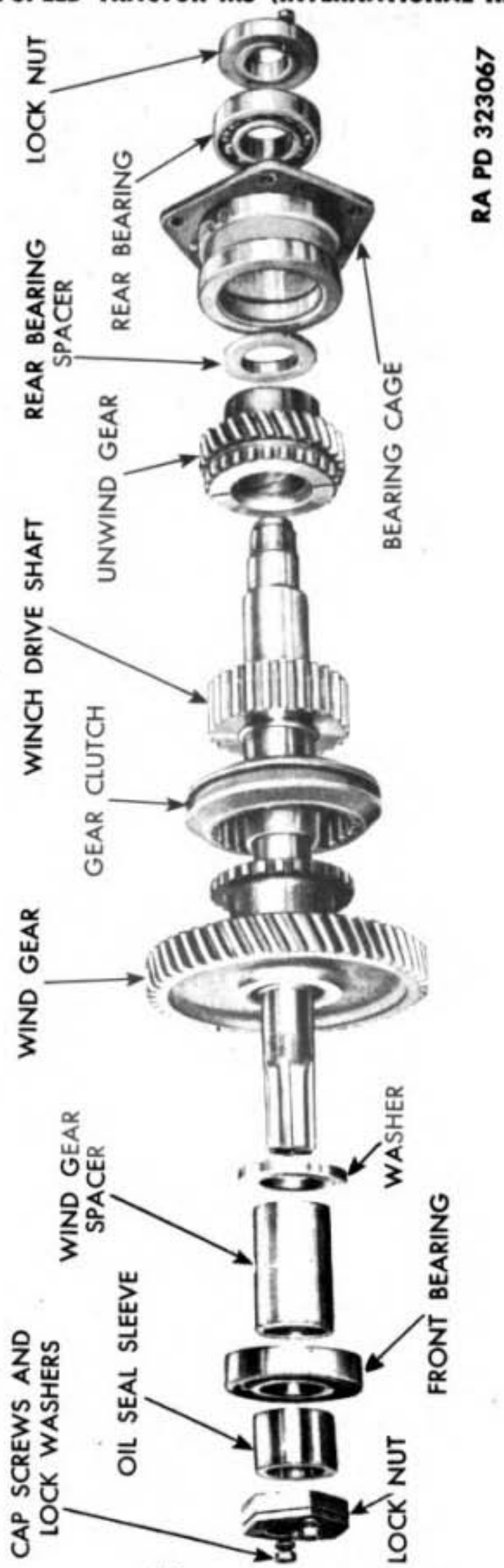
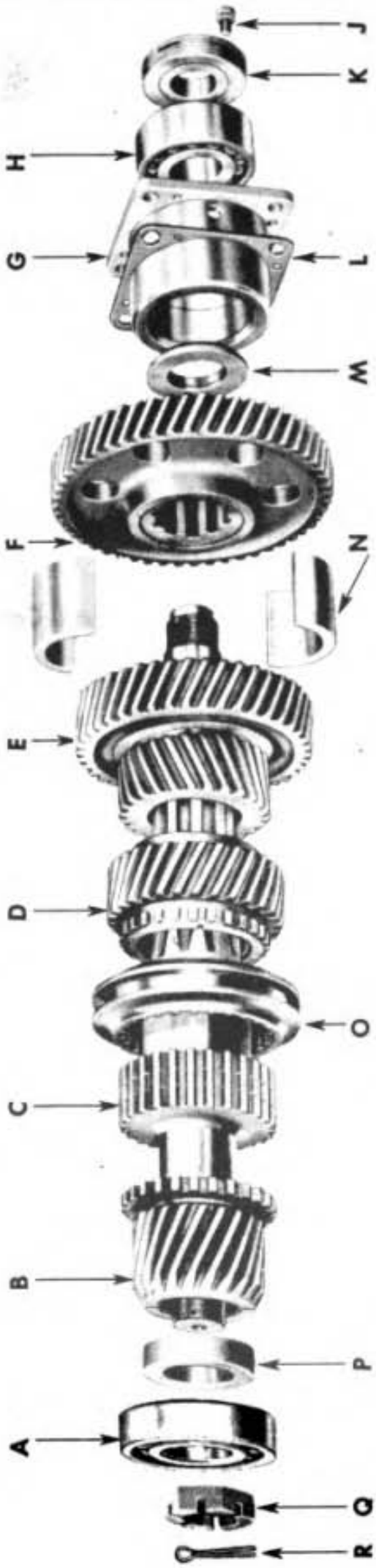



*Figure 67 — Transmission Winch Drive Shaft Disassembled*


***Figure 68 — Installing Winch Drive Shaft Rear Bearing and Bearing Cage***

drive shaft into transmission case (fig. 39). Insert rear end of shaft through rear bearing cage bore in transmission case. Move splined end of shaft under front bearing bore in case, and lift end of shaft into bore. Install winch drive shaft oil seal sleeve in oil seal (fig. 40). Slide splined end of shaft sleeve, place front bearing lock nut on shaft, and drive front bearing into transmission case. Using special wrench (41-W-3336-900), securely tighten lock nut (fig. 38), and install two cap screws and lock washers in lock nut. Coat unwind gear bearing surface of winch drive shaft with engine oil. Install unwind gear on shaft through opening in rear of transmission (fig. 37). Place rear bearing spacer on shaft. Insert rear bearing in bearing cage and, using bearing replacer (41-R-2383-785), drive bearing onto shaft (fig. 68) and cage into transmission case. Use a new gasket between cage and case. Install and securely tighten lock nut. Install two cap screws and lock washers in lock nut (fig. 34). Attach new gasket and rear bearing retainer to case with five cap screws and lock washers (fig. 25).

**l. Assemble and Install Countershaft.** Coat first speed gear bearing surface of countershaft with engine oil. Slide first speed gear and front bearing spacer onto shaft (fig. 69). Use bearing replacer (41-R-2383-785) to drive front bearing onto countershaft (fig. 70). Install and securely tighten front bearing retainer nut. Lock the nut to shaft with cotter pin. Coat second speed gear bearing surface of shaft with engine oil. Install gear clutch, second speed gear, third speed gear, and constant mesh gear on countershaft. Hitch a strap or rope around second speed clutch gear, and insert another strap or rope through two holes in constant mesh gear. Grasp two straps, and lift countershaft assembly into transmission case (fig. 29). Push




A—FRONT BEARING
B—FIRST SPEED GEAR WITH BUSHINGS
C—COUNTERSHAFT
D—SECOND SPEED GEAR WITH BUSHINGS
E—THIRD SPEED GEAR
F—CONSTANT MESH GEAR
G—REAR BEARING CAGE
H—REAR BEARING
J—CAP SCREW AND LOCK WASHER
K—REAR BEARING LOCK NUT
L—REAR BEARING CAGE GASKET
M—REAR BEARING SPACER
N—CONSTANT MESH AND THIRD SPEED GEAR SPACER
O—FIRST AND SECOND SPEED GEAR CLUTCH
P—FRONT BEARING SPACER
Q—FRONT BEARING RETAINER NUT
R—COTTER PIN

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***Figure 69 — Transmission Countershaft Disassembled***

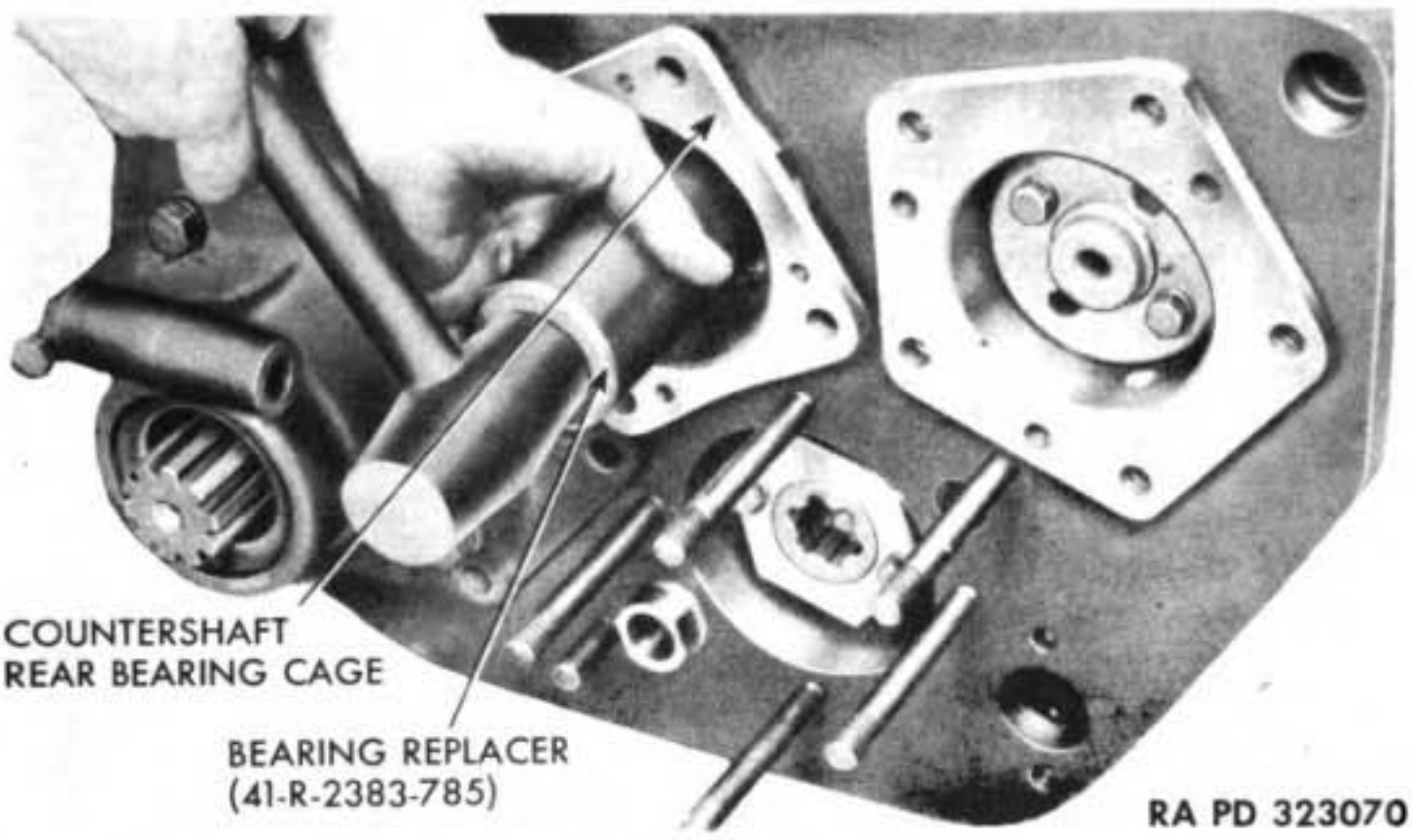


***Figure 70 — Installing Countershaft Rear Bearing and Bearing Cage***

constant mesh gear against inside of transmission case. Install two halves of constant mesh gear spacer on shaft (fig. 27). Drive reverse shaft assembly all the way into front of case. Place countershaft rear bearing spacer on shaft. Insert rear bearing into bearing cage. Place a new gasket on cage and, using bearing replacer (41-R-2383-785), drive bearing onto shaft and cage into case. Install and securely tighten rear bearing lock nut, using wrench (41-W-3247-170). Install two cap screws and lock washers in lock nut (fig. 25). Attach rear bearing retainer and gasket to transmission case with four cap screws and lock washers (fig. 24). Drive input shaft assembly tight against case, and secure with five cap screws and lock washers.

**m. Install Winch Gear Shifting Shaft and Fork.** Install winch gear shifting shaft poppet spring and poppet in hole (fig. 22). Holding poppet down, install shaft from rear of transmission. Place shifting fork in position on gear clutch, and push shaft through fork into front of transmission (fig. 22). Install cap screw, lock washer, and nut in fork. Place sealing compound on threads of two winch gear shifting shaft stop plugs, and install plugs in transmission case at each end of shifting shaft.

**n. Insert First and Second, Third and Fourth, and Reverse Gear Shifting Shafts.** Place third and fourth, and first and second speed, shifting forks in position on gear clutches (fig. 2). Install first and second, and third and fourth speed, gear shifting shafts through front of transmission case, through shifting forks, and through rear of case. Install reverse gear intermediate shifting shaft in bear-

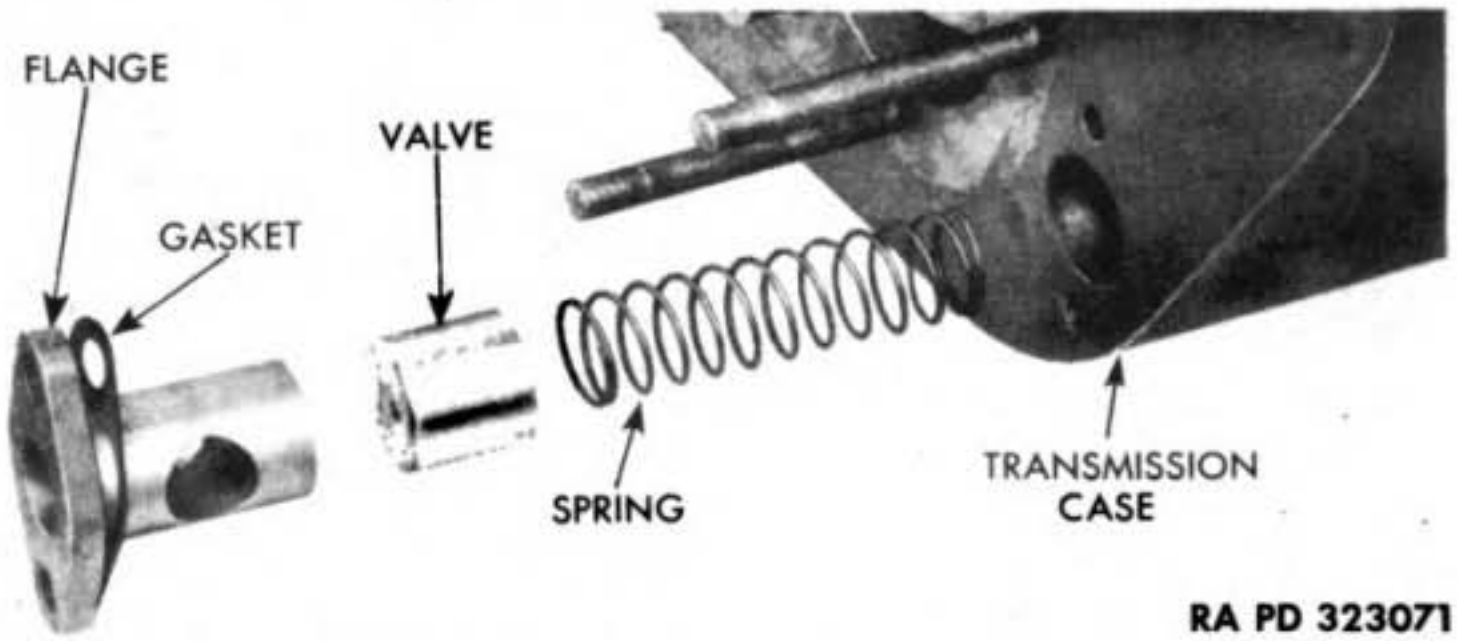


***Figure 71 — Transmission Oil Pressure Relief Valve Components***

ing at bottom of transmission case (fig. 22). Both ends of shaft are the same. Install lightweight poppet spring and poppet in reverse gear shifting shaft poppet hole (fig. 21). Push down on poppet to compress poppet spring, and slide reverse gear shifting shaft over poppet. Slide upper shifting shaft rear head onto shaft. Push shaft through to rear of transmission case. Install third and fourth, and first and second speed, gear shifting shaft poppets, poppet springs, and spacers (fig. 21).

## 9. INSTALLATION.

**a. Preliminary Instructions.** The transmission can be installed completely assembled if the output shaft (with bevel pinion and shim pack thickness) has not been changed. If, however, the shim pack thickness has been changed because of replacing either or both the transmission case and the output shaft with bevel pinion, install only the transmission case and output shaft with bevel pinion. This is to permit adjustment of the bevel pinion and drive gear, and preload differential bearings (par. 16 **e**).

**b. Install Transmission Assembly.** Shellac new gasket on rear face of differential and final drive housing. Remove four cap screws and lock washers attaching countershaft rear bearing retainer to transmission case. Install rear transmission lifting bracket (41-B-1926-755) in place of countershaft rear bearing retainer, using same four cap screws (fig. 20). Place a wire rope sling around front of transmission case, and another sling around lifting bracket. Attach slings to hoist hook. Suspend transmission in center portion of vehicle in front of clutch housing, then move front end of transmission between fender support crossmember and frame crossmember. Block transmission on crossmember and frame side channels. Remove sling, and

install front transmission lifting bracket (41-B-1926-750) on top of transmission with four cap screws. Attach lifting brackets to hoist hook with wire rope slings (fig. 19) so that transmission will balance when lifted. With hoist, move transmission into place against differential and final drive housing. Attach transmission case to housing with three nuts and lock washers on studs, and seven cap screws and lock washers. Remove slings and two lifting brackets from transmission case. Install countershaft rear bearing retainer and gasket to transmission case with four cap screws and lock washers. Connect speedometer cable to adapter at left side of case. Slide winch drive shaft coupling onto transmission splined shaft, and install pin and cotter pin. Shellac new gaskets on both sides of oil pressure relief valve flange. Install oil pressure relief valve spring, valve, and flange in transmission case (fig. 71). Attach oil cooler pipe with tee and oil pressure relief valve flange to transmission case with two cap screws and lock washers. Install transmission oil temperature indicator bulb in oil cooler pipe tee, and attach with retaining nut.

**c. Install Gear Shifting Heads and Guide** (fig. 2). Install shifting guide in differential case, attaching it with two cap screws and lock washers. Push three shifting shafts forward through differential case, and install three shifting shaft heads, clamping them onto shafts with three cap screws and lock washers. Install reverse shifting shaft rear head with slot engaged with reverse gear intermediate shifting shaft (fig. 18), and clamp head to shaft with cap screw, nut, and lock washer. Clamp shifting forks on two other shifting shafts with two cap screws and lock washers. Shellac gasket to sealing plate, and attach sealing plate to rear of transmission case (fig. 12).

**d. Install Gear Shifting Lever Swivel Housing** (fig. 17). Shellac new gasket to housing, and install housing to differential cover, by placing bottom of gearshift lever into guide. Attach housing to differential cover with six cap screws and lock washers. Hook two steering lever springs to anchors. Install transmission oil level rod in housing.

**e. Install Transmission Case Cover.** Shellac new gasket to transmission case cover. Attach cover to transmission with 13 cap screws and lock washers. Shellac new gasket to reverse gear intermediate shifting shaft bearing, and install bearing on shaft and cover. Attach bearing to cover with four cap screws and lock washers. Shellac new gasket to winch shifting lever housing, insert lever into slot of winch gear shifting fork, and install housing on studs in transmission cover. Attach housing with four nuts and lock washers. Install two hoses to winch shifting lever housing tee, attaching them with hose clamps. Connect vent tube to tee on rear of winch shifting lever housing. Install crossmember brace between transmission case cover and fender support crossmember (fig. 12), attaching brace with six cap screws, three nuts, and six lock washers.

**f. Install Clutch Power Cylinder Bracket.** Install clutch power cylinder bracket (fig. 15) on left frame side channel, and attach bracket to frame with four cap screws, nuts, and lock washers. Attach upper part of the bracket to transmission case cover (fig. 14) with four cap screws and lock washers. Attach clutch shifting lever rod to clutch shifting lever and power cylinder lever (fig. 12) with two pins and cotter pins. Connect clutch brake power cylinder hose to adapter (fig. 12) on rear of bracket. Attach compartment rear side sheet inside left front compartment with two cap screws and lock washers. Install front control bracket on power cylinder bracket, and attach with three cap screws, nuts, and lock washers. Install the tubes running from left and right fuel filters and fuel tanks (fig. 11), and attach at fuel tank outlet elbows. Install air brake service coupler tube (fig. 13). Install transmission oil pressure tube (fig. 14). Install air brake emergency coupler tube (fig. 14). Connect the air separator to air manifold tube at air manifold. Install clutch shifting valve hose.

**g. Install Electric Brake Controller.** Refer to TM 9-786.

**h. Install Clutch Selector Unit.** Refer to TM 9-786.

**i. Install Air Reservoir Tanks.** Refer to TM 9-786.

**j. Install Propeller Shaft.** Refer to TM 9-786.

**k. Install Shell Box Support** (fig. 11). Place shell box support in position on frame side channels, and attach with eight cap screws and lock washers. Install gear reduction oil filler tube to hose on clutch housing nipple, and attach filler tube to shell box support with two cap screws and lock washers. Tighten hose clamp. Connect air tank drain control rod to cross lever with pin and cotter pin. Connect transmission oil filter control rod to ratchet handle with cotter pin. Place tachometer cable and engine heat indicator cable in two clips on shell box support. Install right cable harness in three clips, and left cable harness in five clips on shell box support. Connect right and left fuel gage cables to terminals on fuel tanks. Shellac new gasket to left coolant elbow. Slip hose on elbow, and two clamps on hose. Attach elbow to left side of clutch housing with two cap screws and lock washers. Connect hose to elbow and coolant pipes, and secure with two hose clamps.

**l. Install Shell Box.** Refer to TM 9-786.

**m. Install Driver's Seat.** Refer to TM 9-786.

**n. Install Transmission and Differential Oil Screen.** Refer to TM 9-786.

**o. Fill Transmission and Differential With Lubricating Oil.** Transmission and differential capacity is 12 U. S. gallons.

**p. Install Center Bottom Plates, Front and Center.** NOTE: *Test transmission* (par 10) *before installing bottom plates. This permits a better visual inspection for leaks.* Install center bottom plate, center, attaching with 18 cap screws and lock washers. Install front center bottom plate, attaching with 18 cap screws and lock washers.

## 10. TEST.

**a.** Before starting the vehicle, make sure that the transmission has been filled with oil, and the engine cooling system with coolant. Make a thorough inspection of vehicle to see that everything is in readiness for starting. Start the vehicle, and give the transmission a road test. Watch to see that the transmission oil pressure gage registers pressure, and that oil temperature gage registers in the white band. Try transmission in all four forward speeds and in reverse, and listen for unusual gear noise. Stop the vehicle, and inspect transmission for oil leaks. Inspect for coolant leaks around clutch reduction unit inlet and outlet elbows.

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## Section III

## DIFFERENTIAL

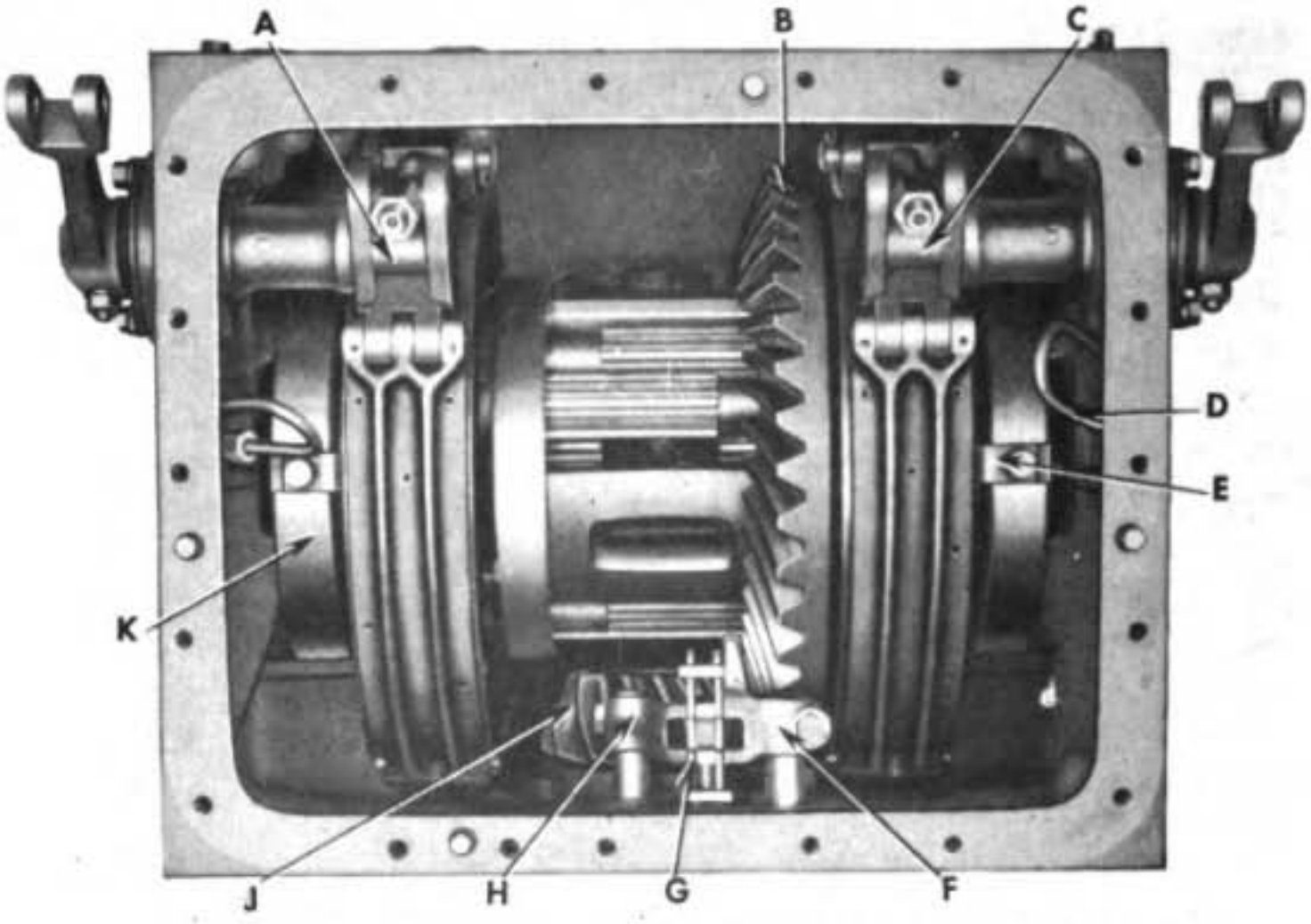


## 11. DESCRIPTION, OPERATION, AND DATA.

**a.** The differential is a unit assembly located in the center compartment of the same housing that carries the final drives (fig. 72). This housing, known as the differential and final drive housing, is bolted and doweled to the two main frame side channels at the front end of the vehicle. The differential is mounted on two tapered roller bearings. The bearing cages are adjustable, to provide a means of preloading the two differential tapered roller bearings, and a means of adjusting the backlash between the bevel pinion and bevel drive gear.

**b.** The differential consists of pinions and gears which function in the same way, with simple modifications, as an automobile differ-

**ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**




A—LEFT STEERING BRAKE
B—BEVEL DRIVE GEAR
C—RIGHT STEERING BRAKE
D—VENT TUBE
E—ROLLER BEARING ADJUSTING LOCKS
F—REVERSE GEAR UPPER SHIFTING SHAFT FRONT HEAD
G—TRANSMISSION SHIFTING GUIDE
H—THIRD AND FOURTH SPEED GEAR SHIFTING SHAFT HEAD
J—BEVEL PINION WITH SHAFT
K—BEARING CAGE RA PD 323072

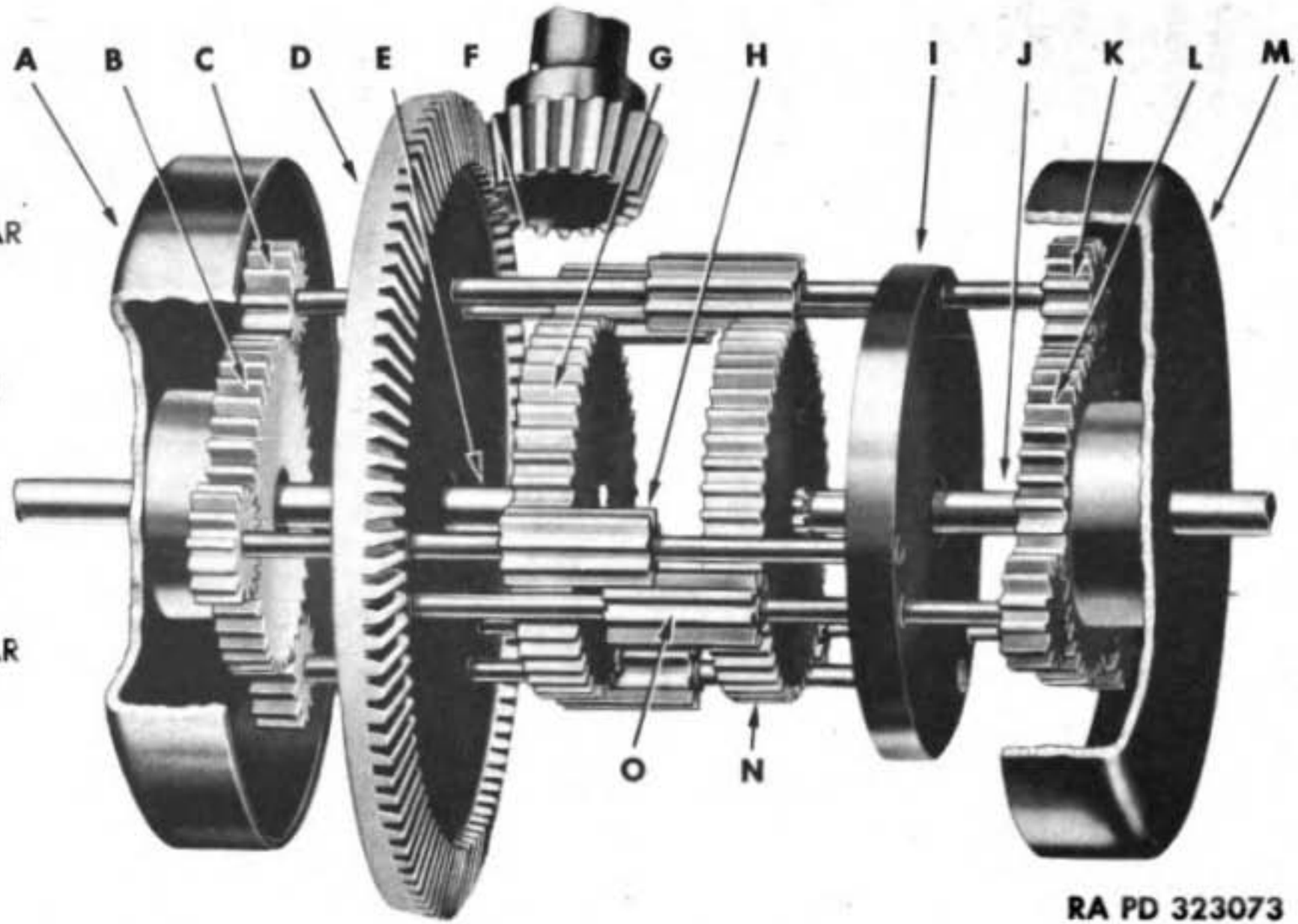
***Figure 72 — Top View of Differential Installed***

ential. It provides a means by which one drive shaft can travel faster than the other shaft when turning.

**c.** The steering and braking action is accomplished by two brake drum rim and gear assemblies. These mesh with external pinions on extended shafts of the internal pinions on each side of the differential. Brake bands, controlled by suitable linkage connected to the steering brake levers, contract on the brake drum rims. Slowing up one brake rim, which causes one track to travel faster than the other, turns the vehicle.

**d.** The differential performs the following functions:

(1) It changes the direction of power transmitted from the transmission to the final drive by 90 degrees, or from a crosswise to a forward rotation. This is accomplished by the spiral bevel drive gear which engages with the transmission output shaft spiral bevel pinions.




A—STEERING BRAKE DRUM RIM
B—STEERING DRUM FLANGE GEAR
C—EXTERNAL PINION
D—BEVEL DRIVE GEAR
E—FINAL DRIVE PINION SHAFT
F—TRANSMISSION BEVEL PINION WITH OUTPUT SHAFT
G—COMPENSATING GEAR
H—INTERNAL PINION
I—COMPENSATING CASE COVER
J—FINAL DRIVE PINION SHAFT
K—EXTERNAL PINION
L—STEERING DRUM FLANGE GEAR
M—STEERING BRAKE DRUM RIM
N—COMPENSATING GEAR
O— INTERNAL PINION

*Figure 73 — Differential as Viewed from Front of Vehicle (Schematic)*

By the same means a fixed reduction in gear ratio between the engine and the driving sprockets is caused. NOTE: *Another fixed reduction is provided by the final drive gears.*

(2) The differential provides a means of steering and stopping the vehicle through contact of the brake drum rims with the brake bands.

(3) The differential compensates for irregularities in terrain and delivers power to both tracks at all times.

**e. Operation** (fig. 73).

(1) The differential is contained within a compensating case and two covers. This case and cover assembly contains six internal pinions on shafts which connect with six external pinions on the outer ends, three on each side of the compensating case covers. The internal pinions engage with two compensating gears which are splined to the final drive pinion shaft. The external pinions engage with gears on each of the steering brake drum flanges. The steering brake drum gears are a part of their steering drums, but have no connection with any power shaft. The bevel gear is splined and bolted to one of the compensating case covers. When the vehicle moves straight ahead the whole differential assembly, driven by the bevel gear, rotates as a unit; the pinions and gears within the differential do not turn in their bearings. The compensating gears on the final drive pinion shafts both turn at the same speed, resulting in the tracks moving at equal speeds. The steering brake drum gears turn as a unit with the differential.

(2) To turn the vehicle, one steering brake band is applied on one brake drum by pulling back one steering lever. This tends to stop the brake drum rim, depending on the pull exerted on the steering lever. For example, if the right brake drum rim is held stationary, the right external and internal pinions turn with their shafts in the same direction as the spiral bevel gear is turning. The left pinions are thereby driven in the opposite direction. Because the right external pinions are rotating around the right steering drum rim gear while turning in the same direction, the right compensating gear is turning slower. The left internal pinions are rotating opposite to the rotation of the bevel gear, thus causing the left compensating gear to rotate as much faster as the right compensating gear has been retarded. Consequently, the right track has been slowed down and the left track speeded up, causing the vehicle to turn to the right. A turn to the left is made by braking the left steering brake drum rim.

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

**f. Data.**

| | |
|---|---|
| Serial number | F101 and up |
| Serial number location | On front side of differential and final drive housing on each final drive gear compartment |
| Differential and final drive housing, material | Cast steel |
| Differential gearing, type | Spur |
| Differential ratio | 1.844 to 1 |
| Drive gearing, type | Spiral bevel |
| Drive gearing, ratio | 2.6 to 1 |
| Parking brakes application | Buttons on steering levers |
| Brakes, type of application | Mechanical, with levers |
| Steering brake drum rims: | |
| Material | Cast iron |
| Number used | 2 |
| Size | 15 in. dia. x 3¼ in. |
| Brake linings: | |
| Number per brake band | 3 |
| Size | 13 x 3 in. |
| Type | Thermoid type BX-9 |

## 12. REMOVAL.

**a. Preliminary Instructions.** The differential can be removed from the vehicle while the differential and final drive housing is either in the vehicle or out of the vehicle. If the housing is out of the vehicle, it is not necessary to remove the sheet metal parts as described in subparagraphs **b** through **p**. Removal of the differential, final drives, and transmission as an assembly is described in TM 9-786.

**b. Disconnect Tracks, and Remove Sprockets, Hubs, Left Side Seat, and Steering Brake Bands.** Refer to TM 9-786. Also remove final drive components as described in paragraph 22 of this manual. It is not necessary to remove the final drive shaft inner and outer bearings or the outer bearing retainer.

**c. Remove Left Side Seat Bottom.** Remove 30 cap screws and lock washers, and 27 nuts securing seat bottom to left side rail and to left side sheet (fig. 74).

**d. Remove Left Front Platform Door Support.** Remove 11 cap screws and lock washers, and two nuts securing support.

**e. Remove Left Front Door.** Remove five nuts and lock washers securing door to cowl and driver's seat support.

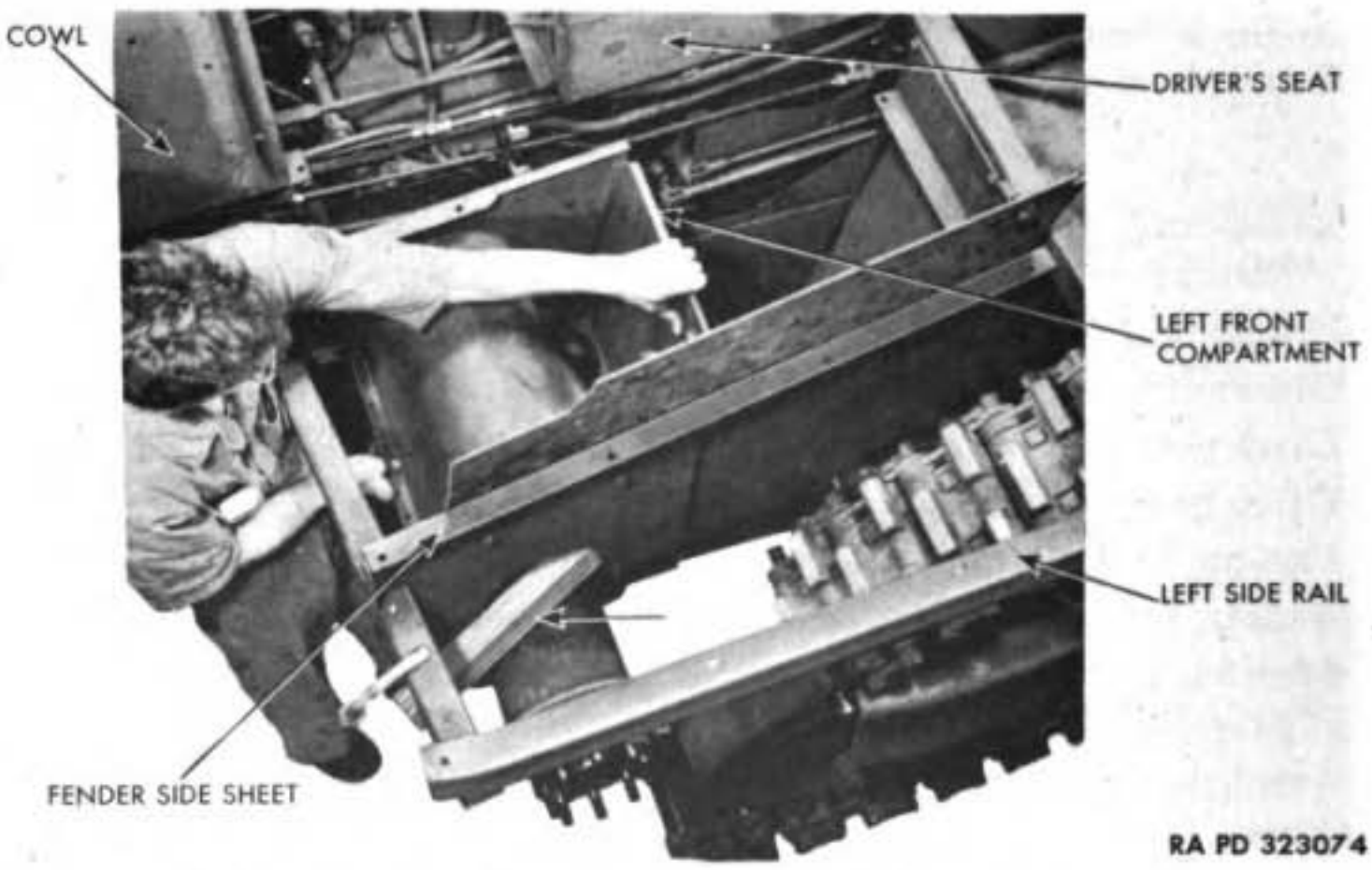



*Figure 74 — Removing Left Front Compartment*

**f. Remove Driver's Seat Left Support.** Remove two screws and lock washers attaching air manifold to support. Remove cap screw, lock washer, and nut securing air hose and air tube leading to air manifold. Remove cap screws, lock washers, and nuts securing driver's seat to support, cowl to support, and support to left side sheet.

**g. Remove Clutch Pedal Bracket.** Take out cap screws securing winch cable guard to front cowl support, and to front enclosure sheet. Remove nut and cotter pin from clutch pedal shaft. Remove shaft, and push clutch pedals up and clear of bracket. Take out four cap screws and lock washers securing clutch pedal bracket to front of differential and final drive housing.

**h. Loosen Front Fender Left Support** (fig. 74). Remove four cap screws and lock washers securing left fender side sheet to final drive housing. Pry fender side sheet away from housing, and place a 2-inch block between sheet and housing.

**i. Remove Left Front Compartment** (figs. 74 and 75). Remove two cap screws and lock washers securing left front compartment to fender side sheet. Lift out left front compartment.

**j. Remove Left Steering Brake Shaft Bearing Support** (fig. 76). Remove cap screw, nut, and lock washer clamping left steering brake shaft lever to brake shaft. Drive lever from shaft, and remove felt washer. Remove key from shaft, and pull shaft from bearing sup-

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

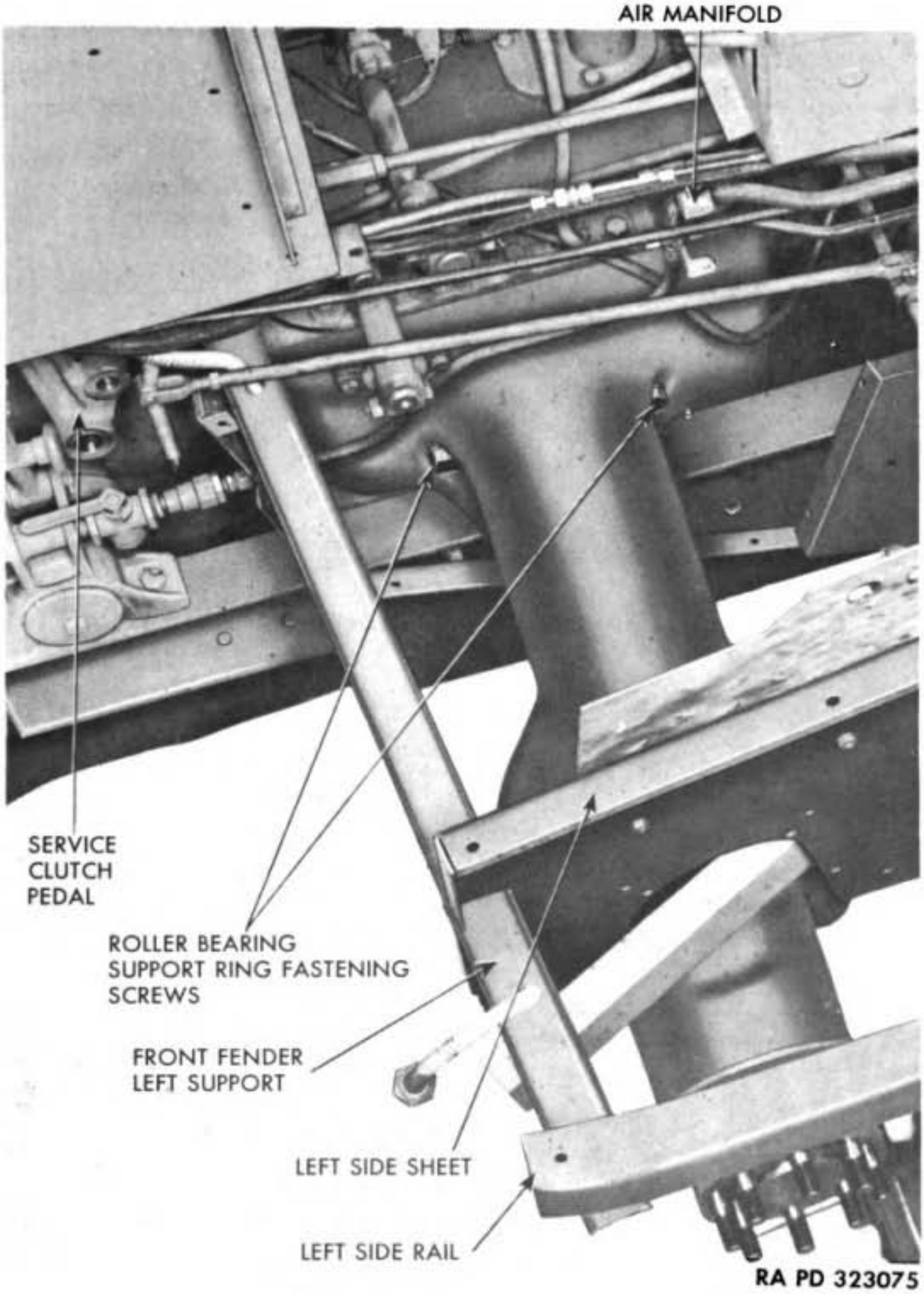
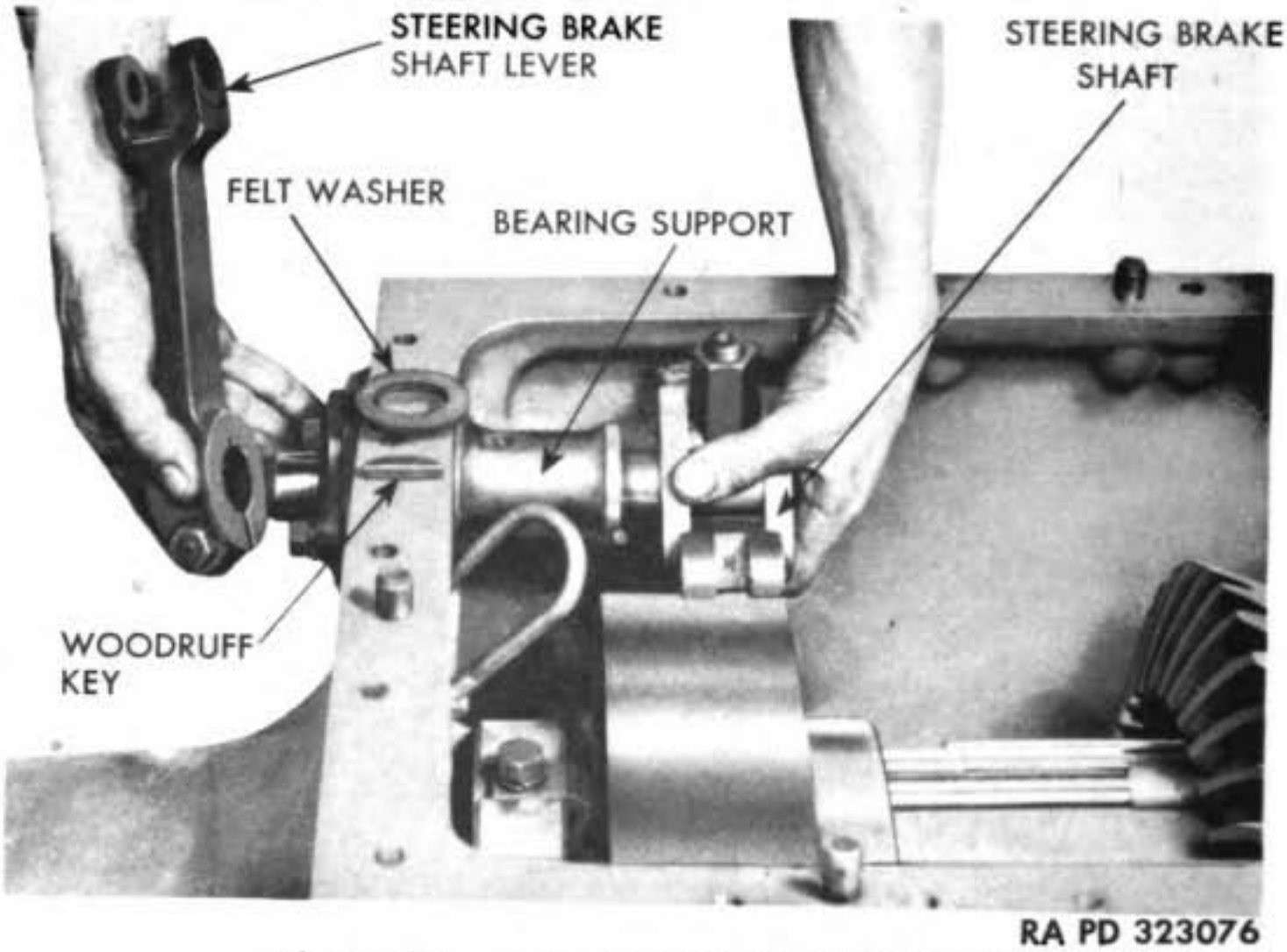



***Figure 75 — Left Front Compartment Removed***

**ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**




RA PD 323076

***Figure 76 — Removing Steering Brake Shaft***

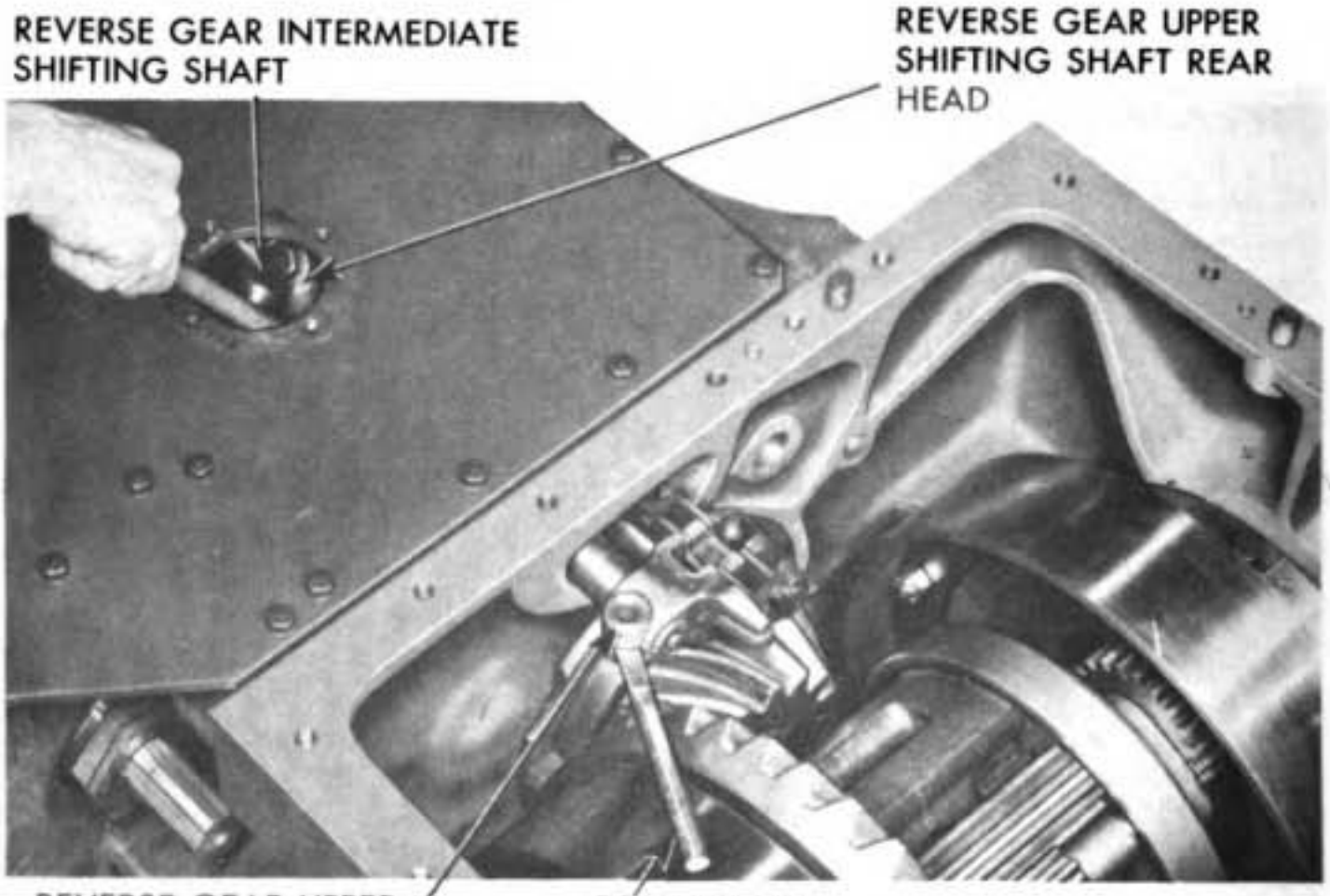



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***Figure 77 — Removing Reverse Gear Upper Shifting Shaft Head***

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

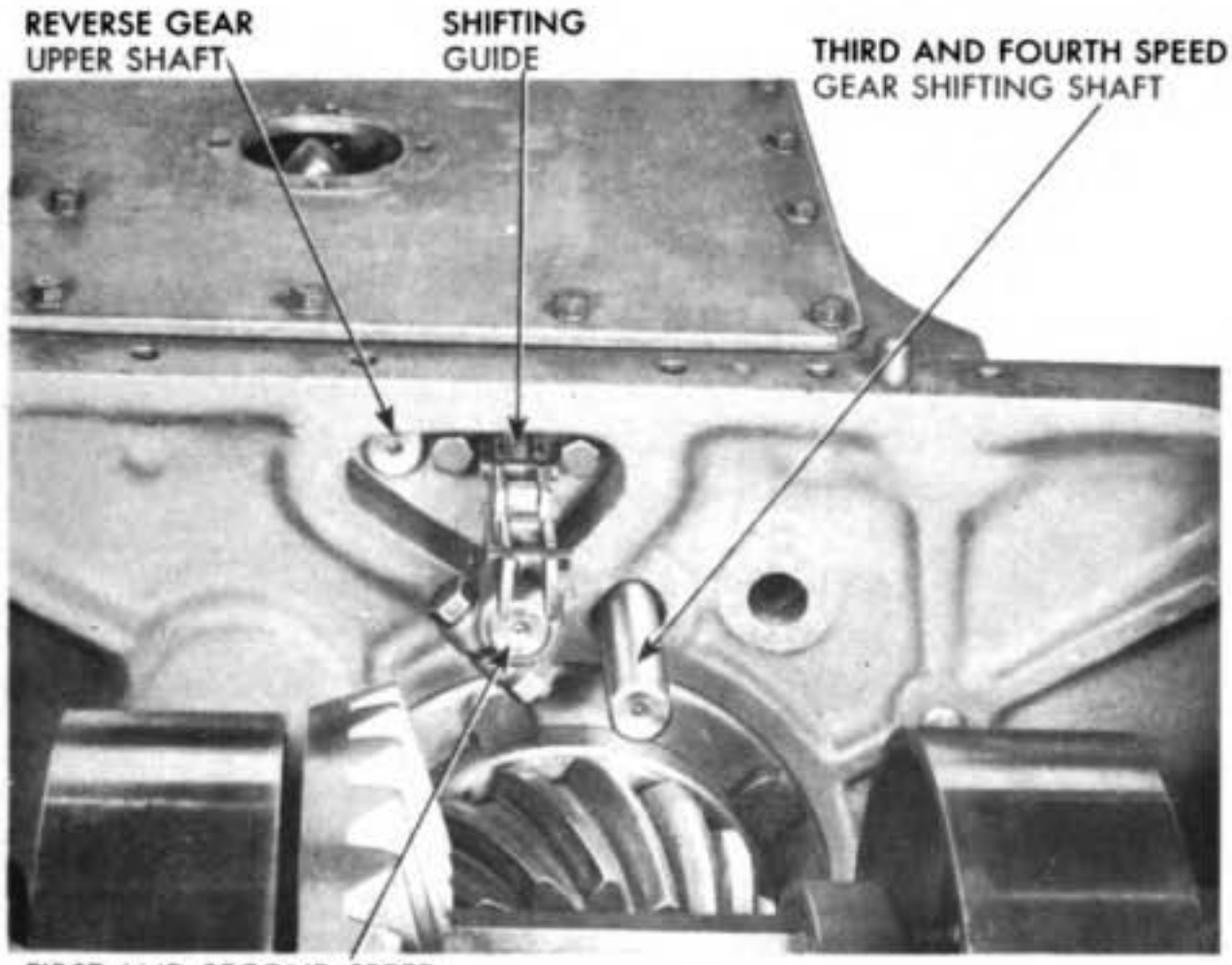



***Figure 78 — Location of Shifting Guide Attaching Screws***

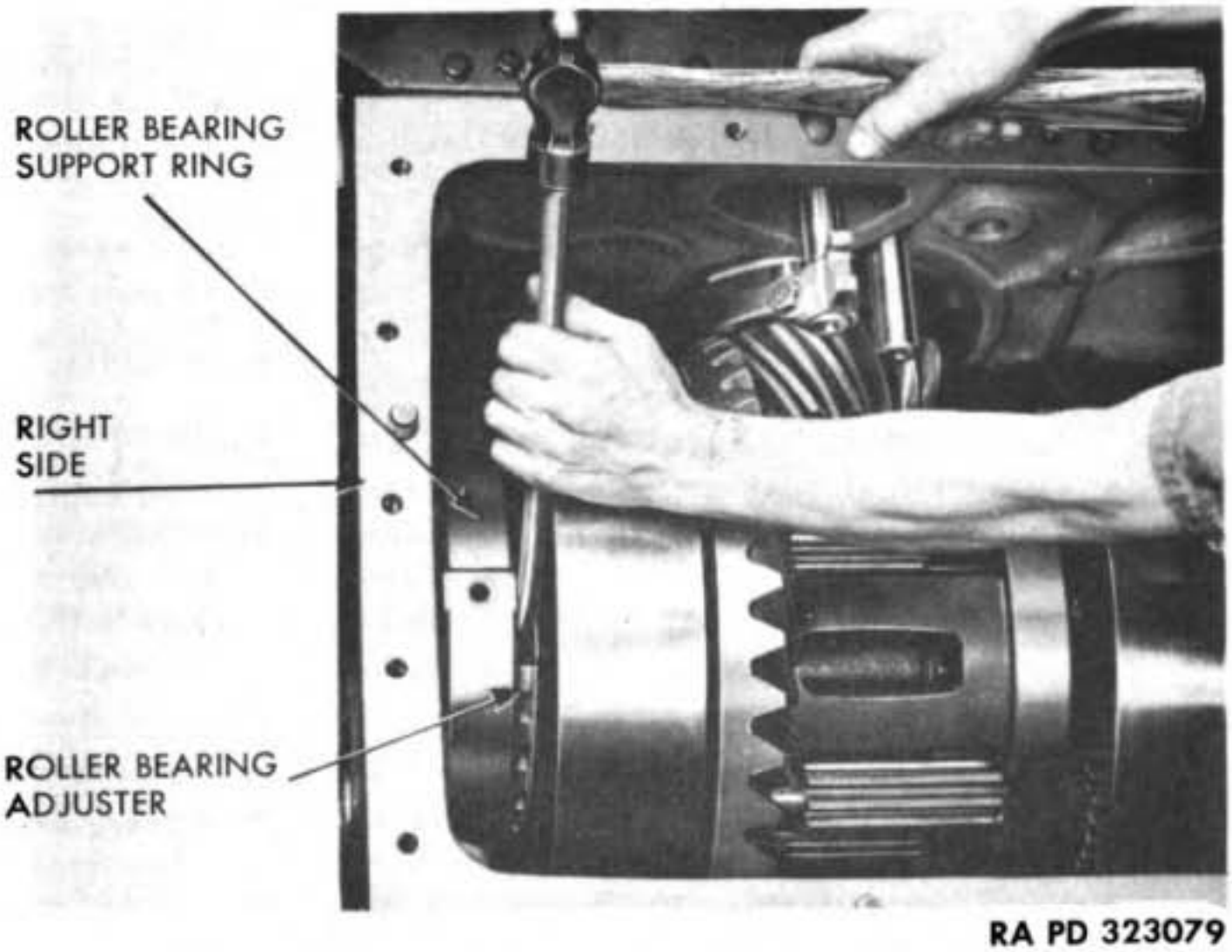



***Figure 79 — Turning Roller Bearing Adjuster***

port. Remove two cap screws and lock washers securing bearing support to housing, and tap support out of housing.

**k. Remove Two Final Drive Vent Tubes.** Unscrew coupling nut, and remove tubes.

**l. Remove Transmission Shifting Guide.** Remove cap screw, lock washer, and nut clamping reverse gear upper shifting shaft front head to shaft (fig. 72). Lift up driver's seat bottom plate, and remove back rest plate. Remove four cap screws and lock washers attaching transmission reverse gear intermediate shifting shaft bearing to top of transmission cover. Lift bearing from cover and shaft. Working through opening in transmission cover, turn reverse gear upper shifting shaft rear head to disengage it from reverse gear intermediate shifting shaft (fig. 77). Reach in back of transmission and remove two cap screws attaching shifting shaft sealing plate. Push reverse shifting shaft back flush with differential housing, and at same time remove reverse shifting shaft front head. Remove cap screw, nut, and lock washer clamping third and fourth speed gear shifting shaft head to shaft, and remove head (fig. 72). Remove two cap screws and lock washers attaching shifting guide to rear of transmission case (fig. 78). Push first and second speed gear shifting shaft and head to the rear, or into second gear.

**m. Relieve Preload on Differential Roller Bearings.** Remove cap screw and lock washer securing each roller bearing adjuster lock, and remove the two locks (fig. 72). Turn each roller bearing adjuster counterclockwise until it is loose (fig. 79), so that differential can be moved sideways (fig. 104).

**n. Remove Differential Roller Bearing Support Ring Fastening Screws** (figs. 75 and 80). Remove two screws and lock washers from each side of differential and final drive housing, and one screw and lock washer from bottom of each side of housing.

**o. Remove differential and Bearing Support Rings.** Place a cable or rope sling around center of differential, and attach sling to a lifting device. Lift differential out of housing, and at the same time rock it slightly sideways with a crow bar so that bevel drive gear and pinion do not lock (fig. 81). When differential is lifted over halfway out of housing, remove bearing support ring assembly from each side of differential (fig. 82).

**p. Remove Differential and Final Drive Housing.** Before housing can be removed, the differential, final drive, and transmission must be removed from the vehicle as a complete assembly, as described in TM 9-786. Then remove seven cap screws and lock washers, and three nuts and lock washers securing transmission case to differential and final drive housing.

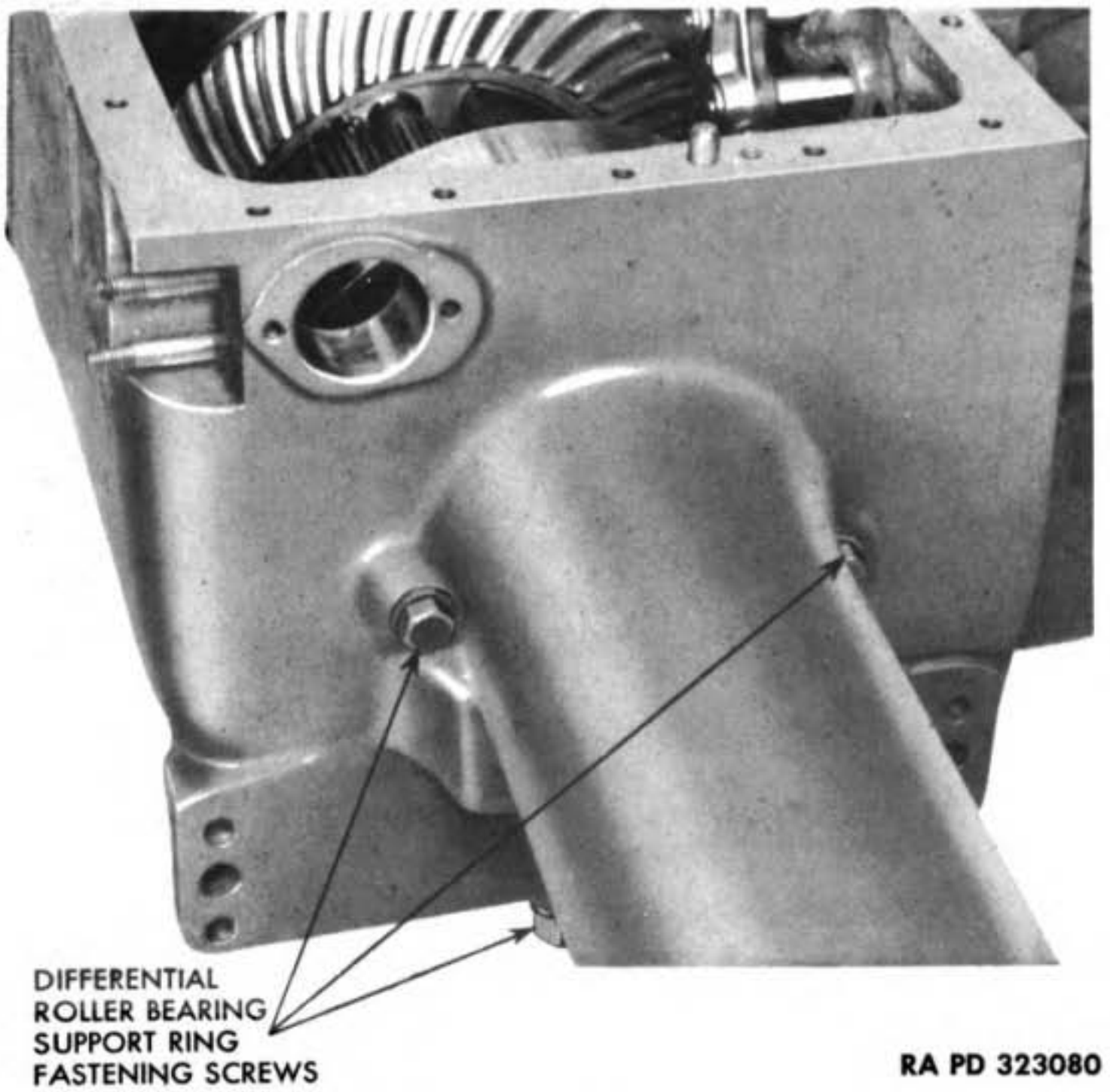


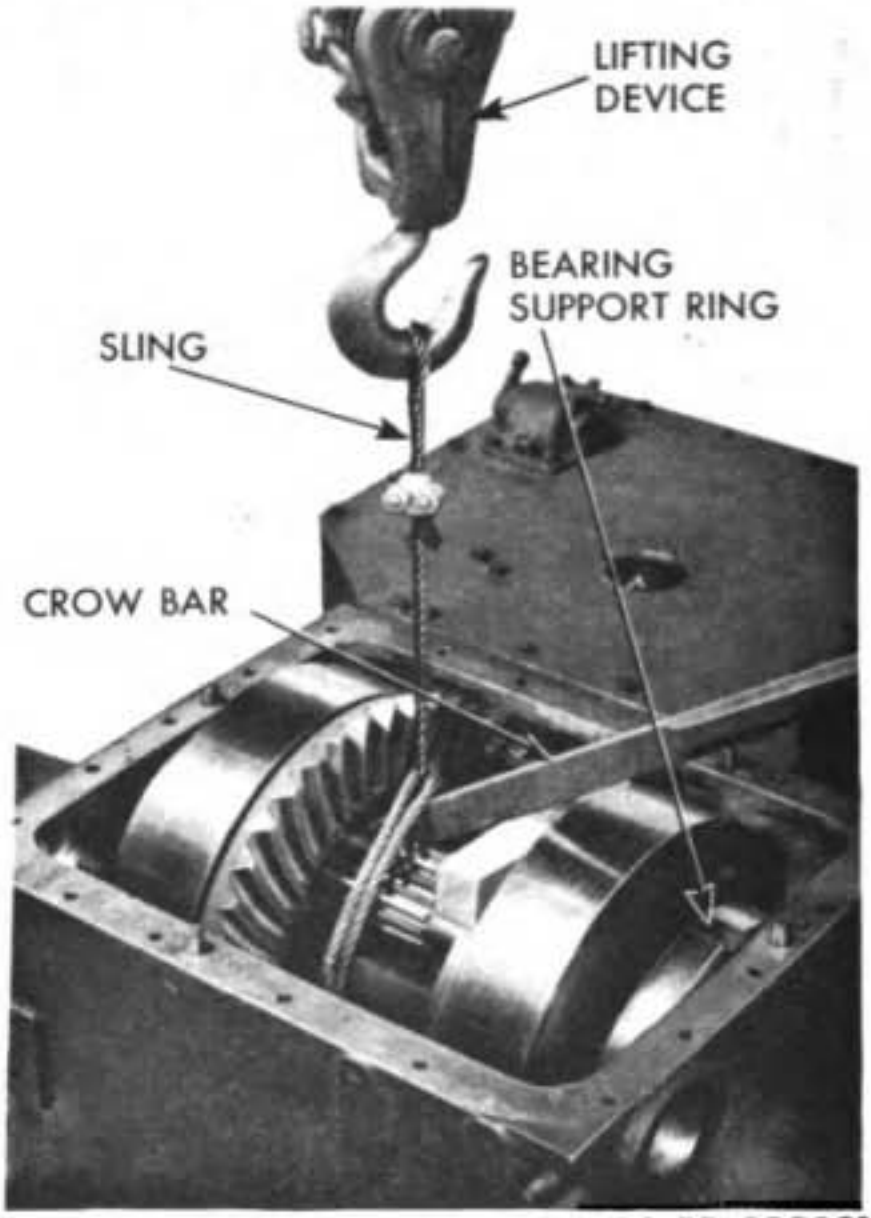

*Figure 80 — Location of Roller Bearing Support Ring Fastening Screws*

## 13. DISASSEMBLY.

**a. Remove Roller Bearing Cone and Spacer** (fig. 83). Install puller (41-P-2905-60) over roller bearing cone, and place a plug in end of compensating case cover hub so that puller screw will center on plug. Tighten puller screw nut, and remove bearing. Remove bearing spacer washer. Remove roller bearing cone and spacer from opposite side of differential in same manner.

**b. Remove Steering Brake Drum Rim and Gear Flange** (fig. 84). Place differential on end on two blocks. Lift off drum rim and gear flange. Remove opposite assembly in same manner.

**c. Remove Steering Brake Drum Rim From Gear Flange** (fig. 85). Remove cotter pins and nuts from eight cap screws securing rim to gear flange. Lift gear flange out of brake drum rim.




RA PD 323081

*Figure 81 — Lifting Differential Out of Housing*

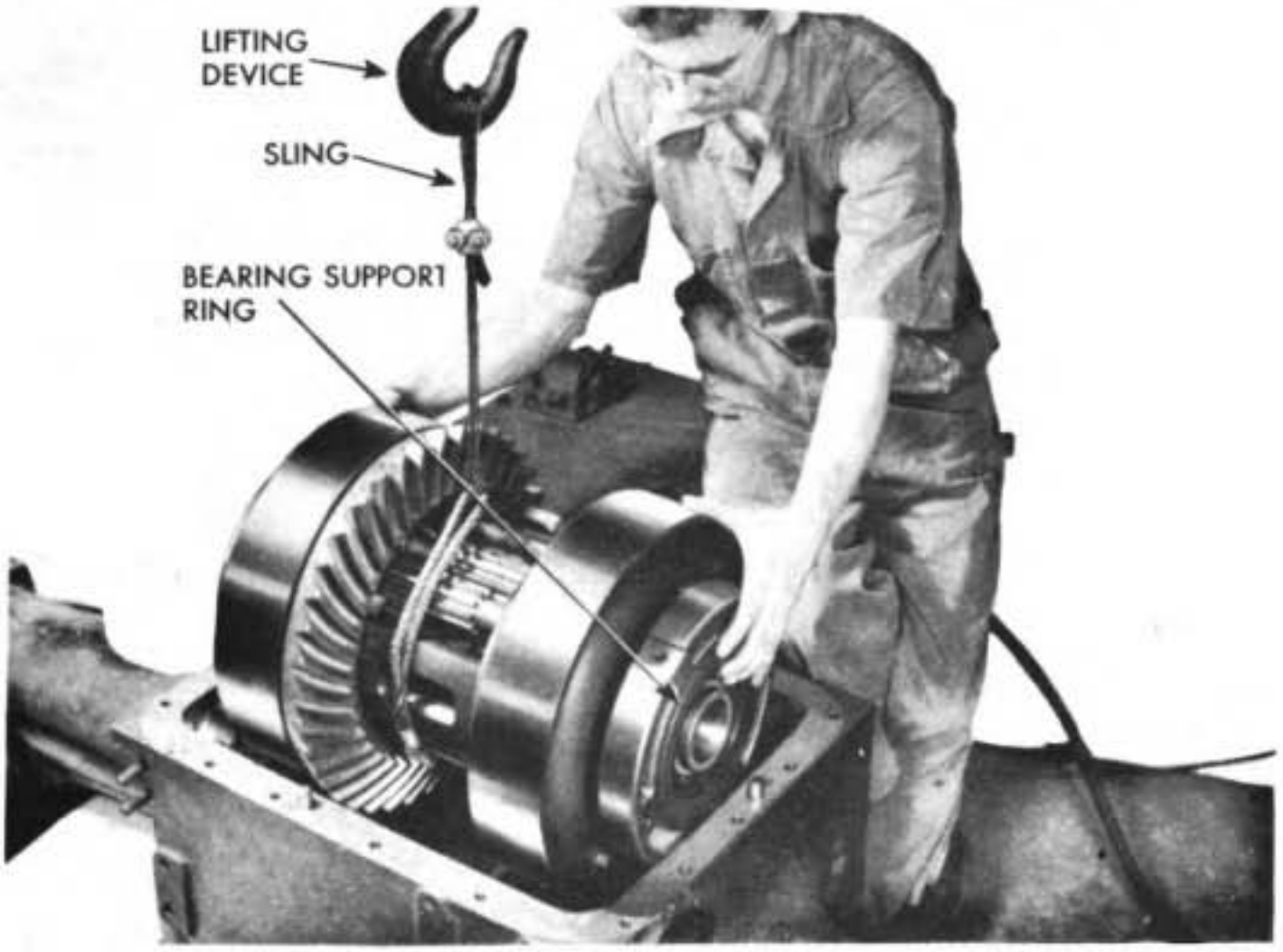
**d. Remove External Pinions.** Remove cotter pins and nuts securing six external pinions, three on each side (fig. 86). Hold pinions from turning by placing a brass drift between internal pinions and compensating case. Remove external pinions with puller (41-P-2912) (fig. 87). Remove Woodruff key from each internal pinion shaft.

**e. Remove Right Compensating Case Cover.** Remove cotter pins and nuts from six compensating case bolts, and remove bolts (fig 86). Drive cover from case by tapping around edge of cover (fig. 88). Three dowel pins locate cover in relation to case.

**f. Remove Internal Pinions and Right Compensating Gear.** Remove compensating gear from case. Remove six internal pinions from bushings in left compensating case cover (fig. 89).

**g. Remove Compensating Case From Left Compensating Case Cover.** Drive case from cover.

**h. Remove Bevel Drive Gear From Left Compensating Case Cover.** NOTE: *It is not necessary to remove gear from cover unless*




RA PD 323082

***Figure 82 — Holding Bearing Support Rings***

*cover or gear must be replaced.* Remove locking wire from 12 bevel drive gear attaching cap screws, and remove cap screws (fig. 98). Place cover on two blocks so that gear overhangs blocks. Working around rim of gear, drive gear from cover.

## 14. CLEANING, INSPECTION, AND REPAIR OR REBUILDING.

**a. Clean Differential Assembly Parts.** Wash all parts thoroughly in dry-cleaning solvent, and dry with compressed air. Be sure to remove all hardened grease, using a stiff brush if necessary. Clean all oil holes.

**b. Inspect All Parts for Wear and Damage, and Replace or Rebuild as Necessary.**

(1) BEARING CONE. Rotate bearing cone, and inspect each roller for roughness and wear. Replace bearing cone if any roller shows indication of wear. If cone is in good condition, lubricate thoroughly with engine oil, and wrap in paper awaiting installation.

(2) BEARING CUP AND SUPPORT RING (fig. 90). Bearing cup must be smooth and show no indication of wear. There must be no clearance between back of bearing cup and shoulder of support ring. Check bearing adjuster for cracks, and see that it turns freely on threads of bearing cage. To replace bearing cup, press old cup out of support ring.

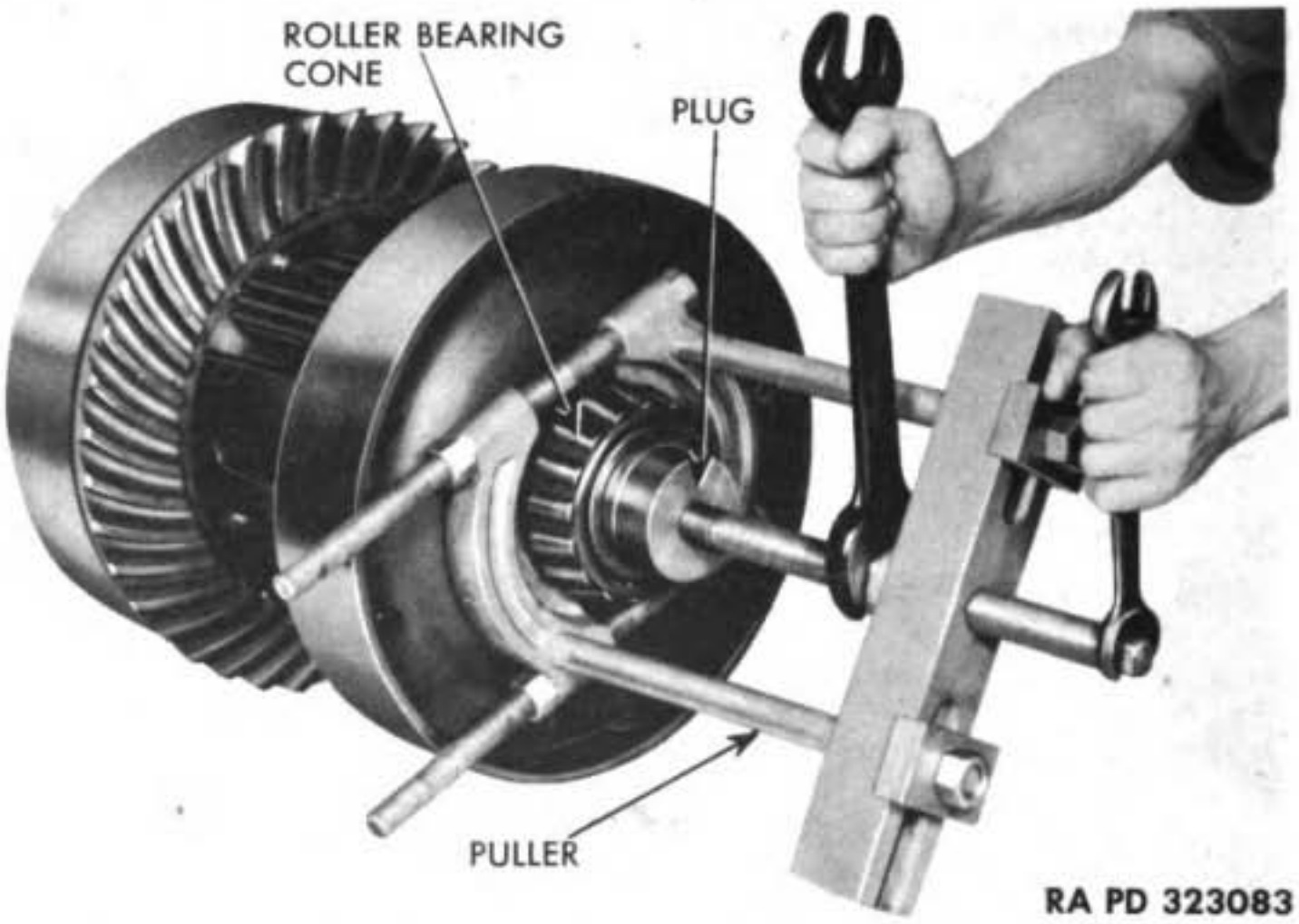



*Figure 83 — Removing Differential Roller Bearing Cone, Using Puller (41-P-2905-60)*

With differential case bearing cup replacer (41-R-2384-785), drive in new cup so that it is tight against support ring shoulder (fig. 91).

(3) STEERING BRAKE DRUM RIM AND FLANGE ASSEMBLY (fig. 92). If the brake drum rim is smooth and shows only normal wear, it can be used again. If the rim is grooved and rough, it should be replaced. The manufacturing diameter limits of rim are 14.99 to 15.00 inches. Inspect steering drum rim flange bushing, and replace if it shows indications of wear. The manufacturing internal diameter limits of bushing are 3.375 to 3.377 inches. New bushing is installed by pressing out old bushing, and pressing in new bushing, chamfered end first, from the gear side, until flush with face of flange on opposite side. Drill three ⅛-inch holes through oil holes in gear. Machine bushing to above dimensions.

(4) LEFT AND RIGHT COMPENSATING CASE COVER.

*(a)* Inspect bearing surface on which steering drum rim flange rotates. If surface is not in serviceable condition, replace left and right covers and compensating case as an assembly.

*(b)* Inspect 12 internal pinion bushings, six in each cover. If bushings are not in serviceable condition, remove and replace them with differential case cover right and left internal pinion bearing re-


***Figure 84 — Removing Steering Brake Drum Rim and Gear Flange***

mover and replacer (41-R-2373-835) (fig. 93). Manufacturing internal diameter limits of bushings are 1.191 to 1.193 inches. Whenever a bushing is replaced in one cover, it must be line-reamed to above dimension, together with the corresponding bushing in the opposite cover, after the two covers and compensating case are doweled and bolted together.

*(c)* Inspect differential compensating case cover bushings, one in each cover (fig. 94). If bushings are not in serviceable condition, they must be replaced. Manufacturing internal diameter limits are 3.375 to 3.377 inches. To install a new bushing, first remove the old one. Then press new one into place so that chamfered end of bushing is pressed into bore of cover first. Machine two V-slots through bushing to line up with slots in cover. Drill three ¼-inch holes in bushing, using three holes in cover as pilots. Machine internal diameter of

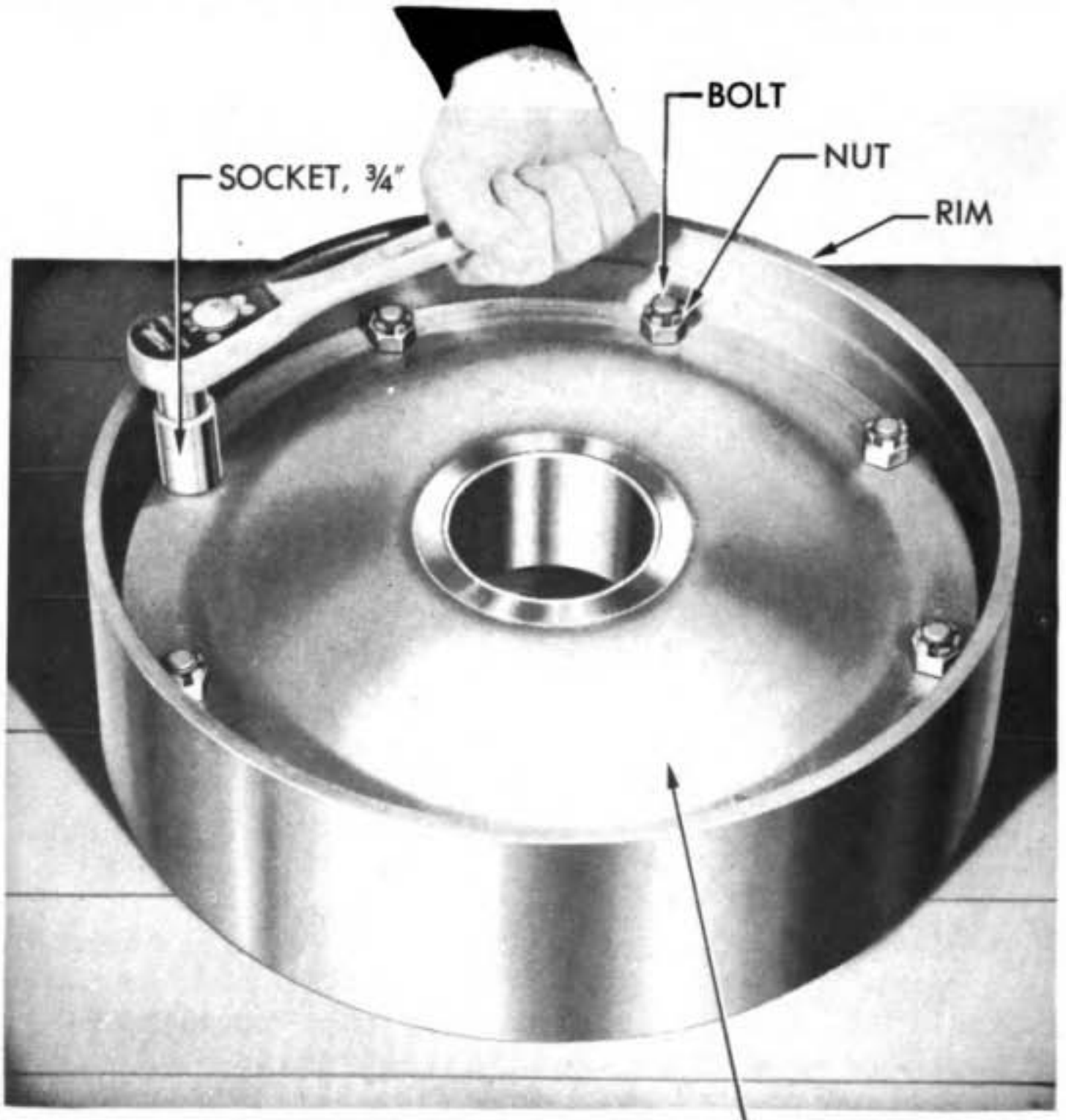



*Figure 85 — Removing Steering Brake Rim from Flange and Gear*

bushing within above limits. The bushing must be machined concentric with inner face and with external diameter of cover hub (fig. 94).

(5) Carefully inspect six external pinions, six internal pinions, two compensating gears, and the bevel drive gear (fig. 92). If abnormally worn, or if teeth are broken or chipped, replace defective gear or pinion together with all related or meshing gears or pinions. If bevel drive gear must be replaced, the bevel pinion in transmission must also be replaced, as they are furnished in a matched set to assure proper tooth contact (par. 8).

(6) STEERING BRAKE SHAFT BEARING SUPPORT AND BRAKE SHAFT (fig. 95).

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

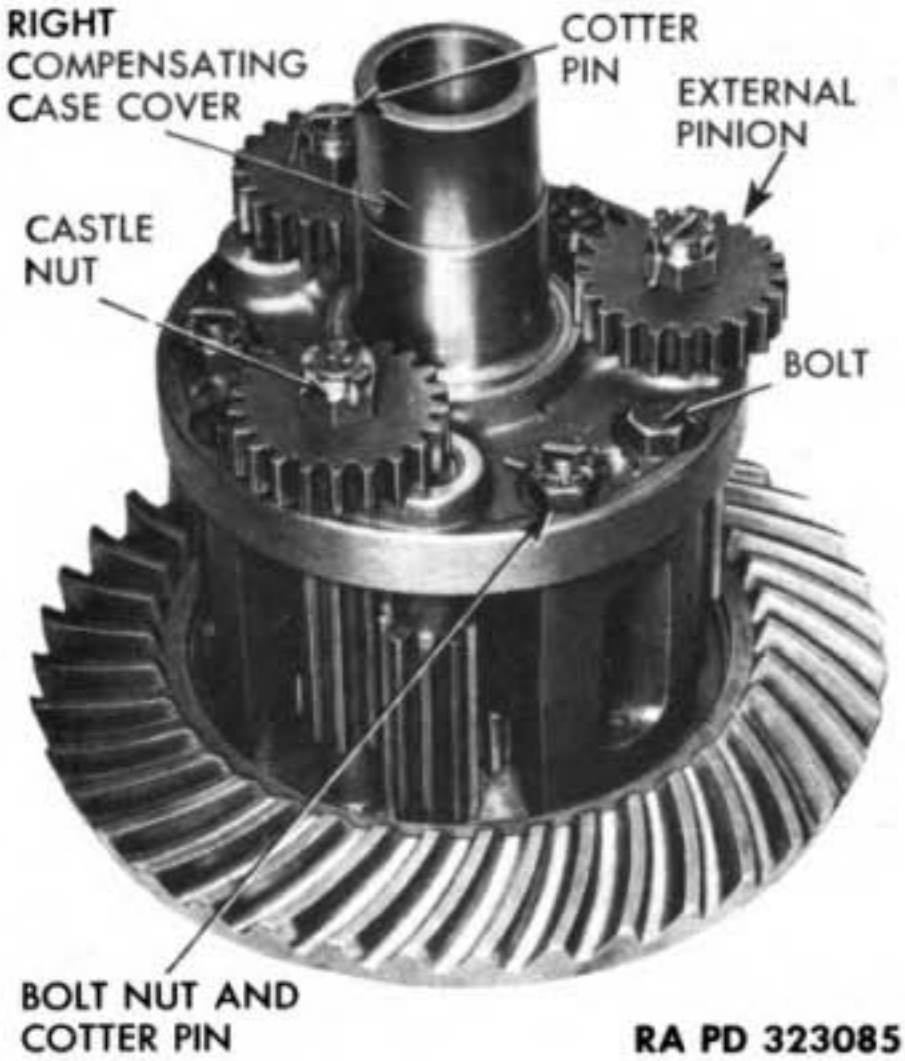



***Figure 86 — Differential Compensating External Pinion Installation***

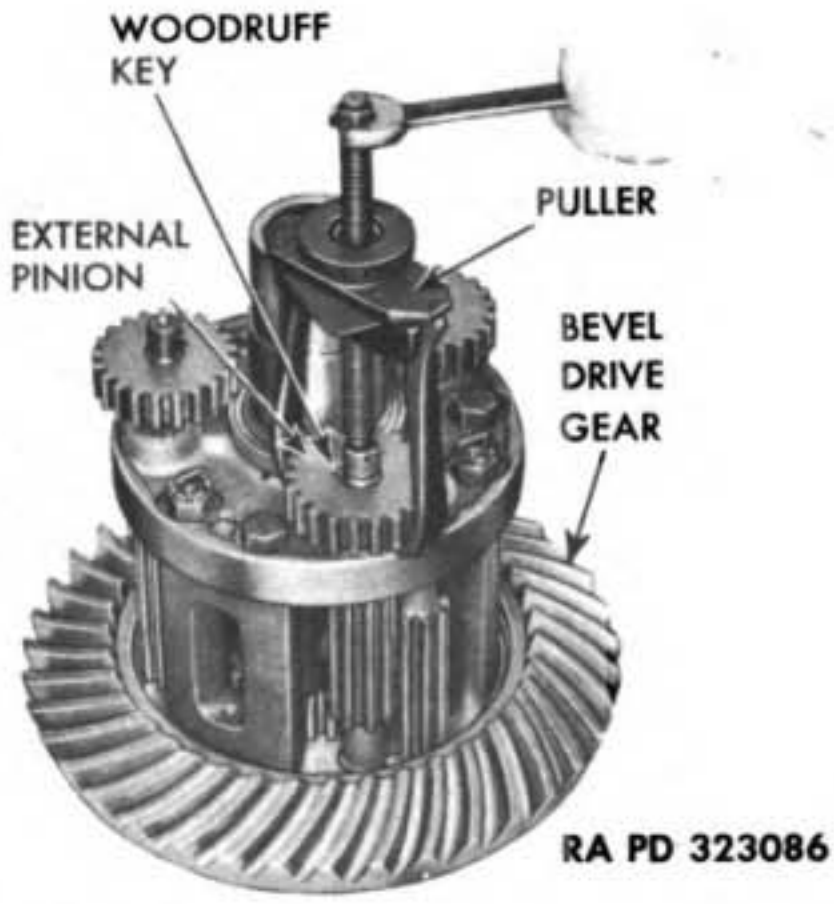



***Figure 87 — Removing External Pinion, Using Puller (41-P-2912)***


***Figure 88 — Removing Right Compensating Case Cover***

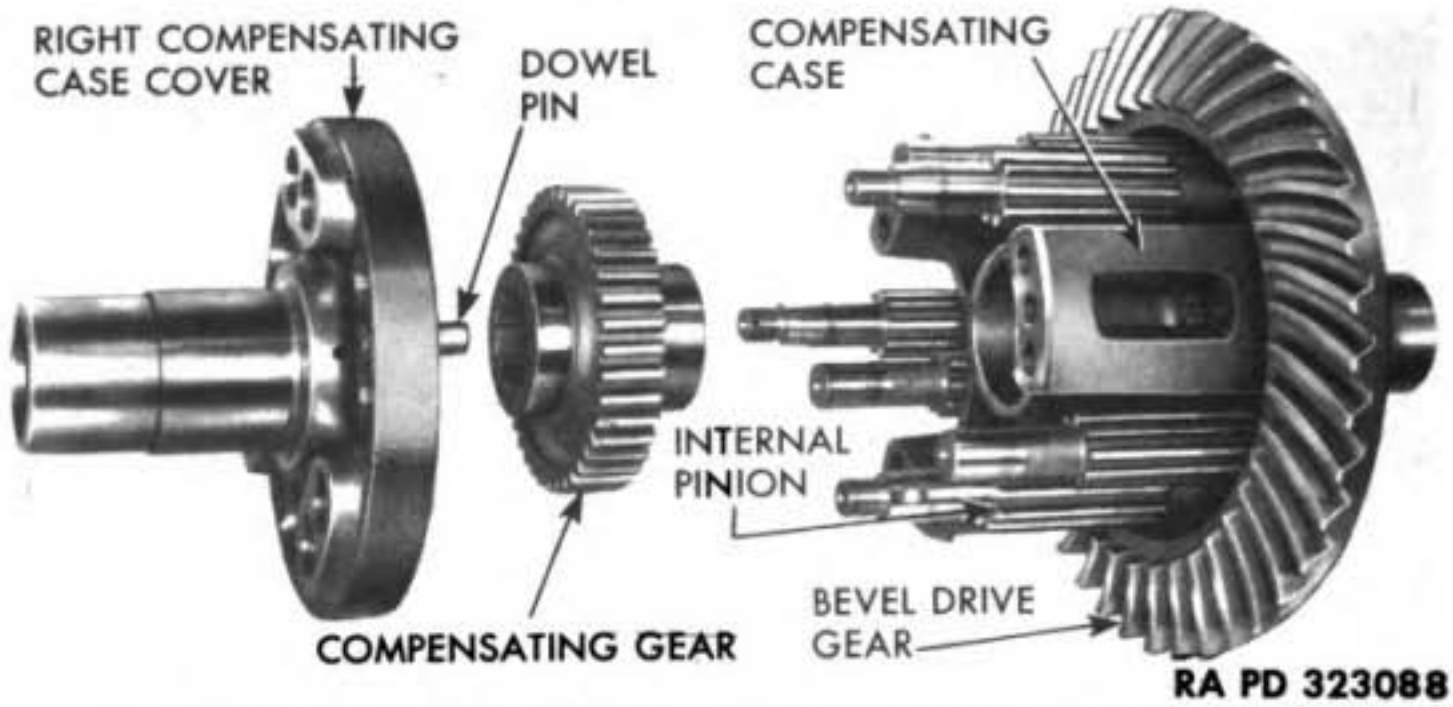



***Figure 89 — Compensating Cover and Gear Removed***

*(a)* Inspect two bushings in each support for abnormal wear, and replace if necessary. Manufacturing internal diameter limits are 1.251 to 1.255 inches. To install new bushings, pry out oil seal. Using brake shaft bearing support bushing remover and replacer (41-R-2375-125), drive out old bushings and drive new bushings into support, one from each end (fig. 96). Inside bushing must be pushed in until flush with inside of chamfer in support. Line-ream two bushings to above dimensions. Install oil seal as described in subparagraph *(b)* below.

*(b)* Inspect oil seal and replace if leathers show wear or mutilation (fig. 95). New seal must be pressed in against shoulder in support to provide space for felt washer.

*(c)* Inspect brake shaft for wear, and replace if necessary.

(7) BRAKE BAND ASSEMBLY (fig. 95).

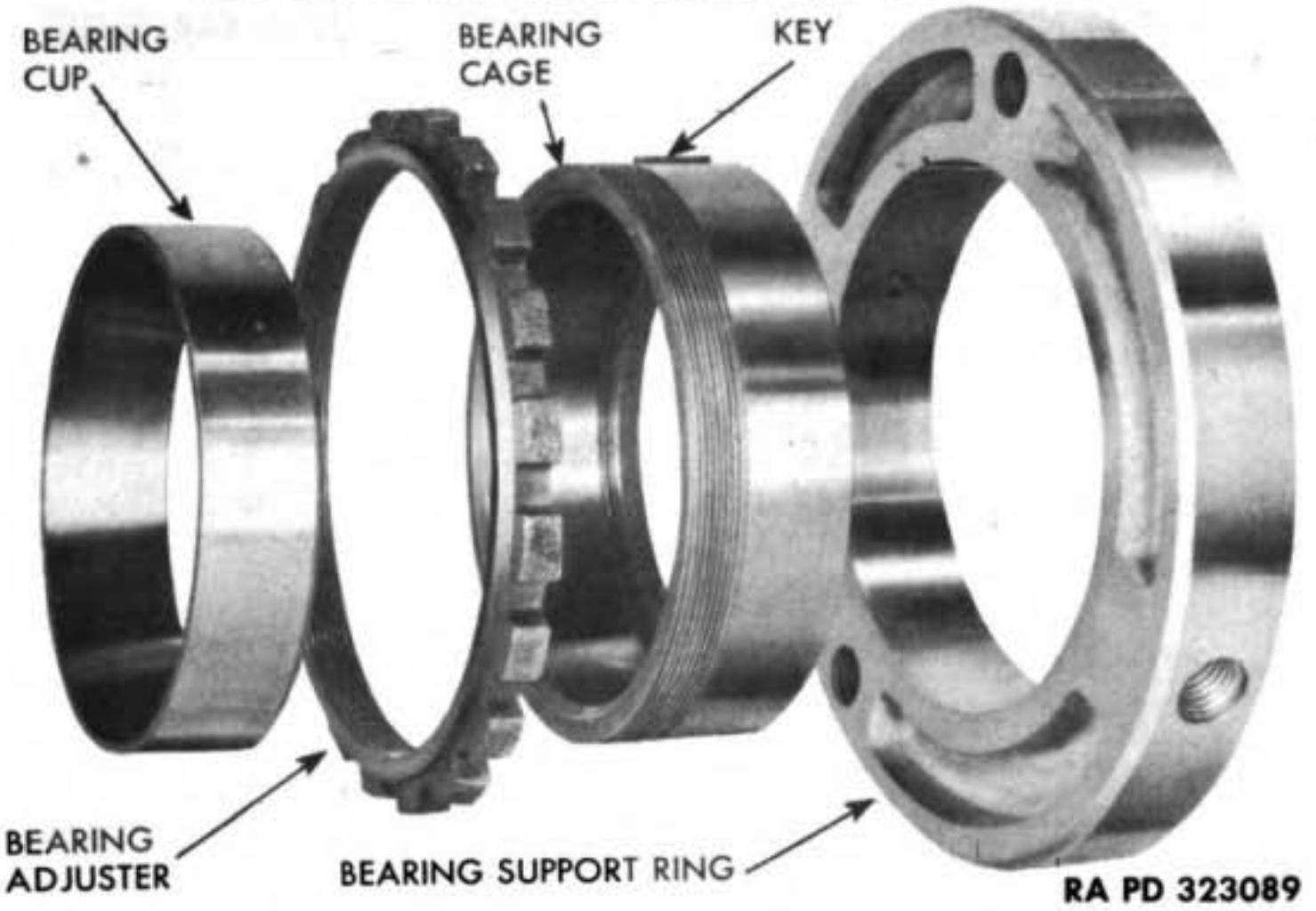
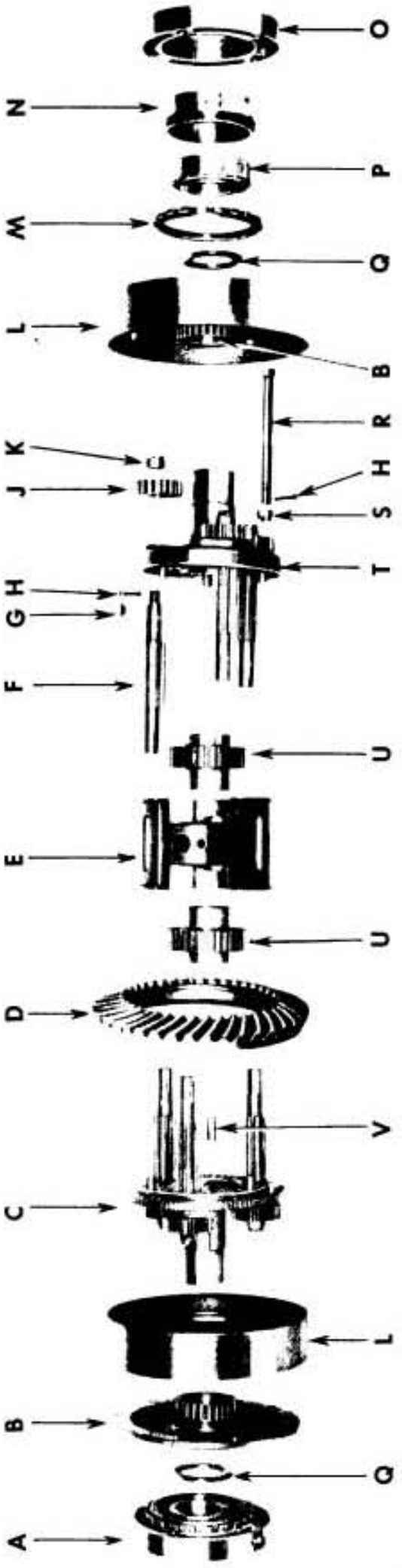



*Figure 90 — Bearing Support Ring Disassembled*

*(a)* Check brake shoe linings for wear. If worn down to, or nearly to rivet heads, linings must be replaced. Remove and inspect shoe connecting pins. If they have ridges worn in them they must be replaced. If new pins are loose in shoe, the complete shoe and linings must be replaced. Inspect brake shaft and linkage. If they show abnormal wear, they must be replaced.

*(b) Relining Brake Shoes.* Drive out rivets from outside of shoe inward with a $\frac{5}{32}$-inch punch. Remove old lining. Clean shoe. Clamp new lining to shoe, using three or more clamps. Drill through rivet holes in shoe and through lining with a $\frac{3}{16}$-inch drill. Remove lining from shoe, and counterbore all drilled holes in lining to a depth of $\frac{5}{32}$-inch with a $\frac{25}{64}$-inch counterbore. Rivet lining to shoe, starting at center and working toward ends of shoe. When shoe is lined, check clearance between lining and shoe. Clearance of more than 0.005 inch will cause chatter and loosening of the lining. Connect shoes together with connecting pins, and install cotter pins. Store assemblies in a clean place until ready for use.

(8) DIFFERENTIAL AND FINAL DRIVE HOUSING. Inspect all machined surfaces on housing for burs and nicks, and remove burs. Inspect oil seals at each side of housing. If seal leathers are worn or mutilated, seals must be replaced. Pry out old seals, and, using final drive pinion shaft oil seal replacer (41-R-2392-515), drive new seals into place (fig. 97).




A—BEARING SUPPORT RING AND BEARING
B—STEERING DRUM GEAR FLANGE WITH BUSHINGS
C—LEFT COMPENSATING CASE COVER
D—BEVEL DRIVE GEAR
E—COMPENSATING CASE
F—INTERNAL PINION
G—KEY
H—COTTER PIN
J—EXTERNAL PINION
K—NUT
L—STEERING BRAKE DRUM RIM
M—BEARING ADJUSTER
N—BEARING CAGE
O—BEARING SUPPORT RING
P—BEARING
Q—BEARING SPACER WASHER
R—COMPENSATING CASE BOLT
S—NUT
T—RIGHT COMPENSATING CASE COVER
U—COMPENSATING GEAR
V—DOWEL PIN

*Figure 91 — Differential Disassembled*


***Figure 92 — Installing Differential Bearing Cup***


***Figure 93 — Removing Compensating Case Cover Internal Pinion Bushing***

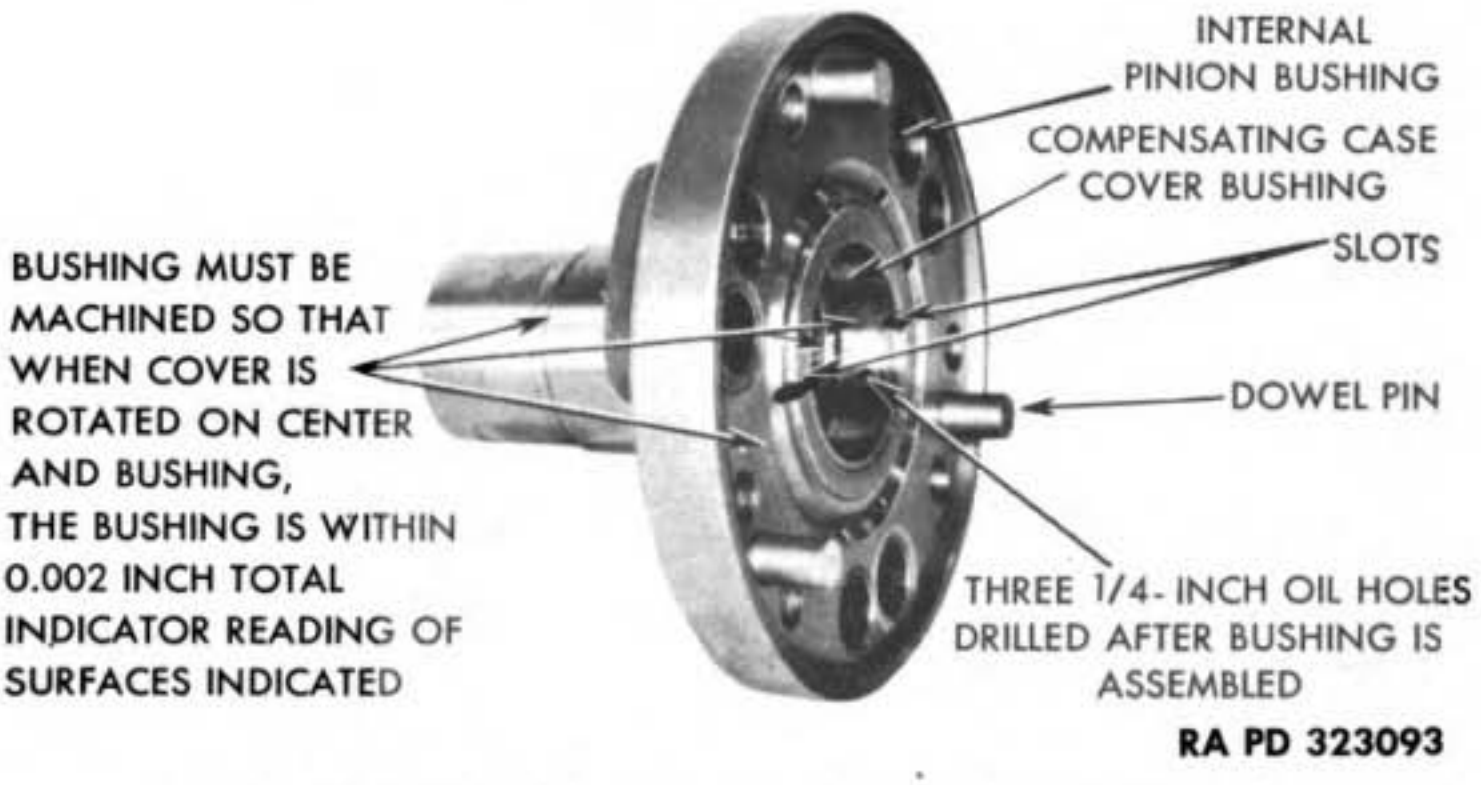



***Figure 94 — Right Compensating Case Cover with Bushing***

**ORDNANCE MAINTENANCE — POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

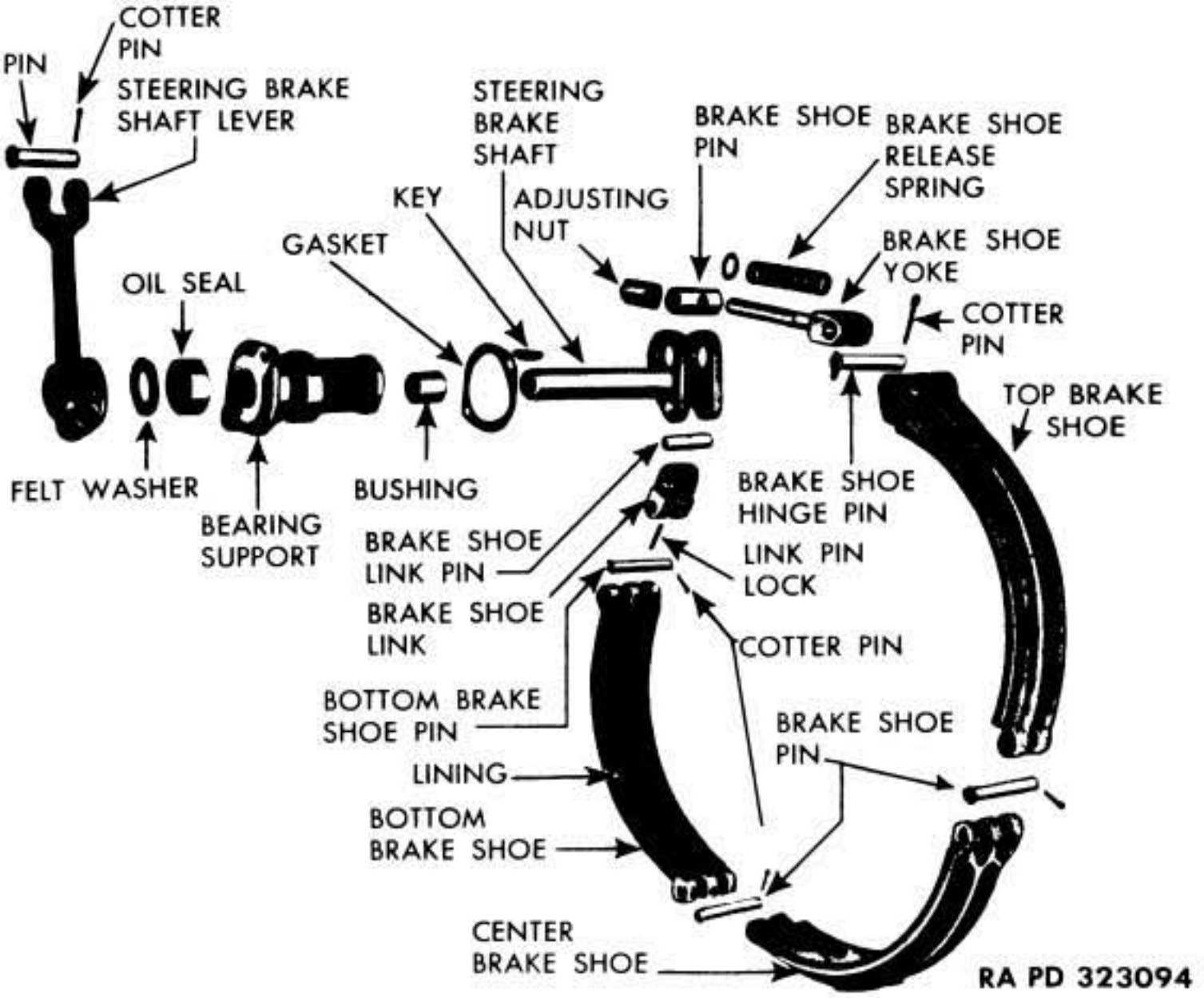



***Figure 95 — Steering Brake Disassembled***


***Figure 96 — Installing Bushing in Steering Brake Shaft Bearing Support***


*Figure 97 — Installing Final Drive Shaft Oil Seal*

## 15. ASSEMBLY.

**a. Assemble Left Compensating Cover to Bevel Drive Gear.** Before assembling gear to cover, the gear splines must be properly lined up with splineways in cover. Inspect three screw holes in cover, opposite pinion bushing bosses. At one of these three holes, the splineway for gear spline is centered on mounting hole. The center punch mark on gear must line up with this splineway as shown in figure 98. Install cover in gear, and tap it into place by working around outside edge of cover. Install 12 cap screws and locking wire.

**b. Assemble Compensating Case to Left Compensating Cover.** Place compensating gear with short hub in left compensating cover bushing. Place case on dowel pins in cover so that two center punch marks on case line up with two center punch marks on outside face of cover. Drive case onto three dowel pins (fig. 99).

**c. Install and Properly Time Internal Pinions and Compensating Gear.** Install three internal pinions with threaded end down. NOTE: *Viewed from outside of cover, internal pinions are installed in right-hand hole at each pair of bushings.* Keyway in each pinion must face out and be on a line with center of cover hub. Install three internal pinions, with threaded end up, and with each keyway facing as far outward from center of assembly as possible without turning the mating pinion (fig. 100). Install compensating gear, with long end of hub in compensating case.

**d. Install Left Compensating Case Cover.** Line up three center punch marks on cover with three center punch marks on case (fig. 101). Place cover on case, and drive cover with three dowel pins into holes in case.

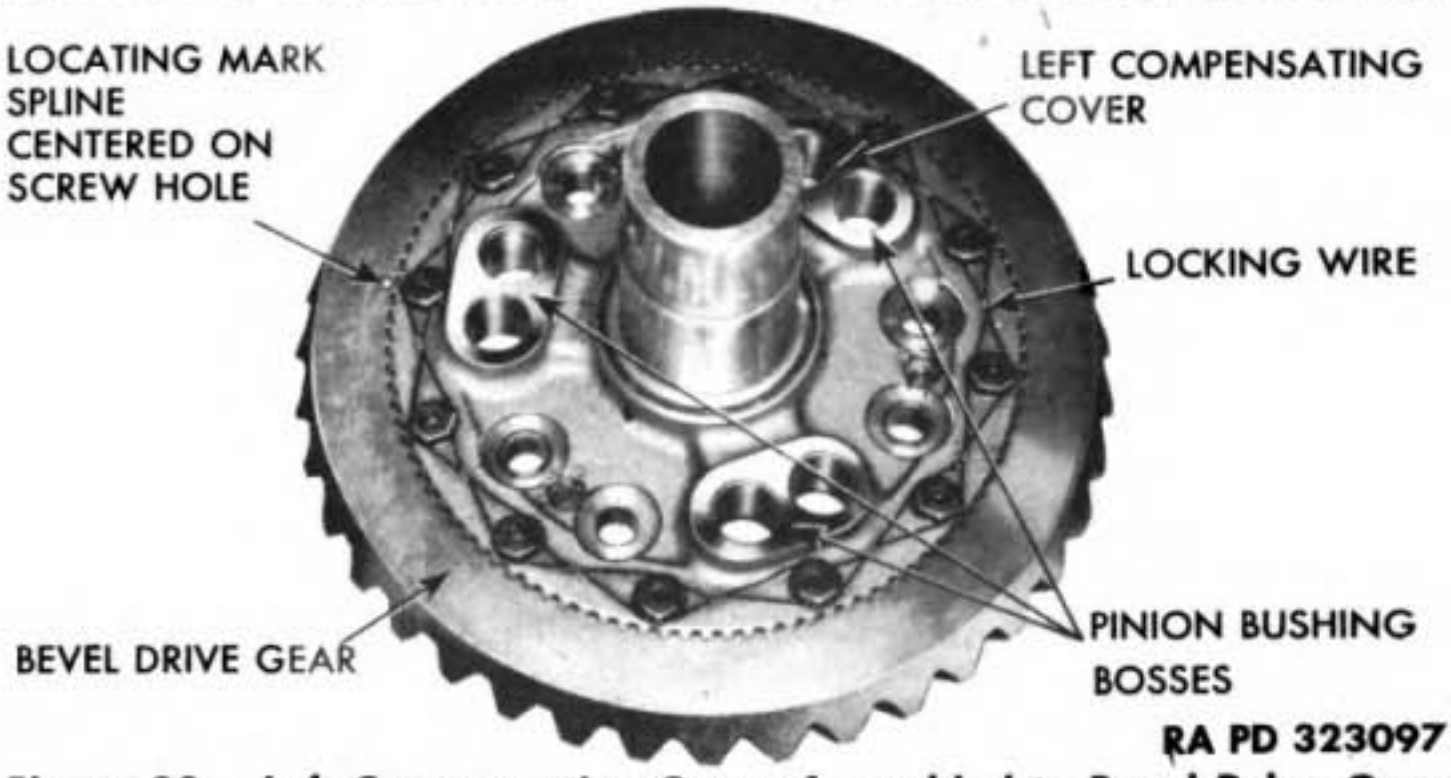



***Figure 98 — Left Compensating Cover Assembled to Bevel Drive Gear***

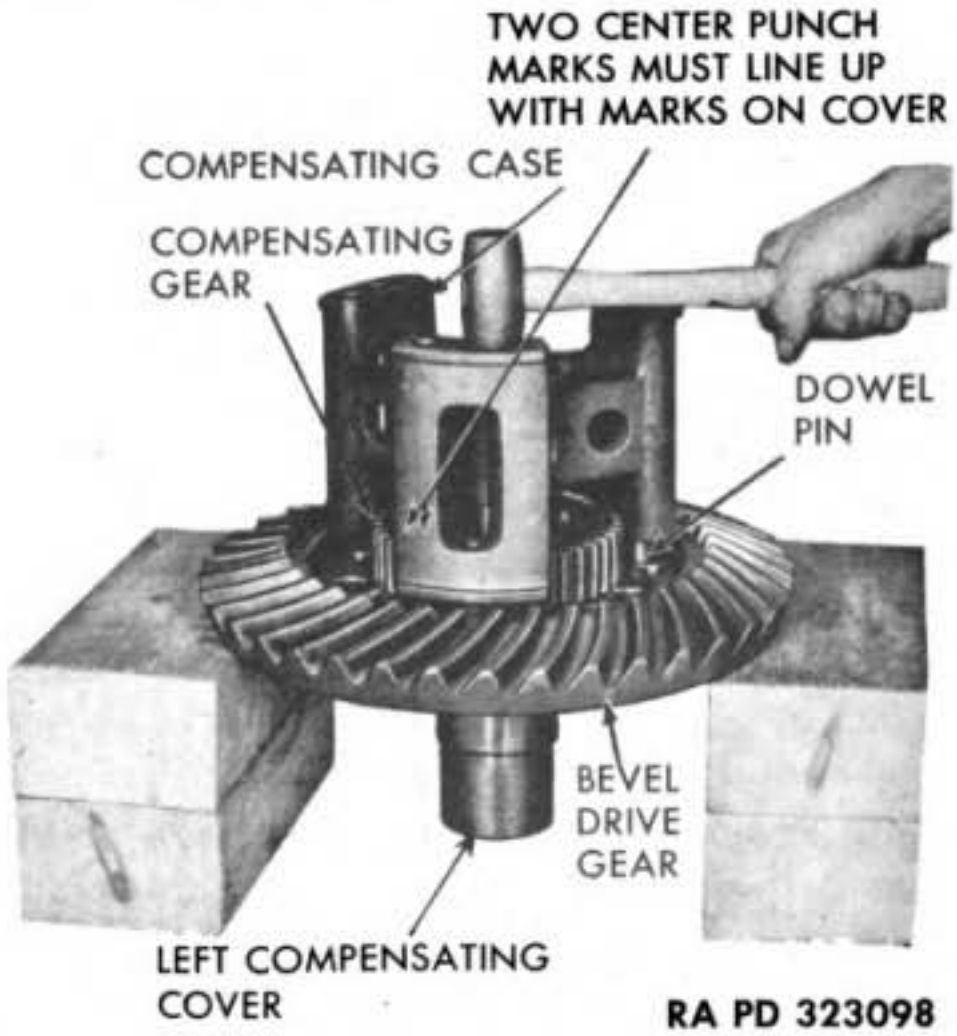



***Figure 99 — Installing Compensating Case on Left Compensating Cover***

**e. Install Compensating Case Bolts** (fig. 86). Install three bolts, nuts, and cotter pins in each cover. Bolts must be placed in holes that bring bolt heads closest to threaded ends of external pinion shafts.

**f. Install External Pinions** (fig. 86). Tap Woodruff keys into slots provided in threaded ends of internal pinion shafts. Install external pinions on shafts, and secure with nuts and cotter pins.

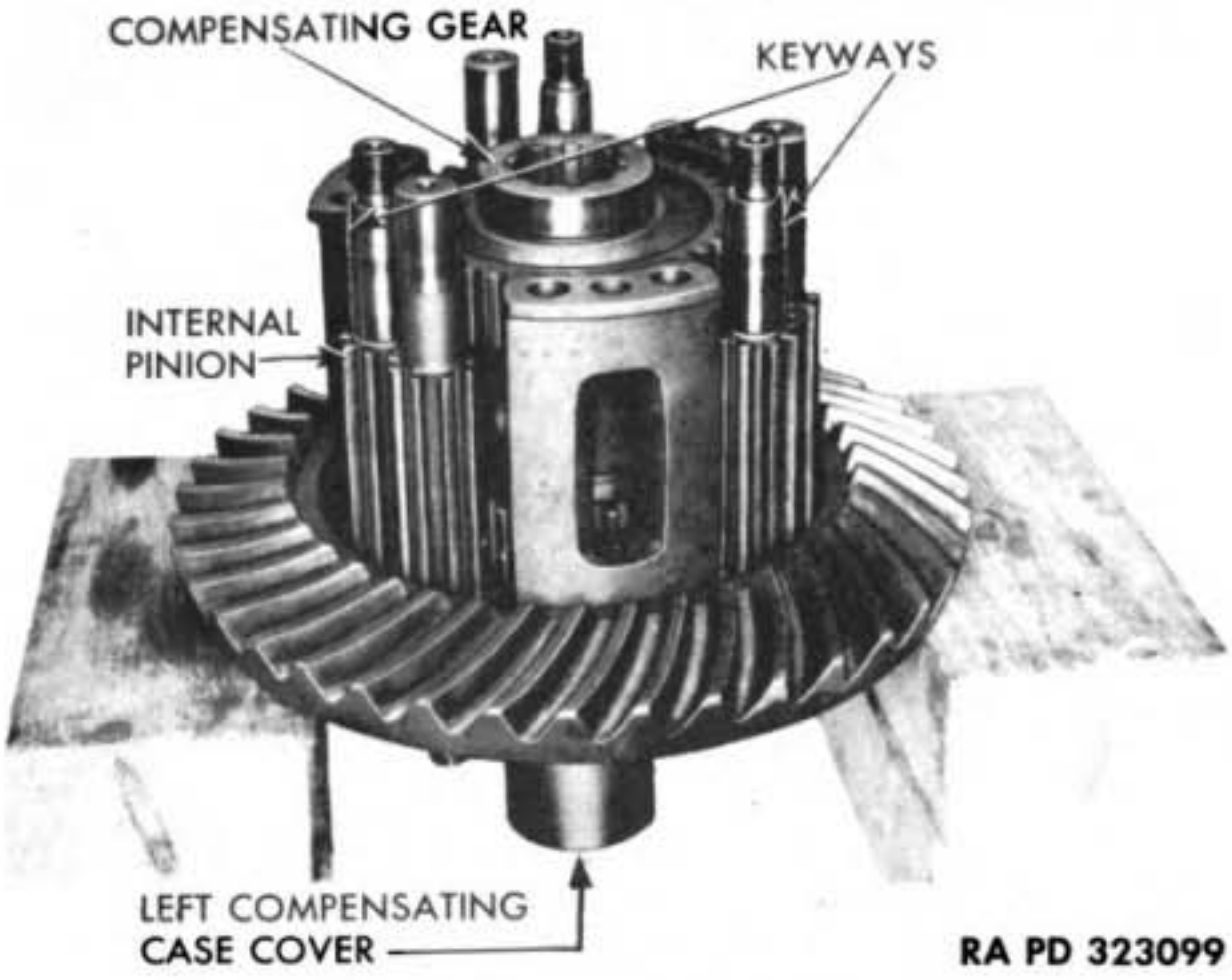



***Figure 100 — Internal Pinion Installation***


***Figure 101 — Locating Marks on Compensating Covers and Case***

**g. Assemble Steering Brake Drum Rim to Gear Flange** (fig. 85). Place gear flange inside rim, and secure with eight cap screws, nuts, and cotter pins.

**h. Install Steering Brake Drum Rim and Gear Flange.** Slide gear flange bushing onto cover hub, and mesh gear with external pinions (fig. 84). Turn rim to see that differential is timed properly. If it is not, make sure that keys in pinions all face toward or away from center of cover hub at same time.

**ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**


***Figure 102 — Installing Differential Bearing Cone***

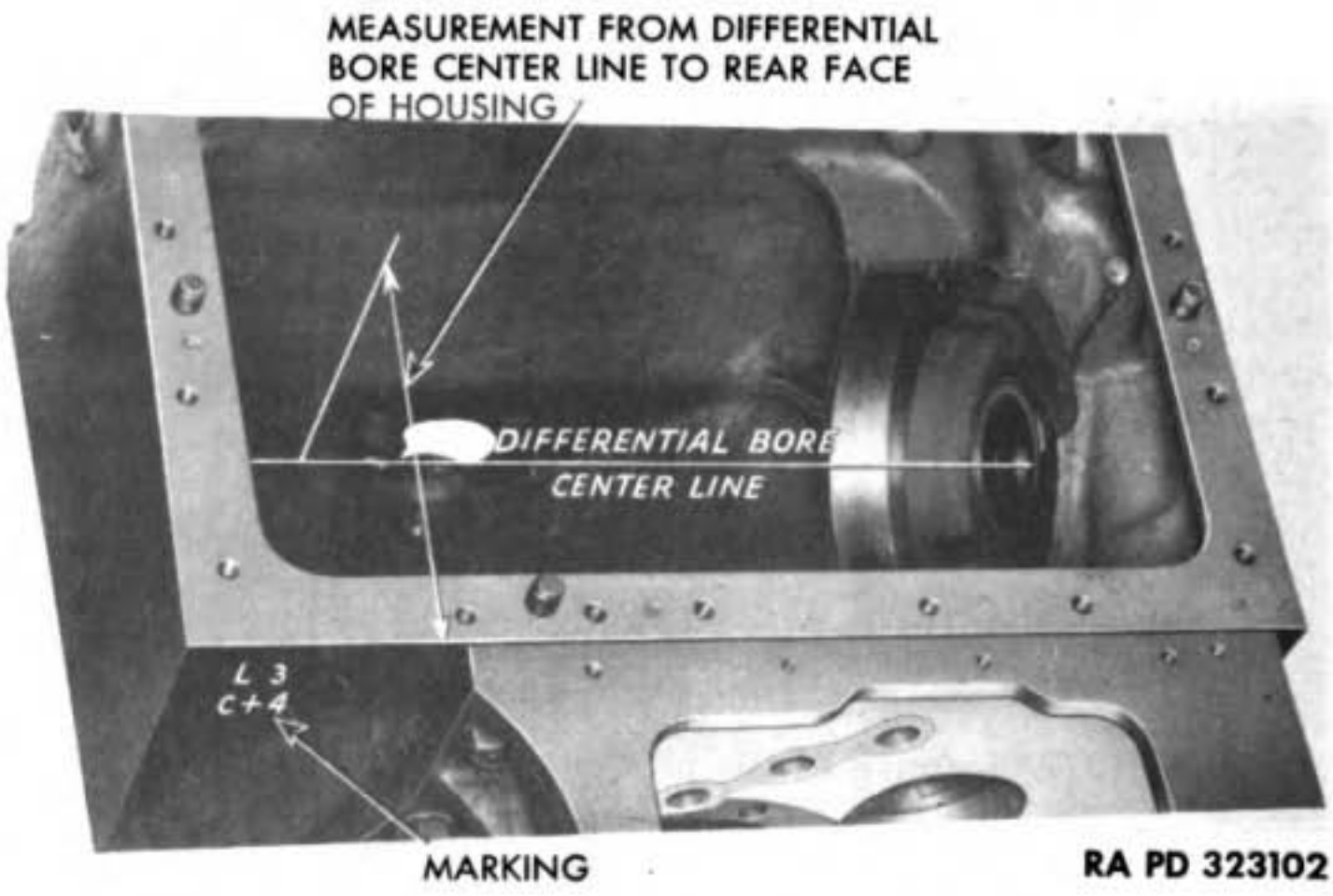



***Figure 103 — Differential and Final Drive Housing Marking***

**i. Install Roller Bearing Cone and Bearing Spacer Washer.** Slide spacer washer onto compensating cover hub. Using differential case bearing cone replacer (41-R-2384-135), drive bearing tight against washer (fig. 102).

## 16. INSTALLATION.

### a. Install Differential and Final Drive Housing.

(1) If housing is damaged beyond repair, it must be replaced with a new one. To do this, the differential and final drive housing, and the transmission case, must be removed from the vehicle as described in TM 9-786.

(2) MARKINGS ON HOUSING. On upper left corner of housing surface to which transmission case is attached are stamped two sets of code letters and numbers (fig. 103). The "L" or "H" letters must be disregarded because they are used only for assembly purposes in manufacturing the vehicle. The letter "C" and the number following indicate in thousandths of an inch the individual variation from a standard dimension measured from the center line of the differential bore to the rear face of the housing to which the transmission case attaches. When replacing differential and final drive housing, compare the "C" number on the housing being removed with that on the housing to be installed. If the difference is more than 2 (0.002 inch), the shim pack on the transmission output bevel pinion bearing case must be changed to maintain the proper tooth contact between the bevel drive gear and the transmission output pinion. NOTE: *Changing shim pack thickness requires complete disassembly of the transmission* (par. 6). EXAMPLE: If housing being removed is stamped "C-3" and new housing is stamped C+2, there is a difference of 0.005 inch between the two housings. If the same bevel drive gear and transmission output bevel pinion are used again, a 0.005-inch shim must be added to the output bevel pinion shim pack as described in paragraph 8 c (3). If the housing removed is stamped "C+5" and new housing is stamped "C–5," it indicates there is a difference of 0.010 inch. To maintain proper tooth contact between bevel drive gear and bevel pinion, 0.010-inch shim thickness must be removed from shim pack.

(3) ATTACH HOUSING TO TRANSMISSION CASE. Shellac a new gasket on housing face, and secure case to housing with seven cap screws and lock washers, and three nuts and lock washers.

(4) Change bevel pinior shim pack in transmission if necessary (pars. 6 l and 8 c).

**b. Lift Differential Into Housing.** Install bearing cage into bearing support ring, and assemble bearing adjuster (fig. 90). Place a sling around center of differential and, using a lifting device, lower differential into housing until brake rims start entering housing. Place bearing support ring assembly on each bearing cone, and continue lowering differential into housing (fig. 82). If necessary, rock differential sideways with a crow bar (fig. 81) to prevent bevel drive gear from locking in teeth of bevel pinion. Guide bearing support rings so that slots for bearing adjuster locks are on top. Do not

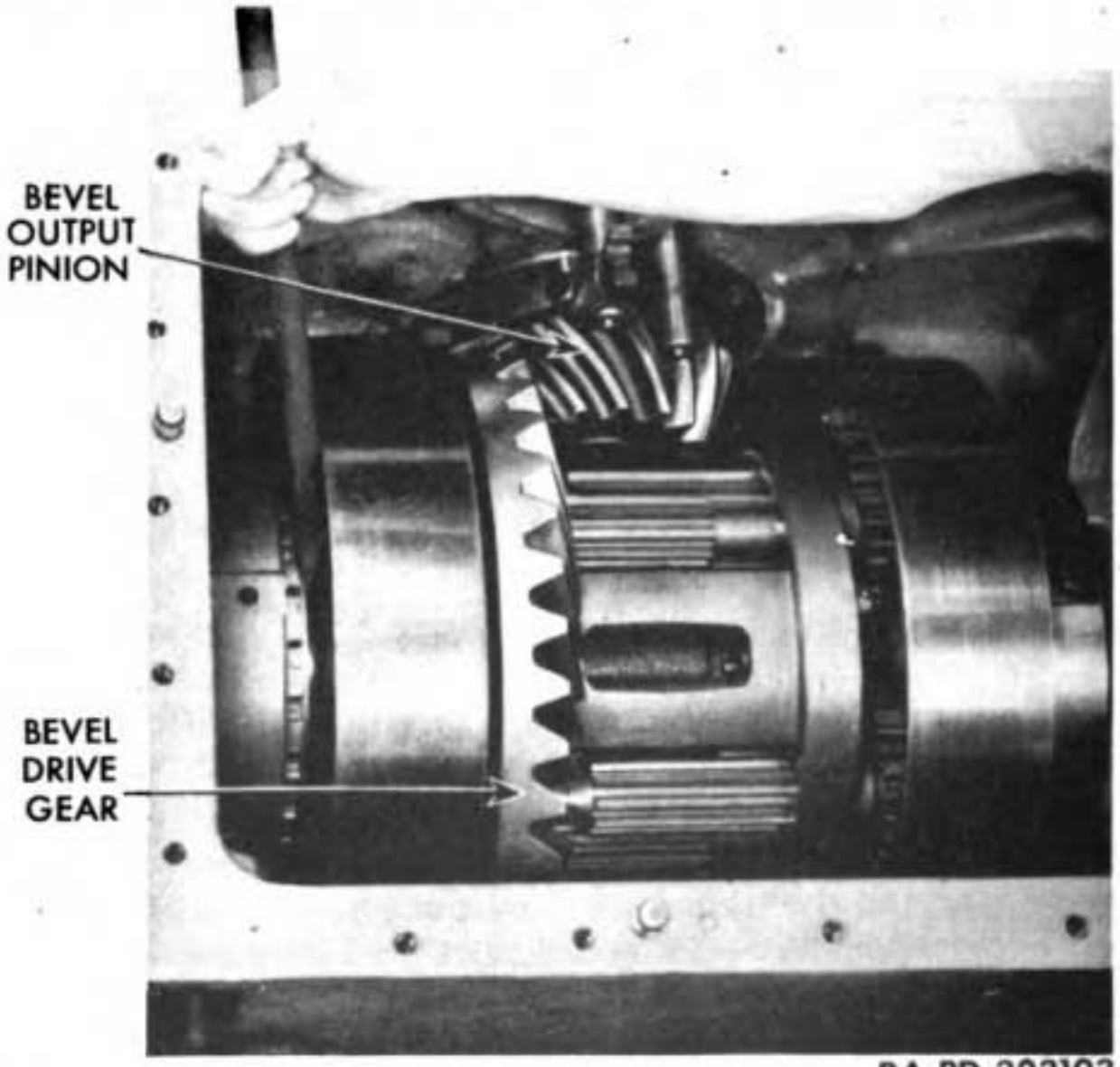



*Figure 104 — Prying Differential from One Side to the Other to Make Sure Bevel Drive Gear Teeth Bottom in Pinion*

remove sling or hoisting device until bearing support ring fastening screws have been started.

**c. Secure Bearing Support Ring to Housing.** From underneath housing, start two support ring fastening screws, one at each end, but do not tighten until side screws (fig. 80) are started. Then tighten two bottom screws and four side screws. Remove lifting sling from around differential.

**d. Check to See That Bevel Drive Gear Teeth Bottom Between Teeth of Output Pinion** (fig. 104). Pry differential from side to side to see that it is free, and that bevel drive gear teeth bottom in transmission output pinion before left bearing cone seats in its cup. If there is backlash between bevel drive gear and pinion when differential is pried toward pinion, turn left bearing adjuster counterclockwise, as viewed from outside, until gear teeth have no backlash.

**e. Preloading Differential Roller Bearings and Setting Bevel Drive Gear Backlash.** Turn right roller bearing adjuster counterclockwise, as viewed from outside, until nearly all backlash is taken

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

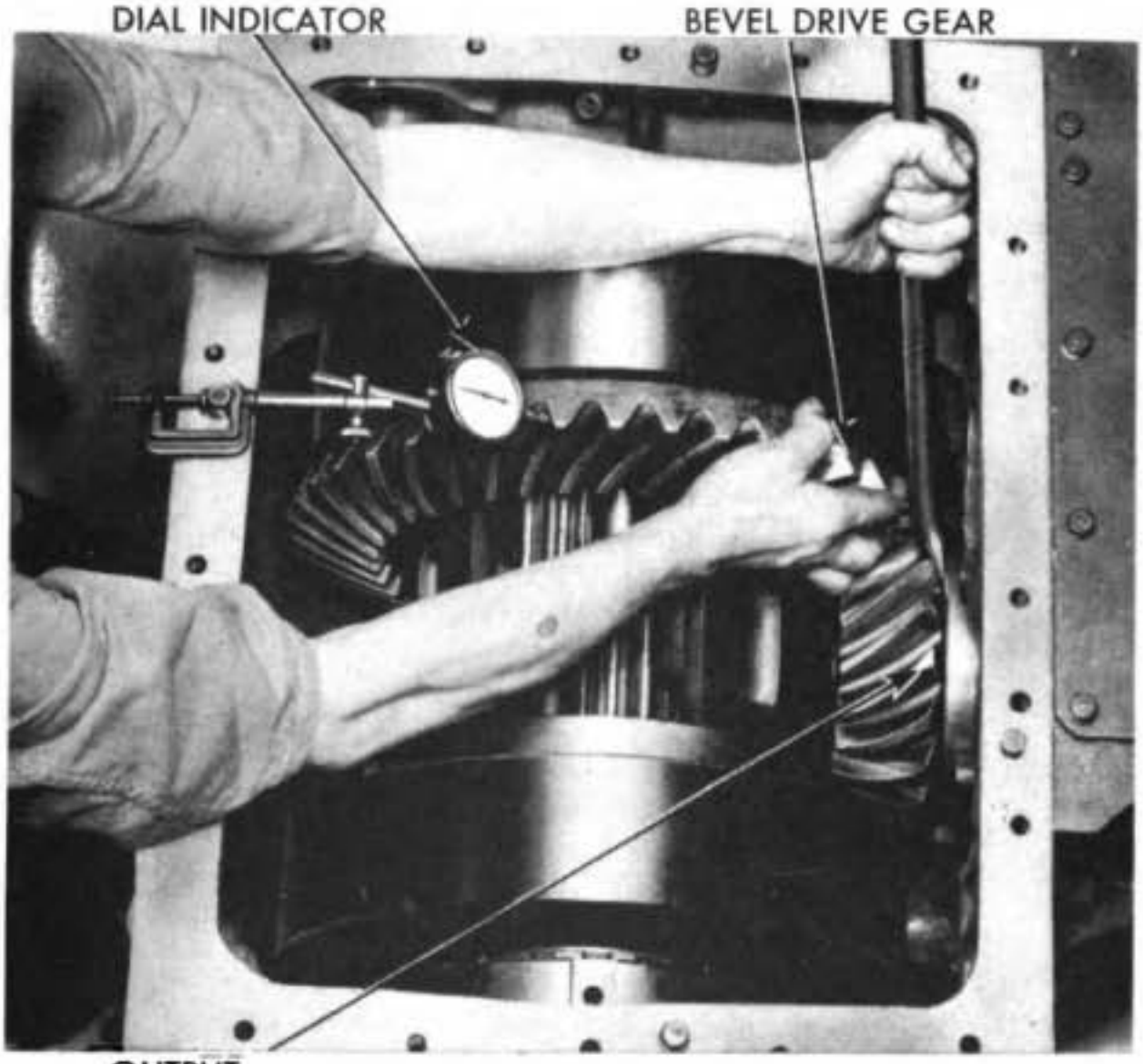



***Figure 105 — Checking Backlash Between Bevel Drive Gear and Transmission Output Bevel Pinion, Using Indicator (41-I-100)***

up between bevel drive gear and transmission output bevel pinion (fig. 79). Attach a dial indicator (41-I-100) to a differential and final drive cover dowel pin so that the indicator contacts the face of a bevel drive gear tooth (fig. 105). Continue turning right bearing adjuster counterclockwise until dial indicator shows there is 0.004-inch backlash between bevel drive gear and pinion. Turn left bearing adjuster until dial indicator shows there is 0.010-inch backlash between gear and pinion. To check backlash, lock transmission output bevel pinion with a pry bar, rotate bevel drive gear back and forth, and note dial indicator reading. When reading is correct, install bearing adjuster lock (fig. 72).

**f. Checking Differential Roller Bearing Preload.** NOTE: *After the transmission is completely assembled, there is no way to check preload on differential bearings.* When transmission is disassembled except for output bevel pinion and shaft, the differential bearing preload can be checked with a spring scale and strong cord (fig. 106). Tie one end of cord to compensating case, and wrap it two or three times around center of differential. Attach other end of cord to

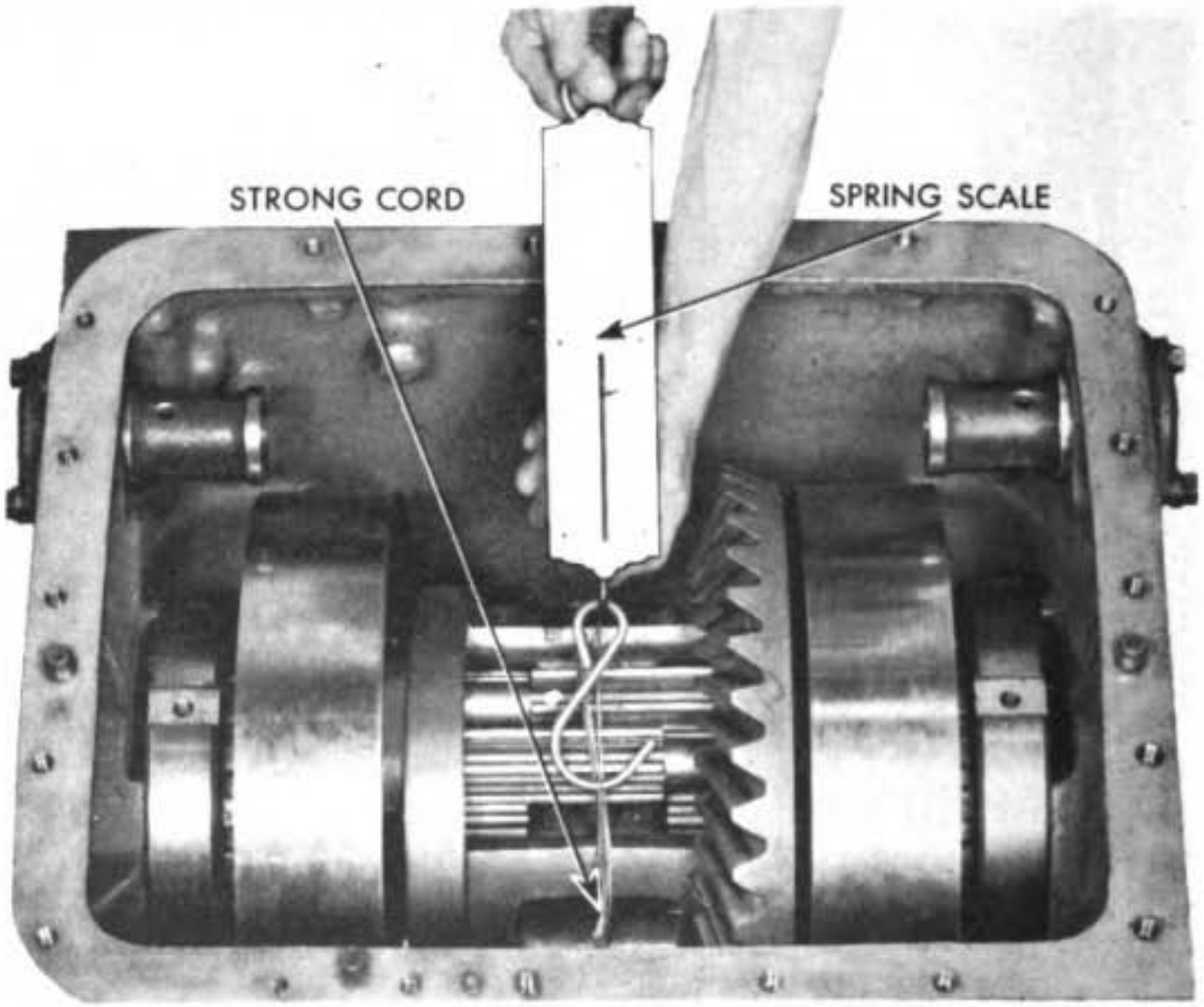



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*Figure 106 — Checking Differential Bearing Preload*

spring scale. When bearings are properly adjusted, it takes 10 to 15 pounds pull to rotate differential. If the effort required to rotate differential is more than 15, or less than 10 pounds, repeat preload adjustment (subpar. e above).

**g. Install Transmission Shifting Guide and Rear Shifting Heads.** Attach shifting guide (fig. 72) to front of transmission with two cap screws and lock washers. Install third and fourth speed gear shifting shaft head on shaft, and clamp head to shaft with cap screw, lock washer, and nut. Slide reverse gear upper shaft toward front of transmission until reverse gear upper shifting shaft rear head lines up with reverse gear intermediate shifting shaft (fig. 77). **CAUTION:** *Do not push shaft past poppet.* Turn reverse shaft rear head so that it engages with intermediate shifting shaft. Install reverse gear upper shifting front head on shaft, and clamp with capscrew, lock washer, and nut.

**h. Install Left Steering Brake Shaft Bearing Support and Shaft** (fig. 76). Install bearing support in housing, and secure with two cap

screws and lock washers. Install steering brake shaft assembly in support. Place felt washer on end of shaft, and tap Woodruff key into slot. Drive left steering brake shaft lever onto shaft, and secure with cap screw, lock washer, and nut.

**i. Install Final Drive Vent Tubes.** Connect vent tubes (fig. 72) to couplers, and tighten coupling nuts.

**j. Install Left Front Compartment** (fig. 74). Install compartment over final drive housing. Remove block from between housing and fender side sheet. Install four cap screws and lock washers attaching fender side sheet to final drive housing. Install six cap screws, lock washers, and nuts attaching compartment to fender side sheet.

**k. Attach Left Front Fender Support to Differential and Final Drive Housing.** Slide support onto two studs in housing, and secure with two nuts and lock washers. Install two cap screws, lock washers, and nuts attaching support bracket to fender side sheet.

**l. Install Clutch Pedal Bracket and Pedals.** Attach bracket to differential and final drive housing with four cap screws and lock washers. Place clutch pedals in position in bracket, and install shaft through pedals. Install shaft nut and cotter pin.

**m. Install Left Driver's Seat Support.** Place support in position under left side of cowl and attach it to seat, cowl, fender support, and front fender support crossmember with cap screws, lock washers, and nuts. Attach air manifold to support with two screws and lock washers. Attach air hose and tube clips.

**n. Install Left Front Door.** Place door in position on cowl, and attach with five nuts and lock washers.

**o. Install Left Front Platform Door Support.** Place support in position over front fender left support, and attach with 11 cap screws and lock washers, and 2 nuts.

**p. Install Left Side Seat Bottom.** Place seat bottom in position, and attach to left side rail and left side sheet with 30 cap screws and lock washers, and 27 nuts.

**q. Install Steering Brake Bands, Left Side Seat, Sprockets, Hubs, and Tracks.** Refer to TM 9-786. For installation of final drive components, refer to paragraph 24 of this manual.

Section IV

# STEERING LEVERS AND COMPONENTS



## 17. DESCRIPTION (fig. 107).

a. The steering levers and shafts are mounted on the differential and final drive cover. The steering lever shafts are mounted in bushings pressed into two brackets on top of the differential and final drive cover. Each steering lever is provided with two buttons. The outside button controls a pawl which engages with a ratchet to lock the steering brakes. The inside button on the right steering lever applies the brakes on the towed load. The inside button on the left steering lever controls the siren. The differential and final drive cover, in addition to mounting the steering levers and shafts, mounts the service and emergency clutch pedal return springs, steering lever torsion spring, air and electric brake control valve, electric brake controller power cylinder, and siren and stop light switches. These parts are usually left attached to the cover when it is removed from the differential and final drive housing. The transmission gear shifting housing also attaches to the cover. The cover is secured to the differential housing with dowel pins and cap screws.

b. Removal and installation of the differential and final drive housing cover is described in TM 9-786.

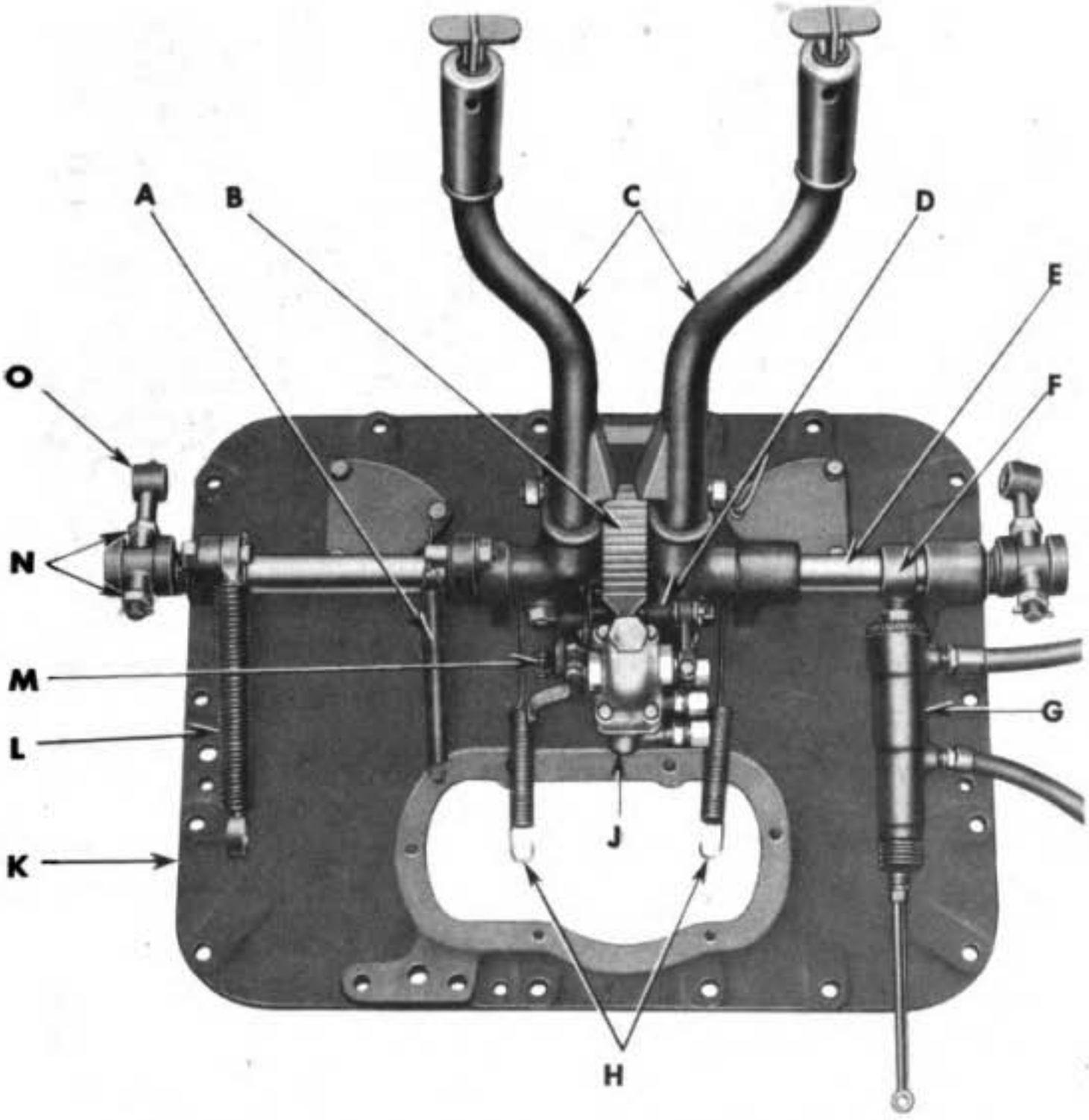
## 18. DISASSEMBLY.

a. **Remove Air and Electric Brake Control Valve** (fig. 107). Remove cotter pin and pin attaching bell crank to valve lever. Remove two cap screws attaching valve to steering lever ratchet, and remove valve.

b. **Remove Siren Switch.** Remove two screws and lock washers securing switch to steering lever ratchet. Loosen screw and nut in switch clamp, and remove switch.

c. **Remove Bell Crank.** Remove two cap screws and lock washers securing steering lever ratchet to differential and final drive cover. Remove cotter pin from bell crank supporting pin. Remove cotter pin from screw attaching button control wire to bell crank. Loosen nut on screw. Pull up on button and wire, and remove bell crank.

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES




**A**—EMERGENCY CLUTCH PEDAL RETURN SPRING
**B**—RATCHET
**C**—STEERING LEVERS
**D**—BELL CRANK
**E**—STEERING LEVER SHAFT
**F**—POWER CYLINDER EYE BOLT
**G**—ELECTRIC BRAKE CONTROLLER POWER CYLINDER
**H**—STEERING LEVER TORSION SPRINGS
**J**—AIR AND ELECTRIC BRAKE CONTROL VALVE
**K**—DIFFERENTIAL AND FINAL DRIVE COVER
**L**—SERVICE CLUTCH PEDAL RETURN SPRING
**M**—SIREN SWITCH
**N**—STEERING SHAFT TURNBUCKLE EYE NUTS
**O**—TURNBUCKLE EYE

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***Figure 107 — Steering Lever Installation***

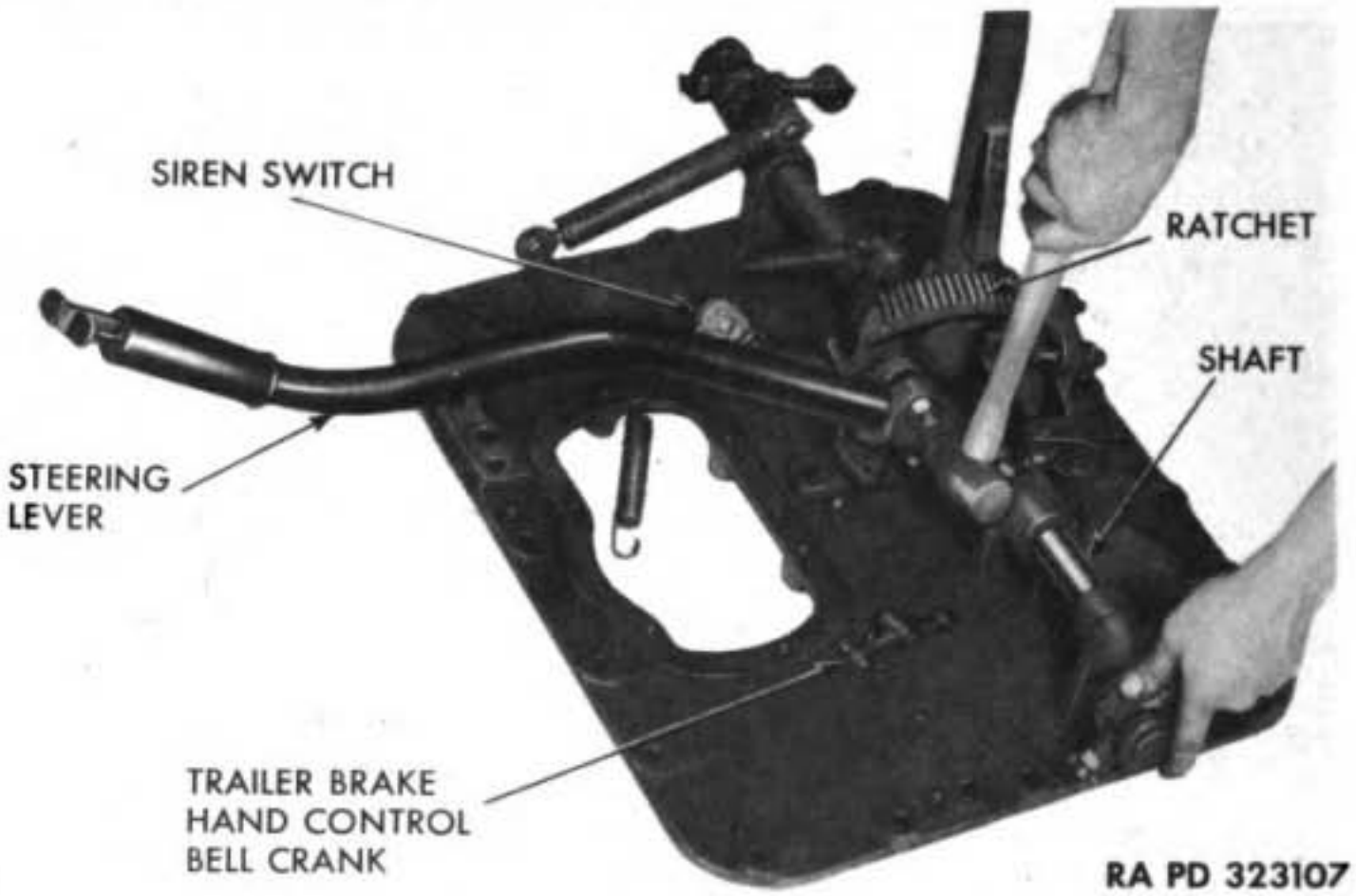


*Figure 108 — Removing Steering Lever*

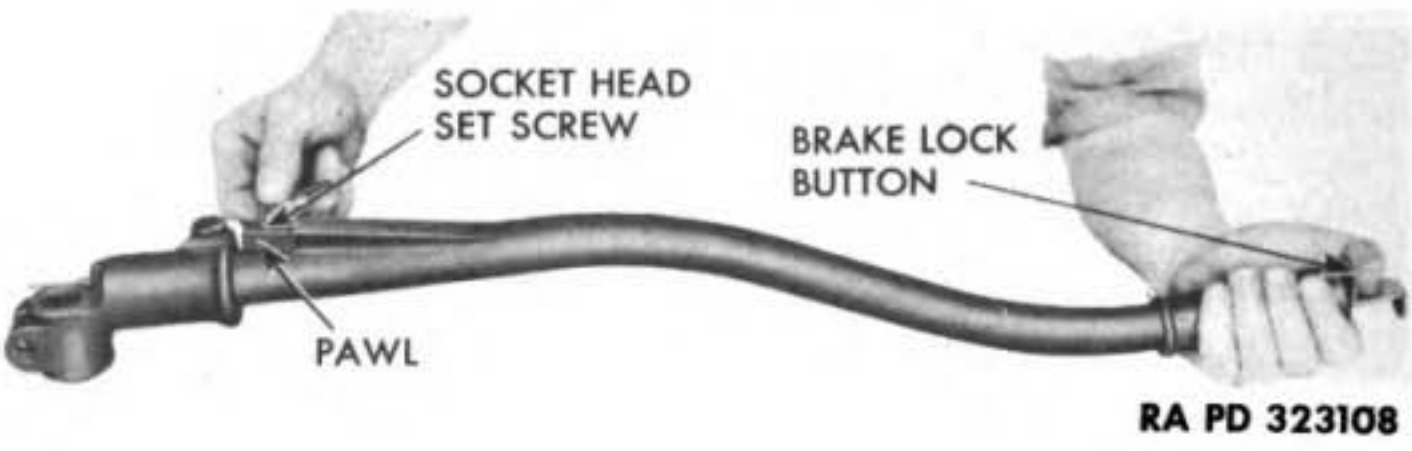


*Figure 109 — Removing Steering Lever Pawl*

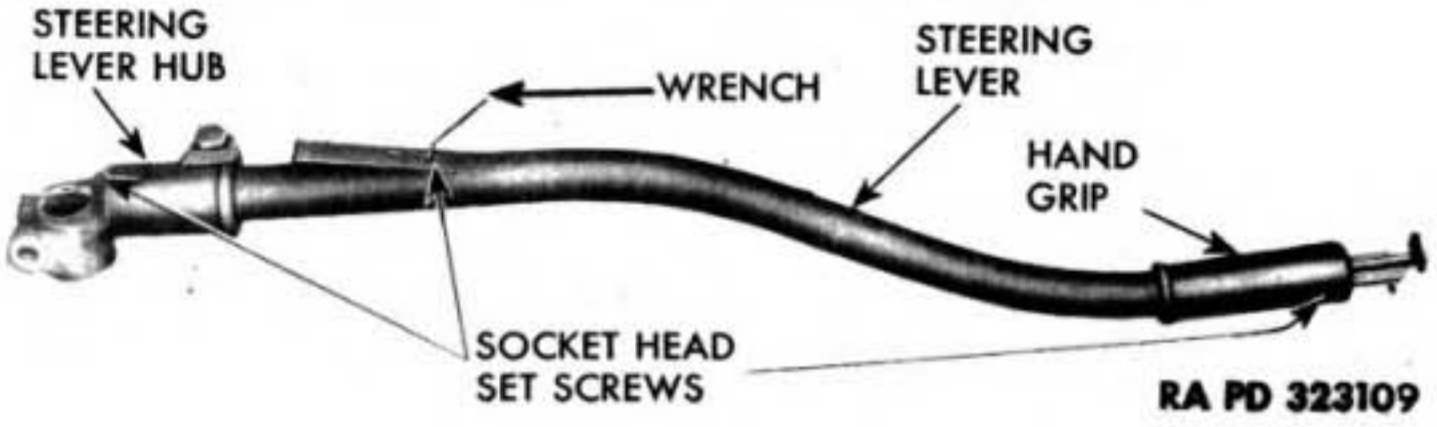


*Figure 110 — Steering Lever with Parts Identified*

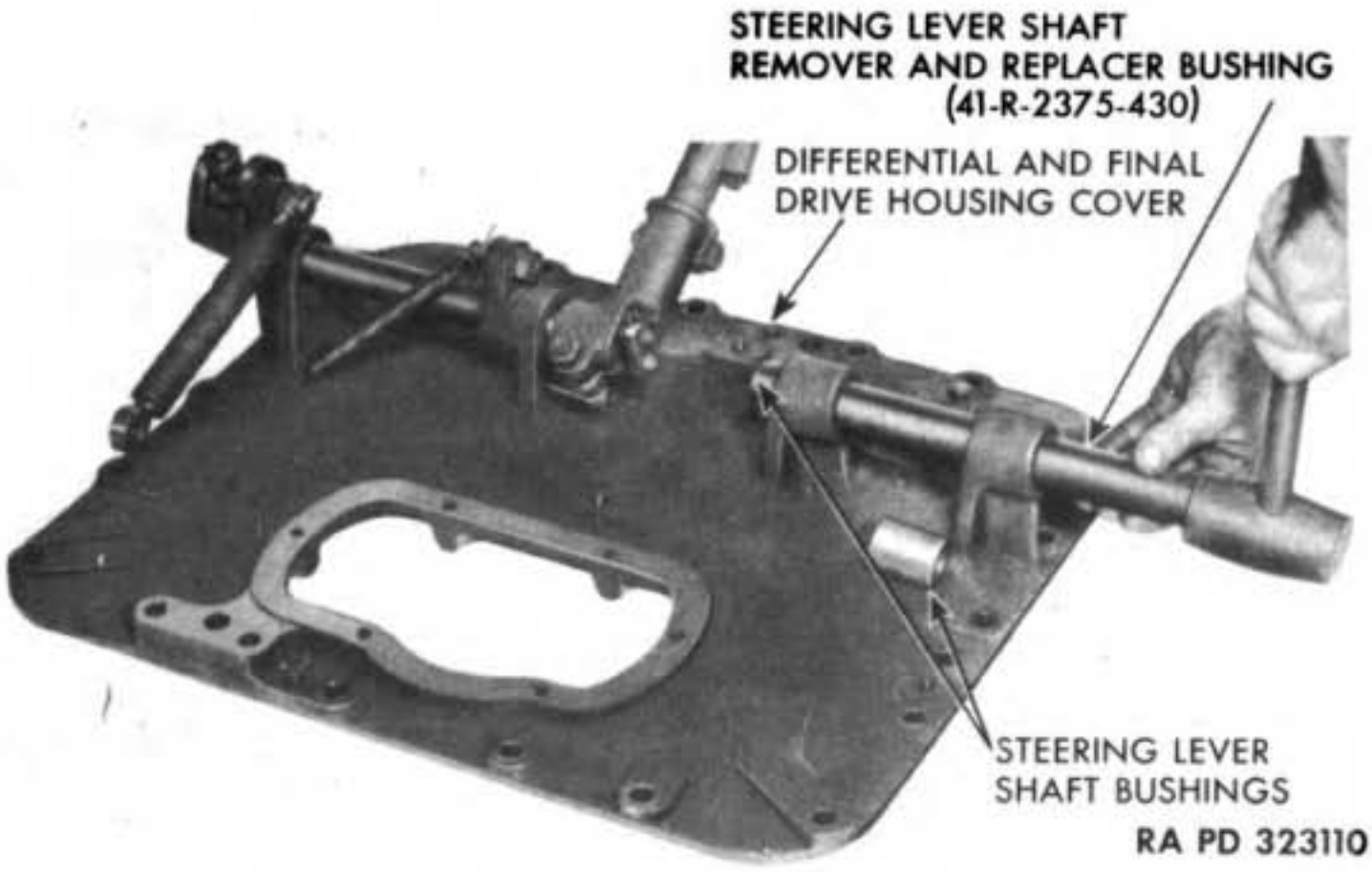


*Figure 111 — Removing Steering Lever Shaft Bushing*

**d. Remove Steering Levers and Shafts.** Loosen nut on cap screw in either shaft (fig. 108). Remove steering lever ratchet. Remove Woodruff key from end of shaft. Pull shaft out of bushings and power cylinder eye bolt. Remove opposite lever and shaft in same manner.

**e. Disassemble Each Steering Lever.** Remove cotter pin, and loosen nut on bolt which attaches wire to siren switch clamp. Pressing down on brake lock button, remove socket-head set screw from brake pawl, and remove pawl (fig. 109). Remove three socket-head set screws; one at lever hand grip, one at steering lever hub, and one at guide from which pawl was removed (fig. 110). Pull thumb control unit out of lever. Pull buttons with wire and springs out of control unit.

## 19. CLEANING, INSPECTION, AND REPAIR.

**a. Clean.** Clean all parts in dry-cleaning solvent, and dry with compressed air.

**b. Inspect and Repair.**

(1) DIFFERENTIAL AND FINAL DRIVE HOUSING COVER. Inspect cover for cracks and burs on the finished surfaces. If cracked, replace cover. Burs can be removed with a fine file. Check four steering lever shaft bushings for wear. Manufacturing limits of a new bushing are 1.251 to 1.255 inches after it is driven into place. If bushings are worn excessively, replace with new ones. Using steering lever


*Figure 112 — Steering Lever Thumb Control Unit Installation*

shaft bushing remover and replacer (41-R-2375-430), drive out old bushings, and drive in new ones, chamfered end first (fig. 111). This tool holds bushings to correct size.

(2) STEERING LEVER SHAFTS. Inspect diameter of shafts for wear at points where they oscillate in bushings. Manufacturing limits are 1.120 to 1.123 inches. The limits of hole in outside end of shafts are 1.248 to 1.253 inches. Replace shaft if worn excessively.

(3) Inspect all other parts, and replace if worn excessively or damaged. NOTE: *Air and electric brake control valve and controller power cylinder are covered in paragraphs 101 and 108.*

## 20. ASSEMBLY.

**a. Steering Levers.** Install buttons and wires in bottom end of steering lever. Install separator and casing over wires, and push it into position in top of steering lever (fig. 112). Remove buttons and wires, and insert them with springs in separator and casing. Install three socket-head screws; one at hand grip, one at pawl guide, and one at steering lever hub (fig. 110). Pressing down on brake lock button, install pawl in position, and install socket-head set screw (fig. 109).

**b. Steering Levers and Shafts.** Place two washers on each shaft, and install left and right steering lever shafts through bushings in cover. Install electric brake controller power cylinder eye bolt between bushing brackets on right shaft. Drive Woodruff key into slot in each shaft. Drive steering lever hubs onto shafts. Before second steering lever is driven onto shaft, place ratchet in position (fig. 108). Install steering lever return spring clip on cap screw; install cap screw, lock washer, and nut in steering lever hub. Place trailer brake hand control bell crank on shaft in ratchet, and install cotter pin. Secure ratchet to cover with two cap screws and lock washers. Insert trailer brake control wire in fastening bolt, tighten nut on bolt, and insert cotter pin. The stop screw under end of bell crank must be ¾ inch from top head to face on ratchet. Bell crank must rest on stop screw after control wire is attached. Attach siren switch to ratchet with two screws and lock washers. Place siren switch clamp on switch lever, and insert control wire through bolt. Tighten nut on bolt, and insert cotter pin. After

attaching control wire, siren switch lever must be against stop when pushed down, to operate the siren. Install air and electric brake control valve to ratchet with two cap screws and lock washers. Install rod pin and cotter pin attaching control links to bell crank.

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## Section V

# FINAL DRIVES AND SPROCKETS



## 21. DESCRIPTION AND OPERATION (figs. 113 and 114).

**a. Description.** The two final drives are located in the differential and final drive housing. Each includes a pinion shaft, pinion, drive shaft, and gear. Both shafts are mounted in ball bearings, the final drive shaft turning in two double-row ball bearings, and the pinion shaft turning in two single-row ball bearings. A double leather oil seal and a felt washer are provided to seal the final drive shaft as it protrudes from the differential and final drive housing. The inner end of the pinion shaft extends into the differential, and is splined to the differential compensating gear. A double oil seal surrounds the pinion shaft, sealing the differential compartment from the final drive compartment. The outer end of the final drive shaft is flanged for attaching the sprocket hub. Two steel sprockets are bolted to each hub.

**b. Operation.** Power is transmitted to the final drives through the differential compensating gears, which are splined to the pinion shafts. The pinion shafts transmit the power through the pinions, gears, final drive shafts, hubs, and sprockets. The sprockets pull the tracks forward over the top of the track supporting idlers, and lay them down in the path of the bogie wheels.

## 22. DISASSEMBLY.

**a.** The left and right final drives are identical with the exception of the pinion shafts. The right pinion shaft is longer than the left pinion shaft. The following procedure of disassembly applies to both final drives.

**b. Remove Track and Hub With Sprockets.** Refer to TM 9-786.

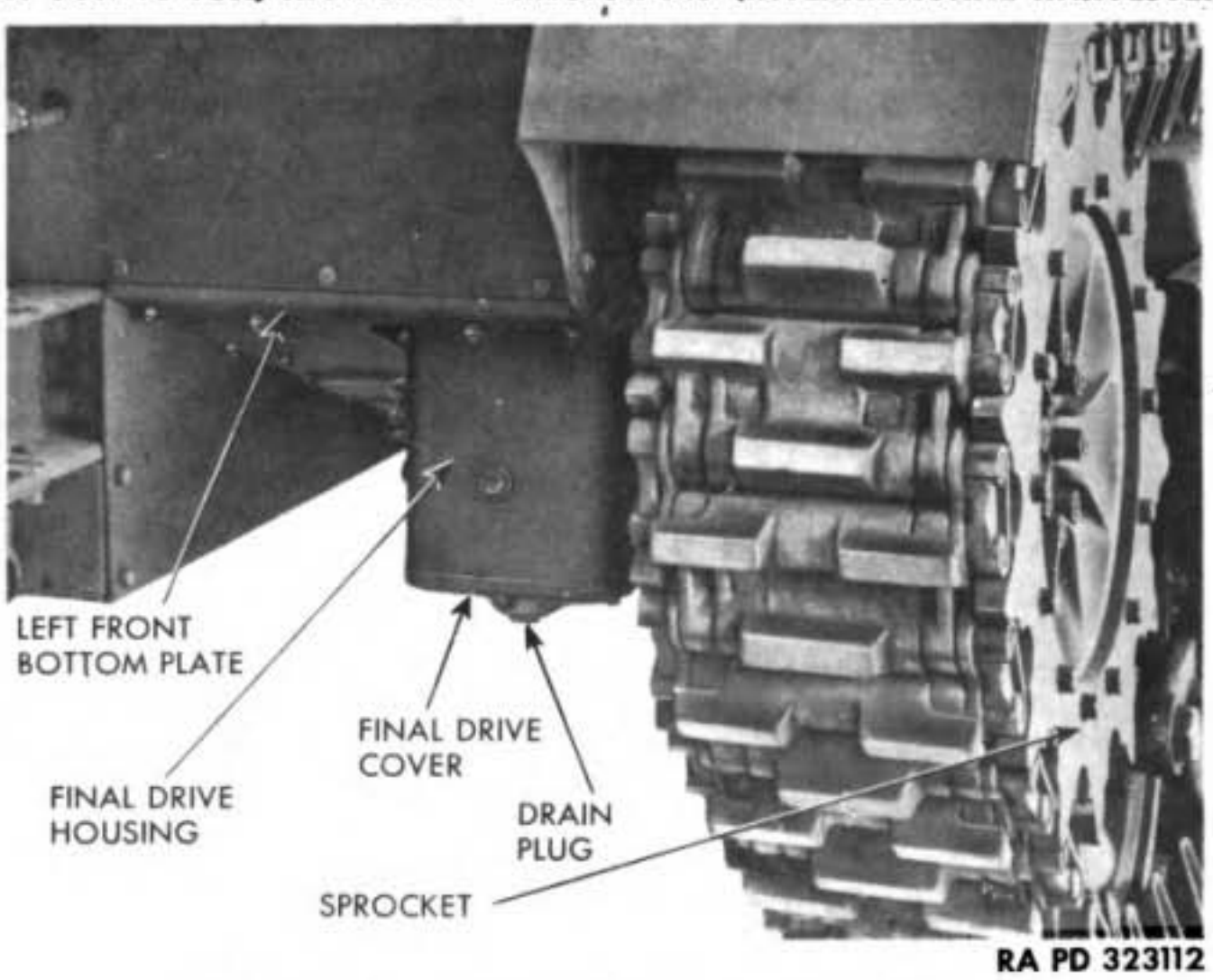


***Figure 113 — Left Final Drive and Sprocket***

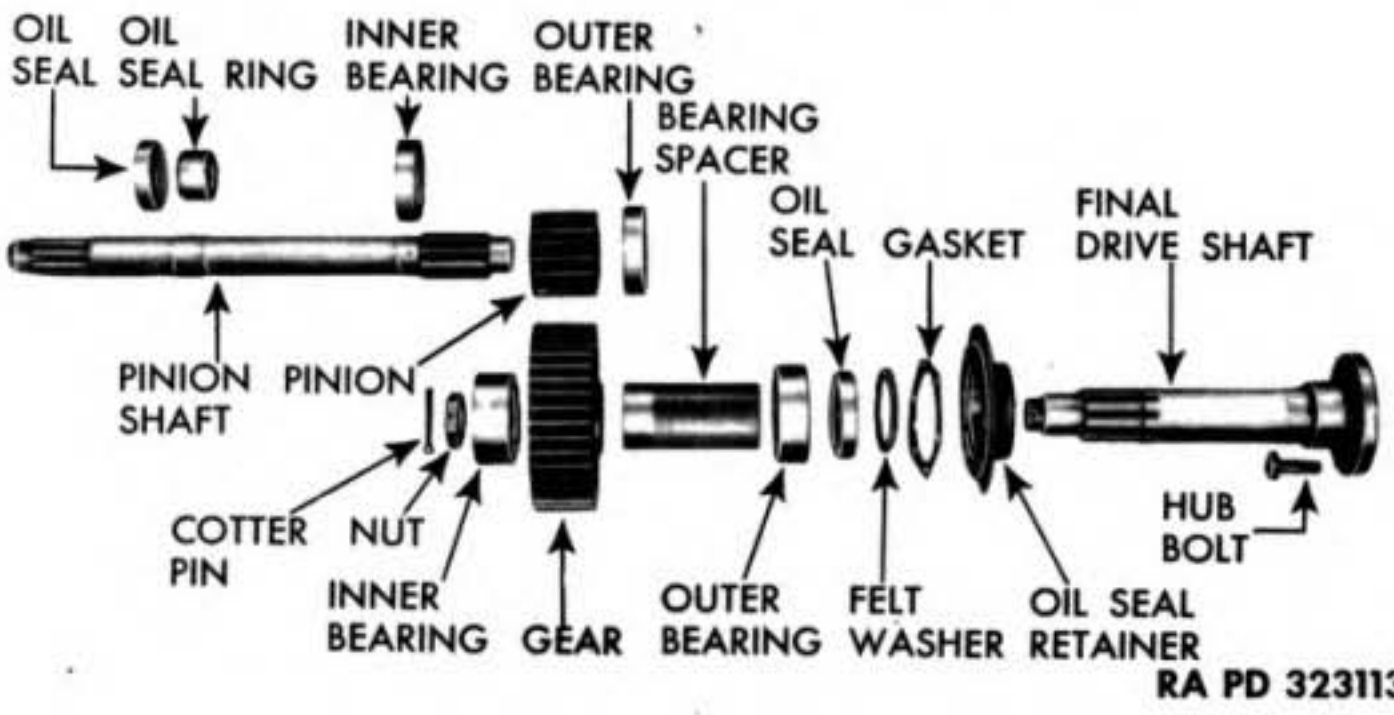


***Figure 114 — Final Drive Disassembled***

**c. Remove Left or Right Front Bottom Plates** (fig. 113). Remove 23 cap screws, 12 nuts, and 23 lock washers attaching bottom plate. Remove bottom plate.

**d. Drain Oil** (fig. 113). Remove drain plug from final drive cover, and allow oil to drain.

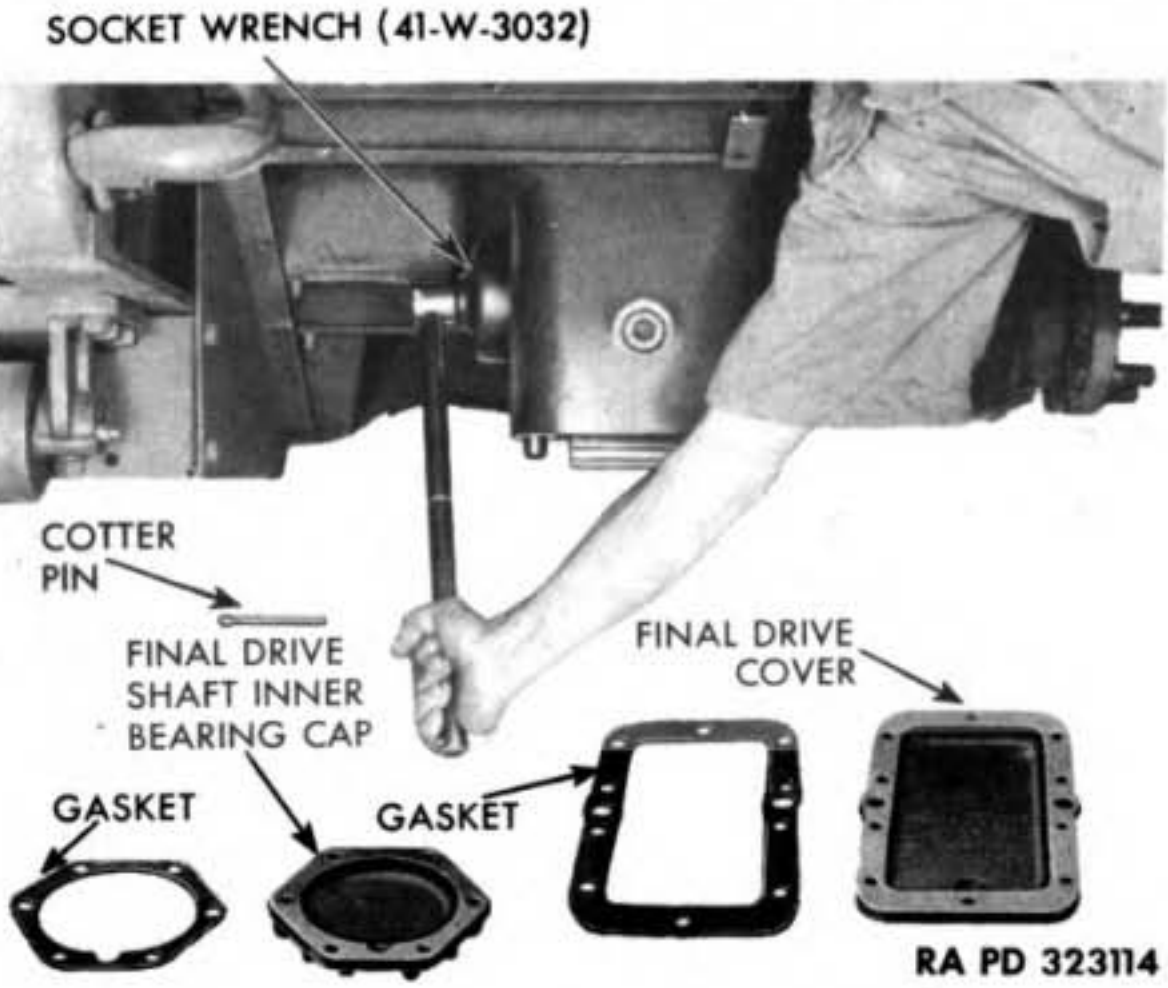


***Figure 115 — Removing Bearing Retainer Nut***


***Figure 116 — Use of Tool for Removing Final Drive Shaft***

**e. Remove Final Drive Cover** (fig. 115). Remove 10 cap screws and lock washers attaching cover to housing. Remove cover and gasket from housing.

**f. Remove Final Drive Shaft Inner Bearing Cap** (fig. 115). Remove six cap screws and lock washers attaching inner bearing cap to housing. Remove cap and gasket from housing.

**g. Remove Final Drive Shaft.** Remove cotter pin attaching retainer nut. Using bearing retainer nut socket wrench (41-W-3032), remove nut from final drive shaft (fig. 115). Assemble final drive shaft remover and replacer (41-R-2378-605) in position (fig. 116). Install puller screw onto end of final drive shaft. Install nut onto puller screw. Install puller flange onto final drive housing, and secure with six cap screws and lock washers. Turn final drive shaft by turning the re-

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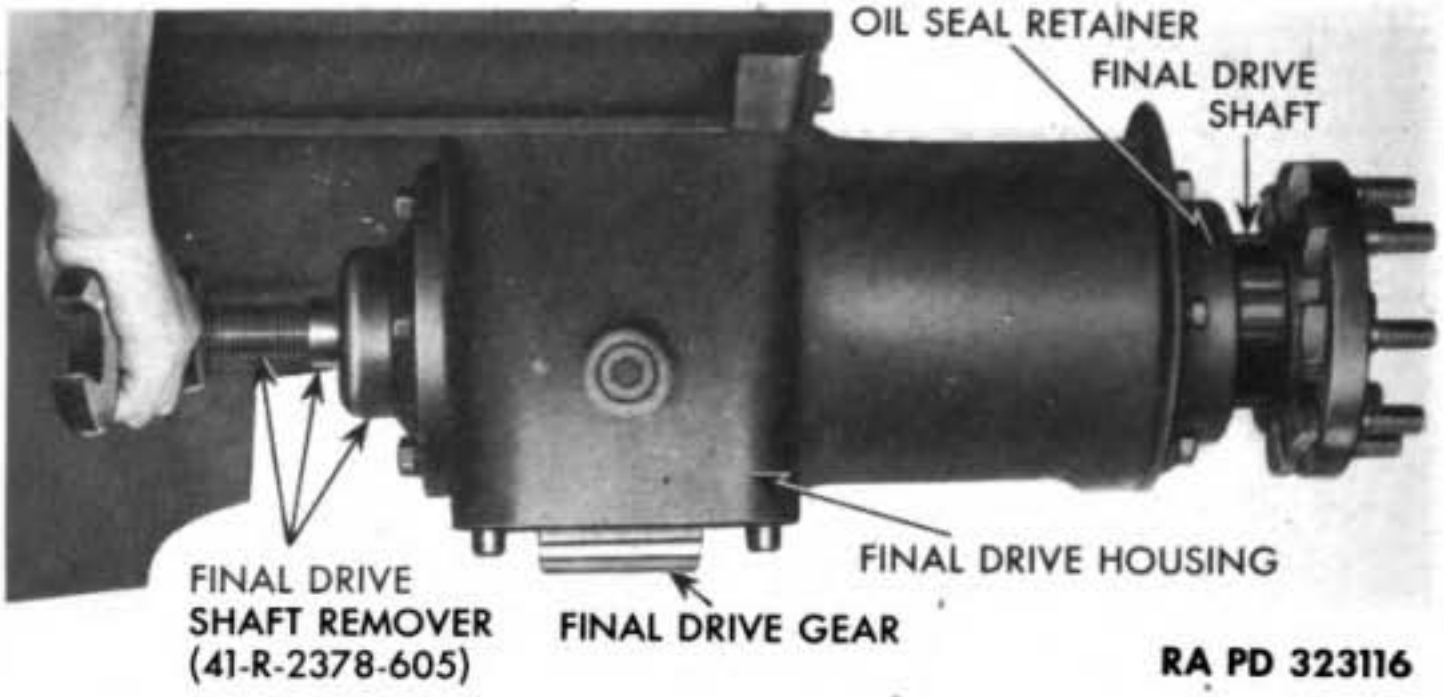


***Figure 117 — Removing Final Drive Shaft***

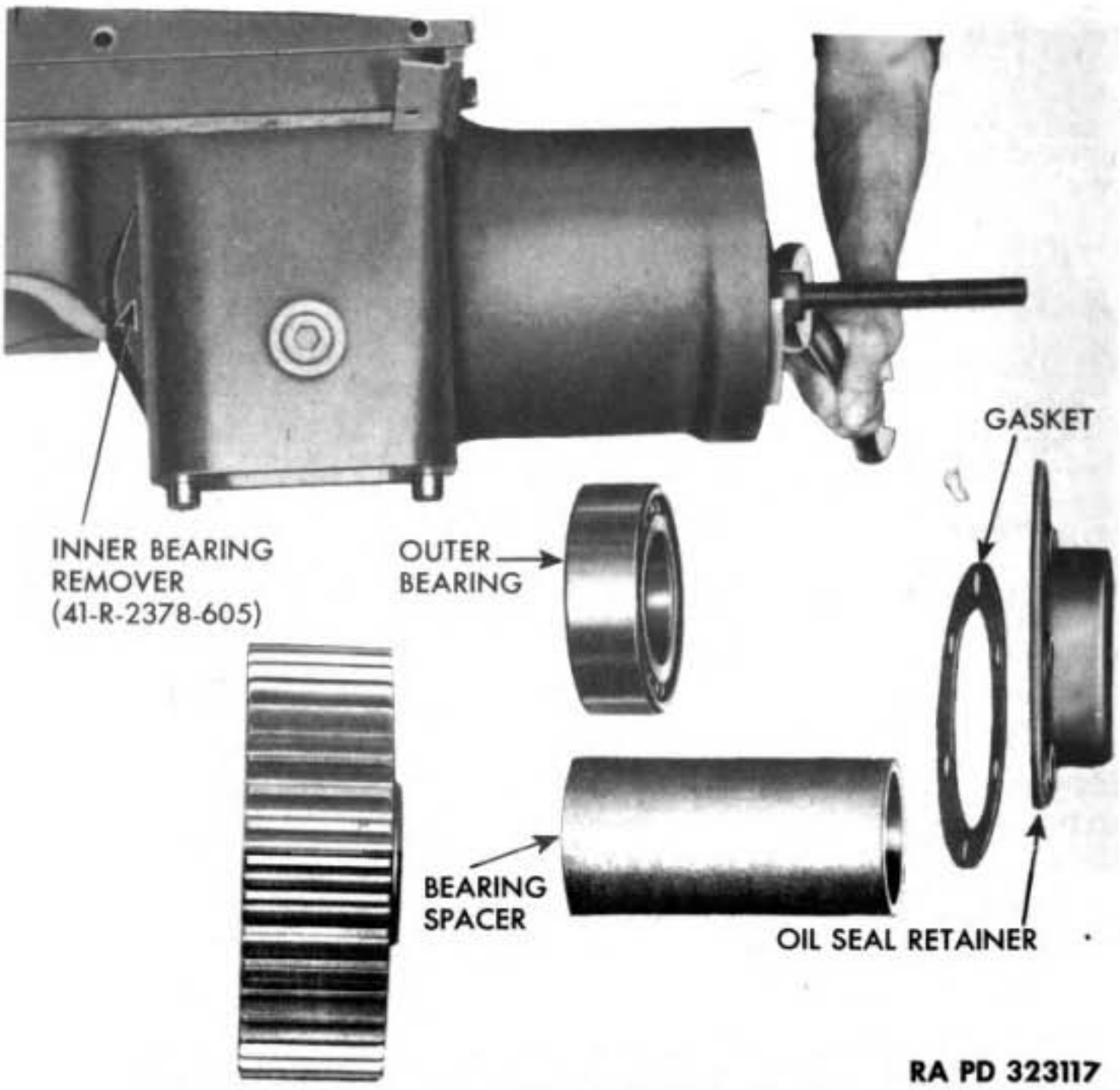


***Figure 118 — Removing Final Drive Shaft Inner Bearing***

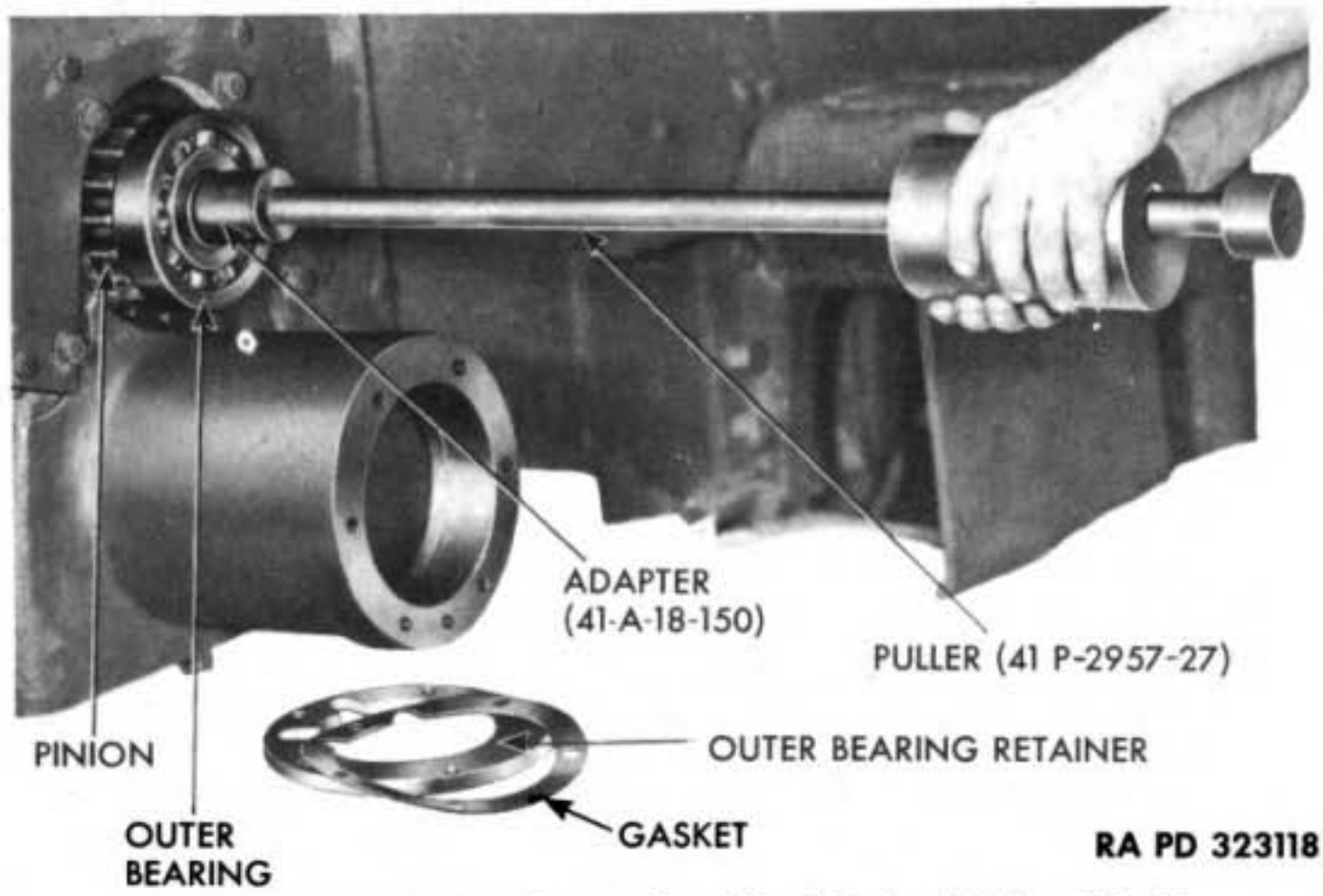


***Figure 119 — Removing Final Drive Pinion Shaft***

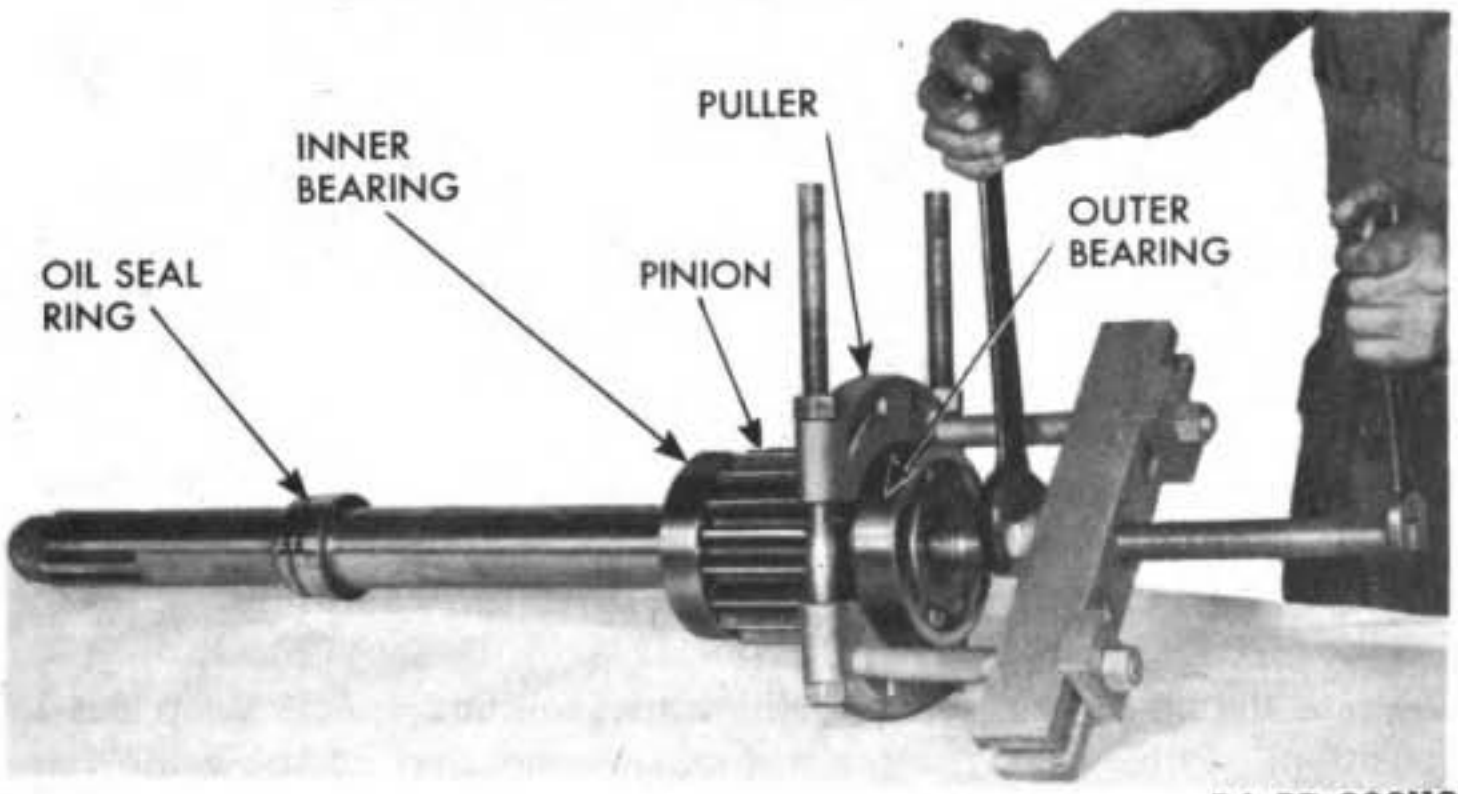


***Figure 120 — Removing Final Drive Pinion Shaft Outer Bearing, Using Puller (41-P-2905-60)***

mover screw clockwise until shaft is pushed out of bearings (fig. 116). Remove final drive shaft. Remove six cap screws and lock washers attaching final drive shaft remover flange to housing, and remove flange.

**h. Remove Outer and Inner Final Drive Shaft Bearings** (fig. 118). Remove six cap screws and lock washers attaching final drive shaft oil seal retainer. Remove oil seal retainer and gasket. Pry against

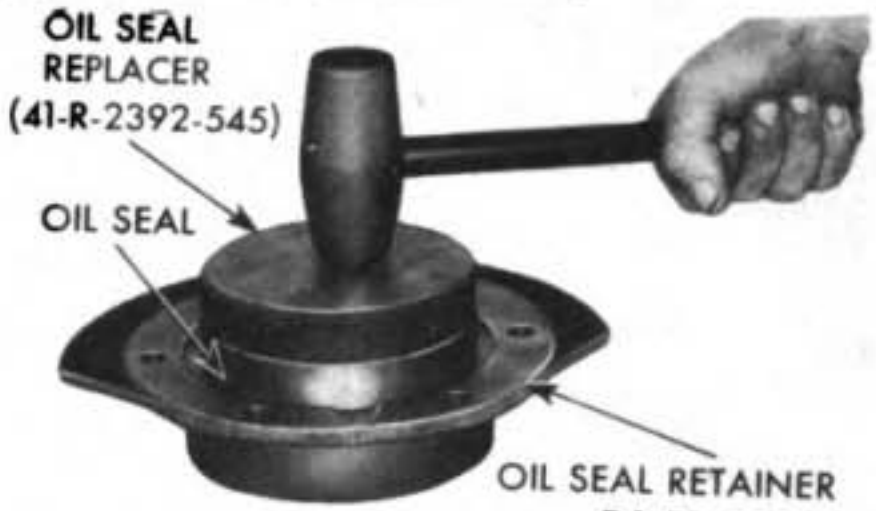


***Figure 121 — Installing Final Drive Shaft Oil Seal***

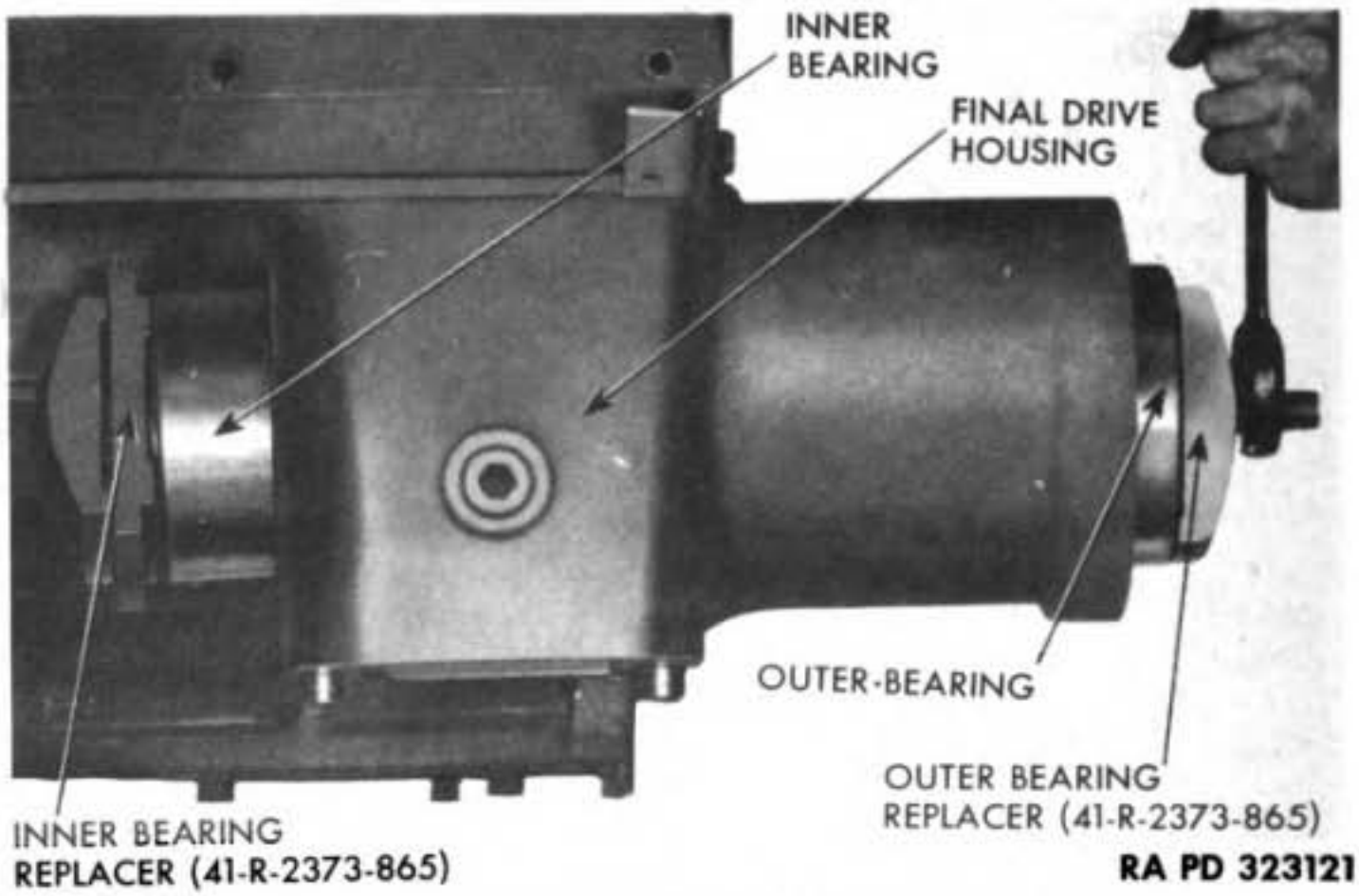


***Figure 122 — Installing Final Drive Shaft Bearings***

bottom flange of final drive gear until gear and spacer drop out of position. Pull outer bearing out of housing, and at the same time remove final drive gear. Remove spacer from housing. Install final drive shaft inner bearing remover (41-R-2378-605), and pull inner bearing toward inside of final drive compartment. Remove puller assembly and inner bearing from housing. NOTE: *It is not necessary to pull these bearings to remove final drive pinion shaft.*

**i. Remove Final Drive Pinion Shaft** (fig. 119). Remove five cap screws and lock washers attaching outer bearing retainer to housing. Remove retainer and gasket from housing. Install pinion shaft puller adapter (41-A-18-150) in tapped hole in shaft, and attach slide hammer puller (41-P-2957-27). Pull pinion shaft with inner and

outer pinion bearings from housing. Remove puller and adapter from pinion shaft.

**j. Remove Final Drive Pinion Shaft Bearings** (fig. 120) Install bearing puller (41-P-2905-60) on outer bearing, and pull bearing from final drive pinion shaft. Mark outer end of pinion so that it can be installed on shaft same way as removed, as it is possible to reverse the pinion on the shaft, if not marked. Slide final drive pinion from splines on pinion shaft. Install puller on oil seal ring, and remove oil seal ring from final drive pinion shaft. Install bearing puller to pinion shaft inner bearing, and remove bearing from pinion shaft. **NOTE:** *It is not necessary to remove the inner bearing unless inspection reveals that the bearing on shaft must be replaced*

## 23. CLEANING, INSPECTION, AND REPAIR.

**a. Clean.** Clean all parts thoroughly with dry-cleaning solvent, and dry with compressed air. Remove all gaskets, and clean the surfaces where sealing compound has been used on final drive housing and covers. Bearings, after soaking thoroughly, must be slushed up and down, and spun slowly below surface of liquid, to remove as much old grease as possible. Blow out bearings with compressed air, being careful to direct air pressure across bearings to remove last traces of old lubricant without spinning bearings. Inspect bearings immediately (subpar. **b** (3) below).

**b. Inspect and Repair.**

(1) FINAL DRIVE PINION SHAFTS AND FINAL DRIVE SHAFTS. Inspect shafts for twisting or bending. Inspect splines for wear, chipping, nicks, or roughness. Nicks or roughness can be removed with an oilstone. Worn shafts must be replaced. If inner races of bearings have been rotating on shafts, replace shafts.

(2) FINAL DRIVE PINIONS AND GEARS. Inspect pinion and gear teeth for wear and chipping. Replace damaged gear or pinion.

(3) BEARINGS. Inspect balls and races carefully for chipping, cracks, or worn spots to determine fitness for future use. Replace bearings if damaged. Lubricate bearings with light oil, and wrap in paper until ready for use.

(4) OIL SEALS AND FELT WASHERS. Inspect final drive shaft oil seal for worn or damaged lips. Replace oil seal if found to be defective. Pry old oil seal and felt washer out of oil seal retainer. Install new felt washer. With final drive shaft oil seal replacer (41-R-2392-545), drive new oil seal into oil seal retainer (fig. 121).

(5) OIL SEAL RINGS. Inspect oil seal rings for scoring or burs. If damaged, replace with new oil seal rings.

(6) SPROCKETS AND HUBS. Inspect sprockets for wear, or broken or damaged teeth. Replace sprockets if teeth are worn or broken. Inspect sprocket for flatness. If bent more than $\frac{1}{32}$ inch, straighten or replace sprocket. Inspect hub bolt holes in sprocket hub and final drive shaft flange for wear. Repair by welding or by replacing hub. Check for bent or sheared hub bolts, and replace any damaged hub bolts. If the sprockets show wear only on one side of the teeth, the complete sprocket and hub assembly may be transferred from one side of the vehicle to the other thereby providing new wearing surfaces between the sprocket teeth and the track. NOTE: *It is advisable to change the sprockets from one side of the vehicle to the other when installing a new track or reversing the track.*

## 24. ASSEMBLY.

**a. Install Final Drive Pinion Shaft Bearings** (fig. 120). Press inner bearing onto journal, next to splines on pinion shaft. Press oil seal ring, square-corner side first, onto pinion shaft. The edge of ring must be $10\frac{3}{8}$ inches from inner end of shaft by actual measurement. Install pinion on shaft splines with marked end of pinion facing outer end of shaft. Press outer bearing onto journal of shaft next to pinion. NOTE: *If pinion and drive gear show wear on one side of the teeth, they should be installed on the opposite side of the vehicle, so that unworn sides of the teeth are in mesh.*

**b. Install Final Drive Pinion Shaft** (fig. 119). Install final drive pinion shaft puller adapter (41-A-18-150) in outer end of pinion shaft. Place inner end of pinion shaft into housing, and carefully insert shaft through oil seal to prevent damage to lips of seal by the splines. Install slide hammer puller (41-P-2957-27) in puller adapter, and drive inner bearing into housing. Turn pinion shaft until splines aline with splines in differential compensating gear. Then drive pinion shaft inward until outer bearing is flush with housing. Shellac new gasket to final drive pinion shaft outer bearing retainer, and attach retainer to housing with five cap screws and lock washers.

**c. Install Final Drive Gear and Final Drive Shaft Bearings** (fig. 122). Install final drive gear in housing, using blocks to hold it in alinement. Place bearing spacer in position inside housing. Install final drive shaft inner and outer bearing replacer (41-R-2373-865) through spacer and gear; place inner bearing on replacer at inner side of housing, and outer bearing on replacer at outer end of housing. Turn nut on puller clockwise to draw outer and inner bearings in until tight. Shellac new gasket to oil seal retainer, and attach it to housing with six cap screws and lock washers.

**d. Install Final Drive Shaft.** Install final drive shaft remover and replacer screw (41-R-2378-605) on shaft (fig. 124). Insert screw

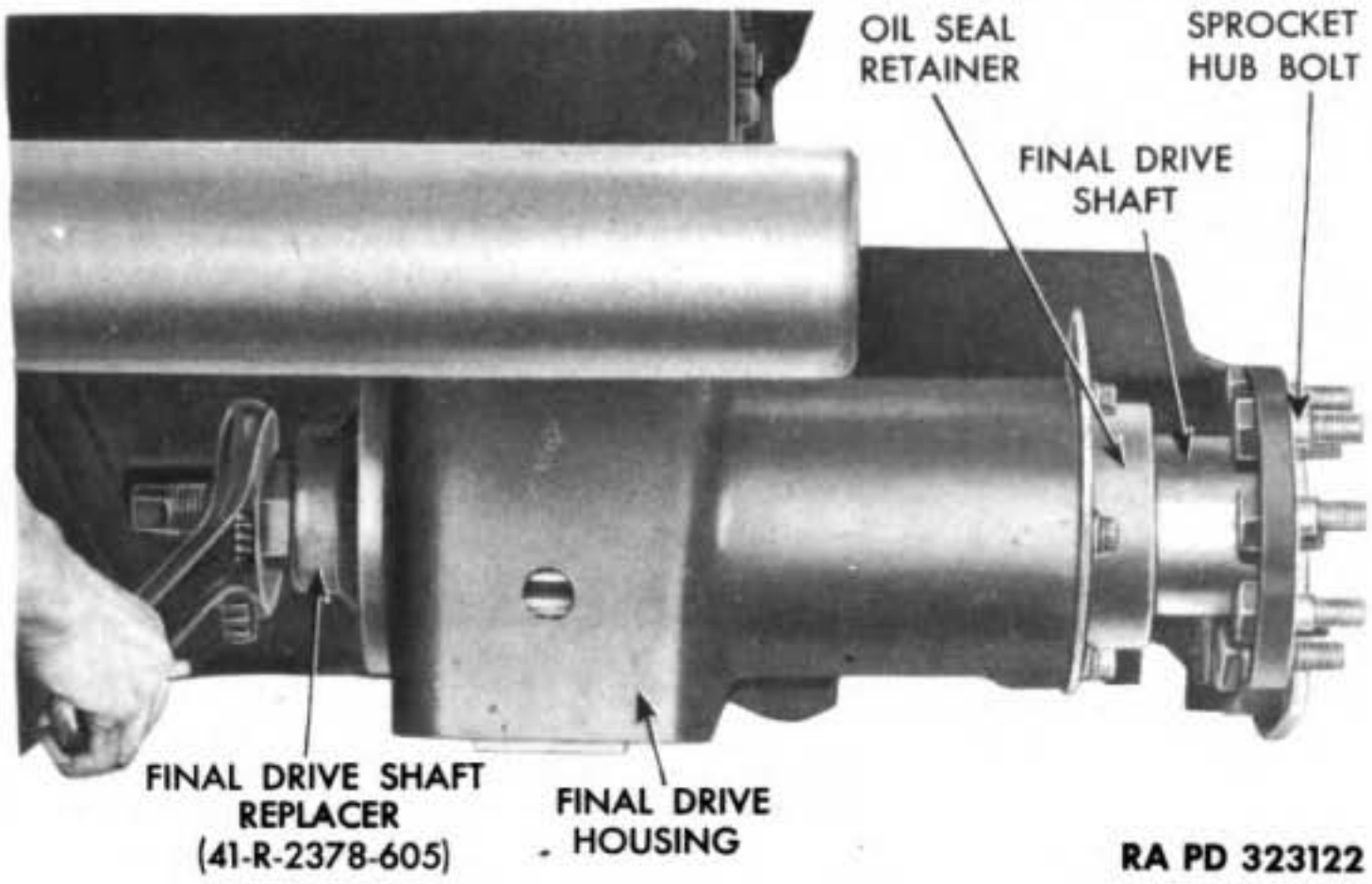


*Figure 123 — Installing Final Drive Shaft*


*Figure 124 — Use of Tool for Installing Final Drive Shaft*

and final drive shaft through oil seal retainer, outer bearing, spacer, gear, and inner bearing. Place remover and replacer flange and nut on screw. Pull shaft into bearings (fig. 123) by tightening nut. Remove remover and replacer from shaft. With inner bearing nut socket wrench (41-W-3032), install nut on final drive shaft (fig. 115). Install cotter pin through nut and shaft. Shellac new gasket to inner bearing cap, and attach cap to housing with six cap screws and lock washers.

**e. Install Final Drive Cover** (fig. 115). Shellac gasket to final drive cover, and attach to housing with 10 cap screws and lock washers.

**f. Fill Both Final Drive Cases With Oil.** Use lubricant as specified in TM 9-786.

**g. Install Left or Right Front Bottom Plate.** Install front bottom plate, and attach with 23 cap screws, 12 nuts, and 23 lock washers.

**h. Install Sprocket Assemblies.** Install sprockets, hub, and track as described in TM 9-786.

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Section VI

## FITS AND TOLERANCES



### 25. DIFFERENTIAL.

| | |
|---|---|
| Bearing preload | 0.006 to 0.008 in. |
| Bearing adjustment | Adjusting rings |
| Bevel pinion to bevel drive gear backlash | 0.010 to 0.012 in. |
| Bevel drive gear run-out, not over | 0.003 in. |
| Bevel drive gear and bevel pinion with shaft matched set markings | Number on end of pinion must be the same as number on edge of gear. |
| Compensating case cover bushing | 3.3740 to 3.355 in. |
| Compensating gear | 3.372 to 3.373 in. |
| Clearance between gear and bushing | 0.001 to 0.0035 in. |
| Compensating case cover bushing run-out when cover is rotated on center and bushing hole | Inside face of cover and inside and outside of hub must be within 0.002 in. total indicator reading. |
| Compensating case internal pinion bushing | 1.191 to 1.193 in. |
| Internal pinion shaft | 1.187 to 1.189 in. |
| Clearance between shaft and bushing | 0.002 to 0.006 in. |
| Steering drum gear flange bushing | 3.375 to 3.377 in. |
| Compensating case cover hub | 3.371 to 3.372 in. |
| Clearance cover hub and bushing | 0.004 to 0.006 in. |

## TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVES

### 26. STEERING BRAKE EQUIPMENT.

| | |
|---|---|
| Steering brake shaft bushing | 1.251 to 1.255 in. |
| Steering brake shaft | 1.249 to 1.247 in. |
| Clearance between shaft and bushing | 0.004 to 0.006 in. |
| Steering lever shaft bushing | 1.1264 to 1.1274 in. |
| Steering lever shaft | 1.120 to 1.123 in. |
| Clearance between shaft and bushing | 0.0034 to 0.0074 in. |
| Steering brake drum rim diameter | 15.00 to 15.01 |
| Steering brake shoe lining | ¼ x 3 x 13 in. |

### 27. TRANSMISSION.

| | |
|---|---|
| Bevel pinion and bevel drive gear matched set markings | Same number on both gears |
| Bevel pinion "C" number marking on front face of pinion | Indicates plus (+) or minus (−) amount of change in shim thickness for pinion to be in best running position. |
| Bevel pinion front bearing cage shim thickness: | |
| A324687 Heavy | 0.0299 in. |
| A324686 Medium | 0.0149 in. |
| A324685 Light | 0.007 in. |
| Bevel pinion backlash | 0.010 to 0.012 in. |
| Output shaft with bevel pinion third speed bushing | 3.1265 to 3.1275 in. |
| Output shaft with bevel pinion fourth speed gear sleeve diameter | 3.1215 to 3.1225 in. |
| Clearance between third speed bushing and shaft | 0.004 to 0.006 in. |
| Clearance between end of output shaft and end of fourth speed gear | 0.0469 to 0.078 in. |
| Output shaft with bevel pinion second and third speed spacer available thicknesses | $^{11}/_{32}$, $^{23}/_{64}$, $^{3}/_{8}$, $^{25}/_{64}$, and $^{13}/_{32}$ in. |
| Countershaft first speed gear bushing | 2.2515 to 2.2525 in. |
| Countershaft first speed gear bearing surface | 2.2465 to 2.2475 in. |
| Clearance between countershaft and first speed gear bushing | 0.004 to 0.006 in. |
| Countershaft second speed gear bushing | 3.1265 to 3.1275 in. |
| Countershaft second speed gear bearing surface | 3.1215 to 3.1225 in. |

**ORDNANCE MAINTENANCE — POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

| | |
|---|---|
| Clearance between countershaft and second speed gear bushing | 0.004 to 0.006 in. |
| Winch wind and unwind gear bushing | 2.2515 to 2.2525 in. |
| Winch drive shaft wind and unwind gear bearing surface | 2.2465 to 2.2475 in. |
| Clearance between shaft and bushings | 0.004 to 0.006 in. |
| Reverse idler pinion bushing | 3.1265 to 3.1275 in. |
| Reverse idler pinion spacer | 3.1215 to 3.1225 in. |
| Clearance between bushing and spacer | 0.004 to 0.006 in. |
| Speedometer drive shaft bearing sleeve bushing | 0.469 to 0.471 in. |
| Speedometer drive shaft | 0.465 to 0.469 in. |
| Clearance between sleeve bushing and shaft | 0.000 to 0.006 in. |
| Poppet springs in first and second, third and fourth, and reverse gear lower shifting shafts: | |
| Free length | 2 5/8 in. |
| Pressure when compressed to 1 11/16-inch length | 40 to 50 lb |
| Poppet spring in upper reverse shift shaft: | |
| Free length | 3 in. |
| Pressure when compressed to 1 11/16-inch length | 11.42 to 15.18 lb |
| Clearance between shifter forks and gear clutches | 0.005 to 0.016 in. |
| Transmission oil pressure relief valve spring: | |
| Free length | 4 17/32 to 4 21/32 in. |
| Pressure when compressed to 1 25/32-inch length | 16.48 to 18.22 lb |

## 28. FINAL DRIVES AND SPROCKETS.

| | |
|---|---|
| Pinion shaft oil seal ring outside diameter | 3.122 to 3.125 in. |
| Sprockets must be flat within | 1/32 in. |

# CHAPTER 3

# TRANSMISSION LUBRICATING SYSTEM

## Section I

## DESCRIPTION



### 29. DESCRIPTION (fig. 125).

**a.** The transmission lubricating system includes a rotary pump with by-pass valve, an intake screen with by-pass valve, a filter with relief valve, a pressure relief valve, an oil cooler with shutter, an oil gallery which is an integral part of the transmission case, and the necessary connecting oil pipes. Transmission gears are in constant mesh; therefore, all rotate whenever the transmission operates. Most of these gears have bushings that permit them to rotate freely on the shafts. The bushings, to keep from overheating and wearing out, require pressure lubrication. This is furnished through drilled passages in the shafts into which oil is fed from an oil gallery, located across the rear end of the transmission case, into which the ends of the shafts extend. Forced lubrication is supplied to all the transmission gears that rotate on bushings, with the exception of the reverse idler pinion. This pinion is lubricated by the oil that collects in a cored pocket in the transmission case, runs down into a chamber at the end of the shaft, and from there through a drilled passage in the shaft to the pinion bushings. The ball bearings in the gallery end of the transmission case are lubricated by oil from the oil gallery. The ball bearings in the forward end of the transmisson case are splash-lubricated. Oil pressure is maintained by a pressure relief valve which permits the excess oil to spill out of the gallery directly into the transmission. The oil cooler removes from the transmission oil the heat that is generated by the steering brakes, and the transmission and differential gears.

**b.** The transmission oil pump and pump by-pass valve are serviced as a complete assembly. For removal and installation of the oil pump, refer to TM 9-786.

**c.** For removal and installation of the differential and transmission oil screen and by-pass valve, refer to TM 9-786.

### 30. OPERATION (fig. 125).

**a.** Oil circulates from the differential housing sump through a 16-mesh brass wire cylindrical screen. The oil screen is equipped

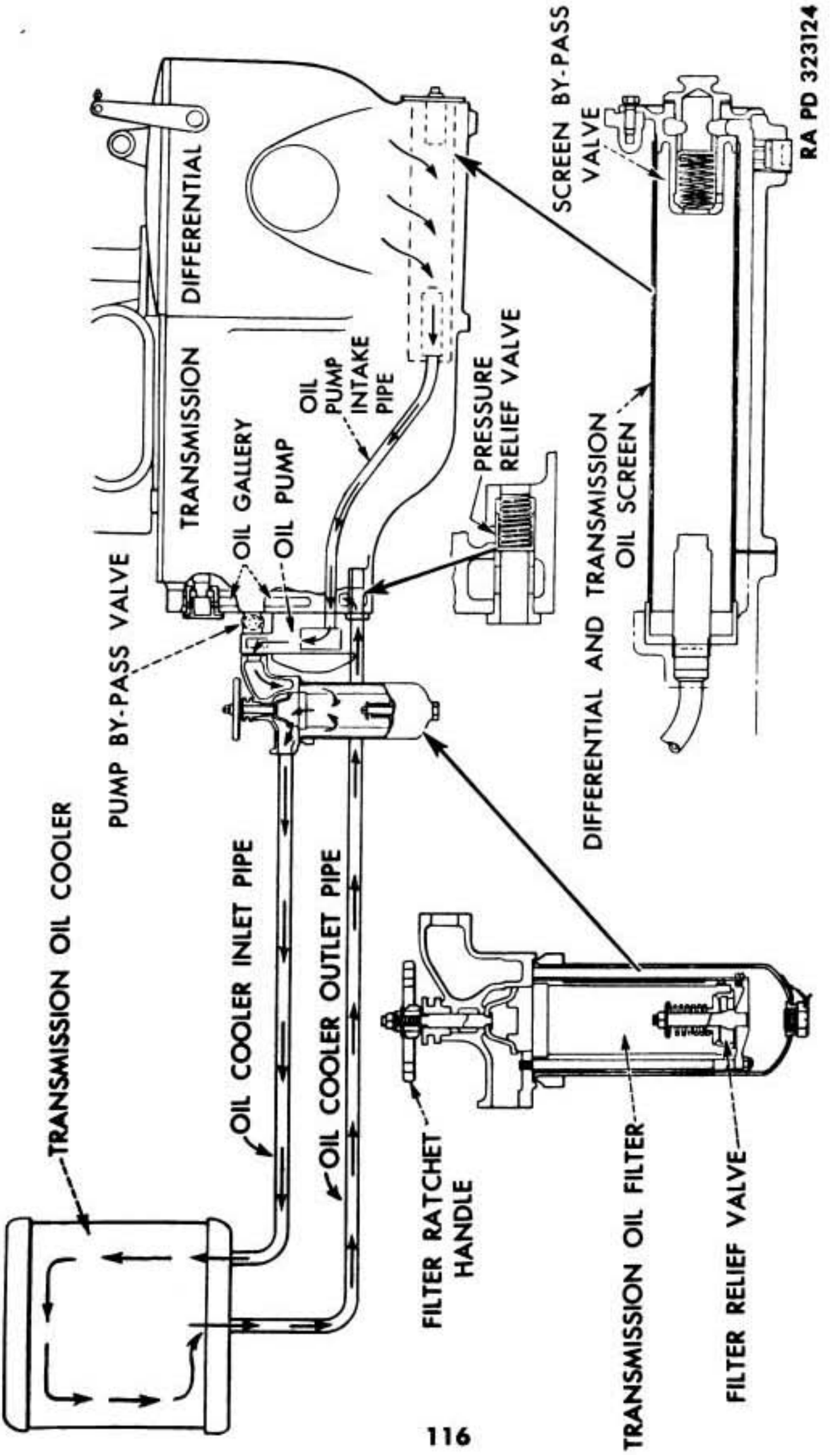


*Figure 125 — Transmission Lubricating System Diagram*

with a by-pass valve that permits the oil to by-pass the screen in the event the oil is too thick, or the screen becomes clogged. From inside the screen, the oil flows through an intake pipe to the rotary oil pump. The oil pump is driven off the end of the transmission reverse shaft through a splined connection. The pump forces the oil under pressure through the oil filter, the oil cooler inlet pipe, the oil cooler, and the oil cooler outlet pipe, into the oil gallery located inside the rear wall of the transmission case. Oil pressure is maintained by a pressure relief valve which permits the excess oil to spill out of the gallery directly into the transmission. The filter has a relief valve that opens at a pressure of 19 to 21 pounds per square inch, and permits the oil to by-pass the filter element whenever the oil is too heavy, or the filter is clogged. There is also a by-pass valve in the pump housing that opens at 55 to 65 pounds per square inch pressure, permitting the oil to by-pass the oil cooler and filter, and go directly from the pump into the oil gallery when the oil is too heavy to circulate immediately in cold weather. From the oil gallery the oil passes through the drilled passages in the transmission shafts to the gear bushings, and through the rear shaft ball bearings to lubricate them. Gear teeth are lubricated by the oil that leaks past the gear bushings and splashes around as it returns to the sump.

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## Section II

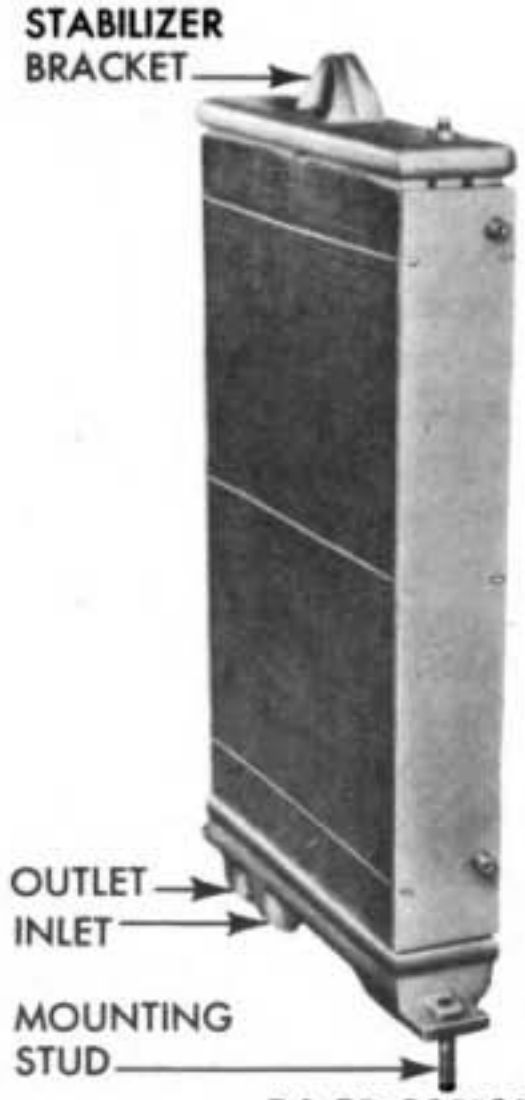
# OIL COOLER



### 31. DESCRIPTION (fig. 126).

**a.** This is an air-cooled steel radiator consisting of a fin-and-tube core which is brazed at the ends to headers. The top header is welded to a return tank, and the bottom header to an inlet and outlet tank. A stabilizing bracket is welded on top of the return tank at the center. A vent plug is provided in the return tank. The inlet and outlet tank, as the name indicates, contains two tapped holes for connecting the inlet and outlet flexible hoses. This tank has two tapped holes for mounting screws. When facing the outside of the oil cooler radiator, the oil circulates up through the right half of the radiator tubes, across through the return tank, and down the left half of the radiator tubes.

**b.** Removal and installation procedures are described in TM 9-786.




RA PD 323125

*Figure 126 — Transmission Oil Cooler Radiator*

## 32. CLEANING AND INSPECTION.

**a.** Clean the oil cooler radiator inside and out with dry-cleaning solvent, and dry with compressed air.

**b.** Examine core for leaks and bent tubes. Repair leaks.

**c.** Inspect mounting studs. Replace bent or damaged studs.

**d.** Inspect top mounting bracket for looseness. Weld in place if loose.

## 33. REPAIR.

**a.** Bent fins can be straightened by using a long steel bar. Be careful not to damage the tubes in this operation.

**b.** Repair leaks in tubes or between tubes and headers by brazing, also braze bosses to side pieces if they are loose. Weld loose stabilizing bracket to top tank. If leaks cannot be repaired because of their location in core, replace with new radiator.

**c.** Remove bent or damaged mounting studs by turning them out and installing new studs.

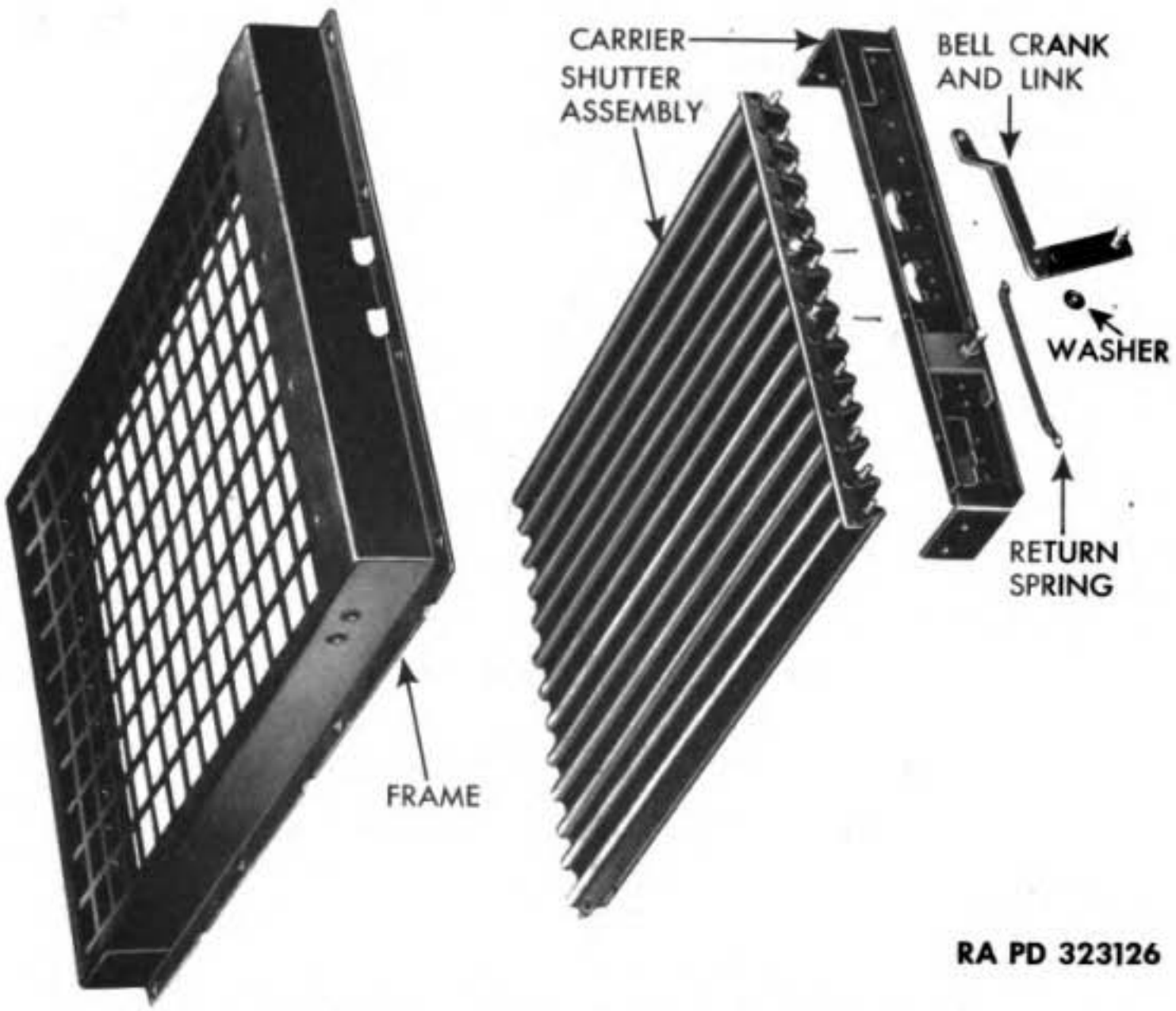



*Figure 127 — Transmission Oil Cooler Shutter Disassembled*

**34. TEST.**

**a.** Plug inlet opening and install fitting in outlet opening. Connect air pressure line to fitting. Apply air pressure of 75 pounds per square inch to radiator.

**b.** Immerse radiator in water, and observe for air bubbles. Mark leaks and repair by brazing.

**c.** After tests and repairs are completed, flush out radiator with crankcase grade engine oil.

---

**Section III**

## OIL COOLER SHUTTER


*Figure 128 — Transmission Oil Filter*

**35. DESCRIPTION** (fig. 127).

**a.** This is a manually controlled shutter that is located across the outer face of the oil cooler radiator. It is similar in construction to the radiator shutter described in TM 9-1786A.

**b.** Removal and installation procedures are described in TM 9-786.

**36. DISASSEMBLY** (fig. 127).

**a. Remove Shutter Assembly.** Remove two cap screws with lock washers attaching both ends of carrier to frame. Pull top end of shutter assembly out of frame, and lift shutter out of frame.

**b. Remove Bell Crank and Carrier.** Unhook and remove return spring. Remove two cotter pins and one washer attaching bell crank and link to pin on carrier and pin on operating bar. Lift bell crank and link off pins, and lift carrier off shutter assembly.

**37. CLEANING, INSPECTION, AND REPAIR.**

**a.** Clean all parts with steam-cleaning equipment, or dry-cleaning solvent.

**b.** Inspect shutter louvers for damage. Straighten louvers where possible, and rivet over loose trunnions and studs. Replace with new shutter assembly if beyond repair.

**c.** Straighten bent grille. Replace return spring if broken.

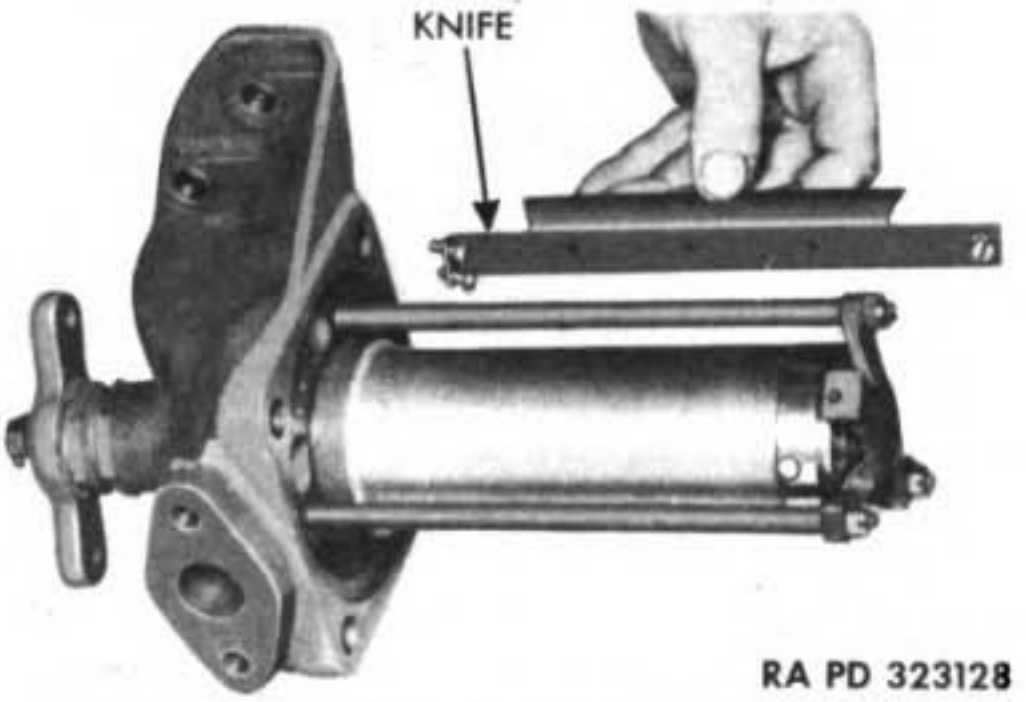



*Figure 129 — Removing Knife from Filter*

**38. ASSEMBLY** (fig. 127).

**a. Install Carrier and Bell Crank.** Place carrier on upper end of shutter assembly, making sure all louver trunnions locate in holes provided in carrier. Place bell crank and link over pin on carrier and pin on operating arm, and place a washer over pin on carrier. Install cotter pin in both pins. Hook one end of return spring over anchor on carrier, and other end over operating bar stud.

**b. Install Shutter Assembly.** Set shutter assembly into frame, and insert lower louver trunnions into holes provided at bottom of frame. Move upper end of shutter assembly into frame, and install four cap screws and lock washers attaching carrier to frame.

---

## Section IV

# OIL FILTER



**39. DESCRIPTION** (fig. 128).

**a.** This is a 0.0035-inch spaced metal element filter which is mounted to the rear side of the transmission oil pump. It is cleaned by turning a ratchet handle on top in a clockwise direction. This rotates the filter element past a stationary blade which scrapes it clean. The dirt scraped from the element falls to the bottom of the case, and is removed

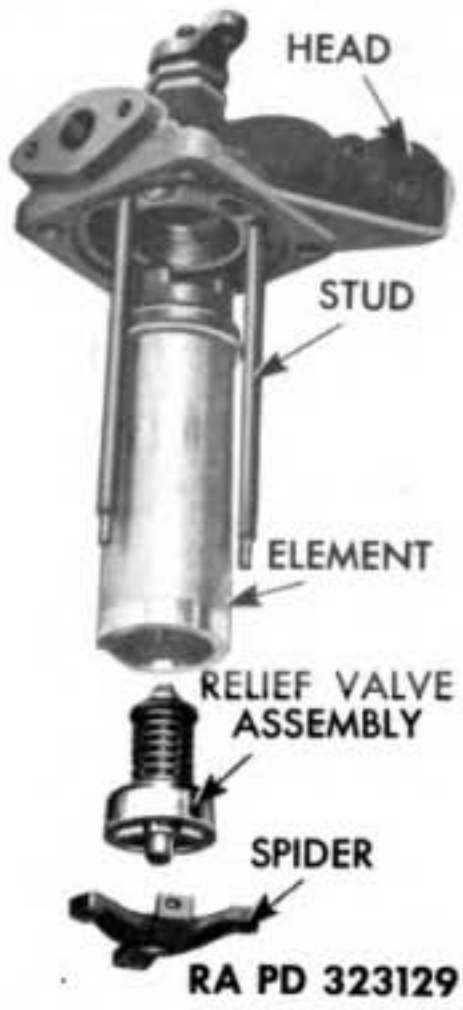



*Figure 130 — Oil Filter Element, Relief Valve, and Spider Removed*

by removing the drain plug. The ratchet handle is operated by moving the operating handle, located in the right center platform compartment, up and down. On the up-stroke the element turns with the rachet handle, and on the down-stroke the element remains stationary, while the handle turns on its ratchet. Packing is provided in the filter head around the driver to prevent oil leakage. A relief valve located in the lower end of the element opens at 19 to 21 pounds per square inch pressure to permit the oil to flow through valve, in the event the oil is too thick to pass through the element, or the element is clogged.

**b.** Removal and installation are described in TM 9-786.

## 40. DISASSEMBLY.

**a. Remove Case** (fig. 131). Remove four cotter pins and nuts from cap screws attaching ring to filter head and remove case, ring, gasket, and four cap screws.

**b. Remove Cleaning Knife** (fig. 129). Break and remove locking wire from the three fillister-head screws attaching cleaning knife and remove screws, lock washers, and knife.

**c. Remove Element** (fig. 130). Remove three cotter pins and unscrew three nuts from ends of studs. Remove relief valve spider, relief valve assembly and element.

## TRANSMISSION LUBRICATING SYSTEM

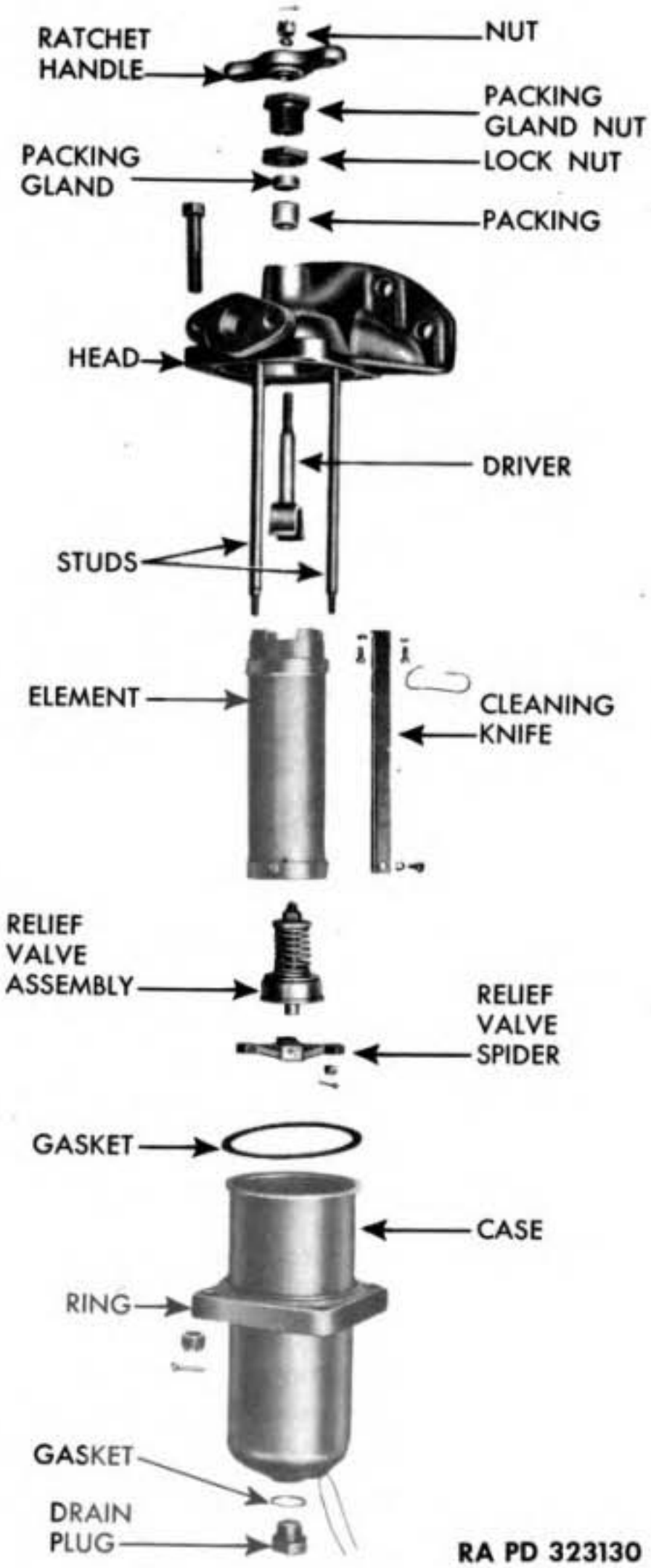



***Figure 131 — Transmission Oil Filter Disassembled***

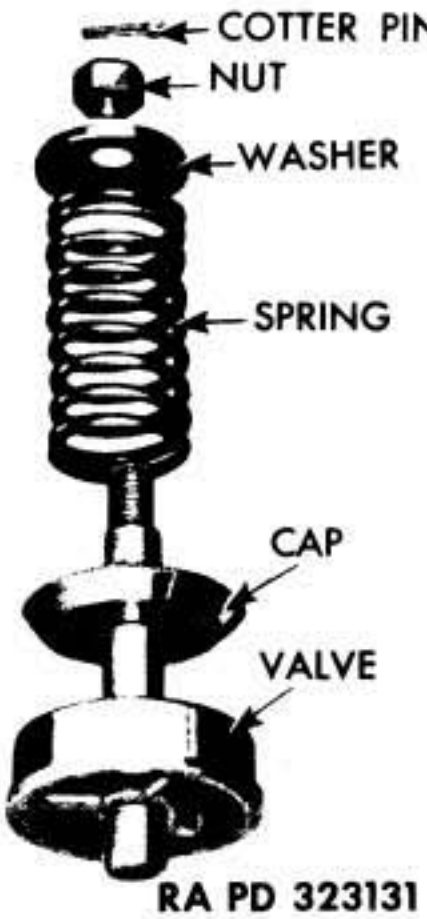



*Figure 132 — Relief Valve Disassembled*

**d. Remove Driver** (fig. 131). Remove cotter pin and nut from top end of driver. Unscrew ratchet handle from driver. Loosen lock nut on packing gland nut, and turn packing gland nut out until it is loose. Pull driver out from below head.

**e. Remove Packing** (fig. 131). Remove packing gland nut and lock nut, and pull packing gland and packing out of filter head with aid of a hooked tool.

**f. Disassemble Relief Valve** (fig. 132). Remove cotter pin and nut from threaded end of valve stem. Lift off washer, spring, and cap.

## 41. CLEANING, INSPECTION, AND REPAIR.

**a.** Clean all parts thoroughly in dry-cleaning solvent, and dry with compressed air.

**b.** Inspect element and replace with new element if winding is broken or bent in any place.

**c.** Inspect cleaning knife, and straighten if contacting edge is bent. Replace with new knife if it cannot be repaired.

**d.** Inspect relief valve seats for good condition, and metal-to-metal contact all around. Remove all nicks. Lap seats together with fine lapping compound if needed.

**e.** Inspect packing and replace if damaged.

**f.** Smooth the surface of driver shaft with crocus cloth if it is rough.

**g.** Inspect ratchet handle for turning in a counterclockwise direction on hub nut. Oil ratchet. If ratchet does not work satisfactorily, replace with new ratchet handle.

## 42. ASSEMBLY.

**a. Assemble Relief Valve** (fig. 132). Place cap, spring, and washer on valve stem. Replace nut, washer, and cotter pin.

**b. Install Driver and Packing** (fig. 131). Insert driver through hole in head. Place packing on driver, and push it into tapped hole in head. Place packing gland on top of packing with countersunk side against packing. Install packing gland nut and lock nut into head. Tighten lock nut when gland nut is snug on packing. Screw ratchet handle onto driver, and lock in place with nut and cotter pin.

**c. Install Element** (fig. 130). Place element into filter head, making sure driver locates in slots in element. Insert relief valve assembly into end of element, and install relief valve spider on valve and studs. Install nuts on studs, and lock with cotter pins.

**d. Install Cleaning Knife** (fig. 129). Install three fillister-head screws and lock washers, thus attaching cleaning knife to filter head and relief valve spider. Lock screws with locking wire.

**e. Install Case** (fig. 131). Place gasket, case, and ring in place below filter head. Install four attaching cap screws, nuts, and cotter pins. Use new gasket if necessary.

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CHAPTER 4

# ELECTRICAL SYSTEM

## Section I

## DESCRIPTION



### 43. DESCRIPTION.

**a.** The electrical system is the single-wire type. This means that the current is carried from the positive terminal of a 12-volt battery through cables to the various electrical units, and is returned to the negative terminal through the grounded vehicle body and frame. Chassis cables are contained in waterproof and oilproof nonmetallic woven braid to form harnesses. Metallic flexible conduit is used over the cables which go through the fender supports to the headlights and taillights. It is also used over cable from battery to cranking motor switch, and over cables from generator regulator to generator. Three junction blocks and four amphenol plugs are provided. These make it easy to remove, and replace the harnesses. And, they also facilitate testing for grounded or broken wires. Metal clips are used throughout the vehicle to hold the harnesses in place. Radio suppression bond straps are used to ground the engine, doors, radiators, and oil cooler. These are copper braided straps which are attached by cap screws.

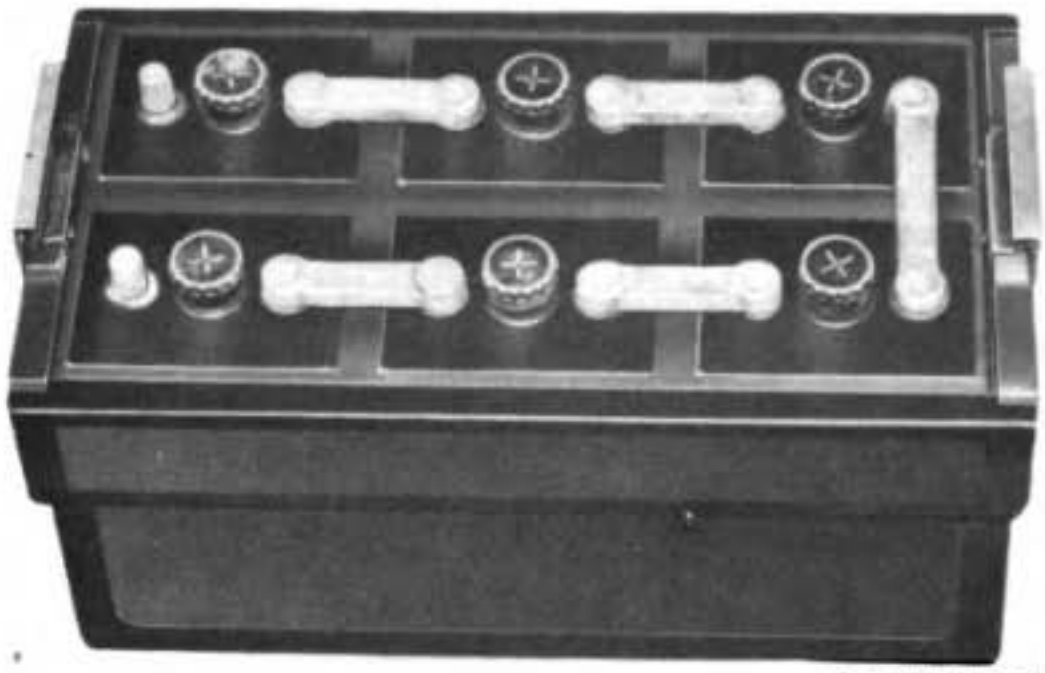
**b.** Units of the electrical system herein include the battery, buzzers, lights, siren, towed-load coupling socket, and carburetor shut-off solenoid.

**c.** The entire vehicle electrical wiring system is shown on three diagrams in TM 9-786. All cables on these diagrams are numbered, and can be readily identified as to cable color, number and color of tracer, gage of wire, and route of cable, by referring to charts which follow the diagrams. Refer to diagrams and charts for tracing or repairing electrical cables and leads.

**d.** All electrical equipment used on this vehicle related to the power plant such as distributors, generator, cranking motor, regulator, etc., are covered in TM 9-1825A.

## Section II

## BATTERY



RA PD 323132

*Figure 133 — Battery*

## 44. DESCRIPTION (fig. 133).

**a.** The battery is a 12-volt, 168-ampere-hour unit equipped with lifting handles and aviation type nonspill vent plugs. It is located in the upper front end of the engine compartment. The negative terminal is grounded to the vehicle body.

## 45. CLEANING, INSPECTION, AND TEST.

**a. Clean.** Clean battery terminals, also top of battery with a solution of soda ash. Wash entire battery with warm water.

**b. Inspect.** Inspect battery case for cracks, bulges, or separation of sealing compound between covers and case. Inspect terminal posts and cell connectors for secure mounting. Make sure vent holes are open. Electrolyte should be up to level of star-shaped indicators in filler openings, or ⅜ inch above top of plates.

**c. Test.** Determine state of charge of battery by using a hydrometer. The following specific gravities can be taken as an approximate measure of the condition of charge of the battery, and also the temperatures at which solution will freeze.

| | Specific Gravity | Freezing Temp. |
|---|---|---|
| Battery charged | 1.285 | –96°F. (–70°C.) |
| Battery ⅓ discharged | 1.255 | –60°F. (–50°C.) |
| Battery ½ discharged | 1.220 | –31°F. (–30°C.) |
| Battery ¾ discharged | 1.185 | –8°F. (–22°C.) |
| Battery normally discharged | 1.150 | +5°F. (–15°C.) |
| Battery completely discharged | 1.100 | +18°F. (–8°C.) |

Perform high-rate discharge test to determine condition of cells in the battery (battery must test at least 1.220 for satisfactory results). Follow instructions accompanying the test instrument. If cells are found to be loose or shorted, the battery should be rebuilt. Charge battery if specific gravity is below 1.220, and then make a high-rate discharge test.

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## Section III

## BUZZERS



### 46. HIGH TEMPERATURE INDICATOR BUZZER.

**a. Description** (figs. 134 and 135). This is an electrically operated buzzer which is mounted to the back of the driver's seat. It operates when engine coolant temperature is above 225°F. and the ignition switch is on. The buzzer has two electro-magnetic coils which supply the magnetic force required to actuate the buzzer armature. A condenser is connected across the two wire terminals to prevent arcing at the points, and also to prevent radio interference. A cover is held to the buzzer base by a screw, and is sealed by a cork gasket which is cemented to the cover.

**b. Repair and Adjust** (figs. 134 and 135).

(1) When the cover is removed, the internal parts of the buzzer can be cleaned and adjusted.

(2) Clean internal parts with compressed air. Dress contact points with a clean, thin contact file. Clean all burning or oxidation from points and blow-off with compressed air.

(3) Hold the buzzer armature tightly against the pole pieces, and check gap between contact points with a thickness gage. Gap should be 0.018 inch. Adjustment is made by loosening lock nut on top of post, and turning adjustable point until gap measurement is correct. Then tighten lock nut on top of post.

(4) Armature requires a force of 2 ounces applied at the extreme end (bakelite armature bridge) to move it, to make contact between contact spring and armature bridge. Correct force is obtained by changing the tension of armature return spring. Loosen lock screw on top of spring post, and turn armature return spring adjusting nut


***Figure 134 — High Temperature Indicator Buzzer with Cover Removed***

to change spring tension. Tighten lock screw when adjustment is correct.

(5) Armature requires a total force of 6 ounces applied at the extreme end (bakelite armature bridge) to hold it against the pole pieces. This is obtained by carefully bending the contact spring mounting bracket to increase or decrease the force of the contact spring on the armature.

**c. Test.** Connect buzzer to a 12-volt battery, and observe its operation. The sound of the buzzing can be changed slightly by adjusting the armature return spring tension on the armature.

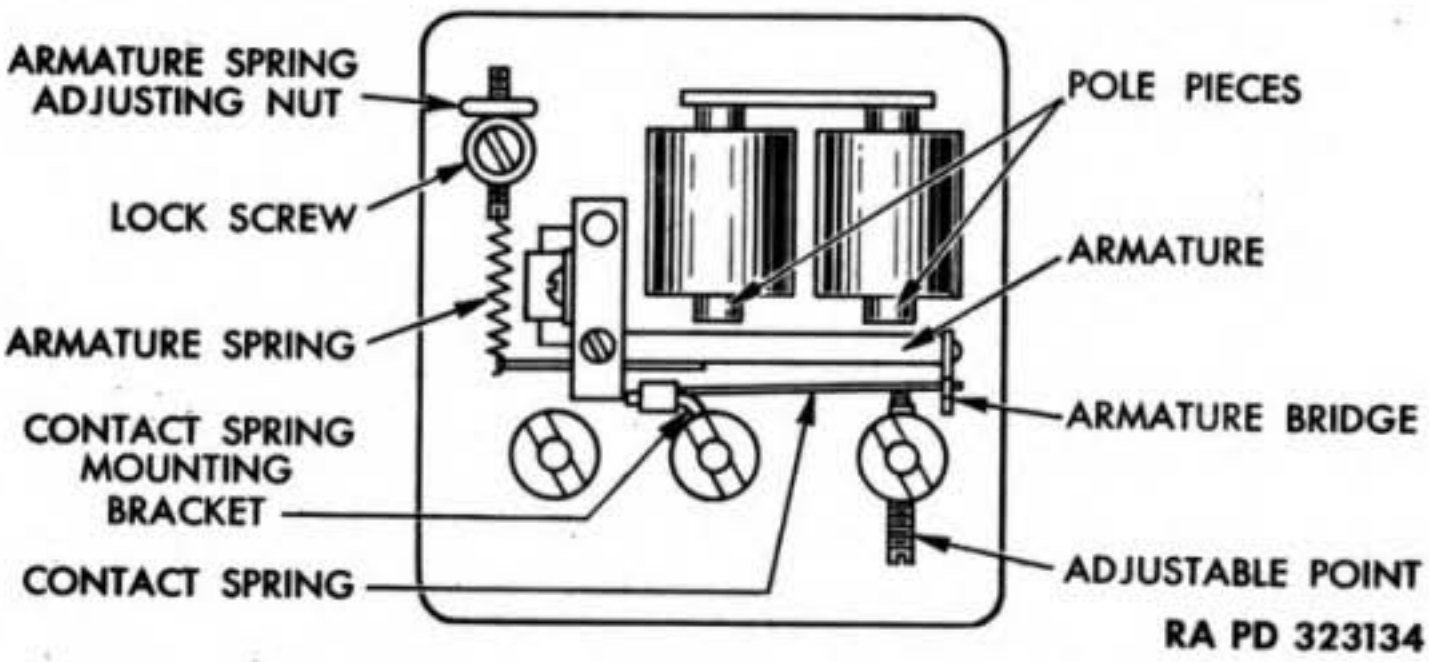


***Figure 135 — Diagram of High Temperature Indicator Buzzer***

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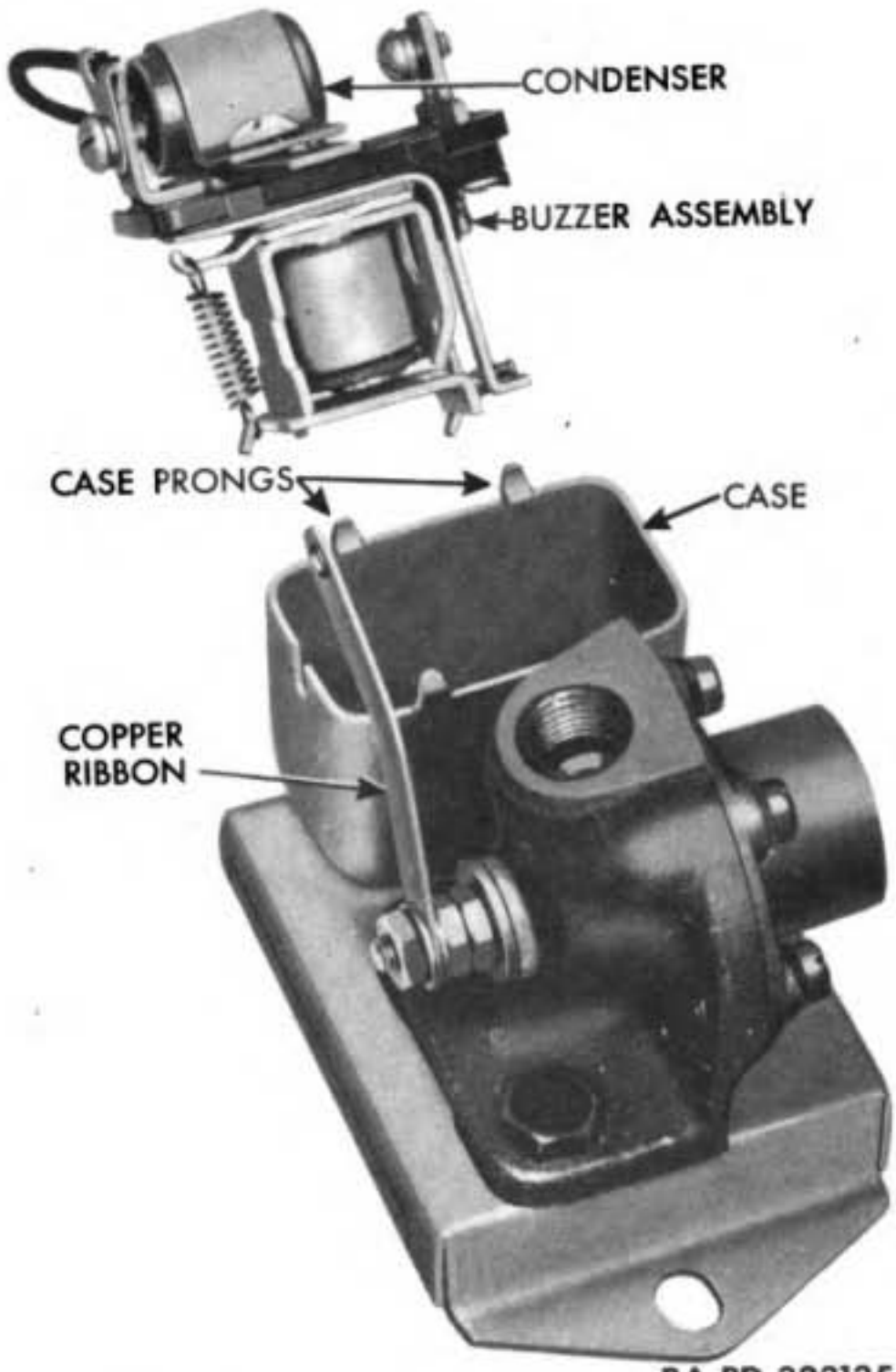


*Figure 136 — Low Pressure Indicator Buzzer Assembly Removed from Case*

## 47. LOW PRESSURE INDICATOR BUZZER.

**a. Description** (fig. 244). This is an electrically operated buzzer which is riveted to the same base that supports the low pressure indicator switch. See paragraph 109. The assembly is attached to the underside of the cowl. When air pressure in the air reservoir tanks is below 60 pounds and the ignition switch is on, the buzzer operates.

**b. Disassemble** (fig. 136). Remove screw and lock washer attaching the condenser wire terminal and copper ribbon to the buzzer terminal. Bend the four case prongs away from the buzzer base just

far enough to permit removing buzzer assembly. Lift buzzer assembly out of case.

**c. Clean and Repair.**

(1) Clean all burning or oxidation from contact points with a clean, thin contact file. Contact point gap should measure 0.018 inch when armature is held against the pole piece. Bend stationary point bracket to change gap measurement.

(2) Connect buzzer terminals to battery, making sure also to connect condenser wire to buzzer terminal. Observe operation. Buzzer will not make the same buzzing noise out of the case that it will when in the case. This is due to the armature striking an insulated rivet in the bottom of the case when the buzzer is installed. Arc should occur in approximate center of points.

**d. Assemble.** Insert buzzer in case, and carefully bend prongs over buzzer base to make secure. Connect condenser wire terminal and copper ribbon to buzzer terminal.

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## Section IV

# LIGHTS



## 48. HEADLIGHTS.

**a. Description** (fig. 137). There are three headlight assemblies furnished with the vehicle. Two are service headlights, and one is a blackout headlight. On top of each light is a small marker light. Below is supporting shaft which is attached to the light body by three cap screws and lock washers. The only difference between the service headlight and the blackout headlight is the sealed beam lamp-unit and the electrical connector. The service headlight has a clear lens to provide good illumination, while the blackout headlight has a flat, thin slot in the lens which permits a beam of light to pass through. The headlights can be readily removed or installed in either one of two sockets provided at the front end of the vehicle. When a headlight is installed in the socket, electrical contact is made between two contact points at the lower end of the support shaft and two leads in the socket. There are actually three leads in each socket; one for the marker light, one for the blackout headlight, and one for the service headlight. But only two leads are contacted, depending on which headlight is installed. When not in use the headlights are stored below the driver's seat in a clamp on top of the clutch selector unit.

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***Figure 137 — Headlights***

**b. Disassemble.**

(1) REMOVE SEALED BEAM LAMP-UNIT (fig. 138). Remove set at lower side of door. Lift door with sealed beam unit and ring out of light body. Disconnect wire from lamp terminal and wire from ground terminal. Pry three ring springs from door and separate ring, door, and seal beam lamp-unit.

(2) REMOVE MARKER LIGHT LENS (fig. 138). Remove screw from face of lens, and pull lower end of lens out; then lift lens up, and remove.

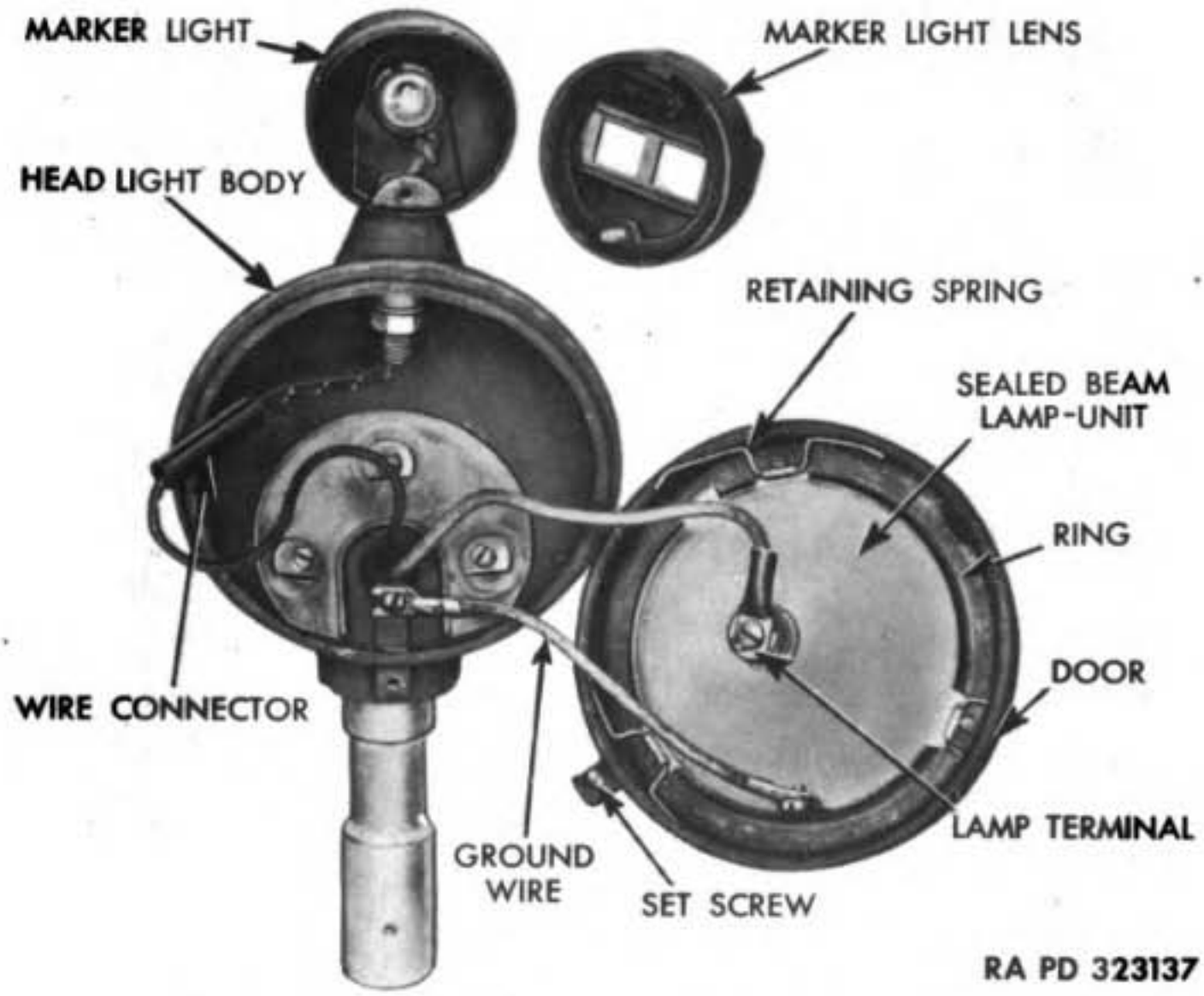


*Figure 138 — Headlight and Marker Light Opened*

(3) REMOVE MARKER LIGHT (fig. 139). Pull marker light wire from bakelite connector. Remove nut and lock washer from marker light mounting bolt. Remove spacer from bolt and lift marker light off.

(4) REMOVE SUPPORTING SHAFT (fig. 139). Remove bakelite connector from wire. Remove three cap screws and lock washers attaching supporting shaft, light body, and stiffener together. Remove grommet.

(5) DISASSEMBLE SHAFT (fig. 139). Remove cardboard wire holder from inside shaft. Remove set screw holding connector with wires, push on both wires, and remove connector from shaft.

**c. Repair.** Solder wires in connector and terminals if they are broken loose. Clean out old solder with soldering iron. Insert wire and let solder run into end of terminal until a good connection is made. Clean contact points with fine flint paper.

**d. Assemble.**

(1) ASSEMBLE CONNECTOR WITH WIRES INTO SUPPORTING SHAFT (fig. 139). Run wires through supporting shaft and pull connector into place, making certain hole in side of connector lines up

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***Figure 139 — Headlight Disassembled***

under set screw hole in shaft. Install set screw. Place wires in holes provided in cardboard wire holder, and slide holder into shaft. Use sealing compound around wires and cardboard wire holder.

(2) INSTALL SUPPORTING SHAFT (fig. 139). Place shaft on outside of light body, and spacer inside. Install three cap screws and lock

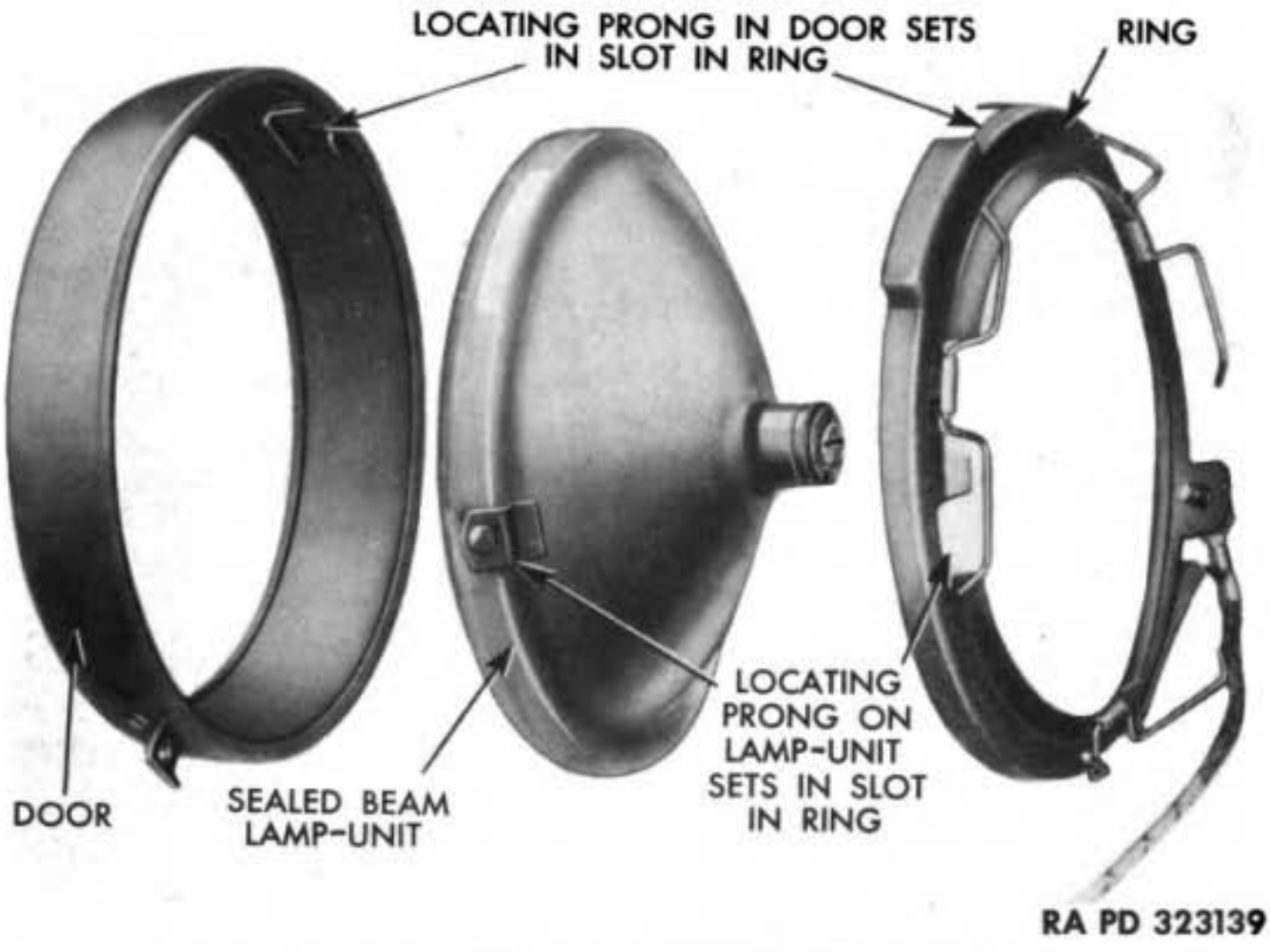


***Figure 140 — Locating Points for Assembling Lamp Unit, Door, and Ring***

washers, but do not tighten until after light is adjusted (subparagraph **e**). Holes are slotted in body to provide a means of adjusting light up or down. Cap screws are slotted at the threaded end so they can be spread to prevent them from turning loose. Do not spread cap screws until after light is adjusted.

(3) INSTALL MARKER LIGHT (fig. 139). Insert wire and mounting bolt through hole in top of light body. Install spacer, lock washer, and nut on mounting bolt. Insert wires in both ends of bakelite connector. Hook marker light lens on upper prong of marker light, and install screw.

(4 INSTALL SEALED BEAM LAMP-UNIT (fig. 140). Place lamp-unit in ring so that locating prong sets in slot in ring. Put assembly in light door so that slot in ring sets over locating prong in door (see fig. 140). Pry retaining springs under door flange. Connect wires to lamp terminal, and ground terminal in light body. Set lamp-unit assembly on body, and install attaching screw.

**e. Adjust.**

(1) SERVICE HEADLIGHT. Place a vertical screen or wall 25 feet ahead of the vehicle. Screen and vehicle should rest on a fairly level floor. Measure the distance from the floor up to the fender side rail

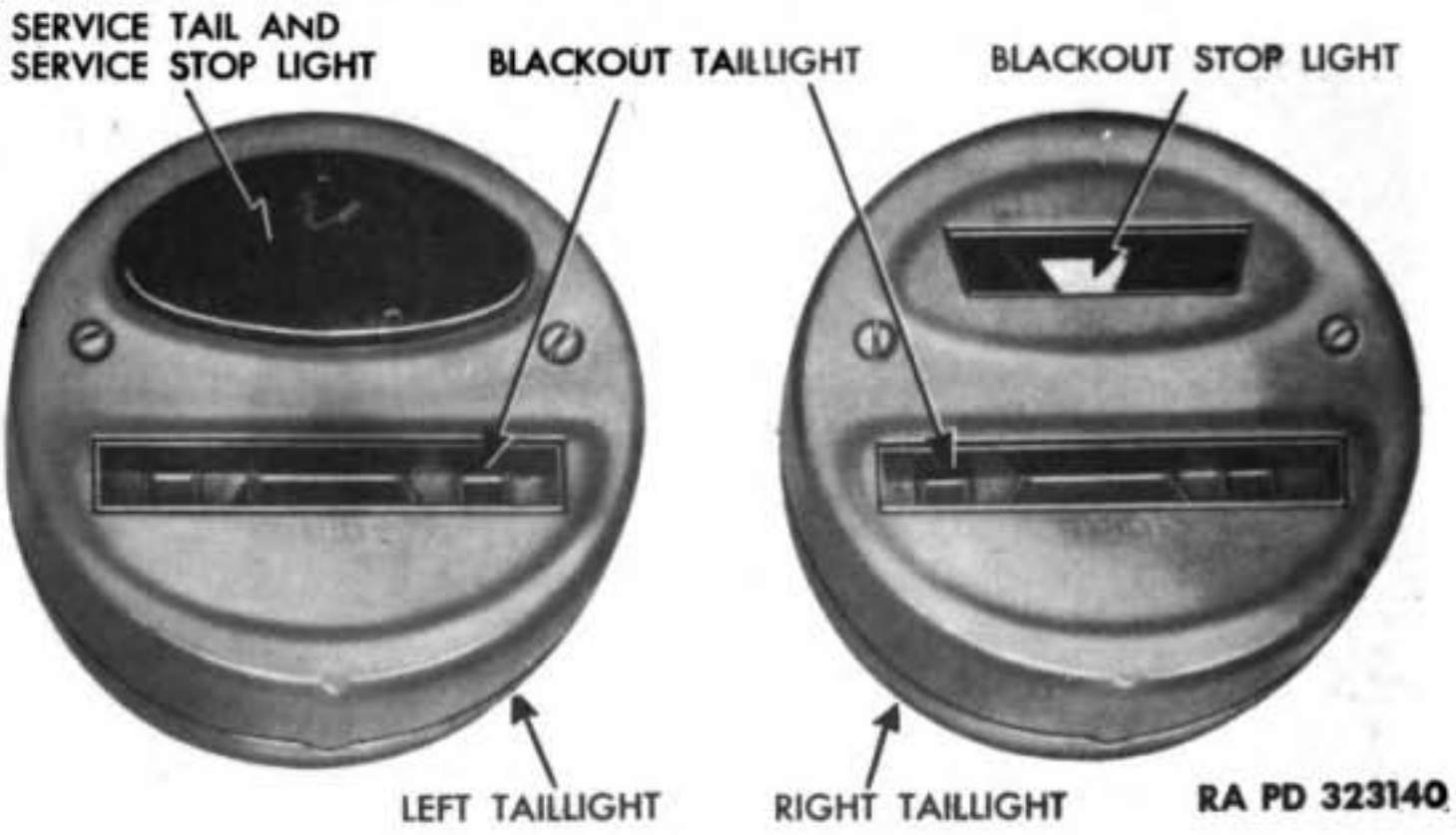


***Figure 141 — Taillights***

at front and rear. These distances will be equal if the vehicle is level. If necessary, jack up the front or rear end of the vehicle to make it level. Measure distance from center of light lens to floor, and draw a horizontal line on the screen or wall the same distance up from the floor. Turn on service headlight. Cover one headlight and move the other up or down until the top of its beam is 5 inches below horizontal line on screen. The visual cut-off of the top of its beam on the screen or wall should be 5 inches below the horizontal line (light center line). Tighten the three cap screws attaching supporting shafts to light body when adjustment is correct. Remove sealed beam lamp-unit, door, and ring assembly from light body. Spread slotted ends of cap screws to lock them. Install sealed beam lamp-unit, door, and ring assembly.

(2) BLACKOUT HEADLIGHT. Place a vertical screen or wall 10 feet in front-of the vehicle. Level vehicle as covered in subparagraph e (1) above. Turn on blackout driving light. Adjust light up or down until the visual cut-off of the top of the beam on the screen or wall is between 2 and 3 inches below the level of the bottom of the slot. Tighten the three cap screws attaching supporting shaft to light body when adjustment is correct. Remove sealed beam lamp-unit, door, and ring assembly from light body. Spread slotted ends of cap screws to lock them. Then, replace sealed beam lamp-unit, door, and ring assembly.

## 49. TAILLIGHTS.

**a. Description** (fig. 141). Two taillights are provided on the vehicle, one in the rear of the left powder box, and the other in the

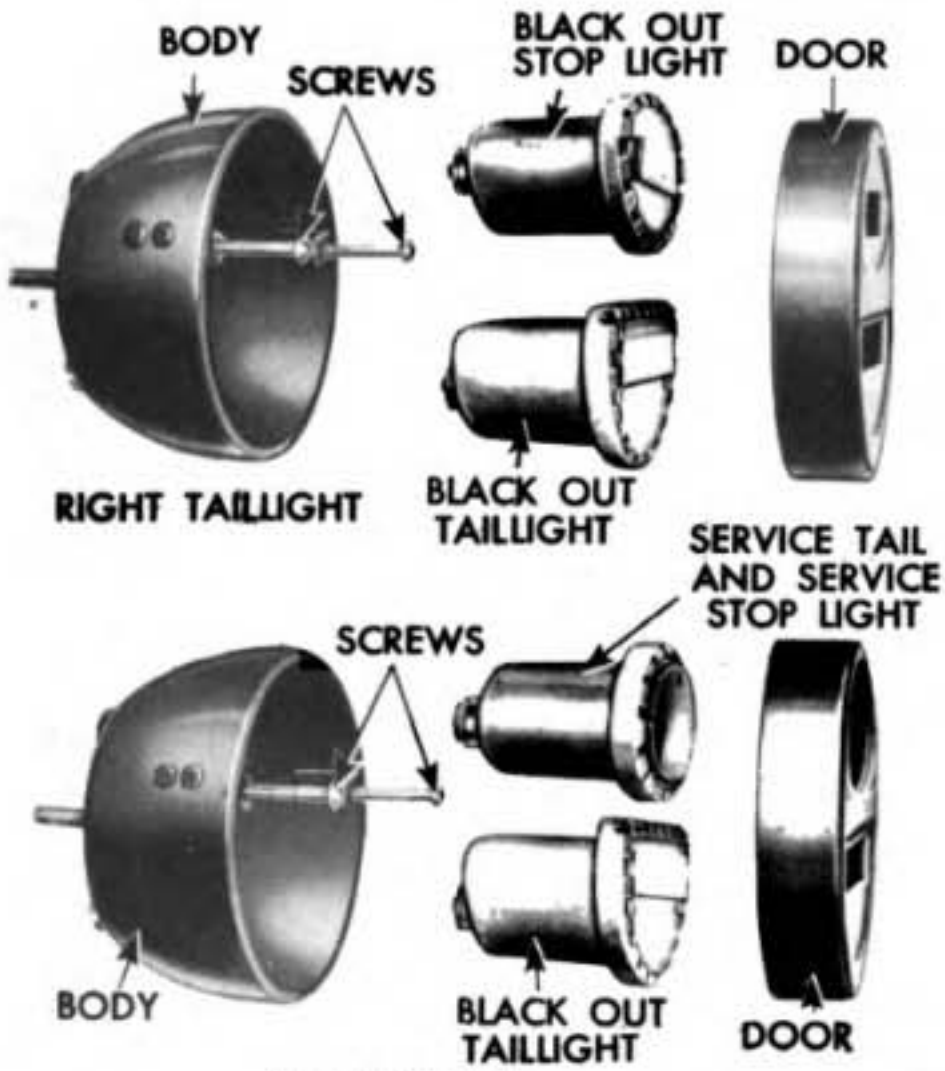


*Figure 142 — Taillights Disassembled*

rear of the right powder box. The left light is the blackout tail, service tail, and service stop light. The right light is the blackout tail and blackout stop light. Both lights are divided into upper and lower compartments. The upper compartment of the left taillight has a red lens and a two-filament bulb. One filament is for the service tail signal, and the other for the service stop signal. The service stop signal is the brighter. The upper compartment in the right taillight has one window which emits amber light. This is the blackout stop light. The lower compartments in the two taillights are the blackout tail signals. Each has four triangular windows which emit beams of red light that can be seen up to 900 feet when in line with the lamp axis. The light is shielded from low flying airplanes.

**b. Disassemble.**

Remove light assemblies (fig. 142). Remove two screws from door. Remove door, and pull each light assembly from body.

**c. Assemble.**

Install light assemblies (fig. 142). Insert the light assemblies into the taillight body in their proper location. Place door on body, and install two attaching screws.

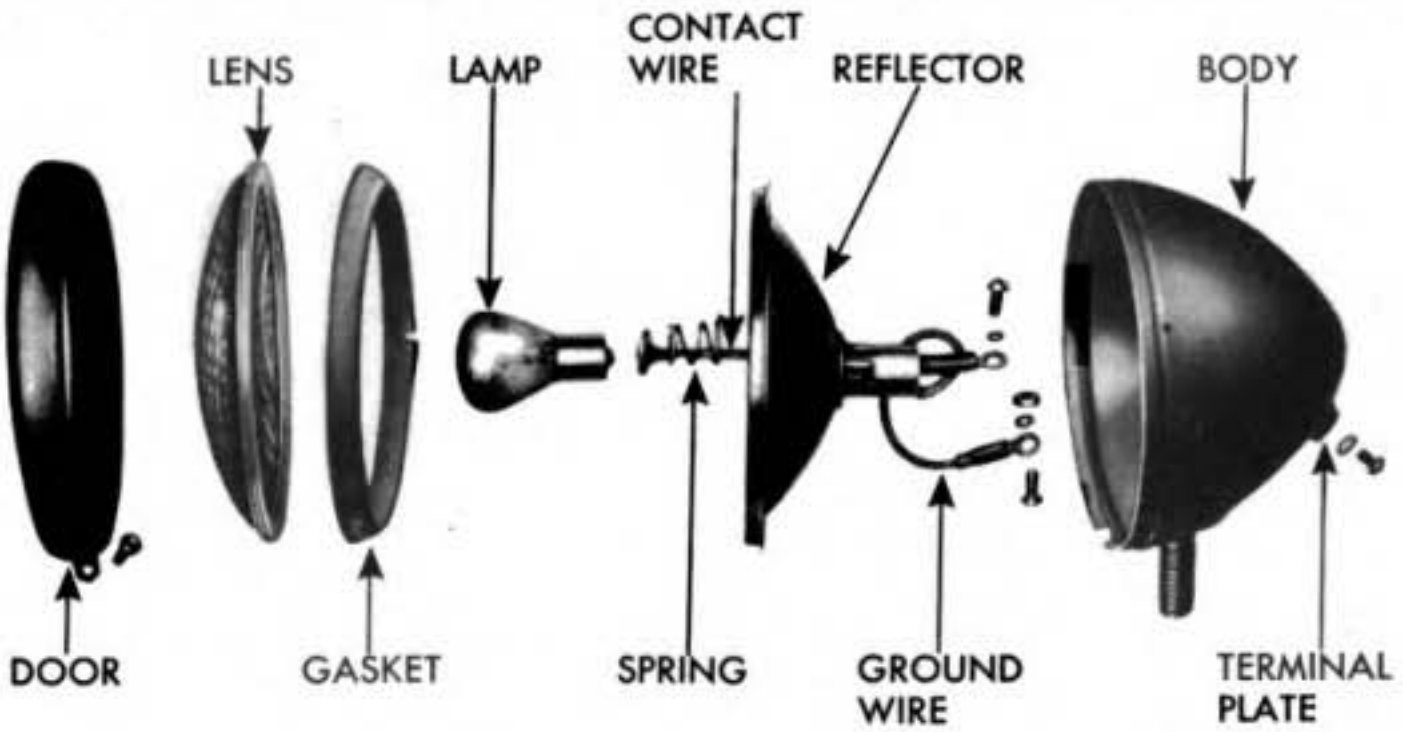


*Figure 143 — Rear Flood Light Disassembled*

## 50. REAR FLOOD LIGHTS.

**a. Description.** There are two rear flood lights on the vehicle, located in the rear end of the left and right powder boxes just above the taillights. The flood lights consist of a body with a threaded stud at the bottom for mounting. Inside the body is a reflector which carries a single-filament bulb at its center. The bulb socket is grounded to the body by a ground wire. The reflector fits into the front of the body against the rim. A rubber gasket makes a tight seal between the reflector and lens. The door holds these parts securely to the body. A single-contact wire connects a single-contact point in the lamp socket to a terminal plate in the rear of the body.

**b. Disassemble** (fig. 143).

(1) REMOVE LENS AND LAMP. Remove screw from bottom of door. Spread door and remove door, lens, and gasket. Turn and remove electric lamp.

(2) REMOVE REFLECTOR. Remove reflector from body by prying at bottom with screwdriver. Remove screw and lock washer attaching contact wire terminal to terminal plate inside of light body. Remove nut, lock washer, and screw attaching ground wire terminal to light body. Remove contact wire and spring from reflector.

(3) REMOVE TERMINAL PLATES. Slide the flatspring from terminal plate inside of light body, and remove terminal plate and spring.

**c. Clean and Repair.**

(1) CLEAN LENS. Polish reflector with a soft, clean cloth. Rub

back and forth from rim to center. Do not use abrasive. Replace reflector if sprung, bent, or if polished surface is damaged.

(2) Replace contact wire spring if it is broken or weak.

(3) Solder broken wire connections, or replace with new wire where necessary.

**d. Assemble** (fig. 143).

(1) INSTALL TERMINAL PLATE. Insert terminal plate into hole in back of light body, and slip spring under flange on inside of light body to secure plate in place.

(2) INSTALL REFLECTOR. Insert contact wire with spring in socket in reflector. Install screw and lock washer attaching contact wire terminal to terminal plate inside of light body. Install screw, nut, and lock washer attaching ground wire terminal to light body. Insert reflector in flange in light body.

(3) INSTALL LAMP AND LENS. Insert and turn lamp in socket. Place gasket in groove around reflector, and place lens over gasket. Spread the door, and place it over the lens and light body with the large bulge toward the front of the light. Make certain side of lens marked "TOP" is at the top of light, and that door clamping screw is at bottom. Install door clamping screw.

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## Section V

# SIREN



## 51. DESCRIPTION (fig. 144).

**a.** This is a 12-volt electric-motor driven siren which runs at 7,200 revolutions per minute. It draws 20 amperes when starting, and 10 amperes when running. The siren is attached to the vehicle by a mounting ring which is spot-welded to the motor cover. Other parts of the siren such as grille, rotor housing, and motor support plate, are attached to the mounting ring and cover by four round-head machine screws and lock washers.

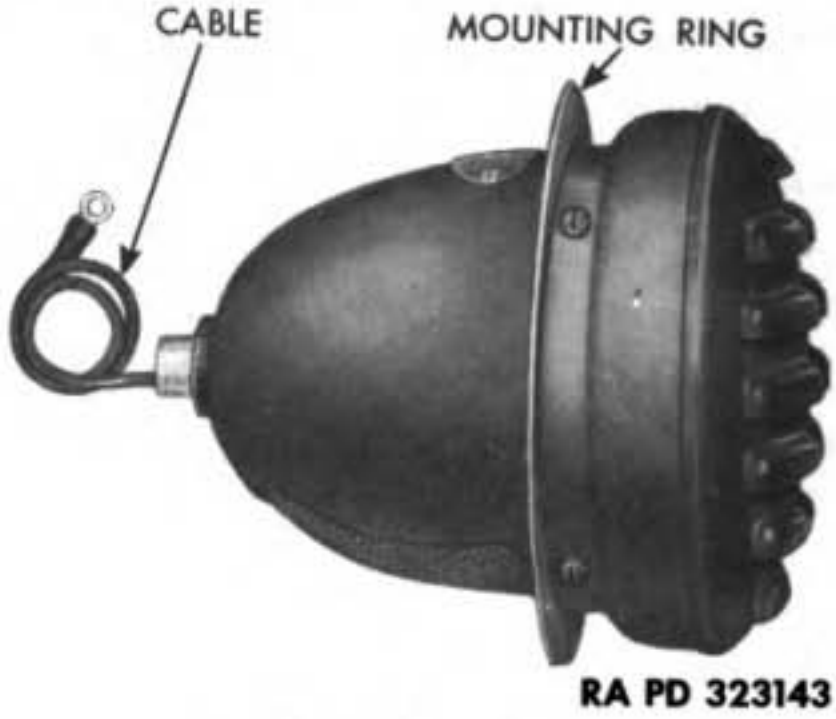


*Figure 144 — Siren*

## 52. DISASSEMBLY.

**a. Remove Grille and Siren Motor Cover** (fig. 145). Remove four round-head screws and lock washers from around the grille and cover. Pull grille off motor cover. Grasp siren rotor housing in one hand, and pull motor cover off with the other hand, being careful not to damage cable when pulling it through bushing in cover.

**b. Remove Siren Rotor and Housing** (fig. 146). Pull rotor housing from the motor support plate. Reach through opening provided in motor support plate with $\frac{3}{32}$-inch hexagon safety screw wrench, and loosen the two safety set screws that attach siren rotor to shaft. Pull siren rotor off shaft.

**c. Remove Armature** (figs. 147 and 148). Take out screw in motor case cover, and remove cover. Remove two nuts and lock washers which attach motor yoke, motor case, and motor support

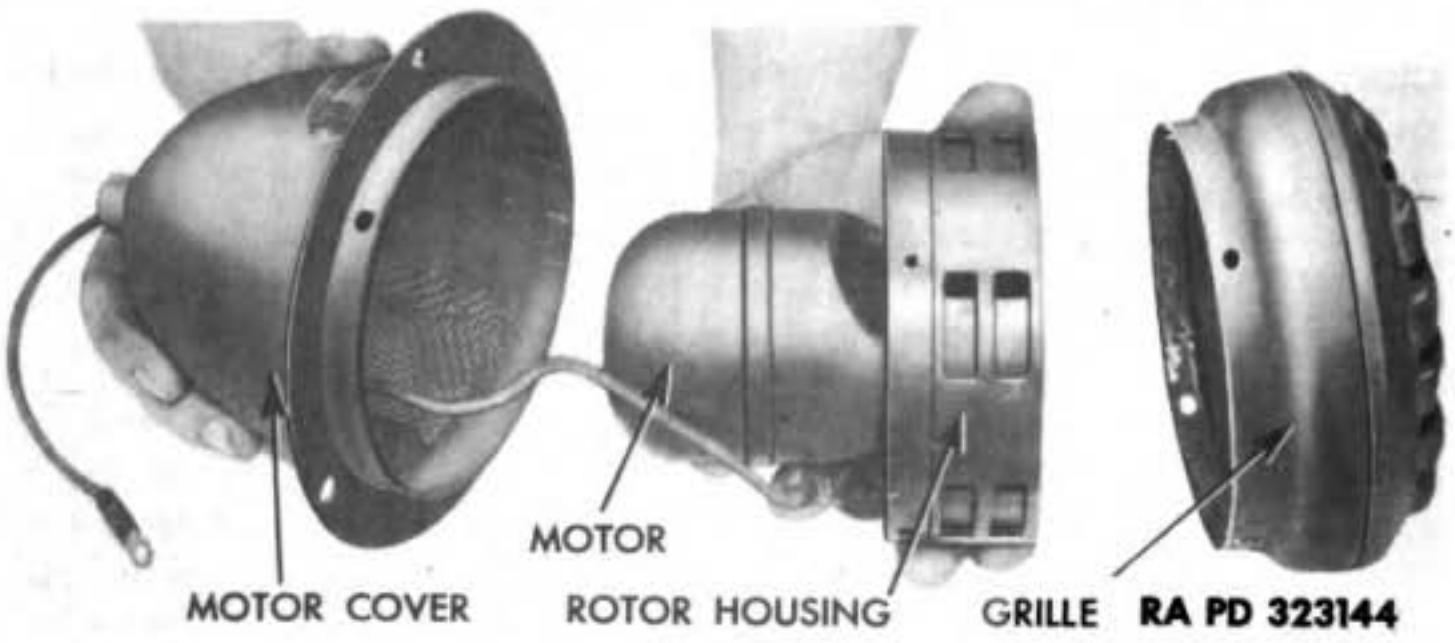


*Figure 145 — Removing Rotor Cover from Rotor Housing*

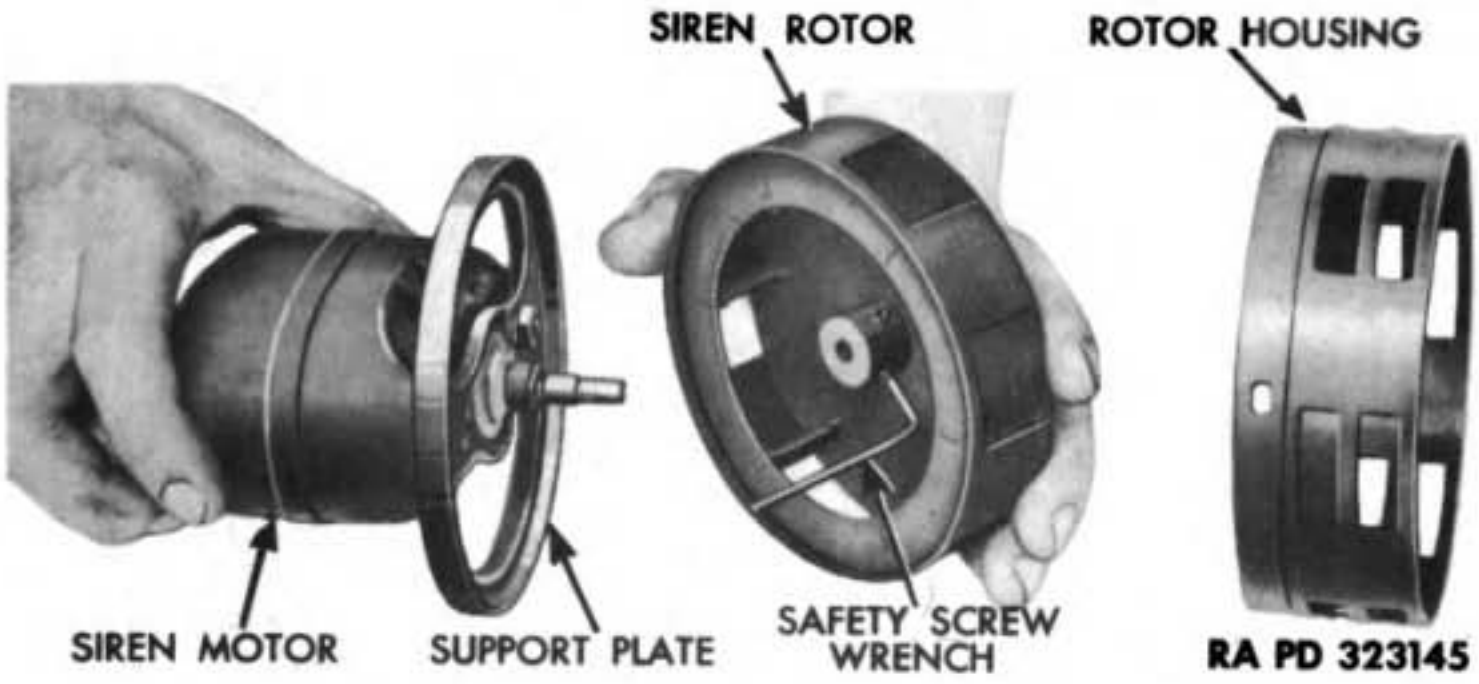


*Figure 146 — Removing Siren Rotor*

plate. Carefully pull motor support plate from yoke, and remove the motor case and motor armature. Be careful not to break the wires loose from terminals in motor case.

**d. Remove Brush Holder and Spring** (fig. 149). **NOTE:** ***Do not disturb these parts if inspection and tests show they are in good condition.*** Remove flat head screw and formed insulator attaching brush holder. Remove brush holder and spring from brush, and lift off flat insulator.

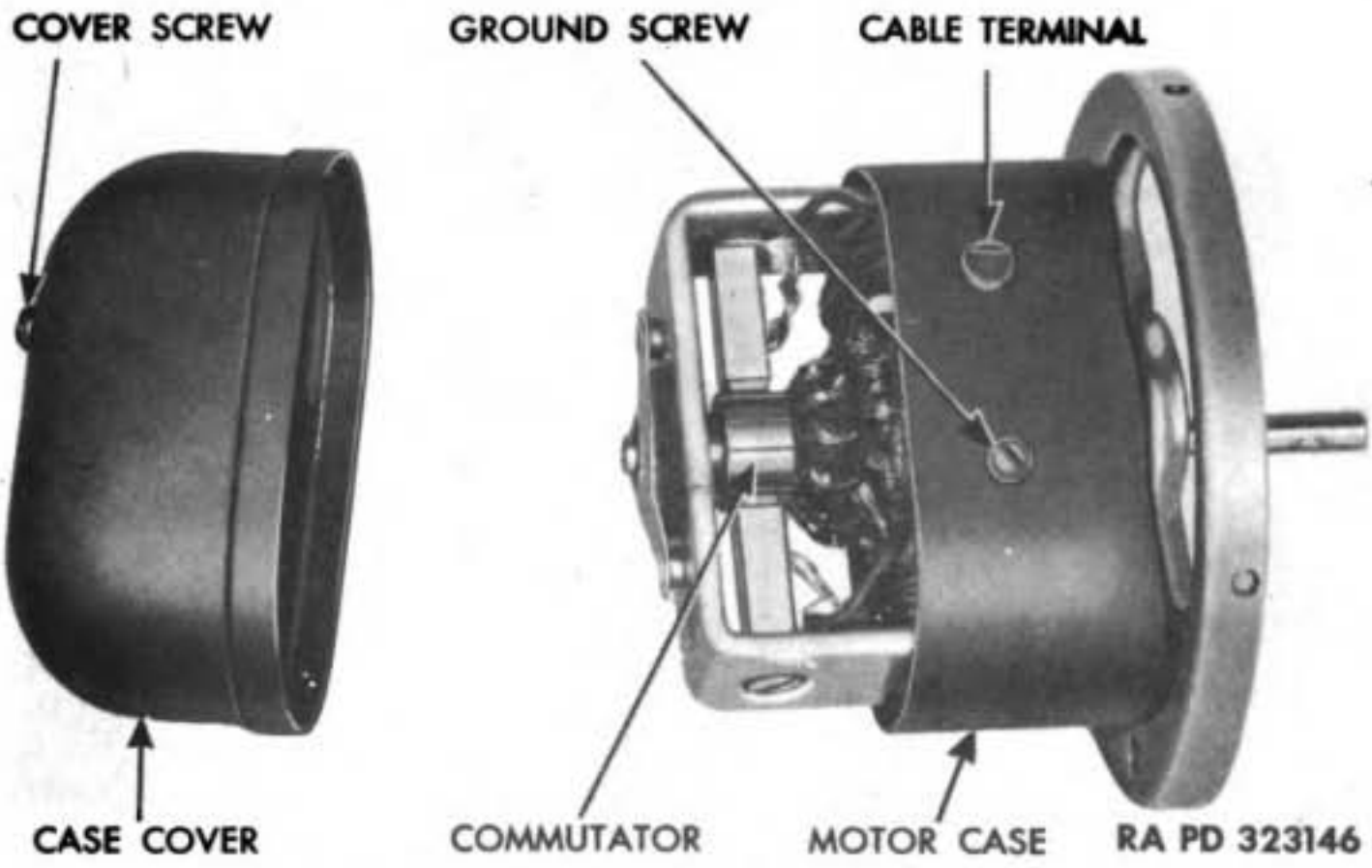


*Figure 147 — Siren Motor Case Cover Removed*

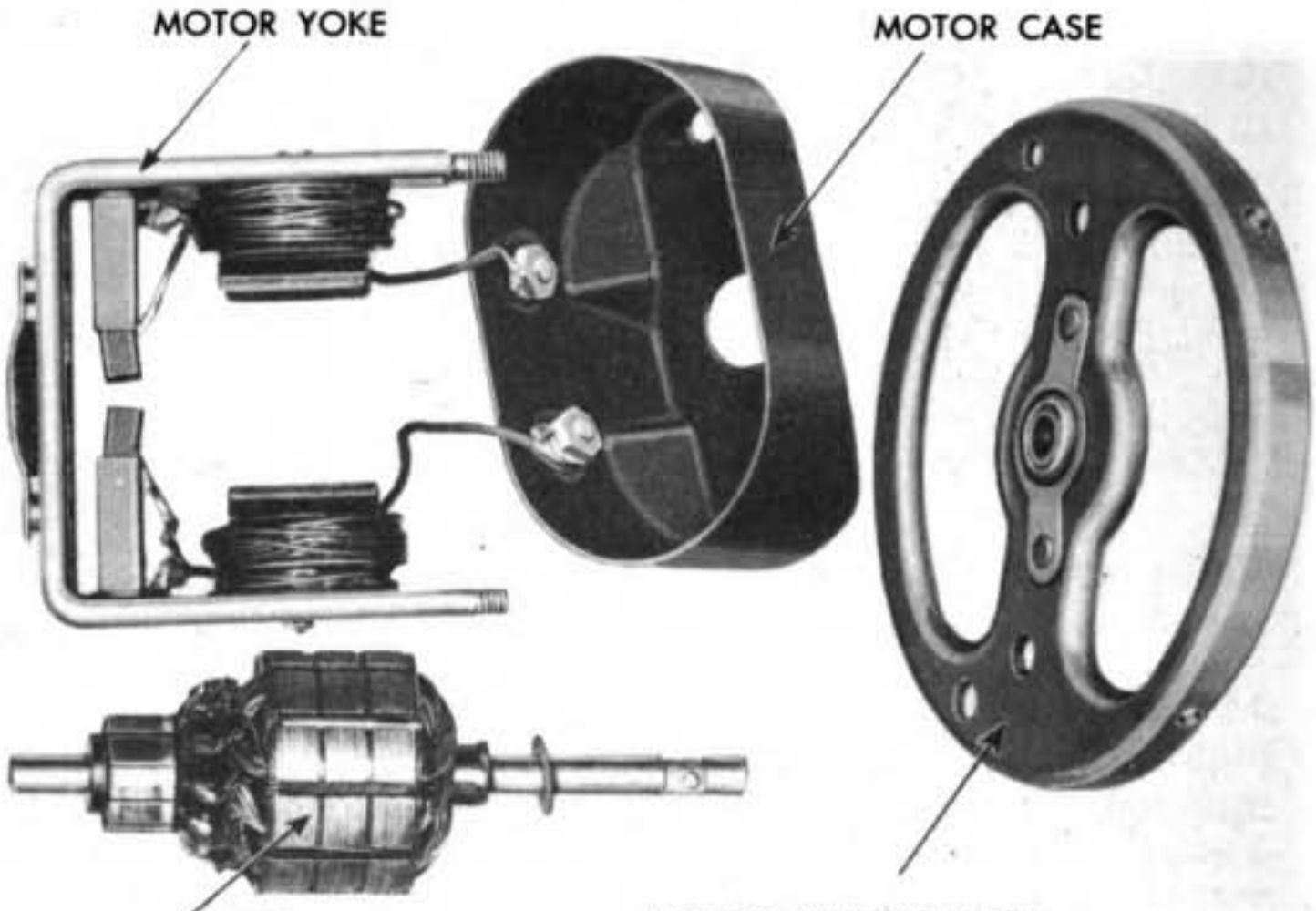


*Figure 148 — Siren Motor Armature Removed*

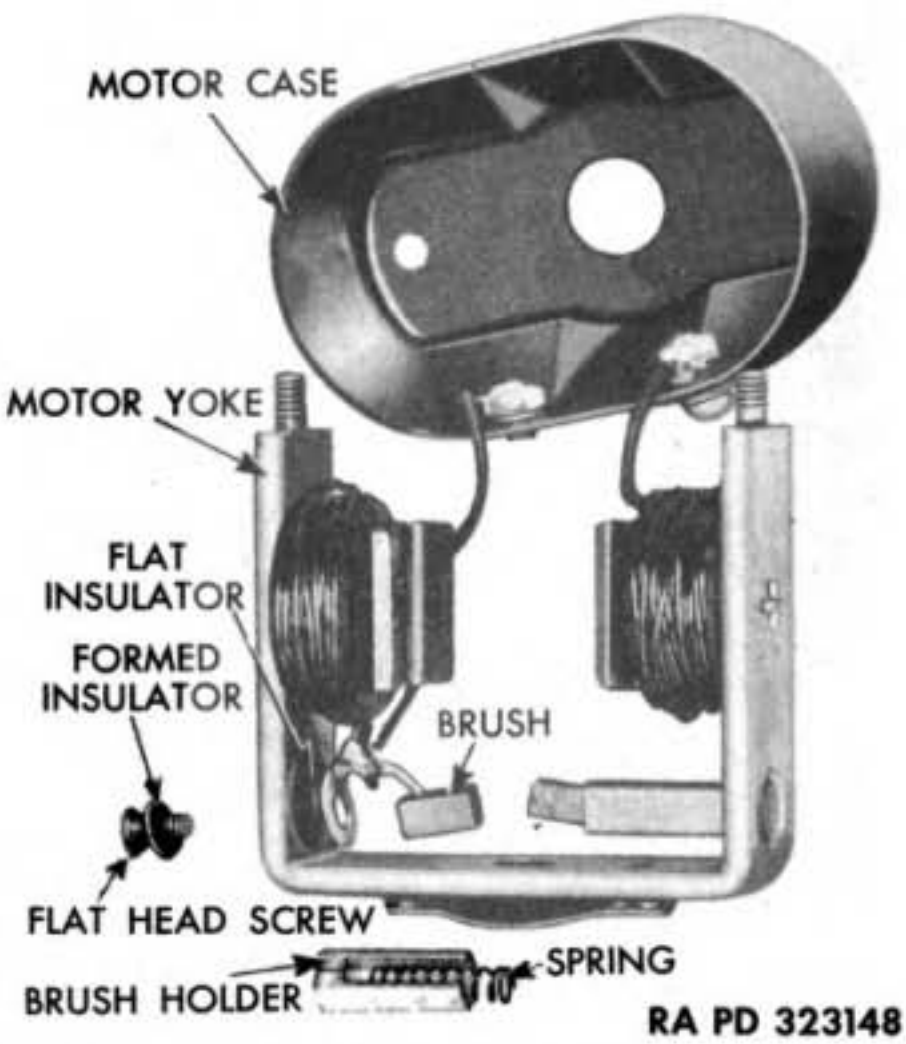


*Figure 149 — Siren Motor Brush Holder and Spring Removed*

## ELECTRICAL SYSTEM

### 53. CLEANING, INSPECTION, AND TEST.

**a.** Clean all parts with dry-cleaning solvent and dry with compressed air.

**b.** Test field coils for shorts.

**c.** Test brushes, holders, and cable terminals in motor case for grounds.

**d.** Test armature for grounds.

**e.** Check bushings for clearance on armature shaft. If bushings are excessively worn, install a new siren motor assembly.

**f.** Check all soldered connections to make sure they are secure.

**g.** Check brushes for cracks.

**h.** Check siren rotor for run-out.

### 54. REPAIR.

**a.** Use 2/0 flint paper and clean commutator, being sure to remove all dust after cleaning.

**b.** Solder all wire connections which are loose or broken.

### 55. ASSEMBLY.

**a. Ins all Brush Holder and Spring** (fig. 149). Insert brush spring and brush in holder. Attach brush holder to motor yoke by installing flat-head screw. Make sure the flat insulator is between holder and yoke, and the formed insulator is under screw head. Repeat operation if second brush holder is removed.

**b. Install Armature** (figs. 148 and 149). Insert armature shaft through hole in motor case and into bushing in motor support plate. Place armature between field, spread brushes until commutator will pass between, and move armature until its shaft enters bushing in yoke. Install two nuts with lock washers attaching yoke motor case and motor support plate together. Install motor case cover, and tighten attaching screw. Oil felt washers next to motor bushings sparingly with engine oil SAE 10.

**c. Install Siren Rotor and Housing** (fig. 146). Place siren rotor on motor armature shaft making sure to line up set screws over flats on shaft. Tighten both set screws. Place rotor housing over siren rotor, and onto motor support plate; line up screw holes.

**d. Install Siren Motor Cover and Grille** (fig. 145). Run cable through bushing in motor cover and slip the cover onto the rotor housing, making sure to line up the screw holes. Place grille over motor cover, and install four round-head screws and lock washers.

Section VI

# SOLENOID



## 56. DESCRIPTION AND OPERATION (fig. 150).

**a.** The solenoid is an electro-magnetic puller which is mounted by a bracket between the two carburetors. The specific duty of the solenoid is to operate an idle control cam which opens the throttles to idling position when the ignition switch is turned on, and permits the throttles to close completely when the ignition switch is turned off. Closing of the throttles is necessary to prevent the engine from running by heat of compression after the ignition switch is turned off.

**b.** The solenoid consists chiefly of two concentric coils of insulated wire, a movable plunger, and a small breaker switch. The outer coil winding is for pulling in the plunger only (called a "pull-in" coil) and the inner winding is for both pulling in and holding the plunger (called a "holding" coil). When the ignition switch is turned off, no current is delivered to the solenoid. The plunger is out and contact points are closed (fig. 151). When the ignition switch is turned on, current from the 12-volt electric system flows to both the outer and inner coil windings, pulling the plunger in. When the plunger has almost reached its inner position, the plunger tip separates the contact points, opening the electric circuit to the outer winding (pull-in coil). This leaves the inner coil (holding coil) to keep the plunger all the way in (fig. 152). The holding coil is capable of operating indefinitely without overheating, while the pull-in coil would soon overheat if energized for more than a few seconds. A relay is used in conjunction with the solenoid to carry the 29-ampere current required to operate the solenoid. After the solenoid has operated, and the plunger is all the way in, only .75 amperes are required to hold it there.

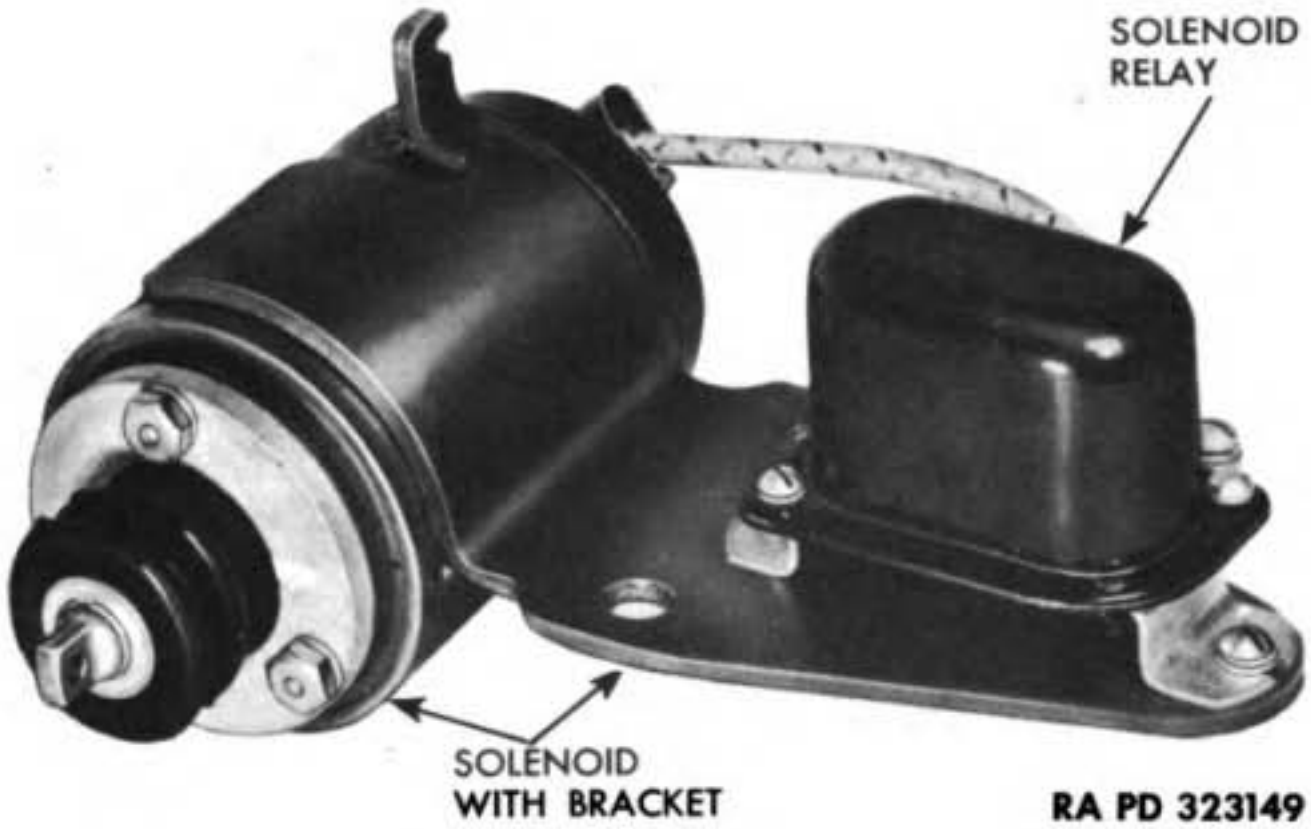


*Figure 150 — Carburetor Shut-off Solenoid and Relay*

**57. DISASSEMBLY.** (fig. 153).

**a. Remove Breaker Cover.** Bend corners of breaker cover lock away from nuts and remove two nuts, cover lock, cable clip, gasket, and breaker cover. This exposes coil leads and contact points.

**b. Remove Spring Contact.** Remove nut and lock washer attaching spring contact, and lift spring contact off screw.

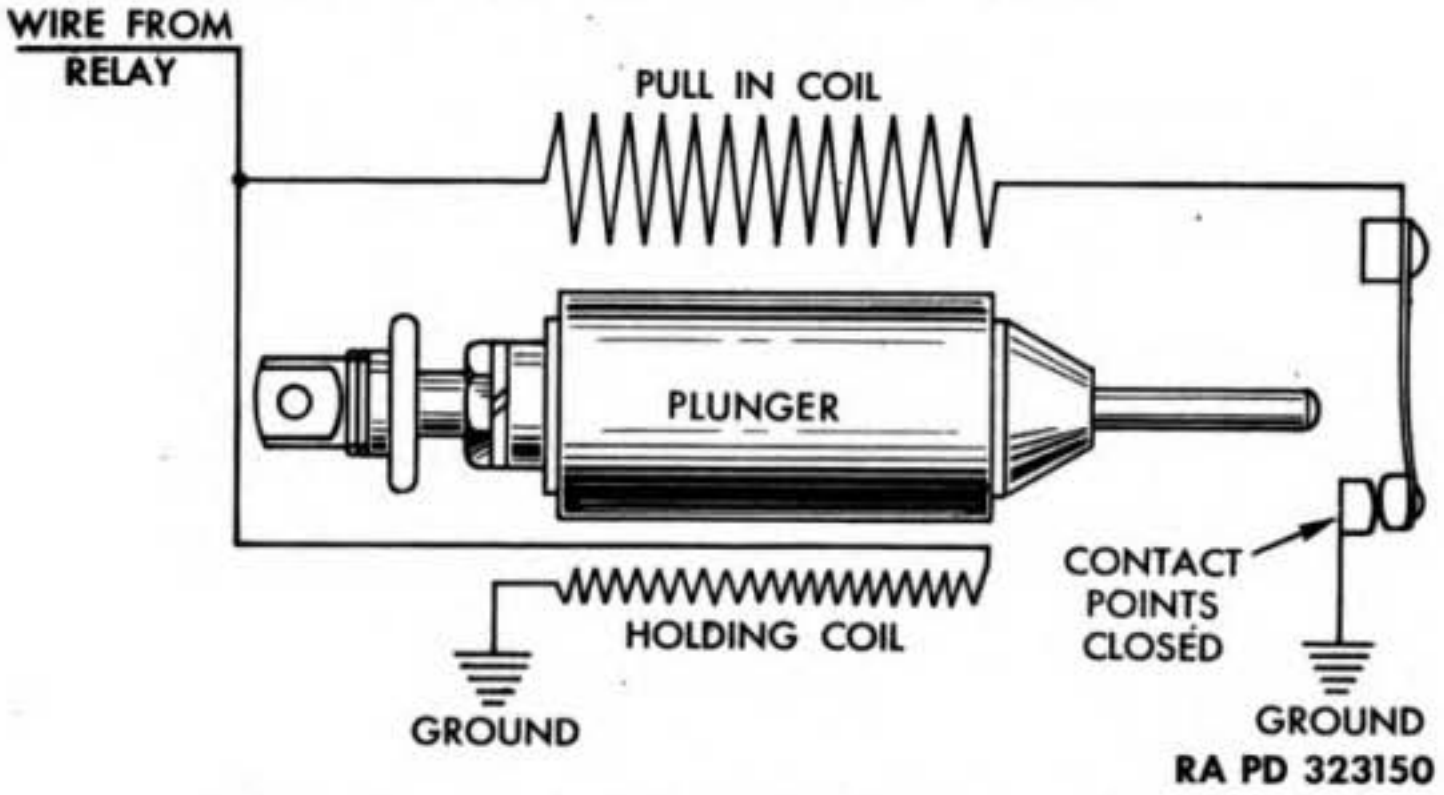


*Figure 151 — Solenoid Wiring Diagram — Plunger Out*

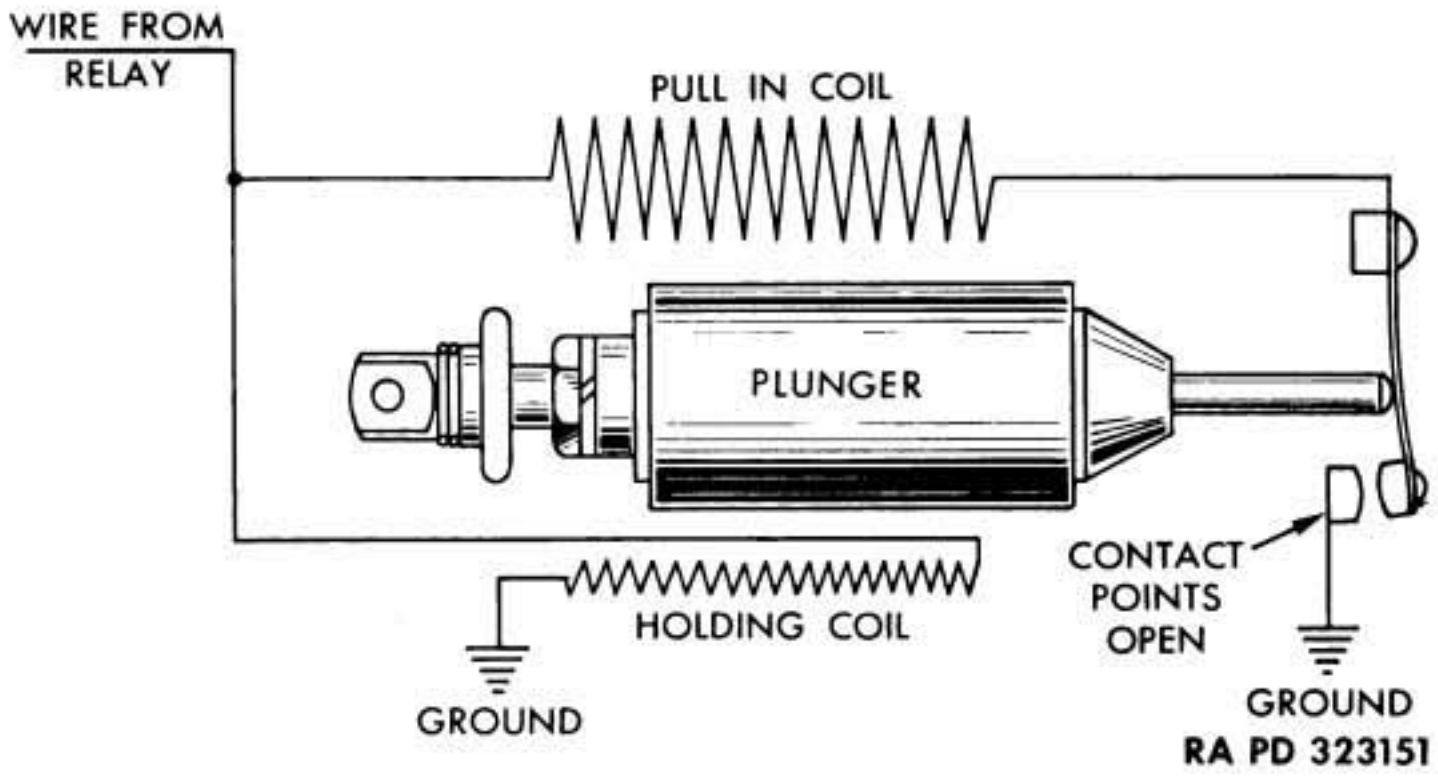


*Figure 152 — Solenoid Wiring Diagram — Plunger In*

**c. Remove Dust Cap.** Pry snap ring from plunger adjusting screw, and remove dust cap retainer. Remove three cap screws and lock washers attaching retainer plate to solenoid housing, and remove retainer plate and dust cap.

**d. Remove Plunger.** Remove three flat-head screws attaching plunger stop to solenoid housing, and lift off plunger stop and gasket. Pull plunger out of housing. Loosen adjusting screw lock nut, and unscrew adjusting screw, lock nut, and lock washer from plunger.

## 58. CLEANING AND INSPECTION.

**a.** Clean all parts of solenoid with dry-cleaning solvent. Dry with compressed air. Do not use oil on any part of the solenoid.

**b.** Plunger should move back and forth freely in housing when moved by hand.

**c.** Neoprene dust cap must be free of cracks.

**d.** Inspect contact points, and clean off all burning or oxidation. Replace with new terminal plate and spring contact if points are badly burned or defective (par. 59).

**e.** Inspect coil lead-soldered connections. They must be mechanically and electrically secure.

## 59. REPAIR AND REBUILD (fig. 154).

**a.** When terminal plate or breaker cover gasket need replacing, melt solder at coil lead connections, and bend tongs that hold leads. Remove nut and lock washer attaching terminal plate to housing and

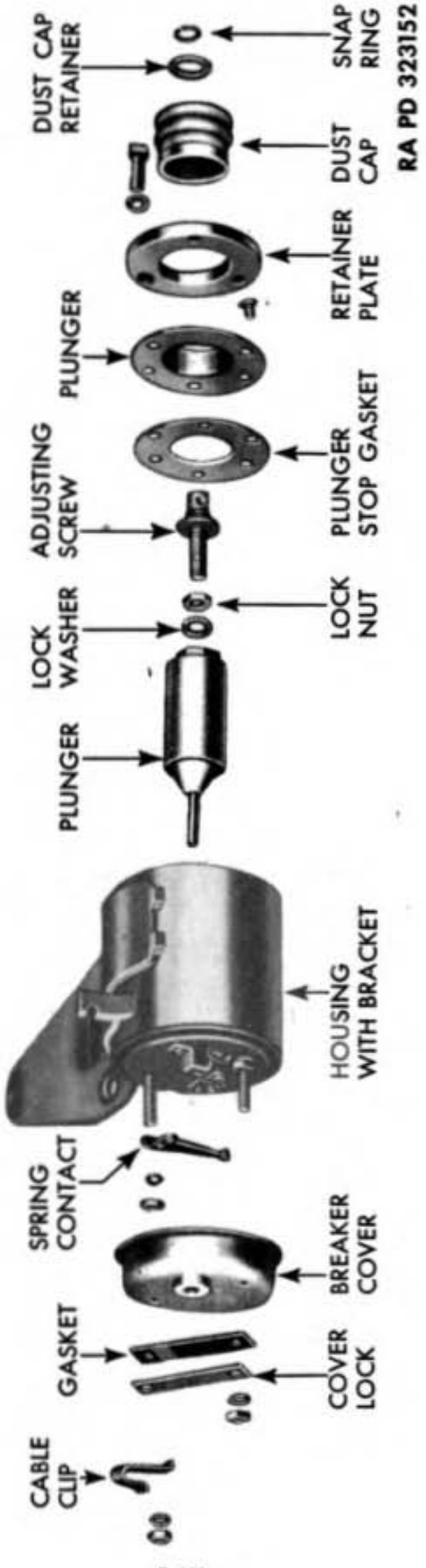


*Figure 153 — Solenoid Disassembled*

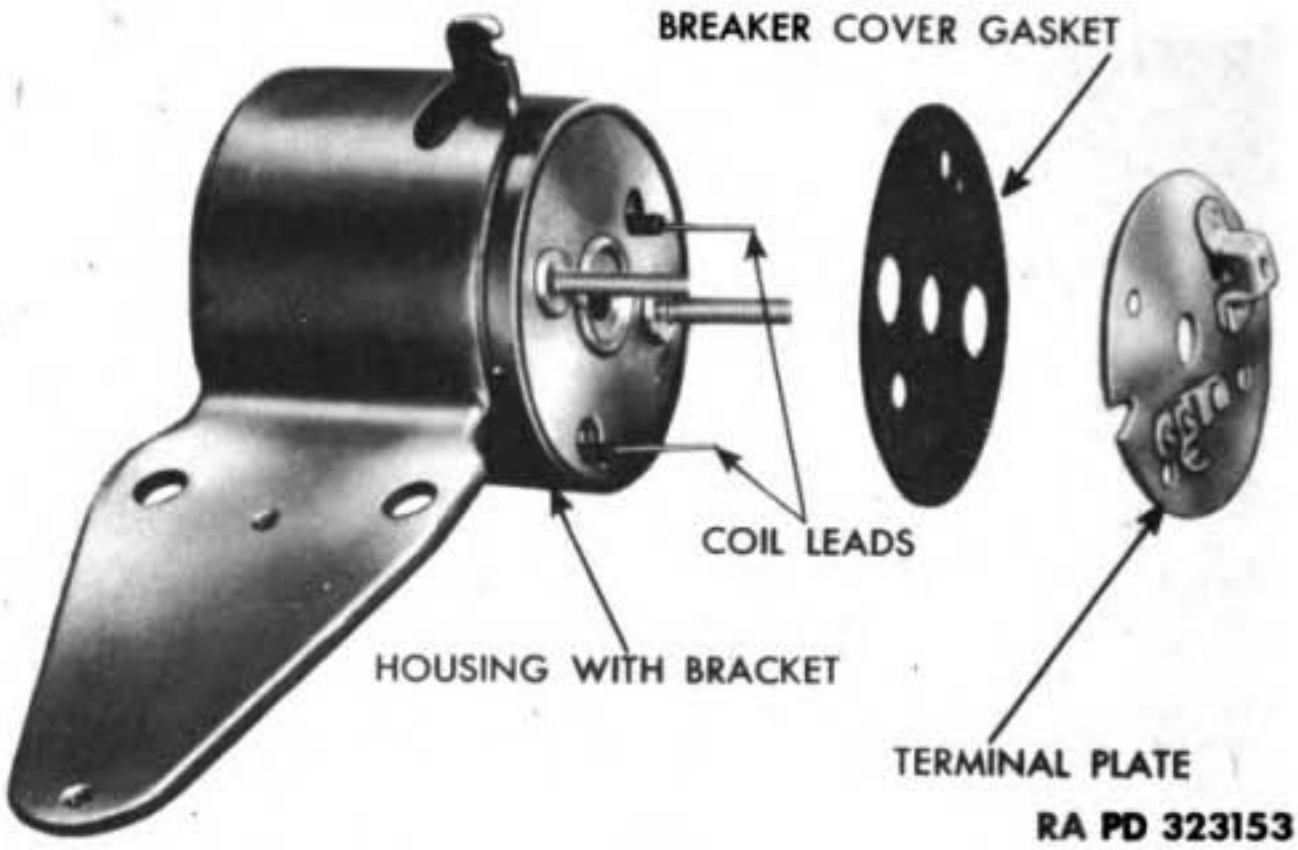


***Figure 154 — Terminal Plate Removed***

lift off terminal plate and gasket. Install new gasket and terminal plate if needed, or if coils are defective. Install terminal plate and gasket which were removed, onto a new solenoid housing with bracket. Straighten coil leads, and insert them through holes in breaker cover gasket and terminal plate. Turn nut and lock washer down on the stud which does not attach the spring contact. Bend tongs around coil leads and solder. Use only noncorrosive solder flux.

**60. ASSEMBLY** (fig. 153).

**a. Install Plunger.** Turn adjusting screw and lock nut and washer into end of plunger, but do not tighten. Insert plunger into solenoid housing. Place plunger stop with gasket over end of housing, and install three attaching flat-head screws. Tighten screws securely.

**b. Install Dust Cap.** NOTE: *See paragraph 61* **a** *for adjusting the plunger adjusting screw before installing dust cap.* Insert dust cap into retainer plate. Make sure the small flange on end of the cap locates in beveled end of hole in retainer plate. Attach retainer plate to housing by installing three cap screws and lock nuts. Place dust cap retainer over adjusting screw, and install snap ring in groove in adjusting screw.

**c. Install Spring Contact.** Place spring contact over screw in end of housing, and install nut and lock washer. Line up points and tighten nut.

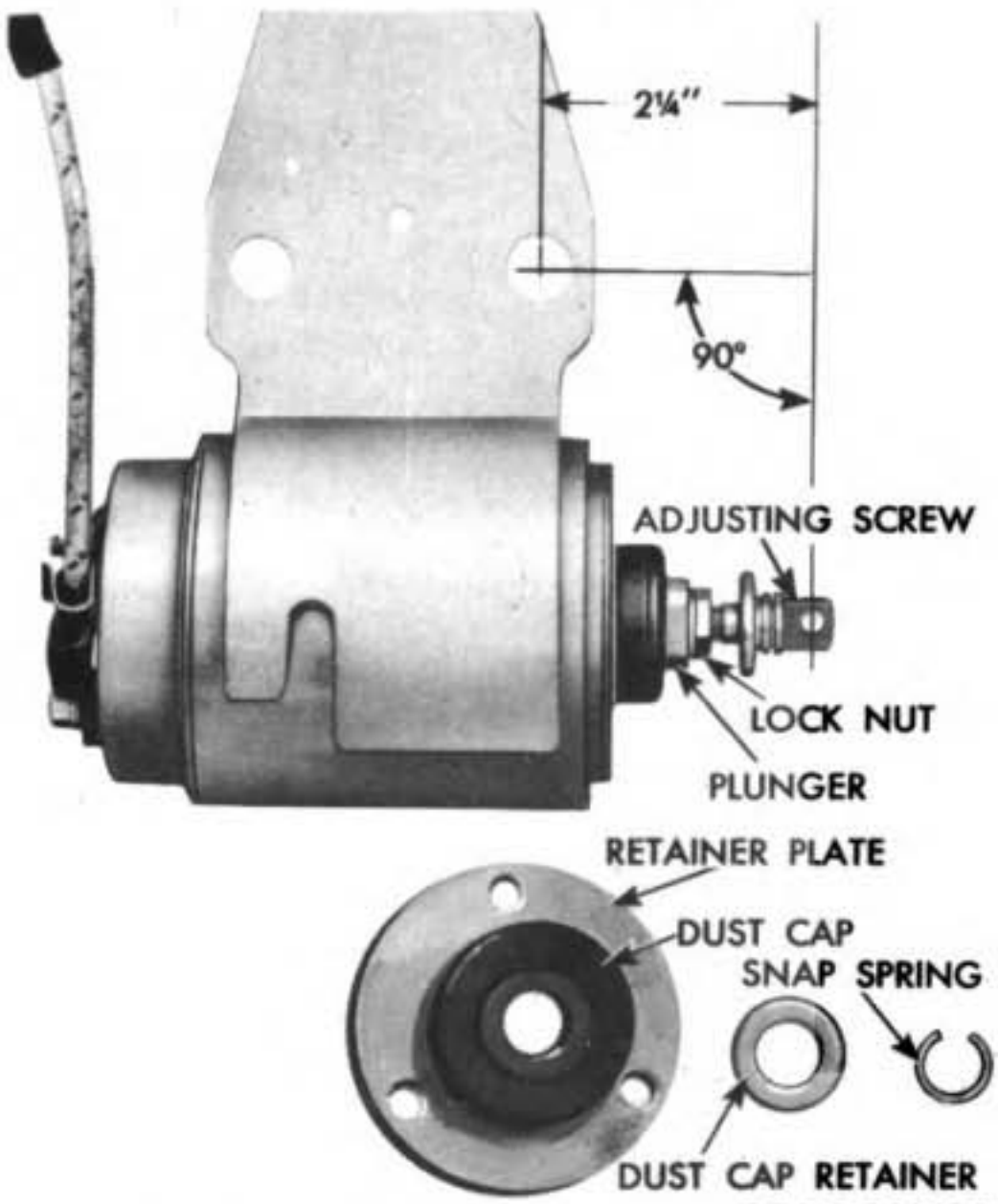


*Figure 155 — Solenoid Plunger Adjusting Screw Setting*

**d. Install Breaker Cover.** NOTE: *See paragraph 61* **b** *for adjusting breaker points before installing breaker cover.* Place breaker cover, cover lock gasket, cable clip, and cover lock over screws at end of solenoid housing in order mentioned. Install nuts, and bend opposite corners of cover lock against nuts to keep them from working loose.

## 61. ADJUSTMENT.

**a. Plunger Adjusting Screw** (fig. 155). Remove snap spring, dust cap retainer, dust cap, and retainer plate. Pull plunger out of housing as far as possible until it is against stop. The distance from the center of the pin hole in the adjusting screw to the center of the first mounting hole in the bracket should be 2¼ inches (fig. 155) when measured parallel with the axis of the plunger. Turn adjusting screw in plunger to get this measurement, then tighten lock nut.

**b. Breaker Points.** Remove breaker cover. Push plunger all the way into housing until it is against stop. Contact points should be

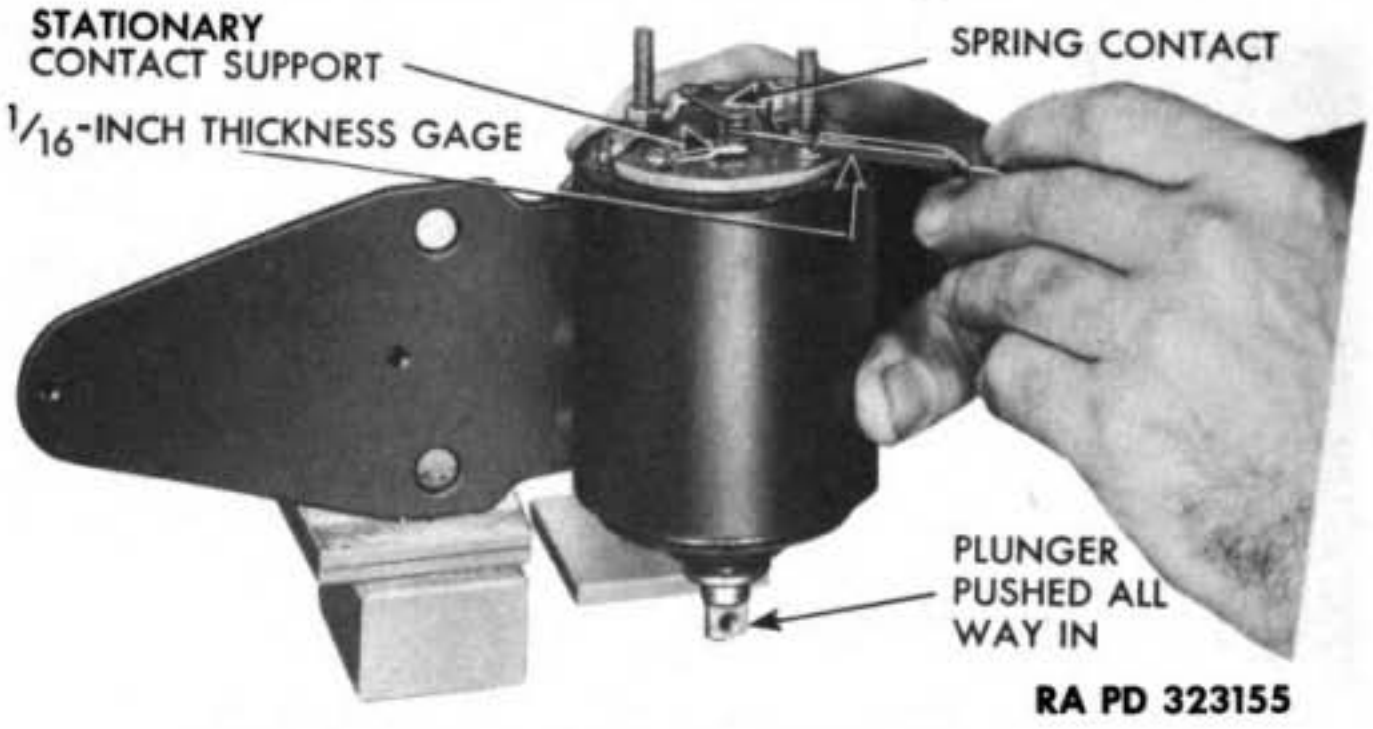


*Figure 156 — Measuring Contact Point Gap*

open 1/16 inch (fig. 156). Make adjustment by bending stationary contact support. With contact points closed (plunger pulled out) the contact pressure should be 17 to 22 ounces. Check this pressure by pulling contact spring point away from stationary point with tension gage (41-G-105) (fig. 157), and adjust by bending contact spring bracket.

## 62. TEST.

**a. Solenoid Operation** (fig. 158). Attach the solenoid bracket to a solid vertical support with the plunger adjusting screw down. Connect the plunger adjusting screw to the hook end of a tension gage. Connect opposite ring end of the tension gage to a heavy spring which is anchored at the lower end. Connect solenoid to a fully charged 12-volt battery with one wire to terminal screw on solenoid

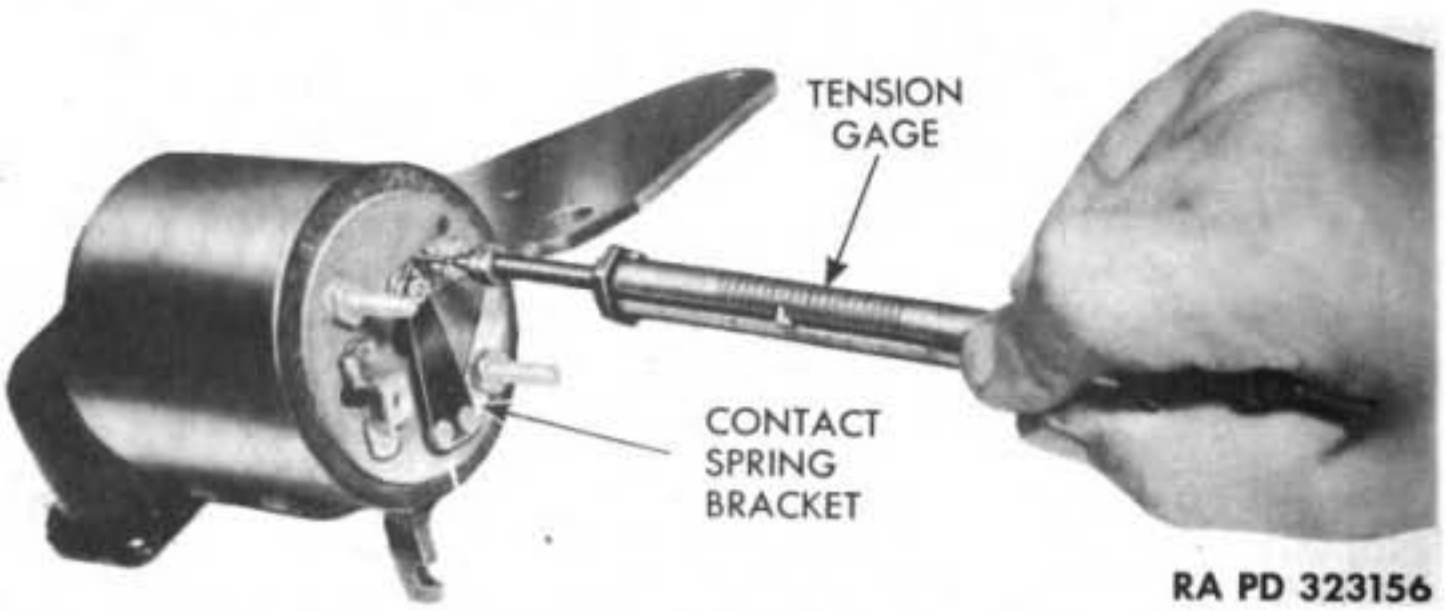


*Figure 157 — Checking Contact Point Pressure, Using Tool (41-G-105)*

## ELECTRICAL SYSTEM

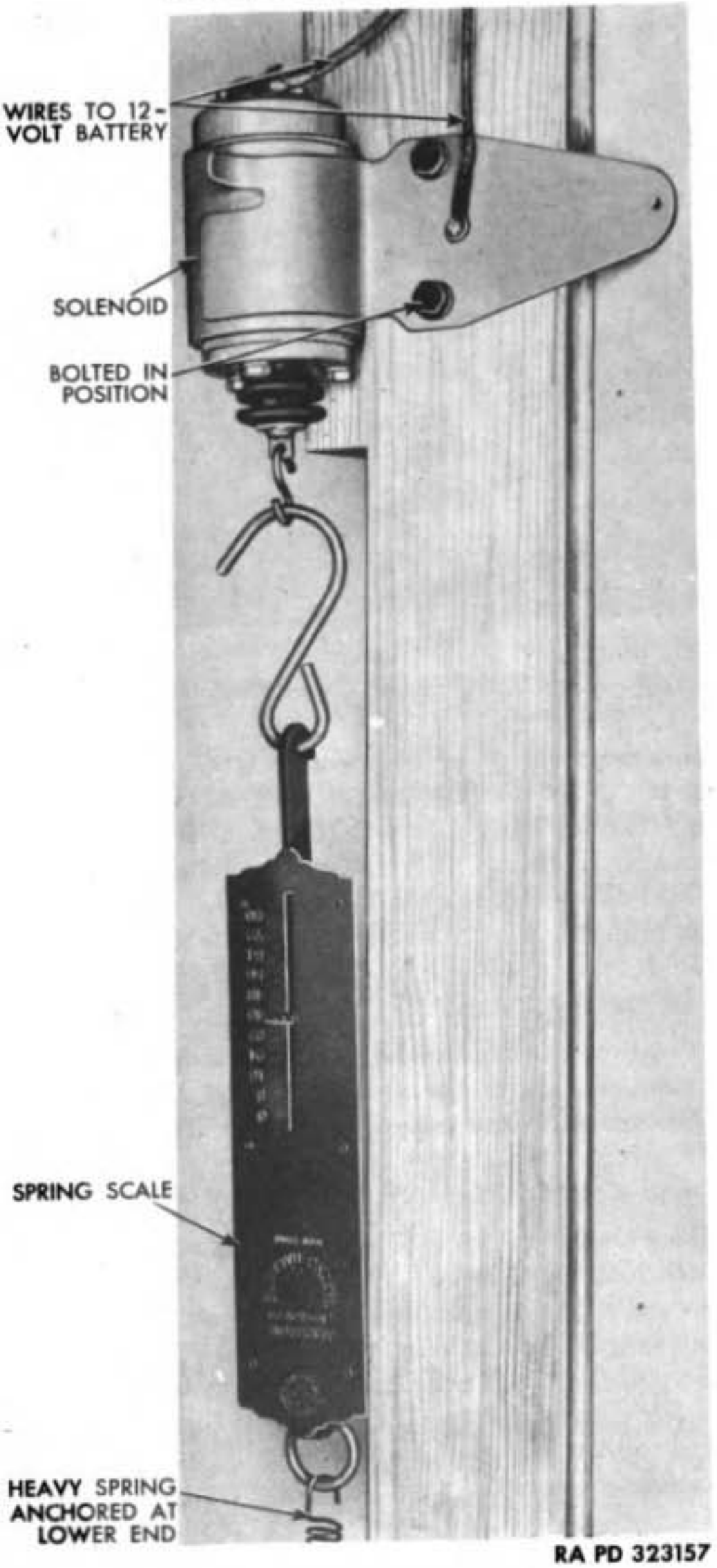


***Figure 158 — Testing Pulling Force of Solenoid***

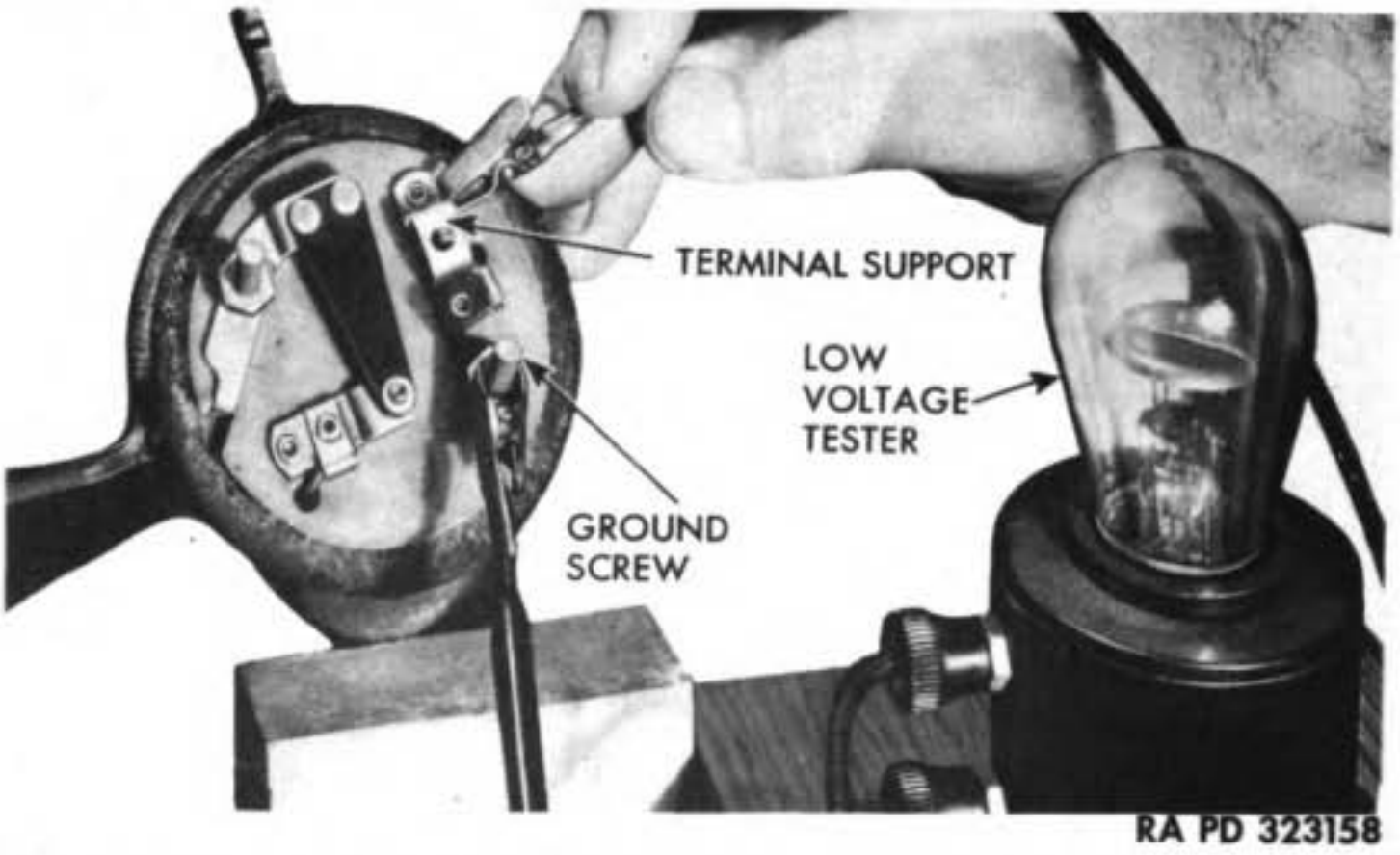


*Figure 159 — Testing Coil for Open Circuit, Using Tester (17-T-5575)*

breaker cover, and other wire connected to solenoid bracket. When current is turned on, the initial pull should be a minimum of 40 pounds. Do not keep plunger from pulling all the way up into solenoid housing for more than a few seconds when current is turned on, or pull-in coil will become hot and damaged. The force required to pull the plunger from its seat when it is all the way up with current on, should be a minimum of 50 pounds. Apply pressure on lower spring to make this check.

**b. Contact Spring Pressure.** Set the solenoid in its normal horizontal position. After operating it several times, turn off the current while plunger is in the far-end position. Normally the point spring pressure against the end of the plunger should be just enough to push the plunger off the inner stop.

**c. Test Coil** (fig. 159). Use low voltage circuit tester (17-T-5575) and check for breaks in coil. Have breaker cover removed. Connect one test point to grounded part of solenoid, and other test point to terminal support. When solenoid contact points are together, both coils carry current. When contact points are apart, only the holding coil carries current. If test light shows the holding coil to be open when the contact points are apart, replace with new solenoid housing and bracket assembly.

## ELECTRICAL SYSTEM

### Section VII

# RELAYS



## 63. DESCRIPTION (figs. 160 and 161).

**a.** Two identical relays are used on the vehicle. One is the carburetor shut-off solenoid relay which is mounted to the solenoid bracket. The other is the siren relay which is mounted to the underside of the cowl next to the siren. The relay is a remote controlled electro-magnetic switch. Its principal parts are a base, an armature, a coil and core assembly, and a cover. When the relay coil is energized by being connected to the battery (through ignition switch in case of solenoid relay or through siren switch in case of siren relay) the relay contact points close, connecting the solenoid or siren direct to the battery. This eliminates the voltage drop that would occur if solenoid or siren were connected to the battery through lengthy wiring and switch. Better solenoid and siren performance is obtained by using relays.

## 64. DISASSEMBLY.

**a. Remove Cover** (fig. 162). Remove two screws and lock washers, and lift off cover and gasket.

**b. Remove Armature** (fig. 163). Remove two screws and lock washers attaching armature to yoke, and lift off armature with hinged anchor plate and armature spacing plate.

## 65. CLEANING AND INSPECTION.

**a.** Clean all parts with dry-cleaning solvent. Dry with compressed air. Clean contact points of burning or oxidation, and examine them to see that they are smooth and clean.

**b.** Check coil leads for secure soldered connections and good insulation.

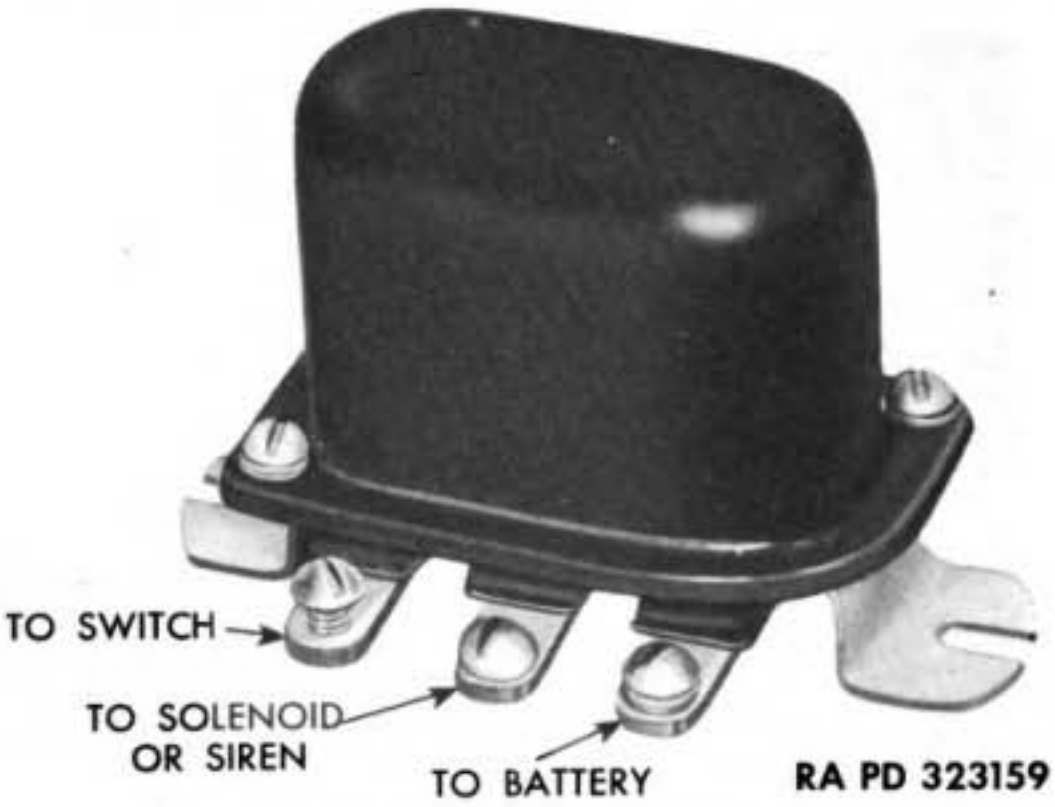


*Figure 160 — Solenoid or Siren Relay*

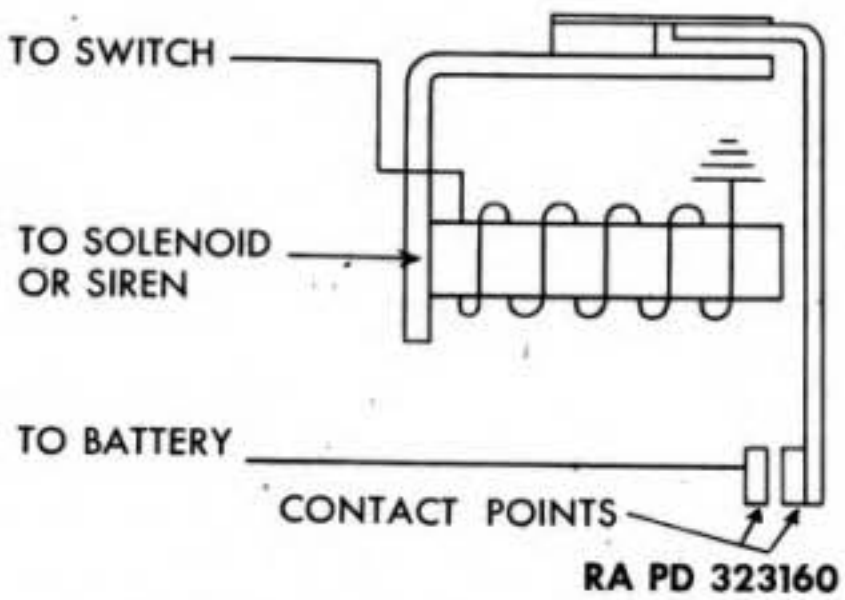


*Figure 161 — Relay Wiring Diagram*

**66. REPAIR** (figs. 164, 165, and 166).

**a.** If coil proves faulty, replace it with a new one. Melt solder at coil lead connections, and bend tongs to release leads. Remove nut and lock washer from lower end of core, and remove load terminal. Lift coil and core assembly from relay base. This assembly can readily be disassembled by pressing core with adjusting plate out of coil and yoke. Set new coil and core assembly in place on relay base. Be sure the locating pin in bottom of yoke fits into hole in insulation. Place load terminal on threaded end of core, and install nut and lock washer. Bend tongs over coil leads and solder wires to tongs. Use only noncorrosive soldering flux. Be sure joints are mechanically and electrically secure.

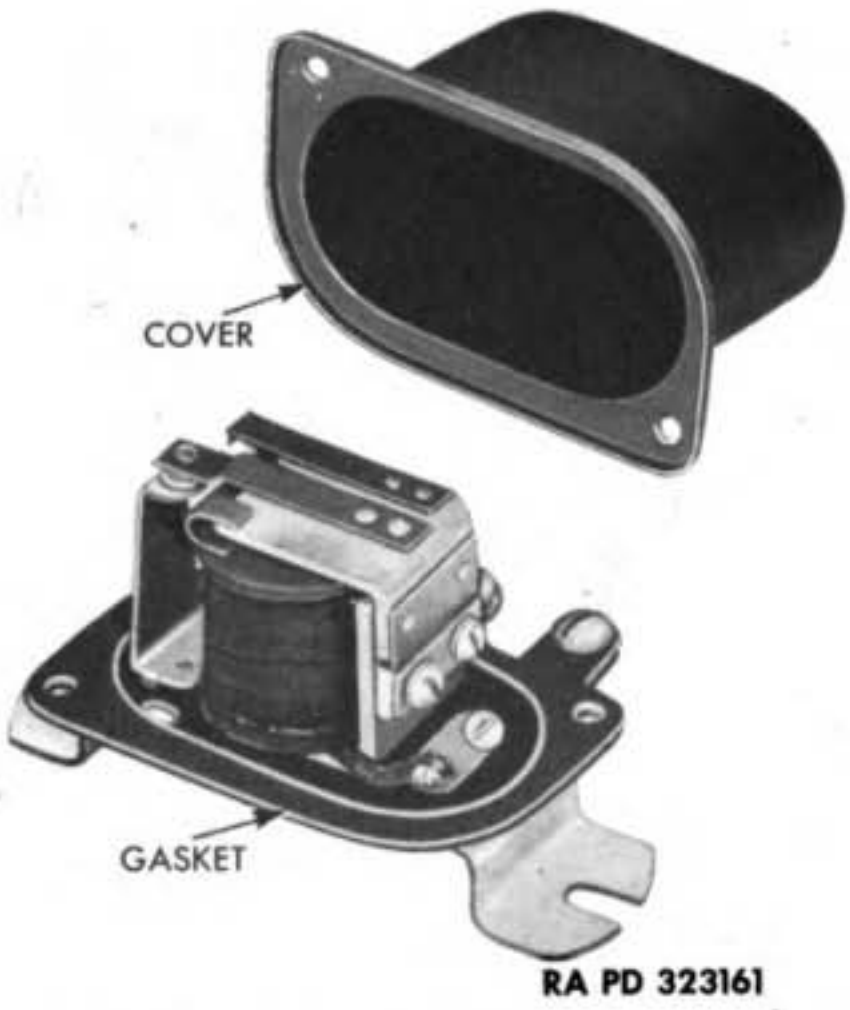


*Figure 162 — Relay Cover Removed*

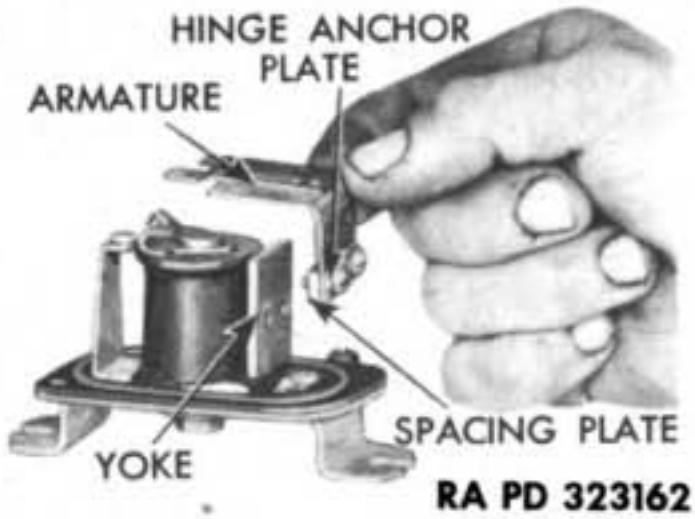


*Figure 163 — Removing Relay Armature*

## 67. ASSEMBLY.

**a. Install Armature** (fig. 163). Attach hinge anchor plate, armature, and armature spacing plate to yoke, in order mentioned, by installing two screws and lock washers. Do not tighten these two screws until contact points are adjusted (par. 68).

**b. Install Cover** (fig. 162). Set cover with gasket over relay base, and attach with two screws and lock washers.

## 68. ADJUSTMENT.

**a. Armature Air Gap** (fig. 167). With contact points just closed, the air gap between the armature and core must measure 0.020 inch. This setting is obtained by loosening the two round-head screws attach-

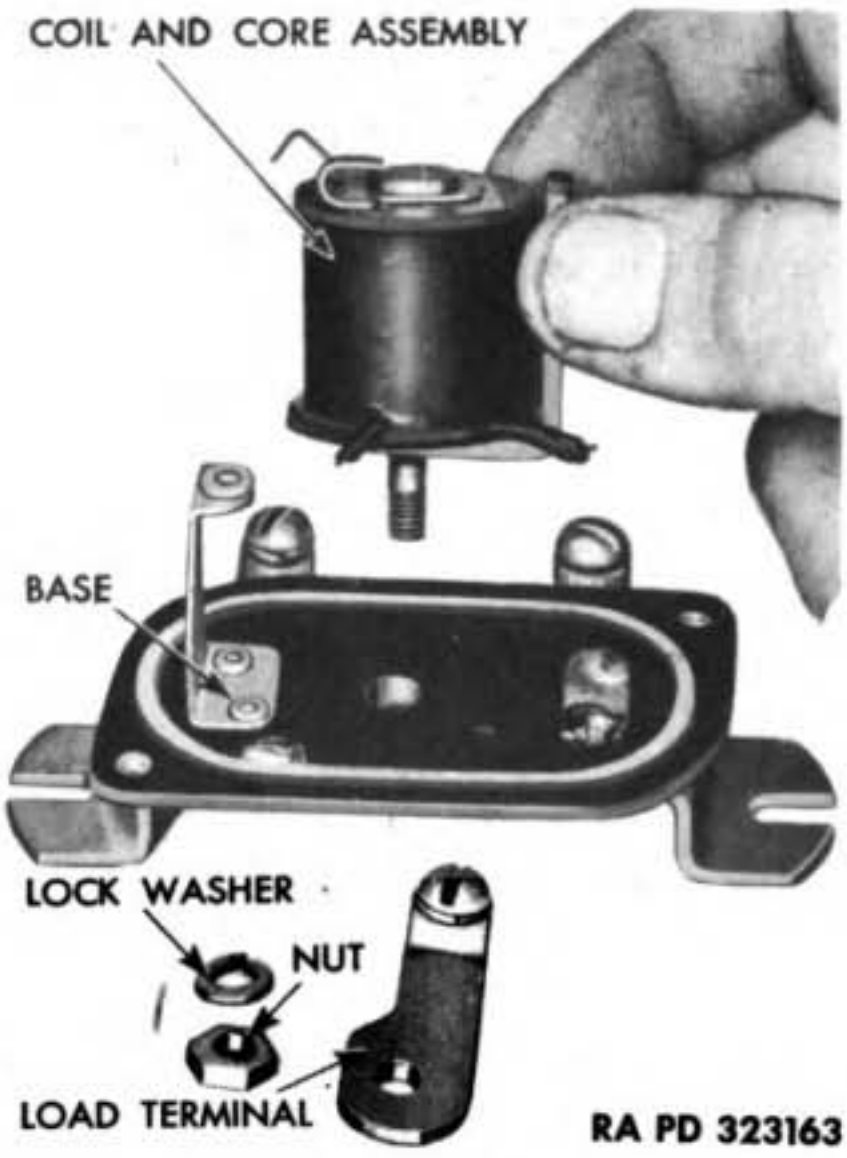


*Figure 164 — Removing Relay Coil and Core Assembly*

ing the armature to the yoke, and moving the armature up or down. Contact point alinement must be maintained during this operation.

**b. Contact Point Gap** (fig. 168). With armature in the up position the contact point opening must be 0.020 inch. This adjustment is made by bending the stop on adjusting plate. Be sure that spring pressure adjusting lip is high enough to exert a slight upward pressure on armature spring before checking point opening. Adjusting plate stop must clear armature in all positions except open position, where stop will limit opening of contact points.

## 69. TEST.

**a. Relay Operation** (fig. 170). Remove relay cover. Connect a 12-volt battery to the relay with rheostat connected in circuit. Connect one wire to switch terminal on relay, and other wire to relay base. Connect voltmeter across wires connecting relay. Adjust the rheostat to vary the voltage reading. The contact points should just close with a reading of 6 to 8 volts on the voltmeter. Bend adjusting lip (fig. 168) to accomplish this setting. The armature should pull down and touch the coil core by increasing the voltage above 8. This should happen before 10 volts register. At least a 1-volt lag should

## ELECTRICAL SYSTEM

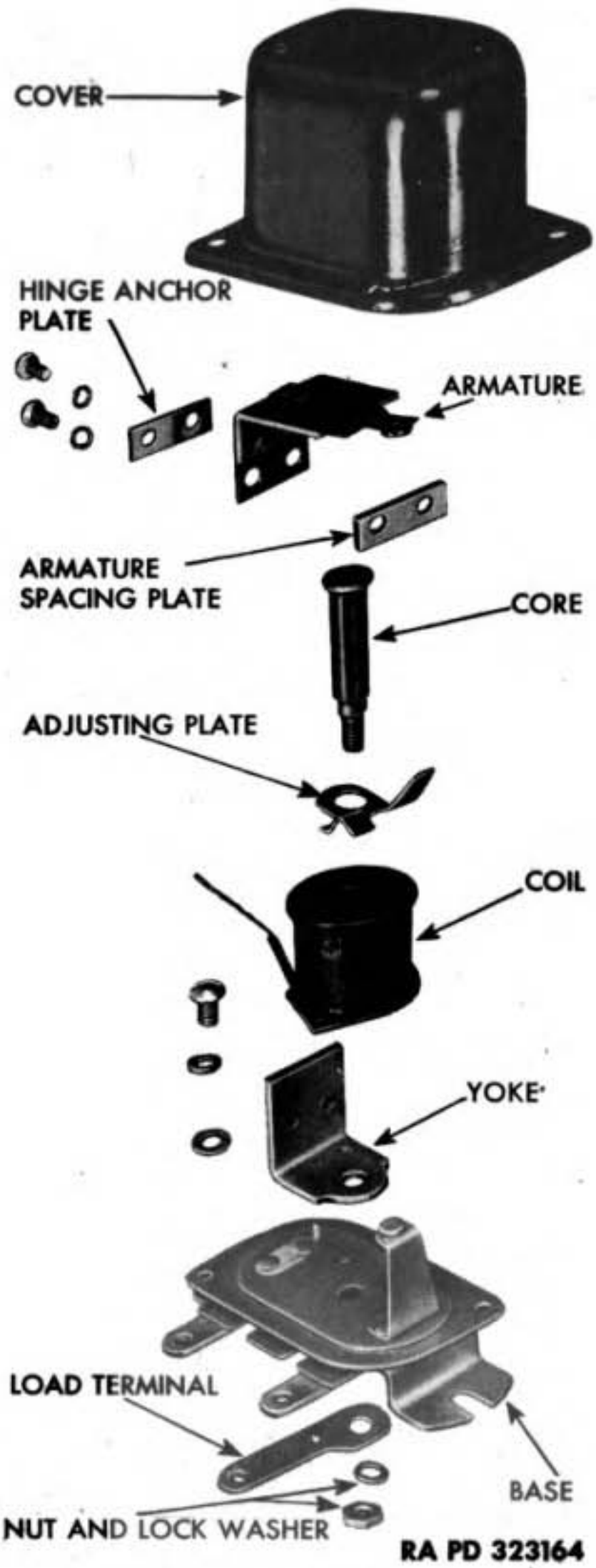


***Figure 165 — Relay Disassembled***

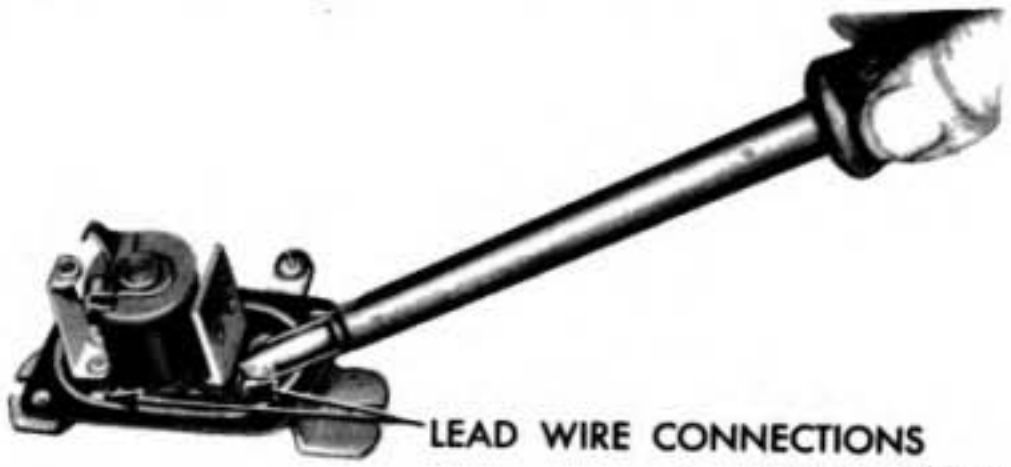


*Figure 166 — Soldering Coil Lead Wire*

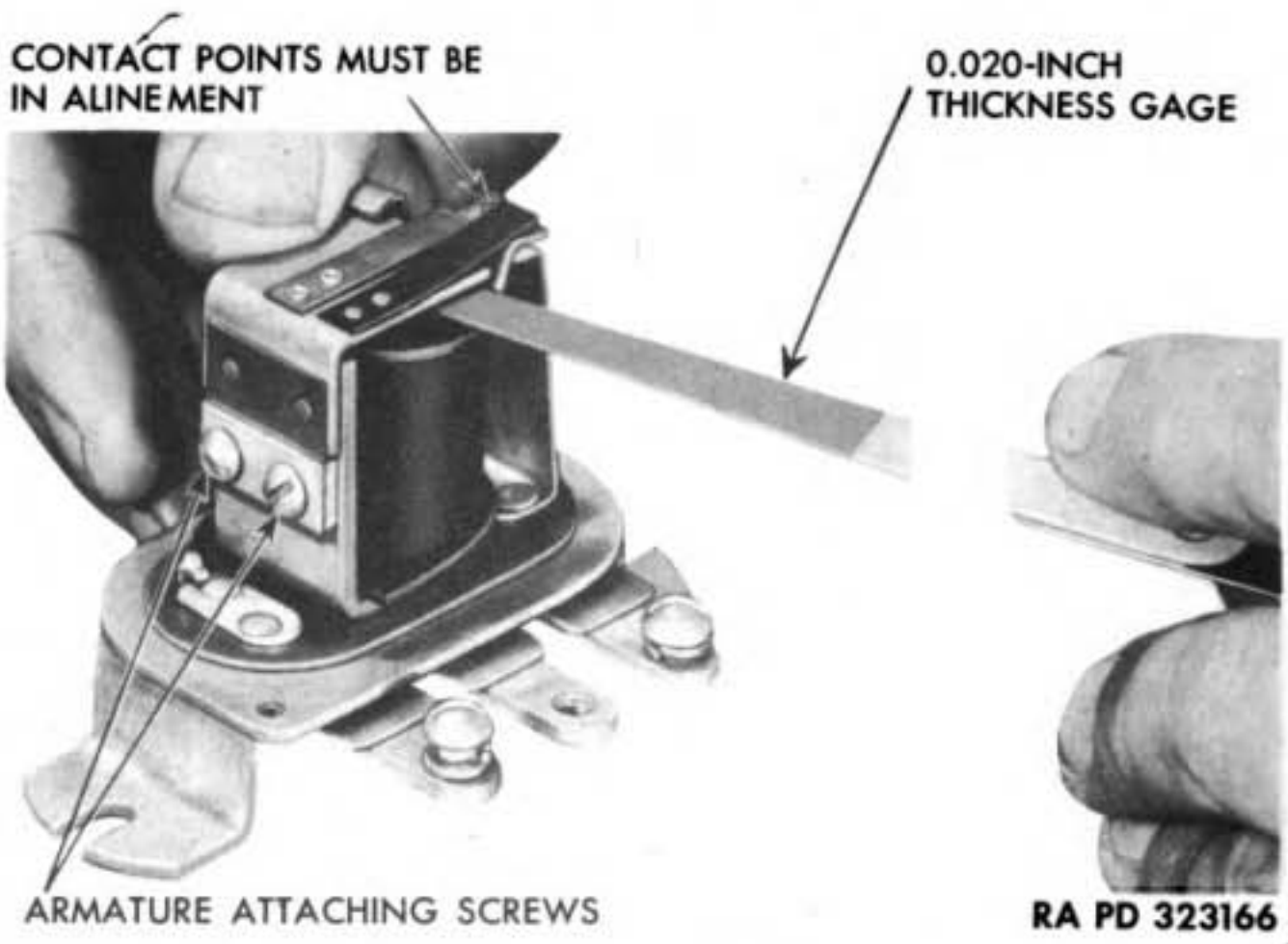


*Figure 167 — Measuring Armature Air Gap*

occur between contact point closing and the armature pulling against the core. Slight bending of the movable contact point arm or armature hinge may be required to obtain this setting.

**b. Coil** (fig. 169). Assuming coil is installed in relay: To make a thorough check of the coil for open circuit, melt the solder connection and disconnect the wire lead from the terminal tong farthest from the contact points. Use low voltage circuit tester (17-T-5575). Place one test point on coil lead which is still soldered to tong on base, and other test point on coil lead which is disconnected. If test light indicates a ground, check all insulated points and replace with new parts,

## ELECTRICAL SYSTEM

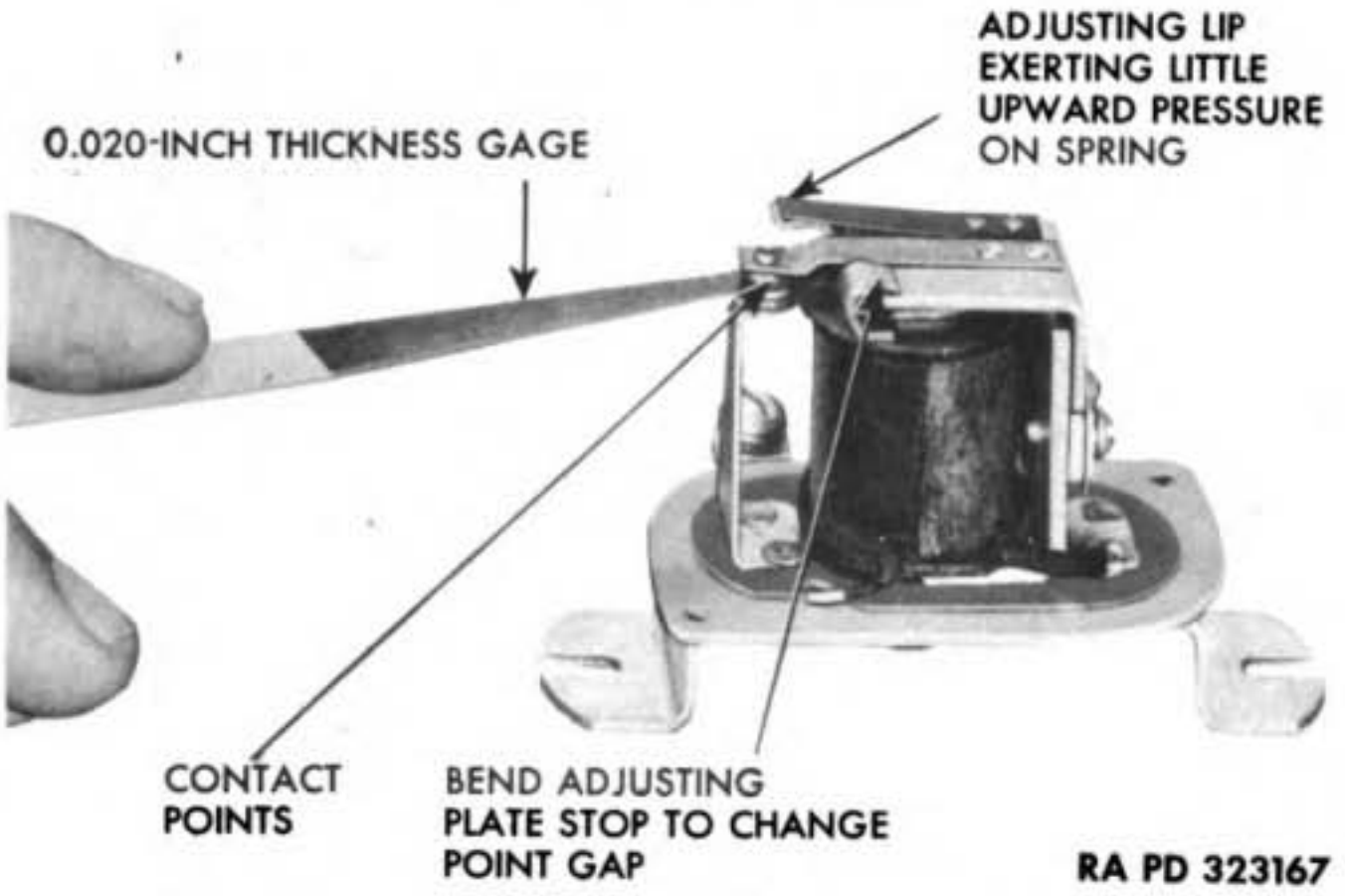


***Figure 168 — Measuring Contact Point Gap***

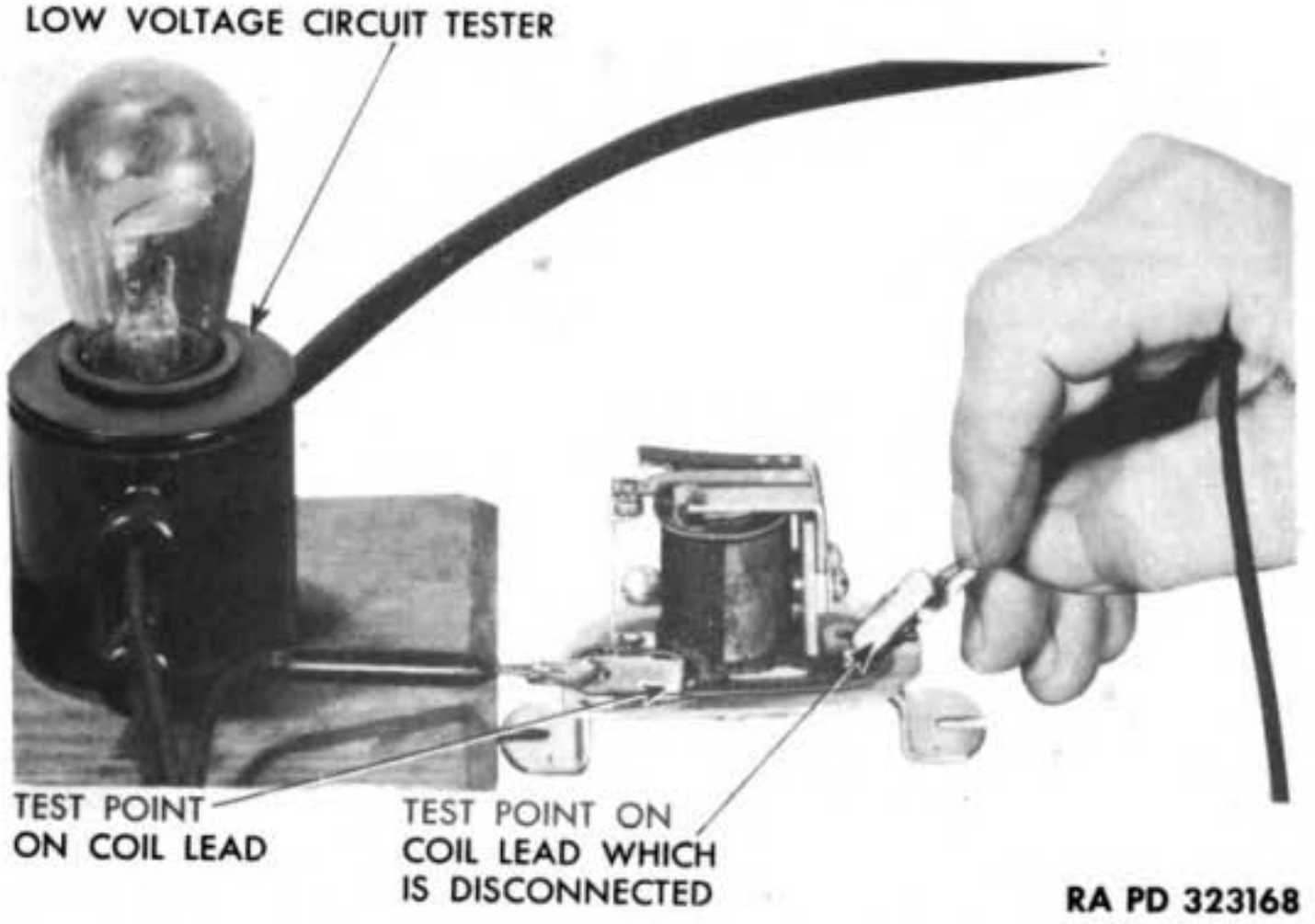


***Figure 169 — Testing Coil for Open Circuit, Using Tester (17-T-5575)***

where repairs cannot be made. Connect a test point to each coil lead. If light does not go on, coil is open and should be replaced with a new one.

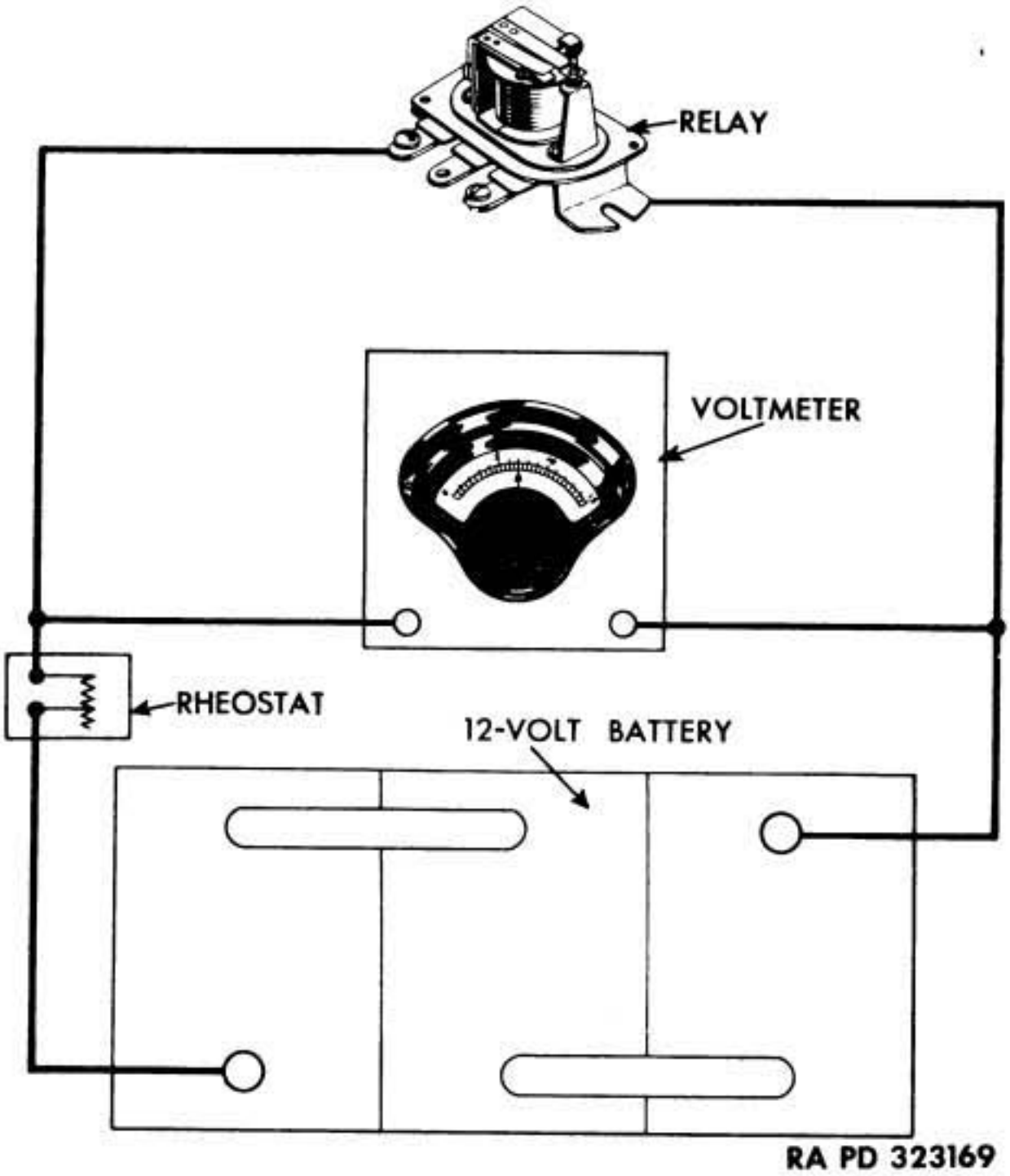


*Figure 170 — Wiring Diagram for Testing Relay Operation*

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Section VIII

## ELECTRIC BRAKE CONTROLLER



### 70. DESCRIPTION AND OPERATION (fig. 171).

a. The electric brake controller is mounted on top of the transmission cover on the right side. This controller supplies electric cur-

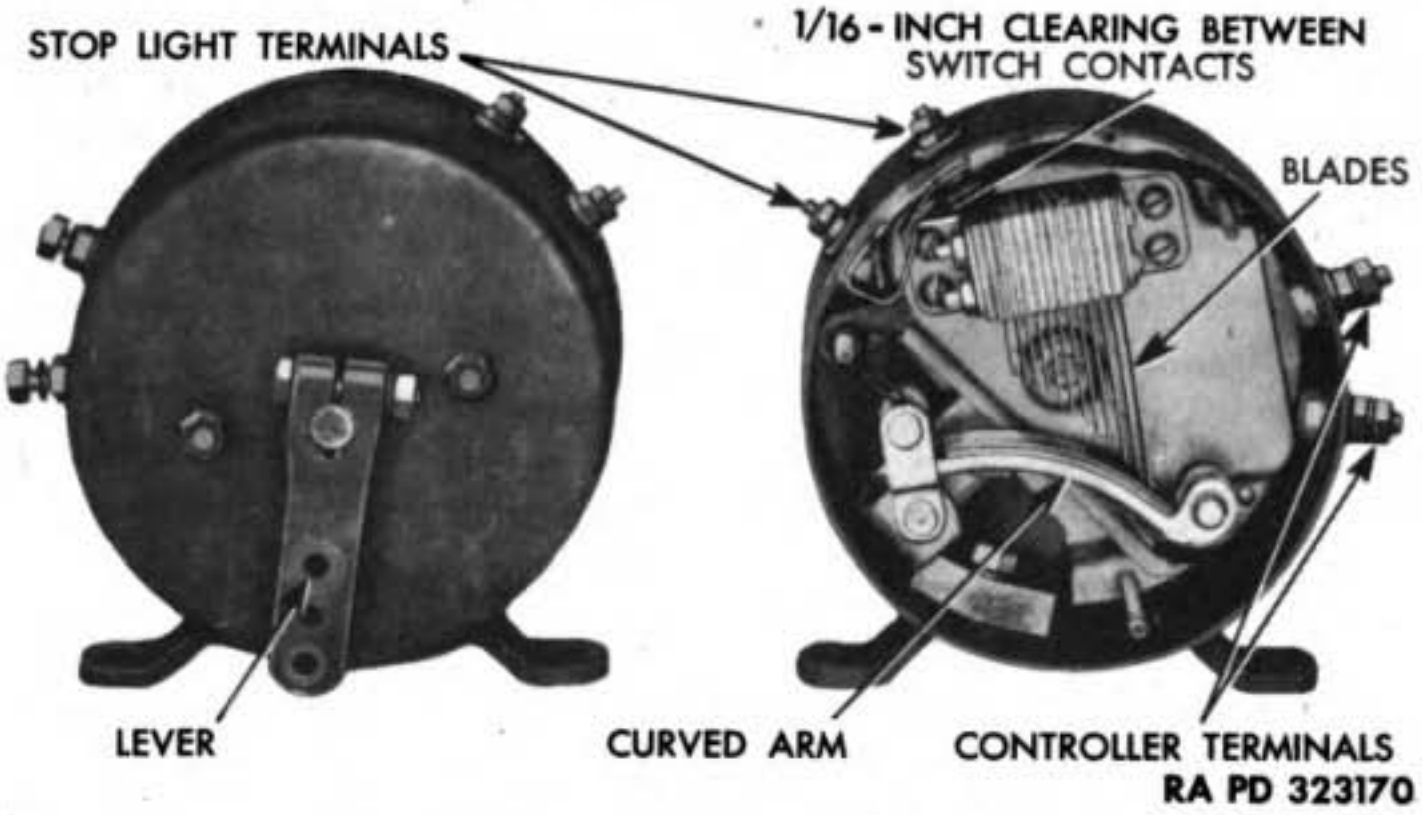


*Figure 171 — Electric Brake Controller*

rent to the towed-load electric brakes proportionate to the movement of the electric brake controller power cylinder. The power cylinder is operated by air pressure which is applied to the towed-load air brake system. Greater air pressure causes more movement in the power cylinder and electric brake controller, and more electric current will flow, thus increasing the braking effect on the towed load. In event of air failure, the controller can be operated manually by depressing the brake pedal. The pedal must be depressed about two-thirds of the way down before the controller begins to operate, and from there on down the controller supplies a flow of electric current in proportion to the movement of the pedal.

**b.** Moving the lever on the outside of the controller causes a curved arm in the controller to contact a series of variable length copper blades. These blades are all electrically connected in series by resistance coils. When the curved arm contacts the first blade, which is the longer, all the resistance coils are in the electric circuit, and little current flows. As the curved arm moves upward, it contacts the shorter blades, thus cutting out the resistance coils, and permitting greater current to flow. With this construction, the current flow is in proportion to the movement of the lever on the side of the controller. Also included in the controller is the trailer stop light switch, which makes contact whenever the curved arm contacts the blades.

## 71. DISASSEMBLY (fig. 172).

**a. Remove Cover.** Support controller in vise by clamping its mounting bracket. Remove three nuts and lock washers attaching cover, and pry cover off.

**b. Remove Stop Light Switch Parts.** Scratch outer side of stop light switch cam so it will be installed with same side out. Remove cam, cam spring, and cam spacer from cover screw. Remove two nuts and lock washers from each stop light switch terminal screw and drive screws out. Remove switch parts.

**c. Remove Controller Terminal.** Remove two nuts and lock washers from controller terminal, and drive out terminal screw. Remove insulators and washers.

## 72. CLEANING AND INSPECTION.

**a.** Clean all parts of controller with dry-cleaning solvent. Dry with compressed air.

**b.** Inspect copper blades and curved arm. If contact surfaces are dirty or corroded, scrape clean with a knife or other sharp tool.

**c.** Inspect stop light switch contacts, and scrape contacting surfaces clean.

**d.** Replace stop light switch cam spring if broken.

**e.** Inspect all soldered wire connections.

**f.** If the lever does not spring back to the stop when released, the return spring is broken inside the unit. This spring cannot be replaced in the field, as it is contained within a riveted assembly. Replace the complete controller.

## 73. REPAIR.

**a.** Solder any wire connections which are broken loose.

**b.** Straighten contact blades to make them all parallel. If there are breaks in the resistance coils, or if blades cannot be straightened, replace complete controller with a new one.

## 74. ASSEMBLY.

**a. Install Controller Terminal** (fig. 172). Insert controller terminal screw through contacts, lock plates, and inner insulator. Set this subassembly inside controller case with terminal screws through holes provided in case. Install contact insulator, terminal insulator, brass washer, and two nuts with lock washer between, on terminal screw. Place cam spacer on cover screw. Push cam and cam spring on cover screw with scratched side out. Compress long ends of cam spring until they clear clevis and rest on clevis pin.

**b. Install Cover.** NOTE: *See paragraphs 75 and 76 for adjusting and testing before installing cover.* Set cover on controller case

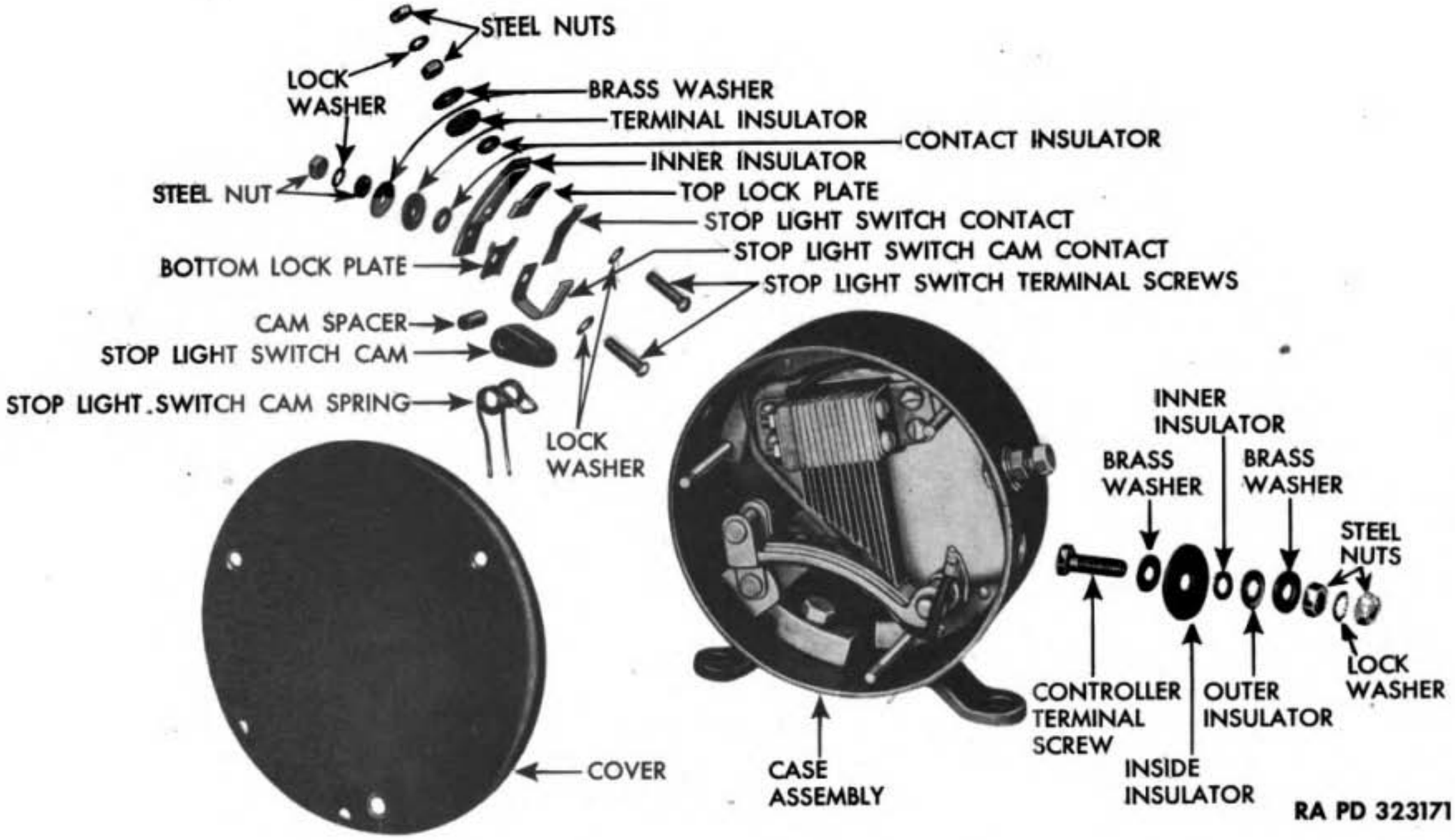


*Figure 172 — Electric Brake Controller Disassembled*

with drain holes at bottom. Install three nuts and lock washers on cover screws.

## 75. ADJUSTMENT.

**a. Stop Light Switch** (fig. 171). Remove cover. Bend copper stop light switch contacts with thin, flat-nosed pliers so there is $\frac{1}{16}$-inch clearance between the contacting surfaces.

## 76. TEST.

**a.** Connect 6-volt, 21-candlepower, single-contact lamp to a 6-volt battery, and connect the electric brake controller into the circuit. The lamp will not light when controller lever is released. Move the controller slowly through its full arc of application. The lamp will light to a glow; then increase in brightness in ten steps. If these results are not obtained, replace complete controller.

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### Section IX

# TOWED-LOAD COUPLING SOCKET



## 77. DESCRIPTION (fig. 173).

**a.** The coupling socket is located in the right rear side of the pintle hook housing. It has a cover assembly which is kept closed by a spring when not in use, to keep out dirt. Inside the socket are four blades which are held in place by four terminal bolts. When the cable plug assembly from the towed load is inserted into the socket, electrical contact is made with the four blades. These contacts connect to the taillight wire, the stop light wire, the brake operating wire, and the ground wire.

## 78. DISASSEMBLY (fig. 174).

**a.** Remove two steel nuts, brass washer, lock washer, brass nut, and plain washer from each of the four terminal bolts. Then remove 6 blades, terminal bolts, and insulating insert from case. Unscrew jam nut from cover bolt, and remove cover bolt and insulator.

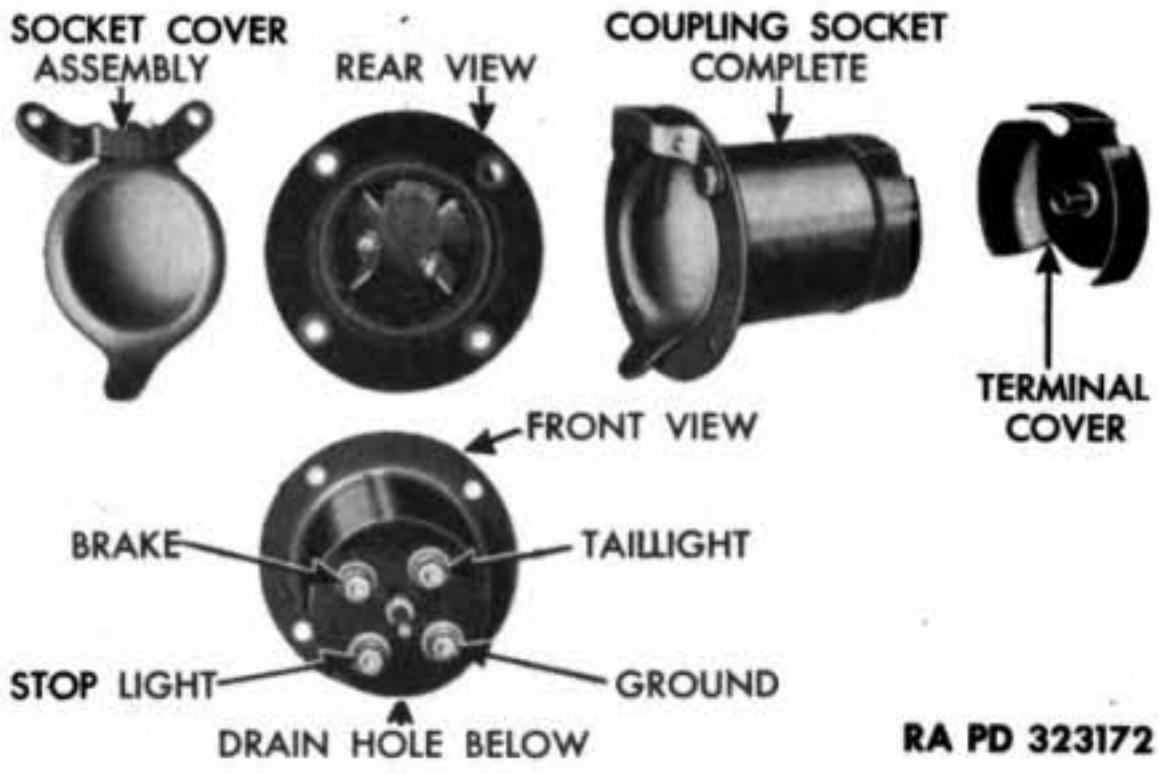


***Figure 173 — Towed-load Electric Coupling Socket***

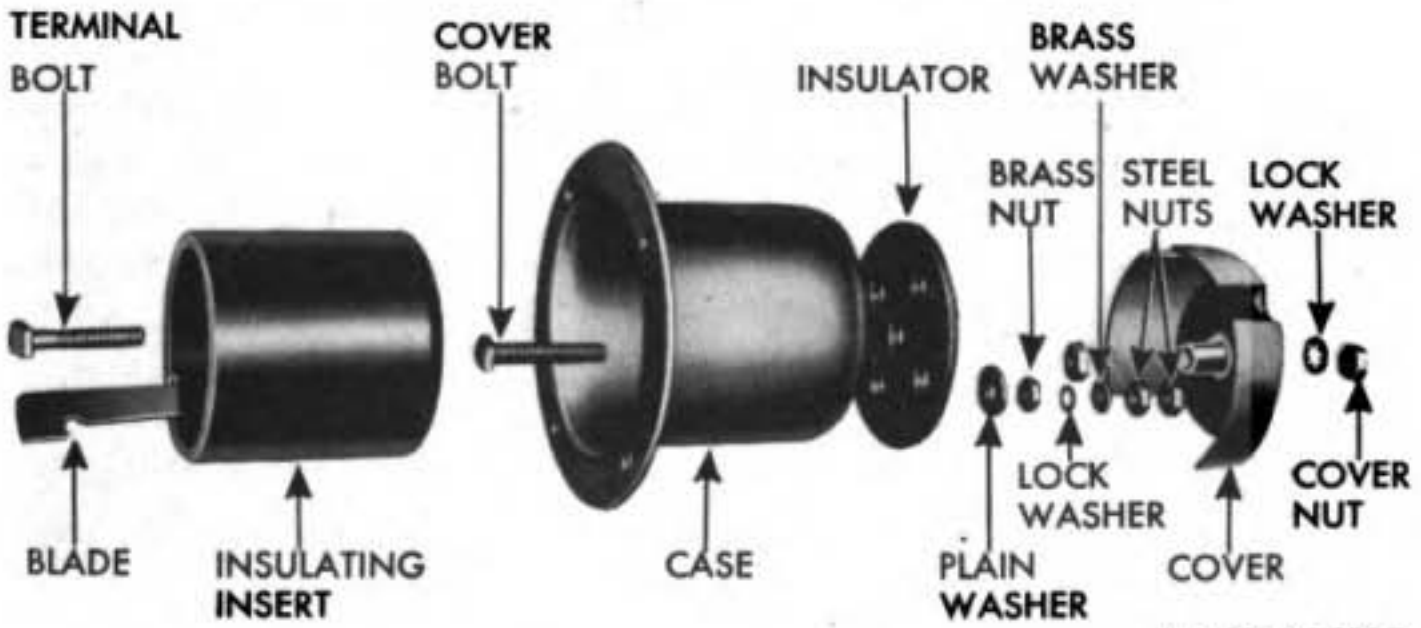


***Figure 174 — Towed-load Electric Coupling Socket, Disassembled***

## 79. CLEANING AND INSPECTION.

**a.** Clean all parts with dry-cleaning solvent. Dry with compressed air.

**b.** Inspect four blades for wear. Replace if elongated edge of blade is worn to knife edge. Replace if circular groove is worn in each side of blade to one-half the thickness of the metal.

**c.** Inspect insulating insert, and replace with a complete new socket assembly if cracked or damaged.

## 80. ASSEMBLY (fig. 174).

**a.** Place insulator on end of case with lettered side out. Insert cover bolt through center hole in case and insulator. Then turn jam

nut down on cover bolt, but do not tighten. Place insulating insert into case so that the drain hole at the inner end of the large groove lines up with the drain hole in the case (fig. 173). Turn the insulator on the outside of case so that when facing the terminal end with the drain hole in the case facing down, the stop light terminal will be on the left, and the ground terminal on the right of center (fig. 173). Line up the terminal holes and push insulating insert, case, and insulator together. Insert terminal bolt in hole in blade, and set blade in slot provided in insulating insert with terminal bolt through hole in insert. Install plain washer and brass nut (with locking surface out) on the terminal bolt. Install remaining three blades, terminal bolts, brass nuts, and plain washer. Install lock washer, brass washer, and two steel nuts on each terminal bolt.

# CHAPTER 5

# AIR SYSTEM

## Section I

## DESCRIPTION



### 81. DESCRIPTION (figs. 175 and 176).

**a.** The engine clutch, clutch brake, towed-load air brakes, towed-load electric brake controller, and windshield wiper, are all operated by compressed air from the air system. At the rear of the vehicle is an air outlet which provides a supply of compressed air for such uses as inflating tires. A pressure gage on the instrument panel indicates the air pressure in the system. When the air pressure is below 60 pounds, and the ignition switch is on, a buzzer operates below the cowl, indicating low air pressure. Air pressure is controlled by a pressure control valve which is mounted on top of the compressor. It regulates the pumping cycle of the compressor to maintain a pressure of approximately 80 to 100 pounds in the system. A safety valve opens at 172 to 178 pounds to bleed off excess pressure should the control valve fail to perform its function. Seamless steel tubing is used throughout the air system. This tubing is covered with a protective loom, and is connected by compression tube fittings.

**b.** A belt-driven, rotary-type air compressor is supported on a bracket mounted to the distributor side of the engine. It is cooled by the engine cooling system. All the intake air entering the air system must first pass through the engine air cleaner, where it is cleaned. From the air cleaner it is drawn into the air compressor, where it is pumped under pressure to the two air reservoir tanks. The tanks are connected in series, which means that the air must first pass through one tank and then the other. The moisture which collects in these tanks is removed through drain cocks by pulling up on a drain control rod located below the right center platform door. From the tanks the air passes through a separator, where the remaining moisture is separated, and then to the manifold. The manifold is the common feeder for the tubes or flexible hoses supplying compressed air to three branches of the air system; namely, the engine clutch branch, the trailer brake branch, and the windshield wiper, air pressure gage, and low pressure indicator branch.

**c.** The engine clutch branch of the air system consists of the clutch shifting valve which controls the operation of the two clutch

## ORDNANCE MAINTENANCE — POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)

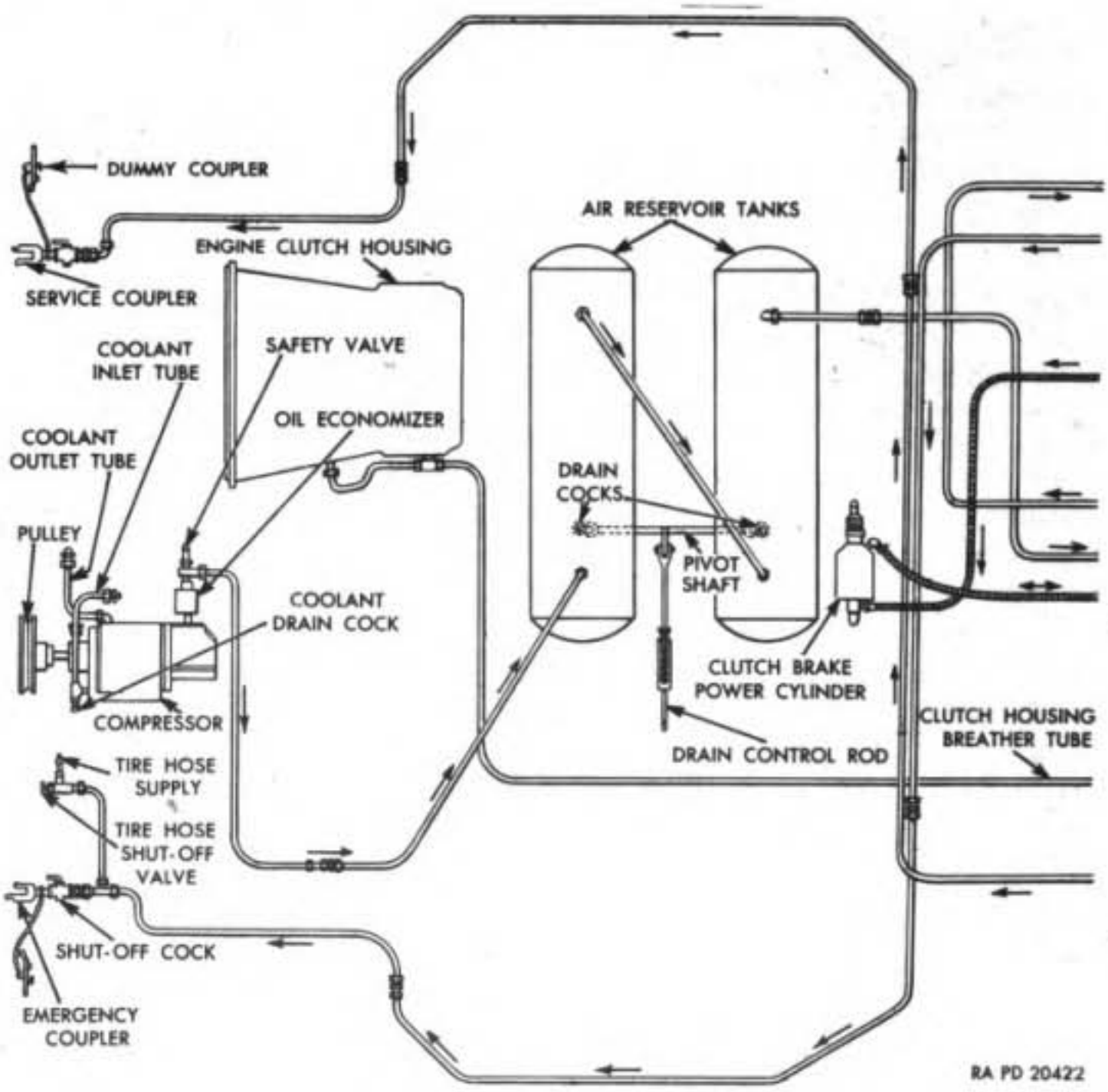


***Figure 175 — Air System Diagram, Rear Half***

shifting power cylinders, and the clutch brake application valve which controls the operation of the clutch brake power cylinder.

**d.** The trailer brake branch of the air system includes the air and electric brake control valve which controls the air pressure to the service coupler located at the rear of the vehicle, and the electric brake controller power cylinder. The service coupler is connected to the towed-load brake system by a trailer air brake hose. The electric brake controller power cylinder operates the electric brake controller, causing a greater or lesser flow of electric current to the trailer electric brakes, as the air pressure in the brake system is increased or decreased. A two-way valve is connected in the air brake system. This valve automatically closes on either one of two seats, depending on which direction the air is flowing. When it is closed on one seat, it prevents the air in the brake system from escaping past the front service coupler,

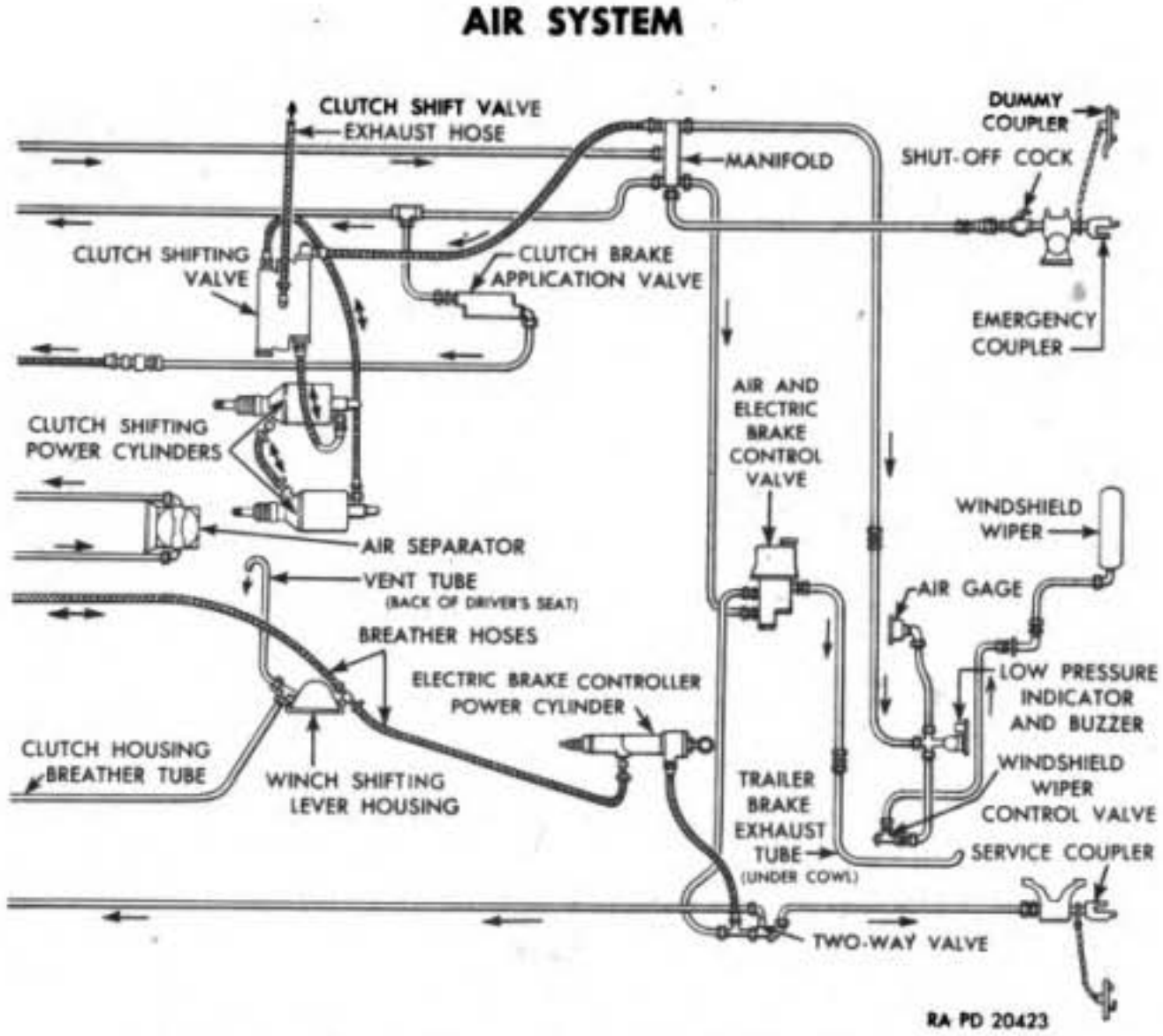


***Figure 176 — Air System Diagram, Front Half***

and when it is closed on the opposite seat, the air entering the front service coupler will bypass the vehicle air system and go directly to the service coupler at the rear of the vehicle. Tubing connects the air manifold to the emergency couplers located at the front and rear of the vehicle. A shut-off cock is located ahead of each emergency coupler. Directly ahead of the rear shut-off cock is a branch tube leading to the tire hose supply. Directly ahead of the front shut-off cock is a one-way valve which allows compressed air to pass into the system, but not out.

**e.** The third branch of the air system connects the air manifold to the windshield wiper, air pressure gage, and low pressure indicator.

**f.** As was mentioned above, there are four power cylinders used in the air system: two for operating the dual engine clutch, one for operating the clutch brake, and one for operating the electric brake controller. The construction of these power cylinders requires that they breathe air in and out of the cylinders on the low pressure side of the pistons when they operate. Therefore, to assure the entrance of only clean air, the clutch brake power cylinder and electric brake controller power cylinder are connected by breather hoses to the winch shifting lever housing. This housing is open to the transmission and differential, and is connected by vent tubes to the clutch housing and

gear reduction unit housing. Another vent tube located in back of the driver's seat and also connected to the winch shifting lever housing, permits breathing into the atmosphere. The two clutch cylinders breathe into each other because they always operate in opposite directions.

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## Section II

# AIR COMPRESSOR



### 82. DESCRIPTION (fig. 177).

**a.** The air compressor is a rotary-type manufactured by Wagner Electric Corporation. It is belt-driven off the front end of the crankshaft, and is cooled by the engine cooling system. The air compressor assembly includes integral units which perform functions other than compressing air; namely, a pressure control valve to regulate the pumping cycles, an oil economizer to effect air and oil separation, and a self-contained pressure oiling system.

**b.** Basically, the compressor consists of a cylindrical stator with two end plates and a rotor which spins on its axis within the stator. The rotor is centered on and revolves with a shaft suspended in bearings located in either end plate. The shaft is alined so that it is centered horizontally, and off-center vertically, in relation to the stator. The rotor is of smaller diameter than the stator, and the shaft alinement is such that the rotor just clears the stator at the bottom, while the top clearance is large. Four rotor blades, equally spaced on the rotor periphery, slide in slots located in the rotor so that the trailing edge of each blade forms an acute angle with the stator wall. Springs and push pins are located in each rotor slot, cushioning the movements of the rotor blades. Parts are machined to tolerances so exacting that gaskets are not needed between mating surfaces. A film of oil provides an effective seal between moving parts so that air under pressure will

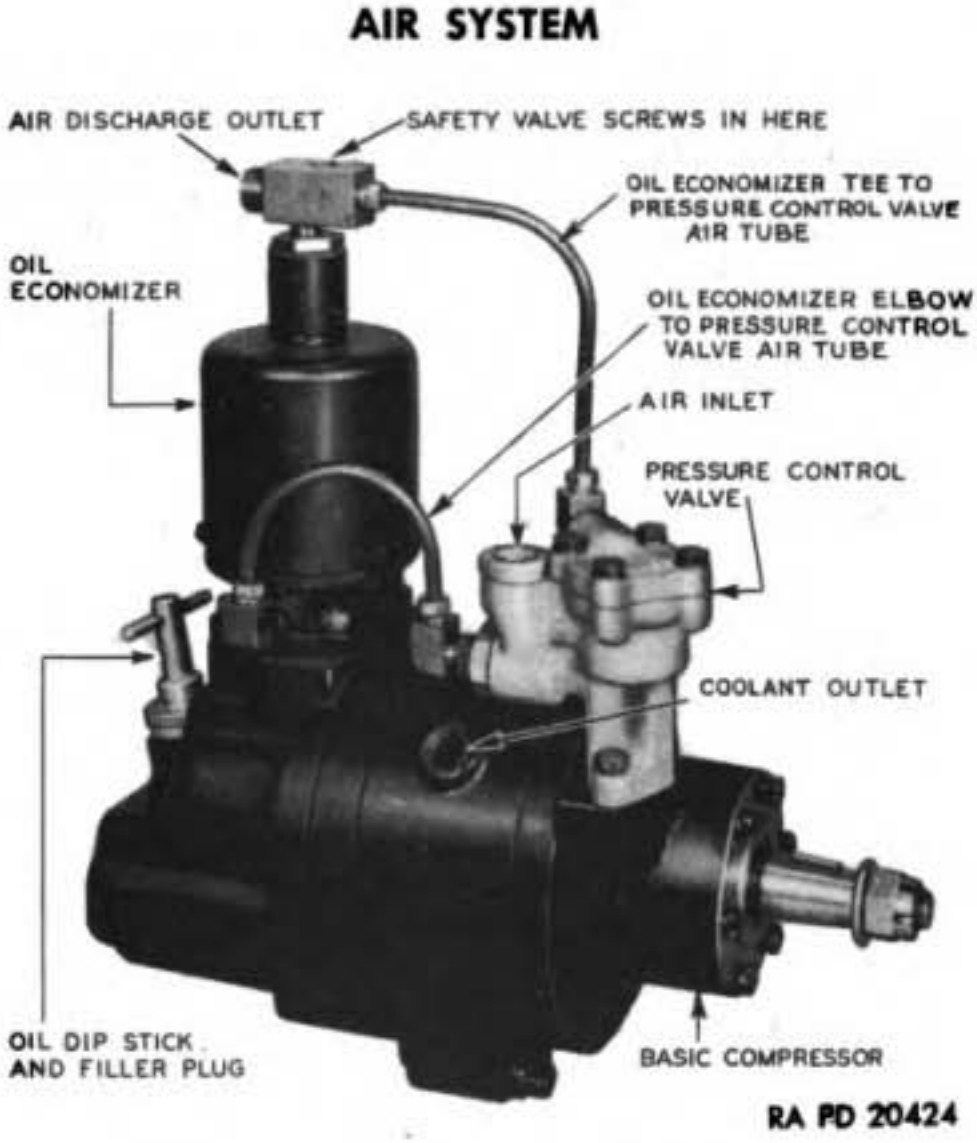



***Figure 177 — Air Compressor***

not escape. A rotary oil seal is used to prevent the oil from leaking out through the clearance between the drive end plate and shaft.

**c.** The pressure control valve consists of a body casting which mounts on a boss provided on the stator drive end plate. Contained within the valve body proper is the pressure regulating spring, shut-off piston, piston diaphragm, and dome unloading piston, seat, and spring.

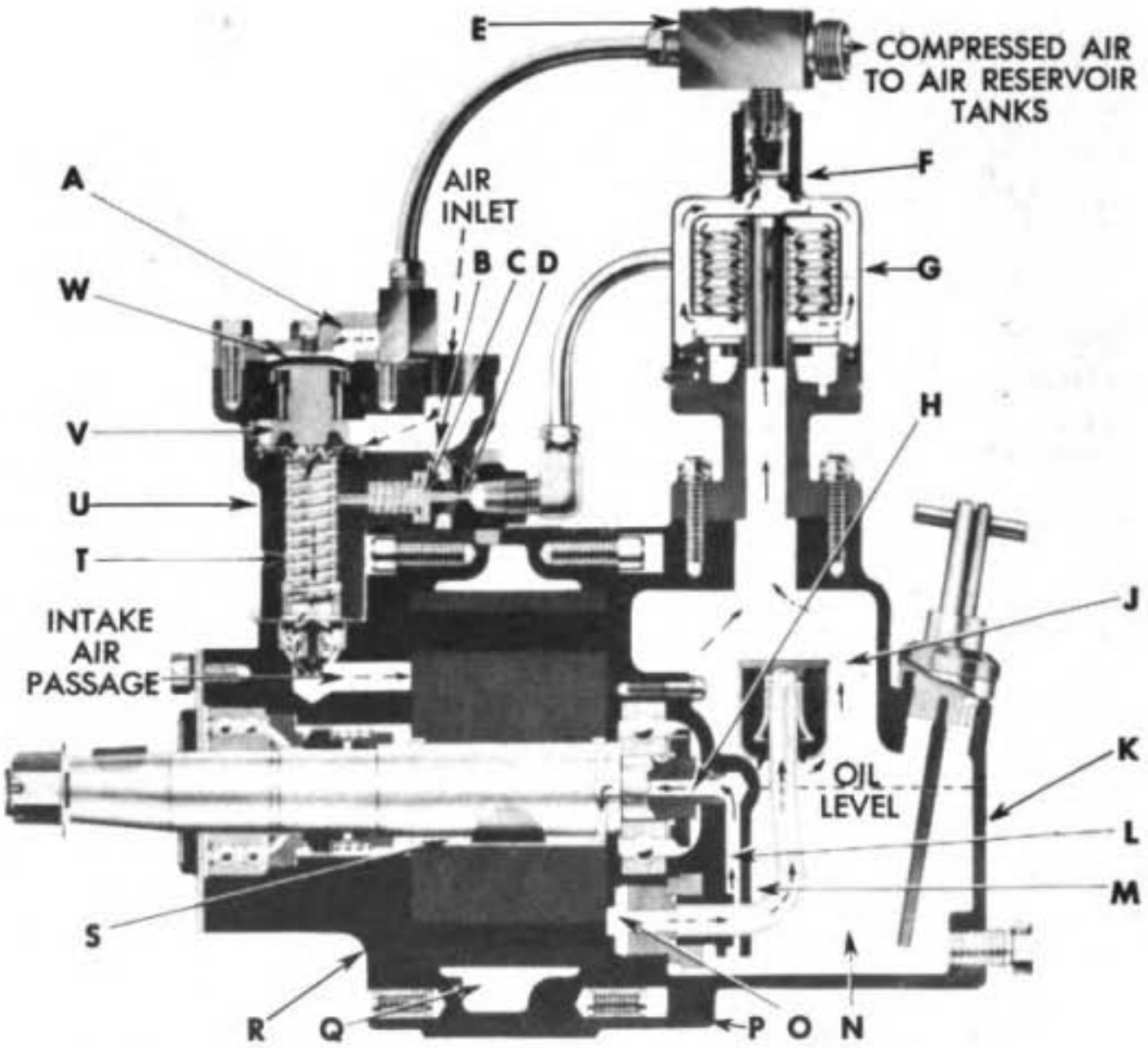
**d.** The oil economizer mounts on bosses provided on the oil dome, which is attached to the stator dome end plate. The economizer consists of a mounting base and tank with outlet fitting at the top. Contained within the outlet fitting is the outlet check valve. Inside the tank is the inner shell and oil baffle plate.

**e.** The pressure control valve and oil economizer are connected by two external tube assemblies, completing the rotary compressor assembly.

## 83. OPERATION.

**a. Air Compression** (figs. 178 and 179). As the rotor revolves, the four rotor blades move outward and inward in relation to the rotor axis, according to the clearance between the rotor and the stator. The rotor blades thereby maintain constant contact with the stator. As the clearance between the rotor and stator lessens, the space between the

**ORDNANCE MAINTENANCE — POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**




A—RESERVOIR TANK AIR PRESSURE
B—BY-PASS TO AIR INLET
C—DOME RELIEF PISTON
D—BY-PASS PORT
E—TEE
F—OUTER CHECK VALVE
G—OIL ECONOMIZER
H—RIFLE DRILLED ROTOR SHAFT
J—OIL-MISTED AIR
K—OIL DOME
L—OIL PASSAGE
M—DOME BEARING CAP
N—OIL SUMP
O—AIR ESCAPE PORT
P—STATOR DOME END PLATE
Q—WATER JACKET
R—STATOR DRIVE END PLATE
S—KEYWAY (PERMITS OIL TO GET TO END PLATES)
T—CONTROL VALVE SPRING
U—PRESSURE CONTROL VALVE
V—PISTON
W—DIAPHRAGM

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***Figure 178 — Cross Section of Air Compressor, Pressure Control Valve, and Oil Economizer — Side View***

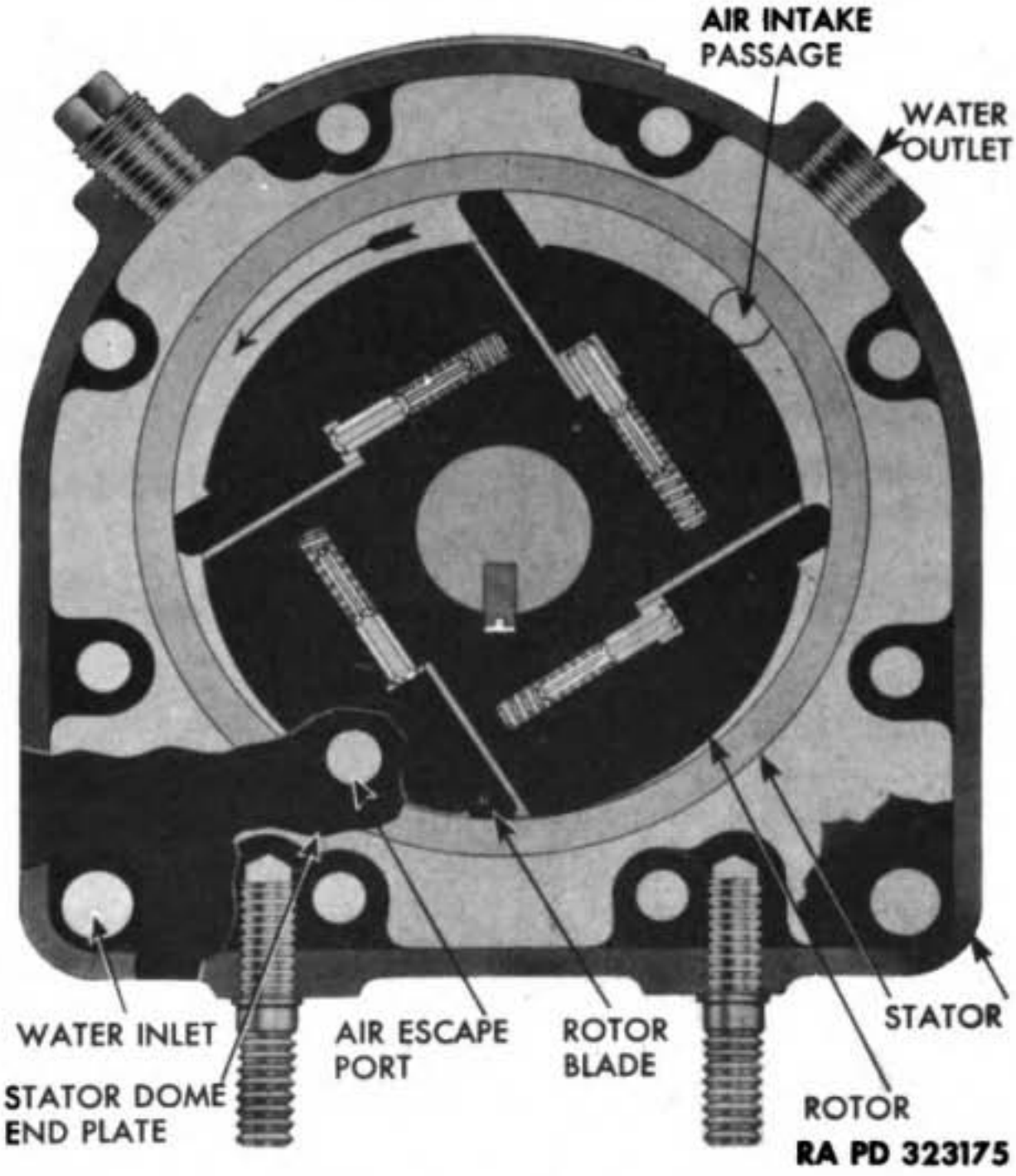


***Figure 179 — Cross Section of Air Compressor Rotor and Stator***

blades is reduced. Air trapped between the blades is compressed and forced out of the stator through an escape port in the dome end plate. As the clearance between the rotor and stator increases, the space between the blades, rotor, and stator increases, forming a vacuum. Atmospheric pressure forces air through the intake passages in the control valve and drive end plate, and into this space, where compression takes place.

**b. Compressor Lubrication** (fig. 178). Air pressure within the compressor, except at the dome end plate air escape port, is always lower than the air pressure in the upper part of the oil dome. This pressure differential forces the oil from the oil sump in the oil dome, through an oil passage in the dome bearing cap. Oil is then forced from the bearing cap through the rifle drilled passages in the rotor shaft, and through the rotor keyway to each end plate, where it is impelled between the end plates, rotor, and rotor blades. Here the oil not only

**ORDNANCE MAINTENANCE — POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

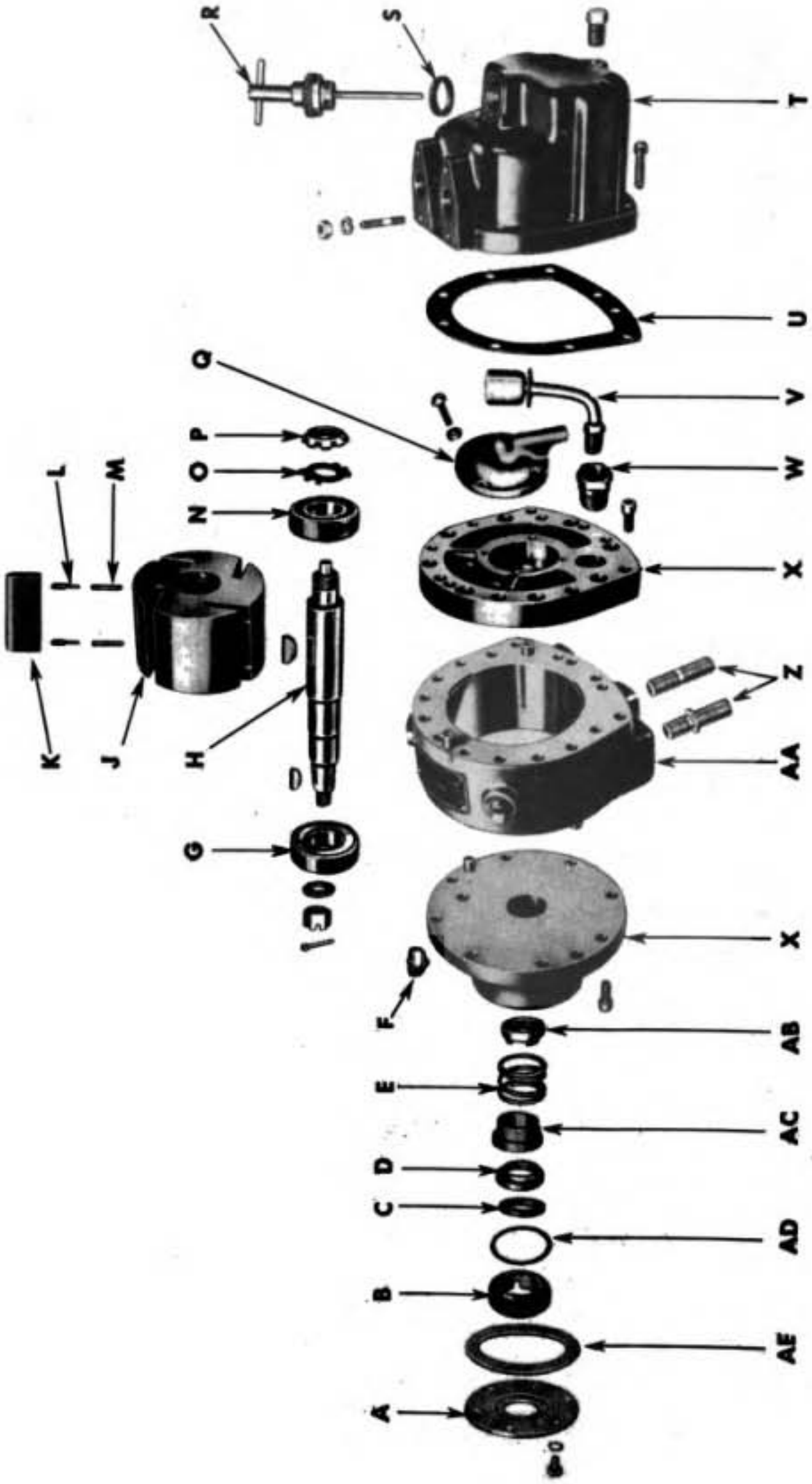


*Figure 180 — Air Compressor Disassembled*

A—SEALING CAP
B—SEALING RING NUT
C—CARBON SEALING RING
D—RUBBER SEALING RING
E—SEALING RING SPRING
F—INLET CHECK VALVE
G—STATOR DRIVE END PLATE BEARING
H—ROTOR SHAFT
J—ROTOR
K—ROTOR BLADE
L—ROTOR BLADE PIN
M—ROTOR BLADE SPRING
N—DOME END BEARING
O—LOCK WASHER
P—LOCK NUT
Q—ROTOR SHAFT DOME END BEARING CAP
R—FILLER PLUG
S—FILLER PLUG OIL SEAL
T—OIL DOME
U—DOME GASKET
V—OIL SEPARATOR WITH TUBE
W—FITTING
X—STATOR DOME END PLATE
Y—DOWEL PINS
Z—MOUNTING STUDS
AA—STATOR
AB—SEALING RING SPRING COLLAR
AC—SPRING RETAINER
AD—NUT GASKET
AE—CAP GASKET

RA PD 323176B

*Legend for Figure 180*

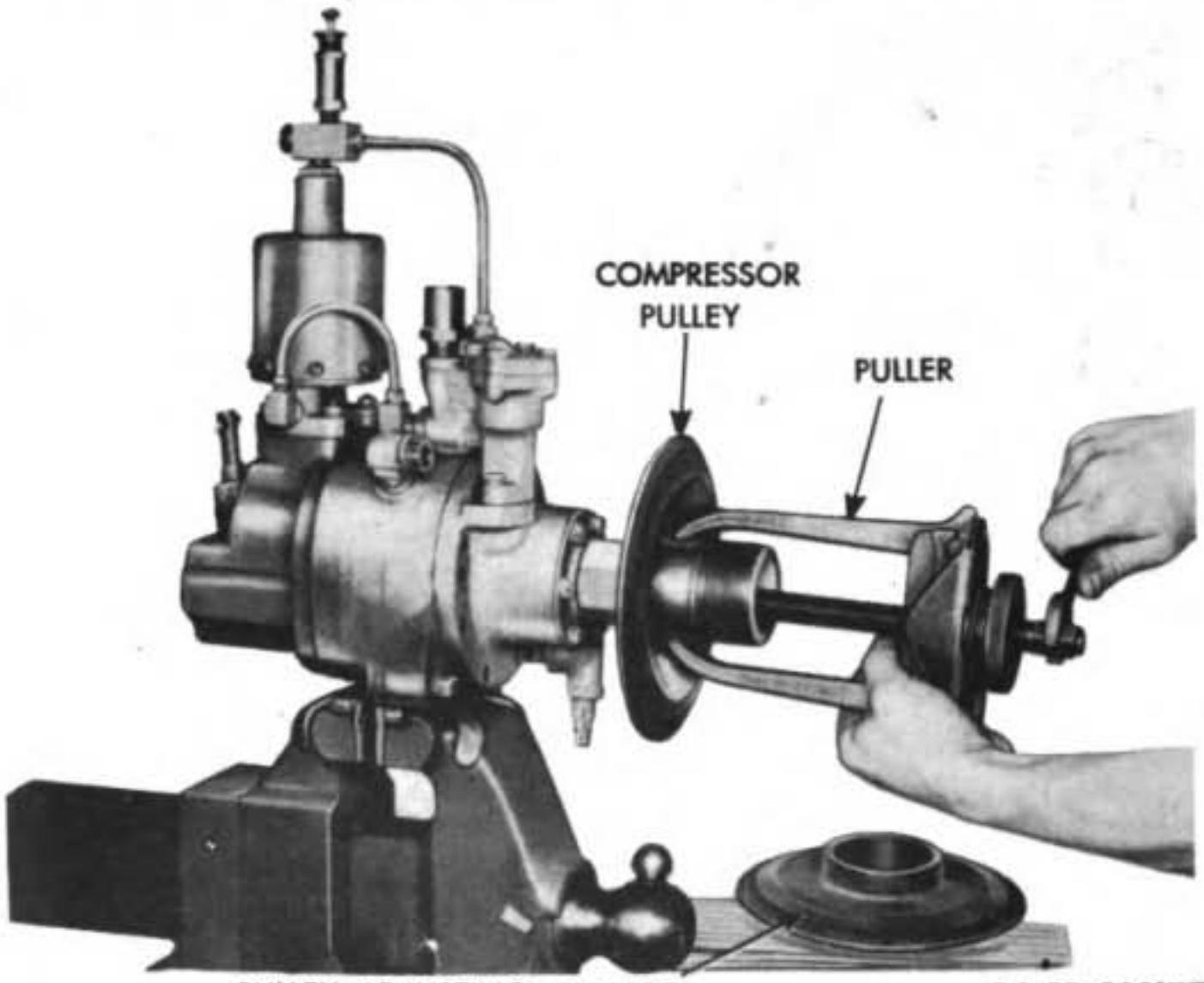


*Figure 181 — Removing Compressor Pulley, Using Puller (41-P-2912)*

lubricates, but also seals the chambers between the rotor blades and stator so that the air under compression does not escape. The oil is carried with the compressed air, through the air escape port in the dome end plate, and into the oil dome.

**c. Oil Economizer** (fig. 178). As the oil-misted air is discharged from the oil dome, it passes into the oil economizer where the oil is removed from the air by passing the mixture through a series of baffles contained in the inner shell. The air is then discharged through the outer check valve located in the outlet fitting at the top of the economizer. After the air passes the outer check valve, it goes through a tube to the air reservoir tanks where it is stored. When the compressor reaches shut-off pressure and the dome and economizer are unloaded, the oil which is accumulated in the economizer is returned to the oil dome.

**d. Pressure Control Valve** (fig. 178). The diaphragm in the pressure control valve is at all times under reservoir tank air pressure. This pressure is maintained through the air tube which connects the tee over the oil economizer to the pressure control valve. When the

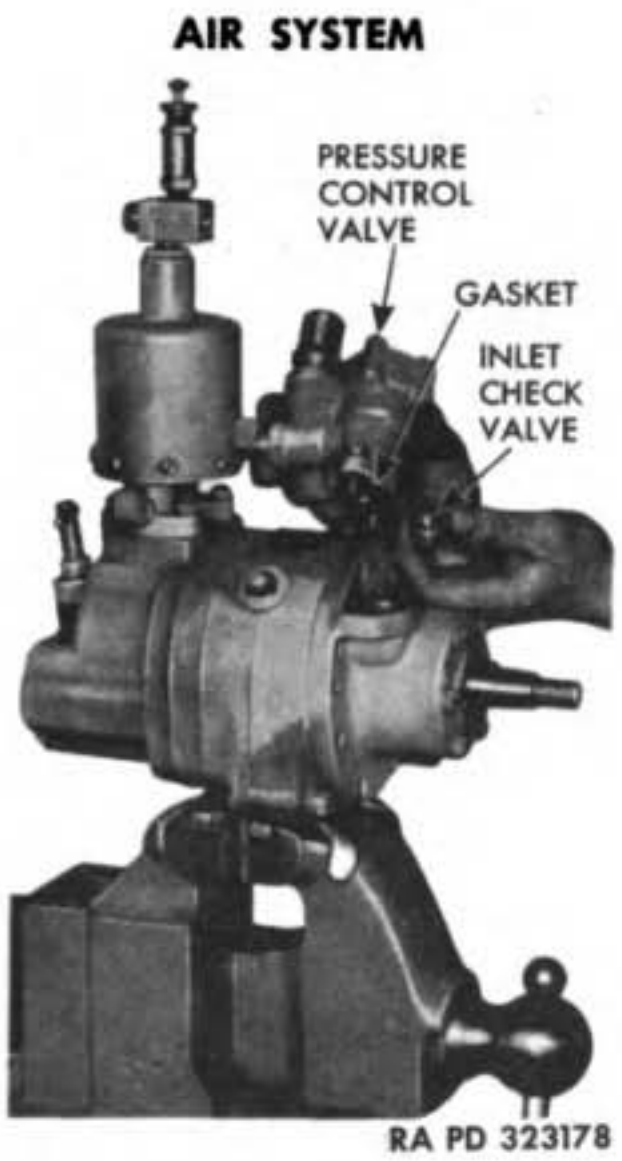


***Figure 182 — Removing Pressure Control Valve and Inlet Check Valve***

reservoir air pressure is raised to the pressure at which the control valve is set, it overcomes the compression of the control valve spring and the diaphragm is forced downward, causing the valve piston to seat on the valve body insert, closing the air inlet passage, and creating a high vacuum in the lower inlet passage; then air compression is stopped. The vacuum unbalances the dome relief piston, which moves against the tension of the piston spring and allows the piston to seat on the insert, opening a by-pass. The by-pass port is connected to the oil dome through an air tube, which permits the air pressure which is held in the oil dome and economizer to discharge through the by-pass and air inlet passage.

## 84. DISASSEMBLY.

**a. Compressor** (fig. 180).

(1) CLAMP COMPRESSOR IN VISE. Remove the two compressor mounting studs nearest the drive pulley end (studs have the locating flanges). Clamp the remaining two studs in the vise to hold compressor during disassembly.

(2) DRAIN OIL. Remove oil filler plug and oil drain plug.

(3) REMOVE COMPRESSOR PULLEY (fig. 181). Unscrew adjusting flange from pulley. Remove cotton pin, castellated nut, and washer

**ORDNANCE MAINTENANCE — POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**


***Figure 183 — Removing Oil Economizer with Tee and Safety Valve***


***Figure 184 — Removing Oil Dome***

## AIR SYSTEM

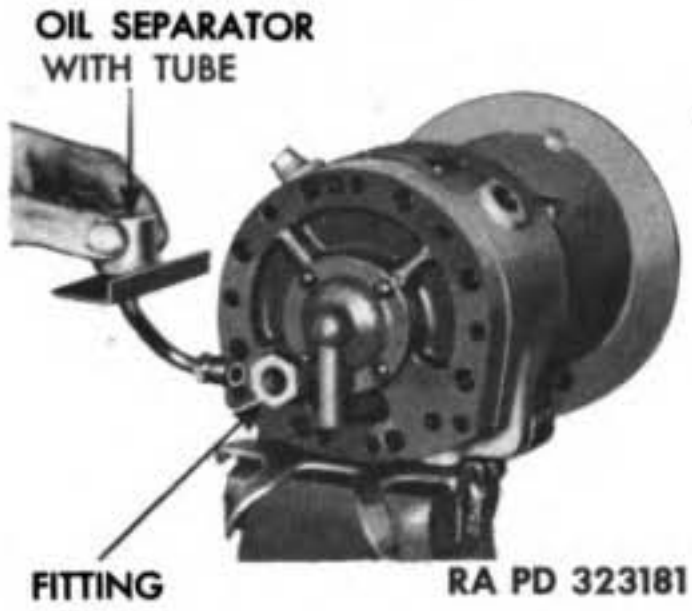


***Figure 185 — Removing Oil Separator with Tube***

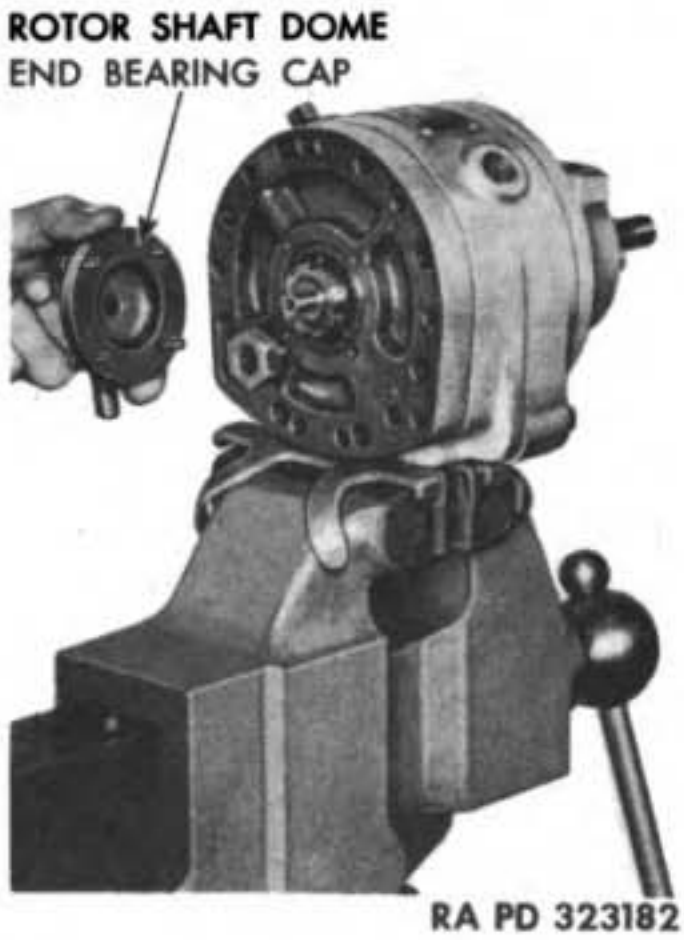


***Figure 186 — Removing Rotor Shaft Dome End Bearing Cap***

from end of compressor rotor shaft, and pull pulley off with gear puller (41-P-2912). Remove Woodruff key.

(4) REMOVE BOTH AIR TUBES (fig. 182). Unscrew fitting nuts attaching ends of tubes.

(5) REMOVE PRESSURE CONTROL VALVE AND INLET CHECK VALVE (fig. 182). Remove two cap screws and lock washers securing valve to stator drive end plate, and lift off pressure control valve and gasket. Use a small screwdriver between the check valve and seat to lift out inlet check valve.

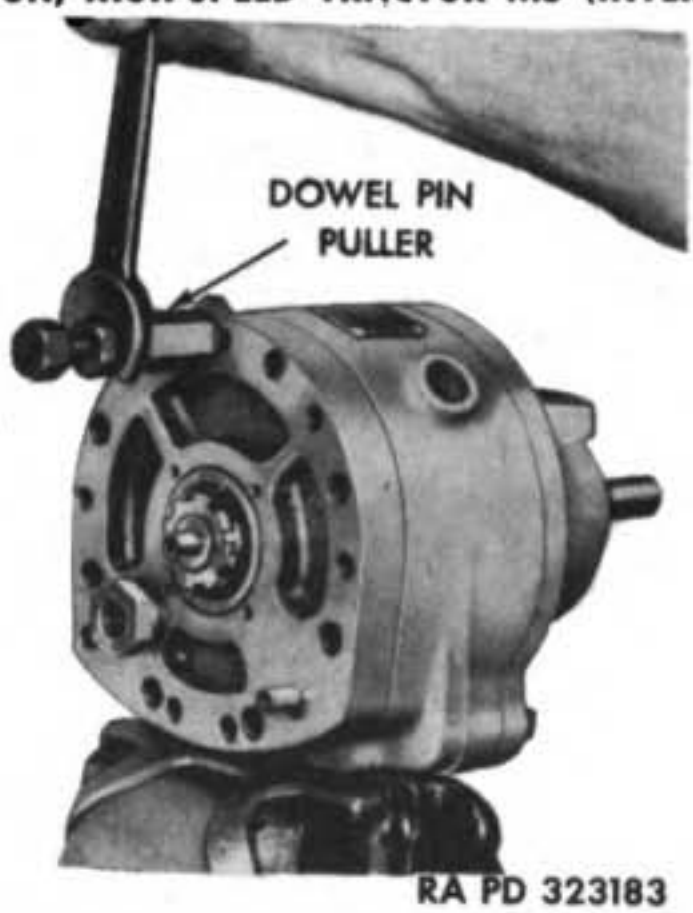


*Figure 187 — Pulling Dowel Pin from Stator Dome End Plate, Using Dowel Pin Puller*




*Figure 188 — Locating End Plate Puller (41-P-2907-197) for Removing Stator Dome End Plate, Rotor, and Shaft Unit*

(6) REMOVE OIL ECONOMIZER (fig. 183). Unscrew four nuts and lock washers securing oil economizer base to oil dome. Lift off oil economizer and gaskets.

(7) REMOVE OIL DOME (fig. 184). Take out nine cap screws attaching oil dome to stator dome end plate. Remove oil dome and gasket.

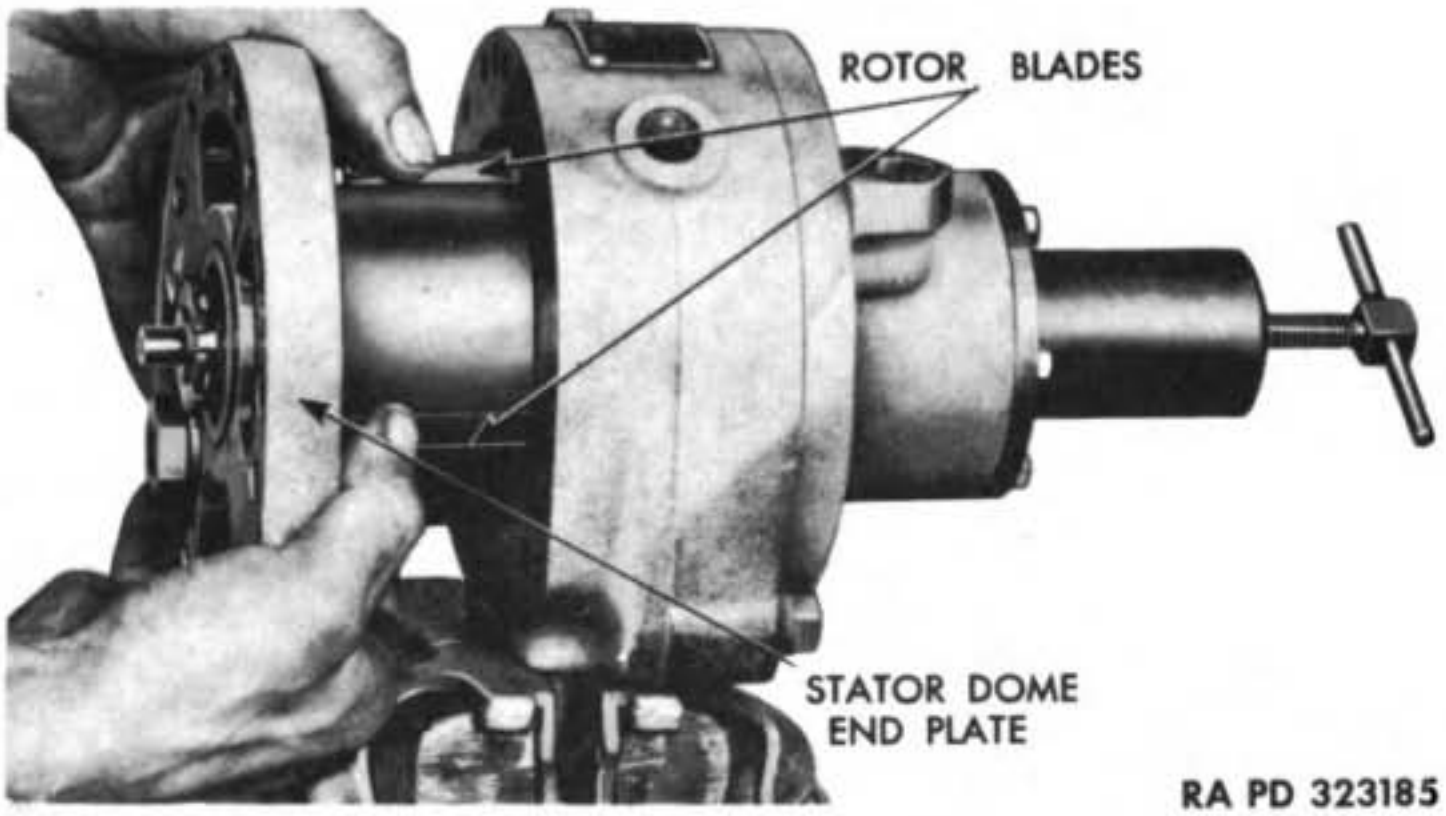


*Figure 189 — Removing Stator Dome End Plate, Rotor, and Shaft*

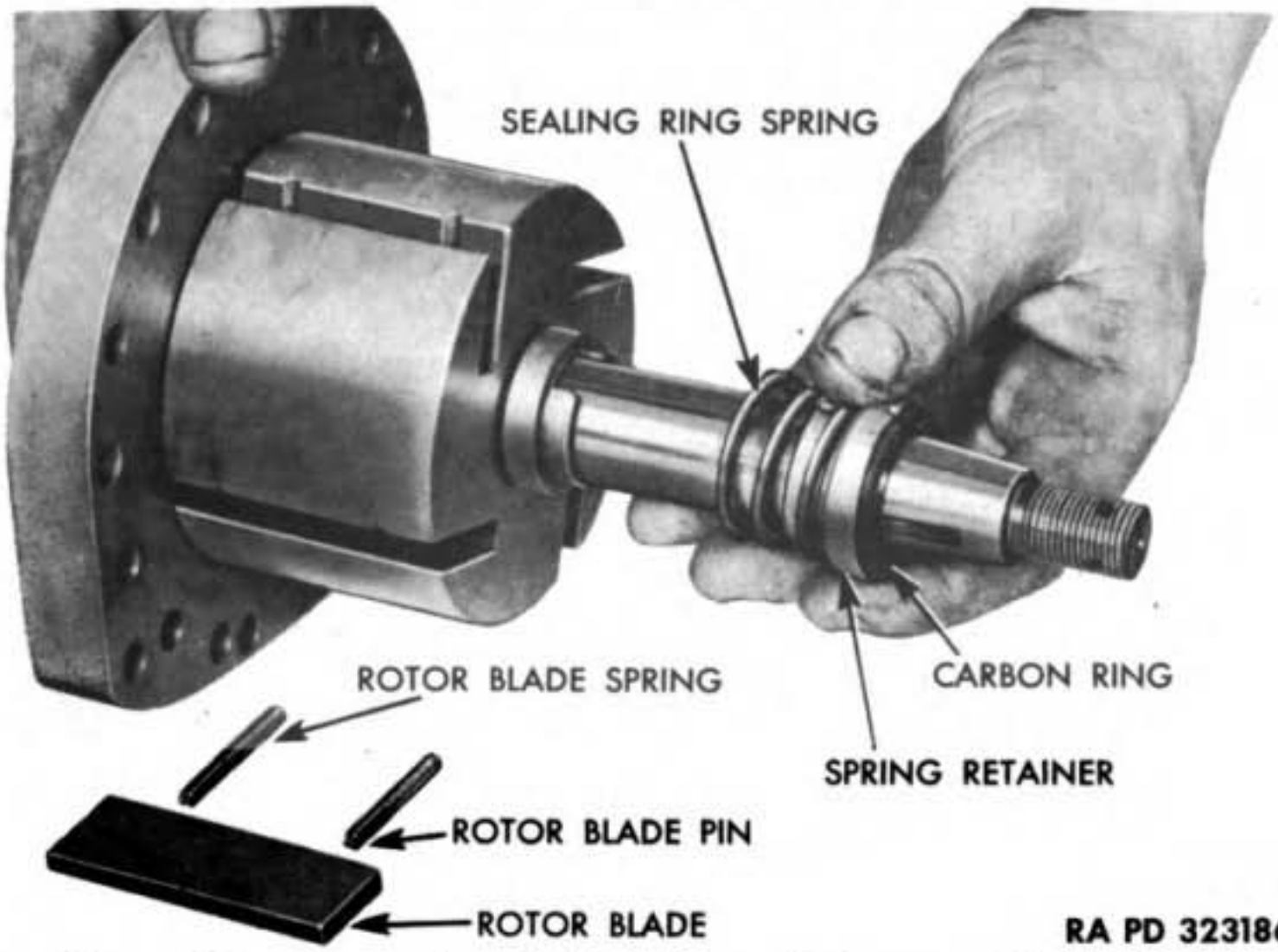


*Figure 190 — Removing Sealing Rings, Spring, and Spring Retainer*

(8) REMOVE OIL SEPARATOR WITH TUBE (fig. 185). Unscrew tube nut from fitting in stator dome end plate.

(9) REMOVE ROTOR SHAFT DOME END BEARING CAP (fig. 186). Remove four machine screws and lock washers attaching bearing cap to rotor dome and plate.

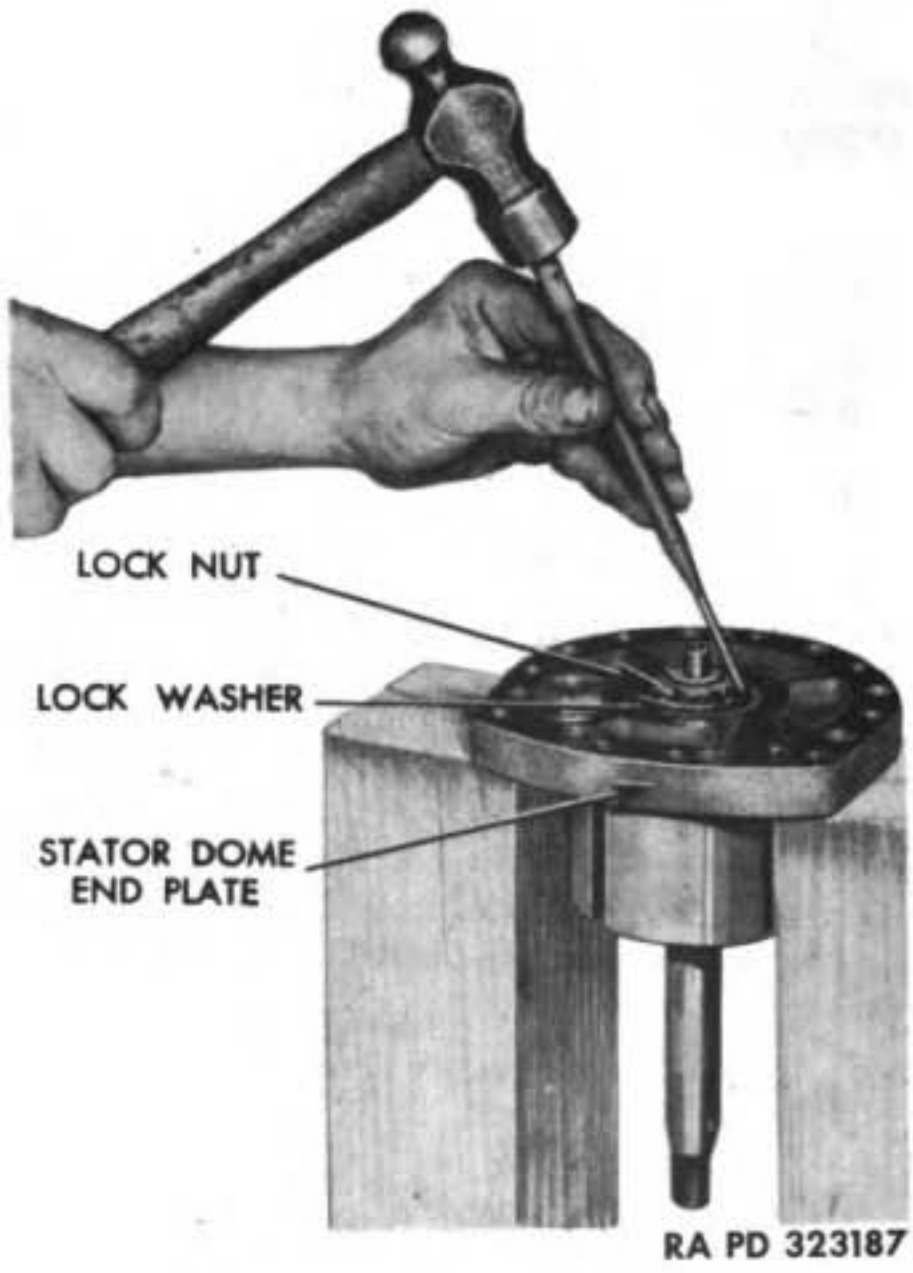


*Figure 191 — Releasing Lock Washer from Ball Bearing Lock Nut*

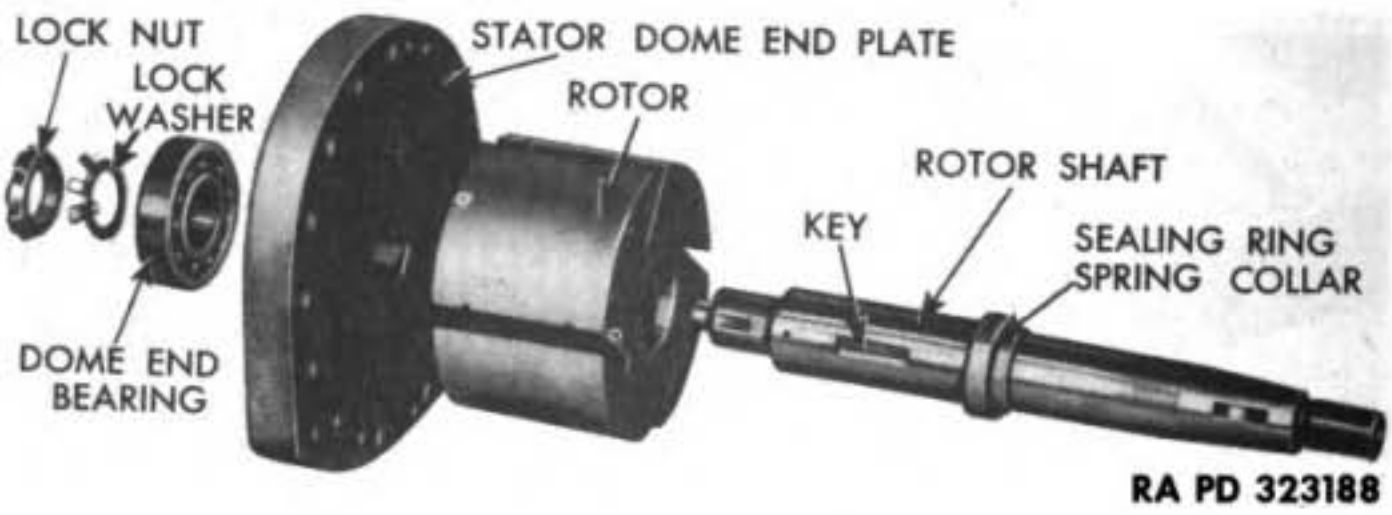


*Figure 192 — Stator Dome End Plate and Rotor Shaft Disassembled*


*Figure 193 — Driving Rotor Shaft from Sealing Ring Spring Collar*

(10) REMOVE STATOR DOME END PLATE, BEARING, ROTOR ASSEMBLY, SHAFT, AND SEAL PARTS AS A UNIT. Pull two end plate dowel pins with dowel pin puller (fig. 187). Use a copper washer $\frac{3}{8}$ inch (I.D. x $\frac{3}{16}$ inch O.D) under dowel pin puller to protect the smooth surface on the end plate. Remove eight cap screws attaching end plate to stator. Remove six cap screws and lock washers attaching sealing cap to stator drive end plate and rear cap and gasket. Place end plate puller (41-P-2907-197) over end of shaft, and make secure to end plate with six cap screws (fig. 188). Turn puller screw and push out the end plate, bearing, rotor assembly, shaft, and seal parts as a unit from the stator (fig. 189). **NOTE:** *As the rotor is withdrawn from the stator, the blades, blade springs, and pins will fall from the rotor. Care must be exercised not to damage in any manner the mating surfaces of the end plates and stator, as no gaskets are used and this is a metal-to-metal seal. Any mars or scratches may result in air or coolant leaks.*

(11) DISASSEMBLE UNIT CONSISTING OF STATOR DOME END PLATE, BEARING, ROTOR SHAFT, AND SHAFT SEALING PARTS (fig. 192). Remove all blades, springs, and pins from rotor. Pry between sealing spring coils, all around, and slide sealing ring retainer with rubber ring and carbon ring off rotor shaft (fig. 190). Carbon ring is brittle


*Figure 194 — Removing Sealing Nut with Wrench (41-W-3336-690)*

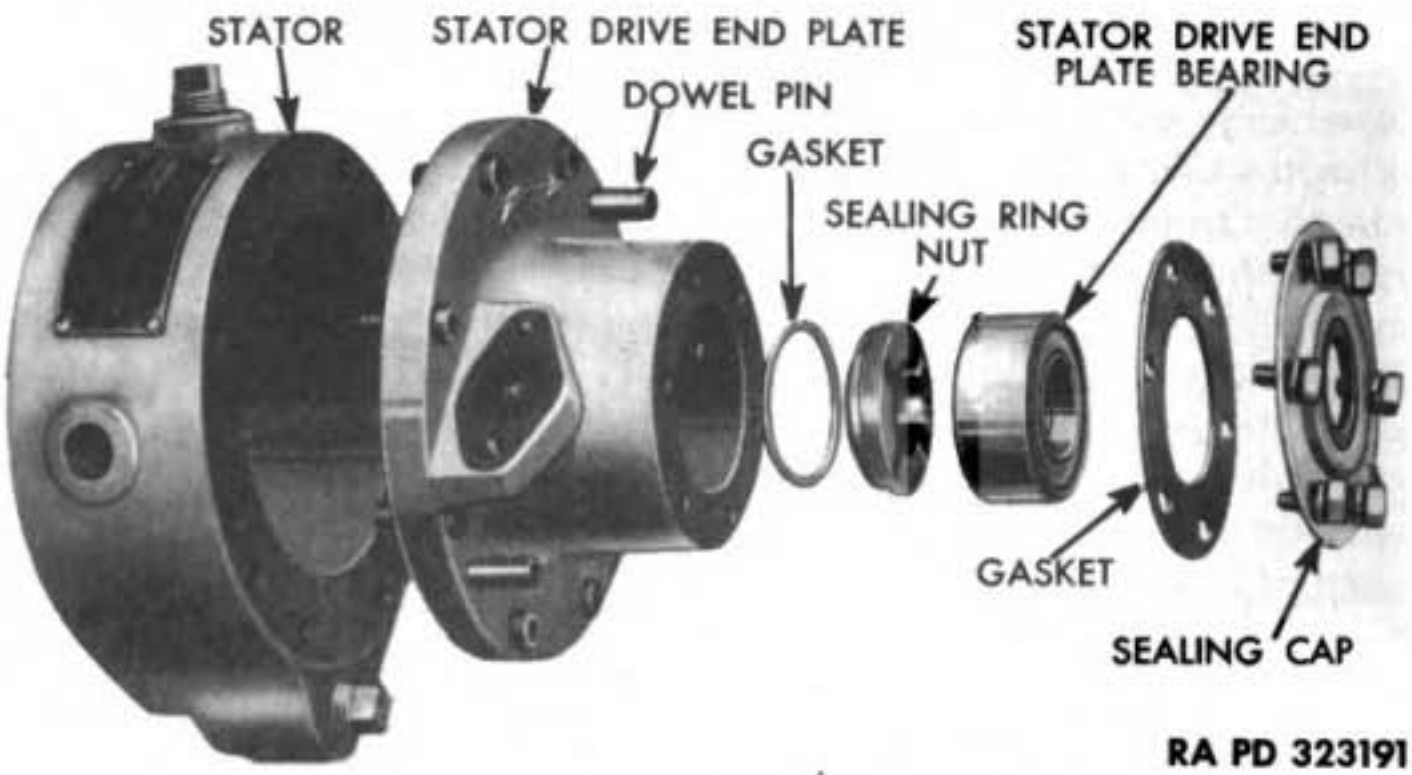


*Figure 195 — Stator Drive End Plate Disassembled*

and will break if it is pressed against shaft when retainer is pried off. Release the lock washer from the nut securing the bearing to the rotor shaft (fig. 191), and remove the nut and washer. Press the rotor shaft out of the dome end bearing. The rotor is a slide fit on


*Figure 196 — Removing Cap and Diaphragm from Pressure Control Valve*

the shaft, and can be easily withdrawn. Drive the rotor shaft from the sealing ring spring collar (fig. 193). Remove bearing from stator dome end plate, using a brass rod and hammer.

(12) REMOVE STATOR DRIVE END PLATE BEARING. Drive bearing from end plate, with brass rod and hammer.

(13) REMOVE SEAL NUTS (figs. 194 and 195). Using a special seal nut wrench (41-W-3336-690) unscrew seal nut from stator drive end plate. Use two ¼- x 1⅜-inch cap screws to attach wrench to end plate.

(14) REMOVE STATOR DRIVE END PLATE (fig. 195). Pull two dowel pins from stator drive end plate, using dowel pin puller (fig. 187). Remove eight cap screws attaching stator drive end plate to stator, and remove stator drive end plate.

**b. Pressure Control Valve.**

(1) REMOVE DIAPHRAGM (fig. 196). Clamp base of valve body in a vise. Remove four cap screws and lock washers attaching diaphragm cap, and remove cap diaphragm washer and diaphragm.

(2) REMOVE PISTON (fig. 198). Unscrew piston guide from valve body, using piston guide wrench (41-W-3336-740) (fig. 197), and lift out piston and compression spring.

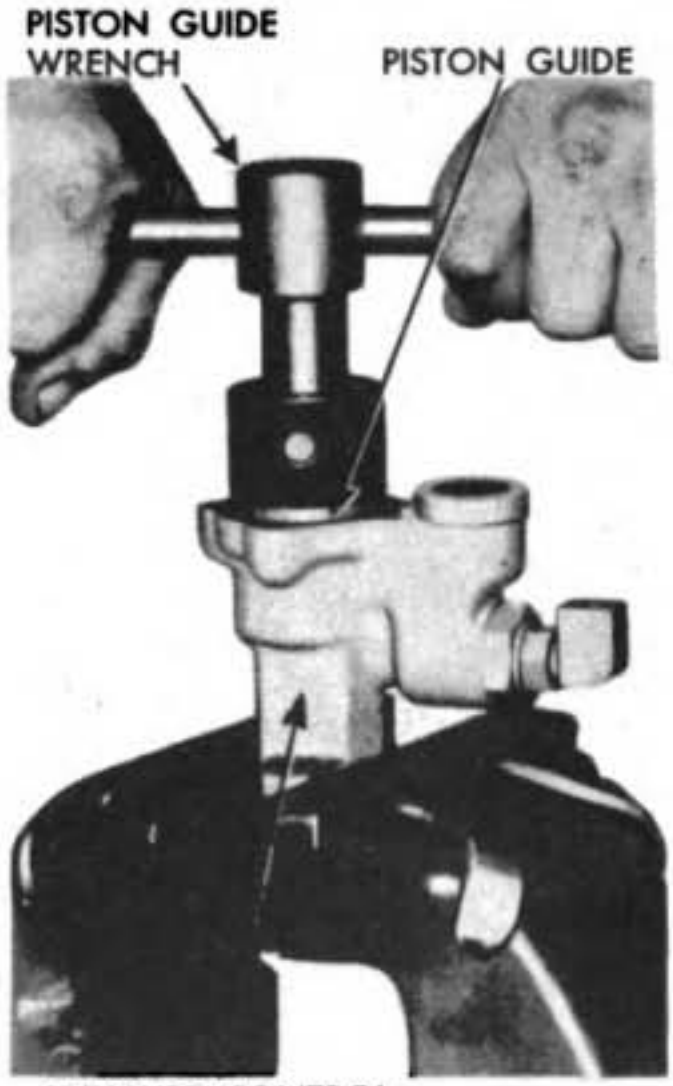


*Figure 197 — Removing Piston Guide with Piston Guide Wrench (41-W-3336-740)*

(3) REMOVE VALVE BODY INSERT (fig. 198). Remove valve body insert snap ring from valve body, using screwdriver. Pry out insert retainer and insert.

(4) REMOVE DOME RELIEF VALVE (fig. 198). Loosen relief valve cap lock nut, and unscrew relief valve cap from body. Remove valve, insert, and compression spring.

(5) REMOVE ADJUSTING SCREW (fig. 198). Measure distance from adjusting screw and face of valve body. (This dimension will be used later when installing.) Turn out adjusting screw from valve body.

**c. Oil Economizer.**

(1) REMOVE OUTER CHECK VALVE DISK (fig. 199). Clamp the oil economizer base in a vise. Unscrew the check valve spring guide from the outlet fitting on top of the oil economizer tank. Remove spring guide, gasket, spring, and disk.

(2) REMOVE OIL ECONOMIZER TANK. Remove eight machine screws and lock washers attaching tank to base, and lift off tank (fig.

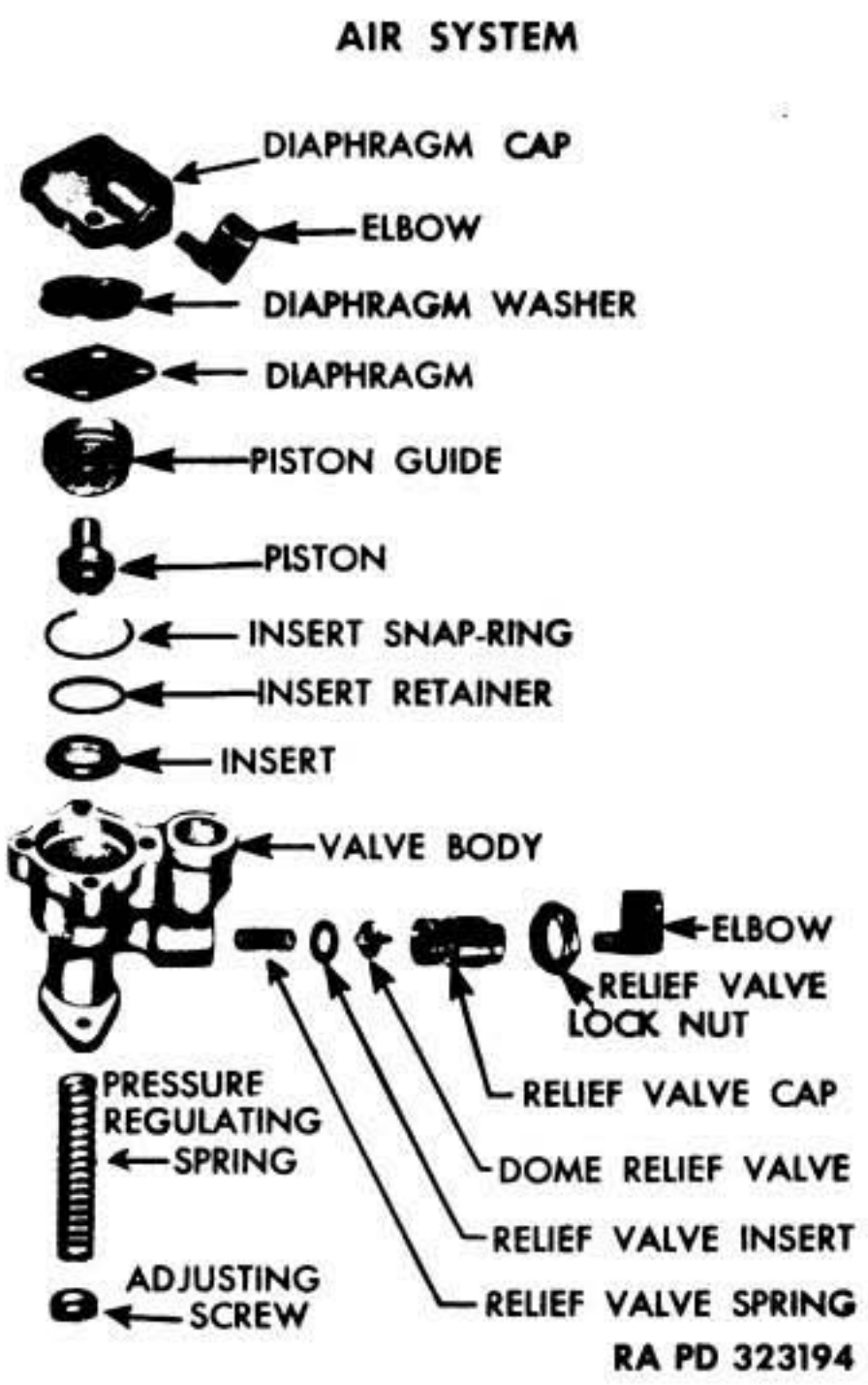


*Figure 198 — Pressure Control Valve Disassembled*

200). Pry off tank sealing cup from base (fig. 201). Lift out inner shell assembly (fig. 202). If inner shell is tight in base and inspection shows parts to be in good condition, do not remove inner shell or baffle plate.

(3) REMOVE OIL ECONOMIZER BAFFLE PLATE (fig. 202). Remove two drive screws attaching baffle plate to base.

## 85. CLEANING.

**a.** Clean all parts thoroughly with dry-cleaning solvent, and dry with compressed air.

## 86. INSPECTION AND REPAIR (fig. 180).

**a. Compressor.**

(1) STATOR AND END PLATES. Inspect stator bore and end plates for scores. If scores are prevalent, replace stator and end plates as an assembly.

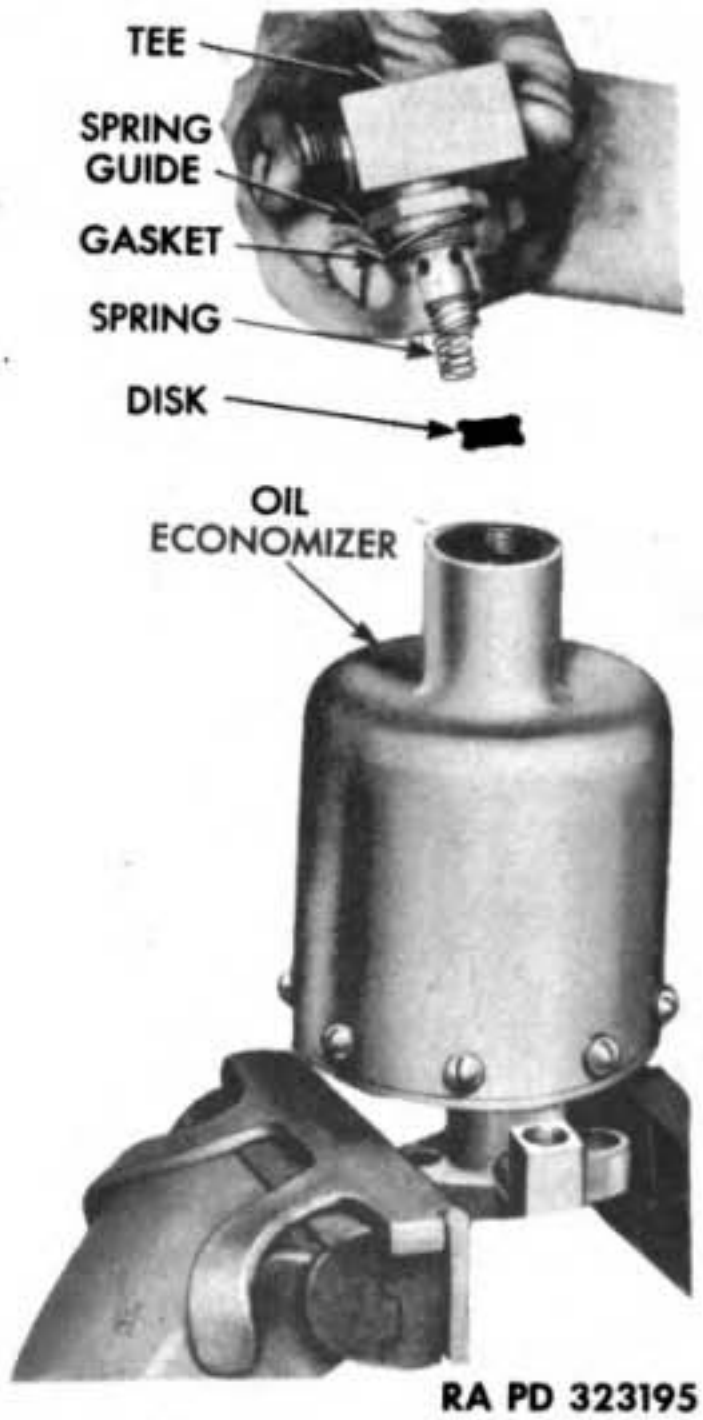


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*Figure 199 — Removing Check Valve Parts*

(2) BEARINGS. Check both rotor shaft bearings. If looseness is detected, replace bearings.

(3) BLADES. Check blades; if they show wear on the back flat, replace with new blades. Discard blade springs and replace with new springs.

(4) OIL SEAL. Inspect sealing ring nut. If contact surface is scored or cracked, replace with new nut. Discard carbon sealing ring and rubber sealing ring. Replace with new.

(5) ROTOR SHAFT. Inspect rifle drilling in rotor shaft, and make sure passage is clear.

(6) INLET CHECK VALVE. Inspect inlet check valve. If spring is broken, replace with new valve unit.

(7) WOODRUFF KEY. Inspect special Woodruff key in rotor shaft, and replace if wear is observed.


*Figure 200 — Removing Oil Economizer Tank*

**b. Pressure Control Valve** (fig. 198).

(1) PISTON AND INSERT. Inspect contacting surfaces of piston and piston insert. If they are scratched or show signs of leaking, replace with new parts.

(2) SPRINGS. Replace broken springs.

(3) RELIEF VALVE. Inspect relief valve, valve insert, and cap for damage; replace defective part.

(4) DIAPHRAGM. Inspect diaphragm for cracks or leaks. Replace if defective.

**c. Oil Economizer.**

(1) INNER SHELL. This shell cannot be disassembled; therefore, flush out with dry-cleaning solvent. Replace if damaged.

(2) CHECK VALVE. Inspect check valve disk and check valve seat in oil economizer tank fitting. Replace disk or tank if faulty.

(3) TANK SEALING CUP. Inspect for scratches in sealing surfaces.


*Figure 201 — Removing Sealing Cup from Oil Economizer Base*

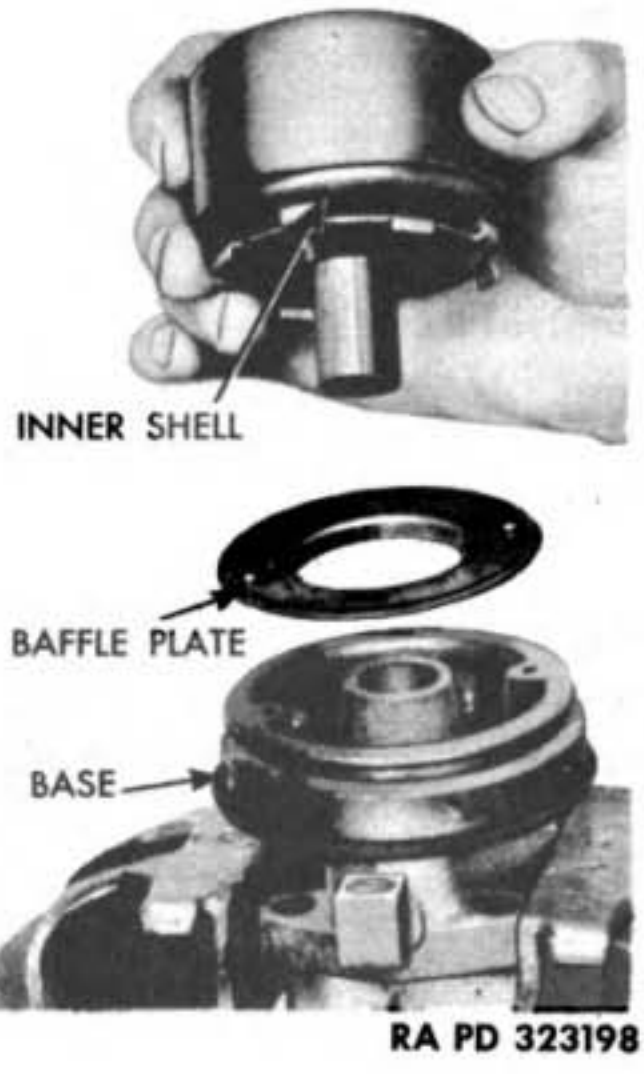


*Figure 202 — Removing Inner Shell, Baffle Plate Removed*

AIR SYSTEM

## 87. ASSEMBLY.

### a. Compressor.

(1) PLACE ROTOR ASSEMBLY IN STATOR. Assemble the springs, pins, and blades to the compressor rotor. When installing the rotor blades, be sure that contact faces of the blades follow the curved surface of the rotor, and that blades face in direction of rotation (fig. 180). This may be determined by observing the arrow on the outer face of the stator drive end plate which indicates direction of rotation. Place a rubber band or string around the circumference of the rotor to hold the blades in place when they are installed. Place the rotor assembly in the stator, and remove the string or rubber band.

(2) ASSEMBLE UNIT, CONSISTING OF STATOR DOME END PLATE, BEARING, AND ROTOR SHAFT (fig. 192). Press dome end bearing on rotor shaft, and install retaining lock washer and nut. Tighten nut securely, and bend lock washer to engage notch in nut. Insert shaft through hole in stator dome end plate, and press bearing into place.

(3) INSTALL UNIT, CONSISTING OF STATOR DOME END PLATE, BEARING, AND ROTOR SHAFT. Install key in rotor shaft keyway. Push shaft through hole in rotor, taking care to line up key with keyway in rotor. Line up screw holes in end plate with those in stator, and start the eight cap screws. Then drive in two dowel pins. Tighten the eight cap screws securing the end plate.

(4) INSTALL SEALING RING SPRING COLLAR (fig. 203). Install collar with collar sleeve, making sure to drive collar solidly against shoulder of rotor shaft.

(5) INSTALL SEALING RING NUT (fig. 195). Install sealing ring and sealing ring nut in stator drive end plate. Tighten nut securely with seal nut wrench (41-W-3336-690) (fig. 194).

(6) PLACE ROTOR SHAFT SEALING PARTS ON SHAFT (fig. 190). Slide sealing spring, retainer, rubber ring, and carbon ring on shaft in their respective order, with the spring against the spring collar. Make sure the lugs on the sealing retainer line up with the slots in the carbon ring.

(7) INSTALL STATOR DRIVE END PLATE. Slide stator drive end plate over rotor shaft and start eight attaching cap screws. Drive two dowel pins into their respective holes in end plate and stator; tighten eight attaching cap screws.

(8) INSTALL DOME END BEARING CAP (fig. 186). Set bearing cap in place on stator dome end plate, and attach with four machine screws.

(9) INSTALL ROTOR SHAFT DRIVE END BEARING. Place about two tablespoonfuls of general purpose grease in the stator drive end plate and around the rotor shaft, and press the bearing into place with shielded side out. Set sealing cap with gasket in place on end

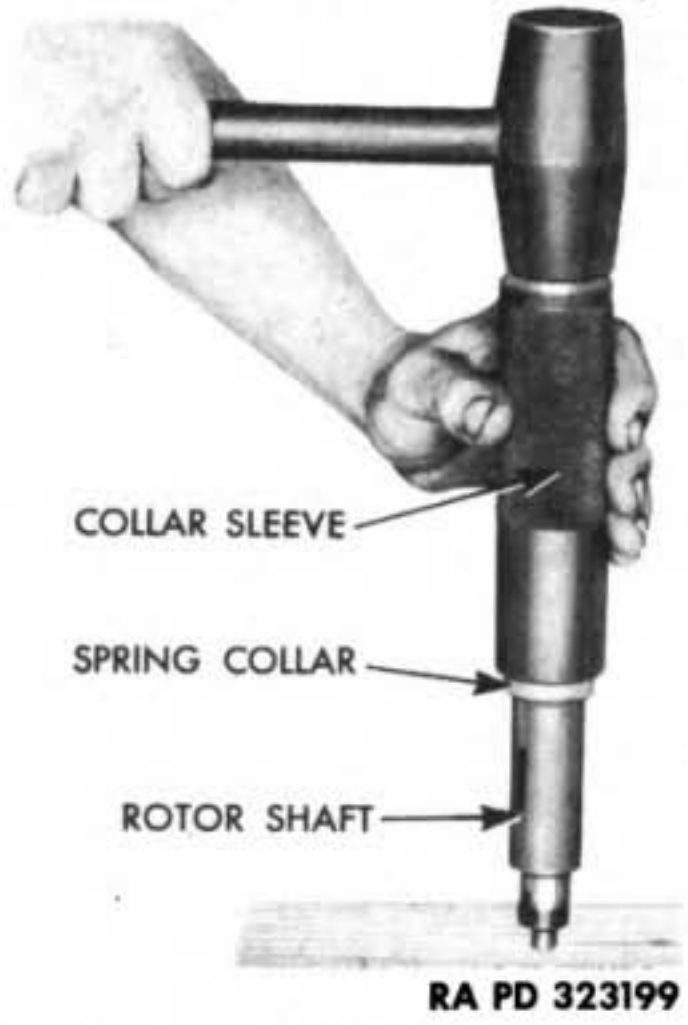


*Figure 203 — Installing Sealing Ring Spring Collar on Rotor Shaft*

of stator drive end plate, and secure with six cap screws and lock washers.

(10) INSTALL OIL SEPARATOR (fig. 185). Screw tube nut into fitting in stator dome end plate, making sure that oil separator unit is in a vertical position when tightening.

(11) INSTALL OIL DOME (fig. 184). Set the oil dome with gasket on stator dome end plate and attach with nine cap screws. Tighten cap screws securely, as dome is under air pressure during pumping cycle.

(12) INSTALL INLET CHECK VALVE (fig. 182). Set valve in stator drive end plate.

(13) INSTALL PRESSURE CONTROL VALVE (fig. 182). Set valve and gasket on top of stator drive end plate, and attach with two cap screws and lock washers.

(14) INSTALL OIL ECONOMIZER (fig. 183). Set oil economizer and gaskets on top of oil dome, and secure with four stud nuts and lock washers.

(15) INSTALL BOTH AIR TUBES. Attach two air tubes to elbow fittings in pressure control valve and oil economizer base, and to tee over oil economizer.

(16) ADD LUBRICATING OIL. Install drain plug in oil dome, and fill the dome with oil to "FULL" mark on filler plug dip stick. Tighten filler plug finger-tight.

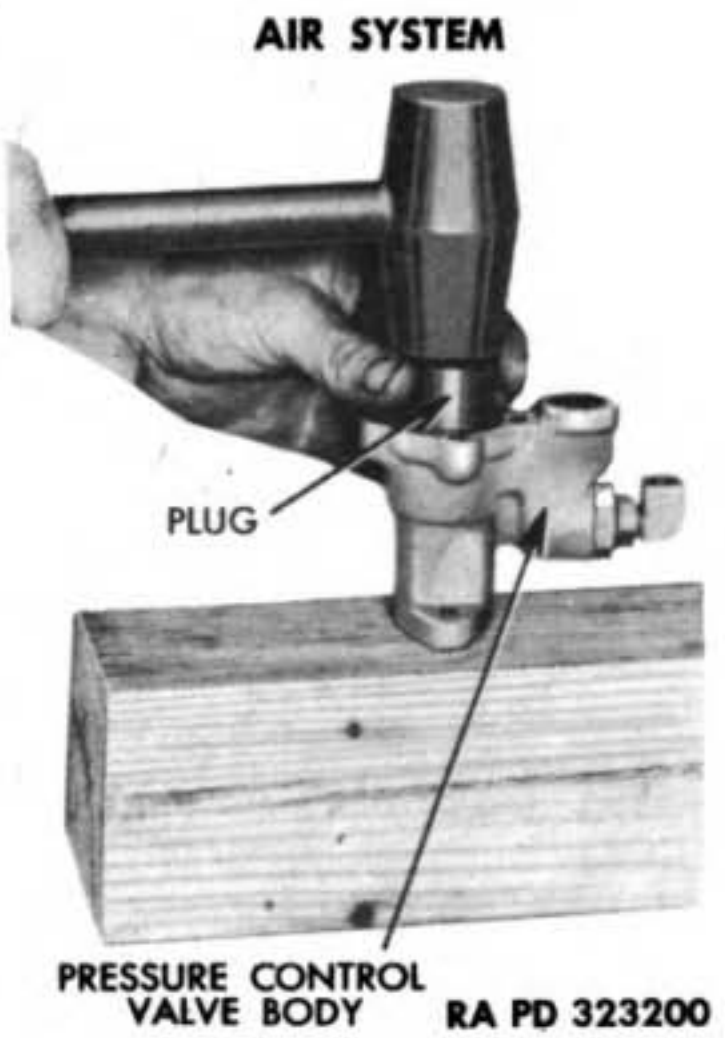


***Figure 204 — Installing Insert in Pressure Control Valve Body***

(17) INSTALL PULLEY. Install Woodruff key in rotor shaft, slide pulley on shaft and install washer, nut, and cotter pin. Screw flange on pulley.

**b. Pressure Control Valve.**

(1) INSTALL VALVE BODY INSERT (fig. 198). Set valve insert in place in valve body with step-cut-side upward. Install insert retainer ring and with plug press into position (fig. 204). Place snap ring in position on top of retainer ring.

(2) INSTALL PISTON (fig. 198). Set piston in valve body. Screw in guide, and tighten securely with piston guide wrench (41-W-3336-740) (fig. 197).

(3) INSTALL DIAPHRAGM (fig. 196). Set diaphragm, diaphragm washer, and cap over piston, and make secure to valve body by installing four cap screws and lock washers.

(4) INSTALL RELIEF VALVE (fig. 198). Install relief valve, insert, and spring in relief valve body. Screw cap assembly into valve body finger-tight, then hold cap and tighten lock nut.

(5) INSTALL PRESSURE REGULATING SPRING (fig. 198). Install spring in the valve body, and secure with adjusting screw. Turn adjusting screw in until the distance from screw to the body face is equal to measurement made before adjusting screw was removed (approximately ⅛ inch). NOTE: *There is no test to be made on pressure control valve before valve is installed on compressor.*

**c. Oil Economizer.**

(1) INSTALL TANK. Attach baffle plate to base with two drive screws (fig. 202). Set inner shell in place on base. Place sealing cup on base (fig. 201). Place tank in position on base, and attach with eight machine screws and lock washers (fig. 200).

(2) INSTALL CHECK VALVE (fig. 199). Place check valve disk in outlet fitting on top of oil economizer tank. Assemble spring and gasket to spring guide, and screw it into outlet fitting.

## 88. TEST.

**a. Before Installing.** Rotate air compressor shaft and check for freeness. It should turn without binding.

**b. After Installing.** Run engine at 600 to 700 revolutions per minute and pump air tanks to shut-off pressure (95 to 100 pounds). Operate towed-load brake and service clutch pedal until air pressure drops sufficiently to cause the compressor to again start pumping. Difference between cut-in and cut-out pressure is 15 to 20 pounds.

## 89. ADJUSTMENT.

**a.** In event the cut-out pressure is above or below 95 to 100 pounds, remove pressure control valve from compressor, and adjust control valve spring adjusting screw. Turn adjusting screw clockwise to raise cut-out pressure, and counterclockwise to lower cut-out pressure. One full turn of the adjusting screw changes cut-out pressure approximately 5 pounds per square inch.

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### Section III

# SAFETY VALVE



## 90. DESCRIPTION (fig. 205).

**a.** The safety valve is a spring-loaded, ball-seating valve which is set to relieve pressure in the air system at 172 to 178 pounds in event pressure control valve fails to perform its function. The safety valve screws into the inverted tee, which is directly over air compressor oil

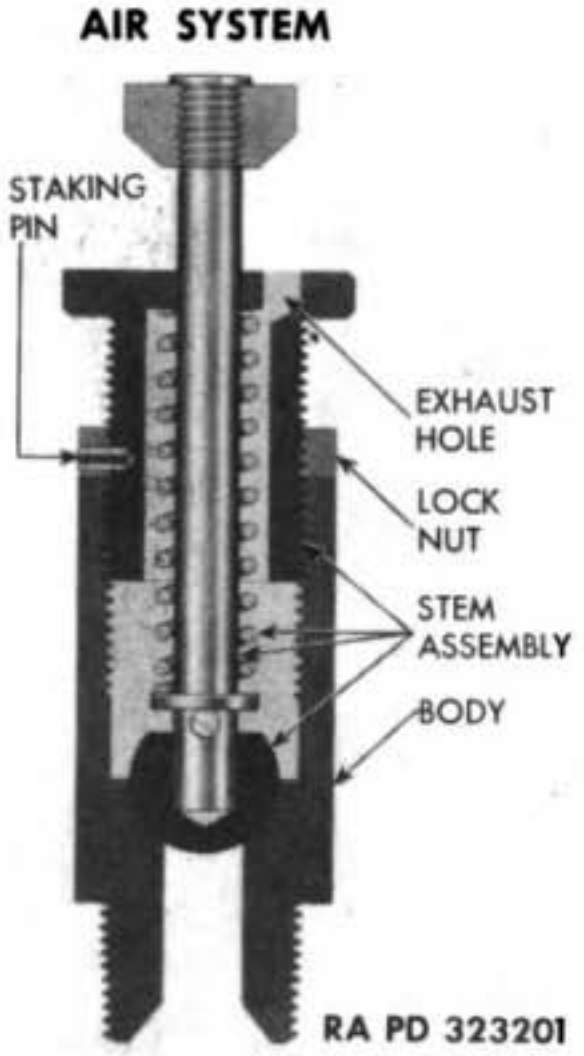


***Figure 205 — Cross-section of Safety Valve***

economizer (fig. 183). The safety valve can be held open manually by lifting up on exposed end of valve stem.

## 91. DISASSEMBLY.

**a. Remove Valve Stem Assembly** (fig. 206). Clamp safety valve body in a vise. Unscrew valve stem assembly with lock nut from valve body. The lock nut is secured to stem by a small staking pin. If it is necessary to adjust the valve, the pin should be removed as follows: Center punch the exposed head of staking pin which is located in lock nut. Drill out locking pin with $\frac{1}{16}$-inch diameter drill. Do not drill deeper than $\frac{5}{32}$ inch.

## 92. CLEANING AND INSPECTION (fig. 206).

**a.** Clean all parts of safety valve with dry-cleaning solvent. Dry with compressed air.

**b.** Inspect ball seat in valve body. If seat is not smooth and free from scratches or other marks, replace with new body.

**c.** Inspect valve stem assembly. If spring is broken, ball is loose on stem, or ball face is not smooth and free of scratches, replace with new valve stem assembly. Exhaust hole in top of spring retainer must be open.


*Figure 206 — Safety Valve Stem Assembly Removed from Body*

## 93. ASSEMBLY.

**a.** Screw safety valve stem assembly into valve body, and tighten lock nut. If staking pin has been removed, turn lock nut up on safety valve stem assembly, and screw stem assembly into valve body. Connect valve body to an air system whose pressure can be raised to a maximum of 180 pounds. Air system must be equipped with an accurate gage to register air pressure applied on safety valve. Apply air pressure to safety valve, and set valve to relieve pressure at 172 to 178 pounds. Then, tighten lock nut against valve body. Recheck valve setting. Use soap solution to check for leaks. Make a center punch mark in middle of one of the flat faces of the lock nut. Drill a $\frac{1}{16}$-inch diameter hole, $\frac{5}{32}$-inch deep, through lock nut. Insert staking pin in drilled hole, and stake it in place with a center punch.

## AIR SYSTEM

### 94. TEST.

a. Connect safety valve to air system whose pressure is at least 180 pounds. Have air pressure gage in system to register air pressure on valve. Valve should not leak below 172 pounds air pressure, and should relieve pressure at 172 to 178 pounds.

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## Section IV

# AIR RESERVOIR TANKS



### 95. DESCRIPTION (fig. 207).

a. Two identical air reservoir tanks are located in the approximate center of the vehicle, and are mounted to the two frame side channels. Both tanks are of welded steel construction, cylindrical in shape, and have a steel bracket welded to each end for mounting purposes. Three tapped holes are provided in each tank for connecting inlet and outlet air tube sleeves and drain cock.

### 96. CLEANING AND INSPECTION.

a. Place a quantity of dry-cleaning solvent in tank, and shake it vigorously until inside surface is clean. Then drain and blow out with compressed air. If the tank is excessively rusty, replace with new one.

### 97. REPAIR.

a. Leaks in tanks can be repaired by welding. If mounting brackets become loose from tank, weld them back on.

### 98. TEST.

a. Test tank under water with 200 pounds per square inch air pressure. Bubbles will indicate air leaks.

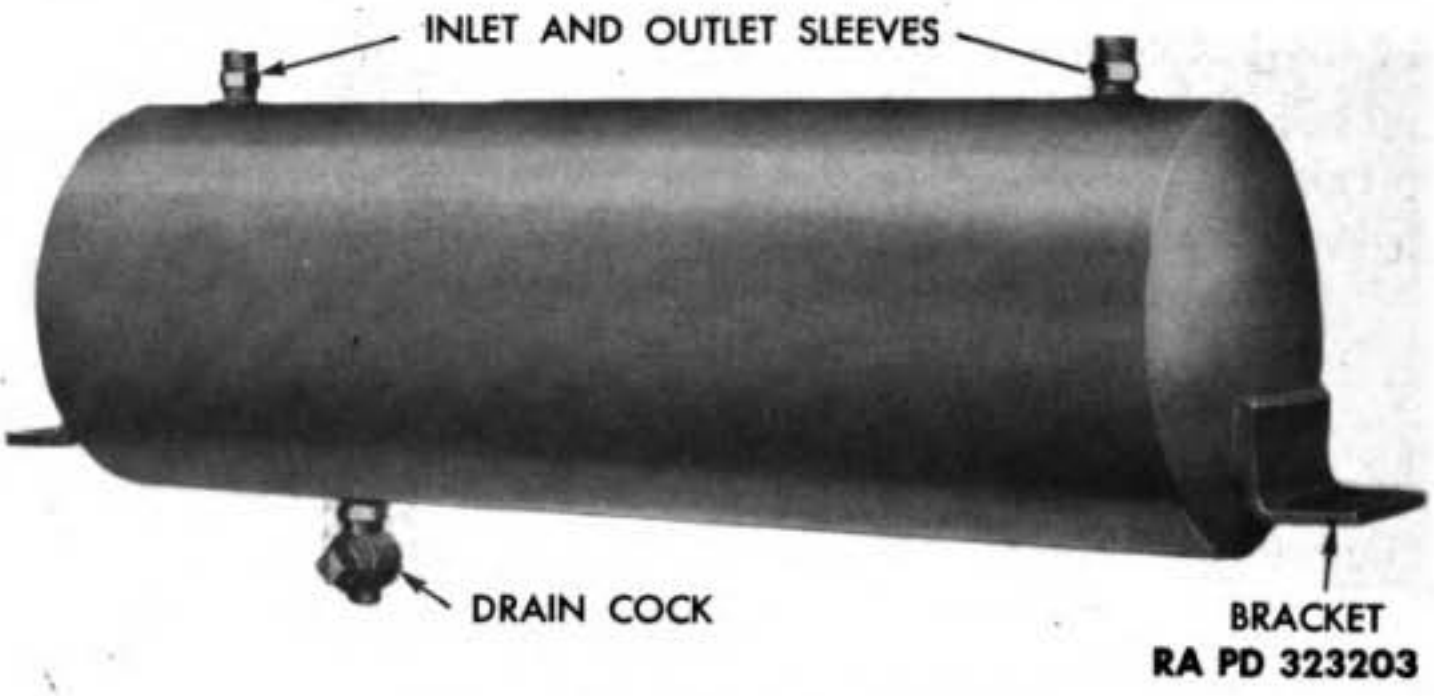


*Figure 207 — Air Reservoir Tank*

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## Section V

# VALVES AND COUPLERS



## 99. ENGINE CLUTCH SHIFTING VALVE.

**a. Description** (figs. 208 and 209). This is a follow-up type valve which is connected into, and is part of, the linkage between clutch pedals and clutch shifting lever. It is located directly in back of clutch selector unit below driver's seat. The valve controls the application of compressed air from air reservoir tanks to clutch power cylinders which operate clutch. In case of air failure, the valve serves as a mechanical link in the controls for shifting clutch manually. A single valve body contains the valve actuating mechanism, also two

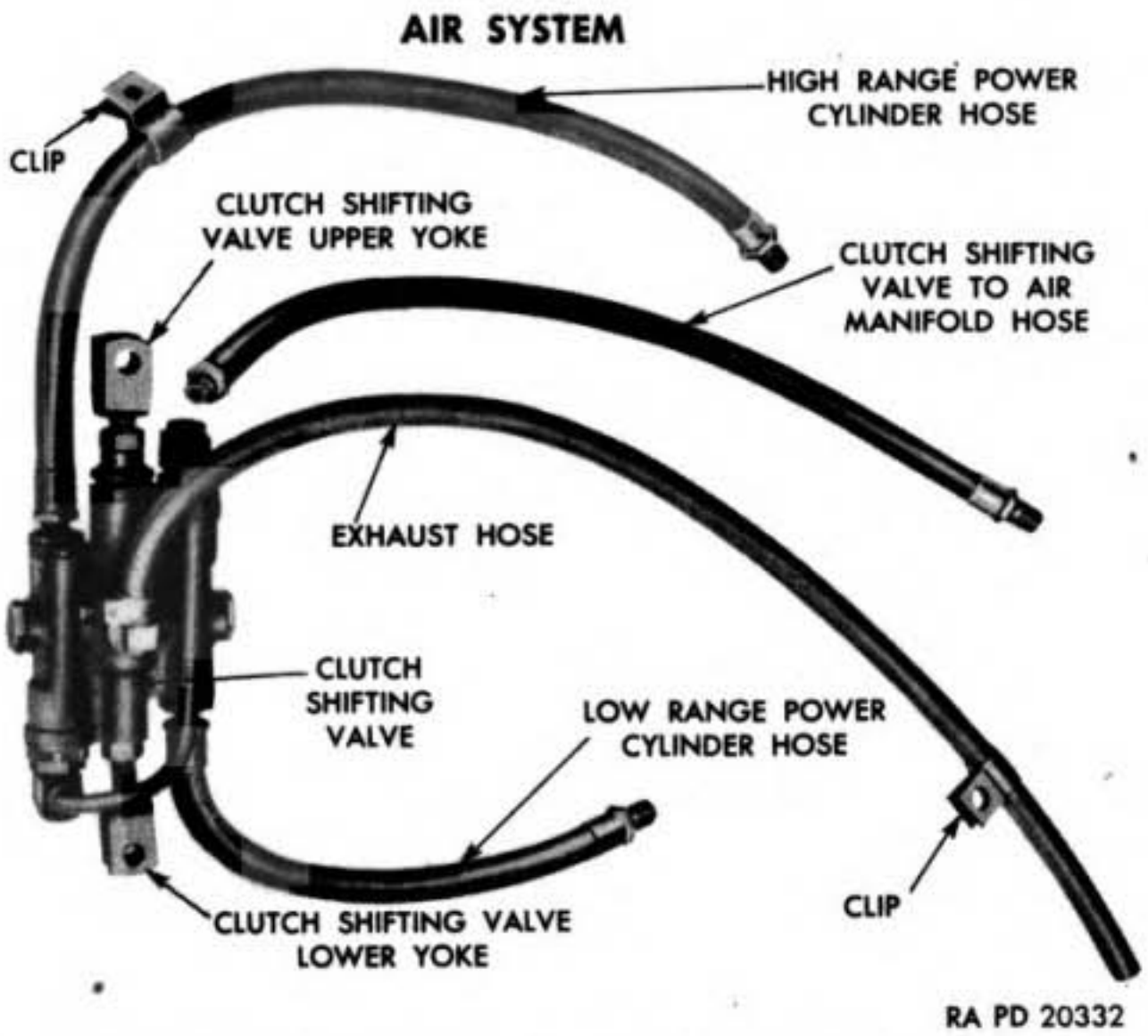



***Figure 208 — Clutch Shifting Valve with Connecting Air Hoses***

inlet valves and two exhaust valves that are identical. Two inlet valve ports are connected by a common external tube, which is in turn connected to air tanks. Each outlet valve port is connected by an air hose to a clutch shifting power cylinder. The exhaust port is located in the center side of valve, and is connected by an elbow fitting to a hose whose outlet end is located in back of driver's seat. One end of valve body is threaded for a yoke, while the opposite end is provided with an actuating shaft that is also threaded for a yoke. The yokes are used to connect the valve to a lever at each end. Connected to the end of the actuating shaft, which is inside clutch shifting valve body, is an actuating lever that operates two air inlet and two air exhaust valves.

**b. Operation** (fig. 209). The clutch shifting valve is suspended in the linkage between clutch pedals and clutch shifting lever. When air pressure is up to normal, and service clutch pedal is pushed down, it moves the actuating lever shaft which is attached to the actuating lever located inside the clutch shifting valve body. When the actuating lever is moved up within the valve body, it opens an inlet and an exhaust check valve. Opening the inlet valve allows air pressure from air reservoir tanks to flow to one of the clutch shifting power cylinders. Opening the exhaust valve allows air to exhaust from the other clutch shifting power cylinder. The amount of air admitted to power cylinder

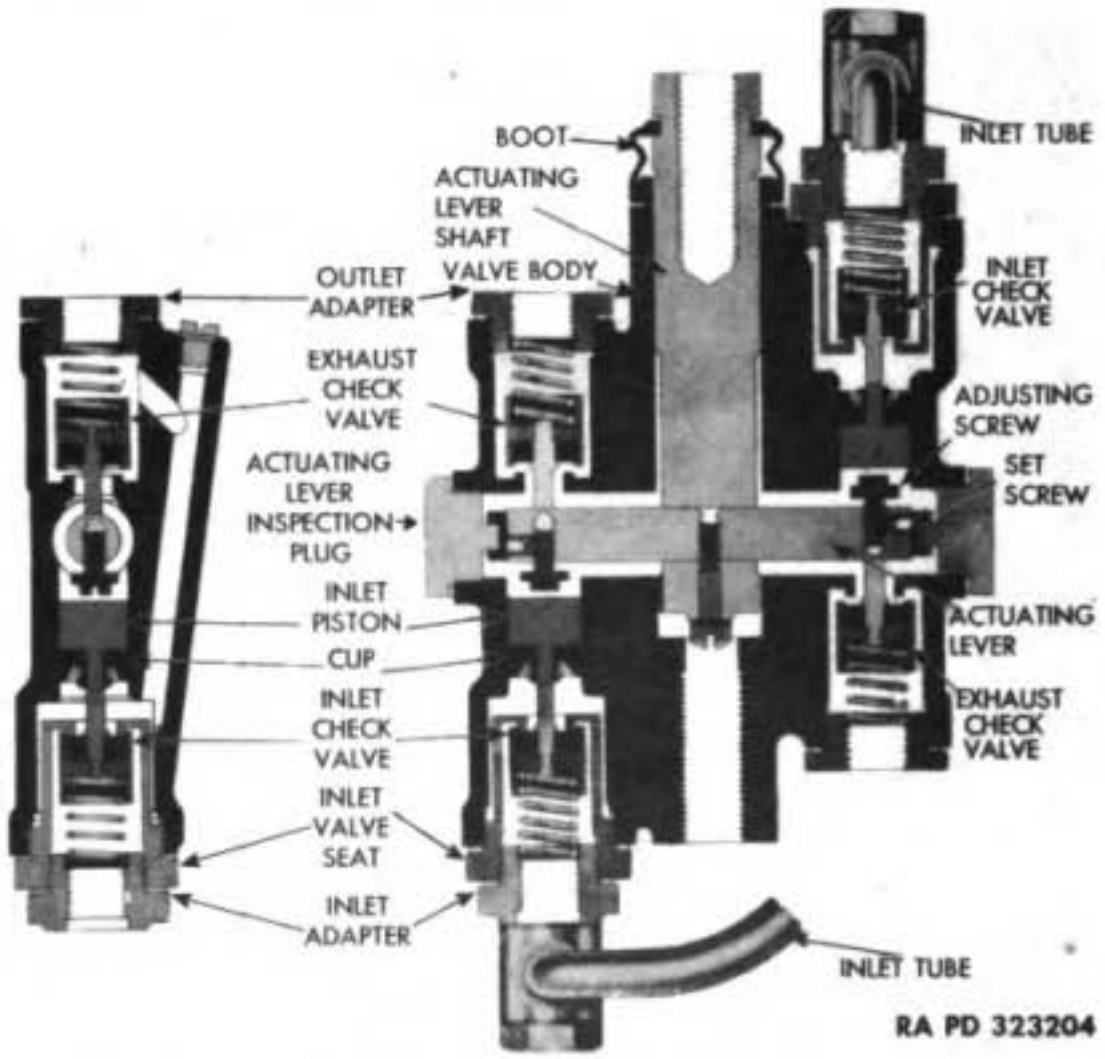



*Figure 209 — Cross-section of Clutch Shifting Valve*

is proportionate to movement of service clutch pedal, due to the follow-up characteristics of valve. When movement of service clutch pedal is stopped, valve action reacts, and both inlet and exhaust valves close, causing clutch shifting valve to balance or hold in this position until further pedal movement takes place. When service clutch pedal is released, the opposite section of the clutch shifting valve functions, and air pressure is applied to the other clutch shifting power cylinder which was exhausting. The power cylinder which was receiving air pressure will now exhaust. The action of one-half of the clutch shifting valve is identical to the action of the opposite half, which permits it to function in either direction as described above. In event of air failure, the actuating lever will contact clutch shifting valve body direct, and thus make a mechanical link between the two yokes.

**c. Disassemble.**

(1) REMOVE HOSES (fig. 208). Clamp valve in vise, and remove both low-range and high-range power cylinder hoses. Remove exhaust hose from exhaust hose elbow, and unscrew elbow from side of valve.

(2) REMOVE YOKES (fig. 210). Loosen lock nuts, and remove both upper and lower yokes.

## AIR SYSTEM

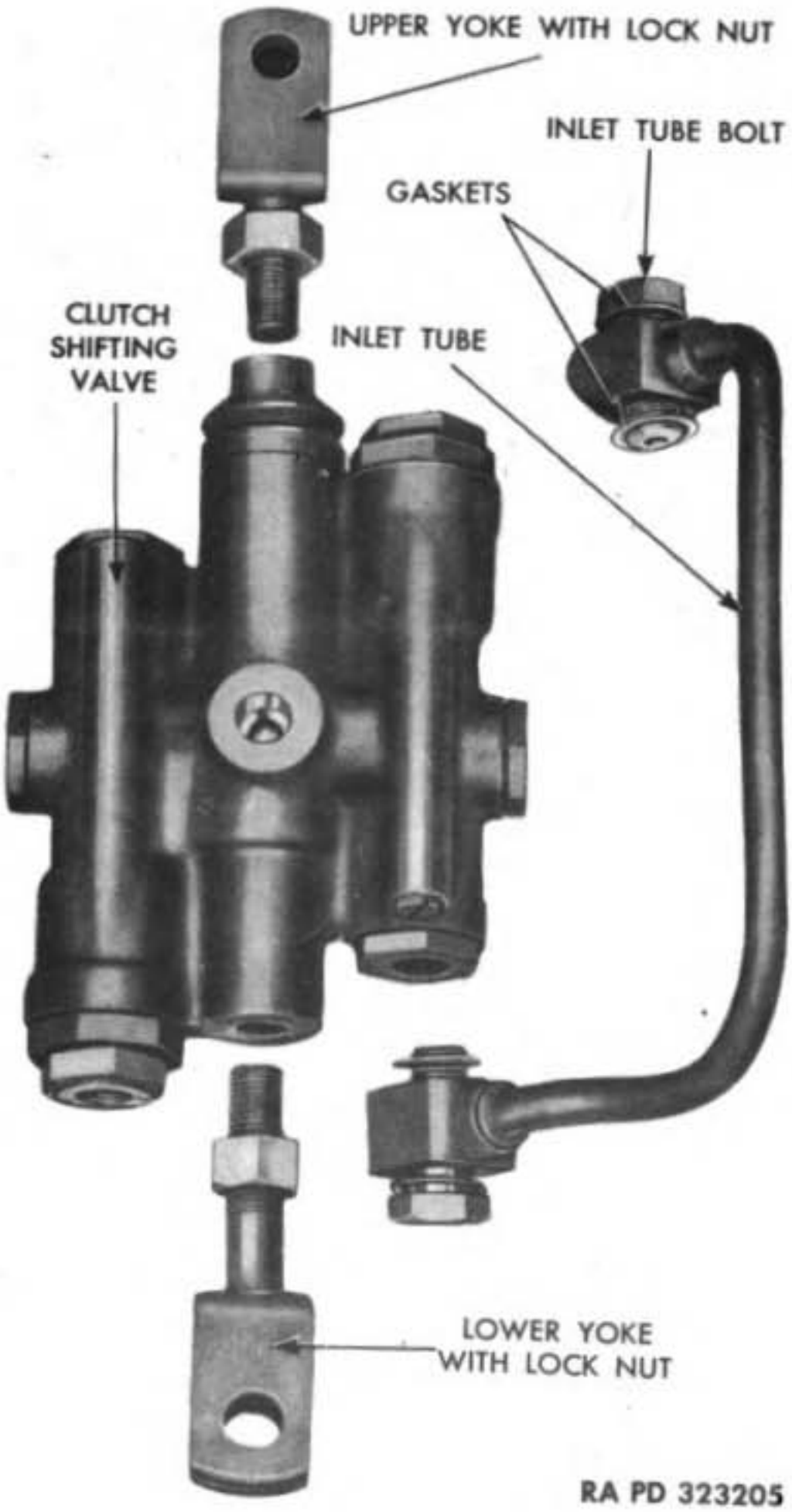



***Figure 210 — Inlet Tube and Yokes Removed***

**ORDNANCE MAINTENANCE — POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

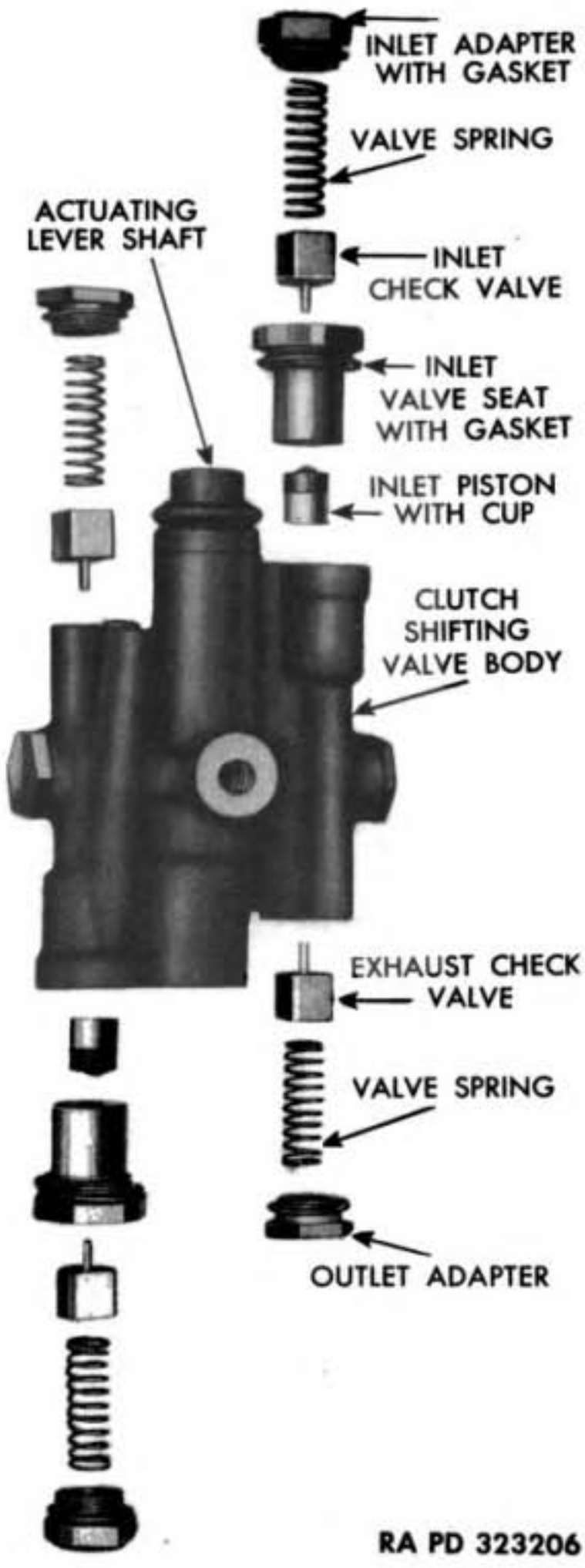



***Figure 211 — Inlet and Exhaust Valve Parts Removed***

## AIR SYSTEM

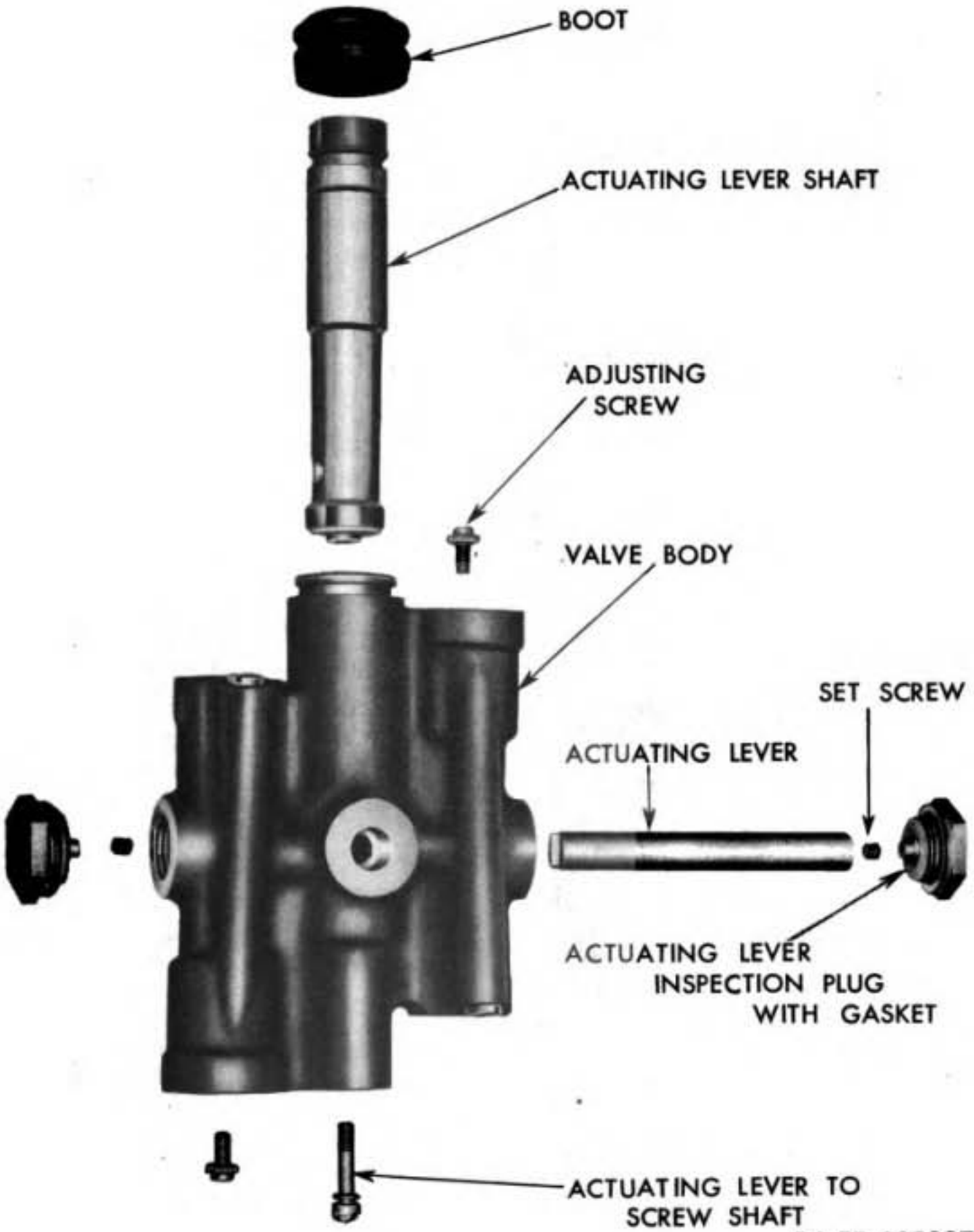



***Figure 212 — Actuating Lever and Shaft Removed***

(3) REMOVE INLET TUBE (fig. 210). Remove inlet tube bolts and washers attaching inlet tube at each end.

(4) REMOVE INLET CHECK VALVE (fig. 211). Clamp valve body in vise with actuating lever shaft down. Unscrew inlet adapter with gasket from inlet valve seat, and remove valve spring and inlet check valve.

(5) REMOVE INLET PISTON (fig. 211). Unscrew inlet valve seat with gasket from valve body, and remove inlet piston with cup.

(6) REMOVE EXHAUST CHECK VALVE (fig. 211). Unscrew outlet adapter with gasket from valve body, and remove valve spring and exhaust check valve.

(7) REMOVE OPPOSITE INLET CHECK VALVE INLET PISTON AND EXHAUST CHECK VALVE. Reclamp valve body in vise with actuating lever shaft up. Repeat operations in steps (4), (5), and (6).

(8) REMOVE ACTUATING LEVER INSPECTION PLUGS (fig. 212). Remove plug with gasket from each side of valve body.

(9) REMOVE ACTUATING LEVER (fig. 212). Insert safety screw wrench ($\frac{3}{16}$-in.) through inspection plug holes, and remove set screws from both ends of actuating lever. Insert screwdriver through inlet port holes in valve body, and remove two adjusting screws from actuating lever. Insert screwdriver through yoke threaded hole in valve body, and remove actuating lever to shaft screw and lock washers. Slide actuating lever out of valve body through inspection plug opening.

(10) REMOVE ACTUATING LEVER SHAFT (fig. 212). Remove boot, and pull shaft from valve body.

**d. Clean and Inspect.** Clean all parts thoroughly with dry-cleaning solvent. Dry with compressed air. Inspect for worn parts, and replace where needed. Renew all check valves as a unit which show insert damage. Inspect rubber boot for cracks or holes, and replace if defective.

**e. Assemble.**

(1) INSTALL ACTUATING LEVER SHAFT (fig. 212). Clamp valve body in vise, and insert actuating lever shaft in valve body with cross-hole in shaft in line with inspection plug holes.

(2) INSTALL ACTUATING LEVER (fig. 212). Insert actuating lever through inspection plug hole, and through cross-hole in shaft. Insert actuating lever to shaft screw and lock washer through yoke threaded hole in valve body, and install it into actuating lever and shaft. Tighten securely. Insert adjusting screws through inlet port holes in valve body, and screw them down tight on actuating lever; then turn

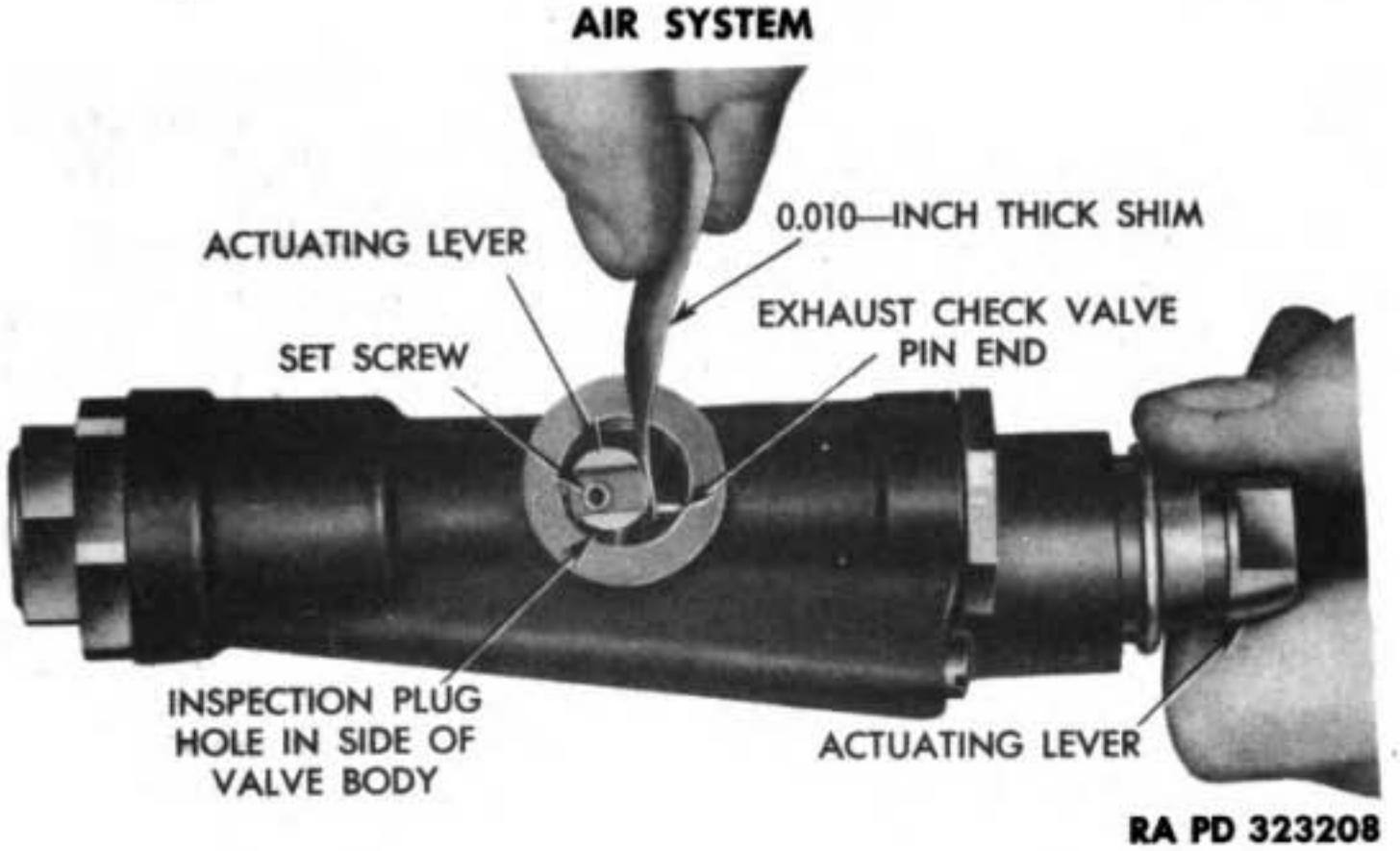



***Figure 213 — Checking Adjusting Screw Setting in Clutch Shifting Valve***

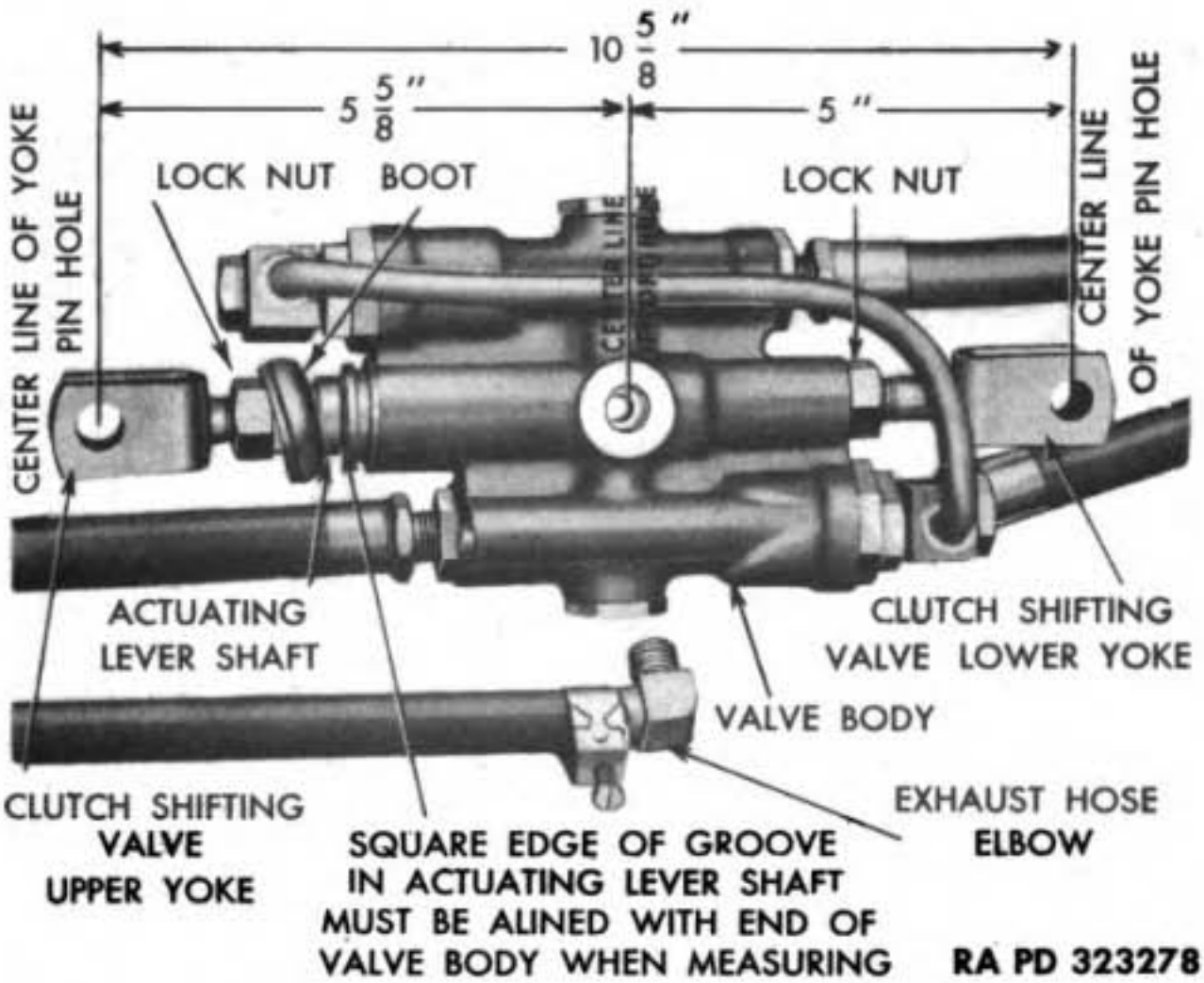



***Figure 214 — Yoke Adjustment of Clutch Shifting Valve***

them back two turns. Install set screws in both ends of actuating lever with safety screw wrench, but do not tighten screws.

(3) INSTALL CHECK VALVES IN INLET SEATS (fig. 211). Clamp large hex end of inlet valve seat in vise. Insert inlet check valve and

spring in seat, and securely screw in the inlet adapter with gasket. Repeat procedure for second inlet check valve.

(4) INSTALL INLET PISTONS (fig. 211). Place one inlet piston in inlet port hole in valve body with lip of sealing cup facing out. Install inlet valve seat assembly and gasket, and tighten securely. Repeat procedure for installing second inlet piston.

(5) INSTALL EXHAUST CHECK VALVES (fig. 211). Place exhaust check valve and spring in outlet port hole in valve body. Install outlet adapter and gasket. Tighten securely. Repeat procedure for installing second exhaust check valve.

(6) INSTALL YOKES (fig. 210). Screw lower yoke and lock nut into valve body, and upper yoke and lock nut into actuating lever shaft. Do not tighten lock nuts until yokes are adjusted. See subparagraph f (2).

(7) INSTALL ACTUATING LEVER INSPECTION PLUGS. NOTE: *Before assembling actuating lever inspection plugs to valve body, the clutch shifting valve must be adjusted as covered in subparagraph f.* Install inspection plug and gasket to each side of valve body. Tighten securely.

(8) INSTALL INLET TUBE (fig. 210). Attach inlet tube to inlet adapter at each end of valve body by installing inlet tube bolts and washers.

(9) INSTALL HOSES (fig. 208). Clamp valve in vise, and install low-range and high-range power cylinder hoses to outlet plugs. Attach exhaust hose elbow to threaded exhaust port at side of valve.

**f. Adjust.**

(1) ADJUSTING SCREWS (fig. 213). Install one actuating lever inspection plug. Turn valve over, and insert screwdriver in inspection plug hole in side of valve body to turn actuating lever adjusting screw. Turn adjusting screw so that when actuating lever shaft is moved to where adjusting screw head just contacts the inlet piston, a 0.010-inch thickness gage can be inserted between actuating lever and exhaust check valve pin end. When adjustment is correct, tighten set screw securing adjusting screw. Repeat this operation for second adjusting screw.

(2) YOKES (fig. 214). Screw lower yoke into valve body until it measures 5 inches from center of exhaust port on side of valve body to center of pin holes in yokes. Tighten lock nut. Screw other upper yoke into actuating lever shaft until it measures 5 5/8 inches from center of exhaust port to center of pin holes in yoke when square edge of groove in actuating lever is alined with end face on valve body. Tighten lock nut. Check by measuring distance between centers of

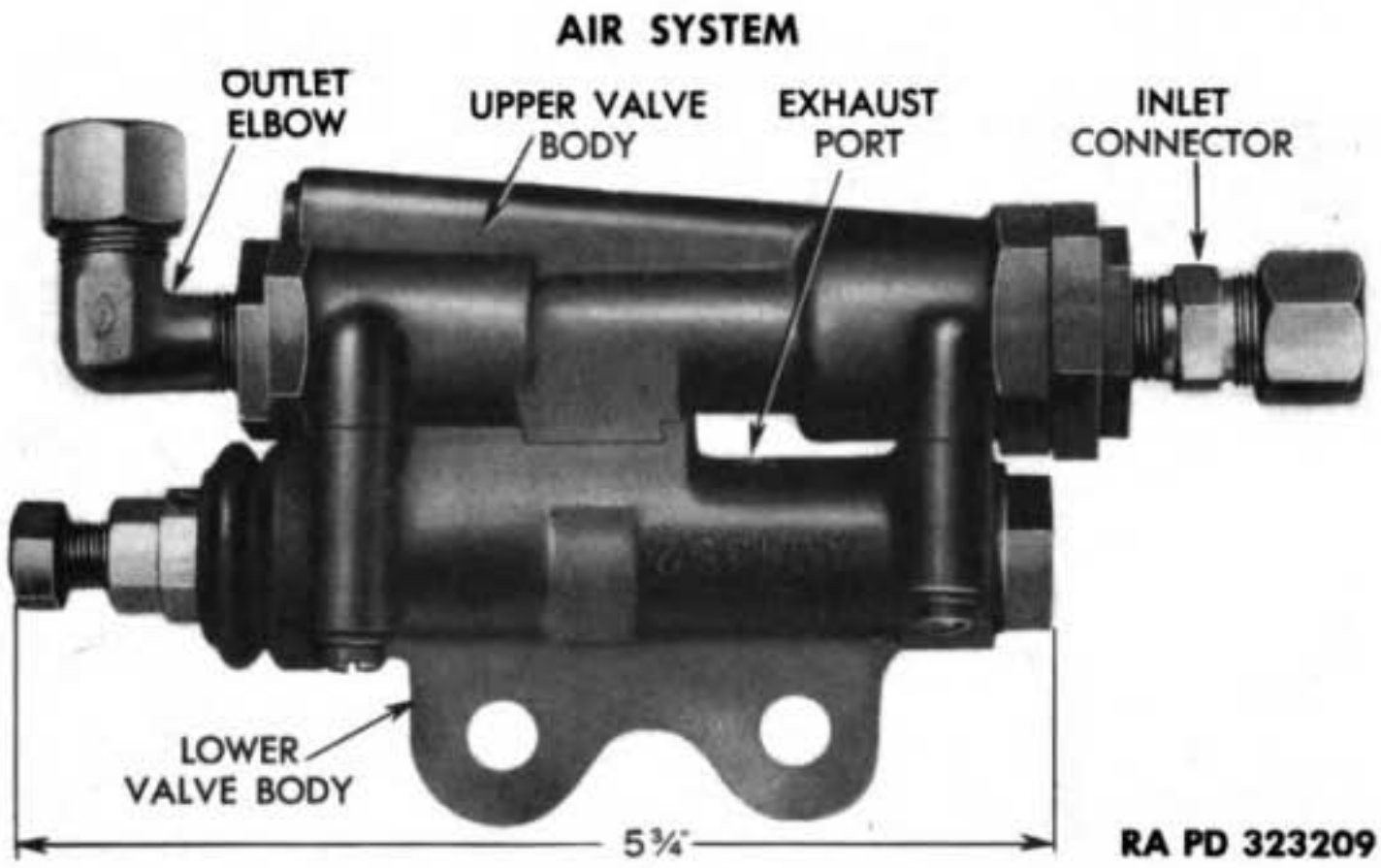



***Figure 215 — Clutch Brake Application Valve***

pin holes in yokes when square edge of groove in actuating lever is alined with end face of valve body. This distance should be 10⅝ inches. Place boot over shaft and valve body.

**g. Test.**

(1) After valve is installed in vehicle, pump up air tanks to shut-off pressure. No leaks should appear around valve when tested with soap solution.

(2) Operate service clutch pedal, and observe action of power cylinders when operating engine clutch.

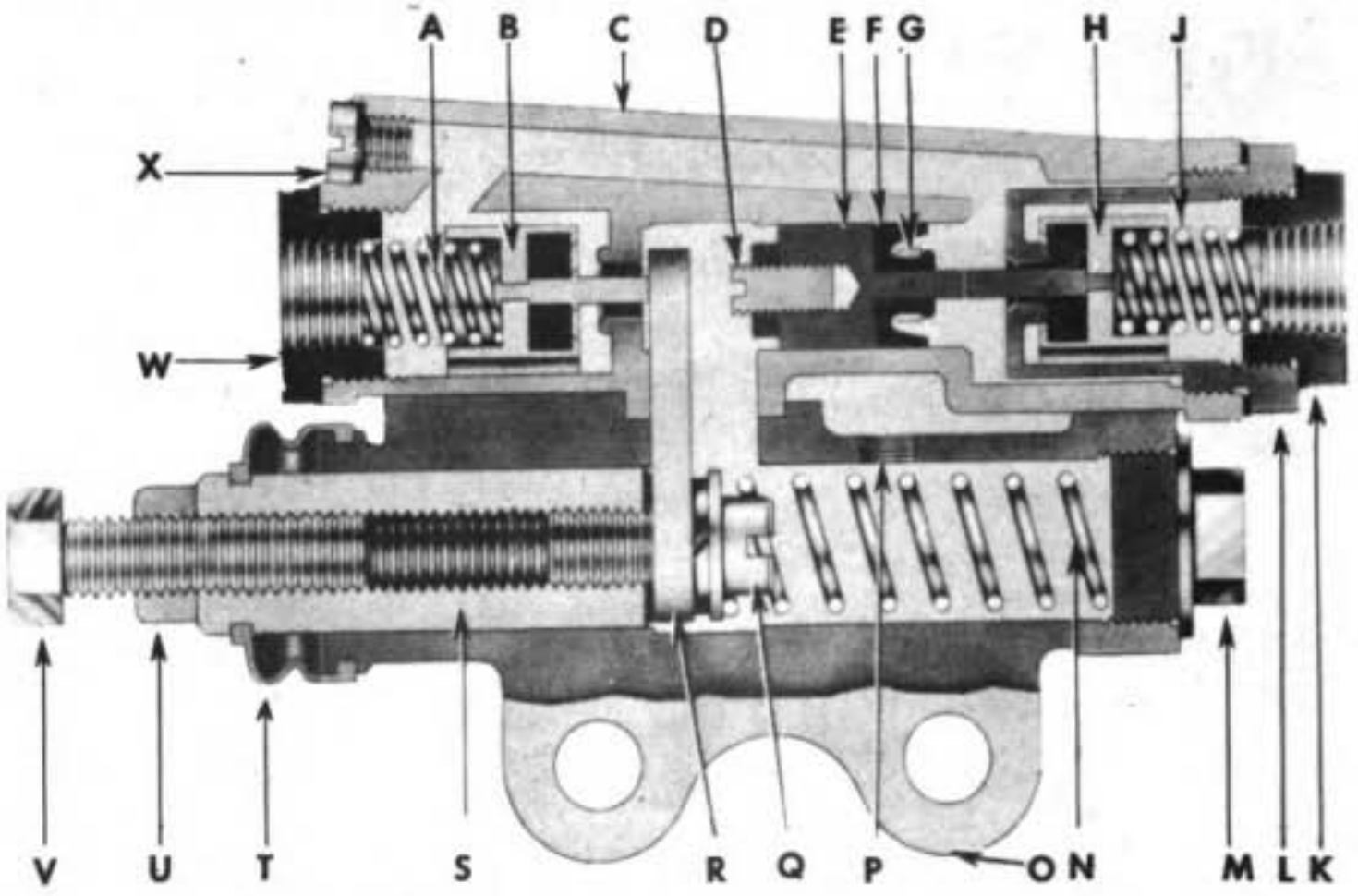
## 100. CLUTCH BRAKE APPLICATION VALVE.

**a. Description** (figs. 215 and 216).

(1) The clutch brake application valve is mounted to the left side of clutch selector unit housing that is located below driver's seat. It is a manually operated air valve, and works off clutch controls. The valve consists of an upper and a lower body which are held together by four machine screws. The lower valve body contains the actuating mechanism, and the upper valve body the air controls. The actuating mechanism includes an operating shaft that has an adjusting cap screw with lock nut at one end, and a finger at the other end. The finger is attached to the operating shaft by a cap screw and lock washer, and extends up into the upper valve body to actuate the inlet and exhaust valves. A compression spring returns the operating shaft to the off position.

(2) The air controls, contained in the upper valve body, include an exhaust valve on one side of the operating shaft finger and an

**ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**




A—VALVE SPRING
B—EXHAUST VALVE
C—UPPER VALVE BODY
D—PISTON ADJUSTING SCREW
E—ACTUATING PISTON
F—PISTON CUP
G—CUP RING
H—INLET VALVE
J—VALVE SPRING
K—INLET PLUG
L—INLET VALVE SEAT
M—RETURN SPRING PLUG
N—RETURN SPRING
O—LOWER VALVE BODY
P—EXHAUST PORT
Q—FINGER SCREW
R—FINGER
S—OPERATING SHAFT
T—BOOT
U—LOCK NUT
V—ADJUSTING SCREW
W—OUTLET PLUG
X—SCREW PLUG

RA PD 323210

***Figure 216 — Cross-section of Clutch Brake Application Valve***

actuating piston and inlet valve on the other side. The actuating piston is equipped with a cup with locking ring which prevents air leakage. Inlet and exhaust valve springs return the valve units to their seats. These springs are held in place by an inlet and an outlet plug. The inlet and outlet plugs, as well as the inlet valve seat, are sealed by gaskets. A screw plug with gasket closes the drilled passage in the upper valve body.

**b. Operation** (fig. 216).

(1) As the service clutch pedal is depressed to disengage the clutch, a series of three levers on the side of the clutch selector unit housing move to exert pressure on the head of the adjusting screw in the valve operating shaft. This pressure moves the operating shaft backward into lower valve body, compressing the return spring. The operating

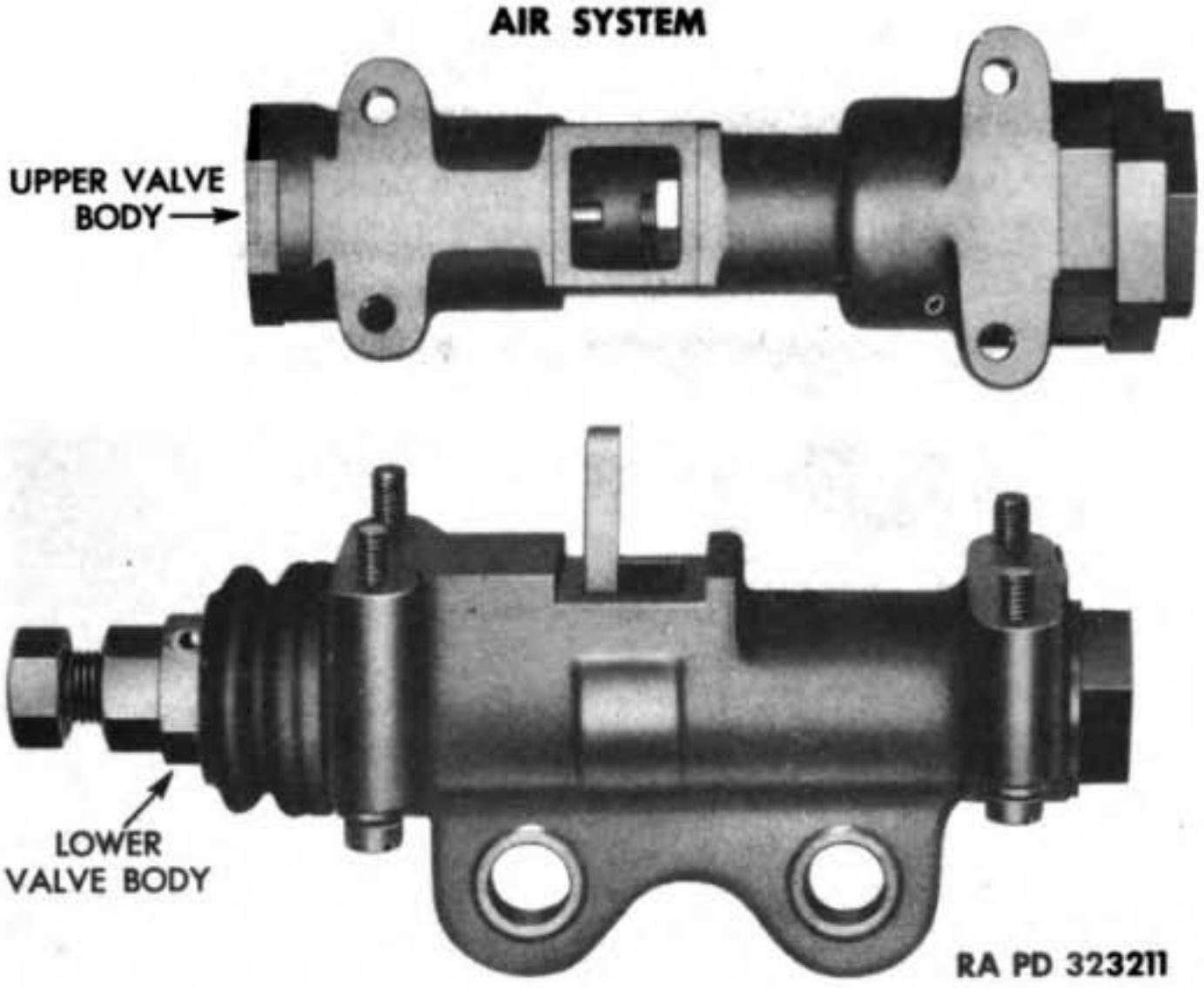



*Figure 217 — Upper Valve Body Separated from Lower Valve Body*

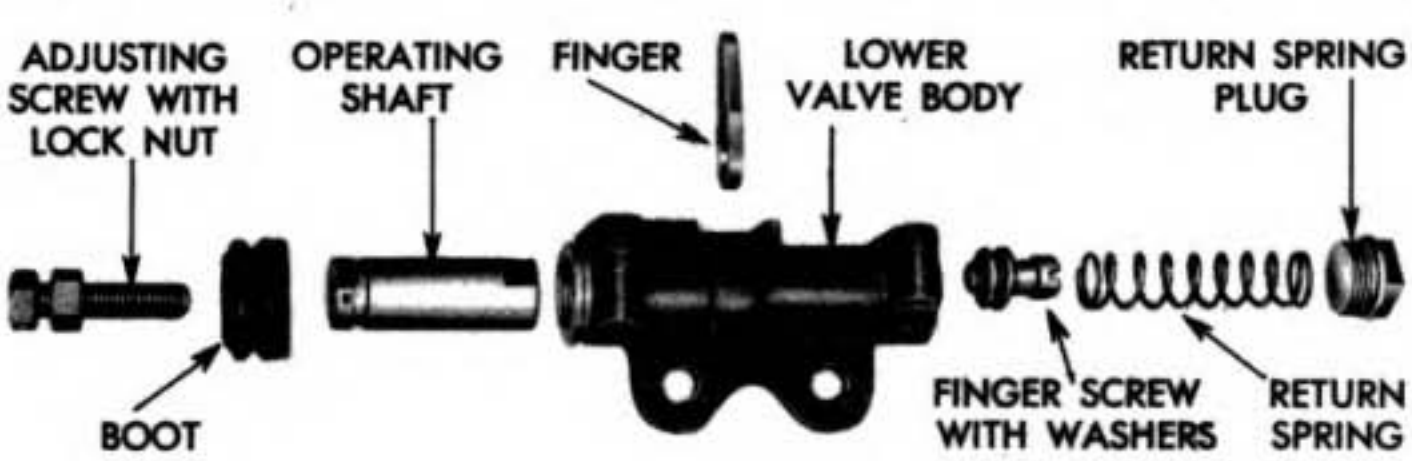



*Figure 218 — Lower Valve Body Disassembled*

shaft finger moves backward with the shaft, and allows exhaust valve to seat. The finger also moves actuating piston and inlet valve backward, unseating inlet valve. The compressed air will then flow from reservoir tanks, through inlet plug, past inlet valve, and through outlet plug to clutch brake power cylinder. This compressed air applies the clutch brake, which stops the transmission gear train during gear shifting operations.

(2) After gear shifting is completed and service clutch pedal is released to engage the clutch, three levers on the side of clutch selector unit housing move in opposite direction and allow valve operating shaft to return to the off position. In so doing, the inlet valve

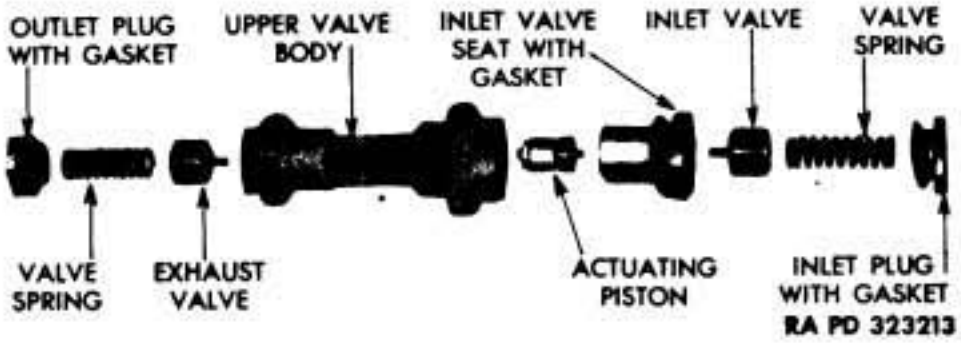



***Figure 219 — Upper Valve Body Disassembled***

seats, closing off air pressure to power cylinder, and the exhaust valve unseats, permitting applied air pressure from clutch brake cylinder to escape past exhaust valve and out exhaust port, into atmosphere. The clutch brake will then release.

**c. Disassemble.**

(1) REMOVE OUTLET ELBOW AND INLET CONNECTOR (fig. 215). Unscrew elbow and connector from plugs.

(2) SEPARATE UPPER VALVE BODY FROM LOWER VALVE BODY (fig. 217). Remove four machine screws and lock washers attaching upper body to lower body.

(3) DISASSEMBLE LOWER VALVE BODY UNIT (fig. 218). Clamp valve body in a vise. Remove return spring plug and return spring. Loosen lock nut and remove cap screw from operating shaft. Remove rubber boot from lower valve body and operating shaft. Remove finger screw, flat washer, and lock washer attaching finger to operating shaft. Remove finger, and pull operating shaft from lower valve body.

(4) REMOVE INLET VALVE (fig. 219). Clamp upper valve body in vise. Unscrew inlet plug and gasket from inlet valve seat. Pull out valve spring and inlet valve. Unscrew valve seat and gasket from valve body.

(5) REMOVE EXHAUST VALVE (fig. 219). Unscrew outlet plug with gasket from upper valve body. Pull out valve spring and exhaust valve.

(6) REMOVE ACTUATING PISTON (fig. 219). Insert a small punch through outlet port, and force actuating piston assembly out through inlet port.

(7) DISASSEMBLE ACTUATING PISTON. Take special care not to scratch the piston. If inspection shows parts to be in good condition, do not disassemble piston. Detach piston cup locking ring, and withdraw piston cup with ring from actuating piston pin. Loosen piston adjusting screw lock nut, and unscrew adjusting screw from piston.

(8) REMOVE SCREW PLUG. Remove screw plug with gasket from drilled passageway in upper valve body.

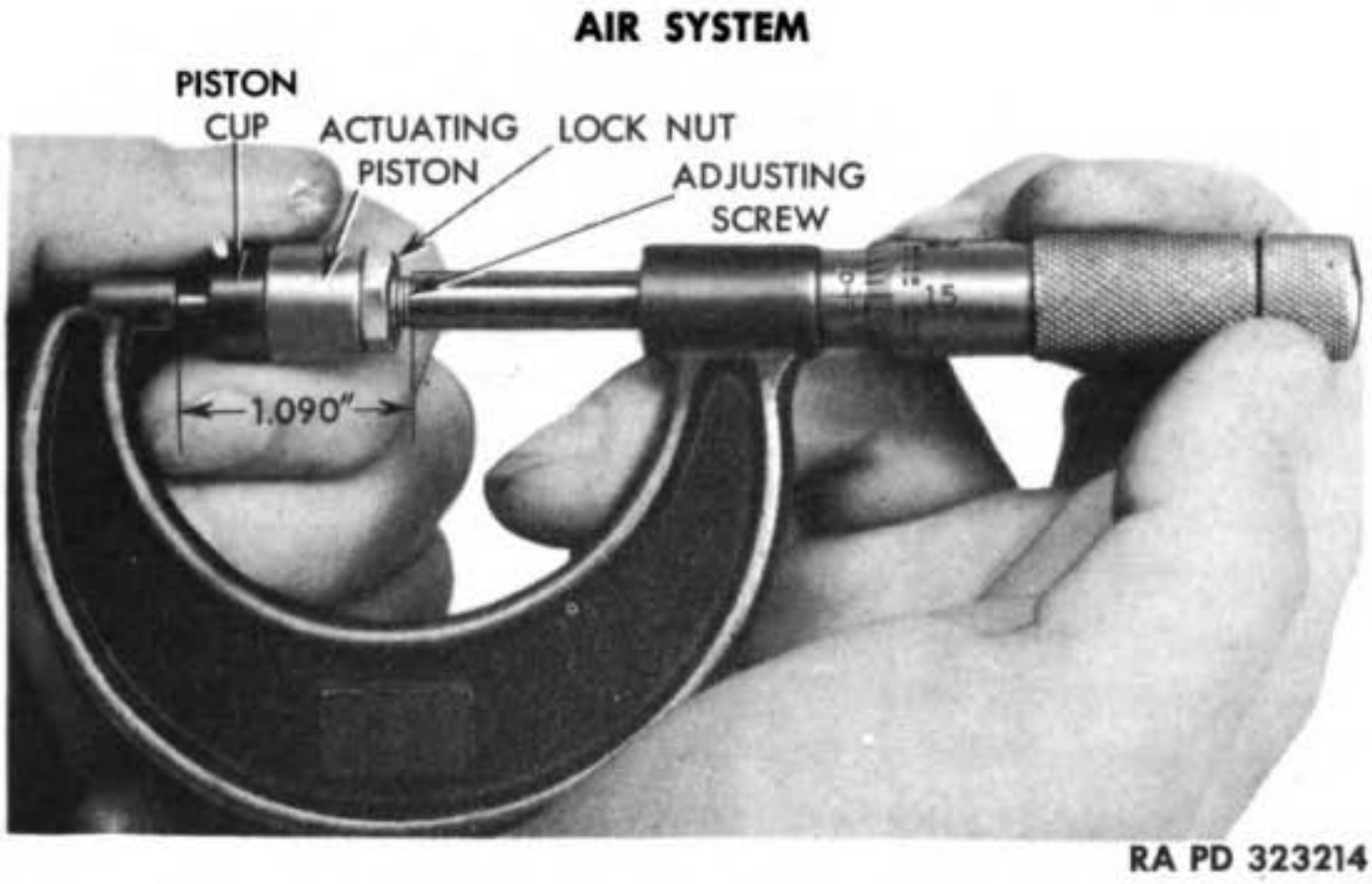



***Figure 220 — Measuring Actuating Piston, Using Tool (41-C-307)***

**d. Clean and Inspect.**

(1) Clean all parts thoroughly with dry-cleaning solvent. Dry with compressed air. Make sure all air passages in valve bodies are open.

(2) Replace all plug gaskets with new gaskets.

(3) Inspect inlet and exhaust valve seats, also piston cup and piston for wear, scratches, or distortion. Replace if any of these imperfections are prevalent.

**e. Assemble.**

(1) Dip all parts in clean engine oil, and permit excess oil to drain off before assembling.

(2) ASSEMBLE ACTUATING PISTON UNIT (fig. 219). Assemble adjusting screw and lock nut to actuating piston. Using a micrometer calipers (41-C-307), set adjusting screw to measure 1.090 inches from end of piston pin to head of screw (fig. 220). Tighten lock nut and recheck measurement. Place locking ring over recessed section of piston cup, and slip piston cup over piston pin with solid end of cup against piston.

(3) INSTALL ACTUATING PISTON UNIT (fig. 219). Insert piston in upper body inlet port, and into smaller bore with adjusting screw toward center of body.

(4) INSTALL INLET VALVE (fig. 219). Place gasket over threads of inlet valve seat, then screw seat into body and tighten. Place inlet valve into inlet valve seat with pin portion through hole in bottom of

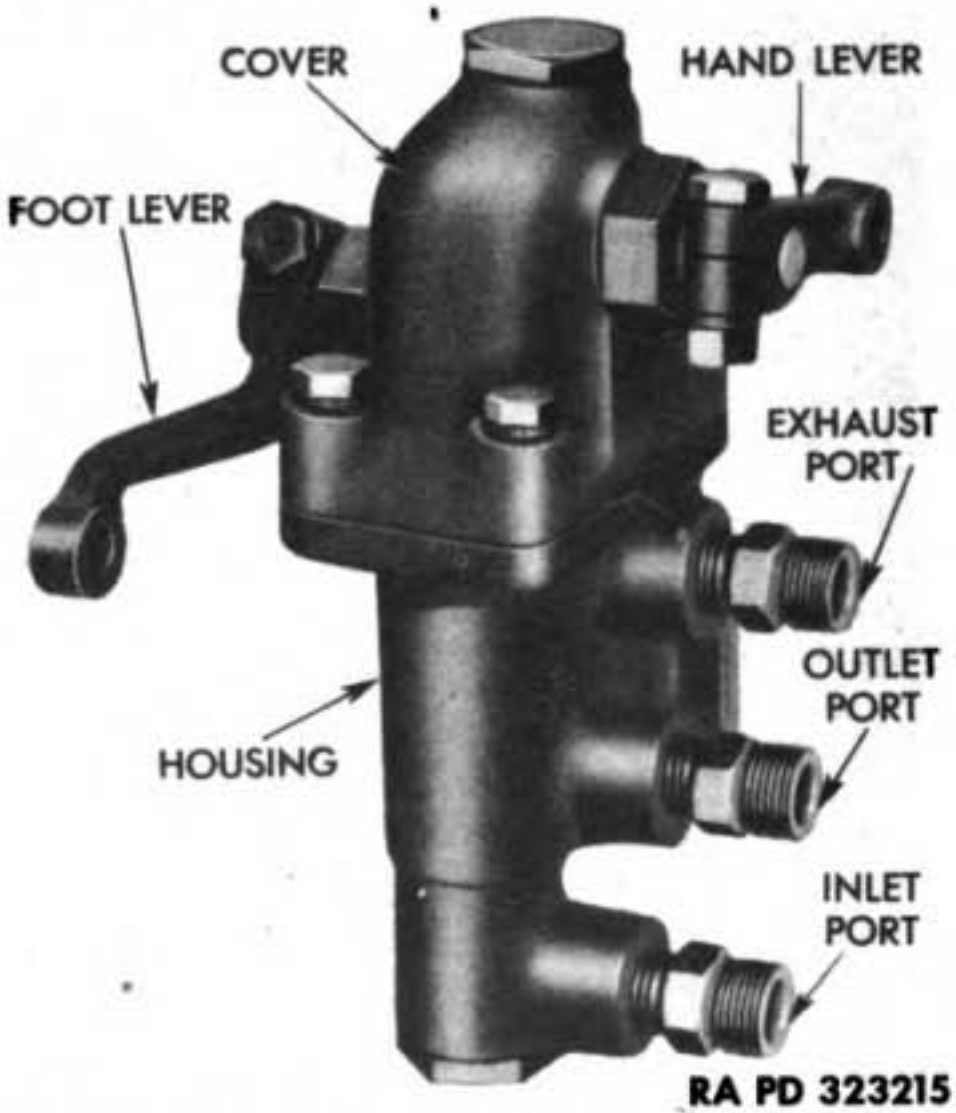



*Figure 221 — Air and Electric Brake Control Valve*

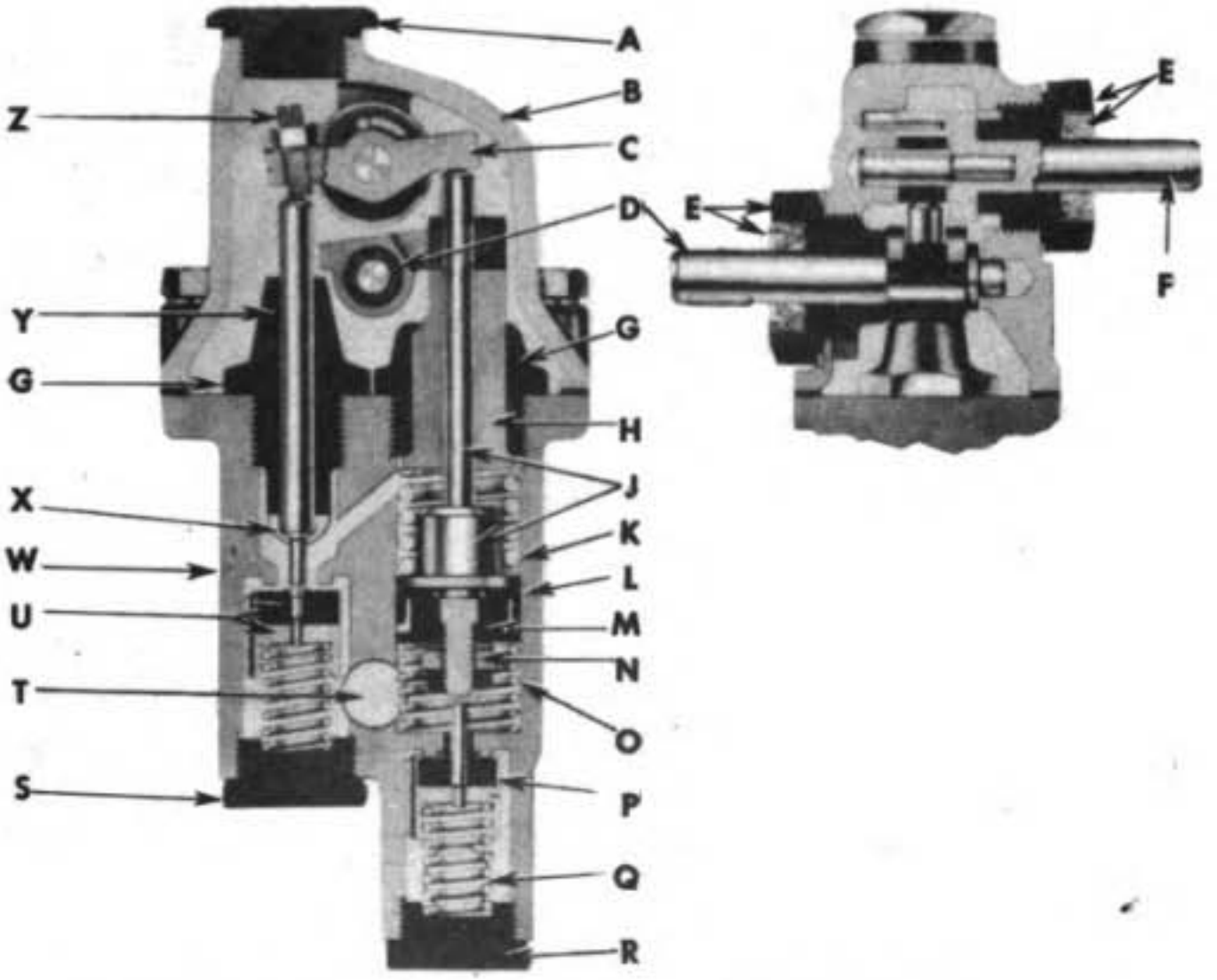
seat. Set valve spring into depressed section of valve. Screw inlet plug with gasket into valve seat and tighten.

(5) INSTALL EXHAUST VALVE (fig. 219). Place exhaust valve in outlet port with pin through hole in bottom of bore. Set valve spring in depressed section of valve. Screw outlet plug with gasket into valve body and tighten.

(6) ASSEMBLE LOWER VALVE BODY UNIT (fig. 218). Turn adjusting screw and lock nut into end of operating shaft nearest boot recess. NOTE: *Do not tighten lock nut, as adjusting screw will have to be adjusted later.* Insert shaft into unthreaded end of lower body with adjusting screw end out. Insert finger screw with flat washer and lock washer in hole in finger, and set finger in position against end of operating shaft. Install finger screw to securely attach finger to shaft. Insert return spring into threaded end of lower body. Then screw in return spring plug with gasket and tighten. Install boot over operating shaft and lower valve body.

(7) INSTALL UPPER BODY TO LOWER BODY (fig. 217). Place two bodies together with operating finger of lower body extending into center opening of upper body. The outlet plug must be on the same side of valve as operating shaft. Install four machine screws and lock washers attaching bodies together and tighten.

**AIR SYSTEM**




A—COVER PLUG
B—HOUSING COVER
C—ROCKER ARM
D—CAMSHAFT
E—SHAFT NUT WITH SEAL
F—ROCKER ARM SHAFT
G—GUIDE NUT
H—METERING SPRING PLUNGER
J—PLUNGER AND PISTON
K—METERING SPRING
L—PISTON SEALING CUP
M—CUP SPREADER
N—CUP SPREADER NUT
O—RETURN SPRING
P—ACTUATING VALVE
Q—INLET PORT
R—ACTUATING VALVE SPRING PLUG
S—EXHAUST VALVE SPRING PLUG
T—OUTLET PORT
U—EXHAUST VALVE
W—HOUSING
X—EXHAUST PORT
Y—EXHAUST VALVE PLUNGER
Z—ROCKER ARM ADJUSTING SCREW

RA PD 323216

***Figure 222 — Cross-section of Air and Electric Brake Control Valve***

(8) INSTALL SCREW PLUG. Install screw plug in threaded end of drilled port in upper valve body.

**f. Adjust.** Push operating shaft into valve body, and let it snap back, to be sure it comes back against stop. Turn adjusting screw in operating shaft until distance from head of screw to head of return spring plug at opposite end is 5¾ inches (fig. 215). Tighten lock nut, and recheck dimension.

## ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH-SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)

### 101. AIR AND ELECTRIC BRAKE CONTROL VALVE.

**a. Description** (fig. 221). This valve is used to apply the air or electric brakes on the towed load. One section of valve is actuated by foot control, and the other by hand control. It is mounted to the steering lever ratchet, and is connected to the controls by linkage. The valve housing has two chambers; one which houses the air actuating valve and air metering parts, and the other which houses the exhaust valve and plunger. A cover seals the upper portion of the valve housing, and carries the actuating mechanism.

**b. Operation** (fig. 222).

(1) There are three port openings on the side of the valve housing. The lower opening, which is the inlet port, connects with the air manifold and air reservoir tanks. The middle opening, which is the outlet port, connects with the towed-load air brake system and electric brake controller power cylinder. The upper opening, which is the exhaust port, connects with an exhaust tube whose outlet is under the cowl.

(2) When the inner thumb button on the right steering lever is depressed, the upper shaft in valve cover rotates and moves the rocker arm. .The adjusting screw end of the rocker arm raises and allows the exhaust valve to close. At the same time, the opposite end of the rocker arm moves downward with the plunger and piston, and opens the actuating valve. This allows compressed air to go through the outlet port, thereby applying towed-load brakes. Air pressure is metered manually by operator. He may apply, hold, or release, any amount of air pressure for desired deceleration by actuating hand control button on right steering lever. When the thumb button on steering lever is released, the rocker arm in the valve moves, allowing plunger and piston to move upward and close the actuating valve. At the same time, the adjusting screw end of the rocker arm moves downward and opens the exhaust valve. Then the applied air pressure in the towed-load brake system escapes past the exhaust valve and out through the exhaust port, and the towed-load brakes release.

(3) When the air and electric towed-load foot brake pedal is depressed, the lower shaft (camshaft) in the air and electric brake control valve is rotated, and its cam forces the metering spring plunger downward. This relieves the upward pressure of the plunger on plunger rocker arm, and allows the exhaust valve to close. The actuating valve opens; compressed air goes past the actuating valve, through the outlet port, and applies the towed-load brakes. The air pressure which is applied to the towed-load brakes is also exerted against the plunger piston, tending to force the plunger and piston up, and compressing the metering spring. At the same time the actuating valve is allowed to close. This construction in the air and electric brake control valve meters the air pressure to the towed-load brakes so that

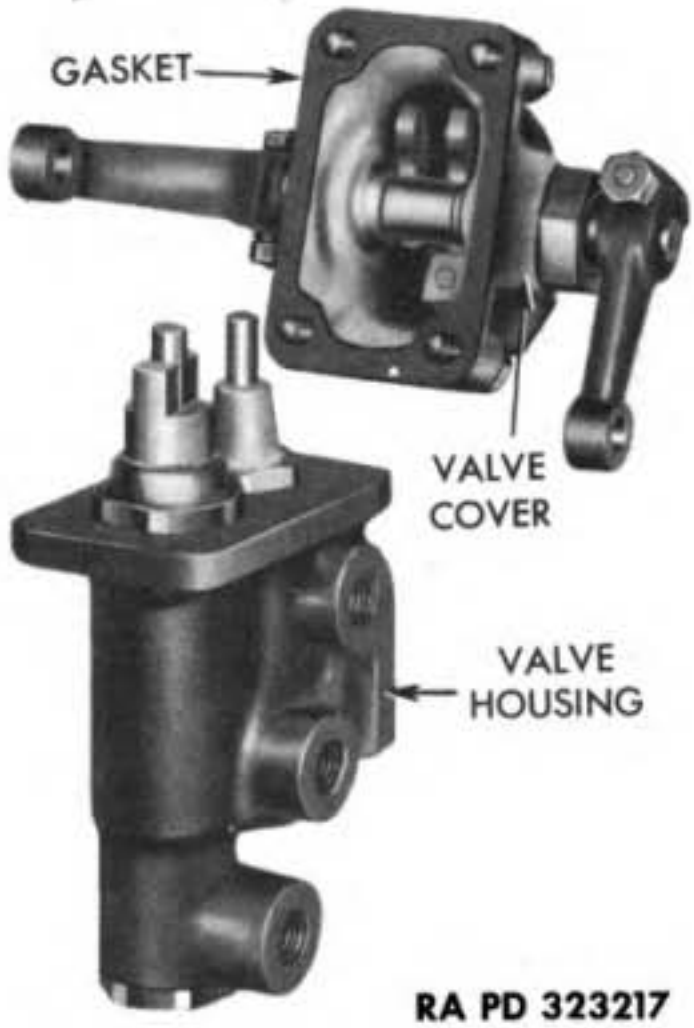



*Figure 223 — Cover Removed from Valve Housing*

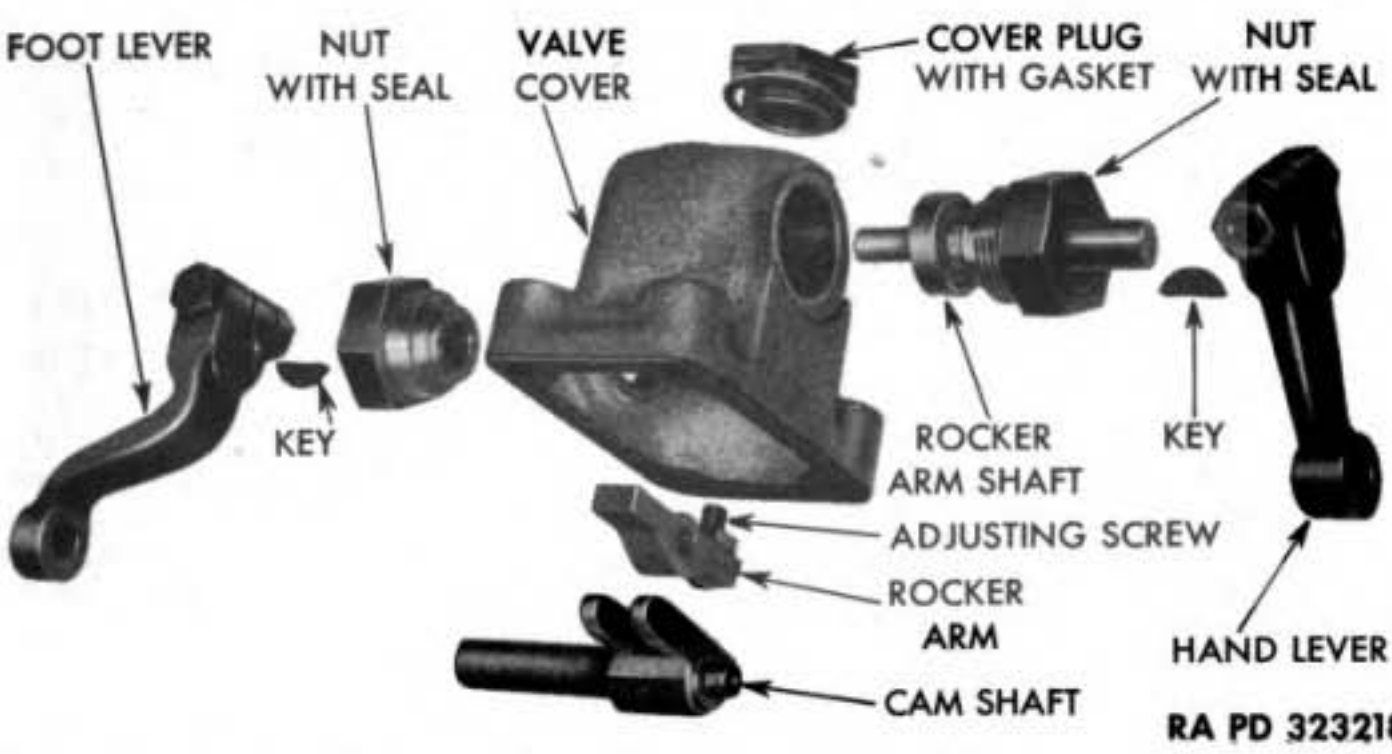



*Figure 224 — Air and Electric Brake Control Valve Disassembled*

a greater air pressure is exerted to the towed-load brakes as the brake pedal is pushed further down.

**c. Disassemble.**

(1) REMOVE VALVE COVER FROM VALVE HOUSING (fig. 223). Remove four cap screws and lock washers attaching cover to housing, and remove cover and gasket.

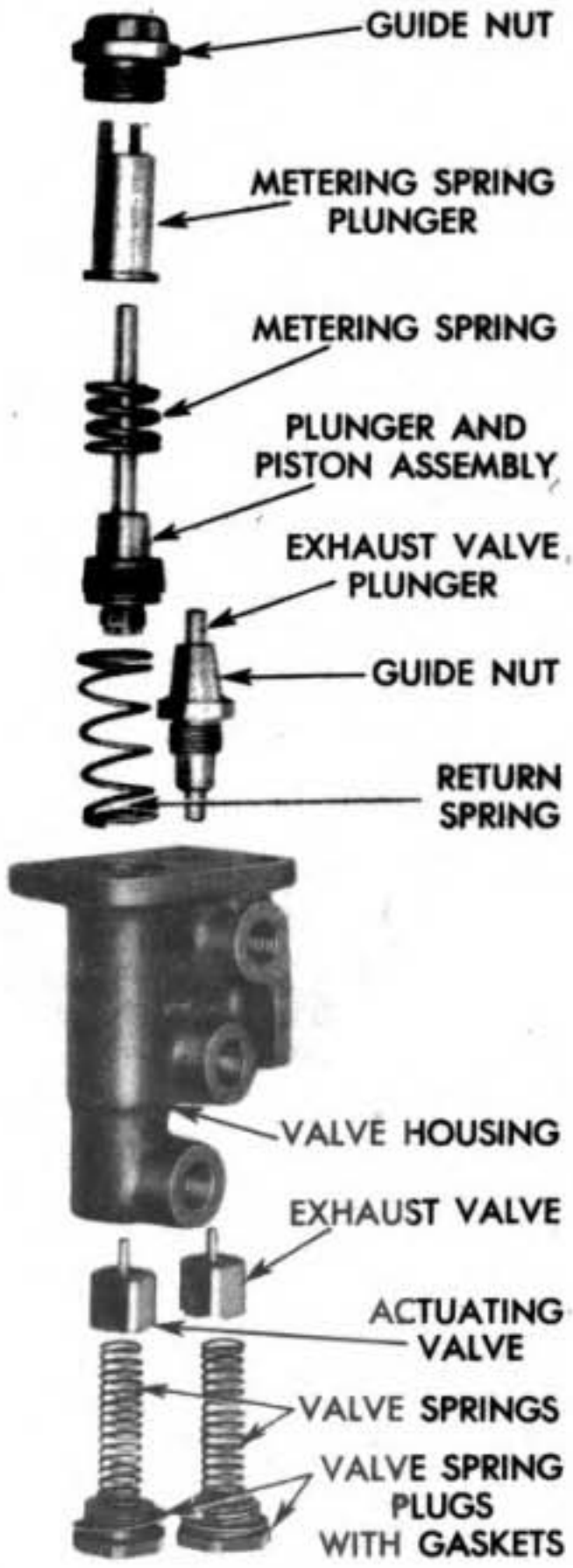



***Figure 225 — Air and Electric Brake Control Valve Housing Disassembled***

(2) REMOVE FOOT AND HAND LEVERS (fig. 224). Loosen nuts on cap screws clamping levers to shafts, and remove levers. Pull Woodruff keys from shafts.

(3) REMOVE COVER PLUG WITH GASKET (fig. 224).

(4) REMOVE CAMSHAFT (fig. 224). Unscrew camshaft nut with seal from valve housing cover. Move camshaft outward until small

end of shaft pulls out of inner bearing, then tip shaft downward and remove it from cover.

(5) REMOVE ROCKER ARM SHAFT (fig. 224). Unscrew rocker arm shaft nut with seal from valve housing cover, and pull shaft out of nut opening. Rocker arm will then drop out of cover.

(6) REMOVE EXHAUST VALVE PLUNGER AND GUIDE NUT (fig. 225). Clamp valve housing in vise, and remove guide nut and plunger.

(7) REMOVE PLUNGER AND PISTON ASSEMBLY (fig. 225). Remove metering spring plunger guide nut and metering spring plunger. Pull out plunger and piston assembly with metering spring, and lift out return spring.

(8) DISASSEMBLE PLUNGER AND PISTON ASSEMBLY (fig. 225). Clamp metering spring guide portion of piston in a vise, and remove piston sealing cup spreader nut and lock washer. Pull cup spreader and piston sealing cup from plunger.

(9) REMOVE EXHAUST AND ACTUATING VALVES (fig. 225). Clamp valve housing in vise, and remove actuating and exhaust valve spring plugs and gaskets. Lift out valve springs and valves. NOTE: *Actuating and exhaust valves, springs, and plugs are identical.*

**d. Clean and Inspect.**

(1) Clean all parts thoroughly with dry-cleaning solvent. Dry with compressed air.

(2) Inspect all parts, and discard those showing excessive wear.

(3) Discard all gaskets and replace with new.

**e. Assemble.**

(1) LUBRICATE PARTS. Lubricate all moving parts including springs with clean engine oil before assembling.

(2) INSTALL ACTUATING AND EXHAUST VALVES (fig. 225). Clamp valve housing in a vise. Insert actuating and exhaust valves and springs. Install valve spring plugs and new gaskets.

(3) ASSEMBLE PLUNGER WITH PISTON ASSEMBLY (fig. 225). Clamp metering spring guide portion of piston in a vise, and install sealing cup on plunger with lip facing away from piston. Install cup spreader, lock washer, and spreader nut. Tighten securely.

(4) INSTALL PLUNGER WITH PISTON ASSEMBLY (fig. 225). Insert return spring, plunger with piston, and metering spring in valve housing. Install metering spring plunger and guide nut.

(5) INSTALL ROCKER ARM SHAFT (fig. 224). Place rocker arm in valve housing cover, and install camshaft. Install shaft nut with seal.

(6) INSTALL CAMSHAFT (fig. 224). Insert camshaft into housing cover through opening in base, and let shaft project through shaft nut

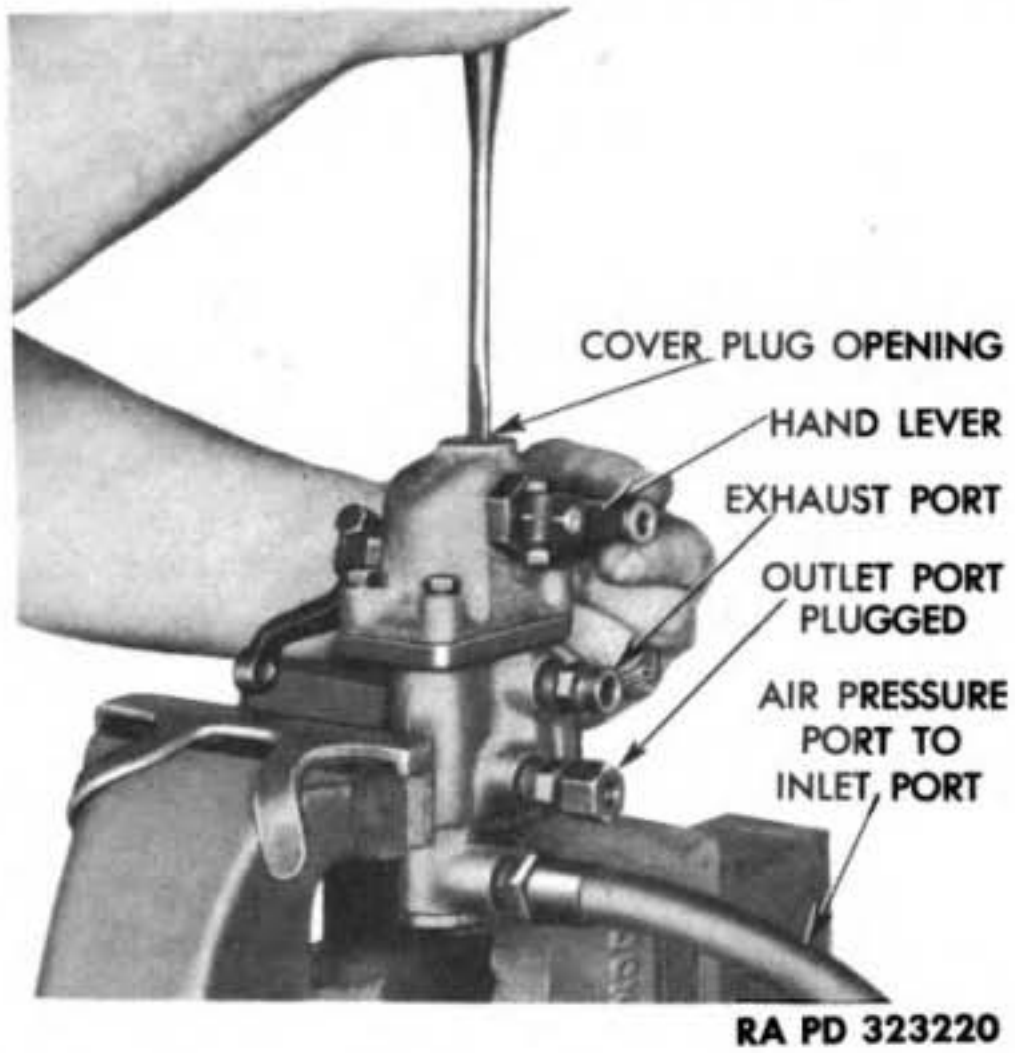



***Figure 226 — Adjusting Air and Electric Brake Control Valve***

opening. Locate inner end of camshaft in inner bearing, and install shaft nut with seal.

(7) INSTALL COVER TO HOUSING (fig. 223). Place gasket and cover on top of valve housing, and secure with four cap screws and lock washers. NOTE: *It is necessary to adjust valve before installing cover plug with gasket.*

(8) INSTALL FOOT AND HAND CONTROL LEVERS. Place Woodruff keys in shafts. Place hand lever on upper shaft and foot lever (offset lever) on lower shaft. Secure levers by tightening nuts on clamping screws.

**f. Adjust** (fig. 226).

(1) Apply air pressure to inlet port (lower opening). **CAUTION:** *Be sure air supply is clean, or valve will be filled with foreign matter.* Plug outlet port (center opening). Rotate rocker arm shaft (upper shaft) by moving hand lever until actuating valve is just unseated. Inserting screwdriver through cover plug opening in valve cover, screw in rocker arm adjusting screw until an air leak is heard through exhaust port. Then let upper shaft return to its stop.

(2) Back off rocker arm adjusting screw three-quarters of a turn, and tighten lock nut securely.

(3) Install cover plug and gasket in housing cover.

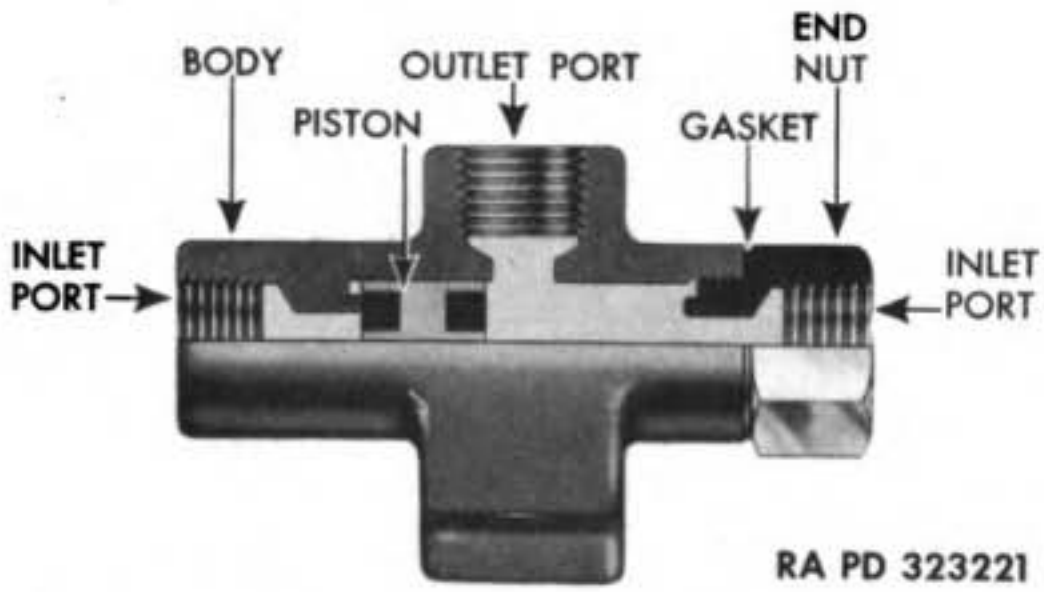



*Figure 227 — Cross-section of Two-way Valve*

## 102. TWO-WAY VALVE.

**a. Description** (fig. 227). The two-way valve is mounted to the inside of the right driver's seat support directly below the right floor plate. It is incorporated in the towed-load air brake system so that it may transfer applied air pressure from either of two sources into one outlet. The operation is performed automatically within the valve. The valve consists of a body with an integral mounting bracket. Directly opposite the bracket, and in the center of the body, is the outlet port. An inlet port is located at each end of the body, one being removable (called an "end nut"). The end nut is a means of assembling and disassembling the valve for the purpose of inspecting piston and seats.

**b. Operation** (fig. 227). The action of the valve is controlled by a piston which moves freely within the body. Applied air pressure to either inlet port forces the piston to the opposite port, sealing it, and permitting the air to be discharged through the outlet port. The valve functions when the tractor with towed load is to be moved by another tractor because of loss of motive power. The towing tractor has its rear air line service coupler connected to the front air line service coupler of the disabled tractor. The applied air pressure of the towing tractor is bypassed through the disabled tractor to the towed-load brake system by the two-way valve. The controls of the disabled tractor, being in their normal off position, would allow the applied air pressure to escape through their exhaust ports, if the two-way valve were not used to bypass these controls.

**c. Disassemble** (fig. 228). Unscrew the end nut with gasket from two-way valve body. Remove piston by tilting valve body to allow piston to slide out of cylindrical bore into hand. CAUTION: *Do not drop piston.*

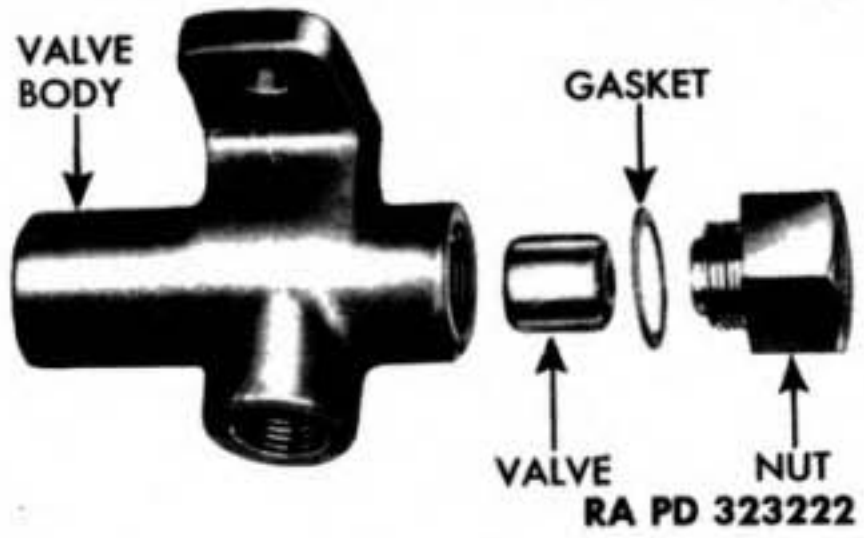



*Figure 228 — Two-way Valve Disassembled*

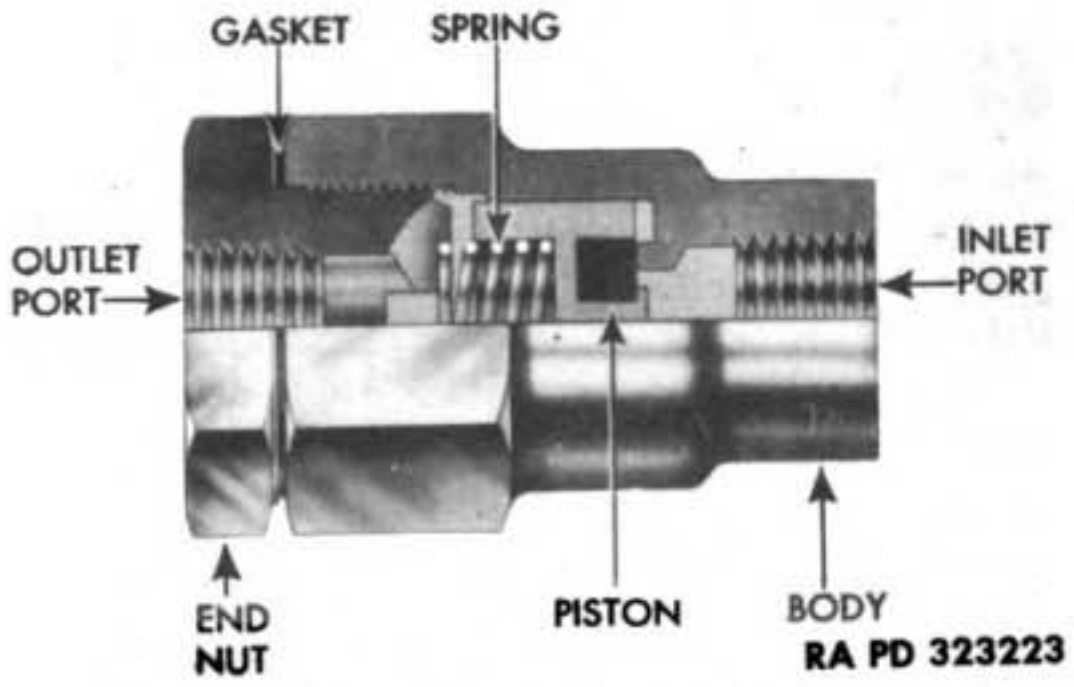



*Figure 229 — Cross-section of One-way Valve*

**d. Clean and Inspect.**

(1) Clean all parts thoroughly with dry-cleaning solvent. Dry with compressed air.

(2) Inspect valve seats in bottom of cylindrical bore in valve body, and also in end nut, for smoothness. Replace end nut or body if seats are defective.

(3) Inspect piston inserts. They must be smooth and show uniform seating marks. Piston must slide freely in body.

**e. Assemble** (fig. 228). Dip piston in clean engine oil, and insert in cylindrical bore in valve body. Place new gasket on end nut, and install nut into valve body and tighten.

## 103. ONE-WAY VALVE.

**a. Description** (fig. 229). The one-way valve is incorporated in the air line between the air manifold and the emergency coupler at the front end of the vehicle. This valve permits compressed air to

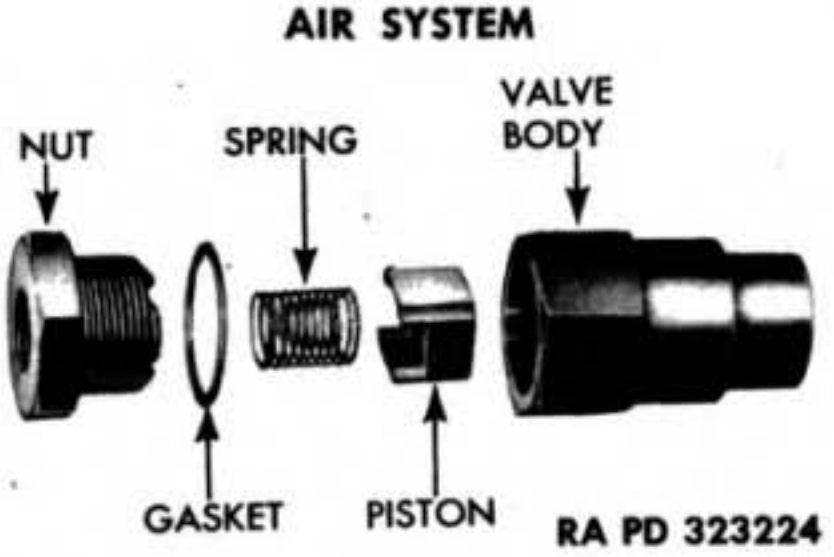



*Figure 230 — One-way Valve Disassembled*

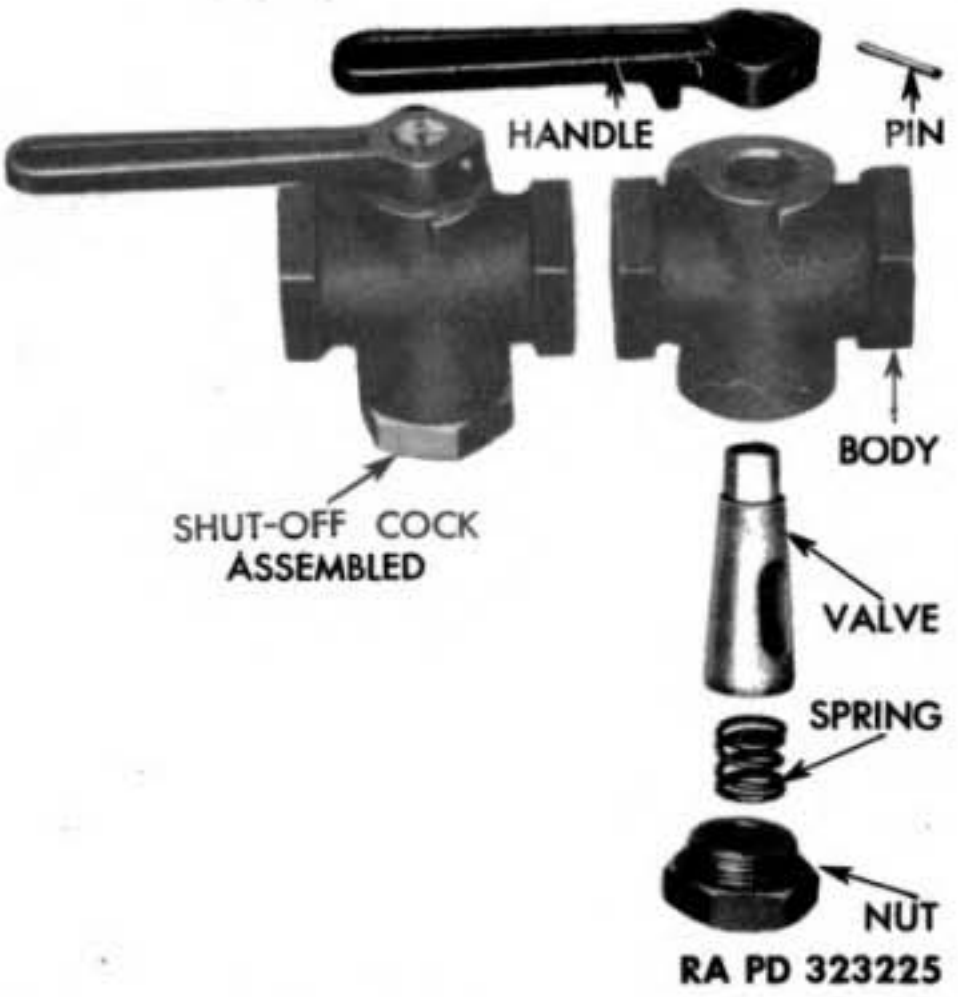



*Figure 231 — Shut-off Cock Assembled and Disassembled*

enter the system through the emergency coupler, but prevents it from leaving through the emergency coupler. The valve consists of a body which contains a piston and return spring. They are retained within the body by a threaded nut and gasket.

**b. Operation** (fig. 229). Compressed air enters valve through inlet port at small end. It forces the piston off its seat, compressing the spring, and then passes on through the valve and out the outlet port. When air pressure in the outlet port becomes greater than air pressure in the inlet port the piston will seat, closing off air flow.

**c. Disassembly** (fig. 230). Clamp valve body in vise. Unscrew nut and gasket, and tip body over to let spring and piston slide out.

**d. Clean and Inspect.** Clean all parts with dry-cleaning solvent. Dry with compressed air. Check insert in piston and piston seat in body for damage. Replace damaged parts.

**e. Assemble** (fig. 230). Dip piston in clean engine oil, and place in valve body with insert end forward. Set spring in recess in piston. Install new gasket on end nut, and screw nut into valve body, making sure that spring seats in recess in face of nut. Tighten securely.

**f. Test.** Attach outlet port side of valve to air pressure line. Apply at least 80 pounds pressure. Check for leaks past piston seat and nut gasket, using soap solution.

## 104. SHUT-OFF COCKS.

**a. Description** (fig. 231). Shut-off cocks are used in the service coupler line, the emergency coupler line at the rear of the tractor, and in the emergency coupler line at the front of the tractor. These shut-off cocks provide a method of closing off the air lines when they are not in use. The shut-off cock consists of a brass body which is threaded at two ends for attaching to pipes. In the center is a tapered valve which is ground to fit the body to prevent air leakage. A compression spring holds the tapered valve tight on the tapered bore in the body. A passage is provided through the tapered valve, so that when the cock is turned to the closed position, the air is prevented from flowing through. The shut-off cock is closed when the handle is parallel with the body, and open when handle is at a 90-degree angle with body. Stops are provided to prevent the handle being turned beyond its normal open and closed positions. A groove across the top of the valve indicates the direction of the passage in the valve.

**b. Disassemble** (fig. 231).

(1) REMOVE HANDLE. Clamp hexagon end of shut-off cock body in a vise. Drive out pin attaching handle to head of tapered valve, and lift off handle.

(2) REMOVE TAPERED VALVE. Remove nut from body, and lift out spring. Remove tapered valve.

**c. Clean, Inspect, and Repair.**

(1) Clean all parts with dry-cleaning solvent. Dry with compressed air.

(2) Inspect sealing surfaces of tapered valve and inside bore of body for ridges and scoring.

(3) Leakage due to slight ridges and scoring can be corrected by lapping tapered valve to body, using fine lapping compound. If leakage cannot be stopped completely, shut-off cock should be replaced. Do not attempt to fit a new tapered valve to an old body, or vice versa.

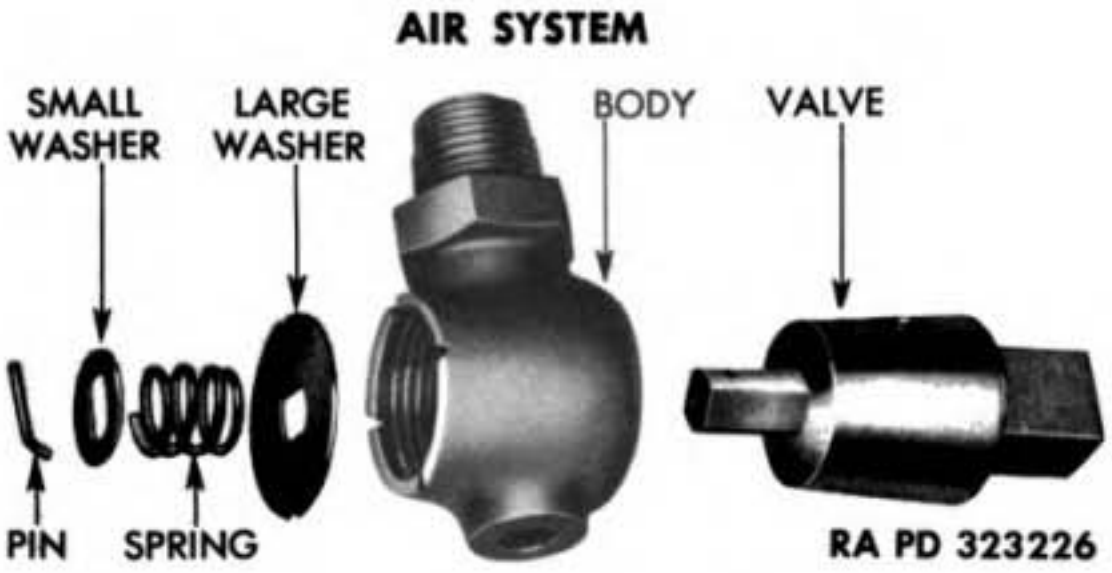



***Figure 232 — Air Reservoir Tank Drain Cock Disassembled***

**d. Assemble** (fig. 231).

*Thoroughly clean lapping compound from all surfaces before assembling.*

(1) INSTALL TAPERED VALVE. Apply thin coating of general purpose grease, with the finger, on contacting surfaces of tapered valve and body. Place tapered valve in body. Set spring in nut, place a thin coating of grease under head of nut, and install nut and spring in body. Tighten nut securely.

(2) INSTALL HANDLE. Place handle on square head of tapered valve. Make sure projection on bottom of handle is between stops in body, and that pin holes line up. Drive pin in holes in handle and valve, and peen the ends to make secure.

**e. Test.**

(1) Turn handle of shut-off cock several times between opened and closed positions.

(2) Place a pipe plug in one end of shut-off cock, and connect other end to an air supply of at least 80 pounds pressure.

(3) With air pressure within shut-off cock and handle in open position, coat outside of cock with soap solution. There should be no leakage.

(4) With air pressure applied at one end of shut-off cock and handle in closed position, loosen pipe plug and coat around threads with soap solution. There should be no leakage.

(5) If excessive leakage is found, shut-off cock should be disassembled, cleaned, repaired, and again tested for leaks; if it is beyond repair, replace with new shut-off cock.

## 105. DRAIN COCKS.

**a. Description** (fig. 232). A drain cock is used in the bottom of each air reservoir tank to provide a means of draining condensation that normally collects in tanks. The drain cock consists of a brass

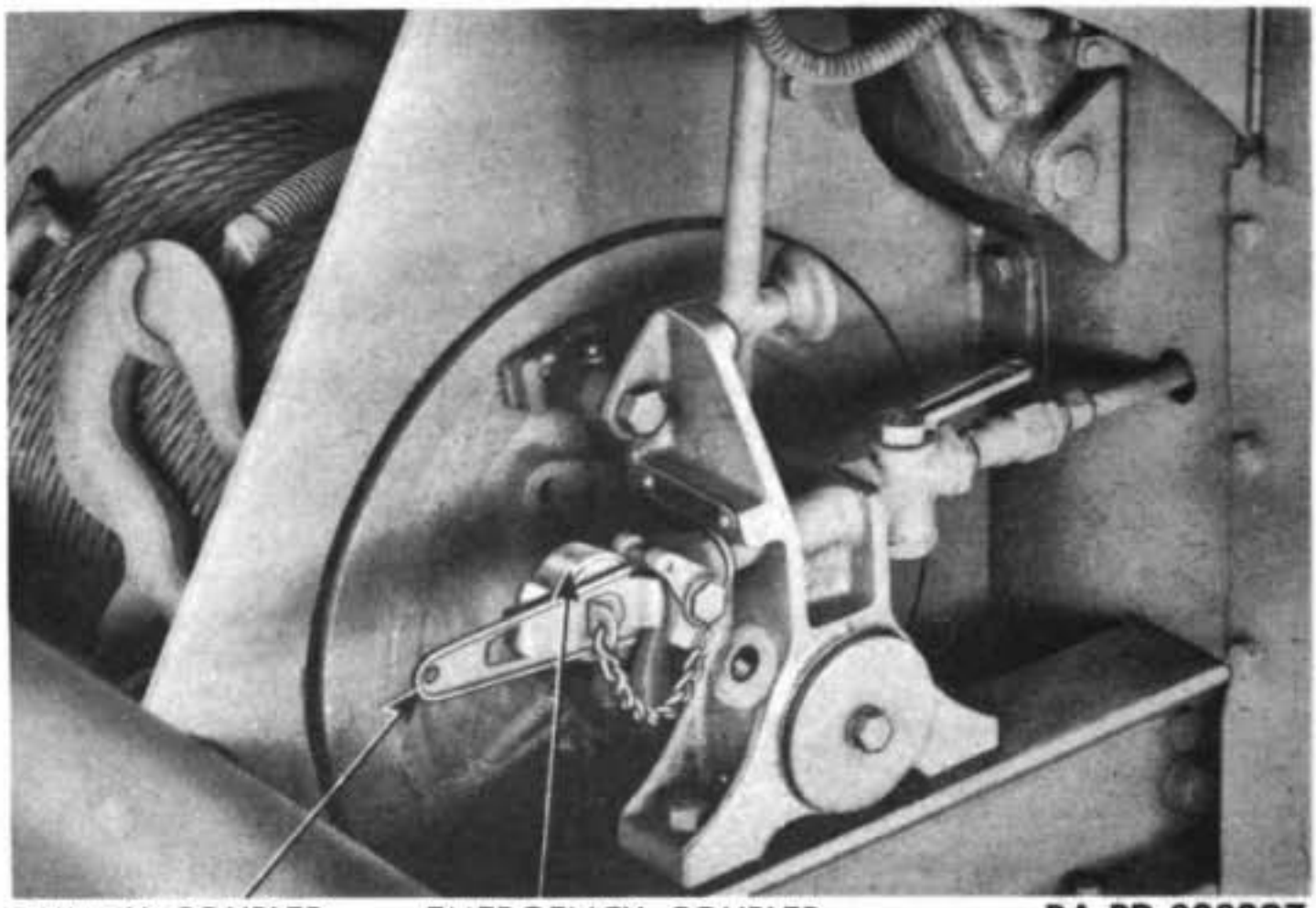



*Figure 233 — Hose Coupler with Dummy Coupler*

body into which is fitted a tapered valve that is held on its seat by a compression spring. Both drain cocks are opened and closed simultaneously by means of a connecting cross rod and control rod. When the control rod, which is located under the right center platform, is pulled up, the drain cocks are opened; when it is pushed down, the drain cocks are closed.

**b. Disassemble** (fig. 232). Remove pin from end of drain cock valve. Lift off small washer, spring, and large washer; remove tapered valve from body.

**c. Clean, Inspect, and Repair.** Clean all parts thoroughly with dry-cleaning solvent. Dry with compressed air. Inspect tapered valve and bore in body for ridges and scoring. Leakage due to slight scoring can be corrected by lapping tapered valve to body with fine lapping compound.

**d. Assemble** (fig. 232). Apply thin coating of grease on tapered surface of valve, and place it in body. Place large washer over end of tapered valve with upset groove toward body. Place spring and small washer over end of tapered valve. Compress spring, and install retaining pin.

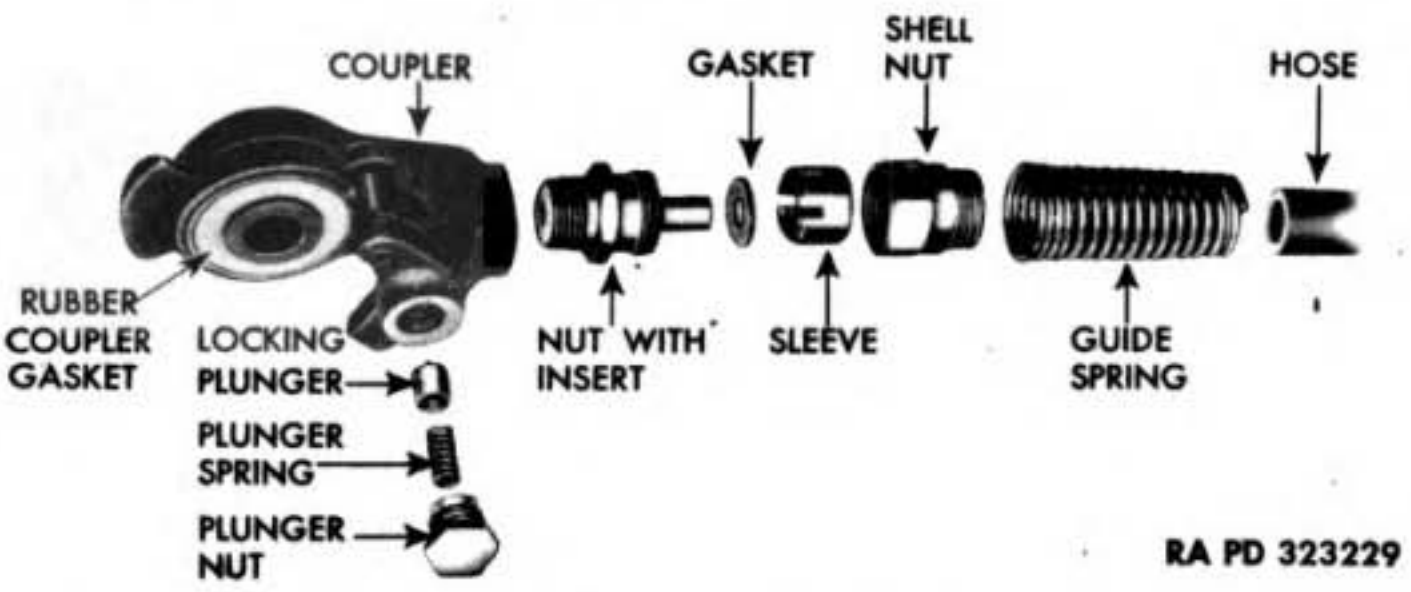



*Figure 234 — Trailer Air Brake Hose Coupler Disassembled*

## 106. TRAILER AIR BRAKE HOSE ASSEMBLY AND COUPLERS.

**a. Description** (fig. 233). The trailer air brake hose assembly includes a coupler, a detachable-type fitting, and a spring guard at each end. There are four couplers identical to the two on each air brake hose. They are provided on the tractor for connecting the air brake hose; two at the front end, and two at the rear. The couplers are a ready means of connecting and disconnecting the air brake hose between two vehicles. When two couplers are coupled together, pressure is exerted on two rubber gaskets, making an airtight seal. A spring-loaded locking plunger in each coupler locks the couplers together. Dummy couplers are provided for the couplers on the vehicle to protect couplings against entry of dirt or foreign matter. Normally, no servicing is required except to be sure they are always connected to the hose coupler when the hose couplers are not being used. The dummy coupler for the emergency coupler at the left front of the vehicle is vented by a drilled hole.

**b. Disassemble** (fig. 234).

(1) REMOVE COUPLER. Unscrew coupler from male body nut and insert, or from nipple, if couplers are on the vehicle.

(2) DISCONNECT HOSE. Unscrew shell nut from male body nut and insert. Pull hose from insert. If hose is to be replaced, cut hose to permit removal of shell nut and guide spring. Do not attempt to remove sleeve. Do not remove guide spring from shell nut unless necessary. Follow same procedure for disassembling coupler and connections at opposite end of hose.

(3) REMOVE LOCKING PLUNGER. Unscrew spring retaining nut, and remove spring and plunger.

**c. Clean and Inspect.**

(1) Clean all metal parts with dry-cleaning solvent. Do not use dry-cleaning solvent on hose.

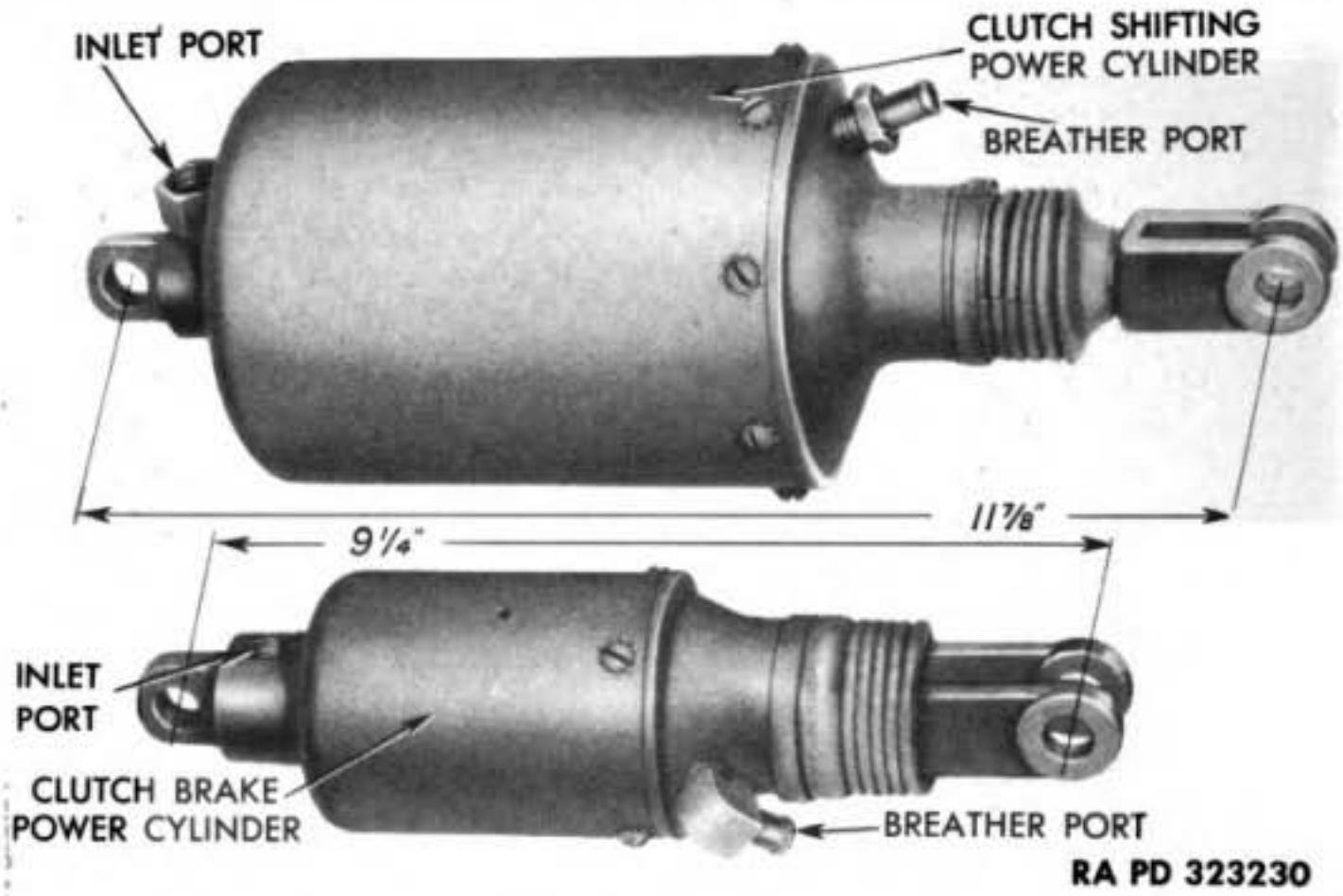



*Figure 235 — Clutch Shifting and Clutch Brake Power Cylinder*

(2) Inspect plunger point for wear. Check freeness of plunger in drilled hole in coupler.

(3) Use a new gasket and sleeve when attaching coupler to a new hose, or to a hose that has had sleeve end cut off.

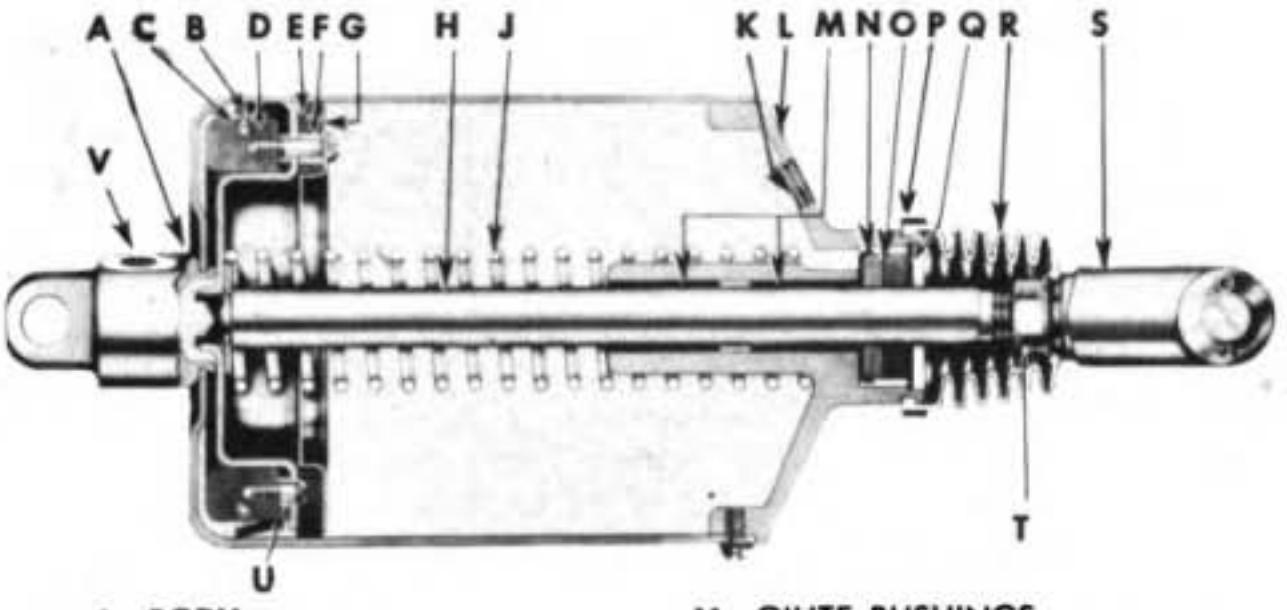
(4) If rubber coupler gasket is defective, replace with new coupler.

**d. Assemble** (fig. 234).

(1) CONNECT HOSE. If hose is to be replaced, cut a new hose 155⅞ inches long, using a knife or hacksaw. Be sure to cut end smooth and square with outside wall. Blow out hose with compressed air. Place shell nut and guide spring on hose. Then install new sleeve approximately 1 inch back from end of hose with finger end toward end of hose. Place gasket over insert in male guide nut with protector covering side away from nut. Remove protector covering from gasket. Install hose all the way on insert. Make sure end of hose is against gasket and down in bottom of recess in male body nut. Install shell nut in male body nut. It is not necessary to draw shell nut tight against male body nut. There should be approximately ⅛ to 3/16 inch between hexagon heads of nuts, when they are drawn up tight.

(2) INSTALL COUPLER. Turn coupler onto hose male body nut, or turn coupler onto nipple on vehicle. Be sure dummy coupler chain ring is on nipple before coupler is screwed on. Turn coupler on nipple until rubber gasket faces to the right.

AIR SYSTEM




A—BODY
B—PISTON CUP
C—CUP SPREADER SPRING
D—CUP SPREADER
E—FELT WASHER
F—RETAINER SLEEVE
G—FELT WASHER RETAINER
H—PISTON AND ROD
J—PISTON RETURN SPRING
K—BREATHER PORT
L—HEAD
M—OILITE BUSHINGS
N—INNER RETAINER WASHER
O—FELT WASHERS
P—STRAP
Q—OUTER RETAINER WASHER
R—BOOT
S—YOKE
T—LOCK NUT
U—CUP SPACING COLLARS
V—INLET PORT

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***Figure 236 — Cross-section of Clutch Shifting Power Cylinder***

(3) INSTALL LOCKING PLUNGER. Place plunger and spring in hole in the coupler body, and install retaining nut.

## 107. CLUTCH SHIFTING AND CLUTCH BRAKE POWER CYLINDERS.

**a. Description** (figs. 235 and 236).

(1) There are two 4⅜-inch diameter by 3⅞-inch stroke power cylinders used to shift the clutch, and one 2⅝-inch diameter with 1⅝-inch stroke power cylinder used to actuate the clutch brake. These three power cylinders are identical in construction, with the exception that the clutch shifting power cylinder has two removable bushings in the head, while the clutch brake power cylinder does not have bushings.

(2) The power cylinder consists of a cylindrical cup with an anchor welded to the center of its closed end. This anchor is drilled and tapped for an inlet air hose fitting. The open end of the cup is closed by a head which serves as the piston guide, and contains a tapped hole for a breather hose fitting. Inside the power cylinder is the piston with rod; the piston cup or sealing unit; the cup spreader and spring which holds the piston cup in proper position; the felt washer, which acts as an oiler and wiper for the inner surface of the cylinder; the retainer sleeves, which protect the felt washer; the piston

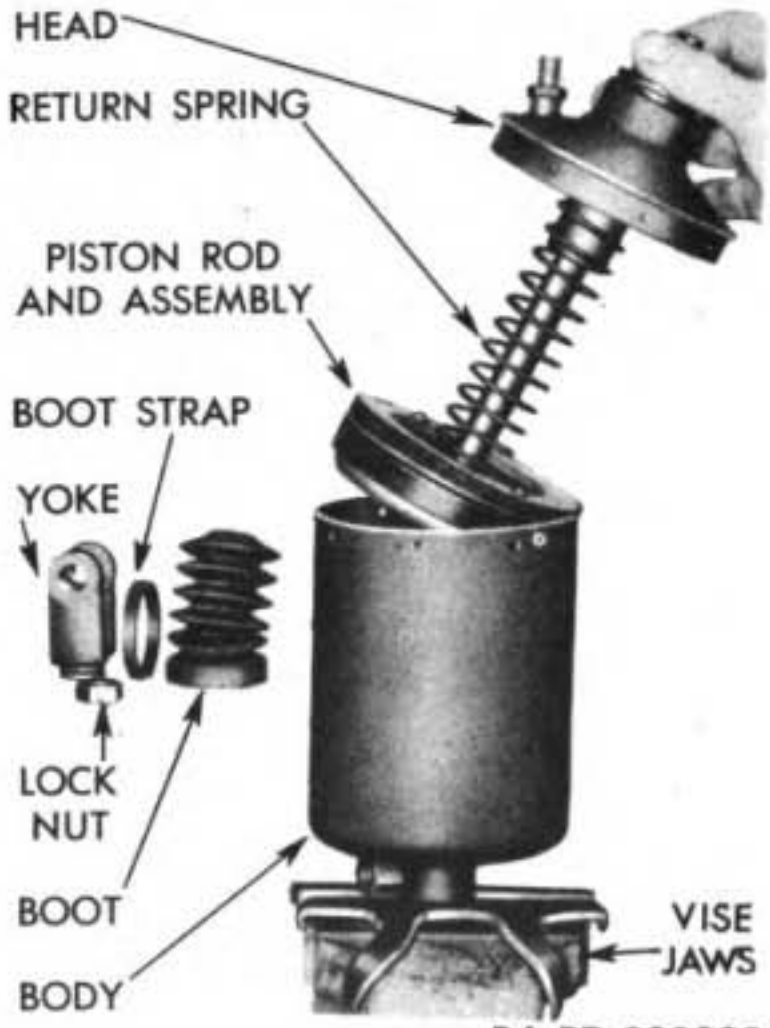


***Figure 237 — Removing Piston and Rod Assembly Return Spring and Head***

return spring; and two piston rod felt washers and retainers in the power cylinder head, which act as oilers and cleaners to protect the inner parts from foreign matter. The outer end of the piston rod has a yoke with lock nut for adjustment. A rubber boot fits over the yoke and head to protect the internal parts from foreign matter.

**b. Disassemble.**

(1) REMOVE YOKE (fig. 237). Slip rubber boot off yoke and over lock nut. Loosen lock nut from yoke, and unscrew yoke and lock nut from piston rod.

(2) REMOVE RUBBER BOOT (fig. 237). Slip boot strap off boot at cylinder head end, using a small blunt tool. Pinch the beaded end of boot out of groove in cylinder head, and slit boot off head. Remove boot strap.

(3) REMOVE PISTON AND ROD ASSEMBLY (fig. 237). **NOTE:** *Place a punch mark on cylinder body, and another next to it on the outer rim of the head. These marks will locate the head in the same position on cylinder when it is assembled later.* Remove machine screws and lock washers attaching power cylinder body to head. Pull cylinder head out of cylinder body. Pull piston and rod with return spring out of cylinder body.

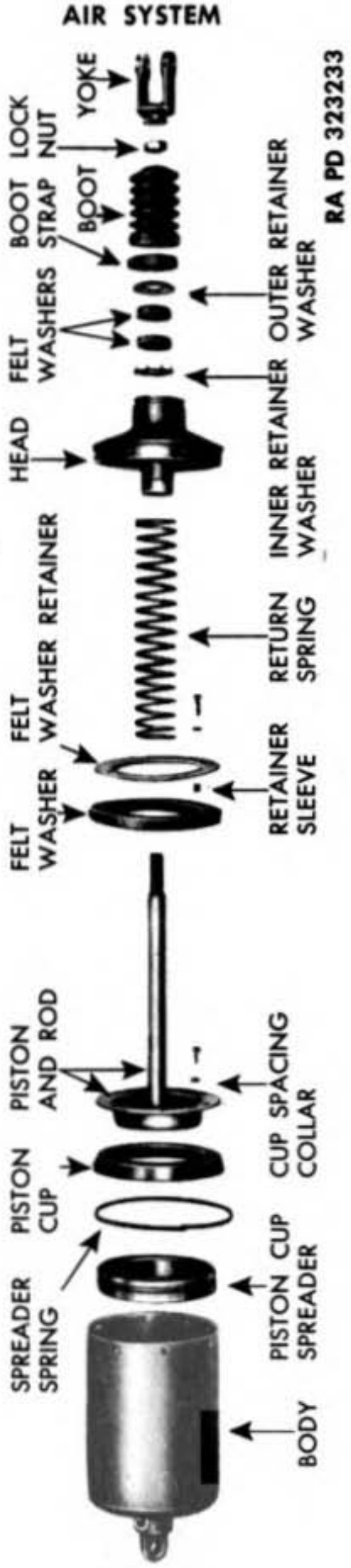


*Figure 238 — Piston and Rod Assembly Disassembled*


***Figure 239 — Removing Washers from Power Cylinder***

(4) DISASSEMBLE PISTON AND ROD ASSEMBLY (fig. 238). Remove machine screws and lock washers attaching felt washer retainer to piston and remove retainer, felt washers, and retainer sleeves. Remove machine screws attaching piston cup spreader to piston and remove cup spreader and spring, piston cup, and small cup spacing collars.

(5) DISASSEMBLE POWER CYLINDER HEAD (fig. 239). Insert a punch through oil hole in head, and carefully drive out the outer retainer washer, two felt washers, and inner retainer washer. The two clutch shifting power cylinders have two bushings in cylinder head. If bushings are excessively worn, replace with new power cylinder head.

**c. Clean and Inspect.** Clean all parts with dry-cleaning solvent. Dry with compressed air. Inspect all parts for wear, and replace if necessary.

**d. Assemble.**

(1) ASSEMBLE POWER CYLINDER HEAD. Insert inner retainer washer into recess at outer opening of shaft hole in head with prongs of washer facing out. Insert both felt washers and outer retainer washer with convex surface facing out. Use a driver with a slightly smaller diameter than retainer washer, and drive on washer until it becomes flat against felt washers (fig. 240). CAUTION: *Do not use a driver with a much smaller diameter than outer retainer washer.*

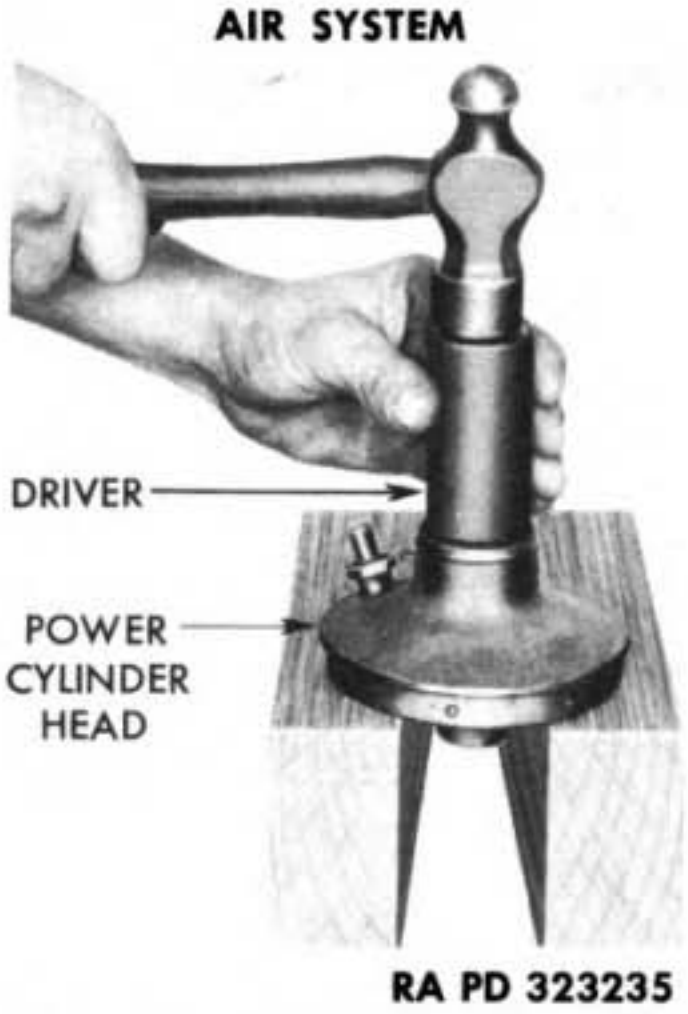


***Figure 240 — Installing Outer Retainer Washer***

(2) ASSEMBLE PISTON AND ROD ASSEMBLY (fig. 238). Install piston cup on shoulder of piston with lip of cup facing front of piston. Place cup spacing collars in screw holes in cup. Insert piston cup spreader and cup spreader spring in its outer groove, between cup lip and piston shoulder with outer radius edge toward front of piston. Line up screw holes, and install machine screws and lock washers attaching cup spreader and piston cup to piston. Place retainer sleeves in screw holes in felt washer, and assemble washer in retainer. Line up screw holes. Place felt washer and retainer on back face of piston, and install machine screws and lock washers.

(3) INSTALL PISTON AND ROD ASSEMBLY (fig. 237). Oil inner surface of cylinder and outer surface of piston and rod assembly with clean engine oil. Coat return spring with preservative lubricating oil. Hold piston at a slight angle in cylinder opening, and insert small portion of piston cup in first; then, using the fingers, work remainder of cup lip into cylinder. NOTE: *Care should be exercised when performing this operation to prevent damaging piston cup.* Place piston return spring and cylinder head onto piston rod. Line up punch mark on cylinder head with punch mark on cylinder. Push the two together, making sure cylinder fits over shoulder on head. Line up screw holes, and install machine screws and lock washers.

(4) INSTALL RUBBER BOOT. Place boot strap over end of head, and install large end of boot over end of head, making sure bead seats in groove in head. Slide split boot strap over boot, and place it flush with edge of boot.

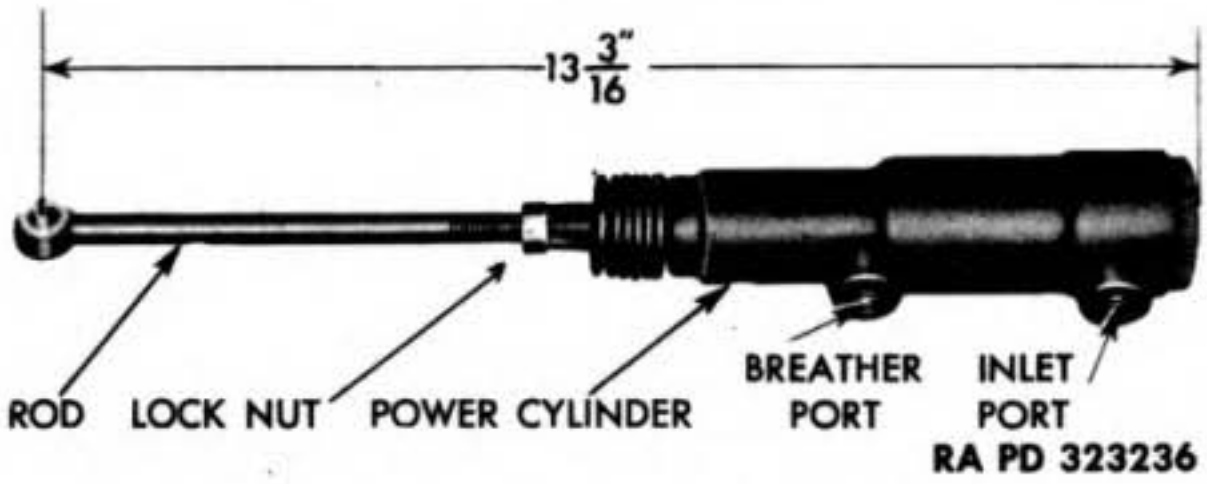


*Figure 241 — Electric Brake Controller Power Cylinder*

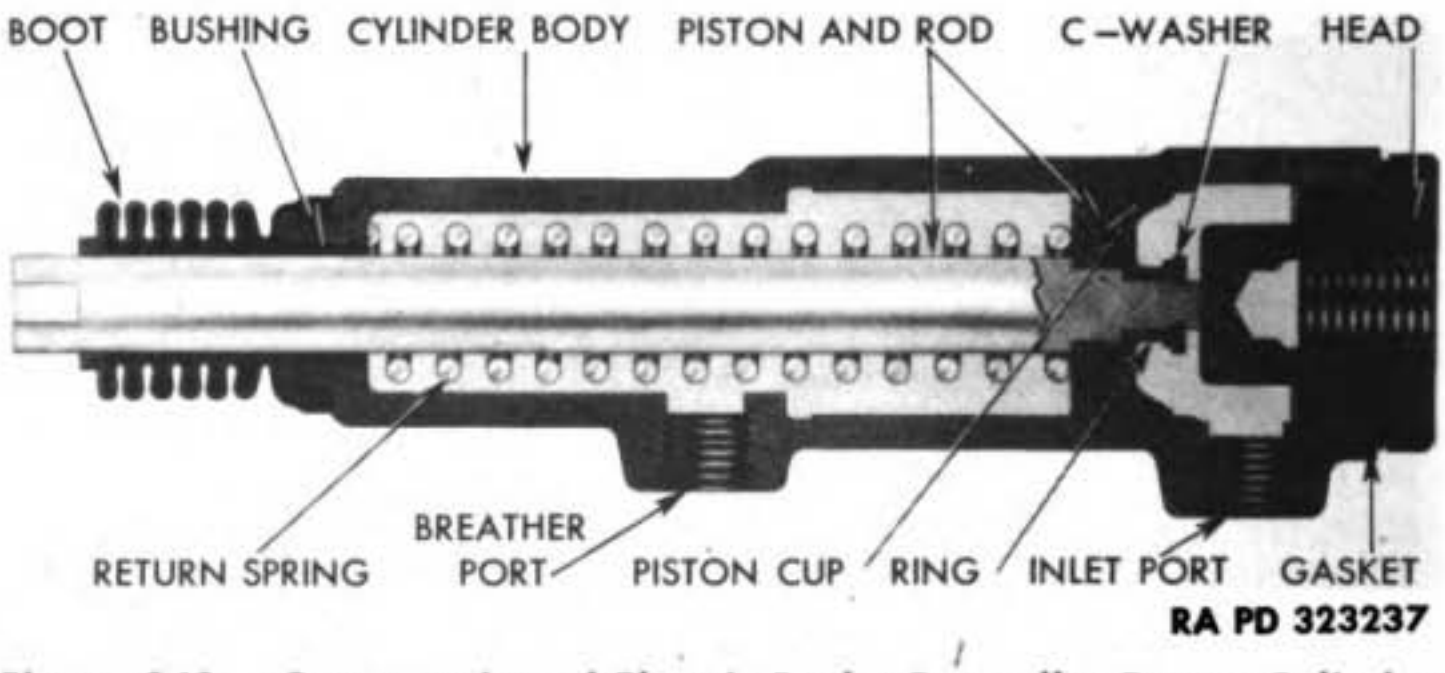


*Figure 242 — Cross-section of Electric Brake Controller Power Cylinder*

(5) INSTALL YOKE. Install lock nut and yoke on piston rod. NOTE: *Do not tighten lock nut on yoke or place boot on yoke until after yoke is adjusted (see subpar. e).*

**e. Adjust.**

(1) CLUTCH SHIFTING POWER CYLINDERS (fig. 235). Turn yoke on piston rod until it measures 11 7/8 inches from center of pin holes in yoke to center of pin hole in anchor. Tighten lock nut securely against yoke when adjustment is correct. Piston and rod must be pushed all the way into cylinder when measurement is taken.

(2) CLUTCH BRAKE POWER CYLINDER (fig. 236). Turn yoke on piston rod until it measures 9 1/4 inches from center of pin holes in yoke to center of pin hole in anchor. Tighten lock nut securely against yoke when adjustment is correct. Piston and rod must be pushed all the way into cylinder when measurement is taken.

(3) Place smaller end of rubber boot over yoke, and make sure that its bead sets in groove in yoke.

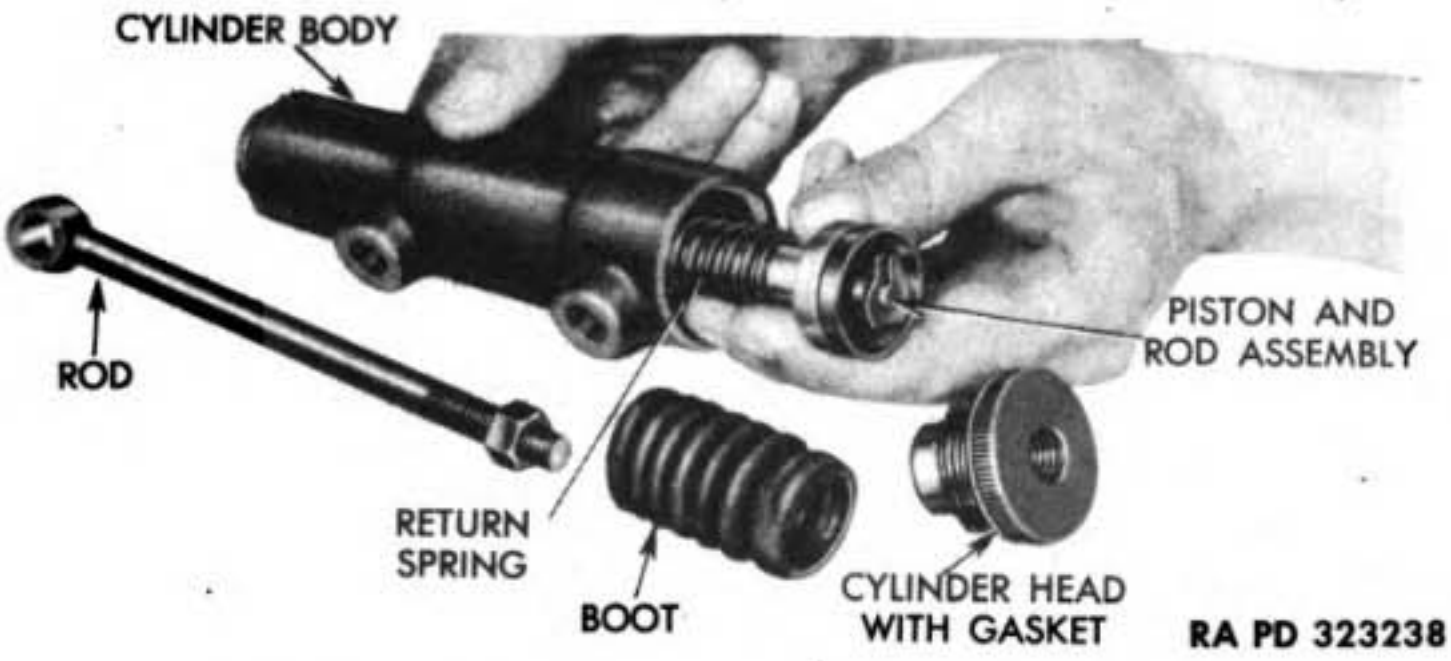


*Figure 243 — Removing Piston and Rod Assembly*

## 108. ELECTRIC BRAKE CONTROLLER POWER CYLINDER.

**a. Description** (figs. 241 and 242). The power cylinder consists of a one-piece body casting with a head screwed into one end and a bushing pressed into the other. A mounting eye bolt screws into the head, and is secured by a lock nut. Inside the cylinder are the piston and rod assembly and a return spring. The piston rod extends out through the bushing. A rubber boot is used to prevent foreign matter from entering between the piston rod and bushing. In the side of the cylinder body are an inlet and a breather port; both are threaded for hose fittings.

**b. Operation.** The electric brake controller power cylinder is operated by the applied air pressure in the towed-load air brake system. Because of the action of the return compression spring on the piston, the greater the applied air pressure the farther out of the cylinder body the piston and rod will move. This movement is used to actuate the electric brake controller.

**c. Disassemble** (fig. 243).

(1) REMOVE POWER CYLINDER ROD FROM POWER CYLINDER. Loosen lock nut, and unscrew rod from piston rod.

(2) REMOVE RUBBER BOOT. Clamp power cylinder body in a vise and remove boot.

(3) REMOVE PISTON AND ROD ASSEMBLY. Unscrew head and gasket from cylinder body. Remove piston and rod assembly, and pull out return spring.

(4) REMOVE PISTON CUP. Spread C-washer with screwdriver, and remove from end of piston rod. Pull off piston cup and ring.

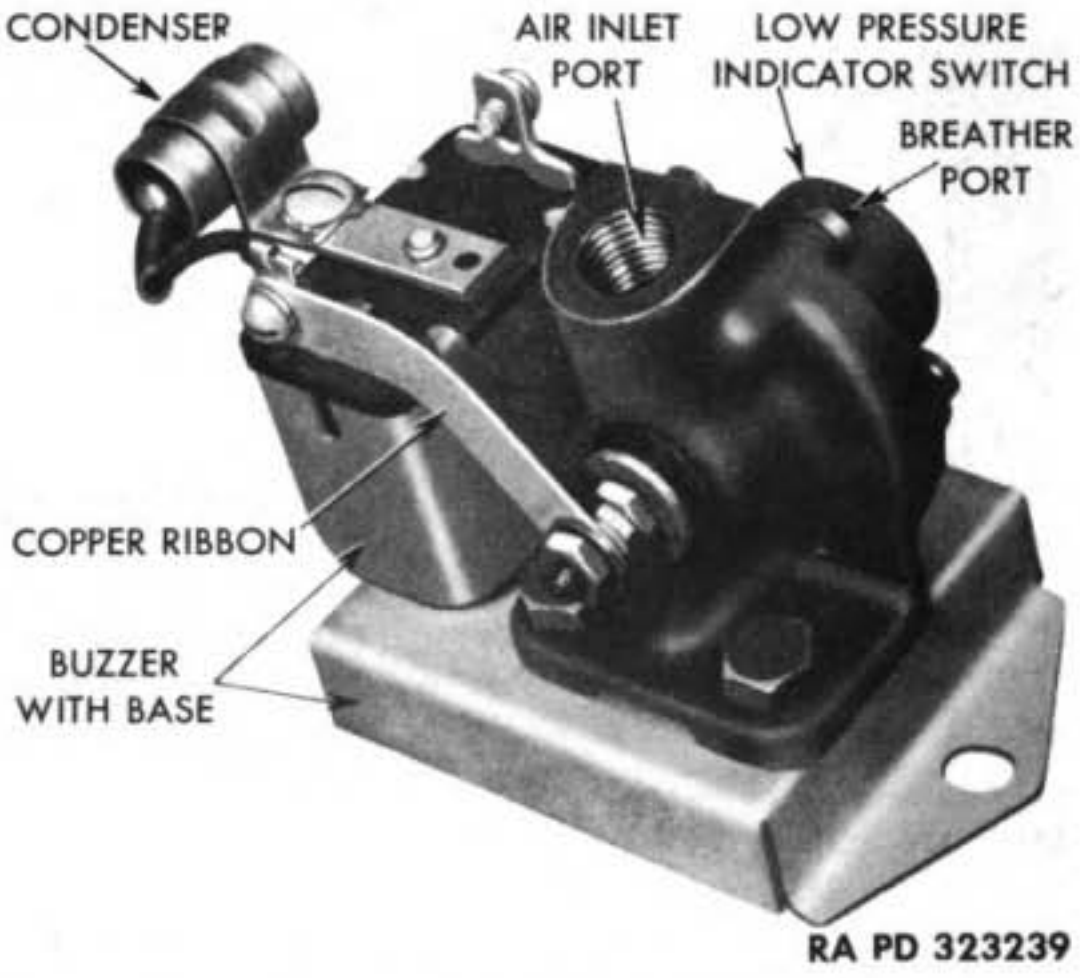


*Figure 244 — Low Pressure Indicator Switch and Buzzer Assembly*

**d. Clean, Inspect, and Repair.**

(1) Clean all parts with dry-cleaning solvent.

(2) Inspect parts, and replace those which show wear or damage.

(3) Inspect bushing in cylinder body. Do not remove bushing unless it shows excessive wear. Use an arbor press to remove a worn bushing and press in a new one. It may be necessary to ream out bushing slightly after it is installed. Correct fit is obtained when bushing has a close sliding fit over full length of piston rod stroke. Finished inside diameter of bushing is 0.563 to 0.565 inch.

**e. Assemble** (fig. 242).

(1) INSTALL PISTON CUP. Place ring over hub of piston cup with chamfered side toward the cup. Slide piston cup over end of rod with lip facing away from piston. Install C-washer by bending it together with pliers.

(2) INSTALL PISTON AND ROD ASSEMBLY. Dip assembly in clean engine oil, and allow excess oil to drain off. Coat return spring with preservative lubricating oil. Place spring in cylinder bore, and insert piston with rod. Install cylinder head and gasket in body.

(3) INSTALL RUBBER BOOT. Slip boot over piston rod and end of body, making sure beaded end seats in groove in body.

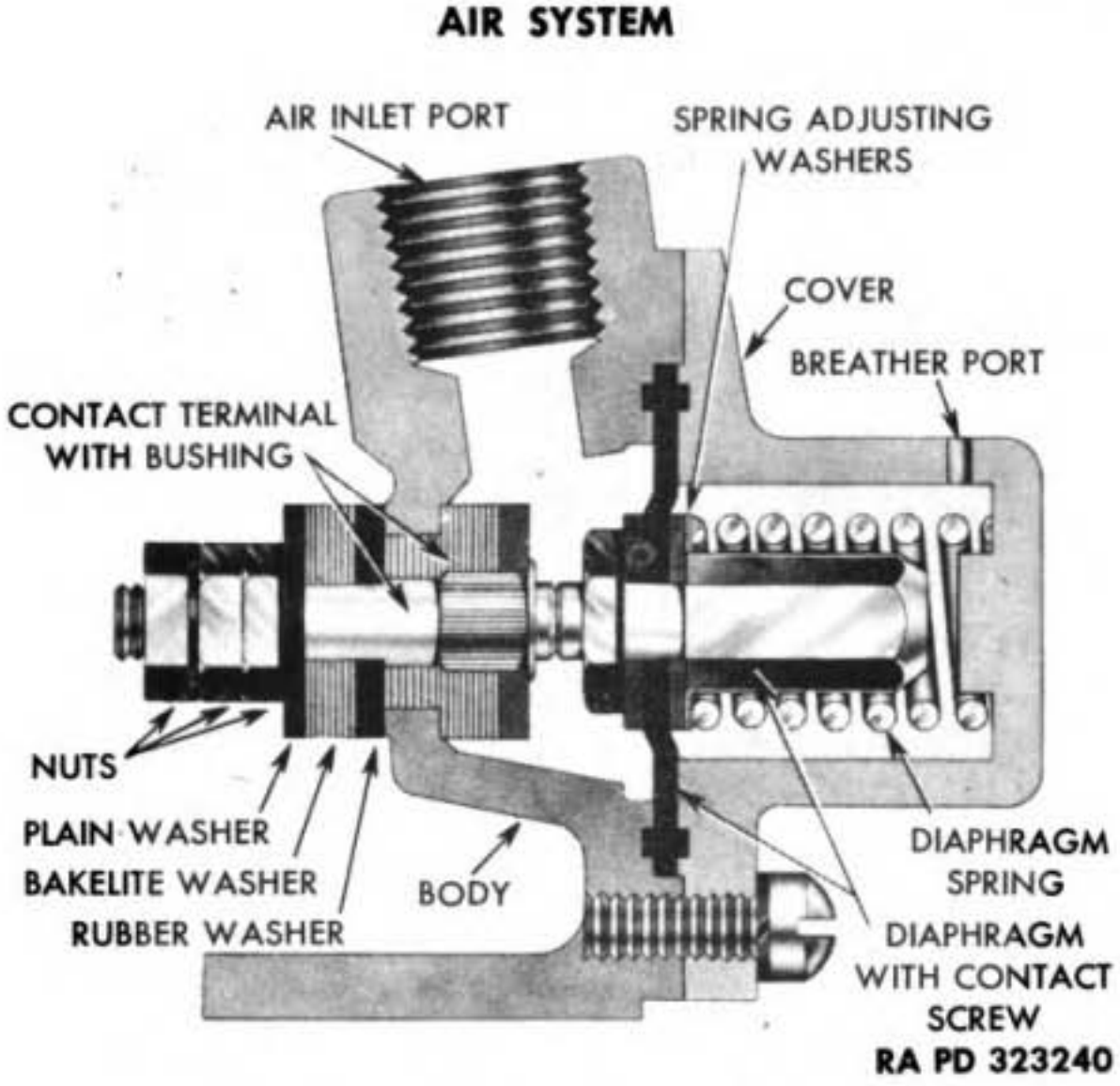


***Figure 245 — Cross-section of Low Pressure Indicator***

(4) INSTALL POWER CYLINDER TO ELECTRIC BRAKE CONTROLLER ROD. Turn rod and lock nut into piston rod until it measures $13\frac{3}{16}$ inches from front face of head to center of pin hole in rod. Tighten lock nut. This adjustment may have to be changed slightly after power cylinder is installed in the vehicle.

## 109. LOW PRESSURE INDICATOR SWITCH.

**a. Description** (figs. 244 and 245). This switch is part of an assembly which includes a warning buzzer with a mounting base. The assembly is attached to the underside on the cowl on the tractor. The switch consists of a cast bronze body to which is attached a cast bronze cover. These are held together by six machine screws and lock washers. Clamped between the cover and body, making an airtight seal, is a diaphragm containing a movable contact screw. The switch body contains a stationary insulated contact terminal, an air inlet port with a threaded opening, and a mounting bracket which is an integral part of the body casting. A small drilled hole in the cover serves as a breather port.

**b. Operation** (fig. 245). The inlet port in the low pressure indicator switch is exposed to the same air pressure as is stored in the two air reservoir tanks. This air pressure is exerted on the contact point

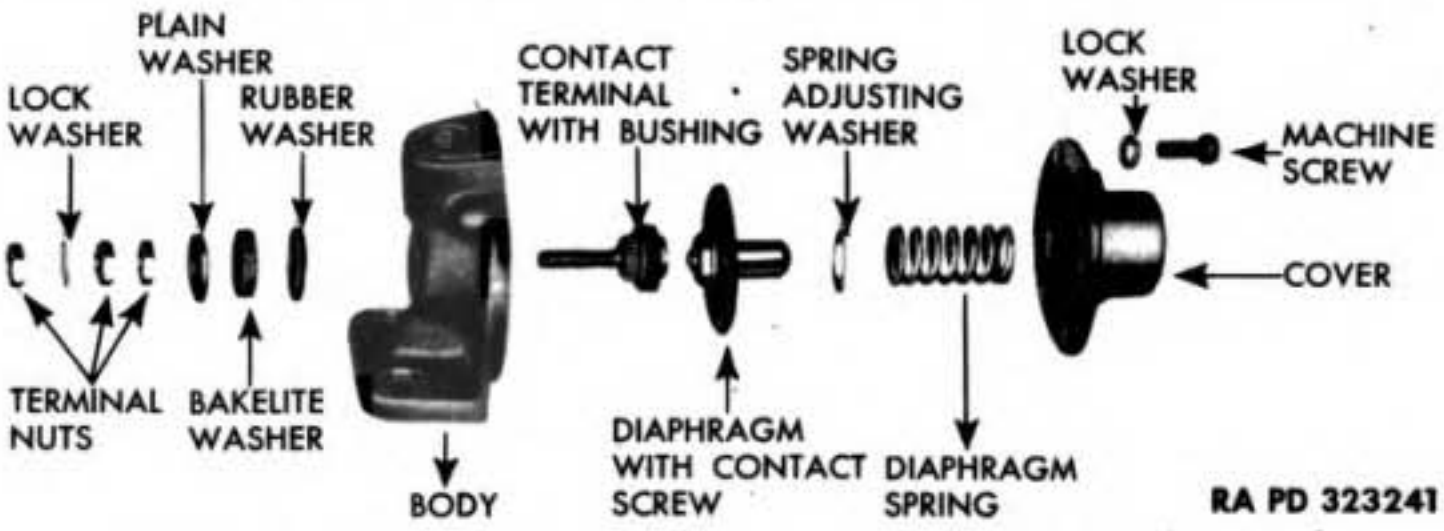


*Figure 246 — Low Pressure Indicator Switch Disassembled*

side of the diaphragm. When air pressure is above 60 pounds, it moves the diaphragm and a contact screw against spring pressure, separating the electric contact points. The diaphragm assembly will remain in this position until air pressure in the reservoir tanks drops below 60 pounds. Then the compression force of the spring will cause the diaphragm to move, and let the contact points come together. When the contact points are together, the switch is grounded through the contact terminal, diaphragm spring, switch cover, and body, causing the buzzer to operate. When the contact points are separated, the ground circuit is broken and the buzzer stops.

**c. Remove and Disassemble.**

(1) REMOVE SWITCH (fig. 244). Remove two cap screws, nuts, and lock washers attaching switch to buzzer base. Remove nut and lock washer from contact terminal, and remove switch.

(2) REMOVE DIAPHRAGM WITH CONTACT SCREW (fig. 246). Remove six machine screws and washers attaching switch cover to body and remove cover, diaphragm and contact screw, diaphragm spring, and spring adjusting washers.

(3) REMOVE CONTACT TERMINAL AND BUSHING (fig. 246). Unscrew nuts from outer end of contact terminal and remove plain washer, bakelite washer, and rubber washer. Remove contact terminal and bushing from inside switch body.

**d. Clean and Inspect.**

(1) Clean all parts with dry-cleaning solvent. Dry with compressed air. Be sure breather port hole in cover is open.

(2) Inspect contact points. If pitted or burned, replace contact terminal, bushing, and diaphragm and contact screw. Replace rubber and bakelite washers which are cracked, also complete diaphragm and contact screw, if diaphragm is cracked or shows signs of leakage.

**e. Assemble.**

(1) INSTALL CONTACT TERMINAL AND BUSHING (fig. 246). Insert terminal and bushing in hole in switch body and place rubber washer, bakelite washer, and plain washer on outer end of terminal. Screw on terminal nuts.

(2) INSTALL DIAPHRAGM AND CONTACT SCREW (fig. 246). NOTE: *If a new diaphragm and contact screw is to be installed, it will be necessary to install proper thickness of spring adjusting washers to make switch open at 60 pounds air pressure. See subparagraph* f. Place three spring adjusting washers over large end of contact screw, and place diaphragm spring on top of these washers. Insert this subassembly into cover, making sure the spring seats around guide in cover. Assemble cover to body, making sure beads on diaphragm line up in grooves in body and cover. Install six attaching machine screws and lock washers.

**f. Test.** Connect indicator switch to an air line equipped with gage to indicate applied air pressure. Use test points and light for checking closing and opening of switch. Hold one test point on switch body and other on contact terminal. Apply air pressure gradually, and observe if test light goes out at 60 pounds pressure. Add spring adjusting washer if necessary to raise cut-off pressure. Remove washer if necessary to lower cut-off pressure.

# CHAPTER 6

# SUSPENSION

## Section I
## DESCRIPTION



### 110. DESCRIPTION (fig. 247).

**a.** On each side of the vehicle is a welded-steel bogie frame attached to the ends of the frame crossmembers on studs, and is secured with lock washers and high nuts. The vehicle is suspended by the bogie frames on volute springs mounted on rubber-tired bogie wheels. In addition to the bogie wheels, the bogie frame carries the trailing idler and track support idlers. The steel grouser track is drawn by the drive sprockets over the trailing idler and track support idler, and is laid in the path of the bogie wheels. Constant tension is maintained on the track by the action of the bogie springs and trailing idler spring. Each bogie wheel and trailing idler moves up and down independently in passing over irregular ground surface, and the shock is absorbed in the volute springs.

**b.** The unit construction of each suspension makes it possible to remove the complete assembly from one vehicle and install it on another vehicle. All that is necessary is to disconnect the track, roll the top section of the track off the support idlers, hoist or jack up one side of the vehicle, and remove the complete suspension, after removing 12 nuts from the studs in the frame crossmembers which attach the bogie frame to the vehicle. Installation of the suspension is performed by reversing the above procedure.

**c.** Removal, installation, and repair of the tracks is described in TM 9-786.

## Section II
## BOGIE ASSEMBLY



### 111. DESCRIPTION (fig. 247).

**a.** The four bogies are the main supporting units of the vehicle. Each bogie assembly consists of two rubber-tired bogie wheels supported by independent arms, and a spring mounted on a shaft above the wheels. Vertical movement of the wheels is permitted as they

## SUSPENSION

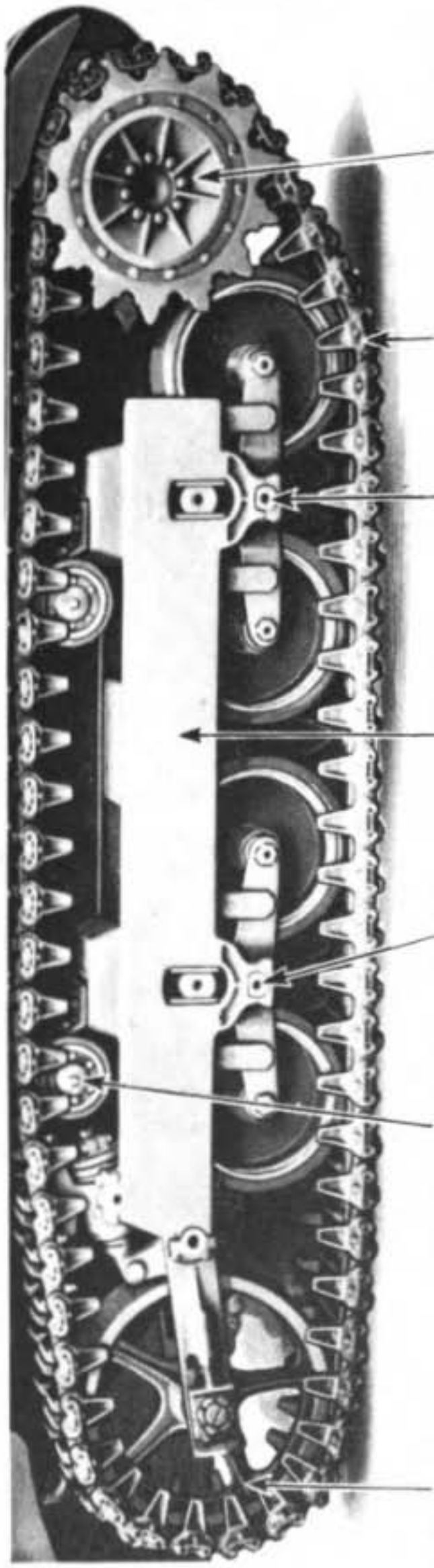


*Figure 247 — Track and Suspension*

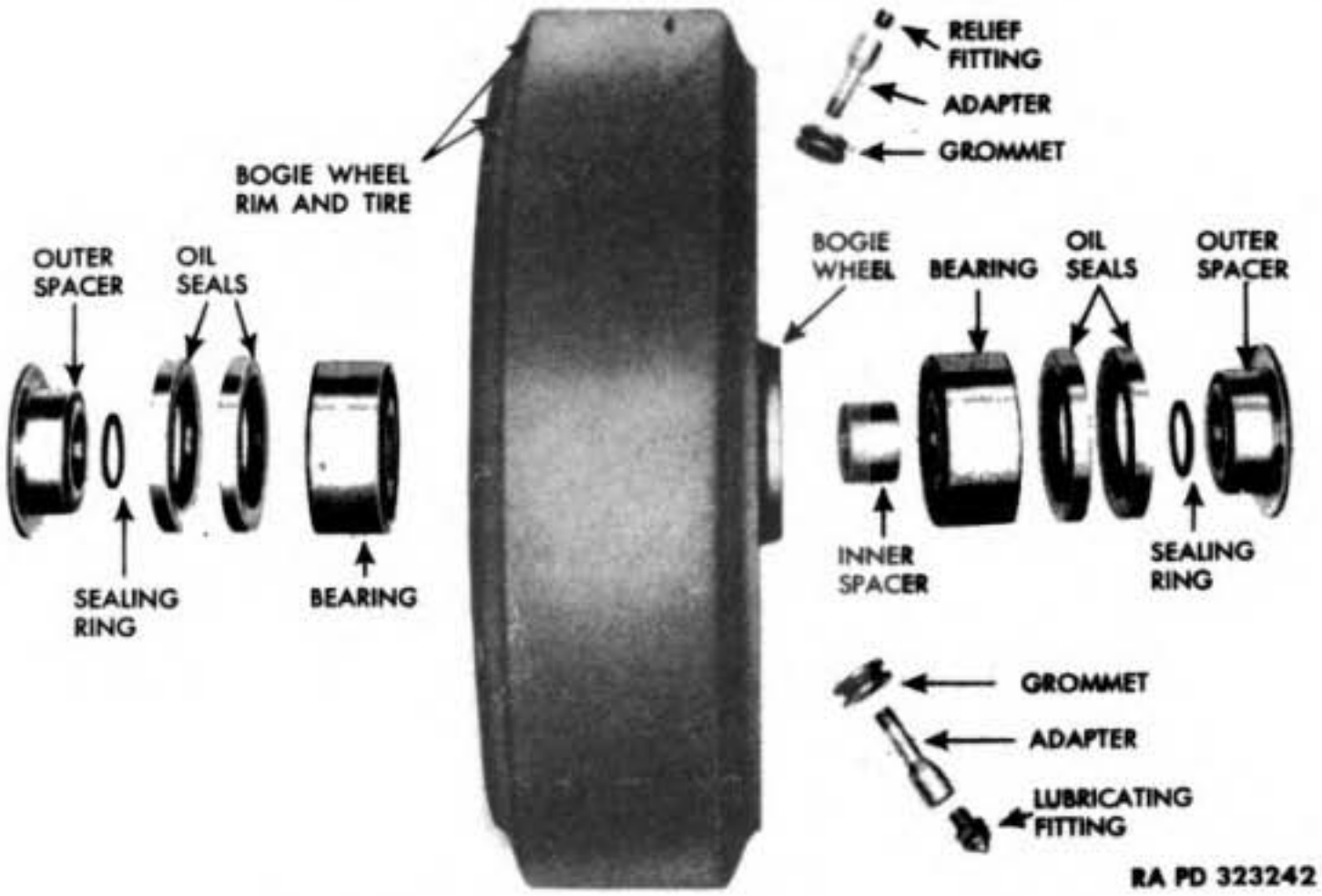


*Figure 248 — Bogie Wheel Disassembled*

pass over irregular ground surface. The movement is transferred from supporting arms to pivots, and absorbed by the volute spring. The bogie wheels are of the disk type, and revolve on two double-row ball bearings. The bearings are sealed against the entrance of dirt by four leather seals, two in each side of wheel.

**b.** The removal and installation of bogie components are described in TM 9-786. The instructions which follow describe inspection, repair, and rebuild, of bogie components not covered in TM 9-786.

## 112. CLEANING, INSPECTION, AND REPAIR.

**a. Clean.** Clean all parts thoroughly with steam-cleaning equipment or dry-cleaning solvent. Dry with compressed air.

(1) CLEAN BEARINGS. Thoroughly clean each bearing in dry-cleaning solvent. Allow it to remain in cleaning fluid long enough to loosen old grease. Slush bearing in fluid, and slowly rotate it below surface of fluid until clean. Blow out bearing, directing air pressure across bearing to remove last traces of old lubricant. Avoid spinning bearing by air blast. NOTE: *Bearing must be inspected immediately after cleaning. If in serviceable condition, it should be repacked with grease and wrapped in clean paper until ready for installation.*

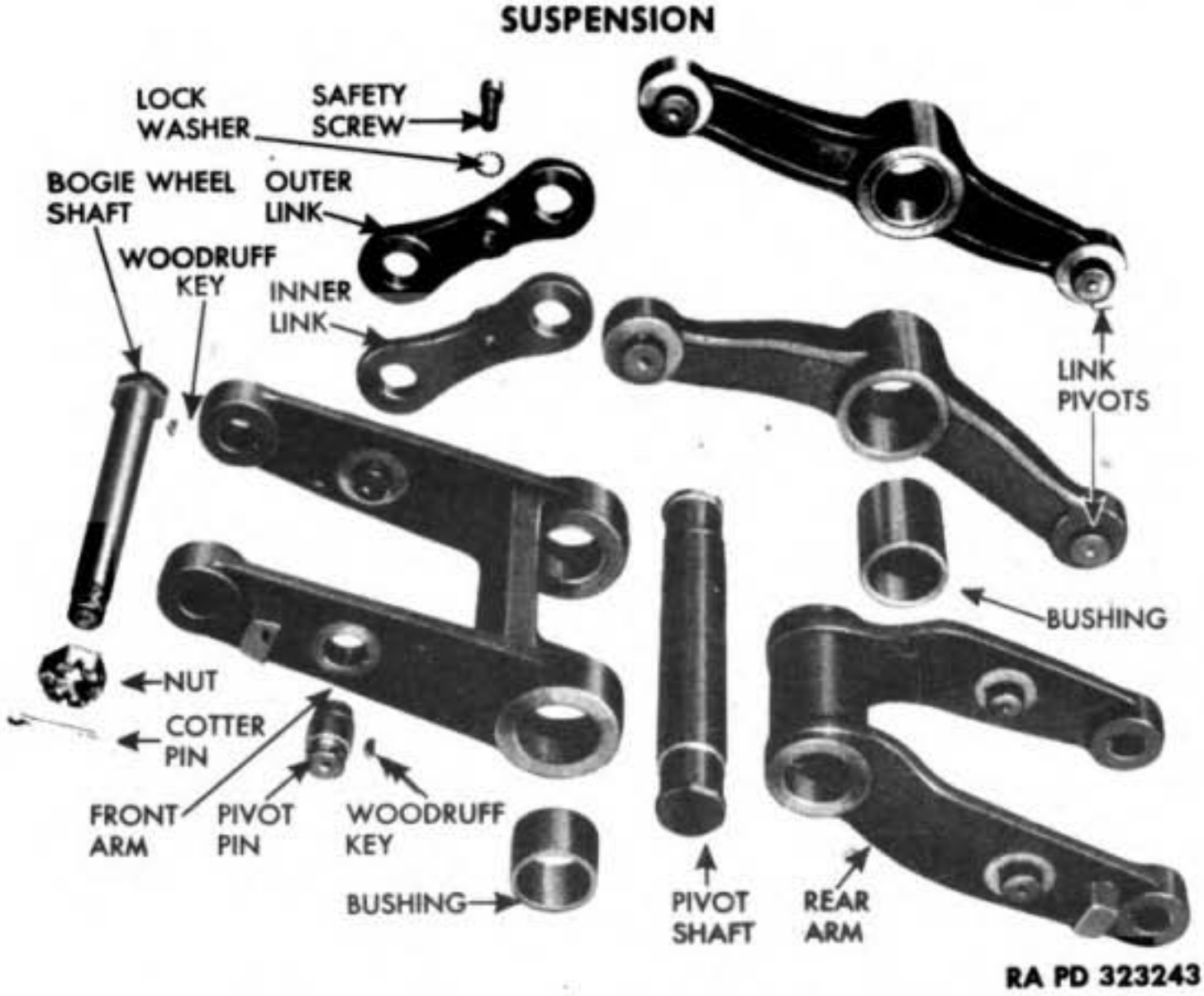


*Figure 249 — Bogie Arms, Shafts, Link Pivots, and Links*

**b. Inspect and Repair** (figs. 248, 249, and 250).

(1) BOGIE WHEELS. Inspect lubrication fittings for good condition, and make sure lubrication passages are open. Inspect tires. If severely grooved or otherwise unserviceable, replace tires (subparagraph **c**). Inspect wheel bearing bore for wear. If worn, replace wheel.

(2) FRONT AND REAR BOGIE ARMS. Inspect bogie arm bushings for wear. Replace if worn excessively. Manufacturers limits on new bushings are 2.499 to 2.501 inches. Inspect link pivot pins for wear. Replace if worn. Manufacturers limits on new pins are 1.369 to 1.372 inches.

(3) BEARINGS. Inspect each bearing for free rolling, for cracked or worn balls, and for worn races. If worn or damaged, replace bearing.

(4) BOGIE WHEEL INNER AND OUTER LINKS. Inspect each link for wear or breaks. Manufacturers limits for holes in links are 1.381 to 1.385 inches. If worn or broken, replace link.

(5) OIL SEALS. Inspect each oil seal for wear or damaged lip. If worn or damaged, replace oil seal.

(6) BOGIE SPRING PILOTS. Inspect each pilot for wear, cracks, or breaks. If worn or broken, replace pilot.

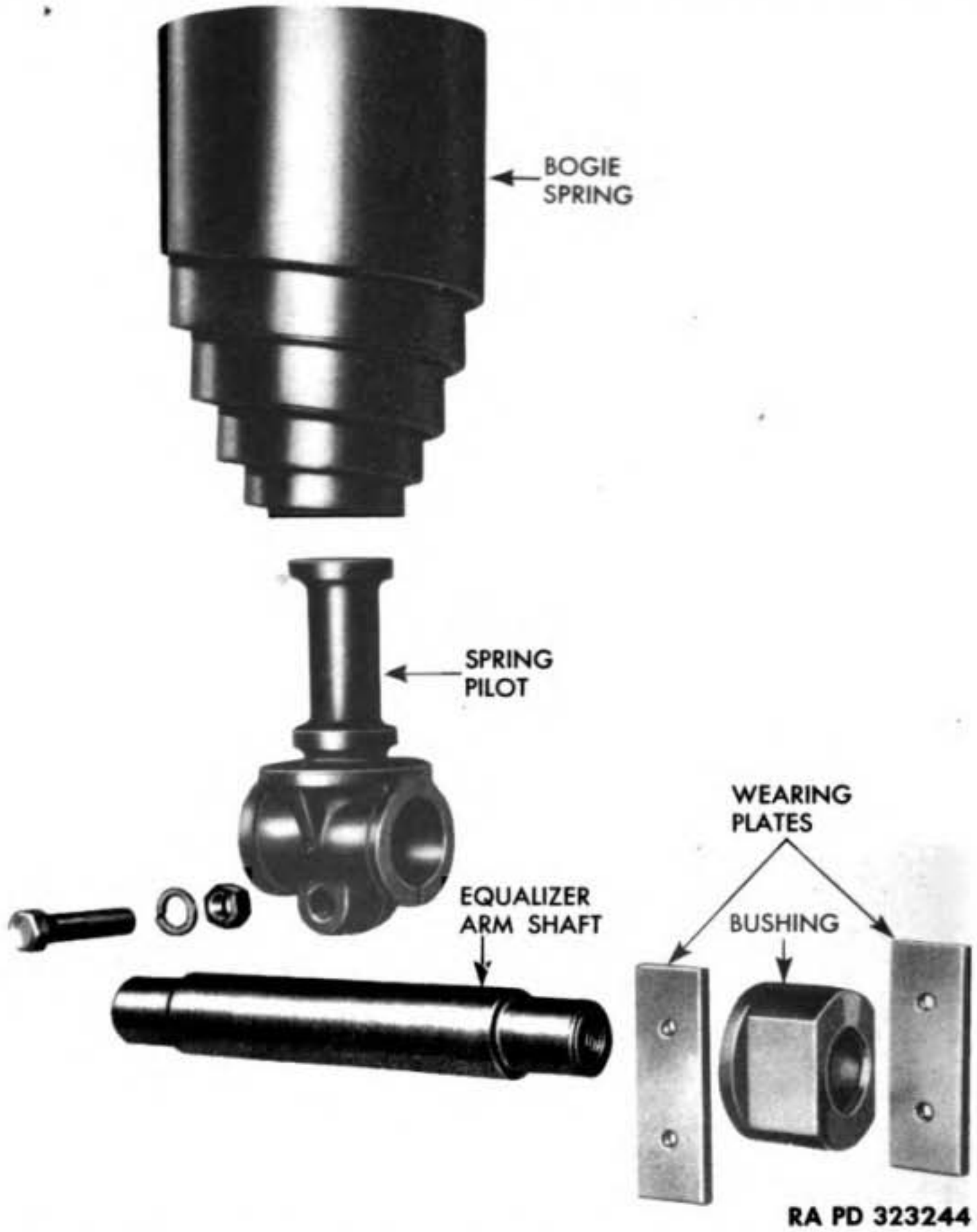


***Figure 250 — Bogie Spring, Equalizer Arm Shaft, Wearing Plates, and Bushing***

(7) BOGIE WHEEL LINK PIVOTS. Inspect each pivot for wear or breaks. If worn or broken, replace pivot. Inspect bushings for wear. If worn excessively, replace. Manufacturers limits for new bushings are 2.256 to 2.259 inches. Inspect link pins for wear. If worn, replace pin. Manufacturers limits on new pins are 1.369 to 1.372 inches.


***Figure 251 — Installing Bogie Wheel Bearing***

(8) BOGIE EQUALIZER ARM SHAFT, BUSHINGS, AND WEARING PLATES. Inspect each part for wear or breaks. Manufacturers limits of a new shaft are 2.239 to 2.241 inches; of a new bushing, limits across flats are 2.680 to 2.690 inches, and wear plate thickness limits are 0.490 to 0.500 inch. Replace each part that is worn excessively, or broken.

(9) BOGIE ARM PIVOT SHAFT. Inspect shaft for wear. If worn, replace. Manufacturers limits of a new shaft are 2.489 to 2.491 inches.

(10) BOGIE WHEEL SHAFT. Inspect bogie wheel shaft for wear due to spacers turning on shaft. If worn, replace shaft. Also inspect threads at end of shaft.

(11) BOGIE WHEEL BEARING INNER AND OUTER SPACER. Inspect the outer spacers for signs of turning on bogie wheel shafts. Inspect the width of bearing spacer for wear. The width of inner bearing spacer should measure 1.172 to 1.177 inches. The width of outer bearing spacer should measure 1.288 to 1.291 inches. If worn or turning on shaft, replace spacer.

(12) BOGIE VOLUTE SPRING. Whenever facilities permit, the spring may be tested by depressing it to a height of 8¾ inches with a load of 10,500 to 11,500 pounds. Free height of spring should be 11½ to 12½ inches. If free height is less than 11½ inches, replace spring.

**c. Rebuild Bogie Wheels.** With suitable fixtures for holding wheel and a 15- to 30-ton press, press old tire and rim off wheel. Place new tire and rim in position on wheel, and press rim carefully down until it is centered on the wheel. Install lubrication fitting and

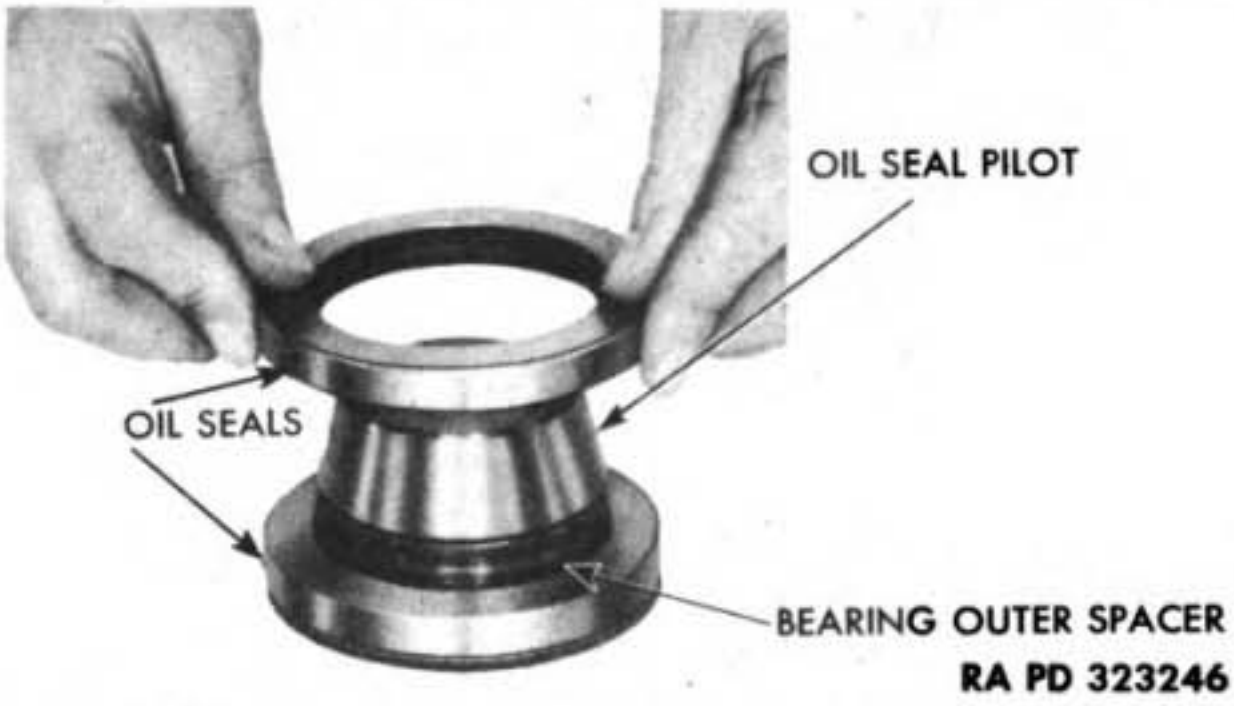


***Figure 252 — Installing Oil Seals on Bearing Outer Spacer with Pilot (41-C-2562-100)***

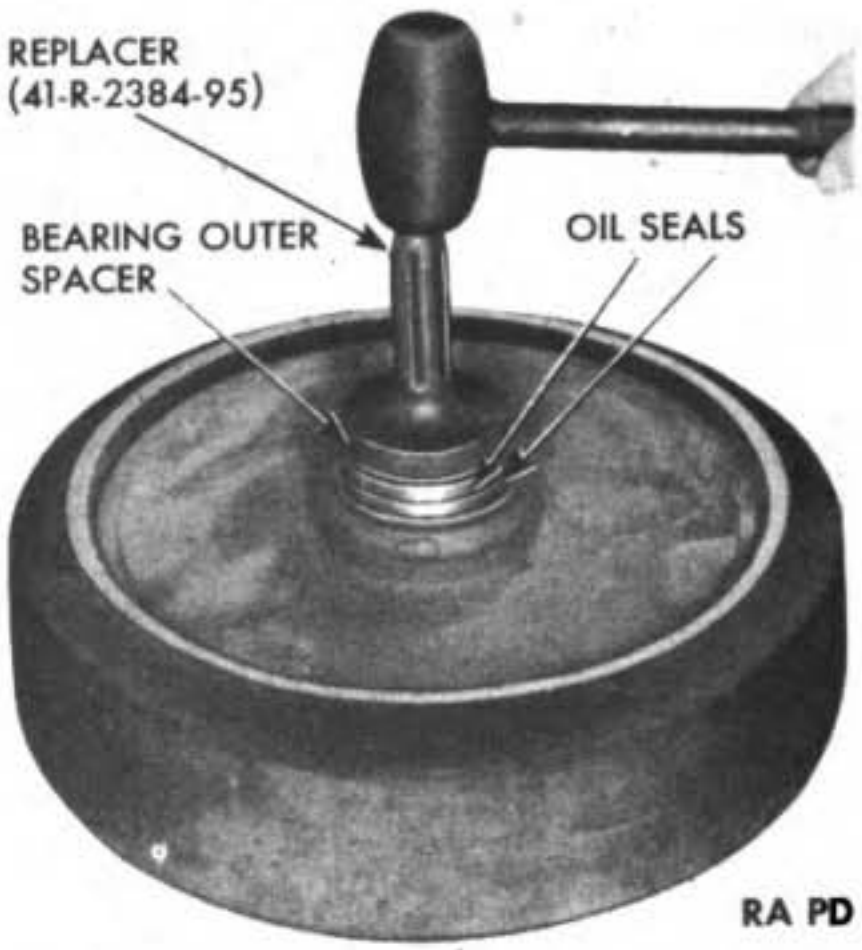


***Figure 253 — Installing Bogie Wheel Bearing Outer Spacer and Oil Seals***

relief fitting in wheel. With replacer (41-R-2384-95) drive bogie wheel bearing (fig. 251) in wheel hub against inner shoulder. With cone (41-C-2562-100) install two oil seals on outer spacer (fig. 252) so lips of seals face toward spacer flange. NOTE: *It is not necessary to use pilot (41-C-2562-100) to install oil seals on outer spacers that have a ½-inch radius on inner shoulder.* Shellac sealing ring in groove around inner edge of outer spacer. With replacer (41-R-2384-95) press or drive bogie wheel outer spacer and oil seals in wheel hub

against the bearing (fig. 253). Turn wheel over and install inner spacer. Install second bearing and second outer spacer with oil seals and sealing ring as described above. Seal bogie wheel hub with masking tape to keep bearings clean until wheel is installed.

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Section III

# TRAILING IDLER



## 113. DESCRIPTION (fig. 247).

**a.** The trailing idler assembly consists of idler wheel, bearings, supporting arm, and compressed volute spring. The trailing idler wheel which is mounted on bearings is supported in the trailing idler arm. The idler arm has slots provided so that idler wheel shaft may be adjusted back and forth to provide proper tension on the track. The idler arm is attached to the rear of the bogie frame by a pivot shaft. Volute spring pressure holds the arm in a set position against a rubber rebound pad. Over rough terrain the arms are permitted to move upward whenever pressure is exerted against idler wheel.

**b.** The removal and disassembly of trailing idler is described in TM 9-786.

## 114. CLEANING, INSPECTION, AND REPAIR.

**a. Clean.** Clean all parts thoroughly with steam-cleaning equipment or dry-cleaning solvent. Dry with compressed air.

(1) CLEAN BEARINGS. Thoroughly clean each bearing as described in paragraph 112, a (1).

**b. Inspect and Repair** (figs. 254 and 255).

(1) TRAILING IDLER WHEELS. Inspect rims and bearing bores for wear. If worn, replace wheel. Inspect wheel for cracks or breaks at hub or around rim. If cracked or broken, replace wheel. Inspect condition of lubrication and relief fittings. Make sure lubrication passages are open. Replace fittings if necessary.

(2) BEARINGS. Inspect each bearing for free rolling, for cracked or worn balls, and worn races. If worn or damaged, replace bearing.

(3) TRAILING IDLER WHEEL BEARING INNER AND OUTER SPACERS. Inspect the outer spacers for signs of turning on wheel shaft. Inspect the thickness of the bearing spacers for wear. The width of inner bearing spacer should measure 0.497 to 0.500 inch. The width of

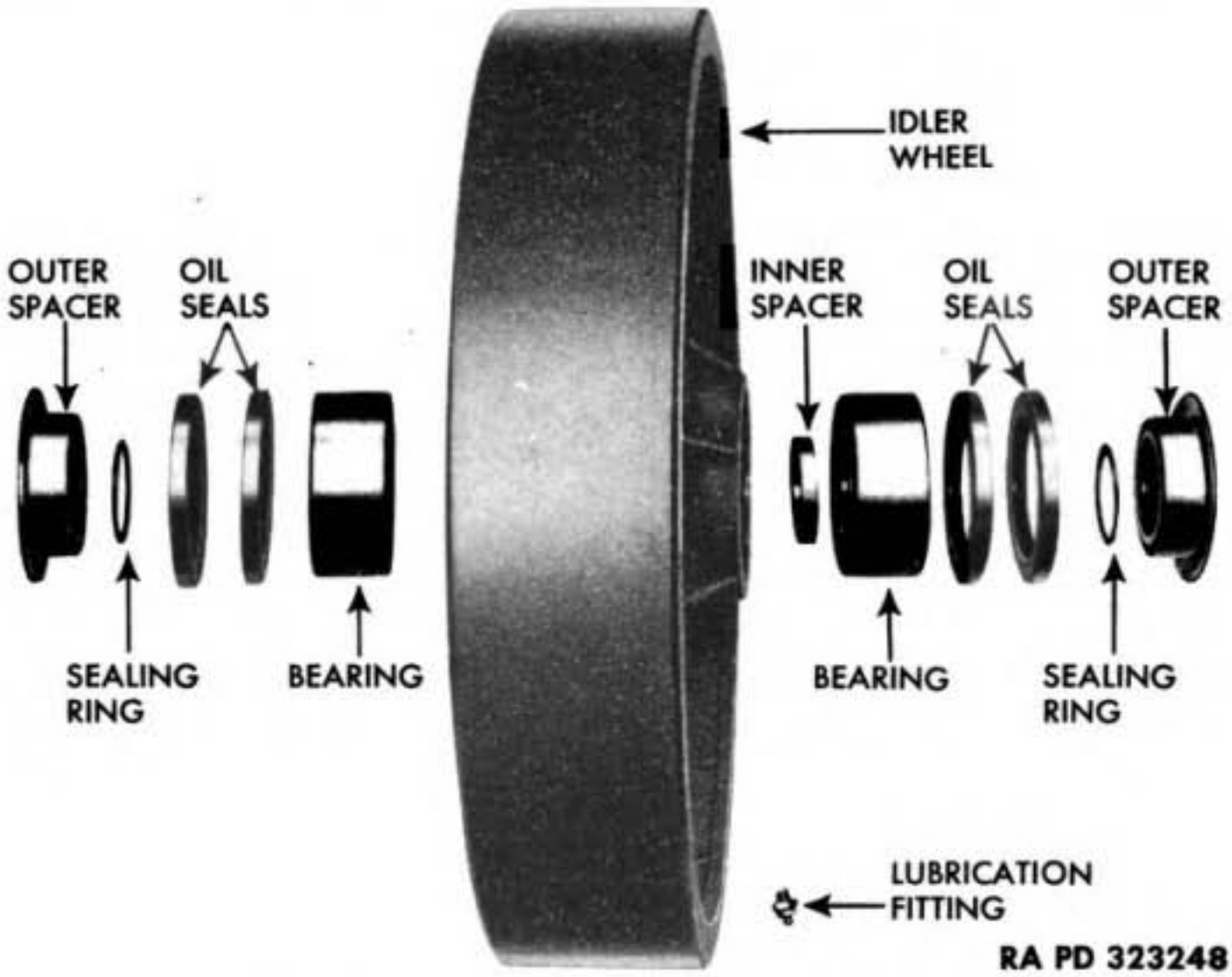


*Figure 254 — Trailing Idler Wheel Disassembled*

outer bearing spacer should measure 1.434 to 1.437 inches. If worn or turning on shaft, replace spacers.

(4) OIL SEALS. Inspect each oil seal for wear or damaged lips. If worn or damaged, replace oil seal.

(5) TRAILING IDLER WHEEL SHAFT. Inspect shaft for wear due to spacers or bearings turning on shaft, and for damaged threads. If worn or damaged, replace shaft.

(6) TRAILING IDLER ARM AND OTHER PARTS. Inspect idler arm wheel guides, and guide bushings for wear, cracks, or breaks. If worn, broken, or cracked, replace defective part. Inspect idler arm shaft bushings and thrust washer for wear. If worn, replace bushings or thrust washer. Manufacturers limits for new bushings are 2.869 to 2.874 inches. Inspect arms for alinement with bushing bore to assure that idler wheel runs true with track. Straighten bent arm or replace.

(7) TRAILING IDLER SPRING AND MOUNTING PARTS. *Whenever* facilities permit, the spring may be tested by depressing it to a height of 8½ inches with a load of 8,000 to 9,000 pounds. Free length of spring should be 12¼ to 13 inches. If free length is less than 12¼ inches, replace spring. Inspect spring link bolt for wear, cracks, or

SUSPENSION

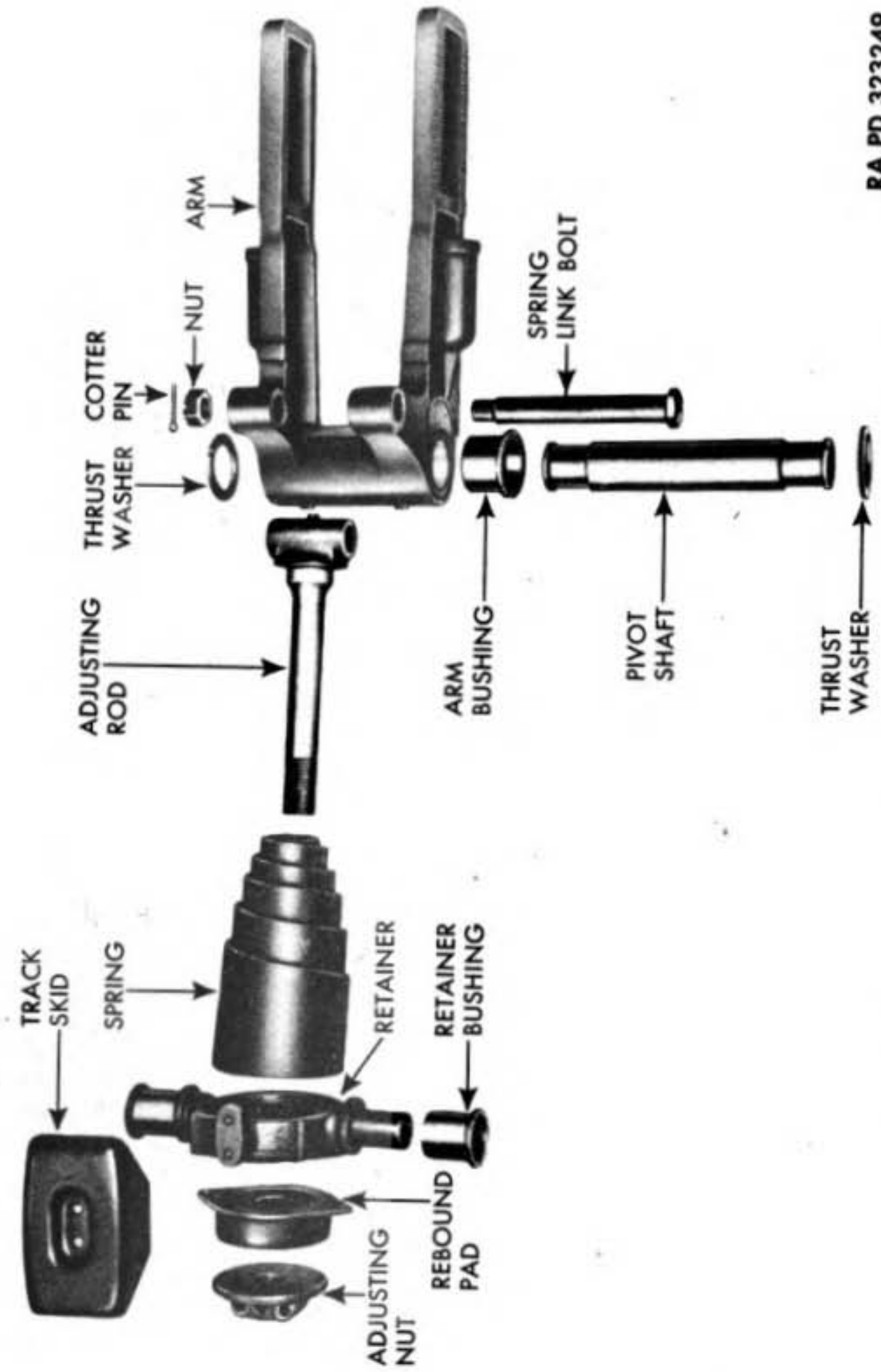


*Figure 255 — Trailing Idler Arm and Spring Disassembled*

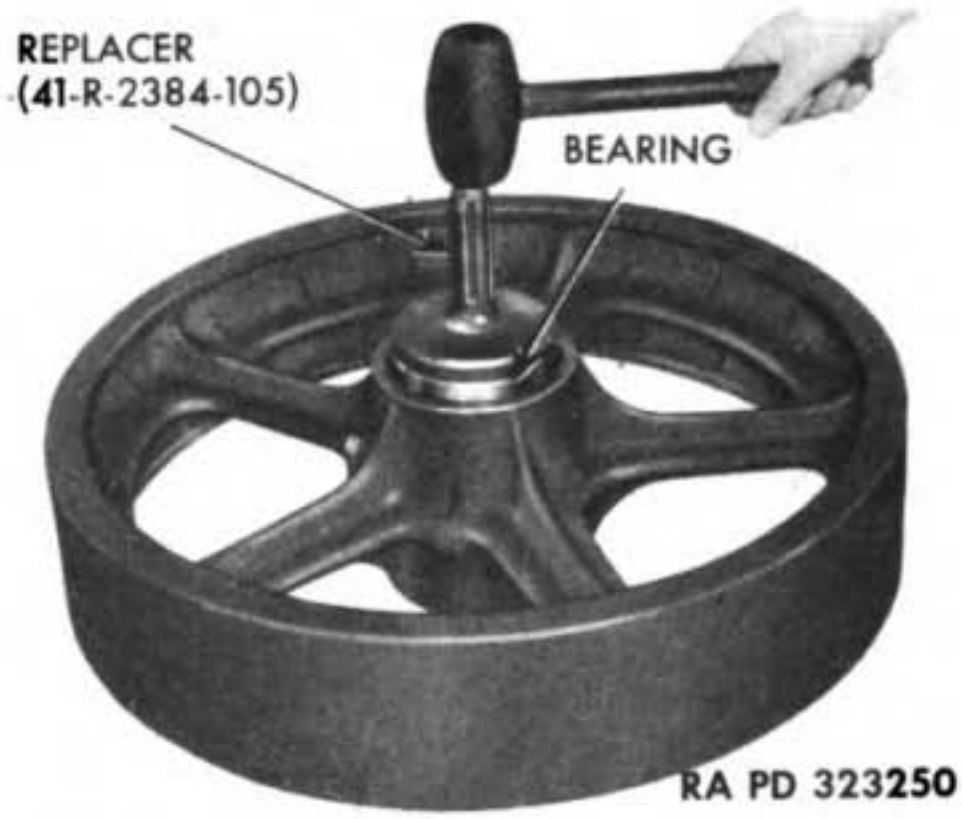


*Figure 256 — Installing Trailing Idler Wheel Bearing*

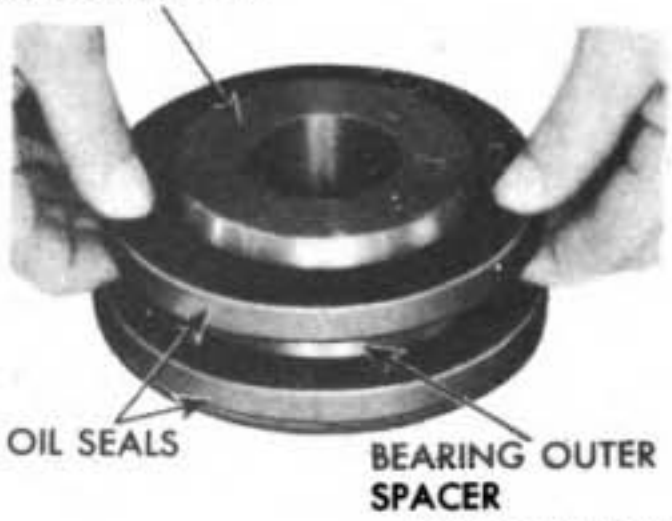


*Figure 257 — Installing Oil Seals on Bearing Outer Spacer with Pilot (41-C-2562-460)*

breaks. Replace bolt if necessary. Inspect adjusting rod for damaged threads or for wear, cracks, or breaks. If rod is damaged, worn, cracked, or broken, replace. Inspect retainer and retainer bushings for wear, cracks, or breaks. If defective, replace retainer or bushings. Inspect track skid for being worn, cracked, or broken. Repair by welding or replacing track skid.

**c. Rebuild Trailing Idler Wheel Assembly.** Install lubrication fitting and relief fitting in idler wheel. With replacer (41-R-2384-105) press or drive bearing into wheel hub (fig. 256). With outer spacer oil seal pilot (41-C-2562-460), install two oil seals on outer spacer (fig. 257) so lips of seals face toward spacer flange. **NOTE:** *It is not*


***Figure 258 — Installing Trailing Idler Wheel Bearing Outer Spacer and Oil Seals***

*necessary to use cone (41-C-2562-460) to install oil seal on outer spacers that have a ½-inch radius on inner shoulder.* Shellac sealing ring in groove around the inner edge of outer spacer. With replacer (41-R-2384-105) press or drive outer spacer and oil seals in idler hub (fig. 258). Turn wheel over and install inner spacer inside of wheel. Install second bearing and second outer spacer, oil seals, and sealing ring as described above. Seal the trailing idler wheel hub with masking tape to keep bearings clean until wheel is installed.

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## Section IV

## TRACK SUPPORT IDLER



### 115. DESCRIPTION (fig. 247).

**a.** The two track support idlers provide support for the track as it travels from the trailing idler to the sprockets. These idlers are mounted on top of bogie frame. The idlers consist of a rubber-tired roller which revolves on two single-row ball bearings. The bearings are protected by a leather seal and felt washer. The lip of the seal faces out, away from the bearings. An adjustable mud scraper is attached on top of the bracket.

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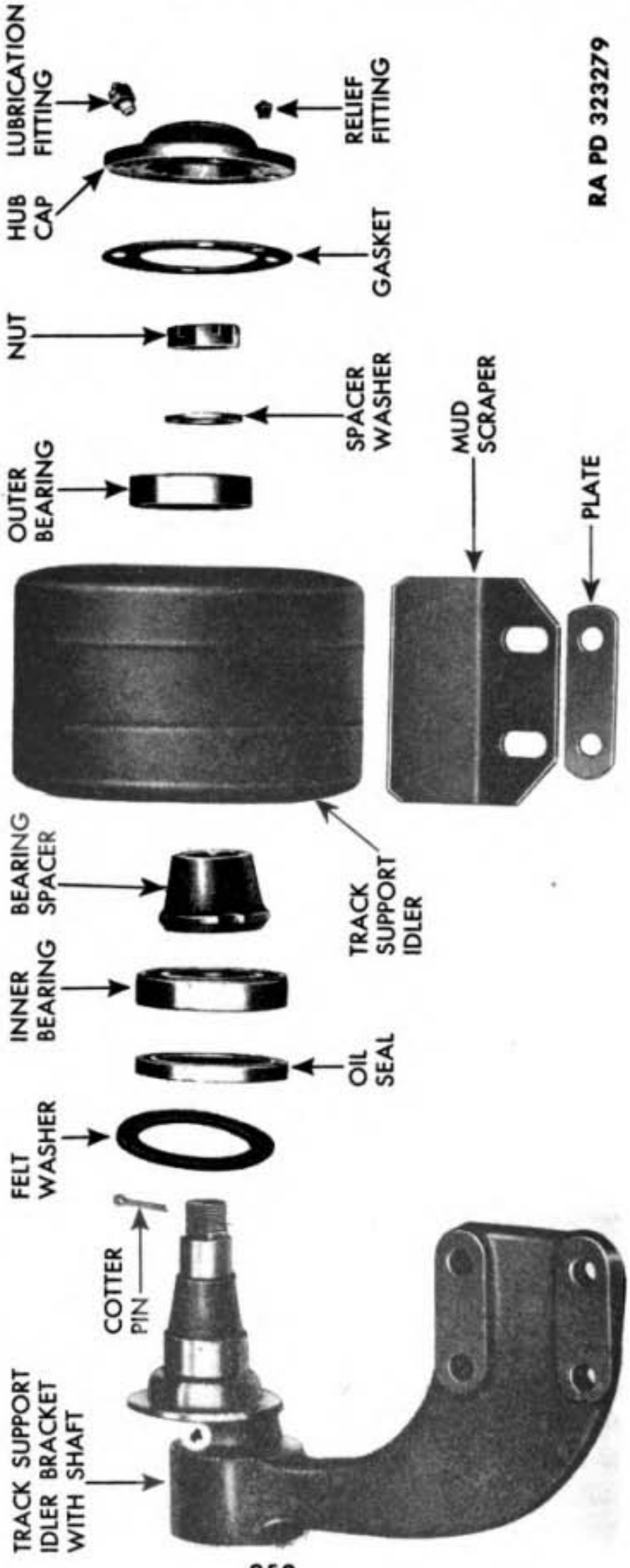


*Figure 259 — Track Support Idler Disassembled*

## SUSPENSION

### 116. DISASSEMBLY (fig. 259).

**a. Remove Idler Hub Cap.** Remove four cap screws and lock washers attaching hub cap to idler. Remove hub cap and gasket.

**b. Remove Idler From Bracket With Shaft.** Remove cotter pin, nut, and outer bearing spacer washer from shaft. Hold inner edge of idler on wood blocks, and drive shaft from idler and bearings.

**c. Remove Track Support Idler Bearings.** Drive outer bearing from idler by tapping around ridge on inside of bearing spacer with a brass rod. Using bearing spacer as a driver, drive inner bearing and oil seal out of idler.

### 117. CLEANING, INSPECTION, AND REPAIR (fig. 259).

**a. Cleaning.** Clean all parts thoroughly with dry-cleaning solvent. Dry with compressed air.

(1) BEARINGS. Clean bearings as described in paragraph 112 a (1).

(2) TRACK SUPPORT IDLER BRACKET WITH SHAFT. Inspect support idler shaft for wear, cracks, or breaks. If worn, cracked, or broken, replace support idler bracket. Inspect shaft for being bent out of line with bracket. If shaft is bent, idler will not run true with track. If shaft is bent, replace bracket with shaft assembly.

(3) OIL SEAL AND FELT WASHER. Inspect oil seal for wear or damaged lip. If worn or damaged, replace oil seal and felt washer.

(4) TRACK SUPPORT IDLER. Inspect rubber tire. If severely grooved or otherwise unserviceable, replace idler. Inspect bearing bores for wear, and if worn, replace idler. Inspect oil passage in idler to be sure it is clean and allows free passage of grease.

(5) TRACK SUPPORT IDLER HUB CAP. Inspect condition of lubrication fitting and relief fitting. Replace damaged fittings.

(6) TRACK SUPPORT IDLER SCRAPER. Inspect scraper for wear, and if worn so that scraper cannot be adjusted within $\frac{1}{16}$ inch from idler tire, replace scraper.

(7) TRACK SUPPORT IDLER BEARING SPACER. Inspect each end of spacer for wear, and check to see if it has been turning on shaft. The width of spacer should be 1.965 to 1.970 inches. If worn, replace bearing spacer.

### 118. ASSEMBLY (fig. 259).

**a. Install Oil Seal and Inner Bearing.** Place felt washer next to flange on the support idler shaft. With lip of the oil seal facing toward felt washer, install oil seal on shaft. Install inner bearing on shaft next to oil seal by driving on inner race until seated against shoulder on shaft.

**b. Install Track Support Idler.** Place idler over shaft on inner bearing, and drive idler on bearing until seated. Place bearing spacer on shaft next to inner bearing. Install outer bearing on shaft and in idler hub, and drive in until seated on shaft and in idler hub. Place outer bearing spacer washer on shaft, and install nut and cotter pin. Check to be certain idler rotates freely on bearings.

**c. Install Idler Hub Cap.** Shellac gasket to hub cap, and install hub cap on idler with relief fitting in line with oil passage. Attach hub cap with four cap screws and lock washers. Lubricate bearings so that idler is ready for installation.

---

## Section V

# BOGIE FRAME



## 119. DESCRIPTION (fig. 247).

**a.** The two bogie frames are attached to the two vehicle frame crossmembers on each side of the tractor. The bogie frames carry the weight of the vehicle. The bogie frame is a welded assembly and is composed of two channels, spring housings, bearings, bogie arm stops, and reinforcing members. The bogie frame is the supporting member for the bogie components, trailing idler, and track support idlers.

**b.** Bogie frame removal is described in TM 9-786.

## 120. INSPECTION, REPAIR, OR REBUILD (fig. 260).

**a. Bearings.** Inspect each bearing for wear. If worn, replace. If new bearings do not take up wear, replace bogie frame. Only undersize bearings are supplies for service.

**b. Bogie Arm Stops.** Inspect welds holding bogie arm stops to bogie frame channels. If cracked, they may be repaired by welding. If stops are broken off, replace bogie frame, or build up by welding.

**c. Bogie Spring Housing.** Inspect bogie spring housing for cracks or breaks. If slightly cracked, repair by welding; otherwise, replace bogie frame.

## SUSPENSION

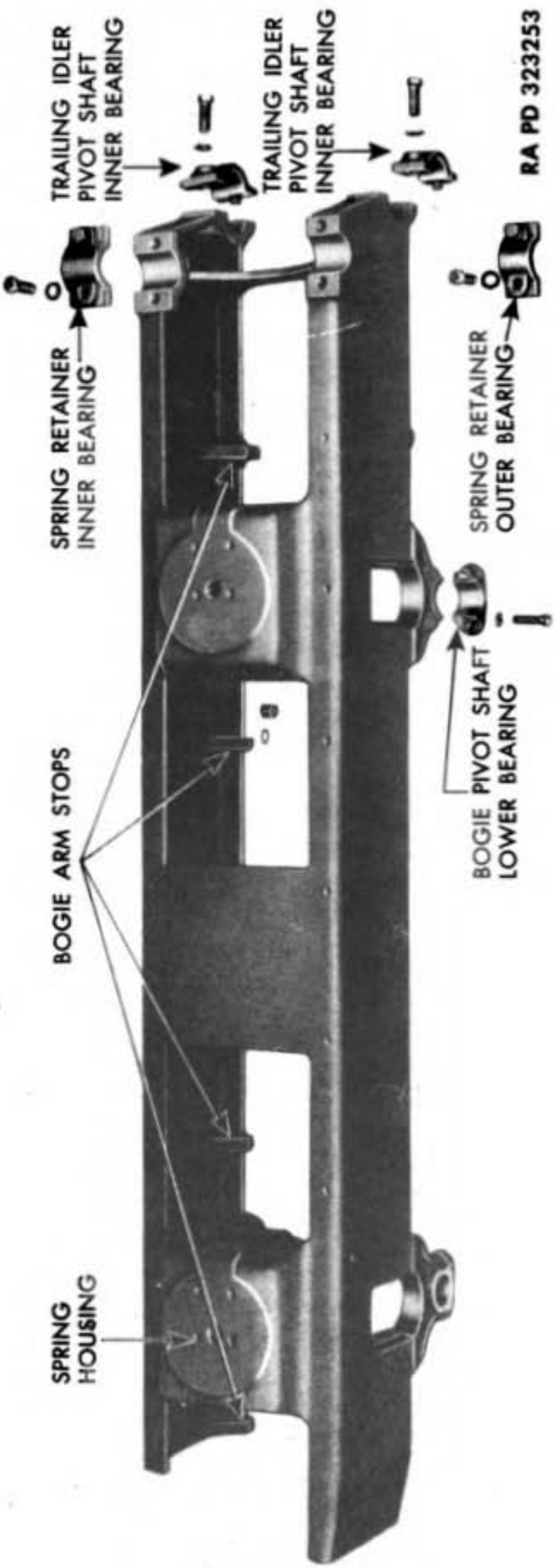


*Figure 260 — Bogie Frame and Bearings*

Section VI

# FITS AND TOLERANCES



## 121. BOGIE ASSEMBLY COMPONENTS.

| | |
|---|---|
| Bogie wheel diameter without tire and rim | 16.000 to 16.005 in. |
| Bogie arm bushing | 2.499 to 2.501 in. |
| Link pivot bushings | 2.256 to 2.259 in. |
| Link pivot pins | 1.369 to 1.372 in. |
| Links | 1.381 to 1.385 in. |
| Equalizer arm shaft | 2.239 to 2.241 in. |
| Equalizer arm shaft bushings, width between wear plates | 2.680 to 2.690 in. |
| Wearing plates thickness | 0.490 to 0.500 in. |
| Arm pivot shaft | 2.489 to 2.491 in. |
| Bogie wheel bearing outer spacer thickness | 1.288 to 1.291 in. |
| Bogie wheel bearing inner spacer thickness | 1.172 to 1.177 in. |
| Bogie spring | |
| Free height | 11½ to 12½ in. |
| Test load at 8¾ inches, height | 10.500 to 11.500 lb |

## 122. TRAILING IDLER COMPONENTS.

| | |
|---|---|
| Trailing idler wheel diameter | 28 in. |
| Trailing idler arm bushing inside diameter | 2.869 to 2.874 in. |
| Trailing idler spring retainer bushing inside diameter | 2.001 to 2.004 in. |
| Trailing idler wheel bearing inner spacer width | 0.497 to 0.500 in. |
| Trailing idler wheel bearing outer spacer width | 1.434 to 1.437 in. |
| Trailing idler spring | |
| Free height | 12¼ to 13 in. |
| Test load at 8½ inches, height | 8000 to 9000 lb |

## 123. TRACK SUPPORT IDLER COMPONENTS.

| | |
|---|---|
| Bearing spacer width | 1.965 to 1.970 in. |

# CHAPTER 7

# WINCH



## 124. DESCRIPTION.

**a.** The Gar Wood Winch, Model US-15T, is mounted on two main frame side channels at front end of tractor (fig. 261). It is protected by the front bumper. The winch is driven by a winch drive shaft which connects the winch worm by a shear pin, and connects the drive shaft in the transmission by a splined coupling. The shear pin protects the winch and cable from overload. The winch drive in the transmission makes it possible to wind or unwind the cable, and the two-way engine clutch gives two wind and two unwind speeds with a given engine speed. The winch drive consists of a worm, worm gear, drum shaft, sliding clutch, and winch drum. The worm rotates in two bearings in the upper gear case. It drives the worm gear which is mounted on the drum shaft. Also mounted on the drum shaft is the sliding jaw clutch which is keyed to the shaft. When the clutch is moved away from the drum by a shifting lever, it is disengaged, and the drum rotates freely on the shaft. When the clutch is moved toward the drum, its jaws engage mating jaws on the side of the drum, and the drum rotates with the shaft. An automatic brake is constantly applied to a brake disk on the front end of the winch worm, and holds the load suspended when the engine clutch is disengaged. A drag brake, applied to the drum, automatically keeps the drum from spinning and the cable from unwinding too rapidly, when the cable is pulled off by hand.

**b.** The winch hand lever is the outside lever to the right, below driver's seat. It selects the direction of rotation of the winch, winding or unwinding the cable. This lever can be moved up or down from its neutral position by pushing in release button on end of lever. With hand lever moved up, the winch will unwind the cable. With hand lever moved down, the winch will wind the cable. The winch hand lever is connected to the shifting lever on the transmission cover by an adjustable yoke rod. The shifting lever is mounted in a housing on top of the transmission case. This housing provides a common junction for tubes and hoses venting the clutch and gear reduction unit, electric brake power cylinder, clutch brake power cylinder, and transmission through a vent tube leading up in back of driver's seat. The winch shifting lever housing assembly is accessible by raising

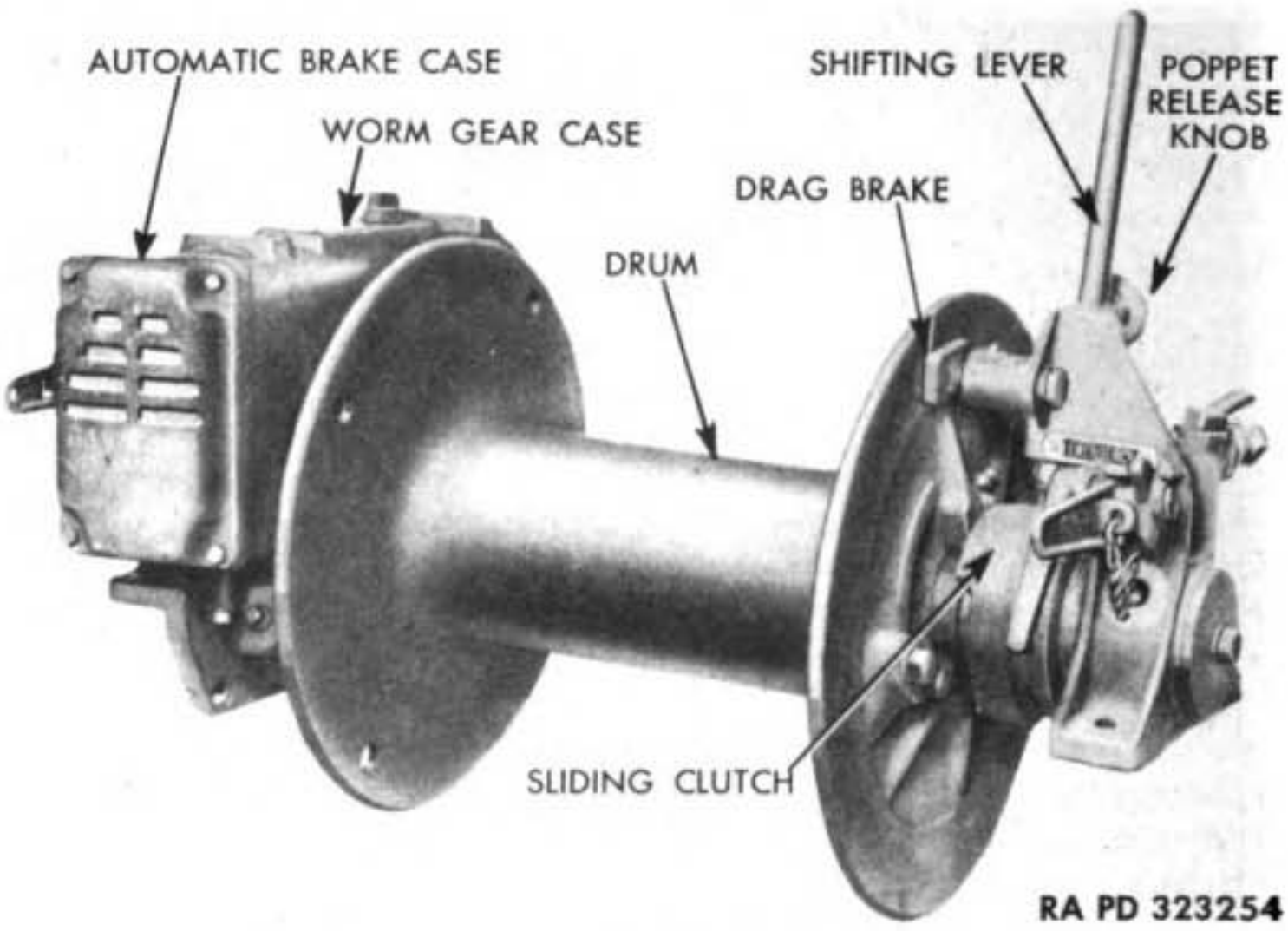


*Figure 261 — Winch Without Cable*

driver's seat, and is removed and installed as described in paragraphs 5 **n** and 9 **e**, respectively.

## 125. DISASSEMBLY.

**a. Drain Worm Gear Case** (fig. 267). Remove drain plug and drain lubricant.

**b. Remove Hose Couplers, Shut-off Cock, One-way Valve, and Connector** (fig. 262). Unscrew emergency trailer brake hose coupler and nipple from front side of end bearing frame. Unscrew shut-off cock, nipples, and one-way valve from rear side. Unscrew service trailer brake hose coupler and nipple from front side of air line bracket next to worm gear case. Unscrew tube connector from rear side.

**c. Remove End Bearing Frame Assembly and Sliding Clutch** (fig. 263). Remove cap screw and lock washer attaching retainer washer to drum shaft, and remove retainer washer and shims. Slide end bearing frame, thrust ring, and sliding clutch off shaft. Remove drag brake shoe and spring from frame.

**d. Disassemble End Bearing Frame Assembly** (fig. 264). Remove cotter pin and headless pin attaching shifting lever to end bear-

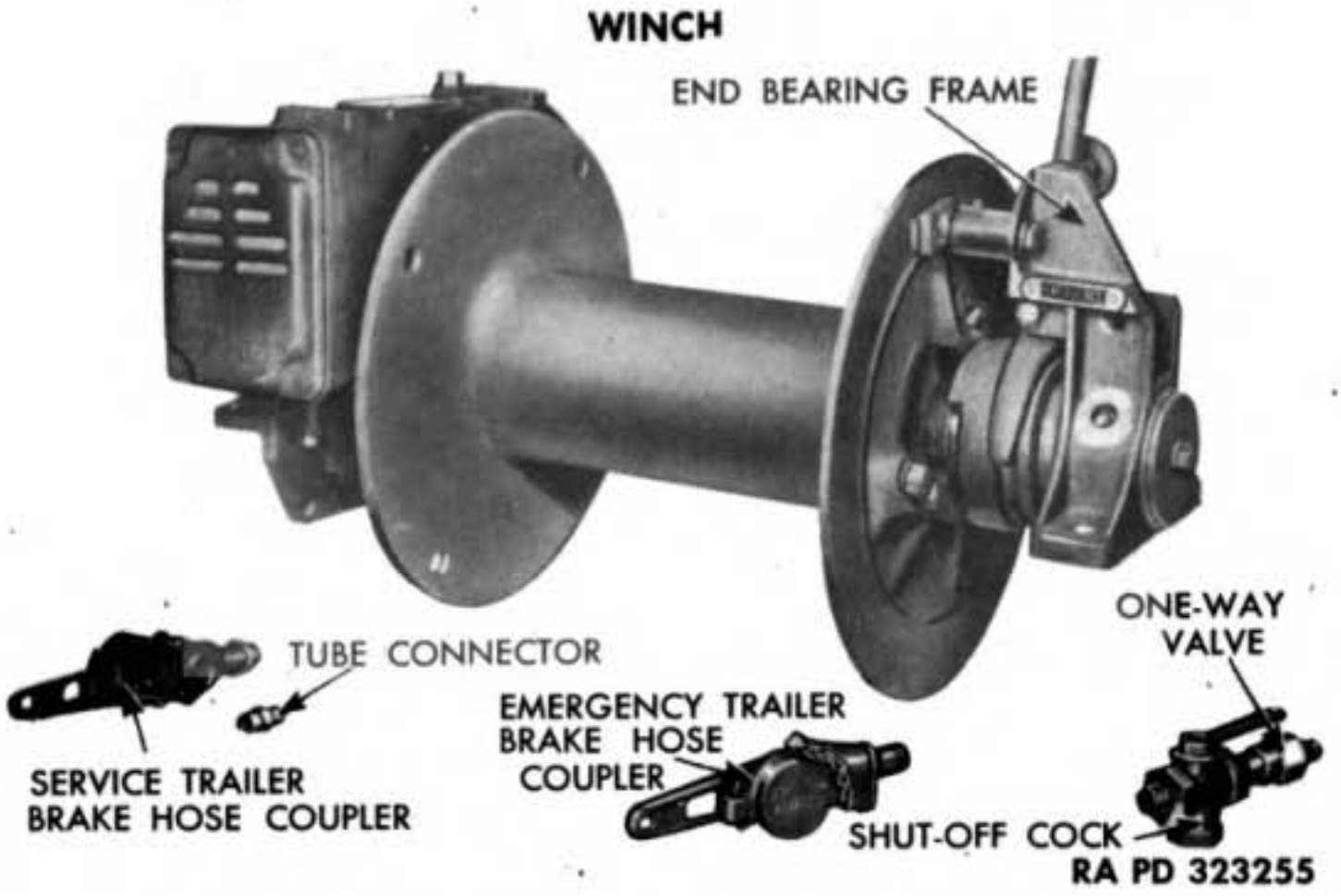


***Figure 262 — Trailer Air Brake Fittings Removed***

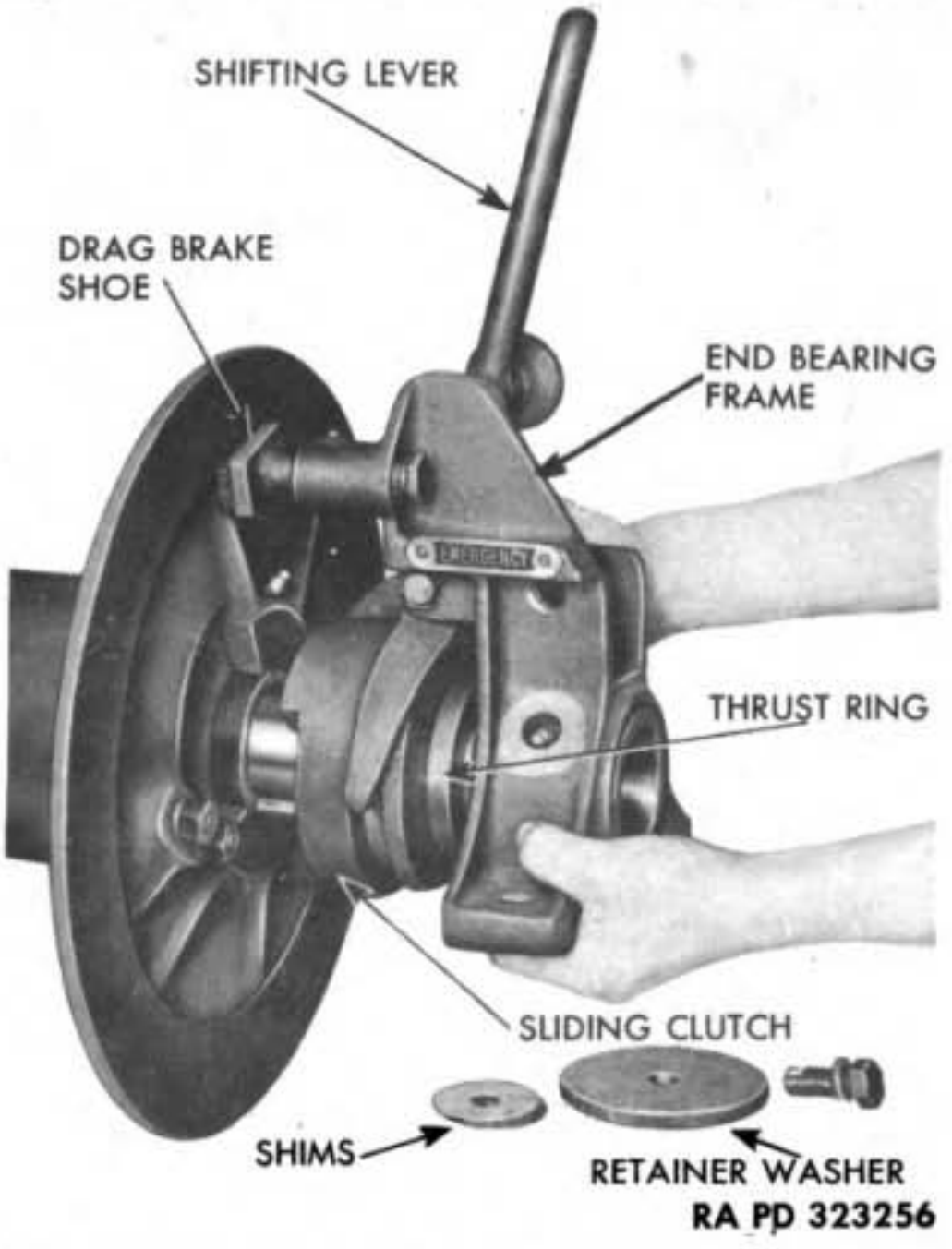


***Figure 263 — Removing End Bearing Frame and Sliding Clutch***

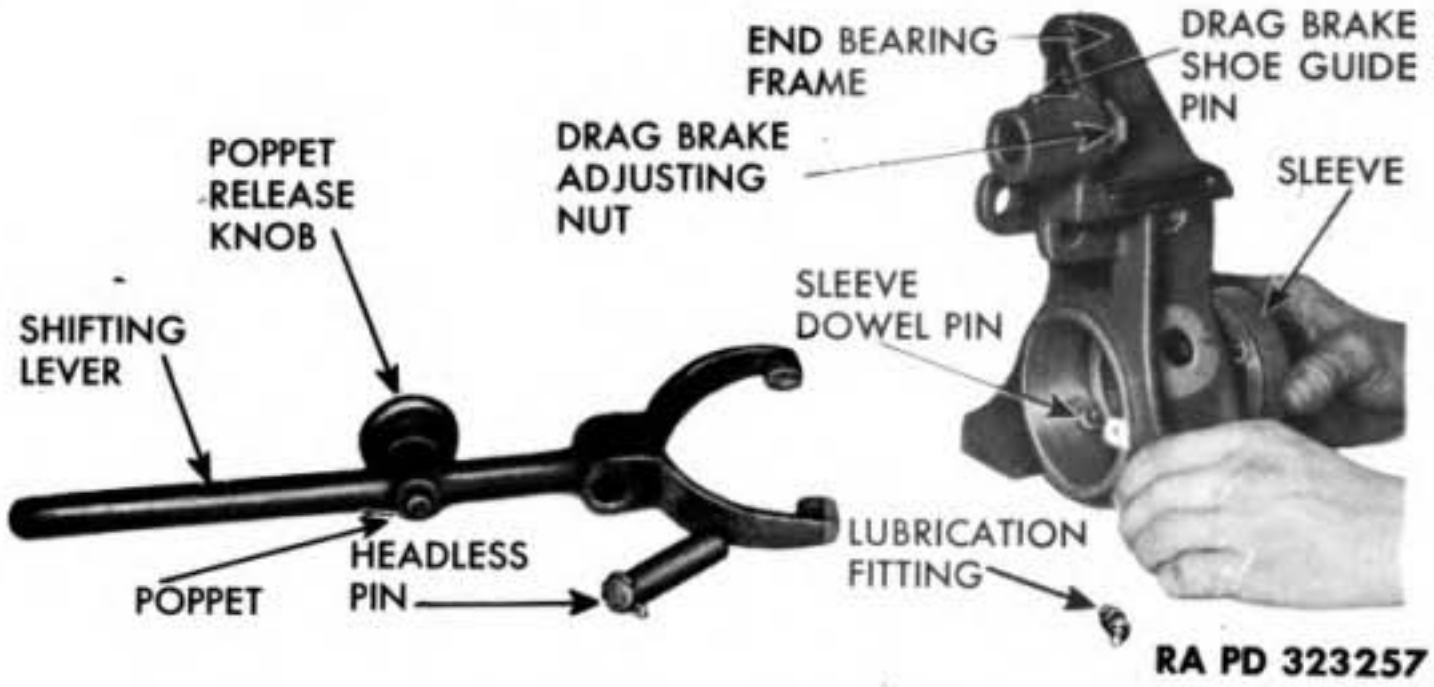


***Figure 264 — Disassembling End Bearing Frame Assembly***

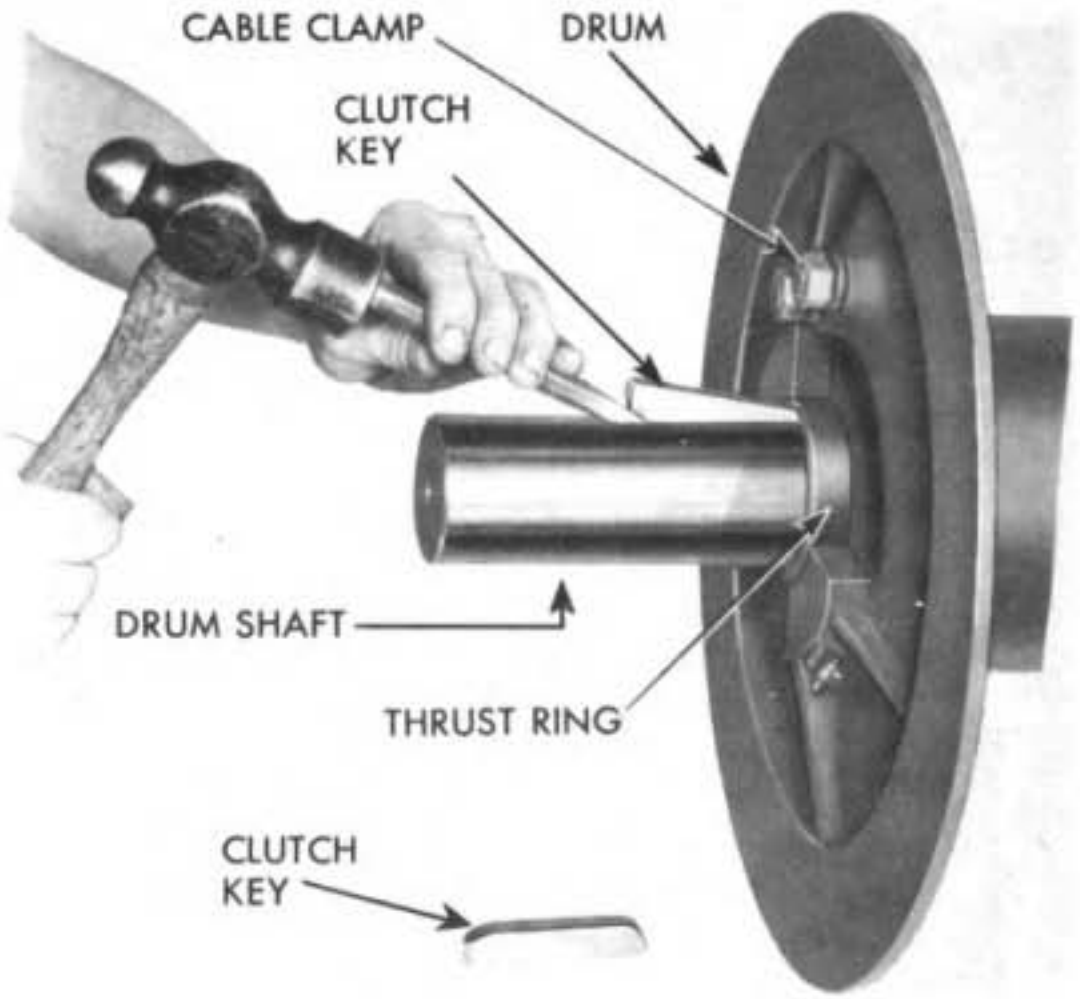


***Figure 265 — Removing Sliding Clutch Key***

ing frame, and remove lever. Unscrew lubrication fitting from sleeve, and pull sleeve out of frame.

**e. Remove Drum.** NOTE: *Cable should have been removed from drum while winch was still on vehicle. Refer to TM 9-786.* Remove two clutch keys from shaft, using a cold chisel (fig. 265). Slide thrust ring and drum off shaft.

## WINCH

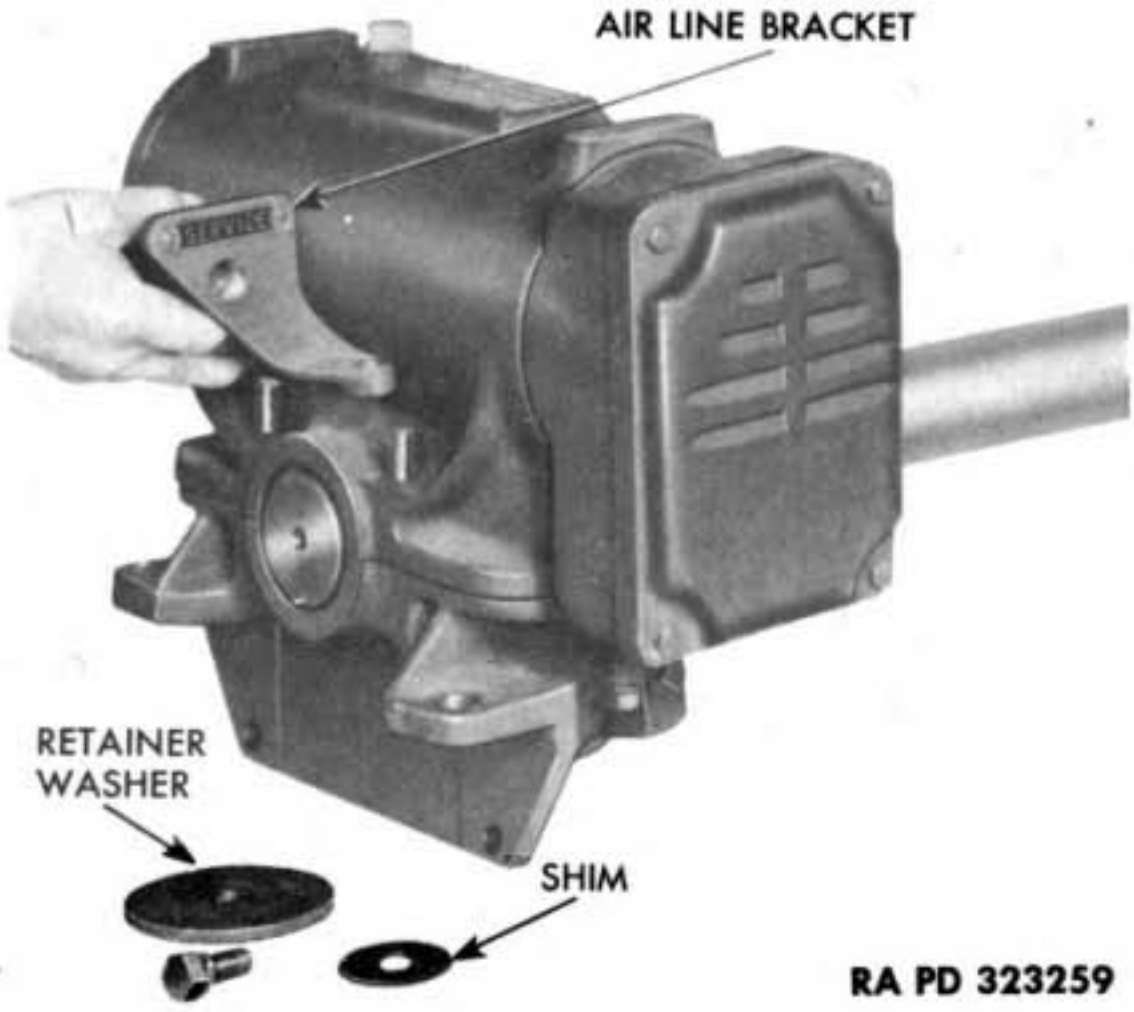


*Figure 266 — Removing Air Line Bracket*


*Figure 267 — Removing Lower Worm Gear Case*

**ORDNANCE MAINTENANCE — POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

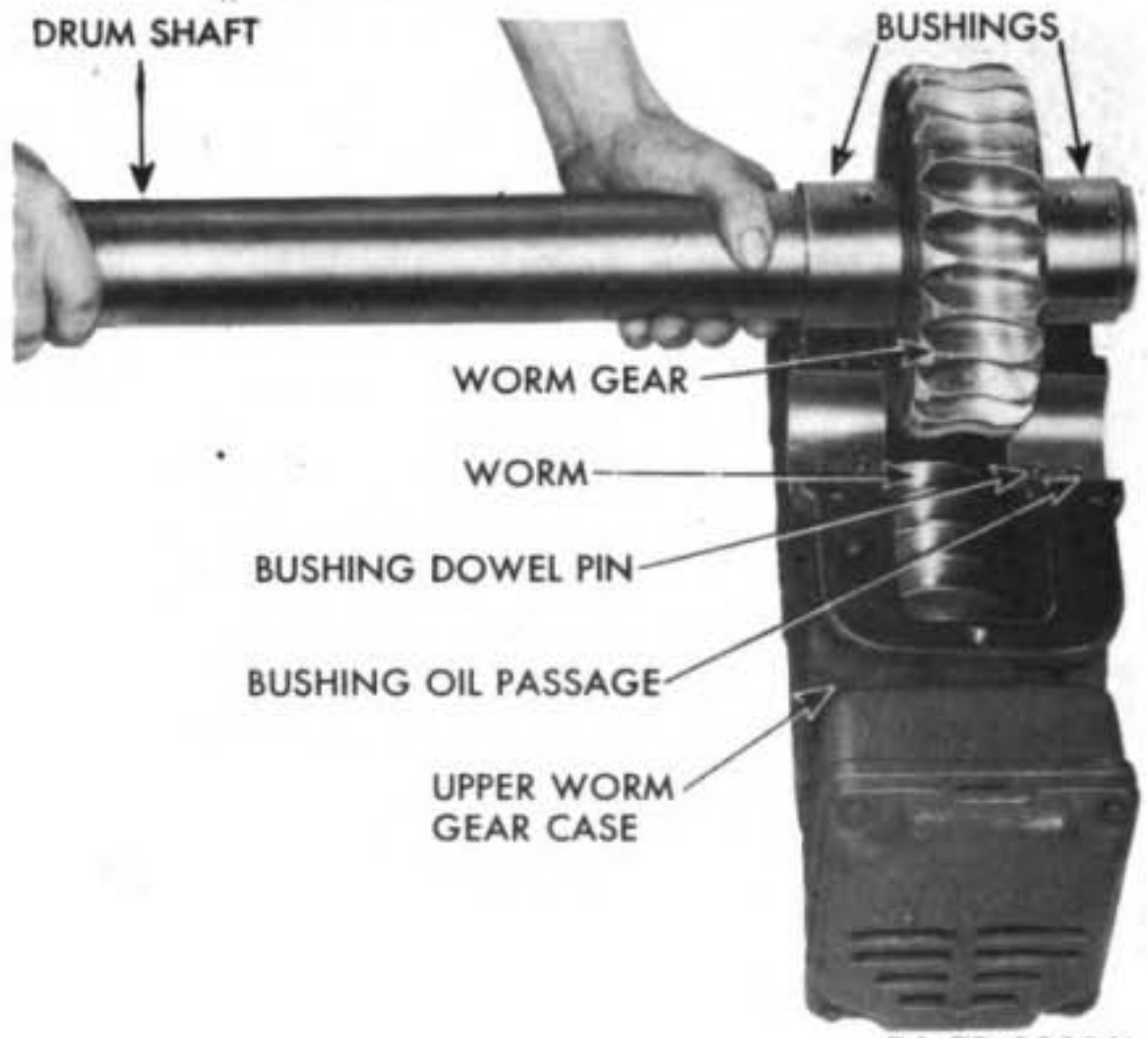


***Figure 268 — Removing Worm Gear, Shaft, and Bushings***

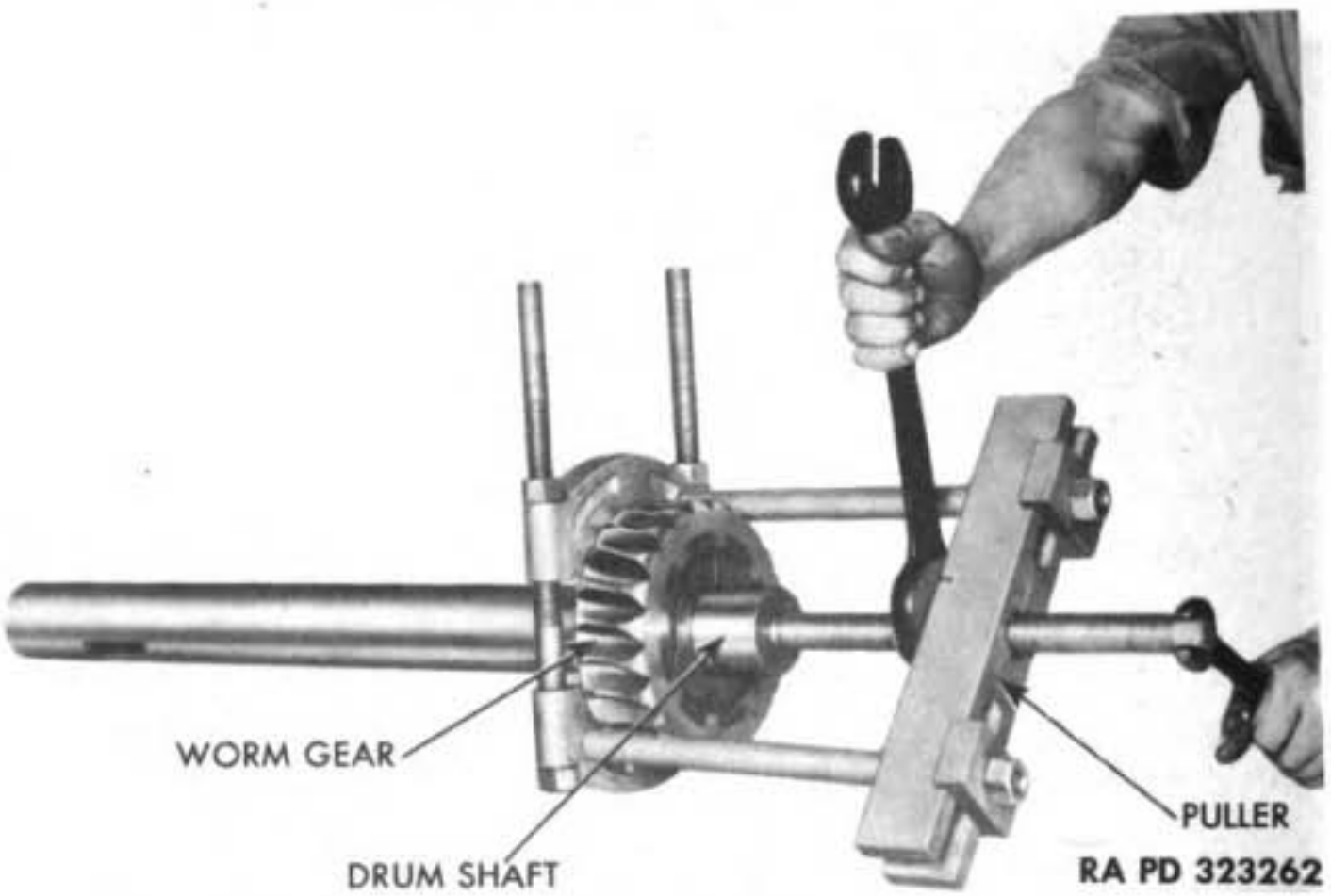


***Figure 269 — Removing Worm Gear from Shaft, Using Puller (41-P-2905-60)***

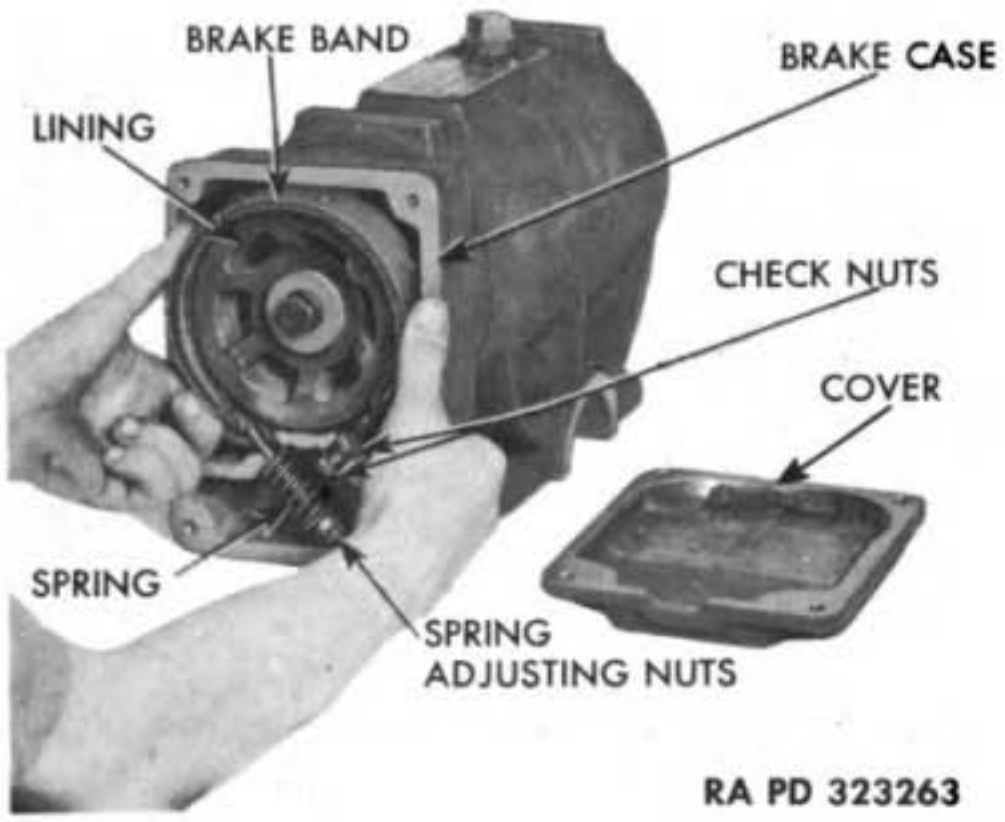


***Figure 270 — Removing Automatic Brake Band Assembly***

**f. Remove Worm Gear and Shaft Assembly.** Remove two nuts and lock washers attaching air line bracket, and remove bracket (fig. 266). Remove cap screw and lock washer attaching retainer washer to end of shaft, and remove washer and shims (fig. 266). Turn assembly over with lower worm gear case on top. Remove two cap screws, two nuts, and four lock washers attaching lower worm gear case to upper worm gear case, and lift off lower worm gear case (fig. 267). Peel off gaskets. Lift out worm gear, shaft, and bushings (fig. 268).

**g. Remove Worm Gear and Bushings from Shaft.** Slide both bushings off shaft. NOTE: *Do not remove worm gear from shaft unless inspection reveals it is necessary.* Using puller (41-P-2905-60), pull worm gear off shaft (fig. 269). Remove two worm gear keys from shaft.

**h. Remove Automatic Brake Assembly.** Remove four cap screws and lock washers attaching cover to brake case and remove cover. Loosen two spring adjusting nuts and two nuts attaching brake band to case; pull brake band off disk and out of case (fig. 270). Remove four cap screws and lock washers attaching rear bearing cap, and remove cap and gasket (fig. 271). Remove cap screw, lock washer, and retainer washer from end of worm shaft, and drive on end of worm shaft with a brass rod until it is forced out of brake disk (fig. 272). Then remove brake disk.

**i. Remove Winch Worm Assembly** (fig. 273). Pull winch worm assembly out of gear case.

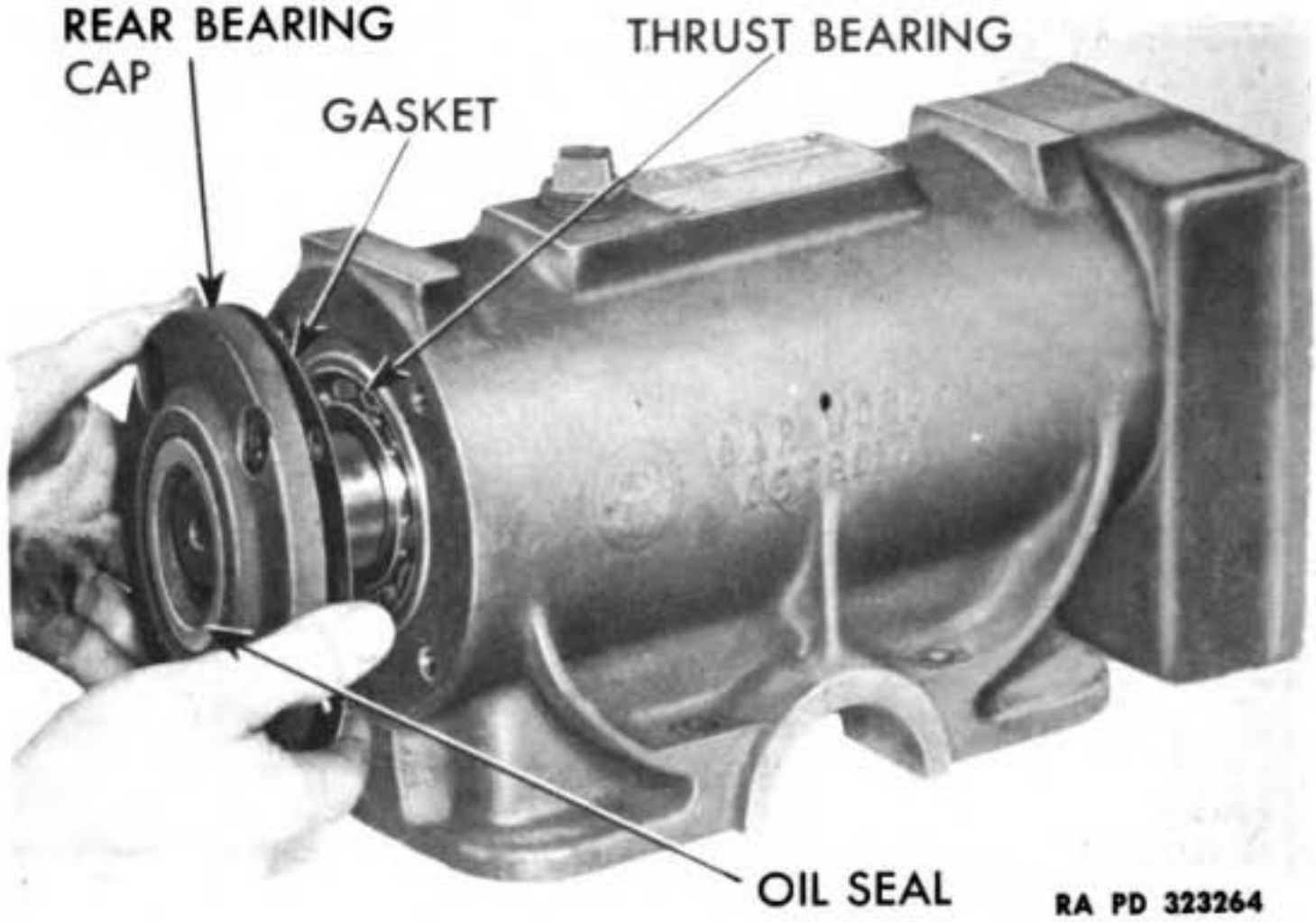


*Figure 271 — Removing Winch Worm Shaft Gear Bearing Cap*

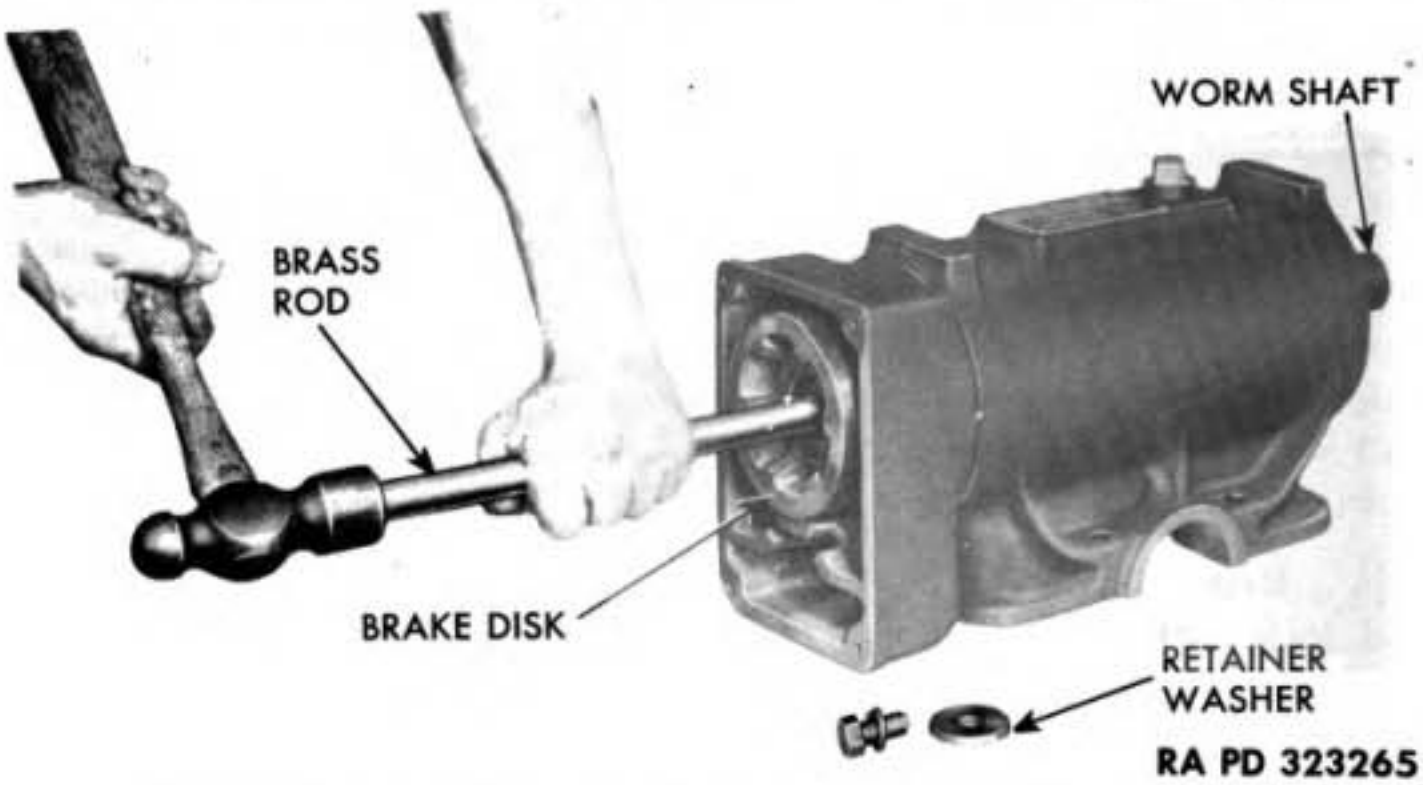


*Figure 272 — Driving Shaft Out of Automatic Brake Disk*

**j. Disassemble Worm Assembly** (fig. 274). Remove brake disk key from worm. **NOTE:** *Do not remove bearings from worm unless inspection reveals it is necessary.* Pull both bearings from worm using puller (fig. 274) or an arbor press. **NOTE:** *When removing bearing, seat puller jaws or bed of press against inner bearing race.*

## WINCH

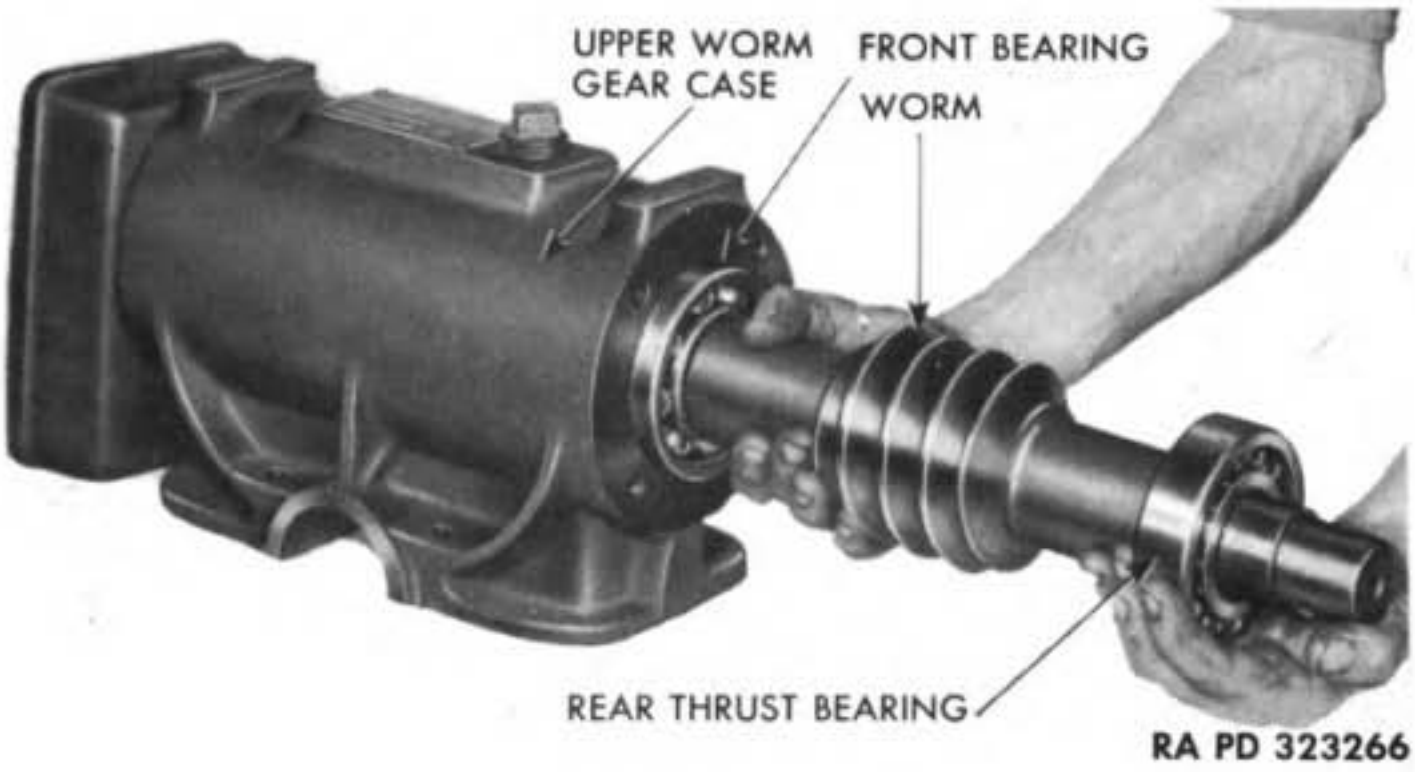


***Figure 273 — Removing Winch Worm Assembly***

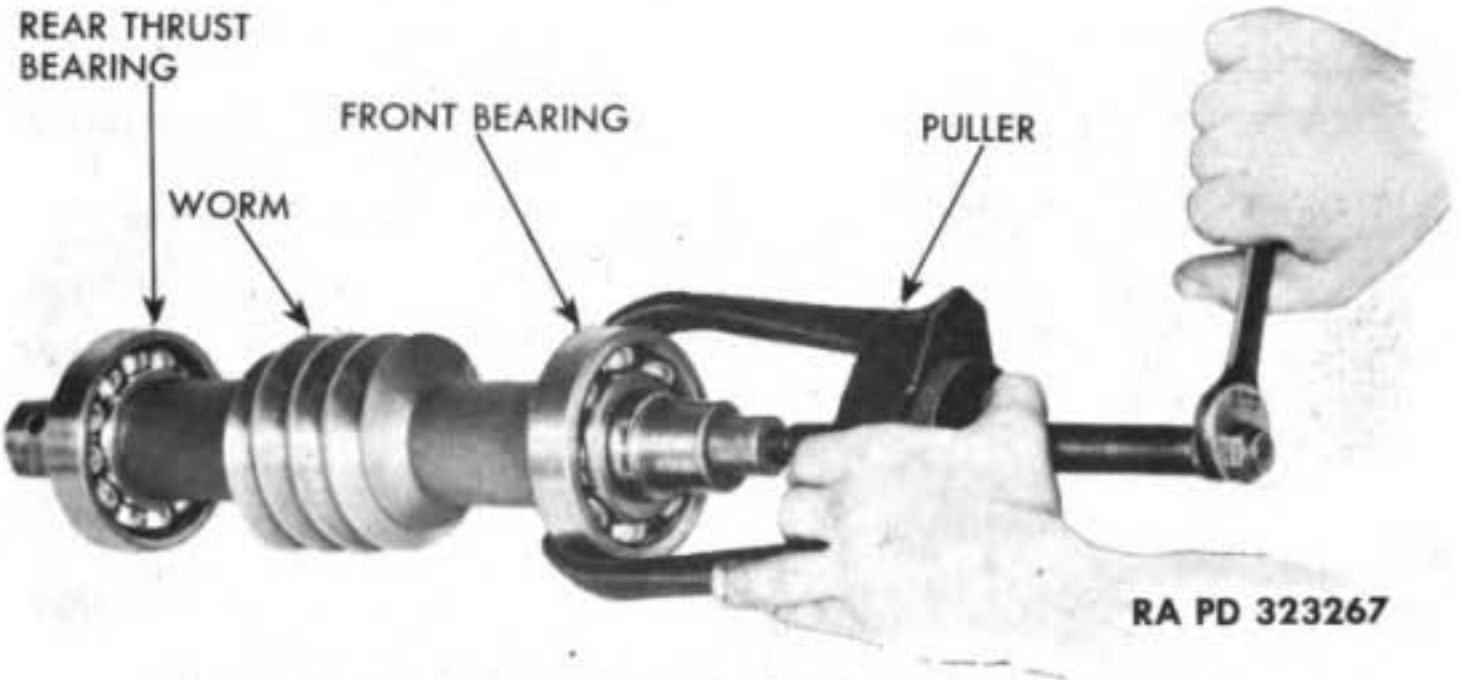


***Figure 274 — Removing Winch Worm Front Bearing***

**k. Remove Automatic Brake Case** (fig. 275). Remove four cap screws and lock washers attaching brake case to upper worm gear case, and remove brake case. Peel off gasket. **NOTE:** *Do not remove brake case from upper worm gear case unless repair or replacement of either part is necessary.*

**l. Disassemble Winch Snatch Block** (fig. 276). Remove two link pins and cotter pins attaching links and swivel hook to sheave block. Remove nut from snatch block shaft, and drive shaft from block.

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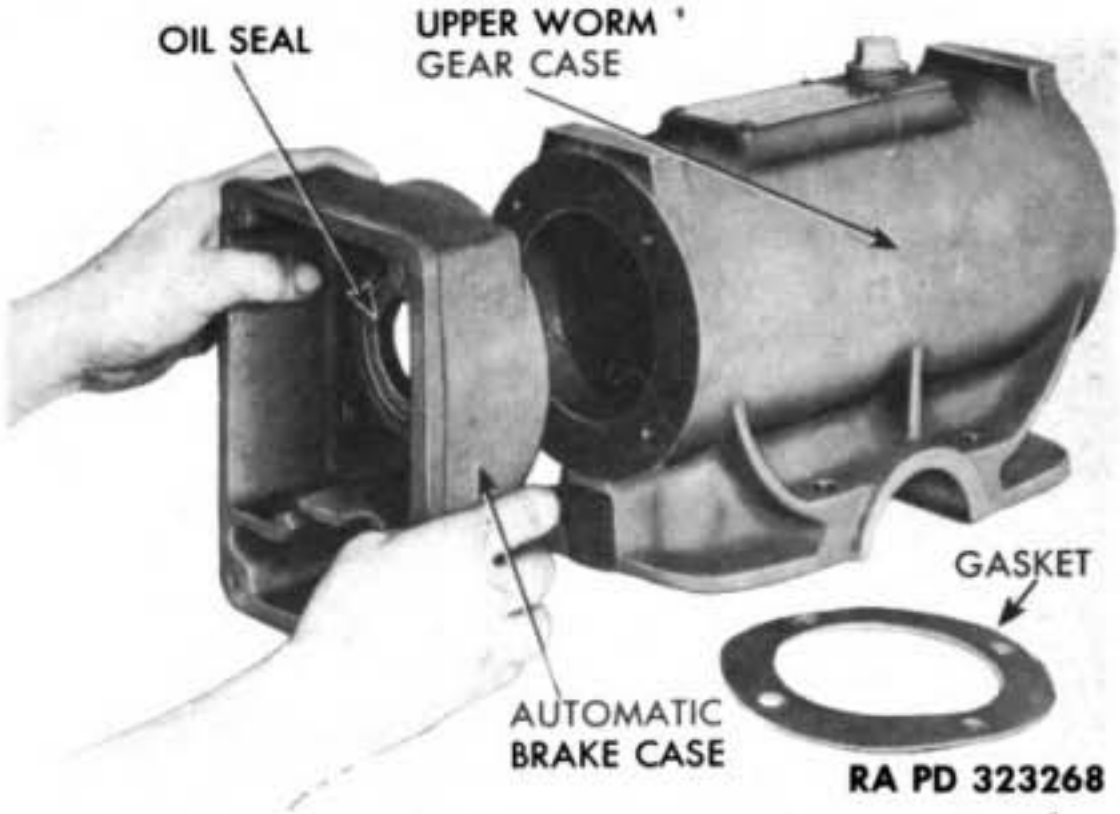



***Figure 275 — Removing Automatic Brake Case***

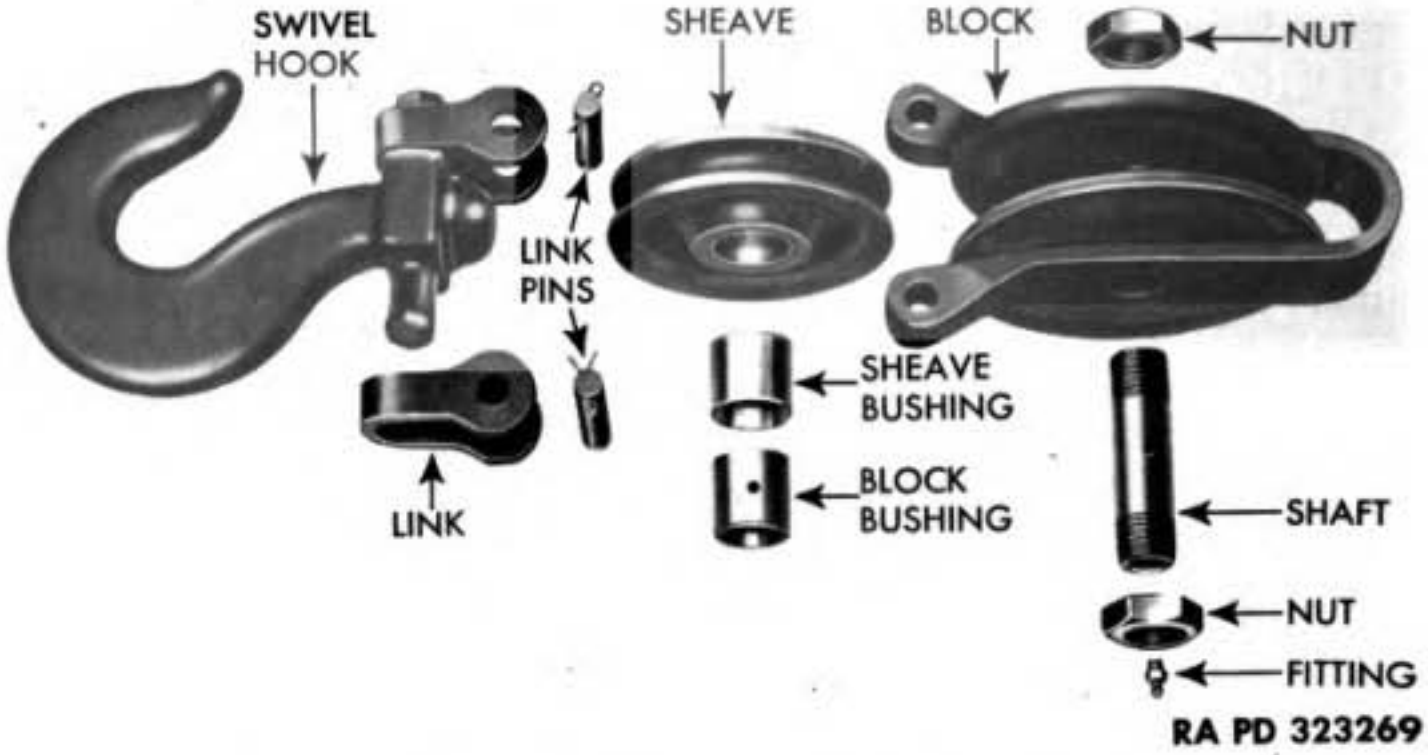



***Figure 276 — Winch Snatch Block Disassembled***

Remove lubricating fitting from shaft. Remove sheave from block, and slide block bushing from sheave.

**m. Disassemble Winch Cable Roller** (fig. 277). Remove four cap screws attaching winch cable roller to frame side channels, and remove roller assembly from vehicle. Remove two cap screws and lock washers attaching brackets to each end of cable roller shaft, and remove brackets. Slide cable roller shaft from roller. Remove two lubrication fittings from shaft.

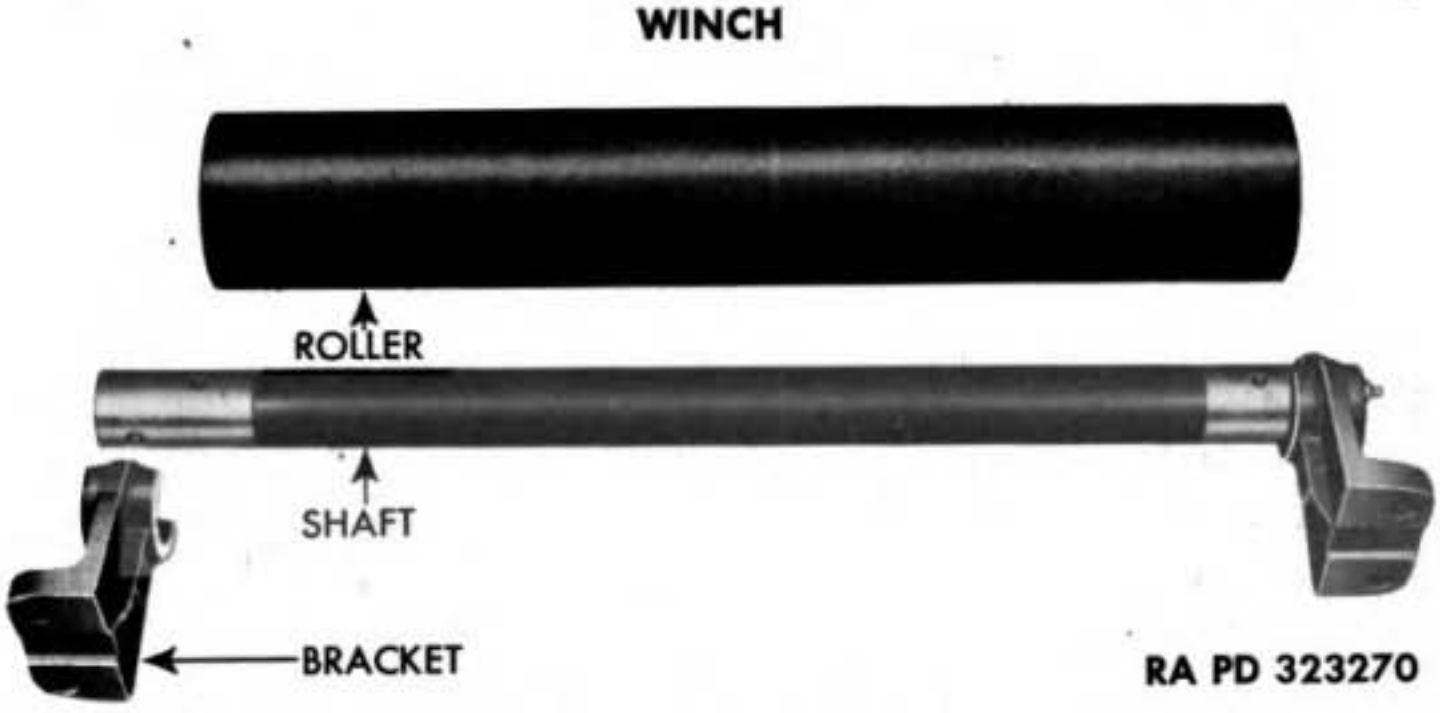



*Figure 277 — Winch Cable Roller Disassembled*

**n. Disassemble Winch Shifting Controls.**

(1) DISASSEMBLE WINCH SHIFTING LEVER AND HOUSING (fig. 278). Remove hose tee and vent tube tee. Remove cap screw and lock washer clamping inside shifting lever on lever shaft. Remove inside lever key out of slots inside shifting lever and shaft. Press screwdriver or chisel into inside lever slot, and slide shifting lever shaft from lever housing and washer.

(2) REMOVE AND DISASSEMBLE WINCH HAND LEVER ASSEMBLY. Remove cotter pin and pin attaching yoke rod to hand lever. Remove nut and lock washer attaching winch hand lever to driver's seat. Remove cotter pin attaching spacing washer to lever shaft. Pull shaft from two levers, spring, and driver's seat. Remove spacing washer, spring, and winch hand lever from driver's seat.

## 126. CLEANING, INSPECTION, AND REPAIR.

**a. Cleaning.** Clean all parts with dry-cleaning solvent. Dry with compressed air.

**b. Worm Gear Case Assembly.** Check oil passages to bushings to make sure they are not clogged. Inspect case for cracks, breaks, or other damage. Replace if defective, or rebuild by welding or brazing if damage is small.

**c. Automatic Brake Case.** Inspect brake case and cover for cracks, breaks, or other damage. If broken or damaged, replace with new parts. Small cracks or breaks may be repaired by welding or brazing.

**d. Automatic Brake Assembly.** Inspect brake disk for scoring on braking surface. Place scored brake disk in lathe, and smooth scored surface. Replace damaged or excessively worn disk. Examine threads on both ends of brake band for damage. Inspect lining for wear and if worn to rivet heads, replace lining. Use punch to drive out rivets

**ORDNANCE MAINTENANCE — POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

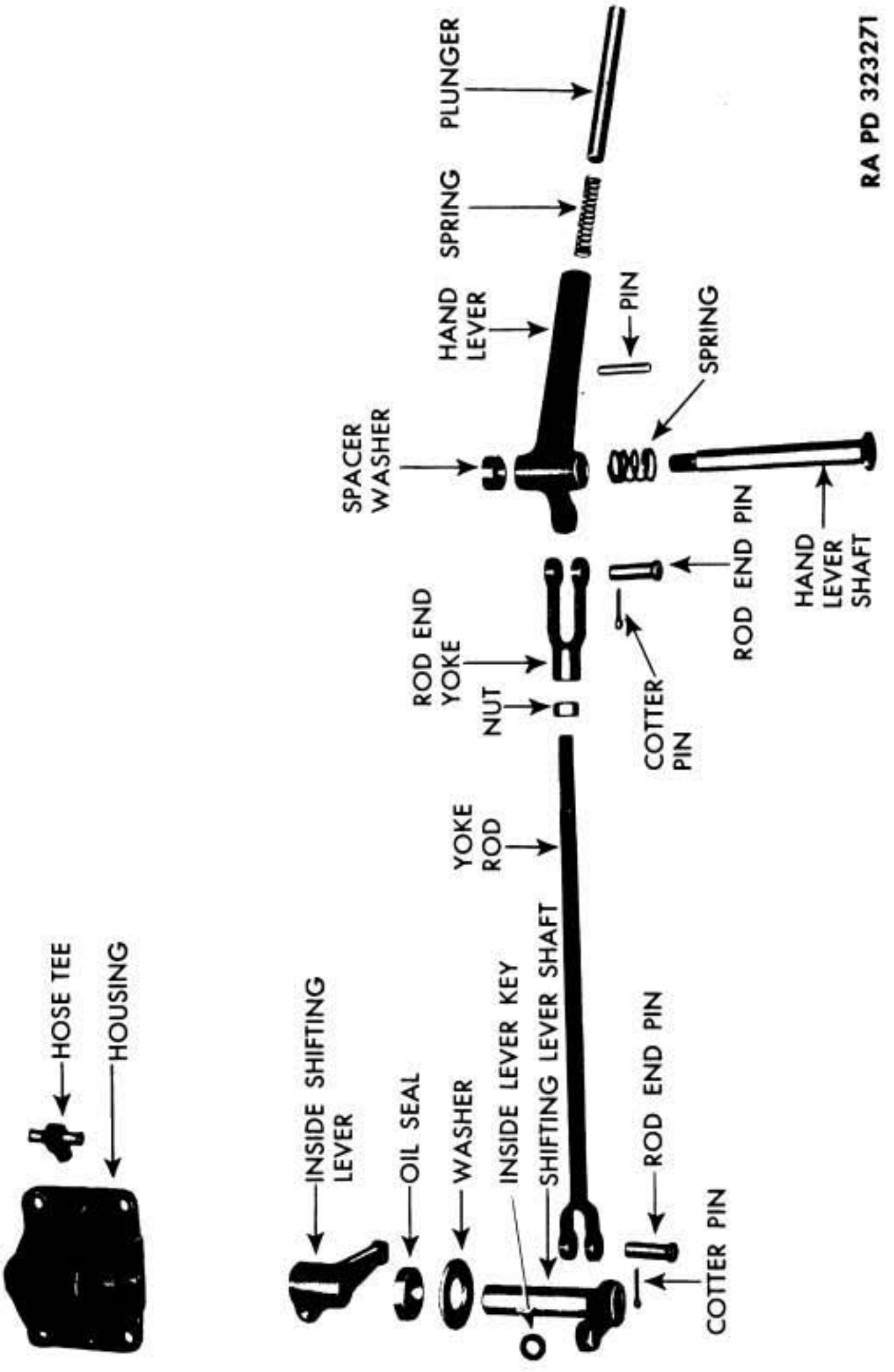



***Figure 278 — Winch Shifting Lever Disassembled***

and remove lining. Clamp new lining in band, using three or more clamps. Using $^{9}/_{64}$-inch drill, drill through six rivet holes in the band and through lining. Remove lining from band and counterbore six drilled holes in lining to depth of $^{3}/_{32}$ inch and diameter of $^{11}/_{32}$ inch. Rivet lining to band, starting at center and working out to ends of band.

**e. Winch Worm, Seals, and Bearings.** Inspect for scored, chipped, or cracked teeth. Replace worm if shaft is damaged or bent. Inspect bearings for rough, pitted, or discolored balls or races. Oil bearings and test for smoothness. If bearings are defective, replace. Inspect oil seal in case and oil seal in rear bearing cap for wear or damage. If defective, remove seals and replace. Press new oil seals into case or cap with lip side toward bearing.

**f. Worm Gear and Drum Shaft Assembly.** Inspect worm gear for scored, chipped, or cracked teeth, and for looseness on drum shaft. Replace worm gear if damaged. Replace worn or damaged keys. If drum shaft is bent or damaged, replace shaft.

**g. Winch Drum Assembly.** Inspect drum for cracks or breaks. Repair or replace if necessary. Inspect threads on cable clamp for good condition and if damaged, replace clamp assembly.

**h. End Bearing Frame Assembly.** Inspect end frame for cracks, breaks, or other damage and if defective, replace. If end bearing sleeve bushing is worn excessively, replace sleeve bushing. Inspect sleeve dowel pin and drag brake dowel pin. If excessively worn or damaged, replace with new dowel pin.

**i. Clutch Assembly.** Inspect sliding clutch for worn or broken jaws. If defective, replace clutch. Inspect winch shifting lever assembly for excessive wear or broken parts. Replace worn or broken parts.

**j. Winch Line Assembly.** Repair cable end if broken. If cable is frayed in any one place or strands broken, replace with new cable. Take care not to take hold of a frayed cable with bare hands.

**k. Winch Drag Brake Assembly.** Inspect lining on drag brake shoe; if worn to rivet heads, replace with new lining. Use punch to drive rivets out, then remove old lining. Clamp new lining to shoe and drill two $^{9}/_{64}$-inch rivet holes through lining. Remove lining from shoe and counterbore both holes in lining to $^{3}/_{32}$-inch depth and $^{11}/_{32}$-inch diameter. Rivet lining to shoe with two rivets. Inspect drag brake spring and if weak or broken, replace with new spring.

**l. Winch Snatch Block Components.** Inspect all parts for wear, cracks, or breaks. Replace defective parts. If sheave bushing is worn, use suitable removing tool to drive out bushing, and replace with new bushing. Inspect oil passages, making sure they are open.

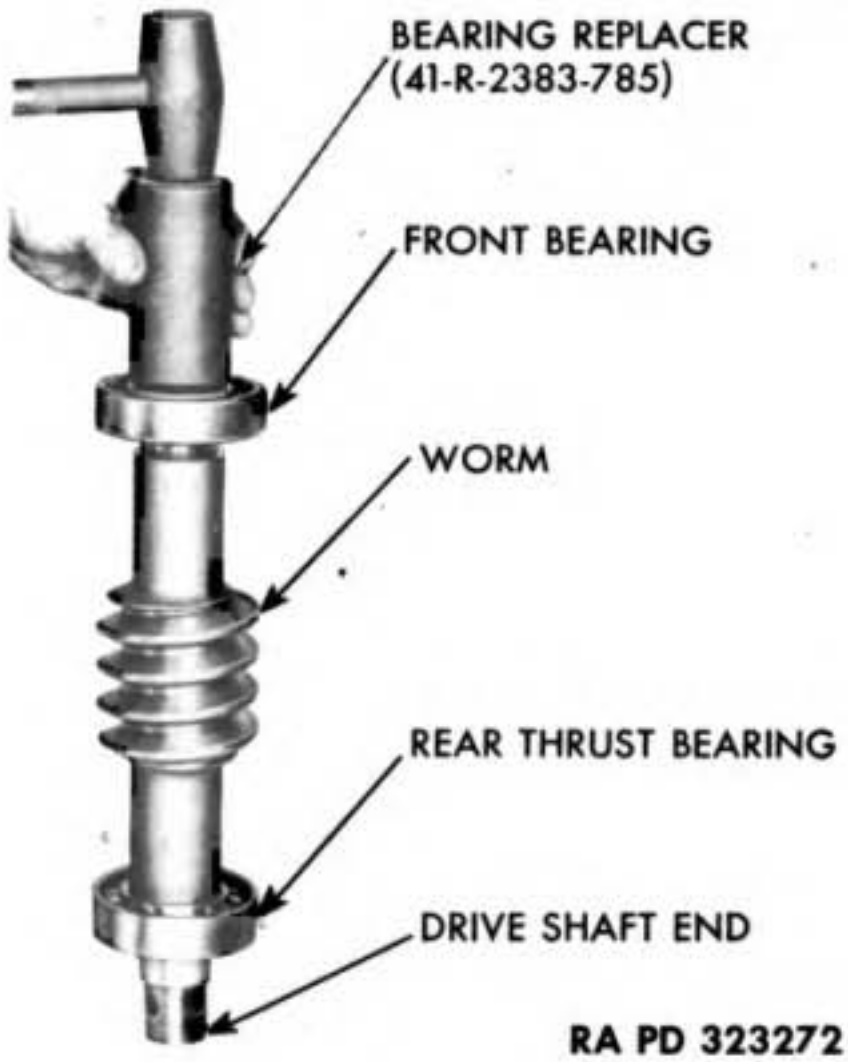



*Figure 279 — Installing Bearing on Worm Shaft*

**m. Winch Cable Roller Components.** Inspect parts for wear, cracks, or breaks; replace any defective part. Inspect lubrication passages in roller shaft to make sure they are open.

**n. Transmission Winch Shifting Control Components** (fig. 278). Inspect oil seal in lever housing for wear or damaged lip. If worn or damaged, pry seal out of housing and replace. Inspect housing lever shaft, and inside shifting lever for wear, cracks, or breaks, and replace defective parts. Inspect yoke rod for damaged or rusted threads, and replace parts if defective, or not adjustable. Inspect hand lever shaft for wear. If worn, replace shaft. Inspect hand lever for proper operation of plunger and pin. The pin in plunger holds hand lever in neutral when installed on driver's seat. If pin is worn or damaged, drive pin from plunger and replace. Replace plunger spring if weak or broken.

## 127. ASSEMBLY.

**a. Install Automatic Brake Case** (fig. 275). Place new gasket on front of upper worm gear case, and place brake case against gasket. Install four cap screws and lock washers.

## WINCH

**b. Assemble Worm Assembly** (fig. 279). With bearing replacer (41-R-2383-785) drive on or press rear thrust bearing onto rear end (drive end) of worm shaft against shoulder. NOTE: *Make sure thrust side of outer bearing race is toward drive shaft end. The thrust side of the outer bearing race is the thicker side.* Install front bearing in same manner, except that this bearing may face either way. Install brake disk key in worm.

**c. Install Worm Assembly.** Insert worm assembly (brake and first) into rear end of upper worm gear case (fig. 273). Use care in inserting brake end of worm shaft through oil seal in automatic brake case. Tap worm and bearings into place with a soft hammer until bearings are seated flush with gear case. Install new gasket and rear bearing cap to upper worm gear case, and attach with four cap screws and lock washers (fig. 271).

**d. Install Automatic Brake Assembly.** Drive automatic brake disk on worm shaft. Install retaining washer, lock washer, and cap screw to end of worm shaft. With lining installed on brake band, install two check nuts on anchor end far enough apart to go on either side of slot in case. Install spring, alining washer, and two adjusting nuts flush with end of screw on brake band. Install brake band in case, placing both ends in slots provided in case (fig. 270). Tighten two anchor end check nuts on case, and adjust brake band (refer to TM 9-786). Place brake case cover on case, and install four cap screws and lock washers.

**e. Install Worm Gear and Bushings on Shaft.** Insert two worm gear keys in drum shaft keyways. Press or drive worm gear in position on drum shaft. Place two worm gear case bushings on drum shaft with oil grooves away from gear.

**f. Install Worm Gear and Shaft Assembly.** With upper worm gear case upside down, place worm gear and drum shaft assembly in case (fig. 268). Mesh worm gear teeth with worm, set worm gear case bushings on dowel pins, and aline oil holes with upper worm gear case oil passages. Install two gaskets on upper worm gear case, and set lower worm gear case on top of gaskets, making sure dowel pins locate in lower worm gear case (fig. 267). Attach with two cap screws, two nuts, and four lock washers. Install air line coupling bracket on two studs at side of upper worm gear case, and attach with two nuts and lock washers (fig. 266).

**g. Install Drum** (fig. 265). Slide winch drum on shaft with clutch jaw side of drum away from worm gear case. Place thrust ring on shaft next to drum with slotted side of ring away from drum. Install two keys into keyway in shaft.

**h. Assemble End Bearing Frame Assembly** (fig. 264). Insert sleeve assembly, with sleeve bushing pressed into place, into end bearing frame. Aline slot in sleeve with dowel in frame. Screw lubrication fitting through hole in end bearing frame into sleeve. Install shifting lever to end bearing frame by installing one headless pin and cotter pin. Insert spring and drag brake into hole provided in end bearing frame, and aline slot in drag brake shoe with dowel pin in end bearing frame.

**i. Install End Bearing Frame Assembly and Sliding Clutch** (fig. 263). Install sliding clutch, thrust ring, and end bearing frame assembly on drum shaft with shifting lever yoke in position on sliding clutch. Install shims and retainer washer to end of shaft by installing one cap screw and lock washer.

**j. Install Hose Couplers, Shut-off Cock, One-way Valve, and Connector** (fig. 262). Screw service trailer brake hose coupler with nipple into front side of air line bracket next to worm gear case, and screw tube connector into rear side. Screw emergency trailer brake hose coupler with nipple into front side of end bearing frame, and screw shut-off cock with nipples and one-way valve into rear side.

**k. Lubricate Winch.** Fill worm gear case to proper level, and lubricate fittings (Refer TM 9-786).

**l. Assemble Winch Snatch Block** (fig. 276). Slide block bushing into sheave, and install sheave in block centering with shaft bore. Insert shaft through block and sheave, and attach with two nuts. Tighten the nuts until block bushing is tight in block. Stake nuts on shaft to prevent loosening of block bushing. Place lubricating fitting in shaft. Install swivel hook to block by attaching with a link, two link pins, and cotter pins. Lubricate snatch block.

**m. Assemble Winch Cable Roller** (fig. 277). Install two lubrication fittings in ends of roller shaft. Slide cable roller on shaft, and install two brackets on shaft, attaching with two cap screws and lock washers. Install cable roller assembly to frame side channels and attach brackets to channels with four cap screws and lock washers.

**n. Assemble Transmission Winch Shifting Controls** (fig. 278).

(1) ASSEMBLE AND INSTALL WINCH HAND LEVER ASSEMBLY. Place the parts in following order from right side of driver's seat, spring, winch hand lever, spacing, washer, and cranking motor control hand lever. Install lever shaft through the driver's seat, spring, winch hand lever, spacing washer, and cranking motor control hand lever. Install cotter pin in spacing washer and lever shaft. Attach lever shaft with nut and lock washer. Attach yoke rod to winch hand lever with pin and cotter pin. NOTE: *Check adjustment of yoke rod to make*

*sure winch drive shaft clutch is in neutral when winch hand lever plunger pin is engaged in neutral slot on driver's seat.*

(2) ASSEMBLE WINCH SHIFTING LEVER AND HOUSING. Place inside shifting lever in housing, and install lever shaft through the oil seal and inside shifting lever. Insert inside lever key in slot, and clamp lever to shaft with cap screw and lock washer. Install hose tee on front of housing and compression tee on rear of housing.

# CHAPTER 8

# FRAME AND BODY

## Section I

## DESCRIPTION



### 128. DESCRIPTION.

**a.** The frame consists of two longitudinal, heavy-section, steel side channels which are rigidly braced and supported on top of two transverse, square frame crossmembers. They are connected by angles which are welded to frame crossmembers, and bolted to side channels. At the ends of the crossmembers are vertical plates welded in place and strengthened by welded gussets. Each vertical plate has six studs used for attaching bogie frame with fender side sheet in between. The bumper connects to front ends of side channels, and pintle housing connects to rear ends. The engine, differential, and final drive housing mount directly onto side channels. The entire weight of vehicle body is carried on side channels and frame crossmembers, which in turn are supported by the bogie frame assembly.

**b.** The body is made up of a number of welded sheet-steel units, brackets, supports, and various sheet-steel parts. These are attached by cap screws, lock washers, and nuts. The welded units include the cowl, driver's seat, side seats, shell box, powder box, doors, bumper, pintle, and canopy top. Various sheet-steel parts include platforms, enclosure sheets, hood sheets, side sheets, etc.

## Section II

## BUMPER AND TOWING HOOKS



### 129. DESCRIPTION.

**a.** The front bumper consists of a 3½-inch extra strong pipe welded to two brackets. These brackets attach to front ends of two side channels by four cap screws and lock washers.

**b.** Two steel ram's-horn towing hooks are mounted to front outer sides of two side channels and bumper brackets. The hooks turn up at their ends to prevent towing cables or chains from falling off when in use.

**c.** Removal and installation of bumper and towing hooks are explained in TM 9-786.

## 130. REPAIR.

**a.** Weld brackets to bumper bar if they are broken loose. Straighten bent bumper, making sure both brackets are in line, and tapped holes in brackets line up with cap screw holes in ends of side channels.

**b.** Reform bent towing hooks. Weld worn or broken towing hooks.

---

### Section III

# PINTLE



## 131. DESCRIPTION.

**a.** The pintle hook is mounted in center of pintle housing, which is attached by dowel pins and cap screws to the rear ends of frame side channels. The hook is provided with a lock and latch, and also a spring which cushions the shock when starts or stops are made.

**b.** Removal and installation of pintle hook and pintle hook assembly are explained in TM 9-786.

## 132. DISASSEMBLY (fig. 280).

**a. Remove Pintle Hook, Spring and Housing Cap.** Clamp pintle hook in a vise with slotted nut end up to remove cotter pin. Line up cotter pin in slotted nut with grooves in front spring seat. Remove cotter pin, slotted nut, front spring seat, pintle hook spring, rear spring seat, and housing cap.

**b. Remove Latch.** Remove cap screw and lock washer from latch. Drive out latch pin and remove latch. Slide spring out of slot in latch.

**c. Remove Lock.** Remove cotter pin and nut from fulcrum bolt. Drive out fulcrum bolt and remove lock.

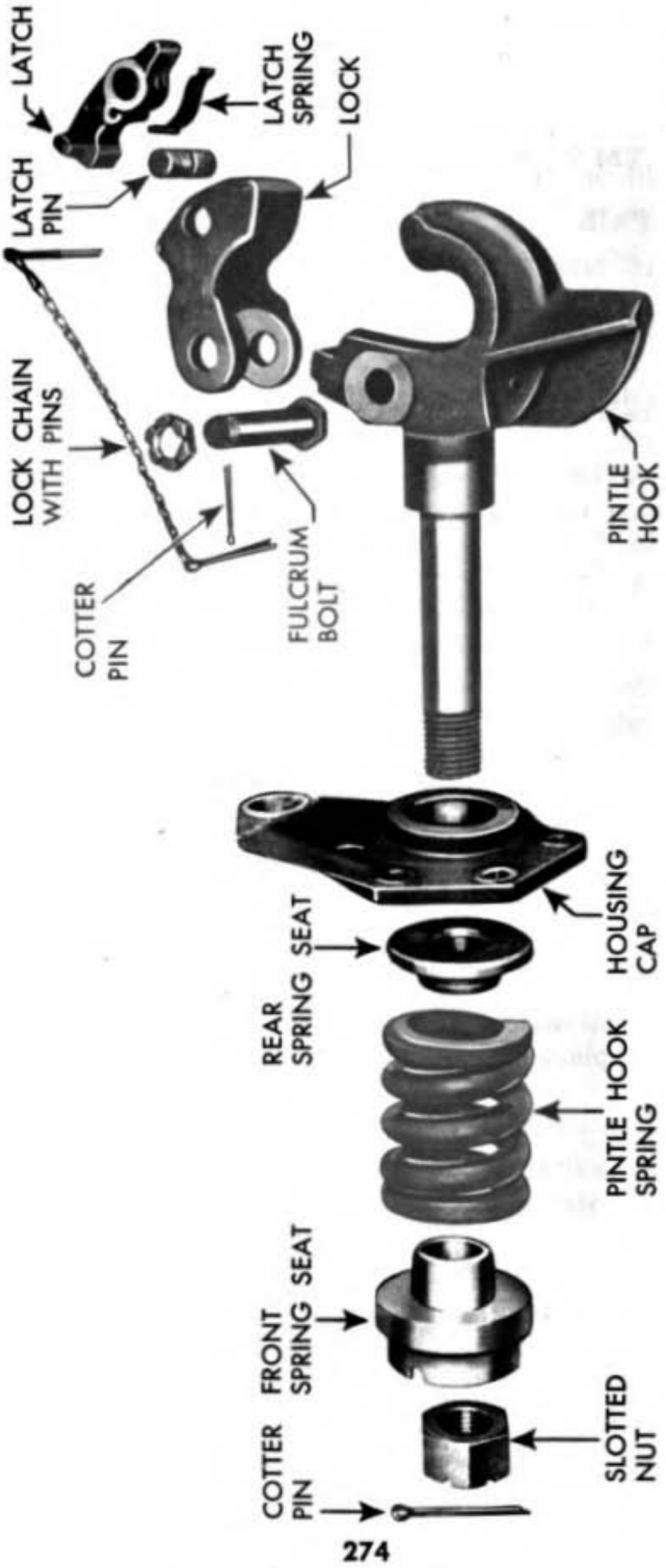



*Figure 280 — Pintle Hook Disassembled*

FRAME AND BODY

## 133. REPAIR OR REBUILD.

**a.** Replace pintle hook spring or latch spring if broken or deformed. Free length of pintle hook spring should be $5\frac{9}{16}$ to $5\frac{11}{16}$ inches.

**b.** Inspect housing cap for cracks. Replace if cracked.

**c.** Build up worn pintle hook with welding material. Weld a broken hook, or if this is not practical, replace with serviceable hook.

**d.** Replace complete lock chain with pins, if chain or pins are broken.

## 134. ASSEMBLY (fig. 280).

**a. Install Lock.** Place lock on pintle hook, and insert fulcrum bolt. Install nut and cotter pin on fulcrum bolt.

**b. Install Latch.** Install latch spring in slot in latch. Place latch in lock, and install latch pin. Install cap screw with lock washer, locking latch pin in place.

**c. Install Housing Cap and Pintle Hook Spring.** Clamp pintle hook in a vise with shaft end up. Place housing cap, rear spring seat, spring, and front spring seat on pintle hook shaft. Install slotted nut on shaft. Turn the slotted nut down until a measurement of $6\frac{3}{4}$ inches is obtained between front finished face of housing cap to front face of flange on front spring seat. NOTE: *This measurement should be the same as the depth of bored hole in pintle housing into which spring end of the pintle hook is installed.* Line up slots in nut and front spring seat with cotter pin hole in shaft, and install cotter pin.

---

Section IV

# CANOPY TOP FRAME



## 135. DESCRIPTION.

**a.** The canopy top frame is constructed of pipes which are either welded or slip-fitted into brackets to form a supporting frame for canvas canopy and curtains. The frame is supported by six vertical pipes which set in sockets provided in back rests of two side seats. The frame also connects to top of windshield by two eye bolts with wing nuts. The pipes and brackets that make up top frame are color-coded at each joint to facilitate assembly.

b. Removal and installation of canopy frame is explained in TM 9-786.

### 136. REPAIR.

a. Weld pipes and brackets together if welded connections are cracked or broken loose. Make sure brackets are positioned correctly on pipes before welding. Straighten bent pipes. Replace expansion plugs into bottoms of slip-fit holes in brackets, if plugs are missing. If brackets are damaged and pipes do not fit, drill out slip-fit holes in brackets with $^{51}/_{64}$-inch drill, and ream 0.824 to 0.829 inch. File or grind nicks on formed ends of pipes to slip-fit into brackets.

---

## Section V

## CANVAS TOP, CURTAINS, AND COVERS



### 137. DESCRIPTION.

a. Canvas top and curtains surround canopy top frame. They are secured by straps with either friction buckles or turn-button fasteners. Curtains have 12 sheet windows of flame-resisting material. The two front door curtains have steel frames sewed within the canvas to support them in an upright position when they swing open with doors. Canvas covers are provided for the windshield, fan guard, and shell box tray.

### 138. REPAIR.

a. Sew open seams in canvas and sew on loose straps. Patch and sew holes in canvas. Replace broken windows with new ones.

---

## Section VI

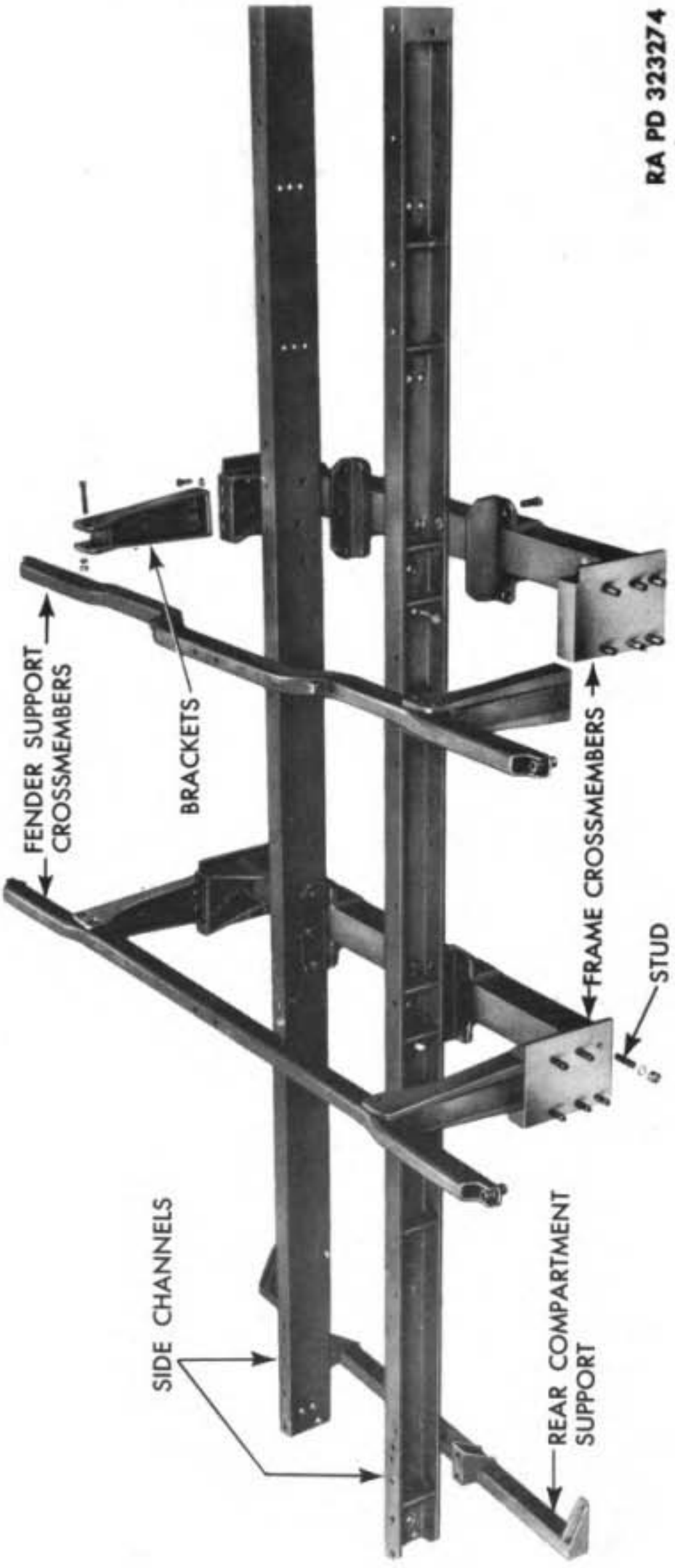
## VEHICLE FRAME



### 139. DESCRIPTION (fig. 281).

a. Vehicle frame consists of two longitudinal, heavy-section, steel side channels and two transverse, square frame crossmembers. Side channels set on top of crossmembers and are bolted to angles which

## FRAME AND BODY




RA PD 323274

*Figure 281 — Main Frame and Crossmembers*

are welded to crossmembers. Side channels are rigidly braced by a number of vertical gussets which are welded within troughs of channels. Frame crossmembers are square-shaped, hollow-steel frames, and have vertical plates welded to their ends.

### 140. REPAIR OR REBUILD.

a. Replace studs in crossmembers if they are damaged. Unscrew damaged studs from vertical end plate, and install serviceable studs with flat ends in. Weld all cracked or broken welds. Straighten bent or sprung frame parts.

---

Section VII

## BOXES, DOORS, SEATS, COWL, FENDERS, GUARDS, HOOD, PLATFORMS, SIDE SHEETS, AND WINDSHIELD



### 141. DESCRIPTION.

a. These units are of welded-steel construction, and are attached to vehicle by cap screws for easy removal and installation.

b. Complete description of units, also removal and installation procedures, are covered in TM 9-786.

### 142. DISASSEMBLY.

a. **Windshield** (fig. 282).

(1) REMOVE LOWER ARM. Remove nut and washer from stud attaching lower arm to upper arm, and remove lower arm.

(2) REMOVE UPPER ARMS. Remove two cap screws, nuts, and lock washers attaching rear view mirror to top of windshield, and remove mirror. Remove two cap screws attaching top bar to upper arms, and remove top bar. Remove five screws attaching each upper arm to windshield frame, and remove both upper arms.

(3) REMOVE FRAME. Remove four flat-head machine screws attaching top frame piece to frame corners. Carefully remove top frame piece from glass by tapping along inner edge with a hammer and a flat piece of wood. Repeat procedure for loosening remainder of windshield frame from glass, and pull glass out of frame.

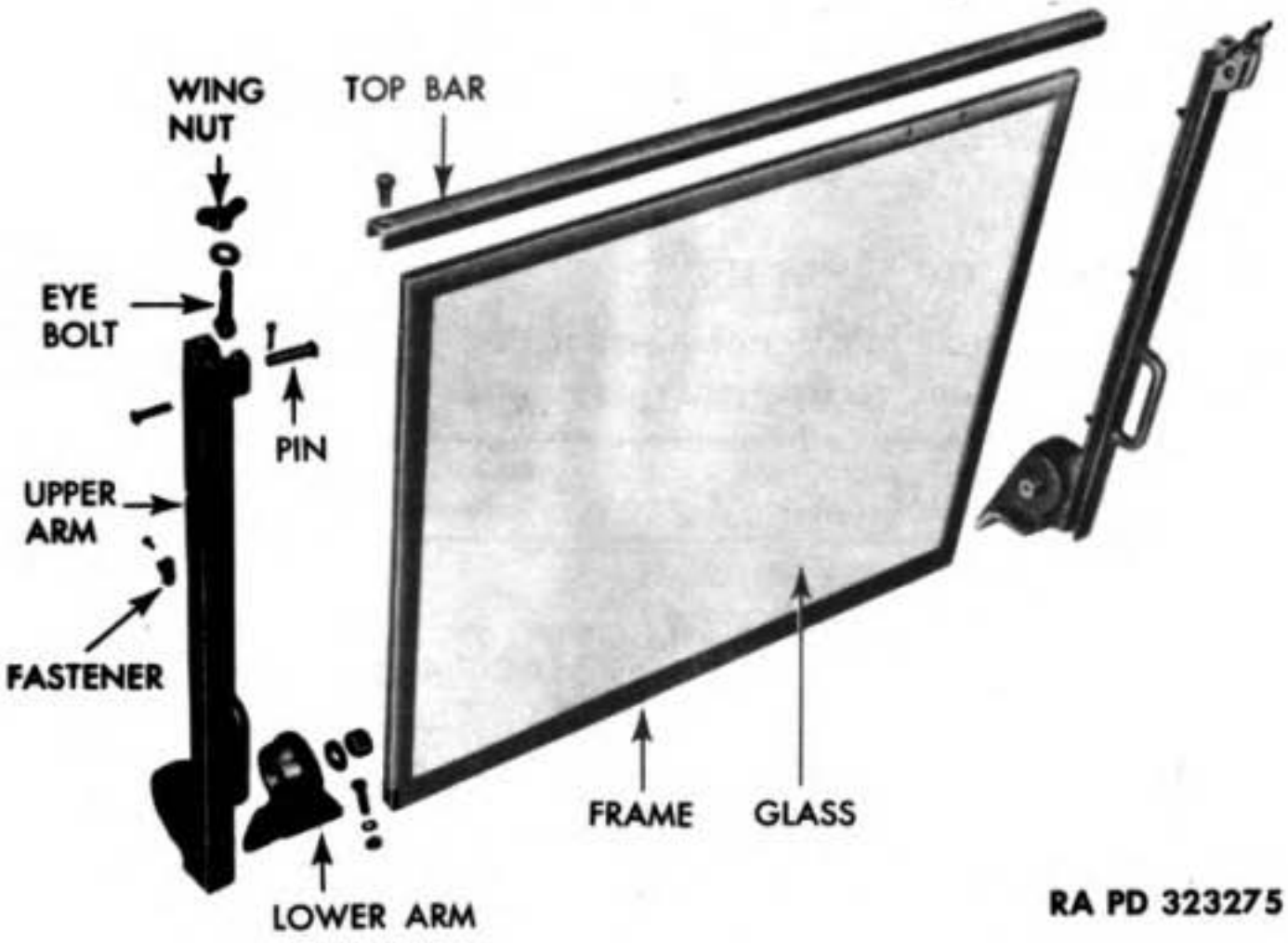



*Figure 282 — Windshield Disassembled*

## 143. REPAIR.

**a.** Straighten bent or damaged sheet metal parts and weld wherever welded connections are cracked or broken.

## 144. ASSEMBLY.

**a. Windshield** (fig. 282).

(1) INSTALL FRAME. Install bottom and sides of windshield frame onto safety glass. Safety glass dimensions are: $25\frac{27}{32}$ inches wide by $29\frac{7}{16}$ inches high by $\frac{1}{4}$ inch thick. Corners have $\frac{3}{16}$-inch radius. Make sure glass seats into seal in frame, and that seal does not roll over. Place two frame corners into position at top of glass and frame. Install top frame piece on glass, and install six flat-head machine screws attaching top frame piece and frame side pieces to both frame corners.

(2) INSTALL UPPER ARMS. Place an upper arm on each side of windshield frame, and secure with 10 screws. Place top bar on top of windshield frame, and install two cap screws attaching bar to upper arms. Attach rear view mirror to windshield by installing two cap screws, nuts, and lock washers.

(3) INSTALL LOWER ARMS. Place lower arms over studs in upper arms, and install two attaching nuts and washers.

## CHAPTER 9

# SPECIAL TOOLS



## 145. SPECIAL TOOLS.

SPECIAL TOOLS

| Special Tool Description | Manufacturer Number | Federal Stock Number |
|---|---|---|
| ADAPTER, puller, final drive shaft pinion (use with 41-P-2957-27 puller) | MAS-7-416 | 41-A-18-150 |
| BRACKET, transmission lifting | MAS-7-301 | 41-B-1926-750 |
| BRACKET, transmission lifting (used with 41-B-1926-750) | MAS-7-303 | 41-B-1926-755 |

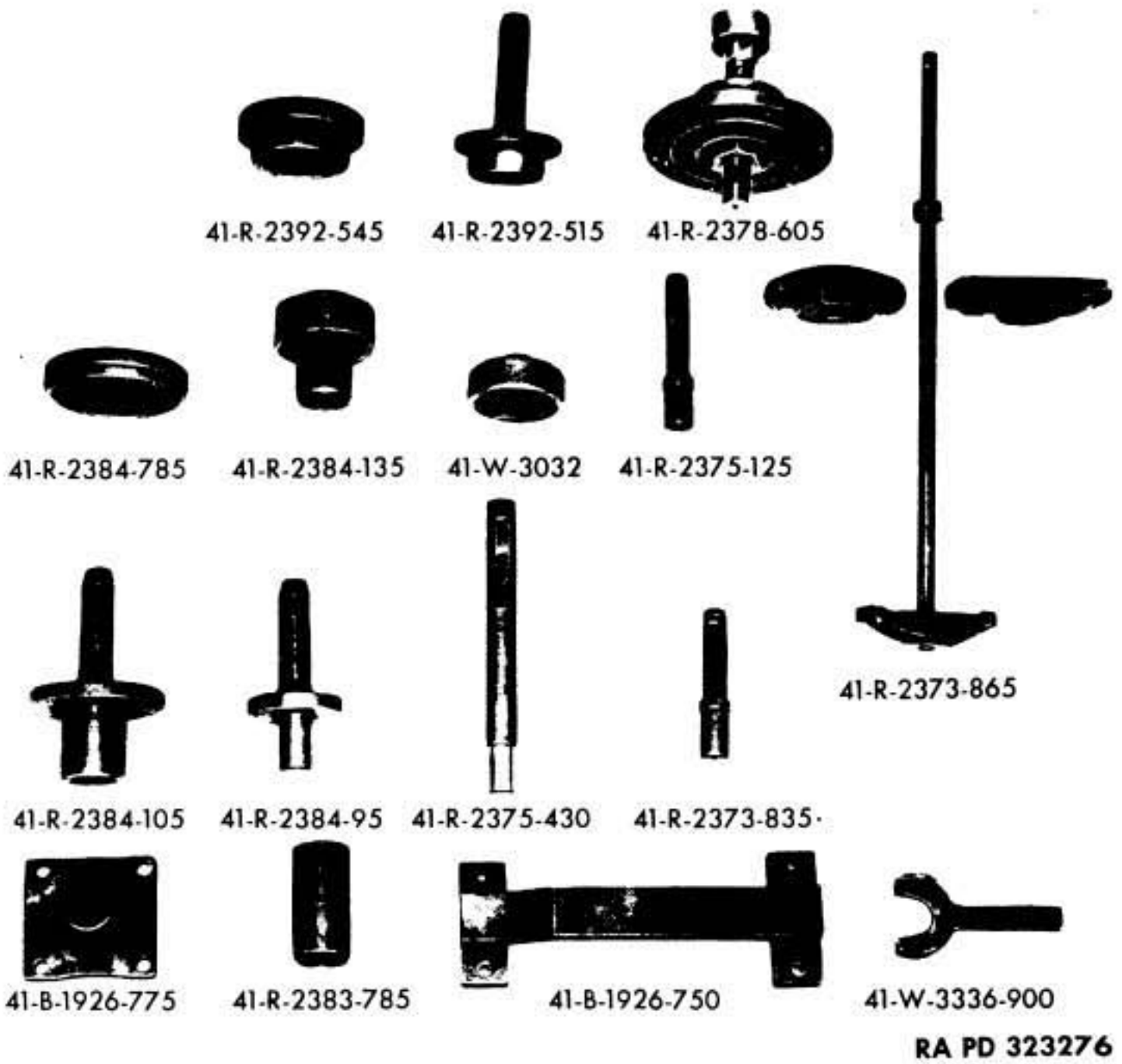



***Figure 283 — Special Tools***

## SPECIAL TOOLS

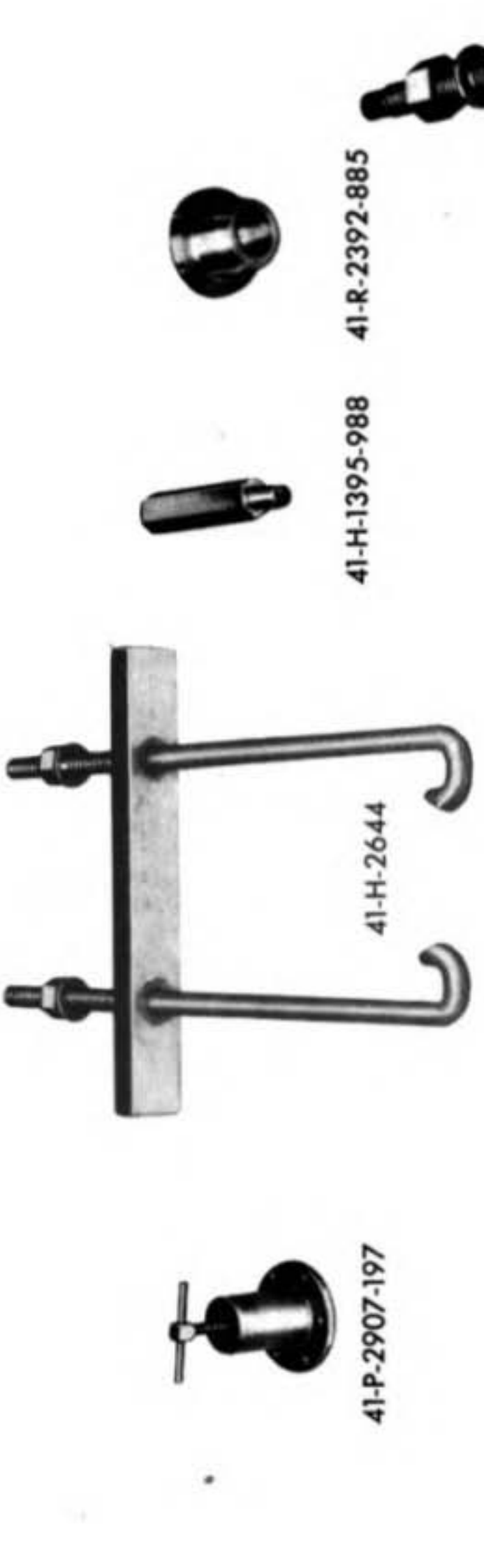



*Figure 284 — Special Tools*

**ORDNANCE MAINTENANCE — POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)**

| Special Tool Description | Manufacturer Number | Federal Stock Number |
|---|---|---|
| COMPRESSOR, stud, suspension volute spring | | 41-C-2555-850 |
| CONE, assembling, bogie wheel grease retainer | MAS-7-506 | 41-C-2562-100 |
| CONE, assembling, trailing idler grease retainer | MAS-7-503 | 41-C-2562-460 |
| HANDLE, ¾-in., for removers and replacers | | 41-H-1395-988 |
| HOOKS, lifting, bogie wheel | MAS-7-513 | 41-H-2644 |
| PULLER, end plate | LO-23015 | 41-P-2907-197 |
| PULLER, slide hammer type | | 41-P-2957-27 |
| REMOVER, and replacer, final drive shaft | MAS-7-403 | 41-R-2378-605 |
| REMOVER and replacer, final drive shaft inner bearings, replacer outer bearing | MAS-7-404 | 41-R-2373-865 |
| REMOVER and replacer, differential and final drive housing cover steering lever bushing | MAS-7-411 | 41-R-2375-430 |
| REMOVER and replacer, brake shaft bearing support bushing | MAS-7-412 | 41-R-2375-125 |
| REMOVER and replacer, bearing, differential case cover RH and LH internal pinion | MAS-7-415 | 41-R-2373-835 |
| REPLACER, bearing cone, differential case | MAS-7-410 | 41-R-2384-135 |
| REPLACER, final drive pinion shaft oil seal | MAS-7-407 | 41-R-2392-515 |
| REPLACER, bogie wheel bearing and spacer with oil seal | MAS-7-504 | 41-R-2384-95 |
| REPLACER, bearing and universal joint flange clutch low range gear | MAS-7-204 | 41-R-2383-785 |
| REPLACER, oil seal input shaft | MAS-7-304 | 41-R-2392-885 |

## SPECIAL TOOLS

| Special Tool Description | Manufacturer Number | Federal Stock Number |
|---|---|---|
| REPLACER, bearing cup differential case | MAS-7-408 | 41-R-2384-785 |
| REPLACER, trailing idler bearings and spacers with oil seal | MAS-7-501 | 41-R-2384-105 |
| REPLACER final drive shaft oil seal | MAS-7-405 | 41-R-2392-545 |
| WRENCH, socket 3/4 in. sq-drive 3 1/64-in. hex opening | MAS-7-401 | 41-W-3032 |
| WRENCH, special, winch drive shaft nut, 2 3/4-in. opening | MAS-7-302 | 41-W-3336-900 |
| WRENCH, spanner, countershaft rear bearing and winch drive shaft lock nut | MAS-7-305 | 41-W-3247-170 |
| WRENCH, oil seal ring shaft retainer | LO-24187-A | 41-W-3336-690 |
| WRENCH, piston guide | LO-25824-A | 41-W-3336-740 |

## REFERENCES

### PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes to, or revisions of the publications given in this list of references and for new publications relating to materiel covered in this manual:

| | |
|---|---|
| Introduction to Ordnance Catalog (explaining SNL system) | ASF Cat. ORD 1 IOC |
| Ordnance Publications for Supply Index (index to SNL's) | ASF Cat. ORD 2 OPSI |
| Index to Ordnance Publications (listing FM's, TM's, TC's, and TB's of interest to ordnance personnel, MWO's, OPSR, BSD, S of SR's, OSSC's, and OFSB's, and includes Alphabetical list of Major Items with Publications Pertaining Thereto) | OFSB 1-1 |
| List of Publications for Training (listing MR's, MTP's, T/BA's, T/A's, FM's, TM's, and TR's, concerning training) | FM 21-6 |
| List of Training Films, Film Strips, and Film Bulletins (listing TF's, FS's, and FB's by serial number and subject) | FM 21-7 |
| Military Training Aids (listing Graphic Training Aids, Models, Devices, and Displays) | FM 21-8 |

### STANDARD NOMENCLATURE LISTS.

| | |
|---|---|
| Tractor, high speed, 13-ton, M5 (International Harvester) | SNL G-162 |
| Cleaning, preserving and lubrication materials, recoil fluids, special oils, and miscellaneous related items | SNL K-1 |
| Soldering, brazing, and welding materials, gases and related items | SNL K-2 |
| Tools, maintenance for repair of automotive vehicles | SNL G-27 Vol. 1 |
| Tool sets—motor transport | SNL N-19 |
| Tool sets, for ordnance service command, automotive shops | SNL N-30 |

## REFERENCES

## EXPLANATORY PUBLICATIONS.

### Fundamental Principles.

| | |
|---|---|
| Automotive electricity | TM 10-580 |
| Automotive lubrication | TM 10-540 |
| Basic Maintenance Manual | TM 38-250 |
| Electrical fundamentals | TM 1-455 |
| Military motor vehicles | AR 850-15 |
| Motor vehicle inspections and preventive maintenance service | TM 9-2810 |
| Precautions in handling gasoline | AR 850-20 |
| Standard Military Motor Vehicles | TM 9-2800 |

### Operation of Materiel.

| | |
|---|---|
| 13-ton, high speed tractor M5 (International Harvester) | TM 9-786 |

### Maintenance and Repair.

| | |
|---|---|
| Cleaning, preserving, lubricating and welding materials and similar items issued by the Ordnance Department | TM 9-850 |
| Cold weather lubrication and service of combat vehicles and automotive materiel | OFSB 6-11 |
| Maintenance and care of pneumatic tires and rubber treads | TM 31-200 |
| Ordnance maintenance: Engine and engine accessories for 13-ton, high speed tractor M5 (International Harvester) | TM 9-1786A |
| Ordnance maintenance: Electrical equipment (Delco-Remy) | TM 9-1825A |
| Ordnance maintenance: Carburetors (Zenith) | TM 9-1826C |
| Ordnance maintenance: Fuel pumps | TM 9-1828A |
| Ordnance maintenance: Speedometers and tachometers | TM 9-1829A |
| Tune-up and adjustment | TM 10-530 |

## ORDNANCE MAINTENANCE—POWER TRAIN, TRACK, SUSPENSION, AND EQUIPMENT FOR 13-TON, HIGH SPEED TRACTOR M5 (INTERNATIONAL HARVESTER)

**Protection of Materiel.**

| | |
|---|---|
| Camouflage | FM 5-20 |
| Chemical decontamination, materials and equipment | TM 3-220 |
| Decontamination of armored force vehicles | FM 17-59 |
| Defense against chemical attack | FM 21-40 |
| Explosives and demolitions | FM 5-25 |

**Storage and Shipment.**

| | |
|---|---|
| Ordnance storage and shipment chart, group G—Major items | OSSC-G |
| Registration of motor vehicles | AR 850-10 |
| Rules governing the loading of mechanized and motorized army equipment, also major caliber guns, for the United States Army and Navy, on open top equipment published by Operations and Maintenance Department of Association of American Railroads. | |
| Storage of motor vehicle equipment | AR 850-18 |

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