TM 9-1750H

WAR DEPARTMENT

TECHNICAL MANUAL

ORDNANCE MAINTENANCE

HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

APRIL 10, 1943

UNCLASSIFIED

TECHNICAL MANUAL
No. 9-1750H

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ORDNANCE MAINTENANCE

HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

Prepared under the direction of the
Chief of Ordnance

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Section I

INTRODUCTION

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1. SCOPE.

a. This manual is published for the information and guidance of ordnance maintenance personnel. It contains detailed instructions for inspection, disassembly, assembly, maintenance and repair of the Hydraulic Turret Traversing Mechanism (Logansport) for Medium Tank M3 and Modifications, supplementary to those in the field and technical manuals prepared for the using arms. Additional descriptive matter and illustrations are included to aid in providing a complete working knowledge of the materiel.

2. ARRANGEMENT.

a. One section of the manual is devoted to each of the components of the hydraulic turret traversing mechanism. These sections are arranged in the order in which the components will be removed when the entire mechanism is taken out of the vehicle. Section XIV lists the publications relative to the materiel mentioned in this manual.

Section II

GENERAL DESCRIPTION

	Paragraph
Purpose of mechanism	3
Description	4
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Statement regarding TM 9-750	6
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Allocation of maintenance on Hydraulic Turret Traversing Mechanism (Logansport) For Medium Tank M3	8

3. PURPOSE OF MECHANISM.

a. The hydraulic turret traversing mechanism is a device to assist in the quick aiming and firing of the guns in the revolving turret of a tank. The purpose of this mechanism is to rotate the turret at required speeds and to stop the turret dead on the target. It also provides a means of electric control of the gun firing mechanism.

4. DESCRIPTION (fig. 1).

a. The hydraulic turret traversing mechanism has an electric motor mounted on the floor of the turret basket, directly connected to a hydraulic pressure pump. The pump draws hydraulic oil from an oil reservoir mounted on the wall of the turret basket and delivers it under pressure to the inlet port of a manually operated control valve. The control valve is also mounted on the wall of the basket near the top edge and to the left of the turret guns.

b. The control valve governs the flow of oil through one of two tubes that connect with the hydraulic motor. The oil pressure rotates the motor in one direction or the other, depending upon which tube is carrying the oil. Turning the control valve to the right or left determines which tube the oil will flow through, the direction of motor rotation, and the direction of turret rotation.

c. The hydraulic motor is mounted on the top of the traversing gear mechanism and is connected through a series of gears to a pinion that engages with the stationary ring gear on the hull of the tank. NOTE: Avoid confusing the hydraulic pump with the hydraulic motor. These two components are similar in appearance and in their principle of operation, although they serve entirely different functions and their parts are not interchangeable. Note that the word "PUMP" is cast into

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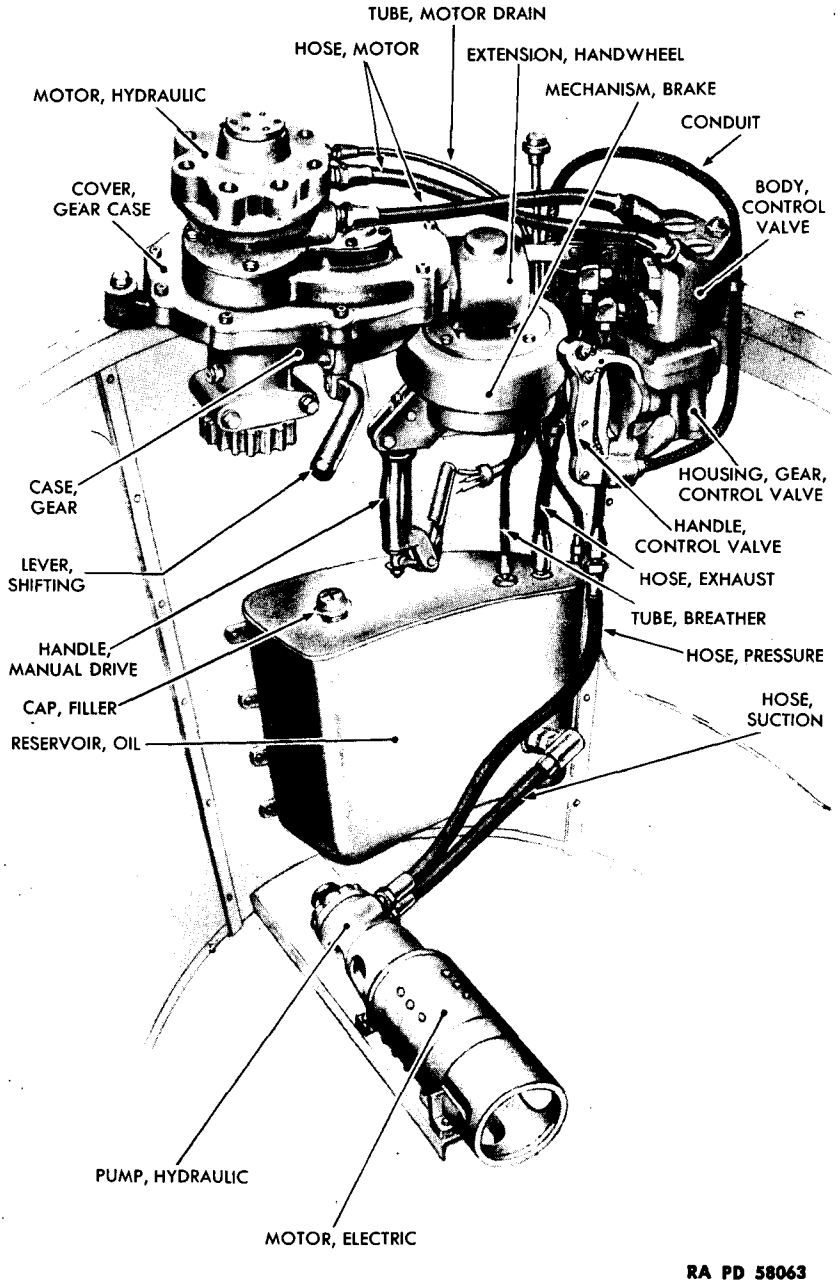

RA PD 58063

Figure 1 – Hydraulic Turret Traversing Mechanism Installed In Tank

the body of the pump and the word "MOTOR" is cast into the body of the hydraulic motor.

d. Also mounted on the traversing gear box is a separate hand-operated mechanism and a shift lever which enables the operator to change over to manual traversing of the turret.

e. Incorporated in the control valve is a relief valve that determines the system pressure. Oil returned by the hydraulic motor or spilled over by the relief valve returns to the oil reservoir for recirculation.

f. Electric control of the gun firing mechanism is accomplished by means of toggle switches mounted on the handle of the hydraulic control valve.

5. OPERATION OF MECHANISM.

a. In using the mechanism, the operator first closes the switch that starts the electric motor, the handle of the control valve being locked in a vertical position. Place the shifting lever in the "UP" position. As soon as the electric motor starts, the hydraulic pump begins to draw oil from the oil reservoir and sends it under pressure to the control valve. As long as the handle of the control valve is in the vertical position, the oil bypasses through the control valve and returns to the reservoir.

b. The operator grasps the control valve handle and squeezes the trigger with his left hand. Squeezing the trigger unlocks the valve handle and at the same time energizes the gun firing switches mounted on the handle. The operator then turns the handle in the direction he wishes the turret to rotate; the farther he turns the handle, the faster the turret will rotate. Returning the handle to vertical position stops the rotation of the turret.

c. The operator's right hand is free to elevate or depress the gun by turning the handwheel of the elevating mechanism on the gun mount. Firing is accomplished by pushing down toggle switches mounted on the control valve handle.

d. If, for any reason, the hydraulic mechanism should fail, the changeover to manual operation is made by pushing down on shifting lever mounted on the traversing gear box. When this lever is in the downward position, the hydraulic mechanism does not work. The turret can then be rotated by squeezing the grip lever and turning the handwheel of a separate mechanism which is also mounted on the traversing gear case.

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6. STATEMENT REGARDING TM 9-750.

a. Second echelon operations outlined in TM 9-750 are often performed by ordnance maintenance personnel. In such instances, TM 9-750 should be referred to.

7. DEFINITIONS.

a. In the allocation of maintenance operations to the various echelons given in paragraph 8 and in references throughout this manual, the following definitions are adhered to:

(1) SERVICE. Consists of cleaning, lubricating, tightening bolts and nuts, and making external adjustments of subassemblies or assemblies and controls.

(2) REPAIR. Consists of making repairs to, or replacements of such parts, subassemblies or assemblies that can be accomplished without completely disassembling the subassembly or assemblies, and does not require heavy welding or riveting, machining, fitting and/or alining.

(3) REPLACE. Consists of removing a part, subassembly or assembly from the vehicle and replacing it with a new, reconditioned or rebuilt part, subassembly or assembly, whichever the case may be.

(4) REBUILD. Consists of completely reconditioning and placing in serviceable condition any unserviceable part, subassembly or assembly of the motor vehicle, including welding, riveting, machining, fitting, alining, assembling, and testing.

8. ALLOCATION OF MAINTENANCE ON HYDRAULIC TURRET TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3.

a. The following allocations of maintenance applies to operations performed on this materiel by ordnance personnel:

	Echelons		
	2nd	3rd	4th
Turret traversing mechanism — replace or repair		X	
Turret traversing mechanism — rebuild			X

Section III

INSPECTION

	Paragraph
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Inspection procedure	10

9. GENERAL.

a. An inspection of the hydraulic turret traversing mechanism as a whole, its operation, and the operation of its various components should be made each time the tank is turned over to ordnance maintenance personnel for maintenance work. The extent of the inspection will depend upon the time and facilities available, but it should be as complete as possible. Frequent and careful check-up will help to keep the mechanism operating at full efficiency and will reduce maintenance work to a minimum. Practical inspection of the turret traversing mechanism can be made only with the complete mechanism installed in the tank.

10. INSPECTION PROCEDURE.

a. **Check The Oil Level In The Reservoir.** Be sure it is up to the "FULL" mark on the gage.

b. **Check Electric Motor.** Check all electrical connections. Then close the motor switch, but be prepared to open it again immediately. If the motor fails to start, open the switch. If the motor is noisy, runs too fast or sparks when running, turn it off immediately and locate the trouble (par. 21).

c. **Check For Oil Leaks.** Inspect all tube and hose connections for oil leakage. Inspect hydraulic motor, control valve, and hydraulic pump for oil seepage at joints. Tighten bolts, cap screws, and fittings at all points. Inspect oil reservoir for leaks. Be sure reservoir drain plug is tight.

d. **Check Control Valve.**

(1) With the motor switch open and the mechanism not operating, try the control valve handle by squeezing the trigger and turning the handle as far as it will go in either direction, then letting it go. The handle should turn about 45 degrees and return to approximately vertical position when released. Try this to both right and left.

(2) With the tank level and the mechanism in operation, squeeze the trigger and turn the handle very slowly to the right. The turret

should rotate slowly to the right, gathering speed as the handle is moved away from vertical position. Repeat operation, turning handle to the left.

(3) Check the speed of rotation of the turret (par. 40 c (4)).

e. **Check Hand-traversing Mechanism.** Move the shift lever on the traversing gear housing downward to the hand operation position and try the hand-traversing wheel to see that it operates easily and smoothly while grip lever is squeezed. Releasing grip lever should apply the brake and hold turret stationary.

f. **Check The Turret Lock.** This is the small handwheel to the right of the control valve, near the gun mount. Be sure it turns easily and locks the turret.

Section IV

TROUBLE SHOOTING OF ENTIRE MECHANISM

Paragraph
General 11

11. GENERAL.

a. Following are the major symptoms of malfunctioning of the hydraulic turret traversing mechanism, together with probable causes and probable remedies.

b. Electric Motor Does Not Start.

Probable Cause	Probable Remedy
No power from source.	Check position of switch (par. 5).
Brushes not in contact with commutator.	Seat brushes on commutator (par. 25 b (6)).
Motor has short or open in field.	Replace field assembly (pars. 23, 24, and 25).

c. Motor Starts, But System Has No Pressure.

No oil in system.	Fill reservoir with correct OIL, hydraulic (par. 32 b (5)).
Pump may have foreign matter between gerotors.	Disassemble and inspect pump. Clean all parts, check, and reassemble (pars. 15, 16, and 17).
Pump parts may have seized.	Disassemble and inspect pump. Clean all parts, check and reassemble (pars. 15, 16, and 17).
Sheared gerotor drive key in hydraulic pump.	Test system for pressure (par. 40). If pressure gage shows no pressure, remove, disassemble, and inspect hydraulic pump. Replace damaged parts (pars. 15, 16, and 17).

d. Control Valve Turns Only Part Way Or Not At All.

Control valve piston binding, due to link pin not being driven all the way in.	Remove and disassemble control valve. Clean all parts and assemble correctly (pars. 36, 37, and 38).
Foreign particles wedged between working parts.	Remove and disassemble control valve. Clean all parts and assemble correctly (pars. 36, 37, and 38).

Probable Cause	Probable Remedy
Lock plunger stuck, preventing the trigger from being compressed.	Remove and disassemble control valve. Clean all parts and assemble correctly (pars. 36, 37, and 38).
Relief valve remaining open.	Remove, inspect, repair or replace. Reset relief valve (par. 40).

e. Turret Rotates In Wrong Direction.

Hydraulic motor hoses connected to wrong ports of motor or control valve.	Connect motor hoses as shown in figure 1.

f. Turret Speed Too Slow Or Too Fast.

Hydraulic pressure too low.	Check and adjust relief valve (par. 40).
Foreign matter wedged between parts of hydraulic motor or parts excessively worn or scored.	Disassemble, inspect, and clean hydraulic motor. Check clearances. Assemble, replacing worn parts (pars. 44, 45, and 46).
Foreign matter wedged between parts of hydraulic pump or parts excessively worn or scored.	Disassemble, inspect, and clean hydraulic pump. Check clearances. Assemble, using new parts if necessary (pars. 15, 16, and 17).
Foreign matter wedged between main drive pinion and turret ring gear.	Clean pinion and ring gear.

g. Manual Drive Hard To Operate.

Handwheel brake adjustment too tight.	Adjust handwheel brake (par. 62 b (5)). NOTE: This adjustment can be made without removing or disassembling any part of the traversing gear mechanism.

h. Traversing Gear Mechanism Excessively Noisy.

Too loose fit of hydraulic motor shaft sets up vibration that is transmitted to gear cover and gear case.	This noise does not necessarily indicate impaired efficiency. If shaft fit is too loose, replace shaft or needle bearings in hydraulic motor (pars. 44, 45, and 46).

Section V

HYDRAULIC PUMP

	Paragraph
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Trouble shooting	13
Removal of hydraulic pump	14
Disassembling hydraulic pump	15
Maintenance and repair of pump	16
Assembly of hydraulic pump	17
Installation of pump on electric motor	18
Service data	19

12. DESCRIPTION.

a. The hydraulic pump (HTP-4.5-IF, Gerotor) is an oil pressure pump of 4.5 gallons per minute capacity, at 1,800 revolutions per minute, and is directly connected to the shaft of the electric motor. Its working mechanism consists of 2 gears called gerotors, one working eccentrically inside the other within an oiltight pocket between the body and head of the pump. Inlet and outlet ports are cast in the body of the pump.

b. The outer gerotor has 7 internal teeth; the inner gerotor has 6 external teeth. These 2 gerotors are so designed that, when assembled, there are always 6 points of contact between the teeth. Between these 6 points of contact are 6 spaces or "chambers," 3 on each side of a center line which marks the division between the inlet or suction side and the outlet or pressure side of the pump.

c. As the inner gerotor is driven by its shaft, the outer gerotor rotates with it, and the 3 chambers on the inlet side move around and increase in size, causing oil to be drawn into the pump. As each chamber reaches its fullest capacity, it passes the center line of the pump and moves over into the outlet side. As the gerotors continue to rotate, the chambers on the outlet side grow smaller. This has the effect of squeezing the oil out through the outlet or pressure port of the pump. Thus, as the pump shaft revolves, there is a constant flow of oil through the system.

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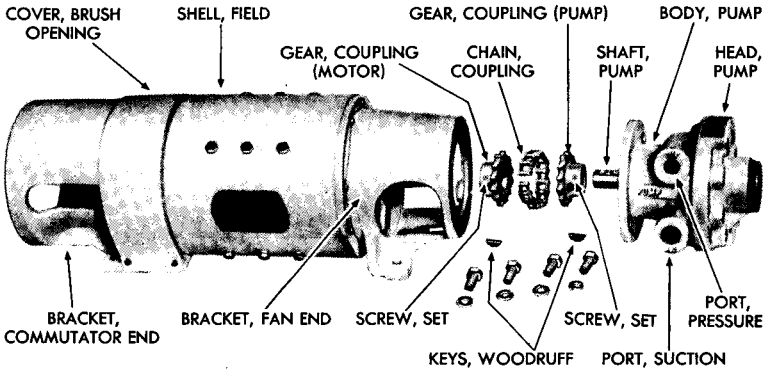

Figure 2 – Hydraulic Pump Removed From Electric Motor

13. TROUBLE SHOOTING.

a. Lack Of Pressure.

Probable Cause	Probable Remedy
Sheared gerotor drive key, probably caused by temporary seizure of rotating parts of hydraulic motor, gear box or the pump itself.	Disassemble pump, replace key and other damaged parts. Assemble (pars. 15, 16, and 17).
Badly scored gerotors, or surfaces of pump body or head.	Disassemble pump and replace scored parts. Assemble (pars. 15, 16, and 17).
Normal wear of working parts.	Disassemble and check dimensions of working parts. Replace worn parts (pars. 15, 16, and 17).

b. Failure To Start.

Foreign material between teeth of gerotors.	Disassemble, clean all parts and change oil. Assemble (pars. 15, 16, and 17).
Gerotors may have seized in housing.	Replace entire pump (pars. 14, and 18).
Shaft may have seized in bushing.	Replace shaft and bushing (pars. 15, 16, and 17).
Retainer ring may have seized on head cap.	Disassemble (par. 15). Check clearances of shaft and retainer ring before assembling (par. 17 b (2) and (4)).

HYDRAULIC PUMP

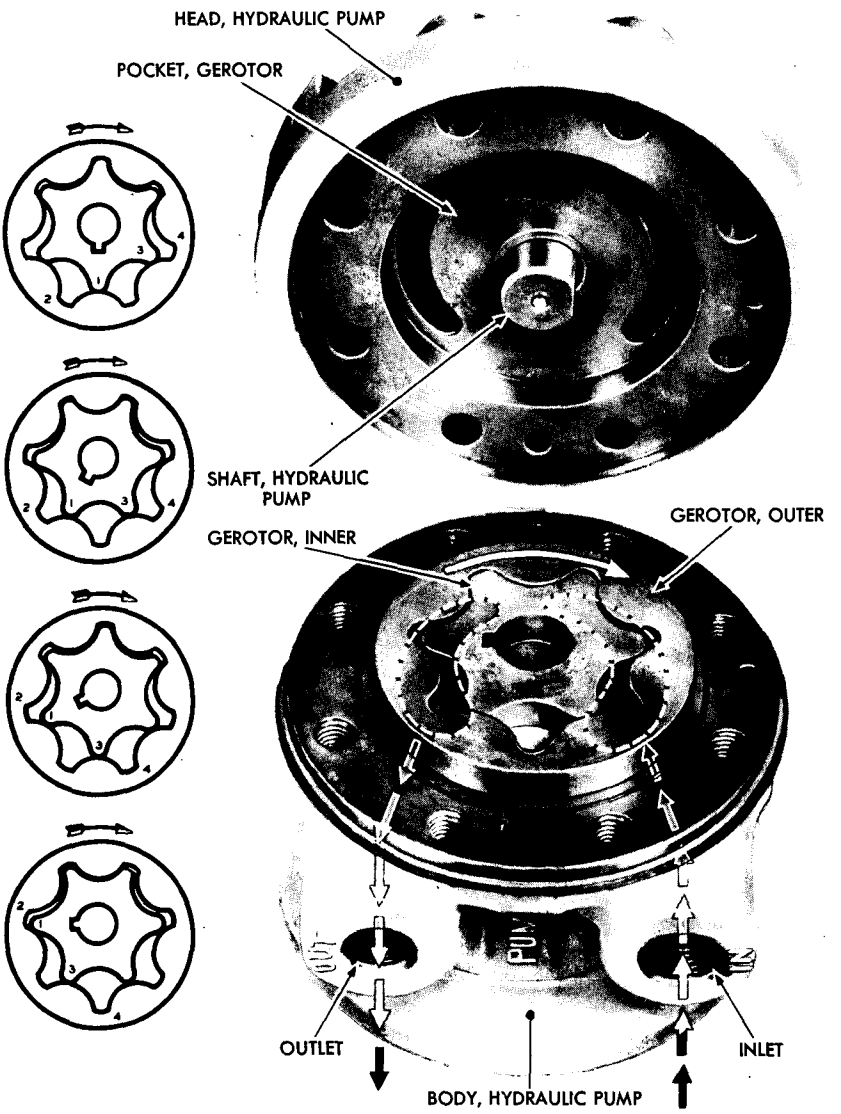

DIAGRAM OF HYDRAULIC PUMP, PARTLY DISASSEMBLED. LONG ARROW SHOWS DIRECTION IN WHICH GEROTORS ARE ROTATED BY SHAFT. SHORT ARROWS SHOW HOW OIL IS DRAWN THROUGH SUCTION PORTS AND SQUEEZED OUT THROUGH PRESSURE PORTS. SMALL DRAWINGS SHOW HOW ROTATION OF INNER GEROTOR IS TRANSMITTED TO OUTER GEROTOR.

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Figure 3 — Principle Of Operation Of Gerotor Mechanism

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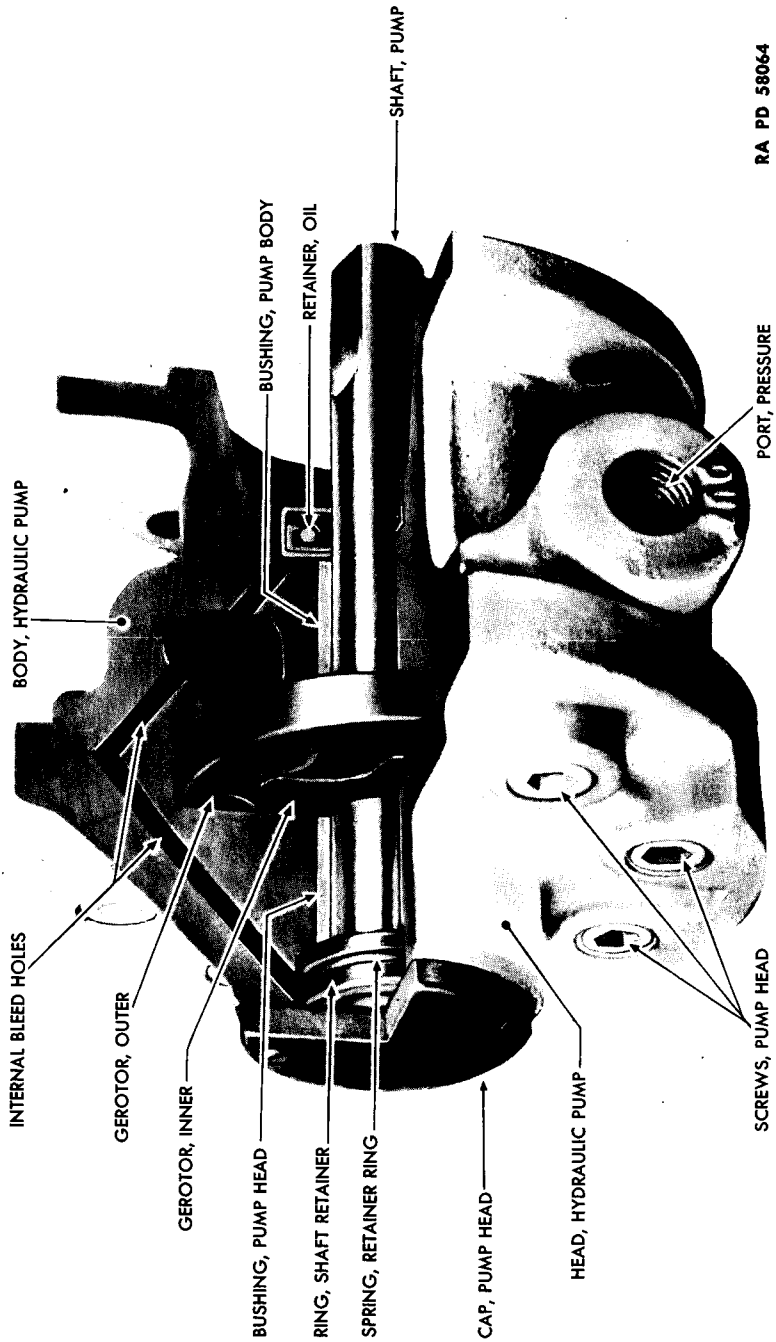

Figure 4 — Cutaway View Of Hydraulic Pump

c. **Oil Leak.**

Probable Cause	Probable Remedy
Defective oil retainer.	Replace (pars. 15, 16, and 17).

14. REMOVAL OF HYDRAULIC PUMP.

a. **Equipment.**

CAN, 3-gal capacity
SCREWDRIVER
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{7}{8}$-in.
WRENCH, open-end, $\frac{15}{16}$-in.
WRENCH, open-end, 1-in.
WRENCH, socket-head set screw, $\frac{1}{8}$-in.

b. **Procedure.**

(1) DISCONNECT PRESSURE HOSE FROM PRESSURE TUBE ON CONTROL VALVE (fig. 1).

WRENCH, open-end, $\frac{7}{8}$-in. WRENCH, open-end, $\frac{15}{16}$-in.

Hold hose fitting with $\frac{15}{16}$-inch open-end wrench and unscrew connection with $\frac{7}{8}$-inch open-end wrench.

(2) DRAIN RESERVOIR AND PUMP.

CAN, 3-gal capacity

Place end of pressure hose that was connected to pressure tube on control valve in 3-gallon can. Operate pump by closing electric motor switch. This quickly drains oil from reservoir and pump. Open switch immediately after oil is drained to avoid running pump without oil. CAUTION: If hydraulic oil is to be reused, be sure that can is clean and free from any particles of foreign matter.

(3) OPEN MAIN BATTERY SWITCH.

(4) REMOVE PUMP HOSES.

WRENCH, open-end, $\frac{15}{16}$-in. WRENCH, open-end, 1-in.

Remove pressure hose from pump ($\frac{15}{16}$-in. open-end wrench). Remove suction hose from pump (1-in. open-end wrench).

(5) REMOVE CHAIN COUPLING.

SCREWDRIVER

Reach into opening in fan end bracket with screwdriver and turn chain coupling to master link. Pry link open (screwdriver) and remove coupling chain.

(6) REMOVE PUMP FROM ELECTRIC MOTOR.

WRENCH, open-end, $\frac{9}{16}$-in.

Remove 4 cap screws and lock washers that hold pump to fan end bracket ($\frac{9}{16}$-in. open-end wrench). Remove pump from bracket.

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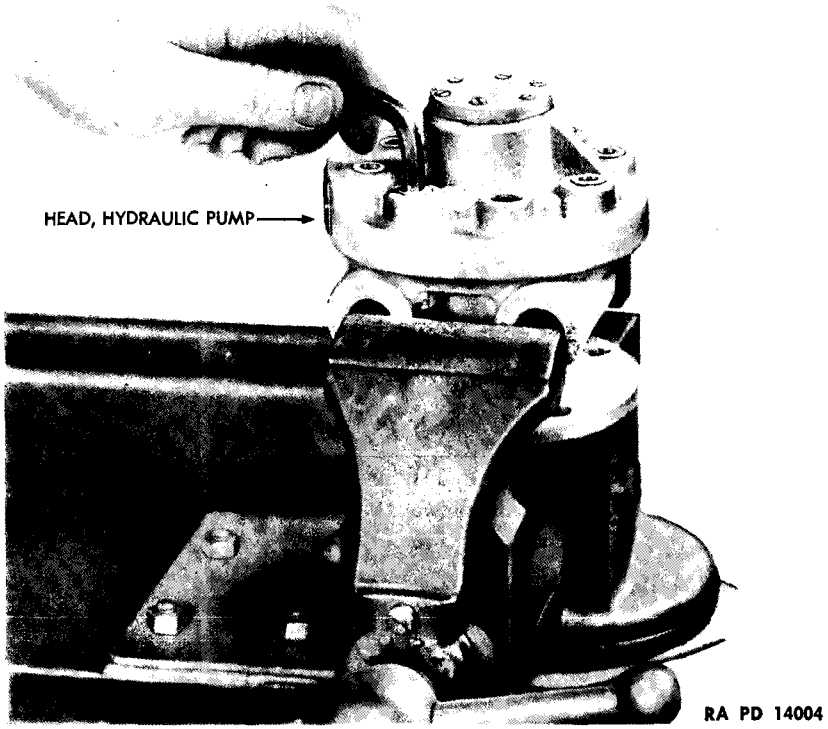

Figure 5 — Removal Of Pump Head Cap Screws

(7) REMOVE COUPLING GEARS.

WRENCH, socket-head set screw, ⅛-in.

Loosen set screw that holds coupling gear to motor shaft one full turn (⅛-in. socket-head set screw wrench). Remove coupling gear and lift out Woodruff key. Remove coupling gear from pump shaft in same way.

15. DISASSEMBLING HYDRAULIC PUMP.

a. Equipment.

DRIVER, GR2 (par. 68)
HAMMER, light
PUNCH, pin, ⅛-in.
SCREWDRIVER
VISE with soft jaws
WRENCH, socket-head set screw, ⅜-in.

HYDRAULIC PUMP

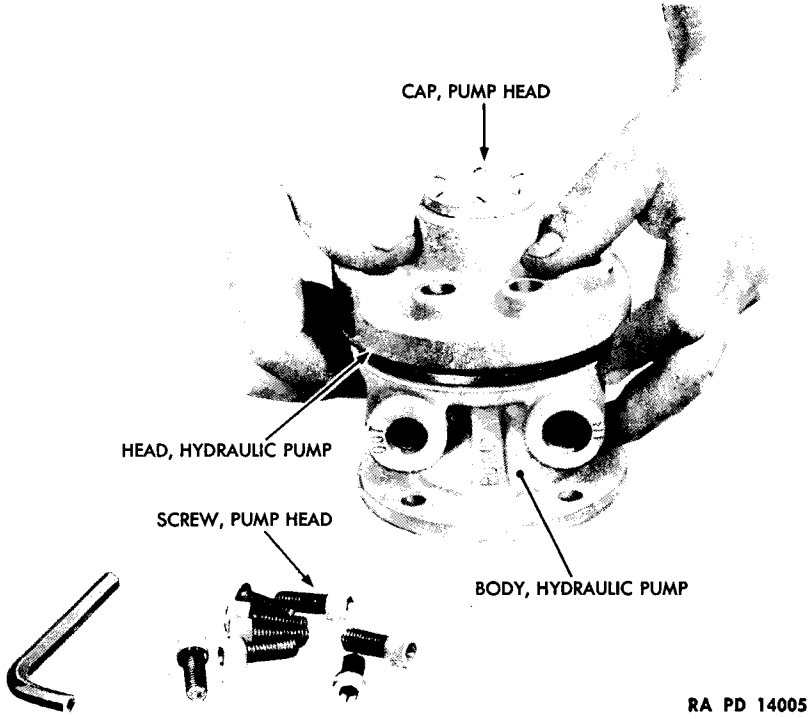

Figure 6 — Loosening Pump Body From Head

b. Procedure.

(1) REMOVE PUMP HEAD SCREWS (fig. 5).

VISE with soft jaws

WRENCH, socket-head set screw, 3/8-in.

Clamp body of pump in vise with shaft side down and jaws of vise across the ports in the pump body. Remove the 8 socket-head screws from the pump head (3/8-in. socket-head set screw wrench). Remove pump from vise.

(2) SEPARATE PUMP HEAD FROM BODY.

Holding body of pump in the hands, tap the end of the shaft lightly on bench until the body drops away from head (fig. 6). Invert and lift body off shaft. Remove dowel pin from pump head.

(3) REMOVE GEROTORS FROM PUMP HEAD.

Hold the pump head, shaft side down, and shake outer gerotor from the pocket in the head. Slide inner gerotor off shaft and remove gerotor drive key from the shaft. Handle gerotors carefully to avoid nicking or scoring.

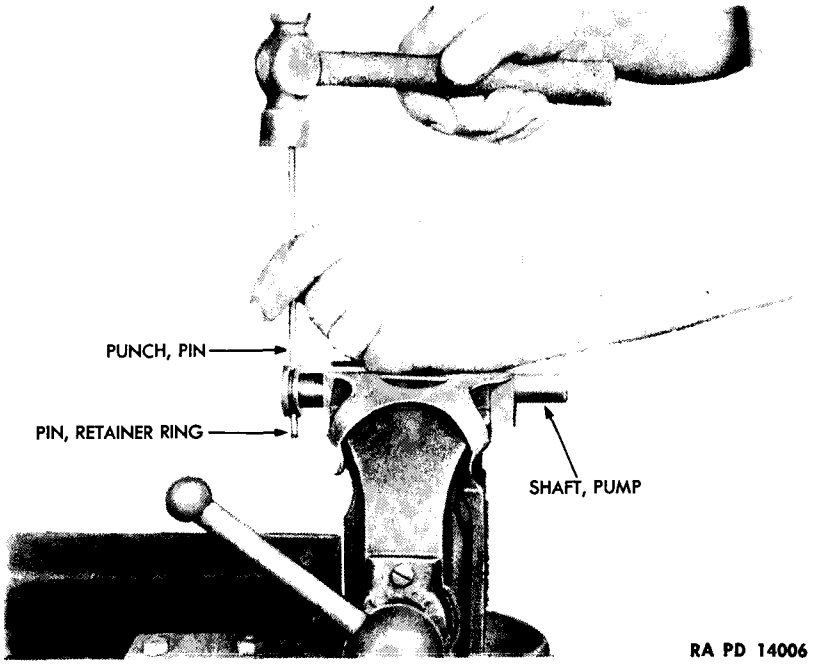

Figure 7 – Removal Of Retainer Ring From Pump Shaft

(4) REMOVE CAP FROM PUMP HEAD (fig. 11).

SCREWDRIVER

Mark position of pump head cap so that screw holes will line up for reassembly. Remove 6 screws which hold cap to head (screwdriver). Lift off pump head cap and gasket from pump head.

(5) REMOVE SHAFT ASSEMBLY.

Tap lightly on coupling end of shaft and remove through cap end of head.

(6) REMOVE SHAFT RETAINER RING FROM SHAFT (fig. 7).

HAMMER, light
PUNCH, pin, ⅛-in.
SCREWDRIVER
VISE with soft jaws

Pry off retainer ring spring from retainer ring. Drive out shaft retainer ring pin. This releases retainer ring so that it will slide off shaft.

(7) REMOVE OIL RETAINER FROM PUMP BODY (fig. 8).

DRIVER, GR2 (par. 68)
HAMMER, light

Insert curved end of driver in oil retainer and drive retainer from pump body, being careful not to injure bushing. NOTE: Oil retainer

HYDRAULIC PUMP

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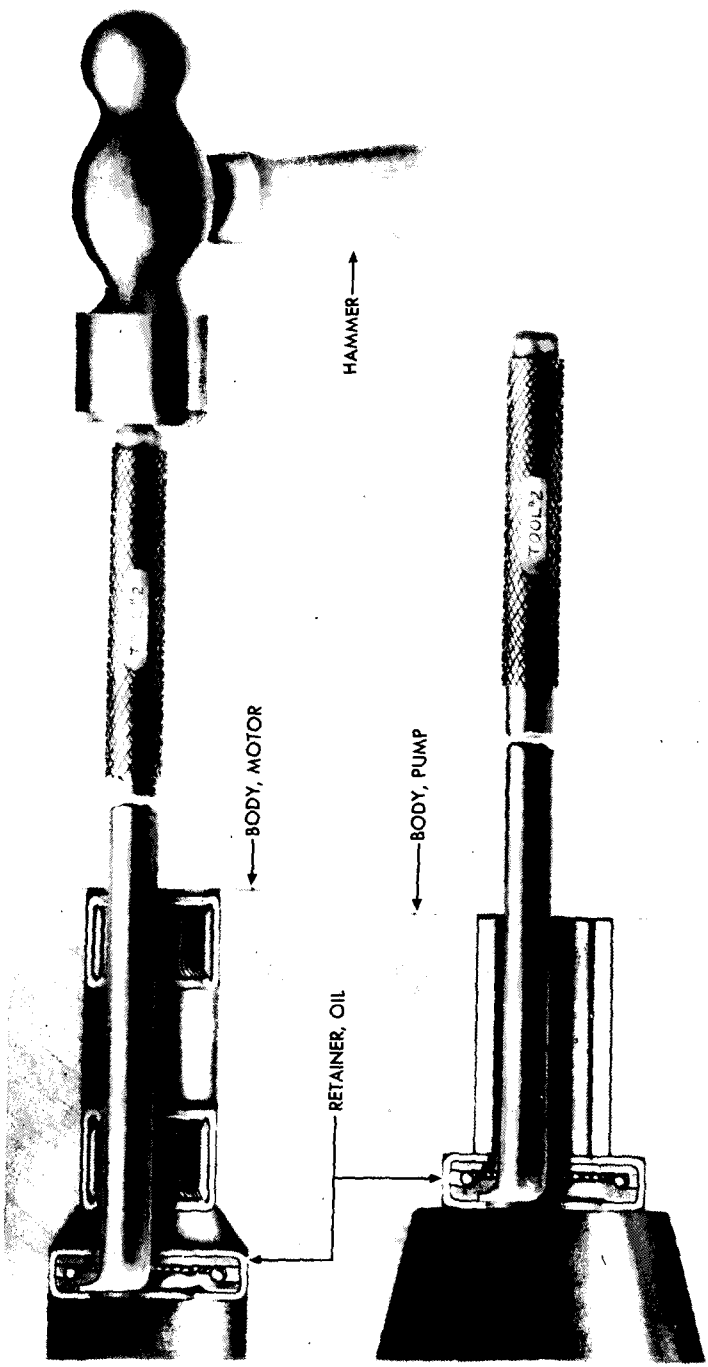

Figure 8 – Removal Of Oil Retainer From Motor And Pump Body

should not be removed unless it is defective or worn to such an extent that it leaks. It will be destroyed in removal.

(8) REMOVE HEAD AND BODY BUSHINGS.

NOTE: Head and body bushings should not be removed unless they are badly worn. For removal and replacement of bushings, see paragraph 16, b (7) and (8).

16. MAINTENANCE AND REPAIR OF PUMP.

a. Equipment.

CLOTH, wiping
GAGE, feeler
MICROMETER, depth, 0- to 1-in.
MICROMETER, 2- to 3-in. inside
MICROMETER, 2- to 3-in. outside
PRESS, arbor
REAMER, expansion, ¾-in.
SOLVENT, dry-cleaning
STRAIGHTEDGE, 4- to 4½-in. long
TOOL, GR4 (par. 68)
TOOL, GR5 (par. 68)

b. Procedure.

(1) CLEAN ALL PARTS.

CLOTH, wiping
SOLVENT, dry-cleaning

Carefully wash and dry all parts.

(2) VISUAL INSPECTION.

Inspect surfaces of body and head for nicks and deep scoring. Inspect all surfaces of gerotors. Scoring is evidence of foreign matter in the oil; deeply scored parts should be replaced.

(3) CHECK INTERNAL BLEED HOLES (fig. 4).

Be sure that the holes in both head and body are unobstructed. Lubrication of the pump depends upon the flow of oil through these holes.

(4) MEASURE INNER AND OUTER GEROTORS.

GAGE, feeler
MICROMETER, 2- to 3-in. inside
MICROMETER, 2- to 3-in. outside

There are two methods of checking wear on gerotor teeth:

(a) Measure the diameter of inner gerotor at outer edge. Measure the distance between the top of tooth and bottom of tooth space diamet-

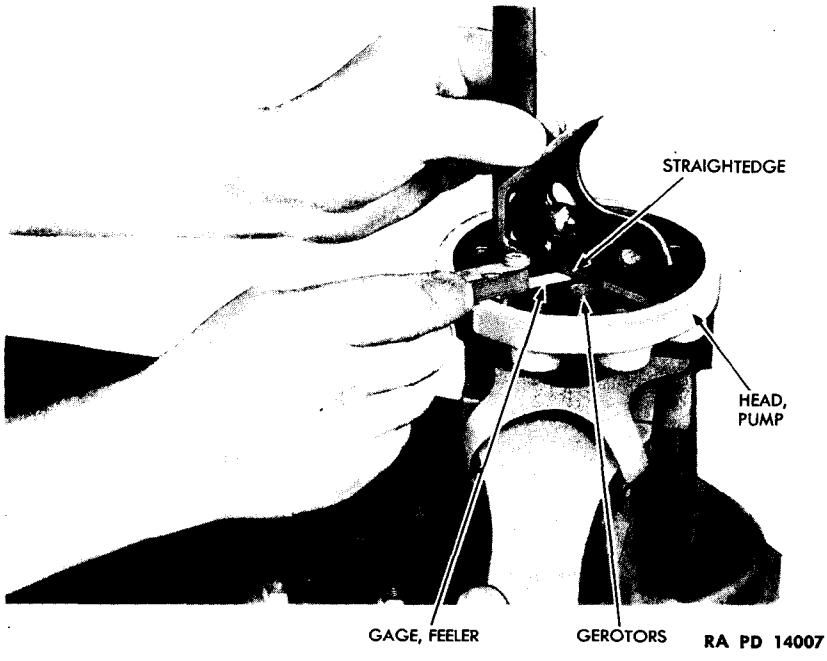

Figure 9 — Measuring Gerotors For End Play

rically opposite on the outer gerotor at inner edge (2- to 3-in. micrometer). If the difference between these measurements is more than 0.003 inch, the gerotors should be replaced.

(b) Assemble the 2 gerotors, being sure that star (*) stamped on each is facing down. Press the engaged tooth of inner gerotor as far as possible into its space in outer gerotor. The point of maximum clearance will then be opposite the engaged teeth. Measure clearance at this point with a feeler gage. If clearance is more than 0.003 inch, the gerotors must be replaced.

(5) CHECK GEROTORS FOR END CLEARANCE (fig. 9).

GAGE, feeler — STRAIGHTEDGE, 4- to 4½-in. long.

(a) Wipe the gerotors and gerotor pocket free of all oil. Assemble gerotors in pocket with the star (*) on each facing down. Be sure they are seated all the way into pocket.

(b) Lay a straightedge on machined surface of head (fig. 9). With a feeler gage, measure clearance between surfaces of each of the gerotors and the straightedge. Maximum end clearance of inner gerotor should

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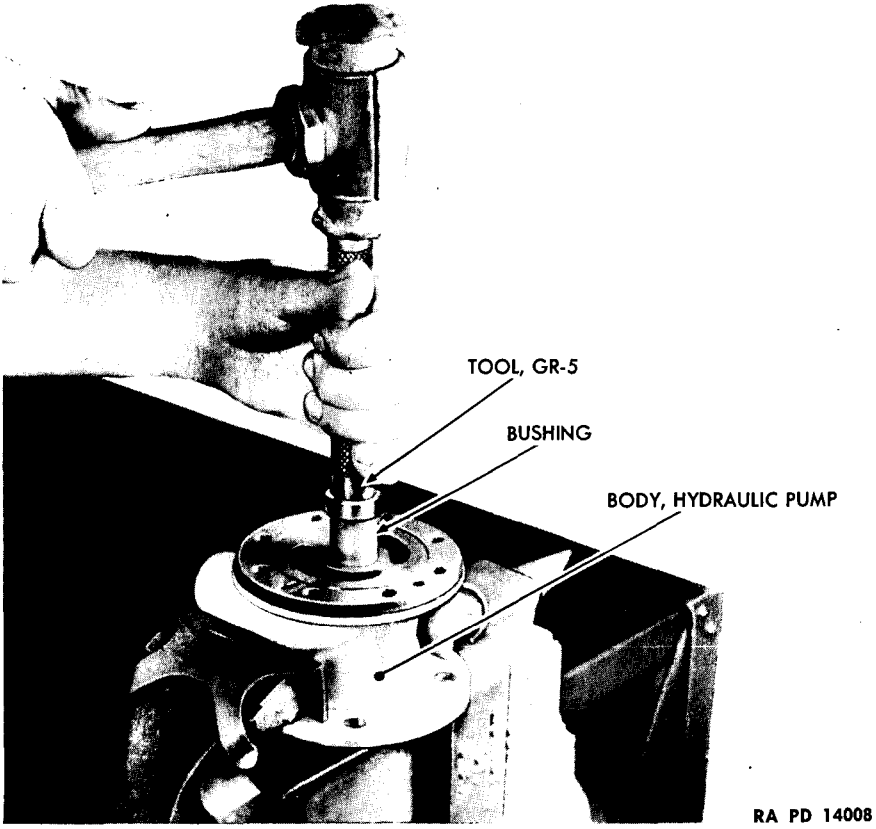

Figure 10 – Assembling New Bushing In Pump Body

be 0.003 inch; of the outer gerotor, 0.0025 inch. Since wear in the gerotor pocket is probably much less than wear on the gerotors, replace the gerotors when the specified end clearances are exceeded. NOTE: These gerotors, however, may give allowable end clearances when assembled in a new pump head. The gerotors must be replaced as a pair because they are selectively fitted. If, however, new gerotors are assembled in the pump head and the allowable end clearances are still exceeded, the pump head must be replaced.

(6) MEASURE DEPTH OF GEROTOR POCKET.

MICROMETER, depth,
0- to 1-in.

The manufactured depth of the gerotor pocket in the pump head is from 0.3699 inch to 0.3703 inch. Replace the pump head in accordance with step (5), above.

(7) INSPECT SHAFT BUSHINGS.

Try the shaft in the head and body bushings for fit. Maximum manufactured clearance between bushings and shaft is 0.0026 inch. If the fit is loose, new bushings are needed. Replace the head or body casting that has defective bushing with a new casting containing a reamed bushing, or replace the defective bushing.

(8) REPLACE SHAFT BUSHING (fig. 10).

CLOTH, wiping
PRESS, arbor
REAMER, expansion, ¾-in.
TOOL, GR4 (par. 68)
TOOL, GR5 (par. 68)

(a) Remove defective bushing by inserting tool GR4 in shaft opening and driving out bushing. Procedure is the same whether head or body bushing is removed.

(b) Install new bushing by inserting short pilot tool GR5 into bushing and pressing into place. Be sure that face of bushing does not extend above face of casting in which it is installed.

(c) With new bushings installed, assemble the head and body castings temporarily. Aline-ream both bushings with an expansion reamer to dimensions that will fit the shaft correctly. Clearance between shaft and bushings should be 0.0018 inch to 0.0026 inch.

(d) Separate pump body and head, and carefully clean out all metal particles (CLOTH, wiping).

17. ASSEMBLY OF HYDRAULIC PUMP (fig. 11).

a. Equipment.

CLOTH, wiping
GRINDER, bench
HAMMER, light
OIL, lubricating
PRESS, arbor
PUNCH, pin, ⅛-in.
SCREWDRIVER
STRAIGHTEDGE
TOOL, GR1 (par. 68)
TOOL, GR3 (par. 68)
VISE with soft jaws
WRENCH, socket-head set screw, ⅜-in.

b. Procedure.

(1) INSTALL SHAFT RETAINER RING ON SHAFT.

HAMMER, light
PUNCH, pin, ⅛-in.

Slide ring on shaft. Insert retainer ring pin through ring and hole in shaft and tap pin into place (⅛-in. pin punch and light hammer) (fig. 7). Place retaining spring over end of ring and into groove in ring. This holds pin in place.

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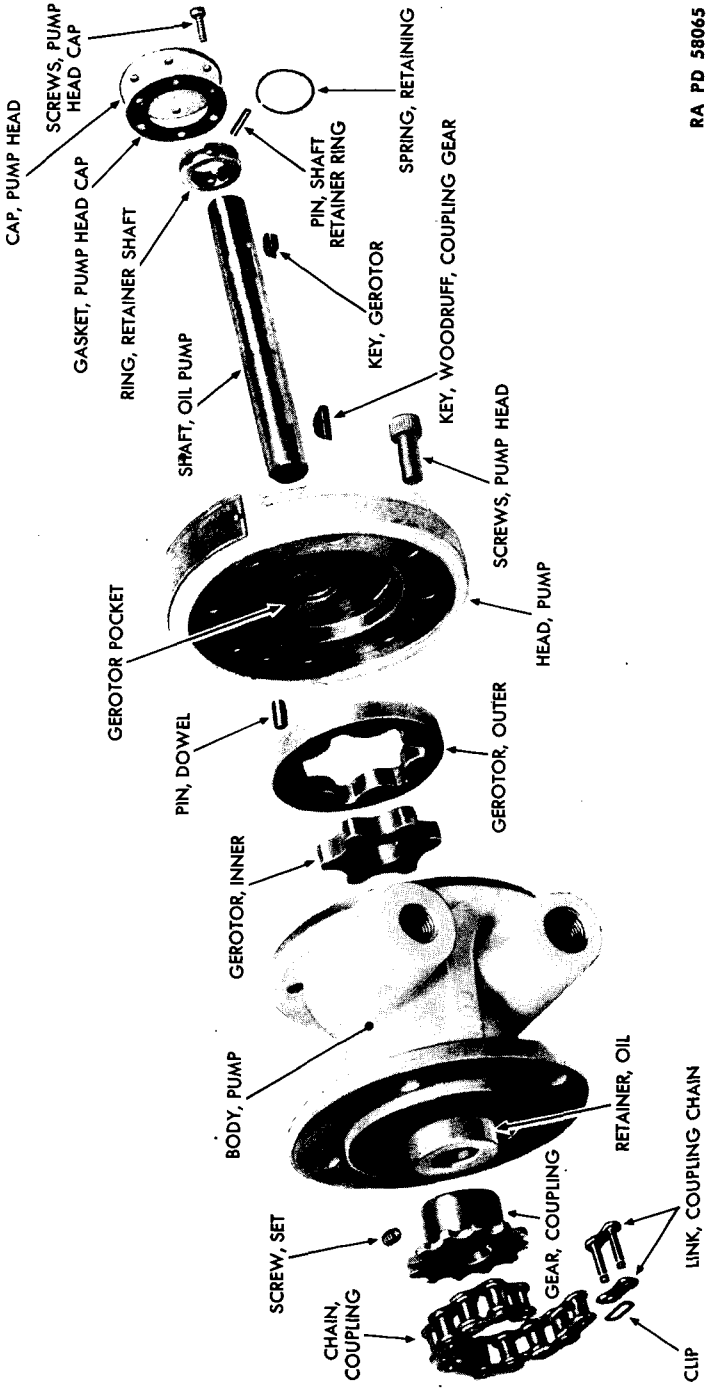

Figure 11 — Pump — Disassembled

(2) CHECK SHAFT FOR END CLEARANCE.

GRINDER, bench STRAIGHTEDGE

Holding shaft upright, place a straightedge across face of shaft retainer ring. Light should show between end of shaft and straightedge. Otherwise shaft might rub against the pump head cap and interfere with correct pump operation. If there is no clearance, remove shaft and grind off about 0.003 inch from end of shaft (bench grinder).

(3) INSERT SHAFT THROUGH PUMP HEAD.

CLOTH, wiping OIL, hydraulic

Be sure that all parts of shaft and pump head are wiped free of dust, dirt, or foreign matter. Place a few drops of oil in the retainer ring pocket of pump head. Insert shaft through pump head from retainer ring pocket end.

(4) CHECK SHAFT RETAINER RING FOR CLEARANCE.

STRAIGHTEDGE

Being sure that retainer ring is seated in pocket, install pump head gasket, and place a straightedge across face of pump head. Light should show between straightedge and face of retainer ring. If light does not show, install another gasket. Make sure that there is clearance between retainer ring and pump head cap when assembled.

(5) INSTALL PUMP HEAD CAP (fig. 11).

OIL, lubricating SCREWDRIVER

Rub a few drops of oil on face of pump head and install a new pump head cap gasket or gaskets as described in step (4). Rub oil on inner face of pump head cap and install cap in marked position on pump head (par. 15 b (4)). Insert and tighten the 6 screws (screwdriver).

(6) INSTALL NEW OIL RETAINER IN PUMP BODY (fig. 12).

PRESS, arbor TOOL, GR3 (par. 68)

Place oil retainer in the rear of pump body with leather curving inward (fig. 12). Insert pilot of tool GR3 through oil retainer and press oil retainer in pump body, using arbor press.

(7) INSTALL GEROTORS.

OIL, lubricating

Insert gerotor key in slot in shaft and slide inner gerotor into place over key. Note that a small star (*) is stamped on one side of the gerotor. This marks the side that should face down. Place pump head on bench with shaft up. Put a few drops of oil in gerotor pocket. Place outer gerotor over shaft, resting on inner gerotor, with star (*) facing down. Line up outside of outer gerotor with the pocket in pump head. Holding outer

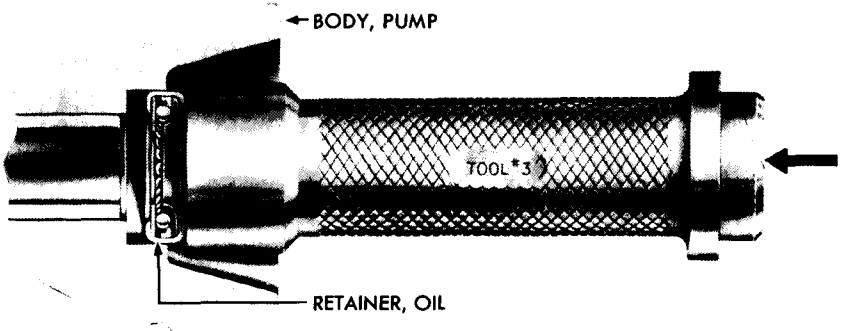

Figure 12 — Installing Oil Retainer In Pump Body

gerotor in this position, rotate shaft until both gerotors are seated in pocket in pump head.

(8) ASSEMBLE BODY AND HEAD ASSEMBLIES.

TOOL, GR1 (par. 68)	WRENCH, socket-head set
VISE with soft jaws	screw, 3/8-in.

Insert dowel pin in head. From gerotor side of pump body, insert tapered end of tool GR1 through oil retainer. Slide body down over shaft, pushing tool out. Tool protects oil retainer from damage. Line up dowel pin in pump head with dowel hole in pump body and press body into place on head. Holding entire assembly together in hands, turn it over and place in vise. Clamp jaws of vise across ports in the body (fig. 5). Install 8 socket-head screws and tighten uniformly (3/8-in. socket-head set screw wrench).

(9) CHECK FOR FREEDOM OF ROTATION.

Turn shaft by hand to see that gerotors are free. Sometimes the oil put in the pump may cause a locking effect. This can be overcome by turning the shaft with a wrench, being careful not to damage the surface of the shaft. Once started, the shaft should turn easily. If any undue resistance to rotation is felt, disassemble the pump and determine the cause.

c. Test.

AMMETER (0-100)	GAGE, pressure (500 lb per sq in.)

The pump must supply 3.75 gallons per minute at 400 pounds per square inch, and the current consumption of the electric motor driving

the pump must not exceed 75 amperes provided the motor is in good condition. If these conditions are not met, disassemble, clean, and inspect the rotating parts of the pump.

18. INSTALLATION OF PUMP ON ELECTRIC MOTOR.

a. Equipment.

SCREWDRIVER
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{15}{16}$-in.
WRENCH, open-end, 1-in.
WRENCH, socket-head set screw, $\frac{1}{8}$-in.

b. Procedure.

(1) INSTALL COUPLING GEARS ON PUMP SHAFT AND MOTOR SHAFT (fig. 2).

WRENCH, socket-head set screw, $\frac{1}{8}$-in.

Place Woodruff key in slot in pump shaft. Slide coupling gear over key and tighten set screw ($\frac{1}{8}$-in. socket-head set screw wrench). Follow same procedure in installing coupling gear on motor shaft.

(2) INSTALL PUMP ON MOTOR.

WRENCH, open-end, $\frac{9}{16}$-in.

Place pump in position against fan end bracket. Install the 4 cap screws and lock washers, and tighten ($\frac{9}{16}$-in. open-end wrench).

(3) INSTALL COUPLING CHAIN.

SCREWDRIVER

Line up teeth of coupling gear on pump shaft with those on motor shaft. Allow about $\frac{1}{16}$ inch between the 2 gears. Place coupling chain around the 2 gears and fasten with master link (screwdriver). Press clip on with fingers.

(4) CONNECT HOSES (figs. 1 and 80).

WRENCH, open-end, $\frac{7}{8}$-in.
WRENCH, open-end, $\frac{15}{16}$-in.
WRENCH, open-end, 1-in.

Connect suction hose (fig. 80) to "IN" port of pump (1-in. open-end wrench). Connect pressure hose to pressure tube on control valve ($\frac{15}{16}$-in. open-end wrench) and to "OUT" port of pump ($\frac{15}{16}$-in. open-end wrench) (fig. 3 shows how pressure and suction ports of pump are identified).

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19. SERVICE DATA.

a. The following are the manufactured dimensions of the working parts of the hydraulic pump:

	Dimensions	Limits
Width of outer gerotor (inside measurement)	0.3687 in.	Plus 0.0000 in. Minus 0.0002 in.
Width of inner gerotor (outside measurement)	0.3684 in.	Plus 0.0000 in. Minus 0.0002 in.
Outer diameter of outer gerotor	2.9985 in.	Plus 0.0000 in. Minus 0.0005 in.
Depth of gerotor pocket in head	0.3701 in.	Plus 0.0002 in. Minus 0.0002 in.
Diameter of gerotor pocket in head	3.0007 in.	Plus 0.0003 in. Minus 0.0002 in.
Diameter of shaft	0.7490 in.	Plus 0.0002 in. Minus 0.0002 in.
Inside diameter of shaft bearing	0.7512 in.	Plus 0.0002 in. Minus 0.0002 in.

b. The following are gerotor and shaft clearances:

End clearance of outer gerotor, with pocket ..... 0.0012 in. to 0.0018 in.

End clearance of inner gerotor, with pocket ..... 0.0015 in. to 0.0021 in.

Gerotor tooth clearance ..... 0.002 in. maximum

Shaft clearance ..... 0.0018 in. to 0.0026 in.

Outer gerotor outer diameter clearance, with pocket 0.002 in. to 0.003 in.

(1) If end clearance of outer gerotor exceeds 0.0025 inch, if end clearance of inner gerotor exceeds 0.003 inch, or if tooth clearance exceeds 0.003 inch, gerotors must be replaced unless the excessive end clearance is found to be caused by wear of gerotor pocket in head. In this case, head should be replaced.

c. Pump capacity.

(1) Correct displacement of the pump is 4.5 gallons per minute at 1,800 revolutions per minute.

Section VI

ELECTRIC MOTOR

	Paragraph
Description	20
Trouble shooting	21
Removal of electric motor	22
Disassembling electric motor	23
Maintenance and test of electric motor	24
Assembling electric motor	25
Installing electric motor	26
Service data	27

20. DESCRIPTION.

a. The electric motor (ASD-9210, Pioneer Gen-E-Motor Company) providing power for the turret traversing mechanism is a 24-volt direct-current motor, drawing 43 amperes and developing 1 horsepower continuous duty at 1,950 revolutions per minute. It is a compound-wound, 4-pole motor. Its over-all dimensions are: length, 18⅞ inches; width, 5⅝ inches; height, 5$\frac{11}{16}$ inches; weight, 64 pounds.

21. TROUBLE SHOOTING.

a. Motor Will Not Start.

Probable Cause	Probable Remedy
No power from source.	Check battery switch, connections and cables. Check battery terminals with voltmeter or test lamp. Tighten connection.
Brushes not in contact with commutator.	Remove and inspect brushes. Seat brushes properly (par. 25 b (6)).
Short or open in field.	Disassemble motor (par. 23). Replace field coils. Assemble motor (par. 25).

b. Motor Runs Too Fast.

Open shunt field.	Disassemble motor (par 23). Test field coils for open circuit (par. 24 b (7)). Replace field coils if open circuit is found (par. 25).

c. Motor Runs Too Slow.

Probable Cause	Probable Remedy
Low voltage from source.	Check battery terminals with voltmeter to determine if battery is in good condition.
Poor brush contact or improper grade of brush.	Remove and inspect brushes (par. 24 **b** (2)). Replace or reassemble brushes, being sure they are properly seated on commutator (par. 25 **b** (6)).
Shorted field.	Disassemble motor and test for short in field (pars. 23 and 24 **b** (6)). Replace field coils if short is found (par. 25).
Tight bearings.	Disassemble and inspect bearings (pars. 23 and 24 **b** (1)). Replace defective bearings.
Something wedged between armature and field.	Disassemble motor and inspect (pars. 23 and 24). Clean all parts and assemble (par. 25).
Armature too tight or no end play in armature.	Correct by removing shims from armature shaft.

d. Motor Vibrates.

Improper coupling between motor and pump.	Remove coupling chain and gears and assemble (par. 18 **b** (3)).
Bent shaft.	Disassemble and test armature for alinement on bench lathe (par. 24 **b** (5) *(a)*). Replace armature if shaft is bent.
Worn bearing.	Disassemble and inspect bearings pars. 23 and 24 **b** (1)). Replace defective bearings.
Armature out of balance.	Disassemble and inspect for loose balancing wedges in armature. Check for alinement on bench lathe (par. 24 **b** (5) *(a)*). Replace armature if out of balance.

ELECTRIC MOTOR

Probable Cause	Probable Remedy
Improper air gap between pole shoes and armature.	Adjust pole shoes to proper air gap (0.025 in.).

e. Motor Sparks Excessively.

Brushes damaged, worn, sticking, or not properly seated.	Remove and inspect brushes (par. 24 b (2)). Replace if necessary, and seat brushes correctly on commutator (par. 25 b (6)).
Foreign matter between commutator bars or commutator is dirty, has high or low bars, or mica above surface.	Disassemble motor and recondition commutator (pars. 23 and 24 b (5)).

f. Motor Smoking.

Short in armature or field.	Disassemble motor and test armature and field coils for short (pars. 23 and 24). Replace armature or coils if shorted.

22. REMOVAL OF ELECTRIC MOTOR.

a. Equipment.

SCREWDRIVER
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, ½-in.

b. Procedure.

(1) REMOVE HYDRAULIC PUMP FROM FAN END BRACKET. See paragraph 14 b for procedure.

(2) DISCONNECT MOTOR.

SCREWDRIVER
WRENCH, open-end, ½-in.

Remove brush opening cover from motor by taking out 4 screws that hold it to lugs on commutator end bracket (screwdriver). Disconnect motor by removing battery cable from terminal post (½-in. open-end wrench).

(3) REMOVE MOTOR FROM TANK.

WRENCH, open-end, $\frac{9}{16}$-in.

Remove 4 cap screws and lock washers that hold motor to channel on floor ($\frac{9}{16}$-in. open-end wrench). Lift motor out of tank.

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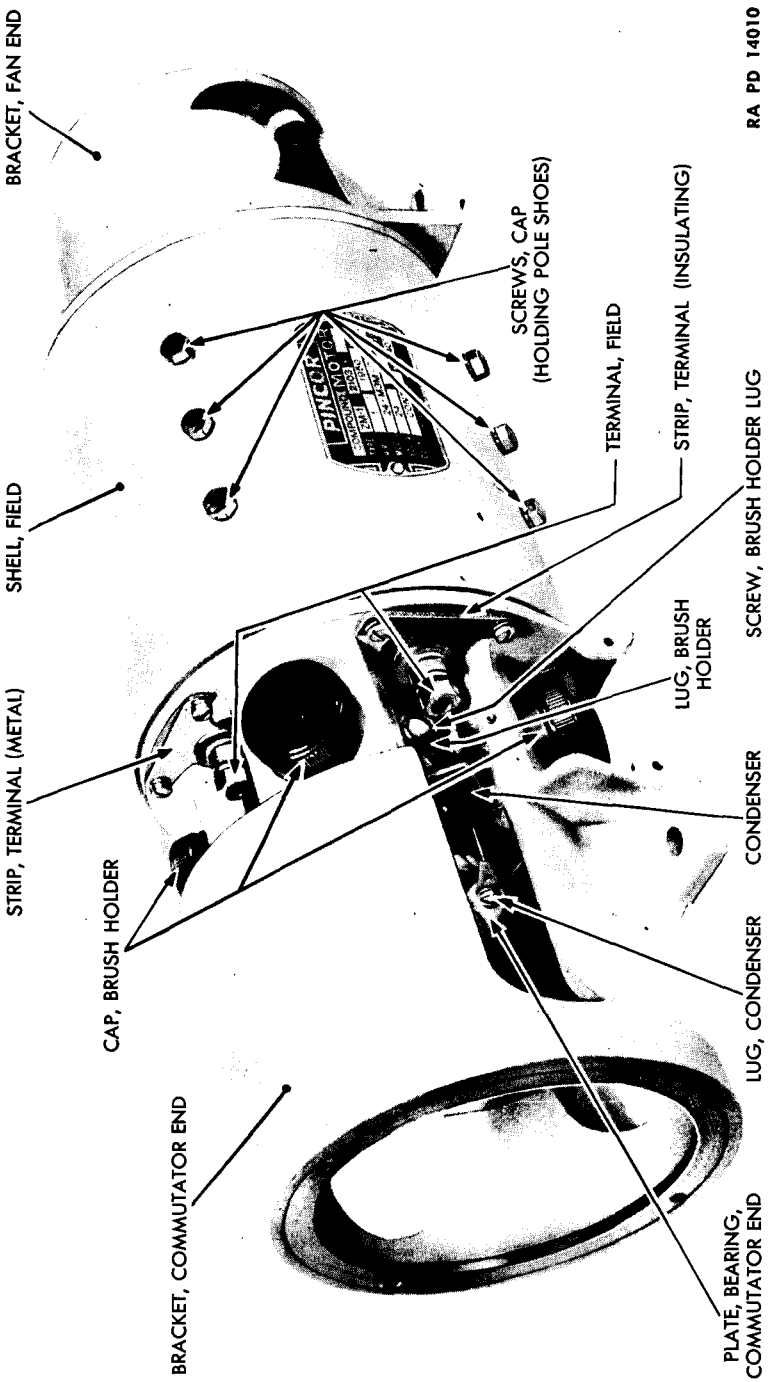

Figure 13 — Electric Motor With Brush Opening Cover Removed

ELECTRIC MOTOR

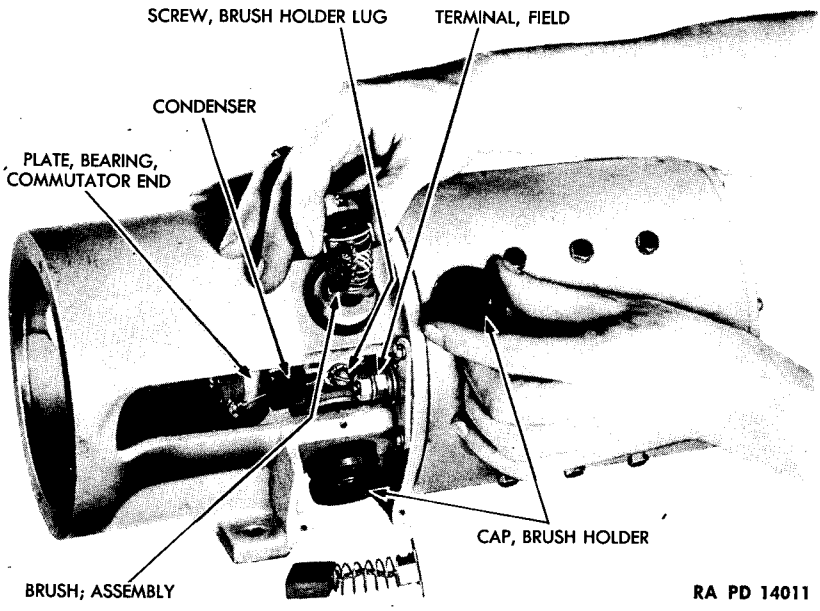

Figure 14 — Removing Brush Assemblies

23. DISASSEMBLING ELECTRIC MOTOR.

a. Equipment.

CHALK
HAMMER, soft
IRON, angle, 1-ft. x 2-in. (2)
PLIERS, long-nosed
PRESS, arbor
SCREWDRIVER
WRENCH, box, $\frac{7}{16}$-in.
WRENCH, box, ½-in.
WRENCH, socket-head set screw, $\frac{3}{32}$-in.

b. Procedure.

(1) REMOVE THE BRUSH OPENING COVER (fig. 2).

SCREWDRIVER

Remove 4 screws and lock washers that hold brush opening cover to lugs on commutator end bracket (screwdriver). Lift off cover.

(2) REMOVE BRUSH ASSEMBLIES (figs. 13 and 14).

CHALK SCREWDRIVER

Unscrew brush holder cap. Then lift out the 4 brush assemblies, being sure to chalk mark each brush with its holder for reassembly.

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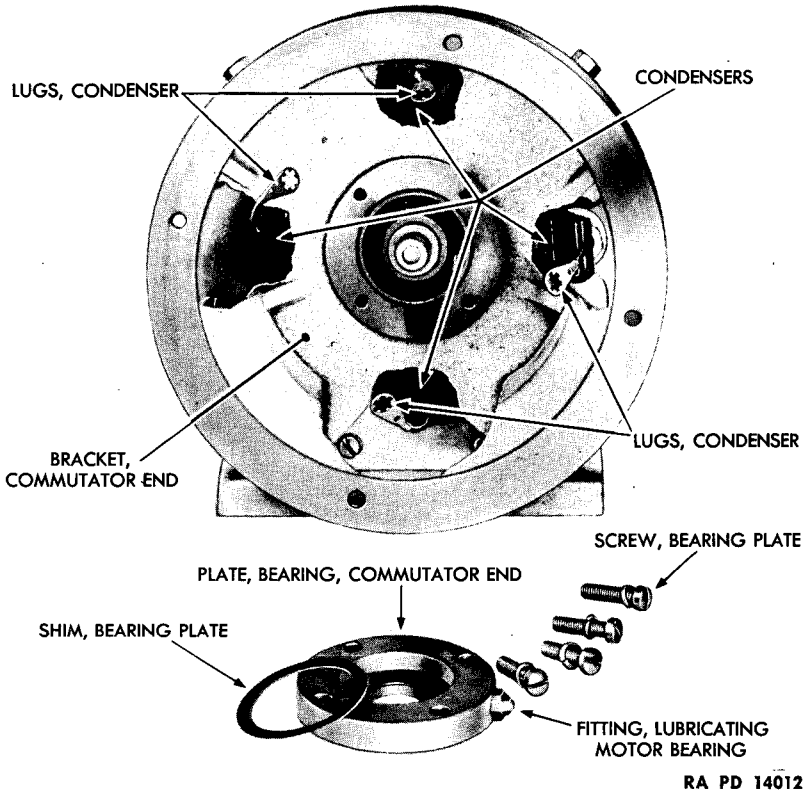

Figure 15 — Commutator End Bracket With Bearing Plate Removed

(3) REMOVE COMMUTATOR END BEARING PLATE AND SHIM (fig. 15).

PLIERS, long-nosed SCREWDRIVER

Remove locking wires from bearing plate screws (long-nosed pliers). Remove 4 screws and lock washers from bearing plate (screwdriver). This releases one end of each of the 4 condensers. Lift off bearing plate and remove shim.

(4) REMOVE CONDENSERS (fig. 13).

SCREWDRIVER

Hold each condenser in the fingers and remove screw (screwdriver). Lift off lock washer, condenser wire, and field coil wire to brush holder lug.

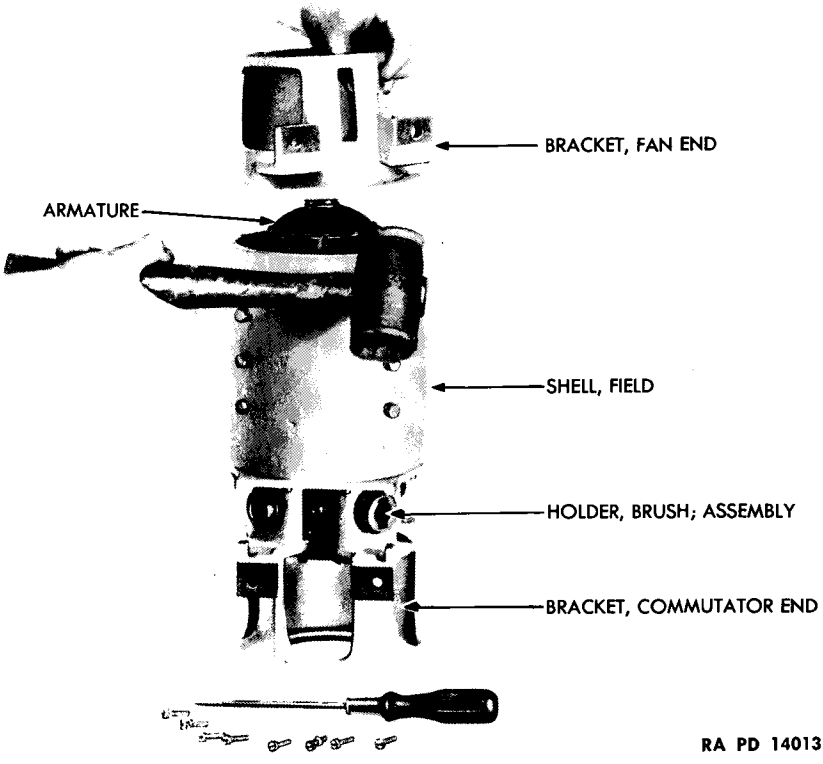

Figure 16 — Removing Fan End Bracket And Armature From Field Shell

(5) REMOVE FAN END BRACKET AND ARMATURE FROM FIELD SHELL (fig. 16).

HAMMER, soft
PLIERS, long-nosed
SCREWDRIVER

Stand motor on end with fan end bracket up. Remove locking wires from bracket screws. Remove the 8 screws and lock washers that hold fan end bracket to field shell. Holding bracket in hand, tap upward on it with a soft hammer until it separates from field shell (fig. 16). Remove bracket together with armature from field shell. Commutator end bearing will usually come with armature.

(6) REMOVE ARMATURE FROM FAN END BRACKET (fig. 17).

HAMMER, soft
SCREWDRIVER

Holding armature in hand, tap lightly on bracket with hammer. When bracket is removed, pry out grease retainer and felt washer from bracket (screwdriver).

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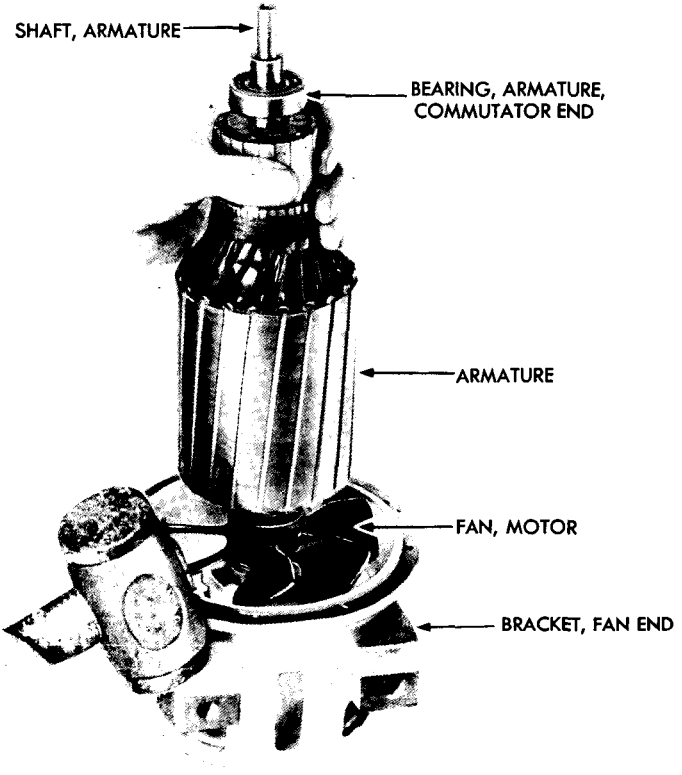

Figure 17 — Removing Armature From Fan End Bracket

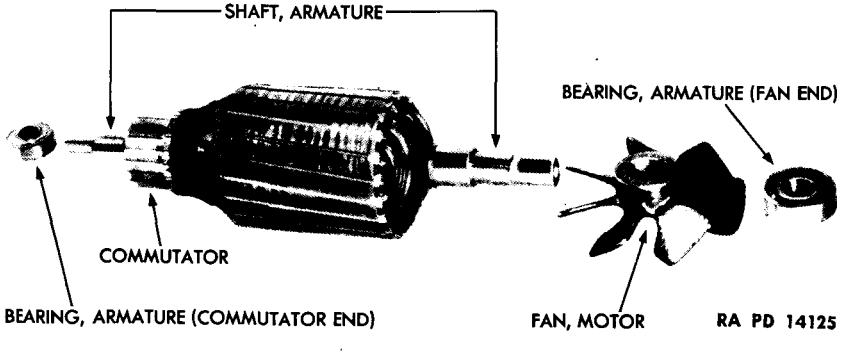

Figure 18 — Fan And Bearings Removed From Armature

ELECTRIC MOTOR

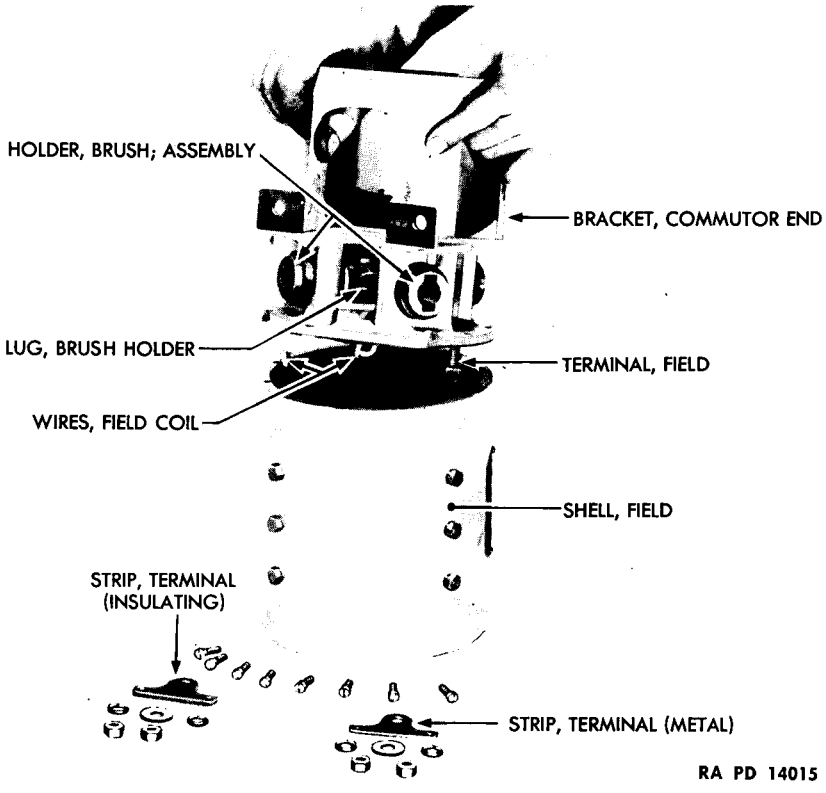

Figure 19 — Removing Commutator End Bracket From Field Shell

(7) REMOVE BEARINGS AND FAN FROM ARMATURE SHAFT (fig. 18).

IRON, angle (2) PRESS, arbor

Suspend assembly on arbor press with bearing resting on 2 angle irons, armature extending below press. While supporting armature in hand, press bearing off shaft. Both bearings are removed in same way. Use same procedure to remove fan.

(8) REMOVE COMMUTATOR END BRACKET FROM FIELD SHELL (figs. 13 and 19).

PLIERS, long-nosed WRENCH, box, ½-in.
SCREWDRIVER

Stand unit on bench so that commutator end bracket is up. Loosen 2 terminal posts from terminal strips by removing nuts and washers (½-in. box wrench) (fig. 13). Remove 8 screws and lock washers that hold commutator end bracket to field shell (screwdriver). Lift off terminal strips and remove bracket from field shell.

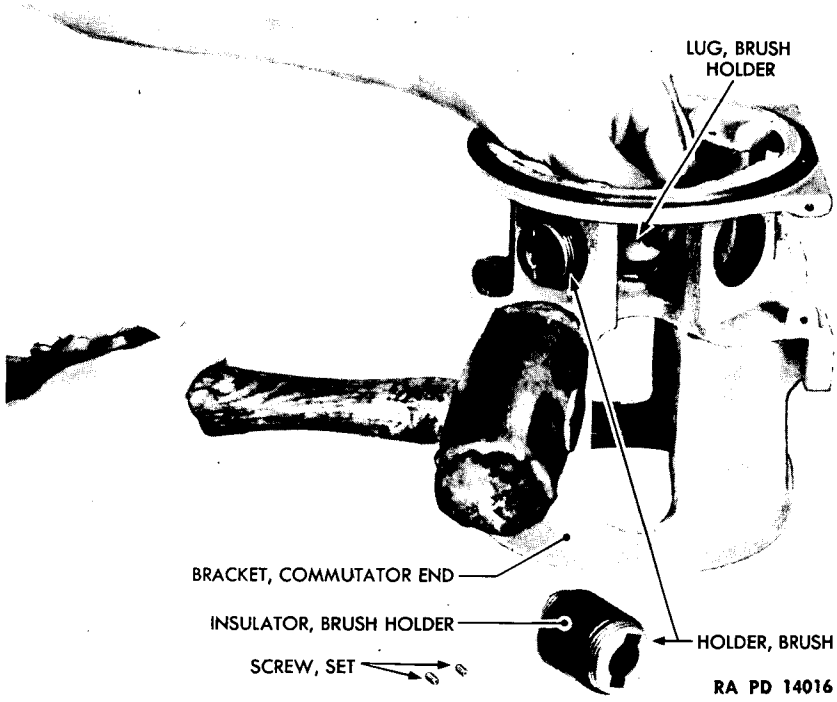

Figure 20 — Removing Brush Holders From Commutator End Bracket

(9) REMOVE BRUSH HOLDERS FROM COMMUTATOR END BRACKET.

HAMMER, soft

WRENCH, socket-head set screw, $\frac{3}{32}$-in.

Remove the 2 set screws that hold each of the 4 brush holders ($\frac{3}{32}$-in. socket-head set screw wrench). Tap brush holder lightly (soft hammer) and remove from inside of bracket (fig. 20). NOTE: Brush holders should not be removed from bracket unless insulators are faulty. Procedure for testing brush holders is explained in paragraph 24 **b** (9).

(10) REMOVE FIELD COILS FROM FIELD SHELL.

CHALK

WRENCH, box, $\frac{7}{16}$-in.

Remove the 12 cap screws and lock washers from outside of field shell ($\frac{7}{16}$-in. box wrench). This releases pole shoes from shell. Lift field coils and pole shoes out of shell, marking position of shoes with chalk for ease of reassembly. Lift pole shoes from coils. NOTE: Field coils and shoes should not be removed from field shell unless replacement is necessary. For testing field coils, refer to paragraph 24 **b** (6), (7), and (8).

ELECTRIC MOTOR

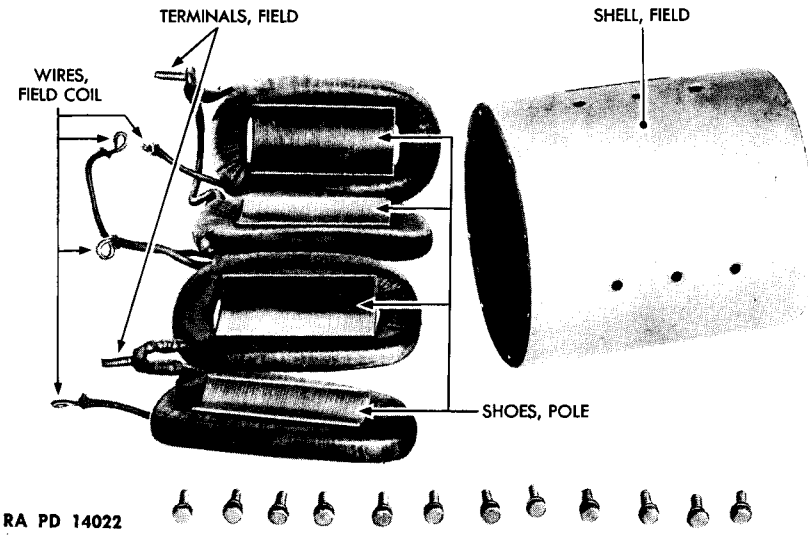

Figure 21 – Field Coils And Pole Shoes Removed From Field Shell

24. MAINTENANCE AND TEST OF ELECTRIC MOTOR.

a. Equipment.

AIR, compressed
AMMETER
BLADE, hacksaw
BRUSH, paint
CLOTH, wiping
GLYPTAL, No. 1209, black
GROWLER
INSTRUMENT, electrical testing, 500 volts
LATHE, bench
LIGHT, test
MACHINE, undercutting
OIL, engine, SAE 30
PAPER, flint, No. 00
SOLVENT, dry-cleaning
TOOL, cutting
WOOD, small stick

b. Procedure.

(1) BEARINGS.

OIL, engine, SAE 30

(a) Extreme care must be taken to prevent dirt or foreign matter from getting into bearings. Keep them covered or wrapped.

(b) Bearings must be lubricated with OIL, engine, SAE 30. Use only enough oil to cover bearings. Do not attempt to pack them.

(c) Inspect bearings carefully. If they bind, roll unevenly or if there is any side play, replace with new bearing. Be sure the new bearing is perfectly clean and correctly lubricated.

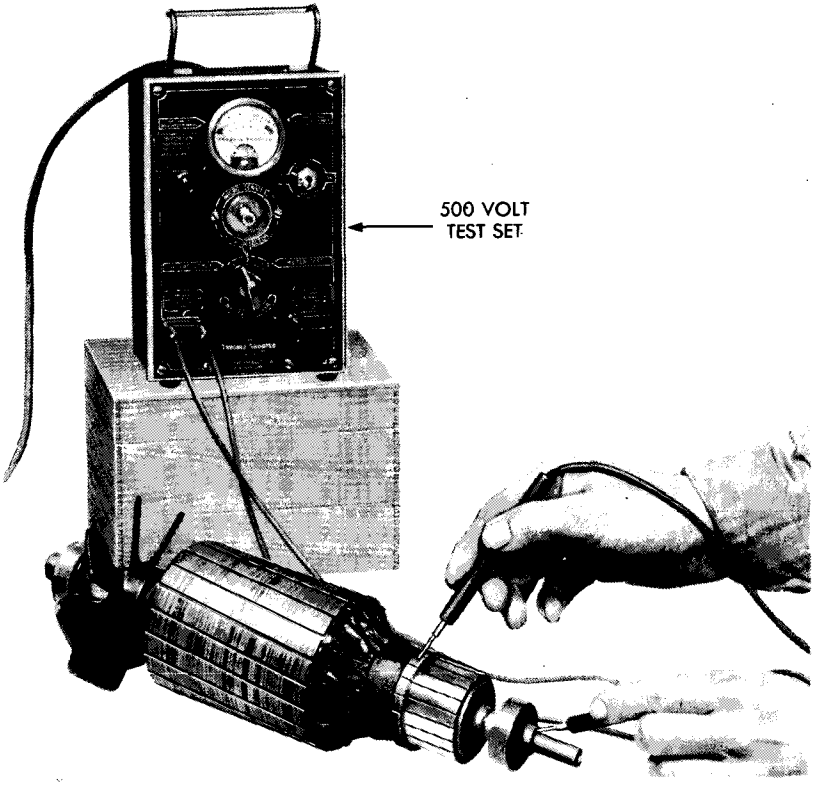

Figure 22 — Testing For Ground In Armature RA PD 14017

(2) BRUSHES.

(a) Inspect brushes for wear (fig. 14). Original length is 1 inch. Brushes worn down to a length of ⅜ inch must be replaced (par. 25 b (6)).

(b) When brushes are removed for inspection and not replaced with new ones, each brush must be reinstalled in same position from which it was removed. This insures maximum contact between brushes and commutator.

(c) When brushes are replaced, be sure they slide freely in their holders.

(3) TEST ARMATURE FOR GROUND (fig. 22).

INSTRUMENT, electrical testing, 500 volts — LIGHT, test

Place one prod of test light on armature shaft (electrical testing instrument, 500 volts, and test light). Then touch other prod to riser of

ELECTRIC MOTOR

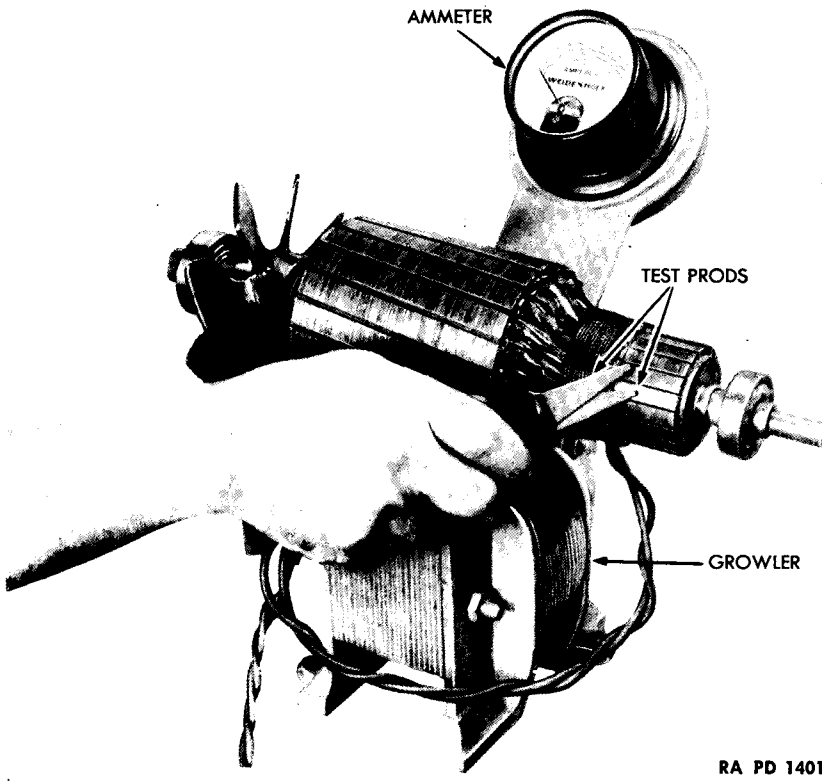

Figure 23 — Testing Armature For Short

each segment of commutator in turn. If light shows when any commutator segment is touched, it indicates that the segment is grounded and that the armature must be replaced. NOTE: While 110 volts will detect most grounds, it is better to use the higher voltage if available to insure the detection of all grounded conditions. CAUTION: Be careful of the high voltage. Do not touch prods to commutator bars, as it may fuse them.

(4) TEST ARMATURE FOR SHORT OR OPEN CIRCUIT (fig. 23).

AMMETER GROWLER
BLADE, hacksaw

(a) Place armature on growler. Touch prods of ammeter to risers of each 2 adjoining commutator segments in turn. Readings should be approximately the same. If there is no reading between any 2 segments, it is an indication of either short or open circuit.

(b) Inspect the space between the 2 segments from which there is no reading. Look for particles of metal. With hacksaw blade, scrape the space between the 2 segments, being careful not to score the face

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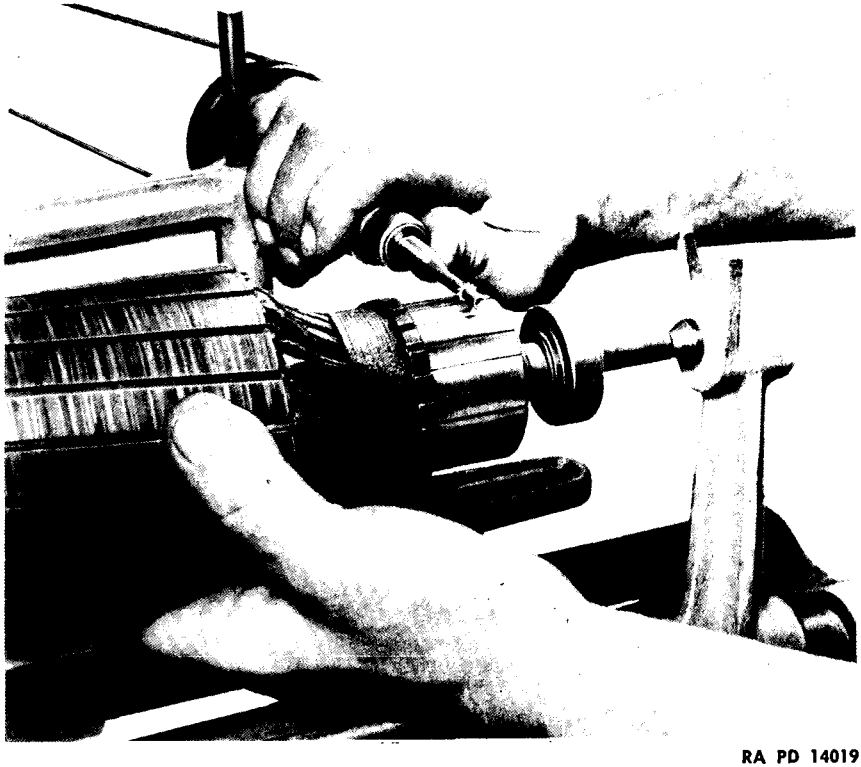

RA PD 14019

Figure 24 – Undercutting Mica In Commutator

of the commutator. This should eliminate any cause of a short. Take another reading.

(c) If, after making sure that there is no short between the 2 segments, you still fail to get a reading on the ammeter, it indicates that there is an open circuit in the armature, and it must be replaced.

(5) RECONDITIONING ARMATURE AND COMMUTATOR.

BRUSH, paint
CLOTH, wiping
GLYPTAL, No. 1209, black
INSTRUMENT, electrical testing
LATHE, bench
LIGHT, test
MACHINE, undercutting
PAPER, flint, No. 00
SOLVENT, dry-cleaning
TOOL, cutting
WOOD, small stick

(a) Check For Bent Armature Shaft.

Place armature in bench lathe and start the lathe. Hold stick of wood lightly against armature. Check for continuous contact between wood

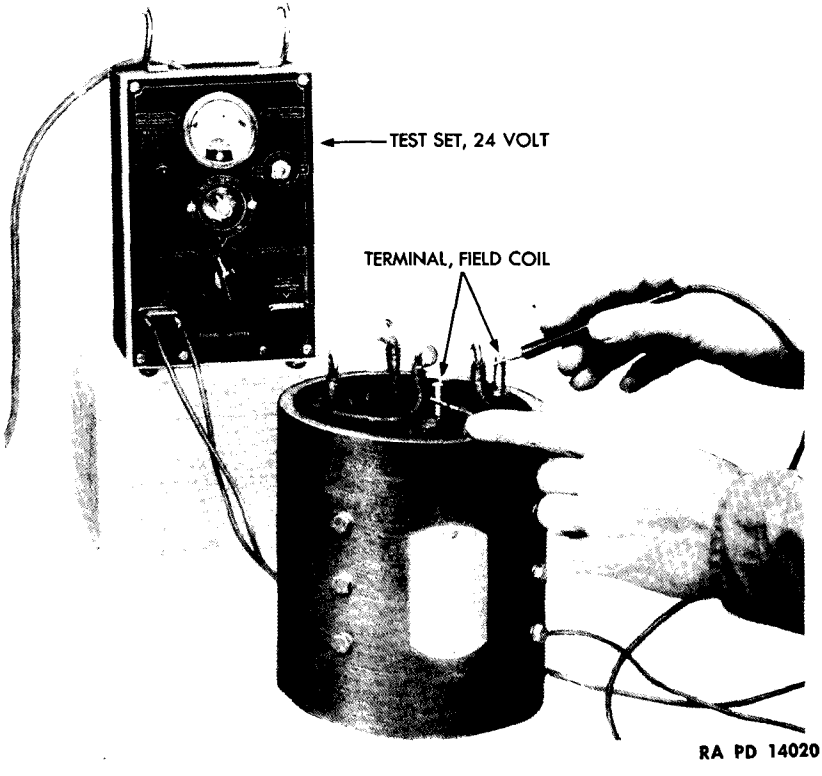

Figure 25 — Checking Field Coils For Open Circuit

and armature to make sure the armature runs true. If armature does not run true, it indicates a bent shaft and armature will have to be replaced.

(b) Smooth Commutator Surface.

With armature in bench lathe, turn down surface of commutator with cutting tool until it is smooth and round. Do not remove any more metal than is necessary to get a smooth surface.

(c) Undercut Mica.

Place armature in undercutting machine (fig. 24). Undercut between each 2 commutator segments to a depth of approximately 0.030 inch and wide enough to remove all mica. Do not attempt to undercut vertical segments of commutator. Be careful to remove every particle of loose metal from commutator. Then smooth commutator with PAPER, flint, No. 00, and wipe with a clean cloth dampened with SOLVENT, dry-cleaning.

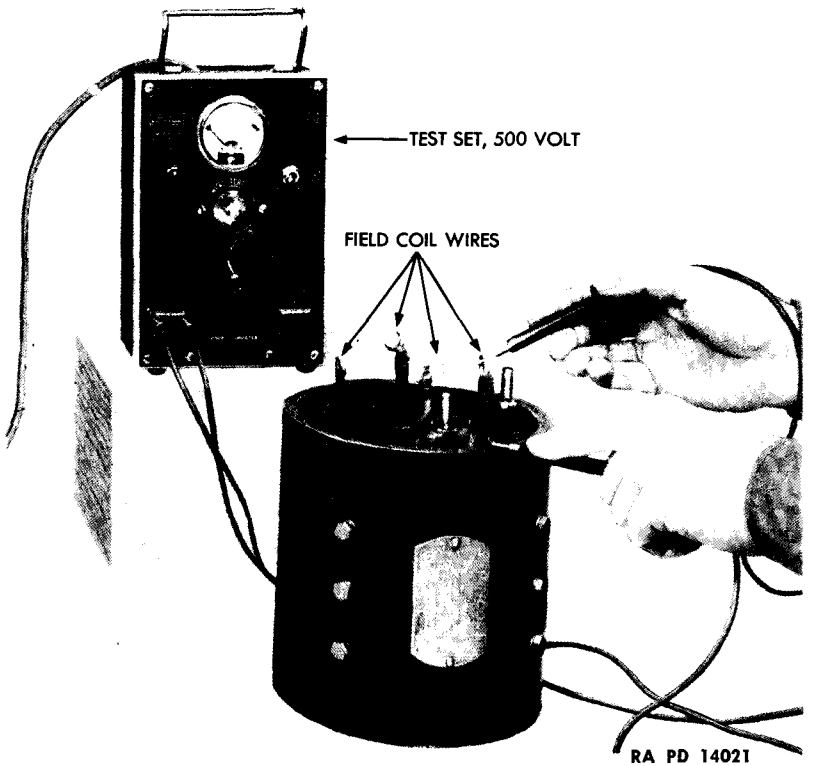

Figure 26 — Testing For Ground In Field

(d) Repainting Armature.

Inspect surface of armature to determine if it needs repainting. If surface is worn or scaled, rub lightly with flint paper to remove dirt and loose paint. Clean with cloth dampened with SOLVENT, dry-cleaning, and repaint with GLYPTAL, No. 1209, black.

(6) CHECK FIELD COIL FOR SHORT OR OPEN CIRCUIT.

Check to make sure that there is no visible electrical contact between field coils and field shell. If any uninsulated parts of field wires are touching the field shell, insulate spot of contact with tape.

(7) TEST FIELD COILS FOR OPEN CIRCUIT (fig. 25.)

LIGHT, test

Touch one prod of test light to each of the 2 field terminals (fig. 25). If light does not show, the field is open and field coil assembly (4 coils) must be replaced.

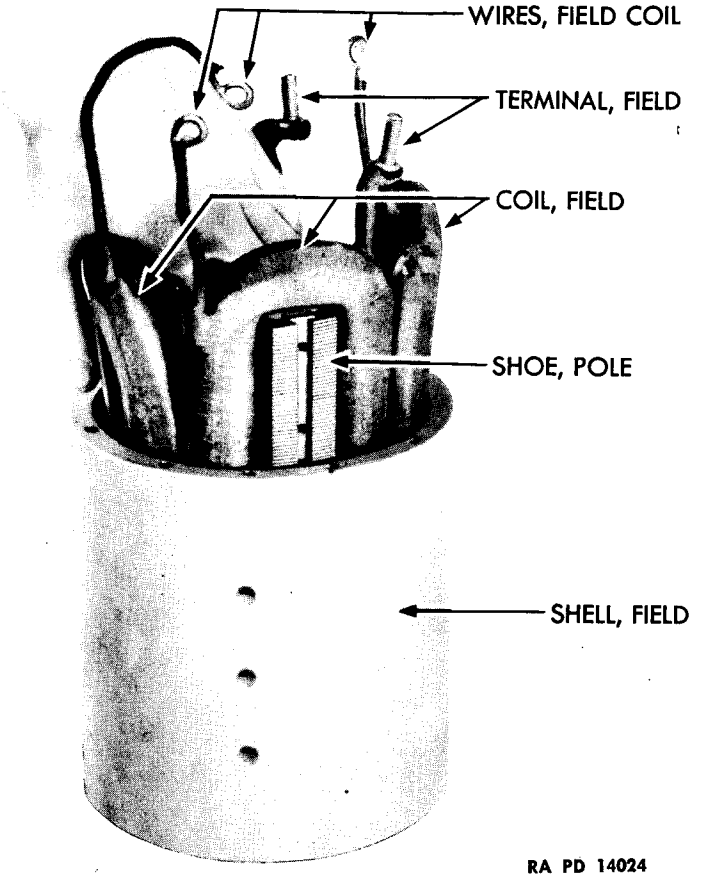

Figure 27 — Installing Field Coils And Pole Shoes In Field Shell

(8) TEST FIELD COILS FOR GROUND (fig. 26).

AIR, compressed	LIGHT, test
INSTRUMENT, electrical testing, 500 volts	SOLVENT, dry-cleaning

Hold one prod of test light on any unpainted spot on outside of field shell. Touch other prod to each of the 4 field coil wires and to each of the 2 field terminals. If light shows, it is an indication of a ground, and field coil assembly (4 coils) must be replaced. NOTE: While 110 volts will detect most grounds, it is better to use the higher voltage if available to insure the detection of all grounded conditions. If foregoing tests show that field coils are in good condition, do not remove them from field shell. Wash in SOLVENT, dry-cleaning, and dry thoroughly

with compressed air. If necessary to replace field coils, proceed as in paragraph 23 **b** (10) and paragraph 25 **b** (1).

(9) TEST BRUSH HOLDER INSULATORS.

INSTRUMENT, electrical testing, 24 volts
LIGHT, test

(a) Hold one prod of test light on any spot on the commutator end bracket that is not covered with paint. Touch the other prod to each of the 4 brush holder lugs (fig. 13). If light shows, it indicates a defective insulator that must be replaced.

(b) Brush holders need not be removed from bracket unless insulators are faulty. If necessary to replace, refer to paragraph 23 **b** (9) and paragraph 25 **b** (2).

25. ASSEMBLING ELECTRIC MOTOR.

a. Equipment.

DRIVER, 1⅜-in. diam
HAMMER, soft
PAPER, flint, No. 00 (1- x 12-in.)
PLIERS, long-nosed
PRESS, arbor
SCREWDRIVER
WRENCH, box, $\frac{7}{16}$-in.
WRENCH, box, ½-in.
WRENCH, socket-head set screw, $\frac{3}{32}$-in.

b. Procedure.

(1) INSTALL FIELD COILS IN FIELD SHELL (figs. 21 and 27).

WRENCH, box, $\frac{7}{16}$-in.

(a) Lay field coils out on bench in correct position with outer side down. Place pole shoes in coils in the position they are to be installed in the shell (fig. 21).

(b) Place coils and shoe assembly in shell arranging shoes in the position from which they were removed. Press tightly into position.

(c) Install the 12 cap screws and lock washers that hold the pole shoes to the field shell ($\frac{7}{16}$-in. box wrench). Tighten cap screws to draw pole shoes and coils tight against shell. The coil assembly must leave enough clearance in the center of the field shell to permit installation of the armature without interference.

(d) Retest field coils for short, open and ground as decribed in paragraph 24 **b** (6), (7), and (8).

ELECTRIC MOTOR

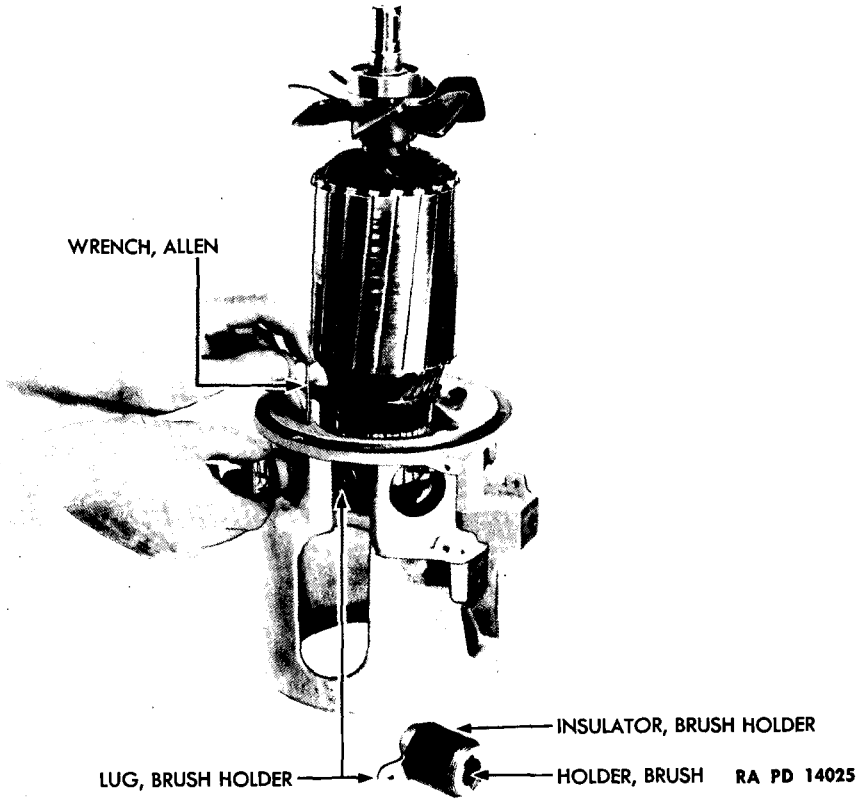

Figure 28 — Installing Brush Holders

(2) INSTALL BRUSH HOLDERS (fig. 28).

HAMMER, soft

WRENCH, socket-head set screw, $\frac{3}{32}$-in.

Insert metal part of each of 4 brush holders in insulator. Place each assembly in position in the commutator end bracket. Start the 2 set screws that hold each brush holder in place, but do not tighten ($\frac{3}{32}$-in. socket-head set screw wrench).

(3) INSTALL COMMUTATOR END BRACKET ON FIELD SHELL (fig. 19).

PLIERS, long-nosed

WRENCH, box, ½-in.

SCREWDRIVER

(a) Stand field shell upright on bench with field coil wires and brass field terminals upward. Place commutator end bracket in position on field shell with the 4 field coil wires near brush holder lugs (fig. 19).

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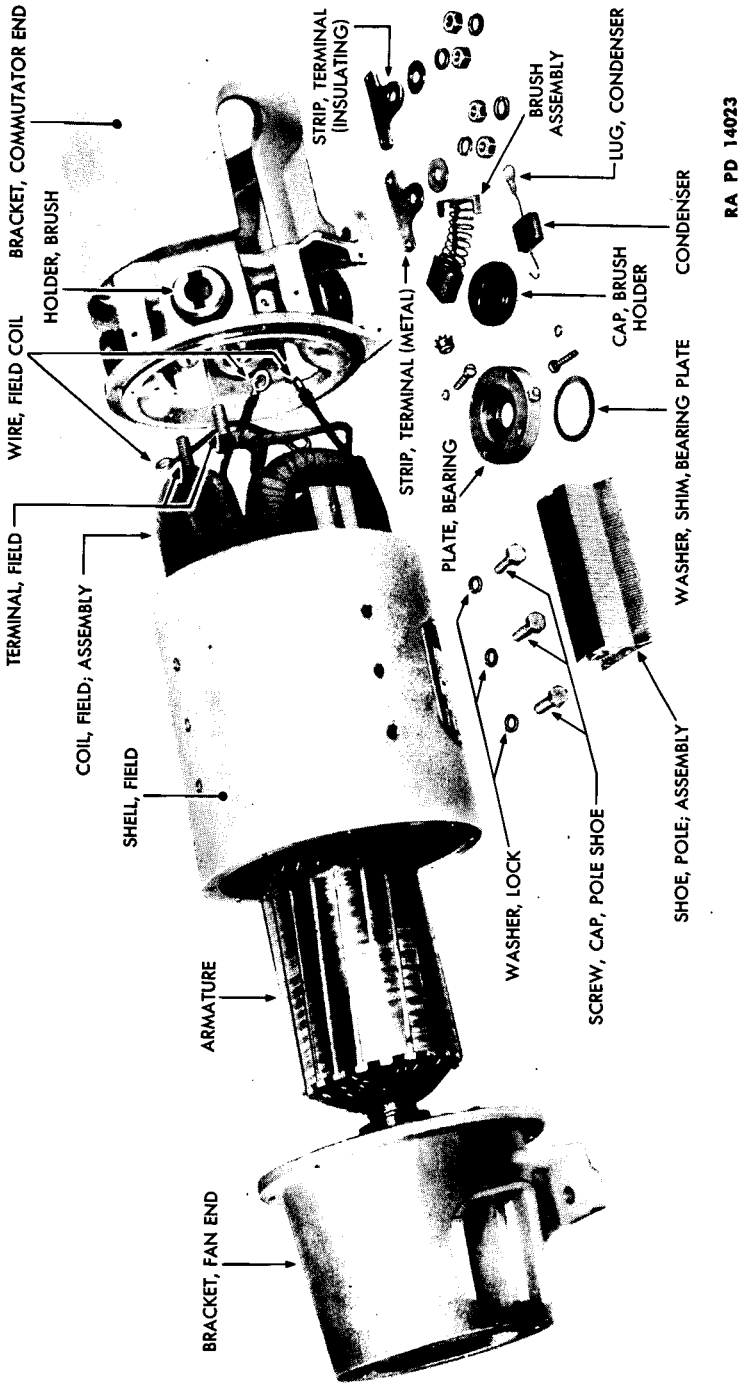

Figure 29 — Electric Motor — Partially Disassembled

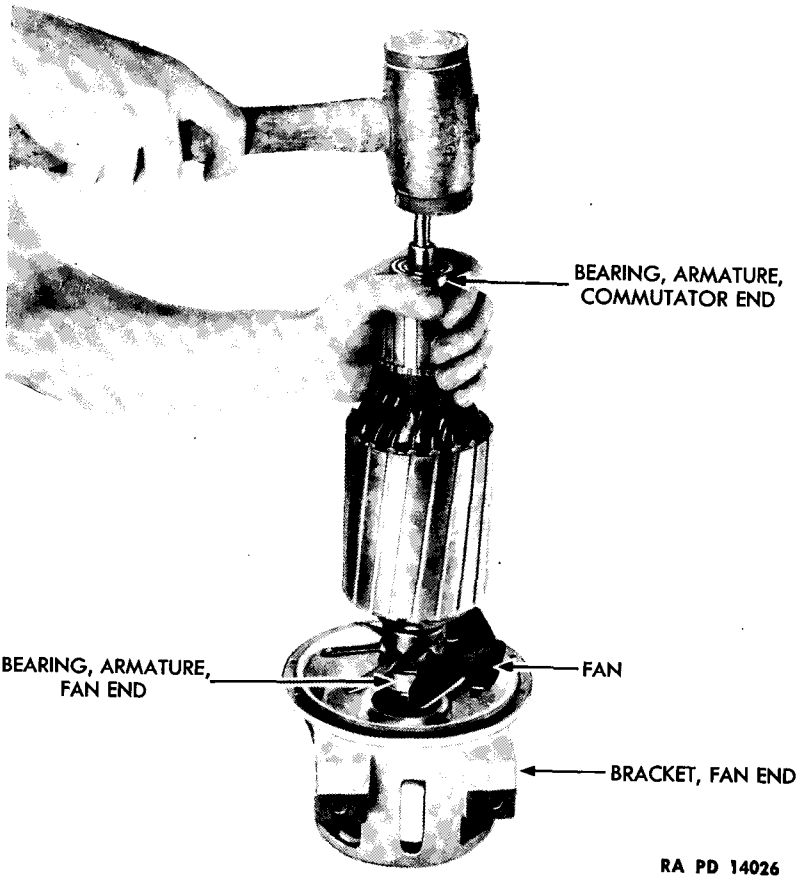

Figure 30 — Installing Armature In Fan End Bracket

(b) Install field coil wires and condensers on brush holder lugs (screwdriver) (fig. 13). Place lock washer over brush holder lug screw and loop condenser wire over the screw (long-nosed pliers). Place loop of field wire on brush holder lug and fasten in place by installing the lug screw with condenser wire and lock washer (screwdriver). Repeat with all 4 field coil wires so that there is 1 field coil wire, 1 condenser wire and a lock washer installed on each brush holder lug.

(c) Install field terminals on commutator end bracket (fig. 13). Place a terminal strip over each of the field terminals; the metal strip at top, opposite base of unit, and the insulating strip opposite side opening of bracket. Install terminal strips with screws and lock washers (screwdriver). Fasten terminals onto terminal strips by installing in turn, plain washer, lock washer, nut, lock washer, and lock nut (½-in. box wrench).

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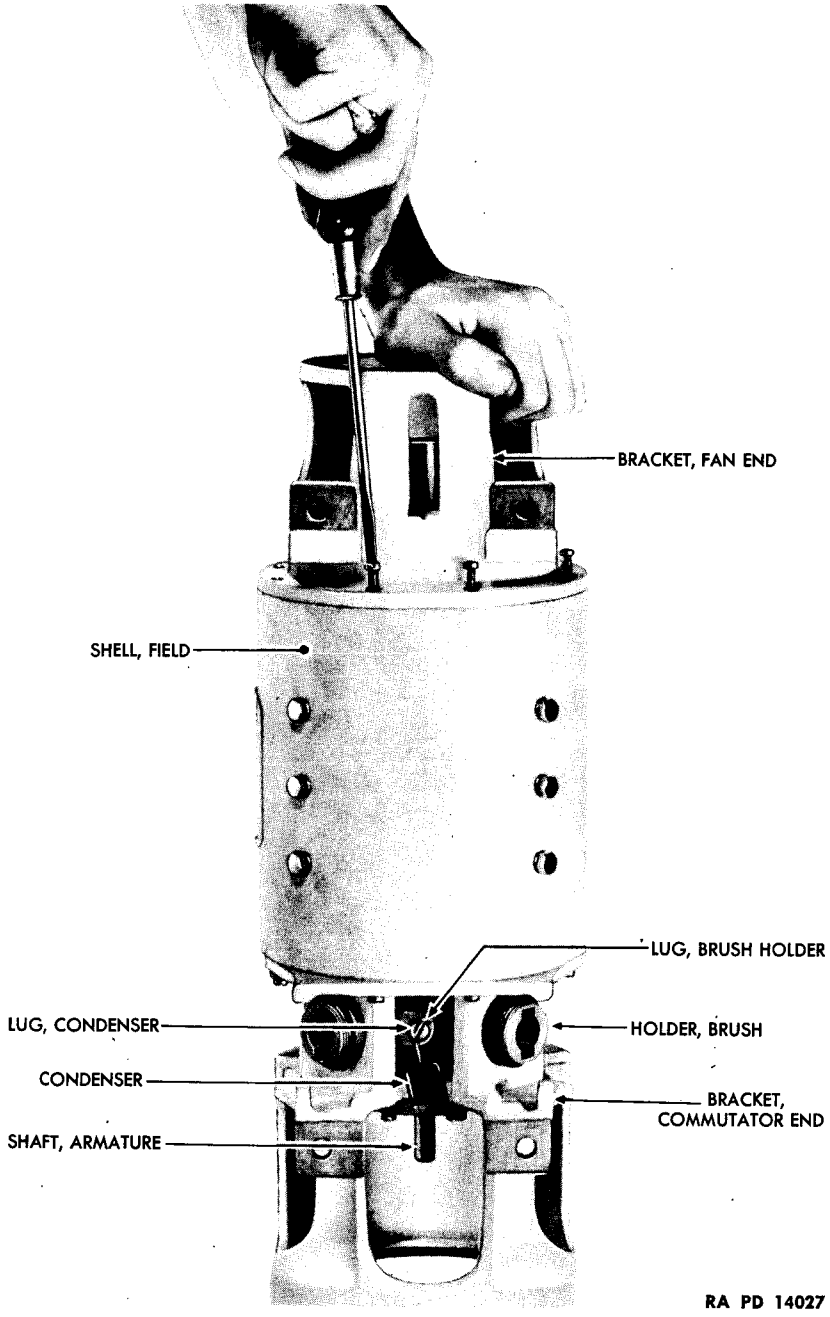

Figure 31 — Installing Fan End Bracket To Field Shell

(d) Install remaining 4 screws and lock washers that hold commutator end bracket to field shell (screwdriver). Lock with locking wires (long-nosed pliers).

(4) INSTALL ARMATURE IN FAN END BRACKET (fig. 30).

DRIVER, 1⅜-in. diam
HAMMER, soft
PRESS, arbor

(a) Place fan on end of armature shaft opposite commutator and press on (arbor press). Place armature shaft bearing over shaft and press on until there is $\frac{3}{16}$-inch clearance between fan and bearing.

(b) Place felt washer and split steel washer in the pocket of fan end bracket. Tap into place (1⅜-in. diam driver and soft hammer).

(c) Insert fan end of armature shaft into bracket. With bearing started into bore, tap the other end of the shaft lightly with a soft hammer until the bearing seats itself (fig. 28).

(5) INSTALL ARMATURE IN FIELD SHELL (fig. 31).

HAMMER, soft
PLIERS, long-nosed
PRESS, arbor
SCREWDRIVER
WRENCH, socket-head set screw, $\frac{3}{32}$-in.

(a) Place commutator end bearing on armature shaft and press on with arbor press. There must be $\frac{1}{32}$-inch clearance between bearing and commutator.

(b) Insert armature through field shell until commutator end bearing fits into bore in commutator end bracket. Tap bracket lightly until fan end and commutator end brackets are in line, and screw holes in fan end bracket line up with those in the field shell. Insert 8 screws and lock washers and tighten (screwdriver). Install locking wires to hold the 8 screws (long-nosed pliers).

(c) After armature has been installed in motor, adjust the position of the 4 brush holders so that there is a clearance of about $\frac{1}{16}$ inch between brush holder and commutator. Then tighten the 2 set screws on each brush holder ($\frac{3}{32}$-in. socket-head set screw wrench).

(6) INSTALL BRUSHES (fig. 14).

PAPER, flint, No. 00
(1- x 12-in.)

(a) Install brush assemblies in brush holders. If new brushes are not installed, be sure to reinstall the old ones in the same position from which they were removed, so that they will seat properly on the commutator. Be sure brushes work freely in their holders and go all the way through to rest on commutator.

(b) If old brushes are replaced with new ones, they must be seated properly. Slip a strip of flint paper between brush and commutator with the sanded side out (PAPER, flint, No. 00, 1- x 12-in.). Hold flint paper tight against commutator and rotate back and forth until the end of the brush will form a good contact with surface of commutator. CAUTION: Do not use emery paper.

(c) With brushes properly installed, screw on brush holder caps.

(7) INSTALL COMMUTATOR END BEARING PLATE (fig. 15).

PLIERS, long-nosed SCREWDRIVER

(a) With the fingers, test armature shaft for end play. The original end clearance between bearing and shoulder of shaft is 0.005 inch. To take up end play, place one or more shims on the bearing before installing the plate. Place split steel washer and then felt washer over end of shaft.

(b) With unit standing upright on bench, place bearing plate in position with lubricating fitting toward side opening in bracket and with screw holes in plate lined up with those in bracket. Place lock washer and condenser lug over the end of a screw, insert screw in hole in bearing plate and tighten (screwdriver). Repeat this with each of the condenser lugs and screws. Install locking wire through the 4 bearing plate screws (long-nosed pliers).

(8) INSTALL BRUSH OPENING COVER (fig. 2).

SCREWDRIVER

Place brush opening cover in position on commutator end bracket. Install and tighten the 4 screws that hold cover to feet of bracket (screwdriver). NOTE: If motor is to be immediately installed in tank, do not install brush opening cover until battery cable has been connected to motor terminal.

26. INSTALLING ELECTRIC MOTOR.

a. Equipment.

SCREWDRIVER WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, ½-in.

b. Procedure.

(1) INSTALL MOTOR (fig. 1).

WRENCH, open-end, $\frac{9}{16}$-in.

Place motor in position in channel on floor of turret basket. Line up screw holes in feet of motor brackets with those in channel. Insert the 4 cap screws and lock washers and tighten ($\frac{9}{16}$-in. open-end wrench).

(2) CONNECT CABLE TO MOTOR (fig. 13).

SCREWDRIVER WRENCH, open-end, ½-in.

Be sure motor switch is open. Connect motor cable to field terminal post that is mounted on the insulating terminal strip (fig. 13). Remove top lock nut and lock washer from terminal post. Install terminal of cable on post and reinstall lock washer and lock nut on post ½-in. open-end wrench).

27. SERVICE DATA.

a. Clearances. The following are the important clearances which should be maintained in the electric motor:

Between brush holders and commutator	$\frac{1}{16}$ in. to $\frac{1}{32}$ in.
Between pole shoes and armature	0.025 in.
Between bearing and fan	$\frac{3}{16}$ in.
Between commutator and bearing	$\frac{11}{32}$ in.
Between brush holder insulator and brush holder lug	$\frac{1}{32}$ in.
Between brush opening cover and brush holder caps	$^3/_{64}$ in.
Armature end play	0.005 in.

b. Brushes. Original dimensions of brushes are ⅜ inch thick, 1 inch wide and 1 inch long. Brushes should be replaced when worn to a length of ⅜ inch.

c. General Description. The motor is compound-wound, 4-pole, 24-volt direct current, 1-horsepower, continuous duty at 1,950 revolutions per minute; 40-degree centigrade rise, 2-horsepower, intermittent duty at 1,800 revolutions per minute.

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

Section VII

OIL RESERVOIR

	Paragraph
Description	28
Removing reservoir from turret basket	29
Disassembling oil reservoir	30
Inspection and repair of oil reservoir	31
Assembly and installation of oil reservoir	32

28. DESCRIPTION.

a. General. The oil reservoir of the hydraulic turret traversing mechanism is a welded steel tank with a capacity of approximately 2.2 gallons. A drain hose from the control valve, a drain tube from the hydraulic motor, a suction hose leading to the pump and a breather tube to relieve air pressure in the reservoir are connected to the reservoir. There is also a filler pipe on the top of the reservoir and a drain opening and plug on the bottom. The filler pipe has a screw cap to which a bayonet-type level gage is fixed.

b. Hydraulic Oil. Only OIL, hydraulic, should be used in the turret traversing mechanism. Should it become necessary to add oil when a supply of the correct grade is not available, a good grade of OIL, engine, SAE 10, or OIL, recoil, heavy, may be temporarily substituted. This should be replaced by the proper OIL, hydraulic, at the first opportunity.

29. REMOVING RESERVOIR FROM TURRET BASKET.

a. Equipment.

SCREWDRIVER
WRENCH, adjustable, 6-in.
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{5}{8}$-in.
WRENCH, open-end, $\frac{11}{16}$-in.
WRENCH, open-end, $\frac{3}{4}$-in.
WRENCH, open-end, $\frac{7}{8}$-in.
WRENCH, open-end, $1\frac{5}{16}$-in.

b. Procedure.

(1) DRAIN OIL FROM RESERVOIR.

See paragraph 14 b (1) and (2) for procedure.

(2) DISCONNECT HOSES (figs. 1 and 80).

WRENCH, open-end, $\frac{7}{8}$-in.
WRENCH, open-end, $1\frac{5}{16}$-in.

Disconnect suction hose to hydraulic pump ($\frac{7}{8}$-in. open-end wrench). Disconnect exhaust hose to control valve ($1\frac{5}{16}$-in. open-end wrench).

OIL RESERVOIR

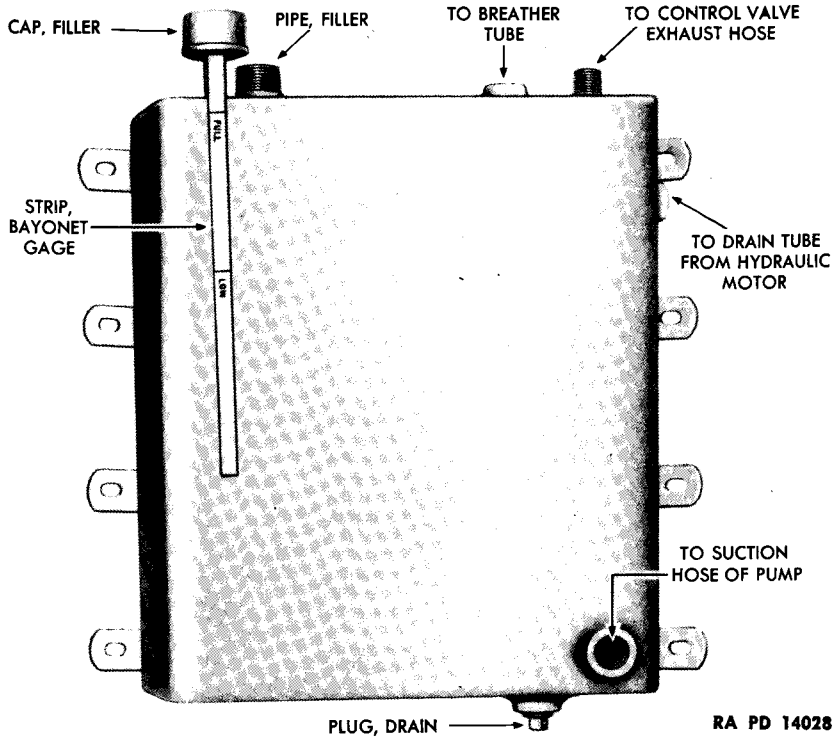

Figure 32 — Oil Reservoir

(3) DISCONNECT DRAIN TUBE (fig. 1).

WRENCH, open-end, $\frac{9}{16}$-in. WRENCH, open-end, $\frac{5}{8}$-in.

Using 2 wrenches, disconnect the hydraulic motor drain tube from the elbow fitting on side near top of reservoir.

(4) REMOVE BREATHER TUBE (fig. 1).

WRENCH, open-end, $\frac{11}{16}$-in. WRENCH, open-end, $\frac{3}{4}$-in.

Hold fitting with 1 wrench and, with the other, remove breather tube from top of reservoir.

(5) REMOVE RESERVOIR.

SCREWDRIVER WRENCH, adjustable, 6-in.

NOTE: The reservoir is bolted through walls of turret basket, sometimes with slotted head and sometimes with hex-head bolts. Using appropriate tools, remove the 8 bolts holding reservoir to wall of basket and lift off reservoir.

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30. DISASSEMBLING OIL RESERVOIR.

a. Except for removal of filler cap and gage assembly and removal of drain plug, there is no disassembly operation on the oil reservoir. All other fittings are welded into place.

31. INSPECTION AND REPAIR OF OIL RESERVOIR.

a. Equipment.

AIR, compressed
EQUIPMENT, welding
SOLVENT, dry-cleaning

b. Procedure.

(1) VISUAL INSPECTION.

EQUIPMENT, welding

Inspect reservoir carefully for any indication of leaks. Leaks in reservoir may be repaired by welding. (Leaks at fittings may sometimes be due to bruised threads. If the damage to threads is slight, repair can be made by use of a thread chaser or tap.)

(2) CLEAN RESERVOIR.

AIR, compressed
SOLVENT, dry-cleaning

Flush reservoir thoroughly with SOLVENT, dry-cleaning. Dry with compressed air. Make sure that reservoir contains no dirt, bits of metal, or other foreign substance that might get into the system. If any holes have been welded, be sure that no weld splatter is left inside the reservoir.

(3) CLEAN BREATHER TUBE.

AIR, compressed.

Blow out breather tube with compressed air to remove dust or other obstructions.

32. ASSEMBLY AND INSTALLATION OF OIL RESERVOIR (figs. 1, 32, and 80).

a. Equipment.

WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{5}{8}$-in.
WRENCH, open-end, $\frac{11}{16}$-in.
WRENCH, open-end, $\frac{3}{4}$-in.
WRENCH, open-end, $\frac{7}{8}$-in.
WRENCH, open-end, $\frac{15}{16}$-in.

b. Procedure.

(1) BOLT RESERVOIR TO WALL OF TURRET BASKET.

See paragraph 29 b (5) for procedure.

OIL RESERVOIR

(2) INSTALL BREATHER TUBE.

WRENCH, open-end, $\frac{11}{16}$-in. WRENCH, open-end, $\frac{3}{4}$-in.

Place breather tube in position on top of reservoir and tighten down, using 2 wrenches.

(3) INSTALL DRAIN TUBE FROM HYDRAULIC MOTOR.

WRENCH, open-end, $\frac{9}{16}$-in. WRENCH, open-end, $\frac{5}{8}$-in.

Connect hydraulic motor drain tube to its fitting on the side near the top of reservoir, using 2 wrenches.

(4) INSTALL HOSES.

WRENCH, open-end, $\frac{7}{8}$-in. WRENCH, open-end, $\frac{15}{16}$-in.

Install exhaust hose from control valve to its fitting on top of reservoir ($\frac{15}{16}$-in. open-end wrench). Install hydraulic pump suction hose on its fitting on front of reservoir ($\frac{7}{8}$-in. open-end wrench).

(5) FILL RESERVOIR.

When complete traversing mechanism has been installed, fill reservoir with OIL, hydraulic, to the point marked "FULL" on the bayonet gage strip. Operate the system for a few minutes to expel surplus air. Then remove filler cap, again fill reservoir to "FULL" mark and reinstall filler cap. The system holds less than one-half gallon in addition to the 2.2 gallons contained in the reservoir.

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

Section VIII

HYDRAULIC CONTROL VALVE

	Paragraph
Description	33
Trouble shooting	34
Removal of control valve	35
Disassembling control valve	36
Maintenance and repair of control valve	37
Assembling control valve	38
Installation of control valve	39
Adjust relief valve	40

33. DESCRIPTION (figs. 33 and 34).

a. Purpose. The hydraulic control valve is a manually operated two-way piston valve, the primary purpose of which is to direct the flow of oil under pressure to one side or the other of the hydraulic motor which rotates the turret. Two switches which control the firing mechanism of the two turret guns are located on the control valve handle.

b. Operation. The main working parts of the control valve are two pistons which move in their liners in opposite directions as the handle of the valve is turned. When the handle of the valve is in vertical position, both pistons allow the oil from the pump to bypass through a series of holes in the piston liners and return to the oil reservoir for recirculation. When the handle is turned, it turns a gear which engages with two racks, each of which is linked to one of the pistons. Turning the handle to the right, or clockwise, moves the right piston downward, the left upward. As the right piston moves downward, it shuts off the flow of oil through the holes in the right piston liner. As the left piston rises, it opens up the flow of oil through the holes in the left liner. Thus the oil is prevented from flowing through one of the valve ports and allowed to flow freely through the other to the hydraulic motor, causing it to operate and rotate the turret. Turning the handle of the valve to the left or counterclockwise, transposes the position of the two pistons, causing the oil to flow through the other port to the hydraulic motor, and rotating it and the turret in the opposite direction. When the valve handle is turned to the right, the power transmitted through the hydraulic motor rotates the turret to the

right. Turning the valve handle to the left reverses the direction of the motor and turns the turret to the left. In a vertical position, with trigger released, the valve handle is in "NEUTRAL" and the turret does not move in either direction.

c. Operation Of Gun Firing Switches. Mounted on the upper part of the control valve handle are two switches (fig. 33), one to operate the gun firing mechanism of each of the two turret guns. A safety switch is located on the lower part of the handle. While this safety switch remains open, the two gun firing switches are inoperative. Squeezing the trigger of the handle closes the safety switch, thus energizing the two gun firing switches. Should the gunner's hand relax, the valve control handle automatically returns to "NEUTRAL" position and the safety switch opens, making the gun firing switches inoperative.

34. TROUBLE SHOOTING.

a. Handle Does Not Turn Or Turns Only Part Way.

Probable Cause	Probable Remedy
Foreign particles have become wedged between working parts.	Disassemble entire valve (par. 36). Clean all parts carefully. Inspect to make sure no damage has been done to parts. Replace any damaged parts. Assemble valve (pars. 36, 37, and 38).
Lock plunger stuck which prevents trigger from being compressed.	Disassemble entire valve (par. 36). Clean all parts carefully. Inspect to make sure no damage has been done to parts. Replace any damaged parts. Assemble valve (pars. 36, 37, and 38).
Piston and rack bind due to link pin falling part way out.	Disassemble entire valve (par. 36). Clean all parts carefully. Inspect to make sure no damage has been done to parts. Replace any damaged parts. Assemble valve (pars. 36, 37, and 38).

b. Oil Leakage.

Leakage around piston spring caps or relief valve acorn nut.	First tighten cap or nut. If this does not stop the leakage, replace gasket (pars. 36 b (1) and 36 b (4)).

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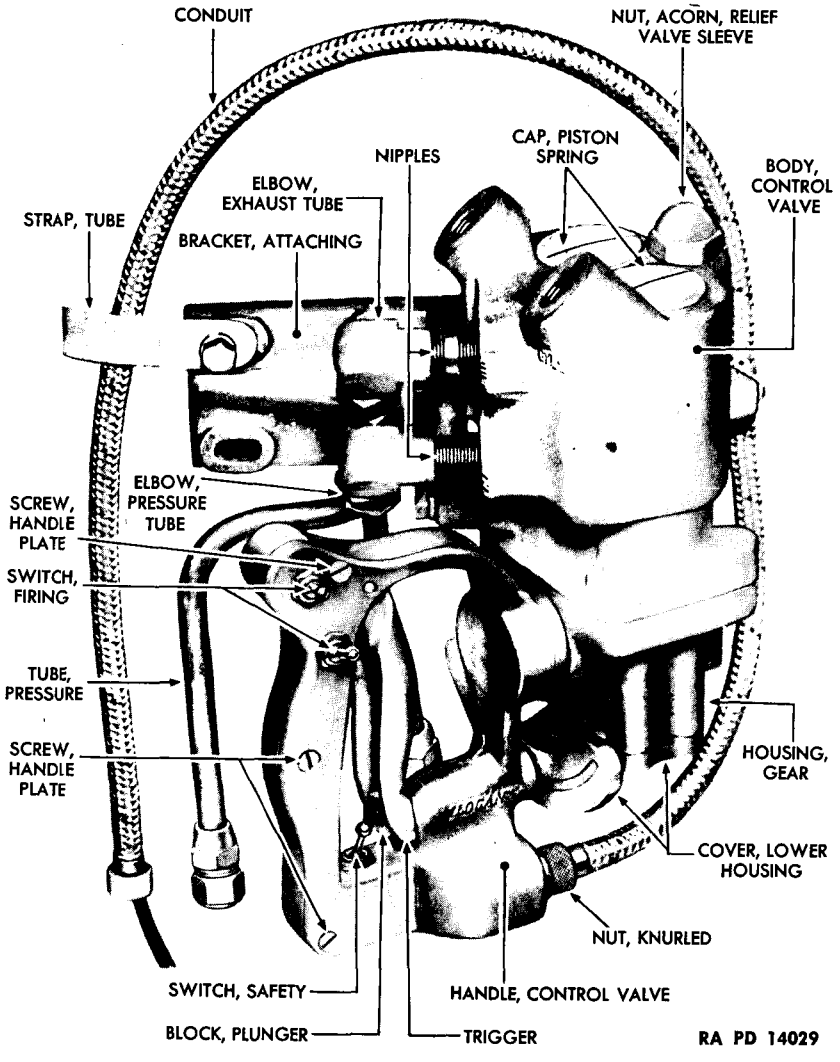

Figure 33 – Hydraulic Control Valve – Side View

HYDRAULIC CONTROL VALVE

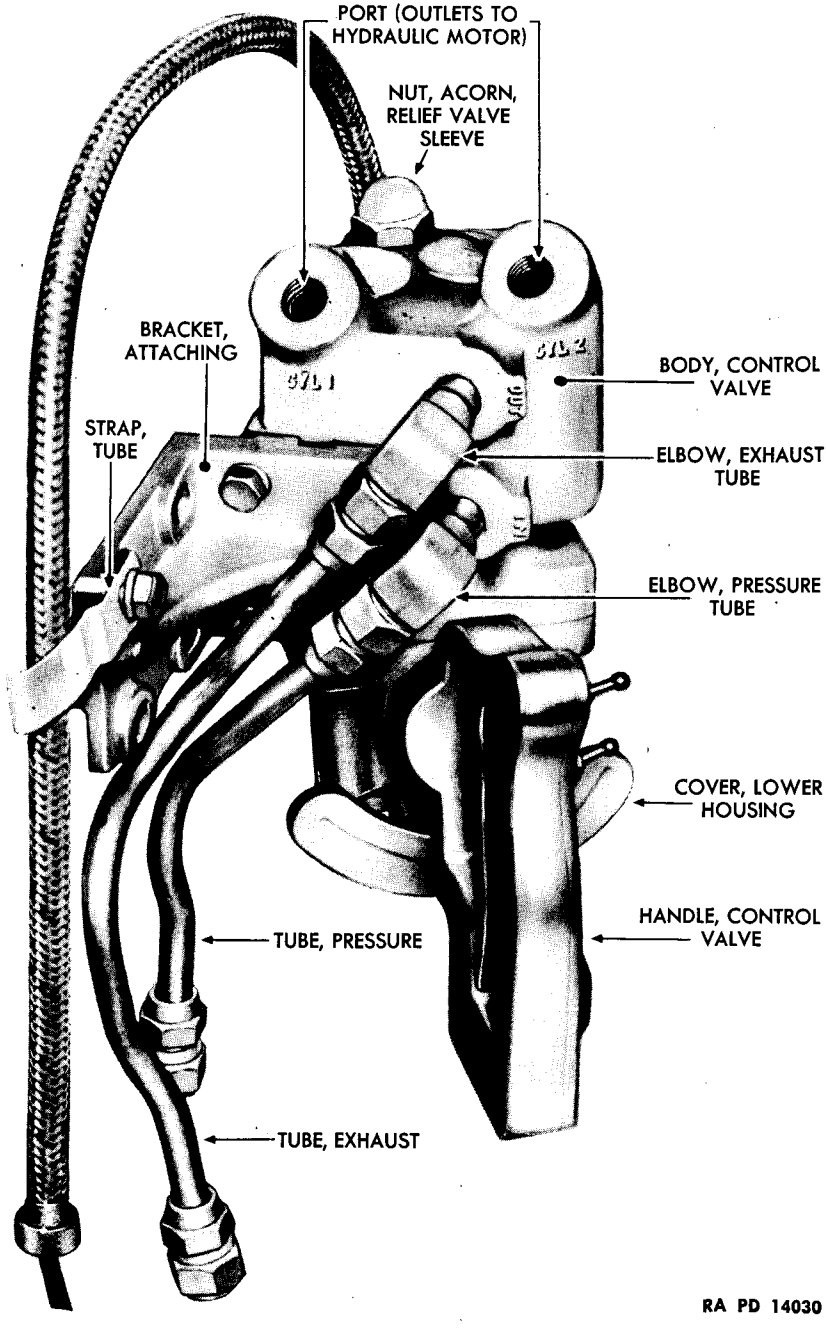

Figure 34 — Hydraulic Control Valve

Probable Cause	Probable Remedy
Leakage around body gasket bearing cover and lower cover.	First tighten bolts. If this does not stop the leakage, remove and inspect gaskets. Replace if damaged. Apply a thin coating of shellac on gasket surfaces. Then tighten screws and allow to set from 10 to 15 minutes (pars. 36, 37, and 38).
Leakage around the oil retainer.	Replace retainer, taking care not to damage the seal bore in the gear housing (pars. 36, 37, and 38).
Leakage around pressure or exhaust pipe connectors.	Remove elbows and pipe nipples. Place sealing compound on threads. Reinstall and tighten nipples and elbows (pars. 36, 37, and 38).

c. Turret "Creeps" In Either Direction With Valve Handle In Vertical Position.

Piston or piston liner excessively worn.	Replace entire control valve (pars. 35 and 39).

35. REMOVAL OF CONTROL VALVE.

a. Equipment.

WRENCH, box, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{7}{8}$-in.
WRENCH, open-end, $\frac{15}{16}$-in. (2)
WRENCH, open-end, 1-in.
WRENCH, pipe, small
WRENCH, socket, $\frac{7}{16}$-in.

b. Procedure.

(1) REMOVE HOSES FROM PRESSURE TUBE AND EXHAUST TUBE (fig. 34).

WRENCH, open-end, $\frac{7}{8}$-in.
WRENCH, open-end, $\frac{15}{16}$-in. (2)
WRENCH, open-end, 1-in.

Open battery switch. Provide a receptacle to catch any oil that will drain after the lines are disconnected. Hold coupling nut ($\frac{15}{16}$-in. open-end wrench) while loosening lock nut on pressure tube ($\frac{7}{8}$-in. open-end wrench). Hold pressure hose (1-in. open-end wrench) while unscrewing

coupling nut ($1\frac{5}{16}$-in. open-end wrench). Hold coupling nut ($1\frac{5}{16}$-in. open-end wrench) while loosening lock nut on exhaust tube ($\frac{7}{8}$-in. open-end wrench). Hold exhaust hose ($1\frac{5}{16}$-in. open-end wrench) while unscrewing coupling nut ($1\frac{5}{16}$-in. open-end wrench).

(2) DISCONNECT MOTOR HOSES (fig. 1).

WRENCH, open-end, $\frac{7}{8}$-in. WRENCH, open-end, 1-in.

Hold motor hose (1-in. open-end wrench) while unscrewing coupling nut in connector in valve body ($\frac{7}{8}$-in. open-end wrench). Disconnect both motor hoses in the same way.

(3) REMOVE PRESSURE TUBE CLIP.

WRENCH, open-end, $\frac{7}{16}$-in.

Remove clip that holds control valve pressure tube to wall of turret basket.

(4) REMOVE PRESSURE AND EXHAUST TUBES FROM ELBOWS.

WRENCH, open-end, $\frac{7}{8}$-in. WRENCH, open-end, $1\frac{5}{16}$-in.

Disconnect and remove pressure and exhaust tubes, using 2 wrenches (fig. 34).

(5) REMOVE TUBE STRAP FROM ATTACHING BRACKET.

WRENCH, box, $\frac{9}{16}$-in.

Remove cap screw and lock washer from strap that holds reservoir breather tube, conduit, and hydraulic motor drain tube to wall of turret basket. This cap screw also holds upper left corner of control valve attaching bracket (fig. 33).

(6) REMOVE LOWER CLIP.

WRENCH, socket, $\frac{7}{16}$-in.

Remove the 2 bolts from the clip that holds breather tube, hydraulic motor drain tube, and conduit.

(7) REMOVE CONTROL VALVE FROM TURRET (figs. 33 and 34).

WRENCH, box, $\frac{9}{16}$-in.

Remove the remaining upper and 2 lower cap screws, lock washers, and plain washers that hold the control valve attaching bracket to turret. Remove 4 cap screws and lock washers that hold attaching bracket to control valve body.

(8) REMOVE PRESSURE AND EXHAUST TUBE ELBOWS (fig. 33).

WRENCH, open-end, $1\frac{5}{16}$-in. WRENCH, small pipe

Remove elbows from nipples ($1\frac{5}{16}$-in. open-end wrench). Remove nipples from valve body (small pipe wrench).

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

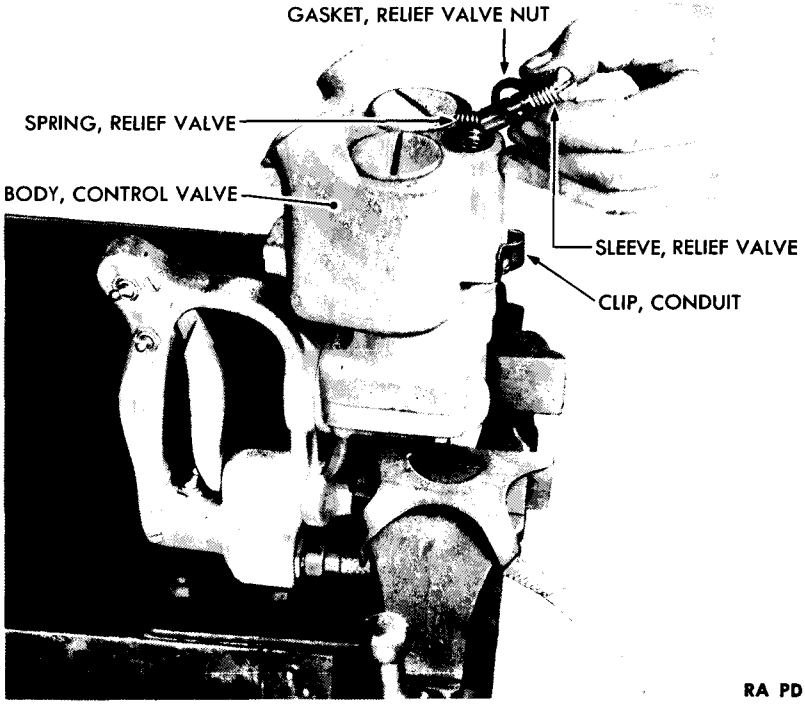

Figure 35 — Removal Of Relief Valve

36. DISASSEMBLING CONTROL VALVE.

a. Equipment.

HAMMER, light
PIN, drift, $\frac{3}{32}$-in.
PIN, drift, $\frac{5}{32}$-in.
PLIERS
PLIERS, long-nosed
PRESS, arbor
ROD, brass, $\frac{3}{16}$-in. diam, 3½-in. or 4-in. long
SCREWDRIVER, heavy
SCREWDRIVER, wide
VISE with soft jaws
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, 1-in.
WRENCH, socket, ¾-in.
WRENCH, socket-head set screw, $\frac{3}{16}$-in.
WRENCH, socket-head set screw, $\frac{5}{16}$-in.

b. Procedure.

(1) REMOVE RELIEF VALVE (fig. 35).

SCREWDRIVER
VISE with soft jaws
WRENCH, open-end, 1-in.

Clamp control valve in vise, right side up. Unscrew and remove the acorn relief valve sleeve nut from top of valve body (fig. 33) (1-in. open-

HYDRAULIC CONTROL VALVE

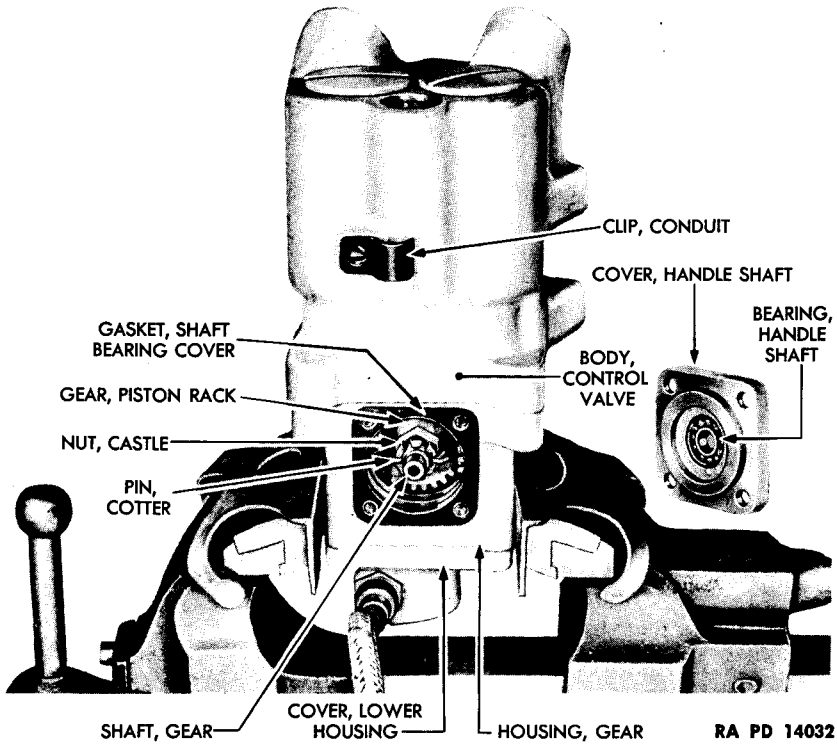

Figure 36 — Valve Body And Gear Housing With Handle Shaft Cover Removed

end wrench). Remove relief valve nut gasket (fig. 35). Unscrew and remove the relief valve sleeve (screwdriver). Remove relief valve spring from sleeve. Remove control valve from vise, turn it over, and shake out the relief valve ball.

(2) REMOVE HANDLE SHAFT COVER ASSEMBLY (fig. 36).
SCREWDRIVER
WRENCH, socket-head set screw, $\frac{3}{16}$-in.

Remove conduit clip (screwdriver) (fig. 36). Remove the 4 socket-head screws that hold handle shaft cover to back of gear housing ($\frac{3}{16}$-in. socket-head set screw wrench). Pry off cover and remove gasket. **NOTE:** Do not attempt to remove bearing from cover unless it must be replaced with a new one (par. 37 **b** (5)).

(3) REMOVE LOWER HOUSING COVER (fig. 36).
WRENCH, socket-head set screw, $\frac{3}{16}$-in.

Remove the 4 socket-head screws that hold the lower housing cover to the gear housing ($\frac{3}{16}$-in. socket-head set screw wrench). Squeeze

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

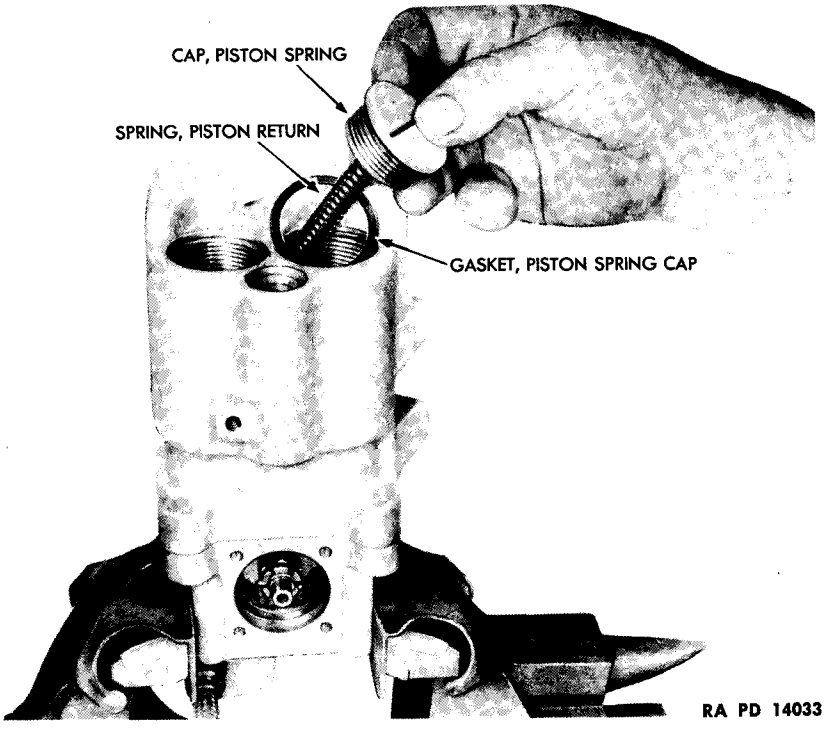

Figure 37 — Removal Of Piston Spring Cap And Piston Return Spring

handle trigger to disengage locking plunger and remove lower cover and gasket.

(4) REMOVE PISTON SPRING CAPS AND RETURN SPRINGS (fig. 37).

SCREWDRIVER, wide

Unscrew piston spring caps (wide screwdriver). Lift off caps with piston return springs. Lift out piston spring cap gasket. NOTE: Do not attempt to remove piston liners. Removing them would destroy the press fit.

(5) REMOVE GEAR HOUSING, HANDLE AND PISTON ASSEMBLIES FROM VALVE BODY (fig. 38).

VISE with soft jaws

WRENCH, socket-head set screw, $\frac{5}{16}$-in.

Remove the 4 socket-head screws that hold gear housing to control valve body ($\frac{5}{16}$-in. socket-head set screw wrench). Clamp valve body in vise, upside down. Grasp gear housing and lift upward, removing entire assembly. Lift off shim.

HYDRAULIC CONTROL VALVE

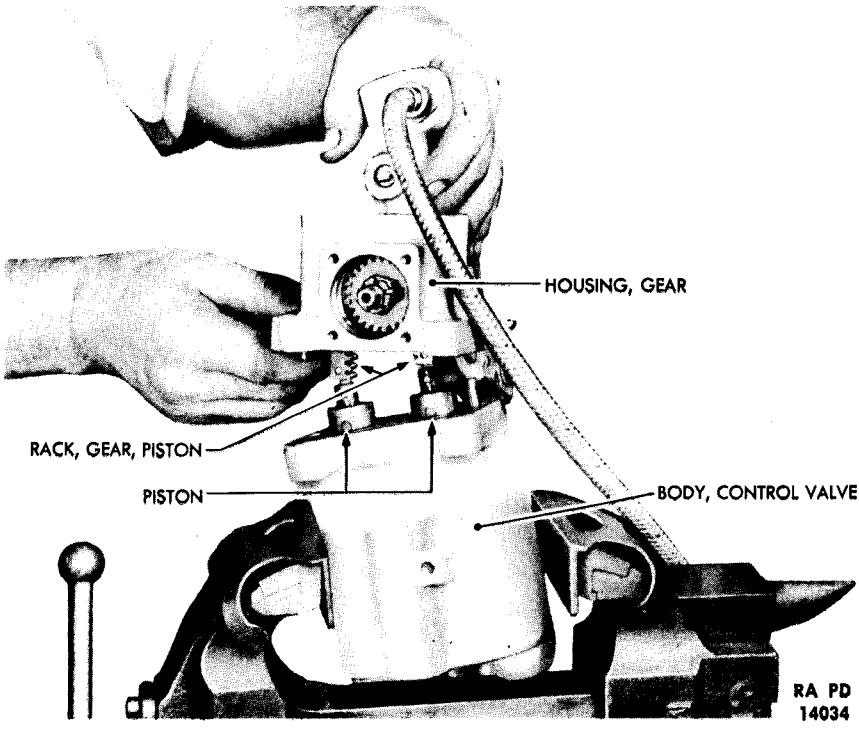

Figure 38 — Removing Gear Housing, Handle, And Piston Assembly From Valve Body

(6) REMOVE PISTON ASSEMBLIES FROM GEAR HOUSING (fig. 39).

VISE with soft jaws

Place gear housing in vise, with handle free and pistons up. Turn control valve handle counterclockwise as far as it will go. This makes it possible to lift out right piston and rack. Then turn control valve handle clockwise and remove the left piston and rack the same way. Mark pistons for reassembly as each piston is selectively fitted to its liner.

(7) REMOVE HANDLE ASSEMBLY FROM GEAR HOUSING (fig. 40).

PLIERS, long-nosed
SCREWDRIVER, heavy
VISE with soft jaws
WRENCH, socket, ¾-in.

Reach into larger opening of gear housing with long-nosed pliers and remove cotter pin from the castle nut on gear shaft. Remove castle nut (¾-in. socket wrench) (fig. 36). Clamp gear housing in vise, right end up. Reach in from top with heavy screwdriver and pry piston rack gear off shaft toward back of gear housing (fig. 40). Remove Woodruff key from slot in shaft. Slide washer off shaft. Pull handle and shaft assembly out through front of housing.

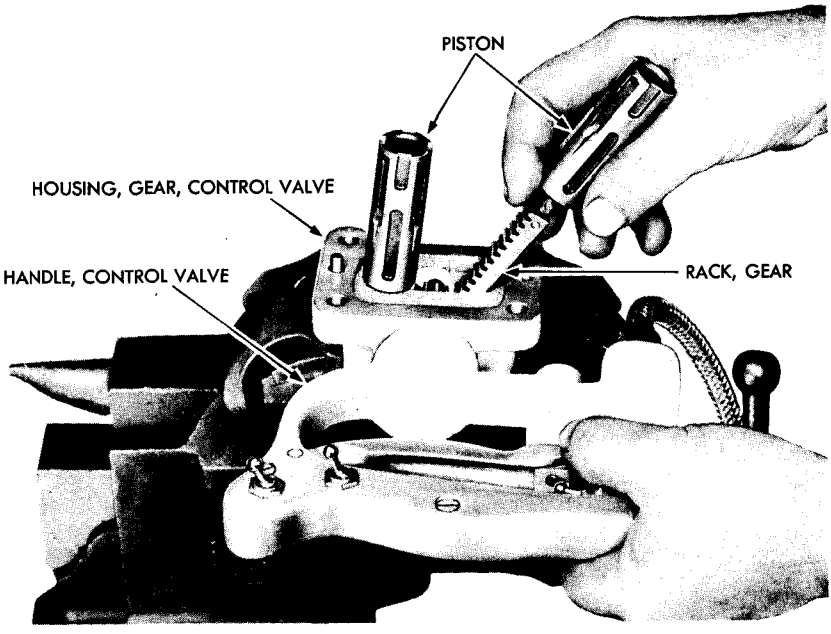

Figure 39 — Removing Piston Assemblies From Control Valve Gear Housing

(8) REMOVE GEAR SHAFT FROM HANDLE (fig. 41).

SCREWDRIVER, heavy VISE with soft jaws

Clamp control valve handle in vise with shaft up. Remove the 4 screws holding shaft flange to handle (heavy screwdriver). Pry shaft from handle, and remove the 2 dowel pins if loose. If dowels are tight in handle, do not attempt to remove.

(9) REMOVE HANDLE LOCKING PLUNGER (fig. 43).

HAMMER, light PLIERS
PIN, drift, $\frac{3}{32}$-in.

Press handle locking plunger in from back of handle until plunger block pin is accessible. Remove pin from block by driving pin from small end ($\frac{3}{32}$-in. drift pin and light hammer). When plunger block pin has been driven part way out, grasp with pliers and remove. This releases the block from the plunger. Pull out plunger and plunger spring from back of handle.

HYDRAULIC CONTROL VALVE

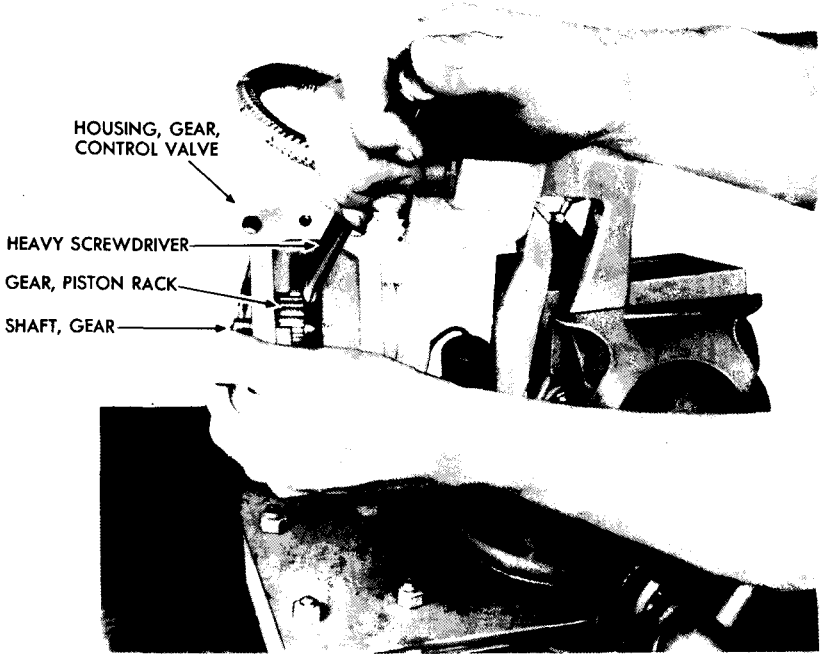

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Figure 40 — Removing Piston Rack Gear From Control Valve Housing

(10) REMOVE HANDLE PLATE, TRIGGER, AND WIRING FROM HANDLE.

PLIERS
SCREWDRIVER
WRENCH, open-end, $\frac{9}{16}$-in.

Remove hexagonal nut that holds safety switch to handle ($\frac{9}{16}$-in. open-end wrench). Remove the 3 handle plate screws (screwdriver) (fig. 33). Loosen conduit from control valve handle by unscrewing knurled nut from adapter (pliers) (fig. 42). Remove the terminal connectors that hold the wires at the junction box end. Lift handle plate and take out trigger and trigger washer. Push safety switch down into handle. Entire wiring harness, still connected to firing switches and handle plate, can be drawn out from the conduit. Unscrew hexagonal nuts and lock washers that hold firing switches to handle plate ($\frac{9}{16}$-in. open-end wrench). Pull switches through handle plate. NOTE: Do not remove handle plate, trigger, or wiring from control valve handle unless it is necessary to make repairs to the wiring.

(11) REMOVE RACKS FROM PISTON.

HAMMER, light
PIN, drift, $\frac{5}{32}$-in.

Drive out link pins from small end ($\frac{5}{32}$-in. drift pin and light hammer). Note that pins are inserted through piston and rack from opposite sides

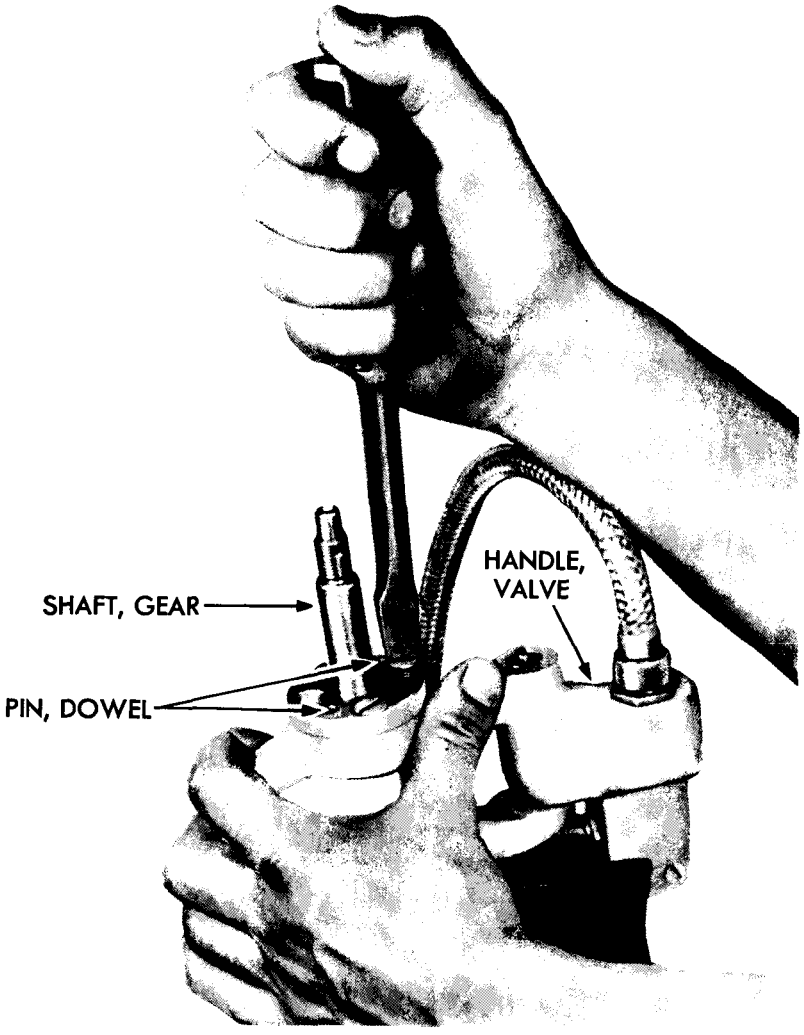

Figure 41 — Removing Gear Shaft From Control Valve Handle

(M and N, fig. 44). NOTE: It is not necessary to remove racks from pistons except to replace racks, links, or link pins.

(12) REMOVE OIL RETAINER (FF, fig. 44).

SCREWDRIVER, heavy

Pry out retainer with heavy screwdriver, being careful not to damage bore in gear housing. Retainer will be destroyed in removal. NOTE: It

HYDRAULIC CONTROL VALVE

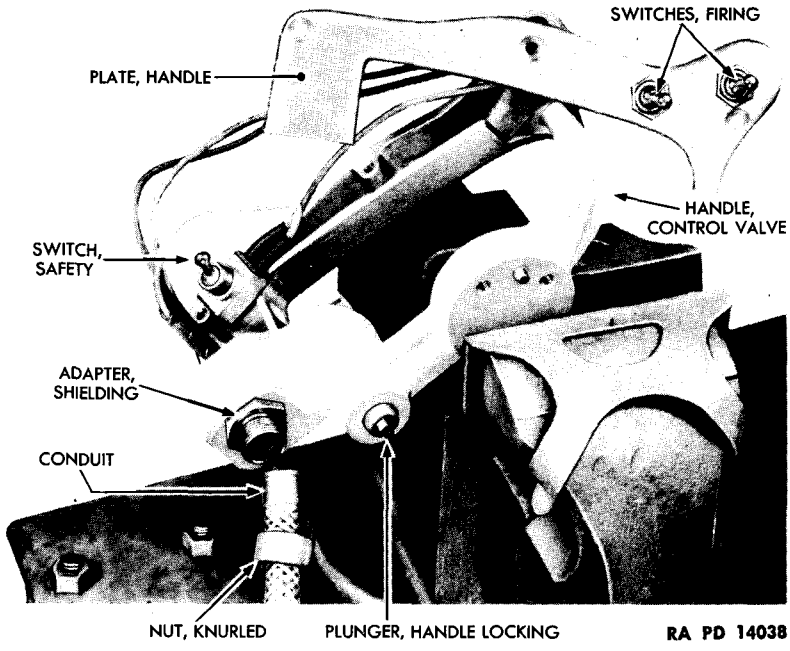

Figure 42 — Removing Wiring Harness

is not necessary to remove oil retainer unless it leaks and must be replaced.

(13) REMOVE NEEDLE BEARING (EE, fig. 44).

PRESS, arbor
ROD, brass, $\frac{3}{16}$-in. diam, 3½-in. or 4-in. long

Place rod against end of needle bearing and press out. NOTE: It is not necessary to remove needle bearing unless bearing is damaged or worn to excess.

37. MAINTENANCE AND REPAIR OF CONTROL VALVE.

a. Equipment.

CLOTH, wiping
SCREWDRIVER
SOLVENT, dry-cleaning
VISE with soft jaws

b. Procedure.

(1) GENERAL PRECAUTIONS.

(a) Never attempt to remove piston liners or replace pistons. Removing liners will destroy press fit. Pistons are selectively fitted to their liners and must be reinstalled in the same liners from which they were removed (par. 34 c).

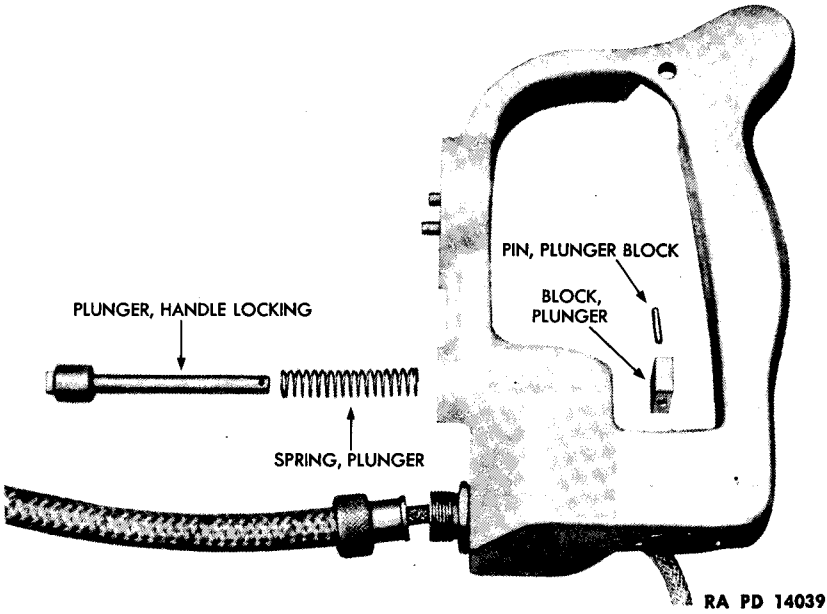

Figure 43 — Disassembly Of Handle Locking Plunger Assembly

(b) Do not attempt to remove the ball seat from valve body. This part is pressed in and removal would destroy the press fit.

(c) Take every precaution to keep all parts clean. Wash all parts in SOLVENT, dry-cleaning, dry thoroughly, and keep parts wrapped or covered until they are reassembled to prevent any dust, dirt or foreign matter from getting into the system.

(2) INSPECT HANDLE LOCKING PLUNGER.

Inspect plunger spring free length. Correct length is 1¾ inches. Replace if weak or broken. Inspect fit of plunger block pin in block before reassembly. Replace pin if it does not fit tightly. Replace plunger if it does not slide freely through its bore.

(3) INSPECT NEEDLE BEARING.

Clean needle bearing thoroughly in SOLVENT, dry-cleaning, and inspect for broken needles.

(4) INSPECT GEAR AND RACKS.

Replace gear or racks if there are any broken teeth. Replace Woodruff key if there is any sign of wear or cracking.

(5) INSPECT HANDLE SHAFT BEARING.

SCREWDRIVER
VISE with soft jaws

Inspect the bearing for broken balls and for smooth running. If bearing is imperfect, remove by prying out with a screwdriver, being careful not to damage the bearing pocket. Press in a new bearing (vise with soft jaws).

(6) INSPECT RELIEF VALVE.

If ball is cracked, chipped or out-of-round, replace with a new ball. Ball is a standard 3/8-inch bearing ball. Be sure spring is in good condition; replace if broken. (NOTE: This spring is made in a curved shape.) Replace the synthetic rubber gasket if it does not fit perfectly into its pocket. Inspect sleeve and acorn nut and replace if threads are damaged or worn enough to interfere with oiltight fit.

38. ASSEMBLING CONTROL VALVE.

a. Equipment.

BRUSH, shellac
CLOTH, wiping
HAMMER, light
PLIERS
PLIERS, long-nosed
PRESS, arbor
ROD, brass, 7/8-in. diam, 3-in. or 4-in. long
SCREWDRIVER
SCREWDRIVER, heavy
SCREWDRIVER, wide
SHELLAC
SOLVENT, dry-cleaning
VISE with soft jaws
WRENCH, open-end, 9/16-in.
WRENCH, open-end, 1-in.
WRENCH, socket, 3/4-in.
WRENCH, socket-head set screw, 3/16-in.
WRENCH, socket-head set screw, 5/16-in.

b. Procedure.

(1) INSTALL WIRING HARNESS AND SWITCHES.

SCREWDRIVER
WRENCH, open-end, 9/16-in.

Insert toggle switch with green wire through top opening in handle plate. Install lock washer and hexagonal nut, and tighten (9/16-in. open-end wrench). Insert switch with black wire in the other opening and tighten in same way. Insert toggle of safety switch through the opening in the lower part of the handle and tighten into place with lock washer and hexagonal nut (9/16-in. open-end wrench). Arrange all wires so that they fit snugly into handle. Place trigger in position in handle, install trigger washer and handle plate. Insert the 3 handle plate screws (fig. 33) and tighten (screwdriver).

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

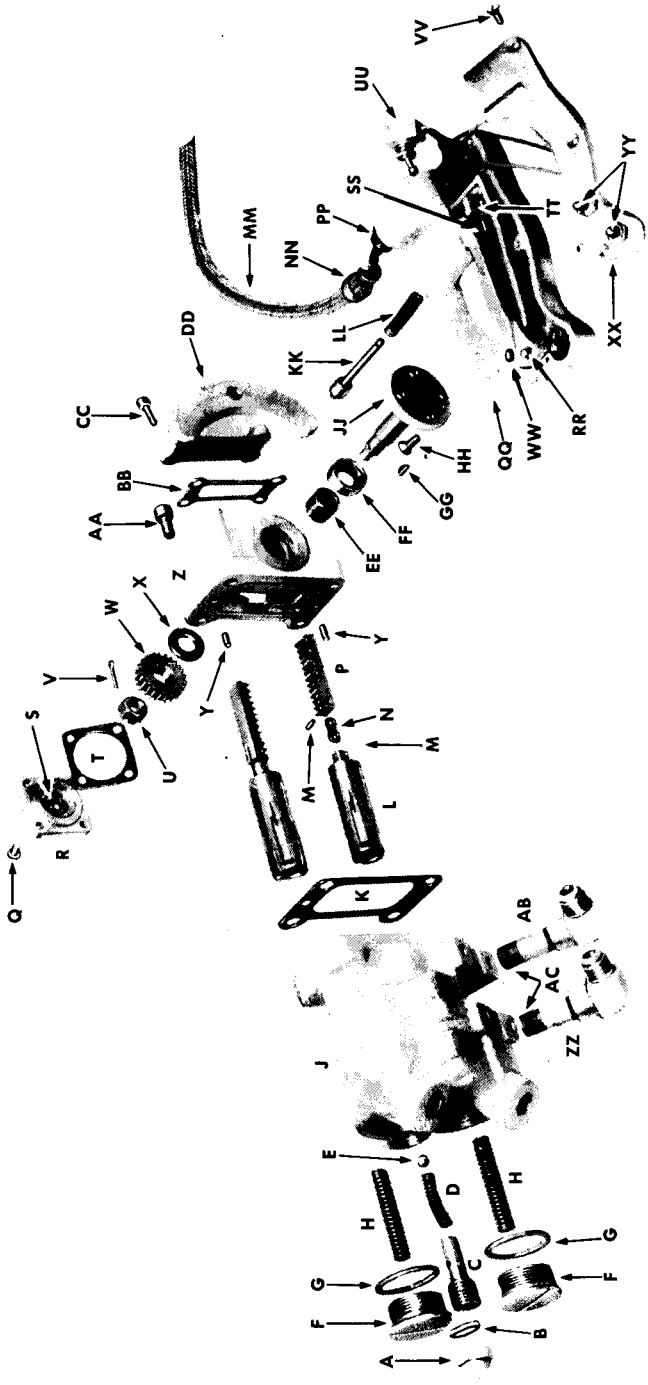

Figure 44 — Control Valve — Disassembled

A—NUT, ACORN, RELIEF VALVE SLEEVE

B—GASKET, RELIEF VALVE NUT

C—SLEEVE, RELIEF VALVE

D—SPRING, RELIEF VALVE

E—BALL, RELIEF VALVE

F—CAP, PISTON SPRING

G—GASKET, PISTON SPRING CAP

H—SPRING, PISTON RETURN

J—BODY, CONTROL VALVE

K—GASKET, BODY

L—PISTON

M—PIN, PISTON LINK

N—LINK, PISTON TO RACK

P—RACK, GEAR

Q—SCREW, HANDLE SHAFT COVER

R—COVER, HANDLE SHAFT

S—BEARING, HANDLE SHAFT

T—GASKET, HANDLE SHAFT COVER

U—NUT, CASTLE

V—PIN, COTTER

W—GEAR, PISTON RACK

X—WASHER, HANDLE SHAFT

Y—PIN, DOWEL

Z—HOUSING, GEAR

AA—SCREW, BODY

BB—GASKET, LOWER HOUSING COVER

CC—SCREW, LOWER HOUSING COVER

DD—COVER, LOWER HOUSING

EE—BEARING, NEEDLE, HANDLE SHAFT

FF—RETAINER, OIL

GG—KEY, WOODRUFF

HH—SCREW, GEAR SHAFT

JJ—SHAFT, GEAR

KK—PLUNGER, HANDLE LOCKING

LL—SPRING, PLUNGER

MM—CONDUIT

NN—NUT, KNURLED (INCLUDED IN WIRING HARNESS)

PP—ADAPTER, SHIELDING

QQ—HANDLE, CONTROL VALVE

RR—TRIGGER

SS—PIN, PLUNGER BLOCK

TT—BLOCK, PLUNGER

UU—SWITCH, SAFETY (INCLUDED IN WIRING HARNESS)

VV—SCREW, HANDLE PLATE

WW—WASHER, TRIGGER

XX—PLATE, HANDLE

YY—SWITCH, FIRING (INCLUDED IN WIRING HARNESS)

ZZ—ELBOW, PRESSURE TUBE

AB—ELBOW, EXHAUST TUBE

AC—NIPPLE

RA PD 14040A

Legend For Figure 44 — Control Valve — Disassembled

(2) INSTALL LOCKING PLUNGER (fig. 43).

PLIERS

Insert spring and plunger from the back through hole in handle. Push forward until plunger can be inserted through the fork in trigger. With plunger inserted through trigger, slip plunger block over end of plunger and line up holes in plunger and block. Insert plunger block pin through block and plunger. Press in with pliers.

(3) ATTACH GEAR SHAFT TO HANDLE (fig. 41).

HAMMER, light
SCREWDRIVER

Place gear shaft flange against handle with keyway slot up. Insert dowels if they have been removed. Line up screw holes in shaft flange with those in handle and tap flange against handle (light hammer). Insert the 4 flat-heat screws and tighten (screwdriver).

(4) INSTALL NEEDLE BEARING AND OIL RETAINER IN GEAR HOUSING (fig. 44).

PRESS, arbor
ROD, brass, 7/8-in., 3-in. or 4-in. long

Place needle bearing in recess in gear housing. Place 7/8-inch brass rod against bearing and press in from rear. Edge of bearing should be flush with edge of recess. Place oil retainer in recess on handle side of gear housing with manufacturer's name side in. Press in with arbor press as far as it will go.

(5) INSTALL HANDLE ON GEAR HOUSING (fig. 44).

PLIERS, long-nosed
SCREWDRIVER, heavy
WRENCH, socket, 3/4-in.

Insert gear shaft through oil retainer and needle bearing in gear housing. Place handle shaft washer over gear shaft. Insert Woodruff key in key slot in shaft and install piston rack gear on shaft, over key. Pry gear into place if necessary (heavy screwdriver) (fig. 40). Screw castle nut onto shaft. Tighten it down; then back it off enough to allow to turn freely (3/4-in. socket wrench). There should not be more than 1/64-inch end play in shaft. Secure castle nut with cotter pin (long-nosed pliers) (fig. 36).

(6) INSTALL HANDLE SHAFT COVER (fig. 36).

BRUSH, shellac
CLOTH, wiping
SHELLAC
SOLVENT, dry-cleaning
WRENCH, socket-head set screw, 3/16-in.

Clean off old shellac from sealing surfaces of gear housing and cover (SOLVENT, dry-cleaning, and CLOTH, wiping). Spread light coat of shellac on a new bearing cover gasket (shellac and brush). Install gasket

and place cover in position with name side down. Line up screw holes in cover with those in gear housing. Insert the 4 socket-head screws and tighten ($\frac{3}{16}$-in. socket-head set screw wrench).

(7) ASSEMBLE PISTONS AND RACKS (fig. 44).

HAMMER, light

Insert one link in slot in piston. Narrower end of link goes in rack. Insert smaller end of link pin in larger hole in piston and tap pin into place through piston and link. Insert other end of link into slot in end of piston gear rack. Insert smaller end of link pin into larger hole in rack and tap into place. Note that pins must be driven into piston and rack from opposite directions (light hammer). Repeat the foregoing procedure with the other piston and rack. CAUTION: Be sure pins are driven in all the way to prevent pistons from binding.

(8) INSTALL PISTON ASSEMBLIES IN GEAR HOUSING (fig. 39).

VISE

Place gear housing in vise in upright position, with handle free to turn. Select piston that was removed from left liner. Turn valve handle clockwise in a little more than 90 degrees from vertical. Engage bottom teeth of left rack with gear at left side and turn handle back to vertical. Turn valve handle counterclockwise slightly more than 90 degrees from vertical and engage bottom teeth of right rack with gear. When handle is turned back to vertical position, both racks should extend equally about ½ inch above top finished surface of gear housing. If top ends of racks do not line up, remove and reinstall.

(9) INSTALL LOWER HOUSING COVER ON GEAR HOUSING (fig. 33).

BRUSH, shellac
CLOTH, wiping
SOLVENT, dry-cleaning
WRENCH, socket-head set screw, $\frac{3}{16}$-in.

Clean off old shellac from surface of lower cover and gear housing (SOLVENT, dry-cleaning, and CLOTH, wiping). Spread thin coat of shellac on new gasket and install (shellac and brush). Place lower housing cover on gear housing, install 4 socket-head screws and tighten ($\frac{3}{16}$-in. socket-head set screw wrench).

(10) ASSEMBLE GEAR HOUSING AND VALVE BODY (fig. 38).

BRUSH, shellac
CLOTH, wiping
SHELLAC
SOLVENT, dry-cleaning
VISE with soft jaws
WRENCH, socket-head set screw, $\frac{5}{16}$-in.

Clamp valve body in vise, bottom side up. Clean off old shellac from sealing surfaces of gear housing and valve body (SOLVENT, dry-clean-

ing, and CLOTH, wiping). Apply a thin coating of shellac to a new gasket and install in place on machined surface of valve body (shellac and brush). Place dowel pins in their holes. Insert pistons into liners and place gear housing against valve body. Install the 4 socket-head screws and tighten ($\frac{5}{16}$-in. socket-head set screw wrench).

(11) INSTALL PISTON SPRING CAPS (fig. 37).

SCREWDRIVER, wide

Lay piston spring cap gaskets in their recesses. Place piston return springs over the studs on inside of piston spring caps. Insert springs into pistons and screw caps down until they seat firmly on the gaskets (wide screwdriver).

(12) INSTALL RELIEF VALVE ASSEMBLY (fig. 35).

SCREWDRIVER, wide WRENCH, open-end, 1-in.

Drop relief valve ball into relief valve hole. Lay relief valve nut gasket in its recess. Insert relief spring into relief valve sleeve and screw sleeve into place in valve body (wide screwdriver). Sleeve should be screwed in until 3 threads show above valve body. If the complete traversing mechanism is not to be installed and placed in service immediately, install acorn nut over sleeve (1-in. open-end wrench). If the complete mechanism is to be installed and placed in service at once, do not install acorn nut until pressure adjustment has been made (par. 40).

(13) INSTALL CONDUIT CLIP (fig. 36).

SCREWDRIVER

Place conduit clip over conduit and install clip on back of control valve body.

39. INSTALLATION OF CONTROL VALVE.

a. Equipment.

WRENCH, box, $\frac{7}{16}$-in. WRENCH, open-end, $\frac{15}{16}$-in.
WRENCH, box, $\frac{9}{16}$-in. WRENCH, open-end, 1-in.
WRENCH, open-end, $\frac{7}{8}$-in. WRENCH, small pipe

b. Procedure.

(1) INSTALL PRESSURE AND EXHAUST TUBE ELBOWS (fig. 33).

WRENCH, open-end, $\frac{15}{16}$-in. WRENCH, small pipe

Insert nipples into ports in valve body and tighten (small pipe wrench). Install elbows on nipples ($\frac{15}{16}$-in. open-end wrench).

(2) INSTALL CONTROL VALVE ON TURRET (figs. 33 and 34).

WRENCH, box, $\frac{9}{16}$-in.

Install control valve attaching bracket on valve body with 4 cap screws and lock washers ($\frac{9}{16}$-in. box wrench). Install attaching bracket on turret. Install and tighten 2 lower, shorter cap screws with plain washers and lock washers ($\frac{9}{16}$-in. box wrench) (fig. 33). Install and tighten upper right longer cap screw with plain washer and lock washer ($\frac{9}{16}$-in. box wrench). Install upper left cap screw and lock washer over tube strap and tighten with fingers.

(3) INSTALL CLIPS AND STRAP.

WRENCH, box, $\frac{7}{16}$-in. WRENCH, box, $\frac{9}{16}$-in.

Install lower clip that holds breather tube, hydraulic motor drain tube and conduit. Tighten the 2 cap screws and lock washers ($\frac{7}{16}$-in. box wrench). Install clip that holds control valve pressure pipe with 2 cap screws and lock washers ($\frac{7}{16}$-in. box wrench). Place reservoir breather tube, conduit, and motor drain tube under tube strap that is held by upper left valve bracket cap screw and lock washer. Tighten cap screw ($\frac{9}{16}$-in. box wrench).

(4) INSTALL PRESSURE AND EXHAUST TUBES ON ELBOWS (fig. 34).

WRENCH, open-end, $\frac{7}{8}$-in. WRENCH, open-end, $1\frac{5}{16}$-in.

Install pressure and exhaust tubes on elbows ($1\frac{5}{16}$-in. open-end wrench). Tighten lock nuts ($\frac{7}{8}$-in. open-end wrench). The shorter tube is the pressure tube and connects with the lower port. The exhaust tube is the longer one and connects with the upper port.

(5) INSTALL HYDRAULIC MOTOR HOSES (fig. 1).

WRENCH, open-end, $\frac{7}{8}$-in. WRENCH, open-end, 1-in.

Install the 2 connectors in the ports in top of valve body ($\frac{7}{8}$-in. open-end wrench) (fig. 34). Connect the longer hydraulic motor hose (fig. 80) to rear outlet of the hydraulic motor and to the front or right port of the valve (1-in. open-end wrench). Then connect the shorter hose to the front outlet of the motor and to the rear or left port of the valve (1-in. open-end wrench). NOTE: These 2 hoses cross when correctly installed.

(6) INSTALL PRESSURE AND EXHAUST HOSES ON TUBES (figs. 34 and 80).

WRENCH, open-end, $\frac{7}{8}$-in. WRENCH, open-end, 1-in.
WRENCH, open-end, $1\frac{5}{16}$-in.
(2)

Install pressure hose from hydraulic pump to pressure tube of control valve (1-in. open-end wrench on hose, and $1\frac{5}{16}$-in. open-end wrench on

coupling nut). Tighten lock nut (7/8-in. open-end wrench). Install exhaust hose from reservoir to exhaust tube on control valve (1 5/16-in. open-end wrench on hose, and 1 5/16-in. open-end wrench on coupling nut) (fig. 1). Tighten lock nut (7/8-in. open-end wrench).

40. ADJUST RELIEF VALVE.

NOTE: With the complete traversing mechanism installed, adjustment of hydraulic pressure throughout the system is made by adjusting the relief valve in the top of the control valve.

a. Equipment.

GAGE, pressure (500 to 1,000 lb per sq in.)
SCREWDRIVER
WRENCH, adjustable
WRENCH, open-end, 1-in.

b. Procedure.

(1) Lock the turret to prevent its turning. This is done by turning the small wheel of the turret lock, located on the turret to the right of the control valve.

(2) Connect the pressure gage in the line between the hydraulic pump and the control valve (adjustable wrench). Then close the switch on the top of the junction box, starting the mechanism.

(3) With the acorn nut on top of the control valve removed (1-in. open-end wrench), turn the valve handle as far as it will go in either direction. Then, with a screwdriver, turn the relief valve sleeve until the gage reads 600 pounds per square inch. This is the maximum pressure at which the system should operate. CAUTION: Do not operate at a period of more than 15 minutes when setting the relief valve, as the motor is running at 100 percent overload and is designed to stand this for only 15 minutes at a pressure of 600 pounds per square inch.

(4) Allow the valve handle to return to vertical position. Install the gasket and acorn nut on the top of the relief valve (1-in. open-end wrench), and recheck pressure. Remove the pressure gage and reinstall the pressure hose from the hydraulic pump to the valve. Unlock turret. NOTE: When properly installed, the traversing mechanism should rotate the turret at the rate of 3 revolutions per minute or one complete revolution every 20 seconds.

Section IX

HYDRAULIC MOTOR

	Paragraph
Description	41
Trouble shooting	42
Removing hydraulic motor from traversing gear assembly	43
Disassembling hydraulic motor	44
Maintenance and repair of hydraulic motor	45
Assembling hydraulic motor	46
Installing hydraulic motor	47
Fits and tolerances	48

41. DESCRIPTION.

a. The hydraulic motor (HTM-1.7-IF, Gerotor) is a motor which operates on oil pressure. It rotates in either direction, depending upon which of 2 inlet ports supplies the oil under pressure. Its working mechanism consists of 2 gears called gerotors, 1 working eccentrically inside the other within an oiltight pocket between the body and head of the motor. Either of the 2 ports cast into the body of the motor may serve as inlet or pressure port, the alternate one allowing the oil to flow off at approximately atmospheric pressure.

b. The outer gerotor has 7 internal teeth, and the inner gerotor has 6 external teeth. These 2 gerotors are so designed that, when assembled, there are always 6 points of contact between the teeth. Between these 6 points of contact are 6 spaces or "chambers," 3 on each side of a center line which marks the division between the 2 sides of the motor, either side being the pressure side, the opposite one being the exhaust side, when the motor is in operation.

c. As oil under pressure enters the chambers on one side of the motor, the pressure causes these chambers to increase in size. This, in turn, causes the gerotors to rotate; as the gerotors rotate, the chambers pass the center line of the motor and the oil passes off through the exhaust port. The rotation of the inner gerotor is transmitted through the motor shaft to the traversing gear mechanism which rotates the turret.

d. In principle, the hydraulic pump and hydraulic motor are the same. The difference is that in the pump, the rotation of the shaft pumps the oil out under pressure; in the motor, the incoming pressure of the oil causes rotation of the shaft (par. 4 c and par. 12).

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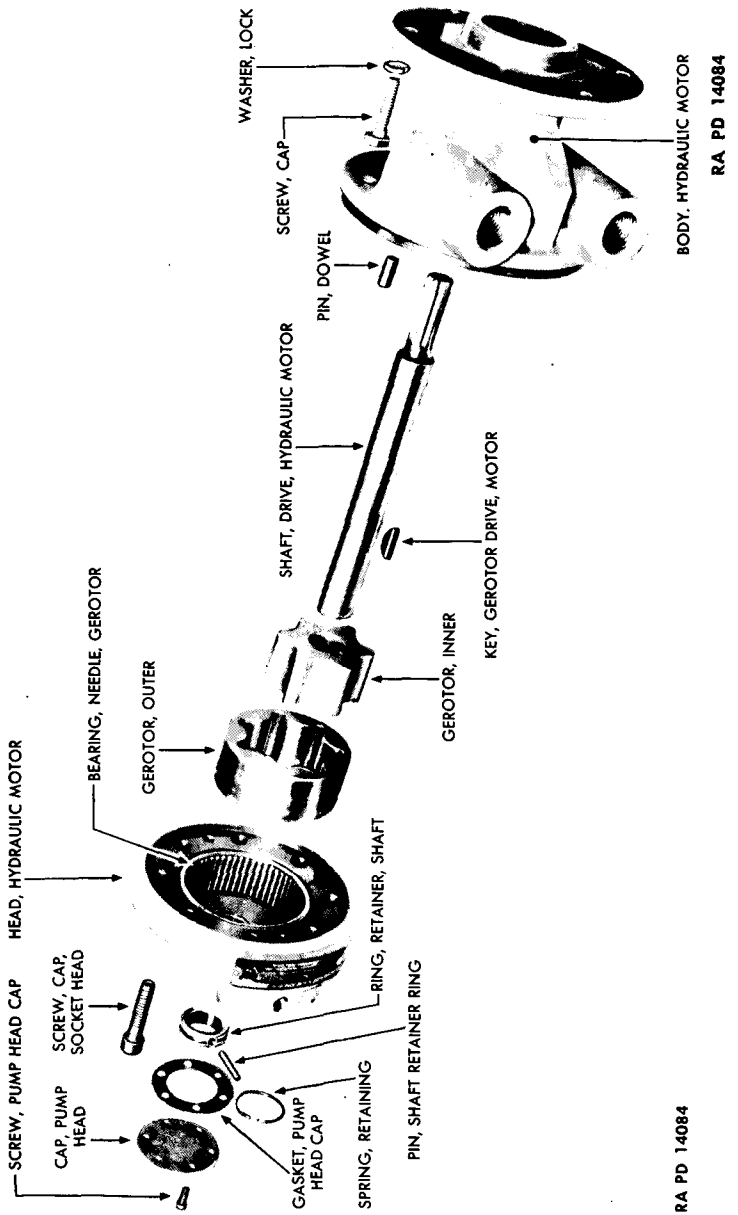

Figure 45 — Hydraulic Motor — Partially Disassembled

HYDRAULIC MOTOR

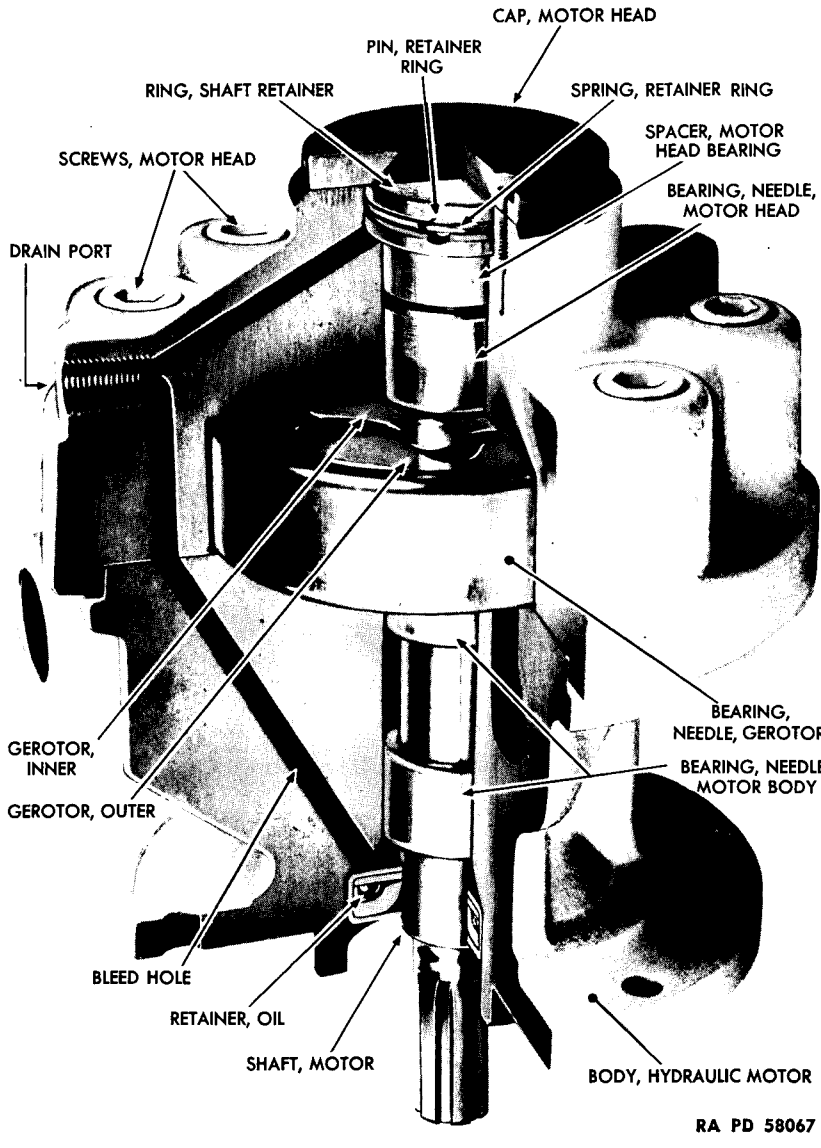

Figure 46 — Cutaway View of Hydraulic Motor

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

42. TROUBLE SHOOTING.

a. Failure To Start.

Probable Cause	Probable Remedy
Foreign particles between teeth of gerotors or in race of needle bearings.	Disassemble motor, clean all parts thoroughly and reassemble (pars. 44, 45, and 46).
Cocked needles in needle bearings.	Disassemble motor and realine needles with a scribe. If this is not possible, replace faulty bearings (pars. 44, 45, and 46).
Excessive shaft wear at the bearings.	Disassemble motor and replace shaft. Also replace shaft bearings if they are excessively worn (pars. 44, 45, and 46).
Scoring of outside edge of outer gerotor.	Replace both gerotors. Inspect needle bearing and replace if it is badly worn or does not work smoothly (pars. 44, 45, and 46).
Sheared motor gerotor key.	Disassemble motor and replace drive key and any other parts that may have been damaged (pars. 44, 45, and 46).

b. Insufficient Speed.

Badly scored part due to dirty oil.	Disassemble motor and replace any scored parts (pars. 44, 45, and 46). Flush reservoir and refill with clean oil (par. 32).
Normal wear of working parts.	Disassemble and check for worn gerotors or worn gerotor pocket in motor head (pars. 44, 45, and 46). Replace worn parts.
Foreign particles between gerotor teeth or between gerotors and pocket.	Disassemble motor (par. 44). Clean all parts thoroughly and reassemble (par. 46).

c. Oil Leakage At Oil Retainer.

Scratched or damaged retainer.	Replace oil retainer (pars. 44, 45, and 46).

HYDRAULIC MOTOR

Probable Cause	Probable Remedy
Retainer may have blown because of a stoppage in the drain circuit.	Remove and disassemble motor (pars. 43 and 44). Inspect drain holes in head and body castings. Be sure the drain pipe from motor to reservoir is clear. Replace oil retainer. Assemble motor (par. 46).

43. REMOVING HYDRAULIC MOTOR FROM TRAVERSING GEAR ASSEMBLY.

a. Equipment.

WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{5}{8}$-in.
WRENCH, open-end, 1-in.

b. Procedure.

(1) REMOVE MOTOR HOSES.

WRENCH, open-end, 1-in.

Remove the long and short hoses that lead from hydraulic motor to control valve, having first disconnected hoses from control valve (par. 35 b (2)).

(2) DISCONNECT DRAIN.

WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{5}{8}$-in.

Using 2 wrenches, disconnect the couplings that hold motor drain tube to hydraulic motor.

(3) REMOVE MOTOR FROM TRAVERSING GEAR MECHANISM.

WRENCH, open-end, $\frac{7}{16}$-in.

Remove 4 cap screws and lock washers that hold motor to motor adapter plate on traversing gear cover. Lift off motor.

44. DISASSEMBLING HYDRAULIC MOTOR.

a. Disassembly of the hydraulic motor follows procedure similar to disassembly of the hydraulic pump (par. 15). It will be noted that the outer gerotor of the motor rotates in a needle bearing and that the shaft rotates in needle bearings instead of bronze bushings as in the hydraulic pump. These needle bearings should not be removed unless they are to be replaced with new ones (par. 45 b (5), (6), and (7)).

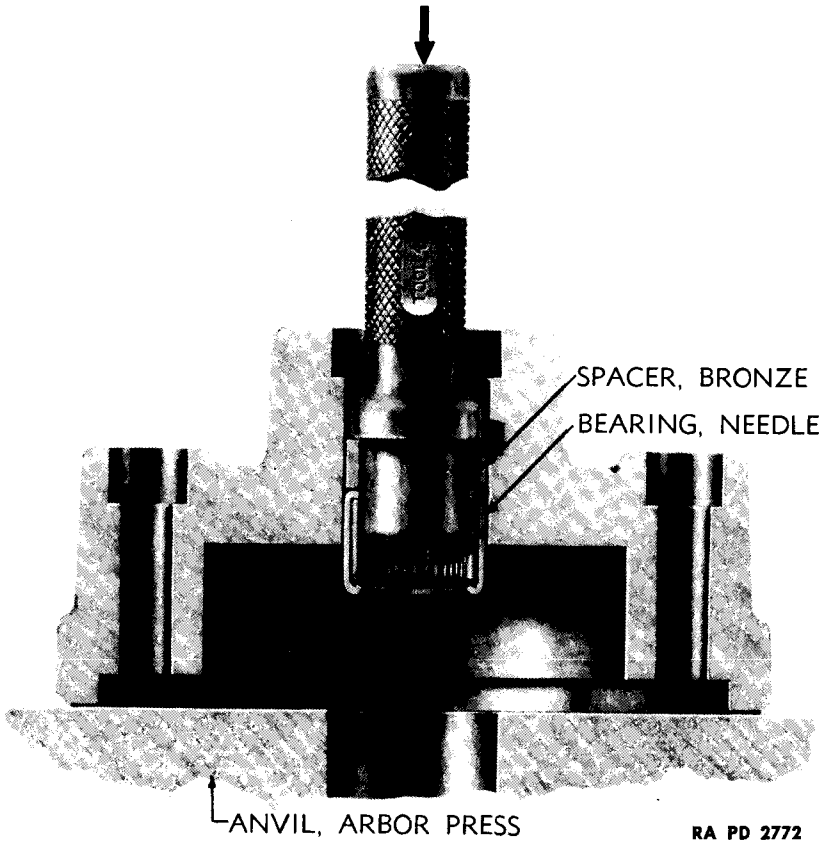

Figure 47—Removing Shaft Needle Bearing And Spacer From Motor Head

45. MAINTENANCE AND REPAIR OF HYDRAULIC MOTOR.

a. Equipment.

CHISEL, cold
CLOTH, wiping
HAMMER
MICROMETER, set
PLIERS
PRESS, arbor
SOLVENT, dry-cleaning
TOOL, GR2 (par. 68)
TOOL, GR3 (par. 68)
TOOL, GR4 (par. 68)
TOOL, GR5 (par. 68)
TOOL, GR6 (par. 68)
TOOL, GR7 (par. 68)
TOOL, GR8 (par. 68)
TOOL, GR9 (par. 68)

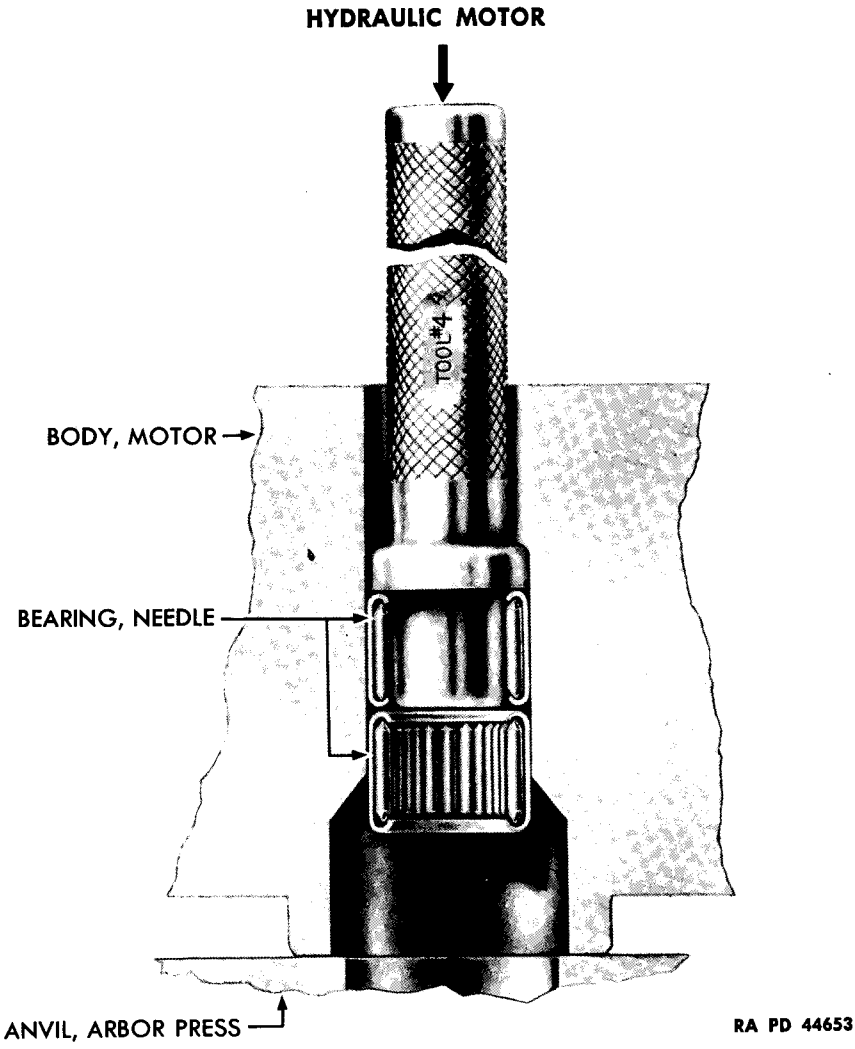

Figure 48 — Removal Of Shaft Needle Bearing From Motor Body

b. Procedure.

(1) VISUAL INSPECTION.

CLOTH, wiping SOLVENT, dry-cleaning

Clean all parts in SOLVENT, dry-cleaning, and dry thoroughly. Inspect surfaces of inner and outer gerotors and wearing surfaces of body and head for nicks and scoring. Deep scoring is evidence of foreign matter in the oil; deeply scored parts should be replaced.

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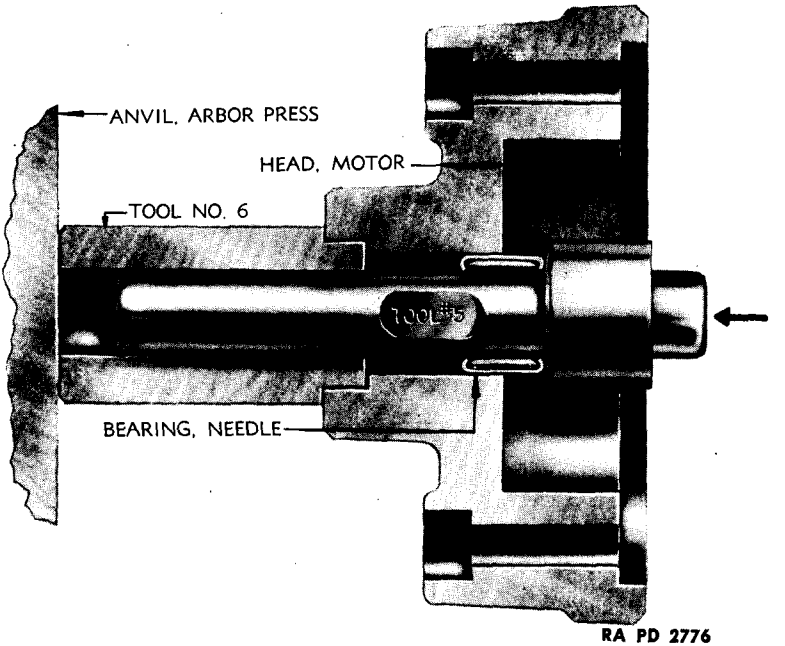

Figure 49 — Installing Shaft Needle Bearing In Motor Head

(2) MEASURE GEROTORS FOR EVIDENCE OF WEAR.

See paragraph 16 **b** for procedure.

(3) MEASURE GEROTOR END CLEARANCE.

See paragraph 16 **b** for procedure.

(4) MEASURE DEPTH OF GEROTOR POCKET.

MICROMETER, depth, 0- to 1-in.

The manufactured depth of the gerotor pocket is between 0.9999 inch to 1.0003 inches. The motor head will be replaced in accordance with paragraph 16 **b** (5).

(5) INSPECT SHAFT BEARINGS.

Try shaft in motor body and motor head. If there is any side play in the shaft, it indicates worn bearings. If rotation of shaft is uneven or if it binds in spots, it is an indication of a warped bearing or cocked needles. In either case, bearing or bearings should be replaced.

(6) REPLACE SHAFT BEARINGS IN MOTOR HEAD.

PRESS, arbor	TOOL, GR5 (par. 68)
TOOL, GR4 (par. 68)	TOOL, GR6 (par. 68)

Insert pilot of tool GR4 into spacer (fig. 47) and press out spacer and

HYDRAULIC MOTOR

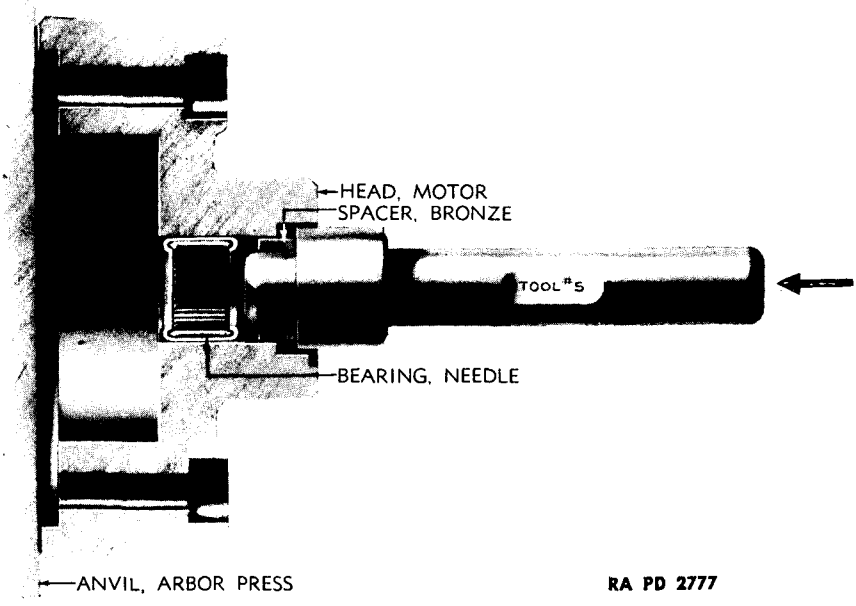

Figure 50 — Installing Bronze Spacer In Motor Head

bearing (arbor press). Insert smaller end of tool GR6 in retainer collar end of head (fig. 49) and hold head upright with gerotor pocket up. Insert longer pilot of tool GR5 through bearing, into bearing bore, and into bore of tool GR6. Press bearing in head (arbor press). Insert short pilot of tool GR5 through spacer (fig. 50). Press spacer into bore of head from retainer ring pocket end (arbor press).

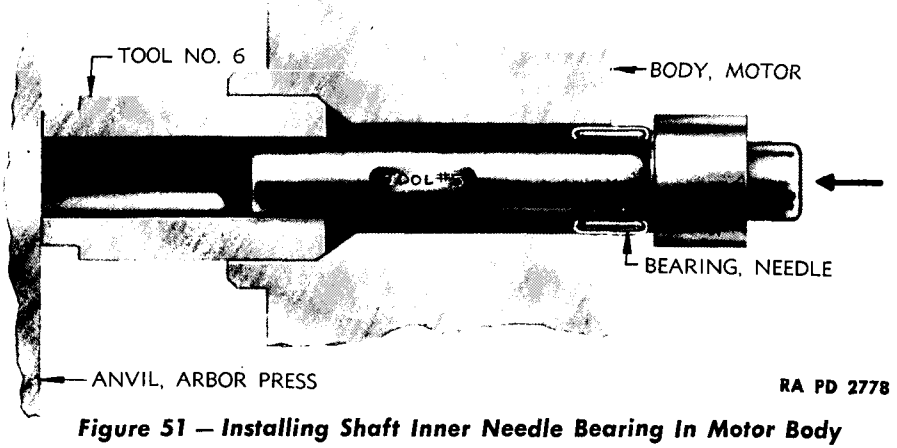

Figure 51 — Installing Shaft Inner Needle Bearing In Motor Body

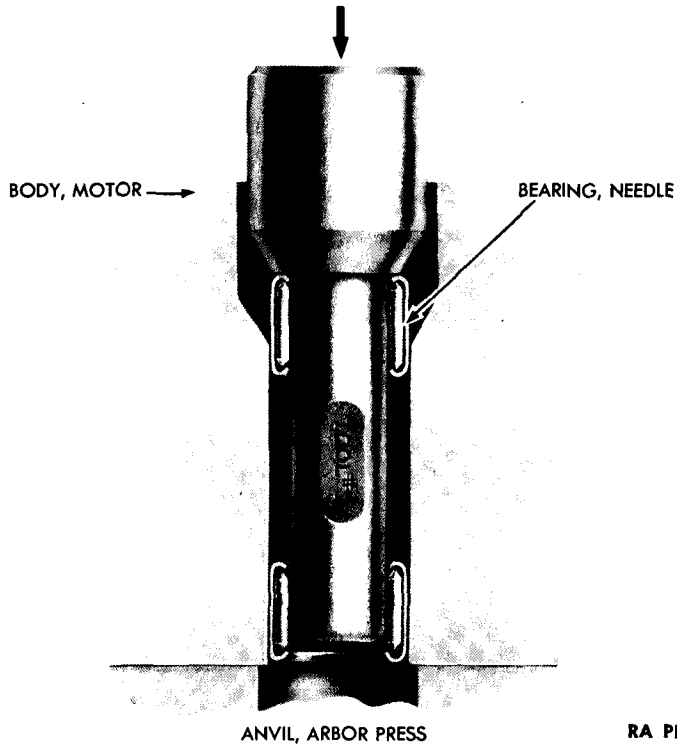

Figure 52 — Installing Shaft Outer Needle Bearing In Motor Body

(7) REPLACE SHAFT BEARINGS IN MOTOR BODY.

PRESS, arbor
TOOL, GR4 (par. 68)
TOOL, GR5 (par. 68)
TOOL, GR6 (par. 68)
TOOL, GR7 (par. 68)

Insert pilot of tool GR4 into bearing (fig. 48) and press bearing out of body (arbor press). Insert larger end of tool GR6 in larger bore of motor body. Insert longer pilot of tool GR5 through bearing, into bearing bore, and into bore of tool GR6 (fig. 51). Press bearing in body (arbor press). Set motor body upright with larger bore up. Insert tool GR7 through bearing (fig. 52), and press bearing in body (arbor press).

(8) REPLACE GEROTOR BEARING (fig. 53).

CHISEL, cold
HAMMER
PLIERS
TOOL, GR8 (par. 68)
TOOL, GR9 (par. 68)

Gerotor bearing cannot be removed without destroying it. To remove, cut bearing race with cold chisel and hammer, and pull out with pliers.

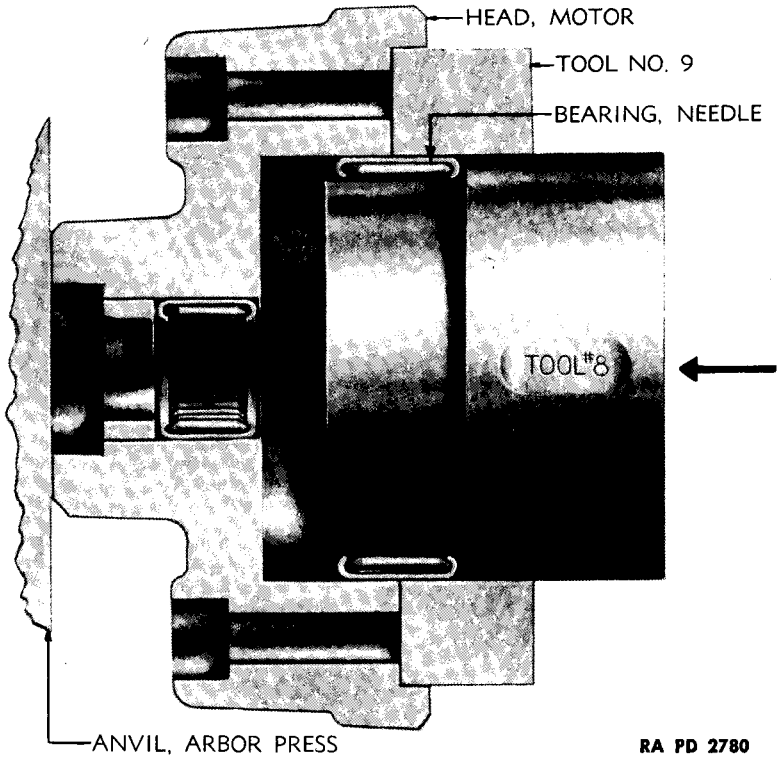

Figure 53 — Installing Gerotor Needle Bearing In Motor Head

To install, place motor head upright, with gerotor pocket up. Place tool GR9 in recess of head. Insert small end of tool GR8 through gerotor bearing and press bearing through tool GR9 and into gerotor pocket in motor head (arbor press).

(9) REPLACE OIL RETAINER (fig. 54).

HAMMER	TOOL, GR2 (par. 68)
PRESS, arbor	TOOL, GR3 (par. 68)

Remove defective oil retainer by inserting curved end of tool GR2 in retainer and driving out with hammer. To install, start new retainer into bore with leather curving inward. Place smaller end of tool GR3 against retainer and press retainer in body (arbor press).

46. ASSEMBLING HYDRAULIC MOTOR (fig. 45).

a. Assembly of the hydraulic motor follows a procedure similar to the assembly of the hydraulic pump described in paragraph 17.

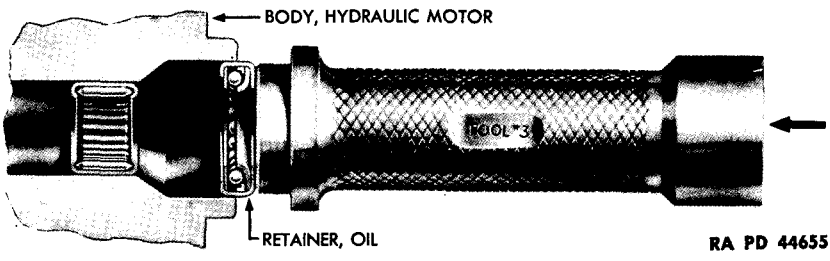

Figure 54 — Installing Oil Retainer In Hydraulic Motor Body

47. INSTALLING HYDRAULIC MOTOR.

a. Equipment.

BRAKE, prony
GAGE, pressure (500 lb per sq in.)
TACHOMETER
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{5}{8}$-in.

b. Procedure.

(1) INSTALL MOTOR.

WRENCH, open-end, $\frac{7}{16}$-in.

Place motor in position on motor adapter plate on top of gear mechanism cover with ports of the motor turned to the right, or toward the handwheel extension. Install 4 cap screws and lock washers, and tighten ($\frac{7}{16}$-in. open-end wrench).

(2) INSTALL DRAIN TUBE.

WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, $\frac{5}{8}$-in.

Using both wrenches, connect the coupling that holds the drain tube to the motor.

(3) INSTALL MOTOR HOSES.

See paragraph 39 b (5) for procedure.

c. Test.

BRAKE, prony
GAGE, pressure (500 lb per sq in.)
TACHOMETER

Supply a pressure of 400 pounds per square inch to the motor. The pump must deliver at least 5 foot-pounds of torque, and the motor shaft

must rotate at not less than 513 revolutions per minute. If these conditions are not met, disassemble, clean, and inspect the rotating parts.

48. FITS AND TOLERANCES.

a. The following are the manufactured dimensions of the working parts of the hydraulic motor:

	Dimensions	Limits
Width of outer gerotor (inside measurement)	0.9987 in.	Plus 0.0000 in. Minus 0.0002 in.
Inner gerotor width (outside measurement)	0.9982 in.	Plus 0.0000 in. Minus 0.0002 in.
Gerotor pocket depth in head	1.0001 in.	Plus 0.0002 in. Minus 0.0002 in.

b. The following are hydraulic motor gerotor clearances:

End clearance of outer gerotor with gerotor pocket	0.0012 in. to 0.0018 in.
End clearance of inner gerotor with gerotor pocket	0.0017 in. to 0.0023 in.
Gerotor tooth clearance	0.002 in. maximum

(1) If end clearance of outer gerotor exceeds 0.0025 inch, if end clearance of inner gerotor exceeds 0.003 inch, or if tooth clearance exceeds 0.003 inch, gerotors must be replaced unless the excessive end clearance is found to be caused by wear in gerotor pocket in head. In this case, head should be replaced.

ORDNANCE MAINTENANCE – HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

Section X

TRAVERSING GEAR MECHANISM

	Paragraph
Description	49
Removal from turret	50
Remove subassemblies from case	51
Disassemble brake mechanism assembly	52
Disassemble handwheel extension assembly	53
Disassemble motor adapter plate assembly	54
Disassemble case assembly	55
Repair	56
Assemble case assembly	57
Assemble motor adapter plate assembly	58
Assemble handwheel extension assembly	59
Install oil retainer in brake drum (fig. 65)	60
Assemble brake mechanism assembly	61
Assemble subassemblies with case	62
Install traversing gear mechanism in turret	63

49. DESCRIPTION.

a. Rotation of the turret is accomplished through gear trains (D47419) to a pinion that meshes with the large stationary internal gear fastened to the hull of the tank. Operation of the mechanism causes turret to rotate around the stationary gear on a ball bearing. In hydraulic operation the gear train is driven by the splined shaft of the hydraulic motor through two pairs of spur gears. Manual operation is by means of a handwheel; manual drive is through two pairs of bevel gears and one pair of spur gears. A shift lever serves to select the drive desired, hydraulic or manual.

b. Manual drive assembly includes a brake mechanism to hold the turret in position. In manual operation the brake is automatically held in engagement by two springs. It is released for traversing the turret manually by squeezing the grip lever on the manual drive handle.

50. REMOVAL FROM TURRET.

a. **Equipment.**

HAMMER
PIN, drift
PLIERS
WRENCH, box, ¾-in.
WRENCH, socket, ⅞-in.

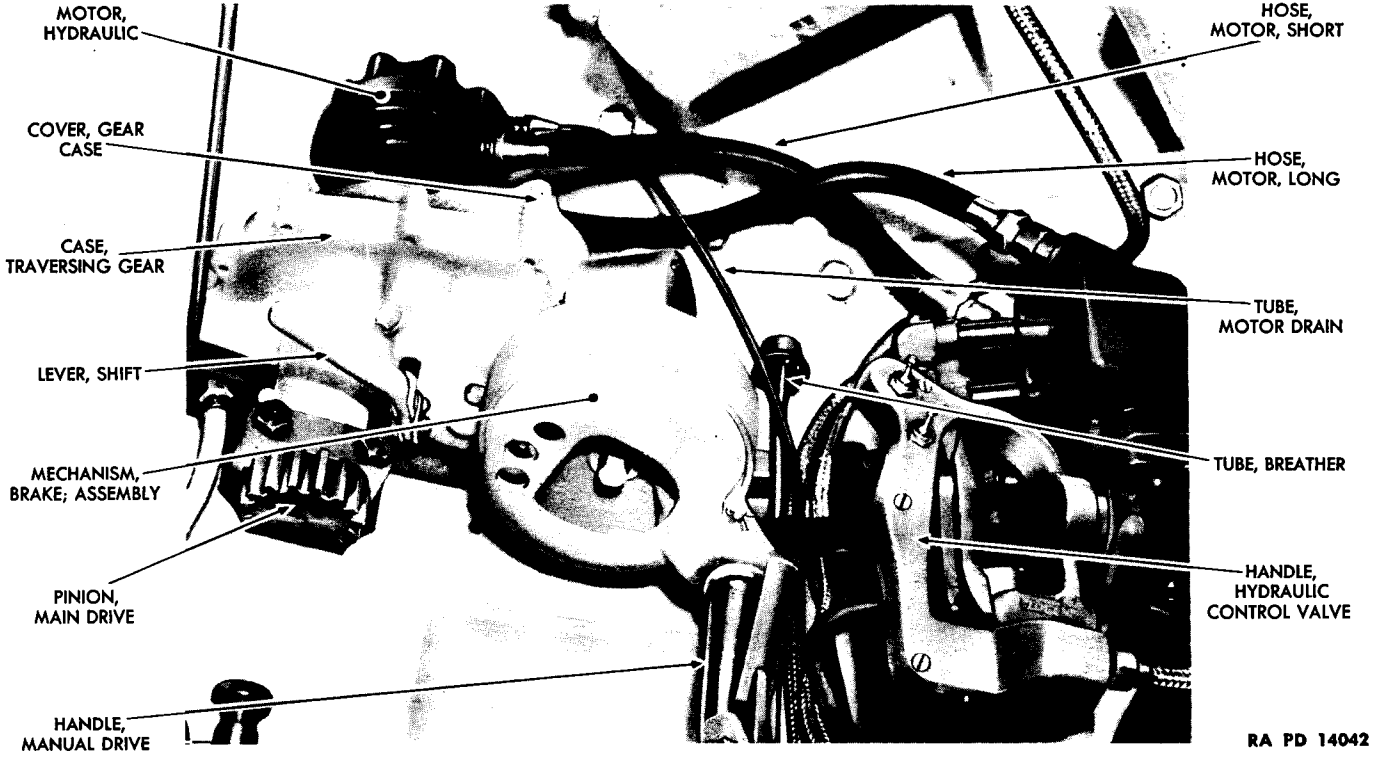

Figure 55 — Traversing Gear Mechanism Installed

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

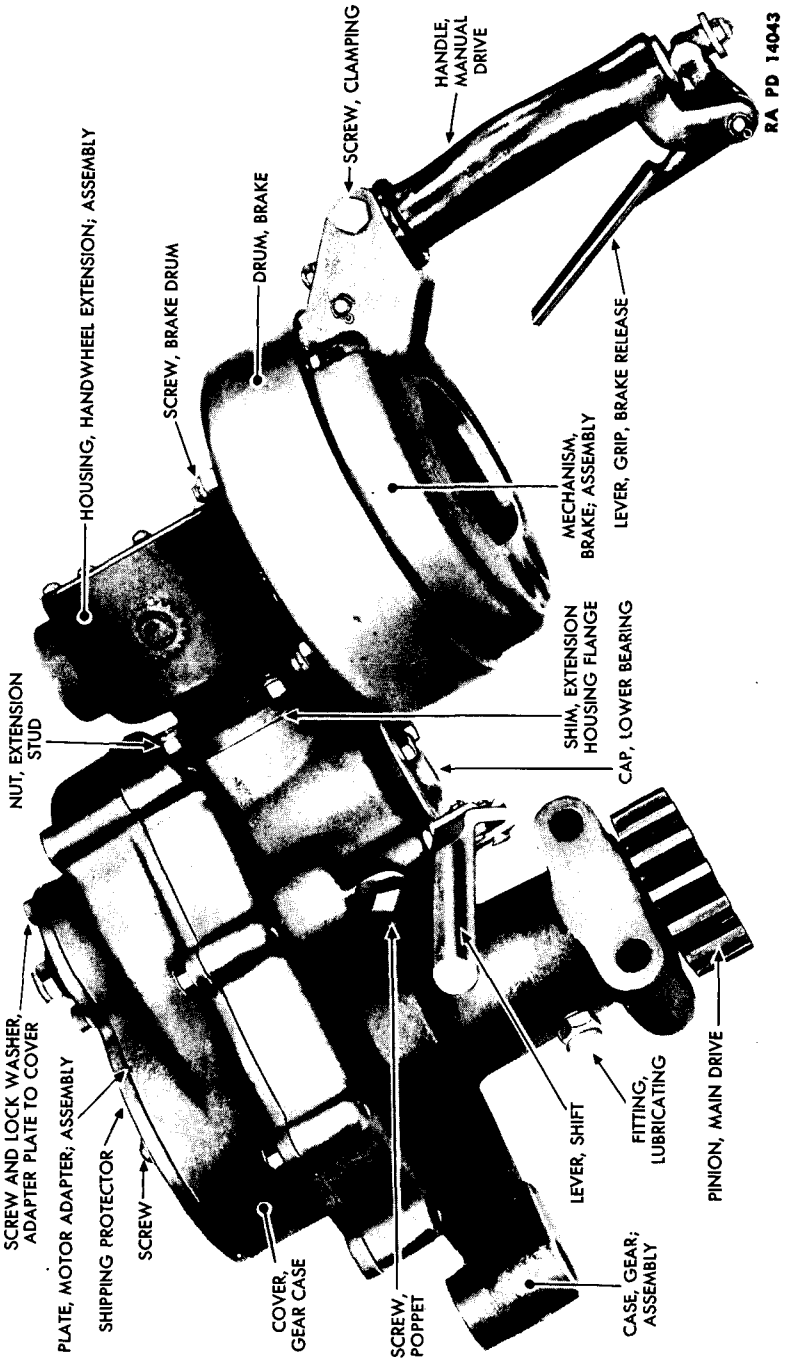

Figure 56 — Traversing Gear Mechanism

TRAVERSING GEAR MECHANISM

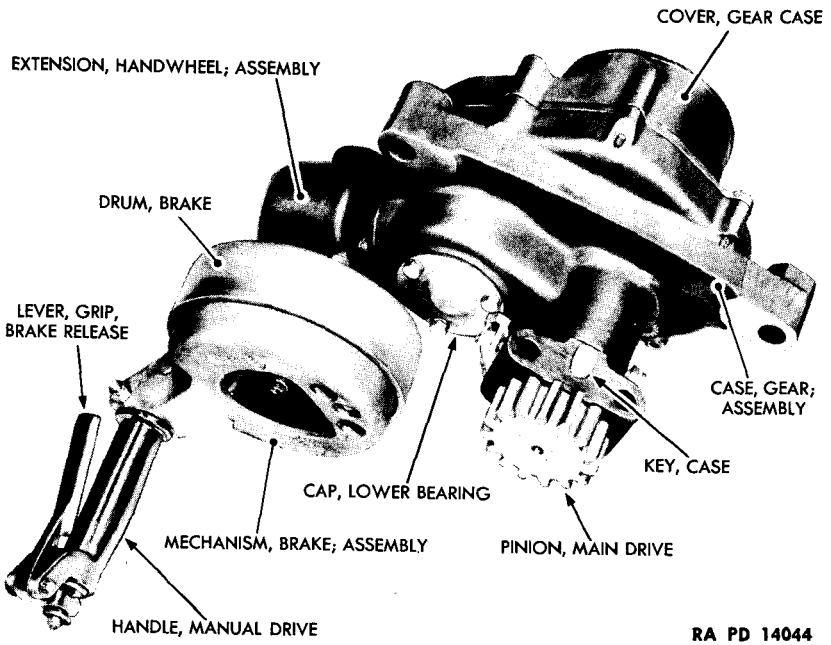

Figure 57 — Traversing Gear Mechanism

b. Procedure.

(1) REMOVE HYDRAULIC MOTOR FROM TRAVERSING GEAR MECHANISM.

See paragraph 43 for procedure.

(2) REMOVE TRAVERSING GEAR MECHANISM FROM TURRET.

HAMMER	PUNCH, drive
PIN, drift	WRENCH, box, 3/4-in.
PLIERS	WRENCH, socket, 7/8-in.

Remove locking wires from 2 lower cap screws that hold mechanism to turret (pliers). Remove lower cap screws and lock washers (3/4-in. box wrench). Remove the 2 upper cap screws (7/8-in. socket wrench). Lift off entire assembly, being careful not to lose case key (fig. 57). NOTE: Right upper screw is very close to the case and may have to be removed with drift pin and hammer.

ORDNANCE MAINTENANCE – HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

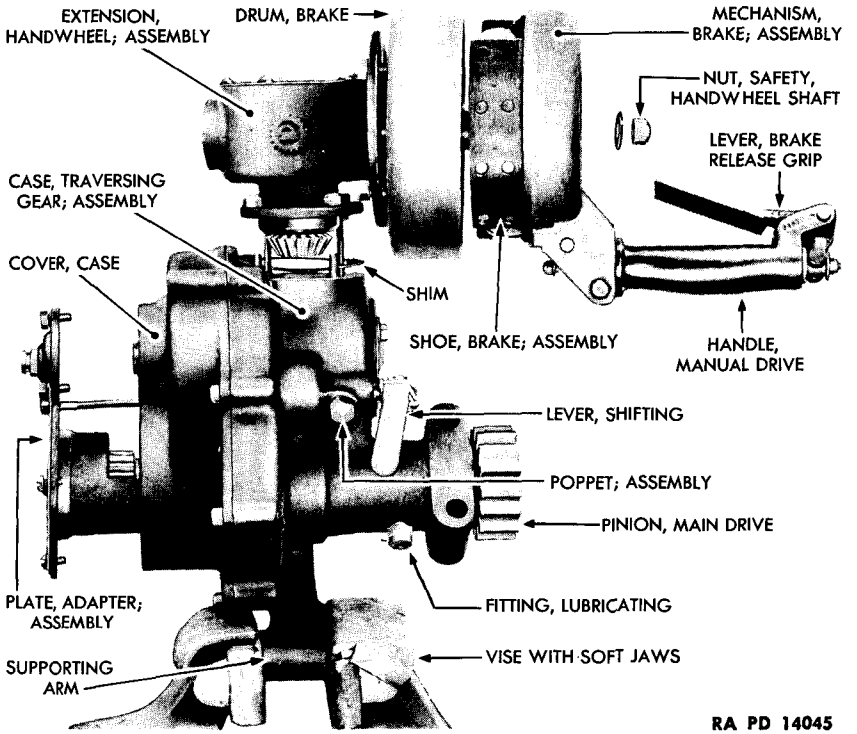

Figure 58 – Traversing Gear Mechanism Subassemblies

51. REMOVE SUBASSEMBLIES FROM CASE (fig. 58).

a. Equipment.

SCREWDRIVER
VISE with soft jaws
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{1}{2}$-in.
WRENCH, socket, $\frac{5}{8}$-in.

b. Procedure.

(1) REMOVE BRAKE MECHANISM ASSEMBLY (fig. 58).

VISE with soft jaws
WRENCH, socket, $\frac{5}{8}$-in.

Clamp traversing gear mechanism assembly in a vise with soft jaws, lengthwise of hole in supporting arm. Remove brake mechanism assembly by taking off handwheel shaft nut and washer, then squeezing the grip lever and pulling the brake mechanism assembly off the shaft ($\frac{5}{8}$-in. socket wrench).

TRAVERSING GEAR MECHANISM

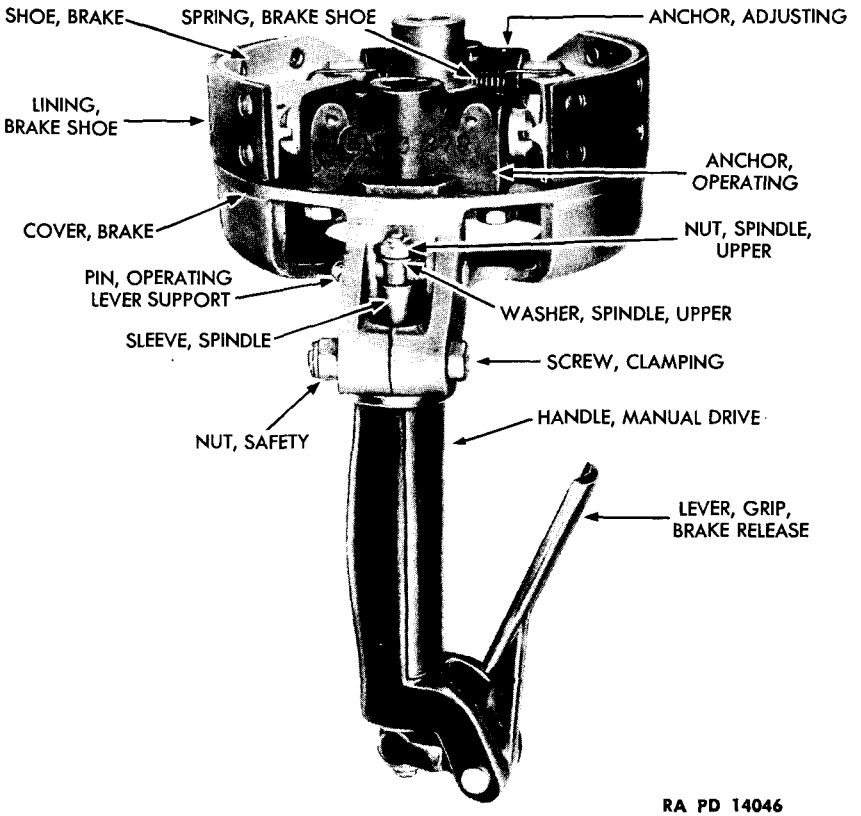

Figure 59 — Side View of Brake Mechanism Assembly

(2) REMOVE THE BRAKE DRUM.

SCREWDRIVER WRENCH, open-end, ½-in.

Holding safety nuts with wrench, remove 4 screws (screwdriver). Take off drum.

(3) REMOVE HANDWHEEL EXTENSION ASSEMBLY.

WRENCH, open-end, $\frac{7}{16}$-in.

Remove 4 nuts from studs ($\frac{7}{16}$-in. open-end wrench), and lift off assembly, being careful not to injure gear teeth. Remove shims and tag for identification.

(4) REMOVE ADAPTER PLATE ASSEMBLY.

WRENCH, open-end, $\frac{7}{16}$-in.

Remove cap screws and lock washers that hold adapter plate assembly to gear case cover ($\frac{7}{16}$-in. open-end wrench). Take care to protect bearings from dirt. Remove case assembly from vise.

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

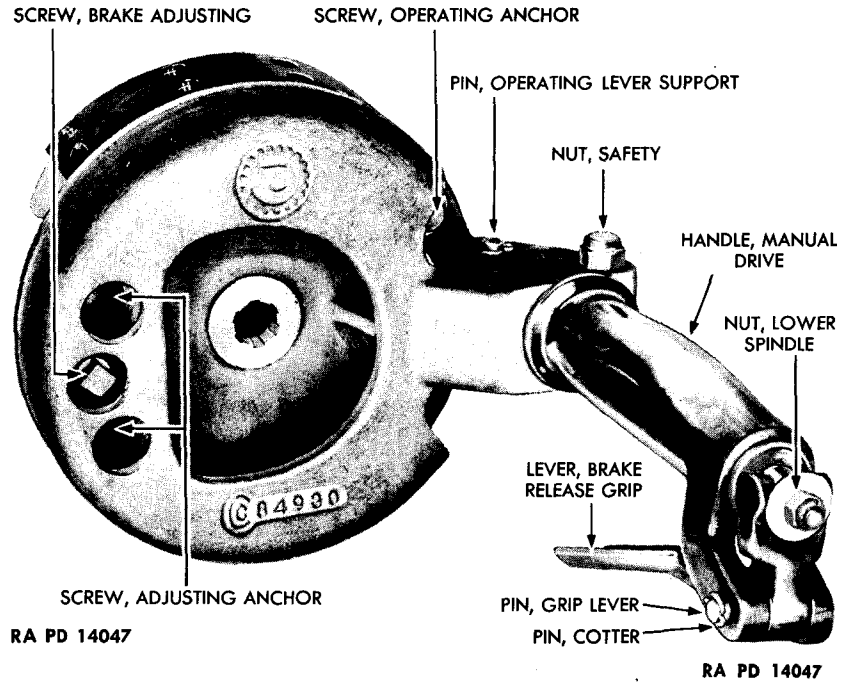

Figure 60 — Bottom View Of Brake Mechanism Assembly

52. DISASSEMBLE BRAKE MECHANISM ASSEMBLY (figs. 59 and 60).

a. Equipment.

CHISEL, cold
HAMMER
PLIERS
PUNCH, $\frac{5}{32}$-in.
PUNCH, $^{15}/_{64}$-in.
VISE with soft jaws
WRENCH, box, $\frac{3}{8}$-in. (2)
WRENCH, box, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{5}{16}$-in.
WRENCH, open-end, ½-in.(2)
WRENCH, socket, ½-in.

b. Procedure.

(1) REMOVE BRAKE SHOES AND SPRINGS (fig. 61).

Pull the end of one brake shoe out of slot in adjusting plunger and move it to the center of brake cover to lessen spring tension. Remove end of the other shoe in the same way. Remove the brake shoe spring nearer the adjusting anchor. Remove the other ends of the shoes from slots in operating plungers, and remove the other spring in the same way. Remove shoes.

TRAVERSING GEAR MECHANISM

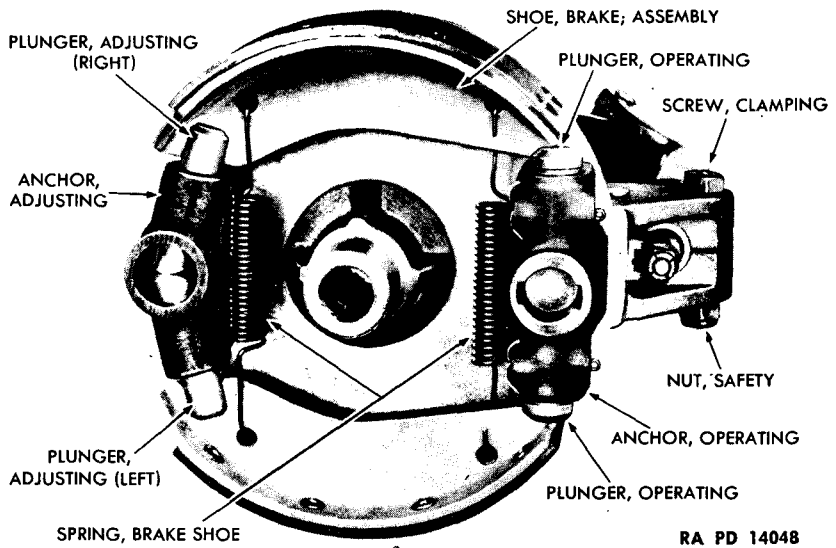

Figure 61 — Top View of Brake Mechanism Assembly

(2) REMOVE BRAKE LINING FROM SHOE (fig. 62).

CHISEL, cold
HAMMER
PUNCH, $\frac{5}{32}$-in.

Cut off upset ends of 8 rivets on inside of shoe with cold chisel and hammer. Drive out rivets with punch and remove lining.

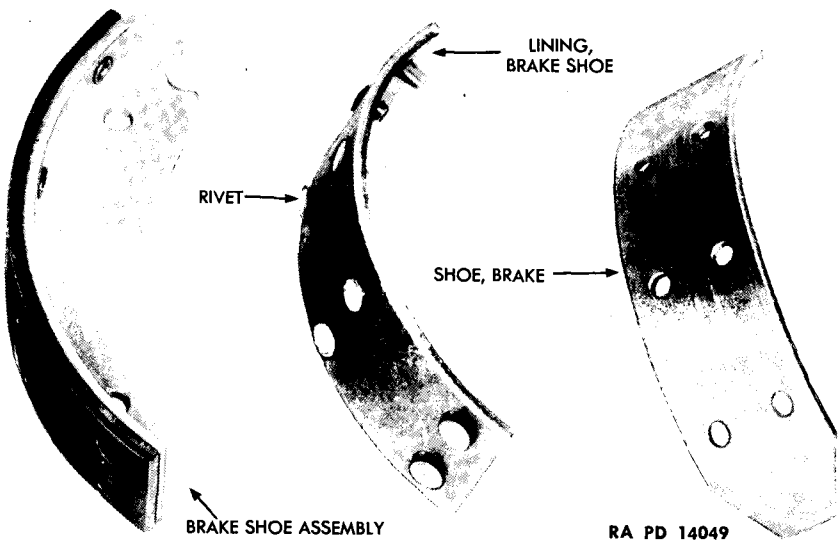

Figure 62 — Brake Shoe Assembly

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

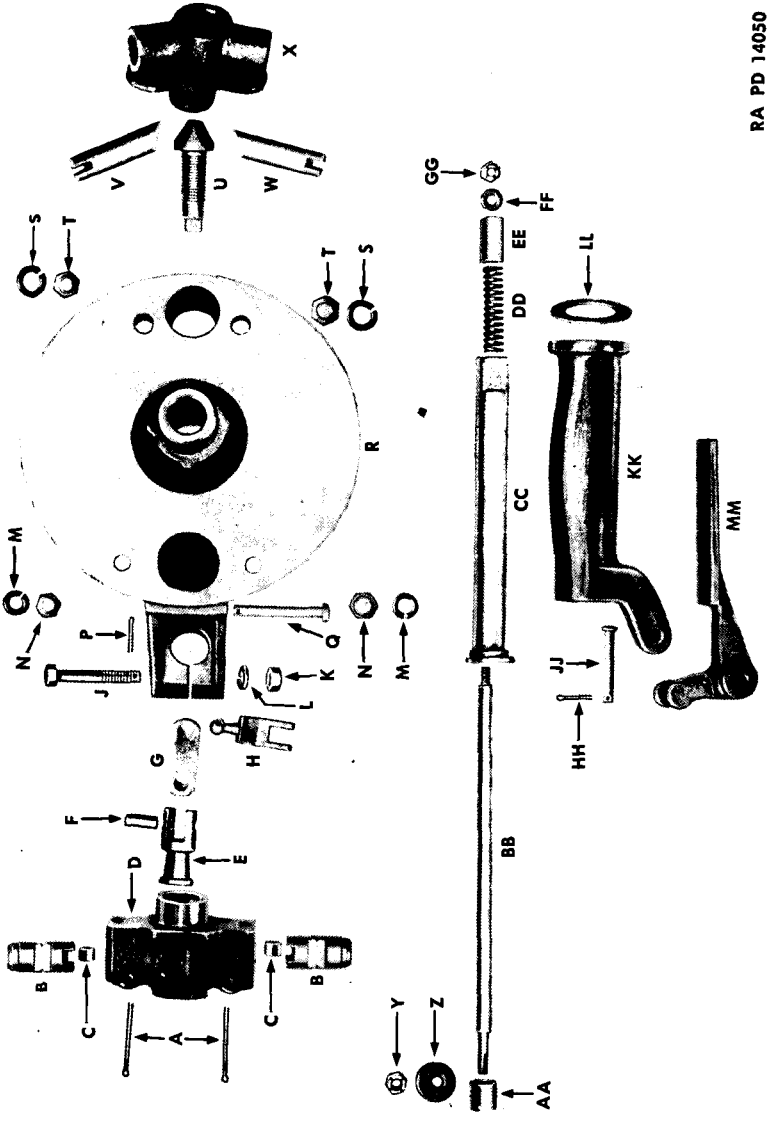

Figure 63 — Brake Mechanism Assembly — Disassembled

A—PIN, COTTER, PLUNGER RETAINING
B—PLUNGER, OPERATING
C—ROLLER, OPERATING
D—ANCHOR, OPERATING
E—SPREADER, OPERATING
F—PIN, OPERATING SPREADER
G—LINK, LEVER TO SPREADER
H—LEVER, BRAKE OPERATING
J—SCREW, CLAMPING
K—NUT, SAFETY
L—WASHER, LOCK
M—WASHER, LOCK
N—SCREW, OPERATING ANCHOR
P—PIN, COTTER
Q—PIN, OPERATING LEVER SUPPORT
R—COVER, BRAKE
S—WASHER, LOCK
T—SCREW, ADJUSTING ANCHOR
U—SCREW, BRAKE ADJUSTING
V—PLUNGER, ADJUSTING (LEFT)
W—PLUNGER, ADJUSTING (RIGHT)
X—ANCHOR, ADJUSTING
Y—NUT, LOWER SPINDLE
Z—WASHER, GRIP LEVER
AA—COLLAR, HANDLE SLEEVE
BB—SPINDLE, GRIP LEVER
CC—SLEEVE, BRAKE HANDLE
DD—SPRING, OPERATING LEVER
EE—SLEEVE, SPINDLE
FF—WASHER, SPINDLE, UPPER
GG—NUT, SPINDLE, UPPER
HH—PIN, COTTER
JJ—PIN, GRIP LEVER
KK—HANDLE, MANUAL DRIVE
LL—SHIM, HANDLE
MM—LEVER, GRIP, BRAKE RELEASE

RA PD 14050A

Legend For Figure 63 — Brake Mechanism Assembly — Disassembled

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

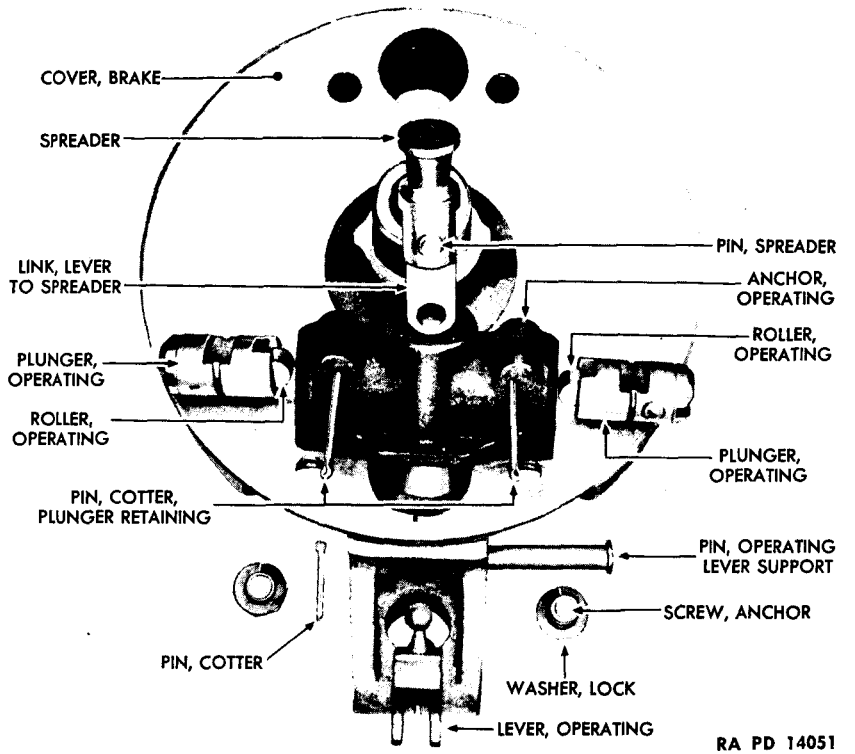

Figure 64 — Brake Operating Anchor Assembly

(3) REMOVE ADJUSTING PLUNGERS. Pull plungers out of brake adjusting anchor (fig. 61).

(4) REMOVE BRAKE ADJUSTING ANCHOR AND BRAKE ADJUSTING SCREW (fig. 63).

WRENCH, open-end, $\frac{5}{16}$-in. WRENCH, socket, ½-in.

Remove 2 adjusting anchor screws and lock washers from under side of brake cover (½-in. socket wrench). Lift off adjusting anchor. Screw brake adjusting screw (U, fig. 63) out of anchor ($\frac{5}{16}$-in. open-end wrench).

(5) REMOVE BRAKE RELEASE GRIP LEVER (MM, fig. 63).

PLIERS

Take out cotter pin from grip lever pin (pliers). Remove grip lever pin and brake release grip lever.

(6) REMOVE GRIP LEVER SPINDLE (BB, fig. 63).

VISE, with soft jaws WRENCH, box, ⅜-in. (2)

Using a wrench at each end of the spindle, remove upper spindle nut

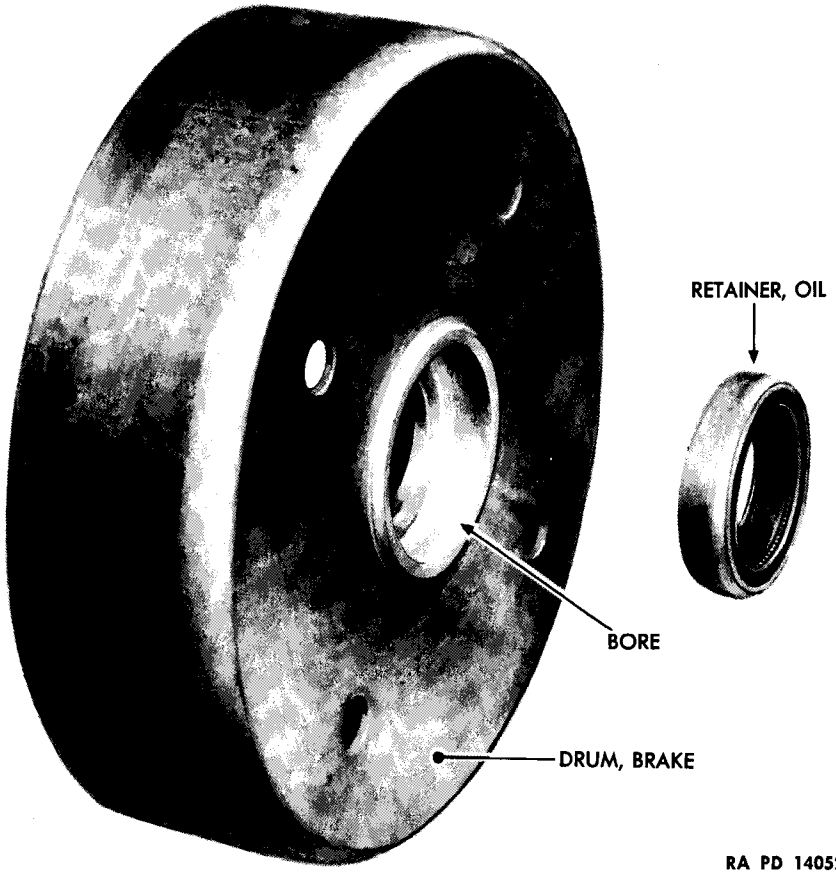

Figure 65 — Brake Drum And Oil Retainer

and washer. Slide spindle downward out of handle. Clamp spindle in vise and remove lower nut, washer and handle sleeve collar.

(7) REMOVE MANUAL DRIVE HANDLE, SLEEVES AND SPRING (fig. 63).

VISE with soft jaws WRENCH, open-end, ½-in. (2)

Clamp brake cover in vise; using two wrenches, remove safety nut and washer from clamping screw (J, K, L, fig. 63). Push brake handle sleeve toward brake cover against the spring pressure, and remove clamping screw (½-in. open-end wrench) (fig. 63). Remove manual drive handle and separate handle, handle sleeve, operating lever, spring, shim and spindle sleeve.

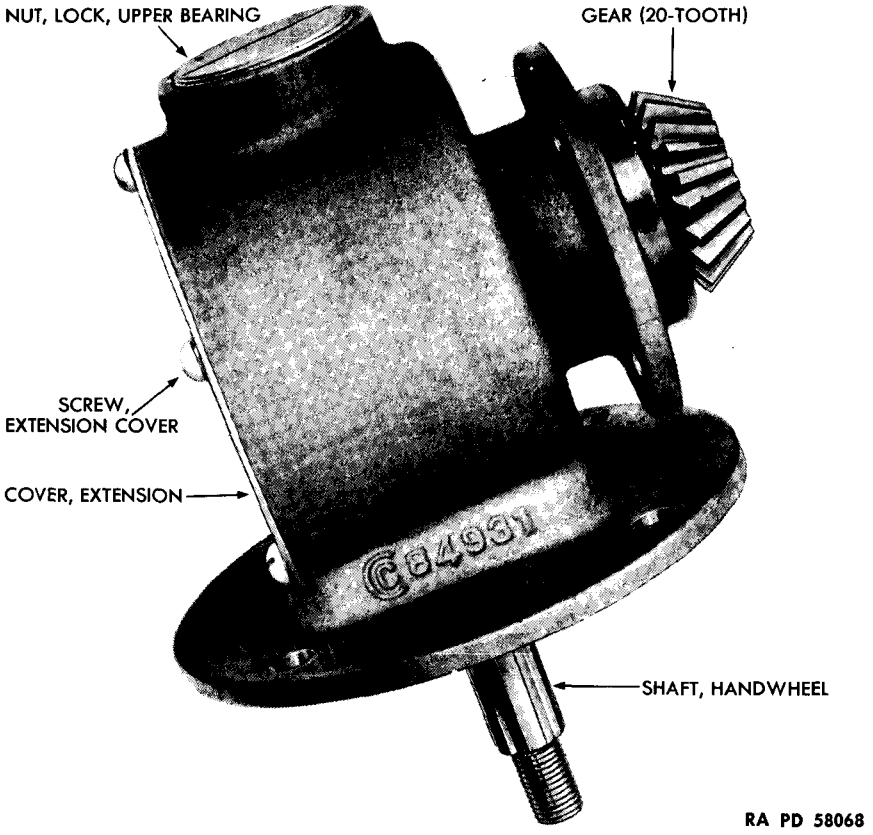

Figure 66 — Handwheel Extension Assembly

(8) REMOVE BRAKE OPERATING LEVER AND ANCHOR (fig. 64).

PLIERS WRENCH, box, $\frac{7}{16}$-in.

Remove cotter pin from operating lever support pin (pliers) (fig. 64). Remove support pin and push out operating lever. Remove 2 operating anchor screws and lock washers that hold operating anchor to brake cover ($\frac{7}{16}$-in. box wrench). Remove anchor.

(9) REMOVE OPERATING PLUNGERS, ROLLERS, SPREADER AND LINK (figs. 63 and 64).

PLIERS PUNCH, $^{15}/_{64}$-in.

Remove 2 plunger retaining cotter pins from anchor (fig. 64). Remove operating plungers and operating rollers. Remove spreader and link assembly. With punch, drive link pin out of operating spreader and remove the lever to spreader link.

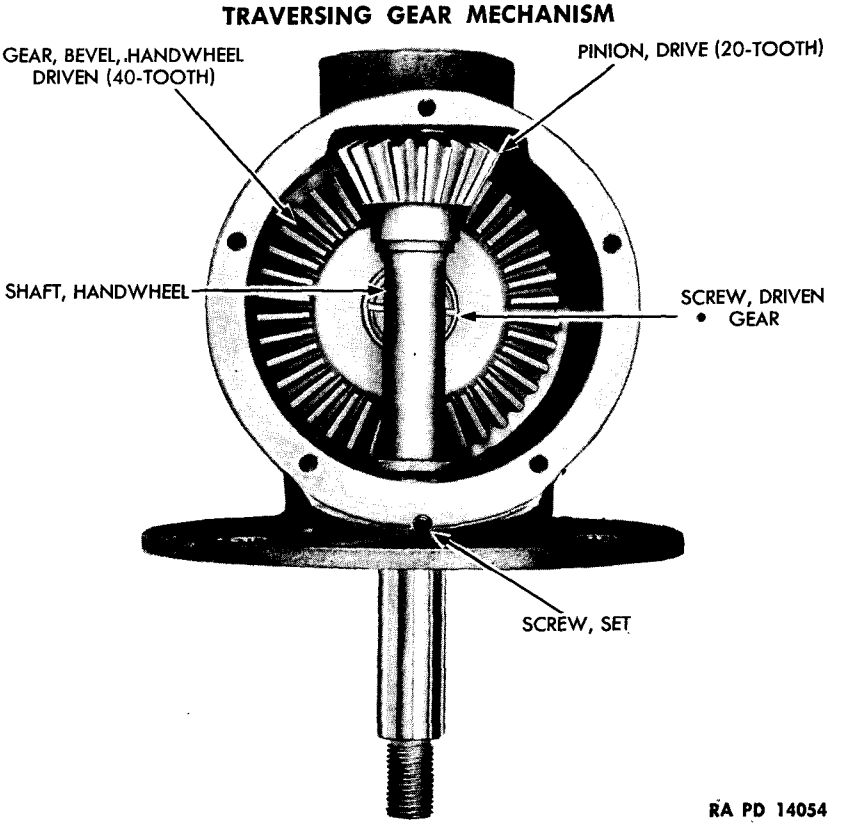

Figure 67 — Handwheel Extension Assembly With Cover Removed

(10) REMOVE OIL RETAINER FROM BRAKE DRUM. NOTE: Do not attempt to remove the oil retainer unless it is defective. It will be destroyed in removal and must be replaced with a new one. If found defective, drive oil retainer out of the hub of brake drum with cold chisel or punch (fig. 65).

53. DISASSEMBLE HANDWHEEL EXTENSION ASSEMBLY (fig. 66).

a. Equipment.

BLOCK, wood, with 1½-in. hole
DRIFT, copper or brass, ½-in.
HAMMER
PRESS, arbor
PULLER, bearing
SCREWDRIVER
SCREWDRIVER, wide
STEEL, flat, $^{11}/_{64}$- x $1\frac{7}{32}$- x 3-in.
WRENCH, adjustable, 8-in.
WRENCH, adjustable face spanner, with pins 0.110-0.120 in. diam, 0.110-0.120 in. long
WRENCH, adjustable face spanner, with pins 0.085-0.090 in. diam, 0.110-0.120 in. long
WRENCH, socket-head set screw, $\frac{3}{32}$-in.

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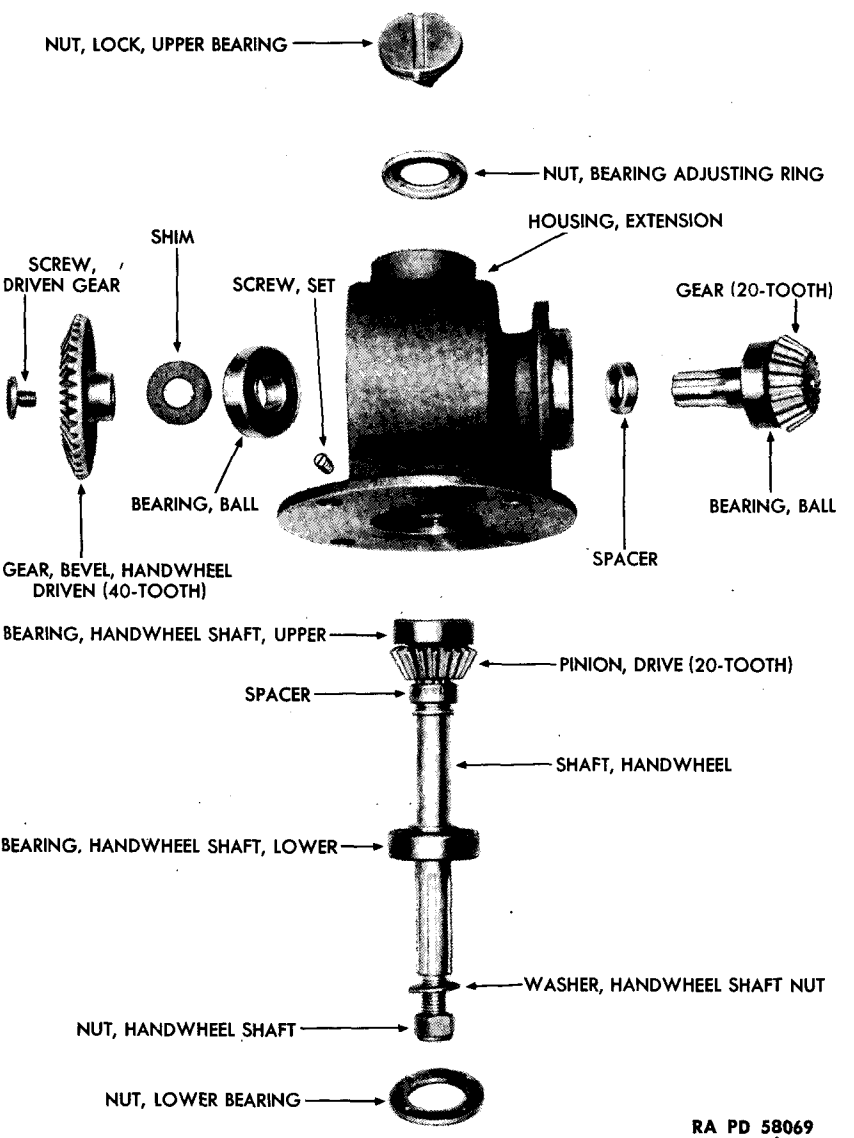


Figure 68 – Handwheel Extension – Partially Disassembled

TRAVERSING GEAR MECHANISM

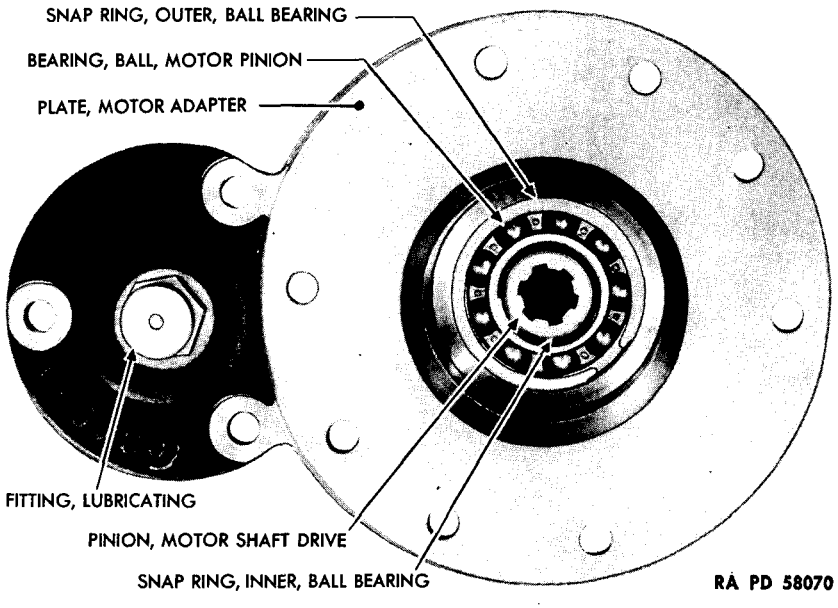


Figure 69 — Motor Adapter Plate Assembly — Top View

b. Procedure.

(1) REMOVE EXTENSION COVER.

SCREWDRIVER

Remove the 5 screws and lock washers and lift off cover.

(2) REMOVE SET SCREW FROM EXTENSION (fig. 67).

WRENCH, socket-head set screw, $\frac{3}{32}$-in.

Remove set screw that holds lower bearing lock nut.

(3) REMOVE LOWER BEARING LOCK NUT (fig. 68).

STEEL, flat, $^{11}/_{64}$- x $1\frac{7}{32}$- x 3-in.

WRENCH, adjustable, 8-in.

WRENCH, adjustable face spanner, with pins 0.110-0.120 in. diam, 0.110-0.120 in. long

Remove slotted upper bearing lock nut with piece of flat steel and adjustable wrench. Remove lower bearing lock nut with adjustable face spanner wrench.

(4) REMOVE BEARING ADJUSTING RING NUT (fig. 68).

WRENCH, adjustable face spanner, with pins 0.085-0.090 in. diam, 0.110-0.120 in. long

Unscrew and remove upper bearing adjusting ring nut.

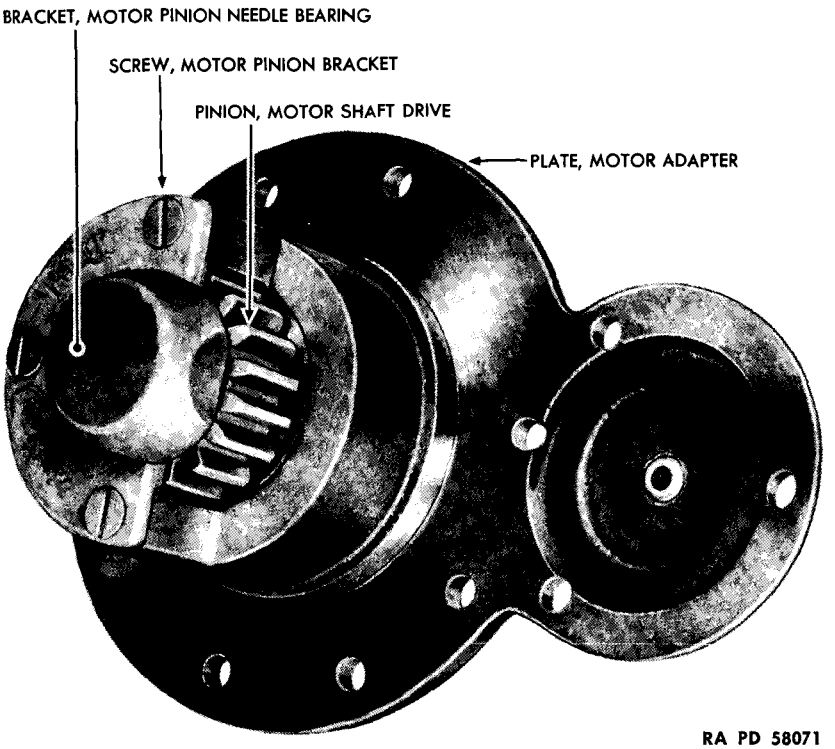


Figure 70 — Motor Adapter Plate Assembly — Bottom View

(5) REMOVE HANDWHEEL SHAFT.

DRIFT, copper or brass, ½-in. HAMMER

Drive the shaft downward out of upper handwheel shaft bearing (copper or brass drift, hammer). This also drives the lower bearing out of the housing. The shaft can now be pulled entirely out of the housing by tipping it so that the drive pinion can pass the handwheel driven bevel gear.

(6) REMOVE UPPER HANDWHEEL SHAFT BEARING FROM HOUSING.

PRESS, arbor

Use any piece of wood or metal so that bearing can be pressed out from lower side.

(7) REMOVE DRIVE PINION AND SPACER FROM SHAFT (fig. 68).

Pull off with fingers.

TRAVERSING GEAR MECHANISM

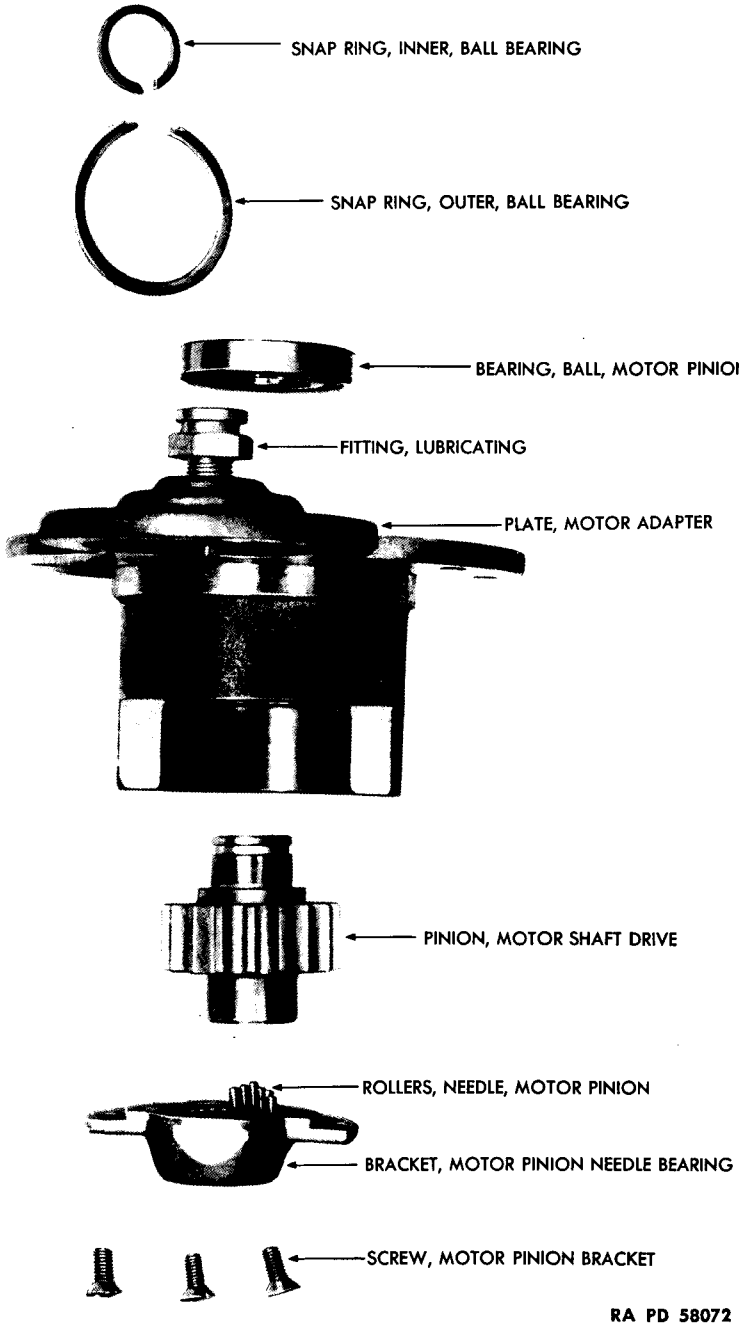


Figure 71 — Motor Adapter Plate Assembly — Disassembled

(8) REMOVE LOWER HANDWHEEL SHAFT BEARING FROM SHAFT.

PRESS, arbor

Press the handwheel shaft bearing off the splined end of shaft.

(9) REMOVE GEARS, BEARINGS, SHIMS AND SPACER FROM HOUSING (fig. 68).

BLOCK, wood with 1½-in. hole
DRIFT, copper or brass, ½-in.
HAMMER
PULLER, bearing
SCREWDRIVER, wide

Rest housing on wood block with gear (20-tooth) in hole. Remove screw from center of driven bevel gear (40-tooth) (wide screwdriver). Remove shaft (with ball bearing and spacer) by driving the shaft out of the bore (copper or brass drift, hammer). Push out bearing that remains in housing. Remove spacer from shaft. Remove bearing from shaft (bearing puller).

54. DISASSEMBLE MOTOR ADAPTER PLATE ASSEMBLY (figs. 69 and 70).

a. Equipment.

BLOCK, wood or metal, 1 5/16-in. diam, 3½-in. long
PLIERS, spreading
PRESS, arbor
SCREWDRIVER
WRENCH, open-end, ⅝-in.

b. Procedure.

(1) REMOVE LUBRICATING FITTING (fig. 69).

WRENCH, open-end, ⅝-in.

Unscrew and remove lubricating fitting from top of motor adapter plate.

(2) REMOVE SNAP RING FROM PINION (fig. 71).

PLIERS, spreading (par. 68)

Remove the snap ring from top of motor shaft drive pinion (spreading pliers).

(3) REMOVE NEEDLEBEARING BRACKET (fig. 71).

SCREWDRIVER

Remove the 3 screws from motor pinion needle bearing bracket (screwdriver) and lift off bracket, being careful not to lose any of the 28 needles.

(4) REMOVE MOTOR SHAFT DRIVE PINION.

Push pinion out by hand.

(5) REMOVE MOTOR PINION BALL BEARING (fig. 69).

BLOCK, wood or metal, 1 5/16-in. diam, 3½-in. long
PRESS, arbor
SCREWDRIVER

TRAVERSING GEAR MECHANISM

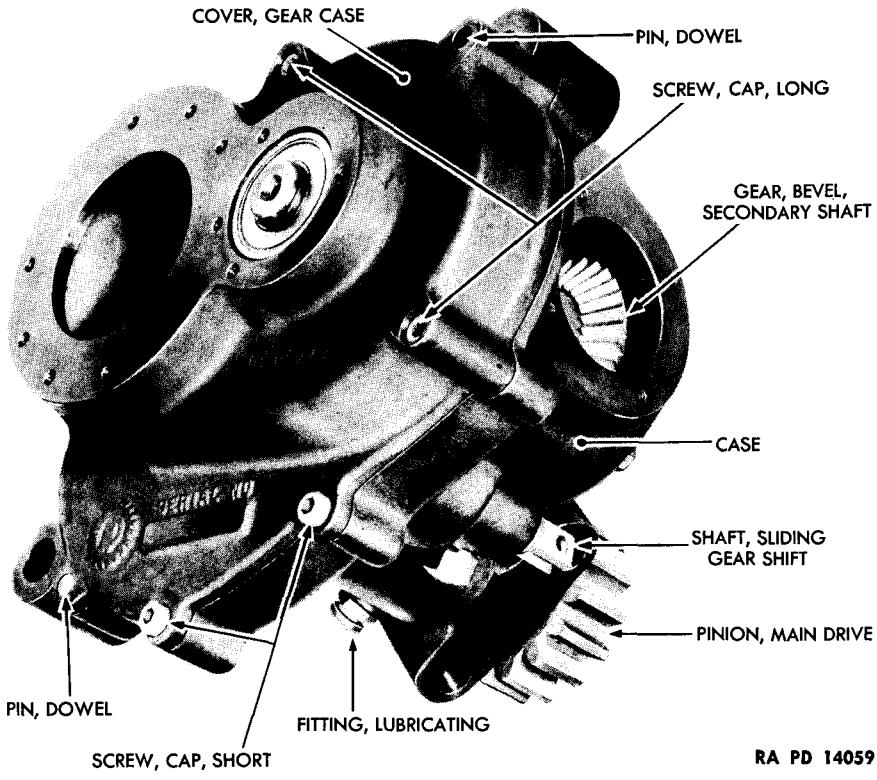


Figure 72 — Gear Case Assembly

Remove bearing snap ring by prying out with a screwdriver at one end of ring. Press out bearing from bottom, using wood or metal block (arbor press).

55. DISASSEMBLE CASE ASSEMBLY.

a. Equipment.

DRIFT, copper or brass, 5/8-in.
DRILL, 1/8-in.
DRIVER (par. 68)
EXTRACTOR, screw
HAMMER
PIN, drift
PLIERS
PLIERS, spreading
PULLER, stud
PUNCH, $^{19}/_{64}$-in.
STEEL, flat, 1/4-in.
STEEL, flat, 2- x 3 1/2- x $\frac{3}{16}$-in.
VISE with soft jaws
WRENCH, adjustable
WRENCH, socket-head set screw, $\frac{5}{16}$-in.
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, $\frac{9}{16}$-in.
WRENCH, open-end, 5/8-in.
WRENCH, socket, 1 $\frac{3}{16}$-in.

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

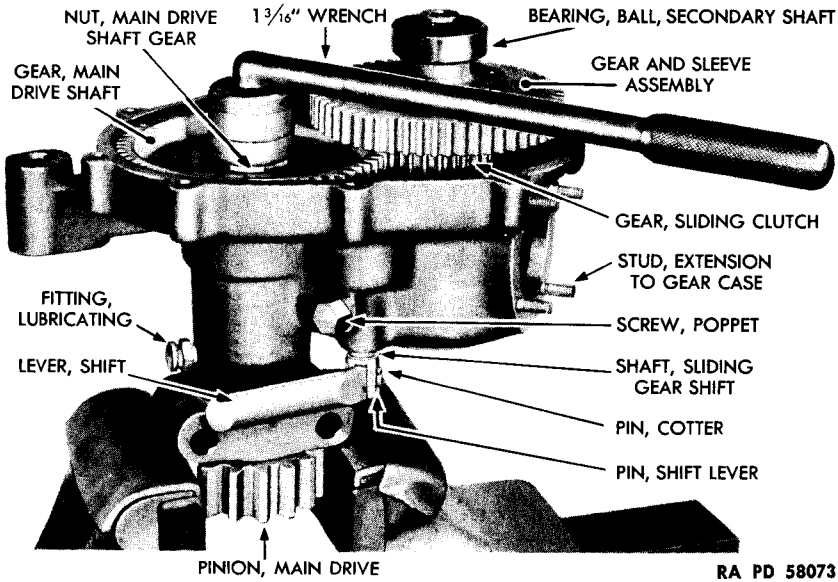


Figure 73 — Disassembling Main Drive Shaft Assembly

b. Procedure.

(1) REMOVE COVER (fig. 72).

HAMMER
PUNCH, $^{19}/_{64}$-in.
WRENCH, socket-head set screw, $\frac{5}{16}$-in.

Drive out 2 dowel pins ($^{19}/_{64}$-in. punch and hammer), then remove 3 long and 3 short socket-head screws holding cover to case ($\frac{5}{16}$-in. socket-head, set screw wrench). Remove cover by lifting and twisting. Avoid cocking the cover, as this will cause it to bind on the bearing.

(2) REMOVE MAIN DRIVE PINION.

DRIFT, copper or brass, $\frac{5}{8}$-in.
HAMMER
VISE with soft jaws
WRENCH, socket, $1\frac{3}{16}$-in.

Clamp main drive pinion (15-tooth) in a vise and remove the main drive shaft lock nut and nut ($1\frac{3}{16}$-in. socket wrench) (fig. 73). Remove assembly from vise and drive the pinion and main drive shaft out of main drive shaft gear (copper or brass drift, $\frac{5}{8}$-in., hammer). Lift gear out of case and slide pinion and shaft out of case (fig. 75).

(3) REMOVE SHIFTING LEVER (fig. 73).

PLIERS
WRENCH, open-end, $\frac{5}{8}$-in.

Remove the cotter pins from the 2 shifting lever pins (pliers). Then remove the pins and the shifting lever. Remove shifting lever fulcrum ($\frac{5}{8}$-in. open-end wrench) (R, fig. 78).

TRAVERSING GEAR MECHANISM

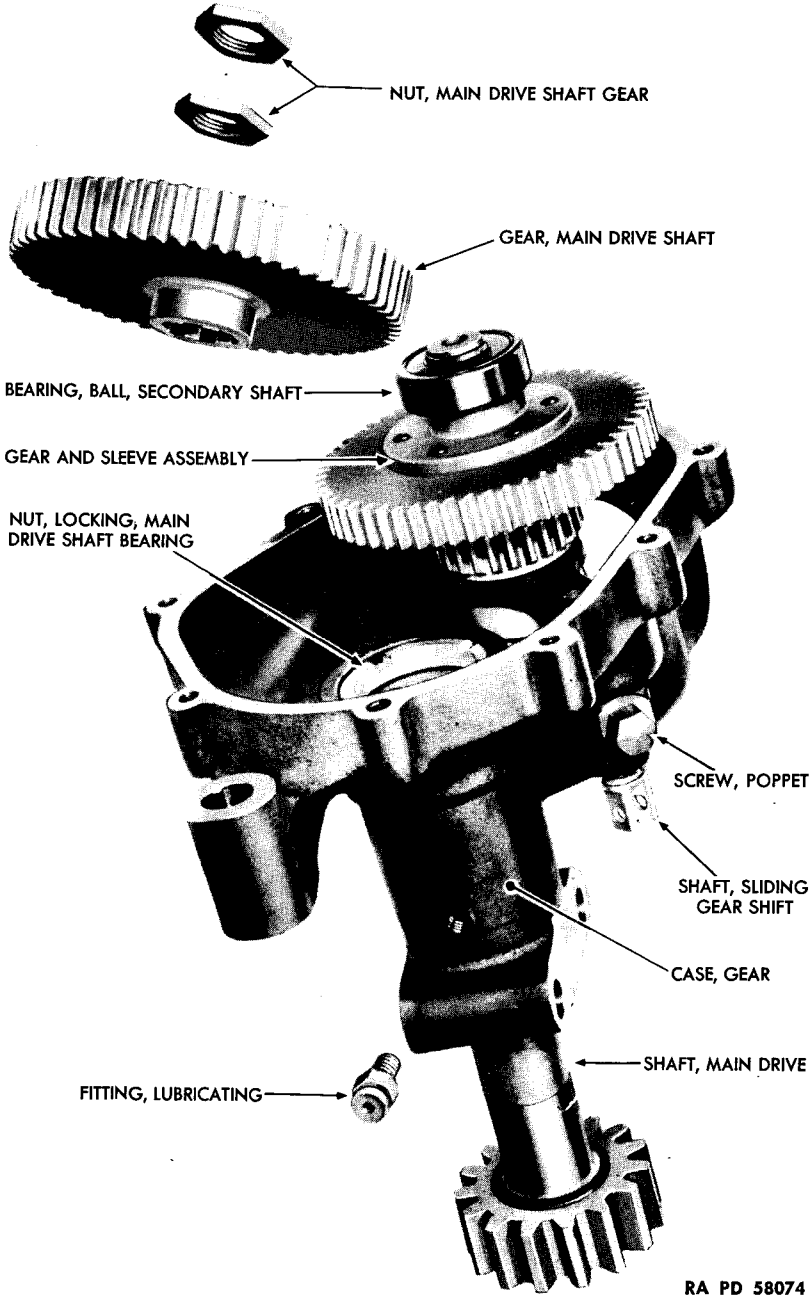


Figure 74 — Disassembling Gear Case Mechanism

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

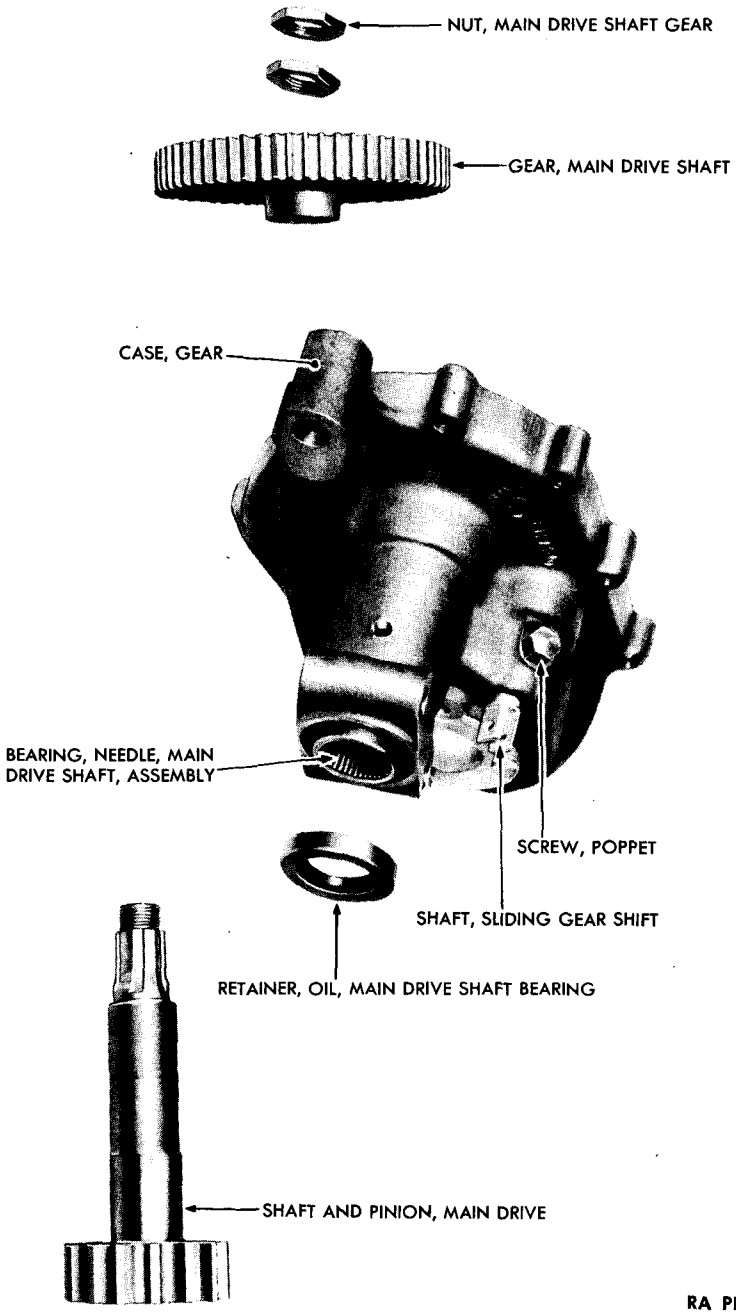


Figure 75 — Bottom View Of Gear Case Mechanism — Partly Disassembled

(4) REMOVE SLIDING CLUTCH GEAR SHIFTER SHAFT AND FORK (fig. 77).

STEEL, flat, ¼-in. WRENCH, open-end, $\frac{9}{16}$-in.

Unscrew poppet screw and remove poppet spring and poppet ($\frac{9}{16}$-in. open-end wrench). Unscrew shifter shaft from sliding clutch gear shifter fork (piece of ¼-in. steel). Pull shaft out of case and lift out fork.

(5) REMOVE BALL BEARING CAP AND SHIMS FROM LOWER END OF SECONDARY SHAFT (T, fig. 78).

WRENCH, open-end, $\frac{7}{16}$-in.

Remove 3 cap screws and lock washers holding lower bearing cap to case ($\frac{7}{16}$-in. open-end wrench). Remove shims and tag for correct assembly.

(6) REMOVE SECONDARY SHAFT.

DRIFT, copper or brass, ⅝-in. PLIERS, spreading
HAMMER

With spreading pliers, remove ball bearing snap ring from lower end of secondary shaft (fig. 77). With case bottom side up, drive secondary shaft out of ball bearing (copper or brass drift, and hammer). Hold shaft so that loose parts do not fall off (fig. 76).

(7) REMOVE PARTS FROM SECONDARY SHAFT (fig. 76).

PLIERS, spreading

Lift ball bearing thrust washer off lower end of shaft. Remove bevel gear, being careful not to lose any of the 20 needles on which the gear runs. Remove snap ring from upper end of shaft (spreading pliers). Lift off gear and sleeve assembly, being careful not to lose any of the 20 needles on which the gear runs. Lift off sliding clutch gear and collar, and remove key.

(8) REMOVE MAIN DRIVE SHAFT UPPER BEARING (fig. 74).

DRIVER (par. 68) STEEL, flat, 2- x 3½- x $\frac{3}{16}$-in.
HAMMER WRENCH, adjustable
PIN, drift

Unscrew main drive shaft upper bearing locking nut (piece of flat steel or drift pin and hammer). Drive bearing out of case, using driver against under side of inner bearing race (hammer).

(9) REMOVE LUBRICATING FITTING (fig. 74).

WRENCH, open-end, ⅝-in.

Unscrew and remove lubricating fitting from side of case (⅝-in. open-end wrench).

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

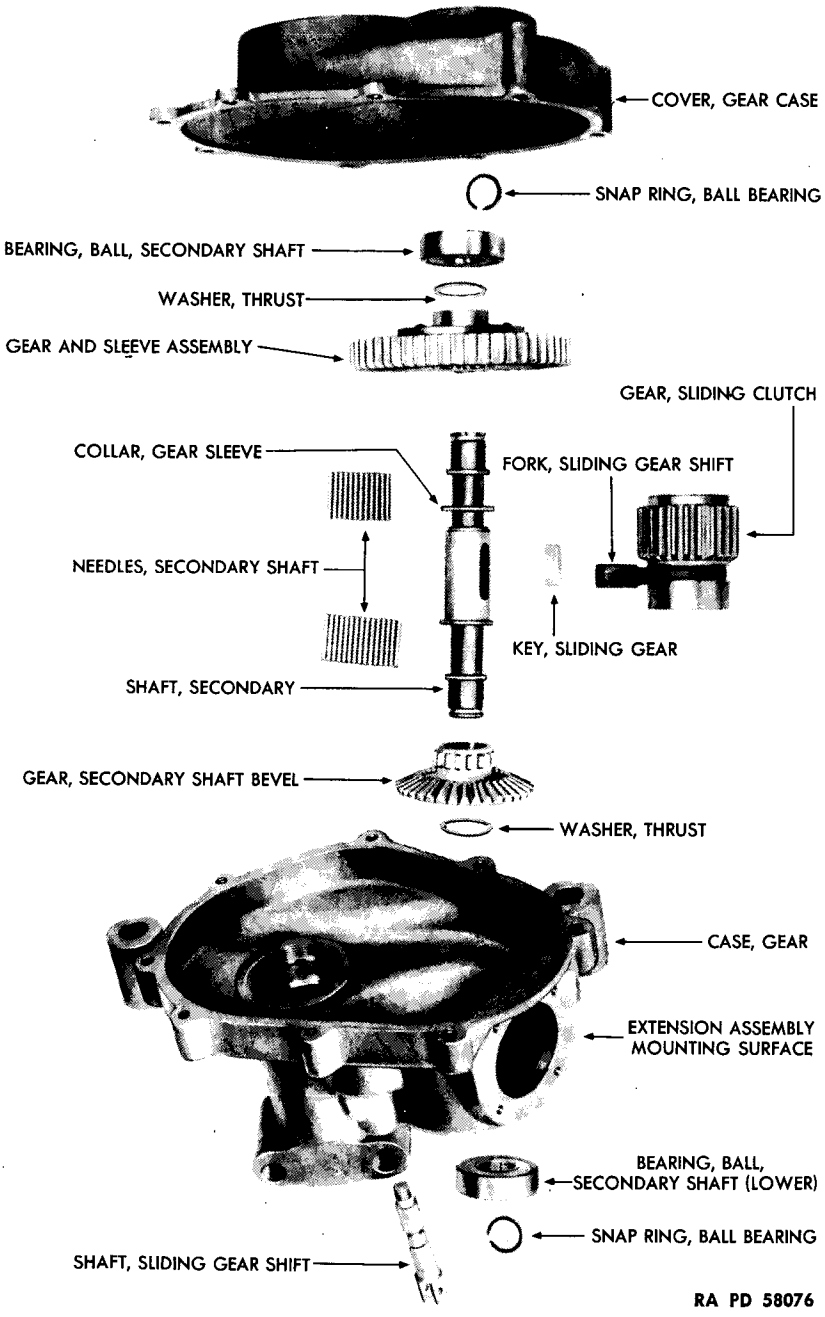


Figure 76 — Secondary Shaft Assembly — Disassembled

TRAVERSING GEAR MECHANISM

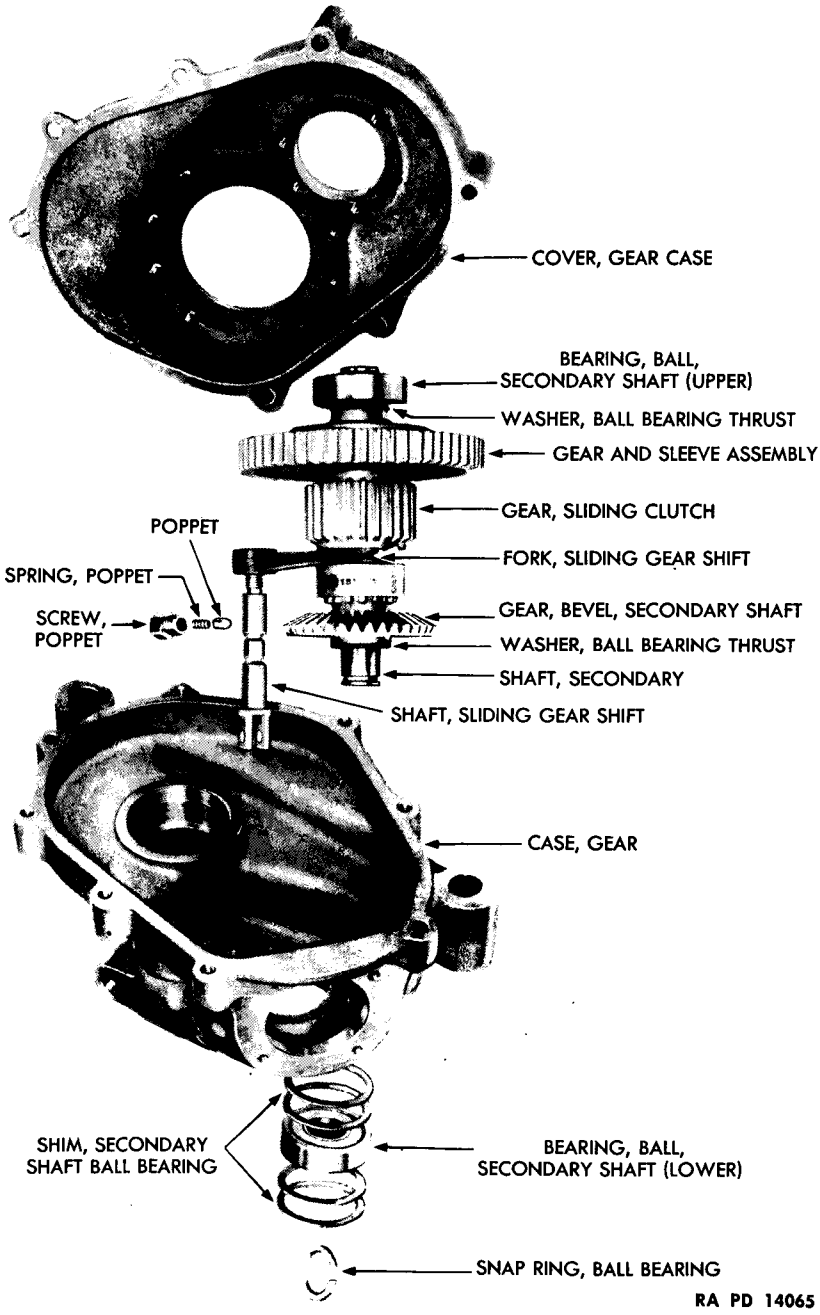


Figure 77 — Gear Case With Secondary Shaft Partly Assembled

(10) REMOVE OIL RETAINER (fig. 75).
DRIVER (par. 68) HAMMER

Insert driver into main drive shaft lower needle bearing from upper side against edge of oil retainer and drive out (hammer). This destroys the retainer which will then be replaced with a new one.

(11) REMOVE MAIN DRIVE SHAFT NEEDLE BEARING (fig. 75).
DRIVER (par. 68) HAMMER

Place driver against lower end of bearing and drive out.

(12) REMOVE HOUSING EXTENSION STUDS (Q, fig. 78).
DRILL, 1/8-in. PULLER, stud
EXTRACTOR, screw

To remove defective studs which extend beyond the surface on gear case to which the extension assembly is secured, install the stud puller over the stud and unscrew the stud. When the stud has broken flush or below the surface on the gear case, drill a 1/8-inch hole in the center of the stud. CAUTION: This hole must be in the center of the stud so that the threads in the gear case will not be damaged. Install the screw extractor in the stud and unscrew the stud.

56. REPAIR.

a. The entire assembly should require practically no repair work other than replacement of broken parts, directions for which are included under assembly and disassembly.

57. ASSEMBLE CASE ASSEMBLY.

a. Equipment.

CLOTH, wiping
DISK, steel (par. 68)
DRIVER (par. 68)
DRIVER, stud, 1/4-in.
FILE, fine
GREASE, general purpose, No. 1
HAMMER
HAMMER, soft
MICROMETERS, set of
PLIERS
PLIERS, spreading
PRESS, arbor
PUNCH, drive
PUNCH, prick
SOLVENT, dry-cleaning
SPACER (about 2-in. inside diam, 4-in. long)
STEEL, flat, 1/4-in. thick
STEEL, flat, 2- x 3 1/2- x 3/16-in.
VISE with soft jaws
WASHER, flat, 2 1/8- x 1 9/32- x 3/16-in.
WRENCH, adjustable, 10-in.
WRENCH, socket-head set screw, 5/16-in.
WRENCH, open-end, 3/8-in.
WRENCH, open-end, 9/16-in.
WRENCH, open-end, 5/8-in.
WRENCH, socket, 1 3/16-in.

TRAVERSING GEAR MECHANISM

A—SCREW, GEAR CASE AND COVER (SHORT)
B—SCREW, GEAR CASE AND COVER (LONG)
C—DOWEL, GEAR CASE TO COVER
D—SNAP RING, BALL BEARING
E—BEARING, BALL, SECONDARY SHAFT
F—WASHER, BALL BEARING THRUST
G—GEAR AND SLEEVE ASSEMBLY
H—COLLAR, GEAR SLEEVE
J—GEAR, SLIDING CLUTCH
K—NEEDLES, SECONDARY SHAFT
L—KEY, SLIDING GEAR
M—SHAFT, SECONDARY
N—GEAR, SECONDARY SHAFT, BEVEL
P—CASE, GEAR
Q—STUD, EXTENSION TO GEAR CASE
R—FULCRUM, SHIFT LEVER
S—SHIM, BALL BEARING, SECONDARY SHAFT
T—CAP, LOWER BALL BEARING
U—SCREW, BALL BEARING ADAPTER AND ANCHOR
V—WASHER, LOCK
W—LEVER, SHIFT
X—PIN, COTTER, SHIFT LEVER AND FULCRUM
Y—PIN, SHIFT LEVER
Z—SHAFT AND PINION, MAIN DRIVE
AA—RETAINER, OIL, MAIN DRIVE SHAFT BEARING
BB—BEARING, NEEDLE, MAIN DRIVE SHAFT, ASSEMBLY
CC—FITTING, LUBRICATING, BALL AND NEEDLE BEARING
DD—KEY, CASE
EE—POPPET
FF—SPRING, POPPET
GG—SCREW, POPPET
HH—BEARING, BALL, MAIN DRIVE SHAFT UPPER
JJ—NUT, LOCKING, MAIN DRIVE SHAFT UPPER BEARING
KK—GEAR, MAIN DRIVE SHAFT
LL—FORK, SLIDING GEAR SHIFT
MM—NUT, PINION SHAFT GEAR
NN—SHAFT, SLIDING GEAR SHIFT
PP—COVER, GEAR CASE

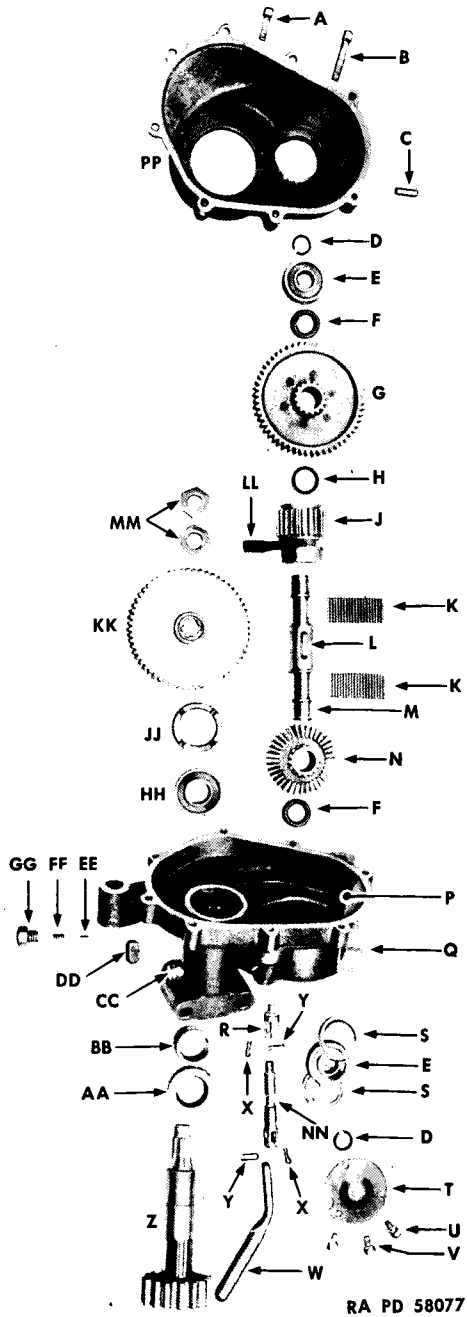


Figure 78 — Gear Case Assembly — Disassembled

b. Procedure.

(1) CLEAN CASE AND COVER.

CLOTH, wiping
SOLVENT, dry-cleaning

Inspect case and cover to make sure they are clean and free from burs. Clean with SOLVENT, dry-cleaning, and CLOTH, wiping.

(2) INSTALL MAIN DRIVE SHAFT NEEDLE BEARING (fig. 75).

DRIVER (par. 68)
PRESS, arbor

Enter unnumbered end of needle bearing in bottom end of bore. Insert driver and press in until end of bearing is $\frac{3}{8}$-inch from the bottom end of the case. Care must be taken to press bearing in straight to avoid damage to shell of bearing (arbor press).

(3) INSTALL MAIN DRIVE SHAFT BEARING OIL RETAINER (fig. 75).

DRIVER (par. 68)
PRESS, arbor
WASHER, flat, 2 1/8- x $1^{9}/_{32}$- x $\frac{3}{16}$-in.

Place washer on pilot end of driver against the shoulder. Place oil retainer on pilot end of driver against the washer, with lip of retainer toward end of pilot. Enter end of pilot in needle bearing and press oil retainer into bore until it seats against bearing (arbor press).

(4) INSTALL MAIN DRIVE SHAFT UPPER BEARING AND LOCKING NUT (HH and JJ, fig. 78).

DRIVER (par. 68)
HAMMER
PRESS, arbor
PUNCH, prick
STEEL, flat, 2- x 3 1/2- x $\frac{3}{16}$-in.
WRENCH, adjustable, 10-in.

Using driver, press bearing into upper end of main drive shaft bore until it seats on shoulder inside bore (arbor press). Screw bearing locking nut in (flat steel and 10-in. adjustable wrench) (fig. 74). Lock nut into place by staking casting into one slot of nut (prick punch and hammer).

(5) TAKE MEASUREMENTS TO DETERMINE CORRECT THICKNESS OF SHIMS FOR LOCATING SECONDARY SHAFT BEVEL GEAR (36-tooth) AND TO LOCATE HANDWHEEL EXTENSION HOUSING ASSEMBLY (fig. 79).

DISK, steel (par. 68)
MICROMETER, 0 to 1-in. depth
MICROMETER, 1- to 2-in. depth
MICROMETER, 1-in. outside

(a) Insert lower secondary shaft ball bearing in bore with bearing projecting out of bore approximately $\frac{3}{16}$ inch. Using 1- to 2-inch depth micrometer measure from flat surface on which extension assembly is mounted to outside surface of bearing. Add 0.9254 inch to this measurement and call it dimension "D." Remove bearing.

TRAVERSING GEAR MECHANISM

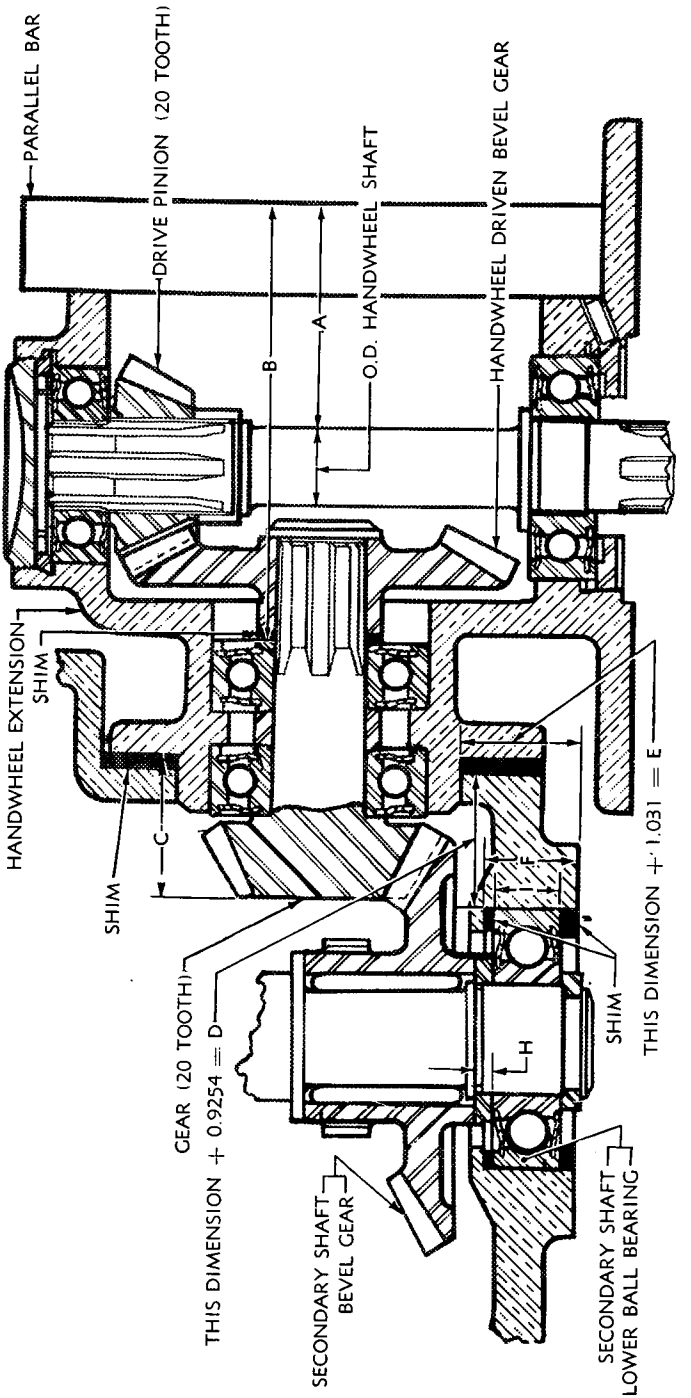


Figure 79 — Measurements Taken In Determining Shim Thicknesses

(b) Insert special disk in bore of extension assembly mounting surface. Using zero to one-inch depth micrometer, measure from flat surface at end of lower secondary shaft bore to outside surface disk. Add 1.031 inch to this measurement and call it dimension "E."

(c) With zero to one-inch depth micrometer, measure from flat surface at end of lower secondary shaft bore to bearing shoulder in bore, being careful to avoid fillet between shoulder and wall of bore. Call this measurement dimension "F."

(d) Using one-inch micrometer, measure thickness of thrust washer to be installed between lower secondary shaft bearing and bevel gear (F, fig. 78). Call this dimension "H."

(e) Using zero to one-inch micrometer, measure thickness of lower secondary shaft bearing (E, fig. 78). Call this dimension "I."

(6) DETERMINE THICKNESS OF SHIMS FOR LOWER SECONDARY SHAFT BEARING (S, fig. 78 and fig. 79).

(a) Shims used on both sides of lower secondary shaft bearings are $1\frac{3}{16}$-inch outside diameter by 1½ inch inside diameter by 0.005 inch and 0.0075 inch thick. These shims can be combined to make total thicknesses 0.005 inch, 0.0075 inch, 0.010 inch, etc., increasing in increments of 0.0025 inch. However, because of manufacturing tolerances each shim should be measured, and this measurement used in determining total thickness.

(b) The thickness of shim to be installed between shoulder and lower secondary shaft bearing is 1.125 inch plus "F" plus "H" minus "E."

(c) If required total thickness of shims cannot be obtained exactly, use a 0.001 inch less if obtainable; if not, use next combination above the required total.

(d) The thickness of shims to be installed below the lower secondary shaft bearing is "F" minus "I" minus total thickness of shims installed between bearing and shoulder. If the required total cannot be obtained exactly, use the next combination greater than the required total.

(7) INSTALL LOWER SECONDARY SHAFT BALL BEARING SHIMS AND CAP (E, S and T, fig. 78).

WRENCH, open-end, ⅜-in.

Place shims (thicknesses of which were determined in preceding operation) in bore against shoulder. Push ball bearing in against shim. Place lower shim (thickness as determined in previous operation) on bottom of bearing. Install lower bearing cap (T, fig. 78), and fasten it temporarily with 3 cap screws and lock washers (⅜-in. open-end wrench).

(8) TRY SLIDING CLUTCH GEAR ON SHAFT (J, fig. 78).

FILE, fine

Install sliding gear key in secondary shaft. Put sliding clutch gear on secondary shaft and see that it slides freely on shaft and key. If it does not, remove points of interference with a fine file. Remove the gear.

(9) INSTALL BEVEL GEAR AND BEARING ON SECONDARY SHAFT (figs. 76 and 77).

GREASE, general purpose, No. 1

Coat lower shaft bearing with grease to hold needles. (Upper end of shaft is drilled; lower end centered but not drilled.) Arrange 20 needles around the shaft and slide the bevel gear over them. Long end of hub with clutch teeth must be toward upper end of shaft. Slide thrust washer over lower end of shaft and against the bevel gear, with chamfered side of washer away from the gear.

(10) ASSEMBLE REMAINING PARTS ON SECONDARY SHAFT (figs. 76 and 77).

GREASE, general purpose, No. 1
HAMMER, soft
PLIERS, spreading (par. 68)
VISE with soft jaws

(a) Clamp lower end of shaft in vise to keep thrust washer and bevel gear in place. Slide clutch gear on shaft over the key, with groove for shifting fork toward lower end of shaft, until it meshes with clutch teeth on bevel gear.

(b) Slide the gear sleeve collar (fig. 76) on the shaft at upper end of sliding clutch gear, chamfered side of collar toward sliding gear.

(c) Coat shaft bearing with GREASE, general purpose, No. 1, and arrange the 20 needles in grease around shaft. Slide gear and sleeve assembly (56-tooth) over needles with clutch teeth toward sliding clutch gear.

(d) Place thrust washer on shaft against gear and sleeve assembly (56-tooth) with chamfered side toward upper end of shaft. Slide upper ball bearing on shaft. Bearing should be hand-push or light-tap fit on shaft.

(e) Install snap ring in groove near upper end of shaft (spreading pliers). Remove the assembly from vise, being careful to hold lower thrust washer and bevel gear in position.

(11) INSTALL SECONDARY SHAFT ASSEMBLY IN CASE (fig. 77).

PLIERS, spreading (par. 68)
WRENCH, open-end, 3/8-in.

(a) Start the end of the shaft into lower ball bearing. Push or tap shaft into bearing.

(b) Remove lower bearing cap and shims which have been temporarily installed. Install snap ring in groove near lower end of shaft (spread-

ing pliers). Then reinstall shims and cap; tighten screws (3/8-in. open-end wrench).

(12) INSTALL SLIDING GEAR SHIFTER FORK AND SHIFTER SHAFT (fig. 77).

STEEL, flat, 1/4-in. thick

(a) Screw gear shifter shaft into sliding gear shifter fork to find if threads work smoothly, and then remove. Slide sliding gear shifter fork into groove of clutch gear with sloping side of fork away from the gear and sleeve assembly.

(b) Slide shifter shaft through hole in case and screw it into sliding gear shifter fork. Tighten (piece of flat steel, 1/4-in. thick).

(13) INSTALL MAIN DRIVE PINION AND MAIN DRIVE SHAFT GEAR (60-TOOTH GEAR) (figs. 73, 74 and 75).

PRESS, arbor
SPACER (about 2-in. inside diam, 4-in. long)
VISE with soft jaws
WRENCH, socket, $1\frac{3}{16}$-in.

(a) Slide main drive shaft gear on and off splined end of main drive shaft a few times to remove any possible burs or excess cadmium plate. (Hub of main drive shaft gear should be toward pinion end of drive shaft).

(b) Insert main drive shaft into oil retainer and through both lower needle and upper ball bearings (fig. 75). Push upward until splines on drive shaft begin to show above the ball bearing.

(c) Place main drive gear in position with its hub on lower side. Line gear up with main drive shaft and start shaft into gear (fig. 74).

(d) Place pinion on anvil of arbor press, and press main drive gear on main drive shaft (spacer with about 2-in. inside diam.). This pressure also seats shoulder of main drive shaft against inner race of ball bearing.

(e) Clamp drive pinion in vise, and screw first nut and then lock nut on upper end of main drive shaft ($1\frac{3}{16}$-in. socket wrench) (fig. 73).

(14) INSTALL COVER ON CASE (fig. 72).

GREASE, general purpose, No. 1
HAMMER
WRENCH, socket-head set screw, $\frac{5}{16}$-in.

Pack gear case with GREASE, general purpose, No. 1. Place cover on case. Insert the three 1 3/4-inch long socket head cap screws through long bosses in the cover, one-inch long cap screws through the short bosses. Start the 6 screws into threaded holes in case. Drive the 2 dowels through holes in cover and into case (hammer). Then tighten the 6 cap screws ($\frac{5}{16}$-in. socket-head set screw wrench).

(15) INSTALL SHIFTING LEVER (fig. 73).

PLIERS
WRENCH, open-end, 5/8-in.

Screw the shifting lever fulcrum (R, fig. 78) into the tapped hole in the lower side of the case, lining up slot in fulcrum with slot in gear shifter shaft (5/8-in. open-end wrench). Place shifting lever in slots with handle of lever toward main drive pinion (fig. 73). Insert shifting lever pins attaching lever to fulcrum and shaft; fasten with cotter pins (pliers).

(16) INSTALL POPPET (figs. 73 and 78).

WRENCH, open-end, $\frac{9}{16}$-in.

Assemble poppet in bore of poppet screw. Install poppet spring and then poppet screw into tapped hole in case. Tighten screw.

(17) INSTALL HOUSING EXTENSION STUDS (Q, fig. 78).

DRIVER, stud, 1/4-in.

Studs are threaded 1/4-20 on one end and 1/4-28 on the other. Screw 1/4-20 ends of studs into tapped holes in case.

58. ASSEMBLE MOTOR ADAPTER PLATE ASSEMBLY (figs. 69, 70, 71).

a. Equipment.

BLOCK, metal, $1\frac{9}{16}$-in. diam, 4-in. long
GREASE, general purpose, No. 1
PLIERS, spreading (par. 68)
PRESS, arbor
SCREWDRIVER
WRENCH, open-end, 5/8-in.

b. Procedure.

(1) INSTALL MOTOR PINION BALL BEARING IN ADAPTER PLATE (fig. 69).

BLOCK, metal, $1\frac{9}{16}$-in. diam, 4-in. long
PRESS, arbor
SCREWDRIVER

Be sure plate and bracket are clean and free of burs. Press ball bearing into bore in upper side of adapter plate (arbor press and metal block). Install bearing snap ring in groove in bearing bore just above bearing (screwdriver). This secures bearing in bore.

(2) INSTALL MOTOR SHAFT DRIVE PINION AND NEEDLE BEARING (figs. 70 and 71).

GREASE, general purpose, No. 1
PLIERS, spreading (par. 68)
SCREWDRIVER

Coat bore of needle bearing bracket with grease to hold needles in place. Install the 28 needles. Line up needles in bore by running finger around inside of needles. Insert ungrooved end of motor shaft drive pinion

inside needles, turn a few revolutions and remove. Repeat until all 28 needles remain in place when pinion is removed. Slide grooved end of pinion into lower side of ball bearing until pinion rests against inner race of bearing. Install ball bearing snap ring (fig. 71) on upper end of pinion shaft above bearing (spreading pliers). Slide bracket with the 28 needles over lower end of pinion shaft. Install 3 screws that hold bracket on motor adapter plate (screwdriver) (fig. 70).

(3) INSTALL LUBRICATING FITTING (fig. 69).

WRENCH, open-end, 5/8-in.

Screw lubricating fitting into tapped hole in top of plate.

(4) INSTALL SHIPPING PROTECTOR (fig. 56).

SCREWDRIVER

If hydraulic motor is not to be installed at once, install shipping protector plate to protect bearings from dirt. Place on motor mounting surface and install with 4 screws (screwdriver). If protector is not available, wrap assembly.

59. ASSEMBLE HANDWHEEL EXTENSION ASSEMBLY (fig. 66).

a. Equipment.

BLOCK, wood, 1½-in. diam hole
DRIVER, $1\frac{9}{16}$-in. outside diam 4-in. long
GREASE, general purpose, No. 1
MICROMETERS, set of
PARALLELS, hardened and ground, 0.625- x 4½- or 5-in. (2) (par. 68)
PIPE, iron, 1¼-in., or wood block
PRESS, arbor
SCREWDRIVER
SCREWDRIVER, wide
STEEL, flat, $^{11}/_{64}$-in. thick, $1\frac{7}{32}$-in. wide
VISE, bench
WRENCH, adjustable
WRENCH, adjustable face spanner (par. 68)
WRENCH, socket-head set screw, $\frac{3}{32}$-in.

b. Procedure.

(1) INSTALL BEARING AND SPACER ON SHAFT (fig. 68).

PRESS, arbor

Press handwheel driven bevel gear (40-tooth) (fig. 68) on and off splined end of shaft to remove any excess cadmium plate. Insert shaft through ball bearing and press bearing down against shoulder on shaft next to gear (20-tooth). Install spacer on shaft against bearing.

TRAVERSING GEAR MECHANISM

(2) TAKE MEASUREMENTS TO DETERMINE CORRECT THICKNESS OF SHIMS BETWEEN BEARING AND HUB OF HANDWHEEL DRIVEN BEVEL GEAR (fig. 79).

DRIVER, $1\frac{9}{16}$-in. outside diam, 4-in. long
MICROMETERS, set of
PARALLELS, hardened and ground, 0.625-in. x 4½- or 5-in. (2) (par. 68)
PRESS, arbor

(a) Insert the threaded end of handwheel shaft into ball bearing and press bearing against shoulder on shaft. Place ball bearing on top end of shaft with top of bearing flush with end of shaft. Measure outside diameter of the shaft with 1-inch micrometer, this measurement being taken between flanges and ½ inch from upper flange.

(b) Inspect housing to be sure it is free from dirt or burs. Then install shaft with bearings in cross bore of housing (bearings should be hand-push fit or slightly tighter in bore). Lay two 0.625-inch parallels across large open end of the housing. Measure from upper surface of parallels to handwheel shaft, along center line of large end of housing, with 1-inch to 2-inch depth micrometer. Call this measurement "A."

(c) Remove handwheel shaft from housing and bearings from shaft. Press the inner gear shaft bearing into bore in housing. Lay two 0.625-inch parallels across large open-end of housing and with 3-inch to 4-inch depth micrometer measure from parallels to inner race of bearing. Call this measurement "B."

(d) Remove bearing from housing. The total thickness of shims required between inner race of bearing and hub of driven bevel gear is "B" minus (1.230 inch plus $\frac{\text{O.D. handwheel shaft}}{2}$ plus "A"). These shims are 0.0075 inch and 0.010 inch thick allowing combinations to be made 0.0075 inch, 0.010 inch, 0.015 inch and increasing in successive increments of 0.0025 inch. NOTE: Due to manufacturing tolerances these thicknesses are only approximate and each shim must be measured. If required total thickness cannot be obtained exactly, use the next lower combination available.

(3) INSTALL HANDWHEEL DRIVEN BEVEL GEAR (40-TOOTH) (fig. 68).

BLOCK, wood, with 1½-in. hole
PRESS, arbor
SCREWDRIVER, wide

(a) Install bearing in bore through large opening in housing. Press in (arbor press).

(b) Push splined end of gear shaft, with bearing and spacer installed, through smaller opening in extension housing and on through bearing which has just been installed in housing (arbor press).

(c) Place shims (fig. 68) of correct thickness as determined in step (2) above, over gear shaft on bearing. Push handwheel driven bevel gear (40-tooth) on splined end of gear shaft with longer hub toward shims and bearing.

(d) Place shaft gear in a 1½-inch hole in a wood block. Install driven gear screw through driven gear into end of gear shaft (wide screwdriver). Gears should now turn freely and have practically no end play.

(4) TAKE MEASUREMENT TO DETERMINE CORRECT THICKNESS OF SHIM TO USE BETWEEN FLANGE OF EXTENSION HOUSING AND CASE (fig. 79).

MICROMETER, depth, 1-in. to 2-in.
PIPE, iron 1¼-in., or wood block
VISE, bench

(a) Clamp a piece of 1¼-inch iron pipe or wood block in a bench vise with 3⅛ inches extending above the jaws of the vise. Rest the handwheel driven bevel gear on this in order to put all end play in shaft at gear end.

(b) Measure the distance from the end of gear to machined surface of flange on gear case side of extension housing. Call this dimension "C." It will be referred to in instruction for installing handwheel extension housing on case (par. 62 **b** (2)).

(5) INSTALL HANDWHEEL SHAFT.

STEEL, flat, $^{11}/_{64}$-in. thick, $1\frac{7}{32}$-in. wide
WRENCH, socket-head set screw, $\frac{3}{32}$-in.
WRENCH, adjustable
WRENCH, adjustable face spanner (par. 68)

(a) Slide spacer and drive pinion (fig. 68) on upper or unthreaded end of handwheel shaft. Spacer should be against flange on shaft and small end of pinion toward spacer.

(b) With end of shaft flush with end of pinion, grasp threaded end of the shaft and, by tilting the shaft, work pinion through bore of bottom end of housing and over driven gear (fig. 67).

(c) Install lower handwheel shaft bearing into bore. Screw lower bearing nut into bore (fig. 68) (spanner face wrench).

(d) Install upper bearing into bore in top of housing and over upper end of handwheel shaft. Screw the bearing adjusting ring nut into bore

(fig. 68) (face spanner wrench). Be sure that recessed side of nut is toward bearing.

(e) Note backlash between driven gear (40-tooth) and pinion. If there is too much backlash, loosen bottom bearing nut and tighten upper one a little at a time. If gear and pinion do not roll freely, loosen upper and tighten bottom bearing nut. Adjust until gear and pinion roll freely with minimum of backlash. Then install slotted upper bearing lock nut on bearing adjusting ring nut and tighten (flat steel and adjustable wrench).

(f) Tighten set screw through housing on bottom bearing nut ($\frac{3}{32}$-in. socket-head set screw wrench) (figs. 67 and 68). Again check adjustment of shaft. Shaft should turn freely but have no noticeable end play. Gears should roll freely with a minimum of backlash. Be sure proper adjustment is made before installing cover.

(6) INSTALL COVER (fig. 66).

GREASE, general purpose, No. 1
SCREWDRIVER

Pack gears with GREASE, general purpose, No. 1. Place cover in position on surface of large bore in housing. Install 5 screws and lock washers and tighten (screwdriver).

60. INSTALL OIL RETAINER IN BRAKE DRUM (fig. 65).

a. Equipment.

BLOCK, metal (at least 1⅜-in. thick, from 2-in. to 6-in. in diam)
COMPOUND, sealing
PLATE, metal (at least ½-in. thick, 2-in. or more in diam)
PRESS, arbor

b. Procedure.

(1) INSTALL OIL RETAINER.

BLOCK, metal
COMPOUND, sealing
PLATE, metal
PRESS, arbor

Be sure that bore of drum is smooth, clean and free from burs. If bore has been roughened in removing oil retainer, apply a little sealing compound, but not enough to get on lip of retainer. Place drum, open side down, on a block in arbor press so that block supports hub of drum. Start oil retainer into the bore of drum with lip of the retainer up. Place a metal plate over retainer and press until plate rests against hub of drum (arbor press).

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

61. ASSEMBLE BRAKE MECHANISM ASSEMBLY.

a. Equipment.

GREASE, general purpose, No. 1
HAMMER, light
PLIERS
PUNCH, $\frac{5}{16}$-in.
RIVET, set for $\frac{3}{16}$-in. hollow rivets
STICK, wood, 12-in. to 14-in. long
VISE, bench
WRENCH, box, $\frac{3}{8}$-in. (2)
WRENCH, open-end, $\frac{1}{2}$-in. (2)
WRENCH, square socket, $\frac{5}{16}$-in., not over $\frac{3}{4}$-in. outside diam

b. Procedure.

(1) ASSEMBLE BRAKE LININGS TO SHOES (fig. 62).

HAMMER, light
PUNCH, $\frac{5}{16}$-in.
RIVET, set for $\frac{3}{16}$-in. rivets

Place lining on shoe and install 8 hollow rivets with their heads countersunk in lining. Take care that lining fits snugly to shoe. Secure lining by setting rivets (rivet set, punch and hammer).

(2) ASSEMBLE OPERATING SPREADER AND LINK (fig. 64).

HAMMER, light

Place end of lever to spreader link in slot in operating spreader. Insert pin and drive into place with light hammer. Pin should project equally at both ends.

(3) ASSEMBLE PARTS IN OPERATING ANCHOR (fig. 64).

GREASE, general purpose, No. 1
PLIERS

(a) Insert spreader and link into operating anchor in such a way that pin slides in slots in bore of anchor and link projects beyond hub of anchor. Assembly should slide freely in anchor.

(b) Place an operating roller in slot in end of a brake operating plunger and apply enough GREASE, general purpose, No. 1, to hold it in position. Repeat with the other roller and plunger.

(c) Insert spreader into anchor until end is about in line with 2 drilled cotter pin holes. Then insert one plunger, with roller, into hole in side of anchor in such a way as to bring roller against the tapered neck of spreader, and the notch in upper side of plunger in line with a cotter pin hole. Install plunger retaining cotter pin through hole in anchor and notch in plunger. Push cotter pin all the way through, and spread ends lengthwise (pliers). Then install the other plunger, roller and cotter pin in the same manner, having both cotter pin heads on outer side of anchor.

(4) INSTALL BRAKE OPERATING ANCHOR (fig. 59).

Place brake operating anchor on brake cover with machined hub in cored hole, and heads of cotter pins toward handle. Insert 2 cap screws and lock washers through holes in cover and into threaded holes in anchor. Tighten temporarily with fingers.

(5) INSTALL BRAKE OPERATING LEVER (fig. 63).

PLIERS

Slide ball end of brake operating lever through hole in brake cover and into hole in lever to spreader link. Line up hole in lever with support pin holes in brake cover, and insert support pin. Insert cotter pin through support pin (pliers).

(6) INSTALL SPRING, SLEEVES AND MANUAL DRIVE HANDLE (fig. 63).

STICK, wood, 12-in. to 14-in. long
VISE, bench
WRENCH, open-end, ½-in. (2)

(a) Clamp brake cover in vise with operating anchor down and pointing toward vise handle. Push spindle sleeve (short) through hole in handle support against forked end of operating lever (fig. 59).

(b) Insert handle sleeve (long) in handle with flanged end of sleeve at lower end of handle. Insert operating lever spring in upper end of drive handle sleeve (long). Then insert grip lever spindle through spring so that short threaded end projects about 2 inches out of end of spring.

(c) Put drive handle shim over end of handle sleeve (long) against flanged end of handle. With lug on handle pointing downward and notch in handle sleeve up, start end of grip lever spindle into spindle sleeve (short).

(d) Holding flanged end of handle in place against brake cover, push with thumbs on flanged end of handle sleeve until handle presses shim against cover (fig. 59). Insert clamping screw through handle support and notch on the handle sleeve; install nut and tighten finger-tight.

(e) Push on flanged end of handle sleeve with a piece of wood held against chest, leaving hands free to hold clamping screw with one ½-inch open-end wrench and tighten safety nut with another. The handle should have only a few thousandths of an inch clearance between brake cover at one end and flanged end of handle sleeve at the other.

(f) Remove spindle from handle.

(7) INSTALL GRIP LEVER SPINDLE (fig. 63).

WRENCH, box, ⅜-in. (2)

(a) Place grip lever washer and handle sleeve collar on long threaded end of spindle, and screw lever spindle nut on finger-tight. Then insert spindle through flanged end of handle sleeve (long), through operating

lever spring and spindle sleeve and into forked end of operating lever (fig. 60).

(b) Place upper spindle washer on short threaded end of spindle and screw upper spindle nut on finger-tight. There is now a nut on each end of spindle. Hold upper one with a ⅜-inch box wrench and tighten lower one with another ⅜-inch box wrench.

(8) INSTALL BRAKE RELEASE GRIP LEVER.

PLIERS

Place brake release grip lever between lugs on brake handle, with forked end of grip lever straddling spindle sleeve and handle toward brake cover (fig. 60). Slide grip lever pin through holes in lugs and release lever and fasten with cotter pin (pliers).

(9) INSTALL BRAKE ADJUSTING ANCHOR (figs. 61 and 63).

(a) Screw brake adjusting screw (U, fig. 63) into brake adjusting anchor so that tapered end of screw is inside anchor and squared end projects beyond hub of anchor about $\frac{7}{16}$-inch.

(b) Insert hub of anchor into drilled hole in top of brake cover (fig. 63). Line up drilled holes in brake cover with drilled and tapped holes in anchor and install 2 cap screws and lock washers from below. Tighten with fingers.

(10) INSTALL BRAKE SHOES (figs. 61 and 63).

PLIERS
VISE, bench
WRENCH, square socket, $\frac{5}{16}$-in., not over ¾-in. outside diam

(a) Clamp brake cover in vise with handle down. Insert the 2 brake adjusting plungers into holes in adjusting anchor until angle faces of plungers contact tapered face of adjusting screw. Slots in outer ends of plungers must be parallel with machined face of cover; if they are not, interchange them, as they are made right and left.

(b) Place the 2 brake shoes on brake cover and slip semicircular notches of shoes into slots in ends of adjusting plungers. Place other end of each shoe on top of operating anchor.

(c) Install spring at operating anchor end of shoes first. Hook the two ends of spring up through hole in each shoe so that ends of spring are above shoes (fig. 61). Then install other spring at adjusting anchor end of shoe, by hooking ends of the spring downward through hole in each shoe so that ends of spring are below shoes.

(d) Move shoes apart and engage ends of shoes in the slots in ends of operating plungers.

(e) Back out the adjusting screw until inner ends of adjusting plungers just touch. Anchor screws will be tightened after assembly is attached to handwheel extension.

62. ASSEMBLE SUBASSEMBLIES WITH CASE (fig. 58).

a. Equipment.

MICROMETER, 1-in.
SCREWDRIVER
WRENCH, open-end, $\frac{7}{16}$-in.
WRENCH, open-end, ½-in.
WRENCH, open-end, thin, $\frac{7}{16}$-in., not over $\frac{3}{16}$-in. thick
WRENCH, socket, ½-in., not over ¾-in., outside diam
WRENCH, socket, ⅝-in.
WRENCH, square socket, $\frac{5}{16}$-in., not over ¾-in. outside diam

b. Procedure.

(1) INSTALL MOTOR ADAPTER PLATE ASSEMBLY ON CASE (fig. 58).

WRENCH, open-end, $\frac{7}{16}$-in.

Place motor adapter plate assembly on cover of case, meshing pinion of adapter plate with gear in case. Install 3 cap screws and lock washers in holes that surround lubricating fitting.

(2) INSTALL HANDWHEEL EXTENSION ASSEMBLY ON CASE (figs. 56 and 66).

MICROMETER, 1-in.
WRENCH, open-end, thin, $\frac{7}{16}$-in., not over $\frac{3}{16}$-in. thick

(a) Place shims over 4 studs on mounting surface on case. Correct thickness of shims is 0.9935 inch plus "C" (par. 59 **b** (4)), minus "D" (par. 57 **b** (5) (a)). NOTE: Shims are made 0.005 inch and 0.0075 inch thick, allowing combinations to be made increasing in increments of 0.0025 inch from 0.005 inch up. However, due to manufacturing tolerances, each shim must be measured. If the required exact total of shims is not available, use the next combination greater.

(b) Place handwheel extension assembly over the 4 studs and on shims. Secure in place with safety nuts on studs ($\frac{7}{16}$-in. open-end wrench, not over $\frac{3}{16}$-in. thick).

(3) INSTALL BRAKE DRUM ASSEMBLY ON HANDWHEEL SHAFT (fig. 58).

SCREWDRIVER
WRENCH, open-end, ½-in.

Place convex or closed side of brake drum against flange of extension assembly. Install the 4 slotted, countersunk head screws and safety nuts and tighten (½-in. open-end wrench, screwdriver).

(4) INSTALL BRAKE MECHANISM ASSEMBLY ON HANDWHEEL SHAFT (figs. 58 and 60).

WRENCH, socket, 5/8-in.

Squeeze release grip lever against manual drive handle to compress brake. Slide handwheel on splined end of handwheel shaft, bringing brake shoes inside drum. Release brake release grip lever. Place flat washer over lower end of handwheel shaft against brake cover, then install safety nut and tighten (5/8-in. socket wrench).

(5) ADJUST BRAKE (fig. 60).

WRENCH, socket, 1/2-in., not over 3/4-in. outside diam
WRENCH, socket, 5/8-in.
WRENCH, square socket, 5/16-in., not over 3/4-in. outside diam

(a) Hold brake release grip lever against manual drive handle and tighten brake adjusting screw (5/16-in. square socket wrench) until brake drags when handle is turned, then turn adjusting screw back 1/4 turn. NOTE: The inner end of the brake adjusting screw has a 60-degree taper and 4 flat sides (U, fig. 63). The adjusting plungers press against 2 of these flat sides at a time. Each 1/4 turn of the adjusting screw brings the next 2 flat sides of the screw in contact with the plungers. This pushes the plungers farther apart (because of the taper) and exerts added pressure on the brake shoes (fig. 61). The brake is correctly adjusted when it does not drag as the wheel is turned with the release grip lever squeezed against the handle, but would drag if the adjusting screw were given one more 1/4 turn.

(b) With brake properly adjusted, release grip lever and tighten the 2 operating anchor screws and adjusting anchor screws (1/2-in. socket wrench) (fig. 60). Handwheel should now turn freely with grip lever squeezed against handle, but not when grip lever is released.

(6) INSTALL LUBRICATING FITTING.

WRENCH, socket, 5/8-in.

Screw fitting into tapped hole in side of gear case. NOTE: This fitting may be replaced by a new button head elbow fitting 90 degrees CDX1L.

63. INSTALL TRAVERSING GEAR MECHANISM IN TURRET.

a. Equipment.

HAMMER
PIN, drift
PLIERS
SCREWDRIVER
WRENCH, socket, 3/4-in.
WRENCH, socket, 7/8-in.

b. Procedure.

(1) REMOVE SHIPPING COVER.

SCREWDRIVER

If shipping cover has been installed on motor adapter plate, remove 4 screws (screwdriver) and lift off cover.

(2) INSTALL HYDRAULIC MOTOR ON TRAVERSING GEAR CASE.

See paragraph 47 for procedure.

(3) INSTALL TRAVERSING GEAR MECHANISM IN TURRET.

HAMMER
PIN, drift
PLIERS
WRENCH, socket, ¾-in.
WRENCH, socket, ⅞-in.

Place case key in slot in case (fig. 57). Lift assembly into place and engage case key with slot in turret ring; engage drive pinion with turret ring gear (fig. 55). Clearance between main drive pinion and ring gear on hull should be 0.005 inch. Install the 2 upper cap screws and lock washers (⅞-in. socket wrench). NOTE: The right upper cap screw is very close to case and may have to be tightened with punch and hammer. Install the 2 lower cap screws and locking wires (¾-in. socket wrench).

(4) CONNECT HYDRAULIC MOTOR DRAIN TUBE AND MOTOR HOSES.

See paragraphs 39 b (5) and 43 b (2).

ORDNANCE MAINTENANCE — HYDRAULIC TRAVERSING MECHANISM (LOGANSPORT) FOR MEDIUM TANK M3 AND MODIFICATIONS

Section XI

HOSES AND TUBES

Paragraph
Hoses and tubes 64

64. HOSES AND TUBES.

a. Identification. Connecting hoses and tubes used in hydraulic turret traversing mechanism, shown in figure 80 are identified below:

TUBE, drain, assembly
(A, fig. 80) ..... Connecting hydraulic motor with oil reservoir.

HOSE, pressure, assembly
(B, fig. 80) ..... Connecting hydraulic pump to pressure tube on control valve. Over-all length is 28⅜ inches.

HOSE, motor, long, assembly
(C, fig. 80) ..... Connecting hydraulic motor to control valve, from rear port of motor to front or right port of control valve. Over-all length is 18⅝ inches.

HOSE, motor, short, assembly
(D, fig. 80) ..... Connecting hydraulic motor to control valve from front port of motor to rear or left port of control valve. Over-all length is 16⅝ inches.

HOSE, suction, assembly
(E, fig. 80) ..... Connecting pump and oil reservoir.

HOSE, exhaust, assembly
(F, fig. 80) ..... Connecting control valve exhaust tube to oil reservoir. Over-all length is 8 inches.

TUBE, breather, assembly
(G, fig. 80) ..... Connects at top of oil reservoir.

b. Maintenance.

(1) INSPECTION.

AIR, compressed
CLOTH, wiping
OIL, engine, SAE 10
SOLVENT, dry-cleaning

Inspect hoses and tubes carefully for leaks. Look for evidence of weak spots in hoses, indicated by enlarged portion. Inspect fittings for damaged

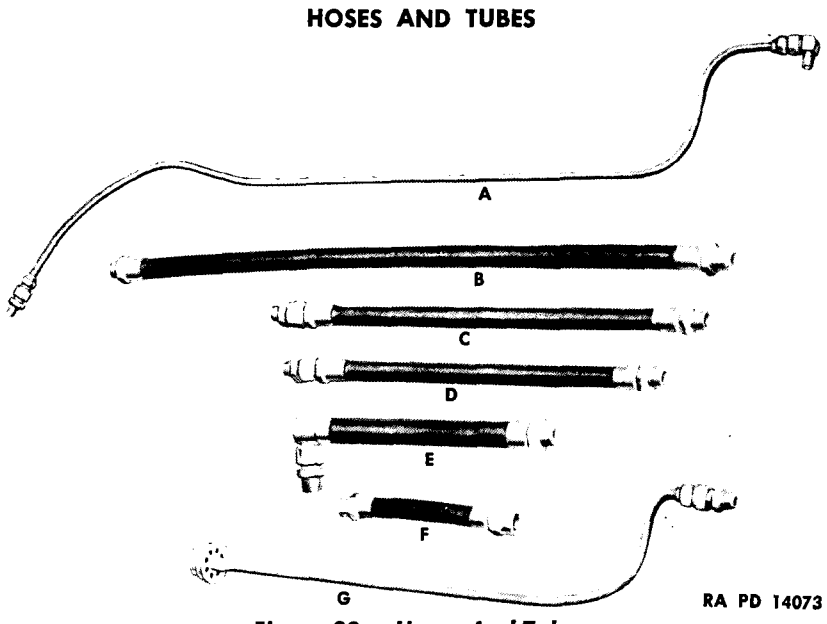


Figure 80 — Hoses And Tubes

threads. Replace any tube or hose that is imperfect, unless it is a matter of slight thread damage that can be repaired by using a tap or thread chaser.

(2) CLEANING.

AIR, compressed	OIL, engine, SAE 10
CLOTH, wiping	SOLVENT, dry-cleaning

Clean all hoses and tubes thoroughly with compressed air. Wipe fittings with cloth dampened with SOLVENT, dry-cleaning, and wrap to avoid dust or dirt getting into system. Wash breather in SOLVENT, dry-cleaning, dry, and dip in OIL, engine, SAE 10, before installing.

Section XII

LUBRICATION

	Paragraph
General	65
Lubrication guide	66
Detailed instructions	67

65. GENERAL.

a. The following lubrication instructions for the Hydraulic Turret Traversing Mechanism for the Medium Tank M3 are published for the information and guidance of all concerned and supersede all previous instructions.

b. **References.** Materiel must be lubricated in accordance with the latest instructions contained in technical manuals and/or ordnance field service bulletins.

66. LUBRICATION GUIDE.

a. Lubrication instructions for all points to be serviced are shown in the lubrication guide (fig. 81) which specifies the types of lubricant required and the intervals at which they are to be applied. This is supplementary to lubricating instructions for the using troops, included in TM 9-750.

67. DETAILED INSTRUCTIONS.

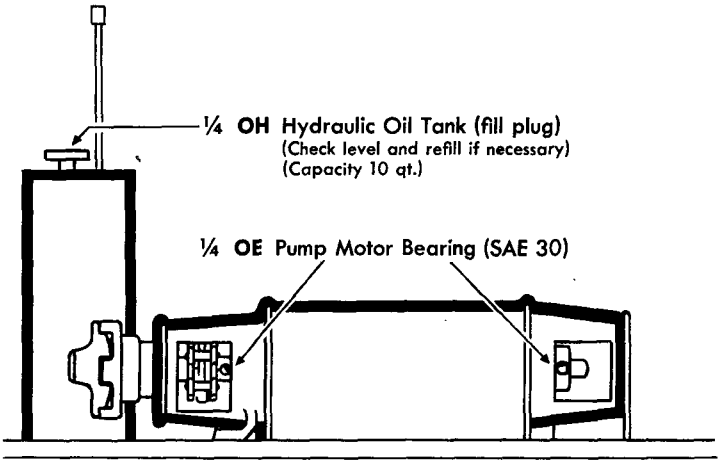
a. OIL, hydraulic, which is the medium for transmitting pressure to operate the traversing mechanism, also serves to lubricate pump, control valve and hydraulic motor. Be sure there is a plentiful supply of OIL, hydraulic, at all times (par. 32 **b** (5)).

b. Bearings in electric motor must be lubricated sparingly (par. 24 **b** (1)).

c. Gears in traversing gear mechanism are to be packed with lubricant when assembled (pars. 57 **b** (14) and 59 **b** (6)).

d. Lubricating fitting in traversing gear mechanism (fig. 56) is a straight button-head type fitting. This fitting may be replaced by a new button-head elbow fitting, 90 degrees CLDX1L.

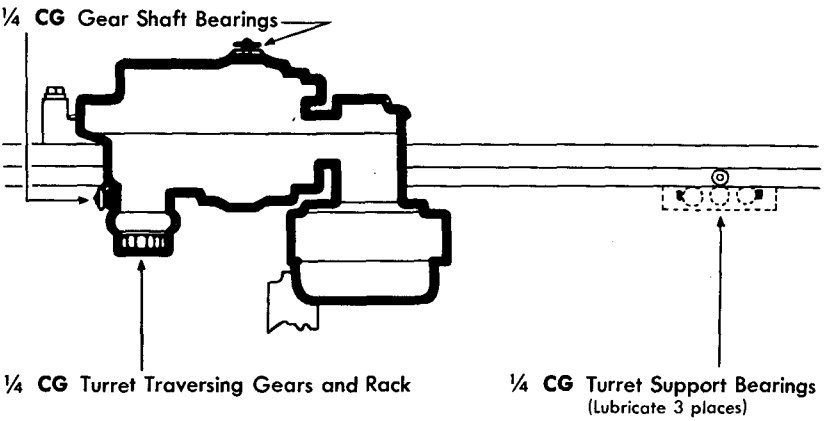
LUBRICATION



TURRET HYDRAULIC DRIVE

KEY

LUBRICANTS	INTERVAL
OE—OIL, Engine **CG**—GREASE, General Purpose No. 1 (above +32°) No. 1 or No. 0 (+32° to +10°) No. 0 (below +10°) **OH**—OIL, Hydraulic	¼—250 miles



RA PD 58078

Figure 81 — Lubrication Guide

Section XIII

SPECIAL TOOLS AND EQUIPMENT

Paragraph

Special tools and equipment 68

68. SPECIAL TOOLS AND EQUIPMENT.

a. The following tools and equipment will be found useful in assembling and disassembling components of the turret traversing mechanism:

b. **Hydraulic Motor And Pump.**

(1) The following tools are designed specifically for use in assembling and disassembling hydraulic motor and pump (prefix GR denotes Gerotor May Company):

GR1—TOOL, motor and pump shaft installing.

GR2—DRIVER, motor and pump body oil retainer removing.

GR3—TOOL, motor body and pump body oil retainer installing.

GR4—TOOL, motor head and motor body needle bearing installing.

GR5—TOOL, motor head needle bearing and bronze spacer installing.

GR6—PILOT, motor head needle bearing installing.

GR7—TOOL, motor head inner needle bearing installing.

GR8—TOOL, motor head outer needle bearing installing.

GR9—PILOT, motor head outer needle bearing installing.

(2) If these standard tools are not available, substitutes may be made as indicated:

(a) TOOL, hydraulic motor and pump shaft assembly (fig. 82). This tool may be used instead of GR1 for inserting pump or motor shaft through oil retainer.

(b) TOOL, hydraulic motor and pump shaft bearing (fig. 84). May be used instead of GR4 and GR5 for removing pump shaft bushings or motor shaft needle bearings.

(c) WASHER, special tool (fig. 83). Used with motor and pump shaft bearing tool for installing pump shaft bushings, motor shaft needle bearings and oil retainers in both pump and motor.

(d) TOOL, gerotor bearing assembling (fig. 85) may be used instead of GR8 for installing gerotor bearing in motor head.

SPECIAL TOOLS AND EQUIPMENT

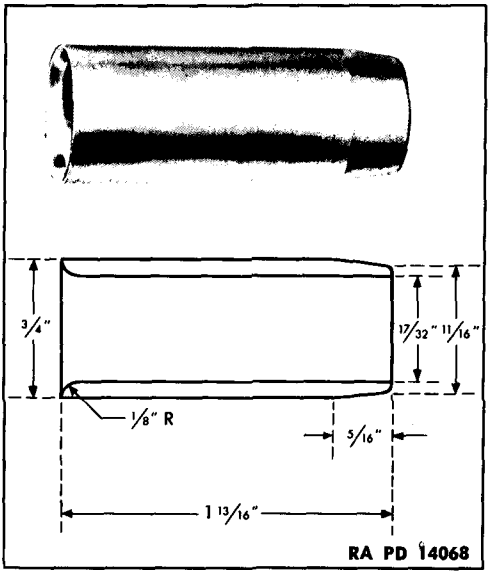


Figure 82 — Hydraulic Motor And Pump Shaft Assembly Tool

c. Traversing Gear Mechanism.

(1) Spreading pliers for snap rings with side points ground narrow enough to enter groove 0.090-inch wide, and inner faces of points ground thinner to go between ring ends.

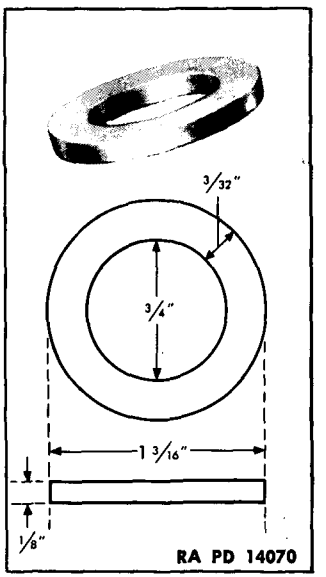


Figure 83 — Special Tool Washer

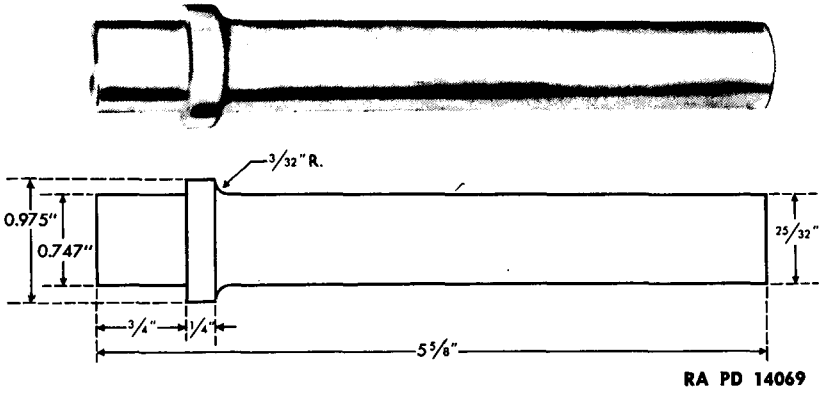


Figure 84 — Hydraulic Motor And Pump Shaft Bearing Tool

(2) Box wrench, $\frac{7}{16}$ inch twelve point, with box ground to a maximum height of $\frac{3}{16}$ inch for nuts on handwheel extension-housing assembly studs.

(3) Flat bar steel $^{11}/_{64}$ by $1\frac{7}{32}$ by 3 inches to fit lock nut in handwheel extension-housing assembly.

(4) Flat bar steel $\frac{3}{16}$ to $^{15}/_{64}$ by 2 by 2½ inches to fit slots in main drive-shaft-bearing lock nut.

(5) Flat bar steel ¼ by ¾ by 6 inches to fit slot in end of sliding-gearfork shaft.

(6) Round steel 1.249 inches - 0.0005 inch OD., 8 inches long to remove oil seal next to 15-tooth pinion.

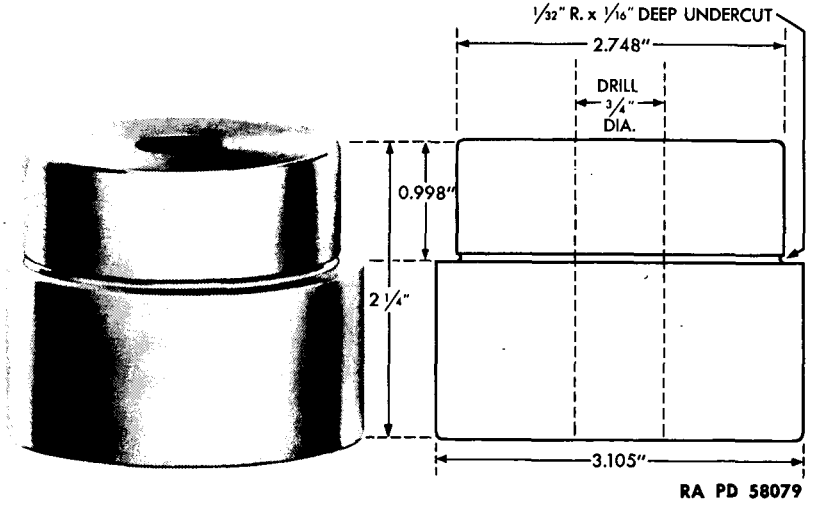


Figure 85 — Gerotor Bearing Tool

SPECIAL TOOLS AND EQUIPMENT

(7) Driver for main drive shaft lower bearing and oil seal. Body $1\frac{15}{32}$ inches diameter, 3 inches long with pilot 1.248 - 1.249 inches diameter, 1⅛ inches long. Shoulder undercut at 75 degrees with body.

(8) Flat washer 2⅛ by $1\frac{9}{32}$ by $\frac{3}{16}$ inch to ⅜ inch for use on driver to install oil seal.

(9) Disk, hardened and ground, 2.0617 inches - 2.0622 inches OD. by ¾ inch including ⅛ inch by 30 degree chamfer on each end. For taking measurements to determine thickness of shims.

(10) Two parallels, hardened and ground, 0.6250 by 4½ inches or 5 inches long. For taking measurements to determine thickness of shims.

(11) Driver, body $1^{53}/_{64}$ inch diameter, 3½ inches long with pilot 0.780 - 0.785 inch diameter, $\frac{9}{16}$ inch long for installing main drive shaft ball bearing.

(12) Driver, body $1\frac{7}{32}$ inch diameter, 7 inches long with pilot 0.780-0.785 inch diameter, $\frac{9}{16}$ inch long for removing main drive shaft ball bearing.

(13) Adjustable face spanner wrench with pins 0.085 - 0.090 inch diameter, 0.110 inch to 0.120 inch long.

(14) Adjustable face spanner wrench with pins 0.110 - 0.120 inch diameter, 0.110 - 0.120 inch long.

Section XIV

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69. STANDARD NOMENCLATURE LISTS.

a. Armament.

Gun, machine, cal. .30, Browning, M1919A4—fixed and flexible, and M1919A5—fixed; and ground mounts ..... SNL A-6

Gun, submachine, cal. .45, Thompson, M1928A1 and M1 ..... SNL A-32

Gun, 37-mm, M5 and M6, and cradle, tank, 37-mm, T2 ..... SNL A-45

Gun, 75-mm, M2 and M3, and recoil mechanisms (tank) ..... SNL C-34

b. Cleaning, preserving and lubricating materials; recoil fluids, special oils, and miscellaneous related items ..... SNL K-1

c. Tank, medium ..... SNL G-104

Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained as the "Ordnance Publications for Supply Index" ..... OPSI

70. EXPLANATORY PUBLICATIONS.

a. Armament.

Browning machine gun, cal. .30, HB, M1919A4 (mounted in combat vehicles) ..... FM 23-50

Ordnance maintenance: Browning machine gun, cal. .30, all types, U. S. machine gun, cal. .22, and trainer, cal. .22 ..... TM 9-1205

REFERENCES

Ordnance maintenance: Thompson submachine gun, cal. .45, M1928A1 ..... TM 9-1215

Ordnance maintenance: 37-mm gun materiel (tank) M5 and M6 ..... TM 9-1250

Thompson submachine gun, cal. .45, M1928A1 ..... FM 23-40

37-mm gun, tank, M5 (mounted in tanks) ..... FM 23-80

37-mm gun, tank, M6 (mounted in tanks) ..... FM 23-81

75-mm gun materiel M2 and M3 (tank) ..... TM 9-307

b. Cleaning, preserving, lubricating, and welding materials and similar items issued by the Ordnance Department ..... TM 9-850

c. **Engines.**

Ordnance maintenance: Accessories for Wright R975EC-2 engines for medium tanks M3 and M4 ..... TM 9-1750D

Ordnance maintenance: Breeze cartridge starter for radial Diesel engines ..... TM 9-1731

Ordnance maintenance: Guiberson Diesel engine, model T-1400, series 3 ..... TM 9-1750E

Ordnance maintenance: Wright Whirlwind engine, model R975EC-2 ..... TM 9-1751

d. Medium tank M3, M3A1, and M3A2 ..... TM 9-750

e. Ordnance maintenance: Auxiliary generator (Homelite model HRH-28) for medium tank M3 ..... TM 9-1752

f. Ordnance maintenance: Power train unit, three-piece differential case, for medium tanks M3, M4, and modifications ..... TM 9-1750

g. **Stabilizers.**

Ordnance maintenance: Stabilizers ..... TM 9-1798A

Ordnance maintenance: Gyro control mechanism (confidential) ..... TM 9-1798B

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A.G. 062.11 (1-22-43)
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