

UNCLASSIFIED

RESTRICTED

Advance copy for use of Ordnance Office only. Regular distribution by G.O. to follow.

DECLASSIFIED

Auth: EMD 785097

By DATE - NARS 11-5-78

TM 9-1750

WAR DEPARTMENT

TECHNICAL MANUAL



ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE
DIFFERENTIAL CASE, FOR MEDIUM TANKS,
M3, M4, AND MODIFICATIONS

MARCH 1, 1942

TECHNICAL

LIBRARY,
PUBLICATIONS DEPT.,
RARITAN ARSENAL,
LIBRARY,
PUBLICATIONS DEPT.,
RARITAN ARSENAL.

REGRADED UNCLASSIFIED BY
AUTHORITY OF DOD DIR. 5200.1-R
BY Rakely ON 06/06/06

UNCLASSIFIED

ORDNANCE MAINTENANCE

**POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE,
FOR MEDIUM TANKS, M3, M4, AND MODIFICATIONS**

Prepared under the direction of the
Chief of Ordnance

CONTENTS

	Paragraphs	Pages
Section I. Introduction	1-3	1-3
II. Description	4-5	4-8
III. Removal of power train unit from hull.....	6-7	9-15
IV. Disassembly of component assemblies.....	8-12	16-60
V. Maintenance	13-15	61-67
VI. Assembly of component assemblies.....	16-20	68-97
VII. Assembly of power train and related parts to hull.....	21	98-104
VIII. List of major overhaul tools.....	22	105-106
IX. References	23-24	107
List of illustrations.....		108-110
Index to text.....		111-116

SECRET

PUBLIC INFORMATION

TRAINING MANUAL

1

**ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS**

SECTION I

INTRODUCTION

	Paragraph
Purpose	1
Scope	2
References	3

1. PURPOSE. — The purpose of this manual is to furnish instructions to all personnel charged with the maintenance and overhaul of the power train unit of the Medium Tank, M3, M4, and modifications which include the three-piece differential case. The power train unit consists of the transmission, differential, steering brake assemblies, final drive and sprocket and hub assemblies.

2. SCOPE. — This manual contains information on the detailed construction of the unit, disassembly and assembly procedure, inspection, maintenance and repair, supplementary to those covered in TM 9-750. As changes are made or additional information is obtained on the power train unit, changes to the manual will be issued to the field.

3. REFERENCES. — Section IX lists all Technical Manuals, Standard Nomenclature Lists, and other publications relative to the materiel described herein.

INTRODUCTION

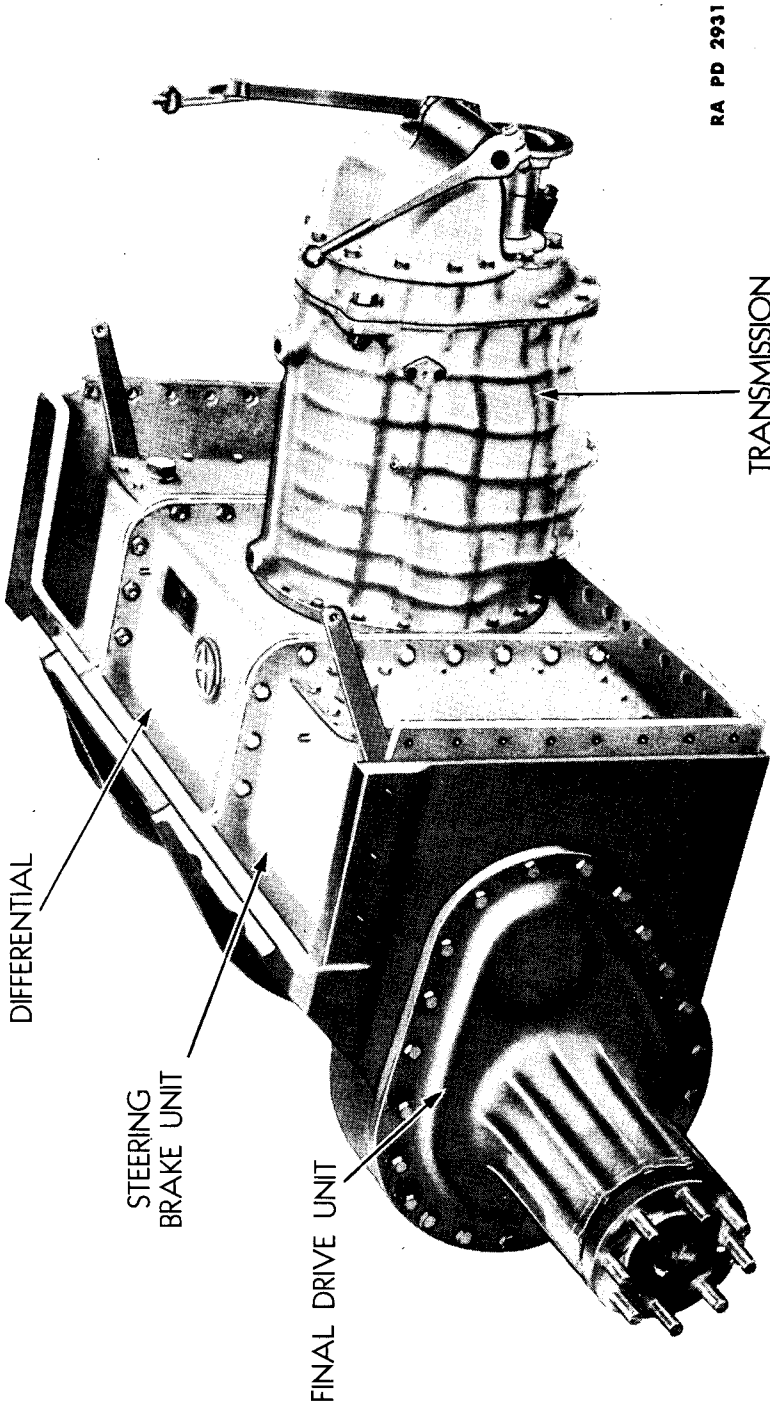


FIGURE 1 - POWER TRAIN UNIT

SECTION II

DESCRIPTION

Paragraph

Construction	4
Operation	5

4. CONSTRUCTION. — *a.* The power train unit consists of two sprocket and hub assemblies, two final drive assemblies, two steering brake assemblies, a differential assembly and a transmission and parking brake assembly.

b. The steering brake assemblies are bolted to the two sides of the differential assembly housing and the final drive assemblies are secured to the outer sides of the steering brake assemblies. The sprocket and hub assemblies are secured to the flanges on the shafts projecting from the outer sides of the final drive assemblies.

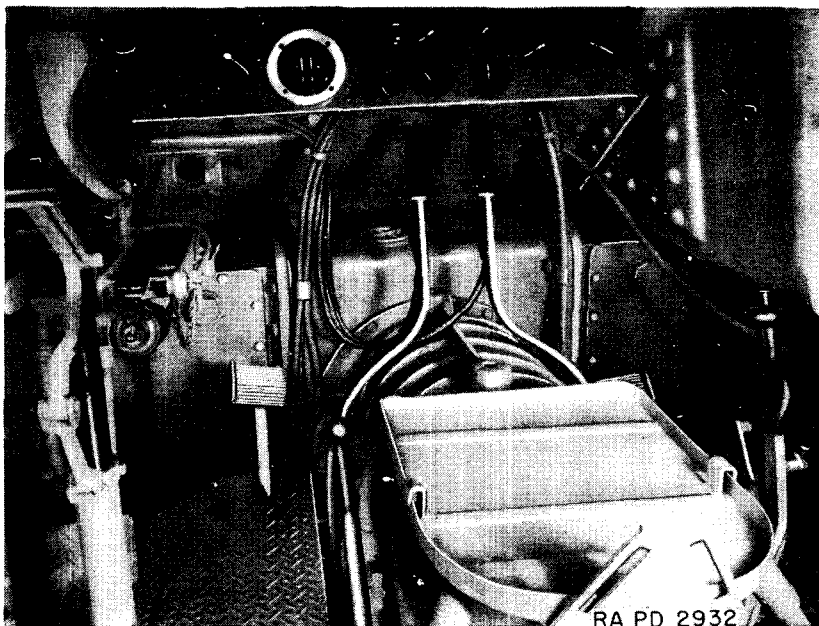


FIGURE 2 — INTERIOR OF DRIVER'S COMPARTMENT

c. The transmission and parking brake assembly are secured to the rear end of the differential assembly.

d. The steering brake bands may be adjusted or replaced, and the final drives may be removed from the steering brake assemblies without removing the power train unit from the tank. However, most other repair operations require removal of the power train unit.

DESCRIPTION

e. There are three breathers on the unit; one in each steering brake housing and one in the transmission housing serving the transmission and differential (fig. 3).

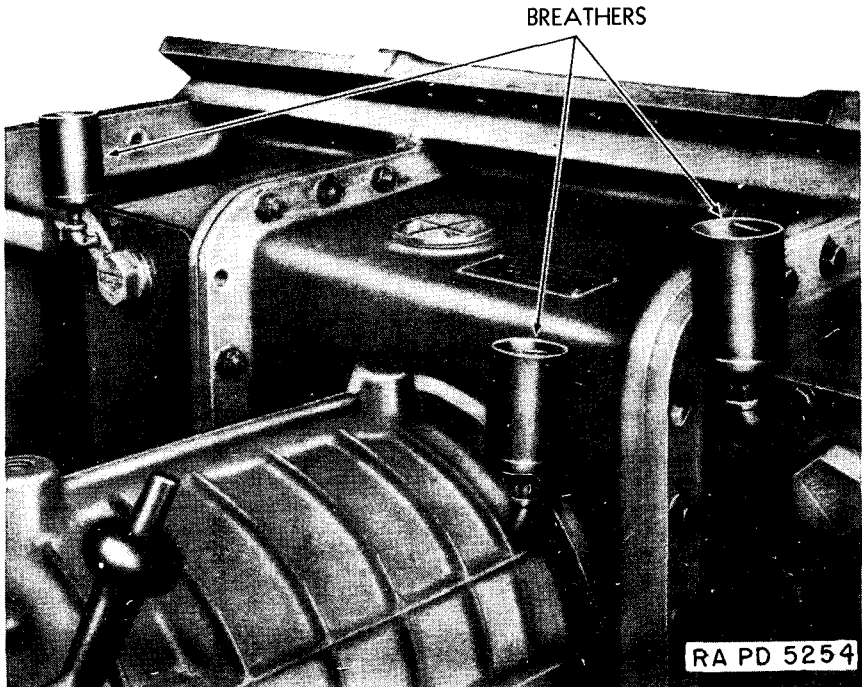


FIGURE 3 — BREATHERS USED ON POWER TRAIN

5. **OPERATION.** — *a.* In operation power is transmitted from a flange on the end of the input shaft on the rear end of the transmission through various gears (five speeds forward and one reverse) to the output shaft. From a spiral bevel pinion on the front end of the output shaft the power goes to a spiral bevel gear in the differential, through the differential and compensating drive shafts, to the herringbone pinions and gears in the final drive. From the herringbone gears of the final drive assemblies, the power is transmitted through the final drive shafts to the sprocket and hub assemblies (fig. 47).

b. The transmission provides five speeds forward and one reverse, all speeds except first and reverse being of the synchromesh type. Shifting of gears is accomplished by a lever at the right rear of the transmission. This lever operates selectively any one of three shifting rods, each with a shifting yoke attached. Two forks operate on the output shaft (one on the second and third speed synchronizer and the other on the first and reverse speed clutch gear) and a third fork which operates on the input shaft (on the fourth and fifth speed synchronizer). Power enters the transmission at the rear end of the lower or input shaft assembly and leaves at the bevel pinion on the forward

**ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS**

end of the upper or output shaft assembly. There are also countershaft and reverse idler assemblies. An interlock mechanism is incorporated which prevents more than one speed being engaged at a time. In the synchromesh type of construction, the helical drive gears are in constant mesh and a cone on the shifting sleeve or synchromesh engages a hollow cone on the drive gear and thus equalizes the speed of the two sets of clutch teeth before the actual engagement of the shifting sleeve. This assures easy, quiet shifting. An oil pump and circulation system are incorporated to provide for lubrication.

c. The cone for the parking brake is located on the rear end of the output shaft, and the hollow cone or brake shoe is held in the parking brake housing attached to the rear of the transmission housing. The shoe is moved into and out of engagement by a lever at the left rear of the transmission. The operating mechanism includes a lock.

d. Power enters the differential on the bevel gear. The differential is of the "compensating" type. It serves to allow one track to move slower or faster than the other to compensate for irregular ground or corners and also provides for steering. With this construction the bevel gear operates one set of gears and a compensating shaft on each side for steering and braking purposes, and another set of gears and a compensating drive shaft on each side for driving purposes. Each compensating shaft carries a steering brake drum. When a steering brake lever is operated, it tightens the brake band and slows or stops the brake drum on its particular side. This slowing or stopping of the brake drum and its compensating shaft causes a slowing of the track on the side on which the steering brake lever is operated, and causes the tank to turn toward that side, sharpness of the turn depending upon the amount the steering lever is operated. If both steering levers are operated equally the tank will slow or stop without turning to either side. This type of construction also relieves the driving gears and shafts of the extra stresses imposed by the steering mechanism. Power leaves the differential through the two compensating drive shafts.

e. Power enters the final drive assemblies at the herringbone pinions on the ends of the compensating drive shafts, and is transmitted through the herringbone gears and final drive shafts to the sprocket and hub assemblies.

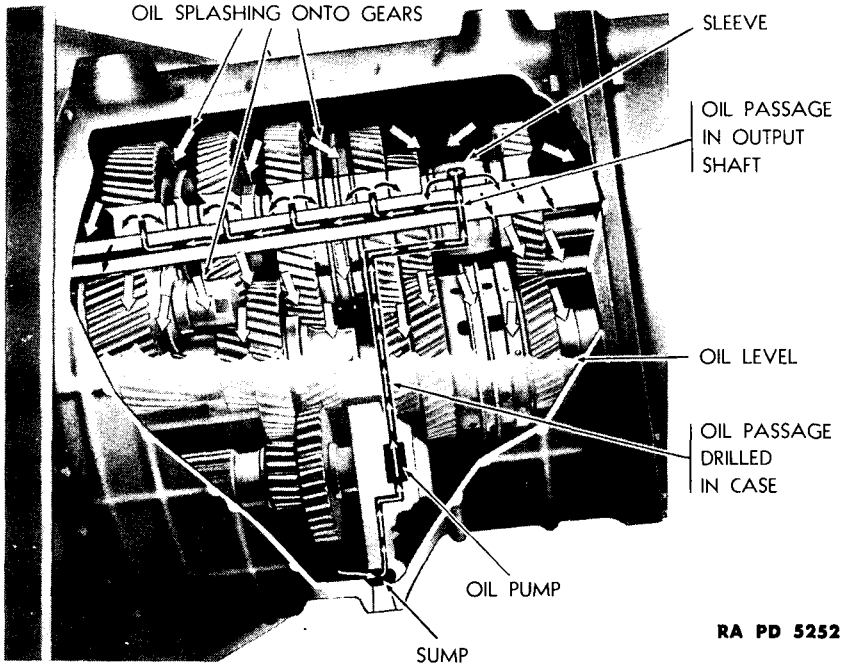
f. One gear reduction is secured between the bevel pinion and gear and a second between the herringbone pinion and gear.

g. On the early power train units, no cooler was provided for the oil in the transmission. Oil is drawn from the sump at the bottom of the transmission case to the oil pump and forced through the drilled oil passage in the case to the sleeve, and to the oil collar on the output shaft. From the collar the oil passes through holes to the hollow center of the output shaft and is forced out through holes in this shaft to lubricate each gear bearing. From there it drips down onto the gears and is splashed by them to other parts in the transmission. In addition (fig. 4) the parts in the lower section of the crankcase are completely submerged in oil at all times and, as the gears in this section revolve,

DESCRIPTION

the oil is forcefully splashed to all parts of the transmission. Bearings on the input shaft, countershaft and idler shaft are lubricated by splash. Another splash system is used in the final drive unit and the differential.

h. On later power train units, an oil cooling system has been installed. In these installations oil flows from the differential through a tube to the sump in the bottom of the transmission case. From there it is drawn into the pump which forces it out through a drilled hole in the case into hose lines and tubes that carry it to the oil cooler. This cooler is located on the bulkhead in such a position that air is drawn through it by the engine fan while the engine is operating. After entering at the bottom of this cooler, the oil circulates upward during the cooling process until it reaches the return pipe near the top of the cooler. From there it is forced back through hose and tubing to re-enter the transmission case through the sleeve. It is then forced through the collar, into the output shaft, and out through holes to each gear bearing, after which it drips down onto the gears. The parts in the lower section of the

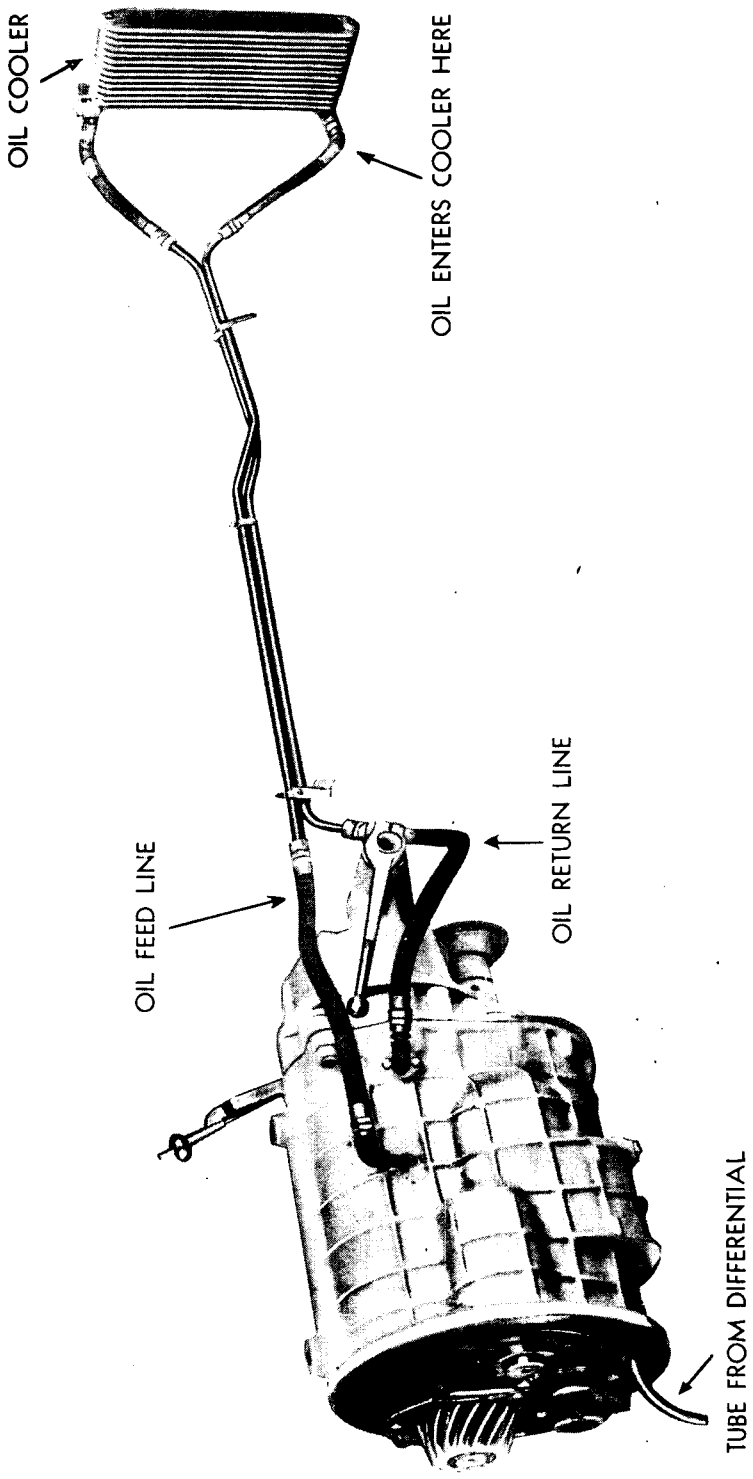


RA PD 5252

FIGURE 4 — OIL SYSTEM OF THE TRANSMISSION WITHOUT OIL COOLER

transmission case are submerged in oil and, as the gears revolve, the oil is splashed to all parts of the transmission. The oil then passes through openings in the front wall of the transmission case to the differential where it starts its cycle over again.

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS



RA PD 5249

FIGURE 5 -- OIL SYSTEM IN TRANSMISSION EQUIPPED WITH OIL COOLER

REMOVAL OF THE POWER TRAIN UNIT FROM HULL

SECTION III

REMOVAL OF THE POWER TRAIN UNIT FROM HULL

Paragraph

General 6
 Steps in removing power train unit from hull..... 7

6. GENERAL. — *a.* Removal of the power train from the tank is a major service operation that will require several hours. Two men are necessary for much of the operation. On many of the bolts to be removed, the nut must be held within the tank while the bolt is being turned from the outside. No special tools are required to remove the assembly, but because of its size and weight (8,000 pounds) some sort of hoist or lifting mechanism is necessary. A specially designed carrier has been found extremely helpful. This carrier is described and illustrated (see NOTE in par. 7 *b* (6)).

b. First step in removing the power train assembly is to remove the tracks from the drive sprockets. The fenders are then taken off and instruments and levers are separated from the unit inside the tank. The bolts holding the power train to the tank are removed. The complete step-by-step procedure follows:

7. STEPS IN REMOVING POWER TRAIN UNIT FROM HULL — *a.*

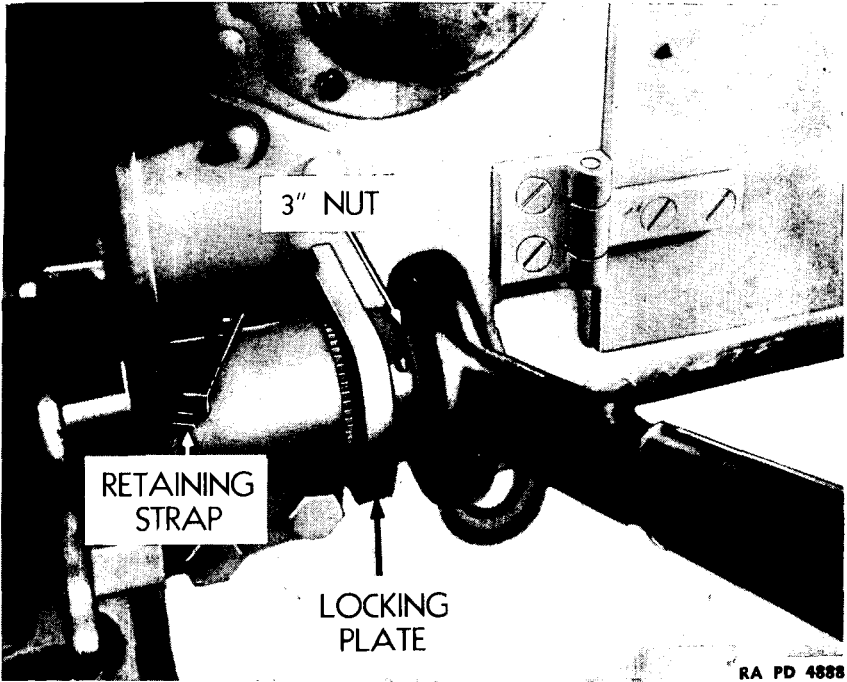
Equipment.—

Crowbar	Screwdriver, small	Wrench, 7/8-in.
Hammer, 1-lb.	Winch, power train carrier	Wrench, 1 1/8-in.
Pliers, 8-in.	Wrench, 1 9/16-in.	Wrench, 1 1/2-in.
Screwdriver, 10-in.	Wrench, 3/4-in.	Wrench, 3-in.
Screwdriver, 12-in.	Wrench, 3 1/2-in.	

b. Procedure. — (1) Loosen tracks. Loosen two outside clamping screws (1 1/8-in. wrench) which hold eccentric shaft of track idler in split housing or bracket. Spread split housing slightly by turning center (1 1/8-in. wrench) screw counterclockwise (left hand thread). Raise end of retaining strap and drive locking plate off serrations on shaft. (It may be necessary to take up pull of track by using 3-in. wrench on hexagonal head or nut on shaft. Because of effort required to turn this shaft, a pipe attached to the wrench (fig. 94) may be helpful. Otherwise, a long-handled wrench can be used.) After locking plate is removed, turn eccentric shaft and loosen track by pushing end of wrench downward. Repeat operation on second track.

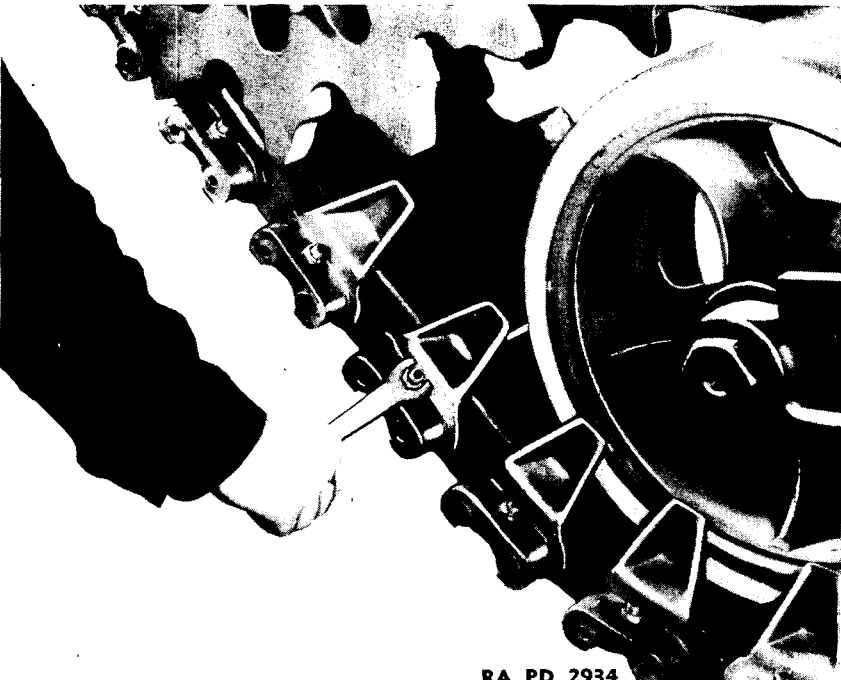
(2) Break tracks. Track is broken at first connection of front wheel (fig. 7). It is important that break be made at this point to permit turning track all the way down when it is replaced. Remove nuts (7/8-in. wrench) on both sides of both tracks, remove wedges and knock connections off ends of shoes. Place wooden wedges behind wheels to prevent any movement of tank. Start engine and operate in reverse gear until tracks have rolled back clear of drive sprockets. Tracks can be pulled further back by hand.

(3) Disconnect headlight, conduits and wires. Unscrew knurled nuts connecting conduits to fittings in hull and disconnect wires at separable plugs.



RA PD 4888

FIGURE 6 — TURNING ECCENTRIC TO LOOSEN TRACK



RA PD 2934

FIGURE 7 — TRACK BROKEN AHEAD OF FRONT WHEEL

REMOVAL OF THE POWER TRAIN UNIT FROM HULL

(4) Remove front fenders. Remove two bolts ($\frac{3}{4}$ -in. wrench) underneath right fender and five bolts underneath left fender. Remove three bolts ($1\frac{1}{8}$ -in. wrench) which hold each fender to the power train. (Teeth of sprocket may cover these bolts, and it will be necessary to pry sprocket around with crow-bar until there is an opening in front of bolt). Remove bolts ($\frac{9}{16}$ -in. wrench) which hold fenders to aprons. Fenders can then be lifted off.

(5) Disconnect interior connections. All cables, levers and controls which are attached to power train must be disconnected. To remove driver's seat, turn wing nuts in four legs of seat support and lift out seat. Disconnect two brake linkages at upper ends of vertical links. Disconnect hand throttle linkage. (Remove cotter pin, separate rod from fork, and remove spring from throttle linkage). Disconnect stop light underneath subfloor and tape ends of wires. Remove right subfloor by removing four bolts which hold subfloor to tank. (Nuts must be held inside tank ($\frac{25}{32}$ in. wrench) while bolts are being turned from

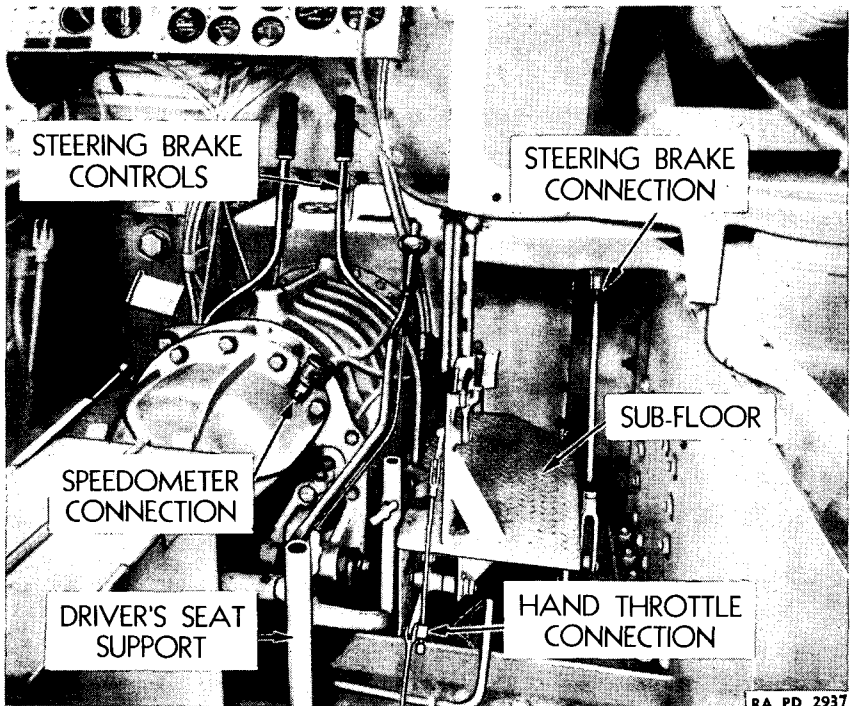


FIGURE 8 — RIGHT SIDE OF DRIVER'S COMPARTMENT

underneath the screwdriver). Remove right seat support by taking out bolts ($\frac{9}{16}$ -in. wrench) which hold it to floor. These nuts must also be held inside tank while the bolts are being turned from beneath. Release machine gun cables and controls from brake levers by removing screws below each handle. Remove

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

four bolts from universal joint cover and remove cover. Separate universal joint flanges by removing the bolts ($\frac{3}{16}$ -in. wrench). To provide access to the bolts, the joint will have to be turned by prying with the wrench. Loosen nut attaching speedometer cable to transmission case and remove cable from case. Release cables attached to inner flanges of the power train by removing bolts ($1\frac{1}{8}$ -in. wrench). If transmission is equipped with oil cooler disconnect two couplings in oil lines on left side of transmission (fig. 5).

(6) Remove power train from hull. Remove row of bolts connecting lower flange of power train to bottom of hull ($1\frac{1}{8}$ -in. wrench holding nuts inside tank while bolts are turned from outside with $\frac{1}{8}$ -in. wrench). Place carrier under power train and elevate all jacks until they support weight of power train. Remove the bolts up the sides and across the top of the power train. Pull power train away from hull with truck tackle or other mechanical means as available, attached to towing shackles.

NOTE: Figure 10 shows a carrier which is not difficult to build. Four hydraulic jacks are placed at corners of an angle iron platform mounted on 6-in. casters. Since power train weighs four tons, jacks must have a combined capacity sufficient to support this weight. Braces welded to front corners, and a cross member about six inches ahead of rear frame piece, support the jacks. Front jacks have "U" members welded to lifts. The tow shackles rest upon these, and "U" members must be 40 inches apart at centers. Front jacks should be approximately 24 inches ahead of rear jacks.

CAUTION: Pull *slowly*. As soon as power train is broken away from tank, shorten hitch on left side so that power train will swing out, as shown in figure 12. This is necessary to allow brake lever and transmission gearshift to clear. Proceed slowly and make sure that sufficient clearance is available. Remove shims separating power train from side plates.

REMOVAL OF THE POWER TRAIN UNIT FROM HULL

RA PD 2939

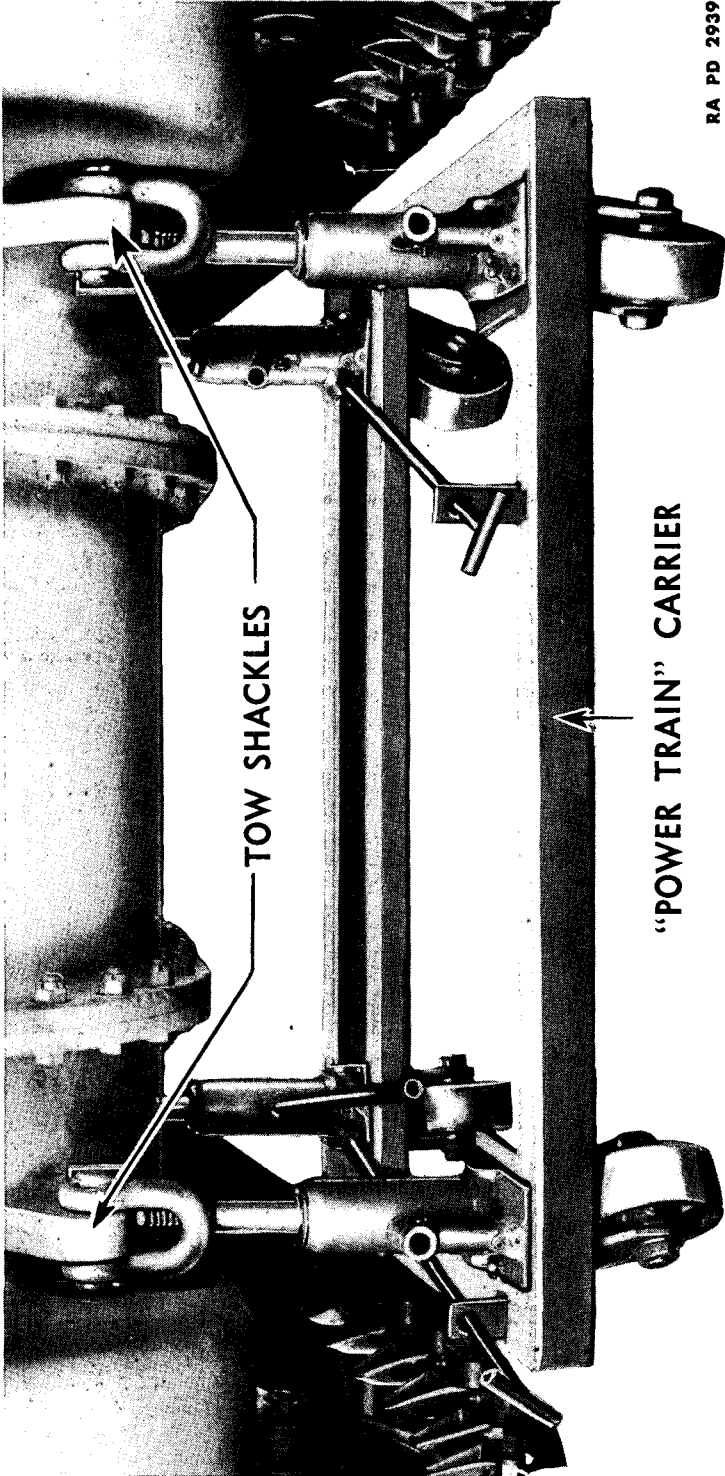


FIGURE 9 — POWER TRAIN CARRIER UNDER POWER TRAIN

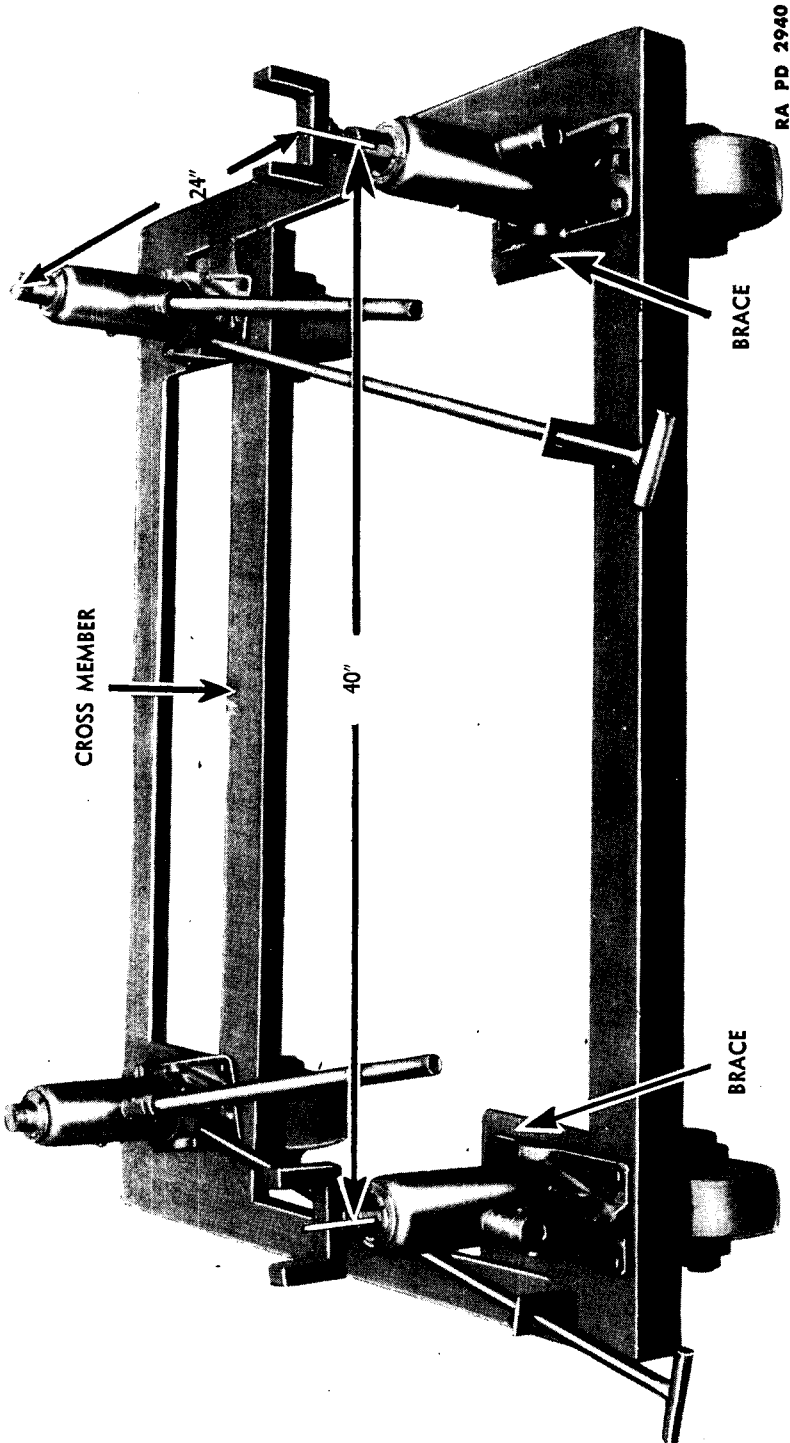
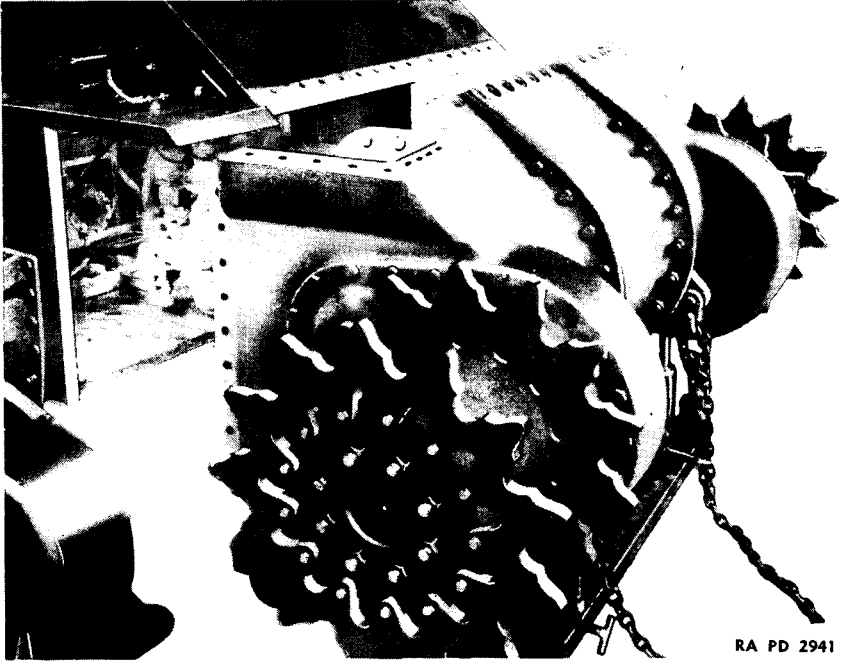


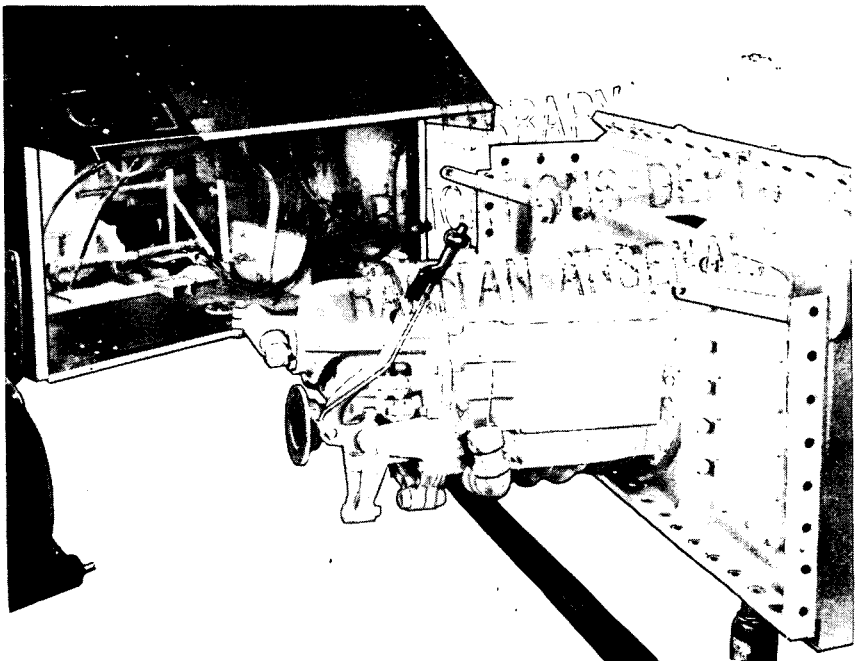
FIGURE 10 — POWER TRAIN CARRIER

REMOVAL OF THE POWER TRAIN UNIT FROM HULL



RA PD 2941

FIGURE 11 — POWER TRAIN PARTLY PULLED OUT OF TANK



RA PD 2942

FIGURE 12 — POWER TRAIN COMPLETELY OUT OF TANK

SECTION IV

DISASSEMBLY OF COMPONENT ASSEMBLIES

	Paragraph
Transmission and parking brake assembly.....	8
Sprocket and hub assemblies.....	9
Final drive assemblies.....	10
Steering brake assemblies.....	11
Differential assembly.....	12

8. TRANSMISSION AND PARKING BRAKE ASSEMBLY. — a. Remove and disassemble parking brake.

b. *Equipment.* —

Bar, bumping, bronze	Punch, drift, 10-in. or 12-in. with ¼-in. end
Bar, pinch	Punch, drive
Chisel, cold	Rod, brass, short
Eyebolts, 2, threaded 1-in., 8NC	Screwdriver
Hammer	Splitter, snap, ring
Hammer, bronze	Tool, special
Hammer, wood	Wrench, Allen, ¾-in.
Hoist	Wrench, Allen, ½-in.
Mallet, bronze	Wrench, ¾-in.
Mallet, wood	Wrench, ⅝-in.
Mallet, wood or copper	Wrench, ⅞-in.
Nut, special, lifting	Wrench, 1 ⅞-in.
Nut, special, lifting, for output shaft	Wrench, 1 7/8-in.
Pliers	Wrench, ¾-in.
Plate, steel, 1-in. with ½-in. protruding pin for synchronizers	Wrench, 7/8-in.
Pliers, snap, ring	Wrench, ⅝-in.
Press, arbor	Wrench, 2 ⅝-in.
Puller, drum	Wrench, adjustable
Puller, gear	Wrench, special
Puller, locking, arm	Wrench, special, input and countershaft
Puller, pinion, gear	

c. *Procedure.* — (1) Remove and dismantle parking brake (*figs. 13 and 14*). Pull cotter pin from universal joint nut and remove the nut and washer (2 ⅝-in. wrench). Drive universal joint flange off shaft with wood hammer. Remove bolts (¾-in. wrench) that hold parking brake housing to the transmission. Lift off brake assembly. Remove cotter pin, washer and spacer from brake lever shaft and slide parking brake shaft out of housing. Lift brake shoe out of housing. Drive link pin out of link and collar and remove adjusting nut and link from splined collar of brake shoe. Lining of shoe should not be removed unless excessively worn or damaged. If lining must be removed, drive rivets out of shoe and lining with small punch and hammer and remove lining.

DISASSEMBLY OF COMPONENT ASSEMBLIES

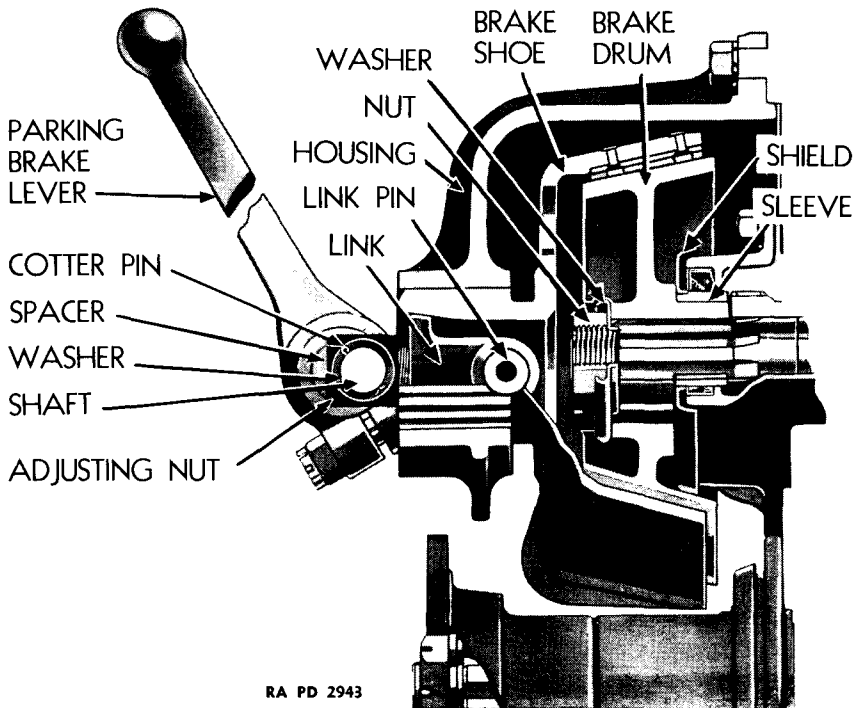


FIGURE 13 — CUT-AWAY OF PARKING BRAKE

Remove cotter pin and nut from bolt holding lever to brake shaft, remove bolt from lever and slide lever off end of shaft.

(2) Remove and disassemble input shaft flange spacer and shield. Slide spacer out of oil seal and off rear end of input shaft. Remove snap ring holding shield to spacer and remove shield from spacer.

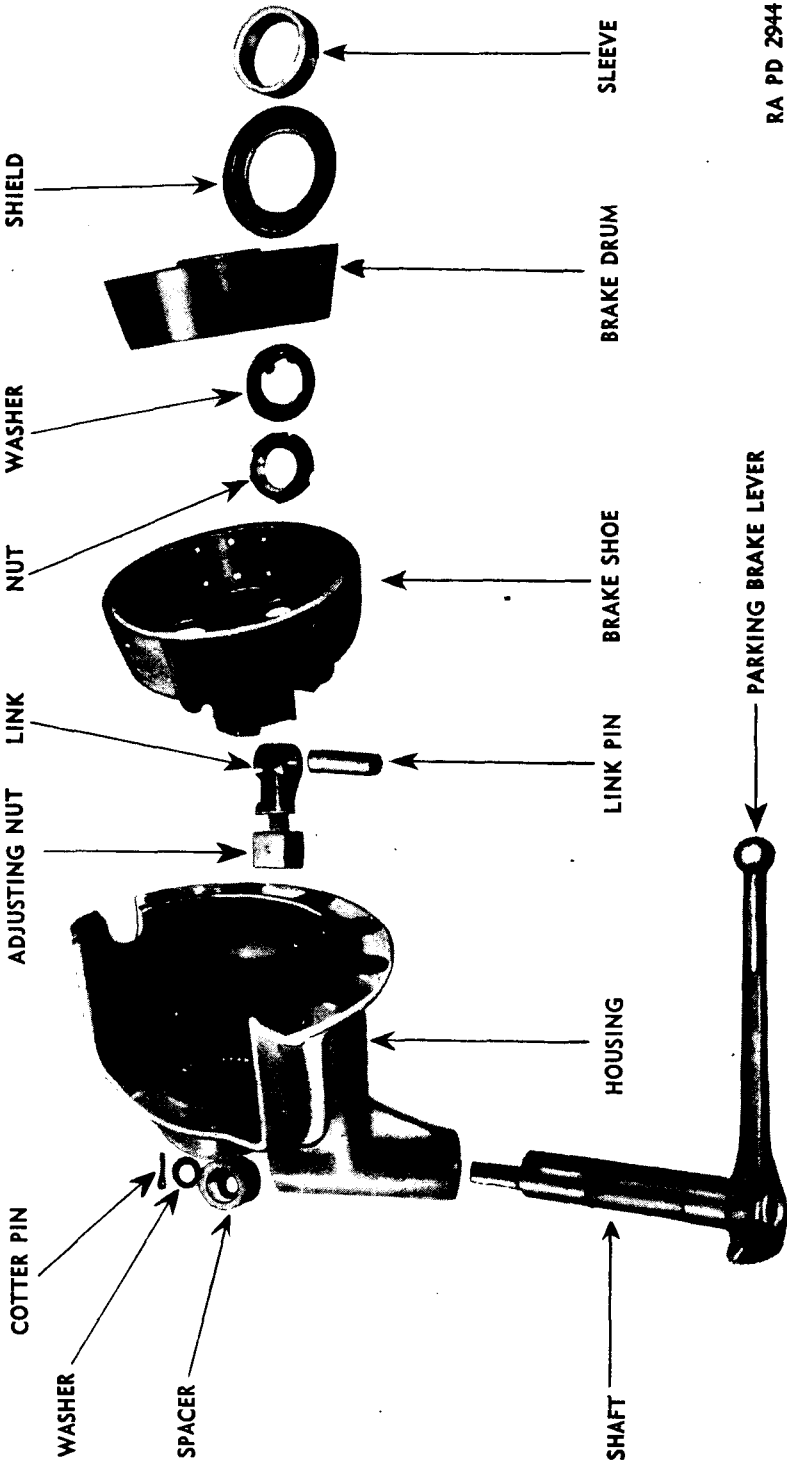
(3) Remove and disassemble brake drum. Pry up edge of metal locking washer used for securing brake drum nut. Loosen brake drum nut with special input and countershaft wrench (fig. 23) and remove nut and washer. The drum may be loose enough to permit knocking off with a wooden mallet. If not, use a puller (fig. 15). The sleeve and shield should not be removed from front hub of drum unless damaged, as they may be destroyed in removal. If they must be removed, drive off end of hub with punch through spokes of drum.

d. Remove and disassemble transmission. —

NOTE: Under no conditions, when disassembling or reassembling transmission, should any one of these gears become separated from its original spacer and bearings.

For replacement purposes, in case of a damaged gear, bearing or spacer, a complete new gear assembly with bearings and proper spacer is to be installed as a unit.

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS



RA PD 2944

FIGURE 14 — BRAKE ASSEMBLY

DISASSEMBLY OF COMPONENT ASSEMBLIES

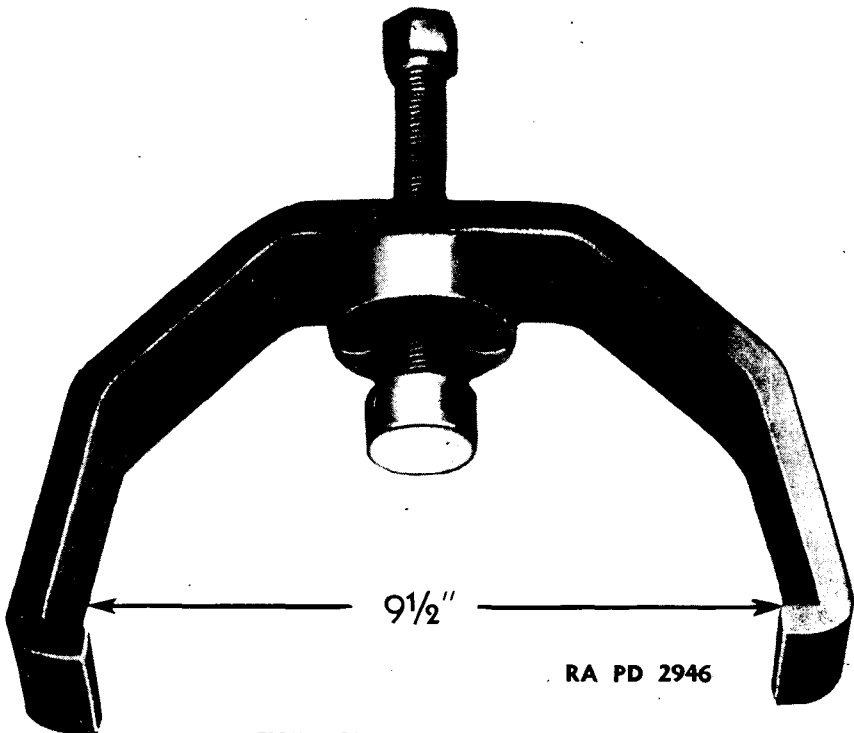


FIGURE 15 — BRAKE DRUM PULLER

(1) Drain oil from power train. Oil must be drained at four places — one in each steering brake unit, one in differential and one in transmission (fig. 19). ($\frac{3}{4}$ -in. Allen wrench on differential and steering brake plugs, and $\frac{1}{2}$ -in. wrench on transmission plug). Drain lubricant from one unit at a time, replacing plug. When all units have been drained, repeat procedure to remove additional lubricant that has collected.

(2) Remove transmission. Install two eyebolts (1 in. — 8NC) in threaded holes in top of transmission case, attach sling and apply *slight* lift with hoist. (This will aid in separating transmission unit from differential). Remove cap screws ($\frac{3}{4}$ -in. wrench) from around transmission case flange, and use pinch bar to pry transmission case loose from differential case. It may be necessary to manipulate transmission to disengage transmission pinion gear from differential bevel gear. Place transmission on stand (fig. 18), or other convenient place. (It has been found that an engine repair stand with special plate to which transmission flange can be bolted makes a convenient holding device for disassembly and repair).

(3) Remove gear shift lever assembly and disassemble. Remove cotter pin from nut on left end of steering lever shaft and remove nut ($\frac{7}{8}$ -in. wrench) and washer. Drive out shaft and lift out shift lever and yoke. Remove cotter pin and nut ($\frac{3}{4}$ -in. wrench) from yoke pin and drive out pin, freeing yoke. Slide the spacer and ring off the lower or input shaft. Remove locking wires from bolt heads on the three shifting brackets, and remove bolts ($\frac{5}{8}$ -in. wrench). These bolts fit into slots in shifting rods, and must be entirely removed before the

RA PD 2947

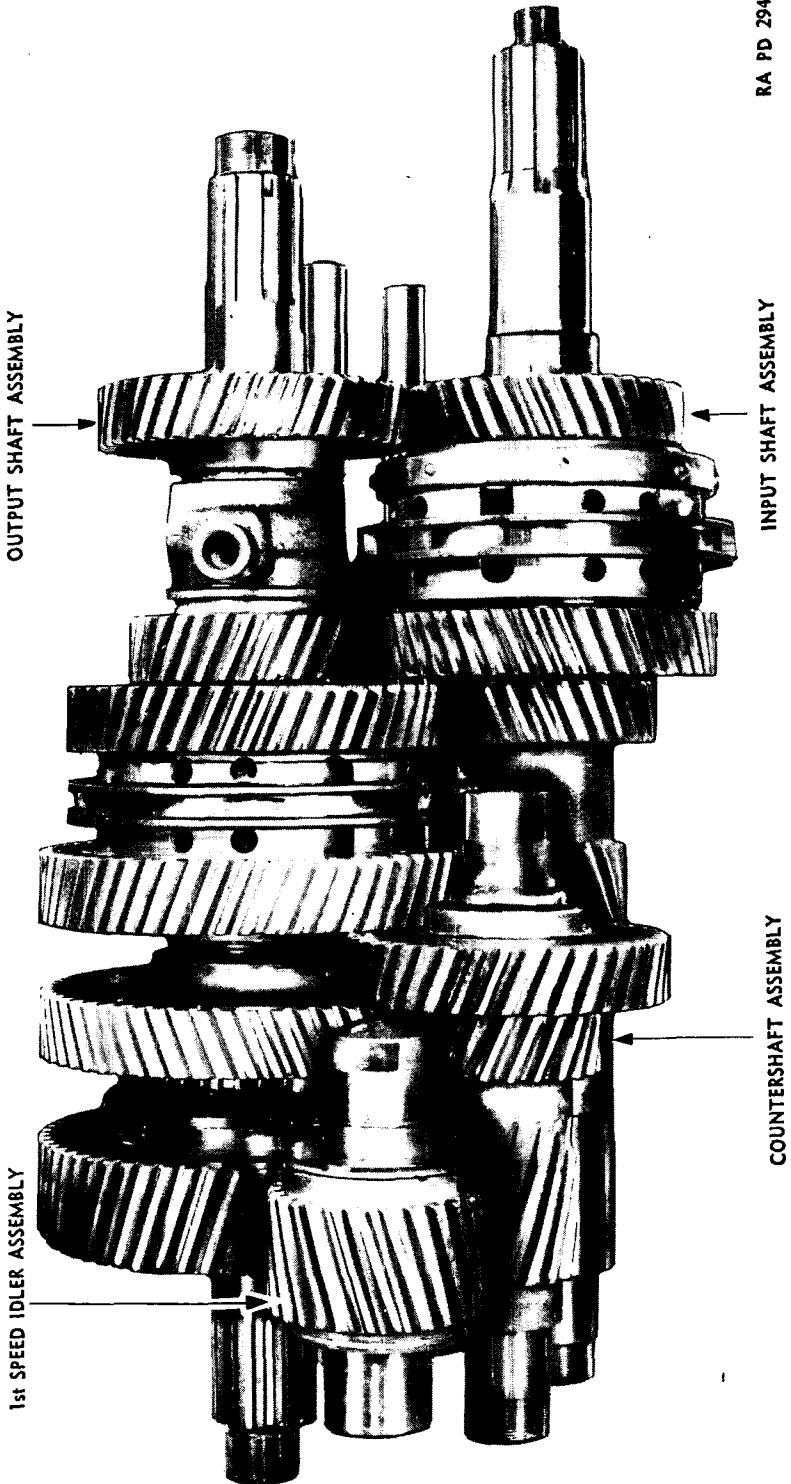


FIGURE 16.— TRANSMISSION GEAR ASSEMBLIES

DISASSEMBLY OF COMPONENT ASSEMBLIES

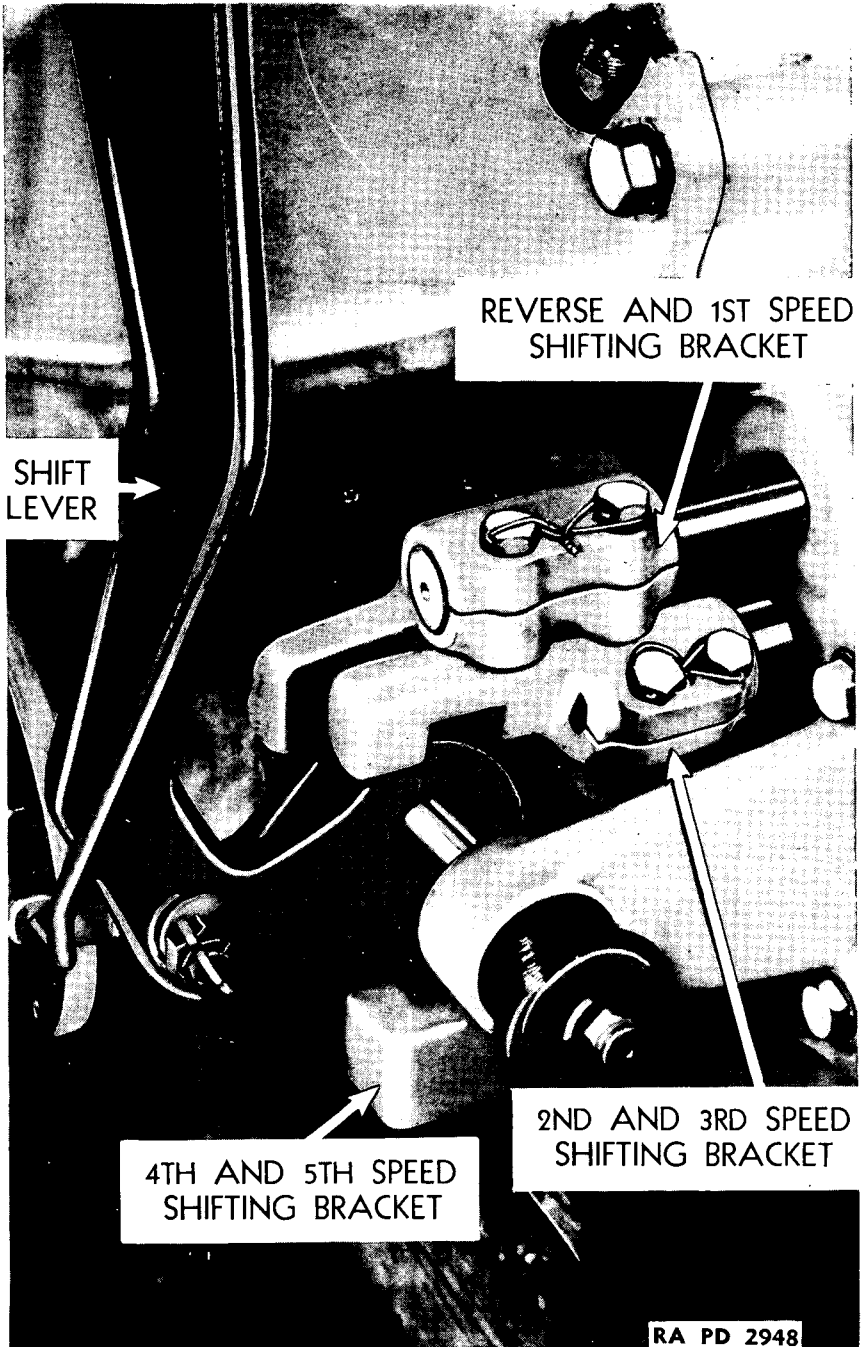
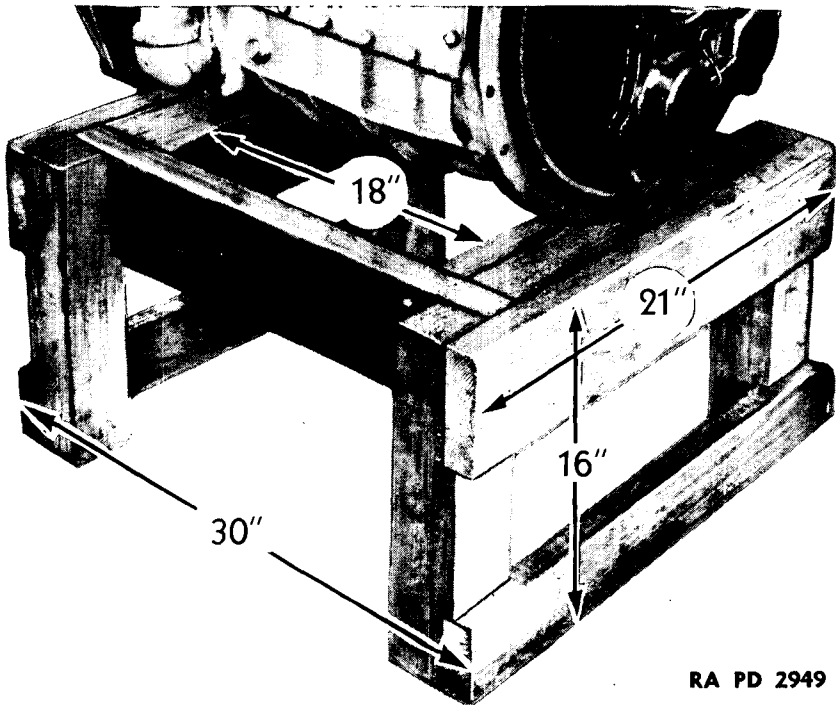


FIGURE 17 — TRANSMISSION SHIFTING BRACKETS

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS



RA PD 2949

FIGURE 18 — TRANSMISSION ON STAND

brackets will slide off rods. Slide brackets off rods. Remove cotter pin and washer from lower end of latch rod, slide rod out of latch and push rod up through handle a few inches. Remove pin holding button to upper end of latch rod and remove button, spring and washer. Slide latch rod downward out of handle. Remove cotter pin and nut ($\frac{3}{4}$ -in. wrench) from bolt holding latch to lever, and remove bolt and latch.

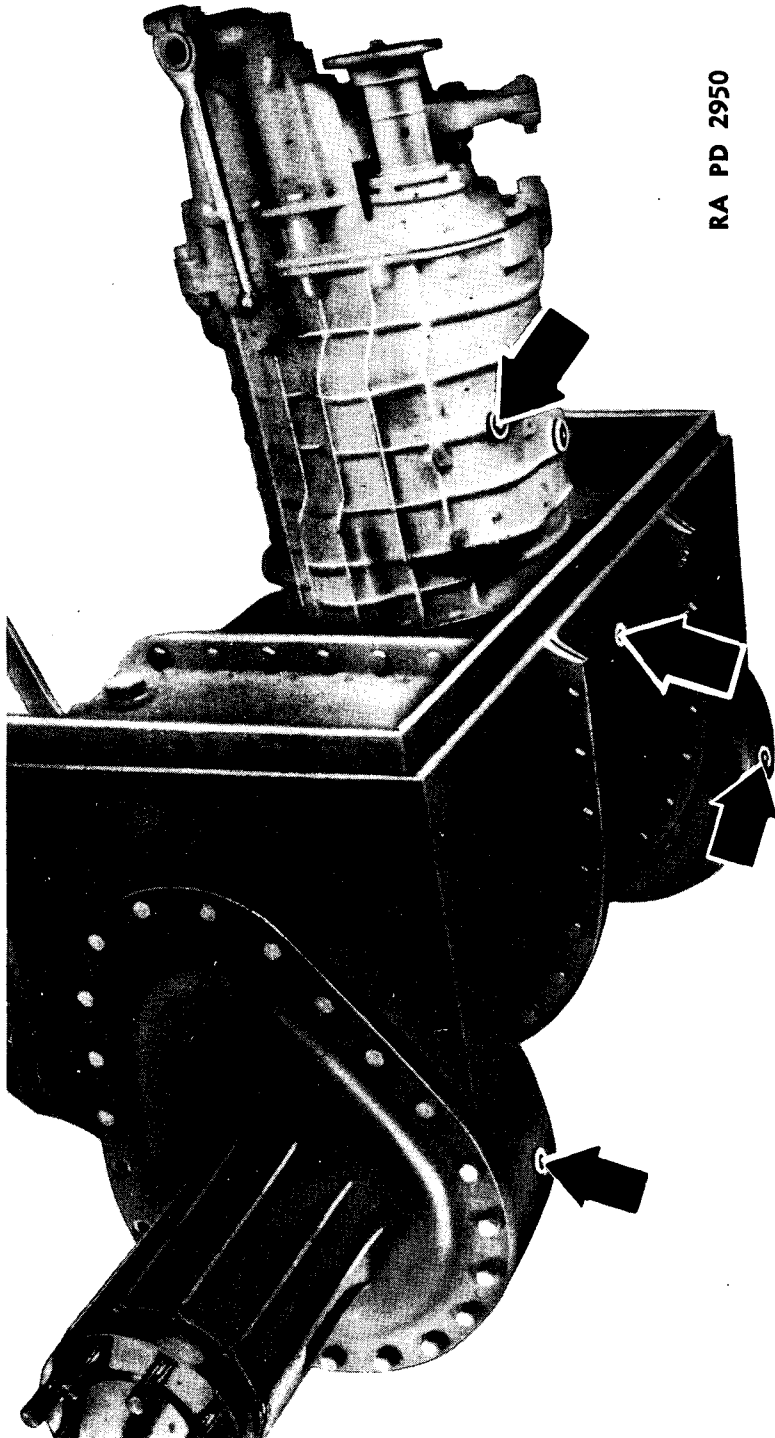
(4) Remove speedometer drive assembly. Remove bolts ($\frac{3}{8}$ -in. wrench) from each side of the speedometer cable and lift out speedometer drive assembly.

(5) Remove input and output shaft caps, and speedometer drive gear. Remove the bolts ($\frac{3}{4}$ -in. wrench) around input and output shafts at rear end of transmission. Use screwdriver to pry off caps, with oil seal rings and gaskets from input and output shafts. Do not remove oil seals from caps unless worn out or injured. If removal is necessary, drive oil seals out of caps with punch and hammer. Lift speedometer drive gear off output shaft, and remove Woodruff key.

(6) Remove inspection plate. Remove bolts ($\frac{9}{16}$ -in. wrench) around inspection plate on side of transmission and lift off plate and gasket.

(7) Remove pinion gear and bearing. Output, input, and countershafts are removed from rear end of transmission, but must be released at front end. Remove locking wire and bolts ($\frac{3}{4}$ -in. wrench) from front bearing cover and remove cover. Remove cotter pin from drive pinion nut, and unscrew nut.

DISASSEMBLY OF COMPONENT ASSEMBLIES



RA PD 2950

FIGURE 19 — DRAIN OIL AT POINTS INDICATED BY ARROWS

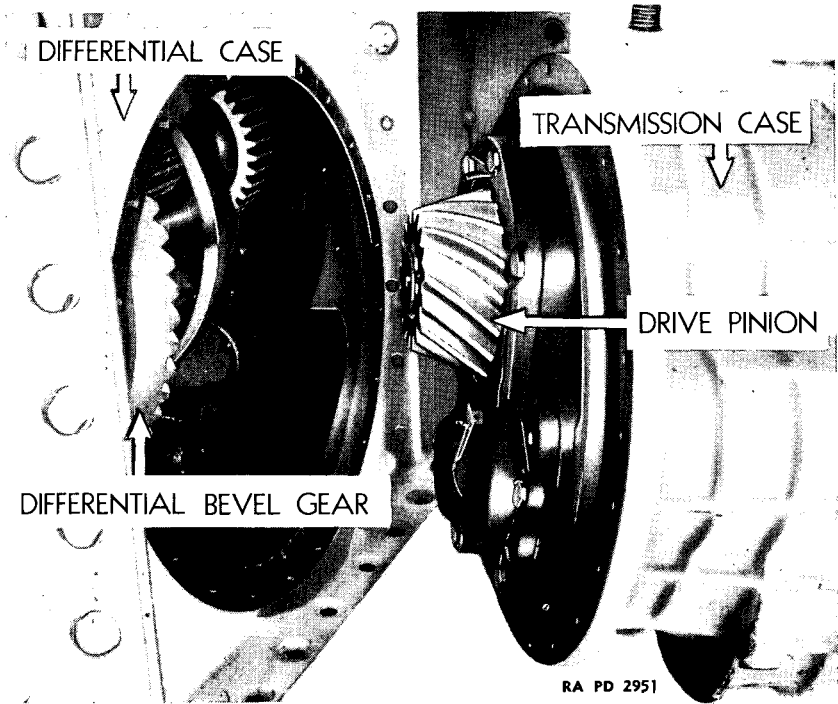


FIGURE 20 — TRANSMISSION REMOVED FROM DIFFERENTIAL

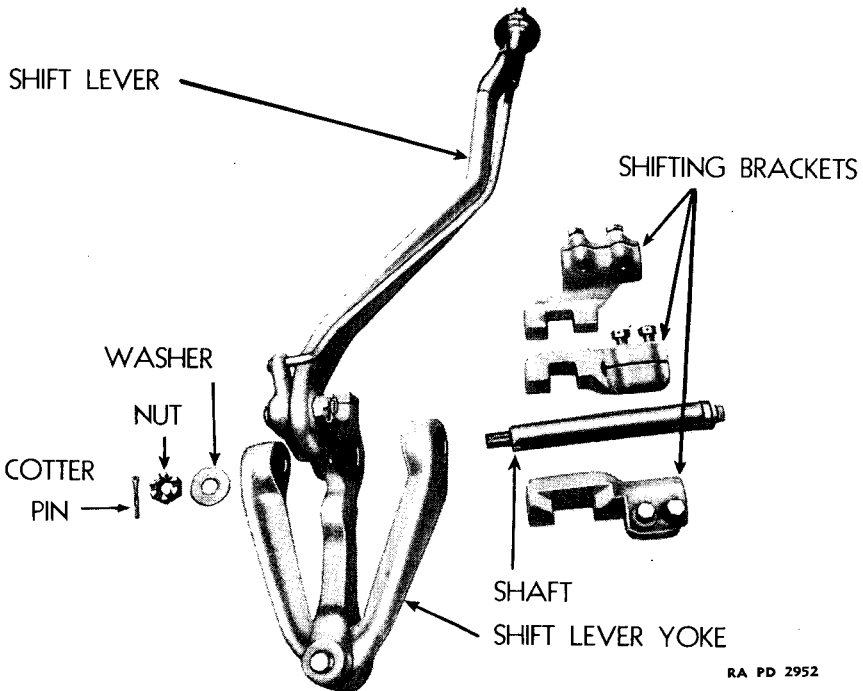
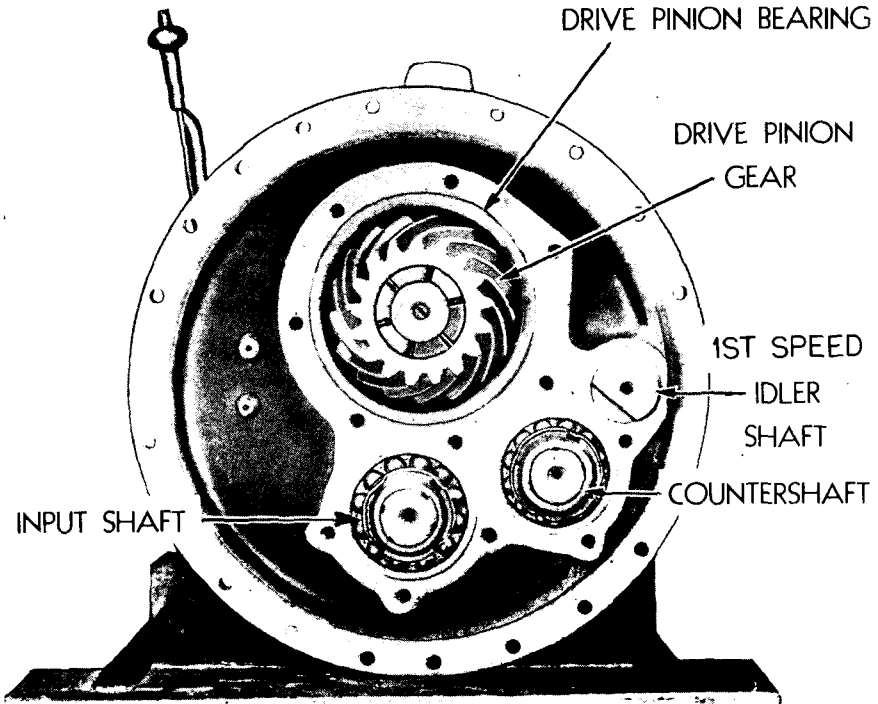


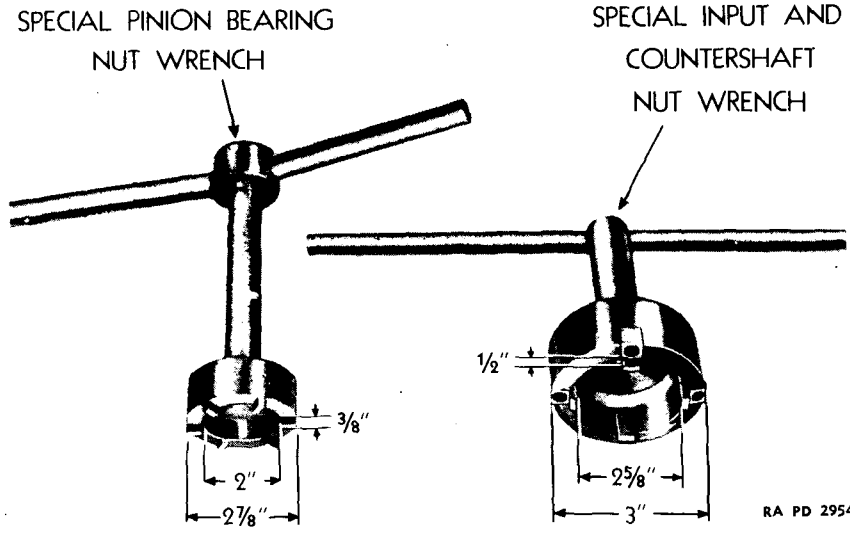
FIGURE 21 — GEAR SHIFT LEVER ASSEMBLY

DISASSEMBLY OF COMPONENT ASSEMBLIES



RA PD 2953

FIGURE 22 — PINION GEAR END OF TRANSMISSION WITH BEARING COVER REMOVED



RA PD 2954

FIGURE 23 — SPECIAL WRENCHES USED ON PINION, INPUT AND COUNTERSHAFT NUTS

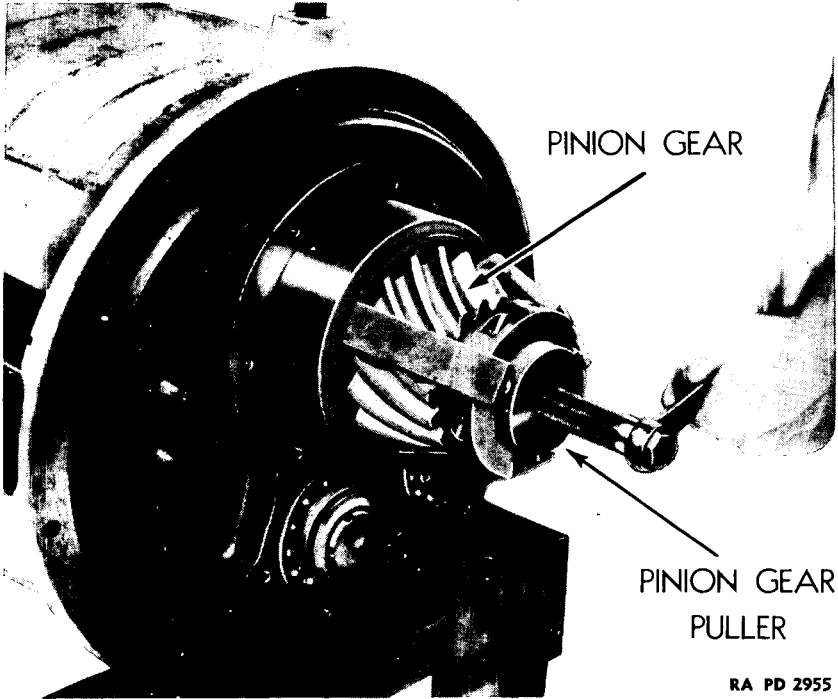


FIGURE 24 — PINION GEAR PULLER

RA PD 2955

This nut is set into end of pinion gear and requires special wrench (*fig. 23*). Remove pinion gear washer. The pinion gear and pinion bearing are removed as a unit, using gear puller (*fig. 24*). Remove shims from behind bearing and tag for replacement as exact thickness must be replaced. If bearing does not come out with pinion it must be removed with bearing puller.

(8) Remove input shaft and countershaft nuts. Remove nuts from input and countershafts with special wrench (*fig. 23*).

(9) Turn transmission to rest on pinion gear end. To prevent gears and shafts from dropping out while transmission is being dismantled, it should be turned so that the pinion gear end is down.

(10) Remove transmission cover (*fig. 25*). Remove the two large bolts ($1\frac{7}{8}$ -in. wrench) on opposite sides of transmission case. Remove the eight bolts ($\frac{3}{4}$ -in. wrench) from cover around input and output shafts. The cover is now ready to be removed. A special tool (*fig. 25*) will be useful in lifting cover since it is important to raise it evenly to prevent binding. A block of metal two inches thick is used, with two $\frac{1}{2}$ -in. drilled holes $13\frac{1}{2}$ inches apart. Two $\frac{7}{8}$ -in. rods, threaded for several inches at each end are inserted in these holes, with a nut at top above block. A pipe or block, four inches long, must be placed upon output shaft to build it up to input shaft level. The block is laid across input shaft and over pipe section on output shaft, with lower ends of rods screwed into bolt holes in transmission cover. Turning nuts above block will raise cover. The nuts should be turned alternately so that cover is raised evenly.

DISASSEMBLY OF COMPONENT ASSEMBLIES

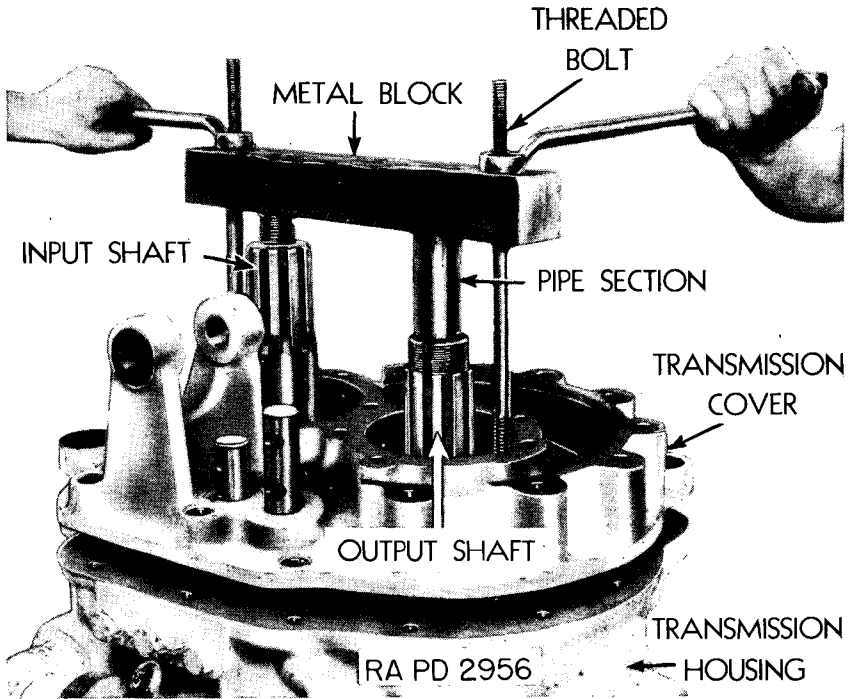


FIGURE 25 — RAISING TRANSMISSION COVER

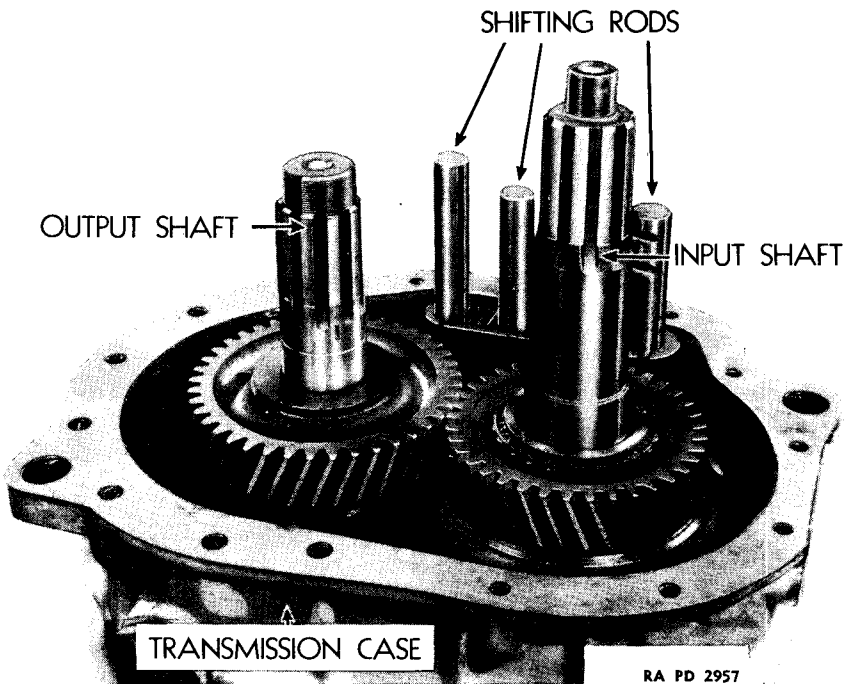
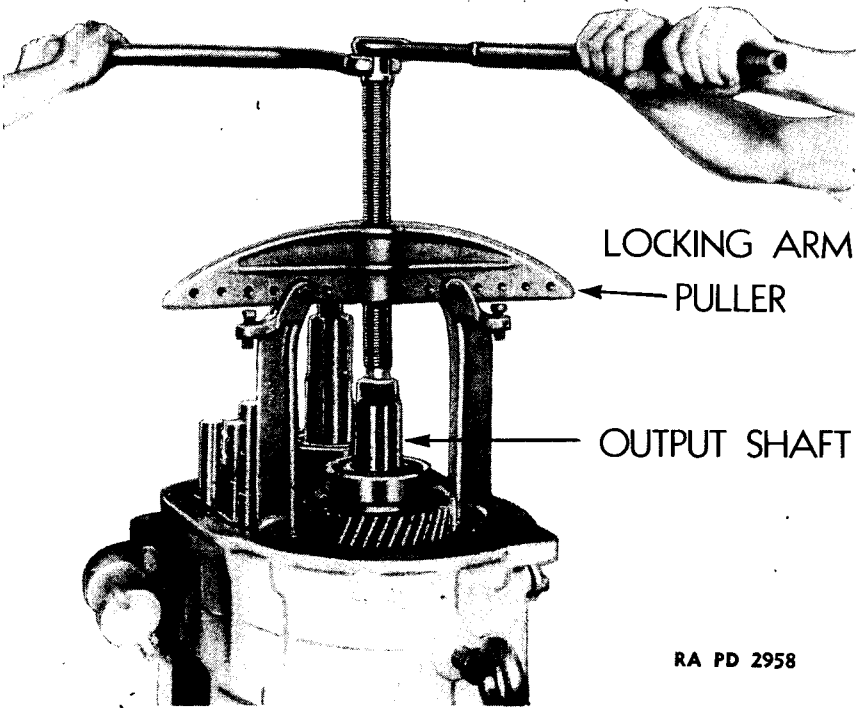


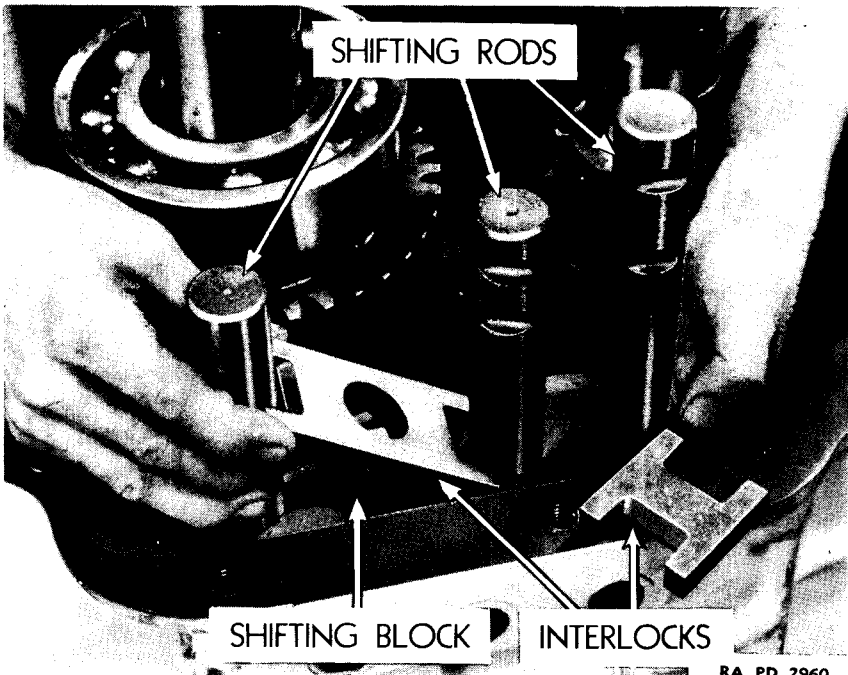
FIGURE 26 — TRANSMISSION WITH COVER REMOVED

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS



RA PD 2958

FIGURE 27 — REMOVING FOURTH SPEED GEAR WITH A LOCKING ARM PULLER



RA PD 2960

FIGURE 28 — SHIFT ROD SUPPORT BLOCKS AND INTERLOCKS

DISASSEMBLY OF COMPONENT ASSEMBLIES

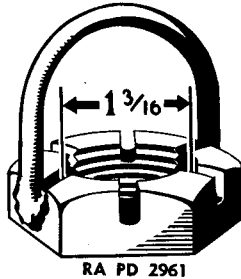


FIGURE 29 — INPUT SHAFT LIFTING NUT

(11) Remove bearing from input shaft. Remove rear input shaft bearing by inserting pinch bar or similar lever between bearing and gear, prying up evenly all around. When loose, lift bearing off shaft.

(12) Remove oil stem. Oil stem extends from transmission case to oil collar on output shaft. Remove the two bolts from flange on shaft and pull out oil stem.

(13) Remove fourth speed gear and bearing from output shaft (fig. 27). Rear gear on output shaft must be removed before input and output shaft assemblies can be removed from housing. Pull gear and bearing off seat on shaft with gear puller, hammering on end of screw with bronze hammer if necessary. When loose, lift off bearing, washer, and gear. Remove the two keys from shaft.

(14) Remove shifting rod support block and interlocks (fig. 28). Remove locking wire and bolts holding shifting block to housing ($\frac{7}{8}$ -in. wrench). Remove interlocks and lift out support block.

(15) Remove oil collar and spacer (fig. 40). Slide oil collar and spacer off output shaft by hand.

(16) Remove shifting rods. Remove bolts from transmission housing at front ends of shifting rods, and take out springs and balls. Working through inspection plate hole, remove locking wires and bolts holding shifting forks and bracket to shifting rods. Slide shifting rods out of forks and out through rear end of transmission, being careful not to lose sleeve on front end of middle rod. Lift out the three forks.

(17) Remove input shaft assembly. Screw special lifting nut (fig. 29) onto rear end of input shaft and lift shaft assembly out through rear end of housing with hoist. Lift slowly. Input shaft gears are meshed with output shaft gears, and input shaft must be manipulated to free gears before assembly can be removed. With assembly removed, knock bearing off end of shaft with a wood mallet.

(18) Remove oil pump assembly. Oil pump must be taken out before removing either countershaft or output shaft. Remove locking wire from bolts and remove bolts ($\frac{9}{16}$ -in. wrench) which hold oil pump assembly to its support. Lift out oil pump.

(19) Dismantle oil pump assembly. No oil cooler used (fig. 31). Remove three bolts ($\frac{9}{16}$ -in. wrench) which hold cover to base, and lift off cover and gasket. Lift gears out of pump. Remove plug, spring and ball, being careful spring

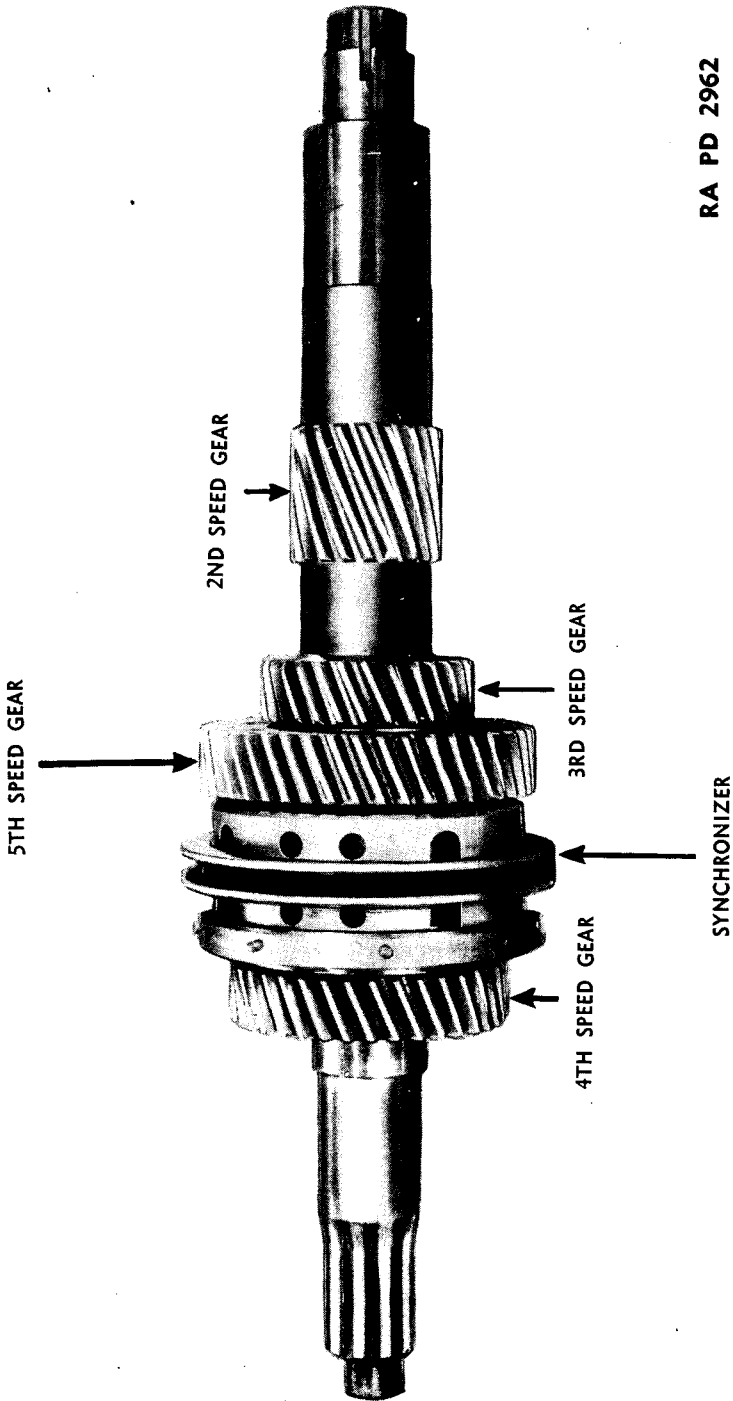


FIGURE 30 — INPUT SHAFT ASSEMBLY

RA PD 2963

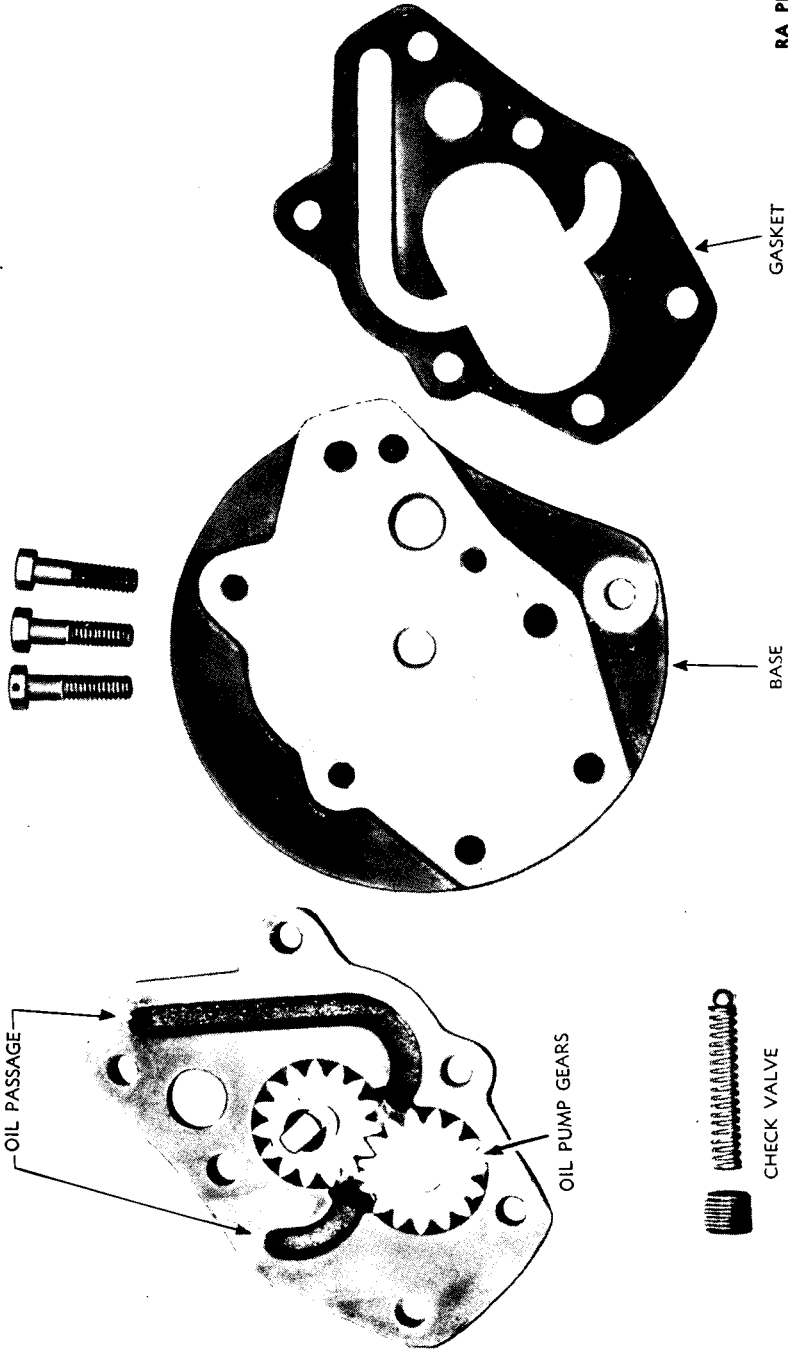
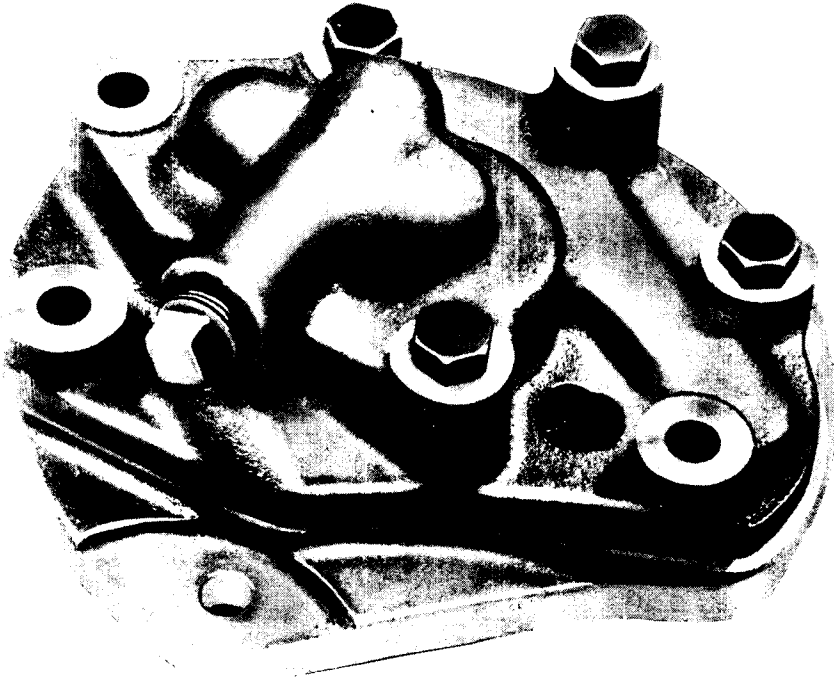


FIGURE 31 - OIL PUMP ASSEMBLY



RA PD 5251

FIGURE 32 — OIL PUMP USED IN TANKS EQUIPPED WITH OIL COOLER

and ball do not jump out and become lost when plug is removed. Do not remove bushings unless worn or damaged. If necessary, bushings can be pressed out of base and driven gear, but must be broken out of body with punch or cold chisel.

(20) Dismantle oil pump assembly. Oil cooler used (*fig. 33*). Remove bolts ($\frac{7}{16}$ -in. wrench) which hold cover to base and lift off cover. Lift shaft and gears out by hand. Remove plug, spring and ball, being careful spring and ball do not jump out and become lost when plug is removed. Do not remove bushings unless worn or damaged. If necessary, bushings can be pressed out of driven gear and case but must be broken out of body with punch or cold chisel.

(21) Remove output shaft assembly (*fig. 34*). Screw lifting nut on rear end of output shaft and attach hoist. Raise slowly. The countershaft must be freed before output shaft assembly can be removed. Use bronze mallet to hammer on front end of countershaft bearing, raising output shaft as countershaft comes up. When front countershaft bearing is free, hammer on rear end of it with bronze bumping bar until it comes off shaft. A special tool (*fig. 35*) will be useful in removing rear countershaft bearing. It is simply a large metal washer with a section cut out. Lift countershaft assembly sufficiently to insert tool between bearing and support. Hammer down on shaft, with a short brass rod and hammer, until shaft is free of bearing. Countershaft will then be loose

DISASSEMBLY OF COMPONENT ASSEMBLIES

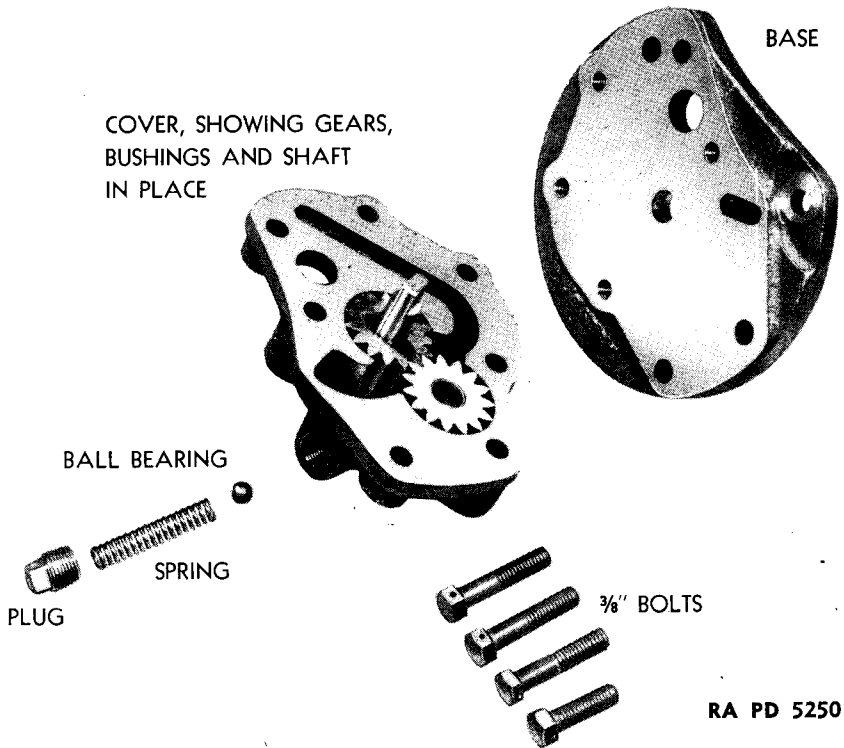


FIGURE 33 — WORKING PARTS IN OIL PUMP EQUIPPED WITH OIL COOLER

in transmission case and output shaft assembly can be hoisted out.

(22) Remove countershaft assembly (*fig. 37*). With output shaft assembly removed from transmission case, countershaft assembly can be lifted out.

(23) Remove reverse idler gear (*fig. 39*). Force first speed idler shaft out through front end of transmission case, using brass rod and hammer. Lift out first speed idler gear, with two washers on each side. Remove washers and two Hyatt bearings from gear by hand.

(24) Remove fifth speed gear from output shaft (*fig. 40*). There is not sufficient space between fifth and third speed gears to insert puller fingers, so gears must be started off shaft together. Hook puller fingers onto third speed gear and pull both gears about $\frac{1}{4}$ -in. until stopped by fifth speed gear keys. Remove puller, push third speed gear away from fifth speed gear, install puller on fifth speed gear and pull gear off shaft. Remove keys from shaft.

(25) Remove third speed gear, bearing and synchronizer from output shaft (*fig. 40*). Install puller on gear and pull gear with roller bearing ahead of it off shaft. Lift spacer off shaft. Lift synchronizer off clutch gear and shaft.

(26) Remove bearing and third and second speed clutch gear from output

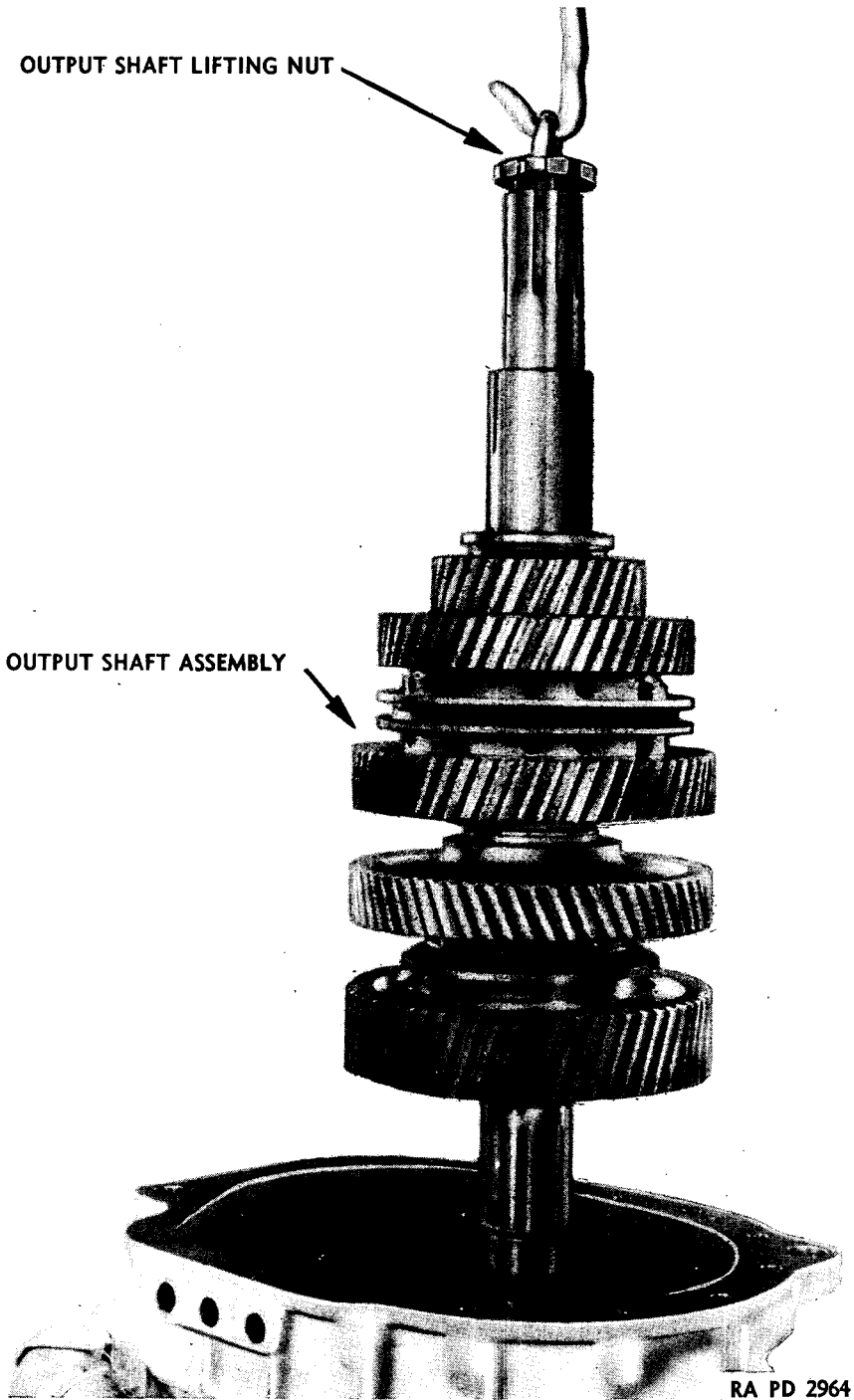


FIGURE 34 — REMOVING OUTPUT SHAFT

DISASSEMBLY OF COMPONENT ASSEMBLIES

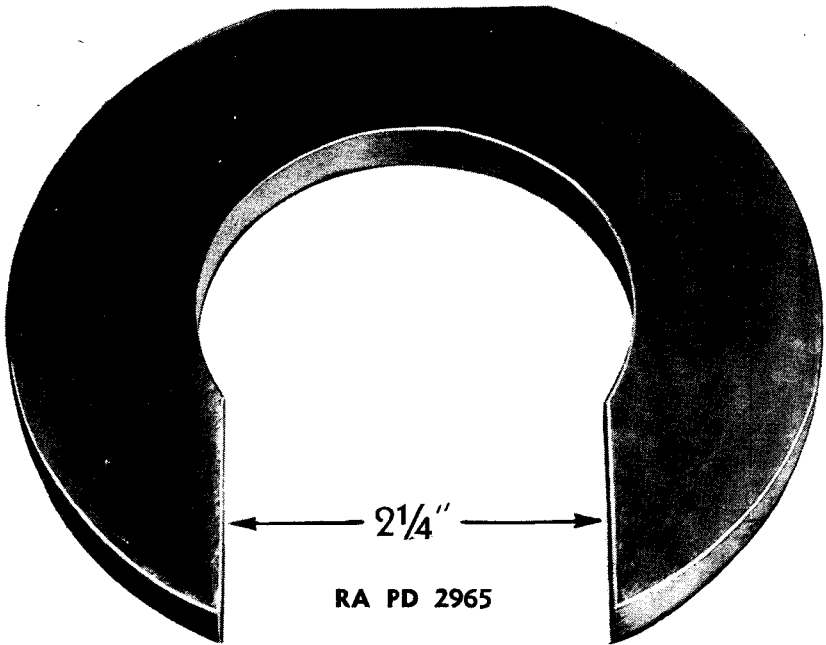


FIGURE 35 — TOOL USED TO REMOVE REAR COUNTERSHAFT BEARING

shaft (*fig. 40*). There is no room between clutch and second speed gears to insert puller fingers, so gears must be started off shaft together. Hook puller fingers onto second speed gear and pull both gears until stopped by clutch gear keys. Remove puller, push second speed gear away from clutch gear, install puller on clutch gear and pull gear with roller bearing ahead of it off shaft. Remove keys from shaft.

(27) Remove bearing, second speed gear and spacer from output shaft (*fig. 40*). Install puller on gear and pull gear with roller bearing ahead of it off shaft. Lift spacer off shaft.

(28) Remove two bearings, reverse gear, spacer and shifting sleeve from output shaft (*fig. 40*). Install puller on gear and pull gear with two bearings ahead of it off shaft. Lift spacer and reverse and first speed shifting sleeve off shaft.

(29) Remove bearing, and reverse and first speed clutch gear from output shaft (*fig. 40*). There is no room between clutch and first speed gears to insert puller fingers, so gears must be started off shaft together. Hook puller fingers onto first speed gear and pull both gears until stopped by clutch gear keys. Remove puller, push first speed gear away from clutch gear, install puller on clutch gear and pull gear with roller bearing ahead of it off shaft. Remove keys from shaft.

(30) Remove bearing, first speed gear and spacer from output shaft

RA PD 2966

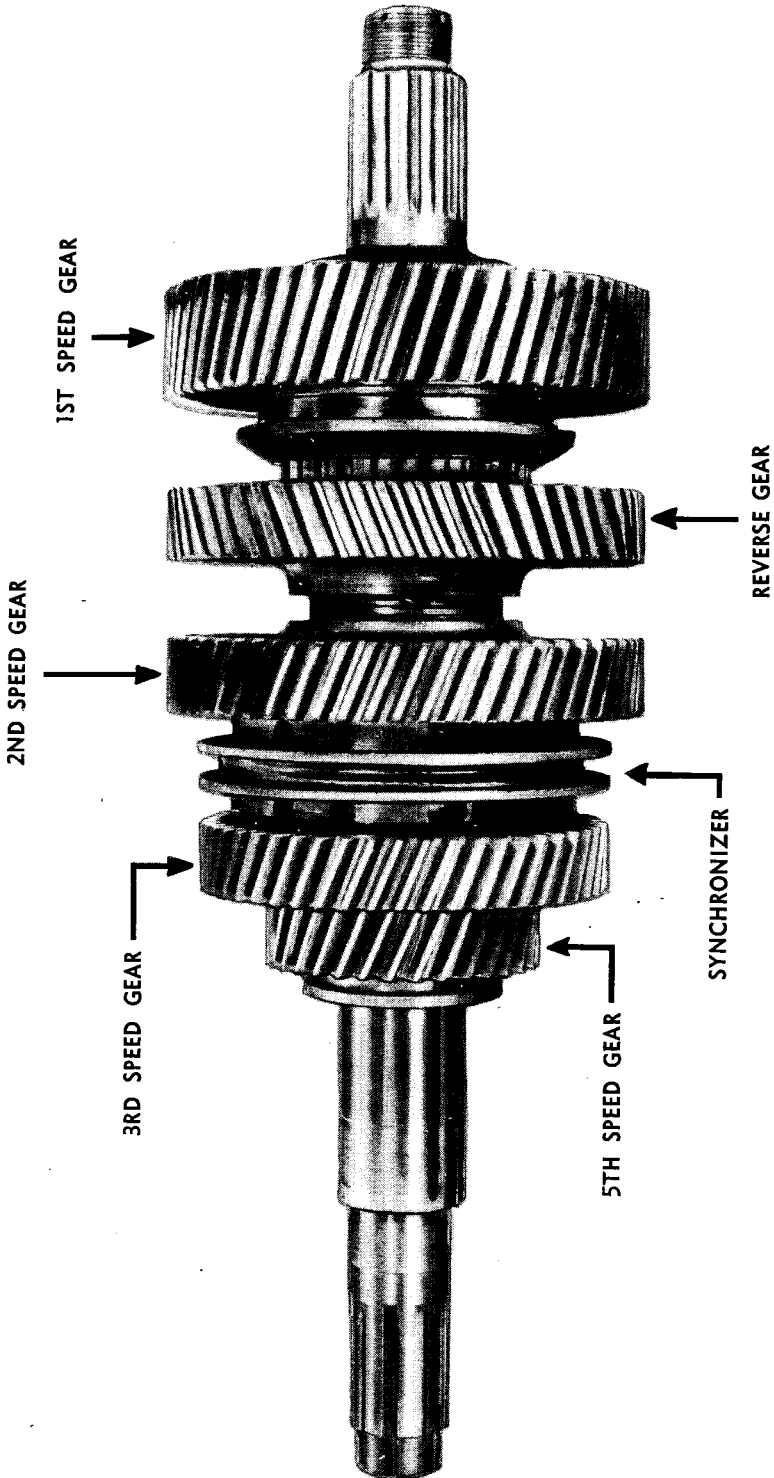


FIGURE 36 — OUTPUT SHAFT ASSEMBLY

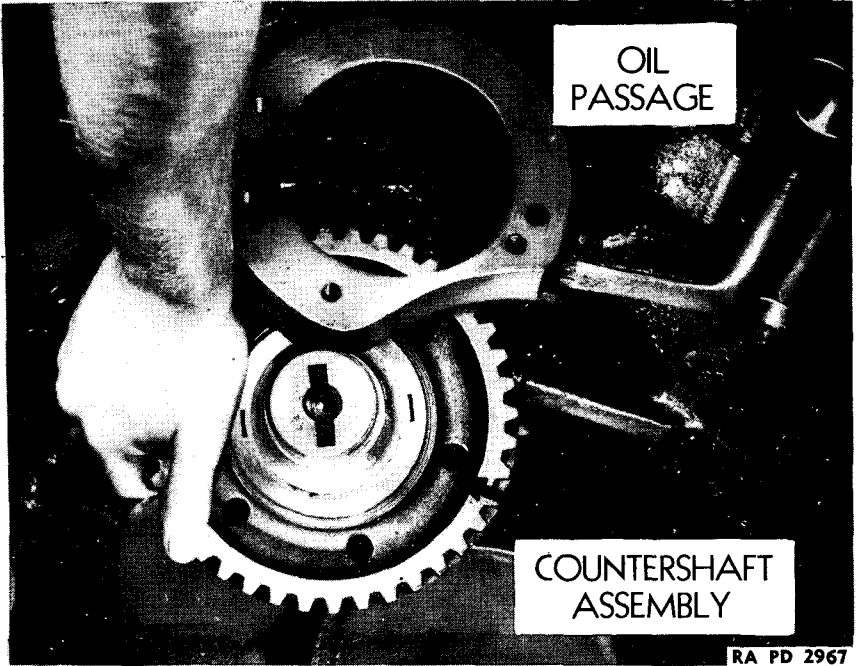


FIGURE 37 - REMOVING COUNTERSHAFT ASSEMBLY

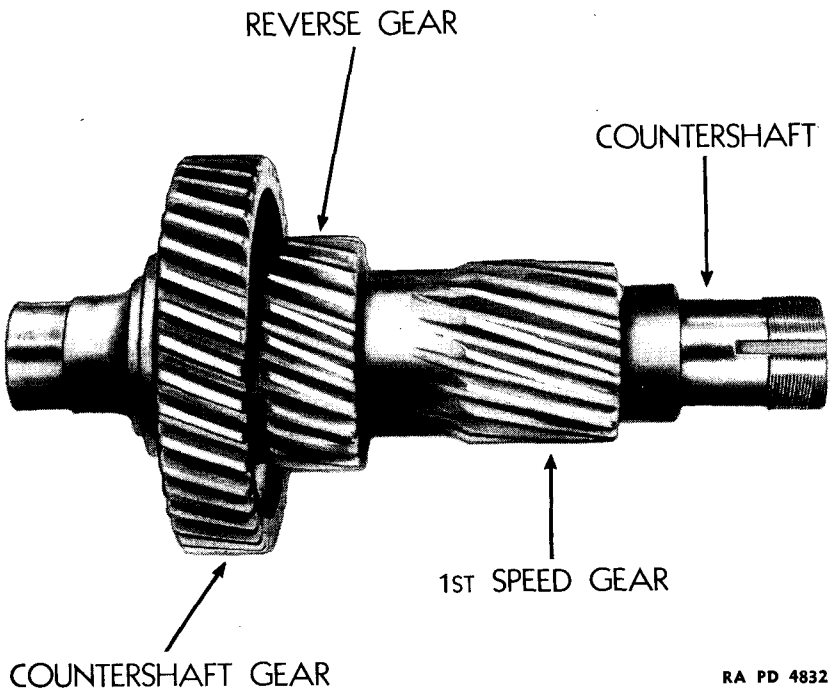


FIGURE 38 - COUNTERSHAFT ASSEMBLY

RA PD 4832

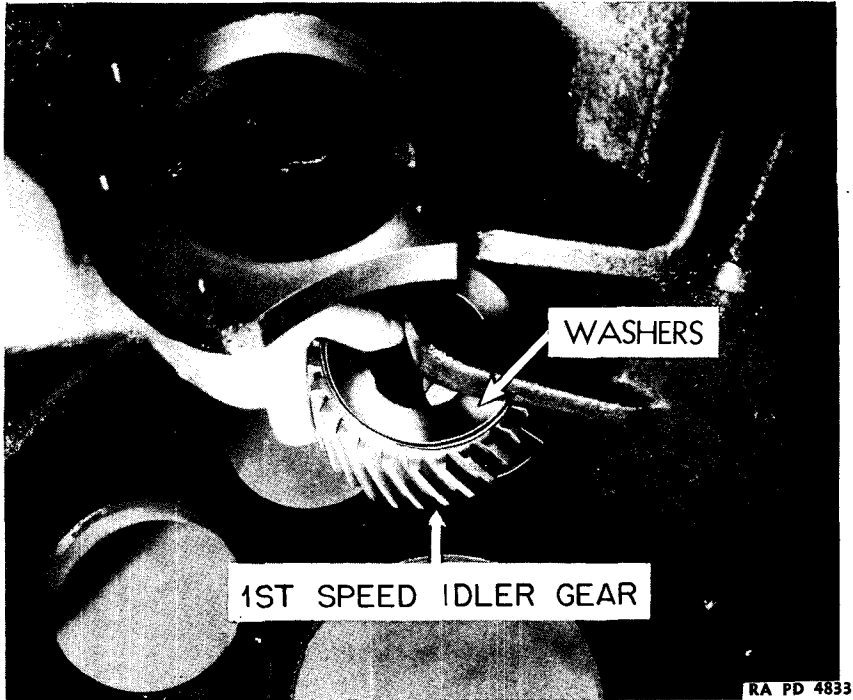


FIGURE 39 — FIRST SPEED IDLER GEAR BEING REMOVED

(fig. 40). Install puller on gear and pull gear with bearing ahead of it off shaft. Lift spacer off shaft.

(31) Remove bearing from output shaft (fig. 40). Install puller on first speed gear bearing and pull it off shaft. Output shaft is now bare.

(32) Dismantle second and third speed synchronizer (fig. 42). It is recommended that whenever possible this synchronizer assembly be replaced in its entirety. If impossible proceed as follows: Place piece of 1-in. steel plate on arbor press under the synchronizer assembly and press out the four pins with an ordinary bolt or some such article between outside ends of pins and press ram. Knock collar off assembly with a wood or copper mallet. Chisel off heads of eight rivets holding steel ring with cold chisel and punch out rivets from inside with drift punch (10 or 12 inches with ¼-in. end). Knock off the tapered ring with a wood or copper mallet. Pull "dog collar" out of sleeve; 12 poppets and springs will either fall out or can be lifted out by hand.

(33) Remove bearing, fourth speed gear, spacer and synchronizer from input shaft (fig. 45). There is no room between fourth speed gear and synchronizer to insert puller fingers so hook fingers onto synchronizer and pull synchronizer, fourth speed gear and bearing off shaft. Lift spacer off shaft.

LIBRARY,

PUBLICATIONS DEPT.,
ARLINGTON HALL
ARLINGTON, VIRGINIA

RA PD 4834

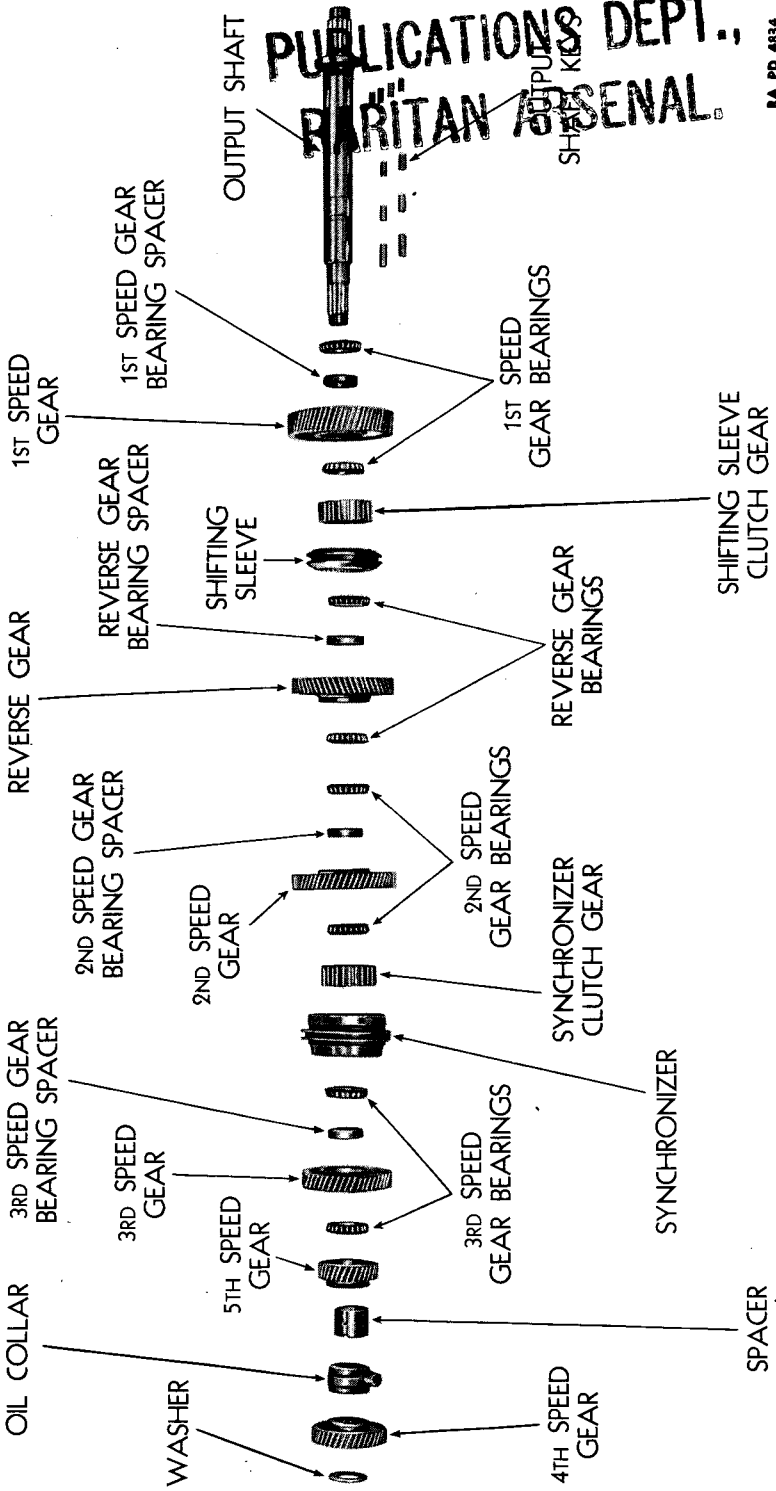
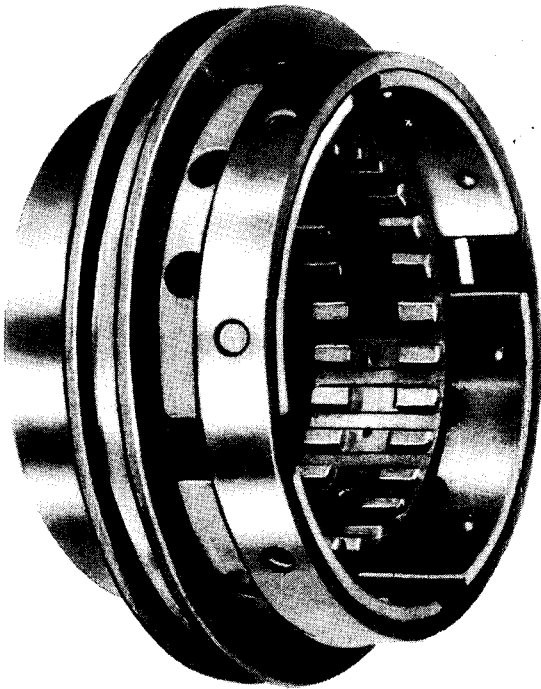


FIGURE 40 - OUTPUT SHAFT ASSEMBLY



SECOND AND THIRD SPEED
 SYNCHRONIZER

RA PD 5255

FIGURE 41 — SECOND AND THIRD SPEED SYNCHRONIZER

(34) Remove bearing and fourth and fifth speed clutch gear from input shaft (*fig. 45*). Install puller on fifth speed gear and pull both gears until stopped by clutch gear keys. Remove puller, push fifth speed gear away from clutch gear, install puller on clutch gear and pull gear with roller bearing ahead of it off shaft. Remove keys from shaft.

(35) Remove bearing, fifth speed gear and spacer from input shaft (*fig. 45*). Install puller on gear and pull gear with bearing ahead of it off shaft. Lift spacer off shaft. Remove keys from shaft.

(36) Remove bearing from input shaft (*fig. 45*). Install puller on fifth speed gear bearing and pull it off shaft. Input shaft is now bare, as second and third speed gears are made integral with it.

(37) Dismantle fourth and fifth speed synchronizer (*fig. 44*). Procedure is same as in paragraph (32) except that this assembly includes in addition a brass ring, held to sleeve by same rivets that hold steel ring. Chisel off heads of eight rivets from outside of steel ring, and punch rivets out from outside with drift punch (10 or 12 inches with $\frac{1}{4}$ -in. end).

(38) Disassemble countershaft assembly (*fig. 46*). Remove snap ring holding large gear, install puller on large gear and unthreaded end of shaft and pull gear off shaft. Remove keys. Countershaft is now bare as first speed and reverse gears are made integral with it.

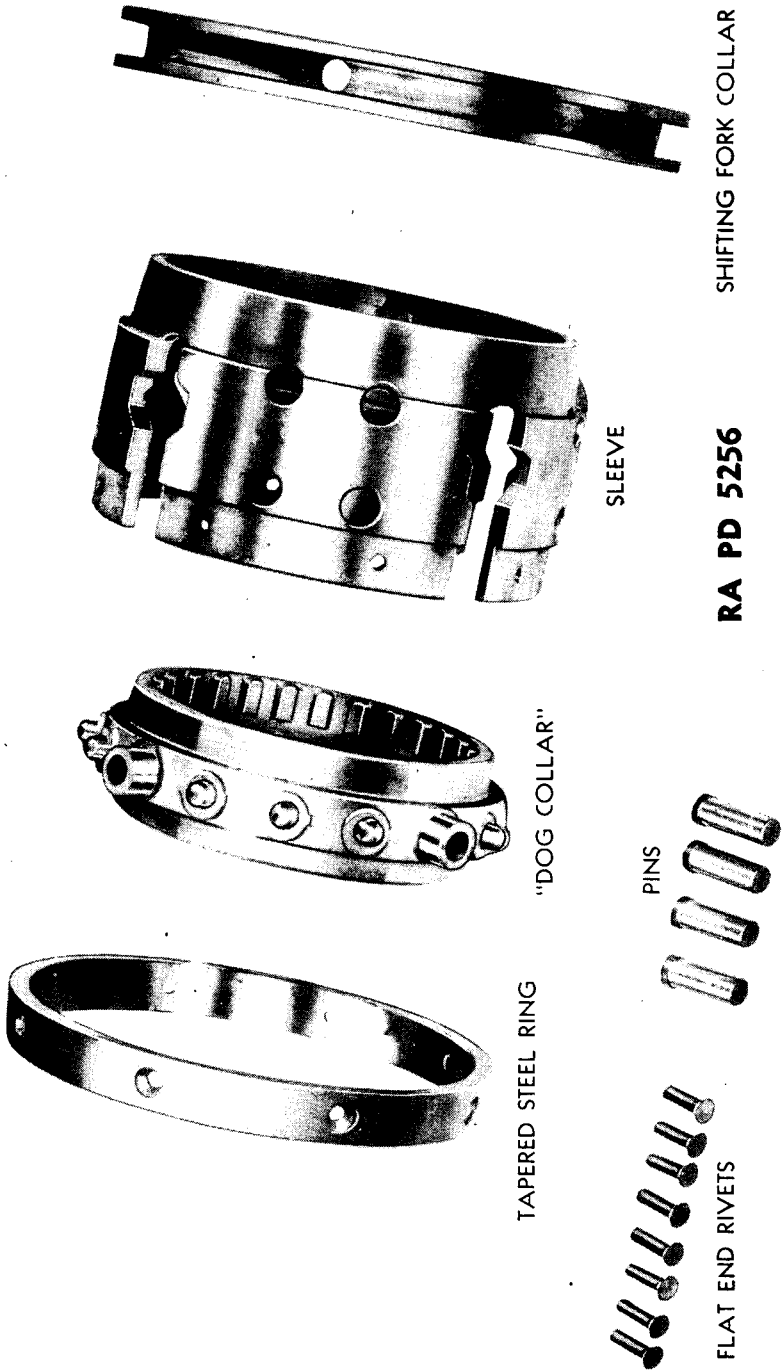
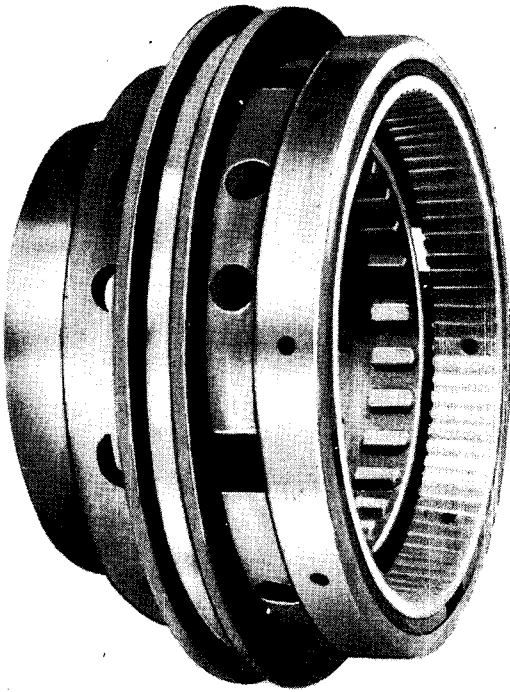


FIGURE 42 — SECOND AND THIRD SPEED SYNCHRONIZER DISASSEMBLED



FOURTH AND FIFTH SPEED
 SYNCHRONIZER

RA PD 5258

FIGURE 43 — FOURTH AND FIFTH SPEED SYNCHRONIZER

9. SPROCKET AND HUB ASSEMBLIES. — a. Equipment. —

Wrench, $\frac{3}{4}$ -in.

Wrench, $1\frac{7}{16}$ -in.

b. Procedure. — (1) Remove sprocket assembly from final drive shaft. Remove the eight nuts ($1\frac{7}{16}$ -in. wrench) and lock washers from studs projecting from final drive shaft flange through hub. Slide assembly off studs, bumping if necessary.

(2) Remove two sprockets from hub. Remove cap screws ($\frac{3}{4}$ -in. wrench) and lock washers holding sprockets to hub (13 screws in each sprocket) and bump sprockets off hub.

10. FINAL DRIVE ASSEMBLIES. — a. Equipment. —

Bar, pinch

Pliers

Wrench, $\frac{3}{4}$ -in.

Hoist

Puller, gear

Wrench, $1\frac{1}{8}$ -in.

Mallet, wood

Screwdriver

Wrench, $4\frac{1}{2}$ -in.

b. Procedure. — (1) Remove final drive (figs. 47 and 48). Arrange hoist to support final drive while being removed, exerting just enough lift to take weight off assembly. Remove row of bolts ($1\frac{1}{8}$ -in. wrench) around final drive

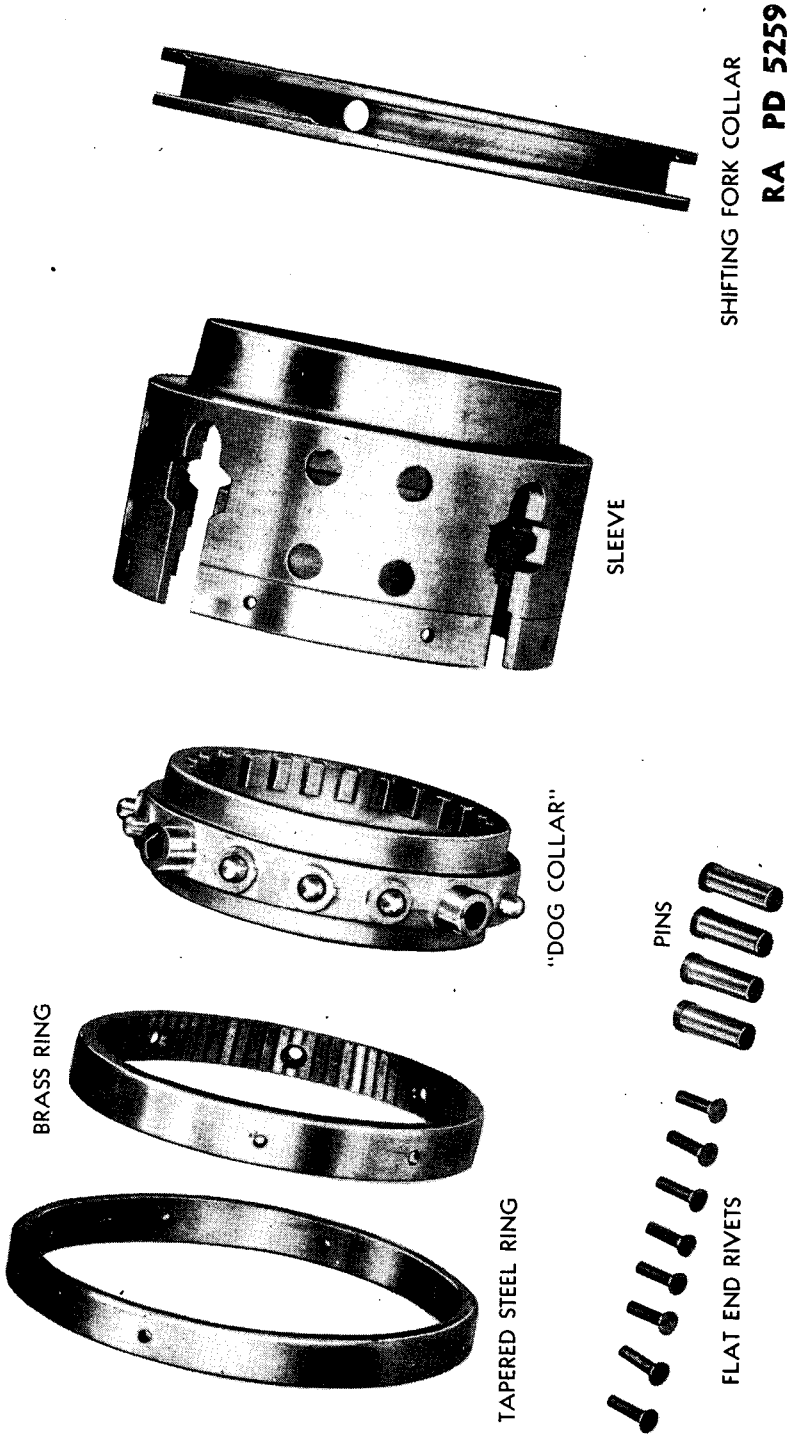
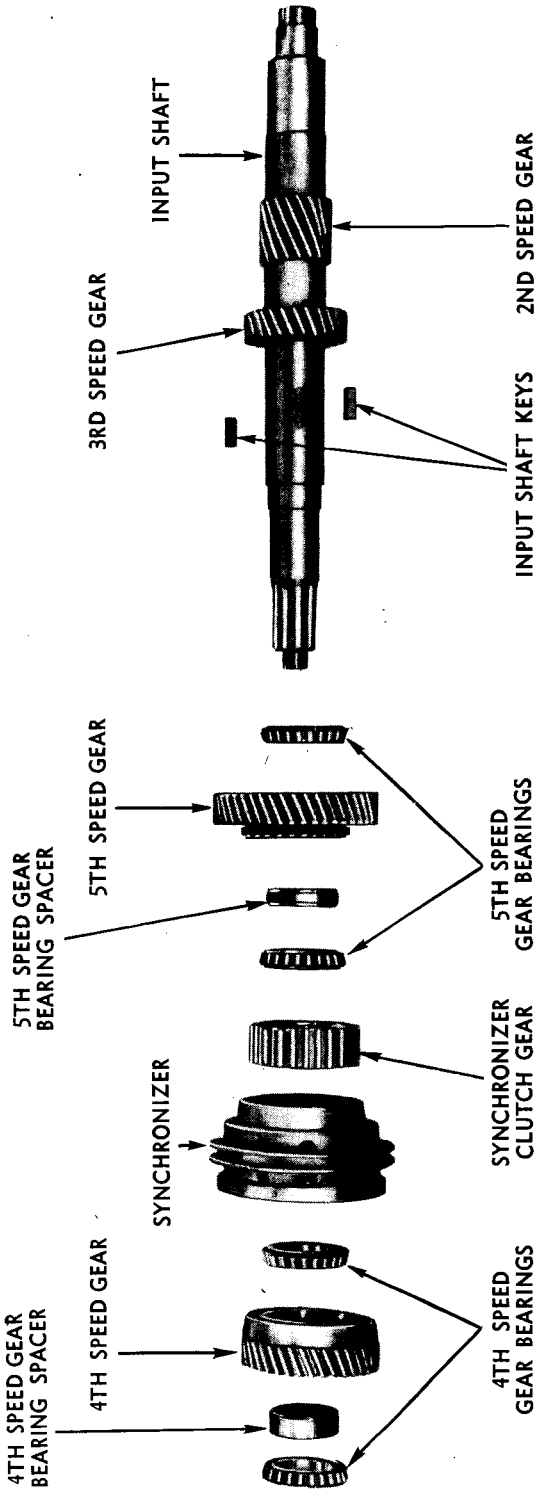


FIGURE 44 — FOURTH AND FIFTH SPEED SYNCHRONIZER DISASSEMBLED

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS



RA PD 4835

FIGURE 45 — INPUT SHAFT ASSEMBLY

DISASSEMBLY OF COMPONENT ASSEMBLIES

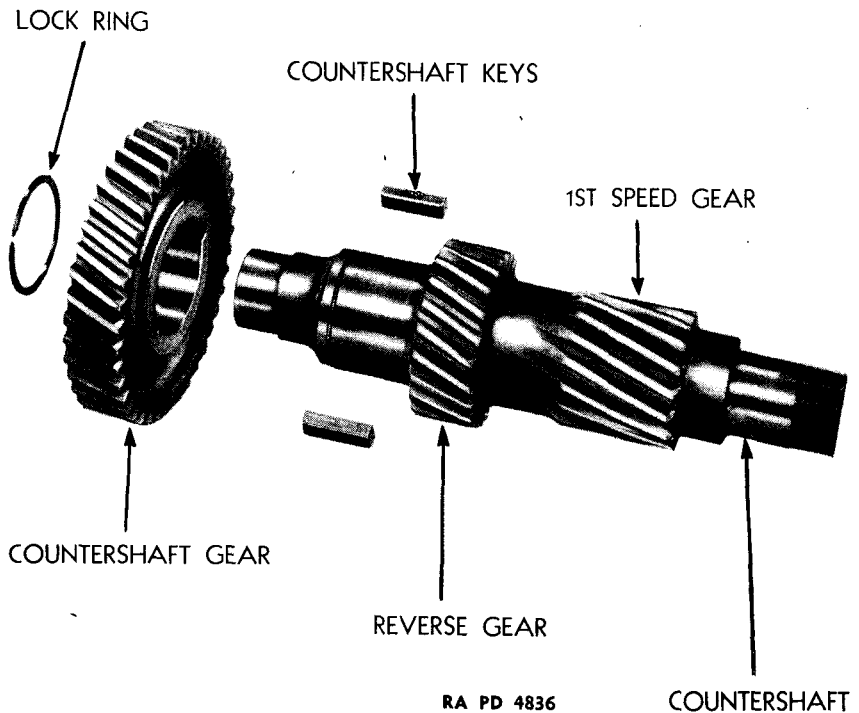


FIGURE 46 — COUNTERSHAFT ASSEMBLY

cover and pry away from steering brake housing with pinch bar. The assembly must be manipulated to remove it, since pinion gear encloses and meshes with compensating drive shaft. Lower final drive to floor. Remove dowel pins. Repeat operation to remove assembly on opposite side.

(2) Remove herringbone gear and pinion (*fig. 49*). Herringbone gear and pinion must be removed at the same time on account of interlocking teeth. Remove cotter pin from nut on herringbone gear and remove nut ($4\frac{1}{2}$ -in. wrench) and washer. Install puller on herringbone gear and pull slowly off shaft. The pinion must be kept in line with herringbone gear as it is raised, to prevent cocking of pinion gear in its bearing in cover. The pinion must slide out of its bearing as gear is pulled off shaft.

(3) Remove pinion gear bearing from cover. Remove locking wire and three bolts ($\frac{3}{4}$ -in. wrench) holding retainer to cover and remove the retainer. Lift bearing out of cover.

(4) Remove bearing races from pinion gear (*fig. 50*). Remove snap ring from each end of gear, with screwdriver, and slide races off gear.

(5) Remove spacer and bearing from herringbone gear (*fig. 50*). Knock spacer off hub of gear with wood mallet and lift bearing off hub.

ORDNANCE MAINTENANCE
 POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

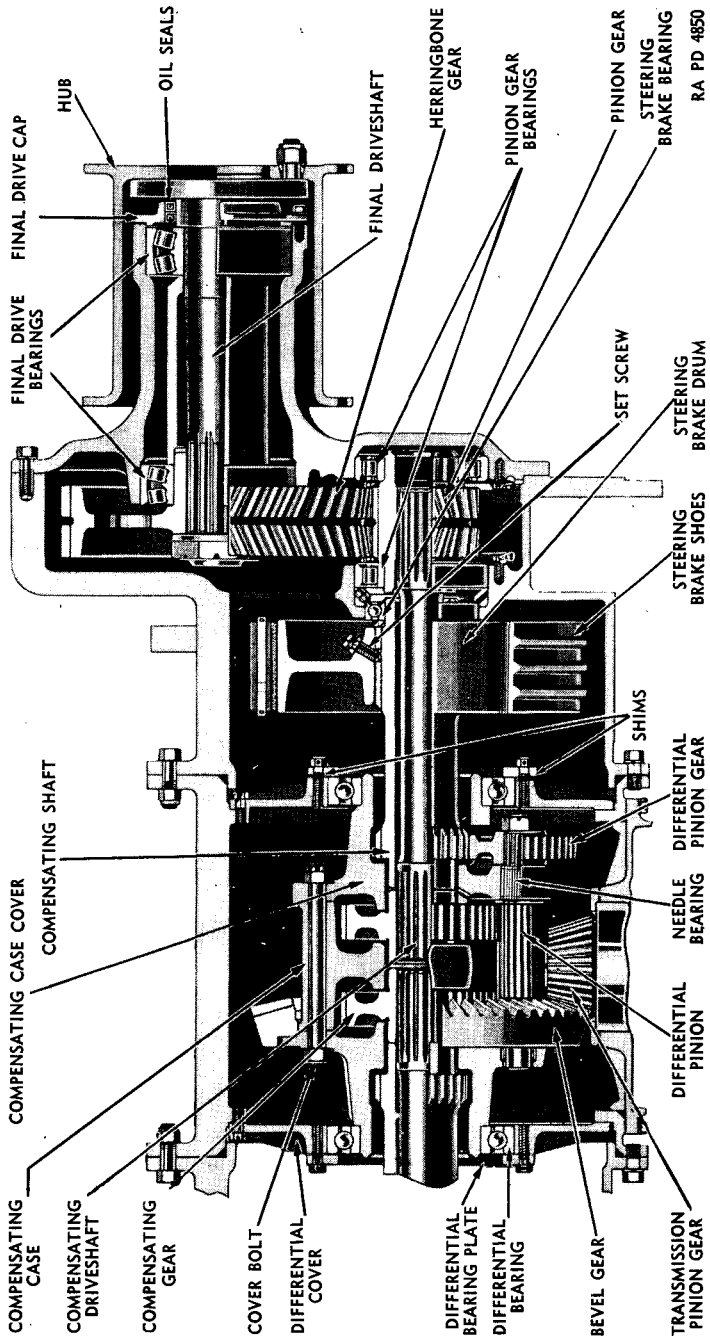
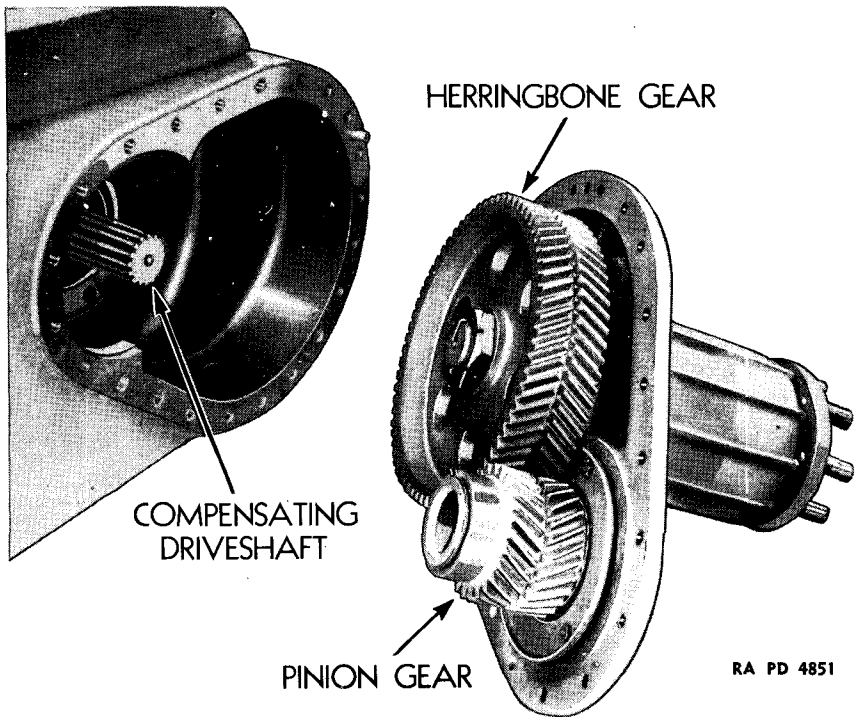


FIGURE 47 — DIFFERENTIAL AND FINAL DRIVE ASSEMBLY

DISASSEMBLY OF COMPONENT ASSEMBLIES



RA PD 4851

FIGURE 48 — FINAL DRIVE UNIT REMOVED FROM ASSEMBLY

(6) Remove cover or housing from drive shaft and bearing (figs. 51 and 52). Stand assembly on sprocket studs, supporting it with wood blocks or something similar. Install puller with fingers under edge of cover, and center screw on end of drive shaft. End of screw should be lubricated with white lead to prevent marring shaft. Be sure to keep puller in line with shaft to prevent binding. Pull cover with bearing until bearing is freed from its seat on shaft, remove puller and lift cover off shaft.

(7) Remove final drive cap, oil seals and bearing from cover (fig. 52). Remove the ten bolts ($\frac{3}{4}$ -in. wrench) and lock washers holding cap to cover and push two oil seals out of cap. Slide bearing out of end of cover. Remove gasket.

11. STEERING BRAKE ASSEMBLIES. — a. Equipment. —

Bar, brass, bumping	Pliers
Bar, pinch	Press, arbor
Driver, bearing	Splitter, ring
Driver, bearing for compensating shaft	Wrench, $\frac{5}{8}$ -in.
Eyebolt	Wrench, $\frac{3}{4}$ -in.
Hoist	Wrench, $\frac{7}{8}$ -in.
Mallet, bronze	Wrench, 1-in.
Mallet, wood	Wrench, $1\frac{1}{8}$ -in.

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

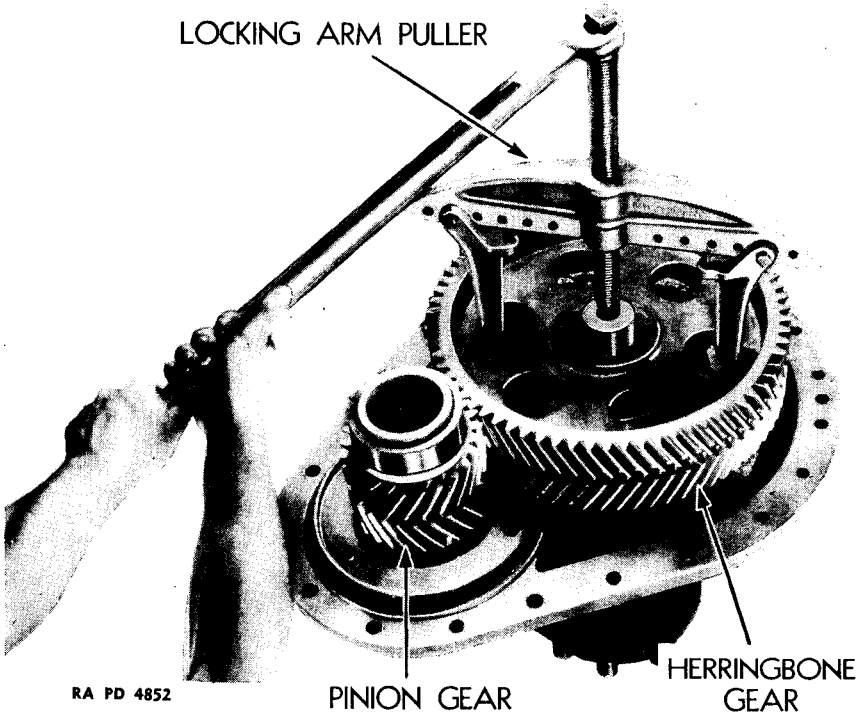


FIGURE 49 - REMOVING HERRINGBONE GEAR

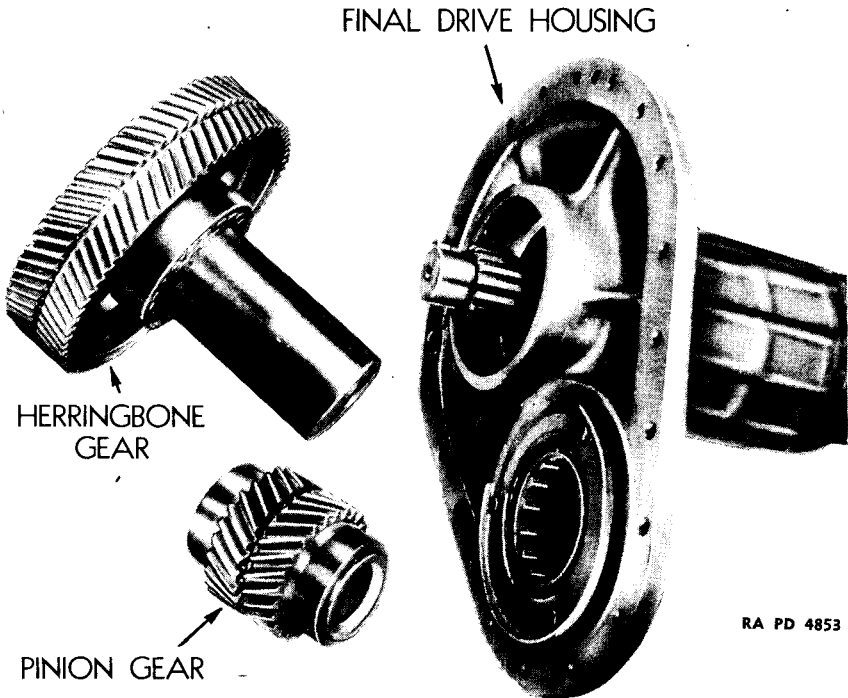


FIGURE 50 - HERRINGBONE AND PINION GEARS

DISASSEMBLY OF COMPONENT ASSEMBLIES

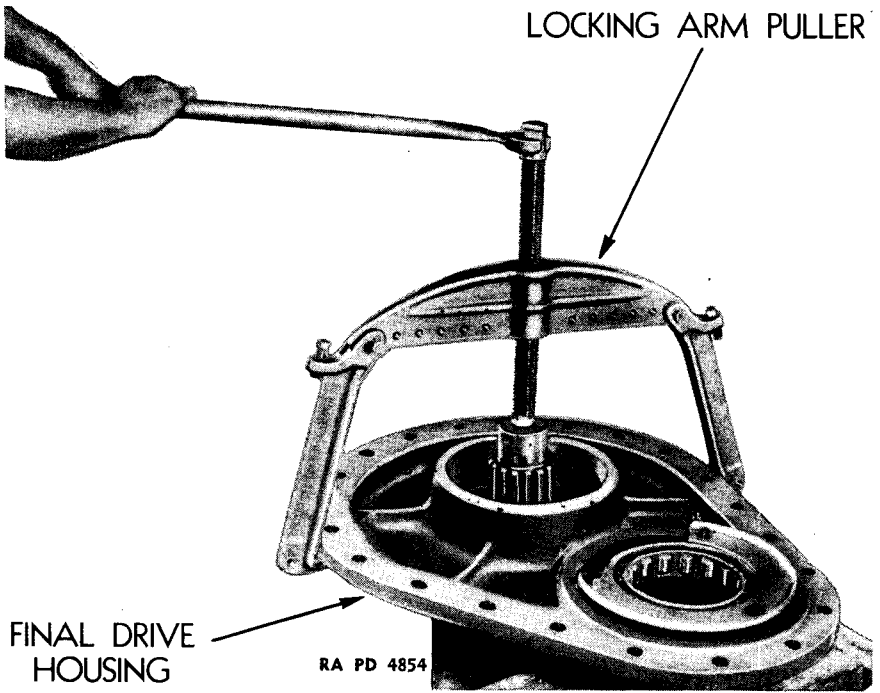


FIGURE 51 — REMOVING FINAL DRIVE SHAFT

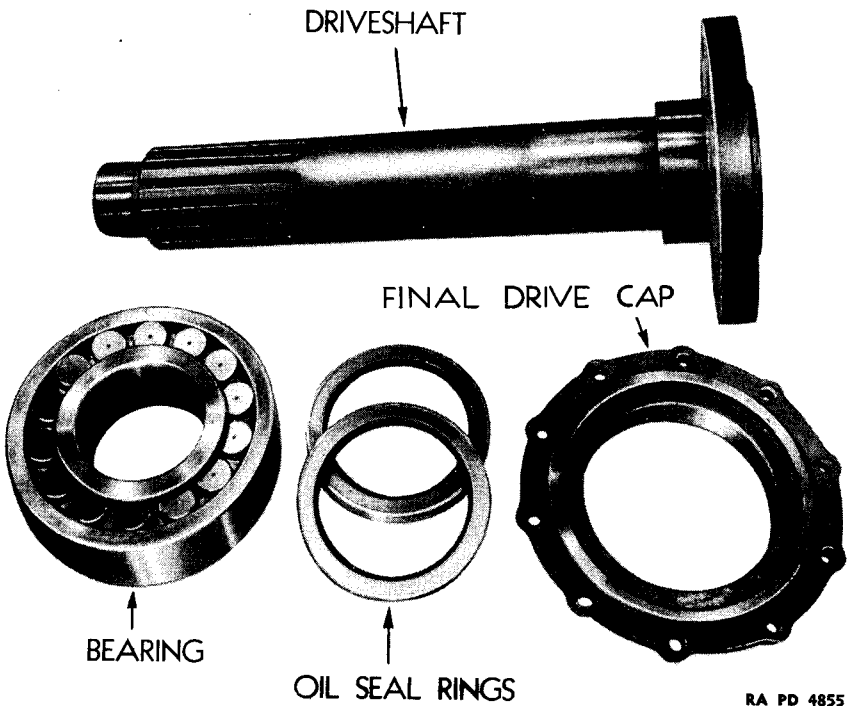
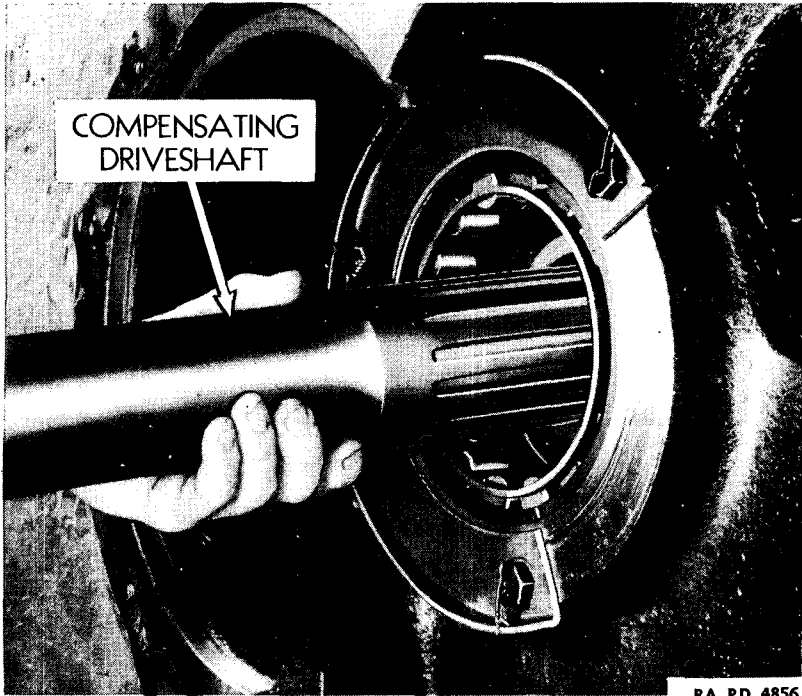


FIGURE 52 — FINAL DRIVE SHAFT AND BEARING

b. Procedure. — (1) Remove compensating drive shaft (*fig. 53*). With final drive assembly removed, compensating drive shaft can be readily pulled out of steering brake housing by hand.

(2) Remove steering brake assembly from differential (*figs. 19 and 54*). Raise differential and steering brake assemblies with hoist, remove bolts (1½-in.



RA PD 4856

FIGURE 53 — REMOVING COMPENSATING DRIVE SHAFT

wrench) from flanges on bottom of assembly (*fig. 20*), and lower to rest on wood blocks. Insert eyebolt into bolt hole in upper flange of steering brake housing, attach hoist and apply sufficient tension to take weight of steering brake assembly. Remove bolts on inner flange (1-in. wrench) and bolts on outer flange (1½-in. wrench). Use pinch bar to pry steering brake housing from differential housing. Compensating shaft meshes with gears in differential and will have to be manipulated to free it before steering brake assembly can be removed. When free, lower steering brake assembly to floor and repeat procedure on other assembly.

(3) Remove steering brake shoes (*fig. 55*). (To remove shoes without removing steering brake assembly from tank see par. 15.) Remove bolts (¾-in. wrench) holding brake inspection plate to housing and remove plate. Remove bolt (¾-in. wrench) from the brake lever arm and pry arm off shaft. Turn down the centering bolt (⅞-in. wrench) in housing below brake shoes. Remove brake adjusting nut

DISASSEMBLY OF COMPONENT ASSEMBLIES

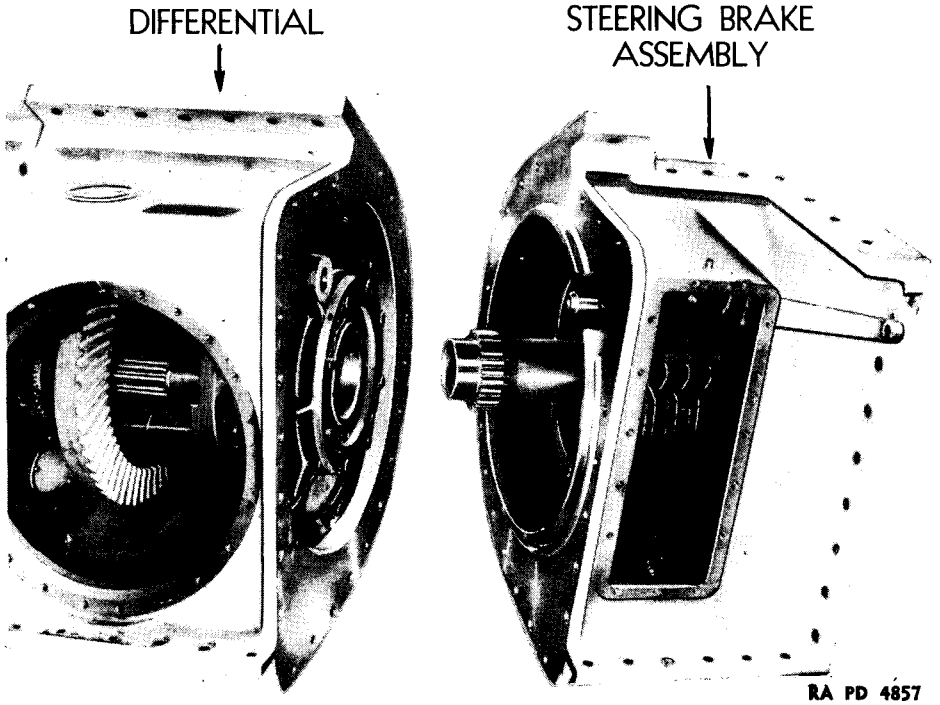


FIGURE 54 — REMOVING STEERING BRAKE ASSEMBLY

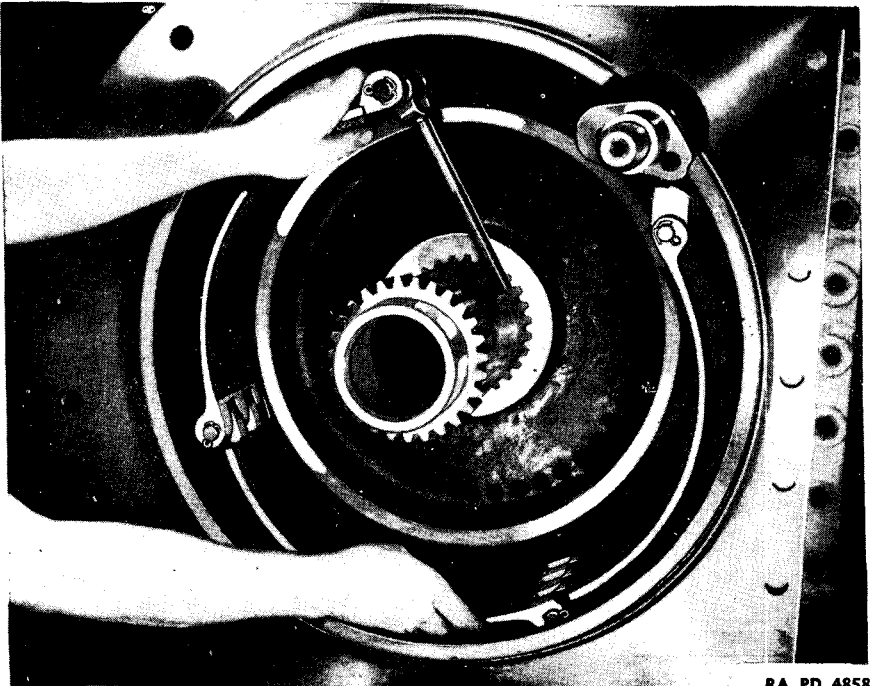
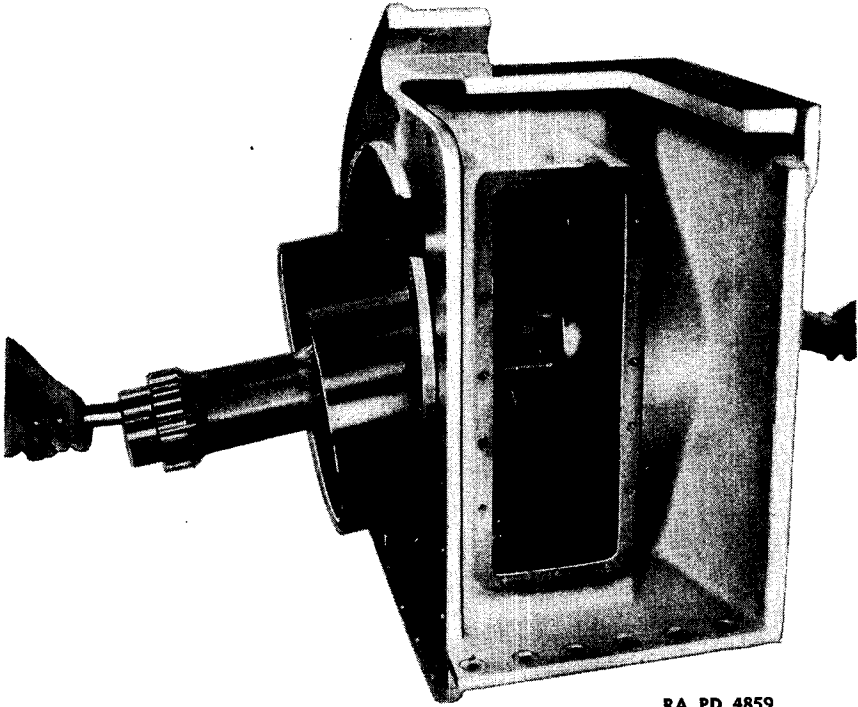


FIGURE 55 — REMOVING BRAKE SHOE FROM HOUSING



RA PD 4859

FIGURE 56 — REMOVING BRAKE DRUM FROM HOUSING

($1\frac{1}{8}$ -in. wrench) through inspection plate opening, slide screw out of yoke and take spring and washer off screw. Turn brake cam so that it clears housing and pull brake shoes and shaft out through side of housing. Remove centering bolt and nut. (See paragraph 15 for disassembling and relining instructions).

(4) Remove pinion bearing and spacer (*fig. 48*). Remove locking wire and the three bolts ($\frac{3}{4}$ -in. wrench) which hold retaining plate over bearing, and lift out retaining plate, bearing and spacer.

(5) Remove compensating shaft, bearing and brake drum (*fig. 56*). Remove snap ring (ring splitter) from outer race of ball bearing. (If ring is pinched between bearing and outer surface of housing, tap on differential end of shaft with wood mallet. This moves shaft and bearing outward and frees ring). Place bar about four feet long inside hollow shaft and, supporting weight on bar, drive shaft, bearing and drum out of housing from outside end with brass bumping bar and bearing driver.

(6) Remove bearing, spacer and drum from compensating shaft. Loosen two lock nuts and remove locking screws from hub of drum. Remove snap ring holding bearing on end of shaft. (If ring is pinched between bearing and shaft, hammer on long end of shaft with bronze mallet, driving shaft through drum far enough to free ring). Lift ball bearing and spacer off end of shaft. Drive shaft

DISASSEMBLY OF COMPONENT ASSEMBLIES

out of drum with bearing driver and bumping bar on short end of shaft.

(7) Remove brake shaft bushings. Brake shaft bushings should not be removed unless worn or damaged. If removal is necessary, press out with arbor press.

12. DIFFERENTIAL ASSEMBLY. — *a. Equipment.* —

Bar, metal, 1-ft.	Press, arbor
Fixture, bearing, differential	Puller, bearing
Hammer	Remover and Driver, bearing, needle
Hammer, brass	Remover, bearing, needle
Hammer, bronze	Wrench, $1\frac{3}{8}$ -in.
Hoist	Wrench, 1-in.
Mallet, wood	Wrench, $1\frac{7}{8}$ -in.
Pliers	Wrench, $1\frac{1}{8}$ -in.

b. Procedure. — (1) Remove right bearing holder plate from cover plate (figs. 47 and 54). Use hoist to turn differential assembly to rest upon left end of housing (nearest bevel gear). At right end remove locking wire and bolts (1-in. wrench) around bearing holder plate (inner circle of bolts). Lift off bearing holder plate and shims, tagging shims to identify end from which they were taken.

(2) Remove right differential cover plate (figs. 47 and 54). Remove locking wire and bolts (1-in. wrench) from differential cover plate (outer circle of bolts). Place metal bar about one foot long across opening in cover plate and bolt bearing holder plate over bar, thus locking bar between cover and holder plates. Attach hoist to bar and lift, hammering outside of cover plate to break it loose. Do not remove brake shaft bushing unless worn or damaged. If removal is necessary, press bushing out with arbor press.

(3) Remove differential (figs. 47, 57 and 64). Insert metal bar between differential pinion gears and compensating case cover and attach hoist to bar, passing sling through end of cover. Lift differential out of housing.

(4) Remove differential end bearings (figs. 47, 58, 59 and 64). Stand differential on end, place differential bearing fixture on end of differential compensating case cover, hook fingers of puller under bearing and pull bearing off end of cover. Raise the bearing up over the fixture and off the cover. A hydraulic puller can be used if one is available. Turn differential onto other end and remove second bearing in same way.

NOTE: The inside part of differential bearing fixture (fig. 59) is used for removing the differential bearings and both parts are used in replacing bearings.

(5) Separate compensating case from case covers (figs. 47, 58 and 60). Remove cotter pins and nuts ($1\frac{7}{8}$ -in. wrench) from six bolts holding compensating case and two covers together. Alternate bolts are put through from opposite sides, placing three nuts on each cover. Insert metal bar between pinion gears and cover and attach hoist to bar, sling passing through hole in end of cover. Lift slowly with hoist, separating covers from case and lifting out two compensating gears. (Three dowel pins are used between each cover and case, and it may be necessary to use brass hammer to separate). Remove the six dowel pins.

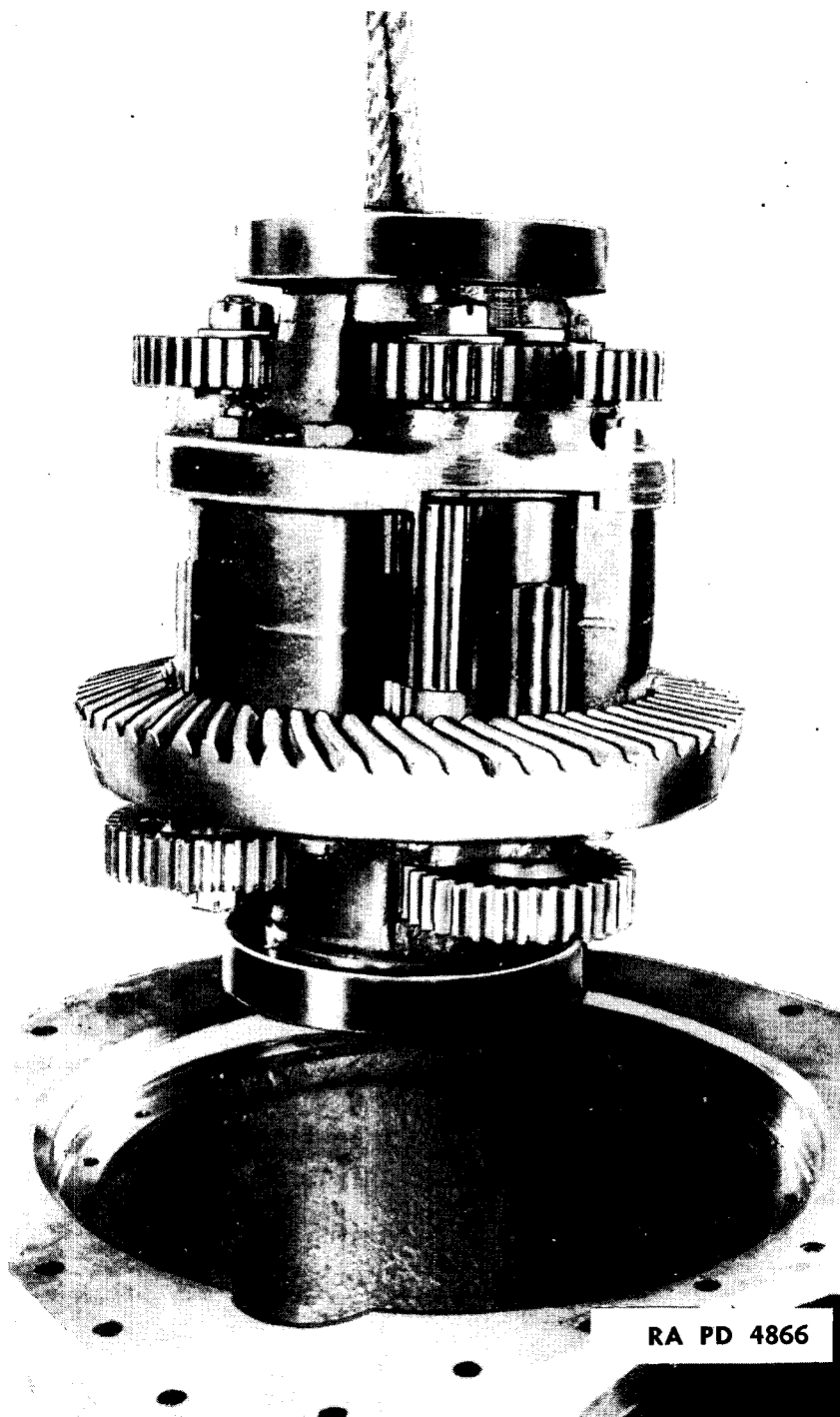


FIGURE 57 — REMOVING DIFFERENTIAL FROM HOUSING

DISASSEMBLY OF COMPONENT ASSEMBLIES

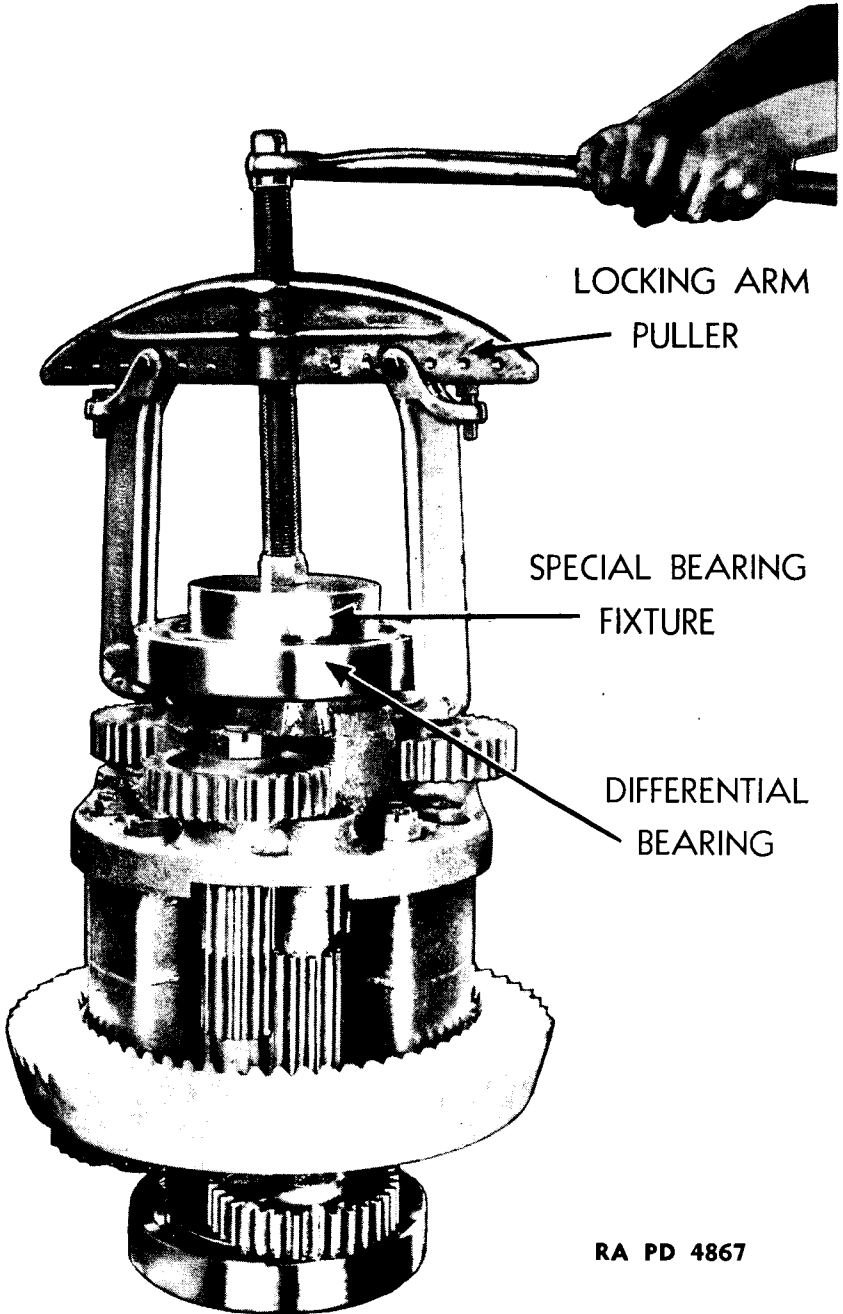


FIGURE 58 — REMOVING DIFFERENTIAL BEARING

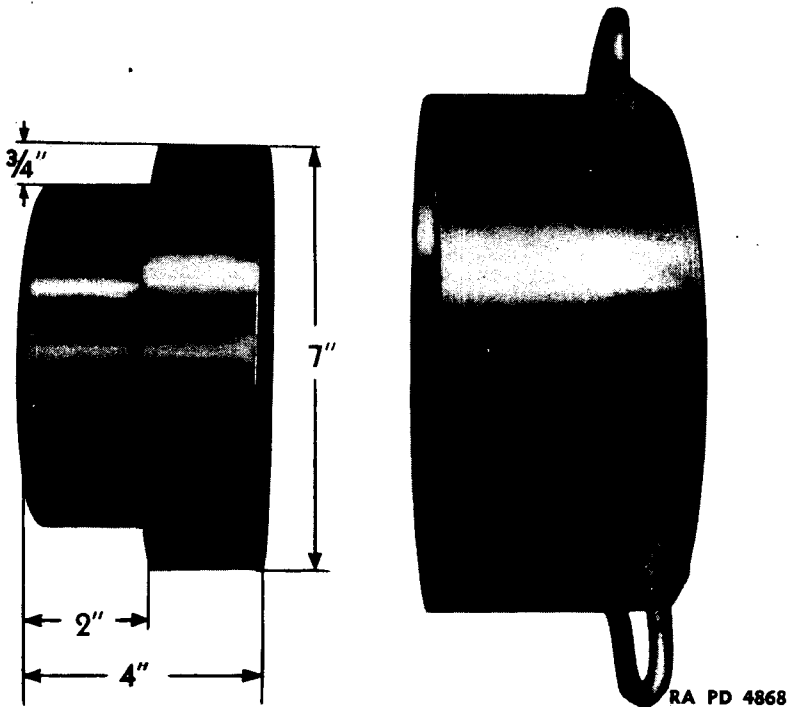


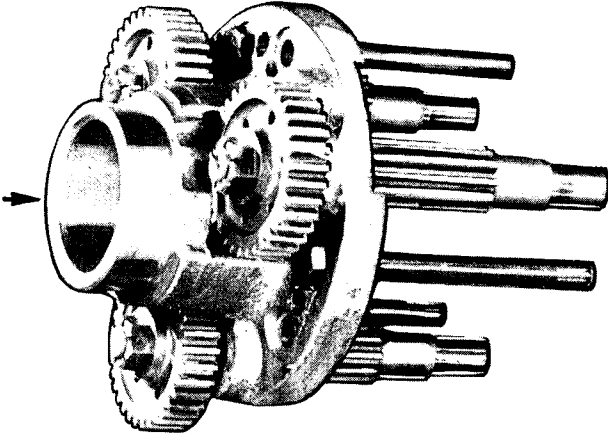
FIGURE 59 — DIFFERENTIAL BEARING FIXTURE

(6) Remove pinions and pinion gears from left compensating case cover (figs. 47, 60, 61 and 64). The left compensating case cover is enclosed by bevel gear. Turn cover so that bevel gear is face down and place on end of compensating case and gear, with block of wood under case so that pinion shafts are clear of floor. Remove cotter pins from the three pinion gear nuts and remove nuts ($1\frac{1}{8}$ -in. wrench). To keep pinion from turning while removing nut, insert wood block or brass rod between teeth of pinion and compensating gear. The pinion gears cannot be lifted directly off pinions when nuts are removed, since they are partly enclosed by cover. Drive pinions and shafts out of pinion gears and remove pinions and pinion gears from cover. (Each pinion and its shaft are made integral).

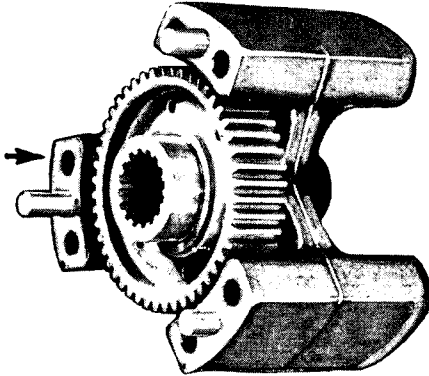
(7) Remove needle bearings from compensating case cover (figs. 47, 62 and 64). Remove washers over needle bearings and drive bearings out of cover from outside end with special needle bearing remover (left tool fig. 62). One end of tool is used to remove smaller bearing and other end for larger bearing.

(8) Remove bevel gear from left compensating case cover (figs. 47, 61, 63 and 64). Lay compensating case cover on floor with bevel gear face down. Remove locking wire from bolts around bevel gear and remove bolts ($\frac{1}{8}$ -in.

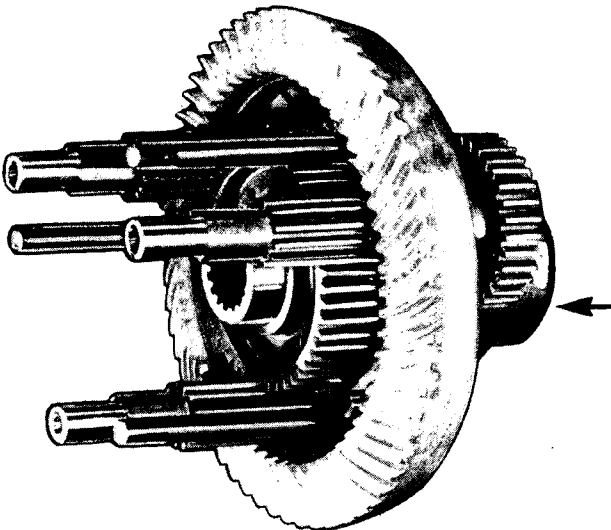
RIGHT HALF COMPENSATING CASE COVER



COMPENSATING CASE

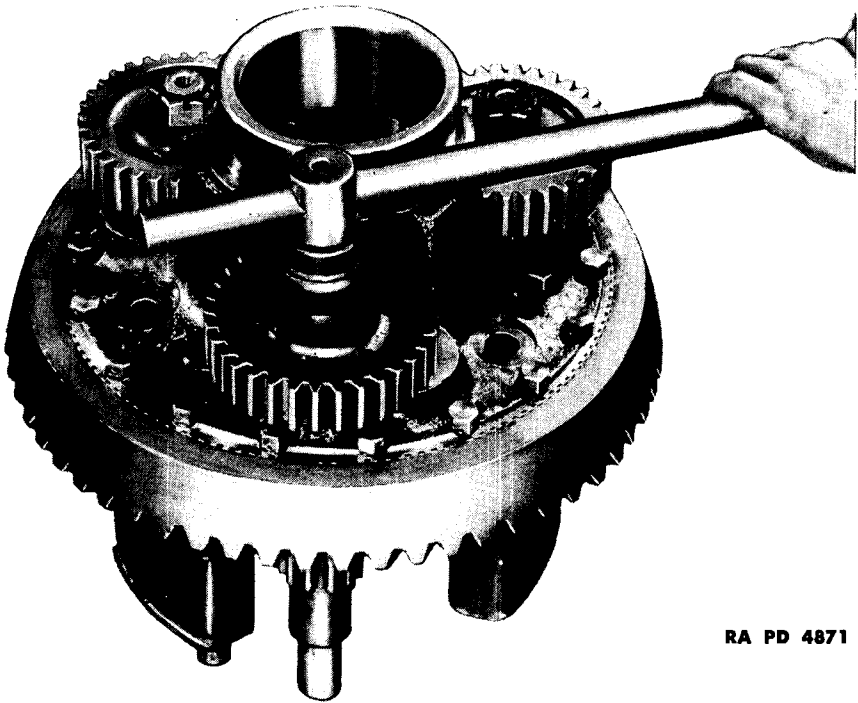


LEFT HALF COMPENSATING CASE COVER



RA PD 4870

FIGURE 60 — COMPENSATING CASE AND COVERS



RA PD 4871

FIGURE 61 — REMOVING PINION GEAR NUT

wrench). Place wood block under cover to raise bevel gear off floor and knock gear off cover with wood mallet, hammering evenly around edge of gear.

(9) Disassemble right compensating case cover. The right compensating case cover is disassembled in same way as left except that there is no bevel gear. (See paragraph 12 b (5), (6) and (7) preceding).

(10) Remove and disassemble left bearing holder plate and differential cover plate. Turn differential housing on right end and remove and disassemble left bearing holder plate and differential cover plate as described in paragraph 12 b (1) and (2).

(11) Remove bushings from compensating case and covers. Do not remove steel backed bronze bushings from covers or case unless worn or damaged beyond usefulness. If bushings must be removed, press out with arbor press.

DISASSEMBLY OF COMPONENT ASSEMBLIES

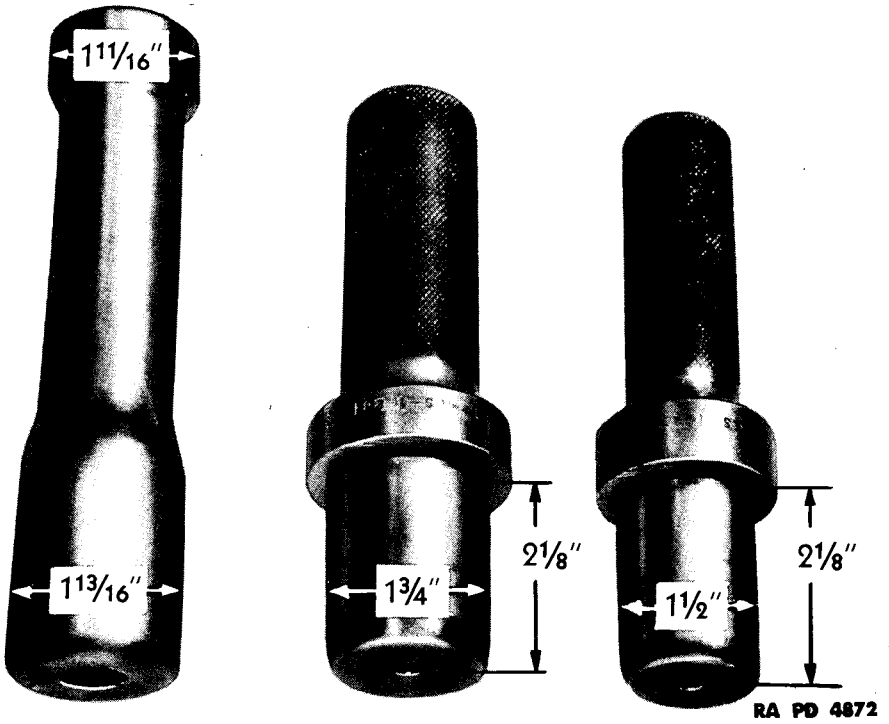


FIGURE 62 — NEEDLE BEARING REMOVER AND NEEDLE BEARING DRIVERS

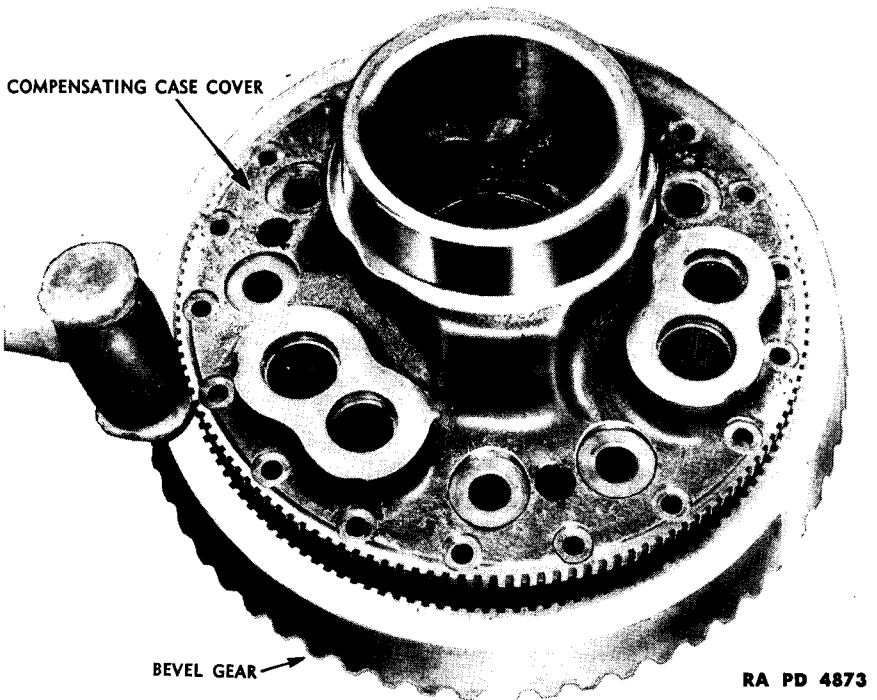
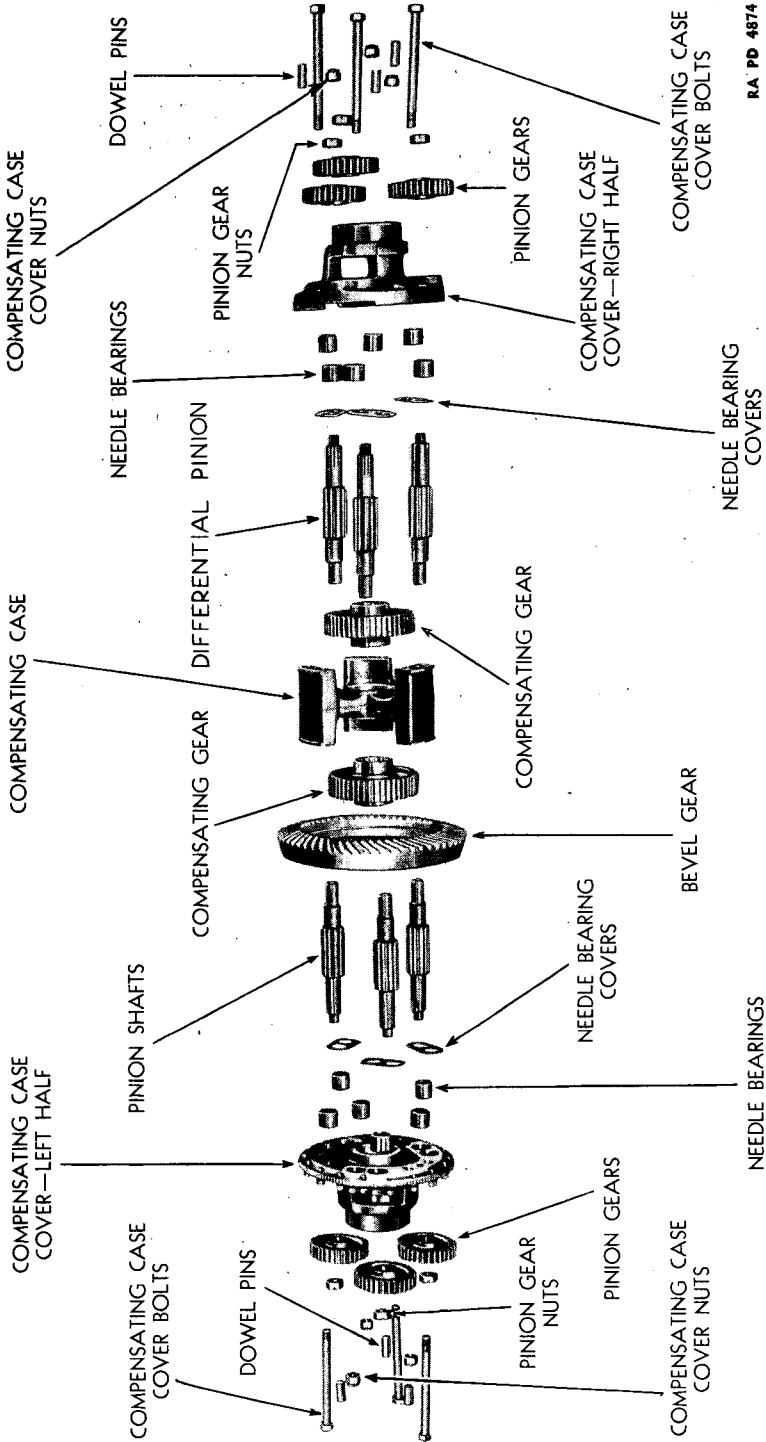


FIGURE 63 — REMOVING BEVEL GEAR

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS



RA PD 4874

FIGURE 64 — DIFFERENTIAL ASSEMBLY

MAINTENANCE

SECTION V

MAINTENANCE

	Paragraph
Parking brake	13
Transmission	14
Remove steering brake shoe assembly.....	15

13. PARKING BRAKE. — The lining of the parking brake is riveted to the inside of the brake shoe and should not be disturbed unless worn or damaged. If necessary to replace the lining, hold the shoe in a vise, drive the rivets out of the shoe and lining with a punch and remove the old lining. Push a new lining into place and line up the holes in the shoe and lining. Push rivets through the lining and the shoe, with the rivet heads in the countersunk holes in the lining and head over the rivets on the outside of the shoe.

14. TRANSMISSION. — *a.* Chief trouble encountered with the transmission is difficulty in shifting. This may be due to a number of causes, but about the only way to locate the difficulty is to disassemble the transmission until the cause is found. Some of the troubles follow.

b. Synchronizer clutch gear. — The outside diameter of the clutch gears is a close fit in the synchronizers and shifting sleeve. If these parts do not slide freely it may be necessary to free slightly the points of interference.

c. Synchronizing cones. — The bronze cones or linings in the second, third, and fifth speed gears are held in place by a number of small rivets centered on the outside cylindrical surface of the cone. If a cone works loose on these rivets the resultant motion causes irregular shifting in the speed affected. The remedy is to install a new cone and rivet in place.

d. Snap ring on fourth speed gear. — The fourth speed gear and cone are held together by a flat snap ring. Snap rings in the first transmissions were narrower than those now used and sometimes broke. A broken ring frees the cone from the gear, resulting in irregular shifting. To remedy, find and remove the pieces of the broken snap ring and replace with a ring of the newer, wider type.

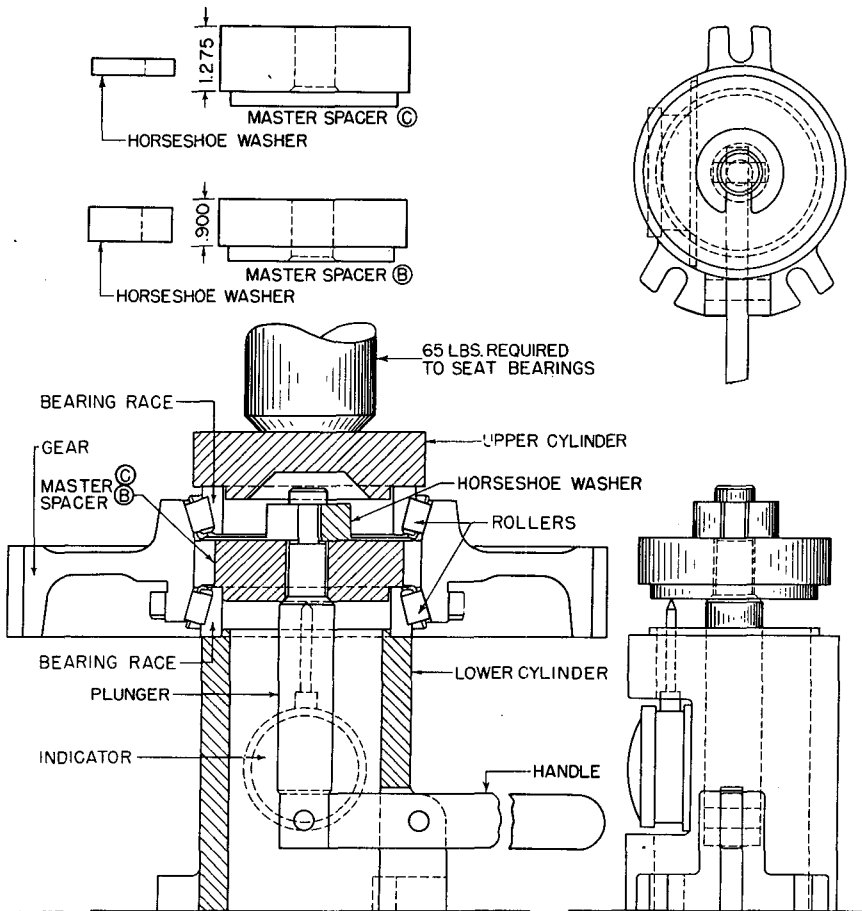
e. Roller bearings. — Roller bearings or races showing undue wear should be replaced. Before assembly in the transmission all bearings should be checked in the fixture for determining the proper spacer width (*fig. 65*) and the proper spacer installed. The method of using the fixture is as follows:

(1) Place one bearing race with rollers on the lower cylinder of the fixture, the cone being held in proper position by the pilot on the cylinder.

(2) Place the master spacer (C for fourth speed gear and B for other gears) on top of the bearing cone and lock it to the plunger with the horseshoe washer.

(3) Place the gear or outer race over the rollers and place the second bearing race with rollers in the upper side of the gear. Place the upper cylinder on top of the second bearing race and a weight of 65 lb. on top of the cylinder.

**ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS**



NOTE: WITH CORRECT SPACER, THE LATERAL PLAY OF THE GEAR SHOULD BE .002 TO .004 BEFORE THE ASSEMBLY IS MOUNTED ON THE SHAFT.

SPEEDS	GEAR NO.	BEARING NO.	MASTER SPACER	INDICATOR READING	SPACER NO.	SIZE
3 RD .	C77553	A217353	B	.015-.014	A217331-A	.918-.001
			B	.013-.012	A217331-B	.916-.001
2 ND .	C77555	A217353	B	.011-.010	A217331-C	.914-.001
REVERSE	C77557	A217346	B	.009-.008	A217331-D	.912-.001
1 ST .	C77559	A217346	B	.007-.006	A217331-E	.910-.001
5 TH .	C77549	A217346	B	.005-.004	A217331-F	.908-.001
4 TH .	C77551	A217353	C	.015-.014	A217328-A	1.293-.001
			C	.013-.012	A217328-B	1.291-.001
			C	.011-.010	A217328-C	1.289-.001
			C	.009-.008	A217328-D	1.287-.001
			C	.007-.006	A217328-E	1.285-.001
			C	.005-.004	A217328-F	1.283-.001

RA PD 5248

**FIGURE 65 — FIXTURE FOR DETERMINING WIDTH OF SPACERS FOR
TAPER-ROLLER BEARINGS**

MAINTENANCE

(If the load is applied by an arbor press use 60 lb. instead of the 65 lb. weight).

(4) Turn the gear on the bearings to allow them to seat properly. Move the handle up and down, causing the master spacer to move up and down between the faces of the bearing races. Inasmuch as the indicator is mounted on the body of the fixture and the indicator point contacts the master spacer, the total movement of the master spacer is read directly on the dial. Referring to the table (fig. 65), the proper spacer for the assembly under test corresponding to the indicator readings can be determined. With the correct spacer installed between the bearing races, the lateral play of the gear should be .002 in. to .004 in. before the assembly is mounted on the shaft.

f. *Oil collar.* — If the oil collar is removed from the output shaft check to see that no sludge remains in the internal annular groove. In reassembling be careful to see that the oil shaft is properly assembled with the oil collar or no oil will be delivered to the output shaft.

g. *Interlocks.* — If the edges of the interlocks that contact the shifting rods are too sharp the rods may be roughened, causing difficult shifting. Inspect for this condition and smooth the parts affected if necessary.

h. *Oil pump.* — In the first transmissions, a gasket was used between the body and cover of the oil pump. This caused uncertain clearance at the ends of the pump gears and uncertain oil pump capacity. This is remedied by installing a pump with a lapped joint instead of a gasket.

i. *Cleaning and inspection.* — Before being assembled all parts will be thoroughly cleaned to free them from grease, oil and dirt; and will be carefully inspected to see that they are in usable condition. If not in usable condition parts will be replaced.

15. REMOVE STEERING BRAKE SHOE ASSEMBLY. — a. *General.* — Steering brake shoes or bands can be adjusted, removed, relined and replaced without removing the power train unit from the tank. This work is done from the inside of the tank through the inspection plates on the rear of the steering brake housings.

b. *Equipment.* —

Bar, 4- or 5-ft.	Hammer	Wrench, $\frac{3}{4}$ -in.
Block, riveting	Pliers	Wrench, Allen, $\frac{3}{4}$ -in.
Clamps	Punch, rivet, 5/32-in.	Wrench, $\frac{7}{8}$ -in.
Counterbore, $\frac{3}{8}$ -in.	Screwdriver	Wrench, 1 $\frac{1}{8}$ -in.
Drill, $\frac{3}{16}$ -in.	Rivet, set	Wrench, socket, 2 $\frac{1}{2}$ in.

c. *Procedure.* — (1) Drain oil. On assemblies incorporating transmission oil cooler, oil is drained from steering brake housings ($\frac{3}{4}$ -in. Allen wrench). On assemblies not incorporating oil cooler, oil must be drained from steering brake housing and differential housing.

(2) Disconnect steering rod from brake shaft arm. Remove cotter pin from clevis pin and remove clevis pin connecting steering rod and brake shaft arm.

(3) Remove inspection plate. Remove bolts ($\frac{3}{4}$ -in. wrench) holding inspection plate to steering brake housing and remove plate.

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

(4) Remove brake shoes (figs. 66 and 67). Turn down centering bolt beneath shoe ($\frac{7}{8}$ -in. wrench). Remove cotter pin that passes through center lobe of cam and link pin. Remove brake adjusting nut ($1\frac{1}{8}$ -in. wrench), push rod forward through cam and remove washer and spring. Forward end of brake shoes will now be free. Insert screwdriver into annular groove in inside end of pin connecting lower end of cam and link, pry with screwdriver and slide pin out of inside end of cam (fig. 66). Brake shoes are now free and can be pulled out of housing from beneath brake drum. It may be necessary to use 4- or 5-ft. bar to lift shoes over centering bolt. Repeat process to remove shoes on other housing.

d. Disassemble, reline and reassemble brake shoe assembly. —

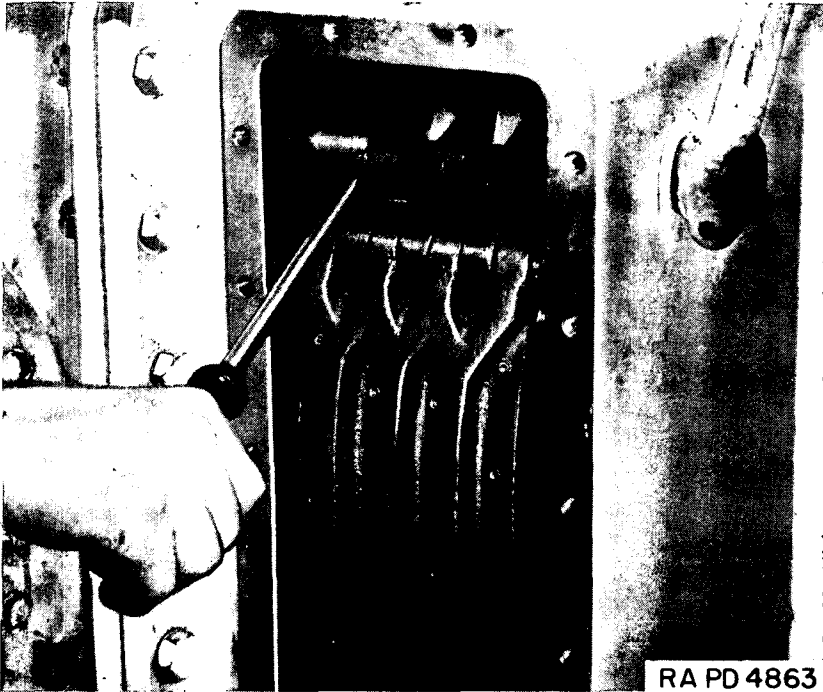
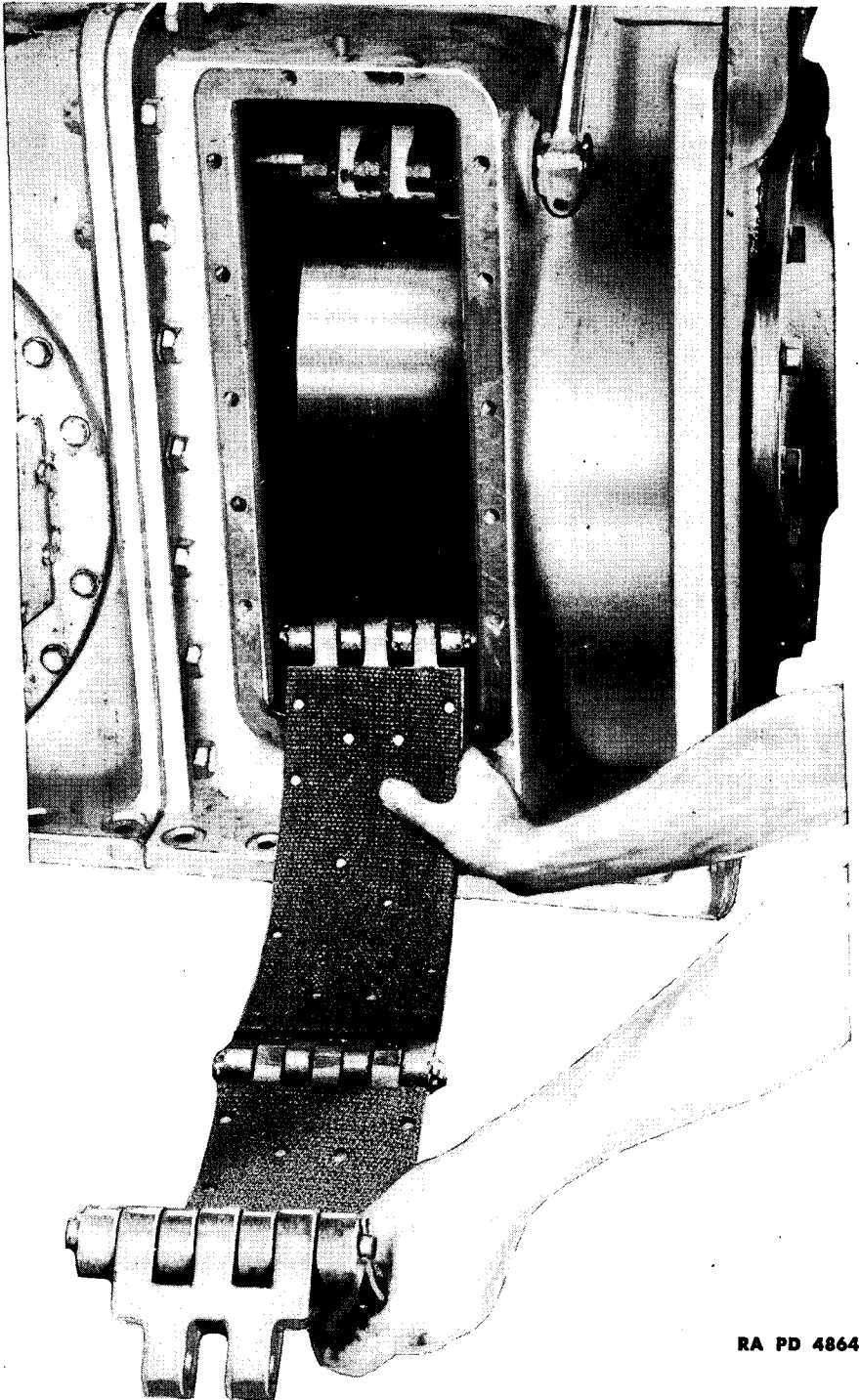


FIGURE 66 — REMOVING LINK PIN FROM CAM

(1) Disassemble. Remove cotter pins from four pins connecting various parts, remove pins and separate parts. Linings should not be removed from shoes unless worn or damaged.

(2) Reline shoes. If shoe must be relined, drive out rivets from outside of shoe with small punch and remove lining. Clamp new lining in place on shoe and drill ($\frac{3}{16}$ in.) for rivets. Counterbore ($\frac{3}{8}$ in.) inside of lining for rivet heads and install rivets, heading over on outside of shoe. (Lining is $\frac{5}{16}$ -in. thick, counterbore $\frac{3}{8}$ -in. diam., to depth sufficient to leave $\frac{1}{8}$ -in. of lining).

MAINTENANCE



RA PD 4864

FIGURE 67 — PULLING BRAKE SHOES OUT OF HOUSING

STEERING BRAKE ADJUSTING NUT

$\frac{7}{8}$ "

RA PD 4865

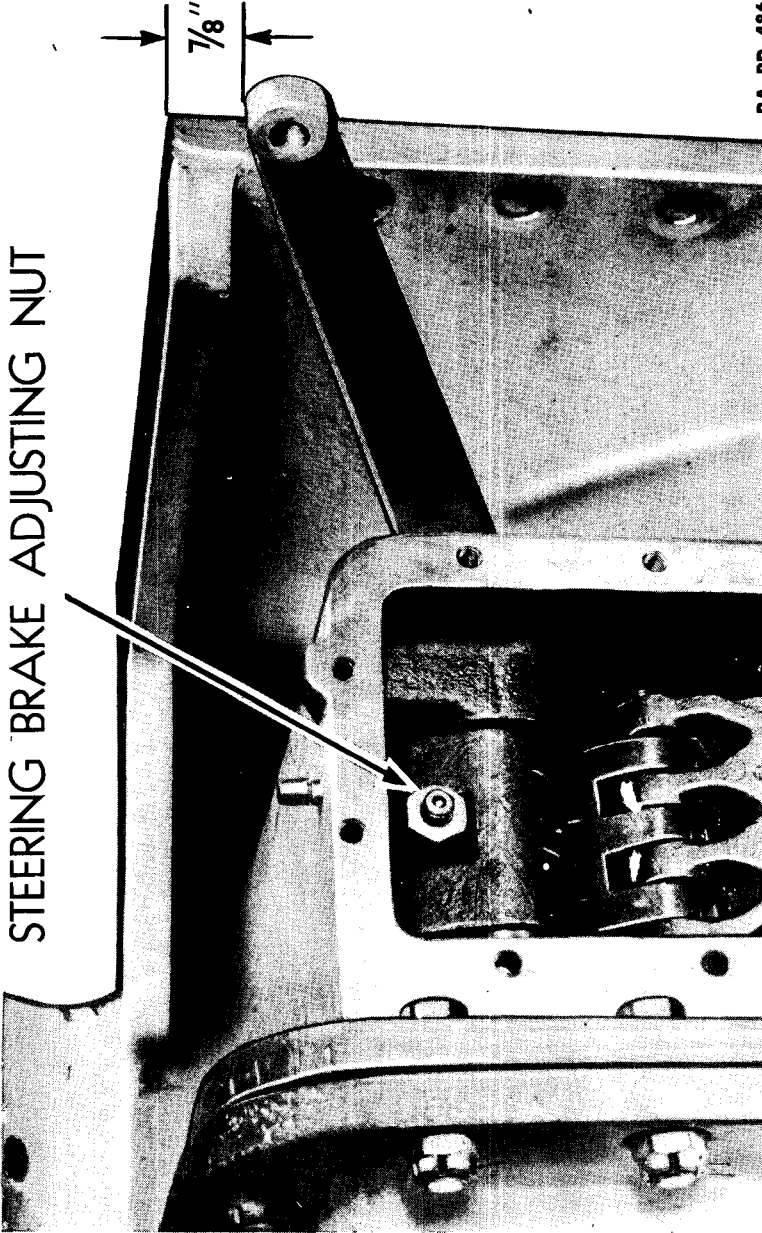


FIGURE 68 — BRAKE ADJUSTMENT

MAINTENANCE

(3) Assemble. Assemble parts as shown in figure 55, install pins and secure in place with cotter pins.

e. *Install brake shoe assembly.* — (1) Install brake shoe assembly (figs. 66, 67 and 68). Check to see that centering bolt is in place in steering brake housing and if not, install bolt and nut ($\frac{7}{8}$ -in. wrench). Shove rod end of brake shoe assembly under and around brake drum until it can be reached over top of drum. Lift link end of shoe assembly into place, engage link and cam and slip pin connecting link and cam into place from inside of cam, being sure that end of pin with annular groove is on inside. Turn pin to aline cotter pin holes in pin and cam, insert cotter pin and split ends of pin. Reach over drum, slide spring and washer onto rod, slide rod through pin in upper end of brake cam and screw adjusting nut onto rod. Adjust centering bolt to give .005-in. clearance between bottom of drum and brake lining. Adjust brake nut to give a distance of $3\frac{1}{8}$ in. between rear surface of upper pin and face of inspection hole (fig. 92) with rear end of brake arm at top of its travel. The brake arm should be set on serrated brake shaft to give a distance of $\frac{7}{8}$ in. from top rear end of arm to level of top of brake housing.

(2) Install inspection plate. Inspect to see that gasket is in good condition and if not, replace. Slide inspection plate into place and fasten with bolts ($\frac{3}{4}$ -in. wrench).

(3) Connect steering rod and brake shaft arm. Aline holes in brake shaft arm and steering rod, insert clevis pin and secure in place with cotter pin.

(4) Replace oil in housings. Replace oil in housings, following directions on lubrication chart.

f. *Adjust steering brake nut.* — (1) Adjust steering brake nut without removing inspection plate. Remove plug near top of inspection plate ($2\frac{1}{4}$ -in. wrench), turn adjusting nut ($1\frac{1}{8}$ -in. wrench) as needed, and replace plug.

SECTION VI

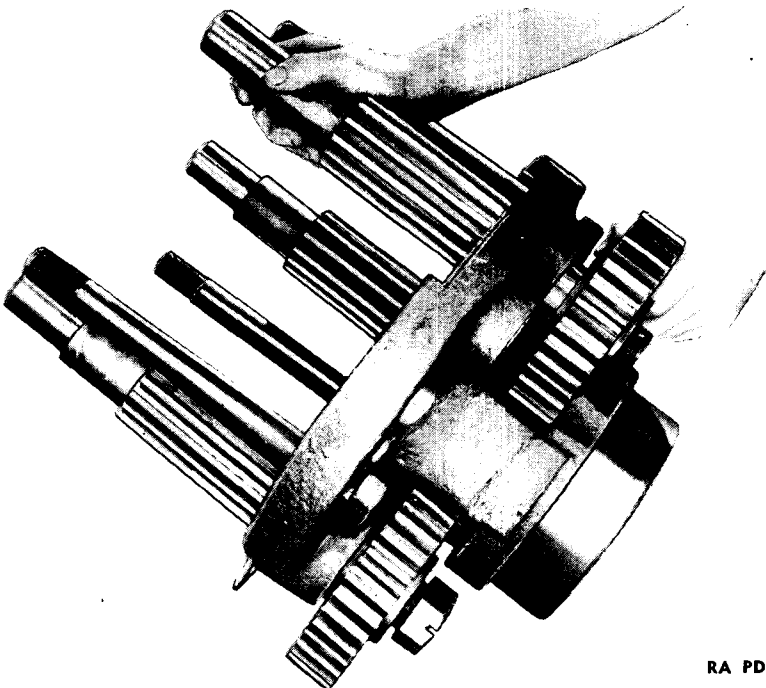
ASSEMBLY OF COMPONENT ASSEMBLIES

	Paragraph
Differential assembly	16
Transmission and parking brake assembly.....	17
Steering brake assemblies.....	18
Final drive assemblies.....	19
Sprocket and hub assemblies.....	20

16. DIFFERENTIAL ASSEMBLY. — a. Equipment. —

- | | |
|------------------------------------------|-----------------------|
| Bar, metal, 1-ft. | Punch |
| Driver, bearing, needle | Reamer, 1-in. |
| Fixture, bearing replacing, differential | Reamer, aline, 1½-in. |
| Hammer, ¾-lb., ball peen | Sledge, bronze |
| Hoist | Wrench, 1⅜-in. |
| Mallet, wood | Wrench, 1-in. |
| Pliers | Wrench, 1⅞-in. |
| Press, arbor | Wrench, 1⅞-in. |

b. Procedure. — (1) Install brake shaft bushings in steering brake housings



RA PD 4875

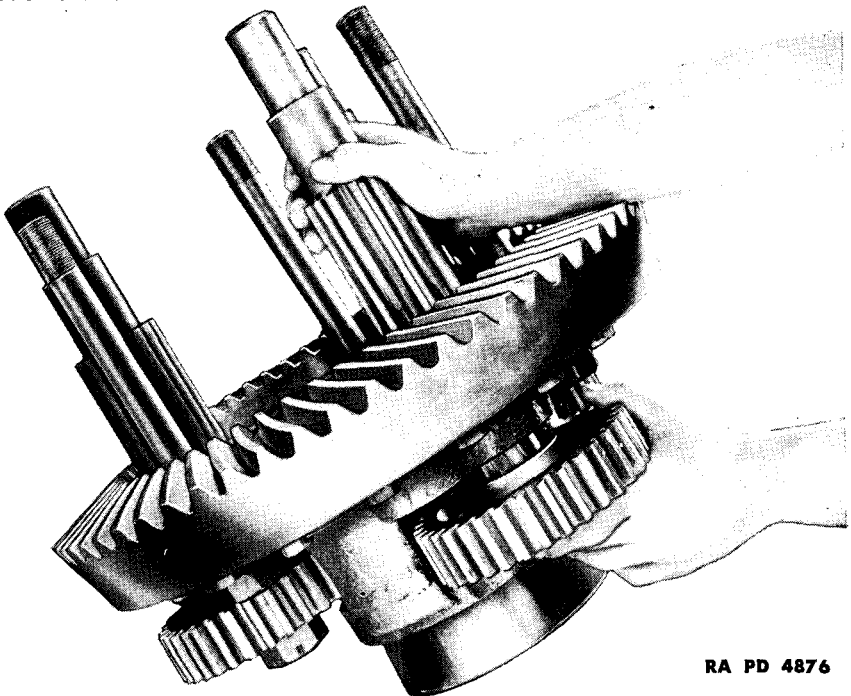
FIGURE 69 — REPLACING PINION AND GEAR IN RIGHT HALF OF COVER

ASSEMBLY OF COMPONENT ASSEMBLIES

and differential cover plates. If brake shaft bushings have been removed from steering brake housings or differential cover plates, it will be necessary to replace and align ream before assembling other parts in either differential or steering brake housings. Press bushings into bores, assemble differential cover plate with differential housing, assemble steering brake housing with differential and align ream (1½-in.) bushings. It will be necessary to install only a sufficient number of bolts to hold parts in correct position during reaming operation. After align reaming, remove bolts and clean housings thoroughly to remove reamer chips.

(2) Replace needle bearings in compensating case covers (*figs. 62 and 64*). Slide needle bearing over pilot and against shoulder of driving tool and drive bearing into bore on inside of cover with needle bearing driver. Drive lightly with wood mallet until bearing seats on shoulder in bore. These bearings should not be forced too hard. If light tapping will not force bearing in, try the bearing in a different location. Repeat operation on remaining bearings. (Two sizes of bearings require two drivers as shown).

(3) Install steel-backed bronze bushings in compensating case and covers. Press bushing into bore and fasten in place by peening edge of bushing into notches located at each end of bore. There is one bushing in case and one in each cover.



RA PD 4876

FIGURE 70 — REPLACING PINION AND GEAR IN LEFT HALF OF COVER

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

(4) Assemble right compensating case cover (figs. 64 and 69). Ream out dowel pin holes (1-in.) in cover to remove metal upset in previous staking operation. Insert bearing washers over needle bearings, with rounded corners of washers toward case. Insert long bolts through left hole of each series of three holes. (IMPORTANT: These three bolts must be inserted before pinion gears are installed, as gears cover bolts.) Place a pinion gear in position, slide threaded and splined end of pinion shaft through needle gearing and into splines in pinion gear, and screw nut on end of shaft by hand. Install remaining two pinion gears and shafts in like manner. Place compensating gear temporarily in place in inside of cover, and tighten pinion shaft nuts ($1\frac{7}{8}$ -in. wrench) holding shafts by means of wood block or brass rod placed between teeth of pinion and compensating gear. Remove compensating gear from cover and install cotter pins holding pinion shaft nuts.

(5) Assemble left compensating case cover (figs. 64 and 69). Lay bevel gear on its face and place cover over it. An "O" is stamped into both bevel gear and cover, and these must be lined up when gear is replaced. Mesh teeth of bevel gear and cover together and drive cover into bevel gear with a wood mallet. Install bolts ($1\frac{3}{8}$ -in. wrench) which hold bevel gear and cover together. Install locking wire through openings in bolt heads to wire them together. Complete assembly of cover by following directions for assembling of right cover paragraph 16 b (4) directly preceding.

(6) Assemble compensating case and two case covers. Set left compensating case cover on floor with bevel gear face up. Lower compensating gear in place with short hub next to cover, meshing the teeth with those on pinion shafts.

IMPORTANT: Pinion gears must be in proper position to mesh with gear end of compensating shaft when unit is replaced. Each gear is stamped with an "O." Line up this mark with some point on cover, such as head of nearest bolt, and line up other gears in same position in relation to bolt nearest them. Insert compensating gear, being careful not to move pinion gears. Some backlash must be present between each pinion shaft and compensating gear, or gears will bind. Make sure this backlash is present before proceeding further. If no backlash is present, it will be necessary to change positions of pinion shafts. The amount of backlash does not have to be measured, so long as some is present. Lower compensating case into position over compensating gear and bolts.

Place second compensating gear in compensating case, with the long hub of gear next to case. Lower right compensating case cover into position over case, inserting bolts in proper holes in case and lining up pinion gears by method described above for left case. Install six dowel pins (three in each cover), which hold case and covers in alinement. Screw nuts ($1\frac{7}{16}$ -in. wrench) onto six bolts holding assembly together and install cotter pins securing nuts. Stake metal of covers over dowel pins to hold them in place.

(7) Replace differential bearings (figs. 59 and 71). Place bearing over bearing collar on cover. Place inner fixture (fig. 59) on end of cover with small

ASSEMBLY OF COMPONENT ASSEMBLIES

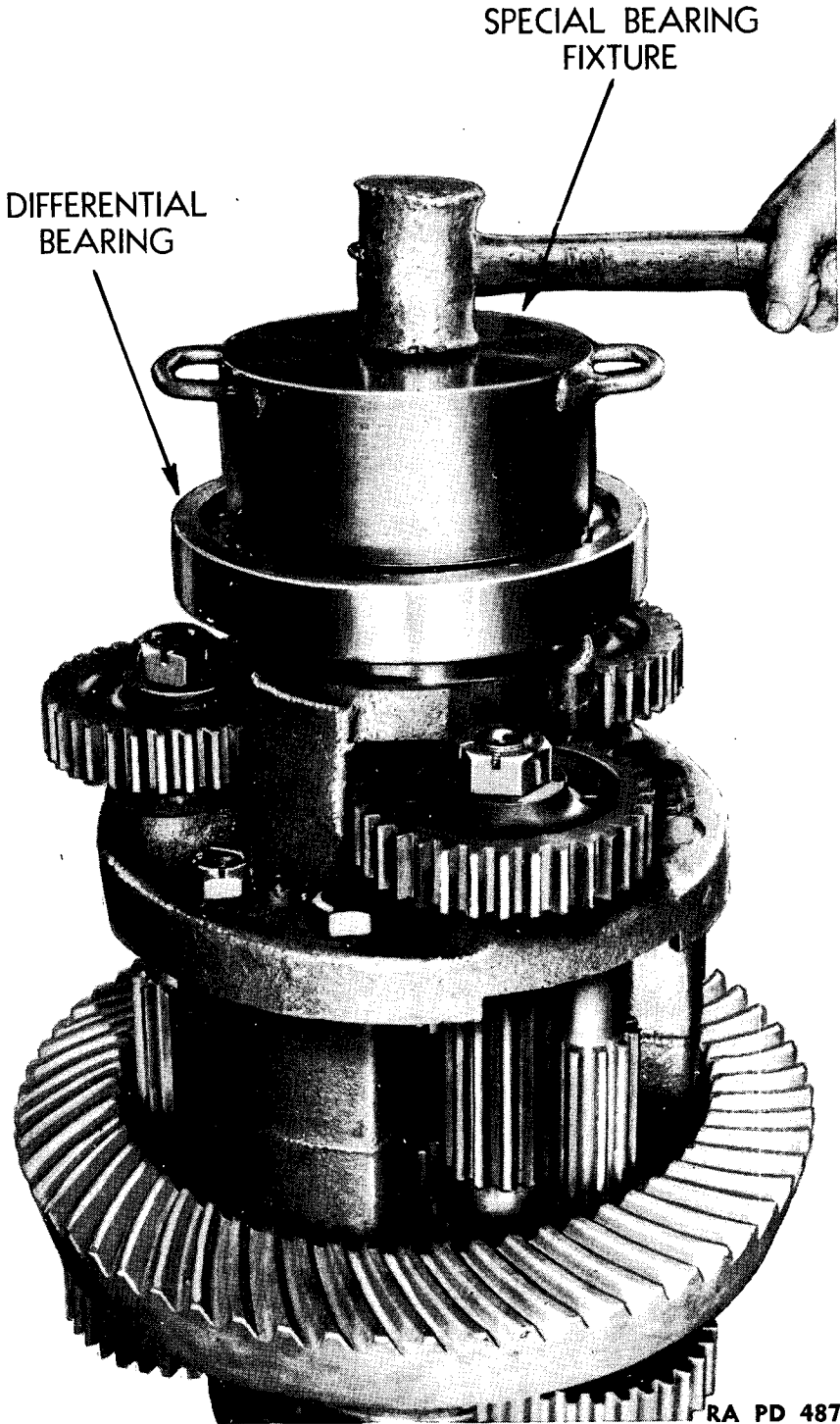


FIGURE 71 - REPLACING DIFFERENTIAL BEARING

end inside bearing collar and large end inside bearing. Place cover of fixture over bearing and hammer it with bronze sledge. This will force bearing off the fixture and onto bearing collar. Remove both parts of fixture and install bearing on second cover in like manner.

(8) Install left differential cover in housing. With differential housing standing on right end put differential cover in place and fasten with bolts (1-in. wrench). Install locking wire on bolts.

(9) Install differential in housing. Turn differential housing on left end. Insert metal bar between differential pinion gears and right compensating case cover, and attach hoist to bar, passing sling through end of cover. Lift differential with hoist and lower into differential housing, guiding bearing into bore of differential cover. Put cover plate in place and bolt down (1-in. wrench). Insert wire through the opening in the bolt heads and wire the bolts in pairs.

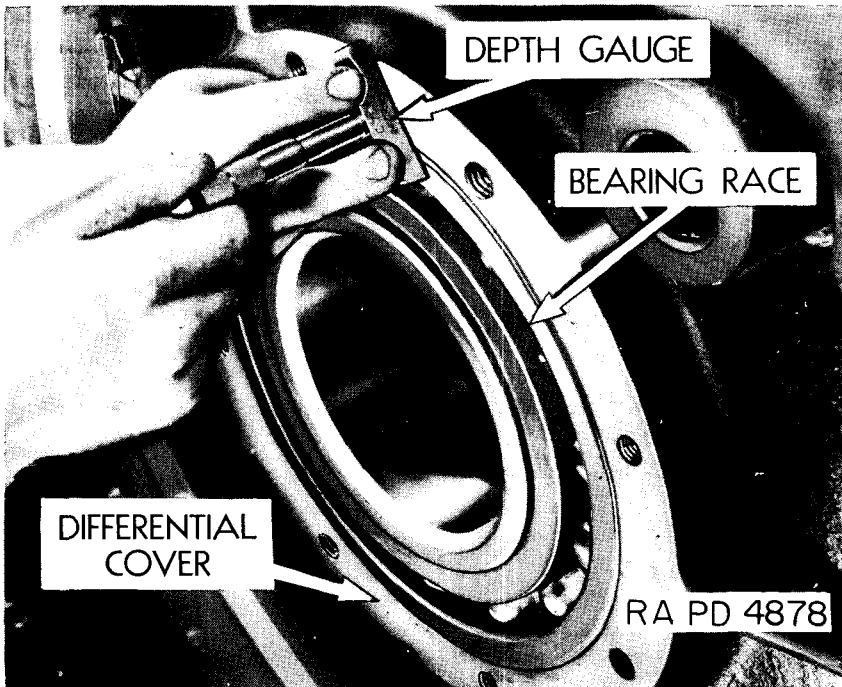


FIGURE 72 — MEASURING DIFFERENTIAL SHIMMING WITH DEPTH MICROMETER

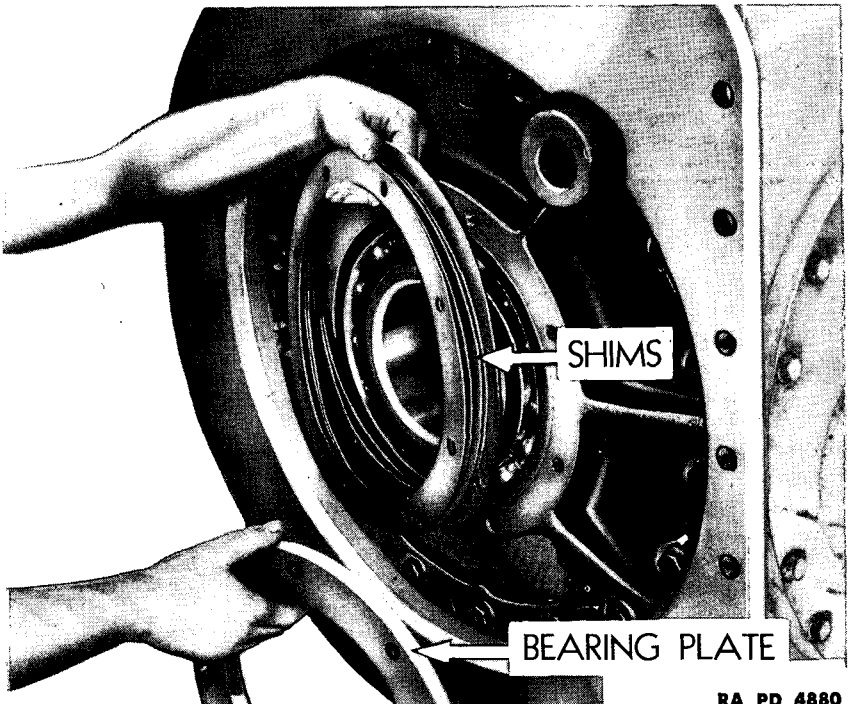
(10) Install right differential cover. Install cover in end of differential housing and over differential bearing and secure in place with bolts (1-in. wrench). Install locking wire on bolts.

(11) Install shims and differential bearing holder plates (*figs. 47, 72 and 73*). If bevel pinion and gear previously removed are being installed, replace

ASSEMBLY OF COMPONENT ASSEMBLIES

same shims as were removed at disassembly, put bearing holder plates in position, fasten with bolts (1-in. wrench) and install locking wires on bolts.

If new bevel pinion and gear are being installed, put .030 in. of shims between right cover and bearing holder plate, bolt plate to cover and secure bolts with locking wire. Turn differential housing onto right end and measure distance left bearing race protrudes from cover with depth micrometer (fig. 72). This measurement is thickness of shims required between left cover and bearing holder plate. Install these shims, bolt plate in place and secure bolts with locking wire.



RA PD 4880

FIGURE 73 — ADJUSTING BACKLASH WITH DIFFERENTIAL SHIMS

17. TRANSMISSION AND PARKING BRAKE. — *a. Equipment.* —

Bar, brass, bumping, short	Fixture, shaft, supporting
Bar, metal	Gage, depth
Collar	Hammer
Drivers, bearing	Hoist
Driver, pinion, gear	Indicator, backlash, dial
Dynamometer	Lead, powdered, red
Equipment, heating	Mallet, bronze
Fixture, roller bearing	Mallet, wood

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

Mallet, wood or copper	Wrench, $\frac{5}{8}$ -in.
Micrometer, depth (0 - 1-in.)	Wrench, $\frac{3}{4}$ -in.
Nut, lifting, for output shaft	Wrench, $\frac{7}{8}$ -in.
Nut, lifting, special, input shaft	Wrench, $1\frac{5}{8}$ -in.
Pliers	Wrench, 1-in.
Press, arbor	Wrench, $1\frac{7}{8}$ -in.
Punch, alining, $\frac{1}{2}$ -in.	Wrench, $1\frac{1}{2}$ -in.
Rod, bronze	Wrench, $2\frac{3}{8}$ -in.
Tools, for hollow rivets	Wrench, adjustable
for parking brake	Wrench, special, for parking brake drum nut
Wrench, $\frac{3}{8}$ -in.	Wrench, special, pinion nut
Wrench, $\frac{9}{16}$ -in.	

b. Procedure. — (1) Assemble transmission. — (a) Install first speed idler gear and shaft (figs. 74 and 76). Place transmission housing so that it stands front end up.

First speed idler shaft has a flat milled at front end. The edge of bearing cover plate engages this flat preventing forward or rotary motion of shaft. Therefore, when installing shaft, it must be at proper angle so that edge of cover plate will fit flat spot on end of shaft. To insure correct alinement, put cover plate in place, holding with two or three bolts, and mark (on housing) where it crosses the first speed idler shaft bore. Remove the cover plate. Slide two roller bearings into bore of idler shaft gear and put gear into approximate position with short hub of gear toward front end of housing. Insert brass and steel washers between each end of gear and housing, brass washers next to gear and steel washers next to housing. Oil shaft, aline washers and bearings with bore and

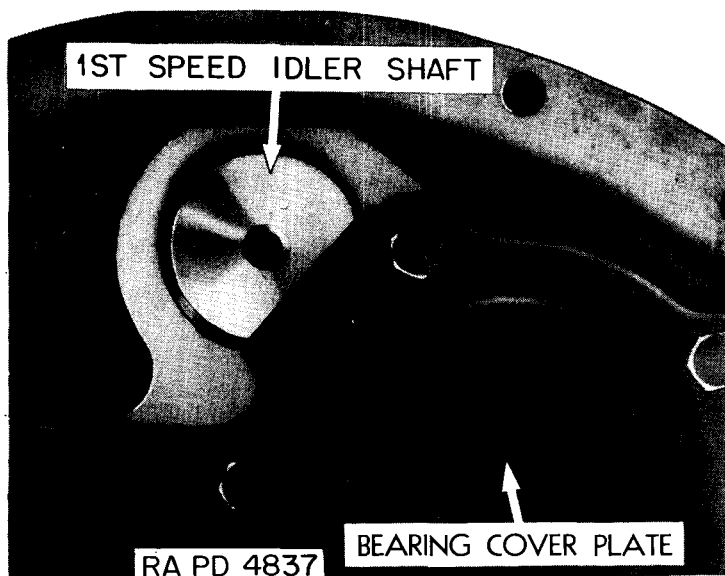


FIGURE 74 — FIRST SPEED IDLER SHAFT, EXTENDING THROUGH COVER PLATE

ASSEMBLY OF COMPONENT ASSEMBLIES

drive shaft small end first into front end with wood mallet, being sure that flat on end of shaft is in line with marks previously made on housing.

CAUTION: First speed idler shaft should fit sufficiently tight to require driving. If it does not, stake it into housing. The housing is turned onto other end while installing gear assemblies, and if first speed idler shaft drops out before bearing cover plate is put on, transmission may have to be torn down again to put shaft back in place.

(b) Turn transmission housing rear end up. Screw two eyebolts into threaded holes in top of housing and turn housing (with hoist) to rest on stand rear or open end up.

(c) Assemble countershaft assembly (*fig. 46*). Replace two keys on countershaft. Force gear onto shaft and over keys with short hub of gear next to reverse gear, and install snap ring to secure gear in place. Assembly of gear with shaft may be facilitated by heating gear to a temperature of not over 250° F., if means for doing this are available.

(d) Insert countershaft assembly in housing. Set countershaft in position in housing with large gear toward rear end of housing and place blocks of wood under the opening in front end (on which housing rests) to support countershaft. Countershaft is left loose in housing until other gear assemblies are in place.

(e) Assemble second and third speed synchronizer (*fig. 42*). Put the 12 springs and poppets into holes in "dog collar." Spring is placed in hole first, followed by poppet. Slide assembled "dog collar" into sleeve. In doing this, poppets will have to be depressed by hand to get "dog collar" into sleeve. Place shifting fork collar over sleeve and align four radial holes in it with four holes in "dog collar," using mallet and ½-in. aligning punch if necessary. Insert four pins into holes in inside of "dog collar" and press into place with arbor press. These pins extend through "dog collar" and into shifting fork collar. Push tapered ring (small end out) over end of sleeve, align rivet holes in ring and sleeve and install eight rivets (¼-in. by ¾-in. fl-hd., steel). Rivets are pushed through holes from outside and headed on inside.

(f) Assemble fourth and fifth speed synchronizer (*fig. 44*). This synchronizer is assembled the same as second and third speed synchronizer (e) above, except that it includes a brass ring inside sleeve and is held to sleeve by same rivets as hold steel ring. Brass ring is installed in sleeve large end out and rivets are driven through brass ring, sleeve and steel ring from inside and headed on outside of steel ring.

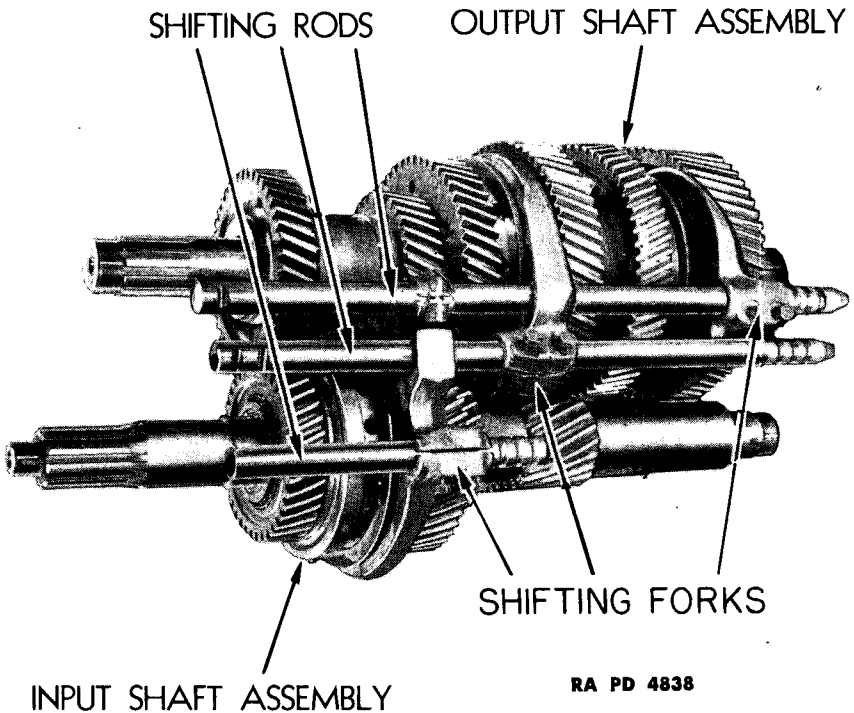
(g) Assemble input shaft assembly (*figs. 30 and 45*). Check fourth and fifth speed gears on roller bearing fixture and determine proper spacers. Press front fifth speed gear bearing onto rear or splined end of shaft, large end first. Bearing seats against shoulder of third speed gear. Slide spacer onto shaft against bearing and install fifth speed gear on bearing with clutch end of gear toward rear end of shaft. Press rear fifth speed gear bearing onto shaft, into gear small end first and against spacer. Install two keys in shaft. Press synchronizer clutch gear onto shaft, over keys and against bearing. Press front fourth

speed gear bearing onto shaft, large end first, against clutch gear. Slide spacer onto shaft against bearing. Slide synchronizer over shaft, small end first, onto clutch gear. Slide fourth speed gear over shaft, cone end first, against its front bearing. Press rear fourth speed bearing onto shaft, small end first into gear and against spacer. Assembly may be facilitated by heating bearings and clutch gear to temperature of not over 250° F before assembly on shaft.

(h) Assemble output shaft assembly (*figs. 36 and 40*). Check first speed, reverse, second speed and third speed gears on roller bearing fixture and determine proper spacers. Check hollow shaft to see that oil holes and interior are free of dirt or sludge. Front end of shaft is end near flange. Press front first speed gear bearing onto rear end of shaft, large end first, against flange. Slide spacer onto shaft against bearing. Slide first speed gear over shaft and spacer, plain hub end first, against bearing. Press second bearing onto shaft and into gear and against spacer, small end first. Install four clutch gear keys in shaft and press gear onto shafts over keys and against bearing. Press reverse gear bearing onto shaft against clutch gear, large end first. Slide reverse gear spacer onto shaft against bearing. Slide shifting sleeve over shaft and onto clutch gear. Slide reverse gear over shaft and spacer onto bearing, clutch gear end first. Press second bearing onto shaft against spacer and into reverse gear, small end first. Press second speed gear bearing onto shaft and against bearing, large end first. Slide spacer onto shaft against bearing. Slide second speed gear over shaft and spacer onto bearing, long hub end first. Press bearing onto shaft against spacer and into second speed gear, small end first. Install two clutch gear keys in shaft. Press second and third speed clutch gear onto shaft, over keys and against bearing. Press third speed gear bearing onto shaft against clutch gear. Slide third speed gear spacer onto shaft against bearing. Slide synchronizer over shaft, spacer and bearing onto clutch gear, large end first. Slide third speed gear over shaft and spacer onto bearing, clutch gear end first. Press bearing onto shaft against spacer and into third speed gear, small end first. Install two fifth speed gear keys in shaft. Press fifth speed gear onto shaft, over keys and against bearing, cup shaped end first. Assembly may be facilitated by heating bearings, clutch gears and fifth speed gear to temperature of not over 250° F before assembly on shaft.

(i) Assemble oil pump, no oil cooler used (*fig. 31*). If bushings have been removed, press new ones into body, base and driven gear; and ream with .563-in. reamer. Put pump gears into place in body of pump and work them up and down by hand until they mesh smoothly. Gear with keyway goes in center of body. (NOTE: There should be not more than .002 in. to .004 in. clearance between ends of gears and pump, otherwise pump will fail to deliver proper pressure. Clearance *between* gears is not as important as between gears and cover). Insert Woodruff key into shaft and pull cylindrical end of shaft through bore of center gear into bushing in pump body. Replace gasket if necessary. Place base over gasket and gears, line up holes, and install three bolts ($\frac{3}{16}$ -in. wrench) holding body to base. Screw bolts down to face of cover equally tight and turn shaft

ASSEMBLY OF COMPONENT ASSEMBLIES



RA PD 4838

FIGURE 75 — SHIFTING RODS AND SHIFTING FORKS IN POSITION

protruding through base with fingers to see that it turns freely. If it does, tighten bolts. Put $\frac{3}{8}$ -in. ball into threaded hole in body, follow with spring and screw in plug to hold spring and ball in place.

NOTE: Spring should stick out of threaded hole $\frac{1}{8}$ in. when in contact with ball.

(j) Assemble oil pump, oil cooler used (figs. 32 and 33). This oil pump is assembled practically the same as pump in (i) above except that shaft and gear are pressed together and are inserted into body as a unit. Also no gasket is used, body and base being a lapped fit.

(k) Assemble shifting forks and rods (fig. 75). Insert shifting rods through the shifting forks, with rounded grooved ends down. Short rod goes in the input shaft shifting fork. Grooves in the rods must line up with bolt holes in the shifter forks. Then replace bolts ($\frac{3}{8}$ -in. wrench) in shifting forks. Drop shifting rod sleeve over center rod. Slide first and reverse speed yoke onto front or rounded end of shifting rod (longest rod of three) with elbow pointing forward. Aline grooves in rod with bolt holes in yoke, install bolts and secure with locking wire. Slide second and third speed yoke onto shifting rod (intermediate length rod) with elbow pointing toward rear or square end of rod. Aline grooves in rod with bolt holes in yoke, install bolts and secure with locking wire. Slide rear end of first and reverse speed rod through hole in second and third speed yoke from front.

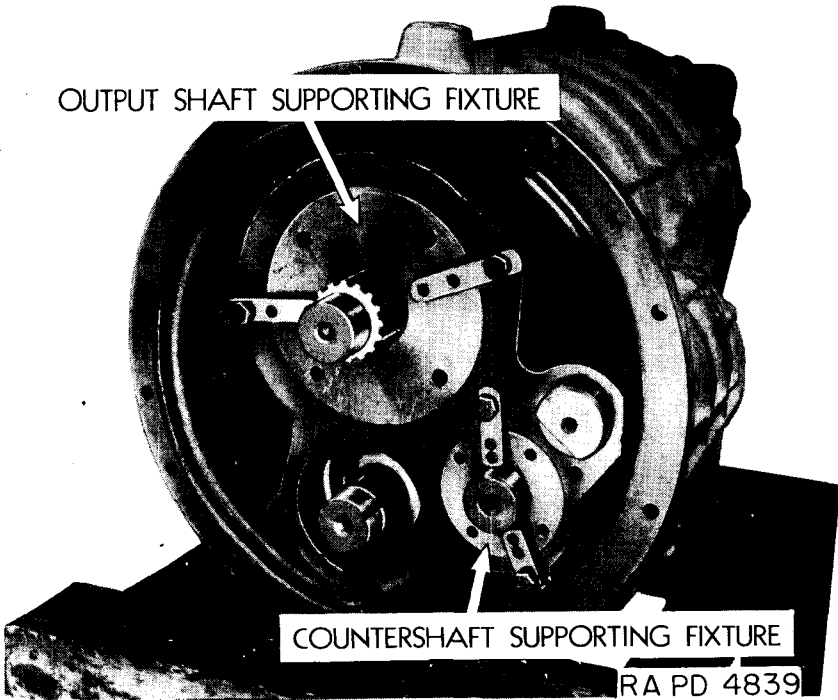


FIGURE 76 — TRANSMISSION WITH FIXTURES IN PLACE

Slide stop bracket onto rear end of first and reverse speed rod, aline groove in rod with bolt hole in bracket, install bolt and secure with locking wire.

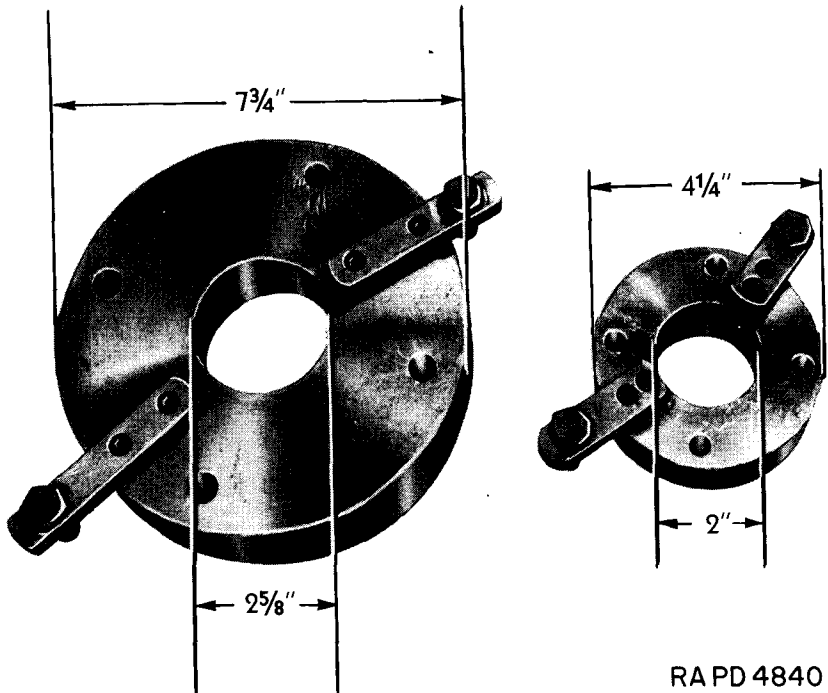
Slide first and fifth speed fork onto front or rounded end of short shifting rod with elbow pointing toward front. Aline grooves in rod with bolt holes in yoke, install bolts and secure with locking wire.

(l) Place shifting forks (fig. 75). The shifting forks are placed on shaft assemblies before assemblies are installed in case. Slide first and fifth shifting forks into groove in sleeve on input shaft synchronizer with square end of rod pointing to rear. Install first and reverse, and second and third speed forks with their rods on output shaft with square ends of rods to rear. The forks are inserted into grooves of synchronizer sleeves.

(m) Install output shaft assembly. Screw special lifting nut onto rear end of shaft, lift shaft assembly with hoist and lower into transmission case. Lower slowly, working output shaft assembly past countershaft, and meshing output shaft gears with countershaft gears, until output shaft assembly rests on front end of transmission case, with pinion shaft extending through opening. Remove hoist.

(n) Install rear countershaft bearing. Fit rear countershaft bearing over countershaft end in support. Use brass bumping bar or mallet and drive bearing into position.

ASSEMBLY OF COMPONENT ASSEMBLIES



RAPD 4840

FIGURE 77 — OUTPUT SHAFT AND COUNTERSHAFT SUPPORTING FIXTURES

(o) Insert shaft supporting fixtures, front end (figs. 76 and 77). Output shaft and countershaft must be held in place at front end of transmission. Fixtures shown in figures 76 and 77 will be useful in accomplishing this. They may be placed in position from underneath, with housing resting on pinion gear end, or housing may be turned to horizontal position. The fixtures are slid over shafts and into holes in front end of housing, and bolted in place as shown in figure 76. If housing has been turned to horizontal position turn to rest on front end.

(p) Install oil pump assembly (fig. 78). Set oil pump in position with flat end of shaft in keyway or groove in end of countershaft and bolt to support ($\frac{3}{16}$ -in. wrench). Wire bolts exactly as shown in figure 78, otherwise wires may be cut by revolving gears.

(q) Install spacer and oil collar. Slide oil spacer onto rear end of output shaft and oil collar over spacer. Notched end of spacer goes to rear.

(r) Insert oil stem. Insert oil stem with gasket installed through opening in side of transmission case into oil collar. Bolt holes are offset and stem can only be installed in one position. Install the two bolts that hold stem to transmission case.

(s) Install input shaft assembly (fig. 79). Screw special lifting nut onto rear end of input shaft assembly, lift with hoist and lower into place in transmission

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

case. Lower slowly, manipulating shaft to mesh gears and move them into position.

(t) Install shifting block and interlocking plates (fig. 28). Slide shifting block over rods. Insert interlocks between rods over block, with tapered ends of interlocks fitting into grooves in shifting rods. Insert 1/64-in. Vellumoid gasket or equivalent between block and case, install three bolts (7/8-in. wrench) holding block to case and secure with locking wire. Install three shifting rod poppets. Two are located in front of inspection plate and one below rear end of inspection plate. Insert ball or poppet, spring, and bolt, in that order in each hole and tighten bolts (7/8-in. wrench).

(u) Install output shaft fourth speed gear (figs. 80 and 81). Insert two keys in output shaft (front ends of keys enter notches in oil spacer and lock it to shaft). Put gear over end of output shaft (long hub end first) and drive into place over keys and against oil spacer with bronze mallet and driver shown in figure 81. This operation may be facilitated by heating gear to temperature of not over 250° F.

(v) Install transmission cover gasket. Install new gasket whenever rear transmission cover has been removed. Coating gasket with grease will hold it in place while alining bolt holes.

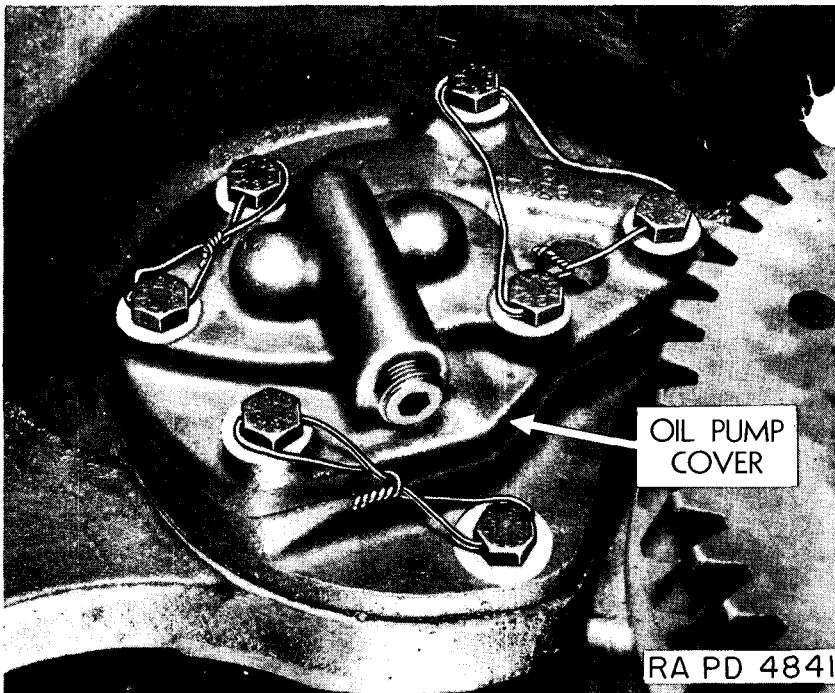
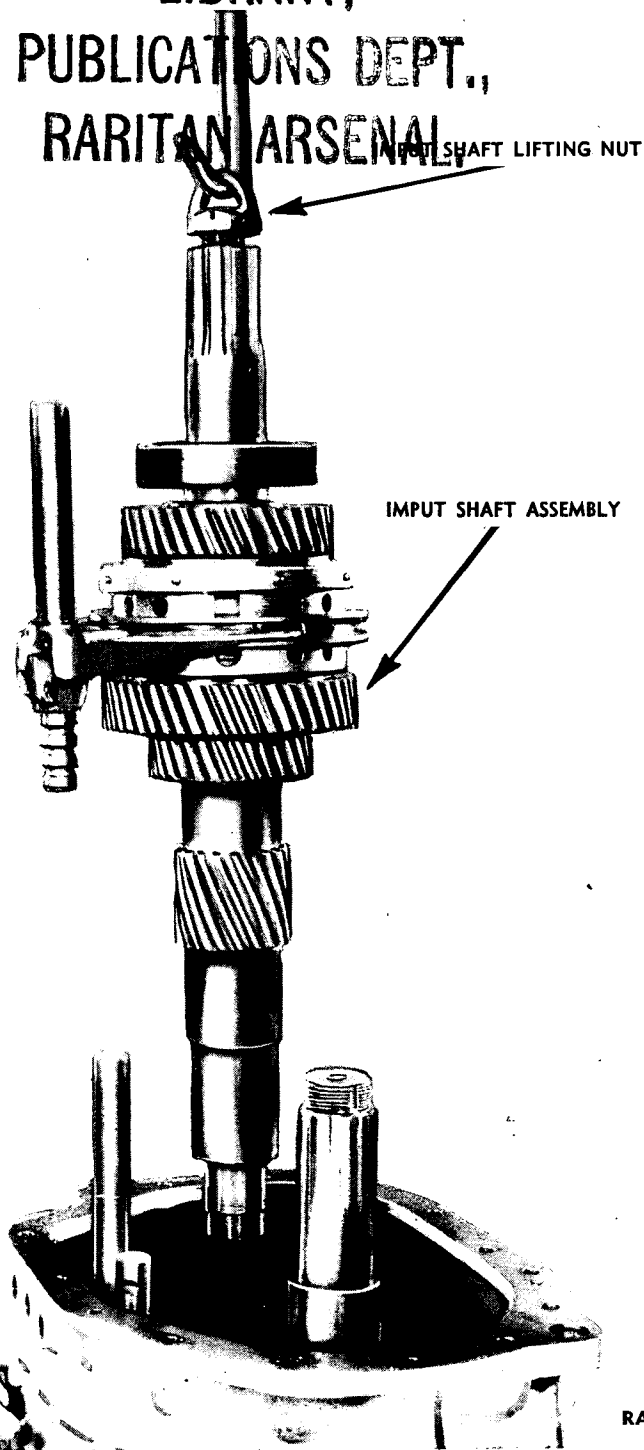


FIGURE 78 — OIL PUMP WIRING

LIBRARY,
ASSEMBLY OF COMPONENT, ASSEMBLIES
PUBLICATIONS DEPT.,
RARITAN ARSENAL



RA PD 4842

FIGURE 79 — REPLACING INPUT SHAFT ASSEMBLY

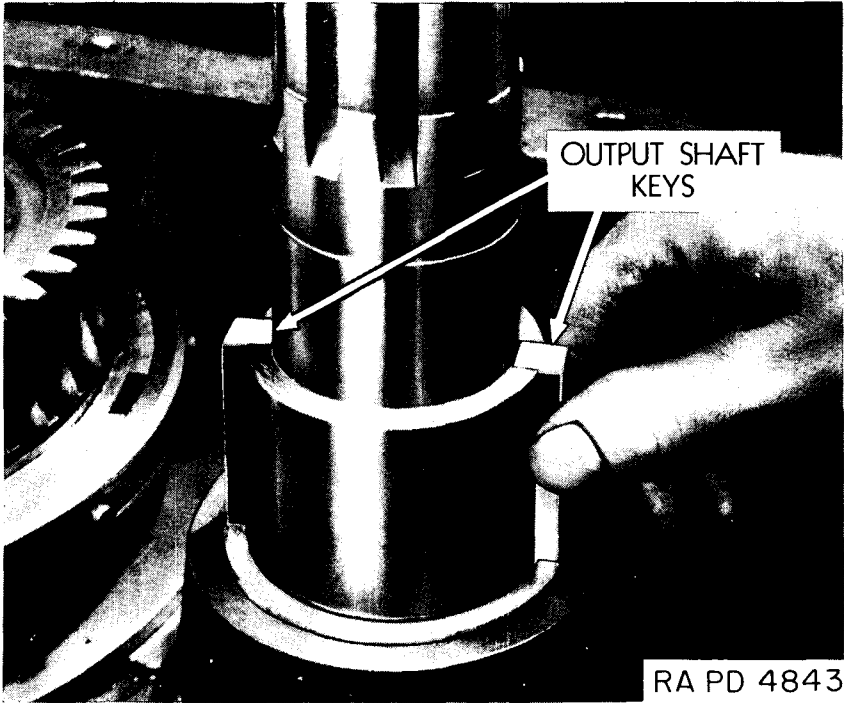


FIGURE 80 — REPLACING KEYS IN OUTPUT SHAFT

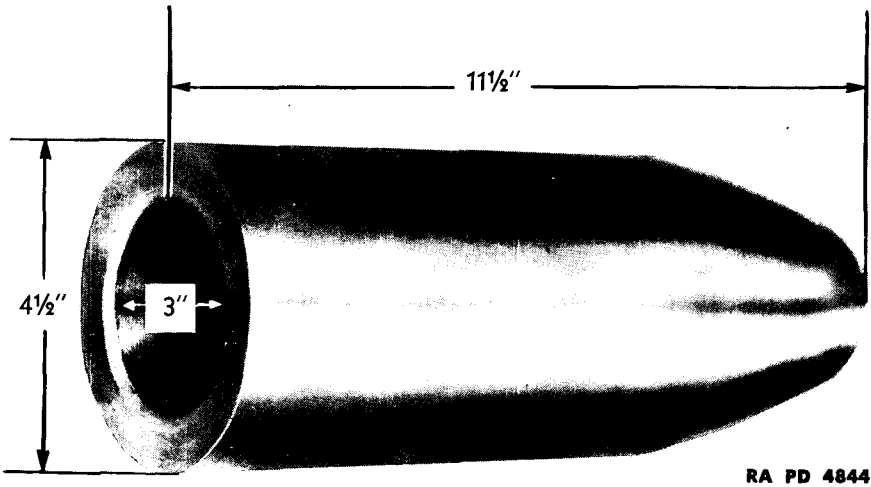


FIGURE 81 — GEAR DRIVING TOOL

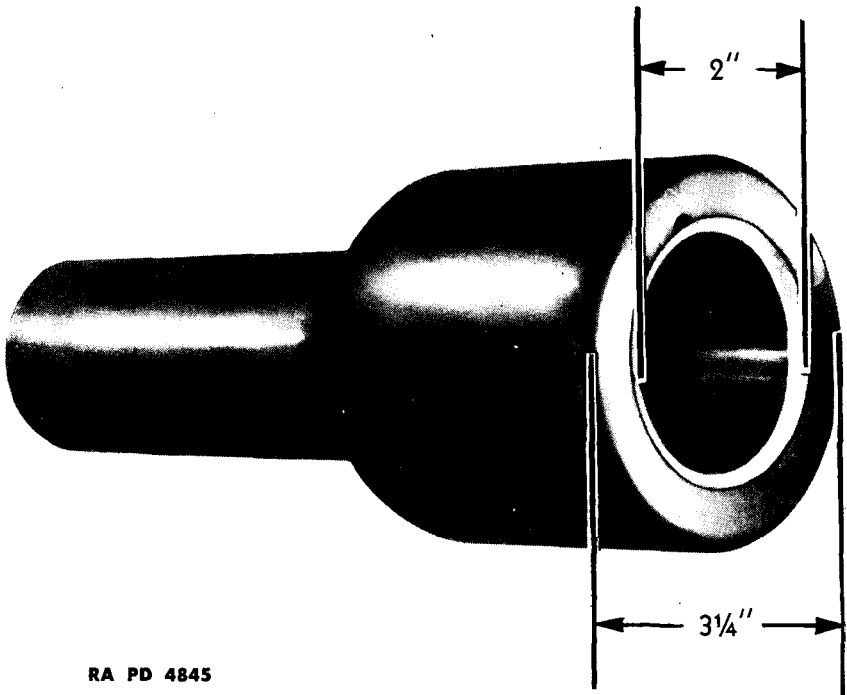
ASSEMBLY OF COMPONENT ASSEMBLIES

(w) Install rear transmission cover (fig. 25). Put cover in place on rear end of case and secure with lock washers and bolts ($1\frac{7}{16}$ -in. and $\frac{3}{4}$ -in. wrenches).

(x) Install rear input and output shaft bearings (figs. 82 and 84). Slide spacer onto end of output shaft and against fourth speed gear. Put bearing onto rear end of output shaft (dirt shield end first) and drive into place in cover and against spacer with bearing driver (fig. 82).

Slide bearing onto rear end of input shaft (dirt shield end first) and drive into place in cover and against roller bearing with driver (fig. 84).

(y) Install speedometer gear and drive assembly. Insert Woodruff key into output shaft and slip gear onto shaft over key. Insert the speedometer shaft and sleeve through the side of transmission cover and bolt in place ($\frac{3}{8}$ -in. wrench).



RA PD 4845

FIGURE 82 — OUTPUT SHAFT BEARING DRIVER

(z) Install input and output shaft caps and spacer. If necessary to install oil seals these may be pressed, spring end first, into counterbores in rear ends of caps. Install new gaskets for shaft caps coating with grease to hold them in place while alining bolt holes. Install caps and secure with lock washers and bolts ($\frac{3}{4}$ -in. wrench). Slide spacer over input shaft, into end of cap and seal.

(aa) Turn transmission to horizontal position. Attach chain to eyebolts in top of transmission and use hoist to turn transmission to horizontal position.

(bb) Assemble gear shift lever assembly (fig. 21). Push bolt through latch and shift lever from left as shown in figure 21, and install nut ($\frac{3}{4}$ -in. wrench) and cotter pin. Latch should turn freely on bolt. Slide straight end of rod through lever handle from lower end. Slide washer and spring over end of rod and into hole in end of lever handle. Push button onto end of rod, aline holes in rod and button and drive connecting pin into hole. Push button into handle against spring, insert lower end of rod into hole in latch and install washer and cotter pin holding rod to latch. Insert yoke in notch in lower end of shift lever, slide bolt through lever and yoke, and fasten in place with nut ($\frac{3}{4}$ -in. wrench) and cotter pin. Yoke should turn freely on lever.

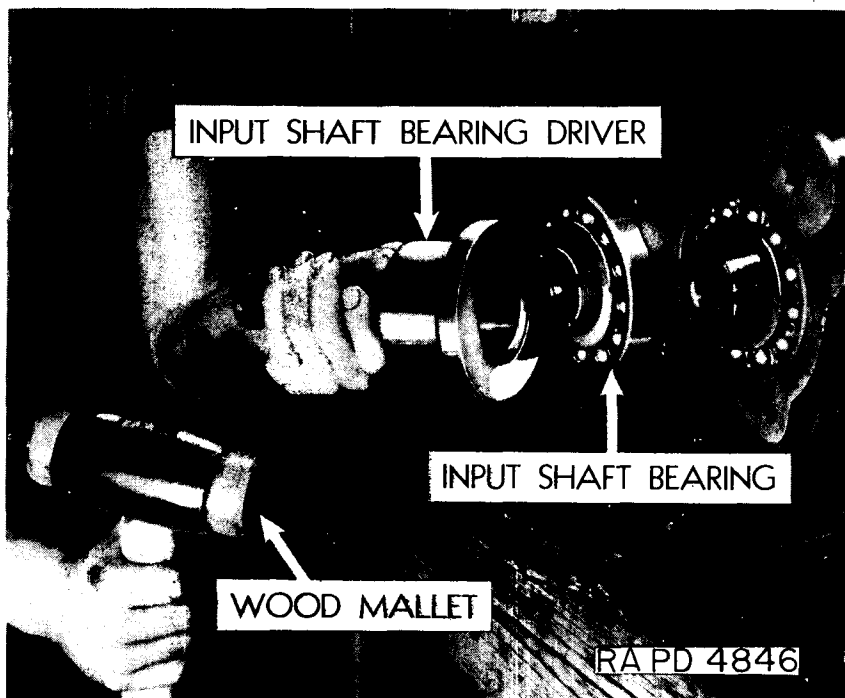


FIGURE 83 — DRIVING INPUT SHAFT BEARING INTO PLACE

(cc) Install shifting lever assembly (figs. 17 and 21). Replace shifting brackets on shifting rods as shown in figure 17. Aline bolt holes with grooves in rods, install bolts ($\frac{5}{8}$ -in. wrench) and locking wires. Place gear shift lever in position and drive shaft through brackets on transmission case and through openings in shift lever and yoke from right side. Install washer, nut ($\frac{7}{8}$ -in. wrench), and cotter pin.

(dd) Install front input shaft and countershaft bearings and nuts (figs. 83 and 84). Remove fixtures installed to hold these in place. Slide bearings onto

ASSEMBLY OF COMPONENT ASSEMBLIES

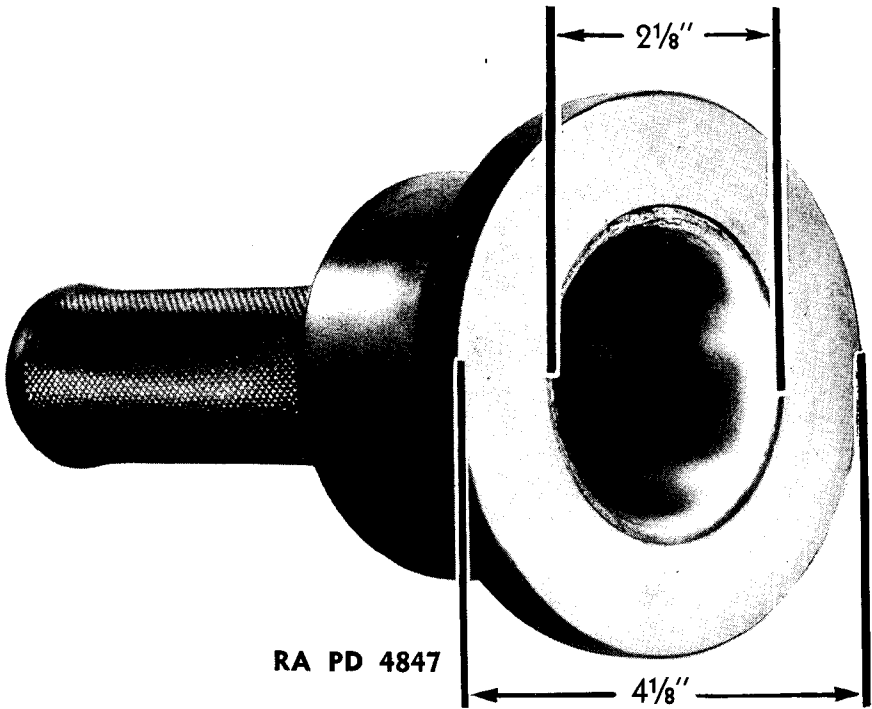


FIGURE 84 — INPUT SHAFT BEARING DRIVER

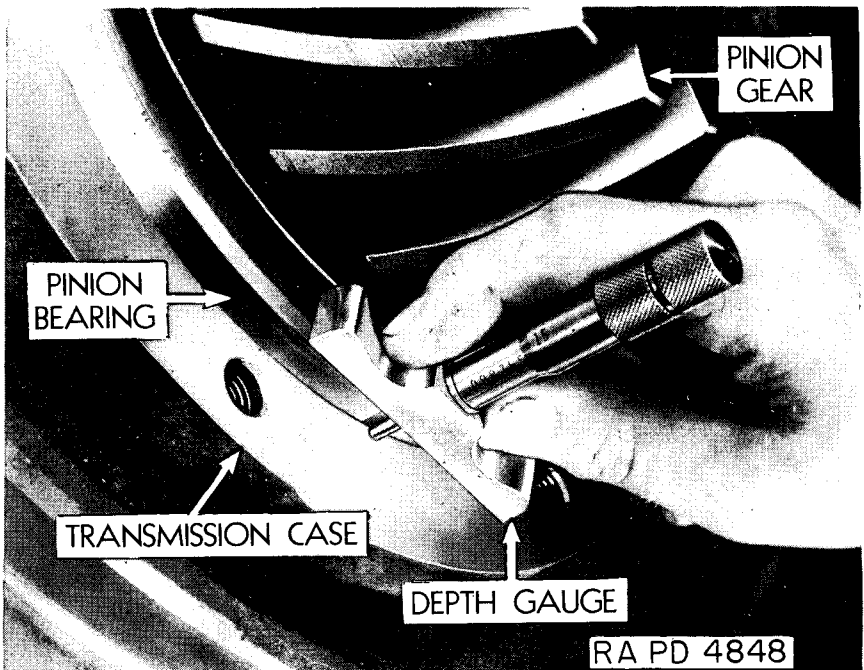


FIGURE 85 — MEASURING PINION BEARING SHOULDER WITH DEPTH GAGE

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

shafts, with notch to rear and lettering on front. Tap bearings to get them started in bores, then use a bearing driver and mallet to drive into final position. Put locking washers on input and countershafts, and screw on nuts, using special wrench, figure 23. Bend edges of locking washers into openings in nuts.

(ee) Install pinion gear and bearing on front end output shaft (figs. 85 and 86). Contact of pinion gear with bevel gear of differential is controlled by shims behind pinion bearing. Increasing amount of shimming moves pinion gear in toward bevel gear, while reducing shimming pulls pinion gear away from bevel gear. If pinion gear, pinion bearing and bevel gear previously removed are installed, original shims which were behind pinion bearing should give satisfactory bearing surface between pinion and bevel gears. If any of parts were changed, new shimming will be necessary. The average assembly will require .075 in. of shimming. This amount can thus be used as a starting point.

Amount of shimming required can also be checked by means of a depth micrometer. Measure height of bearing projecting beyond transmission case. Also measure depression in bearing cover which fits over pinion gear bearing. Difference between these two measurements is amount of shimming required.

With shims in position, start pinion gear and bearing onto output shaft, line up splines of shaft and gear and drive onto shaft with pinion driver and brass bar (fig. 86).

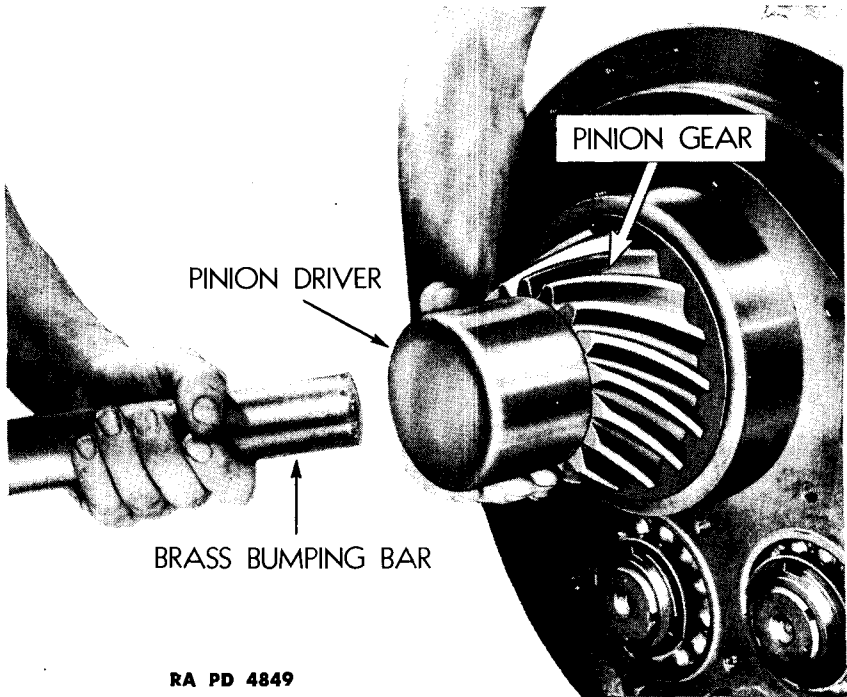


FIGURE 86 — PINION GEAR BEING DRIVEN INTO POSITION

ASSEMBLY OF COMPONENT ASSEMBLIES

Screw pinion gear nut onto shaft with special wrench (*fig. 23*) and secure nut with cotter pin. Cotter pin should not project past nut and be bent over end of shaft, or it will be sheared off. Anchor or secure cotter pin by bending it in center where it passes through center hole in shaft. Install gasket (a coat of grease will hold it in place while bolt holes are being alined).

(*ff*) Install bearing cover on front end of case (*fig. 18*). Put cover in place over gasket, fasten in place with bolts ($\frac{3}{4}$ -in. wrench) and install locking wires on bolts.

(*gg*) Assemble parking brake drum (*fig. 14*). Press shield, concave end first, onto rear or shouldered end of sleeve. Press shield and sleeve assembly, sleeve end first, onto hub of forward end of brake drum until assembly seats against shoulder of hub.

(*hh*) Install brake drum assembly on rear end of output shaft. Put brake drum, large end first, over rear end of output shaft, aline splines and drive assembly onto shaft and into oil seal with wood mallet. Place locking washer on end of shaft, screw on nut with special wrench (*fig. 23*) and bend washer to secure nut.

(*ii*) Assemble and install parking brake (*figs. 13 and 14*). Put brake lining into brake shoe and secure in place with tubular rivets. Place brake shoe face down on floor and insert link eye into splined collar of brake shoe, threaded end to rear. Drive link pin through collar and link eye. Screw adjusting nut into rear end of link. Place brake housing over brake shoe, slide brake lever shaft cam end first into its bearing in left side of housing. Slide spacer over inner end of shaft so that cam passes through small opening in the spacer. Aline hole in adjusting nut with cam and push shaft toward center, the cam entering hole in adjusting nut. Place washer on end of cam and against adjusting nut and secure with cotter pin through end of cam. Push brake lever onto left end of shaft, adjust to such a position that lever is forward and about horizontal when shoe is completely disengaged, and lock is in place with bolt ($\frac{1}{8}$ -in. wrench), securing nut with cotter pin.

(*jj*) Adjust parking brake (*figs. 13 and 14*). The parking brake depends upon the action of a toggle joint for its locking function. A projection on the brake lever shaft link acts as a stop and keeps the toggle system in a "past center" position. Correct adjustment of this linkage should be such that application of the brake lever will cause the toggle action to go past center and into the locked position at the time when the brake shoe lining is firmly seated against the conical brake drum. In most cases this adjustment can be made by turning the adjustable eye ($1\frac{1}{2}$ -in. wrench) which is threaded into the brake lever shaft link. Turning the eye clockwise will cause the brake shoe to contact the brake drum later and turning the eye counterclockwise will cause the brake shoe to contact the brake drum sooner. If, merely by turning the eye, it is not possible to obtain the setting whereby the brake shoe lining becomes firmly seated against the brake drum at the time when toggle action goes past center into the locked position, it will be necessary to correct the size of the stop on the link. This action

is frequently found necessary when a new link or a new brake shoe assembly is installed.

If the condition is such that the projection on the link reaches its stop position before the toggle action goes past center, remove metal from the projection a little at a time until it then reaches its stop with the toggle action just past center.

If the condition is such that the projection on the link does not reach its stop until the toggle action is well past center, a new link will have to be used.

(kk) Assemble spacer and install on input shaft. Slide shield, concave end first, onto small end of spacer until it seats on shoulder. Install locking ring holding shield in place. Slide spacer assembly onto rear end of input shaft, into oil seal and against bearing.

(ll) Install universal joint flange on rear end input shaft. Slide or drive universal joint flange onto end of input shaft with flange end to rear. Put washer on end of shaft and against flange, screw nut ($2\frac{3}{8}$ -in. wrench) onto end of shaft and secure with cotter pin.

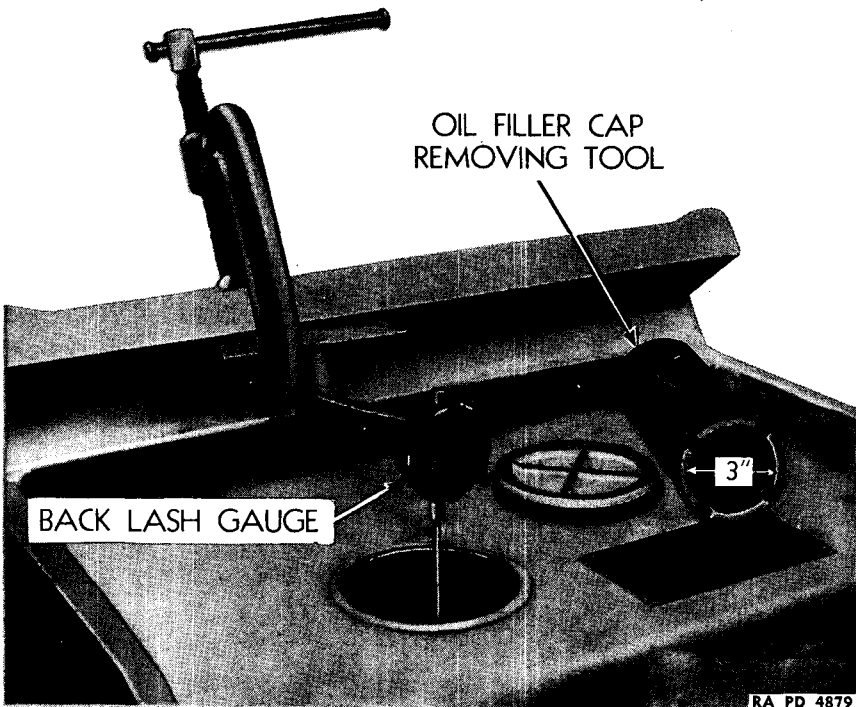
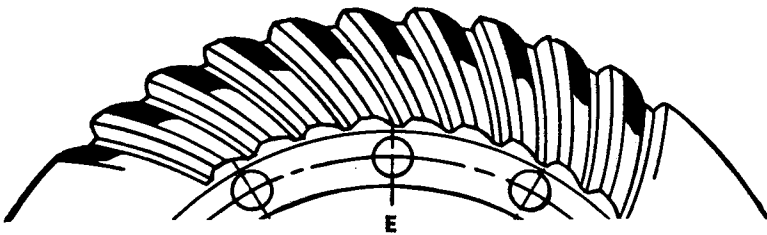
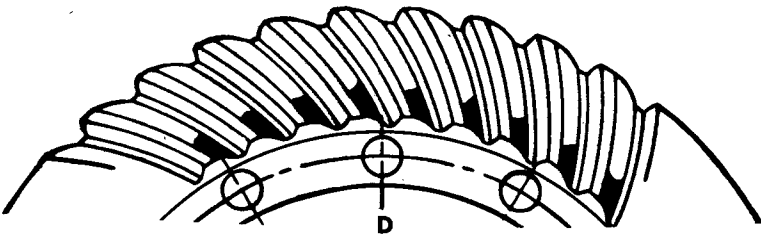
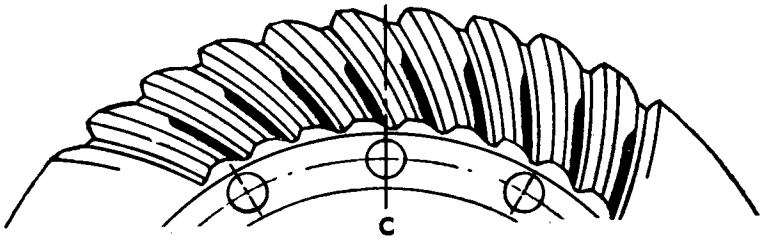
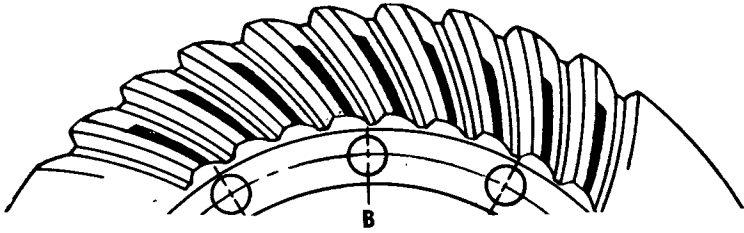
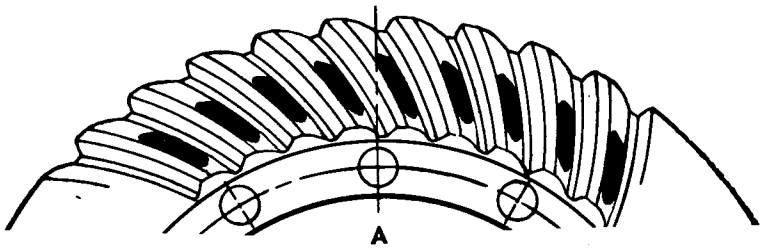


FIGURE 87 – CHECKING BACKLASH WITH GAGE

(mm) Install inspection plate. Fit new gasket around inspection plate opening, install inspection plate and secure with lock washers and bolts ($\frac{9}{16}$ -in. wrench).

ASSEMBLY OF COMPONENT ASSEMBLIES



RA PD 4881

FIGURE 88 — BEARING SURFACES

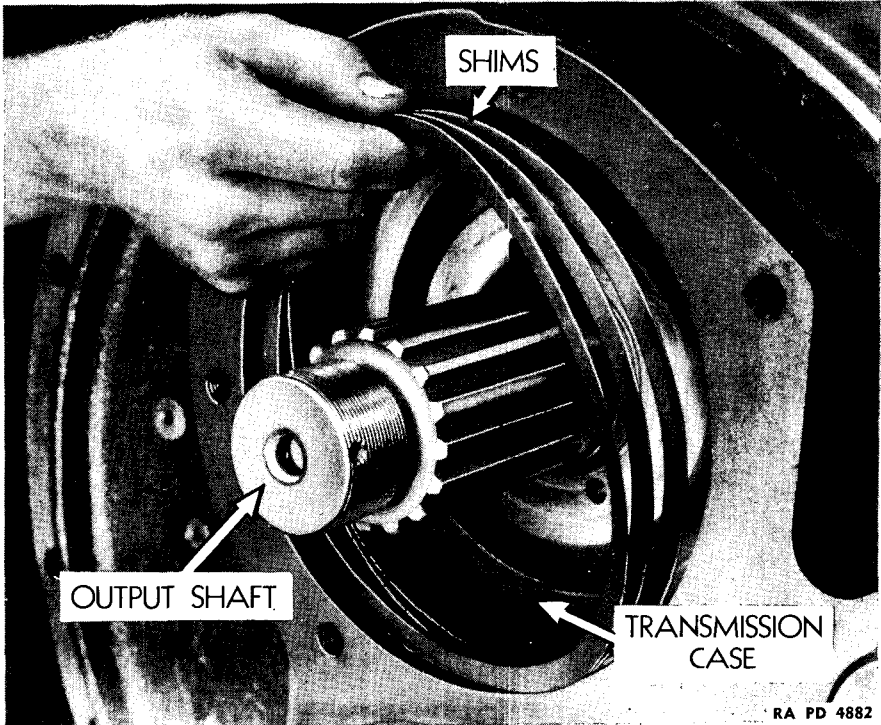


FIGURE 89 — PINION BEARING SHIMS

(2) Assemble transmission with differential. — (a) Assemble transmission and differential. Attach hoist to two eyebolts on top of transmission, raise transmission, slide Neoprene gasket against front flange and fit front end into opening in rear of differential housing. The pinion gear must be meshed with bevel gear. These gears may be observed through oil filler opening in top of differential housing. With gears meshed, insert two dowel pins, one just left of eyebolt at top of transmission, and one directly opposite at bottom of transmission case. Install lock washers and bolts ($\frac{3}{4}$ -in. wrench) around edge of transmission case. One short bolt is used just above reverse idler housing and another directly opposite at top of inspection plate. Place blocks under transmission and remove hoist and eyebolts. There must be no clearance between transmission case and differential case. Check with .0015-in. shim to make sure none exists.

(b) Check backlash between pinion and bevel. Backlash is amount of free play between teeth of transmission pinion gear and differential bevel gear. This should be .006 to .008 in. The amount of backlash is controlled by moving bevel gear toward or away from pinion, or by moving pinion toward or away from gear, the movement being accomplished by changing shims. Attach backlash dial indicator to flange of differential housing (fig. 17), with end of indicating rod in contact with tooth of bevel gear in mesh with pinion. Reach into bore of left differential case cover, grasp edge of hole in cover and turn slightly on

ASSEMBLY OF COMPONENT ASSEMBLIES

bearings to bring teeth of gear and pinion into contact. Take a reading of indicator. Turn cover and gear in opposite direction until teeth meet, and take another gage reading. Difference between these two readings is amount of backlash.

CAUTION: In turning gear to check backlash be sure pinion is not turned. If backlash is less than .006 in., bevel gear must be moved away from pinion gear. This is done by removing required amount of shims from right side and adding them to left side. If backlash is over .008 in., remove shims from left side and add them to right side. Make adjustments until desired backlash is secured.

(c) Check bearing between pinion and bevel gear. It is necessary that bevel gears be adjusted to give proper contact between teeth of gear and teeth of pinion. Proper adjustment distributes the load over a considerable area of the teeth, keeps bearing pressure low and minimizes wear. If contact is not correct loads will be concentrated on small tooth areas and breakage, chipping, or undue wear will result. A dynamometer or some other device is necessary to turn the input shaft of transmission and put a load on the differential bevel gear, and it may be necessary to finish the assembly of the power train to accomplish this. Paint a few gear teeth with a light coat of mixture of powdered red lead and any light machine oil to allow the bearing surface to be observed. Run the unit a few moments with a load and observe the tooth bearing on the bevel gear teeth.

Condition A (*fig. 88*) shows a bearing on the bevel gear which is considered satisfactory. The area of contact starts close to the toe (inside end) and extends well out toward the heel (outside end) on the drive side of the tooth.

Condition B shows a high narrow contact on the gear tooth 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 and correct the backlash by moving the gear away from the pinion.

Condition C shows a low narrow contact on the gear tooth. 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 and correct the backlash by moving the gear toward the pinion.

Condition D shows a short contact on the toe of the gear tooth. 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 a correct contact move the gear away from the pinion and correct the backlash by moving the pinion toward the gear.

Condition E shows a short contact on the heel of the gear tooth. If gears are operated with this adjustment, chipping, excessive 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.

The pinion is moved toward or away from the gear by adding or removing shims from behind the pinion bearing as directed in paragraph 17 b (1) (ee).

The gear is moved toward or away from the pinion by transposing shims

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

located between differential bearing holder plates and differential housing covers. Transposing shims from left bearing to right bearing moves the gear toward the pinion and transposing shims from right bearing to left bearing moves the gear away from the pinion. Instructions for this operation are given in paragraph 16 b (9).

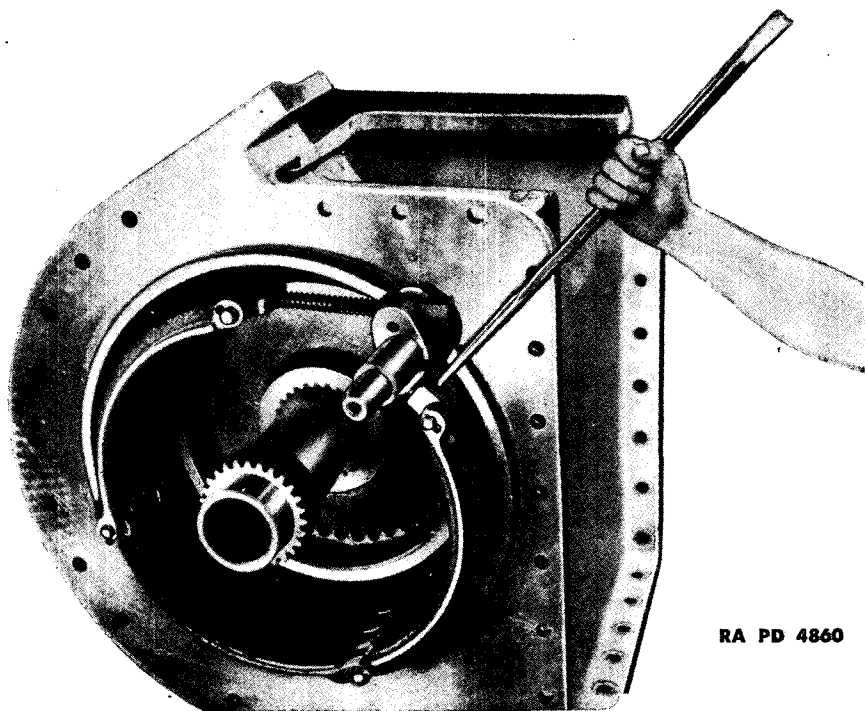
Instructions for checking backlash are given in paragraph 17 b (2) (b).

It is necessary to disassemble the transmission from the differential housing to reach the shims back of the pinion gear. If the final drives and the steering brakes have been assembled with the differential it will be necessary to remove these parts to reach the differential bearing shims.

The bevel gear and pinion are made up in matched sets and if it becomes necessary to replace one the other should also be replaced.

18. STEERING BRAKE ASSEMBLIES. — a. Equipment. —

Bar, 4 ft.	Hoist
Bar, alining	Mallet, bronze
Bar, bumping, bronze	Mallet, wood
Bar, pinch	Pliers
Block, metal	Rule
Gage, measuring, for brake adjustment	Wrench, 5/8-in.



RA PD 4860

FIGURE 90 — REPLACING BRAKE SHOES

ASSEMBLY OF COMPONENT ASSEMBLIES

Wrench, $\frac{3}{4}$ -in.Wrench, $\frac{7}{8}$ -in.

Wrench, 1-in.

Wrench, $1\frac{1}{16}$ -in.Wrench, $1\frac{1}{8}$ -in.Wrench, $1\frac{1}{4}$ -in.

b. Procedure. — (1) Assemble steering brake assembly. — (a) Assemble brake drum, spacer and bearing with compensating shaft (fig. 47). Lay drum on blocks on floor, locking nut side down. Insert compensating shaft, rear end up into bore of drum, aline splines and drive shaft into drum with bronze mallet. Drive shaft through far enough to get spacer, bearing, and snap ring on outside end. Turn drum outside end up and rest on blocks with end of shaft clear of floor. Slide spacer onto outside end of shaft and straight drum. Drive ball bearing onto end of shaft far enough to clear snap ring groove near end of shaft, and install snap ring.

CAUTION: There is also a snap ring groove on outside diameter of bearing near one end. Bearing must be driven onto shaft with this groove toward outside end of shaft. Drive shaft back into drum far enough to clamp bearing and spacer between snap ring and drum. Tighten locking screws ($\frac{5}{8}$ -in. wrench) and lock nuts (1-in. wrench) located in outside hub of drum.

(b) Install brake drum assembly in housing (fig. 56). Drum assembly is

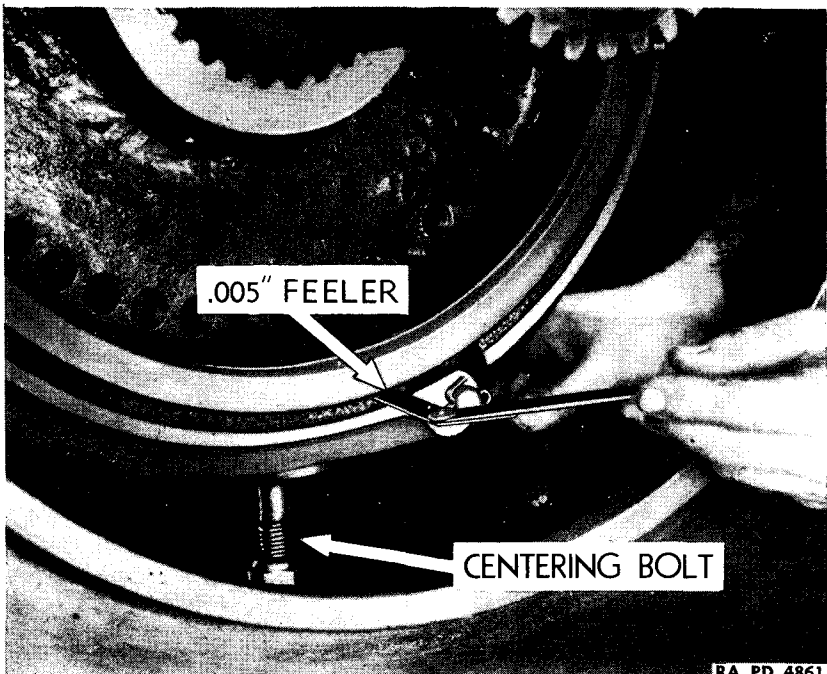


FIGURE 91 — ADJUSTING CENTERING BOLT

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

put into inside end of steering brake housing, drum end first. Slide bar (4 ft.) into compensating shaft, and pass end of bar through opening in steering brake housing as shown in figure 56. With man at each end of bar, line up bearing on compensating shaft with bore in housing and drive drum assembly into place with bronze bumping bar. Install snap ring on outside diameter of compensating shaft bearing at outside of brake housing. Install spacer and outer race of pinion gear bearing in bore in outside of housing. Bolt retainer plate over bearing race ($\frac{3}{4}$ -in. wrench) and secure bolts with locking wires through bolt heads and openings in retainer plate.

(c) Assemble steering brake shoes. For instructions on relining and assembling brake shoe assemblies, see paragraph 15.

(d) Replace brake shoe assembly in housing (fig. 90). Screw centering bolt ($\frac{7}{8}$ -in. wrench) with nut into boss in bottom of housing. Slide spring over long adjusting screw at end of shoes, slide screw through brake operating cam at other end of shoes, and turn adjusting nut onto bolt a few turns to hold in place (fig. 90). Slide brake shoe assembly over brake drum into housing, with splined end of brake shaft going through hole in housing. Drive shaft through hole with wood mallet if necessary. Brake cam should be in vertical position to pass through opening, and it may be necessary to pry up under brake shoes to get them into position.

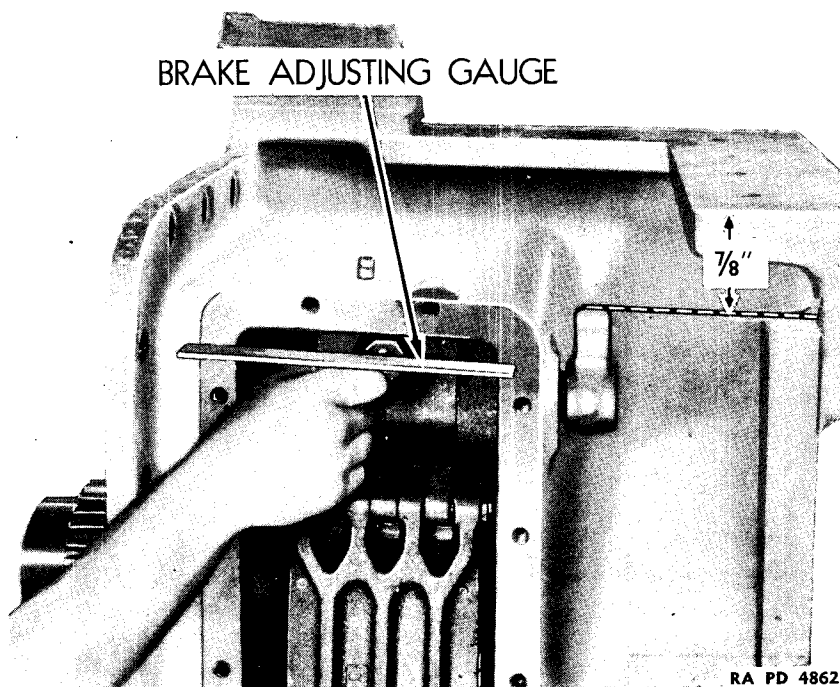


FIGURE 92 — CHECKING BRAKE ADJUSTMENT

ASSEMBLY OF COMPONENT ASSEMBLIES

(e) Adjust brake shoe assembly (figs. 91 and 92). Slide brake arm temporarily onto serrated end of shaft. Adjust centering bolt ($\frac{7}{8}$ -in. wrench) until there is .005 in. clearance between the brake lining and bottom of drum. Turn brake adjusting nut ($1\frac{1}{8}$ -in. wrench) to give $3\frac{1}{8}$ in. clearance from rear surface upper link pin to face of inspection plate hole (fig. 92) with brake lever down. Remove brake arm from shaft and replace in such a position that highest point of arm is $\frac{7}{8}$ in. below top surface of housing (fig. 68). Install bolt clamping arm to end of brake shaft. (Bolt passes through groove in shaft.)

(f) Install brake inspection plate. Put inspection plate in place using new gasket and secure with lock washers and bolts ($\frac{3}{4}$ -in. wrench).

(g) Assemble second steering brake assembly. Repeat operations (a), (b), (c), (d), (e) and (f) above on second assembly.

(2) Assemble steering brake assembly with differential assembly. — (a) Install gasket. Place composition gasket around flange of steering brake housing. This gasket does not fit entirely around housing, a gap being left at steering brake shaft. Use gasket cement at ends of gasket and on side of housing around brake shaft hole.

(b) Assemble steering brake assembly with differential assembly. Raise steering brake assembly with hoist and insert end of compensating shaft into differential cover. It may be necessary to turn compensating shaft and brake drum to line up teeth on shaft with teeth of differential gear, so that shaft can enter. Insert alining bar through bolt hole in brake and differential housing flanges to aline housing. Install top bolt in front flange and bottom bolt in rear flange first as these holes are bored smaller than the rest and bolts serve as dowels. Install bolts around entire assembly (1-in., $1\frac{1}{8}$ -in., $1\frac{1}{2}$ -in., and $1\frac{1}{4}$ -in. wrenches), and secure nuts with cotter pins.

(c) Assemble second steering brake assembly with differential assembly. To assemble second assembly with differential assembly repeat operations (a) and (b) above.

19. FINAL DRIVE ASSEMBLIES. — a. Equipment. —

Bar, bumping, bronze	Pliers
Bar, pinch	Press, arbor
Hammer, $\frac{1}{2}$ -lb.	Wrench, $\frac{3}{4}$ -in.
Hammer, bronze	Wrench, $1\frac{1}{8}$ -in.
Hoist	Wrench, $4\frac{1}{2}$ -in.
Mallet, bronze or rawhide	

b. Procedure. — (1) Assemble final drive assembly. — (a) Assemble oil seals, final drive cap and bearing on final drive shaft (fig. 47). Start oil seal into outside end of bore in final drive cap and tap into place carefully with hammer. Put second seal over first and tap into place, carrying first seal ahead of it.

CAUTION: The inside seal should be installed open end in and the outside seal open end out. This prevents loss of lubricant or entrance of dirt or water.

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

Slide final drive cap, outside end first, over inner end of drive shaft. Put lock washers on bolts and put bolts through holes in cap from outside.

CAUTION: Bolts must be installed in cap before bearing is pressed in place, otherwise there is not sufficient room. Slide outside bearing over inner end of shaft and press in place against shoulder with arbor press.

(b) Install pinion gear bearing in housing (fig. 50). Push roller bearing into bore in final drive housing or cover. Put locking or retaining plate in place over bearing with open side toward final drive shaft and secure in place with lock washers and bolts ($\frac{3}{4}$ -in. wrench).

(c) Assemble bearing races on pinion (fig. 50). Slide bearing races onto both ends of pinion and secure in place with snap rings.

(d) Install bearing and spacer on hub of herringbone gear (fig. 50). Push roller bearing onto outside hub of herringbone gear and drive spacer (flat end first) onto end of hub and against bearing.

(e) Install final drive shaft and outside bearing in final drive housing (fig. 47). Stand housing on inside end, using wood blocks to hold it about six inches off floor. Place Neoprene gasket on end of housing. Slide shaft into outside end of housing and drive bearing into bore by pounding on outside end of shaft. Aline bolts in cap with holes in gasket and housing, then screw into housing.

(f) Assemble gear and pinion with housing (fig. 48). Herringbone gear and pinion must be installed at same time on account of interlocking teeth. Slide spacer on herringbone gear over splined end of drive shaft and start gear onto shaft. Mesh pinion with gear and start end of pinion bearing race into bearing in housing. Drive or press gear slowly onto shaft, being careful that pinion follows it without jamming. Put washer on end of drive shaft against gear, screw on nut ($4\frac{1}{2}$ -in. wrench) and secure in place with cotter pin.

(g) Assemble second final drive assembly. To assemble second final drive assembly repeat operations (a), (b), (c), (d) and (e) above.

(2) Assemble final drive assemblies to steering brake housings. — (a) Install compensating drive shaft. Slide final drive shaft (either end first) into compensating shaft, turning slightly to mesh splines on end with splines in gear.

(b) Install gasket. New gaskets should be used whenever final drive assemblies are assembled to steering brake housings. Cover flanges with gasket cement if available and place Neoprene gasket in place, lining up holes in housing.

(c) Attach final drive assembly to steering brake assembly. Insert dowel pins in steering brake housing. Raise final drive assembly on hoist and use bar through bolt hole to aline with steering brake housing. Drive into place with bronze bumping bar. Secure housing in place with lock washers and bolts ($1\frac{1}{8}$ -in. wrench).

(d) Assemble second final drive assembly to steering brake housing. To assemble second final drive assembly to steering brake housing repeat operation (a), (b), and (c) above.

ASSEMBLY OF COMPONENT ASSEMBLIES**20. SPROCKET AND HUB ASSEMBLIES. — a. Equipment. —**

Hoist

Wrench, $\frac{3}{4}$ -in.

Wrench, $1\frac{7}{8}$ -in.

b. Procedure. — (1) Assemble sprockets with hub. Place sprockets on hub (flat sides of sprockets away from hub) and fasten in place with lock washers and bolts ($\frac{3}{4}$ -in. wrench).

(2) Assemble sprocket and hub assembly with final drive shaft. Lift sprocket and hub assembly with hoist, slide onto end of drive shaft and over studs. Install lock washers and nuts ($1\frac{7}{8}$ -in. wrench) on ends of studs. Repeat with second assembly on other side of tank.

SECTION VII

**ASSEMBLY OF POWER TRAIN AND RELATED PARTS
 TO HULL**

Paragraph

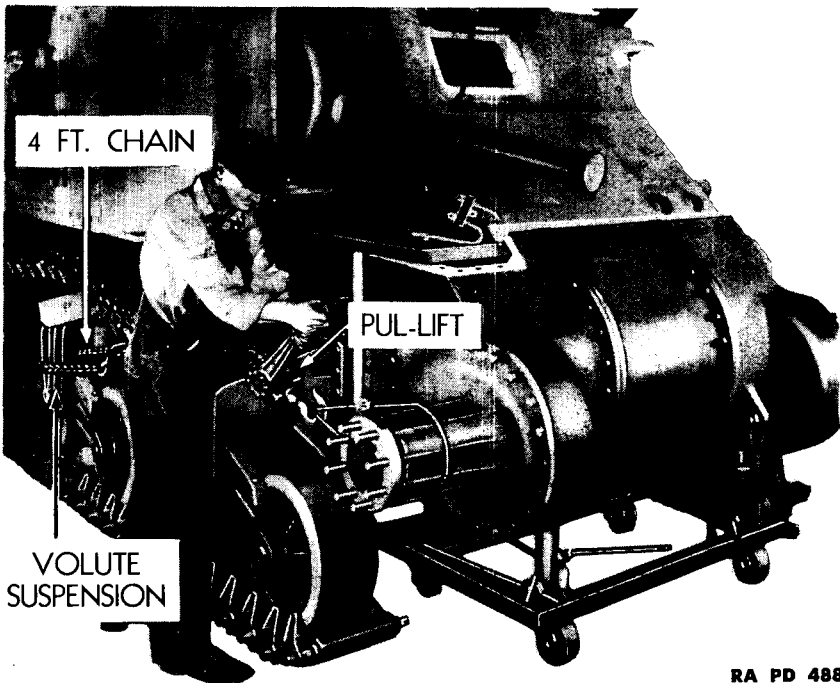
Install power train in hull..... 21

21. INSTALL POWER TRAIN IN HULL. — a. Equipment. —

- | | |
|-------------------------------------------|--------------------|
| Carrier, train power | Screwdriver |
| Chain, 4-ft. | Truck |
| Hammer | Wrench, adjustable |
| Hoist | Wrench, 3/4-in. |
| Fixtures, special | Wrench, 7/8-in. |
| Pliers | Wrench, 1 1/8-in. |
| Pin, drift, 3/4-in. (1/64-in., undersize) | Wrench, 1 1/2-in. |
| Pul-lift | Wrench, 2 1/2-in. |
| Reamer, tapered, 3/4-in. | Wrench, 1 1/8-in. |
| Rope, wire | Wrench, 3-in. |

b. Procedure. — (1) Paint all flanges with "Alumilastic." Before power train is installed in tank, paint all bearing surfaces around opening in tank with "Alumilastic" or similar sealing material.

(2) Connect power train to tank. Lift power train with hoist and place



RA PD 4884

FIGURE 93 — PULLING POWER TRAIN INTO HULL

ASSEMBLY OF POWER TRAIN AND RELATED PARTS TO HULL

on carrier (see par. 7). Put top and bottom bolts through each side plate of hull and place two shims on bolts on inside of hull plates. These bolts must not project inside beyond shims or they will interfere when power train is pushed into hull. Move power train into opening in tank, at slightly lower level than opening. The right side is moved in first, to permit clearing transmission shift lever. It is advisable to have one man inside tank as unit is moved in, to watch clearance. Jack up two rear jacks of carrier until rear of power train is at right height, and then raise front jacks. This method of moving unit up from underneath will aid in clearing cables on inside of tank. Final movement of the power train into place is accomplished with a come-along or Pul-lift. A 4-ft. chain is passed around suspension bracket (fig. 93) and metal rope or chain is passed around final drive housing. The Pul-lift is connected between these two chains, and power train is pulled into place. Insert $\frac{3}{4}$ -in. drift pins, one in top right corner, one in fourth bolt hole down on each side, and one in third bolt hole back at top of left side. These will hold power train and tank in alinement while bolts are being replaced. Install bolts and lock washers, nuts being held inside while bolts are turned in. A $1\frac{1}{8}$ -in. wrench will be required for nuts, and $1\frac{1}{8}$ -in. wrench for bolts. It may be necessary to ream out some of bolt holes, using $\frac{3}{4}$ -in. tapered reamer. Remove taper pins and replace with bolts. Remove the carrier. The two bolts in the center underneath the power train are directly under the transmission and nuts cannot be used on inside. These bolts are secured with locking wire. Install remainder of bolts underneath power train.

(3) Replace fenders. Hold each fender in position and replace bolts. Four upper bolts on left side and two on right side require $\frac{3}{4}$ -in. wrench; a $\frac{9}{16}$ -in. wrench is used for bolts at rear of each fender; and a $1\frac{1}{8}$ -in. wrench is used for three bolts which hold each fender to final drive housing.

(4) Replace headlights. Headlights are attached to fenders by three bolts in headlight bases. These must be held by a screwdriver underneath fender while nuts are being installed ($\frac{9}{16}$ -in. wrench).

(5) Replace subfloor. Place subfloor in position and insert four bolts ($25/32$ -in. wrench) which hold it to floor. Nuts must be held inside tank while bolt is being turned from beneath with screwdriver.

(6) Connect brake linkage. Connect brake linkages to steering brake arms (one at each side) by placing arm in yoke and inserting clevis pin and securing with cotter pin.

(7) Connect hand throttle linkage. Connect hand throttle rod and fork with clevis pin and secure with cotter pin. Connect spring to throttle linkage.

(8) Connect stop light switch. Connect wires to stop light switch under subfloor.

(9) Connect machine gun controls. Connect machine gun controls to steering brake levers and transmission, using screws and clips to hold in position.

(10) Attach cables to flanges. Remove bolts ($1\frac{1}{8}$ -in. wrench) from the upper corners of two inner flanges of differential housing. Replace bolts, bolt-

ing brackets holding groups of cables to differential flanges.

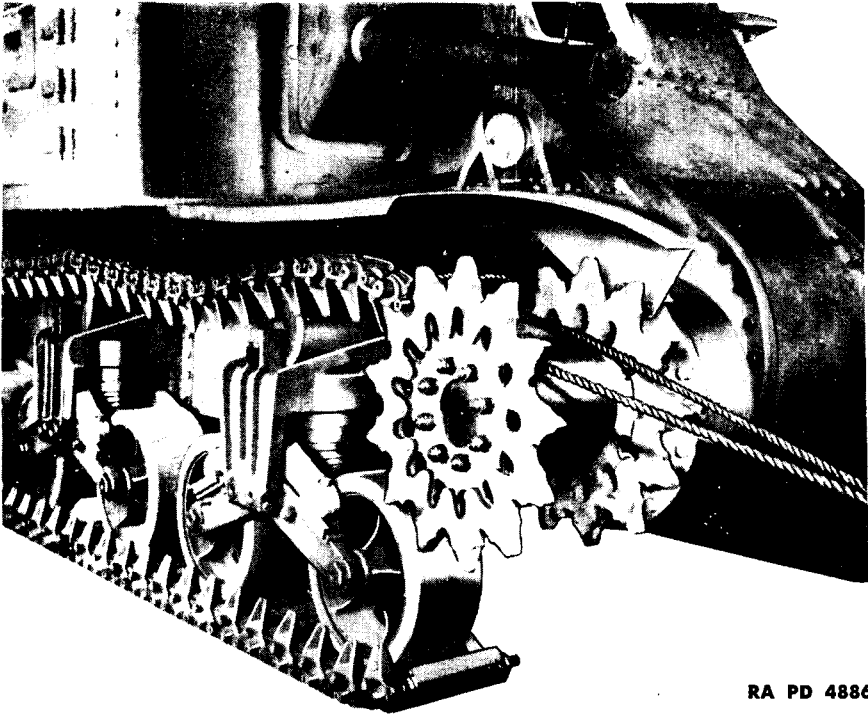
(11) Connect universal joint flanges. Bolt together two flanges of universal joint ($\frac{9}{16}$ -in. wrench). Replace universal joint cover, securing in place with four small bolts with lock washers.

(12) Connect speedometer cable. Put end of speedometer cable in place and secure by tightening knurled nut.

(13) Replace right side of seat support. Replace right side of seat support and bolt to floor ($\frac{9}{16}$ -in. wrench). Nuts will have to be held inside tank while bolts are being turned from beneath tank with screwdriver.

(14) Replace driver's seat. Replace driver's seat in supports, and insert slip pins to hold seat at desired level.

(15) Connect oil lines. If oil cooler is used connect two couplings connecting transmission and oil lines.



RA PD 4886

FIGURE 94 — PULLING TRACK OVER DRIVE SPROCKETS

(16) Replace tracks (figs. 94, 95, 97 and 98.) The tracks are too heavy to be pulled up over sprockets by hand. Attach them to a truck by rope or chain and pull up meshing into teeth of sprockets. When tracks have been pulled well over sprockets, unfasten rope or chain. Hook special angle iron fixtures (figs. 95, 97 and 98) onto track, attach a Pul-lift to eyebolts and pull ends of track together. Drive end connections onto inside and outside ends of

ASSEMBLY OF POWER TRAIN AND RELATED PARTS TO HULL

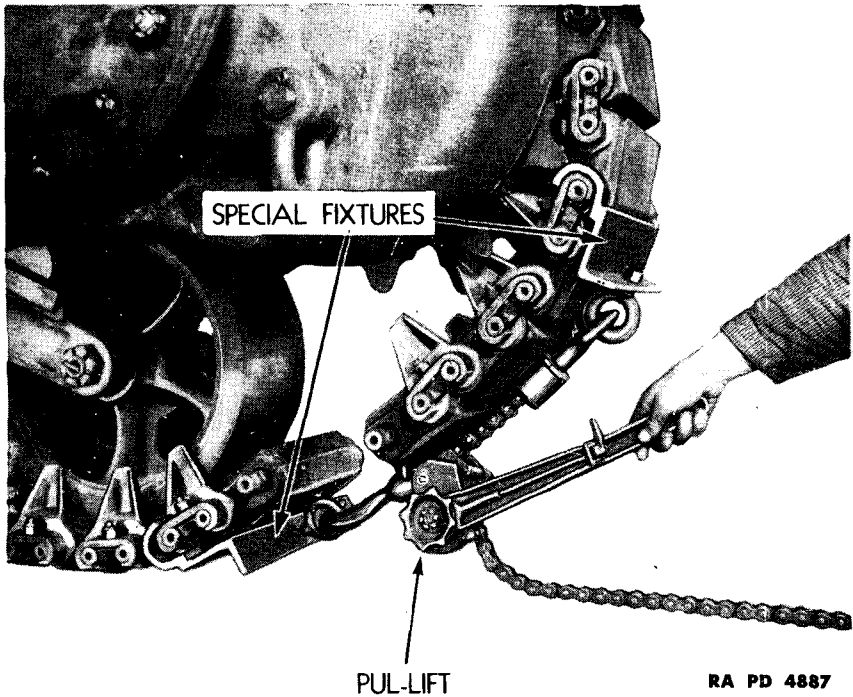


FIGURE 95 — PULLING ENDS OF TRACK TOGETHER

track pins, install wedges in connections and secure with nuts ($\frac{7}{8}$ -in. wrench).

(17) Adjust track. Tension of tracks is adjusted by means of eccentrics on track idlers. Use long handled 3-in. wrench, or wrench connected to jack as shown in figure 96, turn adjusting eccentric nut as far as possible to raise eccentric and produce tension on track. Hammer locking plate onto serrations on eccentric shaft and see that retaining strap is in place. Loosen center or splitting bolt in bracket (turn clockwise, left hand thread) and tighten the two end bolts ($1\frac{1}{8}$ -in. wrench).

(18) Fill with oil. Fill transmission, differential and steering brake housings as instructed on lubrication chart.

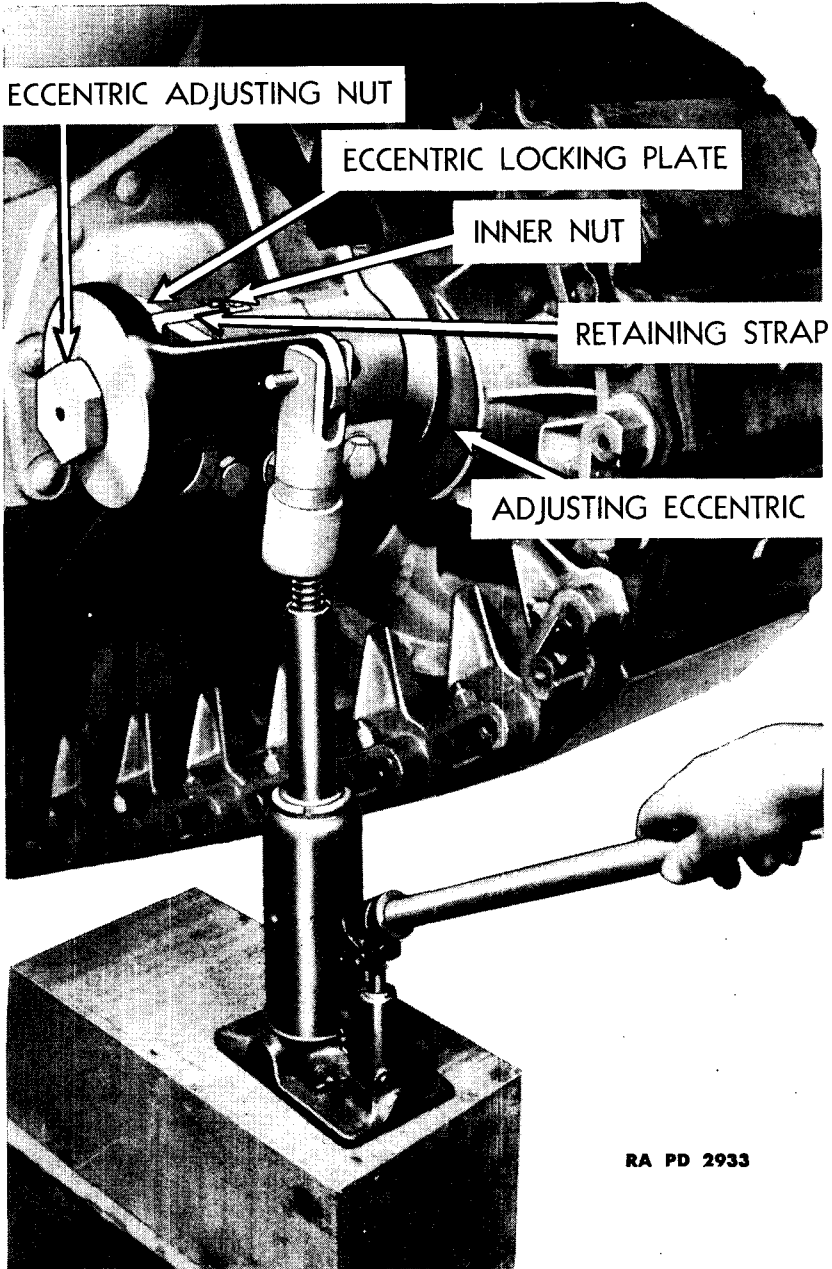
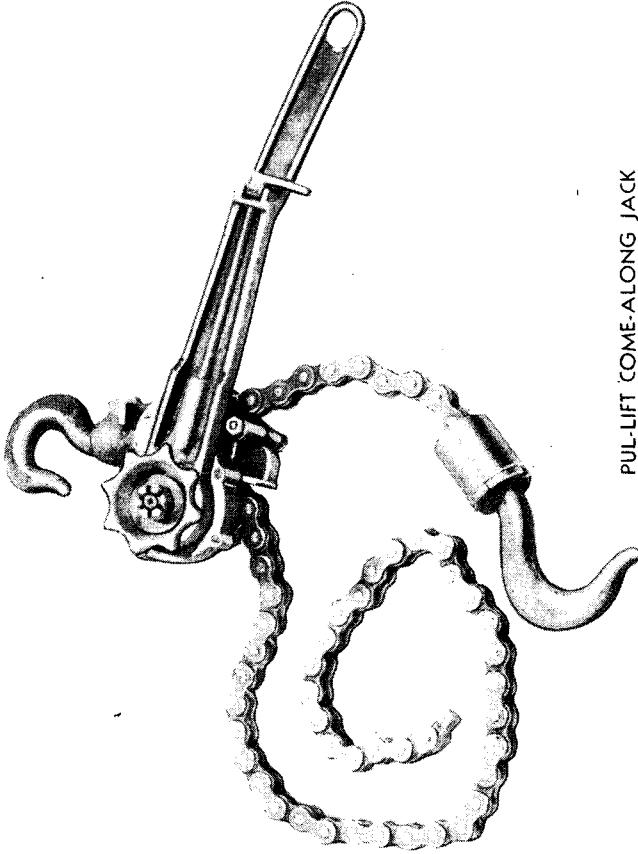
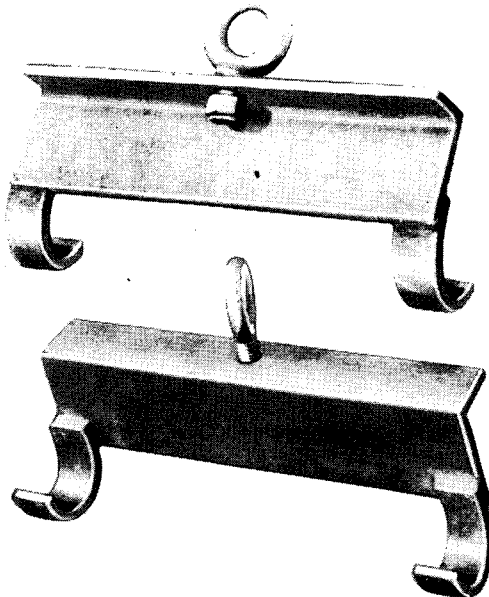


FIGURE 96 - TURNING ECCENTRIC TO TIGHTEN TRACK



PUL-LIFT COME-ALONG JACK



SPECIAL CLAMPS FOR REMOVING TRACKS

RA PD 5253

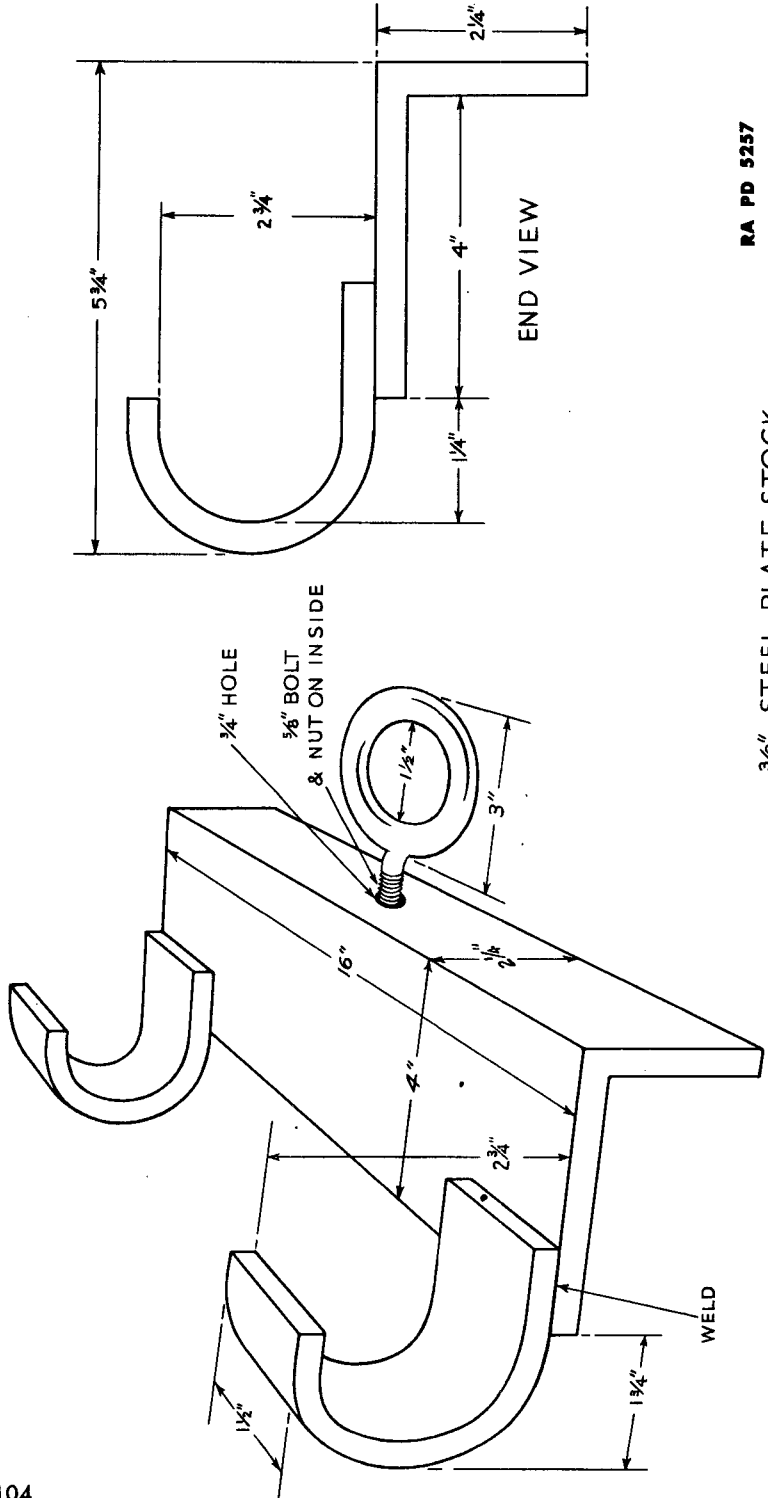
FIGURE 97 — TOOLS FOR CONNECTING TRACK

ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS

RA PD 5257

3/8" STEEL PLATE STOCK

FIGURE 98 — DETAILS OF TRACK CONNECTING HOOK



LIST OF MAJOR OVERHAUL TOOLS

SECTION VIII

LIST OF MAJOR OVERHAUL TOOLS

Paragraph

List of major overhaul tools..... 22

22. LIST OF MAJOR OVERHAUL TOOLS. — Numbers with prefix "M" are for Miller Tool and Mfg. Co.

<i>Drg. No.</i>	<i>Piece Mark</i>	<i>Quantity</i>
	M-M3-123 BAR, pair, input shaft, installing and removing	1
	M-M3-114 BAR, pair, output shaft, installing and removing	1
D47504	CARRIAGE, power train, complete with four jacks	2
	M-M3-112 DRIFT, countershaft and input shaft front end bearing, installing	1
	M-M3-106 DRIFT, front cover shaft rod oil seal, installing	1
	M-M3-124 DRIFT, oil seal in final drive cover cap, installing	1
	M-M3-110 FIXTURE, countershaft gear, countershaft snap ring, countershaft rear end bearing, installing	1
	M-M3-100 FIXTURE, holding, input and output shaft gear, assembling	1
	M-M3-119 FIXTURE, riser, gear and bearing puller plate, supporting	2
	M-M3-121 PILOT, idler shaft thrust and spacer washer, alining	1
	M-M3-105 PULLER, plate, transmission clutch gears (gears C77599 and C83701).....	1
	M-M3-118-1 PULLER, plate, transmission, fifth speed gear (gear C77580).....	1
C85121	PULLER, transmission bevel pinion gear.....	1
	M-M3-139 PULLER, transmission case rear cover.....	1
	M-M3-125 PULLER, transmission idler gear shaft.....	1
	M-M3-107 SLEEVE, final drive stub shaft outer bearing inner race, installing.....	1
	M-M3-113 SLEEVES, pair, input and output shaft rear end bearing, assembling.....	1
	M-M3-103 SLEEVES, pair, with two alining keys, input and output shaft gears, installing.....	1
	M-M3-115 SLEEVE, pilot, fourth and fifth clutch gear onto input shaft	1
	M-M3-101 SLEEVE, pilot, fourth speed gear onto output shaft	1
	M-M3-136 SLING, power train, complete.....	2
	M-M3-141 TOOL, compensating shaft outer end bearing (C77532), assembling	1

**ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS**

<i>Drg. No.</i>	<i>Piece Mark</i>	<i>Quantity</i>
M-M3-109	TOOL, final drive shaft herringbone gear bearing, installing	1
M-M3-108	TOOL, final drive shaft pinion bearing inner race, installing	1
M-M3-140	TOOL, differential end bearing (A196390), installing	1
M-M3-138	TOOL, transmission drive pinion and bearing assembly (into case).....	1
M-M3-111	TOOL, transmission drive pinion bearing, installing (on pinion)	1
M-M3-102	WRENCH, couitershaft, input shaft, and parking brake drum lock nuts.....	1
M-M3-128	WRENCH, final drive herringbone gear lock nut (with handle).....	1
M-M3-131	WRENCH, plug, $\frac{9}{16}$ in. hex., transmission and oil tank drain plugs.....	4
A191315	WRENCH, socket, brake nut adjusting, $1\frac{1}{8}$ in. hex.	2
B183480	WRENCH, transmission drive pinion lock nut	1

REFERENCES

SECTION IX

REFERENCES

	Paragraph
Technical manuals and field manuals.....	23
Standard nomenclature lists.....	24

23. TECHNICAL MANUALS AND FIELD MANUALS. — a. General. —

Medium Tank M3.....	TM 9-750
Ordnance Maintenance, Wright Whirlwind Engine Model R975EC-2.....	TM 9-1751
Ordnance Maintenance Auxiliary Generator for Medium Tank M3.....	TM 9-1752
Ordnance Maintenance, Accessories for Wright R975EC-2 Engines, Medium Tanks M3 and M4.....	TM 9-1753
Ordnance Maintenance, Hull Section, Medium Tank M3.....	TM 9-1754
Ordnance Maintenance, Turret Section, Medium Tank M3.....	TM 9-1755
Ordnance Maintenance, Guiberson Diesel Engine, Model T-1400.....	TM 9-1756
Cleaning, Preserving, Lubrication and Welding Materials and similar items issued by the Ordnance Department.....	TM 9-850

b. Armament. —

37 mm Gun, M5 (Mounted in tanks).....	TM 9-1250
	FM 23-80
37 mm Gun, M6 (Mounted in tanks).....	TM 9-1250
	FM 23-81
Browning Machine Gun, Cal. .30, HB M1919A4 (Mounted in combat vehicles).....	TM 9-1205
	FM 23-50
Thompson Submachine Gun, Cal. .45, M1928A1.....	TM 9-1215
	FM 23-40
75 mm Tank Gun Materiel.....	TM 9-307

24. STANDARD NOMENCLATURE LISTS. —

Gun, Machine, Cal. .30, Browning, M1919A4, Fixed and Flexible, and Mount, Tripod, M2.....	SNL A-6
Gun, Submachine, Cal. .45, Thompson, M1928A1.....	SNL A-32
Gun, 37 mm, M5 and M6.....	SNL A-45
Materiel, 75 mm Tank Gun M2, M3.....	SNL C-34
Cleaning, Preserving and Lubricating Materials, Recoil Fluids, Special Oils, and similar items of issue.....	SNL K-1
Tank, Medium, M3.....	SNL G-104

LIST OF ILLUSTRATIONS

<i>Figure</i>	<i>Title</i>	<i>Page</i>
1	Power train unit	3
2	Interior of driver's compartment	4
3	Breathers used on power train	5
4	Oil system of the transmission without oil cooler	7
5	Oil system in transmission equipped with oil cooler	8
6	Turning eccentric to loosen track	10
7	Track broken ahead of front wheel	10
8	Right side of driver's compartment	11
9	Power train carrier under power train	13
10	Power train carrier	14
11	Power train partly pulled out of tank	15
12	Power train completely out of tank	15
13	Cut-away of parking brake	17
14	Brake assembly	18
15	Brake drum puller	19
16	Transmission gear assemblies	20
17	Transmission shifting brackets	21
18	Transmission on stand	22
19	Drain oil at points indicated by arrows	23
20	Transmission removed from differential	24
21	Gear shift lever assembly	24
22	Pinion gear end of transmission with bearing cover removed	25
23	Special wrenches used on pinion, input and countershaft nuts	25
24	Pinion gear puller	26
25	Raising transmission cover	27
26	Transmission with cover removed	27
27	Removing fourth speed gear with a locking arm puller	28
28	Shift rod support blocks and interlocks	28
29	Input shaft lifting nut	29
30	Input shaft assembly	30
31	Oil pump assembly	31
32	Oil pump used in tanks equipped with oil cooler	32
33	Working parts in oil pump equipped with oil cooler	33
34	Removing output shaft	34
35	Tool used to remove rear countershaft bearing	35
36	Output shaft assembly	36
37	Removing countershaft assembly	37
38	Countershaft assembly	37
39	First speed idler gear being removed	38
40	Output shaft assembly	39
41	Second and third speed synchronizer	40
42	Second and third speed synchronizer disassembled	41

LIST OF ILLUSTRATIONS

Figure	Title	Page
43	Fourth and fifth speed synchronizer.....	42
44	Fourth and fifth speed synchronizer disassembled.....	43
45	Input shaft assembly.....	44
46	Countershaft assembly.....	45
47	Differential and final drive assembly.....	46
48	Final drive unit removed from assembly.....	47
49	Removing herringbone gear.....	48
50	Herringbone and pinion gears.....	48
51	Removing final drive shaft.....	49
52	Final drive shaft and bearing.....	49
53	Removing compensating drive shaft.....	50
54	Removing steering brake assembly.....	51
55	Removing brake shoe from housing.....	51
56	Removing brake drum from housing.....	52
57	Removing differential from housing.....	54
58	Removing differential bearing.....	55
59	Differential bearing fixture.....	56
60	Compensating case and covers.....	57
61	Removing pinion gear nut.....	58
62	Needle bearing remover and needle bearing drivers.....	59
63	Removing bevel gear.....	59
64	Differential assembly.....	60
65	Fixture for determining width of spacers for taper-roller bearings..	62
66	Removing link pin from cam.....	64
67	Pulling brake shoes out of housing.....	65
68	Brake adjustment.....	66
69	Replacing pinion and gear in right half of cover.....	68
70	Replacing pinion and gear in left half of cover.....	69
71	Replacing differential bearing.....	71
72	Measuring differential shimming with depth micrometer.....	72
73	Adjusting backlash with differential shims.....	73
74	First speed idler shaft, extending through cover plate.....	74
75	Shifting rods and shifting forks in position.....	77
76	Transmission with fixtures in place.....	78
77	Output shaft and countershaft supporting fixtures.....	79
78	Oil pump wiring.....	80
79	Replacing input shaft assembly.....	81
80	Replacing keys in output shaft.....	82
81	Gear driving tool.....	82
82	Output shaft bearing driver.....	83
83	Driving input shaft bearing into place.....	84
84	Input shaft bearing driver.....	85
85	Measuring pinion bearing shoulder with depth gage.....	85
86	Pinion gear being driven into position.....	86

**ORDNANCE MAINTENANCE
POWER TRAIN UNIT, THREE-PIECE DIFFERENTIAL CASE, FOR MEDIUM TANKS**

<i>Figure</i>	<i>Title</i>	<i>Page</i>
87	Checking backlash with gage	88
88	Bearing surfaces	89
89	Pinion bearing shims	90
90	Replacing brake shoes	92
91	Adjusting centering nut	93
92	Checking brake adjustment	94
93	Pulling power train into hull	98
94	Pulling track over drive sprockets	100
95	Pulling ends of track together	101
96	Turning eccentric to tighten track	102
97	Tools for connecting track	103
98	Details of track connecting hook	104

INDEX TO TEXT

A	Page
Adjustment, brake.....	67
illustrated	66
Aluminastic, painting with	98
Assembly of component assemblies.....	68-97
cleaning of parts before.....	63
differential assembly	68-73
bearing	70, 72
illustrated	71
bushings	
brake shaft	68-69
bronze, steel-backed	69
compensating case	70-72
covers	
left	70
right	70
cover	72
gear, bevel	73
pinion and	70
holder plates	72-73
installing in housing	72
needle bearings	69
pinion and gear	70
shims	72-73
final drive assemblies	95-97
parking brake (See Transmission below)	
speedometer drive assembly, installing ..	83
sprocket and hub assemblies.....	97
steering brake assemblies	92-95
differential, assembly to	95
drum assembly	93-94
shoe assembly	94-95
transmission and parking brake	
assembly	73-92
bearing	
cover	87
countershaft	84-86
input shaft	
front	84
rear	83
output shaft	
front	86-87
rear	83
brake drum assembly, installing	87
cover, installing	80-83
countershaft assembly	75
gasket	80
gear	
idler, and shaft	75
fourth-speed, output shaft	80
pinion, output shaft	86-87
gear shift lever assembly	84

Assembly of component assemblies	Page
— Continued	
input shaft assembly	
assembling	75-76
installing	79-80
input shaft bearings	
front	84-86
rear	83
input shaft cap and spacer.....	83
input shaft universal joint flange....	88
inspection plate, installing	88
oil pump	
assembling	76-77
installing	79
output shaft assembly	
assembling	76
installing	78
output shaft bearings	
front	86-87
rear	83
output shaft caps and spacer.....	83
output shaft gears	
fourth-speed	80
pinion	86-87
parking brake	87-88
shaft supporting fixtures	79
illustrated	78, 79
shifting block	80
shifting forks and rods.....	78
synchronizers	75

B

Backlash	
compensating gears	70
differential gear	72
illustrated	73
transmission pinion and bevel.....	88-92
illustrated	77
Bearing, differential	
cover	72
illustrated	46, 55, 56, 60, 71
removing	53
illustrated	55
replacing	70-72
illustrated	71
Bearing cover, installing	87
Bearing surfaces (gear teeth), painting...	98
Bevel gear	
illustrated	46, 57, 59, 60
removing	56-58
Brake, parking	
adjusting	87-88
assembling	87-88
disassembling	16-17

INDEX TO TEXT

Brake, parking — Continued	Page
illustrated	13, 18
installing	87-88
location of	6
maintenance of	61
relining	61
Brake, steering, assemblies (See also Brake shoe and Brake shoe assembly)	
adjusting	4
assembling	92-95
disassembling	47-50
illustrated	51
lever, operation of	6
Brake adjustment	63-67
illustrated	66
Brake drum	
assembly	93-94
installing on output shaft.....	87
installing in housing.....	93-94
disassembling	17
puller, illustrated	19
removing from housing.....	52
illustrated	52
Brake linkage, connecting.....	99
Brakes, relining	
parking	61
steering	64
Brake shoe, removing.....	64
from housing, illustrated.....	51
Brake shoe assembly, removing.....	64-67
illustrated	64, 65, 66
Breathers, location of	5

C

Cam, removing link pin from.....	64
illustrated	64
Carrier, power train.....	12, 99
illustrated	13, 14
Cleaning parts	63
Compensating case	
disassembly of.....	53-58
illustrated	46, 54, 60
Compensating gears	70
Compensating drive shaft, removing.....	50
Compensating shaft, removing.....	52
Connecting hook, track, illustrated.....	104
Countershaft assembly	
assembling	75
bearing, installing	84-86
disassembling	40-42
housing, inserting in	75
illustrated	37, 45
removing	33
illustrated	37

Cover plate, differential	Page
illustrated	46, 51
removing	53
Cover, transmission	
installing	80
removing	26

D

Depth gage, illustrated.....	85
Differential assembly	
assembling	68-73
cover plate	53
illustrated	46, 51
described	6-7
disassembling	53-58
housing, removing from, illustrated....	54
illustrated	46, 51, 54, 55, 56, 57, 58, 59, 60, 71
Disassembly of component assemblies... 16-58	
differential assembly	53-58
bearings end.....	53
compensating case.....	53-58
cover plate.....	53
holder plate.....	53
illustrated	54, 55, 56
final drive assemblies.....	42-47
cover	47
herringbone gear.....	45
pinion and gear.....	45
sprocket and hub assemblies.....	42
steering brake assemblies.....	47-53
bushings, brake shaft, removing....	53
compensating shaft.....	52-53
compensating drive shaft.....	50
differential, removing from.....	50
drum	52-53
shoes, brake	50-52
transmission and parking brake	
assembly	16-42
bearing cover, front.....	22-26
brake drum	17
countershaft, released at front....	22-26
countershaft assembly	
disassembling	40-42
releasing at front.....	22-26
removing	33
drive shaft cover.....	47
gear, fourth-speed, removing.....	29
gear shift lever assembly.....	19-22
gears, removing	19-22
input shaft assembly	
caps removed	22
disassembling	38-40
released at front.....	22-26
removing	29

INDEX TO TEXT

Disassembly of component assemblies	Page		Page
— Continued			
transmission and parking brake assembly — Continued		Final drive assemblies	
inspection plate	22	assembling	95-97
oil pump assembly	29-32	disassembling	42-47
output shaft assembly		illustrated	46, 47
caps removed	22	location of	4
disassembling	33-38	operation of	7
rear gear removed	29	Final drive shaft	
released at front	22-26	illustrated	49
removing	32-33	installing	96
illustrated	34	removing	45-47
parking brake	16-17	First speed clutch gear, removing	35
pinion gear and bearing	22-26	Fixture, spacer, illustrated	62
shifting rods	29	Flanges	
support blocks	29	attaching cables to	99-100
speedometer drive assembly	22	painting	98
synchronizers, dismantling		Fourth and fifth speed synchronizer, dismantling	40
fourth and fifth speed	40	Fourth speed gear	
second and third speed	38	removing	29
transmission, removing	19	illustrated	28
cover	26	snap ring broken	61
Driver's compartment			
interior of, illustrated	4	G	
removing seat	11-12	Gasket	
illustrated	11	bearing cover	87
replacing seat	100	Neoprene (transmission—differential)	90
Driving tool, gear, illustrated	82	steering-brake differential	95
		transmission cover	80
E		Gear driving tool, illustrated	82
Eccentric shaft, turning	9, 101	Gear(s)	
illustrated	10, 102	bearings, lubrication of	6-7
End bearings (differential), removing	53	compensating	
Equipment for: (See also Tools)		backlash in	70
assembly of		damaged	17
differential	68	lining up	70
final drive	95	lubrication of	6-7
sprocket and hub	96-97	reductions	6
steering brake	92-93	teeth, painting surfaces	98
shoes	63	transmission	
transmission and parking brake	73-74	caution in assembly	17
disassembly of		removing	33-42
differential	53	replacing	86-87
final drive	42	Gear shift lever assembly	
sprocket and hub	42	assembling	84
steering brake	47	disassembling	19-22
transmission and parking brake	16	illustrated	20, 24
power train			
installing	98	H	
removing	9	Hand throttle linkage, connecting	99
tracks, connecting, illustrated	103	Headlights	
Fenders, front		disconnecting	9
removing	11	replacing	99
replacing	99	Herringbone gear	
		function of	6
		installing	96

INDEX TO TEXT

I	Page
Input shaft	
bearing	
installing	
front	84-86
rear	83
removing	29
caps and spacer	83
removing	22-26
spacer, installing	88
universal joint flange, installing	88
Input shaft assembly	
assembling	75-76
disassembling	38-40
illustrated	44
installing	79-80
illustrated	81, 82
removing	29
illustrated	30
Inspection of parts	63
Inspection plate	
installing	88
removing	22
Interlocks too sharp	63
K	
Keys, replacing in output shaft, illustrated	82
L	
Lining, brake, replacing	
parking	61
steering	67
Link pin, removing from cam	64
illustrated	64
Locking arm puller, illustrated	28
Lubrication	6-7
after assembly	101
illustrated	8
M	
Machine gun controls	
connecting	99
releasing	11
Maintenance	61-67
brake shoe assembly, removing	64-67
parking brake	61
transmission, causes of difficulty in shifting	61-63
N	
Needle bearing remover	56
illustrated	59
Needle bearings, removing	56
illustrated	46, 59, 60
O	
Oil, draining	19, 63
illustrated	23

	Page
Oil collar and spacer	
fitted properly	63
illustrated	40
removing	29
Oil cooler	
connecting	100
described	7-8
disconnecting	12
location of	7
operation of	7-8
Oil lines	
connecting	100
disconnecting	12
Oil pump, capacity of	63
Oil pump assembly	
assembling	76-77
dismantling	29-32
illustrated	
with cooler	32, 33
without cooler	31
installing	78
removing	29
Oil seals, removing	22
Oil stem, removing	29
Oil system	
with cooler	7-8
illustrated	8
without cooler	6-7
Output shaft	
bearing	
driver, illustrated	83
installing	
front	86-87
rear	83
removing	22-26
gears from	29
illustrated	28
Output shaft assembly	
assembling	76
disassembling	32-38
illustrated	36, 40
installing	78
removing	32-33
illustrated	34
P	
Parking brake	
adjusting	87-88
assembling	87
disassembling	16-17
illustrated	17, 18
location of	4
maintenance of	61
relining	61

INDEX TO TEXT

	Page
Pinion gear	
bearing, removing	22-26
nut, removing, illustrated	58
puller, illustrated	26
Power, how transmitted	5
Power train carrier	12, 99
described	12
illustrated	13, 14
Power train unit	
assembly of	68-97
construction of	4-5
described	4-7
disassembling	16-58
illustrated	3
installing in hull	98-104
illustrated	98, 100, 101, 102, 103, 104
lubrication of	6-7
maintenance of	61-67
oil, draining from	19
operation of	5-7
removing from hull	9-12
illustrated	9, 10, 11, 13, 14, 15
Puller, illustrated	
brake drum	19
locking arm	28
pinion gear	26
Pul-lift	100
R	
Remover, needle bearing	56
illustrated	59
Reverse	
clutch gear, removing	35
idler gear, removing	33
Roller bearings, spacer width of	61-63
illustrated	62
S	
Shifting	5
causes of difficulty in	61
Shifting block	
installing	80
removing	29
illustrated	28
Shifting brackets, illustrated	21
Shifting forks, assembling	77-78
Shifting rods	
assembling	77-78
removing	29
Shimming, checking for	86
Shims	
differential bearing	72-73
illustrated	73

	Page
Shims — Continued	
pinion bearing	90-92
illustrated	90
Speedometer drive assembly	
installing	83
removing	22
Sprocket and hub assemblies	
assembling	97
disassembling	42
location of	4
Steering brake assemblies (See also Steering brake shoe assembly)	
assembling	92-95
disassembling	47-53
illustrated	51
location of	4
Steering brake bands, adjusting	4
Steering brake lever, operation of	6
Steering brake shoe assembly	
adjusting	95
illustrated	92, 93, 94
assembling	67
with differential	95
inspection plate	95
replacing in housing	94-95
Stop light switch	
connecting	99
disconnecting	11
Subfloor	
removing	11-12
replacing	99
Synchronizer cones, causes of difficulty in shifting	61
Synchronizer gears	
clutch, trouble with	61
operation of	5-6
Synchronizers	
assembling	75
disassembling	38-40
illustrated	41
illustrated	40
removing	33
T	
Tools (See also Equipment)	
gear driving, illustrated	82
hook, track connecting, illustrated	104
puller, locking arm, illustrated	28
puller, pinion gear, illustrated	26
remover, needle bearing	56
illustrated	59
special, for:	
countershaft, bearing, removing described	33

INDEX TO TEXT

Tools — Continued	Page	Transmission — Continued	Page
special, for:		assembling — Continued	
countershaft bearing, removing		shifting block, installing	80
— Continued		shifting rods and forks	77-78
illustrated	35	shimming, adjusting	86-87
major overhaul	105-106	speedometer drive assembly	83
output shaft, removing	34	synchronizers	75
track, connecting, illustrated	103	disassembling	17-42
transmission cover, raising	26	bearings	
Track		input shaft	29
adjusting	101	output shaft	29
removing			28
illustrated			33
replacing			40-42
illustrated			35, 37, 40
tools for			26
Transmission			27
assembling			19
bearings			23
counters			22-26
front			19-22
rear			20, 21
input sh			
front			12-40
rear			44
output s			29
front			30
rear			29
countersha			29-32
cover			31
installing			29
removing			32-38
differential			34, 36
gears			29
idler			28
pinion			22
gear shift			38-40
input assem			22, 24, 27
assem			4
install			6-7
oil pump			61-63
assem			19
install			
output a			100
assem			
install			
parking			25

U.S. Army Military History Institute

(A. G. 062.1
BY ORDER C

OFFICIAL:

E. S. Al
Ma

DISTRIBUTIO