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TM 9-1653

WAR DEPARTMENT

TECHNICAL MANUAL

ORDNANCE MAINTENANCE
DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

OCTOBER 10, 1942

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TECHNICAL MANUAL
No. 9-1653

WAR DEPARTMENT,
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ORDNANCE MAINTENANCE

DATA TRANSMISSION SYSTEM M6

(For 90-MM Antiaircraft Gun Mount M1)

Prepared under the direction of the
Chief of Ordnance

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DATA TRANSMISSION SYSTEM M6
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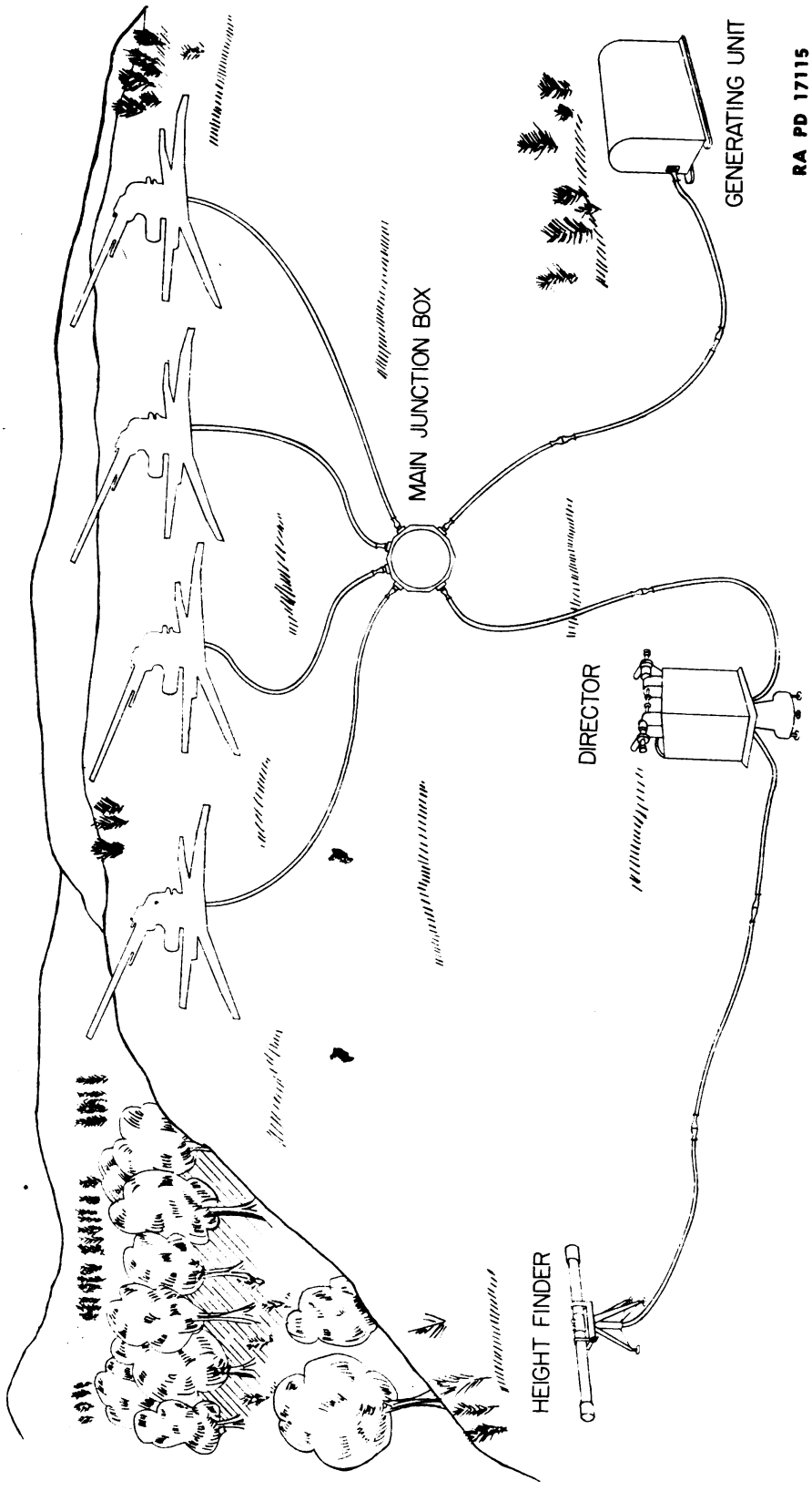

Figure 1 — Arrangement of Data Transmission System

Section I

INTRODUCTION

1. SCOPE.

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 Data Transmission System M6, supplementary to those in the Field and Technical Manuals prepared for the using arm. Additional descriptive matter and illustrations are included to aid in providing a complete working knowledge of the materiel.

2. CHARACTERISTICS.

a. The data transmission system M6 is for use with the 90-mm. A.A. gun mount M1. The system normally serves a four gun battery, as shown in figure 1 but may be used equally well with a smaller number of guns. This system is similar to the data transmission system T-17 with which the early gun mounts were equipped.

b. The data transmission system operates as one unit of the complete fire control equipment which includes a height finder and an A.A. director. Gun pointing data (firing azimuth, quadrant elevation, and fuze setting data) for the battery, originate at the A.A. director, and may be read on the director dials. The data transmission system transmits the director dial readings electrically to indicator dials on the separate gun mounts. Handwheel operators at the corresponding gun controls match pointers on the indicator dials to apply the data to the gun. A similar data transmission arrangement is used between the height finder and the A.A. director.

c. Electric power (115 to 125 volts, 60 cycles, alternating current) for operation of the data transmission system is supplied by a gasoline-electric alternating-current generating unit, M6 or M4. These generating units are described in separate technical manuals. See section X.

d. The fuze setter used with this system is fuze setter M13 (previously designated T15). This fuze setter is described in a separate technical manual. See section X.

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Section II

DESCRIPTION

3. COMPONENTS.

a. The general arrangement of off-carriage components is shown in figure 2. On-carriage components for one gun are shown in figure 3.

b. The main junction box (figs. 7 and 8) connects the director and generating unit to the guns by cable and plug assemblies. The actual arrangement of off-carriage cables connected to the main junction box may differ from that shown in figure 2, depending on the relative location of guns and connected equipment. The cable and plug assembly which connects the height finder to the director does not pass through the main junction box.

c. Cable connections are brought in to the gun carriage through a receptacle box (fig. 9) which is part of the contact ring assembly and is located on the lower (stationary) part of the carriage. The cable then passes to the contact ring assembly, which provides a sliding connection to the terminal box on the upper (revolving) part of the carriage, preventing twisting of the cable as the gun is traversed. The contact ring (fig. 10) and terminal box (fig. 11) are located centrally in the base of the gun mount.

d. The cable from the terminal box ends in a plug which fits into the receptacle on the gun junction box (fig. 12). The gun junction box contains a transformer which provides a 6-volt power source for energizing the electric lamps in the azimuth and elevation indicators

DESCRIPTION

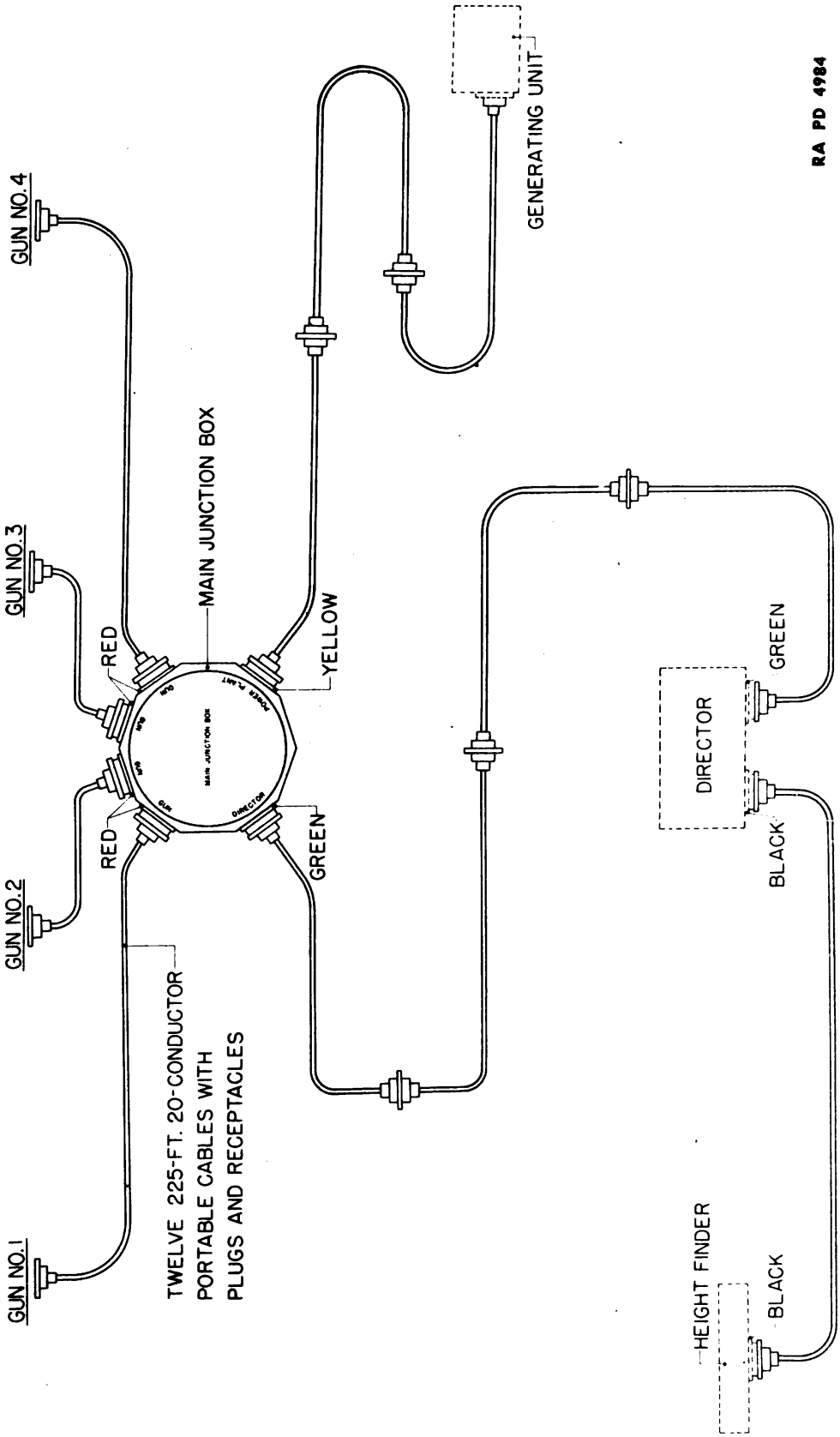

Figure 2 — Schematic Arrangement of Off-carriage Parts

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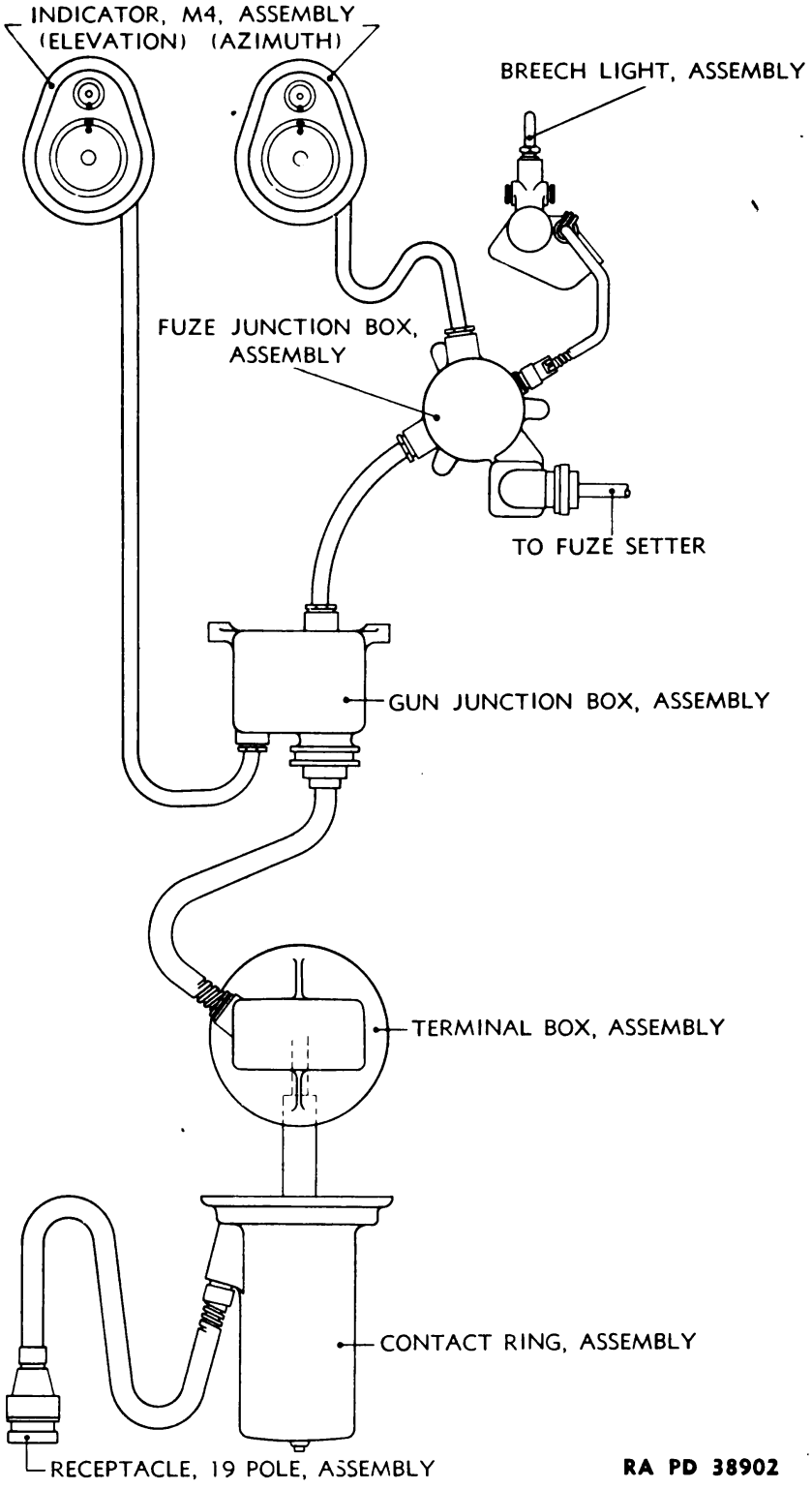

Figure 3 — Schematic Arrangement of On-carriage Parts for One Gun

DESCRIPTION

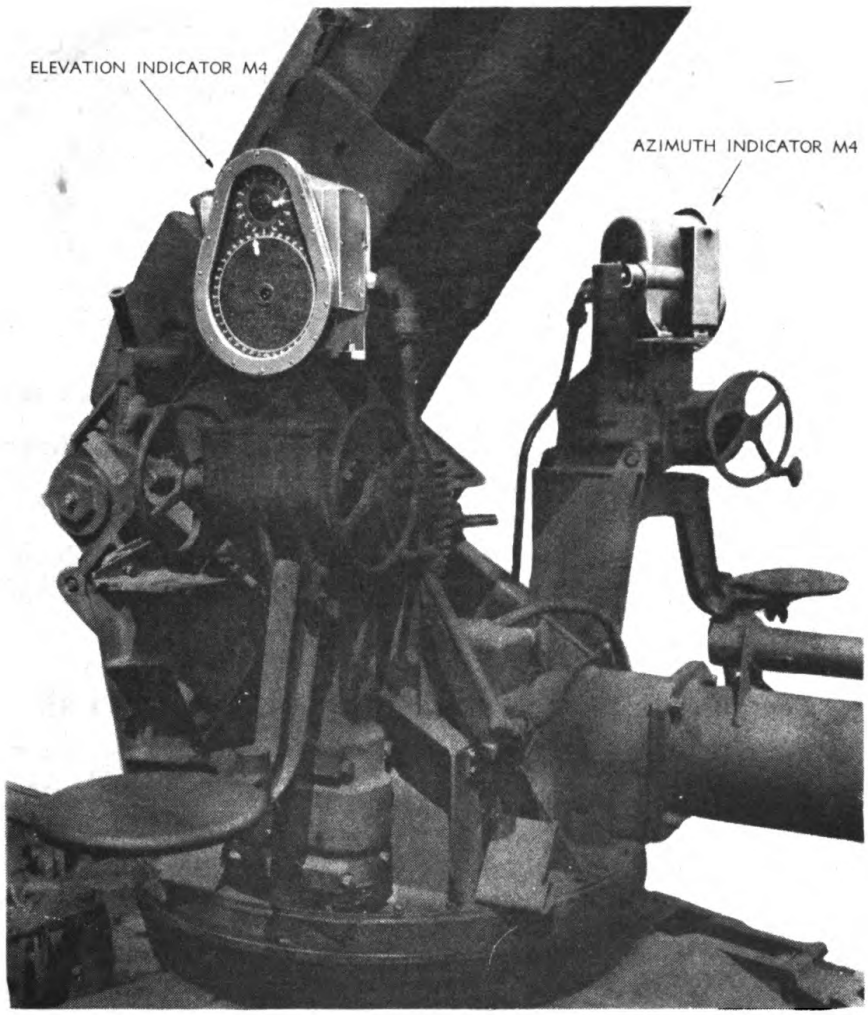

Figure 4 — Location of Azimuth and Elevation Indicators M4

(fig. 4), fuze setter, and breech light (fig. 16). The two cables from the gun junction box are routed to the right and left sides of the carriage through separate conduits, one leading to the elevation indicator, the other to the fuze junction box.

e. The fuze junction box (fig. 13) on the left side of the carriage has a receptacle to which the fuze setter is connected, and a clamp and adapter for connecting the breech light. A conduit and cable lead to the azimuth indicator.

f. Azimuth and elevation indicators M4 are identical. They are located where they can be read easily and conveniently by the azimuth

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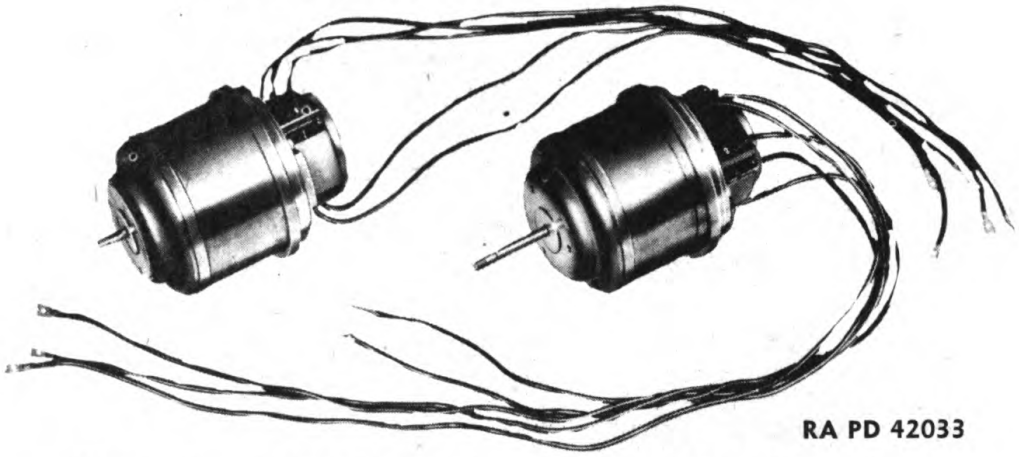

Figure 5 — Synchronous Repeaters Used in the Azimuth and Elevation Indicator M4

and elevation handwheel operators of the gun. The azimuth indicator is mounted on the left side and the elevation indicator on the right side of the gun, as shown in figure 4.

4. SYNCHRONOUS TRANSMITTERS AND REPEATERS.

a. Operation of the data transmission system is based on the use of self-synchronous transmitters and repeaters. The transmitters and repeaters operate from alternating current. For each element of data transmitted by the system, an alternating-current synchronous transmitter, one or more alternating-current synchronous repeaters, and connecting means are provided. Transmitters and repeaters are similar in appearance, and have the same electrical construction. Repeaters of the type used in the azimuth and elevation indicator are shown in figure 5.

b. A transmitter and single repeater with the necessary electrical connections are shown schematically in figure 6. It will be noticed that the transmitters and repeaters resemble small electric motors. However, the armature shafts do not revolve continuously, as in the case of a motor, but assume a definite angular position which is determined by the position of the transmitter armature shaft. The repeater armature shaft follows any motion of the transmitter armature shaft. The transmitter is mounted in the director, and has its armature shaft positioned by the computing device therein. As the computed data changes, the repeater follows immediately and thereby provides a continuous, definite indication of the transmitted data.

c. An important characteristic of this type of data transmission is that the repeater armature shaft automatically resets (synchronizes) to the same relative angular position with respect to the transmitter

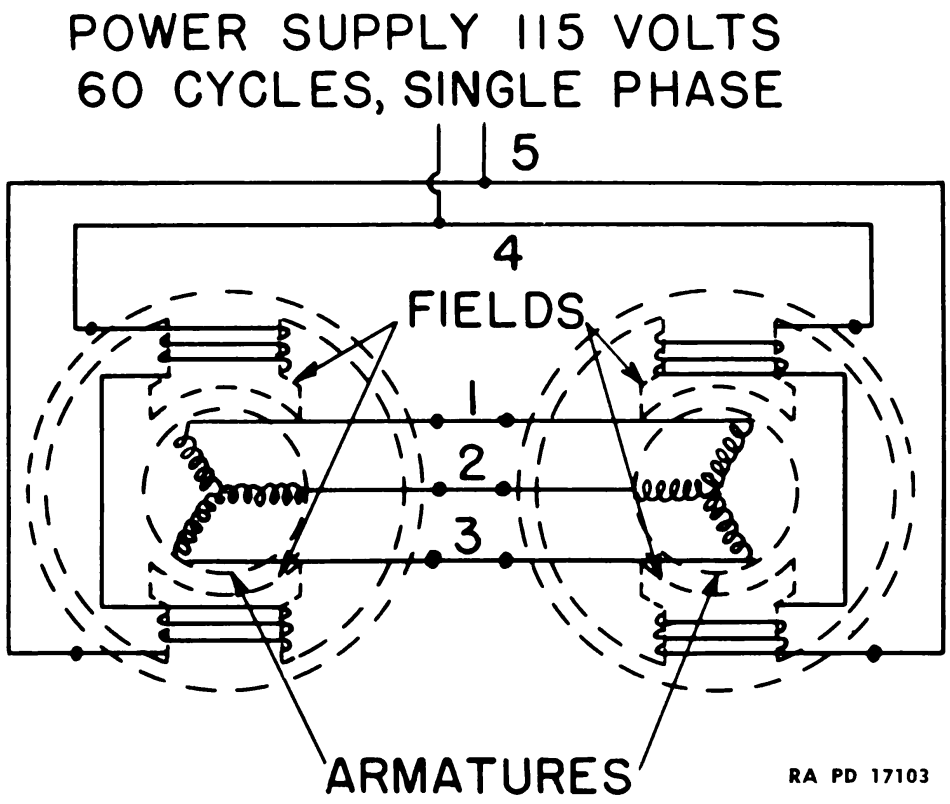

Figure 6 — Synchronous Transmitter and Repeater

whenever power is applied. Because of this characteristic, the system is termed "self-synchronous."

d. For transmission of the same data to different points, several repeaters can be connected in multiple to a single transmitter. Each repeater responds as though it were separately connected, and is not affected by the other repeaters except under certain abnormal conditions, described in section VI.

5. MAIN JUNCTION BOX.

a. The main junction box (figs. 7 and 8) is entirely portable and may be placed in any convenient position to accommodate the desired arrangement of guns and director. It consists of a decagonal cast aluminum body with a removable cover. The body supports six 19 pole receptacles and contains an annular terminal ring. Assembled and sectioned views of the main junction box are shown in figure 17.

b. Four of the 19 pole receptacles C56703 (fig. 18) are painted red for the gun cables, and one is painted green for the director cable. One 19 pole receptacle C69409 (fig. 19) with male contact fingers is painted yellow for the power cable from the generating unit. The cover

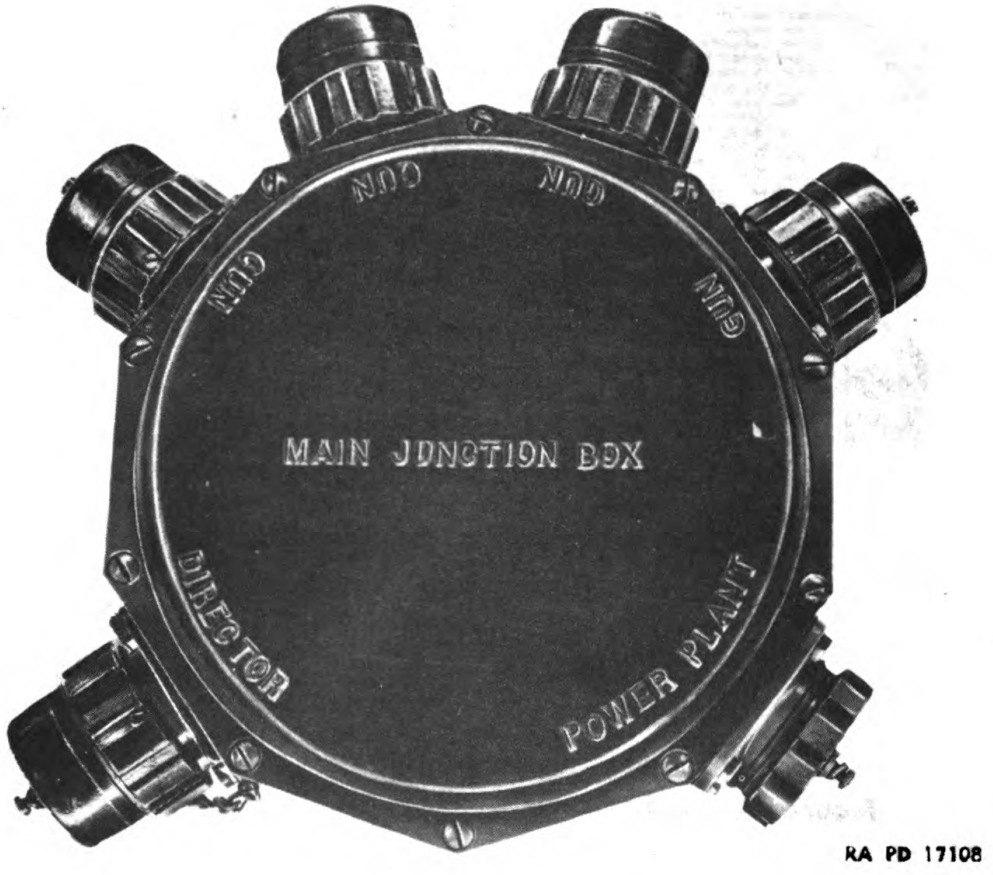

Figure 7 — Main Junction Box (D28880)

bears designations to show the units to be connected to various receptacles. Assembly of the cover in the correct relation to the body is secured by a locating pin. Gaskets under the cover and receptacles render the box watertight.

c. Receptacle and plug connections for assembling cables to the main junction box are shown in figure 20. This figure is arranged to show which of the plugs or receptacles have male contact fingers, and which ones have female spring terminals.

d. The terminal ring contains 20 terminal plates for interconnecting the various receptacles. These terminal plates are marked with numerals corresponding to the numerals on the terminals of the conductors. The wiring diagram (fig. 21) shows how the various receptacles are interconnected through the terminal ring. All four gun receptacles are wired like the one shown. Numerals and symbols to designate the conductors

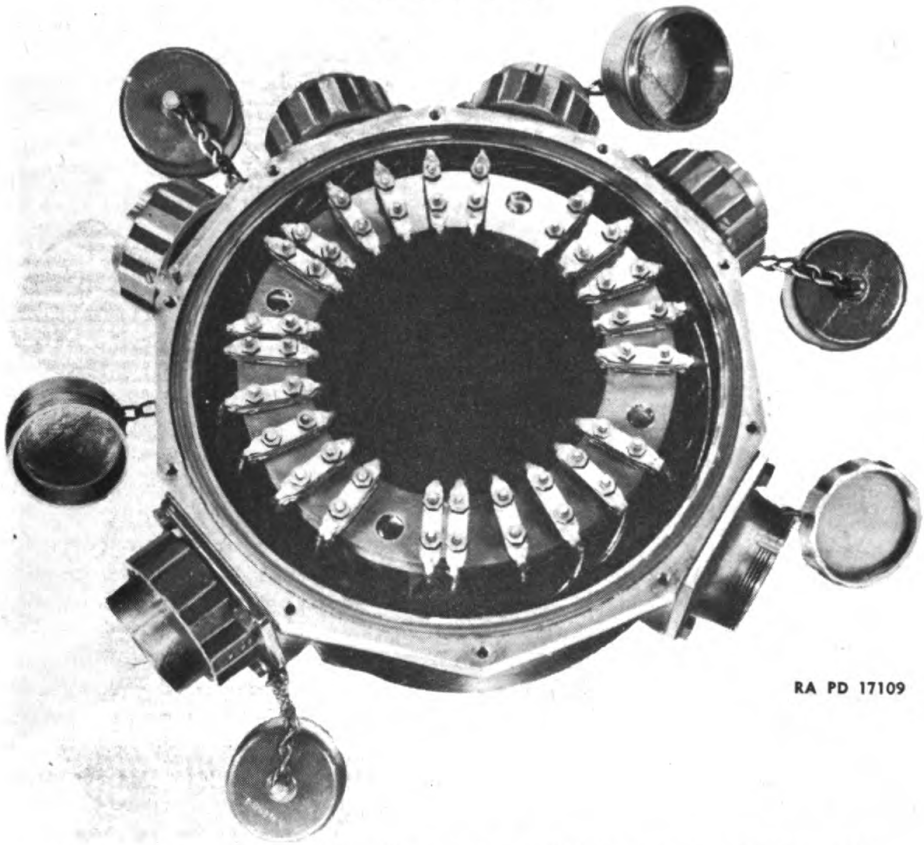

Figure 8 — Main Junction Box with Covers Removed

in the various circuits are employed in accordance with the following code:

1, 2, 3 — Azimuth, fine.
6, 7, 8 — Azimuth, coarse.
11, 12, 13 — Elevation, fine.
16, 17, 18 — Elevation, coarse.
9, 10, 19 — Fuze range.
4, 5, 14, 15 — Power, 115 volts.
4, 5A — Power, 115 to 125 volts.

6. RECEPTACLE BOX.

The receptacle box (fig. 9) for connection of the portable cable to the gun carriage is formed by the fixed end of the contact ring cable (fig. 22).

7. CONTACT RING.

a. The contact ring (fig. 10) consists of a cylindrical housing, which contains a spindle and brush rigging assembly, and a terminal segment

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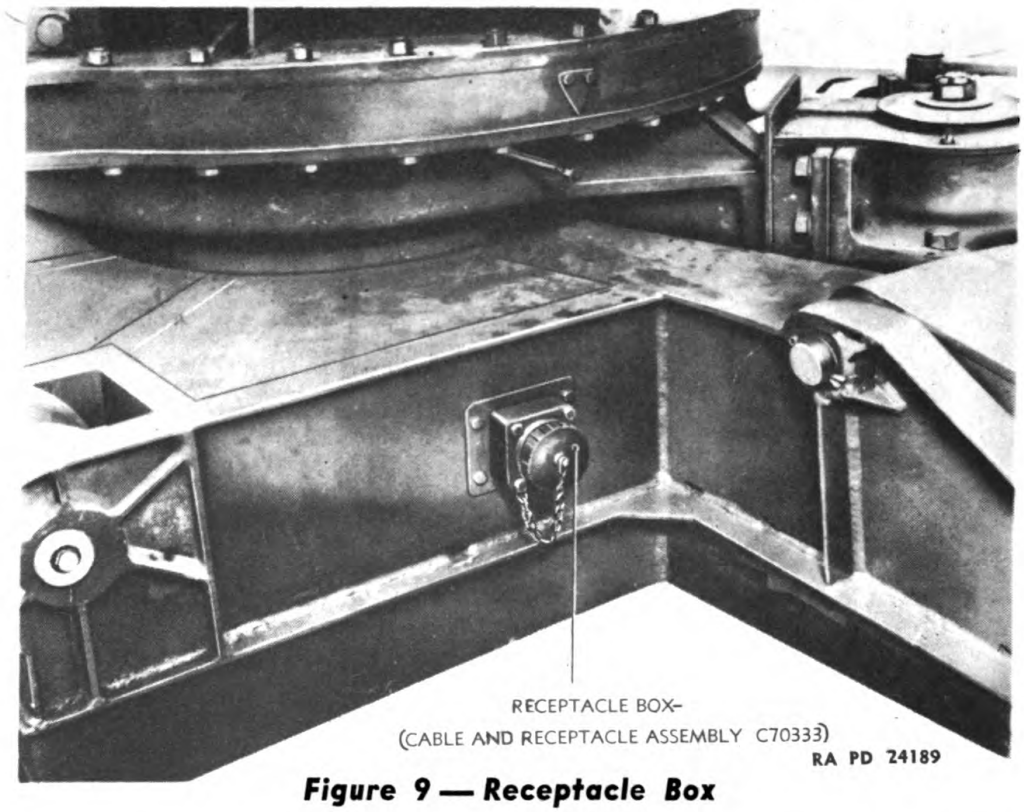

Figure 9 — Receptacle Box

assembly. Assembled and sectioned views of the contact ring are shown in figures 23 to 29.

b. The housing is bolted to the fixed undercarriage in the center of the gun mount. The cable leading to the contact ring from the receptacle box on the gun mount is connected to the terminal plates in the terminal segment assembly and these terminal plates are in turn wired to the corresponding contact screws in the brush rigging assembly.

c. The spindle assembly revolves within the brush rigging assembly making contact at all times with the spring brushes contained therein. The terminals soldered to the 20 conductors leading from the spindle assembly are stamped and connected in accordance with the coding shown in figure 46. These terminals are connected to the corresponding contact screws in the terminal box (fig. 30).

d. The contact ring is wired in accordance with the wiring diagram shown in figure 47.

8. TERMINAL BOX.

a. The terminal box (fig. 11) mounts directly over the contact ring and centers over the contact ring spindle. The cable leading from the

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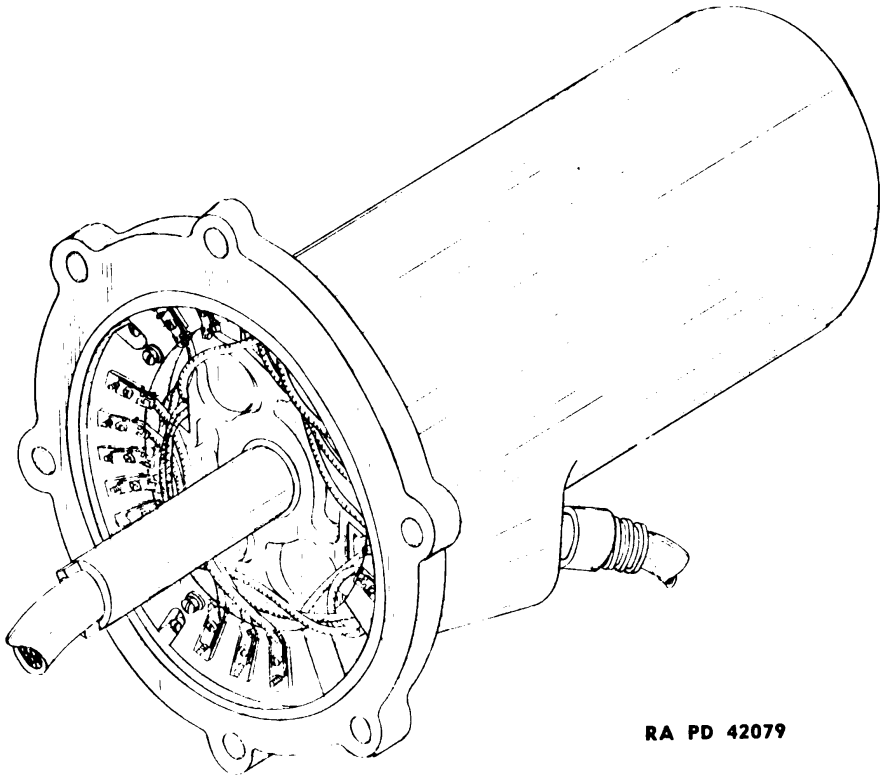


Figure 10 — Contact Ring

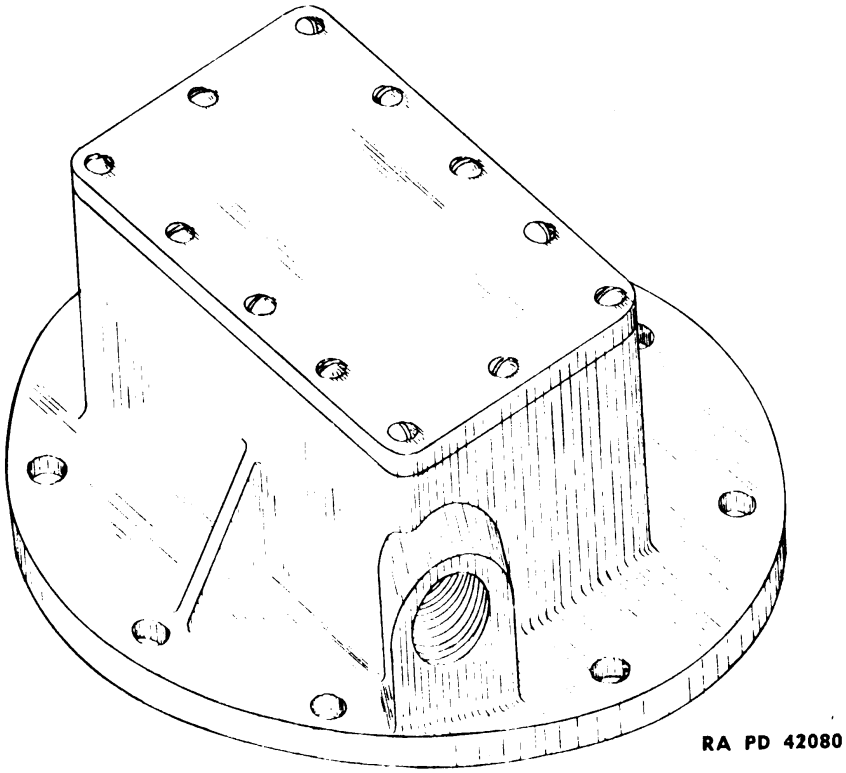


Figure 11 — Terminal Box

contact ring is connected to the terminals on the terminal strips, (figs. 30 and 31) and these terminals are in turn wired through another cable (fig. 32) to the gun junction box.

b. The top cover is removable and has a gasket for waterproofing. A gasket is also inserted between the terminal box flange and the supporting surface on the gun carriage.

9. GUN JUNCTION BOX.

a. The gun junction box (figs. 12 and 33) has a rectangular body and a removable top cover. The top cover is sealed by a gasket. The hollow rib in the body is fitted with a drain plug containing a fiberglass filter.

b. The 19 pole receptacle C69409 (fig. 19) on the front of the gun junction box receives the mating plug of the cable (fig. 32) from the terminal box. The receptacle cover is screwed onto the dummy receptacle body to keep it from dangling when the cable is connected.

c. A trouble light socket receptacle (fig. 34) and a light switch receptacle (fig. 35) are mounted on the front of the box.

d. The box has two packing glands to accommodate the conduit tubing for the outgoing conductors.

e. Mounted within the box are a step-down transformer and two terminal strips (fig. 36). The terminal strips carry stamped terminal plates for wiring in accordance with the wiring diagram shown in figure 47. The terminal strips with their attached wires can be lifted out of the box when the cover is removed.

10. FUZE JUNCTION BOX.

a. The fuze junction box (figs. 13 and 37) has a circular body and a removable cover. The cover is sealed by a gasket. The sump in the bottom of the body is fitted with a drain plug containing a fiberglass filter.

b. The 19 pole receptacle C77962 (fig. 38) receives the mating plug of the cable from the fuze setter.

c. The box has two packing glands to accommodate the conduit tubing for the incoming and outgoing conductors, and a cable clamp to accommodate the breech light cable.

d. Mounted within the box are two terminal strips (fig. 39). The terminal strips carry stamped terminal plates for wiring in accordance with the wiring diagram shown in figure 47.

DESCRIPTION

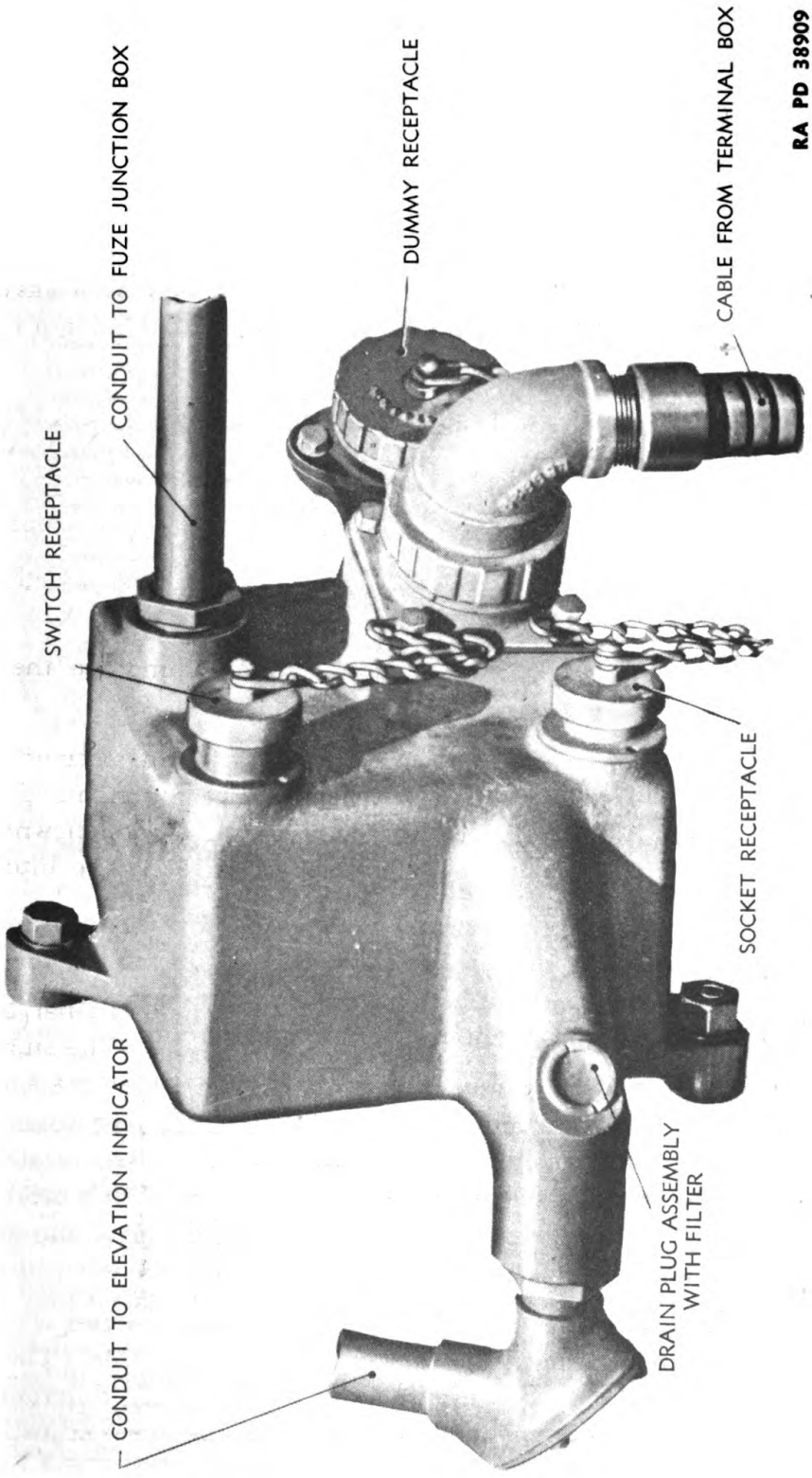
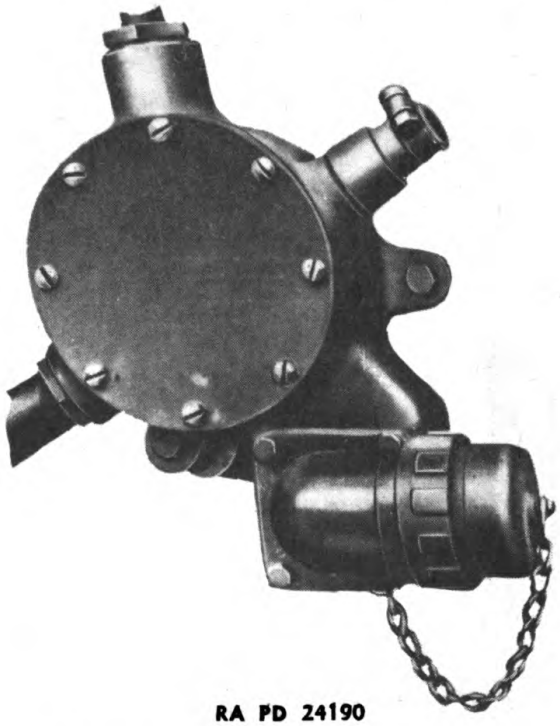


Figure 12 — Gun Junction Box



RA PD 24190

Figure 13 — Fuze Junction Box

11. AZIMUTH AND ELEVATION INDICATOR M4.

a. Two identical azimuth and elevation indicators M4, shown in figures 14 and 15, are provided for each gun mount. One indicator controls the gun azimuth and the other indicator controls the gun elevation, using the values for these quantities computed by the director. The azimuth indicator is on the left-hand side of the gun mount; the elevation indicator is on the right-hand side. Indicators are located where they may be observed continuously by the operators of the corresponding motions of the guns.

b. Each indicator consists essentially of two alternating-current synchronous repeaters (fig. 5) with the necessary dials, scales, and indexes, housed in a weathertight case, and provided with a mechanical drive geared to the traversing or elevating mechanism of the gun.

c. The upper repeater is electrically connected to the coarse (6,400 mils per rev.) transmitter of the director; the lower repeater is electrically connected to the fine (400 mils per rev.) transmitter. (These two repeaters are similar in construction but have slightly different shaft extensions.) The arrangement of the repeaters and their adjusting devices is shown in figure 40. The adjusting worms rotate the repeater frames to synchronize the repeater indications with those at the trans-

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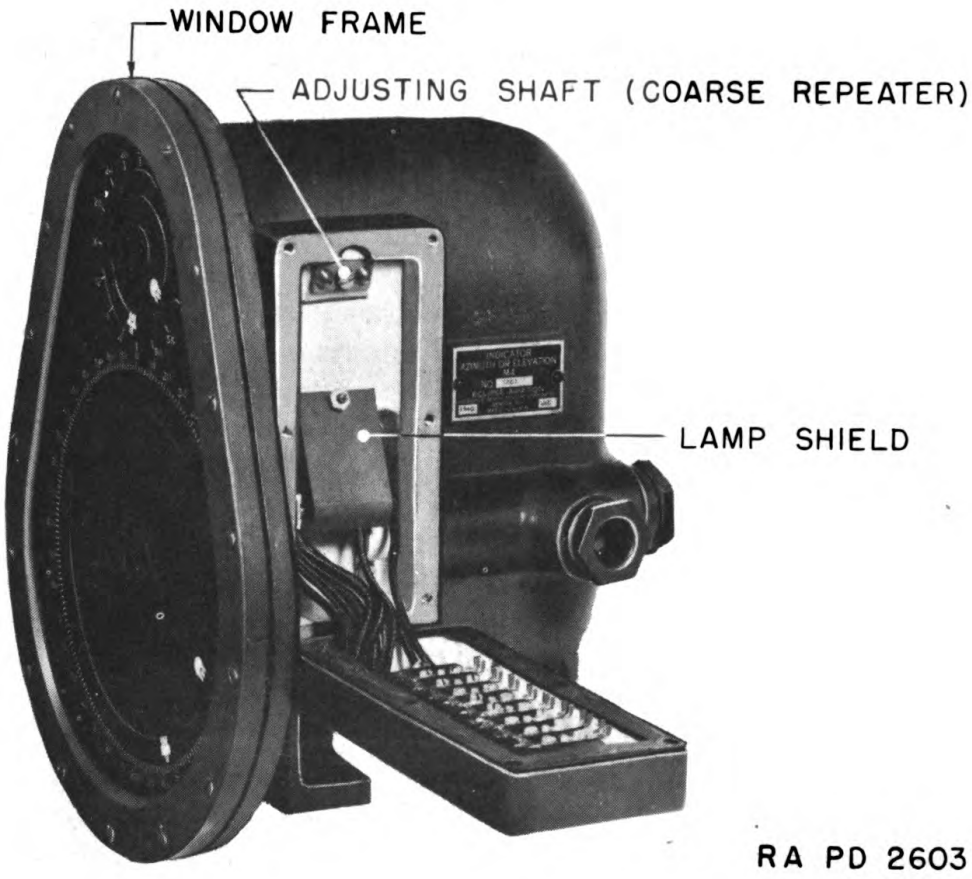

Figure 14 — Azimuth and Elevation Indicator, M4— Right-hand Cover Open

mitters. The worm gears are bolted to the repeater housings. The adjusting worms are positioned by slotted flexible shafts, accessible outside the case. The slotted shaft for adjusting the upper (coarse) repeater is located on the upper right-hand side of the indicator and is accessible when the terminal block cover is swung open. The slotted shaft for adjusting the lower (fine) repeater is located on the lower left-hand side of the indicator and is accessible when the sliding cover is raised. The slotted shafts are purposely adjusted at assembly to turn quite hard, to prevent possibility of accidental changes. Stop screws are butted into the worm gear teeth for limiting the adjusting motion, to prevent possibility of tearing the repeater wiring. To permit larger adjustments than can be accommodated with the slotted shafts, the inner coarse and fine indexes are arranged so as to be shifted readily, relative to the shafts of their respective repeaters when the three clamping screws near the center are loosened.

d. The lower or fine repeater has assembled on its shaft the inner

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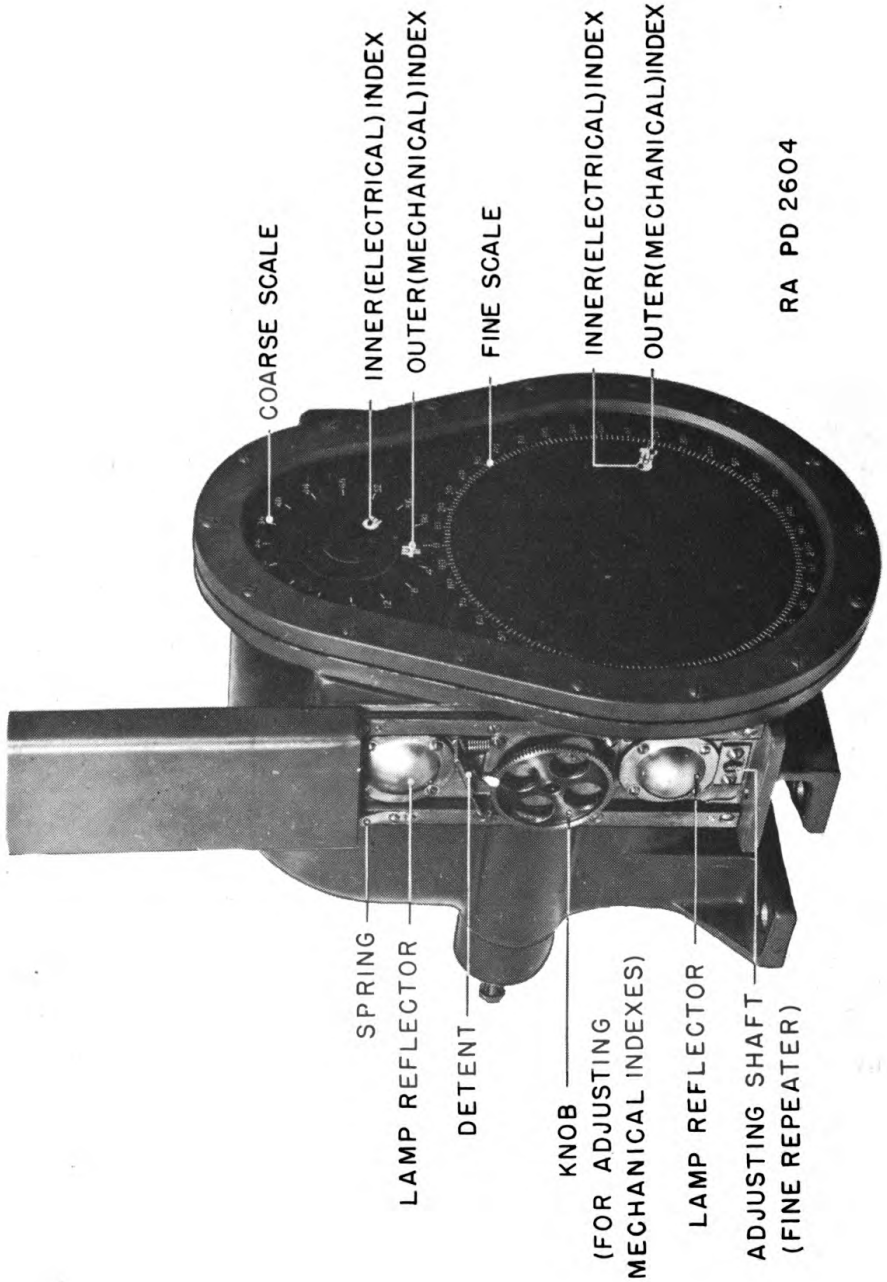

Figure 15 — Azimuth and Elevation Indicator, M4—Left-hand Cover Raised

DESCRIPTION

index for the fine motion. The annular outer index (fig. 41) rotates concentrically with the inner index. This outer index is driven from the traversing or elevating drive of the mount, through a differential gear mechanism by which adjustments for orienting purposes are introduced. Motion of the inner and outer fine indexes is in the ratio of 1 turn for 400 mils (16:1 ratio) change in elevation or azimuth. Each of the fine indexes carries a single index graduation and together they comprise the inner and outer elements of a follow-the-pointer system. Coincidence of the actual and transmitted angles is indicated when the index graduations are matched. The outer index also indicates angular values against the graduations of the outer (fine) scale, which is graduated at 2-mil intervals and numbered at 10-mil intervals.

e. The upper or coarse repeater drives the inner index for the coarse motion. The annular outer index rotates concentrically with the inner index. This outer index is driven by a worm from the gear on the fine motion. Motion of the inner and outer (coarse) indexes is in the ratio of 1 turn for 6,400 mils (1:1 ratio) change in elevation or azimuth. The outer (coarse) scale is graduated and numbered (final "00" omitted) at 400-mil intervals to provide a coarse indication.

f. The drive shaft is geared to the indicator drive mechanism of the gun mount. Gear ratios are such that the drive shaft makes 1 turn for 100 mils motion of the gun in azimuth, or elevation, as the case may be. The bevel gears for connecting the shaft with the corresponding drive from the gun mount are part of the mount, not of the data transmission system.

g. Adjustment of the mechanical drive so that the coarse and fine outer indexes indicate the actual azimuth or elevation of the gun is accomplished by a differential gear mechanism (fig. 41). Any such adjustment is introduced by means of the mechanical index adjusting knob (fig. 15) which has a toothed edge engaged by the detent to prevent movement when once adjusted. The knob is accessible when the cover is raised. In the case of the azimuth indicator this adjustment will be required each time the battery is emplaced. The elevation indicator ordinarily requires such adjustment only once, when initially installed.

h. The case in which the indicator is housed is weathertight. The drive shaft is provided with a suitable oil seal. The window frame is removable from the front of the instrument, and is sealed by a gasket. The window is of non-shatterable glass and is held in place by a retainer.

i. Three lamps illuminate the scale and indexes. Two are located in the compartment on the left-hand side when facing the indicator and one in the compartment on the right-hand side. For replacement of

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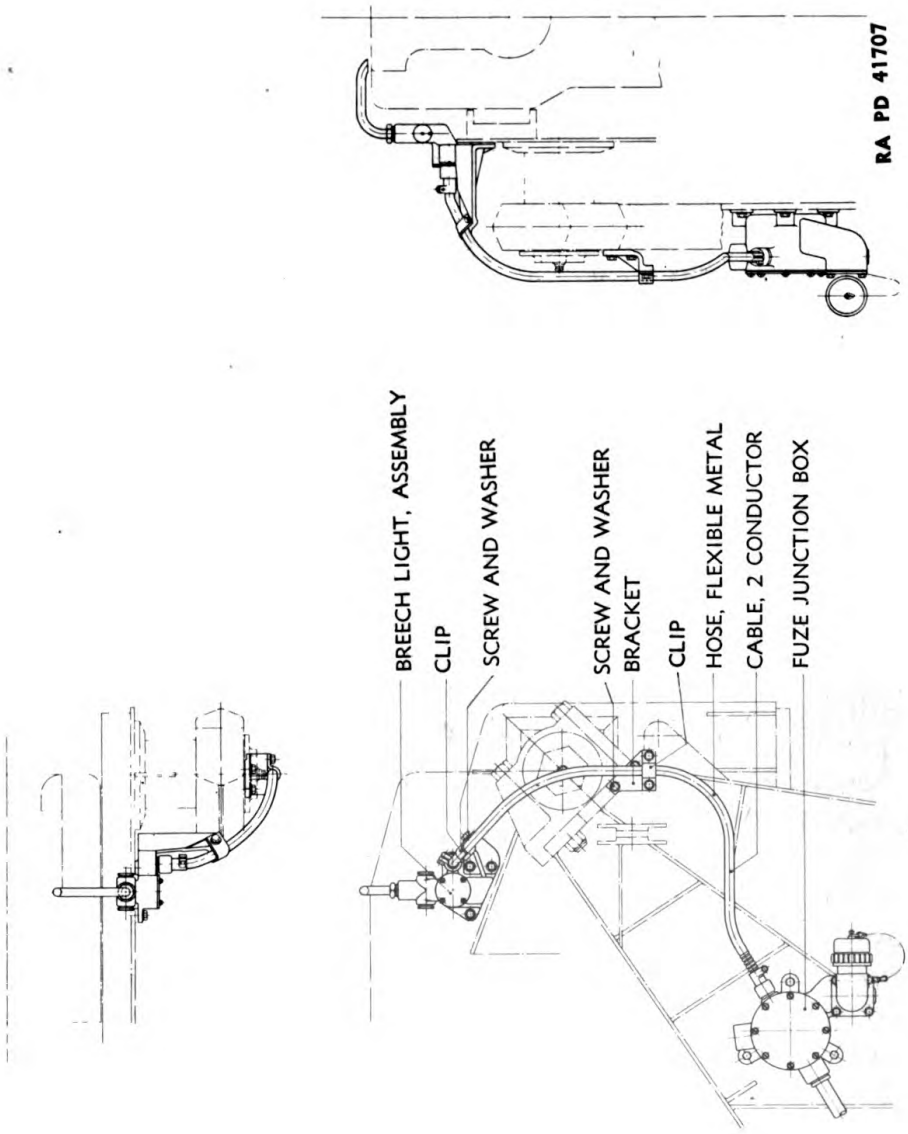

Figure 16 — Mounting of Breech Light on Gun Carriage

those on the left-hand side, reflectors are removable by means of 4 screws; for the one on the right-hand side, the shield may be removed by means of the nut at the top. These lamps are standard 6-8 volt, 2-3 cp., miniature lamps with G-6, (¾-inch) bulb and double contact bayonet base.

j. The graduations on all the indexes are painted with luminous paint.

k. Figures 47 and 48 show the wiring of these indicators and the on-carriage wiring associated therewith. The plates on the terminal block are numbered. The terminal block is assembled to the cover and is readily accessible when the cover is swung down.

12. BREECH LIGHT.

a. The breech light is mounted on the gun carriage as shown in figure 16. Assembled and sectioned views of the breech light are shown in figure 42.

b. The lamp well within the breech light bracket contains two 6-8 volt miniature lamps (No. 51) with G-3½, ($\frac{7}{16}$-inch) bulb and bayonet base. Each lamp is mounted in a receptacle assembly which is readily removable to permit lamp replacement. The receptacle assembly threads into the lamp well opening, and is locked by a clamping screw in the rim of the receptacle cap.

c. A rod of clear, transparent plastic carries the light from the lamp well to the breech opening. This rod has a peculiar property which enables it to carry light around bends and corners. The rod is furnished as part of a complete tube assembly. The tube assembly is held in the bracket by a packing gland which prevents entrance of moisture to the lamp well.

13. CABLES.

The twelve cables used in the off-carriage wiring are 20-conductor cables, each 225 feet long. Each complete cable assembly (fig. 43) includes a receptacle assembly C69778 (fig. 44) on one end and a plug assembly C69777 (fig. 45) on the other. The receptacle has male contact fingers, and the plug has mating spring terminals. Contact fingers and terminals are numbered. The individual conductors are identified by color, and are connected to the contact fingers and terminals according to the code shown in figure 46.

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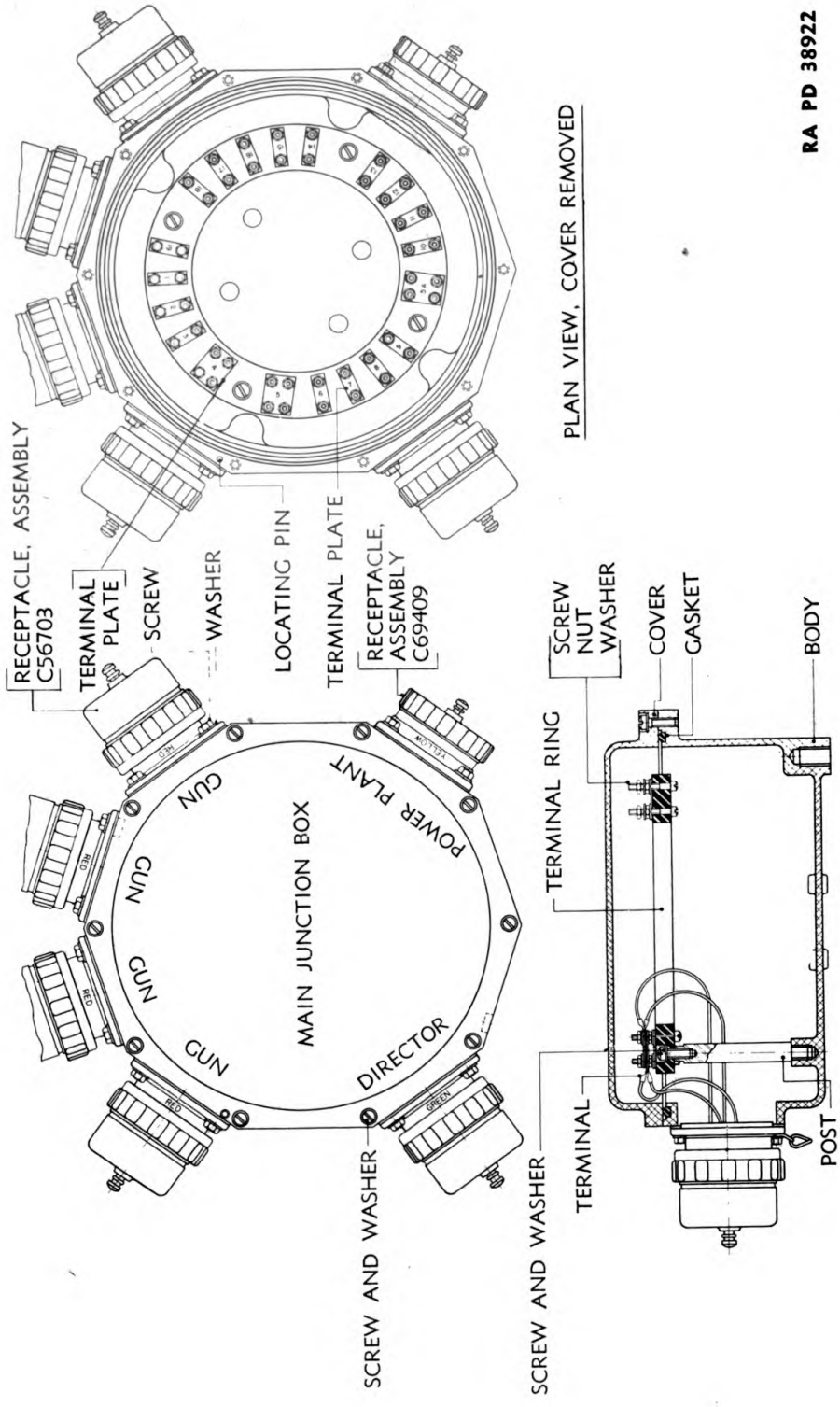

Figure 17 — Main Junction Box — Assembled and Sectioned Views

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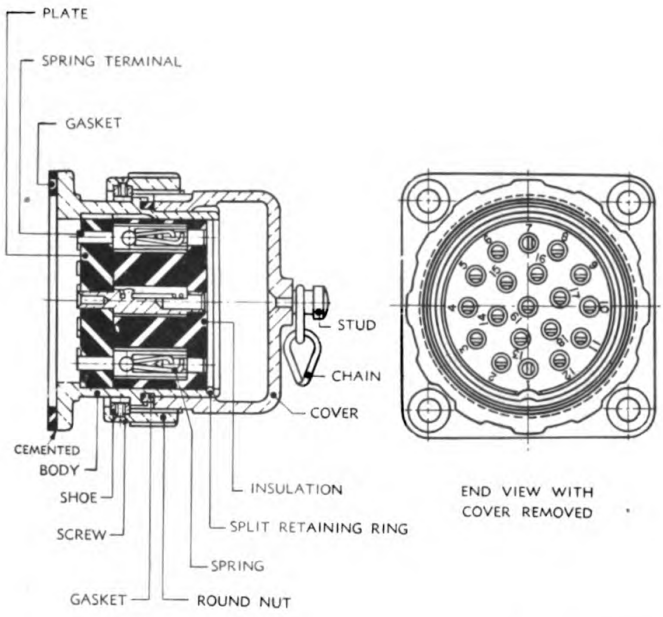

Figure 18 — Receptacle Assembly (C56703) for Main Junction Box

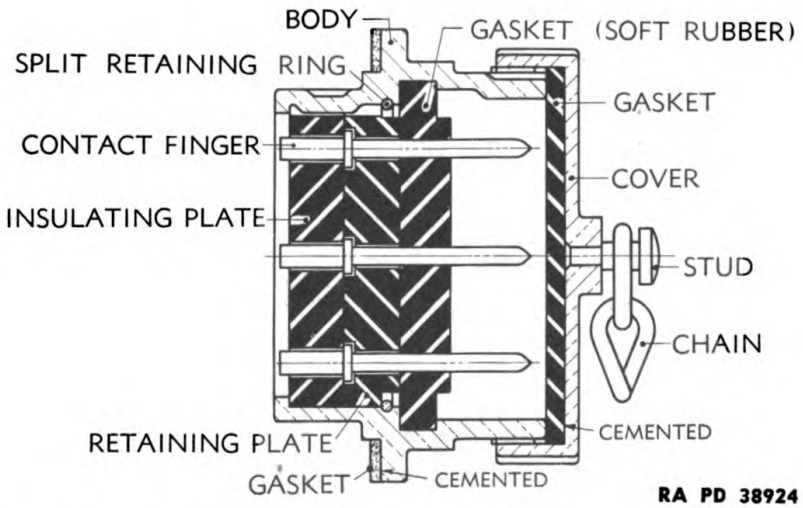

Figure 19 — Receptacle Assembly (C69409) for Main Junction Box, Gun Junction Box and Receptacle Box

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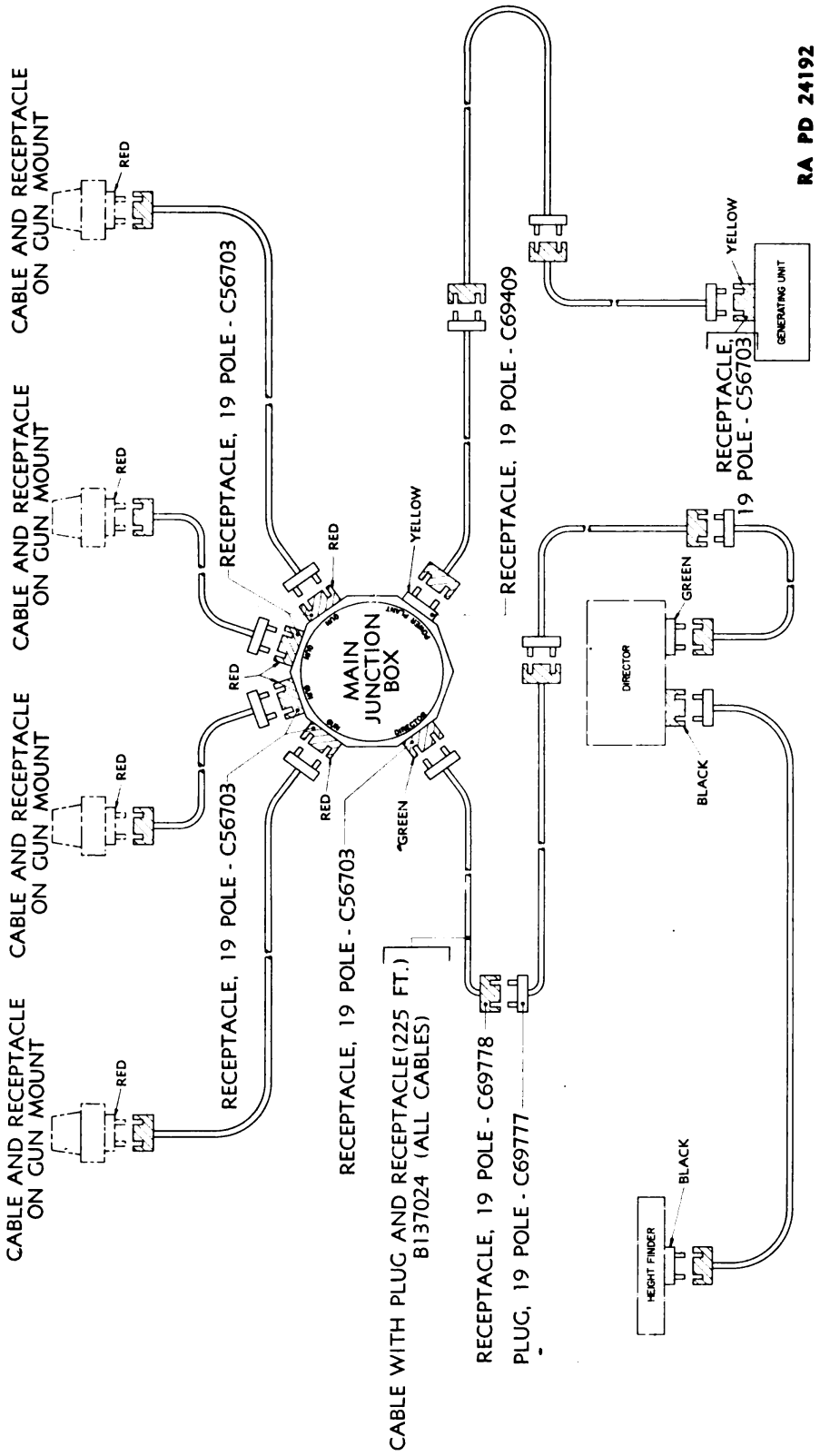

Figure 20 — Receptacle and Plug Connections for Assembling Cables

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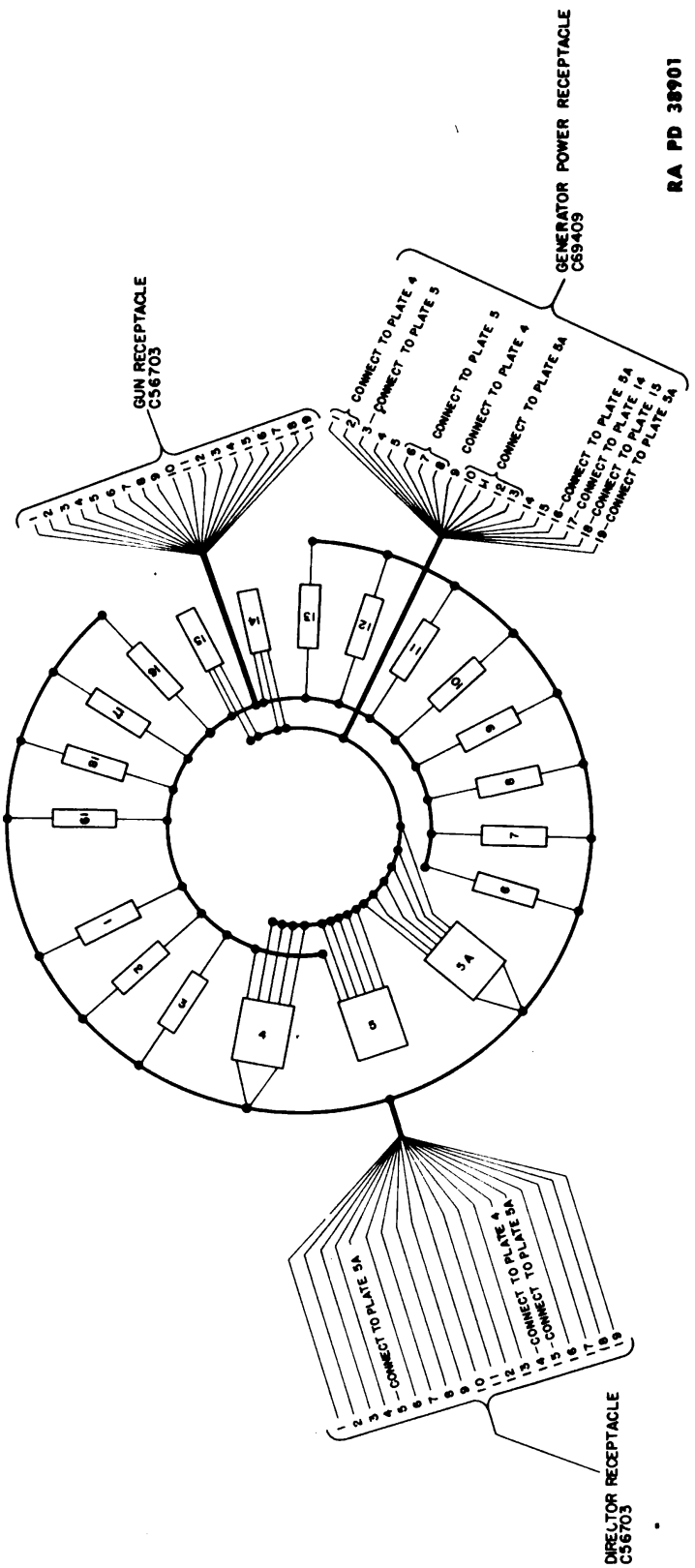

Figure 21 — Wiring Diagram for Main Junction Box

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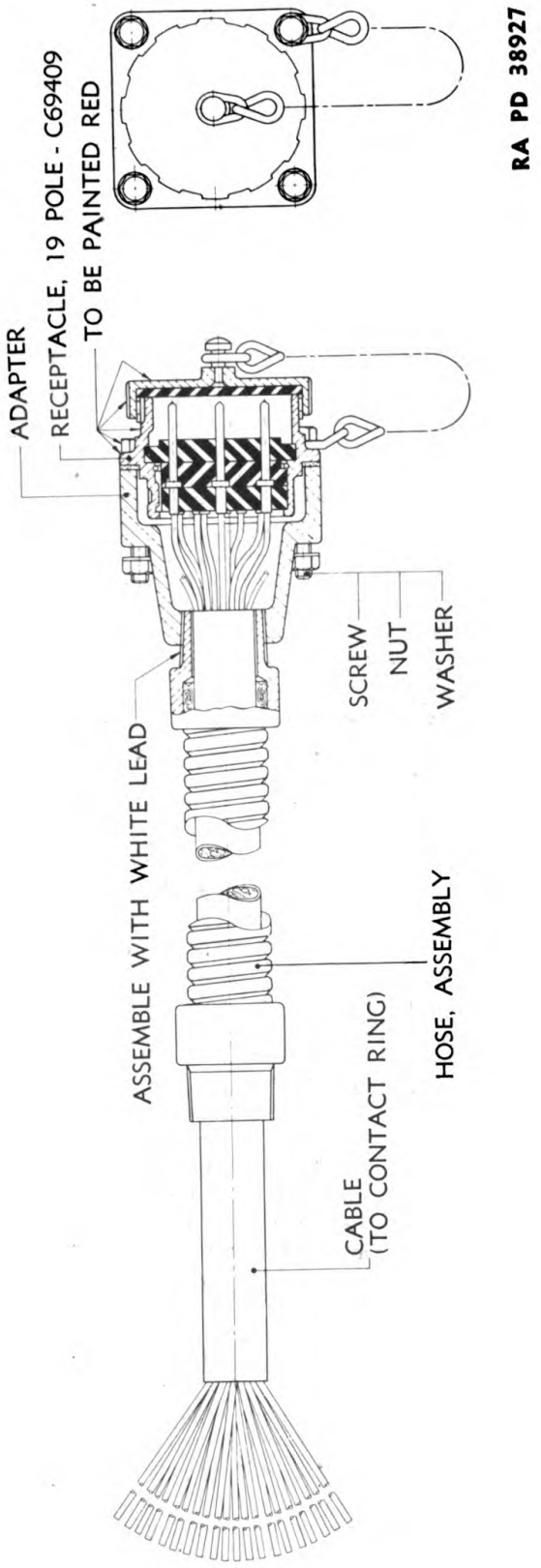

Figure 22 — Cable with Receptacle Box

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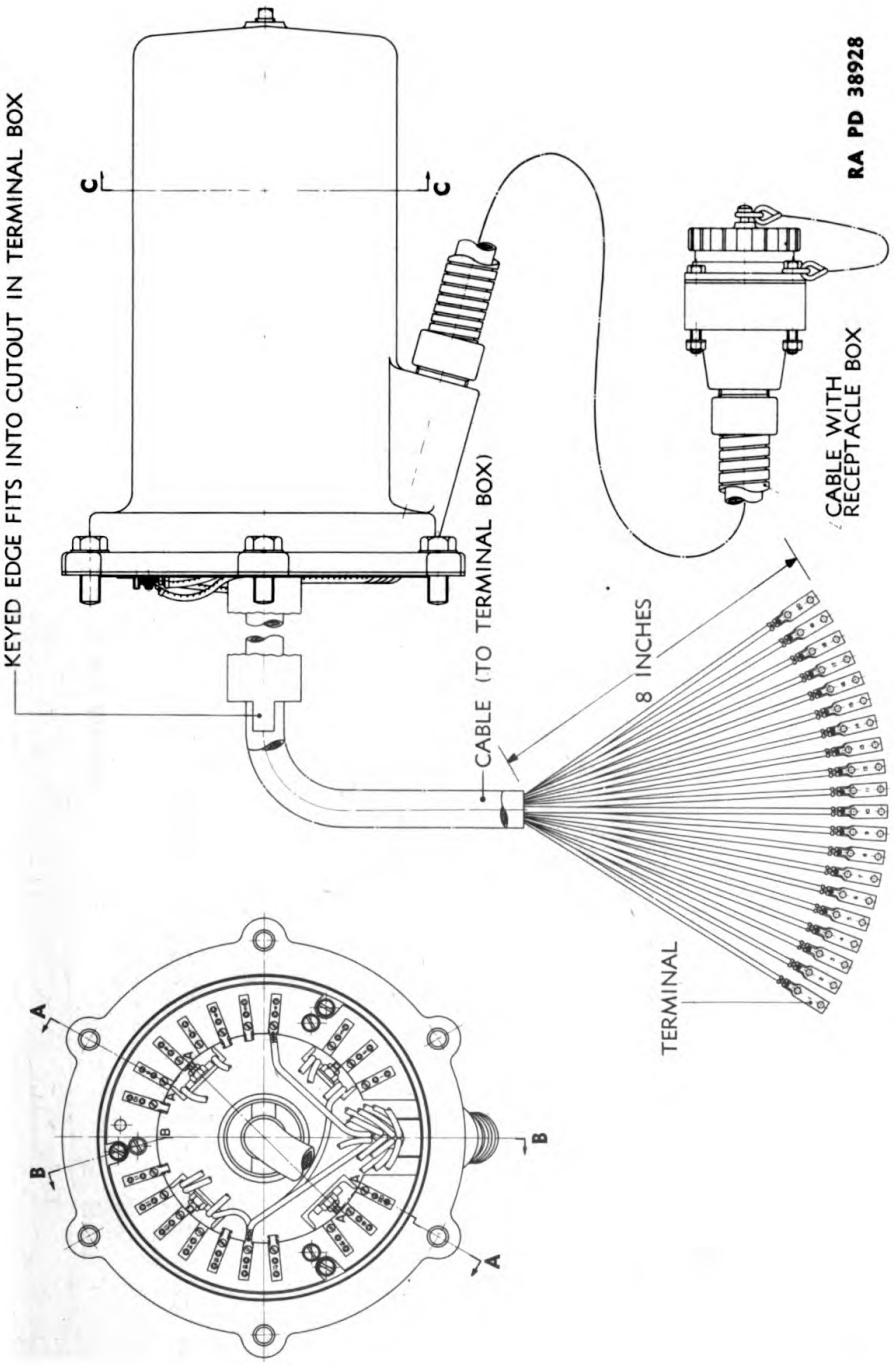

Figure 23 — Contact Ring — Assembled View

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(For 90-MM Antiaircraft Gun Mount M1)

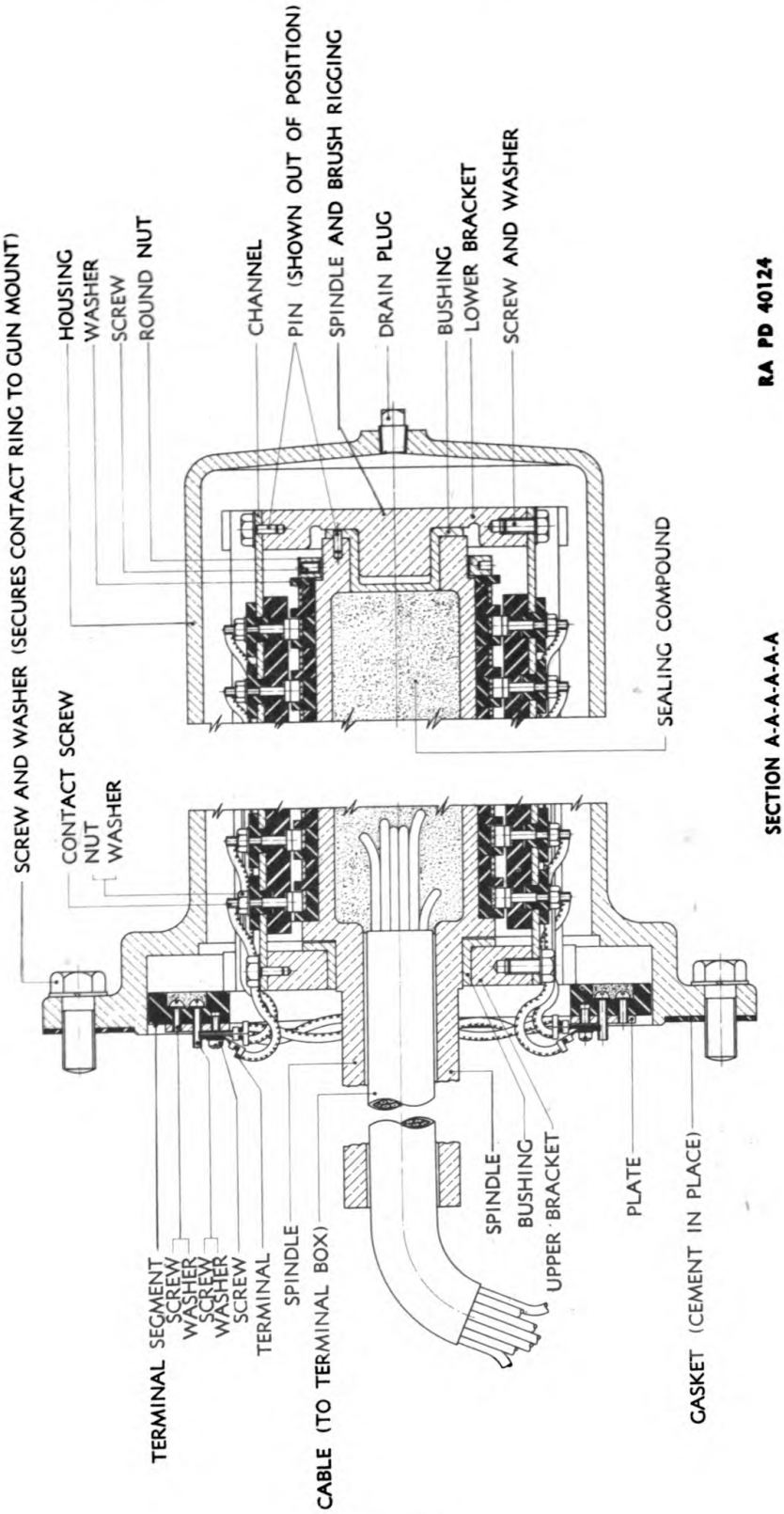
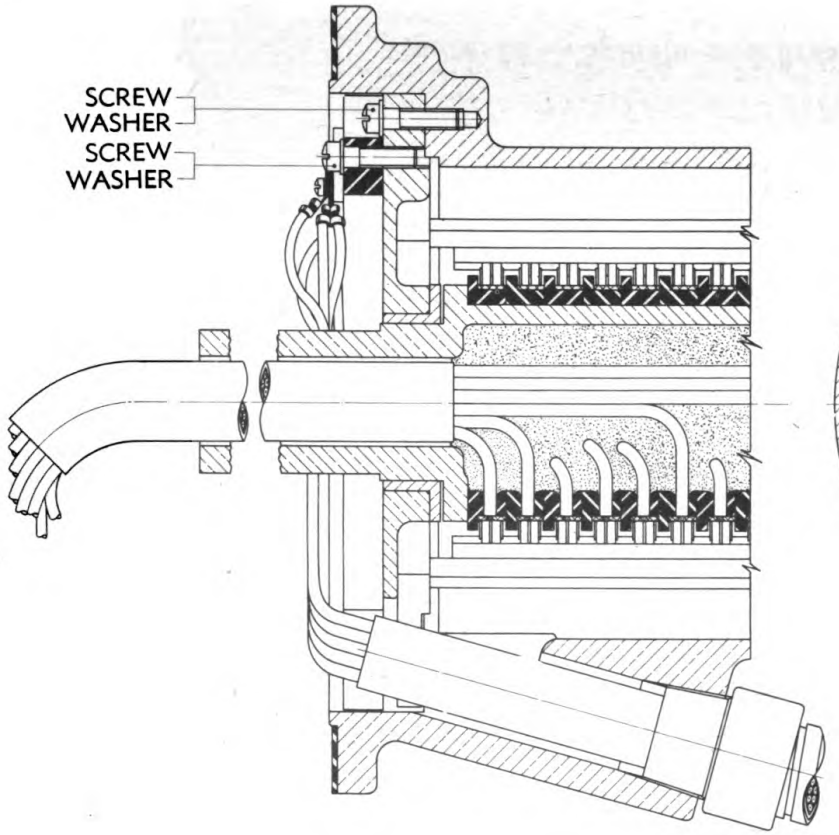
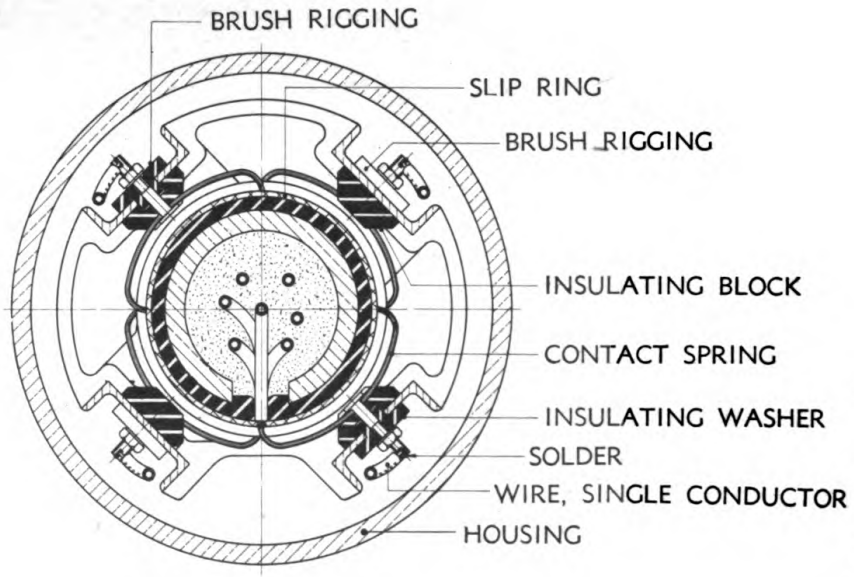


Figure 24 — Contact Ring — Vertical Section (Location of Section Plane Is Shown in Assembled View of Contact Ring)



SECTION B-B-B



SECTION C-C

RA PD 40125

Figure 25 — Contact Ring — Cross Sections (Locations of Section Planes Are Shown in Assembled View of Contact Ring)

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

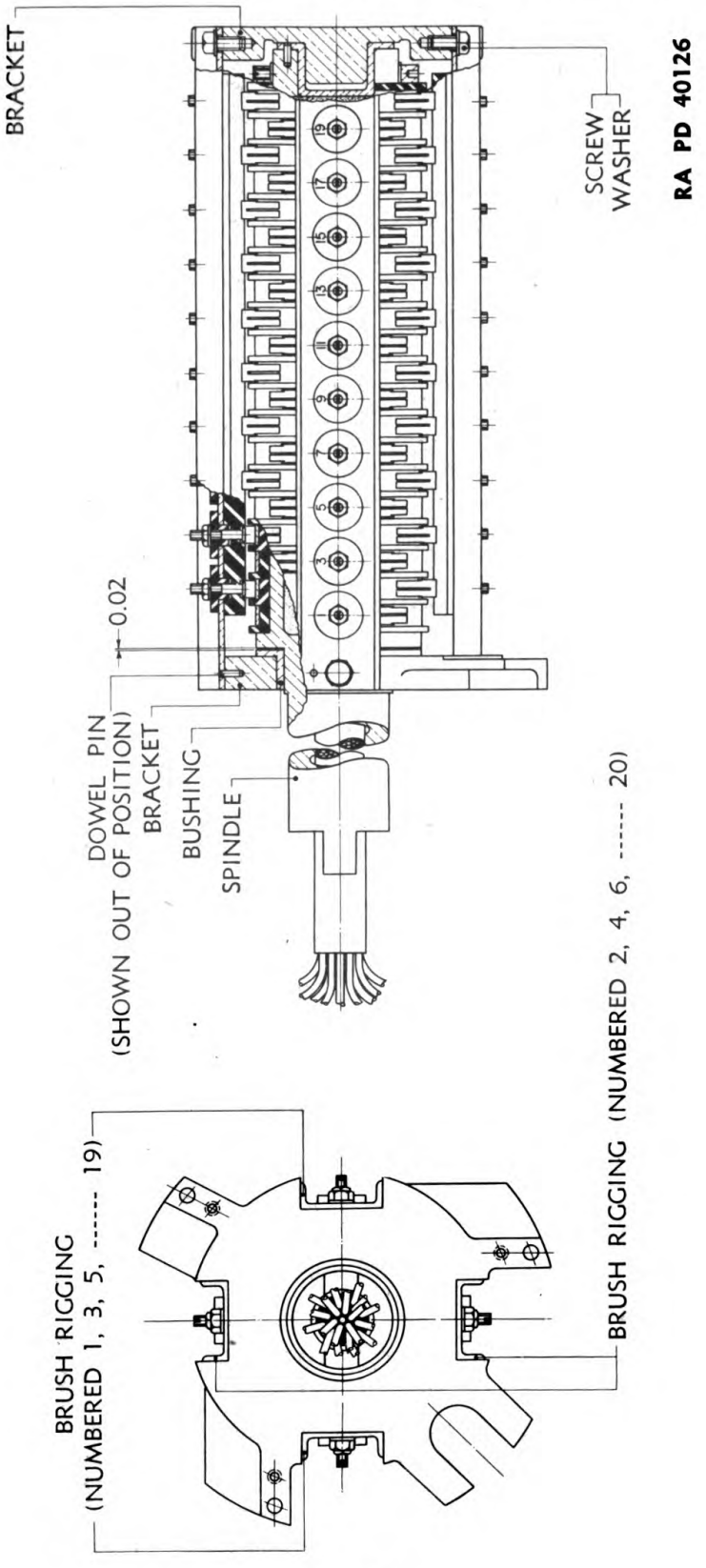


Figure 26 — Spindle and Brush Rigging for Contact Ring

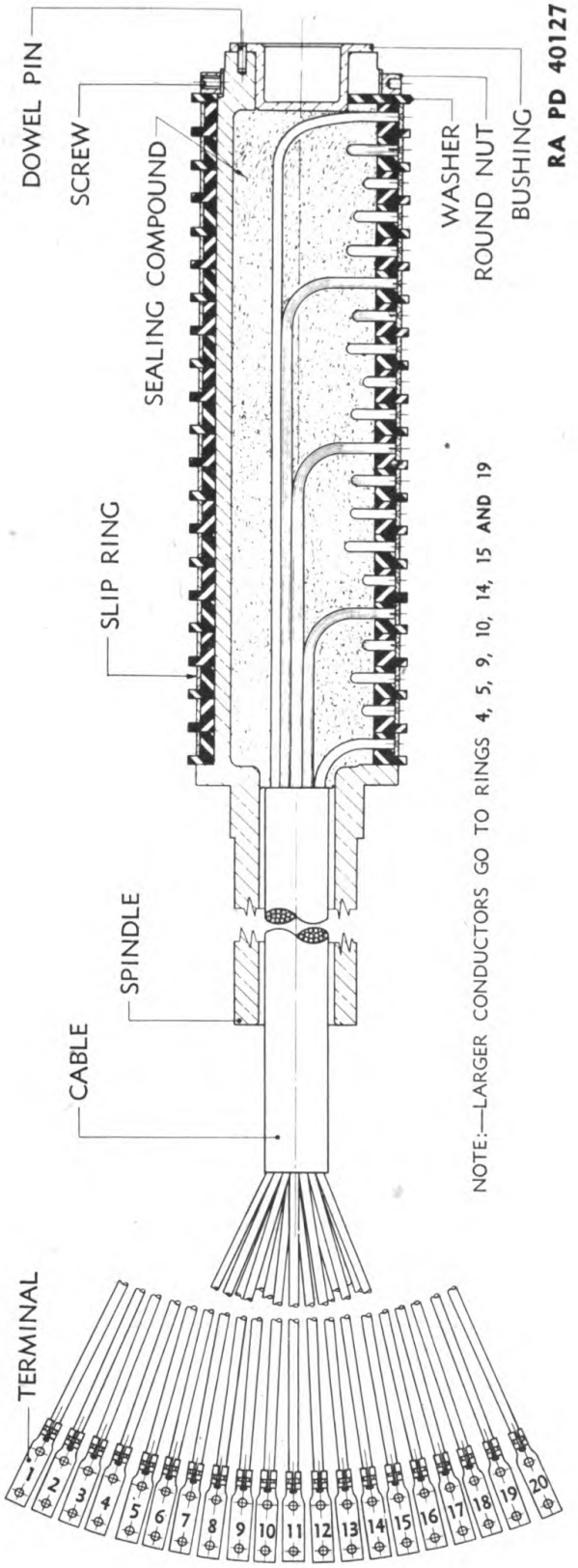


Figure 27 — Spindle for Contact Ring

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

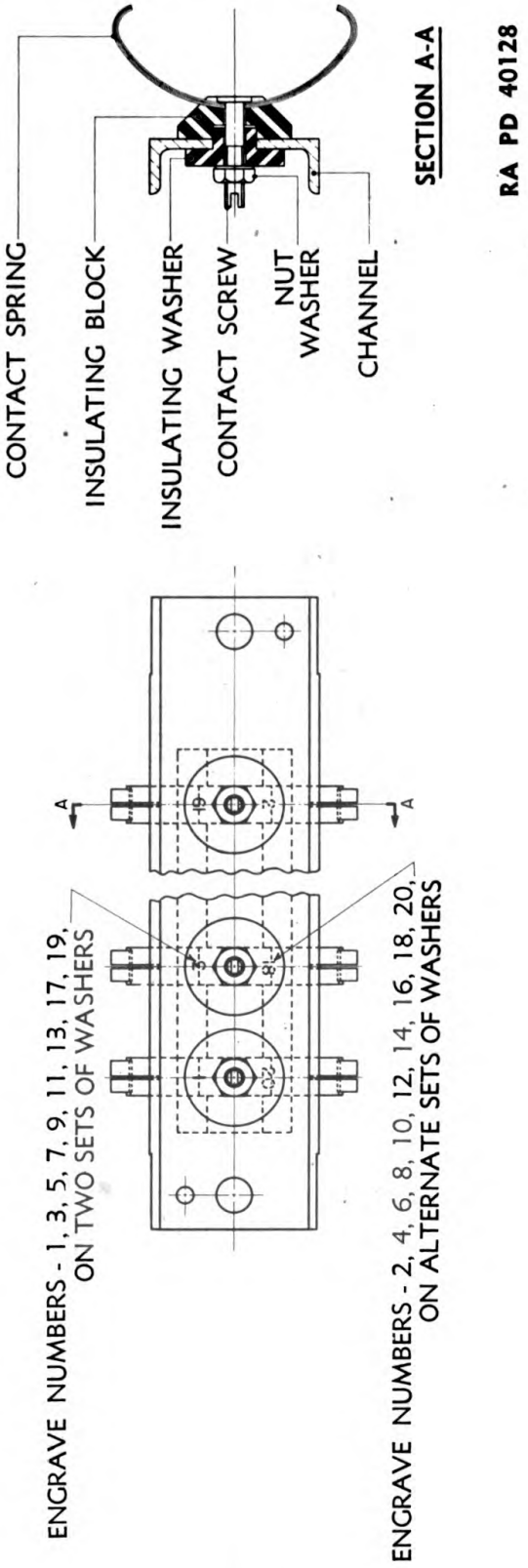


Figure 28 — Brush Rigging for Contact Ring

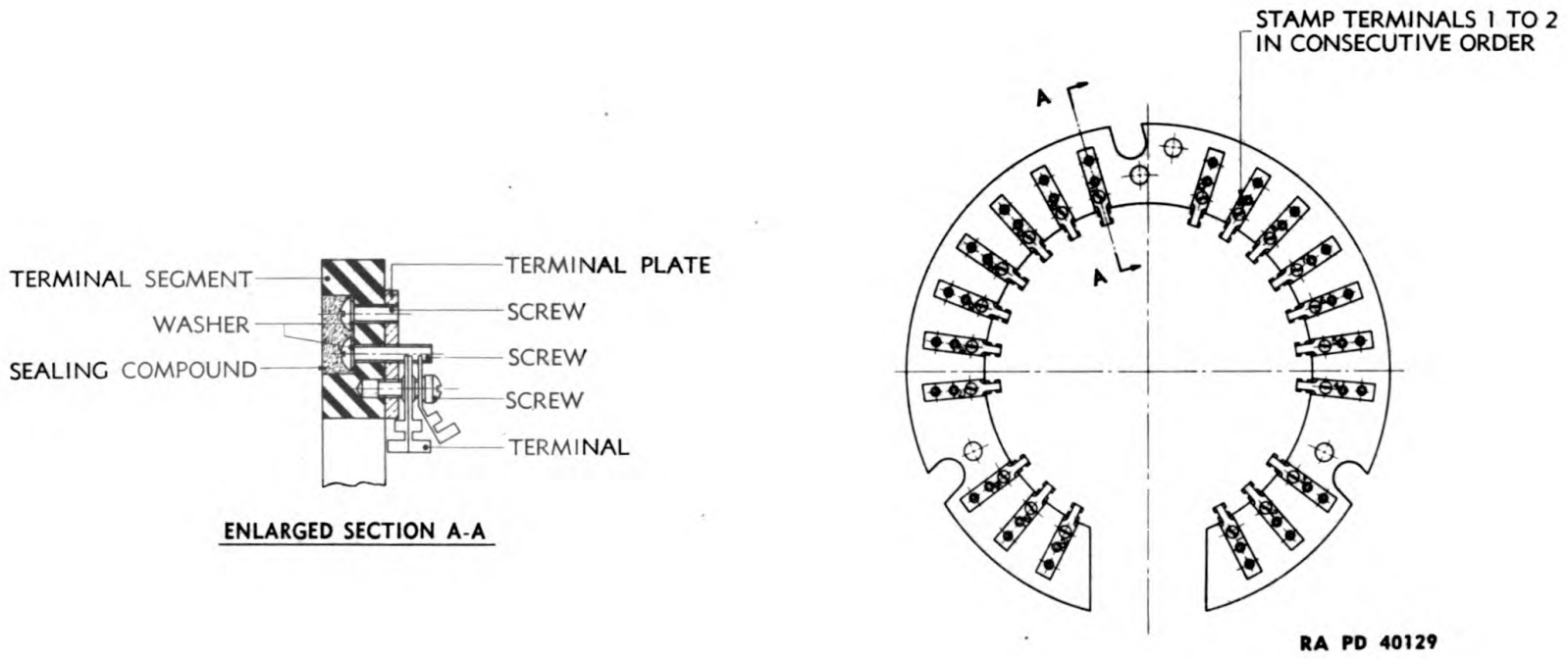


Figure 29 — Terminal Segment Assembly for Contact Ring

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

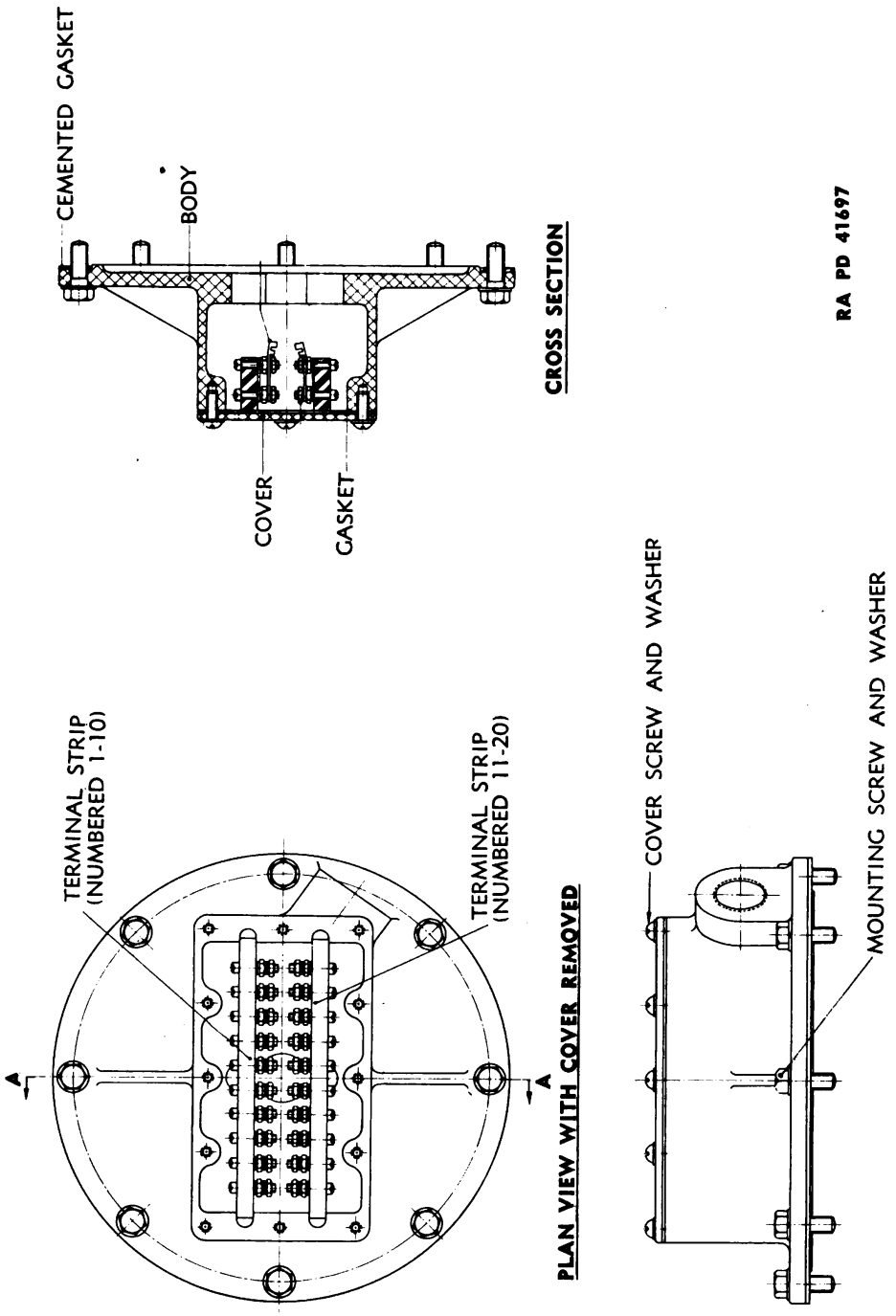


Figure 30 — Terminal Box — Assembled View and Cross Section

DESCRIPTION

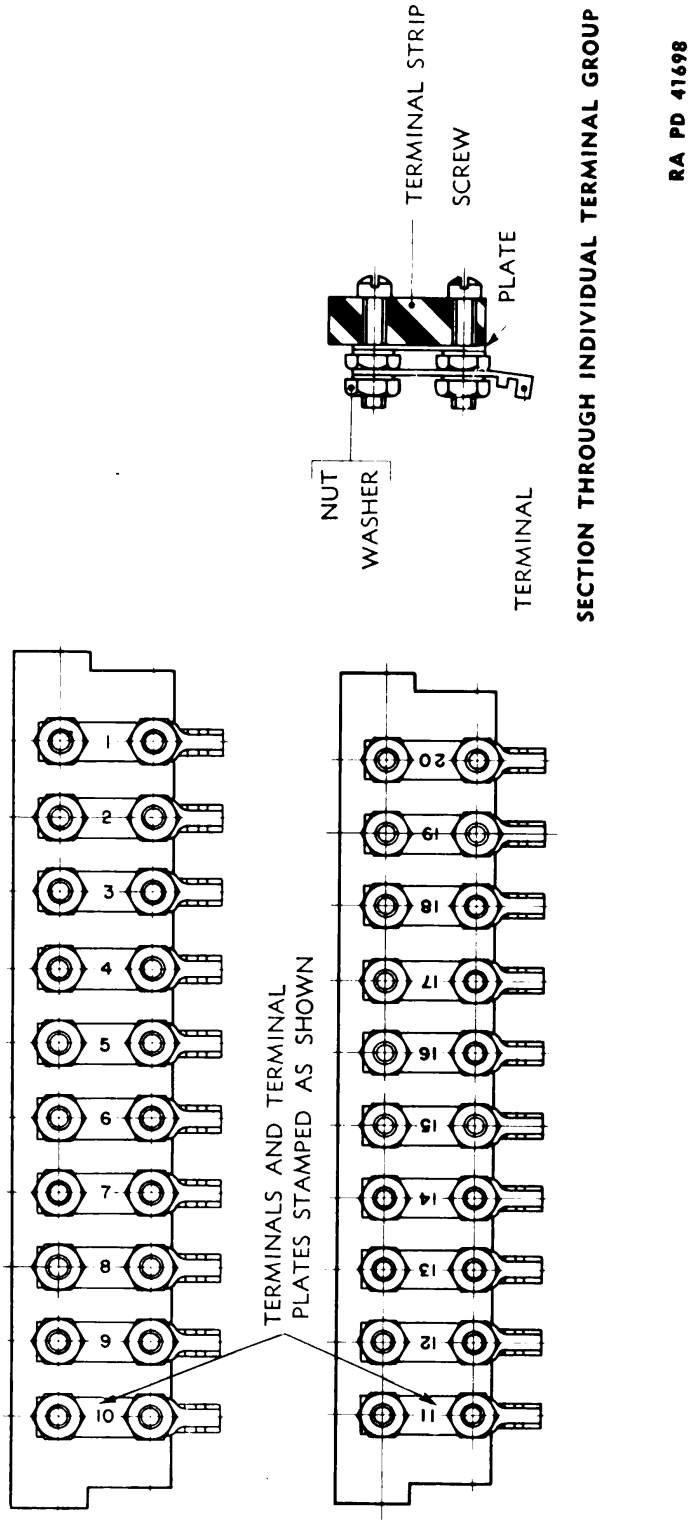
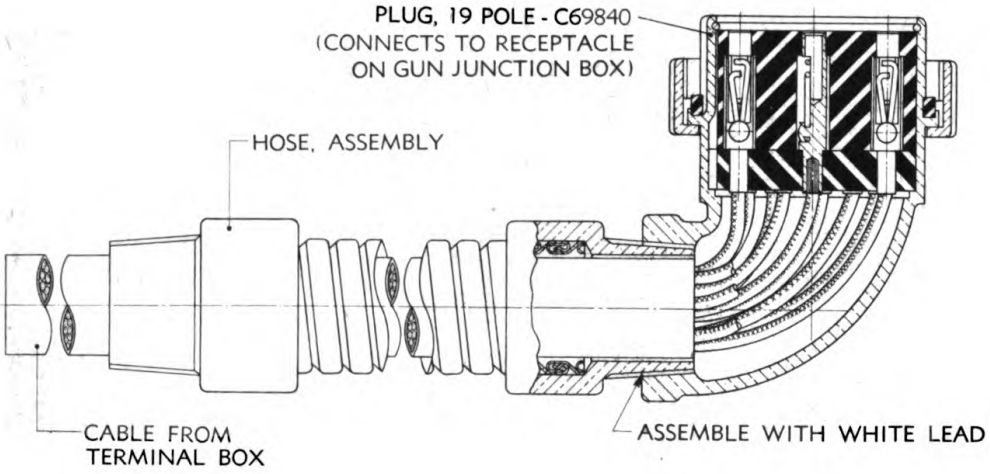


Figure 31 — Terminal Strips for Terminal Box

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)



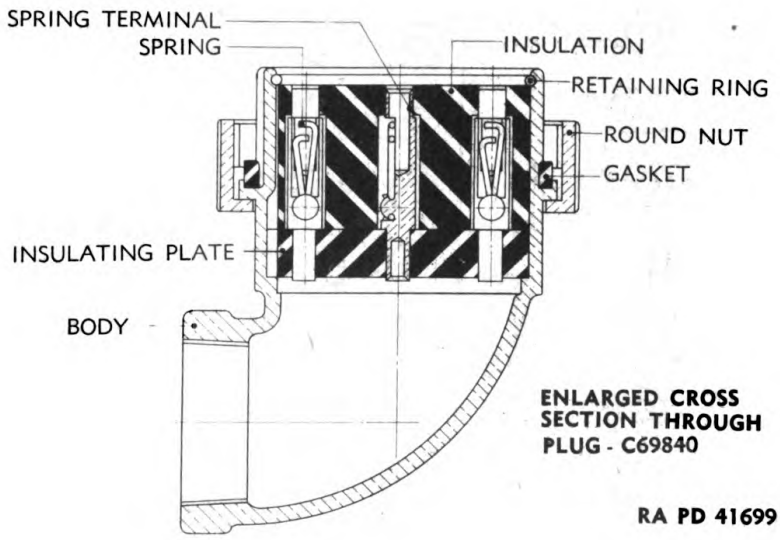


Figure 32 — Cable and Plug Assembly — Terminal Box to Gun Junction Box

DESCRIPTION

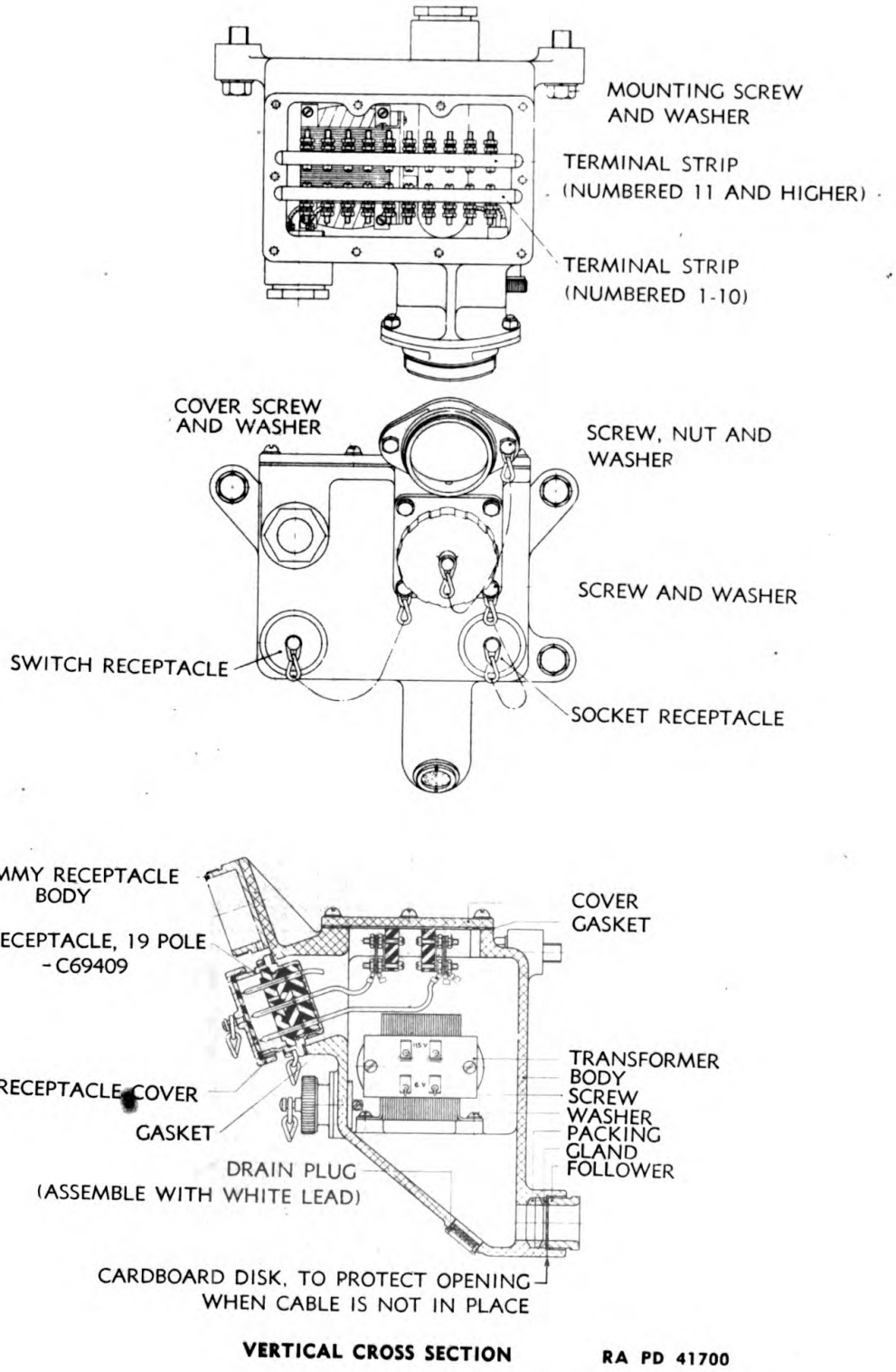


Figure 33—Gun Junction Box—Assembled Views and Cross Section

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

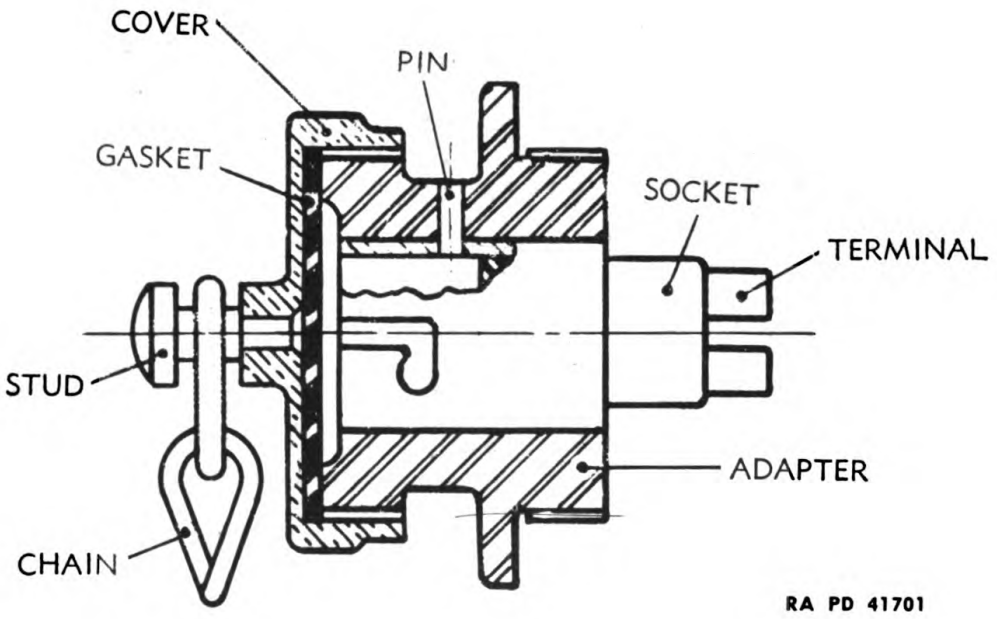


Figure 34 — Socket Receptacle for Gun Junction Box

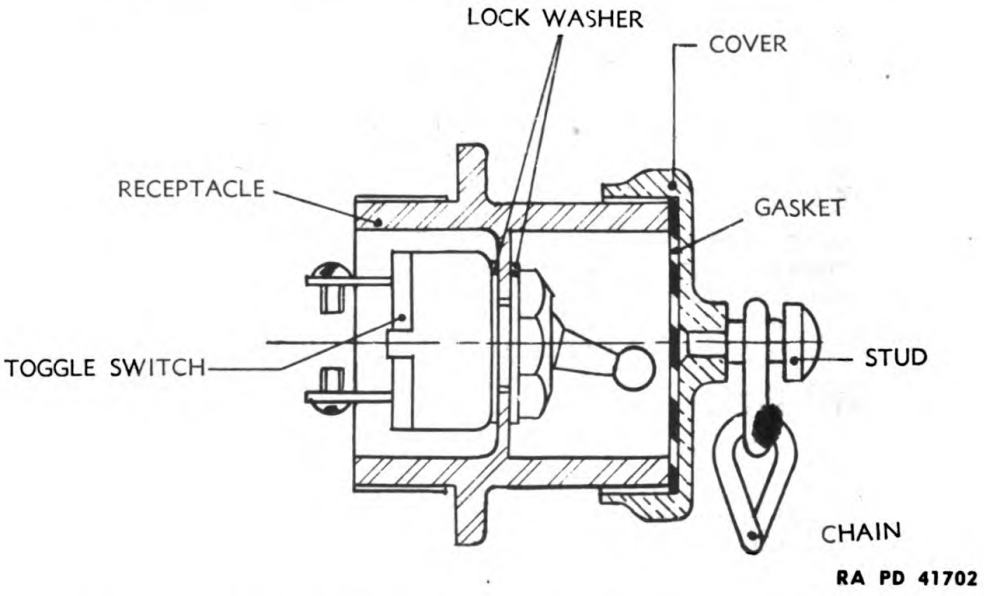
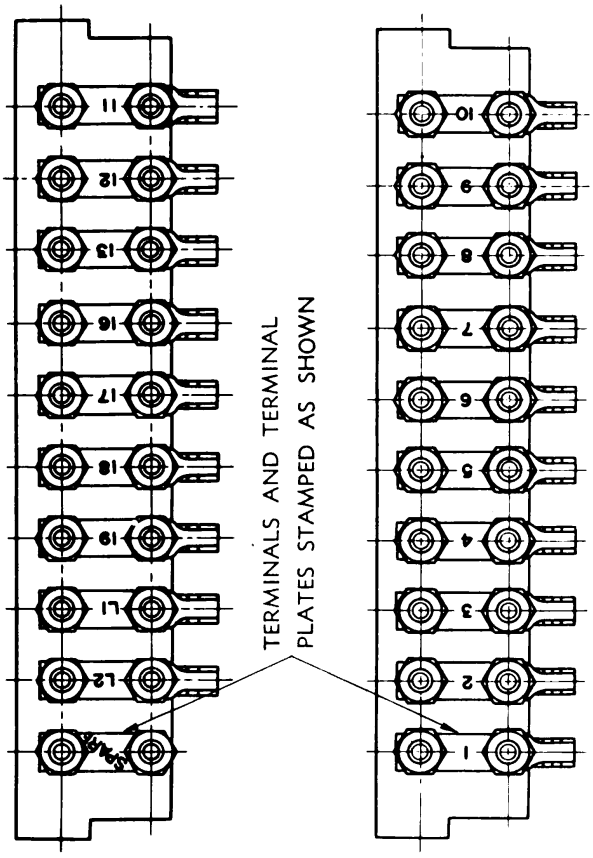
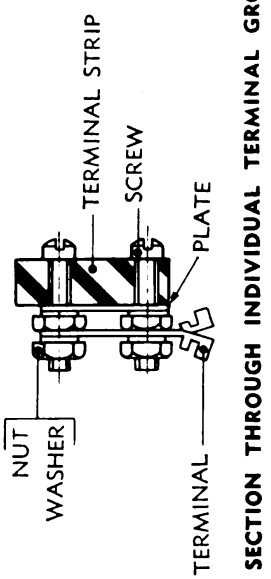


Figure 35 — Switch Receptacle for Gun Junction Box

DESCRIPTION





SECTION THROUGH INDIVIDUAL TERMINAL GROUP

RA PD 41703

Figure 36 — Terminal Strips for Gun Junction Box

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

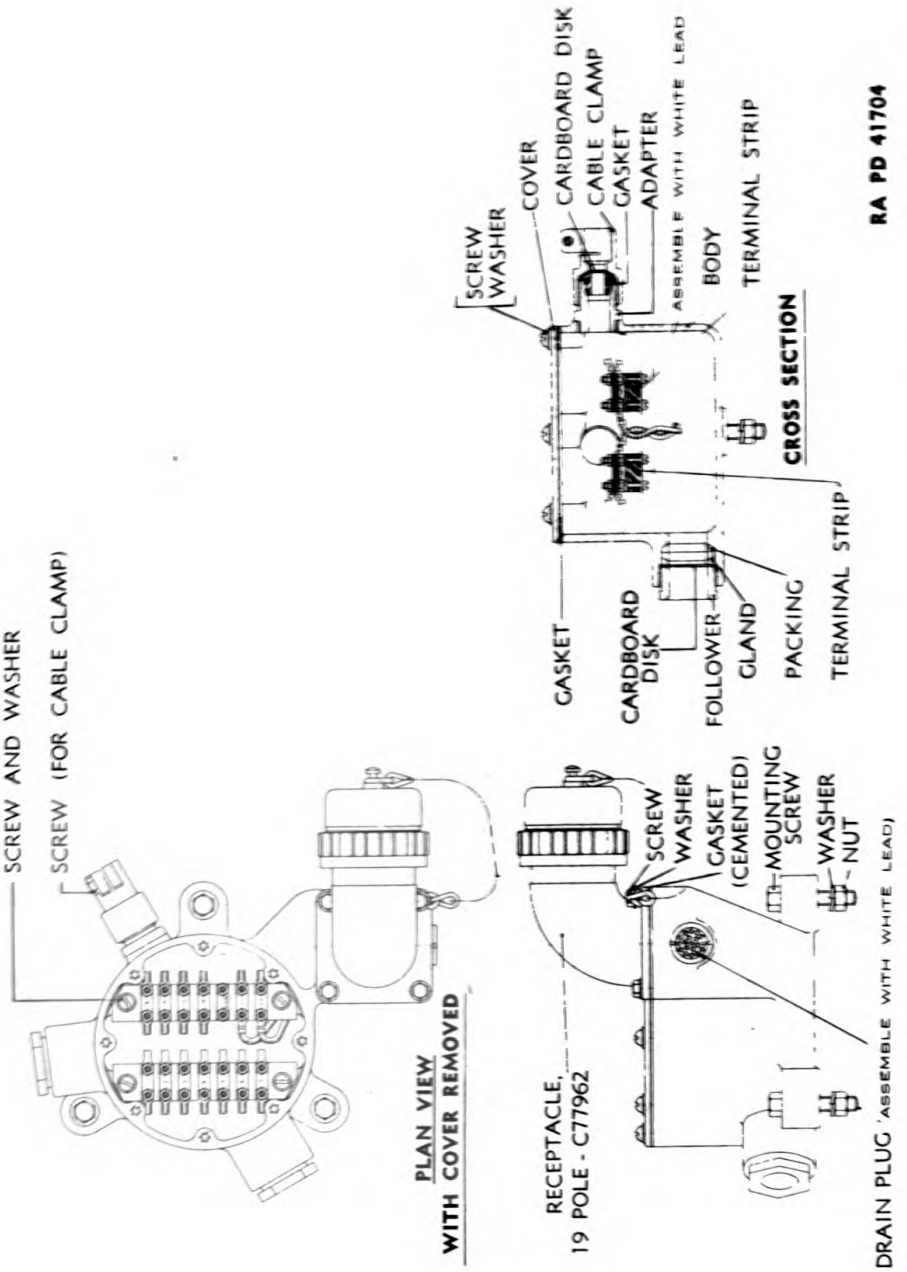


Figure 37—Fuze Junction Box—Assembled Views and Cross Section

DESCRIPTION

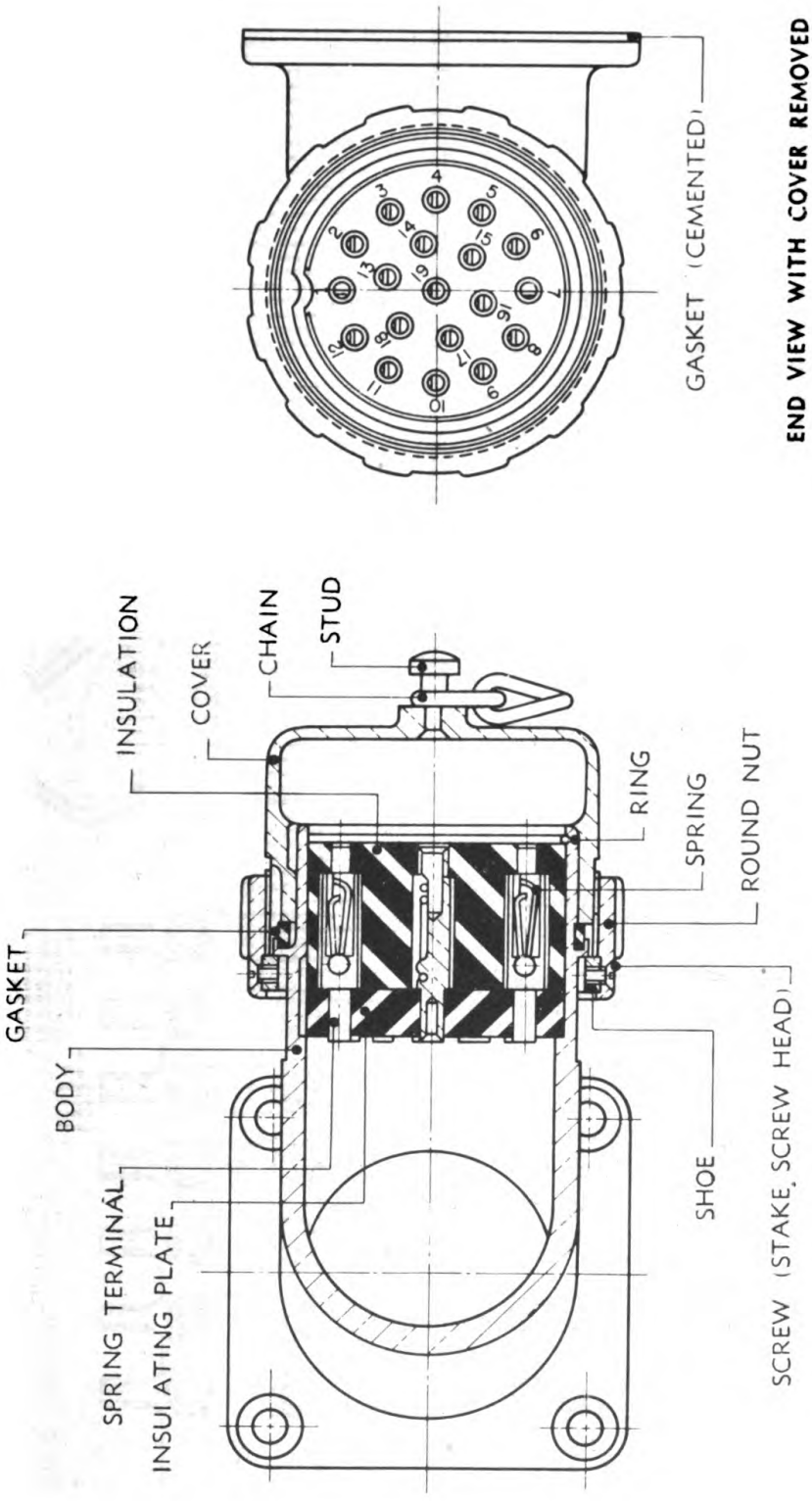


Figure 38 — Receptacle Assembly (C77962) for Fuze Junction Box

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

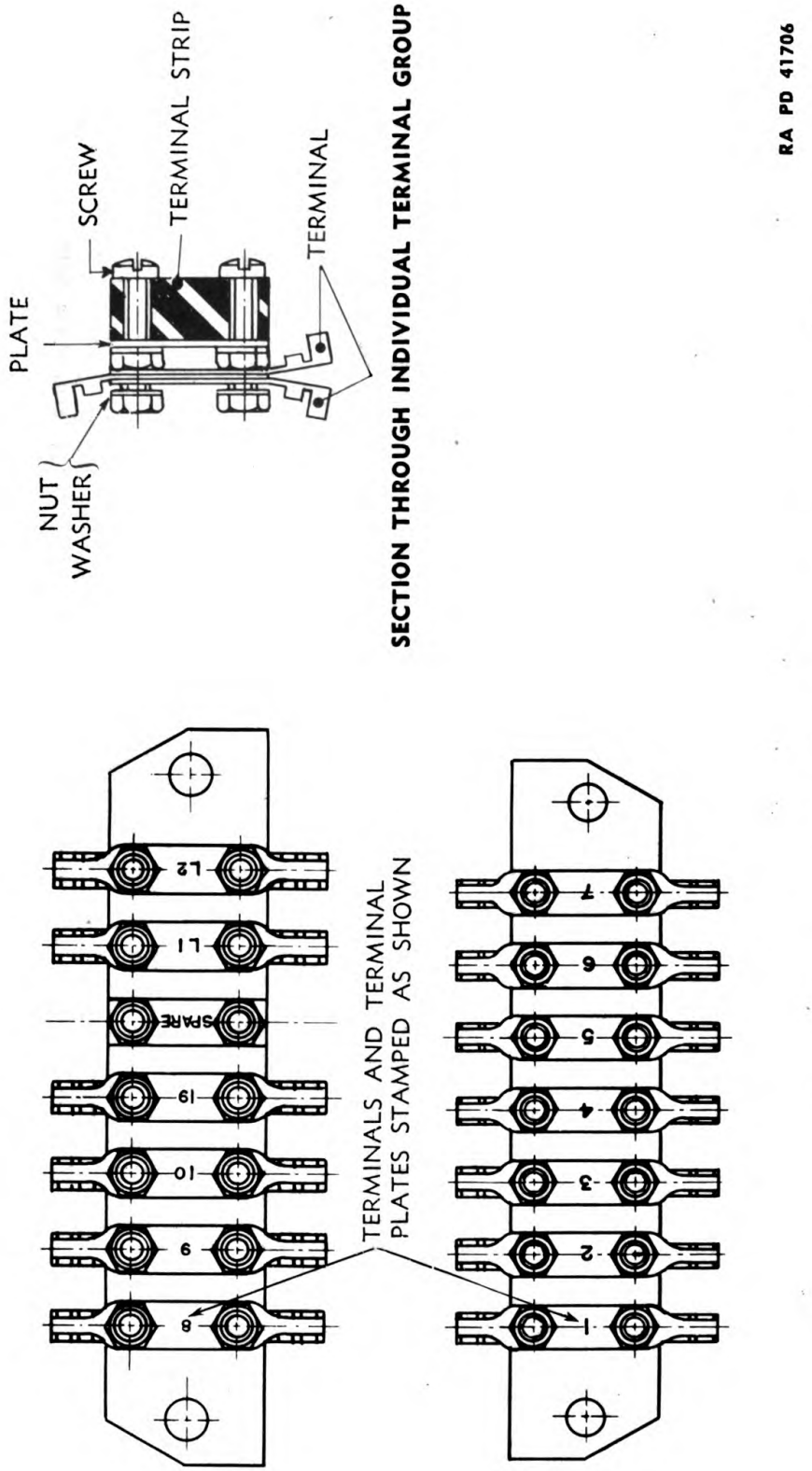


Figure 39 — Terminal Strips for Fuze Junction Box

DESCRIPTION

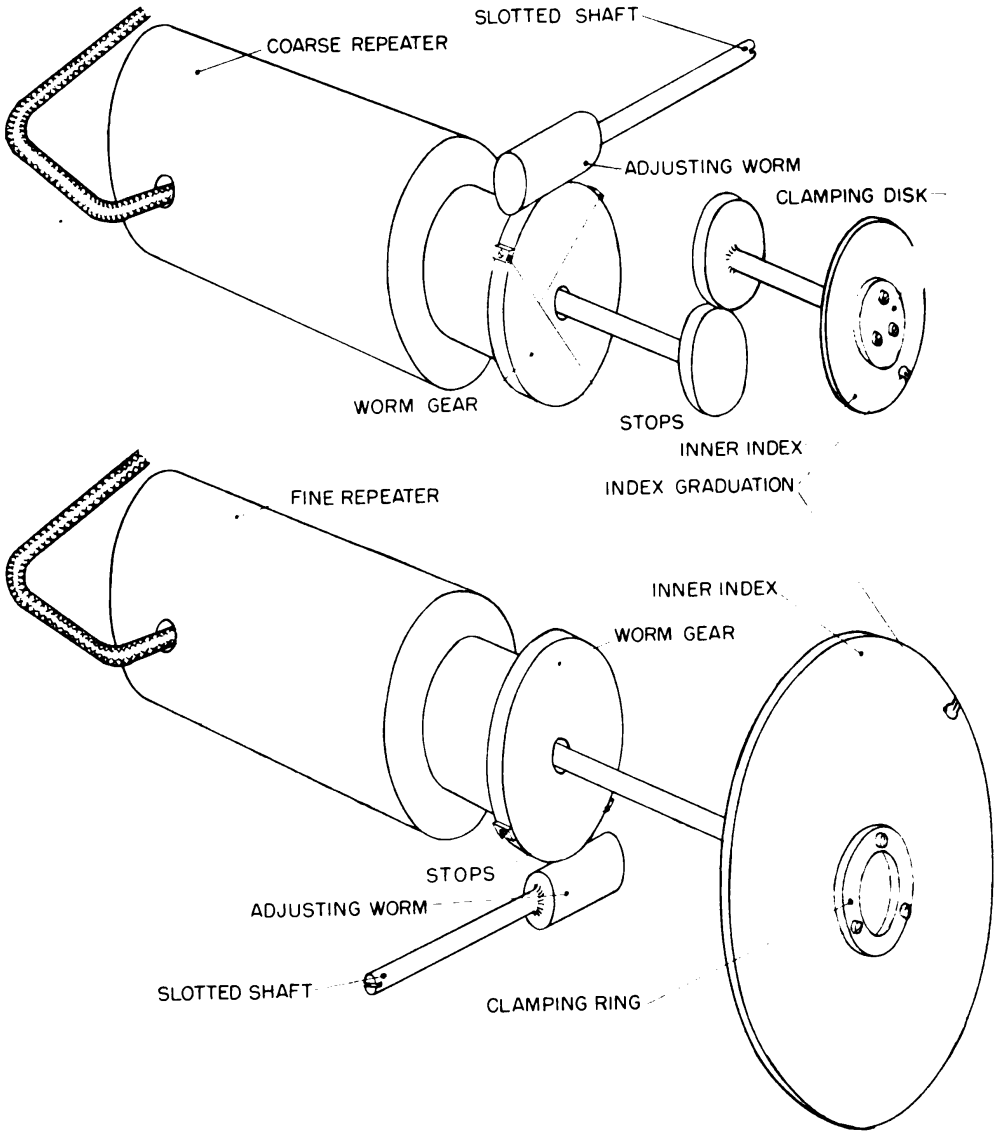


Figure 40 — Schematic Diagram Showing Arrangement of Repeaters and Their Adjusting Devices

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

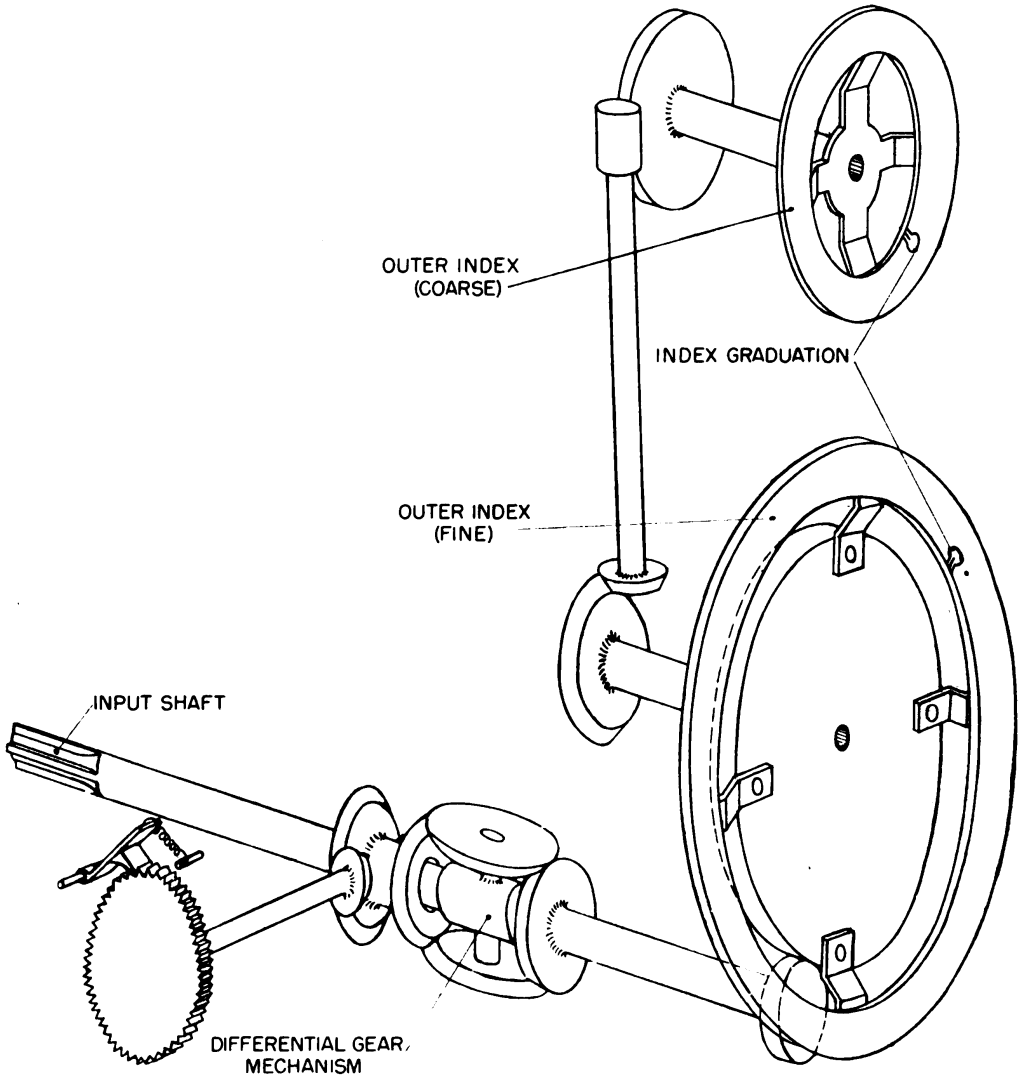


Figure 41 — Schematic Diagram Showing Gearing for Outer Indexes

DESCRIPTION

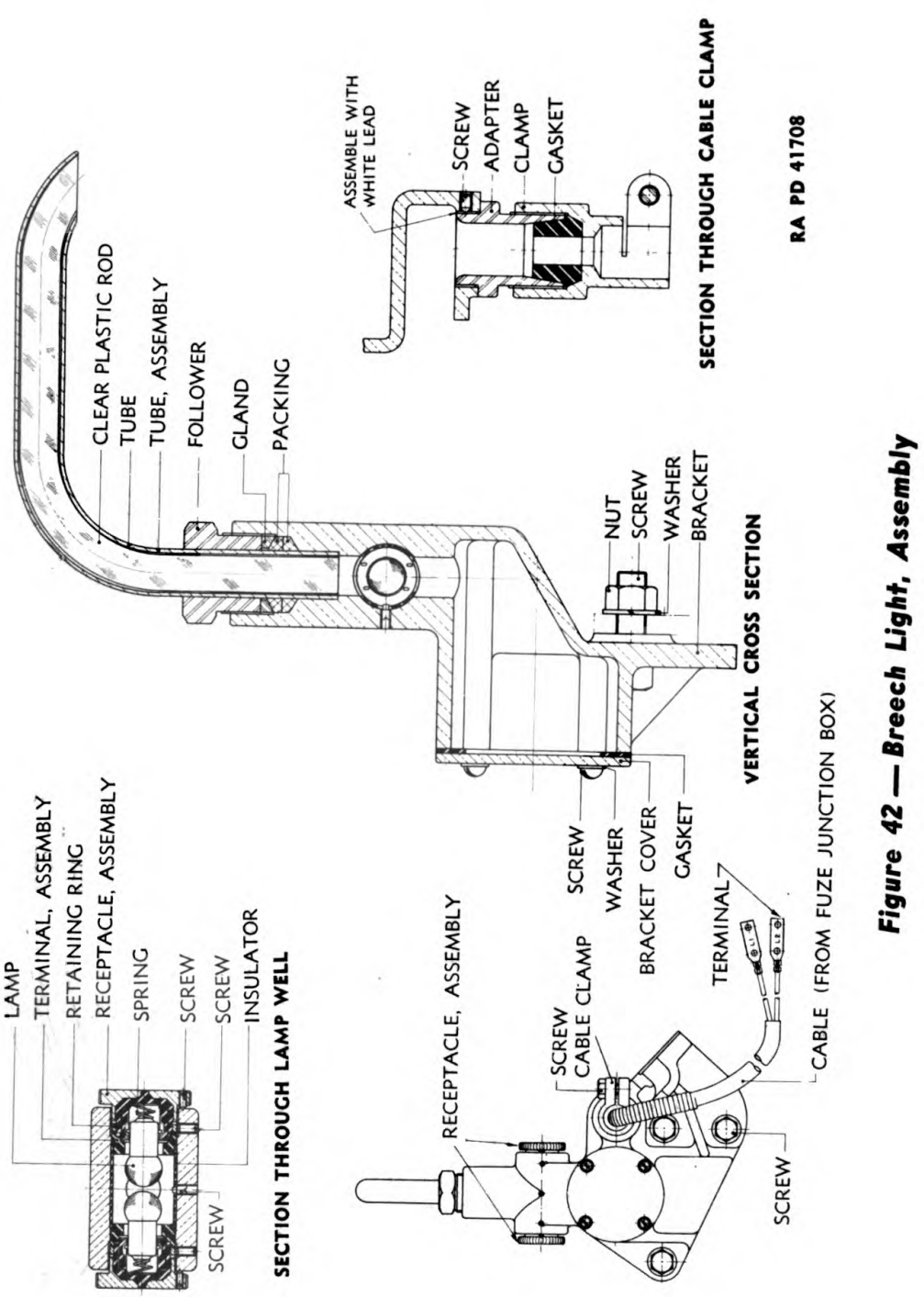


Figure 42 — Breech Light, Assembly

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

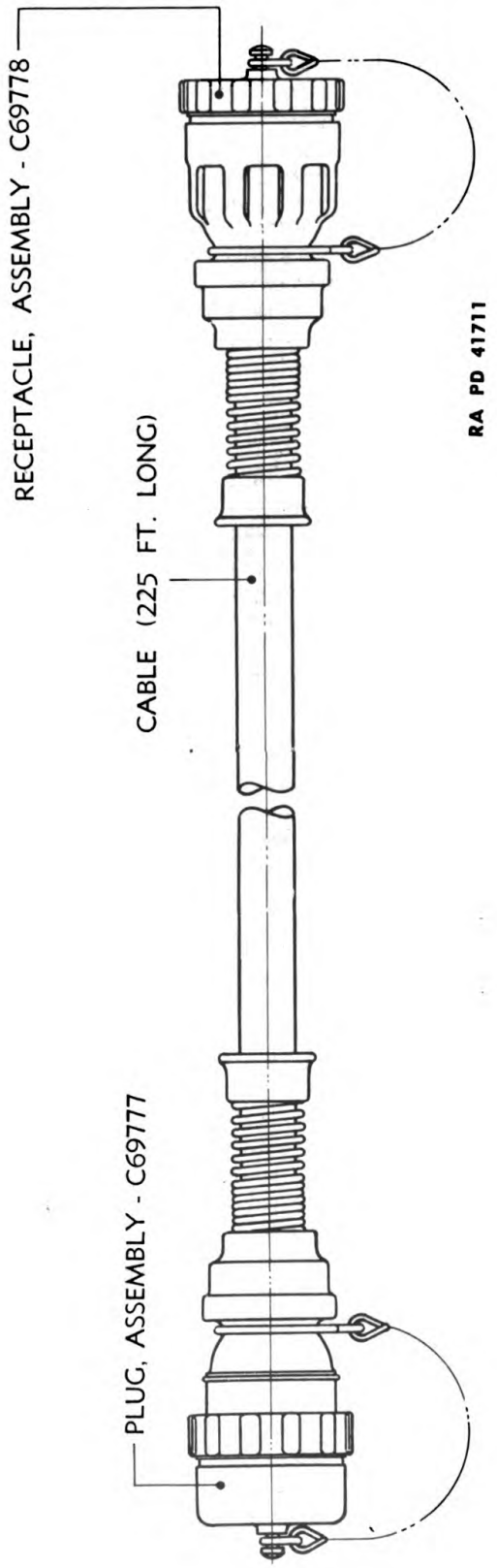


Figure 43 — Portable Cable

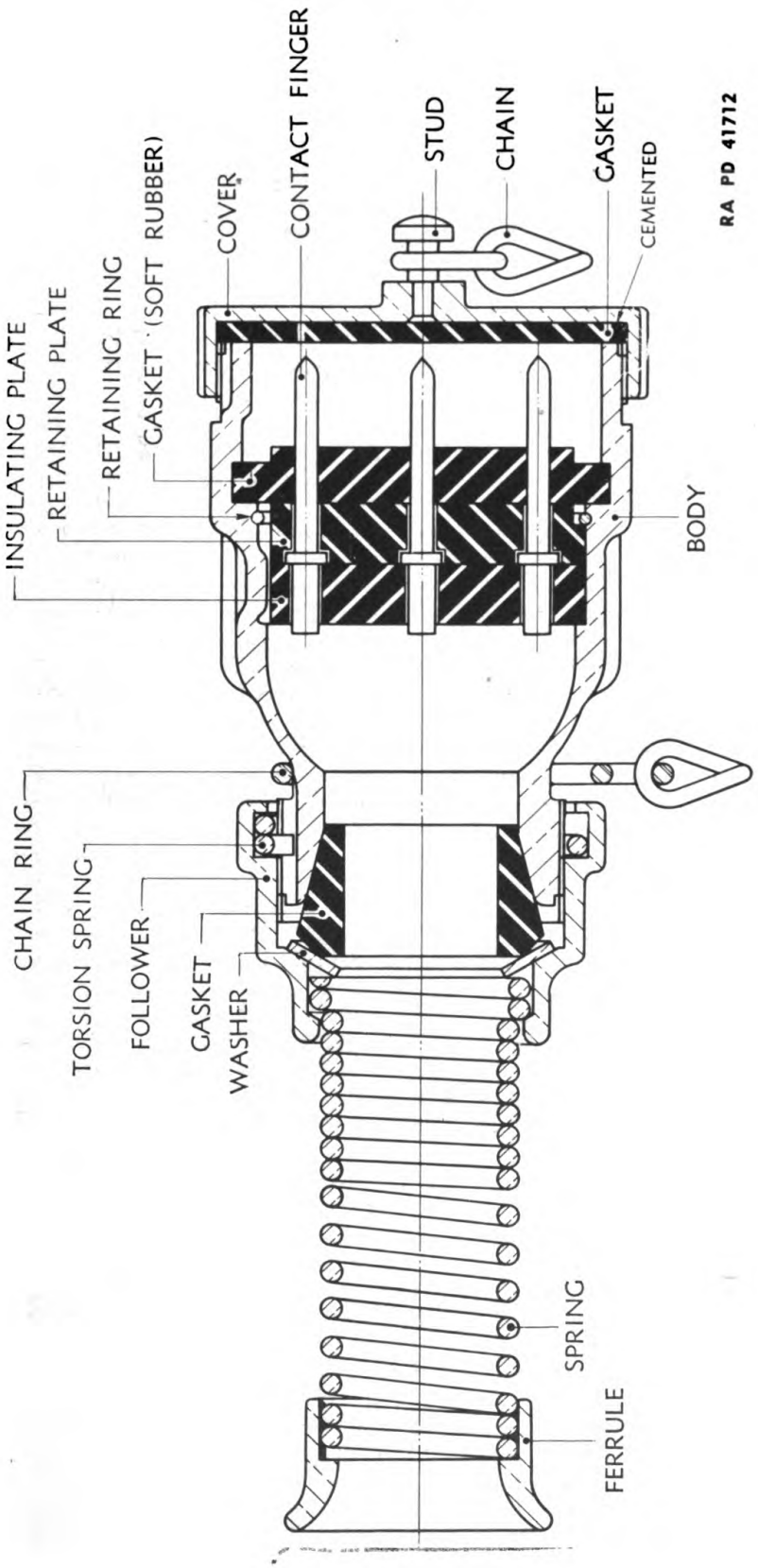


Figure 44 — Receptacle Assembly (C69778) for Portable Cable

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

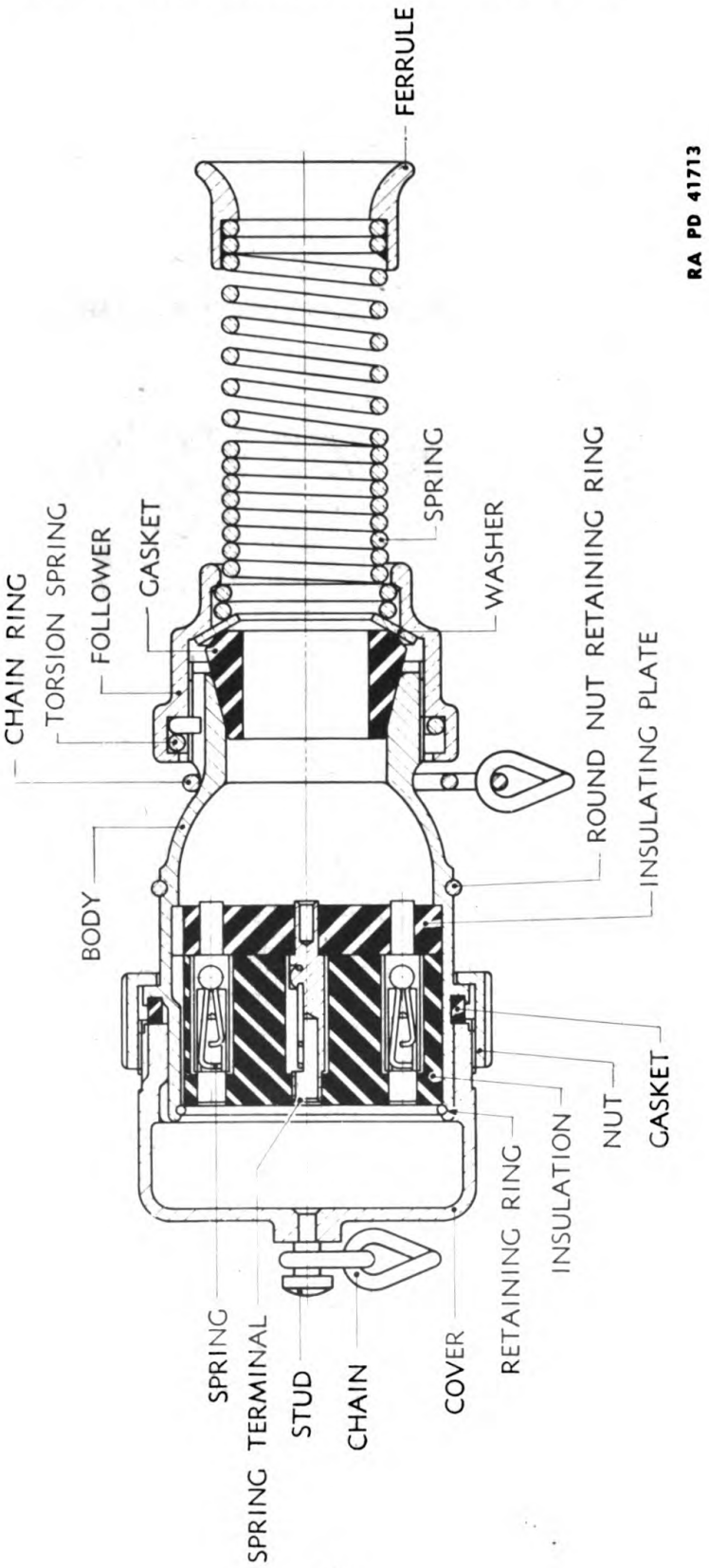


Figure 45 — Plug Assembly (C69777) for Portable Cable

DESCRIPTION

20 CONDUCTOR TRANSMISSION CABLE COLOR CODING OF CONDUCTORS CONNECTED TO TERMINALS		
TERMINAL MARKINGS	COLOR CODING OF CONDUCTORS	DATA LINES
1 2 3	ORANGE FIELD - WHITE TRACE ORANGE FIELD - BLACK TRACE ORANGE	AZIMUTH, FINE
4 5	WHITE BLACK	POWER, 115 V.
6 7 8	RED FIELD - WHITE TRACE RED FIELD - BLACK TRACE RED	AZIMUTH, COARSE
9 10	GREEN FIELD - WHITE TRACE GREEN FIELD - BLACK TRACE	FUZE
11 12 13	BLUE FIELD - WHITE TRACE BLUE FIELD - BLACK TRACE BLUE	ELEVATION, FINE
14 15	WHITE FIELD - BLACK TRACE BLACK FIELD - WHITE TRACE	POWER, 115 V.
16 17 18	YELLOW FIELD - WHITE TRACE YELLOW FIELD - BLACK TRACE YELLOW	ELEVATION, COARSE
19	GREEN	FUZE
	SLATE	SPARE

RA PD 41714

Figure 46 — Color Coding for 20 Conductor Cable

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

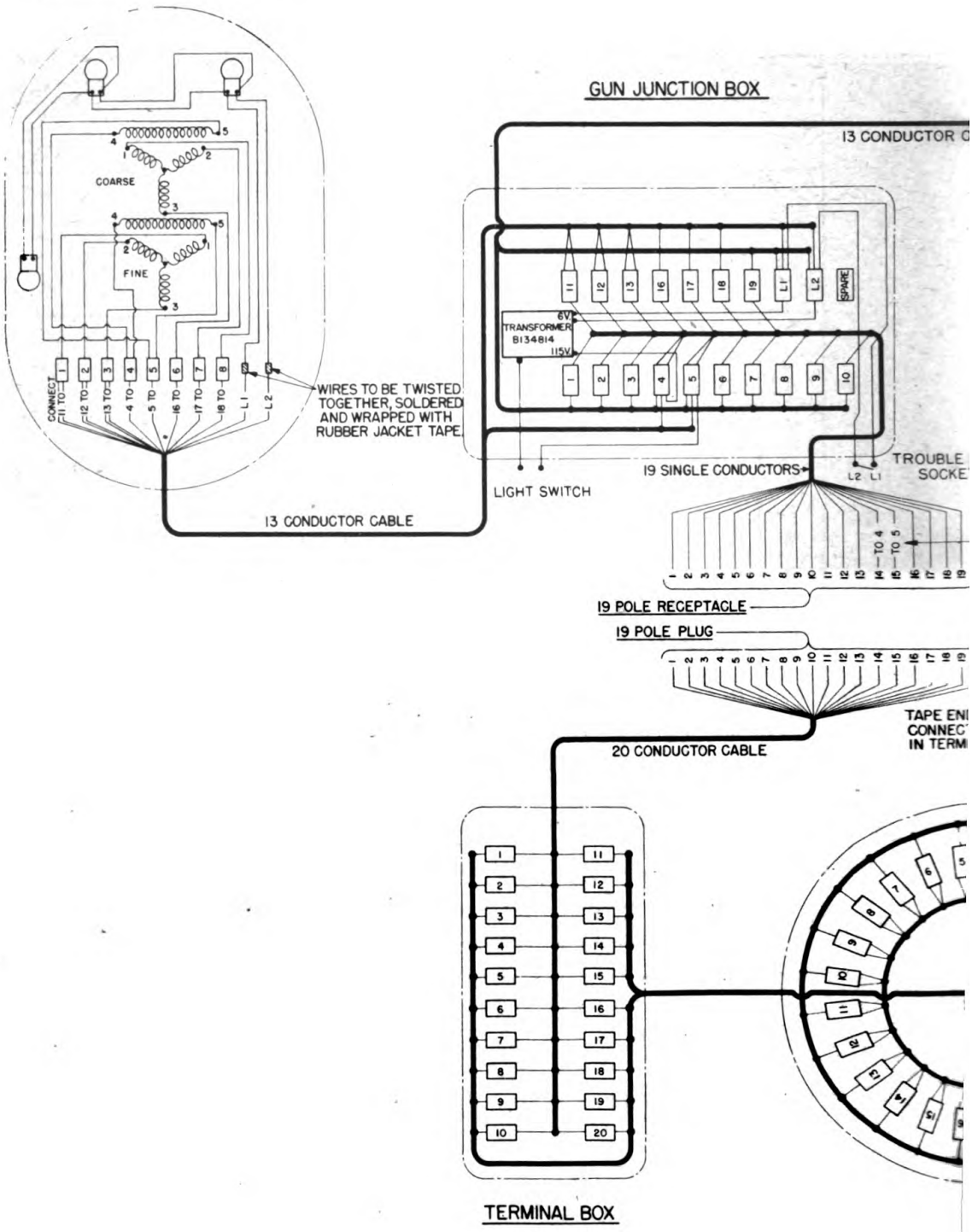
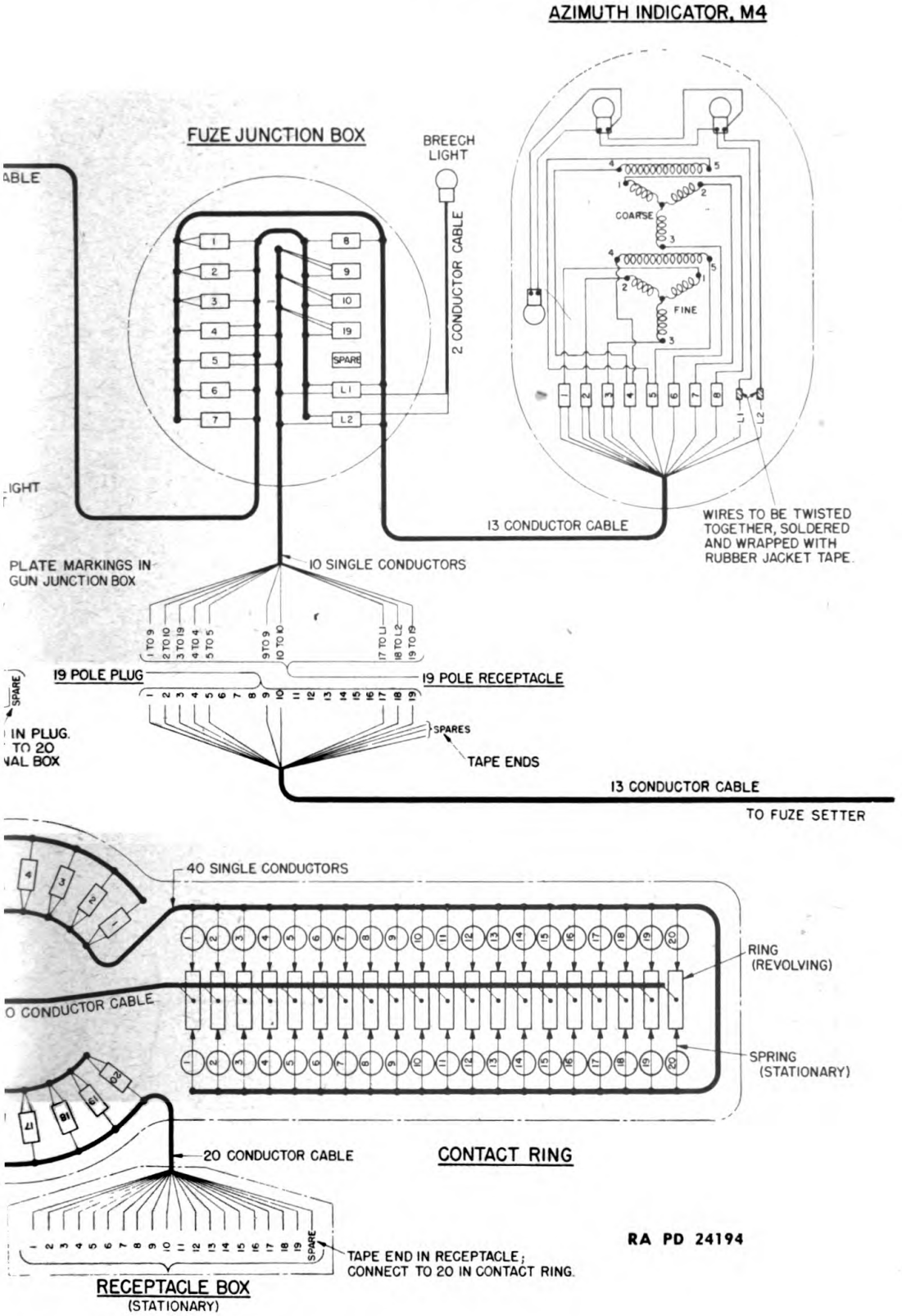


Figure 47 — Wiring Diagram of

DESCRIPTION



On-carriage Parts for One Gun

13 CONDUCTOR TRANSMISSION CABLE

COLOR CODING OF CONDUCTORS CONNECTED TO TERMINALS

CONNECT COLOR CODED CONDUCTORS TO TERMINALS MARKED IN						COLOR CODING OF CONDUCTORS	BASIC DATA LINES	MULTIPLE CONNECTIONS OF CONDUCTORS FOR DATA LINES
GUN JUNCTION BOX (ELEVATION INDICATOR CABLE)	GUN JUNCTION BOX AND FUZE JUNCTION BOX (ACROSS CARRIAGE CABLE)	FUZE JUNCTION BOX (AZIMUTH INDICATOR CABLE)	ELEVATION INDICATOR (ELEVATION INDICATOR CABLE)	FUZE SETTER (FUZE INDICATOR CABLE)	CABLE RECEPTACLE (FUZE INDICATOR CABLE) ◑			
11	1	1	1	1	1	ORANGE FIELD-WHITE TRACE	AZIMUTH OR ELEVATION (FINE)	FUZE OR ELEVATION (FINE)
12	2	2	2	2	2	ORANGE FIELD-BLACK TRACE		
13	3	3	3	3	3	ORANGE		
4	4	4	4	4	4	WHITE	POWER 115 VOLT	
5	5	5	5	5	5	BLACK		
16	6	6	6	⊕	⊕	RED FIELD-WHITE TRACE	AZIMUTH OR ELEVATION (COARSE)	
17	7	7	7	⊕	⊕	RED FIELD-BLACK TRACE		
18	8	8	8	⊕	⊕	RED		
11	9		1	1	9	GREEN FIELD-WHITE TRACE	FUZE	FUZE OR ELEVATION (FINE ONLY)
12	10		2	2	10	GREEN FIELD-BLACK TRACE		
13	19		3	3	19	GREEN		
L1	L1	L1	✳	L1	17	WHITE FIELD-BLACK TRACE	POWER 6 VOLT	
L2	L2	L2	✳	L2	18	BLACK FIELD-WHITE TRACE		

⊕ = ENDS TO BE WRAPPED WITH RUBBER JACKET TAPE.

✳ = SOLDER TO LAMP LEADS IN AZIMUTH OR ELEVATION INDICATOR

◒ = TERMINALS 6,7,8 AND 11 TO 16 INCL. NOT CONNECTED

RA PD 41715

Figure 48 — Color Coding for 13 Conductor Cable

Section III

ACCESSORIES

14. TESTING EQUIPMENT.

The following instruments (fig. 49) are furnished as accessories for checking these systems:

A.C. voltmeter, double range: 0-15 and 0-150 volts.
A.C. ammeter, double range: 0-3 and 0-15 amperes.
Ohmmeter, double range: 0-10 and 0-1,000 ohms.

a. The voltmeter and ammeter are of the movable iron vane type, accurate to within two percent. The voltmeter and ammeter are furnished with test leads, the ammeter leads being heavier than those for the voltmeter. These meters require care in selection of the proper voltage or current range. The use of higher voltage or current than that marked for the particular range will burn out the meter or bend the meter needle. When in doubt, try the highest range first. The ammeter must be connected in series with, never across, the line.

b. The ohmmeter is a pocket-size instrument for continuity and resistance checking. It is furnished with test leads and an internal 1½-volt flashlight battery. Instructions for use are printed on the back cover plate of the ohmmeter. For compensating for change in battery voltage, an externally adjustable magnetic shunt is provided. This shunt is to be adjusted before each series of readings so that the meter reads zero when the test leads are shorted. (The battery requires replacement if the meter can not be adjusted to zero reading.) In using the 10-ohm scale, the high range terminals are shorted by the link provided. The ohmmeter may be damaged if connected to a live circuit; it is therefore essential that power be removed from the system before using the ohmmeter.

15. VOLTAGE CONTROLLER M1.

a. This item is for use only when the data transmission system is to operate from established power lines or source of power other than the specified generating unit. It is issued only on specific request of the Battery Commander.

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

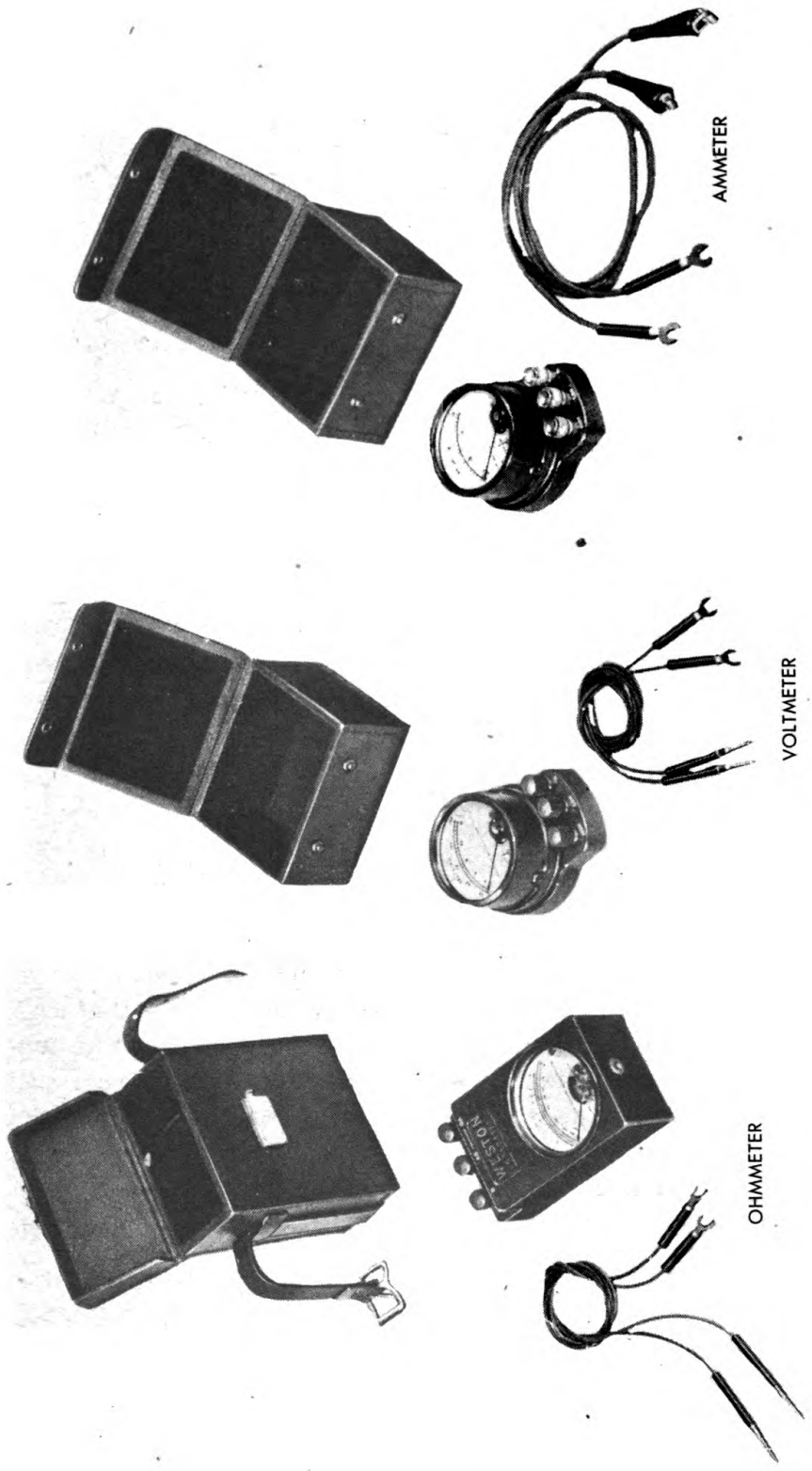


Figure 49 — Ohmmeter, Voltmeter and Ammeter with Test Leads and Carrying Cases

b. The generating units M4 and M6, designed for use with the data transmission system, incorporate a time delay feature which applies a reduced voltage for several seconds before the full voltage is applied. The effect is to permit the synchronous transmitters and repeaters to reach their synchronous positions slowly.

c. Sudden application of full voltage, as from a power line, might cause damage in two ways:

(1) The repeater, accelerating rapidly, might pick up synchronous speed and "run away," that is, continue to run at high speed as a motor.

(2) The transmitter, acting in reverse as a repeater, might lift its cam follower (in the computing device) and then allow it to snap back onto the polished cam surface.

d. When it is desired to use current from post or commercial power lines to operate the data transmission system, the voltage controller must be used to prevent possible damage from the above mentioned causes. The voltage controller incorporates a time delay feature similar to that in the generating unit.

e. The voltage controller operates from single-phase alternating-current supply at 110 volts, 60 cycles.

16. CABLE REEL.

a. The cable reel is shown in figure 50.

b. Twelve cable reels, one for each of the portable cables, are furnished with the data transmission system.

c. To wind a cable onto the reel, place the plug or receptacle end of the cable into the spring clip at the center of the reel drum. Lay the cable loosely in the drum depression and start the first few turns at the end of the reel. After winding the first few turns, check to see that the clipped cable end is not strained. When the first few turns have been started satisfactorily, continue to wind the cable in close, even layers until the full cable length is on the reel.

17. CABLE REPAIR KIT M1.

a. The cable repair kit M1 is for use in repairing cables of the data transmission system M6. It consists of a conventional portable tool box containing a vulcanizer and various tools and supplies necessary to make electrical connections and sheath repairs on multiple conductor transmission cables. A complete set of instructions covering the use of the equipment, and a list of the equipment comprising the kit as included in each kit.

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

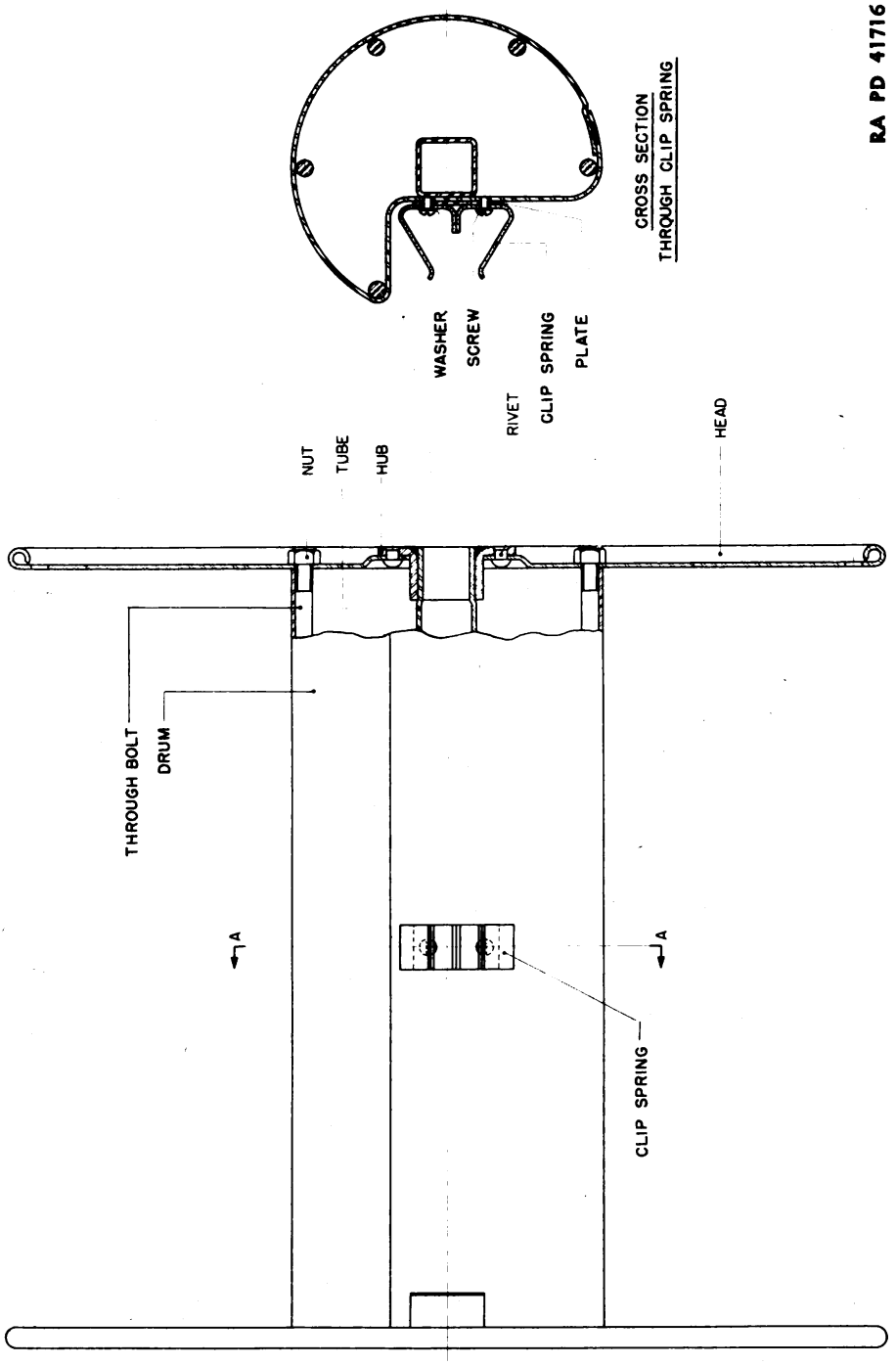


Figure 50 — Cable Reel

ACCESSORIES

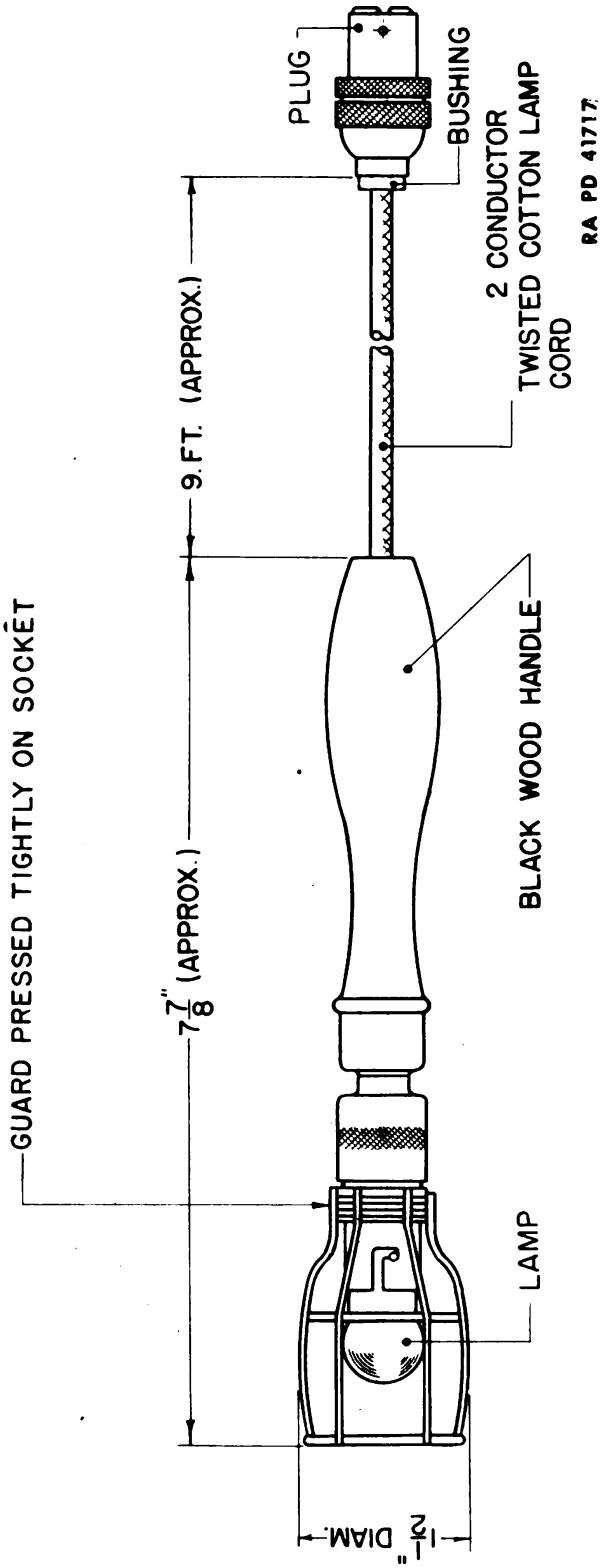


Figure 51 — Trouble Lamp

b. The vulcanizer and soldering iron of the kit are electrically operated from power lines or from power supplied by the generating unit. The generating unit at present has no receptacle to receive the connecting plugs of these tools, but will be modified in the near future to provide suitable receptacles. Until these receptacles are added, emergency connection can be made by connecting the appliance wires to the binding posts on the rear of the instrument panel voltmeter. With this emergency connection the main switch does not control the power to the appliances, so that the generating unit must be shut down when connecting or disconnecting the wires.

18. TROUBLE LAMP.

The trouble lamp (fig. 51) furnished with the system plugs into the socket receptacle on the gun junction box.

Section IV

CARE AND PRESERVATION

19. CAUTION.

A 19 pole receptacle, painted yellow, located on the rear of the generating unit, is provided for connection of the portable cable. As all poles of this receptacle are energized, *it is necessary that no direct cable connection be made therefrom to the director, height finder, or gun mount.* The cable connection should be made only to the yellow receptacle on the main junction box. Failure to observe this precaution will result in burning out the synchronous transmitters and repeaters in the connected units and may otherwise result in severe damage to the internal mechanism.

20. CLEANING AND PRESERVING MATERIALS.

a. Lubricants.

OIL, lubricating, for aircraft instruments and machine guns (for all lubrication where oil is required).

GREASE, lubricating, special (GREASE, special, low temperature) (for all lubrication where grease is required).

b. Cleaning Materials.

SOLVENT, dry-cleaning (for cleaning metal components).

SOAP, liquid, lens cleaning or ALCOHOL, ethyl (for cleaning indicator windows).

PAPER, lens tissue (for cleaning indicator windows).

BRUSH, artist, camel hair, rd.

21. CABLES.

The portable cables supplied with the data transmission system M6 are of the highest grade obtainable. The importance of giving the cable the best possible care cannot be overemphasized.

a. No cable of this size will withstand repeated kinking or twisting. Avoid bending the cable on a short radius, or allowing it to chafe against a moving object.

b. Do not allow heavy vehicles to run over unprotected cables.

c. Wind the cables on the reels provided for them, and protect the cables from sunlight when not in use. Store in a cool, dark place. Heat and sunlight cause rapid deterioration of rubber.

d. Do not allow dirt of any kind to accumulate in the plugs or receptacles as this will impair the connections accomplished by them.

e. When the cables are not connected, close all plugs and receptacles with the covers provided so as to exclude dirt and moisture.

f. When the cables are connected, the mating plugs and receptacles must be mechanically secured together by means of the round nut provided. Where possible, screw the covers together to protect the threads.

g. When disconnecting a cable, grasp the body of the plug to pull on, never pull on the cable or spring.

h. In case it becomes necessary to tape the ends of any of the conductors of the flexible cables, use rubber tape only. The solvent in the saturated cloth of friction tape will in time dissolve the latex insulation.

i. Oil and grease are detrimental to rubber; care should therefore be exercised to see that the cables are kept free of these materials. If oil or grease does get on the rubber, wipe it off and wash the place with soapy water.

22. JUNCTION AND TERMINAL BOXES.

a. Keep the covers on the various boxes fastened tightly at all times to prevent entrance of dust and moisture into the boxes.

b. Should it become necessary to remove the cover from a box, care must be exercised not to damage the gasket. If the gasket is damaged, it must be replaced in order to maintain a watertight seal.

c. Protect the receptacles on the boxes by means of the covers provided for that purpose when the cables are not plugged in.

d. Remove the plug from the bottom of the contact ring housing, frequently, to drain off any moisture which might have condensed in the housing. During assembly only, lightly lubricate the bushings at either end of the contact ring spindle with GREASE, lubricating, special.

23. AZIMUTH AND ELEVATION INDICATORS.

a. Should any repeater start to "run away," that is, run as a motor at a high rate of speed, shut off the power on the system immediately.

CARE AND PRESERVATION

b. Keep the side covers closed at all times except when actually making adjustments or repairs which require that the covers be open.

c. Care must be exercised to prevent damaging the gaskets when removing the window and frame, or the right side cover. If a gasket is damaged, it must be replaced in order to maintain a watertight seal.

d. Operating personnel are not permitted to lubricate the indicator. During assembly only, maintenance personnel should lubricate ball bearings, bushed bearings and all other sliding surfaces of the indicator with GREASE, lubricating, special. The bearings and surfaces should be coated lightly, preferably with a brush. A few drops of OIL, lubricating, for aircraft instruments and machine guns, should be placed on gear trains and points where shafts enter the housing. Repeaters are not to be lubricated.

e. No attempt should be made to wipe the window with the hand or a cleaning cloth. Continued use of a cleaning cloth will scratch the glass and make it difficult to see through. Remove dust with a camel hair brush or lens tissue paper. Remove oil or grease by applying liquid lens cleaning soap or alcohol sparingly with camel hair brush and wiping dry with lens tissue.

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

Section V

INSPECTION INSTRUCTIONS

24. PURPOSE OF INSPECTION.

a. Inspection is for the purpose of determining the condition of the entire data transmission system, whether repairs or adjustments are required, and the action necessary to place the system in serviceable condition.

b. The first inspection performed on the system is a basic inspection to determine the condition of the system and to locate basic faults. The inspection procedures contained in this section are instructions for basic inspection. As a result of this inspection, proper disposition of the system can be made and necessary action taken or recommended. Inspection forms (O.O.F. 7228 and O.O.F. 7229, fig. 52) are provided for recording the results of the inspection. Instructions concerning the entries to be made are printed on the back of the form.

c. The detailed inspection and correction instructions in Section VI are performed by the instrument repairman if the basic inspection shows the existence of major faults. From these detailed instructions the repairman locates and then performs the specific repair required to place the instrument in serviceable condition. The procedure for detailed inspection and correction may vary with each system, depending on the faults indicated by the basic inspection. Inspection forms and methods used in connection with the detailed inspection are described in TM 9-2602 "Instruction Guide, The Instrument Repairman."

25. TOLERANCES.

Tolerances, or allowable errors, are specified where necessary to indicate the degree of accuracy required in performing certain adjustments.

INSPECTION INSTRUCTIONS

O. O. F. 7229

INSPECTION OF ORDNANCE MATERIAL

Sheet No. _____

Organization _____ Date of inspection _____

Station _____ Inspected by _____

Organization commander _____

Item and Serial No.	Defects noted	Action to be taken

RA PD 9893

Figure 52 — Inspection Form

DATA TRANSMISSION SYSTEM M6
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In general, an instrument is considered unserviceable if the error in any part exceeds the specified tolerance. However, it must be realized that the specified tolerance is intended to serve mainly as a guide for the inspector, and must be supplemented by good judgment on the part of the inspector. These tolerances do not necessarily infer that the instrument repairman should not attempt to reduce the errors to lower limits if time and conditions permit.

26. INSPECTION REQUIREMENTS.

a. The simplest complete inspection for the data transmission system is a performance test, with the entire system connected to the generating unit and to a properly adjusted director, height finder and the fuze setter. This inspection can be readily performed at the gun battery when inspecting the data transmission system in the field. The complete basic inspection will then include the following tests:

(1) VISUAL CHECK OF MAIN JUNCTION BOX AND ON-CARRIAGE PARTS FOR COMPLETENESS, APPEARANCE, MECHANICAL CONDITION, ILLUMINATION, TIGHTNESS OF FOLLOWERS, ETC.

(2) PORTABLE CABLES.

(*a*) Continuity of all conductors between correspondingly numbered contacts (no open or crossed circuits).

(*b*) Continuous insulation between all separate conductors (no short circuits).

(*c*) Tightness of followers in the plugs and receptacles.

(*d*) Condition of plug and receptacle covers.

(*e*) Engagement of plug and receptacle.

(3) AZIMUTH AND ELEVATION INDICATORS M4.

(*a*) Operation of adjusting devices (slotted flexible adjusting shafts and toothed adjusting knob).

(*b*) Legibility of scales and indexes.

(*c*) Operation of mechanical (outer) indexes.

(4) PERFORMANCE OF SYNCHRONOUS REPEATERS IN THE FIVE PRINCIPAL DATA TRANSMISSION CHANNELS (FINE AZIMUTH, COARSE AZIMUTH, FINE ELEVATION, COARSE ELEVATION, FUZE).

(*a*) Rotation in same direction as connected transmitter.

(*b*) Freedom from binding or intermittent faults.

(*c*) Correct operation of damping device in repeater.

b. It will not always be possible to perform the basic inspection by a performance test as described above. In this case it will be necessary to inspect each individual unit for mechanical condition and for con-

formance to standard wiring connections. It can be assumed that if each unit meets the mechanical and electrical requirements, and is assembled and connected properly, the completed system will function correctly.

27. FACILITIES NEEDED FOR INSPECTION.

a. A working knowledge of electrical fundamentals.

b. Electrical testing equipment (par. 14).

c. Common hand tools. (These are in the instrument repair kit which is issued to ordnance maintenance companies.)

d. Standard Nomenclature List (SNL) F-222 (to check completeness, etc.).

28. INSPECTION FOR COMPLETENESS, APPEARANCE, ETC.

a. Record the serial numbers of the azimuth and elevation indicators (name plate is on right side of indicator) and any additional data necessary for system identification.

b. Visually check for completeness of the system, and for completeness of accessories and equipment. Refer to Standard Nomenclature List (SNL) F-222 for a complete listing of the system components.

c. Inspect the main junction box and on-carriage parts for completeness, appearance, and mechanical condition. See that plug and receptacle covers are in place, where provided, and that they thread properly onto the plug or receptacle body. Note any signs of abuse such as cracked castings, torn gaskets, etc.

d. Check each unit for watertightness. An unbroken film of paint around a gasketed joint will generally indicate that a proper seal exists. If there is any doubt, remove the cover over the joint and examine the gasket for tears or other defects. Try the packing gland followers for tightness.

e. During a later phase of the inspection, when power has been applied to the system, check illumination in the azimuth and elevation indicators, fuze setter, breech light, and trouble lamp. Try the action of the toggle switch in the gun junction box.

29. INSPECTION OF PORTABLE CABLES.

a. Examine the cable sheath for cuts or tears. (Damage from cuts or tears is progressive, so that even a slight cut or tear may eventually make the cable unserviceable. Sheath repairs should be made as soon as possible.)

b. Test each cable for continuity of all conductors between correspondingly numbered contacts (no open or crossed circuits). Use the ohmmeter at low range (0-10 ohm) setting for this test. Place the cable ends conveniently close together and remove the plug and receptacle covers. Push one ohmmeter test prod into the plug terminal marked "1" and touch the other test prod to the receptacle contact finger marked "1". The ohmmeter should show a very low resistance reading (not over 2 ohms for any conductor). Continue to test all correspondingly numbered terminals and contact fingers in the same manner. An open circuit in any conductor will be indicated by a very high or infinite resistance reading. If two or more conductors are found open, test for crossed circuits. A crossed circuit will be indicated by a continuity reading between conductors which are not correspondingly numbered. Open circuits, crossed circuits, or high resistance (over 2 ohms) circuit must be repaired (par. 42) before the cable can be placed in service.

c. If no open or crossed circuits are found, test each cable for insulation between all separate conductors (no short circuits). Use the ohmmeter at high-range (0-1,000) ohm setting; at this setting the meter will indicate zero ohms on short circuit. Test from either end of the cable, as convenient, but make certain that the other end of the cable is not connected. Test each conductor systematically against every other conductor. If a short circuit is found between any conductors, the cable must be repaired (par. 42).

d. The usefulness of both of the foregoing tests is increased considerably if the cable is flexed progressively throughout its entire length while making the tests. Intermittent cable faults that might otherwise escape detection can be positively located by this procedure.

e. Try tightness of followers in plugs and receptacles.

f. Check condition of plug and receptacle covers.

g. See that each plug and receptacle properly engages its mating part. Insert the plug of each cable in the receptacle on the other end of the cable and lock them together with the nut of the plug to see that they connect properly.

30. INSPECTION OF AZIMUTH AND ELEVATION INDICATOR.

a. Open the covers (see figs. 14 and 15) on the right and left sides of the indicators. This exposes the two slotted flexible adjusting shafts which control the adjustment of the electrical indexes. Using a screwdriver, check the number of turns of each shaft in both directions to the stops. CAUTION: If the system is known to be in adjustment, take

an accurate count of the number of turns to the stop, so that the shaft can be returned to its original adjustment setting on completion of the test. Each shaft should make about seven turns between stops, and should operate smoothly throughout its range. The correct adjustment setting should be approximately midway in the range. Rough motion indicates a damaged adjusting worm or flexible shaft, probably caused by forcing the worm against the action of the stop. If the motion is greatly in excess of seven turns it is due to improper functioning of the stop mechanism (stop screws threaded into the adjusting worm gear teeth), and requires repair as there is a possibility of tearing the repeater wiring.

b. Lift the detent on the left side of the indicator and turn the toothed adjusting knob through several revolutions. CAUTION: If the system is known to be in adjustment, note the coarse and fine scale readings at the start of the test, and return the adjustment to these readings at the end of the test. Do not elevate or traverse the gun during the test. The knob should turn smoothly with no looseness or binding, and both mechanical (outer) indexes should follow the knob motion. Check for backlash by rocking the knob gently back and forth to note any play or lost motion; backlash at this point must not exceed one-half tooth space on the adjusting knob. If backlash is in excess of the tolerance it must be corrected (par. 51 g. (4)). Turn the adjusting knob to set the coarse and fine mechanical indexes to their zero positions on the scale; both indexes should read zero simultaneously. Note any tendency of the outer indexes to bind against the scale or inner indexes.

c. Scale and index graduations should be clearly legible. If possible, check the luminosity of the self-luminous markings. This can be performed in daylight by looking at the indicator face under a dark cloth.

31. PERFORMANCE TEST.

The performance test is conducted with the system connected and energized as described in TM 9-370 (90-mm. antiaircraft gun materiel, M1 and M1A1). The procedure described below is to be repeated for each of the five principal data transmission channels (fine azimuth, coarse azimuth, fine elevation, coarse elevation, and fuze), using test points obtained by operating the director through several of the authorized test problems.

a. Check the rotation of the electrical (inner) index on the synchronous repeater. It should duplicate any setting of the corresponding transmitter in the director. If there is a constant error, adjust the re-

peater by means of its slotted shaft to make certain that the operating point is within the adjustment range.

b. Note any tendency of the electrical index to oscillate about its synchronized position. A slight oscillation is permissible, but a large oscillation persisting for several seconds indicates a defective damping device in the repeater. A repeater with a defective damping device will also have a tendency to "run away." Such a repeater is unserviceable, and must be replaced (par. 51).

c. The electrical index must not touch or drag against the mechanical index at any setting. If there is any doubt, remove the window over the indicator face and test by turning the dial gently with the finger tips. CAUTION: Remove power for this test.

d. Traverse the gun carriage through 360 degrees, while watching the electrical index. Wavering or reversal of the index position probably indicates a defective contact in the contact ring assembly.

32. ACTION TO BE TAKEN.

a. Systems found defective must be repaired or adjusted to render them serviceable. Defects noted and action to be taken must be entered on the inspection form for each system. The action to be taken will be governed by the facilities available. If the facilities of the section do not permit satisfactory accomplishment of the repair or adjustment, the unserviceable components will be passed on to a higher maintenance echelon; replacement items should then be issued to the using arm.

b. If no faults are indicated by the completion of the basic inspection, the system is determined to be in serviceable condition. If minor faults which can be readily corrected are found, the necessary repairs should be made and the system thereby placed in serviceable condition. Certain basic faults do not lend themselves to simple repair, as they must be further localized before the necessary repair can be accomplished. If such faults are found, further inspection will be necessary to complete the inspection procedure in detail, and determine the specific correction necessary to place the system in serviceable condition. Procedure for detailed inspection and correction is described in Section VI, below.

c. Corrections made in the field are, of necessity, the most rapid and expedient measures available that will restore the system to an operable condition. In some cases it may be necessary to use spare conductors (par. 42) or otherwise change the wiring from that in the standard wiring diagrams. It may also be necessary to disturb the standardized

INSPECTION INSTRUCTIONS

electrical zero adjustment (par. 34) of the synchronous repeaters. Such corrective measures are permissible, but must be considered as temporary measures only. A thorough recheck of connections and adjustments to obtain standardized conditions must be made as soon as there is an opportunity to do so.

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(For 90-MM Antiaircraft Gun Mount M1)

Section VI

MAINTENANCE AND REPAIR

33. FACILITIES FOR DETAILED INSPECTION.

a. The facilities for this phase of the inspection are generally the same as those required for the basic inspection.

b. A testing instrument designed for this data transmission system is available for use at base shops and arsenals. The testing instrument is in effect a "dummy" director because it contains five synchronous transmitters which generate the same type of firing data as that which the director would transmit to the guns. The synchronous transmitters of the testing instrument are wired and adjusted in accordance with standard conventions, and therefore show correct operation of the synchronous repeaters. The testing instrument is not furnished for field use, and instructions for its operation are therefore not included herein. Refer to Notes on Materiel (Instruction Guide, Testing Instrument for On-Carriage Wiring and Indicators of Data Transmission Systems, M4, M4A1, M6 and Cable Systems, M1 and M2, November 15, 1941) for complete operating instructions when using this instrument.

34. PROCEDURE FOR DETERMINING ELECTRICAL ZERO.

a. To permit maximum interchangeability between synchronous units, the individual transmitters and repeaters are commonly set to a

standardized reference position known as "electrical zero." This position has been arbitrarily chosen as the position which the unit will assume when the electrical connections are made to a certain standardized pattern, the index then being set to read zero on its scale (fig. 53). Repeaters which have been standardized on electrical zero will read correctly with little or no adjustment when connected in a normal data transmission system.

b. It should be understood that an electrical zero setting is not essential for satisfactory operation. The only essential requirement is that the repeater read the same as its corresponding transmitter. If the electrical zero setting is not made, the feature of interchangeability without readjustment is lost.

c. To determine the electrical zero of a synchronous unit proceed as follows:

(1) Connect the terminals of the unit marked 1, 3, and 5 (odd-numbered) to one side of the 115 volts, alternating-current power line, and terminals marked 2 and 4 (even-numbered) to the other side. When the power circuit is energized, the rotor, if unrestrained, will assume a position which is very close to that defined as the zero position (within a few tenths of a degree).

(2) Without otherwise disturbing the connections, break the connection to the terminal marked 2, leaving it open. With the power circuit energized, the rotor, if unrestrained, will assume either the exact electrical zero position, or a position 180 degrees therefrom. The previous procedure will distinguish between these two positions.

(3) The unit is correctly standardized if the electrical index reads zero against its outer scale (or can be brought to zero reading by the slotted flexible adjusting shaft) when the rotor is in the exact electrical zero position.

d. To perform the standardizing adjustment, turn the slotted adjusting shaft to the center of its travel. Adjust the electrical index to read zero against its outer scale when the rotor is in the exact electrical zero position. Perform the adjustment by temporarily loosening the three screws which clamp the index on the rotor shaft and turning the index on the shaft. Be sure that the rotor is not displaced from its equilibrium position by frictional forces.

e. The polarity of the power terminals 4 and 5 must not be interchanged in a given system. That is, the terminal marked 4 on the transmitter, and the terminal marked 4 on the repeater must be connected to the same side of the power supply. Reversal of terminals will cause the units to read 180 degrees out of agreement.

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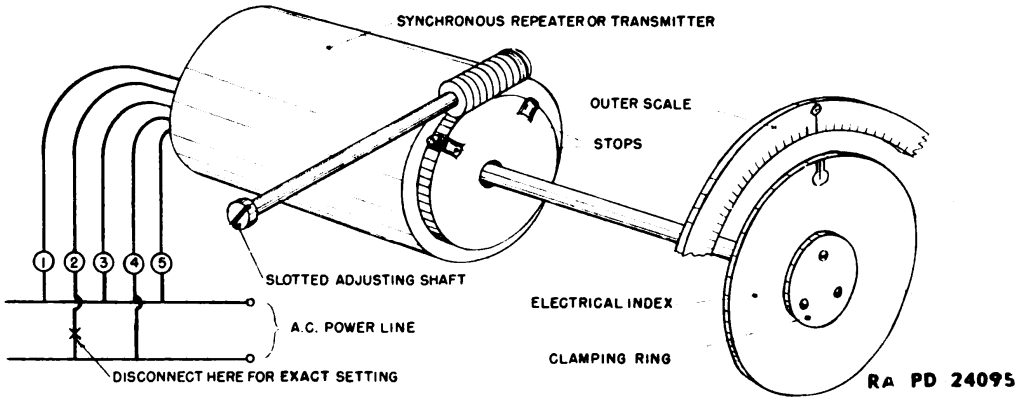

Figure 53 — Condition for Electrical Zero Setting of Synchronous Units

f. If, due to incorrect marking of the terminals of a unit, the rotation is opposite to the normal rotation, correct by reversing the connections to terminals marked 1 and 3. Reversal of any other terminals will cause the units to read 120 degrees out of agreement. (It would be better if the terminals were correctly marked before being issued.)

35. PROCEDURE IF ONE OR MORE REPEATERS REMAIN INOPERATIVE OR FALL OUT OF SYNCHRONISM DURING OPERATION.

a. This condition usually indicates an open circuit or short circuit in one of the transmitters, repeaters, or connecting cable. It may also occur through a small region in azimuth due to a faulty contact ring. Intermittent faults of this character are sometimes difficult to locate as they seldom occur consistently. Therefore, when an intermittent fault of this nature is noticed but disappears before being corrected, a complete record of the occurrence should be made by using personnel to assist in locating the trouble should it recur later.

b. The first step is to determine whether the trouble is due to a mechanical fault, such as an index binding at some point. See paragraph 37. The possibility of mechanical fault should be definitely eliminated before proceeding with the electrical tests.

c. The next steps are to proceed to locate the particular unit at fault or the particular portion of the circuit in which the fault occurs.

d. When due to trouble at a repeater, all other repeaters connected in parallel will be affected somewhat, but the faulty repeater will usually experience the greatest effect. When the faulty repeater is disconnected, by removing the plug (cut off power while disconnecting) at the receptacle box, main junction box, or (for fuze indicators only) gun junction box, as convenient, the balance of the system will function

MAINTENANCE AND REPAIR

correctly. If the first attempt is not successful in locating the faulty unit, it may be reached by a process of elimination.

e. When due to trouble at a transmitter, all repeaters will be affected alike. It will not be possible to eliminate the fault by disconnecting repeaters.

f. Electrical troubles of this type may be found in either transmitter or repeater and usually consist of a defect in a brush, brush rigging, or slip ring which will cause a circuit interruption at a specific angular position. The interruption may be in either the field or armature depending on the manufacturer's practice. The location may be found by the use of the ohmmeter or voltmeter and ammeter. In any case, if a fault is definitely located within a unit, the unit must be replaced to render the system serviceable. No attempt should ordinarily be made to repair a faulty transmitter or repeater.

g. Ohmmeter tests can be made with the unit disconnected from other transmitters and repeaters, at the appropriate plug. Power must be removed from the unit if not removed by the above disconnection. The ohmmeter leads are to be connected to any convenient plug or receptacle terminals which are connected to the unit (refer to wiring diagram fig. 47). Measure successively the resistance between terminals of the unit over a 360 degree rotation in each direction. Open circuits or short circuits are indicated by a sharp swing of the meter needle.

h. Voltmeter tests require that the field (4-5) terminals be energized at approximately 115 volts, 60 cycles, with other terminals disconnected. This can be performed by disconnecting at the appropriate plug and, if necessary, improvising leads to points connected to the above terminals (proceed cautiously to avoid short circuits). Connect the voltmeter (150-volt scale) successively to terminals 1-2, 2-3, and 1-3, and in each case observe the voltage variation over a 360 degree rotation in each direction. The voltage should rise and fall smoothly from zero to maximum as the unit is rotated. A sudden voltage interruption or a uniform low voltage indicates a defective unit.

i. Ammeter tests of field and armature currents may also be made. Field currents in the repeaters are measured under the same conditions as outlined in **h** above, placing the ammeter in series with the power supply. Armature currents are measured with the system completely connected up and operating. The value of the armature current at the synchronized position should be very close to zero. High current indicates an armature short circuit, an open field circuit or an increase in load, such as caused by the mechanical faults subsequently described. Repeater armature currents in excess of 0.3 ampere may result in excessive heating and indicate that power should be removed until the faulty unit is disconnected or the fault remedied.

j. Normal voltage, current and resistance readings for the foregoing tests are shown below. These readings may, however, vary considerably in individual units.

	Transmitter	Repeater
Field (Terminals 4 and 5):		
Rated voltage	115 volts	115 volts
Resistance (terminals 4-5) approximate	7 ohms	16 ohms
Excitation current approximate	0.9 amp	0.4 amp
Armature (Terminals 1, 2, 3):		
Rated maximum voltage	105 volts	105 volts
Resistance (terminals 1-2, 2-3, or 3-1) approximate	8 ohms	24 ohms

k. If the fault cannot be found in the individual units it will be necessary to carefully trace back through all circuit connections, checking tightness of terminals and continuity of conductors. Refer to wiring diagram, figure 47.

36. PROCEDURE IF ONE OR MORE REPEATERS ROTATE IN OPPOSITE DIRECTION FROM THE CONNECTED TRANSMITTER.

The direction of rotation of a repeater may be reversed by interchanging any two of the armature connections (1, 2, and 3). If the electrical zero indication is correct, it may be retained by confining the interchange to terminals marked 1 and 3 on the repeater. The other possible combinations rotate the electrical zero position by plus or minus 120 degrees. This change may be made anywhere in the wiring between the transmitter and the repeater. In the case of transmitters, which have multiple repeaters, reversal at the transmitter terminals (in the main junction box) will reverse all four repeaters; reversal at the repeater terminals (on carriage) will reverse only the single repeater involved without affecting the directions of the others.

37. PROCEDURE IF ONE OR MORE REPEATERS LAG BEHIND THE TRANSMITTER IN EITHER DIRECTION OF ROTATION.

a. This condition indicates excessive mechanical load, or insufficient torque at the repeater. The amount of lag will be found to vary with the speed or acceleration, and may become zero when at rest.

b. The generator voltage or the voltage at the gun indicators, or both (normally 115 volts), may be incorrect. A system voltage below 75 volts or a difference of over 40 volts between transmitter and re-

peater may be expected to cause this difficulty. An open circuit in the field circuit of a transmitter or repeater will also cause a great reduction of torque, the repeater then assuming either of two positions 180 degrees apart with equal facility.

c. An excessive mechanical load such as a tight bearing or binding index will cause this condition. The overload in this case is more uniform in character than that described above, but a similar procedure is to be followed for its location and remedy.

d. On repeaters with accessible indexes, a simple and often effective test is to displace the index a small amount (say 1 degree) first in one direction then in the other. If the indication returned to in both cases is not the same, mechanical difficulty or a deficiency of torque is indicated.

38. PROCEDURE IF A REPEATER FAILS TO COME TO REST, BUT OSCILLATES ABOUT ITS SYNCHRONOUS POSITION.

a. This is indicative of a defective damping mechanism in the repeater. In the case of multiple repeaters, all repeaters will usually be affected somewhat, but the defective repeater will usually oscillate through a greater angle.

b. The damping mechanism is built into the repeater, and its repair in the field is not feasible. The damping mechanism is designed to bring the repeater to rest after 180 degrees displacement within three seconds.

c. If the oscillation is not large, it may be possible to retain the unit in service, following the average rather than the instantaneous motion with the follow-the-pointer drive. When the oscillation is too large for this, or when it interferes with the use of other connected repeaters, the unit must be disconnected as unserviceable. In either case this fault requires replacement of the repeater.

d. When operating with a defective damping device, the repeater must be watched closely and, if it starts to run as a motor, power must be removed from the system at once.

39. PROCEDURE IF A REPEATER REMAINS STATIONARY FOR A TIME THEN SUDDENLY ROTATES 180 DEGREES AND AGAIN REMAINS STATIONARY.

This condition usually indicates an intermittent short circuit between two armature (1, 2, 3) leads and will be accompanied by an abnormally loud hum at certain angular positions. Power must be removed from the system immediately when this fault is noticed, as excessive armature currents flow and the windings may be burned out. This condition

is also accompanied by a reacting torque on the transmitter which may cause injury to the delicate mechanisms connected thereto. Procedure for locating short circuits in armature leads is given in paragraph 35.

40. PROCEDURE FOR LOCATING FAULTS IN CONTACT RING.

a. When the contact ring assembly is mounted on the gun carriage, the most convenient procedure is to disconnect the plug connection on the gun junction box and test between this plug and the receptacle in the stationary receptacle box. The test is conducted in exactly the same manner as for cable testing (par. 29). To completely test the contact surface, it will be necessary to traverse the gun carriage through a full revolution when testing each conductor for continuity.

b. Notice that when testing in this manner, the conductors pass through the terminal box as well as through the contact ring. Hence, if shorted, open, or crossed circuits are found, check the connections in the terminal box before proceeding with the more difficult operation of disassembling the contact ring. An open or short circuit through a definite region in azimuth can be taken as a positive indication of a defect in the contact ring. A short circuit of fairly high resistance (a few hundred to a few thousand ohms) generally indicates excessive moisture in the contact ring housing.

c. Faults in the contact ring are corrected by disassembling the unit (par. 50) and thoroughly cleaning the interior surfaces. Remove corrosion or "goo" from the contact ring surfaces with SOLVENT, dry-cleaning, then polish the surface lightly with CLOTH, crocus, or PAPER, flint, No. 00. Do not use emery paper or emery cloth on the contact surfaces.

41. PROCEDURE IF THERE IS FAILURE OF ILLUMINATION IN TWO OR MORE UNITS.

a. The most common cause of illumination failure is burned out electric lamps. The obvious remedy is to replace the lamps. If, however, all the lamps in one branch of the wiring remain dark after replacement, trace the wiring (terminals L_1 and L_2) in that branch for an open circuit.

b. Complete failure of illumination will probably be due to a defective transformer or light switch in the gun junction box. Verify by reading the voltage across terminals L_1 and L_2 in the gun junction box. The normal voltage reading is 6 volts or slightly more. If there is no voltage across these terminals with the system energized, check the

light switch and the transformer primary connections (terminals 4 and 5). The light switch is connected in the primary circuit of the transformer.

42. CABLE REPAIR.

a. When once a faulty cable is detected and located, the cable must be repaired or replaced. Perform sheath repairs and other cable repairs when required by using the cable repair kit (par. 17).

b. If the fault is in a portable cable and the arrangement is, or can be made, such that all the cables furnished are not in use, substitute another cable for the faulty one while making the repair. All portable cables of this system are interchangeable.

c. Portable cables can frequently be repaired by substituting a spare conductor in the cable for the faulty conductor. If the fault is a short circuit between two or more conductors, one conductor may remain in service, but the remainder of the shorted conductors must be disconnected and carefully taped up (use rubber tape only) at both ends. Each portable cable as furnished has one idle conductor taped up for use as a spare. In addition, the conductors connected to terminals 4 and 14, also 5 and 15, of plugs and receptacles are connected externally in parallel at both ends; one of these conductors may therefore be disconnected to replace one of the other conductors developing an open circuit.

d. When insufficient spares are available, it may be necessary to disconnect the faulty conductor and substitute an external wire, improvised for the purpose. Ordinarily, No. 14 rubber insulated wire, commonly used for house wiring, may be employed satisfactorily. Since the cover on the box or terminal strip connected cannot then be closed because of the wire, precautions must be taken to prevent entrance of moisture, using paulins or other covering.

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Section VII

DISASSEMBLY AND ASSEMBLY

43. GENERAL.

a. The disassembly and assembly procedures described herein are intended for use of ordnance maintenance personnel.

b. Disassembly of the system should always be kept to the minimum limit which will permit the necessary repairs or adjustments to be made. The extent of disassembly is determined by the repairman when he makes his detailed inspection.

c. Assembly is practically the reverse of disassembly. The various subassemblies should first be assembled, and then the subassemblies combined to complete the system. Where the assembly operations vary greatly from the reverse procedure of those for disassembly, a description of the proper method of assembly is included in this manual.

d. The use of good judgment in marking or tagging parts as they are disassembled will save valuable time which would otherwise be lost in positioning the parts during reassembly. Handle all parts carefully.

44. FACILITIES FOR DISASSEMBLY AND ASSEMBLY.

a. Common hand tools. (These are in the instrument repair kit which is issued to ordnance maintenance companies.)

b. Clean metal trays or containers of sufficient size to hold small parts as they are disassembled.

c. Soldering iron.

d. Solder, tin-lead, grade A.

e. Paste, soldering.

DISASSEMBLY AND ASSEMBLY

45. INSTRUCTION FOR SOLDERING.

a. Thoroughly clean or scrape the surfaces to be soldered. Copper will show a bright surface when properly cleaned.

b. Use rosin flux, either in paste form, or in the self-contained core form in which some solders are furnished. When using paste, dab a very small amount of the paste on the cleaned surfaces. Flux in self-contained cores needs no special application, as it will flow properly when the soldering iron is applied.

c. If possible, wrap the wire around the terminal device or other connecting wire so as to get a mechanically solid joint before soldering. The wire cannot be wrapped around contact fingers or terminals in plugs and receptacles, but must be stripped back about ¼-inch and inserted into the drilled hole. Remember that the solder is intended primarily to provide electrical contact, and is not intended to withstand mechanical strain.

d. Heat the joint with the point of a hot soldering iron, and flow the solder smoothly into the joint. Remove the soldering iron and allow the joint to cool. A good joint should show a thin continuous film of solder, with no lumps or excess of solder. If too much solder has been applied, reheat the joint with the soldering iron and allow the excess to flow onto the iron.

e. To separate two soldered parts apply a hot soldering iron to the joint until the solder flows, then pull the parts away from each other.

f. Avoid prolonged heating of parts to prevent charring the adjoining insulation. If the soldering iron is at the proper working temperature and the point is properly tinned, not more than a few seconds will be required to complete the soldering operation. An iron that is too cold will produce "lumpy" joints, and require prolonged use of the iron in an effort to smooth the joints. An iron with a pitted or improperly tinned point (both of these faults are accelerated by overheating of the iron) will be difficult to use, and will also prolong the operation.

46. DISASSEMBLY OF PLUGS AND RECEPTACLES.

The various plugs and receptacles used throughout the data transmission system are built to either one of two similar basic patterns, one pattern employing contact fingers and the other employing spring terminals. The plugs and receptacles used on the portable cables are representative of each of these patterns. The disassembly and assembly instructions for these plugs and receptacles may, in general, be followed for the other plugs and receptacles in the system.

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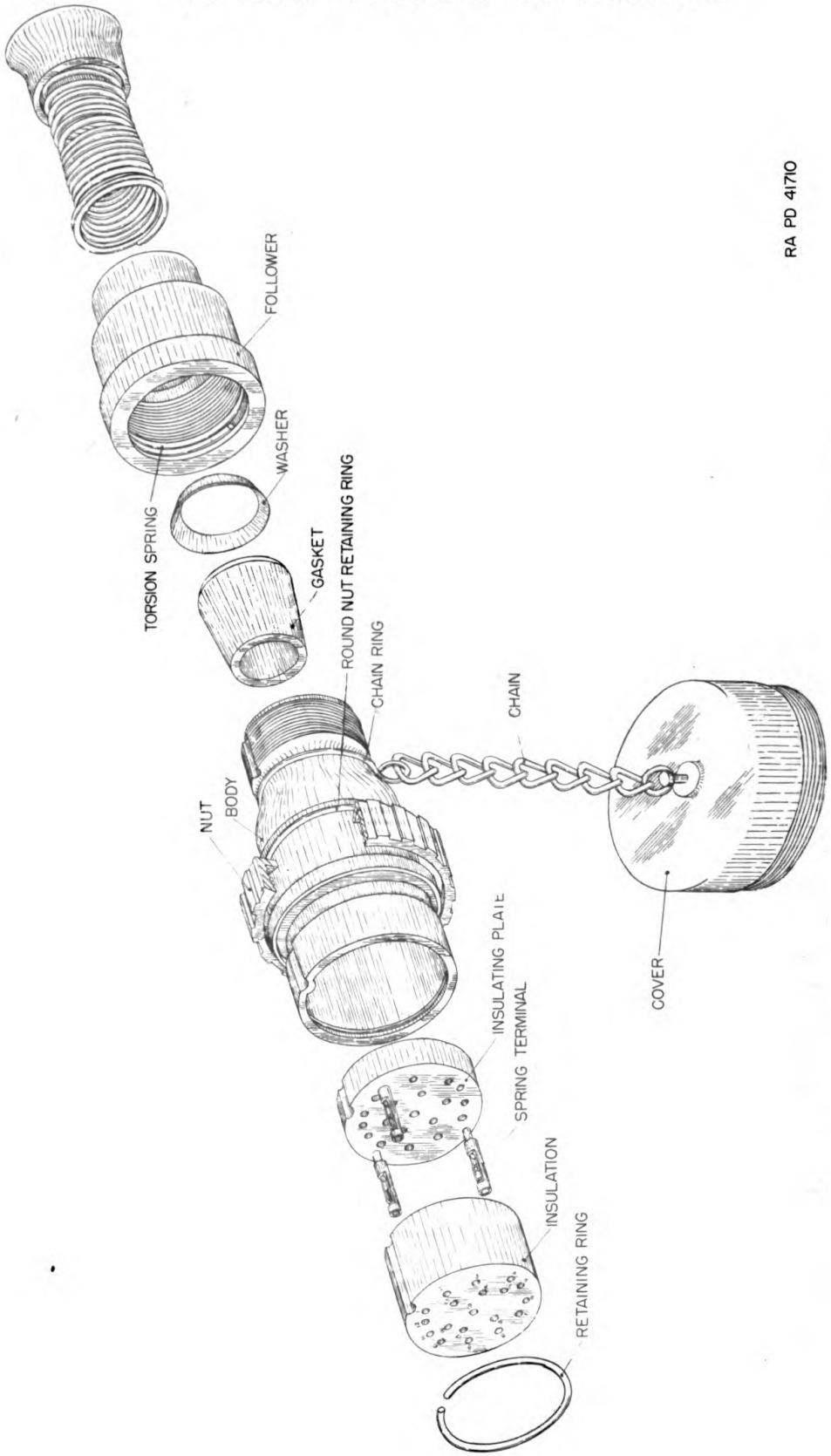

Figure 54 — Exploded View Showing Disassembly of Plug

DISASSEMBLY AND ASSEMBLY

a. Disassembly and Assembly of Plug Assembly (fig. 54).

(1) Open the plug cover to expose the spring terminal openings.

(2) Using a thin-bladed screwdriver, pry one end of the split retaining ring out of the body groove. Continue working from this end until the entire ring is free for removal from the groove.

(3) When the split retaining ring has been removed, the insulation, the spring terminals, and the spring terminal insulating plate can be lifted out in the order shown.

(4) Should it be necessary to increase the slack in the wires to the spring terminals, loosen the follower and push the cable through the gasket. The follower will turn quite hard when being loosened, because the torsion spring will expand against the groove in the follower and exert considerable friction against loosening.

(5) To replace a spring terminal, unsolder the old terminal and solder a new terminal in place. See instructions for soldering, paragraph 45. Be certain that each wire from which a terminal has been unsoldered is replaced in the same hole from which it was removed. See figure 46 for identification of wires by color coding.

(6) To reassemble the plug, slip each spring terminal into its hole in the plate and then place the insulation over the group or terminals, keeping the edge locating slots in the plate and insulation in line with each other. Fit this compact group into the plug body. The locating slots line up with the pressed key in the body. Work the split retaining ring back into its groove in the body. Tighten the follower.

(7) Additional disassembly and assembly operations, involving removal of parts shown in figure 54 may be performed if required.

b. Disassembly and Assembly of Receptacle, Assembly (fig. 55).

(1) Open the receptacle cover to expose the contact fingers.

(2) With a blunt screwdriver or similar tool, free an edge of the soft rubber gasket and then carefully pull the gasket clear of the contact fingers.

(3) Using a thin-bladed screwdriver, pry one end of the split retaining ring out of the body groove. Continue working from this end until the entire ring is free for removal from the groove.

(4) When the split retaining ring has been removed, the retaining plate, the contact fingers, and the insulating plate can be lifted out in the order shown.

(5) Should it be necessary to increase the slack in the wires to the contact fingers, loosen the follower and push the cable through the gasket. The follower will turn quite hard when being loosened,

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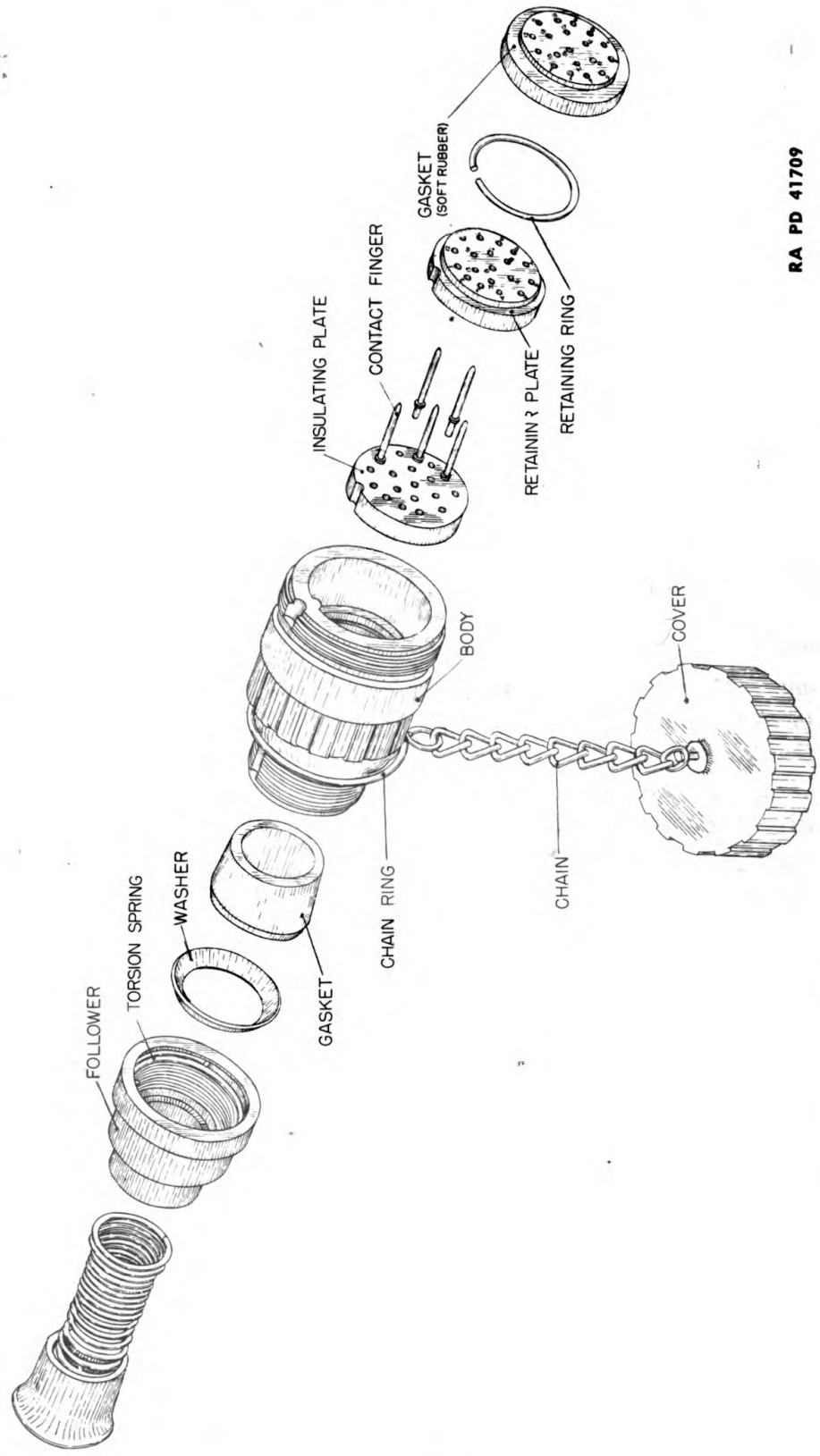

Figure 55 — Exploded View Showing Disassembly of Receptacle

because the torsion spring will expand against the groove in the follower and exert considerable friction against loosening.

(6) To replace a contact finger, unsolder the old contact finger and solder a new one in place. See instructions for soldering, paragraph 45. Be certain that each wire from which a contact finger has been unsoldered is replaced in the same hole from which it was removed. See figure 46 for identification of wires by color coding.

(7) To reassemble the receptacle, slip each contact finger into the hole in the insulating plate, and then place the retaining plate over the group of contact fingers, keeping the edge locating slots in the plates in line with each other. Fit this compact group into the receptacle body. The locating slots line up with the pressed key in the body. Work the split retaining ring back into its groove in the body. Fit the soft rubber gasket over the contact fingers so that the numbered holes in the gasket agree with the numbered holes in the retaining plate. Seat the soft rubber gasket into its groove. Tighten the follower.

(8) Additional disassembly and assembly operations, involving removal of parts shown in figure 55 may be performed if required.

47. REMOVAL OF COVERS FROM BOXES.

When removing the covers from boxes or terminal strips which have been closed for some time, it will often be found that the rubber gasket adheres tightly to the cover. To facilitate breaking this bond, slots have been provided to permit the insertion of a narrow chisel or screwdriver to pry the cover loose. After the cover has been loosened, care must be exercised not to insert the tool to a point where the gaskets will be damaged. Care must also be taken not to nick the sealing surface of the cover or body and thus impair the effectiveness of the watertight joints. The covers must be properly replaced and tightened to prevent entrance of dampness.

48. TERMINAL STRIPS.

The terminal strips in the various wiring boxes are conveniently located for access to the terminals. Terminals and terminal plates are numbered for circuit identification. The wire connected to each terminal also has a distinctive identifying color. Refer to figures 46, 47 and 48 for wiring diagrams and color coding.

49. INSTRUCTIONS FOR REMOVING CONTACT RING FROM GUN MOUNT.

a. Raise the pedestal of the gun mount about two feet from the floor and block it securely. Elevate the gun until the equilibrator parts clear the terminal box to allow working space.

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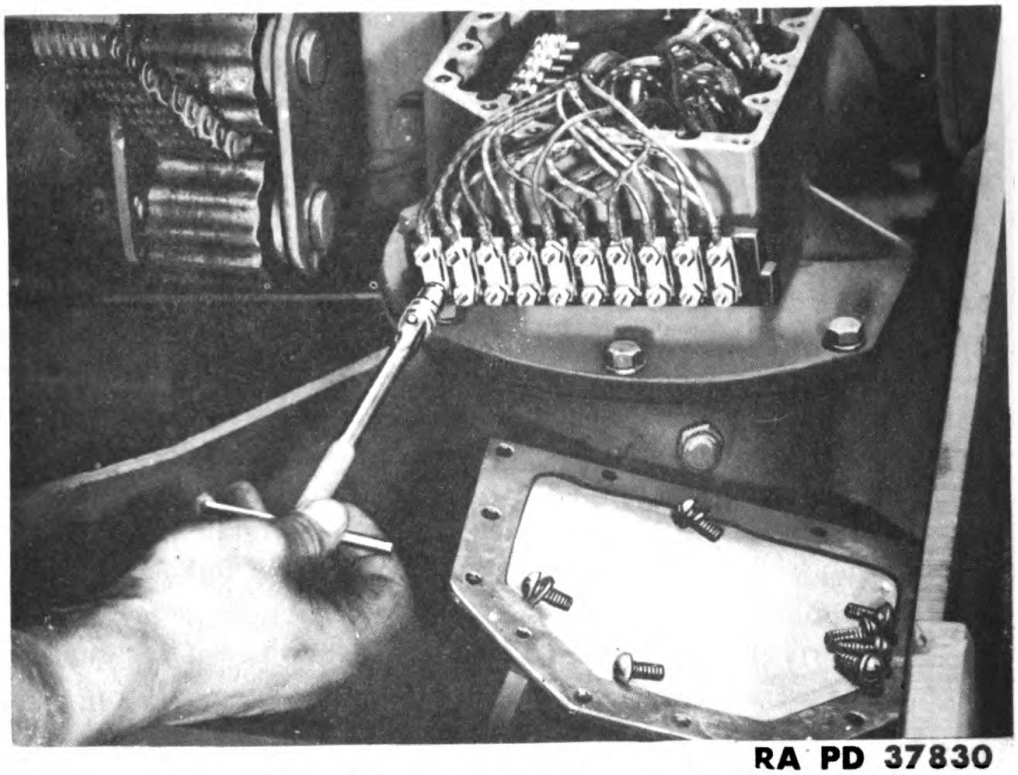

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Figure 56 — Disconnecting Terminal Box Wires

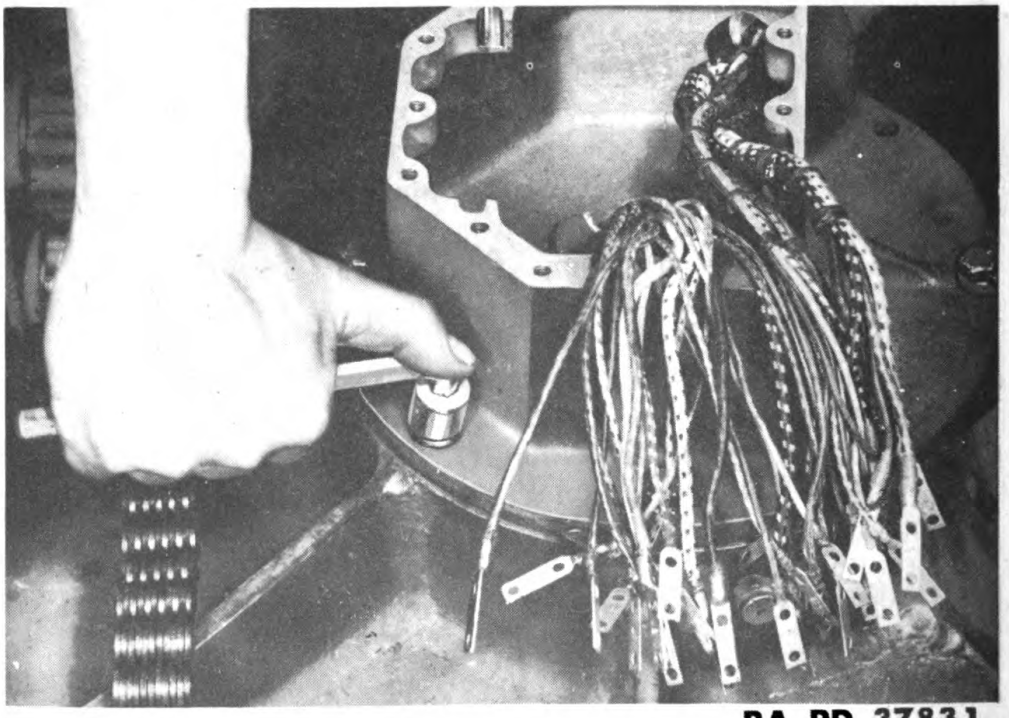

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Figure 57 — Removal of Terminal Box

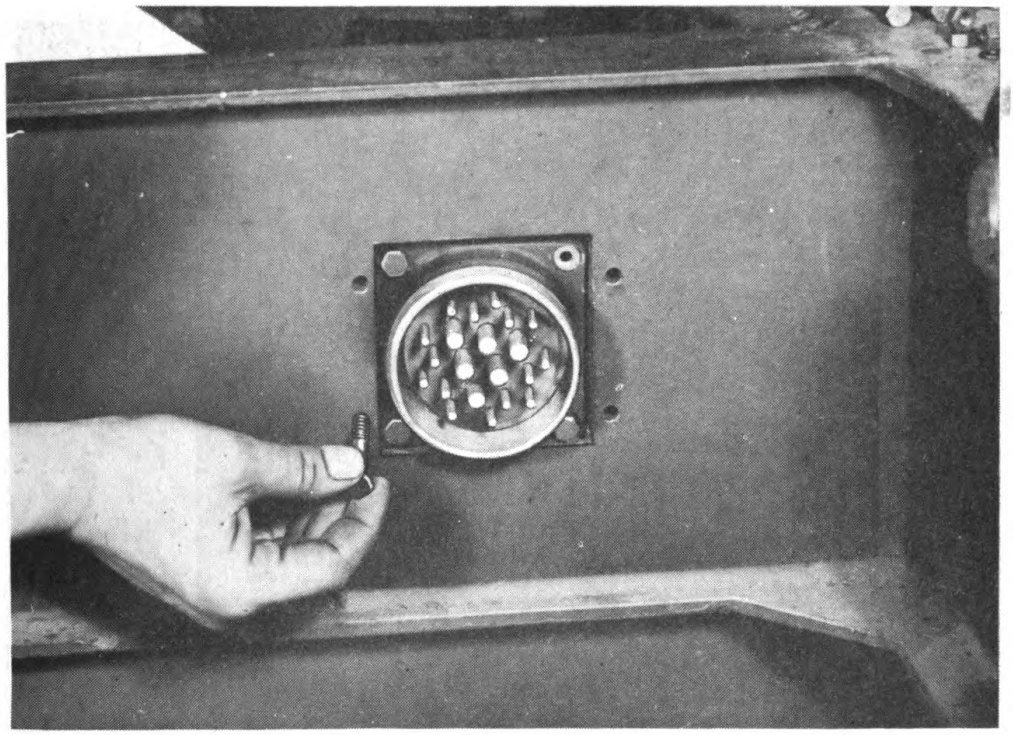

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Figure 58 — Removal of Receptacle Box

b. Remove the terminal box cover and disconnect the wire terminals from the terminal strips (fig. 56). Be sure that each wire can be properly identified for reconnection. If markings or colors do not agree with the standard arrangement (figs. 46 and 47), tag each wire before disconnecting.

c. Remove the terminal box (fig. 57).

d. Remove the cable and receptacle retainer plate over the receptacle box. Remove the receptacle box (fig. 58).

e. Remove the pedestal bottom closure plate. Tape a length of rope to the contact ring cable. Remove the contact ring retaining screws and washers and lower the ring to the floor (fig. 59).

f. When replacing the contact ring, proceed in the reverse order from that given for removal.

50. DISASSEMBLY OF CONTACT RING (fig. 60).

a. Disconnect the terminal segment wires leading into the contact ring from the receptacle box. Be sure that each wire can be properly identified for reconnection. If markings or colors do not agree with the

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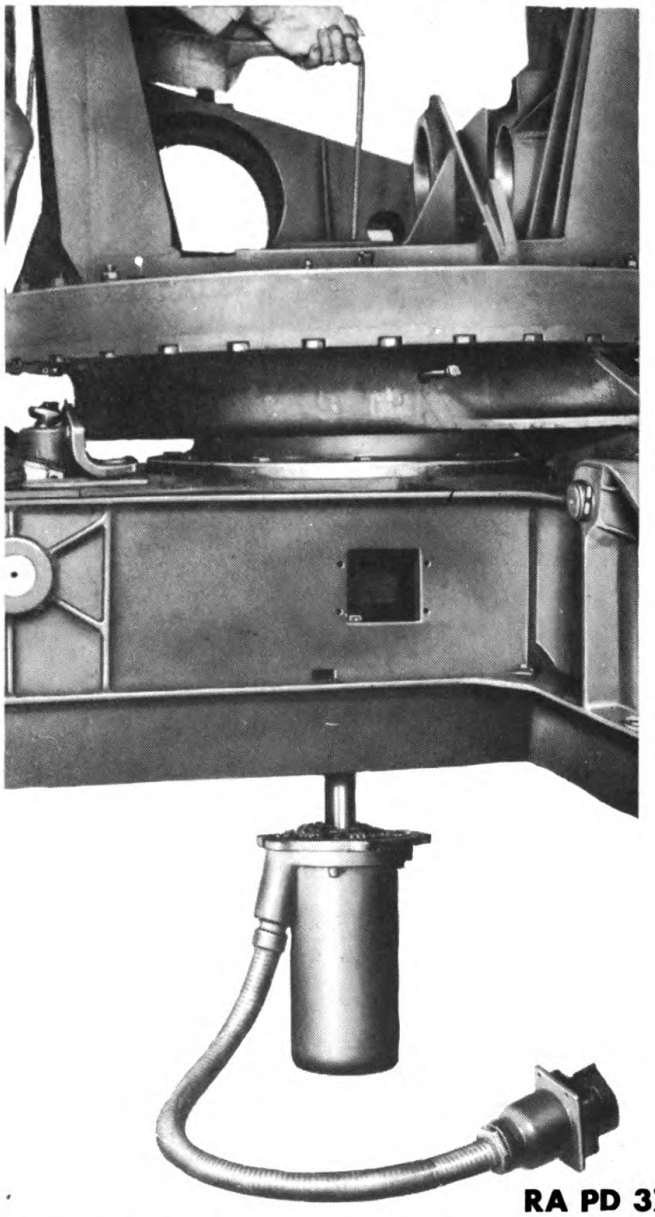

RA PD 37833

Figure 59 — Removal of Contact Ring

standard arrangement (figs. 46 and 47), tag each wire before disconnecting.

b. Remove the three screws (1, fig. 60) in the edge grooves of the terminal segment. Lift the spindle and brush rigging assembly (2) out of the housing. All internal working parts will then be accessible for cleaning or further disassembly.

c. To remove an individual brush rigging assembly (3), remove the screw (4) at each end of the supporting channel and pry the channel

DISASSEMBLY AND ASSEMBLY

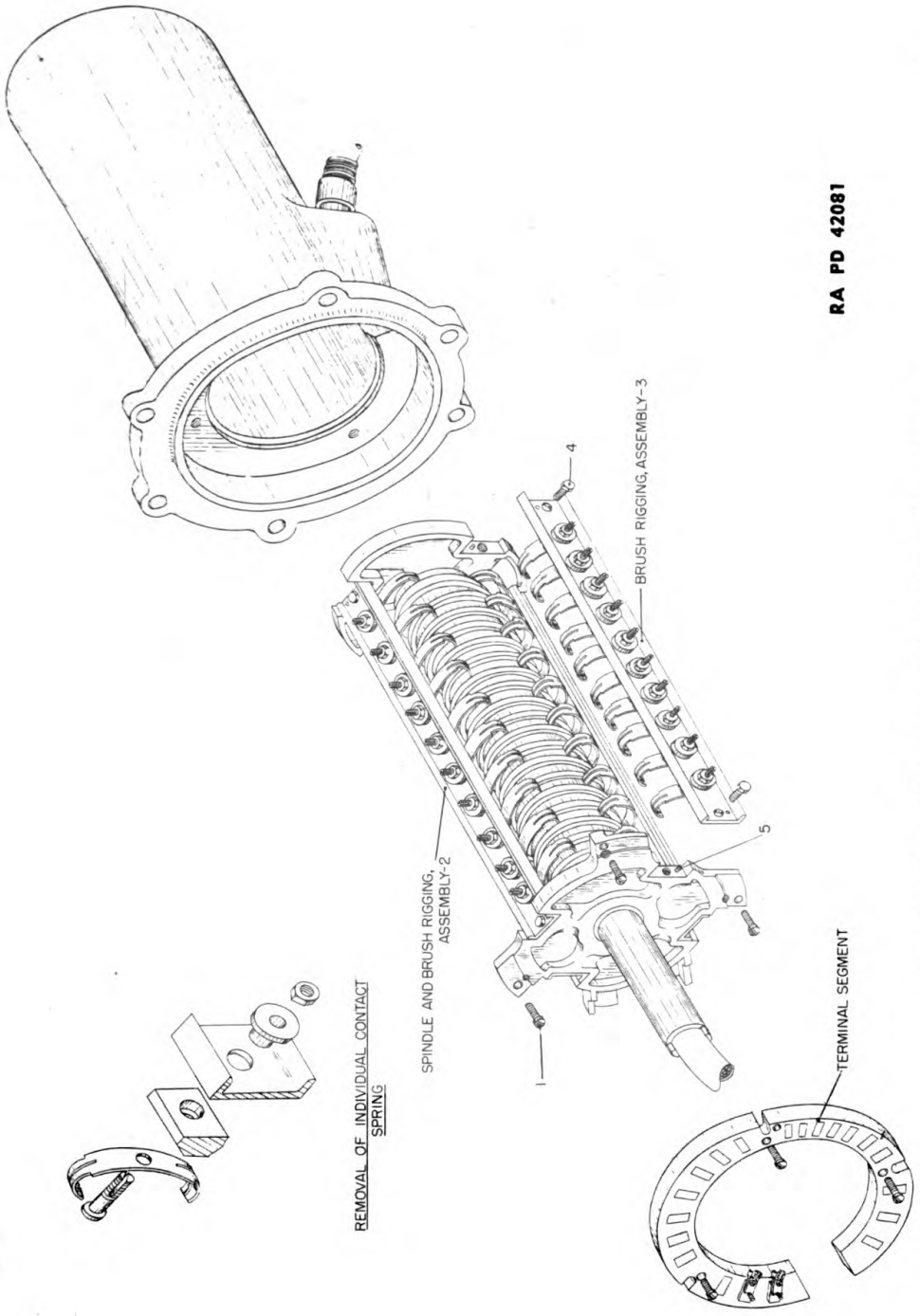

Figure 60 — Disassembly of Contact Ring

free of the dowel pin (5) at each end. It may or may not be necessary to unsolder the individual brush wires. For soldering instructions, see paragraph 45.

d. Reassembly is performed in the reverse order of disassembly, Lightly lubricate the bushings at either end of the spindle with GREASE, lubricating, special.

51. DISASSEMBLY OF AZIMUTH AND ELEVATION INDICATOR M4 (figs. 61 to 96).

The procedure described below is the procedure for complete disassembly of the indicator as a whole. Complete disassembly to the full extent shown in the figures will not usually be required. Partial disassembly may conveniently follow the order shown, or may be altered according to the nature of the repair. Appearance of the indicator before disassembly is shown in figures 61 and 62. During assembly, lubricate ball bearings, bushed bearings and sliding surfaces with GREASE, lubricating, special. Apply light coats of grease, preferably with a brush. Place a few drops of oil on gear trains and points where shafts enter the housing, using OIL, lubricating, for aircraft instruments and machine guns. Repeaters are not to be lubricated.

a. Window Frame Assembly (figs. 63 and 64).

(1) Remove 16 screws which secure the window frame to the case, and pry the window frame free from the case. Be careful not to damage the gasket.

(2) If necessary to replace the window, remove 16 flat-head screws which secure window retainer to window frame. Remove the window retainer and press window out of frame. Place new window in position and seal edges with sealing compound. Reassemble window retainer.

b. Scale and Indexes (figs. 65 and 66).

(1) Remove clamping ring and clamping disk, each secured by three screws BCOX3BC (fig. 66). Lift out inner indexes. Remove scale, secured by four screws BCLX3DC and BCOX3CC (fig. 66). Remove outer indexes, each secured by four screws BCOX3AB (fig. 66). As each index or scale is removed, wrap it in tissue paper and lay it flat in a safe place. *Handle the scale only by the reinforced outer edge, not by the central scale openings; improper handling will cause the translucent white paint to crack away from the stenciled graduations and scale numerals.*

(2) Removal of the inner indexes will disturb the electrical zero adjustment (par. 34). For major disassembly or overhaul of the indicator, this loss of adjustment will be of little consequence, as final re-

adjustment of the coarse and fine indicators will be required at this stage of the reassembly. However, for minor disassembly, it is advisable to retain the adjustment by marking a light pencil line across the edge where the inner index meets the adapter.

(3) During reassembly of the scale and indexes, adjust the outer indexes to simultaneous zero reading, as follows: Turn the drive shaft (fig. 62) until the outer coarse index stands at the zero graduation of the scale. Then remove the screws which have been temporarily placed to fasten the outer fine index, and refasten this index in the position closest to zero.

c. Terminal Block Cover Assembly (figs. 67 to 72).

(1) LAMP REPLACEMENT.

Remove six fillister head screws in the edge of the cover (fig. 67). Open the cover. Remove the lamp shield and lamp (fig. 66). The lamp may be replaced at this stage without further disassembly of the indicator.

(2) REMOVAL OF COVER ASSEMBLY.

Remove the wiring clips and terminal screws (fig. 69) so as to free the wires from the cover, assembly. Remove the cotter pin (fig. 70) and drive out the hinge pin.

(3) TERMINAL BLOCK ASSEMBLY.

Removal of the terminal block assembly is seldom required. For removal or replacement of parts refer to figures 71 and 72.

d. Mechanical Index Adjusting Knob Cover Assembly (figs. 73 to 75).

(1) LAMP REPLACEMENT.

Pull out the plunger knob to unlatch the cover, then raise the cover until it is held by the cover retaining spring (fig. 73). Remove the lamp reflectors and lamps. The lamps may be replaced at this stage without further disassembly of the indicator.

(2) REMOVAL OF COVER ASSEMBLY.

Loosen or remove the cover retaining screw (fig. 74) and pull the cover, assembly clear of the indicator.

(3) PLUNGER PARTS.

Removal of the plunger parts is seldom required. For removal or replacement of plunger parts refer to figure 75.

e. Removal of Bracket with Repeaters Assembly (figs. 76 to 80).

(1) Remove the nut and lock washer in the fine index adapter (fig. 76) and slide the slotted washer out of its groove in the repeater shaft. The adapter has an integral key which fits into the keyway in the repeater shaft.

(2) Scribe a light locating line between the gear and the hub assembly (fig. 76). Remove the gear.

(3) Remove the flexible adjusting shafts (fig. 77).

(4) Remove the mechanical index adjusting knob group (fig. 78). (When replacing this group it will be necessary to apply new sealing compound under the edge of the adapter.)

(5) Remove the repeater worm bracket assemblies (fig. 78). Each bracket is secured by three screws and lock washers, and located by two dowel pins. (When replacing these brackets be sure to mesh the worm in the short arc of the repeater worm gear, between the stop screws.)

(6) Remove the gear, assembly (figs. 78 and 86) leaving the ball bearings in position within the hub. The special tool shown in figure 78 will be useful if the round nut is difficult to remove. This tool is not furnished in the instrument repair kit, but should be prepared locally.

(7) Remove the reduction worm bracket, assembly (fig. 78). The bracket is secured by three screws and lock washers, and located by two dowel pins.

(8) Remove the four screws and lock washers (fig. 79) which secure the bracket with repeaters assembly to the indicator case. Pull the repeater wires out, one at a time, from the passage slot in the case. Support the bracket firmly and pull it forward, out of the indicator case (fig. 80).

f. Removal of Repeaters from Bracket with Repeaters Assembly (figs. 81 to 83).

(1) Scribe locating marks at the points shown in figure 81. These marks will be helpful in determining the proper slack in the repeater wires during reassembly. (To determine proper slack, dress the wires neatly around the rear of the repeater (fig. 82) and turn the repeater to the limit of its adjusting motion. It may be helpful to temporarily assemble the adjusting worm bracket. There should be just enough slack to permit full adjusting motion of the repeaters without strain or tearing of the wires at the adjustment limits).

(2) The repeater wires are bound with heavy cotton cord (fig. 82). The cords must be cut away, and the wires pulled through the bracket opening before the repeaters can be removed.

(3) To remove either repeater, remove the clip (fig. 83) on each side of the repeater and then pull the repeater out of the bracket.

g. Removal of Drive Shaft from Bracket with Repeaters Assembly.

(1) Remove the spur pinion, assembly (2, fig. 84) and the nut (3) directly underneath it. Remove the keyed washer (4). Pull the gear

(5) off the end of the drive shaft (ball bearings need not be removed from the gear). Rest the differential spider on a solid supporting block and drive out the taper pin (6) which secures the spider (7) to the drive shaft. Pull the spider group off the end of the drive shaft. Pull the gear, assembly (8) off the end of the drive shaft.

(2) Further disassembly of differential parts (fig. 84) may be performed if required. Should it be necessary to drive out any of the ball bearings, use a ¾-inch wooden drift and tap the bearing out gently. Wrap each bearing in clean waxed paper immediately on removal.

(3) Before disassembling the drive shaft parts, spot mark both retaining rings (fig. 85) to locate them accurately for reassembly. Loosen the set screws and remove the retaining rings. Push the drive shaft and ball bearings out of the bracket. The outer bearing race will probably separate from the remainder of the bearing, as this is characteristic of the magneto type ball bearing. Push the outer race out from the bracket and reassemble it with the remainder of the bearing. Wrap the bearings in clean waxed paper.

(4) After reassembling the drive shaft and differential parts, replace the bracket in the indicator case. Check for backlash in the mechanical index adjusting knob by rocking the knob gently back and forth while holding the drive shaft stationary. If backlash exceeds one-half tooth space on the adjustment knob, it must be removed. To take up backlash, remove the bracket from the case and push the drive shaft forward slightly by loosening the front retaining ring (fig. 85) and tightening the back retaining ring until backlash is within the limits described above.

h. Removal of External Parts from Coarse Repeater with Gear Assembly (fig. 86).

(1) Follow the order of removal shown in figure 86.

(2) The pinion has an internal key which fits the keyway in the repeater shaft.

i. Removal of External Parts from Fine Repeater with Gear Assembly (fig. 87).

(1) Follow the order of removal shown in figure 87.

(2) It is extremely important that both ball bearings in the hub of the gear be in perfect condition. Any high spot or binding in either of these bearings will produce errors in the indicator reading. As an emergency repair, when a replacement bearing is not available, it will be possible to substitute a serviceable bearing of the same size from one of the repeater worm brackets. The unserviceable bearing may then be reassembled with the adjusting worm.

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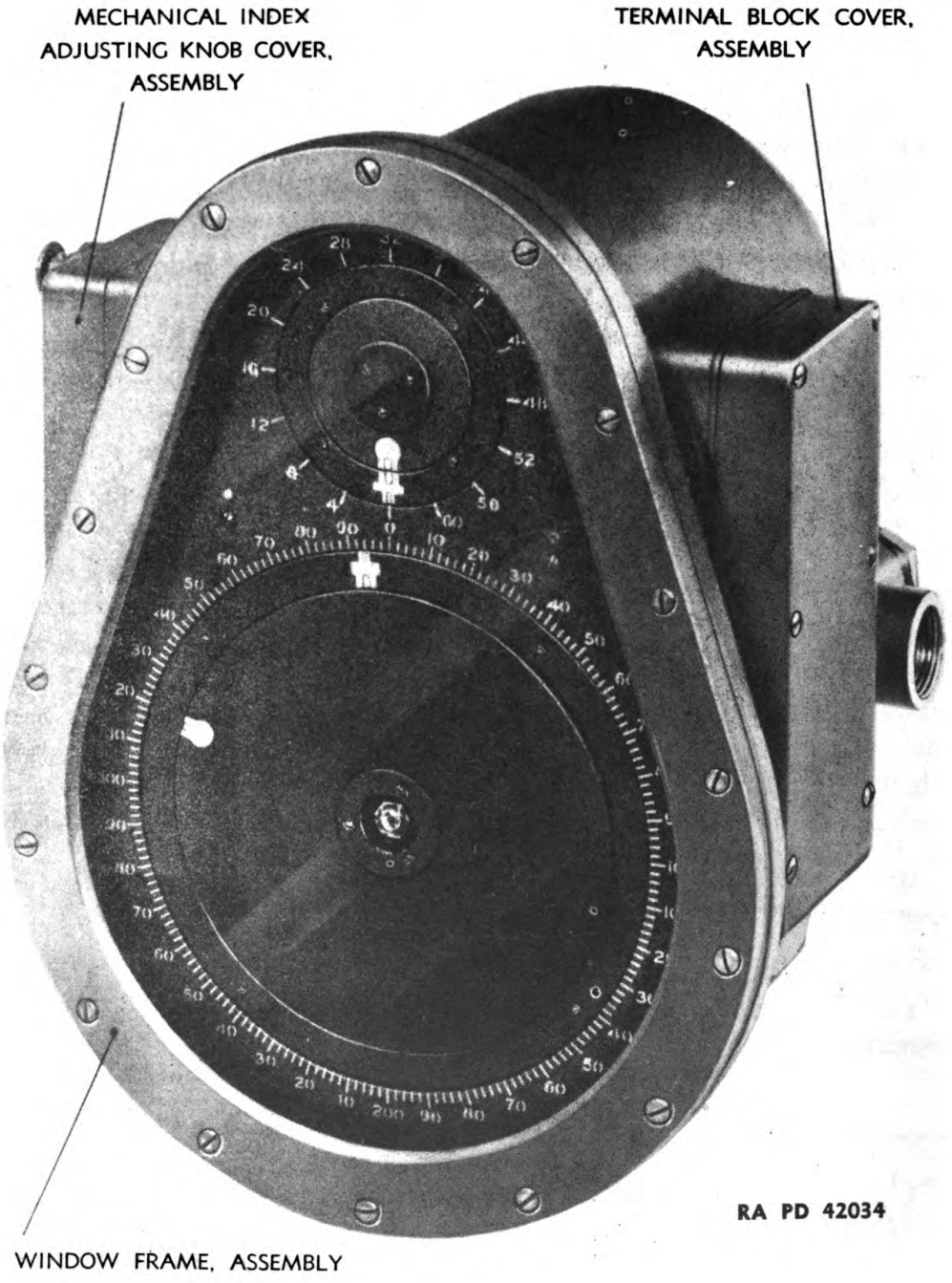

Figure 61 — Azimuth and Elevation Indicator, M4 — Right Side

DISASSEMBLY AND ASSEMBLY

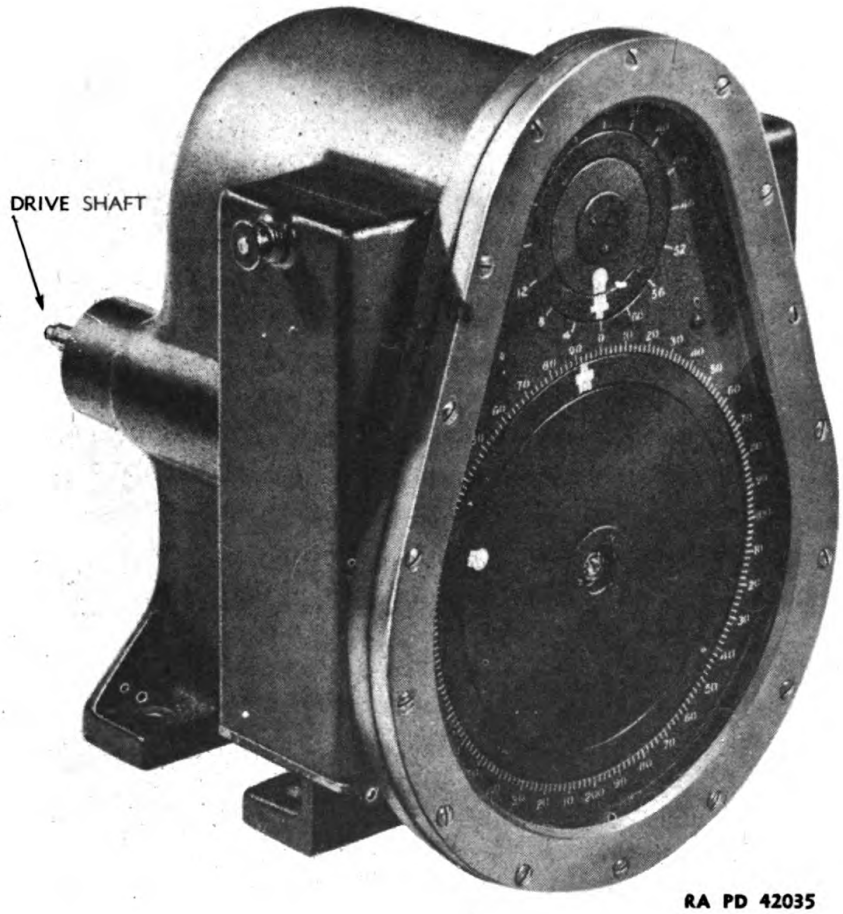

Figure 62 — Azimuth and Elevation Indicator, M4 — Left Side

j. Reduction Worm Bracket Assembly (fig. 88).

(1) Before disassembly, spot mark both retaining rings (fig. 88) to locate them accurately for reassembly. Also, mark the pinion position on the worm shaft.

(2) Follow the order of disassembly shown in figure 88.

k. Repeater Worm Brackets (figs. 89 to 91).

(1) Follow the order of disassembly shown in the figures.

(2) Be careful not to reverse the adjusting worms when reassembling. The end of the worm with the hexagonal opening should be toward the flexible shaft.

l. Mechanical Index Adjusting Knob Group (fig. 92).

(1) Before disassembling, scribe a light locating line across the edge between the adjusting knob and the gear.

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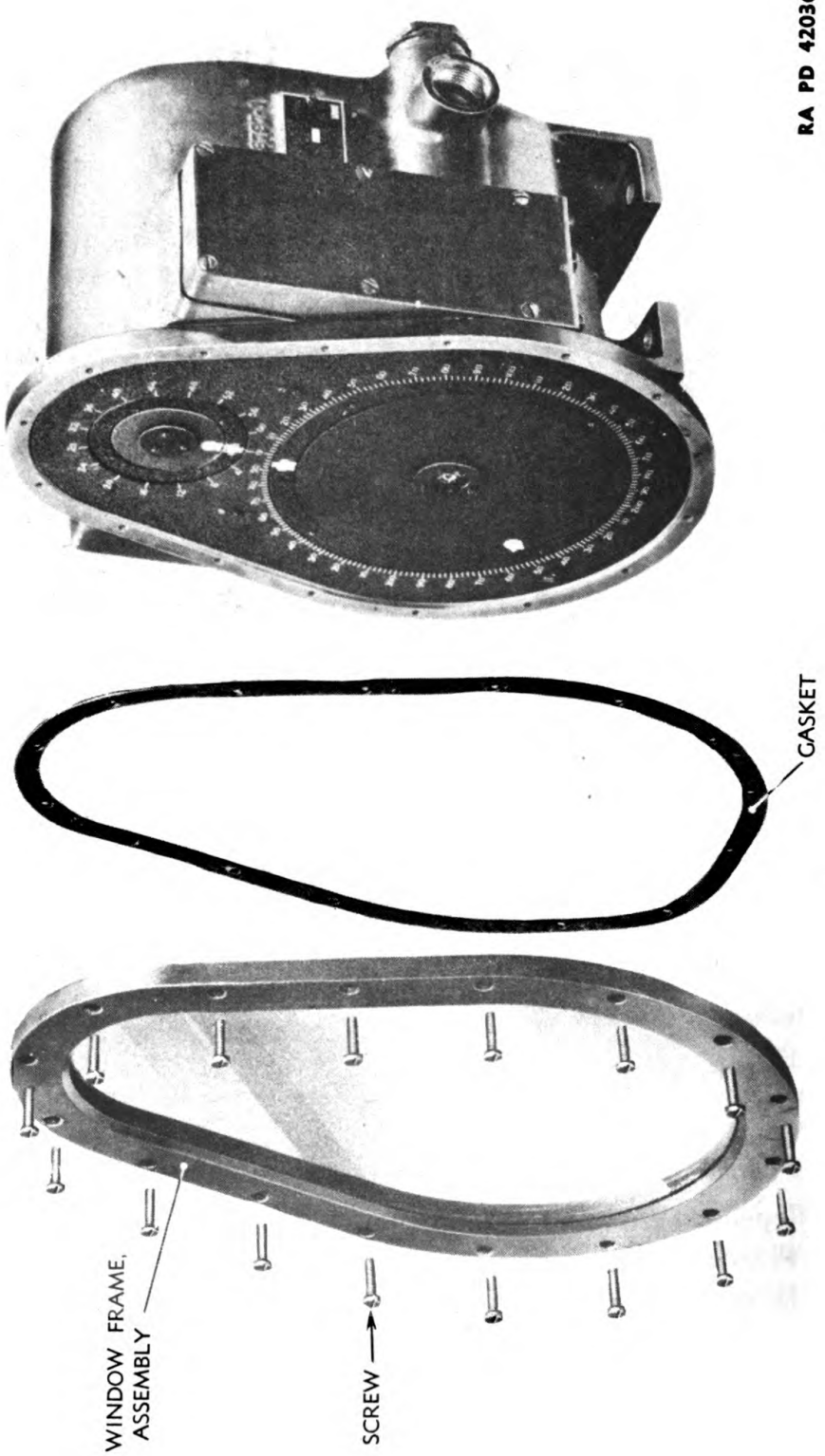

Figure 63 — Removal of Window Frame Assembly

DISASSEMBLY AND ASSEMBLY

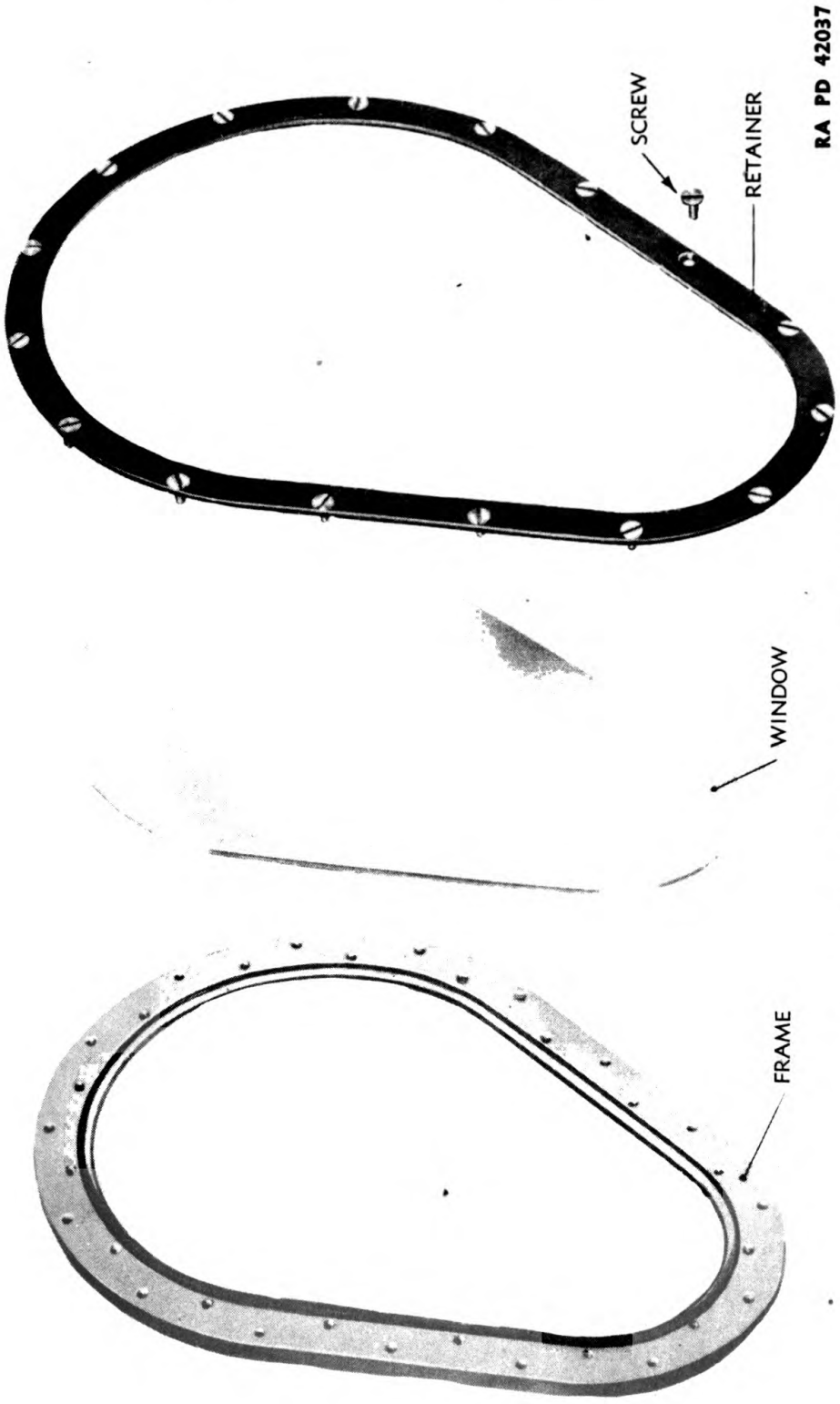

Figure 64 — Replacement of Window

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

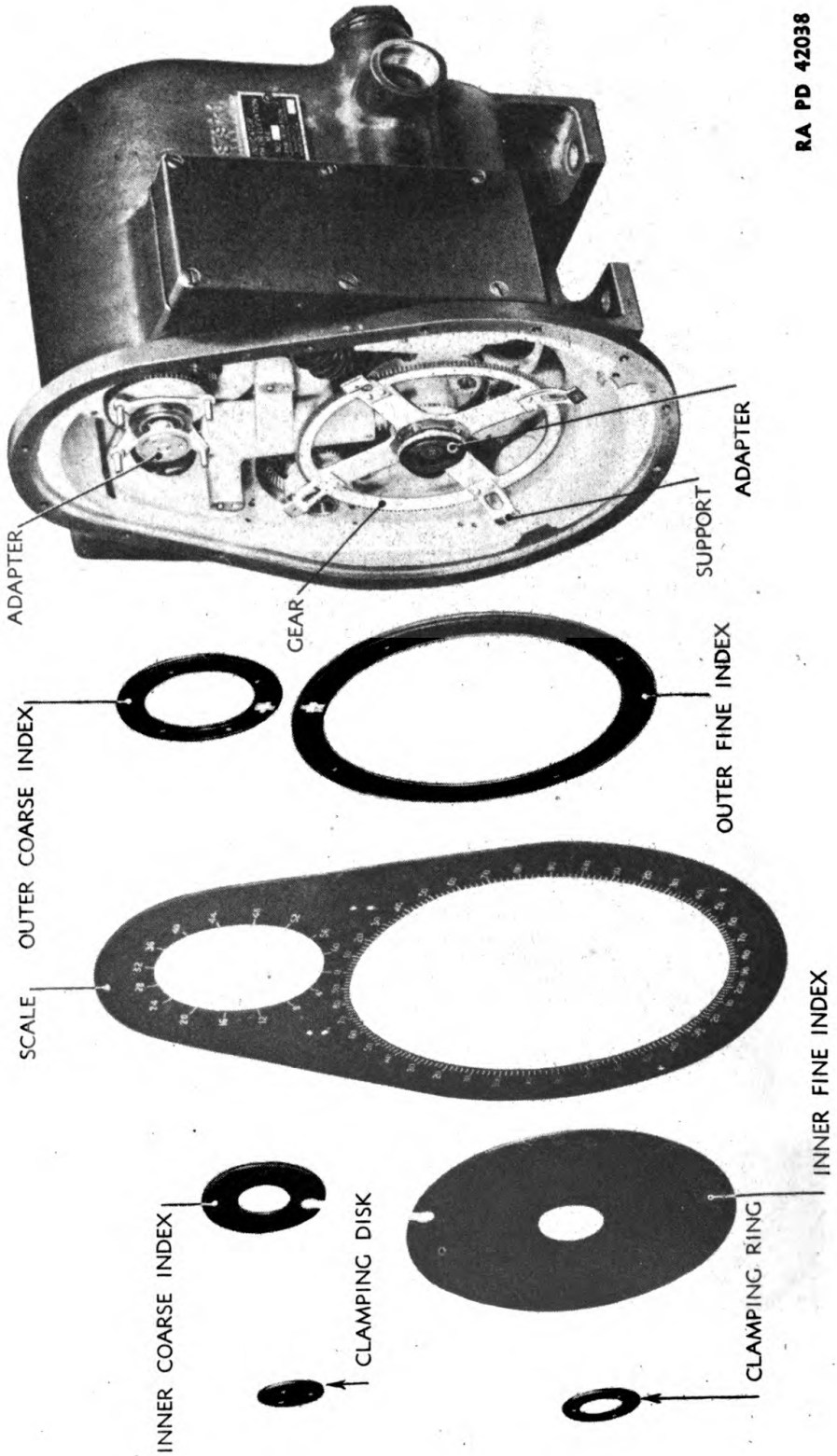

Figure 65 — Sequence of Removal of Scale and Indexes

DISASSEMBLY AND ASSEMBLY

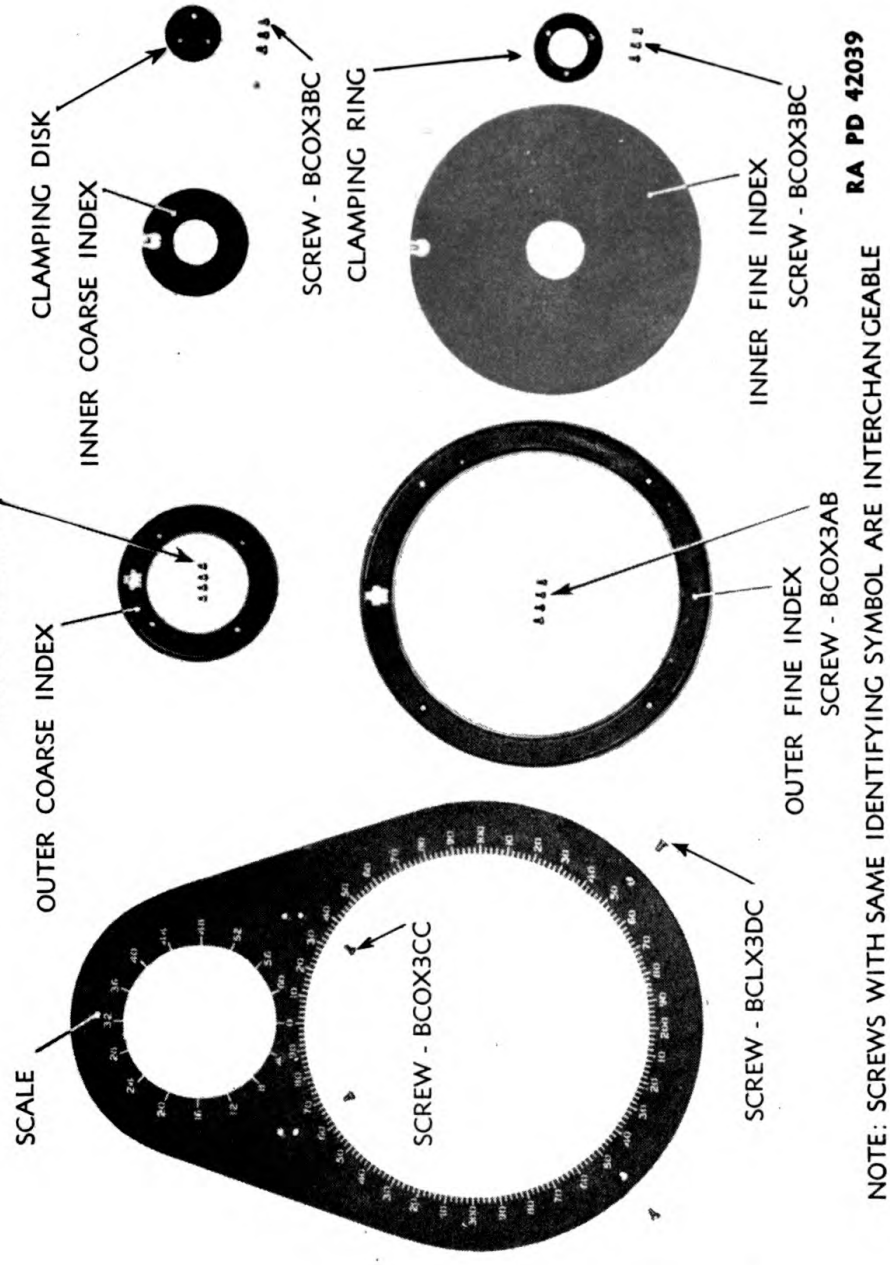

Figure 66 — Scale and Indexes

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

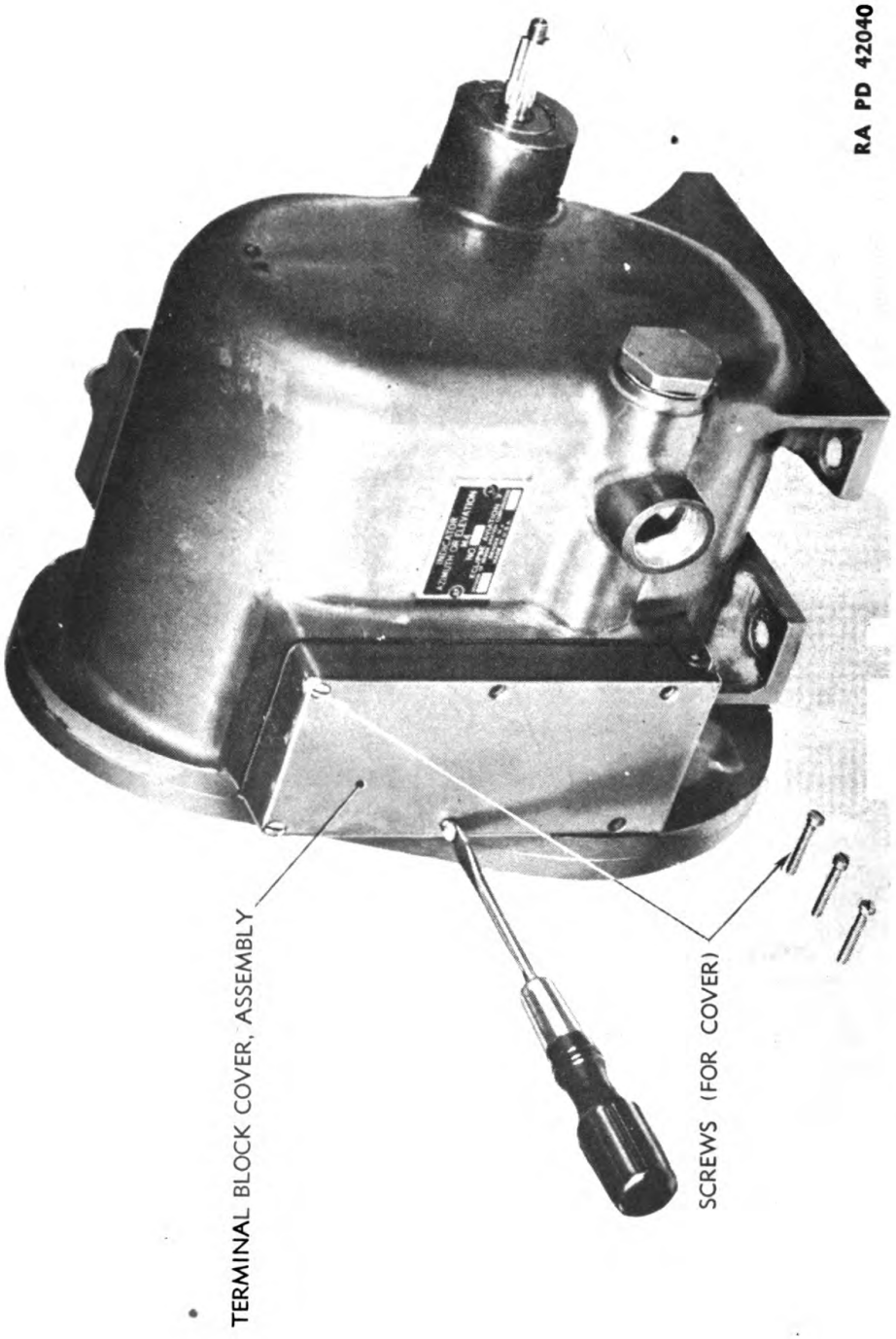

Figure 67 — Opening the Terminal Block Cover Assembly

DISASSEMBLY AND ASSEMBLY

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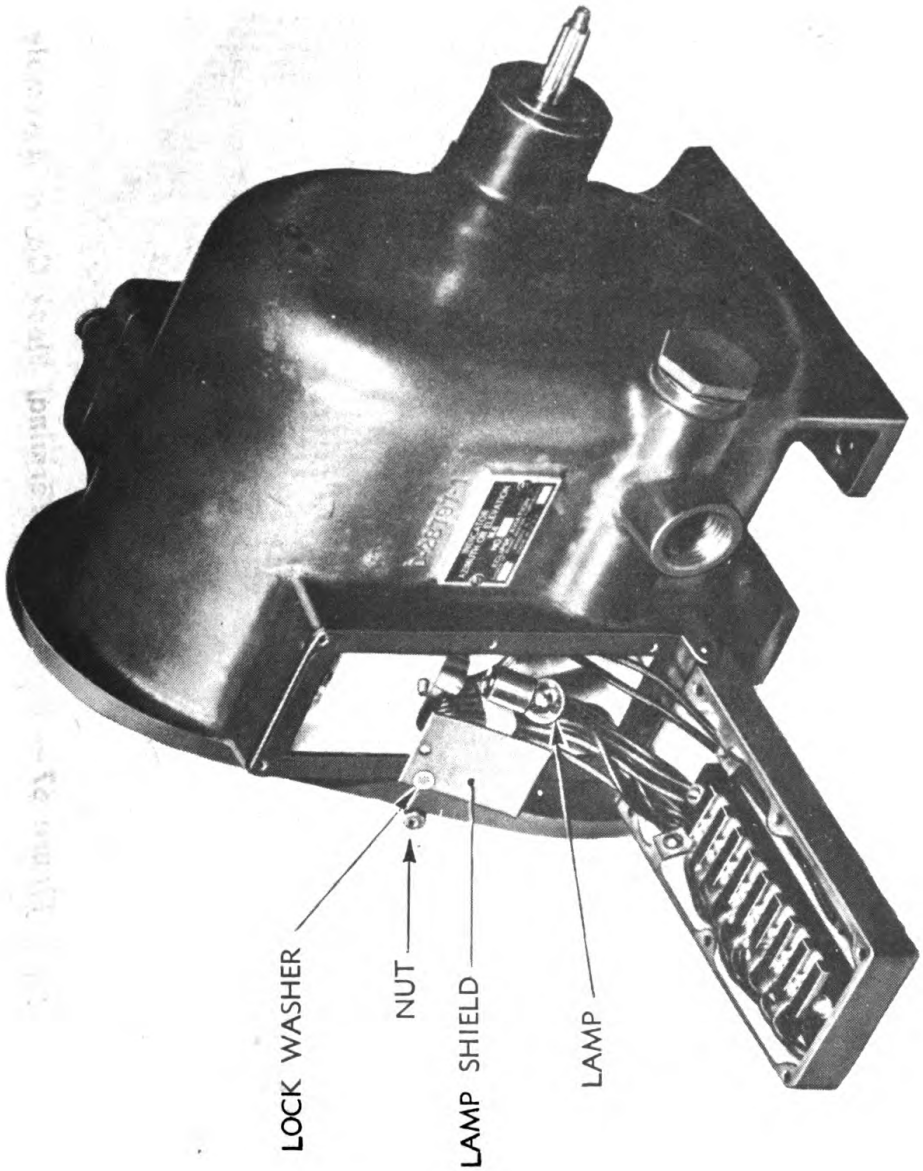

Figure 68 — Lamp Replacement (Right Side)

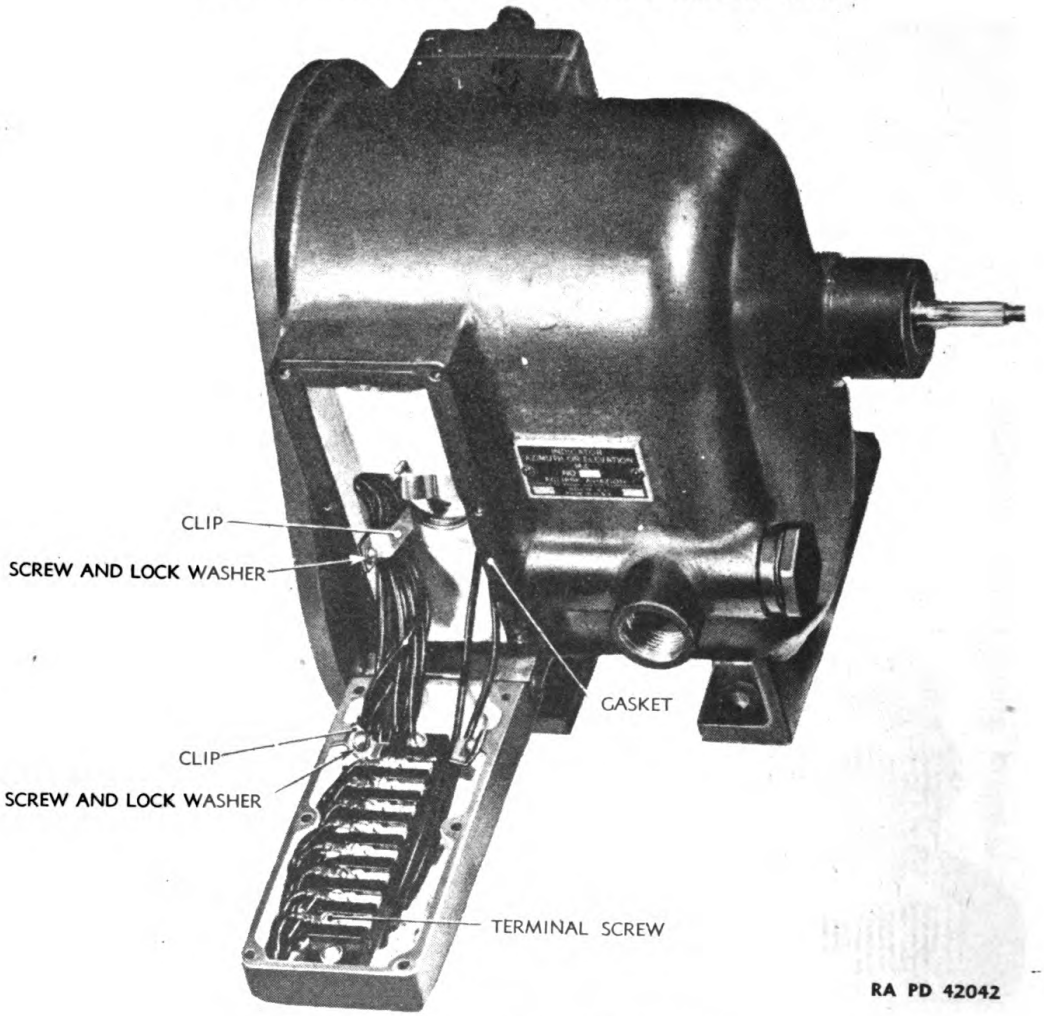

Figure 69 — Lamp Removed

(2) To disassemble, drive out the taper pin.

m. Removal of Fittings from Indicator Case (figs. 93 to 96).

(1) Refer to the figures for method of disassembly.

(2) To remove the oil seal (fig. 96) use a 1¼-inch wooden drift and drive the oil seal out from the inside of the case. To replace the oil seal use a flat wooden block and drive the oil seal in flush with the outer surface.

n. Reassembly.

Reassembly is performed in the reverse order of disassembly unless otherwise indicated.

o. Inspection.

After reassembly, the various parts and mechanisms should be inspected according to the procedure given in section V.

DISASSEMBLY AND ASSEMBLY

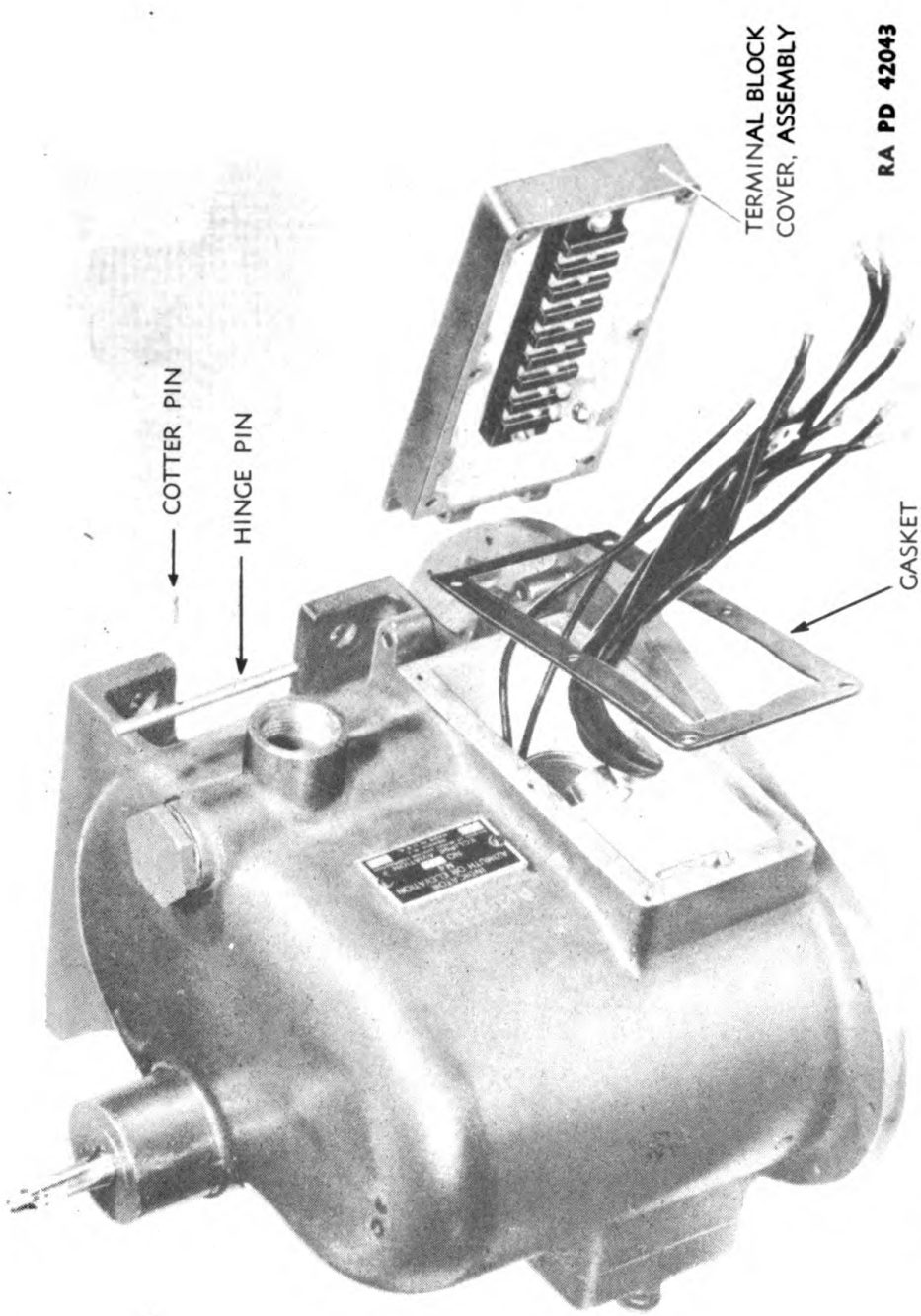

Figure 70 — Removal of Terminal Block Cover Assembly

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

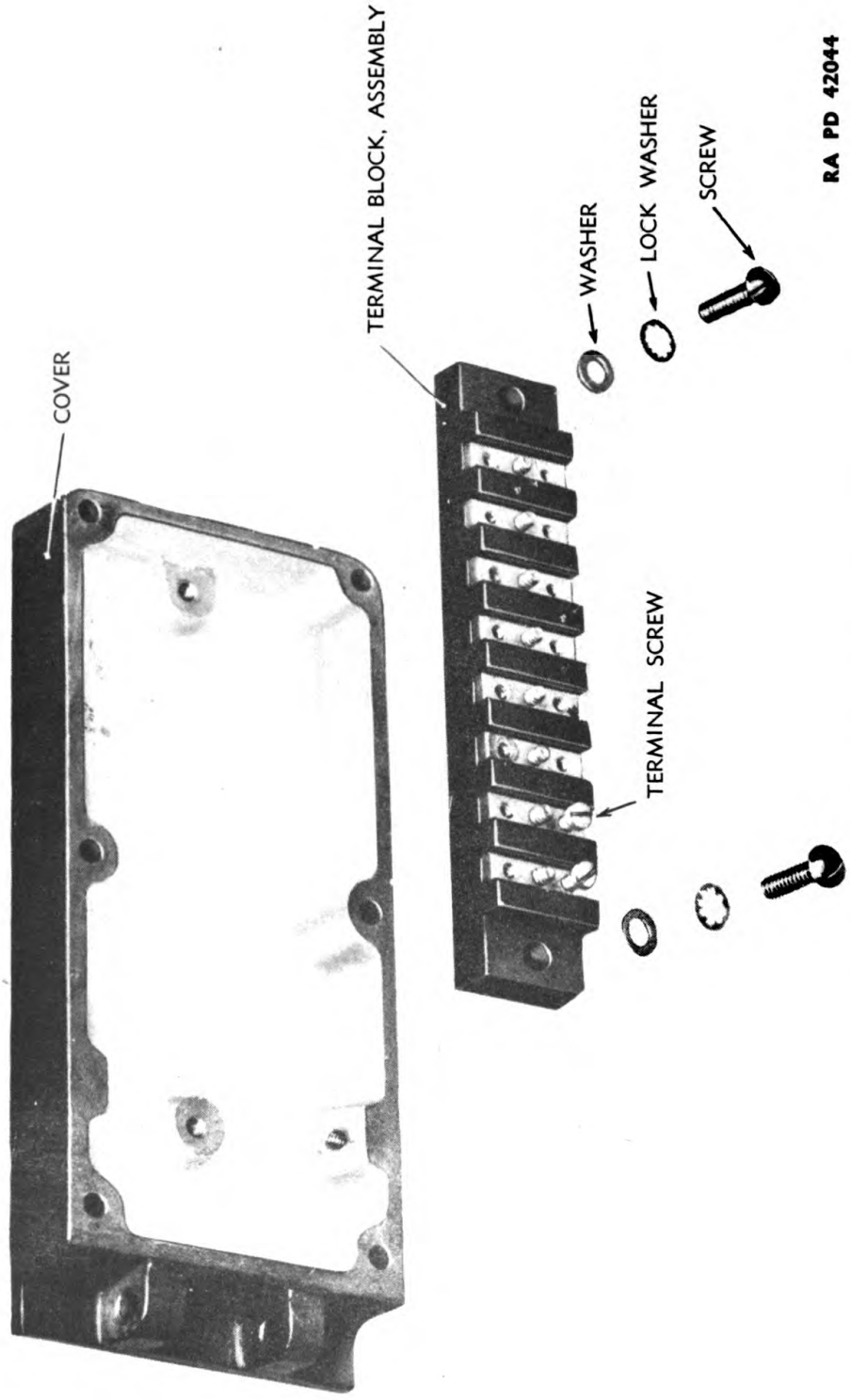

Figure 71 — Removal of Terminal Block Assembly

DISASSEMBLY AND ASSEMBLY

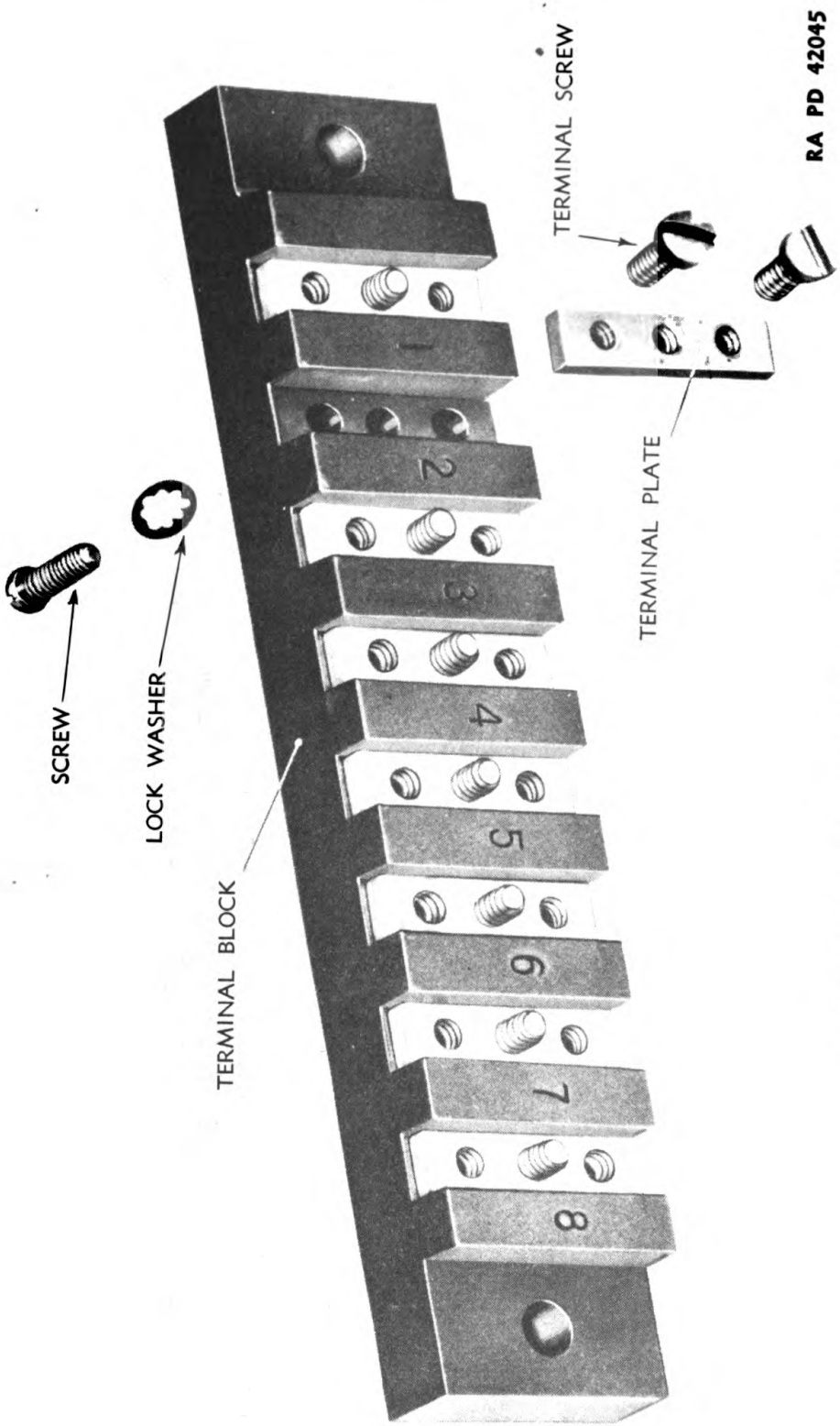

Figure 72 — Removal of Terminal Plate

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

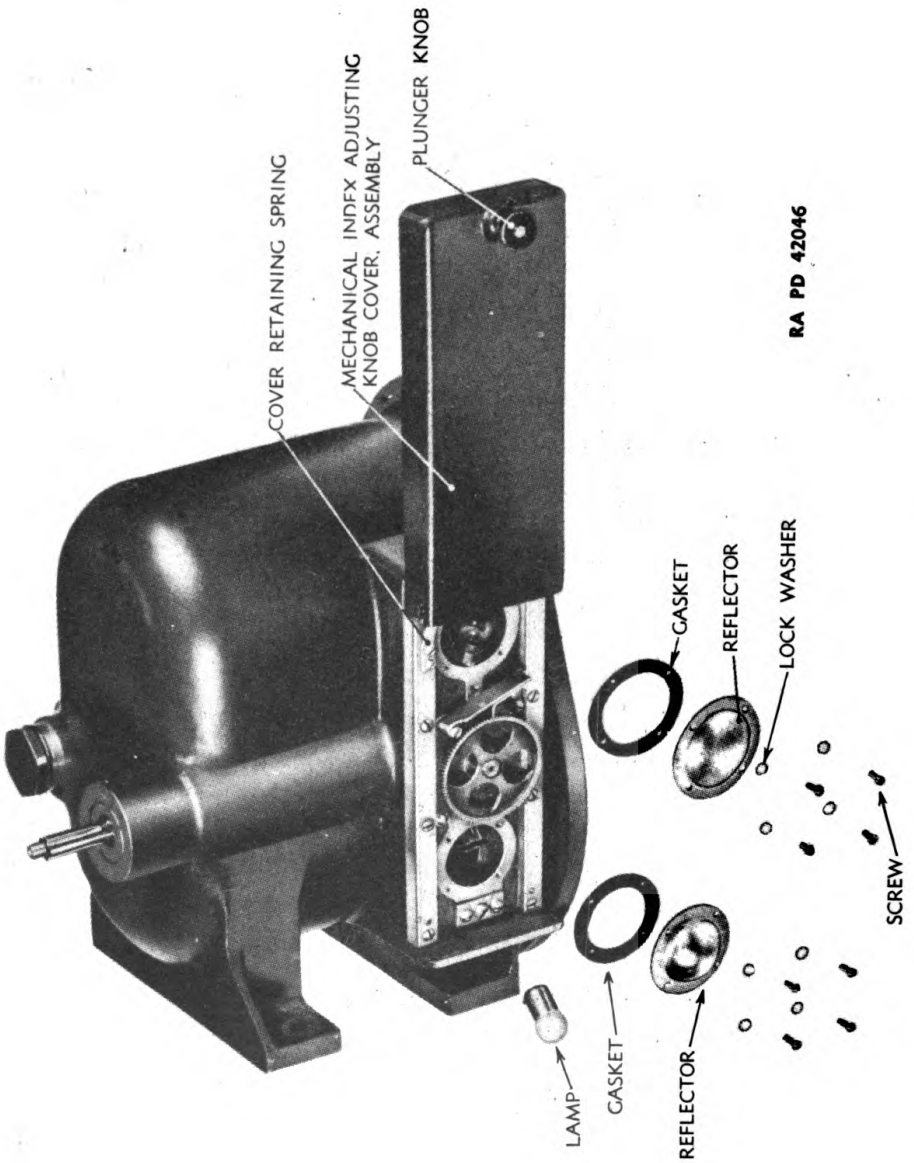

Figure 73 — Lamp Replacement (Left Side)

DISASSEMBLY AND ASSEMBLY

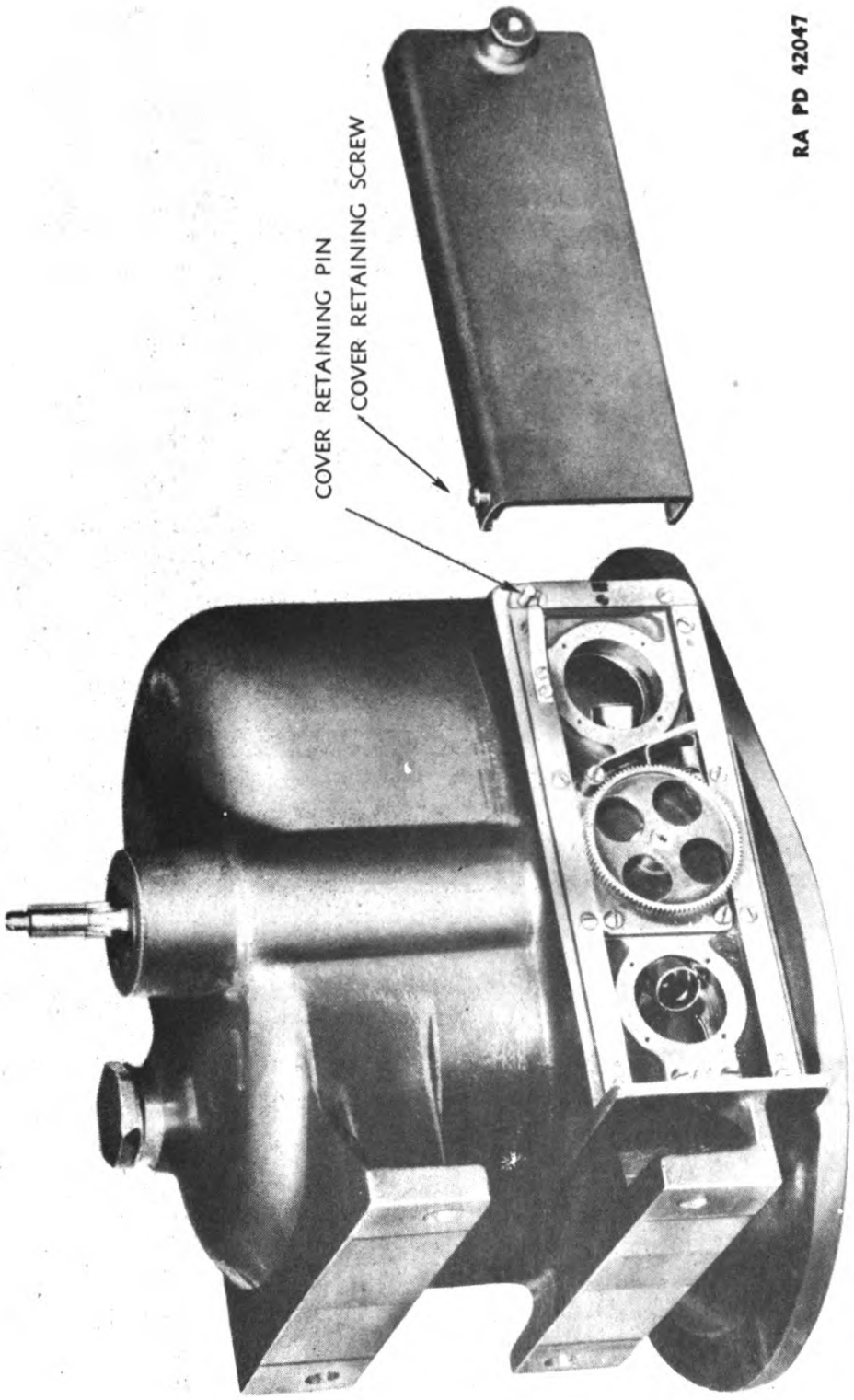

Figure 74 — Removal of Mechanical Index Adjusting Knob Cover Assembly

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

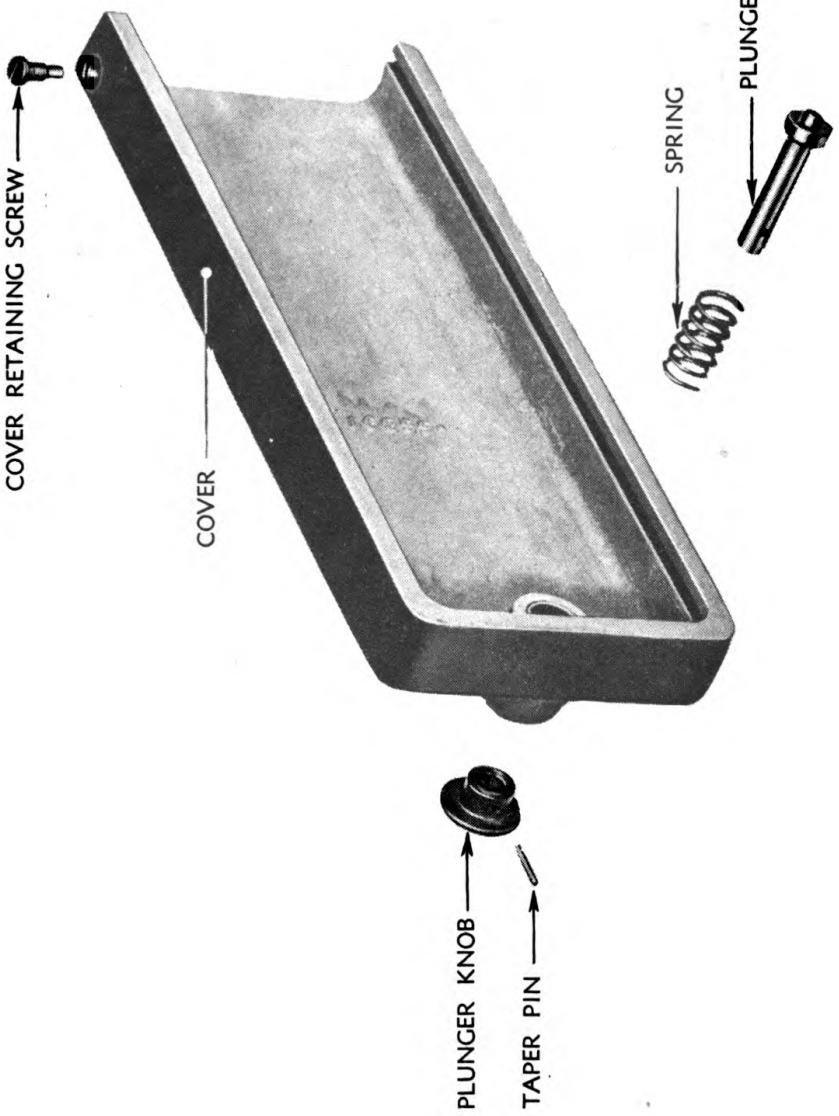

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Figure 75 — Exploded View of Mechanical Index Adjusting Knob Cover Assembly

DISASSEMBLY AND ASSEMBLY

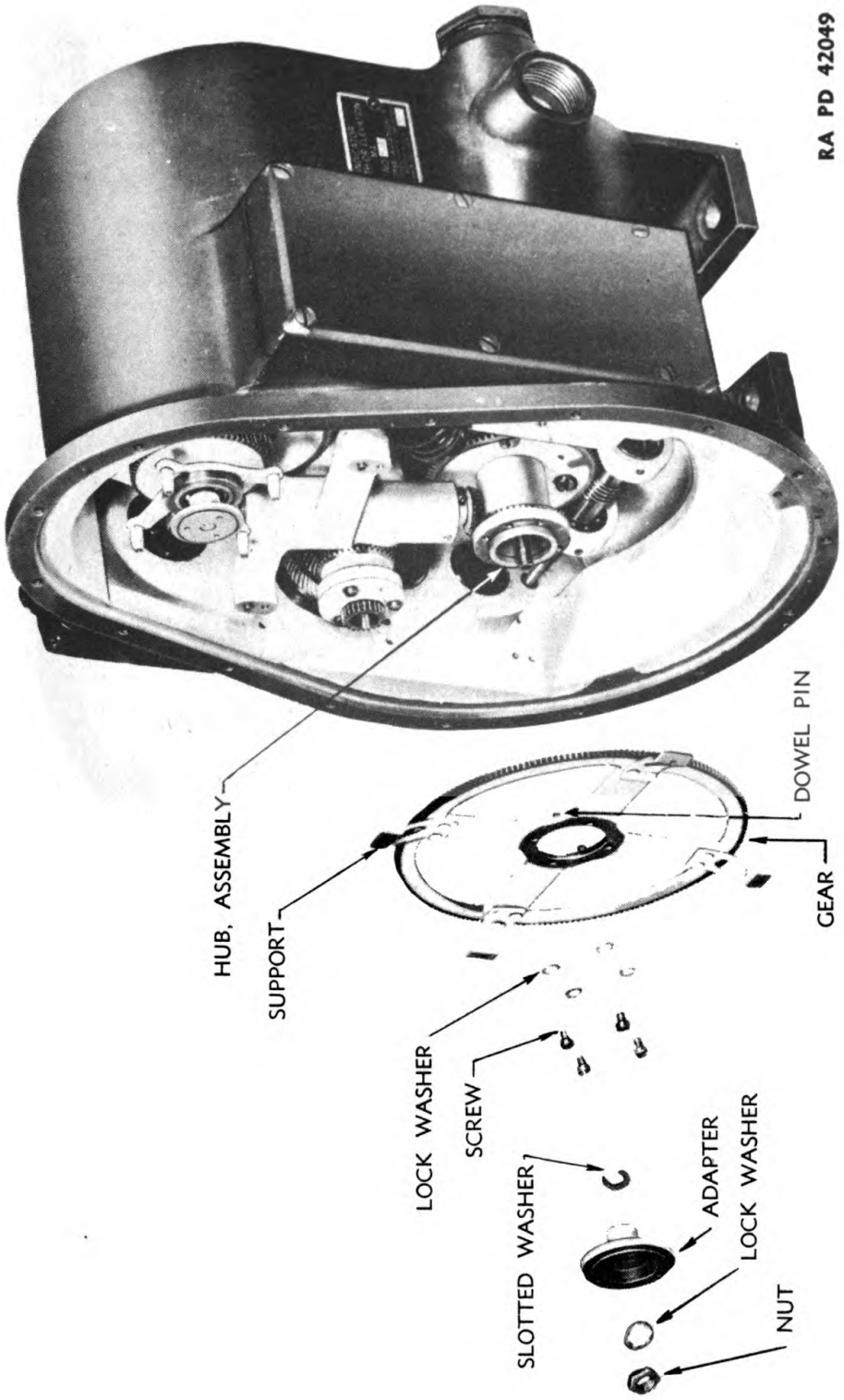

Figure 76 — Removal of Fine Index Adapter and Gear

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

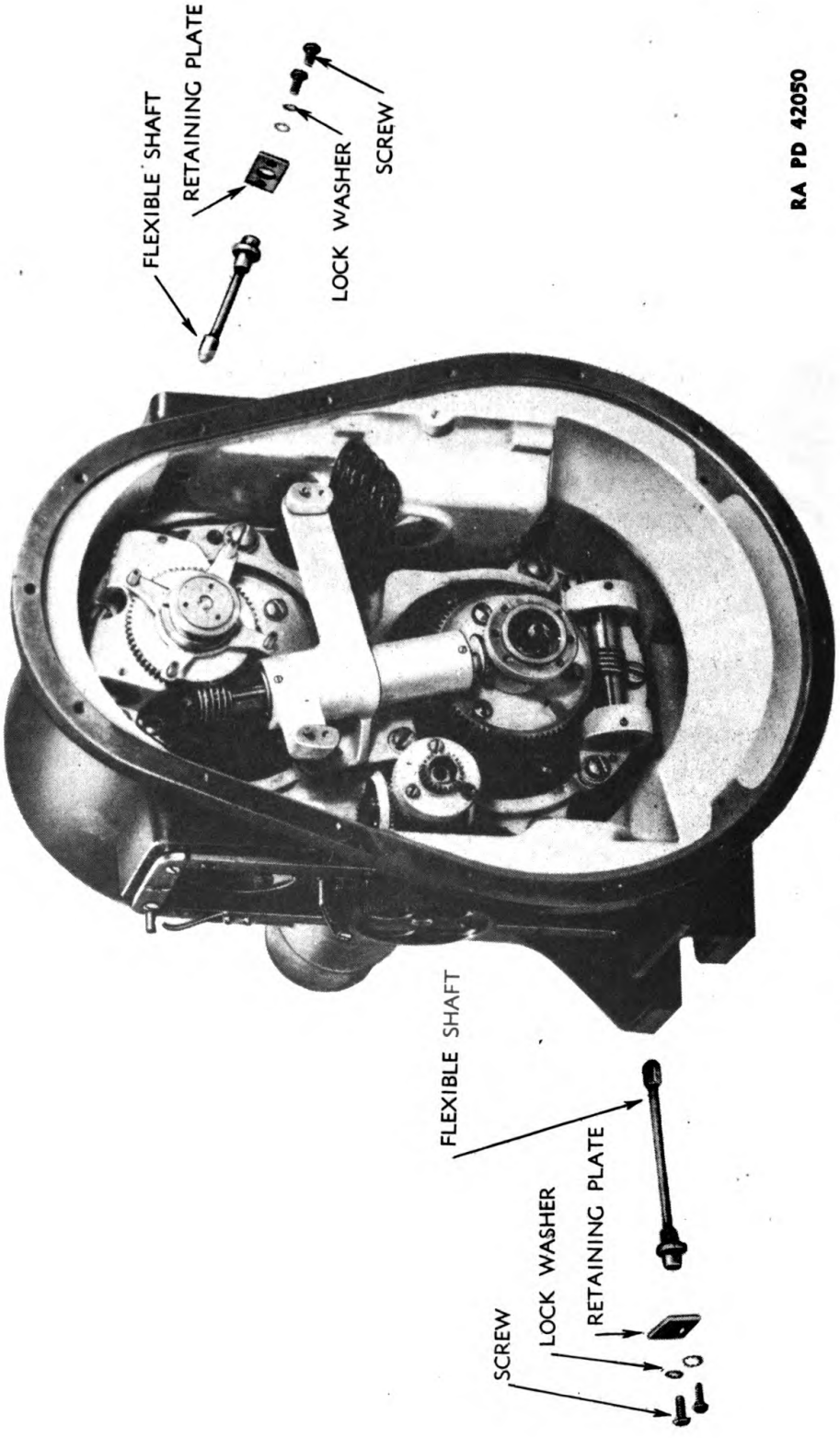

Figure 77 — Removal of Flexible Shafts

DISASSEMBLY AND ASSEMBLY

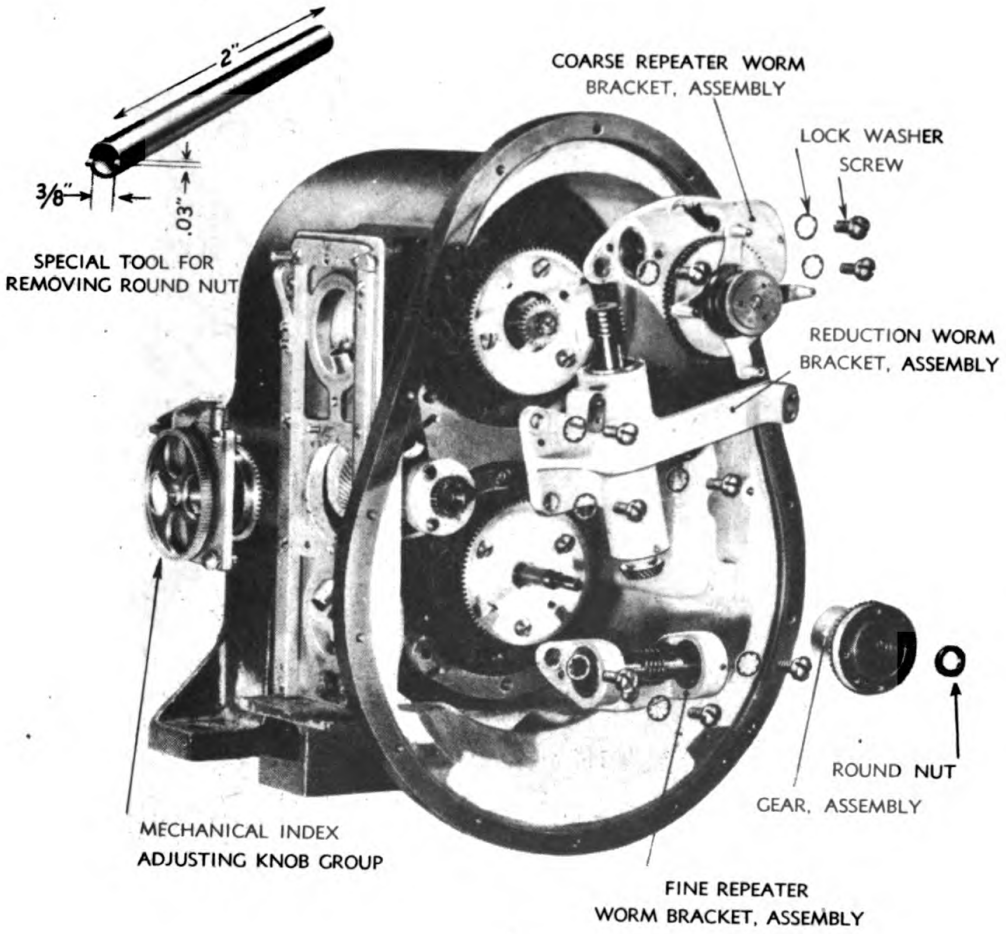

Figure 78 — Removal of Groups Prior to Removal of Bracket with Repeaters Assembly

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

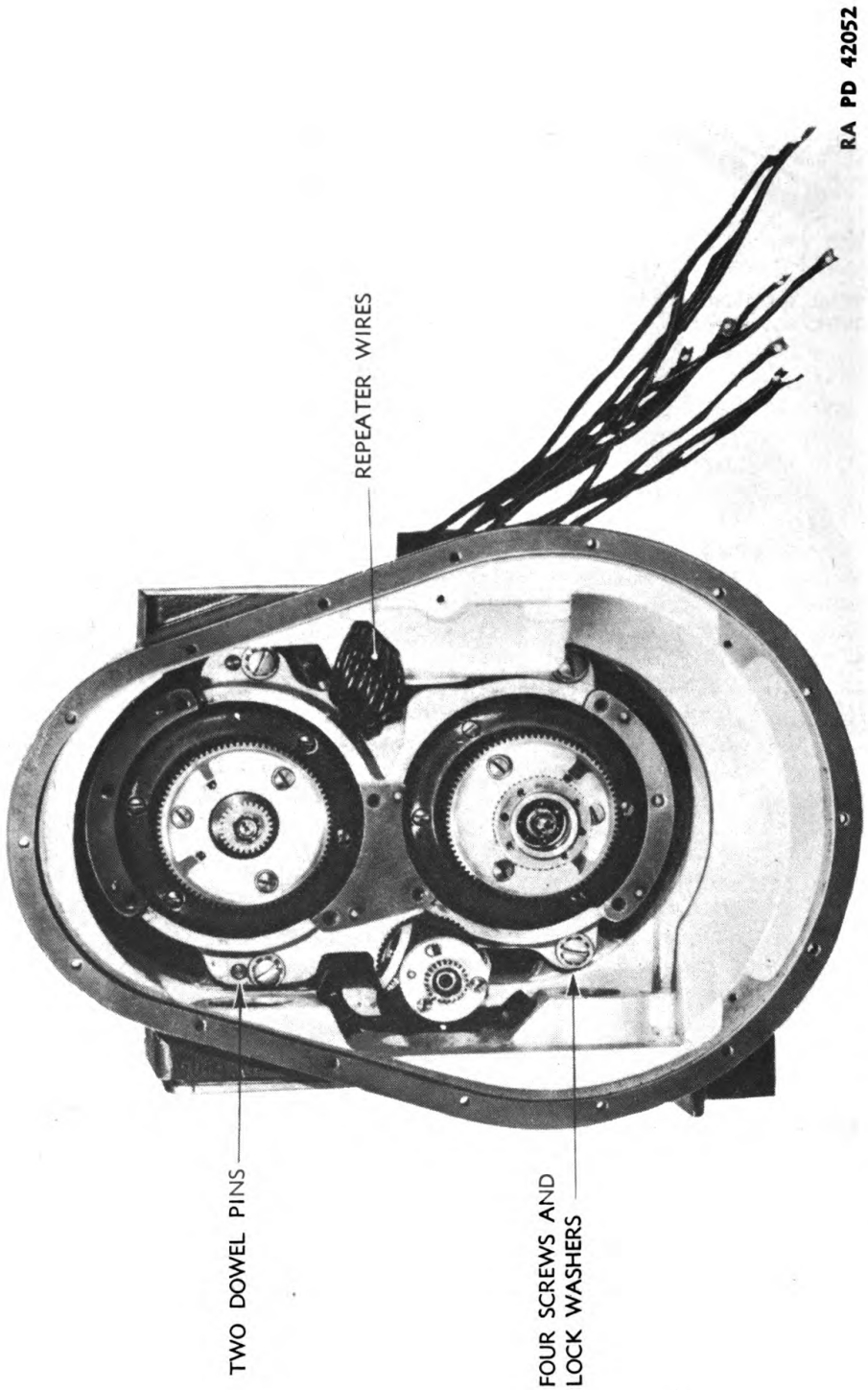

Figure 79 — Bracket with Repeaters Assembly Ready for Removal from Case

DISASSEMBLY AND ASSEMBLY

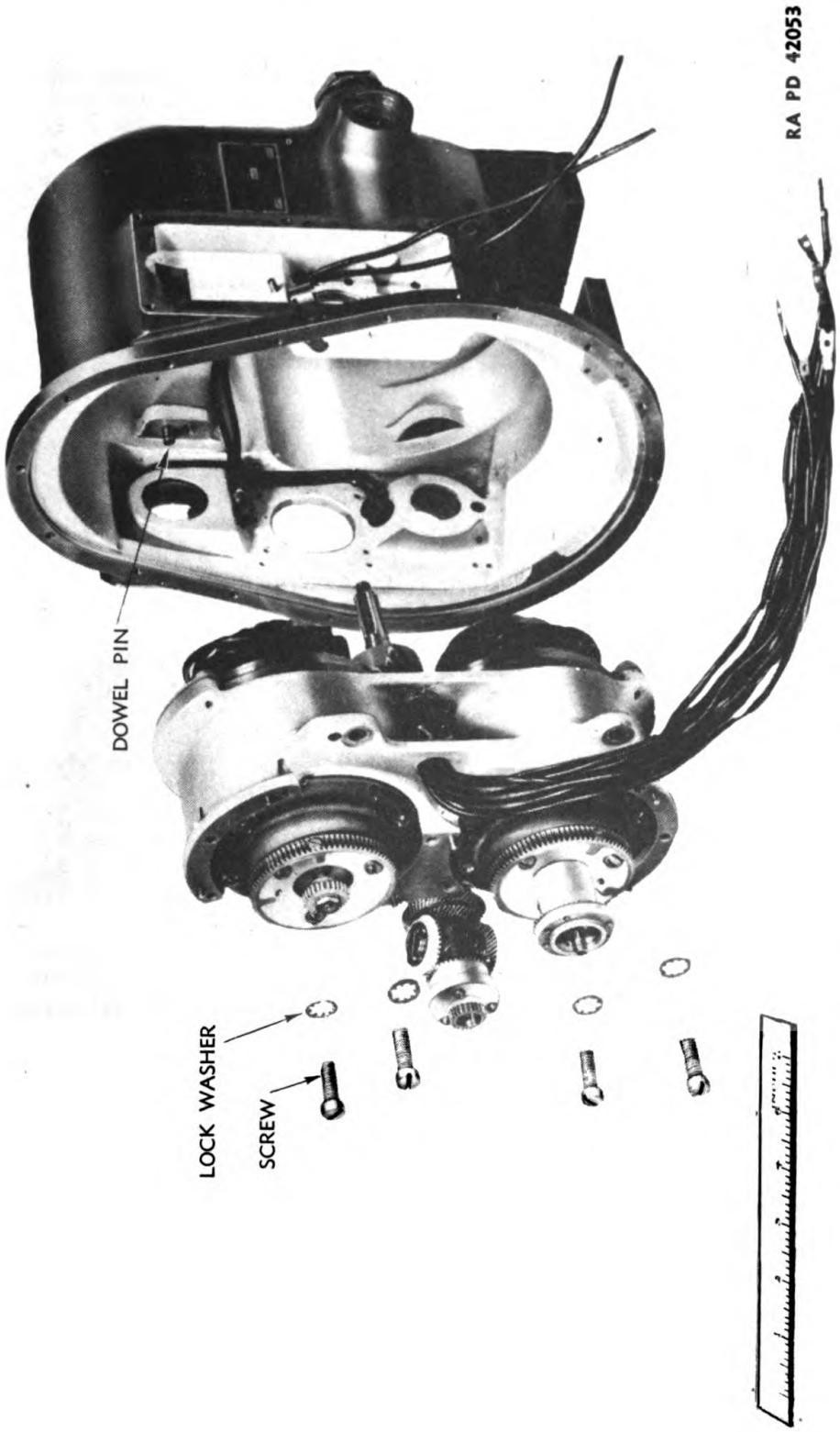

Figure 80 — Removal of Bracket with Repeaters Assembly

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

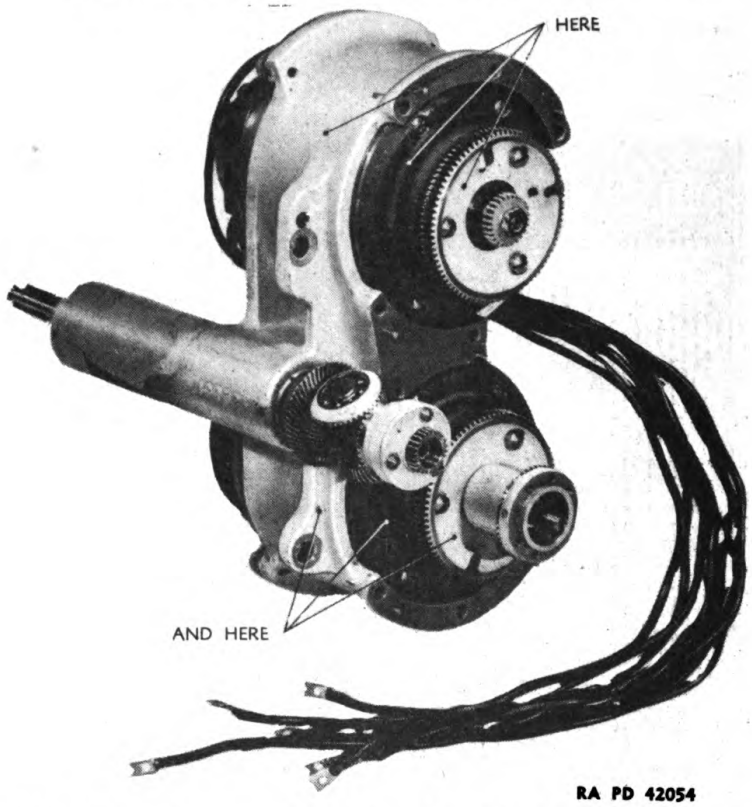

Figure 81 — Scribe Locating Marks Before Disassembly

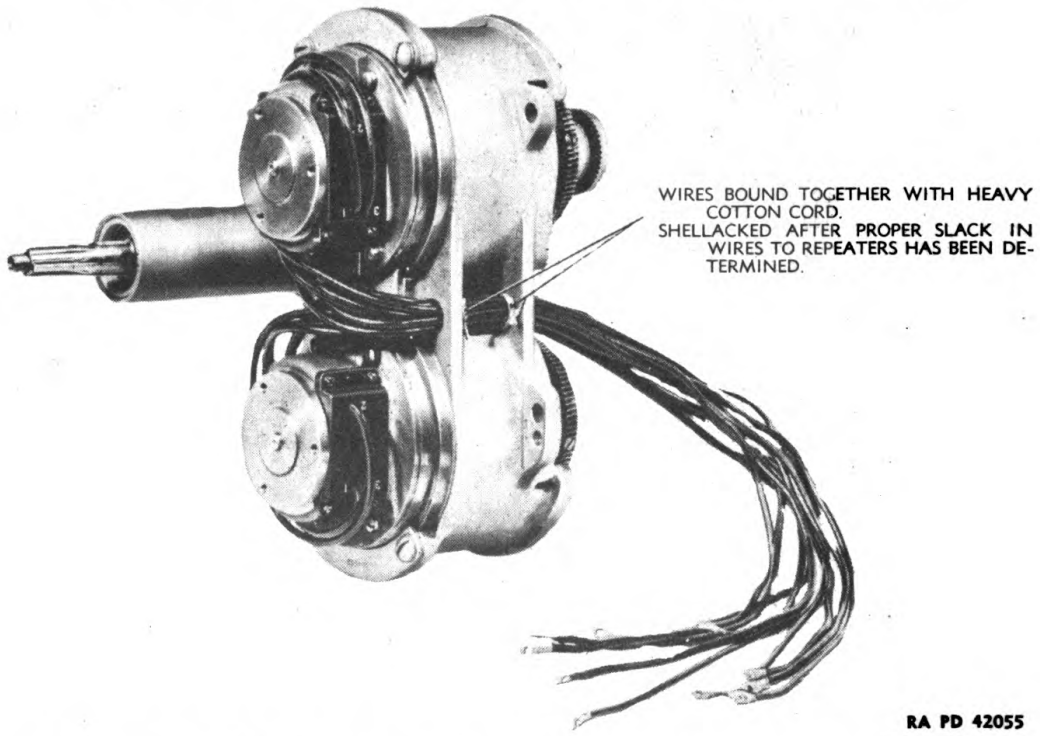

Figure 82 — Rear View of Bracket, Showing Repeater Wires

DISASSEMBLY AND ASSEMBLY

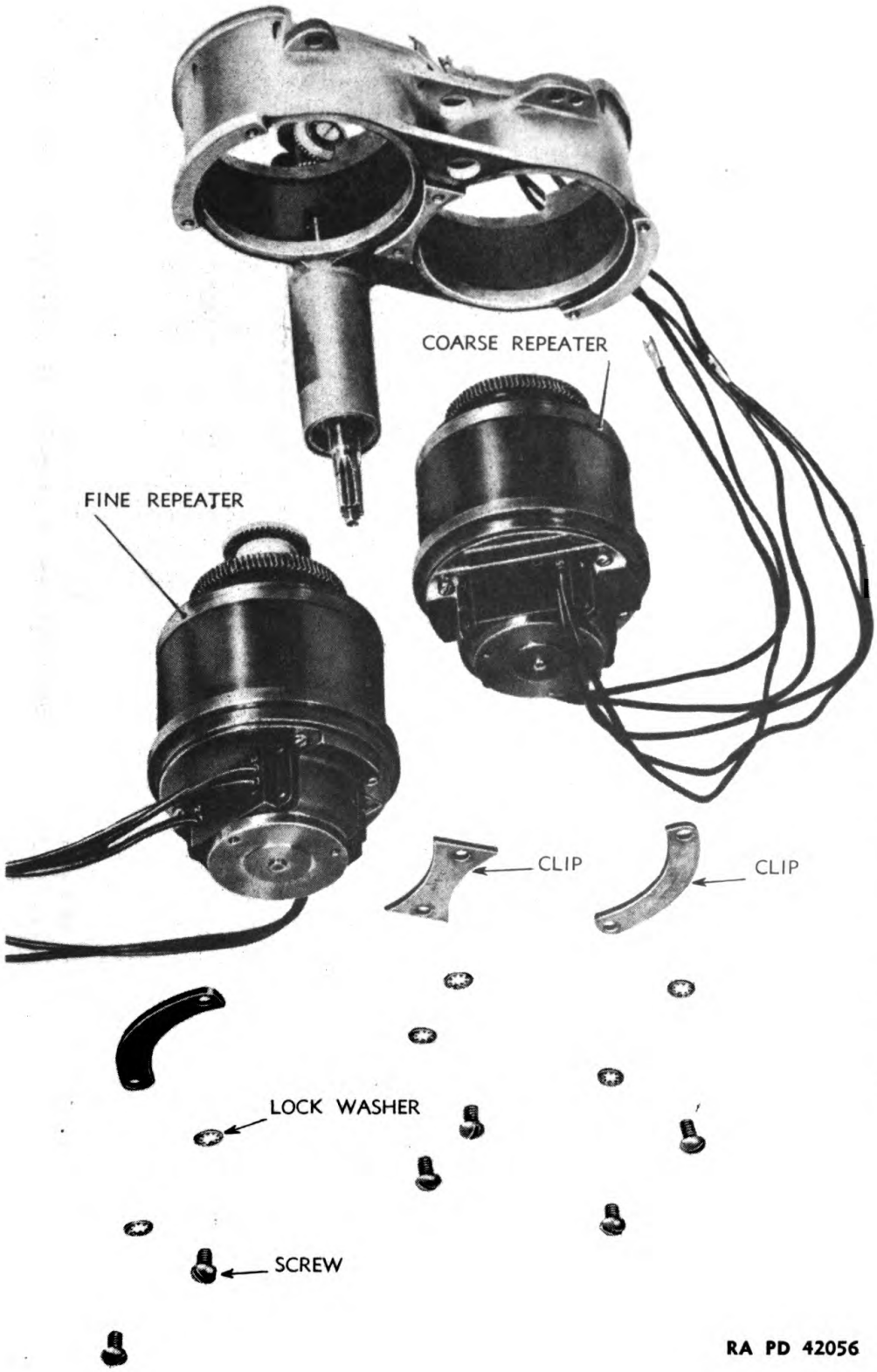

Figure 83 — Removal of Repeaters from Bracket Assembly

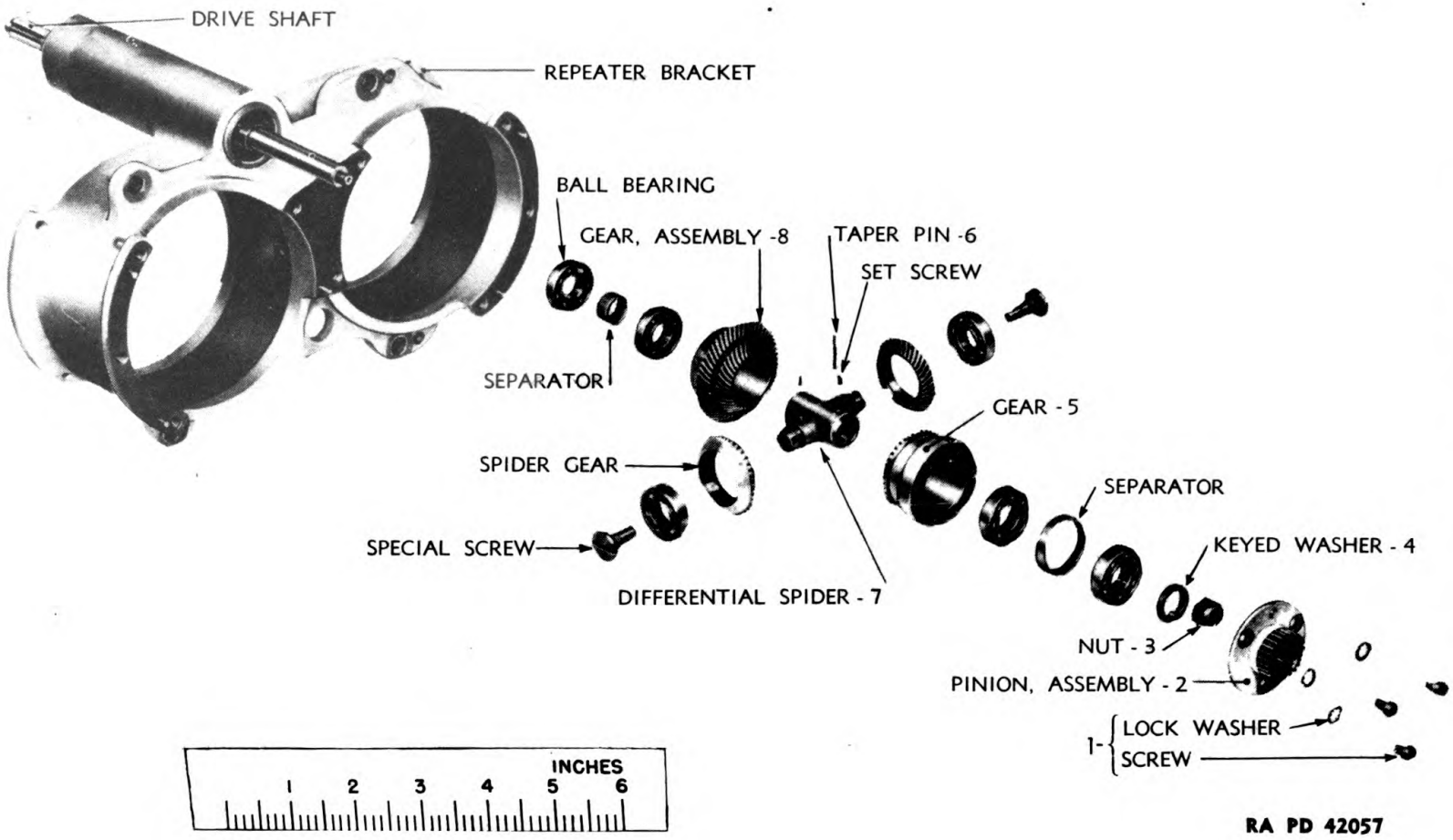

Figure 84 — Removal of Drive Shaft Differential

DISASSEMBLY AND ASSEMBLY

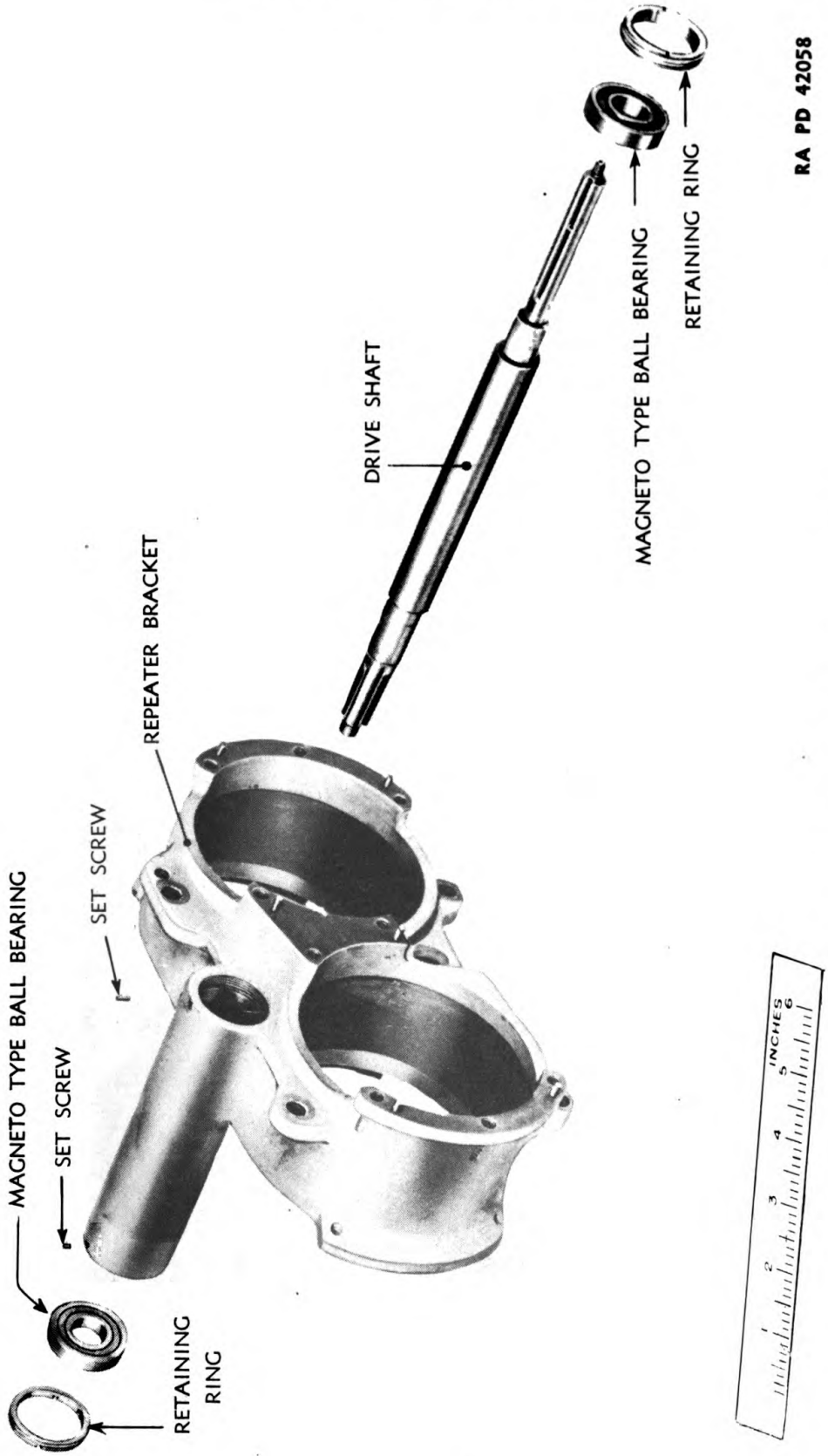

Figure 85 — Removal of Drive Shaft

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

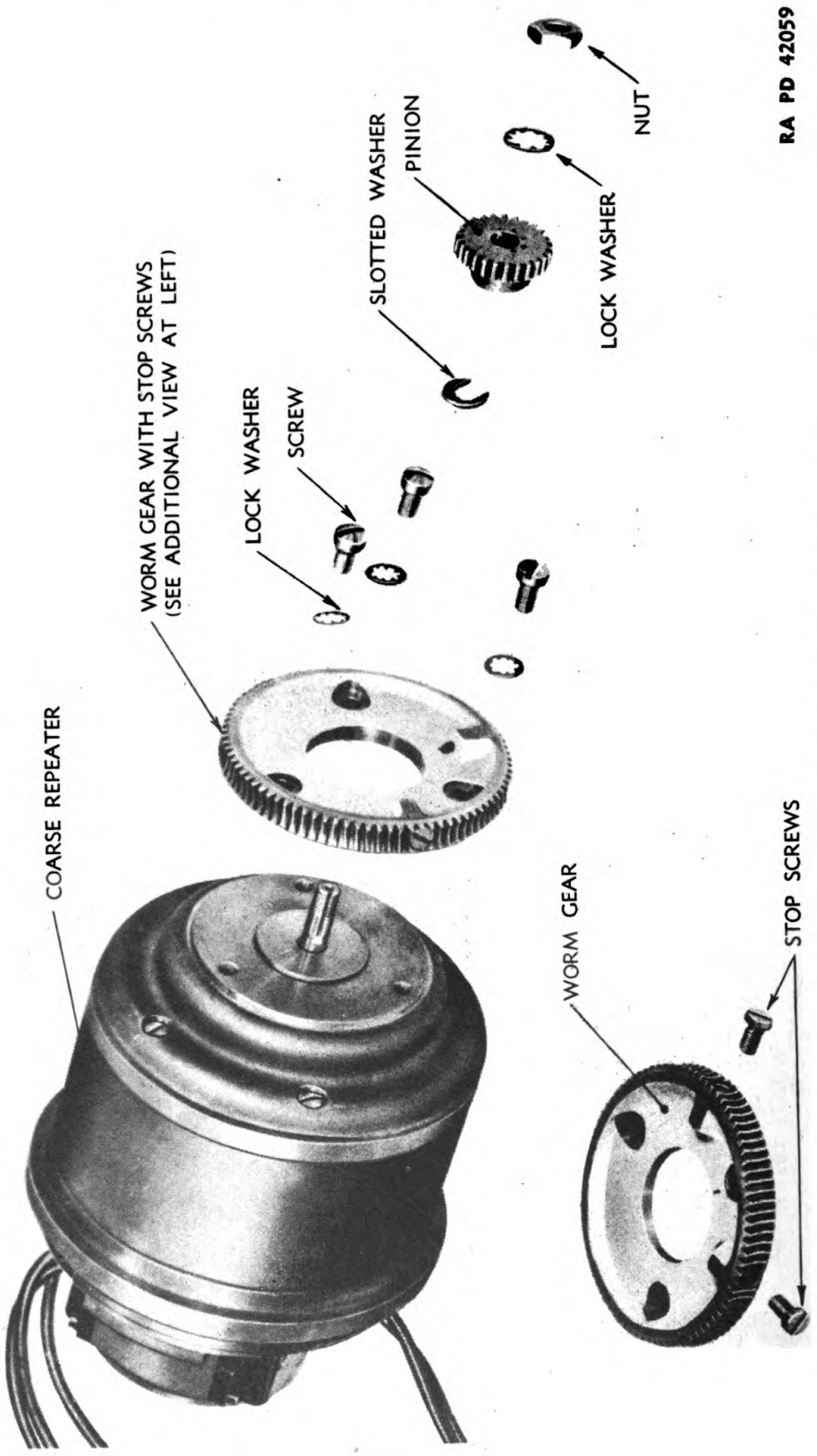

Figure 86 — Removal of External Parts from Coarse Repeater

DISASSEMBLY AND ASSEMBLY

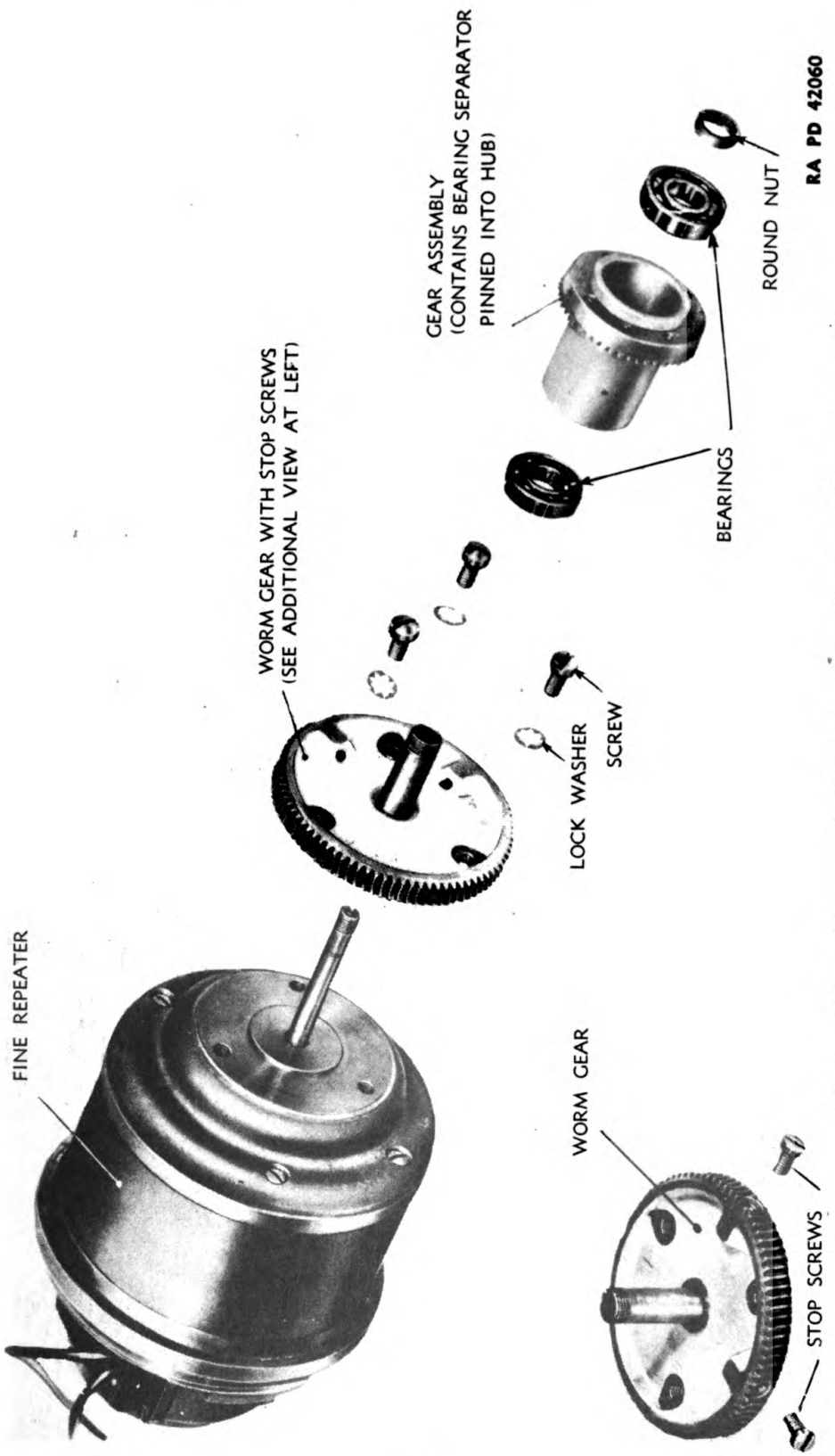

Figure 87 — Removal of External Parts from Fine Repeater

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

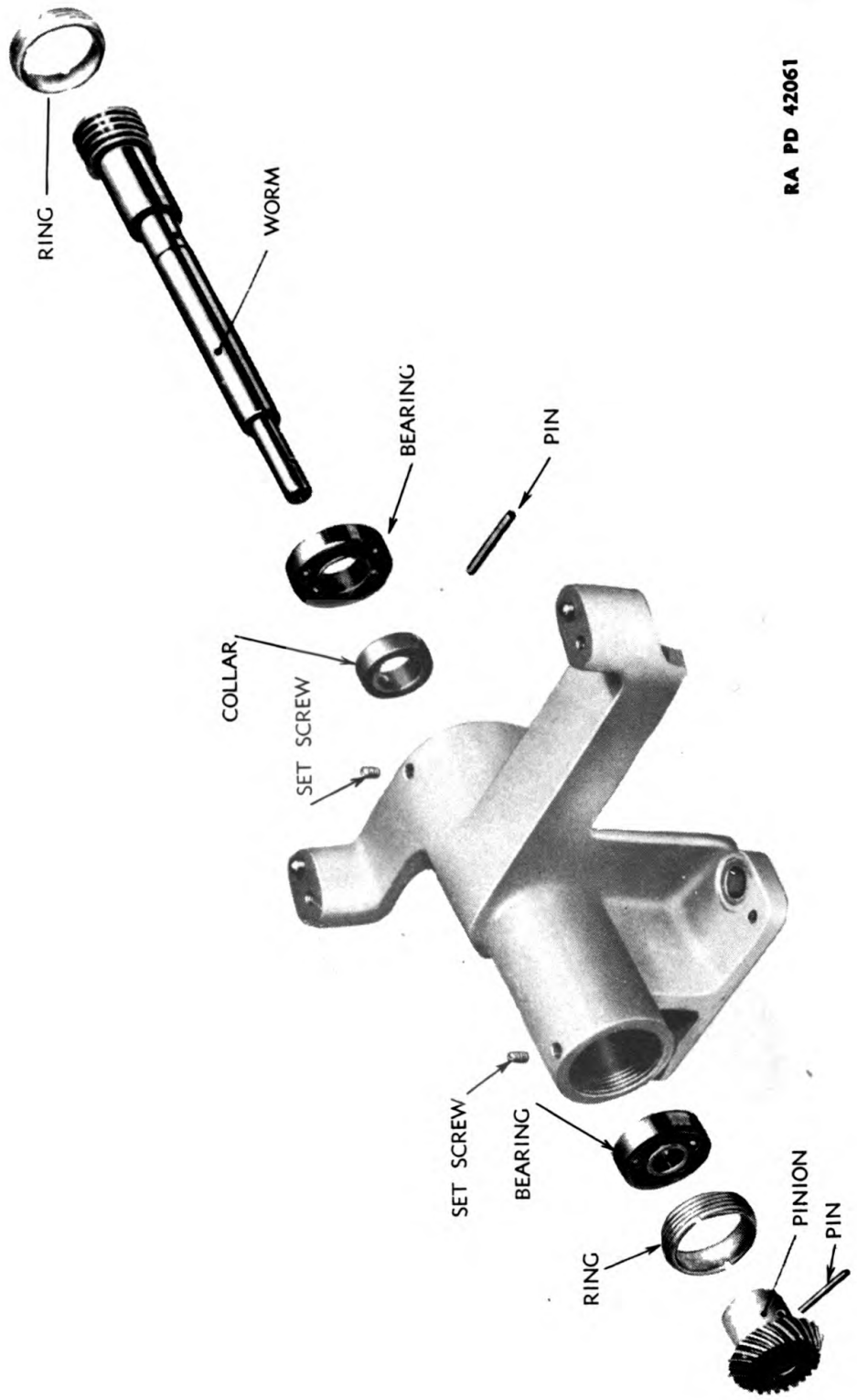

Figure 88 — Exploded View of Reduction Worm Bracket

DISASSEMBLY AND ASSEMBLY

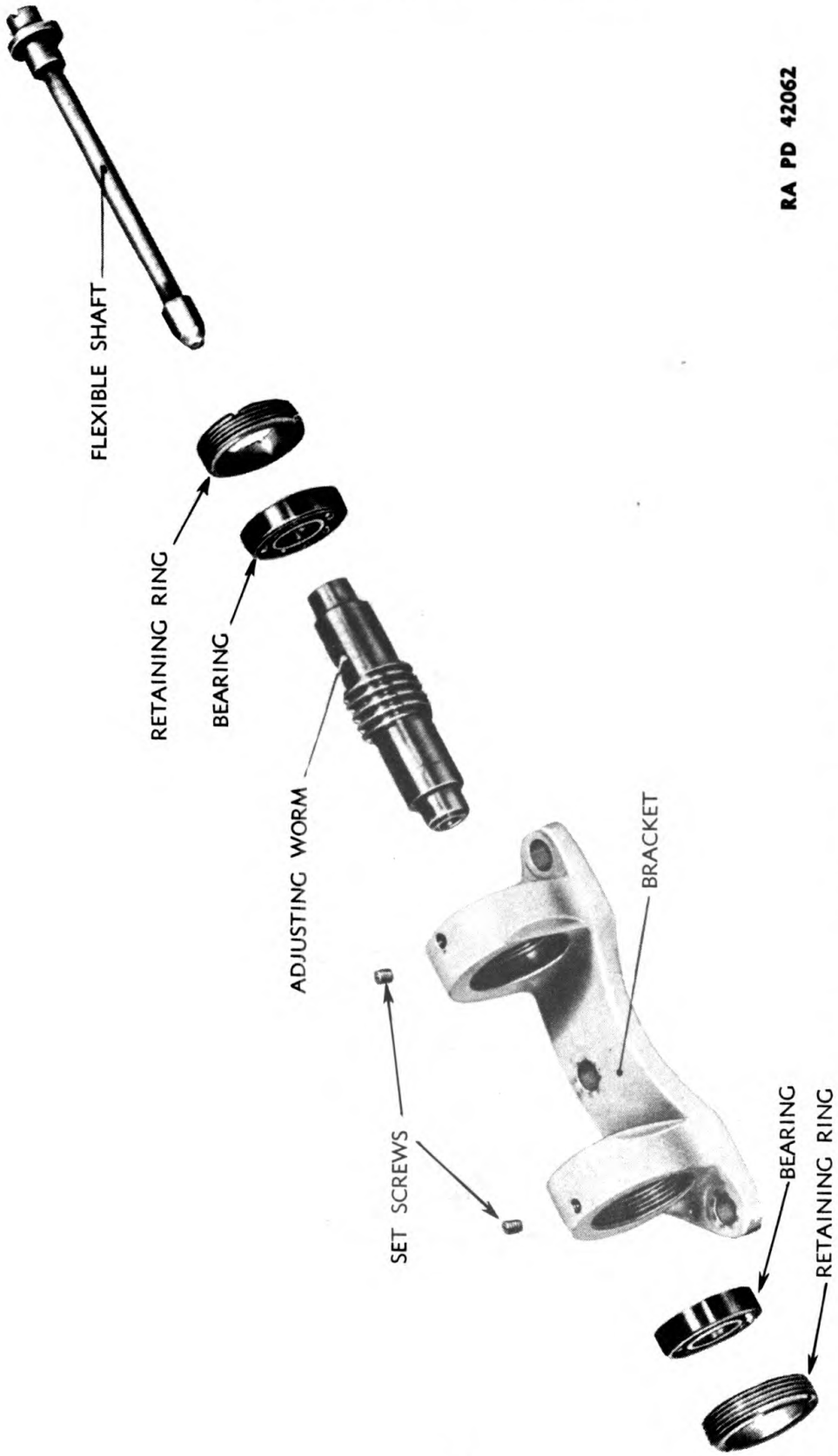

Figure 89 — Exploded View of Fine Repeater Worm Bracket Assembly

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

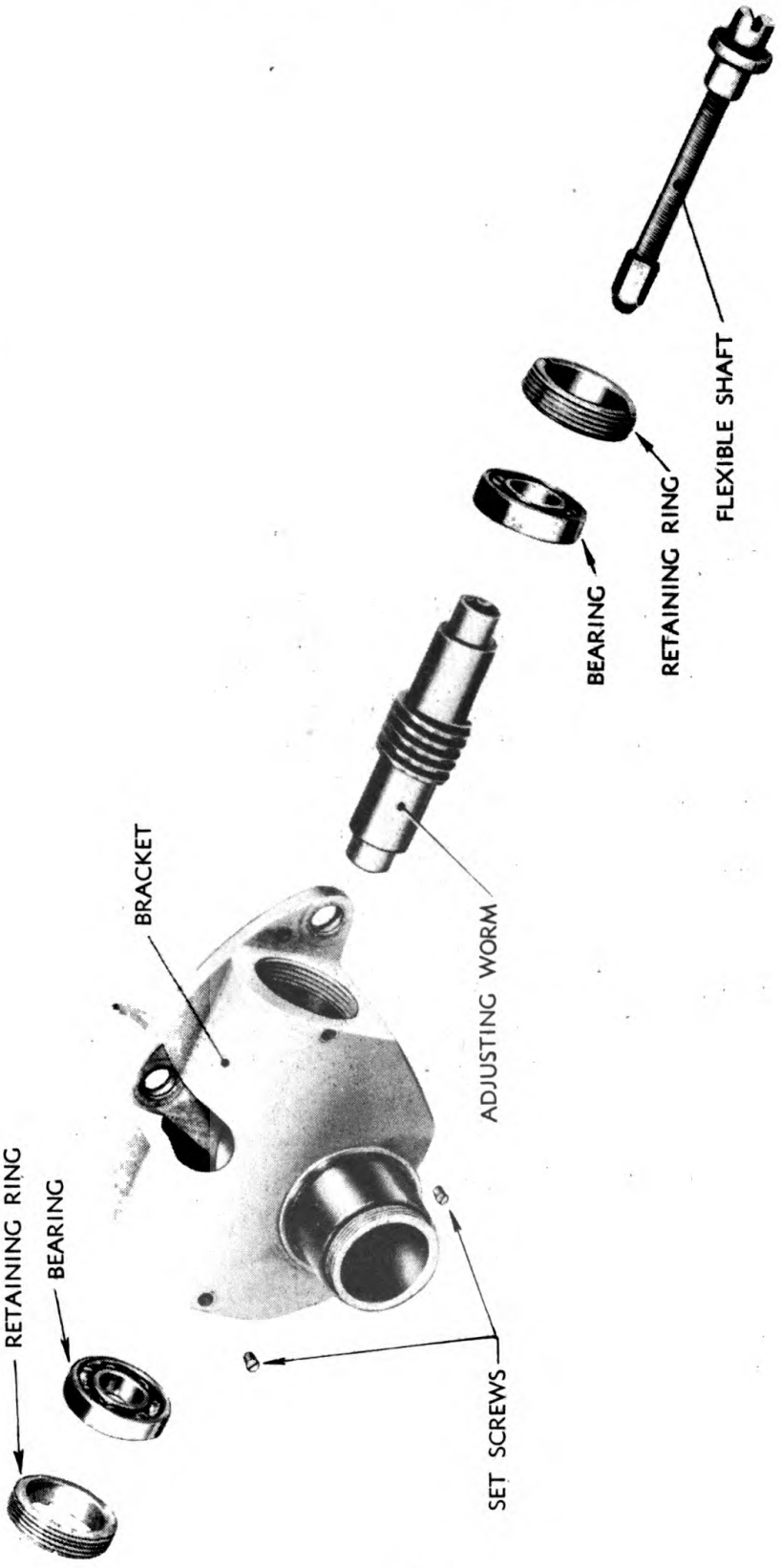

Figure 90 — Coarse Repeater Worm Bracket Assembly — Exploded View of Worm Parts

DISASSEMBLY AND ASSEMBLY

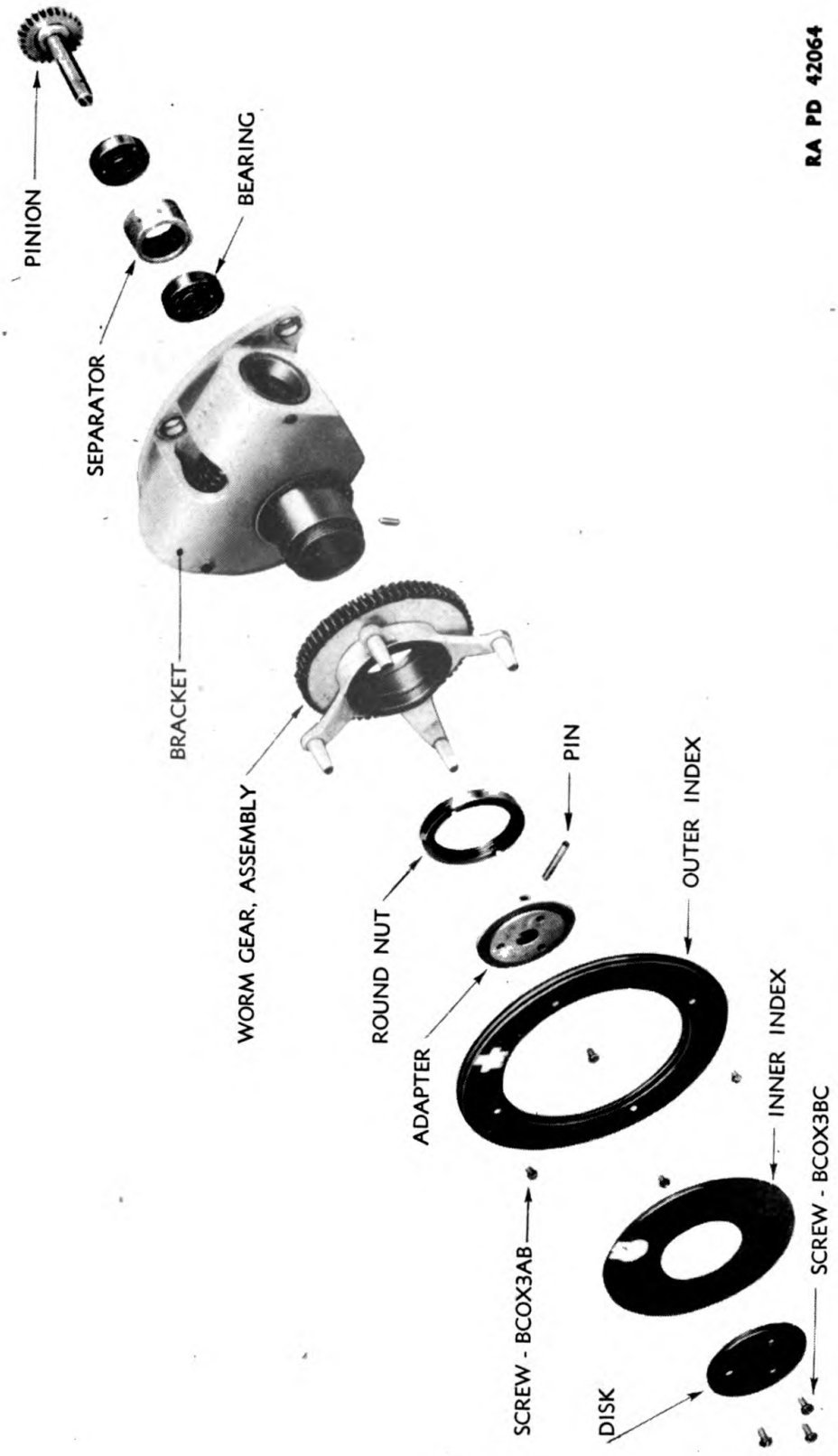

Figure 91 — Coarse Repeater Worm Bracket Assembly — Exploded View of Index Parts

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

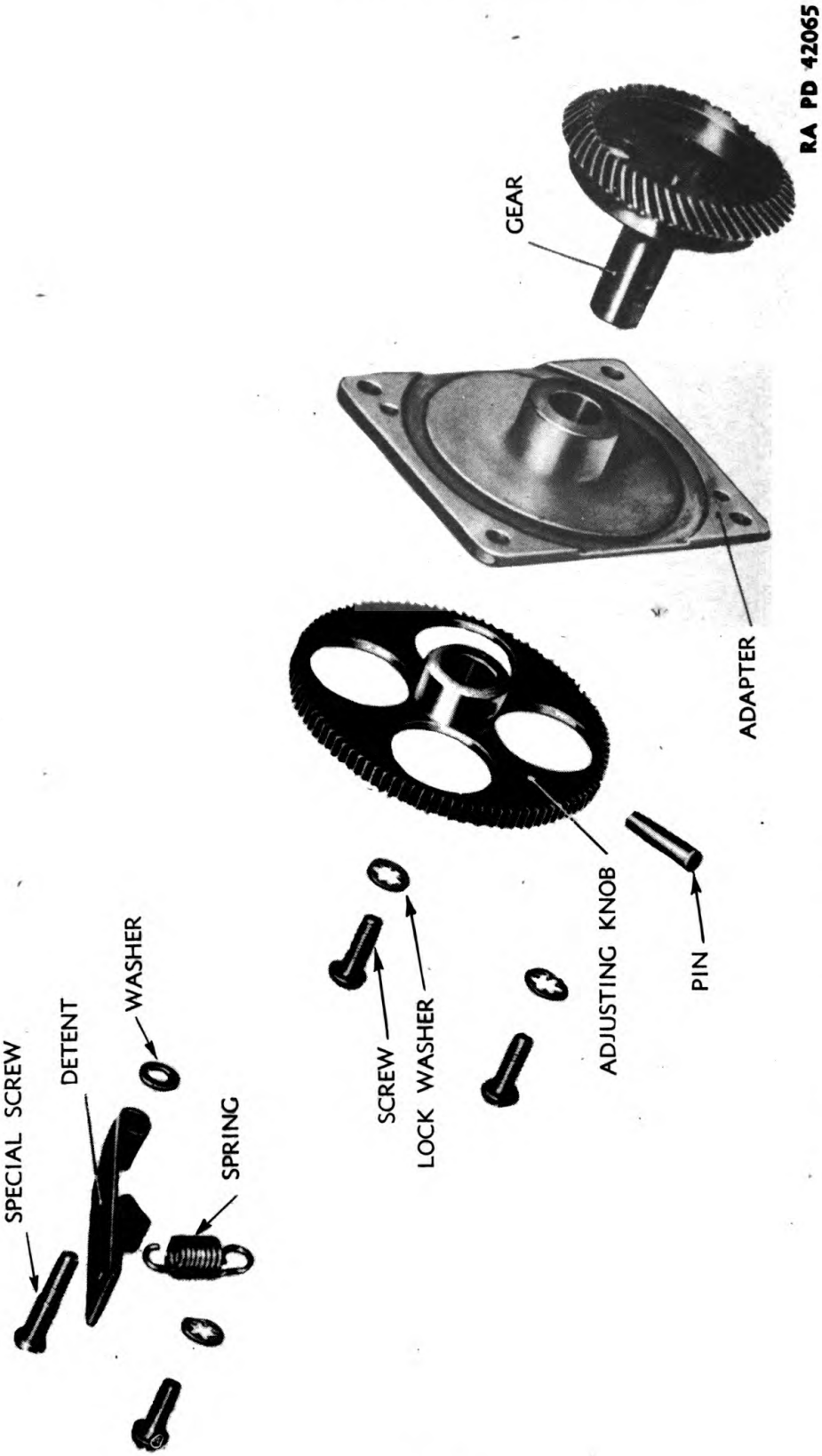

Figure 92 — Exploded View of Mechanical Index Adjusting Knob Group

DISASSEMBLY AND ASSEMBLY

RA PD 42066

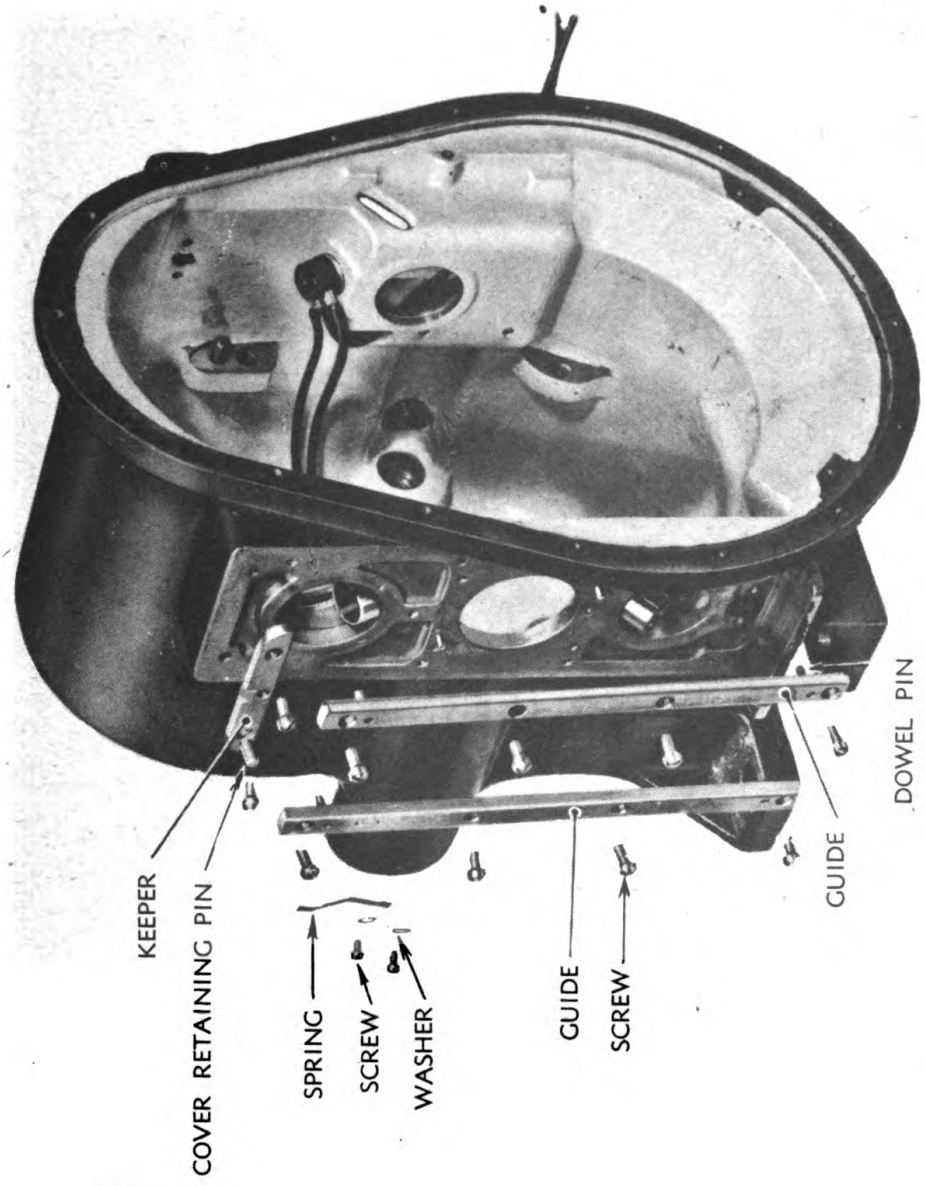

Figure 93 — Removal of Cover Guides and Keeper from Case

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

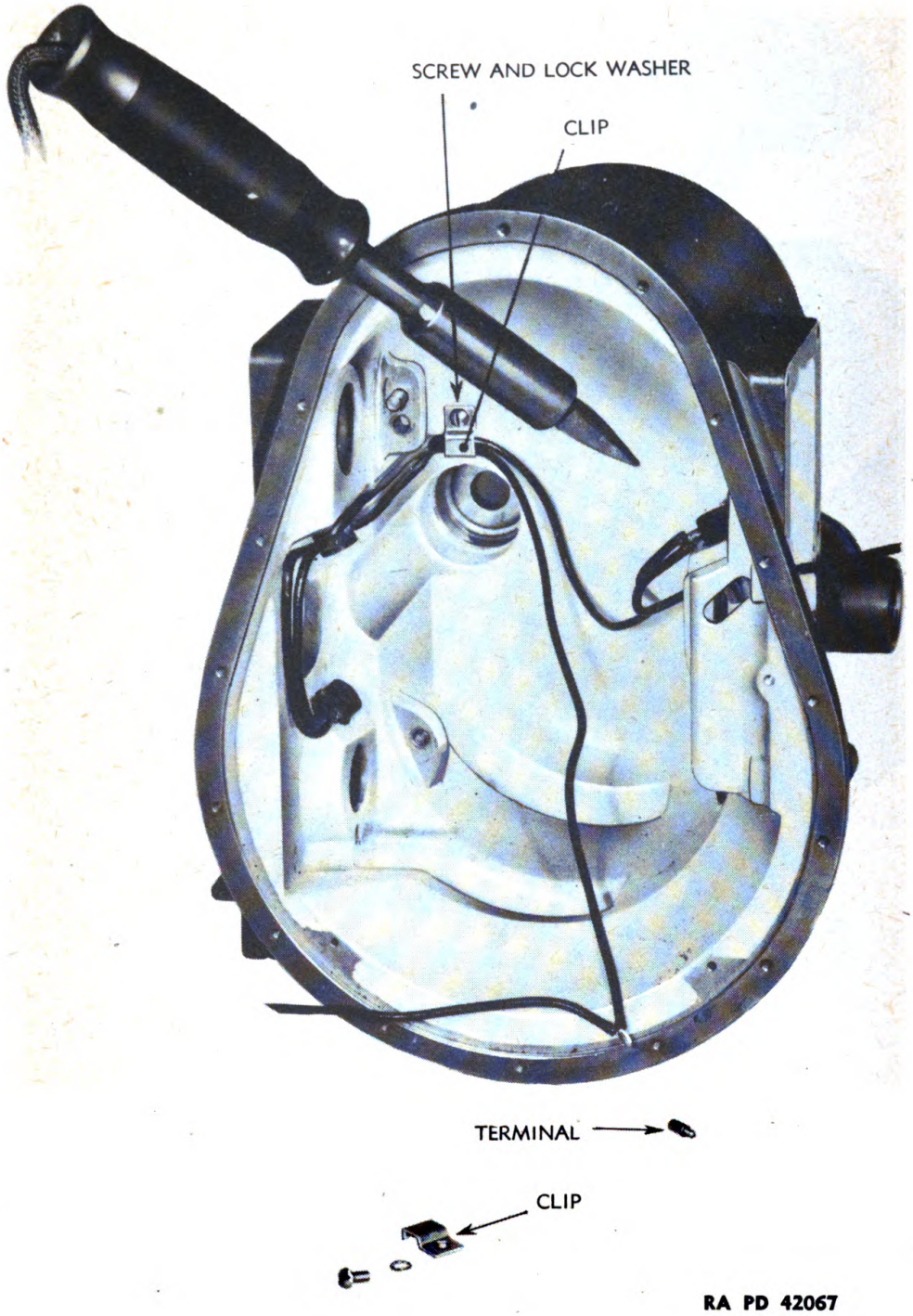

Figure 94 — Unsoldering Lamp Socket Terminals

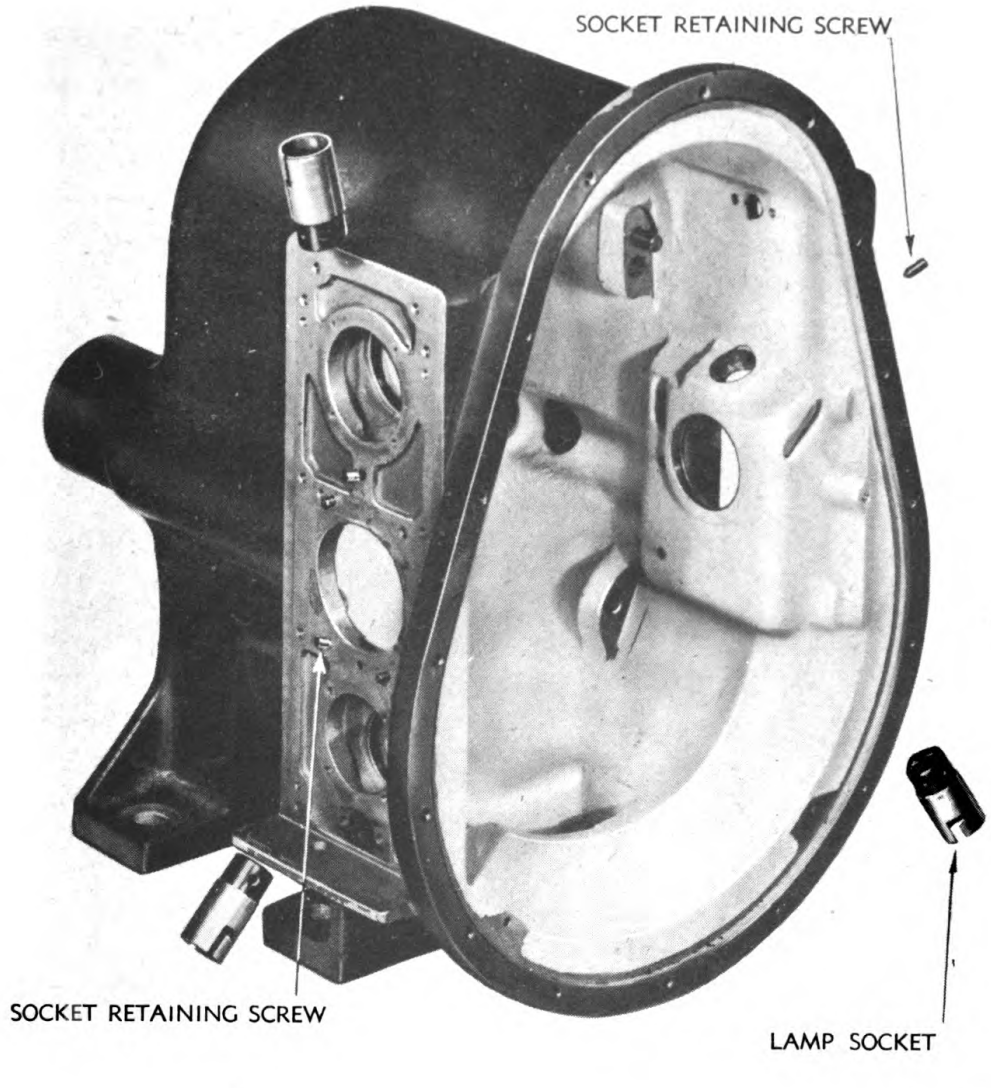

Figure 95 — Removal of Lamp Sockets

DATA TRANSMISSION SYSTEM M6
(For 90-MM Antiaircraft Gun Mount M1)

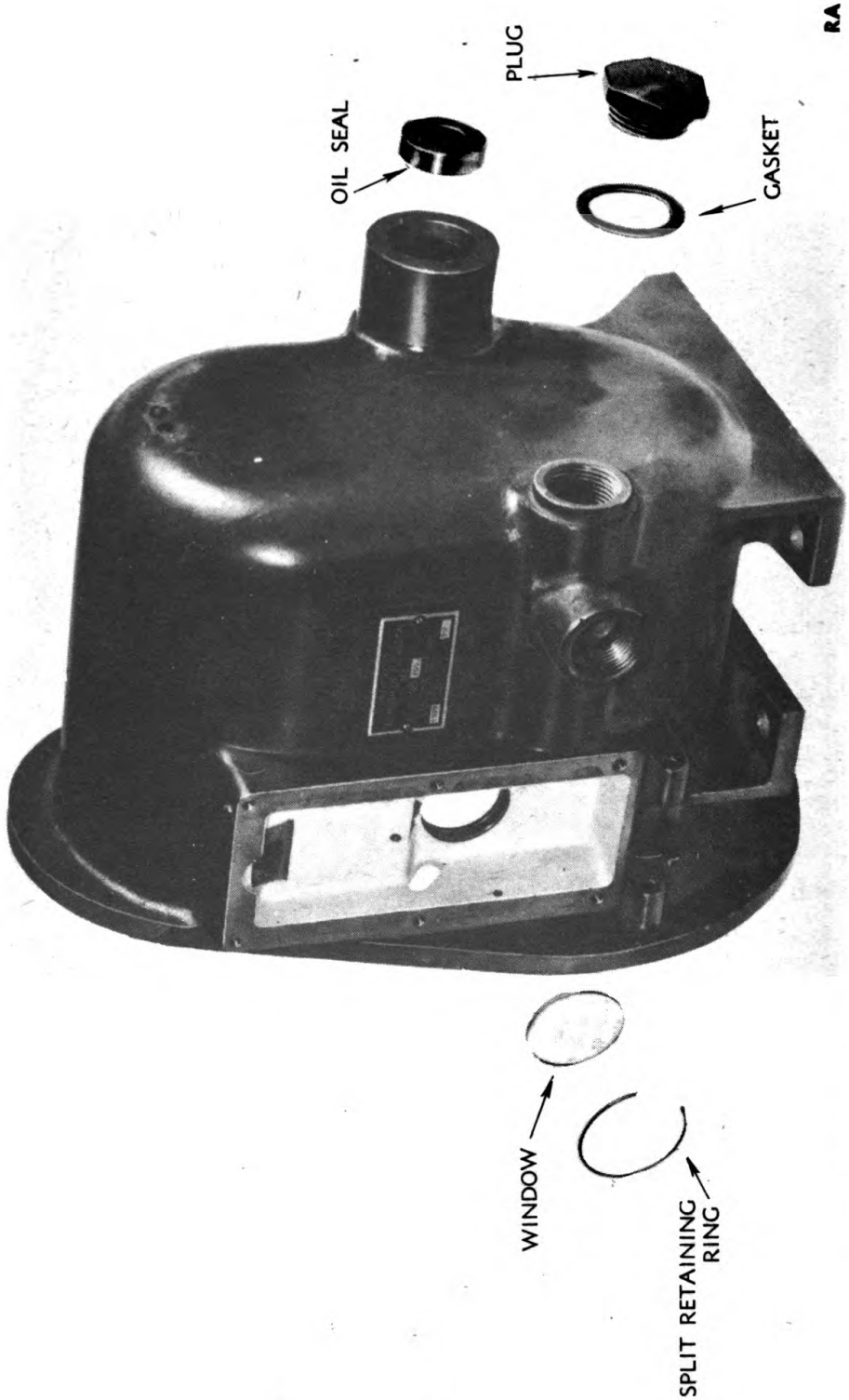

Figure 96 — Removal of Lamp Well Windows and External Parts from Indicator Case

Section VIII

PAINTING

52. TOUCH-UP PAINTING.

a. Small scratches or worn spots, as well as unavoidable blemishes caused by assembly or adjusting operations should be touched up with an air drying enamel of a practical color match of the original finish.

b. The scale and indexes of the azimuth and elevation indicator may be touched up with plain black (or white) paint on the front (or rear) surfaces. However, no attempt should be made to repair the luminous index markings or the translucent scale graduations. If the index markings or graduations are badly damaged, replace the entire part.

53. PERIODIC PAINTING.

a. General.

(1) Ordnance materiel is painted before issue and from time to time depending on the service conditions and climatic conditions to which the materiel is subjected.

(2) Painting of instruments must be supervised by some one familiar with the functioning of the instruments. Care should be exercised that no paint comes in contact with scales, gear teeth, bearings, or locating surfaces. The effect of paint on bearings and other finely finished parts is obvious.

b. Preparing for Painting.

(1) To Clean.

All surfaces to be painted must be dry and free from dirt, oil, grease, and rust. For cleaning use SOLVENT, dry-cleaning, and rinse with hot water. Dry in an air stream. It must be remembered that frequent washing of metal components in the same batch of solvent will soon render it unfit for further use, since it easily becomes saturated with grease, oil, and dirt. The solvent must be changed frequently. Rough, sand-cast surfaces to be finished should be filed or ground to remove all projections that will result in a poor finish.

(2) To Remove Old Paint.

(*a*) Remove loose paint around marred parts by means of PAPER, flint, No. 1. Dust off all loose sand.

(*b*) Use REMOVER, paint and varnish, if the paint is in bad condition and necessitates removal in entirety before paint is applied.

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Apply the remover as it comes from the can. Allow the remover to stay on until the paint can be scraped or wiped off. Keep it out of finished joints or bearings. As the remover is very inflammable, proper precautions should be taken when using or handling it. See SNL K-1 and TM 9-850.

c. Painting. Apply the paint with a brush or spray gun. Exercise care to avoid splashing or spraying paint on parts which are not to be painted. Finished colors must conform to authorized prescribed hues. Minor deviations of pigment proportions are permissible, if necessary to match colors.

Section IX

PREPARATION FOR SPECIAL CLIMATIC CONDITIONS

54. CLEANING FINISHED SURFACES UNDER DESERT CONDITIONS.

a. General. Cleaning polished glass surfaces or finished metal surfaces involves careful removal of dust and sand to prevent abrasion of the surfaces.

b. Materials and Equipment Required.

(1) One 1-inch paint brush with fairly stiff bristles.

(2) One ¼-inch camel's hair brush.

(3) One piece of chamois 6 inches square.

(4) One piece of cheesecloth 10 inches square.

(5) SOAP, liquid, lens cleaning.

c. Methods.

(1) METAL SURFACES.

Remove sand with the large brush.

(2) GLASS SURFACES.

Be extremely careful to avoid scratching the glass.

(*a*) Remove dry sand with gentle strokes of the camel's hair brush.

(*b*) Remove wet sand by rinsing the glass surfaces with water and drying with chamois.

(*c*) Apply a little of the cleaning fluid to the glass with the camel's hair brush.

(*d*) Wipe and dry with cheesecloth

55. ACCUMULATION OF MOISTURE.

Trouble has been experienced in some climates with the accumulation of moisture in A.A. data indicators. The following procedures, developed by actual experiment under adverse climatic conditions, have proven satisfactory in remedying this condition:

a. The first step requires a partial overhaul and close inspection of such indicators as may have accumulated moisture, to determine and eliminate the source of all leaks into the indicator housing. To accomplish this the indicators in question should be uncoupled from their respective gun mounts and removed to a dry room where the various glass seals, window frame, and cover plate gaskets, etc., may be in-

spected and the necessary procedures taken for restoring them to a watertight condition.

(1) All possible sources of direct seepage into the indicator cases should be eliminated. Detail procedures for obtaining watertight housings will have to be governed by the actual conditions encountered with any particular unit. For example, the small machine screws used to attach the name plates have, in some cases, permitted seepage. On the M4 indicators, however, these screw holes are not supposed to go through the housing wall and, if properly machined, will cause no trouble. If the holes are tapped through, the screws should be slushed with a sealing compound to make them watertight. The extra boss for alternate hook-up of the conductor conduit should be checked for serviceability of the gasket under the closure plug, and the packing gland follower on the used boss should be backed out and the cone packing in the case replaced if it does not completely seal the circumference of the cable or conduit. The drive shaft oil seal should be examined for signs of leakage, and replaced if necessary.

(2) The removal of repeaters and other internal parts from the indicator case should not be attempted unless absolutely necessary, and then only by competent personnel. Evidences of surface moisture on internal parts should be removed by light swabbing with dry cloths, and the opened housing subjected to a flow of dry, hot air for a thorough desiccation before replacing the various covers, etc. The reconditioned and thoroughly dried indicators should then be lubricated, reassembled and installed on their respective gun mounts.

b. The second step concerns the preservation of the above dry condition. This may be accomplished over a period of one year from the reconditioning date by subjecting the indicators to a periodical warm-up in which the repeaters are operated one hour a week. This practice may vary somewhat in accordance with climatic conditions or activity of the gun mount, but should be strictly observed during rainy seasons and inactive periods of the materiel.

c. It has been found that the above procedures will maintain the indicators in serviceable condition for at least one year. It is, therefore, recommended that at the end of each year the indicators be subjected to the same inspection and reconditioning as outlined above.

Section X

REFERENCES

56. STANDARD NOMENCLATURE LISTS.

SYSTEM, data transmission, M6 (for 90-mm A.A. gun mount, M1) ..... SNL F-222

SETTER, fuze, M13 (for 90-mm A.A. gun mount, M1) (previously T15) ..... SNL F-211

FINDER, height, 13½ ft., M1 (Keuffel and Esser and Eastman) ..... SNL F-171

FINDER, height, 13½ ft., M2 (Bausch and Lomb) .. SNL F-189

DIRECTOR, A.A., M7 ..... SNL F-167

UNIT, generating, M4 ..... SNL F-5

UNIT, generating, M6 ..... SNL F-227

GUN, 90-mm, M1, and mount, gun, antiaircraft, 90-mm, M1 and M1A1 — parts and equipment ..... SNL D-28

CONTROLLER, voltage, M1 ..... SNL F-202

KIT, cable repair, M1, M2, M3 ..... SNL F-200

KIT, repair, instrument, equipment ..... SNL F-206

TRUCK, instrument, repair, M1 — body parts and equipment ..... SNL G-92

Cleaning, preserving and lubrication materials, recoil fluids, special oils and similar items of issue ..... SNL K-1

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

57. EXPLANATORY PUBLICATIONS.

a. Lubrication.

Cleaning, preserving, lubricating and welding materials and similar items issued by the Ordnance Department .. TM 9-850

Sighting and fire control instruments — lubrication — general ..... OFSB 6-9

DATA TRANSMISSION SYSTEM M6
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b. Gun Materiel.

90-mm antiaircraft gun materiel, M1 and M1A1.... TM 9-370

Ordnance Maintenance: 90-mm gun, M1 and mounts, M1 and M1A1 — gun and upper carriage..... TM 9-1370A

Ordnance Maintenance: 90-mm gun, M1 and mounts, M1 and M1A1 — lower carriage..... TM 9-1370B

c. Other Related Materiel.

Ordnance Maintenance: fuze, setter, M13 (previously T15) ..... TM 9-1641

Ordnance Maintenance: Height finder, M1..... TM 9-1623

Ordnance Maintenance: Height finder, M2..... TM 9-1624

Ordnance Maintenance Manual Director, M7 — for the 3-in. 90-mm and 105-mm A.A. gun materiel..... TM 9-1658

Operator's Manual: Generating unit, M5 and M6.... TM 9-616

Ordnance Maintenance: Generating unit, M5..... TM 9-1616

d. Miscellaneous.

Instruction guide: the instrument repairman..... TM 9-2602

Maintenance of materiel in the hands of troops..... OFSB 4-1

Special instructions — group F materiel..... OFSB 4-8

Appendix

ADDITIONAL ILLUSTRATIONS

The illustrations which follow are included as a supplement to those found in the text. They were added after the manual was written, and have not been correlated with the detailed instructions to be found in the text. However, the information they contain is considered valuable for the guidance of ordnance maintenance personnel, and will aid in providing a complete working knowledge of the materiel.

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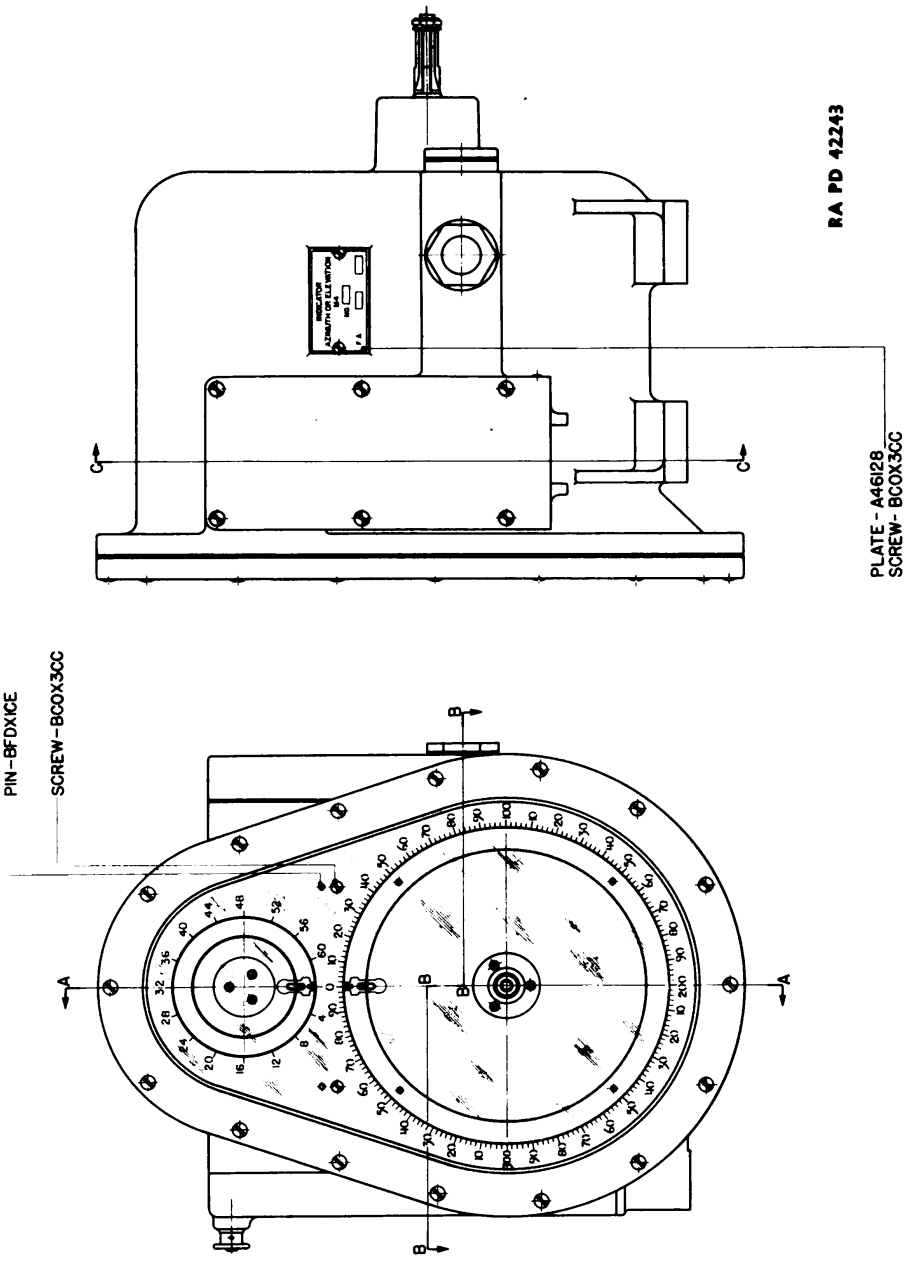

Figure 97 — Azimuth and Elevation Indicator M4 — Assembled Views

ADDITIONAL ILLUSTRATIONS

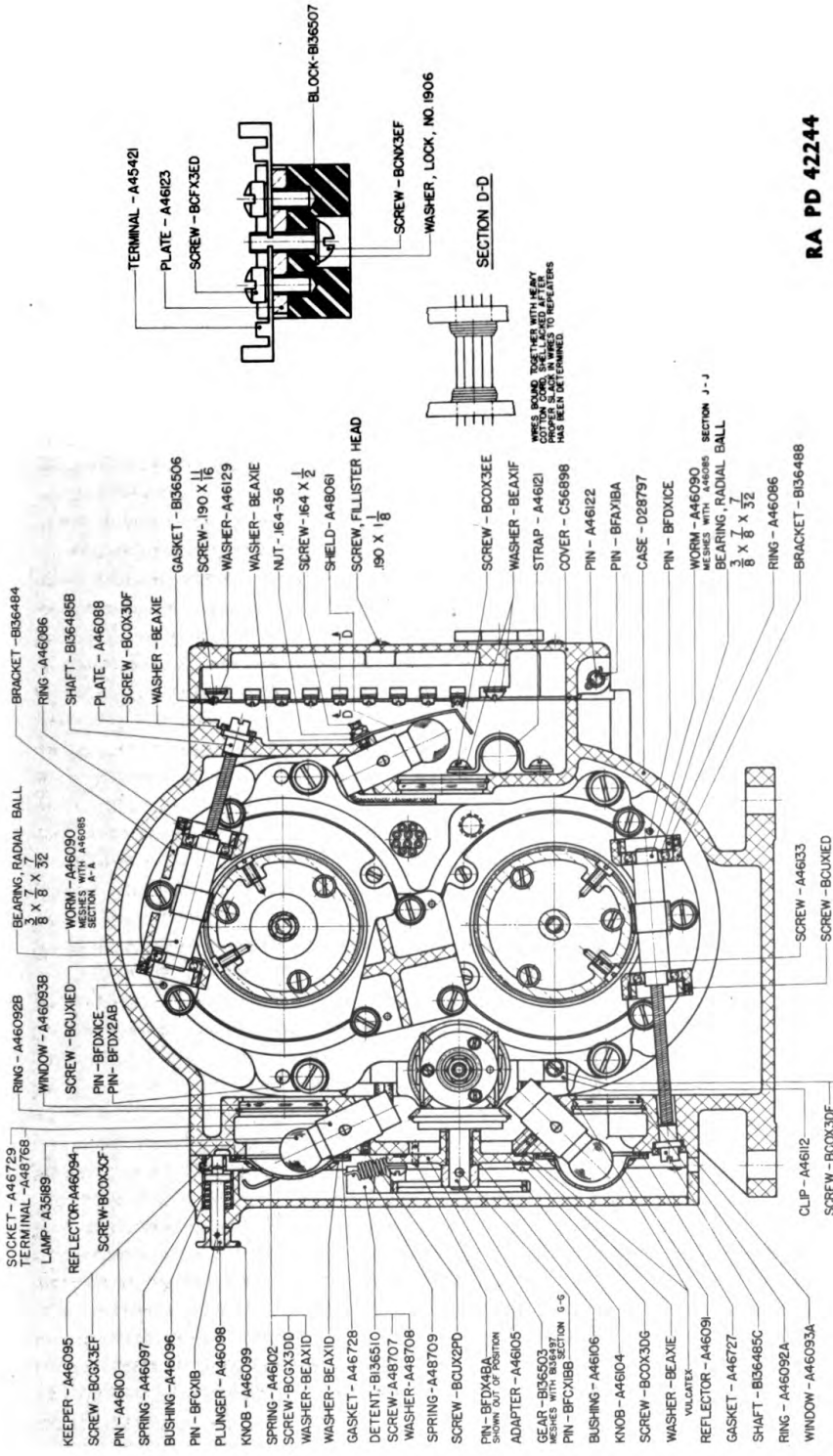

Figure 98 — Azimuth and Elevation Indicator M4 — Sectioned Views (Location of Section C-C Is Shown in Figure 97)

DATA TRANSMISSION SYSTEM M6
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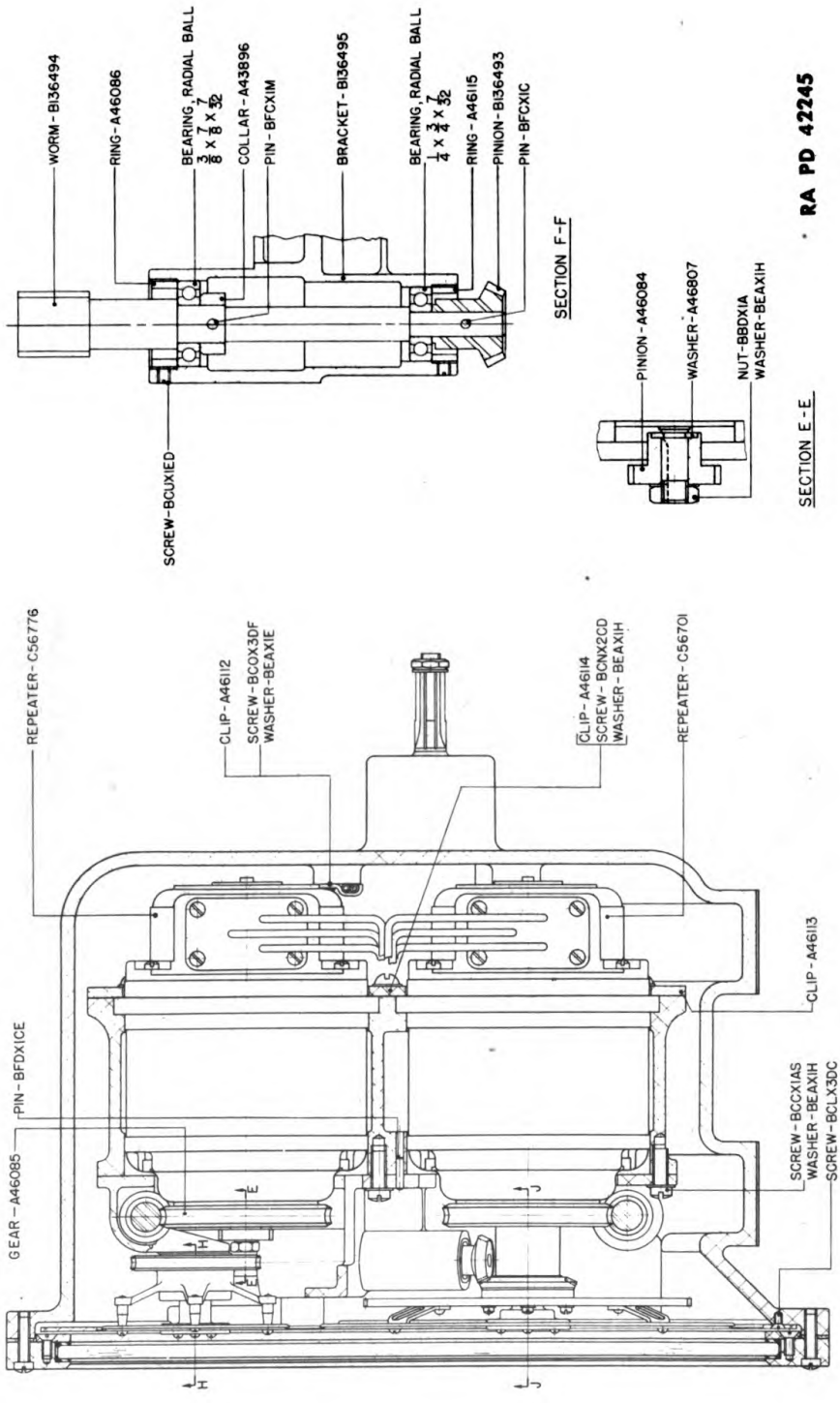

Figure 99 — Azimuth and Elevation Indicator M4 — Sectioned Views (Location of Section A-A Is Shown in Figure 97)

ADDITIONAL ILLUSTRATIONS

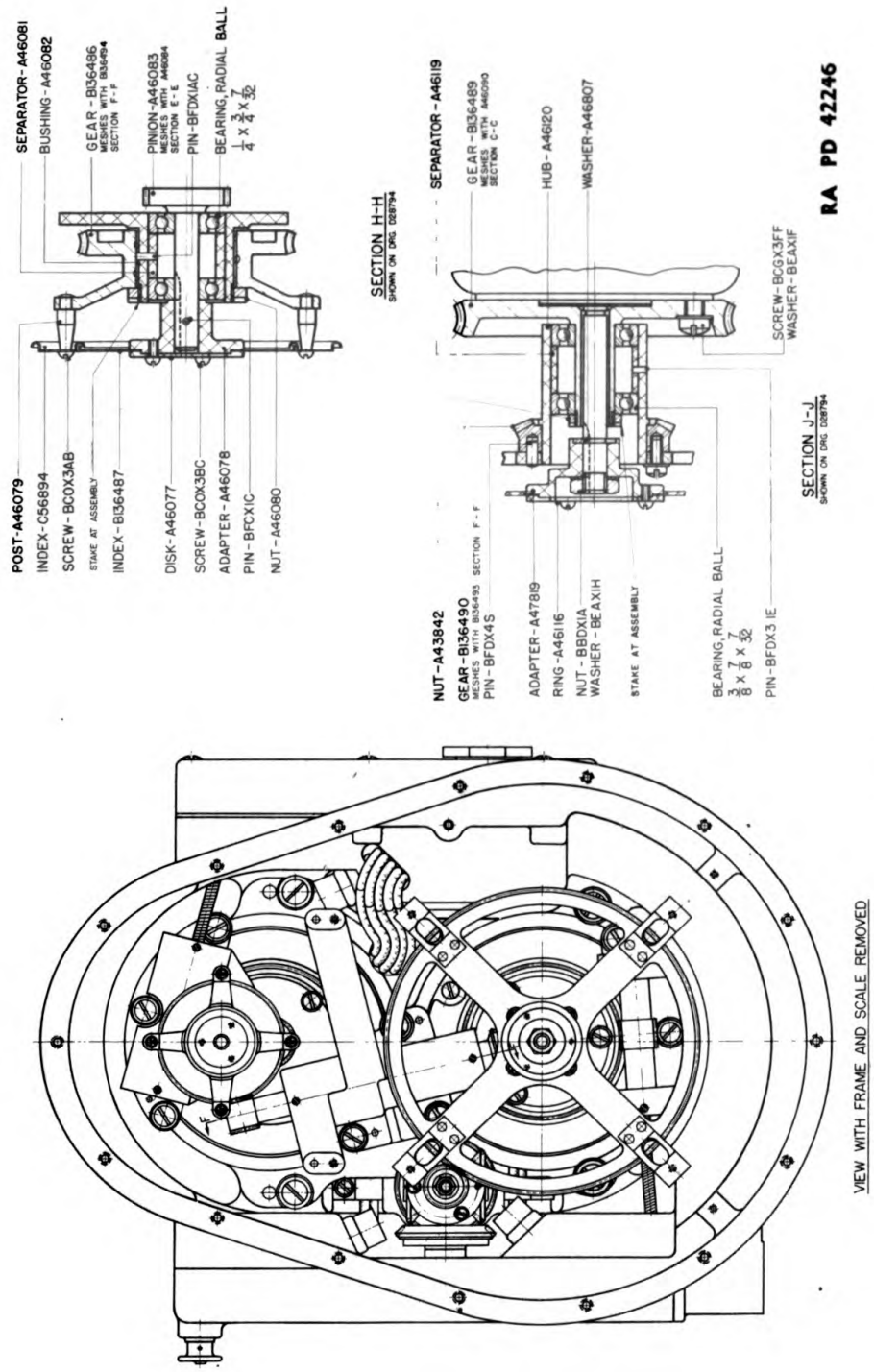

Figure 100 — Azimuth and Elevation Indicator M4 — Sectioned Views (Location of Section Planes Is Shown in Figure 99)

DATA TRANSMISSION SYSTEM M6
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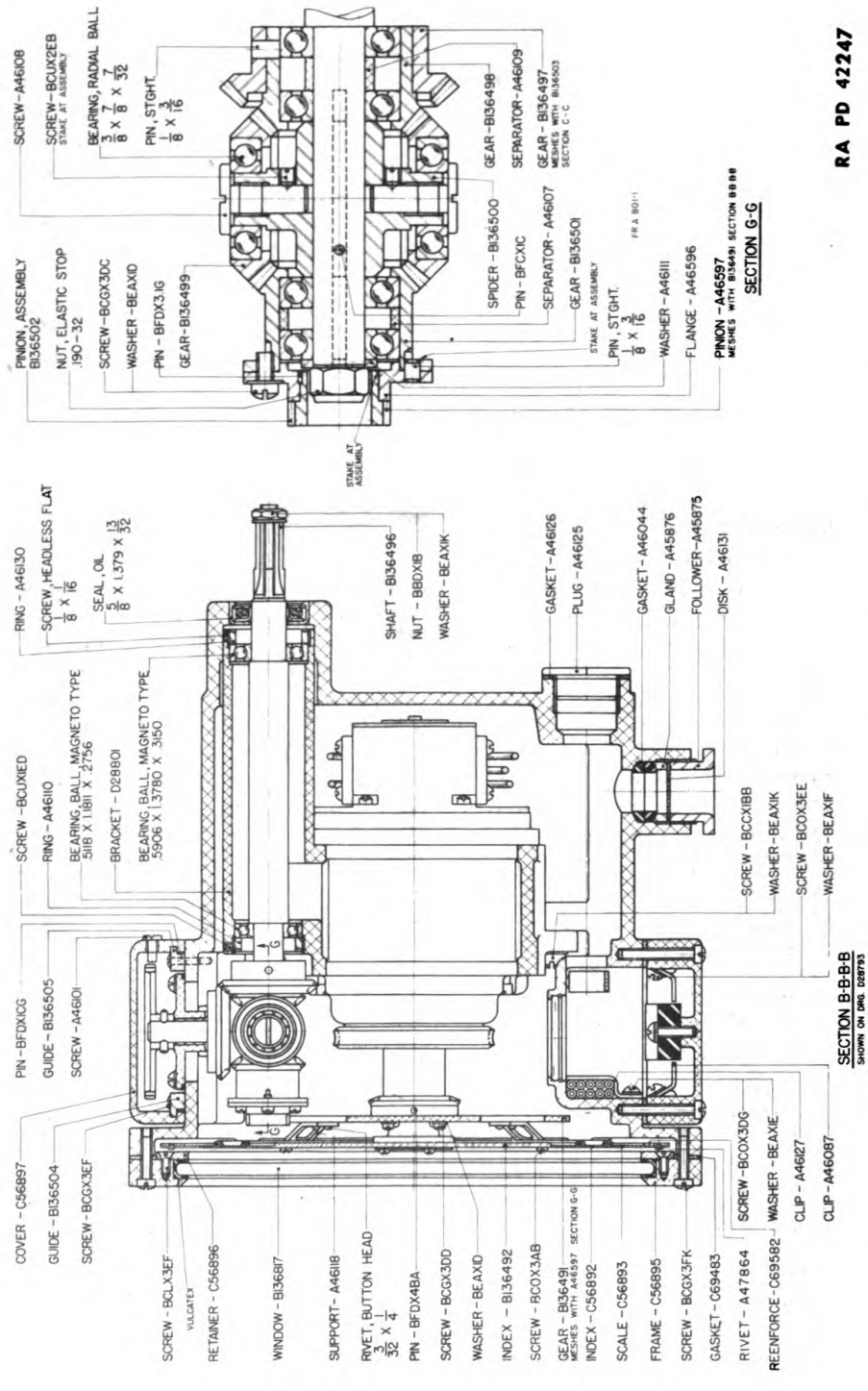

Figure 101 — Azimuth and Elevation Indicator M4 — Sectioned Views (Location of Section B-B-B-B Is Shown in Figure 97)

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

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